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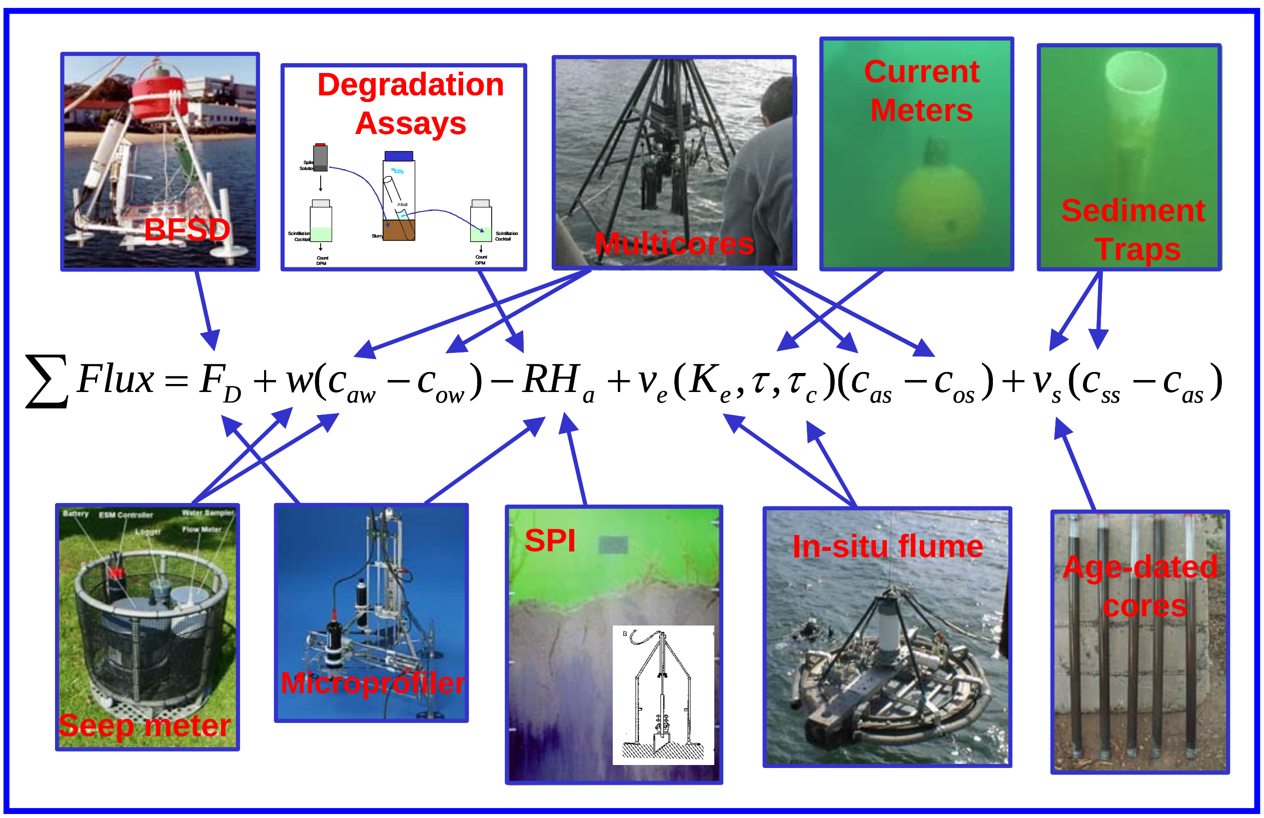
Strategic Environmental Research and Development Program

Pathway Ranking for In-place Sediment Management (CU1209)

Executive Summary

June 2006



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OBJECTIVE

The objective of the Pathway Ranking for In-place Sediment Management (PRISM) was to provide an understanding of the relative importance of critical pathways contaminant transport across the sediment/seawater interface in the risk, fate and management of near-shore, in-place contaminated sediments via: 1) An integrated suite of measurement techniques to characterize and quantify important transport pathways for in-place sediments, 2) A corresponding set of indices that quantify the transport phenomenon on a common dimensional scale and 3) Field scale evaluation of the effectiveness of the measurement tools and the importance of quantified transport pathways. This program consisted of two field demonstrations, the first at Paleta Creek in San Diego Bay, California, and the second at Southeast Loch and Bishop Point in Pearl Harbor, Hawaii. The detailed methods, results, and analyses for the two field studies at Paleta Creek and Bishop Point can be found in Volume I and Volume II of this report, respectively. Volume III summarizes and compares the main results of the field efforts, and critically analyzes their implications for pathway analysis and ranking as a future tool in contaminated sediment management.

The program was successful in fielding the measurement suite, and quantifying a range of process-based transport pathways including:

- Diffusive Fluxes (combined molecular and bio)
- Advective Fluxes
- Sedimentation Fluxes (background and storm)
- Erosion Fluxes
- Biodegradation Fluxes

APPROACH

The technical approach for PRISM contained the following elements: 1) evaluation of the site conceptual model, 2) evaluation of available site data, 3) field design, 4) field deployment and synthesis of field data immediately available (screening and SPI results), 5) analytical results, 6) process-specific analysis (evaluation of BFSD, flume, etc. on their own), 8) synthesis of results in terms of the field site, and 9) evaluation of results in terms of management/contaminant behavior insight. For each site we conducted process-specific analyses, along with analysis of the variability associated with each flux estimate.

Quantification of contaminant transport pathways in common terms is an essential element of sediment management. The PRISM approach for evaluating pathways of contaminant flux to or from the surface sediment layer was unique in that it integrated a comprehensive field-based measurement tools of on a common dimensional scale to allow comparative assessment of risk and recovery mechanisms to aid in the selection of appropriate management strategies. To achieve this, a measurement framework was developed that was tied to a classical 1D vertical mass balance model for the transport of contaminants in sediments. Mobility was then quantified as a net flux from the “active” surface layer. Changes in this layer resulted from the balance of fluxes through the defined pathways of mobility. The results from each pathway evaluation were converted to fluxes, and all fluxes were calculated in common units. For each contaminant (16 PAHs, 9 metals), fluxes were then compared. Based upon results, dominant pathways were determined and appropriate management approaches were assessed.

There were assumptions and uncertainties inherent in this approach. For example, it was assumed that in spite of spatial and temporal variability, field measures, even if “noisy” provided insight beyond what could be inferred from theoretical models alone. Integration and synthesis of field-based indices forced an acknowledgement of the variability present in natural sediment systems. Integrating information from multiple field measurements provided insight into the sources and magnitude of variability of contaminant mobility in sediment systems, providing an accurate reflection of the reality environmental managers face. Quantification of rates and variability provided bounds for modeling the uncertainty associated with various sediment management strategies. Thus, although no approach for determining the fate and behavior of contaminants in complex systems is without uncertainty, the field-based PRISM strategy requires an acceptance of the variability inherent to these systems that is often overlooked in more purely theoretical strategies.

PALETA CREEK DEMONSTRATION

As the first PRISM application, the Paleta Creek effort included an initial assessment of both the maturity and reliability of the individual field tools. Technology maturity generally ranged from commercial-off-the-shelf (e.g. current meters, particle sizing, SPI) to published (e.g. flumes), and methodologies generally ranged from published (e.g. seepage meters, microprofilers) to certified (BFSD) to standard (porewater chemistry). Although some failures were encountered, most of the technologies were found to operate reliably for the application to PRISM pathways. An exception was the bio-inhibited BFSD measurements, which were unsuccessful due to difficulties in gauging the oxygen uptake rate.

Replicate measurements were conducted at two stations in the Paleta Creek study area, including a station near the creek mouth (P17), and a station between the pier reaches (P04). The PRISM pathway analysis in Paleta Creek was carried out by comparing the raw flux rates associated with each pathway. The analysis provided a means of evaluating which pathways were dominant for the given site where the measurements were conducted.

For PAHs, at P04, pathway ranking indicated a balance between settling and degradation. Advection, diffusion and erosion pathways were not significant for most PAHs. Pathway ranking indicated site P17 is dominated by background settling, with some attenuation from storm inputs and degradation. Advection, diffusion and erosion pathways were not significant for most PAHs. For metals, pathway ranking indicated site P04 has high background settling for some metals (Cu, Pb, Zn). Some metals showed significant advection and diffusion, but the erosion pathway was generally not significant for most metals. Pathway ranking indicated P17 had lower background settling than P04 and higher advection and diffusion. Storm settling was important for some metals. The erosion pathway was generally not significant for most metals.

On a contaminant-specific level, these patterns provided insight into management approaches, and also into those parameters that might warrant further investigation. For example, at P04, arsenic and zinc show significant fluxes out of the sediment by advection and diffusion. While there is continuing input by settling, this may be significantly attenuated by fluxes out. Fluxes of arsenic and zinc should be evaluated both in terms of recovery and risk, as the rate of fluxes may result in recovery over time, but advecting and diffusion dissolved metals may pose an exposure risk under some conditions. Source control in the bay should be evaluated to reduce inputs by settling over time. These conclusions are sensitive to data on trap particle and COPC input, and seep and diffusion are subject to considerable variability, so any further investigation should focus on reducing uncertainty of these parameters. It is important to note that these conclusions are based only upon the spatial and temporal scale of the study carried out, and that conclusions may differ if analyses are carried out at larger scales. However, PRISM results have successfully provided insights into the probable dominant pathways of contaminant transport, the direction of future studies, and, if conclusions are borne out, the need for source control before site-specific remediation is carried out.

PEARL HARBOR DEMONSTRATION

The PRISM pathway analysis for metals in Pearl Harbor was carried out by comparing the raw flux rates associated with each pathway. The analysis provides a means of evaluating which pathways may be dominant for the given site where the measurements were conducted. The analysis revealed that, in general, deposition at the Bishop Point site is driving a reduction in metals levels in the mixed layer, while deposition at Southeast Loch represents a potential source of some metals to the mixed layer including copper and zinc. Other processes play an active role in the fate and transport of individual metals, particularly advection and diffusion with respect to arsenic, cadmium and nickel. We also calculated recovery indices for selected metals for each of the PRISM pathways. Indices were only calculated for those metals for which the mixed layer concentration exceeded the ERM, including copper, nickel and zinc. Based on this analysis, we found that settling appears to be a significant pathway for recovery at Bishop Point for copper and zinc. For nickel, recovery by settling is weaker but is supplemented by diffusion. However, both of these processes appear to be offset by a continuing source from advection. For Southeast Loch, settling continues to act as a source for copper and zinc to the extent that no other process is dominant enough to drive recovery for these metals. For nickel at Southeast Loch, potential recovery via settling and diffusion appears to be balanced by a continuing source from advection.

The PRISM pathway analysis for PAHs in Pearl Harbor was carried out by comparing the raw flux rates associated with each pathway. The analysis indicated that, in general, settling represents an ongoing source of PAHs to the mixed layer sediments of Bishop Point. This source appears to be offset by a high biodegradation potential, especially for the lower molecular weight PAHs such as naphthalene and phenanthrene. In contrast, settling does not appear to be a dominant source at Southeast Loch, and in some cases (fluoranthene) represents a loss of PAHs from the mixed layer. Advection may be acting as a source for some PAHs at Southeast Loch, although this is offset to some degree by biodegradation. We also calculated recovery indices for selected PAHs for each of the PRISM pathways. Indices were only calculated for those PAHs for which biodegradation rates were available, and for which the mixed layer concentration exceeded the ERL, including phenanthrene and fluoranthene. Based on the indices developed from these recovery rates, biodegradation appears to be a key process controlling recovery of phenanthrene at both sites. At Bishop Point, the loss due to biodegradation is balanced by an ongoing source of similar magnitude from settling. At Southeast Loch, the settling source is small relative to depth-integrated biodegradation. However, if we assume aerobic biodegradation of phenanthrene is only active in the surface layer, then the ongoing source from settling at Bishop Point would overwhelm any recovery process. For fluoranthene, depth-integrated degradation was still the dominant recovery mechanism at Bishop Point, however, the magnitude of the index was <1, and the settling flux for fluoranthene represents a significant ongoing source at Bishop Point relative to all recovery processes. For Southeast Loch, both settling and biodegradation represent significant recovery processes. However, these processes appear to be balanced to a lesser degree by an advective source.

CROSS SITE COMPARISON

The PRISM pathway analysis provided a means of evaluating general differences between the two areas in San Diego Bay and Pearl Harbor. On a contaminant-specific level, these patterns provided insight into management approaches, and also into those parameters that might warrant further investigation. These pathway flux estimates can provide insight into important management approaches (e.g., source control, capping, recovery). Results can help focus further site studies to most important or uncertain parameters. Flux rates can be utilized in models for predicting exposure risks or recovery rates. General findings from the cross-comparison of the sites are summarized below.

Cross-site comparisons revealed a number of differences and similarities between the study areas in Pearl Harbor and Paleta Creek. Both the mean biological mixing depth and the mean RPD were deeper at the Pearl Harbor sites compared to the San Diego sites. In particular, the time-lapse profile at Southeast Loch showed quite dramatic changes in subsurface feeding void/burrow structure over time that explained the low shear strength and high water content observed in this area, along with the bioirrigation variability detected in the groundwater flux data. Tidally-averaged specific discharge rates across the two sites were comparable, and the variation among replicates was also comparable, even though the spatial separation at the Pearl Harbor stations was significantly greater than for Paleta Creek. Porewater and surface water metal concentrations for the two sites were of similar magnitude, but showed differing trends for different metals. General agreement between the advective metal fluxes at the two sites was observed for the approximate magnitude and direction of fluxes for As, Cu and Zn. Clear differences were observed for Ni and Pb. These differences appear to hinge on the assumption of low metal concentrations in the deep sediment layer at the Paleta Creek stations.

Cross-site comparison of diffusive metal fluxes for the two sites indicates highest Ni and Pb fluxes at Pearl Harbor stations, highest Cu and Zn fluxes at Paleta Creek, and fairly comparable fluxes of other metals. Cross-site comparison for the two sites indicates generally similar patterns of diffusive PAH fluxes, with some differences in magnitude, and particularly highest Fluoranthene and Pyrene fluxes at Pearl Harbor.

Sedimentation rates were generally similar across sites, in the range of 1-2 cm/d. These rates are typical of coastal harbors and embayments. Trap sediment metals followed similar general patterns of concentration for the two sites with some notable exceptions such as Cu and Zn at Southeast Loch, and Cu, Zn and Cd at P17. For the surface sediments, metals were generally higher at the Pearl Harbor stations compared to Paleta Creek, particularly Cu and Zn. Cross-site comparison indicates that settling fluxes at Paleta Creek were consistently negative (source to the surface layer) and of lower magnitude when compared to Pearl Harbor stations. For Southeast Loch, Cu and Zn settling added to the surface sediment mass, while in contrast, Bishop Point results indicated strong positive fluxes for most metals indicating a general reduction in surface sediment loading as a result of settling. Trap and surface sediment PAHs followed similar general trends of concentration for the two demo sites with higher concentrations for higher molecular weight PAHs (e.g. Fluoranthene and Pyrene). PAHs were significantly higher in the Bishop Point traps, while trap concentrations at P17 and Southeast Loch were moderate and comparable, and P04 concentrations were consistently the lowest. For the surface sediments, PAHs were consistently higher at the Pearl Harbor stations compared to Paleta Creek. For PAHs, settling fluxes at both sites for most PAHs indicated settling as a source to the surface layer, with the exception of the heavier molecular weight PAHs at Southeast Loch. Settling fluxes (whether positive or negative) were generally of higher magnitude at Pearl Harbor, consistent with the stronger contaminant gradients observed in the traps and sediments.

Critical shear stress was found to be the same value in both replicates at both Paleta Creek sites, while critical shear stress at the Pearl Harbor stations was generally lower, and particularly for the Southeast Loch sediments where critical shear stress was about half the value observed at other locations. Erosion rate characteristics were similar for the Paleta Creek stations and the Bishop Point station, but at the Southeast Loch station, smaller applied excess shear stress resulted in larger erosion rates, and the erosion rate increased less dramatically with higher applied excess shear. In general, very low current speeds were observed at both demonstration sites. At the Paleta stations, some short-term, high-current events were observed and are believed to be related to ship and tug movements in the area. Based on these current velocities, the calculated bottom shear at Paleta Creek stations was generally very low during the majority of the measurement conditions. During the suspected ship movement events at Paleta Creek, shear stresses at both sites significantly exceeded critical shear stress. These higher energy events were not detected during the Pearl Harbor deployments, but it is likely they do occur. Where erosion was predicted to occur, the flux of a contaminant depends on the concentration gradient between the mixed layer and the deep layer. Metal concentrations in both layers were generally higher at the Pearl Harbor stations, with the exceptions of Cd and Ag. Vertical gradients varied across stations and sites, with generally higher concentrations in the deeper sediments at P04 and SL, minimal difference at BP (except Cu), and higher concentrations in the surface layer for P17, particularly for Cu and Zn. PAH concentrations in both layers were generally higher at the Pearl Harbor stations. Vertical gradients varied across stations and sites, with generally higher concentrations in the shallower sediments at P04, P17, and SL, and minimal difference at BP. At both sites, the flux associated with erosion was at most times negligible, at least under the conditions represented by the current meter deployments, except during ship movements. The results indicate that at P04, the concentration of several metals (Cu, Pb, Ni, Zn) increase as the mixed layer erodes as a result of higher concentration of metals in the deep layer. At P17 the opposite occurs, particularly for Cu and Zn. Potential for erosive fluxes at the Pearl sites based on the Paleta erosion rates indicate that erosion could result in significant mass loss of metals from the surface sediments at BP, particularly for Cu and Zn. This should be viewed as an erosion potential, since as previously mentioned, the measured shear stress never exceeded the critical shear. For PAHs, the erosion flux at Paleta Creek stations generally resulted in an decrease in the mixed layer concentration. Potential for erosive fluxes at the Pearl sites based on the Paleta erosion rates indicate that erosion could result in significant mass loss of PAHs from the surface sediments at BP, and particularly for SL.

For both sites, the magnitude of pathway fluxes for arsenic followed a pattern of Advection=Settling>Diffusion>Erosion. Pathway analysis for arsenic indicates that dissolved contaminant processes (advection and diffusion) are leading to a loss of arsenic in the surface layer at both sites, with the exception of advection at BP. However, the sites show opposing patterns for sedimentation with mass loss at the Pearl Harbor sites, and mass gain to the surface layer for the Paleta Creek sites. The magnitude of pathway fluxes for copper indicated a pattern dominated by settling fluxes. Fluxes associated with advection, diffusion and erosion were all negligible relative to settling. At Paleta Creek, settling fluxes at both stations suggest mass gain of Copper in the surface mixed layer, while for Pearl, SL showed a mass gain and BP showed a mass loss due to settling. An examination of all fluxes suggests that the surface mixed layer may be experiencing a net gain of Copper as the sum of all processes at all areas except Bishop Point, with the flux dominated by settling. This pattern is consistent with ongoing activities in the Paleta Creek and Southeast Loch areas including use of antifouling coatings, shipyard operations, and stormwater discharges. These sources are not present to the same degree at Bishop Point.

Pathway analysis for cadmium indicates that dissolved contaminant processes (advection and diffusion) are generally leading to a loss of Cd in the surface layer at both sites, although the variability is very high, especially for diffusion. The advection pathway at Pearl Harbor was negligible relative to Paleta. At Pearl Harbor, settling fluxes at both stations suggest mass loss of cadmium in the surface mixed layer, while for Paleta, P04 showed a mass loss and P17 showed a mass gain due to settling. An examination of all fluxes suggests that the surface mixed layer at both sites may be experiencing a net loss of cadmium as the sum of all processes, dominated by settling, with the exception of Paleta station P17 where results suggest a net gain dominated by settling. This difference at P17 is related to the station proximity to the mouth of Paleta Creek and associated release from storm events. Lead fluxes associated with advection, diffusion and erosion were all negligible relative to settling. Settling fluxes for lead at Paleta Creek are acting as a continuing source to the surface layer, while at Pearl Harbor they are driving a mass loss from the surface layer. An examination of all fluxes suggests that the surface mixed layer may be experiencing a net gain of lead as the sum of all processes at Paleta Creek areas, and a net loss of lead at Pearl harbor areas, with the fluxes at both sties dominated by settling. This pattern is consistent with ongoing stormwater sources in the Paleta Creek area. It appears these sources are not as prevalent at the Pearl Harbor sites.

Diffusive fluxes of nickel at the two sites were of comparable magnitude and generally indicate mass loss of nickel from the surface layer. Advective fluxes at Pearl Harbor were significantly higher in magnitude and appear to act as a source to the surface layer, in contrast to Paleta Creek where these fluxes generally indicate a mass loss from the surface sediments. Differences in advective fluxes at the two sites could be linked to different approaches for determining the deep layer porewater concentration that were used. Settling fluxes showed the opposite pattern as advective fluxes, with settling leading to mass loss in the surface sediments at Paleta Creek and mass gain in the surface sediments at Pearl Harbor. An examination of all fluxes suggests that Ni concentrations in the surface layer may be near steady state, with Paleta Creek sediments balanced by losses from advection and diffusion and gain from settling, and Pearl harbor sediments balanced by gain from advection and loss from diffusion and settling.

Pathway analysis for silver indicates that variations in surface layer concentrations at both sites are strongly dominated by settling fluxes. Fluxes associated with advection, diffusion and erosion were generally negligible relative to settling, except at P17. Settling fluxes showed no clear pattern between the two sites, with both positive and negative mean fluxes at both harbors. Results suggest settling is and ongoing source of silver to the surface sediments at P04 and Bishop Point, as opposed to Southeast Loch where the settling acts to reduce silver in the surface layer, and P17 where the settling flux is relatively small. An examination of all fluxes suggests that the surface mixed layer response for silver showed no clear pattern across sites, with net gain, net loss, or near steady state conditions occurring at various stations. The net loss or near steady state conditions observed at P17 and Southeast Loch are interesting from the standpoint that these areas are generally closer to industrial and non-point sources than the other two sites. This difference may indicate that the net gain of silver at P04 and Bishop Point results from transport from other areas as opposed to local sources.

Pathway analysis for zinc indicates that dissolved contaminant processes (advection and diffusion) are generally leading to a loss of zinc in the surface layer at both sites. The advection and diffusion pathways were generally stronger at Pearl Harbor relative to Paleta. At Paleta Creek, settling fluxes at both stations suggest mass gain of zinc in the surface mixed layer, while for Pearl Harbor, Bishop Point showed a mass loss and Southeast Loch showed a mass gain due to settling. This pattern is similar to the pattern observed to copper, and these are metals that commonly co-occur in both industrial sources and non-point source. An examination of all fluxes suggests that the surface mixed layer may be experiencing a net gain of zinc as the sum of all processes at all areas except Bishop Point, with the flux dominated by settling. This pattern is consistent with ongoing activities in the Paleta Creek and Southeast Loch areas including use of antifouling coatings, shipyard operations, and stormwater discharges. These sources are not present to the same degree at Bishop Point.

Cross-site comparison for the two demonstration sites was evaluated based on comparison of the site-average degradation flux rates for both the depth-integrated assumption and the surface layer assumption. In general, both sites showed a similar pattern in terms of the magnitude of the flux with P>F>N. Depth-integrated mineralization fluxes were generally an order of magnitude higher than near surface fluxes. Fluxes at the Pearl Harbor stations were generally higher than those at Paleta Creek, with the exception of Fluoranthene which was higher at P04. This is consistent with the generally higher level of PAHs present in Pearl Harbor. When the sites and stations are further compared, elevated measured bacterial mineralization of the PAHs naphthalene, phenanthrene, and fluoranthene were found to associate with areas of the sediment that appear to be more bioturbated based on analyses using the SPI camera and microprofiler data (i.e. P04 and SL).

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Site I Report – Paleta Creek

April 2006

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1 Objective

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The objective of this program was to provide an understanding of the relative importance of critical contaminant transport pathways for near-shore in-place sediments in the risk, fate and management of contaminated sediments via: 1) An integrated suite of measurement techniques to characterize and quantify important transport pathways for in-place sediments, 2) A corresponding set of indices that quantify the transport phenomenon on a common dimensional scale and 3) Field scale evaluation of the effectiveness of the measurement tools and the importance of quantified transport pathways. This program consisted of two field demonstrations. The bulk of this report describes results of the first demonstration, which was carried out at Paleta Creek, San Diego, CA.

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2 Background

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Given the economic, logistical, technological and ecological limitations of contaminated sediment removal and treatment technologies, it is inevitable that some contaminated sediments will be left in place, in the short or the long term, even if contaminants pose some ecological or human health risk. However, leaving sediments in place has met with regulator and public resistance at many sites due to concerns about the long-term risk to the marine environment. It is assumed that the management process will seek to balance two parallel goals: 1) minimizing contaminant risk to the environment and human health and 2) minimizing cost (NRC, 1997). A set of diagnostic tools for characterizing and quantifying potential in-place contaminant pathways will allow for the selection, permitting and monitoring of in situ management strategies.

An appropriate evaluation of management choices involves a comparative evaluation of the potential effectiveness of removal-based management strategies vs. appropriate in-place management strategies. This requires knowledge of the relative importance and magnitude of potential pathways of contaminant removal or transport in sediments and the surrounding environment. Determining the relative importance of these mechanisms on a site-specific basis is critically important to the selection, approval and success of any in situ management strategy. Adequate approaches for evaluating these pathways do not currently exist. Assessment and monitoring strategies for multiple contaminant pathways before, during and after in-place remediation must be standardized and validated.

While EPA and the Army Corps of Engineers have developed extensive data and guidance documents on the evaluation of contaminant pathways in sediment management (see http://www.wes.army.mil/el/dots/ for extensive resources), the focus and driver have been the disposal of dredged materials (Lunz, et al., 1984; Fredette and Nelson 1990; Fredette et al., 1990; Sumeri et al., 1991; Fredette et al., 1992; Murray et al., 1994; Palermo et al., 1998, USEPA, 1992). By necessity, dredged material will be removed (and exposed at least in part to the water column) and thus pathways of contaminant transport such as leaching, bulk resuspension and amenability to ocean disposal have been extensively studied.

On the other hand, many of the contaminated marine sediment sites are currently under investigation due to ecological concerns, not for construction or navigational dredging. Many of these sites are in shallow, coastal areas, and thus are much more likely than offshore (disposed) sediments to be impacted by resuspension by ship and storm activity, as well as advective processes such as groundwater flow, tidal and wave pumping. While these processes are recognized in the oceanographic community as having significance to the transport of chemical constituents (see Moore, 1999 and references therein), the relative magnitudes of these processes as compared to the traditionally assessed processes such as diffusion and bioturbation have not been determined in contaminated sediment sites. Fundamentally different management and monitoring strategies must be applied for these different processes.

In this discussion, we define the range of in situ sediment management options as a continuum – beginning with those requiring no containment or physical control (those which are to allow natural attenuation or biodegradation or more engineered in-place treatments), through simple or thin caps, and ending with more aggressive capping and containment technologies using armor, geofabric, or other sediment or contaminant controls. In essence, in-place sediment management consists of “pathway interdiction” while ex situ approaches represent mass removal. If contaminants are to be left in place, it is critical to evaluate potential pathways by which contaminants might pose an ecological or human health risk, and to monitor, minimize or eliminate these pathways. As Dennis Timberlake, Program Manager for Contaminated Sediment Risk Management Research at the EPA's National Risk Management Research Laboratory states, "Currently, there is no demonstrated, systematic process for measuring and evaluating contaminant transport pathways within sediment systems." This project sought to address that situation.

3 Technical Approach

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3.1 CONVERTING FIELD MEASUREMENTS INTO EQUATION TERMS: APPROACHES, ASSUMPTIONS AND LIMITATIONS

Processes controlling the fate of contaminants in sediment can be broadly categorized into those governed by porewater dynamics, and those governed by solid phase dynamics. The porewater and solid phase compartments and similarly linked by a range of biogeochemical processes (Figure 3-1).

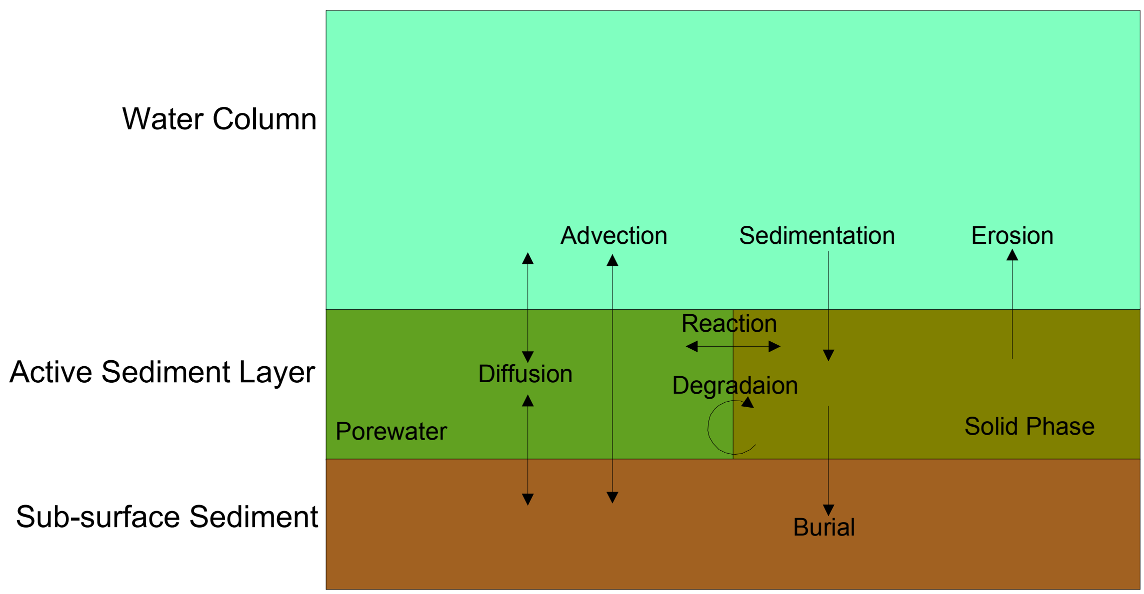

Figure 3-1. Pathway schematic for contaminant transport mechanisms in sediment

Contaminant migration in porewater can be described from basic principles by the one-dimensional vertical chemodynamic balance,

$$\frac{dc}{dt} = \frac{d}{dz}\left(D\frac{dc}{dz}\right) - w\frac{dc}{dz} - R \qquad (1)$$

where c is the concentration, z is the depth, D is the effective diffusivity (including chemically and biologically driven diffusion), w is the vertical pore fluid velocity and R is a chemical reaction term, which includes degradation, and transformations between porewater and solid phase.

In words, this equation states that the time change in concentration in the porewater for a given constituent will be controlled by the relative balance of diffusion, advection across the interface, and chemical reactions within the sediment.

The objective of this program was to provide an understanding of the relative importance of critical contaminant transport pathways in the risk, fate and management of near-shore, in-place contaminated sediments via: 1) An integrated suite of measurement techniques to characterize and quantify important transport pathways for in-place sediments, 2) A corresponding set of indices that quantify the transport phenomenon on a common dimensional scale and 3) Field scale evaluation of the effectiveness of the measurement tools and the importance of quantified transport pathways. In order to achieve this, a number of theoretical parameters needed to be evaluated in terms of simplified, field-measurable terms. In this project, we have attempted to develop "field-measurable" parameters that, as much as possible, parallel the processes addressed in most risk and recovery models. In order to produce a useful form of Equation 1 for interpreting our field measurements, we must convert many of the above parameters to field-measurable terms. Flux of contaminants by various pathways can then be integrated over a vertical control volume of depth H, where H is chosen to be a representative depth over which we wish to evaluate the changes in chemical concentration and mass balance. The discussion below will first discuss the basis of some of these terms, then how they will be integrated in a modified version of Equation 1, and then how the instruments themselves are used in support of this effort.

Depth Scale

If integrated measures of multiple pathways are to assess contaminant transport through sediments, a common area, thickness and thus volume of sediment must be specified. A difficult issue in any integrated field effort is the problem of scaling. While we are attempting to put a number of disparate processes into common terms (as do most models), these processes occur at very different rates, and on different scales. Furthermore, measurement techniques examine the processes at different rates and scales. For instance, microprofilers measure porewater chemistry at millimeter resolution, while the BFSD and seep meters (described below) enclose a few square feet of sediment. The BFSD is deployed for a few days while the microprofiler takes minutes. Biodegradability, permeability, contaminant levels, flow, etc., vary spatially and as a function of tidal cycle, temperature, etc. Thus, whether in a model or a field effort, several simplifying assumptions are made. A difficult question the PRISM team evaluated was choice of sediment depth of interest, or H, for the integrated equations described in the next section. Clearly, a depth of interest can be based upon some management goal, chemical, physical or biological parameter (e.g., depth of contaminated layer, depth considered to be at risk in an extreme storm, depth to be dredged, stratigraphic layer depth, depth of tidal penetration, bioturbation depth, aerobic depth, mixed layer etc.). During the field design effort, it was decided that the Sediment Profile Imagining (SPI) camera would initially be used as a reconnaissance tool to select the deployment sites. Then, for a field determination of H, which would guide sampling decisions such as core depths to be analyzed, etc., SPI images were used to designate H, based on the depth to which the sediment column was bioturbated, determined by the depth of deepest feeding void. It was assumed that once image analyses were are completed, the question of which measurement is best, based upon correlations with the other data, (i.e., the depth of the mean apparent Redox Potential Discontinuity (RPD), the maximum RPD depth, the minimum feeding void depth, the maximum feeding void depth (which was the one used for the "quick-look" estimate), or the average feeding void depth), could be examined for future deployments. Thus, based upon field SPI imaging, core depths, etc., were designated for other measurements.

Diffusive Fluxes

An important pathway of contaminant transport for in situ sediments, and one that has been the most studied and modeled in support of in place capping of sediments, is the diffusive transport of contaminants across the sediment/seawater interface. The Benthic Flux Sampling Device (BFSD, see sections below for details) is designed to measure diffusive fluxes of contaminants of potential concern (COPCs) across the sediment/seawater interface. To do this, a volume of water is enclosed in a non-reactive "box", which is sealed with a knife-edge at the sediment-seawater interface. Water samples are taken over time. When returned to the laboratory, concentrations of chemicals of interest are measured in water samples. If COPCs are either fluxing into or out of the sediment, these concentrations will change over time. Because the volume of water and sediment surface area are known, these results can be converted to a flux (such as mg/m^2 day).

The BFSD as used in standard applications cannot separate fluxes driven by diffusion from fluxes across the sediment-water interface driven by bioirrigation. In general, such fluxes, which are inferred by measuring the changes in COPC concentrations in the sealed chamber over time, can result from multiple mechanisms, such as diffusion from porewaters, partitioning from sediments and bioirrigation. However, previous studies by us and other investigators (e.g. Dryssen et al., 1984) suggest that, when oxygen is allowed to deplete in a BFSD chamber, the flux rate of Si drops significantly. In applications designed to measure metal flux, oxygen levels are kept constant in the BFSD so metal redox states (and thus solubilities) stay constant. Si, on the other hand, is not sensitive to redox state, and thus oxygen does not have to be maintained to maintain its solubility. Thus, a reduction in Si flux corresponding to an oxygen drop is not the direct result of a change in redox states, suggesting that flux from sediments to the chamber from biological irrigation had ceased or significantly decreased due to oxygen limitations for bioirrigating organisms. It was hypothesized that this phenomenon could be exploited to separate "diffusive" from "bioirrigation" flux in the field.

To separate flux by these two mechanisms, "normal" and "bioinhibited" flux can be measured in the BFSD, by first maintaining oxygen levels and then turning off the oxygen source and allowing respiration to deplete the oxygen. The difference in the flux with and without oxygen can then be designated as the flux that is driven by bioirrigation. Thus, if one considers the aerobic and anaerobic runs separately, during the aerobic (standard) run, COPC fluxes can be considered to be the sum of diffusive and bioirrigation fluxes, which will be termed $F_{COPC\text{-}DT}$. Under anaerobic conditions, flux by bioirrigation is inhibited, so fluxes measured are assumed to be "purely" diffusive. However, since the redox state of the overlying water has been changed, these activities may change the diffusive properties of metals and/or organics. Thus, Si can be as a surrogate for COPC flux - Si can be measured, and then COPC fluxes can be calculated based upon the surrogate:COPC ratio in the biologically active flux measurements. We can assume that both Si and the COPC will both diffuse and be transported by bioirrigation at a constant ratio. For a given COPC, then, the bioinhibited flux (assumed to be diffusive) can be calculated as

$$F_{COPC\text{-}Diff} = F_{Si\text{-}Diff} * (F_{COPC\text{-}DT}/F_{Si\text{-}DT}) \quad (2)$$

Finally, then, the flux of COPC as a function of bioirrigation ($F_{COPC\text{-}DB}$) can be calculated by subtraction:

$$F_{COPC\text{-}DB} = F_{COPC\text{-}DT} - F_{COPC\text{-}Diff} \quad (3)$$

The SPI camera can be used as a qualitative “reality check” for this measurement. If a very high bioirrigation flux is calculated, then SPI images of the sediments will be examined for evidence of bioirrigating organisms. Over time (but not with just two field sites), it may be possible to use SPI images as predictors of the ratio of diffusive and bioirrigation flux.

Advective Fluxes

Advection of contaminants through sediments and into the overlying waters is generally considered in capping models only in terms of the advective flow during consolidation. However, since many of these sites are in shallow, coastal areas, and thus are much more likely than offshore (disposed) sediments to be impacted by advective processes such as groundwater flow, tidal and wave pumping, the relative magnitudes of these processes as compared to the traditionally assessed processes such as diffusion and bioturbation should be determined in contaminated sediment sites. In field measurement terms, the advection rate (w) expressed in cm/day (average) and can be applied to metals, PAHs and nutrients. As with the BFSD, a seep meter encloses a volume of water at the sediment/seawater interface. However, while the BFSD is a nearly closed system, the seep meter allows for advective flow. Using an ultrasonic flow meter, flow volume can be measured. With a known surface area of sediment, fluid flow rates (w) can thus be calculated. Particularly in nearshore sediments where tidal cycles can have a strong influence, fluid flow rates vary, in magnitude and direction, over time. There are then several options for the choice of w to insert into the flux equations. One option is to run the equations with w from various parts of the tidal cycle – generating maxima and minima, or flux ranges. Another is to use net flow over a selected time period. Depending upon the questions being asked at a site, there may be more than one appropriate choice.

To convert this flow into a chemical flux, it is necessary to know the COPC concentrations in the fluid flow. This can be done two ways. In one, some of the fluid that flows through the seep meter is collected, and concentrations are measured in the laboratory. In the second, COPC concentrations in porewaters in the mixed layer (c_H), the deep layer (c_{H-}), and at the surface are measured (c_0). Depending upon the analyte of concern, this can be done either with microprofilers, or with porewaters collected and brought to the laboratory. In the case of the Paleta Creek site, cores were collected as closely as possible to where seep was measured. Cores were cut at depth H determined by field SPI imaging and the porewaters were collected from the composited core from the surface to depth H, and from H to the bottom of the core.

Reaction (Biodegradation) Rate

Any chemical or biological process that removes contaminants from the sediment can be considered a reaction flux. In this study, the only reaction term considered is biodegradation. As with all other parameters, the only organic component evaluated was PAHs. While there may be other organic contaminants of interest (both degradable and recalcitrant), they were outside the scope of this study. PAH mineralization rates can be expressed in units of µg PAH Carbon metabolized per g of sediment dry weight per day. In this study, a field measure of instantaneous PAH mineralization was used to determine this parameter. To estimate how much degradation is occurring over the study site, the averages for sections of core slices can be integrated with depth (up to the 15 cm studied). In this Site I demonstration, mineralization rates for unbioturbated and bioturbated depth sections were determined. Ultimately, it is hoped that SPI reconnaissance images can be used to determine the bioturbation depth for a given station or area, and then a depth-integrated PAH mineralization rate can be determined. A patchwork of these estimates can be used to estimate biodegradation within the entire study site. Environmental parameters affecting PAH metabolism may be inferred from comparison with the nutrient, electron acceptor, ambient PAH, and metal concentration in core slices taken for measurement by SIO team members. If groundwater transport of PAHs is measurable, whether this transport mechanism for PAHs is offset by intrinsic biodegradation can be calculated using a direct depth-integrated rate comparison. In addition, if the deposition rate of PAHs to the sediment on a per surface area basis is greater than the biodegradation rate estimates for the same area; one would expect an accumulation of PAHs in the surface sediments. The ratio of PAH to non-PAH organic matter between the sediment trap material and the surface sediments can be reconciled by comparing PAH mineralization in surface sediments to bacterial production (metabolism of all organic matter).

It should be pointed out that the assay used focuses on aerobic mineralization processes, and may thus underestimate potential downcore mineralization. It has been shown by a number of workers that degradation of some PAHs does occur in this region by strictly anaerobic processes (e.g., Coates et al., 1997). Where total PAH mineralization rates are reported, they are extrapolated based upon spiked measurements of three individual PAHs. While the mineralization rates of these three PAHs have been observed to be strikingly similar at many sediment sites (by this methodology), the simplifying assumption that these spiked PAHs will reflect the behavior of the full PAH mixture is still subject to some controversy. To be conservative, parallel calculations will be made for just the PAHs measured as well as for total PAHs. Direct mineralization rates were only measured for three PAHs, naphthalene , phenanthrene and fluoranthene. Mineralization rates for 13 other PAHs were derived from the measured phenanthrene rates and the ratio between a given PAH in trap and surface sediments, on the assumption that changes in signatures and concentrations reflected biodegradation during settling. This assumption was validated for fluoranthene. Flux rates were only estimated for the 16 PAHs, and not for a "total PAH" value.

Resuspension

Contaminants can flux out of a sediment layer due to erosion if they are resuspended and transported from the site. This assumes not only a resuspension event but also a situation in which contaminated sediments do not simply re-settle. A more complex situation can occur as well, in which resuspended sediments re-equilibrate with overlying waters, releasing some contaminants, and then resettling with lower contaminant levels. In this study, it is assumed that sediments that resuspend will be transported from the site and will not redeposit. However, it is also assumed that redeposition will be captured in the settling traps, and thus any over-estimate of erosive removal will be offset by this measurement.

Flux of a given contaminant by erosion is calculated by the equation:

$$F_E = Ec_S = K_E(\tau - \tau_c)c_B \qquad (4)$$

K_E, and τ_c are determined using the in situ flume. τ, the shear stress, varies over time. For use in Equation 11, it can be based upon an average shear stress, a maximum shear stress (perhaps based upon an extreme event or a ship passing), or a range of expected stresses. Using Acoustic Doppler Current Profiler (ADCP) deployments, current velocities were measured for two months, indicating the shear stresses that can be expected through normal tidal cycles, and also capturing a few events that are interpreted as the effects of ships passing overhead. Historical records of storm events, and standard models can predict the effects of extreme events. The flume measures the critical shear stress, as well as erosion rates under various shear stresses. $c_{s,}$ the COPC concentration in suspended sediments in the flume, was ultimately based upon COPC concentrations in bulk surface sediments, composited sediments, and filter samples.

Sedimentation

If flux of contaminants is modeled or measured in a constant thickness of sediments, contaminants can flux into a layer of sediment if sediments with COPC levels higher than those in the layer are deposited, but can flux out of the layer if cleaner sediments are deposited. Sedimentation rates were determined by two methods: sediment traps and radioisotope dating of cores. These two approaches give insight into sedimentation at very different timescales, and the results, their similarities, differences, and implications, are discussed. C_B is determined in the laboratory – it is the COPC concentration of bulk sediments at the site. C_S is based upon COPC concentrations found in traps. As discussed below, this equation was modified based on field observations.

3.2 TRANSPORT EQUATIONS FOR PRISM ASSESSMENT

The PRISM measurement framework is tied to a classical 1-dimensional vertical mass balance model of contaminated sediments. Mobility is quantified as a net flux from the "active" surface layer, and changes in this layer result from the balance of fluxes through the defined pathways of mobility. For the PRISM program, these theoretical equations are modified so that field-measurable parameters can be used.

As stated before, contaminant migration in porewater can be described from basic principles by the one-dimensional vertical chemodynamic balance,

$$\frac{dc}{dt} = \frac{d}{dz}\left(D\frac{dc}{dz}\right) - w\frac{dc}{dz} - R \qquad (5)$$

where c is the concentration, z is the depth, D is the effective diffusivity (including chemically and biologically driven diffusion), w is the vertical pore fluid velocity and R is a chemical reaction term, which includes degradation, and transformations between porewater and solid phase.

In words, this equation states that the time change in concentration in the porewater for a given constituent will be controlled by the relative balance of diffusion, advection across the interface, and chemical reactions within the sediment.

Equation 1 can be rewritten as

$$\frac{dm}{dt} = D\frac{dc}{dz}\bigg|_0^H - wc\big|_0^H - RH \qquad (6)$$

where m is the mass per unit area. The diffusion term on the right can be separated into biological and chemical components and simplified assuming that the diffusion through the bottom of the control volume (at z=H) is negligible. However, for the advective flux term it is unlikely that the chemical transport into the bottom of the control volume is small compared to that exiting at the top, thus both terms must be retained. Finally, the reaction term can be separated into separate terms for degradation (loss) and interaction with the solid phase. Equation 2 then becomes

$$\frac{dm}{dt} = \left(D_C + D_B\right)\frac{dc}{dz}\bigg|_0 - wc\big|_0^H - R_B H - R_S H \qquad (7)$$

where D_C is the chemical diffusion constant, D_B is the bioirrigation diffusion constant, R_B is the biodegradation term, and R_S is the solid phase reaction term. The first term on the right hand side represents the diffusive flux at the sediment-water interface, precisely what is measured using the Benthic Flux Sampling Device (BFSD). The standard BFSD protocol does not distinguish between chemically and biologically mediated fluxes, however, utilizing the bioinhibited BFSD protocol should allow the chemical flux component to be isolated and then the biological contribution to the flux can be estimated by difference. The second term on the right is the differential advective flux at the sediment-water interface and bottom of the control volume. The sediment-water interface term can be quantified directly by use of the Tidal Seepage Meter or by determining the flow with the TSM and the concentration by direct measurement of the porewater. The advective term at the bottom of the control volume can only be determined by measuring the flow with the TSM, and collecting porewater at depth H to determine the concentration. If most of the contaminants are confined to the upper level between z=0 and z=H, then the second term may be negligible. Quantification of the degradation term can be achieved by direct measurement of ^{14}C labeled compound mineralization rates. The solid phase reaction term can be evaluated from two primary perspectives. In the case of the typical historically contaminated site, the solid phase sediment is generally viewed as a source of contaminated material to the porewater. In this case, the reaction term can be viewed as a steady source term that is balanced (at least over short time scales) by the losses due to diffusion, advection and degradation (i.e. dc/dt = 0). In the other common case where a contaminated groundwater plume is migrating through the sediment, the solid phase may act as a sorptive sink for the contaminants. In this case, the source of the contamination is likely to be advection through the bottom of the control volume, which will in turn be balanced by interfacial losses and degradation. Thus depending on the site and the contaminant characteristics, R_S may act as either a source or sink, however if we assume that steady state conditions prevail, then it will simply be the balancing term and need not be directly quantified.

In a similar way, the solid phase dynamical balance is governed primarily by the balance between deposition and erosion. If erosion exceeds deposition, the sedimentation rate is negative, and contaminated sediment may be removed from the site via this process. On the other hand, if deposition exceeds erosion, then the sedimentation rate will be positive and the site will accumulate new material. If this material is relatively clean, then this sedimentation may result in a perceived “loss” of contaminated material from a given control volume, since the more contaminated material will be buried, and thus effectively moved through the bottom of the control volume at depth H beneath the sediment-water interface. Indices for solid phase transport phenomenon can be characterized in a similar way as those for porewater dynamics. The erosion rate of a sediment (mass per unit area) can be parameterized as

$$E = K_E(\tau - \tau_c) \tag{8}$$

where τ is the bed shear stress, τ_c is the critical shear stress for erosion, and K_E is a bed dependent erosion rate constant. Given the solid phase sediment contamination concentration, the mass flux of contamination per unit area due to erosion can be calculated as

$$F_E = Ec_S = K_E(\tau - \tau_c)c_B \tag{9}$$

where c_S is the solid phase concentration. Here the site-specific bed parameters K_E and τ_c can be determined directly from the in situ flume measurements, and the sediment concentration from traditional solid phase chemistry.

In the case of sedimentation of clean material into the layer of depth H we can assume that contaminated material is displaced through the bottom of the control volume as clean material is added at the top and parameterize the flux as

$$F_S = S(c_B - c_S) \tag{10}$$

where S is the sedimentation rate in mass per unit area, and c_S is the solid phase concentration of the material that is settling onto the bed. The sedimentation rate can be estimated from either age-dated cores, or from sediment traps.

Taking the most common case for a historically contaminated site, assuming steady state, and redefining terms based on measured parameters, equation 3 can be rewritten as follows

$$\sum flux = -R_S = F_{DC} + F_{DB} + w(c_0 - c_H) + R_D H + K_E(\tau - \tau_c)c_B + S(c_B - c_S)$$

where

(11)

$$F_{DC} = D_C \left.\frac{dc}{dz}\right|_0 \quad \textit{chemical diffusion}$$

$$F_{DB} = D_B \left.\frac{dc}{dz}\right|_0 \quad \textit{bioirrigation}$$

3.3 LINKING THE FIELD-MEASUREMENT PROGRAM TO PROPOSED PRISM INDICES

Figure 3-2 illustrates, in cartoon form, which field measurements are expected to contribute to which portions of the transport index equations, or Equation 7, above. In the previous discussion, we described how instrument outputs feed into these equations, and a few of the assumptions inherent in these approaches. In subsequent sections, we will discuss some modifications to this approach based on specific results of the field effort..

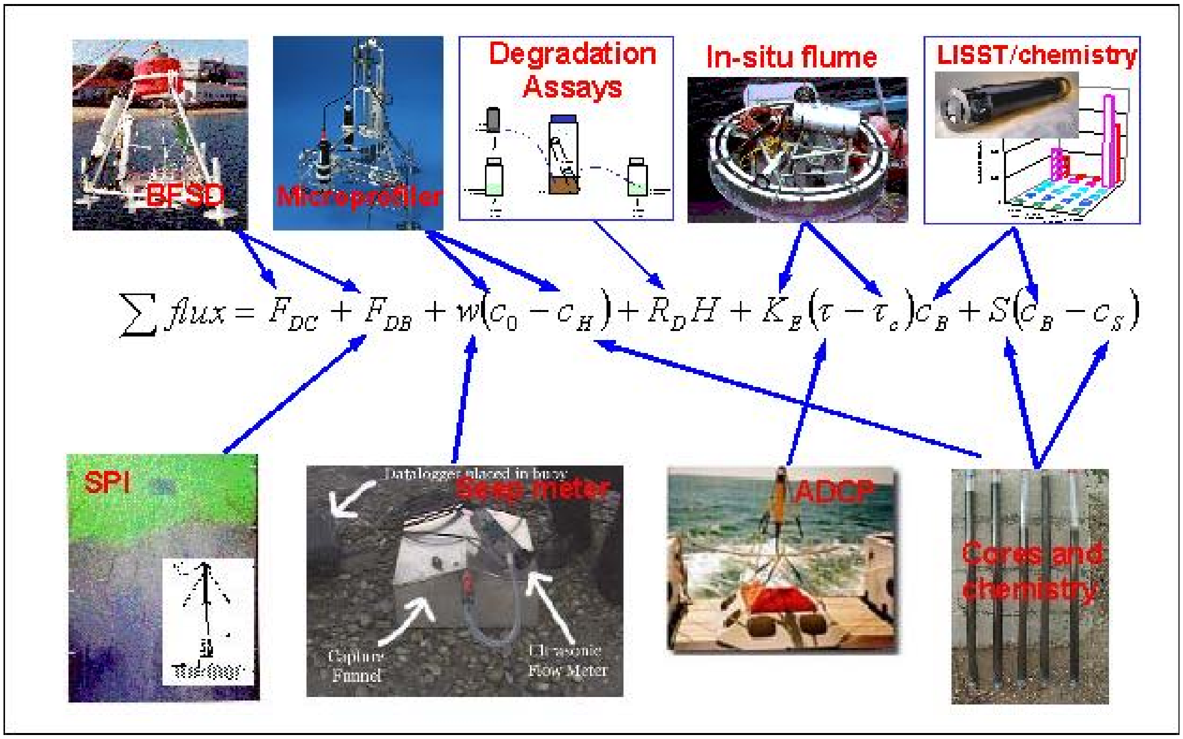

Figure 3-2. Input of field measurements into flux equation.

3.4 MATURITY OF TOOLS USED

The success of this project hinges on the effectiveness, success, and regulatory acceptance of a number of innovative technologies. A number of questions must be addressed, including: Are all of these technologies commercially available? Are they accepted for use at DoD sites? Have the reliability and accuracy of field measurements of individual processes been demonstrated and validated using the different field instruments? Where, if at all, has regulatory acceptance been achieved? What are their limitations? Table 3-1, below, addresses these questions for each of the instruments used.

The limitations (as well as strengths) are discussed in some detail in various sections of this report. Table 3-1 below describes the maturity of the tools used. However, it should be pointed out that the goal of this project is NOT yet to provide data at a level capable of being used in a regulatory program. Rather, the goal is to provide the first simultaneous field measurements of the various processes that may control contaminant fate and transport in nearshore sediments. The results of these studies should provide insight into both what processes should be studied in greater detail at a research level, and what processes are most critical for a regulatory-level contaminated sediment management study. Ultimately, a subset of the measurements used in this study might be used in programs that will require regulatory acceptance. The figure below attempts to illustrate the feedback that was anticipated between the PRISM project, research and sediment management. Thus, while it is important that the tools used in the PRISM project have some degree of regulatory acceptance, and it is critical that the strengths, weaknesses and assumptions involved in each method are made clear, it is expected that any focused set of measurements that are determined to be critical to sediment management will be further standardized and validated under a program such as ESTCP.

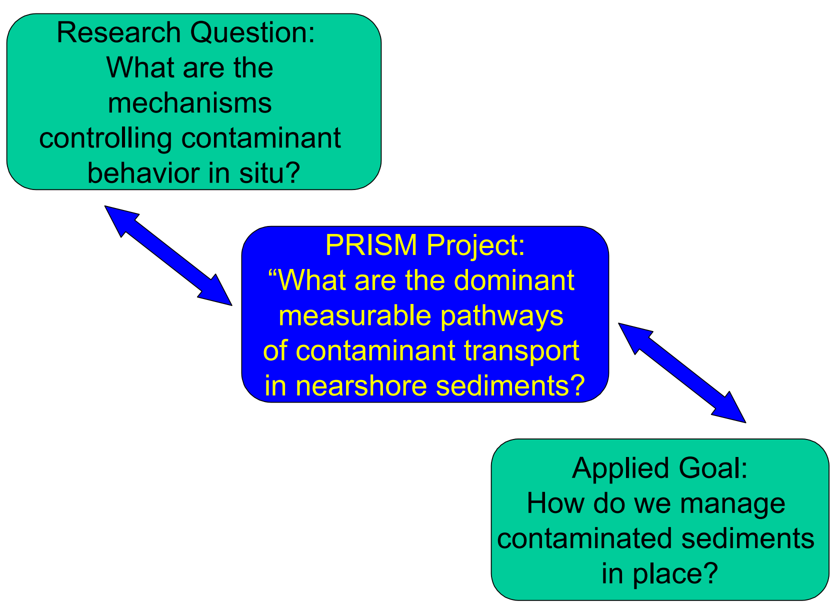

Figure 3-3. PRISM, research and applications.

Table 3-1. Technical maturity, acceptance level, and availability of PRISM methods.

Tools; (lead lab)	Maturity/Acceptance/Availability
BFSD; (SSD San Diego)	Metals – mature - CalCert PAHs – mature – CalCert Various BFSD units available via universities, ESTCP tech transfer makes tool available
Bioinhibited BFSD; (SSC San Diego)	Published observations, never used in this context; developmental; method to be critically assessed in project
Porewater gradients – squeeze and measure; (microgradients – SIO; composited cores – Battelle)	Standard, used in multiple regulatory programs Available via trained scientists
Porewater gradients – microprofiling; (SIO)	For "surrogates", standard and COTS; not often used in regulatory programs, but extensively published in peer-reviewed literature; available via trained scientists
Tidal Seep Meter; (Cornell)	SSC validating under ESTCP funding; can easily be produced
In situ Flume; (VIMS)	Several versions have published results; this flume being used at Anacostia and other contaminated sites with visibility; limited availability
LISST; (SSC San Diego)	Established, COTS. While there are some limitations to method, they will be extensively documented in this program
ADCP; (SSC San Diego)	Established, COTS; used in many regulatory programs
Sediment/Contaminant Geochemical signatures; (SSC San Diego)	Standard methods; SSC has developed and published use in contaminated sediment management; part of Navy sediment guidance; applications similar to those cited in EPA documents; available via most good analytical contractors
^{210}Pb, $^{7}Be/^{137}Cs$; (Battelle)	Standard; published, used extensively at sediment sites; available via many contractors
SPI Camera; (Germano and Associates)	Published, used at multiple sites; commercially available
^{14}C – labeled compound mineralization; (NRL)	NRL has published application at several sites; methods standard; published methods can be applied by trained microbiologists

3.5 HOW ARE THESE RESULTS THEN USED TO COMPARE AND RANK PATHWAYS?

For a given site, it is possible to compare these terms directly as flux rates. However, for some applications, additional insight can be gained by normalizing the terms to a scale that is relevant to risk reduction or recovery for the site. The risk/recovery level could be based on any number of criteria including water quality standards, sediment quality standards, or site-specific cleanup levels (for either sediment or porewater). An equivalent time scale can also be adopted for the site based on a target recovery time. A desired recovery rate (with the same dimension as our fluxes) can then be defined as

$$R_R = \frac{\Delta m}{\Delta t} = \frac{(c - c_C)H}{t_R} \tag{12}$$

where c is the current concentration in the sediment, c_C is the target level for cleanup or risk reduction and t_R is the target recovery time scale. Normalizing all flux terms to R_R results in a set of indices that reflect the relative contribution of various transport processes to site recovery or risk.

$$\begin{aligned}
I_{DC} &= \frac{F_{DC}}{R_R} \quad \textit{diffusion index} \\
I_{DS} &= \frac{F_{DB}}{R_R} \quad \textit{bioirrigation index} \\
I_A &= \frac{w(c_0 - c_H)}{R_R} \quad \textit{advection index} \\
I_B &= \frac{R_B H}{R_R} \quad \textit{biodegradation index} \\
I_E &= \frac{K_E(\tau - \tau_c)c_B}{R_R} \quad \textit{erosion index} \\
I_S &= \frac{S(c_B - c_S)}{R_R} \quad \textit{sedimenation index}
\end{aligned} \tag{13}$$

These indices then provide one non-dimensional yardstick for pathway ranking of important processes that can influence the fate of in-place sediment contamination. The interpretation of these indices would be that the larger indices are the more dominant pathways, and that pathways with I O(1) or greater could represent an important process for recovery (or exposure).
Of course, there are substantial risks in predicting long-term (years to decades) contaminant behavior based upon short-term (minutes to days) measurements. Furthermore, there are clear problems in examining or predicting changes over time from equations developed assuming steady state. For example, there is no doubt that PAH degradation rates vary substantially as concentration, nutrient level, temperature, and other factors vary. Thus, a measurement of instantaneous mineralization rates, while predictive of recovery times if all things remained constant, will not actually predict how long actual recovery of sediments would take by

biodegradation or how far that process will go. Parallel arguments can be made for all of the processes being discussed, since all measurements being made are short-term measurements (e.g., the SPI measurements are instantaneous snapshots, seep and BFSD are measured for ~72 hours, flume measurements for a few hours at the most). However, these problems exist for all current approaches to these issues. Currently, models try to predict recovery or exposure over time based either on short-term laboratory measurements (even less realistic, but more controllable, than field measurements) or based upon order-of-magnitude estimates based upon theoretical approaches. In any complex, multivariate process, predictions are just that. Having said this, this integrated field approach at least allows for the evaluation of multiple processes simultaneously and in common terms. This provides new insight into the relative importance of these processes in near-shore sediment environments. A critical assessment of the utility of this approach in sediment management, and a refinement of data evaluation processes as the project progresses, is one of the fundamental goals of this project.

It should be pointed out that these equations are only one way in which results can be applied to site management. Either all or a portion of the results can be used to refine Conceptual Site Models (CSMs), and specific data can be inserted into other models used to predict contaminant fate in terms of either risk or recovery. More details on approaches to data use are being summarized in a paper in preparation.

4 Site I Field Program

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4.1 SITE SELECTION AND OVERALL SAMPLING DESIGN

Site I Selection

Several parameters were considered in the site selection process. Included are where the site is in the RI/FS process, willingness of RPMs and stakeholders to provide access, and technical feasibility. Ideally, PRISM field work should be carried out at a minimum of two sites (choosing varied sites helps to widen the applicability of the developed methods to more situations) which meet the following criteria: 1) The sites should have a probability that they differ in dominant contaminant transport pathways (e.g., one site should be expected to be driven by diffusion, one by advection or biological processes or resuspension), 2) Sites should have sufficient levels of contaminants that fluxes and changes are detectable, 3) Sites should be undergoing RI/FS or some other remedial investigation so that data can contribute to the decision process ***or*** Site has recently (or will soon) be managed in situ, so that data can be used to evaluate efficacy (ideally, measurements would be made before and after a management approach was implemented), and 4) Investigators must have site access.

A number of Site Selection Issues have been identified, among them being: 1) What are the contaminants of concern? Are a broad mix or a narrow range of contaminants at each site? Should both field sites have comparable mixes and concentration ranges of contaminants, but different hydrodynamic processes, or should one have low levels, one high levels, but with similar driving processes? Should we have two disparate sites in respect to all factors? 2) What are the regulatory drivers? 3) What stage of the process is this site at (e.g., dredging history assessment, feasibility or cleanup)? 4) What data are available? What form are the data in (hard copy or electronic)? 5) Are there constraints on ultimate management options? 6) What is the hydrodynamic regime? 7) Is there a probability of good site access?

Several candidate sites were reviewed, based upon the above criteria, and, after a review of available data, Paleta Creek at Naval Station San Diego was selected as the Phase I site (see Table 4-1 and Figure 4-1). Addressing the issues above: 1) There are a mix of contaminants of concern, including metals, PAHs and pesticides (see Appendix 1 for a synopsis of site data), increasing the probability that the methods applied will be applicable, 2) The California Bay Protection and Toxic Cleanup Program (BPTCP) has designated this a Toxic Hotspot, and thus it is undergoing intense scrutiny, 3) The Navy is currently collaborating with a number of agencies to address this site, and thus any data may help in the management decision process, 4) Large volumes of site data are available from a number of sources (see Appendix for a compilation of some data), 5) A wide range of management options, including in-place management, are being considered, and 6) Since SSC scientists are involved in numerous projects at the site, including BPTCP and ONR-funded work, access is likely. One potential pitfall of Paleta Creek as a demonstration site is that episodic rainfall events in winter could dwarf transport by other mechanisms the rest of the year. While rainfall effects are being evaluated in other studies, this potential issue will have to be taken into account in data interpretation and application. Figure 4-2 shows some of the site characteristics that led to site selection, and Figure 4-1 is a map showing where the site is in San Diego Bay. As can be seen, many COPCs, both inorganic and organic, are elevated at the site.

Table 4-1. Evaluation criteria for demonstration sites considered for Site I.

Site	Location	Reg. Driver	Site Assess. Status	Hypoth. Dominant Pathway Defined	COPCs Defined	User Demand	Reg. Interest	Logistics and Access	Overall Rank
Treasure Island	San Franciso Bay,CA	BRAC	RI	Yes: Direct Ingestion	Yes: Pb	Low	Low	Mod	Low
Hunters Point	San Franciso Bay, CA	BRAC	FS	Yes: Diffusion/ Erosion	Yes: PCB, PAH, metals	Low	Mod	Mod	Mod
Eagle Harbor	Puget Sound, WA	CERCLA/ Superfund	Cleanup	Yes: Advection	Yes: PAH	Mod	Mod	Poor	Mod
Anacostia River	Wash., DC	CERCLA/ other	FS	Yes: Burial/ Diffusion	Yes PCB, PAH	Mod	Mod	Poor	Mod
Paleta Creek	San Diego, CA	BPTCP/ TMDL	RI	Yes: Diffusion	Yes PAH, PCB, metals	High	High	Good	High
Chollas Creek	San Diego, CA	BPTCP/ TMDL	RI	Yes: Diffusion/ Erosion	Yes PCB, Pest.	Mod	High	Good	Mod
Graving Dock	San Diego, CA	BPTCP/ TMDL	PA	No	Yes Metals	Low	Mod	Good	Low

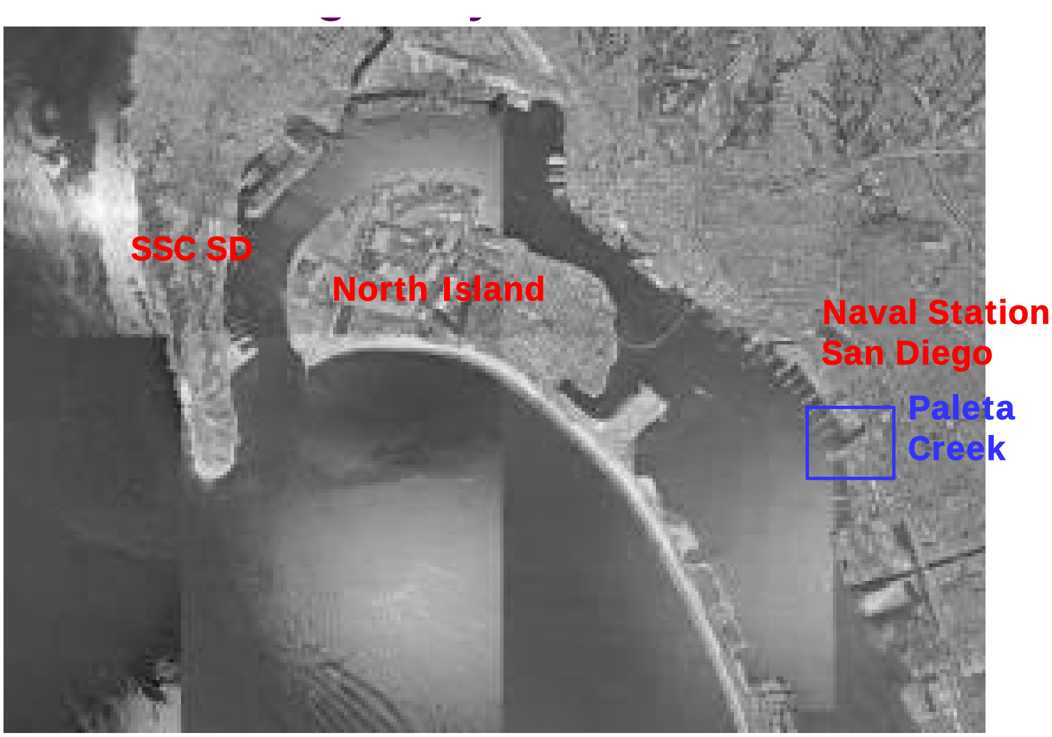

Figure 4-1. Map showing the location of Paleta Creek within San Diego Bay.

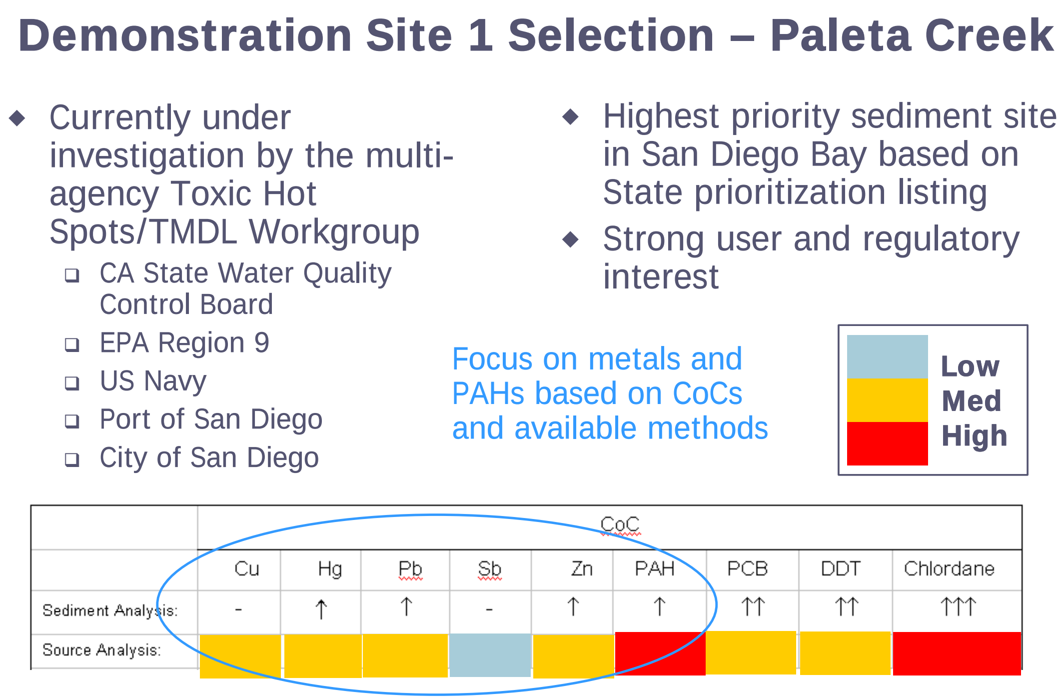

Figure 4-2. Brief summary of site characteristics

Site 1 Field Design Discussion

Site layout issues

For the PRISM study, two strata were laid out, based upon preliminary site data. The first is at Creek mouth (P17, see Figure 4-3). At this site, conditions are quiet, access is easy, there could be some groundwater influence, we have documented diffusive fluxes in the past, and there are some of highest contaminant levels in the area. The second is in outer piers (P04, see Figure 4-3). This site may be influenced by physical transport and ship scour, and should reflect bay conditions, with some Naval Station impact. The number of sampling sites per stratum depends upon the complexity and expense of the measurement, and will be discussed below. In order to maximize the amount of data available to leverage from other programs, sampling sites were selected to correspond with sites being sampled for the Sediment Quality Assessment Study at Chollas Creek and Paleta Creek, San Diego, BPTCP program, with a particular emphasis on the sites designated as Chemistry/bioassay/bioaccumulation sites (see Figure 4-4). The BPTCP study evaluated bulk sediment characteristics and chemistry, toxicity, bioaccumulation and benthic community analysis, and these data are available to PRISM scientists. Figure 4-4 shows the PRISM sites in relation to the BPTCP sites.

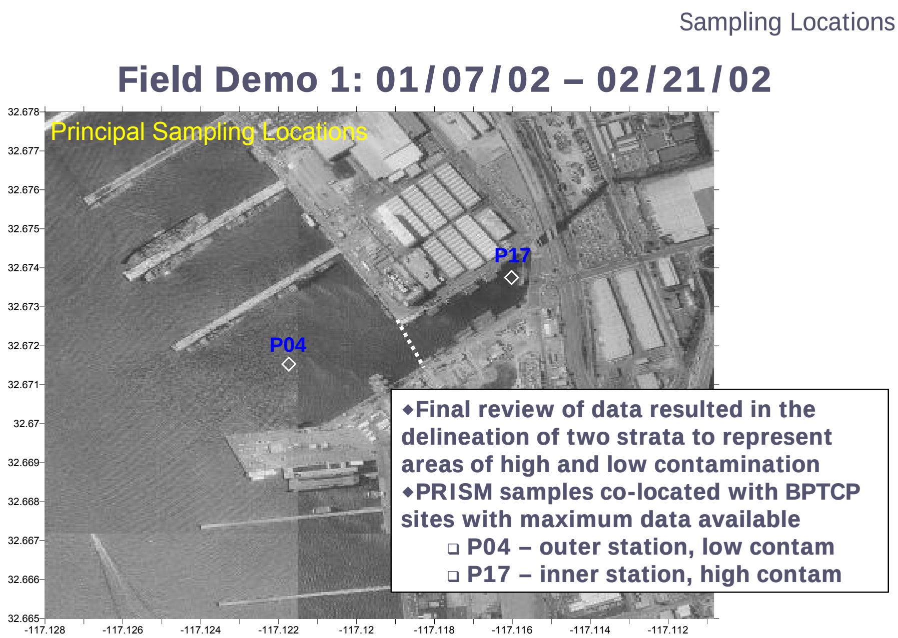

Figure 4-3. location of strata

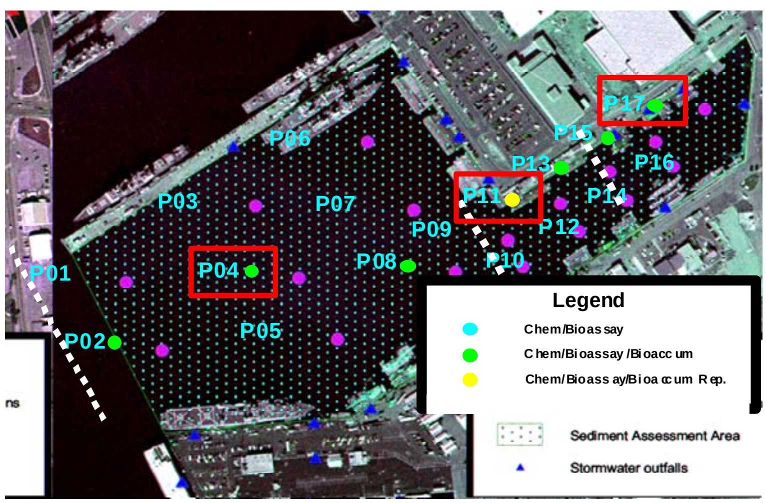

Figure 4-4. locations of BPTCP analyses. PRISM sites were selected to be co-located to sites with as much BPTCP data as possible

COPCs

The decision was made to limit the candidate analytes for study (bulk sediment and fraction analyses, PW measurements, seep and flux). PAHs (a selected subset), were analyzed, while pesticides and PCBs were not. The reasons for this decision were: 1) Our team does not have methods to examine PCBs and pesticides for some of the pathways (e.g., biodegradation), 2) for BFSD, PCBs and pesticides were barely detectable at the site, and 3) budget considerations suggested that is was better to do a thorough evaluation of a narrow band of COPCs than a less-complete evaluation of a larger list. Selected metals were measured as well (though not relevant for the biodegradation pathway).

Site I Sampling Schedule
Figure 4-5 below shows the order and timing of the work done at Site I.

Deployment

Field Deployment Timeline: January 2002

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7. SPI Camera: P04 and P17	8	9. SPI: P17; Coring: P17-1 and P17-2 (SIO, NRL); Coring: P17 (water, sed)	10. BFSD I and II: P17; Sediment Traps: P17 and P04	11. Check Seep Meters at P04	12. Check Seep Meters at P04
13. Check Seep Meters at P04	14. BFSD Retrieval; Remove Sed. Trap Caps at P17, Photos	15. SPI: P04, Multi-Coring: P04-3 (SIO, NRL)	16	17. BFSD I and II: P04	18	19
20	21. Retrieve BFSD I and II at P04	22	23	24. BFSD-B: P04 and P17; Age-Dating Cores	25	26
27. Retrieve BFSD-B; Redeploy BFSD-II at P04	28	29	30. Retrieve BFSD-II at P04 after redeployment	31		

Detailed notes: Prism_Field1notes.doc

Deployment

Field Deployment Timeline: February 2002

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6. Sediment Trap Recovery; Deployment of Current Meters	7	8	9
10	11	12	13	14	15	16
17	18. Flume Assembly	19. Flume Deplyment at P17-1	20. Flume Deployment at P17-2, P04-1	21. Flume Deployment at P04-2	22	23
24	25	26	27	28		

Detailed notes: Prism_Field1notes.doc

Figure 4-5. Field deployment calendar.

Field Sampling and integration
The field-sampling plan incorporated the requirements for the individual sampling protocols as well as the requirements for integration of methods and sample collection. To carry out this fieldwork and data integration, the following sampling frequencies and analyses were carried out (Table 4-2).

Table 4-2. Sampling frequency. Based on Paleta Creek + Outside Region (2 strata, 3 samples per stratum, barring BFSD and seep); with age dating; only one organic class (PAH not PCB/Pest); PAHs in bioinhibited BFSD; metals analysis of some flume filtrates.

Measurement Technique	Matrix	Vol (ea)	Dep. Time (h)	# of Dep.	Samp. Per Dep.	Total Samp.	Analytes	Method
1. BFSD	SW	150	72	4	6	24	Metals[1]	ICP/MS and GFAA
	SW	150	72	4	6	24	PAH or PCB/Pest[2]	GCMS
	SW	50	72	4	12	48	Si	(Si in house-Hach)
	SW	50	72	4	12	48	NO_3, NO_2, NH_4, PO_4	SIO ODF
2. BFSD-Bioinhibited (w/o O_2)	SW	50	48	2	12	24	Si	(Si in house-Hach)
	SW	200	48	2	12	24	NO_3, NO_2, NH_4, PO_4	SIO ODF
	SW	200	48	2	6	12	PAHs	GCMS
3. Seep Meter	SW	125	12	2	6	12	Metals[1]	ICP/MS and GFAA
(chem. on positive seep)	SW	125	12	2	6	12	PAH or PCB/Pest[2]	GCMS
4. Bulk Porewater	SW	125		6	1	6	Metals[1]	ICP/MS and GFAA
	SW	250		6	1	6	PAH or PCB/Pest[2]	GCMS
5. Surface Water	SW	500		6	1	6	Metals[1]	ICP/MS and GFAA
	SW	2000		6	1	6	PAH or PCB/Pest[2]	GCMS
6. Porewater/Solids Gradients	S/PW	m-core		2	10	20	Fe, Si, NO_3, NH_4 ???	per SIO
	S/PW	m-core		2	10	20	Metals[1]	ICPMS
7. Surface Sediment Grabs	S	250		6	1	6	Metals[3]	ICP/MS and GFAA
	S	500		6	1	6	PAH or PCB/Pest[2]	GC
	S	250		6	1	6	SSA, TOC	(in house)
8. Age-Dated Cores	S	g-core	1 h	2	10	20	Pb-210	Alpha
(e.g., assume 100 cm cores @ 10 cm intervals for Pb-210 and 20 cm cores @ 2 cm intervals for Be-7 and Cs-137)	S			2	10	20	Metals[3]	ICP/MS and GFAA
				2	10	20	PAH or PCB/Pest[2]	GCMS
				2	10	20	Cs-137, Be-7, K-40	Gamma
9. Grainsize/LISST (related to Flume)	S			2	1	3	LISST	(in house, LISST, settling, cont. distribution?)
(fraction resuspended in Flume?)								
	S fract	50		2	2	4	metals	ICP/MS and GFAA
	S fract	50		2	2	4	PAHs	GC
flume filtrate	S	25mg		2	1	2	metals	ICP/MS and GFAA
10. Sediment Trap	S			2	3	6	sediment flux rates	
11. Hydrodynamics				2	1	3	current velocity	ADCP
12. Flume (Maa)	S	sea floor		2	1	3	critical bed shear stress, erosion rate	
(will need sediment grab, from # 7 above?)							sediment compistion, grainsize, clay minerals	
(will also collect water samples w/flume)	SW	?		2	1	3	TSS/LISST	
13. Microprofiling (Ziebis)	S	core		6	1	9	O_2, other	Electrode
14. REMOTS (Bioturbation Pathway) (Germano)	S			TBD: 6 (min)			sediment profile-image	camera
15. Biodegradation Potential (NRL)	S	50 g		TBD: 6 (min)			mineralization of 14C-PAHs	
16. Seep/Resistivity (Smith) (concurrent with 3 above?) (Ultrasonic TSM, resistivity probes)								

5 Site I Field Results

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5.1 SEDIMENT PROFILE INVESTIGATION OF BIOTURBATION DEPTHS

Introduction

As part of multidisciplinary research program to investigate contaminant transport pathways for coastal sediments, Germano & Associates, Inc. (G&A) performed a Sediment Profile Imaging (SPI) survey in San Diego Bay in the area between Pier 8 and the Seventh Street Channel between January 7-15, 2002. The purpose of the SPI survey was to delineate gradients in sediment grain-size, redox depth, small-scale boundary roughness, and benthic community assemblage. In addition to using the SPI results to confirm the choice of the two stations used for more detailed investigations, our intent was to also look at selected parameters from the SPI image analysis to see what (if any) correlations existed between the SPI variables and those measured by other investigators.

Materials And Methods

SPI operations were carried out aboard the *R/V ECOS* on January 7, 9, and 15, 2002; a reconnaissance survey of the entire area of interest was completed on the first day. Sediment profile images were collected at 24 stations on January 7; on January 9, additional shots were taken at Stations P1, P2, and P9 as well as 9 replicate images at P-17 to correspond with multi-core sampling. On January 15, nine replicate images were also taken at Station P-4 to correspond with multi-core sampling at that location. A total of 125 images were collected over the course of the three field survey days at the 24 sampling locations (Figure 5-1).

At the beginning of the survey, the time on the sediment profile camera's internal data logger was synchronized with the internal clock on the computerized navigation system to Pacific Time. Three replicate images were taken at each station; each SPI replicate is identified by the time recorded on the film and on disk along with vessel position. Even though multiple images were taken at each location, each image was assigned a unique frame number by the data logger and cross-checked with the time stamp in the navigational system’s computer data file. Redundant sample logs were kept by the field crew.

Test exposures of the Kodak® Color Separation Guide (Publication No. Q-13) were fired on deck at the beginning and end of each survey day to verify that all internal electronic systems were working to design specifications and to provide a color standard against which final film emulsion could be checked for proper color balance. Charged spare batteries were carried in the field at all times to insure uninterrupted sample acquisition. After deployment of the camera at each station, the frame counter was checked to make sure that the requisite number of replicates had been taken. In addition, a prism penetration depth indicator on the camera frame was checked to verify that the optical prism had actually penetrated the bottom to a sufficient depth to acquire a profile image. If images were been missed (frame counter indicator) or the penetration depth was insufficient (penetration indicator), weights were added or removed and additional replicates taken. Changes in prism weight amounts, the presence or absence of mud doors, and chassis stop positions were noted in the log for each replicate image. All film taken was developed in the field at the end of each survey day to verify successful data acquisition; strict controls were maintained for development temperatures, times, and chemicals to insure consistent density on the film emulsion. The film was then visually inspected under magnification to determine whether any stations needed resampling.

Following completion of field operations, the color slides were scanned and stored in photo-CD format by ProLab, Inc., Seattle, WA. A total of 58 digital images were analyzed from this survey using Image Pro® (Media Cybernetics, Inc.). Calibration information was determined by measuring 1-cm gradations from the Kodak® Color Separation Guide. This calibration information was applied to all SPI images analyzed. Linear and area measurements were recorded as number of pixels and converted to scientific units using the calibration information.

Measured parameters were recorded on a Microsoft® Excel spreadsheet. These data were subsequently checked by G&A's senior scientist (Dr. J. Germano) as an independent quality assurance/quality control review of the measurements before final interpretation was performed.

Measuring, Interpreting, and Mapping SPI Parameters

Sediment Type

The sediment grain-size major mode and range were visually estimated from the color slides by overlaying a grain-size comparator that was at the same scale. This comparator was prepared by photographing a series of Udden-Wentworth size classes (equal to or less than coarse silt up to granule and larger sizes) with the SPI camera. Seven grain-size classes were on this comparator: >4 ϕ, 4 - 3 ϕ, 3-2 ϕ, 2 - 1 ϕ, 1-0 ϕ, 0 - (-)1 ϕ, < -1 ϕ. The lower limit of optical resolution of the photographic system was about 62 microns, allowing recognition of grain sizes equal to or greater than coarse silt ($\geq$ 4 ϕ). The accuracy of this method has been documented by comparing SPI estimates with grain-size statistics determined from laboratory sieve analyses.

The comparison of the SPI images with Udden-Wentworth sediment standards photographed through the SPI optical system was also used to map near-surface stratigraphy such as sand-over-mud and mud-over-sand. When mapped on a local scale, this stratigraphy can provide information on relative transport magnitude and frequency.

Prism Penetration Depth

The SPI prism penetration depth was measured from the bottom of the image to the sediment-water interface. The average penetration depth was determined by measuring across the entire cross-sectional image. Linear maximum and minimum depths of penetration were also measured. Maximum, minimum, and average penetration depths were recorded in the data file.

Prism penetration is potentially a noteworthy parameter; if the number of weights used in the camera is held constant throughout a survey, the camera functions as a static-load penetrometer. Comparative penetration values from sites of similar grain size give an indication of the relative water content of the sediment. Highly bioturbated sediments and rapidly accumulating sediments tend to have the highest water contents and greatest prism penetration depths.

The depth of the camera's penetration into the bottom also reflects the bearing capacity and shear strength of local sediments. Overconsolidated or relic sediments and shell-bearing sands resist camera penetration. Highly bioturbated, sulfitic, or methanogenic muds are the least consolidated, and deep penetration is typical. Seasonal changes in camera prism penetration are typically observed at the same station and are related to the control of sediment geotechnical properties by bioturbation (Rhoads and Boyer 1982). The effect of water temperature on bioturbation rates appears to be important in controlling both biogenic surface relief and prism penetration depth (Rhoads and Germano 1982).

Small-Scale Surface Boundary Roughness

Surface boundary roughness was determined by measuring the vertical distance (parallel to the film border) between the highest and lowest points of the sediment-water interface. The surface boundary roughness (sediment surface relief) measured over a horizontal distance of 15 cm typically ranges from 0.02 to 3.8 cm, and may be related to either physical structures (ripples, rip-up structures, mud clasts) or biogenic features (burrow openings, fecal mounds, foraging depressions). Biogenic roughness typically changes seasonally and is related to the interaction of bottom turbulence and bioturbational activities.

The camera must be level in order to take accurate boundary roughness measurements. In sandy sediments, boundary roughness can be a measure of sand wave height. On silt-clay bottoms, boundary roughness values often reflect biogenic features such as fecal mounds or surface burrows.

Thickness of Depositional Layers

Because of the camera's unique design, SPI can be used to detect the thickness of depositional and dredged material layers. SPI is effective in measuring layers ranging in thickness from 20 cm (the height of the SPI optical window) to 1 mm. During image analysis, the thickness of the newly deposited sedimentary layers can be determined by measuring the linear distance between the pre- and post-disposal sediment-water interface. Recently deposited material is usually evident because of its unique optical reflectance and/or color relative to the underlying material representing the pre-disposal surface. Also, in most cases, the point of contact between the two layers is clearly visible as a textural change in sediment composition, facilitating measurement of the thickness of the newly deposited layer.

Mud Clasts

When fine-grained, cohesive sediments are disturbed, either by physical bottom scour or faunal activity, e.g., decapod foraging, intact clumps of sediment are often scattered about the seafloor. These mud clasts can be seen at the sediment-water interface in SPI images. During analysis, the number of clasts was counted, the diameter of a typical clast was measured, and their oxidation state (discussed below) was assessed. The abundance, distribution, oxidation state, and angularity of mud clasts can be used to make inferences about the recent pattern of seafloor disturbance in an area.

Depending on their place of origin and the depth of disturbance of the sediment column, mud clasts can be reduced or oxidized. In SPI images, the oxidation state is apparent from the reflectance; see Section 2.1.6. Also, once at the sediment-water interface, these mud clasts are subject to bottom-water oxygen concentrations and currents. Evidence from laboratory microcosm observations of reduced sediments placed within an aerobic environment indicates that oxidation of reduced surface layers by diffusion alone is quite rapid, occurring within 6 to 12 hours (Germano 1983). Consequently, the detection of reduced mud clasts in an obviously aerobic setting suggests a recent origin. The size and shape of the mud clasts are also revealing. Mud clasts may be moved and broken by bottom currents and animals (macro- or meiofauna; Germano 1983). Over time, large angular clasts become small and rounded.

Apparent Redox Potential Discontinuity Depth

Aerobic near-surface marine sediments typically have higher reflectance relative to underlying hypoxic or anoxic sediments. Surface sands washed free of mud also have higher optical reflectance than underlying muddy sands. These differences in optical reflectance are readily apparent in SPI images; the oxidized surface sediment contains particles coated with ferric hydroxide (an olive or tan color when associated with particles), while reduced and muddy sediments below this oxygenated layer are darker, generally grey to black. The boundary between the colored ferric hydroxide surface sediment and underlying grey to black sediment is called the apparent redox potential discontinuity (RPD).

The depth of the apparent RPD in the sediment column is an important time-integrator of dissolved oxygen conditions within sediment porewaters. In the absence of bioturbating organisms, this high reflectance layer (in muds) will typically reach a thickness of 2 mm (Rhoads 1974). This depth is related to the supply rate of molecular oxygen by diffusion into the bottom and the consumption of that oxygen by the sediment and associated microflora. In sediments that have very high sediment oxygen demand (SOD), the sediment may lack a high reflectance layer even when the overlying water column is aerobic.

In the presence of bioturbating macrofauna, the thickness of the high reflectance layer may be several centimeters. The relationship between the thickness of this high reflectance layer and the presence or absence of free molecular oxygen in the associated porewaters must be considered with caution. The actual RPD is the boundary or horizon that separates the positive Eh region of the sediment column from the underlying negative Eh region. The exact location of this Eh = 0 boundary can be determined accurately only with microelectrodes; hence, the relationship between the change in optical reflectance, as imaged with the SPI camera, and the actual RPD can be determined only by making the appropriate *in situ* Eh measurements. For this reason, the optical reflectance boundary, as imaged, was described in this study as the “apparent” RPD and it was mapped as a mean value. In general, the depth of the actual Eh = 0 horizon will be either equal to or slightly shallower than the depth of the optical reflectance boundary. This is because bioturbating organisms can mix ferric hydroxide-coated particles downward into the bottom below the Eh = 0 horizon. As a result, the apparent mean RPD depth can be used as an estimate of the depth of porewater exchange, usually through porewater irrigation (bioturbation). Biogenic particle mixing depths can be estimated by measuring the maximum and minimum depths of imaged feeding voids in the sediment column. This parameter represents the particle mixing depths of head-down feeders, mainly polychaetes.

The rate of depression of the apparent RPD within the sediment is relatively slow in organic-rich muds, on the order of 200 to 300 micrometers per day; therefore this parameter has a long time constant (Germano and Rhoads 1984). The rebound in the apparent RPD is also slow (Germano 1983). Measurable changes in the apparent RPD depth using the SPI optical technique can be detected over periods of 1 or 2 months. This parameter is used effectively to document changes (or gradients) that develop over a seasonal or yearly cycle related to water temperature effects on bioturbation rates, seasonal hypoxia, SOD, and infaunal recruitment. Time-series RPD measurements following a disturbance can be a critical diagnostic element in monitoring the degree of recolonization in an area by the ambient benthos (Rhoads and Germano 1986).

The apparent mean RPD depth also can be affected by local erosion. The peaks of disposal mounds commonly are scoured by divergent flow over the mound. This scouring can wash away fines and shell or gravel lag deposits, and can result in very thin apparent RPD depths. During storm periods, erosion may completely remove any evidence of the apparent RPD (Fredette et al. 1988).

Another important characteristic of the apparent RPD is the contrast in reflectance at this boundary. This contrast is related to the interactions among the degree of organic loading, the bioturbation activity in the sediment, and the concentrations of bottom-water dissolved oxygen in an area. High inputs of labile organic material increase SOD and, subsequently, sulfate reduction rates and the associated abundance of sulfide end products. This results in more highly reduced, lower-reflectance sediments at depth and higher RPD contrasts. In a region of generally low RPD contrasts, images with high RPD contrasts indicate localized sites of relatively high past inputs of organic-rich material such as phytoplankton or other naturally-occurring organic detritus, dredged material, and sewage sludge.

Sedimentary Methane

If organic loading is extremely high, porewater sulfate is depleted and methanogenesis occurs. The process of methanogenesis is indicated by the appearance of methane bubbles in the sediment column, and the number and total area covered by all methane pockets is measured. These gas-filled voids are readily discernable in SPI images because of their irregular, generally circular aspect and glassy texture (due to the reflection of the strobe off the gas bubble).

Infaunal Successional Stage

The mapping of infaunal successional stages is readily accomplished with SPI technology. These stages are recognized in SPI images by the presence of dense assemblages of near-surface polychaetes and/or the presence of subsurface feeding voids; both may be present in the same image. Mapping of successional stages is based on the theory that organism-sediment interactions in fine-grained sediments follow a predictable sequence after a major seafloor perturbation. This theory states that primary succession results in “the predictable appearance of macrobenthic invertebrates belonging to specific functional types following a benthic disturbance. These invertebrates interact with sediment in specific ways. Because functional types are the biological units of interest..., our definition does not demand a sequential appearance of particular invertebrate species or genera” (Rhoads and Boyer 1982). This theory is presented in Pearson and Rosenberg (1978) and further developed in Rhoads and Germano (1982) and Rhoads and Boyer (1982).

This continuum of change in animal communities after a disturbance (primary succession) has been divided subjectively into three stages: Stage I is the initial community of tiny, densely populated polychaete assemblages; Stage II is the start of the transition to head-down deposit feeders; and Stage III is the mature, equilibrium community of deep-dwelling, head-down deposit feeders.

After an area of bottom is disturbed by natural or anthropogenic events, the first invertebrate assemblage (Stage I) appears within days after the disturbance. Stage I consists of assemblages of tiny tube-dwelling marine polychaetes that reach population densities of 10^4 to 10^6 individuals per m². These animals feed at or near the sediment-water interface and physically stabilize or bind the sediment surface by producing a mucous “glue” that they use to build their tubes. Sometimes deposited dredged material layers contain Stage I tubes still attached to mud clasts from their location of origin; these transported individuals are considered as part of the *in situ* fauna in our assignment of successional stages.

If there are no repeated disturbances to the newly colonized area, then these initial tube-dwelling suspension or surface-deposit feeding taxa are followed by burrowing, head-down deposit-feeders that rework the sediment deeper and deeper over time and mix oxygen from the overlying water into the sediment. The animals in these later-appearing communities (Stage II or III) are larger, have lower overall population densities (10 to 100 individuals per m²), and can rework the sediments to depths of 3 to 20 cm or more. These animals “loosen” the sedimentary fabric, increase the water content in the sediment, thereby lowering the sediment shear strength, and actively recycle nutrients because of the high exchange rate with the overlying waters resulting from their burrowing and feeding activities.

Organism-Sediment Index

The Organism-Sediment Index (OSI) is a summary mapping statistic that is calculated on the basis of four independently measured SPI parameters: apparent mean RPD depth, presence of methane gas, low/no dissolved oxygen at the sediment-water interface, and infaunal successional stage. Table 5-1 shows how these parameters are summed to derive the OSI.

The highest possible OSI is +11, which reflects a mature benthic community in relatively undisturbed conditions (generally a good yardstick for high benthic habitat quality). These conditions are characterized by deeply oxidized sediment with a low inventory of anaerobic metabolites and low SOD, and by the presence of a climax (Stage III) benthic community. The lowest possible OSI is -10, which indicates that the sediment has a high inventory of anaerobic metabolites, has a high oxygen demand, and is azoic. In our mapping experience over the past

15 years, we have found that OSI values of 6 or less indicate that the benthic habitat has experienced physical disturbance, organic enrichment, or excessive bioavailable contamination in the recent past.

Table 5-1. Calculation of the SPI Organism-Sediment Index.

PARAMETER	INDEX VALUE
A. Mean RPD Depth (choose one)	
0.00 cm	0
> 0-0.75 cm	1
0.76-1.50 cm	2
1.51-2.25 cm	3
2.26-3.00 cm	4
3.01-3.75 cm	5
> 3.75 cm	6
B. Successional Stage (choose one)	
Azoic	-4
Stage I	1
Stage I → II	2
Stage II	3
Stage II → III	4
Stage III	5
Stage I on III	5
Stage II on III	5
C. Chemical Parameters (choose one or both if appropriate)	
Methane Present	-2
No/Low Dissolved Oxygen[a]	-4
Organism-sediment Index = Total of above subset indices (A+B+C)	
Range: -10 to +11	

[a] This is not based on a Winkler or polarigraphic electrode measurement, but on the imaged evidence of reduced, low reflectance (i.e., high-oxygen-demand) sediment at the sediment-water interface.

Using SPI Data to Assess Benthic Health

While various measurements of water quality such as dissolved oxygen, contaminants, or nutrients are often used to assess regional ecological health, interpretation is difficult because of the transient nature of water-column phenomena. Measurement of a particular value of any water-column variable represents an instantaneous “snapshot” that can change within minutes after the measurement is taken. By the time an adverse signal in the water column such as a low dissolved oxygen concentration is persistent, the system may have degraded to the point where resource managers can do little but map the areal extent of the phenomenon while gaining a minimal understanding of factors contributing to the overall degradation.

The seafloor, on the other hand, is a long-term time integrator of sediment and overlying water quality; values for any variable measured are the result of physical, chemical, and biological interactions on time scales much longer than those present in a rapidly moving fluid. The seafloor is thus an excellent indicator of environmental health, both in terms of historical impacts and of future trends for any particular variable.

Physical measurements made with the SPI system from profile images provide background information about gradients in physical disturbance (caused by dredging, disposal, trawling, or storm resuspension and transport) in the form of maps of sediment grain size, boundary roughness, fabrics, and structures. The concentration of organic matter and the SOD can be inferred from the optical reflectance of the sediment column and the apparent RPD depth. Organic matter is an important indicator of the relative value of the sediment as a carbon source for both bacteria and infaunal deposit feeders. SOD is an important measure of ecological health; oxygen can be depleted quickly in sediment by the accumulation of organic matter and by bacterial respiration, both of which place an oxygen demand on the porewater and compete with animals for a potentially limited oxygen resource (Kennish 1986).

The apparent RPD depth is useful in assessing the quality of a habitat for epifauna and infauna from both physical and biological points of view. The apparent RPD depth in profile images has been shown to be directly correlated to the quality of the benthic habitat in polyhaline and mesohaline estuarine zones (Rhoads and Germano 1986; Revelas et al. 1987; Valente et al. 1992). Controlling for differences in sediment type and physical disturbance factors, apparent RPD depths < 1 cm can indicate chronic benthic environmental stress or recent catastrophic disturbance.

The distribution of successional stages in the context of the mapped disturbance gradients is one of the most sensitive indicators of the ecological health of the seafloor (Rhoads and Germano 1986). The presence of Stage III equilibrium taxa (mapped from subsurface feeding voids as observed in profile images) can be a good indication of high benthic habitat stability and relative “health.” A Stage III assemblage indicates that the sediment surrounding these organisms has not been disturbed severely in the recent past and that the inventory of bioavailable contaminants is relatively small. These inferences are based on past work, primarily in temperate latitudes, showing that Stage III species are relatively intolerant to sediment disturbance, organic enrichment, and sediment contamination. Stage III species expend metabolic energy on sediment bioturbation (both particle advection and porewater irrigation) to control sediment properties, including porewater profiles of sulfate, nitrate, and RPD depth in the sedimentary matrix near their burrows or tubes (Aller and Stupakoff 1996; Rice and Rhoads 1989). This bioturbation results in an enhanced rate of decomposition of polymerized organic matter by stimulating microbial decomposition ("microbial gardening"). Stage III benthic assemblages are very stable and are also called climax or equilibrium seres.

The metabolic energy expended in bioturbation is rewarded by creating a sedimentary environment where refractory organic matter is converted to usable food. Stage III bioturbation has been likened to processes such as stirring and aeration used in tertiary sewage treatment plants to accelerate organic decomposition. These processes can be interpreted as a form of human bioturbation. Physical disturbance, contaminant loading, and/or over-enrichment result in habitat destruction and in local extinction of the climax seres. Loss of Stage III species results in the loss of sediment stirring and aeration and may be followed by a buildup of organic matter (eutrophication) of the sediment. Because Stage III species tend to have relatively conservative rates of recruitment, intrinsic population increase, and ontogenetic growth, they may not reappear for several years once they are excluded from an area.

The presence of Stage I seres (in the absence of Stage III seres) can indicate that the bottom is an advanced state of organic enrichment or has received high contaminant loading. Unlike Stage III communities, Stage I seres have a relatively high tolerance for organic enrichment and contaminants. These opportunistic species have high rates of recruitment, high ontogenetic growth rates, and live and feed near the sediment-water interface, typically in high densities. Stage I seres often co-occur with Stage III seres in marginally enriched areas. In this case, Stage I seres feed on labile organic detritus settling onto the sediment surface, while the subsurface Stage III seres tend to specialize on the more refractory buried organic reservoir of detritus.

Stage I and III seres have dramatically different effects on the geotechnical properties of the sediment (Rhoads and Boyer 1982). With their high population densities and their feeding efforts concentrated at or near the sediment-water interface, Stage I communities tend to bind fine-grained sediments physically, making them less susceptible to resuspension and transport. Just as a thick cover of grass will prevent erosion on a terrestrial hillside, so too will these dense assemblages of tiny polychaetes serve to stabilize the sediment surface. Conversely, Stage III taxa increase the water content of the sediment and lower its shear strength through their deep burrowing and pumping activities, rendering the bottom more susceptible to erosion and resuspension. In shallow areas of fine-grained sediments that are susceptible to storm-induced or wave orbital energy, it is quite possible for Stage III taxa to be carried along in the water column in suspension with fluid muds. When redeposition occurs, these Stage III taxa can become quickly re-established in an otherwise physically disturbed surface sedimentary fabric.

Results

A complete set of all the summary data measured from each image is presented in Appendix A. Water depths ranged from 3.5 – 12.5 meters over the area surveyed.

Grain Size

The sediments throughout the entire area surveyed were primarily fine-grained (major mode $\geq 4\phi$) with the exception of Station P9; despite repeated attempts with all the lead weights in the camera frame, we were not able to obtain any profile images at this location due to the presence of rocks/cobble at the sediment surface (Figure 5-2). The example images in Figure 5-2 are typical of all the profile images obtained at this location.

While silt-clay sediments constituted the bulk of the sediments at most of the other locations sampled, two stations (P1 and P21) had minor modes of very fine sand (4-3 ϕ). Station P-1, located at the western end of the area surveyed just south of Pier 8, had a thin armoring of sand at the sediment-water interface and a 2-3 cm thick layer of muddy fine-sand overlying a silt-clay base (Figure 5-3). Station P-21, just north of the Seventh Street Channel and also toward the western end of the area surveyed, had a layer of find sand as a distinct depositional interval about 5-6 cm below a surface layer of silt-clay (Figure 5-4). While most of the stations surveyed are in an area that would be relatively protected from strong currents due to the energy barriers offered by the piers on three sides, it is apparent from the cross-sectional profiles that periodic deposition and/or transport does occur at many of the stations between these slips, either due to input from Paleta Creek at the eastern end or from resuspension caused by propeller wash from ship traffic in this area.

Surface Boundary Roughness

From the subset of images measured, the small-scale surface boundary roughness ranged from 0.24 to 3.81 cm across the area surveyed (Appendix A; Figure 5-5). Most of the small-scale roughness elements were biogenic structures (feeding mounds/burrow openings), ranging in size from less than 1 cm to greater than 3 cm (Figure 5-6). At the two locations (Stations P4 and P17) where replicate images were analyzed, the within-station variance in boundary roughness results could be quite dramatic (Figure 5-7).

Prism Penetration Depth

With sediment grain-size fairly uniform across the entire study area, the variation in prism penetration was a good indicator of relative sediment shear strength as a function of biological mixing depth; both the stop collar position and number of weights were held constant throughout the survey, with the exception of Station P-9. A second attempt to get profile images at P-9 was made on January 9 with a total of 8 weights (200 lbs of lead) in the weight carriage, but these were also unsuccessful because of the rocks at this location.

The average prism penetration depth at all the other stations surveyed in the study area ranged from 3.97 cm (Station P-17) to 15.42 cm (Station P-23); one of the replicate images from Station P-17 had an average prism penetration depth of 17.37 (Appendix A). The spatial distribution of mean penetration depth at all stations sampled is shown in Figure 5-8; the overall average penetration for the site was approximately 10.5 cm.

Apparent Redox Potential Discontinuity Depth

The distribution of mean apparent RPD depths is shown in Figure 5-9. Not surprisingly, the lowest apparent RPD values were found at the innermost stations (near the source of organic loading) and generally increased to the west as one moved toward the end of the piers next to the open channel; values ranged from a minimum of 0.26 cm to a maximum 3.63 cm (both end-member values found in replicates from Station P-4; see Appendix A and Figure 5-10).

Infaunal Successional Stage

The mapped distribution of infaunal successional stages is shown in Figure 5-11. Station P-13 was the only location sampled where there wasn't evidence of a well-developed, mature, Stage III equilibrium community of head-down deposit feeders (Stage II deposit-feeders were present at this location). The common presence of deposit-feeding taxa throughout the entire area surveyed (Figure 5-12) was quite surprising, given the location of the survey area and likelihood of anthropogenic impact.

Biological Mixing Depth

Upon completion of the first two days of field work, the maximum bioturbation depths were visually estimated from the color slides obtained at Stations P-4 and P-17 in order to allow the other investigators to make decisions about the optimum interval over which to composite the sediment samples for bulk chemical analyses. The visual estimates recorded in the field for these two locations are presented in Table 5-2:

Actual measurements for the mean apparent RPD and bioturbation depth (maximum feeding void depth) for the replicate images measured at these two locations can be found in Appendix A and are summarized below in Table 5-3.

The spatial distribution of both the average and maximum feeding void depths were plotted (Figure 5-13 and Figure 5-14). Biological mixing depths tended to increase as one moved to the east and north from the end of the piers toward the shoreline.

Void Ratio

One parameter of potential interest to the investigations being conducted in this area is the void ratio, or what percentage of the cross-sectional area of the sediment is occupied by feeding voids. The amount that a sediment is "dilated" by bioturbational activities can have an effect on the erosion potential for an area of bottom and also affect the flux rate of porewater with the overlying water column.

The void ratio was generally rather low, less than 2% across the entire area surveyed (Appendix A). There were a total of seven images where the void ratio exceeded 0.5%: P-1, P-3, two of the twelve replicate images from P-4, P-8, P-14, and one of the twelve replicates from P-17.

Organism-Sediment Index

The spatial distribution of median OSI values throughout the study area can be seen in Figure 5-15. An OSI of 6 or less typically indicates that a benthic habitat has undergone disturbance, either from physical forces, eutrophication, or excessive bioavailable contamination in the recent past. The values plotted at Stations P-4 and P-17 (6 and 5, respectively) are the median values of the twelve replicates analyzed from each location.

Table 5-2. Field Visual Estimates of Apparent RPD & Bioturbation Depths.

STATION	**RPD (cm)**	**Bioturbation Depth (cm)**	STATION	**RPD (cm)**	**Bioturbation Depth (cm)**
P4 – A	2.5	9	P17-A	1	≈ 5
B	2.5	7	B	0.5	7
C	2	12	C	1	≈ 4
C	1.5	10	D	1	5
E	2	7	E	2	8
F	2	13	F	1	8
G	3	Indeterminate	G	1	3 – 4
H	2	5	H	1.25	8
I	2	9	I	1	≈ 4
J	2	7	J	0.5	4
K	1.5	7	L	1	8
L	1.5 – 2	10	M	0.5	3
N	2	15	N	1.5	7
O	2	7	O	1 – 1.5	7
P	1.5	6	AA	0.5 - 1	≈ 5
Q	2	10	BB	0.5 – 1	≈ 5
R	2	11	CC	1	4
S	2	10			
T	1	11			
U	≈ 1	5			
V	2	8			
W	1.5	9			
X	2	5			
Y	1	5			

Table 5-3. Summary of Measured Biological Parameters for Stations P-4 and P-17 Replicate Images.

Station 4:	Mean RPD Depth (cm)	Max RPD Depth (cm)	Max Feeding Void Depth (cm)	Mean Feeding Void Depth (cm)	OSI
P4 A	1.78	2.54	6.86	5.20	8
P4 B	0.43	0.82	7.85	6.77	6
P4 C	0.59	1.08	0.00	0.00	3
P04-1 A	2.46	2.86	10.61	7.37	9
P04-1 B	3.63	4.18	2.83	2.73	10
P04-1 C	0.26	0.72	0.00	0.00	3
P04-2 A	3.54	3.83	0.00	0.00	6
P04-2 B	3.02	3.72	9.47	6.60	10
P04-2 C	Indeterminate	Indeterminate	10.80	6.14	Indeterminate
P04-3 A	3.20	3.64	8.47	6.27	10
P04-3 B	2.09	2.59	0.00	0.00	4
P04-3 C	2.32	2.78	0.00	0.00	5
STATION					
MAXIMUM:	3.63	4.18	10.80	7.37	10.00
MEAN:	2.12	2.62	4.74	3.42	6.73
MEDIAN:	2.32	2.78	4.85	3.96	6
CV:	58%	48%	98%	94%	42%
Station 17:					
P17 A	1.06	1.89	6.64	4.45	3
P17 C	1.37	2.32	7.58	6.56	7
P17 E	2.11	2.40	11.34	9.65	8
P17-1 A	0.83	1.27	5.29	5.09	7
P17-1 B	0.84	1.19	5.72	5.57	3
P17-1 C	0.51	0.87	0.00	0.00	2
P17-2 A	1.72	2.11	0.00	0.00	4
P17-2 B	1.06	1.24	0.00	0.00	3
P17-2 C	0.49	0.52	9.37	8.00	6
P17-3 A	1.19	3.24	4.38	3.55	7
P17-3 B	1.24	2.16	10.61	7.56	7
P17-3 C	1.87	3.29	0.00	0.00	4
STATION					
MAXIMUM:	2.11	3.29	11.34	9.65	8.00
MEAN:	1.19	1.87	5.08	4.20	5.08
MEDIAN:	1.12	2.00	5.51	4.77	5
CV:	43%	47%	84%	83%	41%

Discussion

From a physical dynamics standpoint, the area surveyed appeared to be a low kinetic regime overall; boundary roughness values were low (less than 1.5 cm) and due mainly to biogenic activity (physical forces from bottom currents, storm, or wind wave energy did not appear to play a strong role in the formation of boundary roughness structures at the time the survey was performed).

Sediment grain-size and shear strength was relatively uniform throughout the area with a few exceptions (Stations P9 and P18 had the lowest penetration values, and some stations had evidence of past depositional intervals of fine to medium sand – see Figure 5-16). Even though the survey took place during the winter (wet) season, the only evidence of any apparent physical impact was at the eastern end of the area surveyed, consisting of distinct depositional intervals of organically-enriched sediment at several of the stations near the mouth of Paleta Creek. The periodic inputs of sediments that comprised these organic-rich layers most likely coincided with high flow events in the Creek during the recent past. Evidence of organic-rich depositional intervals was found at Stations P-17, P-16, P-15, P-14, and extending as far west as Stations P-11 and P-12. However, while this organic enrichment at the eastern end of the area surveyed was definitely contributing to high sediment oxygen demand and most likely increased sulfate reduction rates, it did not seem to be compromising the biological community structure very substantially.

One of the singular features that stands out from the SPI results was the relative "health" of the benthic community; the presence of deposit-feeding taxa at all stations, especially given the location of these stations in an urban, industrial setting, is not very common. While the distribution of OSI values did show a decrease as one moved toward the mouth of Paleta Creek (indicating a gradient of disturbance, primarily from the organic loading that caused smaller mean apparent RPD values), the lowest median OSI value was only +5 (at Station P-17), just below the threshold boundary of +6 indicating disturbance and fifteen points above the minimum possible value (our experience has been for OSI values to commonly be in the negative range at areas between berthing slips in urban estuaries).

There was evidence of deposit-feeding taxa at all locations, with active feeding voids ranging in depth from 1.5 cm to 15 cm below the sediment-water interface. The other notable feature was the within-station heterogeneity as far as evidence of bioturbation and depth of the mean apparent RPD (Table 5-3). Unfortunately, this conclusion is based on the detailed examination of multiple replicate images at only two stations, which were the primary locations of interest (Stations P-4 and P-17); our assumption is that a similar range of variability was present at other stations. If this is the case, many of the values in the maps showing the plotted distribution of SPI parameters (Figure 5-5, Figure 5-9, and Figure 5-13 - Figure 5-15) would probably change, and the overall "Gestalt" of the area would be quite different than what is portrayed in those figures. Because additional measurements were focused at Stations P-4 and P-17, it is worthwhile to spend some time examining the results from these two locations in more detail.

The prototype characterization of Station P-4 vs. P-17 could be simply stated as one location (P-4) showing a well-developed redox layer and high-reflectance sediment at depth (indicating a lack of sulfide inventory) vs. another location (P-017) that is affected by excess organic inputs, a thin redox layer, and reduced (low-reflectance) sediments at depth (indicating a high sulfide inventory). Unfortunately, the characterization of these two locations is not that simple. As one examines the replicate images from each location, a wide range of variation in both physical and biological parameters can be found. For example, despite the apparently "healthy" conditions that exist at Station P-4, there were replicate images with very thin redox layers and more reduced sediment near the sediment-water interface, indicating very shallow vertical porewater flux exchange intervals (Figure 5-17). While many of the images from Station P-4 showed dramatic evidence of deep bioturbators and active particle transport (Figure 5-18), there was also sufficient evidence of quite a diverse biological community at Station P-17, despite the organic enrichment that was obviously occurring at this location. This ranged from surface suspension feeders (Figure 5-19) that are usually quite sensitive to boundary-layer hypoxia and elevated contaminant concentrations, to head-down deposit feeders that were actively burrowing in the subsurface layers of reduced, organically-enriched sediment and both feeding and actively pumping overlying water, causing oxygenated halos of ferric hydroxide precipitates surrounding their burrows and feeding structures at depth (Figure 5-20). Some of the images from Station P-17 had profile characteristics that were more like that of Station P-14, with high reflectance sediment at depth and active feeding voids (Figure 5-21).

This within-station variation and small-scale spatial heterogeneity help explain the difficulties in easily correlating the results found by other investigators in this study. Ziebis examined two replicate cores from P-4 and observed that one of the cores taken was "characterized by a network of small burrows" and had more than twice the depth of mean oxygen penetration depth and almost four times the diffusive oxygen flux as the other core from that same location. Gieskes found that while sulfate reduction does take place at "all sites" (porewater from Station P-11 was also examined, so a total of 3 stations had geochemical profiles performed), it is much more pronounced at Station P-17 (corresponding with inferences drawn from the profile image examination). The porewater phosphate profiles match quite well with the imaged characteristics in the "prototype" replicates from these two locations, with Station P-4 showing a well-mixed sediment column due to bioturbation, whereas the profile at P-17 is typical of a diffusional profile with active exchange only occurring in the top 2 cm (Figure 5-22).

Montgomery's results also show a difference between these 2 locations as far as heterotrophic production, but only in the top 2 cm of the cores. What is most intriguing in Montgomery's data is the hint of the same kind of within-station heterogeneity documented in the SPI photographs as well as in some of Gieskes' and Ziebis' replicate profiles. The plots of heterotrophic production show data for 2 replicates at P-17 that are quite different in the 0-2 cm layer (while similar the rest of the way down the core). Unfortunately, only 1 core was analyzed at P-04, so it is impossible to say whether or not the high variance seen in the SPI images and the microprofiles would also exist in the microbiological data from this location. While the results from P-4 were indeed dramatically different than those from the two cores from P-17 in the top 2 cm, chances are that replicate data from the P-4 location could have produced the same type of variation seen in the profile images from these locations.

The other confounding variable for Montgomery's microbiological investigations was the selection of this site; as it turns out, this particular location was not really conducive to detecting notable differences in microbial mineralization rates for PAH. Past studies by Montgomery at a variety of other locations have shown that PAH concentrations generally have to be above 10 µg/g to see selective enhancement of PAH mineralization rates, and the PAH concentrations found at this site were well below the 10 µg/g threshold (the highest concentration found was 3.18 µg/g); his findings that more "noise" than "signal" was seen is not too surprising taken in this context.

One advantage of the multi-corer design for the data generated from the geochemical profiles and the microbiological investigations is the small spatial scale over which replicate sediment cores are taken, thereby (hopefully) minimizing the potential confounding effects of spatial variation. However, the scale of variation both within individual SPI images as well as within-station variation dramatically illustrates how the effects of sampling scale and spatial heterogeneity will bias our view of what is occurring in the system. The width of an SPI image is equivalent to approximately 3 sediment core diameters; just examining the biological structures seen in cross-section in some of the previous figures will give one an appreciation of what different results could have been found by Montgomery or Gieskes depending on whether the core was punched through the right, center, or left side of the cross-section portrayed in the profile images. Extrapolating conclusions from just one or two core profiles (be it for bacterial mineralization or porewater chemistry) may give a very biased view of what's going on in a system as heterogeneous as this. It will be interesting to see what results were derived from the flux chamber measurements at these two locations and which of the parameters from Table 5-3 will give the best fit for the for the F_{DC} and F_{DB} components of the flux equation once the results from all the individual studies are available.

LESSONS LEARNED

Based on the mapped parameters shown in Figure 5-9, Figure 5-13, Figure 5-14, and Figure 5-15, it appears in hindsight that while Station P-17 was indeed one of the "end-members' in the spectrum of variables measured, a greater apparent contrast would probably have been found if that station was compared to either P-1 or P-6 instead of P-4. The wide range in variation in imaged parameters (as well as the indication for the same type of small-scale variation seen in the results from Ziebis, Gieskes, and Montgomery) appear to indicate that future investigations of this sort would benefit from a slight change in the timing between SPI image acquisition and analysis, as well as the number of samples taken at each location.

Given the relatively low concentration of PAHs at the San Diego site, it would be worthwhile to insure at future sites where this type of multidisciplinary research is carried out that a sufficient gradient in PAH contamination exists to insure that bacterial mineralization studies will give meaningful results. If the surface sediment chemical contamination gradients are not known in a potential area of interest, then a reconnaissance pilot study where just rapid PAH screening is performed (5-10 locations) would be worthwhile to insure that the location chosen for detailed multidisciplinary studies is indeed one that has a large enough gradient so that the measured results will give be in the “signal” instead of just “noise” output range.

Once the chemical contamination gradient is known and it has been determined that a particular location is worthy of further detailed investigation, then a reconnaissance SPI study should be performed. While the concept of using SPI in a reconnaissance mode on an orthogonal sampling grid as was done at the San Diego location is still the best approach, it appears that more replicates (at least 5) should be taken at each station to document if within-station variation is as high as was seen in San Diego is present at this new location. If so, then it would be worthwhile to have the SPI image analysis done immediately (instead of waiting until the next funding cycle) and the results plotted to insure that the locations illustrating the end-member conditions of whatever gradient detected (be it chemical contamination or benthic community structure) are indeed the ones that are chosen for more detailed investigations.

In addition, the level of within-station variation seen in San Diego would argue for more replicate samples being analyzed by the individual investigators performing related profiling (e.g., Montgomery, Gieskes, Ziebes) to insure that representative values of the parameters they are measuring for these locations are indeed found. While this revised plan of operation would definitely increase the costs of the study, the resulting benefit would be a much higher probability of being able to link the results to one another and achieving the overall objectives of the PRISM program.

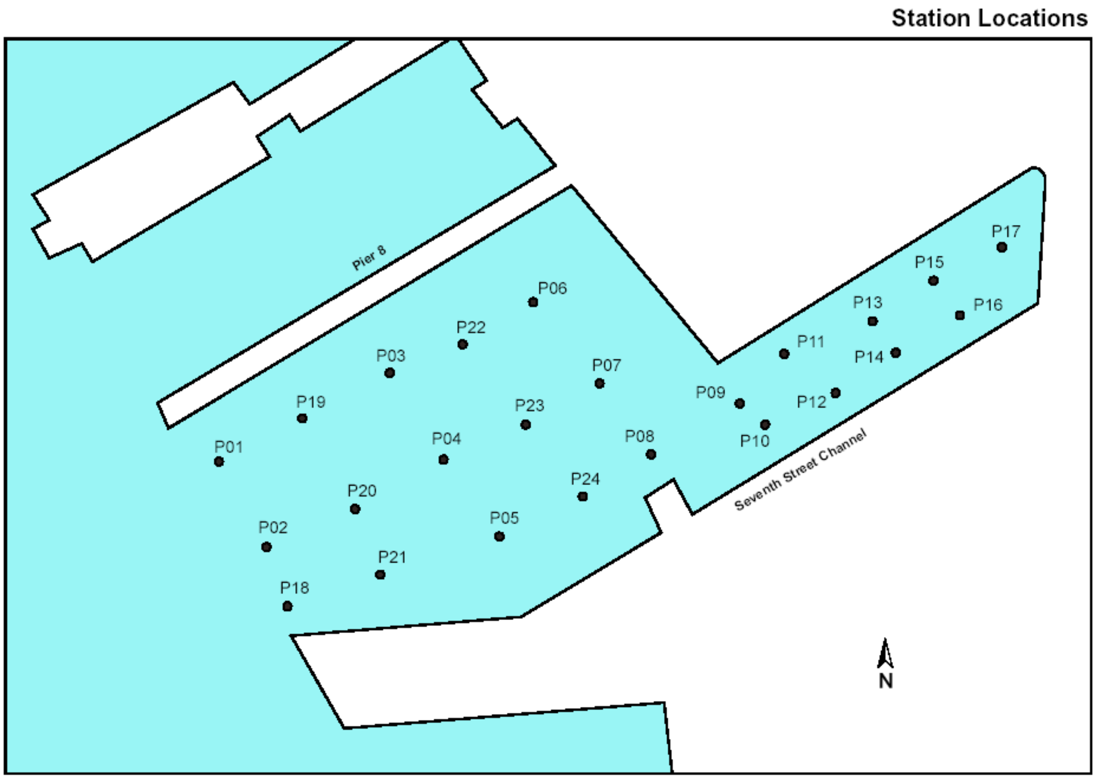


Figure 5-1. Location of the 24 sampling stations surveyed with the sediment profile camera in January 2002.

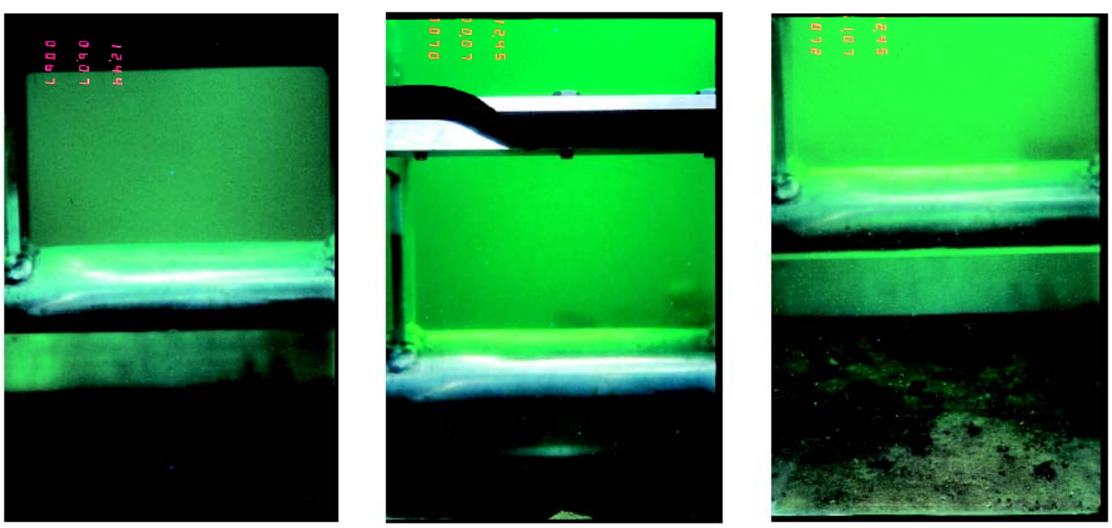


Figure 5-2. Sediment profile images from Station p-9; the rocks/hard bottom prevented camera prism penetration and acquisition of any usable profile images.

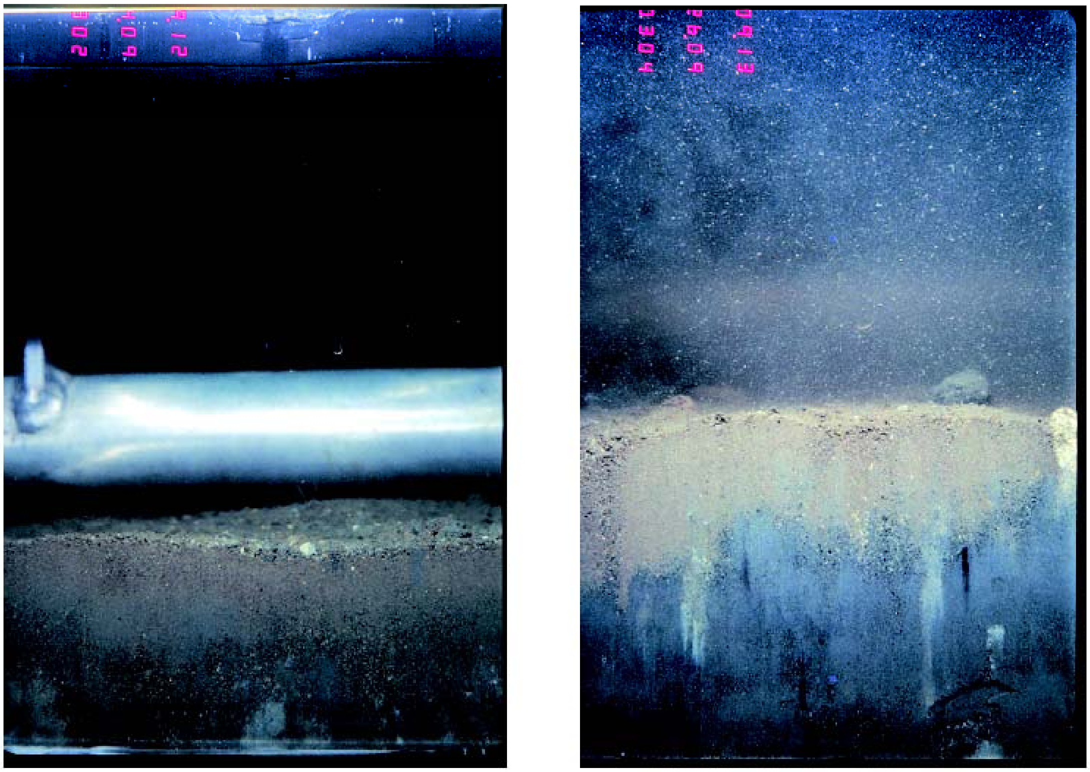


Figure 5-3. Replicate profile images from Station P-1; note the 2-3 cm surface layer of muddy sand in both pictures. The image on the left has a thin surface armor of coarser sediments (Scale: Width of each image = 15 cm).

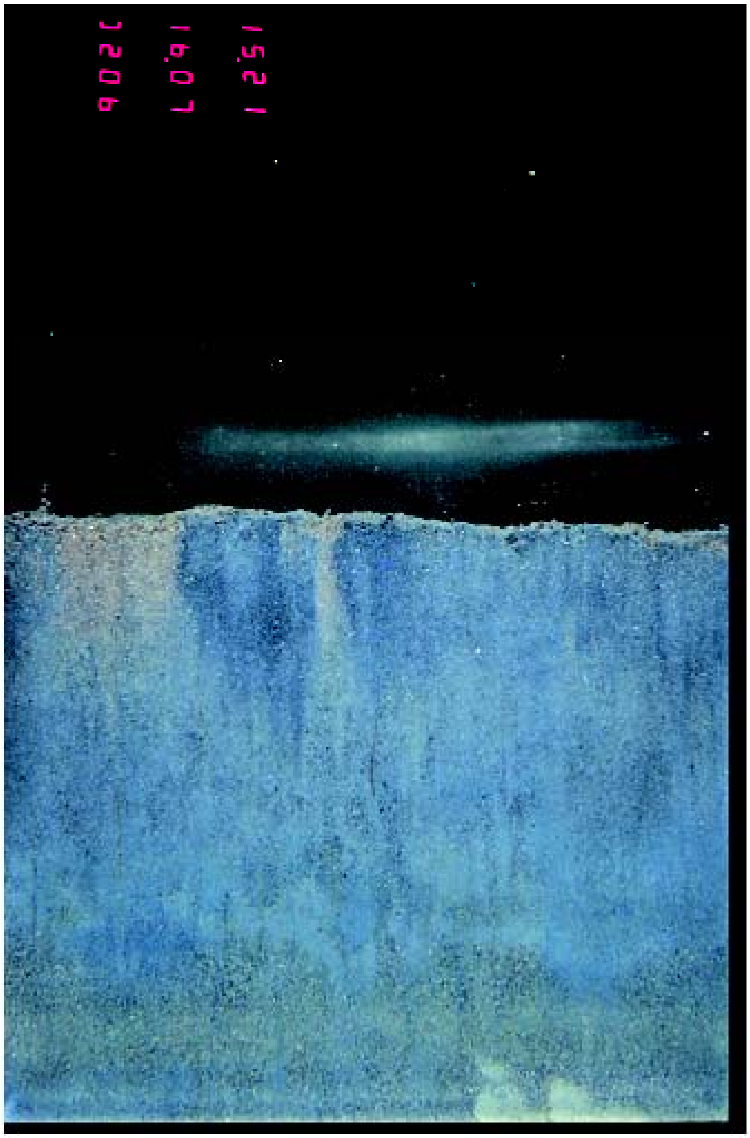


Figure 5-4. Sediment profile image from Station P-21; note the distinct layer of coarser grain sediments at the bottom of the image (Scale: Width of image = 15 cm).

Boundary Roughness

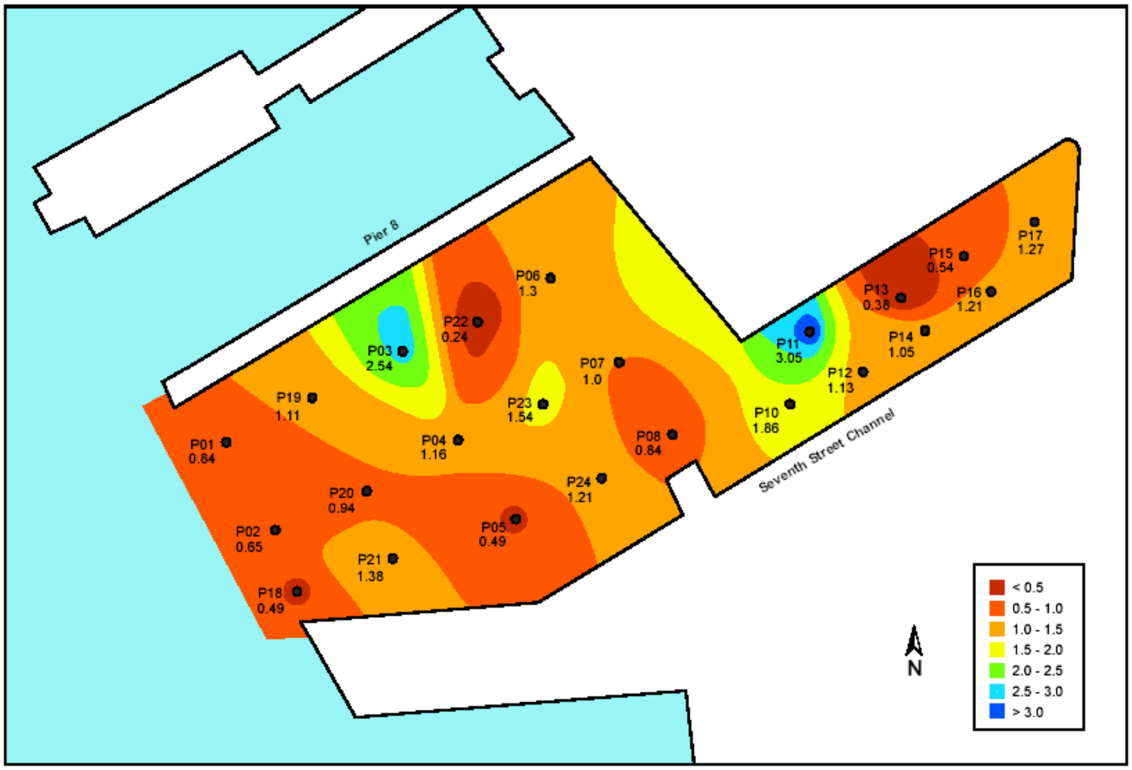


Figure 5-5. Distribution of small-scale surface boundary roughness (cm) across area surveyed.

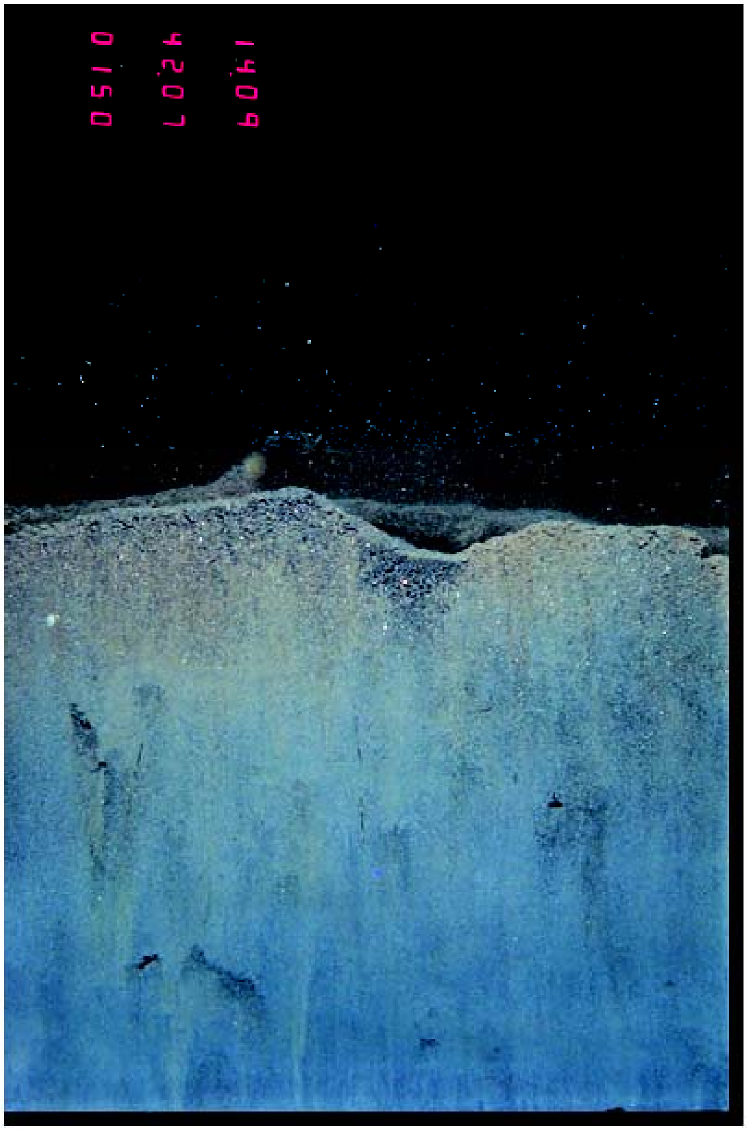


Figure 5-6. Sediment profile image from Station P-4 showing small-scale topographic biogenic structures; note the burrow opening and associated layer of reduced fecal pellets in the center of the image (Scale: Width of image = 15 cm).

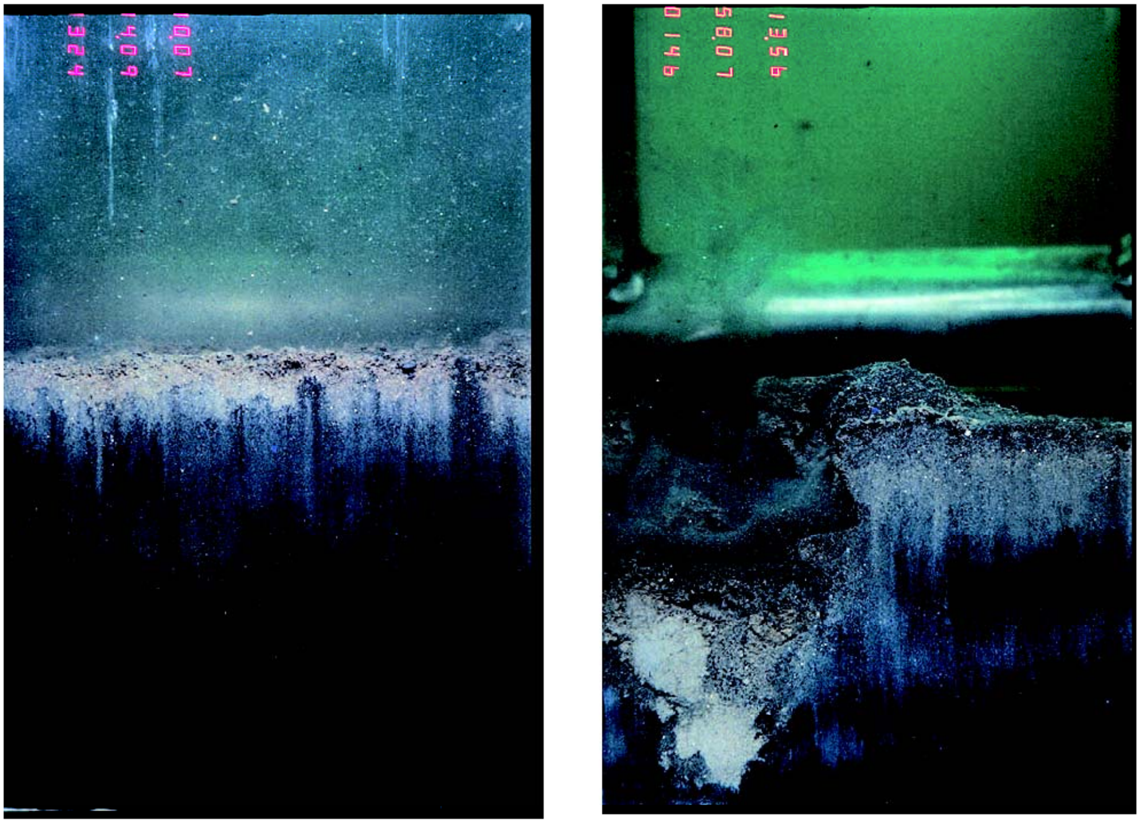


Figure 5-7. Replicate sediment profile images from Station P17 showing the dramatic variation in small-scale boundary roughness elements (Scale: Width of image = 15 cm).

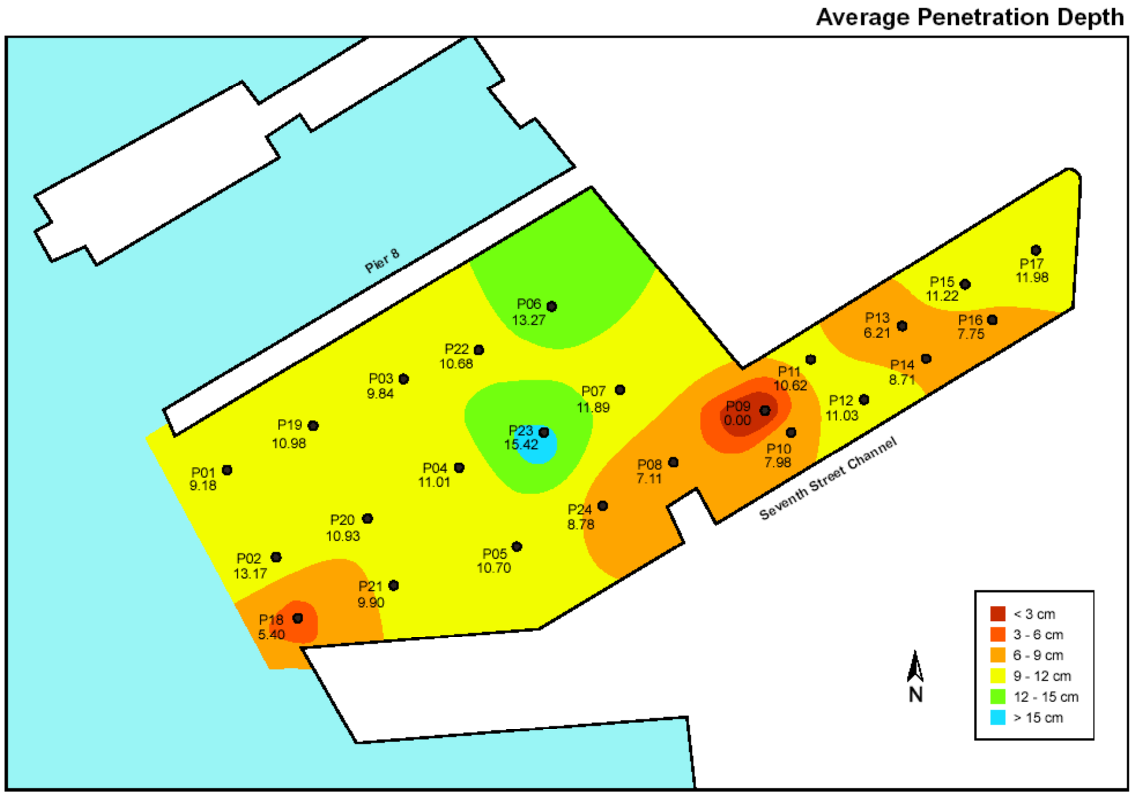


Figure 5-8. Distribution of average camera prism penetration depths (cm) across area surveyed; camera settings and weights were kept constant at all locations for these plotted values.

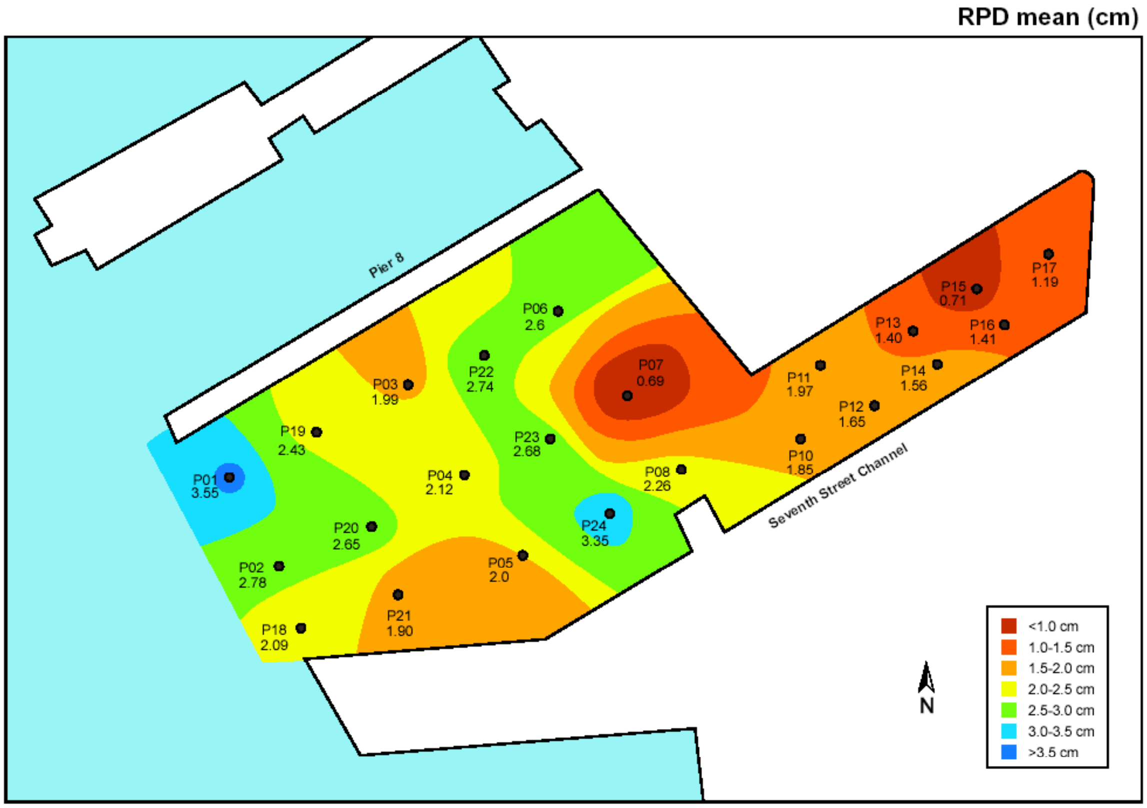


Figure 5-9. Distribution of mean apparent RPD depths (cm) across area surveyed.

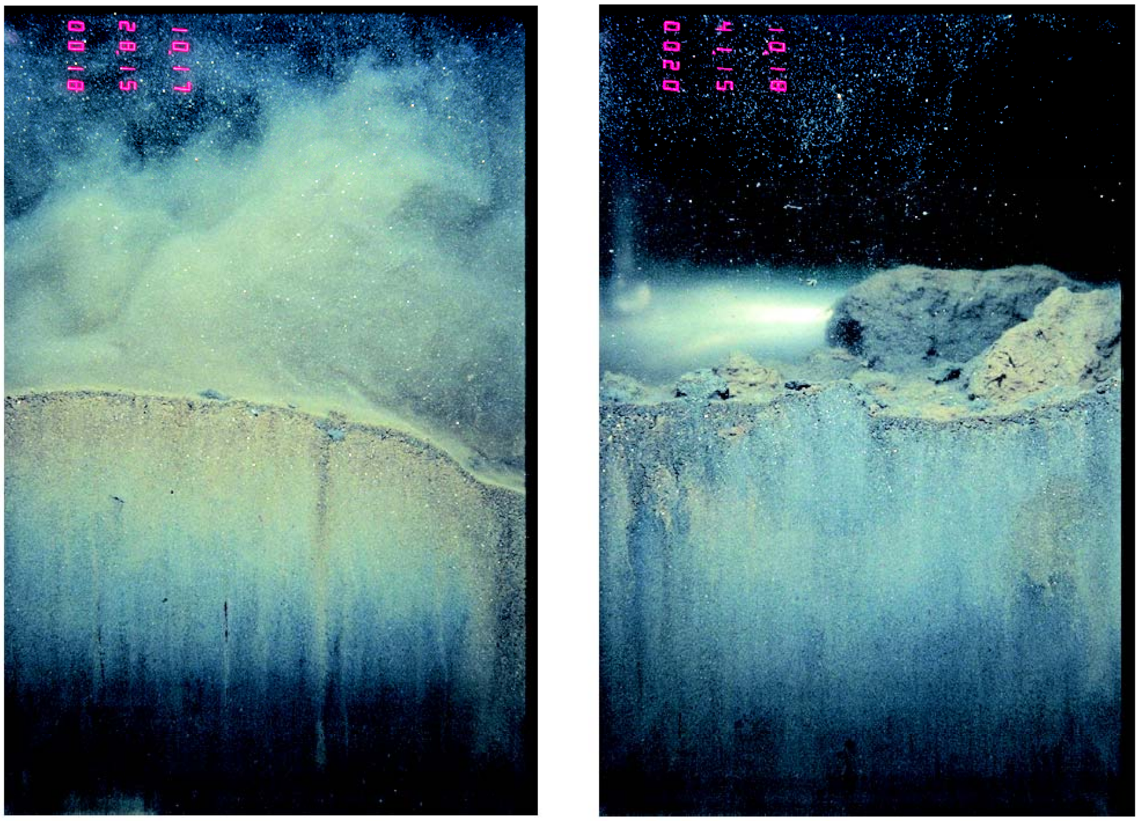


Figure 5-10. Sediment profile images from Station P4 showing minimum and maximum extremes in mean apparent RPD depth (Scale: Width of image = 15 cm).

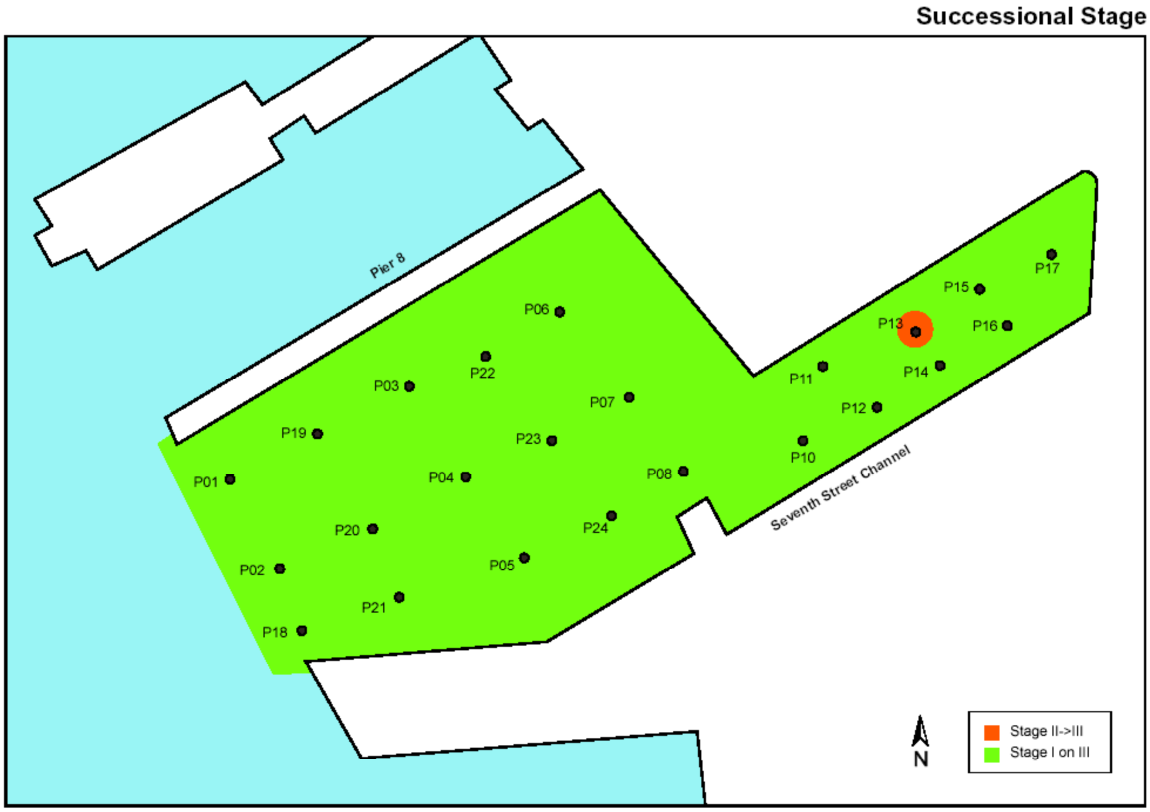


Figure 5-11. Distribution of infaunal successional stages across area surveyed.

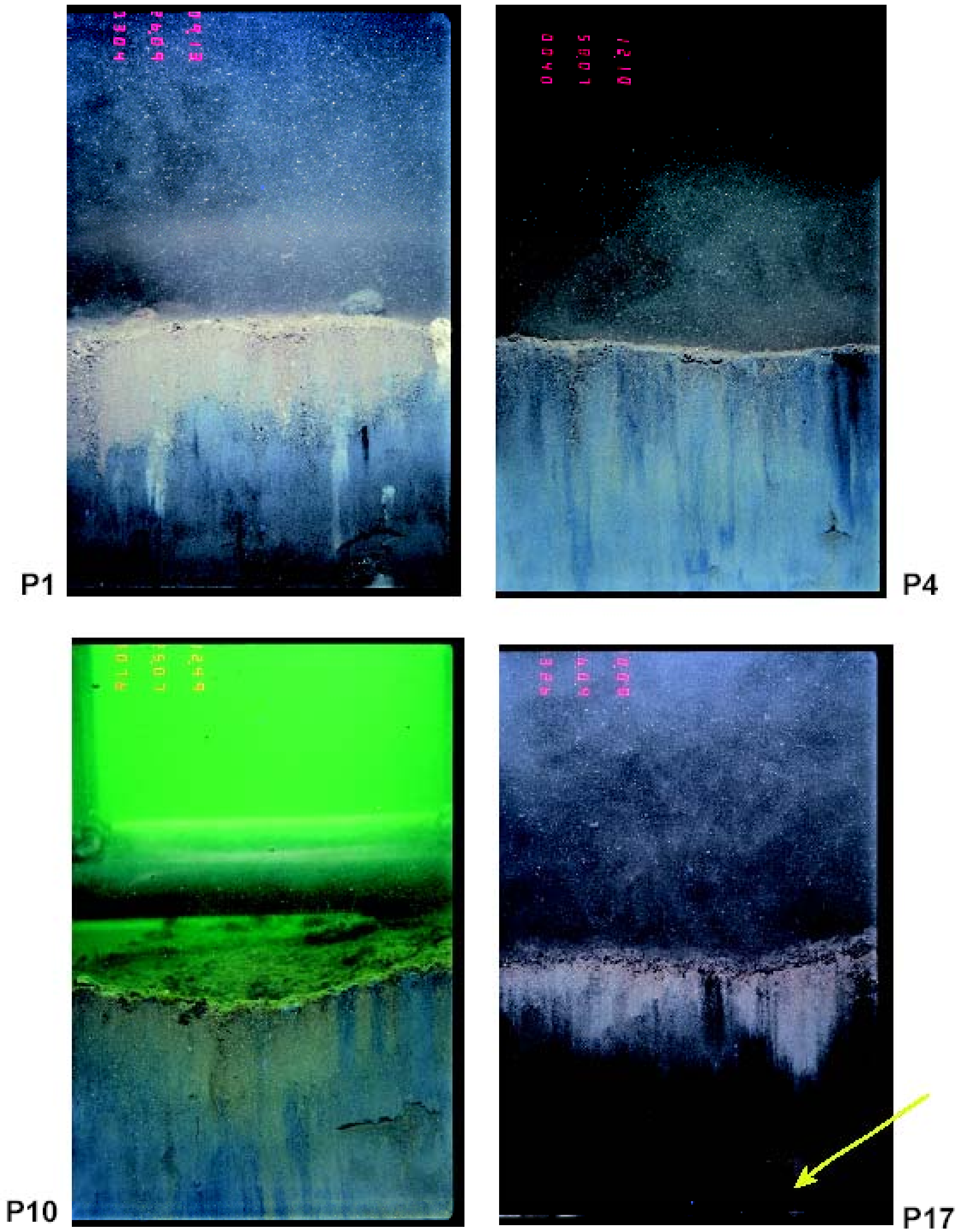


Figure 5-12. Sediment profile images from Stations P1, P4, P10, and P17 show the presence of head-down deposit feeders across the range of stations sampled (Scale: Width of image = 15 cm).

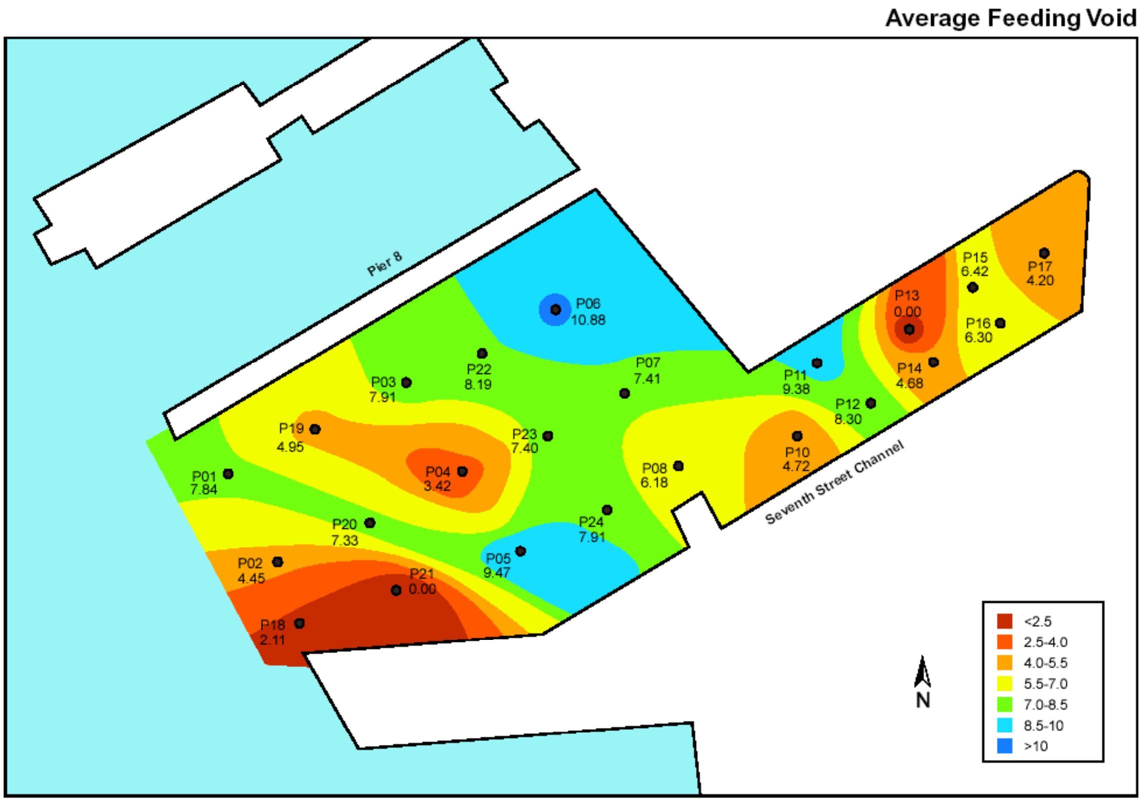


Figure 5-13. Distribution of average feeding void depth (cm) across area surveyed.

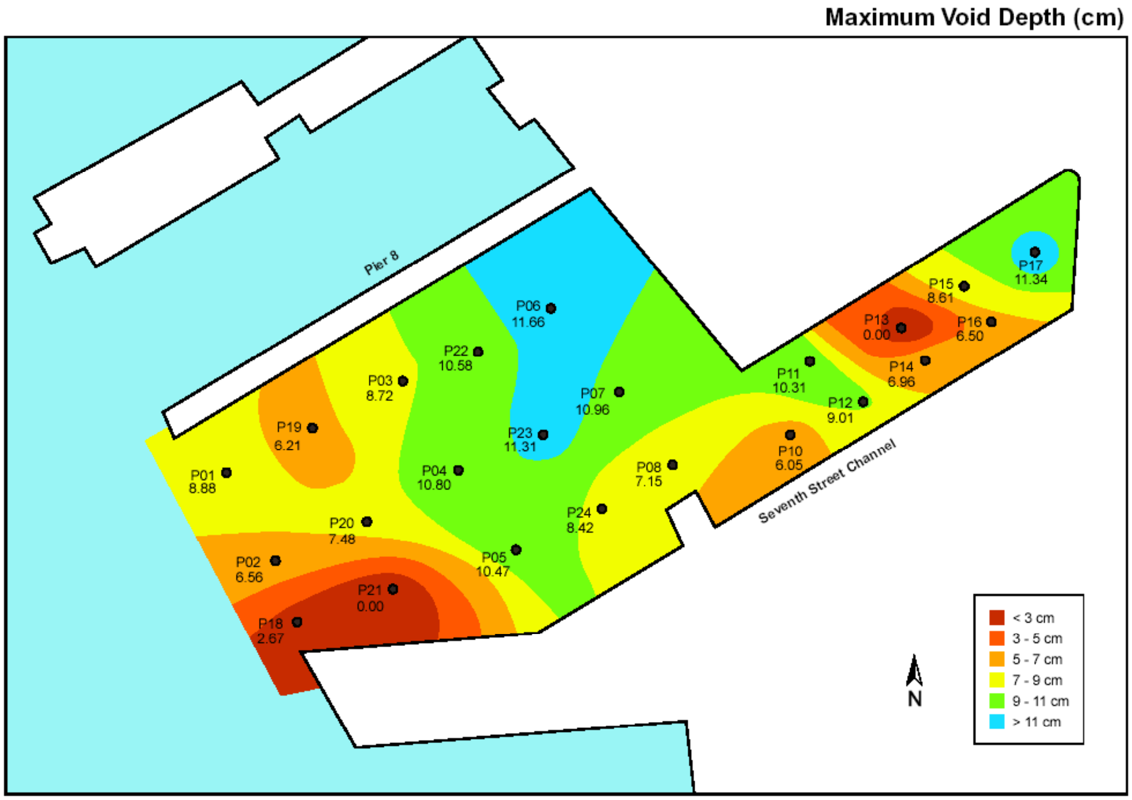


Figure 5-14. Distribution of maximum feeding void depth (cm) across area surveyed.

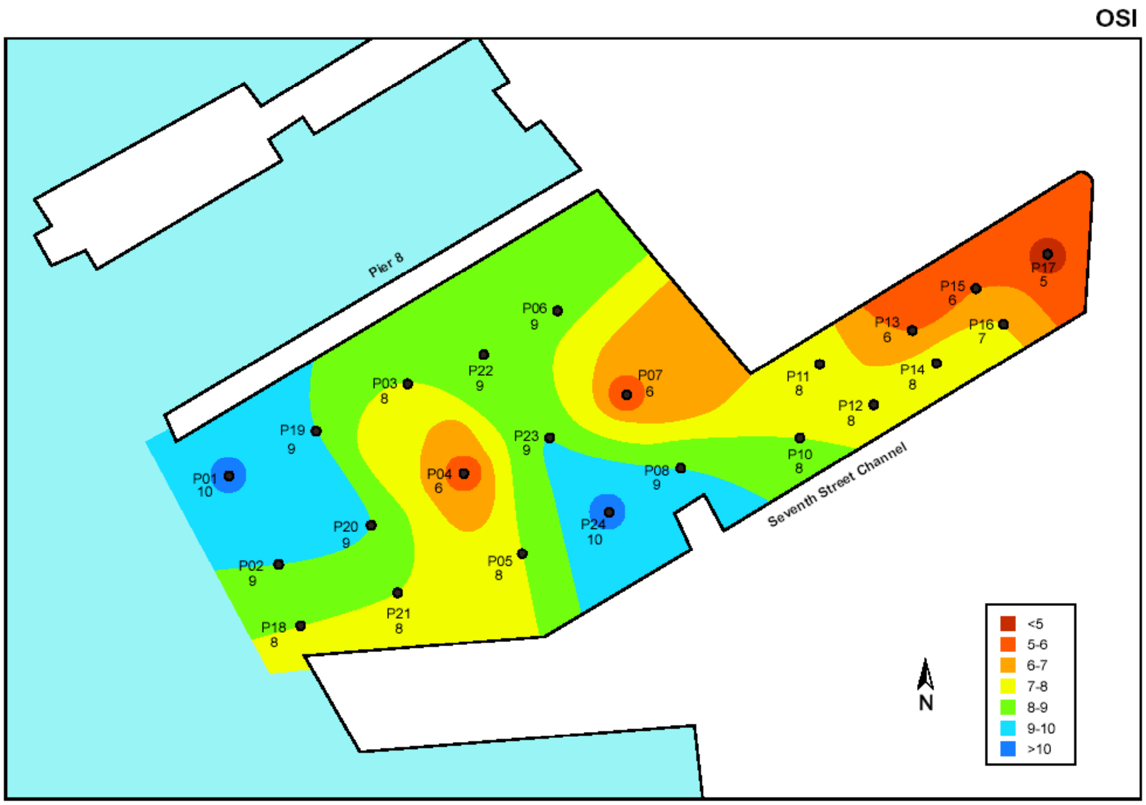


Figure 5-15. Distribution of Organism-Sediment Index values across area surveyed.

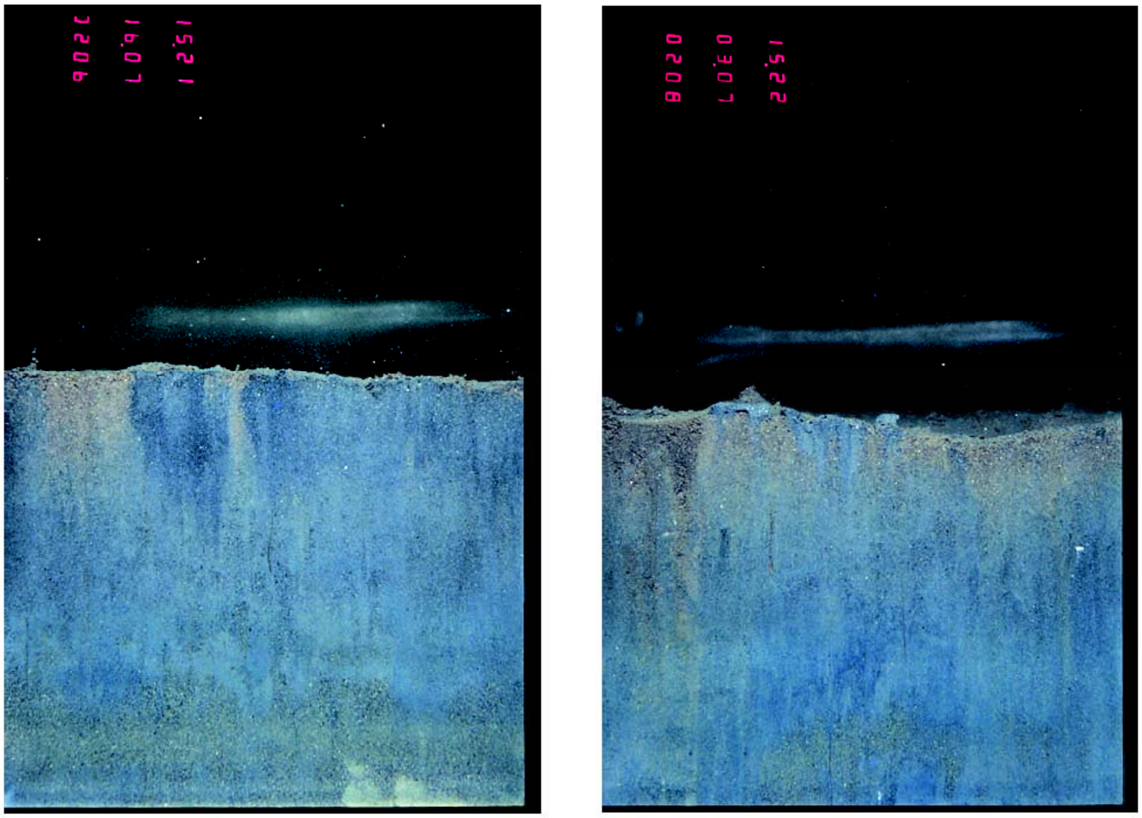


Figure 5-16. Sediment profile images from Station P21. Note the mud over sand stratigraphy with the sand interval at the bottom of the profile image (Scale: Width of image = 15 cm).

Figure 5-17. Sediment profile image from Station P4; note the shallow apparent RPD and darker sediments at the surface (Scale: Width of image = 15 cm).

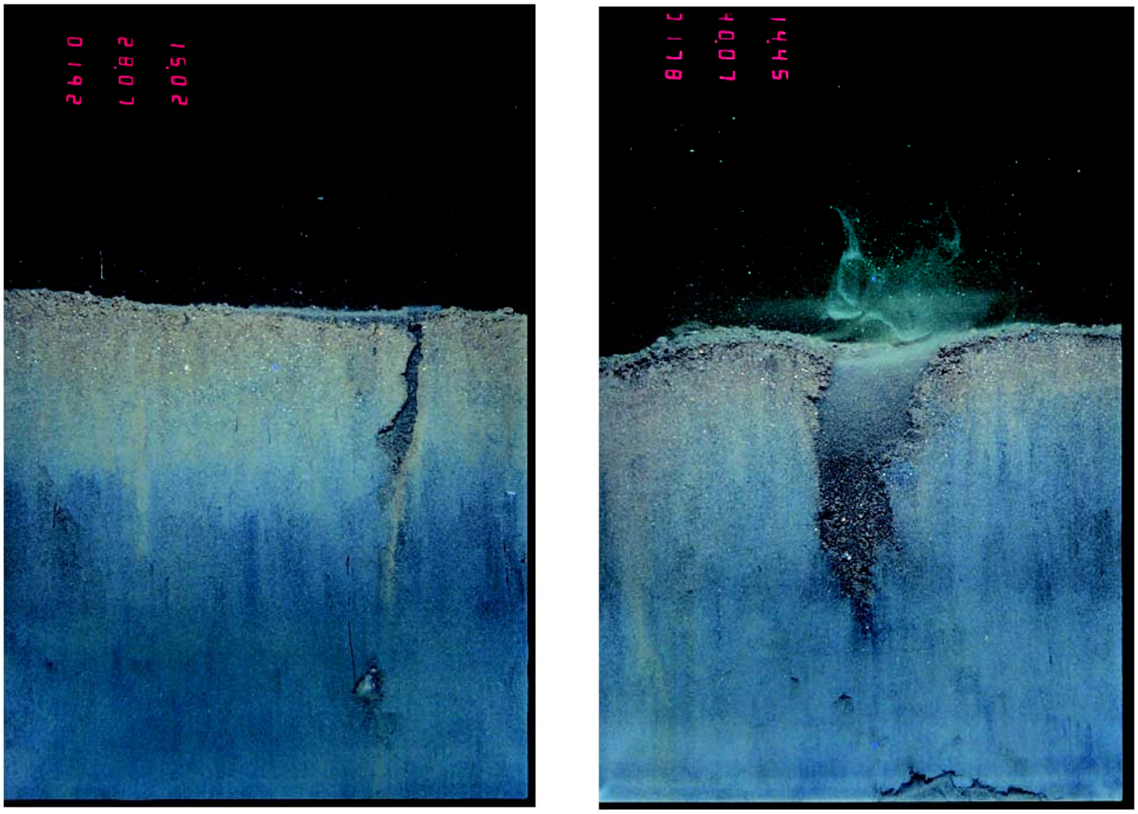


Figure 5-18. Sediment profile images from Station P4 showing evidence of deep, active bioturbation (Scale: Width of image = 15 cm).

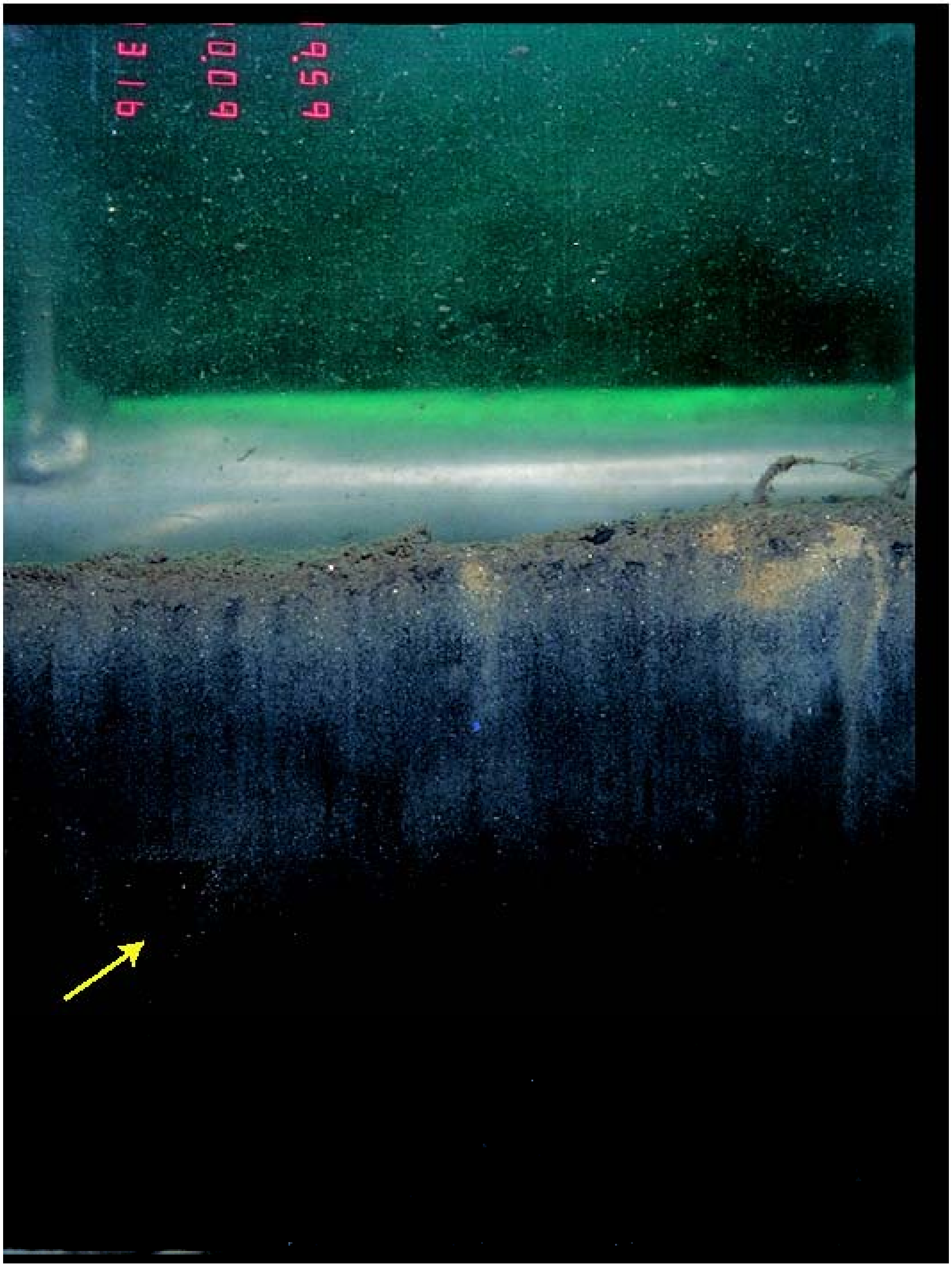


Figure 5-19. Sediment profile image from Station P17; a solitary hydroid (Corymorpha sp.) can be seen bent over in the boundary layer current at the sediment-water interface (Scale: Width of image = 15 cm).

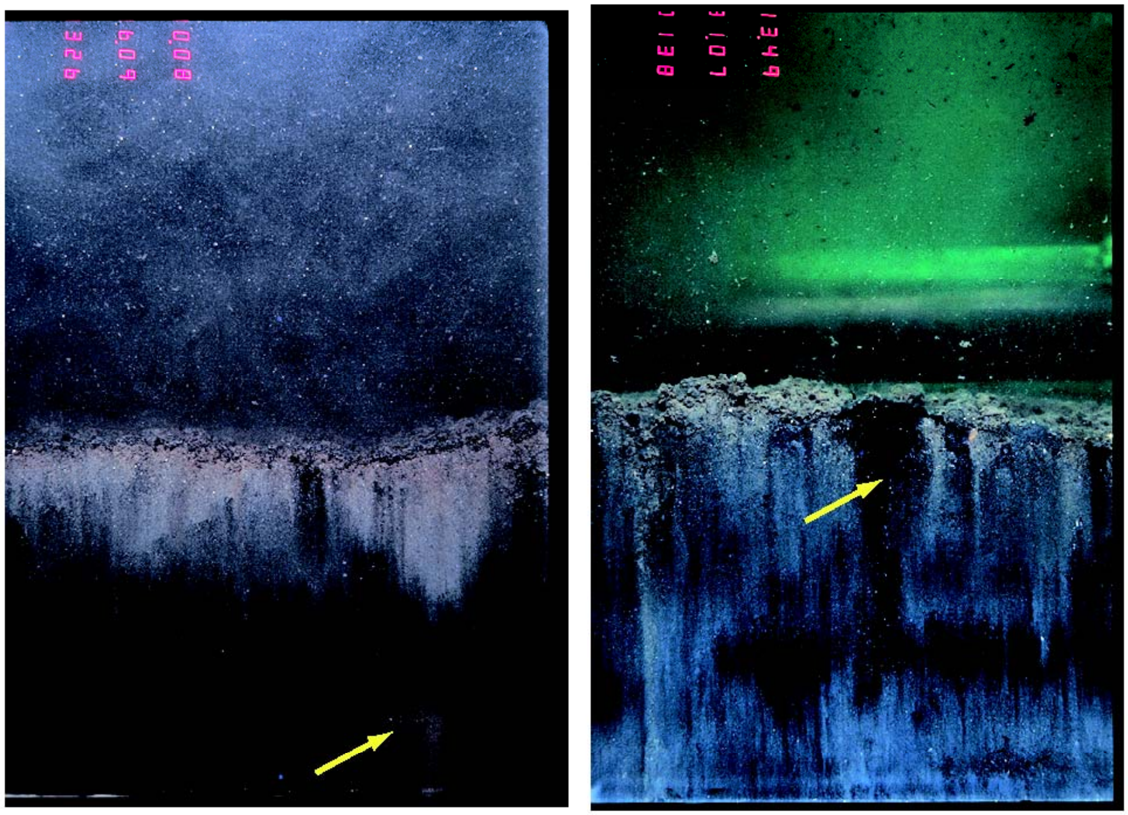


Figure 5-20. Sediment profile images from Station P17 showing evidence of deep, active bioturbation. The image on the right shows upward transport of reduced fecal pellets from the subsurface feeding activity of a hidden deposit-feeder (Scale: Width of image = 15 cm).

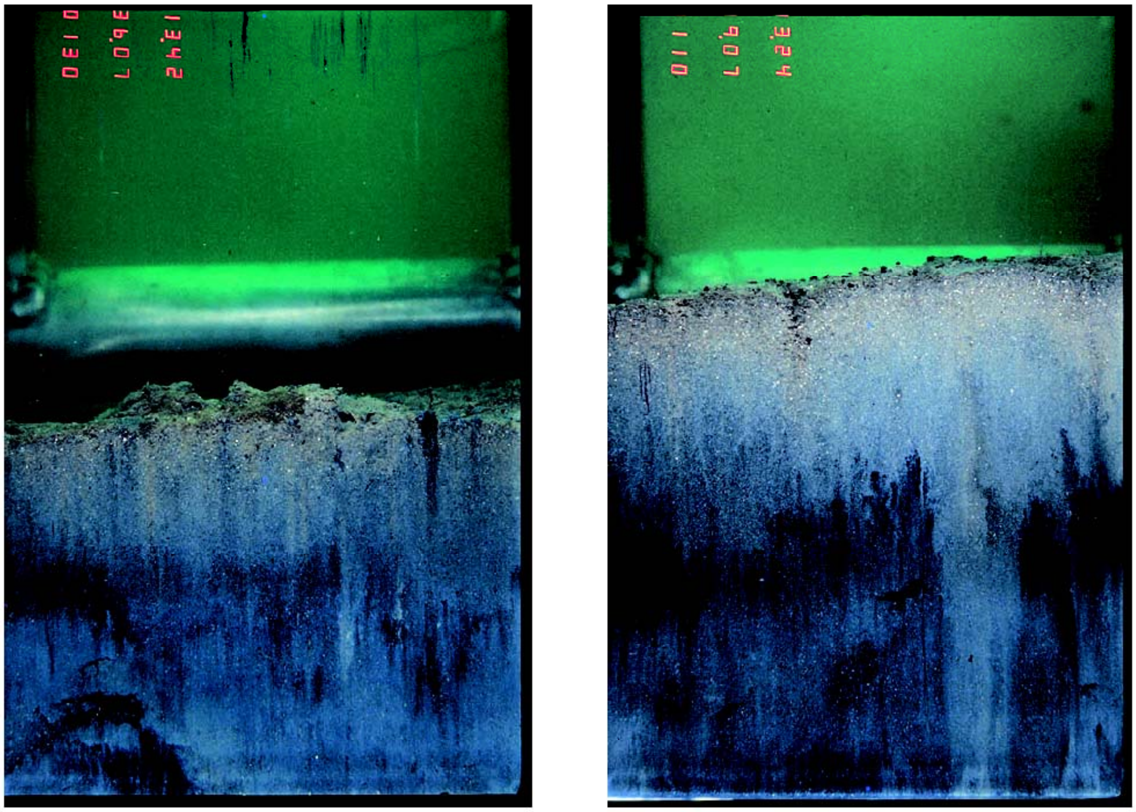


Figure 5-21. Sediment profile images from Station P17 showing low sulfide inventories at depth as well as active feeding voids (Scale: Width of image = 15 cm).

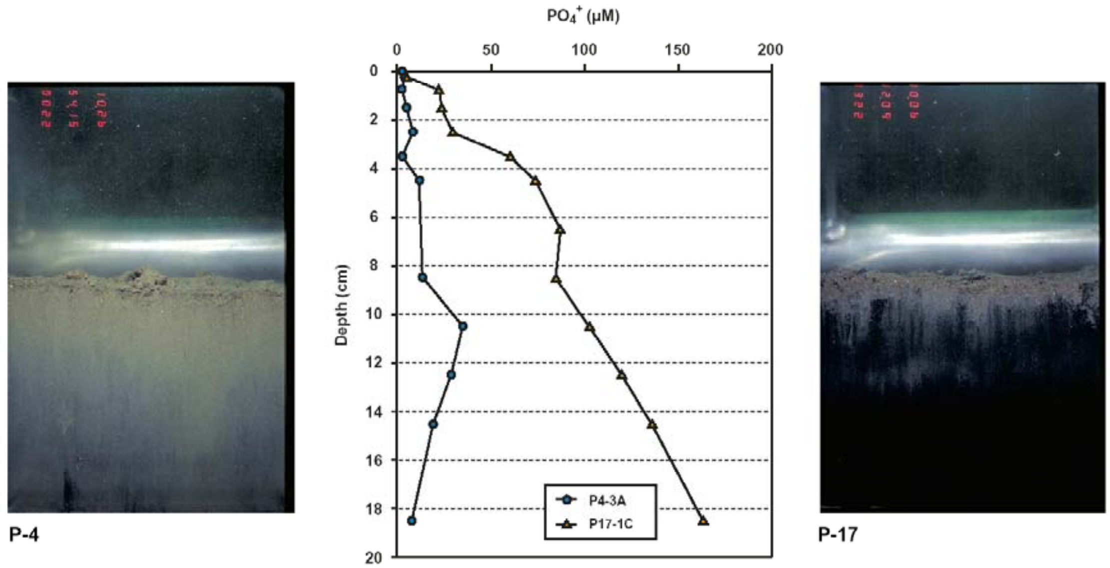


Figure 5-22. Porewater profiles of $P0_4^+$ at Stations P4 and P17 with representative sediment profile images.

5.2 PRISM SITE I – PALETA CREEK; IN-SITU QUANTIFICATION OF METAL AND PAH FLUXES USING THE BENTHIC FLUX SAMPLING DEVICE

Introduction

The objective of the PRISM program is to provide an understanding of the relative importance of critical contaminant transport pathways for in-place sediments in the risk, fate and management of contaminated sediments via: 1) An integrated suite of measurement techniques to characterize and quantify important transport pathways for in-place sediments, 2) A corresponding set of indices that quantify the transport phenomenon on a common dimensional scale and 3) Field scale evaluation of the effectiveness of the measurement tools and the importance of quantified transport pathways.

As a component of the Pathway Ranking for In-place Sediment Management project (PRISM), six 70-hour deployments using Benthic Flux Sampling Devices (BFSD 1 and BFSD 2; see Figure 5-23) were conducted at the Paleta Creek Toxic Hotspot Site. The goal of the BFSD deployments was to quantify the magnitude and variability of the diffusive flux pathway within the PRISM conceptual model.

The study site was located at the base of Paleta Creek where it enters San Diego Bay adjacent to Naval Station San Diego, California. The area is used for mooring Navy industrial waste and sewage collection barges, emergency oil spill response vessels, and other transient industrial support vessels. Naval Station San Diego began operations in 1919 as a docking/fleet repair base for the U.S. Shipping Board. In 1921, the Navy acquired the land for use as the San Diego Repair Base. From 1921 to the early 1940s, the station expanded as a result of land acquisitions and facilities development programs. The sources of contamination in San Diego Bay have varied over time and include sewage, industrial (commercial and military) wastes, ship discharges, urban runoff, and accidental spills. Current sources of pollution to San Diego Bay include underground dewatering, industries in the bay area, marinas and anchorages, Navy installations, underwater hull cleaning and vessel antifouling paints, and urban runoff. Known contaminants in the bay include: arsenic, copper, chromium, lead, cadmium, selenium, mercury, tin, manganese, silver, zinc, tributyltin, PAH, petroleum hydrocarbons, PCBs, chlordane, dieldrin, and DDT (Chadwick et al., 1999).

A general assessment of the site is currently being conducted under the Bay Protection and Toxic Cleanup Program (BPTCP) established in 1989 by the California State legislature. Based on the BPTCP and subsequent legislation (Guidance on the Development of Regional Toxic Hot Spots Cleanup Plans (SWRCB, 1998)) the SDRWQCB to developed a Regional Toxic Hot Spot Cleanup Plan (SDRWQCB, 1998a) for the San Diego Region that was adopted into the Consolidated Statewide Toxic Hot Spot Cleanup Plan in 1999 (SWRCB, 1999). Using data compiled by Fairey et al., (1996), the regional plan identified five candidate THS sites within the San Diego Bay Region that met the State’s designation criteria and were subsequently adopted as known THS in the State’s consolidated plan. Of the five identified sites, the Paleta Creek site was ranked as highest priority.

Figure 5-23. View from San Diego Bay looking Northeast into the Paleta Creek study area.

Methods

Site Selection

Two survey strata were selected on the basis of previous sampling in Paleta Creek. The strata were selected to represent a potential range of conditions that could lead to differences in dominant pathways of contaminant migration and fate. The sampling design specified one sampling site within each strata, with replicate deployments at each site. The sites were designated in accordance with the ongoing sediment assessment study as P17 for the inner strata, and P04 for the outer strata. The inner strata extended from the mouth of Paleta Creek to the base of the quay wall structure. The outer strata extended from the base of the quay wall to the end of the piers. At each site, three BFSD deployments were made, including two standard deployments and one in which we attempted to determine bioinhibited flux rates.

Traditional flux measurements

Diffusive fluxes were quantified through the direct measurement of benthic fluxes utilizing the Navy's existing Benthic Flux Sampling Devices (BFSD1 and BFSD2). The BFSD consists of an open-bottomed chamber mounted in a tripod-shaped framework with associated sampling gear, sensors, control system, power supply, and deployment/retrieval equipment. The chamber is a bottomless box approximately 40-cm square by 25-cm tall that isolates 37.5 l of seawater. As samples are drawn from this volume, bottom water is allowed to replace it via a length of 4-mm Teflon tubing. The volume was chosen to allow for a maximum overall dilution of 10% due to sampling withdrawal and subsequent replacement of twelve samples of 250-ml each. The chamber is constructed of clear polycarbonate to avoid disrupting any exchanges that may be biologically driven and potentially light sensitive. The bottom of the chamber forms a knife edge with a flange circling it 5 cm above the base providing a positive seal between the box and the sediment. The data logger collects data from a suite of sensors mounted in a flow-through loop on the lid of the chamber including temperature, oxygen, pH, and salinity. The control system is an integrated part of the data logger and performs several functions including control of lid closure, activation of flow-through/mixing pump, opening of sampling valves, and chamber oxygen regulation. The method has been utilized for a range of analytes including inorganic constituents such as oxygen and nutrients (McCaffrey et al., 1980; Berlson et al., 1986), trace metals (Ciceri et al., 1992; Leather et al., 1995; Hampton and Chadwick, 2000), and is currently being adapted for organic contaminants under support from the ESTCP program.

Bioinhibited flux measurements

While the BFSD is capable of measuring diffusive fluxes of COPCs independently of most advectively-driven fluxes (which will be measured with seep meters), the BFSD as currently used cannot separate fluxes driven by diffusion from fluxes across the sediment-water interface driven by bioirrigation. However, these fundamentally different flux drivers may affect the way contaminant pathways may be managed. Dryssen et al (1984) observed that, when oxygen was allowed to deplete in a BFSD chamber, the flux rate of Si dropped significantly, suggesting that the flux from biological irrigation had ceased or significantly decreased due to oxygen limitations. To separate flux by these two mechanisms, bioinhibited flux were measured in the BFSD. In these experiments, we attempted to inhibit biological activity allowing oxygen to deplete in the chamber. Since these activities may change the diffusive properties of metals and/or organics, we also evaluated fluxes of Si, and then proposed that the COPC flux be calculated based upon the surrogate:COPC ratio in the biologically active flux measurements.

Pre-Survey Preparation

Prior to deployments, the BFSDs were cleaned and prepared using previously standardized procedures (Chadwick and Stanley, 1993; Hampton and Chadwick, 1999). Decontamination involves soaking and/or rinsing all surfaces contacting seawater samples in a series of fluids beginning with tap water, then de-ionized water, then a special detergent (“RBS”), then de-ionized water, then nitric acid, then 18 meg-ohm de-ionized water and finally filtered air. In addition, components of BFSD1 were subjected to a final rinse with methanol to remove any residual organic contaminants. The collection bottles for BFSD2 were disassembled and all component parts were soaked for a minimum of four hours in each fluid. A 25% concentration of ultra-pure nitric acid was used to soak Teflon™ parts (bottles, lids, and sensor chamber) and a 10% concentration is used for all other parts (including acid-sensitive polycarbonate filter bodies). Glass sample bottles for BFSD1 and BFSD2 were purchased pre-cleaned. For both chambers, the collection chamber, lid, diffuser, circulation pump, tubes and fittings were physically scrubbed and rinsed in place with non-metallic brushes. All decontaminated surfaces were dried, reassembled or otherwise sealed to isolate them from ambient, air-borne contaminants.

Deployment

Aboard R/V Ecos, after loading and connecting various equipment (laptop computer, TV monitor and light, cabling) a standard pre-deployment checklist was followed (Hampton and Chadwick, 1999). Once moored at the site with the GPS location logged, the BFSD was lowered to within 2 feet of the bottom and a 15-minute test was started to stabilize the flow-through sensors and to measure the ambient dissolved oxygen level. The ambient dissolved oxygen level is used to establish system control limits for maintaining a narrow range of dissolved oxygen in the collection chamber during the 70-hour test, as well as for assessment of sediment oxygen uptake rates. The BFSD was then allowed to free-fall to the bottom and insert its collection chamber into the sediment. The landing and insertion were monitored using a video camera. The video camera, aided by a floodlight, also allowed a limited assessment of the site prior to initiating the 70-hour test. After starting the test, it also allowed confirmation of lid closure prior to complete detachment of lanyards and connections for autonomous operation. Following detachment of the lifting and telemetry cables, the BFSD was left in its autonomous operation mode for the following 3 days.

Retrieval
Retrieval of the BFSD after the deployment was made using the onboard recovery system. Once the BFSD was washed down and on deck, the sample bottles were removed for processing using EPA handling and chain of custody procedures. The samples were returned to the shoreside laboratory for splits (nutrients, metals and organics). Nutrient measurements were made at the SIO Ocean Data Facility. The metals samples were packaged and shipped to Battelle Marine Sciences Laboratory for analysis of the metals selected for evaluation (Table 5-4). Samples for analysis of organics were shipped to the laboratory of Arthur D. Little (Table 5-4).

Data Analysis
Following chemical analysis, flux rates were determined using the standard Microsoft Excel spreadsheet template developed during CALEPA certification (Hampton and Chadwick, 1999). The spreadsheet calculates flux rates using the time-series concentrations from each bottle and adjusting for dilution. The flux rates are then evaluated statistically to determine if the fluxes are significantly different from flux chamber blanks. Results of this analysis are described below.

Figure 5-24. The Benthic Flux Sampling Device (BFSD2) used to sample sediment fluxes at Paleta Creek.

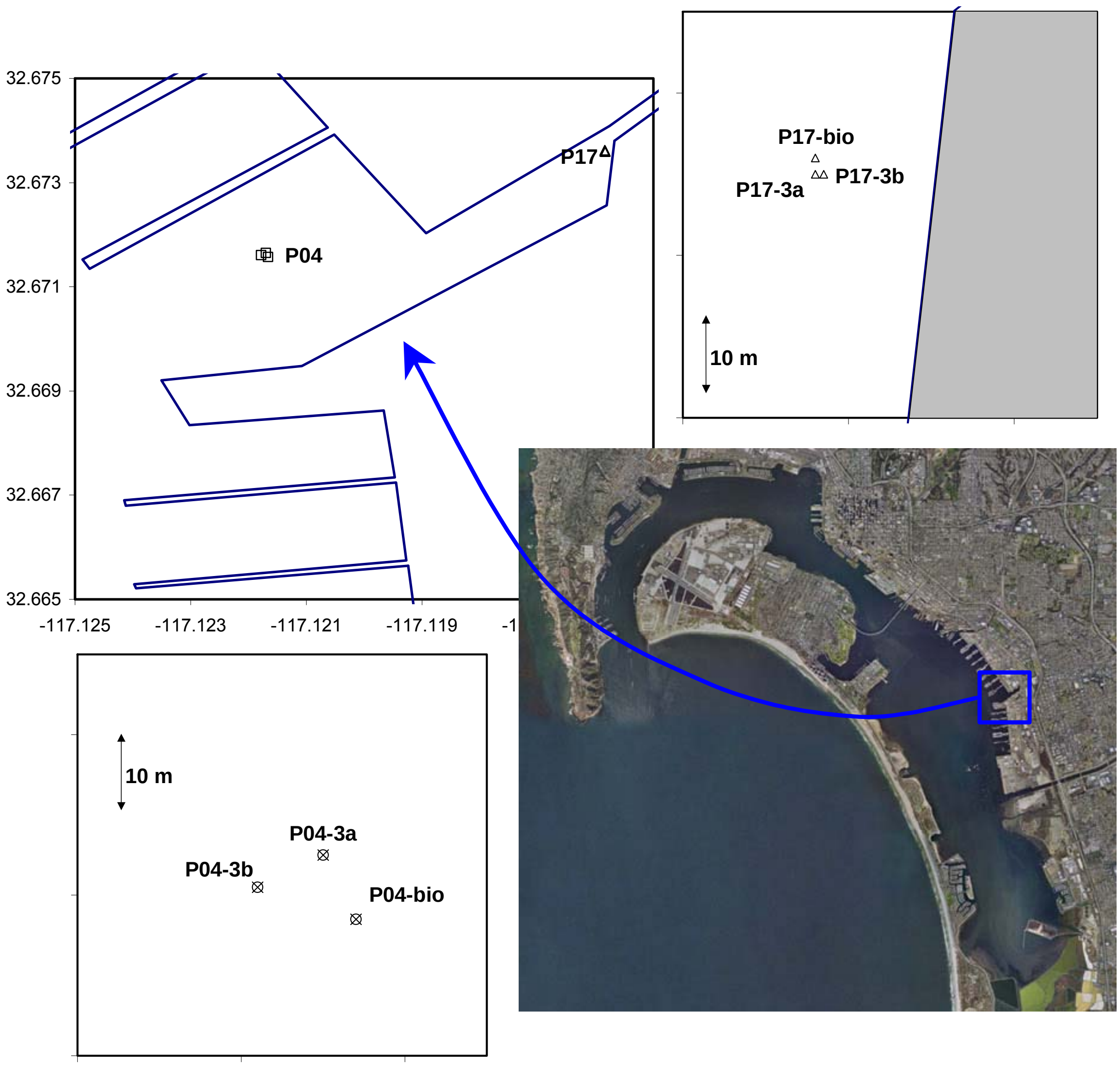


Figure 5-25. Map of Paleta Creek, showing sampling strata, stations and replicate deployment locations for the flux study.

Table 5-4. Target analytes and analytical methods for the flux study.

Metals - U.S. EPA 1631,1638 & 1640	
Aluminum	Manganese
Arsenic	Mercury
Cadmium	Nickel
Chromium	Selenium
Copper	Silver
Iron	Tin
Lead	Zinc
Polynuclear Aromatic Hydrocarbons - U.S. EPA SW-846 8270 modified using SIM	
Naphthalene	Dibenzothiophene
C1-Naphthalenes	C1-Dibenzothiophenes
C2-Naphthalenes	C2-Dibenzothiophenes
C3-Naphthalenes	C3-Dibenzothiophenes
C4-Naphthalenes	Fluoranthene
2-Methylnaphthalene	Pyrene
1-Methylnaphthalene	C1-Fluoranthenes/Pyrenes
2,6-Dimethylnaphthalene	C2-Fluoranthenes/Pyrenes
2,3,5-Trimethylnaphthalene	C3-Fluoranthenes/Pyrenes
Biphenyl	Benzo(a)anthracene
Acenaphthylene	Chrysene
Acenaphthene	C1-Chrysenes
Fluorene	C2-Chrysenes
C1-Fluorenes	C3-Chrysenes
C2-Fluorenes	C4-Chrysenes
C3-Fluorenes	Benzo(b)fluoranthene
Phenanthrene	Benzo(k)fluoranthene
Anthracene	Benzo(e)pyrene
C1-Phenanthrenes/Anthracenes	Benzo(a)pyrene
C2-Phenanthrenes/Anthracenes	Perylene
C3-Phenanthrenes/Anthracenes	Indeno(1,2,3-c,d)pyrene
C4-Phenanthrenes/Anthracenes	Dibenz(a,h)anthracene
1-Methylphenanthrene	Benzo(g,h,i)perylene

Results

Performance Indicators

Several methods were used to evaluate system performance of the BFSDs during and after the demonstrations. To assure a proper seal of the chamber, the deployment was monitored by diver and with an underwater video camera, and silica, pH, Mn and oxygen levels within the chamber were monitored for expected trends. Landing and insertion monitored by diver and with the video indicated a good seals. After starting the test, the video camera also confirmed lid closure of the chambers.

A number of geochemical parameters are also useful in evaluating the general performance of the system, including silica, pH, Mn and oxygen levels within the chamber. Experience has shown that proper chamber seal and performance results in a positive flux for silica and manganese, a negative flux for oxygen, and a decreasing trend in pH (Hampton and Chadwick, 1999). Results for these parameters for the six deployments are summarized in **Table 5-5** below. In general, we found the expected trends for all six deployments. One possible exception was for P04-3b where the pH trend was weak, and the manganese flux was negative. However, all other indicators suggest that the deployment performance was acceptable, indicating that this particular station was probably somewhat less reducing than others, resulting in less respiration (flatter pH trend), and more oxic porewater conditions which are less favorable to manganese flux.

Table 5-5. Summary of performance indicators for the flux study.

Parameter expected	Oxygen Flux (-)	Silica Flux (+)	pH Trend (-)	Mn Flux (+)	Accept
P04-3A	-	+	-	+	y
P04-3B	-	+	weak -	-	y
P04-3Bio	-	+	-	+	y
P17-1A	-	+	-	+	y
P17-1B	-	+	-	+	y
P17-1Bio	-	+	weak -	+	y

Oxygen variations in the chambers were monitored to assure maintenance of ambient oxygen levels, proper chamber seal, and to evaluate sediment oxygen uptake. The oxygen is maintained within a “window” of the ambient level measured at the time of deployment. **Figure 5-26** below shows a typical time trend for oxygen in the controlled chamber. The oxygen level is allowed to drop until it reaches the lower window level, and then the diffusion system is pressurized and the oxygen level rises until the upper window level is reached. The system is then vented, and this process repeats as needed during the deployment. Oxygen levels were effectively maintained during all deployments with the exception of P04-3bio and P17-1bio, where the deployment design called for allowing anoxic conditions to develop. Oxygen uptake rates are quantified from the initial ~2 h of data during the first oxygen cycle descent. These rates are summarized in **Table 5-6**.

At two stations (P04-3bio, and P17-1bio), the oxygen levels were allowed to drop naturally without an attempt to maintain ambient levels. These deployments were designed to evaluate the response of non redox sensitive constituents to a "bioinhibited" condition. The purpose of these deployments was to determine if diffusive fluxes could be quantified in the absence of significant biological irrigation. Results for P04-3bio are shown in **Figure 5-27** below. Although oxygen levels approached zero near the end, anoxic conditions were not produced during any significant portion of the deployment. At P17-1bio, the initial oxygen uptake rate was even lower (see **Table 5-6**), with the result that oxic conditions persisted throughout the deployment at this station as well. Based on these results, only limited bioinhibition may have occurred near the end of the deployments at P04-3bio and P17-1bio.

In the properly sealed BFSD 2 chamber, the pH will generally show a decreasing trend as the breakdown of organic matter at the sediment water interface drives CO2 into the chamber water. This decreasing trend was observed during all deployments, a typical result given in **Figure 5-28** below. At stations P04-3b and P17-1bio the pH trend was somewhat weaker, but still decreasing. These weaker trends are consistent with the low oxygen uptake at these stations.

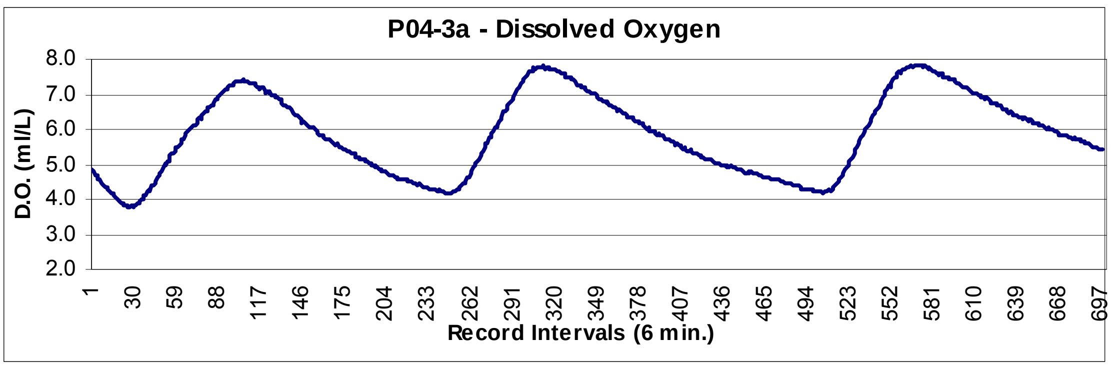


Figure 5-26. Time-course variation of dissolved oxygen in the oxygen-controlled deployment at P04-3a. Vertical axis is dissolved oxygen concentration, and horizontal axis is sample record at 6 min intervals.

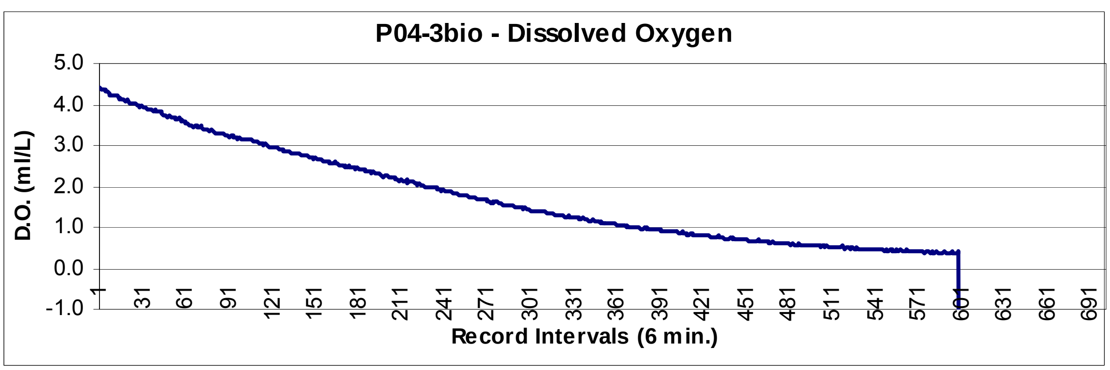


Figure 5-27. Time-course variation of dissolved oxygen in the "bioinhibited" (no oxygen control) deployment at P04-3bio. Vertical axis is dissolved oxygen concentration, and horizontal axis is sample record at 6 min intervals.

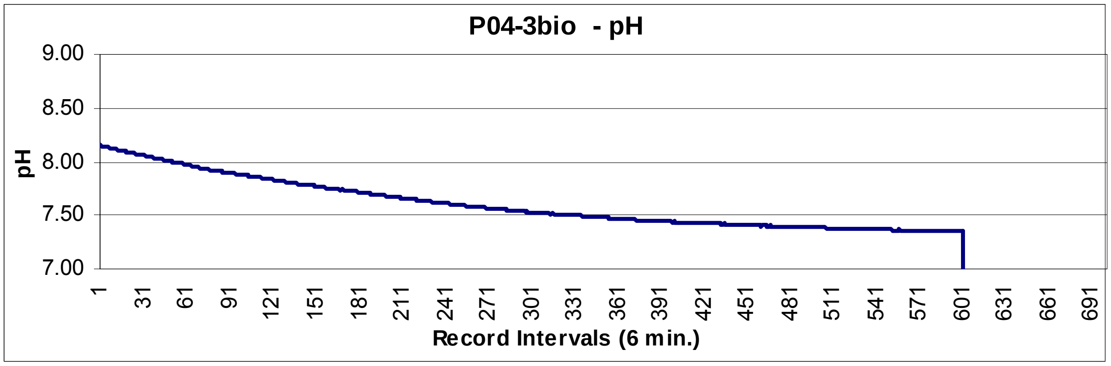


Figure 5-28. Time-course variation in pH the deployment at P04-3bio. Vertical axis is pH concentration, and horizontal axis is sample record at 6 min intervals.

Table 5-6. Oxygen and silica flux rates at the six flux study stations. Oxygen fluxes are in ml/m^2/d, and silica fluxes are in μm/m^2/d. Secondary values for silica fluxes at P17-1b, P04-3a, and P04-3bio are based on initial samples prior to a flattening in the concentration levels.

	P17-1A	P17-1B	P17-1Bio	P04-3A	P04-3B	P04-3Bio
Oxygen (O_2)	-469	-1757	-465	-1902	-376	-700
Silica (SiO_2)	39	9011	292	7269	385	2933
		23978		17506		8417

Metal Fluxes

Results for metal fluxes at the six stations in Paleta Creek are shown in Table 5-7 - Table 5-12. Flux rates are shown for eight metals including As, Cu, Cd, Pb, Ni, Mn, Ag, and Zn. Flux rates were calculated based on the time series concentrations of samples collected from the BFSDs at the four sites. The flux rates were corrected for chamber dilution that occurs during the sampling process. Flux rates were then calculated from the linear regression of concentration versus time. In each case, the fluxes (regression slopes) were statistically compared to the blank chamber flux (the flux with no sediment present) using the Student's t-test. Results for each of these metal are summarized below. Fluxes for the other metals that were measured including Al, Ch, Fe, Hg, Se, and Sn have not been quantified because they are not generally viewed to be COCs at the site, and there is currently no chamber blank to use as a basis for comparison.

Arsenic

Arsenic fluxes were positive at five of the six stations, the exception being P17-1a. Arsenic flux rates ranged from a low of –3.2 µg/m^2/day (P17-1a) to a high of 136 µg/m^2/day (P17-1b). Note that the high flux at P17-1b was calculated on the basis of the first four points only as it appeared that the increasing concentration in the chamber may have decreased the gradient resulting in a reduction in flux rate over time. All fluxes were distinguishable from blanks at $p<0.20$ with the exception of P17-1a. Time-series plots for Arsenic concentrations in the flux chambers at the six stations are shown in Figure 5-29. The mean flux from the three deployments at P04 was 33±28 µg/m^2/day (± one standard deviation). The mean flux from the three deployments at P17 was 45±79 µg/m^2/day. Thus the results for the two sites were quite comparable, though the variability at P17 was somewhat higher.

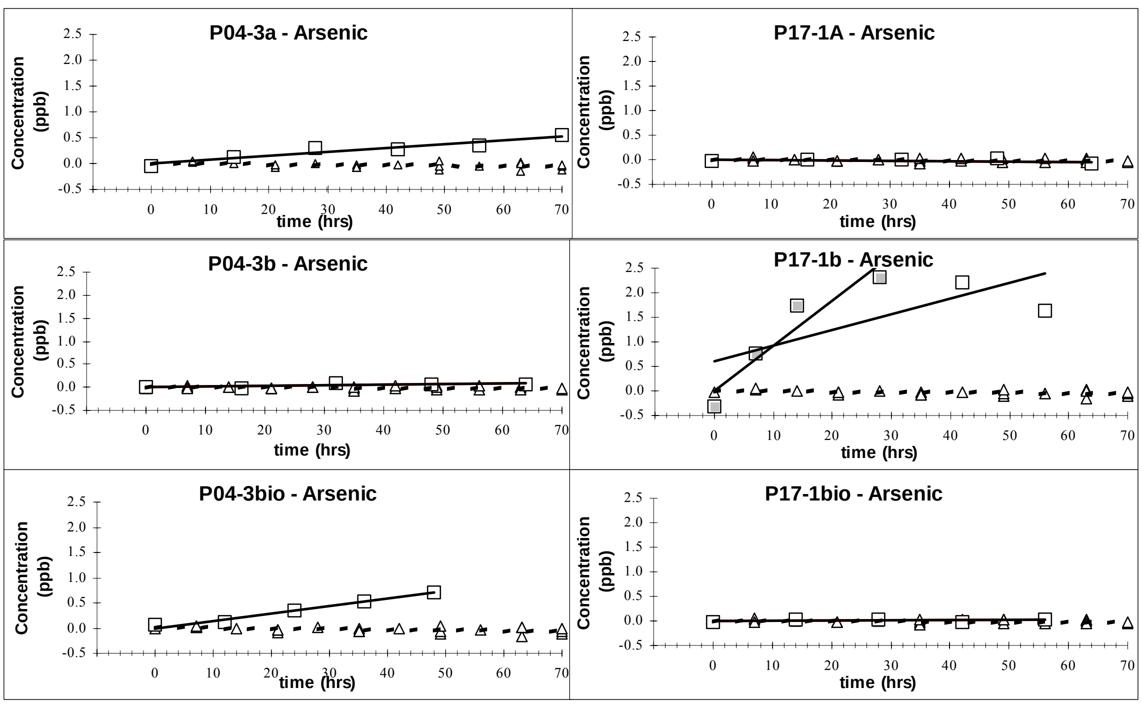


Figure 5-29. Time-series plots for Arsenic in the BFSD chambers. Squares indicate concentrations for station samples, and triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Copper

Copper fluxes were positive at four of the six stations, with negative fluxes at both P04-3a and P04-3bio. Copper flux rates ranged from a low of –39 µg/m^2/day (P04-3bio) to a high of 157 µg/m^2/day (P17-1a). All fluxes were distinguishable from blanks at $p<0.20$ with the exception of P04-3a and P17-1b. Note that the flux at P17-1bio was calculated on the basis of the first three points only as it appeared that the decreasing oxygen level in this uncontrolled chamber may have influenced the flux of redox sensitive metals. Time-series plots for Copper concentrations in the flux chambers at the six stations are shown in Figure 5-30. The mean flux from the three deployments at P04 was -7±30 µg/m^2/day. The mean flux from the three deployments at P17 was 99±77 µg/m^2/day. Thus the Copper flux at P17 was substantially higher than at P04, though again the variability at P17 was somewhat higher.

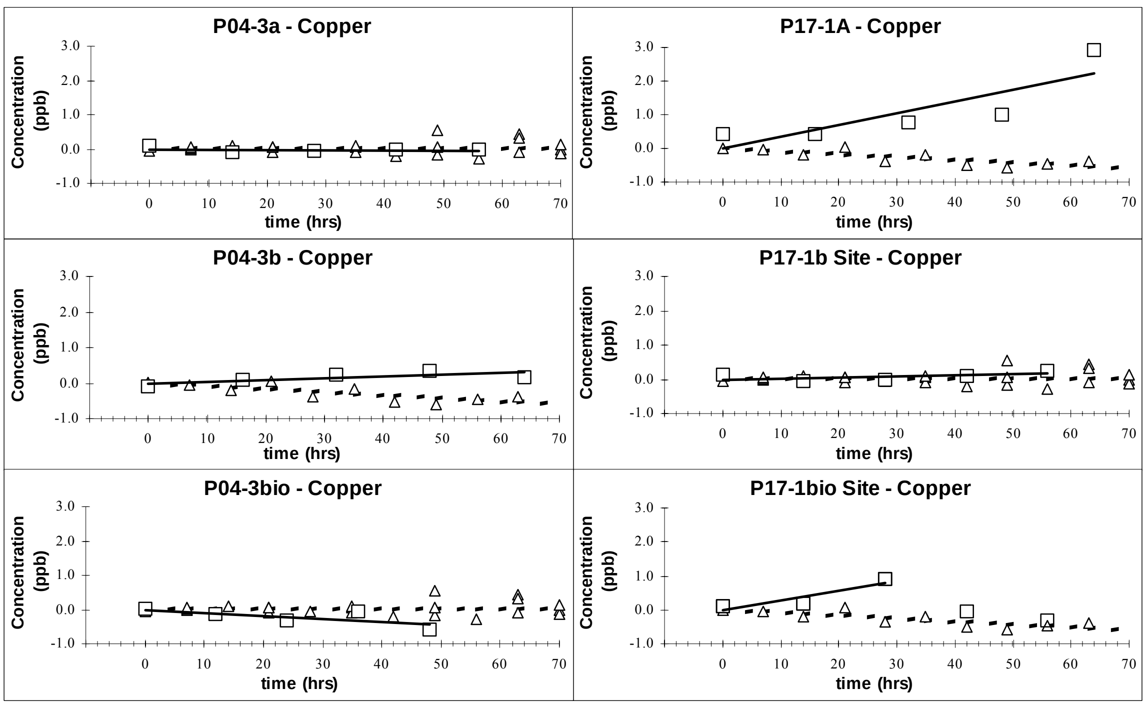


Figure 5-30. Time-series plots for Copper in the BFSD chambers. Red squares indicate concentrations for station samples, and blue triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Cadmium

Cadmium fluxes were positive at four of the six stations, with negative fluxes at both P04-3a and P17-1bio. Cadmium flux rates ranged from a low of –5 μg/m^2/day (P04-3a) to a high of 23 μg/m^2/day (P17-1a), the same station with the maximum copper flux. All fluxes were distinguishable from blanks at $p<0.20$ with the exception of P17-1b and P17-1bio. Time-series plots for Cadmium concentrations in the flux chambers at the six stations are shown in Figure 5-31. The mean flux from the three deployments at P04 was 0.4±5 μg/m^2/day. The mean flux from the three deployments at P17 was 7±14 μg/m^2/day. Thus the pattern for Cadmium was similar to Copper with the flux at P17 substantially higher than at P04, and the variability at P17 was somewhat higher.

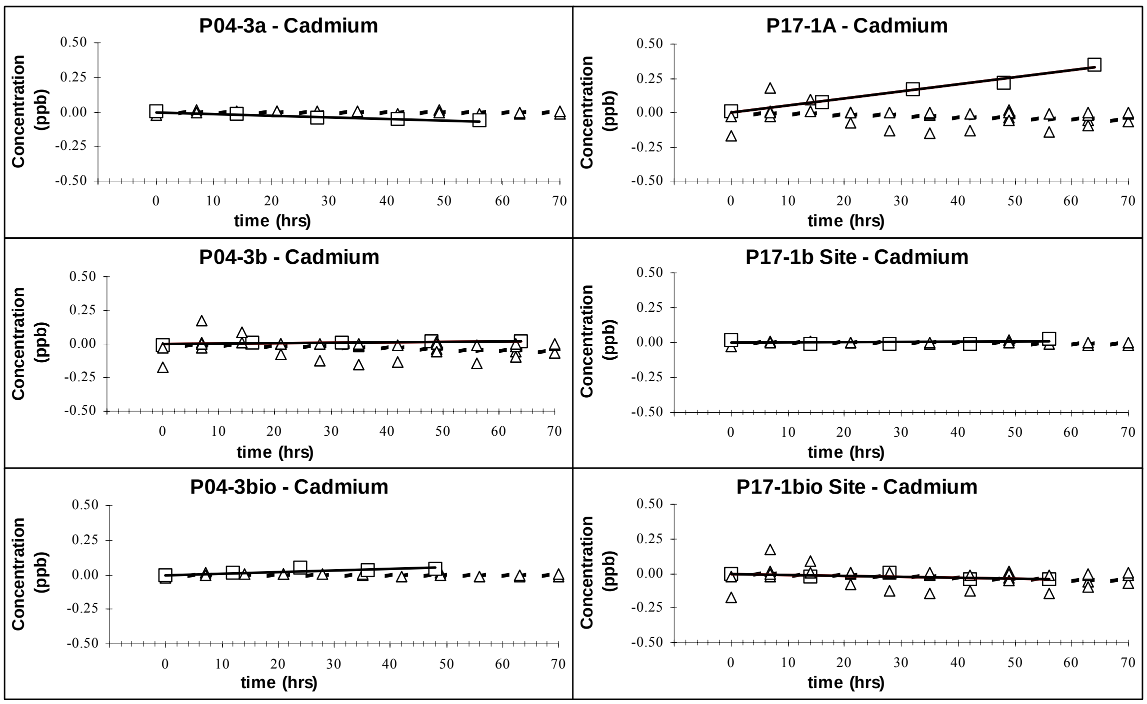


Figure 5-31. Time-series plots for Cadmium in the BFSD chambers. Red squares indicate concentrations for station samples, and blue triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Lead

Lead fluxes were positive at four of the six stations, with negative fluxes at both P17-1a and P17-1bio. Lead flux rates ranged from a low of –2 μg/m²/day (P17-1bio) to a high of 31 μg/m²/day (P04-3b). Only the flux at P04-3b was distinguishable from blanks at $p<0.20$. Time-series plots for Lead concentrations in the flux chambers at the six stations are shown in Figure 5-32. The mean flux from the three deployments at P04 was 11±17 μg/m²/day. The mean flux from the three deployments at P17 was 0.2±3 μg/m²/day. Thus the pattern for Lead was different than for Copper and Cadmium with a somewhat higher mean flux and variability at P04 compared to P17, and most flux rates indistinguishable from blanks.

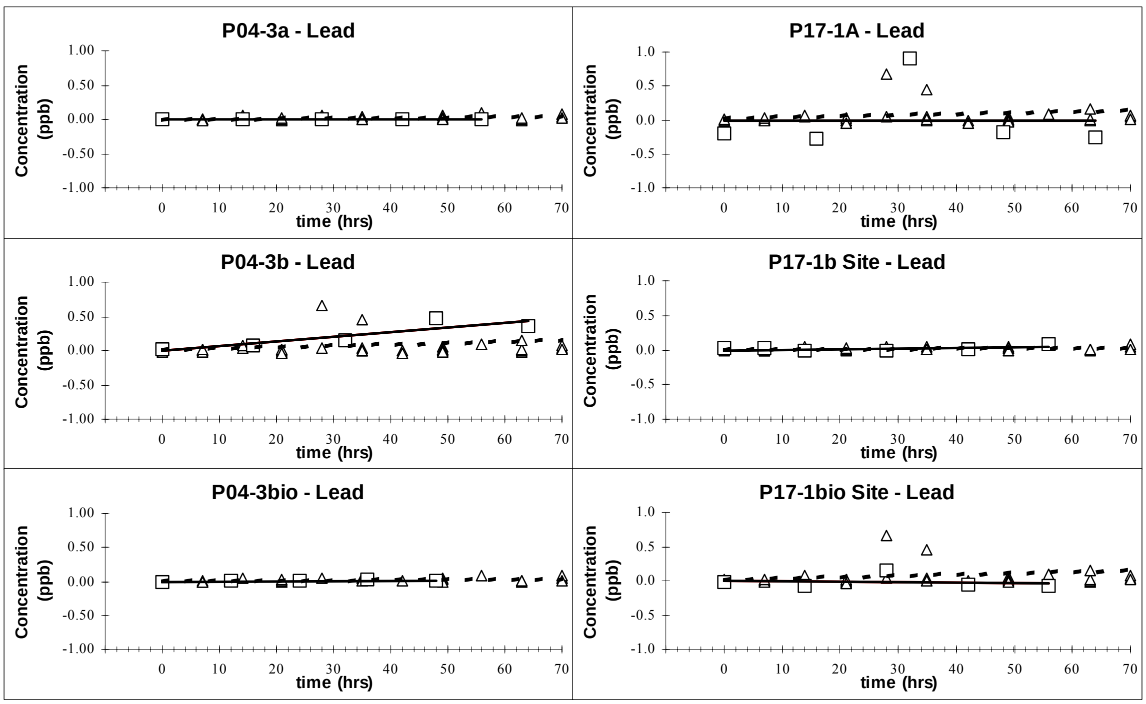


Figure 5-32. Time-series plots for Lead in the BFSD chambers. Red squares indicate concentrations for station samples, and blue triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Nickel

Nickel fluxes were positive at all six stations. Nickel flux rates ranged from a low of 10 μg/m^2/day (P04-3b) to a high of 102 μg/m^2/day (P04-3bio). However, only the fluxes at P04-3bio and P17-1a were distinguishable from blanks at p<0.20. Time-series plots for Nickel concentrations in the flux chambers at the six stations are shown in Figure 5-33. The mean flux from the three deployments at P04 was 41±53 μg/m^2/day. The mean flux from the three deployments at P17 was 19±8 μg/m^2/day. Thus the pattern for Nickel was similar to that of Lead with a somewhat higher mean flux and variability at P04 compared to P17, and most flux rates indistinguishable from blanks.

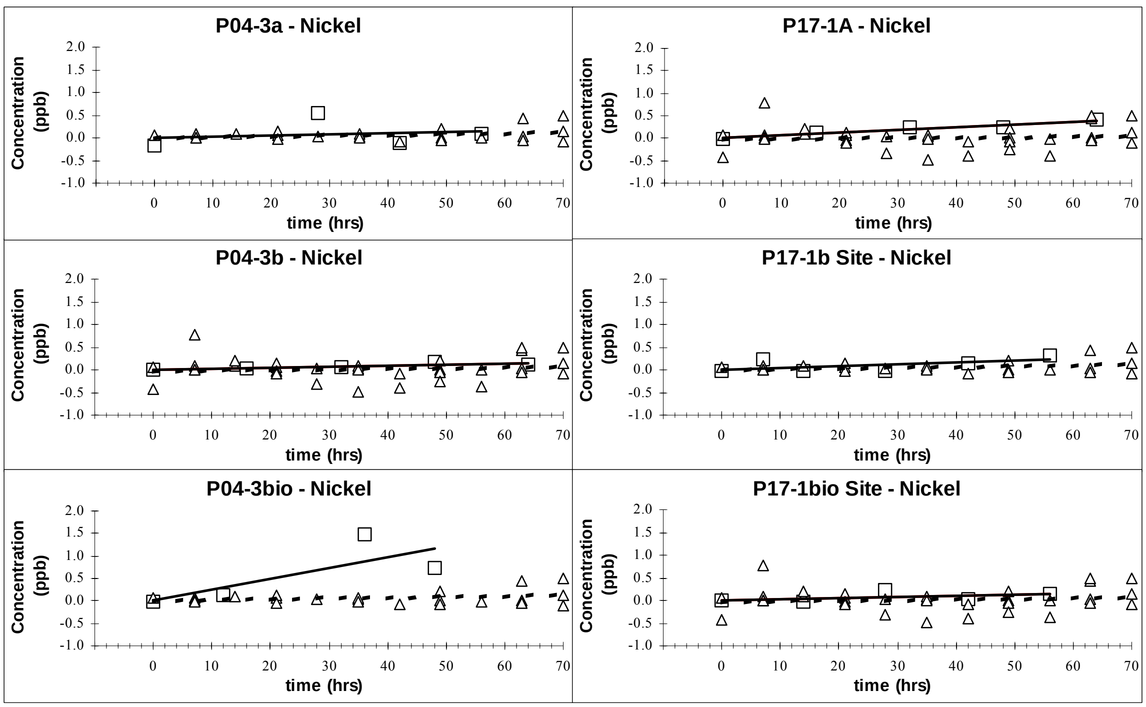


Figure 5-33. Time-series plots for Nickel in the BFSD chambers. Red squares indicate concentrations for station samples, and blue triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Manganese

Manganese fluxes were positive at all stations except P04-3b. Manganese flux rates ranged from a low of -118 µg/m^2/day (P04-3b) to a high of 35600 µg/m^2/day (P04-3bio). Fluxes at all stations were distinguishable from blanks at $p<0.20$. Note that the fluxes at P04-1a and P17-1b were calculated on the basis of the first three and four points of the time course respectively, as it appeared that the increasing concentration in the chamber may have decreased the gradient resulting in a reduction in flux rate over time. Time-series plots for Manganese concentrations in the flux chambers at the six stations are shown in Figure 5-34. The mean flux from the three deployments at P04 was 21800±19200 µg/m^2/day. The mean flux from the three deployments at P17 was 3650±1260 µg/m^2/day. Thus the pattern for Manganese was similar to that of Nickel and Lead with higher mean flux and variability at P04 compared to P17, however for Manganese, all flux rates were distinguishable from blanks.

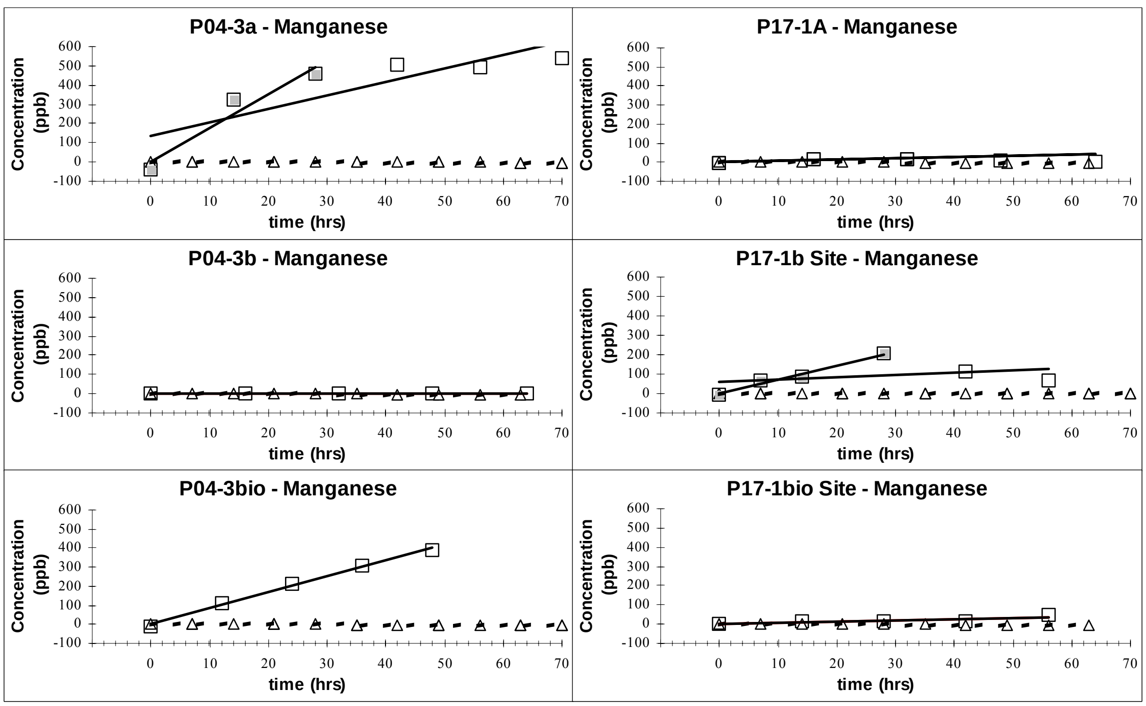


Figure 5-34. Time-series plots for Manganese in the BFSD chambers. Red squares indicate concentrations for station samples, and blue triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Silver

Silver fluxes were positive at three of the six stations, with negative fluxes at P04-3a, P04-3bio, and P17-1a. Silver flux rates ranged from a low of –0.97 μg/m^2/day (P04-3bio) to a high of 2.8 μg/m^2/day (P04-3b). All fluxes at P04 were distinguishable from blanks at $p<0.20$, however at P17, only P17-1a had a flux measurably different from blank. Time-series plots for Silver concentrations in the flux chambers at the six stations are shown in Figure 5-35. The mean flux from the three deployments at P04 was 0.5±2 μg/m^2/day. The mean flux from the three deployments at P17 was 0.5±0.9 μg/m^2/day. Thus the results for the two sites were quite comparable, though the variability at P04 was slightly higher.

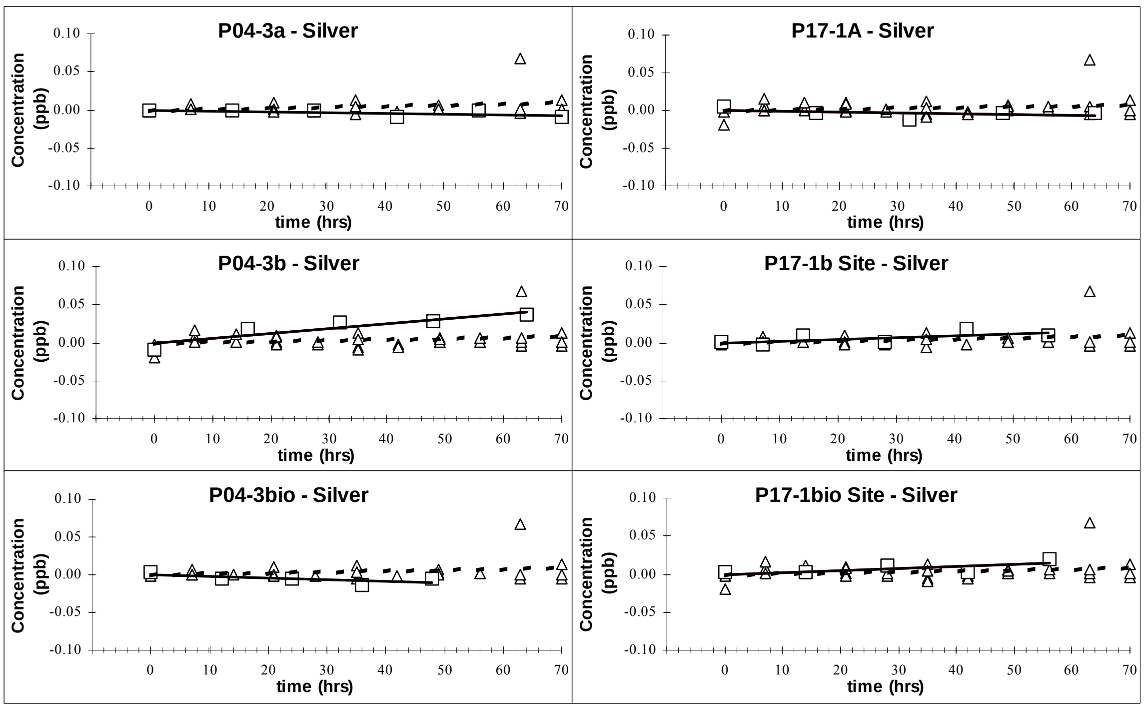


Figure 5-35. Time-series plots for Silver in the BFSD chambers. Red squares indicate concentrations for station samples, and blue triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Zinc

Zinc fluxes were positive at all six stations. Zinc flux rates ranged from a low of 160 μg/m^2/day (P04-3b) to a high of 3162 μg/m^2/day (P17-1a). All fluxes were distinguishable from blanks at p<0.20. Note that the flux at P17-1bio was calculated on the basis of the first three points only as it appeared that the decreasing oxygen level in this uncontrolled chamber may have influenced the flux of redox sensitive metals. Time-series plots for Zinc concentrations in the flux chambers at the six stations are shown in Figure 5-36. The mean flux from the three deployments at P04 was 724±907 μg/m^2/day. The mean flux from the three deployments at P17 was 2165±1409 μg/m^2/day. Thus, as for Copper, the Zinc flux and variability at P17 was substantially higher than at P04.

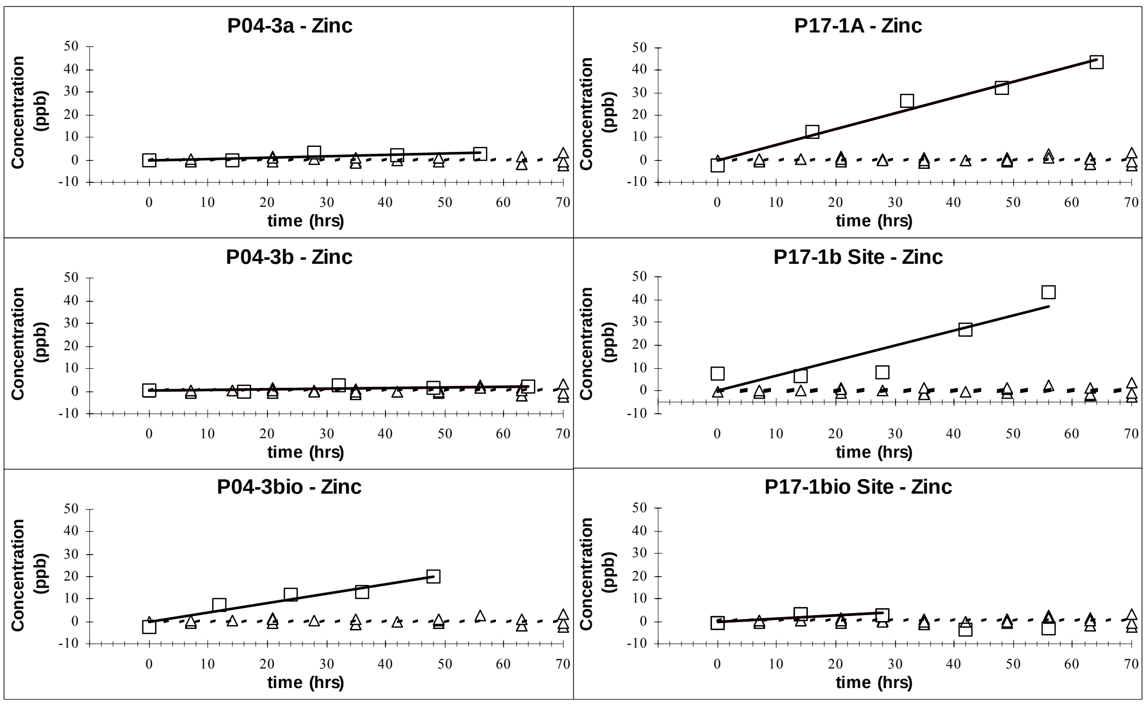


Figure 5-36. Time-series plots for Zinc in the BFSD chambers. Red squares indicate concentrations for station samples, and blue triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Table 5-7. BFSD results from site P04-3a. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study are shown for comparison. Secondary flux rates for Mn and Si are based on the initial three samples.

Metal	Flux ($\mu g/m^2/day$)*	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.
Arsenic (As)	31.43	13.15	100%	-5.16	2.10
Copper (Cu)	-3.25	21.16	39.8%	2.82	8.73
Cadmium (Cd)	-5.10	2.91	100.0%	-0.52	0.75
Lead (Pb)	0.39	0.59	68.7%	3.16	1.59
Nickel (Ni)	11.25	172.36	26.5%	10.28	7.34
Manganese (Mn)	29865 74511	26038 247681	100.0% 100.0%	-265 -265	7.49 7.49
Silver (Ag)	-0.47	0.81	84.3%	0.64	0.68
Zinc (Zn)	242.28	365.23	99.5%	-3.38	65.22

Table 5-8. BFSD results from site P04-3b. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study are shown for comparison.

Metal	Flux ($\mu g/m^2/day$)*	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.
Arsenic (As)	5.37	11.77	100%	-1.44	1.65
Copper (Cu)	21.11	39.19	99.8%	-51.99	15.72
Cadmium (Cd)	1.67	1.77	83.0%	-4.77	3.03
Lead (Pb)	30.58	29.98	81.4%	15.27	11.45
Nickel (Ni)	10.15	11.51	37.4%	3.05	12.99
Manganese (Mn)	-118	131	99.9%	-382	37.89
Silver (Ag)	2.84	2.39	99.9%	0.56	0.55
Zinc (Zn)	159.31	268.80	98.4%	7.65	46.99

Table 5-9. BFSD results from site P04-3bio. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study are shown for comparison. Secondary flux rates for Si are based on the initial three samples.

Metal	Flux ($\mu g/m^2/day$)*	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.
Arsenic (As)	61.05	17.26	100%	-5.16	2.10
Copper (Cu)	-38.88	63.14	99.8%	2.82	8.73
Cadmium (Cd)	4.68	5.37	100.0%	-0.52	0.75
Lead (Pb)	1.61	4.06	23.4%	3.16	1.59
Nickel (Ni)	102.22	258.20	100.0%	10.28	7.34
Manganese (Mn)	35589	4768	100.0%	-265	7.49
Silver (Ag)	-0.97	1.92	89.0%	0.64	0.68
Zinc (Zn)	1771	906	100.0%	-3.38	65.22

Table 5-10. BFSD results from site P017-3a. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study are shown for comparison.

Metal	Flux ($\mu g/m^2/day$)*	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.
Arsenic (As)	-3.20	11.37	69%	-1.44	1.65
Copper (Cu)	157	184	100.0%	-51.99	15.72
Cadmium (Cd)	23.15	5.77	100.0%	-4.77	3.03
Lead (Pb)	-0.23	168	47.3%	15.27	11.45
Nickel (Ni)	28	13	88.3%	3.05	12.99
Manganese (Mn)	2968	18582	100.0%	-382.19	37.89
Silver (Ag)	-0.53	1.85	82.2%	0.56	0.55
Zinc (Zn)	3162	866	100.0%	7.65	46.99

Table 5-11. BFSD results from site P017-3b. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study are shown for comparison. Secondary flux rates for As, Mn and Si are based on the initial three samples.

Metal	Flux ($\mu g/m^2/day$)*	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.
Arsenic (As)	136	198	100%	-5.16	2.10
	389	390	100%	-5.16	2.10
Copper (Cu)	11.83	35.53	65.9%	2.82	8.73
Cadmium (Cd)	0.45	5.67	59.9%	-0.52	0.75
Lead (Pb)	3.34	8.53	42.6%	3.16	1.59
Nickel (Ni)	16.97	34.21	71.8%	10.28	7.34
Manganese (Mn)	5094	17474	98.4%	-265	7.49
	30561	14403	100.0%	-265	7.49
Silver (Ag)	0.99	1.59	52.1%	0.64	0.68
Zinc (Zn)	2781	2544	100.0%	-3.38	65.22

Table 5-12. BFSD results from site P017-3b. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study are shown for comparison.

Metal	Flux ($\mu g/m^2/day$)*	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.
Arsenic (As)	1.78	8.98	80%	-1.44	1.65
Copper (Cu)	129.03	828.28	99.9%	-51.99	15.72
Cadmium (Cd)	-3.25	5.59	5.8%	-4.77	3.03
Lead (Pb)	-2.46	36.11	61.7%	15.27	11.45
Nickel (Ni)	12.31	36.40	42.6%	3.05	12.99
Manganese (Mn)	2872	3583	100.0%	-382	37.89
Silver (Ag)	1.16	2.12	67.1%	0.56	0.55
Zinc (Zn)	553	5877	99.9%	7.65	46.99

Table 5-13. Summary of BFSD results for metals from site P04. Shaded cells indicate flux rates that were statistically distinguishable from blanks at $p<0.20$.

	P04-3A	P04-3B	P04-3Bio	Min	Max	Mean	Std
Arsenic (As)	31.43	5.37	61.05	5.37	61.05	32.62	27.86
Copper (Cu)	-3.25	21.11	-38.88	-38.88	21.11	-7.01	30.17
Cadmium (Cd)	-5.10	1.67	4.68	-5.10	4.68	0.42	5.01
Lead (Pb)	0.39	30.58	1.61	0.39	30.58	10.86	17.09
Nickel (Ni)	11.2	10.1	102.2	10.1	102.2	41.2	52.8
Manganese (Mn)	29865	-118	35589	-118	35589	21779	19178
	74511						
Silver (Ag)	-0.47	2.84	-0.97	-0.97	2.84	0.47	2.07
Zinc (Zn)	242	159	1771	159	1771	724	907

Table 5-14. Summary of BFSD results for metals from site P17. Shaded cells indicate flux rates that were statistically distinguishable from blanks at $p<0.20$.

	P17-1A	P17-1B	P17-1Bio	Min	Max	Mean	Std
Arsenic (As)	-3.20	135.89	1.78	-3.20	135.89	44.82	78.91
		388.80					
Copper (Cu)	157.0	11.8	129.0	11.8	157.0	99.3	77.0
Cadmium (Cd)	23.15	0.45	-3.25	-3.25	23.15	6.78	14.30
Lead (Pb)	-0.23	3.34	-2.46	-2.46	3.34	0.22	2.92
Nickel (Ni)	28.0	17.0	12.3	12.3	28.0	19.1	8.1
Manganese (Mn)	2968	5094	2872	2872	5094	3645	1256
		30561					
Silver (Ag)	-0.53	0.99	1.16	-0.53	1.16	0.54	0.93
Zinc (Zn)	3162	2781	553	553	3162	2165	1409

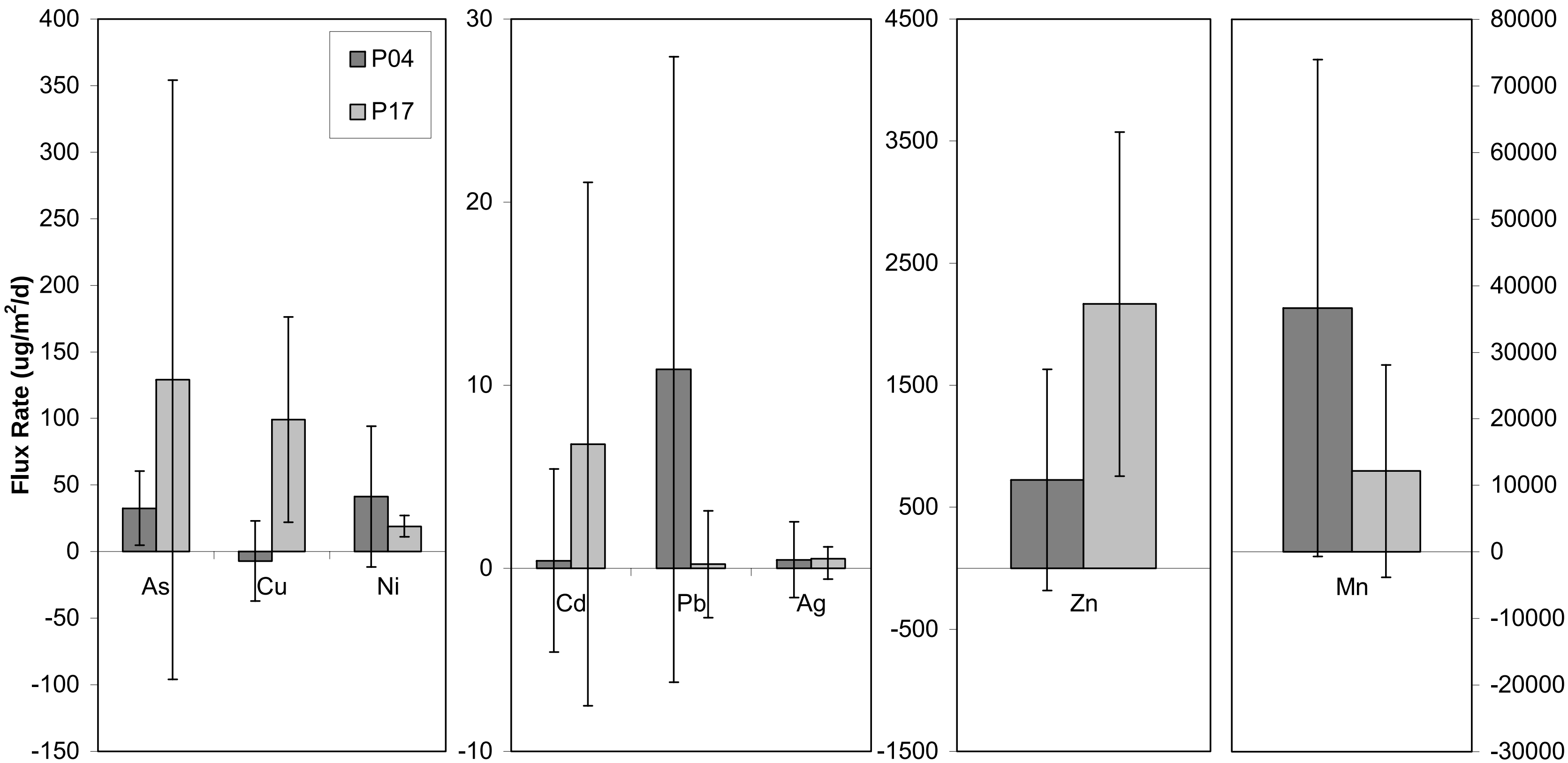


Figure 5-37. Summary plot for mean flux rates of metals at P04 and P17. Note variation in vertical scale for different groups of metals. Error bars are standard deviations based on the variability of the three deployments within each area.

PAH Fluxes

Results for PAH fluxes at the six stations in Paleta Creek are shown in Table 5-15 - Table 5-20. Flux rates are shown for eight PAHs including Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, and Pyrene. Flux rates were calculated based on the time series concentrations of samples collected from the BFSDs at the six sites. The flux rates were corrected for chamber dilution that occurs during the sampling process. In addition, flux rates for Naphthalene, Fluoranthene, and Pyrene were corrected for blank flux rates. Flux rates were then calculated from the linear regression of concentration versus time. In each case, the fluxes (regression slopes) were statistically compared to the blank chamber flux (the flux with no sediment present) using the Student's t-test. Results for each of these PAHs are summarized below. Fluxes for the other PAHs that were measured have not been quantified because either the concentrations were below detection, they are not generally viewed to be COCs at the site, and/or there is currently no chamber blank to use as a basis for comparison.

Naphthalene

Naphthalene fluxes were positive at all six stations. Naphthalene flux rates ranged from a low of 14 ng/m^2/day (P17-1bio) to a high of 878 ng/m^2/day (P17-1a). Note that the fluxes for Naphthalene were corrected for a negative blank flux by subtracting the blank regression from the station regression. Only the flux at P17-1a was distinguishable from blank at $p<0.20$. Time-series plots for Naphthalene concentrations in the flux chambers at the six stations are shown in Figure 5-38. The mean flux from the three deployments at P04 was 620±364 μg/m^2/day (± one standard deviation). The mean flux from the three deployments at P17 was 333±474 μg/m^2/day. Thus the mean flux for P04 was somewhat higher although P17 had the highest flux at an individual station, and the variability at P17 was somewhat higher.

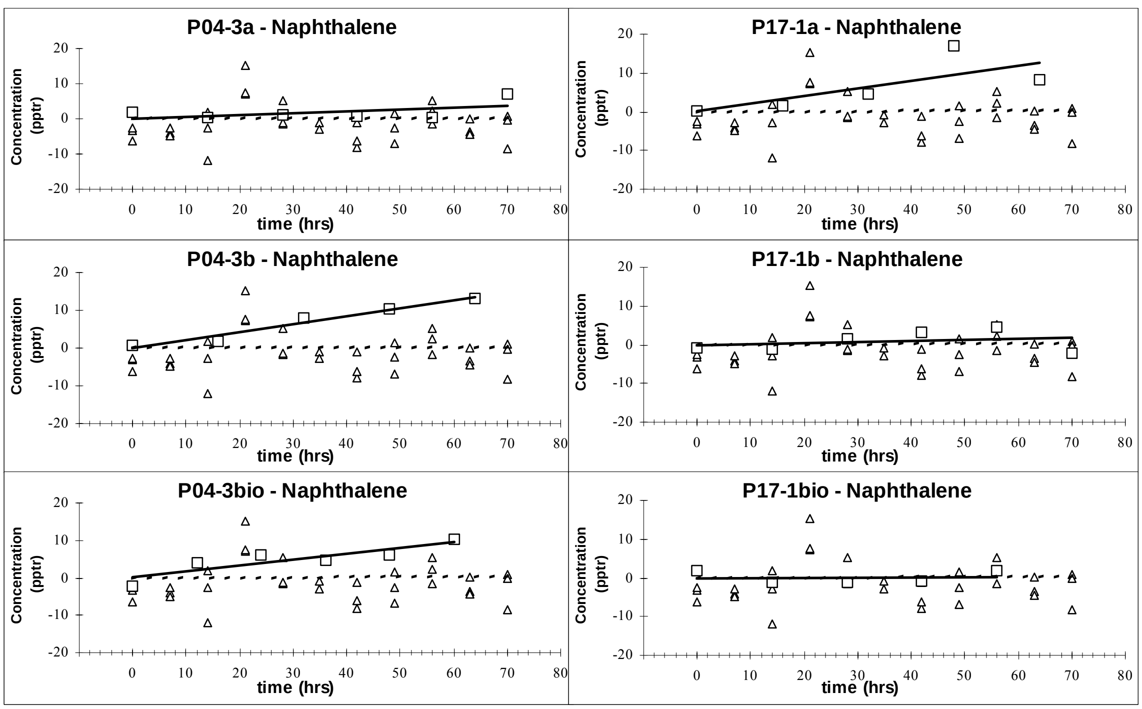


Figure 5-38. Time-series plots for Naphthalene in the BFSD chambers. Squares indicate concentrations for station samples, and triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Acenaphthylene

Acenaphthylene fluxes were below detection at four of the six stations. At the other two stations both fluxes were positive (P04-3bio and P17-1bio). Acenaphthylene flux rates ranged from a low of 29 ng/m^2/day (P04-3bio) to a high of 636 ng/m^2/day (P17-1bio). Only the flux at P17-1bio was distinguishable from blank at $p<0.20$. Time-series plots for Acenaphthylene concentrations in the flux chambers at the six stations are shown in Figure 5-39. The mean fluxes in the two areas were identical to the individual fluxes since only one measurable flux was determined in each area. On the basis of this limited data set, the flux at P17 appears to be substantially higher than at P04, however no evaluation of within-within site variability can be made.

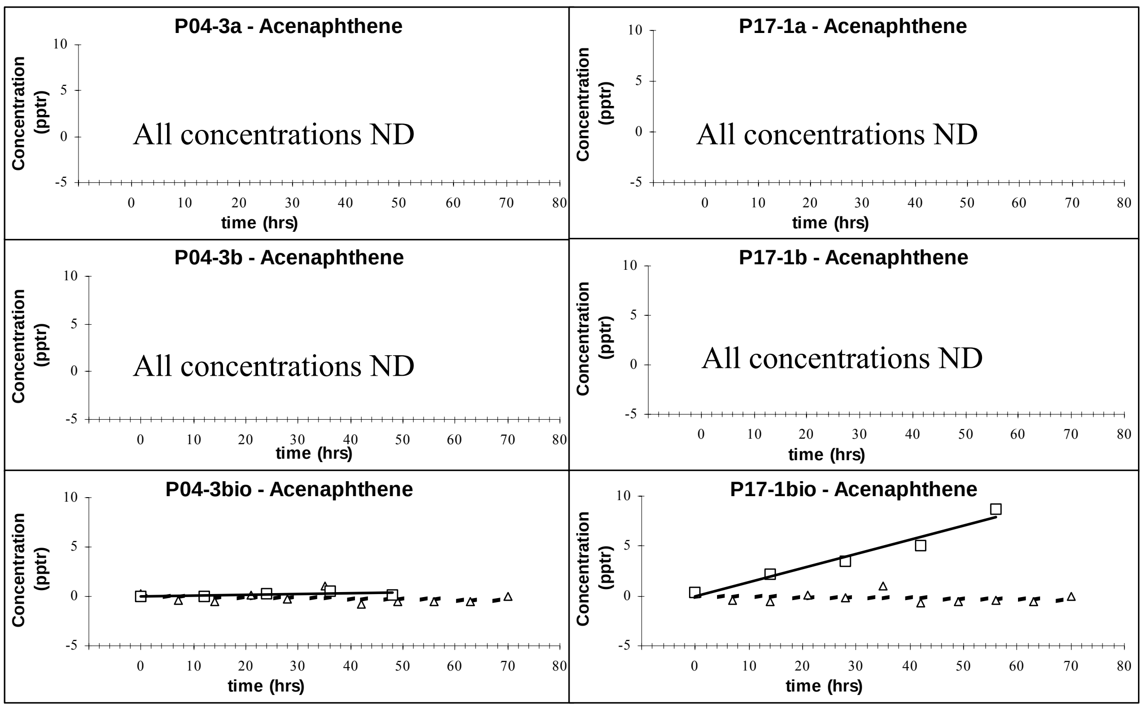


Figure 5-39. Time-series plots for Acenaphthylene in the BFSD chambers. Squares indicate concentrations for station samples, and triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Acenaphthene

Acenaphthene fluxes were positive at only two of the six stations, with negative fluxes at P04-3a, P04-3b, P17-1a, and P17-1bio. Acenaphthene flux rates ranged from a low of -63 ng/m^2/day (P17-1a) to a high of 29 ng/m^2/day (P04-3bio). Only the fluxes at P04-3a and P17-1a were distinguishable from blanks at $p<0.20$. Time-series plots for Acenaphthene concentrations in the flux chambers at the six stations are shown in Figure 5-40. The mean flux from the three deployments at P04 was 6±20 μg/m^2/day. The mean flux from the three deployments at P17 was -19±38 μg/m^2/day. Thus the pattern for Acenaphthene suggests minimal fluxes at both P04 and P17.

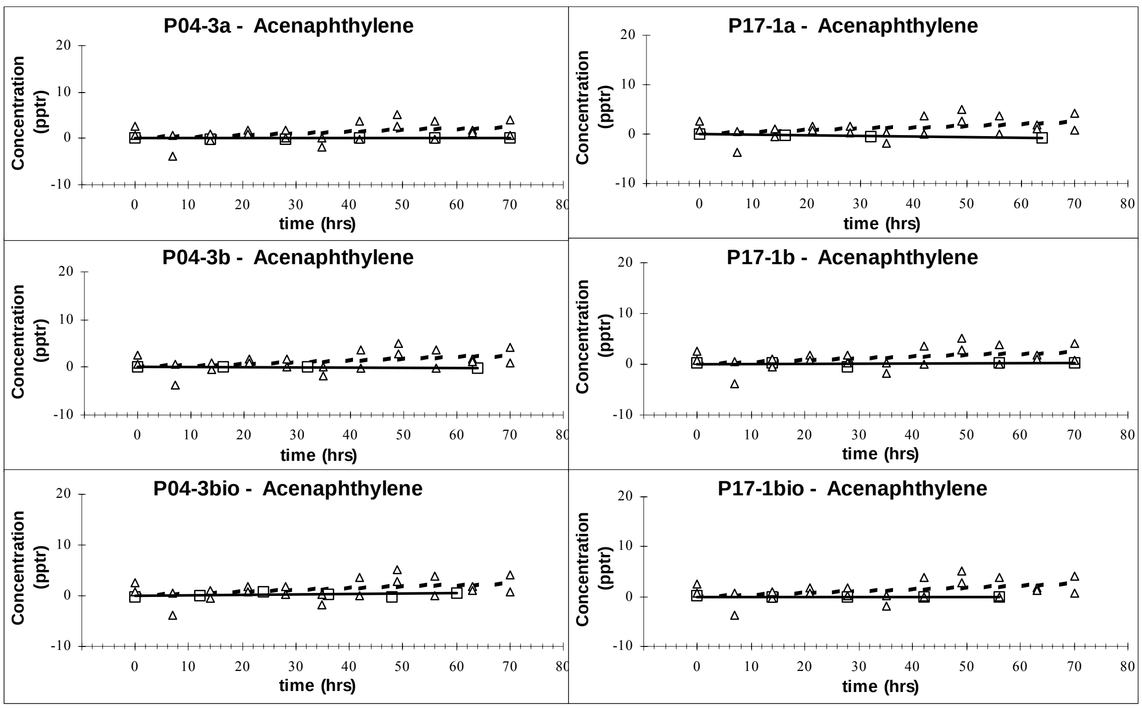


Figure 5-40. Time-series plots for Acenaphthene in the BFSD chambers. Squares indicate concentrations for station samples, and triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Fluorene

Fluorene fluxes were positive at two stations (P04-3a, P17-1bio), negative at three stations (P04-3b, P04-3bio, P17-1a), and below detection at P17-1b. Fluorene flux rates ranged from a low of –303 ng/m^2/day (P17-1a) to a high of 177 ng/m^2/day (P17-1bio). Fluxes at four stations (P04-3a, P04-3bio, P17-1a,and P17-1bio) were distinguishable from blanks at p<0.20. Time-series plots for Fluorene concentrations in the flux chambers at the six stations are shown in Figure 5-41. The mean flux from the three deployments at P04 was -101±146 ng/m^2/day. The mean flux from the three deployments at P17 was -63±339 ng/m^2/day. Thus Fluorene showed both positive and negative fluxes in both areas, with resulting negative mean rates. Within-site variability was somewhat higher at P17.

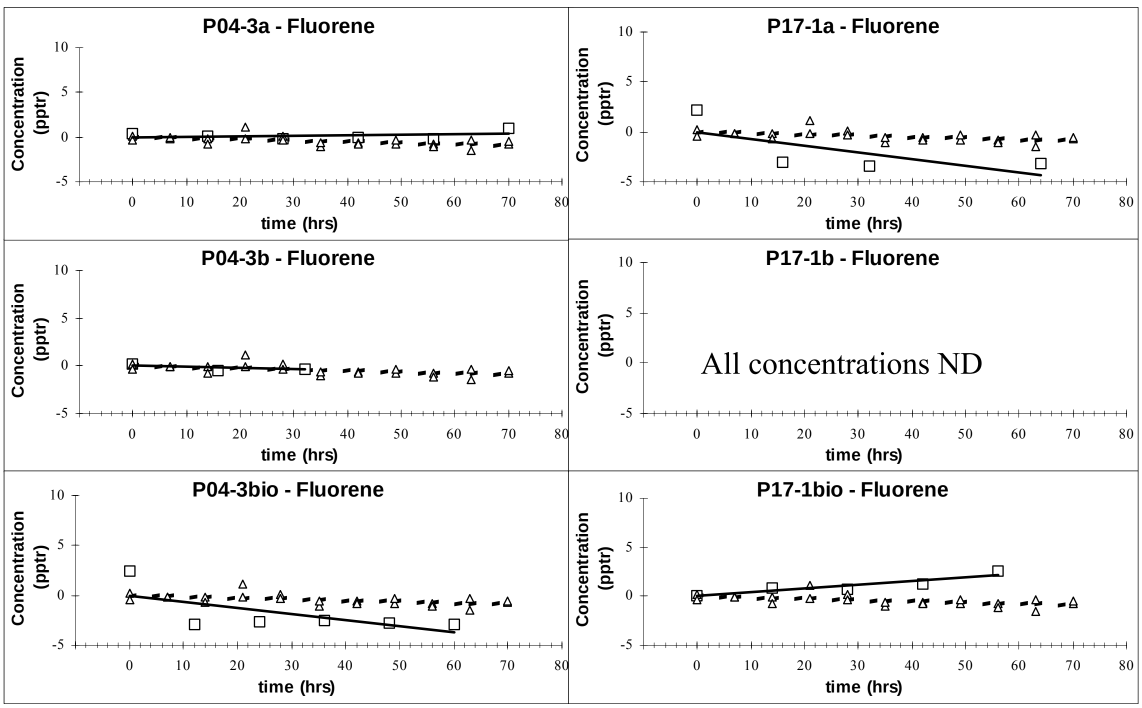


Figure 5-41. Time-series plots for Fluorene in the BFSD chambers. Squares indicate concentrations for station samples, and triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Phenanthrene

Phenanthrene fluxes were positive at five of the six stations, the exception being P03-3b. Phenanthrene flux rates ranged from a low of -132 ng/m^2/day (P04-3b) to a high of 121 ng/m^2/day (P17-3bio). Fluxes at three stations (P04-3b, P17-1b and P17-1bio) were statistically distinguishable from blanks at $p<0.20$. Time-series plots for Phenanthrene concentrations in the flux chambers at the six stations are shown in Figure 5-42. The mean flux from the three deployments at P04 was -11±53 ng/m^2/day, primarily as a result of the relatively large negative flux at P04-3b. The mean flux from the three deployments at P17 was 51±61 ng/m^2/day. Thus the pattern for Phenanthrene was fairly similar between the two areas, with the negative flux at P04-3b leading to a negative mean for P04, and the positive flux at P17-1bio leading to a positive mean at P17. Variability at within the two sites was similar.

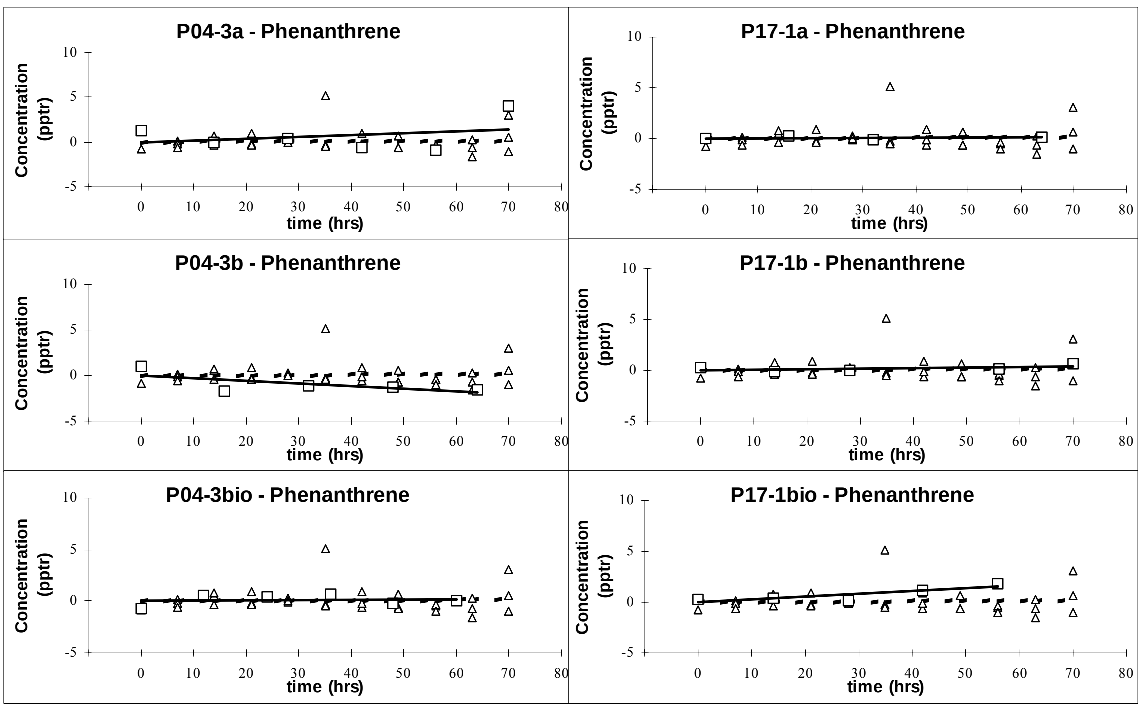


Figure 5-42. Time-series plots for Phenanthrene in the BFSD chambers. Squares indicate concentrations for station samples, and triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Anthracene

Anthracene fluxes were positive at all six stations. Anthracene flux rates ranged from a low of 74 $ng/m^2/day$ (P17-1bio) to a high of 613 $ng/m^2/day$ (P04-3bio). Fluxes at four of the six stations were distinguishable from blanks at $p<0.20$, with the exceptions being P17-1b and P17-1bio. Time-series plots for Anthracene concentrations in the flux chambers at the six stations are shown in Figure 5-43. The mean flux from the three deployments at P04 was 431±198 $ng/m^2/day$. The mean flux from the three deployments at P17 was 250±153 $ng/m^2/day$. Thus the pattern for Anthracene was similar at both P04 and P17 with somewhat higher mean flux at P04. Variability within the two sites was comparable, although individual flux measurements were generally tighter at P04.

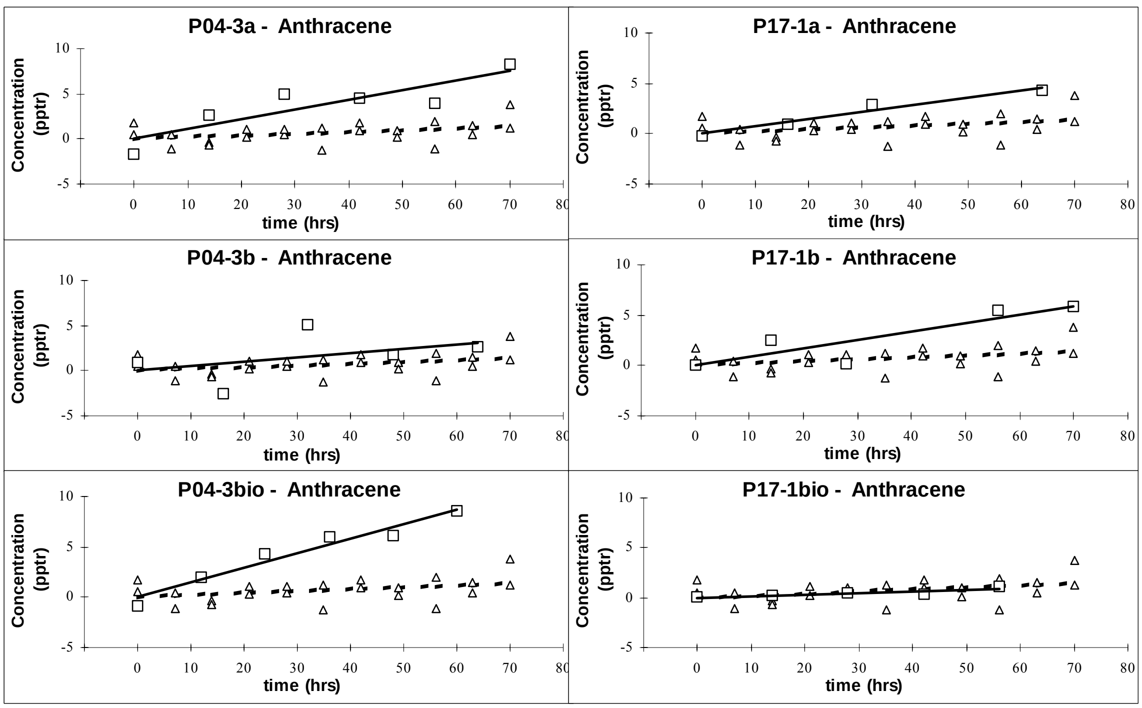


Figure 5-43. Time-series plots for Anthracene in the BFSD chambers. Squares indicate concentrations for station samples, and triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Fluoranthene

Fluoranthene fluxes were positive at five of the six stations, with a negative flux only at P17-1a. Fluoranthene flux rates ranged from a low of –149 ng/m^2/day (P17-1a) to a high of 1267 ng/m^2/day (P17-1bio). Note that the fluxes for Naphthalene were corrected for a negative blank flux by subtracting the blank regression from the station regression. Four of six fluxes were distinguishable from blanks at $p<0.20$, exceptions being at P04-1a and P17-1a. Time-series plots for Fluoranthene concentrations in the flux chambers at the six stations are shown in Figure 5-44. The mean flux from the three deployments at P04 was 513±385 ng/m^2/day. The mean flux from the three deployments at P17 was 721±761 ng/m^2/day. Thus the results for the two sites indicate both higher mean flux and higher variability at P17 compared to P04, although both sites revealed consistent positive flux rates.

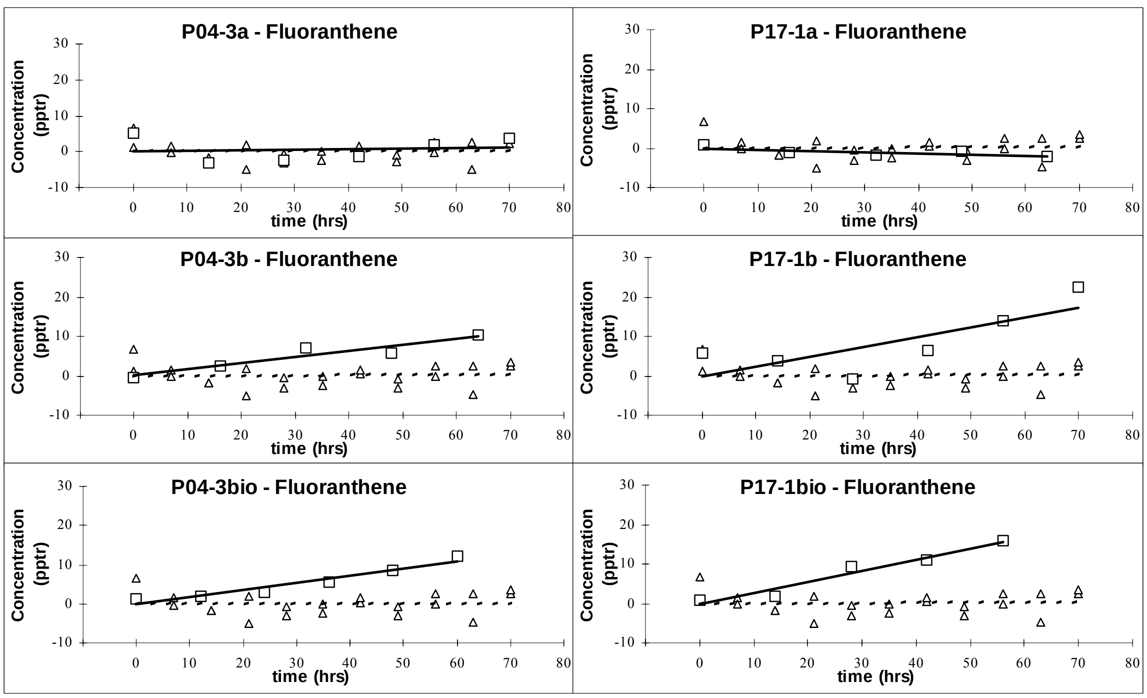


Figure 5-44. Time-series plots for Fluoranthene in the BFSD chambers. Squares indicate concentrations for station samples, and triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Pyrene

Pyrene fluxes were positive at all six stations. Pyrene flux rates ranged from a low of 127 ng/m^2/day (P17-1a) to a high of 1323 ng/m^2/day (P17-1b). Note that the fluxes for Naphthalene were corrected for a negative blank flux by subtracting the blank regression from the station regression. All fluxes were distinguishable from blanks at $p<0.20$. Time-series plots for Pyrene concentrations in the flux chambers at the six stations are shown in Figure 5-45. The mean flux from the three deployments at P04 was 190±9 μg/m^2/day. The mean flux from the three deployments at P17 was 668±606 ng/m^2/day. Thus the Pyrene flux and variability at P17 was somewhat higher than at P04, although both stations showed consistently positive flux rates.

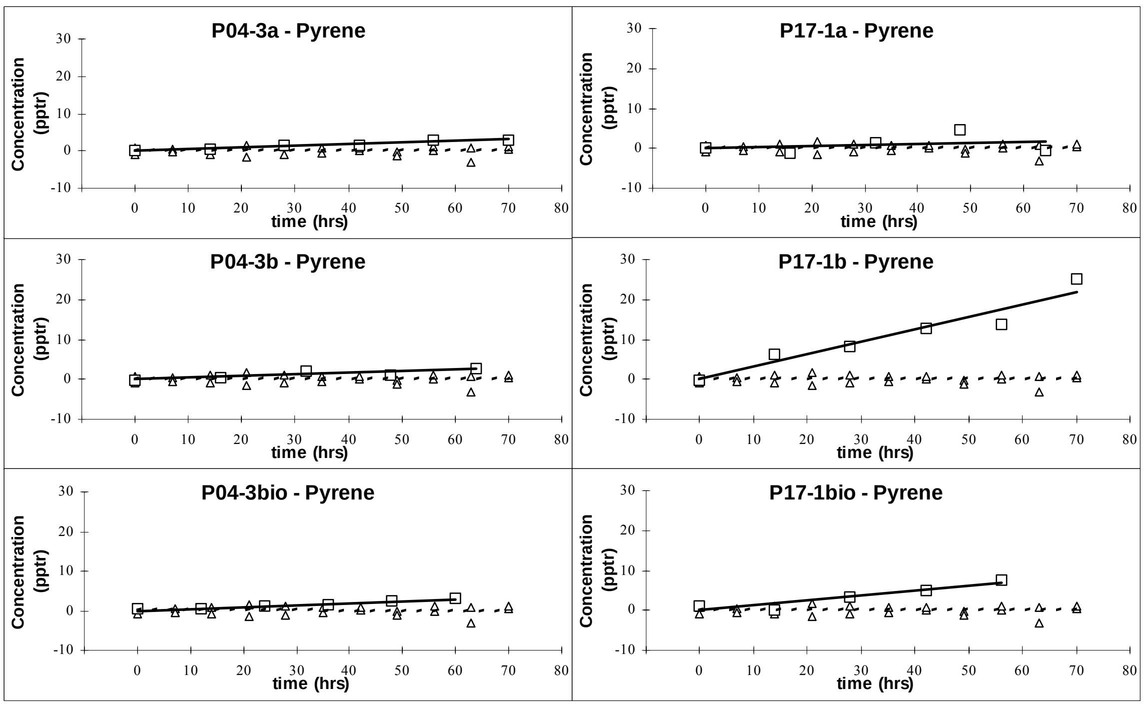


Figure 5-45. Time-series plots for Pyrene in the BFSD chambers. Squares indicate concentrations for station samples, and triangles indicate blank chamber concentrations. Best-fit linear-regression lines are also shown.

Table 5-15. BFSD results from site P04-3a. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate.

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux Rate Confidence (%)
1. Naphthalene	232	474	37.2%
2. Acenaphthene	na	na	na
3. Acenaphthylene	-0.96	33	84.0%
4. Fluorene	21	99	98.5%
5. Phenanthrene	83	392	70.8%
6. Anthracene	458	359	100.0%
7. Fluoranthene	70	778	29.0%
8. Pyrene	185	57	99.2%

Table 5-16. BFSD results from site P04-3b. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate.

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux Rate Confidence (%)
1. Naphthalene	954	363	45.9%
2. Acenaphthene	na	na	na
3. Acenaphthylene	-8.7	24	75.1%
4. Fluorene	-60	708	4.0%
5. Phenanthrene	-132	270	92.7%
6. Anthracene	221	811	80.1%
7. Fluoranthene	703	454	100.0%
8. Pyrene	185	188	99.2%

Table 5-17. BFSD results from site P04-3bio. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate.

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux Rate Confidence (%)
1. Naphthalene	673	493	2.1%
2. Acenaphthene	29	66	72.4%
3. Acenaphthylene	29	92	70.1%
4. Fluorene	-263	422	99.9%
5. Phenanthrene	15	133	9.0%
6. Anthracene	613	197	100.0%
7. Fluoranthene	768	295	99.8%
8. Pyrene	200	65	95.8%

Table 5-18. BFSD results from site P017-3a. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate.

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux Rate Confidence (%)
1. Naphthalene	878	1483	85.9%
2. Acenaphthene	na	na	na
3. Acenaphthylene	-63	50	87.0%
4. Fluorene	-303	986	99.8%
5. Phenanthrene	8	95	0.3%
6. Anthracene	321	214	99.1%
7. Fluoranthene	-149	252	6.8%
8. Pyrene	127	747	88.9%

Table 5-19. BFSD results from site P017-3b. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate.

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux Rate Confidence (%)
1. Naphthalene	108	575	17.9%
2. Acenaphthene	na	na	40.9%
3. Acenaphthylene	9	76	78.1%
4. Fluorene	na	na	90.3%
5. Phenanthrene	23	56	19.0%
6. Anthracene	355	363	99.9%
7. Fluoranthene	1044	1163	100.0%
8. Pyrene	1323	535	100.0%

Table 5-20. BFSD results from site P017-3b. Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate.

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux Rate Confidence (%)
1. Naphthalene	14	583	1.9%
2. Acenaphthene	636	252	100.0%
3. Acenaphthylene	-3.0	42	76.1%
4. Fluorene	177	145	100.0%
5. Phenanthrene	121	148	82.7%
6. Anthracene	74	83	14.3%
7. Fluoranthene	1267	527	100.0%
8. Pyrene	554	373	100.0%

Table 5-21. Summary of BFSD results for PAHs from site P04. Shaded cells indicate flux rates that were statistically distinguishable from blanks at p<0.20.

	P04-3A	P04-3B	P04-3Bio	Min	Max	Mean	Std
Naphthalene	232	954	673	232	954	620	364
Acenaphthene	ND	ND	29	29	29	29	NA
Acenaphthylene	-1	-9	29	-9	29	6	20
Fluorene	21	-60	-263	-263	21	-101	146
Phenanthrene	83	-132	15	-132	83	-11	110
Anthracene	458	221	613	221	613	431	198
Fluoranthene	70	703	768	70	768	513	385
Pyrene	185	185	200	185	200	190	9

Table 5-22. Summary of BFSD results for PAHs from site P17. Shaded cells indicate flux rates that were statistically distinguishable from blanks at p<0.20.

	P17-1A	P17-1B	P17-1Bio	Min	Max	Mean	Std
Naphthalene	878	108	14	14	878	333	474
Acenaphthene	ND	ND	636	636	636	636	NA
Acenaphthylene	-63	9	-3	-63	9	-19	38
Fluorene	-303	ND	177	-303	177	-63	339
Phenanthrene	8	23	121	8	121	51	61
Anthracene	321	355	74	74	355	250	153
Fluoranthene	-149	1044	1267	-149	1267	721	761
Pyrene	127	1323	554	127	1323	668	606

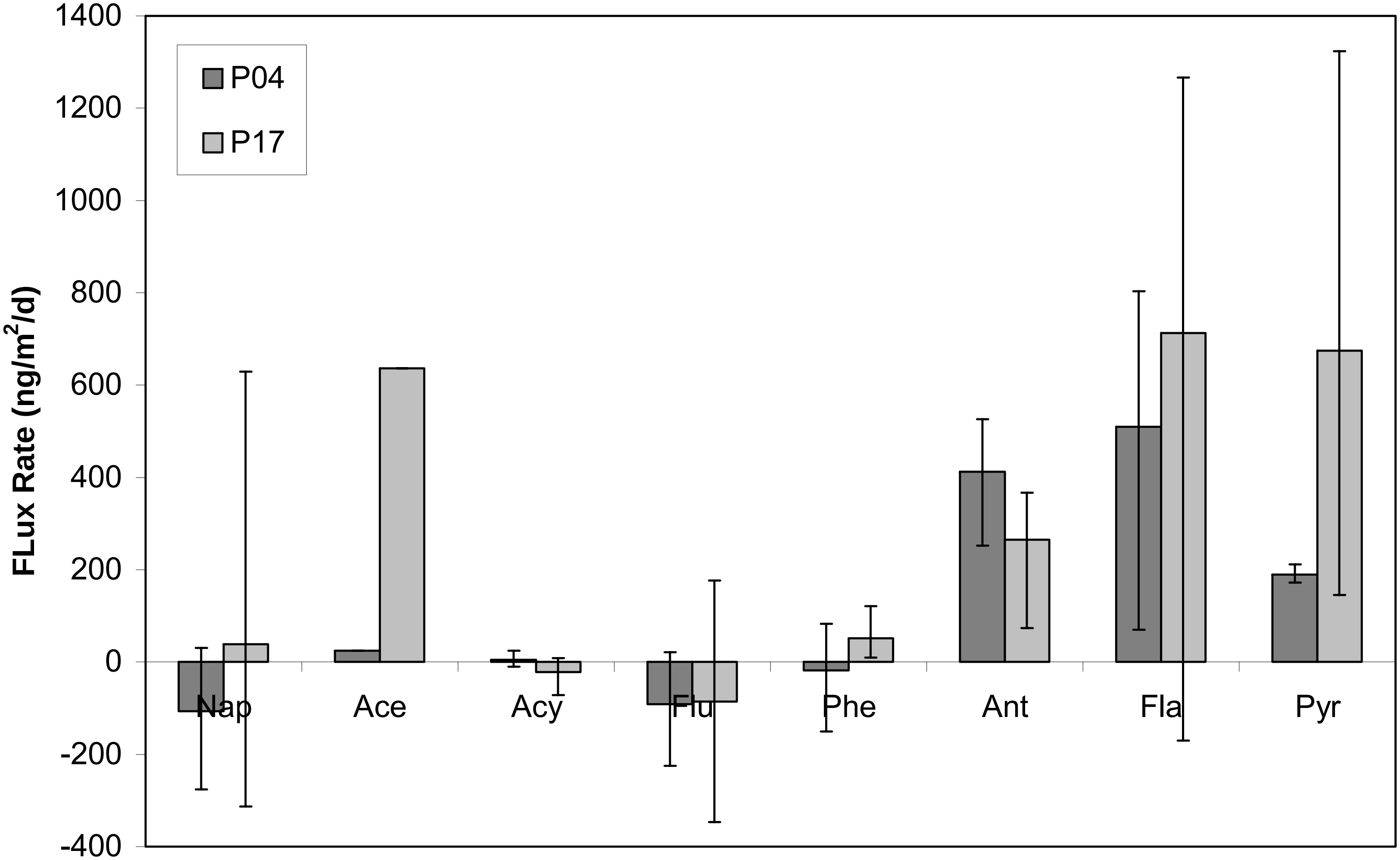


Figure 5-46. Summary plot for mean flux rates of PAHs at P04 and P17. Error bars are standard deviations based on the variability of the three deployments within each area.

Discussion

System performance

In general, the flux deployments were successful in providing quantitative data for assessment of diffusive fluxes. For metals, flux rates were obtained at all six sites for all metals of interest. For PAHs, the heavier molecular weight components were generally below detection limits, but flux rates were successfully quantified for a range of light to moderate molecular weight PAHs in both areas. The three station deployments within each area provided data for the assessment of localized variability. Quantification of this variability is critical in establishing bounds on the relative importance of diffusive mobility to the general contaminant fate balance in surface sediments.

Variability

Variability in metal and PAH fluxes was quantified on three distinct scales in this study including variability in individual measurements, variability within a site (scale 2-10 m), and variability between sites (scale 1 km). Variability within an individual flux measurement is quantified based on the variance of the slope of the concentration with time. The variability in the slope may arise from a number of factors including actual non-linearity of the measured process, sample contamination, and analytical variability. For the BFSD, assessment of this variability is evaluated based on comparison to blank chamber runs (runs with a Teflon panel in place of sediment). Based on a statistical comparison of the deployment data versus the blank, an assessment is made as to whether the flux is "detectable". This simply means that a flux was detected by the instrument that can be distinguished from a flux when no sediment is present. This does not necessarily imply that the flux is significant from a transport or ecological perspective. By the same token, failure to detect a flux that is distinguished from the blank does not necessarily mean that the flux is insignificant, rather that with the BFSD technology, we are simply not able to determine a flux rate that is quantifiable in comparison to the blank. This is parallel to, for example, the measurement of a water concentration. If the concentration is detectable, we can quantify the value, but this does not infer that it exceeds an effects threshold. Similarly if we cannot detect it, but the effects threshold is below our detection limit, we cannot rule out a potential effect. For this reason, it is important to know whether fluxes were detectable when interpreting the data here, but we continue to use the entire data set for the general analysis so that perspective can be gained on the relative importance of fluxes within the context of PRISM.

In general, we found that fluxes for the listed metal and PAH constituents were detectable in the majority of the deployments. The primary exceptions included Pb and Ni for the metals, and Naphthalene, Acenaphthene, and Acenphthylene for the PAHs.

Within site variability was evaluated on the basis of three deployments at stations separated by a few meters. In general, these results indicate a fairly high degree of variability. This is expected to some degree because of the heterogeneous nature of the sediments and the geochemical and biological processes that regulate fluxes. While the variability is not surprising, it is critical that it be quantified within the context of PRISM. Since the flux rates will be used to compare the relative importance of various processes within a general transport balance, quantification of within site variability will allow the range of possible outcomes to be explored.

Variability across the two sites (P04 and P17) was evaluated on the basis that these two areas could have different transport processes that might be active or dominant. Thus comparison across sites provides insight into how well our tools can distinguish differences as we move from one environment to another.

Metal fluxes

Metal flux results can be used to evaluate the general mobility of site CoCs, the relative differences among metals, the differences within a site, and the differences between the two sites. The fluxes can also be evaluated in the context of other supporting data such as oxygen and pH that may provide insight into the redox conditions at the sites.

In general, contaminant metals displayed a range of fluxes. Lowest flux rates were generally observed for Ag, Cd, and Pb. Moderate fluxes were observed for As, Cu, and Ni, and highest fluxes were consistently found for Zn. This pattern is consistent with previous BFSD results from a number of harbors that also found lowest (based on means) flux rates for Ag, Cd, and Pb and highest fluxes for Zn (see Table 5-23 and Figure 5-47). The range of flux rates measured in this study is also consistent with the larger historical data set. For example, the flux of As at P04 and P17 averaged 33 and 45 $\mu g/m^2/day$ respectively compared to the historical mean of 21 $\mu g/m^2/day$. Site average flux rates for Zn of 724 and 2165 $\mu g/m^2/day$ at P04 and P17 bracket the historical mean value of 1577 $\mu g/m^2/day$. This same comparability holds for the metals in general, suggesting that the measurements obtained by this program should provide rates that are consistent with general trends observed across a number of harbors.

Table 5-23. Statistical summary of historical flux rate measurements using the BFSD in San Diego Bay, San Francisco Bay, Pearl Harbor and Puget Sound.

	As	Ag	Cd	Cu	Ni	Pb	Zn
Average	20.6	0.36	19.3	52.5	54.3	4.68	1577
St. Dev.	40.3	8.14	31.6	111	41.3	16.5	3169
Min.	-20.9	-21.0	-3.0	-107	-3.55	-22.0	-37.3
Max.	98	14.7	125	304	141	39.2	14861
Count	18	17	27	26	26	24	26

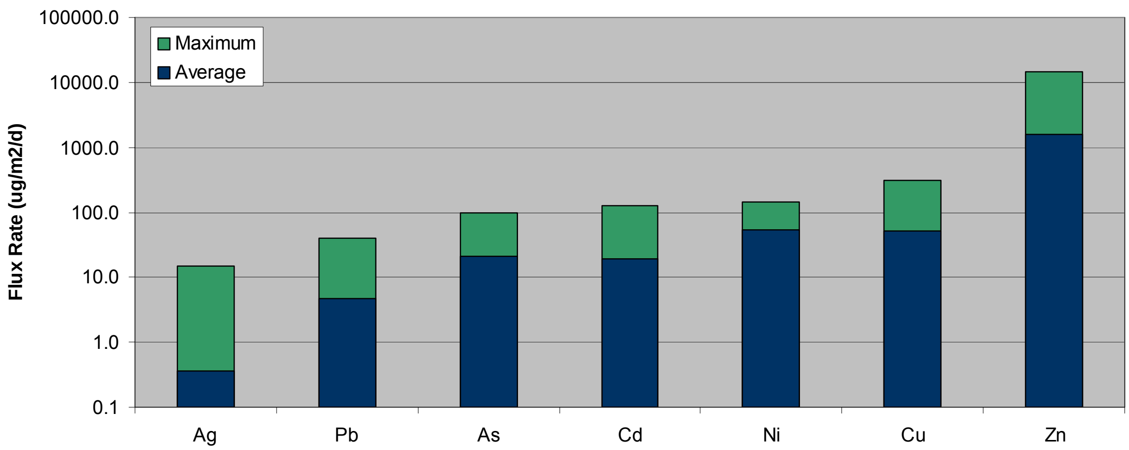


Figure 5-47. Graphical representation of the historical flux rate measurements using the BFSD in San Diego Bay, San Francisco Bay, Pearl Harbor and Puget Sound.

Comparison of metal fluxes between the P04 and P17 areas also showed distinctive patterns. In general, site mean metal fluxes were higher at P17 compared to P04 (see Figure 5-47). This was the case for As, Cu, Cd, and Zn. Contaminant metals that had higher mean fluxes at P04 included Ni and Pb. Site mean fluxes for Ag were comparable at the two sites. Direct comparison of the two areas indicates statistical differences for Cu ($p<0.06$), Pb ($p<0.20$), and Zn ($p<0.12$).

PAH fluxes

PAH flux results can be used to evaluate the general mobility of site CoCs, the relative differences among PAHs, the differences within a site, and the differences between the two sites. In general, PAHs displayed a range of fluxes. Lowest flux rates were generally observed for Naphthalene, Acenaphthene, Fluorene, and Phenanthrene. Highest fluxes were observed for Anthracene, Fluoranthene, and Pyrene. Flux rates for Acenaphthylene were often below detection, but showed strong fluxes in one deployment.

Historical data for PAH fluxes is limited. The results can be compared to results from the CALEPA Certification demonstration that was performed at a nearby station in Paleta Creek (Figure 5-48). From this comparison we find that the patterns of fluxes between this earlier study and the current one are similar in terms of which PAHs had fluxes and their relative magnitudes within each study, but the magnitude of the flux rates was generally higher during the CALEPA demonstration. Of course this was based on only a single deployment, at a somewhat different location, so some differences are expected. There is also some evidence that PAH levels in Paleta Creek have been decreasing due to source control efforts. At any rate, the consistency in the pattern of fluxes is encouraging from the standpoint that it suggests a process oriented control.

Comparison of PAH fluxes between the P04 and P17 areas also showed some distinctive patterns. In general, site mean metal fluxes were higher at P17 compared to P04 (see Figure 5-46). This was the case for Naphthalene, Acenaphthylene, Phenanthrene, Fluoranthene, and Pyrene. Only Anthracene had a higher mean fluxes at P04. Site mean fluxes for Fluorene were negative at both sites. Direct comparison of the two areas indicates statistical differences for Acenaphthylene ($p<0.19$), Anthracene ($p<0.14$), and Pyrene ($p<0.15$).

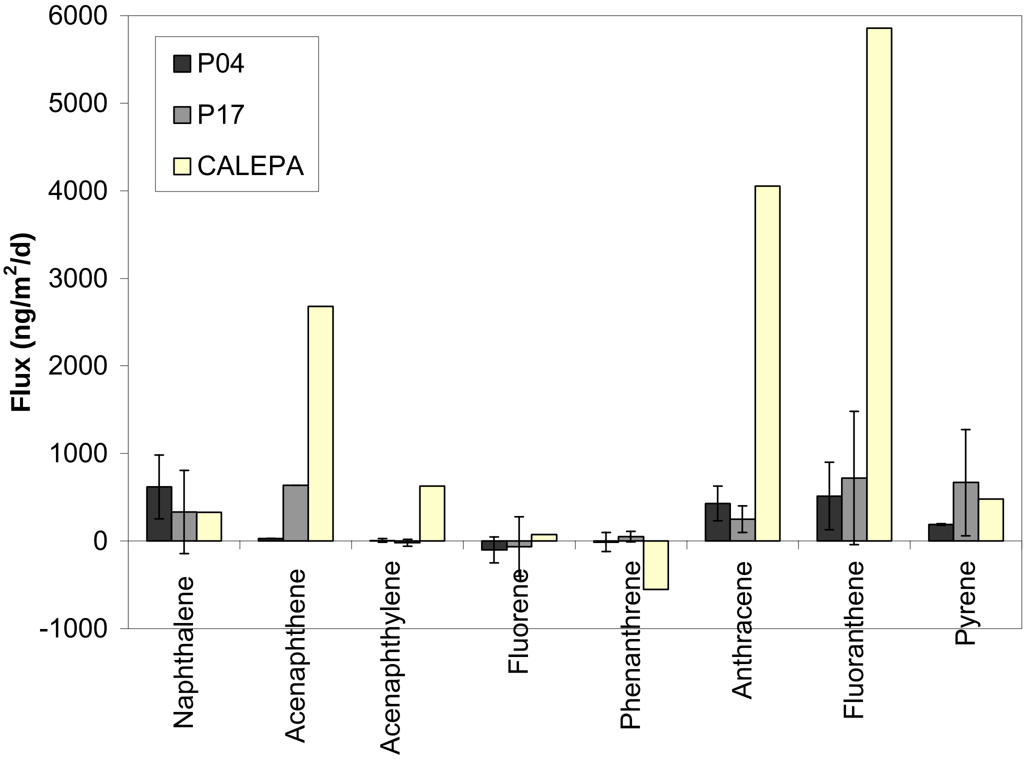


Figure 5-48. Comparison of P04 and P17 PAH flux rates with the single deployment for CALEPA Certification conducted in Paleta Creek.

Application to PRISM

Application of the flux results to the general transport balance in PRISM is relatively straight-forward. This is because the BFSD provides direct measurement of surface fluxes that are a specific component of the PRISM indices. Thus integration of the flux results requires application of site mean fluxes to the general balance equation. In addition, evaluation of variability must be incorporated based on the replicate measurements, and the results must be interpreted within the context of quantification of individual flux rates in comparison to blanks.

Another important consideration for application of the flux results is in relation to time-scales. The flux rates are generally determined over a period of about three days. This time frame was developed to provide a good level of detection, balanced against too long of a deployment that might result in significant alterations of the chamber environment. Thus the flux chamber results are, in general, most applicable for time scales of days to weeks. This means that the results are best interpreted as providing insight into the balance as it currently stands. However, evaluations of rate balances, as is required for PRISM, may require extrapolation of this data to longer time scales. These extrapolations must be done with care since changing conditions in redox, concentration gradients, and overlying water may alter fluxes. However, some context for this extrapolation is provided by comparison of these rates to rate measurements at a number of other harbor sites (e.g. Figure 5-47). These results suggest that the magnitude of these rates is not likely to change too substantially, and if the flux currently constitutes a significant pathway, it probably will continue to do so for some time into the future.

Finally, it should be pointed out that our initial attempt to quantify bioinhibited flux rates was largely unsuccessful. Two factors played into this failure, the primary issue being the inability to drive the oxygen levels completely to zero over the deployment time. The second factor was that in several cases, it appeared that silica fluxes were large enough to quench flux rates, probably as a result of a decrease in the gradient between the porewater and the chamber water as silica accumulated in the chamber. This outcome confounds the bioinhibited results because it causes the same type of response, but for a different reason. Both of these problems can be attributed to some degree to the time of year the deployments were made. While historically, field deployments have generally been conducted during warmer water periods in the spring, fall and summer, these deployments were conducted in mid winter. Cold water conditions during this period have two effects. The first is to reduce microbial activity, which in turn reduces oxygen uptake by the sediments. The second effect is that cold water enhances the dissolution of silica, thus leading to higher silica fluxes. Future efforts to assess bioinhibited flux rates should attempt to account for these factors.

Summary

Flux rates were successfully quantified at three stations each within two sites at Paleta Creek, Naval Station San Diego. Fluxes were measured for a number of metal and PAH constituents. Mean fluxes and the variability of these fluxes were estimated based on the replicate deployments at each site. Patterns of metal fluxes were similar to historical deployments, with lowest fluxes generally for Ag, Cd, and Pb, moderate fluxes for Cu, Ni and As, and highest fluxes for Zn. For PAHs, highest fluxes were generally observed for Anthracene, Flouranthene, and Pyrene. However PAH fluxes during this study were somewhat lower than previously observed at one station in Paleta Creek. Fluxes were distinguishable from blanks for the majority of deployments and constituents. Highest fluxes for both metals and PAHs were generally detected at P17 versus P04. Fluxes for several metals and PAHs were distinguishable between sites.

5.3 PRISM SITE I – PALETA CREEK; IN-SITU QUANTIFICATION OF POREWATER ADVECTION RATES USING ULTRASONIC SEEPAGE METERS

Introduction

As part of the Pathway Ranking for In-place Sediment Management (PRISM) project, the Marine Program of Cornell Cooperative Extension (CCE) has assisted in the development, testing and field deployment of systems for sediment porewater and associated contaminant advection potential. In a coordinated effort with other scientists, Cornell utilized their ultrasonic groundwater seepage meter (Paulsen et al., 2001) to quantify submarine groundwater discharge (SGD) into San Diego Bay as a means of determining the relative importance of this process for contaminant transport in coastal environments.

The specific objectives of this project were to: (1) review existing site data reports to support the design of appropriate field demonstrations; and (2) deploy instrumentation, and collect and analyze samples at the first demonstration site. Deployments and sampling will include the preparation of instruments and sampling equipment, the physical installation of the instruments and collection of the samples, and the retrieval of the instruments described above. Data acquired from San Diego Harbor (Paleta Creek) at sites P04 and P17 were analyzed and results where forwarded to Dr. Chadwick and the project team for review.

Methods

Conductivity Probes

To identify potential areas where groundwater is entering the surface water, we employed a simple direct-push system equipped with a conductivity probes. Contrast in conductivity between surface water and groundwater were used to determine likely areas of groundwater impingement.

The conductivity sensor utilizes a standard GeoProbe Wenner-type resistance cell. The probe is configured with two pairs of stainless steel electrodes, the outer pair through which a known current is imposed, and the inner pair through which the voltage is monitored. Both pairs of electrodes are coupled through an underwater connecter and cable to a standard, Geoprobe model FC4000 deck unit which controls the outer electrode pair current, monitors the inner electrode pair voltage, and records the corresponding raw conductivity signal to a computer. The conductivity signal varies primarily as a function of changes in salinity, and secondarily as a function of clay content and porosity. Areas of likely groundwater seepage are generally associated with low conductivity, either as a result of low salinity, low clay content (high permeability), or both.

Seepage Meters
Specific discharge measurements for the Paleta Creek sites were collected using the time transient ultrasonic groundwater seepage meter introduced by Paulsen et al (2001). The seepage meter uses two piezoelectric transducers to continuously measure the travel times of ultrasonic waves. As water enters the flow tube, it passes through the ultrasonic beam path (Fig. 1). The ultrasonic signal that travels with the flow will have a shorter travel time than the signal traveling against flow. The perturbation of travel time is directly proportional to the velocity of flow in the tube.

To collect groundwater seepage across the sediment water interface, an angled funnel with a square cross section of 0.209 m2 is inserted into the sediment using a 5-lb rubber mallet when necessary. As with the Lee (1977) method, the funnel is equipped with a nozzle that allows water to escape. Attached to the nozzle of the funnel is 44-cm of tygon tubing (1.8 cm I.D.) that leads to the flow tube. The angle of the collection funnel was chosen such that the end of the funnel with the outflow tubing is slightly higher than the back end, thus allowing air to escape. The flow tube is connected to a data logger that records both incremental and cumulative discharge simultaneously (Fig. 2). The data logger is capable of recording in time increments ranging from 1 second to 24 hours. The data logger is also able to detect reversals of flow such as a negative groundwater flux in which the overlying surface water is recharging the seepage zone. For field deployment in Eagle Harbor, the data logger and a back-up battery were housed in a buoy that was anchored to the harbor bottom. The battery life of the logger itself is approximately 5 hours, while the back-up battery (marine / car battery) has a life span of approximately 120 hours.

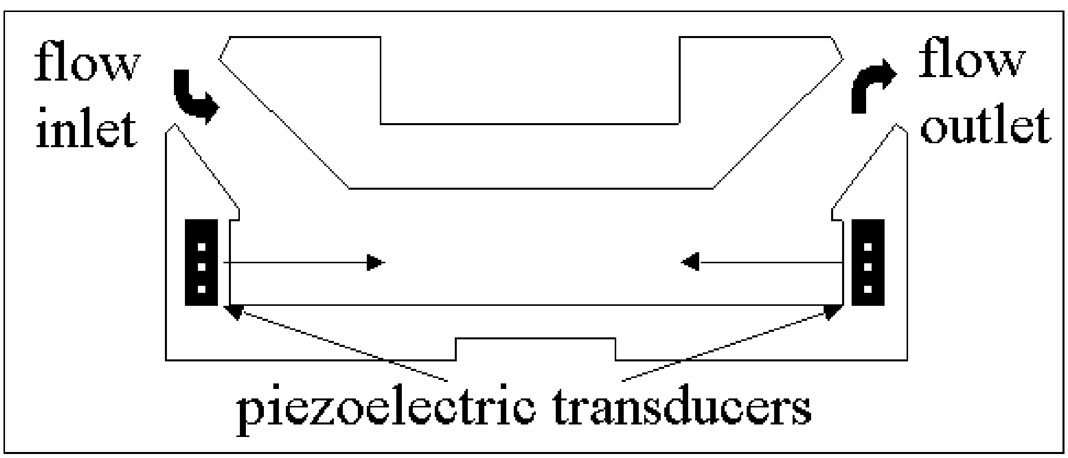


Figure 5-49. Cross section of the ultrasonic seepage meter flow tube showing the difference in signal arrival times with flow (from Paulsen et al, 2001).

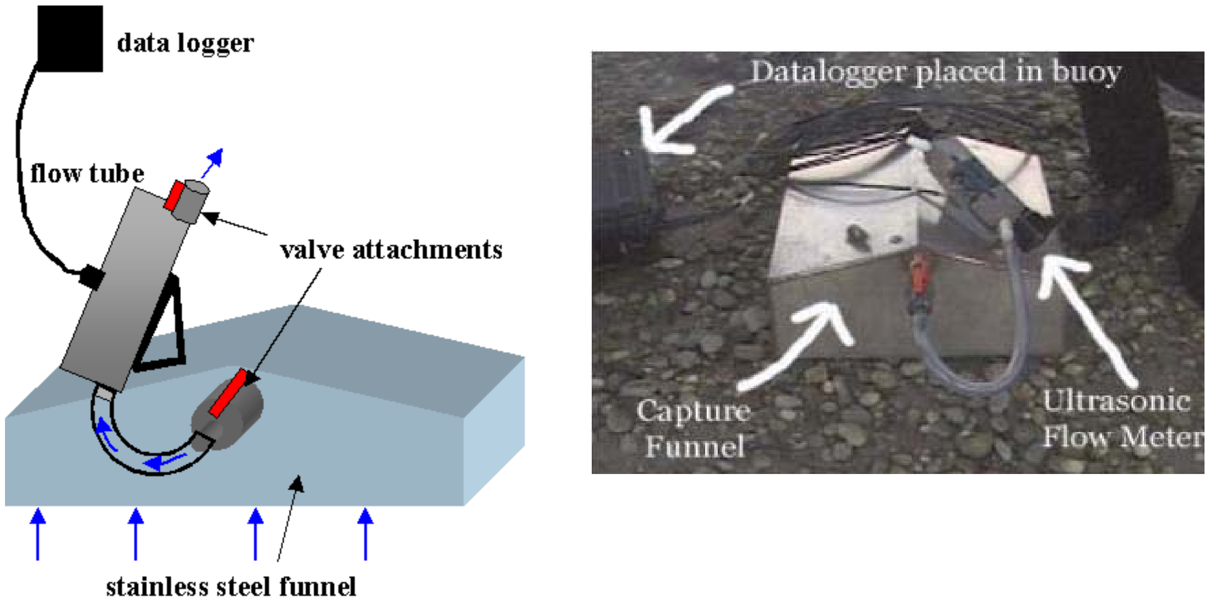


Figure 5-50. Schematic and photo of the ultrasonic seepage meter.

The ultrasonic seepage meter records specific discharge in cm^3/s. Therefore, to obtain the specific discharge through the capture area over the sediment-water interface:

$$q = \left(\frac{Q}{A_t}\right)\left(\frac{A_t}{A_f}\right) = \frac{Q}{A_f} \qquad (1)$$

where q = specific discharge (cm/s)
Q = discharge (cm^3/s);
A_t = area of flow tube (cm^2)
A_f = area of the funnel (cm^2).

An example data set of specific discharge into West Neck Bay, Shelter Island, NY using the ultrasonic seepage meter is shown in Figure 5-51. Shown on the figure is the inverse relationship between specific discharge and tidal stage. This relationship results from the cyclic head changes that overlie the seepage zone. As tide rises, the salt water hydraulic head is increasing, therefore limiting the vertical gradient between the seepage and the surface water. This leads to a decrease in the seepage flux across the sediment-water interface. As the tide is lowered, the vertical gradient begins to increase until low tide where maximum seepage flux occurs.

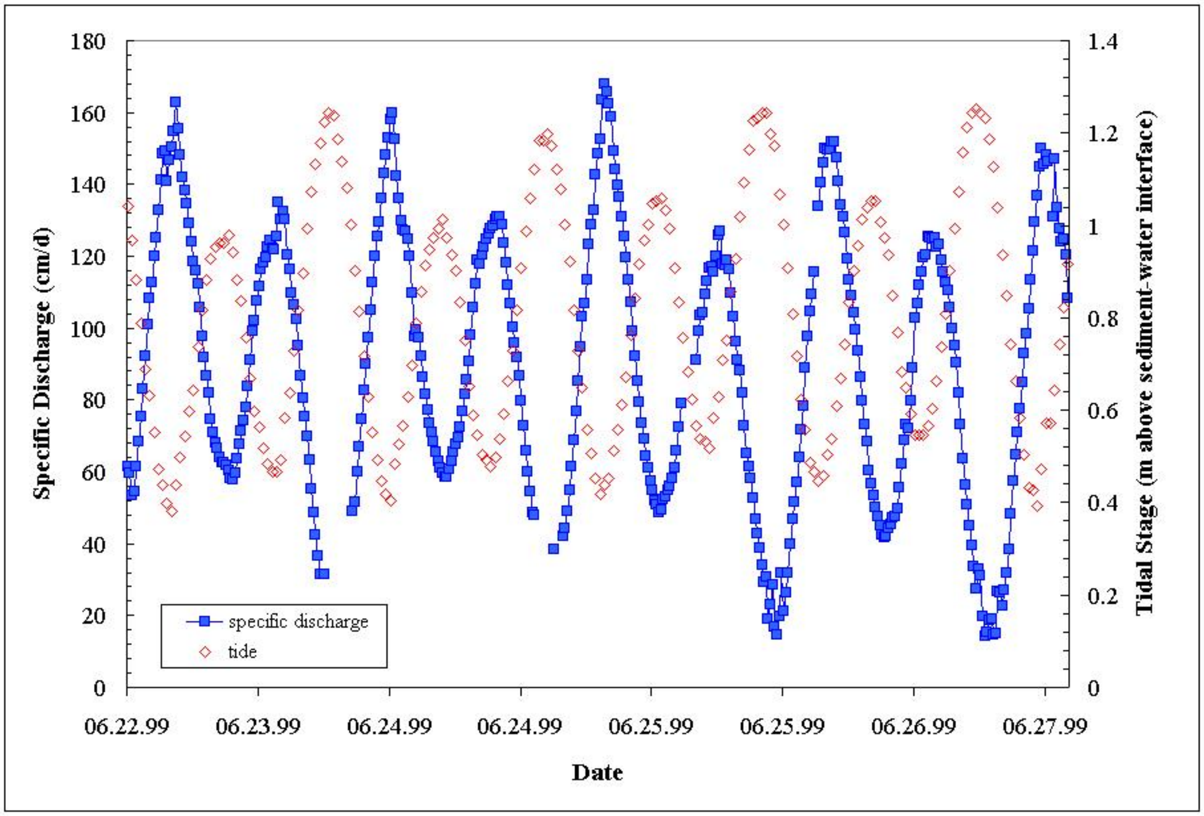


Figure 5-51. Example data set of specific discharge recorded using the ultrasonic seepage meter collected from West Neck Bay, Shelter Island, NY; sampling interval = 15 minutes.

Measurement Sites

Upland Monitoring Well

Head measurements were obtained at an existing upland monitoring well to evaluate the communication between the bay and the adjacent groundwater zone. The location of this well was chosen based on its close proximity to site P17. The location of this well is shown in Figure 5-52.

Conductivity

Conductivity profiling measurements were performed adjacent to each of the seepage meter deployment locations. At the P04 location, the probe was profiled from the sediment surface to a depth of about 2 ft at 0.5 ft increments. At the P17 station, the probe was profiled to a depth of about 2.5 ft at 0.5 ft increments. Locations of these individual conductivity pushes are shown in Figure 5-52.

In addition, a conductivity transect was performed in the area extending from near the mouth of Paleta Creek, toward site P17. The transect consisted of six profiles along a 100 ft distance with a spacing of about 20 ft. Each profile extended from the sediment surface to a depth of 2.5 ft at 0.5 ft increments. The location of this transect is also shown in Figure 5-52.

Seepage

Seepage meter deployment locations were chosen to correspond closely with the deployments of other PRISM instruments. At each site, two meters were deployed to help evaluate variability. At the P04 site, the meters were deployed approximately 5 m apart, adjacent to the locations of the BFSDs and sediment traps. At the P17 site, the meters were deployed about 15 m apart, with the one meter closer to the creek mouth, and one meter adjacent to the other instruments. Locations are shown in Figure 4.

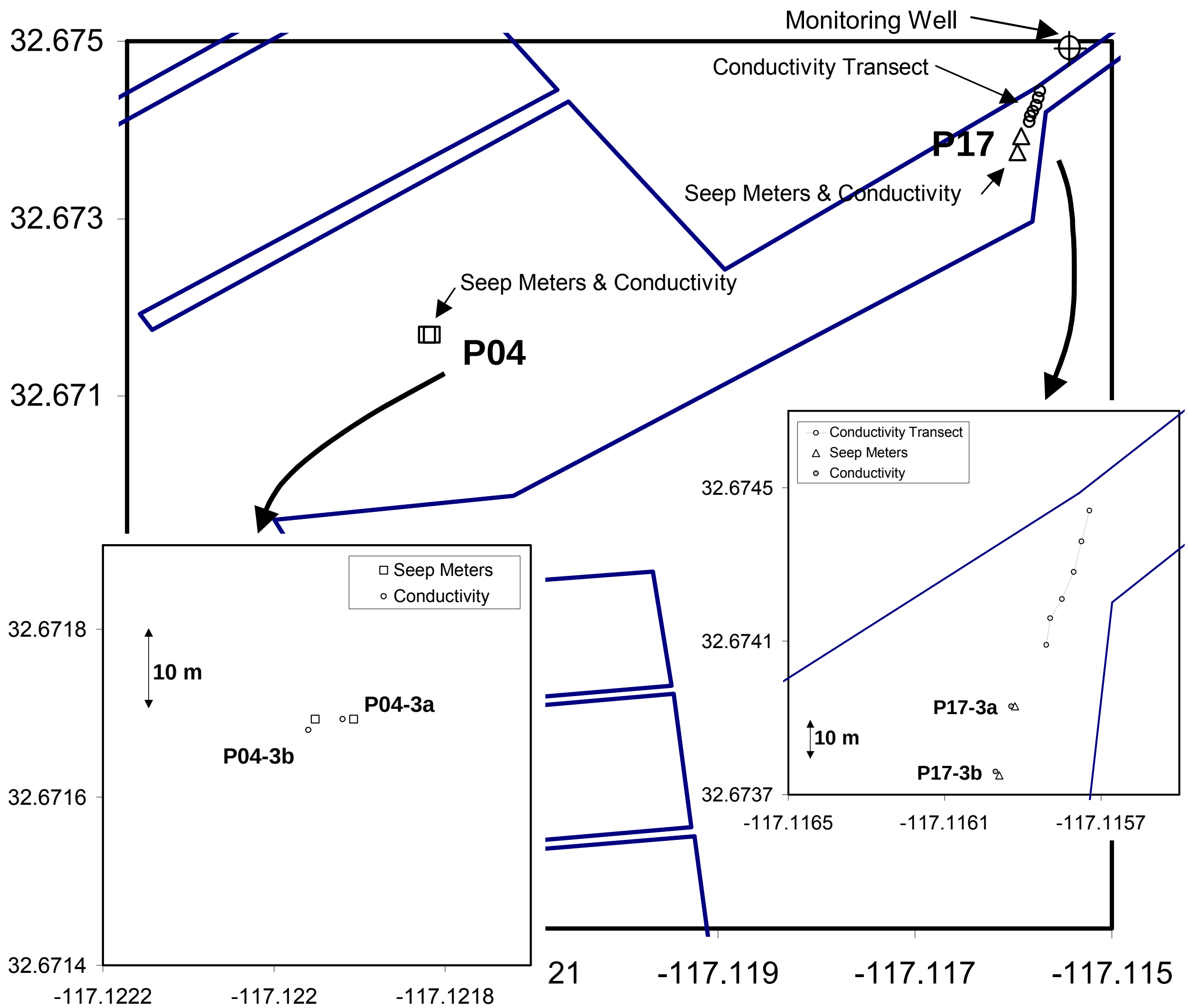


Figure 5-52. Map of the Paleta Creek are showing the location of monitoring well, conductivity, and seepage meter deployments.

Hydrogelogic features

Groundwater and sediment properties in the Paleta creek area were discussed with Peter Stang a senior geologist with Bechtel Consultants. Bechtel and has performed a geotechnical investigation in the deployment area. The San Diego formation contains a shallow and deep component (Figure 5-53).

The deeper component known as the San Diego formation and is located ~300 meters below sea level. Little is known about this formation in Paleta creek area. The off shore discharge area for this aquifer is unknown and assumed to be discharging further offshore or sparsely over a large area. Overlying the San Diego formation is an alluvial aquifer, know as the Bay Point formation. This formation does contain terrestrial groundwater and may influence advective flow offshore. It is composed of marine and non-marine poorly sorted, brown to gray sands, silty sands, and sandy clays. Additionally this formation can be very compact and nearly cemented. The area along the shoreline also contains a quay wall that acts as a barrier and will impede the off shore discharge of fresh water from the alluvial shallow aquifer.

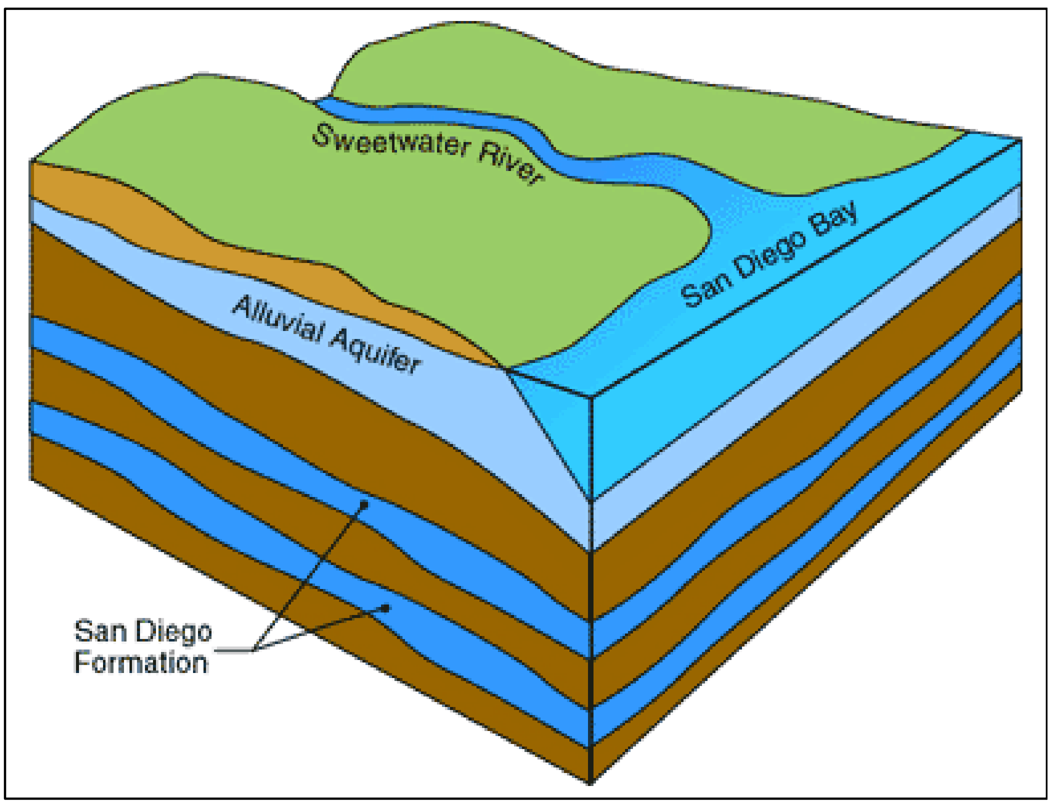


Figure 5-53. Schematic representation of the San Diego formation in the vicinity of the study site.

Figure 5-54 is a generalized cross section from a Navy pier near the study site. The cross-section reveals the Bay Point formation overlying are depositional deposits, 1-3 meters in thickness also present are clay lenses. These depositional deposits and the presence of the compact Bay Point formation were observed during the field deployments. The field observations are consistent with previous geotechnical reports. The salt/fresh water interface of the shallow aquifer was located about 30 to 40 ft below grade in the vicinity of the monitoring well near the creek (pers. comm. Peter Stang).

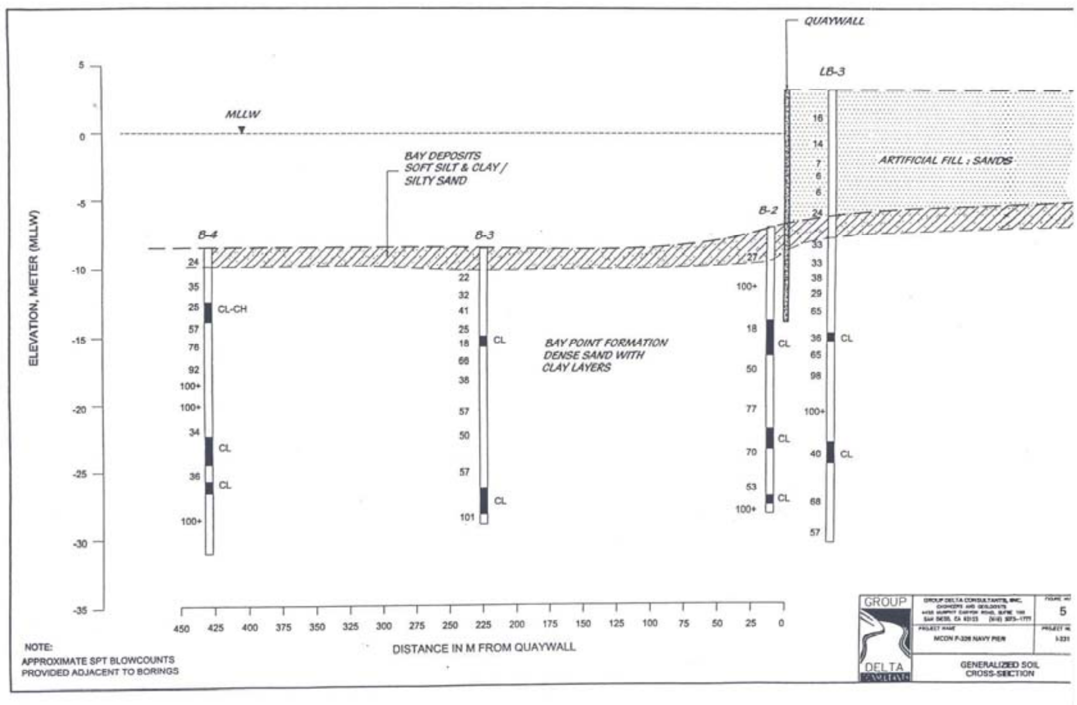


Figure 5-54. Bay bottom sediment cross-section based on borings (taken from Bechtel 1999).

Monitoring well results

A monitoring well was established approximately 100 meters landward from the edge of Paleta Creek to determine if the aquifer inland varied in association with variations in creek water levels. The figure below (Figure 5-55) is the graphical result of this deployment. It can be seen that the water level in the monitoring well changed in unison with changes in tidal state. The delay in response is largely due to the fine grain nature of the Bay Point formation and the associated low hydraulic conductivity. This result indicates that the landward aquifer is communicating with the surface waters in Paleta Creek and influencing the specific discharge rates offshore.

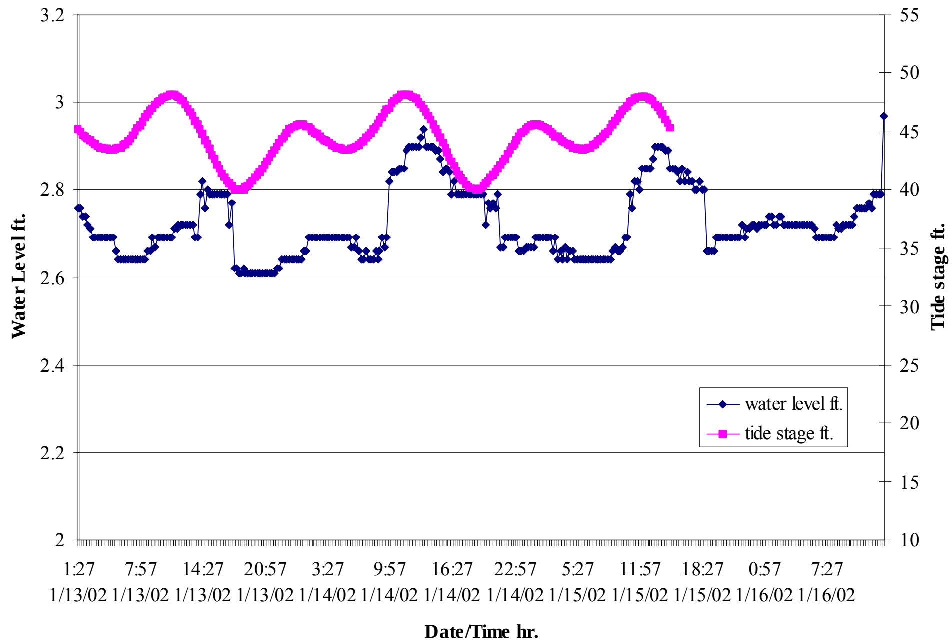


Figure 5-55. Time series variation in tide stage in San Diego Bay, and water level in the monitoring well adjacent to Paleta Creek.

Resistivity Profiles

Hydrogeological information gathered for the Paleta creek area verify the presence of a hard, and somewhat, compact formation known as the Bay Point formation as described previously in the hydrogeologic section. Their exists, however, the possibility that lower resistivity measurements may also be influenced by fresh terrestrial groundwater that has been diverted offshore due to the presence of clay lenses within the Bay Point formation or from leakage through/beneath the quay wall near site P17.

The profiles indicate that inland groundwater may be mixing with re-circulating seawater and discharging at the sediment water interface at both site P4 and P 17. Resistivity measurements at site P-4 (Figure 5-56) were taken near the TSM measurement station. The resistivity probe encountered resistance at 2-foot depth mark indicating the presence of the compact Bay Point formation. Lower resistivity values measured at the 2 to 2.5 interval are most likely the result of this compact formation. It should be noted that it is also possible that fresh groundwater is being diverted off shore by the clay stringers known to be present in the Bay point formation.

Resistivity measurements taken at P17 near the TSM measurement sites (Figure 5-57) do not indicate any major freshening of pore waters. No hard compact formation was encountered at site P17 while inserting the resistivity probe 2 ft. into the bottom sediments. Sediment resistivity were also measured along a 100ft transect, the transect started at the bulkhead (quay wall) and extended 100ft offshore (Figure 5-58). Results of the transect resistivity measurements indicated areas of lower conductance, this may be due to changes in sediment type (porosity) or possibly from the influence of fresh groundwater leaking through the quay wall and freshening pore waters off shore.

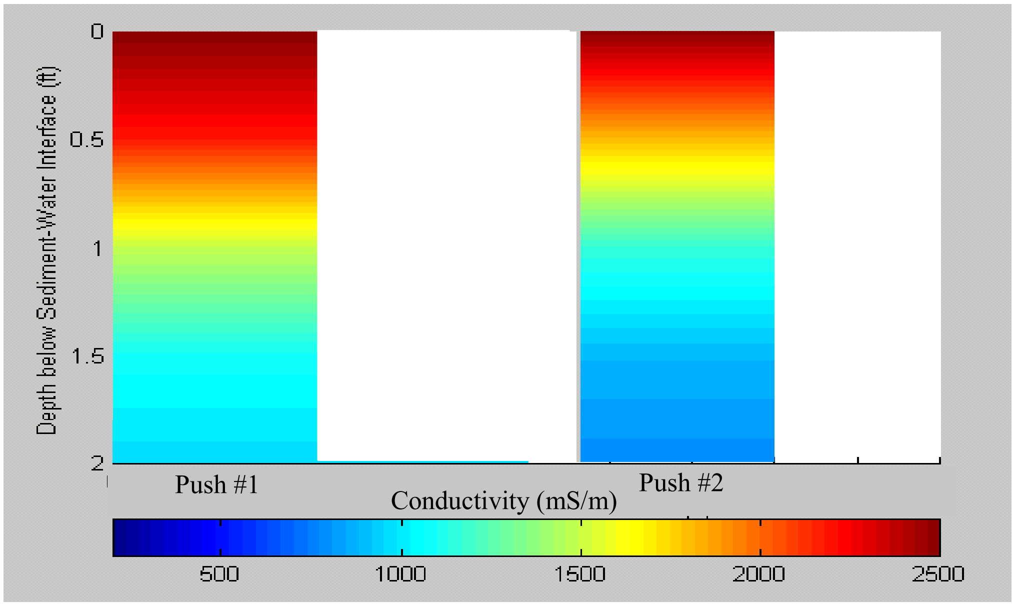


Figure 5-56. Replicate conductivity measurements at site P4. Note- Blue or light color indicates lower conductance zones or fresher water and red indicates higher conductance zones or saltier water.

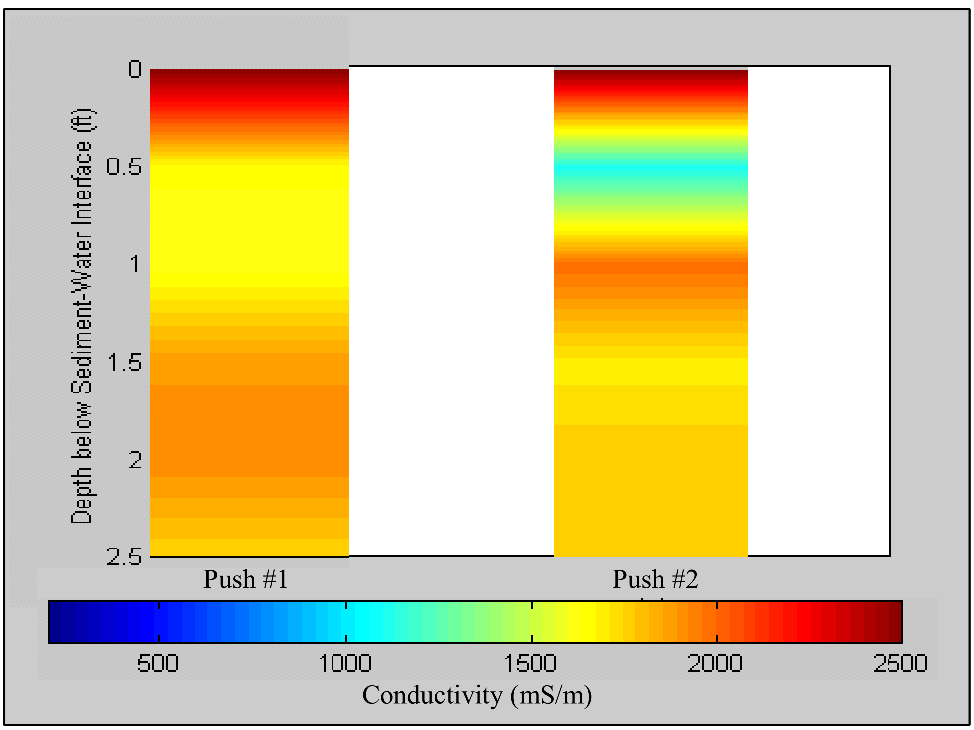


Figure 5-57. Conductivity measurements at site P-17. Note- Blue or light color indicates lower conductance zones or fresh water and red indicates higher conductance zones or salt water.

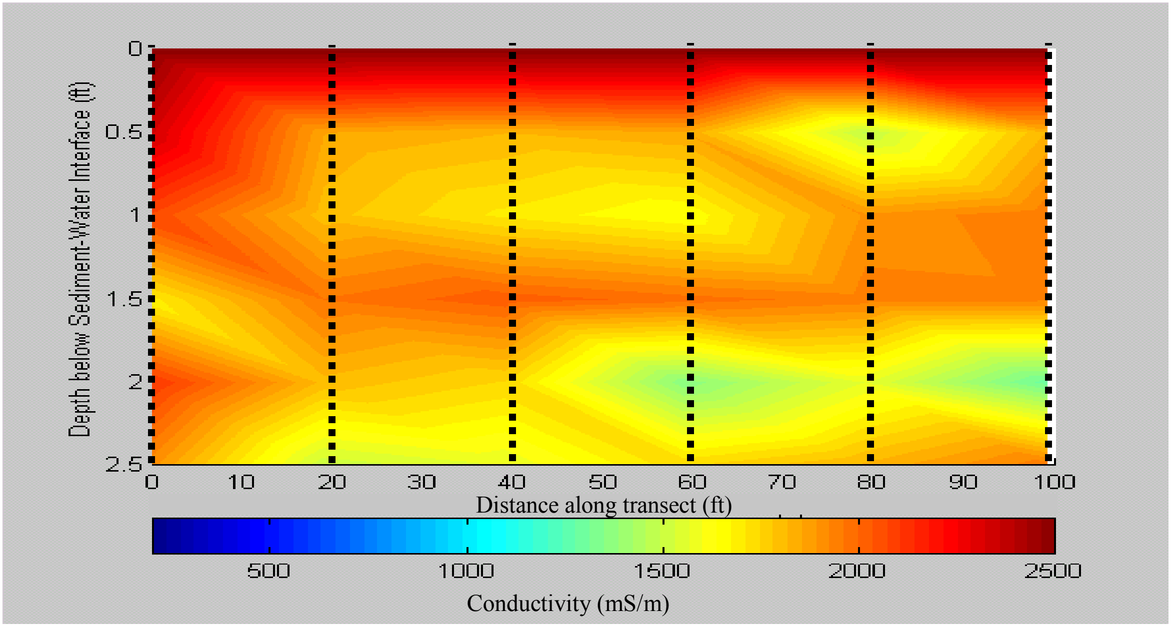


Figure 5-58. Conductivity transect at site p17.

Specific Discharge Measurements at sites P4 and P17

Data acquired from San Diego Harbor (Paleta Creek) at sites P4 and P17 was analyzed and results are presented below. Average specific discharge rates were calculated for each tidal period from the data acquired using the tidal seepage meters.

Site P-4

The specific discharge at site p4 was measured from 1/11/02 to1/13/02 (Figure 5-59). The meter was allowed to equilibrate in the bottom for approximately 6 hrs. Although two meters were deployed, one meter detached from the cable and only a short period of data was obtained. Results here are thus based on only a single deployment. The results indicate specific discharge rates were always positive (out of the sediment), ranging from a low of about 4 cm/d to a high of about 11 cm/d. Highest discharge occurred during the period from about 1300-2400 on 1/12/02. This period of high discharge appears to develop during and following the lower low tide. Decreased levels of discharge appear to correspond to the period extending from the lower high tide, through the higher high tide. This results in a characteristic diurnal pattern in the discharge rate. Data collected on 1/12/02 was used to calculate an average daily (24-hr) specific discharge rate for the site. The rate for this period was determined to be 8.37 cm/d.

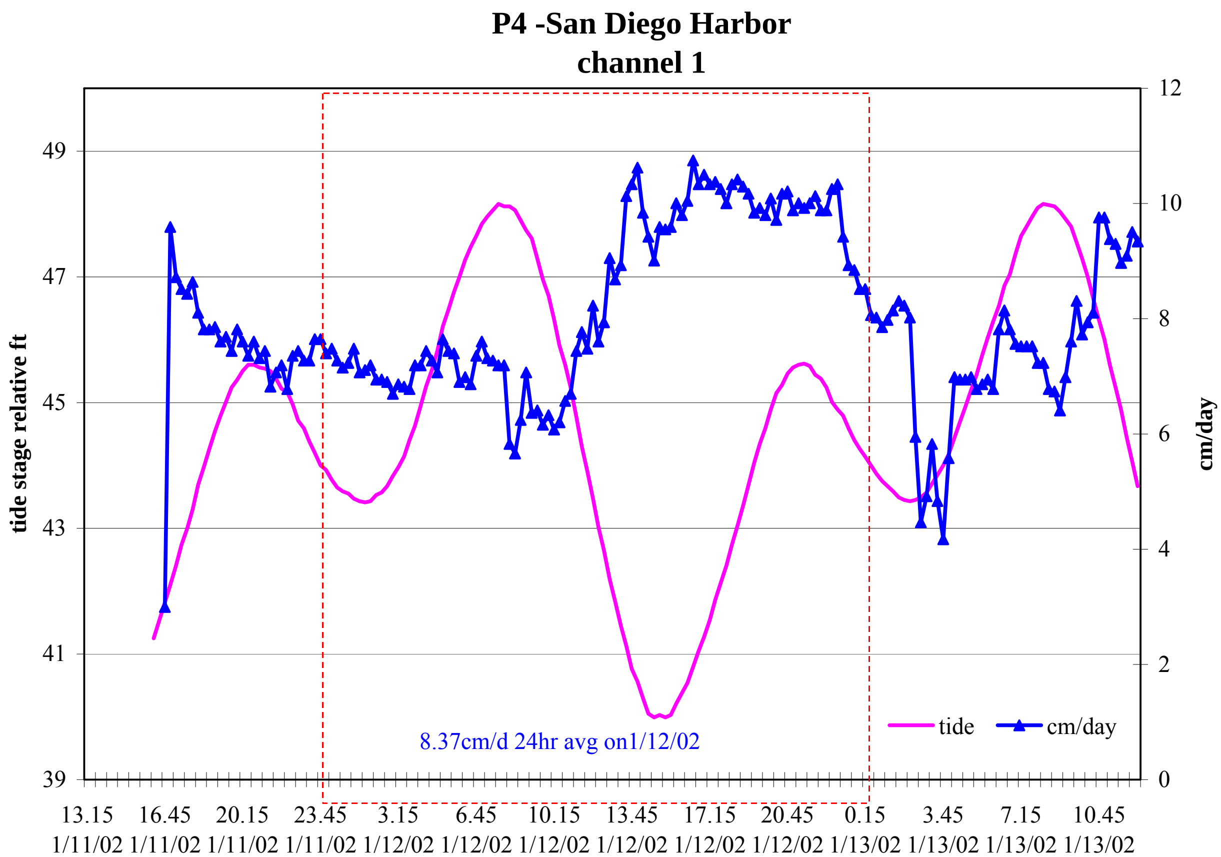


Figure 5-59. Specific discharge and tidal measurements at site P04. The red boxed area corresponds to the time period used to estimate a daily discharge rate.

Site P-17

The specific discharge at site P17 was measured from 1/15/02 to1/18/02 (Figure 5-60). The meter was allowed to equilibrate in the bottom for approximately 2 hrs. Two meters were successfully deployed at the station. Results here are thus based on the measurements from both meters. The results indicate specific discharge rates were always positive at the inner station (P17-3a), ranging from a low of about 3 cm/d to a high of about 8 cm/d. Highest discharge at the inner site generally occurred during both the higher and lower low tide conditions. At the outer site (P17-3b), seepage rates were generally positive, but there were some periods of slight negative flow (recharge). Seepage rates at the outer site ranged from about –0.5 to 6 cm/d. Along with the magnitude, the pattern of flow at the outer site was somewhat different than at the inner site. At the outer site, highest discharge generally occurred in association with the ebb tide prior to lower low water, not during both low water conditions. This results in a characteristic diurnal pattern in the discharge rate as opposed to a semidiurnal pattern as observed at the inner site. The 48 h period from 1/16/02-1/17/02 was used to calculate an average daily discharge rate using combined measurements from both stations. The discharge rate for this period was determined to be 3.29 cm/d.

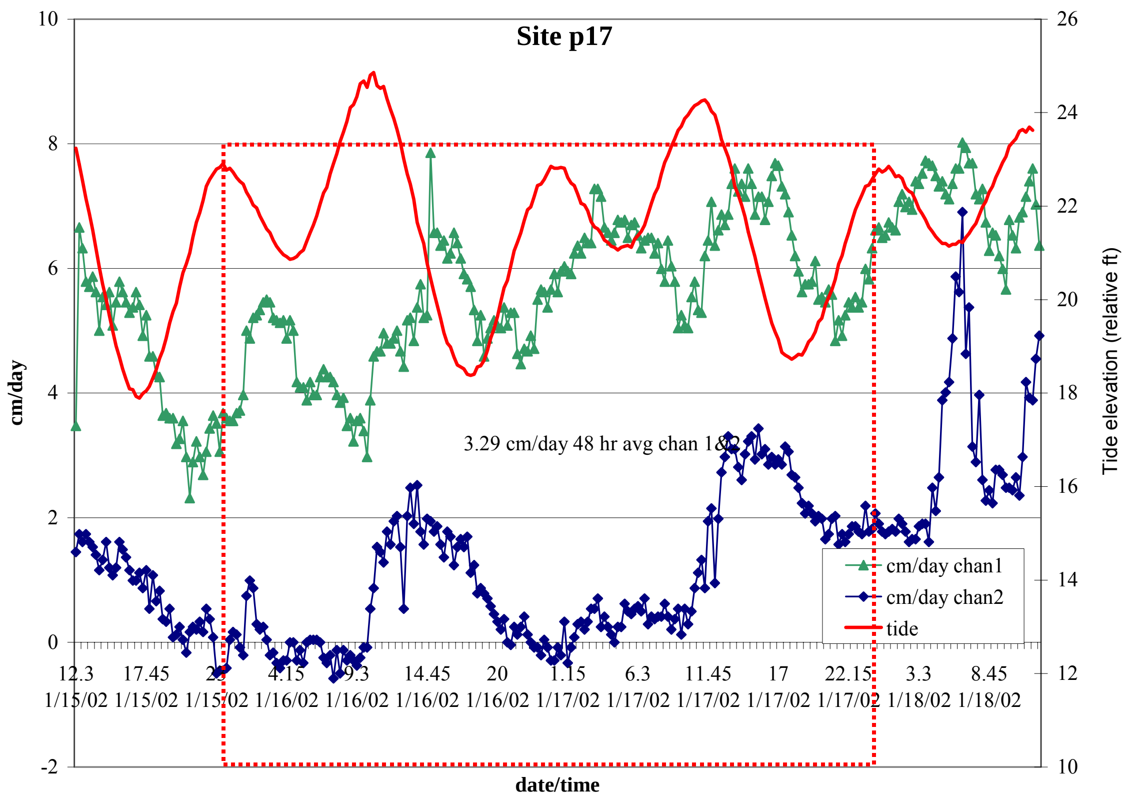


Figure 5-60. Specific discharge and tidal measurements at site P17. The red boxed area corresponds to the time period used to estimate a daily discharge rate.

Summary

The goal of the advective component of PRISM was to develop a quantified measurement of specific discharge rates at sites P04 and P17 in Paleta Creek. This was accomplished based on deployment of ultrasonic seepage meters at each of the sites. Measured seepage rates were used to determine daily average discharge rates of 8.37 cm/d for site P17 and 3.29 cm/d for site P04. Additionally, it was determined that the near shore groundwater gradient is small .001-.004. This combined with the measurements indicating relatively low conductance of the Bay Point formation are consistent with the measurements of low specific discharge made at the Paleta Creek stations.

Variability at these stations appeared to be largely controlled by tidal action. This is also consistent with previous observations of seepage in tidally influenced coastal environments. Most results suggest a damping of discharge during the higher low tide, with strongest discharge occurring during the lower low tide. At both stations, the tidal variability represented about 30% of the overall signal. Results at P04 showed no indication of any longer term components in the seepage, while the results at P17 indicated a potential increase in signal during the later part of the deployment that may be related to a longer term variation in forcing that could not be resolved by these relatively short term deployments. The P17 site, because of its closer proximity to the creek and the shore, may be subject to greater variability associated with coupling to the upland groundwater system. Thus the daily rates that are calculated based on these deployments would need to be verified by longer term or repeated deployments in order to evaluate their representative ness for longer time scales.

5.4 COMPOSITED POREWATER AND OVERLYING SEAWATER ANALYSES

Introduction

While detailed porewater profiles were generated for some of the geochemically important constituents, using either microelectrodes or high-resolution core sections, these methods do not have either the specificity or the sensitivity for a number of the COPCs under consideration. However, in order to calculate fluxes of various constituents using the developed equations, porewater and surface water concentrations of these COPCs were required.

Methods

Cores were retrieved from the multicorer, and brought to the surface. For seawater analyses, overlying water from the cores was carefully siphoned off, and such surface waters from 12 replicate multicores from each site were composited and sent to Battelle laboratories for analyses. For porewater analyses, cores were sliced at the depth assigned as H based upon SPI interpretations. Sediments were then centrifuged in the laboratory, and porewaters were separated. The porewaters from 12 replicate multicores from each site were composited and sent to Battelle laboratories for analyses. The remaining sediments were then composited, subsampled, and sent to various laboratories for analysis, as described in the following sections.

Results and Discussion

Figure 5-61 and Figure 5-62 below show the PAH levels and distributions measured in porewaters and seawaters sampled at the three replicate sites at P04 and P17. In general, the porewater PAH levels in P04 samples are higher than the seawater values, though there is a great degree of variability. Mean seawater PAH levels are comparable to porewater levels at P17, but the range is much greater, with two replicates being at much lower levels than the third.

Figure 5-63 and Figure 5-64 show dissolved metals in P04 and P17 porewater and seawater composites. Note that the scales differ from graph to graph and site to site. Table 5-24 shows the means and standard deviations for total PAH and metals for porewaters and seawater from each stratum. It should be noted that the metals data labeled in these tables and graphs as P04-SW are those reported in the contract laboratory data reports as P04-PW, and visa versa. An extensive review of the P04 metals results revealed that the PW and SW sample labels had been switched, either before shipping or at the contract laboratory. Based upon the conclusions of this review, data are reported here with their corrected labels.

The very high Fe and Mn values reported in P04 porewater samples are consistent with the very high Mn and Fe porewater values at P04 reported by Gieskes et al (Section 4.10,

Figure 5-66 in this report). While Mn and Fe maxima were also observed by Geiskes et al in P17 (Section 4.10, Figure 5-63 and Figure 5-64 of this report), they were not nearly as pronounced as those in P04. Similarly, while elevated, P17 porewater composite Mn and Fe values are not as high as those observed at P04. Of course, fine-scale porewater measurements can be quite variable, since burrows, bioturbation and other processes can cause heterogeneity at every scale, but it is of note that the composited porewaters show the same relative trends as do the fine-scale porewater measurements.

Mean and standard deviation for metals in the seawater values in P04 and P17 are quite similar to the "seawater" values at the site measured in the BFSD deployments at t=0 (see Table 5-25, below). These values provide and independent confirmation of the validity of the composited seawater values.

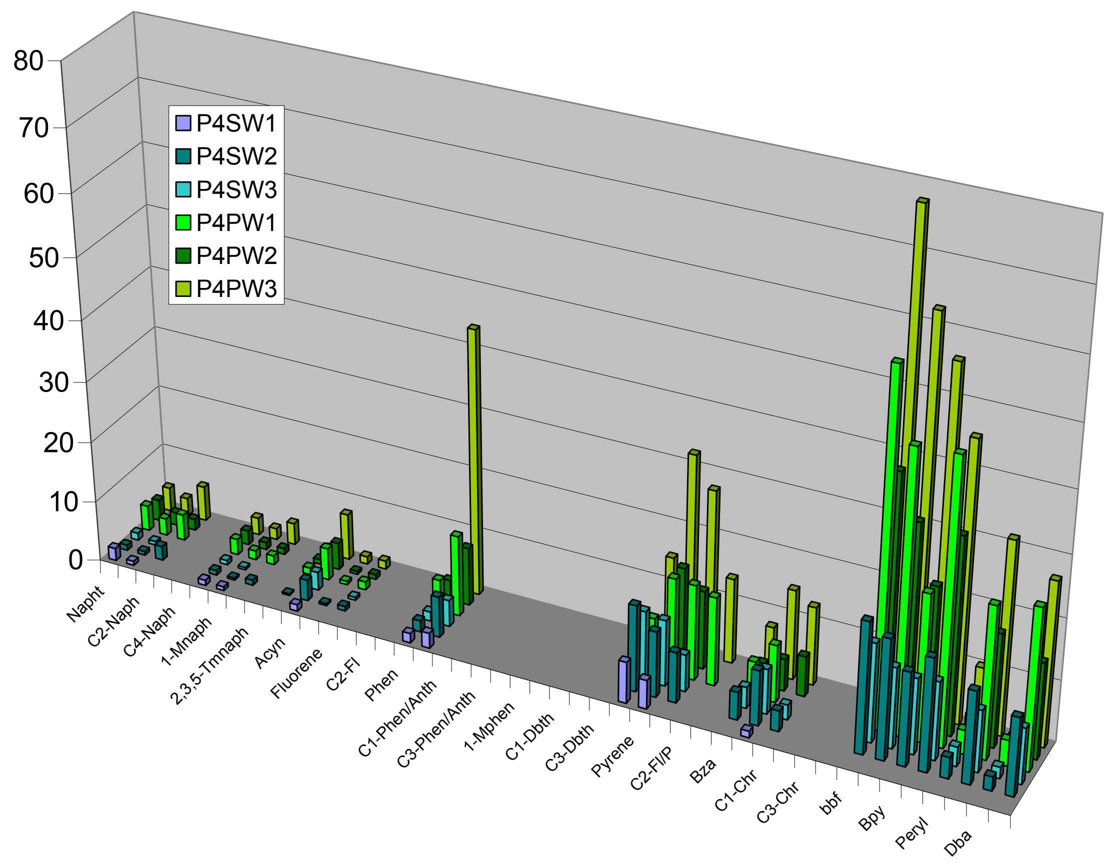


Figure 5-61. P04 dissolved PAHs: Porewater PAH levels are comparable to or higher than are seawater levels. Concentrations in ng/L

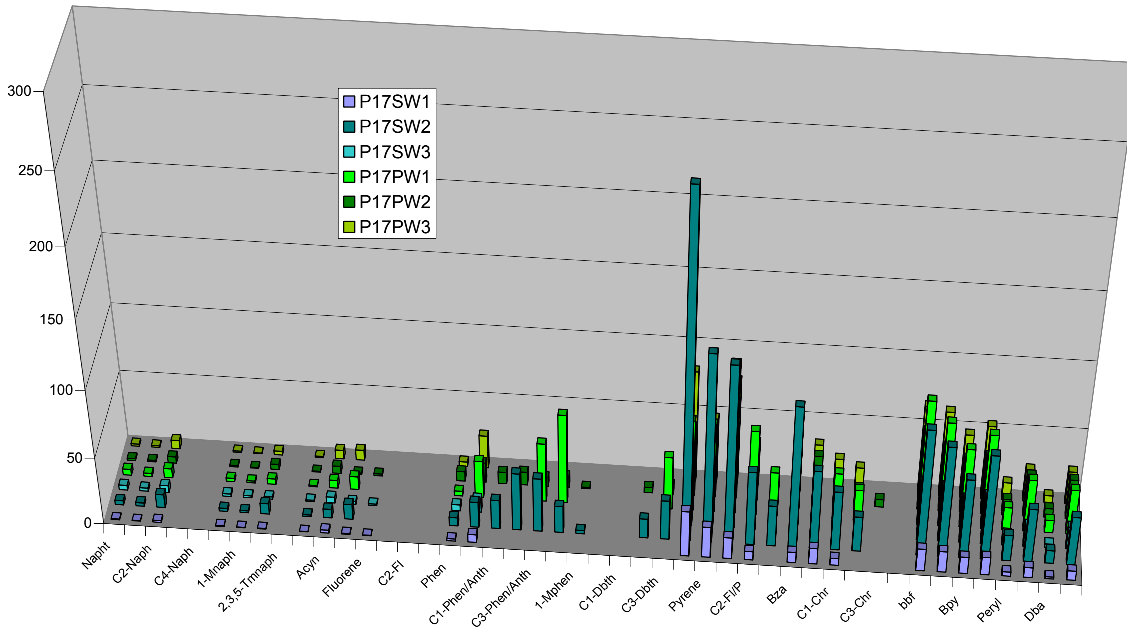


Figure 5-62. P17 dissolved PAHs: Mean seawater PAH levels are comparable to porewater levels, but the range is much greater. Concentrations in ng/L

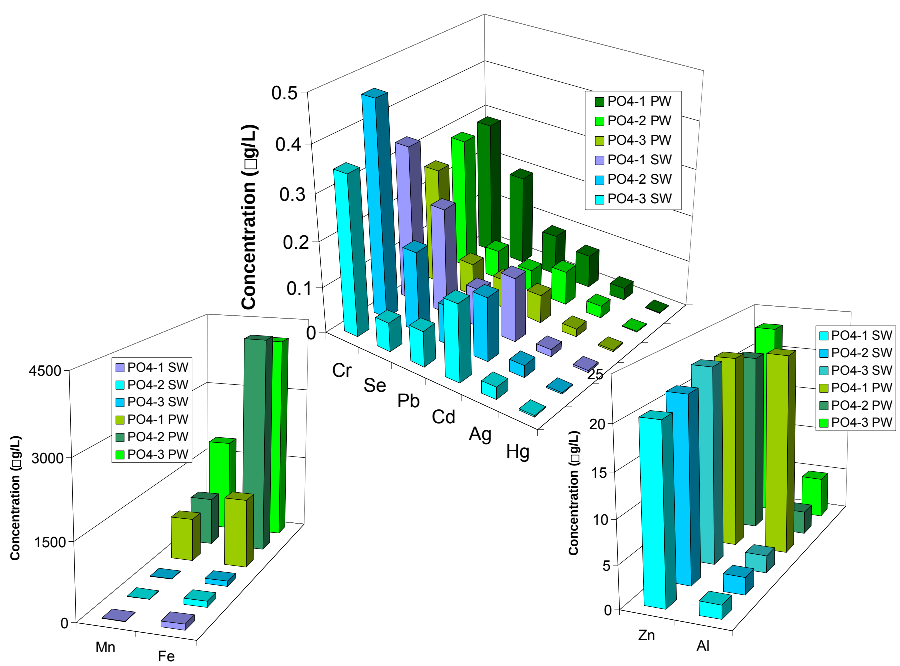


Figure 5-63. Dissolved metal concentrations, in µg/L, in P04 seawater and porewater composites.

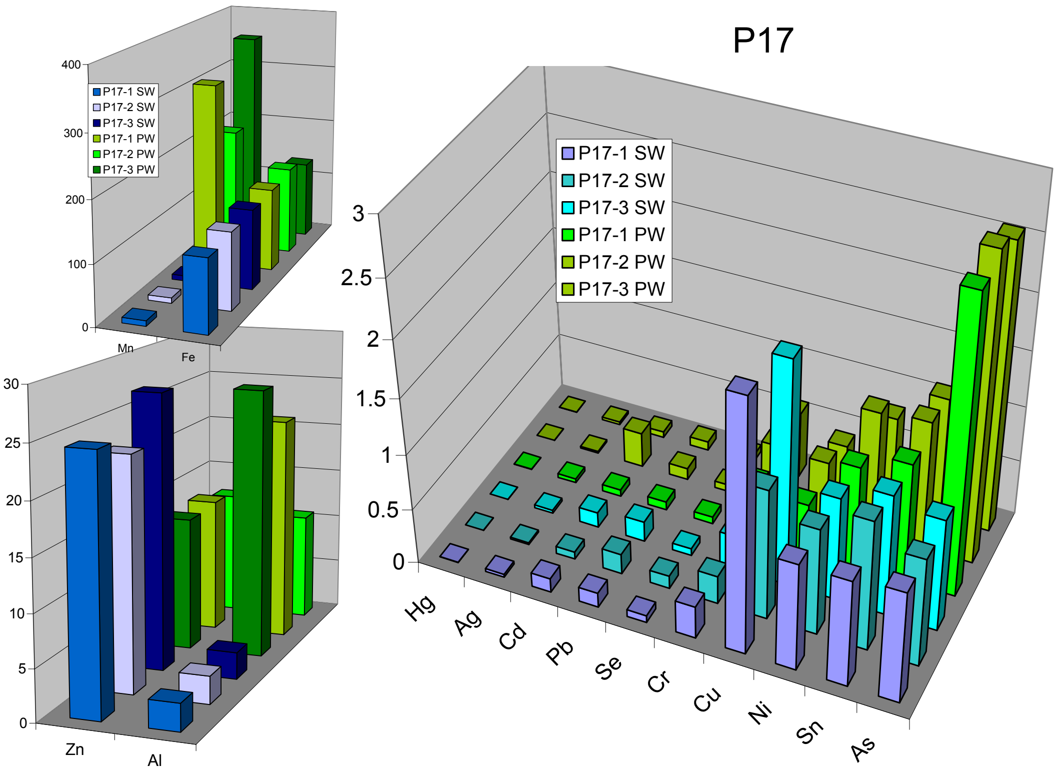


Figure 5-64. Dissolved metal concentrations, in μg/L in P17 seawater and porewater composites.

Table 5-24. Porewater and seawater chemistry from multicore composites. PAHs are in ng/L; metals are in μg/L.

Analyte	P04 PW mean	P04 PW std	P04 SW mean	P04 SW std	P17 PW mean	P17 PW std	P17 SW mean	P17 SW std
TPAH	111.002	80.317	369.573	134.477	797.765	235.061	717.629	692.591
Hg	0.002	0.001	0.003	0.001	0.002	0.001	0.002	0.001
Ag	0.024	0.005	0.023	0.006	0.027	0.009	0.024	0.005
Cd	0.069	0.007	0.150	0.017	0.143	0.151	0.110	0.038
Pb	0.067	0.021	0.083	0.004	0.086	0.017	0.165	0.029
Se	0.110	0.074	0.157	0.085	0.063	0.000	0.081	0.031
Cr	0.277	0.020	0.384	0.071	0.561	0.045	0.287	0.029
Cu	0.427	0.051	2.587	0.139	0.467	0.068	1.820	0.567
Ni	0.886	0.033	1.054	0.181	0.949	0.169	0.960	0.017
Sn	1.173	0.231	1.393	0.029	1.117	0.047	1.082	0.108
As	4.316	1.886	1.060	0.058	2.650	0.083	1.003	0.019
Zn	22.100	1.114	21.533	1.206	13.000	0.529	24.667	2.212
Al	10.240	11.272	1.900	0.234	19.800	8.169	2.650	0.036
Mn	1233.000	562.083	7.690	0.892	289.000	76.000	8.897	0.196
Fe	3290.000	1657.438	111.000	5.000	139.333	8.505	128.000	6.557

Table 5-25. Seawater metal concentrations for seawater from multicores, and from t=0 samples from BFSD. For cores, these are means and standard deviations from three replicate analyses. For BFSD samples, these are means and standard deviations of t=0 values for the three BFSD deployments at the site. All values in μg/L, or ppb.

	P04-SW mean	P04-SW std	P04 BFSD t=0 mean	P04 BFSD t=0 std	P17-SW mean	P17-SW std	P17 BFSD t=0 mean	P17 BFSD t=0 std
Hg	0.003107	0.000909	0.003567	0.000751	0.00165	0.000656	0.003967	0.001097
Ag	0.023287	0.00631	0.0299	0.005196	0.023943	0.005147	0.023967	0.010335
Cd	0.149667	0.016743	0.152667	0.026633	0.109533	0.038443	0.389433	0.53745
Pb	0.0825	0.003915	0.070167	0.033654	0.165333	0.028885	0.1267	0.029344
Se	0.156767	0.085488	0.079667	0.137987	0.081	0.031177	0.217667	0.188521
Cr	0.384	0.07119	0.183	0.082456	0.286667	0.028711	0.388	0.128172
Cu	2.586667	0.138684	1.683	0.705505	1.82	0.567098	1.032	0.384021
Ni	1.053667	0.180644	0.804333	0.026312	0.959667	0.017098	0.7105	0.536163
Sn	1.393333	0.028868	1.213333	0.051316	1.082	0.10813	1.213333	0.028868
As	1.059528	0.058095	0.997867	0.0158	1.002568	0.018764	0.9553	0.059194
Zn	21.53333	1.205543	22.2	4.229657	24.66667	2.212088	19.4	4.167733
Al	1.9	0.23388	2.93	1.322838	2.65	0.036056	15.78	10.77336
Mn	7.69	0.891684	20.63333	6.222808	8.896667	0.195533	15.16667	4.257151
Fe	111	5	82.06667	115.9924	128	6.557439	156.6667	2.309401

5.5 DEPTH PROFILE OF BACTERIAL METABOLISM AND PAH BIODEGRADATION IN BIOTURBATED AND UNBIOTURBATED MARINE SEDIMENTS.

Introduction

Both polycyclic aromatic hydrocarbons (PAHs) and PAH-degrading bacteria are relatively ubiquitous in estuarine sediments and are commonly found in areas that do not have substantial known sources (Chung and King 2001). Rapid PAH metabolism generally depends on the availability of molecular oxygen to the sedimentary bacteria (Cerniglia 1992, Chung and King 1999, Leahy and Olsen 1997), though recently, PAH mineralization has been coupled with sulfate reduction (Coates et al. 1998, Hayes and Lovely 2001, Young and Zhang 1997; Bedessem et al. 1997) and nitrification (Deni and Penninckx 1999, Bonin et al. 1994; Gilewicz et al. 1991, Hutchins et al. 1991). In unperturbed submerged sediment, heterotrophic bacterial metabolism rapidly depletes oxygen, limiting its availability to the top several millimeters (Rasmussen and Jorgensen 1992).

Processes the physically mix the surface sediment with oxygenated bottom waters can increase the amount of oxygen available to bacteria that are deeper in the sediment. One of these processes involves the activities of benthic macrofauna which excavate and mix large portions of the surface sediment and then increase oxygen transfer by ventilating their burrows (Aller 1988). This bioturbation of the sediment has been linked to dramatic changes in both the composition and the metabolic activity of the associated bacterial assemblage (Hall 1994, Soltwedel and Vopel 2001). Macrofaunal burrows have been shown to harbor unique assemblages of PAH-degrading bacteria that mineralize PAHs more rapidly than those from adjacent non-burrow sediment (Chung and King 1999, 2001, Madsen et al. 1997, Schaffner et al. 1997, Bauer et al. 1988). In a microcosm experiment, Madsen et al. (1997) found that the depth-integrated removal of fluoranthene was twice as high when capitellids were present. Bauer et al. (1988) had similar findings with regards to capitellids but involving anthracene degradation by bacteria in sediments. The activity of diverse macrofaunal communities has also been linked to long-term seasonal removal of PAHs and PCBs using sediment microcosms (Schaffner et al. 1997).

These findings have led several researchers to postulate that the relative composition and abundance of benthic macroorganisms communities can influence the rate of PAH degradation by natural bacterial assemblages in marine sediment (Madsen et al. 1997). Chung and King (2001) concluded that the capacity for PAH biodegradation in hydrocarbon-impacted ecosystems depends on the qualities of the naturally occurring bacteria and their responses to environmental parameters, rather than on the introduction of new taxa (bioaugmentation) or selective modification of existing ones. The activities of the benthic meio- and macrofauna may create an environment that preferentially selects for PAH-degrading bacteria and may increase the transition zones within the sediment that are important to enhancing depth integrated bacterial metabolism.

We measured rates of heterotrophic bacterial production (leucine incorporation method) and mineralization of naphthalene, phenanthrene and fluoranthene (^{14}C-radiotracer additions) in sections of sediment cores sampled from two stations in an urbanized waterway feeding San Diego Bay. These stations were initially selected as distinct from each other in bioturbation depth, as determined by REMOTS camera analyses (Germano 2002). The differences were also characterized by pore water analyses of nutrients and electron acceptors and microprobe measurements taken with depth on replicate cores and published separately (Gieskes et al. 2002).

Material and Methods

PAH Mineralization

PAH mineralization assays were initiated within three hours of sediment sample collection using a modification of Boyd et al. (1996) and Pohlman et al. (2002). Radiotracers three sentinel PAHs: UL-^{14}C-naphthalene (18.6 mCi mmol^{-1}), 3-^{14}C-fluoranthene (45 mCi mmol^{-1}), and 9-^{14}C-phenanthrene (47 mCi mmol^{-1}) were purchased from Sigma Chemical. They were added in separate incubations to surface sediment samples (1 mL wet volume) in 100×16 mm test tubes to a final concentration of about 0.2 µg g^{-1} (depending on specific activity). Isotope dilution was calculated from the ambient test PAH concentration. Samples were incubated no longer than 24 h at *in situ* temperature and evolved $^{14}CO_2$ was captured on NaOH-soaked filter papers. H_2SO_4 was added to end incubations and to partition any remaining CO_2 into headspace of the tube and to the filter paper trap. The filter paper traps containing metabolized $^{14}CO_2$ were removed, radioassayed and subsequently used to calculate substrate mineralization.

Heterotrophic Bacterial Production

The leucine incorporation method (Kirchman et al. 1985, Kirchman 1993, Smith and Azam 1992) was used to measure bacterial production as adapted by Montgomery et al. (1999). A 0.50 µL of wet surface sediment subsample from each station was added to 2 mL centrifuge tubes (three experimental and one control) which were pre-charged with [^{3}H-4,5]-L-leucine (154 mCi mmol^{-1}). The sediment was extracted from the benthic grab sample and added to the 2 mL tube using a 1 mL plastic syringe with the end cut off. One mL of 0.22 µm (nom. pore dia.) filtered bottom water (collected <1 m above bottom) was then added to each tube to form a sediment slurry. Samples were incubated for 1-2 hours at *in situ* temperatures and subsequently processed by the method of Smith and Azam (1992). A constant isotope dilution factor of 1000 was used for all samples. This was estimated from actual measurements of sediment dissolved free amino acids (Burdige and Martens 1990) and saturation experiment estimates (Tuominen 1995). One mL syringed samples of wet sediment were dried at 50 ^{o}C and used to covert production values to dry weight. Leucine incorporation rate was converted to bacterial carbon using factors determined by Simon and Azam (1989).

Sampling

Replicate gravity cores housed on a multicorer were sampled from two stations in Paleta Creek that feeds the San Diego Bay. Station P17 was sampled on 16 January 2002 and station P04 was sampled on 22 January 2003. The multicorer was deployed off the research vessel R/V Ecos and transferred to the laboratory at ambient temperature within 3 hours. Two cores from station P17 was sectioned and assayed for bacterial production and PAH mineralization while a third replicate core was sectioned for PAH concentration. One core from station P04 was sectioned and assayed for bacterial production and PAH mineralization while a second replicate core was sectioned for PAH concentration. Slurries for biological assays were made from filtered water overlying the respective cores.

PAH Concentration
Ambient PAH concentrations of the 18 semi volatile priority pollutants were determined by drying 10-15 g sediment samples with diatomaceous earth, accelerated solvent extraction of dried samples and GC/MS analysis of the extracts (Fisher et al. 1997). *p*-Terphenyl-d_{14} and 2-fluorobiphenyl were used as surrogate standards and the method is further described in Pohlman et al. (2002).

Results

Sediment from Paleta Creek in San Diego Bay is impacted from a variety of historical and current day inputs. Two stations within the creek (P17 and P04) were initially found to have different characteristics in terms of bioturbation depth (Germano 2002). From both the less bioturbated station P04 and the more bioturbated station P17, four replicate cores were taken using a multicore sampling device. Two cores were sectioned (2-3 cm each) and sampled for PAH and lignin concentration, bacterial production, and mineralization of PAH (e.g. naphthalene, phenanthrene, and fluoranthene). In a related study, two replicate cores were microprobed to measure electron acceptors and sectioned to measure nutrient concentrations in the pore water (Gieskes et al. 2002). Based on initial REMOTS camera analyses (Germano 2002), Station P17 was bioturbated to a depth of 2-3 cm and Station P04 was bioturbated to a depth of 12-14 cm.

In general, PAH concentration was low compared to many submerged sediments in anthropogenically influenced waterways surveyed by our group (Pohlman et al. 2002, Montgomery et al. 1999, 2002, Boyd et al. 1999). The highest total PAH concentration was only 3.18 ppm and was found in the 8-10 cm below surface at P17 (Fig. 1). In P04, the highest PAH concentration was found 14-17 cm below the surface and was likely the only section below the bioturbation zone though there was reportedly high variability in bioturbation zones even within station replicates, based on REMOTS (Germano 2002) and microprobe analyses (Gieskes et al. 2002). The PAH concentrations for all sections were higher in cores from the less bioturbated station, P17, than from P04.

Heterotrophic bacteria production, using the leucine incorporation assay, was measured on replicate cores from station P17 (-1B and -2B; Fig. 2A) and on one core from station P04 (-3; Fig. 2B). Bacterial production ranged from 11.9 to 297 $\mu g\ C\ g^{-1}\ d^{-1}$ along the depth profile at P04 and from 6.00 to 198 $\mu g\ C\ g^{-1}\ d^{-1}$ at P17 and generally decreased with depth at both stations. Production was higher in the two uppermost (0-2 and 2-4 cm below surface) sections at station P04 than in the cores from station P17 but was similar below 4 cm.

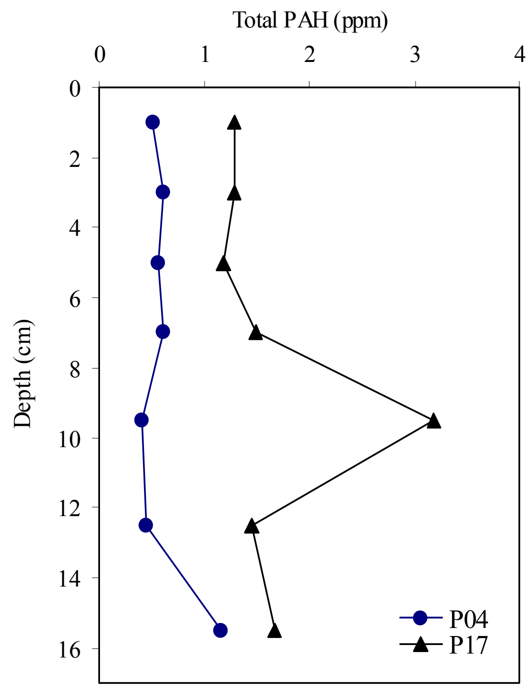


Figure 5-65. Total PAH concentration vs. depth at P04 and P17.

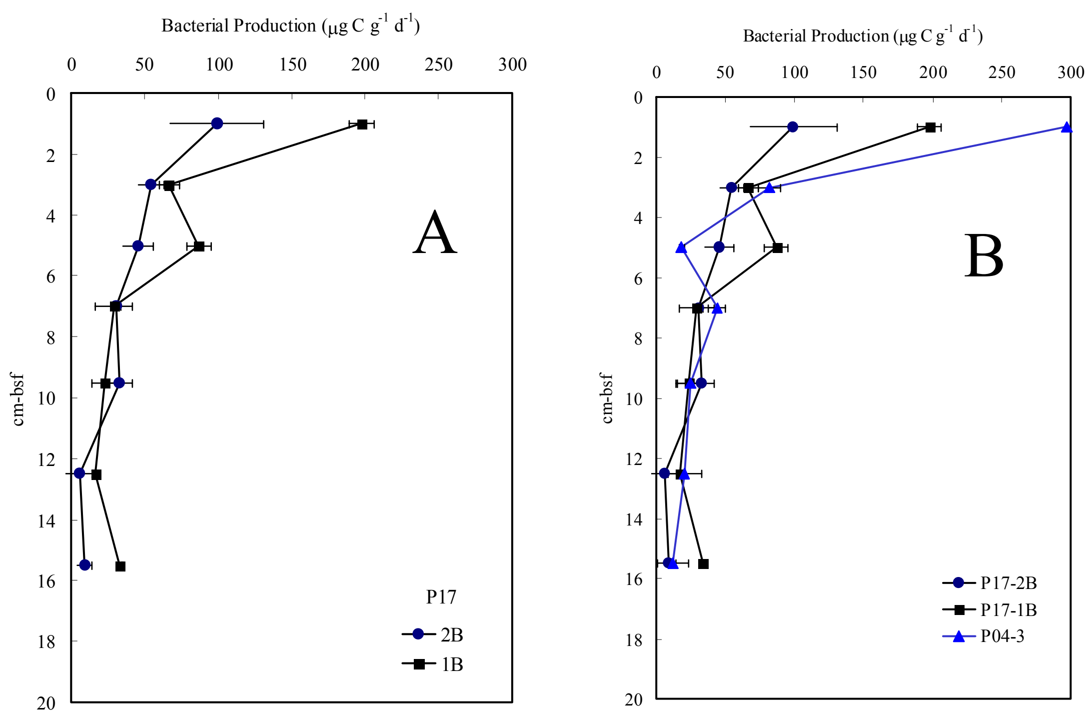


Figure 5-66. Bacterial production vs. depth at (A) the P17 site, and (B) the P17 and P04 sites.

Bacterial metabolism of PAHs to carbon dioxide was measured using radiotracer additions of ^{14}C-naphthelene, -phenanthrene and –fluoranthene to sediment slurries mixed with filtered bottom water from the respective station. Naphthalene mineralization ranged from below the detection level of 1 x 10^{-3} μg kg^{-1} d^{-1} up to 1.06 (+/- 0.16) μg kg^{-1} d^{-1} in all three cores but most values were not differentiable from background. Only two sections were above detection limit from both the P04-3 core (2-4 and 11-14 cm; Fig. 3) and the P17-1B core (0-2 cm, 1.06 (+/- 0.16) μg kg^{-1} d^{-1}; 2-4 cm, 0.27 (+/- 0.04) μg kg^{-1} d^{-1}). Five of the seven sections from the P17-2A core had naphthalene mineralization rates above the detection limit though only three sections appeared to be different (Fig. 3).

Phenanthrene mineralization rates were similar between the P17 cores and were slightly higher in the 0-2 cm section (Fig. 4A). Rates in the upper two sections (0-4 cm) from the P04 core were highest overall (0-2 cm, 3.2 +/- 0.44 μg kg^{-1} d^{-1}) with each section higher in P04-3 than in the core from P17-1B (Fig. 4B). The average phenanthrene mineralization rate for all sections were about five-fold higher in P04-3 core compared with the P17-1B core (2.1 vs. 0.43 μg kg^{-1} d^{-1}). Likewise for fluoranthene mineralization, rates were similar between replicate cores for station P17 (Fig. 5A) but were higher in the P04-3 core than in P17-1B (Fig. 5B). Fluoranthene mineralization rates ranged from 0.79 (+/- 0.49) to 18 (+/- 17) μg kg^{-1} d^{-1} compare with 0 to 1.1 (+/- 0.54) μg kg^{-1} d^{-1} at P17.

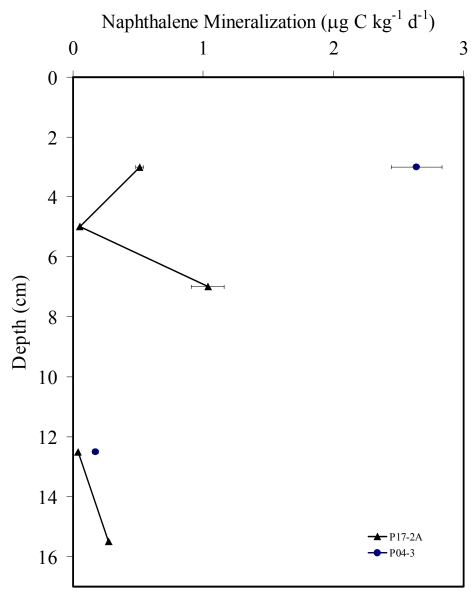


Fig. 4

Figure 5-67. Naphthalene mineralization rates at P04 and P17.

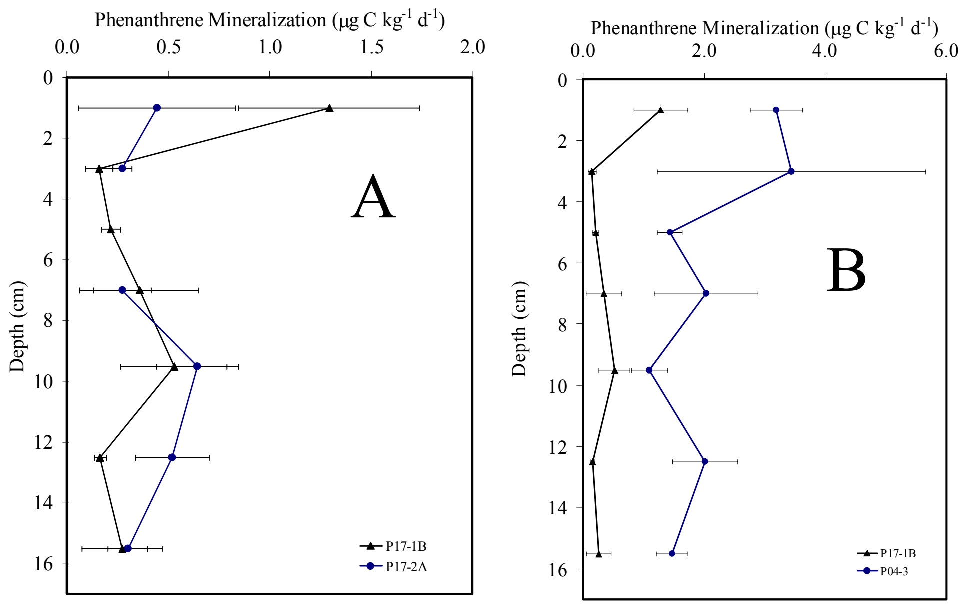


Figure 5-68. Phenanthrene mineralization rates for (A) site P04, and (B) P04 and P17 as a function of depth into the sediment.

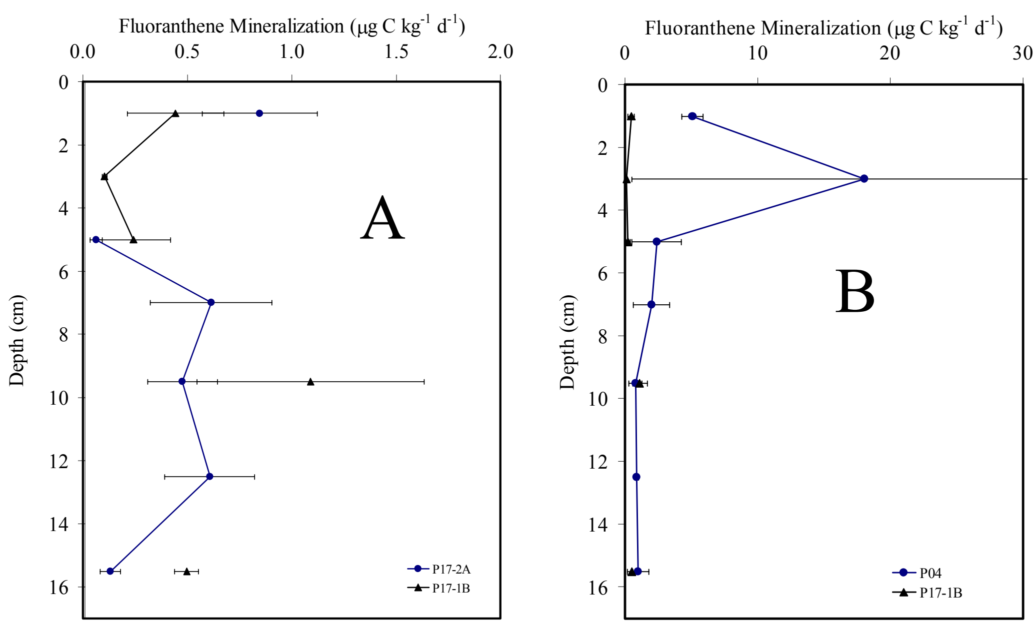


Figure 5-69. Fluoranthene mineralization rates for (A) site P04, and (B) P04 and P17 as a function of depth into the sediment.

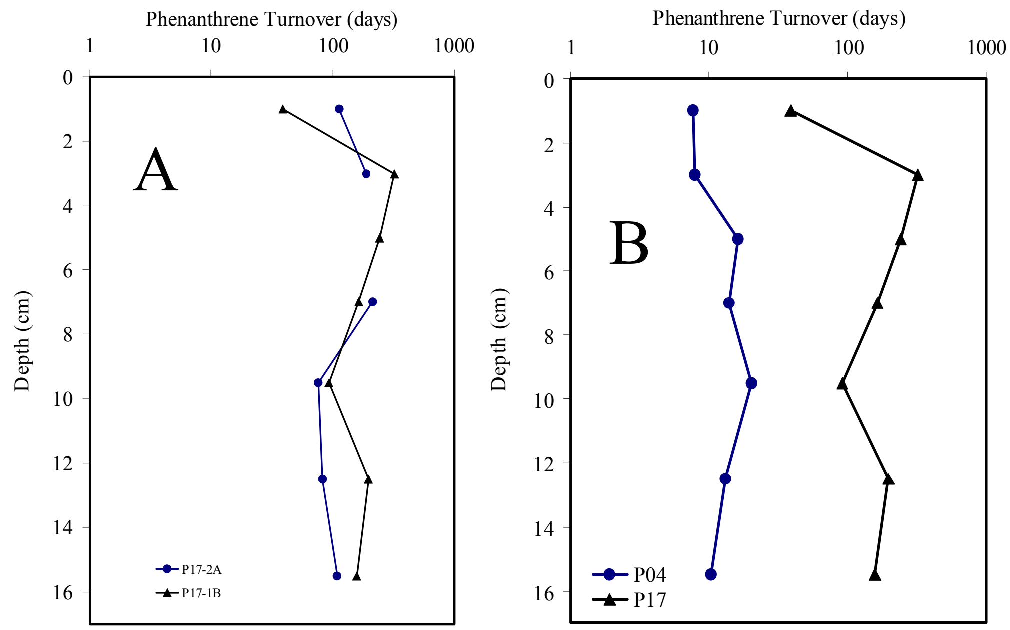


Figure 5-70. Turnover rate for phenanthrene for (A) site P04, and (B) P04 and P17 as a function of depth into the sediment.

The turnover rate for phenanthrene and fluoranthene was calculated by dividing the mineralization rate by the ambient concentration of the individual PAH. This value is expressed as the average number of days a PAH molecule would be in the ambient PAH pool assuming the rate of mineralization and PAH flux into the sediment remained constant. Phenanthrene turnover times ranged from 76 to 213 days in the P17-2A core and 39 to 322 in the replicate P17-1B core (Fig. 6A) with the average being similar, 130 days for P17-2A and 174 days for P17-1B. The phenanthrene turnover times were about an order of magnitude more rapid in the P04 core, ranging from 8 to 20 days and averaging 13 days (Fig. 6B). Fluoranthene turnover times ranged from 193 to 1632 days in the P17-2A core and 236 to 1598 in the replicate P17-1B core (Fig. 7A) with the average being very similar, 629 days for P17-2A and 638 days for P17-1B. The fluoranthene turnover times were also an order of magnitude more rapid in the P04 core, ranging from 5 to 91 days and averaging 43 days (Fig. 7B). Turnover times could not be calculated for samples where the mineralization rate was below the detection limit.

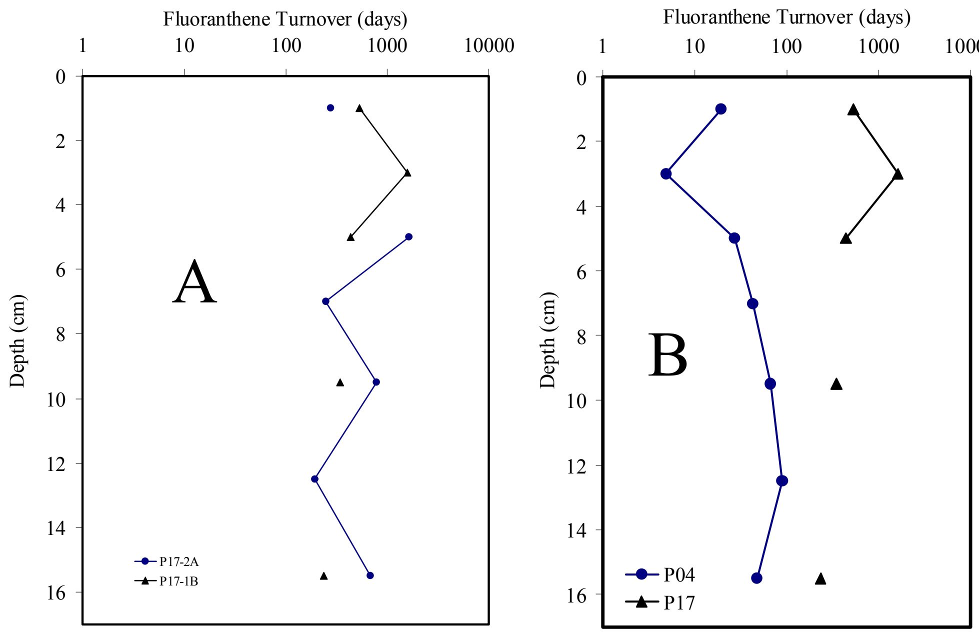


Figure 5-71. Turnover rate for fluoranthene for (A) site P04, and (B) P04 and P17 as a function of depth into the sediment.

Sedimentation rate (Apitz and Chadwick 2002) for individual PAHs onto a cm^2 of surface sediment was compared with the mineralization rates for those same PAHs but normalized for the volume of a typical assay (mL = cm^3) (Table 5-26). The bioturbation depth needed for a cm^2 sediment column to mineralize the amount of PAH depositing onto the cm^2 column is calculated by dividing the sedimentation rate with the mineralization rate for each station (Table 5-26). With a bioturbation depth of 12-15 cm at station P04, but only a 0.63 cm depth needed to biodegrade the amount of fluoranthene depositing on the site, it suggests that there is about 21 µg cm^{-2} yr^{-1} of extra capacity to metabolize fluoranthene (11.5 cm x 1857 ng PAH cm^{-3} yr^{-1}). Conversely, with a bioturbation depth of 2 cm at station P17, but a 12.2 cm depth needed to metabolize the fluoranthene depositing, then there is a deficit capacity of about -1.7 µg cm^{-2} yr^{-1} at this less bioturbated station (-10.2 cm x 162 ng PAH cm^{-3} yr^{-1}).

Table 5-26. Sedimentation rate (Apitz and Chadwick 2002) for individual PAHs compared with the mineralization rates for those same PAHs and the bioturbation depth needed to mineralize the amount of PAH depositing onto the cm^2 column at each site.

PAH	Sedimentation (ng PAH cm^{-2} y^{-1})		Mineralization (ng PAH cm^{-3} yr^{-1})		Bioturbation Depth Needed (cm)	
	P04	P17	P04	P17	P04	P17
Naphthalene	27	17	966	190	0.03	0.09
Phenanthrene	626	1139	1169	472	0.54	2.41
Fluoranthene	1171	1972	1857	162	0.63	12.2

Discussion

The presence of active macrofauna and meiofauna can affect the factors known to enhance bacterial PAH biodegradation through numerous mechanisms. Some organisms create burrows and then circulate water through the cavity which increases the amount of oxygen available for microbial processes, as well as the depth of penetration of overlying waters (Madsen et al. 1997). This increased flux of both oxygen and carbon dioxide is a function of the macroorganism abundance (Pelegri and Blackburn 1994). By increasing the surface area in the sediment available to direct contact with the water column, it also increases nutrient transfer and removes accumulated metabolic waste products that limit bacterial metabolism (review by Madsen 1997). The activities of deposit feeders stimulate bacteria metabolism directly by grazing and remineralizing nutrients, or indirectly, by causing changes in aggregate surface area (Holmer et al. 1997). It has even been suggested that grazing on bacteria and burrow irrigation is a strategy that deposit feeders use to create their own food supply (Snelgrove and Butman 1994).

Macrofauna can also remove PAHs from sediment through direct metabolism (Holmer et al. 1997, Forbes et al. 1996) or by ingesting PAHs at depth and defecating into the overlying water column (Koerting-Walker and Buck 1989) though ingestion has been shown to reduce macrofaunal growth and fecundity (Foss and Forbes 1997). Irrigation of benthic sediments can preferentially remove low molecular weight alkanes and PAHs (Koerting-Walker and Buck 1989) that are known to inhibit bacterial metabolism of higher molecular weight PAHs (Lantz et al. 1996). It is possible that the apparent relationship between benthic microorganisms and PAH-degrading bacteria may not be spurious. The presence of high concentration of oil and the resulting hypoxia (Peterson 1991) are known to be toxic to benthic copepods and other organisms (Carmen et al. 2000ab, Bennett et al. 1999, Carmen et al. 1997, Carmen and Todaro 1996). By increasing the rate of PAH degradation and reducing accumulation in the sediment, sensitive benthic organisms may actually increase their own growth (Carmen et al. 1996).

We found that PAH mineralization was elevated in the bioturbated zones from both stations relative to core subsections from below the bioturbated zone. This is consistent with the hypothesis that the activities of benthic infauna stimulate bacterial metabolism of PAHs. Though PAH mineralization rates were low relative to those found in sediments from other estuarine systems (Montgomery et al. 2002, Pohlman et al. 2002, Boyd et al. 1999), turnover times in the sediment for phenanthrene and fluoranthene were relatively rapid (39 to 322 d) and similar to those reported by other researchers for three ring PAHs (16 to 126 d; Shuttleworth and Cerniglia 1995). The low ambient PAH concentrations (1-3 ppm) found in all sections from both cores may be too low to select for a bacterial assemblage that will rapidly metabolize PAH. Although low PAH degradation rates are often attributed to low bioavailability (see review by Reid et al. 2000), recent evidence reported by Schwartz and Scow (2001) demonstrates that it may actually be the lack of enzyme induction amongst the PAH degrading members of the bacterial assemblage that is responsible for low mineralization rates below a threshold PAH concentration. Other researchers have reported this phenomenon for aromatic organics (Zaidi et al. 1988, Roch and Alexander 1997) and, in fact, it is more generally applicable to bacterial carbon metabolism (Button 1985).

Schwartz and Scow (2001) found that PAH-degrading bacteria mineralized phenanthrene more rapidly above 2.5 ppm (8.8×10^{1} $\mu g\ kg^{-1}\ d^{-1}$) than at a lower ambient concentration of 0.05 ppm (9.5×10^{-2} $\mu g\ kg^{-1}\ d^{-1}$). Though these values were obtained in a flask studies, they compare very favorably with the rates measured in this study with phenanthrene concentrations of 0.02 to 0.06 ppm which ranged from 1.6×10^{-1} to 3.5×10^{0} μg kg^{-1} d^{-1}. In other systems, ambient total PAH concentrations above 10 ppm of total PAH correlated with higher PAH mineralization rates as determined with the methods used in this study (Pohlman et al. 2002, Montgomery et al. 1999, 2002, Langworthy et al. 1998, Boyd et al. 1999) and those used by other researchers (Geiselbrecht et al. 1998, Carmen et al. 1995, 1996, Griffiths et al. 1981). Exposure to PAH concentration above the threshold level (which may be species specific) would support natural selection of a PAH-degrading assemblage leading to elevated mineralization rates (Ghiorse et al. 1995).

One explanation for the rapid PAH turnover despite the low ambient PAH concentration could be high flux of PAH from the water column to the sediments within the bioturbation zone. If particles with PAH concentrations above 10 ppm were transported into the benthos, they would locally increase the PAH concentration and elevate the selective pressure for PAH degrading bacteria. High ambient PAH levels might not be measured because of rapid turnover time, but affects of such a PAH flux could be reflected in the composition of the natural bacterial assemblage. Transport of PAHs from particles suspended in the overlying bottom waters into the sediment may involve gravitational settling or activities of the macrobiota themselves. Most research involving the effect of macrofauna on PAH transport has involved their role in resuspended PAH-bound contaminants from the sediments into the water column (Reible and Mohanty 2002, Reible et al. 1996, Ciarelli et al. 1999). However, others have found that certain types of macrofauna trap organic matter and associated PAHs that are suspended in the water column and move them deeper into the sediment (Aller 1988; Holmer et al., 1997). Amphipods transfer PAH-coated particles from the water column to the subsurface through ingestion, encapsulation within a peritrophic membrane and defecation in the subsurface burrows (Lotufo and Landrum 2002). Sediment reworking can also homogenize organic matter concentrations in the bioturbated zone with small meiofauna like capitellids having this effect in the top 10-20 mm (Holmer et al. 1997, Madsen et al. 1997) and larger oligochaetes extending down to 10 cm. (Cunningham et al. 1999). Reworking of sediments by benthic organisms and the resultant changes in PAH metabolism by bacteria can complicate interpretation of sedimentation and biodegradation rates based on analytical chemistry of the core sections.

In a related study, PAH and organic matter deposition to the two study stations was measured using sediment trap collections of particles over two weeks subsequent to this study (Apitz and Chadwick 2002). PAH concentrations on the particles collected in these traps were over 40 ppm verses that in the underlying sediment which was around 1-3 ppm (Apitz and Chadwick 2002). In the short term, material is the sediment trap should be similar compositionally to that in the surface sediment unless transported laterally, abiotically changed (e.g. diffusion, resuspension), biodegraded in the bottom boundary layer, or subducted into the sediments and buried or biodegraded. Long term processes involving lateral transport and resuspension are not likely at this site given the low flow and reduced surface water input into this area in San Diego Bay, but they cannot be ruled out. The importance of abiotic diffusion relative to PAH mineralization was measured in this project and will be reported elsewhere (Apitz and Chadwick 2002). Sediment trap material could be trapped in the bottom boundary layer and periodically resuspended from storm events or ship traffic and eventually biodegraded to reduce the PAH concentration from 40 to 1-3 ppm before being buried.

It is possible that water column organic matter and associated PAHs deposit at or near the sediment water interface and are then subducted into the bioturbation zone where they are metabolized by PAH-degrading bacteria in the macrofaunal and meiofaunal burrows. There are several lines of evidence collected in this and related studies to support this hypothesis including:

1) rapid PAH turnover times despite low ambient PAH concentration;
2) higher naphthalene, phenanthrene and fluoranthene mineralization rates in the upper sediments than in the lower sediments;
3) depth of elevated mineralization rates consistent with bioturbation depth estimates from REMOTS analyses (Germano 2002) of surface sediments from both stations;
4) depth of elevated mineralization rates consistent with bioturbation depth estimates from microprobe and ambient nutrient analyses of replicate cores from both stations (Gieskes et al. 2002);
5) calculation of PAH deposition rates based on sediment trap data and PAH mineralization rates from the core indicate that the difference in PAH concentration can be accounted for by the bioturbation depths measured for station P04.

In summary, elevated bacterial mineralization of the PAHs, naphthalene, phenanthrene, and fluoranthene were associated with areas of the sediment that appear to be more bioturbated based on analyses using REMOTS (Germano 2002) and microprobe profiles (Gieskes et al. 2002). PAH deposition rates determined using sediment trap analyses (Apitz and Chadwick 2002) are consistent with PAH biodegradation rates measured for the top cm at station P04 that was more bioturbated and was consistent with that measured for the top 12 cm in the less bioturbated station, P17. It should be cautioned that though the relationships between bacterial activity and parameters measured on replicate cores appear interpretable, they are not absolute. Because this research involves field work on collected submerged sediment samples, the sampling locations are collected shipboard and so they are approximate. The REMOTS camera analyses demonstrated an extremely high heterogeneity in bioturbation depth over the scale of meters and even within one image (Germano 2002). Replicate cores used in a preliminary site survey were widely variable in the parameters measured in the microprobe analyses (Gieskes et al. 2002). In addition, essentially one time point was evaluated and is being extrapolated to annual PAH transport and degradation. Extrapolation of these measurements to longer time frames and across larger sediment study sites will likely reduce their relevance to describing *in situ* conditions, but this is a limitation of all necessary field work. Confidence in our understanding of PAH transport and biodegradation in marine sediments will come with iteration of these field measurements seasonally and over different ecosystems (Madsen 1998).

5.6 DERIVED MINERALIZATION RATES FOR OTHER PAHS

Introduction

Instantaneous mineralization rates for three radiolabeled PAH spikes, naphthalene, phenanthrene and fluoranthene, were measured in the field as described in Section 5.5 above. These three PAHs are commonly studied in tests as labeled standards are readily available, degradation rates are generally measurable, and the PAHs have reasonably good solubilities, making them relatively easy to measure and spike into test tubes without using large volumes of potentially toxic solvents. However, these PAHs are only three of the hundreds of PAHs that can be found in fuels and environmental samples. In Paleta Creek sediment trap and core samples, these three PAHs make up only 3-~20% of the tPAH concentration, based upon the 46 PAHs measured (see Figure 5-72). Thus, whilst instantaneous mineralization rates for three PAHs are quite indicative of the presence and activity of PAH degraders in surface sediments, they may not provide definitive information on the turnover rates for all the PAHs in the sediment, which can differ dramatically in terms of bioavailability and degradability.

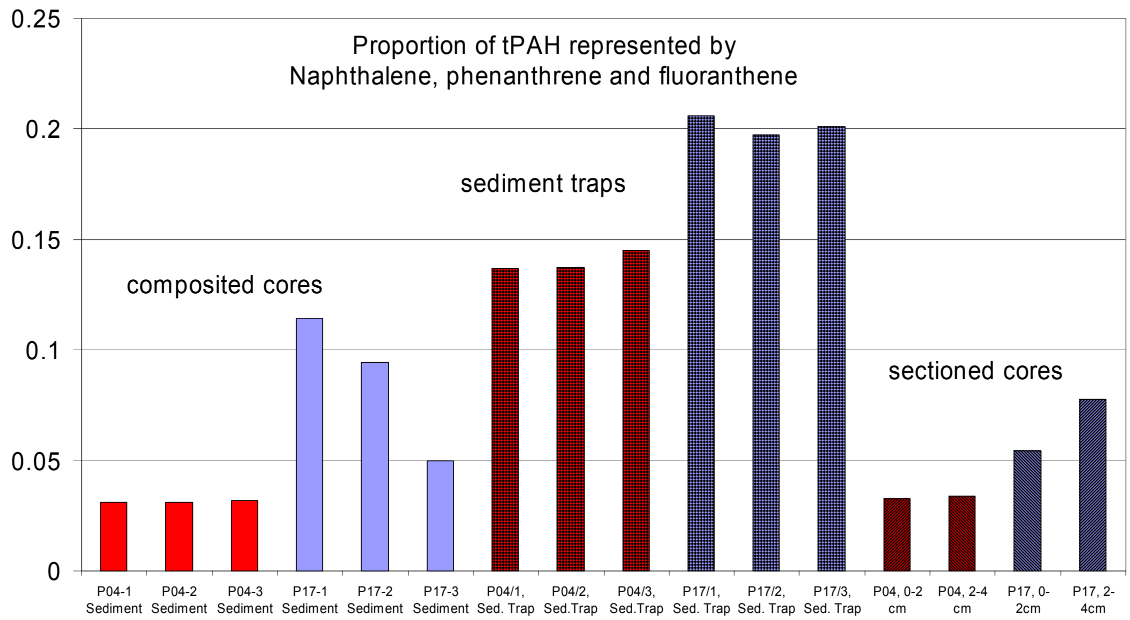


Figure 5-72. Proportion of tPAH represented by naphthalene, phenanthrene and fluoranthene in P04 and P17 composited core, trap and sectioned core sediment samples.

Results and Discussion

In Paleta Creek sediments, it was possible to exploit differences in PAH patterns in trap and surface sediments to attempt to derive mineralization rates for other PAHs in the sediments. Examination of Figure 5-73 reveals that there is a significant change in PAH distributions from the time that they settle in the traps to when the are found in surface sediments: 1) There are lower concentrations of the lighter, more volatile, more soluble PAHs than there are the heavier, more particle reactive and possibly less degradable PAHs. In all cases, what ends up in particles (either in traps or in the bed) is the result of what was in solution, what partitioned onto particles and what is not degraded. 2) There are lower concentrations of most PAH congeners in the surface sediments than in the traps 3) The signatures are not the same in the traps and the surface sediments. In the traps, parents (unsubstituted PAHs) generally are more abundant than children (substituted PAHs), where they are detectable. In the surface sediments, this dominance shifts. A number of processes might be able to explain the shift from trap to bed. The more volatile PAHs are probably lost, the more soluble are dissolved, and the more degradable are degraded. Whilst some differences in grain size, organic content and/or surface area might explain some of these shifts, no attempts to normalize these could explain the offset. The traps have somewhat higher OC than the surface but lower SSA, so it is hard to separate out these effect. However, the offsets in metals concentrations between traps and surface sediments (Figure 5-75) is much less than in PAHs, suggesting that these are not the controlling parameters.

Close examination of "families" of PAHs suggests that the more degradable "parent" PAHs are lost to a greater extent than the less degradable, but similarly soluble and volatile substituted "children". Such a shift can be indicative of biodegradation, rather than the other physical processes that can cause shifts in PAHs during weathering.

In Figure 5-74, the average PAH concentration in trap sediments is divided by the average in surface sediments. This gives some insight into the biological and physical processes that may happen to the PAHs after deposition. In general, the more soluble and volatile PAHs (note the naphthalenes) tend to have a higher ratio than the heavier, regardless of degree of substitution, suggesting a function of the Henry's constant – volatility and solubility. Note that the heaviest, least soluble, least degradable PAHs have a ratio, in general, close to 1, suggesting that the physical processes such as grain size, etc. are not important, but rather that other selective processes may be. However, there is another clear effect. A focus on the phenanthrene/anthracene or the other families reveals a shift that is sometimes considered a "classic" pattern suggesting biodegradation. As can be seen, the ratio for phenanthrene is very high, suggesting that there has been a dramatic loss of phenanthrene during settling and deposition. This is in line with the very high turnover rates that are seen in the instantaneous phenanthrene mineralization rate studies. However, this ratio rapidly drops off for the substituted constituents, coming near unity at the most substituted. This pattern can be seen in the other families as well, though not quite as obvious.

This shift in PAH was exploited to derive relative mineralization rates, which were then normalized to the field-measured phenanthrene mineralization rates. This assumes that changes in PAH histograms can be attributed solely to mineralization, and that these rates can be applied to flux calculations. Based upon the significant differences in PAH concentrations in PAH signatures and concentrations, and the rapid mineralization rates measured in the field tests, these are reasonable assumptions for the less volatile PAHs, but whether they are directly "true" would be difficult to prove.

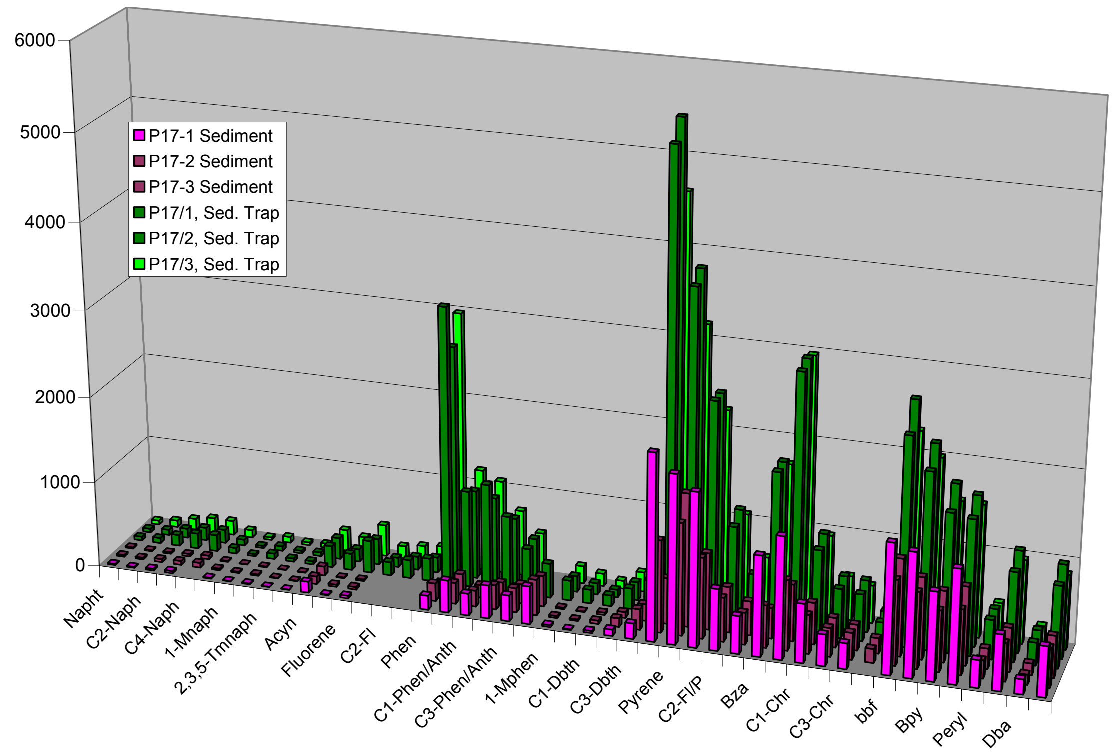


Figure 5-73. PAH signatures in sediments from P17 traps and surface sediments.

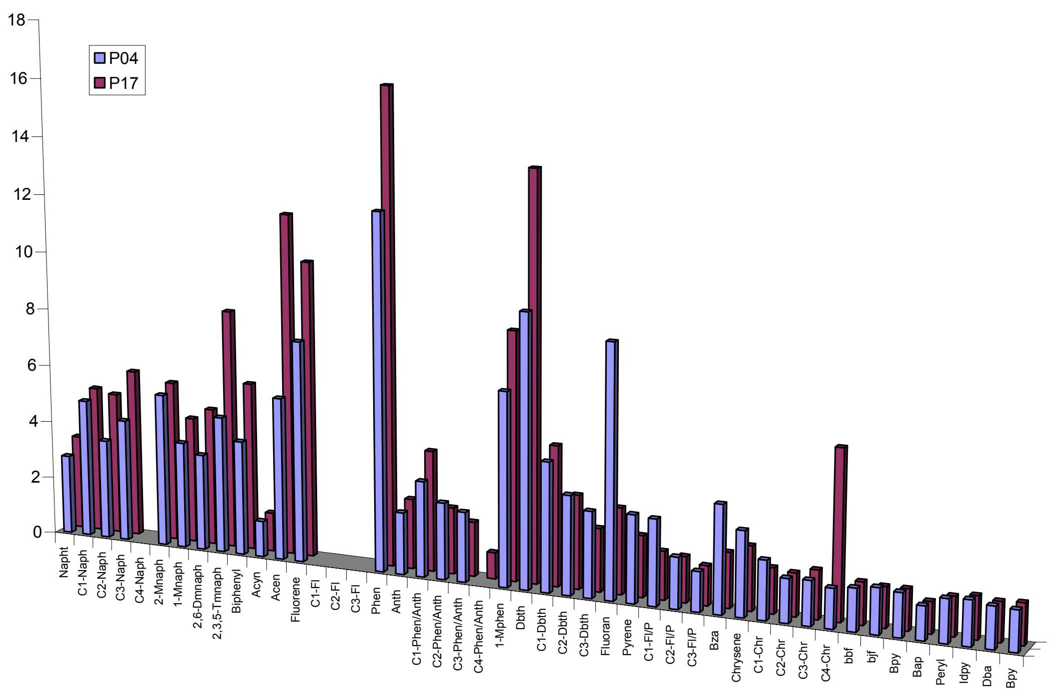


Figure 5-74. Ratio of PAH concentrations in Traps vs. in surface sediments.

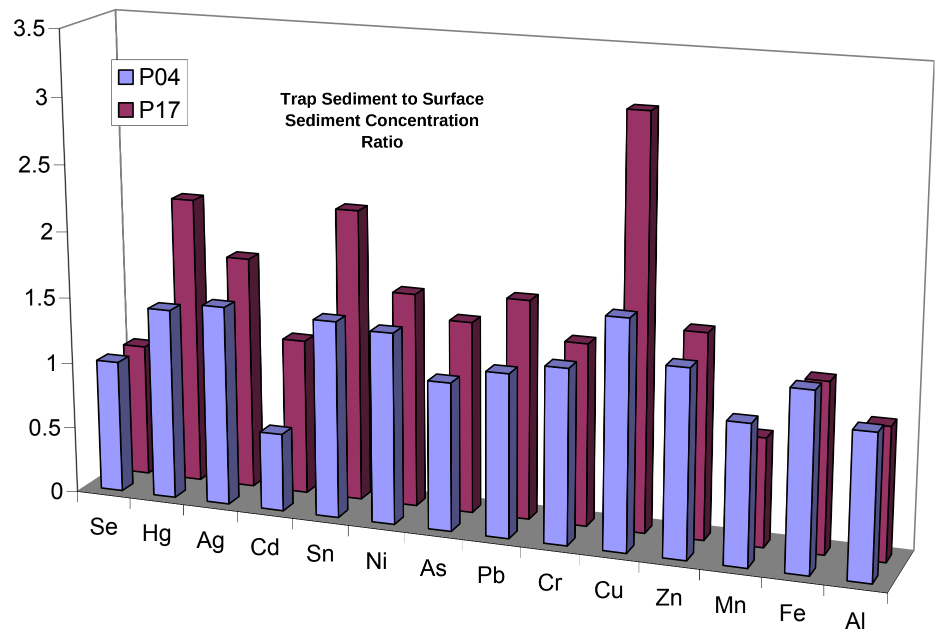


Figure 5-75. Ratio of metals in sediment trap sediments vs. surface sediments.

The calculated surface mineralization rate for a given PAH, then, or $R_{DSURF(calc)}$ is calculated as

$R_{DSURF(calc)} = R_{DSURF(phen)} * ((C_{PAH(trap)}/C_{PAH(surf)})/(C_{phen(trap)}/C_{phen(surf)}))$

Similarly, the calculated depth-averaged mineralization rate $R_{DH(calc)}$ is calculated based upon the depth-averaged phenanthrene mineralization rate and the trap/surface PAH rations:

$R_{DH(calc)} = R_{DH(phen)} * ((C_{PAH(trap)}/C_{PAH(surf)})/(C_{phen(trap)}/C_{phen(surf)}))$

Whilst it is not possible to confirm these calculations for most PAHs, a check was done by comparing $R_{DSURF(calc)fluor}$ with the measured $R_{DSURF(fluor)}$. The value for fluoranthene measured by NRL was 1857 ng/cm^2/yr, and the value calculated as above was 1977 ng/cm^2/yr, a reasonable match. Table 5-27 shows the derived surface and depth-averaged mineralization rates for all the PAHs.

Table 5-27. Derived surface and depth-averaged mineralization rates for all the PAHs. Directly measured rates (naphthalene, phenanthrene and fluoranthene) are highlighted in yellow.

	$ng/cm^3/y$	$R_{DSURF(calc)}$		$R_{DH(calc)}$	
		mean	Std	mean	Std
P04	Naphthalene	0.00	0.00	193.21	432.03
	Acenaphthylene	38.70	5.28	27.31	12.77
	Acenaphthene	1039.90	142.00	733.78	343.26
	Fluorene	1295.64	176.92	914.24	427.68
	Phenanthrene	2869.33	391.81	2024.69	947.14
	Anthracene	303.57	41.45	214.21	100.20
	Fluoranthene	1856.57	294.53	2065.22	2591.21
	Pyrene	753.34	102.87	531.58	248.67
	Benzo(a)anthracene	632.77	86.40	446.50	208.87
	Chrysene	511.51	69.85	360.94	168.85
	Benzo(b)fluoranthene	173.49	23.69	122.42	57.27
	Benzo(k)fluoranthene	173.49	23.69	122.42	57.27
	Benzo(e)pyrene	208.99	28.54	147.47	68.99
	Benzo(a)pyrene	67.12	9.16	47.36	22.15
	Perylene	214.48	29.29	151.35	70.80
	Indeno(1,2,3-c,d)pyrene	197.74	27.00	139.53	65.27
	Dibenz(a,h)anthracene	154.73	21.13	109.18	51.07
	Benzo(g,h,i)perylene	158.17	21.60	111.61	52.21

	$ng/cm^3/y$	$R_{DSURF(calc)}$		$R_{DH(calc)}$	
		mean	Std	mean	Std
P17	Naphthalene	194.22	274.66	116.87	151.99
	Acenaphthylene	112.56	77.66	51.70	59.76
	Acenaphthene	846.70	584.20	388.93	449.51
	Fluorene	572.03	394.68	262.76	303.69
	Phenanthrene	853.96	589.20	392.26	453.36
	Anthracene	167.08	115.28	76.75	88.70
	Fluoranthene	235.94	104.15	103.86	116.14
	Pyrene	83.35	57.51	38.28	44.25
	Benzo(a)anthracene	103.54	71.44	47.56	54.97
	Chrysene	93.75	64.69	43.07	49.77
	Benzo(b)fluoranthene	36.50	25.18	16.77	19.38
	Benzo(k)fluoranthene	36.50	25.18	16.77	19.38
	Benzo(e)pyrene	30.05	20.73	13.80	15.95
	Benzo(a)pyrene	17.88	12.33	8.21	9.49
	Perylene	24.18	16.68	11.11	12.84
	Indeno(1,2,3-c,d)pyrene	32.71	22.57	15.02	17.36
	Dibenz(a,h)anthracene	31.27	21.58	14.36	16.60
	Benzo(g,h,i)perylene	27.51	18.98	12.64	14.60

5.7 FIELD DEPLOYMENT OF VIMS SEA CAROUSEL FOR QUANTIFYING CONTAMINANT LOADING TO SURFACE WATERS

Introduction

Pollutants from contaminated marine sediment that settled on the sea floor may have many ways to re-enter the water column above. As the consequence, an originally inactive source of pollutants may become active again and causes concern. The possible mechanisms that can carry pollutants away from their buried locations may include advection from ground water flow, pure diffusion within sediment, redistribution caused by bioturbation, and sediment erosion caused by physical forces. To evaluate the importance of each possible pathway, an index equation that represents all the possible processes has been proposed as follows.

$$\sum flux = F_{dc} + F_{dc} + W(C_o - C_H) + R_d H + E_{eff} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1\text{-}1)$$

where F_{dc} is the chemical diffusion term, F_{dc} is the bioturbation term, $W(C_o - C_H)$ is the ground water advection term, R_dH is the chemical degradation term, and the last term represents the net effect (or the effective erosion rate) from solid phase dynamics: erosion and deposition. This report is concentrated on one of the solid phase dynamics, erosion, with a limited discussion on deposition. We started with the traditional approach on how to address the erosion rate, and then, tried to address the effective erosion rate with suggested approaches.

Considering the complex of nature marine environment, it is not a simple task to obtain a reliable estimation on each process mentioned above. *In-situ* measurements would be the best approach for obtaining this information because only an *in-situ* approach can minimize the possible error caused by changing experimental environments.

Sediment erosion process itself is not a well-understood process yet because of the significant variation among sediment composition, consolidation history, ambient water conditions, and benthic bio-activities (Wright *et al.*, 1997). In other words, each system may have a different response because of the varying natural environments. Thus the best way to study sediment erosion characteristics is by carrying out i*n-situ* experiments. All of the controlling factors would be the same for an *in-situ* experiment and the possibility of introducing an "art effect" is minimized. For this reason, we conducted the field experiments using the VIMS Sea Carousel (Maa *et al.*, 1993) to address sediment erosion behavior in the San Diego Bay.

Methods

Two sites (P04 and P17) were selected for *in-situ* erosion experiments (Figure 5-76). The coordinates for Site P04 are 32^o 40.287" N and $117\,^o$7.2984" W with a water depth of 34 ft. For Site P17, the coordinates are 32^o40.417" N and $117\,^o$06.967" W with a water depth of 25 ft. Sediment samples collected from these two sites reveal that sediment at Site P17 has more coarse material (39% clay, 30%silt, and 31% sand) than that at Site P04 (51% clay, 31% silt, and 18% sand). Because the clay content at both sites are more than 20%, the erosion process is controlled by the electric static force between clay particles rather than the gravity force.

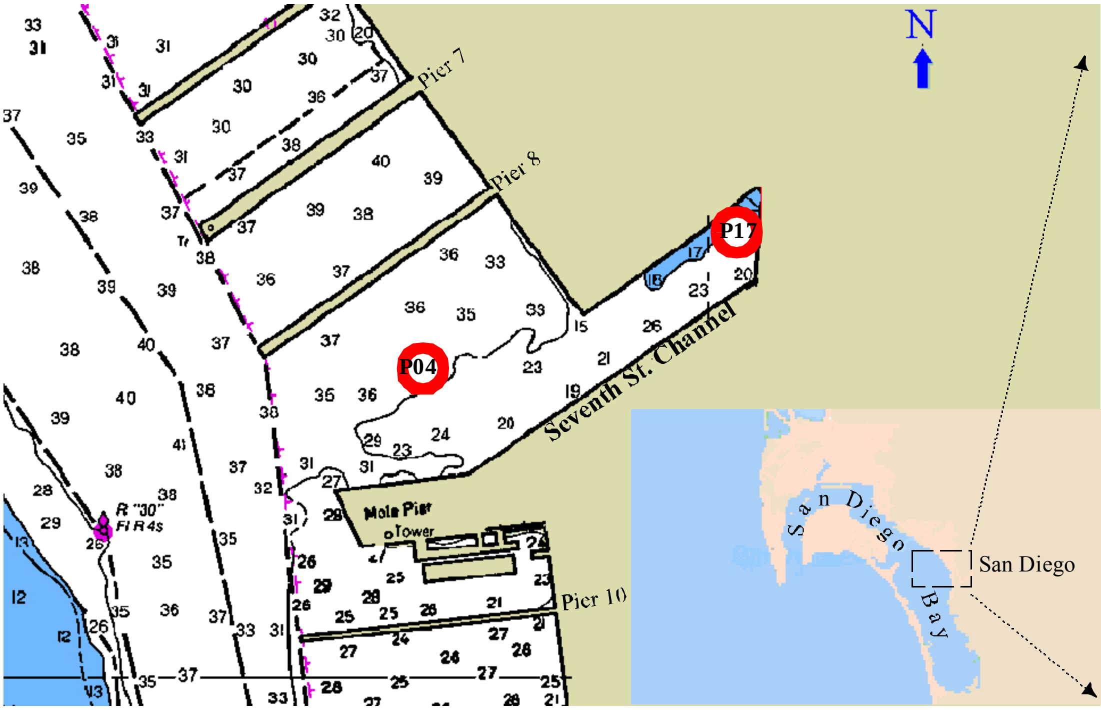


Figure 5-76. VIMS Sea Carousel experiment sites in San Diego Bay.

The VIMS Sea Carousel (Figure 5-77) is an annular flume for field experiments. It has an inside diameter of 2.0 m and an outside diameter of 2.3 m. The cross section (width x height) is 0.15 m x 0.1 m (Figure 5-78). The driving force is provided by a rotation ring on the top of the flume. The response of the seabed (*e.g.*, erosion), and consequently, the change in suspended sediment concentration (SSC) within the flume, is measured by an Optical Backscatter Sensor (OBS, Downing, 1983) mounted at the middle elevation of the inner wall.

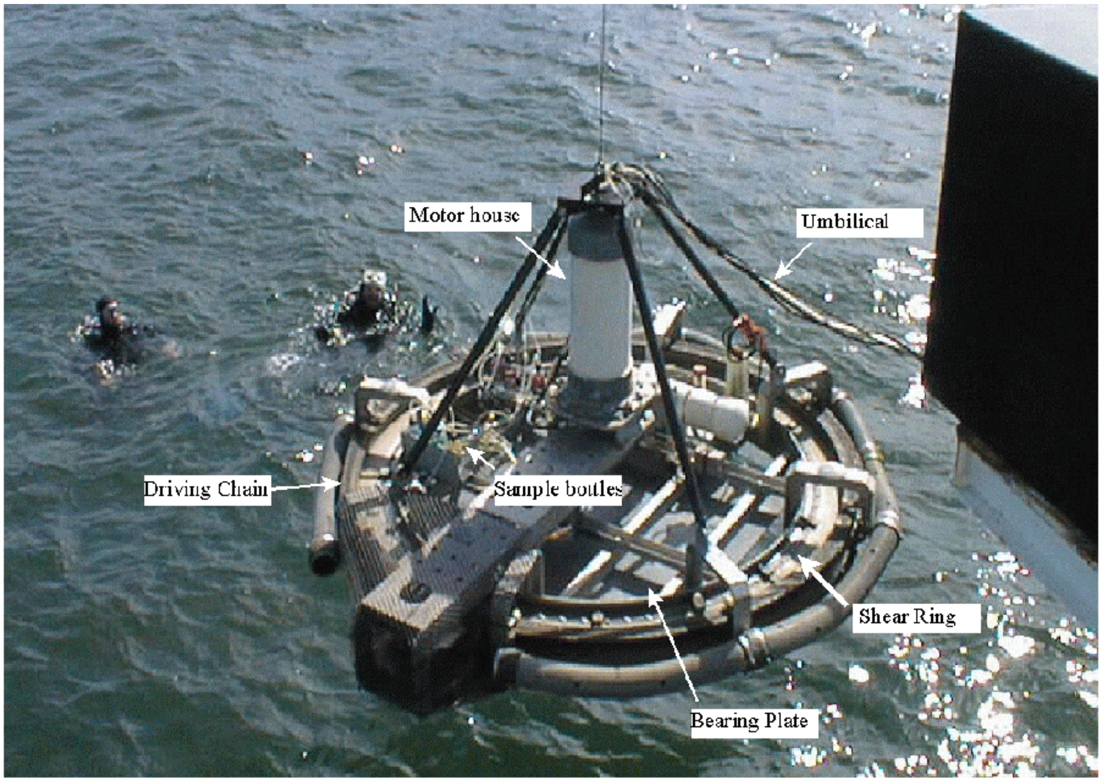


Figure 5-77. VIMS Sea Carousel during a deployment in San Diego Bay.

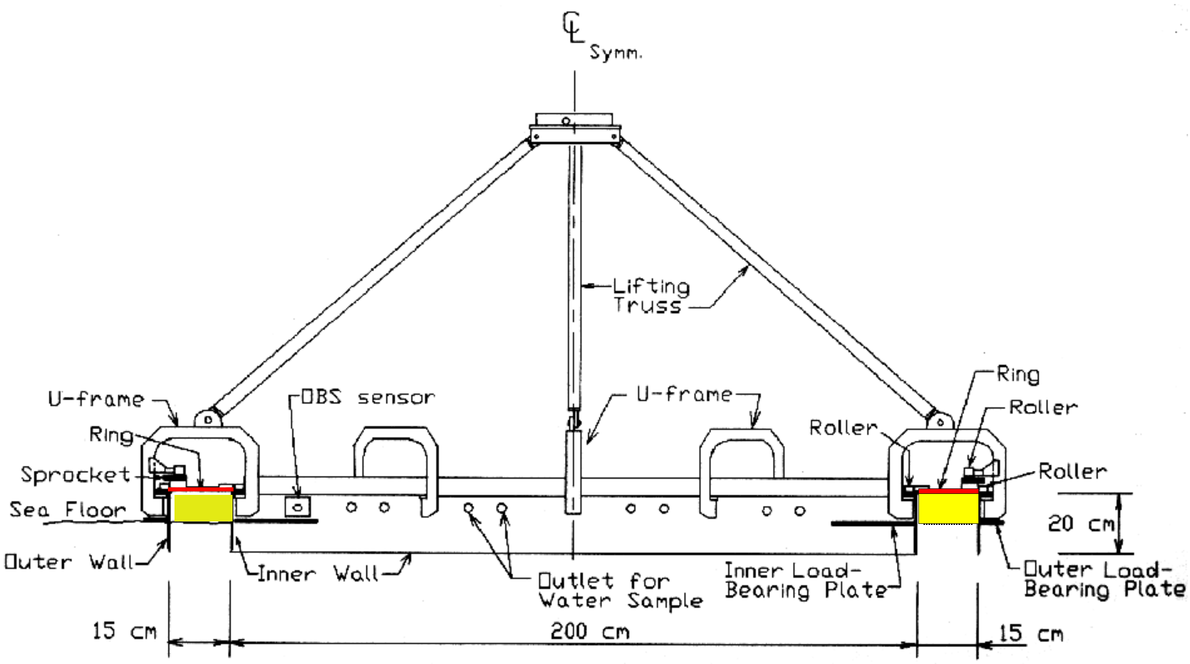


Figure 5-78. General structure of the VIMS Sea Carousel.

The carousel was lowered into the water slowly to allow the build up of air pressure in the motor house to prevent water intrusion. It used its own weight (about 200 kg in water) to penetrate into the sea floor and build up an annular flume. A bearing plate prevented it from sinking into soft mud beds. Deployment of the carousel was usually carried out during a slack tide with care not to seriously disturb the bottom fluffy sediment.

The spatial-averaged bed shear stresses, τ_b, caused by the rotating ring can be calculated as $\tau_b = 0.0114\ \Omega^{1.693}$, where τ_b is in Pascal (N/m^2) and the ring speed (Ω) is in rpm (Maa, 1993; Maa *et al.,* 1995). The actual ring speed was calibrated with the motor controller's speed reading (Figure 5-79). The maximum spatial variation of τ_b is about 15% of the average value at a large bed shear stress, 0.8 Pa. For smaller τ_b, the spatial variation is smaller.

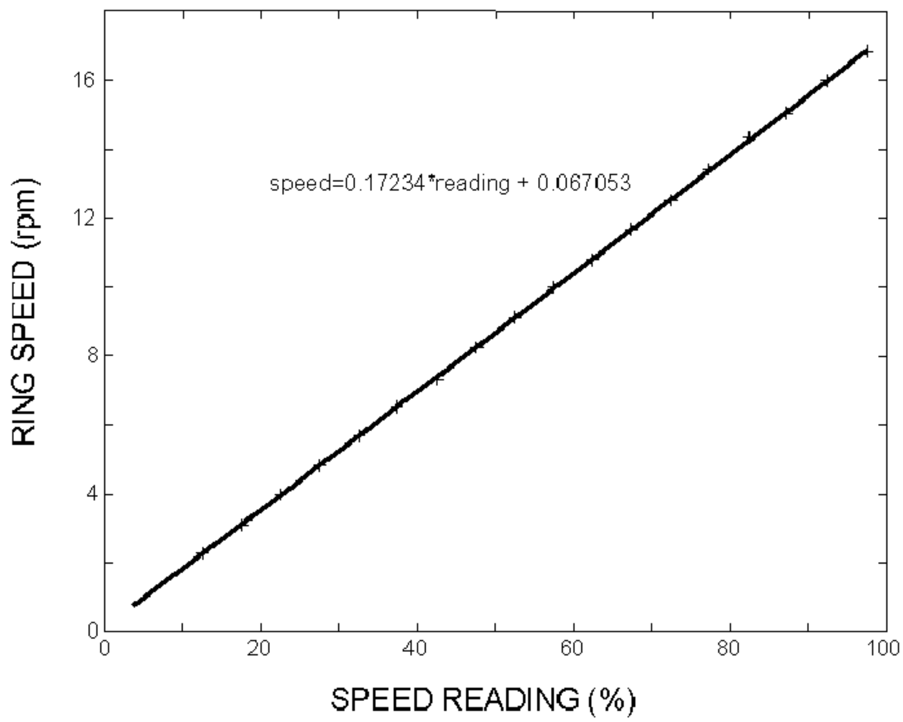


Figure 5-79. Calibration of ring speed versus speed reading.

The OBS was calibrated using an *in-situ* calibration procedure because the response of OBS is very sensitive to the grain size in suspension. Water samples for calibrating the OBS was taken while the carousel was in operation. Details of the *in-site* OBS calibration procedures were given in Maa *et al.* (1993) and the results of OBS calibration at San Diego Bay sites are given in Figure 5-80.

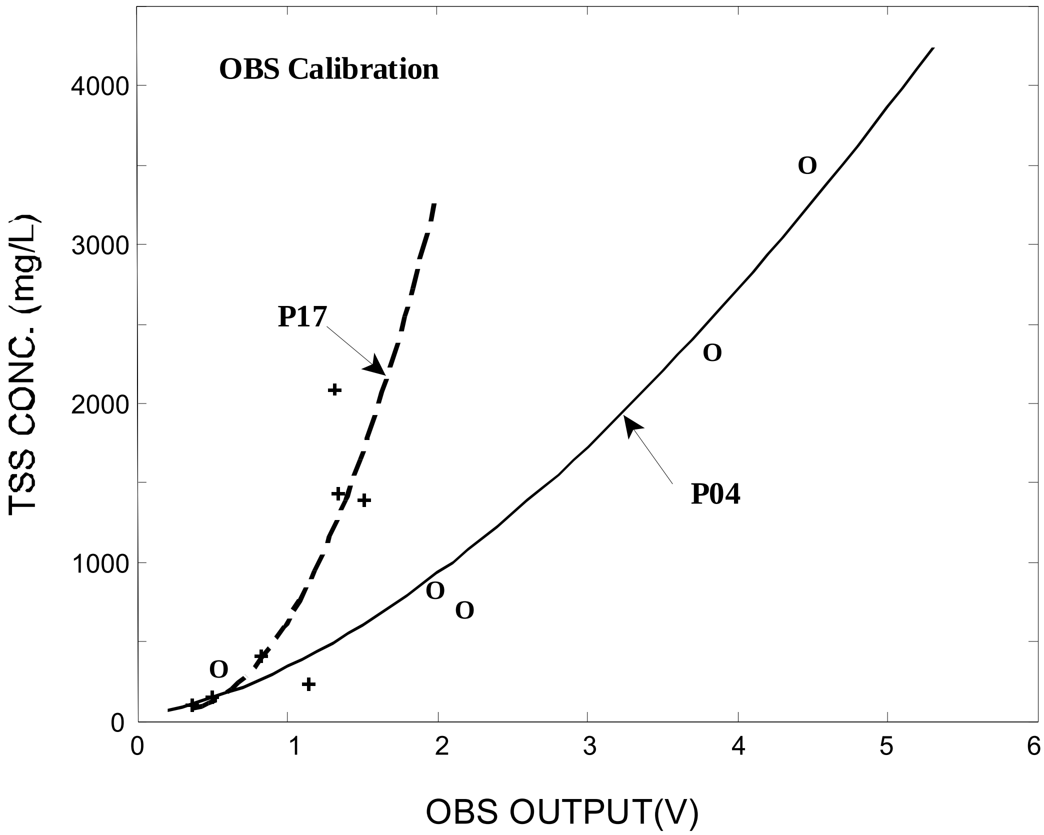


Figure 5-80. OBS calibration curves for Site P04 and P17. Sediment suspended in the flume is much finer at P04 compared with that at P17.

There are two types of tests at each site: an incipient test and an erosion rate test. The incipient test starts with a small τ_b and uses a small increment of τ_b (*e.g.*, $\tau_{b1} = 0.02$ Pa and $\Delta\tau_b < 0.02$ Pa) to identify the critical bed shear stress (τ_{cr}) at the water-sediment interface, z = 0. The erosion rate test starts with a relatively large τ_b and uses a large and unequal $\Delta\tau_b$ (*e.g.*, $\tau_{b1} = 0.2$ Pa and $0.05 < \Delta\tau_b < 0.2$ Pa) to find erosion rates. All the operation parameters (ring speeds and durations) were pre-programmed and only minor modification was possible during the experiment. Details of the criterion for selecting the critical bed shear stress and the method for finding the erosion rates are given in this report. They can also be found in Maa and Lee (1997), and Maa *et al.* (1998).

We have completed many field deployments in both the Upper (Maa, *et al.*, 1998) and Lower Chesapeake Bay sites (Maa and Lee, 1997), on the inner shelf of the Atlantic Bight near Duck, North Carolina (Maa *et al.*, 1993), and in the Anacostia River (Maa *et al.*, in prep.). These experiments have shown that the VIMS Sea Carousel is a reliable instrument for carrying out field experiments in shallow water areas (up to 20 m). It is possible to do this kind of experiment at a water depth up to 50 m without major modifications.

Results

Critical Bed Shear Stress at Sediment Surface

The Total Suspended Solid (TSS) concentration inside the carousel changes only when the applied bed shear stress is large enough to stir up sediment from the bed. However, it is impossible to notice the change of TSS unless the change is significant. Because of the high background concentration on TSS at field, more than 70 mg/L in our cases, we have to select 5 mg/L as the noticeable change of TSS. When the change of TSS is more than this critical level (5 mg/L) and continue to increase for the next few higher bed shear stresses, we then defines the average of the two successive bed shear stress that cause the noticeable change on TSS is the τ_{cr} at the sediment surface. This critical value is rather subjective, but it well serves the purpose.

Figure 5-81 shows the results of our first measurement of the critical bed shear stress, ϑ_{cr}, at the sediment surface at Site P17. The first bed shear stress, 0.03 Pa, although small, stirred up surficial fluff and caused a temporary raise of the TSS reading (Figure 5-81). The readings, however, decreased slowly until the end of the seventh bed shear stress, 0.085 Pa. The next six higher bed shear stresses, from 0.1 to 0.155 Pa, could not further increase the TSS significantly. When the bed shear stress increased to about 0.19 Pa, we notice a clear increase of TSS more than 5 mg/L. Thus, we selected the average bed shear stress, 0.17 Pa, as the τ_{cr} for incipient motion at bed-sediment surface for this site.

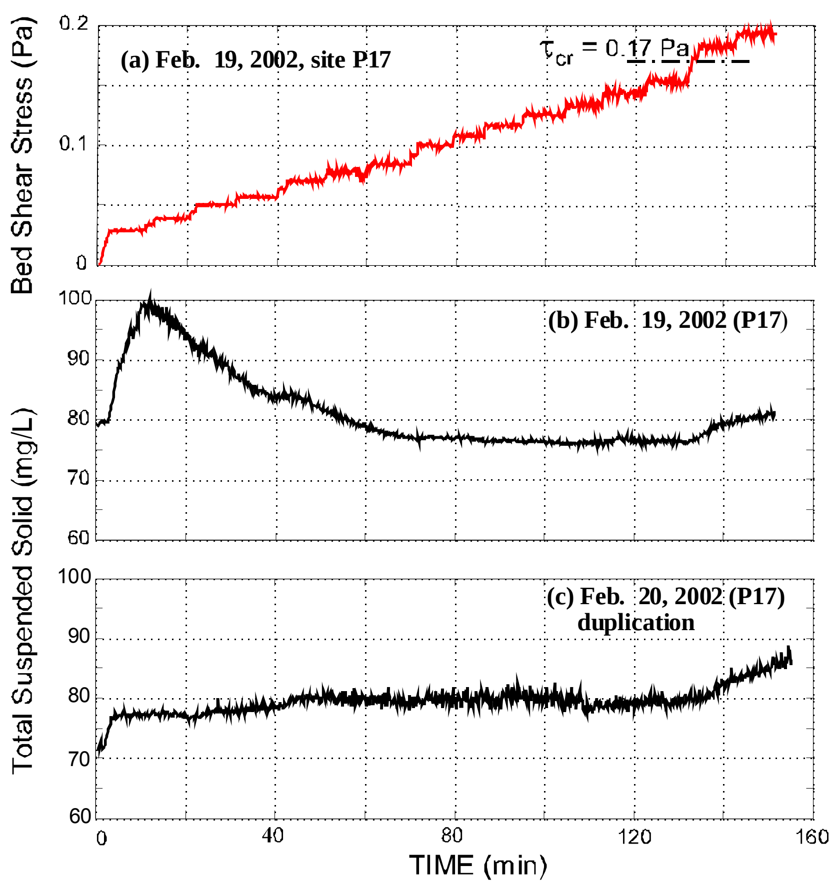


Figure 5-81. Experiment to measure the critical bed shear stress at the bed surface for site P17.

After the experiment for measuring τ_{cr} at the sediment surface, we immediately began the experiment for measuring the erosion rate. However, we will show the details of the erosion rate experiment later. Here we will proceed to report the results of a duplicate incipient test that was performed after the erosion rate experiment.

After the erosion rate experiment, we lifted the Sea Carousel and moved the R/V Ecos about five meters. The Carousel was then redeployed for a duplication test. The results are given in Figure 5-81. This time, however, we did not see the initial big plume generated during the first few bed shear stresses. The TSS concentration inside the carousel increased a little, but then maintained at a near-the-same level until $\tau_b = 0.19$ again. Thus, the same conclusion of $\tau_{cr} = 0.17$ Pa was obtained. This duplication is a demonstration of the repeatability of the experiment. We have conducted another duplicate experiment at Site P04, and found a consistent result.

The incipient erosion experiment carried out at Site P04 also found that $\tau_{cr} \approx 0.17$ Pa at this site (Figure 5-82). For the first experiment, a rise of TSS reading at the elapsed time = 20 minutes indicated that there is a partially consolidated layer with an erosion resistance about 0.04 Pa. Another sharp rise at the elapse time = 42 minutes might indicate a local erosion because it is a rather isolated event. Because of the decreasing TSS after these two events, we have to declare that $\tau_{cr} = 0.17$ Pa. The response of seabed is slightly different for the duplicate experiment at this site. For the elapsed time between 40 and 80 minutes, it seemed there is a partially consolidated sediment layer with an erosion resistance less than 0.1 Pa. After 80 minutes, this layer is probably nearly depleted, and thus, the TSS concentration only increased slightly even the τ_b increased from 0.1 to 0.15 Pa. Notice that there were significantly more fluffs at this site which contributes to the generation of a rather large plume spike at the beginning.

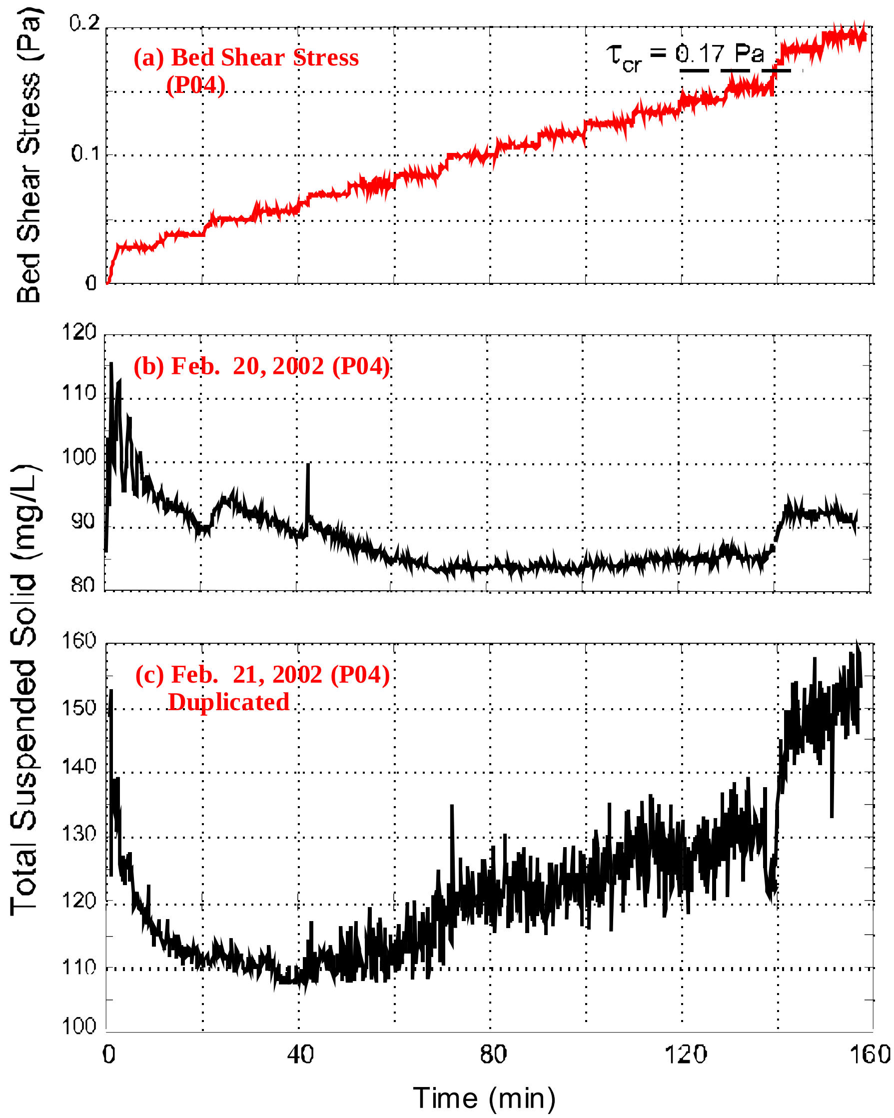


Figure 5-82. Experiments to measure the surface critical bed shear stress at site P04.

Erosion Rate Experiments

The first erosion rate experiment was conducted at Site P17. The Flume was deployed using the R/V Acoustic Explorer which has the lifting capability to deploy the VIMS Sea Carousel with a weight about 700 kg in air. After deployment, the control and monitoring system was transferred to a smaller R/V Ecos. Details of the applied shear force and bed response observed by the OBS are given in Figure 5-83.

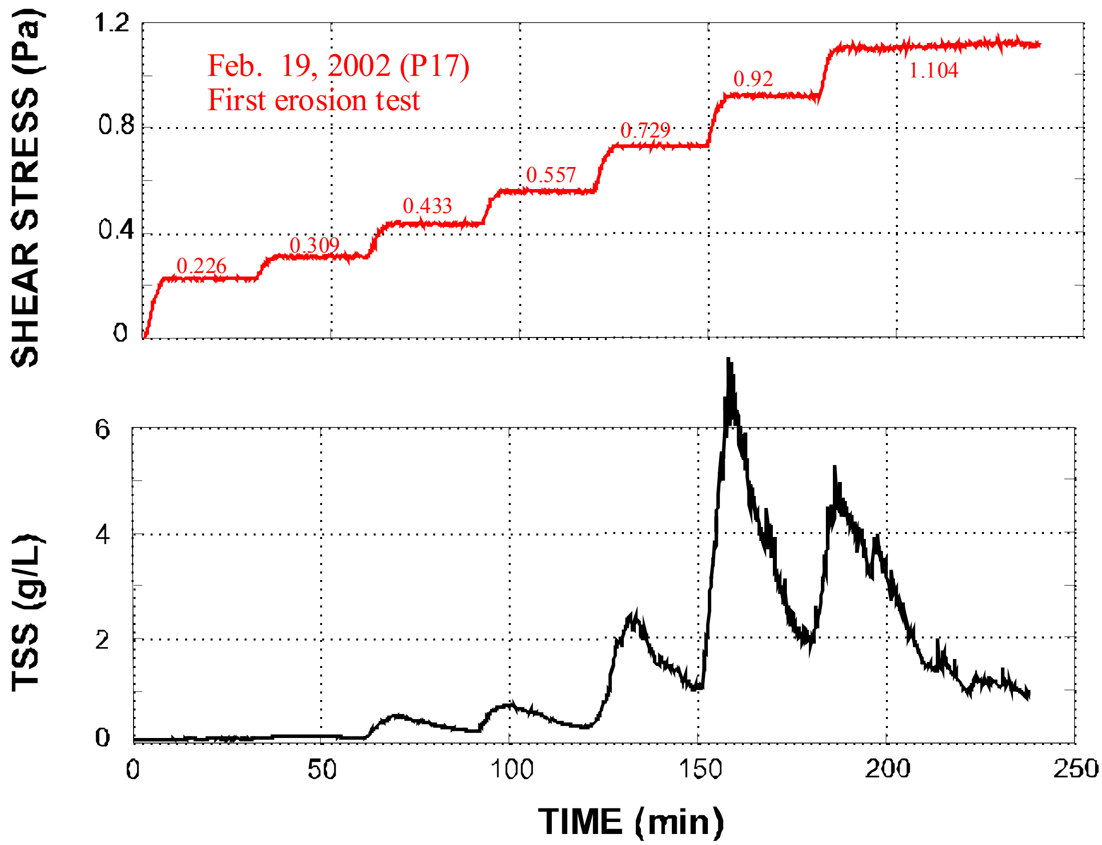


Figure 5-83. Bed shear stresses and bed responses during the erosion test at site P17. Numbers in the shear stress diagram are the average bed shear stresses.

As mentioned in the previous chapter, we have designed a duplicate experiment for the incipient experiment. We also tried to duplicate the erosion rate experiment. Because of time limitation, however, the duplication was changed with only three bed shear stresses (Figure 5-84) and the 3rd bed shear stress was much larger than that for the first experiment (*i.e.*, 0.59 Pa instead of 0.443 Pa). Thus the bed response is significantly different because of a much large excess bed shear stress.

Experimental results for the other site (P04) are given in Figure 5-85 and Figure 5-86. A noticeable feature at this site is that the TSS concentration is not as high as that for Site P17. The OBS sensor saturated much fast at this site. This indicates that the suspended material is much finer at this site compared with that at Site P17. A comparison of the OBS readings between these two sites (Figure 5-87) shows the difference more clearly.

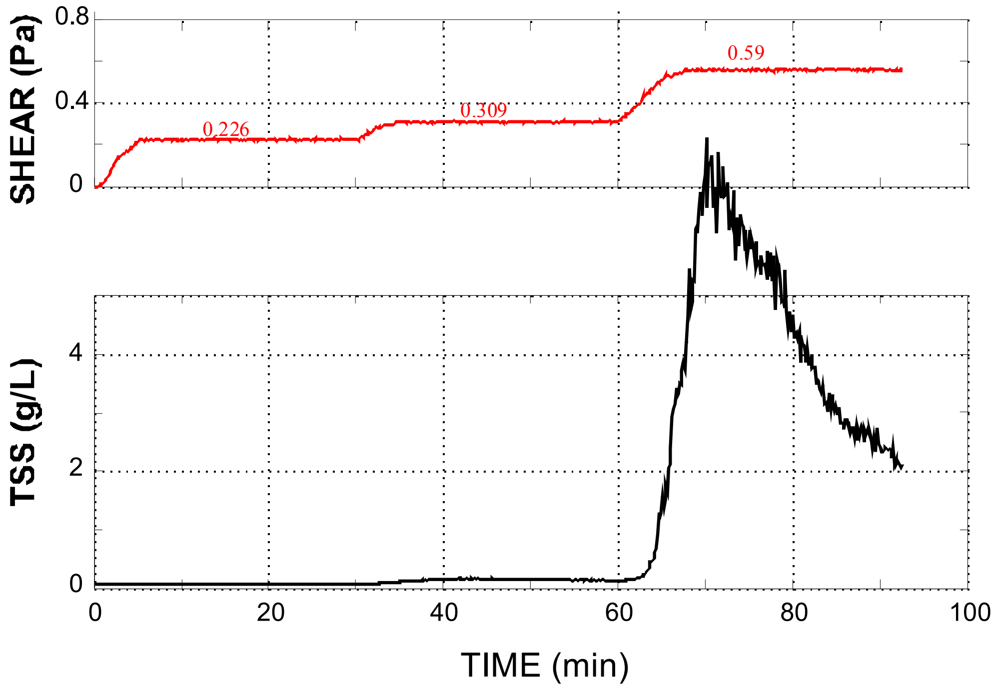


Figure 5-84. A duplicate erosion test at site P17. Numbers in the shear stress diagram are the average bed shear stress.

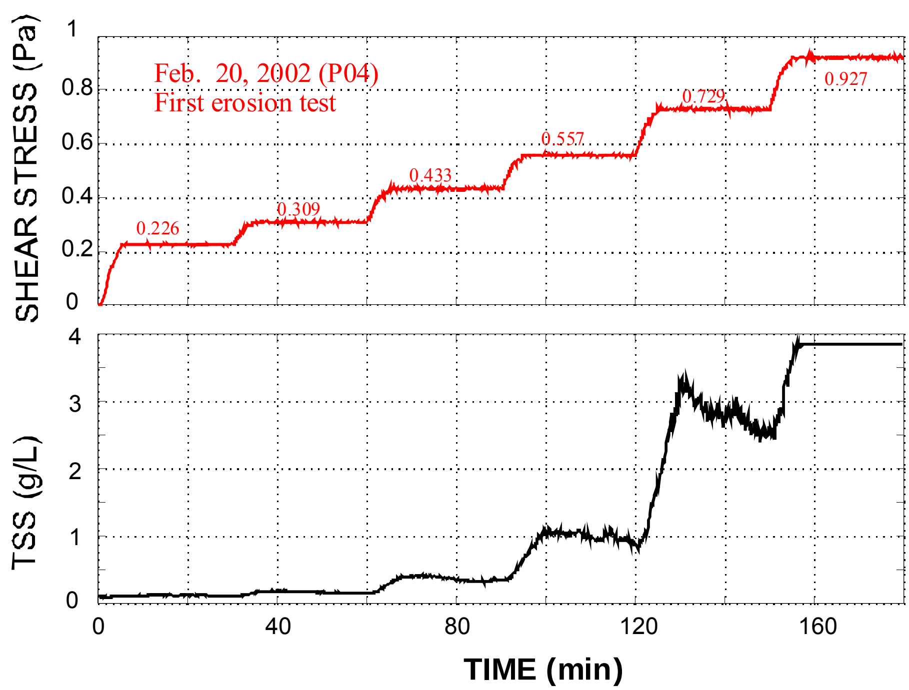


Figure 5-85. Bed shear stresses and bed responses during the erosion test at site P04. The saturation of the OBS at a relatively low TSS value indicates that more fine material was resuspended at this site.

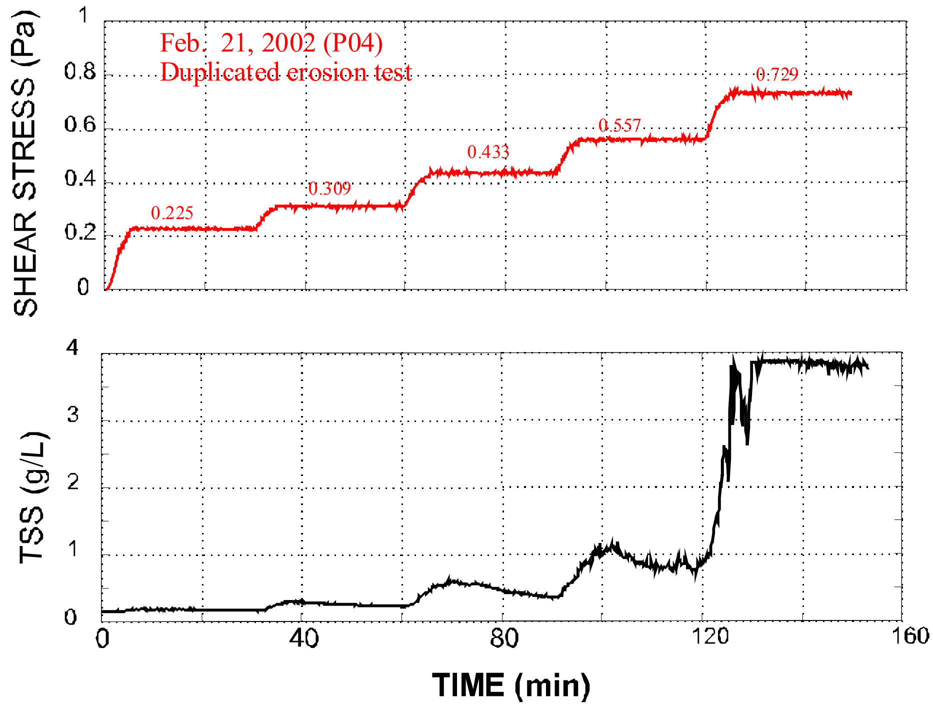


Figure 5-86. A duplicate erosion test at P04. The OBS was saturated after 130 minutes.

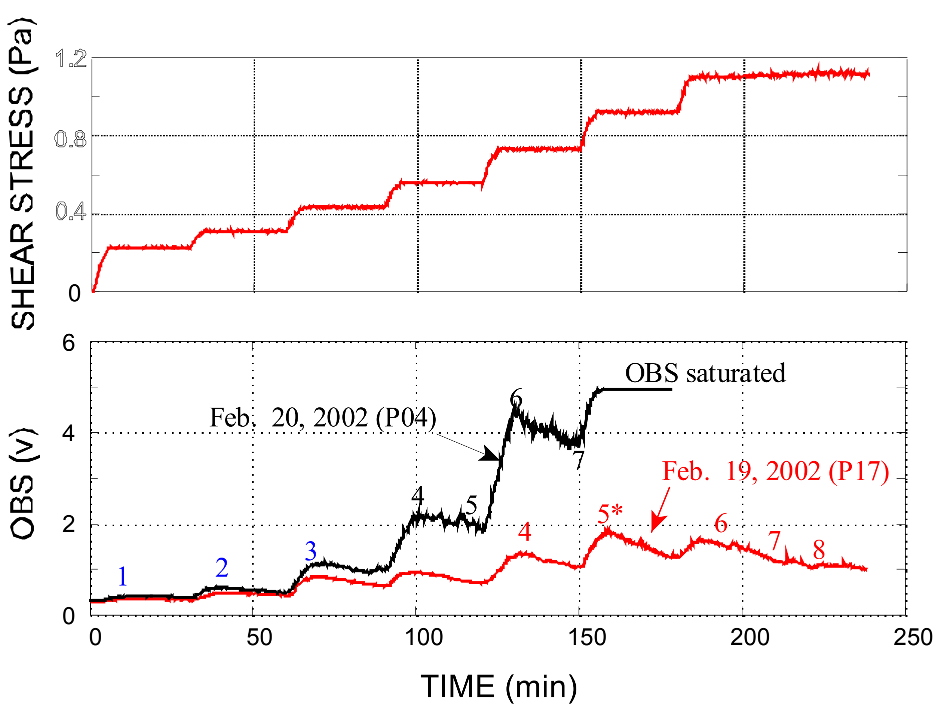


Figure 5-87. Comparison of OBS responses for the two San Diego Bay erosion tests. Numbers in the bottom diagram indicate when a water sample was taken.

Erosion Data Analysis and Results

A general pattern observed from the erosion rate experiments was that within a constant τ_b, the TSSC increased for the first several minutes and then decreased. This phenomenon was also observed in other tests carried out in the Lower Chesapeake Bay (Maa *et al.,* 1993; Maa and Lee 1997, Maa *et al.,* 1998), Anacostia River (Maa, 2002). This phenomenon can be described using Eq. 4-1, which shows the change of TSSC as the result of a decreasing resuspension rate with time (Yeh, 1979; Fukuda and Lick, 1980) and a constant leakage of water from the rotating ring (Lee, 1995).

$$Ah \frac{dc}{dt} = AE_o\, e^{-\lambda t} - c(t)\, Q_L \quad \text{(4-1)}$$

where A (10132 cm^2) is the area covered by the VIMS Carousel, h = 10 cm is the channel depth, c is the TSS concentration in g/cm^3, t is time in seconds, Q_L is the leakage rate of water in cm^3/sec, E_o is a erosion rate constant (in $g/cm^2/sec$), and λ is a time rate constant (in sec^{-1}).

The leakage was caused by the dynamic pressure difference and the imperfect sealing between the rotating ring and the two sidewalls. Since the dynamic pressure is induced by the rotating ring, it is related to the ring speed (*i.e.*, τ_b). Therefore the leakage rate can be assumed as a constant for a given constant τ_b. Lee (1995) showed that the distribution of suspended sediment is almost uniform within the flume for fine-grained sediment. Thus, the leakage of sediment mass can be described as the last term in Eq. 4-1.

The time-decreasing erosion rate (first term on the right side of Eq. 4-1) is the typical "Type I" erosion behavior observed in many laboratories as well as in field experiments for fine-grained sediments (Parchure and Mehta, 1985; Amos *et el.*, 1992). Equation 4-1 indicates that the TSSC will increase ($dc/dt > 0$) if the amount of sediment eroded is larger than the leakage. Otherwise, the TSSC will decrease. Equation 4-1 has an analytical solution as $c = -k_1e^{-\lambda t} + k_2e^{-\beta t}$, where $k_1 = \gamma/(\lambda - \beta)$, $\gamma = E_o/h$, $\beta = Q_L/(Ah)$, $k_2 = k_1 + c_i$, and c_i is the initial concentration for a given constant τ_b. In the above equation, there are three unknown parameters: E_o, λ, and Q_L, which define the erosion process and the leakage rate. To estimate these unknown parameters, least-square fitting techniques using the Nelder-Mead simplex method (Dennis and Woods, 1987) for a nonlinear equation was selected to fit the N concentration data points (c_i and t_i, i = 1, 2, ... , N) within a constant bed shear stress. Details of this method can be found in Maa and Lee (1997). Figure 5-88 and Figure 5-89 shows two examples of least square fitting using data from Site P17 with τ_b = 0.226 Pa and 0.309 Pa. The estimated constants, E_o, λ, and Q_L are also listed in the figures.

Results of the data analysis are summarized in Table 5-28 and Figure 5-90. The time constant, λ, varies between 0.002 and 0.008 and has an average of 0.005 s^{-1} (Figure 5-90). This is an indication that erosion is a fast process because $\exp(-\lambda t)$ approaches zero with $\lambda = 0.005\ s^{-1}$ and t > 1500 seconds (25 minutes). Thus, the erosion process can be considered ceased at the end of all the applied bed shear stresses given in our field experiments. For this reason, the difference between any two successive bed shear stresses given in the second column of Table 5-28 is the excess bed shear stress, τ_{ex} and the measured E_o is the erosion rate, ε, for the τ_{ex}. The relationship between ε versus τ_{ex} is summarized in Figure 5-90.

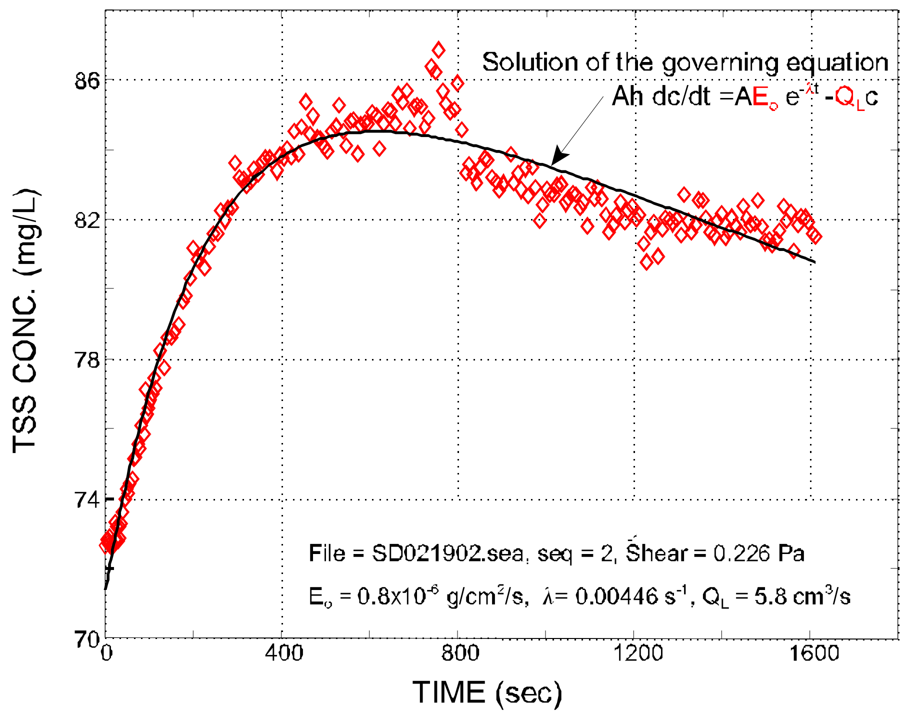


Figure 5-88. Nonlinear curve fitting for finding the constants: E_o, λ and Q_L for τ_b = 0.226 Pa. Diamonds are data and solid line is the regression equation.

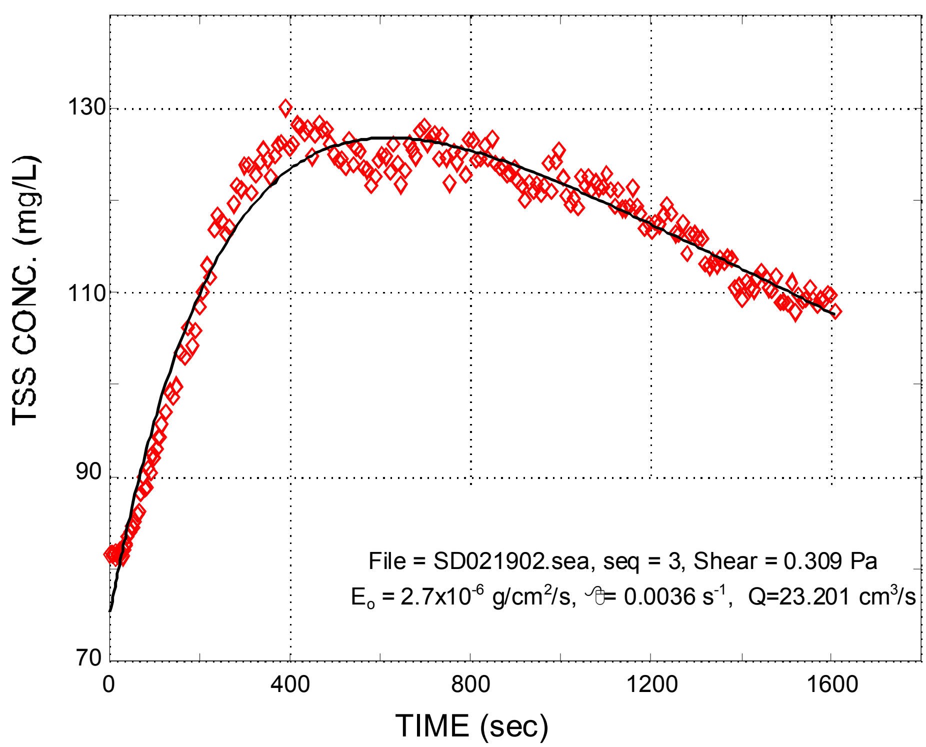


Figure 5-89. Another nonlinear curve fitting for finding the constants: E_o, λ and Q_L for τ_b = 0.309 Pa. Diamonds are data and solid line is the regression equation.

Table 5-28. Results of in-situ erosion rate experiments.

Seq	Shear (Pa)	E_o g/cm^2/s	8 s^{-1}	Q cm^3/s	Remark
1	0.17				p17_1
2	0.226	0.0000008	0.00446	5.912	p17_1
3	0.309	0.0000027	0.00364	23.201	p17_1
4	0.433	0.0000322	0.00489	86.100	p17_1
5	0.557	0.0000456	0.00547	89.023	p17_1
6	0.729	0.0000986	0.00174	176.387	p17_1
7	0.920	0.0004799	0.00514	127.490	P17_1
8	1.104	0.0003221	0.00757	74.119	P17_1
1	0.17				P17_2
2	0.225	0.0000006	0.00368	4.521	P17_2
3	0.309	0.0000044	0.00340	29.653	P17_2
1	0.17				P04_1
2	0.225	0.0000011	0.00204	15.778	P04_1
3	0.309	0.0000070	0.00727	19.854	P04_1
4	0.433	0.0000221	0.00659	24.289	P04_1
5	0.557	0.0000421	0.00454	19.896	P04_1
6	0.729	0.0001306	0.00435	28.007	P04_1
1	0.17				P04_2
2	0.225	0.0000024	0.00538	9.814	P04_2
3	0.309	0.0000148	0.00843	24.402	P04_2
4	0.433	0.0000286	0.00515	53.939	P04_2
5	0.557	0.0000538	0.00604	30.775	P04_2

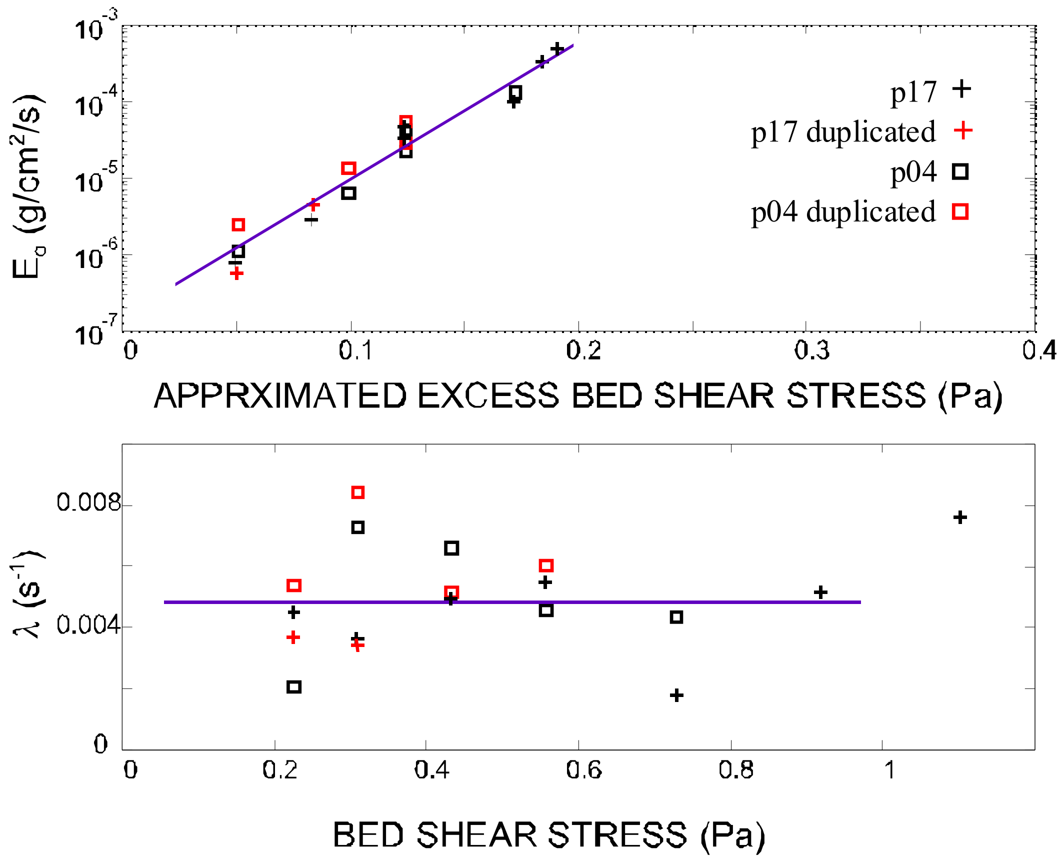


Figure 5-90. Summary of results for in-situ erosion rate experiments at P04 and P17.

Notice that the erosion rate given above cannot be applied to Eq. 1-1 directly because any erosion is an isolated event in a deposition dominant environment. In other words, deposition must be considered together with the possible erosion. For this reason, a concept of the effective erosion rate, ε_e, is introduced and more is given in the discussion.

Discussion

The traditional studies of sediment erosion indicate that the erosion rate, ε, varies with the excess bed shear stress, $\tau_{ex} = \tau_b - \tau_{cr}$, where τ_b is the bed shear stress caused by fluid motion, and τ_{cr} is the critical bed shear stress for sediment erosion. Notice that τ_{cr} is mainly a property of sediment and only changes slightly with the ambient pore water chemical conditions. For non-cohesive sediment, *e.g.*, fine sand, τ_{cr} only vary slightly in the vertical direction, and its value can be estimated using the Shields diagram based on grain size. For cohesive sediments, however, τ_{cr} can vary significantly in the vertical direction, especially near the water-sediment interface. For example, Maa *et al*. (1998) found that $\tau_{cr} \approx 0.1$ Pa near the interface, but it increases to about 0.8 Pa only 1 cm below the interface.

For a tidal dominant flow, Maa and Kim (2000) suggested that the erosion rate can be selected as a constant to simulate the erosion process because of the fact that tidal erosion is always near-equilibrium. Thus, tidal flows can only cause erosion during tidal acceleration phases because of a small but positive τ_{ex} in that period of time. Erosion stops during slack tides and tidal deceleration phases because of a zero or a negative τ_{ex}. For this kind of flow environment, we have a repeated erosion and deposition that happened alternately with time.

For a deposition dominant environment, *i.e.*, tidal current is usually too weak to cause severe erosion. The constant erosion rate model suggested in the previous paragraph may only contribute to a small portion of the total erosion. The occasionally happened propeller washes and/or severe storm events may be more important for finding the total erosion. Figure 5-91 is a conceptual diagram to show the occasionally happened erosion events during a specified period of time. Notice that a propeller wash is a local event in time and spatial domain, and a severe storm event is a local event is time domain.

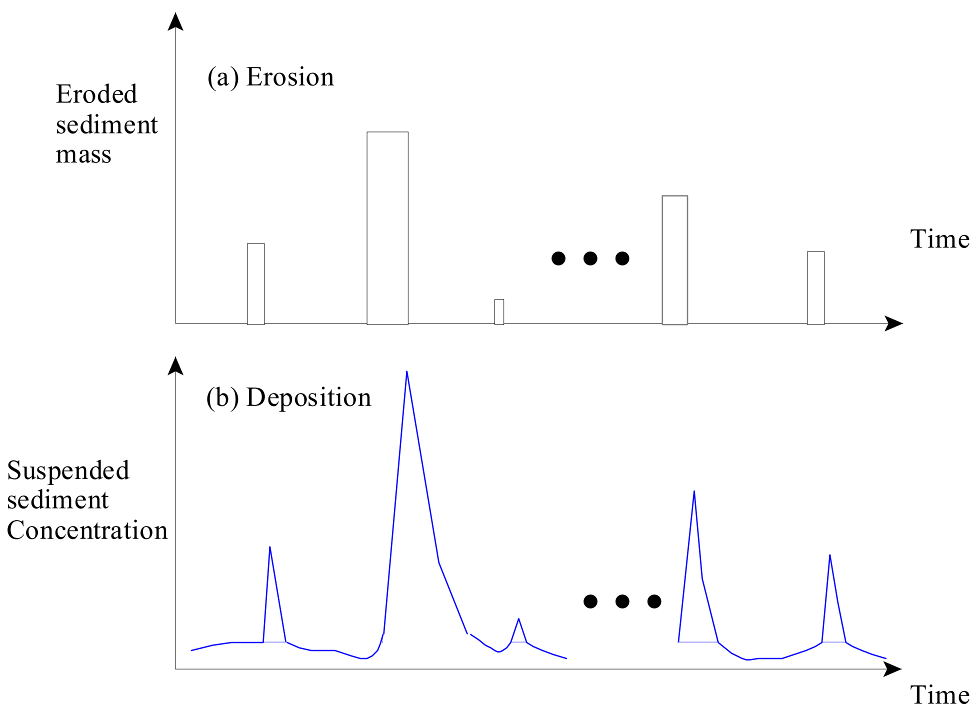


Figure 5-91. A conceptual diagram to show the spike-like propeller washes and storm erosion events in a deposition dominant environment.

Each of the three erosion forces (regular tidal, storm events, and propeller washes) given in the previous paragraph has their own erosion rate. These rates can be found in Figure 5-90 based on the different excess bed shear stress. For a regular tidal erosion, a small excess bed shear stress should be used, *e.g.*, $\tau_{ex} = 0.01 - 0.02$ Pa. For a storm event, $\tau_{ex} = 0.04 - 0.1$ Pa, and for propeller wash, $\tau_{ex} > 0.2$ Pa. The VIMS Sea Carousel is the best instrument to obtain the relationship between the excess bed shear stress and erosion rate, *e.g.*, Figure 5-90. The selection of above given τ_{ex} may be subjective, but it would be the appropriate approach to address the question posted.

If no deposition at all, the time required for eroding a layer with thickness H can be simply calculated as the accumulation of the erosion time series. The actual process, however, is complicated by the existence of deposition. The following are two possible approaches for estimate the effective erosion rate which may worth for further studies.

Approach 1.
Corresponding to Figure 5-91, if the time series of erosion forces and ambient TSS concentration are available for a particular period of time, then it is possible to calculate the time series of sediment mass that was eroded and the amount of sediment deposited. The amount of sediment erosion can be calculated if τ_{ex} information is available at the site, and that is why we need the information provided in Figure 5-90. Since we have shown details on this subject, it will not be discussed more. The amount of sediment deposition can be calculated as pC_sw_s, where p is the probability of having sediment deposition, C_s is the concentration of near bed total suspended solid, and w_s is the settling velocity for the given C_s. The source of suspended sediment can be local eroded material or transported to the site from advection motion. In general, w_s is a function of C_s and ambient turbulence.

In-situ measurements of settling velocity using the Owen Tube method (Owen, 1971; 1976) would be the best approach if the ambient flow turbulence is important. For a deposition dominant environment, flow turbulence is usually weak, and thus, sediment settling velocity would be primarily depends on the local TSS concentration, C_s. To establish a relationship between C_s and w_s using the Owen tube approach in laboratory is recommended during the second year of this project. Bottom sediment samples collected from the field will be used to produce water samples with different C_s for measuring the settling velocity, w_s.

When the bed shear stress is larger than a particular value, τ_{cd} (defined as the critical bed shear stress for sediment deposition), p would be zero. When the bed shear stress is lower than τ_{cd}, then p approach 1. The relationship between τ_{cd} and τ_{cr} is not clear yet, however, it can be safely assumed that τ_{cd} is a fraction of τ_{cr} (*e.g.*, $\tau_{cd} = 0.2\ \tau_{cr}$). In summary, for calculating the deposition rate, settling velocity, local suspended sediment concentration, and the flow condition should be available.

Assuming the information showed in Figure 5-91 are available, or can be estimated, the difference in these two time series is the effective amount of erosion/deposition time series. An integration of this time series for a selected period of time will lead to address the question on "what is the effective erosion rate for that particular period of time?" The answer obtained from this approach can further be compared with the net erosion rate or the net deposition rate measured by using short life isotropic, *e.g.*, Beryllium-7 (^{7}Be, half life = 53 days) if possible.

Approach 2
Since sediment deposition rates have been measured at the two project sites using sediment traps. The information obtained by a sediment trap may be considered as the possible maximum deposition rate. This is because there was no erosion involved in the trapping devices. On the

other hand, the deposition rate obtained from a short life isotropic (*e.g.*, Beryllium-7, ^{7}Be, with a half life = 53 days) may represent the net of deposition and erosion. Thus, the difference in deposition between the isotropic and the trapping approach would be total erosion amount for the measurement period. The total erosion amount may be caused by one or many erosion events, and that is when we need the erosion rate information given by Figure 5-90 to estimate how many erosion events are possible. Of course, the worse scenario is that one erosion event can cause that much of erosion.

The above two possible approaches may be a complement for each other. It would be the best if it is possible to estimate the effective erosion rate from both approaches.

Because the erosion rate is usually expressed in terms of mass per unit time per unit area, *e.g.*, $\varepsilon_s = 10^{-5}$ gram/s/cm^2 for a severe erosion events with $\tau_{ex} = 0.1$ Pa. Thus, the dry density or bulk density structure of the sediment layer H must be known in order to estimate the time required for eroding this layer away. In general, the dry density varies with the depth and increases downward quickly from the water-sediment interface, z = 0. A rough estimation of $\rho_d(z = 0 - 1$ cm$) = 0.4$ gram/cm^3 may be used. Thus, the above selected severe storm event must last more than 2×10^4 seconds (*i.e.*, 5.5 hr) in order to erode 5 mm of sediment bed. Assuming the contaminants concerned within this 5 mm layer has a concentration of C_{ci}. Then the actual time require for release the concerned contaminants can be estimated as 5.5 hours.

Propeller wash, on the other hand, will produce more severe erosion with an erosion rate more than 10^{-3} g/s/cm^2. To erode 5 mm of sediment, it only requires 20 seconds if the minimum excess bed shear stress is used. Because the erosion caused by propeller washes or severe storm events is an isolated event in a deposition dominant environment, how to obtain the averaged erosion rate over a period of time is still pending for more studies.

5.8 BOTTOM CURRENTS AND SHEAR STRESS AT THE PALETA CREEK PRISM SITES

Introduction

As a contaminant transport pathway, erosion of the sediment bed depends on both the properties of the bed, and the energetics of the overlying water. In order to evaluate erosion as a potential pathway for contaminant mobility within the PRISM framework, current meters were deployed at the P04 and P17 sites at Paleta Creek. Currents were measured near the be to provide estimates of the bottom stresses that occur at the site during typical conditions during the year. These measurements, when combined with the in-situ flume studies, provide a means of evaluating whether or not erosion would occur, and then quantifying the amount of contamination that could be transported from the site by this process.

Methods

Current meters were deployed for two periods at the two sites. Each period encompassed a two-week spring-neap tide cycle. The first period extended from approximately 10/30/2001 to 11/14/2001 (NOV2001), and the second period extended from approximately 2/6/2002 to 2/21/2002 (FEB2002). The deployment locations were the same for each period, and are shown in Figure 5-92.

S4 electromagnetic current meter were used for all deployments. The S4 is a 25 cm diameter spherical instrument designed to measure the magnitude and direction of horizontal current motion in a water environment. The S4 measures the voltage resulting from the motion of a conductor (water flow velocity) through a magnetic field according to Faraday's law of electromagnetic induction. Faraday's law defines the voltage produced in a conductor as the product of the speed of the conductor (water flow velocity) times the magnitude of the magnetic field times the length of the conductor. In the case of the S4, the conductor length is the effective path between the sensing electrodes. The magnetic field intensity is generated by a circular coil, internal to the S4, driven by a precisely regulated alternating current. The use of an alternating magnetic field and synchronous detection techniques to measure the voltage at the sensing electrodes provides an extremely stable, low noise current measurement. Two orthogonal pairs of electrodes and an internal flux gate compass provide the current vector. Because of its low threshold and low noise level, the S4 is the current meter of choice for low current regimes such as those encountered in the protected Paleta Creek region. The S4s are configured for a current speed range of 0-50 with an accuracy of about +/- 1 cm/sec. The directional component from the flux-gate compass has a resolution of 0.5 degrees and an accuracy of about +/- 2 deg.

For these deployments, the current meters were deployed just above the bottom as shown in Figure 5-92. This was done using divers by first driving an aluminum stake into the sediment, and then bolting the current meter to the stake. The current meters were programmed to collect a 2 min sample average at 2 hz every 4 min.

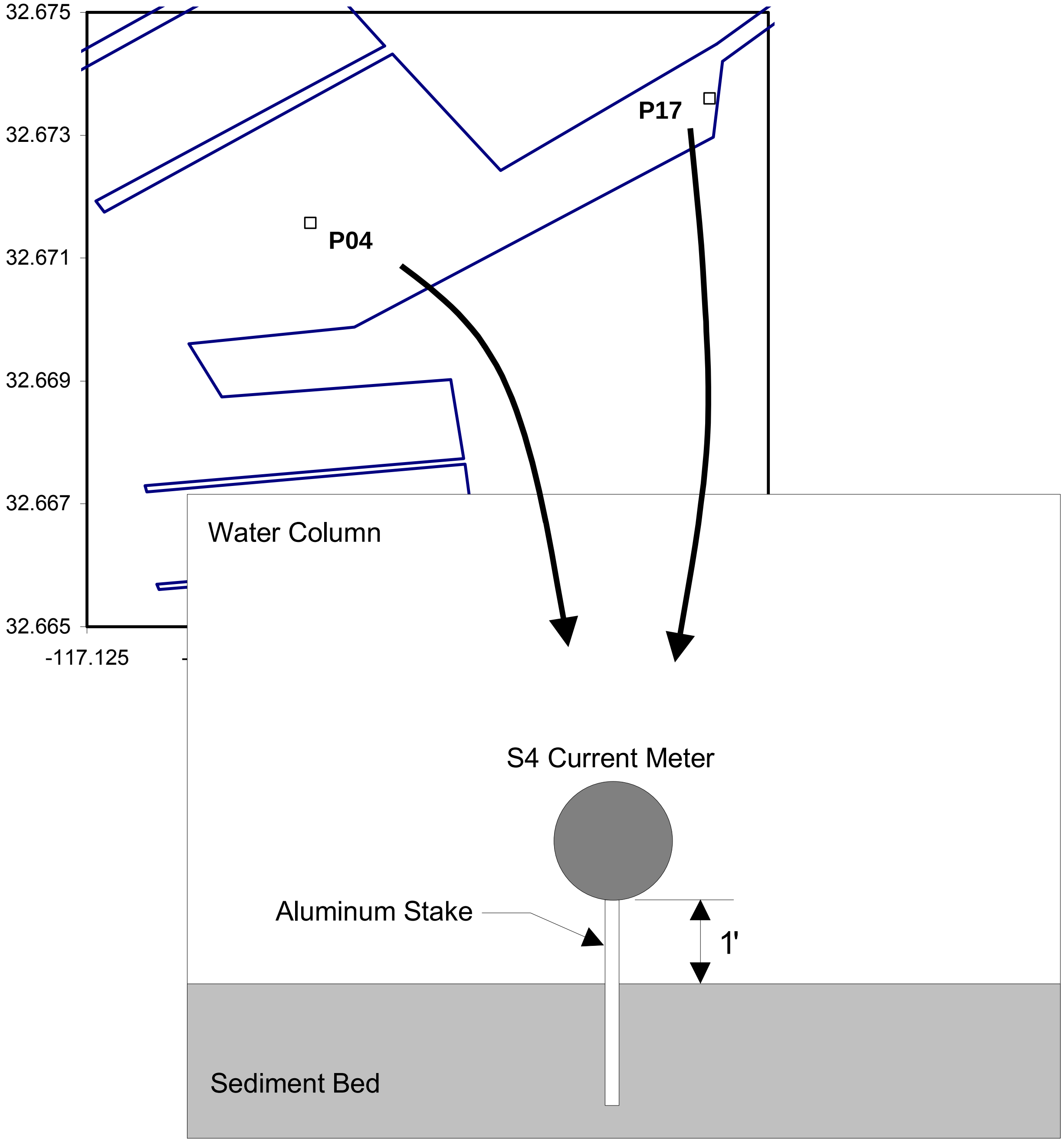


Figure 5-92. Current meter locations and deployment configuration.

Results and Discussion

Results from the current meter deployments during the NOV2001 deployment are shown in Figure 5-93 - Figure 5-94, and results from the FEB2002 deployment are shown in Figure 5-97 - Figure 5-99. In general, we observed very low current speeds at P17 (0-2 cm/s), and somewhat higher current speeds at P04 (0-7 cm/s). Currents at the P17 site consistently aligned toward the southwest during NOV2001, but were more variable during FEB2002 with what appears as a weak tidal fluctuation. Currents at the P04 site were predominantly aligned toward the northern quadrants during both deployments, with the direction appearing to clock from the northeast during the flood tide to the northwest during the ebb. At both sites, some short-term, high-current events were observed. There are believed to be related to ship and tug movements in the area.

The measured currents were used to calculate estimated bottom shear stresses for the deployment periods. This was carried out flowing the method described by Dyer (1985) such that

$$\tau_o = \rho C_D U^2$$

where τ_o is the bed shear stress, ρ is the fluid density, C_D is a drag coefficient, and U is the current speed. In this case, the current meters were deployed ~43 cm above the bed so we take

$$\tau_o = \rho C_{43} U_{43}^2$$

where U_{43} is the current measured at 43 cm above the bed, and C_{43} is the corresponding drag coefficient calculated as

$$C_{43} = \frac{\kappa}{\ln(43/z_o)}$$

where κ is the Von Karmen constant (0.4), and z_o is the roughness length, taken to be 0.002 for silty sand (Dyer, 1985).

The estimated bottom shear stresses are shown in Figure 5-96 for NOV2001, and Figure 5-100 for FEB2002. As expected, the shear at P17 is generally very low (~0.1 dyn/cm^2). Shear stresses at P04 were somewhat higher, ranging from about 0.5-2 dyn/cm^2 during the majority of the deployment. During the suspected ship movement events, shear stresses at both sites exceeded 10 dyn/cm^2. Comparison of these estimated shear stresses to the measured critical shear stress at the sites (0.17 Pa = 1.7 dyn/cm^2) indicates that the critical shear stress at P17 is only exceeded during high energy events such as ship movements. At P04 the results indicate that the critical shear stress is exceeded during high energy events, but may also be exceeded slightly during peak tidal flows. Analysis of the high energy events indicates that they occur about 1-2 times per week, and persist for about 10-30 minutes. This is consistent with the frequency and duration of ship movements in the Naval Station area.

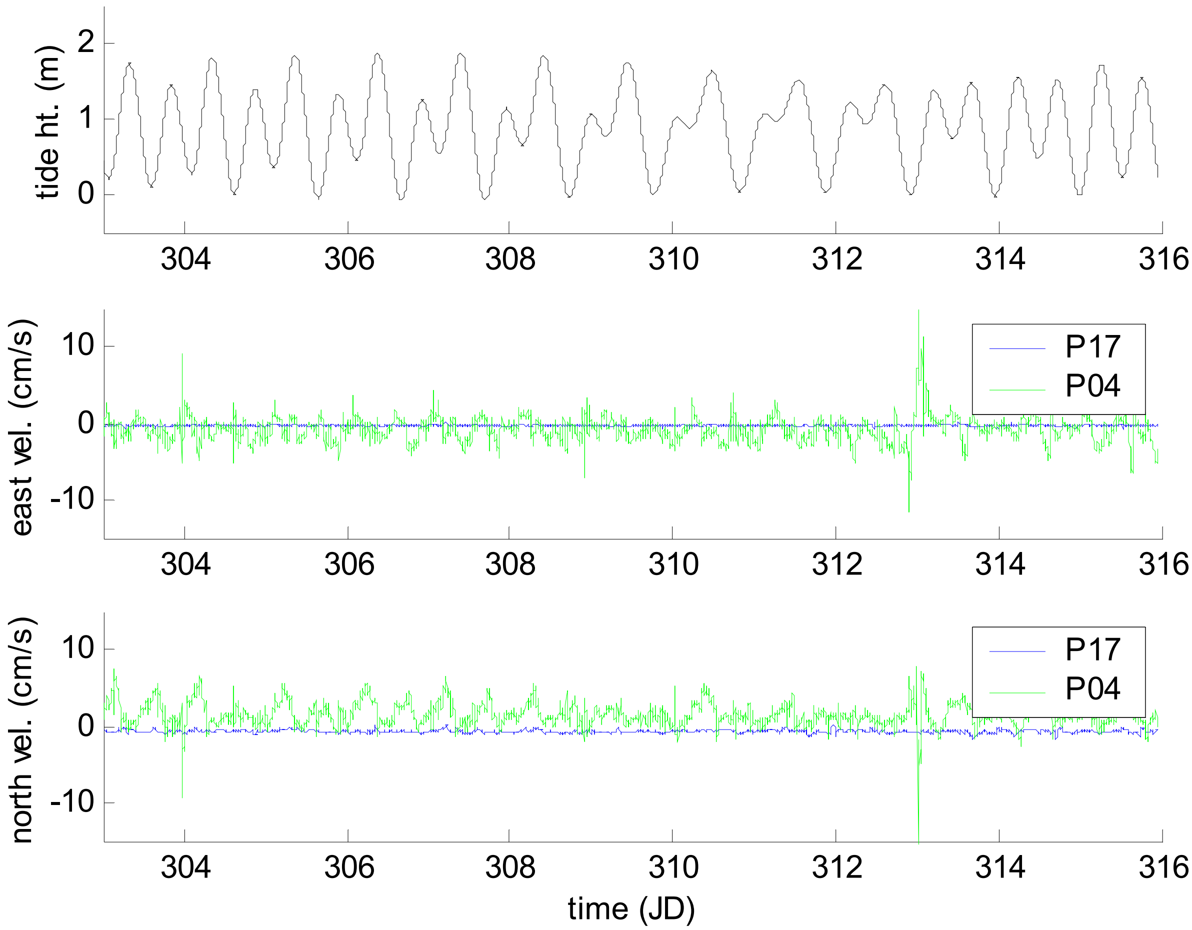


Figure 5-93. Paleta Creek tide and currents for the NOV2001 deployment.

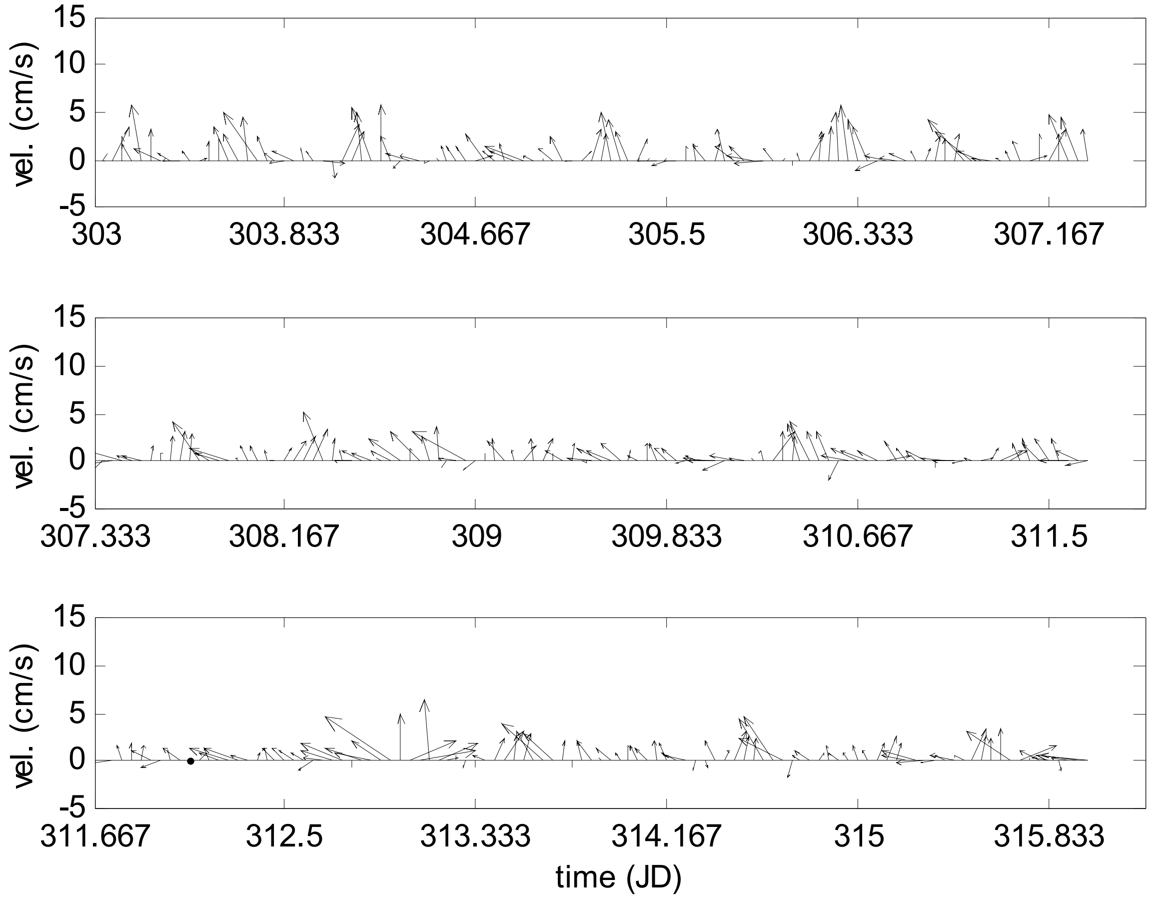


Figure 5-94. P04 near-bottom currents for the NOV2001 deployment.

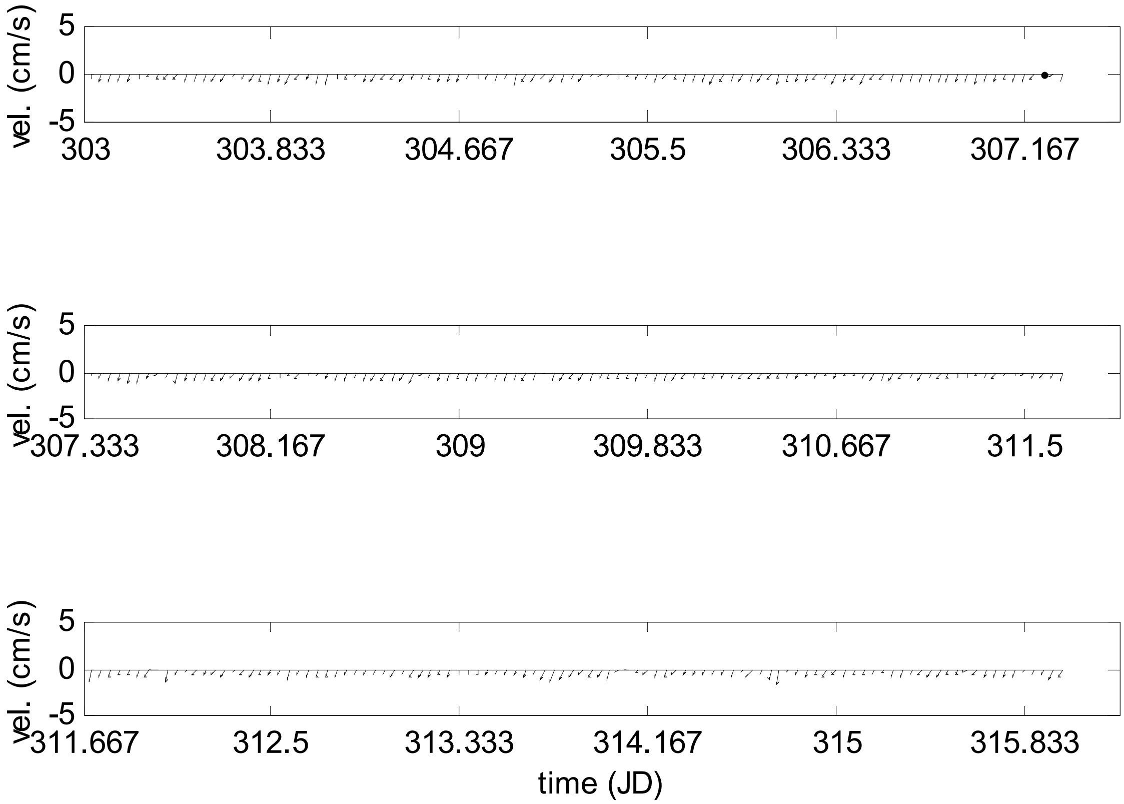


Figure 5-95. P17 near-bottom currents for the NOV2001 deployment.

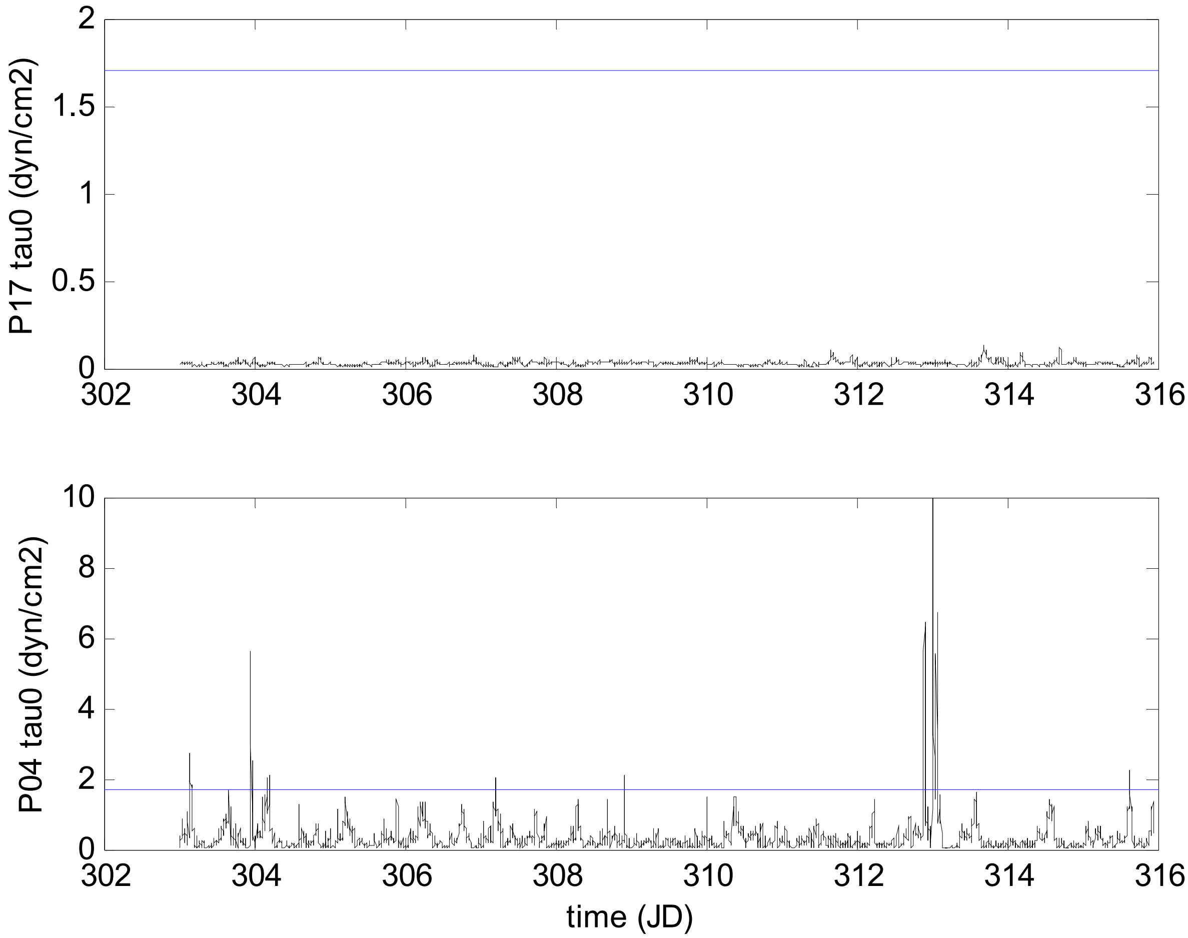


Figure 5-96. Estimated bottom shear stress for the NOV2001 deployment vs. critical shear stress from the in-situ flume.

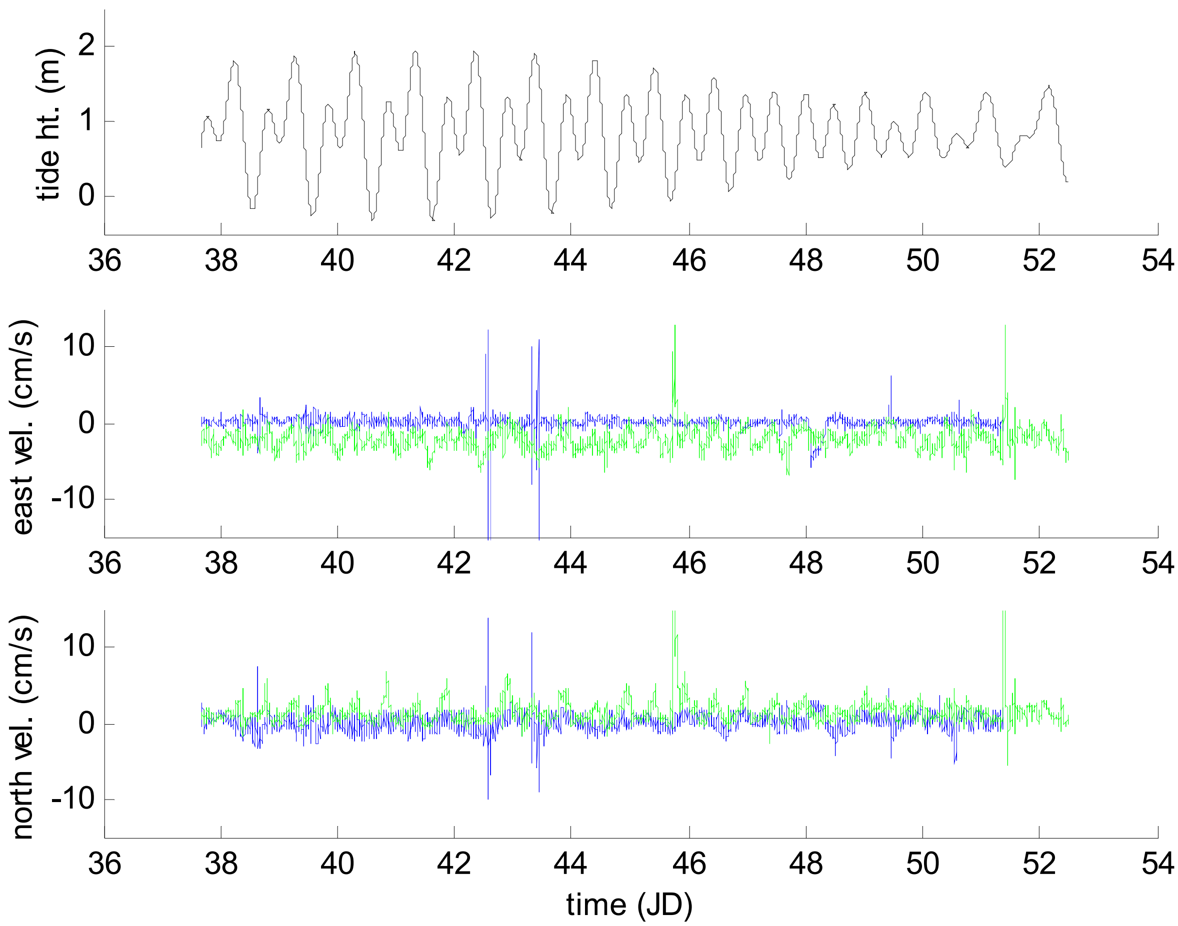


Figure 5-97. Paleta Creek tide and currents for the FEB2002 deployment.

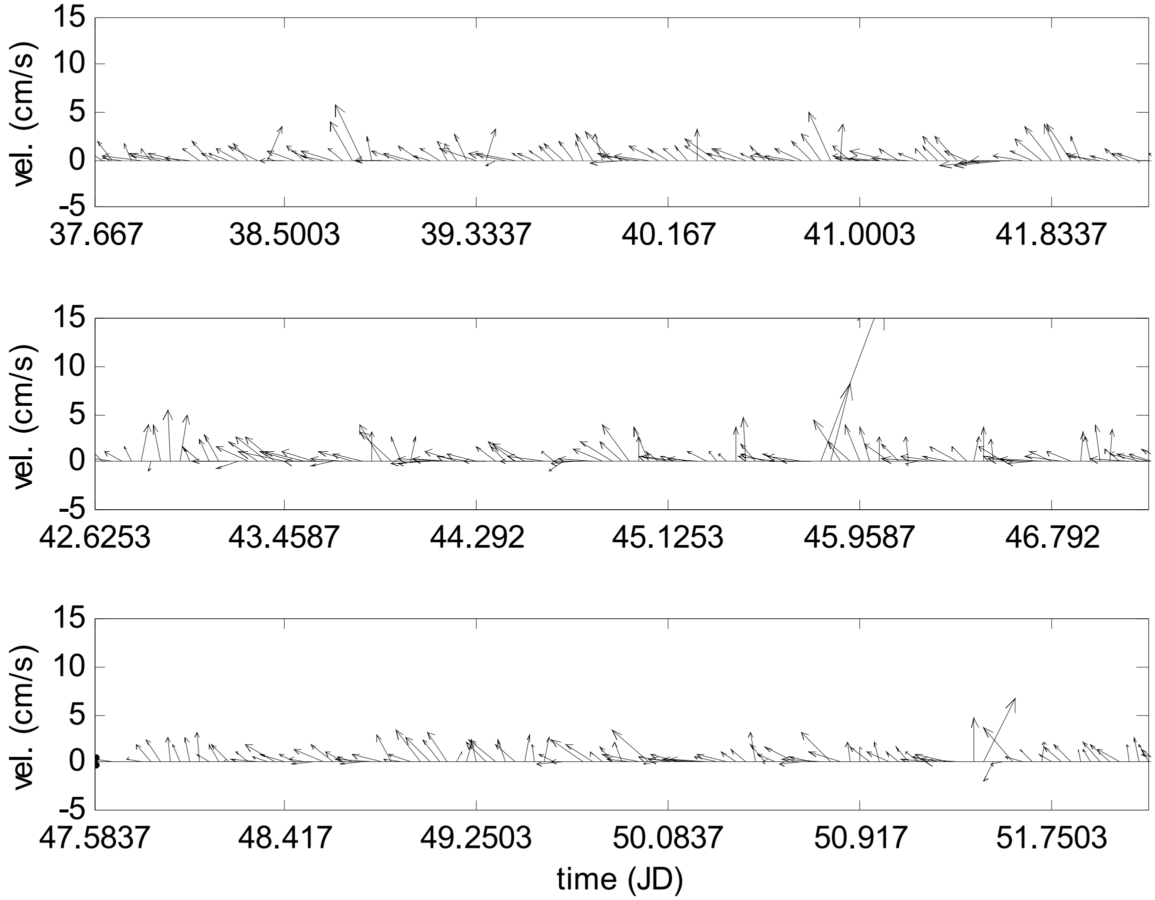


Figure 5-98. P04 near-bottom currents for the FEB2002 deployment.

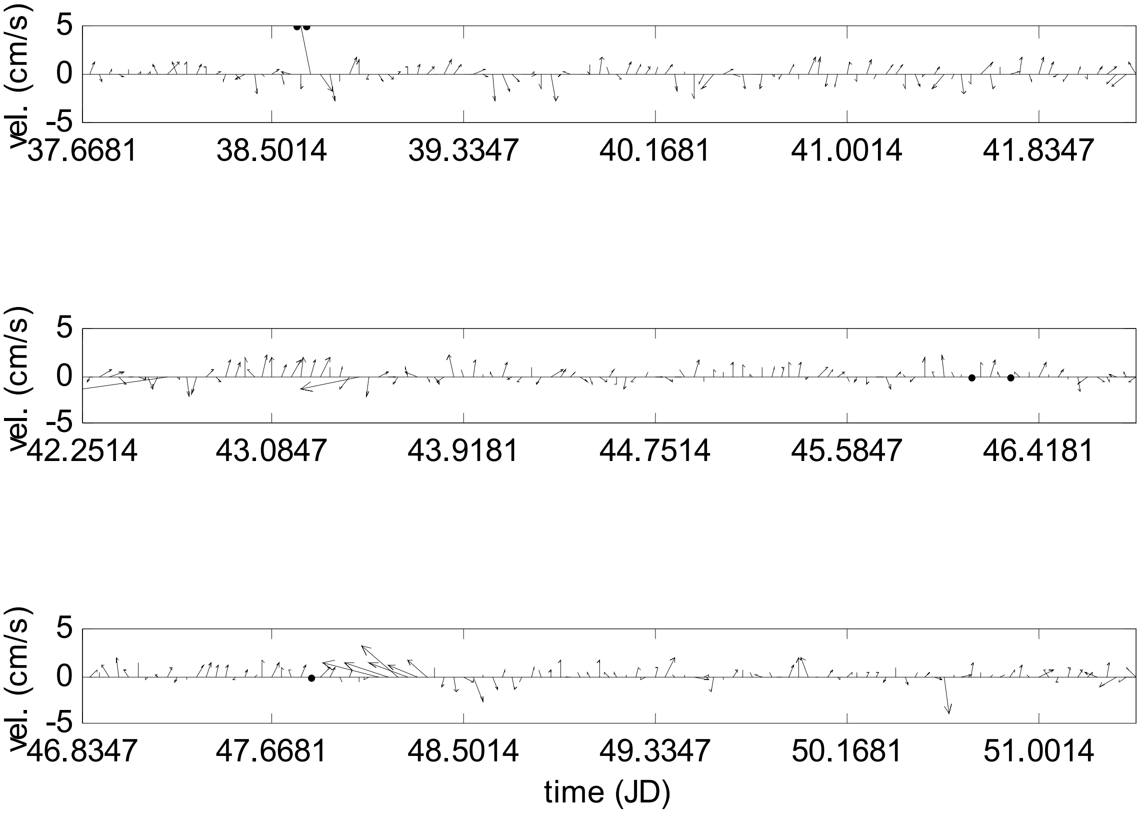


Figure 5-99. P17 near-bottom currents for the FEB2002 deployment.

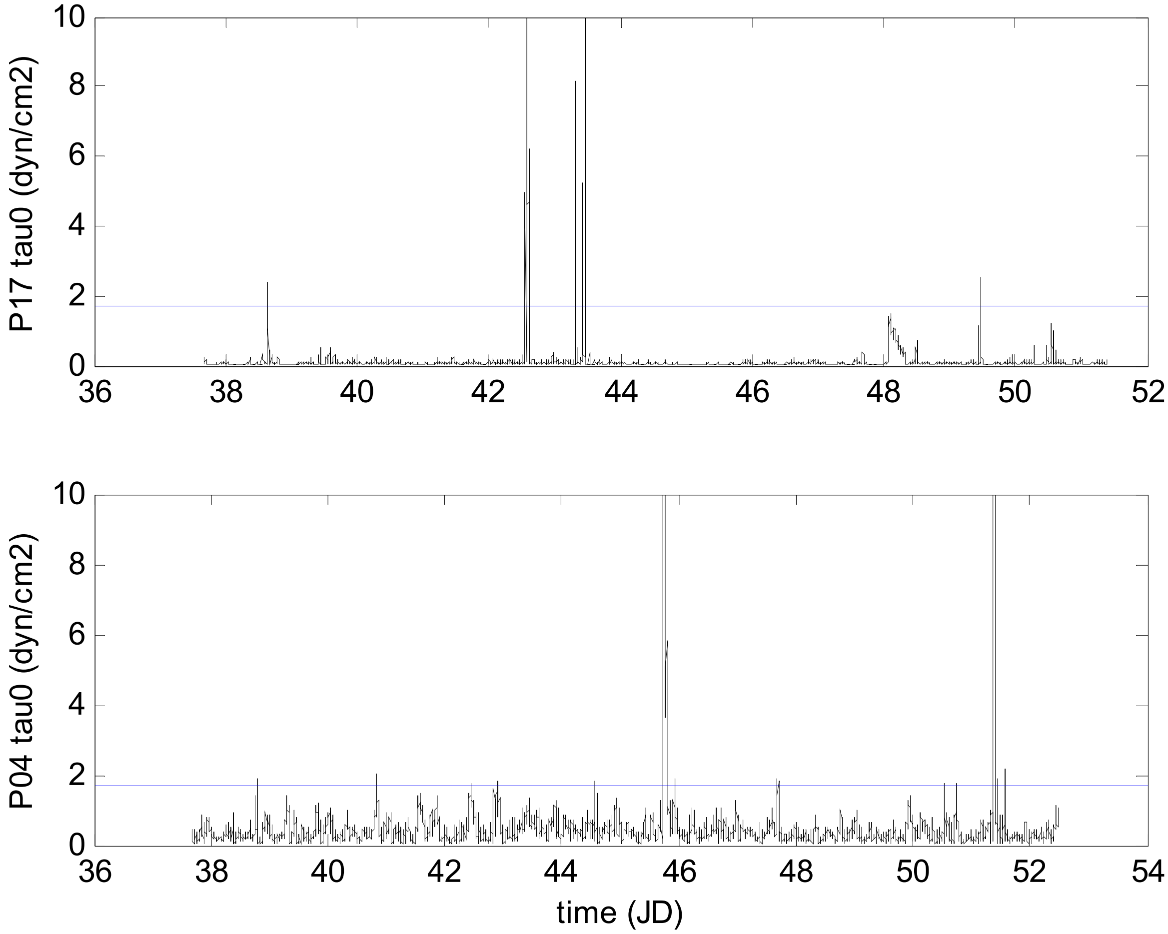


Figure 5-100. Estimated bottom shear stress for the FEB2002 deployment vs. critical shear stress from the in-situ flume.

5.9 PARTICLE SIZE DISTRIBUTIONS OF BED SEDIMENTS AND FLUME SEDIMENT SUSPENSIONS AT THE PALETA CREEK PRISM SITES

Introduction

In constructing the sampling and analytical plan for the field demonstration program at Paleta Creek, San Diego Bay it was proposed that the LISST-Portable particle size analyzer would enhance surficial sediment characteristization provided by the VIM's in situ flume. The LISST analyzer was to be used to characterize the particle size profiles of suspended sediment samples generated by shear stresses applied by the flume. The conceptual basis for the need of the LISST analyzer was based on expected shifts in the particle size distributions as the shear stresses generated by the flume were varied. At the start of the flume deployment, at the lowest shear energies, we expected to see movement and resuspension of fractions of sediment dominated by smaller particles. Increases in shear energy would dislodge and suspend larger sized particles resulting in changes in the size distribution profile. One objective of the LISST–Portable analyzer deployment therefore was to characterize and define the relationship between the shear energy exerted by the flume and the particle sizes or size fractions suspended into the overlying water column.

The Paleta Creek field deployment was also designed to characterize the contaminant loadings of resuspended sediments associated with the erosive processes as characterized by the VIM's flume. As was described above, during planning for this deployment we perceived that the flume generated resuspended sediments would be enhanced, relative to the bulk surface sediment, with smaller particles. Contaminant transfer via the erosion pathway would be in error if bulk sediment contaminant concentrations were used to quantify this fraction. This would be especially true for organic and metal contaminants primarily associated with fine grain material. Due to the sample mass requirements for chemical analysis it was estimated that sufficient resuspended sediment amounts could not be recovered from the VIM's flume sampler for contaminants analysis. For this field deployment it was proposed that size separation techniques would be employed to separate and analyze sufficient quantities of the fraction of sediment identified by LISST in the resuspended sediment. The techniques proposed for size fraction separation were particle settling as characterized by the Stoke's equation and size fractionation by sieve.

Methods

Previous characterization of the LISST-Portable particle size analyzer with a set of microsphere size standards showed that the instrument correctly measured particle diameter and for individual standards the instrument responded linearly to the total volume concentration of the individual standards. However the same data showed that instrument response was not constant over the range of measurement (1.5 to 200 µm). Instrument response to particle volume (mass) was greatest for a 2 µm microsphere standard, decreasing significantly for 4 and 10 µm standards then gradually for 20, 80 and 160 µm standards. Therefore, in assessing the particle size profiles and making relative comparisons of sizes it should be understood that distributions are skewed towards greater concentrations for the smaller sizes (or conversely, lesser concentrations for the larger sizes).

Also of important note in the use of the LISST instrument is the effect of air bubbles and vortexing in the sample chamber during sample analysis. Through repeated use and experimentation it has been determined that detector responses in the largest size bins (LISST measures 32 logarithmically space bins, each corresponding to a size range) are significantly affected by air bubbles in the sample chamber. Efforts to "subtract out" these responses by use of a background spectra were unsuccessful due to the high variability associated with these responses. Therefore when characterizing sediment size distributions the greater than 125 µm particle sizes are excluded from plots and calculations.

Even given the measurement limitations of the instrument, previous work has shown that the LISST-Portable can measure slight variations in distribution profiles between sediments. The instrument consistently reproduced size distributions for sediment samples measured months apart, and when properly calibrated the LISST unit was shown to accurately determine particle concentrations.

Results and Discussion

Particle Size Distributions of Flume Generated Sediment Suspensions

The particle size distributions in Figure 5-101 below represent the samples collected from the flume deployments at the Paleta Creek P04 and P17 sites, respectively. In the format below the distributions are presented in units of percentage of total volume concentration versus particle diameter. This format allows one to compare the size distribution profiles of samples of differing concentrations. In Figure 5-102 below the same profiles are presented in absolute concentration units.

The distributions in each of the plots below represent sediment suspension samples that correspond to different shear stress energies (Pa units). At the P04 deployment site (Figure 5-101 and Figure 5-102) the remarkable feature of the size distributions is their similarity. As was discussed previously the expectation for these series of plots was that the distributions of samples collected at lower shear energies would be more largely dominated by smaller particle sizes. In Figure 5-101 it might be argued that the samples collected at 0.23 and 0.31 Pa (lowest energies) relative to the other samples exhibit greater small particle character as evidenced by the abundances in the 5.11 – 19.2 µm range relative to the shoulder at 43.9 µm. Other than this the profiles do not show pronounced changes in profile shape and are even virtually indistinguishable.

In Figure 5-101, size distributions for the P17 deployment, similar profiles were also measured at the various shear energies. In comparison to the P04 site the large particle shoulder is extended to a slightly larger value of around 51.9 µm. The smaller sizes below 19.2 µm are less pronounced in the P17 samples relative to the P04 samples. For the P17 samples there were not distinguishable differences in the profiles versus shear stress. The sample collected at 0.43 Pa cannot be explained though the size distribution was repeatably measured for this sample.

Figure 5-102, plots of absolute particle concentrations, are presented to show that the quantities of particles suspended by the flume increase with shear energy and are measurable by the LISST instrument. The increase in particle concentration did generally follow the increase of shear stress energy. Particle concentration increases were verified by TSS (total suspended solids) determined for each flume sample.

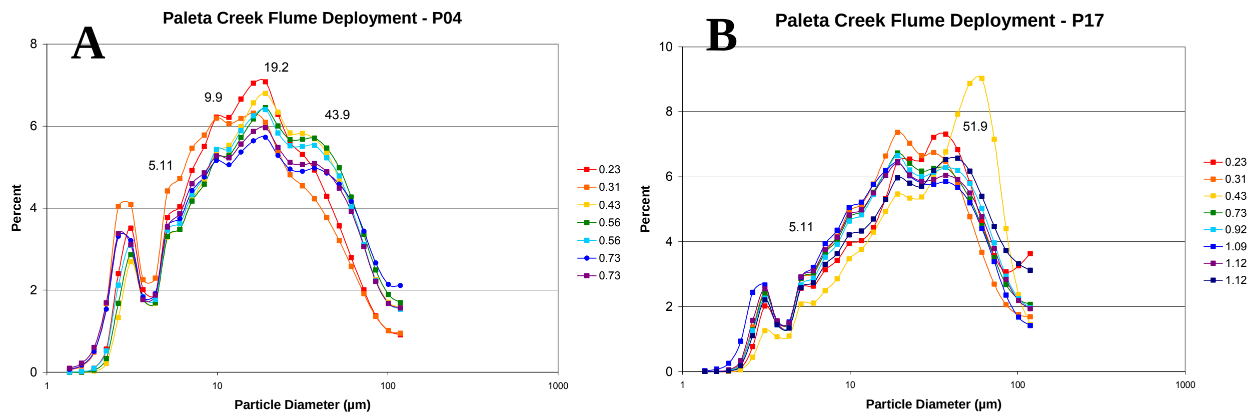


Figure 5-101. Particle size distribution versus shear stress (Pa) for the P04 (A) and P17 (B) flume deployment sites.

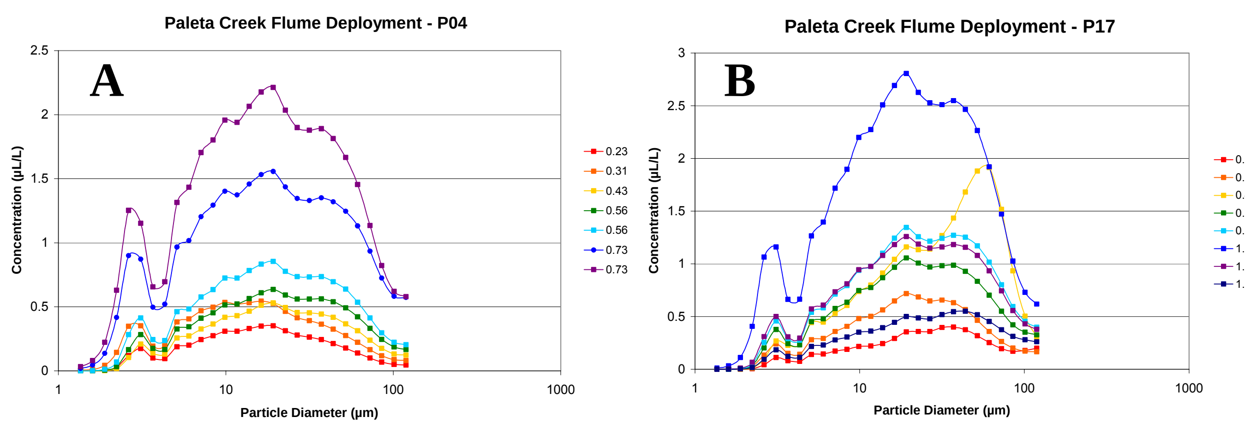


Figure 5-102. Particle size distribution versus shear stress (Pa) for P04 (A) and P17 (B) flume deployment sites.

Particle Size Distribution of Composite Sediments

Figure 5-103 shows the size distributions of the sediment core composite samples from site locations P04 and P17. The bulk sediments were prepared by making a sediment slurry in filtered seawater and transferring an aliquot to the LISST sample chamber. Further dilution with filtered seawater was usually necessary to ensure that a representative sample of around 25 mg of wet sediment weight was introduced into the instrument at a concentration range suitable for optimum instrument performance. Of interesting note in the two figures are the very similar profiles for the different samples collected from within the locations. Similarly to the flume generated samples at these two sites the P17 samples exhibit a slightly greater large particle shoulder than the P04 composite sediment sample. The small particle character may also be more significant in the P04 samples than in the P17 sediment.

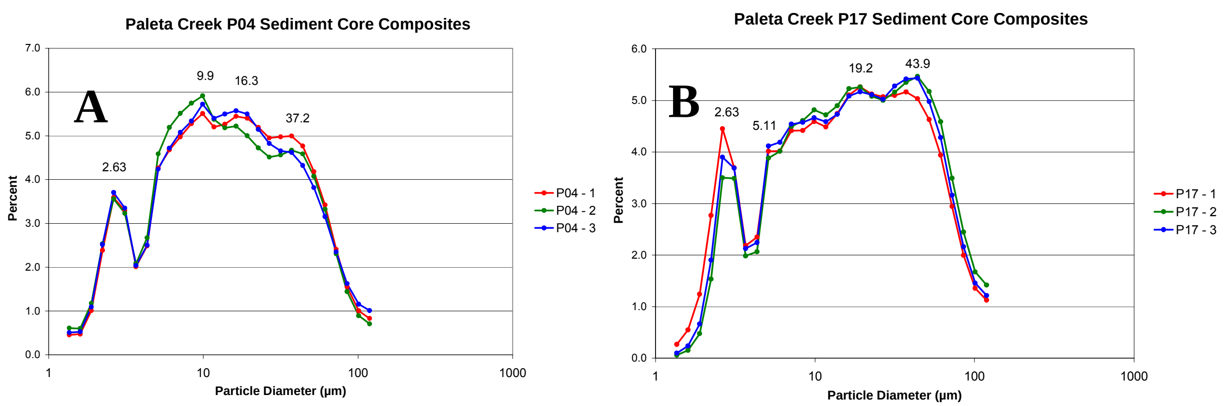


Figure 5-103. Particle size distributions for sediment core composites at P04 (A) and P17 (B).

As was discussed above one objective of the LISST-Portable deployment was to define the fraction of surficial sediment suspended into the water column by the VIM's flume. As this fraction was defined, based on the particle size range, size separation techniques would be employed to obtain a comparable size fraction from the sediment composite sample in sufficient quantities for chemical analysis. Figure 5-104 are comparisons of the size distributions of flume suspended samples with the sediment core composites. As is shown in Figure 5-105 there are only slight differences between the sediment bulk and the resuspended sediment for the P04 location. As was seen earlier in comparing flume samples of varying shear stresses, there does not appear to be size differentiation in the bulk and suspended samples. In Figure 5-105, flume and sediment composite samples at P17, differences are more pronounced but the general size range remains consistent.

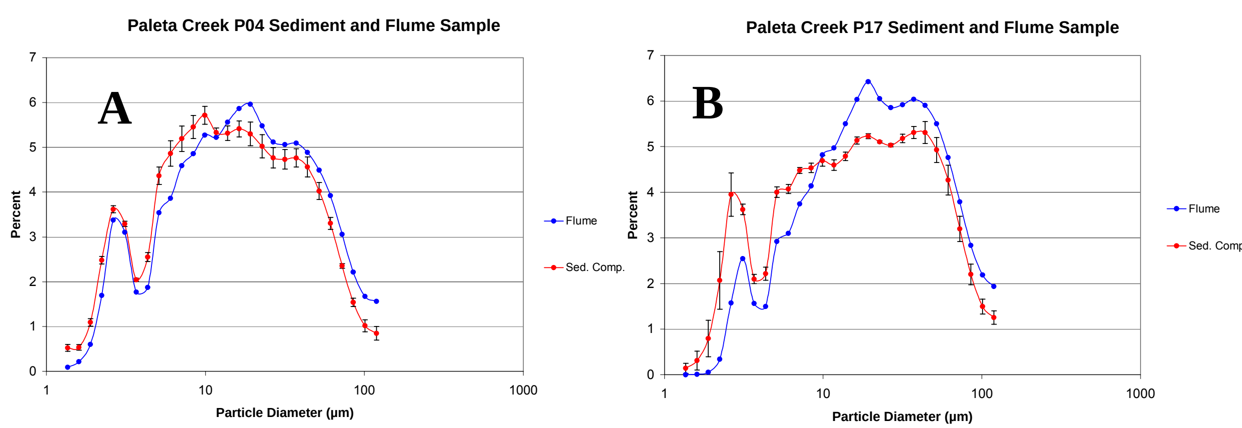


Figure 5-104. Flume generated resuspended sediment compared to sediment composite sample at P04 (A) and P17 (B).

Though the similarities between the bulk composite and resuspended sediment samples were unexpected and called for non-modification of the bulk composite, procedures were carried out to characterize the size separation techniques. In this procedure the sediment composite sample was passed through a 63 µm sieve filter. The sediments were first gently broken-up in a minimum of seawater then spread on the sieve mesh. A minimum of seawater was used to thoroughly wash the sediment through the mesh. The use of the 0.63 µm mesh size was based on previous work with sieving a Paleta Creek sediment. Figure 5-105 show the results of LISST analysis of the sieved sediments. In comparing the sieved sediment distributions with the sediment composite and flume samples it is seen that the large size shoulder of the sieved sediment has shifted considerably to smaller sizes (for both sites) and the less than 3 µm size range is significantly enhanced in the sieved sediment. On viewing the results of the filtration technique it cannot be argued that this would yield a sample more appropriate for analysis than the non-modified bulk composite sample.

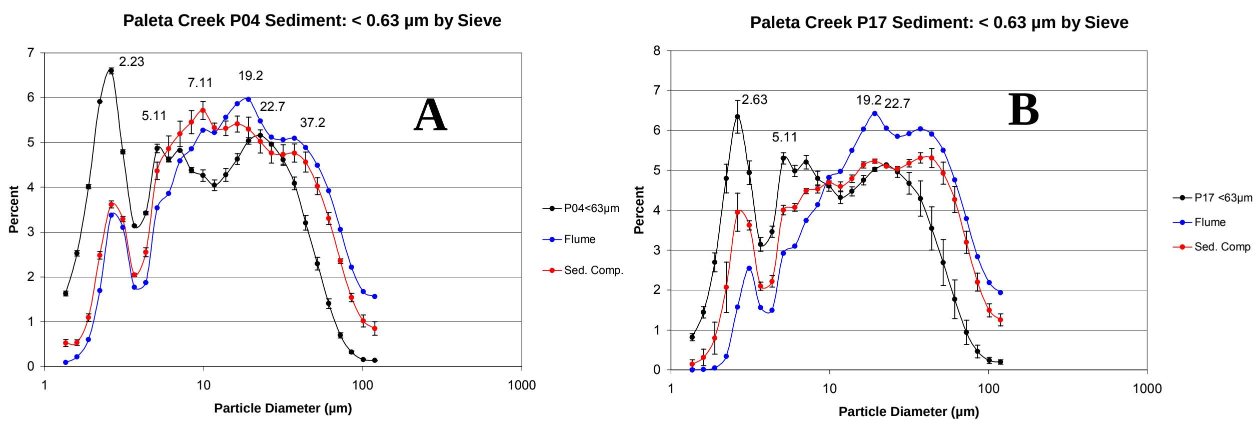


Figure 5-105. Comparison of P04 (A) and P17 (B) sieved sediment to flume and composite samples.

5.10 VERTICAL PROFILES OF MAJOR AND MINOR CONSTITUENTS IN THE SEDIMENT AND POREWATER OF THE PALETA CREEK PRISM SITES

Introduction

The major purpose of the present program Pathway Ranking for In-place Sediment Management (PRISM) in the Paleta Creek area of San Diego Bay, is the assessment of the various physical, chemical, and biological processes affecting these sediments and their biota.
Under the auspices of PRISM, our laboratory has undertaken the study of the chemistry of the interstitial fluids and associated sediments in a number of cores centered around the Paleta Creek. In this report we present our preliminary results of this effort, which is only a part of the very comprehensive studies undertaken by the SPAWAR Group and their associates.
The location of the Paleta Creek area and the stations hitherto investigated are presented in Figure 5-106.

Station locations and descriptions
The locations of the Stations in the Paleta Creek area are presented in Figure 5-106.

Station P17 is located near the entrance of Paleta Creek into the Bay at water depths of about 18 feet (~ 5.5 meters);

Station P11 is located near the end of the Paleta Creek inlet (close to the Navy Pier) at a similar depth of ~ 18 feet (~ 5.5 meters);

Station P04 is located at some more distance into the Bay – characterized by greater water depths of 35 feet35/3 (~ 10.5 meters).

Results

Pore fluids
The major reason for the study of the chemical composition of the pore fluids from the various Paleta Creek sites is the ability to use these data to describe the redox conditions of these sediments. In addition, concentration depth profiles of trace elements allow to determine whether the sediments are sinks or sources with respect to the overlying waters (pore water trace metals will be determined in the near future). In many sediments with elevated organic carbon contents the pore waters are affected by biochemical processes involving the oxidation of organic carbon. These processes involve the use of a number of oxidants in a sequence determined by the relative yield of energy gained from the organic matter combustion. Figure 5-107 represents these processes, which lead to the usually observed redox sequence, i.e., the sequence of the electron acceptors used. In many instances the zone of oxygen depletion and denitrification can be very thin, at best a few millimeters. This is the case with our stations in the Paleta Creek area, where dissolved oxygen is consumed within 2-3 mm from the sediment water interface (Wiebke Ziebis, personal communication). Below we present data for dissolved

manganese, which indicate that the zone of denitrification must also be no thicker than 1 centimeter or less.

Station P17

We made several trips to this area: in November 2001 (P17/B) and in January 2002 (P17-1A/C). Station P17-1A/C is located slightly to the south of P17. Results are presented separately in Figure 5-108 and Figure 5-109.

The sediments in the upper 1 cm of P-17 and the upper 2.5 cm in P-17B (November, 2001) show the mobilization of manganese almost immediately at the sediment-water interface, closely followed by well established maxima in dissolved iron. The manganese and iron oxide reduction zone spans over a depth of no more than 4 centimeters below the sediment surface. Some of the dissolved manganese may diffuse upward to the zone where oxygen is present, either at the very surface of the sediments or in the water column. Below the iron-oxide reduction zone the cores are characterized by sulfate reduction. The gradients in dissolved sulfate and alkalinity show a sharp change at about 7-8 cm in core P17, also noticeable in the gradients of "Yellow Substance" (humics), phosphate, and ammonium. The changes in P17-1A start at very shallow depth, whereas in P17-1C the Mn/Fe reduction zone is almost 4 cm thick. Dissolved silica in all cores shows gradients in the upper 1 – 4 cm, indicating a diffusive gradient toward the sediment-water interface. Phosphate and ammonium follow the sulfate gradient below ~ 4 cm, indicating regeneration of these constituents associated with the sulfate reduction process.

Micro-profiling data of Wiebke Ziebis indicate sulfide profiles of a similar nature as observed in this study. In one core the sulfide starts to increase at 1 cm depth, whereas in the other core the micro-profiles indicate increases in sulfide below 2 cm depth. Thus, though some depth variability occurs in the initiation of the sulfide gradients, this may indicate some subtle changes in the thickness of the iron oxide reduction zone.

Station P-11

Two cores were obtained at Station P11 in December, 2001. The data of Figure 5-110 clearly show that they are well correlated. Manganese reduction occurs immediately below the sediment water interface and manganese concentrations become essentially zero with the upper 2 centimeters. Dissolved iron shows a distinct maximum at about 1.5 cm depth, again showing the classical sequence of manganese oxide reduction followed by iron-oxide reduction. Sulfide concentrations are very low and appear only measurable between 4 and 12 cm depth. Sulfate depletions are less than those in Cores from P-17 (Figure 5-109). The low sulfides indicate rapid removal of sulfide into solid phases (e.g., FeS). These sulfides, of course, will be sinks for trace metals also, particularly for copper and zinc.

Station P-04

Site P04 was visited two times, in November 2001 (Figure 5-111) and in January 2002 (Figure 5-112). The pore fluids at station PO4 show moderate to small increases in alkalinity. The production of alkalinity (mostly bi-carbonate) is associated with the reduction of iron oxides, suggesting that this is the major electron acceptor in these sediments. The generation of dissolved iron is large, with maximum values as high as ~ 400 µM. Dissolved manganese shows a large initial increase, but especially below 10 cm depth large, almost linear increases are observed. These increases are, perhaps, the result of diffusion from deeper sediments. The

November data show various minima at ~ 10 cm depth. This may well be related to the phenomenon of bio-turbation or bio-irrigation. Typically we did find some worms at a depth of ~ 5 cm in these sediments. Silica gradients show a diffusive nature in the upper 4 cm of the cores.

Microprofiling data of Wiebke Ziebis indicate oxygen penetration depths of about 3 millimeters. However, the sulfide profiles indicate the initiation of sulfides below 8 – 9 centimeters depth. We did not carry out any sulfide measurements in this study, but it is of interest to note that dissolved iron maxima occur above ~ 8 cm depth, thus suggesting that the sulfate reduction zone starts below these depths, consonant with the sulfide profiles. The large increases in dissolved manganese are not readily explained and may well be due to diffusion from the underlying harder sediment layers.

Lithium concentrations

Lithium concentrations were determined during the routine work on Fe and Mn in our acidified samples. This is demonstrated in Figure 5-113. The lithium concentrations show significant decreases in cores of P17 and P11. Again the gradient in PO4 shows a reversal, probably associated with the proposed bioturbation phenomenon. It is interesting to note that the concentration gradients imply a significant flux of lithium into the sediments, with concentrations falling to about ~ 75 % lower than in the overlying water in a short distance of only 18 cm.

Sedimentary solids

Hitherto we have investigated three representative cores: P17-1A, P11-B, and PO4. In this study we report both the distributions with depth of major sedimentary components, Si, Al, Fe, and Ti (as % oxides) and of the trace elements, Cu, Zn, Mn, Ni, and Cr (in mg/kg). Especially the trace element distributions are of importance in the study of potential toxicity of these sediments.

Of interest is to provide the data from the general survey of the Paleta Creek area for the chemical composition of the surface sediments – upper 10 cm, homogenized samples (Bart Chadwick, personal communication). These data are presented as bar graphs in Figure 5-114. Whereas Al_2O_3 contents show little variability, those of iron and the trace metals show considerably more changes. We will discuss our depth profiles in the light of this evidence.

Major Constituents

The depth distributions of the major oxides are presented in Figure 5-115. Al_2O_3, TiO_2, Fe_2O_3, and SiO_2 contents in core PO4 are fairly uniform, whereas core P11 shows more variations with depth. Core P17-1A indicates lower Fe-oxide and titanium oxide concentrations in the upper 10 cm. Below this depth, however, there is good agreement between cores PO4 and P17-1A.

The ratios of Fe_2O_3/Al_2O_3 are plotted versus those of TiO_2/Al_2O_3 and SiO_2/Al_2O_3 respectively in Figure 5-116. Error bars are given as + 5 %. The thick dashed line represents the trends observed in the Shelter Island Basin, where a very tight correlation occurred for these ratios. Whereas in the Shelter Island Cores we postulated linearity to be the result of end member mixing, the trends in the Paleta Creek cores are less apparent. Perhaps there is greater variability in sediment sources in the Paleta Creek area.

Minor constituents

The data for Cr, Mn, Ni, Cu, and Zn are presented in Figure 5-117. Whereas the profiles for Cr, Mn, and Ni are relatively uniform with depth in Core PO4, those in Cu and Zn show somewhat greater variability, especially for Cu. For Cu there are no clear trends with depth. Core P11 shows much larger variability in most trace metal concentration-depth profiles. Noteworthy are the low Cu and Zn concentrations in the depth range of 1.5 – 3.5 cm. Core P17-1A shows a large variability in the Cu and Zn depth profiles.

Chadwick et al. (1999) suggest that plots of the Fe concentrations versus those of the trace metals may be instructive to determine potential excess values of the trace metals over those of presumed background values. These plots are presented in Figure 5-118 (background data are plotted as crosses). Of importance in this analysis are the ERL (Effect Low Range – less than 10 % of compiled biological studies indicate adverse effects) and ERM (Effect Medium Range – more than 50% show adverse effects) values. Our data, especially in Core PO4, indicate that especially for Cu ERM values are exceeded, both in PO4, P11, and P17-1A, but for Zn this is only the case in P17-1A and some values deeper in P11. Cr and Ni do not appear to be metals of concern. If the dashed trend lines (background) are representative, most Ni and Cr concentrations follow these trend lines. As in the previous study in the Shelter Island Basin carried out in our laboratory (Gieskes et al., SIH report), the data for manganese concentrations show no trend with the Fe concentrations, presumably because Mn is less associated with iron oxide phases. For comparison the data for Shelter Island Bay are presented in Figure 5-119. This figure also shows the data for the NASTA stations reported by Chadwick et al. (1999).

Conclusions

The data presented in this report allow some general observations with respect to the geochemical conditions of the sediments in the Paleta Creek area studied under the auspices of the PRISM program in San Diego Bay.

Pore water studies, both those presented in this report and by Dr. Wiebke Ziebis in a separate report, indicate that sulfate reduction does take place in all sites, but most pronounced in the site near the entrance of the Paleta Creek. This may be caused by slightly higher concentrations of reactive carbon, though differences in TOC (Figure 5-114) are small in this area. Nonetheless, in the cores P11 and P17A the redox sequence of O_2 consumption, manganese oxide reduction, and iron oxide reduction, occurs mostly in the upper few centimeters of the sediments, followed by sulfate reduction. In core PO4, however, iron oxide reduction is the dominant process in the upper ~ 10 centimeters, followed by sulfate reduction (Wiebke Ziebis, personal communication).

A study of the depth distributions of trace metals in representative cores of stations PO4, P11, and P17-1A indicates that mostly for the elements copper and zinc do higher values occur, with large variability in the concentrations depth profiles. Correlation plots between iron contents and trace metal concentrations indicate that only the trace metals Cu and Zn are elements of concern, with concentrations exceeding the so-called ERM level (Effect Medium Range – more than 50% of compiled biological studies indicate adverse effects).

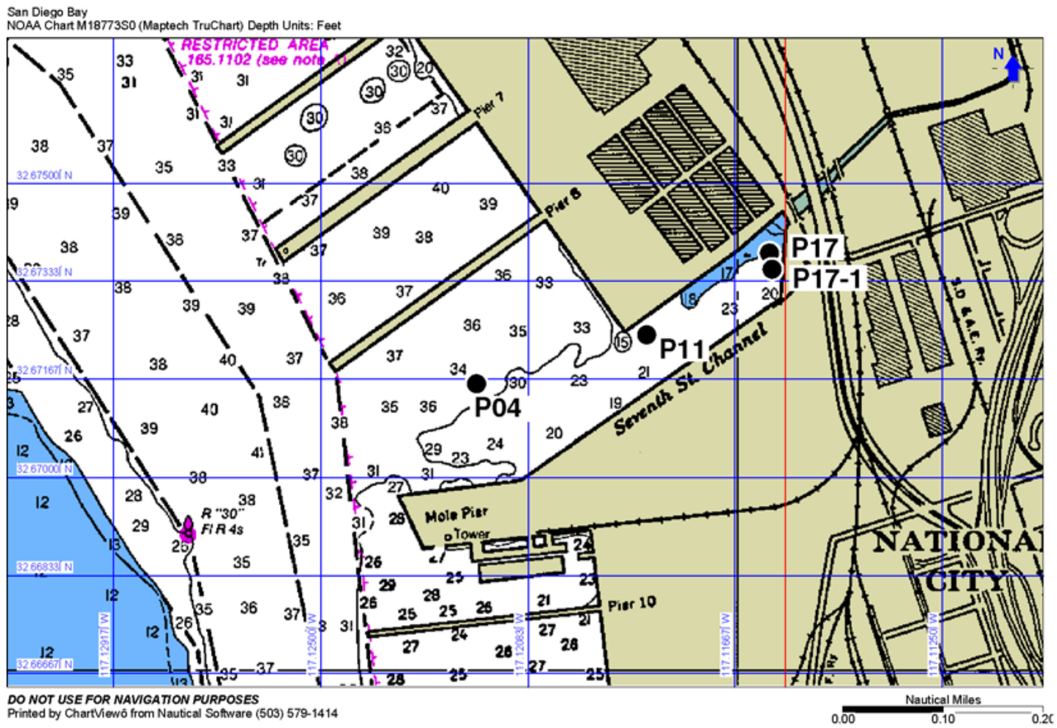


Figure 5-106. Core station locations in Paleta Creek.

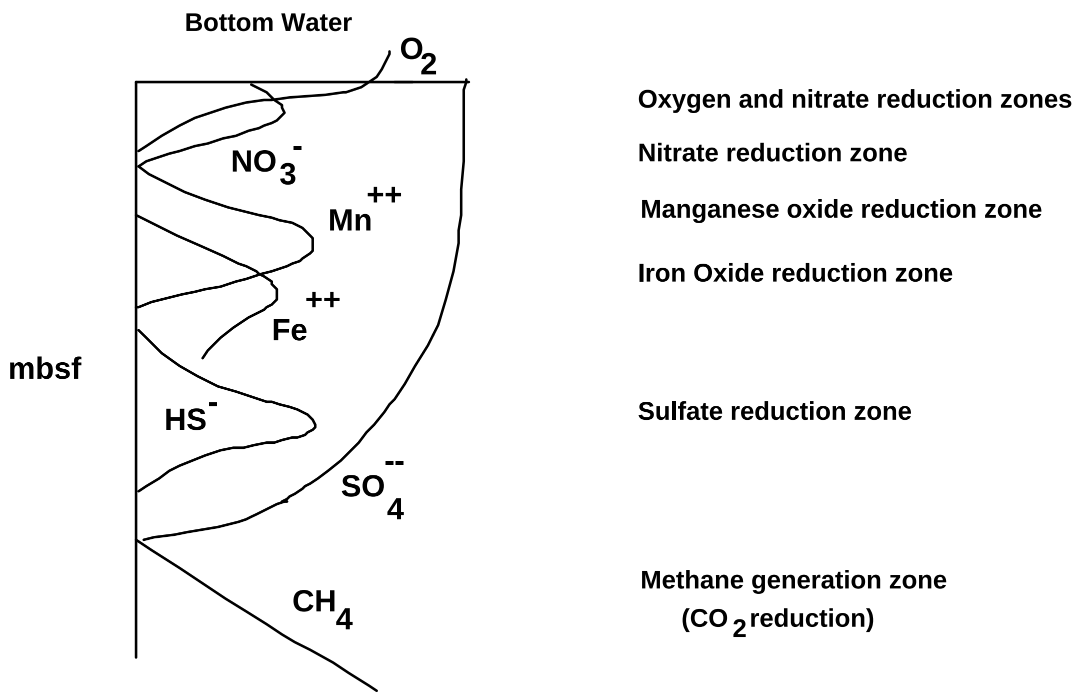


Figure 5-107. Conceptual redox gradients in sediment.

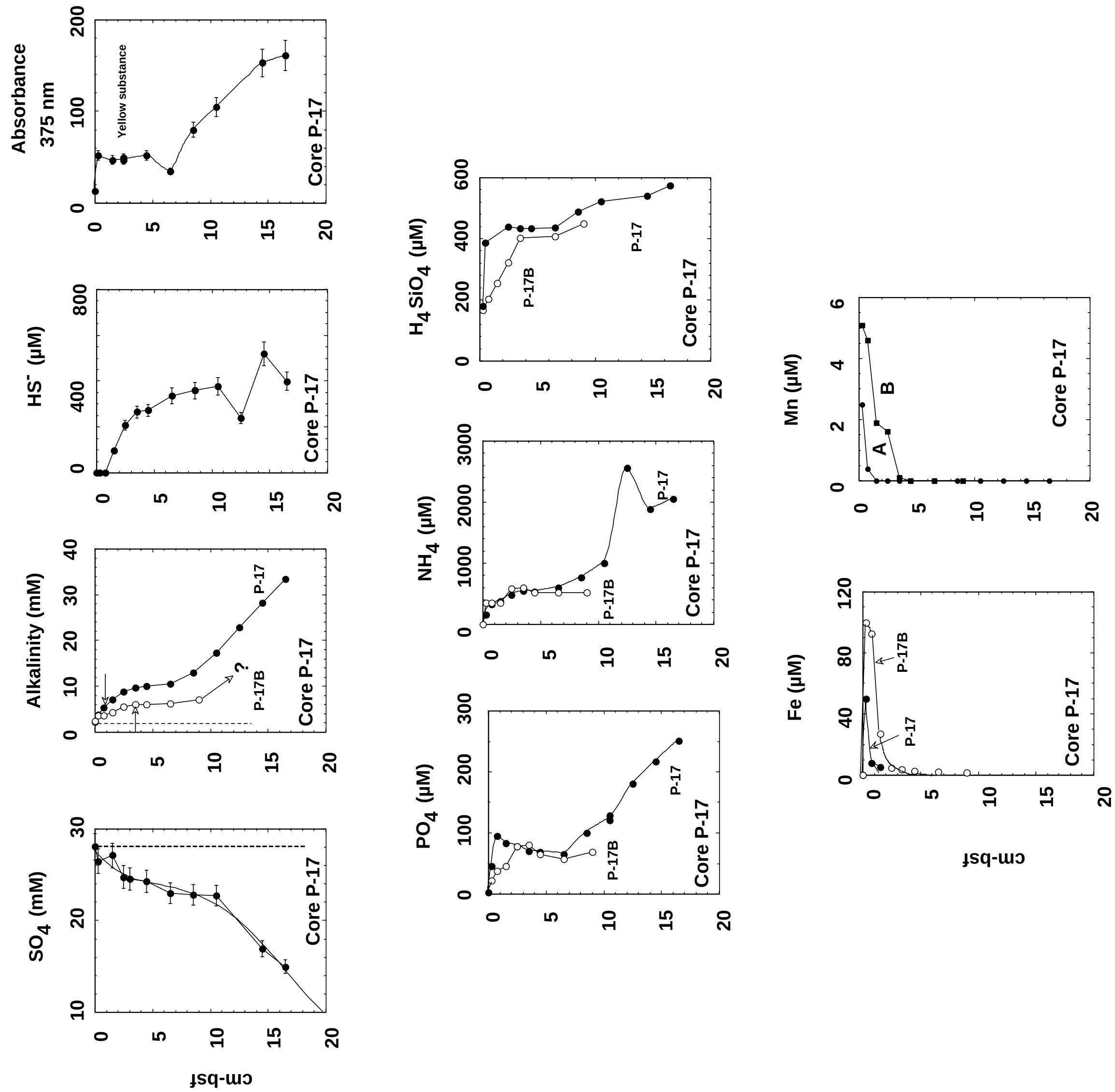


Figure 5-108. Geochemical profiles at Site P-17.

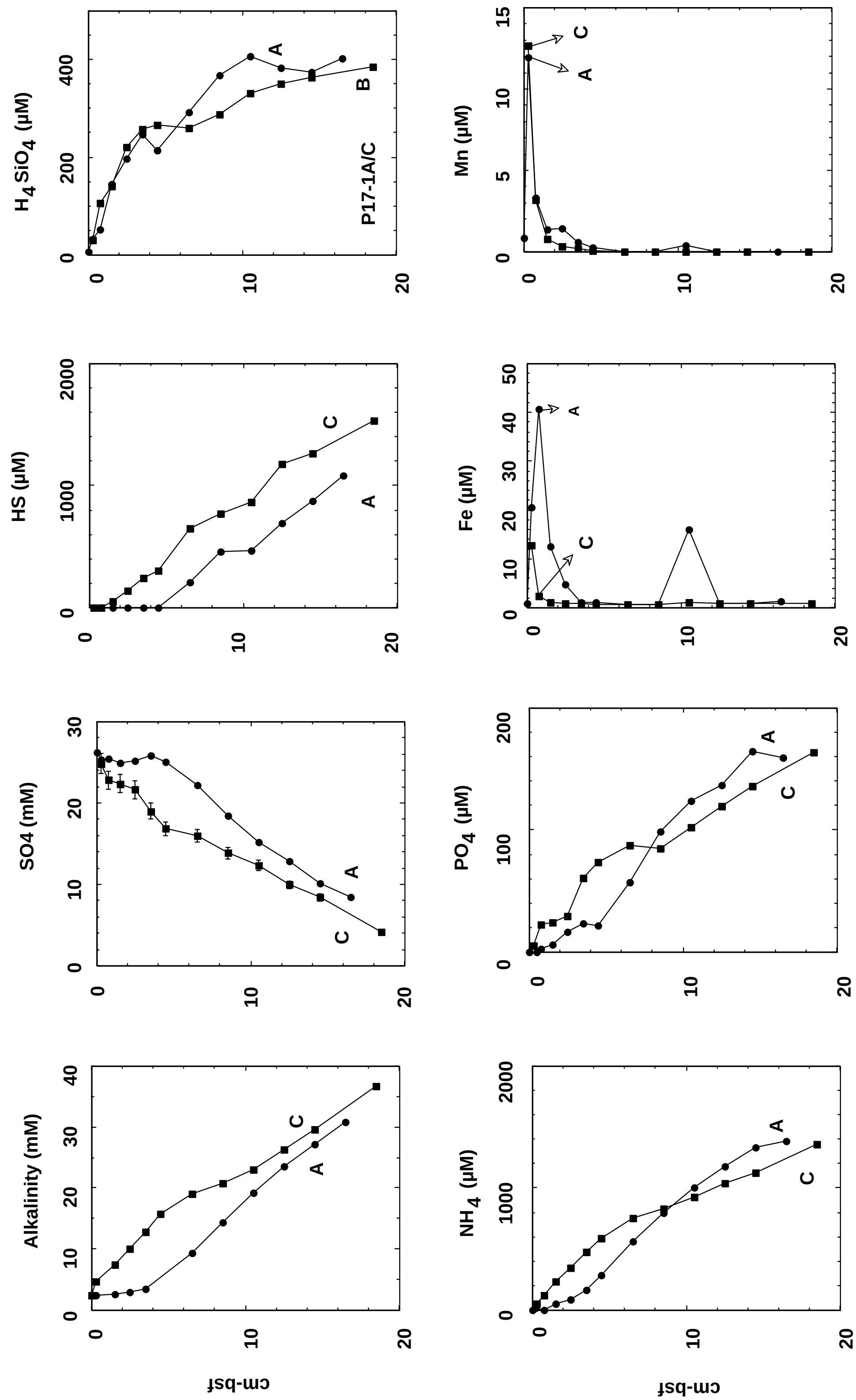


Figure 5-109. Geochemical profiles at Site P-17.

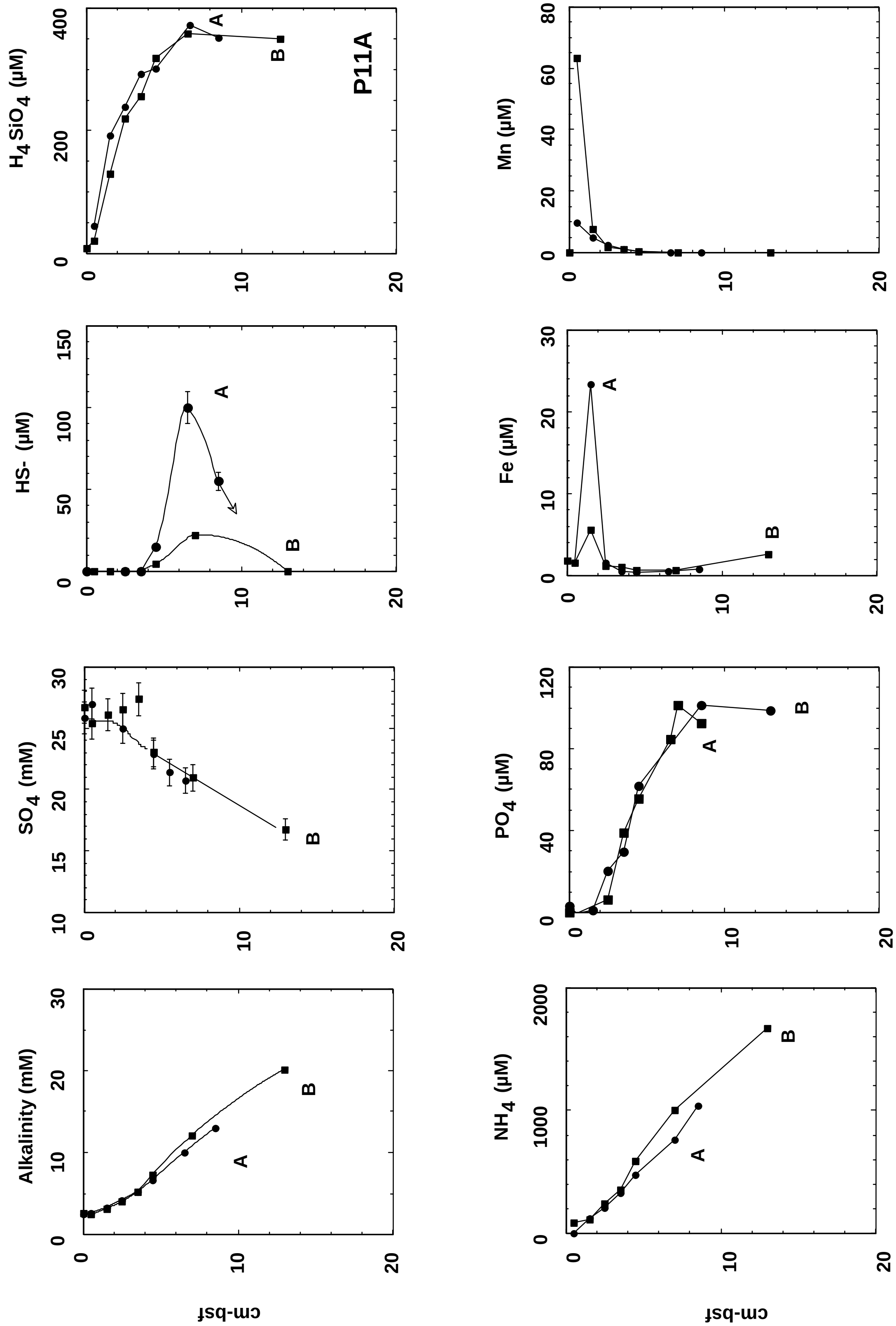


Figure 5-110. Geochemical profiles at site P-11.

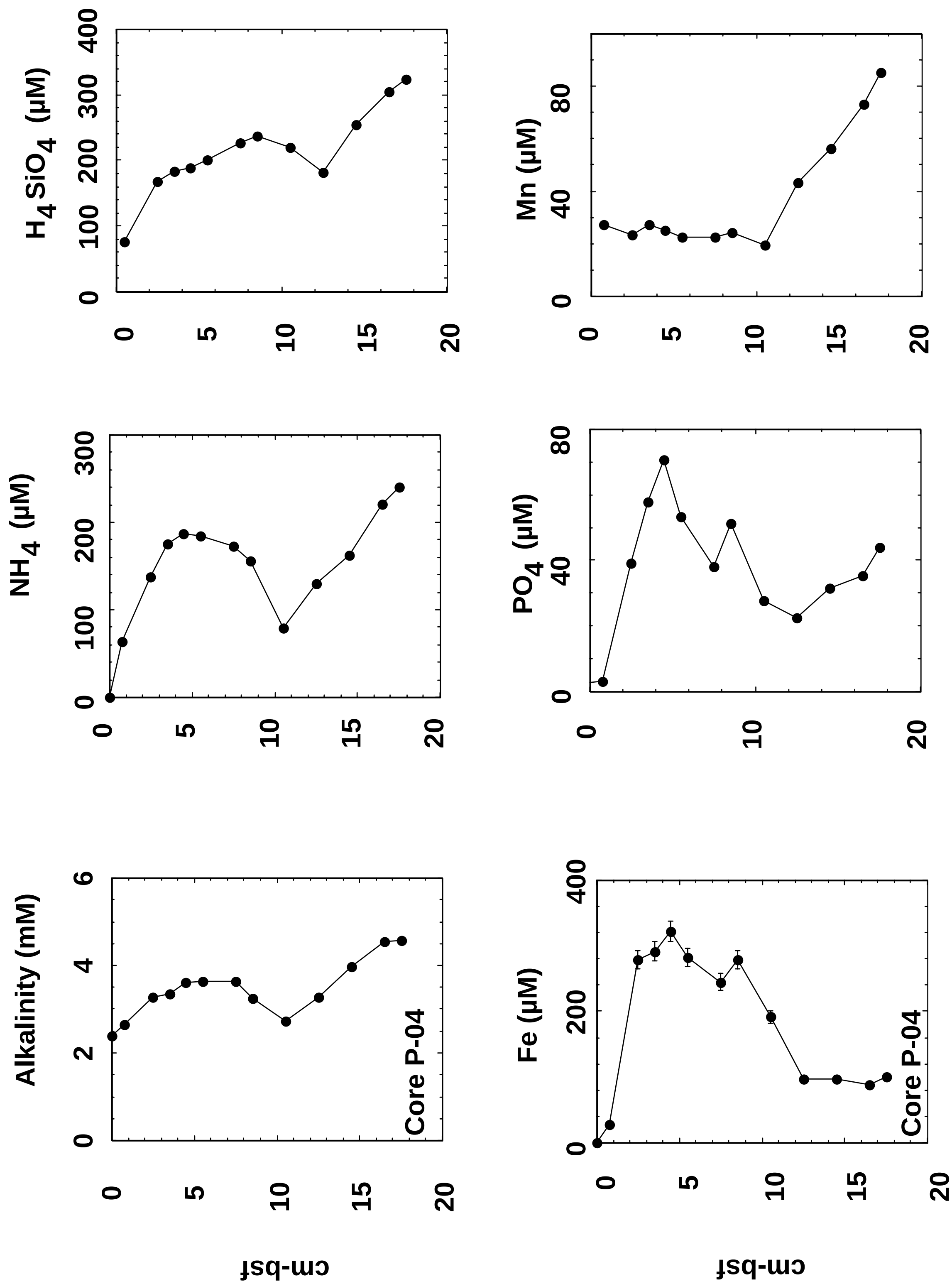


Figure 5-111. Geochemical profiles at site P-04.

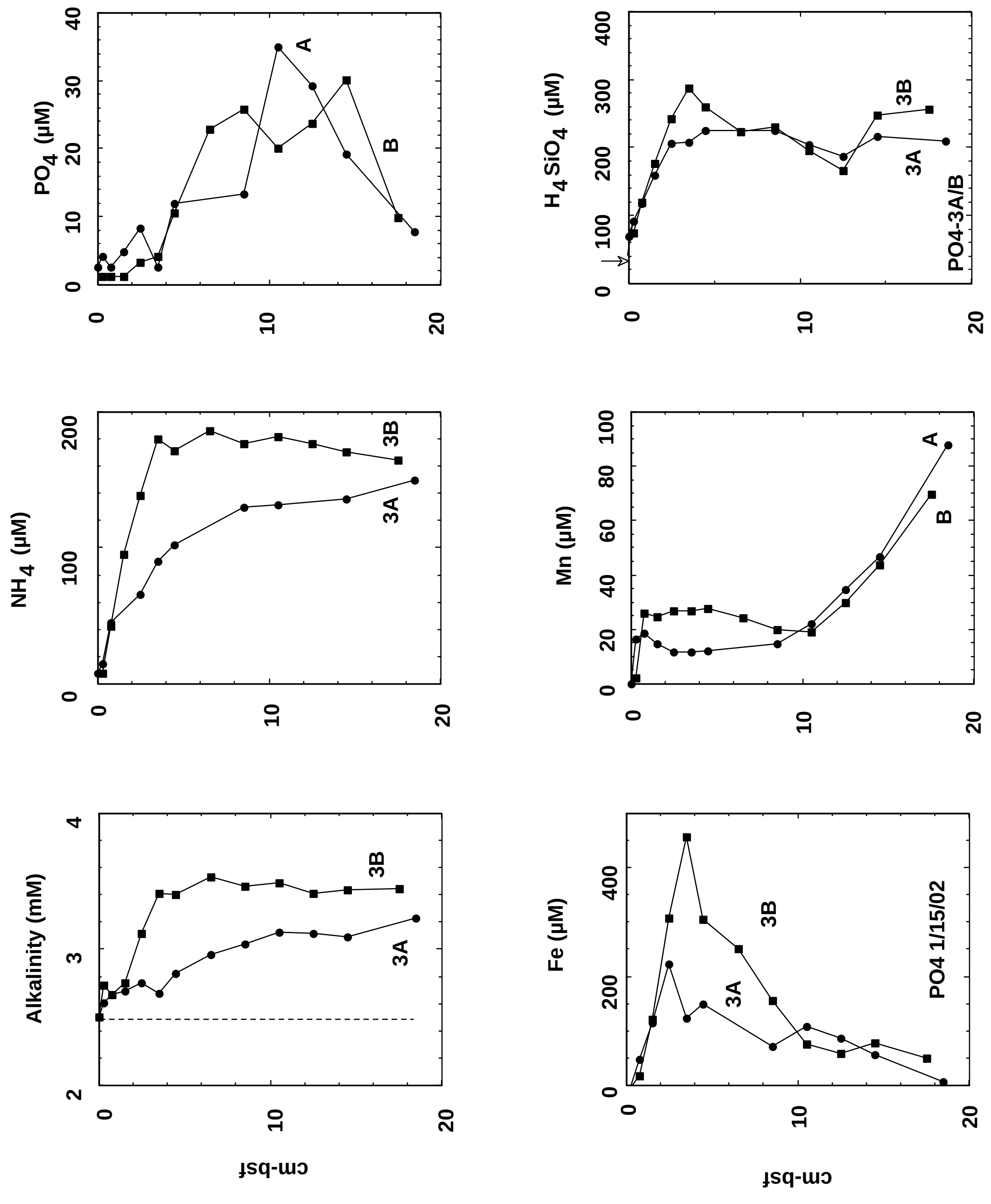


Figure 5-112. Geochemical profiles at site P-04.

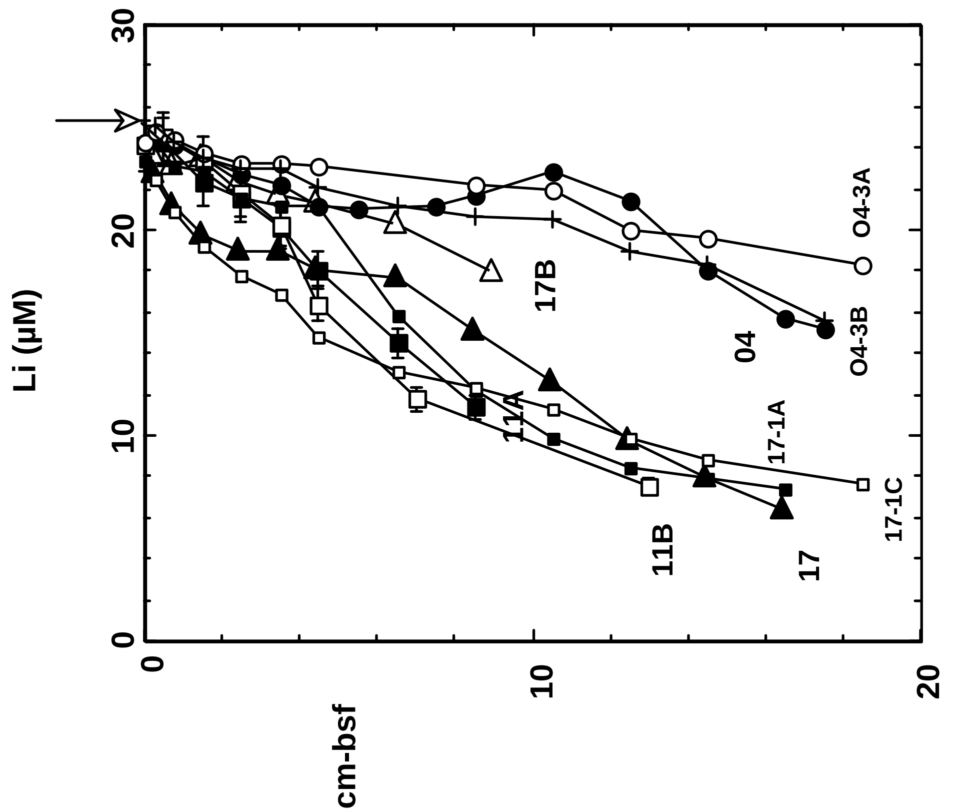


Figure 5-113. Lithium profiles from Paleta Creek stations.

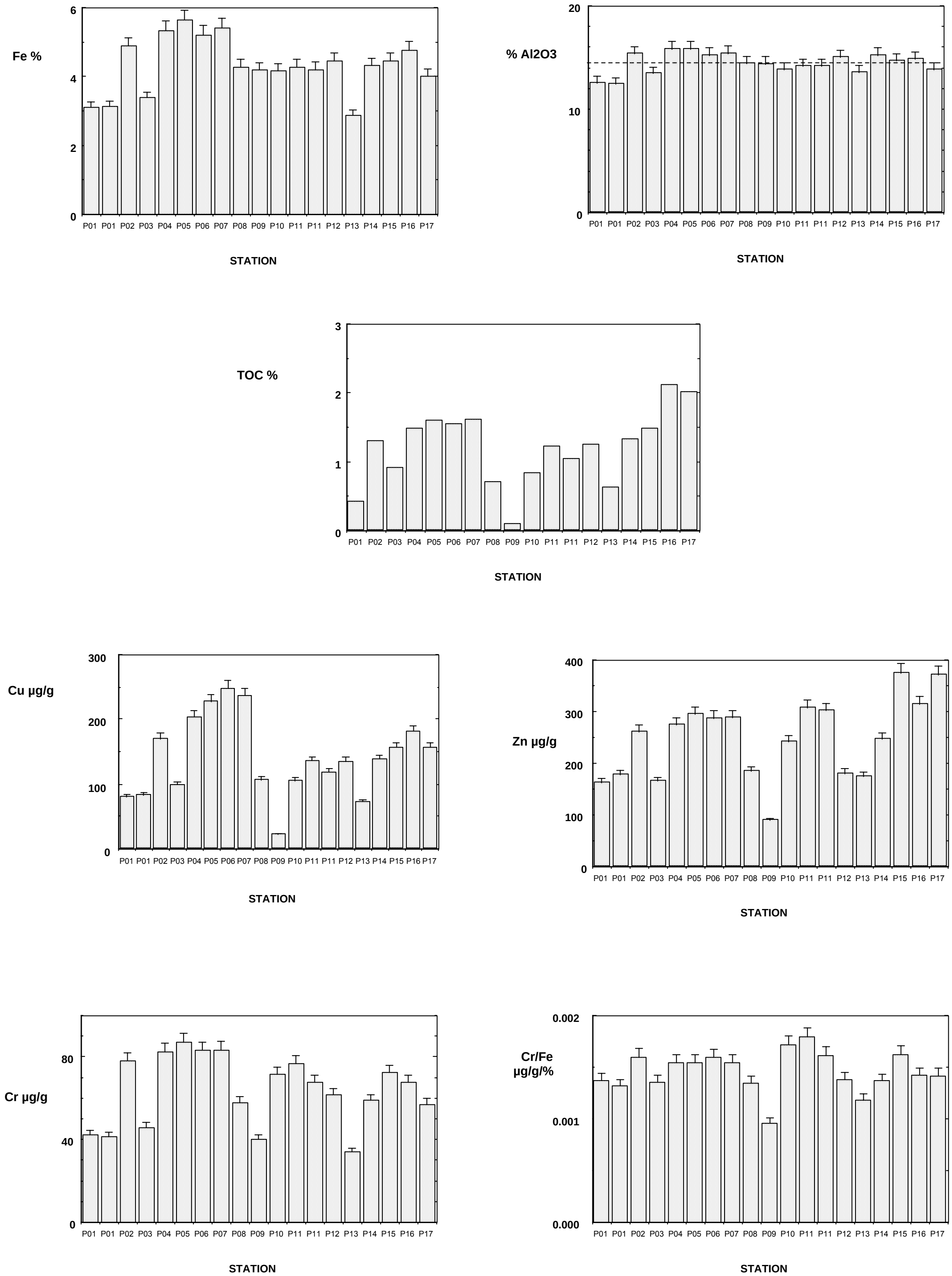


Figure 5-114. Geochemical patterns in Paleta Creek surface sediments.

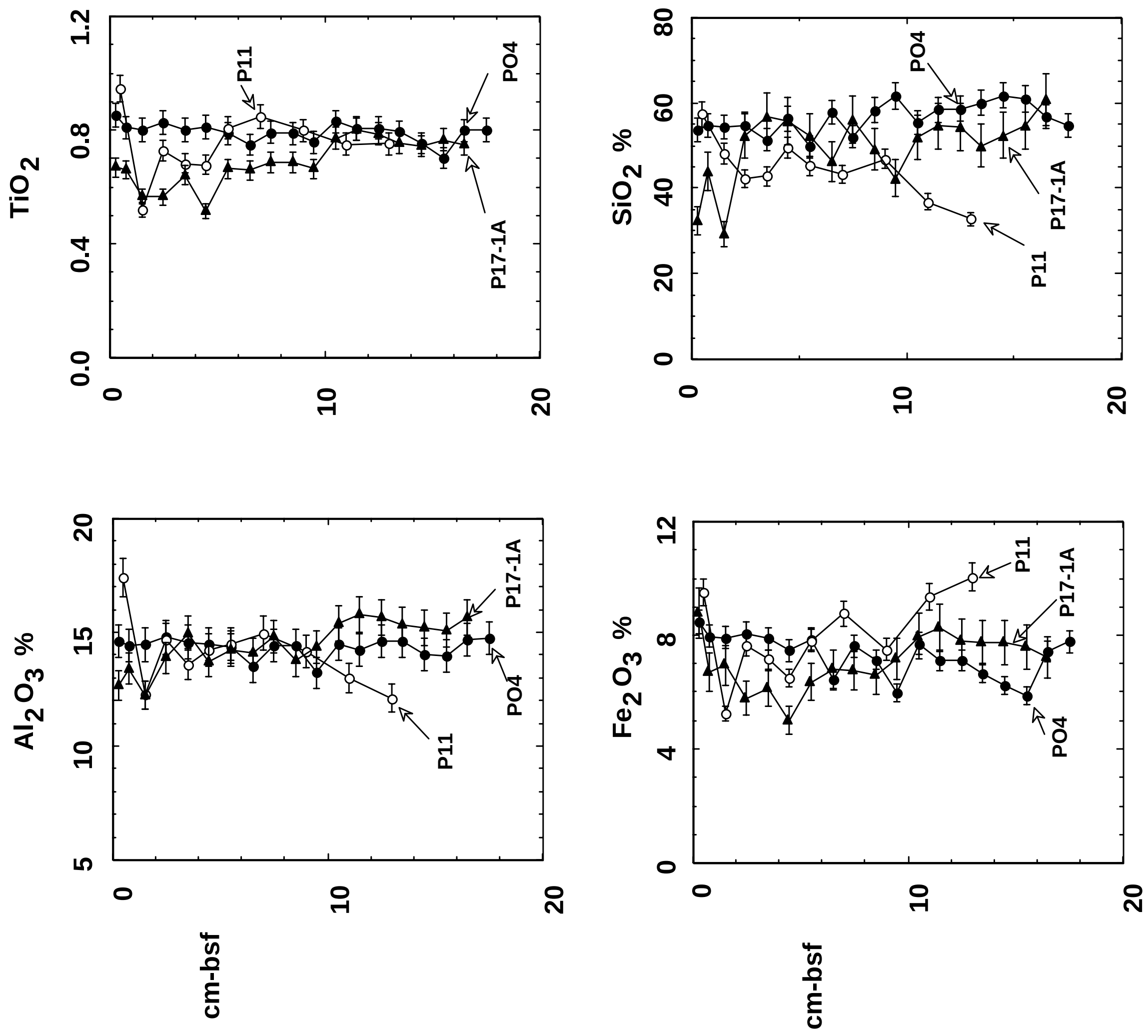
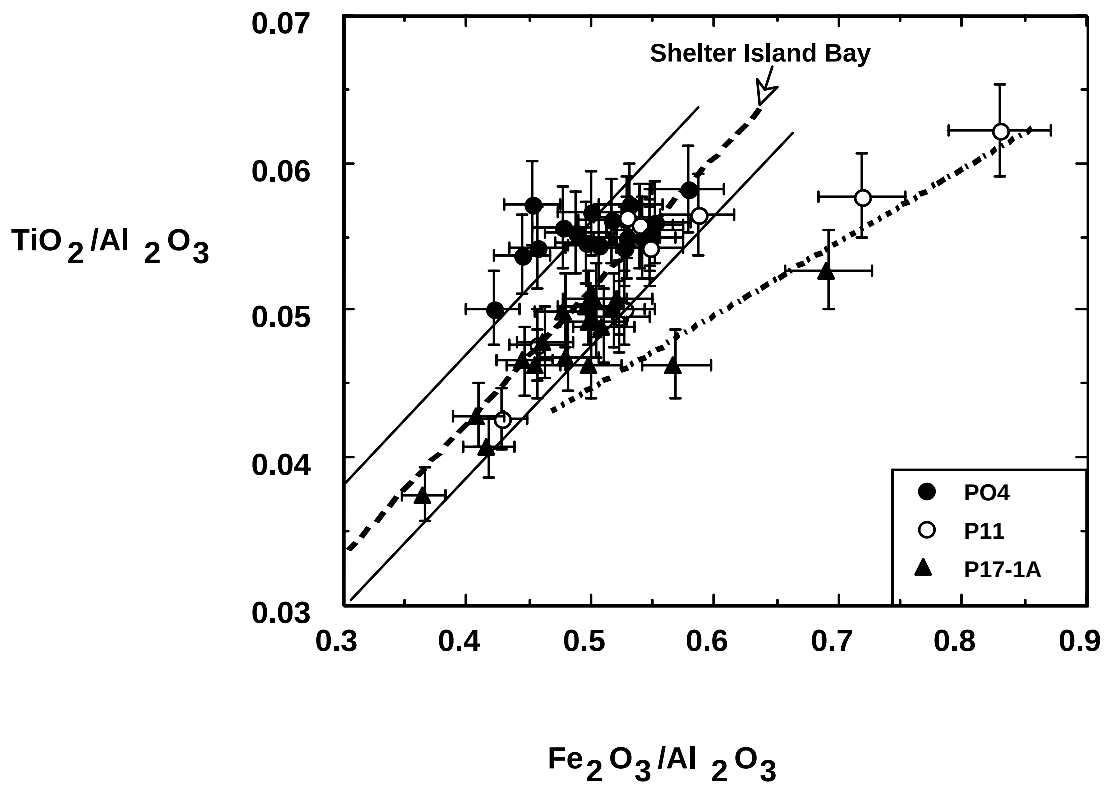


Figure 5-115. Comparative geochemical profiles from Paleta Creek stations P-04, P-11 and P-17.



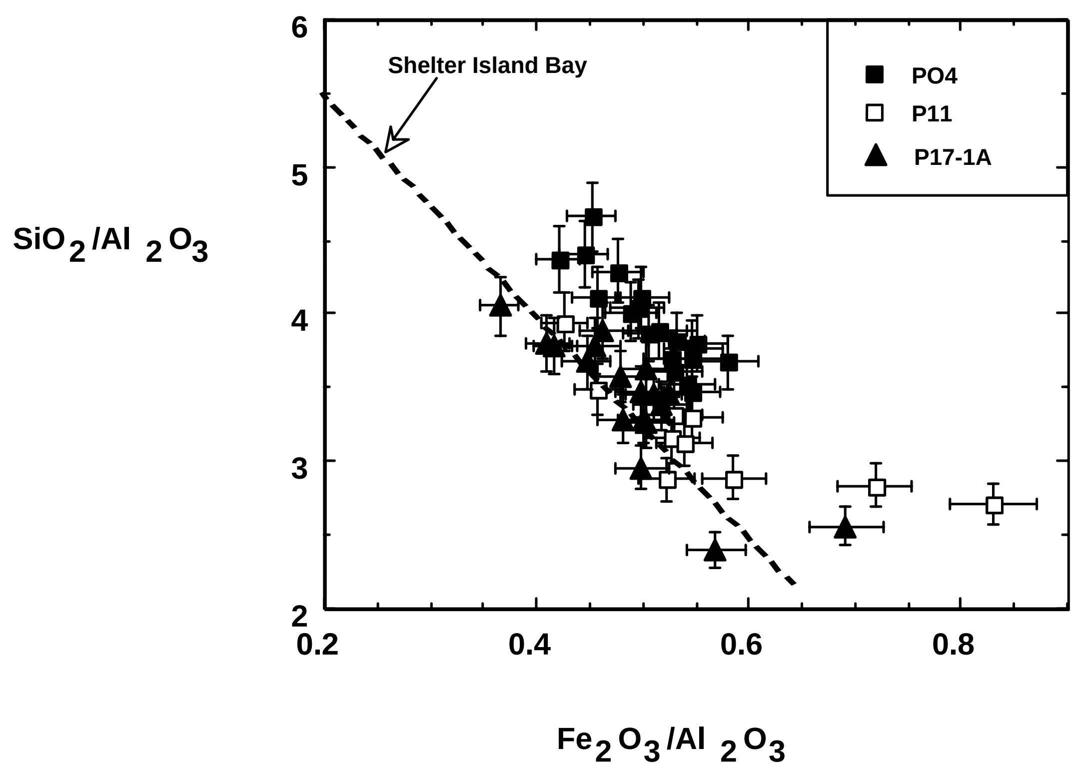


Figure 5-116. Elemental ratios and trends in Paleta Creek sediments relative to marina sediments.

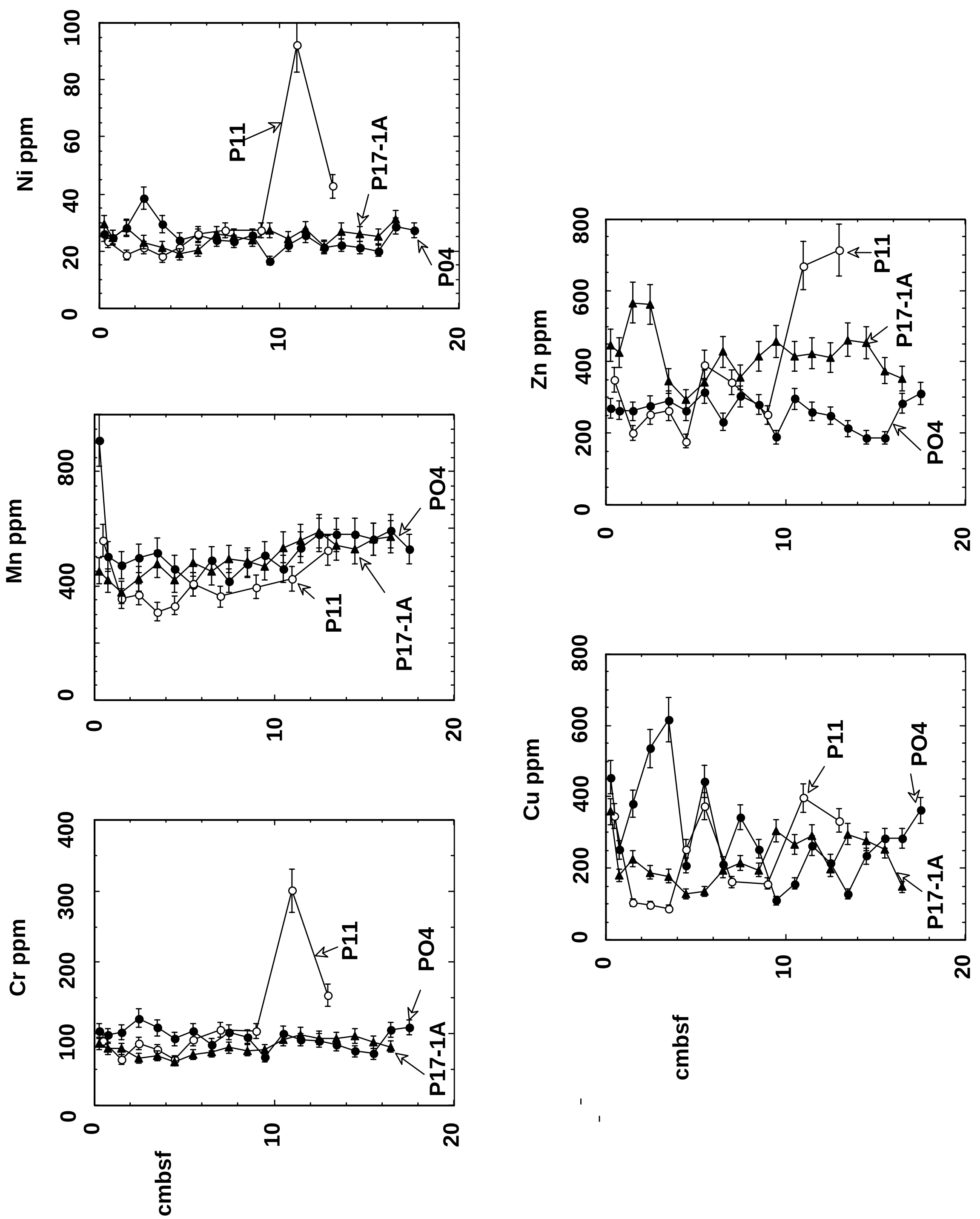


Figure 5-117. Trace metal profiles at the Paleta Creek stations.

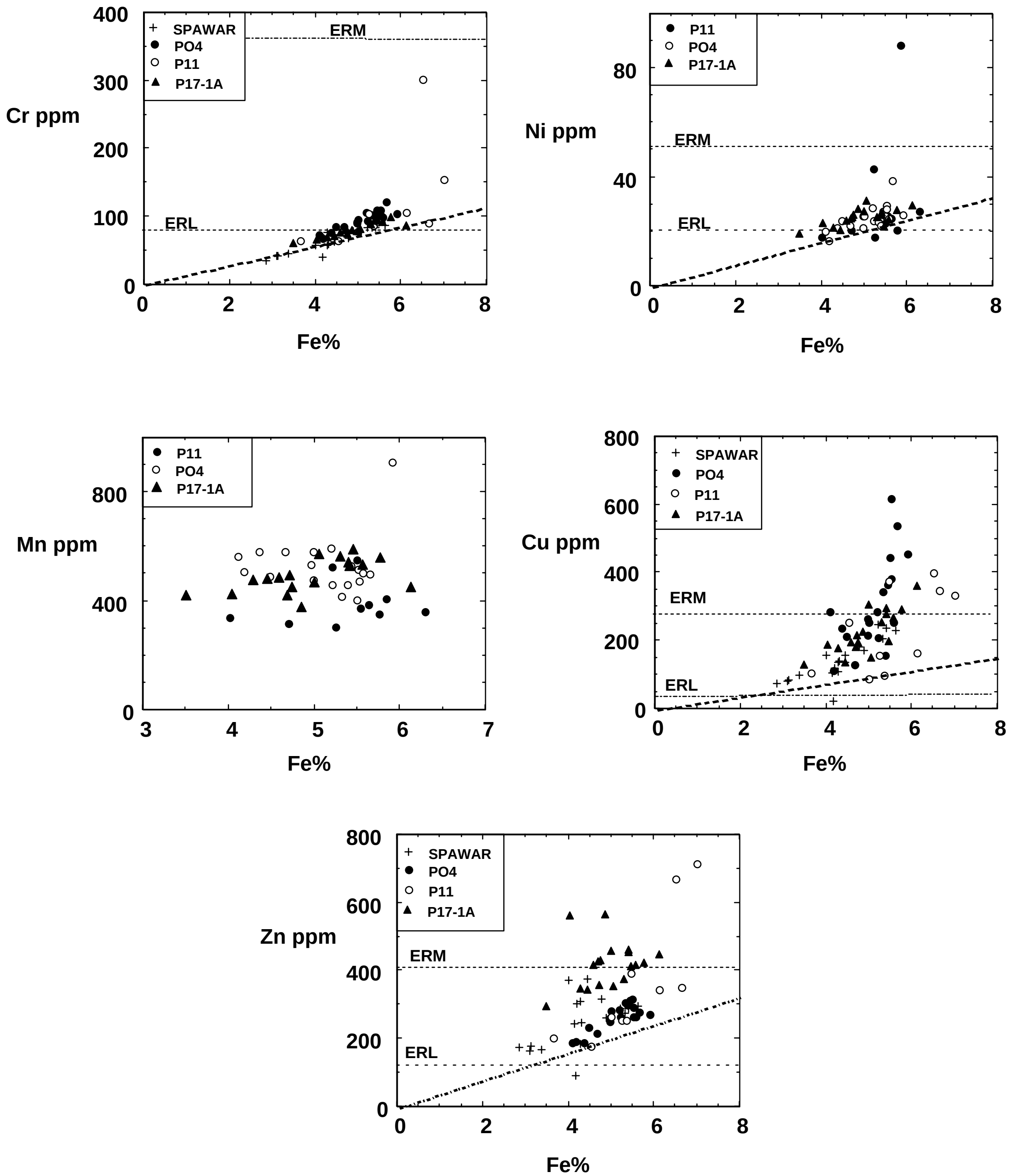


Figure 5-118. Trace metal – iron regressions for the Paleta Creek stations.

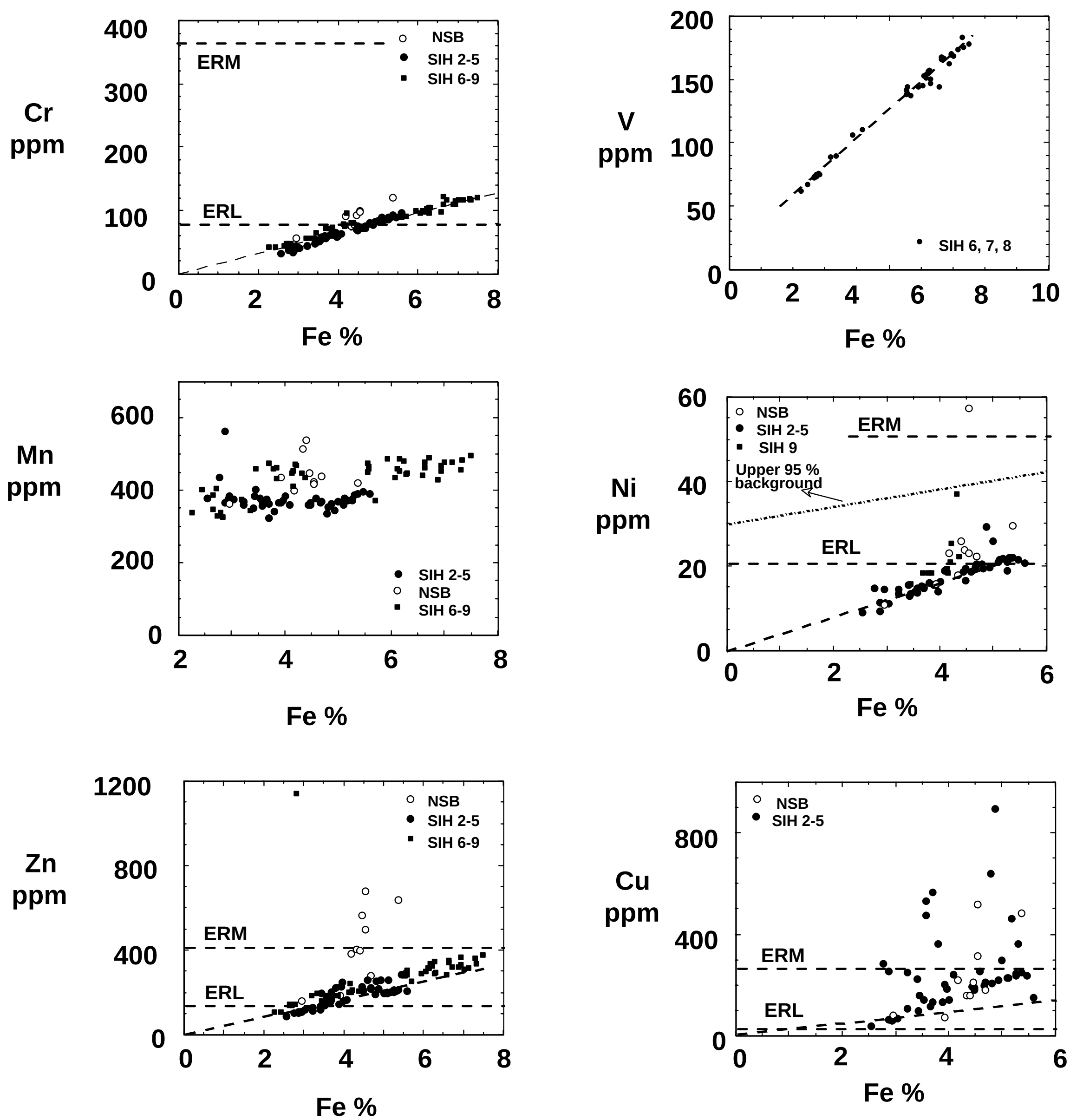


Figure 5-119. Trace metal – iron regressions for the marina stations.

5.11 OXYGEN AND HYDROGEN SULFIDE MICROPROFILING IN SEDIMENT CORES FROM THE PALETA CREEK PRISM SITES

Introduction

O_2 and H_2S microgradients were measured in intact cores from two stations in San Diego Bay: the shallower station P17 and the deeper station P04. Only a thin film, 2 mm thick, of sediment was oxic during dark incubations at station P17, in both cores. Diffusive oxygen flux, through a 600-µm thick diffusive boundary layer into the sediment was calculated to be 638 µmol O_2 $m^{-2}h^{-1}$ (core 1) and 424 µmol O_2 $m^{-2}h^{-1}$ (core 2). Illumination of the sediment surface initiated photosynthetic activity within the upper 3 mm of the sediment, which lead to high oxygen concentrations (up to 400 µM), deeper oxygen penetration (3 mm) and oxygen fluxes from the sediment into the overlying water of 1237 µmol O_2 $m^{-2}h^{-1}$(core 1) and 1122 µmol O_2 $m^{-2}h^{-1}$ (core 2).

The two cores from the deeper station showed different oxygen distributions. Core A was characterized by a network of small burrows (ø 2mm) down to ~ 1-cm sediment depth. Bio-irrigation enhanced oxygen transport into the sediment, which was evident from subsurface peaks in oxygen concentration. The mean oxygen penetration depth was ~ 4 mm, but oxygen was transported below 5 mm, when burrows were present. Core B was not bioturbated and oxygen penetrated only down to 2-mm depth. The calculated diffusive oxygen fluxes into the sediment also varied significantly with 835 µmol O_2 $m^{-2}h^{-1}$ in core A, compared to 234 µmol O_2 $m^{-2}h^{-1}$ in core B. In contrast to station P17, exposure to light did not result in photosynthetic activity. In the cores from station p17, H_2S was present at 1-cm (core 1) or 2-cm (core 2) and increased with depth. Highest values of 1.7 mM were measured in core 1 compared to 0.5 mM in core 2. In contrast, in cores A and B, from station P04, sulfide was not detectable in the upper 8 cm , below this depth sulfide concentrations increased to only 0.15 mM at 11-cm sediment depth.

Methods

Sampling

Sediment cores from two different sites (P17 and P04) were extracted from the sea floor in San Diego Bay by using a multiple corer (Jan. 9 and 15, 2002). 2 parallel, undisturbed cores from each station were brought immediately to the laboratory and were subjected to oxygen and sulfide microprofiling.

O_2 microgradients

Vertical oxygen distribution in intact cores was measured by Clark-type microelectrodes provided with a built-in reference and a guard cathode (Jørgensen and Revsbech, 1988, Revsbech 1989). The electrodes were purchased from UNISENSE, Denmark and had a sensing tip of 15 – 20 µm, a stirring sensitivity of < 2% and a 90% response time ≤ 1s. Electrode currents had a linear response to 0% and 100 % air saturation of O_2. Linear calibration was done at 20 ºC in 100% saturated seawater (35‰) and nitrogen purged seawater with 0 % oxygen saturation.

The electrodes were attached to a micromanipulator, driven by a stepping motor (Oriel), signals were amplified and transformed to mV by a picoammeter (Unisense PA 2000) and data were collected directly on a computer. Measurements were performed in vertical increments of typically 200 µm. The position of the microsensor was observed by using a dissecting microscope.

Several oxygen profiles were performed in the dark at different locations within the same core under stagnant (no-flow) conditions.

Subsequently the cores were exposed to different light intensities (25 %, 50 %, 100 %) for increasing periods of time (5 min., 10 min., 15 min,, 20 min.) and repeated oxygen profiles were measured in the same locations.

A cold-light source with a 0 % to 100 % intensity adjustment was used for illumination (exact light intensities in µEinstein can be measured if desired).

Diffusive O_2 flux

The diffusive flux J of oxygen downwards across the sediment-water interface was calculated after Fick's first law of one-dimensional diffusion from the measured O_2 microgradients (in the dark), dC/dz, through the DBL (Diffusive Boundary layer) (Crank 1983, Jørgensen and Revsbech 1985):

$$J \Downarrow = - D_0 \; dC/dz$$

Where D_0 = molecular diffusion coefficient of oxygen in seawater (at a specific temperature and salinity), C = O_2 concentration, and z = depth (z = 0 at sediment water interface).

Diffusive fluxes were calculated from measured O_2 microgradients that showed a distinct DBL (linear increase of oxygen concentration with height above the sediment surface), which could be recognized from 2 shifts in the slope of the O_2 gradient. The DBL constitutes a partial barrier to the flux of solutes across the sediment-water interface. By assuming a pure molecular diffusion through the DBL, chemical microgradients measured in this film can be used to calculate the total flux of oxygen to and from the sediment (Jørgensen and Des Marais 1986).

When photosynthesis occurred, during light exposure, the diffusive flux of oxygen through the DBL into overlying water was calculated from the steady state oxygen profile. This oxygen flux is equal to the areal net photosynthesis.

$$P_{Net} = J \Uparrow \; -D_0 \; dC/dz$$

Porosity was not measured in the cores but:

The downward flux of oxygen in the sediment can be calculated by

$$J \Downarrow = - \phi D_S \; dC/dz$$

Where ϕ is the sediment porosity at a specific depth and D_S is the sediment specific diffusion coefficient of O_2 which can be calculated by

$$D_s = D_0 \; / \; 1 + n \; (1-\phi)$$

where n = 3 for mud, and n = 2 for sand. Further, the net photosynthetic production of O_2 can be calculated from the upward flux plus the downward flux $P_{Nphot} = |J\Downarrow| + |J \Uparrow|$. In addition O_2 consumption rates within the oxic surface layer of the sediment can be calculated from O_2 microgradients assuming zero-order kinetics (Rasmussen and Jørgensen 1992)

$$R = D_S \; d^2C \; / \; dz^2$$

H_2S microgradients

Principle: The H_2S microsensor is a miniaturized amperometric sensor with an internal reference and a guard anode (Jeroschewsky et al., 1996). The sensor is connected to a high-sensitivity picoammeter (Unisense PA 2000) and the anode is polarized against the internal reference (polarisation voltage + 0.085V). H_2S from the environment will penetrate through the sensor tip membrane (tip diameter 30 – 50 µm) into the alkaline electrolyte, where the HS- ions formed are oxidized immediately by ferricyanide, producing sulfur and ferrocyanide. The sensor signal is generated by re-oxidation of ferrocyanide at the anode tip of the sensor. The picoammeter converts the resulting reduction current to a voltage signal. The internal guard electrode is polarized to scavenge H_2S and help keeping a constant ratio of ferri- to ferro cyanide in the electrolyte, thus minimizing the zero-current.

Calibration

Calibration is performed after the sensor signal has stabilized during pre-polarization. The H_2S microsensor responds linearly over a certain range. A stock solution of S^{2-} (i. e. 100 mM) is prepared from dissolving Na_2S in N2-flushed 0.1 M NaOH in a closed container. The final concentration of stock solution should be determined by standard analysis. A calibration buffer (100 mM phosphate buffer, pH 7) is prepared. Oxygen is removed from this buffer by vigorously bubbling with an oxygen-free inert gas (e. g. N_2) before aliquots are transferred to gas-proof containers with rubber stoppers. A maximum of 10 % of the vial volume should be left as head space.

The signal zero is obtained by immersing the sensor tip into the calibration buffer. Further calibration points are prepared by injecting suitable amounts of the S^{2-} stock solution into the calibration vials with a micro-syringe. The calibration curve is used to convert measured values (pA) to concentrations of H_2S. These H_2S sensors have been successfully applied in marine ecology (Kuehl et al. 1998) and were purchased from UNISENSE, Denmark.

Measurements
The electrode was moved vertically by the micromanipulator into the sediment core. Vertical profiles of H_2S in the sediment were measured in intervals of typically 0.5 mm – 1 mm. The sensor was attached to a picoammeter and the data was recorded on a strip chart recorder. pH was measured, parallel to H_2S microprofiles, with a long Needle Combination pH Electrode (Diamond General) at 5-mm intervals. Redox potential was measured using a mini-electrode (Ingold) in typical depth increments of 1 cm.

Results & Discussion

Oxygen profiles

Station P17

Oxygen profiles in core 1 and 2 were similar. There was a sharp decrease of oxygen at the sediment-water interface and oxygen penetrated only 1.2 mm (core 2) or 2 mm (core 1) into the sediment during dark incubation. Most of the microprofiles showed the development of a diffusive boundary layer, characterized by a linear increase of oxygen with height above the interface. The thickness of the boundary layer was ~ 600 µm. From microprofiles measured within this thin film, downward diffusive fluxes of oxygen were calculated. Oxygen flux was slightly higher in core 1 (638 µmol O_2 $m^{-2}h^{-1}$) compare to core 2 (424 µmol O_2 $m^{-2}h^{-1}$). Exposure to light (100%) showed in both cores a photosynthetically active layer within the upper 2 mm of sediment. Oxygen concentrations increased by a factor of 4 at the sediment-water interface within 5 minutes of light exposure. A steady state oxygen profile was established after ~ 20 min. from which an upward oxygen flux into the overlying water could be calculated. The upward flux was twice as high as the calculated downward flux in the dark (core 1: 1237 µmol O_2 $m^{-2}h^{-1}$; core 2: 1122 µmol O_2 $m^{-2}h^{-1}$). Oxygen penetration depth increased by a factor of 2 during illumination.

Station P04

Oxygen penetrated deeper into the sediment at station P04 during dark incubations. Core A had a network of small burrows (ø 2 mm) within the top 1 cm of the core. The inner walls of the burrows had a light color, indicating oxygenation. Oxygen penetrated down to 4 mm and showed a subsurface peak of oxygen when the electrode went through a burrow. The bio-irrigation of the burrows enhanced oxygen penetration below 5 mm sediment depth. Core B was not bioturbated and oxygen penetrated only ~2 mm deep.

Exposure to light did not result in photosynthetic activity in the sediment and there was no increase in oxygen penetration during light incubations. Diffusive oxygen fluxes varied from 835 µmol O_2 $m^{-2}h^{-1}$ in the bioturbated core to only 234 in the non-bioturbated core.

H_2S microprofiles

Station P17

Core 2 of station P17 showed the highest sulfide concentration of 1.7 mM. H_2S was detectable at 8-mm sediment depth and increased downward. H_2S occurred at 2-cm sediment depth in core

2 and increased with depth. 0.5 mM was the highest concentration that was measured at the lower end of the sediment core (7 cm).

Station P04

The H_2S profiles measured in the 2 cores of station P04 were very similar. H_2S was not detectable in the upper 8 cm of sediment. Below this, sulfide increased with depth to 150 µM at the bottom of the cores (11 cm).

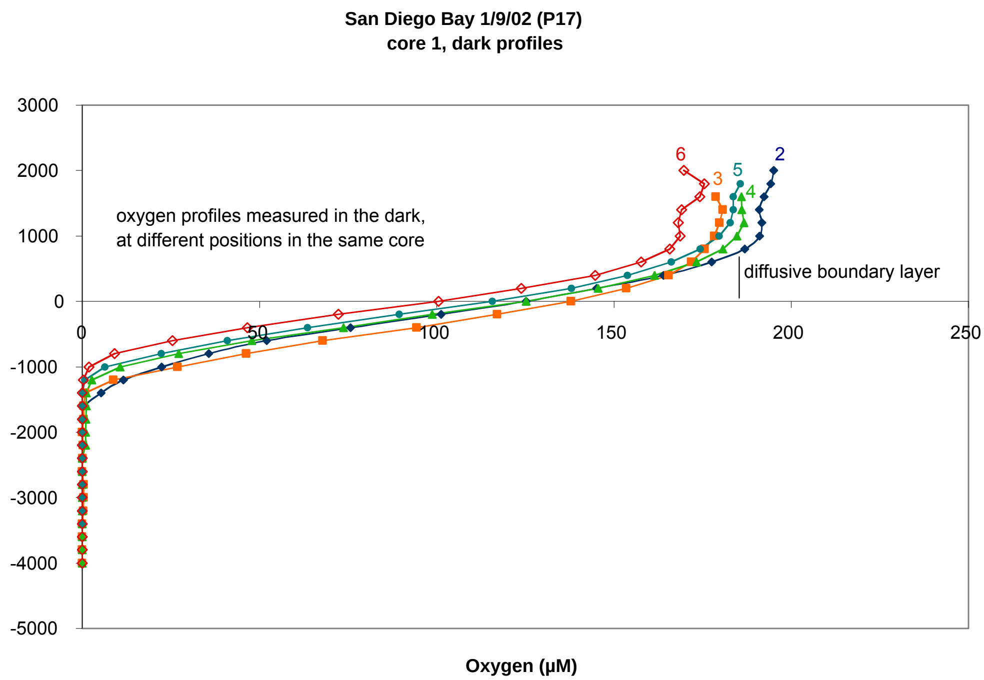


Figure 5-120. P17 core 1 oxygen replicate profiles measured in the dark.

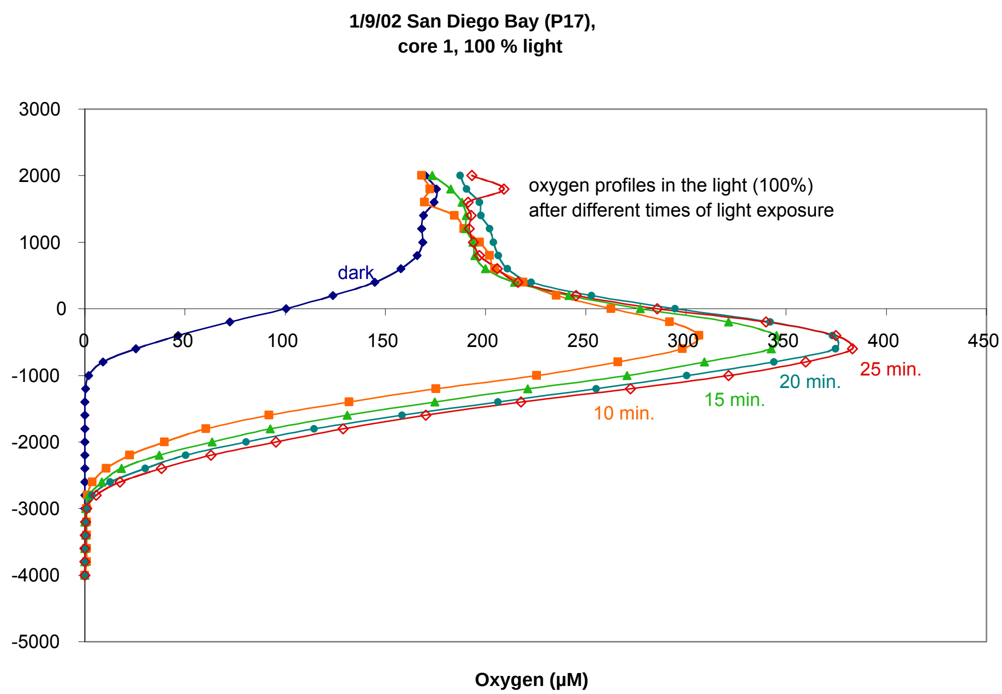


Figure 5-121. P17 core 1 oxygen replicate profiles measured in the light.

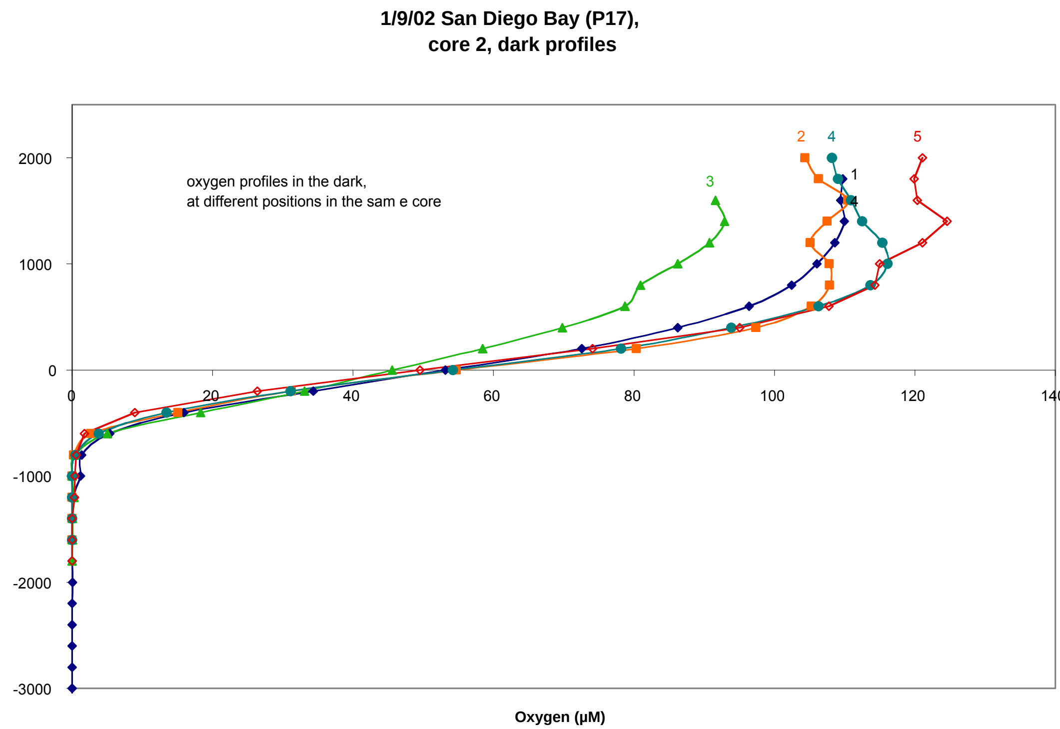


Figure 5-122. P17 core 2 oxygen replicate profiles measured in the dark.

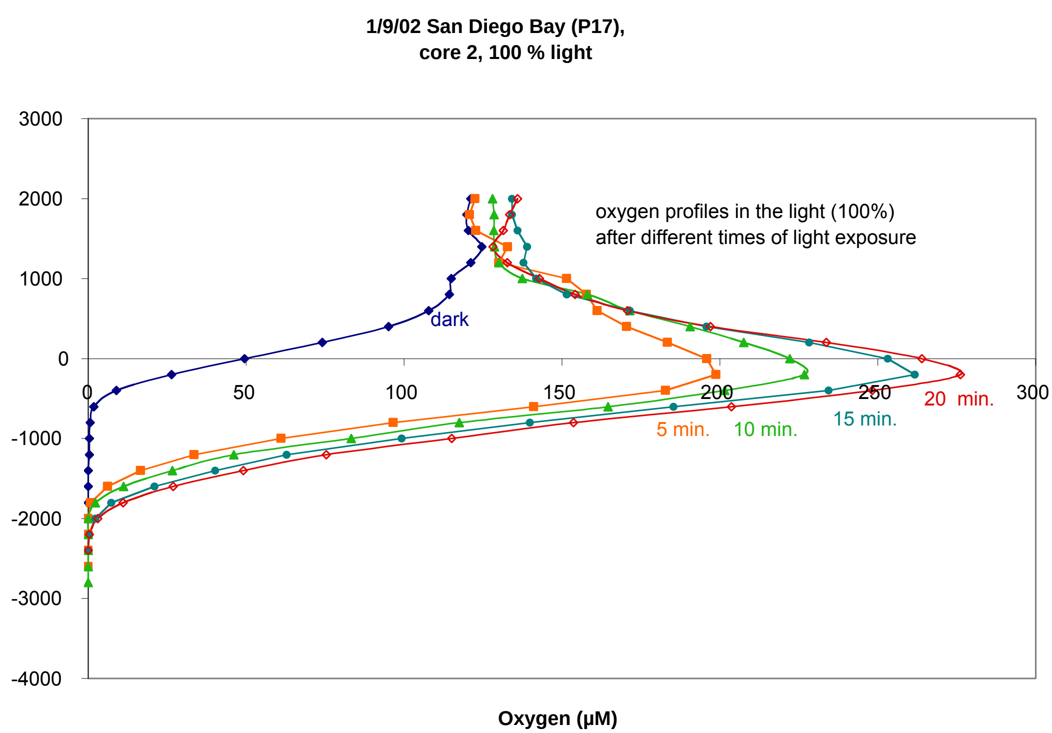


Figure 5-123. P17 core 2 oxygen replicate profiles measured in the light.

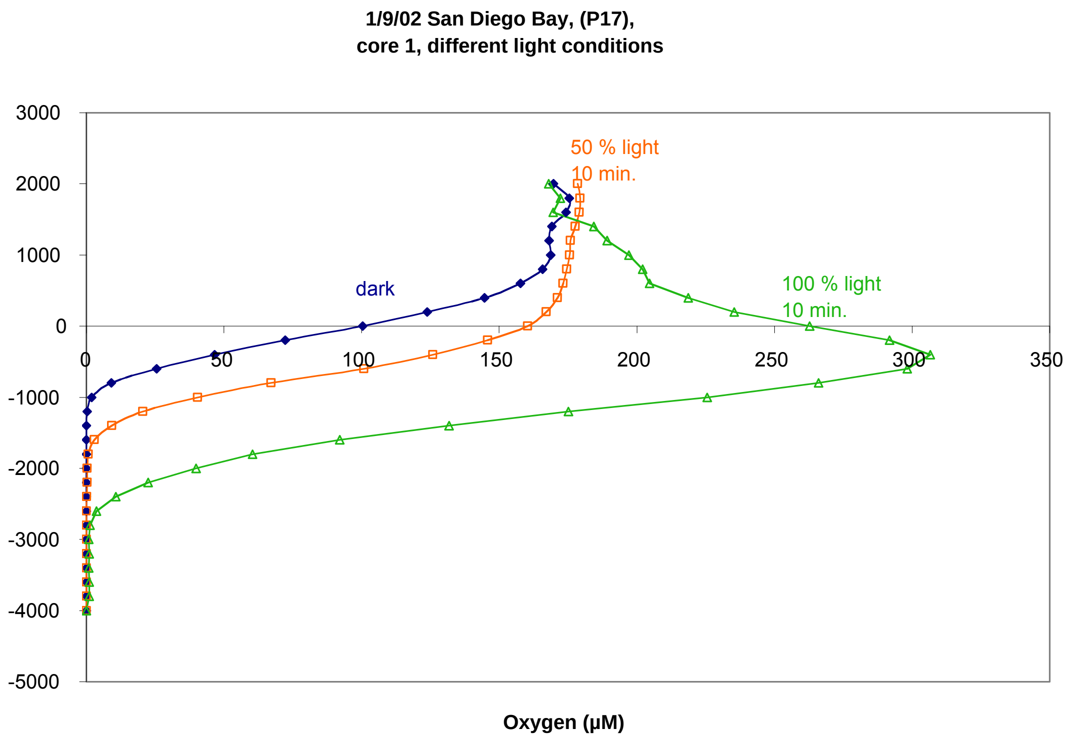


Figure 5-124. . P17 core 1 oxygen profiles measured at different light intensities.

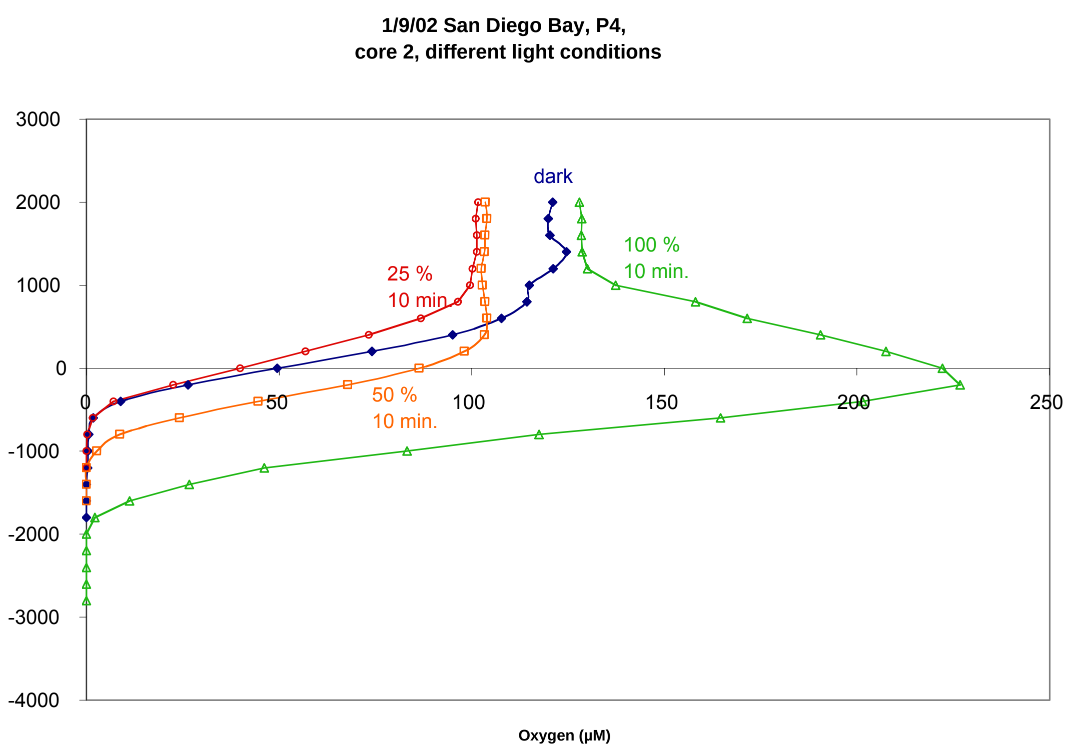


Figure 5-125. P17 core 2 oxygen profiles measured at different light intensities.

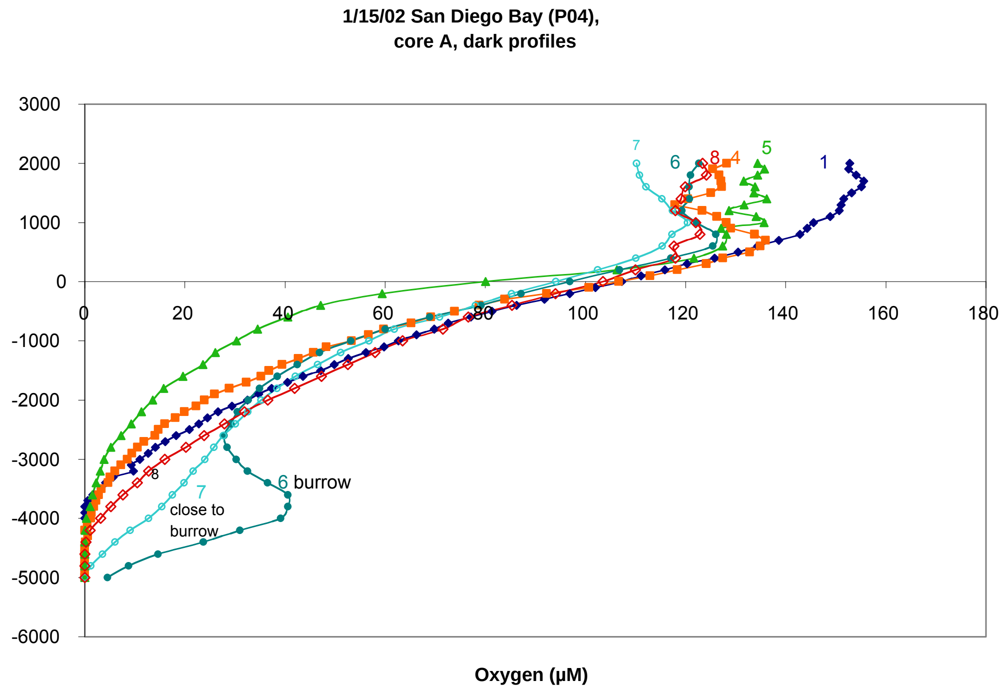


Figure 5-126. P04 core A oxygen replicate profiles measured in the dark.

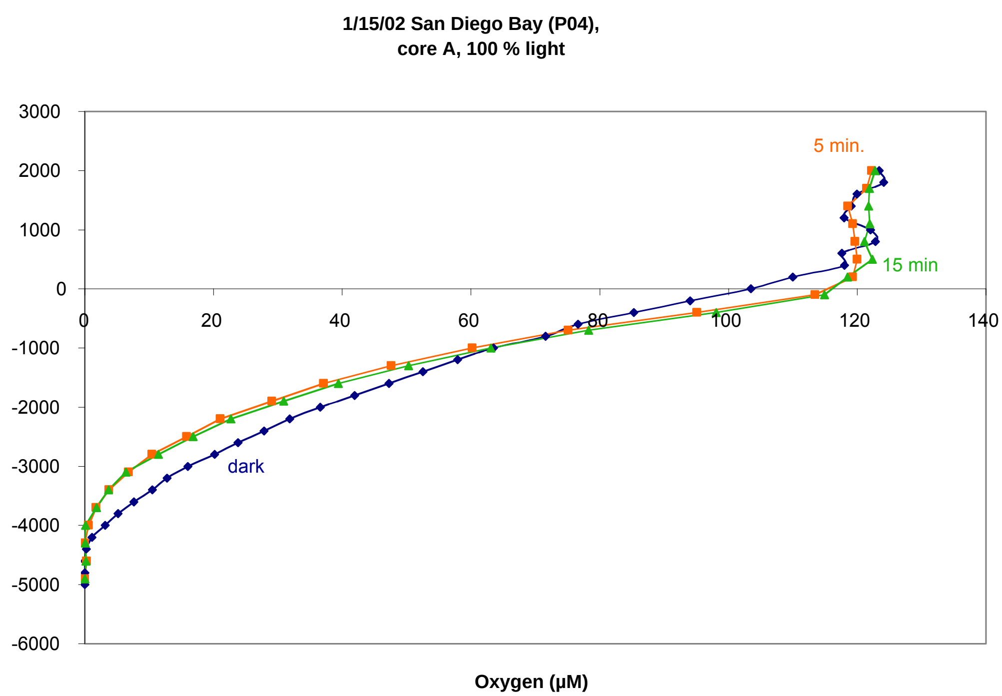


Figure 5-127. P04 core A oxygen replicate profiles measured in the light.

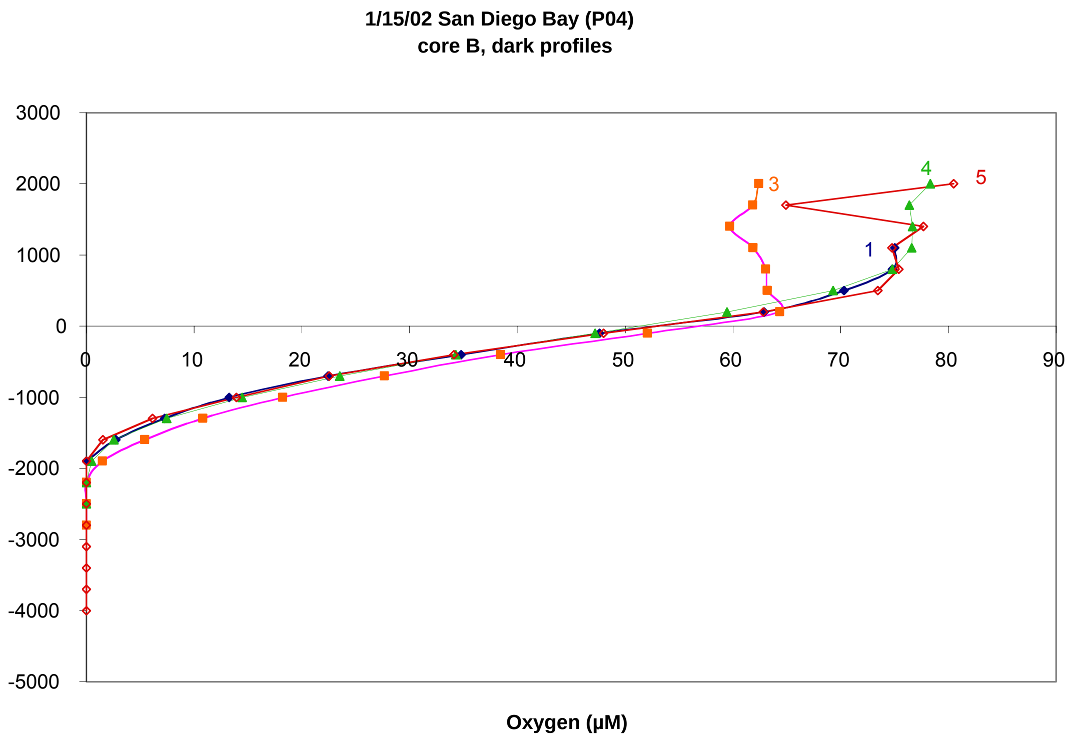


Figure 5-128. P04 core B oxygen replicate profiles measured in the dark.

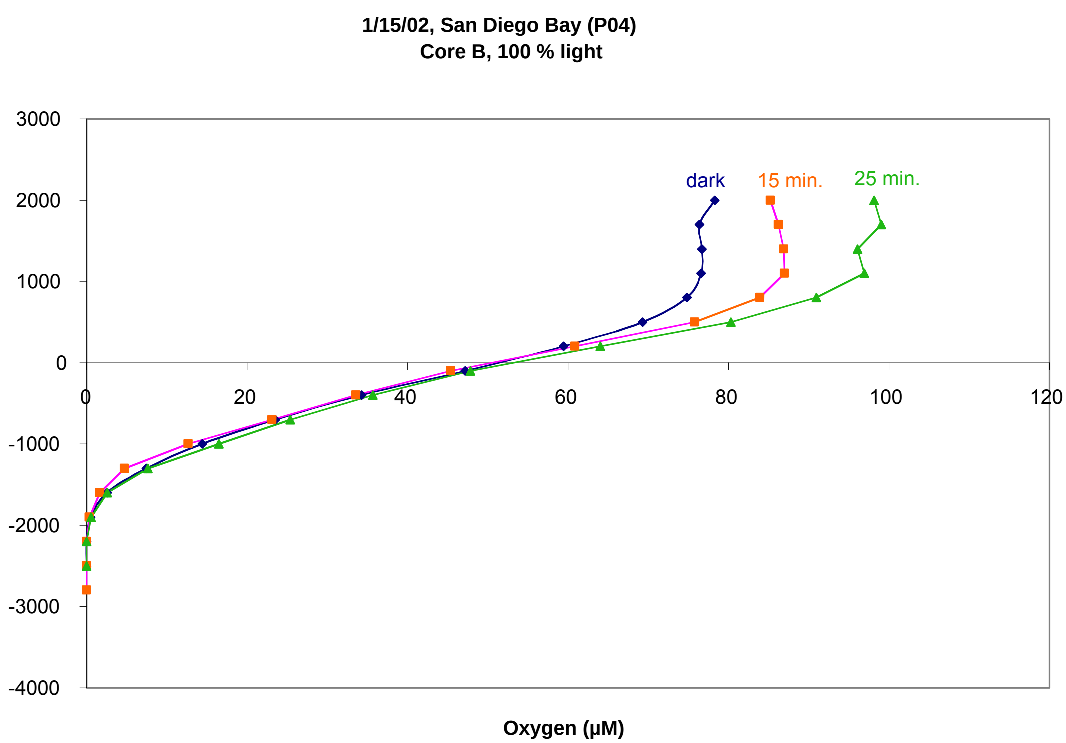


Figure 5-129. P04 core B oxygen replicate profiles measured in the light.

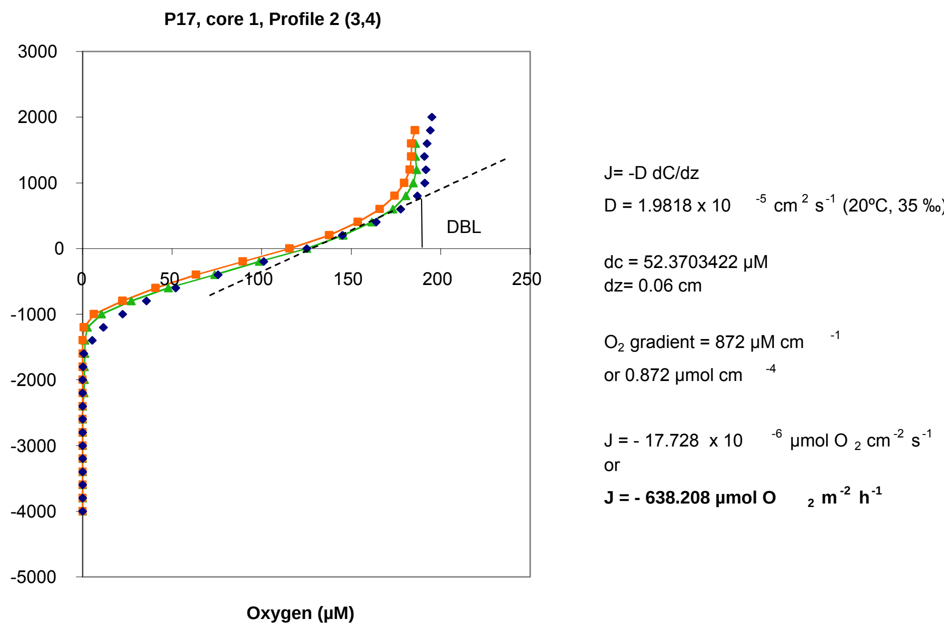


Figure 5-130. Oxygen fluxes at P17 for core 1, profile 2 (dark).

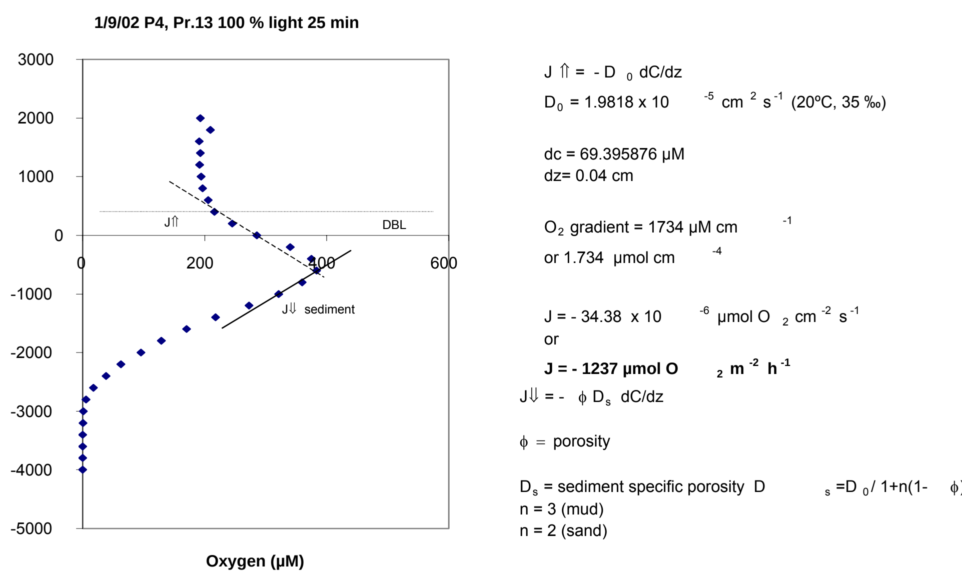


Figure 5-131. Calculation of oxygen flux during light exposure. During light exposure the diffusive flux of O_2 through the DBL into the overlying water can also be calculated from the steady state profile: $P_{net} = J \Uparrow = -D_0\ dC/dz$. The O_2 flux is equal to the areal net photosynthesis.

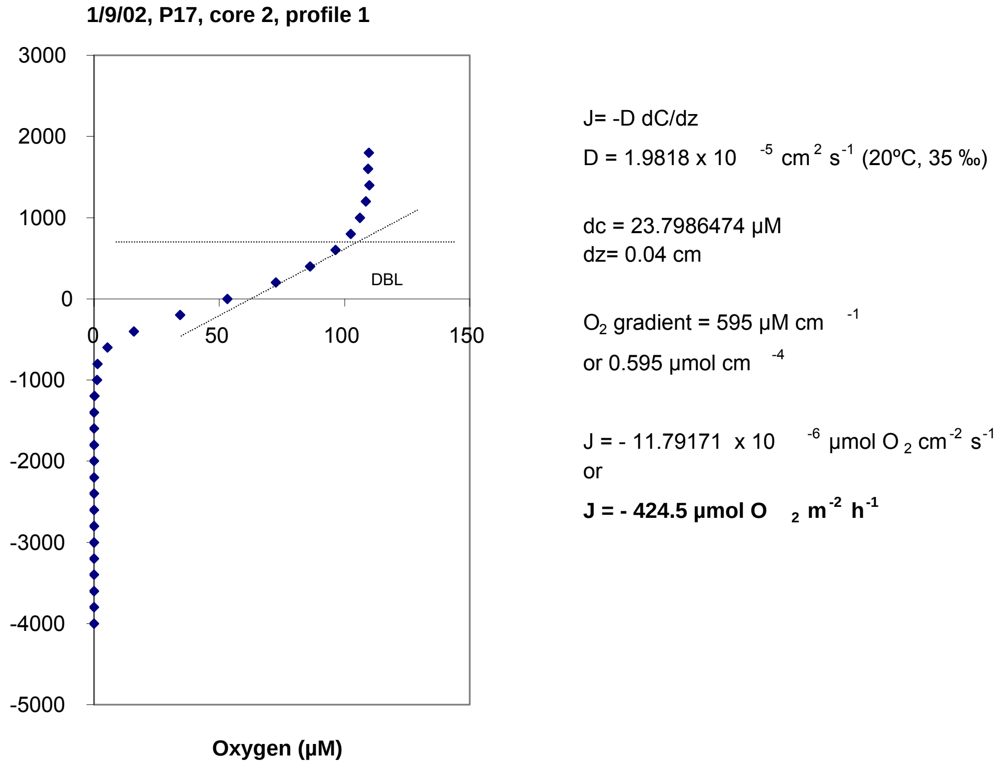


Figure 5-132. Oxygen flux at P17, core 2, profile 1 (dark).

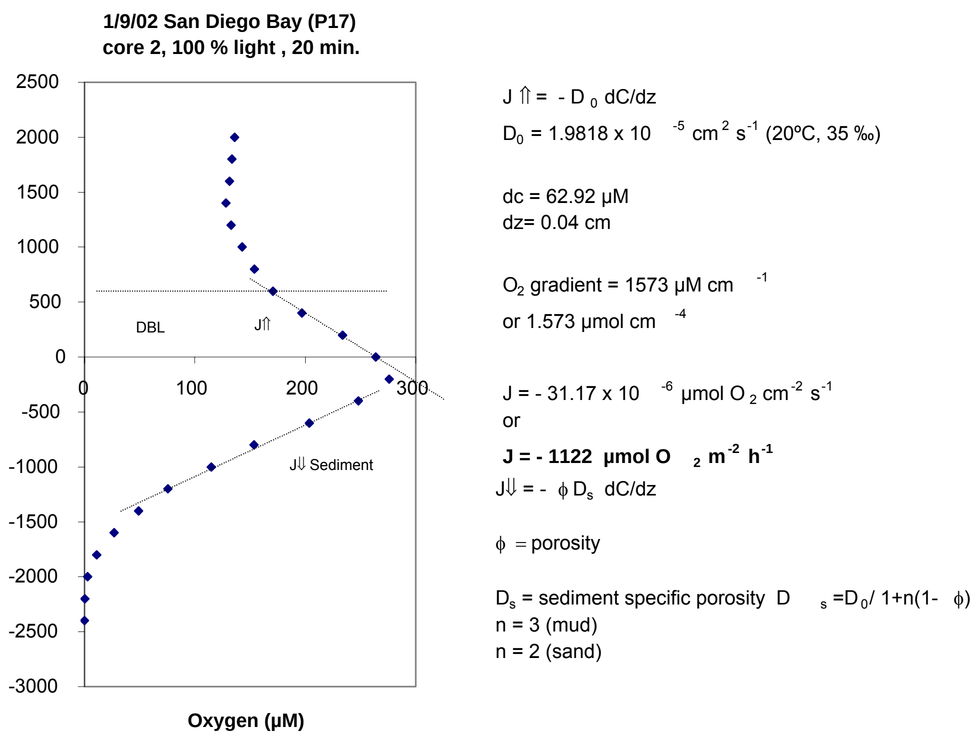
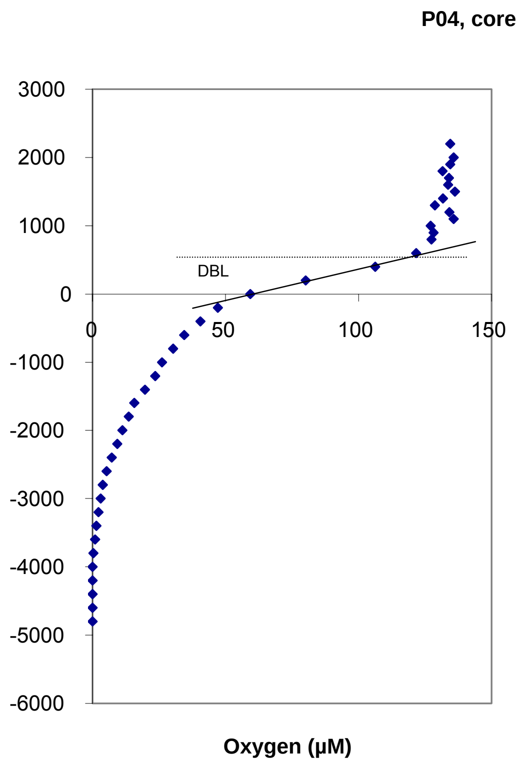


Figure 5-133. Oxygen flux at P17, core 2, profile 1 (light).



J= -D dC/dz

D = 1.9818 x 10^{-5} cm^2 s^{-1} (20ºC, 35 ‰)

dc = 46.88 µM

dz= 0.04cm

O_2 gradient = 1172 µM cm^{-1}

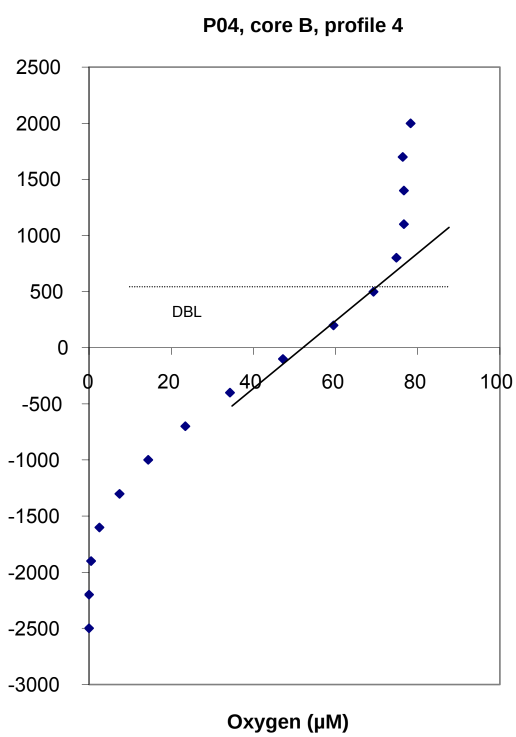
or 1.172 µmol cm^{-4}

J = - 23.22 x 10^{-6} µmol O_2 cm^{-2} s^{-1}

or

J = - 835 µmol O_2 m^{-2} h^{-1}

Figure 5-134. Oxygen flux at P04, core A, profile 5 (dark).



J= -D dC/dz

D = 1.9818 x 10^{-5} cm^2 s^{-1} (20ºC, 35 ‰)

dc = 9.8291006 µM

dz= 0.03 cm

O_2 gradient = 327.6 µM cm^{-1}

or 0.327 µmol cm^{-4}

J = - 6.493 x 10^{-6} µmol O_2 cm^{-2} s^{-1}

or

J = - 233.7 µmol O_2 m^{-2} h^{-1}

Figure 5-135. Oxygen flux at P04, core B, profile 4 (dark).

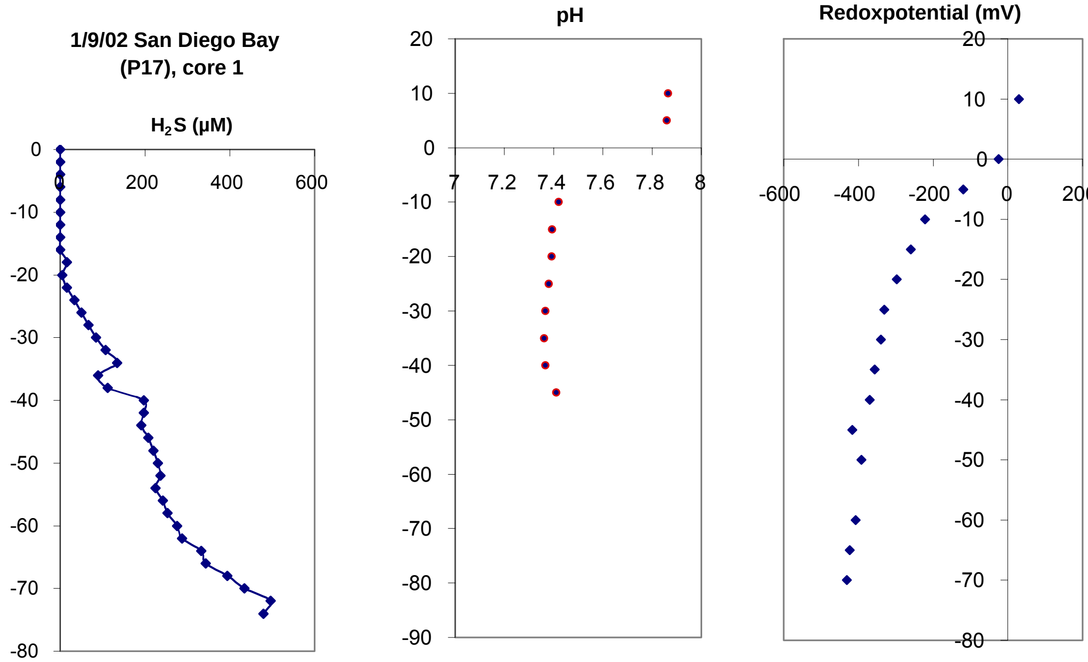


Figure 5-136. H_2S microgradients along with pH and redox-potential profiles, P17, core 1.

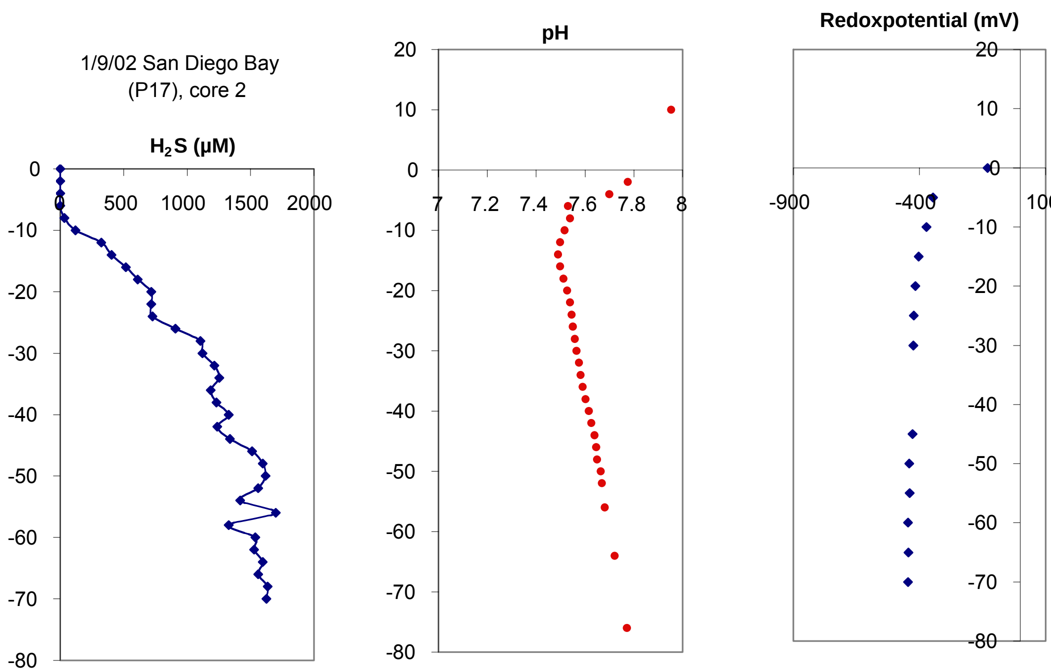


Figure 5-137. . H_2S microgradients along with pH and redox-potential profiles, P17, core 2.

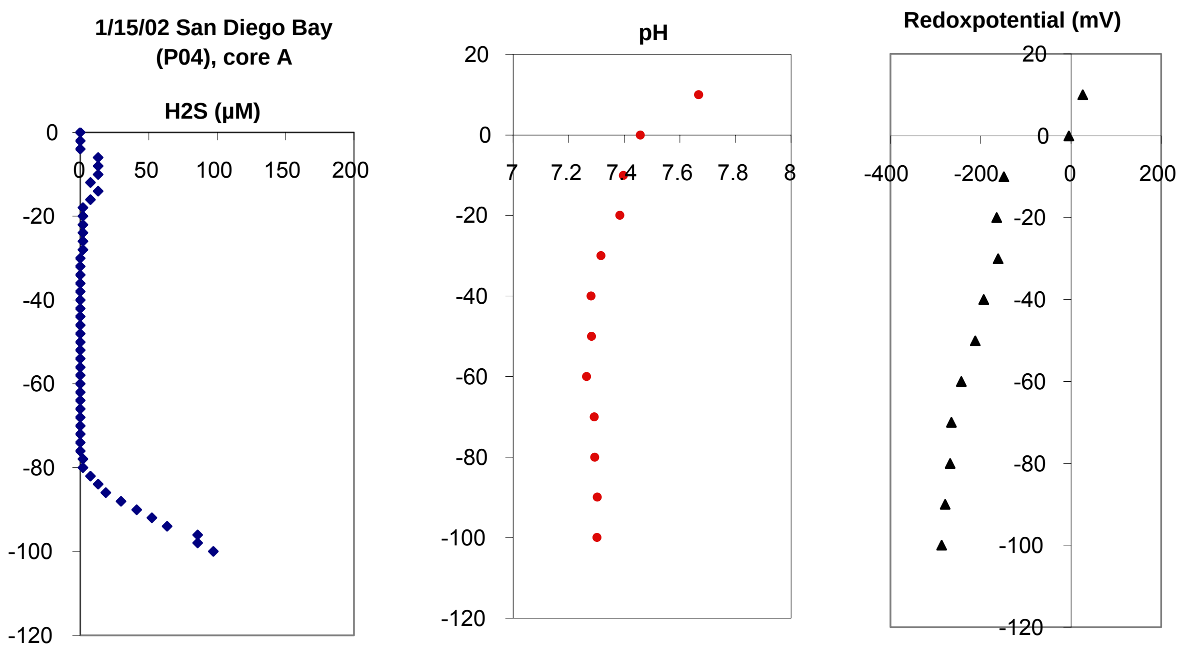


Figure 5-138. . H_2S microgradients along with pH and redox-potential profiles, P04, core A.

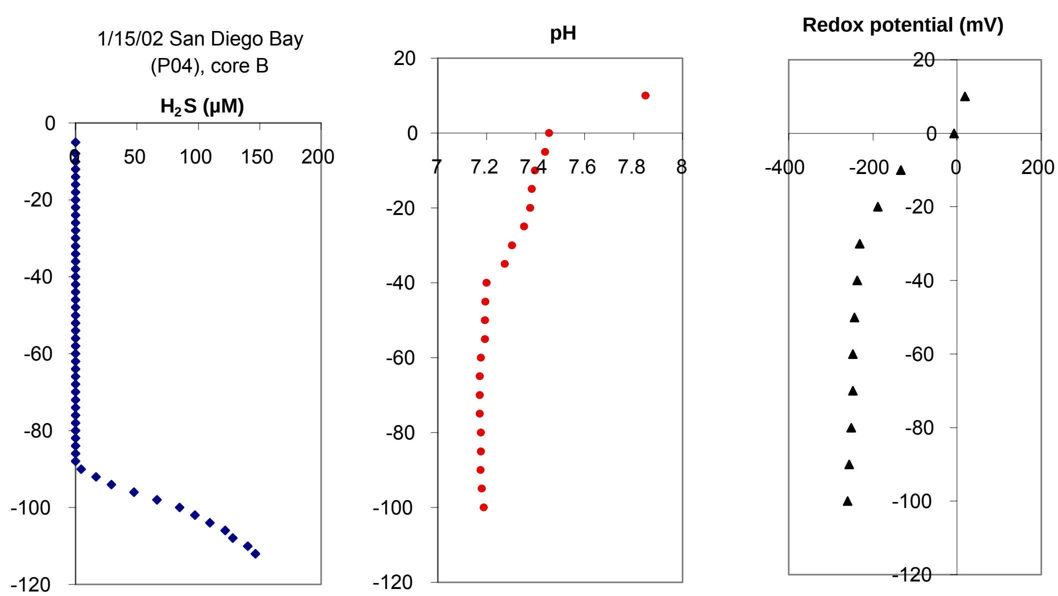


Figure 5-139. . H_2S microgradients along with pH and redox-potential profiles, P04, core B.

Table 5-29. Summary of Results

	(P17) 1	(P17) 2	(P04) A	(P04) B
O_2 penetration depth (mm) dark	(n=6) 2.1	(n=5) 1.2	(n=6) 4.4 burr (2) ≥ 5	(n=5) 2
Photosynthesis	yes	yes	no	no
O_2 penetr. depth (mm) light	3.8 (x 1.8)	2.6 (x 2.1)	4.9 (x 1.1)	2.2 (1.1)
Burrows	no	no	**yes**	no
Bio-irrigation	no	no	**yes**	no
Diffusive flux (Downward DBL) μmol O_2 $m^{-2}h^{-1}$ ⇓	638	424	835	234
Diffusive flux (Upward DBL) μmol O_2 $m^{-2}h^{-1}$ ⇑	1237	1122	-	-
Depth (mm) H_2S first detected	-18	-8	-78	-90
Max. H_2S conc. (mM)/depth (mm)	0.48 / -74	1.7 / -56	0.1 / -110	0.14 / -116

5.12 EVALUATION OF SEDIMENTATION AT THE PALETA CREEK PRISM SITES BY SEDIMENT TRAP AND AGE-DATED CORES

Introduction

Sedimentation rates were evaluated at Paleta Creek to allow estimates of the sedimentation pathway for PRSIM. Two methods were used including sediment traps and age-date cores. Age-date cores generally are advantageous because they are not confounded by resuspension as traps may be. However, in busy harbors, sediment disturbance and dredging activities may limit the utility of the age-dated cores. In this case, both methods were used and the outcomes compared.

Methods

Sediment Traps

At both the P04 and P17 Paleta Creek locations three sedimentation traps were deployed from January 10, 2002 to February 6, 2002. Each of the 6 in. diameter x 30 in. tall traps was filled with a 5 L solution of 5.0% NaCl, 0.50% NaN_3 and trace Rhodamine. Prior to insertion on the sediment surface each of the traps was carefully filled with approximately 10 L of San Diego Bay seawater. At the time of recovery a diffuse but discernable interface separating the Rhodamine dye containing layer and overlying seawater layer could be seen in the bottom half of the trap. In the three traps recovered at the P17 location, 2 to 7 (3/4 – 1 in. size) intact snails were found at the bottom with the accumulated sediment layer. The trap designated as P17-1 also contained a sea slug of around 4 in. in length.

Separation of sediment from the 15.5 L of trap seawater was by done by a combination of settling and carefully drawing off of water with a container and decanting. When the remaining water and sediment mixture was reduced to a volume of around 2 L the sediment was isolated by repeated centrifugation in a 500 mL centrifuge bottle. The sediment was allowed to dry at room temperature with a gentle stream of air directed at the sediment pellet inside of the centrifuge bottle. The remaining dry sediment was carefully removed from the bottle, weighed, then split for characterization and analysis.

Age-Dated Cores

During coring of the sediment bed for chemical analysis separate cores were collected and sectioned at predetermined intervals for radionuclide counting of Pb-210, Cs-137 and Be-7. Age dating of the core sections resulted in determination of sedimentation rates for the P04 and P17 locations. Below is a discussion of the age dating results provided by Battelle Laboratory.

Each of the cores analyzed for Pb-210, Cs-137 and Be-7 had high percent dry weight (>~50%), indicating a sandy texture with depth. Sediments that contain a lot of sand generally have low Pb-210 activity and this was evidenced in these cores. Enough information was obtainable to calculate sedimentation rates and associated section ages that were supported by Cs-137 results for Core P4 and P17.

Results

Sediment Trap Sedimentation Rates

In Table 5-30 below are the weights of sediment recovered from each of the traps with calculated sedimentation rates. The average sedimentation rates at the P04 and P17 locations are 1.27 and 0.38 g/cm^2/yr (dry weight), respectively. At the P04 location the sedimentation results were very consistent among the three traps. Results for P17 were also fairly consistent, though somewhat more variable than P04.

Table 5-30. Results of Sedimentation Trap Deployment

Sample	Wt. (g)	Period (days)	Sedimentation Rate (cm/cm^2/yr)	(g/cm^2/yr)	Sed. Rate Ave. (g/cm^2/yr)
P04 - 1	17.27	27	0.48	1.28	1.27
P04 - 2	16.72	27	0.47	1.24	
P04 - 3	17.45	27	0.49	1.29	
P17 - 1	4.30	27	0.12	0.32	0.38
P17 - 2	5.32	27	0.15	0.39	
P17 - 3	5.95	27	0.17	0.44	

Sedimentation Rate Determination by Radionuclide Counting

General Descriptions

Core P04: Percent dry weight varied from 47.1 to 70.1%, the supported (or background level) Pb-210 was assumed to be 0.80 disintegrations per minute per gram (dpm/g). Overall the Pb-210 activity in this core was quite low, although the profile does follow a trend of descending activity with depth. One of the assumptions of the sedimentation rate calculation is that grain size is constant with depth. The sedimentation rate was fairly low at 1.09 g/cm2/year. From the calculated sedimentation rates, the year of deposition for 1960 occurs between 30 and 35 cm depth and correlates well with the Cs-137 data obtained from this core where a definite decline in Cs-137 activity occurs below 18 cm. Consistently detected Cs-137 of about 0.2 to 0.5 dpm/g in marine sediments is normally associated with the years after 1957 when nuclear testing was actively conducted.

Core P17: This core had relatively high percent dry weight that was not consistent with depth, ranging from 45.7 to 68%. A decreasing trend was not apparent for Pb-210, indicating the background level had not been reached at 85 cm. The background level was assumed to be 1.0 dpm/g Pb-210. The sedimentation rate was 2.58 g/cm2/year and dated to 1962 at 82.5 cm depth. The Cs-137 verified that the year 1960 was not found above 20 cm as the counts were reasonably consistent with depth and did not show a dramatic decline in activity.

Be/Cs Percent Dry Weight

P04 shows a fairly constant increase in %DW with depth, likely suggesting a combination of coarsening and compaction down-core. P17 shows variable changes in %DW, suggesting episodic deposition events in this location. Both cores show a sharp decrease in %DW in the top ~2cm which is likely an unconsolidated surface layer.

Be Results

No ^{7}Be was detected in either of the cores. ^{7}Be is a short-term isotope with a 53.3 day half-life. This method provides dating on recent sediments deposited within approximately 9 months, showing evidence that no sediment had been deposited within that time period at either coring location.

Cs Results

^{137}Cs activity in P04 shows a decrease to background levels (before nuclear testing ~ 1950's). P04 also shows and fairly constant decrease in ^{137}Cs levels down-core, suggesting a constant deposition rate. A definite decline in Cs-137 activity occurs below 18 cm, likely associated with the years after 1957 when nuclear testing was actively conducted. P17 levels are more variable, suggesting more episodic deposition events. A dramatic decline in Cs-137 was not seen in this core, suggesting that the horizon associated with nuclear testing events was deeper than 20 cm.

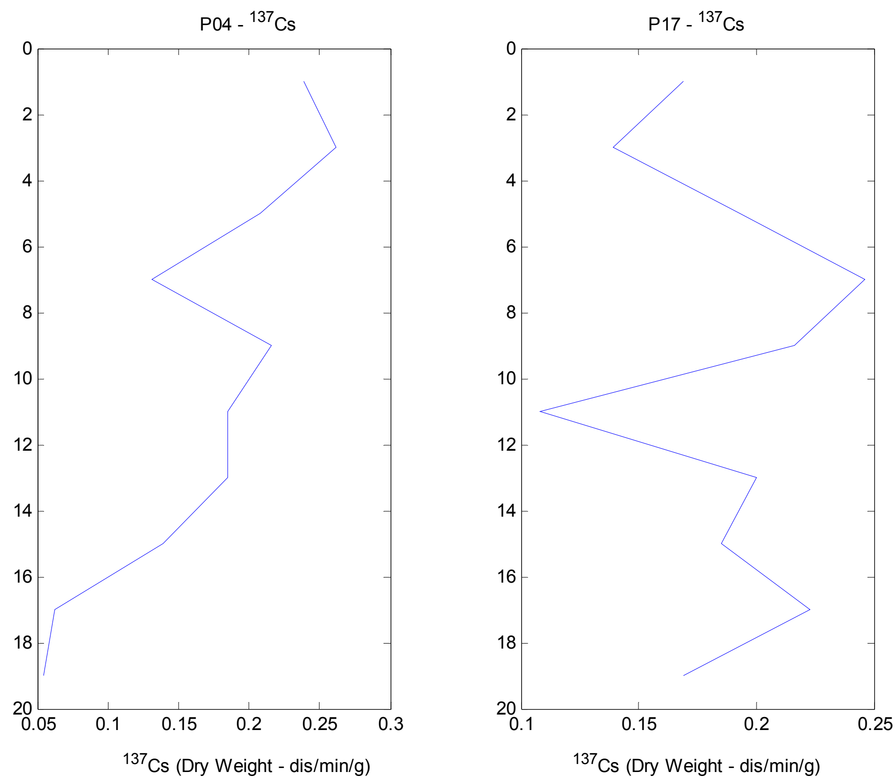


Figure 5-140. Cs-137 activity levels

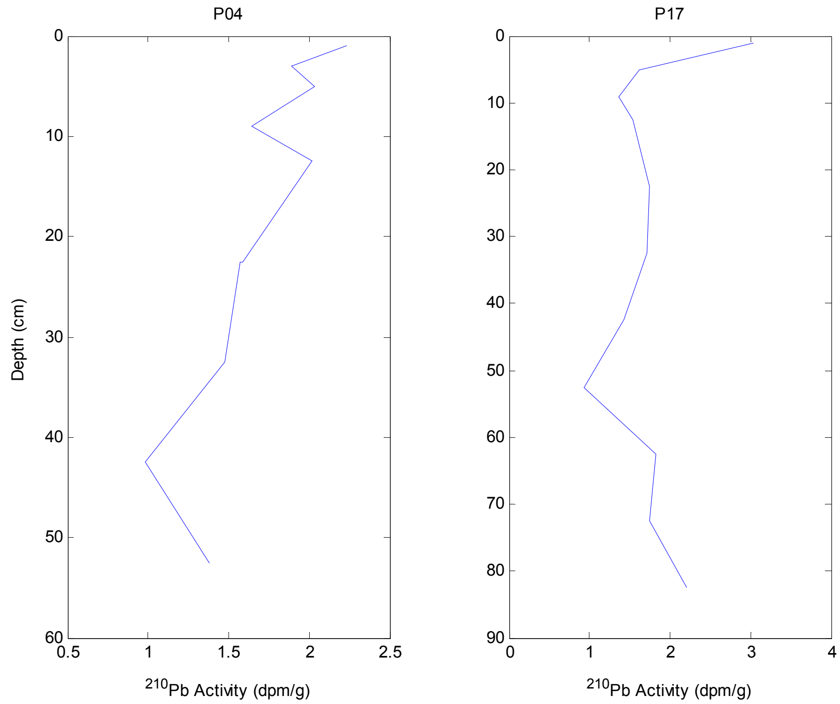


Figure 5-141. Pb-210 activity levels.

Pb Percent Dry Weight

%DW was also measured for the ^{210}Pb cores. Results are similar to those from the Be/Cs cores. P04 shows a constant increase in %DW with depth, and P17 shows a generally increasing trend with several large spikes in %DW. Again, both cores show a decrease in %DW in the top ~3-5 cm which is likely an unconsolidated surface layer.

Pb Results

Both cores had relatively low ^{210}Pb activity levels, which is characteristic of sediments that contain a lot of sand. Results for P04 showed a decrease in ^{210}Pb activity with depth, suggesting that a net accumulation of sediments in occurring in this region. At P17, a decreasing trend was not apparent for Pb-210, indicating that the background level had not been reached at 85 cm. The background level was assumed to be 1.0 dpm/g Pb-210. Enough information was obtainable to calculate sedimentation rates and associated section ages that were supported by Cs-137 results for Core P4 and P17.

Sediment Accumulation Rates

A sedimentation rate of 1.09 g/cm^2/yr was measured at P04, dating back to 1933 (55 cm). The sedimentation rate at P17 was much more rapid at 2.58 g/cm^2/yr, dating back to 1962 (85 cm). Similar to the results for %DW, P04 shows evidence of a much more constant rate of deposition over time, while P17 shows a more episodic variability. This is likely due to the close vicinity of P17 to the entrance of Paleta Creek making this site susceptible to sediment discharge during winter storm events.

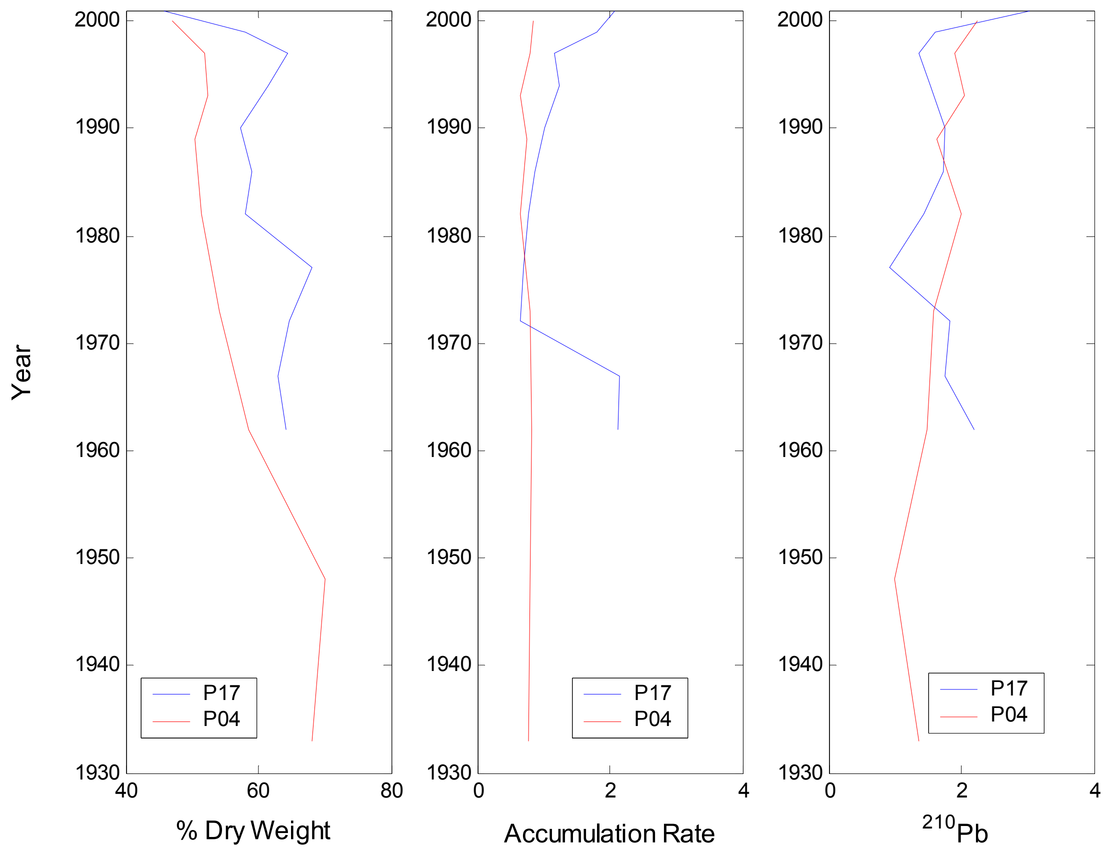


Figure 5-142. Dry weight, accumulation rates and Pb-210 activity levels for P04 and P17.

Sedimentation rates were also measured for sediment traps that were deployed at the same stations. The traps were deployed for 27 day each. Results from this analysis are shown in Table 5-31. Sedimentation rates for P04 are very similar for the two calculations (with ~85%). The results for P17 are very different, however.

Sedimentation Rate Comparisons

Table 2 contains the sedimentation rate measurements as determined by radionuclide counting and sediment trap deployment. At the P04 location the rates as determined by the separate techniques differ by around 15%. Whereas for the P04 location the two techniques were found to be corroborative this was not the case for the two techniques when applied to the P17 location. At the P17 location the sedimentation rate as determined by radionuclide age dating is greater than six times the rate as determined by use of sedimentation traps over approximately a month deployment. This is likely a result of close vicinity of P17 to the mouth of Paleta Creek. Seasonal sediment inputs are likely in this area as a result of winter storms. Because the sediment trap deployment did not occur over the period of the winter storm events, this input is not reflected in the calculated sedimentation rate for this station.

Table 5-31. Sedimentation Rates

Site	$^{137}Cs/^{7}Be/^{210}Pb$	Sed. Traps
Paleta Creek: P04	1.09	1.27
Paleta Creek: P17	2.58	0.38

Particle Size Analysis of Trap Sediments by LISST

Particle size analysis performed by a LISST-Portable particle size analyzer yielded the distributions seen below in Figure 5-143 and Figure 5-144. In Figure 5-143 it is seen that at the P04 location the size distributions are consistent for the three traps. Comparison to the distribution of a P04 sediment core composite sample shows that the trap sediments are fines rich, as seen by the relative abundances at the 2.2 µm peaks. The large particle cutoff at around 22.7 µm for the trap sediments relative to the cutoff at 37.2 µm for the composite sample also indicates that the trap sediments have lesser large particle character.

For the P17 trap sediments similar statements can be made regarding the relative abundances of the small particle peak at 2.53 µm and the large particle "cutoff". In these samples a significant difference was seen in the distribution profiles of the trap sediments. The P17-1 sample shows reduced particle abundance for > 7.11 µm sizes relative to samples P17-2 and P17-3. Interestingly, it was in this trap that a sea slug was found and from which a lesser amount of sediment was recovered (4.30 g vs. 5.32 and 5.95 g in P17-2 and P17-3).

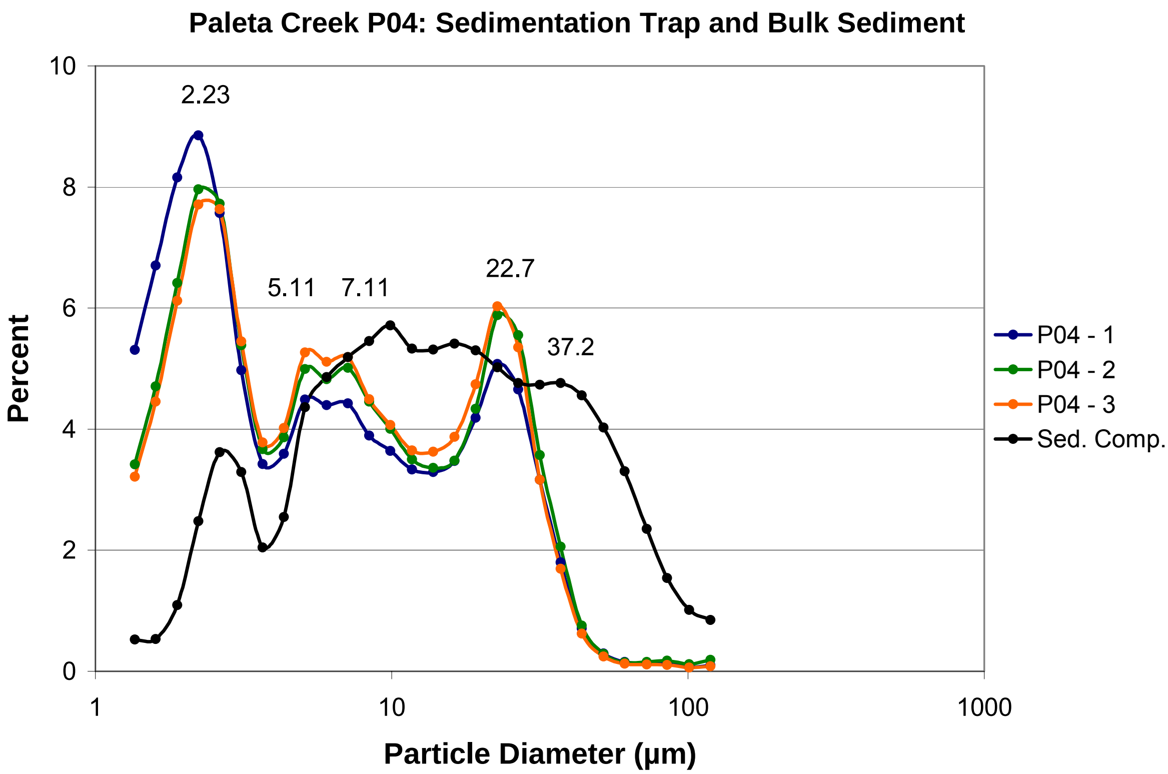


Figure 5-143. Particle Size Distribution by LISST of P04 trap sediments and P04 bulk sediment composite.

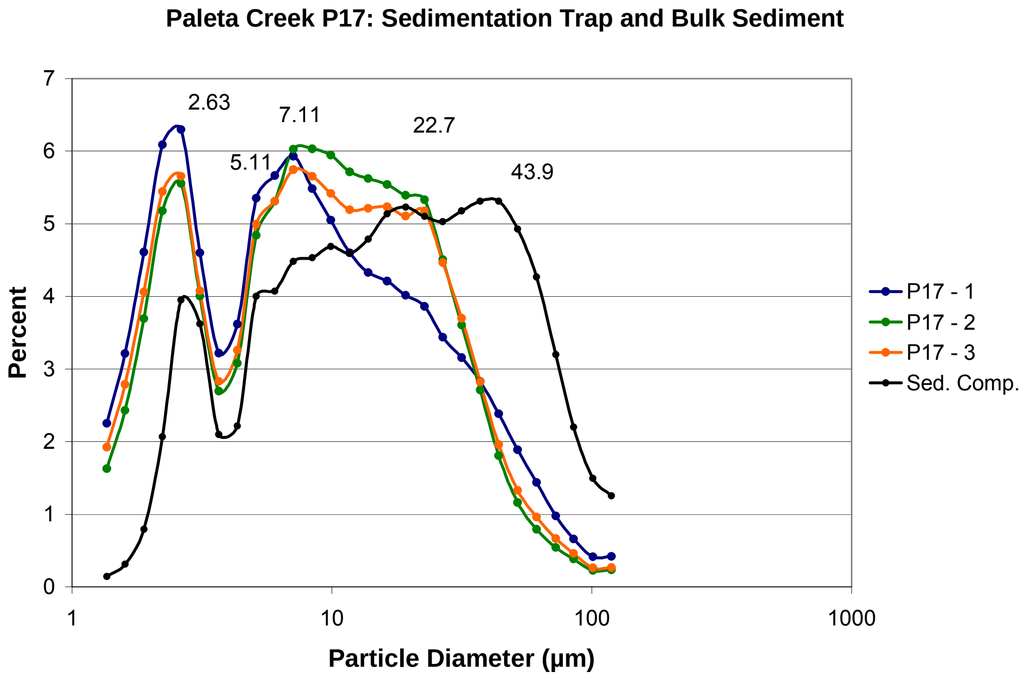


Figure 5-144. Particle Size Distribution by LISST of P17 trap sediments and P04 bulk sediment composite.

PAH Analysis of Sediment Trap and Bed Sediment Solids
Figure 5-145 and Figure 5-146 below represent the results of PAH analysis of the P04 trap sediments with other P04 sediments included for comparison. Figure 5-145 are the results for the "light" PAHs (lPAHs) and Figure 5-146 the results for the 3-ring and greater size PAHs, or "heavy" PAHs (hPAHs). Separating the distributions into their light and heavy components allows for the use of a different concentration axis and therefore greater visual resolution of absolute concentration, especially for the lPAHs. The sediments that are included for comparison are the three sediment core composites generated from the P04 location and a 0-2 cm core section also collected at the P04 location.

In Figure 5-145 and Figure 5-146 it is seen that the concentrations and distributions of the three trap sediments are very similar. When compared to the bed sediment composites significant differences are seen in the concentration of PAHs and in the PAH distribution profiles. In the trap sediments, concentrations are greater for both lPAHs and hPAHs in comparison to the core composites. This is true with the exception of the heaviest PAHs (5-rings) where concentrations are similar (trap vs. composites). Also of note are the shapes of the homologue series of PAHs; for example the Fluoranthene/Pyrene, C1-Fl/P, C2-Fl/P, and C3-Fl/P series. For the trap sediments the shape is step-wise, with the parent PAHs of greatest abundance. The core composites show a bell-shaped distribution for this series of PAHs. These differences in the fingerprint profile may indicate different sources or weathering histories.

Figure 5-147 and Figure 5-148 below present the PAH analytical results for the P17 trap sediments, the core composites and a core section for comparison. Here it is seen that the differences in the results are mainly in the concentration of PAHs, the distribution profiles for the trap sediments and composites are similar. Figure 5-149 are the PAH results for all of the trap sediment samples and is provided for comparing the P04 and P17 traps. The profiles are similar for all of the trap sediments with differences seen in the PAH concentrations. The concentrations are generally greater at the P17 location in comparison to the P04 location.

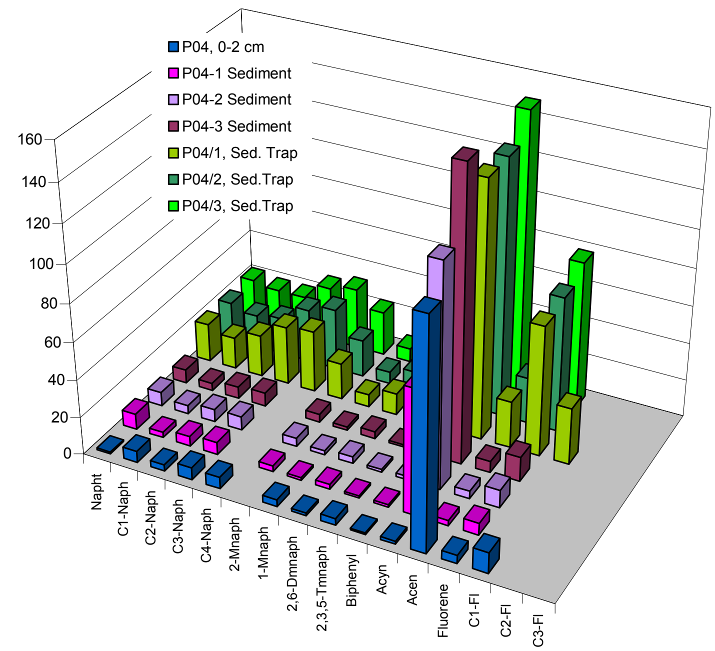


Figure 5-145. Light PAHs Comparisons of P04 Sediments

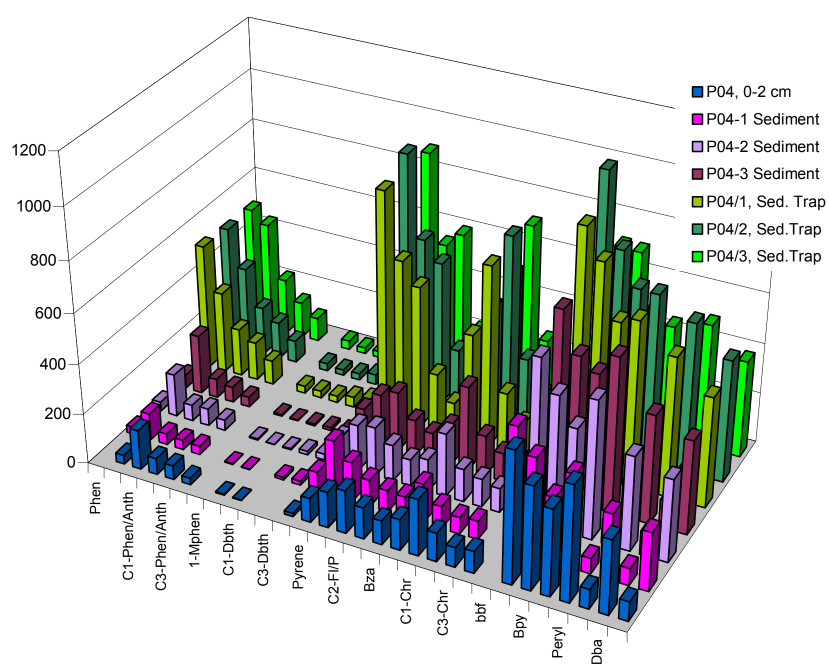


Figure 5-146. Heavy PAHs Comparisons of P04 Sediments

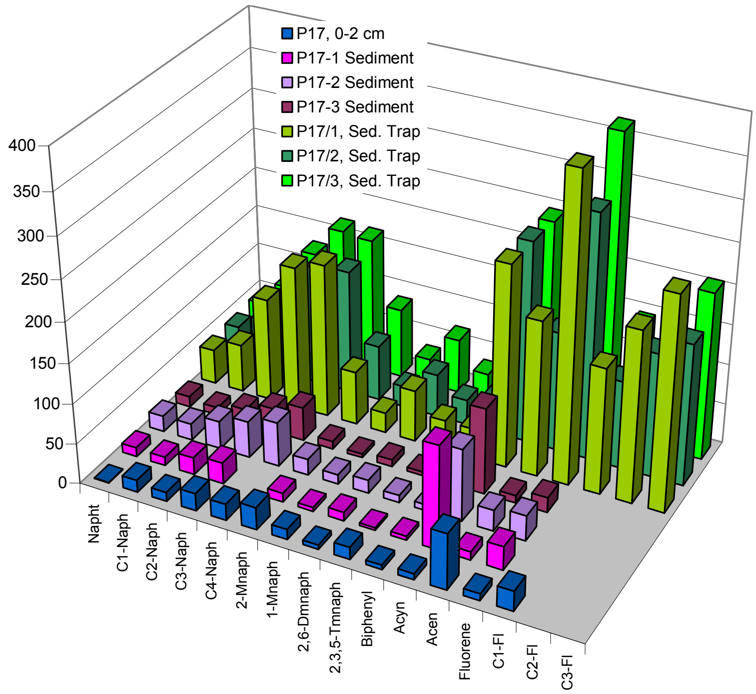


Figure 5-147. Light PAHs Comparisons of P17 Sediments

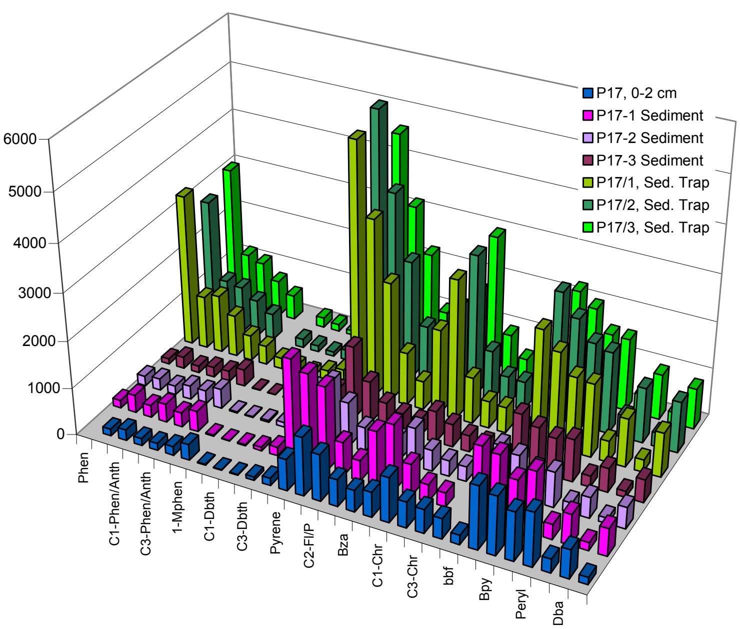


Figure 5-148. Heavy PAHs Comparisons of P17 Sediments

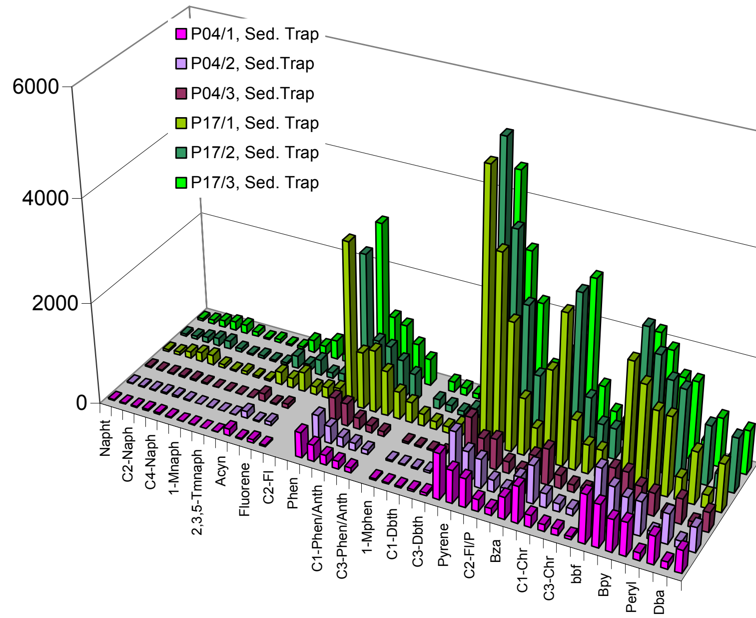


Figure 5-149. PAH distributions of sediment trap sediments, P04 and P17 comparisons.

Metals Analysis of Sediment Trap and Bed Sediment Solids

In Figure 5-150 and Figure 5-151 below are the results of metals analysis of the P04 and P17 sediments, respectively. The results presented in the figures are averages for the trap sediments, core composite samples and the value for the 0-2 cm core section taken at those locations. As is seen in the figures concentrations of metals in the samples from within a location are similar with greater concentrations generally seen in the trap sediment samples. This generalization is not necessarily true for all sediments and all metals though. Also included is Figure 5-152, a comparison of the metals results for the sediments at the P04 and P17 locations.

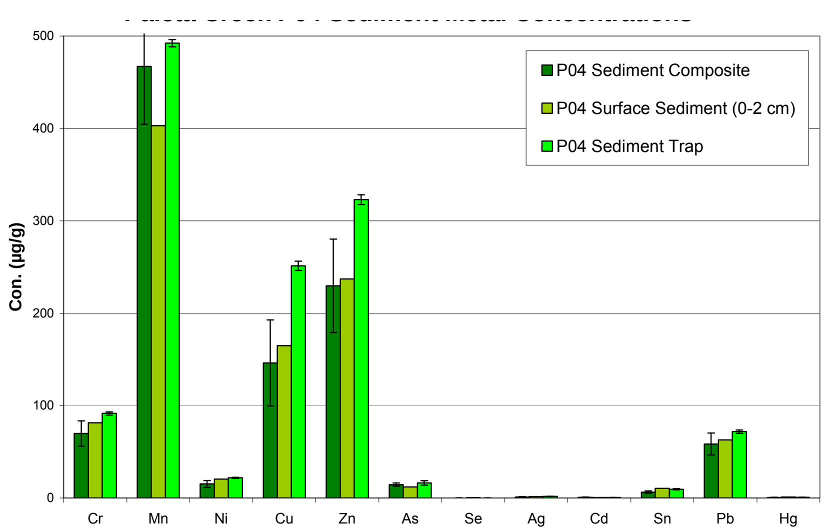


Figure 5-150. Metals analysis results of core composite sediments, 0-2 cm core section and trap sediments at Paleta Creek P04 location.

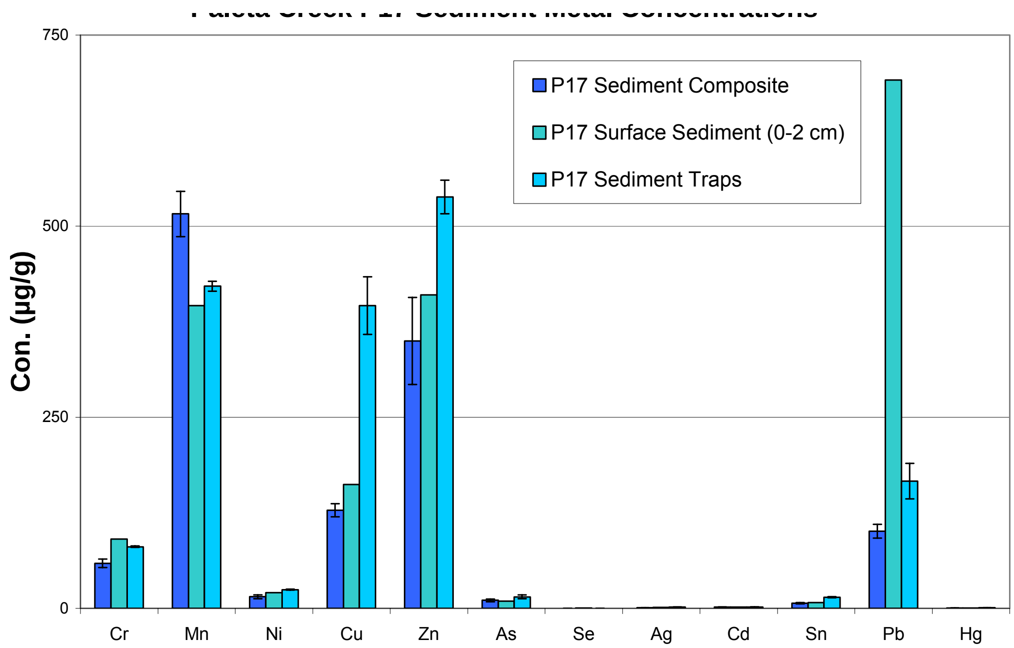


Figure 5-151. Metals analysis results of core composite sediments, 0-2 cm core section and trap sediments at Paleta Creek P17 location.

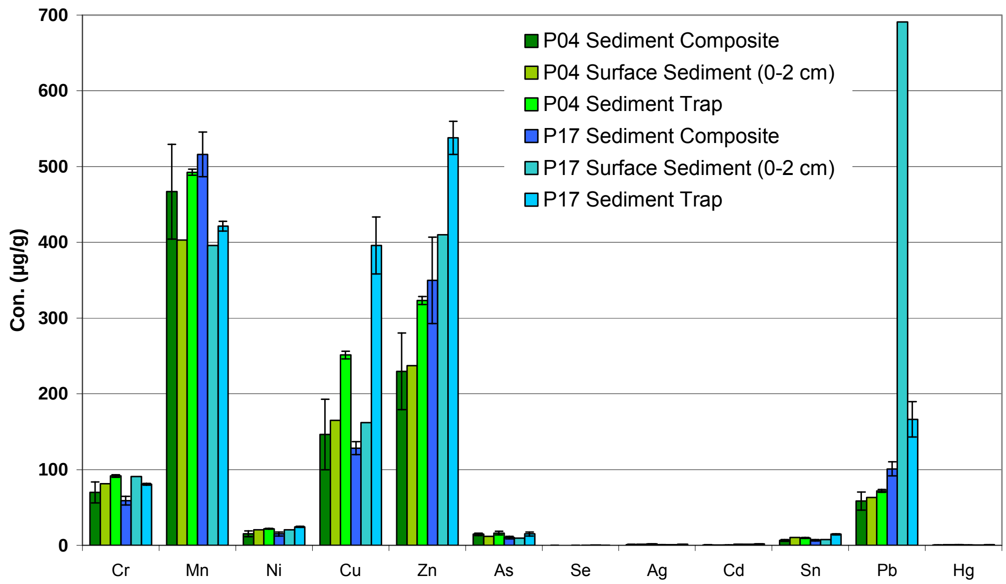


Figure 5-152. Metals analysis results of core composite sediments, 0-2 cm core section and trap sediments at Paleta Creek P04 and P17 location.

CHN and Surface Area Analysis of Sediment Trap and Bed Sediment Solids

In Table 5-32 below are the results of elemental analysis (C, H and N) and surface area determination by gas sorption analysis of the sediment core composite and sedimentation trap sediments. For elemental analysis a Perkin-Elmer Series II 2400 Elemental Analyzer was employed. Total organic carbon (TOC) was determined by first eliminating inorganic carbon as carbonates by subjecting approximately 1 g dry sediment to digestion with 3 N HCl. For the sedimentation trap sediments, which were quantity limited, approximately 200 mg of the sediment was used for the digestion process.

Average values for TOC, total carbon (TC) and nitrogen (N) are presented below in Table 5-32. As can be seen the carbon content of the traps are greater than the core composites taken from the same location. At the P17 location the percent carbon values are greater for both the composite and trap sediments than at the P04 location. Also included in the table are the calculated atomic carbon to nitrogen ratios (C:N) which can indicate sourcing and aging of the sediment organic matter.

Also in Table 5-32 are the results of surface area analysis of the sediments performed by gas sorption analysis. A Quantachrome Nova 2200 Gas Sorption Analyzer using N_2 as the measuring gas at liquid nitrogen temperatures was used for these analyses. At the P04 location specific surface areas (S.S.A.) are substantially higher for the core composite and trap sediments than for the P17 location. The trap sediments measure slightly greater surface area values than the core sediments from the same locations. Values of sediment density, an ancillary measurement determined during the gas sorption process is also included in the table. Densities determined by gas sorption analysis are generally greater than those determined by other techniques as they exclude measurement of sediment voids into which the nitrogen gas is able to diffuse.

Table 5-32. Results of Elemental Analysis and Surface Area Determination

	P04 Bed Sediment	**P04 Sedimenta-tion Trap**	**P17 Bed Sediment**	**P17 Sedimeta-tion Trap**
TOC (%)	1.13 ± 0.31	2.08 ± 0.02	2.20 ± 0.46	5.43 ± 0.69
TC (%)	1.36 ± 0.23	2.35 ± 0.07	2.37 ± 0.56	5.93 ± 0.70
N (%)	0.17 ± 0.02	0.29 ± 0.02	0.19 ± 0.02	0.60 ± 0.16
C:N Ratio	7.7 ± 1.6	8.7 ± 0.8	12.7 ± 0.1	11.0 ± 1.5
S.S.A. (m^2/g)	14.6 ± 2.8	17.1 ± 0.3	5.7 ± 0.6	6.7 ± 0.5
Density (g/mL)	3.05 ± 0.12	2.98 ± 0.13	2.72 ± 0.04	2.58 ± 0.10

Grain Size Analysis of Bed Sediment Solids

Each of the core composite sediments generated for each of the deployment locations was subjected to grain size analysis by a standard laboratory technique. Table 5-33 contains the results of the analysis as percentages of gravel, sand, silt and clay. With the exception of P04-1 the percentage of sand is greater in the P17 composite samples than the P04 sediments. The percentages of silt and clay are greater in P04-2 and P04-3 than the P17 samples.

Table 5-33. Grain Size Analysis of Sediment Core Composite Samples

	P04 - 1	P04 - 2	P04 - 3	P17 - 1	P17 - 2	P17 – 3
Gravel (%)	3.92	0.47	0.22	0.43	0.18	0.91
Sand (%)	49.06	28.70	30.42	51.39	48.92	60.05
Silt (%)	25.01	36.15	36.22	30.52	31.72	32.62
Clay (%)	22.01	34.67	33.03	17.67	19.17	6.43

PAH Measurements in Age-Dated Cores

PAH measurements from P04 show a decrease in concentration with depth (Figure 5-153). Extremely high concentrations (> 100,000 ng/g) for all constituents were observed at 7 cm depth, but have been omitted from the figure below. P17 shows minimal change in concentration over the depth of the core, with the exception of the top ~10 cm of the core, which appears to be a mixed surface layer.

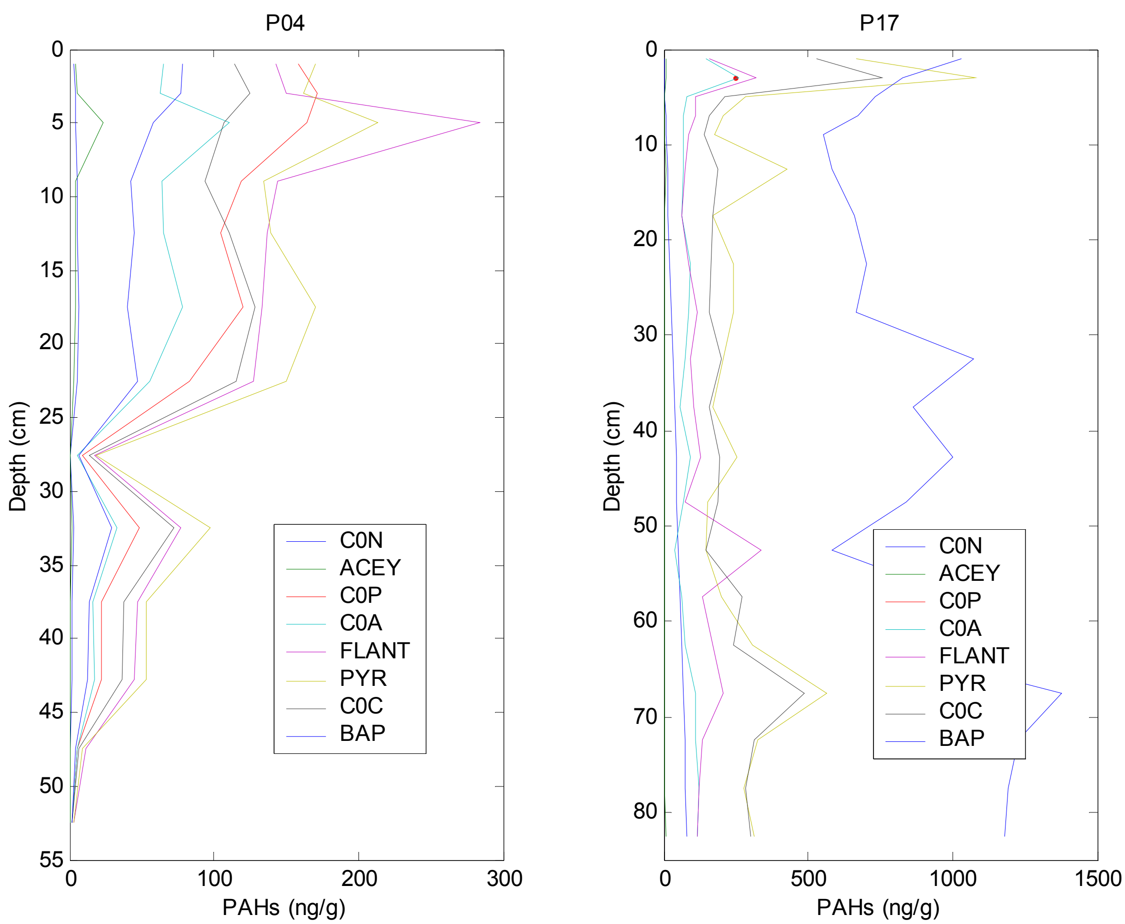


Figure 5-153. Selected PAH concentrations at stations P04 and P17

Metals Measurements in Age-Date Cores

The core taken at P04 shows a decrease in metal concentrations with depth (Figure 5-154). Percent dry weight increases with depth. Using this parameter as a proxy for grain size, this would show an inverse relationship between metal concentrations and grain size, where metal would preferentially adhere to smaller particles. P17 shows minimal change in metal concentrations over the depth of the core, with the exception of the top ~10 cm of the core which appears to be a mixed surface layer (Figure 5-155).

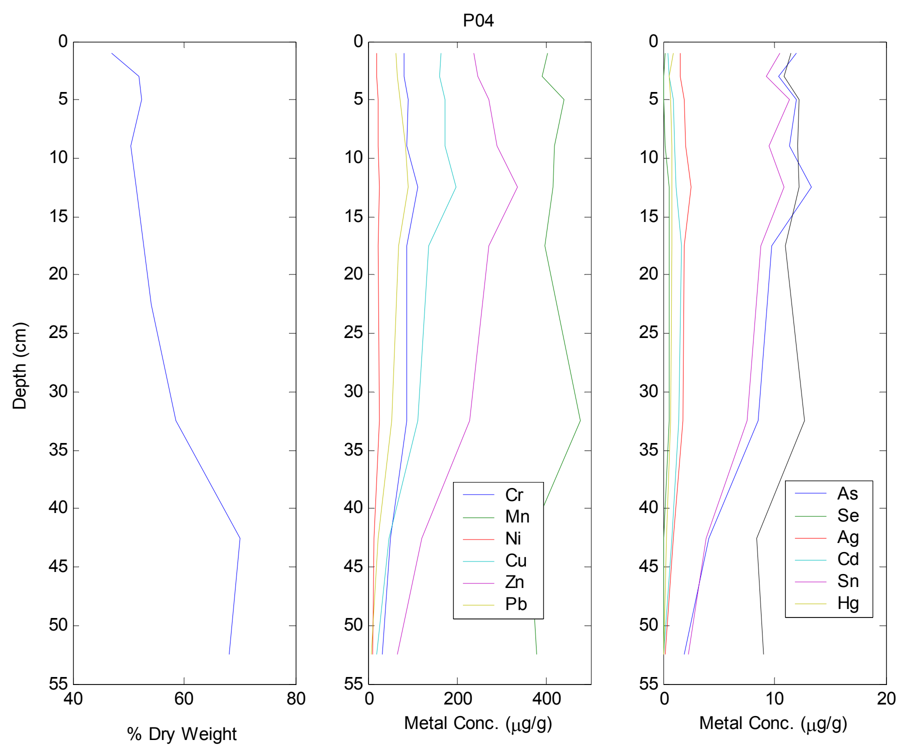


Figure 5-154. Metals concentrations in the age-dated core at P04.

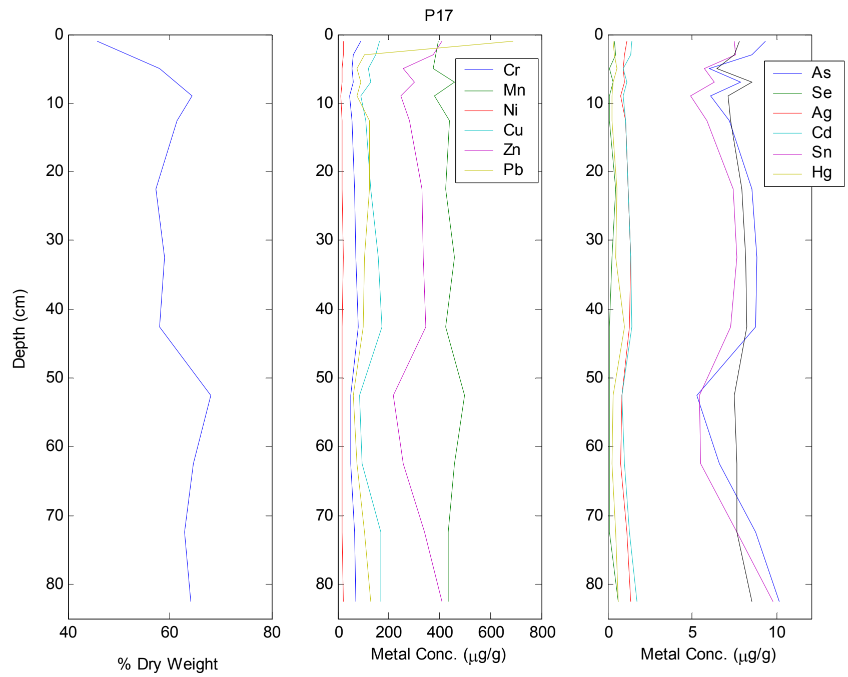


Figure 5-155. Metals concentrations in the age-dated core at P17.

6 Calculations of Fluxes for PRISM Pathways

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6.1 PATHWAY ANALYSIS

Analysis for Site I contained the following elements: 1) Evaluation of conceptual model, 2) evaluation of available site data, 3) field design, 4) field deployment and synthesis of field data immediately available (screening and SPI results), 5) analytical results, 6) process-specific analysis (evaluation of BFSD, flume, etc. on their own), 8) synthesis of results in terms of the field site, and 9) evaluation of results in terms of management/contaminant behavior insight. Here we present the process-specific analyses, along with analysis of the variability associated with each flux estimate.

Quantification of contaminant transport pathways in common terms is an essential element of sediment management. The PRISM approach for evaluating various pathways of contaminant flux to or from the surface sediment layer is to carry out a field-based assessment on a common scale to aid in the evaluation of risks and mechanisms of recovery or exposure to aid in management strategies. To achieve this, a measurement framework was developed that is tied to a classical 1D vertical mass balance model for the transport of contaminants in sediments. Mobility is then quantified as a net flux from the "active" surface layer. Changes in this layer result from the balance of fluxes through the defined pathways of mobility.

To achieve this, an active sediment layer of depth H is treated as a box from which contaminants can flux in or out. The results from each pathway evaluation are converted to fluxes, and all fluxes are calculated in common units. For each contaminant (16 PAHs, 9 metals), fluxes are then compared. Based upon results, dominant pathways can be determined, further site-specific studies can be recommended, the most sensitive or critical measures can be further evaluated and management approaches can be prioritized.

There are some assumptions inherent in this approach. It is assumed that in spite of spatial and temporal variability, field measures, even if "noisy" provide insight no theoretical model can. Integration and synthesis of field-based indices forces an acknowledgement of the variability present in natural sediment systems. Integrating information from multiple field measurements makes clear the variability and heterogeneity of sediment systems in a way that no theoretical model can. While this can seem unsettling when one is used to seeing tight, modeled parameters, this is not a problem with the measurements, but an accurate reflection of the reality environmental managers face. Quantification of rates and variability provide bounds for modeling the uncertainty associated with various sediment management strategies. Thus, it is assumed that no study or approach for determining the fate and behavior of contaminants in complex systems is perfect and that intelligent users of data will apply insights into the strengths and weaknesses of this and other approaches to strike a balance between models, field data and controlled studies to inform decisions. It is the relative rates and directions of fluxes, and the management question that is applied, that determines to what extent any flux represents risk and/or recovery potential. Thus, as with other types of studies, results will be applied in various ways depending upon the site and the questions being asked.

6.2 BIOTURBATION DEPTH

As described above, all fluxes are evaluated relative to an active sediment layer of depth H. The bioturbation depth at a given site was used to establish the depth of H, and all further calculations used this H value. The approach for determining bioturbation depth was to use the REMOTS Sediment Profile Imager (SPI) to take in-place images throughout area, and at high density in study sites. Standard methods (Rhodes and Germano, 1982) were then used to estimate the "bio-active" layer depth based on on-site analysis of feeding void depth in SPI images. This depth scale is then used as the common depth (H) for sampling and data synthesis for most processes. There are a number of assumptions inherent in this approach. It is assumed that the bio-active mixing depth scale (H) is represented by the depth of visible feeding voids in replicate images at the site. In this study, it is assumed that high density SPI images provide a means of quantifying variability and heterogeneity at the site. This measure does not evaluate a specific flux, but provides a depth scale, as well as insight into the scale and nature of biological activity. It is assumed that the effects of bioturbation on contaminant fluxes (whether diffusive, advective or from resuspension) are embedded in other field measurements of flux.

SPI images were analyzed on-site to provide estimates of "active" mixing depths, this depth at P04 was ~6-11 cm, and at P17 was ~4-7 cm. Redox Penetration Depth (RPD) and bioturbation depth were both deeper at P04. Additional analyses for indicators of redox penetration, successional stage and physical disturbance are consistent with geochemical and microbial observations. Table 6-1 illustrates the results of this evaluation.

Table 6-1. Summary of on-site determination of RPD and visual bioturbation depth.

P04	RPD (cm)	Visual Bioturbation Depth (cm)	P17	RPD (cm)	Visual Bioturbation Depth (cm)
N	24	23	**N**	17	17
Mean	1.86	8.61	**Mean**	1.00	5.62
Stdev	0.47	2.73	**Stdev**	0.38	1.80

6.3 ADVECTIVE FLUX

Advective flux rates were calculated based on two measurement data sets. Specific discharge rates (w) were determined from multiple deployments of ultrasonic seepage meters within each site. Porewater concentrations were measured in the laboratory from composite samples collected at the same stations where the seepage meters were deployed. Porewater concentrations were determined for the sediments in the mixed layer (c_H), and the overlying surface water (c_O). Concentrations below the mixed layer (c_{H-}) were assumed to be zero for metals (due to reduced conditions), or calculated based upon a partitioning ratio with the solid concentration for PAHs. The advective flux for a given chemical is then estimated as

$$F_A = w(c_{H-} - c_H) \quad w \geq 0$$

$$F_A = w(c_H - c_O) \quad w < 0 \tag{1}$$

Advective fluxes were calculated for each station at each site based on the equations above. At site P04, two meters were deployed, but one meter detached from the cable and only a short period of data was obtained. Results for P04 are thus based on only a single deployment. For P17, two meters were deployed, and the site-mean flux was then calculated as the average of the stations fluxes within the site. Results for metals are shown in Table 6-2 and Figure 6-1, and for PAHs are shown in Table 6-3 and Figure 6-2. Note that advective flux rates are based on 24-hour mean discharge rates at each station and do not account for short-term variations associated with tides. Tidal pumping can act to both enhance discharge, and to attenuate porewater concentrations.

Table 6-2. Advective flux rates for metals at P04 and P17 All values are μg/m2/d.

P04	mean	Stdev.
Arsenic	85.61	4.69
Copper	209.00	11.21
Cadmium	12.09	1.35
Lead	6.67	0.32
Nickel)	85.14	14.60
Manganese	621.34	72.05
Silver	1.88	0.51
Zinc	1739.87	97.41
P17	mean	Stdev.
Arsenic	91.57	82.03
Copper	16.13	14.63
Cadmium	4.93	6.83
Lead	2.98	2.74
Nickel	32.79	29.93
Manganese	9984.81	9316.72
Silver	0.93	0.89
Zinc	449.14	402.52

Table 6-3. Advective flux rates for PAHs at P04 and P17. All values are ng/m^2/d.

P04	mean	Stdev	P17	mean	Stdev
Naphthalene	-43.29	1.81	Naphthalene	17.62	18.32
Acenaphthylene	151.63	36.26	Acenaphthylene	45.30	40.66
Acenaphthene	6.61	2.31	Acenaphthene	106.09	111.16
Fluorene	6.03	1.84	Fluorene	34.35	
Phenanthrene	-70.19	16.52	Phenanthrene	94.45	90.24
Anthracene	986.69	590.85	Anthracene	324.24	299.33
Fluoranthene	116.72	53.04	Fluoranthene	1389.64	1359.10
Pyrene	859.12	259.31	Pyrene	544.65	490.76
Benzo(a)anthracene	40.27	14.02	Benzo(a)anthracene	469.74	429.86
Chrysene	250.21	102.81	Chrysene	702.76	632.10
Benzo(b)fluoranthene	-304.43	64.54	Benzo(b)fluoranthene	700.07	636.19
Benzo(k)fluoranthene	-163.09	33.14	Benzo(k)fluoranthene	709.13	642.84
Benzo(e)pyrene	1148.06	412.13	Benzo(e)pyrene	492.42	444.76
Benzo(a)pyrene	-1148.12	254.54	Benzo(a)pyrene	580.67	526.36
Perylene	309.86	128.70	Perylene	173.18	156.51
Indeno(1,2,3-c,d)pyrene	-284.46	65.53	Indeno(1,2,3-c,d)pyrene	298.41	271.46
Dibenz(a,h)anthracene	-148.62	41.19	Dibenz(a,h)anthracene	71.80	65.88
Benzo(g,h,i)perylene	-457.26	134.12	Benzo(g,h,i)perylene	288.40	260.01

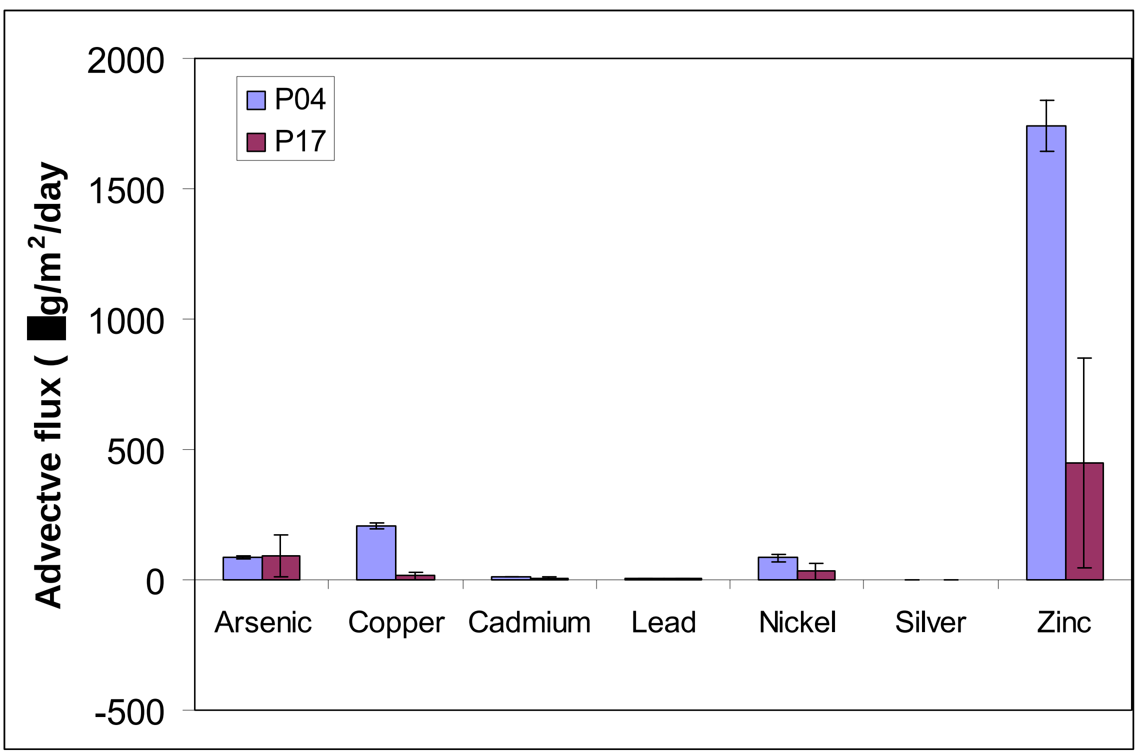


Figure 6-1. Comparison of advective metal fluxes for the P04 and P17 sites.

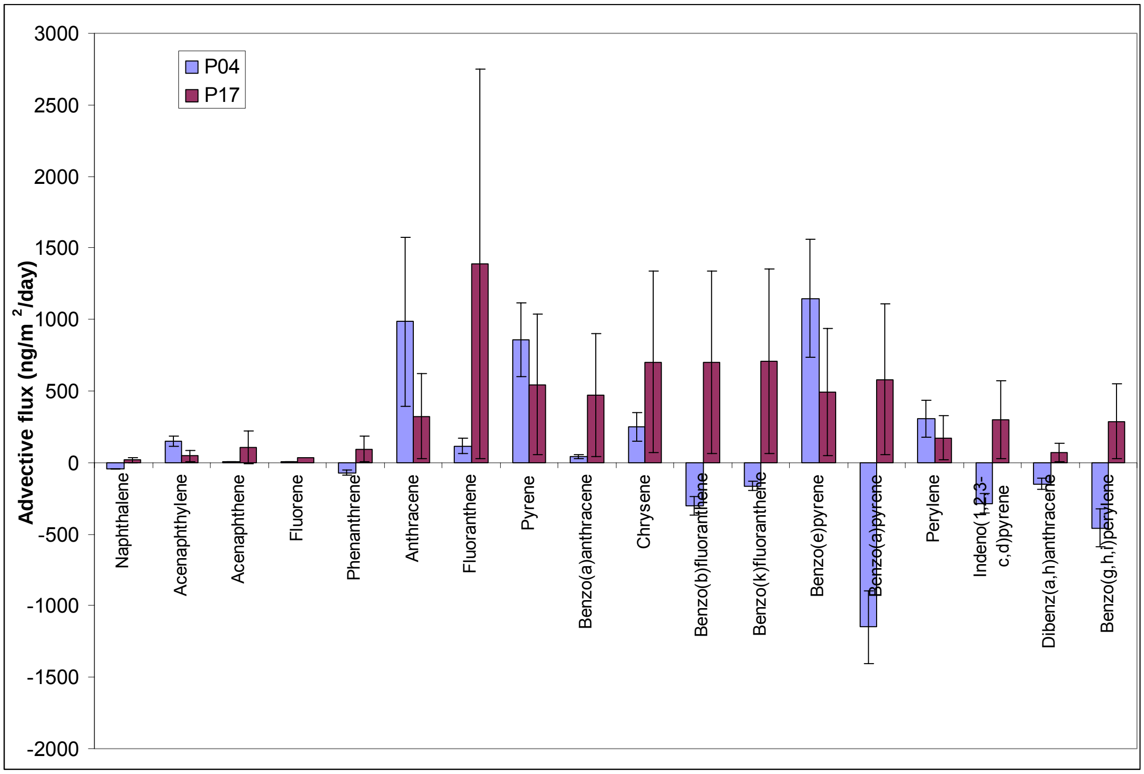


Figure 6-2. Comparison of site-average advective PAH fluxes for the P04 and P17 sites.

Variability of the measurement

Variability for advective discharge was quantified based on (1) variations in the specific discharge time-series record at each station, (2) variation in specific discharge rates between replicate deployments at the same station, (3) variation in specific discharge rates, porewater concentrations, and flux rates between stations within the same site, and (4) variation in specific discharge rates, porewater concentrations, and flux rates across the two sites.

For Site P04, although two meters were deployed, one meter detached from the cable and only a short period of data was obtained. Results were thus based on only a single deployment. The results indicate specific discharge rates were always positive (out of the sediment), ranging from a low of about 4 cm/d to a high of about 11 cm/d. Highest discharge occurred during the period from about 1300-2400 on 1/12/02. This period of high discharge appears to develop during and following the lower low tide. Decreased levels of discharge appear to correspond to the period extending from the lower high tide, through the higher high tide. This results in a characteristic diurnal pattern in the discharge rate. Data collected on 1/12/02 was used to calculate an average daily (24-hr) specific discharge rate for the site. The rate for this period was determined to be 8.37 cm/d.

Two meters were successfully deployed at station P17. Mean results are thus based on the measurements from both meters. The results indicate specific discharge rates were always positive at the inner station (P17-3a), ranging from a low of about 3 cm/d to a high of about 8 cm/d. Highest discharge at the inner site generally occurred during both the higher and lower low tide conditions. At the outer site (P17-3b), seepage rates were generally positive, but there were some periods of slight negative flow (recharge). Seepage rates at the outer site ranged from about –0.5 to 6 cm/d. Along with the magnitude, the pattern of flow at the outer site was somewhat different than at the inner site. At the outer site, highest discharge generally occurred in association with the ebb tide prior to lower low water, not during both low water conditions. This results in a characteristic diurnal pattern in the discharge rate as opposed to a semidiurnal pattern as observed at the inner site. The 48 h period from 1/16/02-1/17/02 was used to calculate an average daily discharge rate using combined measurements from both stations. The discharge rate for this period was determined to be 3.3 cm/d.

Variability at these stations appeared to be largely controlled by tidal action. This is also consistent with previous observations of seepage in tidally influenced coastal environments. Most results suggest a damping of discharge during the higher low tide, with strongest discharge occurring during the lower low tide. At both stations, the tidal variability represented about 30% of the overall signal. Results at P04 showed no indication of any longer term components in the seepage, while the results at P17 indicated a potential increase in signal during the later part of the deployment that may be related to a longer term variation in forcing that could not be resolved by these relatively short term deployments. The P17 site, because of its closer proximity to the creek and the shore, may be subject to greater variability associated with coupling to the upland groundwater system. Thus the daily rates that are calculated based on these deployments would need to be verified by longer term or repeated deployments in order to evaluate their representative ness for longer time scales.

Measured seepage rates were used to determine daily average discharge rates of 8.4 cm/d for site P04 (based on a single measure, so no variability could be determined) and 3.3 ± 3.0 cm/d for site P17. Additionally, it was determined that the near shore groundwater gradient is small 0.001-0.004. This, combined with the measurements indicating relatively low conductance of the Bay Point formation, are consistent with the measurements of low specific discharge made at the Paleta Creek stations.

Within site variability of measured advective flux rates was influenced by variations in both specific discharge rates and porewater concentrations. For P04, since only one advective flux was measured, all variability in the flux range is driven by the variability in the porewater (H) measurement, which is the mean of triplicate pore waters extracted from cores sliced at depth H. For P17, the large range in seep rates for the site is a greater component of the variability than is the porewater chemistry measurement. This drives the generally larger relative error bars for P17 in Figure 6-1 and Figure 6-2. Because all mean seep rates are positive, the magnitude and direction of flux for a given component is dependent upon the dissolved contaminant gradient. Since all H- porewater metal concentrations are assumed to be zero (based upon the presence of sulfide below depth H), then metal fluxes are positive. In general, contaminant metals displayed a range of fluxes. Lowest flux rates were generally observed for Ag, Cd, and Pb. Moderate fluxes were observed for As, Cu, and Ni, and highest fluxes were consistently found for Zn. For PAHs, H- porewater levels are calculated based upon 0-H porewater concentrations and ratio of PAH concentrations in the sediments in 0-H and H-. If the PAH levels in H- are higher than in 0-H, then the fluxes are negative, otherwise they are positive. Magnitude and variability of porewater and seawater contaminant concentrations are shown in Figure 6-3 and Figure 6-4.

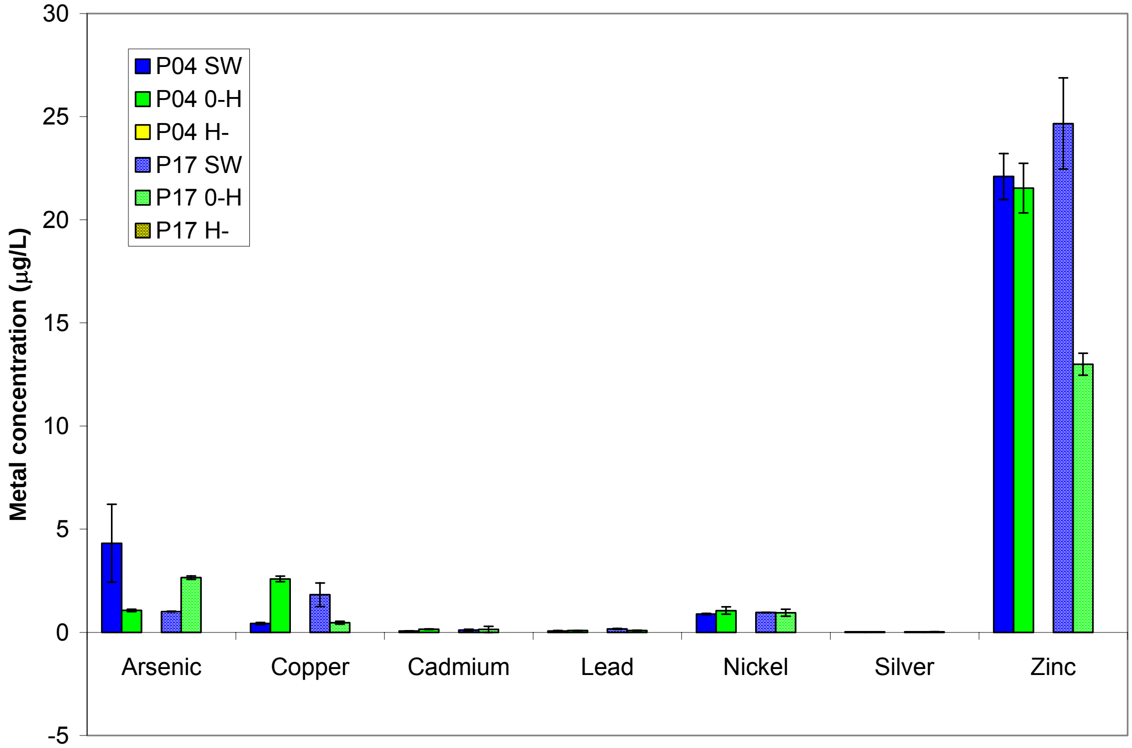


Figure 6-3. Seawater and porewater metals concentrations.

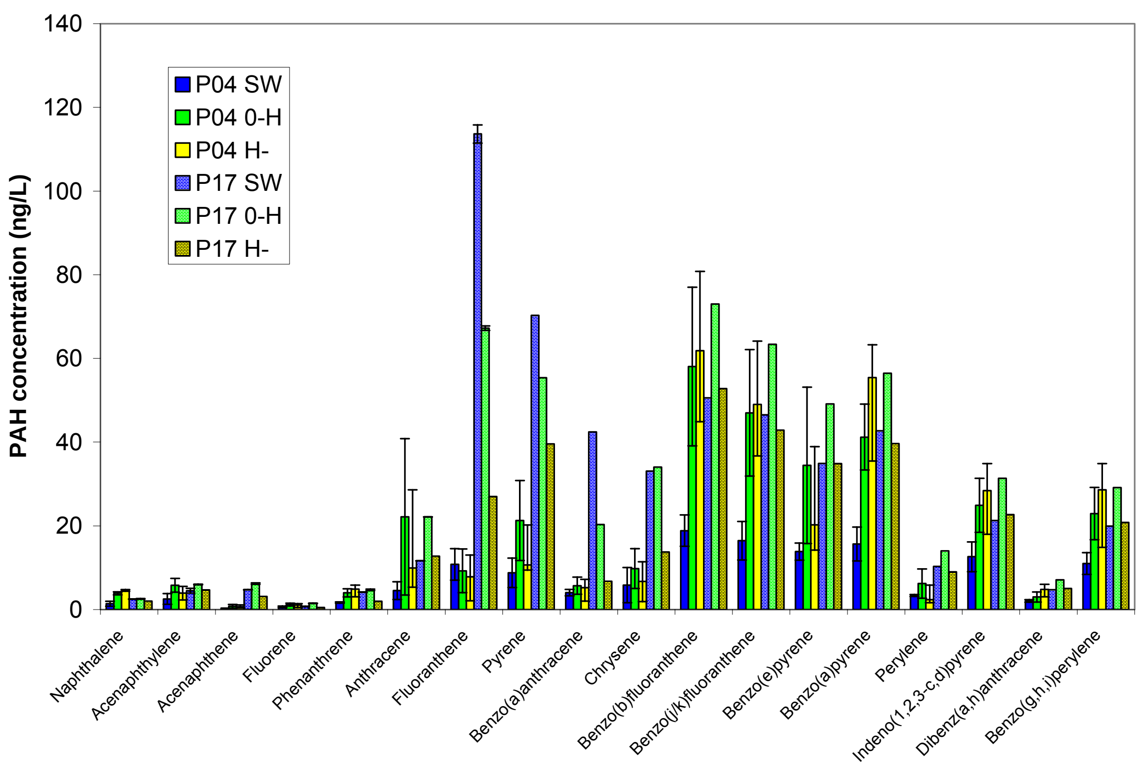


Figure 6-4. Seawater and porewater PAH concentrations.

Variations in advective fluxes across sites are associated with differences in contamination levels, groundwater gradients, physical characteristics of the sediment, geochemical conditions, and biological communities. In general, it appears that advective discharge of groundwater is generally higher at P04 compared to P17. Thus, for metals, advective flux was generally higher at P04, though this difference is tempered, or even offset for when porewater gradients are higher at P17. For PAHs, since all PAHs in sediments below H (and thus the calculated porewater levels) are lower than in sediments from 0-H, the fluxes are consistently positive. On the other hand, some PAHs at P04 are higher below H and some are lower, so the direction of flux is driven by this factor, and the magnitude of the fluxes are driven by the magnitude of the gradient. For many PAHs, the magnitude of the gradient at P17 is so much higher than it is at P04 that this offsets the differences in flow rate. Thus comparative advective contaminant fluxes for the two sites varied considerably due to differences in the interaction of contaminant gradients in the porewater with the magnitude of the specific discharge.

In summary, mean and tidal seepage rates at each site were determined from harmonic analysis of 2-4 day time series deployment. The strongest mean seepage rates were at P04. Porewater gradient were largest for metals at P04 and largest for PAHs at P17. These combined to result in the strongest metal advection fluxes at P04 and somewhat stronger PAH advection fluxes at P17.

6.4 DIFFUSIVE/BIOIRRIGATION FLUX

Fluxes associated with molecular and biologically mediated diffusive pathways were calculated directly from the time-series concentrations measured in the BFSD. Attempts to separate the biological component of the flux by limiting oxygen supply to the BFSD chamber were unsuccessful. Thus the reported flux rates represent the combined effect of all diffusive and bioirrigation processes. Because there is no flow path for water through the BFSD, the fluxes do not include advection. The diffusive flux was calculated from the time series data as

$$F_D = F_{DC} + F_{DB} = \frac{V}{A}\frac{dc}{dt} \qquad (2)$$

Here V is the chamber volume, and A is the surface area of the sediment enclosed by the chamber. Diffusive fluxes were calculated for each station at each site based on the equations above. The site-mean flux was then calculated as the average of the stations fluxes within the site. Results for metals are shown in Table 6-4 and Figure 6-5 and for PAHs are shown in Table 6-5 and Figure 6-6.

Variability in metal and PAH fluxes was quantified on three distinct scales in this study including variability in individual measurements, variability within a site (scale 2-10 m), and variability between sites (scale 1 km). Variability within an individual flux measurement is quantified based on the variance of the slope of the concentration with time. The variability in the slope may arise from a number of factors including actual non-linearity of the measured process, sample contamination, and analytical variability. For the BFSD, assessment of this variability is evaluated based on comparison to blank chamber runs (runs with a Teflon panel in place of sediment). Based on a statistical comparison of the deployment data versus the blank, an assessment is made as to whether the flux is “detectable”. This simply means that a flux was detected by the instrument that can be distinguished from a flux when no sediment is present.

This does not necessarily imply that the flux is significant from a transport or ecological perspective. By the same token, failure to detect a flux that is distinguished from the blank does not necessarily mean that the flux is insignificant, rather that with the BFSD technology, we are simply not able to determine a flux rate that is quantifiable in comparison to the blank. This is parallel to, for example, the measurement of a water concentration. If the concentration is detectable, we can quantify the value, but this does not infer that it exceeds an effects threshold. Similarly if we cannot detect it, but the effects threshold is below our detection limit, we cannot rule out a potential effect. For this reason, it is important to know whether fluxes were detectable when interpreting the data here, but we continue to use the entire data set for the general analysis so that perspective can be gained on the relative importance of fluxes within the context of PRISM.

In general, we found that fluxes for the listed metal and PAH constituents were detectable in the majority of the deployments. The primary exceptions included Pb and Ni for the metals, and Naphthalene, Acenaphthene, and Acenphthylene for the PAHs.

Table 6-4. Diffusive flux rates for metals at P04 and P17 including individual station fluxes, and site-average fluxes. All values are μg/m2/d. Shaded cells indicate flux rates that were statistically distinguishable from blanks at p<0.20.

	P04-3A	**P04-3B**	**P04-3Bio**	**Min**	**Max**	**Mean**	**Std**
Arsenic (As)	31.43	5.37	61.05	5.37	61.05	32.62	27.86
Copper (Cu)	-3.25	21.11	-38.88	-38.88	21.11	-7.01	30.17
Cadmium (Cd)	-5.10	1.67	4.68	-5.10	4.68	0.42	5.01
Lead (Pb)	0.39	30.58	1.61	0.39	30.58	10.86	17.09
Nickel (Ni)	11.2	10.1	102.2	10.1	102.2	41.2	52.8
Manganese (Mn)	29865	-118	35589	-118	35589	21779	19178
	74511						
Silver (Ag)	-0.47	2.84	-0.97	-0.97	2.84	0.47	2.07
Zinc (Zn)	242	159	1771	159	1771	724	907
	P17-1A	**P17-1B**	**P17-1Bio**	**Min**	**Max**	**Mean**	**Std**
Arsenic (As)	-3.20	135.89	1.78	-3.20	135.89	44.82	78.91
		388.80					
Copper (Cu)	157.0	11.8	129.0	11.8	157.0	99.3	77.0
Cadmium (Cd)	23.15	0.45	-3.25	-3.25	23.15	6.78	14.30
Lead (Pb)	-0.23	3.34	-2.46	-2.46	3.34	0.22	2.92
Nickel (Ni)	28.0	17.0	12.3	12.3	28.0	19.1	8.1
Manganese (Mn)	2968	5094	2872	2872	5094	3645	1256
		30561					
Silver (Ag)	-0.53	0.99	1.16	-0.53	1.16	0.54	0.93
Zinc (Zn)	3162	2781	553	553	3162	2165	1409

Within site variability was evaluated on the basis of three deployments at stations separated by a few meters. In general, these results indicate a fairly high degree of variability. This is expected to some degree because of the heterogeneous nature of the sediments and the geochemical and biological processes that regulate fluxes. While the variability is not surprising, it is critical that it be quantified within the context of PRISM. Since the flux rates will be used to compare the relative importance of various processes within a general transport balance, quantification of within site variability will allow the range of possible outcomes to be explored.

Variability across the two sites (P04 and P17) was evaluated on the basis that these two areas could have different transport processes that might be active or dominant. Thus comparison across sites provides insight into how well our tools can distinguish differences as we move from one environment to another.

Table 6-5. Diffusive flux rates for PAHs at P04 and P17 including individual station fluxes, and site-average fluxes. All values are ng/m2/d. Shaded cells indicate flux rates that were statistically distinguishable from blanks at p<0.20.

	P04-3A	P04-3B	P04-3Bio	Min	Max	Mean	Std
Naphthalene	232	954	673	232	954	620	364
Acenaphthene	ND	ND	29	29	29	29	NA
Acenaphthylene	-1	-9	29	-9	29	6	20
Fluorene	21	-60	-263	-263	21	-101	146
Phenanthrene	83	-132	15	-132	83	-11	110
Anthracene	458	221	613	221	613	431	198
Fluoranthene	70	703	768	70	768	513	385
Pyrene	185	185	200	185	200	190	9
	P17-1A	**P17-1B**	**P17-1Bio**	**Min**	**Max**	**Mean**	**Std**
Naphthalene	878	108	14	14	878	333	474
Acenaphthene	ND	ND	636	636	636	636	NA
Acenaphthylene	-63	9	-3	-63	9	-19	38
Fluorene	-303	ND	177	-303	177	-63	339
Phenanthrene	8	23	121	8	121	51	61
Anthracene	321	355	74	74	355	250	153
Fluoranthene	-149	1044	1267	-149	1267	721	761
Pyrene	127	1323	554	127	1323	668	606

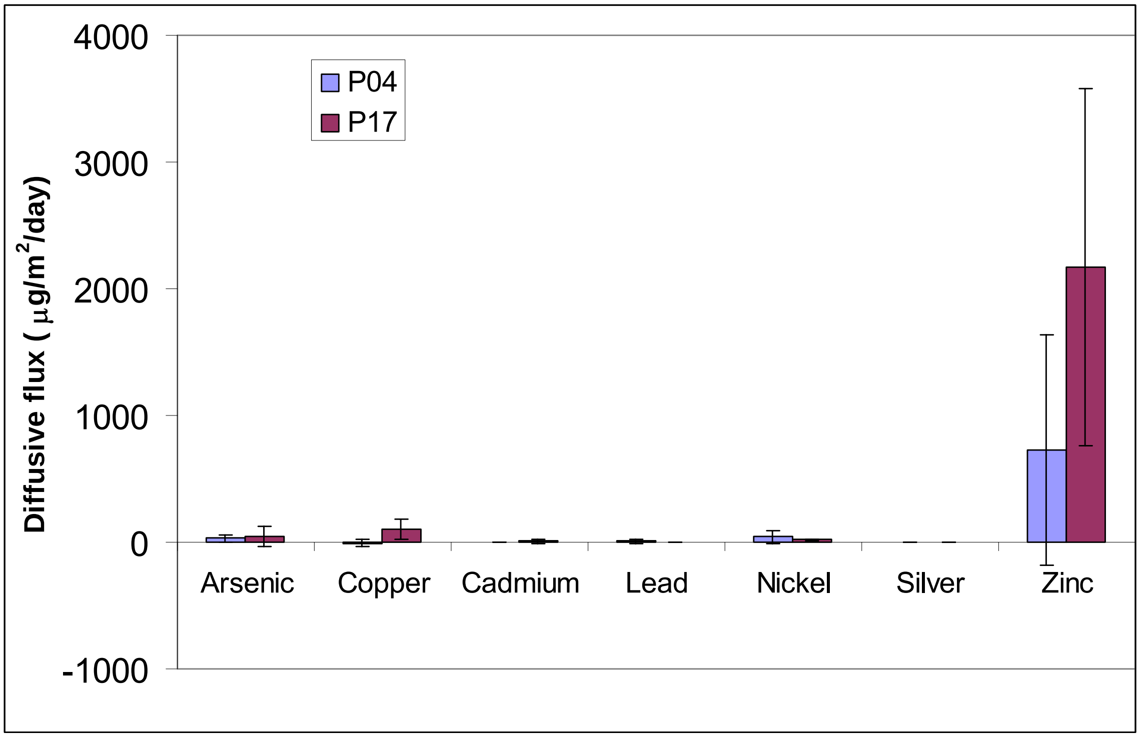


Figure 6-5. Comparison of site-average diffusive metal fluxes for the P04 and P17 sites.

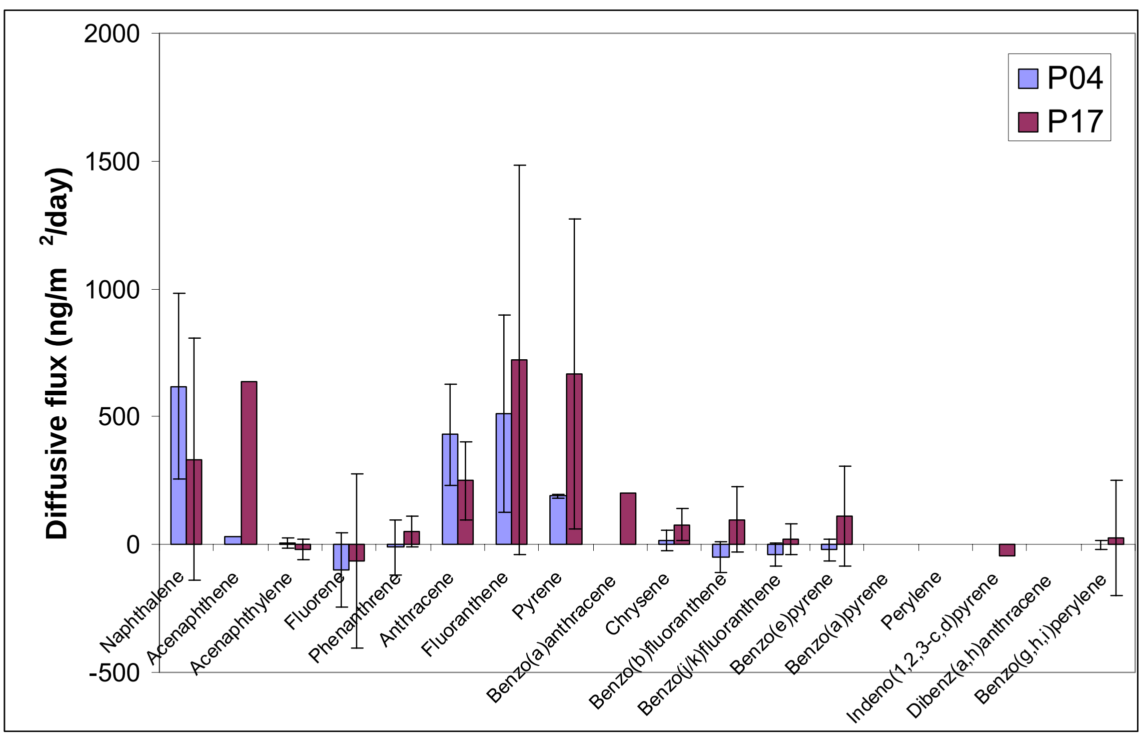


Figure 6-6. Comparison of site-average diffusive PAH fluxes for the P04 and P17 sites.

Metal fluxes
Metal flux results can be used to evaluate the general mobility of site CoCs, the relative differences among metals, the differences within a site, and the differences between the two sites. The fluxes can also be evaluated in the context of other supporting data such as oxygen and pH that may provide insight into the redox conditions at the sites.

In general, contaminant metals displayed a range of fluxes. Lowest flux rates were generally observed for Ag, Cd, and Pb. Moderate fluxes were observed for As, Cu, and Ni, and highest fluxes were consistently found for Zn. This pattern is consistent with previous BFSD results from a number of harbors that also found lowest (based on means) flux rates for Ag, Cd, and Pb and highest fluxes for Zn. The range of flux rates measured in this study is also consistent with the larger historical data set. For example, the flux of As at P04 and P17 averaged 33 and 45 $\mu g/m^2/day$ respectively compared to the historical mean of 21 $\mu g/m^2/day$. Site average flux rates for Zn of 724 and 2165 $\mu g/m^2/day$ at P04 and P17 bracket the historical mean value of 1577 $\mu g/m^2/day$. This same comparability holds for the metals in general, suggesting that the measurements obtained by this program should provide rates that are consistent with general trends observed across a number of harbors.

Comparison of metal fluxes between the P04 and P17 areas also showed distinctive patterns. In general, site mean metal fluxes were higher at P17 compared to P04 (see Figure 6-5). This was the case for As, Cu, Cd, and Zn. Contaminant metals that had higher mean fluxes at P04 included Ni and Pb. Site mean fluxes for Ag were comparable at the two sites. Direct comparison of the two areas indicates statistical differences for Cu ($p<0.06$), Pb ($p<0.20$), and Zn ($p<0.12$).

PAH fluxes
PAH flux results can be used to evaluate the general mobility of site CoCs, the relative differences among PAHs, the differences within a site, and the differences between the two sites. In general, PAHs displayed a range of fluxes. Lowest flux rates were generally observed for Naphthalene, Acenaphthene, Fluorene, and Phenanthrene. Highest fluxes were observed for Anthracene, Fluoranthene, and Pyrene. Flux rates for Acenaphthylene were often below detection, but showed strong fluxes in one deployment.

Historical data for PAH fluxes is limited. The results can be compared to results from the CALEPA Certification demonstration that was performed at a nearby station in Paleta Creek (Figure 6-7). From this comparison we find that the patterns of fluxes between this earlier study and the current one are similar in terms of which PAHs had fluxes and their relative magnitudes within each study, but the magnitude of the flux rates was generally higher during the CALEPA demonstration. Of course this was based on only a single deployment, at a somewhat different location, so some differences are expected. There is also some evidence that PAH levels in Paleta Creek have been decreasing due to source control efforts. At any rate, the consistency in the pattern of fluxes is encouraging from the standpoint that it suggests a process oriented control.

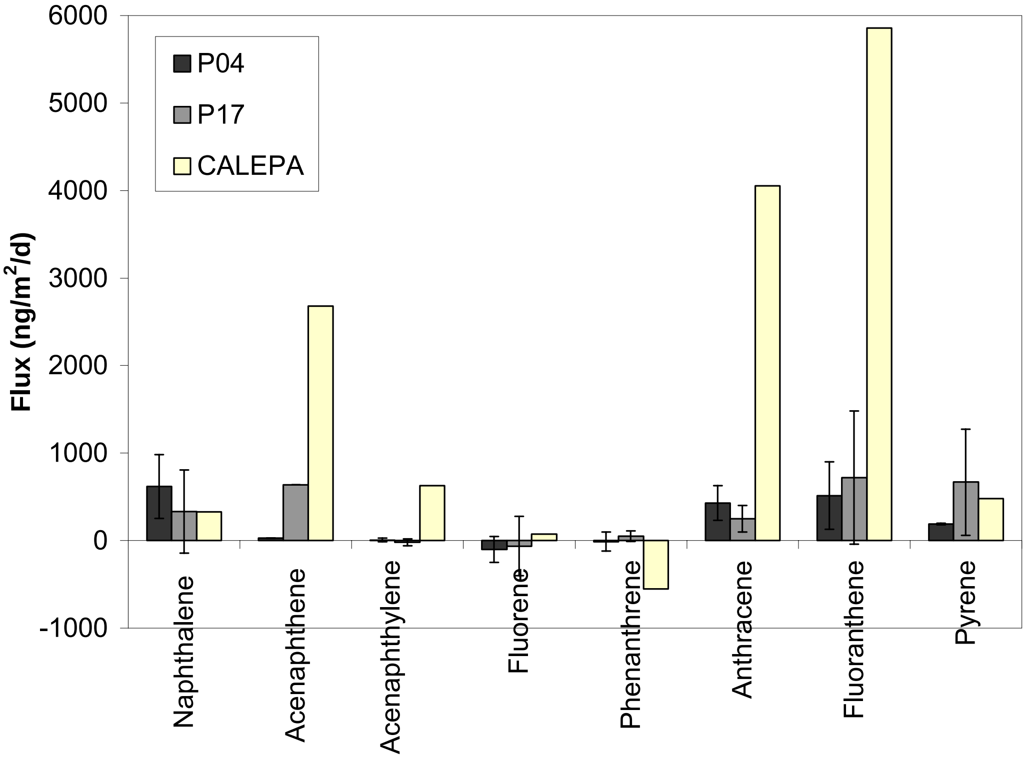


Figure 6-7. Comparison of P04 and P17 PAH flux rates with the single deployment for CALEPA Certification conducted in Paleta Creek.

Comparison of PAH fluxes between the P04 and P17 areas also showed some distinctive patterns. In general, site mean metal fluxes were higher at P17 compared to P04 (see Figure 6-6). This was the case for Naphthalene, Acenaphthylene, Phenanthrene, Fluoranthene, and Pyrene. Only Anthracene had a higher mean fluxes at P04. Site mean fluxes for Fluorene were negative at both sites. Direct comparison of the two areas indicates statistical differences for Acenaphthylene ($p<0.19$), Anthracene ($p<0.14$), and Pyrene ($p<0.15$).

In summary, metal diffusive fluxes were strongest for Zn, with moderate fluxes for Ni, As and Cu. Flux rates show similar progression to previous studies. For PAHs, mid-molecular weight (2-4 ring) PAHs have highest flux rates. For most CoCs, diffusive fluxes were generally higher at P17 than at P04.

6.5 FLUX BY SEDIMENTATION

In this study, two mechanisms of sedimentation flux were considered, and they were calculated differently. Sedimentation was considered to have two components; a constant "background" sedimentation and an occasional storm-induced sedimentation. "Background" sedimentation rates were based upon trap sedimentation rates. For P17, since age-dated core rates were significantly higher than trap rates, storm-induced sedimentation rates were derived from a study at Paleta Creek which evaluated the volume (and CoC levels) of particles that were deposited into Paleta Creek during storms (Katz et al., in prep.). For P04, which is further from the creek mouth, trap rates are higher than age-dated core rates, and thus the storm input is considered to be negligible.
Fluxes associated with sedimentation were calculated from trap and storm study derived sedimentation rates (S_t and S_s), and trap (c_S), bed (c_B), and storm particle (c_{ss}) contaminant concentrations. When new sediment deposits on the bed, the contaminant load of the mixed layer can be changed in several ways. If the depositing sediment is cleaner than the bed, then the sedimentation will reduce the concentration in the mixed layer. Alternatively, if the depositing sediment is more contaminated than the bed, then the sedimentation will increase the concentration in the mixed layer.

The background sedimentation flux was calculated from the sediment trap data as

$$F_{sB} = S_t(c_B - c_S) \qquad (3)$$

and the storm-induced sedimentation flux was calculated as:

$$F_{sS} = S_s(c_{ss} - c_S) \qquad (4)$$

Background sedimentation fluxes were calculated for each station at each site based on the equations above. The site-mean fluxes were then calculated as the average of the stations fluxes within the site. Storm-induced sedimentation fluxes were based upon data in the Katz et al. study, and thus were not done for each station, but calculated once for P17. All variability in the estimated values is driven by variability in the c_S value, as the other values in the equation are single estimates with no data on variability. Results for metals and PAHs are shown in Table 6-6 and Table 6-7 and Figure 6-8 and Figure 6-9. It should be noted that resuspension effects can lead to a high bias in sedimentation rates from trap. However, in the context of contaminant deposition, if the material is resuspended sediment, the deposition rate will be negligible because the depositing sediment and bed sediment concentrations will be approximately the same ($c_S \cong c_B$).

Table 6-6. Settling flux rates for metals at P04 and P17 including individual replicate fluxes, and site-average fluxes. All values are $\mu g/m^2/d$.

		Settling Flux					Storm Flux	
		Rep 1	Rep 2	Rep 3	Average	Stdev.	Average	Stdev.
P04	Arsenic	-42	-41	-92	-58	29	0	0
	Copper	-5723	-2276	-3004	-3668	1817	0	0
	Cadmium	31	11	-12	10	22	0	0
	Lead	-989	-88	-329	-469	466	0	0
	Nickel	-351	-119	-230	-233	116	0	0
	Manganese	-3437	238	530	-890	2211	0	0
	Silver	-30	-17	-15	-21	8	0	0
	Zinc	-5295	-1835	-2651	-3260	1809	0	0
P17	Arsenic	-36	-20	-95	-50	39	0	0
	Copper	-2402	-2340	-3737	-2826	789	212	93
	Cadmium	-2	-2	-4	-3	1	-30	1
	Lead	-528	-566	-1001	-698	263	-110	99
	Nickel	-102	-64	-123	-96	30	-220	29
	Manganese	1008	737	1205	984	235	0	0
	Silver	-6	-6	-9	-7	2	8	0
	Zinc	-1990	-1122	-2809	-1974	844	-3733	620

Table 6-7. Settling flux rates for PAHs at P04 and P17 including individual replicate fluxes, and site-average fluxes. All values are µg/m2/d.

		Settling Flux					Storm Flux	
		Rep 1	Rep 2	Rep 3	Average	Stdev.	Average	Stdev.
P04	Naphthalene	-0.4	-0.4	-0.5	-0.5	0.1	0	0
	Acenaphthylene	-2.4	-0.6	0.2	-1.0	1.3	0	0
	Acenaphthene	-1	-1	-1	-1	0	0	0
	Fluorene	-2	-2	-2	-2	0	0	0
	Phenanthrene	-17	-15	-15	-16	1	0	0
	Anthracene	-8	-6	-7	-7	1	0	0
	Fluoranthene	-29	-29	-27	-28	1	0	0
	Pyrene	-15	-16	-12	-14	2	0	0
	Benzo(a)anthracene	-12	-11	-12	-12	1	0	0
	Chrysene	-20	-17	-13	-17	3	0	0
	Benzo(b)fluoranthene	-16	-15	1	-10	10	0	0
	Benzo(k)fluoranthene	-16	-9	-5	-10	6	0	0
	Benzo(e)pyrene	-13	-9	1	-7	7	0	0
	Benzo(a)pyrene	-10	-4	6	-3	8	0	0
	Perylene	-3	-2	0	-2	1	0	0
	Indeno(1,2,3-c,d)pyrene	-10	-7	-2	-7	4	0	0
	Dibenz(a,h)anthracene	-2.5	-1.4	-0.2	-1.4	1.1	0	0
	Benzo(g,h,i)perylene	-7	-5	0	-4	3	0	0
P17	Naphthalene	-0.3	-0.3	-0.4	-0.3	0.1	-2.4	0.0
	Acenaphthylene	-1.1	-1.7	-1.7	-1.5	0.4	0.8	0.2
	Acenaphthene	-1.6	-1.3	-2.2	-1.7	0.5	-0.4	0.1
	Fluorene	-3	-3	-4	-3	0.7	-0.5	0.1
	Phenanthrene	-27	-26	-35	-29	5	-3.3	0.5
	Anthracene	-7	-8	-11	-9	2	2.1	0.8
	Fluoranthene	-27	-47	-49	-41	12	8.4	9.0
	Pyrene	-16	-28	-20	-21	6	11.4	3.6
	Benzo(a)anthracene	-6	-14	-16	-12	6	5.4	4.7
	Chrysene	-14	-24	-28	-22	7	6.2	4.3
	Benzo(b)fluoranthene	-8	-18	-14	-13	5	9.3	2.9
	Benzo(k)fluoranthene	-5	-15	-13	-11	5	10.8	3.3
	Benzo(e)pyrene	-5	-12	-9	-9	3	6.6	1.7
	Benzo(a)pyrene	-2	-10	-8	-7	4	8.4	3.2
	Perylene	-1	-2.8	-2.4	-2	0.9	1.8	0.6
	Indeno(1,2,3-c,d)pyrene	-3	-7.8	-5.5	-5.6	2.2	4.2	1.1
	Dibenz(a,h)anthracene	-0.8	-1.9	-1.3	-1.3	0.6	1.1	0.3
	Benzo(g,h,i)perylene	-3	-6.7	-4.6	-4.8	1.8	2.7	0.7

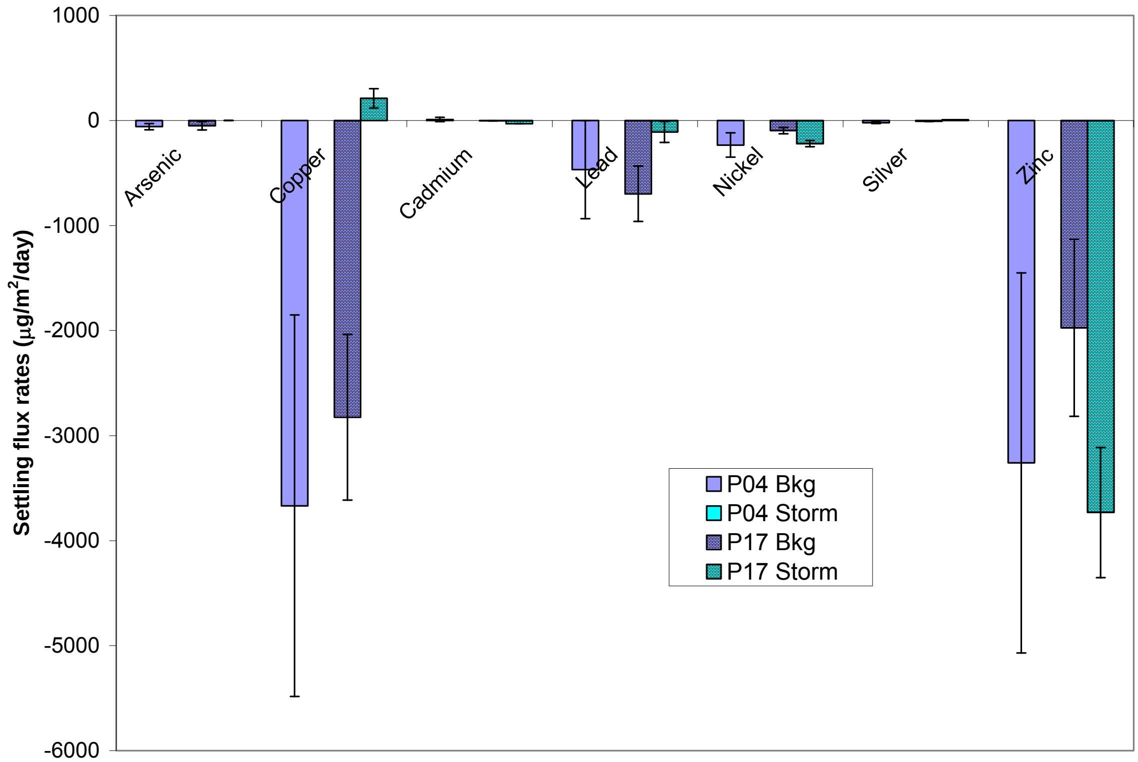


Figure 6-8. Comparison of site-average settling metal fluxes for the P04 and P17 sites.

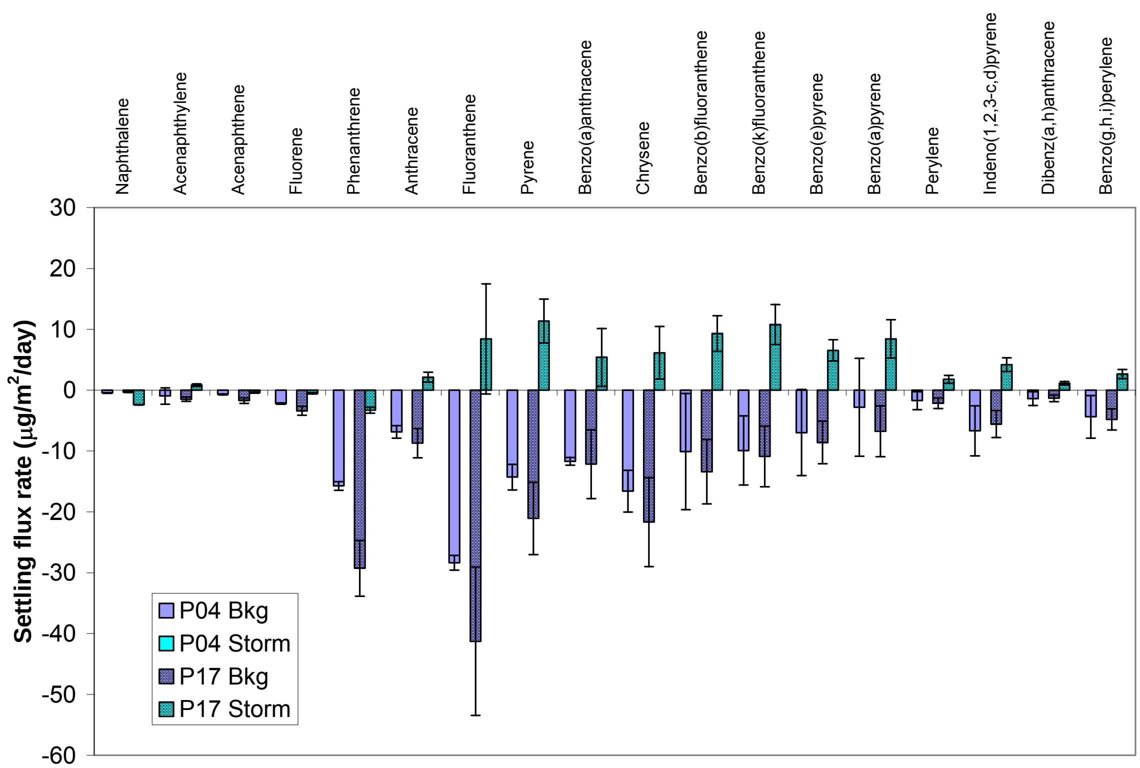


Figure 6-9. Comparison of site-average settling PAH fluxes for the P04 and P17 sites.

Variability of the measurement

Variability for sedimentation fluxes was quantified based on (1) variation in sedimentation rates determined by two methods (cores and traps), (2) variation in sedimentation rates, bed concentrations, and trap concentrations between replicate deployments at the same station, and (3) variation in sedimentation flux rates across the two sites.

Methodological variability in sedimentation rates was assessed based on comparison of results for age-dated cores with results from sediment traps (see Table 6-8). In general, sedimentation rates based on age dating with Pb^{210} provide a long-term (~10-100 year) average for the site, while sediment traps provide a short-term average (length of deployment 10-100 days). At the P04 location, the rates as determined by the separate techniques differ by around 40%, a reasonable difference based upon methodological variability. The sedimentation rate measured using the sediment trap is higher; likely a result of localized ship resuspension events that are not captured in the long-term sediment record. At the P17 location, the sedimentation rate as determined by radionuclide age dating is approximately three times the rate as determined by use of sedimentation traps over the deployment period. This is likely a result of close vicinity of P17 to the mouth of Paleta Creek. Seasonal sediment inputs are likely in this area as a result of winter storms. Because the sediment trap deployment did not occur over the period of the winter storm events, this input is not reflected in the calculated sedimentation rate for this station.

Table 6-8. Sedimentation Rates

Site	$^{137}Cs/^{7}Be/^{210}Pb$	Sed. Traps
Paleta Creek: P04	0.53	1.27
Paleta Creek: P17	1.11	0.38

Variability between replicate trap deployments at the same station reflects the combined effects of small scale heterogeneity and measurement error. Replicate measurements showed very reproducible values of sedimentation rate. For example, at P04, replicates sedimentation rate measurements in the traps ranged from about 1.24 – 1.29 g/cm^2/year, while replicates in P17 ranged from 0.32 – 0.44 g/cm^2/year, slightly higher variability, but still quite little. As stated above, storm settling rates are based upon single numbers and thus no estimate of variability has been made.

Variations in sedimentation fluxes across sites are associated with differences in deposition rates, regional contaminant loading, and existing site conditions for bed concentrations. At this site, many CoC levels in trap and storm particles are higher than those in bed sediments. In general, it appears that for most metals, both storm and background sedimentation of at P04 and P17 has the potential to *increase* contaminant concentrations in the bed, although storm sedimentation at P17 and background sedimentation at P04 may be acting as a source for copper and Cd, respectively (Figure 6-8). For PAHs, background sedimentation tended to act as a source to the sediments of both sites most compounds, but storm settling at P17 acted as a recovery mechanism, reducing PAH levels (Figure 6-9). The magnitude of the PAH background sedimentation pathway was similar at the two sites, with comparable magnitude, but opposite direction, fluxes for storm settling at P17. The variation with congener suggest that the particles that are depositing to the bed contain a fresher, less weathered mixture of PAHs, that is comparatively enriched in more degradable compounds, while the PAH mixture in the bed has been modified through preferential degradation of the unsubstituted fraction. This hypothesis is supported by the observation of high instantaneous biodegradation rates for naphthalene, phenanthrene and fluoranthene in surface sediments.

In summary, background settling rates were characterized using sediment traps and age-dated cores. Background settling concentrations were characterized using sediment traps. Storm settling was characterized using recent stormwater survey data from Paleta Creek and storm drains. It is possible that traps may include a component of resuspension, and this would have to be evaluated in detail if settling fluxes became a major component of a management decision. Stormwater particles were assumed to settle uniformly over the P17 area and to have no influence on P04 based on mapping surveys. Settling rates measured appear to be typical for coastal areas. However, deposition remains a source for many chemicals. Higher contaminant levels in surface vs. depth of cores reflects ongoing sources for many contaminants. Depositional inputs of metals are generally higher at P04, and inputs of PAHs are higher at P17.

6.6 FLUX BY EROSION/RESUSPENSION

Fluxes associated with erosion were evaluated from critical shear stress (τ_c) and erosion rate (K_E) characteristics measured by the flumes, bed shear stresses (τ) estimated from the current meters, and the contaminant concentrations measured in within and below the mixed layer (c_{H-}, c_H). If the bed shear stress at the site exceeds the critical shear stress, then the potential exists for sediments to be eroded from the bed and transported by the harbor currents. In this case, the amount of erosion depends on the erosion rate characteristics of the bed as a function of depth, and the strength, variability, and duration (T) of the applied shear stress. The erosion flux was calculated from the sediment flume and current meter data as

$$F_E = \frac{c_H - c_{H-}}{T} \int_0^T K_E(z)\left(\tau(t) - \tau_c\right) dt \quad (5)$$

At this site, the flux associated with erosion is at most times negligible, at least under the conditions represented by the current meter deployments, except during ship movements (see below). However, for the estimated time that shear stress exceeds critical shear stress, erosive fluxes can be estimated from the equation above. Results can be seen in Table 6-9 and Figure 6-10 and Figure 6-11.

Table 6-9. Site average erosive flux rates for metals and PAHs at P04 and P17. All values are μg/m2/d.

		Erosion flux	
		Average	Stdev.
P04	Arsenic	6	6
	Copper	-41	128
	Cadmium	-1	1
	Lead	-44	39
	Nickel	-20	9
	Manganese	122	128
	Silver	-2	1
	Zinc	-149	135
P17	Arsenic	3	1
	Copper	14	16
	Cadmium	0	0
	Lead	3	21
	Nickel	-1	3
	Manganese	70	40
	Silver	0	0
	Zinc	56	49

		Erosion Flux	
		Average	Stdev.
P04	Naphthalene	-2.8	1.4
	Acenaphthylene	88.9	88.8
	Acenaphthene	0	3
	Fluorene	4	7
	Phenanthrene	4	26
	Anthracene	118	134
	Fluoranthene	12	58
	Pyrene	136	40
	Benzo(a)anthracene	39	81
	Chrysene	172	183
	Benzo(b)fluoranthene	-198	370
	Benzo(k)fluoranthene	-147	299
	Benzo(e)pyrene	253	275
	Benzo(a)pyrene	-238	331
	Perylene	117	85
	Indeno(1,2,3-c,d)pyrene	-91	187
	Dibenz(a,h)anthracene	-31.2	50.5
	Benzo(g,h,i)perylene	-110	163
P17	Naphthalene	3.2	3.5
	Acenaphthylene	19.1	16.8
	Acenaphthene	8.0	7.3
	Fluorene	13	5.2
	Phenanthrene	72	36
	Anthracene	98	60
	Fluoranthene	767	656
	Pyrene	356	279
	Benzo(a)anthracene	393	338
	Chrysene	469	312
	Benzo(b)fluoranthene	259	229
	Benzo(k)fluoranthene	278	238
	Benzo(e)pyrene	192	134
	Benzo(a)pyrene	233	230
	Perylene	71	46.7
	Indeno(1,2,3-c,d)pyrene	115.1	85.8
	Dibenz(a,h)anthracene	32.1	22.9
	Benzo(g,h,i)perylene	113.6	56.3

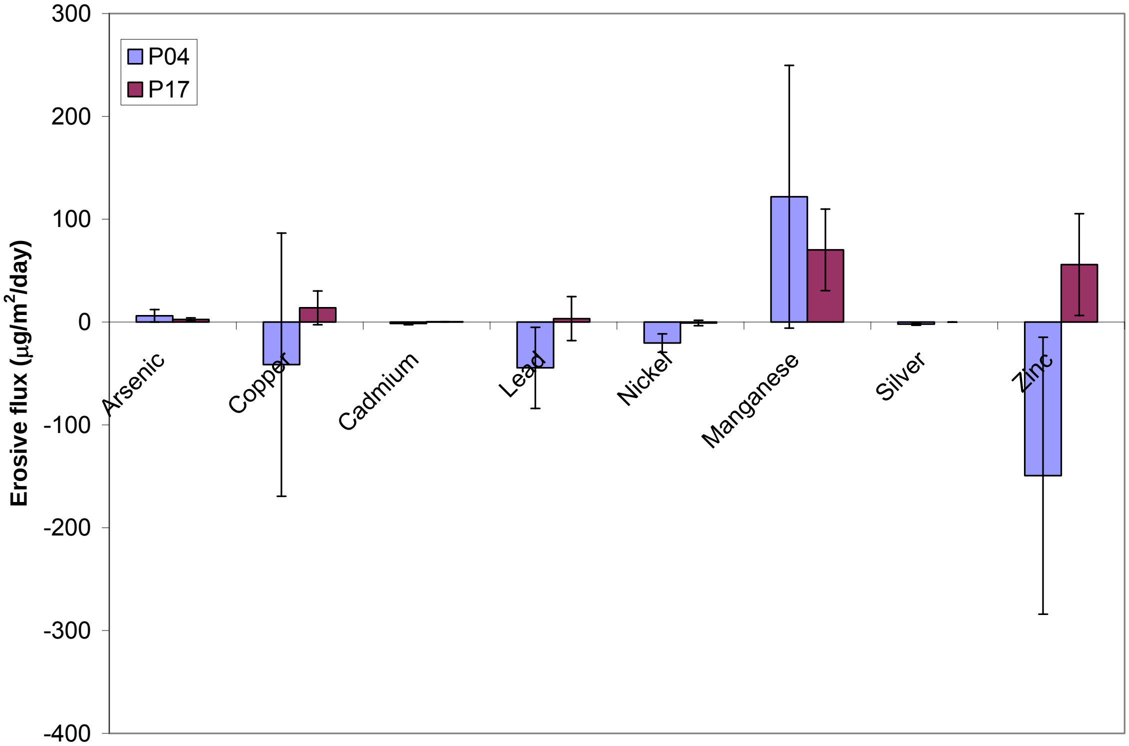


Figure 6-10. Erosive metal flux for metals in P04 and P17. All units in µg/m^2/day

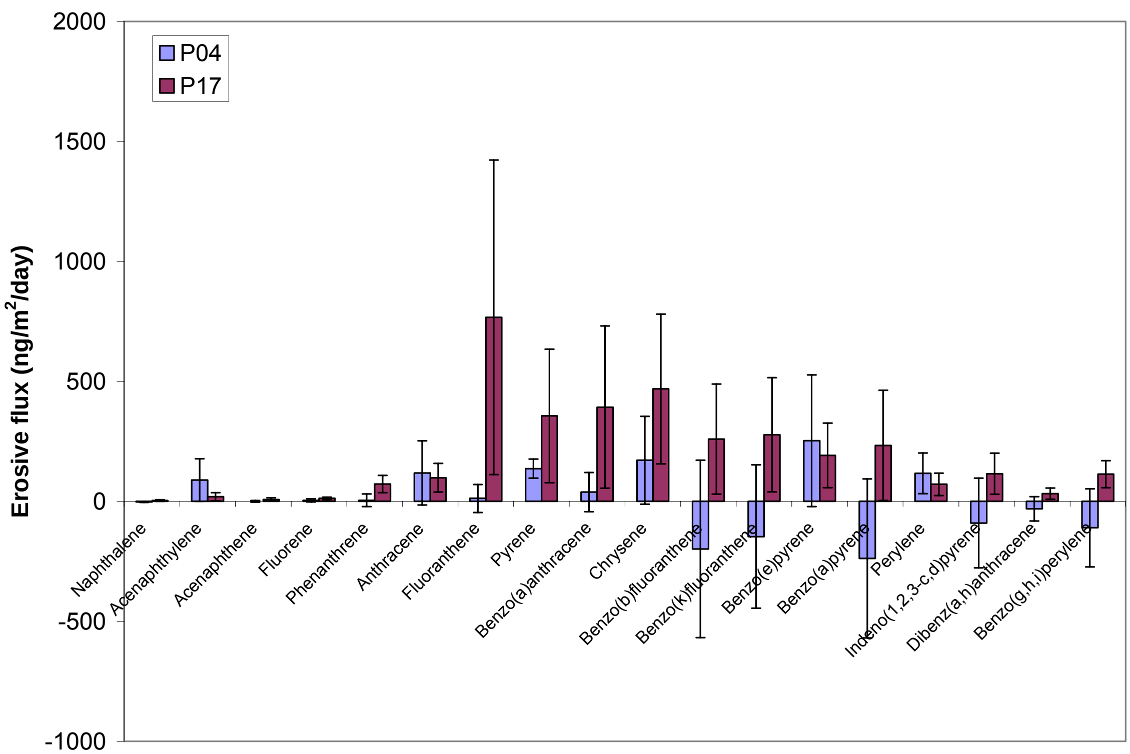


Figure 6-11. Erosive PAH flux for metals in P04 and P17. All units in ng/m2/day

Variability of the measurement

Variability for the erosion flux was quantified based on (1) variations in the current meter time-series record at each station, (2) variation in critical shear stress and erosion rate determined by two different flume systems, the in-situ annular Sea Carousel, and the axial laboratory SedFlume, (3) variation in contaminant concentrations below and within the mixed layer between stations within the same site, and (4) variation in bed stress, critical shear stress, erosion rate, and chemical concentrations across the two sites.

Within the accuracy of the measurement, the critical shear stress was found to be the same value, 0.17 Pa, in both replicates at both sites. Variability in the bed stress as estimated by near-bottom current meters was influenced primarily by tidal and wind driven forcing of water currents. In general, very low current speeds were observed at P17 (0-2 cm/s), and somewhat higher current speeds at P04 (0-7 cm/s). Currents at the P17 site consistently aligned toward the southwest during NOV2001, but were more variable during FEB2002 with what appears as a weak tidal fluctuation, suggesting some temporal, possibly seasonal, variation. Currents at the P04 site were predominantly aligned toward the northern quadrants during both deployments, with the direction appearing to clock from the northeast during the flood tide to the northwest during the ebb. At both sites, some short-term, high-current events were observed. There are believed to be related to ship and tug movements in the area.

Based on these current velocities, the calculated bottom shear at P17 is generally very low (~0.1 dyn/cm^2). Shear stresses at P04 were somewhat higher, ranging from about 0.5-2 dyn/cm^2 during the majority of the deployment. During the suspected ship movement events, shear stresses at both sites exceeded 10 dyn/cm^2. Comparison of these estimated shear stresses to the measured critical shear stress at the sites (0.17 Pa = 1.7 dyn/cm^2) indicates that the critical shear stress at P17 is only exceeded during high energy events such as ship movements. At P04 the results indicate that the critical shear stress is exceeded during high energy events, but may also be exceeded slightly during peak tidal flows. Analysis of the high energy events indicates that they occur about 1-2 times per week, and persist for about 10-30 minutes. This is consistent with the frequency and duration of ship movements in the Naval Station area.

Within site variability of measured contaminant concentrations below and within the sediment mixed layer is important in assessing the potential for erosive flux. If the concentration in the mixed layer (H) is lower than the concentration in the deep layer (H-), then as the surface layer erodes the concentration in the mixed layer will increase. In general, we found that concentrations in the mixed layer at the three stations within P04 varied from about 43-300% (RSD) for metals (Figure 6-12), and 30-600% for PAHs (Figure 6-13). For P17 the variability was somewhat lower (13-230%) for metals and PAHs (40-100%). These large RSDs in (C_{H-} - C_H) drive the direction and the large variability in erosive flux measurements. For P04, the sediment erosive fluxes are out of the sediments for As, Mn and the light PAHs, whilst the higher levels in deeper sediments mean that erosion results in an increase in Cu, Pb, Ni, As and Zn in the surface layer. For P17, all CoCs examined increase in the surface layer during erosion due to the strong contaminant gradients with depth. So, whilst the magnitudes of erosive fluxes are similar for the two sites, some contaminants are lost with erosion at P04, with some at P04 and all at P17 increasing at the surface in an erosive event.

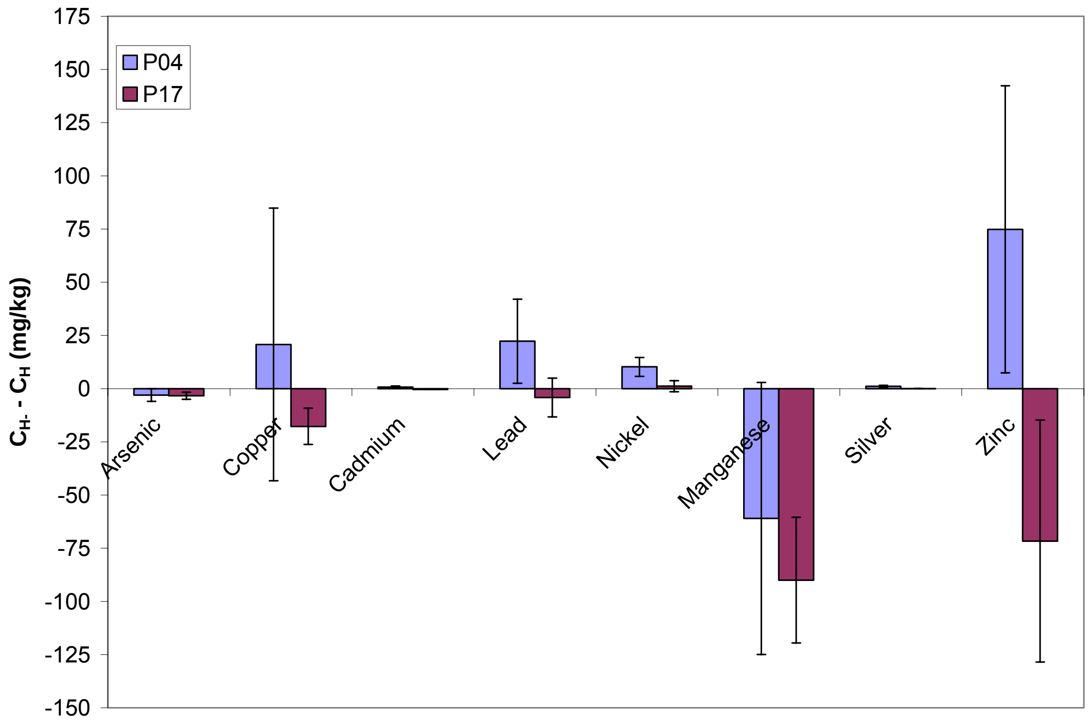


Figure 6-12. Site-average vertical gradients in metals from the shallow cores at P04 and P17.

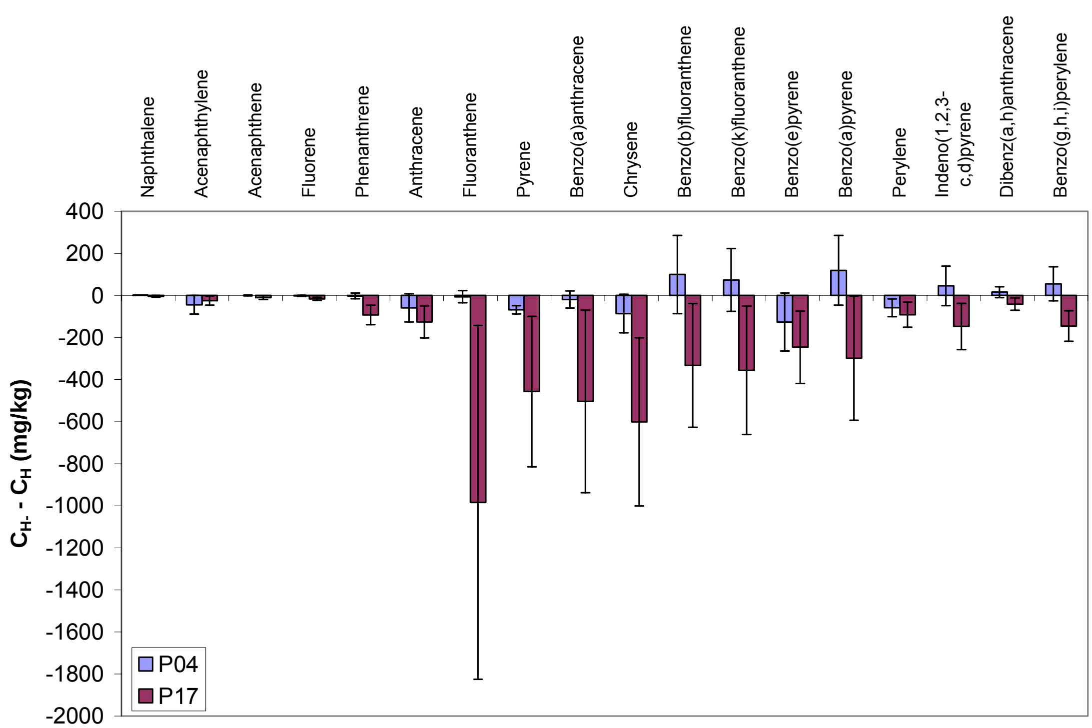


Figure 6-13. Site-average vertical gradients in metals from the shallow cores at P04 and P17.

In summary, sediment bed erosion properties were directly measured using an *in situ* flume. Bed stresses were determined over two one-month periods using near-bottom deployed current meters. Erosion rates were determined based upon the amount of time that measured bed stresses exceeded critical shear stresses. Solid phase CoC concentrations at H and H- were determined from samples collected by multicore and deep cores. Field variability was assessed by replicate flume deployments and coring in each area. Bottom stresses were estimated assuming logarithmic current profiles, and the concentration of eroded material was assumed to be surface layer concentration. No correction was made for near-field settling, as it was assumed that this was accounted for in the sediment traps. Tidal currents at both sites are generally weak compared to critical shear stress, with the exception of flock resuspension. Both sites show evidence of erosive potential during short periods (<1 h) associated with ship movements, however. Highest erosion was observed at P04, but erosion at both sites appears to be weak. Erosion at P04 generally leads to increase in surface layer contaminant concentrations due to higher concentrations at depth, with opposite for P17.

6.7 FLUX BY BIODEGRADATION

Fluxes associated with biodegradation were evaluated from core profiles of measured short-term mineralization rates (RD) of radio labeled additions to site sediments. Mineralization rate measurements were limited to three PAHs: naphthalene, phenanthrene and fluoranthene. Mineralization rates for other PAHs were derived by Exploiting shifts in PAH concentrations and distributions between sediment traps and surface sediments, assuming that changes in PAH histograms could be attributed solely to mineralization. The biodegradation flux for all PAHs was estimated in two ways. The first estimate was made from the core profiles and mixing depth by calculating the integral-average mineralization rate over the mixed layer depth (H) as

$$F_B = \int_0^H R_D(z)dz \qquad (6)$$

This estimate is based on the assumption that aerobic biodegradation of PAHs occurs within the mixed layer at the measured rates as a function of depth. The second estimate was made from only the measured surface mineralization rate (R_{DSURF}) and applied to the measured oxygen penetration depth (H_{O2}) as

$$F_B = H_{O2} R_{DSURF} \qquad (7)$$

The second estimate is based on the assumption that aerobic biodegradation at the rates measured will only occur in the presence of oxygen within the sediment column. Alternatively, this estimate could be viewed to be based on the assumption that the time that a mixed layer particle spends in the aerobic zone is proportional to the ratio of the aerobic layer depth to the mixed layer depth. Biodegradation fluxes were calculated for each station at each site based on the equations above. The site-mean flux was then calculated as the average of the stations fluxes within the site. Results for the measured PAHs are shown in Table 6-10 and Figure 6-14 and Figure 6-15.

Table 6-10. Depth-integrated and surface layer biodegradation flux rates for PAHs at P04 and P17. All values are ng/m^2/d.

	$R_{DSURF(calc)}$	+/-	Effective Depth	+/-	Fluxsurf	+/-	$R_{DH(calc)}$	+/-	Effective Depth	+/-	FluxH	+/-
	ng/cm3/y		cm		ng/m2/d		ng/cm3/y		cm		ng/m2/d	
Site: P04												
Naphthalene	0	0	0.35	0.13	0		193	432	8.61	2.73	-45576	101911
Acenaphthylene	39	5	0.35	0.13	-371	148	27	13	8.61	2.73	-6442	3013
Acenaphthene	1040	142	0.35	0.13	-9972	3988	734	343	8.61	2.73	-173092	80972
Fluorene	1296	177	0.35	0.13	-12424	4969	914	428	8.61	2.73	-215660	100885
Phenanthrene	2869	392	0.35	0.13	-27514	11004	2025	947	8.61	2.73	-477604	223421
Anthracene	304	41	0.35	0.13	-2911	1164	214	100	8.61	2.73	-50529	23637
Fluoranthene	1857	295	0.35	0.13	-17803	7264	2065	2591	8.61	2.73	-487165	611242
Pyrene	753	103	0.35	0.13	-7224	2889	532	249	8.61	2.73	-125394	58659
Benzo(a)anthracene	633	86	0.35	0.13	-6068	2427	447	209	8.61	2.73	-105326	49271
Chrysene	512	70	0.35	0.13	-4905	1962	361	169	8.61	2.73	-85142	39829
Benzo(b)fluoranthene	173	24	0.35	0.13	-1664	665	122	57	8.61	2.73	-28878	13509
Benzo(k)fluoranthene	173	29	0.35	0.13	-1664	683	122	69	8.61	2.73	-28878	16273
Benzo(e)pyrene	209	24	0.35	0.13	-2004	787	147	57	8.61	2.73	-34787	13503
Benzo(a)pyrene	67	9	0.35	0.13	-644	257	47	22	8.61	2.73	-11172	5226
Perylene	214	29	0.35	0.13	-2057	823	151	71	8.61	2.73	-35701	16701
Indeno(1,2,3-c,d)pyrene	198	27	0.35	0.13	-1896	758	140	65	8.61	2.73	-32913	15397
Dibenz(a,h)anthracene	155	21	0.35	0.13	-1484	593	109	51	8.61	2.73	-25755	12048
Benzo(g,h,i)perylene	158	22	0.35	0.13	-1517	607	112	52	8.61	2.73	-26327	12316
Site: P17												
Naphthalene	194	275	0.12	0.03	-633	910	117	152	5.62	1.80	-17995	35854
Acenaphthylene	113	106	0.12	0.03	-367	358	52	82	5.62	1.80	-7961	19234
Acenaphthene	847	554	0.12	0.03	-2760	1940	389	427	5.62	1.80	-59885	100625
Fluorene	572	413	0.12	0.03	-1865	1428	263	318	5.62	1.80	-40458	74964
Phenanthrene	854	589	0.12	0.03	-2784	2048	392	453	5.62	1.80	-60398	106943
Anthracene	167	118	0.12	0.03	-545	411	77	91	5.62	1.80	-11817	21506
Fluoranthene	236	104	0.12	0.03	-769	392	104	116	5.62	1.80	-15991	27396
Pyrene	83	22	0.12	0.03	-272	101	38	17	5.62	1.80	-5895	4068
Benzo(a)anthracene	104	50	0.12	0.03	-338	184	48	38	5.62	1.80	-7323	9064
Chrysene	94	37	0.12	0.03	-306	145	43	29	5.62	1.80	-6631	6784
Benzo(b)fluoranthene	36	3	0.12	0.03	-119	32	17	2	5.62	1.80	-2581	516
Benzo(k)fluoranthene	36	0	0.12	0.03	-119	30	17	0	5.62	1.80	-2581	0
Benzo(e)pyrene	30	0	0.12	0.03	-98	25	14	0	5.62	1.80	-2125	0
Benzo(a)pyrene	18	0	0.12	0.03	-58	15	8	0	5.62	1.80	-1264	0
Perylene	24	0	0.12	0.03	-79	20	11	0	5.62	1.80	-1710	0
Indeno(1,2,3-c,d)pyrene	33	11	0.12	0.03	-107	46	15	9	5.62	1.80	-2313	2076
Dibenz(a,h)anthracene	31	7	0.12	0.03	-102	35	14	5	5.62	1.80	-2212	1293
Benzo(g,h,i)perylene	28	2	0.12	0.03	-90	23	13	1	5.62	1.80	-1946	298

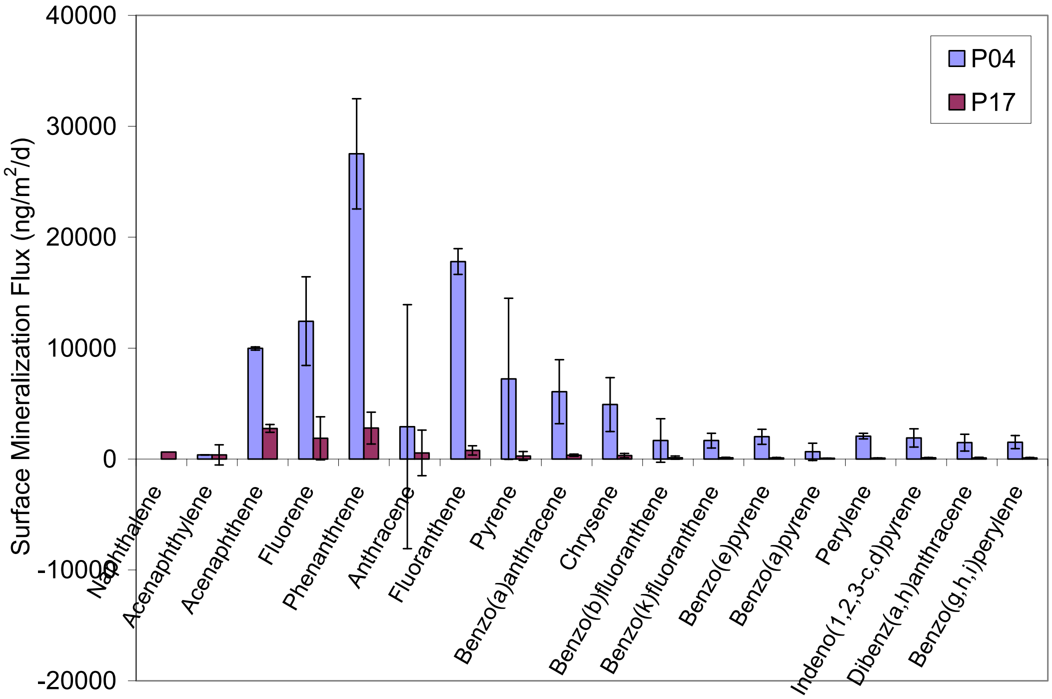


Figure 6-14. Comparison of site-average biodegradation fluxes for surface layer sediments at the P04 and P17 sites.

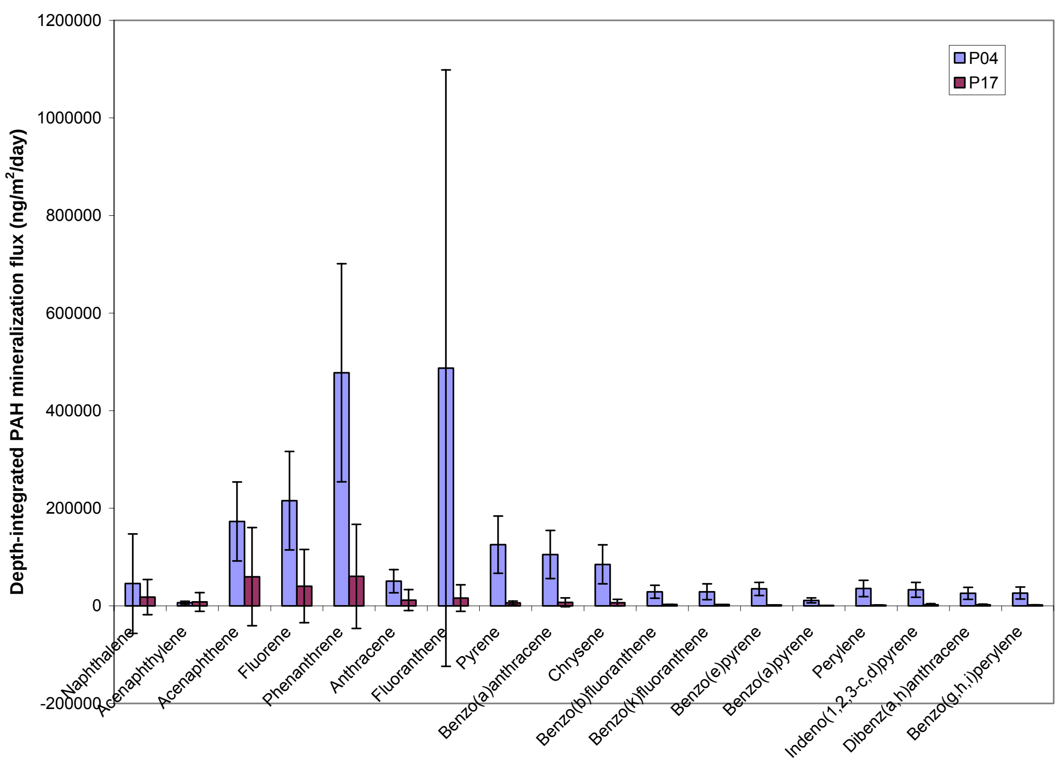


Figure 6-15. Comparison of site-average biodegradation fluxes for depth-integrated cores at the P04 and P17 sites.

Variability of the measurement

Variability for biodegradation fluxes was quantified based on (1) variation in mineralization rates within the core profiles at individual stations, (2) variations in rates at different stations within the same site, and (3) variation in rates across the two sites. As described above, variations associated with different assumptions about the active depth of biodegradation were also examined.

Variability within cores was examined based on variability with core depth, a function of oxygen penetration, PAH concentration and availability and microbial composition. For the P04 cores, RSDs for mineralization rates for all the depth intervals were found to range from about 140-210% for naphthalene, 60-95% for phenanthrene, and 83-136% for fluoranthene. For the P17 cores, RSDs for mineralization rates for all the depth intervals were found to range from about 245-236% for naphthalene, 42-103% for phenanthrene, and 192-145% for fluoranthene. These large variabilities are to be expected as oxygen levels, and thus degradability, should vary greatly with depth. Variability was also examined in triplicate measurements at each core depth interval. For the P04 cores, RSDs for mineralization rates for each depth intervals were found to range from about 3-100% for naphthalene, 16-87% for phenanthrene, and 11-73% for fluoranthene. For the P17 cores, RSDs for mineralization rates for each depth intervals were found to range from about 7-11% for naphthalene, 13-65% for phenanthrene, and 15-97% for fluoranthene. These lower RSDs are indicative of methodological as well as small scale field variability.

When the sites and cores are compared, elevated measured bacterial mineralization of the PAHs naphthalene, phenanthrene, and fluoranthene were associated with areas of the sediment that appear to be more bioturbated based on analyses using the REMOTS SPI camera and microprofiler data. PAH deposition rates determined using sediment trap analyses are consistent with PAH biodegradation rates measured for the top cm at station P04 that was more bioturbated and was consistent with that measured for the top 12 cm in the less bioturbated station, P17. It should be noted that though the relationships between bacterial activity and parameters measured on replicate cores appear interpretable, they are not absolute. Because this research involves field work on collected submerged sediment samples, the sampling locations are collected shipboard and so they are approximate. The REMOTS camera analyses demonstrated an extremely high heterogeneity in bioturbation depth over the scale of meters and even within one image. Replicate cores used in a preliminary site survey were widely variable in the parameters measured in the microprofile analyses. In addition, essentially one time point was evaluated and is being extrapolated to annual PAH transport and degradation. Extrapolation of these measurements to longer time frames and across larger sediment study sites will likely reduce their relevance to describing *in situ* conditions, but this is a limitation of all necessary field work. Confidence in our understanding of PAH transport and biodegradation in marine sediments will come with iteration of these field measurements seasonally and over different ecosystems.

Variability across the two sites was evaluated based on comparison of the site-average degradation flux rates for both the depth-integrated assumption and the surface layer assumption. In general, both sites showed a similar pattern in terms of the magnitude of the flux with P>F>N (Table 6-10). Because no N degradation was detected in the surface layer of P04, P17 surface layer degradation flux is higher than that at P04, for P and F, the flux is higher at P04. Depth-integrated mineralization flux is higher at P04 for all three PAHs. The mineralization fluxes calculated for other PAHs based upon derived mineralization rates follow the same patterns -

PAH fluxes out of the sediment due to mineralization for most PAHs, with the magnitudes being higher for P04 than P17, and with depth integrated mineralization fluxes being higher than surface mineralization fluxes. Not surprisingly, the more degradable parent and lighter PAHs have higher mineralization fluxes than do the heavier and substituted PAHs.

In summary, naphthalene, phenanthrene and fluoranthene mineralization rates were directly characterized at surface and with depth using an instantaneous mineralization assay with labeled PAHs. Assays were carried out as soon as possible after sampling to avoid microbial adaptation. Mineralization results were then put in terms of site as well as of other comparable studies. It is assumed that instantaneous assays reflect *in situ* rates, and that mineralization rates for labeled PAHs reflect rates in sediments. The measured rates were generally stronger and extended deeper at P04 than. P17, probably due to stronger bioturbation at P04. These results correlated with geochemical profiling and SPI observations. Mineralization rates for other PAHs were derived by exploiting shifts in PAH concentrations *and distributions* in traps vs. surface sediments. PAHs ratios in traps and surface sediments were calculated, and mineralization rates were derived based upon these ratios and the measured phenanthrene mineralization rates and ratios. This approach assumed that changes in PAH histograms could be attributed solely to mineralization.

Mineralization fluxes were then calculated by applying surface mineralization rates measured by NRL for N, P, F, and applying derived rates for other PAHs to the depth of oxygen penetration based upon microelectrode measurements, and depth-averaged mineralization rates to the depth of H. The high mineralization rates observed on low PAH sediments is assumed to be the result of entrainment of fresh material during bioturbation, with the presumption that bioturbation and other disturbance events can introduce microbial populations and conditions for active removal of mobile PAHs. Degradation fluxes were generally higher at P04 than at P17, due to lower mineralization rates and shallow O_2 penetration at P17. The highest rates were observed for mid-MW PAHs (2-3 ring). The surface mineralization estimates are probably conservative, as they do not take into account deeper degradation potential observed at sites, but the depth-integrated estimates are most likely over-estimates, as it is unlikely that aerobic degradation is occurring at all times throughout the layer. Methods may overestimate shallow fluxes at P04 for heavier PAHs, as the assumptions applied to derive mineralization rates are lass applicable for those PAHs.

6.8 PATHWAY ANALYSIS FOR METALS

The PRISM pathway analysis for metals at Paleta Creek in San Diego Bay was carried out by comparing the raw flux rates associated with each pathway. The analysis provides a means of evaluating which pathways may be dominant for the given site where the measurements were conducted. The primary pathways that were evaluated for metals at each site included

- Diffusive Flux (combined molecular and bio)
- Advective Flux
- Sedimentation Flux (background and storm)
- Erosion Flux

Comparative fluxes for all metals are summarized in

Table 6-11. A summary of these fluxes is illustrated for P04 in Figure 6-16, and for P17 in Figure 6-17. Convention for the fluxes in the pathway analysis is that a positive flux indicates a loss of contaminant from the surface layer, and a negative flux indicates a source of contaminant to the surface layer. Estimates of the variability for each metal at each site are included. In general, the variability estimates were compiled from propagation formulas that account for variability in the individual parameters within each pathway flux equation. Results are presented below for individual metals that were identified as CoCs at the initiation of the study.

Table 6-11. Summary of PRISM pathway fluxes for metals at the P04 and P17 sites. All fluxes are in $\mu g/m^2/d$.

		PRISM Pathway Flux											
		Advection		Diffusion		Background Settling		Storm Settling		Total Settling		Erosion	
		Site Mean	Estimated Var.	Site Mean	Estimated Var.	Site Mean	Estimated Var.	Site Mean	Estimated Var.	Site Mean	Estimated Var.	Site Mean	Estimated Var.
P04	Arsenic (As)	86	77	33	28	-58	103	n/a	n/a	-58	103	6	6
	Copper (Cu)	209	187	-7	30	-3656	1636	n/a	n/a	-3656	1636	-41	128
	Cadmium (Cd)	12.1	10.9	0.4	5.0	10.2	17.3	n/a	n/a	10.2	17.3	-1.4	1.1
	Lead (Pb)	6.7	6.0	10.9	17.1	-465.1	415.4	n/a	n/a	-465.1	415.4	-44.5	39.4
	Nickel (Ni)	85	78	41	53	-232	131	n/a	n/a	-232	131	-20	9
	Manganese (Mn)	621	561	21779	19178	-881	2174	n/a	n/a	-881	2174	122	128
	Silver (Ag)	1.9	1.8	0.5	2.1	-20.5	13.7	n/a	n/a	-20.5	13.7	-2.0	1.1
	Zinc (Zn)	1740	1561	724	908	-3247	1773	n/a	n/a	-3247	1773	-149	135
P17	Arsenic (As)	92	82	45	79	-49	33	n/a	n/a	-49	33	3	1
	Copper (Cu)	16	15	99	77	-2811	599	212	-93	-2600	606	14	16
	Cadmium (Cd)	4.9	6.8	6.8	14.3	-2.6	1.6	-29.9	-0.6	-32.5	1.7	0.3	0.1
	Lead (Pb)	3.0	2.7	0.2	2.9	-686.8	282.4	-109.5	-99.2	-796.4	299.3	3.3	21.3
	Nickel (Ni)	33	30	19	8	-97	32	-220	-29	-317	43	-1	3
	Manganese (Mn)	9985	9317	3645	1256	994	354	n/a	n/a	994	354	70	40
	Silver (Ag)	0.9	0.9	0.5	0.9	-6.9	1.5	7.7	-0.5	0.8	1.6	-0.1	0.1
	Zinc (Zn)	449	403	2165	1409	-1978	712	-3733	-620	-5711	944	56	49

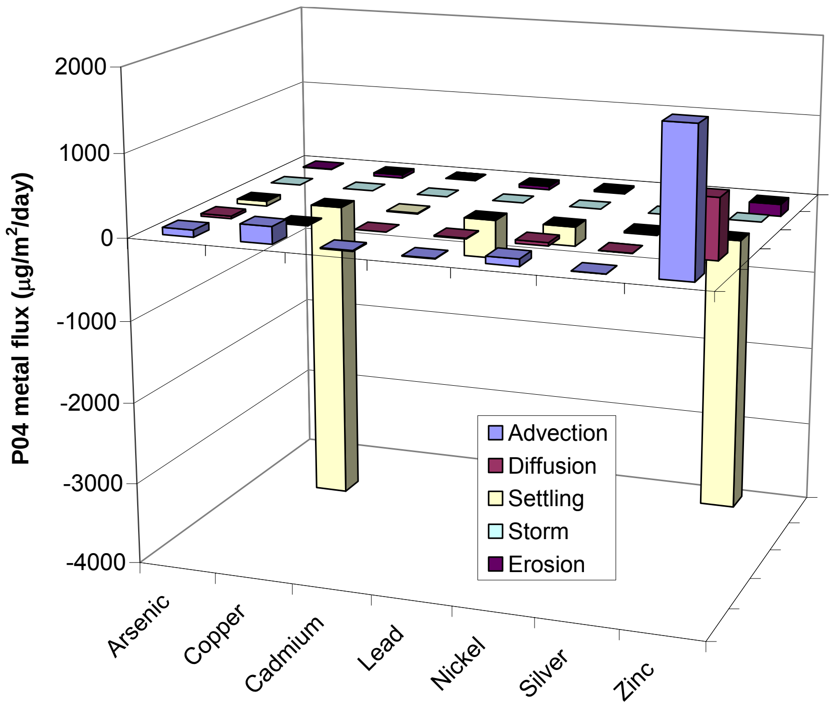


Figure 6-16. Summary of site-averaged metal fluxes for all pathways for P04.

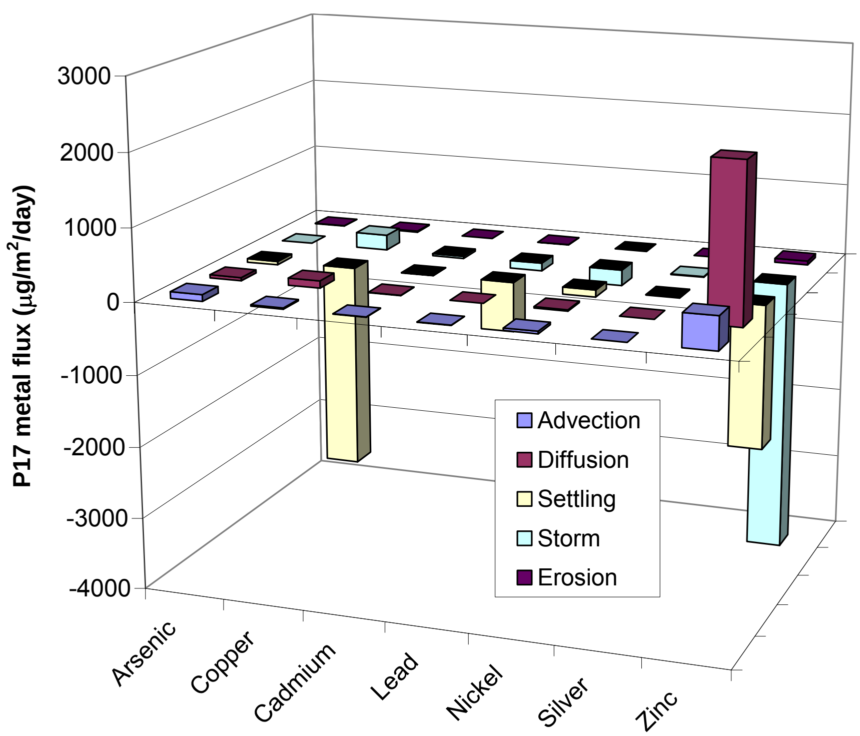


Figure 6-17. Summary of site-averaged metal fluxes for all pathways for P17.

Arsenic

Pathway analysis for arsenic indicates that dissolved contaminant processes (advection and diffusion) are leading to a loss of arsenic in the surface layer at both sites (Figure 6-18), although the variability is very high, especially for diffusion at P17. Particle processes (sedimentation and erosion) are less definitive. The uncertainty in the differences between trap, storm and surface sediment concentrations lead to large error bars, but it appears that background sedimentation remains an ongoing source of As at P04 and possibly at P17. Storm-induced sedimentation causes an uncertain or negligible effect, and erosion, which seems to expose deeper sediments with lower As levels, seems to result in a slight flux of As out of the surface layer. Advection, diffusion and erosion fluxes all indicate that P04 and P17 sediments are losing arsenic either by migration to the water column, or by exposure from cleaner deep material. The magnitude of the advection and diffusion fluxes at the two sites were comparable, while the magnitude of the settling fluxes were also similar but of opposite sign. Within-site variability in the two areas indicates that some fluxes are positive throughout both sites, while other fluxes may vary from positive to negative based on within-site conditions. An examination of all fluxes suggests that As may be experiencing a net loss as the sum of all processes, but variability and uncertainty are high.

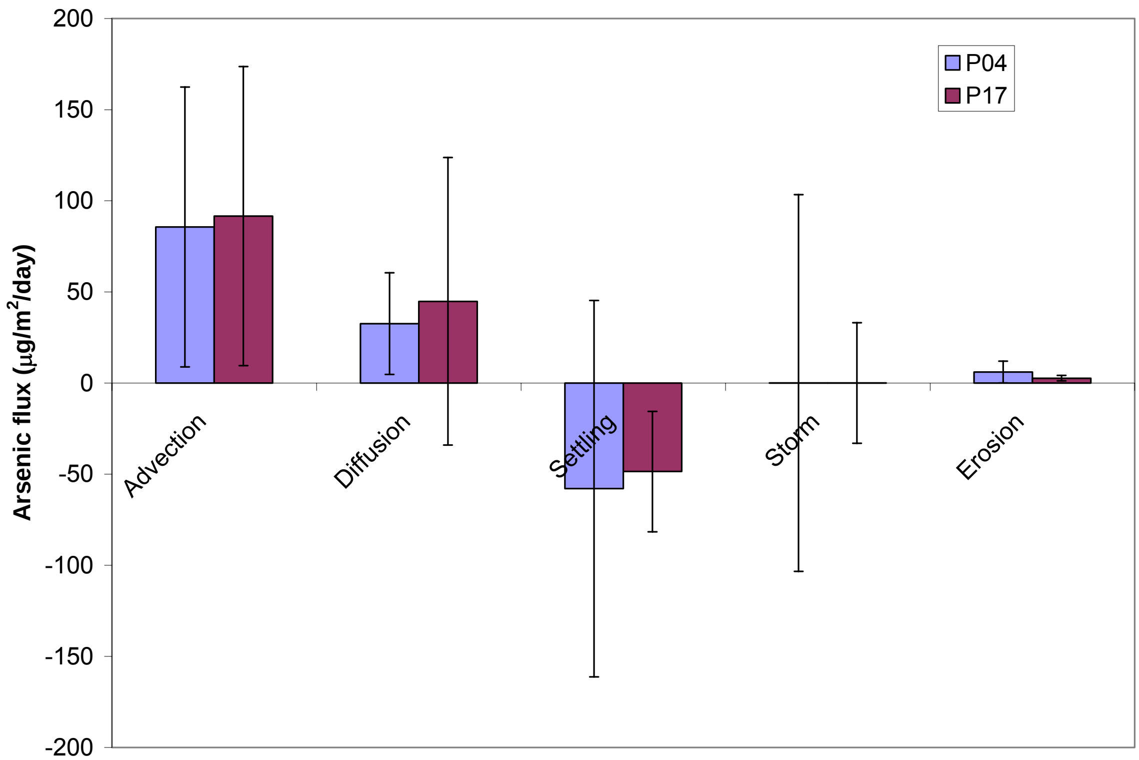


Figure 6-18. PRISM pathway fluxes for arsenic.

Copper

Pathway analysis for copper indicates that variations in surface layer concentrations at both sites are strongly dominated by background settling fluxes Because trap Cu concentrations are significantly higher than surface sediment concentration, background sedimentation provides a significant source of Cu to the surface layer, overwhelming fluxes by other processes. Dissolved contaminant processes (advection and diffusion) are leading to a loss of copper in the surface layer at both sites (Figure 6-19), although the variability is very high. The other particle processes (storm sedimentation and erosion) are less definitive. The uncertainty in the differences between H-, storm and surface sediment concentrations lead to large error bars, but it appears that storm sedimentation may remain an ongoing source of Cu at P04 and P17. Advection, diffusion and erosion fluxes all indicate that P04 and P17 sediments are losing copper either by migration to the water column, or by exposure from cleaner deep material. Within-site variability in the two areas indicates that some fluxes may vary from positive to negative based on within-site conditions. An examination of all fluxes suggests that Cu is experiencing a net gain as the sum of all processes, but variability and uncertainty are high for some processes.

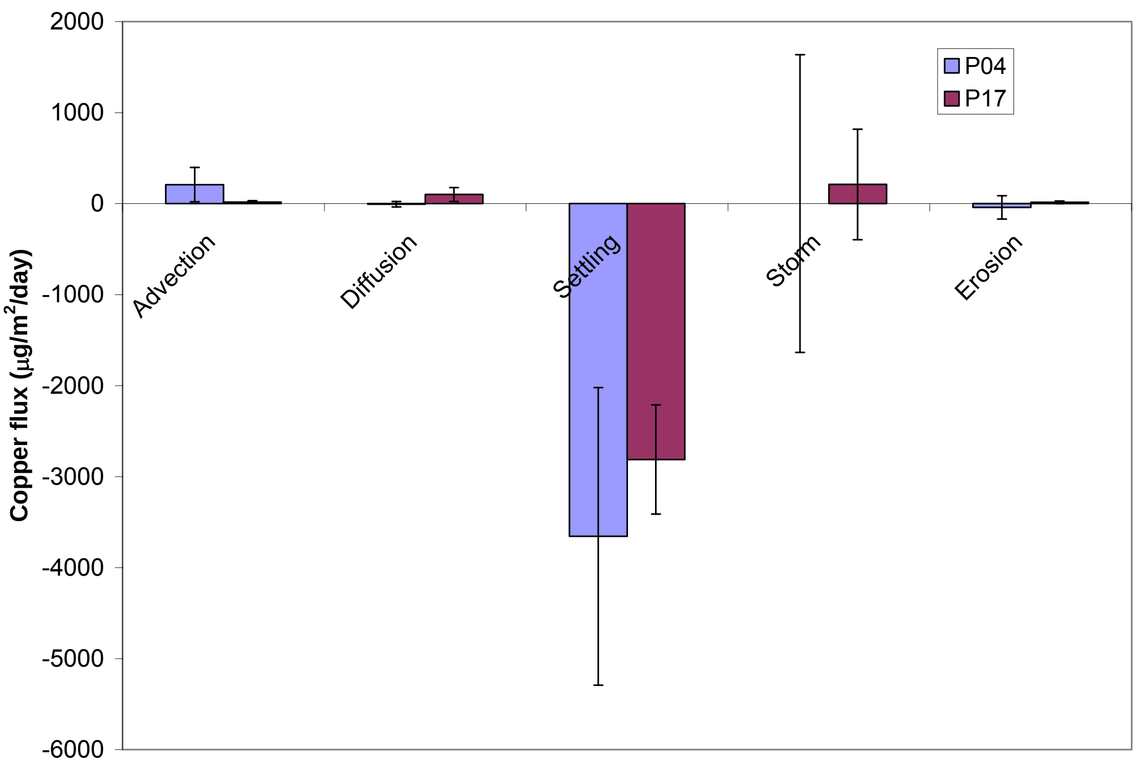


Figure 6-19. PRISM pathway fluxes for copper.

Cadmium

Pathway analysis for cadmium indicates that dissolved contaminant processes (advection and diffusion) are leading to a loss of Cd in the surface layer at both sites (Figure 6-20), although the variability is very high, especially for diffusion. Particle processes (sedimentation and erosion) are less consistent. The uncertainty in the differences between trap, storm and surface sediment concentrations lead to large error bars, but it appears that background sedimentation may be an ongoing removal mechanism of Cd at P04 and a source at P17. Storm-induced sedimentation causes an uncertain or negligible effect at P04 and a strong source at P17. Erosion, which seems to expose deeper sediments with higher Cd levels, seems to result in a slight flux of Cd into the surface layer at P04. At P17, on the other hand, slightly lower deeper sediments may result in a slight flux of Cd out of the surface sediments during erosion. Advection, diffusion and background settling fluxes all seem to result in a slight net flux of Cd out of P04 surface sediments, which is slightly offset by erosion, but variability and uncertainty are high. On the other hand, storm and background settling seem to result in a net increase of Cd, somewhat offset by advection, diffusion and erosion. However, given the uncertainty of estimates, the fluxes may be roughly balanced.

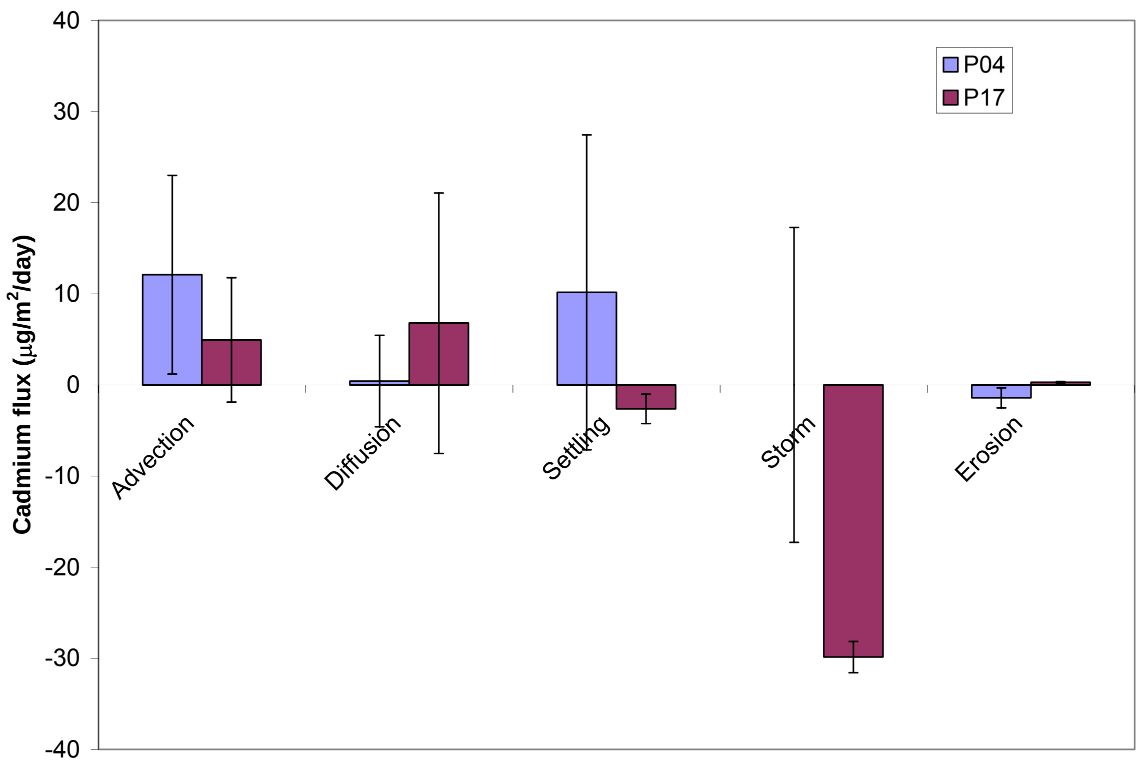


Figure 6-20. PRISM pathway fluxes for cadmium.

Lead

Pathway analysis for lead indicates that variations in surface layer concentrations at both sites are strongly dominated by background settling fluxes Because trap Pb concentrations are significantly higher than surface sediment concentration, background sedimentation provides a significant source of Pb to the surface layer, overwhelming fluxes by other processes. Dissolved contaminant processes (advection and diffusion) may be leading to a slight loss of lead in the surface layer at both sites (Figure 6-21), although the variability is very high. The other particle processes (storm sedimentation and erosion) are less definitive. The uncertainty in the differences between H-, storm and surface sediment concentrations lead to large error bars, but it appears that storm sedimentation may remain an ongoing source of Pb at P04 and P17. Advection, and diffusion fluxes indicate that P04 and P17 sediments may be losing lead by migration to the water column, but this is strongly offset by the sedimentation input fluxes. Within-site variability in the two areas indicates that some fluxes may vary from positive to negative based on within-site conditions. An examination of all fluxes suggests that Pb is experiencing a net gain as the sum of all processes, but variability and uncertainty are high for some processes.

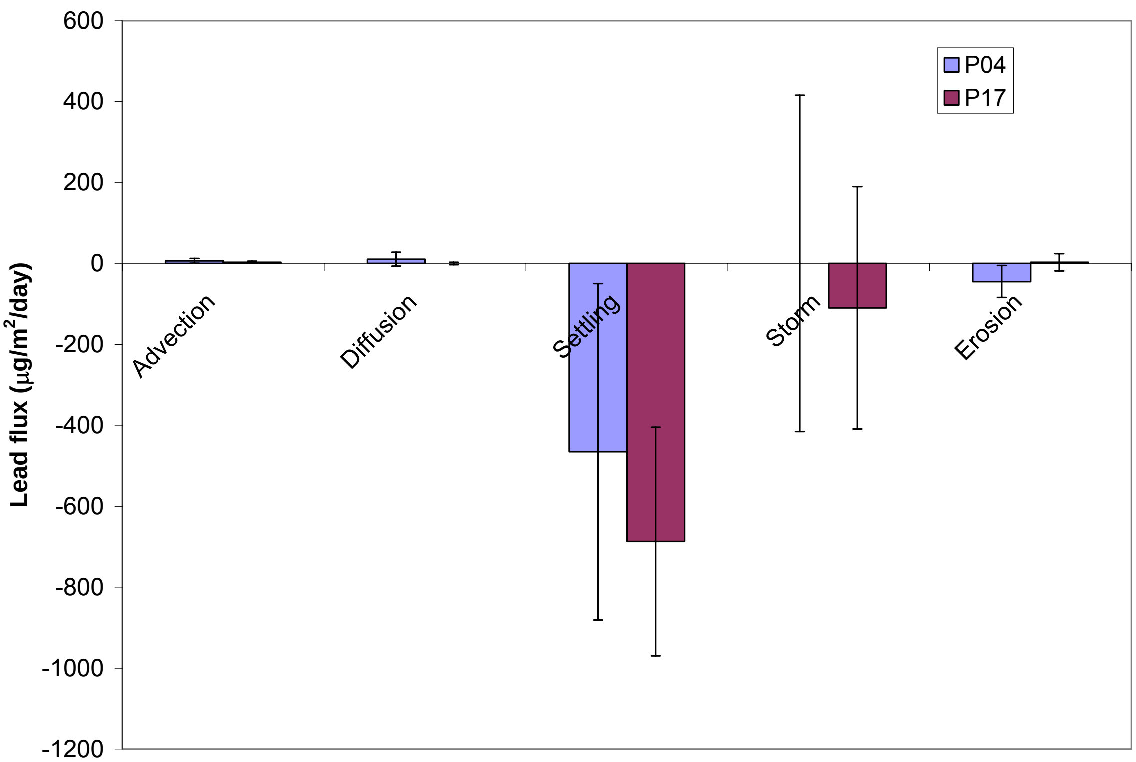


Figure 6-21. PRISM pathway fluxes for lead.

Nickel

Pathway analysis for nickel indicates that dissolved contaminant processes (advection and diffusion) may be leading to a loss of Ni in the surface layer at both sites (Figure 6-22) although the variability is very high, especially for diffusion at P04. Particle processes (sedimentation and erosion) are, however, ongoing sources of Ni to the sediment. The uncertainty in the differences between trap, storm and surface sediment concentrations lead to large error bars, but it appears that background sedimentation remains an ongoing source of Ni at P04 and P17. Storm-induced sedimentation causes an uncertain or negligible effect at P04, but is a strong source at P17. Erosion, which seems to expose deeper sediments with higher Ni levels at P04, seems to result in a slight flux of Ni into surface layer at P04, but causes a negligible or uncertain effect at P17. Advection, and diffusion fluxes out of the sediment appear to be overwhelmed by inputs from particle processes, indicating that P04 and P17 sediments may be experiencing a net increase of Ni. With the exception of storm-induced sedimentation, the magnitude of most fluxes are higher at P04 than they are at P17. Within-site variability in the two areas indicates that some fluxes may vary from positive to negative based on within-site conditions. An examination of all fluxes suggests that Ni may be experiencing a net gain as the sum of all processes, but variability and uncertainty are high.

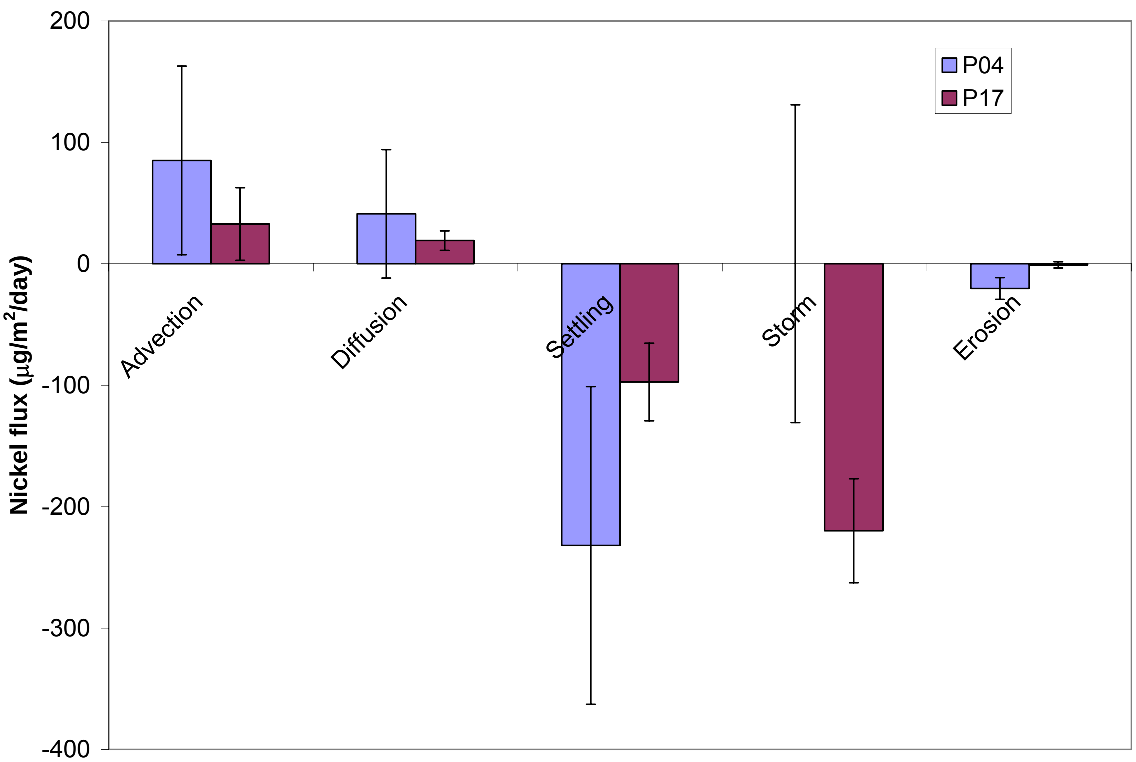


Figure 6-22. PRISM pathway fluxes for nickel.

Silver

Pathway analysis for silver indicates that dissolved contaminant processes (advection and diffusion) may be leading to a loss of Ag in the surface layer at both sites (Figure 6-23), although the variability is very high, especially for diffusion. Storm-induced sedimentation causes an uncertain or negligible effect at P04, but is a reasonable sink at P17. Other particle processes (background sedimentation and erosion) are, however, ongoing sources of Ag to the sediment. The uncertainty in the differences between trap, deep and surface sediment concentrations lead to large error bars, but it appears that background sedimentation remains an ongoing and strong source of Ag at P04 and P17. Erosion, which seems to expose deeper sediments with higher Ag levels at P04, seems to result in a slight flux of Ag into surface layer at P04, but causes a negligible or uncertain effect at P17. Advection, diffusion and storm sedimentation fluxes out of the sediment appear to be overwhelmed by inputs from background sedimentation at P04, indicating sediments may be experiencing a net increase of Ag at that site, but processes may be balanced at P17. With the exception of storm-induced sedimentation, the magnitude of most fluxes are higher at P04 than they are at P17. Within-site variability in the two areas indicates that some fluxes may vary from positive to negative based on within-site conditions.

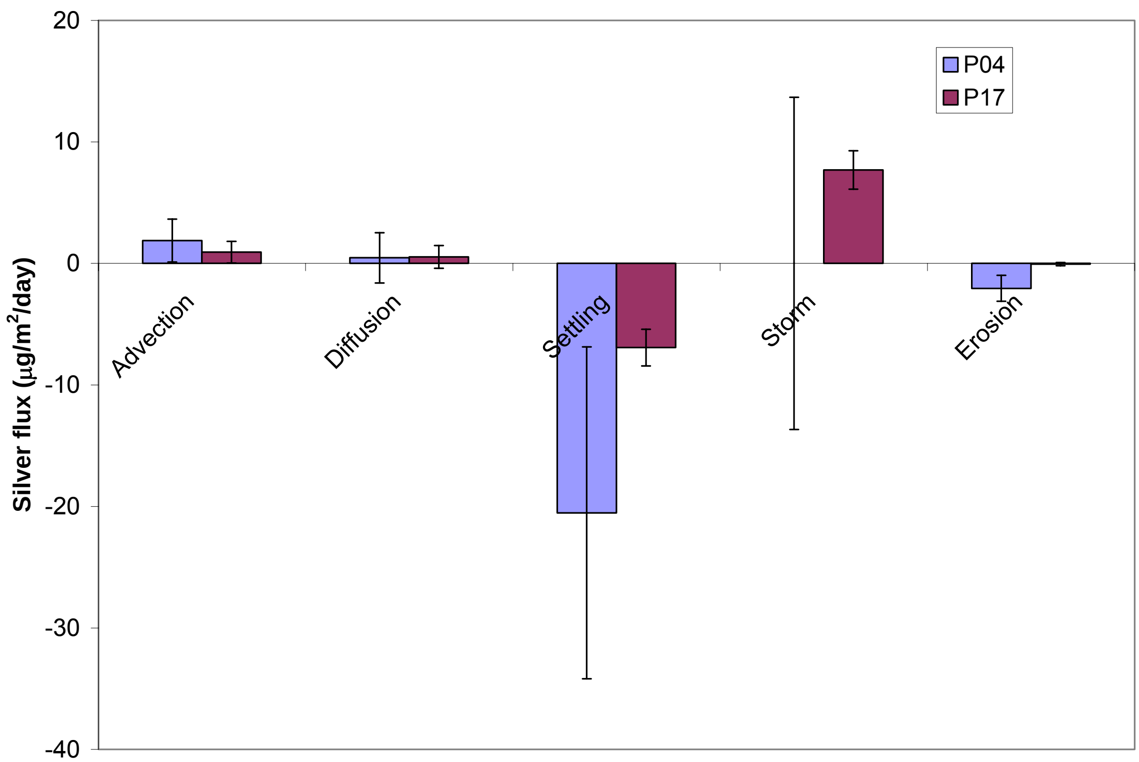


Figure 6-23. PRISM pathway fluxes for silver.

Zinc

Pathway analysis for zinc indicates that dissolved contaminant processes (advection and diffusion) may be leading to a loss of Zn in the surface layer at both sites (Figure 6-24), although the variability is very high, especially for diffusion at P04. Particle processes (sedimentation and erosion) are, however, ongoing sources of Zn to the sediment. The uncertainty in the differences between trap, storm and surface sediment concentrations lead to large error bars, but it appears that background sedimentation remains an ongoing source of Zn at P04 and, to a lesser extent, P17. Storm-induced sedimentation causes an uncertain or negligible effect at P04, but is a strong source at P17. Erosion, which seems to expose deeper sediments with higher Zn levels at P04, seems to result in a slight flux of Zn into surface layer at P04, but causes a negligible or uncertain effect at P17. Advection, and diffusion fluxes out of the sediment appear to be roughly balanced by inputs from particle processes, indicating that P04 and P17 sediments may be experiencing either a net increase or loss of Zn, depending upon site and time-varying conditions. The magnitude of advection, background settling and erosive fluxes are higher at P04, while the other fluxes are greater at P17. Within-site variability in the two areas indicates that some fluxes may vary from positive to negative based on within-site conditions.

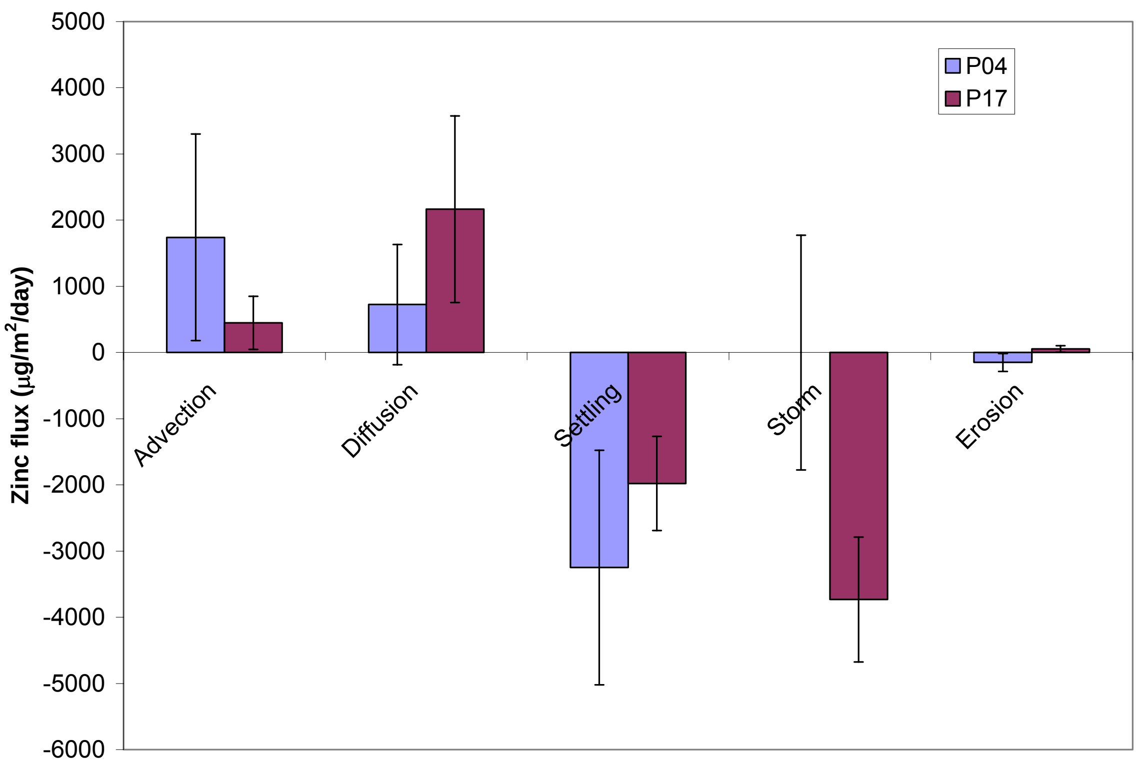


Figure 6-24. PRISM pathway fluxes for zinc.

6.9 PATHWAY ANALYSIS FOR PAHS

The PRISM pathway analysis for PAHs at Paleta Creek, San Diego Bay was carried out by comparing the raw flux rates associated with each pathway. The analysis provides a means of evaluating which pathways may be dominant for the given site where the measurements were conducted. The primary pathways that were evaluated for metals at each site included

- Diffusive Flux (combined molecular and bio)
- Advective Flux
- Sedimentation Flux (background and storm)
- Erosion Flux
- Biodegradation Flux (surface and depth-integrated)

Comparative fluxes for all PAHs are summarized in

Table 6-12. Convention for the fluxes in the pathway analysis is that a positive flux indicates a loss of contaminant from the surface layer, and a negative flux indicates a source of contaminant to the surface layer. Estimates of the variability for each PAH at each site are included. In general, the variability estimates were compiled from propagation formulas that account for variability in the individual parameters within each pathway flux equation. Results are presented below for the individual PAHs naphthalene, phenanthrene and fluoranthene, for which all processes were measured.

Table 6-12. Summary of PRISM pathway fluxes for measured PAHs at the P04 and P17 sites. All fluxes are in $\mu g/m^2/d$.

		Advection		Diffusion		Settling		Storm Settling		Erosion		Surface Layer Degradation		Depth-integrated (H) Degradation	
		Site Mean	Est. Var.	Site Mean	Est. Var.	Site Mean	Est. Var.	Site Mean	Est. Var.	Site Mean	Est. Var.	Site Mean	Est. Var.	Site Mean	Est. Var.
P04	Naphthalene	-0.04	0.04	-0.62	0.36	-0.47	0.04	0.00	0.00	0.00	0.00	0.00	0.00	45.58	101.91
	Acenaphthylene	0.15	0.14	-0.03	0.00	-0.96	1.55	0.00	0.00	0.09	0.09	0.37	0.15	6.44	3.01
	Acenaphthene	0.01	0.01	-0.01	0.02	-0.69	0.06	0.00	0.00	0.00	0.00	9.97	3.99	173.09	80.97
	Fluorene	0.01	0.01	0.10	0.15	-2.22	0.21	0.00	0.00	0.00	0.01	12.42	4.97	215.66	100.88
	Phenanthrene	-0.07	0.06	0.01	0.11	-15.74	0.61	0.00	0.00	0.00	0.03	27.51	11.00	477.60	223.42
	Anthracene	0.99	1.06	-0.43	0.20	-6.83	3.17	0.00	0.00	0.12	0.13	2.91	1.16	50.53	23.64
	Fluoranthene	0.12	0.12	-0.51	0.39	-28.38	1.79	0.00	0.00	0.01	0.06	17.80	7.26	487.16	611.24
	Pyrene	0.86	0.81	-0.19	0.01	-14.31	2.26	0.00	0.00	0.14	0.04	7.22	2.89	125.39	58.66
	Benzo(a)anthracene	0.04	0.04	0.00	0.00	-11.69	1.87	0.00	0.00	0.04	0.08	6.07	2.43	105.33	49.27
	Chrysene	0.25	0.25	-0.02	0.04	-16.62	3.30	0.00	0.00	0.17	0.18	4.90	1.96	85.14	39.83
	Benzo(b)fluoranthene	-0.30	0.28	0.05	0.06	-10.17	7.90	0.00	0.00	-0.20	0.37	1.66	0.67	28.88	13.51
	Benzo(k)fluoranthene	-0.16	0.15	0.04	0.05	-9.93	4.16	0.00	0.00	-0.15	0.30	1.66	0.68	28.88	16.27
	Benzo(e)pyrene	1.15	1.11	0.02	0.04	-7.02	5.59	0.00	0.00	0.25	0.27	2.00	0.79	34.79	13.50
	Benzo(a)pyrene	-1.15	1.06	0.00	0.00	-2.84	6.15	0.00	0.00	-0.24	0.33	0.64	0.26	11.17	5.23
	Perylene	0.31	0.31	0.00	0.00	-1.73	1.48	0.00	0.00	0.12	0.08	2.06	0.82	35.70	16.70
	Indeno(1,2,3-c,d)pyrene	-0.28	0.26	0.00	0.00	-6.72	3.48	0.00	0.00	-0.09	0.19	1.90	0.76	32.91	15.40
	Dibenz(a,h)anthracene	-0.15	0.14	0.00	0.00	-1.37	0.86	0.00	0.00	-0.03	0.05	1.48	0.59	25.75	12.05
	Benzo(g,h,i)perylene	-0.46	0.43	0.00	0.02	-4.40	3.03	0.00	0.00	-0.11	0.16	1.52	0.61	26.33	12.32
P17	Naphthalene	0.02	0.02	-0.33	0.47	-0.31	0.08	-2.39	0.05	0.00	0.00	0.63	0.91	17.99	35.85
	Acenaphthylene	0.05	0.04	-0.64	0.00	-1.47	0.38	0.82	0.21	0.02	0.02	0.37	0.36	7.96	19.23
	Acenaphthene	0.11	0.11	0.02	0.04	-1.71	0.41	-0.39	0.10	0.01	0.01	2.76	1.94	59.88	100.62
	Fluorene	0.03	0.00	0.06	0.34	-3.39	0.70	-0.54	0.07	0.01	0.01	1.86	1.43	40.46	74.96
	Phenanthrene	0.09	0.09	-0.05	0.06	-29.39	5.47	-3.27	0.50	0.07	0.04	2.78	2.05	60.40	106.94
	Anthracene	0.32	0.30	-0.25	0.15	-8.62	1.94	2.13	0.82	0.10	0.06	0.54	0.41	11.82	21.51
	Fluoranthene	1.39	1.36	-0.72	0.76	-40.68	14.88	8.44	9.05	0.77	0.66	0.77	0.39	15.99	27.40
	Pyrene	0.54	0.49	-0.67	0.61	-21.11	7.16	11.37	3.58	0.36	0.28	0.27	0.10	5.89	4.07
	Benzo(a)anthracene	0.47	0.43	-0.20	0.00	-11.73	6.84	5.40	4.72	0.39	0.34	0.34	0.18	7.32	9.06
	Chrysene	0.70	0.63	-0.08	0.06	-21.24	6.88	6.15	4.33	0.47	0.31	0.31	0.14	6.63	6.78
	Benzo(b)fluoranthene	0.70	0.64	-0.10	0.13	-13.22	5.13	9.31	2.92	0.26	0.23	0.12	0.03	2.58	0.52
	Benzo(k)fluoranthene	0.71	0.64	-0.02	0.06	-10.60	5.07	10.79	3.29	0.28	0.24	0.12	0.03	2.58	0.00
	Benzo(e)pyrene	0.49	0.44	-0.11	0.20	-8.50	3.20	6.55	1.75	0.19	0.13	0.10	0.02	2.13	0.00
	Benzo(a)pyrene	0.58	0.53	0.00	0.00	-6.50	4.64	8.43	3.16	0.23	0.23	0.06	0.01	1.26	0.00
	Perylene	0.17	0.16	0.00	0.00	-2.10	0.95	1.81	0.63	0.07	0.05	0.08	0.02	1.71	0.00
	Indeno(1,2,3-c,d)pyrene	0.30	0.27	0.04	0.00	-5.52	2.11	4.18	1.13	0.12	0.09	0.11	0.05	2.31	2.08
	Dibenz(a,h)anthracene	0.07	0.07	0.00	0.00	-1.31	0.56	1.15	0.30	0.03	0.02	0.10	0.03	2.21	1.29
	Benzo(g,h,i)perylene	0.29	0.26	-0.03	0.23	-4.78	1.70	2.66	0.72	0.11	0.06	0.09	0.02	1.95	0.30

Naphthalene

Pathway analysis for naphthalene was examined comparing the two biodegradation assumptions (depth-integrated and surface layer; Figure 6-25). Applying the depth-integrated degradation flux, the pathway analysis indicates that variations in surface layer concentrations at both sites are dominated by biodegradation fluxes. Relative to the depth-integrated biodegradation, surface mineralization, settling, advection, diffusion and erosion are all negligible at both sites. If only surface mineralization is considered, then the other processes become important as well. For P04, diffusion and background settling appear to be sources of naphthalene to the sediment, whilst advection, erosion, storm-induced settling and surface mineralization are negligible. For P17, diffusion may be a source and surface mineralization may be a sink to the sediments, although variability is high. Background settling appears to provide comparable naphthalene to the sediments as does diffusion, and variability is lower. Storm settling is a strong source of naphthalene to the sediment at P17, overwhelming all processes except depth-integrated mineralization.

Whether surface mineralization or depth-integrated mineralization is the more relevant process to apply to the sediments to determine mineralization flux is not clear. Most researchers have only found aerobic mineralization in the shallow surface layer in which oxygen penetrates. However, this study found evidence of instantaneous aerobic mineralization rates in some samples to a depth of several cm, especially in the more bioturbated P04 cores. Oxygen microprofiles also showed some cases of deeper oxygen penetration, especially around burrows. Recently work at the University of Copenhagen in which oxygen optodes were used to measure in situ oxygen penetration in surface sediments over hours to days has shown that apparently anaerobic sediments can be frequently aerated due to bioturbation (Glud et al., 2005). These processes may introduce biodegraders and oxygen deeper into the sediments, enhancing mineralization over time. Clearly, if these sediments are anoxic most of the time, it is unlikely that rapid degradation occurs continuously, but it is possible that microbial populations may be able to exploit pulsed changes due to redox oscillation. Most likely, degradation fluxes lie somewhere between these two estimates. However, the presence of active degraders in burrows and at the sediment surface may provide a strong protection against exposure risks - dissolved PAHs advecting or diffusion through the surface sediments may be rapidly attenuated. However, the high degradation fluxes may be indicative of degradation “potential” rather than the actual rate, given that if this rate persisted in the absence of any significant source, the naphthalene would be completely depleted in a very short time. This is consistent with the low concentrations generally observed in the mixed layer sediments at both sites.

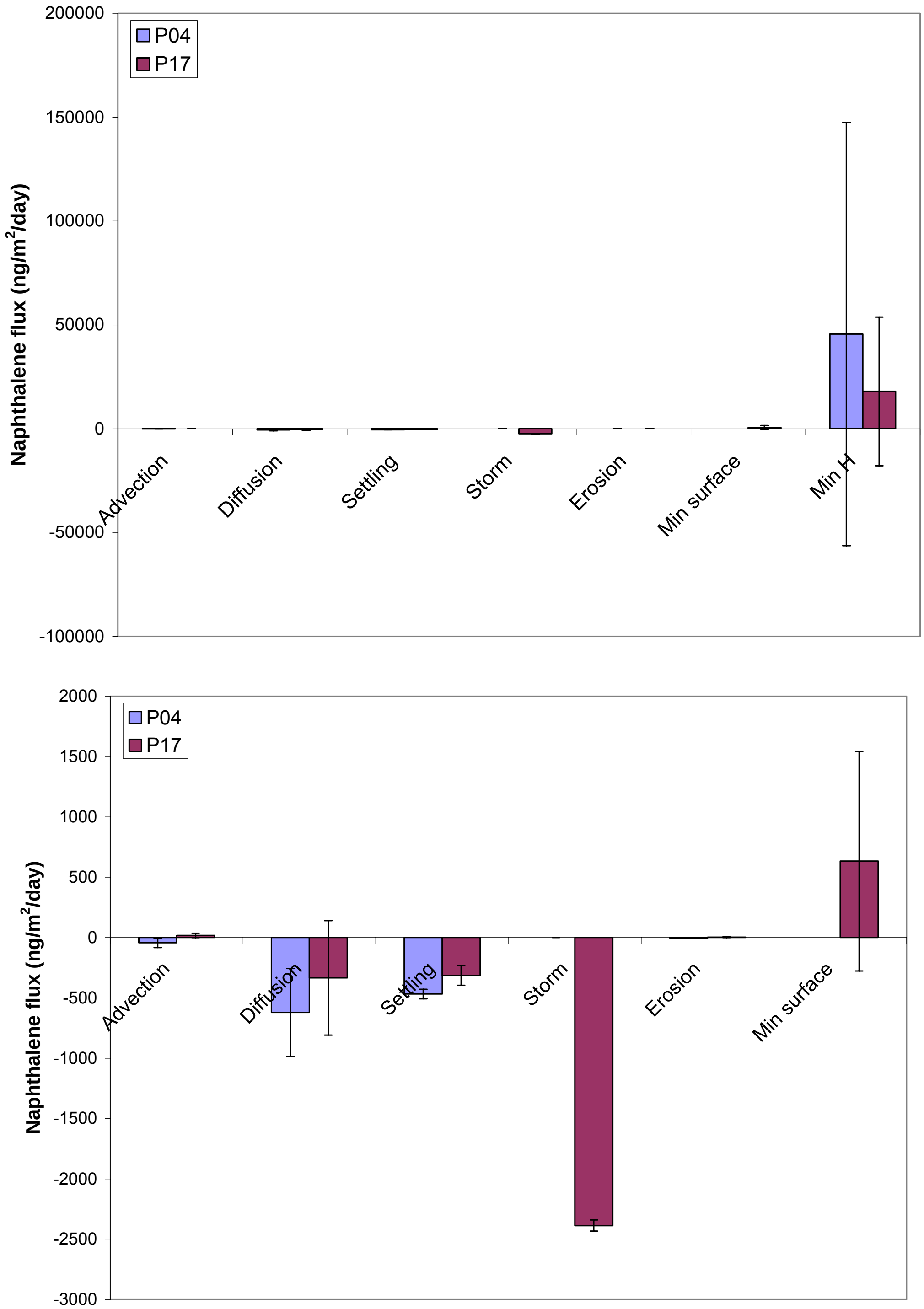


Figure 6-25. PRISM pathway fluxes for naphthalene including comparison for depth-integrated biodegradation (top) and without it (bottom).

Phenanthrene

Pathway analysis for phenanthrene was examined for the two biodegradation assumptions (depth-integrated and surface layer; Figure 6-26). Applying the depth-integrated degradation flux, the pathway analysis indicates that minor inputs by background settling are balanced by and degradation at the P17 site, and are dominated by biodegradation fluxes at the P04. Relative to the depth-integrated biodegradation and settling, advection, diffusion and erosion are all negligible at the sites. The magnitude of the depth-integrated degradation flux at the P04 site was about 5 times that at P17. Within-site variability in the two areas indicates that depth-integrated degradation fluxes are highly variable within the two sites.

Applying the surface layer degradation flux, the pathway analysis indicates that at P04, inputs by background settling are either offset or overwhelmed by surface mineralization, with other processes being negligible. At P17, inputs from background settling are several times higher than outputs by surface mineralization, which are roughly equivalent to inputs by storm settling. All other processes are negligible compared to these processes.

Whether surface mineralization or depth-integrated mineralization is the more relevant process to apply to the sediments to determine mineralization flux is not clear. Most researchers have only found aerobic mineralization in the shallow surface layer in which oxygen penetrates. However, this study found evidence of instantaneous aerobic mineralization rates in some samples to a depth of several cm, especially in the more bioturbated P04 cores. Oxygen microprofiles also showed some cases of deeper oxygen penetration, especially around burrows. Recently work at the University of Copenhagen in which oxygen optodes were used to measure in situ oxygen penetration in surface sediments over hours to days has shown that apparently anaerobic sediments can be frequently aerated due to bioturbation (Glud et al., 2005). These processes may introduce biodegraders and oxygen deeper into the sediments, enhancing mineralization over time. Clearly, if these sediments are anoxic most of the time, it is unlikely that rapid degradation occurs continuously, but it is possible that microbial populations may be able to exploit pulsed changes due to redox oscillation. Most likely, degradation fluxes lie somewhere between these two estimates. However, the presence of active degraders in burrows and at the sediment surface may provide a strong protection against exposure risks - dissolved PAHs advecting or diffusion through the surface sediments may be rapidly attenuated. However, the high degradation fluxes may be indicative of degradation “potential” rather than the actual rate, given that if this rate persisted in the absence of any significant source, the naphthalene would be completely depleted in a very short time. This is consistent with the low concentrations generally observed in the mixed layer sediments at both sites.

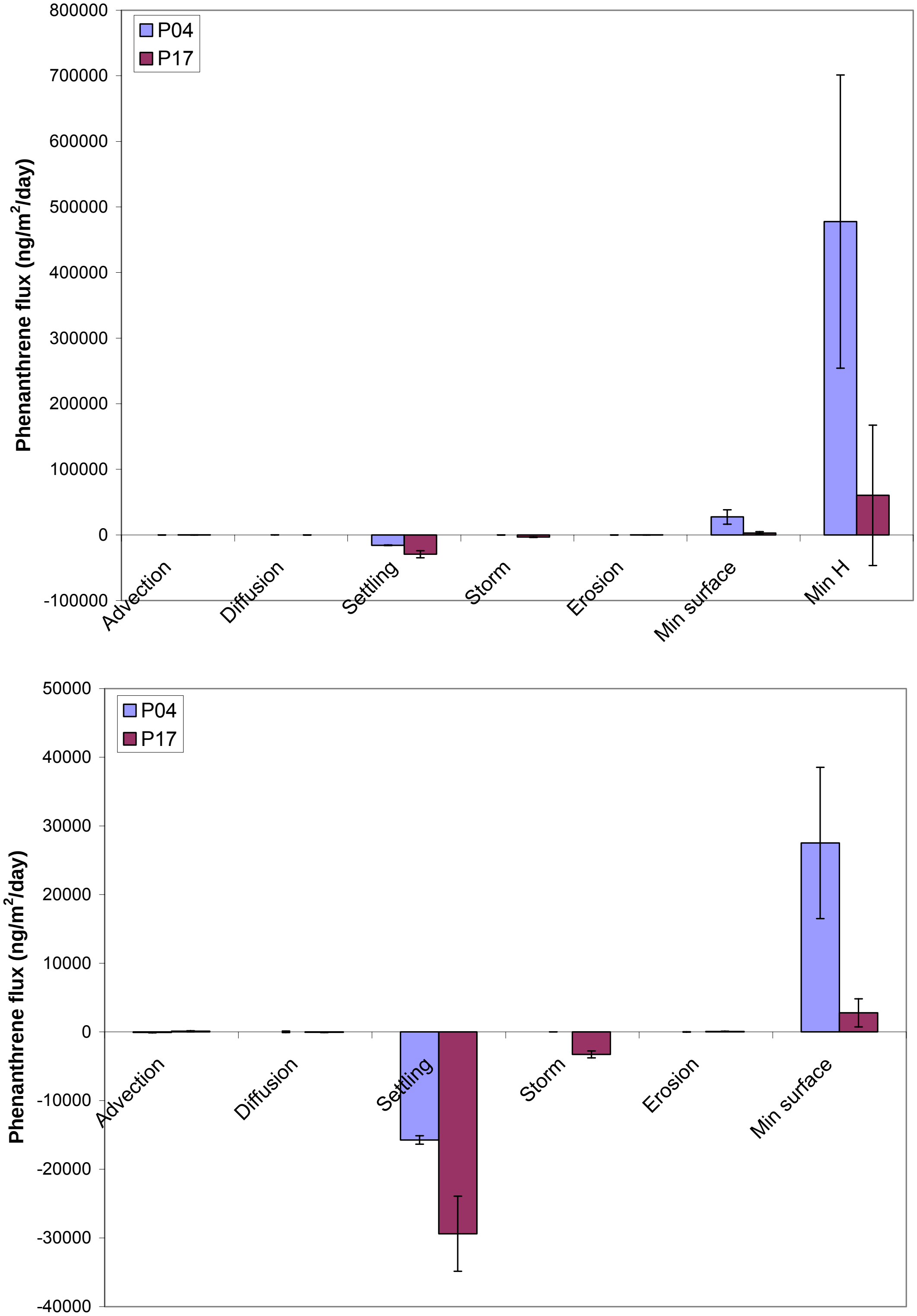


Figure 6-26. PRISM pathway fluxes for phenanthrene including comparison for depth-integrated biodegradation (top) and without it (bottom).

Fluoranthene

Pathway analysis for fluoranthene was examined for the two biodegradation assumptions (depth-integrated and surface layer; Figure 6-27). Applying the depth-integrated degradation flux, the pathway analysis indicates that minor inputs by background settling are balanced by losses from storm sedimentation and degradation at the P17 site, and are dominated by biodegradation fluxes at the P04. Relative to the depth-integrated biodegradation and settling, advection, diffusion and erosion are all negligible at the sites. The magnitude of the depth-integrated degradation flux at the P04 site was about 10 times that at P17. Within-site variability in the two areas indicates that depth-integrated degradation fluxes are highly variable within the two sites.

Applying the surface layer degradation flux, the pathway analysis indicates that at P04, inputs by background settling are almost offset by surface mineralization, with other processes being negligible. At P17, minor inputs from diffusion and significant background settling are somewhat higher than minor outputs by outputs by advection, erosion and surface mineralization, and moderate, but highly variable, outputs by storm settling. Both depth-integrated and surface mineralization are significantly higher at P04 than at P17.

Whether surface mineralization or depth-integrated mineralization is the more relevant process to apply to the sediments to determine mineralization flux is not clear. Most researchers have only found aerobic mineralization in the shallow surface layer in which oxygen penetrates. However, this study found evidence of instantaneous aerobic mineralization rates in some samples to a depth of several cm, especially in the more bioturbated P04 cores. Oxygen microprofiles also showed some cases of deeper oxygen penetration, especially around burrows. Recently work at the University of Copenhagen in which oxygen optodes were used to measure in situ oxygen penetration in surface sediments over hours to days has shown that apparently anaerobic sediments can be frequently aerated due to bioturbation (Glud et al., 2005). These processes may introduce biodegraders and oxygen deeper into the sediments, enhancing mineralization over time. Clearly, if these sediments are anoxic most of the time, it is unlikely that rapid degradation occurs continuously, but it is possible that microbial populations may be able to exploit pulsed changes due to redox oscillation. Most likely, degradation fluxes lie somewhere between these two estimates. However, the presence of active degraders in burrows and at the sediment surface may provide a strong protection against exposure risks - dissolved PAHs advecting or diffusion through the surface sediments may be rapidly attenuated. However, the high degradation fluxes may be indicative of degradation “potential” rather than the actual rate, given that if this rate persisted in the absence of any significant source, the naphthalene would be completely depleted in a very short time. This is consistent with the low concentrations generally observed in the mixed layer sediments at both sites.

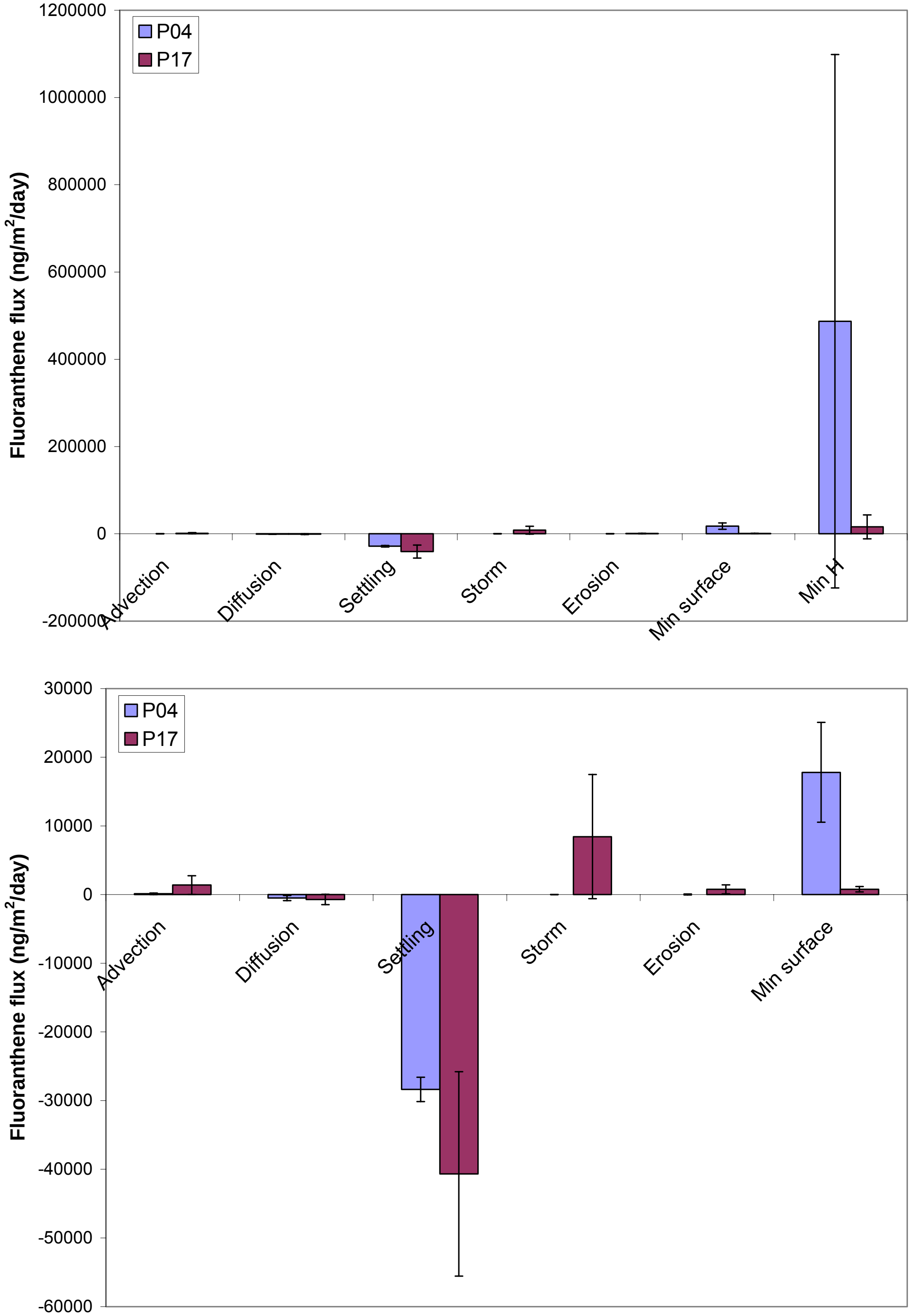


Figure 6-27. PRISM pathway fluxes for fluoranthene including comparison for depth-integrated biodegradation (top) and without it (bottom).

Other PAHs

Examination of flux pathways for all PAHs, shows a similar story to the three described above in detail (Figure 6-28 - Figure 6-31). If only surface mineralization is considered, then for P04, inputs from background settling may be offset by surface mineralization, with other processes being of only minor importance. However, the relative importance of these processes is dependent upon the molecular weight, volatility and degradability of the PAH congener and the relative PAH signatures of various "pools" of sediment. If depth-integrated mineralization is considered, all other processes become trivial. The most likely degradation flux is somewhere between these two estimates. The fact that some PAHs are preserved in sediments suggests that the maximum values are probably too high, but the significant shifts in PAH signatures between traps and surface sediments suggests that at least at the surface, very high fluxes are possible, probably reducing the risk of PAHs brought to the sediment surface by diffusion, advection, erosion or bioturbation.

At P17, for the mid-range PAHs, even if depth-integrated mineralization is considered, inputs by background settling and outputs from storm settling are significant, and greater than mineralization for some PAHs. Still, outputs from depth-integrated mineralization and storm settling may offset inputs from background settling. Variability is high for most processes, so whether surface sediments lose or accrue PAHs may differ greatly over space and time.

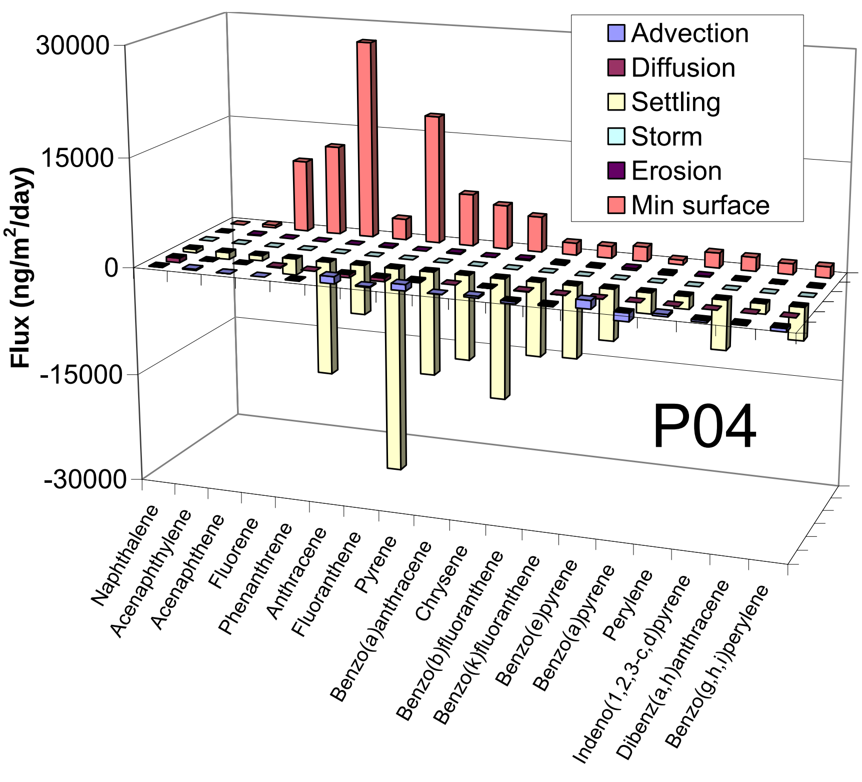


Figure 6-28. Flux of PAHs by all pathways at P04, with only surface mineralization illustrated.

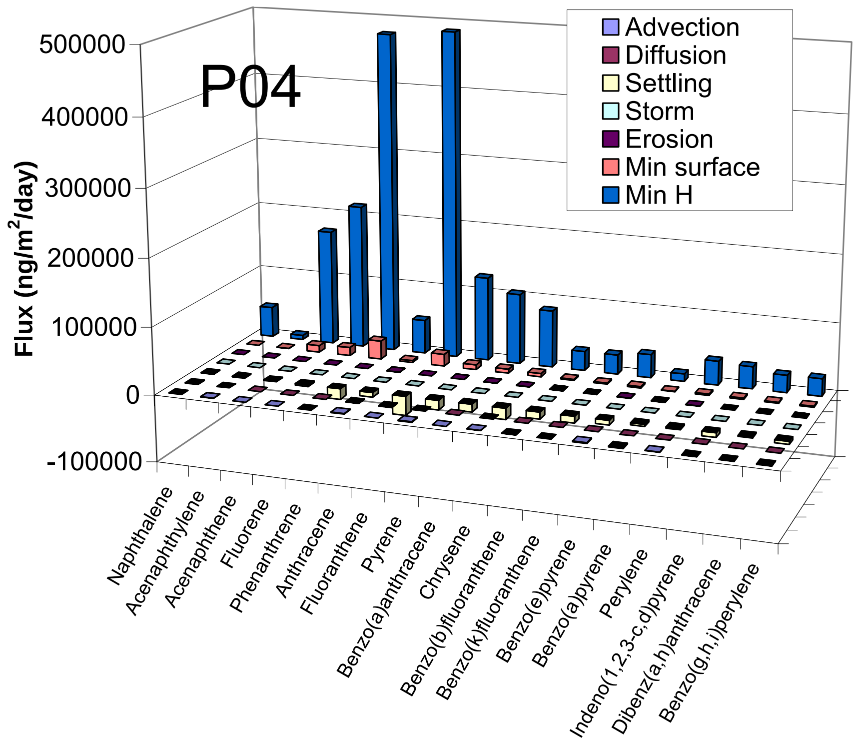


Figure 6-29. Flux of PAHs by all pathways at P04, with surface and depth-integrated mineralization illustrated.

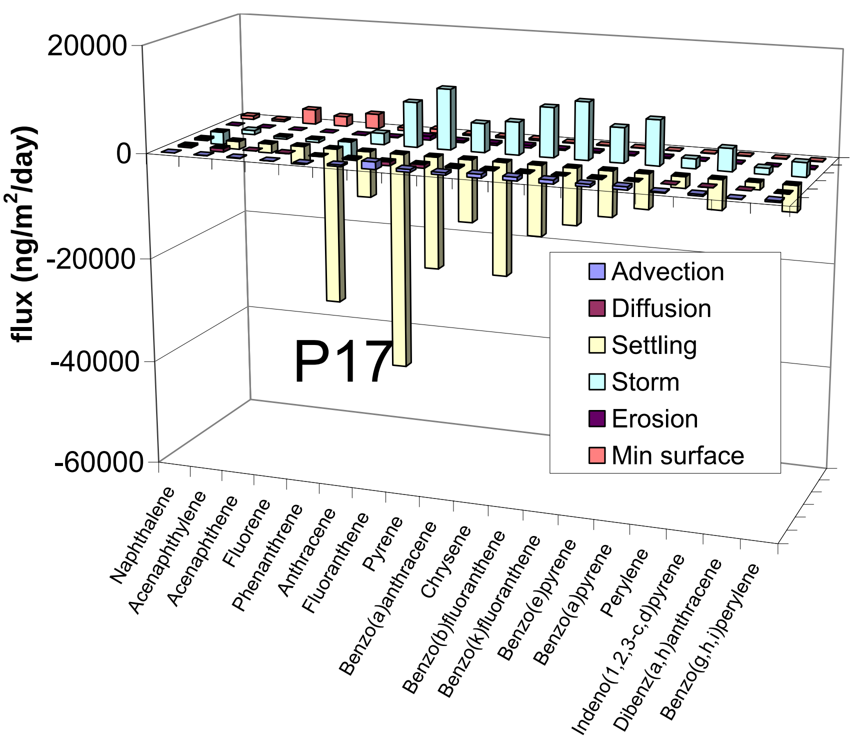


Figure 6-30. Flux of PAHs by all pathways at P17, with only surface mineralization illustrated.

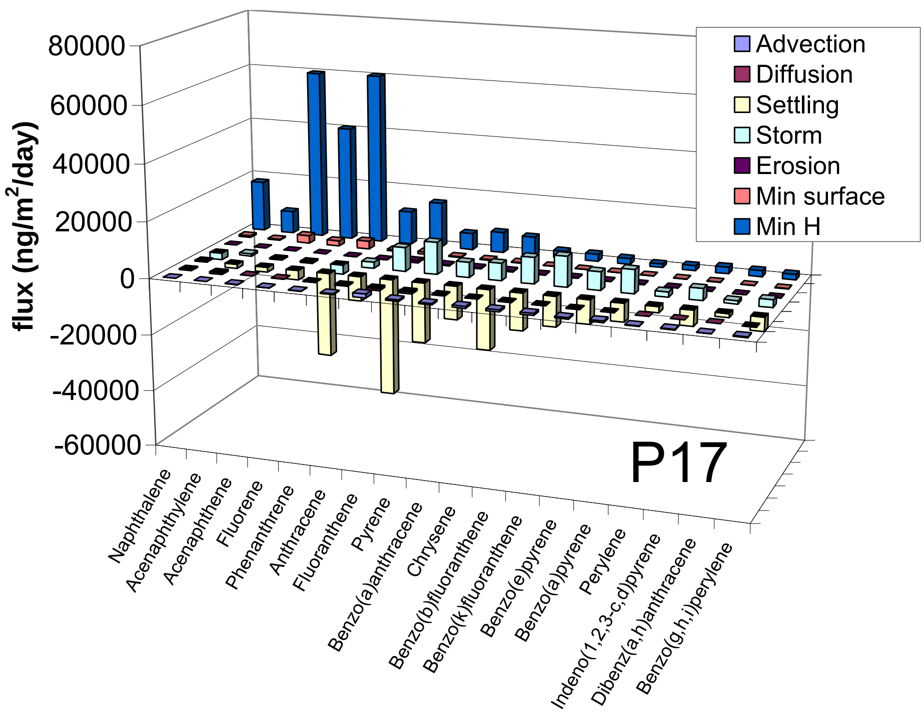


Figure 6-31. Flux of PAHs by all pathways at P17, with surface and depth-integrated mineralization illustrated.

6.10 PATHWAY INTERPRETATION

As shown above, for a given site it is possible to compare the PRSIM pathways directly as flux rates. However, these comparisons lack the context of environmental relevance since a relatively large flux for a given pathway relative to other pathways does not imply that the pathway is important from the standpoint of risk or remedy selection. Some additional insight can be gained into this relevance by normalizing the terms to a scale that is relevant to risk reduction or recovery for the site. The risk/recovery level could be based on any number of criteria including water quality standards, sediment quality standards, or site specific cleanup levels (for either sediment or porewater). An equivalent time scale can also be adopted for the site based on a target recovery times or exposure durations. For example, a desired recovery rate (with the same dimension as our fluxes) can be defined as

$$R_R = \frac{\Delta m}{\Delta t} = \frac{(c - c_C)H}{t_R}$$

where c is the current concentration in the sediment, c_C is the target level for cleanup or risk reduction and t_R is the target recovery time scale. Normalizing all flux terms to R_R results in a set of indices that reflect the relative contribution of various transport processes to site recovery or risk.

$$I_{DC} = \frac{F_{DC}}{R_R} \quad diffusion\ \ index$$

$$I_{DS} = \frac{F_{DB}}{R_R} \quad bioirrigation\ \ index$$

$$I_A = \frac{w(c_0 - c_H)}{R_R} \quad advection\ \ index$$

$$I_B = \frac{R_B H}{R_R} \quad biodegradation\ \ index$$

$$I_E = \frac{K_E(\tau - \tau_c)c_B}{R_R} \quad erosion\ \ index$$

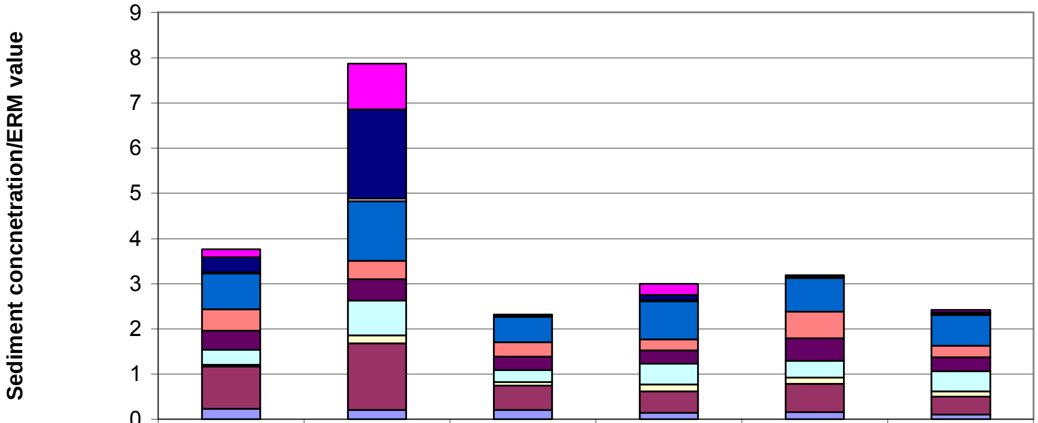
$$I_S = \frac{S(c_B - c_S)}{R_R} \quad sedimnation\ \ index$$

These indices then provide one non-dimensional yardstick for pathway ranking of important processes that can influence the fate and exposure of in-place sediment contamination. The interpretation of these indices would be that the larger indices are the more dominant pathways, and that pathways with I O(1) or greater could represent an important process for recovery (or exposure).

Of course, there are substantial uncertainties in predicting long-term (years to decades) contaminant behavior based upon short-term (minutes to months) measurements. Furthermore, there are clear problems in examining or predicting changes over time from equations developed assuming steady state. For example, there is no doubt that PAH degradation rates vary substantially as concentration, nutrient level, temperature, and other factors vary. Thus, a measurement of instantaneous mineralization rates, while predictive of recovery times if all things remained constant, will not actually predict how long actual recovery of sediments would take by biodegradation or how far that process will go. Similarly, advective rates measured are a function of the sediment and hydrodynamic conditions at the current time, and changes in groundwater flow, tides, etc., will change the advective rates and thus the fluxes. Parallel arguments can be made for all of the processes being discussed, since all measurements being made are short-term measurements (e.g., the SPI measurements are instantaneous snapshots, seep and BFSD are measured for ~72 hours, flume measurements for a few hours at the most). It should be pointed out that these indices are only one way in which results can be applied to site management. Either all or a portion of the results can be used to refine Conceptual Site Models (CSMs), and specific data can be inserted into other models used to predict contaminant fate in terms of either risk or recovery.

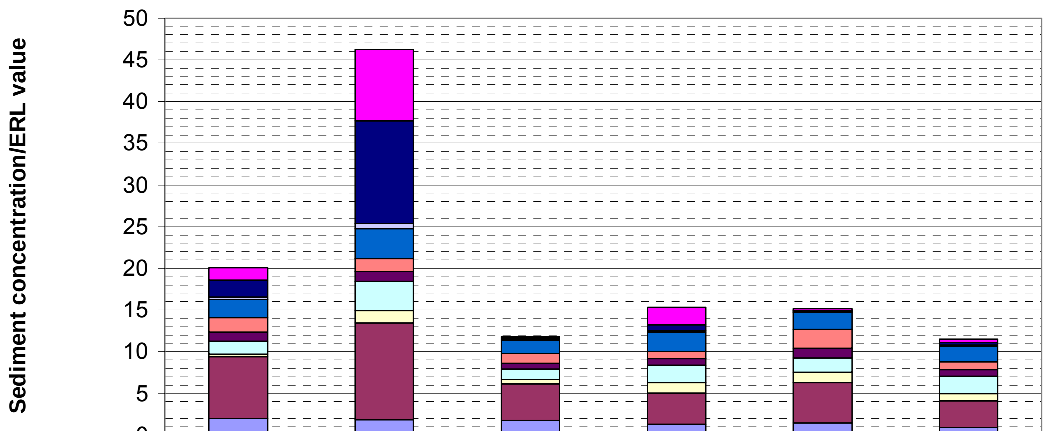
Recovery Indices

As an example application for the PRISM pathway fluxes, recovery indices were calculated for each of the pathways. The normalizing recovery rate was estimated using the measured concentration in the mixed layer for c, the ERL for that chemical for c_c, and a recovery time of ten years for t_R. Note that these are just examples, and that site-specific PRGs or other thresholds could be used in place of ERLs, and that the time scale of ten years could be varied depending on management goals. Figure 6-32 and Figure 6-33 shows the stacked ERM and ERL hazard quotients (ERM HQs and ERL HQs) for bulk surface (H), deep (H-) and trap sediments. Note that no ERM is available for Mn, so it is not listed in figures. ERM (or ERL) HQs are calculated by dividing the mean sediment COPC concentration by the ERM (or ERL). If the ERM HQ is greater than one, the ERM is exceeded. These values help put sediment values in perspective, b y demonstrating which contaminants may “drive” risk or management at a site, for surface, deep and settling sediments. Indices were only calculated for those chemicals for which the mixed layer concentration exceeded the ERL, as no CoCs exceeded ERM. For P04 these included Zn, Ag, Pb, Cu and As, and for P17, this included fluoranthene, Zn, Pb, Cd, Cu and As .



	P04 Trap	P17 Trap	P04 H	P17 H	P04 H-	P17 H-
Fluoranthene	0.18	1.01	0.02	0.25	0.02	0.05
Phenanthrene	0.33	1.97	0.03	0.11	0.03	0.05
Naphthalene	0.03	0.07	0.01	0.02	0.01	0.02
Zinc	0.79	1.31	0.56	0.85	0.74	0.68
Silver	0.48	0.41	0.32	0.23	0.59	0.25
Nickel	0.42	0.47	0.30	0.29	0.49	0.32
Lead	0.33	0.76	0.27	0.46	0.37	0.44
Cadmium	0.04	0.18	0.07	0.15	0.15	0.11
Copper	0.93	1.47	0.54	0.48	0.62	0.41
Arsenic	0.23	0.22	0.21	0.15	0.17	0.10

Figure 6-32. Stacked ERM HQ values for P04 and P17 surface, deep and trap sediments.



	P04 Trap	P17 Trap	P04 H	P17 H	P04 H-	P17 H-
Fluoranthene	1.54	8.54	0.18	2.09	0.17	0.45
Phenanthrene	2.05	12.33	0.17	0.67	0.16	0.29
Naphthalene	0.30	0.64	0.11	0.21	0.13	0.15
Zinc	2.15	3.59	1.53	2.33	2.03	1.85
Silver	1.76	1.53	1.17	0.87	2.20	0.94
Nickel	1.05	1.17	0.73	0.72	1.22	0.78
Lead	1.54	3.56	1.25	2.16	1.73	2.07
Cadmium	0.35	1.41	0.59	1.20	1.18	0.87
Copper	7.39	11.65	4.30	3.77	4.91	3.25
Arsenic	1.98	1.84	1.78	1.27	1.41	0.86

Figure 6-33. ERL HQ values for P04 and P17 surface, deep and trap sediments.

Based on this analysis, we found that background settling appears to be a significant barrier to recovery at Paleta Creek for several of the contaminants (Figure 6-34 - Figure 6-40). For Cu and Pb, continuing contamination significantly offsets any potential recovery from other processes. For arsenic, on the other hand, slow recovery by advection, diffusion, and, to a lesser extent, erosion, may offset the continuing inputs by background settling. For cadmium, ongoing inputs from advection, background settling and, to a lesser extent, diffusion, significantly offset the small erosion recovery index. Similarly, particle process inputs also offset minor diffusive and advective recovery. Even for fluoranthene, the potentially significant recovery by storm settling, erosion and depth-integrated mineralization is offset by background settling inputs. However, if we assume aerobic biodegradation of fluoranthene is only active in the surface layer, then the ongoing source from settling at P17 would overwhelm any recovery process. Clearly, recovery at this site is not possible until sources are better controlled, as background and storm settling are offsetting all recovery processes. This should, however, be put in some perspective - no CoC levels were above ERM, and the highest ERL HQ is 4.3 for Cu at P04. Still, these observations have important implications for any management strategy.

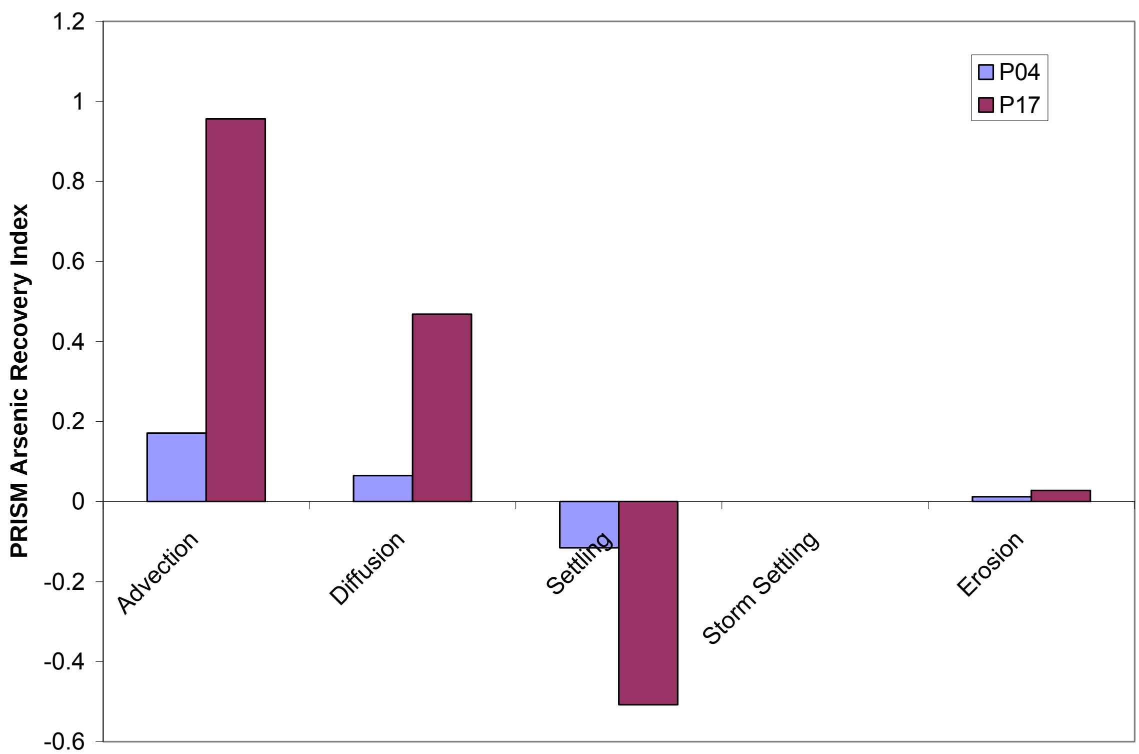


Figure 6-34. Recovery rate normalized pathway index for arsenic at P04 and P17.

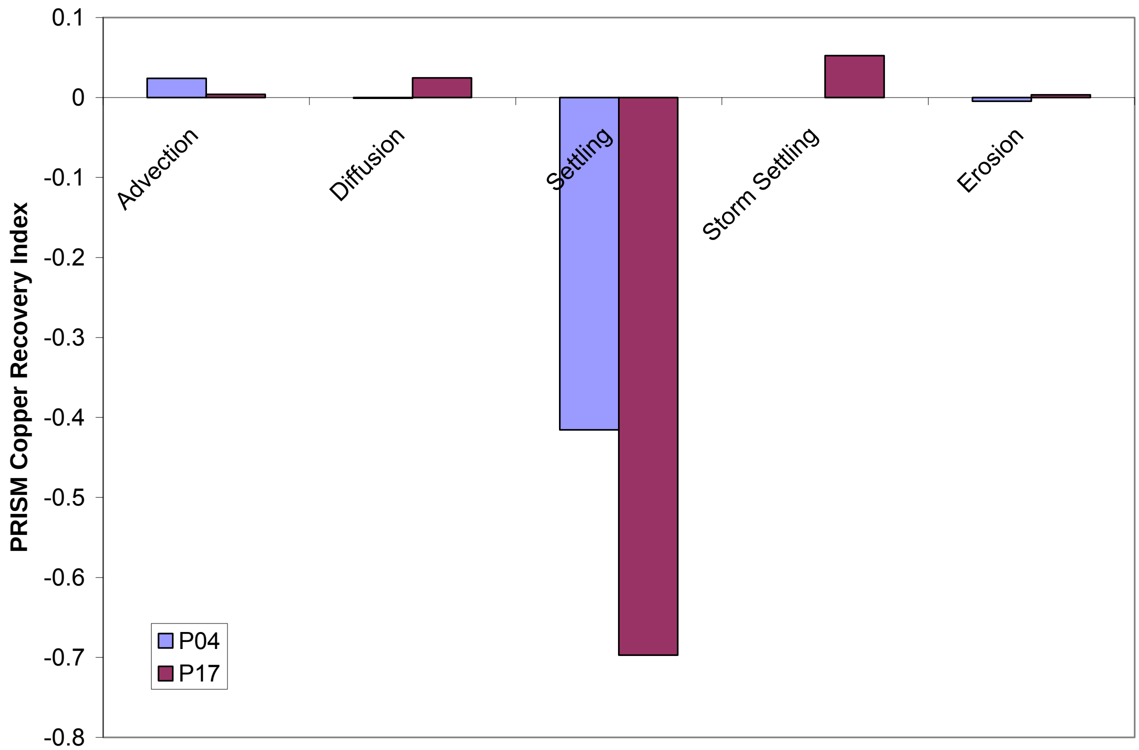


Figure 6-35. Recovery rate normalized pathway index for copper at P04 and P17.

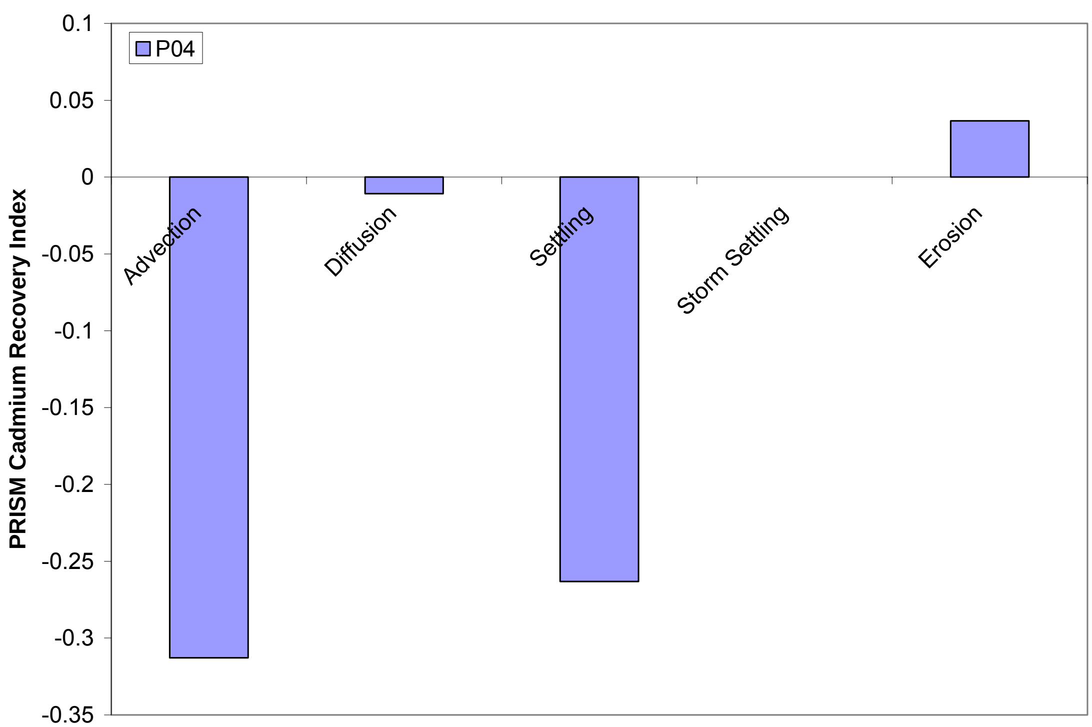


Figure 6-36. Recovery rate normalized pathway index for cadmium at P04.

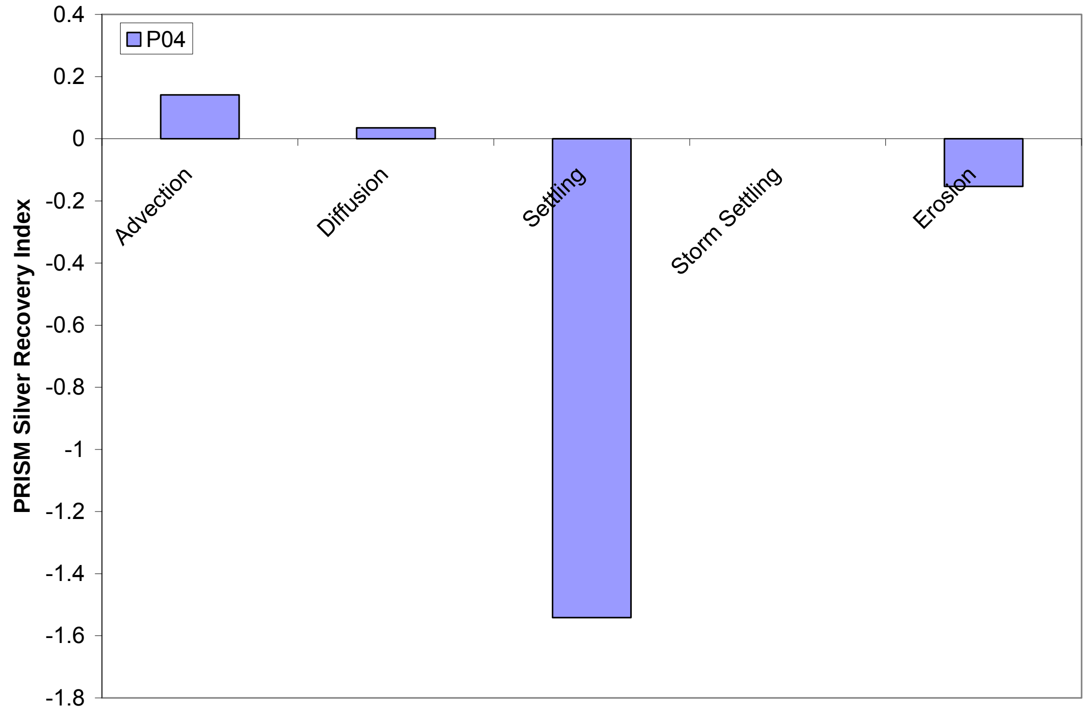


Figure 6-37. Recovery rate normalized pathway index for silver at P04.

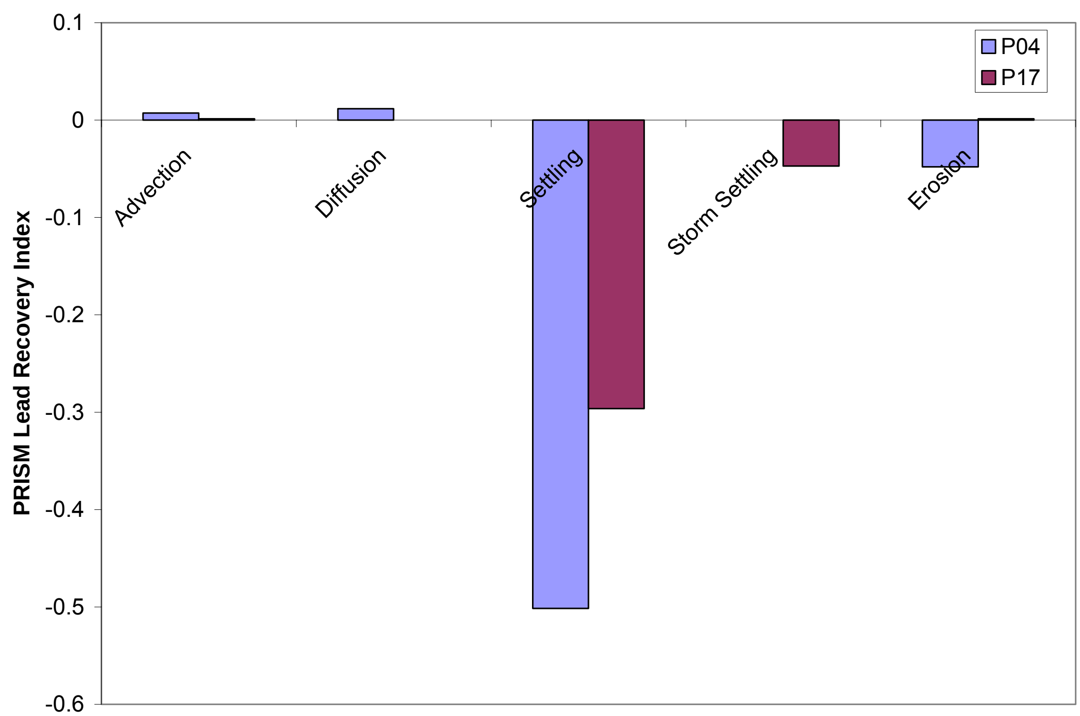


Figure 6-38. Recovery rate normalized pathway index for lead at P04 and P17.

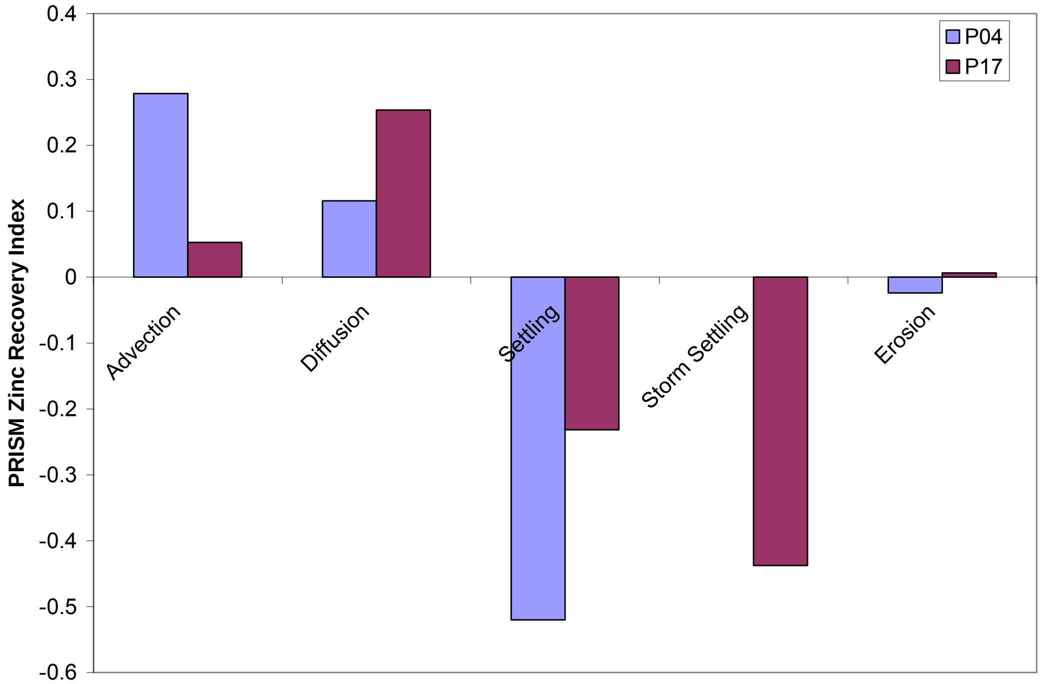


Figure 6-39. Recovery rate normalized pathway index for zinc at P04 and P17.

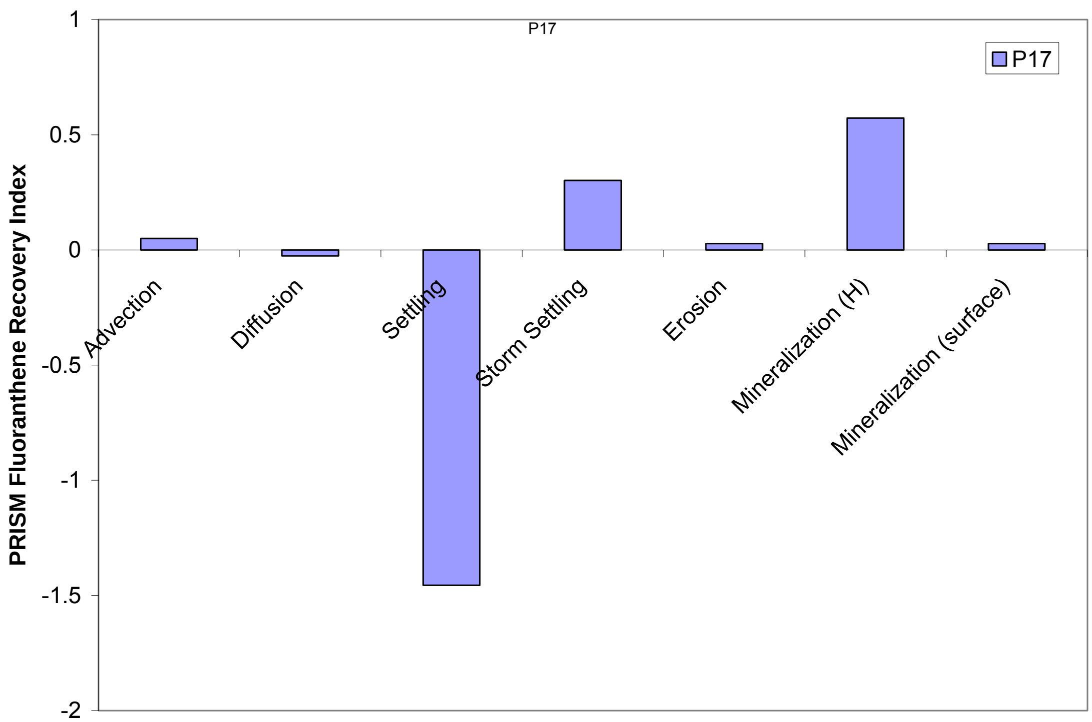


Figure 6-40. Recovery rate normalized pathway index for fluoranthene at P17.

7 Summary and Recommendations

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The objective of this program was to provide an understanding of the relative importance of critical contaminant transport pathways for near-shore in-place sediments in the risk, fate and management of contaminated sediments via: 1) An integrated suite of measurement techniques to characterize and quantify important transport pathways for in-place sediments, 2) A corresponding set of indices that quantify the transport phenomenon on a common dimensional scale and 3) Field scale evaluation of the effectiveness of the measurement tools and the importance of quantified transport pathways.

The program was successful in fielding the measurement suite, and quantifying a range of process-based transport pathways including:

- Diffusive Fluxes (combined molecular and bio)
- Advective Fluxes
- Sedimentation Fluxes (background and storm)
- Erosion Fluxes
- Biodegradation Fluxes

The maturity and reliability of the individual field tools was assessed. Technology maturity generally ranged from commercial-off-the-shelf (current meters, particle sizing, SPI) to published (flumes). Methodologies generally ranged from published (seepage meters, microprofilers) to certified (BFSD) to standard (porewater chemistry). Although some failures were encountered, most of the technologies were found to operate reliably for the application to PRISM pathways. An exception was the bio-inhibited BFSD measurements, which were unsuccessful due to difficulties in gauging the oxygen uptake rate.

The PRISM pathway analysis for metals in Paleta Creek was carried out by comparing the raw flux rates associated with each pathway. The analysis provides a means of evaluating which pathways may be dominant for the given site where the measurements were conducted. For PAHs, at P04, pathway ranking indicates a balance between settling and degradation. Advection, diffusion and erosion pathways are not significant for most PAHs. At P17, pathway ranking indicates site P17 is dominated by background settling, with some attenuation from storm inputs and degradation. Advection, diffusion and erosion pathways are not significant for most PAHs. For metals at Station P04, pathway ranking indicates site P04 has high background settling for some metals (Cu, Pb, Zn). Some metals show significant advection and diffusion, but the erosion pathway is generally not significant for most metals. For metals, pathway ranking indicates P17 has lower background settling than P04 and higher advection and diffusion. Storm settling is important for some metals. The erosion pathway is generally not significant for most metals. On a contaminant-specific level, these patterns can provide insight into management approaches, and also into those parameters that might warrant further investigation. For example, at P04, arsenic and zinc show significant fluxes out of the sediment by advection and diffusion. Whilst there is continuing input by settling, this may be significantly attenuated by fluxes out. Fluxes of arsenic and zinc should be evaluated both in terms of recovery and risk, as the rate of fluxes may result in recovery over time, but advecting and diffusion dissolved metals may pose an exposure risk under some conditions. Source control in the bay should be evaluated to reduce inputs by settling over time. These conclusions are sensitive to data on trap particle and COPC input, and seep and diffusion are subject to considerable variability, so any further investigation should focus on reducing uncertainty of these parameters.

At site P17, copper and lead have measurable fluxes by all pathways, but loss by advection, diffusion, and erosion are minimal. These metals have significant inputs from background and/or storm settling. Thus, these metals are source dominated, and recovery is unlikely until sources (in-bay and upstream) are controlled. These conclusions are sensitive to data on trap and stormwater particle and COPC input, so further investigation should focus on reducing uncertainty of these parameters..

At sites P04 and P17, inputs by background settling are significant for fluoranthene at both sites. There is minor loss by advection, diffusion and erosion. P17 storm inputs reduce concentrations in the surface layer. Mineralization of fluoranthene is significant at P04, and may be significant at P17. Thus, there is strong evidence of fluoranthene attenuation at P04. This strong degradation potential will attenuate risk of mobile PAHs, reduce loads and may result in deep degradation during natural and anthropogenic disturbances. These conclusions are sensitive to spatial and temporal scales of mineralization rate application. However, data applied in various ways should bound both risk and recovery models.

When contaminant mobility pathways are compared to the total settling load (generally background and storm settling), calculations indicate that advection and diffusion may balance sources for As and to a lesser degree for Cd, Ni and Zn, but other contaminants appear to be subject to net inputs. Even though fluxes are higher at P17 than they are at P04, they are not significantly higher relative to the site settling load.

These pathway flux estimates can provide insight into important management approaches (e.g., source control, capping, recovery). Results can help focus further site studies to most important or uncertain parameters. Flux rates can be utilized in models for predicting exposure risks or recovery rates.

Recommendations for further work at Paleta Creek based upon PRISM results

It is important to note that, although Paleta Creek has been identified as the highest priority contaminated sediment site in San Diego Bay, with Cu, Zn, Pb, PAHs, PCBs, some pesticides identified as CoCs, none of the CoCs examined in surface sediments at P04 and P17 in this study exceeded ERM levels, although several exceeded ERL levels. For the metals (barring Mn) and the three PAHs naphthalene, phenanthrene and fluoranthene, the mean ERM hazard quotient (mERM-HQ) for surface sediments at PO4 is 0.23 and for surface sediments at P17 is 0.30. For deeper sediments, mERM-HQs are 0.32 and 0.24 for P04 and P17, respectively. However, the higher contaminant levels in trap sediments result in mERM-HQs of 0.38 and 0.79 for P04 and P17, respectively. The level for P17 is well above the level (0.5) at which Long et al (2000) state that there is a “much higher probability” (than sediments with lower mERM-HQs) that sediments will be toxic. Clearly, the focus in this region should be for continuing source control, both in the region and upstream of Paleta Creek. With the relatively high levels of contaminant, any attempts to clean up the site may result in re-contamination. Still, there is evidence that contaminants, both organic and inorganic, are fluxing out of the sediments by a number of processes as well, which may result in partial attenuation of inputs, and, if sources are reduced over time, slow recovery. Whether such natural recovery is an appropriate remedial action will depend upon an evaluation of the short- and long-term risks of various management options, which must be balanced against benefits and costs.

Further site assessment should focus on these processes. 1) Examine scale, source and distribution of advective fluxes. If either biologically mediated or groundwater flows are introducing contaminants into the sediments (and possibly, the overlying waters), then the source and direction of these flows must be established, and, if possible, controlled. 2) Better characterize settling inputs. For many contaminants, the COPC levels found in the traps were higher than those in the surface sediments. This suggests either continuing inputs into the Bay or transport from other contaminated sites. Inputs sources should be characterized (see, for example, Bart's study in San Diego Bay). If sediments at this site are being contaminated by other sites in the Bay, then remedial action should be prioritized to control the sites that represent the greatest transport risk. 3) if PAHs are a decision driver, better determine depth and extent of PAH degradation. Clearly, active PAH degradation in surface sediments provides strong evidence that native microbes are attenuating PAH inputs from the surface, and, most likely, degrading dissolved PAHs that advect or diffuse to the surface. Thus, biodegradation is a major component of risk attenuation for the PAHs examined. However, the fact that PAHs are buried in the sediments to some extent may suggest that degradation is not rapid enough to remove all PAHs. The form and availability of remaining PAHs should be examined, as should the relevance of these measurements to the other PAHs present.

It is important to note that these conclusions are based only upon the spatial and temporal scale of the study carried out, and that conclusions may differ if analyses are carried out at larger scales. However, PRISM results have successfully provided insights into the probable dominant pathways of contaminant transport, the direction of future studies, and, if conclusions are borne out, the need for source control before site-specific remediation is carried out.

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8 References

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Site 1 – Paleta Creek

Data Appendix

GENERAL CHEMISTRY

CHNS CHEMISTRY

CHRONO TRACER CHEMISTRY

MAJOR ELEMENT CHEMISTRY

MICROPROFILE CHEMISTRY

SPI IMAGES

HYDRODYNAMIC CURRENTS

FLUME DATA

BATTELLE MARINE SCIENCES LABORATORY
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SPAWAR
CONCENTRATIONS OF METALS IN SEAWATER SAMPLES
Samples Received: 2/01/02
(concentrations in µg/L - not blank corrected)

(cf#1764)		Fe/Pd	direct	Fe/Pd	direct	Fe/Pd	Fe/Pd	direct	FIAS	FIAS	GFAA	Fe/Pd	direct	Fe/Pd
MSL Code	**Sponsor Rep I.D.**	**Al ICP-MS**	**Fe ICP-MS**	**Cr ICP-MS**	**Mn ICP-MS**	**Ni ICP-MS**	**Cu ICP-MS**	**Zn ICP-MS**	**As FIAS**	**Se FIAS**	**Ag GFAA**	**Cd ICP-MS**	**Sn ICP-MS**	**Pb ICP-MS**
SAMPLE RESULTS														
1764*1	PO4-1 PW	1.63	111	0.338	7.44	0.977	0.48	20.4	1.08	0.231	0.016 U	0.140	1.41	0.0838
1764*2	PO4-2 PW	2.04	116	0.466	6.95	1.26	0.38	21.4	1.10	0.176	0.0269	0.140	1.36	0.0856
1764*3	PO4-3 PW	2.03	106	0.348	8.68	0.924	0.43	22.8	0.994	0.0633	0.0269	0.169	1.41	0.0781
1764*4	P17-1 PW	26.5	139	0.512	309	0.922	0.445	13.2	2.65	0.063 U	0.0359	0.0602	1.08	0.0748
1764*5	P17-2 PW	22.2	148	0.572	205	1.13	0.543	13.4	2.73	0.063 U	0.0180	0.317	1.17	0.106
1764*6	P17-3 PW	10.7	131	0.599	353	0.795	0.413	12.4	2.57	0.063 U	0.0269	0.0513	1.10	0.0783
1764*7	PO4-1 SW	23.2	1380	0.290	865	0.917	2.550	22.3	3.24	0.195	0.0269	0.0714	1.33	0.0888
1764*8	PO4-2 SW	2.72	4350	0.286	954	0.889	2.740	20.9	3.22	0.063 U	0.0269	0.0739	0.908	0.0477
1764*9	PO4-3 SW	4.80	4140	0.254	1880	0.851	2.470	23.1	6.49	0.0716	0.0180	0.0613	1.28	0.0637
1764*10	P17-1 SW	2.64	121	0.294	9.10	0.971	2.26	24.4	1.01	0.063 U	0.0269	0.126	0.966	0.132
1764*11	P17-2 SW	2.69	129	0.255	8.88	0.968	1.18	22.6	0.981	0.117	0.0180	0.0656	1.18	0.181
1764*12	P17-3 SW	2.62	134	0.311	8.71	0.940	2.02	27.0	1.02	0.063 U	0.0269	0.137	1.10	0.183
1764*13	BFSD1-P17-1-C1	22.0	158	0.462	18.2	1.03	1.32	21.5	0.997	0.329	0.0359	0.0741	1.23	0.151
1764*14	BFSD1-P17-1-C2	5.32	152	0.265	37.7	1.19	1.32	36.7	1.01	0.0817	0.0269	0.137	1.39	0.0844
1764*15	BFSD1-P17-1-C3	4.46	131	0.355	39.1	1.31	1.66	50.3	1.01	0.289	0.0180	0.228	1.37	1.27
1764*16	BFSD1-P17-1-C4	3.94	146	0.227	27.3	1.31	1.89	55.7	1.03	0.063 U	0.0269	0.282	1.36	0.180
1764*17	BFSD1-P17-1-C5	4.57	150	0.240	20.3	1.46	3.81	67.3	0.929	0.0730	0.0269	0.408	1.56	0.0874
1764*18	BFSD2-P17-1-B1	3.34	154	0.240	10.3	0.915	2.10	29.2	0.982	0.063 U	0.0180	0.149	1.51	0.0941
1764*19	BFSD2-P17-1-B2	3.09	199	0.272	79.7	1.19	0.546	14.6	2.05	0.063 U	0.016 U	0.0842	1.18	0.0916
1764*20	BFSD2-P17-1-B3	2.74	237	0.372	97.9	0.914	0.380	13.8	3.04	0.0974	0.0269	0.0606	1.08	0.0517
1764*21	BFSD2-P17-1-B4	2.57	210	0.426	219	0.933	0.404	15.3	3.59	0.160	0.0180	0.0549	1.12	0.0518
1764*22	BFSD2-P17-1-B5	2.74	223	0.410	123	1.09	0.519	34.1	3.47	0.063 U	0.0359	0.0614	1.36	0.0829
1764*23	BFSD2-P17-1-B6	2.17	212	0.324	75.9	1.26	0.676	50.3	2.88	0.144	0.0269	0.0920	1.33	0.149
1764*24	BFSD1-PO4-3-C6	4.30	159	0.278	16.6	0.821	2.39	23.4	0.979	0.063 U	0.0269	0.130	1.20	0.109
1764*25	BFSD1-PO4-3-C7	2.83	129	0.202	15.1	0.834	2.59	22.7	0.969	0.528	0.0539	0.149	1.19	0.175
1764*26	BFSD1-PO4-3-C8	3.53	175	0.188	15.5	0.869	2.72	25.5	1.08	0.063 U	0.0628	0.148	1.39	0.233
1764*27	BFSD1-PO4-3-C9	3.87	125	0.238	15.0	0.980	2.84	24.5	1.05	0.063 U	0.0628	0.157	1.45	0.564
1764*28	BFSD1-PO4-3-C1(	3.78	127	0.344	14.6	0.926	2.63	25.3	1.03	0.063 U	0.0718	0.155	1.25	0.451
1764*29	BFSD2-PO4-3-B7	2.83	216	0.216	27.8	0.949	2.49	27.3	1.02	0.063 U	0.0269	0.315	1.40	0.0769
1764*30	BFSD2-PO4-3-B8	2.11	462	0.141	386	0.774	0.979	25.7	1.18	0.063 U	0.0269	0.182	1.17	0.0518
1764*31	BFSD2-PO4-3-B9	3.93	711	0.168	518	4.84	0.814	25.7	1.35	0.063 U	0.0269	0.163	1.06	0.0537
1764*32	BFSD2-PO4-3-B1(	1.90	757	0.168	566	1.49	0.845	29.2	1.34	0.063 U	0.0180	0.131	1.38	0.0512
1764*33	BFSD2-PO4-3-B11	1.74	906	0.145	547	0.829	0.879	27.8	1.40	0.063 U	0.0269	0.123	1.38	0.0568
1764*34	BFSD2-PO4-3-B1:	1.79	1180	0.145	591	1.00	0.897	28.6	1.60	0.063 U	0.0180	0.119	1.44	0.0566
1764*35	BFSD2-PO4-3-D6-l	1.66	143	0.293	17.5	0.818	3.92	17.5	1.00	0.063 U	0.0359	0.146	1.27	0.0993
1764*36	BFSD2-PO4-3-D7-l	1.79	221	0.130	140	0.973	1.68	27.3	1.06	0.063 U	0.0269	0.164	1.38	0.0495
1764*37	BFSD2-PO4-3-D8-l	1.62	360	0.126	244	6.42	1.53	32.0	1.29	0.0703	0.0269	0.204	1.24	0.0548
1764*38	BFSD2-PO4-3-D9-l	1.45	467	0.122	335	2.31	1.35	32.9	1.47	0.063 U	0.0180	0.189	1.28	0.0563
1764*39	BFSD2-PO4-3-D10-	2.28	494	0.139	418	1.55	1.60	39.4	1.66	0.063 U	0.0269	0.200	1.45	0.0811
1764*40	BFSD2-PO4-3-D11-	0.69 U	370	0.063 U	436	1.44	1.10	37.9	1.52	0.063 U	0.0269	0.169	1.34	0.0588
1764*41	BFSD1-P17-1-D1-I	20.2	152	0.447	17.0	1.01	1.18	22.1	0.888	0.103	0.0180	0.101	1.29	0.135
1764*42	BFSD1-P17-1-D2-I	4.19	152	0.200	27.7	0.984	1.23	26.3	0.925	0.063 U	0.0180	0.0813	1.40	0.0709
1764*43	BFSD1-P17-1-D3-I	6.28	132	0.344	25.5	1.26	1.98	25.5	0.929	0.063 U	0.0269	0.109	1.03	0.308
1764*44	BFSD1-P17-1-D4-I	4.58	138	0.202	28.0	1.06	1.00	18.9	0.881	0.063 U	0.0180	0.0652	1.27	0.102
1764*45	BFSD1-P17-1-D5-I	5.98	181	0.191	61.1	1.16	0.740	19.9	0.936	0.063 U	0.0359	0.0590	1.39	0.0804

BATTELLE MARINE SCIENCES LABORATORY
1529 W. Sequim Bay Road
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SPAWAR
CONCENTRATIONS OF METALS IN SEAWATER SAMPLES
Samples Received: 2/01/02
(concentrations in µg/L - not blank corrected)

(cf#1764)		Fe/Pd	direct	Fe/Pd	direct	Fe/Pd	Fe/Pd	direct	FIAS	FIAS	GFAA	Fe/Pd	direct	Fe/Pd
MSL Code	**Sponsor Rep I.D.**	**Al ICP-MS**	**Fe ICP-MS**	**Cr ICP-MS**	**Mn ICP-MS**	**Ni ICP-MS**	**Cu ICP-MS**	**Zn ICP-MS**	**As FIAS**	**Se FIAS**	**Ag GFAA**	**Cd ICP-MS**	**Sn ICP-MS**	**Pb ICP-MS**
PROCEDURAL BLANK		7.87	3.57 U	0.178	0.30 U	0.0416	0.0860	0.225 U	0.050 U	0.063 U	0.0180	0.0419	0.036 U	0.0303
		8.39	3.57 U	0.167	0.30 U	0.0426	0.0655	0.225 U	0.050 U	0.063 U	0.0180	0.0426	0.036 U	0.0278
		3.48	4.94	0.0820	0.30 U	0.0492	0.0856	0.225 U	0.050 U	0.063 U	0.016 U	0.0401	0.0447	0.0410
Method Detection Limit		**0.69**	**3.57**	**0.063**	**0.30**	**0.014**	**0.019**	**0.225**	**0.050**	**0.063**	**0.016**	**0.014**	**0.036**	**0.005**
Client Detection Limit		**50.0**	**10.0**	**1.00**	**0.50**	**0.05**	**0.05**	**0.50**	**0.50**	**0.20**	**0.50**	**0.05**	**0.50**	**0.05**
STANDARD REFERENCE MATERIAL														
1640	Dissolved (mean)	50.3	18.9	39.1	117	28.1	86.7	64.1	25.6	23.4	7.76	26.2	2.16	25.9
1640	Dissolved (mean)	44.5	24.7	32.7	125	23.8	74.4	68.4	26.7	23.0	e	25.5	2.21	25.1
1640	Dissolved (mean)	e	24.8	e	121	e	e	66.8	e	22.9	e	e	2.12	e
1640	certified value	52.0	34.3	38.6	122	27.4	85.2	53.2	26.7	22.0	7.62	22.8	NC	27.9
1640	range	±1.5	±1.6	±1.6	±1.1	±0.8	±1.2	±1.1	±0.73	±0.51	±0.25	±0.96	NC	±0.14
	% difference	**3%**	**45%** #	**1%**	**4%**	**3%**	**2%**	**20%**	**4%**	**7%**	**2%**	**15%**	**N/A**	**7%**
	% difference	**14%**	**28%**	**15%**	**3%**	**13%**	**13%**	**29%**	**0%**	**5%**	**N/A**	**12%**	**N/A**	**10%**
	% difference	**N/A**	**28%**	**N/A**	**0%**	**N/A**	**N/A**	**26%**	**N/A**	**4%**	**N/A**	**N/A**	**N/A**	**N/A**
CASS-4	Dissolved	3.17	e	0.309	e	0.512	0.563	e	1.09	e	0.0269	0.0612	e	0.0331
CASS-4	Dissolved	3.37	e	0.331	e	0.525	0.577	e	0.978	e	0.0180	0.0635	e	0.0348
CASS-4	Dissolved	2.45	e	0.230	e	0.412	0.591	e	1.03	e	0.0269	0.0666	e	0.0425
CASS-4	certified value	NC	0.71 U	0.144	2.78	0.314	0.592	0.381	1.11	NC	NC	0.026	NC	0.0098
CASS-4	range	NC	±0.058	±0.029	±0.19	±0.030	±0.055	±0.057	±0.16	NC	N/A	±0.003	NC	±0.0036
	% difference	**N/A**	**N/A**	**115%** #	**N/A**	**63%** #	**5%**	**N/A**	**2%**	**N/A**	**N/A**	**135%** #	**N/A**	**238%** #
	% difference	**N/A**	**N/A**	**130%** #	**N/A**	**67%** #	**3%**	**N/A**	**12%**	**N/A**	**N/A**	**144%** #	**N/A**	**255%** #
	% difference	**N/A**	**N/A**	**60%** #	**N/A**	**31%** #	**0%**	**N/A**	**7%**	**N/A**	**N/A**	**156%** #	**N/A**	**334%** #
1641d	Dissolved	e	e	e	e	e	e	e	e	e	e	e	e	e
1641d	Dissolved	e	e	e	e	e	e	e	e	e	e	e	e	e
1641d	Dissolved	e	e	e	e	e	e	e	e	e	e	e	e	e
1641d	certified value	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
1641d	range	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	% difference	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
	% difference	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
	% difference	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
ICV, CCV														
ICV		**102%**	**104%**	**102%**	**98%**	**102%**	**102%**	**98%**	**####**	**88%**	**88%**	**102%**	**104%**	**102%**
CCV		**106%**	**116%**	**103%**	**102%**	**102%**	**103%**	**101%**	**####**	**92%**	**100%**	**103%**	**105%**	**101%**
CCV		**106%**	**124%** #	**100%**	**114%**	**99%**	**100%**	**104%**	**####**	**81%**	**107%**	**104%**	**105%**	**99%**
CCV		**101%**	**109%**	**96%**	**101%**	**96%**	**97%**	**101%**	**####**	**93%**	**106%**	**102%**	**98%**	**100%**
CCV		**96%**	**117%**	**94%**	**103%**	**93%**	**93%**	**105%**	**####**	**85%**	**106%**	**101%**	**99%**	**102%**
CCV		**94%**	**120%**	**91%**	**105%**	**92%**	**92%**	**105%**	**####**	**100%**	**115%**	**102%**	**98%**	**97%**
CCV		**92%**	**114%**	**91%**	**101%**	**89%**	**90%**	**101%**	**####**	**96%**	**106%**	**102%**	**96%**	**98%**
CCV		**89%**	**112%**	**87%**	**104%**	**87%**	**87%**	**103%**	**####**	**95%**	**N/A**	**101%**	**101%**	**98%**
CCV		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**91%**	**N/A**	**N/A**	**N/A**	**N/A**
CCV		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
CCV		**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

BATTELLE MARINE SCIENCES LABORATORY
1529 W. Sequim Bay Road
Sequim, WA 98382
(360) 683-4151

SPAWAR
CONCENTRATIONS OF METALS IN SEAWATER SAMPLES
Samples Received: 2/01/02
(concentrations in µg/L - not blank corrected)

(cf#1764)		Fe/Pd	direct	Fe/Pd	direct	Fe/Pd	Fe/Pd	direct	FIAS	FIAS	GFAA	Fe/Pd	direct	Fe/Pd
MSL	**Sponsor**	**Al**	**Fe**	**Cr**	**Mn**	**Ni**	**Cu**	**Zn**	**As**	**Se**	**Ag**	**Cd**	**Sn**	**Pb**
Code	**Rep I.D.**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**FIAS**	**FIAS**	**GFAA**	**ICP-MS**	**ICP-MS**	**ICP-MS**
BLANK SPIKE RESULTS														
	Amount Spiked	2.00	25.0	2.00	10.0	2.00	2.00	10.0	5.00	50.0	2.00	2.00	10.0	2.00
	Blank 1	7.87	3.57 U	0.178	0.30 U	0.0416	0.0860	0.225 U	0.050 U	0.063 U	0.016 U	0.0419	0.036 U	0.0303
	Blank 1 + Spike	2.49	34.6	1.87	10.2	1.68	1.82	10.5	4.87	51.1	1.68	1.92	12.1	1.58
	Amount Recovered	2.49	34.6	1.69	10.2	1.64	1.73	10.3	4.87	51.1	1.66	1.88	12.1	1.55
	Percent Recovery	**125%**	**138%**	**85%**	**102%**	**82%**	**87%**	**103%**	**97%**	**102%**	**83%**	**94%**	**121%**	**77%**
BLANK SPIKE RESULTS, cont.														
	Amount Spiked	2.00	25.0	2.00	10.0	2.00	2.00	10.0	5.00	50.0	2.00	2.00	10.0	2.00
	Blank 2	8.39	3.57 U	0.167	0.30 U	0.0426	0.0655	0.225 U	0.050 U	0.063 U	0.016 U	0.0426	0.036 U	0.0278
	Blank 2 + Spike	2.25	116	1.87	11.0	1.70	1.82	13.3	5.27	48.3	1.68	1.96	11.8	1.60
	Amount Recovered	2.25	116	1.70	11.0	1.66	1.75	13.1	5.27	48.3	1.66	1.92	11.8	1.57
	Percent Recovery	**113%**	**464% w**	**85%**	**110%**	**83%**	**88%**	**131%**	**####**	**97%**	**83%**	**96%**	**118%**	**79%**
	Amount Spiked	2.00	25.0	2.00	10.0	2.00	2.00	10.0	5.00	50.0	2.00	2.00	10.0	2.00
	Blank 3	3.48	4.94	0.0820	0.30 U	0.0492	0.0856	0.225 U	0.050 U	0.063 U	0.016 U	0.0401	0.0447	0.0410
	Blank 3 + Spike	1.94	94.5	1.82	11.1	1.68	1.83	12.6	5.43	49.6	1.78	2.11	11.9	1.76
	Amount Recovered	1.94	89.6	1.74	11.1	1.63	1.74	12.4	5.43	49.6	1.76	2.07	11.9	1.72
	Percent Recovery	**97%**	**358% w**	**87%**	**111%**	**82%**	**87%**	**124%**	**####**	**99%**	**88%**	**103%**	**119%**	**86%**
MATRIX SPIKE RESULTS														
	Amount Spiked	NS	25.0	NS	10.0	NS	NS	10.0	NS	NS	NS	NS	10.0	NS
	1764*1	N/A	116	N/A	7.46	N/A	N/A	20.1	N/A	N/A	N/A	N/A	1.42	N/A
	1764*1 + Spike	NS	147	NS	17.8	NS	NS	29.3	NS	NS	NS	NS	11.8	NS
	Amount Recovered	N/A	31.0	N/A	10.3	N/A	N/A	9.17	N/A	N/A	N/A	N/A	10.4	N/A
	Percent Recovery	**N/A**	**124%**	**N/A**	**103%**	**N/A**	**N/A**	**92%**	**N/A**	**N/A**	**N/A**	**N/A**	**104%**	**N/A**
	Amount Spiked	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1764*3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	1764*3 + Spike	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
	Amount Spiked	50.0	NS	5.00	NS	50.0	50.0	NS	NS	NS	2.00	2.00	NS	2.00
	1764*8	2.72	N/A	0.286	N/A	0.889	0.375	N/A	N/A	N/A	0.0269	0.0739	N/A	0.0477
	1764*8 + Spike	67.2	NS	5.54	NS	54.3	46.2	NS	NS	NS	1.88	1.76	NS	1.49
	Amount Recovered	67.2	N/A	5.25	N/A	53.4	45.8	N/A	N/A	N/A	1.85	1.69	N/A	1.44
	Percent Recovery	**134%**	**N/A**	**105%**	**N/A**	**107%**	**92%**	**N/A**	**N/A**	**N/A**	**92%**	**84%**	**N/A**	**72%**
	Amount Spiked	50.0	NS	5.00	NS	50.0	50.0	NS	NS	NS	2.00	2.00	NS	2.00
	1764*9	4.80	N/A	0.254	N/A	0.851	0.429	N/A	N/A	N/A	0.0180	0.0613	N/A	0.0637
	1764*9 + Spike	65.5	NS	5.31	NS	54.8	46.2	NS	NS	NS	1.97	1.74	NS	1.49
	Amount Recovered	65.5	N/A	5.06	N/A	53.9	45.8	N/A	N/A	N/A	1.96	1.68	N/A	1.43
	Percent Recovery	**131%**	**N/A**	**101%**	**N/A**	**108%**	**92%**	**N/A**	**N/A**	**N/A**	**98%**	**84%**	**N/A**	**71%**
	Amount Spiked	50.0	NS	5.00	NS	50.0	50.0	NS	5.00	NS	2.00	2.00	NS	2.00
	1764*10	2.64	N/A	0.294	N/A	0.971	2.26	N/A	1.01	N/A	0.0269	0.126	N/A	0.132
	1764*10 + Spike	65.5	NS	5.31	NS	54.8	46.2	NS	6.11	NS	2.17	1.92	NS	1.58
	Amount Recovered	65.5	N/A	5.02	N/A	53.8	43.9	N/A	5.10	N/A	2.15	1.79	N/A	1.45
	Percent Recovery	**131%**	**N/A**	**100%**	**N/A**	**108%**	**88%**	**N/A**	**####**	**N/A**	**107%**	**90%**	**N/A**	**72%**

BATTELLE MARINE SCIENCES LABORATORY
1529 W. Sequim Bay Road
Sequim, WA 98382
(360) 683-4151

SPAWAR
CONCENTRATIONS OF METALS IN SEAWATER SAMPLES
Samples Received: 2/01/02
(concentrations in µg/L - not blank corrected)

(cf#1764)		Fe/Pd	direct	Fe/Pd	direct	Fe/Pd	Fe/Pd	direct	FIAS	FIAS	GFAA	Fe/Pd	direct	Fe/Pd
MSL	**Sponsor**	**Al**	**Fe**	**Cr**	**Mn**	**Ni**	**Cu**	**Zn**	**As**	**Se**	**Ag**	**Cd**	**Sn**	**Pb**
Code	**Rep I.D.**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**FIAS**	**FIAS**	**GFAA**	**ICP-MS**	**ICP-MS**	**ICP-MS**
	Amount Spiked	50.0	NS	5.00	NS	50.0	50.0	NS	NS	NS	2.00	2.00	NS	2.00
	1764*11	2.72	N/A	0.260	N/A	0.984	1.15	N/A	N/A	N/A	0.0180	0.0685	N/A	0.178
	1764*11 + Spike	65.5	NS	5.31	NS	54.8	46.2	NS	NS	NS	2.07	1.82	NS	1.61
	Amount Recovered	65.5	N/A	5.05	N/A	53.8	45.1	N/A	N/A	N/A	2.06	1.75	N/A	1.43
	Percent Recovery	**131%**	**N/A**	**101%**	**N/A**	**108%**	**90%**	**N/A**	**N/A**	**N/A**	**103%**	**88%**	**N/A**	**72%**

MATRIX SPIKE RESULTS, cont.

	Amount Spiked	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1764*12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	1764*12 + Spike	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
	Amount Spiked	NS	NS	NS	NS	NS	NS	NS	NS	50.0	NS	NS	NS	NS
	1764*13	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.329	N/A	N/A	N/A	N/A
	1764*13 + Spike	NS	NS	NS	NS	NS	NS	NS	NS	22.1	NS	NS	NS	NS
	Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	21.8	N/A	N/A	N/A	N/A
	Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**44% w**	**N/A**	**N/A**	**N/A**	**N/A**
	Amount Spiked	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1764*16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	1764*16 + Spike	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
	Amount Spiked	NS	25.0	NS	10.0	NS	NS	10.0	NS	NS	NS	NS	10.0	NS
	1764*21	N/A	218	N/A	222	N/A	N/A	15.3	N/A	N/A	N/A	N/A	1.24	N/A
	1764*21 + Spike	NS	280	NS	232	NS	NS	24.1	NS	NS	NS	NS	11.4	NS
	Amount Recovered	N/A	61.7	N/A	10.3	N/A	N/A	8.83	N/A	N/A	N/A	N/A	10.2	N/A
	Percent Recovery	**N/A**	**247% w**	**N/A**	**103%**	**N/A**	**N/A**	**88%**	**N/A**	**N/A**	**N/A**	**N/A**	**102%**	**N/A**
	Amount Spiked	NS	NS	NS	NS	NS	NS	NS	NS	50.0	NS	NS	NS	NS
	1764*22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.063 U	N/A	N/A	N/A	N/A
	1764*22 + Spike	NS	NS	NS	NS	NS	NS	NS	NS	54.3	NS	NS	NS	NS
	Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	54.3	N/A	N/A	N/A	N/A
	Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**109%**	**N/A**	**N/A**	**N/A**	**N/A**
	Amount Spiked	NS	NS	NS	NS	NS	NS	NS	5.00	NS	NS	NS	NS	NS
	1764*25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.969	N/A	N/A	N/A	N/A	N/A
	1764*25 + Spike	NS	NS	NS	NS	NS	NS	NS	5.85	NS	NS	NS	NS	NS
	Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.88	N/A	N/A	N/A	N/A	N/A
	Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**98%**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
	Amount Spiked	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1764*30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	1764*30 + Spike	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

BATTELLE MARINE SCIENCES LABORATORY
1529 W. Sequim Bay Road
Sequim, WA 98382
(360) 683-4151

SPAWAR
CONCENTRATIONS OF METALS IN SEAWATER SAMPLES
Samples Received: 2/01/02
(concentrations in µg/L - not blank corrected)

(cf#1764)			Fe/Pd	direct	Fe/Pd	direct	Fe/Pd	Fe/Pd	direct	FIAS	FIAS	GFAA	Fe/Pd	direct	Fe/Pd
MSL Code		**Sponsor Rep I.D.**	**Al ICP-MS**	**Fe ICP-MS**	**Cr ICP-MS**	**Mn ICP-MS**	**Ni ICP-MS**	**Cu ICP-MS**	**Zn ICP-MS**	**As FIAS**	**Se FIAS**	**Ag GFAA**	**Cd ICP-MS**	**Sn ICP-MS**	**Pb ICP-MS**
		Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
		Amount Spiked	NS	NS	NS	NS	NS	NS	NS	5.00	NS	NS	NS	NS	NS
		1764*40	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.52	N/A	N/A	N/A	N/A	N/A
		1764*40 + Spike	NS	NS	NS	NS	NS	NS	NS	6.56	NS	NS	NS	NS	NS
		Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.04	N/A	N/A	N/A	N/A	N/A
		Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**####**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
		Amount Spiked	NS	25.0	NS	10.0	NS	NS	10.0	NS	NS	NS	NS	10.0	NS
		1764*41	N/A	161	N/A	17.3	N/A	N/A	22.0	N/A	N/A	N/A	N/A	1.22	N/A
		1764*41 + Spike	NS	193	NS	28.1	NS	NS	31.2	NS	NS	NS	NS	11.4	NS
		Amount Recovered	N/A	31.7	N/A	10.8	N/A	N/A	9.20	N/A	N/A	N/A	N/A	10.2	N/A
		Percent Recovery	**N/A**	**127%**	**N/A**	**108%**	**N/A**	**N/A**	**92%**	**N/A**	**N/A**	**N/A**	**N/A**	**102%**	**N/A**
MATRIX SPIKE RESULTS, cont.															
		Amount Spiked	NS	NS	NS	NS	NS	NS	NS	NS	50.0	NS	NS	NS	NS
		1764*42	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.063 U	N/A	N/A	N/A	N/A
		1764*42 + Spike	NS	NS	NS	NS	NS	NS	NS	NS	37.3	NS	NS	NS	NS
		Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	37.3	N/A	N/A	N/A	N/A
		Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**75%**	**N/A**	**N/A**	**N/A**	**N/A**
		Amount Spiked	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		1764*43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		1764*43 + Spike	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		Amount Recovered	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Percent Recovery	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
REPLICATE RESULTS															
1764*1	1	PO4-1 PW	1.63	111	0.338	7.44	0.977	2.55	20.4	1.08	0.231	0.016 U	0.0404	1.41	0.0500
1764*1	2	PO4-1 PW	NA	106	NA	7.50	NA	NA	20.0	1.04	0.258	NA	NA	1.32	NA
		% difference	**N/A**	**5%**	**N/A**	**1%**	**N/A**	**N/A**	**2%**	**4%**	**11%**	**N/A**	**N/A**	**7%**	**N/A**
1764*10	1	P17-1 SW	2.64	121	0.294	9.10	0.971	2.26	24.4	1.01	0.063 U	0.0269	0.126	0.966	0.132
1764*10	2	P17-1 SW	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		% difference	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
1764*11	1	P17-2 SW	2.69	129	0.255	8.88	0.968	1.18	22.6	0.981	0.117	0.0180	0.0656	1.18	0.181
1764*11	2	P17-2 SW	2.75	NA	0.265	NA	1.00	1.12	NA	NA	NA	0.0359	0.0713	NA	0.174
		% difference	**2%**	**N/A**	**4%**	**N/A**	**3%**	**5%**	**N/A**	**N/A**	**N/A**	**66% ***	**8%**	**N/A**	**4%**
1764*17	1	BFSD1-P17-1-C5	4.57	150	0.240	20.3	1.46	3.81	67.3	0.929	0.0730	0.0269	0.408	1.56	0.0874
1764*17	2	BFSD1-P17-1-C5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		% difference	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
1764*18	1	BFSD2-P17-1-B1	3.34	154	0.240	10.3	0.915	2.10	29.2	0.982	0.063 U	0.0180	0.149	1.51	0.0941
1764*18	2	BFSD2-P17-1-B1	NA	NA	NA	NA	NA	NA	NA	0.974	NA	NA	NA	NA	NA
		% difference	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**1%**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
1764*21	1	BFSD2-P17-1-B4	2.57	210	0.426	219	0.933	0.404	15.3	3.59	0.160	0.0180	0.0549	1.12	0.0518

BATTELLE MARINE SCIENCES LABORATORY
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SPAWAR
CONCENTRATIONS OF METALS IN SEAWATER SAMPLES
Samples Received: 2/01/02
(concentrations in µg/L - not blank corrected)

(cf#1764)			Fe/Pd	direct	Fe/Pd	direct	Fe/Pd	Fe/Pd	direct	FIAS	FIAS	GFAA	Fe/Pd	direct	Fe/Pd
MSL		**Sponsor**	**Al**	**Fe**	**Cr**	**Mn**	**Ni**	**Cu**	**Zn**	**As**	**Se**	**Ag**	**Cd**	**Sn**	**Pb**
Code	**Rep**	**I.D.**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**ICP-MS**	**FIAS**	**FIAS**	**GFAA**	**ICP-MS**	**ICP-MS**	**ICP-MS**
1764*21	2	BFSD2-P17-1-B4	NA	231	NA	225	NA	NA	15.2	NA	0.140	NA	NA	1.43	NA
		% difference	**N/A**	**10%**	**N/A**	**3%**	**N/A**	**N/A**	**1%**	**N/A**	**13%**	**N/A**	**N/A**	**24%**	**N/A**
1764*27	1	BFSD1-PO4-3-C9	3.87	125	0.238	15.0	0.980	2.84	24.5	1.05	0.063 U	0.0628	0.157	1.45	0.564
1764*27	2	BFSD1-PO4-3-C9	3.79	NA	0.264	NA	0.966	2.80	NA	NA	NA	0.0628	0.151	NA	0.549
		% difference	**2%**	**N/A**	**10%**	**N/A**	**1%**	**1%**	**N/A**	**N/A**	**N/A**	**0%**	**4%**	**N/A**	**3%**
1764*31	1	BFSD2-PO4-3-B9	3.93	711	0.168	518	4.84	0.814	25.7	1.35	0.063 U	0.0269	0.163	1.06	0.0537
1764*31	2	BFSD2-PO4-3-B9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		% difference	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
1764*32	1	BFSD2-PO4-3-B1(	1.90	757	0.168	566	1.49	0.845	29.2	1.34	0.063 U	0.0180	0.131	1.38	0.0512
1764*32	2	BFSD2-PO4-3-B1(	2.15	NA	0.185	NA	1.53	0.860	NA	NA	NA	0.0269	0.131	NA	0.0509
		% difference	**12%**	**N/A**	**10%**	**N/A**	**3%**	**2%**	**N/A**	**N/A**	**N/A**	**40% ***	**0%**	**N/A**	**1%**
REPLICATE RESULTS, cont.															
1764*33	1	BFSD2-PO4-3-B11	1.74	906	0.145	547	0.829	0.879	27.8	1.40	0.063 U	0.0269	0.123	1.38	0.0568
1764*33	2	BFSD2-PO4-3-B11	NA	NA	NA	NA	NA	NA	NA	1.37	NA	NA	NA	NA	NA
		% difference	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**2%**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
1764*41	1	3FSD1-P17-1-D1-I	20.2	152	0.447	17.0	1.01	1.18	22.1	0.888	0.103	0.0180	0.101	1.29	0.135
1764*41	2	3FSD1-P17-1-D1-I	NA	161	NA	17.1	NA	NA	22.6	NA	0.311	NA	NA	1.14	NA
		% difference	**N/A**	**6%**	**N/A**	**1%**	**N/A**	**N/A**	**2%**	**N/A**	**100% ***	**N/A**	**N/A**	**12%**	**N/A**
1764*44	1	3FSD1-P17-1-D4-I	4.58	138	0.202	28.0	1.06	1.00	18.9	0.881	0.063 U	0.0180	0.0652	1.27	0.102
1764*44	2	3FSD1-P17-1-D4-I	4.35	NA	0.156	NA	1.01	1.01	NA	NA	NA	0.0359	0.0646	NA	0.103
		% difference	**5%**	**N/A**	**26%**	**N/A**	**5%**	**1%**	**N/A**	**N/A**	**N/A**	**66% ***	**1%**	**N/A**	**1%**

U = not detected at or above detection limit.
NC = not certified.
NA = not analyzed.
N/A = not applicable.
= outside Quality Control Criteria.

BATTELLE MARINE SCIENCES LABORATORY
1529 W. Sequim Bay Road
Sequim, WA 98382
(360) 683-4151

SPAWAR ENTERPRISES, INC.
CONCENTRATIONS OF METALS IN SEDIMENT SAMPLES
Samples Received: 3/19/02
(concentrations in µg/g dry weight - not blank corrected)

(cf#1781)

MSL Code	Rep	Sponsor I.D.	Al AES	Fe AES	Cr AES	Mn AES	Ni AES	Cu AES	Zn AES	As ICP-MS	Se ICP-MS	Ag ICP-MS	Cd ICP-MS	Sn ICP-MS	Pb ICP-MS	Hg CVAF
SAMPLE RESULTS																
1781*55		PO4-1	65595	32427	54.3	395	11.3	92.8	174	12.9	0.100 U	0.750	1.20	5.37	45.7	0.391
1781*56		PO4-2	74997	46734	80.4	503	18.7	179	273	14.6	0.100 U	1.33	0.652 J	7.84	68.9	0.652
1781*57		PO4-3	72390	44505	74.8	503	15.7	167	242	16.3	0.100 U	1.43	0.268 J	6.15	61.0	0.607
1781*58		P17-1	65060	35351	54.6	540	12.7	125	306	12.2	0.100 U	0.901	1.48	6.72	91.8	0.329
1781*59		P17-2	66067	35123	65.2	483	17.9	138	414	10.2	0.100 U	0.885	1.38	7.48	101	0.326
1781*60		P17-3	66140	36620	56.7	525	14.8	122	329	8.92	0.100 U	0.816	1.46	5.69	110	0.355
1781*61		PO4-1,ST	77986	55304	92.7	493	21.3	256	325	14.1	0.100 U	1.60	0.305 J	10.3	73.9	0.778
1781*62		PO4-2,ST	77786	56001	92.6	496	22.2	246	327	15.8	0.100 U	1.83	0.334 J	8.95	71.5	0.798
1781*63		PO4-3,ST	75776	54158	89.7	488	22.2	252	317	18.9	0.100 U	1.85	0.604 J	9.41	70.3	0.799
1781*64		P17-1,ST	65793	45492	80.1	425	24.3	399	533	16.3	0.100 U	1.60	1.76	14.4	152	0.786
1781*65		P17-2,ST	64350	44296	79.9	414	23.9	357	519	12.1	0.100 U	1.43	1.53	13.9	154	0.798
1781*66		P17-3,ST	66570	46737	81.9	425	25.0	432	562	16.8	0.100 U	1.55	1.78	15.4	193	0.607
PROCEDURAL BLANK			7.46 U	21.3	9.87	0.356 U	4.92 U	0.718 J	1.85	0.50 U	0.825 J	0.100 U	0.339 J	0.617 U	0.745 J	0.0022 U
Instrument Detection Limit			**7.46**	**0.545**	**4.88**	**0.356**	**4.92**	**1.27**	**1.18**	**3.99**	**30.5**	**0.136**	**1.11**	**1.06**	**1.24**	**0.0022**
Client Reporting Limit			**N/S**	**N/S**	**2.00**	**N/S**	**5.00**	**0.55**	**1.00**	**0.50**	**0.100**	**0.100**	**0.200**	**0.500**	**0.50**	**0.05**
Method Detection Limit			**2.39**	**0.564**	**0.512**	**0.074**	**1.05**	**0.24**	**0.178**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.0021**
STANDARD REFERENCE MATERIAL																
MESS-3			72007	36304	98.3	278	39.0	29.2	149	22.0	0.100 J	e	0.858 J	2.67	21.4	0.0900
MESS-3		certified value	85900	43400	105	324	46.9	33.9	159	21.2	0.720 J	0.180	0.240 J	2.50	21.1	0.091
MESS-3		range	±2300	±0.11	±4	±12	±2.2	±1.6	±8	±1.1	±0.05	±0.02	±0.01	±0.50	±0.7	±0.009
		% difference	**16%**	**16%**	**6%**	**14%**	**17%**	**14%**	**6%**	**4%**	**N/A**	**N/A**	**N/A**	**N/A**	**1%**	**1%**
PACS-2			54424	34882	83.5	374.0	31.6	275	348	25.6	0.100 J	1.34	2.03	17.7	176.0	2.82
PACS-2		certified value	66200	40900	90.7	440	39.5	310	364	26.2	0.92 J	1.22	2.11	19.8	183	3.04
PACS-2		range	±3200	±0.06	±4.6	±19	±2.3	±12	±23	±1.5	±0.22	±0.14	±0.15	±2.5	±8	±0.2
		% difference	**18%**	**15%**	**8%**	**15%**	**20%**	**11%**	**4%**	**2%**	**N/A**	**10%**	**4%**	**11%**	**4%**	**7%**
ICV, CCV Results																
ICV			**92%**	**99%**	**98%**	**100%**	**99%**	**100%**	**100%**	**100%**	**101%**	**101%**	**101%**	**102%**	**100%**	**98%**
CCV			**103%**	**104%**	**102%**	**105%**	**103%**	**104%**	**105%**	**99%**	**100%**	**100%**	**102%**	**105%**	**99%**	**102%**
CCV			**103%**	**105%**	**103%**	**106%**	**105%**	**104%**	**105%**	**94%**	**93%**	**101%**	**102%**	**103%**	**98%**	**102%**
CCV			**103%**	**105%**	**103%**	**105%**	**104%**	**103%**	**105%**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
CCV			**98%**	**99%**	**99%**	**101%**	**97%**	**100%**	**101%**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
BLANK SPIKE RESULTS																
		Amount Spiked	25.0	100	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	1.00
		Blank	7.46 U	21.3	9.87	0.356 U	4.92 U	0.718 J	1.85	0.50 U	0.100 U	0.0408 J	0.3390 J	0.617	0.75 U	0.0022 U
		Blank + Spike	35.1	99.6	29.2	20.9	19.7	21.7	22.4	24.2	24.5	21.4	23.6	24.6	23.7	0.925
		Amount Recovere	35.1	78.3	19.3	20.9	19.7	21.0	20.6	24.2	24.5	21.4	23.3	24.0	23.7	0.925
		Percent Recover	**140%**	**78%**	**77%**	**84%**	**79%**	**84%**	**82%**	**97%**	**98%**	**86%**	**93%**	**96%**	**95%**	**93%**
MATRIX SPIKE RESULTS																

BATTELLE MARINE SCIENCES LABORATORY
1529 W. Sequim Bay Road
Sequim, WA 98382
(360) 683-4151

SPAWAR ENTERPRISES, INC.
CONCENTRATIONS OF METALS IN SEDIMENT SAMPLES
Samples Received: 3/19/02
(concentrations in µg/g dry weight - not blank corrected)

(cf#1781)

MSL Code	Rep	Sponsor I.D.	Al AES	Fe AES	Cr AES	Mn AES	Ni AES	Cu AES	Zn AES	As ICP-MS	Se ICP-MS	Ag ICP-MS	Cd ICP-MS	Sn ICP-MS	Pb ICP-MS	Hg CVAF
		Amount Spiked	102	102	102	102	102	102	102	102	102	4.95	4.95	4.95	102	0.990
		1781*58	65060	35351	54.6	540	12.7	125	306	12.2	0.100 U	0.901	1.48	6.72	91.8	0.329
		1781*58 + Spike	66759	34906	143	580	101	215	397	105	87.9	5.29	6.14	11.2	190	1.30
		Amount Recovere	1699	-445	88.4	40.0	88.3	90.0	91.0	92.8	87.9	4.39	4.66	4.48	98.2	0.971
		Percent Recovery	**#####** W	**0%** W	**87%**	**39%** W	**87%**	**88%**	**89%**	**91%**	**86%**	**89%**	**94%**	**91%**	**96%**	**98%**
REPLICATE RESULTS																
1781*5	1	PO4-1	65595	32427	54.3	395	11.3	92.8	174	12.9	0.100 U	0.750	1.20	5.37	45.7	0.391
1781*5	2	PO4-1	72502	43442	69.6	539	15.8	125	222	12.6	0.100 U	1.14	1.48	7.70	62.2	0.539
		RPD	**10%**	**29%**	**25%**	**31% ***	**33% ***	**30%**	**24%**	**2%**	**N/A**	**41% ***	**21%**	**36% ***	**31% ***	**32% ***

U = not detected at or above detection limit.
NC = not certified.
NA = not analyzed.
N/A = not applicable.
* = duplicate is out of control.
J = result less than the instrument detection limit, but more than the MDL.
N/S = not supplied.
NR = not reported.
w = spike recovery is out of control due to inappropriate spiking level.

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DRAFT RESULTS

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SPAWAR ENTERPRISES, INC.
CONCENTRATIONS OF METALS IN SEDIMENT SAMPLES
Samples Received: 3/07/02
(concentrations in µg/g dry weight - not blank corrected)

(cf#1781)

MSL Code	Rep	Sponsor I.D.	Al CP/MS	Fe ICP/MS	Cr ICP/MS	Mn ICP/MS	Ni ICP/MS	Cu ICP/MS	Zn ICP/MS	As ICP/MS	Se ICP-MS	Ag ICP-MS	Cd ICP-MS	Sn ICP-MS	Pb ICP-MS	Hg CVAF
SAMPLE RESULTS																
1781*21		PO4, 10-15		36400	113	416	27.2	198	336	13.3	0.528 J	2.47	1.21	10.8	92.0	0.814
1781*23		PO4, 15-20		32500	86.5	396	23.7	136	273	9.81	0.493 J	1.92	1.62	8.72	69.6	0.772
1781*25		PO4, 30-35		37900	87.8	476	25.3	113	228	8.55	0.531 J	1.75	1.44	7.60	52.9	0.665
1781*27		PO4, 40-45		25000	49.7	365	14.1	46.2	120	4.06	0.100 U	0.890	0.737	3.83	22.7	0.312
1781*29		PO4, 50-55		26700	33.5	378	11.7	19.3	64.5	1.87	0.100 U	0.226	0.122	2.24	7.97	0.0220
1781*30		P17, 0-2		30600	90.6	396	20.3	162	410	9.30	0.438 J	1.12	1.44	7.44	691	0.366
1781*31		P17, 2-4		29600	60.8	386	20.5	151	376	8.47	0.447 J	1.03	1.33	7.52	105	0.378
1781*32		P17, 4-6		25300	54.2	376	15.6	121	257	5.98	0.100 U	0.890	0.917	5.71	74.6	0.538
1781*33		P17, 6-8		33700	60.3	460	18.2	129	303	7.87	0.299 J	0.980	1.12	6.28	90.8	0.311
1781*34		P17, 8-10		28100	47.3	380	14.2	90.8	248	6.10	0.100 U	0.770	0.931	4.86	74.4	0.233
1781*35		P17, 10-15		28600	55.0	438	16.4	112	283	7.19	0.100 U	1.08	1.09	5.84	125	0.292
1781*37		P17, 20-25		31200	66.8	423	18.2	131	330	8.53	0.478 J	1.20	1.24	7.42	126	0.533
1781*39		P17, 30-35		32100	72.2	458	19.8	160	335	8.78	0.237 J	1.36	1.39	7.61	104	0.475
1781*41		P17, 40-45		32500	78.8	426	19.0	175	348	8.76	0.100 U	1.30	1.40	7.28	99.8	1.01
1781*43		P17, 50-55		29400	52.3	498	15.4	87.4	220	5.26	0.100 U	0.855	0.818	5.43	62.2	0.310
1781*45		P17, 60-65		30000	53.3	457	16.5	94.6	260	6.62	0.100 U	0.760	0.996	5.49	76.7	0.282
1781*47		P17, 70-75		30200	65.8	432	18.9	168	340	8.73	0.100 U	1.12	1.28	7.61	106	0.504
1781*49		P17, 80-85		33500	69.1	435	21.3	168	412	10.1	0.602 J	1.38	1.71	9.72	128	0.638
1781*50		PO4, 0-2		34000	81.4	403	20.5	165	237	12.0	0.231 J	1.55	0.405	10.5	63.0	0.967
1781*51		PO4, 2-4		32400	82.4	392	20.0	160	246	10.4	0.100 U	1.57	0.497	9.31	64.8	0.595
1781*52		PO4, 4-6		36200	90.6	439	22.5	172	271	12.0	0.100 U	1.90	0.861	11.4	72.5	0.691
1781*54		PO4, 8-10		36100	86.5	420	22.0	172	290	11.3	0.153 J	2.03	1.09	9.49	84.8	0.792
PROCEDURAL BLANK																
1				3.99	0.464 U	0.0486	0.121 U	0.057 U	0.084 U	0.408 U	0.100 U	0.016 U	0.055 U	0.025 U	0.019 U	0.0021 U
2				3.71	0.464 U	0.0729	0.121 U	0.218	0.430	0.408 U	0.100 U	0.016 U	0.055 U	0.025 U	0.0213	0.0021 U
Instrument Detection Limit				**3.75**	**0.464**	**0.022**	**0.121**	**0.057**	**0.084**	**0.408**	**0.629**	**0.016**	**0.055**	**0.025**	**0.019**	**0.0023**
Client Reporting Limit			**N/S**	**N/S**	**2.00**	**N/S**	**5.00**	**0.55**	**1.00**	**0.50**	**0.100**	**0.100**	**0.200**	**0.500**	**0.50**	**0.05**
Method Detection Limit			**2.39**	**0.564**	**0.512**	**0.074**	**1.05**	**0.24**	**0.178**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.0021**
STANDARD REFERENCE MATERIAL																
MESS-3				31500	105	272	45.9	34.0	151	21.2	0.786	0.620	0.256	2.54	21.1	0.0840
MESS-3				29700	95.3	238	42.0	32.5	137	20.1	0.152 J	0.509	0.238	2.57	20.9	0.0870
MESS-3		certified value	85900	43400	105	324	46.9	33.9	159	21.2	0.720	0.180	0.240	2.50	21.1	0.091
MESS-3		range	±2300	±0.11	±4	±12	±2.2	±1.6	±8	±1.1	±0.05	±0.02	±0.01	±0.50	±0.7	±0.009
		% difference		**27%**	**0%**	**16%**	**2%**	**0%**	**5%**	**0%**	**9%**	**244% e**	**7%**	**2%**	**0%**	**8%**
		% difference		**32% e**	**9%**	**27%**	**10%**	**4%**	**14%**	**5%**	**79% e**	**183% e**	**1%**	**3%**	**1%**	**4%**
ICV, CCV Results																
ICV				**102%**	**102%**	**103%**	**101%**	**101%**	**100%**	**101%**	**103%**	**101%**	**101%**	**102%**	**101%**	**101%**
CCV				**103%**	**99%**	**94%**	**98%**	**97%**	**100%**	**104%**	**99%**	**95%**	**97%**	**102%**	**94%**	**94%**
CCV				**105%**	**100%**	**102%**	**100%**	**100%**	**99%**	**100%**	**100%**	**102%**	**100%**	**102%**	**102%**	**102%**

BATTELLE MARINE SCIENCES LABORATORY
1529 W. Sequim Bay Road
Sequim, WA 98382
(360) 683-4151

DRAFT RESULTS

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SPAWAR ENTERPRISES, INC.
CONCENTRATIONS OF METALS IN SEDIMENT SAMPLES
Samples Received: 3/07/02
(concentrations in µg/g dry weight - not blank corrected)

(cf#1781)

MSL Code	Rep	Sponsor I.D.	Al CP/MS	Fe ICP/MS	Cr ICP/MS	Mn ICP/MS	Ni ICP/MS	Cu ICP/MS	Zn ICP/MS	As ICP/MS	Se ICP-MS	Ag ICP-MS	Cd ICP-MS	Sn ICP-MS	Pb ICP-MS	Hg CVAF
CCV				**104%**	**97%**	**100%**	**98%**	**98%**	**98%**	**99%**	**96%**	**101%**	**101%**	**103%**	**104%**	**102%**
CCV				**106%**	**93%**	**96%**	**93%**	**94%**	**93%**	**96%**	**95%**	**98%**	**96%**	**103%**	**99%**	**101%**
				107%	**97%**	**98%**	**95%**	**95%**	**96%**	**98%**	**97%**	**99%**	**98%**	**105%**	**99%**	**NA**
				109%	**96%**	**99%**	**96%**	**98%**	**95%**	**98%**	**97%**	**98%**	**97%**	**103%**	**97%**	**NA**
				124% #	**101%**	**102%**	**98%**	**100%**	**98%**	**101%**	**100%**	**97%**	**97%**	**105%**	**93%**	**NA**
				118%	**99%**	**101%**	**97%**	**98%**	**96%**	**102%**	**97%**	**97%**	**95%**	**102%**	**94%**	**NA**
				119%	**102%**	**103%**	**98%**	**100%**	**98%**	**103%**	**99%**	**98%**	**96%**	**105%**	**94%**	**NA**
BLANK SPIKE RESULTS																
		Amount Spiked		100	100	100	100	100	100	50.0	10.0	10.0	10.0	10.0	100	1.00
		Blank (mean)		3.85	0.464 U	0.0608	0.121 U	0.127	0.227	0.408 U	0.100 U	0.016 U	0.055 U	0.025 U	0.019 U	0.0021 U
		Blank + Spike		109	93.1	95.9	94.1	93.2	97.5	50.1	10.4	10.3	10.0	10.7	100	0.920
		Amount Recovered		105	93.1	95.8	94.1	93.1	97.3	50.1	10.4	10.3	10.0	10.7	100	0.920
		Percent Recovery		**105%**	**93%**	**96%**	**94%**	**93%**	**97%**	**100%**	**104%**	**103%**	**100%**	**107%**	**100%**	**92%**
		Amount Spiked		100	100	100	100	100	100	50.0	10.0	10.0	10.0	10.0	100	1.00
		Blank (mean)		3.85	0.464 U	0.0608	0.121 U	0.127	0.227	0.408 U	0.100 U	0.016 U	0.055 U	0.025 U	0.019 U	0.0021 U
		Blank + Spike		107	92.0	94.3	93.7	91.4	96.2	49.0	10.3	10.1	10.2	10.8	99.3	1.02
		Amount Recovered		103	92.0	94.2	93.7	91.3	96.0	49.0	10.3	10.1	10.2	10.8	99.3	1.02
		Percent Recovery		**103%**	**92%**	**94%**	**94%**	**91%**	**96%**	**98%**	**103%**	**101%**	**102%**	**108%**	**99%**	**102%**
MATRIX SPIKE RESULTS																
		Amount Spiked		NS	101	101	101	101	101	48.7	8.70	8.70	8.70	8.70	101	1.01
		1781*25		N/A	87.8	476	25.3	113	228	8.55	0.531 J	1.75	1.44	7.60	52.9	0.665
		1781*25 + Spike		N/A	168	448	116	190	295	52.4	9.23	10.1	10.2	17.5	136	1.69
		Amount Recovered		N/A	80.2	-28.0	90.7	77.0	67.0	43.9	9.23	8.35	8.76	9.90	83.1	1.03
		Percent Recovery		**N/A**	**79%**	**0%** W	**90%**	**76%**	**66%**	**90%**	**106%**	**96%**	**101%**	**114%**	**82%**	**101%**
		Amount Spiked		NS	97.6	97.6	97.6	97.6	97.6	48.9	8.85	8.85	8.85	8.85	97.6	0.970
		1781*54		N/A	86.5	420	22.0	172	290	11.3	0.153 J	2.03	1.09	9.49	84.8	0.792
		1781*54 + Spike		N/A	181	479	113	261	363	53.6	8.36	9.75	9.55	19.4	173	1.73
		Amount Recovered		N/A	94.5	59.0	91.0	89.0	73.0	42.3	8.36	7.72	8.46	9.91	88.2	0.938
		Percent Recovery		**N/A**	**97%**	**60%**	**93%**	**91%**	**75%**	**87%**	**94%**	**87%**	**96%**	**112%**	**90%**	**97%**
REPLICATE RESULTS																
1781*2	1	PO4, 15-20		32500	86.5	396	23.7	136	273	9.81	0.493 J	1.92	1.62	8.72	69.6	0.772
1781*2	2	PO4, 15-20		36600	93.3	441	24.8	145	298	11.3	0.403 J	2.10	1.62	10.8	82.8	0.801
		RPD		**12%**	**8%**	**11%**	**5%**	**6%**	**9%**	**14%**	**20%**	**9%**	**0%**	**21% ***	**17%**	**4%**
1781*5	1	PO4, 4-6		36200	90.6	439	22.5	172	271	12.0	0.100 U	1.90	0.861	11.4	72.5	0.691
1781*5	2	PO4, 4-6		35000	85.4	427	21.9	166	267	11.2	0.100 U	1.74	0.837	8.91	73.2	0.694
		RPD		**3%**	**6%**	**3%**	**3%**	**4%**	**1%**	**7%**	**N/A**	**9%**	**3%**	**25% ***	**1%**	**N/A**

U = not detected at or above detection limit.
NC = not certified.
NA = not analyzed.
N/A = not applicable.
* = duplicate is out of control.
J = result less than the instrument detection limit, but more than the MDL.

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DRAFT RESULTS

#######

SPAWAR ENTERPRISES, INC.
CONCENTRATIONS OF METALS IN SEDIMENT SAMPLES
Samples Received: 3/07/02
(concentrations in µg/g dry weight - not blank corrected)

(cf#1781)

MSL Code	Rep	Sponsor I.D.	Al CP/MS	Fe ICP/MS	Cr ICP/MS	Mn ICP/MS	Ni ICP/MS	Cu ICP/MS	Zn ICP/MS	As ICP/MS	Se ICP-MS	Ag ICP-MS	Cd ICP-MS	Sn ICP-MS	Pb ICP-MS	Hg CVAF

N/S = not supplied.
NR = not reported.
w = spike recovery is out of control due to inappropriate spiking level.

Battelle
. . . Putting Technology To Work

Project Name SPAWAR - PRISIM Field Site 1 Supporting Analysis
Project Number G600101-1000

Client Sample ID	P17-3 SEAWATER	P04-1 POREWATER	P04-2 POREWATER	P04-3 POREWATER	P17-1 POREWATER
Battelle Sample ID	V1785	V1786	V1787	V1788	V1789
Battelle Batch ID	02-079	02-079	02-079	02-079	02-079
Associated Blank	ZU92PB	ZU92PB	ZU92PB	ZU92PB	ZU92PB
QC Type	N	N	N	N	N
Data File	B8377.D	B8378.D	B8379.D	B8380.D	B8381.D
Field Date	01/09/02	01/15/02	01/15/02	01/15/02	01/09/02
Extraction Date	02/14/02	02/14/02	02/14/02	02/14/02	02/14/02
Acquired Date	02/24/02	02/24/02	02/24/02	02/24/02	02/24/02
Percent Moisture	NA	NA	NA	NA	NA
Sample Size	0.5 L	0.67 L	0.92 L	0.95 L	0.71 L
Weight Basis	NA	NA	NA	NA	NA
Dilution Factor	1	1	1	1	1
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	10	7.46	5.43	5.26	7.04
Amount Units	ng/L	ng/L	ng/L	ng/L	ng/L
Naphthalene	3.57 BJ	4.19 BJ	3.51 BJ	3.94 BJ	4.5 BJ
C1-Naphthalenes	2.42 BJ	2.82 BJ	2.12 BJ	2.95 BJ	2.45 BJ
C2-Naphthalenes	5.35 J	4.32 J	1.84 J	5.75 J	6.91 J
C3-Naphthalenes	ND U	ND U	ND U	ND U	ND U
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND U
2-Methylnaphthalene	1.92 B	2.64 B	2.36 B	2.84 B	2.52 B
1-Methylnaphthalene	1.47 B	1.5 B	1.18 B	1.87 B	1.48 B
2,6-Dimethylnaphthalene	1.64 B	1.47 B	1 B	3.57 B	4.09 B
2,3,5-Trimethylnaphthalene	ND U	ND U	ND U	ND U	ND U
Biphenyl	1.08 B	1.1 B	0.782 B	0.895 B	0.949 B
Acenaphthylene	4.44	5.29	4.46	7.62	5.93
Acenaphthene	2.08	0.561 J	0.476 J	1.25	9.74
Fluorene	1.1 J	1.33	0.784	1.36	ND U
C1-Fluorenes	ND U	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U	ND U
Phenanthrene	4.55	5.09	3.27	3.58	3.52
Anthracene	9.97	13.3	9.56	43.6	27.4
C1-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C2-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C3-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	43.7
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	66.2
1-Methylphenanthrene	ND U	ND U	ND U	ND U	ND U
Dibenzothiophene	ND U	ND U	ND U	ND U	ND U
C1-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C2-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C3-Dibenzothiophenes	ND U	ND U	ND U	ND U	39.3
Fluoranthene	55.1	8.38	4.52	14.8	67.7
Pyrene	49.1	15.8	15.7	32.3	65.8
C1-Fluoranthenes/Pyrenes	38.4	15.6	12.8	27.4	111
C2-Fluoranthenes/Pyrenes	18	14.5	ND U	13.9	62.9
C3-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	32.7
Benzo(a)anthracene	14.5	5.74	3.62	7.71	17.7
Chrysene	28.8	9.4	5.21	14.7	33.2
C1-Chrysenes	13.7	ND U	6.58	12.8	34.9
C2-Chrysenes	ND U	ND U	ND U	ND U	23.3
C3-Chrysenes	ND U	ND U	ND U	ND U	ND U
C4-Chrysenes	ND U	ND U	ND U	ND U	ND U
Benzo(b)fluoranthene	41.3	57.3	39.5	77.4	93
Benzo(j/k)fluoranthene	41.5	45.8	32.5	62.7	77.8
Benzo(e)pyrene	33.1	24	23.3	56	59.1
Benzo(a)pyrene	36.7	46.2	32.1	45.3	70.7
Perylene	8.41	3.9	4.48	10.2	17.1
Indeno(1,2,3-c,d)pyrene	16.2	24.8	18.5	31.4	39
Dibenz(a,h)anthracene	2.91	4.21	2.88	1.81	9.38
Benzo(g,h,i)perylene	16.8	26.3	15.7	26.8	33.4
Surrogate Recoveries (%)					
Naphthalene-d8	53	50	45	62	52
Phenanthrene-d10	80	79	68	84	80
Chrysene-d12	91	89	79	92	90

J=Result < Peak MDL
B=Result > 5 x PB.
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Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID	P17-2 SEAWATER	P17-2 POREWATER	BFSD1-P17-1-E1-B	BFSD1-P17-1-E2-B	BFSD1-P17-1-E3-B
Battelle Sample ID	V1784	V1790	V1791	V1792	V1793
Battelle Batch ID	02-079	02-079	02-079	02-079	02-079
Associated Blank	ZU92PB	ZU92PB	ZU92PB	ZU92PB	ZU92PB
QC Type	N	N	N	N	N
Data File	B8383.D	B8384.D	B8564.D	B8565.D	B8566.D
Field Date	01/09/02	01/09/02	NA	NA	NA
Extraction Date	02/14/02	02/14/02	02/14/02	02/14/02	02/14/02
Acquired Date	02/24/02	02/24/02	03/08/02	03/08/02	03/08/02
Percent Moisture	NA	NA	NA	NA	NA
Sample Size	0.89 L	2.1 L	0.17 L	0.19 L	0.18 L
Weight Basis	NA	NA	NA	NA	NA
Dilution Factor	1	1	1	1	1
PIV	0.5	0.5	0.1	0.1	0.1
Min Reporting Limit	5.62	2.38	5.88	5.26	5.56
Amount Units	ng/L	ng/L	ng/L	ng/L	ng/L
Naphthalene	3.15 BJ	1.49 BJ	15.2 J	11.1 J	10.3 J
C1-Naphthalenes	2.48 BJ	1.07 BJ	7.12 J	5.55 J	4.5 J
C2-Naphthalenes	9.84 J	4.89 J	5.68 J	5.77 J	5.88 J
C3-Naphthalenes	ND U	ND U	ND U	ND U	ND U
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND U
2-Methylnaphthalene	2.3 B	1.17 B	6.7	5.11	3.96
1-Methylnaphthalene	1.45 B	0.573 B	4.56	3.66	2.98 J
2,6-Dimethylnaphthalene	7.95	3.95 B	1.86 BJ	1.4 BJ	1.67 BJ
2,3,5-Trimethylnaphthalene	ND U	ND U	ND U	ND U	ND U
Biphenyl	1.29 B	0.658 B	2.63 J	2.31 J	1.91 J
Acenaphthylene	6.71	5.48	1.74 J	1.44 J	1.56 J
Acenaphthene	11.4	1.26	1.03 J	2.93 J	4.17
Fluorene	ND U	1.47	1.14 J	1.9 J	1.82 J
C1-Fluorenes	ND U	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U	ND U
Phenanthrene	6.32	7.21	2.98	3.08	2.76
Anthracene	19.1	14.6	4.14	4.17	4.44
C1-Phenanthrenes/Anthracenes	21.6	8.67	ND U	ND U	ND U
C2-Phenanthrenes/Anthracenes	42.8	9.81	ND U	ND U	ND U
C3-Phenanthrenes/Anthracenes	40	6.79	ND U	ND U	ND U
C4-Phenanthrenes/Anthracenes	20	8.47	ND U	ND U	ND U
1-Methylphenanthrene	2.51	1.09	ND U	ND U	ND U
Dibenzothiophene	ND U	ND U	ND U	ND U	ND U
C1-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C2-Dibenzothiophenes	14.4	4	ND U	ND U	ND U
C3-Dibenzothiophenes	29.3	6.87	ND U	ND U	ND U
Fluoranthene	252	51.7	19	16.8	21.1
Pyrene	139	52.2	11.5	9.54	11.8
C1-Fluoranthenes/Pyrenes	132	41.6	4.9	0.676 J	6.34
C2-Fluoranthenes/Pyrenes	54.8	22.6	ND U	ND U	ND U
C3-Fluoranthenes/Pyrenes	30.4	11.4	ND U	ND U	ND U
Benzo(a)anthracene	105	22.1	1.05 J	ND U	ND U
Chrysene	58.6	35.8	2.26 J	1.62 J	2.59
C1-Chrysenes	44.1	18.6	ND U	ND U	ND U
C2-Chrysenes	26.1	13.3	ND U	ND U	ND U
C3-Chrysenes	ND U	5.69	ND U	ND U	ND U
C4-Chrysenes	ND U	ND U	ND U	ND U	ND U
Benzo(b)fluoranthene	93.9	59.4	1.95 J	1.28 J	1.52 J
Benzo(j/k)fluoranthene	82.4	48.6	1.7 J	0.925 J	1.18 J
Benzo(e)pyrene	59.2	40.6	2.4 J	1.08 J	1.5 J
Benzo(a)pyrene	78.1	43.7	0.686 BJ	0.595 BJ	0.784 BJ
Perylene	19.3	11.8	ND U	ND U	ND U
Indeno(1,2,3-c,d)pyrene	40.1	30.9	1.25 J	0.74 BJ	0.978 J
Dibenz(a,h)anthracene	9.7	6.67	0.575 J	ND U	ND U
Benzo(g,h,i)perylene	36	29.6	4.68	1.23 BJ	1.44 BJ
Surrogate Recoveries (%)					
Naphthalene-d8	43	57	54	47	42
Phenanthrene-d10	63	79	82	74	72
Chrysene-d12	68	86	86	80	85

J=Result < Peak MDL
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Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID	BFSD1-P17-1-E4-B	BFSD1-P17-1-E5-B	BFSD2-P04-3-A1-B	BFSD2-P04-3-A2-B	BFSD2-P04-3-A3-B
Battelle Sample ID	V1794	V1795	V1796	V1797	V1798
Battelle Batch ID	02-079	02-079	02-079	02-079	02-079
Associated Blank	ZU92PB	ZU92PB	ZU92PB	ZU92PB	ZU92PB
QC Type	N	N	N	N	N
Data File	B8567.D	B8568.D	B8569.D	B8570.D	B8571.D
Field Date	NA	NA	NA	NA	NA
Extraction Date	02/14/02	02/14/02	02/14/02	02/14/02	02/14/02
Acquired Date	03/08/02	03/08/02	03/08/02	03/08/02	03/08/02
Percent Moisture	NA	NA	NA	NA	NA
Sample Size	0.18 L	0.18 L	0.18 L	0.18 L	0.18 L
Weight Basis	NA	NA	NA	NA	NA
Dilution Factor	1	1	1	1	1
PIV	0.1	0.1	0.1	0.1	0.1
Min Reporting Limit	5.56	5.56	5.56	5.56	5.56
Amount Units	ng/L	ng/L	ng/L	ng/L	ng/L
Naphthalene	9.67 J	11.2 J	9.42 J	12.6 J	12 J
C1-Naphthalenes	4.38 J	5.3 J	3.76 BJ	4.12 BJ	5.22 J
C2-Naphthalenes	4.58 J	5.21 J	ND U	4.1 J	5.28 J
C3-Naphthalenes	ND U	ND U	ND U	ND U	ND U
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND U
2-Methylnaphthalene	4.41	4.9	3.66 B	3.8 B	4.69
1-Methylnaphthalene	2.96 J	3.11 J	2.3 BJ	2.37 BJ	3.52
2,6-Dimethylnaphthalene	1.28 BJ	1.5 BJ	ND U	1.18 BJ	1.24 BJ
2,3,5-Trimethylnaphthalene	ND U	ND U	ND U	ND U	ND U
Biphenyl	1.65 BJ	2.16 J	1.55 BJ	2.31 J	2.13 J
Acenaphthylene	1.54 J	1.65 J	1.25 J	1.33 J	2.14 J
Acenaphthene	5.76	9.39	1 J	0.997 J	1.28 J
Fluorene	2.25 J	3.68	6.29	0.911 J	1.21 J
C1-Fluorenes	ND U	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U	ND U
Phenanthrene	3.89	4.45	1.82 BJ	3.01	2.98
Anthracene	4.37	5.18	2.58	5.44	7.72
C1-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C2-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C3-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
1-Methylphenanthrene	ND U	ND U	ND U	ND U	ND U
Dibenzothiophene	ND U	ND U	ND U	ND U	ND U
C1-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C2-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C3-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
Fluoranthene	19.4	20.9	11.9	9.18	7.01
Pyrene	12.2	13.7	7.33	6.37	5.97
C1-Fluoranthenes/Pyrenes	5.22	4.74	ND U	ND U	ND U
C2-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	ND U
C3-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	ND U
Benzo(a)anthracene	ND U	ND U	ND U	ND U	ND U
Chrysene	2.31 J	2.06 J	1.57 J	1.4 J	1.81 J
C1-Chrysenes	ND U	ND U	ND U	ND U	ND U
C2-Chrysenes	ND U	ND U	ND U	ND U	ND U
C3-Chrysenes	ND U	ND U	ND U	ND U	ND U
C4-Chrysenes	ND U	ND U	ND U	ND U	ND U
Benzo(b)fluoranthene	1.64 J	1.36 J	2.7 J	2.04 J	1.79 J
Benzo(j/k)fluoranthene	1.29 J	1.12 J	1.78 J	1.47 J	1.5 J
Benzo(e)pyrene	1.34 J	0.978 J	1.78 J	1.53 J	1.52 J
Benzo(a)pyrene	0.64 BJ	ND U	0.765 BJ	0.69 BJ	ND U
Perylene	ND U	ND U	ND U	ND U	ND U
Indeno(1,2,3-c,d)pyrene	ND U	0.595 BJ	ND U	0.586 BJ	0.684 BJ
Dibenz(a,h)anthracene	0.58 J	ND U	ND U	ND U	ND U
Benzo(g,h,i)perylene	1.46 BJ	1.14 BJ	1.54 BJ	1.35 BJ	1.66 J
Surrogate Recoveries (%)					
Naphthalene-d8	45	49	52	52	50
Phenanthrene-d10	76	80	77	79	74
Chrysene-d12	86	85	91	88	82

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Project Name SPAWAR - PRISIM Field Site 1 Supporting Analysis
Project Number G600101-1000

Client Sample ID	P17-3, Porewater	P04-2, Seawater	P04-3, Seawater	P17-1, Seawater	BFSD2-PO4-3-A4-B
Battelle Sample ID	V1824	V1826	V1827	V1828	V1799
Battelle Batch ID	02-083	02-083	02-083	02-083	02-083
Associated Blank	ZV12PB	ZV12PB	ZV12PB	ZV12PB	ZV12PB
QC Type	N	N	N	N	N
Data File	B8404.D	B8405.D	B8406.D	B8407.D	B8574.D
Field Date	01/09/02	01/15/02	01/15/02	01/09/02	NA
Extraction Date	02/15/02	02/15/02	02/15/02	02/15/02	02/15/02
Acquired Date	02/25/02	02/25/02	02/25/02	02/25/02	03/08/02
Percent Moisture	NA	NA	NA	NA	NA
Sample Size	0.78 L	1.52 L	1 L	2.2 L	0.171 L
Weight Basis	NA	NA	NA	NA	NA
Dilution Factor	1	1	1	1	1
PIV	0.5	0.5	0.5	0.5	0.1
Min Reporting Limit	6.41	3.29	5	2.27	5.85
Amount Units	ng/L	ng/L	ng/L	ng/L	ng/L
Naphthalene	1.59 BJ	0.87 BJ	1.22 BJ	0.679 BJ	7.68 BJ
C1-Naphthalenes	1.15 BJ	0.621 BJ	0.618 BJ	0.433 BJ	3.1 J
C2-Naphthalenes	6.28 J	2.33 J	ND U	1.46 J	2.65 J
C3-Naphthalenes	ND U	ND U	ND U	ND U	ND U
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND U
2-Methylnaphthalene	1 B	0.783 B	0.747 B	0.553 B	2.78 J
1-Methylnaphthalene	0.526 BJ	0.351 BJ	0.391 BJ	0.256 BJ	1.82 J
2,6-Dimethylnaphthalene	2.87	0.845	ND U	0.458	1.01 J
2,3,5-Trimethylnaphthalene	ND U	ND U	ND U	ND U	ND U
Biphenyl	0.819	0.26 J	ND U	0.157 J	1.54 J
Acenaphthylene	6.53	3.48	3	2.27	1.69 J
Acenaphthene	7.57	0.344 J	ND U	0.666	1.49 J
Fluorene	ND U	0.761 B	0.502 BJ	0.354 B	1.43 J
C1-Fluorenes	ND U	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U	ND U
Phenanthrene	3.36 B	1.86 B	1.54 B	1.57 B	3.13 B
Anthracene	24.4	6.75	4.35	5.86	9.35
C1-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C2-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C3-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
1-Methylphenanthrene	ND U	ND U	ND U	ND U	ND U
Dibenzothiophene	ND U	ND U	ND U	ND U	ND U
C1-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C2-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C3-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
Fluoranthene	82.3	14.2	11.4	33.8	6.19
Pyrene	48.1	10.8	10.8	22.9	5.37
C1-Fluoranthenes/Pyrenes	77.2	8.3	6.03	15.9	ND U
C2-Fluoranthenes/Pyrenes	31.4	ND U	ND U	6.33	ND U
C3-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	ND U
Benzo(a)anthracene	21.2	4.58	3.48	7.84	ND U
Chrysene	33.2	9.04	7.36	11.8	1.45 J
C1-Chrysenes	23.3	3.4	2.42	5.16	ND U
C2-Chrysenes	17.6	ND U	ND U	ND U	ND U
C3-Chrysenes	ND U	ND U	ND U	ND U	ND U
C4-Chrysenes	ND U	ND U	ND U	ND U	ND U
Benzo(b)fluoranthene	66.7	21.5	16.2	16.5	0.807 J
Benzo(j/k)fluoranthene	63.8	19.7	13.2	15.6	ND U
Benzo(e)pyrene	47.6	15.3	12.4	12.4	1.12 J
Benzo(a)pyrene	54.9	18.5	12.8	13.3	ND U
Perylene	13.1	3.48	3.18	3.19	ND U
Indeno(1,2,3-c,d)pyrene	24.1	15.1	10.1	7.52	ND U
Dibenz(a,h)anthracene	5.15	2.28	1.84	1.48	ND U
Benzo(g,h,i)perylene	24.4	12.8	9.13	7.04	1.57 J
Surrogate Recoveries (%)					
Naphthalene-d8	53	65	70	56	61
Phenanthrene-d10	77	77	77	74	81
Chrysene-d12	78	86	82	76	91

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B=Result > 5 x PB.
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E=Above calibration response.
ND= Analyte not detected.

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Project Name SPAWAR - PRISIM
Project Number G600101-1000

Client Sample ID	BFSD2-PO4-3-A5-B	BFSD2-PO4-3-A6-B	BFSD2-PO4-3-A7	BFSD2-PO4-3-A8	BFSD2-PO4-3-A9
Battelle Sample ID	V1800	V1801	V1802	V1803	V1804
Battelle Batch ID	02-083	02-083	02-083	02-083	02-083
Associated Blank	ZV12PB	ZV12PB	ZV12PB	ZV12PB	ZV12PB
QC Type	N	N	N	N	N
Data File	B8575.D	B8576.D	B8577.D	B8578.D	B8579.D
Field Date	NA	NA	NA	NA	NA
Extraction Date	02/15/02	02/15/02	02/15/02	02/15/02	02/15/02
Acquired Date	03/08/02	03/08/02	03/09/02	03/09/02	03/09/02
Percent Moisture	NA	NA	NA	NA	NA
Sample Size	0.18 L	0.145 L	0.188 L	0.188 L	0.192 L
Weight Basis	NA	NA	NA	NA	NA
Dilution Factor	1	1	1	1	1
PIV	0.1	0.1	0.1	0.1	0.1
Min Reporting Limit	5.56	6.9	5.32	5.32	5.21
Amount Units	ng/L	ng/L	ng/L	ng/L	ng/L
Naphthalene	6.3 BJ	7.65 BJ	10.3 J	7.95 BJ	7.82 BJ
C1-Naphthalenes	2.26 J	2.71 J	3.31 J	2.92 J	2.44 J
C2-Naphthalenes	3.55 J	3.85 J	4.79 J	4.13 J	4.65 J
C3-Naphthalenes	ND U	ND U	ND U	ND U	ND U
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND U
2-Methylnaphthalene	2.12 J	2.28 J	2.61 J	3.18	2.39 J
1-Methylnaphthalene	1.58 J	1.47 J	1.85 J	1.34 BJ	1.25 BJ
2,6-Dimethylnaphthalene	0.828 J	ND U	1.6 J	0.692 J	1.07 J
2,3,5-Trimethylnaphthalene	ND U	ND U	ND U	ND U	ND U
Biphenyl	1.17 J	1.2 J	1.29 J	0.892 J	1.14 J
Acenaphthylene	1.25 J	1.94 J	2.18 J	1.83 J	1.8 J
Acenaphthene	1.16 J	ND U	1.87 J	ND U	ND U
Fluorene	1.16 J	1.12 J	1.36 J	1.08 J	0.832 BJ
C1-Fluorenes	ND U	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U	ND U
Phenanthrene	2.25 BJ	2.5 BJ	3.84	2.51 B	2.91 B
Anthracene	9.41	11.8	6.53	10.9	13.1
C1-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C2-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C3-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
1-Methylphenanthrene	ND U	ND U	ND U	ND U	ND U
Dibenzothiophene	ND U	ND U	ND U	ND U	ND U
C1-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C2-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C3-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
Fluoranthene	6.06	6.37	23	11.3	8.69
Pyrene	5.32	5.02	8.21	7.72	7.5
C1-Fluoranthenes/Pyrenes	ND U	ND U	4.29	ND U	ND U
C2-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	ND U
C3-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	ND U
Benzo(a)anthracene	ND U	ND U	1.13 J	ND U	1.25 J
Chrysene	0.984 J	ND U	1.86 J	1.43 J	2.39
C1-Chrysenes	ND U	ND U	ND U	ND U	ND U
C2-Chrysenes	ND U	ND U	ND U	ND U	ND U
C3-Chrysenes	ND U	ND U	ND U	ND U	ND U
C4-Chrysenes	ND U	ND U	ND U	ND U	ND U
Benzo(b)fluoranthene	0.797 J	1.35 J	1.4 J	2.88	2.4 J
Benzo(j/k)fluoranthene	0.666 J	ND U	0.954 J	1.52 J	2.84
Benzo(e)pyrene	0.598 J	1.04 J	1.06 J	1.01 J	1.74 J
Benzo(a)pyrene	ND U	ND U	ND U	ND U	1.08 J
Perylene	ND U	ND U	ND U	ND U	0.747 J
Indeno(1,2,3-c,d)pyrene	ND U	ND U	ND U	ND U	1.06 J
Dibenz(a,h)anthracene	ND U	ND U	ND U	ND U	ND U
Benzo(g,h,i)perylene	1.12 J	2.01 J	1.03 J	1.21 J	1.46 J
Surrogate Recoveries (%)					
Naphthalene-d8	57	55	61	58	61
Phenanthrene-d10	80	76	77	77	78
Chrysene-d12	91	92	91	97	92

J=Result < Peak MDL
B=Result > 5 x PB.
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Project Name SPAWAR - PRISIM
Project Number G600101-1000

Client Sample ID	BFSD2-PO4-3-A10	BFSD2-PO4-3-A11	BFSD2-PO4-3-A12	BFSD1-PO4-3-E6	BFSD1-PO4-3-E7
Battelle Sample ID	V1805	V1806	V1807	V1808	V1809
Battelle Batch ID	02-083	02-083	02-083	02-083	02-083
Associated Blank	ZV12PB	ZV12PB	ZV12PB	ZV12PB	ZV12PB
QC Type	N	N	N	N	N
Data File	B8580.D	B8581.D	B8582.D	B8584.D	B8585.D
Field Date	NA	NA	NA	NA	NA
Extraction Date	02/15/02	02/15/02	02/15/02	02/15/02	02/15/02
Acquired Date	03/09/02	03/09/02	03/09/02	03/09/02	03/09/02
Percent Moisture	NA	NA	NA	NA	NA
Sample Size	0.19 L	0.19 L	0.195 L	0.171 L	0.184 L
Weight Basis	NA	NA	NA	NA	NA
Dilution Factor	1	1	1	1	1
PIV	0.1	0.1	0.1	0.1	0.1
Min Reporting Limit	5.26	5.26	5.13	5.85	5.43
Amount Units	ng/L	ng/L	ng/L	ng/L	ng/L
Naphthalene	6.37 BJ	5.15 BJ	10.7 J	9.6 J	7.36 BJ
C1-Naphthalenes	2.08 J	1.92 BJ	3.39 J	3.54 J	1.85 BJ
C2-Naphthalenes	2.78 J	3.5 J	5.6 J	6.11 J	4.37 J
C3-Naphthalenes	ND U	ND U	5.64 J	ND U	ND U
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND U
2-Methylnaphthalene	1.76 J	1.84 J	3.04	3.25 J	1.97 J
1-Methylnaphthalene	1.07 BJ	1.05 BJ	1.86 J	1.99 J	1.09 BJ
2,6-Dimethylnaphthalene	0.916 J	0.972 J	1.52 J	1.56 J	0.616 J
2,3,5-Trimethylnaphthalene	ND U	ND U	0.405 J	ND U	ND U
Biphenyl	0.938 J	0.924 J	1.35 J	1.49 J	0.862 J
Acenaphthylene	2.06 J	2.06 J	1.98 J	1.22 J	1.22 J
Acenaphthene	7.8	7.77	0.965 J	ND U	ND U
Fluorene	0.874 BJ	0.817 BJ	2.01 J	1.17 J	0.614 BJ
C1-Fluorenes	ND U	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U	ND U
Phenanthrene	1.85 BJ	1.61 BJ	6.59	3.99	1.28 BJ
Anthracene	12.6	12	16.3	6.34	2.89
C1-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C2-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C3-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
1-Methylphenanthrene	ND U	ND U	ND U	ND U	ND U
Dibenzothiophene	ND U	ND U	ND U	ND U	ND U
C1-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C2-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C3-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
Fluoranthene	6.59	6.78	5.41	9.38	9.16
Pyrene	6.55	6.92	6.1	4.91	4.57
C1-Fluoranthenes/Pyrenes	3.22	ND U	ND U	ND U	ND U
C2-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	ND U
C3-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	ND U
Benzo(a)anthracene	ND U	ND U	ND U	ND U	ND U
Chrysene	4.63	ND U	1.55 J	1.22 J	1.18 J
C1-Chrysenes	ND U	ND U	ND U	ND U	ND U
C2-Chrysenes	ND U	ND U	ND U	ND U	ND U
C3-Chrysenes	ND U	ND U	ND U	ND U	ND U
C4-Chrysenes	ND U	ND U	ND U	ND U	ND U
Benzo(b)fluoranthene	1.53 J	1.29 J	1.94 J	1.07 J	0.73 J
Benzo(j/k)fluoranthene	1.19 J	0.884 J	1.36 J	0.793 J	0.695 J
Benzo(e)pyrene	0.983 J	1.13 J	1.19 J	0.627 J	0.667 J
Benzo(a)pyrene	0.55 J	ND U	ND U	ND U	ND U
Perylene	ND U	ND U	ND U	ND U	ND U
Indeno(1,2,3-c,d)pyrene	ND U	ND U	ND U	ND U	ND U
Dibenz(a,h)anthracene	ND U	ND U	ND U	ND U	ND U
Benzo(g,h,i)perylene	0.997 J	0.805 J	0.983 J	0.915 J	1 J
Surrogate Recoveries (%)					
Naphthalene-d8	53	53	56	54	57
Phenanthrene-d10	72	76	75	78	74
Chrysene-d12	92	94	89	90	90

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Project Name SPAWAR - PRISIM Field Site 1 Supporting Analysis
Project Number G600101-1000

Client Sample ID	PO4-1-SEAWATER	BFSD1-PO4-3-E8	BFSD1-PO4-3-E10	BFSD1-P17-1-E1	BFSD1-P17-1-E2	BFSD1-P17-1-E3
Battelle Sample ID	V1825	V1810	V1812	V1813	V1814	V1815
Battelle Batch ID	02-091	02-091	02-091	02-091	02-091	02-091
Associated Blank	ZV48PB	ZV48PB	ZV48PB	ZV48PB	ZV48PB	ZV48PB
QC Type	N	N	N	N	N	N
Data File	B8429.D	B8587.D	B8589.D	B8590.D	B8591.D	B8592.D
Field Date	01/15/02	NA	NA	NA	NA	NA
Extraction Date	02/19/02	02/19/02	02/19/02	02/19/02	02/19/02	02/19/02
Acquired Date	02/27/02	03/09/02	03/09/02	03/09/02	03/09/02	03/09/02
Percent Moisture	NA	NA	NA	NA	NA	NA
Sample Size	0.5 L	0.18 L	0.16 L	0.17 L	0.18 L	0.18
Weight Basis	NA	NA	NA	NA	NA	NA
Dilution Factor	1	1	1	1	1	1
PIV	0.5	0.1	0.1	0.1	0.1	0.1
Min Reporting Limit	5	5.56	6.25	5.88	5.56	5.56
Amount Units	ng/L	ng/L	ng/L	ng/L	ng/L	ng/L
Naphthalene	2.06 BJ	10.4 J	9.06 J	7.55 BJ	7.41 BJ	9.33
C1-Naphthalenes	0.697 BJ	4.12 J	4.98 J	2.43 BJ	2.83 BJ	3.59
C2-Naphthalenes	ND U	6.36 J	5.12 J	ND U	3 J	5.6
C3-Naphthalenes	ND U	ND U	ND U	ND U	ND U	ND
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND U	ND
2-Methylnaphthalene	0.911 BJ	4.1	5.13	2.22 BJ	2.69 BJ	3.16
1-Methylnaphthalene	0.644 BJ	2.27 BJ	2.11 BJ	1.62 BJ	1.51 BJ	2.25
2,6-Dimethylnaphthalene	ND U	1.2 BJ	1.18 BJ	ND U	ND U	4.08
2,3,5-Trimethylnaphthalene	ND U	ND U	ND U	ND U	ND U	ND
Biphenyl	ND U	1.96 J	1.5 BJ	1.12 BJ	1.1 BJ	1.7
Acenaphthylene	1.1	1.26 J	1.06 J	1.91 J	1.72 J	1.29
Acenaphthene	ND U	1.2 J	ND U	ND U	ND U	ND
Fluorene	ND U	0.746 BJ	ND U	5.99	0.778 BJ	0.445
C1-Fluorenes	ND U	ND U	ND U	ND U	ND U	ND
C2-Fluorenes	ND U	ND U	ND U	ND U	ND U	ND
C3-Fluorenes	ND U	ND U	ND U	ND U	ND U	ND
Phenanthrene	1.57	1.75 J	1.43 J	1.45 J	1.77 J	1.35
Anthracene	2.51	10.5	8.07	4.06	5.24	7.16
C1-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U	ND
C2-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U	ND
C3-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U	ND
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U	ND
1-Methylphenanthrene	ND U	ND U	ND U	ND U	ND U	ND
Dibenzothiophene	ND U	ND U	ND U	ND U	ND U	ND
C1-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U	ND
C2-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U	ND
C3-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U	ND
Fluoranthene	6.78	10.5	7.03	37.3	32.1	28.3
Pyrene	4.72	5.14	3.82	18.9	16.5	18.3
C1-Fluoranthenes/Pyrenes	ND U	3.33	ND U	6.34	5.96	6.68
C2-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	ND U	ND
C3-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U	ND U	ND
Benzo(a)anthracene	ND U	ND U	ND U	ND U	1.58 J	ND
Chrysene	1.07	1.55 J	1.44 J	4.16	3.87	ND
C1-Chrysenes	ND U	ND U	ND U	ND U	ND U	ND
C2-Chrysenes	ND U	ND U	ND U	ND U	ND U	ND
C3-Chrysenes	ND U	ND U	ND U	ND U	ND U	ND
C4-Chrysenes	ND U	ND U	ND U	ND U	ND U	ND
Benzo(b)fluoranthene	ND U	1.39 J	0.863 J	0.795 J	1.63 J	1.17
Benzo(j/k)fluoranthene	ND U	0.754 J	0.613 J	0.819 J	1.27 J	0.704
Benzo(e)pyrene	ND U	0.779 J	0.7 J	0.816 J	1.1 J	0.681
Benzo(a)pyrene	ND U	ND U	ND U	ND U	ND U	ND
Perylene	ND U	ND U	ND U	ND U	ND U	ND
Indeno(1,2,3-c,d)pyrene	ND U	ND U	ND U	ND U	ND U	ND
Dibenz(a,h)anthracene	ND U	ND U	ND U	ND U	ND U	ND
Benzo(g,h,i)perylene	ND U	0.809 BJ	0.609 BJ	1.15 J	0.96 J	0.423
Surrogate Recoveries (%)						
Naphthalene-d8	80	57	51	49	60	49
Phenanthrene-d10	78	69	65	64	72	58
Chrysene-d12	95	83	87	95	91	82

J=Result < Peak MDL
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U=Not detected.
E=Above calibration response.
ND= Analyte not detected.
&= Out of DQO range.

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Project Name SPAWAR - PRISIM F
Project Number G600101-1000

Client Sample ID		BFSD1-P17-1-E4	BFSD1-P17-1-E5	BFSD2-P17-1-A2	BFSD2-P17-1-A3	BFSD2-P17-1-A4
Battelle Sample ID		V1816	V1817	V1819	V1820	V1821
Battelle Batch ID		02-091	02-091	02-091	02-091	02-091
Associated Blank		ZV48PB	ZV48PB	ZV48PB	ZV48PB	ZV48PB
QC Type		N	N	N	N	N
Data File		B8593.D	B8594.D	B8597.D	B8598.D	D2533.D
Field Date		NA	NA	NA	NA	NA
Extraction Date		02/19/02	02/19/02	02/19/02	02/19/02	02/19/02
Acquired Date		03/09/02	03/10/02	03/10/02	03/10/02	03/17/02
Percent Moisture		NA	NA	NA	NA	NA
Sample Size	L	0.17 L	0.17 L	0.19 L	0.18 L	0.18 L
Weight Basis		NA	NA	NA	NA	NA
Dilution Factor		1	1	1	1	1
PIV		0.1	0.1	0.1	0.1	0.1
Min Reporting Limit		5.88	5.88	5.26	5.56	5.56
Amount Units		ng/L	ng/L	ng/L	ng/L	ng/L
Naphthalene	J	20.6 J	10.6 J	6.73 BJ	8.48 BJ	9.25 J
C1-Naphthalenes	BJ	ND U	4.6 J	2.73 BJ	2.73 BJ	3.49 BJ
C2-Naphthalenes	J	ND U	4.29 J	ND U	2.66 J	ND U
C3-Naphthalenes	U	ND U	ND U	ND U	ND U	ND U
C4-Naphthalenes	U	ND U	ND U	ND U	ND U	ND U
2-Methylnaphthalene	BJ	ND U	3.53	2.5 BJ	3.19 BJ	2.86 BJ
1-Methylnaphthalene	BJ	ND U	2.34 BJ	1.35 BJ	1.23 BJ	1.31 BJ
2,6-Dimethylnaphthalene		ND U	1.46 BJ	ND U	0.62 BJ	ND U
2,3,5-Trimethylnaphthalene	U	ND U	ND U	ND U	ND U	ND U
Biphenyl	J	ND U	2.02 J	0.832 BJ	0.918 BJ	ND U
Acenaphthylene	J	ND U	0.999 J	1.67 J	1.1 J	ND U
Acenaphthene	U	ND U	ND U	ND U	ND U	ND U
Fluorene	BJ	ND U	0.595 BJ	ND U	ND U	ND U
C1-Fluorenes	U	ND U	ND U	ND U	ND U	ND U
C2-Fluorenes	U	ND U	ND U	ND U	ND U	ND U
C3-Fluorenes	U	ND U	ND U	ND U	ND U	ND U
Phenanthrene	BJ	ND U	1.64 J	0.937 BJ	1.04 BJ	ND U
Anthracene		ND U	8.38	6.05	3.63	ND U
C1-Phenanthrenes/Anthracenes	U	ND U	ND U	ND U	ND U	ND U
C2-Phenanthrenes/Anthracenes	U	ND U	ND U	ND U	ND U	ND U
C3-Phenanthrenes/Anthracenes	U	ND U	ND U	ND U	ND U	ND U
C4-Phenanthrenes/Anthracenes	U	ND U	ND U	ND U	ND U	ND U
1-Methylphenanthrene	U	ND U	ND U	ND U	ND U	ND U
Dibenzothiophene	U	ND U	ND U	ND U	ND U	ND U
C1-Dibenzothiophenes	U	ND U	ND U	ND U	ND U	ND U
C2-Dibenzothiophenes	U	ND U	ND U	ND U	ND U	ND U
C3-Dibenzothiophenes	U	ND U	ND U	ND U	ND U	ND U
Fluoranthene		26.2	21.4	27.2	19.4	23.4
Pyrene		20.5	14.1	21.5	22.5	26
C1-Fluoranthenes/Pyrenes		ND U	5.44	6.64	5.74	ND U
C2-Fluoranthenes/Pyrenes	U	ND U	ND U	ND U	ND U	ND U
C3-Fluoranthenes/Pyrenes	U	ND U	ND U	ND U	ND U	ND U
Benzo(a)anthracene	U	6.2	1.08 J	1.11 J	0.939 J	ND U
Chrysene	U	11.6	2.66	2.91	3.66	2.77
C1-Chrysenes	U	ND U	ND U	ND U	ND U	ND U
C2-Chrysenes	U	ND U	ND U	ND U	ND U	ND U
C3-Chrysenes	U	ND U	ND U	ND U	ND U	ND U
C4-Chrysenes	U	ND U	ND U	ND U	ND U	ND U
Benzo(b)fluoranthene	J	8.38	1.4 J	1.5 J	1.49 J	ND U
Benzo(j/k)fluoranthene	J	ND U	1.05 J	1.08 J	1.06 J	ND U
Benzo(e)pyrene	J	12	0.698 J	1.2 J	1.02 J	ND U
Benzo(a)pyrene	U	ND U	ND U	ND U	0.554 J	ND U
Perylene	U	ND U	ND U	ND U	ND U	ND U
Indeno(1,2,3-c,d)pyrene	U	ND U	ND U	ND U	0.44 J	ND U
Dibenz(a,h)anthracene	U	ND U	ND U	ND U	ND U	ND U
Benzo(g,h,i)perylene	BJ	8.74	0.832 BJ	0.819 BJ	0.493 BJ	3.77
Surrogate Recoveries (%)						
Naphthalene-d8		48	56	46	44	39 &
Phenanthrene-d10		72	70	68	60	68
Chrysene-d12		111	90	93	71	96

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E=Above calibration response.
ND= Analyte not detected.
&= Out of DQO range.

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Project Name SPAWAR - PRISIM F
Project Number G600101-1000

Client Sample ID	BFSD2-P17-1-A6	BFSD1-PO4-3-E9	BFSD2-P17-1-A1	BFSD2-P17-1-A5
Battelle Sample ID	V1823	V1811	V1818	V1822
Battelle Batch ID	02-091	02-091	02-091	02-091
Associated Blank	ZV48PB	ZV48PB	ZV48PB	ZV48PB
QC Type	N	N	N	N
Data File	B8601.D	B8603.D	B8604.D	B8605.D
Field Date	NA	NA	NA	NA
Extraction Date	02/19/02	02/19/02	02/19/02	02/19/02
Acquired Date	03/10/02	03/10/02	03/10/02	03/10/02
Percent Moisture	NA	NA	NA	NA
Sample Size	0.19 L	0.18 L	0.18 L	0.18 L
Weight Basis	NA	NA	NA	NA
Dilution Factor	1	1	1	1
PIV	0.1	0.1	0.1	0.1
Min Reporting Limit	5.26	5.56	5.56	5.56
Amount Units	ng/L	ng/L	ng/L	ng/L
Naphthalene	1.85 BJ	9.41 J	8.22 BJ	9.41 J
C1-Naphthalenes	ND U	3.54 BJ	2.72 BJ	1.73 BJ
C2-Naphthalenes	ND U	ND U	ND U	ND U
C3-Naphthalenes	ND U	ND U	ND U	ND U
C4-Naphthalenes	ND U	ND U	ND U	ND U
2-Methylnaphthalene	ND U	3.18 BJ	2.32 BJ	1.98 BJ
1-Methylnaphthalene	ND U	2.29 BJ	1.53 BJ	1.45 BJ
2,6-Dimethylnaphthalene	ND U	ND U	ND U	ND U
2,3,5-Trimethylnaphthalene	ND U	ND U	ND U	3.48
Biphenyl	ND U	ND U	1.12 BJ	ND U
Acenaphthylene	1.76 J	ND U	1.74 J	1.64 J
Acenaphthene	ND U	ND U	0.931 J	ND U
Fluorene	ND U	ND U	ND U	ND U
C1-Fluorenes	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U
Phenanthrene	1.58 J	1.69 J	1.26 BJ	1.13 BJ
Anthracene	9.15	7.23	3.57	8.86
C1-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U
C2-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U
C3-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U
1-Methylphenanthrene	ND U	ND U	ND U	ND U
Dibenzothiophene	ND U	ND U	ND U	ND U
C1-Dibenzothiophenes	ND U	ND U	ND U	ND U
C2-Dibenzothiophenes	ND U	ND U	ND U	ND U
C3-Dibenzothiophenes	ND U	ND U	ND U	ND U
Fluoranthene	32.9	5.91	32.5	27.8
Pyrene	36.1	3.2	16.2	25.8
C1-Fluoranthenes/Pyrenes	10	ND U	4.77	ND U
C2-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U
C3-Fluoranthenes/Pyrenes	ND U	ND U	ND U	ND U
Benzo(a)anthracene	2.35 J	ND U	1.32 J	1.78 J
Chrysene	4.31	1.42 J	3.1	3.48
C1-Chrysenes	ND U	ND U	ND U	ND U
C2-Chrysenes	ND U	ND U	ND U	ND U
C3-Chrysenes	ND U	ND U	ND U	ND U
C4-Chrysenes	ND U	ND U	ND U	ND U
Benzo(b)fluoranthene	2.73	ND U	1.4 J	2.5 J
Benzo(j/k)fluoranthene	2.4 J	ND U	1.04 J	ND U
Benzo(e)pyrene	2.6 J	ND U	0.831 J	ND U
Benzo(a)pyrene	ND U	ND U	ND U	ND U
Perylene	ND U	ND U	ND U	ND U
Indeno(1,2,3-c,d)pyrene	ND U	ND U	ND U	ND U
Dibenz(a,h)anthracene	ND U	ND U	ND U	ND U
Benzo(g,h,i)perylene	1.7 J	1.51 J	ND U	ND U
Surrogate Recoveries (%)				
Naphthalene-d8	7 &	54	55	53
Phenanthrene-d10	84	64	64	72
Chrysene-d12	119	92	90	96

J=Result < Peak MDL
B=Result > 5 x PB.
U=Not detected.
E=Above calibration response.
ND= Analyte not detected.
&= Out of DQO range.

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Project Name SPAWAR - PRISM Field Site 1 Supporting Analysis
Project Number G600101-1000

Client Sample ID	PO4, 20-25cm	PO4, 25-30cm	PO4, 30-35cm	PO4, 35-40cm	PO4, 40-45cm
Battelle Sample ID	V2512	V2513	V2514	V2515	V2516
Battelle Batch ID	02-172	02-172	02-172	02-172	02-172
Associated Blank	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB
QC Type	N	N	N	N	N
Data File	B9033.D	B9036.D	B9037.D	B9038.D	B9039.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02
Percent Moisture	45.99 %	44.2 %	39.54 %	28.85 %	27.38 %
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	15.77 g	16.97 g	18.65 g	21.42 g	20.55 g
Weight Basis	dry	dry	dry	dry	dry
Dilution Factor	6.67	1.01	6.67	3.33	3.33
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	2.11	0.298	1.79	0.777	0.81
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g
Naphthalene	8.45 J	1.09 BJ	5.76 J	3.42 J	3.1 J
C1-Naphthalenes	5.56 J	0.611 J	3.47 J	1.97 J	1.8 J
C2-Naphthalenes	11.8	1.15 J	7.24 J	3.43 J	3.2 J
C3-Naphthalenes	8 J	0.812 J	7.18 J	3.88 J	2.66 J
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND U
2-Methylnaphthalene	6.1	0.666	3.76	2.17	1.9
1-Methylnaphthalene	2.4	0.276	1.49	0.77	0.724
2,6-Dimethylnaphthalene	11.6	1.16	6.6	2.64	2.42
2,3,5-Trimethylnaphthalene	2.2	0.234	1.32	0.834	0.723
Biphenyl	2.03	0.276	1.26	0.936	0.701
Acenaphthylene	41.4	4.87	26	11.6	11.3
Acenaphthene	3.41	0.4	1.8	0.852	1
Fluorene	5.74	0.677	3.24	1.58	1.35
C1-Fluorenes	ND U	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U	ND U
Phenanthrene	38.6	4.72	23.8	12.4	12.2
Anthracene	83.6	9.45	49	22	21.6
C1-Phenanthrenes/Anthracenes	55.7	5.97	33.2	15.6	16.8
C2-Phenanthrenes/Anthracenes	50.6	6.64	30	ND U	12.3
C3-Phenanthrenes/Anthracenes	38.1	4.01	24.7	ND U	11
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND U
1-Methylphenanthrene	4.16	0.512	1.97	1.32	1.06
Dibenzothiophene	3.43	0.355	1.91	1	1.16
C1-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C2-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
C3-Dibenzothiophenes	ND U	ND U	ND U	ND U	ND U
Fluoranthene	94.8	11.9	54.9	27	26.6
Pyrene	127	17.2	77.4	47.4	44.7
C1-Fluoranthenes/Pyrenes	150	18.7	97.4	52.7	53.7
C2-Fluoranthenes/Pyrenes	178	18.7	117	66.6	59.3
C3-Fluoranthenes/Pyrenes	148	16.5	102	58.6	53.4
Benzo(a)anthracene	95.4	11.4	53.7	25	23.8
Chrysene	167	20.8	83.3	39.8	37.1
C1-Chrysenes	115	14.3	71.9	37.4	36.4
C2-Chrysenes	135	16.2	86.9	48.2	47.5
C3-Chrysenes	148	17.8	112	63.1	56.3
C4-Chrysenes	84.3	9.6	69.8	29.4	29.4
Benzo(b)fluoranthene	773	85.7	487	239	227
Benzo(k)fluoranthene	626	73.4	401	197	193
Benzo(e)pyrene	240	35.9	192	116	112
Benzo(a)pyrene	694	79.7	438	212	209
Perylene	47.2	6.56	28.8	13.3	12.6
Indeno(1,2,3-c,d)pyrene	410	50	255	124	127
Dibenz(a,h)anthracene	108	12.9	66.5	31.5	31.5
Benzo(g,h,i)perylene	378	46.9	244	116	121
Surrogate Recoveries (%)					
Naphthalene-d8	76	10 &	74	72	73
Phenanthrene-d10	82	10 &	78	80	77
Chrysene-d12	103	13 &	101	97	95

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B=Result < 5 x PB.
U=Not detected.
E=Above calibration response.
ND= Analyte not detected.

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Project Name SPAWAR - PRISM Field Site 1 Supporting Analysis
Project Number G600101-1000

Client Sample ID	PO4, 20-25cm	PO4, 25-30cm	PO4, 30-35cm	PO4, 35-40cm	PO4, 40-45cm
Battelle Sample ID	V2512	V2513	V2514	V2515	V2516
Battelle Batch ID	02-172	02-172	02-172	02-172	02-172
Associated Blank	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB
QC Type	N	N	N	N	N
Data File	B9033.D	B9036.D	B9037.D	B9038.D	B9039.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/17/02	04/17/02	04/17/02	04/17/02	04/17/02
Percent Moisture	45.99 %	44.2 %	39.54 %	28.85 %	27.38 %
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	15.77 g	16.97 g	18.65 g	21.42 g	20.55 g
Weight Basis	dry	dry	dry	dry	dry
Dilution Factor	6.67	1.01	6.67	3.33	3.33
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	2.11	0.298	1.79	0.777	0.81
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g

&= Out of DQO range.

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Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID	PO4, 45-50cm	PO4, 50-55cm	P17, 0-2cm	P17, 2-4cm	P17, 4-6cm
Battelle Sample ID	V2517	V2518	V2519	V2520	V2521
Battelle Batch ID	02-172	02-172	02-172	02-172	02-172
Associated Blank	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB
QC Type	N	N	N	N	N
Data File	B9040.D	B9041.D	B9042.D	C5285.D	C5286.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/17/02	04/17/02	04/17/02	04/25/02	04/25/02
Percent Moisture	25.4 %	22.46 %	50.98 %	47.78 %	40 %
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	23.61 g	20.11 g	4.94 g	6.51 g	12.16 g
Weight Basis	dry	dry	dry	dry	dry
Dilution Factor	1.01	1.01	6.67	10	10
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	0.214	0.251	6.75	7.68	4.11
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g
Naphthalene	0.975 BJ	0.355 BJ	15.3 J	23.7 J	14.5 J
C1-Naphthalenes	0.615 J	0.191 BJ	11.4 J	15.2 J	9.65 J
C2-Naphthalenes	1.33	0.332 J	21.7 J	32.5 J	14.8 J
C3-Naphthalenes	1.25	0.261 J	20.5 J	47.8	14.9 J
C4-Naphthalenes	ND U	ND U	28.1 J	84.4	ND U
2-Methylnaphthalene	0.628	0.2 B	12.8	16.6	10.5
1-Methylnaphthalene	0.223 B	0.0856 B	5.52	7.24	4.3
2,6-Dimethylnaphthalene	1.22	0.149	15.2	17.8	9.74
2,3,5-Trimethylnaphthalene	0.224	ND U	5.56	8.87	2.31
Biphenyl	0.234	0.0928 B	7.51	9.28	5.13
Acenaphthylene	2.43	0.786	69.6	103	102
Acenaphthene	0.179	0.0537	8.73	14.8	5.36
Fluorene	0.32	0.091	24.8	34	13.6
C1-Fluorenes	ND U	ND U	ND U	27.3	ND U
C2-Fluorenes	ND U	ND U	ND U	97.3	ND U
C3-Fluorenes	ND U	ND U	ND U	249	ND U
Phenanthrene	3.52	1.01	144	260	81.8
Anthracene	4.93	1.35	230	300	199
C1-Phenanthrenes/Anthracenes	4.9	1.24	147	328	113
C2-Phenanthrenes/Anthracenes	4.44	ND U	153	455	134
C3-Phenanthrenes/Anthracenes	3.98	ND U	189	478	139
C4-Phenanthrenes/Anthracenes	ND U	ND U	338	285	ND U
1-Methylphenanthrene	0.48	0.0717	17.6	43.7	11
Dibenzothiophene	0.35	ND U	12	18.3	6.03
C1-Dibenzothiophenes	ND U	ND U	18.2	71	21.3
C2-Dibenzothiophenes	ND U	ND U	72.1	158	33.6
C3-Dibenzothiophenes	ND U	ND U	157	321	112
Fluoranthene	7.8	2.12	667	1080	283
Pyrene	11.5	3.16	1240	1700	916
C1-Fluoranthenes/Pyrenes	9.43	2.74	991	1410	664
C2-Fluoranthenes/Pyrenes	15.4	3.81	568	639	313
C3-Fluoranthenes/Pyrenes	15.8	3.37	454	405	264
Benzo(a)anthracene	6.08	1.47	529	756	215
Chrysene	9.13	2.38	948	1230	539
C1-Chrysenes	6.03	1.6	549	582	342
C2-Chrysenes	10.9	2.42	509	391	260
C3-Chrysenes	14.1	3.58	430	380	228
C4-Chrysenes	8.57	ND U	197	122	121
Benzo(b)fluoranthene	43.4	11.8	1340	1110	1050
Benzo(k)fluoranthene	35.3	9.93	1240	1030	875
Benzo(e)pyrene	21.4	5.67	1030	830	730
Benzo(a)pyrene	40	11.2	1140	945	822
Perylene	4.12	1.2	292	246	197
Indeno(1,2,3-c,d)pyrene	27.9	8.45	603	517	470
Dibenz(a,h)anthracene	5.9	1.96	155	130	125
Benzo(g,h,i)perylene	28	8.59	590	577	442
Surrogate Recoveries (%)					
Naphthalene-d8	36 &	56	72	71	73
Phenanthrene-d10	42	70	85	74	78
Chrysene-d12	55	82	106	84	90

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ND= Analyte not detected.

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Project Name SPAWAR - PRISM
Project Number G600101-1000

Client Sample ID	PO4, 45-50cm	PO4, 50-55cm	P17, 0-2cm	P17, 2-4cm	P17, 4-6cm
Battelle Sample ID	V2517	V2518	V2519	V2520	V2521
Battelle Batch ID	02-172	02-172	02-172	02-172	02-172
Associated Blank	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB
QC Type	N	N	N	N	N
Data File	B9040.D	B9041.D	B9042.D	C5285.D	C5286.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/17/02	04/17/02	04/17/02	04/25/02	04/25/02
Percent Moisture	25.4 %	22.46 %	50.98 %	47.78 %	40 %
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	23.61 g	20.11 g	4.94 g	6.51 g	12.16 g
Weight Basis	dry	dry	dry	dry	dry
Dilution Factor	1.01	1.01	6.67	10	10
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	0.214	0.251	6.75	7.68	4.11
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g

&= Out of DQO range.

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Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID	P17, 6-8cm	P17, 8-10cm	P17, 10-15cm	P17, 15-20cm
Battelle Sample ID	V2522	V2523	V2524	V2525
Battelle Batch ID	02-172	02-172	02-172	02-172
Associated Blank	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB
QC Type	N	N	N	N
Data File	C5287.D	C5288.D	C5289.D	C5290.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/25/02	04/25/02	04/25/02	04/25/02
Percent Moisture	35.01 %	32.24 %	34.7 %	35.7 %
Matrix	Sediment	Sediment	Sediment	Sediment
Sample Size	11.94 g	12.53 g	21.58 g	21.16 g
Weight Basis	dry	dry	dry	dry
Dilution Factor	6.67	10	13.33	13.33
PIV	0.5	0.5	0.5	0.5
Min Reporting Limit	2.79	3.99	3.09	3.15
Amount Units	ng/g	ng/g	ng/g	ng/g
Naphthalene	10.4 J	12.3 J	9.58 J	9.93 J
C1-Naphthalenes	8.31 J	7.35 J	6.58 J	8.56 J
C2-Naphthalenes	14.2 J	11.9 J	10.8 J	15.2 J
C3-Naphthalenes	10 J	10.5 J	12.1 J	11.3 J
C4-Naphthalenes	ND U	ND U	ND U	ND U
2-Methylnaphthalene	8.65	7.59	6.92	8.8
1-Methylnaphthalene	3.68	3.22	3.48	4.21
2,6-Dimethylnaphthalene	8.73	6.68	5.85	7.05
2,3,5-Trimethylnaphthalene	2.2	2.1	1.95	2.29
Biphenyl	3.52	3.87	6.61	2.53
Acenaphthylene	93.3	75.4	84	87.4
Acenaphthene	4.97	4.75	5.57	4.43
Fluorene	11	10.1	9.62	10.2
C1-Fluorenes	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U
Phenanthrene	68.7	66	71.7	65.2
Anthracene	166	152	173	169
C1-Phenanthrenes/Anthracenes	101	86.4	99	97.7
C2-Phenanthrenes/Anthracenes	112	127	112	98.6
C3-Phenanthrenes/Anthracenes	113	106	88.9	88.3
C4-Phenanthrenes/Anthracenes	225	ND U	220	ND U
1-Methylphenanthrene	6.86	7.59	8.31	7.87
Dibenzothiophene	4.78	5.07	4.55	4.99
C1-Dibenzothiophenes	18.8	18	17	18.7
C2-Dibenzothiophenes	25.8	26	23.6	20.5
C3-Dibenzothiophenes	108	86.4	72.2	64.3
Fluoranthene	206	177	426	171
Pyrene	1080	1040	1300	1160
C1-Fluoranthenes/Pyrenes	556	505	585	573
C2-Fluoranthenes/Pyrenes	367	338	340	364
C3-Fluoranthenes/Pyrenes	298	279	288	283
Benzo(a)anthracene	159	138	191	168
Chrysene	417	314	348	347
C1-Chrysenes	318	276	297	313
C2-Chrysenes	228	213	232	228
C3-Chrysenes	210	206	232	228
C4-Chrysenes	103	87	101	103
Benzo(b)fluoranthene	1010	793	803	960
Benzo(k)fluoranthene	784	706	693	800
Benzo(e)pyrene	672	551	582	658
Benzo(a)pyrene	753	651	663	754
Perylene	180	148	160	174
Indeno(1,2,3-c,d)pyrene	423	355	366	414
Dibenz(a,h)anthracene	110	91.7	97.7	115
Benzo(g,h,i)perylene	395	340	348	390
Surrogate Recoveries (%)				
Naphthalene-d8	78	73	76	73
Phenanthrene-d10	71	77	67	71
Chrysene-d12	95	95	93	97

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Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID	P17, 6-8cm	P17, 8-10cm	P17, 10-15cm	P17, 15-20cm
Battelle Sample ID	V2522	V2523	V2524	V2525
Battelle Batch ID	02-172	02-172	02-172	02-172
Associated Blank	ZZ40PB	ZZ40PB	ZZ40PB	ZZ40PB
QC Type	N	N	N	N
Data File	C5287.D	C5288.D	C5289.D	C5290.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/25/02	04/25/02	04/25/02	04/25/02
Percent Moisture	35.01 %	32.24 %	34.7 %	35.7 %
Matrix	Sediment	Sediment	Sediment	Sediment
Sample Size	11.94 g	12.53 g	21.58 g	21.16 g
Weight Basis	dry	dry	dry	dry
Dilution Factor	6.67	10	13.33	13.33
PIV	0.5	0.5	0.5	0.5
Min Reporting Limit	2.79	3.99	3.09	3.15
Amount Units	ng/g	ng/g	ng/g	ng/g

&= Out of DQO range.

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Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID

Battelle Sample ID
Battelle Batch ID
Associated Blank
QC Type
Data File
Field Date
Extraction Date
Acquired Date
Percent Moisture
Matrix
Sample Size
Weight Basis
Dilution Factor
PIV
Min Reporting Limit
Amount Units

Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
2-Methylnaphthalene
1-Methylnaphthalene
2,6-Dimethylnaphthalene
2,3,5-Trimethylnaphthalene
Biphenyl
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Phenanthrene
Anthracene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
1-Methylphenanthrene
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(e)pyrene
Benzo(a)pyrene
Perylene
Indeno(1,2,3-c,d)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

Surrogate Recoveries (%)
Naphthalene-d8
Phenanthrene-d10
Chrysene-d12

J=Result < Peak MDL
B=Result < 5 x PB.
U=Not detected.
E=Above calibration response.
ND= Analyte not detected.

Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID

Battelle Sample ID
Battelle Batch ID
Associated Blank
QC Type
Data File
Field Date
Extraction Date
Acquired Date
Percent Moisture
Matrix
Sample Size
Weight Basis
Dilution Factor
PIV
Min Reporting Limit
Amount Units

&= Out of DQO range.

Battelle
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Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID

Battelle Sample ID
Battelle Batch ID
Associated Blank
QC Type
Data File
Field Date
Extraction Date
Acquired Date
Percent Moisture
Matrix
Sample Size
Weight Basis
Dilution Factor
PIV
Min Reporting Limit
Amount Units

Naphthalene
C1-Naphthalenes
C2-Naphthalenes
C3-Naphthalenes
C4-Naphthalenes
2-Methylnaphthalene
1-Methylnaphthalene
2,6-Dimethylnaphthalene
2,3,5-Trimethylnaphthalene
Biphenyl
Acenaphthylene
Acenaphthene
Fluorene
C1-Fluorenes
C2-Fluorenes
C3-Fluorenes
Phenanthrene
Anthracene
C1-Phenanthrenes/Anthracenes
C2-Phenanthrenes/Anthracenes
C3-Phenanthrenes/Anthracenes
C4-Phenanthrenes/Anthracenes
1-Methylphenanthrene
Dibenzothiophene
C1-Dibenzothiophenes
C2-Dibenzothiophenes
C3-Dibenzothiophenes
Fluoranthene
Pyrene
C1-Fluoranthenes/Pyrenes
C2-Fluoranthenes/Pyrenes
C3-Fluoranthenes/Pyrenes
Benzo(a)anthracene
Chrysene
C1-Chrysenes
C2-Chrysenes
C3-Chrysenes
C4-Chrysenes
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(e)pyrene
Benzo(a)pyrene
Perylene
Indeno(1,2,3-c,d)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

Surrogate Recoveries (%)
Naphthalene-d8
Phenanthrene-d10
Chrysene-d12

J=Result < Peak MDL
B=Result < 5 x PB.
U=Not detected.
E=Above calibration response.
ND= Analyte not detected.

Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID	
Battelle Sample ID	
Battelle Batch ID	
Associated Blank	
QC Type	
Data File	
Field Date	
Extraction Date	
Acquired Date	
Percent Moisture	
Matrix	
Sample Size	
Weight Basis	
Dilution Factor	
PIV	
Min Reporting Limit	
Amount Units	

&= Out of DQO range.

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Project Name SPAWAR - PRISM Field Site 1 Supporting Analysis
Project Number G600101-1000

Client Sample ID	P17, 20-25 cm	P17, 25-30 cm	P17, 30-35 cm	P17, 35-40 cm	P17, 40-45 cm
Battelle Sample ID	V2526	V2527	V2528	V2529	V2530
Battelle Batch ID	02-173	02-173	02-173	02-173	02-173
Associated Blank	ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB
QC Type	N	N	N	N	N
Data File	C5337.D	C5338.D	C5341.D	C5342.D	C5343.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/28/02	04/28/02	04/28/02	04/28/02	04/28/02
Percent Moisture	42.47 %	46.14 %	39.77 %	42.67 %	43.2
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	16.87 g	15.76 g	17.85 g	16.91 g	16.57
Weight Basis	dry	dry	dry	dry	dry
Dilution Factor	13.33	20	13.33	13.33	13.33
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	3.95	6.34	3.73	3.94	4.02
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g
Naphthalene	14.4 J	14.5 J	12.1 J	9.77 J	9.13
C1-Naphthalenes	9.84 J	10.8 J	9.52 J	8.06 J	7.53
C2-Naphthalenes	17 J	8.03 J	8.23 J	12.3 J	15.4
C3-Naphthalenes	15.6 J	19.3 J	19 J	14.5 J	18.8
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND
2-Methylnaphthalene	10	9.62	9.41	8.38	8.2
1-Methylnaphthalene	4.38	4.41	4.08	3.41	3.72
2,6-Dimethylnaphthalene	8.33	7.77	6.78	5.93	7
2,3,5-Trimethylnaphthalene	2.8	2.82	2.86	2.76	2.27
Biphenyl	5.16	4.45	4.07	2.83	2.82
Acenaphthylene	100	90.2	153	124	153
Acenaphthene	8.22	6.51	6.69	6.75	13
Fluorene	12.7	9.83	15.1	11.2	15.5
C1-Fluorenes	ND U	ND U	ND U	ND U	ND
C2-Fluorenes	ND U	ND U	ND U	ND U	ND
C3-Fluorenes	ND U	ND U	ND U	ND U	ND
Phenanthrene	91.4	89.6	73.2	56	93.3
Anthracene	193	162	264	221	284
C1-Phenanthrenes/Anthracenes	100	109	122	101	136
C2-Phenanthrenes/Anthracenes	120	148	152	119	186
C3-Phenanthrenes/Anthracenes	128	175	163	108	159
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND
1-Methylphenanthrene	10.7	9.85	7.81	6.88	7.87
Dibenzothiophene	5.95	5.98	4.45	5.91	9.31
C1-Dibenzothiophenes	23.7	26.8	25.4	22.2	31.3
C2-Dibenzothiophenes	27.2	36	36.3	34.7	39.8
C3-Dibenzothiophenes	89.3	119	90.7	102	128
Fluoranthene	242	240	205	172	252
Pyrene	1180	1230	1680	1730	1810
C1-Fluoranthenes/Pyrenes	590	581	900	736	884
C2-Fluoranthenes/Pyrenes	405	445	523	453	511
C3-Fluoranthenes/Pyrenes	322	376	402	346	392
Benzo(a)anthracene	162	161	200	158	197
Chrysene	421	387	463	360	401
C1-Chrysenes	342	360	486	405	427
C2-Chrysenes	270	316	337	290	280
C3-Chrysenes	255	323	285	255	237
C4-Chrysenes	142	173	159	130	117
Benzo(b)fluoranthene	973	893	1620	1280	1560
Benzo(k)fluoranthene	886	728	1380	1090	1260
Benzo(e)pyrene	704	669	1070	863	1000
Benzo(a)pyrene	790	696	1300	1010	1240
Perylene	189	181	289	214	259
Indeno(1,2,3-c,d)pyrene	432	409	668	521	651
Dibenz(a,h)anthracene	115	109	183	141	169
Benzo(g,h,i)perylene	409	431	594	464	540
Surrogate Recoveries (%)					
Naphthalene-d8	75	74	80	72	68
Phenanthrene-d10	71	65	64	63	59
Chrysene-d12	83	86	97	84	81

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B=Result < 5 x PB.
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ND= Analyte not detected.

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Project Name SPAWAR - PRISM Field Site 1 Supporting Analysis
Project Number G600101-1000

Client Sample ID	P17, 20-25 cm	P17, 25-30 cm	P17, 30-35 cm	P17, 35-40 cm	P17, 40-45 cm
Battelle Sample ID	V2526	V2527	V2528	V2529	V2530
Battelle Batch ID	02-173	02-173	02-173	02-173	02-173
Associated Blank	ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB
QC Type	N	N	N	N	N
Data File	C5337.D	C5338.D	C5341.D	C5342.D	C5343.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/28/02	04/28/02	04/28/02	04/28/02	04/28/02
Percent Moisture	42.47 %	46.14 %	39.77 %	42.67 %	43.2
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	16.87 g	15.76 g	17.85 g	16.91 g	16.57
Weight Basis	dry	dry	dry	dry	dry
Dilution Factor	13.33	20	13.33	13.33	13.33
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	3.95	6.34	3.73	3.94	4.02
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g

&= Out of DQO range.

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Project Name SPAWAR - PRISM
Project Number G600101-1000

Client Sample ID		P17, 45-50 cm	P17, 50-55 cm	P17, 55-60 cm	P17, 60-65 cm
Battelle Sample ID		V2531	V2532	V2533	V2534
Battelle Batch ID		02-173	02-173	02-173	02-173
Associated Blank		ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB
QC Type		N	N	N	N
Data File		C5344.D	C5345.D	C5346.D	C5347.D
Field Date		01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date		04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date		04/28/02	04/29/02	04/29/02	04/29/02
Percent Moisture	%	36.07 %	30.83 %	37.2 %	34.62 %
Matrix		Sediment	Sediment	Sediment	Sediment
Sample Size	g	18.86 g	15.28 g	18.88 g	19.14 g
Weight Basis		dry	dry	dry	dry
Dilution Factor		10	13.33	13.33	13.33
PIV		0.5	0.5	0.5	0.5
Min Reporting Limit		2.65	4.36	3.53	3.48
Amount Units		ng/g	ng/g	ng/g	ng/g
Naphthalene	J	8.22 J	7.1 J	8.59 J	7.98 J
C1-Naphthalenes	J	6.83 J	6.7 J	7.32 J	6.47 J
C2-Naphthalenes	J	11.4 J	14.1 J	13.3 J	14.1 J
C3-Naphthalenes	J	14.5	13.1 J	14.4 J	16.8 J
C4-Naphthalenes	U	ND U	ND U	ND U	ND U
2-Methylnaphthalene		7.24	6.81	7.88	6.9
1-Methylnaphthalene		3.25	2.94	3.07	3.09
2,6-Dimethylnaphthalene		6.07	5.97	7.31	6.05
2,3,5-Trimethylnaphthalene		3.08	2.96	2.26	1.78
Biphenyl		2.62	2	2.22	2.85
Acenaphthylene		128	90.7	156	112
Acenaphthene		6.48	4.52	6.32	6.7
Fluorene		12.3	11	14.8	13.3
C1-Fluorenes	U	ND U	ND U	ND U	ND U
C2-Fluorenes	U	ND U	ND U	ND U	ND U
C3-Fluorenes	U	ND U	ND U	ND U	ND U
Phenanthrene		71.4	39.8	61.6	76.2
Anthracene		253	172	278	205
C1-Phenanthrenes/Anthracenes		120	92.4	132	114
C2-Phenanthrenes/Anthracenes		120	180	186	175
C3-Phenanthrenes/Anthracenes		97.5	362	183	220
C4-Phenanthrenes/Anthracenes	U	ND U	536	ND U	ND U
1-Methylphenanthrene		8.33	25.1	8.78	9.26
Dibenzothiophene		4.48	5.1	5.22	5.99
C1-Dibenzothiophenes		22.4	ND U	4.27	23.2
C2-Dibenzothiophenes		23.9	42.7	28.2	31.8
C3-Dibenzothiophenes		71.8	337	133	172
Fluoranthene		153	146	203	305
Pyrene		1600	1220	1710	2000
C1-Fluoranthenes/Pyrenes		799	663	1010	890
C2-Fluoranthenes/Pyrenes		450	457	553	498
C3-Fluoranthenes/Pyrenes		318	408	390	332
Benzo(a)anthracene		189	149	270	243
Chrysene		419	284	663	578
C1-Chrysenes		419	346	503	437
C2-Chrysenes		267	281	284	254
C3-Chrysenes		203	287	207	246
C4-Chrysenes		103	ND U	81.8	125
Benzo(b)fluoranthene		1300	890	1540	1110
Benzo(k)fluoranthene		1110	710	1370	979
Benzo(e)pyrene		840	584	1020	733
Benzo(a)pyrene		1060	732	1320	903
Perylene		225	170	302	220
Indeno(1,2,3-c,d)pyrene		527	352	643	451
Dibenz(a,h)anthracene		143	94.2	176	119
Benzo(g,h,i)perylene		445	309	534	398
Surrogate Recoveries (%)					
Naphthalene-d8		76	68	75	74
Phenanthrene-d10		64	63	65	66
Chrysene-d12		86	87	93	90

J=Result < Peak MDL
B=Result < 5 x PB.
U=Not detected.
E=Above calibration response.
ND= Analyte not detected.

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Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID		P17, 45-50 cm	P17, 50-55 cm	P17, 55-60 cm	P17, 60-65 cm
Battelle Sample ID		V2531	V2532	V2533	V2534
Battelle Batch ID		02-173	02-173	02-173	02-173
Associated Blank		ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB
QC Type		N	N	N	N
Data File		C5344.D	C5345.D	C5346.D	C5347.D
Field Date		01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date		04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date		04/28/02	04/29/02	04/29/02	04/29/02
Percent Moisture	%	36.07 %	30.83 %	37.2 %	34.62 %
Matrix		Sediment	Sediment	Sediment	Sediment
Sample Size	g	18.86 g	15.28 g	18.88 g	19.14 g
Weight Basis		dry	dry	dry	dry
Dilution Factor		10	13.33	13.33	13.33
PIV		0.5	0.5	0.5	0.5
Min Reporting Limit		2.65	4.36	3.53	3.48
Amount Units		ng/g	ng/g	ng/g	ng/g

&= Out of DQO range.

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Project Name SPAWAR - PRISI
Project Number G600101-1000

Client Sample ID	P17, 65-70 cm	P17, 70-75 cm	P17, 75-80 cm	P17, 80-85 cm	P04, 0-2 cm
Battelle Sample ID	V2535	V2536	V2537	V2538	V2539
Battelle Batch ID	02-173	02-173	02-173	02-173	02-173
Associated Blank	ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB
QC Type	N	N	N	N	N
Data File	C5350.D	C5351.D	C5352.D	C5353.D	C5354.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/29/02	04/29/02	04/29/02	04/29/02	04/29/02
Percent Moisture	37.95 %	36.1 %	33.93 %	34.39 %	47.35
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	18.63 g	18.67 g	19.48 g	20.08 g	6.33
Weight Basis	dry	dry	dry	dry	dry
Dilution Factor	20	20	20	20	2
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	5.37	5.36	5.13	4.98	1.58
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g
Naphthalene	12.7 J	11 J	12.4 J	15 J	6.08
C1-Naphthalenes	11.4 J	10.4 J	12.7 J	13.8 J	3.4
C2-Naphthalenes	19.7 J	17.8 J	22.5 J	27.1	6.56
C3-Naphthalenes	27.8 J	23.9 J	25.4 J	25.2 J	6.13
C4-Naphthalenes	ND U	ND U	ND U	ND U	ND
2-Methylnaphthalene	12.2	11.1	13.4	14.7	3.74
1-Methylnaphthalene	5.83	5.04	5.91	6.66	1.52
2,6-Dimethylnaphthalene	11.2	9.72	13.2	11.9	3.52
2,3,5-Trimethylnaphthalene	4.35	3.34	4.35	4.48	0.914
Biphenyl	5.35	3.53	3.92	7.08	1.53
Acenaphthylene	207	189	187	184	120
Acenaphthene	10.3	9.09	8.34	8.78	4.37
Fluorene	28.1	24.6	28	23.8	11
C1-Fluorenes	ND U	ND U	ND U	ND U	ND
C2-Fluorenes	ND U	ND U	ND U	ND U	ND
C3-Fluorenes	ND U	ND U	ND U	ND U	ND
Phenanthrene	112	109	120	114	36.3
Anthracene	414	383	474	392	158
C1-Phenanthrenes/Anthracenes	218	204	297	270	65
C2-Phenanthrenes/Anthracenes	317	246	350	357	56.4
C3-Phenanthrenes/Anthracenes	250	196	337	242	27.2
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	ND
1-Methylphenanthrene	13.9	13.7	102	14.3	4.51
Dibenzothiophene	8.81	8.03	9.55	9.4	2.15
C1-Dibenzothiophenes	33.4	26.3	38.2	33.7	ND
C2-Dibenzothiophenes	44	40.4	44.9	39	ND
C3-Dibenzothiophenes	204	137	125	115	14
Fluoranthene	565	325	280	313	95.4
Pyrene	3000	2820	2620	2450	143
C1-Fluoranthenes/Pyrenes	1660	1370	1340	1320	170
C2-Fluoranthenes/Pyrenes	778	710	734	746	124
C3-Fluoranthenes/Pyrenes	547	538	562	606	94.4
Benzo(a)anthracene	490	312	285	303	122
Chrysene	1090	836	686	664	224
C1-Chrysenes	789	649	619	600	114
C2-Chrysenes	406	398	374	416	79.4
C3-Chrysenes	336	326	329	372	86.6
C4-Chrysenes	ND U	ND U	ND U	148	ND
Benzo(b)fluoranthene	2140	1810	1700	1830	520
Benzo(k)fluoranthene	1810	1670	1610	1490	408
Benzo(e)pyrene	1380	1230	1190	1180	342
Benzo(a)pyrene	1760	1520	1430	1450	456
Perylene	410	356	332	348	77.7
Indeno(1,2,3-c,d)pyrene	829	712	696	706	293
Dibenz(a,h)anthracene	221	183	184	185	77.3
Benzo(g,h,i)perylene	690	607	589	612	258
Surrogate Recoveries (%)					
Naphthalene-d8	81	75	73	75	64
Phenanthrene-d10	74	69	66	64	69
Chrysene-d12	98	98	93	89	85

J=Result < Peak MDL
B=Result < 5 x PB.
U=Not detected.
E=Above calibration response.
ND= Analyte not detected.

Not Surrogate Corrected
Final results

Prepared by J. Sisson
6/18/2006

S02-173MS values.xls

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Project Name SPAWAR - PRISI
Project Number G600101-1000

Client Sample ID	P17, 65-70 cm	P17, 70-75 cm	P17, 75-80 cm	P17, 80-85 cm	P04, 0-2 cm
Battelle Sample ID	V2535	V2536	V2537	V2538	V2539
Battelle Batch ID	02-173	02-173	02-173	02-173	02-173
Associated Blank	ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB	ZZ45PB
QC Type	N	N	N	N	N
Data File	C5350.D	C5351.D	C5352.D	C5353.D	C5354.D
Field Date	01/24/02	01/24/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/08/02	04/08/02	04/08/02	04/08/02	04/08/02
Acquired Date	04/29/02	04/29/02	04/29/02	04/29/02	04/29/02
Percent Moisture	37.95 %	36.1 %	33.93 %	34.39 %	47.35
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	18.63 g	18.67 g	19.48 g	20.08 g	6.33
Weight Basis	dry	dry	dry	dry	dry
Dilution Factor	20	20	20	20	2
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	5.37	5.36	5.13	4.98	1.58
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g

&= Out of DQO range.

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Project Name SPAWAR - PRIS
Project Number G600101-1000

Client Sample ID		P04, 2-4 cm	P04, 4-6 cm
Battelle Sample ID		V2540	V2541
Battelle Batch ID		02-173	02-173
Associated Blank		ZZ45PB	ZZ45PB
QC Type		N	N
Data File		C5355.D	C5356.D
Field Date		01/24/02	01/24/02
Extraction Date		04/08/02	04/08/02
Acquired Date		04/29/02	04/29/02
Percent Moisture	%	40 %	46.51 %
Matrix		Sediment	Sediment
Sample Size	g	8.36 g	6.83 g
Weight Basis		dry	dry
Dilution Factor		2	2
PIV		0.5	0.5
Min Reporting Limit		1.2	1.46
Amount Units		ng/g	ng/g
Naphthalene	J	6.58	7.37 J
C1-Naphthalenes	J	3.97 J	4.27 J
C2-Naphthalenes	J	5.83 J	10.1
C3-Naphthalenes	J	7.14	12.8
C4-Naphthalenes	U	ND U	ND U
2-Methylnaphthalene		4.3	4.6
1-Methylnaphthalene		1.75	1.85
2,6-Dimethylnaphthalene		3.07	5.17
2,3,5-Trimethylnaphthalene		1.32	2.6
Biphenyl		2.04	1.79
Acenaphthylene		119	100
Acenaphthene		4.99	22.8
Fluorene		10.1	40.3
C1-Fluorenes	U	ND U	ND U
C2-Fluorenes	U	ND U	ND U
C3-Fluorenes	U	ND U	ND U
Phenanthrene		34	294
Anthracene		171	164
C1-Phenanthrenes/Anthracenes		62.4	110
C2-Phenanthrenes/Anthracenes		55.6	76.9
C3-Phenanthrenes/Anthracenes		34.9	44
C4-Phenanthrenes/Anthracenes	U	ND U	ND U
1-Methylphenanthrene		4.07	12.2
Dibenzothiophene		2.54	19.8
C1-Dibenzothiophenes	U	ND U	10.4
C2-Dibenzothiophenes	U	12.8	ND U
C3-Dibenzothiophenes		20.4	ND U
Fluoranthene		106	342
Pyrene		150	284
C1-Fluoranthenes/Pyrenes		162	213
C2-Fluoranthenes/Pyrenes		134	148
C3-Fluoranthenes/Pyrenes		102	117
Benzo(a)anthracene		116	142
Chrysene		215	204
C1-Chrysenes		125	107
C2-Chrysenes		80.7	91.9
C3-Chrysenes		81	99
C4-Chrysenes	U	ND U	ND U
Benzo(b)fluoranthene		552	551
Benzo(k)fluoranthene		429	486
Benzo(e)pyrene		343	299
Benzo(a)pyrene		456	497
Perylene		76.8	58
Indeno(1,2,3-c,d)pyrene		306	310
Dibenz(a,h)anthracene		76.5	81.2
Benzo(g,h,i)perylene		260	274
Surrogate Recoveries (%)			
Naphthalene-d8		72	68
Phenanthrene-d10		72	68
Chrysene-d12		89	85

J=Result < Peak MDL
B=Result < 5 x PB.
U=Not detected.
E=Above calibration response.
ND= Analyte not detected.

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Project Name SPAWAR - PRISM
Project Number G600101-1000

Client Sample ID		P04, 2-4 cm	P04, 4-6 cm
Battelle Sample ID		V2540	V2541
Battelle Batch ID		02-173	02-173
Associated Blank		ZZ45PB	ZZ45PB
QC Type		N	N
Data File		C5355.D	C5356.D
Field Date		01/24/02	01/24/02
Extraction Date		04/08/02	04/08/02
Acquired Date		04/29/02	04/29/02
Percent Moisture	%	40 %	46.51 %
Matrix		Sediment	Sediment
Sample Size	g	8.36 g	6.83 g
Weight Basis		dry	dry
Dilution Factor		2	2
PIV		0.5	0.5
Min Reporting Limit		1.2	1.46
Amount Units		ng/g	ng/g

&= Out of DQO range.

Battelle
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Project Name SPAWAR - PRISM Field Site 1 Supporting Analysis
Project Number G600101-1000

Client Sample ID	P04-1 Sediment	P04-2 Sediment	P04-3 Sediment	P17-1 Sediment	P17-2 Sediment
Battelle Sample ID	V2231	V2232	V2233	V2234	V2235
Battelle Batch ID	02-174	02-174	02-174	02-174	02-174
Associated Blank	ZZ50PB	ZZ50PB	ZZ50PB	ZZ50PB	ZZ50PB
QC Type	N	N	N	N	N
Data File	C5298A.D	C5299.D	C5302.D	C5303.D	C5304.D
Field Date	01/15/02	01/15/02	01/15/02	01/09/02	01/09/02
Extraction Date	04/15/02	04/15/02	04/15/02	04/15/02	04/15/02
Acquired Date	04/26/02	04/26/02	04/26/02	04/26/02	04/26/02
Percent Moisture	26.29 %	30.64 %	33.33 %	23.34 %	28.63 %
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	19.88 g	18.93 g	18.71 g	19.26 g	22.62 g
Weight Basis	dry	dry	dry	dry	dry
Dilution Factor	5	6.67	5	20	25
PIV	0.5	0.5	0.5	0.5	0.5
Min Reporting Limit	1.26	1.76	1.34	5.19	5.53
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g
Naphthalene	8.45	7.47 J	7.28	11.8 J	19.7 J
C1-Naphthalenes	2.91 J	4.49 J	4.07 J	10.8 J	20.8 J
C2-Naphthalenes	5.22 J	6.67 J	6.25 J	21.4 J	34.8
C3-Naphthalenes	6.56 J	7.22 J	7.3	26.3 J	45.4
C4-Naphthalenes	ND U	ND U	ND U	ND U	55.5
2-Methylnaphthalene	3.11	4.45	4.34	11.1	20
1-Methylnaphthalene	1.39	2.23	1.86	4.75	12
2,6-Dimethylnaphthalene	2.6	3.52	3.73	10.8	16.6
2,3,5-Trimethylnaphthalene	1.24	1.36	1.24	3.32	9.04
Biphenyl	1.29	1.87	2.05	4.85	7.47
Acenaphthylene	66.5	118	154	129	90
Acenaphthene	2.82	4.09	6.03	10.3	26.1
Fluorene	6.37	9.36	13	29.3	31.2
C1-Fluorenes	ND U	ND U	ND U	ND U	ND U
C2-Fluorenes	ND U	ND U	ND U	ND U	ND U
C3-Fluorenes	ND U	ND U	ND U	ND U	ND U
Phenanthrene	28.9	37.3	53.6	165	206
Anthracene	106	171	238	377	246
C1-Phenanthrenes/Anthracenes	43.4	63.9	76.2	255	188
C2-Phenanthrenes/Anthracenes	37.7	68.1	62.2	386	287
C3-Phenanthrenes/Anthracenes	33.7	42.1	40.3	303	283
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	440	417
1-Methylphenanthrene	3.45	5.06	5.51	24.2	24
Dibenzothiophene	2.34	2.26	3.32	9.2	19
C1-Dibenzothiophenes	ND U	4.86	6.62	25.3	39.7
C2-Dibenzothiophenes	10.7	14.8	11.4	74.9	99.7
C3-Dibenzothiophenes	16.6	23.3	17.3	180	239
Fluoranthene	74.3	114	129	2160	1070
Pyrene	221	182	207	1950	1300
C1-Fluoranthenes/Pyrenes	156	194	236	1780	936
C2-Fluoranthenes/Pyrenes	107	143	143	713	510
C3-Fluoranthenes/Pyrenes	86.3	106	111	436	370
Benzo(a)anthracene	81.7	127	163	1160	488
Chrysene	155	251	338	1410	813
C1-Chrysenes	87.9	130	161	680	448
C2-Chrysenes	65.5	112	112	365	332
C3-Chrysenes	72.9	96.1	93.4	298	311
C4-Chrysenes	ND U	ND U	43.3	ND U	160
Benzo(b)fluoranthene	486	648	734	1500	984
Benzo(k)fluoranthene	388	524	576	1430	879
Benzo(e)pyrene	256	417	527	1020	703
Benzo(a)pyrene	367	546	612	1310	750
Perylene	60.8	96.7	145	319	209
Indeno(1,2,3-c,d)pyrene	259	373	429	643	440
Dibenz(a,h)anthracene	67	93.5	110	172	118
Benzo(g,h,i)perylene	232	327	372	581	456
Surrogate Recoveries (%)					
Naphthalene-d8	67	68	75	76	77
Phenanthrene-d10	70	67	78	68	73
Chrysene-d12	89	88	94	95	96

J=Result < Peak MDL
B=Result < 5 x PB.
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&= Out of DQO range.

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Project Name SPAWAR - PRISI
Project Number G600101-1000

Client Sample ID	P17-3 Sediment	P04/1, Sed. Trap	P04/2, Sed.Trap	P04/3, Sed.Trap	P17/1, Sed. Trap
Battelle Sample ID	V2236	V2237	V2238	V2239	V2240
Battelle Batch ID	02-174	02-174	02-174	02-174	02-174
Associated Blank	ZZ50PB	ZZ50PB	ZZ50PB	ZZ50PB	ZZ50PB
QC Type	N	N	N	N	N
Data File	C5305.D	C5306.D	C5307.D	C5308.D	C5311.D
Field Date	01/09/02	02/06/02	02/06/02	02/06/02	02/06/02
Extraction Date	04/15/02	04/15/02	04/15/02	04/15/02	04/15/02
Acquired Date	04/26/02	04/26/02	04/27/02	04/27/02	04/27/02
Percent Moisture	23.67 %	NA	NA	NA	NA
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	22.41 g	5.07 g	5.26 g	5.02 g	2.46 g
Weight Basis	dry	wet	wet	wet	wet
Dilution Factor	22.22	2	2	1.01	4
PIV	0.5	0.25	0.25	0.25	0.25
Min Reporting Limit	4.96	0.986	0.95	0.503	4.07
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g
Naphthalene	13.2 J	20.6	20.7	22.2	43.4 J
C1-Naphthalenes	9.54 J	17.1	17.5	20.3	60.2
C2-Naphthalenes	17.9 J	22.4	19.7	20.3	129
C3-Naphthalenes	29.9	31.2	28.7	29.3	179
C4-Naphthalenes	42.2	33	33	32.5	192
2-Methylnaphthalene	9.83	19.5	19.9	23.6	66.9
1-Methylnaphthalene	4.72	6.6	6.46	7.12	25
2,6-Dimethylnaphthalene	8.67	11.4	10.6	10.8	64.5
2,3,5-Trimethylnaphthalene	4.64	6.62	5.54	6	37.4
Biphenyl	5.73	6.8	7.12	6.73	37.1
Acenaphthylene	107	136	136	149	251
Acenaphthene	9.52	24.9	24.4	23.5	193
Fluorene	18.8	69.4	72.1	78.7	378
C1-Fluorenes	ND U	30.3	ND U	ND U	157
C2-Fluorenes	ND U	ND U	ND U	ND U	213
C3-Fluorenes	ND U	ND U	ND U	ND U	265
Phenanthrene	114	501	489	487	3220
Anthracene	246	325	339	440	1120
C1-Phenanthrenes/Anthracenes	147	192	192	223	1230
C2-Phenanthrenes/Anthracenes	214	154	148	144	888
C3-Phenanthrenes/Anthracenes	226	97.5	88.3	95.3	541
C4-Phenanthrenes/Anthracenes	358	ND U	ND U	ND U	400
1-Methylphenanthrene	17	28.9	30.3	34.7	233
Dibenzothiophene	9.17	27.4	22.8	24.5	160
C1-Dibenzothiophenes	26.2	26.2	25.9	24.9	127
C2-Dibenzothiophenes	67.3	41.6	40.3	44.4	242
C3-Dibenzothiophenes	194	54.1	55.5	60	366
Fluoranthene	531	906	966	892 D	5270 D
Pyrene	1540	651	649	544 D	3760
C1-Fluoranthenes/Pyrenes	886	566	572	601	2520
C2-Fluoranthenes/Pyrenes	529	233	237	225	1120
C3-Fluoranthenes/Pyrenes	396	135	145	138	604
Benzo(a)anthracene	351	431	451	498	1810
Chrysene	659	721	750	706	2960
C1-Chrysenes	481	234	276	259	983
C2-Chrysenes	342	135	154	147	570
C3-Chrysenes	298	130	133	140	542
C4-Chrysenes	177	59.3	ND U	ND U	251
Benzo(b)fluoranthene	1120	956	1080	709 D	2400
Benzo(k)fluoranthene	942	841	798	705 D	2030
Benzo(e)pyrene	820	631	668	506 D	1600
Benzo(a)pyrene	903	656	666	448 D	1560
Perylene	234	147	156	149	452
Indeno(1,2,3-c,d)pyrene	504	555	592	493	1030
Dibenz(a,h)anthracene	133	137	136	116	262
Benzo(g,h,i)perylene	483	439	485	386	942
Surrogate Recoveries (%)					
Naphthalene-d8	79	71	76	71	66
Phenanthrene-d10	78	81	86	84	84
Chrysene-d12	93	109	108	97	93

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Project Name SPAWAR - PRISI
Project Number G600101-1000

Client Sample ID	P17/2, Sed. Trap	P17/3, Sed. Trap	P04, 10-15cm	P04, 15-20cm	P04, 6-8 cm
Battelle Sample ID	V2241	V2242	V2510-1	V2511-1	V2542
Battelle Batch ID	02-174	02-174	02-174	02-174	02-174
Associated Blank	ZZ50PB	ZZ50PB	ZZ50PB	ZZ50PB	ZZ50PB
QC Type	N	N	N	N	N
Data File	C5312.D	C5313.D	C5314.D	C5315.D	C5316.D
Field Date	02/06/02	02/06/02	01/24/02	01/24/02	01/24/02
Extraction Date	04/15/02	04/15/02	04/15/02	04/15/02	04/15/02
Acquired Date	04/27/02	04/27/02	04/27/02	04/27/02	04/27/02
Percent Moisture	NA	NA	49.81 %	47.97 %	50.54 %
Matrix	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Size	4.47 g	5.35 g	10.21 g	12.35 g	6.41 g
Weight Basis	wet	wet	dry	dry	dry
Dilution Factor	10	6.67	5	6.67	2.86
PIV	0.25	0.25	0.5	0.5	0.5
Min Reporting Limit	5.59	3.12	2.45	2.7	2.23
Amount Units	ng/g	ng/g	ng/g	ng/g	ng/g
Naphthalene	44.2 J	46.7	8.96 J	9.34 J	10.9 J
C1-Naphthalenes	62.8	77.8	5.26 J	6.1 J	9.06 J
C2-Naphthalenes	107	131	10.9 J	13.2 J	89.5
C3-Naphthalenes	150	170	13 J	16	117
C4-Naphthalenes	155	167	ND U	ND U	ND U
2-Methylnaphthalene	69.5	87.3	5.5	6.76	6.86
1-Methylnaphthalene	26.4	32.6	2.37	2.79	6.31
2,6-Dimethylnaphthalene	53.4	68	5.55	6.74	30.7
2,3,5-Trimethylnaphthalene	31.4	33.7	1.72	2.39	28.5
Biphenyl	43.1	47.5	2.03	2.32	5.02
Acenaphthylene	250	246	63.8	72.8	440
Acenaphthene	148	193	4.39	4.19	242
Fluorene	302	369	7.22	7.87	434
C1-Fluorenes	109	147	ND U	ND U	267
C2-Fluorenes	154	183	ND U	ND U	196
C3-Fluorenes	176	208	ND U	ND U	174
Phenanthrene	2680	2980	34.9	40.5	4750 D
Anthracene	1030	1180	105	120	755
C1-Phenanthrenes/Anthracenes	977	1080	65.1	78.1	1860
C2-Phenanthrenes/Anthracenes	769	762	61.1	82.5	980
C3-Phenanthrenes/Anthracenes	560	528	47.2	55.6	389
C4-Phenanthrenes/Anthracenes	ND U	ND U	ND U	ND U	137
1-Methylphenanthrene	184	202	5.46	5.23	420
Dibenzothiophene	134	146	2.96	3.3	357
C1-Dibenzothiophenes	89.9	93.9	ND U	ND U	182
C2-Dibenzothiophenes	212	226	ND U	ND U	241
C3-Dibenzothiophenes	336	319	ND U	ND U	190
Fluoranthene	5490	4620 D	105	94.2	13900 D
Pyrene	3880	3180 D	137	133	9610 D
C1-Fluoranthenes/Pyrenes	2520	2240	139	170	2160
C2-Fluoranthenes/Pyrenes	1220	1070	144	204	1050
C3-Fluoranthenes/Pyrenes	707	599	126	181	343
Benzo(a)anthracene	1830	1710	106	103	614
Chrysene	3020	2970	166	158	2560
C1-Chrysenes	1070	950	110	128	406
C2-Chrysenes	614	513	93.1	145	148
C3-Chrysenes	599	437	126	206	163
C4-Chrysenes	271	219	69.8	123	82.2
Benzo(b)fluoranthene	2710	2270	626	818	1520
Benzo(k)fluoranthene	2250	2000	489	650	1230
Benzo(e)pyrene	1830	1540	261	286	795
Benzo(a)pyrene	1730	1530	552	703	795
Perylene	472	437	44.5	40.2	88.2
Indeno(1,2,3-c,d)pyrene	1170	964	374	424	554
Dibenz(a,h)anthracene	296	240	96.6	115	124
Benzo(g,h,i)perylene	1080	863	338	393	463
Surrogate Recoveries (%)					
Naphthalene-d8	68	77	70	75	74
Phenanthrene-d10	78	80	65	75	76
Chrysene-d12	104	91	92	104	82

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Project Name SPAWAR - PRISI
Project Number G600101-1000

Client Sample ID	P04, 8-10 cm	
Battelle Sample ID	V2543	
Battelle Batch ID	02-174	
Associated Blank	ZZ50PB	
QC Type	N	
Data File	C5317.D	
Field Date	01/24/02	
Extraction Date	04/15/02	
Acquired Date	04/27/02	
Percent Moisture	47.91	%
Matrix	Sediment	
Sample Size	8.44	g
Weight Basis	dry	
Dilution Factor	2.86	
PIV	0.5	
Min Reporting Limit	1.69	
Amount Units	ng/g	
Naphthalene	8.22	J
C1-Naphthalenes	4.92	J
C2-Naphthalenes	9.31	
C3-Naphthalenes	9.49	
C4-Naphthalenes	ND	U
2-Methylnaphthalene	5	
1-Methylnaphthalene	2.07	
2,6-Dimethylnaphthalene	6.15	
2,3,5-Trimethylnaphthalene	1.84	
Biphenyl	1.92	
Acenaphthylene	70.7	
Acenaphthene	4.29	
Fluorene	7.86	
C1-Fluorenes	ND	U
C2-Fluorenes	ND	U
C3-Fluorenes	ND	U
Phenanthrene	34.7	
Anthracene	119	
C1-Phenanthrenes/Anthracenes	64.3	
C2-Phenanthrenes/Anthracenes	64.1	
C3-Phenanthrenes/Anthracenes	38.5	
C4-Phenanthrenes/Anthracenes	ND	U
1-Methylphenanthrene	5.25	
Dibenzothiophene	2.68	
C1-Dibenzothiophenes	ND	U
C2-Dibenzothiophenes	ND	U
C3-Dibenzothiophenes	ND	U
Fluoranthene	108	
Pyrene	144	
C1-Fluoranthenes/Pyrenes	134	
C2-Fluoranthenes/Pyrenes	148	
C3-Fluoranthenes/Pyrenes	112	
Benzo(a)anthracene	102	
Chrysene	158	
C1-Chrysenes	93.7	
C2-Chrysenes	81.4	
C3-Chrysenes	103	
C4-Chrysenes	70.9	
Benzo(b)fluoranthene	596	
Benzo(k)fluoranthene	437	
Benzo(e)pyrene	212	
Benzo(a)pyrene	508	
Perylene	42.4	
Indeno(1,2,3-c,d)pyrene	332	
Dibenz(a,h)anthracene	89.6	
Benzo(g,h,i)perylene	307	
Surrogate Recoveries (%)		
Naphthalene-d8	71	
Phenanthrene-d10	72	
Chrysene-d12	93	

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&= Out of DQO range.

Applied Marine Sciences, Inc.

Project Title: SPAWAR Task 1
Client Sample ID: V2231 (P04-1)
AMS Sample ID: 11296

Date Sampled:
Date Received: 3/19/2002
Date Analyzed: 3/28/2002

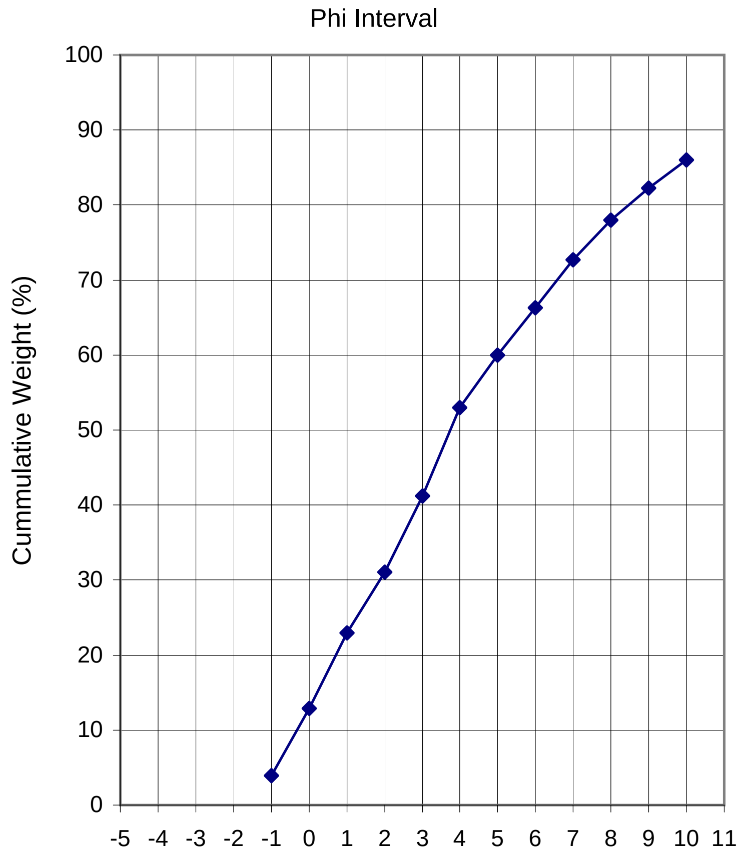
Grain Size Analysis (Plumb, 1981)

Size Classification	Phi Interval (ø)	Frequency Wt (%)	Cummulative Wt. (%)
V. Large Pebble	-5	0.00	0.00
Large Pebble	-4	0.00	0.00
Medium Pebble	-3	0.00	0.00
Small Pebble	-2	0.00	0.00
Gravel	-1	3.92	3.92
V. Coarse Sand	0	9.00	12.92
Coarse Sand	1	10.01	22.93
Medium Sand	2	8.11	31.04
Fine sand	3	10.18	41.22
V. Fine Sand	4	11.76	52.98
Coarse Silt	5	7.00	59.98
Medium Silt	6	6.28	66.26
Fine Silt	7	6.44	72.70
V. Fine Silt	8	5.29	77.99
Clay	9	4.22	82.21
Clay	10	3.81	86.02
Clay	11	13.98	100.00

Gravel (%)	3.92	Silt (%)	25.01
Sand (%)	49.06	Clay (%)	22.01

Wentworth Classification

Graphic Mean, M:	4.55	Coarse Silt
Median diameter, Md_{50} :	3.75	V. Fine Sand
Graphic Sorting,	4.29	Ext. Poorly Sorted



Applied Marine Sciences, Inc.

Project Title: SPAWAR Task 1
Client Sample ID: V2232 (P04-2)
AMS Sample ID: 11297

Date Sampled:
Date Received: 3/19/2002
Date Analyzed: 3/28/2002

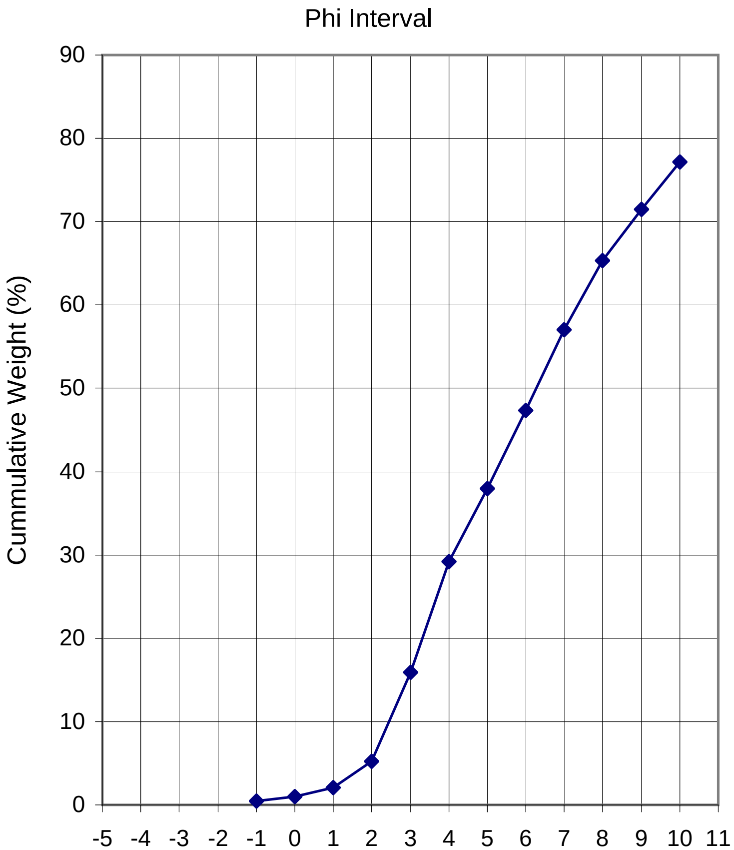
Grain Size Analysis (Plumb, 1981)

Size Classification	Phi Interval (ø)	Frequency Wt (%)	Cummulative Wt. (%)
V. Large Pebble	-5	0.00	0.00
Large Pebble	-4	0.00	0.00
Medium Pebble	-3	0.00	0.00
Small Pebble	-2	0.14	0.14
Gravel	-1	0.33	0.47
V. Coarse Sand	0	0.52	0.99
Coarse Sand	1	1.09	2.08
Medium Sand	2	3.15	5.23
Fine sand	3	10.65	15.88
V. Fine Sand	4	13.29	29.17
Coarse Silt	5	8.79	37.96
Medium Silt	6	9.39	47.35
Fine Silt	7	9.68	57.03
V. Fine Silt	8	8.29	65.32
Clay	9	6.19	71.51
Clay	10	5.62	77.13
Clay	11	22.86	99.99

Gravel (%)	0.47	Silt (%)	36.15
Sand (%)	28.70	Clay (%)	34.67

Wentworth Classification

Graphic Mean, M:	6.59	Fine Silt
Median diameter, Md_{50} :	6.25	Fine Silt
Graphic Sorting,	3.84	V. Pooly Sorted



Applied Marine Sciences, Inc.

Project Title: SPAWAR Task 1
Client Sample ID: V2233 (P04-3)
AMS Sample ID: 11298

Date Sampled:
Date Received: 3/19/2002
Date Analyzed: 3/28/2002

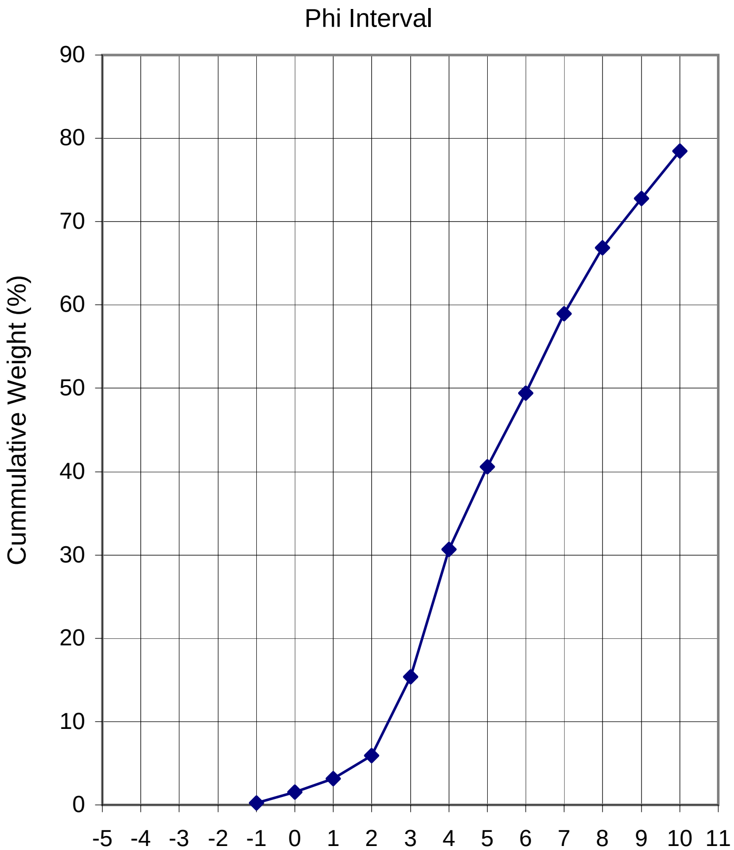
Grain Size Analysis (Plumb, 1981)

Size Classification	Phi Interval (ø)	Frequency Wt (%)	Cummulative Wt. (%)
V. Large Pebble	-5	0.00	0.00
Large Pebble	-4	0.00	0.00
Medium Pebble	-3	0.00	0.00
Small Pebble	-2	0.00	0.00
Gravel	-1	0.22	0.22
V. Coarse Sand	0	1.34	1.56
Coarse Sand	1	1.60	3.16
Medium Sand	2	2.72	5.88
Fine sand	3	9.51	15.39
V. Fine Sand	4	15.25	30.64
Coarse Silt	5	9.96	40.60
Medium Silt	6	8.80	49.40
Fine Silt	7	9.54	58.94
V. Fine Silt	8	7.92	66.86
Clay	9	5.90	72.76
Clay	10	5.71	78.47
Clay	11	21.42	99.89

Gravel (%)	0.22	Silt (%)	36.22
Sand (%)	30.42	Clay (%)	33.03

Wentworth Classification

Graphic Mean, M:	6.75	Fine Silt
Median diameter, Md_{50} :	6	Fine Silt
Graphic Sorting,	3.89	V. Pooly Sorted



Applied Marine Sciences, Inc.

Project Title: SPAWAR Task 1
Client Sample ID: V2234 (P17-1)
AMS Sample ID: 11299

Date Sampled:
Date Received: 3/19/2002
Date Analyzed: 3/28/2002

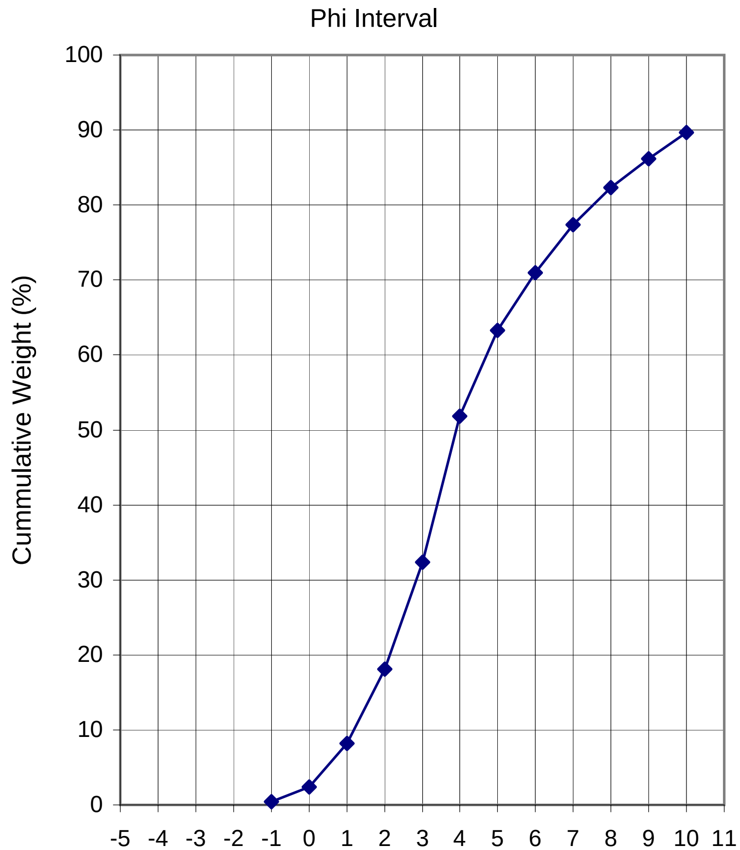
Grain Size Analysis (Plumb, 1981)

Size Classification	Phi Interval (ø)	Frequency Wt (%)	Cummulative Wt. (%)
V. Large Pebble	-5	0.00	0.00
Large Pebble	-4	0.00	0.00
Medium Pebble	-3	0.00	0.00
Small Pebble	-2	0.00	0.00
Gravel	-1	0.43	0.43
V. Coarse Sand	0	1.99	2.42
Coarse Sand	1	5.77	8.19
Medium Sand	2	9.88	18.07
Fine sand	3	14.30	32.37
V. Fine Sand	4	19.45	51.82
Coarse Silt	5	11.43	63.25
Medium Silt	6	7.70	70.95
Fine Silt	7	6.43	77.38
V. Fine Silt	8	4.96	82.34
Clay	9	3.79	86.13
Clay	10	3.50	89.63
Clay	11	10.38	100.01

Gravel (%)	0.43	Silt (%)	30.52
Sand (%)	51.39	Clay (%)	17.67

Wentworth Classification

Graphic Mean, M:	4.73	Coarse Silt
Median diameter, Md_{50} :	3.95	V. Fine Sand
Graphic Sorting,	3.43	V. Poorly Sorted



Applied Marine Sciences, Inc.

Project Title: SPAWAR Task 1
Client Sample ID: V2235 (P17-2)
AMS Sample ID: 11300

Date Sampled:
Date Received: 3/19/2002
Date Analyzed: 3/28/2002

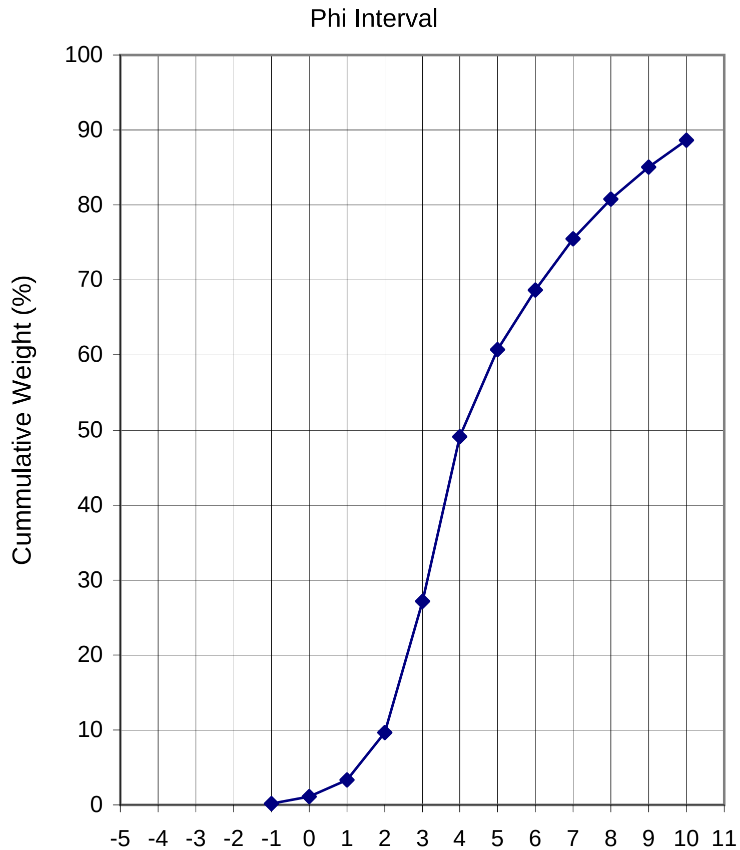
Grain Size Analysis (Plumb, 1981)

Size Classification	Phi Interval (ø)	Frequency Wt (%)	Cummulative Wt. (%)
V. Large Pebble	-5	0.00	0.00
Large Pebble	-4	0.00	0.00
Medium Pebble	-3	0.00	0.00
Small Pebble	-2	0.00	0.00
Gravel	-1	0.18	0.18
V. Coarse Sand	0	0.95	1.13
Coarse Sand	1	2.24	3.37
Medium Sand	2	6.30	9.67
Fine sand	3	17.49	27.16
V. Fine Sand	4	21.94	49.10
Coarse Silt	5	11.58	60.68
Medium Silt	6	7.95	68.63
Fine Silt	7	6.90	75.53
V. Fine Silt	8	5.29	80.82
Clay	9	4.27	85.09
Clay	10	3.58	88.67
Clay	11	11.32	99.99

Gravel (%)	0.18	Silt (%)	31.72
Sand (%)	48.92	Clay (%)	19.17

Wentworth Classification

Graphic Mean, M:	5.12	Medium Silt
Median diameter, Md_{50} :	4.15	Coarse Silt
Graphic Sorting,	3.26	V. Poorly Sorted



Applied Marine Sciences, Inc.

Project Title: SPAWAR Task 1
Client Sample ID: V2236 (P17-3)
AMS Sample ID: 11301

Date Sampled:
Date Received: 3/19/2002
Date Analyzed: 3/28/2002

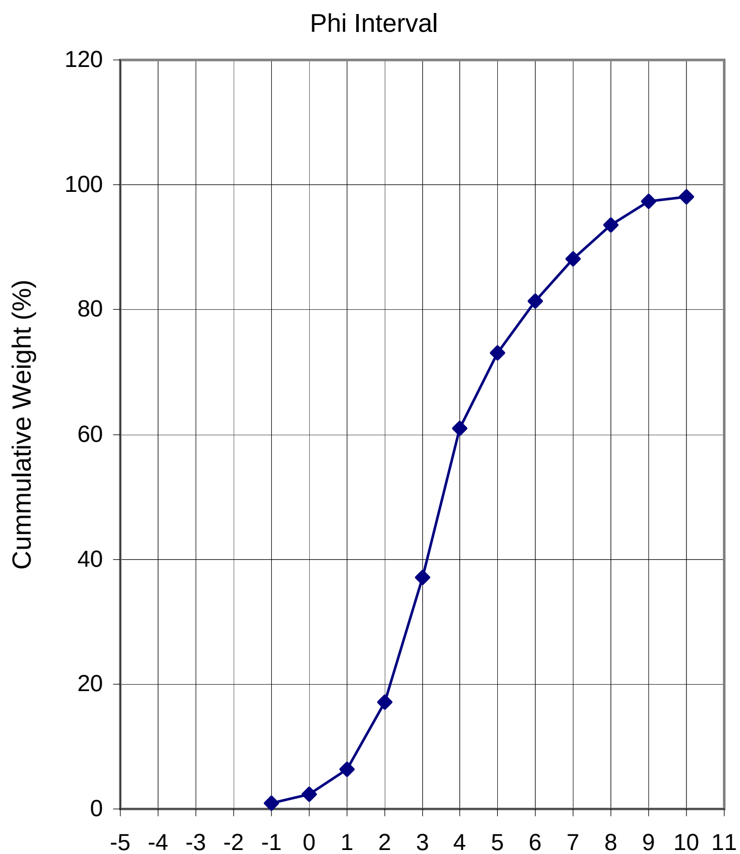
Grain Size Analysis (Plumb, 1981)

Size Classification	Phi Interval (ø)	Frequency Wt (%)	Cummulative Wt. (%)
V. Large Pebble	-5	0.00	0.00
Large Pebble	-4	0.00	0.00
Medium Pebble	-3	0.00	0.00
Small Pebble	-2	0.00	0.00
Gravel	-1	0.91	0.91
V. Coarse Sand	0	1.41	2.32
Coarse Sand	1	4.00	6.32
Medium Sand	2	10.84	17.16
Fine sand	3	19.97	37.13
V. Fine Sand	4	23.83	60.96
Coarse Silt	5	12.12	73.08
Medium Silt	6	8.26	81.34
Fine Silt	7	6.80	88.14
V. Fine Silt	8	5.44	93.58
Clay	9	3.81	97.39
Clay	10	0.71	98.10
Clay	11	1.91	100.01

Gravel (%)	0.91	Silt (%)	32.62
Sand (%)	60.05	Clay (%)	6.43

Wentworth Classification

Graphic Mean, M:	3.92	V. Fine Sand
Median diameter, Md_{50} :	3.5	V. Fine Sand
Graphic Sorting,	2.18	V. Poorly Sorted



CHNS Analysis
Paleta Creek, P04/P17 Sites

OC = organic carbon, inorganic carbon (as carbonates) removed by acid digestion with 3 N HCl
TC = total carbon

Sample	% C	% H	% N	% S	S.D. C	S.D. H	S.D. N	S.D. S	Atomic C/N
P04-1 OC	0.77	0.70	0.16	0.41	0.02	0.04	0.02	0.02	5.82
P04-2 OC	1.34	1.00	0.19	0.51	0.04	0.08	0.01	0.01	8.45
P04-3 OC	1.28	1.01	0.17	0.37	0.02	0.08	0.01	0.01	8.77
P17-1 OC	2.11	0.93	0.21	0.72	0.27	0.12	0.09	0.09	12.60
P17-2 OC	2.70	1.01	0.25	0.67	0.15	0.08	0.06	0.06	12.76
P17-3 OC	1.80	0.79	0.18	0.60	0.16	0.13	0.06	0.08	12.64
P04-1 TC	1.10	0.47	0.17	0.51					7.55
P04-2 TC	1.53	0.65	0.21	0.51					8.50
P04-3 TC	1.46	0.63	0.23	0.38					7.41
P17-1 TC	2.01	0.54	0.18	0.72					13.03
P17-2 TC	3.01	0.57	0.28	0.67					12.54
P17-3 TC	2.09	0.45	0.22	0.55					11.08
P04-1 OC, ST	2.06	1.94	0.30	0.62	0.06	0.92	0.04	0.08	8.00
P04-2 OC, ST	2.10	1.82	0.29	0.56	0.08	0.85	0.02	0.04	8.61
P04-3 OC, ST	2.09	1.46	0.26	0.63	0.01	0.13	0.01	0.04	9.54
P17-1 OC, ST	5.32	1.42	0.52	0.68	0.02	0.11	0.04	0.10	12.07
P17-2 OC, ST	6.17	1.53	0.78	0.67	0.08	0.04	0.03	0.08	9.24
P17-3 OC, ST	4.80	1.36	0.49	0.73	0.37	0.11	0.01	0.01	11.54
P04-1 TC, ST	2.28	1.24	0.39	0.57					6.82
P04-2 TC, ST	2.42	1.35	0.38	0.61					7.43
P04-3 TC, ST	2.36	1.41	0.41	0.62					6.72
P17-1 TC, ST	5.76	1.36	0.60	0.82					11.20
P17-2 TC, ST	6.70	1.63	0.83	0.90					9.42
P17-3 TC, ST	5.32	1.53	0.48	0.76					12.93

Algae	9.23	1.49	0.95	0.77
C/N =	11.30			

Battelle Marine Sciences Laboratory
1529 West Sequim Bay Rd.
Sequim, WA 98382
(360) 683-4151
PROJECT: 1781

6/17/2002

BATTELLE CODE	**Core ID**	**SPONSOR CODE**	**Depth (cm)**	**Percent Dry Wt. (g)**	***Cs137* detection limit (dis/min/g)**	***Cs 137* dis/min/g (dry wt.)**	**SRM CERTIFIED VALUE** dis/min/g	**%RPD**
IAEA-135	NA	IAEA 135 NA		NA	0.501	51.0	53.7	5%
1781*1	P17	P17, 0-2	0-2	50.4	0.069	0.169		
1781*2	P17	P17, 2-4	2-4	58.0	0.062	0.139		
1781*3	P17	P17, 4-6	4-6	59.6	0.054	0.193		
1781*4	P17	P17, 6-8	6-8	58.3	0.054	0.246		
1781*5	P17	P17, 8-10	8-10	57.6	0.062	0.216		
1781*6	P17	P17, 10-12	10-12	63.5	0.046	0.108		
1781*7	P17	P17, 12-14	12-14	59.8	0.054	0.200		
1781*8	P17	P17, 14-16	14-16	58.1	0.062	0.185		
1781*9	P17	P17, 16-18	16-18	53.1	0.069	0.223		
1781*10	P17	P17, 18-20	18-20	57.7	0.062	0.169		
1781*11	P4	P4, 0-2	0-2	42.2	0.085	0.239		
1781*12	P4	P4, 2-4	2-4	48.1	0.077	0.262		
1781*13	P4	P4, 4-6	4-6	49.2	0.077	0.208		
1781*14	P4	P4, 6-8	6-8	52.5	0.069	0.131		
1781*15	P4	P4, 8-10	8-10	50.6	0.069	0.216		
1781*16	P4	P4, 10-12	10-12	52.8	0.077	0.185		
1781*17	P4	P4, 12-14	12-14	55.0	0.062	0.185		
1781*18	P4	P4, 14-16	14-16	59.8	0.054	0.139		
1781*19	P4	P4, 16-18	16-18	63.4	0.054	0.062		
1781*20	P4	P4, 18-20	18-20	69.4	0.054	0.054 U		

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BATTELLE CODE	**Core ID**	**SPONSOR CODE**	**Depth (cm)**	**Percent Dry Wt. (g)**	***Be 7*** **counts/min/g**	***Be 7*** **Detection limit** (Counts/min/g)
1781*1	P17	P17, 0-2	0-2	50.4	-0.0003 U	1.75
1781*2	P17	P17, 2-4	2-4	58.0	-0.0007 U	1.77
1781*3	P17	P17, 4-6	4-6	59.6	-0.0010 U	1.80
1781*4	P17	P17, 6-8	6-8	58.3	-0.0003 U	1.76
1781*5	P17	P17, 8-10	8-10	57.6	-0.0006 U	1.72
1781*6	P17	P17, 10-12	10-12	63.5	-0.0002 U	1.94
1781*7	P17	P17, 12-14	12-14	59.8	-0.0009 U	1.80
1781*8	P17	P17, 14-16	14-16	58.1	-0.0009 U	1.71
1781*9	P17	P17, 16-18	16-18	53.1	-0.0011 U	1.64
1781*10	P17	P17, 18-20	18-20	57.7	-0.0002 U	1.73
1781*11	P4	P4, 0-2	0-2	42.2	-0.0002 U	1.65
1781*12	P4	P4, 2-4	2-4	48.1	-0.0006 U	1.59
1781*13	P4	P4, 4-6	4-6	49.2	-0.0006 U	1.59
1781*14	P4	P4, 6-8	6-8	52.5	-0.0009 U	1.64
1781*15	P4	P4, 8-10	8-10	50.6	-0.0008 U	1.61
1781*16	P4	P4, 10-12	10-12	52.8	-0.0006 U	1.66
1781*17	P4	P4, 12-14	12-14	55	-0.0015 U	1.73
1781*18	P4	P4, 14-16	14-16	59.8	-0.0007 U	1.85
1781*19	P4	P4, 16-18	16-18	63.4	-0.0008 U	1.82
1781*20	P4	P4, 18-20	18-20	69.4	-0.0013 U	1.74

DRAFT RESULTS
Pb-210 Results in Sediments
SPAWARS PRISM

6/17/2002

Battelle Marine Sciences Laboratory
1529 West Sequim Bay Rd.
Sequim, WA 98382

PROJECT: 1781

BATTELLE CODE	SPONSOR ID	Depth (cm)	% Dry Weight	ACTIVITY Pb210 dpm/g	RPD (%)		mean depth
BLANK	N/A	N/A	N/A	0.000			
BLANK SPIKE	N/A	N/A	N/A	0.000			
CHECK STD	N/A	N/A	N/A	11.4	14%	*	
1781*50	PO4-02	0-2	47.1	2.23			1.0
1781*51	PO4-24	2-4	52.0	1.89			3.0
1781*52	PO4-46	4-6	52.3	2.03			5.0
1781*54	PO4-810	8-10	50.5	1.64			9
1781*21	PO4-1015	10-15	51.3	2.02			12.5
1781*23 R1	PO4-2025	20-25	54.2	1.59			22.5
1781*23 R2	PO4-2025	20-25	54.2	1.57			22.5
1781*25	PO4-3035	30-35	58.6	1.48			32.5
1781*27	PO4-4045	40-45	70.1	0.98			42.5
1781*29	PO4-5055	50-55	68.1	1.38			52.5
1781*30	P17-02	0-2	45.7	3.04			1.0
1781*32	P17-46	4-6	58.1	1.61			5.0
1781*34	P17-810	8-10	64.4	1.36			9.0
1781*35	P17-1015	10-15	61.5	1.53			12.5
1781*37	P17-2025	20-25	57.3	1.75			22.5
1781*39	P17-3035	30-35	58.9	1.72			32.5
1781*41	P17-4045	40-45	58.1	1.43			42.5
1781*43	P17-5055	50-55	68.0	0.93			52.5
1781*45	P17-6065	60-65	64.6	1.82			62.5
1781*47	P17-7075	70-75	62.9	1.75			72.5
1781*49	P17-8085	80-85	64.2	2.20			82.5

@Relative percent difference.
= not provided.
*Percent difference from
known value (9.97 dpm/g).

TABLE 1

PALETA CREEK PORE WATER DATA

	SO4 (mM)	Alkalinity (mM)	NH4 (µM)	PO4 (µM)	H4SiO4 (µM)	HS- (µM)	Fe (µM)	Li (µM)	Mn (µM)
P11-B									
-	26.7	2.6	36	3.0	9.1		1.8	24.1	-
0.50	25.4	2.5	89		21.1	-	1.5	24.5	63.3
1.50	26.1	3.1	113	1.1	129.1	-	5.6	23.4	7.6
2.50	26.5	4.0	240	20.3	219.7	-	1.2	21.8	1.9
3.50	27.4	5.2	359	29.4	256.2	-	1.0	20.3	0.9
4.50	23.0	7.3	587	62.1	319.0	4	0.6	16.4	0.3
7.00	21.0	12.1	1,006	101.4	358.0	22	0.6	11.8	-
13.00	16.8	20.2	1,668	98.6	349.3	-	2.6	7.5	-
P11-A									
-	25.8	2.5		0.1		-			
0.50	26.9	2.6	-		45.1		1.6	24.3	9.6
1.50		3.3	124	25.0	191.7		23.4	22.3	4.7
2.50	25.0	4.2	207	39.0	238.5	-	1.5	21.5	2.4
3.50		5.2	329	55.8	292.0	-	0.5	20.1	0.9
4.50	22.9	6.7	477	84.6	302.1	15	0.4	18.0	0.2
5.50	21.4								
6.50	20.7	10.0	763	101.4	372.8	100	0.5	14.5	-
8.50		13.0	1,037	92.3	351.1	55	0.8	11.4	-
P17-B									
-		2.4							
0.25	28.5	3.6		22.0	166.0		95.4	24.3	6.9
0.75	28.5	3.7		37.3	201.0		89.3	24.1	6.6
1.50	27.7			45.2	254.0		27.5	24.1	4.0
2.50	27.0	4.3		78.0	322.0		4.3	23.5	3.8
3.50	26.3	6.1		80.4	401.0		2.6	22.8	2.4
4.50	25.4	6.1		64.8			1.0	22.7	1.2
6.50	25.7	6.3		57.0	408.0		0.7	21.8	0.7
9.00	25.0	7.0		69.5	450.0		0.3	19.3	-
P17									
-	28.1	2.2				-			
0.25	26.5	3.8	158	45.7	178.0	-	50.1	22.7	2.5
0.75		5.4	320	94.7		-	4.9	21.2	0.4
1.50	27.1	7.2	382	83.4	387.0	99	0.1	19.8	-
2.50	24.8	8.9	479	78.6	439.0	205	-	19.0	-
3.50	24.3	9.7	542	70.1	433.0	265	-	18.9	-
4.50	24.2	10.0	538	68.6	433.0	268	-	18.1	-
6.50	23.0	10.5	600	65.4	435.0	337	-	17.6	-
8.50	22.8	13.0	763	100.3	487.0	360	-	15.1	-
10.50	22.8	17.3	1,005	128.7	523.0	378	-	12.6	-
12.50		22.9	2,561	180.0		240	-	9.7	-
14.50	7.0	28.2	1,885	217.4	542.0	520	4.3	7.9	-
16.50	5.0	33.4	2,052	251.2	573.0	395	-	6.4	-
P17-1A									
-	27.2		-	0.3	6.6		0.8	23.4	0.8
0.25	26.4	2.5	17	0.3	32.8	-	20.6	24.3	11.9
0.75	24.9		1	2.6	52.4	-	40.7	23.1	3.3
1.50	26.9	2.7	50	6.3	146.0	-	12.6	22.9	1.4
2.50	25.8	3.0	82	16.2	198.0	-	4.9	21.6	1.4
3.50	25.9	3.5	168	23.2	246.4	-	1.0	21.2	0.6
4.50	25.6		283	21.8	214.1	-	1.0	21.1	0.2
6.50	24.1	9.3	560	57.5	293.0	185	0.7	15.9	0.0

P17-1C

-		2.5							
0.25	26.9	4.7	56	4.9	29.2	-	12.7	22.4	12.6
0.75	24.8		120	22.3	105.1	-	2.4	20.9	3.2
1.50	25.2	7.5	238	23.8	141.6	30	1.0	19.3	0.8
2.50	23.5	10.0	347	29.6	220.0	116	1.0	17.9	0.3
3.50	21.0	12.7	473	60.3	257.3	223	0.9	16.9	0.2
4.50	19.2	15.8	591	73.9	266.4	284	0.7	14.8	0.0
6.50	18.8	19.1	749	87.1	260.3	630	0.7	13.1	0.0
8.50	17.3	20.8	830	84.7	287.6	749	0.6	12.3	0.0
10.50	15.2	23.1	926	102.5	331.9	847	1.1	11.3	0.0
12.50	11.8	26.3	1,041	119.8	350.6	1,157	0.9	9.8	-
14.50	7.6	29.6	1,123	135.9	364.2	1,241	0.8	8.9	-
18.50	3.5	36.7	1,355	163.2	385.9	1,515	0.8	762.0	-

PO4

-		2.4							
0.75		2.6	63	3.1	76.3		22.5	24.2	26.9
1.50									
2.50		3.3	138	39.2	168.1		286.6	24.2	24.4
3.50		3.4	176	57.8	183.4		297.4	21.8	25.9
4.50		3.6	186	70.5	187.8		323.4	23.3	26.4
5.50		3.6	185	53.3	200.9		292.7	22.9	23.9
7.50		3.6	173	38.1	227.1		253.0	23.1	24.1
8.50		3.3	156	51.2	238.1		272.3	22.3	24.5
10.50		2.7	80	27.7	220.6		210.4	26.7	23.1
12.50		3.3	130	22.4	181.2		96.6	21.7	41.0
14.50		4.0	162	31.5	255.5		97.3	19.3	54.2
16.50		4.6	220	35.4	305.8		97.6	17.2	70.0
17.50		4.6	240	44.1	323.3		97.2	16.5	80.2

PO4-3A

-		2.5	8	2.6	69.8		1.3	24.3	0.2
0.25		2.6	14	4.1	92.0		0.7	24.9	16.4
0.75		2.7	45	2.6	117.8		49.8	24.4	18.6
1.50		2.7		4.8	158.7		111.0	23.8	14.9
2.50		2.8	66	8.4	206.0		209.0	23.3	11.8
3.50		2.7	90	2.6	208.1		121.0	23.2	11.5
4.50		2.8	103	12.0	225.4		147.0	23.1	12.0
8.50		3.0	130	13.4	225.4		71.8	22.2	14.6
10.50		3.1	132	34.9	203.8		110.0	21.9	22.1
12.50		3.1		29.2	186.6		82.4	20.6	34.4
14.50		3.1	136	19.1	216.8		56.7	19.6	46.6
18.50		3.2	150	7.8	208.9		10.1	18.3	88.0

PO4-3B

-									
0.25		2.7	8	1.2	74.8		0.7	25.1	2.2
0.75		3.1	43	1.2	120.0		19.5	24.3	25.8
1.50		3.4	95	1.2	175.9		115.0	23.6	24.8
2.50		3.4	139	3.4	242.6		301.0	23.0	27.0
3.50		3.5	180	4.1	287.7		440.0	23.0	26.7
4.50		3.5	171	10.5	259.8		306.0	22.1	27.7
6.50		2.8	186	22.9	223.1		236.0	21.1	24.2
8.50		2.7	177	25.8	229.7		151.0	20.7	20.0
10.50		3.5	181	20.0	194.9		75.0	20.5	19.1
12.50		3.4	177	23.7	166.7		60.6	18.9	29.7
14.50		3.4	170	30.2	247.0		78.2	18.3	43.6
17.50		3.5	165	9.9	255.7		51.4	15.6	69.8

15-Jan core A P4 **1/15/02 San Diego Bay P04, core A, oxy**

Profile 1	**dark**	**postion 1**				
Date:	1/15/2002	Time:	0.617	Data Set:	1	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
2:49:45 PM	-2000	0.067	65.070	64.254	**152.8088628**	**2000**
2:49:58 PM	-1900	0.067	64.979	64.163	**152.5924466**	**1900**
2:50:12 PM	-1800	0.067	65.585	64.769	**154.0336358**	**1800**
2:50:25 PM	-1700	0.068	66.235	65.419	**155.5794658**	**1700**
2:50:39 PM	-1600	0.068	66.052	65.236	**155.1442552**	**1600**
2:50:52 PM	-1500	0.067	65.208	64.392	**153.1370544**	**1500**
2:51:06 PM	-1400	0.066	64.563	63.747	**151.6031154**	**1400**
2:51:19 PM	-1300	0.066	64.334	63.518	**151.0585076**	**1300**
2:51:33 PM	-1200	0.066	64.170	63.354	**150.6684828**	**1200**
2:51:46 PM	-1100	0.065	63.423	62.607	**148.8919674**	**1100**
2:52:00 PM	-1000	0.064	62.012	61.196	**145.5363272**	**1000**
2:52:13 PM	-900	0.064	61.492	60.676	**144.2996632**	**900**
2:52:27 PM	-800	0.063	60.880	60.064	**142.8442048**	**800**
2:52:40 PM	-700	0.061	59.088	58.272	**138.5824704**	**700**
2:52:54 PM	-600	0.060	57.326	56.510	**134.392082**	**600**
2:53:07 PM	-500	0.058	55.679	54.863	**130.4751866**	**500**
2:53:21 PM	-400	0.056	53.699	52.883	**125.7663506**	**400**
2:53:34 PM	-300	0.054	51.410	50.594	**120.3226508**	**300**
2:53:48 PM	-200	0.052	49.520	48.704	**115.8278528**	**200**
2:54:01 PM	-100	0.050	47.544	46.728	**111.1285296**	**100**
2:54:15 PM	0	0.049	45.906	45.090	**107.233038**	**-0**
2:54:28 PM	100	0.046	43.689	42.873	**101.9605686**	**-100**
2:54:42 PM	200	0.044	41.543	40.727	**96.8569514**	**-200**
2:54:55 PM	300	0.042	39.408	38.592	**91.7794944**	**-300**
2:55:09 PM	400	0.040	37.082	36.266	**86.2478012**	**-400**
2:55:22 PM	500	0.038	35.001	34.185	**81.298767**	**-500**
2:55:36 PM	600	0.036	33.253	32.437	**77.1416734**	**-600**
2:55:49 PM	700	0.035	31.331	30.515	**72.570773**	**-700**
2:56:03 PM	800	0.033	30.172	29.356	**69.8144392**	**-800**
2:56:16 PM	900	0.032	28.672	27.856	**66.2471392**	**-900**
2:56:30 PM	1000	0.031	27.158	26.342	**62.6465444**	**-1000**
2:56:43 PM	1100	0.029	25.945	25.129	**59.7617878**	**-1100**
2:56:57 PM	1200	0.028	24.418	23.602	**56.1302764**	**-1200**
2:57:10 PM	1300	0.026	22.949	22.133	**52.6367006**	**-1300**
2:57:24 PM	1400	0.025	21.767	20.951	**49.8256682**	**-1400**
2:57:37 PM	1500	0.024	20.616	19.800	**47.08836**	**-1500**
2:57:51 PM	1600	0.023	19.137	18.321	**43.5710022**	**-1600**
2:58:04 PM	1700	0.022	17.841	17.025	**40.488855**	**-1700**
2:58:18 PM	1800	0.020	16.511	15.695	**37.325849**	**-1800**
2:58:31 PM	1900	0.019	15.438	14.622	**34.7740404**	**-1900**
2:58:45 PM	2000	0.018	14.473	13.657	**32.4790774**	**-2000**
2:58:58 PM	2100	0.017	13.163	12.347	**29.3636354**	**-2100**
2:59:12 PM	2200	0.016	12.013	11.197	**26.6287054**	**-2200**
2:59:25 PM	2300	0.015	11.124	10.308	**24.5144856**	**-2300**
2:59:39 PM	2400	0.014	10.399	9.583	**22.7902906**	**-2400**
2:59:52 PM	2500	0.014	9.599	8.783	**20.88749278**	**-2500**
3:00:06 PM	2600	0.013	8.491	7.675	**18.252685**	**-2600**
3:00:19 PM	2700	0.012	7.553	6.737	**16.02169558**	**-2700**
3:00:33 PM	2800	0.011	6.749	5.933	**14.1086715**	**-2800**

3:00:46 PM	2900	0.010	6.140	5.324	**12.66082334**	**-2900**
3:01:00 PM	3000	0.010	5.441	4.625	**10.99988846**	**-3000**
3:01:13 PM	3100	0.009	4.704	3.888	**9.24691724**	**-3100**
3:01:27 PM	3200	0.009	4.890	4.074	**9.68950026**	**-3200**
3:01:40 PM	3300	0.007	3.182	2.366	**5.62586992**	**-3300**
3:01:54 PM	3400	0.007	2.547	1.731	**4.11618856**	**-3400**
3:02:07 PM	3500	0.007	2.189	1.373	**3.26455514**	**-3500**
3:02:21 PM	3600	0.006	1.496	0.680	**1.61646254**	**-3600**
3:02:34 PM	3700	0.005	1.080	0.264	**0.62855826**	**-3700**
3:02:48 PM	3800	0.005	0.816	0.000	**0**	**-3800**
3:03:01 PM	3900	0.005	0.449	0.000	**0**	**-3900**
3:03:15 PM	4000	0.005	0.340	0.000	**0**	**-4000**

Profile 2	**dark**		**Pos. 2**			
Date:	1/15/2002	Time:	0.635	Data Set:	3	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
3:14:45 PM	-2000	0.037	33.922	33.022	**78.5329204**	**2000**
3:14:58 PM	-1900	0.037	34.004	33.104	**78.7279328**	**1900**
3:15:11 PM	-1800	0.037	34.050	33.150	**78.83733**	**1800**
3:15:24 PM	-1700	0.037	34.070	33.170	**78.884894**	**1700**
3:15:38 PM	-1600	0.037	34.128	33.228	**79.0228296**	**1600**
3:15:51 PM	-1500	0.037	34.034	33.134	**78.7992788**	**1500**
3:16:04 PM	-1400	0.037	33.932	33.032	**78.5567024**	**1400**
3:16:17 PM	-1300	0.037	33.861	32.961	**78.3878502**	**1300**
3:16:30 PM	-1200	0.037	33.827	32.927	**78.3069914**	**1200**
3:16:43 PM	-1100	0.037	33.805	32.905	**78.254671**	**1100**
3:16:56 PM	-1000	0.037	33.482	32.582	**77.4865124**	**1000**
3:17:09 PM	-900	0.037	33.452	32.552	**77.4151664**	**900**
3:17:22 PM	-800	0.037	33.436	32.536	**77.3771152**	**800**
3:17:35 PM	-700	0.036	33.212	32.312	**76.8443984**	**700**
3:17:48 PM	-600	0.036	33.041	32.141	**76.4377262**	**600**
3:18:01 PM	-500	0.036	32.903	32.003	**76.1095346**	**500**
3:18:15 PM	-400	0.036	32.725	31.825	**75.686215**	**400**
3:18:28 PM	-300	0.036	32.684	31.784	**75.5887088**	**300**
3:18:41 PM	-200	0.036	32.596	31.696	**75.3794272**	**200**
3:18:54 PM	-100	0.035	32.212	31.312	**74.4661984**	**100**
3:19:07 PM	0	0.035	31.338	30.438	**72.3876516**	**-0**
3:19:20 PM	100	0.034	30.327	29.427	**69.9832914**	**-100**
3:19:33 PM	200	0.032	29.045	28.145	**66.934439**	**-200**
3:19:46 PM	300	0.031	27.853	26.953	**64.0996246**	**-300**
3:19:59 PM	400	0.030	26.587	25.687	**61.0888234**	**-400**
3:20:12 PM	500	0.029	25.351	24.451	**58.1493682**	**-500**
3:20:25 PM	600	0.028	24.222	23.322	**55.4643804**	**-600**
3:20:38 PM	700	0.027	23.112	22.212	**52.8245784**	**-700**
3:20:51 PM	800	0.026	22.099	21.199	**50.4154618**	**-800**
3:21:04 PM	900	0.025	21.134	20.234	**48.1204988**	**-900**
3:21:17 PM	1000	0.024	20.268	19.368	**46.0609776**	**-1000**
3:21:30 PM	1100	0.023	19.085	18.185	**43.247567**	**-1100**
3:21:43 PM	1200	0.022	18.427	17.527	**41.6827114**	**-1200**
3:21:56 PM	1300	0.022	17.935	17.035	**40.512637**	**-1300**
3:22:09 PM	1400	0.021	17.080	16.180	**38.479276**	**-1400**
3:22:22 PM	1500	0.020	16.176	15.276	**36.3293832**	**-1500**
3:22:35 PM	1600	0.019	14.872	13.972	**33.2282104**	**-1600**

3:22:48 PM	1700	0.018	14.116	13.216	**31.4302912**	**-1700**
3:23:01 PM	1800	0.017	13.474	12.574	**29.9034868**	**-1800**
3:23:14 PM	1900	0.017	12.747	11.847	**28.1745354**	**-1900**
3:23:27 PM	2000	0.016	11.966	11.066	**26.3171612**	**-2000**
3:23:40 PM	2100	0.015	11.033	10.133	**24.0983006**	**-2100**
3:23:53 PM	2200	0.014	10.396	9.496	**22.5833872**	**-2200**
3:24:06 PM	2300	0.014	9.724	8.824	**20.98476116**	**-2300**
3:24:19 PM	2400	0.013	9.193	8.293	**19.72336388**	**-2400**
3:24:32 PM	2500	0.013	8.598	7.698	**18.30785924**	**-2500**
3:24:45 PM	2600	0.012	7.891	6.991	**16.6248071**	**-2600**
3:24:59 PM	2700	0.012	7.431	6.531	**15.5320242**	**-2700**
3:25:12 PM	2800	0.011	6.778	5.878	**13.98001088**	**-2800**
3:25:25 PM	2900	0.011	6.414	5.514	**13.11410826**	**-2900**
3:25:38 PM	3000	0.010	5.882	4.982	**11.84914368**	**-3000**
3:25:51 PM	3100	0.009	5.178	4.278	**10.17441524**	**-3100**
3:26:05 PM	3200	0.009	4.713	3.813	**9.0680766**	**-3200**
3:26:18 PM	3300	0.008	4.244	3.344	**7.95246298**	**-3300**
3:26:31 PM	3400	0.008	3.923	3.023	**7.1892986**	**-3400**
3:26:44 PM	3500	0.008	3.380	2.480	**5.89817382**	**-3500**
3:26:57 PM	3600	0.007	2.993	2.093	**4.97852388**	**-3600**
3:27:10 PM	3700	0.007	2.468	1.568	**3.72925542**	**-3700**
3:27:23 PM	3800	0.006	2.156	1.256	**2.9870192**	**-3800**
3:27:36 PM	3900	0.006	1.979	1.079	**2.5660778**	**-3900**
3:27:49 PM	4000	0.006	1.612	0.712	**1.69256494**	**-4000**

Profile 3	**dark**		**postion 3**			
Date:	1/15/2002	Time:	0.649	Data Set:	4	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
3:34:49 PM	-2000	0.040	37.114	36.967	**87.9149194**	**2000**
3:35:02 PM	-1900	0.041	37.557	37.410	**88.968462**	**1900**
3:35:15 PM	-1800	0.042	39.553	39.406	**93.7153492**	**1800**
3:35:28 PM	-1700	0.043	39.881	39.734	**94.4953988**	**1700**
3:35:41 PM	-1600	0.042	39.268	39.121	**93.0375622**	**1600**
3:35:54 PM	-1500	0.041	38.000	37.853	**90.0220046**	**1500**
3:36:07 PM	-1400	0.040	36.980	36.833	**87.5962406**	**1400**
3:36:20 PM	-1300	0.039	36.264	36.117	**85.8934494**	**1300**
3:36:33 PM	-1200	0.038	35.412	35.265	**83.867223**	**1200**
3:36:46 PM	-1100	0.038	35.374	35.227	**83.7768514**	**1100**
3:36:59 PM	-1000	0.040	36.703	36.556	**86.9374792**	**1000**
3:37:12 PM	-900	0.041	38.234	38.087	**90.5785034**	**900**
3:37:25 PM	-800	0.041	37.737	37.590	**89.396538**	**800**
3:37:38 PM	-700	0.039	35.657	35.510	**84.449882**	**700**
3:37:51 PM	-600	0.037	34.155	34.008	**80.8778256**	**600**
3:38:04 PM	-500	0.039	35.453	35.306	**83.9647292**	**500**
3:38:17 PM	-400	0.039	35.901	35.754	**85.0301628**	**400**
3:38:30 PM	-300	0.037	34.297	34.150	**81.21553**	**300**
3:38:43 PM	-200	0.036	32.376	32.229	**76.6470078**	**200**
3:38:56 PM	-100	0.034	30.928	30.781	**73.2033742**	**100**
3:39:09 PM	0	0.033	29.471	29.324	**69.7383368**	**-0**
3:39:22 PM	100	0.031	27.885	27.738	**65.9665116**	**-100**
3:39:35 PM	200	0.030	26.587	26.440	**62.879608**	**-200**
3:39:48 PM	300	0.029	25.147	25.000	**59.455**	**-300**

3:40:01 PM	400	0.027	24.006	23.859	**56.7414738**	**-400**
3:40:14 PM	500	0.026	22.353	22.206	**52.8103092**	**-500**
3:40:27 PM	600	0.025	21.088	20.941	**49.8018862**	**-600**
3:40:40 PM	700	0.024	19.906	19.759	**46.9908538**	**-700**
3:40:53 PM	800	0.023	18.876	18.729	**44.5413078**	**-800**
3:41:06 PM	900	0.022	17.874	17.727	**42.1583514**	**-900**
3:41:19 PM	1000	0.021	16.743	16.596	**39.4686072**	**-1000**
3:41:32 PM	1100	0.020	15.758	15.611	**37.1260802**	**-1100**
3:41:45 PM	1200	0.019	14.917	14.770	**35.126014**	**-1200**
3:41:58 PM	1300	0.018	13.693	13.546	**32.2150972**	**-1300**
3:42:11 PM	1400	0.016	12.441	12.294	**29.2375908**	**-1400**
3:42:25 PM	1500	0.016	11.601	11.454	**27.2399028**	**-1500**
3:42:38 PM	1600	0.015	10.707	10.560	**25.113792**	**-1600**
3:42:51 PM	1700	0.014	10.076	9.929	**23.6131478**	**-1700**
3:43:04 PM	1800	0.013	9.281	9.134	**21.72319226**	**-1800**
3:43:17 PM	1900	0.013	8.501	8.354	**19.86676934**	**-1900**
3:43:30 PM	2000	0.012	7.956	7.809	**18.5701747**	**-2000**
3:43:43 PM	2100	0.012	7.466	7.319	**17.40652144**	**-2100**
3:43:56 PM	2200	0.011	6.901	6.754	**16.06164934**	**-2200**
3:44:09 PM	2300	0.011	6.399	6.252	**14.8673173**	**-2300**
3:44:22 PM	2400	0.010	5.742	5.595	**13.30674246**	**-2400**
3:44:36 PM	2500	0.009	4.990	4.843	**11.5176226**	**-2500**
3:44:49 PM	2600	0.009	4.526	4.379	**10.41461344**	**-2600**
3:45:02 PM	2700	0.009	4.268	4.121	**9.80032438**	**-2700**
3:45:15 PM	2800	0.008	3.753	3.606	**8.57626484**	**-2800**
3:45:28 PM	2900	0.008	3.232	3.085	**7.336747**	**-2900**
3:45:41 PM	3000	0.007	2.814	2.667	**6.3426594**	**-3000**
3:45:54 PM	3100	0.007	2.611	2.464	**5.8586957**	**-3100**
3:46:07 PM	3200	0.006	2.054	1.907	**4.53451394**	**-3200**
3:46:20 PM	3300	0.006	1.710	1.563	**3.71736442**	**-3300**
3:46:33 PM	3400	0.006	1.614	1.467	**3.48905722**	**-3400**
3:46:46 PM	3500	0.005	1.107	0.960	**2.28354764**	**-3500**
3:46:59 PM	3600	0.005	0.958	0.811	**1.92836347**	**-3600**
3:47:12 PM	3700	0.005	0.944	0.797	**1.894545466**	**-3700**
3:47:25 PM	3800	0.005	0.405	0.258	**0.613979894**	**-3800**
3:47:39 PM	3900	0.005	0.653	0.506	**1.203559456**	**-3900**
3:47:52 PM	4000	0.005	0.417	0.270	**0.642375602**	**-4000**
3:48:05 PM	4100	0.005	0.248	0.101	**0.239056664**	**-4100**
3:48:18 PM	4200	0.004	0.094	0.000	**0**	**-4200**
3:48:31 PM	4300	0.005	0.187	0.040	**0.094152938**	**-4300**
3:48:44 PM	4400	0.005	0.147	0.000	**0**	**-4400**
3:48:57 PM	4500	0.005	0.166	0.000	**0**	**-4500**
3:49:10 PM	4600	0.005	0.328	0.000	**0**	**-4600**
3:49:23 PM	4700	0.005	0.284	0.000	**0**	**-4700**
3:49:37 PM	4800	0.005	0.186	0.000	**0**	**-4800**
3:49:50 PM	4900	0.005	0.265	0.000	**0**	**-4900**
3:50:03 PM	5000	0.005	0.458	0.000	**0**	**-5000**

1/15/02 San Diego Bay P04, core A, oxygen

profile 4	**dark**	**postion 4**				
Date:	1/15/2002	Time:	0.665	Data Set:	5	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat				
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
3:58:20 PM	-2000	0.057	54.377	53.900	**128.18498**	**2000**

3:58:33 PM	-1900	0.056	53.208	52.731	**125.4048642**	**1900**
3:58:47 PM	-1800	0.056	53.770	53.293	**126.7414126**	**1800**
3:59:00 PM	-1700	0.056	53.904	53.427	**127.0600914**	**1700**
3:59:13 PM	-1600	0.056	53.982	53.505	**127.245591**	**1600**
3:59:27 PM	-1500	0.055	53.056	52.579	**125.0433778**	**1500**
3:59:40 PM	-1400	0.054	51.119	50.642	**120.4368044**	**1400**
3:59:53 PM	-1300	0.053	50.063	49.586	**117.9254252**	**1300**
4:00:06 PM	-1200	0.055	52.340	51.863	**123.3405866**	**1200**
4:00:20 PM	-1100	0.056	53.581	53.104	**126.2919328**	**1100**
4:00:33 PM	-1000	0.057	54.362	53.885	**128.149307**	**1000**
4:00:46 PM	-900	0.057	54.742	54.265	**129.053023**	**900**
4:00:59 PM	-800	0.059	56.746	56.269	**133.8189358**	**800**
4:01:12 PM	-700	0.060	57.651	57.174	**135.9712068**	**700**
4:01:25 PM	-600	0.059	57.197	56.720	**134.891504**	**600**
4:01:38 PM	-500	0.059	56.331	55.854	**132.8319828**	**500**
4:01:51 PM	-400	0.056	54.083	53.606	**127.4857892**	**400 ***
4:02:04 PM	-300	0.055	52.676	52.199	**124.1396618**	**300 ***
4:02:18 PM	-200	0.053	50.235	49.758	**118.3344756**	**200 ***
4:02:31 PM	-100	0.051	47.963	47.486	**112.9312052**	**100 ***
4:02:44 PM	0	0.048	45.340	44.863	**106.6931866**	**-0 ***
4:02:57 PM	100	0.046	42.834	42.357	**100.7334174**	**-100**
4:03:10 PM	200	0.042	39.283	38.806	**92.2884292**	**-200**
4:03:24 PM	300	0.039	35.751	35.274	**83.8886268**	**-300**
4:03:37 PM	400	0.037	33.585	33.108	**78.7374456**	**-400**
4:03:50 PM	500	0.035	31.539	31.062	**73.8716484**	**-500**
4:04:04 PM	600	0.033	29.541	29.064	**69.1200048**	**-600**
4:04:17 PM	700	0.031	27.901	27.424	**65.2197568**	**-700**
4:04:30 PM	800	0.029	25.573	25.096	**59.6833072**	**-800**
4:04:44 PM	900	0.028	24.307	23.830	**56.672506**	**-900**
4:04:57 PM	1000	0.026	22.898	22.421	**53.3216222**	**-1000**
4:05:09 PM	1100	0.024	20.760	20.283	**48.2370306**	**-1100**
4:05:23 PM	1200	0.023	19.681	19.204	**45.6709528**	**-1200**
4:05:36 PM	1300	0.022	18.406	17.929	**42.6387478**	**-1300**
4:05:50 PM	1400	0.021	17.064	16.587	**39.4472034**	**-1400**
4:06:03 PM	1500	0.020	15.950	15.473	**36.7978886**	**-1500**
4:06:16 PM	1600	0.019	15.280	14.803	**35.2044946**	**-1600**
4:06:30 PM	1700	0.018	14.044	13.567	**32.2650394**	**-1700**
4:06:43 PM	1800	0.017	12.625	12.148	**28.8903736**	**-1800**
4:06:56 PM	1900	0.015	11.390	10.913	**25.9532966**	**-1900**
4:07:10 PM	2000	0.015	10.522	10.045	**23.889019**	**-2000**
4:07:24 PM	2100	0.014	9.821	9.344	**22.2207117**	**-2100**
4:07:36 PM	2200	0.013	8.830	8.353	**19.86581806**	**-2200**
4:07:50 PM	2300	0.012	8.068	7.591	**18.0529162**	**-2300**
4:08:03 PM	2400	0.011	7.194	6.717	**15.97413158**	**-2400**
4:08:16 PM	2500	0.011	6.666	6.189	**14.71772852**	**-2500**
4:08:29 PM	2600	0.011	6.378	5.901	**14.03352038**	**-2600**
4:08:42 PM	2700	0.010	5.438	4.961	**11.79729892**	**-2700**
4:08:56 PM	2800	0.009	4.926	4.449	**10.57966052**	**-2800**
4:09:09 PM	2900	0.009	4.441	3.964	**9.42670916**	**-2900**
4:09:23 PM	3000	0.008	4.067	3.590	**8.53797582**	**-3000**
4:09:36 PM	3100	0.008	3.526	3.049	**7.25041834**	**-3100**
4:09:50 PM	3200	0.007	3.008	2.531	**6.0180351**	**-3200**
4:10:03 PM	3300	0.007	2.588	2.111	**5.01942892**	**-3300**
4:10:17 PM	3400	0.007	2.443	1.966	**4.67458992**	**-3400**
4:10:30 PM	3500	0.006	1.866	1.389	**3.30236852**	**-3500**
4:10:43 PM	3600	0.006	1.657	1.180	**2.8050869**	**-3600**
4:10:57 PM	3700	0.006	1.441	0.964	**2.2913957**	**-3700**

4:11:10 PM	3800	0.006	1.229	0.752	**1.78745512**	**-3800**
4:11:24 PM	3900	0.005	1.053	0.576	**1.3698432**	**-3900**
4:11:37 PM	4000	0.005	0.994	0.517	**1.228387864**	**-4000**
4:11:51 PM	4100	0.005	0.706	0.229	**0.545535298**	**-4100**
4:12:04 PM	4200	0.005	0.477	0.000	**-0.00085615**	**-4200**
4:12:18 PM	4300	0.005	0.724	0.247	**0.588105078**	**-4300**
4:12:31 PM	4400	0.005	0.536	0.059	**0.139505212**	**-4400**
4:12:44 PM	4500	0.005	0.350	0.000	**0**	**-4500**
4:12:58 PM	4600	0.005	0.449	0.000	**0**	**-4600**
4:13:11 PM	4700	0.005	0.459	0.000	**0**	**-4700**
4:13:25 PM	4800	0.005	0.391	0.000	**0**	**-4800**
4:13:38 PM	4900	0.005	0.414	0.000	**0**	**-4900**
4:13:52 PM	5000	0.005	0.315	0.000	**0**	**-5000**

profile 5	**dark**		**position 4**	shift to 200 µm		
Date:	1/15/2002	Time:	0.678	Data Set:	**6**	
Range A:	500 mV	Range B:	500 mV	Sample Time	**2**	
		% sat	% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
4:16:35 PM	-2000	0.059	57.027	56.522	**134.4206204**	**2200**
4:16:48 PM	-1900	0.060	57.578	57.073	**135.7310086**	**2000**
4:17:01 PM	-1800	0.059	57.028	56.523	**134.4229986**	**1900**
4:17:14 PM	-1700	0.058	55.840	55.335	**131.597697**	**1800**
4:17:27 PM	-1600	0.059	56.808	56.303	**133.8997946**	**1700**
4:17:40 PM	-1500	0.059	56.693	56.188	**133.6263016**	**1600**
4:17:53 PM	-1400	0.060	57.763	57.258	**136.1709756**	**1500**
4:18:06 PM	-1300	0.058	55.876	55.371	**131.6833122**	**1400**
4:18:18 PM	-1200	0.057	54.607	54.102	**128.6653764**	**1300**
4:18:31 PM	-1100	0.059	56.901	56.396	**134.1209672**	**1200**
4:18:44 PM	-1000	0.060	57.550	57.045	**135.664419**	**1100**
4:18:57 PM	-900	0.056	53.932	53.427	**127.0600914**	**1000**
4:19:10 PM	-800	0.057	54.381	53.876	**128.1279032**	**900**
4:19:25 PM	-600	0.056	54.080	53.575	**127.412065**	**800**
4:19:40 PM	-400	0.054	51.661	51.156	**121.6591992**	**600**
4:19:55 PM	-200	0.048	45.180	44.675	**106.246085**	**400 ***
4:20:10 PM	0	0.037	34.167	33.662	**80.0549684**	**200 ***
4:20:25 PM	200	0.029	25.467	24.962	**59.3646284**	**-0 ***
4:20:40 PM	400	0.024	20.330	19.825	**47.147815**	**-200**
4:20:55 PM	600	0.021	17.567	17.062	**40.5768484**	**-400**
4:21:10 PM	800	0.019	15.014	14.509	**34.5053038**	**-600**
4:21:25 PM	1000	0.017	13.253	12.748	**30.3172936**	**-800**
4:21:40 PM	1200	0.015	11.486	10.981	**26.1150142**	**-1000**
4:21:55 PM	1400	0.014	10.438	9.933	**23.6226606**	**-1200**
4:22:10 PM	1600	0.013	8.761	8.256	**19.63394356**	**-1400**
4:22:25 PM	1800	0.011	7.125	6.620	**15.743684**	**-1600**
4:22:39 PM	2000	0.010	6.200	5.695	**13.54313554**	**-1800**
4:22:54 PM	2200	0.009	5.251	4.746	**11.28741284**	**-2000**
4:23:09 PM	2400	0.009	4.390	3.885	**9.2381179**	**-2200**
4:23:24 PM	2600	0.008	3.556	3.051	**7.25541256**	**-2400**
4:23:40 PM	2800	0.007	2.705	2.200	**5.23227782**	**-2600**
4:23:55 PM	3000	0.006	2.131	1.626	**3.86719102**	**-2800**
4:24:10 PM	3200	0.006	1.805	1.300	**3.09166**	**-3000**
4:24:25 PM	3400	0.006	1.460	0.955	**2.2699919**	**-3200**
4:24:40 PM	3600	0.006	1.138	0.633	**1.50587624**	**-3400**
4:24:55 PM	3800	0.005	0.935	0.430	**1.023529716**	**-3600**

4:25:10 PM	4000	0.005	0.627	0.122	**0.289973926**	**-3800**
4:25:25 PM	4200	0.005	0.527	0.022	**0.05148803**	**-4000**
4:25:40 PM	4400	0.005	0.505	0.000	**0.00047564**	**-4200**
4:25:55 PM	4600	0.005	0.481	0.000	**0**	**-4400**
4:26:10 PM	4800	0.004	-0.001	0.000	**0**	**-4600**
4:26:25 PM	5000	0.005	0.393	0.000	**0**	**-4800**
						-5000

profile 6 **dark** **postion 5** **burrow**

Date:	1/15/2002	Time:	0.687	Data Set:	7	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat	% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
4:29:29 PM	-2000	0.054	52.059	51.559	**122.6176138**	**2000**
4:29:44 PM	-1800	0.054	51.360	50.860	**120.955252**	**1800**
4:29:59 PM	-1600	0.054	51.254	50.754	**120.7031628**	**1600**
4:30:14 PM	-1400	0.054	51.266	50.766	**120.7317012**	**1400**
4:30:29 PM	-1200	0.053	50.649	50.149	**119.2643518**	**1200**
4:30:44 PM	-1000	0.054	51.877	51.377	**122.1847814**	**1000**
4:30:59 PM	-800	0.056	53.488	52.988	**126.0160616**	**800**
4:31:14 PM	-600	0.056	53.255	52.755	**125.461941**	**600**
4:31:29 PM	-400	0.052	49.714	49.214	**117.0407348**	**400**
4:31:44 PM	-200	0.048	45.412	44.912	**106.8097184**	**200**
4:31:59 PM	0	0.044	41.239	40.739	**96.8854898**	**-0**
4:32:14 PM	200	0.040	37.130	36.630	**87.113466**	**-200**
4:32:29 PM	400	0.037	33.776	33.276	**79.1369832**	**-400**
4:32:44 PM	600	0.033	29.477	28.977	**68.9131014**	**-600**
4:32:59 PM	800	0.029	25.728	25.228	**59.9972296**	**-800**
4:33:14 PM	1000	0.026	22.837	22.337	**53.1218534**	**-1000**
4:33:29 PM	1200	0.024	20.218	19.718	**46.8933476**	**-1200**
4:33:44 PM	1400	0.022	18.335	17.835	**42.415197**	**-1400**
4:33:59 PM	1600	0.020	16.668	16.168	**38.4507376**	**-1600**
4:34:14 PM	1800	0.019	15.186	14.686	**34.9262452**	**-1800**
4:34:29 PM	2000	0.018	14.211	13.711	**32.6075002**	**-2000**
4:34:44 PM	2200	0.017	13.306	12.806	**30.4552292**	**-2200**
4:34:59 PM	2400	0.017	12.753	12.253	**29.1400846**	**-2400**
4:35:14 PM	2600	0.016	12.196	11.696	**27.8154272**	**-2600**
4:35:29 PM	2800	0.016	12.449	11.949	**28.4171118**	**-2800**
4:35:44 PM	3000	0.017	13.202	12.702	**30.2078964**	**-3000**
4:36:00 PM	3200	0.018	14.145	13.645	**32.450539**	**-3200**
4:36:15 PM	3400	0.020	15.836	15.336	**36.4720752**	**-3400**
4:36:30 PM	3600	0.021	17.541	17.041	**40.5269062**	**-3600**
4:36:45 PM	3800	0.021	17.545	17.045	**40.536419**	**-3800**
4:37:01 PM	4000	0.021	16.952	16.452	**39.1261464**	**-4000**
4:37:16 PM	4200	0.017	13.526	13.026	**30.9784332**	**-4200**
4:37:31 PM	4400	0.014	10.444	9.944	**23.6488208**	**-4400**
4:37:46 PM	4600	0.011	6.652	6.152	**14.63092422**	**-4600**
4:38:01 PM	4800	0.008	4.168	3.668	**8.72418888**	**-4800**
4:38:16 PM	5000	0.007	2.392	1.892	**4.50003004**	**-5000**

Profile7 **dark** **position 5** **3mm to side of burrow**

Date:	1/15/2002	Time:	0.695	Data Set:	8

Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat	% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
4:41:17 PM	-2000	0.050	47.091	46.327	**110.1748714**	**2000**
4:41:32 PM	-1800	0.050	47.350	46.586	**110.7908252**	**1800**
4:41:47 PM	-1600	0.050	47.910	47.146	**112.1226172**	**1600**
4:42:03 PM	-1400	0.052	49.231	48.467	**115.2642194**	**1400**
4:42:18 PM	-1200	0.053	50.121	49.357	**117.3808174**	**1200**
4:42:33 PM	-1000	0.054	51.386	50.622	**120.3892404**	**1000**
4:42:48 PM	-800	0.053	50.072	49.308	**117.2642856**	**800**
4:43:03 PM	-600	0.052	49.247	48.483	**115.3022706**	**600**
4:43:18 PM	-400	0.050	47.052	46.288	**110.0821216**	**400**
4:43:33 PM	-200	0.047	43.844	43.080	**102.452856**	**200**
4:43:48 PM	0	0.043	40.335	39.571	**94.1077522**	**-0**
4:44:03 PM	200	0.040	36.612	35.848	**85.2537136**	**-200**
4:44:18 PM	400	0.037	33.575	32.811	**78.0311202**	**-400**
4:44:33 PM	600	0.034	30.568	29.804	**70.8798728**	**-600**
4:44:49 PM	800	0.030	26.756	25.992	**61.8141744**	**-800**
4:45:04 PM	1000	0.028	24.619	23.855	**56.731961**	**-1000**
4:45:19 PM	1200	0.026	22.261	21.497	**51.1241654**	**-1200**
4:45:34 PM	1400	0.024	20.313	19.549	**46.4914318**	**-1400**
4:45:49 PM	1600	0.022	18.442	17.678	**42.0418196**	**-1600**
4:46:05 PM	1800	0.021	16.912	16.148	**38.4031736**	**-1800**
4:46:20 PM	2000	0.019	15.550	14.786	**35.1640652**	**-2000**
4:46:35 PM	2200	0.018	14.470	13.706	**32.5956092**	**-2200**
4:46:51 PM	2400	0.017	13.395	12.631	**30.0390442**	**-2400**
4:47:06 PM	2600	0.016	12.409	11.645	**27.694139**	**-2600**
4:47:21 PM	2800	0.016	11.601	10.837	**25.7725534**	**-2800**
4:47:37 PM	3000	0.015	10.831	10.067	**23.9413394**	**-3000**
4:47:52 PM	3200	0.014	9.873	9.109	**21.66207252**	**-3200**
4:48:07 PM	3400	0.013	9.099	8.335	**19.82277264**	**-3400**
4:48:22 PM	3600	0.012	8.109	7.345	**17.46835464**	**-3600**
4:48:37 PM	3800	0.011	7.241	6.477	**15.40407704**	**-3800**
4:48:51 PM	4000	0.010	6.108	5.344	**12.7079117**	**-4000**
4:49:06 PM	4200	0.009	4.566	3.802	**9.04096512**	**-4200**
4:49:22 PM	4400	0.008	3.302	2.538	**6.03658506**	**-4400**
4:49:37 PM	4600	0.007	2.264	1.500	**3.56658654**	**-4600**
4:49:53 PM	4800	0.006	1.277	0.513	**1.22073006**	**-4800**
4:50:08 PM	5000	0.005	0.764	0.000	**0.000**	**-5000**

Profile 8	**dark**	**position 6**				
Date:	1/15/2002	Time:	0.703	Data Set:	9	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat	% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
4:53:23 PM	-2000	0.055	52.366	51.889	**123.4024198**	**2000**
4:53:38 PM	-1800	0.055	52.665	52.188	**124.1135016**	**1800**
4:53:53 PM	-1600	0.053	50.918	50.441	**119.9587862**	**1600**
4:54:08 PM	-1400	0.053	50.546	50.069	**119.0740958**	**1400**
4:54:23 PM	-1200	0.053	50.067	49.590	**117.934938**	**1200**
4:54:38 PM	-1000	0.054	51.803	51.326	**122.0634932**	**1000**
4:54:53 PM	-800	0.055	52.132	51.655	**122.845921**	**800**
4:55:08 PM	-600	0.052	49.940	49.463	**117.6329066**	**600**
4:55:23 PM	-400	0.053	50.090	49.613	**117.9896366**	**400**
4:55:38 PM	-200	0.049	46.730	46.253	**109.9988846**	**200**

4:55:53 PM	0	0.047	43.982	43.505	**103.463591**	**-0**
4:56:08 PM	200	0.043	40.010	39.533	**94.0173806**	**-200**
4:56:23 PM	400	0.039	36.344	35.867	**85.2988994**	**-400**
4:56:38 PM	600	0.036	32.691	32.214	**76.6113348**	**-600**
4:56:53 PM	800	0.034	30.566	30.089	**71.5576598**	**-800**
4:57:08 PM	1000	0.031	27.169	26.692	**63.4789144**	**-1000**
4:57:23 PM	1200	0.028	24.842	24.365	**57.944843**	**-1200**
4:57:38 PM	1400	0.026	22.574	22.097	**52.5510854**	**-1400**
4:57:53 PM	1600	0.024	20.344	19.867	**47.2476994**	**-1600**
4:58:08 PM	1800	0.022	18.094	17.617	**41.8967494**	**-1800**
4:58:23 PM	2000	0.020	15.857	15.380	**36.576716**	**-2000**
4:58:38 PM	2200	0.018	13.872	13.395	**31.855989**	**-2200**
4:58:53 PM	2400	0.016	12.196	11.719	**27.8701258**	**-2400**
4:59:08 PM	2600	0.014	10.494	10.017	**23.8224294**	**-2600**
4:59:23 PM	2800	0.013	8.957	8.480	**20.16737382**	**-2800**
4:59:38 PM	3000	0.011	7.203	6.726	**15.99529756**	**-3000**
4:59:54 PM	3200	0.010	5.847	5.370	**12.77022054**	**-3200**
5:00:09 PM	3400	0.009	4.889	4.412	**10.49166712**	**-3400**
5:00:24 PM	3600	0.008	3.693	3.216	**7.6471021**	**-3600**
5:00:39 PM	3800	0.007	2.652	2.175	**5.17187154**	**-3800**
5:00:54 PM	4000	0.006	1.809	1.332	**3.16847586**	**-4000**
5:01:08 PM	4200	0.005	0.936	0.459	**1.091926748**	**-4200**
5:01:23 PM	4400	0.005	0.583	0.106	**0.251518432**	**-4400**
5:01:38 PM	4600	0.005	0.477	0.000	**0.00035673**	**-4600**
5:01:52 PM	4800	0.005	0.401	0.000	**0**	**-4800**
5:02:07 PM	5000	0.005	0.496	0.000	**0**	**-5000**

profile 9	**25 % light**	**5 min**	**position 6**			
Date:	1/15/2002	Time:	0.716	Data Set:	10	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat	% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
5:11:51 PM	-2000	0.064	61.964	61.688	**146.7064016**	**2000**
5:12:06 PM	-1800	0.064	61.866	61.590	**146.473338**	**1800**
5:12:22 PM	-1600	0.064	62.452	62.176	**147.8669632**	**1600**
5:12:37 PM	-1400	0.063	61.406	61.130	**145.379366**	**1400**
5:12:52 PM	-1200	0.062	59.430	59.154	**140.6800428**	**1200**
5:13:07 PM	-1000	0.060	57.737	57.461	**136.6537502**	**1000**
5:13:22 PM	-800	0.060	58.102	57.826	**137.5217932**	**800**
5:13:37 PM	-600	0.061	58.646	58.370	**138.815534**	**600**
5:13:53 PM	-400	0.059	57.115	56.839	**135.1745098**	**400**
5:14:08 PM	-200	0.056	53.699	53.423	**127.0505786**	**200**
5:14:23 PM	0	0.052	49.650	49.374	**117.4212468**	**-0**
5:14:38 PM	200	0.048	45.015	44.739	**106.3982898**	**-200**
5:14:53 PM	400	0.043	40.264	39.988	**95.0994616**	**-400**
5:15:08 PM	600	0.039	36.076	35.800	**85.13956**	**-600**
5:15:23 PM	800	0.035	31.958	31.682	**75.3461324**	**-800**
5:15:38 PM	1000	0.032	28.787	28.511	**67.8048602**	**-1000**
5:15:54 PM	1200	0.029	25.270	24.994	**59.4407308**	**-1200**
5:16:09 PM	1400	0.026	22.305	22.029	**52.3893678**	**-1400**
5:16:24 PM	1600	0.024	19.979	19.703	**46.8576746**	**-1600**
5:16:40 PM	1800	0.021	17.104	16.828	**40.0203496**	**-1800**
5:16:55 PM	2000	0.019	14.867	14.591	**34.7003162**	**-2000**
5:17:10 PM	2200	0.016	12.402	12.126	**28.8380532**	**-2200**
5:17:25 PM	2400	0.015	10.753	10.477	**24.9164014**	**-2400**

5:17:41 PM	2600	0.013	8.953	8.677	**20.63516576**	**-2600**
5:17:56 PM	2800	0.012	7.499	7.223	**17.17726296**	**-2800**
5:18:11 PM	3000	0.010	6.199	5.923	**14.0848895**	**-3000**
5:18:27 PM	3200	0.009	4.822	4.546	**10.81105938**	**-3200**
5:18:42 PM	3400	0.008	3.819	3.543	**8.42548696**	**-3400**
5:18:57 PM	3600	0.007	2.728	2.452	**5.83110858**	**-3600**
5:19:12 PM	3800	0.006	1.848	1.572	**3.73805476**	**-3800**
5:19:26 PM	4000	0.006	1.153	0.877	**2.08496794**	**-4000**
5:19:41 PM	4200	0.005	0.634	0.358	**0.852085278**	**-4200**
5:19:56 PM	4400	0.005	0.461	0.185	**0.43972918**	**-4400**
5:20:12 PM	4600	0.005	0.276	0.000	**0.00**	**-4600**
5:20:27 PM	4800	0.004	0.083	0.000	**0**	**-4800**
5:20:42 PM	5000	0.004	-0.007	0.000	**0**	**-5000**

Profile 10	**25 % light**	**20 min**	**position 6**			
Date:	1/15/2002	Time:	0.726	Data Set:	11	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat	% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
5:26:07 PM	-2000	0.063	60.444	60.078	**142.8774996**	**2000**
5:26:22 PM	-1800	0.064	62.472	62.106	**147.7004892**	**1800**
5:26:37 PM	-1600	0.063	61.168	60.802	**144.5993164**	**1600**
5:26:52 PM	-1400	0.063	61.162	60.796	**144.5850472**	**1400**
5:27:07 PM	-1200	0.064	62.144	61.778	**146.9204396**	**1200**
5:27:22 PM	-1000	0.065	63.104	62.738	**149.2035116**	**1000**
5:27:37 PM	-800	0.065	63.053	62.687	**149.0822234**	**800**
5:27:52 PM	-600	0.064	62.032	61.666	**146.6540812**	**600**
5:28:07 PM	-400	0.062	59.798	59.432	**141.3411824**	**400**
5:28:22 PM	-200	0.058	55.532	55.166	**131.1957812**	**200**
5:28:37 PM	0	0.054	51.677	51.311	**122.0278202**	**-0**
5:28:52 PM	200	0.050	47.210	46.844	**111.4044008**	**-200**
5:29:07 PM	400	0.046	43.118	42.752	**101.6728064**	**-400**
5:29:22 PM	600	0.041	38.396	38.030	**90.442946**	**-600**
5:29:37 PM	800	0.038	34.581	34.215	**81.370113**	**-800**
5:29:53 PM	1050	0.034	30.900	30.534	**72.6159588**	**-1050**
5:30:09 PM	1300	0.030	26.230	25.864	**61.5097648**	**-1300**
5:30:25 PM	1550	0.027	23.259	22.893	**54.4441326**	**-1550**
5:30:41 PM	1800	0.023	19.723	19.357	**46.0348174**	**-1800**
5:30:57 PM	2050	0.020	16.688	16.322	**38.8169804**	**-2050**
5:31:13 PM	2300	0.017	13.600	13.234	**31.4730988**	**-2300**
5:31:29 PM	2550	0.014	10.419	10.053	**23.9080446**	**-2550**
5:31:45 PM	2800	0.012	8.065	7.699	**18.31023744**	**-2800**
5:32:01 PM	3050	0.010	6.197	5.831	**13.86752202**	**-3050**
5:32:17 PM	3300	0.009	4.425	4.059	**9.65382726**	**-3300**
5:32:33 PM	3550	0.007	2.796	2.430	**5.779026**	**-3550**
5:32:49 PM	3800	0.006	1.600	1.234	**2.9335097**	**-3800**
5:33:05 PM	4050	0.005	0.931	0.565	**1.344444024**	**-4050**
5:33:21 PM	4300	0.005	0.488	0.122	**0.290901424**	**-4300**
5:33:37 PM	4550	0.005	0.366	0.000	**0.000784806**	**-4550**
5:33:53 PM	4800	0.005	0.191	0.000	**0**	**-4800**

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Profile 11	50 % light	5 min	position 6			
Date:	1/15/2002	Time:	0.735	Data Set:	12	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat	% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
5:39:44 PM	-2000	0.061	59.028	58.621	**139.4124622**	**2000**
5:40:00 PM	-1750	0.062	60.094	59.687	**141.9476234**	**1750**
5:40:16 PM	-1500	0.063	60.668	60.261	**143.3127102**	**1500**
5:40:32 PM	-1250	0.063	60.844	60.437	**143.7312734**	**1250**
5:40:48 PM	-1000	0.063	61.302	60.895	**144.820489**	**1000**
5:41:04 PM	-750	0.063	60.637	60.230	**143.238986**	**750**
5:41:20 PM	-500	0.061	58.508	58.101	**138.1757982**	**500**
5:41:36 PM	-250	0.057	54.406	53.999	**128.4204218**	**250**
5:41:52 PM	0	0.051	48.968	48.561	**115.4877702**	**-0**
5:42:08 PM	250	0.046	43.003	42.596	**101.3018072**	**-250**
5:42:24 PM	500	0.041	38.303	37.896	**90.1242672**	**-500**
5:42:40 PM	750	0.037	33.541	33.134	**78.7992788**	**-750**
5:42:56 PM	1000	0.032	28.781	28.374	**67.4790468**	**-1000**
5:43:12 PM	1250	0.029	25.303	24.896	**59.2076672**	**-1250**
5:43:28 PM	1500	0.025	21.691	21.284	**50.6176088**	**-1500**
5:43:45 PM	1750	0.022	18.551	18.144	**43.1500608**	**-1750**
5:44:01 PM	2000	0.020	15.739	15.332	**36.4625624**	**-2000**
5:44:17 PM	2250	0.017	13.013	12.606	**29.9795892**	**-2250**
5:44:33 PM	2500	0.015	10.523	10.116	**24.0578712**	**-2500**
5:44:49 PM	2750	0.013	8.624	8.217	**19.54119376**	**-2750**
5:45:05 PM	3000	0.011	6.640	6.233	**14.82355842**	**-3000**
5:45:21 PM	3250	0.009	4.573	4.166	**9.90805684**	**-3250**
5:45:37 PM	3500	0.008	3.220	2.813	**6.68940096**	**-3500**
5:45:53 PM	3750	0.006	1.952	1.545	**3.67455682**	**-3750**
5:46:09 PM	4000	0.005	1.004	0.597	**1.42026104**	**-4000**
5:46:25 PM	4250	0.005	0.689	0.282	**0.671556116**	**-4250**
5:46:41 PM	4500	0.005	0.498	0.091	**0.216939404**	**-4500**
5:46:57 PM	4750	0.005	0.392	0.000	**0**	**-4750**
5:47:13 PM	5000	0.005	0.407	0.000	**0**	**-5000**

Profile 12	50 % light	15 min.	position 6			
Date:	1/15/2002	Time:	0.742	Data Set:	13	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat	% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
5:49:58 PM	-2000	0.055	52.719	52.333	**124.4583406**	**2000**
5:50:14 PM	-1750	0.052	49.008	48.622	**115.6328404**	**1750**
5:50:30 PM	-1500	0.047	44.000	43.614	**103.7228148**	**1500**
5:50:46 PM	-1250	0.053	50.230	49.844	**118.5390008**	**1250**
5:51:02 PM	-1000	0.056	54.009	53.623	**127.5262186**	**1000**
5:51:18 PM	-750	0.056	53.807	53.421	**127.0458222**	**750**
5:51:34 PM	-500	0.056	53.960	53.574	**127.4096868**	**500**
5:51:50 PM	-250	0.053	50.332	49.946	**118.7815772**	**250**
5:52:06 PM	0	0.048	45.536	45.150	**107.37573**	**-0**
5:52:22 PM	250	0.043	40.137	39.751	**94.5358282**	**-250**
5:52:39 PM	550	0.036	32.620	32.234	**76.6588988**	**-550**
5:52:57 PM	850	0.030	26.699	26.313	**62.5775766**	**-850**

5:53:14 PM	1150	0.026	21.947	21.561	**51.2763702**	**-1150**
5:53:31 PM	1450	0.022	18.379	17.993	**42.7909526**	**-1450**
5:53:48 PM	1750	0.019	14.679	14.293	**33.9916126**	**-1750**
5:54:05 PM	2050	0.015	11.450	11.064	**26.3124048**	**-2050**
5:54:22 PM	2350	0.013	8.799	8.413	**20.00708314**	**-2350**
5:54:39 PM	2650	0.011	6.589	6.203	**14.75149896**	**-2650**
5:54:56 PM	2950	0.009	4.536	4.150	**9.8683409**	**-2950**
5:55:13 PM	3250	0.008	3.262	2.876	**6.8397032**	**-3250**
5:55:30 PM	3550	0.007	2.429	2.043	**4.85890042**	**-3550**
5:55:47 PM	3850	0.005	0.894	0.508	**1.2081256**	**-3850**
5:56:05 PM	4150	0.005	0.386	0.000	**0**	**-4150**
5:56:22 PM	4450	0.005	0.290	0.000	**0**	**-4450**
5:56:38 PM	4750	0.005	0.237	0.000	**0**	**-4750**

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| **Profile 13** | **100 % light** | **5 min** | **Position 6** | | | |
|---|---|---|---|---|---|---|
| Date: | 1/15/2002 | Time: | 0.751 | Data Set: | 14 | |
| Range A: | 500 mV | Range B: | 500 mV | Sample Time | 2 | |
| | | % sat | % sat | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | **O2 (µM)** | **Depth (µm)** |
| 6:02:10 PM | -2000 | 0.054 | 51.783 | 51.395 | **122.227589** | **2000** |
| 6:02:27 PM | -1700 | 0.054 | 51.472 | 51.084 | **121.4879688** | **1700** |
| 6:02:44 PM | -1400 | 0.053 | 50.223 | 49.835 | **118.517597** | **1400** |
| 6:03:00 PM | -1100 | 0.053 | 50.556 | 50.168 | **119.3095376** | **1100** |
| 6:03:17 PM | -800 | 0.053 | 50.701 | 50.313 | **119.6543766** | **800** |
| 6:03:34 PM | -500 | 0.053 | 50.862 | 50.474 | **120.0372668** | **500** |
| 6:03:51 PM | -200 | 0.053 | 50.566 | 50.178 | **119.3333196** | **200** |
| 6:04:08 PM | 100 | 0.051 | 48.088 | 47.700 | **113.44014** | **-100** |
| 6:04:25 PM | 400 | 0.043 | 40.373 | 39.985 | **95.092327** | **-400** |
| 6:04:42 PM | 700 | 0.035 | 31.961 | 31.573 | **75.0869086** | **-700** |
| 6:04:59 PM | 1000 | 0.029 | 25.701 | 25.313 | **60.1993766** | **-1000** |
| 6:05:16 PM | 1300 | 0.024 | 20.394 | 20.006 | **47.5782692** | **-1300** |
| 6:05:33 PM | 1600 | 0.020 | 15.991 | 15.603 | **37.1070546** | **-1600** |
| 6:05:50 PM | 1900 | 0.017 | 12.622 | 12.234 | **29.0948988** | **-1900** |
| 6:06:07 PM | 2200 | 0.013 | 9.247 | 8.859 | **21.0672847** | **-2200** |
| 6:06:24 PM | 2500 | 0.011 | 7.052 | 6.664 | **15.84880044** | **-2500** |
| 6:06:41 PM | 2800 | 0.009 | 4.767 | 4.379 | **10.41508908** | **-2800** |
| 6:06:59 PM | 3100 | 0.008 | 3.245 | 2.857 | **6.79404176** | **-3100** |
| 6:07:16 PM | 3400 | 0.006 | 1.974 | 1.586 | **3.7718252** | **-3400** |
| 6:07:34 PM | 3700 | 0.005 | 1.135 | 0.747 | **1.77580194** | **-3700** |
| 6:07:51 PM | 4000 | 0.005 | 0.632 | 0.244 | **0.5790917** | **-4000** |
| 6:08:08 PM | 4300 | 0.005 | 0.372 | 0.000 | **0** | **-4300** |
| 6:08:26 PM | 4600 | 0.005 | 0.502 | 0.114 | **0.27147153** | **-4600** |
| 6:08:43 PM | 4900 | 0.005 | 0.388 | 0.000 | **0.00** | **-4900** |

| **Profile 14** | **100 % light** | **15 min** | **Position 6** | | | |
|---|---|---|---|---|---|---|
| Date: | 1/15/2002 | Time: | 0.758 | Data Set: | 15 | |
| Range A: | 500 mV | Range B: | 500 mV | Sample Time | 2 | |
| | | % sat | % sat | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | **O2 (µM)** | **Depth (µm)** |
| 6:12:05 PM | -2000 | 0.054 | 52.009 | 51.609 | **122.7365238** | **2000** |
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6:12:22 PM	-1700	0.054	51.650	51.250	**121.88275**	**1700**
6:12:39 PM	-1400	0.054	51.608	51.208	**121.7828656**	**1400**
6:12:56 PM	-1100	0.054	51.686	51.286	**121.9683652**	**1100**
6:13:13 PM	-800	0.054	51.324	50.924	**121.1074568**	**800**
6:13:30 PM	-500	0.054	51.838	51.438	**122.3298516**	**500**
6:13:47 PM	-200	0.053	50.231	49.831	**118.5080842**	**200**
6:14:04 PM	100	0.051	48.713	48.313	**114.8979766**	**-100**
6:14:21 PM	400	0.044	41.637	41.237	**98.0698334**	**-400**
6:14:38 PM	700	0.036	33.310	32.910	**78.266562**	**-700**
6:14:55 PM	1000	0.030	26.919	26.519	**63.0674858**	**-1000**
6:15:12 PM	1300	0.025	21.539	21.139	**50.2727698**	**-1300**
6:15:29 PM	1600	0.021	16.954	16.554	**39.3687228**	**-1600**
6:15:46 PM	1900	0.017	13.386	12.986	**30.8833052**	**-1900**
6:16:04 PM	2200	0.014	9.949	9.549	**22.70848052**	**-2200**
6:16:21 PM	2500	0.012	7.473	7.073	**16.82077078**	**-2500**
6:16:38 PM	2800	0.009	5.199	4.799	**11.4129818**	**-2800**
6:16:55 PM	3100	0.007	3.079	2.679	**6.37214908**	**-3100**
6:17:12 PM	3400	0.006	1.961	1.561	**3.7123702**	**-3400**
6:17:30 PM	3700	0.006	1.162	0.762	**1.81171276**	**-3700**
6:17:47 PM	4000	0.005	0.441	0.041	**0.098647736**	**-4000**
6:18:04 PM	4300	0.005	0.414	0.014	**0.033746658**	**-4300**
6:18:22 PM	4600	0.005	0.466	0.066	**0.158102736**	**-4600**
6:18:39 PM	4900	0.005	0.394	0.000	**0**	**-4900**

1/15/02 San Diego Bay (P04) Oxygen core B

Profile 1	**dark**	**Position 1**				
Date:	1/15/2002	Time:	0.771	Data Set:	1	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat				
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
6:30:42 PM	-2000	0.036	32.475	31.547	**75.0250754**	**1100**
6:31:00 PM	-1700	0.036	32.386	31.458	**74.8134156**	**800**
6:31:17 PM	-1400	0.034	30.489	29.561	**70.3019702**	**500**
6:31:34 PM	-1100	0.031	27.368	26.440	**62.879608**	**200**
6:31:51 PM	-800	0.025	20.954	20.026	**47.6258332**	**-100**
6:32:08 PM	-500	0.019	15.560	14.632	**34.7978224**	**-400**
6:32:25 PM	-200	0.014	10.361	9.433	**22.4335606**	**-700**
6:32:42 PM	100	0.011	6.508	5.580	**13.2694047**	**-1000**
6:32:59 PM	400	0.008	3.978	3.050	**7.25446128**	**-1300**
6:33:16 PM	700	0.006	2.078	1.150	**2.73493**	**-1600**
6:33:33 PM	1000	0.005	0.928	0.000	**0**	**-1900**

Profile 2	**dark**	**position 2**				
Date:	1/15/2002	Time:	0.782	Data Set:	4	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat				
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (mm)**
6:46:29 PM	-2000	0.027	23.563	14.323	**34.0629586**	**2000**
6:46:46 PM	-1700	0.028	24.820	15.580	**37.052356**	**1700**
6:47:03 PM	-1400	0.029	25.512	16.272	**38.6980704**	**1400**
6:47:20 PM	-1100	0.029	25.354	16.114	**38.3223148**	**1100**
6:47:37 PM	-800	0.029	25.483	16.243	**38.6291026**	**800**
6:47:55 PM	-500	0.029	25.420	16.180	**38.479276**	**500**
6:48:12 PM	-200	0.029	25.641	16.401	**39.0048582**	**200**
6:48:29 PM	100	0.023	19.748	10.508	**24.9901256**	**-100**
6:48:46 PM	400	0.018	14.294	5.054	**12.0194228**	**-400**
6:49:03 PM	700	0.014	10.045	0.805	**1.914451**	**-700**
6:49:20 PM	1000	0.011	6.490	0.000	**0**	**-1000**
6:49:38 PM	1300	0.008	3.734	0.000	**0**	**-1300**
6:49:55 PM	1600	0.006	1.994	0.000	**0**	**-1600**
6:50:12 PM	1900	0.005	0.924	0.000	**0**	**-1900**
6:50:29 PM	2200	0.005	0.540	0.000	**0**	**-2200**
6:50:46 PM	2500	0.005	0.517	0.000	**0**	**-2500**
6:51:03 PM	2800	0.005	0.501	0.000	**0**	**-2800**
6:51:20 PM	3100	0.005	0.392	0.000	**0**	**-3100**

Profile 3	**dark**	**position 3**				
Date:	1/15/2002	Time:	0.788	Data Set:	5	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat				
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
6:55:47 PM	-2000	0.030	27.129	26.248	**62.4229936**	**2000**
6:56:04 PM	-1700	0.030	26.882	26.001	**61.8355782**	**1700**
6:56:21 PM	-1400	0.029	25.986	25.105	**59.704711**	**1400**

6:56:38 PM	-1100	0.030	26.909	26.028	**61.8997896**	**1100**
6:56:55 PM	-800	0.031	27.385	26.504	**63.0318128**	**800**
6:57:12 PM	-500	0.031	27.461	26.580	**63.212556**	**500**
6:57:29 PM	-200	0.031	27.936	27.055	**64.342201**	**200**
6:57:46 PM	100	0.026	22.776	21.895	**52.070689**	**-100**
6:58:03 PM	400	0.021	17.046	16.165	**38.443603**	**-400**
6:58:20 PM	700	0.016	12.519	11.638	**27.6774916**	**-700**
6:58:37 PM	1000	0.013	8.547	7.666	**18.2322325**	**-1000**
6:58:54 PM	1300	0.010	5.429	4.548	**10.8151023**	**-1300**
6:59:11 PM	1600	0.007	3.164	2.283	**5.42895496**	**-1600**
6:59:28 PM	1900	0.006	1.514	0.633	**1.50444932**	**-1900**
6:59:45 PM	2200	0.005	0.881	0.000	**0**	**-2200**
7:00:02 PM	2500	0.005	0.562	0.000	**0**	**-2500**
7:00:19 PM	2800	0.005	0.484	0.000	**0**	**-2800**

Profile 4	**dark**		**position 4**			
Date:	1/15/2002	Time:	0.808	Data Set:	6	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat				
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
7:24:22 PM	-2000	0.037	33.446	32.927	**78.3069914**	**2000**
7:24:39 PM	-1700	0.036	32.628	32.109	**76.3616238**	**1700**
7:24:56 PM	-1400	0.036	32.753	32.234	**76.6588988**	**1400**
7:25:13 PM	-1100	0.036	32.729	32.210	**76.601822**	**1100**
7:25:30 PM	-800	0.035	31.977	31.458	**74.8134156**	**800**
7:25:47 PM	-500	0.033	29.651	29.132	**69.2817224**	**500 ***
7:26:04 PM	-200	0.029	25.518	24.999	**59.4526218**	**200 ***
7:26:22 PM	100	0.024	20.362	19.843	**47.1906226**	**-100**
7:26:39 PM	400	0.019	14.935	14.416	**34.2841312**	**-400**
7:26:56 PM	700	0.014	10.399	9.880	**23.496616**	**-700**
7:27:13 PM	1000	0.011	6.593	6.074	**14.4454246**	**-1000**
7:27:31 PM	1300	0.008	3.655	3.136	**7.45874866**	**-1300**
7:27:48 PM	1600	0.006	1.591	1.072	**2.54871694**	**-1600**
7:28:05 PM	1900	0.005	0.720	0.201	**0.47766147**	**-1900**
7:28:22 PM	2200	0.005	0.519	0.000	**0.00038051**	**-2200**
7:28:40 PM	2500	0.005	0.494	0.000	**0**	**-2500**

Profile 5	**50 % light**	**15 min**	**Position 4**			
Date:	1/15/2002	Time:	0.821	Data Set:	7	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
		% sat				
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
7:42:15 PM	-2000	0.038	34.566	33.850	**80.50207**	**2000**
7:42:32 PM	-1700	0.031	28.005	27.289	**64.8986998**	**1700**
7:42:49 PM	-1400	0.037	33.382	32.666	**77.6862812**	**1400**
7:43:06 PM	-1100	0.035	32.155	31.439	**74.7682298**	**1100**
7:43:23 PM	-800	0.036	32.425	31.709	**75.4103438**	**800**
7:43:40 PM	-500	0.035	31.608	30.892	**73.4673544**	**500**
7:43:57 PM	-200	0.030	27.132	26.416	**62.8225312**	**200**
7:44:14 PM	100	0.025	20.904	20.188	**48.0111016**	**-100**
7:44:32 PM	400	0.019	15.061	14.345	**34.115279**	**-400**
7:44:49 PM	700	0.014	10.200	9.484	**22.5548488**	**-700**

7:45:06 PM	1000	0.011	6.577	5.861	**13.9374411**	**-1000**
7:45:23 PM	1300	0.008	3.291	2.575	**6.12362718**	**-1300**
7:45:40 PM	1600	0.006	1.368	0.652	**1.55153768**	**-1600**
7:45:57 PM	1900	0.005	0.716	0.000	**0.00068968**	**-1900**
7:46:14 PM	2200	0.005	0.624	0.000	**0**	**-2200**
7:46:31 PM	2500	0.005	0.512	0.000	**0**	**-2500**
7:46:48 PM	2800	0.005	0.595	0.000	**0**	**-2800**
7:47:06 PM	3100	0.005	0.454	0.000	**0**	**-3100**
7:47:23 PM	3400	0.005	0.746	0.000	**0**	**-3400**
7:47:40 PM	3700	0.005	0.735	0.019	**0**	**-3700**
7:47:57 PM	4000	0.005	0.628	0.000	**0**	**-4000**

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| **Profile 6** | **100 % light** | **15 min.** | **Position 4** | | | |
|---|---|---|---|---|---|---|
| Date: | 1/15/2002 | Time: | 0.826 | Data Set: | 8 | |
| Range A: | 500 mV | Range B: | 500 mV | Sample Time | 2 | |
| | | % sat | | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | **O2 (µM)** | **Depth (µm)** |
| 7:50:41 PM | -2000 | 0.039 | 36.327 | 35.842 | **85.2394444** | **2000** |
| 7:50:59 PM | -1700 | 0.040 | 36.753 | 36.268 | **86.2525576** | **1700** |
| 7:51:16 PM | -1400 | 0.040 | 37.014 | 36.529 | **86.8732678** | **1400** |
| 7:51:33 PM | -1100 | 0.040 | 37.070 | 36.585 | **87.006447** | **1100** |
| 7:51:50 PM | -800 | 0.039 | 35.772 | 35.287 | **83.9195434** | **800** |
| 7:52:07 PM | -500 | 0.036 | 32.358 | 31.873 | **75.8003686** | **500** |
| 7:52:25 PM | -200 | 0.029 | 26.083 | 25.598 | **60.8771636** | **200** |
| 7:52:42 PM | 100 | 0.023 | 19.560 | 19.075 | **45.364165** | **-100** |
| 7:52:59 PM | 400 | 0.018 | 14.610 | 14.125 | **33.592075** | **-400** |
| 7:53:16 PM | 700 | 0.014 | 10.198 | 9.713 | **23.0994566** | **-700** |
| 7:53:33 PM | 1000 | 0.010 | 5.806 | 5.321 | **12.6544022** | **-1000** |
| 7:53:50 PM | 1300 | 0.007 | 2.477 | 1.992 | **4.73761222** | **-1300** |
| 7:54:07 PM | 1600 | 0.006 | 1.175 | 0.690 | **1.64072018** | **-1600** |
| 7:54:24 PM | 1900 | 0.005 | 0.636 | 0.151 | **0.35806179** | **-1900** |
| 7:54:41 PM | 2200 | 0.005 | 0.450 | 0.000 | **0** | **-2200** |
| 7:54:58 PM | 2500 | 0.005 | 0.485 | 0.000 | **0** | **-2500** |
| 7:55:15 PM | 2800 | 0.005 | 0.470 | 0.000 | **0** | **-2800** |

| **profile 7** | **100% light** | **25 min** | **different position** | | **5** | |
|---|---|---|---|---|---|---|
| Date: | 1/15/2002 | Time: | 0.831 | Data Set: | 9 | |
| Range A: | 500 mV | Range B: | 500 mV | Sample Time | 2 | |
| | | % sat | | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | **O2 (µM)** | **Depth (µm)** |
| 7:57:41 PM | -2000 | 0.044 | 41.615 | 41.274 | **98.1587781** | **2000** |
| 7:57:58 PM | -1700 | 0.045 | 41.988 | 41.647 | **99.0458467** | **1700** |
| 7:58:15 PM | -1400 | 0.044 | 40.741 | 40.400 | **96.0802313** | **1400** |
| 7:58:32 PM | -1100 | 0.044 | 41.109 | 40.768 | **96.9554089** | **1100** |
| 7:58:49 PM | -800 | 0.042 | 38.595 | 38.254 | **90.9766141** | **800** |
| 7:59:06 PM | -500 | 0.037 | 34.102 | 33.761 | **80.2913615** | **500** |
| 7:59:23 PM | -200 | 0.031 | 27.254 | 26.913 | **64.0054479** | **200** |
| 7:59:40 PM | 100 | 0.024 | 20.452 | 20.111 | **47.8289315** | **-100** |
| 7:59:57 PM | 400 | 0.019 | 15.350 | 15.009 | **35.6953551** | **-400** |
| 8:00:14 PM | 700 | 0.015 | 11.002 | 10.661 | **25.3549415** | **-700** |
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8:00:31 PM	1000	0.011	7.276	6.935	**16.492817**	**-1000**
8:00:48 PM	1300	0.008	3.549	3.208	**7.6292656**	**-1300**
8:01:05 PM	1600	0.006	1.428	1.088	**2.58700596**	**-1600**
8:01:22 PM	1900	0.005	0.583	0.242	**0.57590491**	**-1900**
8:01:39 PM	2200	0.005	0.340	0.000	**0**	**-2200**
8:01:56 PM	2500	0.005	0.200	0.000	**0**	**-2500**

1/15/02 San Diego Bay **cores A and B**
Sulfide , pH, Redox

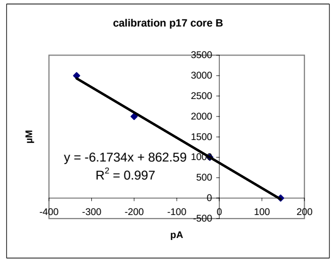
P04 B

core B

sulfide Profile 1 depth (mm)	pA	H2S μM	depth (mm)	sulfide profile 2	pA	**sulfide profile 2 H2S(μM)**	**sediment depth (mm)**
0	176	0	0	0			**0**
-1	174	0	-1	-1			**-1**
-2	174	0	-2	-2			**-2**
-3	173	0	-3	-3			**-3**
-4	173	0	-4	-4			**-4**
-5	173	0	-5	-5	145	**0**	**-5**
-6	173	0	-6	-6			**-6**
-7	174	0	-7	-7			**-7**
-8	174	0	-8	-8	143	**0**	**-8**
-9	174	0	-9	-9			**-9**
-10	175	0	-10	-10	144	**0**	**-10**
-11	176	0	-11	-11			**-11**
-12	167	0	-12	-12	143	**0**	**-12**
-13	167	0	-13	-13			**-13**
-14	168	0	-14	-14	144	**0**	**-14**
-15	168	0	-15	-15			**-15**
-16	167	0	-16	-16	144	**0**	**-16**
-17			-17	-17			**-17**
-18	167	0	-18	-18	144	**0**	**-18**
-19			-19	-19			**-19**
-20	169	0	-20	-20	147	**0**	**-20**
-21			-21	-21			**-21**
-22	170	0	-22	-22	147	**0**	**-22**
-23			-23	-23			**-23**
-24	171	0	-24	-24	147	**0**	**-24**
-25			-25	-25			**-25**
-26	172	0	-26	-26	148	**0**	**-26**
-27			-27	-27			**-27**
-28	174	0	-28	-28	150	**0**	**-28**
-29			-29	-29			**-29**
-30	175	0	-30	-30	151	**0**	**-30**
-31			-31	-31			**-31**
-32	177	0	-32	-32	153	**0**	**-32**
-33			-33	-33			**-33**
-34	178	0	-34	-34	152	**0**	**-34**
-35			-35	-35			**-35**
-36	200	0	-36	-36	155	**0**	**-36**
-37			-37	-37			**-37**
-38	201	0	-38	-38	160	**0**	**-38**
-39			-39	-39			**-39**
-40	201	0	-40	-40	160	**0**	**-40**
-41			-41	-41			**-41**
-42	200	0	-42	-42	160	**0**	**-42**
-43			-43	-43			**-43**
-44	181	0	-44	-44	160	**0**	**-44**
-45			-45	-45			**-45**
-46	182	0	-46	-46	160	**0**	**-46**
-47			-47	-47			**-47**
-48	184	0	-48	-48	160	**0**	**-48**
-49			-49	-49			**-49**
-50	184	0	-50	-50	160	**0**	**-50**
-51			-51	-51			**-51**
-52	185	0	-52	-52	160	**0**	**-52**
-53			-53	-53			**-53**
-54	185	0	-54	-54	160	**0**	**-54**
-55			-55	-55			**-55**
-56	186	0	-56	-56	159	**0**	**-56**
-57			-57	-57			**-57**
-58	186	0	-58	-58	159	**0**	**-58**
-59			-59	-59			**-59**
-60	185	0	-60	-60	158	**0**	**-60**
-61			-61	-61			**-61**
-62	186	0	-62	-62	158	**0**	**-62**
-63			-63	-63			**-63**
-64	186	0	-64	-64	158	**0**	**-64**
-65			-65	-65			**-65**
-66	186	0	-66	-66	157	**0**	**-66**
-67			-67	-67			**-67**
-68	186	0	-68	-68	158	**0**	**-68**
-69			-69	-69			**-69**
-70			-70	-70	157	**0**	**-70**
-71			-71	-71			**-71**
-72	186	0	-72	-72	158	**0**	**-72**
-73			-73	-73			**-73**
-74	186	0	-74	-74	157	**0**	**-74**
-75			-75	-75			**-75**
-76	187	0	-76	-76	157	**0**	**-76**
-77			-77	-77			**-77**
-78	187	0	-78	-78	157	**0**	**-78**
-79			-79	-79			**-79**
-80	181	0	-80	-80	156	**0**	**-80**
-81			-81	-81			**-81**
-82	181	0	-82	-82	156	**0**	**-82**
-83			-83	-83			**-83**

calibration AB
0 = 144
1mM -22
2mM-200
3mM-335

pA	mM
144	0
-22	1000
-200	2000
-335	3000



core A

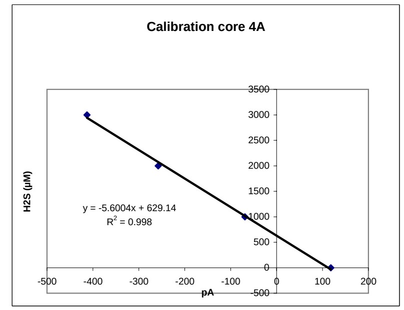
depth (mm)	pA	**H2S (μM)**	**depth (mm)**
0	143	**0**	**0**
2	124	**0**	**-2**
4	116	**0**	**-4**
6	110	**13.096**	**-6**
8	110	**13.096**	**-8**
10	110	**13.096**	**-10**
12	111	**7.4956**	**-12**
14	110	**13.096**	**-14**
16	111	**7.4956**	**-16**
18	112	**1.8952**	**-18**
20	112	**1.8952**	**-20**
22	112	**1.8952**	**-22**
24	112	**1.8952**	**-24**
26	112	**1.8952**	**-26**
28	112	**1.8952**	**-28**
30	113	**0**	**-30**
32	113	**0**	**-32**
34	114	**0**	**-34**
36	114	**0**	**-36**
38	115	**0**	**-38**
40	115	**0**	**-40**
42	115	**0**	**-42**
44	115	**0**	**-44**
46	115	**0**	**-46**
48	115	**0**	**-48**
50	114	**0**	**-50**
52	114	**0**	**-52**
54	113	**0**	**-54**
56	114	**0**	**-56**
58	113	**0**	**-58**
60	113	**0**	**-60**
62	113	**0**	**-62**
64	112	**0**	**-64**
66	112	**0**	**-66**
68	112	**0**	**-68**
70	112	**0**	**-70**
72	112	**0**	**-72**
74	113	**0**	**-74**
76	113	**0**	**-76**
78	112	**1.8952**	**-78**
80	112	**1.8952**	**-80**
82	111	**7.4956**	**-82**
84	110	**13.096**	**-84**
86	109	**18.6964**	**-86**
88	107	**29.8972**	**-88**
90	105	**41.098**	**-90**
92	103	**52.2988**	**-92**
94	101	**63.4996**	**-94**
96	97	**85.9012**	**-96**
98	97	**85.9012**	**-98**
100	95	**97.102**	**-100**
102		**629.14**	**-102**

Calibration A

0=118

1mM -69
2mM-258
3mM - 413

pA	mM
118	0
-69	1000
-258	2000
-413	3000



-84	181	0	-84
-85			-85
-86	176	0	-86
-87			-87
-88	176	0	-88
-89			-89
-90	175	0	-90
-91			-91
-92	173	0	-92
-93			-93
-94	170	0	-94
-95			-95
-96	166	0	-96
-97			-97
-98	163	0	-98
-99			-99
-100	158	0	-100
-101			-101
-102	154	0	-102
-103			-103
-104	150	0	-104
-105			-105
-106	146	0	-106
-107			-107
-108	140	0	-108
-109			-109
-110	139	4.4874	-110
-111			-111
-112	138	10.6608	-112
-113			-113
-114	136	23.0076	-114
-115			-115
-116	135	29.181	-116
-117			-117
-118	134	35.3544	-118
-119			-119
-120	134	35.3544	-120

-84	150	**0**	**-84**
-85			**-85**
-86	149	**0**	**-86**
-87			**-87**
-88	141	**0**	**-88**
-89			**-89**
-90	139	**4.4874**	**-90**
-91			**-91**
-92	137	**16.8342**	**-92**
-93			**-93**
-94	135	**29.181**	**-94**
-95			**-95**
-96	132	**47.7012**	**-96**
-97			**-97**
-98	129	**66.2214**	**-98**
-99			**-99**
-100	126	**84.7416**	**-100**
-101			**-101**
-102	124	**97.0884**	**-102**
-103			**-103**
-104	122	**109.4352**	**-104**
-105			**-105**
-106	120	**121.782**	**-106**
-107			**-107**
-108	119	**127.9554**	**-108**
-109			**-109**
-110	117	**140.3022**	**-110**
-111			**-111**
-112	116	**146.4756**	**-112**
-113			**-113**
-114			**-114**
-115			**-115**
-116			**-116**
-117			**-117**
-118			**-118**
-119			**-119**
-120			**-120**

pH
Core B

depth mm	**pH**	**depth mm**
10	**7.849**	**10**
0	**7.455**	**0**
-5	**7.438**	**-5**
-10	**7.397**	**-10**
-15	**7.384**	**-15**
-20	**7.377**	**-20**
-25	**7.352**	**-25**
-30	**7.303**	**-30**
-35	**7.274**	**-35**
-40	**7.199**	**-40**
-45	**7.194**	**-45**
-50	**7.193**	**-50**
-55	**7.193**	**-55**
-60	**7.177**	**-60**
-65	**7.172**	**-65**
-70	**7.171**	**-70**
-75	**7.171**	**-75**
-80	**7.176**	**-80**
-85	**7.176**	**-85**
-90	**7.174**	**-90**
-95	**7.179**	**-95**
-100	**7.188**	**-100**

pH
core A

	pH	**S depth (mm)**
10	**7.668**	**10**
0	**7.458**	**0**
-5		**-5**
-10	**7.396**	**-10**
-15		**-15**
-20	**7.384**	**-20**
-25		**-25**
-30	**7.316**	**-30**
-35		**-35**
-40	**7.281**	**-40**
-45		**-45**
-50	**7.282**	**-50**
-55		**-55**
-60	**7.264**	**-60**
-65		**-65**
-70	**7.292**	**-70**
-75		**-75**
-80	**7.294**	**-80**
-85		**-85**
-90	**7.303**	**-90**
-95		**-95**
-100	**7.301**	**-100**

Redox core B

sediment dep	**mV**	**sediment depth (mm)**
10	**19**	**10**
0	**-7**	**0**
-10	**-134**	**-10**
-20	**-188**	**-20**
-30	**-231**	**-30**
-40	**-237**	**-40**
-50	**-244**	**-50**
-60	**-248**	**-60**
-70	**-248**	**-70**
-80	**-251**	**-80**
-90	**-256**	**-90**
-100	**-260**	**-100**
-110		**-110**
-120		**-120**

Redox core A

sediment dep	**mV**	**depth (mm)**
10	**26**	**10**
0	**-5**	**0**
-10	**-149**	**-10**
-20	**-165**	**-20**
-30	**-162**	**-30**
-40	**-193**	**-40**
-50	**-212**	**-50**
-60	**-243**	**-60**
-70	**-265**	**-70**
-80	**-268**	**-80**
-90	**-279**	**-90**
-100	**-287**	**-100**
-110		**-110**
-120		**-120**

Profile 1	dark	Position 1					
Date:	1/9/2002	Time:	0.599	Data Set:	1		
Range A:	500 mV	Range B:	500 mV	Sample Time	2		
			% sat				
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**	
2:23:44 PM	-1000	0.047	47.723	47.058	**111.913336**	**1000**	
2:23:57 PM	-800	0.047	47.665	47.000	**111.7754**	**800**	
2:24:09 PM	-600	0.046	46.427	45.762	**108.831188**	**600**	or
2:24:22 PM	-400	0.045	45.726	45.061	**107.16407**	**400**	
2:24:35 PM	-200	0.045	45.145	44.480	**105.782336**	**200**	
2:24:47 PM	0	0.043	43.637	42.972	**102.19601**	**-0**	
2:25:00 PM	200	0.035	34.610	33.945	**80.727999**	**-200**	
2:25:13 PM	400	0.027	25.437	24.772	**58.9127704**	**-400**	
2:25:26 PM	600	0.020	16.973	16.308	**38.7836856**	**-600**	
2:25:38 PM	800	0.012	8.995	8.330	**19.8096925**	**-800**	
2:25:51 PM	1000	0.007	3.024	2.359	**5.61064944**	**-1000**	
2:26:03 PM	1200	0.006	1.484	0.819	**1.94822144**	**-1200**	
2:26:16 PM	1400	0.005	0.874	0.209	**0.49749566**	**-1400**	
2:26:28 PM	1600	0.005	0.717	0.052	**0.1230005**	**-1600**	
2:26:41 PM	1800	0.005	0.671	0.006	**0.01336548**	**-1800**	
2:26:53 PM	2000	0.005	0.665	0.000	**0.0006659**	**-2000**	
2:27:06 PM	2200	0.005	0.567	0.000	**0**	**-2200**	
2:27:18 PM	2400	0.005	0.626	0.000	**0**	**-2400**	
2:27:31 PM	2600	0.004	-0.017	0.000	**0**	**-2600**	
2:27:43 PM	2800	0.005	0.587	0.000	**0**	**-2800**	
2:27:56 PM	3000	0.005	0.223	0.000	**0**	**-3000**	
2:28:09 PM	3200	0.005	0.942	0.000	**0**	**-3200**	
2:28:22 PM	3400	0.005	0.938	0.000	**0**	**-3400**	
2:28:34 PM	3600	0.005	0.888	0.000	**0**	**-3600**	
2:28:47 PM	3800	0.005	0.921	0.000	**0**	**-3800**	
2:29:00 PM	4000	0.005	0.880	0.000	**0**	**-4000**	

Profile 2	dark	Position 2					
Date:	1/9/2002	Time:	0.613	Data Set:	3		
Range A:	500 mV	Range B:	500 mV	Sample Time	2		
			% sat				
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**	
2:43:32 PM	-2000	0.086	91.392	82.003	**195.019535**	**2000**	
2:43:44 PM	-1800	0.086	91.057	81.668	**194.222838**	**1800**	
2:43:56 PM	-1600	0.085	90.277	80.888	**192.367842**	**1600**	
2:44:08 PM	-1400	0.084	89.697	80.308	**190.988486**	**1400**	
2:44:20 PM	-1200	0.085	89.975	80.586	**191.649625**	**1200**	
2:44:32 PM	-1000	0.084	89.724	80.335	**191.052697**	**1000**	
2:44:44 PM	-800	0.083	87.987	78.598	**186.921764**	**800**	
2:44:56 PM	-600	0.079	84.070	74.681	**177.606354**	**600**	*
2:45:08 PM	-400	0.074	78.320	68.931	**163.931704**	**400**	*
2:45:20 PM	-200	0.067	70.386	60.997	**145.063065**	**200**	*
2:45:32 PM	0	0.060	62.049	52.660	**125.236012**	**0**	*
2:45:44 PM	200	0.051	51.966	42.577	**101.256621**	**-200**	
2:45:56 PM	400	0.041	41.207	31.818	**75.6695676**	**-400**	
2:46:08 PM	600	0.032	31.276	21.887	**52.0516634**	**-600**	
2:46:21 PM	800	0.026	24.398	15.009	**35.6944038**	**-800**	

2:46:32 PM	1000	0.021	18.806	9.417	**22.3955094**	**-1000**
2:46:45 PM	1200	0.017	14.293	4.904	**11.6626928**	**-1200**
2:46:57 PM	1400	0.015	11.625	2.236	**5.3176552**	**-1400**
2:47:09 PM	1600	0.013	9.677	0.288	**0.68444596**	**-1600**
2:47:21 PM	1800	0.013	9.468	0.079	**0.1866887**	**-1800**
2:47:33 PM	2000	0.013	9.398	0.009	**0.02116598**	**-2000**
2:47:45 PM	2200	0.013	9.282	0.000	**0**	**-2200**
2:47:58 PM	2400	0.013	9.305	0.000	**0**	**-2400**
2:48:10 PM	2600	0.013	9.192	0.000	**0**	**-2600**
2:48:22 PM	2800	0.013	9.132	0.000	**0**	**-2800**
2:48:34 PM	3000	0.013	9.322	0.000	**0**	**-3000**
2:48:46 PM	3200	0.013	9.264	0.000	**0**	**-3200**
2:48:58 PM	3400	0.013	9.169	0.000	**0**	**-3400**
2:49:11 PM	3600	0.013	9.187	0.000	**0**	**-3600**
2:49:23 PM	3800	0.013	9.154	0.000	**0**	**-3800**
2:49:35 PM	4000	0.012	9.104	0.000	**0**	**-4000**

Profile 3	**dark**		**Position 3**			
Date:	1/9/2002	Time:	0.619	Data Set:	4	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
2:52:14 PM	-2000	0.080	84.262	75.165	**178.757403**	**1600**
2:52:26 PM	-1800	0.080	85.085	75.988	**180.714662**	**1400**
2:52:39 PM	-1600	0.080	84.677	75.580	**179.744356**	**1200**
2:52:51 PM	-1400	0.079	84.058	74.961	**178.27225**	**1000**
2:53:03 PM	-1200	0.078	82.909	73.812	**175.539698**	**800**
2:53:15 PM	-1000	0.077	81.325	72.228	**171.77263**	**600**
2:53:27 PM	-800	0.075	78.654	69.557	**165.420457**	**400**
2:53:39 PM	-600	0.070	73.610	64.513	**153.424817**	**200**
2:53:51 PM	-400	0.064	67.086	57.989	**137.90944**	**-0**
2:54:03 PM	-200	0.056	58.303	49.206	**117.021709**	**-200**
2:54:15 PM	0	0.048	48.776	39.679	**94.3645978**	**-400**
2:54:27 PM	200	0.038	37.624	28.527	**67.8429114**	**-600**
2:54:39 PM	400	0.030	28.534	19.437	**46.2250734**	**-800**
2:54:51 PM	600	0.023	20.401	11.304	**26.8831728**	**-1000**
2:55:03 PM	800	0.016	12.799	3.702	**8.8040964**	**-1200**
2:55:15 PM	1000	0.013	9.443	0.346	**0.82261938**	**-1400**
2:55:27 PM	1200	0.013	9.260	0.163	**0.3864575**	**-1600**
2:55:39 PM	1400	0.013	9.264	0.167	**0.39739722**	**-1800**
2:55:51 PM	1600	0.012	9.097	0.000	**0.00047564**	**-2000**
2:56:03 PM	1800	0.013	9.179	0.082	**0.19525022**	**-2200**
2:56:15 PM	2000	0.013	9.132	0.035	**0.0820479**	**-2400**
2:56:27 PM	2200	0.012	9.097	0.000	**-0.0011891**	**-2600**
2:56:39 PM	2400	0.013	9.289	0.192	**0.4566144**	**-2800**
2:56:51 PM	2600	0.013	9.256	0.159	**0.37765816**	**-3000**
2:57:03 PM	2800	0.013	9.222	0.125	**0.29632372**	**-3200**
2:57:15 PM	3000	0.012	9.118	0.021	**0.05089348**	**-3400**
2:57:27 PM	3200	0.012	8.956	0.000	**0**	**-3600**
2:57:39 PM	3400	0.012	9.027	0.000	**0**	**-3800**
2:57:51 PM	3600	0.013	9.222	0.000	**0**	**-4000**
2:58:04 PM	3800	0.013	9.233	0.000	**0**	
2:58:16 PM	4000	0.013	9.326	0.000	**0**	

Profile 4	**dark**	**Position 4**				
Date:	1/9/2002	Time:	0.626	Data Set:	5	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
3:02:12 PM	-2000	0.082	86.906	78.179	**185.925298**	**1600**
3:02:24 PM	-1800	0.082	86.947	78.220	**186.022804**	**1400**
3:02:37 PM	-1600	0.082	87.208	78.481	**186.643514**	**1200**
3:02:49 PM	-1400	0.081	86.358	77.631	**184.622044**	**1000**
3:03:01 PM	-1200	0.080	84.691	75.964	**180.657585**	**800**
3:03:13 PM	-1000	0.077	81.592	72.865	**173.287543**	**600**
3:03:26 PM	-800	0.073	76.627	67.900	**161.47978**	**400**
3:03:38 PM	-600	0.067	69.937	61.210	**145.569622**	**200**
3:03:50 PM	-400	0.059	61.365	52.638	**125.183692**	**-0**
3:04:02 PM	-200	0.049	50.243	41.516	**98.7333512**	**-200**
3:04:14 PM	0	0.040	39.722	30.995	**73.712309**	**-400**
3:04:26 PM	200	0.030	28.854	20.127	**47.8660314**	**-600**
3:04:38 PM	400	0.022	20.159	11.432	**27.1875824**	**-800**
3:04:50 PM	600	0.016	13.211	4.484	**10.6638488**	**-1000**
3:05:03 PM	800	0.013	9.891	1.164	**2.76798698**	**-1200**
3:05:15 PM	1000	0.013	9.231	0.504	**1.19885062**	**-1400**
3:05:27 PM	1200	0.013	9.209	0.482	**1.14581676**	**-1600**
3:05:39 PM	1400	0.013	9.183	0.456	**1.08398356**	**-1800**
3:05:51 PM	1600	0.013	9.135	0.408	**0.96935432**	**-2000**
3:06:03 PM	1800	0.012	9.119	0.392	**0.93201658**	**-2200**
3:06:15 PM	2000	0.012	8.592	0.000	**0**	**-2400**
3:06:27 PM	2200	0.012	8.709	0.000	**0**	**-2600**
3:06:39 PM	2400	0.012	8.752	0.000	**0**	**-2800**
3:06:52 PM	2600	0.012	8.670	0.000	**0**	**-3000**
3:07:04 PM	2800	0.012	8.622	0.000	**0**	**-3200**
3:07:16 PM	3000	0.012	8.586	0.000	**0**	**-3400**
3:07:28 PM	3200	0.012	8.624	0.000	**0**	**-3600**
3:07:40 PM	3400	0.012	8.671	0.000	**0**	**-3800**
3:07:52 PM	3600	0.012	8.719	0.000	**0**	**-4000**
3:08:04 PM	3800	0.012	8.692	0.000	**0**	
3:08:17 PM	4000	0.012	8.727	0.000	**0**	

Profile 5	**dark**	**Position 5**				
Date:	1/9/2002	Time:	0.633	Data Set:	**6**	
Range A:	500 mV	Range B:	500 mV	Sample Time	**2**	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
3:11:53 PM	-2000	0.082	86.973	78.060	**185.642292**	**1800**
3:12:05 PM	-1800	0.081	86.119	77.206	**183.611309**	**1600**
3:12:17 PM	-1600	0.081	86.136	77.223	**183.651739**	**1400**
3:12:29 PM	-1400	0.081	85.786	76.873	**182.819369**	**1200**
3:12:41 PM	-1200	0.080	84.468	75.555	**179.684901**	**1000**
3:12:53 PM	-1000	0.078	82.199	73.286	**174.288765**	**800**
3:13:05 PM	-800	0.075	78.762	69.849	**166.114892**	**600**
3:13:17 PM	-600	0.070	73.563	64.650	**153.75063**	**400**
3:13:29 PM	-400	0.064	66.913	58.000	**137.9356**	**200**
3:13:41 PM	-200	0.056	57.564	48.651	**115.701808**	**-0**

3:13:53 PM	0	0.046	46.525	37.612	**89.4488584**	**-200**
3:14:05 PM	200	0.036	35.615	26.702	**63.5026964**	**-400**
3:14:18 PM	400	0.028	26.124	17.211	**40.9312002**	**-600**
3:14:30 PM	600	0.021	18.295	9.382	**22.3122724**	**-800**
3:14:42 PM	800	0.015	11.608	2.695	**6.409249**	**-1000**
3:14:54 PM	1000	0.013	9.226	0.313	**0.74413878**	**-1200**
3:15:06 PM	1200	0.012	8.948	0.035	**0.08418828**	**-1400**
3:15:18 PM	1400	0.012	8.913	0.000	**0**	**-1600**
3:15:31 PM	1600	0.012	8.913	0.000	**0**	**-1800**
3:15:43 PM	1800	0.012	8.853	0.000	**0**	**-2000**
3:15:55 PM	2000	0.012	8.812	0.000	**0**	**-2200**
3:16:07 PM	2200	0.012	8.842	0.000	**0**	**-2400**
3:16:19 PM	2400	0.012	8.828	0.000	**0**	**-2600**
3:16:32 PM	2600	0.012	8.775	0.000	**0**	**-2800**
3:16:44 PM	2800	0.012	8.761	0.000	**0**	**-3000**
3:16:56 PM	3000	0.012	8.761	0.000	**0**	**-3200**
3:17:08 PM	3200	0.012	8.780	0.000	**0**	**-3400**
3:17:20 PM	3400	0.012	8.761	0.000	**0**	**-3600**
3:17:33 PM	3600	0.012	8.798	0.000	**0**	**-3800**
3:17:45 PM	3800	0.012	8.718	0.000	**0**	**-4000**
3:17:57 PM	4000	0.012	8.786	0.000	**0**	

Profile 6	**dark**	**Position 6**				
Date:	1/9/2002	Time:	0.640	Data Set:	7	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
3:21:49 PM	-2000	0.076	80.259	71.356	**169.698839**	**2000**
3:22:01 PM	-1800	0.078	82.689	73.786	**175.477865**	**1800**
3:22:14 PM	-1600	0.078	82.167	73.264	**174.236445**	**1600**
3:22:26 PM	-1400	0.076	80.013	71.110	**169.113802**	**1400**
3:22:38 PM	-1200	0.075	79.604	70.701	**168.141118**	**1200**
3:22:50 PM	-1000	0.076	79.838	70.935	**168.697617**	**1000**
3:23:02 PM	-800	0.074	78.601	69.698	**165.755784**	**800**
3:23:14 PM	-600	0.071	75.188	66.285	**157.638987**	**600**
3:23:26 PM	-400	0.067	69.744	60.841	**144.692066**	**400**
3:23:38 PM	-200	0.059	60.990	52.087	**123.873303**	**200**
3:23:50 PM	0	0.050	51.147	42.244	**100.464681**	**-0**
3:24:02 PM	200	0.039	39.294	30.391	**72.2758762**	**-200**
3:24:14 PM	400	0.030	28.491	19.588	**46.5841816**	**-400**
3:24:26 PM	600	0.022	19.602	10.699	**25.4443618**	**-600**
3:24:38 PM	800	0.016	12.713	3.810	**9.060942**	**-800**
3:24:50 PM	1000	0.013	9.686	0.783	**1.86308188**	**-1000**
3:25:03 PM	1200	0.012	9.033	0.130	**0.31011728**	**-1200**
3:25:15 PM	1400	0.012	8.903	0.000	**0.00095128**	**-1400**
3:25:27 PM	1600	0.012	8.849	0.000	**0**	**-1600**
3:25:39 PM	1800	0.012	8.816	0.000	**0**	**-1800**
3:25:51 PM	2000	0.012	8.594	0.000	**0**	**-2000**
3:26:03 PM	2200	0.012	8.411	0.000	**0**	**-2200**
3:26:15 PM	2400	0.012	8.495	0.000	**0**	**-2400**
3:26:27 PM	2600	0.012	8.590	0.000	**0**	**-2600**
3:26:39 PM	2800	0.012	8.638	0.000	**0**	**-2800**
3:26:51 PM	3000	0.012	8.553	0.000	**0**	**-3000**
3:27:04 PM	3200	0.012	8.632	0.000	**0**	**-3200**
3:27:16 PM	3400	0.012	9.016	0.000	**0**	**-3400**

3:27:29 PM	3600	0.012	9.057	0.000	**0**	**-3600**
3:27:41 PM	3800	0.012	9.018	0.000	**0**	**-3800**
3:27:53 PM	4000	0.012	8.624	0.000	**0**	**-4000**

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| **Profile 7** | **50% light** | **5 min,** | **position 6** | | | |
|---|---|---|---|---|---|---|
| Date: | 1/9/2002 | Time: | 0.649 | Data Set: | 8 | |
| Range A: | 500 mV | Range B: | 500 mV | Sample Time | 2 | |
| | | | % sat | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | **O2 (µM)** | **Depth (µm)** |
| 3:35:15 PM | -2000 | 0.073 | 76.564 | 67.252 | **159.938706** | **2000** |
| 3:35:28 PM | -1800 | 0.066 | 69.130 | 59.818 | **142.259168** | **1800** |
| 3:35:40 PM | -1600 | 0.060 | 61.875 | 52.563 | **125.005327** | **1600** |
| 3:35:52 PM | -1400 | 0.056 | 57.923 | 48.611 | **115.60668** | **1400** |
| 3:36:05 PM | -1200 | 0.055 | 57.036 | 47.724 | **113.497217** | **1200** |
| 3:36:17 PM | -1000 | 0.056 | 58.276 | 48.964 | **116.446185** | **1000** |
| 3:36:29 PM | -800 | 0.058 | 59.562 | 50.250 | **119.50455** | **800** |
| 3:36:41 PM | -600 | 0.059 | 60.825 | 51.513 | **122.508217** | **600** |
| 3:36:53 PM | -400 | 0.059 | 61.425 | 52.113 | **123.935137** | **400** |
| 3:37:05 PM | -200 | 0.059 | 61.159 | 51.847 | **123.302535** | **200** |
| 3:37:17 PM | 0 | 0.057 | 59.543 | 50.231 | **119.459364** | **-0** |
| 3:37:29 PM | 200 | 0.054 | 55.987 | 46.675 | **111.002485** | **-200** |
| 3:37:41 PM | 400 | 0.049 | 49.592 | 40.280 | **95.793896** | **-400** |
| 3:37:53 PM | 600 | 0.040 | 40.033 | 30.721 | **73.0606822** | **-600** |
| 3:38:06 PM | 800 | 0.029 | 27.619 | 18.307 | **43.5377074** | **-800** |
| 3:38:18 PM | 1000 | 0.022 | 19.261 | 9.949 | **23.6607118** | **-1000** |
| 3:38:30 PM | 1200 | 0.016 | 13.103 | 3.791 | **9.0157562** | **-1200** |
| 3:38:42 PM | 1400 | 0.014 | 10.503 | 1.191 | **2.8324362** | **-1400** |
| 3:38:54 PM | 1600 | 0.013 | 9.581 | 0.269 | **0.63949798** | **-1600** |
| 3:39:06 PM | 1800 | 0.013 | 9.381 | 0.069 | **0.16362016** | **-1800** |
| 3:39:18 PM | 2000 | 0.013 | 9.435 | 0.123 | **0.2913295** | **-2000** |
| 3:39:30 PM | 2200 | 0.013 | 9.312 | 0.000 | **0.00047564** | **-2200** |
| 3:39:42 PM | 2400 | 0.013 | 9.358 | 0.046 | **0.10844592** | **-2400** |
| 3:39:54 PM | 2600 | 0.013 | 9.280 | 0.000 | **0** | **-2600** |
| 3:40:06 PM | 2800 | 0.013 | 9.244 | 0.000 | **0** | **-2800** |
| 3:40:18 PM | 3000 | 0.013 | 9.267 | 0.000 | **0** | **-3000** |
| 3:40:30 PM | 3200 | 0.013 | 9.317 | 0.000 | **0** | **-3200** |
| 3:40:42 PM | 3400 | 0.013 | 9.294 | 0.000 | **0** | **-3400** |
| 3:40:54 PM | 3600 | 0.013 | 9.246 | 0.000 | **0** | **-3600** |
| 3:41:06 PM | 3800 | 0.013 | 9.232 | 0.000 | **0** | **-3800** |
| 3:41:19 PM | 4000 | 0.013 | 9.304 | 0.000 | **0** | **-4000** |

| **Profile 8** | **50 % light** | **10 min** | **position 6** | | | |
|---|---|---|---|---|---|---|
| Date: | 1/9/2002 | Time: | 0.657 | Data Set: | 9 | |
| Range A: | 500 mV | Range B: | 500 mV | Sample Time | 2 | |
| | | | % sat | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | **O2 (µM)** | **Depth (µm)** |
| 3:46:18 PM | -2000 | 0.079 | 84.167 | 75.065 | **178.519583** | **2000** |
| 3:46:30 PM | -1800 | 0.080 | 84.545 | 75.443 | **179.418543** | **1800** |
| 3:46:42 PM | -1600 | 0.080 | 84.382 | 75.280 | **179.030896** | **1600** |
| 3:46:54 PM | -1400 | 0.079 | 83.781 | 74.679 | **177.601598** | **1400** |
| 3:47:06 PM | -1200 | 0.078 | 83.044 | 73.942 | **175.848864** | **1200** |
| 3:47:18 PM | -1000 | 0.078 | 82.920 | 73.818 | **175.553968** | **1000** |
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3:47:30 PM	-800	0.078	82.489	73.387	**174.528963**	**800**
3:47:42 PM	-600	0.077	81.941	72.839	**173.22571**	**600**
3:47:54 PM	-400	0.077	81.085	71.983	**171.189971**	**400**
3:48:06 PM	-200	0.075	79.354	70.252	**167.073306**	**200**
3:48:18 PM	0	0.073	76.505	67.403	**160.297815**	**-0**
3:48:30 PM	200	0.067	70.405	61.303	**145.790795**	**-200**
3:48:42 PM	400	0.060	62.070	52.968	**125.968498**	**-400**
3:48:54 PM	600	0.050	51.500	42.398	**100.830924**	**-600**
3:49:07 PM	800	0.038	37.314	28.212	**67.0937784**	**-800**
3:49:19 PM	1000	0.028	26.117	17.015	**40.465073**	**-1000**
3:49:31 PM	1200	0.020	17.739	8.637	**20.5405134**	**-1200**
3:49:43 PM	1400	0.016	12.986	3.884	**9.2369288**	**-1400**
3:49:55 PM	1600	0.014	10.343	1.241	**2.9513462**	**-1600**
3:50:07 PM	1800	0.013	9.388	0.286	**0.67992738**	**-1800**
3:50:19 PM	2000	0.013	9.217	0.115	**0.27254172**	**-2000**
3:50:31 PM	2200	0.013	9.254	0.152	**0.3602973**	**-2200**
3:50:43 PM	2400	0.013	9.191	0.089	**0.21070852**	**-2400**
3:50:55 PM	2600	0.012	9.114	0.012	**0.02877622**	**-2600**
3:51:07 PM	2800	0.012	9.102	0.000	**0**	**-2800**
3:51:19 PM	3000	0.012	9.037	0.000	**0**	**-3000**
3:51:31 PM	3200	0.012	9.017	0.000	**0**	**-3200**
3:51:43 PM	3400	0.012	9.061	0.000	**0**	**-3400**
3:51:55 PM	3600	0.013	9.190	0.000	**0**	**-3600**
3:52:07 PM	3800	0.013	9.500	0.000	**0**	**-3800**
3:52:19 PM	4000	0.013	9.540	0.000	**0**	**-4000**

Profile 9	**50 % light**	**15 min**		**position 6**		
Date:	1/9/2002	Time:	0.664	Data Set:	**10**	
Range A:	500 mV	Range B:	500 mV	Sample Time	**2**	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (mm)**
3:56:44 PM	-2000	0.079	83.808	74.804	**177.898873**	**2000**
3:56:56 PM	-1800	0.080	84.269	75.265	**178.995223**	**1800**
3:57:08 PM	-1600	0.079	83.997	74.993	**178.348353**	**1600**
3:57:20 PM	-1400	0.079	83.542	74.538	**177.266272**	**1400**
3:57:33 PM	-1200	0.079	83.139	74.135	**176.307857**	**1200**
3:57:45 PM	-1000	0.078	82.773	73.769	**175.437436**	**1000**
3:57:58 PM	-800	0.078	82.825	73.821	**175.561102**	**800**
3:58:10 PM	-600	0.079	83.378	74.374	**176.876247**	**600**
3:58:22 PM	-400	0.079	83.356	74.352	**176.823926**	**400**
3:58:35 PM	-200	0.078	82.977	73.973	**175.922589**	**200**
3:58:47 PM	0	0.077	81.078	72.074	**171.406387**	**-0**
3:59:00 PM	200	0.073	76.902	67.898	**161.475024**	**-200**
3:59:12 PM	400	0.066	68.738	59.734	**142.059399**	**-400**
3:59:25 PM	600	0.056	57.747	48.743	**115.920603**	**-600**
3:59:37 PM	800	0.044	44.406	35.402	**84.1930364**	**-800**
3:59:49 PM	1000	0.034	32.786	23.782	**56.5583524**	**-1000**
4:00:02 PM	1200	0.024	21.644	12.640	**30.060448**	**-1200**
4:00:14 PM	1400	0.018	15.451	6.447	**15.3322554**	**-1400**
4:00:26 PM	1600	0.015	11.869	2.865	**6.813543**	**-1600**
4:00:38 PM	1800	0.013	9.938	0.934	**2.2212388**	**-1800**
4:00:50 PM	2000	0.013	9.246	0.242	**0.57576222**	**-2000**
4:01:03 PM	2200	0.013	9.178	0.174	**0.41309334**	**-2200**
4:01:15 PM	2400	0.013	9.139	0.135	**0.32200828**	**-2400**

4:01:27 PM	2600	0.013	9.341	0.337	**0.80192904**	**-2600**
4:01:39 PM	2800	0.013	9.244	0.240	**0.57100582**	**-2800**
4:01:51 PM	3000	0.013	9.187	0.183	**0.43616188**	**-3000**
4:02:03 PM	3200	0.013	9.132	0.128	**0.30417178**	**-3200**
4:02:15 PM	3400	0.013	9.265	0.261	**0.6195211**	**-3400**
4:02:27 PM	3600	0.013	9.229	0.225	**0.53461936**	**-3600**
4:02:39 PM	3800	0.013	9.220	0.216	**0.51464248**	**-3800**
4:02:51 PM	4000	0.012	9.004	0.000	**0**	**-4000**

Profile 10	**100%**	**light**	**10 min**	**position 6**		
Date:	1/9/2002	Time:	0.676	Data Set:	**11**	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
4:15:08 PM	-2000	0.075	79.544	70.653	**168.026965**	**2000**
4:15:20 PM	-1800	0.077	81.321	72.430	**172.253026**	**1800**
4:15:32 PM	-1600	0.076	80.183	71.292	**169.546634**	**1600**
4:15:44 PM	-1400	0.081	86.446	77.555	**184.441301**	**1400**
4:15:57 PM	-1200	0.083	88.436	79.545	**189.173919**	**1200**
4:16:09 PM	-1000	0.086	91.795	82.904	**197.162293**	**1000**
4:16:21 PM	-800	0.088	93.860	84.969	**202.073276**	**800**
4:16:33 PM	-600	0.089	94.927	86.036	**204.610815**	**600**
4:16:45 PM	-400	0.094	100.850	91.959	**218.696894**	**400**
4:16:57 PM	-200	0.101	107.880	98.989	**235.41564**	**200**
4:17:09 PM	0	0.111	119.370	110.479	**262.741158**	**-0**
4:17:21 PM	200	0.122	131.610	122.719	**291.850326**	**-200**
4:17:33 PM	400	0.127	137.790	128.899	**306.547602**	**-400**
4:17:45 PM	600	0.124	134.320	125.429	**298.295248**	**-600**
4:17:57 PM	800	0.112	120.750	111.859	**266.023074**	**-800**
4:18:09 PM	1000	0.097	103.740	94.849	**225.569892**	**-1000**
4:18:22 PM	1200	0.078	82.550	73.659	**175.175834**	**-1200**
4:18:34 PM	1400	0.062	64.320	55.429	**131.821248**	**-1400**
4:18:46 PM	1600	0.047	47.594	38.703	**92.0434746**	**-1600**
4:18:58 PM	1800	0.035	34.290	25.399	**60.4039018**	**-1800**
4:19:10 PM	2000	0.027	25.640	16.749	**39.8324718**	**-2000**
4:19:22 PM	2200	0.021	18.313	9.422	**22.4074004**	**-2200**
4:19:34 PM	2400	0.016	13.369	4.478	**10.6495796**	**-2400**
4:19:46 PM	2600	0.014	10.459	1.568	**3.7290176**	**-2600**
4:19:58 PM	2800	0.013	9.430	0.539	**1.2818498**	**-2800**
4:20:10 PM	3000	0.013	9.248	0.357	**0.84854176**	**-3000**
4:20:22 PM	3200	0.013	9.302	0.411	**0.97839148**	**-3200**
4:20:34 PM	3400	0.013	9.272	0.381	**0.9060942**	**-3400**
4:20:46 PM	3600	0.013	9.314	0.423	**1.00526514**	**-3600**
4:20:58 PM	3800	0.013	9.300	0.409	**0.97363508**	**-3800**
4:21:10 PM	4000	0.012	8.891	0.000	**0**	**-4000**

Profile 11	**100 % light**	**15 min**	**position 6**			
Date:	1/9/2002	Time:	0.683	Data Set:	**12**	
Range A:	500 mV	Range B:	500 mV	Sample Time	**2**	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
4:25:09 PM	-2000	0.078	82.371	72.891	**173.349376**	**2000**

4:25:21 PM	-1800	0.081	86.283	76.803	**182.652895**	**1800**
4:25:33 PM	-1600	0.083	88.642	79.162	**188.263068**	**1600**
4:25:45 PM	-1400	0.084	89.507	80.027	**190.320211**	**1400**
4:25:58 PM	-1200	0.084	89.403	79.923	**190.072879**	**1200**
4:26:10 PM	-1000	0.086	90.951	81.471	**193.754332**	**1000**
4:26:22 PM	-800	0.086	91.348	81.868	**194.698478**	**800**
4:26:35 PM	-600	0.088	93.553	84.073	**199.942409**	**600**
4:26:47 PM	-400	0.093	99.683	90.203	**214.520775**	**400**
4:27:00 PM	-200	0.103	111.030	101.550	**241.50621**	**200**
4:27:11 PM	0	0.117	126.000	116.520	**277.107864**	**-0**
4:27:23 PM	200	0.133	144.610	135.130	**321.366166**	**-200**
4:27:36 PM	400	0.142	154.610	145.130	**345.148166**	**-400**
4:27:48 PM	600	0.141	153.500	144.020	**342.508364**	**-600**
4:28:00 PM	800	0.129	139.500	130.020	**309.213564**	**-800**
4:28:13 PM	1000	0.114	123.300	113.820	**270.686724**	**-1000**
4:28:25 PM	1200	0.096	102.450	92.970	**221.101254**	**-1200**
4:28:37 PM	1400	0.078	82.946	73.466	**174.716841**	**-1400**
4:28:49 PM	1600	0.062	64.579	55.099	**131.036442**	**-1600**
4:29:01 PM	1800	0.048	48.401	38.921	**92.5619222**	**-1800**
4:29:13 PM	2000	0.037	36.168	26.688	**63.4694016**	**-2000**
4:29:26 PM	2200	0.027	25.093	15.613	**37.1308366**	**-2200**
4:29:38 PM	2400	0.020	17.166	7.686	**18.2788452**	**-2400**
4:29:50 PM	2600	0.016	13.050	3.570	**8.490174**	**-2600**
4:30:02 PM	2800	0.014	10.390	0.910	**2.164162**	**-2800**
4:30:14 PM	3000	0.013	9.663	0.183	**0.43592406**	**-3000**
4:30:26 PM	3200	0.013	9.507	0.027	**0.06468704**	**-3200**
4:30:38 PM	3400	0.013	9.626	0.146	**0.34674156**	**-3400**
4:30:51 PM	3600	0.013	9.484	0.004	**0.00903716**	**-3600**
4:31:03 PM	3800	0.013	9.518	0.038	**0.08989596**	**-3800**
4:31:15 PM	4000	0.013	9.480	0.000	**0**	**-4000**

Profile 12	**100 % light**	**20 min**	**position 6**			
Date:	1/9/2002	Time:	0.690	Data Set:	13	
Range A:	500 mV	Range B:	500 mV	Sample Time	2	
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
4:35:10 PM	-2000	0.083	88.297	78.768	**187.326058**	**2000**
4:35:23 PM	-1800	0.084	89.604	80.075	**190.434365**	**1800**
4:35:34 PM	-1600	0.087	92.334	82.805	**196.926851**	**1600**
4:35:47 PM	-1400	0.087	92.626	83.097	**197.621285**	**1400**
4:35:58 PM	-1200	0.089	94.499	84.970	**202.075654**	**1200**
4:36:11 PM	-1000	0.089	95.296	85.767	**203.971079**	**1000**
4:36:22 PM	-800	0.090	96.323	86.794	**206.413491**	**800**
4:36:34 PM	-600	0.092	98.193	88.664	**210.860725**	**600**
4:36:46 PM	-400	0.096	103.160	93.631	**222.673244**	**400**
4:36:58 PM	-200	0.108	115.900	106.371	**252.971512**	**200**
4:37:10 PM	0	0.123	133.400	123.871	**294.590012**	**-0**
4:37:22 PM	200	0.141	153.370	143.841	**342.082666**	**-200**
4:37:34 PM	400	0.153	166.420	156.891	**373.118176**	**-400**
4:37:46 PM	600	0.153	167.060	157.531	**374.640224**	**-600**
4:37:59 PM	800	0.142	154.100	144.571	**343.818752**	**-800**
4:38:11 PM	1000	0.126	135.830	126.301	**300.369038**	**-1000**
4:38:24 PM	1200	0.109	116.850	107.321	**255.230802**	**-1200**
4:38:35 PM	1400	0.090	96.253	86.724	**206.247017**	**-1400**
4:38:47 PM	1600	0.072	76.114	66.585	**158.352447**	**-1600**

4:38:59 PM	1800	0.056	57.589	48.060	**114.296292**	**-1800**
4:39:11 PM	2000	0.043	43.337	33.808	**80.4021856**	**-2000**
4:39:23 PM	2200	0.032	30.694	21.165	**50.334603**	**-2200**
4:39:35 PM	2400	0.024	22.225	12.696	**30.1936272**	**-2400**
4:39:48 PM	2600	0.018	14.823	5.294	**12.5901908**	**-2600**
4:40:00 PM	2800	0.014	11.067	1.538	**3.6576716**	**-2800**
4:40:12 PM	3000	0.013	9.906	0.377	**0.89610576**	**-3000**
4:40:24 PM	3200	0.013	9.773	0.244	**0.57932952**	**-3200**
4:40:36 PM	3400	0.013	9.751	0.222	**0.5267713**	**-3400**
4:40:48 PM	3600	0.013	9.728	0.199	**0.47278616**	**-3600**
4:41:00 PM	3800	0.013	9.174	0.000	**0**	**-3800**
4:41:12 PM	4000	0.013	9.529	0.000	**0**	**-4000**

Profile 13	**100 % light**	**25 min**	**postion 6**				
Date:	1/9/2002	Time:	0.697	Data Set:	14		
Range A:	500 mV	Range B:	500 mV	Sample Time	2		
			% sat				
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**	
4:43:38 PM	-2000	0.085	90.895	81.198	**193.105084**	**2000**	
4:43:50 PM	-1800	0.092	97.689	87.992	**209.262574**	**1800**	
4:44:02 PM	-1600	0.085	90.156	80.459	**191.347594**	**1600**	
4:44:14 PM	-1400	0.085	90.763	81.066	**192.791161**	**1400**	
4:44:26 PM	-1200	0.085	90.330	80.633	**191.761401**	**1200**	
4:44:38 PM	-1000	0.086	91.230	81.533	**193.901781**	**1000**	
4:44:50 PM	-800	0.087	92.467	82.770	**196.843614**	**800**	
4:45:02 PM	-600	0.090	96.248	86.551	**205.835588**	**600**	
4:45:14 PM	-400	0.094	100.620	90.923	**216.233079**	**400**	*****
4:45:27 PM	-200	0.105	112.780	103.083	**245.151991**	**200**	*****
4:45:39 PM	0	0.120	129.800	120.103	**285.628955**	**-0**	*****
4:45:51 PM	200	0.141	152.640	142.943	**339.947043**	**-200**	
4:46:03 PM	400	0.154	167.320	157.623	**374.859019**	**-400**	
4:46:16 PM	600	0.157	170.810	161.113	**383.158937**	**-600**	
4:46:28 PM	800	0.148	160.990	151.293	**359.805013**	**-800**	
4:46:40 PM	1000	0.134	144.800	135.103	**321.301955**	**-1000**	
4:46:52 PM	1200	0.115	124.230	114.533	**272.382381**	**-1200**	
4:47:04 PM	1400	0.095	101.190	91.493	**217.588653**	**-1400**	
4:47:16 PM	1600	0.077	81.248	71.551	**170.162588**	**-1600**	
4:47:28 PM	1800	0.061	63.891	54.194	**128.884171**	**-1800**	
4:47:40 PM	2000	0.049	49.762	40.065	**95.282583**	**-2000**	
4:47:53 PM	2200	0.037	36.136	26.439	**62.8772298**	**-2200**	
4:48:05 PM	2400	0.027	25.793	16.096	**38.2795072**	**-2400**	
4:48:17 PM	2600	0.020	17.096	7.399	**17.5963018**	**-2600**	
4:48:29 PM	2800	0.015	12.085	2.388	**5.6791416**	**-2800**	
4:48:41 PM	3000	0.013	10.132	0.435	**1.034517**	**-3000**	
4:48:54 PM	3200	0.013	9.864	0.167	**0.39668376**	**-3200**	
4:49:06 PM	3400	0.013	9.767	0.070	**0.166474**	**-3400**	
4:49:18 PM	3600	0.013	9.697	0.000	**0.00071346**	**-3600**	
4:49:30 PM	3800	0.013	10.129	0.000	**0**	**-3800**	
4:49:43 PM	4000	0.013	10.075	0.000	**0**	**-4000**	

core 2 **P17** **Oxygen**

Profile 1	**dark**	**Position1**				
Date:	1/9/2002	Time:	0.713		Data Set:	1
Range A:	500 mV	Range B:	500 mV		Sample Time	2
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
5:07:39 PM	-2000	0.055	56.409	46.133	**109.713501**	**1800**
5:07:52 PM	-1800	0.055	56.299	46.023	**109.451899**	**1600**
5:08:04 PM	-1600	0.055	56.499	46.223	**109.927539**	**1400**
5:08:17 PM	-1400	0.054	55.943	45.667	**108.605259**	**1200**
5:08:29 PM	-1200	0.053	54.884	44.608	**106.086746**	**1000**
5:08:41 PM	-1000	0.052	53.358	43.082	**102.457612**	**800**
5:08:54 PM	-800	0.050	50.808	40.532	**96.3932024**	**600 ***
5:09:06 PM	-600	0.046	46.531	36.255	**86.221641**	**400 ***
5:09:19 PM	-400	0.041	40.801	30.525	**72.594555**	**200 ***
5:09:31 PM	-200	0.033	32.629	22.353	**53.1599046**	**-0**
5:09:44 PM	0	0.026	24.707	14.431	**34.3198042**	**-200**
5:09:56 PM	200	0.020	16.976	6.700	**15.93394**	**-400**
5:10:08 PM	400	0.016	12.528	2.252	**5.3557064**	**-600**
5:10:20 PM	600	0.014	10.851	0.575	**1.367465**	**-800**
5:10:33 PM	800	0.014	10.773	0.497	**1.1819654**	**-1000**
5:10:45 PM	1000	0.014	10.319	0.043	**0.1022626**	**-1200**
5:10:57 PM	1200	0.014	10.276	0.000	**0**	**-1400**
5:11:09 PM	1400	0.013	10.230	0.000	**0**	**-1600**
5:11:21 PM	1600	0.014	10.269	0.000	**0**	**-1800**
5:11:34 PM	1800	0.014	10.301	0.025	**0.059455**	**-2000**
5:11:46 PM	2000	0.014	10.271	0.000	**0**	**-2200**
5:11:58 PM	2200	0.014	10.273	0.000	**0**	**-2400**
5:12:10 PM	2400	0.013	10.200	0.000	**0**	**-2600**
5:12:22 PM	2600	0.013	10.232	0.000	**0**	**-2800**
5:12:34 PM	2800	0.013	10.176	0.000	**0**	**-3000**
5:12:46 PM	3000	0.013	10.152	0.000	**0**	**-3200**
5:12:58 PM	3200	0.013	10.128	0.000	**0**	**-3400**
5:13:10 PM	3400	0.013	10.125	0.000	**0**	**-3600**
5:13:23 PM	3600	0.013	10.124	0.000	**0**	**-3800**
5:13:35 PM	3800	0.013	10.148	0.000	**0**	**-4000**
5:13:47 PM	4000	0.013	10.128	0.000	**0**	

Profile 2	**dark**	**position 2**				
Date:	1/9/2002	Time:	0.722		Data Set:	2
Range A:	500 mV	Range B:	500 mV		Sample Time	2
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
5:21:23 PM	-2000	0.053	54.046	43.886	**104.369685**	**2000**
5:21:35 PM	-1800	0.053	54.856	44.696	**106.296027**	**1800**
5:21:47 PM	-1600	0.055	56.613	46.453	**110.474525**	**1600**
5:21:59 PM	-1400	0.054	55.366	45.206	**107.508909**	**1400**
5:22:11 PM	-1200	0.053	54.357	44.197	**105.109305**	**1200**
5:22:23 PM	-1000	0.054	55.481	45.321	**107.782402**	**1000**

5:23:35 PM	200	0.025	23.303	13.143	**31.2566826**	**-200**
5:23:47 PM	400	0.019	16.492	6.332	**15.0587624**	**-400**
5:23:59 PM	600	0.014	11.266	1.106	**2.6302892**	**-600**
5:24:11 PM	800	0.014	10.256	0.096	**0.2283072**	**-800**
5:24:23 PM	1000	0.013	10.160	0.000	**0**	**-1000**
5:24:35 PM	1200	0.013	10.148	0.000	**0**	**-1200**
5:24:47 PM	1400	0.013	10.081	0.000	**0**	**-1400**
5:24:59 PM	1600	0.013	9.990	0.000	**0**	**-1600**

Profile 3	**dark**	**position 3**				
Date:	1/9/2002	Time:	0.727		Data Set:	3
Range A:	500 mV	Range B:	500 mV		Sample Time	2
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
5:27:14 PM	-2000	0.048	49.108	38.521	**91.6106422**	**1600**
5:27:26 PM	-1800	0.049	49.641	39.054	**92.8782228**	**1400**
5:27:38 PM	-1600	0.048	48.745	38.158	**90.7473556**	**1200**
5:27:51 PM	-1400	0.046	46.856	36.269	**86.2549358**	**1000**
5:28:03 PM	-1200	0.044	44.606	34.019	**80.9039858**	**800**
5:28:15 PM	-1000	0.043	43.679	33.092	**78.6993944**	**600**
5:28:27 PM	-800	0.040	39.939	29.352	**69.8049264**	**400**
5:28:40 PM	-600	0.036	35.154	24.567	**58.4252394**	**200**
5:28:52 PM	-400	0.031	29.752	19.165	**45.578203**	**-0**
5:29:04 PM	-200	0.026	24.502	13.915	**33.092653**	**-200**
5:29:15 PM	0	0.021	18.283	7.696	**18.3026272**	**-400**
5:29:28 PM	200	0.016	12.694	2.107	**5.0108674**	**-600**
5:29:40 PM	400	0.014	10.747	0.160	**0.380512**	**-800**
5:29:52 PM	600	0.014	10.587	0.000	**0**	**-1000**
5:30:04 PM	800	0.014	10.700	0.113	**0.2687366**	**-1200**
5:30:17 PM	1000	0.014	10.603	0.016	**0.0380512**	**-1400**
5:30:28 PM	1200	0.014	10.620	0.033	**0.0784806**	**-1600**
5:30:41 PM	1400	0.014	10.577	0.000	**0**	**-1800**
5:30:52 PM	1600	0.014	10.514	0.000	**0**	
5:31:05 PM	1800	0.014	10.428	0.000	**0**	

Profile 4	**dark**	**postion 4**				
Date:	1/9/2002	Time:	0.732		Data Set:	4
Range A:	500 mV	Range B:	500 mV		Sample Time	2
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
5:35:33 PM	-2000	0.054	55.713	45.505	**108.219991**	**2000**
5:35:45 PM	-1800	0.054	56.063	45.855	**109.052361**	**1800**
5:35:57 PM	-1600	0.055	56.857	46.649	**110.940652**	**1600**
5:36:09 PM	-1400	0.056	57.504	47.296	**112.479347**	**1400**
5:36:21 PM	-1200	0.057	58.712	48.504	**115.352213**	**1200**
5:36:33 PM	-1000	0.057	59.034	48.826	**116.117993**	**1000**

5:37:46 PM	200	0.025	23.292	13.084	**31.1163688**	**-200**
5:37:58 PM	400	0.019	15.860	5.652	**13.4415864**	**-400**
5:38:10 PM	600	0.015	11.789	1.581	**3.7599342**	**-600**
5:38:22 PM	800	0.014	10.400	0.192	**0.4566144**	**-800**
5:38:35 PM	1000	0.013	10.208	0.000	**0**	**-1000**
5:38:47 PM	1200	0.013	10.151	0.000	**0**	**-1200**
5:38:59 PM	1400	0.013	9.995	0.000	**0**	**-1400**
5:39:12 PM	1600	0.013	9.976	0.000	**0**	**-1600**

Profile 5	**dark**	**position 5**				
Date:	1/9/2002	Time:	0.738		Data Set:	5
Range A:	500 mV	Range B:	500 mV		Sample Time	2
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
5:44:39 PM	-2000	0.059	61.084	50.906	**121.064649**	**2000**
5:44:51 PM	-1800	0.058	60.599	50.421	**119.911222**	**1800**
5:45:03 PM	-1600	0.059	60.778	50.600	**120.33692**	**1600**
5:45:15 PM	-1400	0.060	62.567	52.389	**124.59152**	**1400**
5:45:27 PM	-1200	0.059	61.100	50.922	**121.1027**	**1200**
5:45:39 PM	-1000	0.057	58.531	48.353	**114.993105**	**1000**
5:45:51 PM	-800	0.056	58.232	48.054	**114.282023**	**800**
5:46:04 PM	-600	0.054	55.493	45.315	**107.768133**	**600**
5:46:16 PM	-400	0.049	50.148	39.970	**95.056654**	**400**
5:46:28 PM	-200	0.041	41.339	31.161	**74.1070902**	**200**
5:46:40 PM	0	0.032	31.006	20.828	**49.5331496**	**-0**
5:46:52 PM	200	0.023	21.277	11.099	**26.3956418**	**-200**
5:47:04 PM	400	0.017	13.926	3.748	**8.9134936**	**-400**
5:47:16 PM	600	0.014	10.913	0.735	**1.747977**	**-600**
5:47:28 PM	800	0.014	10.427	0.249	**0.5921718**	**-800**
5:47:40 PM	1000	0.014	10.347	0.169	**0.4019158**	**-1000**
5:47:52 PM	1200	0.014	10.324	0.146	**0.3472172**	**-1200**
5:48:04 PM	1400	0.013	10.178	0.000	**0**	**-1400**
5:48:16 PM	1600	0.013	10.042	0.000	**0**	**-1600**
5:48:28 PM	1800	0.013	10.046	0.000	**0**	**-1800**

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| **Profile 6** | **25% light** | **5 min** | **position 5** | | | |
|---|---|---|---|---|---|---|
| Date: | 1/9/2002 | Time: | 0.746 | | Data Set: | 6 |
| Range A: | 500 mV | Range B: | 500 mV | | Sample Time | 2 |
| | | | % sat | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | O2 (µM) | **Depth (µm)** |
| 5:54:56 PM | -2000 | 0.053 | 53.958 | 43.728 | 103.99393 | 2000 |
| 5:55:08 PM | -1800 | 0.052 | 53.946 | 43.716 | 103.965391 | 1800 |
| 5:55:20 PM | -1600 | 0.052 | 53.727 | 43.497 | 103.444565 | 1600 |
| 5:55:32 PM | -1400 | 0.051 | 52.519 | 42.289 | 100.5717 | 1400 |
| 5:55:44 PM | -1200 | 0.050 | 51.605 | 41.375 | 98.398025 | 1200 |
| 5:55:56 PM | -1000 | 0.050 | 50.643 | 40.413 | 96.1101966 | 1000 |
| 5:56:08 PM | -800 | 0.049 | 49.584 | 39.354 | 93.5916828 | 800 |
| 5:56:20 PM | -600 | 0.046 | 46.973 | 36.743 | 87.3822026 | 600 |
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5:57:32 PM	600	0.014	10.631	0.401	0.9536582	-600
5:57:44 PM	800	0.013	10.230	0.000	0	-800
5:57:56 PM	1000	0.013	10.160	0.000	0	-1000
5:58:08 PM	1200	0.014	10.545	0.000	0	-1200

Profile 7	**25 % light**	**10 min**	**position 5**			
Date:	1/9/2002	Time:	0.749		Data Set:	7
Range A:	500 mV	Range B:	500 mV		Sample Time	2
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
6:00:01 PM	-2000	0.052	52.975	42.738	**101.639512**	**2000**
6:00:13 PM	-1800	0.051	52.708	42.471	**101.004532**	**1800**
6:00:25 PM	-1600	0.052	52.859	42.622	**101.36364**	**1600**
6:00:37 PM	-1400	0.052	52.855	42.618	**101.354128**	**1400**
6:00:50 PM	-1200	0.051	52.377	42.140	**100.217348**	**1200**
6:01:02 PM	-1000	0.051	52.085	41.848	**99.5229136**	**1000**
6:01:14 PM	-800	0.050	50.792	40.555	**96.447901**	**800**
6:01:26 PM	-600	0.046	46.711	36.474	**86.7424668**	**600**
6:01:38 PM	-400	0.041	41.068	30.831	**73.3222842**	**400**
6:01:50 PM	-200	0.035	34.140	23.903	**56.8461146**	**200**
6:02:02 PM	0	0.028	27.010	16.773	**39.8895486**	**-0**
6:02:14 PM	200	0.022	19.692	9.455	**22.485881**	**-200**
6:02:27 PM	400	0.016	13.193	2.956	**7.0299592**	**-400**
6:02:39 PM	600	0.014	10.943	0.706	**1.6790092**	**-600**
6:02:51 PM	800	0.014	10.340	0.103	**0.2449546**	**-800**
6:03:03 PM	1000	0.014	10.259	0.022	**0.0523204**	**-1000**
6:03:15 PM	1200	0.013	10.237	0.000	**0**	**-1200**

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| **Profile 8** | **50 % light** | **5 min** | **position 5** | | | |
|---|---|---|---|---|---|---|
| Date: | 1/9/2002 | Time: | 0.758 | | Data Set: | 9 |
| Range A: | 500 mV | Range B: | 500 mV | | Sample Time | 2 |
| | | | % sat | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | **O2 (µM)** | **Depth (µm)** |
| 6:11:55 PM | -2000 | 0.052 | 53.242 | 43.276 | **102.918983** | **2000** |
| 6:12:06 PM | -1800 | 0.052 | 53.519 | 43.553 | **103.577745** | **1800** |
| 6:12:18 PM | -1600 | 0.052 | 53.311 | 43.345 | **103.083079** | **1600** |
| 6:12:30 PM | -1400 | 0.052 | 53.071 | 43.105 | **102.512311** | **1400** |
| 6:12:42 PM | -1200 | 0.052 | 52.987 | 43.021 | **102.312542** | **1200** |
| 6:12:54 PM | -1000 | 0.052 | 53.239 | 43.273 | **102.911849** | **1000** |
| 6:13:06 PM | -800 | 0.052 | 53.401 | 43.435 | **103.297117** | **800** |
| 6:13:18 PM | -600 | 0.052 | 53.825 | 43.859 | **104.305474** | **600** |
| 6:13:30 PM | -400 | 0.052 | 53.238 | 43.272 | **102.90947** | **400** |
| 6:13:42 PM | -200 | 0.049 | 50.288 | 40.322 | **95.8937804** | **200** |
| 6:13:54 PM | 0 | 0.045 | 45.177 | 35.211 | **83.7388002** | **-0** |
| 6:14:06 PM | 200 | 0.038 | 37.239 | 27.273 | **64.8606486** | **-200** |
| 6:14:18 PM | 400 | 0.027 | 25.702 | 15.736 | **37.4233552** | **-400** |
| 6:14:30 PM | 600 | 0.022 | 19.365 | 9.399 | **22.3527018** | **-600** |
| 6:14:42 PM | 800 | 0.016 | 13.302 | 3.336 | **7.9336752** | **-800** |
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6:15:54 PM	2000	0.013	9.893	0.000	**0**	**-2000**
6:16:06 PM	2200	0.013	9.909	0.000	**0**	**-2200**
6:16:18 PM	2400	0.013	9.900	0.000	**0**	**-2400**
6:16:30 PM	2600	0.013	9.965	0.000	**0**	**-2600**
6:16:42 PM	2800	0.013	9.922	0.000	**0**	**-2800**
6:16:54 PM	3000	0.013	9.946	0.000	**0**	**-3000**

Profile 9	**50 % light**	**10 min**	**position 5**			
Date:	1/9/2002	Time:	0.763		Data Set:	10
Range A:	500 mV	Range B:	500 mV		Sample Time	2
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (mm)**
6:20:26 PM	-2000	0.052	53.530	43.558	**103.589636**	**2000**
6:20:38 PM	-1800	0.052	53.702	43.730	**103.998686**	**1800**
6:20:51 PM	-1600	0.052	53.465	43.493	**103.435053**	**1600**
6:21:03 PM	-1400	0.052	53.427	43.455	**103.344681**	**1400**
6:21:15 PM	-1200	0.052	53.050	43.078	**102.4481**	**1200**
6:21:27 PM	-1000	0.052	53.217	43.245	**102.845259**	**1000**
6:21:39 PM	-800	0.052	53.460	43.488	**103.423162**	**800**
6:21:51 PM	-600	0.052	53.672	43.700	**103.92734**	**600**
6:22:03 PM	-400	0.052	53.418	43.446	**103.323277**	**400**
6:22:15 PM	-200	0.050	51.214	41.242	**98.0817244**	**200**
6:22:27 PM	0	0.046	46.302	36.330	**86.400006**	**-0**
6:22:39 PM	200	0.039	38.514	28.542	**67.8785844**	**-200**
6:22:51 PM	400	0.030	28.742	18.770	**44.638814**	**-400**
6:23:03 PM	600	0.022	20.131	10.159	**24.1601338**	**-600**
6:23:16 PM	800	0.017	13.644	3.672	**8.7327504**	**-800**
6:23:28 PM	1000	0.014	11.125	1.153	**2.7420646**	**-1000**
6:23:40 PM	1200	0.013	9.972	0.000	**0**	**-1200**
6:23:52 PM	1400	0.013	9.788	0.000	**0**	**-1400**
6:24:04 PM	1600	0.013	9.743	0.000	**0**	**-1600**

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| **Profile 10** | **25 % light** | **15 min** | **position 5** | | | 0 shift |
|---|---|---|---|---|---|---|
| Date: | 1/9/2002 | Time: | 0.768 | | Data Set: | 11 |
| Range A: | 500 mV | Range B: | 500 mV | | Sample Time | 2 |
| | | | % sat | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | **O2 (µM)** | **Depth (µm)** |
| 6:26:52 PM | -2000 | 0.055 | 56.244 | 55.481 | **131.944914** | **2000** |
| 6:27:04 PM | -1800 | 0.054 | 56.015 | 55.252 | **131.400306** | **1800** |
| 6:27:16 PM | -1600 | 0.055 | 56.502 | 55.739 | **132.55849** | **1600** |
| 6:27:28 PM | -1400 | 0.055 | 56.338 | 55.575 | **132.168465** | **1400** |
| 6:27:40 PM | -1200 | 0.055 | 56.230 | 55.467 | **131.911619** | **1200** |
| 6:27:51 PM | -1000 | 0.054 | 55.168 | 54.405 | **129.385971** | **1000** |
| 6:28:03 PM | -800 | 0.054 | 56.121 | 55.358 | **131.652396** | **800** |
| 6:28:15 PM | -600 | 0.054 | 55.374 | 54.611 | **129.87588** | **600** |
| 6:28:27 PM | -400 | 0.045 | 45.402 | 44.639 | **106.16047** | **400** |
| 6:28:39 PM | -200 | 0.043 | 42.795 | 42.032 | **99.9605024** | **200** |
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6:29:51 PM	1000	0.006	1.682	0.919	**2.18461452**	**-1000**
6:30:03 PM	1200	0.005	0.763	0.000	**0.00023782**	**-1200**
6:30:15 PM	1400	0.005	0.668	0.000	**0**	**-1400**
6:30:27 PM	1600	0.005	0.610	0.000	**0**	**-1600**

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| **profile 11** | **100 % light** | **5 min** | **postion 5** | | | |
|---|---|---|---|---|---|---|
| Date: | 1/9/2002 | Time: | 0.775 | | Data Set: | 12 |
| Range A: | 500 mV | Range B: | 500 mV | | Sample Time | 2 |
| | | | % sat | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | O2 (µM) | **Depth (µm)** |
| 6:36:46 PM | -2000 | 0.051 | 52.132 | 51.517 | 122.517729 | 2000 |
| 6:36:57 PM | -1800 | 0.050 | 51.375 | 50.760 | 120.717432 | 1800 |
| 6:37:09 PM | -1600 | 0.051 | 52.240 | 51.625 | 122.774575 | 1600 |
| 6:37:21 PM | -1400 | 0.055 | 56.448 | 55.833 | 132.782041 | 1400 |
| 6:37:33 PM | -1200 | 0.054 | 55.297 | 54.682 | 130.044732 | 1200 |
| 6:37:45 PM | -1000 | 0.062 | 64.322 | 63.707 | 151.507987 | 1000 |
| 6:37:57 PM | -800 | 0.064 | 66.946 | 66.331 | 157.748384 | 800 |
| 6:38:09 PM | -600 | 0.065 | 68.405 | 67.790 | 161.218178 | 600 |
| 6:38:21 PM | -400 | 0.069 | 72.312 | 71.697 | 170.509805 | 400 |
| 6:38:33 PM | -200 | 0.074 | 77.742 | 77.127 | 183.423431 | 200 |
| 6:38:45 PM | 0 | 0.078 | 82.950 | 82.335 | 195.809097 | -0 |
| 6:38:57 PM | 200 | 0.079 | 84.178 | 83.563 | 198.729527 | -200 |
| 6:39:09 PM | 400 | 0.074 | 77.500 | 76.885 | 182.847907 | -400 |
| 6:39:21 PM | 600 | 0.058 | 59.914 | 59.299 | 141.024882 | -600 |
| 6:39:34 PM | 800 | 0.041 | 41.247 | 40.632 | 96.6310224 | -800 |
| 6:39:46 PM | 1000 | 0.028 | 26.310 | 25.695 | 61.107849 | -1000 |
| 6:39:57 PM | 1200 | 0.017 | 14.723 | 14.108 | 33.5516456 | -1200 |
| 6:40:09 PM | 1400 | 0.011 | 7.593 | 6.978 | 16.5950796 | -1400 |
| 6:40:21 PM | 1600 | 0.007 | 3.188 | 2.573 | 6.11863296 | -1600 |
| 6:40:33 PM | 1800 | 0.005 | 0.919 | 0.304 | 0.72311549 | -1800 |
| 6:40:44 PM | 2000 | 0.005 | 0.615 | 0.000 | 0 | -2000 |
| 6:40:57 PM | 2200 | 0.005 | 0.488 | 0.000 | 0 | -2200 |
| 6:41:09 PM | 2400 | 0.005 | 0.519 | 0.000 | 0 | -2400 |
| 6:41:21 PM | 2600 | 0.005 | 0.510 | 0.000 | 0 | -2600 |

| **Profile 12** | **100 % light** | **10 min** | **position 5** | | | |
|---|---|---|---|---|---|---|
| Date: | 1/9/2002 | Time: | 0.780 | | Data Set: | 13 |
| Range A: | 500 mV | Range B: | 500 mV | | Sample Time | 2 |
| | | | % sat | | | |
| Time | Depth [µm] | Ch A [V] | Ch A [cal.] | corr. %sat | **O2 (µM)** | **Depth (µm)** |
| 6:43:32 PM | -2000 | 0.053 | 54.436 | 53.812 | **127.975698** | **2000** |
| 6:43:44 PM | -1800 | 0.053 | 54.660 | 54.036 | **128.508415** | **1800** |
| 6:43:57 PM | -1600 | 0.053 | 54.634 | 54.010 | **128.446582** | **1600** |
| 6:44:09 PM | -1400 | 0.053 | 54.733 | 54.109 | **128.682024** | **1400** |
| 6:44:21 PM | -1200 | 0.054 | 55.300 | 54.676 | **130.030463** | **1200** |
| 6:44:33 PM | -1000 | 0.056 | 58.390 | 57.766 | **137.379101** | **1000** |
| 6:44:45 PM | -800 | 0.064 | 67.104 | 66.480 | **158.102736** | **800** |
````````````````````````````````````````````````````````````````````````````````````````````````````````````````````````````````

6:45:59 PM	400	0.080	85.330	84.706	**201.447809**	**-400**
6:46:12 PM	600	0.067	69.845	69.221	**164.621382**	**-600**
6:46:24 PM	800	0.049	50.005	49.381	**117.437894**	**-800**
6:46:36 PM	1000	0.036	35.626	35.002	**83.2417564**	**-1000**
6:46:48 PM	1200	0.022	20.020	19.396	**46.1275672**	**-1200**
6:47:00 PM	1400	0.015	11.828	11.204	**26.6453528**	**-1400**
6:47:12 PM	1600	0.009	5.334	4.710	**11.2001329**	**-1600**
6:47:25 PM	1800	0.006	1.568	0.944	**2.24454516**	**-1800**
6:47:37 PM	2000	0.005	0.624	0.000	**0**	**-2000**
6:47:50 PM	2200	0.005	0.450	0.000	**0**	**-2200**
6:48:02 PM	2400	0.005	0.443	0.000	**0**	**-2400**
6:48:15 PM	2600	0.005	0.445	0.000	**0**	**-2600**
6:48:27 PM	2800	0.005	0.433	0.000	**0**	**-2800**

profile 13	**100 % light**	**15 min**	**postion 5**			
Date:	1/9/2002	Time:	0.785		Data Set:	14
Range A:	500 mV	Range B:	500 mV		Sample Time	2
			% sat			
Time	Depth [µm]	Ch A [V]	Ch A [cal.]	corr. %sat	**O2 (µM)**	**Depth (µm)**
6:50:32 PM	-2000	0.055	57.082	56.441	**134.227986**	**2000**
6:50:44 PM	-1800	0.055	57.073	56.432	**134.206582**	**1800**
6:50:56 PM	-1600	0.056	57.806	57.165	**135.949803**	**1600**
6:51:08 PM	-1400	0.057	59.040	58.399	**138.884502**	**1400**
6:51:20 PM	-1200	0.057	58.604	57.963	**137.847607**	**1200**
6:51:32 PM	-1000	0.058	60.288	59.647	**141.852495**	**1000**
6:51:44 PM	-800	0.062	64.350	63.709	**151.512744**	**800**
6:51:56 PM	-600	0.069	72.721	72.080	**171.420656**	**600**
6:52:08 PM	-400	0.078	82.956	82.315	**195.761533**	**400**
6:52:20 PM	-200	0.091	96.621	95.980	**228.259636**	**200**
6:52:32 PM	0	0.100	107.080	106.439	**253.13323**	**-0**
6:52:44 PM	200	0.103	110.670	110.029	**261.670968**	**-200**
6:52:56 PM	400	0.093	99.235	98.594	**234.476251**	**-400**
6:53:08 PM	600	0.074	78.568	77.927	**185.325991**	**-600**
6:53:20 PM	800	0.057	59.427	58.786	**139.804865**	**-800**
6:53:32 PM	1000	0.042	42.382	41.741	**99.2684462**	**-1000**
6:53:45 PM	1200	0.028	27.038	26.397	**62.7773454**	**-1200**
6:53:57 PM	1400	0.020	17.565	16.924	**40.2486568**	**-1400**
6:54:09 PM	1600	0.013	9.463	8.822	**20.9814317**	**-1600**
6:54:21 PM	1800	0.008	3.697	3.056	**7.26682792**	**-1800**
6:54:33 PM	2000	0.006	1.566	0.925	**2.199835**	**-2000**
6:54:45 PM	2200	0.005	0.813	0.172	**0.40814668**	**-2200**
6:54:57 PM	2400	0.005	0.641	0.000	**0.00049942**	**-2400**

Profile 14	**100 % light**	**20 min.**	**position 5**			
Date:	1/9/2002	Time:	0.789		Data Set:	15
Range A:	500 mV	Range B:	500 mV		Sample Time	2
			% sat			

6:57:47 PM	-1200	0.055	56.666	55.795	**132.691669**	**1200**
6:57:59 PM	-1000	0.059	60.909	60.038	**142.782372**	**1000**
6:58:11 PM	-800	0.063	65.668	64.797	**154.100225**	**800**
6:58:23 PM	-600	0.069	72.658	71.787	**170.723843**	**600 ***
6:58:35 PM	-400	0.079	83.713	82.842	**197.014844**	**400 ***
6:58:48 PM	-200	0.093	99.115	98.244	**233.643881**	**200 ***
6:59:00 PM	0	0.104	111.870	110.999	**263.977822**	**-0**
6:59:12 PM	200	0.109	116.970	116.099	**276.106642**	**-200**
6:59:24 PM	400	0.098	105.260	104.389	**248.25792**	**-400**
6:59:36 PM	600	0.082	86.483	85.612	**203.602458**	**-600**
6:59:48 PM	800	0.063	65.495	64.624	**153.688797**	**-800**
7:00:00 PM	1000	0.048	49.257	48.386	**115.071585**	**-1000**
7:00:13 PM	1200	0.033	32.589	31.718	**75.4317476**	**-1200**
7:00:25 PM	1400	0.024	21.521	20.650	**49.10983**	**-1400**
7:00:37 PM	1600	0.015	12.200	11.329	**26.9426278**	**-1600**
7:00:49 PM	1800	0.009	5.499	4.628	**11.0072609**	**-1800**
7:01:01 PM	2000	0.006	2.147	1.276	**3.03434538**	**-2000**
7:01:13 PM	2200	0.005	1.005	0.134	**0.31796534**	**-2200**
7:01:25 PM	2400	0.005	0.871	0.000	**0.00107019**	**-2400**

San Diego Bay
1/9/2002 **P17**
sulfide, pH, Redoxpotential

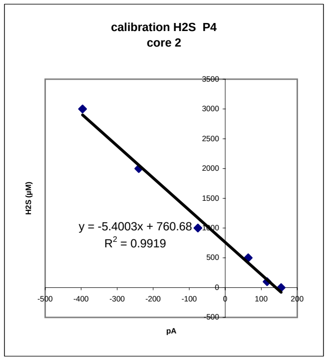
core 2
Sulfide profile 1

sed. Depth m	pA	**H2S (µM)**	**depth (mm)**
0	168	**0**	**-0**
2	164	**0**	**-2**
4	157	**0**	**-4**
6	151	**0**	**-6**
8	135	**31.6395**	**-8**
10	119	**118.0443**	**-10**
12	81	**323.2557**	**-12**
14	66	**404.2602**	**-14**
16	45	**517.6665**	**-16**
18	28	**609.4716**	**-18**
20	8	**717.4776**	**-20**
22	8	**717.4776**	**-22**
24	6	**728.2782**	**-24**
26	-27	**906.4881**	**-26**
28	-64	**1106.2992**	**-28**
30	-67	**1122.5001**	**-30**
32	-84	**1214.3052**	**-32**
34	-91	**1252.1073**	**-34**
36	-79	**1187.3037**	**-36**
38	-87	**1230.5061**	**-38**
40	-105	**1327.7115**	**-40**
42	-88	**1235.9064**	**-42**
44	-107	**1338.5121**	**-44**
46	-139	**1511.3217**	**-46**
48	-155	**1597.7265**	**-48**
50	-159	**1619.3277**	**-50**
52	-148	**1559.9244**	**-52**
54	-122	**1419.5166**	**-54**
56	-174	**1700.3322**	**-56**
58	-105	**1327.7115**	**-58**
60	-144	**1538.3232**	**-60**
62	-142	**1527.5226**	**-62**
64	-155	**1597.7265**	**-64**
66	-148	**1559.9244**	**-66**
68	-162	**1635.5286**	**-68**
70	-160	**1624.728**	**-70**

calibration 2
0=155
1mM-76
2mM-240
3mM-396

500µM+64
100µM=116

pA	H2S (µM)
155	0
116	100
64	500
-76	1000
-240	2000
-396	3000

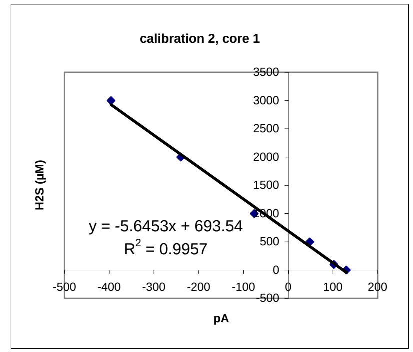


core 1

depth (mm)	pA	**H2S (µM)**	**depth (mm)**
0	131	**0**	**-0**
2	132	**0**	**-2**
4	128	**0**	**-4**
6	127	**0**	**-6**
8	125	**0**	**-8**
10	124	**0**	**-10**
12	123	**0**	**-12**
14	123	**0**	**-14**
16	124	**0**	**-16**
18	120	**16.104**	**-18**
20	122	**4.8134**	**-20**
22	120	**16.104**	**-22**
24	117	**33.0399**	**-24**
26	114	**49.9758**	**-26**
28	111	**66.9117**	**-28**
30	108	**83.8476**	**-30**
32	104	**106.4288**	**-32**
34	99	**134.6553**	**-34**
36	107	**89.4929**	**-36**
38	103	**112.0741**	**-38**
40	88	**196.7536**	**-40**
42	88	**196.7536**	**-42**
44	89	**191.1083**	**-44**
46	86	**208.0442**	**-46**
48	84	**219.3348**	**-48**
50	82	**230.6254**	**-50**
52	81	**236.2707**	**-52**
54	83	**224.9801**	**-54**
56	80	**241.916**	**-56**
58	78	**253.2066**	**-58**
60	74	**275.7878**	**-60**
62	72	**287.0784**	**-62**
64	64	**332.2408**	**-64**
66	62	**343.5314**	**-66**
68	53	**394.3391**	**-68**
70	46	**433.8562**	**-70**
72	35	**495.9545**	**-72**
74	38	**479.0186**	**-74**

calibration 1

pA	H2S (µM)
130	0
102	100
48	500
-76	1000
-240	2000
-396	3000



core 2

depth mm	**pH**	**depth (mm)**
-10	**7.953**	**10**
0	**8.005**	**-0**
2	**7.776**	**-2**
4	**7.7**	**-4**
6	**7.53**	**-6**
8	**7.538**	**-8**
10	**7.516**	**-10**
12	**7.499**	**-12**
14	**7.49**	**-14**
16	**7.499**	**-16**
18	**7.512**	**-18**
20	**7.527**	**-20**
22	**7.538**	**-22**
24	**7.546**	**-24**
26	**7.551**	**-26**
28	**7.559**	**-28**
30	**7.566**	**-30**
32	**7.575**	**-32**
34	**7.583**	**-34**
36	**7.59**	**-36**
38	**7.603**	**-38**
40	**7.615**	**-40**
42	**7.625**	**-42**

core 1

depth cm	**ph**	**Sediment depth (mm)**
1	**7.865**	**10**
0.5	**7.86**	**5**
-1	**7.42**	**-10**
-1.5	**7.394**	**-15**
-2	**7.392**	**-20**
-2.5	**7.38**	**-25**
-3	**7.367**	**-30**
-3.5	**7.362**	**-35**
-4	**7.367**	**-40**
-4.5	**7.411**	**-45**
5		-50
5.5		-55
6		-60
6.5		-65
7		-70
7.5		-75
8		-80

core1
redox

sed.depth	**mV**	**Sediment depth (mm)**
1	**30**	**10**

44	**7.639**	**-44**
46	**7.646**	**-46**
48	**7.649**	**-48**
50	**7.664**	**-50**
52	**7.669**	**-52**
54		**-54**
56	**7.681**	**-56**
58		**-58**
60		**-60**
62		**-62**
64	**7.722**	**-64**
66		**-66**
68		**-68**
70		**-70**
72		**-72**
74		**-74**
76	**7.771**	**-76**

core 2
redox

sed.depth	**mV**	**sediment depth (mm)**
1		**10**
0.5		**5**
0	**-130**	**0**
-0.5	**-347**	**-5**
-1	**-373**	**-10**
-1.5	**-403**	**-15**
-2	**-416**	**-20**
-2.5	**-422**	**-25**
-3	**-425**	**-30**
-3.5		**-35**
-4		**-40**
-4.5	**-428**	**-45**
-5	**-441**	**-50**
-5.5	**-439**	**-55**
-6	**-445**	**-60**
-6.5	**-444**	**-65**
-7	**-446**	**-70**
-7.5		**-75**
-8		**-80**
-8.5		**-85**
-9		**-90**

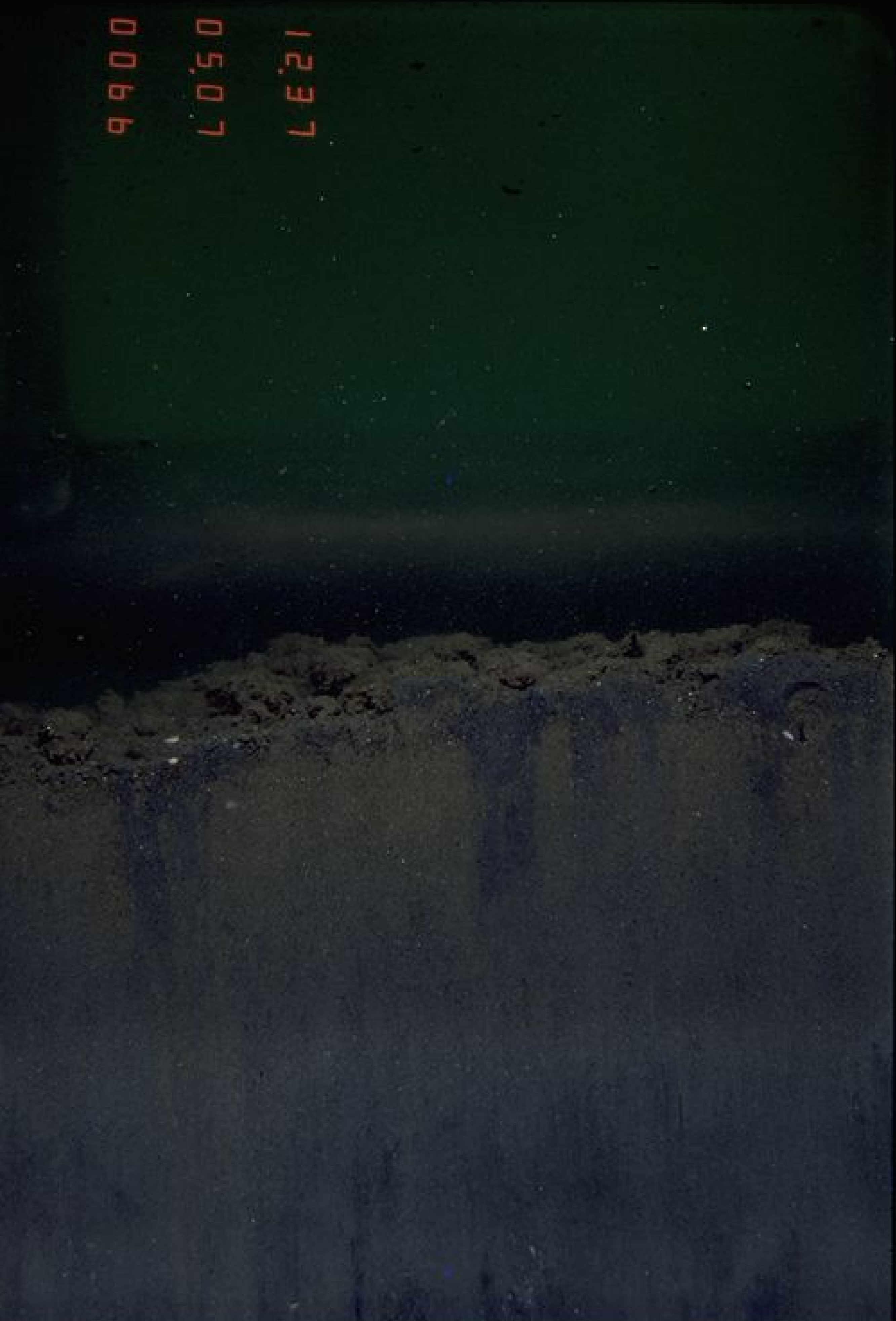
0.5		**5**
0	**-25**	**0**
-0.5	**-119**	**-5**
-1	**-222**	**-10**
-1.5	**-259**	**-15**
-2	**-297**	**-20**
-2.5	**-331**	**-25**
-3	**-340**	**-30**
-3.5	**-356**	**-35**
-4	**-370**	**-40**
-4.5	**-416**	**-45**
-5	**-392**	**-50**
-5.5		**-55**
-6	**-407**	**-60**
-6.5	**-423**	**-65**
-7	**-431**	**-70**
-7.5		**-75**
-8		**-80**
-8.5		**-85**
-9		**-90**

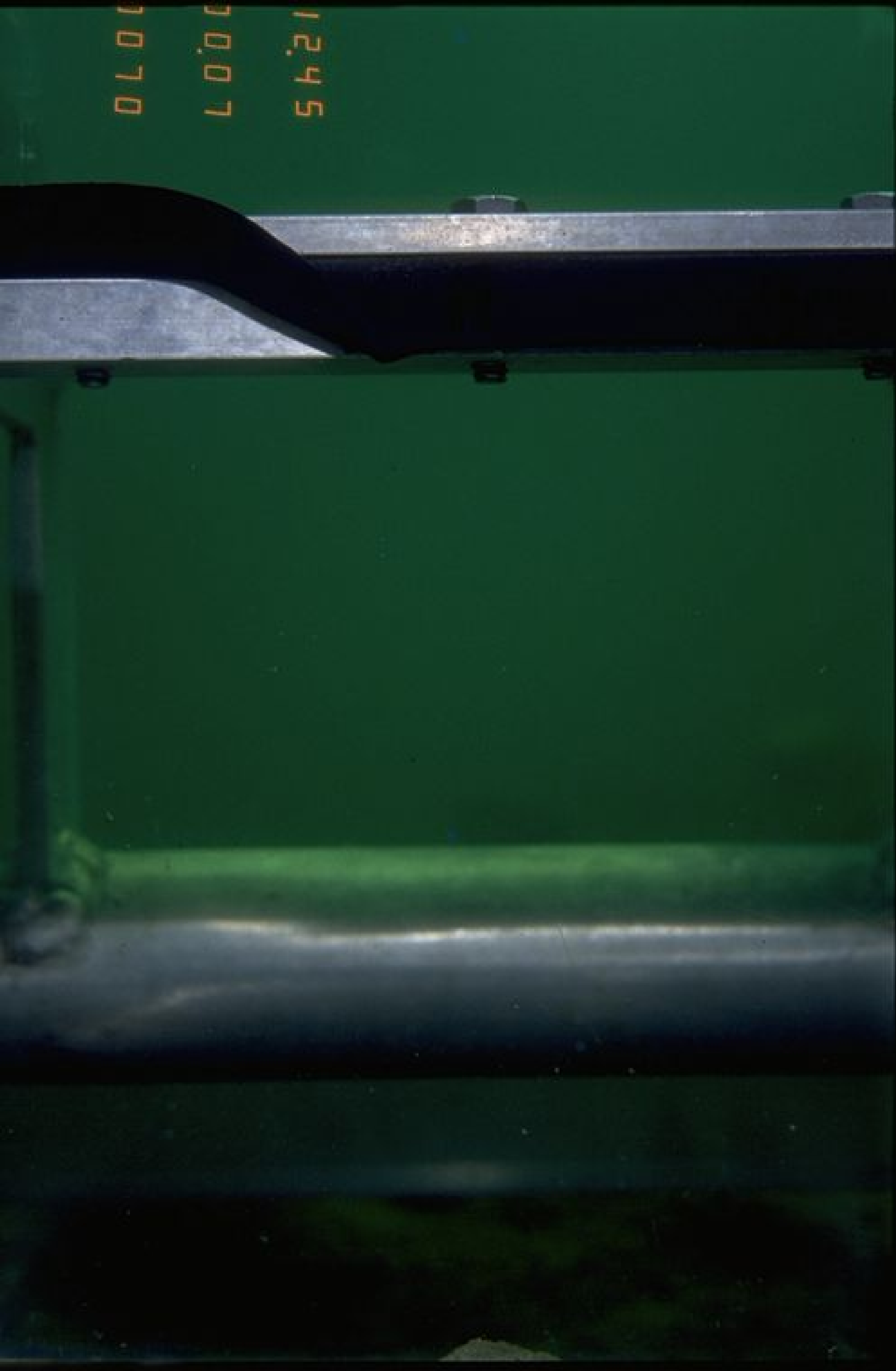

12.10
13.07
0038

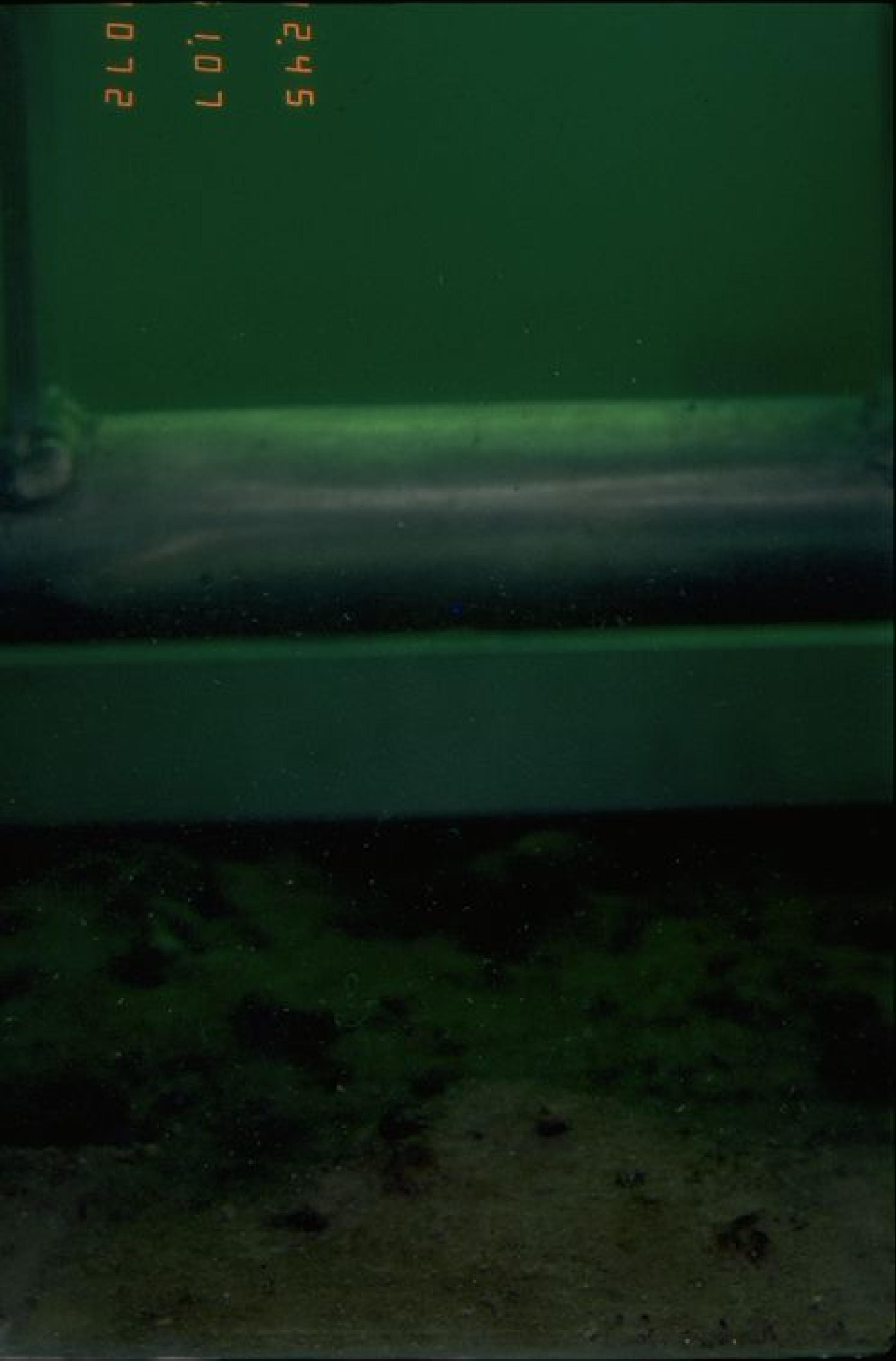

12.17
21.07
0046


12.23
49.07
0050

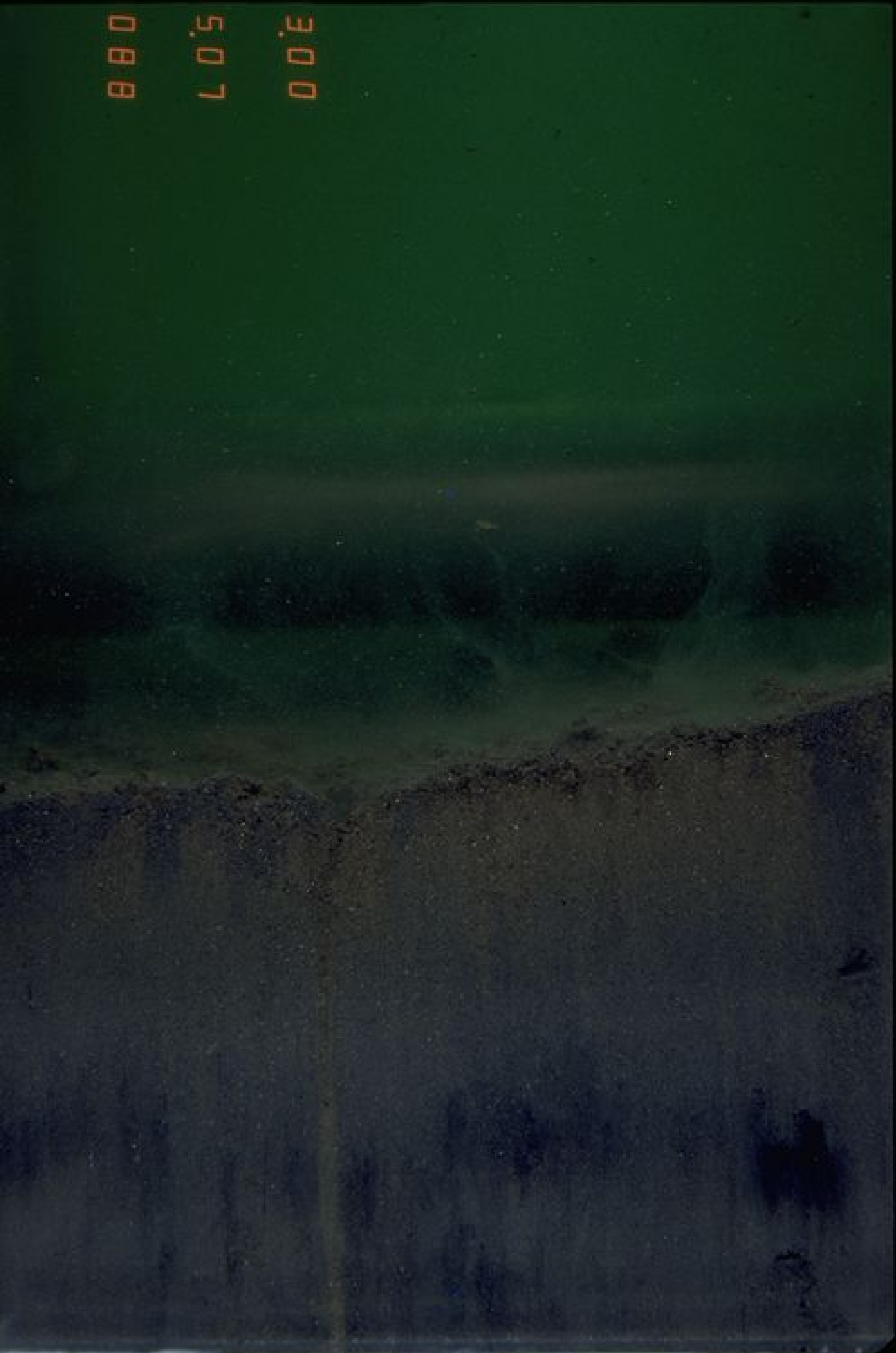

12.36
14.07
0064



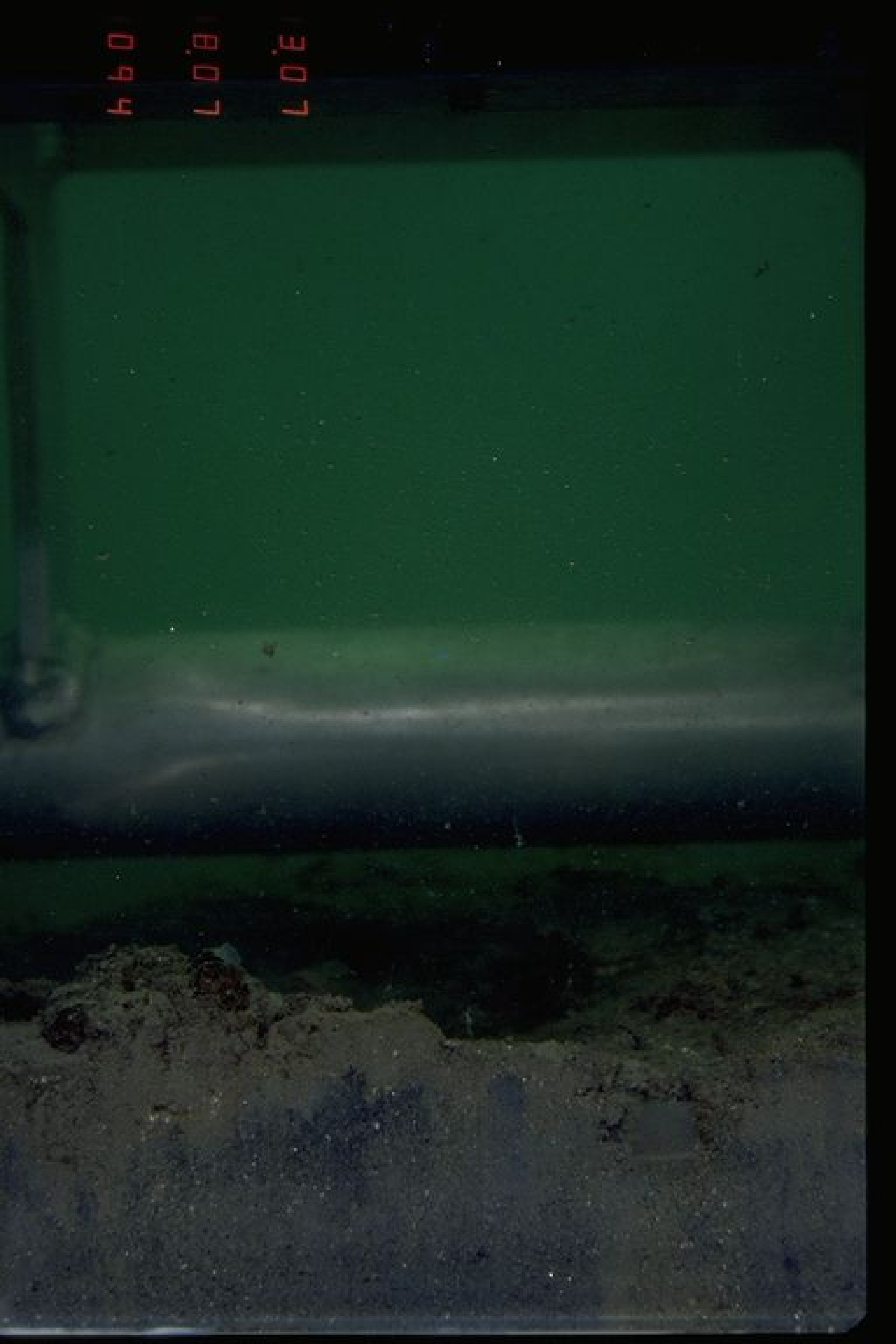




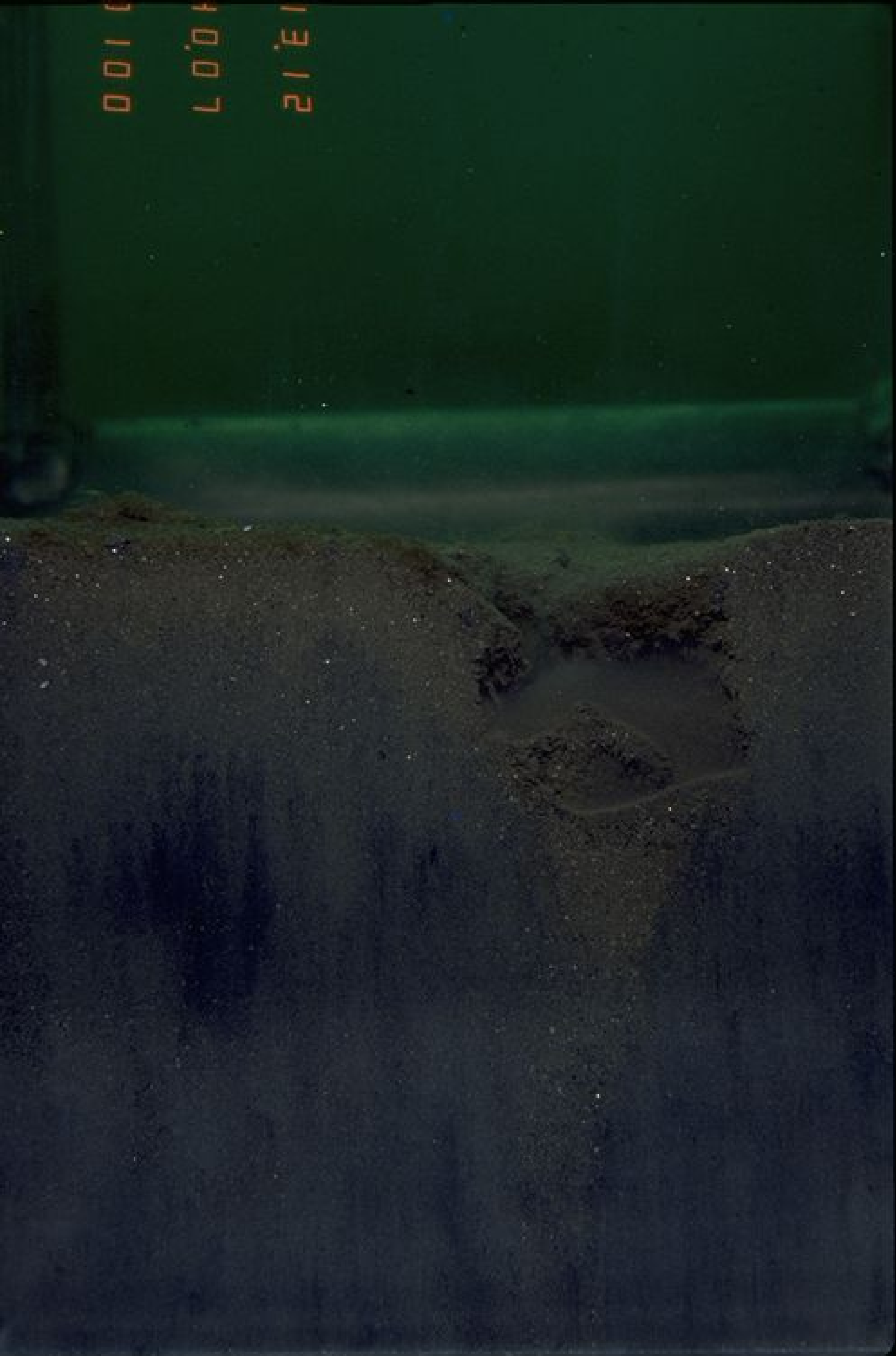

12.48
38.07
0074

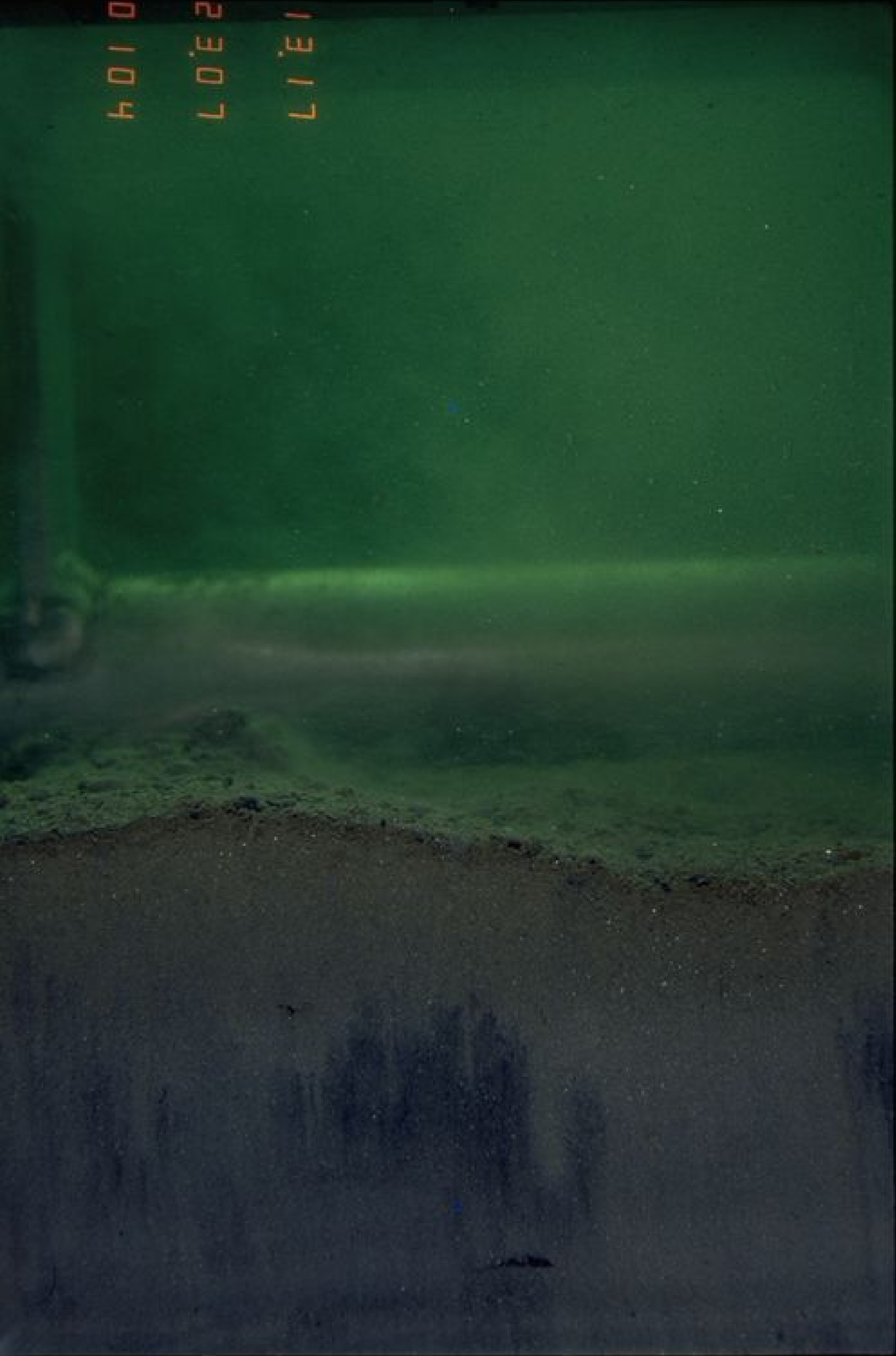


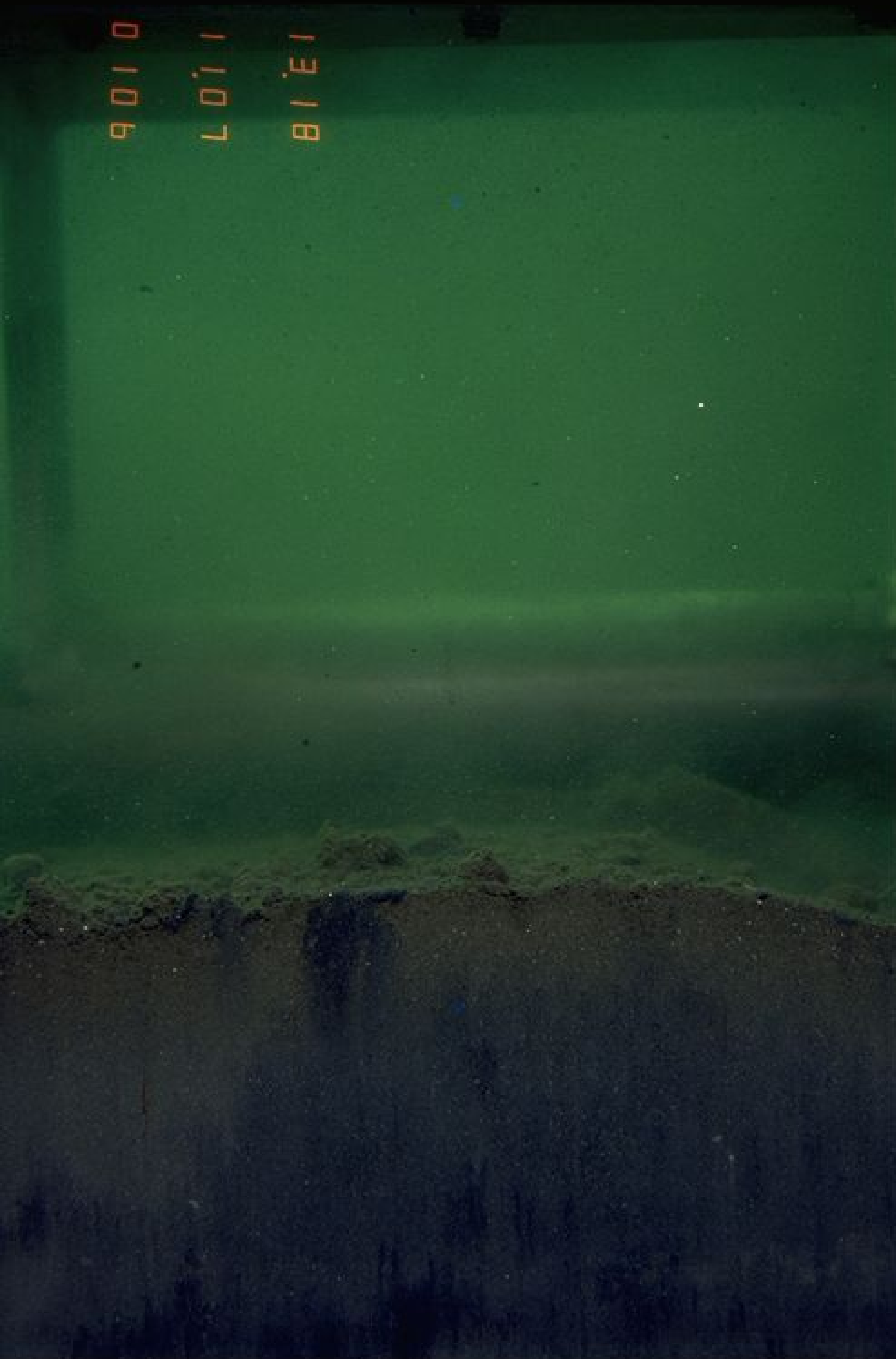
13.06
47.07
0092

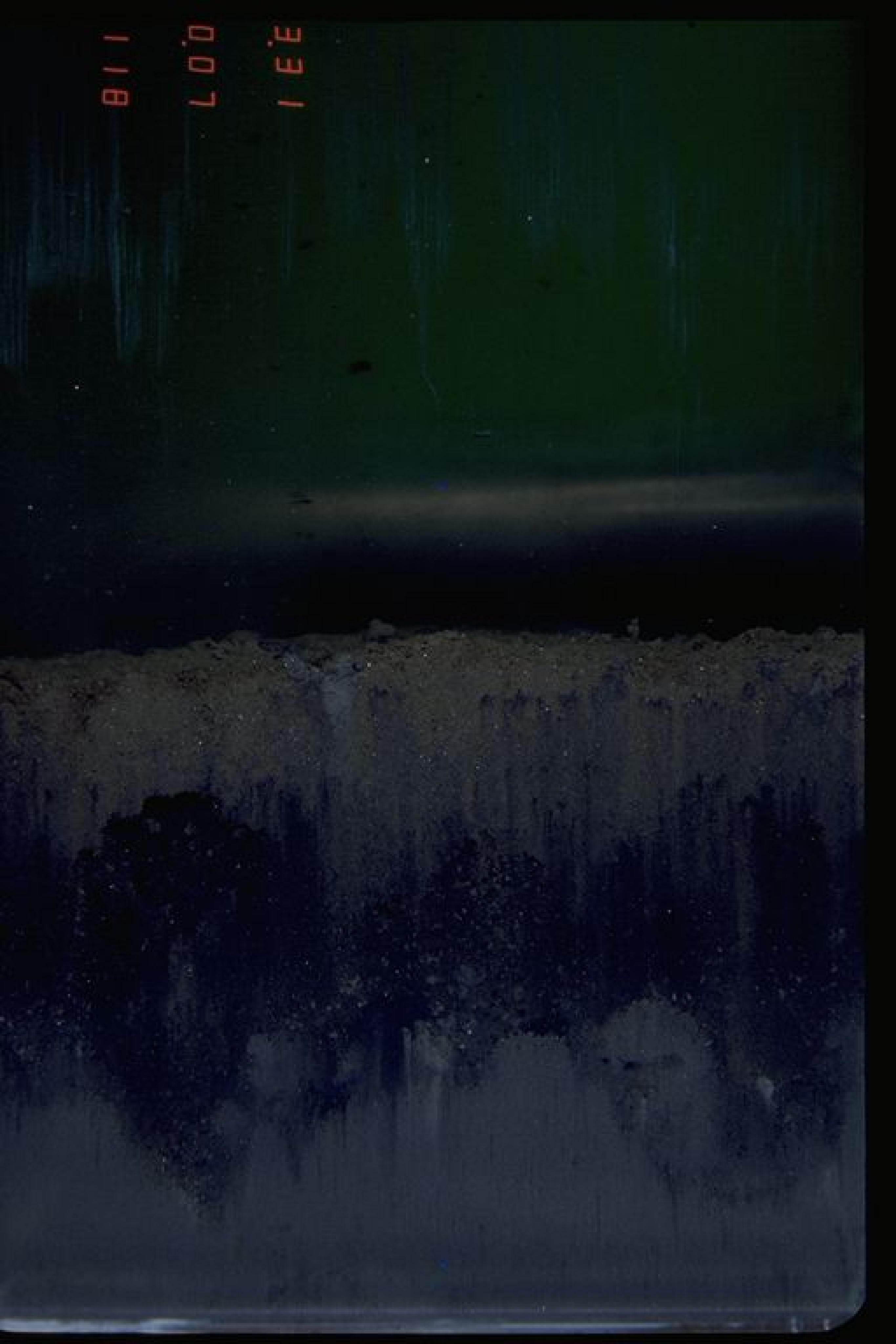


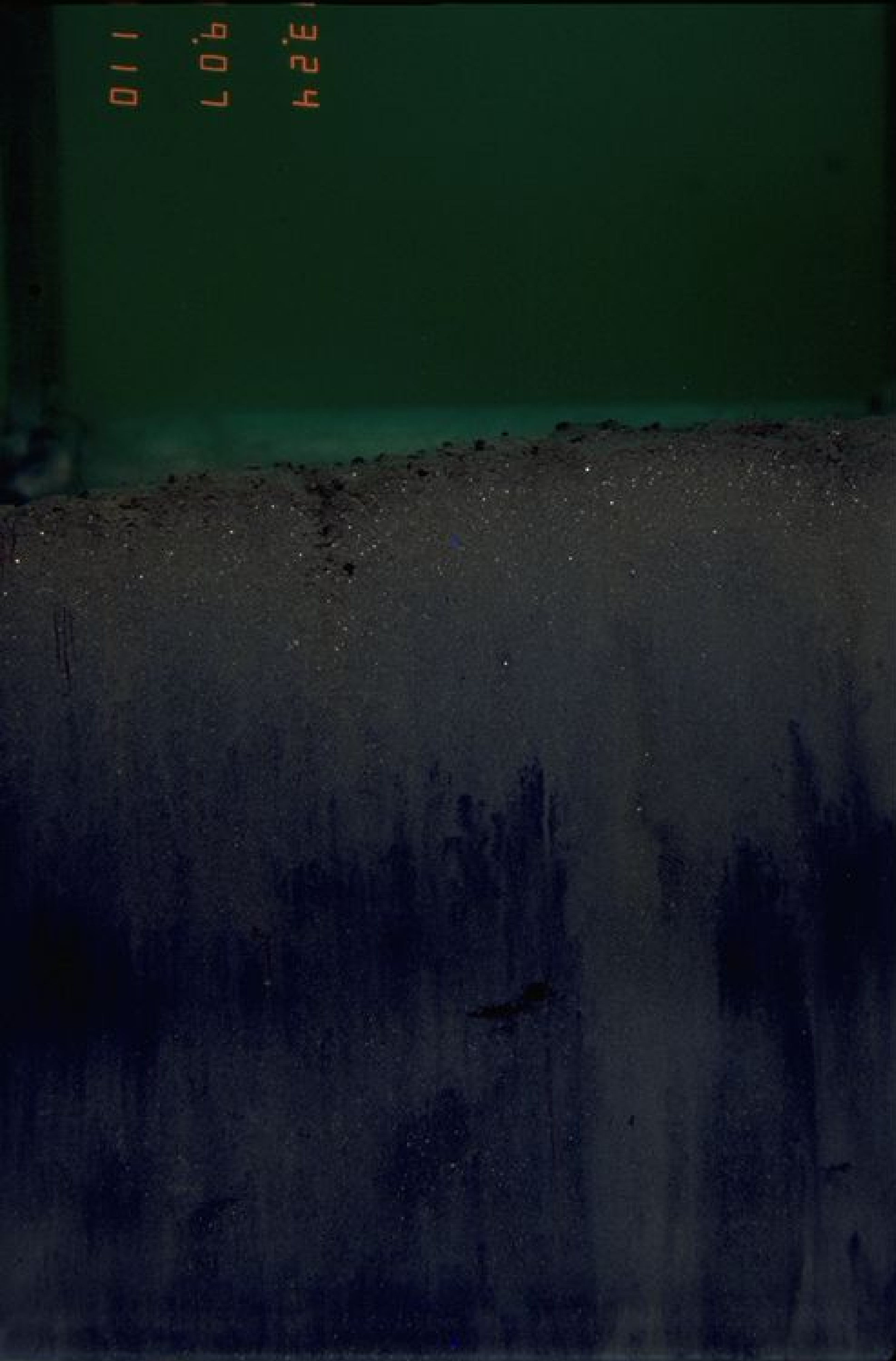

13.11
49.07
0098







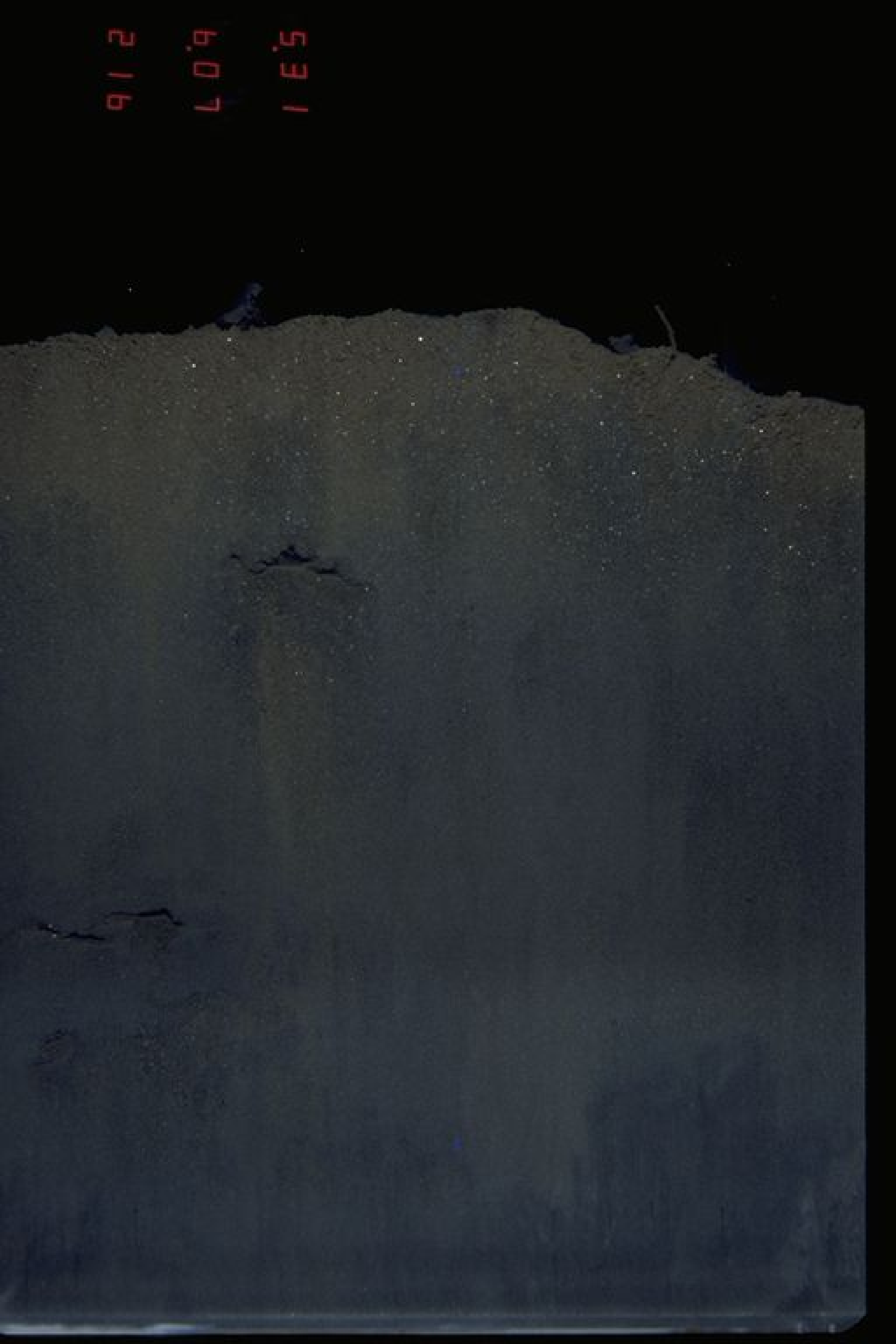


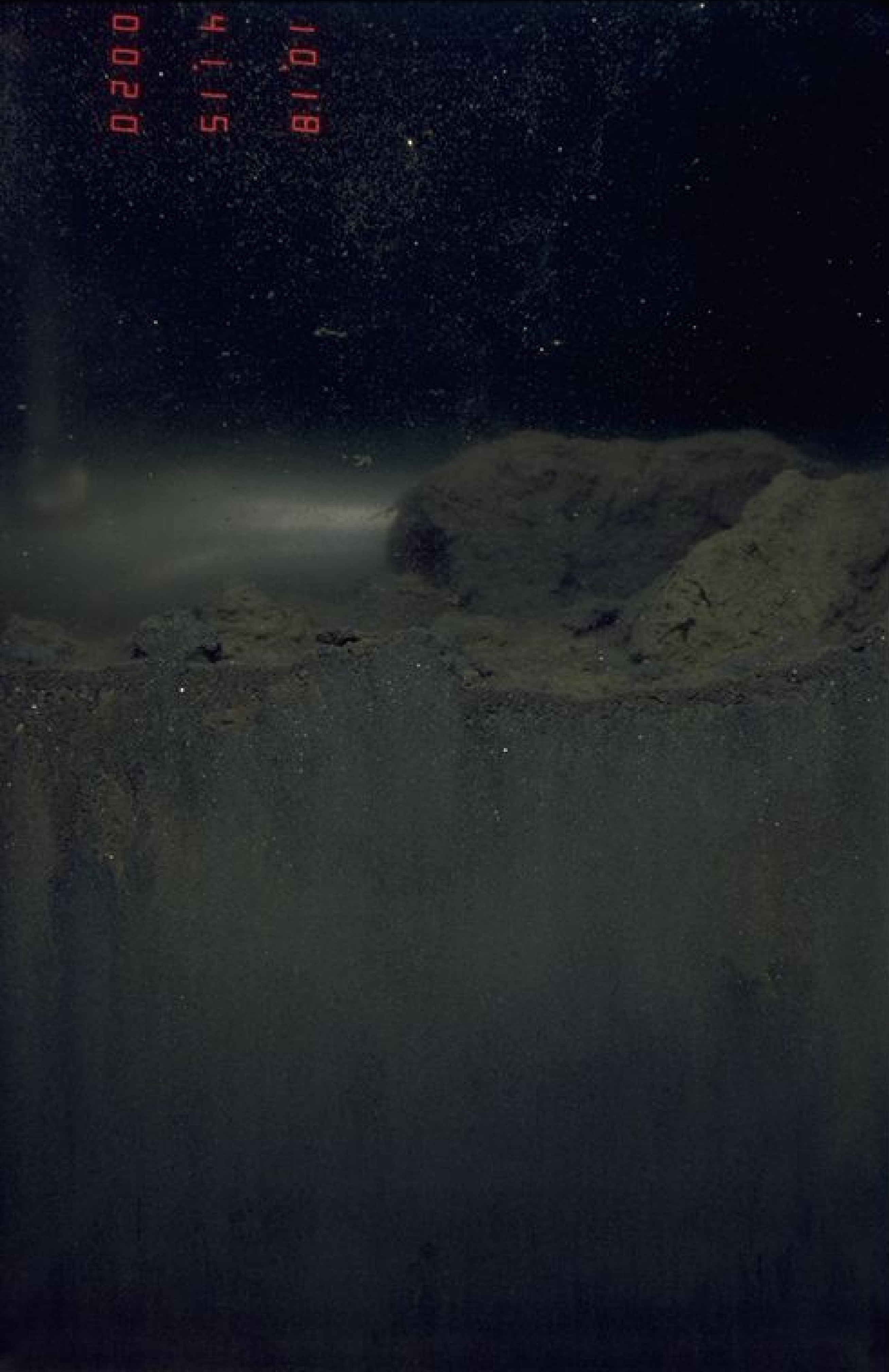


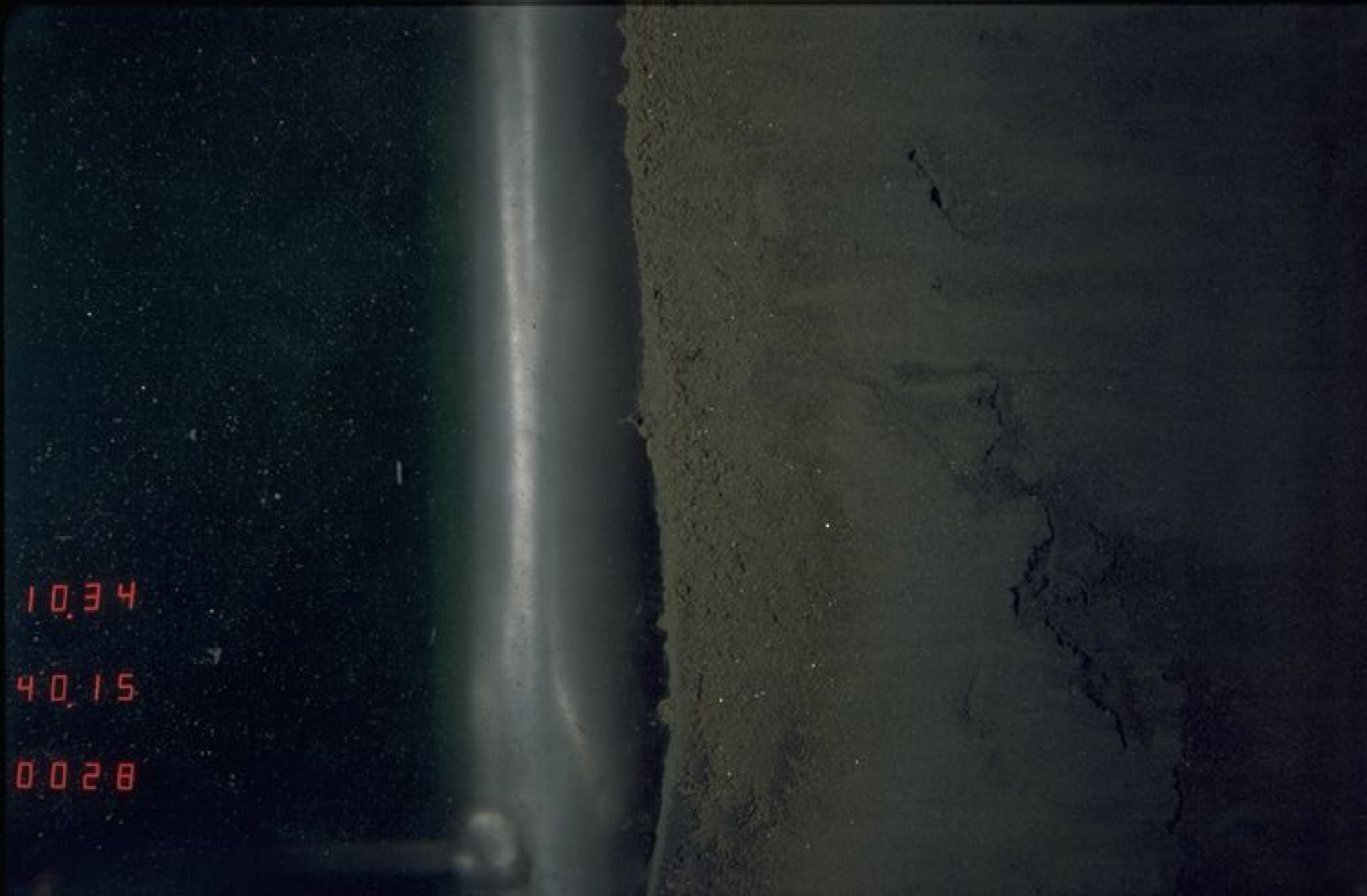

15.14
02.07
0198


15.50
35.07
0238


15.37
42.07
0222




1018
4115
0020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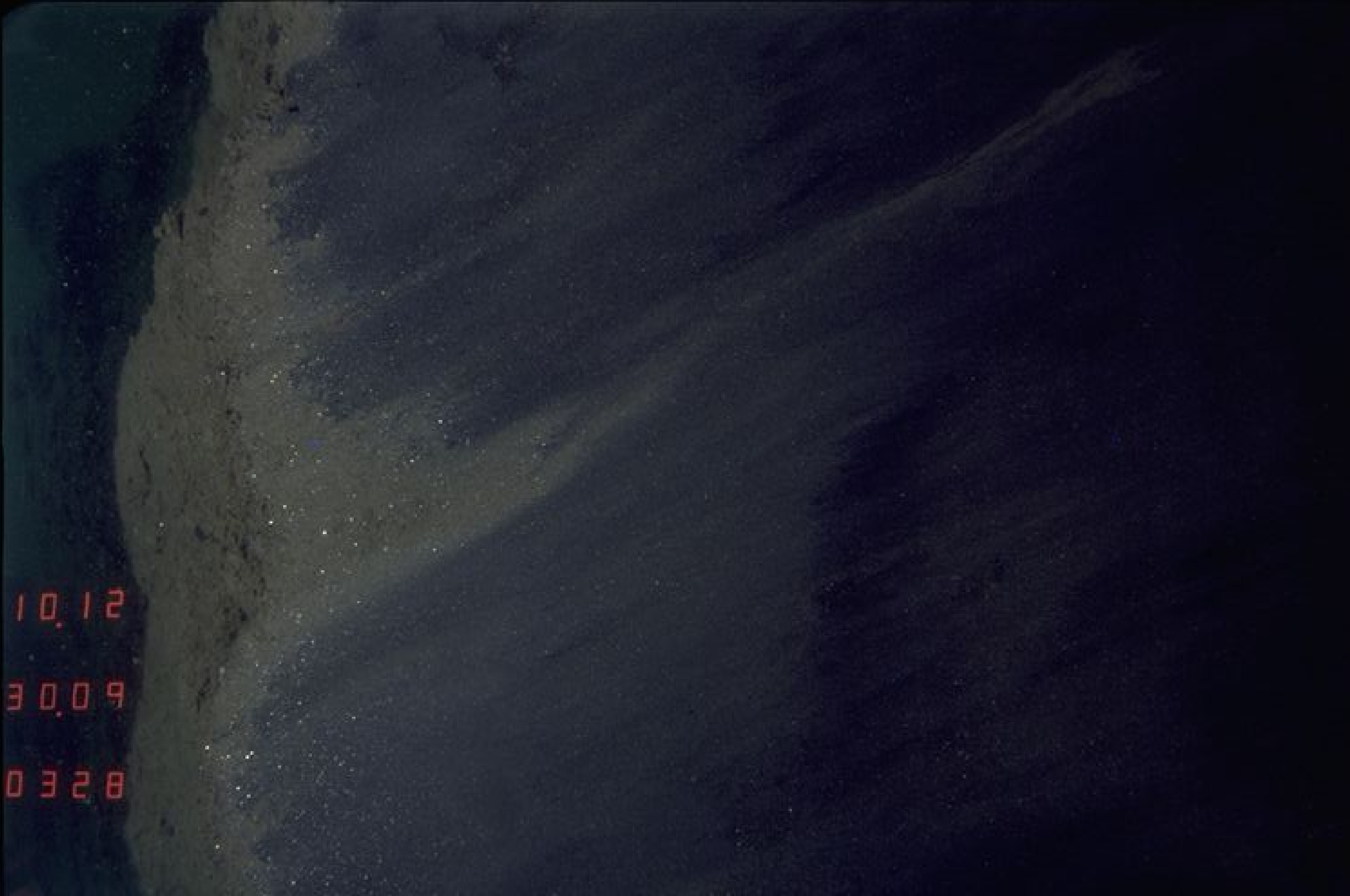
40.15
0028


10.37
11.15
0032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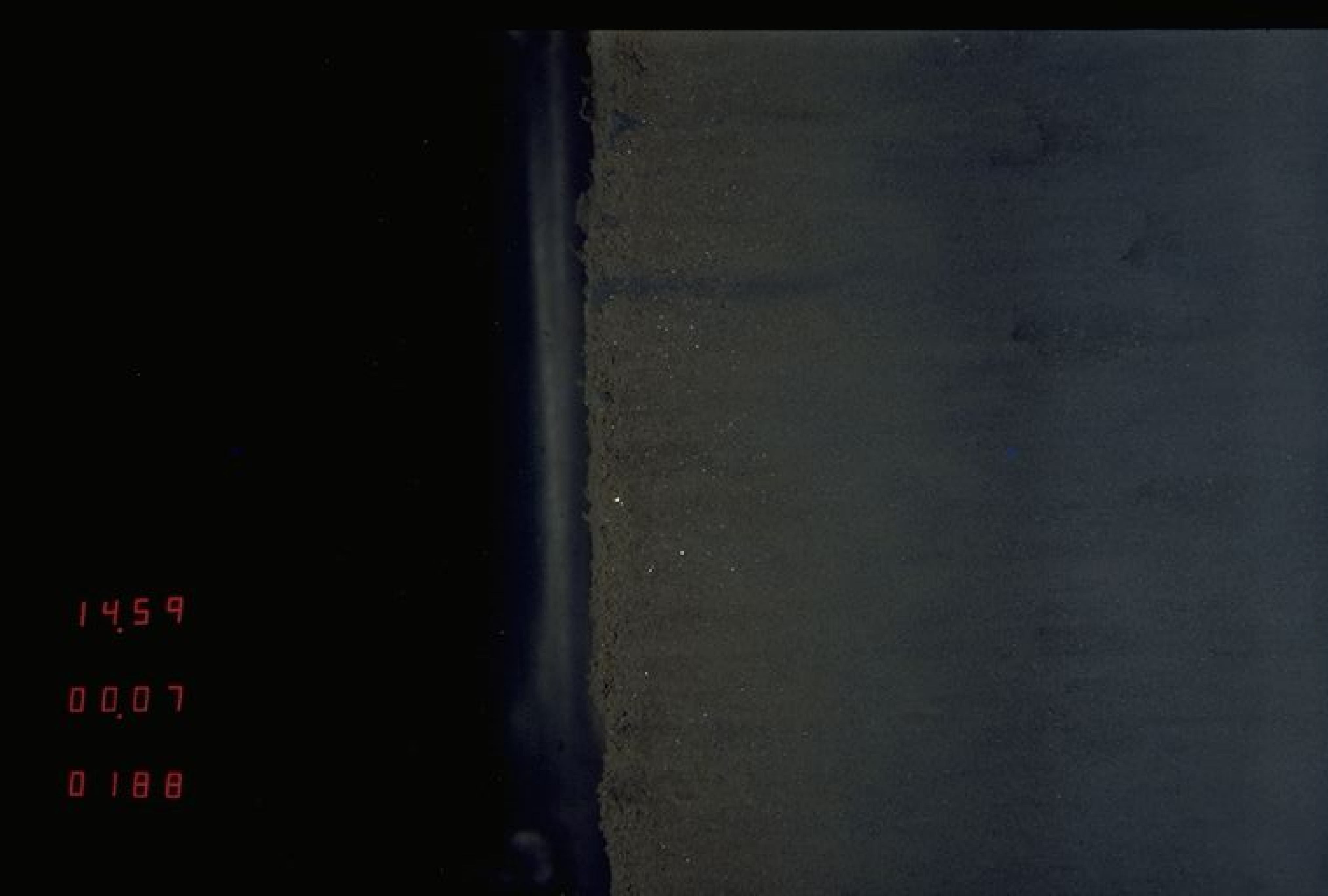
30.09
0328

14.15
18.07
0156

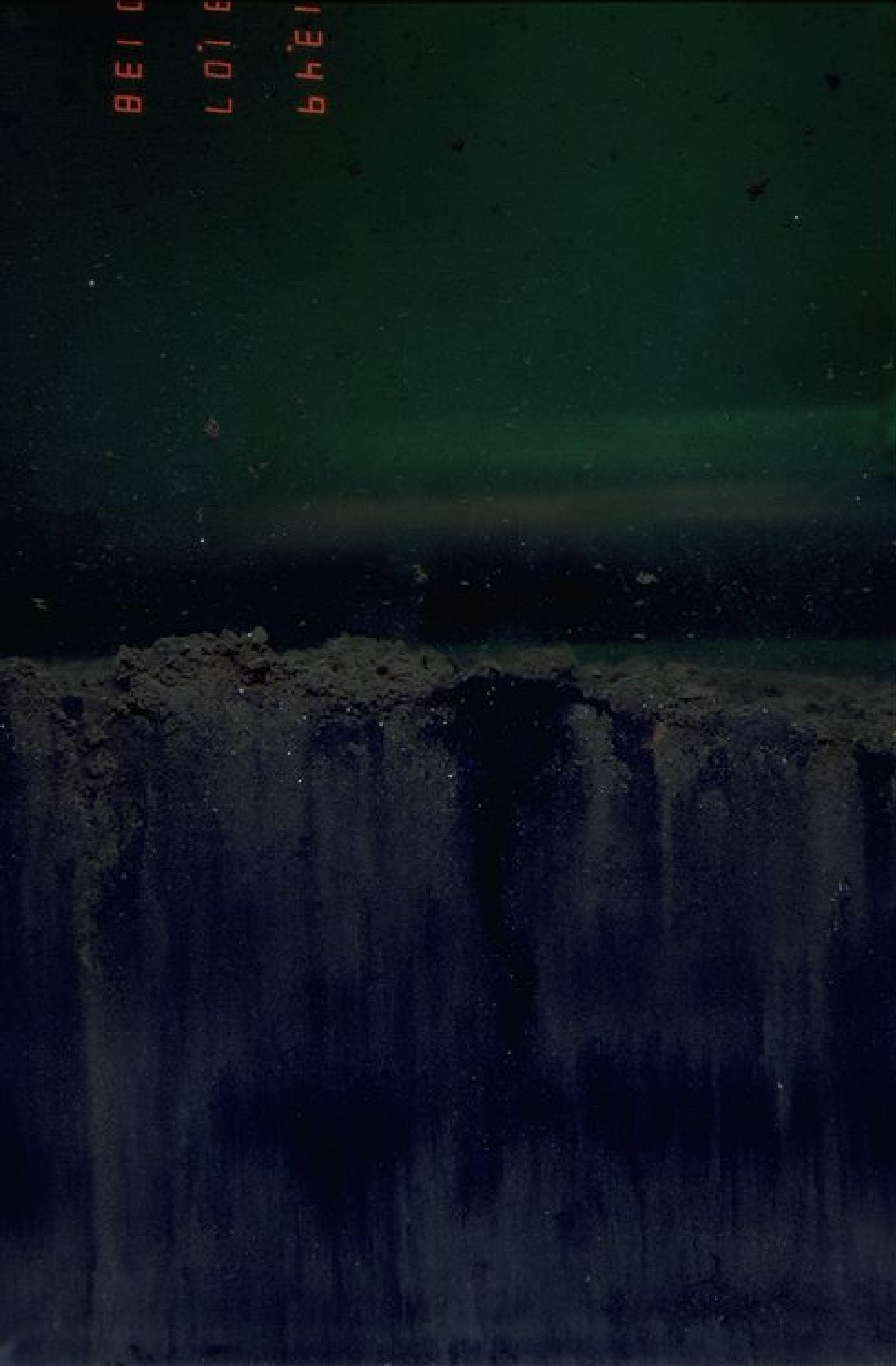
14.17
32.07
0158


14.22
29.07
0162

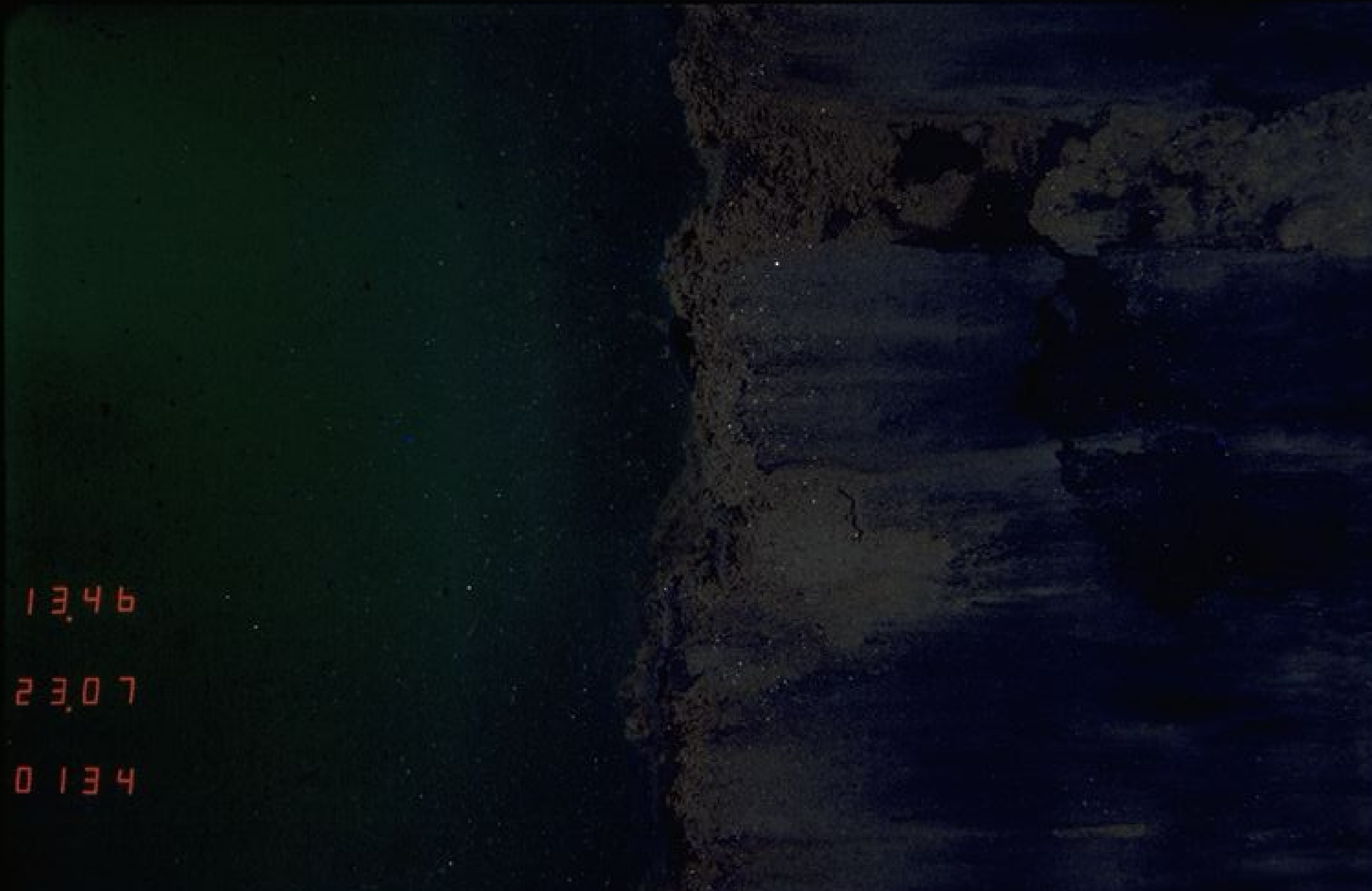

14.59
00.07
0188


15.04
13.07
0194

15.06
31.07
0196




13.40
47.07
0128



13.46
23.07
0134

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		SERIAL	NUMBER	: 054511	94
		HEADER	: Pris	m II	
		CYCLE :	ON FO	R 0 DA	YS, 0 HR, 2 MIN
			EVERY	0 DA	YS, 0 HR, 4 MIN
		AVERAGE	COUNT	: 60	
		CHANNEL	S AT A	VERAGE :	2 3
		TRUE AV	ERAGIN	G : Disab	led
		SRB COU	NT :	0	
		CHANNEL	S IN S	RB : 1	2 3
		FMT: 4			
		SENSITI	VITIES	: X =	249 Y = 251
		OFFSETS		: X =	1742 Y = 1782
		BATTERY	TYPE	: A	
		DATE I	NSTALL	ED :	2/5/2002
		Sample	Count	:	0
		DATE OF	DATA	BLOCK :	2/6/2002
		TIME OF	DATA	BLOCK :	16:00
		SAMPLES	IN BL	OCK :	22555
		S4 VERS	ION :	2.399	
		InterOc	ean Sy	stems, In	c. Model S4 Current Meter #05451194
		Prism I	I		File : 1194prsm.S4B
		Xoffset	: +0.	00 cm/s	Yoffset: +0.00 cm/s Mag.Var.: 13 deg
		Start:	2/06/	02 16:00:	00 End: 2/22/02 07:53:00 Samp: 1 to 22555
		-------	------	---------	--
		Speed	Dir	Hdg	Cond S-Temp Depth Tilt Salin Density SV
		(cm/s)	(deg)	(deg) (	mS/cm) (deg.C) (meters) (deg) (psu) (Kg/M^3) (M/s)
		-------	------	---------	--
16:00:30	2/6/2002 16:00:30	3.5	307	55	
16:01:00	2/6/2002 16:01:00	3.3	308	55	
16:01:30	2/6/2002 16:01:30	3.7	305	55	
16:02:00	2/6/2002 16:02:00	3.5	307	55	
16:04:30	2/5/2002 16:04:30	3	311	55	
16:05:00	2/6/2002 16:05:00	3.1	315	55	
16:05:30	2/6/2002 16:05:30	3.1	315	55	
16:06:00	2/6/2002 16:06:00	2.9	317	55	
		2.4	325	55	
		2.4	318	55	
		2.2	317	55	
		2.7	310	55	
		1.9	315	55	
		2.3	321	55	
		2.2	310	55	
		2.5	312	55	
		2.3	314	55	
		2.3	321	55	
		2.1	324	55	
		2.6	315	55	
		2.6	322	55	
		2.7	325	55	
		2.4	318	55	
		2.4	318	55	
		3.1	310	55	
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4.9	295	55

	InterO	cean Sy	stems, I	nc. Model S4 Current Meter
	SERIAL	NUMBER	: 04590	867
	HEADER	: Pris	m II	
	CYCLE	: ON FO	R 0 D	AYS, 0 HR, 2 MIN
		EVERY	0 D	AYS, 0 HR, 4 MIN
	AVERAG	E COUNT	: 240	
	CHANNE	LS AT A	VERAGE :	2 3
	TRUE A	VERAGIN	G : Disa	bled
	SRB CO	UNT :	0	
	CHANNE	LS IN S	RB : 1	2 3
	FMT: 0			
	SENSIT	IVITIES	: X =	256 Y = 256
	OFFSET	S	: X =	1762 Y = 1760
	BATTER	Y TYPE	: A	
	DATE	INSTALL	ED :	2/5/2002
	Sampl	e Count	:	0
	DATE O	F DATA	BLOCK :	2/6/2002
	TIME O	F DATA	BLOCK :	16:00
	SAMPLE	S IN BL	OCK :	4999
	S4 VER	SION :	2.24	

	InterO	cean Sy	stems, I	nc. Model S4 Current Meter #04590867
	Prism	II		File : 0867prsm.S4B
	Xoffse	t: +0.	00 cm/s	Yoffset: +0.00 cm/s Mag.Var.: 13 deg
	Start:	2/06/	02 16:00	:00 End: 2/20/02 13:12:00 Samp: 1 to 4999
	------	-------	--------	--
	Speed	Dir	Hdg	Cond S-Temp Depth Tilt Salin Density SV
	(cm/s)	(deg)	(deg)	(mS/cm) (deg.C) (meters) (deg) (psu) (Kg/M^3) (M/s)
	------	-------	--------	--
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2/6/2002 16:06:00	7.4	269	347	
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2/6/2002 16:22:00	7.6	285	348	
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2/6/2002 16:34:00	8.8	287	348	
2/6/2002 16:38:00	8.8	283	348	
2/6/2002 16:42:00	8.6	282	348	
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2/7/2002 15:54:00	4.8	266	346
2/7/2002 15:58:00	5.4	256	346
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2/20/2002 8:26:00	8	264	348
2/20/2002 8:30:00	8.2	269	348
2/20/2002 8:34:00	7.4	281	348
2/20/2002 8:38:00	8	280	348
2/20/2002 8:42:00	9	271	348
2/20/2002 8:46:00	8.5	268	348
2/20/2002 8:50:00	7.8	283	349
2/20/2002 8:54:00	8.9	274	348
2/20/2002 8:58:00	9.1	275	349
2/20/2002 9:02:00	8.9	275	348
2/20/2002 9:06:00	8.9	275	348
2/20/2002 9:10:00	8.4	284	348

Paleta Creek Flume Deployment, P04

Incipient or erosion rate experiment in San Diego Bay.

X-coord.= 32.67145N

Y-coord.= 117.12164W

Depth (ft) 34

Date 2/20/2002

Time 20:03:48

k	elptime	OBS	Temp	Power	speed	loading	Titlx	Titly	No	time	Total Elapse	Total Sus.
(s)	(v)	(F)	(v)	(p)	(p)	(v)	(v)				Time (min)	Solids (mg/L)
2	8	0.3535	58.4	14.4	0.4	0	2.688	2.317	50	20:05:26	0.00	107.3693
2	17	0.3524	58.5	14.4	0.4	0	2.688	2.317	50	20:05:35	0.15	107.0959
2	25	0.353	58.5	14.4	0.5	7	2.687	2.319	50	20:05:43	0.28	107.245
2	34	0.3508	58.5	14.4	2.2	32.6	2.687	2.318	50	20:05:52	0.43	106.6991
2	42	0.3478	58.5	14.4	4	28.5	2.688	2.318	50	20:06:00	0.57	105.958
2	50	0.3417	58.5	14.4	5.4	30.5	2.688	2.317	50	20:06:08	0.70	104.463
2	59	0.3478	58.5	14.4	6.9	28.4	2.689	2.316	50	20:06:17	0.85	105.958
2	67	0.3482	58.5	14.4	7.9	26.8	2.689	2.318	50	20:06:25	0.98	106.0566
2	75	0.3484	58.5	14.4	9.8	28.5	2.688	2.316	50	20:06:33	1.12	106.106
2	84	0.3478	58.5	14.4	11.2	26.6	2.689	2.318	50	20:06:42	1.27	105.958
2	92	0.3497	58.5	14.4	12.8	26.8	2.689	2.318	50	20:06:50	1.40	106.4269
2	100	0.343	58.5	14.4	14.3	27.7	2.688	2.317	50	20:06:58	1.53	104.7803
2	109	0.346	58.5	14.4	16	25.1	2.689	2.317	50	20:07:07	1.68	105.5152
2	117	0.3426	58.5	14.4	16.7	25.5	2.688	2.317	50	20:07:15	1.82	104.6826
2	127	0.342	58.5	14.4	18.6	27.1	2.688	2.317	50	20:07:25	1.98	104.5362
2	136	0.3424	58.5	14.4	20.8	25.6	2.688	2.317	50	20:07:34	2.13	104.6338
2	144	0.3442	58.5	14.4	21.9	26.5	2.688	2.317	50	20:07:42	2.27	105.0738
2	153	0.3432	58.5	14.4	24	24.8	2.687	2.318	50	20:07:51	2.42	104.8292
2	161	0.3463	58.5	14.4	24.6	24.8	2.689	2.318	50	20:07:59	2.55	105.5889
2	170	0.3468	58.5	14.4	24.9	25.2	2.689	2.318	50	20:08:08	2.70	105.7119
2	178	0.3452	58.4	14.4	25.4	27.1	2.69	2.318	50	20:08:16	2.83	105.3189
2	186	0.35	58.5	14.4	25.7	26.3	2.689	2.317	50	20:08:24	2.97	106.5011
2	195	0.3511	58.4	14.4	26.4	25.9	2.688	2.318	50	20:08:33	3.12	106.7734
2	203	0.3543	58.4	14.4	26.3	25.5	2.688	2.318	50	20:08:41	3.25	107.5685
2	211	0.3485	58.4	14.4	27.4	25.8	2.689	2.317	50	20:08:49	3.38	106.1306
2	220	0.3567	58.4	14.4	27.7	25.1	2.687	2.318	50	20:08:58	3.53	108.1677
2	228	0.3559	58.4	14.4	28.3	24.8	2.689	2.316	50	20:09:06	3.67	107.9677
2	237	0.3544	58.4	14.4	28.3	25.9	2.687	2.318	50	20:09:15	3.82	107.5934
2	245	0.3536	58.5	14.4	29.5	24.5	2.688	2.318	50	20:09:23	3.95	107.3942
2	253	0.3536	58.5	14.4	30	25.4	2.688	2.317	50	20:09:31	4.08	107.3942

2	262	0.3572	58.5	14.4	30.4	24.8	2.687	2.318	50	20:09:40	4.23	108.2928
2	270	0.3573	58.5	14.4	30.7	24.9	2.689	2.317	50	20:09:48	4.37	108.3178
2	279	0.3586	58.5	14.4	31.5	25	2.689	2.317	50	20:09:57	4.52	108.6437
2	288	0.3589	58.5	14.4	32	25.5	2.687	2.318	50	20:10:06	4.67	108.719
2	296	0.3652	58.5	14.4	32.2	25.1	2.687	2.317	50	20:10:14	4.80	110.3091
2	305	0.3652	58.5	14.4	33.1	25.3	2.69	2.318	50	20:10:23	4.95	110.3091
2	313	0.3656	58.5	14.4	33.4	25	2.689	2.317	50	20:10:31	5.08	110.4106
2	322	0.3716	58.5	14.4	33.5	25.4	2.689	2.317	50	20:10:40	5.23	111.9413
2	330	0.3698	58.5	14.4	33.2	24.8	2.687	2.317	50	20:10:48	5.37	111.4805
2	338	0.3808	58.5	14.4	33.4	25.5	2.688	2.318	50	20:10:56	5.50	114.3174
2	346	0.3825	58.5	14.4	33.1	26.2	2.688	2.317	50	20:11:04	5.63	114.7602
2	354	0.3782	58.4	14.4	33.3	24.4	2.688	2.318	50	20:11:12	5.77	113.6424
2	362	0.3832	58.5	14.4	33.5	24.3	2.688	2.316	50	20:11:20	5.90	114.9429
2	371	0.3873	58.4	14.4	33.7	25.6	2.688	2.318	50	20:11:29	6.05	116.017
2	379	0.3897	58.4	14.4	33.6	24.5	2.688	2.318	50	20:11:37	6.18	116.649
2	388	0.3969	58.4	14.4	33.2	25	2.687	2.318	50	20:11:46	6.33	118.5587
2	396	0.3933	58.4	14.4	33.6	25.1	2.689	2.317	50	20:11:54	6.47	117.6012
2	404	0.3936	58.5	14.4	33.6	24.7	2.689	2.317	50	20:12:02	6.60	117.6808
2	413	0.405	58.5	14.4	33.5	25.9	2.688	2.317	50	20:12:11	6.75	120.7322
2	421	0.3973	58.5	14.4	33.6	25.3	2.688	2.318	50	20:12:19	6.88	118.6654
2	429	0.4022	58.5	14.4	33.5	26.1	2.688	2.318	50	20:12:27	7.02	119.9779
2	437	0.4008	58.4	14.4	33.2	25.2	2.689	2.317	50	20:12:35	7.15	119.6019
2	446	0.4036	58.5	14.4	33.4	25.2	2.689	2.316	50	20:12:44	7.30	120.3547
2	455	0.3978	58.4	14.4	33.5	25.8	2.687	2.318	50	20:12:53	7.45	118.7989
2	463	0.3991	58.4	14.4	33.4	26	2.688	2.318	50	20:13:01	7.58	119.1465
2	471	0.4012	58.4	14.4	33.6	24.5	2.688	2.318	50	20:13:09	7.72	119.7093
2	479	0.4035	58.4	14.4	33.5	25.8	2.689	2.317	50	20:13:17	7.85	120.3277
2	488	0.4103	58.5	14.4	33.6	24.7	2.688	2.317	50	20:13:26	8.00	122.1686
2	497	0.4063	58.5	14.4	33.5	24.4	2.688	2.316	50	20:13:35	8.15	121.0835
2	506	0.4128	58.4	14.4	33.3	25.5	2.689	2.316	50	20:13:44	8.30	122.85
2	515	0.4059	58.4	14.4	33.4	25.5	2.689	2.317	50	20:13:53	8.45	120.9753
2	523	0.4137	58.5	14.4	33.5	25	2.691	2.317	50	20:14:01	8.58	123.0959
2	531	0.4064	58.4	14.4	33.3	25.1	2.687	2.318	50	20:14:09	8.72	121.1105
2	540	0.416	58.4	14.4	33.4	24.7	2.691	2.317	50	20:14:18	8.87	123.7258
2	548	0.4375	58.5	14.4	33.5	24.7	2.687	2.317	50	20:14:26	9.00	129.7147
2	556	0.4278	58.4	14.4	33.2	25	2.687	2.318	50	20:14:34	9.13	126.9904
2	565	0.4198	58.4	14.4	33.6	24.9	2.688	2.318	50	20:14:43	9.28	124.7711
2	572	0.4207	58.4	14.4	33.5	25.4	2.689	2.318	50	20:14:50	9.40	125.0195
2	581	0.4231	58.5	14.4	33.5	24.8	2.689	2.317	50	20:14:59	9.55	125.6835

2	590	0.4206	58.4	14.4	33.3	25	2.688	2.317	50	20:15:08	9.70	124.9919
2	598	0.4233	58.4	14.4	33.5	25.6	2.687	2.318	50	20:15:16	9.83	125.7389
2	606	0.4224	58.4	14.4	33.4	24.7	2.688	2.318	50	20:15:24	9.97	125.4896
2	615	0.4313	58.4	14.4	33.5	25.5	2.689	2.317	50	20:15:33	10.12	127.9692
2	623	0.4244	58.4	14.4	33.2	26.1	2.688	2.317	50	20:15:41	10.25	126.0441
2	631	0.4265	58.4	14.4	33.5	24.7	2.688	2.318	50	20:15:49	10.38	126.628
2	639	0.4198	58.4	14.4	33.7	25.6	2.689	2.318	50	20:15:57	10.52	124.7711
2	648	0.4234	58.4	14.4	33.3	25	2.689	2.318	50	20:16:06	10.67	125.7667
2	656	0.4243	58.4	14.4	33.6	25.3	2.69	2.317	50	20:16:14	10.80	126.0163
2	664	0.4225	58.4	14.4	33.2	24.9	2.689	2.318	50	20:16:22	10.93	125.5173
2	673	0.4427	58.4	14.4	33.7	24.3	2.69	2.316	50	20:16:31	11.08	131.1903
2	682	0.4479	58.4	14.4	33.1	25.8	2.687	2.317	50	20:16:40	11.23	132.6763
2	690	0.4422	58.4	14.4	33.2	25	2.689	2.317	50	20:16:48	11.37	131.0479
2	698	0.4376	58.4	14.4	33.2	25.1	2.688	2.318	50	20:16:56	11.50	129.743
2	707	0.4313	58.4	14.4	33.4	25.1	2.687	2.318	50	20:17:05	11.65	127.9692
2	716	0.439	58.4	14.4	33.2	24.8	2.688	2.318	50	20:17:14	11.80	130.1393
2	724	0.4409	58.4	14.4	33.5	24	2.69	2.317	50	20:17:22	11.93	130.6783
2	733	0.454	58.4	14.4	33.6	25.8	2.689	2.317	50	20:17:31	12.08	134.4327
2	741	0.453	58.4	14.4	33.4	25.2	2.688	2.318	50	20:17:39	12.22	134.1437
2	749	0.4539	58.4	14.4	33.3	25.5	2.689	2.318	50	20:17:47	12.35	134.4037
2	757	0.4491	58.5	14.4	33.6	24.8	2.689	2.317	50	20:17:55	12.48	133.0207
2	766	0.4381	58.4	14.4	33.3	24.3	2.689	2.319	50	20:18:04	12.63	129.8845
2	774	0.4439	58.4	14.4	33.3	26.3	2.688	2.318	50	20:18:12	12.77	131.5323
2	782	0.4435	58.4	14.4	33.5	24.5	2.688	2.317	50	20:18:20	12.90	131.4182
2	790	0.4384	58.4	14.4	33.5	25.6	2.688	2.318	50	20:18:28	13.03	129.9694
2	799	0.4355	58.4	14.4	33.4	24.6	2.689	2.318	50	20:18:37	13.18	129.15
2	807	0.4354	58.4	14.4	33.2	25.2	2.689	2.317	50	20:18:45	13.32	129.1218
2	816	0.4398	58.5	14.4	33.2	26.1	2.687	2.318	50	20:18:54	13.47	130.3661
2	824	0.4391	58.4	14.4	33.4	24	2.687	2.318	50	20:19:02	13.60	130.1676
2	832	0.4612	58.5	14.4	33.6	25.5	2.688	2.318	50	20:19:10	13.73	136.5241
2	842	0.4488	58.5	14.4	33.4	25.4	2.688	2.318	50	20:19:20	13.90	132.9345
2	850	0.4403	58.4	14.4	33	24.9	2.69	2.316	50	20:19:28	14.03	130.508
2	858	0.4337	58.4	14.4	33.4	25.2	2.687	2.32	50	20:19:36	14.17	128.6431
2	867	0.438	58.5	14.4	33.5	25.4	2.688	2.318	50	20:19:45	14.32	129.8562
2	875	0.4394	58.5	14.4	33.5	23.8	2.687	2.318	50	20:19:53	14.45	130.2527
2	884	0.4342	58.5	14.4	33.2	24.8	2.689	2.317	50	20:20:02	14.60	128.7838
2	892	0.4294	58.5	14.4	33.7	24.7	2.689	2.318	50	20:20:10	14.73	127.4372
2	900	0.4361	58.5	14.4	33.4	23.9	2.687	2.318	50	20:20:18	14.87	129.3193
2	908	0.4391	58.5	14.4	33.5	25.4	2.689	2.317	50	20:20:26	15.00	130.1676

2	917	0.4345	58.5	14.4	33.5	24.7	2.687	2.318	50	20:20:35	15.15	128.8682
2	925	0.4314	58.5	14.4	33.7	25.8	2.688	2.317	50	20:20:43	15.28	127.9972
2	933	0.4353	58.5	14.4	33.4	25.7	2.688	2.317	50	20:20:51	15.42	129.0936
2	942	0.4331	58.5	14.4	33.4	23.3	2.689	2.318	50	20:21:00	15.57	128.4744
2	950	0.4365	58.5	14.4	33.4	24.8	2.688	2.319	50	20:21:08	15.70	129.4322
2	959	0.4361	58.5	14.4	33.3	25.1	2.688	2.317	50	20:21:17	15.85	129.3193
2	968	0.4362	58.5	14.4	33.3	25.9	2.689	2.317	50	20:21:26	16.00	129.3475
2	976	0.4366	58.4	14.4	33.4	25.3	2.687	2.318	50	20:21:34	16.13	129.4604
2	984	0.4374	58.4	14.4	33.6	24.1	2.689	2.317	50	20:21:42	16.27	129.6865
2	992	0.4341	58.4	14.4	33.4	24.7	2.689	2.316	50	20:21:50	16.40	128.7556
2	1001	0.4321	58.4	14.4	33.3	25.3	2.687	2.319	50	20:21:59	16.55	128.1935
2	1010	0.4304	58.4	14.4	33.1	24.3	2.689	2.315	50	20:22:08	16.70	127.717
2	1018	0.4324	58.5	14.4	33.4	24.8	2.687	2.319	50	20:22:16	16.83	128.2778
2	1027	0.4279	58.4	14.4	33.6	25	2.688	2.317	50	20:22:25	16.98	127.0183
2	1035	0.4304	58.4	14.4	33.5	24	2.687	2.318	50	20:22:33	17.12	127.717
2	1043	0.4329	58.5	14.4	33	26.3	2.688	2.316	50	20:22:41	17.25	128.4182
2	1051	0.4299	58.5	14.4	33.3	24.2	2.689	2.316	50	20:22:49	17.38	127.5771
2	1059	0.4256	58.4	14.4	33.4	25.3	2.686	2.319	50	20:22:57	17.52	126.3776
2	1068	0.4236	58.4	14.4	33.3	24.8	2.689	2.316	50	20:23:06	17.67	125.8221
2	1077	0.4286	58.5	14.4	33.6	23.9	2.687	2.32	50	20:23:15	17.82	127.2137
2	1085	0.4279	58.4	14.4	33.2	25.5	2.688	2.318	50	20:23:23	17.95	127.0183
2	1094	0.4372	58.4	14.4	33.6	25.4	2.687	2.318	50	20:23:32	18.10	129.6299
2	1102	0.4353	58.4	14.4	33.2	24.6	2.686	2.318	50	20:23:40	18.23	129.0936
2	1111	0.4373	58.5	14.4	33.6	24.3	2.69	2.316	50	20:23:49	18.38	129.6582
2	1119	0.4327	58.4	14.4	33.2	24.1	2.688	2.319	50	20:23:57	18.52	128.362
2	1127	0.4384	58.4	14.4	33.2	24.6	2.688	2.318	50	20:24:05	18.65	129.9694
2	1135	0.4452	58.4	14.4	33.3	25.1	2.688	2.318	50	20:24:13	18.78	131.9034
2	1144	0.4652	58.5	14.4	33.4	23.9	2.689	2.317	50	20:24:22	18.93	137.6945
2	1152	0.4486	58.5	14.4	33.2	24.6	2.686	2.318	50	20:24:30	19.07	132.8771
2	1160	0.4356	58.5	14.4	33.5	24.7	2.688	2.317	50	20:24:38	19.20	129.1782
2	1168	0.4321	58.5	14.4	33.4	25.2	2.688	2.317	50	20:24:46	19.33	128.1935
2	1177	0.4443	58.4	14.4	34	25	2.687	2.317	50	20:24:55	19.48	131.6464
2	1185	0.4469	58.5	14.4	33.3	24.8	2.689	2.317	50	20:25:03	19.62	132.3897
2	1194	0.4459	58.4	14.4	33.2	24.9	2.689	2.317	50	20:25:12	19.77	132.1035
2	1202	0.4404	58.5	14.4	33.2	25	2.688	2.317	50	20:25:20	19.90	130.5363
2	1210	0.4365	58.5	14.4	33.3	25.1	2.689	2.315	50	20:25:28	20.03	129.4322
2	1218	0.4397	58.5	14.4	33.4	25.2	2.689	2.316	50	20:25:36	20.17	130.3377
2	1227	0.4354	58.4	14.4	33.5	23.5	2.687	2.318	50	20:25:45	20.32	129.1218
2	1235	0.4395	58.5	14.4	33.5	26.4	2.688	2.317	50	20:25:53	20.45	130.281

2	1243	0.4304	58.5	14.4	33.4	25.2	2.686	2.319	50	20:26:01	20.58	127.717
2	1252	0.4357	58.5	14.4	33.6	24.4	2.689	2.316	50	20:26:10	20.73	129.2064
2	1260	0.4338	58.5	14.4	32.9	25.4	2.687	2.318	50	20:26:18	20.87	128.6712
2	1269	0.4345	58.5	14.4	33.5	24.2	2.689	2.317	50	20:26:27	21.02	128.8682
2	1277	0.4364	58.4	14.4	33.4	25.2	2.687	2.318	50	20:26:35	21.15	129.4039
2	1285	0.4371	58.4	14.4	33.4	25.2	2.687	2.318	50	20:26:43	21.28	129.6017
2	1293	0.4316	58.4	14.4	33.4	24.8	2.688	2.317	50	20:26:51	21.42	128.0533
2	1302	0.4302	58.5	14.4	33.1	25.9	2.687	2.319	50	20:27:00	21.57	127.661
2	1311	0.4325	58.4	14.4	33.5	24.8	2.689	2.319	50	20:27:09	21.72	128.3058
2	1319	0.4395	58.4	14.4	33.2	24	2.688	2.317	50	20:27:17	21.85	130.281
2	1328	0.4333	58.4	14.4	33.4	25.1	2.689	2.317	50	20:27:26	22.00	128.5306
2	1337	0.4321	58.4	14.4	33.1	24.7	2.688	2.319	50	20:27:35	22.15	128.1935
2	1345	0.4432	58.4	14.4	33.6	24.6	2.688	2.317	50	20:27:43	22.28	131.3327
2	1355	0.438	58.4	14.4	33.5	24	2.688	2.318	50	20:27:53	22.45	129.8562
2	1363	0.4371	58.4	14.4	33.6	24.5	2.688	2.318	50	20:28:01	22.58	129.6017
2	1372	0.4385	58.4	14.4	33.3	24.8	2.688	2.317	50	20:28:10	22.73	129.9977
2	1380	0.4509	58.4	14.4	33.4	25.3	2.689	2.318	50	20:28:18	22.87	133.5383
2	1388	0.436	58.4	14.4	33.5	24.4	2.689	2.317	50	20:28:26	23.00	129.291
2	1397	0.4415	58.4	14.4	33.5	24.7	2.688	2.317	50	20:28:35	23.15	130.8488
2	1405	0.4354	58.4	14.4	33.4	24.7	2.687	2.318	50	20:28:43	23.28	129.1218
2	1413	0.4411	58.4	14.4	33.6	24.5	2.689	2.316	50	20:28:51	23.42	130.7352
2	1421	0.436	58.4	14.4	33.5	25.2	2.689	2.316	50	20:28:59	23.55	129.291
2	1430	0.4302	58.5	14.4	33.4	24.7	2.687	2.318	50	20:29:08	23.70	127.661
2	1438	0.4376	58.4	14.4	33.2	24.2	2.688	2.318	50	20:29:16	23.83	129.743
2	1447	0.434	58.4	14.4	33.5	25.6	2.688	2.317	50	20:29:25	23.98	128.7275
2	1455	0.4352	58.4	14.4	33.4	25	2.687	2.319	50	20:29:33	24.12	129.0654
2	1464	0.4359	58.4	14.4	33.7	24.5	2.687	2.318	50	20:29:42	24.27	129.2628
2	1472	0.4311	58.4	14.4	33.6	25.6	2.688	2.317	50	20:29:50	24.40	127.9131
2	1481	0.4282	58.4	14.4	33.2	24.6	2.688	2.316	50	20:29:59	24.55	127.102
2	1489	0.431	58.4	14.4	33.4	24.6	2.688	2.318	50	20:30:07	24.68	127.8851
2	1498	0.4255	58.4	14.4	33.4	25.1	2.688	2.318	50	20:30:16	24.83	126.3498
2	1506	0.4302	58.4	14.4	33.3	24.7	2.688	2.317	50	20:30:24	24.97	127.661
2	1514	0.4319	58.4	14.4	33.2	24.9	2.689	2.318	50	20:30:32	25.10	128.1374
2	1523	0.429	58.4	14.4	33.5	24.5	2.687	2.318	50	20:30:41	25.25	127.3254
2	1531	0.4319	58.4	14.4	33.4	24.3	2.69	2.316	50	20:30:49	25.38	128.1374
2	1540	0.424	58.4	14.4	33.4	25	2.688	2.317	50	20:30:58	25.53	125.9331
2	1550	0.4275	58.4	14.4	33.3	23.8	2.689	2.316	50	20:31:08	25.70	126.9067
2	1558	0.4261	58.4	14.4	33.4	25	2.689	2.316	50	20:31:16	25.83	126.5167
2	1567	0.4264	58.4	14.4	33.6	25.1	2.687	2.319	50	20:31:25	25.98	126.6002

2	1575	0.4263	58.4	14.4	33.3	25.5	2.689	2.316	50	20:31:33	26.12	126.5723
2	1584	0.4285	58.4	14.4	33.4	24.5	2.69	2.316	50	20:31:42	26.27	127.1857
2	1592	0.4265	58.4	14.4	33.6	24.7	2.688	2.318	50	20:31:50	26.40	126.628
2	1600	0.4257	58.4	14.4	33.2	24.6	2.688	2.32	50	20:31:58	26.53	126.4054
2	1608	0.4287	58.4	14.4	33.5	24.3	2.687	2.318	50	20:32:06	26.67	127.2416
2	1616	0.4237	58.4	14.4	33.4	24.6	2.688	2.316	50	20:32:14	26.80	125.8499
2	1624	0.4281	58.4	14.4	33.4	24.3	2.687	2.318	50	20:32:22	26.93	127.0741
2	1633	0.4293	58.4	14.4	33.3	25.7	2.689	2.316	50	20:32:31	27.08	127.4093
2	1641	0.423	58.4	14.4	33.2	24.8	2.689	2.318	50	20:32:39	27.22	125.6558
2	1649	0.4291	58.5	14.4	33.5	25.3	2.69	2.315	50	20:32:47	27.35	127.3533
2	1657	0.4173	58.4	14.4	33.4	24.9	2.688	2.319	50	20:32:55	27.48	124.0828
2	1665	0.4205	58.5	14.4	33	24.6	2.689	2.318	50	20:33:03	27.62	124.9643
2	1674	0.4177	58.5	14.4	33.6	24.9	2.69	2.316	50	20:33:12	27.77	124.1927
2	1682	0.4219	58.4	14.4	33.3	24.1	2.69	2.316	50	20:33:20	27.90	125.3512
2	1690	0.4178	58.4	14.4	33.4	24.8	2.687	2.319	50	20:33:28	28.03	124.2202
2	1698	0.4209	58.4	14.4	33.3	24.5	2.688	2.316	50	20:33:36	28.17	125.0748
2	1707	0.4151	58.5	14.4	33.6	24.2	2.687	2.318	50	20:33:45	28.32	123.4791
2	1715	0.4111	58.4	14.4	33.4	24.4	2.689	2.316	50	20:33:53	28.45	122.3864
2	1724	0.4196	58.4	14.4	33.1	24.9	2.688	2.317	50	20:34:02	28.60	124.716
2	1733	0.4109	58.4	14.4	33.5	24.4	2.688	2.316	50	20:34:11	28.75	122.3319
2	1741	0.4113	58.4	14.4	33.4	24.4	2.69	2.316	50	20:34:19	28.88	122.4408
2	1750	0.4176	58.4	14.4	33.3	24.7	2.688	2.316	50	20:34:28	29.03	124.1652
2	1758	0.4091	58.4	14.4	33.2	25	2.689	2.318	50	20:34:36	29.17	121.8424
2	1766	0.4141	58.5	14.4	33.5	25.4	2.689	2.316	50	20:34:44	29.30	123.2053
2	1774	0.4147	58.5	14.4	33.4	24.4	2.688	2.318	50	20:34:52	29.43	123.3695
2	1782	0.4154	58.5	14.4	33.7	24.9	2.687	2.318	50	20:35:00	29.57	123.5613
2	1791	0.4142	58.5	14.4	33.9	24.2	2.687	2.318	50	20:35:09	29.72	123.2327
2	1799	0.4088	58.4	14.4	33.3	25.5	2.688	2.316	50	20:35:17	29.85	121.7609
3	8	0.4111	58.5	14.4	33.4	24.9	2.688	2.317	50	20:35:26	30.00	122.3864
3	17	0.408	58.4	14.4	33.4	24.2	2.688	2.317	50	20:35:35	30.15	121.5439
3	25	0.4105	58.5	14.4	33.4	25.3	2.686	2.318	50	20:35:43	30.28	122.223
3	33	0.3996	58.5	14.4	34.2	25.1	2.688	2.317	50	20:35:51	30.42	119.2803
3	42	0.4027	58.5	14.4	34.5	23.6	2.687	2.319	50	20:36:00	30.57	120.1124
3	50	0.4076	58.5	14.4	34	24.5	2.688	2.317	50	20:36:08	30.70	121.4354
3	58	0.4084	58.4	14.4	35.3	24.2	2.689	2.317	50	20:36:16	30.83	121.6524
3	67	0.4137	58.5	14.4	35.5	24.6	2.687	2.317	50	20:36:25	30.98	123.0959
3	75	0.4102	58.5	14.4	35.8	25	2.688	2.317	50	20:36:33	31.12	122.1414
3	83	0.4092	58.5	14.4	35.9	24.8	2.688	2.317	50	20:36:41	31.25	121.8695
3	91	0.4123	58.5	14.4	36.1	25.1	2.687	2.318	50	20:36:49	31.38	122.7135

3	100	0.4098	58.5	14.4	36.4	24.8	2.688	2.318	50	20:36:58	31.53	122.0326
3	108	0.404	58.5	14.4	36.4	25.6	2.687	2.319	50	20:37:06	31.67	120.4625
3	117	0.4112	58.5	14.4	37.6	25.1	2.689	2.316	50	20:37:15	31.82	122.4136
3	126	0.4281	58.5	14.4	37.3	24.6	2.69	2.316	50	20:37:24	31.97	127.0741
3	134	0.4348	58.5	14.4	37.3	24.9	2.688	2.316	50	20:37:32	32.10	128.9527
3	142	0.4343	58.4	14.4	38.3	24.2	2.687	2.318	50	20:37:40	32.23	128.8119
3	150	0.4287	58.4	14.4	38.1	25.5	2.688	2.318	50	20:37:48	32.37	127.2416
3	159	0.4511	58.4	14.4	38.4	25	2.687	2.318	50	20:37:57	32.52	133.5959
3	167	0.4716	58.5	14.4	38.4	25.4	2.688	2.317	50	20:38:05	32.65	139.5797
3	176	0.4793	58.4	14.4	38.2	25.2	2.689	2.318	50	20:38:14	32.80	141.8683
3	185	0.4649	58.4	14.4	38.9	24.5	2.688	2.317	50	20:38:23	32.95	137.6065
3	193	0.4698	58.5	14.4	39.5	25.1	2.689	2.316	50	20:38:31	33.08	139.0479
3	202	0.4799	58.5	14.4	39.2	25.4	2.688	2.318	50	20:38:40	33.23	142.0476
3	210	0.4854	58.5	14.4	39.6	24.7	2.689	2.317	50	20:38:48	33.37	143.6971
3	218	0.4923	58.4	14.4	39.4	24.9	2.688	2.317	50	20:38:56	33.50	145.7824
3	227	0.4934	58.5	14.4	39.5	25.2	2.687	2.319	50	20:39:05	33.65	146.1165
3	236	0.5037	58.4	14.4	39.4	24.4	2.688	2.316	50	20:39:14	33.80	149.2663
3	244	0.5116	58.4	14.4	39.3	24.4	2.689	2.316	50	20:39:22	33.93	151.7085
3	252	0.5125	58.4	14.4	39.5	25.3	2.688	2.317	50	20:39:30	34.07	151.9881
3	260	0.5269	58.5	14.4	39.5	25.1	2.687	2.317	50	20:39:38	34.20	156.5028
3	268	0.5119	58.5	14.4	40.1	24.8	2.689	2.317	50	20:39:46	34.33	151.8017
3	277	0.5236	58.5	14.4	40.3	25.4	2.688	2.316	50	20:39:55	34.48	155.4616
3	285	0.5353	58.4	14.4	40.4	24.6	2.687	2.319	50	20:40:03	34.62	159.1709
3	293	0.5405	58.5	14.4	40.3	25	2.689	2.317	50	20:40:11	34.75	160.8353
3	301	0.5808	58.5	14.4	40.2	24.8	2.688	2.317	50	20:40:19	34.88	174.0578
3	310	0.5705	58.5	14.4	40.2	25.3	2.688	2.317	50	20:40:28	35.03	170.6242
3	318	0.5789	58.5	14.4	39.9	26.2	2.689	2.316	50	20:40:36	35.17	173.4217
3	326	0.5617	58.5	14.4	40.5	25.7	2.689	2.317	50	20:40:44	35.30	167.72
3	335	0.5765	58.5	14.4	40	24.7	2.688	2.319	50	20:40:53	35.45	172.6199
3	343	0.563	58.5	14.4	40.3	25.5	2.689	2.317	50	20:41:01	35.58	168.1473
3	351	0.5778	58.4	14.4	40	24.7	2.687	2.317	50	20:41:09	35.72	173.0539
3	360	0.6058	58.5	14.4	40	25.4	2.688	2.317	50	20:41:18	35.87	182.544
3	369	0.5933	58.5	14.4	40.4	25.1	2.689	2.317	50	20:41:27	36.02	178.2741
3	377	0.5969	58.5	14.4	40.1	25.5	2.689	2.316	50	20:41:35	36.15	179.4984
3	386	0.5998	58.5	14.4	40.5	24.8	2.689	2.318	50	20:41:44	36.30	180.4878
3	394	0.5929	58.5	14.4	40.7	24.9	2.689	2.318	50	20:41:52	36.43	178.1383
3	402	0.6158	58.5	14.4	40	25.3	2.69	2.316	50	20:42:00	36.57	185.9983
3	410	0.614	58.5	14.4	40.4	25.4	2.688	2.318	50	20:42:08	36.70	185.374
3	418	0.6183	58.5	14.4	40.4	25	2.687	2.319	50	20:42:16	36.83	186.8672

3	426	0.6025	58.5	14.4	40.3	25	2.689	2.317	50	20:42:24	36.97	181.4116
3	435	0.6039	58.5	14.4	40.5	24.5	2.687	2.318	50	20:42:33	37.12	181.8916
3	444	0.6122	58.5	14.4	40.6	24.3	2.689	2.318	50	20:42:42	37.27	184.7508
3	453	0.6028	58.5	14.4	40.7	24.2	2.688	2.317	50	20:42:51	37.42	181.5144
3	462	0.596	58.5	14.4	40.5	24.7	2.688	2.318	50	20:43:00	37.57	179.1919
3	470	0.5978	58.5	14.4	40.5	25	2.691	2.317	50	20:43:08	37.70	179.8051
3	479	0.6272	58.5	14.4	40.4	25	2.688	2.317	50	20:43:17	37.85	189.9774
3	487	0.6145	58.5	14.4	40.6	25.2	2.688	2.318	50	20:43:25	37.98	185.5473
3	496	0.6086	58.5	14.4	40.3	24.8	2.688	2.318	50	20:43:34	38.13	183.5078
3	504	0.6196	58.5	14.4	40.2	25.2	2.688	2.317	50	20:43:42	38.27	187.3198
3	512	0.6344	58.5	14.4	40.2	24.7	2.689	2.317	50	20:43:50	38.40	192.513
3	521	0.6104	58.5	14.4	40.4	25.6	2.688	2.317	50	20:43:59	38.55	184.1288
3	530	0.6211	58.5	14.4	40.4	25	2.688	2.317	50	20:44:08	38.70	187.8428
3	538	0.6375	58.5	14.4	40.2	25.1	2.689	2.318	50	20:44:16	38.83	193.6101
3	546	0.6712	58.5	14.4	40.3	25.7	2.689	2.317	50	20:44:24	38.97	205.7418
3	556	0.6255	58.5	14.4	40.3	25.4	2.687	2.318	50	20:44:34	39.13	189.3812
3	564	0.612	58.4	14.4	40.2	25.8	2.688	2.317	50	20:44:42	39.27	184.6817
3	573	0.6275	58.5	14.4	40.5	26.4	2.688	2.317	50	20:44:51	39.42	190.0827
3	581	0.6247	58.5	14.4	40.3	25.4	2.689	2.317	50	20:44:59	39.55	189.101
3	589	0.6146	58.5	14.4	40.3	25.4	2.689	2.316	50	20:45:07	39.68	185.582
3	599	0.632	58.5	14.4	40.6	25.3	2.687	2.318	50	20:45:17	39.85	191.6659
3	607	0.6494	58.5	14.4	40.2	25.9	2.688	2.317	50	20:45:25	39.98	197.8511
3	616	0.6535	58.5	14.4	40.4	25.4	2.689	2.316	50	20:45:34	40.13	199.3232
3	624	0.6585	58.5	14.4	40.8	24.8	2.689	2.316	50	20:45:42	40.27	201.1259
3	632	0.6362	58.5	14.4	40.2	25.2	2.687	2.318	50	20:45:50	40.40	193.1496
3	640	0.6332	58.5	14.4	40.6	26	2.689	2.317	50	20:45:58	40.53	192.0892
3	648	0.6295	58.5	14.4	40.1	26	2.689	2.317	50	20:46:06	40.67	190.7855
3	656	0.6318	58.5	14.4	40.6	25.1	2.688	2.318	50	20:46:14	40.80	191.5954
3	664	0.6261	58.5	14.4	40.3	24.9	2.689	2.317	50	20:46:22	40.93	189.5915
3	673	0.639	58.5	14.4	40.3	25.5	2.688	2.317	50	20:46:31	41.08	194.1421
3	681	0.6294	58.5	14.4	39.8	25	2.688	2.318	50	20:46:39	41.22	190.7503
3	690	0.634	58.5	14.4	40.7	25.1	2.689	2.316	50	20:46:48	41.37	192.3717
3	699	0.6248	58.5	14.4	40.3	24.8	2.688	2.317	50	20:46:57	41.52	189.1361
3	707	0.6431	58.5	14.4	40.1	25.1	2.689	2.318	50	20:47:05	41.65	195.6
3	715	0.6344	58.5	14.4	40.4	25	2.688	2.319	50	20:47:13	41.78	192.513
3	724	0.6331	58.5	14.4	40.8	23.9	2.688	2.318	50	20:47:22	41.93	192.0539
3	733	0.6202	58.5	14.4	40.5	24.6	2.688	2.317	50	20:47:31	42.08	187.5289
3	741	0.6221	58.5	14.4	40.2	24.4	2.688	2.317	50	20:47:39	42.22	188.1919
3	750	0.6268	58.5	14.4	40.4	24.6	2.688	2.316	50	20:47:48	42.37	189.837

3	759	0.6185	58.5	14.4	40.2	25.2	2.688	2.316	50	20:47:57	42.52	186.9368
3	767	0.6142	58.5	14.4	40.1	25	2.688	2.316	50	20:48:05	42.65	185.4433
3	775	0.6128	58.5	14.4	40.3	24.6	2.69	2.317	50	20:48:13	42.78	184.9585
3	783	0.6171	58.5	14.4	40.5	25.3	2.688	2.317	50	20:48:21	42.92	186.4498
3	791	0.611	58.5	14.4	40.5	25.1	2.688	2.316	50	20:48:29	43.05	184.336
3	799	0.6102	58.5	14.4	40.4	25.8	2.689	2.317	50	20:48:37	43.18	184.0597
3	807	0.6113	58.5	14.4	40.5	25.5	2.687	2.317	50	20:48:45	43.32	184.4397
3	816	0.6038	58.5	14.4	40.5	24.5	2.687	2.317	50	20:48:54	43.47	181.8573
3	824	0.6139	58.5	14.4	40.3	24.8	2.689	2.317	50	20:49:02	43.60	185.3394
3	832	0.6114	58.5	14.4	40.4	24.8	2.689	2.317	50	20:49:10	43.73	184.4742
3	841	0.6137	58.5	14.4	40.3	25	2.688	2.317	50	20:49:19	43.88	185.2701
3	849	0.6108	58.5	14.4	40.3	25.4	2.687	2.318	50	20:49:27	44.02	184.2669
3	858	0.6204	58.5	14.4	40.8	24.7	2.689	2.316	50	20:49:36	44.17	187.5986
3	866	0.6087	58.5	14.4	39.9	24.5	2.688	2.317	50	20:49:44	44.30	183.5423
3	874	0.6109	58.5	14.4	39.9	26.2	2.689	2.318	50	20:49:52	44.43	184.3015
3	882	0.6076	58.5	14.4	40.3	25.4	2.687	2.317	50	20:50:00	44.57	183.1633
3	891	0.6217	58.5	14.4	40.3	25.2	2.688	2.317	50	20:50:09	44.72	188.0522
3	900	0.6144	58.5	14.4	40.4	25.8	2.687	2.317	50	20:50:18	44.87	185.5127
3	908	0.617	58.5	14.4	40.4	25.4	2.689	2.317	50	20:50:26	45.00	186.4151
3	916	0.601	58.5	14.4	40.3	25.4	2.687	2.317	50	20:50:34	45.13	180.8981
3	924	0.5977	58.5	14.4	40.1	24.9	2.687	2.317	50	20:50:42	45.27	179.771
3	932	0.6055	58.5	14.4	40.5	25.5	2.689	2.317	50	20:50:50	45.40	182.4409
3	942	0.6045	58.5	14.4	40.3	25.9	2.688	2.317	50	20:51:00	45.57	182.0975
3	950	0.6171	58.5	14.4	40.4	25.6	2.689	2.316	50	20:51:08	45.70	186.4498
3	959	0.6037	58.5	14.4	40.6	25.2	2.69	2.317	50	20:51:17	45.85	181.8229
3	967	0.5948	58.5	14.4	40.3	24.8	2.687	2.318	50	20:51:25	45.98	178.7837
3	975	0.5922	58.5	14.4	40.1	25.4	2.689	2.316	50	20:51:33	46.12	177.9009
3	983	0.5884	58.5	14.4	40	25.4	2.689	2.317	50	20:51:41	46.25	176.6149
3	991	0.5917	58.5	14.4	39.8	25.9	2.689	2.317	50	20:51:49	46.38	177.7314
3	999	0.5827	58.5	14.4	40.5	25	2.691	2.316	50	20:51:57	46.52	174.6952
3	1008	0.5998	58.5	14.4	40.4	25.9	2.687	2.317	50	20:52:06	46.67	180.4878
3	1017	0.5914	58.5	14.4	40.3	25.2	2.688	2.317	50	20:52:15	46.82	177.6298
3	1025	0.5852	58.5	14.4	40	25.7	2.689	2.317	50	20:52:23	46.95	175.5358
3	1033	0.6103	58.5	14.4	40.1	25.4	2.69	2.316	50	20:52:31	47.08	184.0942
3	1041	0.6152	58.5	14.4	40.1	25.3	2.689	2.316	50	20:52:39	47.22	185.7901
3	1050	0.5888	58.5	14.4	40.3	25.6	2.688	2.317	50	20:52:48	47.37	176.75
3	1058	0.5805	58.5	14.4	40.3	25.7	2.688	2.318	50	20:52:56	47.50	173.9573
3	1066	0.5856	58.5	14.4	40.3	25.7	2.689	2.317	50	20:53:04	47.63	175.6705
3	1075	0.5876	58.5	14.4	40.6	25.3	2.69	2.316	50	20:53:13	47.78	176.3448

3	1083	0.5875	58.5	14.4	41	24.8	2.689	2.316	50	20:53:21	47.92	176.311
3	1091	0.583	58.5	14.4	40.3	24.8	2.688	2.319	50	20:53:29	48.05	174.796
3	1100	0.5831	58.5	14.4	40.1	25	2.688	2.317	50	20:53:38	48.20	174.8296
3	1108	0.5744	58.5	14.4	40.4	25.3	2.689	2.317	50	20:53:46	48.33	171.92
3	1117	0.5873	58.5	14.4	40.7	25	2.688	2.317	50	20:53:55	48.48	176.2436
3	1125	0.5771	58.5	14.4	40.2	25.1	2.689	2.315	50	20:54:03	48.62	172.8201
3	1133	0.5715	58.5	14.4	40	25.3	2.688	2.317	50	20:54:11	48.75	170.956
3	1141	0.5717	58.5	14.4	40.4	25.3	2.687	2.316	50	20:54:19	48.88	171.0223
3	1149	0.5781	58.5	14.4	40.4	24.8	2.69	2.317	50	20:54:27	49.02	173.1542
3	1158	0.5782	58.5	14.4	39.8	25.3	2.692	2.315	50	20:54:36	49.17	173.1876
3	1167	0.5803	58.5	14.4	40.7	25.1	2.687	2.317	50	20:54:45	49.32	173.8903
3	1175	0.5788	58.5	14.4	40.2	25.7	2.686	2.318	50	20:54:53	49.45	173.3882
3	1183	0.5802	58.5	14.4	40.3	25.3	2.689	2.317	50	20:55:01	49.58	173.8568
3	1192	0.567	58.5	14.4	40.5	24.8	2.688	2.317	50	20:55:10	49.73	169.4659
3	1200	0.5756	58.5	14.4	40.5	25.7	2.686	2.318	50	20:55:18	49.87	172.3197
3	1209	0.5708	58.5	14.4	40.4	25.3	2.688	2.317	50	20:55:27	50.02	170.7237
3	1217	0.5806	58.5	14.4	40.2	25.5	2.689	2.316	50	20:55:35	50.15	173.9908
3	1226	0.5765	58.5	14.4	39.8	25.1	2.689	2.318	50	20:55:44	50.30	172.6199
3	1234	0.5723	58.5	14.4	40.7	25.2	2.688	2.318	50	20:55:52	50.43	171.2216
3	1243	0.5669	58.5	14.4	40.5	25.4	2.689	2.317	50	20:56:01	50.58	169.4328
3	1251	0.5644	58.5	14.4	40.7	24.7	2.686	2.318	50	20:56:09	50.72	168.6082
3	1259	0.5592	58.5	14.4	40.1	25.8	2.687	2.317	50	20:56:17	50.85	166.8998
3	1268	0.5612	58.5	14.4	40	24.9	2.688	2.318	50	20:56:26	51.00	167.5558
3	1276	0.5588	58.5	14.4	40.2	24.9	2.689	2.319	50	20:56:34	51.13	166.7688
3	1284	0.5568	58.5	14.4	40.4	25.4	2.687	2.319	50	20:56:42	51.27	166.1146
3	1293	0.5634	58.5	14.4	40.3	25	2.689	2.316	50	20:56:51	51.42	168.2789
3	1301	0.5623	58.5	14.4	40.6	25	2.688	2.317	50	20:56:59	51.55	167.9171
3	1309	0.5554	58.6	14.4	40.5	25.6	2.689	2.314	50	20:57:07	51.68	165.6575
3	1317	0.5562	58.5	14.4	40.5	25.7	2.687	2.319	50	20:57:15	51.82	165.9186
3	1326	0.5584	58.5	14.4	40.2	24.3	2.691	2.316	50	20:57:24	51.97	166.6379
3	1335	0.565	58.5	14.4	40.1	25.5	2.689	2.316	50	20:57:33	52.12	168.8059
3	1343	0.5598	58.5	14.4	40.6	25.3	2.688	2.318	50	20:57:41	52.25	167.0965
3	1351	0.5673	58.5	14.4	40.5	24.8	2.689	2.316	50	20:57:49	52.38	169.565
3	1360	0.5517	58.5	14.4	40.6	25.5	2.687	2.319	50	20:57:58	52.53	164.4527
3	1368	0.5674	58.5	14.4	40.1	25.6	2.688	2.318	50	20:58:06	52.67	169.598
3	1377	0.569	58.5	14.4	40.6	25	2.688	2.317	50	20:58:15	52.82	170.1273
3	1385	0.5631	58.5	14.4	40.4	25.6	2.689	2.317	50	20:58:23	52.95	168.1802
3	1393	0.5781	58.5	14.4	40.7	25.3	2.688	2.317	50	20:58:31	53.08	173.1542
3	1401	0.5623	58.5	14.4	39.9	25	2.689	2.317	50	20:58:39	53.22	167.9171

3	1409	0.5659	58.5	14.4	40.4	25.3	2.688	2.316	50	20:58:47	53.35	169.1027
3	1418	0.5717	58.5	14.4	40.3	24.8	2.687	2.319	50	20:58:56	53.50	171.0223
3	1426	0.5716	58.5	14.4	40.6	24.8	2.69	2.316	50	20:59:04	53.63	170.9892
3	1434	0.5746	58.5	14.4	40.1	25.2	2.688	2.316	50	20:59:12	53.77	171.9866
3	1443	0.5624	58.5	14.4	40.5	25.7	2.688	2.318	50	20:59:21	53.92	167.95
3	1451	0.568	58.5	14.4	40.2	25	2.69	2.315	50	20:59:29	54.05	169.7964
3	1460	0.5571	58.5	14.4	40.3	24.8	2.688	2.318	50	20:59:38	54.20	166.2126
3	1468	0.5553	58.5	14.4	40.4	25.1	2.689	2.316	50	20:59:46	54.33	165.6248
3	1477	0.5541	58.5	14.4	40.2	25	2.688	2.317	50	20:59:55	54.48	165.2336
3	1486	0.5601	58.5	14.4	40.3	25.9	2.689	2.317	50	21:00:04	54.63	167.1948
3	1494	0.5538	58.5	14.4	40.3	25.2	2.687	2.316	50	21:00:12	54.77	165.1359
3	1502	0.553	58.5	14.4	40.2	26.3	2.686	2.319	50	21:00:20	54.90	164.8754
3	1510	0.5502	58.5	14.4	40.3	25.1	2.689	2.317	50	21:00:28	55.03	163.9656
3	1519	0.5442	58.5	14.4	40.4	25.7	2.689	2.316	50	21:00:37	55.18	162.0254
3	1527	0.5511	58.6	14.4	40.4	25.4	2.687	2.319	50	21:00:45	55.32	164.2577
3	1535	0.5492	58.6	14.4	40.7	25.1	2.687	2.317	50	21:00:53	55.45	163.6414
3	1545	0.543	58.5	14.4	40.4	24.6	2.688	2.318	50	21:01:03	55.62	161.6389
3	1553	0.5434	58.6	14.4	40.1	25.3	2.689	2.316	50	21:01:11	55.75	161.7676
3	1562	0.5367	58.6	14.4	40.5	24.9	2.687	2.319	50	21:01:20	55.90	159.6181
3	1570	0.5384	58.6	14.4	40.1	25.3	2.688	2.317	50	21:01:28	56.03	160.162
3	1580	0.5401	58.6	14.4	40.2	25.6	2.69	2.317	50	21:01:38	56.20	160.7069
3	1588	0.5391	58.6	14.4	40.3	25.5	2.688	2.319	50	21:01:46	56.33	160.3862
3	1596	0.5506	58.6	14.4	40.5	25.3	2.688	2.318	50	21:01:54	56.47	164.0954
3	1605	0.5394	58.6	14.4	40.5	24.9	2.688	2.317	50	21:02:03	56.62	160.4824
3	1613	0.5341	58.6	14.4	40.4	25.6	2.687	2.319	50	21:02:11	56.75	158.7882
3	1622	0.5314	58.7	14.4	40.2	25.7	2.69	2.316	50	21:02:20	56.90	157.929
3	1630	0.5322	58.6	14.4	40.3	25.6	2.689	2.317	50	21:02:28	57.03	158.1833
3	1639	0.532	58.6	14.4	40.8	25.1	2.687	2.318	50	21:02:37	57.18	158.1197
3	1647	0.5346	58.7	14.4	40.5	25.1	2.687	2.32	50	21:02:45	57.32	158.9476
3	1655	0.5289	58.6	14.4	40.4	24.7	2.687	2.318	50	21:02:53	57.45	157.1358
3	1663	0.5403	58.7	14.4	40.1	25.3	2.689	2.317	50	21:03:01	57.58	160.7711
3	1671	0.5286	58.7	14.4	40.5	25.4	2.689	2.317	50	21:03:09	57.72	157.0408
3	1679	0.5307	58.7	14.4	40.8	24.9	2.687	2.317	50	21:03:17	57.85	157.7067
3	1687	0.5274	58.7	14.4	40.2	25.8	2.688	2.316	50	21:03:25	57.98	156.6609
3	1697	0.5523	58.7	14.4	40.4	25	2.69	2.317	50	21:03:35	58.15	164.6477
3	1706	0.5436	58.7	14.4	40.3	25.1	2.687	2.317	50	21:03:44	58.30	161.832
3	1714	0.5373	58.8	14.4	40.2	25	2.689	2.316	50	21:03:52	58.43	159.8099
3	1722	0.5394	58.7	14.4	40.4	25.7	2.688	2.317	50	21:04:00	58.57	160.4824
3	1731	0.5308	58.7	14.4	40.3	25.5	2.688	2.317	50	21:04:09	58.72	157.7384

3	1740	0.5249	58.7	14.4	40.3	24.5	2.689	2.316	50	21:04:18	58.87	155.8713
3	1748	0.5264	58.7	14.4	40.3	25.2	2.687	2.316	50	21:04:26	59.00	156.3448
3	1757	0.5251	58.7	14.4	40.5	25.2	2.691	2.316	50	21:04:35	59.15	155.9344
3	1765	0.527	58.7	14.4	40.3	24.9	2.687	2.318	50	21:04:43	59.28	156.5344
3	1774	0.5212	58.7	14.4	40.1	24.6	2.688	2.316	50	21:04:52	59.43	154.7068
3	1782	0.527	58.7	14.4	40.2	24.9	2.688	2.316	50	21:05:00	59.57	156.5344
3	1790	0.5205	58.7	14.4	40.1	25	2.687	2.317	50	21:05:08	59.70	154.487
3	1798	0.5203	58.7	14.4	40.3	25.5	2.687	2.319	50	21:05:16	59.83	154.4243
4	8	0.534	58.7	14.4	40.3	25.5	2.689	2.318	50	21:05:26	60.00	158.7563
4	16	0.5305	58.7	14.4	41.2	25.3	2.688	2.318	50	21:05:34	60.13	157.6432
4	24	0.5242	58.7	14.4	41.5	25.1	2.686	2.318	50	21:05:42	60.27	155.6506
4	33	0.5279	58.7	14.4	41.2	25.3	2.687	2.318	50	21:05:51	60.42	156.8191
4	41	0.5265	58.7	14.4	41.9	26	2.69	2.315	50	21:05:59	60.55	156.3764
4	50	0.5363	58.7	14.4	42	25.4	2.687	2.318	50	21:06:08	60.70	159.4902
4	58	0.5446	58.7	14.4	42.3	25.3	2.687	2.317	50	21:06:16	60.83	162.1543
4	66	0.5451	58.8	14.4	43.1	25.7	2.688	2.318	50	21:06:24	60.97	162.3156
4	74	0.5507	58.8	14.4	43.2	25.6	2.689	2.317	50	21:06:32	61.10	164.1279
4	82	0.5669	58.8	14.4	43.4	25.5	2.688	2.318	50	21:06:40	61.23	169.4328
4	90	0.5691	58.8	14.4	44.6	25.7	2.687	2.318	50	21:06:48	61.37	170.1604
4	99	0.565	58.8	14.4	44.1	26.2	2.688	2.318	50	21:06:57	61.52	168.8059
4	107	0.5745	58.8	14.4	44.6	25.4	2.688	2.317	50	21:07:05	61.65	171.9533
4	116	0.5847	58.8	14.4	45.2	24.7	2.687	2.317	50	21:07:14	61.80	175.3675
4	125	0.6034	58.8	14.4	45.2	25.6	2.687	2.317	50	21:07:23	61.95	181.7201
4	133	0.5937	58.8	14.4	45.5	25.4	2.687	2.32	50	21:07:31	62.08	178.4099
4	142	0.6162	58.8	14.4	46.2	25.7	2.688	2.318	50	21:07:40	62.23	186.1372
4	151	0.6294	58.8	14.4	46.3	26.1	2.688	2.317	50	21:07:49	62.38	190.7503
4	160	0.6475	58.8	14.4	46.5	26.8	2.689	2.316	50	21:07:58	62.53	197.1708
4	168	0.6658	58.8	14.4	47.2	25.7	2.688	2.317	50	21:08:06	62.67	203.7727
4	177	0.7055	58.8	14.4	47	26.5	2.688	2.317	50	21:08:15	62.82	218.4706
4	186	0.702	58.7	14.4	47.4	26.8	2.689	2.317	50	21:08:24	62.97	217.1543
4	194	0.7398	58.8	14.4	47.3	26.7	2.688	2.316	50	21:08:32	63.10	231.5762
4	202	0.7661	58.8	14.4	47.3	26.3	2.689	2.316	50	21:08:40	63.23	241.876
4	211	0.7417	58.8	14.4	46.9	26.7	2.689	2.316	50	21:08:49	63.38	232.313
4	219	0.7541	58.8	14.4	47.6	26.6	2.687	2.317	50	21:08:57	63.52	237.1497
4	227	0.7543	58.8	14.4	47.2	26	2.688	2.317	50	21:09:05	63.65	237.2281
4	235	0.7895	58.8	14.4	48.3	26.5	2.688	2.318	50	21:09:13	63.78	251.2203
4	243	0.8222	58.8	14.4	48.4	26.9	2.688	2.318	50	21:09:21	63.92	264.559
4	251	0.8471	58.7	14.4	48.3	26	2.688	2.315	50	21:09:29	64.05	274.9322
4	260	0.8436	58.7	14.4	48	26.9	2.688	2.318	50	21:09:38	64.20	273.4629

4	269	0.8761	58.7	14.4	48.2	27	2.688	2.318	50	21:09:47	64.35	287.2461
4	277	0.8761	58.7	14.4	48.4	25.8	2.688	2.318	50	21:09:55	64.48	287.2461
4	286	0.8696	58.8	14.4	48.7	26.6	2.688	2.317	50	21:10:04	64.63	284.4645
4	294	0.8711	58.7	14.4	48.7	26	2.687	2.317	50	21:10:12	64.77	285.1053
4	302	0.9053	58.8	14.4	48.7	26.2	2.688	2.318	50	21:10:20	64.90	299.8944
4	311	0.9559	58.8	14.4	49.8	27	2.687	2.316	50	21:10:29	65.05	322.396
4	319	0.9367	58.8	14.4	48.8	26.9	2.686	2.318	50	21:10:37	65.18	313.7715
4	329	0.9591	58.8	14.4	49.4	26.3	2.689	2.316	50	21:10:47	65.35	323.8436
4	338	0.9766	58.8	14.4	49.1	26.4	2.688	2.317	50	21:10:56	65.50	331.8114
4	346	0.9737	58.8	14.4	49.7	26	2.688	2.316	50	21:11:04	65.63	330.4851
4	354	0.9877	58.8	14.4	49.8	25.9	2.686	2.318	50	21:11:12	65.77	336.91
4	362	1.0139	58.8	14.4	49.2	26.4	2.69	2.316	50	21:11:20	65.90	349.0809
4	371	1.0169	58.8	14.4	49.2	26.7	2.688	2.317	50	21:11:29	66.05	350.4867
4	379	1.0061	58.8	14.4	49.7	25.9	2.69	2.317	50	21:11:37	66.18	345.4375
4	388	1.0386	58.8	14.4	49	25.9	2.689	2.316	50	21:11:46	66.33	360.7292
4	396	1.042	58.8	14.4	49.3	26.8	2.689	2.318	50	21:11:54	66.47	362.3458
4	404	1.0231	58.8	14.4	49.7	26.3	2.688	2.316	50	21:12:02	66.60	353.3999
4	413	1.0393	58.8	14.4	49.6	26.4	2.687	2.317	50	21:12:11	66.75	361.0618
4	422	1.1034	58.8	14.4	49	27	2.686	2.317	50	21:12:20	66.90	392.0802
4	431	1.0776	58.8	14.4	49.3	26.6	2.689	2.316	50	21:12:29	67.05	379.4616
4	439	1.0797	58.8	14.4	49.4	26	2.689	2.317	50	21:12:37	67.18	380.482
4	447	1.0736	58.8	14.4	49.1	26.3	2.689	2.317	50	21:12:45	67.32	377.5213
4	456	1.1096	58.8	14.4	49.4	26.4	2.688	2.317	50	21:12:54	67.47	395.1392
4	464	1.1037	58.8	14.4	49.6	26.4	2.688	2.317	50	21:13:02	67.60	392.2279
4	473	1.089	58.8	14.4	49.3	26.6	2.688	2.316	50	21:13:11	67.75	385.0151
4	481	1.1421	58.8	14.4	49.3	26.5	2.687	2.317	50	21:13:19	67.88	411.3418
4	489	1.1241	58.8	14.4	49.2	25.9	2.687	2.318	50	21:13:27	68.02	402.3333
4	497	1.0996	58.8	14.4	49.4	26.7	2.689	2.317	50	21:13:35	68.15	390.2104
4	505	1.1251	58.7	14.4	49.4	26.4	2.688	2.318	50	21:13:43	68.28	402.8316
4	513	1.1464	58.7	14.4	49.3	26	2.688	2.317	50	21:13:51	68.42	413.5065
4	522	1.1127	58.8	14.4	49.6	26.2	2.688	2.316	50	21:14:00	68.57	396.6725
4	530	1.1143	58.8	14.4	49.3	27.2	2.687	2.318	50	21:14:08	68.70	397.4649
4	539	1.1402	58.8	14.4	49.4	26.1	2.688	2.318	50	21:14:17	68.85	410.3868
4	547	1.1327	58.8	14.4	49.6	25.5	2.687	2.317	50	21:14:25	68.98	406.6267
4	555	1.1338	58.8	14.4	49.6	26.7	2.686	2.318	50	21:14:33	69.12	407.1772
4	563	1.1289	58.8	14.4	49.4	26.3	2.688	2.317	50	21:14:41	69.25	404.7272
4	572	1.1367	58.8	14.4	49.1	26.3	2.688	2.317	50	21:14:50	69.40	408.6302
4	580	1.1373	58.8	14.4	49.4	25.8	2.688	2.316	50	21:14:58	69.53	408.9311
4	589	1.1567	58.8	14.4	49.5	26.3	2.688	2.317	50	21:15:07	69.68	418.7115

4	598	1.1597	58.8	14.4	49.6	26.4	2.688	2.316	50	21:15:16	69.83	420.2328
4	606	1.1756	58.7	14.4	49.3	26.2	2.687	2.318	50	21:15:24	69.97	428.335
4	614	1.1357	58.8	14.4	49.1	26.9	2.689	2.317	50	21:15:32	70.10	408.1289
4	622	1.1386	58.8	14.4	49.4	26.5	2.689	2.317	50	21:15:40	70.23	409.5834
4	630	1.1529	58.8	14.4	49.4	26.7	2.689	2.316	50	21:15:48	70.37	416.788
4	639	1.1366	58.8	14.4	49.3	27	2.688	2.319	50	21:15:57	70.52	408.5801
4	647	1.1533	58.8	14.4	49.4	27	2.688	2.317	50	21:16:05	70.65	416.9903
4	655	1.1599	58.8	14.4	49.5	26.9	2.688	2.318	50	21:16:13	70.78	420.3343
4	664	1.1594	58.8	14.4	49.2	26.8	2.688	2.317	50	21:16:22	70.93	420.0806
4	672	1.1438	58.8	14.4	49.5	26.1	2.689	2.318	50	21:16:30	71.07	412.197
4	681	1.1594	58.8	14.4	49.3	26.3	2.687	2.317	50	21:16:39	71.22	420.0806
4	689	1.1424	58.8	14.4	49.4	26.5	2.687	2.317	50	21:16:47	71.35	411.4927
4	697	1.1383	58.8	14.4	49.5	26	2.688	2.317	50	21:16:55	71.48	409.4329
4	705	1.1319	58.8	14.4	49.1	26.7	2.688	2.317	50	21:17:03	71.62	406.2265
4	714	1.1692	58.8	14.4	49.5	26	2.688	2.317	50	21:17:12	71.77	425.0658
4	722	1.1633	58.8	14.4	49.3	26.9	2.688	2.316	50	21:17:20	71.90	422.0615
4	730	1.1615	58.8	14.4	49.6	26.3	2.688	2.317	50	21:17:28	72.03	421.1467
4	738	1.1602	58.8	14.4	49.4	26.4	2.688	2.315	50	21:17:36	72.17	420.4866
4	746	1.1871	58.8	14.4	49.6	25.9	2.688	2.317	50	21:17:44	72.30	434.2362
4	755	1.1473	58.8	14.4	49.3	26.2	2.688	2.317	50	21:17:53	72.45	413.9602
4	764	1.1656	58.8	14.4	49.3	26.1	2.688	2.316	50	21:18:02	72.60	423.2315
4	772	1.1399	58.8	14.4	49.2	27	2.688	2.317	50	21:18:10	72.73	410.2362
4	780	1.1707	58.8	14.4	49.7	26.3	2.688	2.317	50	21:18:18	72.87	425.831
4	789	1.1328	58.8	14.4	49.5	25.9	2.689	2.316	50	21:18:27	73.02	406.6767
4	797	1.1394	58.8	14.4	49.4	27.1	2.687	2.319	50	21:18:35	73.15	409.985
4	805	1.1252	58.8	14.4	49.3	26.1	2.687	2.317	50	21:18:43	73.28	402.8814
4	814	1.1465	58.8	14.4	49.2	25.8	2.687	2.318	50	21:18:52	73.43	413.5569
4	823	1.1187	58.9	14.4	49.4	26.9	2.689	2.317	50	21:19:01	73.58	399.6476
4	831	1.1317	58.9	14.4	49.3	26.7	2.688	2.316	50	21:19:09	73.72	406.1264
4	839	1.1829	58.9	14.4	49.5	27	2.688	2.317	50	21:19:17	73.85	432.077
4	847	1.1201	58.9	14.4	49.1	25.8	2.687	2.317	50	21:19:25	73.98	400.3431
4	855	1.1595	58.9	14.4	49.2	26.5	2.688	2.316	50	21:19:33	74.12	420.1313
4	863	1.1229	58.9	14.4	49.4	26.6	2.69	2.316	50	21:19:41	74.25	401.7358
4	872	1.1681	58.9	14.4	49.4	26.2	2.686	2.317	50	21:19:50	74.40	424.5049
4	880	1.1304	58.9	14.4	49.2	26.2	2.688	2.316	50	21:19:58	74.53	405.4765
4	889	1.137	58.9	14.4	49.5	25.7	2.687	2.318	50	21:20:07	74.68	408.7807
4	898	1.1445	58.9	14.4	49.2	26.8	2.689	2.316	50	21:20:16	74.83	412.5494
4	907	1.1484	58.9	14.4	49.2	26.9	2.687	2.318	50	21:20:25	74.98	414.515
4	915	1.1292	58.9	14.4	49.4	25.8	2.688	2.317	50	21:20:33	75.12	404.877

4	923	1.116	58.9	14.4	49.1	26.4	2.687	2.318	50	21:20:41	75.25	398.3076
4	931	1.106	58.8	14.4	49.3	26.3	2.689	2.316	50	21:20:49	75.38	393.3617
4	939	1.1354	58.9	14.4	49.7	25.8	2.688	2.316	50	21:20:57	75.52	407.9786
4	947	1.1037	58.8	14.4	49.1	26.2	2.69	2.315	50	21:21:05	75.65	392.2279
4	957	1.1219	58.9	14.4	49.2	25.9	2.688	2.317	50	21:21:15	75.82	401.2382
4	965	1.1111	58.8	14.4	49.3	26.8	2.687	2.317	50	21:21:23	75.95	395.8808
4	973	1.1077	58.8	14.4	49.1	25.7	2.689	2.316	50	21:21:31	76.08	394.2006
4	981	1.1078	58.9	14.4	49.5	26.3	2.688	2.317	50	21:21:39	76.22	394.25
4	990	1.1446	58.8	14.4	49.1	26.5	2.687	2.318	50	21:21:48	76.37	412.5997
4	998	1.1325	58.8	14.4	49.1	26.5	2.689	2.316	50	21:21:56	76.50	406.5266
4	1006	1.1163	58.8	14.4	49.5	25.8	2.688	2.318	50	21:22:04	76.63	398.4564
4	1015	1.095	58.9	14.4	49.5	26.6	2.688	2.317	50	21:22:13	76.78	387.9521
4	1023	1.1104	58.9	14.4	49.1	25.5	2.69	2.317	50	21:22:21	76.92	395.5346
4	1031	1.0867	58.8	14.4	49.1	26.5	2.688	2.315	50	21:22:29	77.05	383.8919
4	1039	1.1055	58.8	14.4	49.2	26.9	2.687	2.317	50	21:22:37	77.18	393.1151
4	1047	1.1052	58.9	14.4	49.3	26.6	2.688	2.318	50	21:22:45	77.32	392.9672
4	1056	1.0651	58.9	14.4	49.2	25.7	2.688	2.317	50	21:22:54	77.47	373.4126
4	1064	1.0987	58.9	14.4	49.3	26.5	2.687	2.318	50	21:23:02	77.60	389.7681
4	1073	1.0932	58.9	14.4	49.1	25.9	2.689	2.317	50	21:23:11	77.75	387.07
4	1081	1.1167	58.8	14.4	49.2	26.2	2.687	2.317	50	21:23:19	77.88	398.6548
4	1090	1.0971	58.8	14.4	49.3	25.8	2.687	2.318	50	21:23:28	78.03	388.9824
4	1098	1.1059	58.9	14.4	49.6	25.9	2.688	2.318	50	21:23:36	78.17	393.3124
4	1107	1.1028	58.8	14.4	49.6	25.8	2.689	2.318	50	21:23:45	78.32	391.7847
4	1115	1.0832	58.8	14.4	49.2	26.6	2.688	2.318	50	21:23:53	78.45	382.1853
4	1124	1.077	58.8	14.4	49.5	26.2	2.687	2.318	50	21:24:02	78.60	379.1703
4	1132	1.0784	58.7	14.4	49.4	26	2.686	2.318	50	21:24:10	78.73	379.8502
4	1140	1.0576	58.7	14.4	49.6	26.3	2.689	2.316	50	21:24:18	78.87	369.8035
4	1149	1.0816	58.7	14.4	49	27.1	2.687	2.318	50	21:24:27	79.02	381.4062
4	1158	1.0714	58.7	14.4	49.1	26.1	2.686	2.319	50	21:24:36	79.17	376.456
4	1166	1.0719	58.7	14.4	49.3	25.9	2.688	2.316	50	21:24:44	79.30	376.698
4	1176	1.0445	58.7	14.4	49.2	26.9	2.689	2.317	50	21:24:54	79.47	363.5365
4	1184	1.0644	58.7	14.4	49.2	25.9	2.689	2.317	50	21:25:02	79.60	373.0751
4	1193	1.0428	58.6	14.4	49.5	25.7	2.688	2.318	50	21:25:11	79.75	362.7266
4	1201	1.046	58.7	14.4	49.5	26.7	2.688	2.317	50	21:25:19	79.88	364.2517
4	1209	1.056	58.7	14.4	49.2	26.2	2.688	2.316	50	21:25:27	80.02	369.0356
4	1217	1.0623	58.7	14.4	49.3	26.1	2.688	2.316	50	21:25:35	80.15	372.0634
4	1225	1.041	58.7	14.4	49.1	26.3	2.688	2.317	50	21:25:43	80.28	361.87
4	1234	1.0211	58.7	14.4	49.1	26.9	2.688	2.317	50	21:25:52	80.43	352.459
4	1242	1.0247	58.7	14.4	49.3	26.6	2.689	2.316	50	21:26:00	80.57	354.1534

4	1251	1.0147	58.7	14.4	49.2	27.3	2.688	2.316	50	21:26:09	80.72	349.4555
4	1259	1.0228	58.7	14.4	48.7	26.4	2.687	2.317	50	21:26:17	80.85	353.2587
4	1268	1.0044	58.6	14.4	49.3	25.8	2.686	2.316	50	21:26:26	81.00	344.6457
4	1276	1.0211	58.6	14.4	49.2	25.3	2.687	2.317	50	21:26:34	81.13	352.459
4	1284	1.0299	58.6	14.4	49.2	25.7	2.689	2.317	50	21:26:42	81.27	356.6072
4	1292	1.0199	58.6	14.4	49.4	26.1	2.687	2.318	50	21:26:50	81.40	351.895
4	1301	1.0166	58.5	14.4	49.1	26.2	2.688	2.317	50	21:26:59	81.55	350.346
4	1310	1.0111	58.5	14.4	49.1	26.6	2.689	2.316	50	21:27:08	81.70	347.7711
4	1319	1.0012	58.5	14.4	49	26.3	2.688	2.317	50	21:27:17	81.85	343.1574
4	1328	1.0154	58.5	14.4	49.4	26.3	2.687	2.318	50	21:27:26	82.00	349.7835
4	1336	1.0168	58.5	14.4	49.2	26	2.69	2.317	50	21:27:34	82.13	350.4398
4	1345	1.0458	58.5	14.4	49.5	26.3	2.688	2.317	50	21:27:43	82.28	364.1563
4	1353	1.0236	58.5	14.4	49.4	25.8	2.689	2.316	50	21:27:51	82.42	353.6353
4	1361	0.9958	58.5	14.4	49.4	26	2.689	2.316	50	21:27:59	82.55	340.6523
4	1369	0.9911	58.5	14.4	49.3	26.3	2.687	2.317	50	21:28:07	82.68	338.4786
4	1377	1.0064	58.5	14.4	49.7	26.3	2.687	2.317	50	21:28:15	82.82	345.5773
4	1386	1.0046	58.5	14.4	49.5	26.1	2.687	2.316	50	21:28:24	82.97	344.7388
4	1394	0.987	58.5	14.4	49.3	26.1	2.688	2.317	50	21:28:32	83.10	336.5874
4	1402	0.988	58.5	14.4	49.4	25.5	2.688	2.318	50	21:28:40	83.23	337.0483
4	1411	0.9867	58.5	14.4	49.5	26.4	2.687	2.318	50	21:28:49	83.38	336.4492
4	1419	0.9804	58.5	14.4	49.5	25.7	2.689	2.317	50	21:28:57	83.52	333.553
4	1427	0.9971	58.5	14.4	49.3	26.3	2.687	2.318	50	21:29:05	83.65	341.2546
4	1437	1.0109	58.5	14.4	49.4	26.8	2.688	2.316	50	21:29:15	83.82	347.6776
4	1445	0.9643	58.5	14.4	49.4	26.3	2.687	2.317	50	21:29:23	83.95	326.2022
4	1453	0.9789	58.5	14.4	49.4	25.8	2.688	2.317	50	21:29:31	84.08	332.865
4	1461	0.9768	58.5	14.4	49.5	26.5	2.687	2.318	50	21:29:39	84.22	331.903
4	1469	0.9853	58.5	14.4	49.2	26.6	2.688	2.317	50	21:29:47	84.35	335.8047
4	1477	0.9788	58.5	14.4	49.4	26.1	2.688	2.317	50	21:29:55	84.48	332.8192
4	1486	0.9846	58.5	14.4	49.3	26.6	2.688	2.316	50	21:30:04	84.63	335.4826
4	1494	0.9863	58.5	14.4	49.4	25.6	2.687	2.317	50	21:30:12	84.77	336.265
4	1503	0.9984	58.5	14.4	49.2	26.5	2.689	2.317	50	21:30:21	84.92	341.8574
4	1511	0.9773	58.5	14.4	49.3	26.2	2.688	2.317	50	21:30:29	85.05	332.1319
4	1519	0.9693	58.5	14.4	49.4	25.6	2.688	2.316	50	21:30:37	85.18	328.4772
4	1528	0.9634	58.5	14.4	49.6	26.5	2.687	2.318	50	21:30:46	85.33	325.7934
4	1536	1.0035	58.5	14.4	49.7	25.7	2.687	2.317	50	21:30:54	85.47	344.2268
4	1544	0.9648	58.5	14.4	49.3	26	2.687	2.318	50	21:31:02	85.60	326.4293
4	1553	0.9671	58.5	14.4	49.7	26.1	2.688	2.316	50	21:31:11	85.75	327.4753
4	1561	1.0091	58.5	14.4	49.1	26.5	2.687	2.319	50	21:31:19	85.88	346.8368
4	1570	0.953	58.5	14.4	49.2	26.7	2.687	2.317	50	21:31:28	86.03	321.0866

4	1578	0.9695	58.5	14.4	49.3	25.6	2.689	2.317	50	21:31:36	86.17	328.5684
4	1586	0.999	58.5	14.4	49.4	26.3	2.686	2.318	50	21:31:44	86.30	342.1358
4	1595	1.0095	58.5	14.4	49.3	26	2.687	2.317	50	21:31:53	86.45	347.0236
4	1603	0.9913	58.5	14.4	49.5	25.8	2.687	2.319	50	21:32:01	86.58	338.571
4	1611	0.9695	58.5	14.4	49.1	25.7	2.686	2.319	50	21:32:09	86.72	328.5684
4	1619	0.995	58.5	14.4	49.3	26	2.688	2.317	50	21:32:17	86.85	340.2819
4	1628	0.9806	58.5	14.4	49.2	25.8	2.688	2.316	50	21:32:26	87.00	333.6448
4	1636	0.9943	58.5	14.4	49.7	26.6	2.689	2.317	50	21:32:34	87.13	339.9579
4	1644	1.0123	58.5	14.4	49.4	26.1	2.689	2.317	50	21:32:42	87.27	348.3322
4	1652	0.9989	58.5	14.4	49.2	26.5	2.688	2.317	50	21:32:50	87.40	342.0894
4	1661	0.9889	58.5	14.4	49.3	25.7	2.689	2.315	50	21:32:59	87.55	337.4632
4	1669	0.9736	58.5	14.4	49.3	26.8	2.689	2.316	50	21:33:07	87.68	330.4394
4	1678	1.015	58.5	14.4	49.5	25.9	2.689	2.317	50	21:33:16	87.83	349.5961
4	1686	1.0593	58.5	14.4	49.2	26	2.689	2.317	50	21:33:24	87.97	370.6202
4	1694	1.0473	58.5	14.4	49.4	25.9	2.69	2.316	50	21:33:32	88.10	364.872
4	1703	1.03	58.4	14.4	49.5	26.6	2.689	2.317	50	21:33:41	88.25	356.6545
4	1711	1.087	58.5	14.4	49.2	25.8	2.686	2.318	50	21:33:49	88.38	384.0383
4	1720	1.0773	58.5	14.4	49.7	26.4	2.688	2.318	50	21:33:58	88.53	379.3159
4	1728	1.0498	58.5	14.4	49.3	26.2	2.688	2.316	50	21:34:06	88.67	366.0663
4	1737	1.0574	58.5	14.4	49.4	25.7	2.689	2.316	50	21:34:15	88.82	369.7075
4	1745	1.0433	58.5	14.4	49.5	25.8	2.688	2.317	50	21:34:23	88.95	362.9647
4	1753	1.0252	58.5	14.4	49.3	26.4	2.689	2.317	50	21:34:31	89.08	354.389
4	1762	1.0485	58.5	14.4	49	25	2.686	2.318	50	21:34:40	89.23	365.4451
4	1771	1.0171	58.5	14.4	49.3	26.2	2.688	2.317	50	21:34:49	89.38	350.5805
4	1779	1.0236	58.5	14.4	49.2	26.7	2.687	2.317	50	21:34:57	89.52	353.6353
4	1787	1.0243	58.5	14.4	49.5	26.6	2.688	2.317	50	21:35:05	89.65	353.965
4	1796	1.037	58.5	14.4	49.6	25.4	2.687	2.318	50	21:35:14	89.80	359.9696
5	8	1.0156	58.5	14.4	49.3	26.2	2.687	2.316	50	21:35:26	90.00	349.8772
5	16	1.0261	58.5	14.4	49.3	26.6	2.688	2.317	50	21:35:34	90.13	354.8133
5	24	1.0129	58.5	14.4	49.3	26	2.687	2.317	50	21:35:42	90.27	348.6129
5	33	1.049	58.5	14.4	50.3	26.5	2.69	2.318	50	21:35:51	90.42	365.684
5	41	1.0498	58.5	14.4	50.1	26.5	2.688	2.316	50	21:35:59	90.55	366.0663
5	49	1.0322	58.5	14.4	50.5	25.7	2.687	2.318	50	21:36:07	90.68	357.6949
5	58	1.0428	58.5	14.4	51.6	26.3	2.687	2.316	50	21:36:16	90.83	362.7266
5	66	1.0496	58.5	14.4	51.4	25.2	2.688	2.316	50	21:36:24	90.97	365.9707
5	75	1.0708	58.4	14.4	51.6	27.7	2.687	2.316	50	21:36:33	91.12	376.1657
5	84	1.035	58.4	14.4	52.1	27.3	2.688	2.316	50	21:36:42	91.27	359.0211
5	92	1.0643	58.4	14.4	52.4	26.3	2.687	2.318	50	21:36:50	91.40	373.0269
5	101	1.1037	58.4	14.4	52.6	26.6	2.689	2.315	50	21:36:59	91.55	392.2279

5	109	1.0612	58.4	14.4	53.5	26.8	2.69	2.315	50	21:37:07	91.68	371.5339
5	117	1.0657	58.5	14.4	53.7	26.7	2.688	2.317	50	21:37:15	91.82	373.7019
5	125	1.0874	58.4	14.4	53.6	26.5	2.687	2.318	50	21:37:23	91.95	384.2336
5	134	1.1113	58.4	14.4	54.3	27.3	2.688	2.317	50	21:37:32	92.10	395.9797
5	142	1.1182	58.4	14.4	54.3	26.8	2.69	2.315	50	21:37:40	92.23	399.3993
5	150	1.1674	58.4	14.4	54.9	26.7	2.69	2.315	50	21:37:48	92.37	424.1482
5	158	1.1987	58.4	14.4	55.4	27.2	2.688	2.317	50	21:37:56	92.50	440.2236
5	167	1.2346	58.4	14.4	55.5	26.9	2.689	2.315	50	21:38:05	92.65	458.9739
5	175	1.2334	58.4	14.4	55.4	27.3	2.689	2.316	50	21:38:13	92.78	458.3417
5	184	1.2491	58.4	14.4	55.5	26.8	2.688	2.316	50	21:38:22	92.93	466.6409
5	193	1.2243	58.5	14.4	55.8	27.3	2.688	2.316	50	21:38:31	93.08	453.5603
5	201	1.2351	58.4	14.4	55.5	26.6	2.688	2.317	50	21:38:39	93.22	459.2373
5	210	1.3556	58.4	14.4	55	26.5	2.688	2.317	50	21:38:48	93.37	524.5803
5	218	1.3322	58.5	14.4	55.9	27.9	2.687	2.318	50	21:38:56	93.50	511.607
5	226	1.3422	58.4	14.4	56.3	27	2.686	2.317	50	21:39:04	93.63	517.1346
5	235	1.3699	58.4	14.4	56.2	26.7	2.687	2.317	50	21:39:13	93.78	532.5751
5	243	1.4399	58.5	14.4	56.2	27.5	2.686	2.32	50	21:39:21	93.92	572.4309
5	253	1.4508	58.4	14.4	56.2	27.4	2.689	2.316	50	21:39:31	94.08	578.7438
5	261	1.5102	58.4	14.4	56	27.1	2.689	2.316	50	21:39:39	94.22	613.6451
5	269	1.4931	58.4	14.4	56.5	27.2	2.688	2.318	50	21:39:47	94.35	603.5117
5	278	1.522	58.4	14.4	56.1	27.2	2.689	2.317	50	21:39:56	94.50	620.678
5	287	1.5541	58.4	14.4	56.5	27.1	2.686	2.318	50	21:40:05	94.65	639.9756
5	295	1.5227	58.5	14.4	57.3	27.3	2.689	2.317	50	21:40:13	94.78	621.0962
5	304	1.5908	58.5	14.4	57.4	27.4	2.689	2.318	50	21:40:22	94.93	662.3333
5	312	1.6199	58.5	14.4	57.3	27.6	2.689	2.316	50	21:40:30	95.07	680.2827
5	320	1.6719	58.5	14.4	57.1	27.4	2.688	2.317	50	21:40:38	95.20	712.8408
5	328	1.6156	58.5	14.4	57.3	28.3	2.689	2.317	50	21:40:46	95.33	677.6181
5	337	1.6795	58.5	14.4	57.5	27	2.688	2.319	50	21:40:55	95.48	717.6508
5	345	1.6949	58.5	14.4	57.3	27.1	2.689	2.317	50	21:41:03	95.62	727.4376
5	354	1.7083	58.5	14.4	57.3	27.9	2.689	2.316	50	21:41:12	95.77	735.9968
5	363	1.7475	58.5	14.4	57.4	27.6	2.688	2.318	50	21:41:21	95.92	761.2672
5	371	1.6948	58.4	14.4	57.5	27.8	2.686	2.318	50	21:41:29	96.05	727.3738
5	380	1.7302	58.4	14.4	57.1	27.9	2.687	2.317	50	21:41:38	96.20	750.0723
5	388	1.7346	58.5	14.4	57.7	27.4	2.688	2.316	50	21:41:46	96.33	752.9133
5	396	1.7913	58.4	14.4	57.5	27.5	2.689	2.316	50	21:41:54	96.47	789.908
5	405	1.9039	58.4	14.5	57.2	27.6	2.688	2.317	50	21:42:03	96.62	865.4702
5	413	1.8712	58.4	14.5	57.4	26.9	2.687	2.317	50	21:42:11	96.75	843.242
5	421	1.8511	58.4	14.4	57.2	27	2.688	2.319	50	21:42:19	96.88	829.6938
5	430	1.8697	58.4	14.4	57.3	26.9	2.688	2.318	50	21:42:28	97.03	842.2279

5	439	1.8862	58.4	14.4	57.3	26.7	2.691	2.316	50	21:42:37	97.18	853.4097
5	447	1.8728	58.5	14.5	57.1	27.6	2.687	2.318	50	21:42:45	97.32	844.3243
5	455	1.8847	58.4	14.4	57.2	27.7	2.689	2.317	50	21:42:53	97.45	852.3908
5	463	1.8589	58.4	14.4	57.3	27.1	2.687	2.318	50	21:43:01	97.58	834.9409
5	472	1.969	58.5	14.5	57.4	27.4	2.687	2.317	50	21:43:10	97.73	910.4065
5	480	1.9534	58.5	14.5	57.4	27.2	2.688	2.315	50	21:43:18	97.87	899.5558
5	489	2.0456	58.5	14.5	57.2	27.8	2.688	2.315	50	21:43:27	98.02	964.433
5	497	2.0407	58.4	14.5	57.3	27.6	2.688	2.317	50	21:43:35	98.15	960.94
5	506	2.0372	58.5	14.5	57.3	28.1	2.687	2.316	50	21:43:44	98.30	958.4481
5	515	2.1238	58.5	14.5	57.3	28.1	2.688	2.315	50	21:43:53	98.45	1020.854
5	524	2.1047	58.4	14.5	57.3	26.6	2.688	2.316	50	21:44:02	98.60	1006.957
5	532	2.1113	58.5	14.5	57.3	27.4	2.687	2.319	50	21:44:10	98.73	1011.751
5	541	2.0603	58.5	14.5	57.3	27.8	2.688	2.316	50	21:44:19	98.88	974.942
5	549	2.1236	58.5	14.5	57.5	28.1	2.689	2.316	50	21:44:27	99.02	1020.709
5	558	2.2107	58.4	14.5	57	27.6	2.688	2.316	50	21:44:36	99.17	1085.031
5	567	2.1324	58.5	14.5	57.1	27	2.687	2.317	50	21:44:45	99.32	1027.137
5	575	2.1865	58.5	14.5	57.6	27.8	2.688	2.316	50	21:44:53	99.45	1067.004
5	584	2.1018	58.5	14.5	57.5	27.6	2.688	2.318	50	21:45:02	99.60	1004.853
5	592	2.2176	58.5	14.5	57.4	27.5	2.689	2.316	50	21:45:10	99.73	1090.193
5	600	2.1579	58.5	14.5	57.4	27.8	2.687	2.32	50	21:45:18	99.87	1045.853
5	608	2.202	58.5	14.5	57.4	26.7	2.688	2.315	50	21:45:26	100.00	1078.536
5	617	2.1366	58.5	14.5	57.5	27.6	2.687	2.316	50	21:45:35	100.15	1030.21
5	625	2.1841	58.5	14.5	57.4	27.7	2.687	2.317	50	21:45:43	100.28	1065.223
5	633	2.1571	58.5	14.5	57.4	27.4	2.689	2.316	50	21:45:51	100.42	1045.264
5	642	2.1549	58.5	14.5	57.4	27.8	2.688	2.316	50	21:46:00	100.57	1043.645
5	650	2.27	58.5	14.5	57.6	27.2	2.687	2.318	50	21:46:08	100.70	1129.705
5	658	2.2583	58.5	14.5	57.3	27.6	2.689	2.315	50	21:46:16	100.83	1120.835
5	666	2.1715	58.5	14.5	57.6	26.6	2.687	2.317	50	21:46:24	100.97	1055.89
5	675	2.1269	58.5	14.5	57.4	27.6	2.688	2.317	50	21:46:33	101.12	1023.117
5	683	2.1948	58.5	14.5	57.5	27.8	2.689	2.315	50	21:46:41	101.25	1073.173
5	691	2.1417	58.5	14.5	57.4	27.9	2.687	2.316	50	21:46:49	101.38	1033.947
5	700	2.1678	58.5	14.5	57.4	27.3	2.687	2.318	50	21:46:58	101.53	1053.156
5	708	2.1698	58.5	14.5	57.6	27.9	2.688	2.317	50	21:47:06	101.67	1054.634
5	717	2.1295	58.5	14.5	57.4	27.4	2.69	2.315	50	21:47:15	101.82	1025.017
5	725	2.2095	58.5	14.5	57.4	27.5	2.687	2.316	50	21:47:23	101.95	1084.134
5	734	2.2242	58.4	14.5	57.6	27.4	2.688	2.317	50	21:47:32	102.10	1095.139
5	743	2.1539	58.5	14.5	57.1	27.8	2.687	2.318	50	21:47:41	102.25	1042.909
5	751	2.1612	58.5	14.5	57.2	27.6	2.687	2.317	50	21:47:49	102.38	1048.285
5	760	2.1594	58.5	14.5	57.2	27.4	2.688	2.316	50	21:47:58	102.53	1046.959

5	769	2.1882	58.5	14.5	57.3	27.8	2.687	2.317	50	21:48:07	102.68	1068.266
5	777	2.2093	58.5	14.5	57.4	28	2.691	2.315	50	21:48:15	102.82	1083.985
5	785	2.1296	58.5	14.5	57.5	28	2.687	2.316	50	21:48:23	102.95	1025.09
5	794	2.2237	58.5	14.5	57.5	27.4	2.688	2.316	50	21:48:32	103.10	1094.764
5	803	2.2003	58.5	14.5	57.3	26.7	2.687	2.317	50	21:48:41	103.25	1077.269
5	811	2.1792	58.5	14.5	57.4	27.2	2.689	2.317	50	21:48:49	103.38	1061.59
5	820	2.1973	58.5	14.5	57.2	27.4	2.687	2.318	50	21:48:58	103.53	1075.034
5	828	2.1725	58.5	14.5	57.2	27.7	2.689	2.316	50	21:49:06	103.67	1056.63
5	836	2.1926	58.5	14.5	57.2	28.4	2.688	2.318	50	21:49:14	103.80	1071.537
5	845	2.1922	58.5	14.5	57.1	28.2	2.687	2.316	50	21:49:23	103.95	1071.239
5	853	2.1417	58.5	14.5	57.2	27.4	2.686	2.318	50	21:49:31	104.08	1033.947
5	861	2.1656	58.5	14.5	57.5	27.2	2.688	2.317	50	21:49:39	104.22	1051.531
5	870	2.1563	58.5	14.5	57.3	27.4	2.689	2.316	50	21:49:48	104.37	1044.675
5	878	2.1009	58.5	14.5	57.1	27.8	2.686	2.318	50	21:49:56	104.50	1004.201
5	886	2.1379	58.5	14.5	57.4	27.6	2.686	2.318	50	21:50:04	104.63	1031.162
5	895	2.1814	58.5	14.5	57.5	27.4	2.688	2.318	50	21:50:13	104.78	1063.22
5	903	2.1116	58.5	14.5	57.6	27.4	2.688	2.316	50	21:50:21	104.92	1011.969
5	913	2.1337	58.5	14.5	57.3	28	2.689	2.317	50	21:50:31	105.08	1028.088
5	921	2.1188	58.5	14.5	57.2	27.7	2.688	2.316	50	21:50:39	105.22	1017.209
5	929	2.1021	58.5	14.5	57.4	27.5	2.687	2.317	50	21:50:47	105.35	1005.071
5	937	2.1501	58.5	14.5	57.2	27.9	2.69	2.315	50	21:50:55	105.48	1040.114
5	946	2.2041	58.5	14.5	57.3	27.7	2.686	2.315	50	21:51:04	105.63	1080.103
5	955	2.1663	58.5	14.5	57.2	27.5	2.688	2.316	50	21:51:13	105.78	1052.048
5	963	2.175	58.5	14.5	57.8	27.2	2.689	2.318	50	21:51:21	105.92	1058.479
5	971	2.1558	58.5	14.5	57.2	27.6	2.687	2.316	50	21:51:29	106.05	1044.307
5	979	2.1588	58.5	14.5	57.1	27.6	2.689	2.316	50	21:51:37	106.18	1046.516
5	988	2.1606	58.5	14.5	57.4	27.2	2.688	2.317	50	21:51:46	106.33	1047.843
5	996	2.1134	58.5	14.5	57.2	27.1	2.688	2.316	50	21:51:54	106.47	1013.278
5	1005	2.1333	58.5	14.5	57.4	27.6	2.688	2.316	50	21:52:03	106.62	1027.795
5	1013	2.1752	58.5	14.5	57.2	27.4	2.687	2.315	50	21:52:11	106.75	1058.627
5	1022	2.1746	58.6	14.5	57.3	27.3	2.688	2.318	50	21:52:20	106.90	1058.183
5	1031	2.203	58.6	14.5	57.3	27.1	2.688	2.317	50	21:52:29	107.05	1079.282
5	1039	2.2363	58.6	14.5	57	27.6	2.688	2.316	50	21:52:37	107.18	1104.23
5	1048	2.2113	58.6	14.5	57.4	27.5	2.689	2.319	50	21:52:46	107.33	1085.479
5	1056	2.2219	58.6	14.5	57.4	27	2.687	2.317	50	21:52:54	107.47	1093.414
5	1064	2.2101	58.6	14.5	57.3	27.5	2.688	2.316	50	21:53:02	107.60	1084.582
5	1072	2.1693	58.6	14.5	57.2	27.8	2.69	2.315	50	21:53:10	107.73	1054.264
5	1081	2.172	58.6	14.5	57.5	27	2.688	2.318	50	21:53:19	107.88	1056.26
5	1090	2.1674	58.6	14.5	57.4	27.4	2.688	2.317	50	21:53:28	108.03	1052.86

5	1099	2.1215	58.6	14.5	57.2	27.8	2.686	2.319	50	21:53:37	108.18	1019.177
5	1107	2.1954	58.6	14.5	57.6	27.9	2.689	2.315	50	21:53:45	108.32	1073.62
5	1116	2.061	58.5	14.5	57.5	28.3	2.688	2.316	50	21:53:54	108.47	975.4436
5	1124	2.1133	58.6	14.5	57.2	27.1	2.688	2.317	50	21:54:02	108.60	1013.205
5	1132	2.1316	58.5	14.5	57.3	27	2.689	2.316	50	21:54:10	108.73	1026.552
5	1140	2.0896	58.5	14.5	57.5	27.1	2.687	2.317	50	21:54:18	108.87	996.0229
5	1148	2.0745	58.5	14.5	57.3	27	2.688	2.317	50	21:54:26	109.00	985.1364
5	1156	2.1154	58.5	14.5	57.4	27.5	2.687	2.317	50	21:54:34	109.13	1014.733
5	1164	2.0594	58.5	14.5	57.6	28.2	2.689	2.316	50	21:54:42	109.27	974.2973
5	1172	2.0684	58.6	14.5	57	27.3	2.688	2.317	50	21:54:50	109.40	980.752
5	1180	2.1582	58.5	14.5	57.3	27.5	2.687	2.318	50	21:54:58	109.53	1046.074
5	1189	2.055	58.6	14.5	57.5	27.5	2.687	2.319	50	21:55:07	109.68	971.1478
5	1198	2.0991	58.5	14.5	57.3	27.7	2.689	2.316	50	21:55:16	109.83	1002.896
5	1206	2.1004	58.5	14.5	57.6	27.2	2.688	2.316	50	21:55:24	109.97	1003.838
5	1214	2.0615	58.5	14.5	57.4	27.5	2.687	2.318	50	21:55:32	110.10	975.8019
5	1222	2.0615	58.6	14.5	57.1	27.8	2.689	2.317	50	21:55:40	110.23	975.8019
5	1231	2.0729	58.6	14.5	57.3	27.5	2.687	2.316	50	21:55:49	110.38	983.9856
5	1239	2.0676	58.6	14.5	57.3	27.4	2.688	2.317	50	21:55:57	110.52	980.1775
5	1248	2.0621	58.6	14.5	57.5	27.2	2.689	2.317	50	21:56:06	110.67	976.2319
5	1256	2.0475	58.6	14.5	57.2	27.6	2.688	2.315	50	21:56:14	110.80	965.7888
5	1264	2.0057	58.6	14.5	57.5	27.3	2.687	2.316	50	21:56:22	110.93	936.1369
5	1273	2.0464	58.6	14.5	57.4	27.8	2.687	2.318	50	21:56:31	111.08	965.0038
5	1282	2.021	58.6	14.5	57.1	27.1	2.687	2.317	50	21:56:40	111.23	946.9477
5	1290	2.0332	58.6	14.5	57.2	28.1	2.688	2.318	50	21:56:48	111.37	955.6034
5	1299	2.0403	58.6	14.5	57.1	27.4	2.688	2.317	50	21:56:57	111.52	960.6551
5	1307	2.0479	58.6	14.5	57.2	27.7	2.689	2.316	50	21:57:05	111.65	966.0743
5	1316	2.0385	58.6	14.5	57.2	27.5	2.686	2.317	50	21:57:14	111.80	959.3734
5	1325	2.0453	58.6	14.5	57.5	27.2	2.69	2.316	50	21:57:23	111.95	964.219
5	1333	2.0487	58.6	14.5	57.4	27.6	2.687	2.317	50	21:57:31	112.08	966.6454
5	1341	2.0067	58.5	14.5	57.3	28.3	2.689	2.317	50	21:57:39	112.22	936.8419
5	1350	2.0323	58.5	14.5	57.2	27.1	2.687	2.316	50	21:57:48	112.37	954.9638
5	1359	2.0366	58.5	14.5	57.3	27.3	2.687	2.318	50	21:57:57	112.52	958.0212
5	1368	2.026	58.5	14.5	57.3	27	2.69	2.315	50	21:58:06	112.67	950.4914
5	1376	2.0481	58.5	14.5	57.1	27.6	2.687	2.318	50	21:58:14	112.80	966.2171
5	1384	2.1098	58.6	14.5	57.4	27.8	2.689	2.318	50	21:58:22	112.93	1010.66
5	1392	2.1814	58.5	14.5	57.4	27.9	2.688	2.318	50	21:58:30	113.07	1063.22
5	1401	2.0969	58.6	14.5	57.2	27.2	2.687	2.316	50	21:58:39	113.22	1001.303
5	1409	2.0905	58.5	14.5	57	28	2.687	2.317	50	21:58:47	113.35	996.6732
5	1418	2.2095	58.6	14.5	57.5	27.3	2.688	2.317	50	21:58:56	113.50	1084.134

5	1426	2.1066	58.5	14.5	57.4	27.2	2.688	2.316	50	21:59:04	113.63	1008.336
5	1434	2.1366	58.5	14.5	57.2	27.6	2.689	2.317	50	21:59:12	113.77	1030.21
5	1442	2.1835	58.5	14.5	57.2	27.2	2.691	2.316	50	21:59:20	113.90	1064.778
5	1451	2.1292	58.5	14.5	57.3	28	2.686	2.318	50	21:59:29	114.05	1024.797
5	1460	2.1506	58.5	14.5	57.2	27.9	2.69	2.316	50	21:59:38	114.20	1040.482
5	1468	2.1126	58.6	14.5	57.4	26.8	2.688	2.317	50	21:59:46	114.33	1012.696
5	1476	2.2774	58.6	14.5	57.3	27.7	2.685	2.319	50	21:59:54	114.47	1135.33
5	1485	2.2478	58.6	14.5	57.4	28.1	2.688	2.317	50	22:00:03	114.62	1112.898
5	1493	2.1502	58.6	14.5	57.3	26.7	2.688	2.317	50	22:00:11	114.75	1040.188
5	1501	2.1683	58.6	14.5	57.6	27.4	2.687	2.317	50	22:00:19	114.88	1053.525
5	1509	2.1804	58.6	14.5	57.4	28	2.687	2.318	50	22:00:27	115.02	1062.479
5	1517	2.1067	58.6	14.5	57.3	27.7	2.689	2.316	50	22:00:35	115.15	1008.408
5	1526	2.034	58.6	14.5	57.2	27.2	2.687	2.318	50	22:00:44	115.30	956.1721
5	1534	2.0513	58.6	14.5	57.3	27.5	2.687	2.316	50	22:00:52	115.43	968.5026
5	1542	2.1388	58.6	14.5	57.3	28	2.687	2.317	50	22:01:00	115.57	1031.822
5	1550	2.0847	58.6	14.5	57.1	27.5	2.687	2.317	50	22:01:08	115.70	992.485
5	1559	1.9894	58.6	14.5	57.4	27.4	2.688	2.316	50	22:01:17	115.85	924.6737
5	1568	2.046	58.6	14.5	57.2	27.6	2.689	2.318	50	22:01:26	116.00	964.7184
5	1577	2.0198	58.6	14.5	57.4	27.3	2.688	2.317	50	22:01:35	116.15	946.098
5	1586	2.0479	58.6	14.5	57.6	27.3	2.689	2.315	50	22:01:44	116.30	966.0743
5	1594	2.0181	58.6	14.5	57.3	27.2	2.69	2.316	50	22:01:52	116.43	944.8948
5	1602	2.0586	58.6	14.5	57.1	27.4	2.689	2.316	50	22:02:00	116.57	973.7244
5	1611	2.027	58.6	14.5	57	27.5	2.69	2.317	50	22:02:09	116.72	951.2007
5	1620	2.0021	58.6	14.5	57.2	27.8	2.689	2.317	50	22:02:18	116.87	933.6003
5	1628	2.0155	58.6	14.5	57.1	27.5	2.687	2.317	50	22:02:26	117.00	943.0558
5	1637	2.0412	58.6	14.5	57.3	27.7	2.687	2.317	50	22:02:35	117.15	961.2962
5	1645	2.0754	58.6	14.5	57.2	27.6	2.689	2.315	50	22:02:43	117.28	985.7839
5	1653	2.0133	58.6	14.5	57.3	27.3	2.688	2.317	50	22:02:51	117.42	941.5008
5	1663	2.0094	58.6	14.5	57.4	27.6	2.688	2.316	50	22:03:01	117.58	938.7467
5	1671	2.0726	58.6	14.5	57.4	27.3	2.689	2.316	50	22:03:09	117.72	983.7699
5	1679	2.0744	58.7	14.5	57.1	27.4	2.689	2.317	50	22:03:17	117.85	985.0644
5	1688	2.0265	58.7	14.5	57.3	27.3	2.688	2.317	50	22:03:26	118.00	950.846
5	1696	1.9945	58.6	14.5	57.2	27.4	2.688	2.317	50	22:03:34	118.13	928.2543
5	1704	1.9904	58.6	14.5	57.4	26.8	2.687	2.318	50	22:03:42	118.27	925.3754
5	1712	2.0371	58.6	14.5	57.4	28.2	2.688	2.317	50	22:03:50	118.40	958.377
5	1722	1.9857	58.6	14.5	57	27.7	2.686	2.318	50	22:04:00	118.57	922.0795
5	1730	2.0462	58.7	14.5	57.3	27.9	2.687	2.317	50	22:04:08	118.70	964.8611
5	1738	1.9326	58.7	14.4	57.5	27.4	2.687	2.316	50	22:04:16	118.83	885.169
5	1747	2.0308	58.6	14.5	57.1	27.4	2.689	2.317	50	22:04:25	118.98	953.8982

5	1755	2.0041	58.6	14.5	57.6	27.5	2.686	2.318	50	22:04:33	119.12	935.0092
5	1763	1.9382	58.6	14.5	57.1	27.8	2.686	2.317	50	22:04:41	119.25	889.0333
5	1771	1.9864	58.6	14.5	57.4	26.9	2.688	2.316	50	22:04:49	119.38	922.5701
5	1779	1.9758	58.6	14.5	57.5	27.3	2.688	2.318	50	22:04:57	119.52	915.1524
5	1787	1.917	58.6	14.5	57.3	27.2	2.687	2.317	50	22:05:05	119.65	874.4397
5	1796	1.9265	58.7	14.5	57.5	27	2.688	2.317	50	22:05:14	119.80	880.9674
6	8	1.921	58.7	14.5	57.1	26.8	2.688	2.314	50	22:05:26	120.00	877.1858
6	16	1.9637	58.7	14.5	57.2	27.1	2.687	2.317	50	22:05:34	120.13	906.7142
6	25	1.9118	58.7	14.5	58	27.8	2.689	2.317	50	22:05:43	120.28	870.8749
6	34	1.9004	58.7	14.5	58.3	27.1	2.689	2.315	50	22:05:52	120.43	863.08
6	42	1.8351	58.7	14.4	58.9	28	2.686	2.317	50	22:06:00	120.57	818.9721
6	50	1.8986	58.7	14.4	59.3	27.3	2.69	2.315	50	22:06:08	120.70	861.8518
6	58	1.9017	58.7	14.5	59.5	27.6	2.688	2.315	50	22:06:16	120.83	863.9674
6	66	1.8662	58.7	14.4	60.5	27.8	2.687	2.317	50	22:06:24	120.97	839.8636
6	75	2.0228	58.7	14.5	60.2	27.8	2.689	2.316	50	22:06:33	121.12	948.2228
6	83	1.9906	58.7	14.5	60.6	28.1	2.687	2.319	50	22:06:41	121.25	925.5157
6	91	2.0278	58.7	14.5	61.2	27.8	2.687	2.319	50	22:06:49	121.38	951.7683
6	99	2.0037	58.7	14.5	61.4	27.7	2.687	2.318	50	22:06:57	121.52	934.7273
6	107	2.0349	58.7	14.5	62.4	27.9	2.687	2.318	50	22:07:05	121.65	956.812
6	115	2.0845	58.7	14.5	62.2	28.4	2.689	2.314	50	22:07:13	121.78	992.3407
6	123	2.1108	58.8	14.5	62.8	27.8	2.688	2.316	50	22:07:21	121.92	1011.387
6	132	2.1451	58.7	14.5	63.1	28.5	2.689	2.316	50	22:07:30	122.07	1036.442
6	141	2.2036	58.7	14.5	63.7	28.6	2.687	2.317	50	22:07:39	122.22	1079.73
6	149	2.2303	58.6	14.5	64.2	28.6	2.688	2.317	50	22:07:47	122.35	1099.718
6	158	2.2003	58.7	14.5	64.1	28.9	2.688	2.317	50	22:07:56	122.50	1077.269
6	166	2.1668	58.7	14.5	64.2	28.7	2.687	2.318	50	22:08:04	122.63	1052.417
6	174	2.2969	58.7	14.5	64.1	28.5	2.687	2.316	50	22:08:12	122.77	1150.204
6	183	2.2769	58.7	14.5	65.1	29.5	2.689	2.317	50	22:08:21	122.92	1134.949
6	191	2.4213	58.7	14.5	65.3	29.9	2.688	2.317	50	22:08:29	123.05	1246.87
6	199	2.476	58.6	14.6	65.4	29.6	2.687	2.317	50	22:08:37	123.18	1290.337
6	208	2.5364	58.6	14.6	65.4	29.3	2.687	2.317	50	22:08:46	123.33	1339.007
6	216	2.7354	58.6	14.6	65.2	29.3	2.686	2.318	50	22:08:54	123.47	1504.28
6	224	2.6457	58.6	14.6	65.4	29.3	2.688	2.317	50	22:09:02	123.60	1428.856
6	233	2.6981	58.6	14.6	65	30	2.687	2.317	50	22:09:11	123.75	1472.733
6	242	2.6888	58.7	14.6	65.8	29	2.688	2.317	50	22:09:20	123.90	1464.908
6	250	2.7506	58.7	14.6	66.1	29.1	2.69	2.316	50	22:09:28	124.03	1517.21
6	259	2.8458	58.7	14.6	66.1	29.2	2.69	2.316	50	22:09:37	124.18	1599.165
6	267	2.8678	58.7	14.6	66.1	29.4	2.687	2.317	50	22:09:45	124.32	1618.342
6	275	2.945	58.7	14.6	66.3	29.5	2.688	2.317	50	22:09:53	124.45	1686.332

6	284	2.8532	58.7	14.6	66.3	29.2	2.688	2.317	50	22:10:02	124.60	1605.606
6	293	2.9621	58.7	14.7	66.5	29.3	2.688	2.318	50	22:10:11	124.75	1701.538
6	302	3.0058	58.7	14.7	66.5	29.8	2.687	2.316	50	22:10:20	124.90	1740.637
6	311	3.0824	58.7	14.7	67.6	29.7	2.688	2.317	50	22:10:29	125.05	1809.999
6	319	2.9839	58.7	14.7	67.2	29	2.687	2.315	50	22:10:37	125.18	1721
6	328	2.9972	58.7	14.7	67.2	30.1	2.687	2.316	50	22:10:46	125.33	1732.916
6	336	3.2253	58.7	14.7	67.7	29.3	2.689	2.316	50	22:10:54	125.47	1942.173
6	344	3.2027	58.7	14.7	67.2	30.1	2.688	2.316	50	22:11:02	125.60	1921.03
6	352	3.2181	58.7	14.7	67.3	29.7	2.688	2.315	50	22:11:10	125.73	1935.428
6	360	3.3016	58.7	14.7	67.7	30.1	2.688	2.315	50	22:11:18	125.87	2014.208
6	369	3.2849	58.7	14.7	67.2	30.1	2.688	2.315	50	22:11:27	126.02	1998.355
6	377	3.4519	58.7	14.7	67	30	2.687	2.315	50	22:11:35	126.15	2159.041
6	385	3.3685	58.7	14.7	67.3	30.2	2.689	2.314	50	22:11:43	126.28	2078.197
6	394	3.3855	58.7	14.7	67.2	30.1	2.687	2.316	50	22:11:52	126.43	2094.58
6	403	3.4849	58.6	14.8	67.1	30.3	2.687	2.315	50	22:12:01	126.58	2191.356
6	412	3.5612	58.7	14.8	67.4	29.6	2.688	2.315	50	22:12:10	126.73	2266.777
6	421	3.6289	58.7	14.8	66.9	29.8	2.688	2.314	50	22:12:19	126.88	2334.514
6	429	3.7023	58.7	14.8	67.2	30	2.686	2.314	50	22:12:27	127.02	2408.816
6	437	3.773	58.7	14.8	67.1	30	2.689	2.314	50	22:12:35	127.15	2481.225
6	445	3.7008	58.7	14.8	67.1	30.2	2.686	2.315	50	22:12:43	127.28	2407.289
6	454	3.7975	58.7	14.8	67.2	30	2.689	2.315	50	22:12:52	127.43	2506.509
6	462	3.8642	58.7	14.8	67.1	29.9	2.689	2.315	50	22:13:00	127.57	2575.839
6	471	3.8728	58.7	14.8	67.3	29.9	2.688	2.316	50	22:13:09	127.72	2584.83
6	479	3.8425	58.7	14.8	67.3	30.5	2.688	2.317	50	22:13:17	127.85	2553.204
6	488	3.9822	58.7	14.8	67.4	29.9	2.69	2.315	50	22:13:26	128.00	2700.256
6	497	4.1139	58.7	14.9	67	30.5	2.688	2.315	50	22:13:35	128.15	2841.752
6	505	3.857	58.7	14.8	67.1	30.7	2.688	2.313	50	22:13:43	128.28	2568.32
6	513	3.9834	58.7	14.8	67.4	30.6	2.687	2.313	50	22:13:51	128.42	2701.532
6	522	3.9143	58.7	14.8	67.5	29.1	2.687	2.313	50	22:14:00	128.57	2628.389
6	530	3.9924	58.7	14.8	67.2	30.2	2.687	2.314	50	22:14:08	128.70	2711.116
6	539	4.1385	58.7	14.9	67.4	28.6	2.688	2.314	50	22:14:17	128.85	2868.487
6	547	4.1808	58.7	14.9	67	30.5	2.687	2.315	50	22:14:25	128.98	2914.682
6	555	4.0679	58.7	14.9	67.5	30	2.685	2.314	50	22:14:33	129.12	2792.017
6	564	4.3819	58.7	14.9	67	29.3	2.688	2.314	50	22:14:42	129.27	3138.126
6	572	4.0901	58.7	14.9	67.4	29.4	2.689	2.315	50	22:14:50	129.40	2815.978
6	581	4.2875	58.7	14.9	67.3	30.4	2.687	2.315	50	22:14:59	129.55	3032.453
6	589	4.2563	58.7	14.9	67.1	29.8	2.688	2.313	50	22:15:07	129.68	2997.832
6	597	4.4132	58.7	14.9	67.2	29.8	2.69	2.313	50	22:15:15	129.82	3173.468
6	605	4.5165	58.6	14.9	67.2	29.6	2.689	2.313	50	22:15:23	129.95	3291.174

6	614	4.4607	58.6	14.9	67.6	29.4	2.688	2.314	50	22:15:32	130.10	3227.389
6	622	4.5315	58.7	14.9	67.2	30	2.688	2.313	50	22:15:40	130.23	3308.401
6	631	4.5832	58.7	14.9	67.4	29.8	2.688	2.314	50	22:15:49	130.38	3368.041
6	640	4.4441	58.7	14.9	67.2	29.8	2.687	2.314	50	22:15:58	130.53	3208.506
6	649	4.443	58.7	14.9	67.2	30.1	2.689	2.315	50	22:16:07	130.68	3207.256
6	657	4.4617	58.7	14.9	67.2	29.4	2.688	2.314	50	22:16:15	130.82	3228.528
6	665	4.3794	58.7	14.9	67.3	29.6	2.685	2.315	50	22:16:23	130.95	3135.31
6	674	4.4199	58.7	14.9	67.3	30.3	2.687	2.314	50	22:16:32	131.10	3181.052
6	682	4.5203	58.7	14.9	67.1	29.9	2.688	2.313	50	22:16:40	131.23	3295.535
6	690	4.3892	58.7	14.9	67.3	29.7	2.688	2.314	50	22:16:48	131.37	3146.355
6	699	4.5664	58.7	14.9	67.2	30	2.687	2.314	50	22:16:57	131.52	3348.617
6	707	4.4805	58.7	14.9	67.3	30.2	2.687	2.314	50	22:17:05	131.65	3249.968
6	715	4.4418	58.7	14.9	67.3	30.2	2.691	2.315	50	22:17:13	131.78	3205.893
6	723	4.4423	58.7	14.9	67.1	29.8	2.689	2.315	50	22:17:21	131.92	3206.461
6	732	4.444	58.7	14.9	67.3	29.5	2.69	2.317	50	22:17:30	132.07	3208.392
6	741	4.3321	58.7	14.9	67.4	30.3	2.688	2.314	50	22:17:39	132.22	3082.207
6	749	4.3407	58.6	14.9	67.6	29.1	2.689	2.314	50	22:17:47	132.35	3091.836
6	757	4.3538	58.6	14.9	67.4	29.7	2.687	2.313	50	22:17:55	132.48	3106.526
6	766	4.4204	58.6	14.9	67.1	29.9	2.687	2.313	50	22:18:04	132.63	3181.619
6	774	4.3704	58.6	14.9	67.1	29.3	2.685	2.313	50	22:18:12	132.77	3125.179
6	783	4.2511	58.6	14.9	66.9	29.7	2.687	2.315	50	22:18:21	132.92	2992.076
6	790	4.2874	58.7	14.9	67.3	29.6	2.687	2.314	50	22:18:28	133.03	3032.342
6	799	4.1891	58.6	14.9	67.2	29.6	2.689	2.314	50	22:18:37	133.18	2923.779
6	808	4.2823	58.7	14.9	67.3	29.9	2.689	2.315	50	22:18:46	133.33	3026.672
6	816	4.1993	58.7	14.9	67.2	29.5	2.687	2.314	50	22:18:54	133.47	2934.974
6	824	4.2332	58.7	14.9	67.1	28.5	2.687	2.314	50	22:19:02	133.60	2972.297
6	832	4.3106	58.7	14.9	67.3	30.1	2.687	2.314	50	22:19:10	133.73	3058.184
6	840	4.2379	58.7	14.9	67.3	29.9	2.687	2.313	50	22:19:18	133.87	2977.485
6	848	4.3306	58.7	14.9	67.2	29.4	2.69	2.314	50	22:19:26	134.00	3080.529
6	857	4.2898	58.7	14.9	67.1	28.9	2.689	2.315	50	22:19:35	134.15	3035.011
6	866	4.3305	58.7	14.9	67.3	29.6	2.687	2.314	50	22:19:44	134.30	3080.417
6	875	4.286	58.7	14.9	67.1	30.3	2.687	2.313	50	22:19:53	134.45	3030.785
6	883	4.3307	58.7	14.9	67	29.6	2.689	2.313	50	22:20:01	134.58	3080.641
6	891	4.1524	58.7	14.9	67.3	29.2	2.688	2.312	50	22:20:09	134.72	2883.636
6	900	4.2082	58.7	14.9	67	29.5	2.689	2.312	50	22:20:18	134.87	2944.755
6	908	4.1236	58.7	14.9	67.1	28.9	2.689	2.313	50	22:20:26	135.00	2852.283
6	916	4.1955	58.7	14.9	67.5	29.8	2.687	2.313	50	22:20:34	135.13	2930.801
6	925	4.1628	58.7	14.9	67.1	29.1	2.69	2.312	50	22:20:43	135.28	2894.99
6	933	4.107	58.7	14.9	67.5	29.6	2.69	2.313	50	22:20:51	135.42	2834.271

6	941	4.2546	58.7	14.9	67.3	29.1	2.687	2.312	50	22:20:59	135.55	2995.95
6	950	4.2435	58.7	14.9	67.2	29	2.689	2.313	50	22:21:08	135.70	2983.672
6	959	4.2751	58.7	14.9	67.1	29.5	2.69	2.315	50	22:21:17	135.85	3018.675
6	967	4.1173	58.7	14.9	67.3	29.4	2.688	2.313	50	22:21:25	135.98	2845.442
6	975	3.9879	58.7	14.8	67.3	28.7	2.687	2.312	50	22:21:33	136.12	2706.322
6	984	4.0858	58.7	14.9	67.1	29.4	2.689	2.314	50	22:21:42	136.27	2811.331
6	992	4.1037	58.7	14.9	67.3	29.6	2.688	2.314	50	22:21:50	136.40	2830.695
6	1001	4.0966	58.7	14.9	67.4	29.2	2.689	2.312	50	22:21:59	136.55	2823.008
6	1009	4.0019	58.7	14.8	67.1	29.6	2.688	2.313	50	22:22:07	136.68	2721.245
6	1017	4.1104	58.7	14.9	67.2	29	2.688	2.313	50	22:22:15	136.82	2837.956
6	1026	4.0355	58.7	14.9	67.2	28.9	2.689	2.314	50	22:22:24	136.97	2757.188
6	1034	4.1935	58.7	14.9	67.2	29.6	2.688	2.313	50	22:22:32	137.10	2928.606
6	1042	4.1031	58.7	14.9	67.4	28.9	2.687	2.314	50	22:22:40	137.23	2830.045
6	1050	4.0596	58.7	14.8	67.3	28.8	2.687	2.313	50	22:22:48	137.37	2783.079
6	1059	4.1081	58.7	14.9	67.1	29	2.688	2.312	50	22:22:57	137.52	2835.463
6	1067	4.0752	58.7	14.9	67.3	28.6	2.688	2.314	50	22:23:05	137.65	2799.887
6	1075	4.0678	58.7	14.9	67.2	29.8	2.688	2.314	50	22:23:13	137.78	2791.909
6	1084	4.1117	58.7	14.9	67.1	29.1	2.688	2.312	50	22:23:22	137.93	2839.366
6	1093	4.0951	58.7	14.9	67.1	29.3	2.688	2.313	50	22:23:31	138.08	2821.385
6	1102	4.2465	58.7	14.9	67.3	29.5	2.687	2.312	50	22:23:40	138.23	2986.989
6	1111	4.1325	58.7	14.9	67.3	29.2	2.689	2.313	50	22:23:49	138.38	2861.958
6	1120	4.2002	58.7	14.9	67.3	29.3	2.689	2.314	50	22:23:58	138.53	2935.962
6	1128	4.0371	58.7	14.9	67.4	29.7	2.687	2.312	50	22:24:06	138.67	2758.904
6	1136	4.2243	58.7	14.9	67.2	29.4	2.688	2.313	50	22:24:14	138.80	2962.481
6	1144	4.0653	58.7	14.9	67	29.4	2.689	2.315	50	22:24:22	138.93	2789.216
6	1152	4.1005	58.7	14.9	67.1	28.9	2.688	2.312	50	22:24:30	139.07	2827.23
6	1161	4.1007	58.7	14.9	67.3	29	2.689	2.312	50	22:24:39	139.22	2827.446
6	1169	4.1319	58.7	14.9	67.3	29.7	2.687	2.315	50	22:24:47	139.35	2861.305
6	1177	4.0789	58.7	14.9	67.7	29.8	2.687	2.311	50	22:24:55	139.48	2803.88
6	1186	3.9089	58.7	14.8	67.3	29.7	2.689	2.314	50	22:25:04	139.63	2622.705
6	1195	4.0499	58.8	14.8	67.3	29.6	2.686	2.314	50	22:25:13	139.78	2772.647
6	1204	3.9996	58.7	14.8	67.4	28.9	2.689	2.315	50	22:25:22	139.93	2718.791
6	1213	3.9623	58.7	14.8	67.1	29.8	2.688	2.314	50	22:25:31	140.08	2679.116
6	1220	4.1911	58.7	14.9	67	29.7	2.688	2.313	50	22:25:38	140.20	2925.973
6	1229	4.118	58.7	14.9	67.2	29.1	2.688	2.316	50	22:25:47	140.35	2846.202
6	1237	4.1665	58.7	14.9	67.2	29.6	2.688	2.313	50	22:25:55	140.48	2899.034
6	1245	4.1154	58.7	14.9	67.3	28.9	2.687	2.314	50	22:26:03	140.62	2843.38
6	1253	4.0617	58.7	14.9	67.7	29.3	2.687	2.314	50	22:26:11	140.75	2785.339
6	1262	4.1214	58.7	14.9	66.9	29.4	2.688	2.314	50	22:26:20	140.90	2849.893

6	1270	4.1099	58.7	14.9	67.5	29.1	2.688	2.314	50	22:26:28	141.03	2837.414
6	1278	4.0177	58.7	14.8	67.5	29.9	2.688	2.313	50	22:26:36	141.17	2738.124
6	1287	4.0961	58.7	14.9	67.3	29.1	2.686	2.313	50	22:26:45	141.32	2822.467
6	1295	4.0613	58.7	14.9	67.1	29.7	2.686	2.312	50	22:26:53	141.45	2784.909
6	1304	4.1135	58.7	14.9	67.2	29.1	2.691	2.314	50	22:27:02	141.60	2841.318
6	1312	4.1398	58.7	14.9	67.3	29.3	2.686	2.312	50	22:27:10	141.73	2869.903
6	1320	4.1431	58.7	14.9	67	30.2	2.69	2.315	50	22:27:18	141.87	2873.497
6	1328	4.2031	58.7	14.9	67.4	29.5	2.686	2.312	50	22:27:26	142.00	2939.149
6	1337	4.1311	58.7	14.9	67.3	29.1	2.686	2.312	50	22:27:35	142.15	2860.435
6	1345	4.0689	58.6	14.8	67	28.5	2.689	2.313	50	22:27:43	142.28	2793.095
6	1353	4.2299	58.7	14.9	67.2	29.6	2.687	2.313	50	22:27:51	142.42	2968.655
6	1363	4.3172	58.6	14.9	67.3	29.3	2.689	2.312	50	22:28:01	142.58	3065.551
6	1371	4.2861	58.6	14.9	67.3	29.6	2.691	2.314	50	22:28:09	142.72	3030.896
6	1380	4.2135	58.7	14.9	67.4	28.6	2.686	2.312	50	22:28:18	142.87	2950.586
6	1388	4.0419	58.7	14.9	67.1	29.4	2.688	2.311	50	22:28:26	143.00	2764.054
6	1396	4.0008	58.7	14.8	67.1	29.1	2.688	2.312	50	22:28:34	143.13	2720.072
6	1405	4.1375	58.7	14.9	67.3	29.8	2.688	2.313	50	22:28:43	143.28	2867.399
6	1413	4.1729	58.7	14.9	67.2	29.3	2.688	2.313	50	22:28:51	143.42	2906.033
6	1421	4.1952	58.7	14.9	67.5	29.7	2.691	2.315	50	22:28:59	143.55	2930.472
6	1430	4.1344	58.6	14.9	67.1	28.9	2.687	2.312	50	22:29:08	143.70	2864.025
6	1438	3.9372	58.7	14.8	67.3	29.8	2.688	2.312	50	22:29:16	143.83	2652.544
6	1446	4.0544	58.7	14.9	67.2	29.2	2.688	2.312	50	22:29:24	143.97	2777.484
6	1455	3.9535	58.7	14.8	67	29.2	2.686	2.312	50	22:29:33	144.12	2669.789
6	1463	4.1037	58.7	14.9	67.3	29.2	2.688	2.313	50	22:29:41	144.25	2830.695
6	1472	3.9547	58.7	14.8	67.2	29.4	2.689	2.313	50	22:29:50	144.40	2671.06
6	1480	3.8746	58.7	14.8	67.2	29.6	2.687	2.313	50	22:29:58	144.53	2586.714
6	1488	3.978	58.7	14.8	67.3	28.9	2.688	2.314	50	22:30:06	144.67	2695.789
6	1496	4.0357	58.7	14.8	67.2	28.6	2.689	2.315	50	22:30:14	144.80	2757.402
6	1505	4.0116	58.7	14.8	67.1	28.9	2.688	2.314	50	22:30:23	144.95	2731.603
6	1513	4.0801	58.7	14.9	66.9	28.8	2.689	2.315	50	22:30:31	145.08	2805.175
6	1521	3.9694	58.7	14.8	67.4	29.6	2.688	2.314	50	22:30:39	145.22	2686.651
6	1529	3.9412	58.7	14.8	67.3	28.5	2.687	2.315	50	22:30:47	145.35	2656.772
6	1537	3.9576	58.7	14.8	67.2	29.4	2.691	2.315	50	22:30:55	145.48	2674.133
6	1546	3.8705	58.7	14.8	67.1	29.6	2.687	2.313	50	22:31:04	145.63	2582.424
6	1554	3.9655	58.7	14.8	67.1	29.4	2.688	2.314	50	22:31:12	145.77	2682.511
6	1562	3.8022	58.7	14.8	67.3	29	2.687	2.312	50	22:31:20	145.90	2511.371
6	1571	3.91	58.7	14.8	67.2	29	2.687	2.313	50	22:31:29	146.05	2623.863
6	1579	3.8853	58.7	14.8	67.2	29.4	2.687	2.313	50	22:31:37	146.18	2597.921
6	1587	3.8132	58.7	14.8	66.9	29.2	2.688	2.313	50	22:31:45	146.32	2522.763

6	1596	3.9269	58.7	14.8	67.3	28.8	2.689	2.315	50	22:31:54	146.47	2641.669
6	1604	3.9912	58.7	14.8	67.4	28.9	2.689	2.313	50	22:32:02	146.60	2709.837
6	1613	3.8479	58.7	14.8	67.2	28.8	2.688	2.314	50	22:32:11	146.75	2558.829
6	1621	4.0178	58.7	14.9	67.3	29.3	2.688	2.313	50	22:32:19	146.88	2738.231
6	1629	3.8478	58.7	14.8	67.2	29	2.686	2.313	50	22:32:27	147.02	2558.725
6	1638	3.914	58.7	14.8	67.2	28.3	2.687	2.314	50	22:32:36	147.17	2628.073
6	1646	3.7804	58.7	14.8	67.5	28.4	2.688	2.314	50	22:32:44	147.30	2488.852
6	1654	3.8943	58.7	14.8	67.2	30.1	2.689	2.312	50	22:32:52	147.43	2607.362
6	1662	3.8926	58.7	14.8	67.4	28.8	2.686	2.311	50	22:33:00	147.57	2605.578
6	1671	3.8155	58.7	14.8	67.1	28.9	2.688	2.312	50	22:33:09	147.72	2525.147
6	1679	3.7015	58.6	14.8	67.2	28.9	2.688	2.312	50	22:33:17	147.85	2408.001
6	1687	3.7131	58.7	14.8	67.4	29	2.689	2.313	50	22:33:25	147.98	2419.824
6	1696	3.8085	58.7	14.8	67.2	28.4	2.69	2.314	50	22:33:34	148.13	2517.893
6	1704	3.8561	58.6	14.8	67.2	28.6	2.687	2.313	50	22:33:42	148.27	2567.381
6	1712	3.8994	58.7	14.8	67	29	2.689	2.313	50	22:33:50	148.40	2612.718
6	1721	3.804	58.7	14.8	67.2	29.6	2.689	2.313	50	22:33:59	148.55	2513.233
6	1730	3.7799	58.7	14.8	67.2	28.8	2.689	2.313	50	22:34:08	148.70	2488.336
6	1737	3.8629	58.7	14.8	67.1	29	2.688	2.313	50	22:34:15	148.82	2574.481
6	1746	3.931	58.7	14.8	67.5	29.3	2.688	2.312	50	22:34:24	148.97	2645.996
6	1755	3.8706	58.7	14.8	67.1	29.2	2.69	2.313	50	22:34:33	149.12	2582.529
6	1763	3.8199	58.7	14.8	67	28.7	2.687	2.312	50	22:34:41	149.25	2529.711
6	1771	3.8361	58.7	14.8	67.2	28.5	2.687	2.311	50	22:34:49	149.38	2546.543
6	1779	3.7838	58.7	14.8	67.3	29	2.687	2.312	50	22:34:57	149.52	2492.359
6	1787	3.8001	58.7	14.8	67.1	29.1	2.687	2.313	50	22:35:05	149.65	2509.198
6	1796	3.933	58.7	14.8	67.1	28.6	2.687	2.313	50	22:35:14	149.80	2648.107
7	9	3.8541	58.6	14.8	67.2	28.6	2.685	2.311	50	22:35:27	150.02	2565.294
7	17	3.8264	58.6	14.8	67.1	28.7	2.686	2.313	50	22:35:35	150.15	2536.46
7	26	3.8966	58.6	14.8	67.9	28.3	2.688	2.315	50	22:35:44	150.30	2609.777
7	34	3.8525	58.6	14.8	68.3	28.4	2.688	2.314	50	22:35:52	150.43	2563.625
7	42	3.8969	58.6	14.8	68.4	29.3	2.686	2.313	50	22:36:00	150.57	2610.092
7	50	3.8044	58.6	14.8	69.2	29.1	2.688	2.313	50	22:36:08	150.70	2513.647
7	59	3.8501	58.6	14.8	69.2	29.7	2.687	2.315	50	22:36:17	150.85	2561.122
7	68	3.9052	58.7	14.8	70.1	29.5	2.689	2.315	50	22:36:26	151.00	2618.814
7	76	3.7345	58.6	14.8	70	29.5	2.688	2.315	50	22:36:34	151.13	2441.693
7	85	4.0082	58.6	14.8	71.2	29.3	2.686	2.314	50	22:36:43	151.28	2727.971
7	94	3.9667	58.6	14.8	71.1	30.3	2.687	2.314	50	22:36:52	151.43	2683.785
7	102	3.9251	58.6	14.8	71.2	30.3	2.689	2.313	50	22:37:00	151.57	2639.77
7	110	4.0884	58.6	14.9	72	30.1	2.685	2.311	50	22:37:08	151.70	2814.14
7	119	4.0727	58.7	14.8	72.3	29.9	2.688	2.315	50	22:37:17	151.85	2797.191

7	127	4.0823	58.6	14.9	72.9	29.8	2.69	2.314	50	22:37:25	151.98	2807.55
7	136	3.9675	58.7	14.9	73.3	29.6	2.689	2.312	50	22:37:34	152.13	2684.634
7	144	4.1662	58.6	14.9	73.8	30.7	2.687	2.313	50	22:37:42	152.27	2898.706
7	152	4.075	58.7	14.9	74.1	30.5	2.687	2.312	50	22:37:50	152.40	2799.672
7	160	4.178	58.6	14.9	74.2	31	2.685	2.312	50	22:37:58	152.53	2911.616
7	169	4.1779	58.7	14.9	74.3	30.7	2.686	2.313	50	22:38:07	152.68	2911.506
7	179	4.1508	58.6	14.9	74	30.5	2.686	2.311	50	22:38:17	152.85	2881.891
7	187	4.1157	58.7	14.9	75.3	31.3	2.688	2.313	50	22:38:25	152.98	2843.705
7	195	4.3475	58.7	14.9	75.3	31	2.686	2.312	50	22:38:33	153.12	3099.458
7	204	4.4653	58.7	14.9	75.1	30.8	2.687	2.312	50	22:38:42	153.27	3232.629
7	212	4.5198	58.7	14.9	75.2	31.6	2.687	2.313	50	22:38:50	153.40	3294.961
7	220	4.5316	58.7	14.9	75.3	31	2.686	2.312	50	22:38:58	153.53	3308.516
7	228	4.5547	58.6	14.9	75.3	30.4	2.687	2.312	50	22:39:06	153.67	3335.114
7	236	4.6096	58.6	14.9	75.2	31.4	2.685	2.311	50	22:39:14	153.80	3398.652
7	245	4.5686	58.7	14.9	75.9	30.8	2.688	2.313	50	22:39:23	153.95	3351.158
7	253	4.4595	58.7	14.9	76.3	31.4	2.687	2.311	50	22:39:31	154.08	3226.023
7	262	4.6594	58.6	14.9	76.2	31.4	2.688	2.312	50	22:39:40	154.23	3456.681
7	271	4.6538	58.7	14.9	76.4	31.2	2.684	2.31	50	22:39:49	154.38	3450.137
7	279	4.6317	58.6	14.9	76.1	31.3	2.688	2.313	50	22:39:57	154.52	3424.357
7	287	4.7442	58.7	14.9	75.9	31.7	2.688	2.313	50	22:40:05	154.65	3556.352
7	295	4.7911	58.7	14.9	76.2	31.1	2.686	2.312	50	22:40:13	154.78	3611.939
7	303	4.7824	58.7	14.9	76.9	31.7	2.688	2.314	50	22:40:21	154.92	3601.603
7	312	4.7617	58.7	14.9	77.1	31.7	2.687	2.313	50	22:40:30	155.07	3577.055
7	320	4.7786	58.7	14.9	77.4	32.3	2.688	2.314	50	22:40:38	155.20	3597.092
7	328	4.8914	58.8	14.9	77.2	31.8	2.685	2.31	50	22:40:46	155.33	3731.914
7	337	4.9526	58.7	14.9	77.4	31.7	2.687	2.312	50	22:40:55	155.48	3805.85
7	345	4.9191	58.7	14.9	77	32.8	2.686	2.312	50	22:41:03	155.62	3765.31
7	354	4.8807	58.7	15	77.4	32	2.685	2.311	50	22:41:12	155.77	3719.044
7	362	4.9315	58.8	14.9	77.1	32.1	2.686	2.313	50	22:41:20	155.90	3780.297
7	370	4.9883	58.8	14.9	77.1	31.6	2.684	2.31	50	22:41:28	156.03	3849.233
7	379	4.9068	58.7	14.9	76.9	31.7	2.687	2.313	50	22:41:37	156.18	3750.467
7	387	4.9724	58.7	14.9	77.1	32.4	2.683	2.309	50	22:41:45	156.32	3829.888
7	395	4.9396	58.8	14.9	77.1	32.4	2.687	2.313	50	22:41:53	156.45	3790.098
7	403	4.9556	58.7	14.9	77.2	32.2	2.684	2.31	50	22:42:01	156.58	3809.488
7	411	4.9396	58.7	14.9	77.4	32.2	2.686	2.313	50	22:42:09	156.72	3790.098
7	419	4.9897	58.8	14.9	77.4	32.3	2.683	2.31	50	22:42:17	156.85	3850.938
7	427	4.9972	58.8	14.9	77.2	32.9	2.682	2.309	50	22:42:25	156.98	3860.078
7	435	4.9892	58.8	14.9	77.3	32.6	2.682	2.309	50	22:42:33	157.12	3850.329
7	443	4.9909	58.8	14.9	77.4	32.1	2.68	2.308	50	22:42:41	157.25	3852.4

7	451	4.9975	58.8	14.9	77.1	32.1	2.681	2.307	50	22:42:49	157.38	3860.443
7	460	4.9718	58.8	14.9	77.4	32.8	2.685	2.311	50	22:42:58	157.53	3829.159
7	469	4.9892	58.8	14.9	77.4	32.3	2.684	2.31	50	22:43:07	157.68	3850.329
7	477	4.9969	58.8	14.9	77.4	32.4	2.684	2.31	50	22:43:15	157.82	3859.712
7	485	4.9911	58.8	14.9	77	32.4	2.685	2.31	50	22:43:23	157.95	3852.644
7	494	4.993	58.8	14.9	77	31.7	2.683	2.31	50	22:43:32	158.10	3854.959
7	502	4.9912	58.8	14.9	77	32.4	2.684	2.311	50	22:43:40	158.23	3852.765
7	510	4.9962	58.8	14.9	77.3	32.1	2.683	2.309	50	22:43:48	158.37	3858.859
7	518	4.9988	58.8	14.9	76.7	32.6	2.686	2.312	50	22:43:56	158.50	3862.028
7	526	4.9977	58.8	14.9	77.5	32.5	2.686	2.311	50	22:44:04	158.63	3860.687
7	535	4.9986	58.8	14.9	77.1	32.7	2.682	2.308	50	22:44:13	158.78	3861.785
7	543	4.9983	58.8	14.9	77.1	32.7	2.682	2.308	50	22:44:21	158.92	3861.419
7	552	4.9987	58.8	14.9	77	32.4	2.684	2.311	50	22:44:30	159.07	3861.907
7	560	4.9988	58.9	14.9	77.1	32.5	2.682	2.308	50	22:44:38	159.20	3862.028
7	568	4.9988	58.9	14.9	76.9	32.8	2.681	2.307	50	22:44:46	159.33	3862.028
7	576	4.9988	58.9	14.9	77.6	32.4	2.682	2.306	50	22:44:54	159.47	3862.028
7	584	4.9983	58.9	14.9	77.1	33.4	2.683	2.309	50	22:45:02	159.60	3861.419
7	592	4.9988	58.9	14.9	77.6	33.1	2.679	2.305	50	22:45:10	159.73	3862.028
7	600	4.9988	58.9	14.9	77.1	33.5	2.683	2.309	50	22:45:18	159.87	3862.028
7	608	4.9988	58.9	14.9	77.3	31.7	2.684	2.309	50	22:45:26	160.00	3862.028
7	617	4.995	58.9	14.9	77.1	32.5	2.68	2.306	50	22:45:35	160.15	3857.396
7	626	4.9988	58.9	14.9	77.4	32.2	2.682	2.306	50	22:45:44	160.30	3862.028
7	634	4.9988	58.9	14.9	77.2	32.6	2.686	2.309	50	22:45:52	160.43	3862.028
7	642	4.9988	58.9	14.9	77.1	32.4	2.68	2.306	50	22:46:00	160.57	3862.028
7	650	4.9988	58.9	14.9	77.2	32.6	2.68	2.305	50	22:46:08	160.70	3862.028
7	658	4.9988	58.9	14.9	77.2	32.6	2.68	2.306	50	22:46:16	160.83	3862.028
7	666	4.9988	59	14.9	77.4	32.6	2.678	2.304	50	22:46:24	160.97	3862.028
7	674	4.9988	58.9	14.9	77.1	32.5	2.68	2.305	50	22:46:32	161.10	3862.028
7	683	4.9988	58.9	14.9	77.1	31.7	2.681	2.307	50	22:46:41	161.25	3862.028
7	691	4.9988	58.9	14.9	77	32.8	2.679	2.305	50	22:46:49	161.38	3862.028
7	699	4.9988	58.9	14.9	77.2	32.3	2.68	2.305	50	22:46:57	161.52	3862.028
7	708	4.9988	58.9	14.9	77.3	32.9	2.679	2.304	50	22:47:06	161.67	3862.028
7	716	4.9988	59	14.9	77.2	33.4	2.681	2.307	50	22:47:14	161.80	3862.028
7	724	4.9988	59	14.9	77.2	32.3	2.678	2.303	50	22:47:22	161.93	3862.028
7	732	4.9988	58.9	14.9	77.3	32.4	2.684	2.309	50	22:47:30	162.07	3862.028
7	740	4.9988	58.9	14.9	77.1	32.5	2.681	2.307	50	22:47:38	162.20	3862.028
7	749	4.9988	59	14.9	77.1	32.5	2.679	2.304	50	22:47:47	162.35	3862.028
7	758	4.9988	58.9	14.9	77	32.7	2.678	2.304	50	22:47:56	162.50	3862.028
7	766	4.9988	59	14.9	77.3	32.9	2.68	2.305	50	22:48:04	162.63	3862.028

7	774	4.9988	59	14.9	77.2	33.1	2.68	2.306	50	22:48:12	162.77	3862.028
7	783	4.9988	59	14.9	77.4	32.6	2.679	2.304	50	22:48:21	162.92	3862.028
7	791	4.9988	59	14.9	77.1	33.5	2.678	2.303	50	22:48:29	163.05	3862.028
7	799	4.9988	59	14.9	77.2	32.4	2.682	2.306	50	22:48:37	163.18	3862.028
7	808	4.9988	58.9	14.9	77.3	32.4	2.679	2.304	50	22:48:46	163.33	3862.028
7	816	4.9988	58.9	14.9	77.3	33.1	2.678	2.304	50	22:48:54	163.47	3862.028
7	824	4.9988	58.9	14.9	77.4	32.2	2.68	2.305	50	22:49:02	163.60	3862.028
7	832	4.9988	59	14.9	77	32.6	2.68	2.305	50	22:49:10	163.73	3862.028
7	841	4.9988	58.9	14.9	77	33.7	2.68	2.304	50	22:49:19	163.88	3862.028
7	849	4.9988	59	14.9	77.2	32.8	2.68	2.305	50	22:49:27	164.02	3862.028
7	857	4.9988	59	14.9	77.2	33	2.678	2.303	50	22:49:35	164.15	3862.028
7	866	4.9988	59	14.9	77.2	33.3	2.678	2.304	50	22:49:44	164.30	3862.028
7	874	4.9988	59	14.9	77.1	33	2.681	2.307	50	22:49:52	164.43	3862.028
7	883	4.9988	59	14.9	77.1	33.1	2.678	2.303	50	22:50:01	164.58	3862.028
7	891	4.9988	59	14.9	77.3	32.8	2.679	2.305	50	22:50:09	164.72	3862.028
7	899	4.9988	59	14.9	77.4	33.2	2.678	2.304	50	22:50:17	164.85	3862.028
7	908	4.9988	59	14.9	77.1	32.4	2.677	2.304	50	22:50:26	165.00	3862.028
7	916	4.9988	59	14.9	77.1	33	2.676	2.302	50	22:50:34	165.13	3862.028
7	924	4.9988	59	14.9	77	33.7	2.68	2.306	50	22:50:42	165.27	3862.028
7	933	4.9988	59	14.9	77.4	33.3	2.677	2.302	50	22:50:51	165.42	3862.028
7	941	4.9988	59	14.9	77.3	33.7	2.679	2.306	50	22:50:59	165.55	3862.028
7	949	4.9988	59	14.9	77.3	32.4	2.678	2.303	50	22:51:07	165.68	3862.028
7	958	4.9988	59	14.9	77.2	33.2	2.677	2.302	50	22:51:16	165.83	3862.028
7	968	4.9988	59	14.9	77.1	34	2.678	2.303	50	22:51:26	166.00	3862.028
7	976	4.9988	59	14.9	77	33.7	2.678	2.304	50	22:51:34	166.13	3862.028
7	984	4.9988	59	14.9	76.9	33.6	2.677	2.304	50	22:51:42	166.27	3862.028
7	992	4.9988	59	14.9	77.3	32.8	2.678	2.305	50	22:51:50	166.40	3862.028
7	1000	4.9988	59	14.9	77.4	33.2	2.677	2.303	50	22:51:58	166.53	3862.028
7	1009	4.9988	59	14.9	77.2	32.7	2.676	2.302	50	22:52:07	166.68	3862.028
7	1017	4.9988	59	14.9	77.4	32.8	2.677	2.303	50	22:52:15	166.82	3862.028
7	1025	4.9988	59	14.9	77.2	33	2.676	2.302	50	22:52:23	166.95	3862.028
7	1034	4.9988	59	14.9	77.2	33.6	2.677	2.303	50	22:52:32	167.10	3862.028
7	1042	4.9988	59	14.9	77.6	33.2	2.679	2.303	50	22:52:40	167.23	3862.028
7	1050	4.9988	59	14.9	77.2	33.4	2.675	2.301	50	22:52:48	167.37	3862.028
7	1058	4.9988	59	14.9	77.3	33.8	2.677	2.304	50	22:52:56	167.50	3862.028
7	1066	4.9988	59	14.9	77.3	33	2.676	2.303	50	22:53:04	167.63	3862.028
7	1075	4.9988	59	14.9	77	34.4	2.678	2.304	50	22:53:13	167.78	3862.028
7	1084	4.9988	59	14.9	77.2	33.2	2.677	2.304	50	22:53:22	167.93	3862.028
7	1092	4.9988	58.9	14.9	77.1	33.8	2.677	2.303	50	22:53:30	168.07	3862.028

7	1100	4.9988	59	14.9	77.1	33.7	2.677	2.303	50	22:53:38	168.20	3862.028
7	1109	4.9988	59	14.9	77	33.9	2.679	2.305	50	22:53:47	168.35	3862.028
7	1117	4.9988	59	14.9	77.1	33.6	2.677	2.303	50	22:53:55	168.48	3862.028
7	1126	4.9988	59	14.9	77.4	33.5	2.677	2.303	50	22:54:04	168.63	3862.028
7	1134	4.9988	58.9	14.9	77.4	34	2.677	2.303	50	22:54:12	168.77	3862.028
7	1143	4.9988	59	14.9	77.3	33.8	2.679	2.306	50	22:54:21	168.92	3862.028
7	1151	4.9988	59	14.9	77.1	33	2.675	2.302	50	22:54:29	169.05	3862.028
7	1160	4.9988	59	14.9	77.2	33.9	2.677	2.304	50	22:54:38	169.20	3862.028
7	1168	4.9988	59	14.9	77.4	32.9	2.68	2.305	50	22:54:46	169.33	3862.028
7	1177	4.9988	58.9	14.9	77.4	33.3	2.679	2.304	50	22:54:55	169.48	3862.028
7	1185	4.9988	58.9	14.9	77.2	32.8	2.676	2.302	50	22:55:03	169.62	3862.028
7	1194	4.9988	58.9	14.9	77.6	33.7	2.677	2.302	50	22:55:12	169.77	3862.028
7	1202	4.9988	58.8	14.9	77.2	34.4	2.676	2.302	50	22:55:20	169.90	3862.028
7	1211	4.9988	58.8	14.9	77.1	33.2	2.675	2.301	50	22:55:29	170.05	3862.028
7	1219	4.9988	58.8	14.9	77	32.9	2.678	2.305	50	22:55:37	170.18	3862.028
7	1228	4.9988	58.9	14.9	77	33.3	2.675	2.302	50	22:55:46	170.33	3862.028
7	1238	4.9988	58.8	14.9	77.2	32.8	2.679	2.304	50	22:55:56	170.50	3862.028
7	1246	4.9988	58.8	14.9	77.1	33.4	2.678	2.302	50	22:56:04	170.63	3862.028
7	1254	4.9988	58.8	14.9	77.2	33.5	2.679	2.305	50	22:56:12	170.77	3862.028
7	1263	4.9988	58.9	14.9	77.3	33	2.675	2.301	50	22:56:21	170.92	3862.028
7	1271	4.9988	58.8	14.9	77.4	33.2	2.676	2.302	50	22:56:29	171.05	3862.028
7	1279	4.9988	58.8	14.9	77.4	34.1	2.678	2.303	50	22:56:37	171.18	3862.028
7	1288	4.9988	58.8	14.9	77.4	33.5	2.677	2.303	50	22:56:46	171.33	3862.028
7	1297	4.9988	58.8	14.9	77	33.3	2.677	2.302	50	22:56:55	171.48	3862.028
7	1305	4.9988	58.8	14.9	77.3	33.1	2.676	2.303	50	22:57:03	171.62	3862.028
7	1313	4.9988	58.8	14.9	77.2	33.3	2.679	2.305	50	22:57:11	171.75	3862.028
7	1321	4.9988	58.8	14.9	77.1	33.9	2.675	2.302	50	22:57:19	171.88	3862.028
7	1330	4.9988	58.8	14.9	77.3	33.6	2.679	2.304	50	22:57:28	172.03	3862.028
7	1338	4.9988	58.8	14.9	77	32.8	2.678	2.303	50	22:57:36	172.17	3862.028
7	1347	4.9988	58.8	14.9	77.1	33.2	2.676	2.303	50	22:57:45	172.32	3862.028
7	1355	4.9988	58.8	14.9	77.3	33.5	2.68	2.305	50	22:57:53	172.45	3862.028
7	1364	4.9988	58.8	14.9	77.3	33.1	2.677	2.303	50	22:58:02	172.60	3862.028
7	1372	4.9988	58.8	14.9	77.5	33	2.676	2.302	50	22:58:10	172.73	3862.028
7	1380	4.9988	58.8	14.9	77.2	33.4	2.676	2.302	50	22:58:18	172.87	3862.028
7	1388	4.9988	58.8	14.9	77.1	33.3	2.679	2.305	50	22:58:26	173.00	3862.028
7	1396	4.9988	58.8	14.9	77.3	33.1	2.676	2.302	50	22:58:34	173.13	3862.028
7	1405	4.9988	58.8	14.9	77	33.2	2.677	2.303	50	22:58:43	173.28	3862.028
7	1413	4.9988	58.8	14.9	77	32.8	2.678	2.303	50	22:58:51	173.42	3862.028
7	1421	4.9988	58.8	14.9	77.2	32.6	2.679	2.304	50	22:58:59	173.55	3862.028

7	1429	4.9988	58.8	14.9	77.1	33.7	2.678	2.303	50	22:59:07	173.68	3862.028
7	1437	4.9988	58.8	14.9	77.2	33.3	2.679	2.305	50	22:59:15	173.82	3862.028
7	1446	4.9988	58.7	14.9	77.2	32.7	2.679	2.302	50	22:59:24	173.97	3862.028
7	1455	4.9988	58.8	14.9	77.3	33.5	2.677	2.302	50	22:59:33	174.12	3862.028
7	1464	4.9988	58.8	14.9	77.2	33.8	2.677	2.302	50	22:59:42	174.27	3862.028
7	1473	4.9988	58.7	14.9	77.3	33.1	2.68	2.305	50	22:59:51	174.42	3862.028
7	1481	4.9988	58.8	14.9	76.9	34.1	2.68	2.305	50	22:59:59	174.55	3862.028
7	1489	4.9988	58.8	14.9	77.1	32.5	2.678	2.304	50	23:00:07	174.68	3862.028
7	1497	4.9988	58.8	14.9	77.2	32.7	2.677	2.303	50	23:00:15	174.82	3862.028
7	1506	4.9988	58.8	14.9	77	33.8	2.678	2.304	50	23:00:24	174.97	3862.028
7	1514	4.9988	58.8	14.9	77.4	33.6	2.678	2.304	50	23:00:32	175.10	3862.028
7	1524	4.9988	58.8	14.9	77.1	33.4	2.68	2.306	50	23:00:42	175.27	3862.028
7	1532	4.9988	58.8	14.9	76.9	32.8	2.678	2.304	50	23:00:50	175.40	3862.028
7	1541	4.9988	58.8	14.9	77.4	33.2	2.679	2.306	50	23:00:59	175.55	3862.028
7	1549	4.9988	58.8	14.9	77	33.7	2.68	2.305	50	23:01:07	175.68	3862.028
7	1558	4.9988	58.8	14.9	77.4	32.9	2.679	2.305	50	23:01:16	175.83	3862.028
7	1567	4.9988	58.8	14.9	77.3	32.9	2.677	2.303	50	23:01:25	175.98	3862.028
7	1576	4.9988	58.8	14.9	77.3	33	2.677	2.303	50	23:01:34	176.13	3862.028
7	1584	4.9988	58.8	14.9	77.1	33	2.679	2.305	50	23:01:42	176.27	3862.028
7	1592	4.9988	58.8	14.9	77.2	33.6	2.678	2.304	50	23:01:50	176.40	3862.028
7	1600	4.9988	58.8	14.9	77.4	33	2.679	2.304	50	23:01:58	176.53	3862.028
7	1609	4.9988	58.8	14.9	77.6	34.1	2.679	2.305	50	23:02:07	176.68	3862.028
7	1617	4.9988	58.9	14.9	77.3	33.1	2.679	2.305	50	23:02:15	176.82	3862.028
7	1626	4.9988	58.8	14.9	77.1	33.7	2.677	2.303	50	23:02:24	176.97	3862.028
7	1634	4.9988	58.8	14.9	77	33.7	2.678	2.303	50	23:02:32	177.10	3862.028
7	1642	4.9988	58.8	14.9	77	33.1	2.679	2.305	50	23:02:40	177.23	3862.028
7	1651	4.9988	58.9	14.9	77.3	32.9	2.677	2.302	50	23:02:49	177.38	3862.028
7	1660	4.9988	58.9	14.9	77.3	33.5	2.676	2.301	50	23:02:58	177.53	3862.028
7	1669	4.9988	58.8	14.9	77.1	32.8	2.678	2.303	50	23:03:07	177.68	3862.028
7	1678	4.9988	58.9	14.9	77.4	32.7	2.679	2.304	50	23:03:16	177.83	3862.028
7	1686	4.9988	58.9	14.9	77.1	33.7	2.678	2.303	50	23:03:24	177.97	3862.028
7	1695	4.9988	58.9	14.9	77.5	33.3	2.677	2.302	50	23:03:33	178.12	3862.028
7	1703	4.9988	58.9	14.9	77.1	33.8	2.678	2.303	50	23:03:41	178.25	3862.028
7	1711	4.9988	58.9	14.9	77.2	33.1	2.679	2.305	50	23:03:49	178.38	3862.028
7	1720	4.9988	58.9	14.9	77.1	33.3	2.678	2.302	50	23:03:58	178.53	3862.028
7	1728	4.9988	58.9	14.9	77	32.9	2.677	2.301	50	23:04:06	178.67	3862.028
7	1737	4.9988	58.9	14.9	77.3	32.7	2.679	2.304	50	23:04:15	178.82	3862.028
7	1745	4.9988	58.9	14.9	77.5	32.8	2.678	2.303	50	23:04:23	178.95	3862.028
7	1754	4.9988	58.9	14.9	77.3	33.4	2.678	2.302	50	23:04:32	179.10	3862.028

7	1762	4.9988	58.9	14.9	77.3	33.9	2.681	2.306	50	23:04:40	179.23	3862.028
7	1770	4.9988	58.9	14.9	77.2	33.4	2.677	2.303	50	23:04:48	179.37	3862.028
7	1778	4.9988	58.9	14.9	77.5	32.9	2.681	2.307	50	23:04:56	179.50	3862.028
7	1787	4.9988	58.9	14.9	77.2	33.1	2.678	2.303	50	23:05:05	179.65	3862.028
7	1795	4.9988	58.8	14.9	76.8	34.1	2.678	2.304	50	23:05:13	179.78	3862.028

Paleta Creek Flume Deployment, P17
Incipient or erosion rate experiment in San Diego Bay.
X-coord.= 32d40.417m
Y-coord.= 117d06.967m
Depth (ft) 25
Date 2/19/2002
Time 20:07:08

k	elptime (s)	OBS (v)	Temp (F)	Power (v)	speed (p)	loading (p)	Titlx (v)	Titly (v)	No	Time hh:mm:ss	Total Elaps Time (min)	Total Sus. Solids (mg/L)
2	8	0.2783	58.9	14.3	0.3	0	2.49	2.558	50	20:08:26	0.00	72.64337
2	16	0.28	58.9	14.3	0.3	0	2.49	2.558	50	20:08:34	0.13	72.84035
2	24	0.279	58.9	14.4	0.4	9.1	2.491	2.556	50	20:08:42	0.27	72.72412
2	32	0.2798	58.9	14.4	2.2	36.3	2.489	2.559	50	20:08:50	0.40	72.81702
2	41	0.2806	58.8	14.3	3.7	34.4	2.49	2.558	50	20:08:59	0.55	72.91059
2	49	0.2789	58.9	14.4	5.1	31.5	2.489	2.558	50	20:09:07	0.68	72.71255
2	58	0.2782	58.9	14.4	6.7	34.1	2.491	2.559	50	20:09:16	0.83	72.63188
2	66	0.2782	58.9	14.4	8	30.8	2.491	2.558	50	20:09:24	0.97	72.63188
2	75	0.2788	58.8	14.3	9.9	30.2	2.493	2.558	50	20:09:33	1.12	72.70099
2	83	0.2785	58.8	14.3	11.3	30.5	2.491	2.559	50	20:09:41	1.25	72.66639
2	91	0.2799	58.9	14.4	13	29.9	2.492	2.556	50	20:09:49	1.38	72.82868
2	100	0.284	58.9	14.3	14.5	27.7	2.491	2.559	50	20:09:58	1.53	73.31577
2	108	0.283	58.9	14.4	15.9	28.5	2.49	2.559	50	20:10:06	1.67	73.19533
2	116	0.2799	58.9	14.3	17.6	29.4	2.49	2.56	50	20:10:14	1.80	72.82868
2	124	0.2795	58.9	14.3	18.5	29.6	2.491	2.557	50	20:10:22	1.93	72.7821
2	132	0.2803	58.9	14.3	20	28.6	2.49	2.559	50	20:10:30	2.07	72.87542
2	141	0.2831	58.9	14.3	21.6	28.1	2.489	2.558	50	20:10:39	2.22	73.20733
2	149	0.2837	58.9	14.3	23.2	27.8	2.491	2.558	50	20:10:47	2.35	73.27952
2	157	0.2865	58.9	14.3	24.6	28.5	2.489	2.56	50	20:10:55	2.48	73.62153
2	166	0.2893	58.9	14.3	24.5	30	2.491	2.558	50	20:11:04	2.63	73.972
2	174	0.2918	58.9	14.3	25.1	29.2	2.491	2.559	50	20:11:12	2.77	74.29216
2	182	0.2906	58.9	14.3	25.8	29.1	2.49	2.559	50	20:11:20	2.90	74.13763
2	190	0.2928	58.9	14.3	26.4	28.1	2.489	2.558	50	20:11:28	3.03	74.42217
2	198	0.2939	58.8	14.3	26.6	27.6	2.492	2.556	50	20:11:36	3.17	74.56646
2	207	0.2982	58.8	14.3	27.1	29.2	2.489	2.558	50	20:11:45	3.32	75.14359
2	215	0.2986	58.8	14.3	27.4	28.7	2.49	2.56	50	20:11:53	3.45	75.19834
2	224	0.3013	58.8	14.3	28	28.4	2.491	2.557	50	20:12:02	3.60	75.57277
2	232	0.3002	58.8	14.4	28.3	29.6	2.491	2.557	50	20:12:10	3.73	75.41921
2	241	0.305	58.8	14.3	29.2	27.6	2.49	2.558	50	20:12:19	3.88	76.09968
2	250	0.3032	58.8	14.3	29.6	28.7	2.491	2.559	50	20:12:28	4.03	75.84134
2	258	0.3119	58.8	14.3	30.3	28.9	2.491	2.558	50	20:12:36	4.17	77.12586
2	266	0.3071	58.8	14.3	30.3	29.7	2.491	2.556	50	20:12:44	4.30	76.40593

2	274	0.3083	58.8	14.3	31.3	28.3	2.49	2.558	50	20:12:52	4.43	76.5833
2	283	0.3099	58.8	14.3	31.3	29.2	2.491	2.56	50	20:13:01	4.58	76.8225
2	291	0.3112	58.8	14.3	32	28.7	2.49	2.56	50	20:13:09	4.72	77.01913
2	299	0.3141	58.8	14.3	32.6	28.8	2.49	2.559	50	20:13:17	4.85	77.46522
2	308	0.3121	58.8	14.4	33.4	28.8	2.49	2.559	50	20:13:26	5.00	77.15646
2	317	0.3189	58.8	14.3	33.6	27.9	2.49	2.559	50	20:13:35	5.15	78.22655
2	325	0.3159	58.8	14.3	33.5	29.4	2.49	2.559	50	20:13:43	5.28	77.74734
2	334	0.3213	58.8	14.4	33.4	29.1	2.489	2.559	50	20:13:52	5.43	78.61811
2	343	0.3213	58.8	14.3	33.2	28.4	2.489	2.559	50	20:14:01	5.58	78.61811
2	351	0.3222	58.8	14.3	33.3	29.3	2.491	2.557	50	20:14:09	5.72	78.76685
2	360	0.3235	58.8	14.3	33.3	29.3	2.491	2.559	50	20:14:18	5.87	78.98353
2	368	0.3275	58.8	14.3	33.5	28.2	2.49	2.557	50	20:14:26	6.00	79.66403
2	377	0.3283	58.8	14.4	33.7	28.9	2.491	2.558	50	20:14:35	6.15	79.80265
2	385	0.3312	58.8	14.3	33.4	28.2	2.491	2.56	50	20:14:43	6.28	80.31226
2	393	0.3359	58.8	14.3	33.2	29.4	2.492	2.558	50	20:14:51	6.42	81.16221
2	402	0.3342	58.7	14.3	33.1	29	2.49	2.558	50	20:15:00	6.57	80.85132
2	410	0.335	58.8	14.3	33.5	27.8	2.49	2.559	50	20:15:08	6.70	80.99713
2	419	0.3329	58.8	14.4	33.4	28	2.491	2.556	50	20:15:17	6.85	80.61624
2	429	0.3362	58.7	14.3	33.3	28.7	2.49	2.558	50	20:15:27	7.02	81.21748
2	438	0.3382	58.7	14.3	33.3	28.7	2.491	2.556	50	20:15:36	7.17	81.58913
2	447	0.3382	58.8	14.4	33.7	27.8	2.492	2.557	50	20:15:45	7.32	81.58913
2	455	0.3417	58.8	14.3	33.4	29.6	2.49	2.558	50	20:15:53	7.45	82.25286
2	464	0.3403	58.8	14.3	33.5	28.1	2.49	2.559	50	20:16:02	7.60	81.98532
2	472	0.342	58.8	14.3	34	27.6	2.492	2.556	50	20:16:10	7.73	82.31055
2	480	0.3422	58.8	14.4	33.6	28.8	2.491	2.559	50	20:16:18	7.87	82.34908
2	488	0.3486	58.8	14.3	33.3	28.5	2.492	2.557	50	20:16:26	8.00	83.61203
2	497	0.3465	58.8	14.3	33.8	28.4	2.491	2.558	50	20:16:35	8.15	83.19116
2	506	0.3463	58.7	14.3	33.6	28	2.49	2.559	50	20:16:44	8.30	83.15141
2	514	0.3454	58.8	14.4	33.2	28.3	2.491	2.557	50	20:16:52	8.43	82.97324
2	522	0.346	58.8	14.4	33.6	28.9	2.489	2.557	50	20:17:00	8.57	83.09189
2	531	0.3477	58.8	14.3	33.4	28.3	2.49	2.559	50	20:17:09	8.72	83.43088
2	539	0.3469	58.8	14.4	33.4	28.2	2.49	2.556	50	20:17:17	8.85	83.27084
2	548	0.3488	58.8	14.3	33.3	28.2	2.489	2.56	50	20:17:26	9.00	83.65244
2	556	0.3493	58.8	14.3	33.6	28.4	2.489	2.558	50	20:17:34	9.13	83.75373
2	565	0.3493	58.8	14.4	33.6	27.8	2.49	2.557	50	20:17:43	9.28	83.75373
2	573	0.3488	58.8	14.3	33.7	28.1	2.491	2.558	50	20:17:51	9.42	83.65244
2	581	0.3475	58.8	14.3	33.6	28.3	2.492	2.556	50	20:17:59	9.55	83.39078
2	589	0.3497	58.8	14.4	33.4	28.3	2.492	2.559	50	20:18:07	9.68	83.83503
2	597	0.3493	58.8	14.4	33.5	27.8	2.491	2.559	50	20:18:15	9.82	83.75373
2	605	0.3507	58.8	14.3	33.6	28.8	2.49	2.559	50	20:18:23	9.95	84.03928
2	614	0.3495	58.8	14.3	33.4	27.8	2.492	2.558	50	20:18:32	10.10	83.79435

2	622	0.353	58.8	14.4	33.5	27.7	2.491	2.558	50	20:18:40	10.23	84.51462
2	631	0.3499	58.8	14.4	33.5	28.6	2.492	2.558	50	20:18:49	10.38	83.87576
2	639	0.3536	58.8	14.3	33.2	28.2	2.49	2.558	50	20:18:57	10.52	84.6399
2	647	0.357	58.8	14.3	33.5	28.3	2.49	2.556	50	20:19:05	10.65	85.35993
2	656	0.3526	58.8	14.3	33.3	29.8	2.49	2.56	50	20:19:14	10.80	84.43139
2	664	0.3551	58.8	14.3	33.7	27.8	2.491	2.557	50	20:19:22	10.93	84.95544
2	673	0.3521	58.8	14.4	33.5	28.9	2.492	2.558	50	20:19:31	11.08	84.32769
2	682	0.352	58.8	14.3	33.4	28.6	2.491	2.559	50	20:19:40	11.23	84.307
2	690	0.3509	58.8	14.3	33.6	27.7	2.49	2.558	50	20:19:48	11.37	84.08031
2	698	0.3503	58.8	14.3	33.3	28.4	2.491	2.558	50	20:19:56	11.50	83.9574
2	707	0.353	58.8	14.3	33.7	28.8	2.492	2.558	50	20:20:05	11.65	84.51462
2	715	0.3537	58.8	14.3	33.5	27.5	2.49	2.558	50	20:20:13	11.78	84.66083
2	724	0.3565	58.8	14.3	33.6	27.9	2.489	2.56	50	20:20:22	11.93	85.25296
2	732	0.3531	58.7	14.3	33.4	28.4	2.488	2.559	50	20:20:30	12.07	84.53546
2	740	0.3511	58.8	14.4	33.4	27.7	2.491	2.557	50	20:20:38	12.20	84.12139
2	748	0.3544	58.8	14.4	33.1	29	2.492	2.557	50	20:20:46	12.33	84.80777
2	757	0.3546	58.8	14.3	33.6	27.8	2.49	2.559	50	20:20:55	12.48	84.84989
2	765	0.3499	58.8	14.4	33.4	28.6	2.491	2.557	50	20:21:03	12.62	83.87576
2	773	0.3539	58.8	14.3	33.5	27.8	2.491	2.557	50	20:21:11	12.75	84.70274
2	781	0.3542	58.8	14.3	33.5	27.6	2.491	2.557	50	20:21:19	12.88	84.76572
2	790	0.3541	58.8	14.3	33.4	28.4	2.494	2.555	50	20:21:28	13.03	84.74471
2	798	0.3556	58.8	14.4	33.6	27	2.492	2.556	50	20:21:36	13.17	85.06136
2	807	0.3552	58.8	14.3	33.4	28.9	2.492	2.555	50	20:21:45	13.32	84.97659
2	815	0.3506	58.8	14.4	33.5	28.1	2.49	2.558	50	20:21:53	13.45	84.01879
2	824	0.3541	58.7	14.3	33.2	28.3	2.491	2.558	50	20:22:02	13.60	84.74471
2	834	0.356	58.7	14.3	33.3	28	2.49	2.558	50	20:22:12	13.77	85.14637
2	842	0.3558	58.8	14.4	33.5	29.7	2.489	2.56	50	20:22:20	13.90	85.10384
2	850	0.3541	58.7	14.3	33.6	27.5	2.491	2.556	50	20:22:28	14.03	84.74471
2	859	0.358	58.8	14.4	33.3	28.9	2.49	2.56	50	20:22:37	14.18	85.575
2	867	0.357	58.7	14.3	33.4	28.2	2.49	2.557	50	20:22:45	14.32	85.35993
2	876	0.3585	58.8	14.4	33.6	28.3	2.493	2.556	50	20:22:54	14.47	85.68309
2	884	0.3534	58.8	14.4	33.5	29.1	2.491	2.558	50	20:23:02	14.60	84.59808
2	892	0.3563	58.8	14.3	33.4	28.3	2.49	2.558	50	20:23:10	14.73	85.21028
2	901	0.3566	58.8	14.4	33.5	27.3	2.489	2.557	50	20:23:19	14.88	85.27433
2	909	0.3564	58.8	14.3	33.4	28.8	2.492	2.557	50	20:23:27	15.02	85.23161
2	918	0.3536	58.8	14.4	33.6	28.3	2.492	2.556	50	20:23:36	15.17	84.6399
2	926	0.3548	58.7	14.3	33.5	28.5	2.491	2.556	50	20:23:44	15.30	84.89206
2	934	0.3616	58.8	14.4	33.2	29.4	2.491	2.558	50	20:23:52	15.43	86.36175
2	942	0.3609	58.7	14.3	33.6	27.3	2.492	2.558	50	20:24:00	15.57	86.20723
2	950	0.3638	58.8	14.4	33.6	28.8	2.491	2.558	50	20:24:08	15.70	86.85229
2	958	0.3584	58.7	14.3	33.3	28.2	2.49	2.557	50	20:24:16	15.83	85.66144

2	967	0.3568	58.8	14.3	33.7	28.2	2.491	2.56	50	20:24:25	15.98	85.3171
2	975	0.3556	58.7	14.3	33.2	28	2.491	2.558	50	20:24:33	16.12	85.06136
2	984	0.356	58.8	14.4	33.7	28.5	2.492	2.558	50	20:24:42	16.27	85.14637
2	993	0.3595	58.8	14.3	33.4	28.7	2.491	2.557	50	20:24:51	16.42	85.90042
2	1002	0.3532	58.8	14.3	33.6	28.2	2.49	2.557	50	20:25:00	16.57	84.55632
2	1011	0.3472	58.8	14.3	33.5	28.3	2.491	2.558	50	20:25:09	16.72	83.33075
2	1019	0.3484	58.8	14.3	33.5	28.2	2.49	2.558	50	20:25:17	16.85	83.57167
2	1028	0.347	58.7	14.3	33.5	29.3	2.491	2.558	50	20:25:26	17.00	83.29079
2	1036	0.3458	58.8	14.4	33.4	28	2.489	2.56	50	20:25:34	17.13	83.05229
2	1044	0.3481	58.8	14.3	33.5	28.5	2.49	2.558	50	20:25:42	17.27	83.51125
2	1054	0.3493	58.8	14.4	33.6	28.1	2.491	2.557	50	20:25:52	17.43	83.75373
2	1062	0.349	58.7	14.3	33.5	27.6	2.49	2.56	50	20:26:00	17.57	83.69292
2	1070	0.3466	58.8	14.4	33.5	28.4	2.491	2.558	50	20:26:08	17.70	83.21106
2	1079	0.3459	58.8	14.4	33.4	28.6	2.49	2.558	50	20:26:17	17.85	83.07208
2	1087	0.3447	58.7	14.3	33.5	28.3	2.49	2.558	50	20:26:25	17.98	82.83546
2	1095	0.3456	58.8	14.3	33.4	28.4	2.491	2.558	50	20:26:33	18.12	83.01273
2	1103	0.3632	58.8	14.4	33.4	28.2	2.492	2.556	50	20:26:41	18.25	86.71777
2	1112	0.3498	58.8	14.3	33.5	29.1	2.489	2.56	50	20:26:50	18.40	83.85539
2	1120	0.3458	58.8	14.3	33.6	27.8	2.489	2.559	50	20:26:58	18.53	83.05229
2	1129	0.3471	58.7	14.3	33.3	28.1	2.49	2.558	50	20:27:07	18.68	83.31076
2	1137	0.3448	58.8	14.4	33.7	28.7	2.49	2.558	50	20:27:15	18.82	82.8551
2	1145	0.3479	58.8	14.3	33.7	27.8	2.492	2.558	50	20:27:23	18.95	83.47103
2	1153	0.3438	58.8	14.4	33.5	28.6	2.489	2.56	50	20:27:31	19.08	82.65934
2	1161	0.348	58.8	14.3	33.4	28.6	2.491	2.558	50	20:27:39	19.22	83.49113
2	1169	0.3451	58.8	14.3	33.6	28.1	2.493	2.557	50	20:27:47	19.35	82.91411
2	1178	0.3402	58.8	14.3	33.9	28	2.491	2.557	50	20:27:56	19.50	81.96631
2	1186	0.3426	58.8	14.4	33.7	28.6	2.491	2.557	50	20:28:04	19.63	82.4263
2	1195	0.3448	58.8	14.3	33.3	28.3	2.49	2.558	50	20:28:13	19.78	82.8551
2	1203	0.344	58.8	14.4	33.3	29.2	2.489	2.558	50	20:28:21	19.92	82.69838
2	1211	0.344	58.7	14.3	33.5	27.7	2.492	2.558	50	20:28:29	20.05	82.69838
2	1219	0.3454	58.8	14.3	33.2	29.8	2.491	2.557	50	20:28:37	20.18	82.97324
2	1228	0.3456	58.8	14.4	33.3	28.2	2.491	2.558	50	20:28:46	20.33	83.01273
2	1237	0.3429	58.8	14.3	33.3	28.2	2.491	2.56	50	20:28:55	20.48	82.48437
2	1245	0.3435	58.8	14.3	33.7	28.7	2.491	2.559	50	20:29:03	20.62	82.60089
2	1253	0.3442	58.8	14.3	33.2	27.7	2.491	2.557	50	20:29:11	20.75	82.73748
2	1261	0.344	58.8	14.4	33.6	29	2.491	2.557	50	20:29:19	20.88	82.69838
2	1270	0.3421	58.7	14.3	33.6	28.4	2.491	2.557	50	20:29:28	21.03	82.3298
2	1278	0.3429	58.8	14.4	33.5	28.1	2.492	2.558	50	20:29:36	21.17	82.48437
2	1286	0.3394	58.8	14.4	33.6	28.7	2.49	2.558	50	20:29:44	21.30	81.81477
2	1295	0.3451	58.7	14.3	33.4	28.4	2.491	2.557	50	20:29:53	21.45	82.91411
2	1303	0.3434	58.7	14.3	33.7	28.1	2.492	2.557	50	20:30:01	21.58	82.58144

2	1311	0.3451	58.8	14.4	33.2	29.3	2.492	2.556	50	20:30:09	21.72	82.91411
2	1319	0.3435	58.7	14.3	33.5	27.8	2.491	2.557	50	20:30:17	21.85	82.60089
2	1328	0.3411	58.8	14.4	33.3	28.9	2.491	2.557	50	20:30:26	22.00	82.13786
2	1336	0.3385	58.8	14.3	33.8	28.5	2.489	2.559	50	20:30:34	22.13	81.64535
2	1345	0.3396	58.8	14.4	33.5	28.6	2.491	2.557	50	20:30:43	22.28	81.85257
2	1354	0.341	58.8	14.4	33.4	29.8	2.49	2.558	50	20:30:52	22.43	82.11874
2	1362	0.3429	58.7	14.3	33.5	28.1	2.494	2.556	50	20:31:00	22.57	82.48437
2	1371	0.34	58.7	14.3	33.6	28.1	2.492	2.556	50	20:31:09	22.72	81.92834
2	1379	0.3417	58.8	14.3	33.6	29.8	2.49	2.558	50	20:31:17	22.85	82.25286
2	1388	0.3423	58.8	14.4	33.5	28.8	2.49	2.558	50	20:31:26	23.00	82.36836
2	1398	0.3404	58.8	14.3	33.5	28.5	2.49	2.558	50	20:31:36	23.17	82.00434
2	1406	0.341	58.7	14.3	33.3	29.1	2.491	2.557	50	20:31:44	23.30	82.11874
2	1414	0.3366	58.8	14.3	33.8	29	2.491	2.558	50	20:31:52	23.43	81.29137
2	1422	0.3338	58.8	14.4	33.6	28.7	2.49	2.557	50	20:32:00	23.57	80.77875
2	1430	0.3385	58.8	14.4	33.6	29.8	2.491	2.557	50	20:32:08	23.70	81.64535
2	1439	0.3399	58.7	14.3	33.5	27.9	2.49	2.558	50	20:32:17	23.85	81.90938
2	1447	0.3347	58.8	14.4	33.5	27.9	2.492	2.557	50	20:32:25	23.98	80.94235
2	1456	0.3389	58.7	14.3	33.5	27.1	2.49	2.558	50	20:32:34	24.13	81.72051
2	1465	0.3406	58.8	14.4	33.6	28.2	2.49	2.558	50	20:32:43	24.28	82.04242
2	1473	0.3404	58.8	14.3	33.5	29.5	2.49	2.558	50	20:32:51	24.42	82.00434
2	1481	0.3399	58.8	14.4	33.2	28.5	2.491	2.557	50	20:32:59	24.55	81.90938
2	1489	0.3405	58.8	14.3	33.7	29	2.492	2.557	50	20:33:07	24.68	82.02337
2	1499	0.338	58.8	14.3	33.5	29.6	2.491	2.557	50	20:33:17	24.85	81.55172
2	1507	0.3441	58.8	14.3	33.4	28.5	2.489	2.558	50	20:33:25	24.98	82.71792
2	1515	0.3401	58.8	14.4	33.4	28.9	2.492	2.558	50	20:33:33	25.12	81.94732
2	1523	0.3385	58.8	14.4	33.7	28.5	2.49	2.558	50	20:33:41	25.25	81.64535
2	1532	0.3396	58.8	14.4	33.9	28.1	2.491	2.557	50	20:33:50	25.40	81.85257
2	1540	0.3433	58.7	14.3	33.4	28.4	2.49	2.559	50	20:33:58	25.53	82.562
2	1549	0.3432	58.8	14.4	33.3	28.7	2.491	2.557	50	20:34:07	25.68	82.54257
2	1557	0.3406	58.8	14.3	33.6	28.4	2.49	2.559	50	20:34:15	25.82	82.04242
2	1566	0.3385	58.8	14.3	33.4	29.6	2.491	2.558	50	20:34:24	25.97	81.64535
2	1574	0.3379	58.7	14.3	33.1	28.9	2.491	2.557	50	20:34:32	26.10	81.53303
2	1583	0.3402	58.8	14.3	33.6	28.8	2.491	2.558	50	20:34:41	26.25	81.96631
2	1592	0.3412	58.8	14.4	33.4	28.9	2.49	2.559	50	20:34:50	26.40	82.15699
2	1600	0.3376	58.7	14.3	33.7	28.1	2.493	2.557	50	20:34:58	26.53	81.47706
2	1608	0.3385	58.7	14.3	33.5	28	2.491	2.558	50	20:35:06	26.67	81.64535
2	1616	0.3407	58.7	14.3	33.3	28.8	2.491	2.558	50	20:35:14	26.80	82.06148
2	1624	0.3394	58.8	14.3	33.1	28.4	2.491	2.558	50	20:35:22	26.93	81.81477
2	1633	0.3384	58.7	14.4	33.3	28.4	2.491	2.558	50	20:35:31	27.08	81.6266
2	1641	0.3424	58.7	14.3	33.5	28	2.49	2.558	50	20:35:39	27.22	82.38766
2	1649	0.3406	58.7	14.3	33.4	28.9	2.491	2.558	50	20:35:47	27.35	82.04242

2	1658	0.3396	58.8	14.4	33.6	29.3	2.492	2.559	50	20:35:56	27.50	81.85257
2	1666	0.3397	58.7	14.3	33.2	28.1	2.49	2.559	50	20:36:04	27.63	81.87149
2	1675	0.3432	58.7	14.3	33.6	28.9	2.491	2.556	50	20:36:13	27.78	82.54257
2	1683	0.3393	58.8	14.3	33.3	28.7	2.491	2.558	50	20:36:21	27.92	81.79589
2	1691	0.337	58.8	14.3	33.7	27.5	2.491	2.559	50	20:36:29	28.05	81.36548
2	1699	0.3373	58.8	14.4	33.6	29.2	2.491	2.556	50	20:36:37	28.18	81.42121
2	1707	0.3364	58.7	14.3	33.4	28.1	2.49	2.558	50	20:36:45	28.32	81.2544
2	1716	0.3373	58.7	14.3	33.4	30.2	2.492	2.558	50	20:36:54	28.47	81.42121
2	1724	0.3387	58.7	14.3	33.2	28.7	2.49	2.558	50	20:37:02	28.60	81.6829
2	1732	0.3423	58.7	14.4	33.6	28.2	2.491	2.558	50	20:37:10	28.73	82.36836
2	1740	0.3402	58.7	14.3	33.5	29.4	2.491	2.557	50	20:37:18	28.87	81.96631
2	1748	0.3414	58.7	14.3	33.5	28.5	2.491	2.557	50	20:37:26	29.00	82.1953
2	1757	0.3356	58.7	14.3	33.7	28.5	2.491	2.557	50	20:37:35	29.15	81.10706
2	1765	0.3395	58.8	14.3	33.5	28.5	2.491	2.556	50	20:37:43	29.28	81.83366
2	1773	0.3408	58.7	14.3	33.4	28.8	2.491	2.559	50	20:37:51	29.42	82.08055
2	1781	0.3407	58.7	14.3	33.3	28.8	2.49	2.559	50	20:37:59	29.55	82.06148
2	1790	0.34	58.8	14.3	33.4	29	2.491	2.557	50	20:38:08	29.70	81.92834
2	1798	0.3382	58.8	14.3	33.9	27.8	2.49	2.559	50	20:38:16	29.83	81.58913
3	8	0.3378	58.8	14.3	33.2	28.8	2.491	2.558	50	20:38:26	30.00	81.51436
3	16	0.3392	58.7	14.3	33.7	27.9	2.491	2.558	50	20:38:34	30.13	81.77703
3	24	0.3385	58.8	14.3	33.2	28.6	2.492	2.556	50	20:38:42	30.27	81.64535
3	33	0.3373	58.7	14.4	34.1	29.1	2.491	2.558	50	20:38:51	30.42	81.42121
3	42	0.3382	58.7	14.4	34.5	27.6	2.49	2.557	50	20:39:00	30.57	81.58913
3	51	0.3401	58.8	14.4	34.6	28.2	2.491	2.558	50	20:39:09	30.72	81.94732
3	59	0.3359	58.7	14.3	35.4	29.1	2.491	2.558	50	20:39:17	30.85	81.16221
3	67	0.3378	58.7	14.4	35.4	28	2.492	2.557	50	20:39:25	30.98	81.51436
3	75	0.3384	58.7	14.4	35.6	27.4	2.492	2.557	50	20:39:33	31.12	81.6266
3	83	0.3364	58.7	14.3	36.1	28.2	2.493	2.556	50	20:39:41	31.25	81.2544
3	92	0.3375	58.8	14.4	36.2	29.3	2.492	2.556	50	20:39:50	31.40	81.45843
3	100	0.3406	58.8	14.3	36.2	27.7	2.491	2.557	50	20:39:58	31.53	82.04242
3	109	0.3393	58.7	14.3	36.8	27.9	2.491	2.557	50	20:40:07	31.68	81.79589
3	117	0.3413	58.8	14.3	37.4	29.1	2.491	2.559	50	20:40:15	31.82	82.17614
3	126	0.3369	58.8	14.4	37.5	29	2.491	2.557	50	20:40:24	31.97	81.34693
3	134	0.3406	58.7	14.3	37.7	29.5	2.49	2.56	50	20:40:32	32.10	82.04242
3	142	0.3432	58.7	14.3	38.3	28.8	2.489	2.56	50	20:40:40	32.23	82.54257
3	151	0.3444	58.7	14.3	38.3	28.6	2.492	2.556	50	20:40:49	32.38	82.77663
3	159	0.3482	58.8	14.3	38.5	29	2.491	2.556	50	20:40:57	32.52	83.53137
3	167	0.3507	58.7	14.3	38.6	29.6	2.49	2.558	50	20:41:05	32.65	84.03928
3	176	0.3536	58.8	14.4	38.2	29.2	2.49	2.558	50	20:41:14	32.80	84.6399
3	184	0.3527	58.7	14.4	39	28.4	2.492	2.557	50	20:41:22	32.93	84.45218
3	192	0.3557	58.7	14.3	39.2	29.2	2.49	2.558	50	20:41:30	33.07	85.08259

3	200	0.3595	58.7	14.3	39.4	28.9	2.493	2.556	50	20:41:38	33.20	85.90042
3	208	0.3607	58.7	14.3	39.2	28.3	2.491	2.557	50	20:41:46	33.33	86.16322
3	217	0.3696	58.7	14.3	39.4	28.5	2.491	2.557	50	20:41:55	33.48	88.18152
3	225	0.3771	58.7	14.3	39.7	28.7	2.49	2.559	50	20:42:03	33.62	89.97939
3	234	0.3716	58.8	14.4	39.5	29.2	2.491	2.557	50	20:42:12	33.77	88.65215
3	242	0.3725	58.7	14.3	39.2	28.5	2.49	2.559	50	20:42:20	33.90	88.866
3	250	0.3809	58.7	14.3	39.5	28.4	2.489	2.56	50	20:42:28	34.03	90.92512
3	258	0.379	58.7	14.3	39.4	29.2	2.49	2.558	50	20:42:36	34.17	90.44929
3	267	0.3868	58.7	14.4	40.3	28.5	2.49	2.558	50	20:42:45	34.32	92.44094
3	275	0.3854	58.7	14.4	40.1	29.3	2.492	2.557	50	20:42:53	34.45	92.07597
3	284	0.3891	58.7	14.4	40.6	29	2.49	2.56	50	20:43:02	34.60	93.04775
3	292	0.3935	58.7	14.3	40.5	28.4	2.492	2.557	50	20:43:10	34.73	94.23383
3	301	0.3935	58.7	14.4	40.6	28.1	2.491	2.557	50	20:43:19	34.88	94.23383
3	309	0.3986	58.7	14.3	40.6	28.2	2.491	2.556	50	20:43:27	35.02	95.65071
3	318	0.4034	58.7	14.3	40.1	28.6	2.492	2.557	50	20:43:36	35.17	97.0263
3	326	0.4105	58.7	14.4	40.2	28.2	2.492	2.556	50	20:43:44	35.30	99.13741
3	334	0.4088	58.7	14.4	40.1	28	2.489	2.559	50	20:43:52	35.43	98.62353
3	342	0.4126	58.7	14.4	40.6	27.8	2.491	2.56	50	20:44:00	35.57	99.77959
3	350	0.4242	58.7	14.3	40.6	28.1	2.49	2.558	50	20:44:08	35.70	103.4767
3	359	0.4226	58.7	14.3	40.2	28.5	2.489	2.559	50	20:44:17	35.85	102.9515
3	367	0.4321	58.7	14.3	40.4	28.3	2.494	2.555	50	20:44:25	35.98	106.1437
3	376	0.4263	58.7	14.3	40.7	28.5	2.493	2.555	50	20:44:34	36.13	104.1737
3	384	0.4312	58.7	14.3	40.4	28.9	2.49	2.558	50	20:44:42	36.27	105.8336
3	392	0.4384	58.7	14.4	40.5	29.2	2.49	2.558	50	20:44:50	36.40	108.3598
3	401	0.4431	58.7	14.3	40.3	28.1	2.49	2.559	50	20:44:59	36.55	110.0657
3	409	0.4508	58.7	14.3	40.6	28.9	2.492	2.557	50	20:45:07	36.68	112.96
3	417	0.4473	58.7	14.3	40.5	29	2.493	2.556	50	20:45:15	36.82	111.6289
3	426	0.4606	58.7	14.4	40.1	28.3	2.492	2.557	50	20:45:24	36.97	116.8266
3	434	0.4642	58.7	14.3	40.5	29.3	2.491	2.559	50	20:45:32	37.10	118.2997
3	442	0.4628	58.7	14.3	40.6	28.9	2.494	2.556	50	20:45:40	37.23	117.7234
3	452	0.4593	58.7	14.4	40.5	28.3	2.491	2.555	50	20:45:50	37.40	116.3017
3	460	0.4613	58.7	14.3	40.2	28.4	2.492	2.556	50	20:45:58	37.53	117.1108
3	468	0.4673	58.7	14.4	40.4	28.3	2.492	2.558	50	20:46:06	37.67	119.5913
3	476	0.4721	58.7	14.3	40.7	28.6	2.491	2.558	50	20:46:14	37.80	121.6338
3	485	0.4711	58.7	14.3	40.2	28.3	2.492	2.557	50	20:46:23	37.95	121.204
3	493	0.477	58.7	14.4	40.5	27.5	2.491	2.556	50	20:46:31	38.08	123.7732
3	501	0.4772	58.7	14.3	40.2	29.5	2.491	2.558	50	20:46:39	38.22	123.8617
3	509	0.4701	58.7	14.3	40.6	28.2	2.488	2.56	50	20:46:47	38.35	120.7764
3	517	0.4747	58.7	14.3	40.5	28.2	2.491	2.558	50	20:46:55	38.48	122.7621
3	526	0.4778	58.7	14.4	40	29	2.49	2.559	50	20:47:04	38.63	124.1278
3	534	0.4809	58.7	14.3	40.7	28.2	2.49	2.558	50	20:47:12	38.77	125.5157

3	543	0.4784	58.7	14.4	40.5	29	2.493	2.556	50	20:47:21	38.92	124.3947
3	551	0.4741	58.7	14.4	40.6	28.2	2.49	2.557	50	20:47:29	39.05	122.5004
3	559	0.4794	58.7	14.3	40.2	28.5	2.491	2.558	50	20:47:37	39.18	124.8413
3	567	0.4819	58.7	14.3	40.4	28.5	2.491	2.558	50	20:47:45	39.32	125.9682
3	575	0.4825	58.7	14.4	40.4	27.7	2.491	2.558	50	20:47:53	39.45	126.2409
3	584	0.4907	58.7	14.3	40.3	27.6	2.491	2.557	50	20:48:02	39.60	130.0528
3	592	0.4812	58.7	14.4	40.4	28.3	2.491	2.556	50	20:48:10	39.73	125.6512
3	600	0.4822	58.7	14.3	40.4	27.8	2.491	2.557	50	20:48:18	39.87	126.1045
3	609	0.4868	58.7	14.3	40.2	28.3	2.49	2.557	50	20:48:27	40.02	128.2198
3	617	0.4864	58.7	14.4	40.6	27.5	2.491	2.557	50	20:48:35	40.15	128.0338
3	625	0.4846	58.7	14.3	40.5	27.9	2.491	2.556	50	20:48:43	40.28	127.2018
3	633	0.4861	58.7	14.3	40	27.8	2.492	2.556	50	20:48:51	40.42	127.8946
3	641	0.4792	58.7	14.4	40.4	28.3	2.492	2.557	50	20:48:59	40.55	124.7518
3	650	0.4844	58.7	14.3	40.3	27.9	2.492	2.557	50	20:49:08	40.70	127.1099
3	658	0.4871	58.7	14.4	40.1	27.7	2.491	2.557	50	20:49:16	40.83	128.3595
3	666	0.4852	58.7	14.3	40.5	27.5	2.492	2.557	50	20:49:24	40.97	127.4783
3	675	0.4857	58.7	14.3	40.3	27.9	2.491	2.557	50	20:49:33	41.12	127.7094
3	683	0.4823	58.7	14.4	40.3	28.4	2.493	2.556	50	20:49:41	41.25	126.1499
3	691	0.4795	58.7	14.4	40.2	28.4	2.49	2.559	50	20:49:49	41.38	124.8861
3	700	0.4783	58.7	14.4	40.3	28.9	2.491	2.559	50	20:49:58	41.53	124.3501
3	708	0.4786	58.6	14.3	40.1	28.4	2.492	2.557	50	20:50:06	41.67	124.4838
3	716	0.4763	58.7	14.3	40.4	27.8	2.49	2.558	50	20:50:14	41.80	123.4642
3	724	0.4832	58.7	14.3	40.8	28.1	2.492	2.557	50	20:50:22	41.93	126.56
3	733	0.4771	58.6	14.3	40.6	28.4	2.492	2.558	50	20:50:31	42.08	123.8175
3	741	0.4812	58.6	14.4	40.3	27.6	2.492	2.556	50	20:50:39	42.22	125.6512
3	749	0.4803	58.6	14.3	40.3	28.3	2.492	2.556	50	20:50:47	42.35	125.2453
3	757	0.4763	58.7	14.4	40.2	28.4	2.49	2.558	50	20:50:55	42.48	123.4642
3	765	0.4759	58.6	14.3	40.1	27.1	2.49	2.558	50	20:51:03	42.62	123.2881
3	774	0.472	58.6	14.3	40.4	27.3	2.491	2.558	50	20:51:12	42.77	121.5908
3	782	0.4743	58.7	14.4	40.4	28.3	2.491	2.558	50	20:51:20	42.90	122.5876
3	790	0.4783	58.6	14.3	40.6	27.2	2.491	2.557	50	20:51:28	43.03	124.3501
3	798	0.4797	58.7	14.4	39.9	27.9	2.492	2.555	50	20:51:36	43.17	124.9758
3	807	0.4792	58.6	14.3	40.6	27.6	2.49	2.558	50	20:51:45	43.32	124.7518
3	816	0.4754	58.6	14.3	40	28.1	2.49	2.557	50	20:51:54	43.47	123.0686
3	824	0.4821	58.7	14.4	40.3	27.8	2.491	2.557	50	20:52:02	43.60	126.059
3	832	0.4774	58.7	14.3	40.2	28.3	2.491	2.557	50	20:52:10	43.73	123.9503
3	840	0.4722	58.6	14.3	40.4	27.5	2.491	2.556	50	20:52:18	43.87	121.677
3	848	0.4756	58.7	14.3	40.2	28.1	2.489	2.559	50	20:52:26	44.00	123.1563
3	857	0.4823	58.7	14.4	40.5	28	2.491	2.558	50	20:52:35	44.15	126.1499
3	865	0.4809	58.7	14.3	40.7	27.6	2.492	2.558	50	20:52:43	44.28	125.5157
3	873	0.4792	58.7	14.3	40.4	28.1	2.491	2.556	50	20:52:51	44.42	124.7518

3	881	0.4854	58.7	14.4	40.4	27.4	2.49	2.558	50	20:52:59	44.55	127.5707
3	890	0.4863	58.7	14.4	40.3	27.2	2.49	2.558	50	20:53:08	44.70	127.9874
3	898	0.4824	58.7	14.3	40.6	27.5	2.493	2.556	50	20:53:16	44.83	126.1954
3	906	0.4839	58.7	14.3	40.6	27.4	2.491	2.557	50	20:53:24	44.97	126.8804
3	914	0.4845	58.7	14.4	40.5	27.7	2.491	2.558	50	20:53:32	45.10	127.1558
3	923	0.4785	58.7	14.3	40.4	28.9	2.491	2.557	50	20:53:41	45.25	124.4392
3	931	0.4841	58.7	14.3	40.6	28.3	2.49	2.558	50	20:53:49	45.38	126.9721
3	939	0.4788	58.7	14.3	40.3	28.1	2.49	2.559	50	20:53:57	45.52	124.573
3	948	0.4726	58.7	14.3	40.2	26.9	2.49	2.559	50	20:54:06	45.67	121.8496
3	957	0.4803	58.7	14.4	40.7	27.4	2.49	2.558	50	20:54:15	45.82	125.2453
3	965	0.4777	58.6	14.3	40.6	28.2	2.49	2.557	50	20:54:23	45.95	124.0834
3	974	0.4801	58.7	14.3	40.7	26.9	2.492	2.556	50	20:54:32	46.10	125.1554
3	982	0.4747	58.7	14.3	40.4	28.2	2.492	2.558	50	20:54:40	46.23	122.7621
3	991	0.4832	58.7	14.4	40.4	27.7	2.491	2.557	50	20:54:49	46.38	126.56
3	999	0.483	58.7	14.3	40.2	27.4	2.491	2.558	50	20:54:57	46.52	126.4687
3	1007	0.4782	58.7	14.4	40.6	26.8	2.492	2.556	50	20:55:05	46.65	124.3056
3	1016	0.4786	58.7	14.3	40.2	27.7	2.491	2.559	50	20:55:14	46.80	124.4838
3	1025	0.4817	58.7	14.3	40.3	27.9	2.49	2.558	50	20:55:23	46.95	125.8776
3	1033	0.4785	58.7	14.4	40.2	28.1	2.49	2.557	50	20:55:31	47.08	124.4392
3	1041	0.4834	58.7	14.3	40.3	27.4	2.491	2.558	50	20:55:39	47.22	126.6514
3	1049	0.4775	58.7	14.4	40	27	2.491	2.557	50	20:55:47	47.35	123.9946
3	1057	0.4763	58.7	14.4	40.2	27.4	2.491	2.558	50	20:55:55	47.48	123.4642
3	1065	0.4772	58.7	14.4	40.3	28.1	2.492	2.557	50	20:56:03	47.62	123.8617
3	1074	0.4747	58.7	14.4	40.3	27.7	2.49	2.558	50	20:56:12	47.77	122.7621
3	1082	0.4749	58.7	14.4	40.3	27.7	2.491	2.559	50	20:56:20	47.90	122.8496
3	1090	0.4764	58.7	14.3	40.1	27.7	2.492	2.559	50	20:56:28	48.03	123.5083
3	1098	0.4733	58.7	14.4	40.4	27.4	2.492	2.558	50	20:56:36	48.17	122.1527
3	1107	0.472	58.7	14.4	40.4	26.7	2.493	2.556	50	20:56:45	48.32	121.5908
3	1115	0.4684	58.7	14.4	40.9	27.1	2.49	2.558	50	20:56:53	48.45	120.0548
3	1124	0.4727	58.7	14.4	40.3	27.4	2.493	2.556	50	20:57:02	48.60	121.8928
3	1133	0.4705	58.7	14.3	40.5	27.6	2.492	2.558	50	20:57:11	48.75	120.9472
3	1141	0.4724	58.7	14.4	40.4	27	2.489	2.558	50	20:57:19	48.88	121.7632
3	1149	0.4698	58.7	14.3	40.2	27.5	2.49	2.558	50	20:57:27	49.02	120.6486
3	1158	0.4719	58.7	14.4	40.5	26.7	2.491	2.557	50	20:57:36	49.17	121.5477
3	1166	0.4774	58.7	14.3	40.2	27.5	2.491	2.557	50	20:57:44	49.30	123.9503
3	1174	0.4706	58.7	14.3	40.4	27.4	2.492	2.557	50	20:57:52	49.43	120.9899
3	1182	0.478	58.7	14.4	40.5	27.1	2.491	2.557	50	20:58:00	49.57	124.2166
3	1190	0.4806	58.7	14.3	40.6	26.8	2.492	2.556	50	20:58:08	49.70	125.3804
3	1198	0.474	58.7	14.4	40.4	28.2	2.491	2.557	50	20:58:16	49.83	122.4568
3	1206	0.4693	58.7	14.3	40.5	28.1	2.491	2.558	50	20:58:24	49.97	120.436
3	1215	0.4671	58.7	14.4	40.5	28.4	2.491	2.557	50	20:58:33	50.12	119.5073

3	1223	0.4687	58.6	14.3	40.3	28.4	2.49	2.558	50	20:58:41	50.25	120.1816
3	1231	0.4664	58.7	14.4	40.4	28.1	2.492	2.556	50	20:58:49	50.38	119.2141
3	1239	0.4743	58.7	14.4	40.2	27.5	2.492	2.558	50	20:58:57	50.52	122.5876
3	1247	0.472	58.7	14.3	40.3	27.4	2.491	2.558	50	20:59:05	50.65	121.5908
3	1255	0.4741	58.7	14.4	40.5	27.6	2.492	2.557	50	20:59:13	50.78	122.5004
3	1263	0.4708	58.7	14.3	40.2	27.2	2.49	2.558	50	20:59:21	50.92	121.0755
3	1271	0.4729	58.7	14.4	40.4	27.8	2.492	2.556	50	20:59:29	51.05	121.9794
3	1279	0.4715	58.7	14.3	40.5	27.5	2.49	2.559	50	20:59:37	51.18	121.3757
3	1288	0.4717	58.7	14.3	40.3	28	2.49	2.559	50	20:59:46	51.33	121.4616
3	1296	0.4749	58.7	14.4	40.5	27.7	2.492	2.557	50	20:59:54	51.47	122.8496
3	1304	0.4709	58.7	14.3	40.5	27.7	2.491	2.557	50	21:00:02	51.60	121.1183
3	1313	0.4666	58.7	14.4	40.4	28	2.491	2.557	50	21:00:11	51.75	119.2977
3	1321	0.4708	58.7	14.3	40.6	27.4	2.491	2.557	50	21:00:19	51.88	121.0755
3	1329	0.4661	58.7	14.4	40.3	28.2	2.491	2.557	50	21:00:27	52.02	119.0888
3	1338	0.4661	58.7	14.4	40.3	27.6	2.492	2.555	50	21:00:36	52.17	119.0888
3	1346	0.4666	58.7	14.3	40.5	27.8	2.491	2.558	50	21:00:44	52.30	119.2977
3	1354	0.4715	58.7	14.4	40.6	27.2	2.491	2.557	50	21:00:52	52.43	121.3757
3	1363	0.4666	58.7	14.4	40.5	27.2	2.492	2.558	50	21:01:01	52.58	119.2977
3	1371	0.4648	58.7	14.3	40.1	28.3	2.491	2.556	50	21:01:09	52.72	118.548
3	1379	0.4608	58.7	14.3	40.6	27.4	2.492	2.557	50	21:01:17	52.85	116.9077
3	1388	0.462	58.7	14.3	40.2	27.3	2.491	2.558	50	21:01:26	53.00	117.3961
3	1396	0.4601	58.7	14.4	40.4	27.5	2.49	2.558	50	21:01:34	53.13	116.6243
3	1404	0.4624	58.7	14.4	40.5	27.1	2.491	2.556	50	21:01:42	53.27	117.5596
3	1413	0.4619	58.7	14.3	40.3	27.9	2.492	2.557	50	21:01:51	53.42	117.3552
3	1422	0.4645	58.7	14.4	40.6	28	2.491	2.557	50	21:02:00	53.57	118.4237
3	1430	0.467	58.7	14.3	40.7	27.4	2.491	2.557	50	21:02:08	53.70	119.4653
3	1439	0.4647	58.7	14.4	40.7	27.8	2.492	2.555	50	21:02:17	53.85	118.5066
3	1448	0.4595	58.7	14.4	40.1	27.5	2.493	2.557	50	21:02:26	54.00	116.3822
3	1456	0.4593	58.7	14.3	40.6	27.6	2.49	2.556	50	21:02:34	54.13	116.3017
3	1465	0.4622	58.7	14.3	39.6	27.4	2.491	2.557	50	21:02:43	54.28	117.4778
3	1473	0.454	58.7	14.3	39.9	28.4	2.493	2.556	50	21:02:51	54.42	114.1997
3	1481	0.4592	58.7	14.3	40.5	27.3	2.491	2.558	50	21:02:59	54.55	116.2614
3	1490	0.4594	58.7	14.4	40.6	27.6	2.491	2.557	50	21:03:08	54.70	116.3419
3	1498	0.4582	58.7	14.4	40.5	27.1	2.491	2.558	50	21:03:16	54.83	115.8604
3	1506	0.4582	58.7	14.3	40.1	27	2.491	2.556	50	21:03:24	54.97	115.8604
3	1515	0.4512	58.7	14.4	40.3	28.4	2.49	2.558	50	21:03:33	55.12	113.1137
3	1523	0.4505	58.7	14.3	40.2	27.3	2.49	2.557	50	21:03:41	55.25	112.8449
3	1532	0.4517	58.7	14.3	40.3	27.4	2.49	2.556	50	21:03:50	55.40	113.3064
3	1540	0.4509	58.7	14.4	40.5	28.4	2.492	2.555	50	21:03:58	55.53	112.9984
3	1548	0.4526	58.7	14.4	40.1	27.7	2.491	2.556	50	21:04:06	55.67	113.6546
3	1556	0.4516	58.7	14.3	40.6	28.1	2.492	2.555	50	21:04:14	55.80	113.2678

3	1564	0.4529	58.7	14.3	40.2	27.9	2.493	2.557	50	21:04:22	55.93	113.7711
3	1572	0.4525	58.7	14.4	40.4	28	2.491	2.557	50	21:04:30	56.07	113.6159
3	1580	0.4441	58.7	14.4	40.2	27.6	2.492	2.556	50	21:04:38	56.20	110.4346
3	1589	0.4449	58.7	14.3	40.1	27.9	2.491	2.556	50	21:04:47	56.35	110.7311
3	1597	0.441	58.7	14.3	40.6	27	2.49	2.558	50	21:04:55	56.48	109.2979
3	1605	0.446	58.7	14.3	40.4	28.6	2.491	2.556	50	21:05:03	56.62	111.1411
3	1613	0.4441	58.7	14.3	40.2	28	2.489	2.558	50	21:05:11	56.75	110.4346
3	1621	0.4437	58.7	14.4	40.8	27.5	2.493	2.555	50	21:05:19	56.88	110.2868
3	1630	0.4471	58.7	14.3	40.4	27.4	2.491	2.556	50	21:05:28	57.03	111.5537
3	1638	0.449	58.7	14.3	40.4	27.6	2.492	2.558	50	21:05:36	57.17	112.2722
3	1647	0.4474	58.7	14.3	40.8	27.2	2.491	2.558	50	21:05:45	57.32	111.6666
3	1655	0.4441	58.7	14.3	40.4	26.9	2.492	2.555	50	21:05:53	57.45	110.4346
3	1663	0.4433	58.7	14.3	40.7	27.6	2.492	2.557	50	21:06:01	57.58	110.1393
3	1672	0.4475	58.7	14.4	40.6	27.5	2.492	2.556	50	21:06:10	57.73	111.7043
3	1681	0.4398	58.7	14.4	40.6	27.8	2.491	2.555	50	21:06:19	57.88	108.8632
3	1689	0.4401	58.7	14.4	40.6	26.8	2.492	2.556	50	21:06:27	58.02	108.9716
3	1697	0.4394	58.7	14.3	40.6	27.3	2.493	2.556	50	21:06:35	58.15	108.7189
3	1706	0.4457	58.7	14.4	40.1	27.5	2.491	2.557	50	21:06:44	58.30	111.0291
3	1713	0.437	58.7	14.4	40.3	26.7	2.491	2.557	50	21:06:51	58.42	107.8604
3	1722	0.442	58.7	14.4	40.3	27.2	2.492	2.556	50	21:07:00	58.57	109.6624
3	1730	0.4404	58.7	14.3	40.2	27.4	2.49	2.56	50	21:07:08	58.70	109.0801
3	1738	0.4407	58.7	14.3	40.5	26.6	2.491	2.556	50	21:07:16	58.83	109.1889
3	1746	0.4443	58.7	14.4	40	27.3	2.491	2.556	50	21:07:24	58.97	110.5086
3	1754	0.4408	58.7	14.4	40.3	26.9	2.491	2.556	50	21:07:32	59.10	109.2252
3	1762	0.4392	58.7	14.3	39.9	27.7	2.491	2.557	50	21:07:40	59.23	108.6469
3	1770	0.4409	58.7	14.3	40.1	26.9	2.491	2.558	50	21:07:48	59.37	109.2615
3	1778	0.4404	58.7	14.3	40.5	27.1	2.491	2.558	50	21:07:56	59.50	109.0801
3	1786	0.4425	58.7	14.4	40.5	26.5	2.493	2.556	50	21:08:04	59.63	109.8454
3	1794	0.442	58.7	14.3	40.2	27.3	2.491	2.557	50	21:08:12	59.77	109.6624
4	9	0.4371	58.7	14.3	40.6	27.5	2.492	2.557	50	21:08:27	60.02	107.8959
4	17	0.4343	58.7	14.3	41.3	28.2	2.492	2.557	50	21:08:35	60.15	106.9085
4	25	0.4322	58.7	14.3	41.8	28	2.492	2.556	50	21:08:43	60.28	106.1783
4	34	0.4365	58.7	14.4	41.2	28.7	2.492	2.556	50	21:08:52	60.43	107.683
4	41	0.4356	58.7	14.3	42.2	27.4	2.493	2.555	50	21:08:59	60.55	107.3649
4	50	0.4371	58.7	14.3	42.1	29.2	2.491	2.557	50	21:09:08	60.70	107.8959
4	58	0.4381	58.7	14.3	42.7	28.4	2.493	2.554	50	21:09:16	60.83	108.2524
4	67	0.4392	58.7	14.3	43.5	29.6	2.492	2.556	50	21:09:25	60.98	108.6469
4	76	0.4485	58.7	14.4	43.2	28.1	2.49	2.557	50	21:09:34	61.13	112.0824
4	84	0.4463	58.7	14.3	43.6	28.9	2.491	2.556	50	21:09:42	61.27	111.2534
4	92	0.4474	58.7	14.4	44.5	28.5	2.49	2.559	50	21:09:50	61.40	111.6666
4	101	0.4527	58.7	14.3	43.6	29.1	2.491	2.557	50	21:09:59	61.55	113.6934

4	109	0.459	58.7	14.3	44.5	29.1	2.49	2.558	50	21:10:07	61.68	116.1811
4	117	0.4574	58.7	14.3	45.2	28.5	2.491	2.558	50	21:10:15	61.82	115.5411
4	126	0.4654	58.7	14.3	45.6	28.4	2.492	2.556	50	21:10:24	61.97	118.7971
4	134	0.4729	58.7	14.4	45.9	27.7	2.492	2.557	50	21:10:32	62.10	121.9794
4	143	0.4774	58.7	14.4	46.1	28.5	2.491	2.558	50	21:10:41	62.25	123.9503
4	152	0.4888	58.7	14.4	46.3	30.2	2.491	2.557	50	21:10:50	62.40	129.1552
4	160	0.4922	58.7	14.3	46.2	29.6	2.49	2.557	50	21:10:58	62.53	130.7676
4	168	0.4991	58.7	14.3	47.4	29.4	2.491	2.558	50	21:11:06	62.67	134.1263
4	176	0.5083	58.7	14.3	47.7	29.5	2.492	2.557	50	21:11:14	62.80	138.7888
4	185	0.5304	58.7	14.3	47.1	28.8	2.491	2.558	50	21:11:23	62.95	150.8821
4	194	0.6112	58.7	14.3	47.2	29.2	2.493	2.555	50	21:11:32	63.10	207.033
4	202	0.6723	58.7	14.4	47.3	29	2.492	2.556	50	21:11:40	63.23	263.8461
4	210	0.608	58.7	14.3	47.1	28.4	2.491	2.556	50	21:11:48	63.37	204.42
4	218	0.6234	58.7	14.3	47.3	28.9	2.493	2.558	50	21:11:56	63.50	217.3133
4	227	0.6713	58.7	14.3	47.3	29.7	2.491	2.556	50	21:12:05	63.65	262.8051
4	235	0.675	58.7	14.4	48.4	28.8	2.49	2.557	50	21:12:13	63.78	266.6764
4	243	0.6529	58.7	14.4	48.1	28.7	2.49	2.559	50	21:12:21	63.92	244.3312
4	252	0.6667	58.7	14.4	48.8	29.4	2.49	2.557	50	21:12:30	64.07	258.0659
4	260	0.6858	58.7	14.3	48.8	29.6	2.491	2.556	50	21:12:38	64.20	278.2837
4	268	0.6899	58.7	14.3	48.1	29.5	2.49	2.558	50	21:12:46	64.33	282.8116
4	277	0.6925	58.7	14.3	48.4	29.8	2.492	2.557	50	21:12:55	64.48	285.718
4	285	0.7039	58.7	14.4	48.5	29.7	2.49	2.556	50	21:13:03	64.62	298.7873
4	293	0.7191	58.7	14.4	48.5	29.2	2.492	2.556	50	21:13:11	64.75	317.0552
4	301	0.7192	58.7	14.4	48.5	29.2	2.494	2.556	50	21:13:19	64.88	317.1787
4	309	0.7228	58.7	14.4	49.2	29.9	2.491	2.557	50	21:13:27	65.02	321.6509
4	318	0.7405	58.7	14.3	49.4	30	2.491	2.558	50	21:13:36	65.17	344.4621
4	326	0.7564	58.7	14.3	49.6	30.9	2.491	2.556	50	21:13:44	65.30	366.1498
4	335	0.7565	58.7	14.4	49.5	30.9	2.492	2.557	50	21:13:53	65.45	366.2899
4	343	0.7667	58.7	14.3	49.2	30.9	2.491	2.556	50	21:14:01	65.58	380.8213
4	351	0.759	58.7	14.3	49.4	29.7	2.491	2.556	50	21:14:09	65.72	369.8065
4	359	0.7649	58.7	14.3	49.3	30	2.491	2.557	50	21:14:17	65.85	378.2215
4	369	0.7737	58.7	14.3	49	30.5	2.491	2.557	50	21:14:27	66.02	391.0776
4	377	0.7751	58.7	14.3	49.3	30.3	2.491	2.556	50	21:14:35	66.15	393.1569
4	385	0.7803	58.7	14.3	49.4	30.2	2.492	2.556	50	21:14:43	66.28	400.9626
4	393	0.7839	58.7	14.3	49.3	30.2	2.49	2.557	50	21:14:51	66.42	406.4434
4	401	0.7803	58.7	14.3	49.7	30.6	2.492	2.557	50	21:14:59	66.55	400.9626
4	409	0.801	58.7	14.4	49.4	30.5	2.492	2.556	50	21:15:07	66.68	433.3485
4	417	0.8048	58.7	14.3	49.2	30.1	2.49	2.557	50	21:15:15	66.82	439.5261
4	426	0.7963	58.7	14.4	49.2	30.5	2.492	2.557	50	21:15:24	66.97	425.8085
4	434	0.8061	58.7	14.3	49.5	29.8	2.492	2.555	50	21:15:32	67.10	441.6563
4	443	0.7963	58.7	14.3	49.7	30	2.492	2.556	50	21:15:41	67.25	425.8085

4	451	0.8041	58.7	14.4	49.4	29.3	2.49	2.555	50	21:15:49	67.38	438.3826
4	459	0.8045	58.7	14.3	49.6	29.4	2.492	2.556	50	21:15:57	67.52	439.0357
4	467	0.8199	58.7	14.3	49.3	30.2	2.491	2.558	50	21:16:05	67.65	464.8037
4	476	0.8137	58.7	14.4	49.8	29.4	2.493	2.556	50	21:16:14	67.80	454.2826
4	484	0.8145	58.7	14.3	49.9	29.8	2.491	2.557	50	21:16:22	67.93	455.6289
4	492	0.8078	58.7	14.3	49.3	30	2.492	2.556	50	21:16:30	68.07	444.4549
4	501	0.83	58.7	14.3	49.4	30.5	2.491	2.557	50	21:16:39	68.22	482.374
4	509	0.8333	58.7	14.3	49.6	30.3	2.492	2.556	50	21:16:47	68.35	488.2319
4	517	0.8271	58.7	14.4	49.3	29.8	2.492	2.556	50	21:16:55	68.48	477.2739
4	525	0.8396	58.7	14.4	49.7	29.3	2.491	2.556	50	21:17:03	68.62	499.5774
4	533	0.8457	58.7	14.4	49.2	30.9	2.491	2.556	50	21:17:11	68.75	510.7674
4	542	0.8583	58.7	14.3	49.5	30.4	2.493	2.556	50	21:17:20	68.90	534.5283
4	550	0.8498	58.7	14.4	49.4	29.5	2.492	2.557	50	21:17:28	69.03	518.4028
4	559	0.8451	58.7	14.4	49.4	29.7	2.492	2.557	50	21:17:37	69.18	509.6577
4	567	0.8568	58.7	14.4	49.6	29.8	2.491	2.556	50	21:17:45	69.32	531.6534
4	575	0.8559	58.7	14.3	49.5	29.3	2.492	2.557	50	21:17:53	69.45	529.9345
4	583	0.8501	58.7	14.3	49.4	30.4	2.49	2.556	50	21:18:01	69.58	518.9651
4	591	0.8574	58.7	14.3	49.1	30.4	2.491	2.559	50	21:18:09	69.72	532.8018
4	599	0.8486	58.7	14.3	49.5	29.5	2.491	2.556	50	21:18:17	69.85	516.1585
4	608	0.8346	58.7	14.4	49.4	30.2	2.492	2.556	50	21:18:26	70.00	490.5556
4	616	0.8482	58.7	14.3	49.4	29.6	2.492	2.556	50	21:18:34	70.13	515.4121
4	625	0.8386	58.7	14.4	49.5	29.9	2.493	2.555	50	21:18:43	70.28	497.7622
4	633	0.8447	58.7	14.4	49.6	30	2.491	2.557	50	21:18:51	70.42	508.9191
4	641	0.8436	58.7	14.3	49.6	29.8	2.491	2.557	50	21:18:59	70.55	506.8922
4	650	0.8335	58.7	14.3	49.3	30.5	2.492	2.556	50	21:19:08	70.70	488.5888
4	659	0.8414	58.7	14.4	49.6	29.6	2.491	2.558	50	21:19:17	70.85	502.8583
4	667	0.8355	58.7	14.3	49.4	29.2	2.491	2.556	50	21:19:25	70.98	492.1696
4	675	0.8508	58.7	14.3	49.5	29	2.492	2.555	50	21:19:33	71.12	520.2791
4	684	0.8389	58.7	14.4	49.4	29.9	2.491	2.557	50	21:19:42	71.27	498.3062
4	693	0.8441	58.7	14.4	49.2	31.4	2.493	2.555	50	21:19:51	71.42	507.8127
4	702	0.8512	58.7	14.3	49.3	29.9	2.49	2.557	50	21:20:00	71.57	521.0312
4	710	0.8394	58.7	14.3	49.6	29.3	2.493	2.556	50	21:20:08	71.70	499.2139
4	718	0.8378	58.7	14.3	49.5	29.6	2.493	2.556	50	21:20:16	71.83	496.314
4	726	0.8372	58.7	14.4	49.6	29.6	2.491	2.555	50	21:20:24	71.97	495.2301
4	734	0.8286	58.7	14.4	49.5	29.7	2.491	2.556	50	21:20:32	72.10	479.9063
4	743	0.8411	58.7	14.3	49.2	29.7	2.491	2.557	50	21:20:41	72.25	502.3103
4	751	0.8321	58.7	14.3	49.5	30	2.49	2.557	50	21:20:49	72.38	486.095
4	759	0.8247	58.7	14.3	49.4	29.4	2.491	2.557	50	21:20:57	72.52	473.0869
4	767	0.8277	58.7	14.4	49.3	29.5	2.492	2.557	50	21:21:05	72.65	478.3255
4	775	0.8207	58.7	14.3	49.2	30.1	2.491	2.557	50	21:21:13	72.78	466.1758
4	783	0.8193	58.7	14.3	49.3	30.1	2.491	2.558	50	21:21:21	72.92	463.7768

4	792	0.8305	58.7	14.3	49.5	29.2	2.492	2.557	50	21:21:30	73.07	483.2578
4	800	0.8265	58.7	14.4	49.3	29.8	2.492	2.557	50	21:21:38	73.20	476.2243
4	808	0.8199	58.7	14.3	48.9	30.2	2.493	2.556	50	21:21:46	73.33	464.8037
4	817	0.8173	58.7	14.4	49.6	29.8	2.491	2.555	50	21:21:55	73.48	460.3673
4	825	0.816	58.7	14.4	49.5	29.3	2.491	2.558	50	21:22:03	73.62	458.1623
4	834	0.8187	58.7	14.3	49.4	30	2.491	2.557	50	21:22:12	73.77	462.7518
4	842	0.8053	58.7	14.3	49.3	29.2	2.492	2.556	50	21:22:20	73.90	440.3444
4	851	0.8126	58.7	14.3	49.6	29	2.492	2.555	50	21:22:29	74.05	452.4367
4	859	0.8011	58.7	14.4	49.8	29.4	2.49	2.557	50	21:22:37	74.18	433.5101
4	868	0.8082	58.7	14.3	49.2	29.9	2.491	2.558	50	21:22:46	74.33	445.1155
4	876	0.7996	58.7	14.4	49.5	29.3	2.491	2.557	50	21:22:54	74.47	431.091
4	884	0.8003	58.7	14.3	49.3	29.2	2.492	2.557	50	21:23:02	74.60	432.2185
4	893	0.8024	58.7	14.3	49.3	29.4	2.491	2.556	50	21:23:11	74.75	435.6159
4	902	0.8014	58.7	14.3	49.4	29.2	2.49	2.557	50	21:23:20	74.90	433.9953
4	910	0.7887	58.7	14.4	49.6	30.2	2.491	2.558	50	21:23:28	75.03	413.8495
4	919	0.7983	58.7	14.3	49.1	29.5	2.491	2.558	50	21:23:37	75.18	429.0035
4	927	0.7982	58.7	14.3	49.7	30	2.49	2.559	50	21:23:45	75.32	428.8433
4	935	0.7851	58.7	14.4	49.5	30.1	2.493	2.557	50	21:23:53	75.45	408.2843
4	943	0.7931	58.7	14.4	49.4	29.7	2.49	2.556	50	21:24:01	75.58	420.7382
4	952	0.7819	58.7	14.3	49.4	29.8	2.492	2.557	50	21:24:10	75.73	403.3907
4	960	0.7806	58.7	14.4	49.3	30.1	2.492	2.557	50	21:24:18	75.87	401.4169
4	968	0.777	58.7	14.3	49.3	29.5	2.491	2.557	50	21:24:26	76.00	395.9939
4	977	0.7927	58.7	14.4	49.1	29.6	2.491	2.557	50	21:24:35	76.15	420.108
4	986	0.7818	58.7	14.3	49.3	29.8	2.489	2.558	50	21:24:44	76.30	403.2386
4	994	0.7816	58.7	14.4	49.3	30.1	2.491	2.556	50	21:24:52	76.43	402.9345
4	1002	0.784	58.7	14.3	49.4	29.7	2.491	2.556	50	21:25:00	76.57	406.5965
4	1010	0.7783	58.7	14.3	49	29.5	2.493	2.555	50	21:25:08	76.70	397.945
4	1018	0.7838	58.7	14.4	49	30.7	2.49	2.557	50	21:25:16	76.83	406.2903
4	1026	0.7851	58.7	14.4	49.1	29.7	2.491	2.558	50	21:25:24	76.97	408.2843
4	1035	0.7829	58.7	14.3	49.7	29.3	2.49	2.558	50	21:25:33	77.12	404.9146
4	1042	0.7789	58.7	14.4	48.9	30.2	2.489	2.556	50	21:25:40	77.23	398.8482
4	1051	0.7806	58.7	14.3	49.4	30.6	2.49	2.557	50	21:25:49	77.38	401.4169
4	1059	0.7814	58.7	14.3	49.5	29.3	2.49	2.557	50	21:25:57	77.52	402.6306
4	1066	0.7723	58.7	14.3	49.4	29.7	2.493	2.555	50	21:26:04	77.63	389.0076
4	1076	0.7795	58.7	14.3	49.5	30.4	2.491	2.555	50	21:26:14	77.80	399.7532
4	1084	0.7783	58.7	14.4	49.4	29.6	2.49	2.559	50	21:26:22	77.93	397.945
4	1092	0.7739	58.7	14.3	49.5	30.1	2.492	2.557	50	21:26:30	78.07	391.374
4	1101	0.777	58.7	14.4	49.5	29.5	2.492	2.558	50	21:26:39	78.22	395.9939
4	1109	0.7693	58.7	14.3	49.4	29.2	2.49	2.556	50	21:26:47	78.35	384.6036
4	1117	0.7694	58.7	14.4	48.9	29.6	2.495	2.554	50	21:26:55	78.48	384.7497
4	1125	0.7709	58.7	14.4	49	29.3	2.49	2.558	50	21:27:03	78.62	386.9471

4	1133	0.7584	58.7	14.3	49.2	30	2.489	2.556	50	21:27:11	78.75	368.9599
4	1141	0.7622	58.7	14.4	49.3	30.3	2.492	2.557	50	21:27:19	78.88	374.3504
4	1150	0.7629	58.7	14.3	49.5	29.3	2.492	2.557	50	21:27:28	79.03	375.3507
4	1159	0.7479	58.7	14.4	49.2	30	2.491	2.557	50	21:27:37	79.18	354.4125
4	1167	0.7572	58.7	14.3	49.7	29.5	2.49	2.556	50	21:27:45	79.32	367.2716
4	1175	0.7651	58.7	14.4	49.1	29.2	2.49	2.557	50	21:27:53	79.45	378.5096
4	1183	0.7513	58.7	14.4	49.6	29.2	2.491	2.556	50	21:28:01	79.58	359.0677
4	1191	0.7561	58.7	14.4	49.1	29.3	2.492	2.555	50	21:28:09	79.72	365.7299
4	1200	0.7553	58.7	14.4	49.7	30.2	2.49	2.558	50	21:28:18	79.87	364.6121
4	1207	0.7409	58.7	14.3	49.1	30.2	2.492	2.556	50	21:28:25	79.98	344.9937
4	1216	0.7417	58.7	14.4	49	29.6	2.492	2.556	50	21:28:34	80.13	346.0589
4	1223	0.7413	58.7	14.4	49.2	29.2	2.492	2.556	50	21:28:41	80.25	345.5259
4	1232	0.734	58.7	14.4	49.3	29.8	2.491	2.558	50	21:28:50	80.40	335.9246
4	1240	0.728	58.7	14.4	49.5	30.3	2.492	2.556	50	21:28:58	80.53	328.2097
4	1248	0.7368	58.7	14.3	49.2	29.1	2.491	2.558	50	21:29:06	80.67	339.5792
4	1257	0.729	58.7	14.4	49.3	30.1	2.492	2.556	50	21:29:15	80.82	329.4846
4	1265	0.7261	58.7	14.3	49.7	29.4	2.492	2.557	50	21:29:23	80.95	325.7996
4	1273	0.7334	58.7	14.4	49.5	28.7	2.49	2.557	50	21:29:31	81.08	335.1459
4	1282	0.7288	58.6	14.3	49.7	30.2	2.492	2.557	50	21:29:40	81.23	329.2292
4	1290	0.7284	58.7	14.4	49.5	29.4	2.492	2.557	50	21:29:48	81.37	328.7191
4	1298	0.7203	58.7	14.3	49.2	29.9	2.491	2.557	50	21:29:56	81.50	318.5392
4	1306	0.7201	58.7	14.4	49.1	30	2.491	2.556	50	21:30:04	81.63	318.2915
4	1315	0.7198	58.7	14.3	49.4	29.6	2.492	2.556	50	21:30:13	81.78	317.9202
4	1324	0.7136	58.7	14.3	49.2	30.2	2.49	2.557	50	21:30:22	81.93	310.3323
4	1332	0.7078	58.7	14.4	49.4	29.6	2.49	2.557	50	21:30:30	82.07	303.3816
4	1341	0.7088	58.7	14.4	49.2	29.4	2.491	2.557	50	21:30:39	82.22	304.5699
4	1349	0.7107	58.7	14.3	49.2	29.3	2.492	2.557	50	21:30:47	82.35	306.8393
4	1357	0.7074	58.7	14.4	49.5	28.9	2.491	2.558	50	21:30:55	82.48	302.9075
4	1366	0.6994	58.7	14.3	49.7	29.9	2.49	2.557	50	21:31:04	82.63	293.5646
4	1374	0.7105	58.7	14.3	49.6	29	2.492	2.557	50	21:31:12	82.77	306.5997
4	1382	0.7079	58.7	14.4	49.1	29.3	2.493	2.556	50	21:31:20	82.90	303.5003
4	1391	0.7059	58.7	14.3	49.5	29.3	2.492	2.557	50	21:31:29	83.05	301.1354
4	1400	0.7111	58.7	14.4	49.6	29.8	2.491	2.557	50	21:31:38	83.20	307.3189
4	1408	0.7049	58.7	14.4	49.1	30.4	2.492	2.557	50	21:31:46	83.33	299.9593
4	1416	0.7021	58.7	14.3	49.1	29.3	2.492	2.557	50	21:31:54	83.47	296.6881
4	1424	0.7024	58.7	14.4	49.6	28.8	2.49	2.558	50	21:32:02	83.60	297.0371
4	1432	0.6975	58.7	14.3	49.3	30	2.49	2.558	50	21:32:10	83.73	291.3845
4	1441	0.6921	58.7	14.4	49.4	29.7	2.491	2.556	50	21:32:19	83.88	285.2691
4	1449	0.7042	58.7	14.3	49.4	28.5	2.491	2.556	50	21:32:27	84.02	299.1384
4	1457	0.6894	58.7	14.3	49.5	29.2	2.494	2.555	50	21:32:35	84.15	282.2558
4	1465	0.6925	58.7	14.3	49.6	28.4	2.494	2.555	50	21:32:43	84.28	285.718

4	1474	0.6843	58.7	14.3	49.5	29.5	2.491	2.557	50	21:32:52	84.43	276.6439
4	1482	0.6875	58.7	14.3	49.1	28.7	2.492	2.556	50	21:33:00	84.57	280.1529
4	1491	0.6877	58.7	14.3	49.3	28.5	2.489	2.557	50	21:33:09	84.72	280.3736
4	1499	0.6824	58.7	14.3	49.3	29	2.49	2.558	50	21:33:17	84.85	274.5798
4	1507	0.6838	58.7	14.4	49.4	28.8	2.491	2.556	50	21:33:25	84.98	276.0993
4	1515	0.6921	58.7	14.3	49.3	28.9	2.493	2.555	50	21:33:33	85.12	285.2691
4	1524	0.678	58.7	14.4	49.9	29.7	2.491	2.557	50	21:33:42	85.27	269.8545
4	1533	0.6825	58.7	14.3	49.5	28.8	2.492	2.558	50	21:33:51	85.42	274.6881
4	1541	0.6803	58.7	14.4	49	29.4	2.491	2.558	50	21:33:59	85.55	272.315
4	1549	0.674	58.7	14.4	49.6	29.3	2.491	2.556	50	21:34:07	85.68	265.6248
4	1557	0.6762	58.7	14.3	49	29.5	2.491	2.558	50	21:34:15	85.82	267.9434
4	1565	0.675	58.7	14.3	49.4	30	2.493	2.555	50	21:34:23	85.95	266.6764
4	1573	0.6687	58.7	14.4	49.5	29.5	2.491	2.555	50	21:34:31	86.08	260.1164
4	1581	0.6707	58.7	14.3	49.4	29.7	2.493	2.555	50	21:34:39	86.22	262.1823
4	1590	0.6718	58.7	14.4	49.1	29.4	2.491	2.557	50	21:34:48	86.37	263.3251
4	1598	0.6739	58.7	14.3	49.3	30.3	2.49	2.558	50	21:34:56	86.50	265.5199
4	1606	0.6712	58.7	14.3	49.5	28.4	2.492	2.558	50	21:35:04	86.63	262.7012
4	1615	0.6746	58.7	14.4	49.4	28.9	2.492	2.555	50	21:35:13	86.78	266.2553
4	1624	0.6703	58.7	14.4	49.4	28.3	2.49	2.558	50	21:35:22	86.93	261.7679
4	1632	0.6636	58.7	14.3	49.3	29.1	2.49	2.559	50	21:35:30	87.07	254.9178
4	1640	0.6646	58.7	14.4	49.3	29.2	2.491	2.556	50	21:35:38	87.20	255.9293
4	1648	0.6627	58.7	14.3	49.4	29.3	2.49	2.557	50	21:35:46	87.33	254.0107
4	1656	0.6653	58.7	14.3	49.3	29.2	2.491	2.558	50	21:35:54	87.47	256.6396
4	1665	0.6618	58.7	14.4	49.3	29.8	2.492	2.555	50	21:36:03	87.62	253.1067
4	1673	0.6587	58.7	14.4	49.2	28.7	2.492	2.555	50	21:36:11	87.75	250.0163
4	1681	0.6559	58.7	14.3	49.5	28.9	2.491	2.557	50	21:36:19	87.88	247.2561
4	1690	0.6503	58.7	14.4	49.3	29.7	2.491	2.557	50	21:36:28	88.03	241.8233
4	1698	0.6612	58.7	14.4	49.7	29.1	2.492	2.557	50	21:36:36	88.17	252.5058
4	1706	0.6535	58.7	14.3	49.5	28.7	2.49	2.556	50	21:36:44	88.30	244.9135
4	1714	0.6565	58.7	14.4	49.5	28.8	2.492	2.555	50	21:36:52	88.43	247.8451
4	1723	0.6465	58.7	14.3	49.4	29.1	2.491	2.557	50	21:37:01	88.58	238.2028
4	1731	0.6439	58.7	14.3	49.2	28.9	2.492	2.556	50	21:37:09	88.72	235.7561
4	1739	0.6472	58.7	14.4	49.6	27.7	2.492	2.556	50	21:37:17	88.85	238.8658
4	1748	0.6478	58.7	14.4	49.4	28.6	2.491	2.556	50	21:37:26	89.00	239.4355
4	1756	0.647	58.7	14.3	49.3	29	2.49	2.558	50	21:37:34	89.13	238.6762
4	1765	0.645	58.7	14.3	49.2	28.4	2.491	2.556	50	21:37:43	89.28	236.7882
4	1773	0.6434	58.7	14.3	49.3	28.9	2.492	2.556	50	21:37:51	89.42	235.2884
4	1781	0.6414	58.7	14.4	49.6	28.2	2.491	2.556	50	21:37:59	89.55	233.4266
4	1790	0.639	58.7	14.3	49.4	28.9	2.491	2.556	50	21:38:08	89.70	231.2116
4	1798	0.635	58.7	14.4	49.5	28.8	2.492	2.556	50	21:38:16	89.83	227.5658
5	8	0.6405	58.7	14.4	49.3	28.8	2.49	2.557	50	21:38:26	90.00	232.5935

5	17	0.6344	58.7	14.4	49.4	28.6	2.492	2.557	50	21:38:35	90.15	227.0239
5	25	0.6362	58.7	14.3	49.4	29.1	2.491	2.556	50	21:38:43	90.28	228.6535
5	33	0.6306	58.7	14.4	50.5	29.1	2.491	2.556	50	21:38:51	90.42	223.6212
5	42	0.6319	58.7	14.3	50.3	28.9	2.49	2.557	50	21:39:00	90.57	224.7796
5	51	0.6307	58.7	14.3	50.3	29.8	2.491	2.556	50	21:39:09	90.72	223.7101
5	59	0.6327	58.7	14.3	51.4	29.3	2.491	2.557	50	21:39:17	90.85	225.4953
5	67	0.6336	58.7	14.3	51.4	30.3	2.49	2.558	50	21:39:25	90.98	226.3033
5	76	0.6342	58.7	14.4	51.4	30.5	2.491	2.556	50	21:39:34	91.13	226.8435
5	84	0.6421	58.7	14.3	52.2	29.5	2.491	2.556	50	21:39:42	91.27	234.0766
5	93	0.638	58.7	14.3	52.5	28.9	2.493	2.557	50	21:39:51	91.42	230.2948
5	101	0.641	58.7	14.4	52.7	29.6	2.491	2.557	50	21:39:59	91.55	233.056
5	110	0.6401	58.7	14.3	53.3	29.9	2.492	2.556	50	21:40:08	91.70	232.2242
5	118	0.6482	58.7	14.4	53.5	29.6	2.491	2.557	50	21:40:16	91.83	239.816
5	126	0.6483	58.7	14.4	54	30.1	2.492	2.555	50	21:40:24	91.97	239.9112
5	135	0.6436	58.7	14.3	54	30.5	2.491	2.557	50	21:40:33	92.12	235.4753
5	143	0.702	58.7	14.3	54.5	29.1	2.491	2.557	50	21:40:41	92.25	296.5719
5	151	0.7164	58.7	14.4	54.8	29.4	2.491	2.557	50	21:40:49	92.38	313.7388
5	160	0.6961	58.7	14.4	55.3	29.5	2.489	2.558	50	21:40:58	92.53	289.7876
5	168	0.7294	58.7	14.3	55.3	29.9	2.491	2.557	50	21:41:06	92.67	329.9957
5	176	0.7383	58.7	14.3	55.3	29.8	2.491	2.556	50	21:41:14	92.80	341.5514
5	185	0.752	58.7	14.4	55.5	30.7	2.491	2.556	50	21:41:23	92.95	360.0326
5	193	0.7643	58.7	14.3	55.5	30.7	2.492	2.557	50	21:41:31	93.08	377.3583
5	202	0.7735	58.7	14.4	55.6	30.4	2.491	2.557	50	21:41:40	93.23	390.7813
5	210	0.7675	58.7	14.3	55.4	30.9	2.49	2.56	50	21:41:48	93.37	381.9816
5	219	0.7836	58.7	14.3	56.1	30.4	2.493	2.554	50	21:41:57	93.52	405.9842
5	227	0.7979	58.7	14.3	56.3	30.3	2.49	2.558	50	21:42:05	93.65	428.3629
5	236	0.7981	58.7	14.3	56.3	30.7	2.491	2.556	50	21:42:14	93.80	428.6831
5	244	0.8127	58.7	14.4	56.6	30.5	2.492	2.556	50	21:42:22	93.93	452.6042
5	252	0.8309	58.7	14.3	56.7	30.9	2.491	2.556	50	21:42:30	94.07	483.9658
5	260	0.8427	58.7	14.3	56.3	30.7	2.491	2.557	50	21:42:38	94.20	505.2388
5	269	0.8354	58.7	14.3	56.2	30.9	2.49	2.555	50	21:42:47	94.35	491.99
5	277	0.845	58.7	14.3	56.2	30.7	2.491	2.556	50	21:42:55	94.48	509.473
5	286	0.8682	58.7	14.3	56.3	30.6	2.493	2.555	50	21:43:04	94.63	553.8196
5	294	0.8684	58.7	14.4	57.2	30.8	2.492	2.557	50	21:43:12	94.77	554.2151
5	302	0.8712	58.7	14.4	57.1	29.7	2.491	2.556	50	21:43:20	94.90	559.7752
5	310	0.8761	58.7	14.4	57.3	30	2.492	2.555	50	21:43:28	95.03	569.6135
5	319	0.8926	58.7	14.3	57.5	30.6	2.492	2.556	50	21:43:37	95.18	603.7679
5	327	0.8798	58.7	14.4	57.4	31.8	2.493	2.556	50	21:43:45	95.32	577.1342
5	335	0.9005	58.7	14.3	57.3	31.3	2.491	2.556	50	21:43:53	95.45	620.6897
5	344	0.8948	58.7	14.3	57.6	31.3	2.491	2.556	50	21:44:02	95.60	608.4429
5	353	0.9048	58.7	14.4	57.1	31.5	2.491	2.558	50	21:44:11	95.75	630.0577

5	361	0.8946	58.7	14.3	57.7	31.1	2.491	2.556	50	21:44:19	95.88	608.0167
5	369	0.9059	58.7	14.4	57.4	31	2.491	2.558	50	21:44:27	96.02	632.4721
5	377	0.9128	58.7	14.3	57.5	31.4	2.491	2.557	50	21:44:35	96.15	647.785
5	385	0.8908	58.7	14.3	57.2	32.2	2.493	2.555	50	21:44:43	96.28	599.9643
5	393	0.9063	58.7	14.4	57.2	31.5	2.492	2.557	50	21:44:51	96.42	633.3519
5	402	0.912	58.7	14.3	57.2	31	2.49	2.557	50	21:45:00	96.57	645.9947
5	410	0.8999	58.7	14.4	57	31.2	2.492	2.555	50	21:45:08	96.70	619.3914
5	418	0.9143	58.7	14.4	57.3	31	2.494	2.556	50	21:45:16	96.83	651.1525
5	426	0.9229	58.7	14.3	57.4	30.1	2.492	2.557	50	21:45:24	96.97	670.7273
5	434	0.9229	58.7	14.3	57.4	31.4	2.491	2.558	50	21:45:32	97.10	670.7273
5	442	0.9223	58.7	14.3	57.3	31.8	2.492	2.557	50	21:45:40	97.23	669.3468
5	451	0.9257	58.7	14.4	57.4	30.7	2.493	2.555	50	21:45:49	97.38	677.1998
5	460	0.9274	58.7	14.4	57.6	30.8	2.493	2.554	50	21:45:58	97.53	681.1535
5	468	0.9218	58.7	14.3	57.3	30.5	2.491	2.559	50	21:46:06	97.67	668.198
5	476	0.9215	58.7	14.3	57.4	31.9	2.49	2.56	50	21:46:14	97.80	667.5095
5	484	0.922	58.7	14.4	57.4	31.2	2.491	2.557	50	21:46:22	97.93	668.6573
5	492	0.9346	58.7	14.4	57.5	30.9	2.49	2.558	50	21:46:30	98.07	698.1003
5	501	0.9355	58.7	14.3	57.4	31.7	2.493	2.558	50	21:46:39	98.22	700.2418
5	509	0.9292	58.7	14.3	57.4	31.1	2.493	2.556	50	21:46:47	98.35	685.3595
5	517	0.9322	58.7	14.4	57.2	31.4	2.492	2.556	50	21:46:55	98.48	692.4149
5	526	0.9364	58.7	14.4	57.5	31.1	2.493	2.555	50	21:47:04	98.63	702.3884
5	534	0.9441	58.7	14.3	57.2	30.6	2.491	2.558	50	21:47:12	98.77	720.9656
5	542	0.9386	58.7	14.4	57.5	31.7	2.49	2.559	50	21:47:20	98.90	707.6574
5	551	0.9301	58.7	14.4	57.4	32	2.492	2.555	50	21:47:29	99.05	687.4702
5	559	0.9413	58.7	14.4	57.4	30.9	2.49	2.559	50	21:47:37	99.18	714.1662
5	567	0.9375	58.7	14.4	57.1	31.5	2.491	2.559	50	21:47:45	99.32	705.019
5	576	0.9469	58.7	14.4	57.4	31.4	2.49	2.559	50	21:47:54	99.47	727.8156
5	584	0.946	58.7	14.3	57.3	30.8	2.492	2.555	50	21:48:02	99.60	725.6083
5	592	0.9283	58.7	14.4	57.2	30.2	2.492	2.557	50	21:48:10	99.73	683.2539
5	601	0.9304	58.7	14.3	57.2	31.3	2.492	2.555	50	21:48:19	99.88	688.1748
5	609	0.9232	58.7	14.3	57.4	30.6	2.49	2.557	50	21:48:27	100.02	671.4185
5	617	0.9418	58.7	14.3	57.6	31.1	2.49	2.559	50	21:48:35	100.15	715.3767
5	626	0.9394	58.7	14.4	57.4	30.8	2.491	2.557	50	21:48:44	100.30	709.5811
5	635	0.9357	58.7	14.3	57.5	29.7	2.493	2.554	50	21:48:53	100.45	700.7183
5	643	0.9371	58.7	14.3	57.5	31.8	2.492	2.556	50	21:49:01	100.58	704.0615
5	651	0.9444	58.7	14.4	57.4	31.7	2.491	2.556	50	21:49:09	100.72	721.6971
5	660	0.9247	58.7	14.3	57.2	32	2.492	2.554	50	21:49:18	100.87	674.8826
5	668	0.9384	58.7	14.4	57.4	30.9	2.491	2.555	50	21:49:26	101.00	707.1771
5	677	0.9346	58.7	14.3	56.9	30.6	2.492	2.556	50	21:49:35	101.15	698.1003
5	685	0.9335	58.7	14.3	57.3	30.9	2.491	2.558	50	21:49:43	101.28	695.49
5	694	0.9355	58.7	14.3	57.5	30.2	2.493	2.556	50	21:49:52	101.43	700.2418

5	702	0.9135	58.7	14.3	57.7	30.9	2.489	2.558	50	21:50:00	101.57	649.3548
5	711	0.9303	58.7	14.3	57.4	30.3	2.494	2.555	50	21:50:09	101.72	687.9399
5	719	0.9283	58.7	14.4	57.3	31	2.49	2.558	50	21:50:17	101.85	683.2539
5	727	0.9153	58.7	14.3	57.2	30.6	2.493	2.555	50	21:50:25	101.98	653.4051
5	735	0.9139	58.7	14.4	57.5	30.9	2.493	2.556	50	21:50:33	102.12	650.2532
5	744	0.923	58.7	14.4	57.3	30.7	2.494	2.554	50	21:50:42	102.27	670.9577
5	752	0.9102	58.7	14.4	57.3	30.7	2.491	2.557	50	21:50:50	102.40	641.9808
5	760	0.9194	58.7	14.3	57.7	30.6	2.493	2.557	50	21:50:58	102.53	662.7055
5	768	0.9041	58.7	14.4	57.3	30.7	2.492	2.556	50	21:51:06	102.67	628.5251
5	776	0.9198	58.7	14.3	57.4	30.4	2.493	2.554	50	21:51:14	102.80	663.6185
5	785	0.9132	58.7	14.4	57.4	31	2.493	2.554	50	21:51:23	102.95	648.6817
5	793	0.9069	58.7	14.3	57	30.9	2.494	2.554	50	21:51:31	103.08	634.6734
5	801	0.9143	58.7	14.4	57.3	30.4	2.49	2.556	50	21:51:39	103.22	651.1525
5	809	0.9177	58.7	14.4	57.6	30.6	2.49	2.558	50	21:51:47	103.35	658.8367
5	819	0.9079	58.7	14.3	57.3	31.3	2.49	2.557	50	21:51:57	103.52	636.8808
5	827	0.9117	58.7	14.4	57.4	31.2	2.492	2.557	50	21:52:05	103.65	645.3244
5	836	0.8956	58.7	14.4	57.5	31.1	2.49	2.557	50	21:52:14	103.80	610.15
5	845	0.8994	58.7	14.4	57.3	31.1	2.492	2.556	50	21:52:23	103.95	618.3111
5	853	0.9027	58.7	14.4	57.4	30.3	2.493	2.555	50	21:52:31	104.08	625.4687
5	861	0.9002	58.7	14.4	57.5	30.7	2.49	2.557	50	21:52:39	104.22	620.0403
5	870	0.9066	58.7	14.3	57.5	30.9	2.492	2.557	50	21:52:48	104.37	634.0124
5	878	0.8923	58.7	14.3	57.5	31.4	2.492	2.557	50	21:52:56	104.50	603.1326
5	887	0.8919	58.7	14.3	57.4	30.7	2.492	2.557	50	21:53:05	104.65	602.2864
5	895	0.8844	58.7	14.4	57.5	31.3	2.491	2.557	50	21:53:13	104.78	586.5951
5	903	0.892	58.7	14.3	57.3	30.6	2.493	2.556	50	21:53:21	104.92	602.4979
5	912	0.8785	58.7	14.4	57.3	30.6	2.493	2.556	50	21:53:30	105.07	574.4828
5	921	0.8802	58.7	14.3	57.5	30.9	2.492	2.554	50	21:53:39	105.22	577.952
5	929	0.8783	58.7	14.3	57.3	31	2.491	2.557	50	21:53:47	105.35	574.0757
5	938	0.8939	58.7	14.4	57.3	31.6	2.492	2.556	50	21:53:56	105.50	606.5269
5	946	0.8903	58.7	14.3	57.1	31.4	2.493	2.556	50	21:54:04	105.63	598.9111
5	955	0.911	58.7	14.3	57	31.5	2.489	2.557	50	21:54:13	105.78	643.7623
5	963	0.8952	58.7	14.4	57.3	31.5	2.49	2.558	50	21:54:21	105.92	609.296
5	971	0.8887	58.7	14.4	57.3	31.7	2.491	2.556	50	21:54:29	106.05	595.5509
5	980	0.8893	58.7	14.4	57.2	31.3	2.491	2.557	50	21:54:38	106.20	596.8092
5	988	0.8871	58.7	14.3	57.4	31	2.491	2.557	50	21:54:46	106.33	592.2058
5	997	0.8765	58.7	14.3	57.2	31.1	2.49	2.556	50	21:54:55	106.48	570.4228
5	1005	0.8803	58.7	14.3	57.6	30.6	2.491	2.557	50	21:55:03	106.62	578.1566
5	1013	0.8696	58.7	14.4	57.2	30.8	2.492	2.556	50	21:55:11	106.75	556.5925
5	1021	0.8739	58.7	14.3	57.3	31.3	2.49	2.557	50	21:55:19	106.88	565.1793
5	1030	0.8785	58.7	14.3	57.2	30.7	2.494	2.555	50	21:55:28	107.03	574.4828
5	1038	0.8764	58.7	14.3	57.2	31	2.492	2.555	50	21:55:36	107.17	570.2204

5	1047	0.8739	58.7	14.4	57.4	30.6	2.492	2.556	50	21:55:45	107.32	565.1793
5	1055	0.8731	58.7	14.4	57.4	30.9	2.49	2.558	50	21:55:53	107.45	563.5737
5	1064	0.8783	58.7	14.4	57.2	30.9	2.491	2.557	50	21:56:02	107.60	574.0757
5	1073	0.8717	58.7	14.3	57.4	31.6	2.492	2.558	50	21:56:11	107.75	560.7728
5	1081	0.8756	58.7	14.3	57.4	30.8	2.492	2.556	50	21:56:19	107.88	568.6033
5	1089	0.8737	58.7	14.3	57.3	31.1	2.492	2.555	50	21:56:27	108.02	564.7775
5	1097	0.8594	58.7	14.4	57.5	30.6	2.491	2.555	50	21:56:35	108.15	536.6445
5	1105	0.8684	58.7	14.4	57	31.1	2.493	2.554	50	21:56:43	108.28	554.2151
5	1113	0.8639	58.7	14.4	57.5	30.6	2.493	2.557	50	21:56:51	108.42	545.3726
5	1121	0.8686	58.7	14.3	57.1	31	2.494	2.553	50	21:56:59	108.55	554.6108
5	1129	0.8586	58.7	14.4	57.2	30.9	2.493	2.557	50	21:57:07	108.68	535.1047
5	1138	0.8432	58.7	14.4	57.2	30.9	2.492	2.557	50	21:57:16	108.83	506.1568
5	1146	0.8538	58.7	14.3	57.5	31	2.492	2.554	50	21:57:24	108.97	525.9413
5	1155	0.8474	58.7	14.4	57.2	30.6	2.491	2.557	50	21:57:33	109.12	513.9221
5	1163	0.8448	58.7	14.4	57.4	31.1	2.491	2.556	50	21:57:41	109.25	509.1036
5	1172	0.833	58.7	14.4	57.3	30.6	2.489	2.56	50	21:57:50	109.40	487.697
5	1180	0.8425	58.7	14.4	57.4	31.3	2.492	2.557	50	21:57:58	109.53	504.872
5	1188	0.8316	58.7	14.4	57.3	30	2.491	2.554	50	21:58:06	109.67	485.2069
5	1196	0.8332	58.7	14.4	57.3	30.6	2.49	2.555	50	21:58:14	109.80	488.0535
5	1204	0.8263	58.7	14.3	57.1	30.8	2.495	2.555	50	21:58:22	109.93	475.8749
5	1212	0.8257	58.7	14.3	57.4	30.7	2.49	2.557	50	21:58:30	110.07	474.8278
5	1220	0.8201	58.7	14.4	57.5	31	2.492	2.558	50	21:58:38	110.20	465.1464
5	1228	0.8106	58.7	14.4	57.3	31.8	2.491	2.556	50	21:58:46	110.33	449.0966
5	1237	0.8131	58.7	14.3	57.1	31.4	2.489	2.558	50	21:58:55	110.48	453.275
5	1246	0.8041	58.7	14.3	57.4	29.8	2.492	2.557	50	21:59:04	110.63	438.3826
5	1254	0.8035	58.7	14.3	57.1	31	2.492	2.558	50	21:59:12	110.77	437.4045
5	1262	0.8115	58.7	14.3	57.2	30.5	2.493	2.558	50	21:59:20	110.90	450.5971
5	1271	0.7937	58.7	14.4	57.4	30.7	2.494	2.555	50	21:59:29	111.05	421.685
5	1279	0.8082	58.7	14.4	57.2	30.5	2.492	2.557	50	21:59:37	111.18	445.1155
5	1287	0.7988	58.7	14.3	57.4	31	2.491	2.557	50	21:59:45	111.32	429.8053
5	1296	0.8062	58.7	14.4	57.2	30.9	2.489	2.557	50	21:59:54	111.47	441.8205
5	1305	0.7874	58.7	14.4	57.3	29.6	2.489	2.56	50	22:00:03	111.62	411.8325
5	1313	0.7925	58.7	14.3	57.3	30.3	2.49	2.559	50	22:00:11	111.75	419.7932
5	1321	0.7856	58.7	14.3	57.4	30.2	2.494	2.556	50	22:00:19	111.88	409.0534
5	1330	0.7854	58.7	14.3	57.1	31	2.491	2.557	50	22:00:28	112.03	408.7456
5	1338	0.7829	58.7	14.3	57.1	30.8	2.492	2.556	50	22:00:36	112.17	404.9146
5	1346	0.7879	58.7	14.4	57.1	31.1	2.494	2.555	50	22:00:44	112.30	412.6073
5	1355	0.7828	58.7	14.3	57.4	30.9	2.492	2.556	50	22:00:53	112.45	404.762
5	1364	0.7832	58.7	14.3	57.3	30.1	2.49	2.557	50	22:01:02	112.60	405.3727
5	1372	0.7637	58.7	14.3	57.6	30.3	2.492	2.557	50	22:01:10	112.73	376.4968
5	1380	0.7781	58.7	14.3	57.3	31.3	2.491	2.556	50	22:01:18	112.87	397.6443

5	1388	0.7833	58.7	14.3	57.4	30.6	2.492	2.556	50	22:01:26	113.00	405.5255
5	1397	0.7733	58.7	14.4	57.2	29.9	2.492	2.556	50	22:01:35	113.15	390.4852
5	1406	0.7677	58.7	14.4	57.3	31.2	2.492	2.555	50	22:01:44	113.30	382.2722
5	1414	0.7745	58.7	14.4	57.4	30.5	2.492	2.557	50	22:01:52	113.43	392.2646
5	1423	0.781	58.7	14.4	57.4	29.6	2.491	2.557	50	22:02:01	113.58	402.0234
5	1430	0.7672	58.7	14.3	57.4	30	2.493	2.556	50	22:02:08	113.70	381.5461
5	1439	0.7623	58.7	14.4	57.3	30.1	2.494	2.555	50	22:02:17	113.85	374.4931
5	1447	0.7556	58.7	14.3	57.4	29.9	2.493	2.556	50	22:02:25	113.98	365.0309
5	1455	0.7564	58.7	14.3	57.3	30.5	2.492	2.557	50	22:02:33	114.12	366.1498
5	1464	0.7586	58.7	14.3	57.3	31.1	2.491	2.558	50	22:02:42	114.27	369.2419
5	1471	0.7557	58.7	14.4	57.5	30.2	2.49	2.557	50	22:02:49	114.38	365.1706
5	1479	0.751	58.7	14.4	57.2	30.7	2.493	2.556	50	22:02:57	114.52	358.6548
5	1488	0.7519	58.7	14.3	57.4	30.7	2.491	2.558	50	22:03:06	114.67	359.8946
5	1496	0.7515	58.7	14.3	57.5	30.2	2.492	2.557	50	22:03:14	114.80	359.3431
5	1504	0.7462	58.7	14.3	57.3	30.7	2.494	2.556	50	22:03:22	114.93	352.1047
5	1513	0.7498	58.7	14.3	57.2	30.6	2.491	2.558	50	22:03:31	115.08	357.0074
5	1521	0.7512	58.7	14.3	57.2	30.7	2.491	2.558	50	22:03:39	115.22	358.93
5	1530	0.7448	58.7	14.3	57.5	30.7	2.49	2.557	50	22:03:48	115.37	350.214
5	1538	0.75	58.7	14.4	57.4	29.9	2.491	2.556	50	22:03:56	115.50	357.2815
5	1546	0.7387	58.7	14.3	57.2	30.5	2.492	2.557	50	22:04:04	115.63	342.079
5	1555	0.7289	58.7	14.3	57	31	2.492	2.557	50	22:04:13	115.78	329.3569
5	1564	0.7403	58.7	14.3	57.5	30.3	2.49	2.559	50	22:04:22	115.93	344.1966
5	1572	0.7389	58.8	14.4	57.5	29.9	2.494	2.555	50	22:04:30	116.07	342.3431
5	1580	0.7483	58.7	14.3	57.5	30.1	2.492	2.555	50	22:04:38	116.20	354.9575
5	1589	0.7542	58.7	14.4	57	30.5	2.491	2.556	50	22:04:47	116.35	363.0801
5	1598	0.7346	58.7	14.4	57.4	30.4	2.491	2.555	50	22:04:56	116.50	336.7048
5	1607	0.7345	58.7	14.3	57.6	30.2	2.492	2.556	50	22:05:05	116.65	336.5746
5	1615	0.7249	58.8	14.4	57.2	30.2	2.493	2.556	50	22:05:13	116.78	324.2855
5	1623	0.7256	58.7	14.3	57.4	29.5	2.491	2.558	50	22:05:21	116.92	325.1679
5	1633	0.7197	58.7	14.3	57.1	30.9	2.491	2.558	50	22:05:31	117.08	317.7965
5	1641	0.7247	58.7	14.4	57.4	29.9	2.491	2.558	50	22:05:39	117.22	324.0337
5	1649	0.7192	58.8	14.4	57.3	29.9	2.491	2.558	50	22:05:47	117.35	317.1787
5	1657	0.7172	58.7	14.3	57.2	30.5	2.491	2.556	50	22:05:55	117.48	314.7182
5	1665	0.7213	58.7	14.4	57.3	30.2	2.491	2.556	50	22:06:03	117.62	319.7807
5	1674	0.7172	58.8	14.4	57.4	30	2.491	2.557	50	22:06:12	117.77	314.7182
5	1682	0.7242	58.7	14.3	57.6	29.9	2.492	2.556	50	22:06:20	117.90	323.4051
5	1690	0.7218	58.7	14.4	57.3	30.1	2.492	2.558	50	22:06:28	118.03	320.403
5	1699	0.7237	58.7	14.3	57.3	30.2	2.494	2.555	50	22:06:37	118.18	322.7776
5	1707	0.7166	58.7	14.4	57.3	31.6	2.493	2.555	50	22:06:45	118.32	313.9834
5	1716	0.7158	58.7	14.4	57.2	30	2.491	2.559	50	22:06:54	118.47	313.006
5	1725	0.7134	58.7	14.3	57.5	29.7	2.496	2.555	50	22:07:03	118.62	310.0903

5	1733	0.7118	58.7	14.3	57.2	30.1	2.494	2.554	50	22:07:11	118.75	308.16
5	1741	0.7273	58.7	14.4	57.3	30.1	2.492	2.556	50	22:07:19	118.88	327.3199
5	1750	0.704	58.7	14.3	57.3	29.8	2.491	2.555	50	22:07:28	119.03	298.9043
5	1758	0.7065	58.7	14.4	57.4	30.6	2.492	2.554	50	22:07:36	119.17	301.8431
5	1766	0.7078	58.7	14.4	57.2	30.2	2.492	2.557	50	22:07:44	119.30	303.3816
5	1774	0.702	58.7	14.3	57.2	29.4	2.493	2.556	50	22:07:52	119.43	296.5719
5	1782	0.7051	58.7	14.4	57.4	29.8	2.492	2.556	50	22:08:00	119.57	300.1942
5	1791	0.6936	58.7	14.4	57.3	29.5	2.492	2.555	50	22:08:09	119.72	286.9559
5	1799	0.7122	58.7	14.3	57.5	29.4	2.492	2.557	50	22:08:17	119.85	308.6416
6	8	0.6997	58.7	14.3	57.2	29.8	2.489	2.557	50	22:08:26	120.00	293.9102
6	16	0.6981	58.7	14.3	57.1	30.2	2.49	2.558	50	22:08:34	120.13	292.0714
6	25	0.7054	58.8	14.4	58.6	29.4	2.489	2.559	50	22:08:43	120.28	300.5468
6	33	0.6958	58.7	14.3	58.3	30.4	2.492	2.556	50	22:08:51	120.42	289.4465
6	42	0.7025	58.7	14.3	58.6	30.3	2.489	2.559	50	22:09:00	120.57	297.1535
6	50	0.7068	58.7	14.4	59.5	30.9	2.489	2.559	50	22:09:08	120.70	302.1975
6	58	0.7055	58.7	14.3	59.6	30.1	2.494	2.554	50	22:09:16	120.83	300.6645
6	67	0.7175	58.7	14.3	60.1	31.1	2.493	2.554	50	22:09:25	120.98	315.0862
6	75	0.7086	58.7	14.4	60.3	30.5	2.494	2.554	50	22:09:33	121.12	304.3319
6	84	0.712	58.7	14.4	61.3	31	2.491	2.554	50	22:09:42	121.27	308.4007
6	92	0.7163	58.7	14.3	61.4	30.6	2.493	2.555	50	22:09:50	121.40	313.6165
6	100	0.7329	58.7	14.4	61.8	31.3	2.491	2.558	50	22:09:58	121.53	334.4983
6	108	0.7175	58.7	14.3	62.5	31.1	2.492	2.556	50	22:10:06	121.67	315.0862
6	117	0.7232	58.7	14.3	62.4	30.9	2.493	2.555	50	22:10:15	121.82	322.1512
6	125	0.7439	58.7	14.3	63.2	30.6	2.492	2.556	50	22:10:23	121.95	349.0032
6	133	0.7512	58.7	14.3	63.2	31.1	2.491	2.555	50	22:10:31	122.08	358.93
6	142	0.744	58.7	14.3	63.6	30.9	2.493	2.557	50	22:10:40	122.23	349.1376
6	150	0.7595	58.7	14.4	64.2	31.6	2.492	2.557	50	22:10:48	122.37	370.5134
6	159	0.7667	58.7	14.3	64.4	31.4	2.49	2.556	50	22:10:57	122.52	380.8213
6	167	0.7784	58.7	14.4	64.3	31.3	2.493	2.556	50	22:11:05	122.65	398.0954
6	176	0.7755	58.7	14.4	64.1	31.2	2.497	2.554	50	22:11:14	122.80	393.7527
6	185	0.7957	58.7	14.3	64.9	31.9	2.491	2.558	50	22:11:23	122.95	424.854
6	195	0.7926	58.7	14.4	65.5	31.9	2.491	2.557	50	22:11:33	123.12	419.9506
6	204	0.8224	58.7	14.4	65.3	32.1	2.494	2.553	50	22:11:42	123.27	469.1028
6	212	0.822	58.7	14.3	65	31.7	2.493	2.555	50	22:11:50	123.40	468.4127
6	221	0.8345	58.7	14.4	65.4	31.3	2.491	2.557	50	22:11:59	123.55	490.3765
6	230	0.8435	58.7	14.4	65.2	31.8	2.492	2.554	50	22:12:08	123.70	506.7083
6	239	0.8444	58.7	14.4	65.3	31.5	2.493	2.555	50	22:12:17	123.85	508.3656
6	246	0.8495	58.7	14.4	66.3	31.5	2.492	2.556	50	22:12:24	123.97	517.841
6	255	0.8594	58.7	14.3	66.4	32.1	2.492	2.557	50	22:12:33	124.12	536.6445
6	263	0.8861	58.7	14.4	66	33.3	2.491	2.557	50	22:12:41	124.25	590.1228
6	271	0.8986	58.7	14.3	66.5	32	2.493	2.556	50	22:12:49	124.38	616.5858

6	279	0.9016	58.7	14.4	66.1	32.3	2.493	2.555	50	22:12:57	124.52	623.0755
6	289	0.9121	58.7	14.4	66	32.3	2.492	2.555	50	22:13:07	124.68	646.2183
6	298	0.952	58.7	14.4	66.5	32	2.494	2.556	50	22:13:16	124.83	740.4232
6	307	0.9536	58.7	14.3	66.8	32.6	2.493	2.554	50	22:13:25	124.98	744.4134
6	315	0.9629	58.7	14.4	67.4	33.5	2.491	2.556	50	22:13:33	125.12	767.9403
6	324	0.963	58.7	14.3	67.2	33.2	2.489	2.558	50	22:13:42	125.27	768.1964
6	332	0.9604	58.7	14.3	67.3	33.1	2.493	2.555	50	22:13:50	125.40	761.5597
6	340	0.9725	58.7	14.3	67.4	32.4	2.493	2.556	50	22:13:58	125.53	792.8294
6	348	0.9646	58.7	14.4	67.1	34.1	2.492	2.556	50	22:14:06	125.67	772.3029
6	357	0.9859	58.7	14.3	67.5	32.6	2.493	2.556	50	22:14:15	125.82	828.6121
6	365	0.9955	58.7	14.3	67.1	32.9	2.491	2.558	50	22:14:23	125.95	855.0065
6	374	1.0104	58.7	14.4	67.4	32.9	2.491	2.556	50	22:14:32	126.10	897.2517
6	382	1.0124	58.7	14.3	67.3	32.7	2.492	2.556	50	22:14:40	126.23	903.0422
6	390	1.0261	58.7	14.4	67.4	33.6	2.492	2.557	50	22:14:48	126.37	943.4824
6	398	1.0519	58.7	14.3	67.4	32.4	2.495	2.553	50	22:14:56	126.50	1023.388
6	406	1.0484	58.7	14.4	67.3	32.8	2.49	2.559	50	22:15:04	126.63	1012.256
6	414	1.1157	58.7	14.4	67.3	32.6	2.49	2.559	50	22:15:12	126.77	1243.076
6	422	1.1209	58.7	14.4	67.3	32.6	2.492	2.558	50	22:15:20	126.90	1262.431
6	431	1.1277	58.7	14.4	67.2	33.1	2.492	2.557	50	22:15:29	127.05	1288.081
6	439	1.1573	58.7	14.4	67	32.4	2.493	2.555	50	22:15:37	127.18	1404.321
6	447	1.1472	58.7	14.3	67.3	33	2.493	2.556	50	22:15:45	127.32	1363.81
6	455	1.1461	58.7	14.4	67.4	33.3	2.492	2.558	50	22:15:53	127.45	1359.452
6	464	1.1732	58.7	14.3	67.2	32.1	2.491	2.557	50	22:16:02	127.60	1469.911
6	472	1.1774	58.7	14.4	67.3	32.8	2.491	2.557	50	22:16:10	127.73	1487.612
6	480	1.199	58.7	14.3	67.4	33.5	2.493	2.554	50	22:16:18	127.87	1581.169
6	488	1.2191	58.7	14.4	67.3	33.1	2.492	2.558	50	22:16:26	128.00	1672.099
6	496	1.2225	58.7	14.3	67.2	33.4	2.493	2.555	50	22:16:34	128.13	1687.856
6	504	1.2536	58.7	14.4	67.3	32.6	2.491	2.557	50	22:16:42	128.27	1837.144
6	512	1.2511	58.7	14.4	67.5	32.6	2.491	2.558	50	22:16:50	128.40	1824.795
6	521	1.2616	58.7	14.4	67.1	33.5	2.493	2.557	50	22:16:59	128.55	1877.077
6	529	1.2495	58.7	14.4	67.3	33.5	2.491	2.557	50	22:17:07	128.68	1816.924
6	537	1.2779	58.7	14.4	67.3	32.7	2.494	2.553	50	22:17:15	128.82	1960.42
6	546	1.2722	58.7	14.3	67.2	32.8	2.492	2.557	50	22:17:24	128.97	1930.971
6	554	1.2692	58.7	14.4	67.2	32.4	2.493	2.556	50	22:17:32	129.10	1915.604
6	562	1.2636	58.7	14.4	67.4	33.1	2.491	2.555	50	22:17:40	129.23	1887.159
6	570	1.2698	58.7	14.3	67.3	33.1	2.492	2.556	50	22:17:48	129.37	1918.67
6	578	1.2868	58.7	14.4	67.1	32.1	2.491	2.556	50	22:17:56	129.50	2007.064
6	586	1.2804	58.7	14.3	67.1	32.9	2.491	2.557	50	22:18:04	129.63	1973.441
6	596	1.2814	58.7	14.3	67.1	32.7	2.489	2.557	50	22:18:14	129.80	1978.667
6	604	1.2536	58.7	14.4	67.5	32.5	2.491	2.555	50	22:18:22	129.93	1837.144
6	613	1.2839	58.7	14.3	67.4	32.3	2.493	2.556	50	22:18:31	130.08	1991.776

6	621	1.2828	58.7	14.4	67.2	32.4	2.493	2.556	50	22:18:39	130.22	1986
6	629	1.3006	58.7	14.3	67.3	32.4	2.49	2.557	50	22:18:47	130.35	2080.998
6	638	1.3143	58.7	14.3	67.2	33.1	2.491	2.556	50	22:18:56	130.50	2156.363
6	646	1.3085	58.7	14.4	67.1	32.6	2.492	2.556	50	22:19:04	130.63	2124.216
6	655	1.3117	58.7	14.4	67.1	33.3	2.492	2.557	50	22:19:13	130.78	2141.908
6	664	1.3156	58.8	14.4	67.3	33.2	2.494	2.555	50	22:19:22	130.93	2163.617
6	672	1.3231	58.7	14.3	67	31.9	2.492	2.556	50	22:19:30	131.07	2205.82
6	680	1.3219	58.7	14.3	67.3	32.6	2.492	2.557	50	22:19:38	131.20	2199.028
6	690	1.3529	58.8	14.4	67.2	33	2.493	2.555	50	22:19:48	131.37	2379.508
6	698	1.3228	58.7	14.4	67.2	33	2.49	2.559	50	22:19:56	131.50	2204.121
6	707	1.3572	58.7	14.3	67.2	32.4	2.492	2.555	50	22:20:05	131.65	2405.374
6	716	1.3439	58.7	14.3	67.5	31.8	2.493	2.556	50	22:20:14	131.80	2326.03
6	726	1.3556	58.7	14.4	67.1	33.1	2.492	2.556	50	22:20:24	131.97	2395.725
6	735	1.3613	58.7	14.4	67.4	32.5	2.493	2.556	50	22:20:33	132.12	2430.229
6	742	1.3588	58.7	14.3	67.4	33.5	2.491	2.556	50	22:20:40	132.23	2415.051
6	751	1.3436	58.8	14.4	67	32.7	2.492	2.556	50	22:20:49	132.38	2324.263
6	760	1.3309	58.7	14.4	66.9	33.2	2.493	2.556	50	22:20:58	132.53	2250.35
6	768	1.3216	58.8	14.4	67.1	32.9	2.492	2.557	50	22:21:06	132.67	2197.332
6	776	1.3073	58.7	14.4	67.2	32.5	2.492	2.556	50	22:21:14	132.80	2117.609
6	784	1.32	58.8	14.4	67	32.3	2.493	2.556	50	22:21:22	132.93	2188.304
6	792	1.3098	58.7	14.3	67.2	33.9	2.492	2.557	50	22:21:30	133.07	2131.39
6	801	1.3227	58.7	14.4	67.6	32.9	2.492	2.557	50	22:21:39	133.22	2203.554
6	810	1.3425	58.8	14.4	67.4	33.2	2.493	2.556	50	22:21:48	133.37	2317.792
6	818	1.3561	58.7	14.3	67.3	33.5	2.492	2.556	50	22:21:56	133.50	2398.738
6	827	1.3595	58.8	14.4	67.3	33.3	2.492	2.555	50	22:22:05	133.65	2419.294
6	835	1.3351	58.8	14.3	67.1	33.7	2.492	2.557	50	22:22:13	133.78	2274.6
6	844	1.3437	58.8	14.4	67.3	32.7	2.492	2.556	50	22:22:22	133.93	2324.852
6	852	1.3497	58.7	14.3	67.1	33.5	2.491	2.557	50	22:22:30	134.07	2360.391
6	861	1.3472	58.8	14.4	67	32.9	2.492	2.556	50	22:22:39	134.22	2345.535
6	869	1.3397	58.7	14.3	67.1	33.2	2.492	2.557	50	22:22:47	134.35	2301.379
6	878	1.3381	58.8	14.4	67.1	32.5	2.492	2.558	50	22:22:56	134.50	2292.038
6	886	1.328	58.8	14.4	67.5	33.2	2.491	2.558	50	22:23:04	134.63	2233.718
6	894	1.3236	58.8	14.4	67.4	33.2	2.491	2.558	50	22:23:12	134.77	2208.655
6	902	1.323	58.8	14.3	67.4	33.5	2.493	2.554	50	22:23:20	134.90	2205.254
6	911	1.3327	58.7	14.3	67.4	33.6	2.491	2.558	50	22:23:29	135.05	2260.72
6	920	1.2875	58.8	14.4	67.2	33.1	2.492	2.556	50	22:23:38	135.20	2010.767
6	929	1.3187	58.8	14.4	67	33.1	2.494	2.554	50	22:23:47	135.35	2180.989
6	937	1.2796	58.7	14.3	67.7	33.1	2.491	2.557	50	22:23:55	135.48	1969.267
6	945	1.2888	58.8	14.4	67.3	33.4	2.492	2.557	50	22:24:03	135.62	2017.657
6	953	1.2862	58.8	14.4	67.1	33.1	2.492	2.557	50	22:24:11	135.75	2003.894
6	962	1.2827	58.7	14.3	67.4	32.5	2.491	2.558	50	22:24:20	135.90	1985.476

6	970	1.3199	58.7	14.3	67.6	32.3	2.493	2.555	50	22:24:28	136.03	2187.74
6	979	1.2936	58.7	14.3	67.2	32.8	2.492	2.556	50	22:24:37	136.18	2043.249
6	987	1.2741	58.8	14.4	67.3	32.9	2.491	2.557	50	22:24:45	136.32	1940.751
6	996	1.3002	58.8	14.4	66.9	33.5	2.492	2.557	50	22:24:54	136.47	2078.827
6	1004	1.2808	58.8	14.4	67.4	33.1	2.492	2.556	50	22:25:02	136.60	1975.53
6	1013	1.2607	58.7	14.3	67.6	33.5	2.492	2.557	50	22:25:11	136.75	1872.553
6	1021	1.2641	58.7	14.4	67.2	32.6	2.491	2.555	50	22:25:19	136.88	1889.686
6	1029	1.2606	58.8	14.4	67.3	33.3	2.491	2.558	50	22:25:27	137.02	1872.05
6	1037	1.2417	58.7	14.4	67.1	33.4	2.493	2.556	50	22:25:35	137.15	1778.912
6	1046	1.2638	58.8	14.4	67.5	32.4	2.492	2.556	50	22:25:44	137.30	1888.17
6	1055	1.2358	58.8	14.4	67.2	32.6	2.492	2.557	50	22:25:53	137.45	1750.553
6	1063	1.2433	58.8	14.3	67.5	32.3	2.492	2.557	50	22:26:01	137.58	1786.661
6	1072	1.2535	58.8	14.3	67.1	33.7	2.494	2.556	50	22:26:10	137.73	1836.649
6	1080	1.2463	58.8	14.4	67.2	32.9	2.491	2.557	50	22:26:18	137.87	1801.257
6	1088	1.2213	58.8	14.4	67.4	32.6	2.492	2.556	50	22:26:26	138.00	1682.282
6	1097	1.2392	58.8	14.3	67	32.5	2.493	2.556	50	22:26:35	138.15	1766.854
6	1105	1.2224	58.8	14.3	67.1	32.1	2.493	2.555	50	22:26:43	138.28	1687.391
6	1114	1.2185	58.8	14.4	67.5	32.6	2.492	2.558	50	22:26:52	138.43	1669.329
6	1122	1.2101	58.8	14.4	67.2	32.9	2.491	2.557	50	22:27:00	138.57	1630.917
6	1131	1.201	58.8	14.4	67.4	32.4	2.492	2.556	50	22:27:09	138.72	1590.048
6	1140	1.1867	58.8	14.3	67.3	33.1	2.492	2.556	50	22:27:18	138.87	1527.373
6	1148	1.1822	58.8	14.4	67.4	33.5	2.492	2.555	50	22:27:26	139.00	1508.036
6	1156	1.1799	58.8	14.3	67.4	33.3	2.491	2.558	50	22:27:34	139.13	1498.224
6	1164	1.1834	58.8	14.4	67.3	32.3	2.491	2.556	50	22:27:42	139.27	1513.175
6	1173	1.182	58.8	14.4	67.2	33.1	2.494	2.554	50	22:27:51	139.42	1507.181
6	1182	1.1848	58.7	14.3	67	31.8	2.491	2.556	50	22:28:00	139.57	1519.186
6	1190	1.1786	58.8	14.3	67.3	32.2	2.492	2.556	50	22:28:08	139.70	1492.699
6	1199	1.1723	58.8	14.4	67.5	32	2.491	2.556	50	22:28:17	139.85	1466.138
6	1206	1.1895	58.8	14.4	67.4	32.8	2.49	2.557	50	22:28:24	139.97	1539.498
6	1215	1.2174	58.8	14.4	67.2	33.5	2.491	2.558	50	22:28:33	140.12	1664.261
6	1223	1.2098	58.8	14.4	67.3	33.7	2.494	2.555	50	22:28:41	140.25	1629.557
6	1231	1.2058	58.8	14.3	67.2	33.5	2.494	2.554	50	22:28:49	140.38	1611.509
6	1240	1.215	58.8	14.3	67.3	33.2	2.492	2.557	50	22:28:58	140.53	1653.243
6	1249	1.1935	58.8	14.4	67.4	33	2.494	2.556	50	22:29:07	140.68	1556.943
6	1257	1.1837	58.8	14.4	67.2	32.8	2.492	2.558	50	22:29:15	140.82	1514.461
6	1266	1.1913	58.8	14.4	67.2	33	2.492	2.555	50	22:29:24	140.97	1547.33
6	1274	1.1879	58.8	14.3	67.1	33.6	2.491	2.557	50	22:29:32	141.10	1532.56
6	1282	1.1881	58.8	14.3	66.9	32.2	2.493	2.555	50	22:29:40	141.23	1533.426
6	1291	1.1907	58.8	14.3	67.4	33.8	2.49	2.558	50	22:29:49	141.38	1544.716
6	1299	1.169	58.8	14.4	67.2	32.7	2.492	2.557	50	22:29:57	141.52	1452.368
6	1307	1.1845	58.8	14.3	67.1	33	2.493	2.557	50	22:30:05	141.65	1517.896

6	1316	1.1877	58.8	14.4	67.4	32.6	2.492	2.555	50	22:30:14	141.80	1531.695
6	1324	1.1642	58.8	14.4	67.5	33.9	2.492	2.556	50	22:30:22	141.93	1432.51
6	1333	1.1711	58.7	14.3	67.1	33.5	2.494	2.556	50	22:30:31	142.08	1461.12
6	1341	1.1742	58.8	14.3	67.3	33.3	2.495	2.553	50	22:30:39	142.22	1474.111
6	1350	1.1741	58.8	14.4	67.1	34.2	2.492	2.557	50	22:30:48	142.37	1473.691
6	1359	1.1561	58.8	14.3	67.4	32.9	2.492	2.558	50	22:30:57	142.52	1399.462
6	1367	1.1787	58.8	14.4	67.2	33.1	2.494	2.556	50	22:31:05	142.65	1493.123
6	1375	1.1544	58.8	14.3	67.5	33.5	2.492	2.555	50	22:31:13	142.78	1392.599
6	1383	1.1657	58.8	14.3	67.4	32.5	2.493	2.556	50	22:31:21	142.92	1438.694
6	1391	1.1721	58.8	14.4	67.5	33.4	2.49	2.558	50	22:31:29	143.05	1465.301
6	1400	1.1676	58.8	14.3	67.4	33.1	2.492	2.557	50	22:31:38	143.20	1446.555
6	1408	1.1599	58.7	14.3	67.1	33.5	2.495	2.555	50	22:31:46	143.33	1414.894
6	1416	1.1487	58.8	14.4	67.2	33.5	2.49	2.557	50	22:31:54	143.47	1369.771
6	1424	1.1546	58.8	14.3	67.4	32.7	2.493	2.555	50	22:32:02	143.60	1393.405
6	1433	1.1505	58.8	14.4	67.2	32.9	2.491	2.557	50	22:32:11	143.75	1376.949
6	1441	1.1549	58.8	14.4	66.9	32.8	2.492	2.555	50	22:32:19	143.88	1394.614
6	1449	1.1481	58.8	14.3	67.1	34	2.494	2.556	50	22:32:27	144.02	1367.384
6	1457	1.1443	58.8	14.4	67.2	33.4	2.491	2.557	50	22:32:35	144.15	1352.342
6	1466	1.1476	58.8	14.4	67.3	34.1	2.493	2.556	50	22:32:44	144.30	1365.398
6	1474	1.1523	58.8	14.3	67.1	33.3	2.495	2.555	50	22:32:52	144.43	1384.155
6	1482	1.1436	58.7	14.4	67.1	33.7	2.493	2.555	50	22:33:00	144.57	1349.585
6	1491	1.1541	58.7	14.3	67.3	33.5	2.491	2.559	50	22:33:09	144.72	1391.39
6	1499	1.1519	58.8	14.4	67.1	33.3	2.493	2.555	50	22:33:17	144.85	1382.552
6	1507	1.137	58.7	14.3	66.9	33.6	2.492	2.557	50	22:33:25	144.98	1323.793
6	1515	1.1501	58.8	14.4	67.1	33.2	2.492	2.555	50	22:33:33	145.12	1375.351
6	1524	1.1325	58.7	14.3	67.7	32	2.492	2.556	50	22:33:42	145.27	1306.422
6	1533	1.1215	58.7	14.3	67.1	33.8	2.491	2.557	50	22:33:51	145.42	1264.678
6	1541	1.1314	58.8	14.4	67.3	33.6	2.492	2.556	50	22:33:59	145.55	1302.202
6	1550	1.1064	58.8	14.4	67.3	32.6	2.492	2.557	50	22:34:08	145.70	1209.02
6	1559	1.1031	58.8	14.4	67.2	34.2	2.493	2.558	50	22:34:17	145.85	1197.106
6	1567	1.115	58.7	14.3	67.3	33.2	2.492	2.557	50	22:34:25	145.98	1240.488
6	1575	1.1048	58.8	14.4	67.1	33.4	2.492	2.557	50	22:34:33	146.12	1203.232
6	1583	1.1141	58.8	14.3	67.5	32.9	2.491	2.556	50	22:34:41	146.25	1237.166
6	1592	1.1095	58.8	14.4	67.2	32.7	2.491	2.556	50	22:34:50	146.40	1220.293
6	1600	1.106	58.8	14.4	67.3	33.5	2.492	2.556	50	22:34:58	146.53	1207.571
6	1609	1.1307	58.8	14.4	67.3	32.1	2.492	2.557	50	22:35:07	146.68	1299.521
6	1617	1.0965	58.8	14.3	67.2	32.5	2.492	2.557	50	22:35:15	146.82	1173.544
6	1625	1.0946	58.8	14.4	67.6	32.2	2.492	2.557	50	22:35:23	146.95	1166.827
6	1633	1.087	58.8	14.3	67.3	32.3	2.492	2.557	50	22:35:31	147.08	1140.246
6	1641	1.0957	58.8	14.4	67.3	32.6	2.493	2.556	50	22:35:39	147.22	1170.712
6	1650	1.095	58.8	14.4	67.3	32	2.494	2.556	50	22:35:48	147.37	1168.238

6	1659	1.0807	58.8	14.3	67.5	32.2	2.495	2.555	50	22:35:57	147.52	1118.562
6	1668	1.0928	58.8	14.3	67.3	33.3	2.492	2.558	50	22:36:06	147.67	1160.489
6	1676	1.1069	58.8	14.3	67.6	32.1	2.491	2.557	50	22:36:14	147.80	1210.833
6	1684	1.0786	58.8	14.3	67.2	32.9	2.492	2.557	50	22:36:22	147.93	1111.404
6	1692	1.0731	58.8	14.3	67.3	33.3	2.492	2.556	50	22:36:30	148.07	1092.821
6	1700	1.0812	58.8	14.4	67.3	33	2.493	2.557	50	22:36:38	148.20	1120.272
6	1708	1.064	58.8	14.3	67	32.7	2.491	2.556	50	22:36:46	148.33	1062.593
6	1717	1.066	58.8	14.4	67.1	32.4	2.492	2.556	50	22:36:55	148.48	1069.181
6	1725	1.0575	58.8	14.4	67.2	32	2.492	2.556	50	22:37:03	148.62	1041.393
6	1733	1.0503	58.7	14.3	67.5	31.8	2.493	2.555	50	22:37:11	148.75	1018.288
6	1742	1.0448	58.8	14.4	67.1	32.6	2.492	2.557	50	22:37:20	148.90	1000.903
6	1751	1.0567	58.8	14.4	67.3	32.4	2.494	2.553	50	22:37:29	149.05	1038.806
6	1759	1.0331	58.8	14.4	67.2	31.7	2.493	2.555	50	22:37:37	149.18	964.6733
6	1766	1.05	58.7	14.3	67.1	32.5	2.491	2.558	50	22:37:44	149.30	1017.334
6	1775	1.0752	58.8	14.3	67.2	32.9	2.493	2.556	50	22:37:53	149.45	1099.888
6	1783	1.0675	58.7	14.3	67.4	32	2.492	2.557	50	22:38:01	149.58	1074.143
6	1792	1.0585	58.7	14.3	67.6	31.7	2.494	2.555	50	22:38:10	149.73	1044.633
7	8	1.0634	58.7	14.3	67.2	32.1	2.494	2.556	50	22:38:26	150.00	1060.622
7	16	1.0671	58.8	14.4	67.1	32.4	2.491	2.555	50	22:38:34	150.13	1072.818
7	25	1.0604	58.8	14.4	68	32.2	2.492	2.557	50	22:38:43	150.28	1050.811
7	32	1.051	58.7	14.4	68.3	32.8	2.492	2.557	50	22:38:50	150.40	1020.517
7	41	1.0434	58.7	14.3	68.4	32.4	2.492	2.555	50	22:38:59	150.55	996.5136
7	49	1.0534	58.8	14.3	69.3	32.1	2.49	2.559	50	22:39:07	150.68	1028.188
7	58	1.0591	58.7	14.3	68.9	32.9	2.493	2.557	50	22:39:16	150.83	1046.581
7	67	1.0503	58.7	14.4	69.7	32.7	2.493	2.555	50	22:39:25	150.98	1018.288
7	75	1.0471	58.7	14.3	70.4	33	2.491	2.557	50	22:39:33	151.12	1008.145
7	83	1.072	58.7	14.3	70.6	33.2	2.492	2.557	50	22:39:41	151.25	1089.133
7	91	1.0679	58.8	14.4	71.2	34.1	2.492	2.556	50	22:39:49	151.38	1075.469
7	100	1.082	58.7	14.3	71.4	33.8	2.493	2.557	50	22:39:58	151.53	1123.011
7	108	1.0746	58.7	14.4	72	33.8	2.491	2.557	50	22:40:06	151.67	1097.865
7	116	1.1678	58.8	14.3	72.3	34.6	2.493	2.555	50	22:40:14	151.80	1447.384
7	124	1.1482	58.8	14.4	72.6	34.8	2.491	2.557	50	22:40:22	151.93	1367.782
7	133	1.2235	58.8	14.4	73.4	34.5	2.493	2.558	50	22:40:31	152.08	1692.511
7	141	1.2289	58.7	14.3	73.5	33.9	2.492	2.555	50	22:40:39	152.22	1717.814
7	149	1.2245	58.8	14.3	74.4	34.8	2.494	2.555	50	22:40:47	152.35	1697.176
7	158	1.268	58.7	14.3	74	34.5	2.494	2.556	50	22:40:56	152.50	1909.482
7	166	1.2965	58.8	14.4	74.5	34.4	2.492	2.556	50	22:41:04	152.63	2058.826
7	175	1.2907	58.7	14.4	74.4	34.7	2.493	2.555	50	22:41:13	152.78	2027.759
7	183	1.3141	58.8	14.3	74.6	34.7	2.492	2.557	50	22:41:21	152.92	2155.249
7	191	1.3291	58.8	14.4	75.4	35.1	2.493	2.555	50	22:41:29	153.05	2240.016
7	199	1.3763	58.8	14.4	75.3	34.5	2.492	2.557	50	22:41:37	153.18	2522.768

7	208	1.3946	58.7	14.3	75.4	35.1	2.493	2.557	50	22:41:46	153.33	2639.132
7	216	1.4152	58.8	14.4	75.3	35.5	2.493	2.557	50	22:41:54	153.47	2774.768
7	224	1.4313	58.7	14.4	75.3	35.6	2.494	2.555	50	22:42:02	153.60	2884.268
7	232	1.4403	58.8	14.4	75.2	36.1	2.493	2.556	50	22:42:10	153.73	2946.837
7	242	1.4685	58.8	14.4	75.4	35.7	2.492	2.556	50	22:42:20	153.90	3149.308
7	250	1.4675	58.8	14.4	76.3	35.9	2.495	2.555	50	22:42:28	154.03	3141.96
7	258	1.5033	58.7	14.4	76.1	36	2.492	2.557	50	22:42:36	154.17	3412.922
7	266	1.5155	58.8	14.4	76.2	35.5	2.493	2.557	50	22:42:44	154.30	3509.029
7	274	1.4954	58.7	14.4	76.2	35.7	2.491	2.558	50	22:42:52	154.43	3351.72
7	282	1.5584	58.8	14.4	75.9	35.9	2.494	2.556	50	22:43:00	154.57	3862.649
7	290	1.552	58.7	14.4	76.2	35.7	2.492	2.556	50	22:43:08	154.70	3808.321
7	299	1.536	58.7	14.4	76.3	35.5	2.494	2.556	50	22:43:17	154.85	3674.931
7	307	1.5437	58.7	14.4	76.9	36.3	2.493	2.558	50	22:43:25	154.98	3738.694
7	315	1.6073	58.7	14.4	77.4	36.1	2.493	2.556	50	22:43:33	155.12	4296.511
7	324	1.5747	58.7	14.4	77.3	36.8	2.492	2.557	50	22:43:42	155.27	4003.557
7	332	1.6236	58.7	14.4	77.4	36.3	2.493	2.556	50	22:43:50	155.40	4448.673
7	341	1.6266	58.8	14.4	77	36.1	2.492	2.556	50	22:43:59	155.55	4477.098
7	349	1.6447	58.7	14.4	77.2	36.6	2.492	2.556	50	22:44:07	155.68	4651.395
7	358	1.6514	58.7	14.4	77.3	36.9	2.493	2.556	50	22:44:16	155.83	4717.143
7	366	1.6934	58.7	14.4	77.2	37.1	2.493	2.557	50	22:44:24	155.97	5144.726
7	375	1.6765	58.8	14.4	77.2	36.6	2.491	2.559	50	22:44:33	156.12	4969.443
7	383	1.6957	58.8	14.4	77.3	36.8	2.494	2.556	50	22:44:41	156.25	5168.922
7	391	1.7311	58.7	14.4	77	36.9	2.492	2.556	50	22:44:49	156.38	5551.797
7	399	1.703	58.8	14.4	77.2	36.5	2.492	2.556	50	22:44:57	156.52	5246.263
7	408	1.687	58.7	14.4	77.3	36.8	2.493	2.556	50	22:45:06	156.67	5077.829
7	416	1.6826	58.7	14.4	77.4	36.1	2.492	2.556	50	22:45:14	156.80	5032.204
7	424	1.6808	58.7	14.4	77	35.9	2.493	2.557	50	22:45:22	156.93	5013.625
7	432	1.7313	58.8	14.4	77.6	35.9	2.492	2.558	50	22:45:30	157.07	5554.017
7	440	1.7171	58.7	14.4	77.3	36.4	2.494	2.555	50	22:45:38	157.20	5398.011
7	449	1.7676	58.7	14.4	77.3	36.3	2.491	2.557	50	22:45:47	157.35	5967.605
7	457	1.8177	58.8	14.4	77.3	36	2.492	2.555	50	22:45:55	157.48	6574.351
7	465	1.7972	58.7	14.4	77.2	36.4	2.491	2.558	50	22:46:03	157.62	6320.952
7	474	1.7678	58.8	14.4	77.3	36.2	2.491	2.557	50	22:46:12	157.77	5969.943
7	482	1.7535	58.7	14.4	77.1	36.5	2.491	2.556	50	22:46:20	157.90	5804.404
7	490	1.7696	58.8	14.4	77.3	36.5	2.492	2.556	50	22:46:28	158.03	5991.019
7	498	1.7578	58.8	14.4	77.3	36.4	2.493	2.556	50	22:46:36	158.17	5853.828
7	506	1.8349	58.8	14.4	77.2	36	2.494	2.554	50	22:46:44	158.30	6792.545
7	515	1.8773	58.7	14.4	77.4	35.8	2.492	2.556	50	22:46:53	158.45	7352.668
7	523	1.865	58.8	14.4	77.3	36.5	2.491	2.558	50	22:47:01	158.58	7186.878
7	532	1.797	58.8	14.4	77.1	35.6	2.492	2.557	50	22:47:10	158.73	6318.515
7	540	1.7718	58.8	14.4	77.2	36.7	2.492	2.557	50	22:47:18	158.87	6016.851

7	548	1.7927	58.8	14.4	77.2	36.4	2.49	2.558	50	22:47:26	159.00	6266.285
7	557	1.8393	58.8	14.4	77.1	36.4	2.494	2.556	50	22:47:35	159.15	6849.191
7	565	1.8196	58.8	14.4	77.3	36.8	2.492	2.556	50	22:47:43	159.28	6598.202
7	573	1.8693	58.8	14.4	77.3	37.5	2.492	2.557	50	22:47:51	159.42	7244.527
7	581	1.7842	58.8	14.4	77.3	36.9	2.492	2.557	50	22:47:59	159.55	6163.958
7	590	1.7854	58.7	14.4	77.3	36.5	2.492	2.557	50	22:48:08	159.70	6178.33
7	598	1.8526	58.8	14.4	77.4	36.1	2.493	2.557	50	22:48:16	159.83	7022.485
7	606	1.8198	58.8	14.4	77.1	37.2	2.489	2.558	50	22:48:24	159.97	6600.717
7	614	1.8223	58.8	14.4	77.4	36.2	2.491	2.556	50	22:48:32	160.10	6632.203
7	622	1.7726	58.8	14.4	77.4	36.8	2.493	2.556	50	22:48:40	160.23	6026.265
7	633	1.783	58.8	14.4	77.1	36.5	2.493	2.554	50	22:48:51	160.42	6149.61
7	641	1.7966	58.8	14.4	77.1	37	2.494	2.554	50	22:48:59	160.55	6313.643
7	649	1.7855	58.8	14.4	77.1	36.3	2.492	2.556	50	22:49:07	160.68	6179.529
7	657	1.7952	58.8	14.4	77.1	35.8	2.494	2.555	50	22:49:15	160.82	6296.613
7	665	1.7887	58.7	14.4	77.3	36.8	2.493	2.556	50	22:49:23	160.95	6217.98
7	673	1.7487	58.8	14.4	77.3	37.2	2.492	2.556	50	22:49:31	161.08	5749.589
7	682	1.7841	58.8	14.4	77	36.8	2.492	2.556	50	22:49:40	161.23	6162.761
7	690	1.7408	58.8	14.4	77.3	36.3	2.492	2.557	50	22:49:48	161.37	5660.188
7	698	1.7338	58.8	14.4	77.2	36.8	2.492	2.556	50	22:49:56	161.50	5581.816
7	707	1.7717	58.8	14.4	77.1	36.3	2.494	2.554	50	22:50:05	161.65	6015.675
7	716	1.7423	58.8	14.4	77.3	36.2	2.493	2.555	50	22:50:14	161.80	5677.085
7	724	1.7599	58.8	14.4	77.3	36	2.492	2.556	50	22:50:22	161.93	5878.076
7	733	1.7305	58.8	14.4	77.3	36.1	2.491	2.558	50	22:50:31	162.08	5545.142
7	741	1.7228	58.8	14.4	77	36.2	2.492	2.557	50	22:50:39	162.22	5460.247
7	749	1.7555	58.8	14.4	77.1	35.3	2.492	2.556	50	22:50:47	162.35	5827.354
7	758	1.7247	58.7	14.4	77.3	35.7	2.492	2.558	50	22:50:56	162.50	5481.107
7	767	1.7155	58.8	14.4	77.1	36.9	2.492	2.555	50	22:51:05	162.65	5380.634
7	775	1.7619	58.7	14.4	76.9	36.3	2.492	2.557	50	22:51:13	162.78	5901.236
7	783	1.7463	58.8	14.4	77.1	36.5	2.493	2.556	50	22:51:21	162.92	5722.322
7	791	1.6954	58.8	14.4	77.3	35.8	2.492	2.558	50	22:51:29	163.05	5165.761
7	800	1.7032	58.8	14.4	77.2	36.5	2.492	2.557	50	22:51:38	163.20	5248.393
7	808	1.7194	58.8	14.4	77.5	36.4	2.492	2.557	50	22:51:46	163.33	5423.062
7	817	1.6851	58.7	14.4	77.1	35.9	2.492	2.557	50	22:51:55	163.48	5058.091
7	825	1.6854	58.8	14.4	77.2	36.2	2.497	2.554	50	22:52:03	163.62	5061.204
7	833	1.6599	58.8	14.4	77.1	36.1	2.493	2.558	50	22:52:11	163.75	4801.519
7	842	1.6795	58.8	14.4	77.2	36.1	2.494	2.558	50	22:52:20	163.90	5000.238
7	850	1.6323	58.8	14.4	77	36.2	2.494	2.555	50	22:52:28	164.03	4531.467
7	859	1.6178	58.8	14.4	77.5	36.1	2.493	2.558	50	22:52:37	164.18	4394.089
7	867	1.6309	58.8	14.4	77.5	36	2.494	2.556	50	22:52:45	164.32	4518.069
7	876	1.6703	58.8	14.4	76.8	36.5	2.493	2.556	50	22:52:54	164.47	4906.235
7	884	1.6486	58.8	14.4	77.4	36.4	2.494	2.556	50	22:53:02	164.60	4689.585

7	892	1.6641	58.8	14.4	77.1	36.3	2.494	2.557	50	22:53:10	164.73	4843.612
7	900	1.6382	58.8	14.4	77	35.5	2.493	2.559	50	22:53:18	164.87	4588.247
7	909	1.6237	58.8	14.4	77.3	36.6	2.492	2.556	50	22:53:27	165.02	4449.618
7	918	1.6493	58.8	14.4	77.6	36.3	2.495	2.555	50	22:53:36	165.17	4696.463
7	926	1.6498	58.8	14.4	77.1	36	2.492	2.557	50	22:53:44	165.30	4701.381
7	935	1.6437	58.8	14.4	77.2	36.5	2.494	2.555	50	22:53:53	165.45	4641.639
7	943	1.6028	58.8	14.4	77.4	36.6	2.495	2.556	50	22:54:01	165.58	4255.176
7	952	1.6013	58.8	14.4	77.2	35.9	2.492	2.558	50	22:54:10	165.73	4241.462
7	960	1.6116	58.7	14.4	77.4	36.3	2.493	2.556	50	22:54:18	165.87	4336.279
7	968	1.6165	58.8	14.4	77.3	36.1	2.494	2.555	50	22:54:26	166.00	4381.922
7	977	1.598	58.7	14.4	77.1	35.7	2.492	2.556	50	22:54:35	166.15	4211.405
7	985	1.6068	58.8	14.4	77.2	36.4	2.494	2.555	50	22:54:43	166.28	4291.904
7	994	1.5923	58.8	14.4	77.2	36.6	2.493	2.555	50	22:54:52	166.43	4159.851
7	1002	1.5914	58.8	14.4	77.4	36	2.494	2.556	50	22:55:00	166.57	4151.753
7	1011	1.5685	58.8	14.4	77.4	36.1	2.492	2.555	50	22:55:09	166.72	3949.528
7	1019	1.585	58.8	14.4	77.2	35.7	2.493	2.556	50	22:55:17	166.85	4094.497
7	1027	1.5803	58.8	14.4	77.1	36.4	2.492	2.558	50	22:55:25	166.98	4052.816
7	1035	1.5583	58.8	14.4	76.8	36.4	2.493	2.556	50	22:55:33	167.12	3861.796
7	1043	1.5636	58.8	14.4	77.2	36.3	2.494	2.555	50	22:55:41	167.25	3907.203
7	1051	1.5592	58.8	14.4	77.3	35.7	2.494	2.554	50	22:55:49	167.38	3869.48
7	1060	1.5542	58.8	14.4	77.2	36.5	2.495	2.554	50	22:55:58	167.53	3826.933
7	1068	1.5523	58.8	14.4	77.2	35.5	2.492	2.557	50	22:56:06	167.67	3810.855
7	1076	1.541	58.8	14.4	77.2	35.9	2.492	2.557	50	22:56:14	167.80	3716.245
7	1085	1.5678	58.8	14.4	77.1	35.8	2.494	2.554	50	22:56:23	167.95	3943.461
7	1093	1.5739	58.8	14.4	77.2	36.4	2.494	2.554	50	22:56:31	168.08	3996.555
7	1102	1.5453	58.8	14.4	77.1	35.4	2.493	2.556	50	22:56:40	168.23	3752.043
7	1110	1.5993	58.8	14.4	77.1	35.5	2.493	2.555	50	22:56:48	168.37	4223.227
7	1118	1.5777	58.8	14.4	77.4	36.4	2.493	2.554	50	22:56:56	168.50	4029.891
7	1127	1.6241	58.8	14.4	77.2	36	2.494	2.556	50	22:57:05	168.65	4453.401
7	1135	1.596	58.8	14.4	77.4	35.8	2.494	2.556	50	22:57:13	168.78	4193.263
7	1144	1.5965	58.8	14.4	77.2	36.6	2.495	2.556	50	22:57:22	168.93	4197.793
7	1152	1.5417	58.8	14.4	77.5	36.1	2.492	2.558	50	22:57:30	169.07	3722.055
7	1160	1.5426	58.8	14.4	77.2	35.7	2.493	2.556	50	22:57:38	169.20	3729.536
7	1169	1.5486	58.8	14.4	77.1	36.6	2.492	2.556	50	22:57:47	169.35	3779.686
7	1177	1.5948	58.8	14.4	77.3	35.5	2.493	2.556	50	22:57:55	169.48	4182.406
7	1186	1.5431	58.8	14.4	77.2	36.6	2.494	2.555	50	22:58:04	169.63	3733.696
7	1194	1.5914	58.8	14.4	77.2	35	2.494	2.556	50	22:58:12	169.77	4151.753
7	1203	1.5176	58.8	14.4	77.2	35.1	2.492	2.556	50	22:58:21	169.92	3525.768
7	1211	1.5396	58.8	14.4	77.5	35.5	2.493	2.556	50	22:58:29	170.05	3704.643
7	1219	1.551	58.8	14.4	77.3	35.7	2.492	2.556	50	22:58:37	170.18	3799.883
7	1228	1.5212	58.8	14.3	77.4	35.5	2.492	2.556	50	22:58:46	170.33	3554.599

7	1237	1.5651	58.8	14.4	77	36	2.49	2.558	50	22:58:55	170.48	3920.125
7	1245	1.5075	58.8	14.4	77.3	35.6	2.494	2.555	50	22:59:03	170.62	3445.789
7	1253	1.4796	58.8	14.4	77.3	36.1	2.492	2.557	50	22:59:11	170.75	3231.719
7	1262	1.4849	58.8	14.4	77.3	35.2	2.493	2.557	50	22:59:20	170.90	3271.618
7	1270	1.4764	58.8	14.4	77.2	35.9	2.493	2.558	50	22:59:28	171.03	3207.802
7	1280	1.4586	58.8	14.4	77.3	36.6	2.494	2.555	50	22:59:38	171.20	3077.108
7	1288	1.4863	58.8	14.4	77.3	34.5	2.492	2.557	50	22:59:46	171.33	3282.217
7	1297	1.4617	58.8	14.4	77.4	35.4	2.494	2.555	50	22:59:55	171.48	3099.585
7	1305	1.4731	58.8	14.4	77.2	35.3	2.493	2.557	50	23:00:03	171.62	3183.272
7	1314	1.4506	58.8	14.4	77.3	36	2.493	2.556	50	23:00:12	171.77	3019.653
7	1322	1.4631	58.8	14.4	77.2	35.9	2.493	2.556	50	23:00:20	171.90	3109.775
7	1330	1.4488	58.8	14.4	77.3	35.3	2.495	2.555	50	23:00:28	172.03	3006.834
7	1338	1.4225	58.8	14.4	77	36.1	2.492	2.556	50	23:00:36	172.17	2824.034
7	1346	1.4459	58.8	14.4	77.3	35.7	2.492	2.557	50	23:00:44	172.30	2986.265
7	1355	1.4481	58.8	14.4	77.2	35.2	2.493	2.556	50	23:00:53	172.45	3001.86
7	1363	1.432	58.8	14.4	77.3	35.8	2.492	2.556	50	23:01:01	172.58	2889.1
7	1371	1.4035	58.8	14.4	77.2	35.6	2.494	2.555	50	23:01:09	172.72	2697.122
7	1380	1.4187	58.8	14.4	77.3	36.3	2.492	2.554	50	23:01:18	172.87	2798.309
7	1388	1.395	58.8	14.4	77.2	36.1	2.492	2.557	50	23:01:26	173.00	2641.719
7	1397	1.404	58.8	14.4	77.5	35.9	2.493	2.557	50	23:01:35	173.15	2700.408
7	1405	1.4635	58.8	14.4	77.3	35	2.493	2.556	50	23:01:43	173.28	3112.691
7	1413	1.3881	58.8	14.4	77.1	35.9	2.492	2.556	50	23:01:51	173.42	2597.361
7	1421	1.4323	58.8	14.4	77.1	35.5	2.492	2.557	50	23:01:59	173.55	2891.172
7	1430	1.3879	58.8	14.4	77.2	35.4	2.491	2.557	50	23:02:08	173.70	2596.083
7	1439	1.368	58.8	14.4	77.4	35.4	2.494	2.556	50	23:02:17	173.85	2471.25
7	1447	1.3697	58.8	14.4	77.6	35.4	2.492	2.557	50	23:02:25	173.98	2481.739
7	1455	1.3571	58.8	14.3	77.2	35.6	2.493	2.556	50	23:02:33	174.12	2404.77
7	1463	1.3867	58.8	14.4	77.2	35	2.492	2.557	50	23:02:41	174.25	2588.427
7	1472	1.3845	58.8	14.4	77.4	35.6	2.491	2.556	50	23:02:50	174.40	2574.435
7	1480	1.349	58.8	14.4	77	35.7	2.494	2.555	50	23:02:58	174.53	2356.225
7	1488	1.3575	58.8	14.4	77.4	35.3	2.492	2.556	50	23:03:06	174.67	2407.186
7	1497	1.3262	58.7	14.3	77.2	35.7	2.493	2.556	50	23:03:15	174.82	2223.44
7	1505	1.3545	58.8	14.4	77.1	35.4	2.494	2.555	50	23:03:23	174.95	2389.108
7	1513	1.3363	58.7	14.3	77.3	36.1	2.493	2.556	50	23:03:31	175.08	2281.563
7	1522	1.3427	58.8	14.4	77.2	35.3	2.493	2.556	50	23:03:40	175.23	2318.967
7	1530	1.371	58.8	14.3	77.6	36	2.493	2.555	50	23:03:48	175.37	2489.781
7	1538	1.3707	58.8	14.4	77.2	35.9	2.493	2.554	50	23:03:56	175.50	2487.924
7	1547	1.3253	58.7	14.3	77.2	35.1	2.494	2.554	50	23:04:05	175.65	2218.314
7	1555	1.3241	58.8	14.4	77.3	35	2.494	2.554	50	23:04:13	175.78	2211.493
7	1564	1.3333	58.7	14.4	77.2	35.2	2.493	2.557	50	23:04:22	175.93	2264.184
7	1572	1.3203	58.8	14.4	77.1	36.1	2.495	2.552	50	23:04:30	176.07	2189.994

7	1581	1.3159	58.7	14.3	77	36.7	2.496	2.553	50	23:04:39	176.22	2165.294
7	1589	1.3083	58.8	14.4	77.3	35.5	2.492	2.555	50	23:04:47	176.35	2123.114
7	1597	1.3052	58.7	14.3	77.4	36.1	2.493	2.555	50	23:04:55	176.48	2106.083
7	1606	1.3045	58.8	14.4	77.2	35.2	2.493	2.556	50	23:05:04	176.63	2102.252
7	1614	1.3005	58.7	14.4	77.2	35.7	2.493	2.556	50	23:05:12	176.77	2080.455
7	1623	1.3108	58.7	14.3	77.1	35.7	2.494	2.554	50	23:05:21	176.92	2136.921
7	1631	1.3239	58.7	14.3	76.9	35.9	2.492	2.557	50	23:05:29	177.05	2210.357
7	1640	1.2799	58.8	14.3	77.2	36.2	2.492	2.557	50	23:05:38	177.20	1970.832
7	1648	1.2891	58.7	14.3	77.2	35.8	2.493	2.554	50	23:05:46	177.33	2019.249
7	1656	1.2966	58.8	14.3	77.4	35.3	2.493	2.556	50	23:05:54	177.47	2059.365
7	1665	1.3055	58.8	14.4	77.2	36.2	2.494	2.556	50	23:06:03	177.62	2107.727
7	1673	1.2783	58.8	14.4	77.2	35.6	2.492	2.557	50	23:06:11	177.75	1962.499
7	1682	1.2822	58.7	14.3	76.9	35.7	2.493	2.555	50	23:06:20	177.90	1982.855
7	1690	1.2653	58.7	14.3	77.4	35.5	2.492	2.556	50	23:06:28	178.03	1895.761
7	1699	1.2729	58.7	14.4	77.3	35.3	2.493	2.558	50	23:06:37	178.18	1934.57
7	1707	1.2724	58.7	14.3	76.9	35.8	2.494	2.556	50	23:06:45	178.32	1931.999
7	1716	1.2742	58.8	14.4	77.2	35.9	2.493	2.557	50	23:06:54	178.47	1941.267
7	1724	1.3236	58.7	14.4	77.4	35	2.493	2.555	50	23:07:02	178.60	2208.655
7	1732	1.3189	58.7	14.4	77.5	36.2	2.494	2.555	50	23:07:10	178.73	2182.113
7	1740	1.3131	58.8	14.4	77.4	35.9	2.492	2.557	50	23:07:18	178.87	2149.683
7	1748	1.2739	58.7	14.4	77	35.9	2.494	2.556	50	23:07:26	179.00	1939.72
7	1756	1.291	58.7	14.3	77.3	36.7	2.493	2.555	50	23:07:34	179.13	2029.357
7	1765	1.3135	58.8	14.4	77.4	36	2.493	2.557	50	23:07:43	179.28	2151.908
7	1773	1.2716	58.8	14.4	77.5	35.5	2.491	2.557	50	23:07:51	179.42	1927.89
7	1781	1.2741	58.7	14.3	77.1	36.7	2.492	2.557	50	23:07:59	179.55	1940.751
7	1790	1.2849	58.8	14.4	77.2	36	2.493	2.555	50	23:08:08	179.70	1997.038
7	1798	1.296	58.7	14.3	77.3	35.8	2.492	2.555	50	23:08:16	179.83	2056.134
8	8	1.2842	58.7	14.3	77.3	36.4	2.493	2.557	50	23:08:26	180.00	1993.354
8	16	1.2786	58.7	14.3	77.2	36	2.492	2.556	50	23:08:34	180.13	1964.06
8	25	1.2748	58.7	14.4	78	35.5	2.495	2.555	50	23:08:43	180.28	1944.363
8	33	1.2577	58.7	14.3	78.4	35.2	2.493	2.554	50	23:08:51	180.42	1857.53
8	41	1.2796	58.7	14.3	78.2	36.3	2.492	2.558	50	23:08:59	180.55	1969.267
8	49	1.2808	58.8	14.4	79	37.1	2.493	2.557	50	23:09:07	180.68	1975.53
8	58	1.2887	58.8	14.4	79.2	36.3	2.491	2.557	50	23:09:16	180.83	2017.126
8	66	1.2758	58.8	14.4	79.9	36.9	2.49	2.557	50	23:09:24	180.97	1949.532
8	75	1.2613	58.7	14.4	80.4	37.8	2.495	2.556	50	23:09:33	181.12	1875.568
8	83	1.2782	58.8	14.4	80.5	37.7	2.492	2.558	50	23:09:41	181.25	1961.979
8	91	1.3107	58.7	14.3	81.2	37.7	2.491	2.558	50	23:09:49	181.38	2136.368
8	100	1.3194	58.8	14.4	81.2	37.8	2.491	2.557	50	23:09:58	181.53	2184.925
8	108	1.3881	58.8	14.4	82.2	38.1	2.492	2.557	50	23:10:06	181.67	2597.361
8	116	1.3572	58.8	14.4	82	37.8	2.491	2.557	50	23:10:14	181.80	2405.374

8	125	1.3201	58.8	14.3	82.8	37.8	2.493	2.555	50	23:10:23	181.95	2188.867
8	134	1.3383	58.7	14.3	83.1	38.8	2.49	2.558	50	23:10:32	182.10	2293.204
8	142	1.3415	58.7	14.3	83.2	39.5	2.49	2.558	50	23:10:40	182.23	2311.92
8	151	1.3792	58.7	14.3	84	39.5	2.493	2.555	50	23:10:49	182.38	2540.953
8	159	1.3715	58.7	14.3	84.1	39.2	2.493	2.555	50	23:10:57	182.52	2492.88
8	167	1.3605	58.8	14.4	84.3	39.3	2.492	2.556	50	23:11:05	182.65	2425.364
8	175	1.3994	58.8	14.4	84	39.7	2.491	2.554	50	23:11:13	182.78	2670.293
8	184	1.4202	58.8	14.4	84.8	39.2	2.492	2.555	50	23:11:22	182.93	2808.443
8	193	1.42	58.8	14.4	84.8	40.9	2.491	2.555	50	23:11:31	183.08	2807.09
8	201	1.4341	58.8	14.4	85	40.1	2.492	2.555	50	23:11:39	183.22	2903.629
8	209	1.4466	58.8	14.4	85.2	40.6	2.49	2.556	50	23:11:47	183.35	2991.221
8	217	1.4715	58.8	14.4	85	39.4	2.493	2.556	50	23:11:55	183.48	3171.428
8	225	1.4576	58.7	14.3	85.1	40.1	2.49	2.556	50	23:12:03	183.62	3069.883
8	235	1.4823	58.8	14.4	85	39.9	2.491	2.557	50	23:12:13	183.78	3252
8	243	1.5258	58.8	14.4	85.5	40.5	2.49	2.556	50	23:12:21	183.92	3591.688
8	251	1.495	58.8	14.4	86	40.7	2.492	2.555	50	23:12:29	184.05	3348.643
8	259	1.4798	58.8	14.4	85.6	40.8	2.491	2.554	50	23:12:37	184.18	3233.218
8	268	1.4952	58.8	14.4	86	40.7	2.491	2.556	50	23:12:46	184.33	3350.181
8	277	1.5323	58.8	14.4	85.9	40.5	2.493	2.554	50	23:12:55	184.48	3644.575
8	285	1.5365	58.8	14.4	85.7	41.1	2.491	2.556	50	23:13:03	184.62	3679.047
8	293	1.5725	58.8	14.4	85.5	40.6	2.492	2.557	50	23:13:11	184.75	3984.324
8	302	1.6273	58.8	14.4	85.9	40.4	2.494	2.555	50	23:13:20	184.90	4483.749
8	310	1.5754	58.8	14.4	85.5	41.1	2.495	2.552	50	23:13:28	185.03	4009.69
8	319	1.5889	58.8	14.4	86.1	40.7	2.49	2.557	50	23:13:37	185.18	4129.319
8	328	1.5853	58.8	14.4	85.5	41	2.492	2.556	50	23:13:46	185.33	4097.168
8	337	1.6078	58.8	14.4	86	41	2.492	2.554	50	23:13:55	185.48	4301.121
8	345	1.6317	58.8	14.4	85.6	40.8	2.492	2.556	50	23:14:03	185.62	4525.722
8	354	1.6054	58.8	14.4	85.9	40.8	2.491	2.556	50	23:14:12	185.77	4279.023
8	362	1.6002	58.8	14.4	85.9	40.8	2.492	2.555	50	23:14:20	185.90	4231.426
8	370	1.6076	58.8	14.4	85.7	41.1	2.49	2.558	50	23:14:28	186.03	4299.277
8	378	1.6136	58.8	14.4	85.7	40.8	2.491	2.556	50	23:14:36	186.17	4354.867
8	387	1.595	58.8	14.4	85.8	40.8	2.491	2.555	50	23:14:45	186.32	4184.214
8	395	1.6042	58.8	14.4	85.5	40.8	2.491	2.556	50	23:14:53	186.45	4268.005
8	403	1.6333	58.8	14.4	85.9	40.5	2.491	2.557	50	23:15:01	186.58	4541.055
8	412	1.6585	58.8	14.4	85.8	40.9	2.492	2.555	50	23:15:10	186.73	4787.547
8	421	1.7055	58.8	14.4	85.8	40.6	2.492	2.557	50	23:15:19	186.88	5272.941
8	429	1.663	58.8	14.4	86.3	40.9	2.492	2.557	50	23:15:27	187.02	4832.562
8	437	1.6513	58.8	14.4	86.1	40.6	2.492	2.556	50	23:15:35	187.15	4716.157
8	446	1.6349	58.7	14.4	85.8	40.7	2.491	2.555	50	23:15:44	187.30	4556.426
8	454	1.6647	58.8	14.4	86.3	40.7	2.491	2.557	50	23:15:52	187.43	4849.647
8	462	1.622	58.8	14.4	86.2	40.9	2.493	2.554	50	23:16:00	187.57	4433.566

8	471	1.6317	58.7	14.4	85.9	40.5	2.493	2.557	50	23:16:09	187.72	4525.722
8	479	1.616	58.8	14.4	86.3	40.8	2.492	2.558	50	23:16:17	187.85	4377.248
8	488	1.6748	58.7	14.4	85.8	40.7	2.494	2.555	50	23:16:26	188.00	4952.054
8	496	1.6365	58.7	14.4	86.2	41.1	2.491	2.556	50	23:16:34	188.13	4571.834
8	506	1.6088	58.7	14.4	85.5	41	2.493	2.556	50	23:16:44	188.30	4310.353
8	514	1.6319	58.8	14.4	86.1	40.8	2.492	2.555	50	23:16:52	188.43	4527.636
8	523	1.6329	58.8	14.4	86	40.7	2.493	2.555	50	23:17:01	188.58	4537.218
8	532	1.6315	58.8	14.4	85.9	40.3	2.492	2.557	50	23:17:10	188.73	4523.808
8	541	1.6449	58.7	14.4	86.1	40.9	2.493	2.555	50	23:17:19	188.88	4653.348
8	549	1.631	58.8	14.4	86.3	40.6	2.492	2.556	50	23:17:27	189.02	4519.025
8	558	1.6332	58.7	14.4	86.4	40.4	2.491	2.556	50	23:17:36	189.17	4540.096
8	566	1.6122	58.8	14.4	86	40.5	2.492	2.557	50	23:17:44	189.30	4341.85
8	575	1.6384	58.7	14.4	86.1	40.8	2.493	2.555	50	23:17:53	189.45	4590.181
8	583	1.6086	58.8	14.4	86	40.6	2.491	2.556	50	23:18:01	189.58	4308.506
8	591	1.6275	58.7	14.4	85.9	40.8	2.493	2.554	50	23:18:09	189.72	4485.651
8	600	1.6196	58.7	14.4	85.9	40.6	2.493	2.557	50	23:18:18	189.87	4410.977
8	609	1.6183	58.7	14.4	86	41	2.492	2.556	50	23:18:27	190.02	4398.775
8	618	1.59	58.8	14.4	85.6	41.2	2.491	2.557	50	23:18:36	190.17	4139.179
8	627	1.6143	58.7	14.4	86.2	40.5	2.493	2.555	50	23:18:45	190.32	4361.386
8	635	1.6009	58.7	14.4	85.6	40.4	2.492	2.558	50	23:18:53	190.45	4237.811
8	643	1.6087	58.8	14.4	86	40.9	2.492	2.556	50	23:19:01	190.58	4309.429
8	651	1.6086	58.8	14.4	85.9	40.7	2.491	2.557	50	23:19:09	190.72	4308.506
8	661	1.5846	58.8	14.4	85.9	41	2.491	2.557	50	23:19:19	190.88	4090.938
8	671	1.5978	58.7	14.4	85.7	40.8	2.492	2.558	50	23:19:29	191.05	4209.588
8	680	1.6096	58.8	14.4	85.8	40.4	2.493	2.555	50	23:19:38	191.20	4317.749
8	689	1.6016	58.7	14.4	86	40.2	2.492	2.554	50	23:19:47	191.35	4244.203
8	697	1.5723	58.8	14.4	86.3	40.6	2.491	2.557	50	23:19:55	191.48	3982.579
8	706	1.5832	58.8	14.4	86	40.4	2.491	2.557	50	23:20:04	191.63	4078.498
8	714	1.5813	58.8	14.4	85.9	40.8	2.491	2.557	50	23:20:12	191.77	4061.659
8	722	1.5919	58.8	14.4	86.3	41.1	2.493	2.554	50	23:20:20	191.90	4156.251
8	730	1.5959	58.8	14.4	85.8	41	2.493	2.555	50	23:20:28	192.03	4192.358
8	739	1.5679	58.8	14.4	86.2	40.3	2.492	2.555	50	23:20:37	192.18	3944.327
8	747	1.5677	58.8	14.4	85.6	40.5	2.493	2.555	50	23:20:45	192.32	3942.595
8	756	1.5802	58.7	14.4	86.1	40.4	2.493	2.557	50	23:20:54	192.47	4051.933
8	764	1.5593	58.8	14.4	86	40.6	2.492	2.557	50	23:21:02	192.60	3870.334
8	772	1.5298	58.8	14.4	85.7	40.8	2.491	2.558	50	23:21:10	192.73	3624.167
8	780	1.5566	58.8	14.4	85.9	40.8	2.494	2.555	50	23:21:18	192.87	3847.313
8	789	1.5618	58.8	14.4	86	40.8	2.491	2.556	50	23:21:27	193.02	3891.739
8	797	1.5865	58.8	14.4	86	40.8	2.493	2.556	50	23:21:35	193.15	4107.865
8	806	1.5627	58.8	14.4	85.7	40.7	2.491	2.557	50	23:21:44	193.30	3899.466
8	814	1.5761	58.8	14.4	86	40.5	2.492	2.556	50	23:21:52	193.43	4015.83

8	822	1.5646	58.8	14.4	85.8	40.6	2.493	2.555	50	23:22:00	193.57	3915.814
8	831	1.5635	58.8	14.4	85.9	40.8	2.493	2.554	50	23:22:09	193.72	3906.343
8	839	1.5842	58.8	14.4	85.7	40.3	2.492	2.556	50	23:22:17	193.85	4087.381
8	847	1.5496	58.8	14.4	85.9	40.3	2.492	2.556	50	23:22:25	193.98	3788.092
8	856	1.5412	58.8	14.4	85.3	40.4	2.492	2.556	50	23:22:34	194.13	3717.904
8	864	1.5513	58.8	14.4	86	40.1	2.492	2.556	50	23:22:42	194.27	3802.413
8	872	1.5611	58.8	14.4	85.7	41.2	2.493	2.556	50	23:22:50	194.40	3885.737
8	880	1.5183	58.8	14.4	85.9	40.8	2.491	2.556	50	23:22:58	194.53	3531.361
8	888	1.5416	58.8	14.4	85.9	41	2.492	2.556	50	23:23:06	194.67	3721.225
8	896	1.5159	58.8	14.4	86.1	40.7	2.493	2.556	50	23:23:14	194.80	3512.213
8	904	1.5282	58.8	14.4	85.8	41	2.491	2.558	50	23:23:22	194.93	3611.15
8	913	1.4981	58.8	14.4	86	40.7	2.494	2.556	50	23:23:31	195.08	3372.547
8	921	1.4928	58.7	14.4	85.9	40.5	2.492	2.558	50	23:23:39	195.22	3331.754
8	929	1.503	58.8	14.4	86	40.4	2.492	2.557	50	23:23:47	195.35	3410.583
8	937	1.4808	58.8	14.4	86.2	40.4	2.492	2.557	50	23:23:55	195.48	3240.721
8	945	1.4899	58.8	14.4	86.1	40.5	2.493	2.556	50	23:24:03	195.62	3309.586
8	954	1.478	58.8	14.3	85.9	40.5	2.491	2.557	50	23:24:12	195.77	3219.744
8	962	1.4801	58.8	14.4	86.1	40.9	2.494	2.555	50	23:24:20	195.90	3235.468
8	970	1.4704	58.8	14.4	85.7	40.7	2.493	2.555	50	23:24:28	196.03	3163.304
8	980	1.4672	58.8	14.4	85.8	40.6	2.492	2.557	50	23:24:38	196.20	3139.757
8	989	1.469	58.7	14.4	85.7	41.1	2.493	2.557	50	23:24:47	196.35	3152.987
8	998	1.4649	58.8	14.4	85.7	40.6	2.492	2.555	50	23:24:56	196.50	3122.912
8	1007	1.4663	58.8	14.4	86.2	40.6	2.493	2.557	50	23:25:05	196.65	3133.158
8	1016	1.506	58.8	14.4	86.1	41	2.492	2.556	50	23:25:14	196.80	3434.024
8	1024	1.5457	58.8	14.4	86.4	40.5	2.492	2.558	50	23:25:22	196.93	3755.386
8	1032	1.5637	58.7	14.4	86.1	40.2	2.492	2.557	50	23:25:30	197.07	3908.064
8	1041	1.5427	58.8	14.4	85.6	40.9	2.492	2.556	50	23:25:39	197.22	3730.368
8	1050	1.547	58.8	14.4	85.6	40.5	2.495	2.555	50	23:25:48	197.37	3766.265
8	1058	1.5238	58.7	14.4	86	40.8	2.493	2.555	50	23:25:56	197.50	3575.528
8	1066	1.5506	58.8	14.4	85.7	40.4	2.491	2.555	50	23:26:04	197.63	3796.511
8	1074	1.5465	58.8	14.4	86	41	2.492	2.556	50	23:26:12	197.77	3762.078
8	1083	1.5383	58.8	14.4	85.7	41.1	2.491	2.556	50	23:26:21	197.92	3693.894
8	1091	1.5593	58.8	14.4	85.8	41	2.493	2.555	50	23:26:29	198.05	3870.334
8	1100	1.571	58.8	14.4	86	40.5	2.492	2.554	50	23:26:38	198.20	3971.249
8	1108	1.53	58.7	14.4	85.8	40.6	2.492	2.556	50	23:26:46	198.33	3625.797
8	1116	1.5433	58.8	14.4	86.1	41.1	2.492	2.556	50	23:26:54	198.47	3735.362
8	1125	1.5354	58.7	14.4	85.7	40.5	2.494	2.557	50	23:27:03	198.62	3669.996
8	1133	1.5159	58.8	14.4	85.6	40.7	2.492	2.555	50	23:27:11	198.75	3512.213
8	1142	1.5101	58.8	14.4	85.9	40.8	2.494	2.555	50	23:27:20	198.90	3466.25
8	1151	1.5337	58.8	14.4	86.1	40.5	2.492	2.557	50	23:27:29	199.05	3656.039
8	1160	1.4794	58.8	14.4	85.8	40.7	2.493	2.554	50	23:27:38	199.20	3230.22

8	1168	1.4848	58.8	14.4	85.7	40.2	2.492	2.557	50	23:27:46	199.33	3270.862
8	1176	1.4785	58.8	14.4	85.9	41.1	2.493	2.556	50	23:27:54	199.47	3223.483
8	1184	1.4967	58.8	14.4	85.8	40.9	2.492	2.556	50	23:28:02	199.60	3361.736
8	1192	1.5144	58.8	14.4	85.8	40.8	2.492	2.555	50	23:28:10	199.73	3500.283
8	1201	1.5016	58.8	14.4	85.9	40.2	2.492	2.557	50	23:28:19	199.88	3399.684
8	1209	1.5038	58.8	14.4	86	40.4	2.493	2.555	50	23:28:27	200.02	3416.823
8	1217	1.512	58.8	14.4	86.3	40.4	2.493	2.556	50	23:28:35	200.15	3481.258
8	1225	1.4858	58.8	14.4	86.3	40.3	2.491	2.557	50	23:28:43	200.28	3278.428
8	1234	1.4681	58.8	14.4	86.3	40.7	2.492	2.556	50	23:28:52	200.43	3146.367
8	1242	1.4612	58.8	14.4	86.2	40.6	2.493	2.555	50	23:29:00	200.57	3095.952
8	1250	1.4591	58.8	14.4	86	40.7	2.492	2.555	50	23:29:08	200.70	3080.725
8	1259	1.4612	58.8	14.4	86.1	40.1	2.491	2.557	50	23:29:17	200.85	3095.952
8	1267	1.4411	58.8	14.4	86.2	40.4	2.494	2.554	50	23:29:25	200.98	2952.446
8	1276	1.4588	58.8	14.4	85.9	40.6	2.492	2.556	50	23:29:34	201.13	3078.555
8	1284	1.4314	58.8	14.4	85.9	40.2	2.491	2.556	50	23:29:42	201.27	2884.958
8	1292	1.4305	58.8	14.4	86.3	40.3	2.492	2.556	50	23:29:50	201.40	2878.754
8	1301	1.4055	58.8	14.4	86.3	40.3	2.491	2.556	50	23:29:59	201.55	2710.281
8	1309	1.4329	58.8	14.4	86.1	40.3	2.493	2.557	50	23:30:07	201.68	2895.32
8	1317	1.4882	58.8	14.4	86	40.1	2.492	2.556	50	23:30:15	201.82	3296.641
8	1325	1.4409	58.8	14.4	86	40.5	2.491	2.557	50	23:30:23	201.95	2951.043
8	1334	1.4667	58.8	14.4	86.5	40.5	2.491	2.557	50	23:30:32	202.10	3136.09
8	1343	1.4598	58.8	14.4	86.3	40	2.495	2.555	50	23:30:41	202.25	3085.795
8	1351	1.4401	58.8	14.4	86.2	40.1	2.493	2.556	50	23:30:49	202.38	2945.436
8	1360	1.4376	58.7	14.4	85.8	40.8	2.493	2.556	50	23:30:58	202.53	2927.963
8	1368	1.4272	58.8	14.4	86.1	40.3	2.492	2.556	50	23:31:06	202.67	2856.089
8	1376	1.4365	58.8	14.4	86.5	40.4	2.491	2.556	50	23:31:14	202.80	2920.3
8	1385	1.4054	58.8	14.4	86.5	40.5	2.494	2.555	50	23:31:23	202.95	2709.622
8	1393	1.4061	58.8	14.4	86	40.7	2.493	2.555	50	23:31:31	203.08	2714.238
8	1402	1.4008	58.8	14.4	86	40.4	2.492	2.556	50	23:31:40	203.23	2679.432
8	1410	1.4079	58.8	14.4	85.7	40.4	2.494	2.556	50	23:31:48	203.37	2726.134
8	1418	1.3988	58.8	14.4	86.4	40.4	2.49	2.558	50	23:31:56	203.50	2666.384
8	1427	1.3907	58.8	14.4	86.2	40.1	2.492	2.554	50	23:32:05	203.65	2614.011
8	1435	1.3833	58.7	14.4	86.4	40.2	2.495	2.552	50	23:32:13	203.78	2566.826
8	1444	1.3722	58.8	14.4	86.3	40.3	2.493	2.556	50	23:32:22	203.93	2497.222
8	1452	1.38	58.8	14.4	86	40.4	2.492	2.557	50	23:32:30	204.07	2545.986
8	1460	1.3606	58.8	14.4	86.2	40.5	2.489	2.56	50	23:32:38	204.20	2425.972
8	1469	1.3822	58.8	14.4	86.1	40	2.491	2.558	50	23:32:47	204.35	2559.866
8	1477	1.3827	58.8	14.4	86.2	39.9	2.493	2.556	50	23:32:55	204.48	2563.028
8	1485	1.3622	58.8	14.4	86.4	39.9	2.491	2.557	50	23:33:03	204.62	2435.71
8	1494	1.4014	58.8	14.4	85.9	41.3	2.492	2.556	50	23:33:12	204.77	2683.356
8	1503	1.3661	58.7	14.3	86.3	40.1	2.494	2.555	50	23:33:21	204.92	2459.566

8	1511	1.3891	58.8	14.4	86.2	40.3	2.491	2.557	50	23:33:29	205.05	2603.755
8	1520	1.351	58.8	14.4	86.5	40.3	2.492	2.556	50	23:33:38	205.20	2368.144
8	1528	1.349	58.7	14.3	86.1	40.5	2.492	2.557	50	23:33:46	205.33	2356.225
8	1537	1.3417	58.8	14.4	86.3	40.8	2.494	2.555	50	23:33:55	205.48	2313.093
8	1545	1.3361	58.8	14.4	86.3	39.8	2.493	2.556	50	23:34:03	205.62	2280.402
8	1553	1.3145	58.7	14.3	86.3	40.2	2.492	2.555	50	23:34:11	205.75	2157.478
8	1561	1.3259	58.8	14.4	86.4	40.4	2.491	2.557	50	23:34:19	205.88	2221.73
8	1569	1.3413	58.8	14.4	86.2	40.5	2.492	2.556	50	23:34:27	206.02	2310.747
8	1577	1.317	58.7	14.3	86.4	40.5	2.491	2.558	50	23:34:35	206.15	2171.45
8	1586	1.3069	58.7	14.4	86.6	39.9	2.492	2.556	50	23:34:44	206.30	2115.41
8	1594	1.2896	58.7	14.3	86.3	40.2	2.492	2.555	50	23:34:52	206.43	2021.906
8	1603	1.3079	58.7	14.4	86.2	39.8	2.492	2.557	50	23:35:01	206.58	2120.91
8	1611	1.3089	58.7	14.4	86.3	40.4	2.493	2.557	50	23:35:09	206.72	2126.421
8	1619	1.2884	58.7	14.3	86.3	39.7	2.491	2.557	50	23:35:17	206.85	2015.535
8	1628	1.3019	58.7	14.4	86.3	40.7	2.494	2.554	50	23:35:26	207.00	2088.065
8	1636	1.2806	58.7	14.3	86.3	40.5	2.492	2.556	50	23:35:34	207.13	1974.485
8	1644	1.2868	58.8	14.4	86.3	40	2.491	2.558	50	23:35:42	207.27	2007.064
8	1653	1.3057	58.7	14.4	86.3	40.2	2.492	2.555	50	23:35:51	207.42	2108.823
8	1661	1.2895	58.7	14.3	86	39.7	2.495	2.555	50	23:35:59	207.55	2021.374
8	1670	1.279	58.7	14.4	86.1	40.4	2.493	2.556	50	23:36:08	207.70	1966.142
8	1679	1.2481	58.7	14.3	85.9	40.2	2.493	2.556	50	23:36:17	207.85	1810.058
8	1687	1.2769	58.7	14.3	85.9	39.9	2.491	2.556	50	23:36:25	207.98	1955.23
8	1696	1.2538	58.7	14.4	86.1	40.1	2.494	2.556	50	23:36:34	208.13	1838.135
8	1705	1.2546	58.7	14.3	86	40.2	2.492	2.556	50	23:36:43	208.28	1842.101
8	1713	1.2614	58.7	14.4	86.2	40.2	2.493	2.555	50	23:36:51	208.42	1876.071
8	1721	1.2566	58.7	14.3	86.1	40.4	2.492	2.556	50	23:36:59	208.55	1852.045
8	1730	1.2219	58.7	14.4	86.3	40.3	2.494	2.554	50	23:37:08	208.70	1685.067
8	1738	1.2417	58.7	14.4	86.3	40	2.491	2.557	50	23:37:16	208.83	1778.912
8	1746	1.2467	58.7	14.4	86.3	39.6	2.494	2.555	50	23:37:24	208.97	1803.21
8	1755	1.2396	58.7	14.3	86.9	39.9	2.491	2.557	50	23:37:33	209.12	1768.779
8	1764	1.2165	58.7	14.3	86.2	40.5	2.492	2.557	50	23:37:42	209.27	1660.123
8	1772	1.2214	58.7	14.4	86.4	40.3	2.493	2.556	50	23:37:50	209.40	1682.746
8	1781	1.2178	58.7	14.4	86.1	39.8	2.492	2.556	50	23:37:59	209.55	1666.103
8	1789	1.2108	58.7	14.4	86.1	39.9	2.495	2.554	50	23:38:07	209.68	1634.092
8	1798	1.2089	58.7	14.4	86.3	40.3	2.492	2.556	50	23:38:16	209.83	1625.483
9	8	1.1899	58.7	14.4	86.4	40.3	2.493	2.555	50	23:38:26	210.00	1541.235
9	16	1.1893	58.7	14.3	86.1	40.1	2.494	2.555	50	23:38:34	210.13	1538.629
9	24	1.1826	58.7	14.3	86.2	40.1	2.491	2.556	50	23:38:42	210.27	1509.748
9	33	1.1751	58.7	14.4	86.6	39.8	2.492	2.556	50	23:38:51	210.42	1477.899
9	42	1.1865	58.7	14.3	86.6	40.2	2.492	2.557	50	23:39:00	210.57	1526.51
9	50	1.179	58.7	14.4	86.2	40.9	2.49	2.559	50	23:39:08	210.70	1494.397

9	58	1.1626	58.7	14.3	85.8	40.6	2.491	2.557	50	23:39:16	210.83	1425.936
9	67	1.1635	58.7	14.3	86.3	40.2	2.493	2.555	50	23:39:25	210.98	1429.631
9	75	1.1704	58.7	14.3	86.5	40.3	2.493	2.555	50	23:39:33	211.12	1458.198
9	83	1.1782	58.8	14.4	86.2	40.2	2.491	2.556	50	23:39:41	211.25	1491.002
9	92	1.1725	58.7	14.4	86.3	40.2	2.491	2.556	50	23:39:50	211.40	1466.976
9	100	1.1796	58.7	14.3	86.3	39.9	2.492	2.556	50	23:39:58	211.53	1496.947
9	108	1.1889	58.7	14.4	86.1	40.8	2.492	2.556	50	23:40:06	211.67	1536.893
9	117	1.1718	58.7	14.4	86	39.9	2.493	2.555	50	23:40:15	211.82	1464.046
9	125	1.1849	58.7	14.4	86.3	40.5	2.494	2.555	50	23:40:23	211.95	1519.616
9	133	1.1651	58.7	14.4	86.5	39.9	2.493	2.556	50	23:40:31	212.08	1436.218
9	142	1.1667	58.7	14.4	86.3	40.3	2.493	2.556	50	23:40:40	212.23	1442.827
9	151	1.1559	58.7	14.4	86.1	40.1	2.492	2.556	50	23:40:49	212.38	1398.653
9	159	1.1556	58.7	14.3	86.3	40.2	2.492	2.555	50	23:40:57	212.52	1397.44
9	167	1.1704	58.7	14.4	86.6	40.2	2.493	2.556	50	23:41:05	212.65	1458.198
9	177	1.1516	58.7	14.3	86.3	40.4	2.493	2.557	50	23:41:15	212.82	1381.35
9	185	1.1613	58.7	14.4	86.9	39.8	2.494	2.555	50	23:41:23	212.95	1420.612
9	193	1.1526	58.7	14.3	86.3	40	2.492	2.556	50	23:41:31	213.08	1385.359
9	202	1.1603	58.7	14.4	86.9	39.9	2.493	2.556	50	23:41:40	213.23	1416.526
9	211	1.1625	58.7	14.4	86.5	40.3	2.494	2.555	50	23:41:49	213.38	1425.526
9	219	1.1595	58.7	14.4	86.4	40.4	2.493	2.557	50	23:41:57	213.52	1413.264
9	227	1.1428	58.7	14.3	86.6	40	2.493	2.556	50	23:42:05	213.65	1346.439
9	235	1.1429	58.7	14.3	86.6	40.1	2.492	2.557	50	23:42:13	213.78	1346.832
9	243	1.182	58.8	14.4	86.6	40.3	2.492	2.556	50	23:42:21	213.92	1507.181
9	251	1.2842	58.7	14.4	86.8	39.6	2.493	2.556	50	23:42:29	214.05	1993.354
9	260	1.1854	58.7	14.3	86.5	39.9	2.492	2.555	50	23:42:38	214.20	1521.768
9	268	1.177	58.8	14.4	86.3	40	2.492	2.556	50	23:42:46	214.33	1485.919
9	276	1.1604	58.8	14.4	86.5	39.7	2.491	2.557	50	23:42:54	214.47	1416.934
9	284	1.1655	58.7	14.3	86.5	39.7	2.492	2.556	50	23:43:02	214.60	1437.868
9	293	1.1582	58.7	14.4	86.8	39.5	2.492	2.557	50	23:43:11	214.75	1407.974
9	301	1.1661	58.7	14.3	86.4	39.8	2.492	2.556	50	23:43:19	214.88	1440.346
9	309	1.1791	58.7	14.3	86.7	39.9	2.492	2.557	50	23:43:27	215.02	1494.822
9	317	1.155	58.7	14.3	86.2	39.9	2.493	2.555	50	23:43:35	215.15	1395.018
9	325	1.2357	58.7	14.4	86.5	40.3	2.493	2.556	50	23:43:43	215.28	1750.075
9	334	1.2071	58.7	14.4	86.5	39.5	2.493	2.556	50	23:43:52	215.43	1617.358
9	342	1.232	58.7	14.3	86.8	39.8	2.492	2.557	50	23:44:00	215.57	1732.466
9	351	1.2054	58.7	14.4	86.3	40	2.493	2.557	50	23:44:09	215.72	1609.713
9	359	1.1865	58.7	14.4	86	40.7	2.492	2.556	50	23:44:17	215.85	1526.51
9	368	1.2174	58.7	14.4	86.6	40.5	2.492	2.556	50	23:44:26	216.00	1664.261
9	376	1.2062	58.7	14.3	86.6	39.8	2.491	2.557	50	23:44:34	216.13	1613.307
9	384	1.1787	58.7	14.3	86.7	40.6	2.492	2.556	50	23:44:42	216.27	1493.123
9	392	1.1705	58.7	14.4	86.5	39.9	2.494	2.556	50	23:44:50	216.40	1458.615

9	401	1.1663	58.7	14.3	86.3	40.3	2.493	2.556	50	23:44:59	216.55	1441.173
9	409	1.156	58.7	14.3	86.8	40.1	2.493	2.558	50	23:45:07	216.68	1399.057
9	417	1.1758	58.7	14.3	86.6	40.2	2.492	2.556	50	23:45:15	216.82	1480.85
9	425	1.1713	58.7	14.4	86.4	40.2	2.493	2.555	50	23:45:23	216.95	1461.955
9	434	1.1587	58.8	14.4	85.9	40.3	2.492	2.556	50	23:45:32	217.10	1410.007
9	443	1.153	58.8	14.4	86.6	40.3	2.492	2.556	50	23:45:41	217.25	1386.966
9	451	1.146	58.7	14.3	86.3	40	2.493	2.556	50	23:45:49	217.38	1359.056
9	460	1.1359	58.8	14.4	86.9	39.8	2.492	2.556	50	23:45:58	217.53	1319.531
9	468	1.142	58.7	14.3	86.4	39.8	2.492	2.555	50	23:46:06	217.67	1343.298
9	476	1.1343	58.8	14.4	86.3	40	2.492	2.556	50	23:46:14	217.80	1313.35
9	484	1.1365	58.7	14.3	86.3	40	2.491	2.556	50	23:46:22	217.93	1321.855
9	494	1.1244	58.8	14.4	86.3	39.7	2.493	2.554	50	23:46:32	218.10	1275.585
9	502	1.1326	58.7	14.4	86.2	40.3	2.493	2.556	50	23:46:40	218.23	1306.806
9	511	1.1476	58.8	14.4	86.4	39.9	2.493	2.557	50	23:46:49	218.38	1365.398
9	519	1.1977	58.8	14.3	86.2	40	2.492	2.557	50	23:46:57	218.52	1575.418
9	528	1.1278	58.7	14.3	86.3	40.1	2.491	2.557	50	23:47:06	218.67	1288.461
9	536	1.1448	58.7	14.4	86.4	39.8	2.492	2.556	50	23:47:14	218.80	1354.314
9	545	1.111	58.8	14.4	86.5	39.9	2.494	2.555	50	23:47:23	218.95	1225.776
9	553	1.1128	58.7	14.3	86.4	40.2	2.492	2.557	50	23:47:31	219.08	1232.38
9	561	1.1026	58.8	14.4	86.5	39.8	2.494	2.555	50	23:47:39	219.22	1195.309
9	569	1.099	58.7	14.3	86.7	39.9	2.493	2.556	50	23:47:47	219.35	1182.428
9	578	1.0915	58.8	14.4	86.4	39.9	2.492	2.557	50	23:47:56	219.50	1155.929
9	586	1.0988	58.8	14.4	86.1	40.2	2.492	2.559	50	23:48:04	219.63	1181.715
9	594	1.095	58.7	14.3	86.5	39.5	2.494	2.555	50	23:48:12	219.77	1168.238
9	603	1.0904	58.8	14.3	86.5	40	2.492	2.555	50	23:48:21	219.92	1152.08
9	611	1.0959	58.7	14.3	86.7	40.1	2.492	2.555	50	23:48:29	220.05	1171.42
9	619	1.0736	58.7	14.3	87	39.7	2.491	2.555	50	23:48:37	220.18	1094.5
9	628	1.0663	58.7	14.3	86.7	40.2	2.492	2.556	50	23:48:46	220.33	1070.172
9	637	1.0715	58.7	14.4	86.5	39.6	2.491	2.558	50	23:48:55	220.48	1087.459
9	645	1.063	58.7	14.3	86.8	40.3	2.495	2.555	50	23:49:03	220.62	1059.31
9	653	1.0549	58.7	14.4	86.6	39.6	2.493	2.556	50	23:49:11	220.75	1033.004
9	662	1.0493	58.8	14.4	86.8	40.1	2.492	2.557	50	23:49:20	220.90	1015.11
9	670	1.0482	58.7	14.3	86.5	40.5	2.493	2.555	50	23:49:28	221.03	1011.623
9	678	1.0539	58.8	14.4	86.6	39.5	2.493	2.556	50	23:49:36	221.17	1029.791
9	687	1.0582	58.7	14.3	86.3	39.7	2.493	2.556	50	23:49:45	221.32	1043.661
9	695	1.0532	58.8	14.3	86.6	40.1	2.493	2.555	50	23:49:53	221.45	1027.547
9	703	1.0295	58.8	14.4	86.7	39.4	2.493	2.554	50	23:50:01	221.58	953.7301
9	711	1.0543	58.7	14.3	86.7	40	2.492	2.556	50	23:50:09	221.72	1031.075
9	719	1.0416	58.8	14.4	86.9	39.5	2.494	2.557	50	23:50:17	221.85	990.8922
9	728	1.0553	58.7	14.4	86.2	40	2.493	2.555	50	23:50:26	222.00	1034.291
9	736	1.0455	58.7	14.3	86.5	40	2.494	2.554	50	23:50:34	222.13	1003.103

9	744	1.0401	58.7	14.4	86.8	39.8	2.492	2.556	50	23:50:42	222.27	986.2263
9	753	1.0256	58.7	14.4	86.9	39.6	2.492	2.556	50	23:50:51	222.42	941.9825
9	762	1.0451	58.8	14.4	86.5	39.8	2.493	2.558	50	23:51:00	222.57	1001.845
9	770	1.0487	58.8	14.4	86.6	39.5	2.493	2.556	50	23:51:08	222.70	1013.207
9	779	1.0416	58.7	14.4	87.5	40	2.491	2.558	50	23:51:17	222.85	990.8922
9	787	1.0854	58.7	14.3	87	39.4	2.492	2.556	50	23:51:25	222.98	1134.71
9	796	1.0809	58.7	14.3	86.9	39.9	2.494	2.554	50	23:51:34	223.13	1119.246
9	805	1.0597	58.8	14.4	86.6	39.7	2.492	2.556	50	23:51:43	223.28	1048.532
9	813	1.0605	58.8	14.4	86.9	39.8	2.492	2.557	50	23:51:51	223.42	1051.137
9	821	1.0858	58.7	14.4	86.6	39.5	2.493	2.555	50	23:51:59	223.55	1136.092
9	829	1.1062	58.7	14.3	87.1	39.8	2.493	2.557	50	23:52:07	223.68	1208.295
9	838	1.1204	58.7	14.4	86.8	39.9	2.493	2.555	50	23:52:16	223.83	1260.56
9	846	1.1048	58.7	14.3	86.8	40	2.493	2.556	50	23:52:24	223.97	1203.232
9	854	1.0961	58.8	14.4	86.9	39.9	2.494	2.555	50	23:52:32	224.10	1172.128
9	862	1.0958	58.7	14.4	86.4	39.7	2.495	2.554	50	23:52:40	224.23	1171.066
9	871	1.0803	58.7	14.4	87.1	39.7	2.493	2.556	50	23:52:49	224.38	1117.196
9	879	1.1123	58.7	14.4	86.6	39.6	2.492	2.555	50	23:52:57	224.52	1230.543
9	887	1.1239	58.7	14.4	86.8	39.7	2.493	2.557	50	23:53:05	224.65	1273.699
9	895	1.101	58.7	14.3	86.7	39.8	2.491	2.557	50	23:53:13	224.78	1189.571
9	904	1.0956	58.7	14.3	87	39.7	2.494	2.556	50	23:53:22	224.93	1170.359
9	912	1.0896	58.7	14.3	86.6	39.9	2.492	2.557	50	23:53:30	225.07	1149.288
9	921	1.1008	58.8	14.4	86.8	40.1	2.492	2.555	50	23:53:39	225.22	1188.855
9	929	1.103	58.7	14.3	86.6	39.5	2.492	2.557	50	23:53:47	225.35	1196.746
9	938	1.0963	58.7	14.4	86.4	40.1	2.492	2.556	50	23:53:56	225.50	1172.836
9	947	1.0927	58.7	14.3	86.9	39.4	2.492	2.557	50	23:54:05	225.65	1160.138
9	955	1.0783	58.7	14.4	86.8	39.6	2.491	2.557	50	23:54:13	225.78	1110.384
9	963	1.0754	58.7	14.4	86.9	39.4	2.492	2.556	50	23:54:21	225.92	1100.563
9	972	1.1063	58.7	14.3	86.2	40	2.493	2.554	50	23:54:30	226.07	1208.658
9	980	1.0926	58.7	14.4	86.7	39.8	2.493	2.557	50	23:54:38	226.20	1159.787
9	988	1.0838	58.7	14.3	86.8	39.7	2.493	2.555	50	23:54:46	226.33	1129.193
9	996	1.0767	58.7	14.3	87.1	39.8	2.493	2.555	50	23:54:54	226.47	1104.958
9	1004	1.0811	58.7	14.4	86.6	39.9	2.491	2.557	50	23:55:02	226.60	1119.93
9	1012	1.0786	58.7	14.3	86.7	39.5	2.494	2.556	50	23:55:10	226.73	1111.404
9	1021	1.0829	58.7	14.4	86.9	39.8	2.492	2.557	50	23:55:19	226.88	1126.099
9	1030	1.0878	58.7	14.4	86.9	40	2.494	2.556	50	23:55:28	227.03	1143.023
9	1038	1.0796	58.7	14.3	87.4	39.5	2.492	2.557	50	23:55:36	227.17	1114.808
9	1046	1.0837	58.8	14.4	86.9	39.8	2.493	2.556	50	23:55:44	227.30	1128.849
9	1054	1.0676	58.7	14.3	87	39.5	2.493	2.557	50	23:55:52	227.43	1074.474
9	1063	1.0936	58.8	14.4	86.6	39.4	2.494	2.554	50	23:56:01	227.58	1163.303
9	1072	1.1216	58.7	14.3	87.1	39.2	2.492	2.555	50	23:56:10	227.73	1265.053
9	1080	1.084	58.7	14.4	86.9	39.7	2.495	2.555	50	23:56:18	227.87	1129.881

9	1088	1.0727	58.7	14.4	87	39.8	2.493	2.555	50	23:56:26	228.00	1091.479
9	1096	1.0875	58.7	14.3	86.3	39.8	2.491	2.557	50	23:56:34	228.13	1141.981
9	1105	1.0795	58.7	14.4	86.4	39.6	2.493	2.556	50	23:56:43	228.28	1114.468
9	1113	1.0847	58.8	14.4	86.8	39.4	2.493	2.556	50	23:56:51	228.42	1132.293
9	1121	1.0846	58.7	14.4	86.8	39.9	2.494	2.556	50	23:56:59	228.55	1131.949
9	1129	1.1063	58.7	14.3	86.9	39.5	2.493	2.555	50	23:57:07	228.68	1208.658
9	1137	1.0892	58.8	14.4	86.7	39.7	2.493	2.556	50	23:57:15	228.82	1147.893
9	1146	1.0915	58.7	14.3	87	39.7	2.492	2.558	50	23:57:24	228.97	1155.929
9	1154	1.0964	58.7	14.3	86.7	39.2	2.494	2.556	50	23:57:32	229.10	1173.19
9	1162	1.0902	58.7	14.4	87	39.5	2.491	2.557	50	23:57:40	229.23	1151.382
9	1170	1.091	58.7	14.3	86.9	39.6	2.493	2.557	50	23:57:48	229.37	1154.178
9	1178	1.0817	58.7	14.4	86.6	39.7	2.493	2.556	50	23:57:56	229.50	1121.983
9	1186	1.0822	58.7	14.4	86.8	39.9	2.493	2.556	50	23:58:04	229.63	1123.697
9	1195	1.0733	58.7	14.3	86.8	39.6	2.492	2.556	50	23:58:13	229.78	1093.492
9	1204	1.0707	58.7	14.3	87	39.8	2.493	2.556	50	23:58:22	229.93	1084.786
9	1212	1.0788	58.7	14.3	86.7	39.7	2.492	2.557	50	23:58:30	230.07	1112.084
9	1221	1.0666	58.7	14.4	86.9	40	2.493	2.556	50	23:58:39	230.22	1071.164
9	1229	1.0785	58.7	14.3	87	39.8	2.492	2.557	50	23:58:47	230.35	1111.064
9	1237	1.0629	58.7	14.3	87.4	39.8	2.492	2.556	50	23:58:55	230.48	1058.982
9	1247	1.0648	58.7	14.3	86.7	39.7	2.493	2.554	50	23:59:05	230.65	1065.224
9	1256	1.0654	58.7	14.4	87	39.6	2.491	2.556	50	23:59:14	230.80	1067.201
9	1264	1.0657	58.7	14.4	86.6	39.8	2.494	2.556	50	23:59:22	230.93	1068.191
9	1272	1.0764	58.7	14.3	86.9	39.6	2.491	2.557	50	23:59:30	231.07	1103.942
9	1281	1.0669	58.7	14.3	86.8	39.8	2.493	2.558	50	23:59:39	231.22	1072.156
9	1288	1.1606	58.7	14.3	86.9	39.6	2.492	2.556	50	23:59:46	231.33	1417.751
9	1296	1.1182	58.7	14.4	87.1	39.2	2.492	2.557	50	23:59:54	231.47	1252.353
9	1305	1.1082	58.7	14.3	86.6	39.6	2.492	2.554	50	0:00:03	231.57	1215.556
9	1313	1.0942	58.7	14.4	86.7	39.6	2.492	2.556	50	0:00:11	231.70	1165.416
9	1321	1.0938	58.7	14.4	86.3	39.6	2.493	2.558	50	0:00:19	231.84	1164.007
9	1330	1.0974	58.7	14.3	86.9	39.5	2.493	2.555	50	0:00:28	231.99	1176.736
9	1338	1.0896	58.7	14.3	86.7	39.8	2.493	2.555	50	0:00:36	232.12	1149.288
9	1347	1.0675	58.7	14.4	87	39.6	2.492	2.555	50	0:00:45	232.27	1074.143
9	1355	1.0865	58.7	14.3	87	39.8	2.492	2.556	50	0:00:53	232.40	1138.514
9	1363	1.0768	58.7	14.4	87.2	39.7	2.493	2.557	50	0:01:01	232.54	1105.296
9	1371	1.085	58.7	14.4	86.9	39.7	2.494	2.556	50	0:01:09	232.67	1133.328
9	1380	1.09	58.7	14.4	87.3	39.4	2.492	2.556	50	0:01:18	232.82	1150.683
9	1389	1.0889	58.7	14.4	86.7	39.6	2.493	2.556	50	0:01:27	232.97	1146.848
9	1397	1.0708	58.7	14.3	86.7	39.6	2.495	2.555	50	0:01:35	233.10	1085.12
9	1406	1.0892	58.7	14.4	86.8	39.5	2.492	2.556	50	0:01:44	233.25	1147.893
9	1414	1.0562	58.7	14.3	86.7	39.6	2.492	2.557	50	0:01:52	233.39	1037.192
9	1423	1.0967	58.7	14.3	86.4	40.2	2.493	2.558	50	0:02:01	233.54	1174.253

9	1431	1.0554	58.7	14.4	86.3	39.9	2.495	2.554	50	0:02:09	233.67	1034.613
9	1440	1.0683	58.7	14.4	86.9	39.7	2.493	2.557	50	0:02:18	233.82	1076.796
9	1449	1.0646	58.7	14.3	86.8	39.5	2.492	2.555	50	0:02:27	233.97	1064.566
9	1458	1.0521	58.7	14.4	86.5	40.2	2.494	2.555	50	0:02:36	234.12	1024.027
9	1466	1.0726	58.7	14.3	86.7	39.9	2.492	2.557	50	0:02:44	234.25	1091.143
9	1475	1.0561	58.7	14.4	86.5	39.8	2.493	2.555	50	0:02:53	234.40	1036.869
9	1483	1.045	58.7	14.4	86.9	39.8	2.493	2.557	50	0:03:01	234.54	1001.531
9	1491	1.0415	58.7	14.3	86.6	39.6	2.494	2.556	50	0:03:09	234.67	990.5807
9	1499	1.062	58.7	14.4	86.3	39.4	2.493	2.557	50	0:03:17	234.80	1056.035
9	1507	1.0438	58.7	14.3	86.5	39.6	2.492	2.556	50	0:03:25	234.94	997.7661
9	1516	1.0477	58.7	14.4	86.7	39.9	2.493	2.556	50	0:03:34	235.09	1010.041
9	1524	1.0485	58.7	14.4	86.9	40	2.492	2.557	50	0:03:42	235.22	1012.573
9	1533	1.0323	58.7	14.4	86.7	40	2.492	2.557	50	0:03:51	235.37	962.2332
9	1542	1.0402	58.7	14.3	86.5	40.2	2.493	2.555	50	0:04:00	235.52	986.5368
9	1550	1.0376	58.7	14.3	86.7	39.7	2.493	2.556	50	0:04:08	235.65	978.487
9	1558	1.0578	58.7	14.3	86.7	40	2.492	2.556	50	0:04:16	235.79	1042.364
9	1567	1.0308	58.7	14.3	86.4	40.2	2.495	2.555	50	0:04:25	235.94	957.6708
9	1575	1.0313	58.7	14.4	86.3	40.5	2.494	2.554	50	0:04:33	236.07	959.1898
9	1584	1.0303	58.7	14.4	86.6	40.1	2.493	2.555	50	0:04:42	236.22	956.1537
9	1592	1.0263	58.7	14.3	86.5	40.2	2.492	2.555	50	0:04:50	236.35	944.0828
9	1600	1.0109	58.7	14.4	86.2	40.1	2.493	2.554	50	0:04:58	236.49	898.6967
9	1608	1.0127	58.7	14.3	86.2	40	2.492	2.557	50	0:05:06	236.62	903.9133
9	1616	1.027	58.7	14.4	86.7	39.9	2.493	2.555	50	0:05:14	236.75	946.1868
9	1625	1.0195	58.7	14.3	86.6	40	2.493	2.555	50	0:05:23	236.90	923.8306
9	1633	1.0176	58.7	14.3	86.3	40	2.491	2.556	50	0:05:31	237.04	918.2319
9	1641	0.9994	58.7	14.3	86.3	40.5	2.494	2.556	50	0:05:39	237.17	865.9127
9	1649	0.999	58.7	14.3	86.4	40	2.492	2.557	50	0:05:47	237.30	864.7892
9	1658	0.9901	58.7	14.4	86.6	39.8	2.493	2.556	50	0:05:56	237.45	840.081
9	1666	1.0202	58.7	14.3	86.8	39.8	2.491	2.557	50	0:06:04	237.59	925.8999
9	1675	1.0452	58.7	14.3	86.2	40	2.492	2.556	50	0:06:13	237.74	1002.159
9	1683	1.0197	58.7	14.3	86.8	39.8	2.493	2.553	50	0:06:21	237.87	924.4215
9	1692	1.0308	58.7	14.4	86.6	40.3	2.493	2.556	50	0:06:30	238.02	957.6708
9	1700	1.0168	58.7	14.3	86.8	40	2.491	2.557	50	0:06:38	238.15	915.8823
9	1708	1.0292	58.7	14.4	86.6	40.1	2.493	2.556	50	0:06:46	238.29	952.8225
9	1716	1.0339	58.7	14.4	86.4	39.8	2.492	2.557	50	0:06:54	238.42	967.1181
9	1725	1.0365	58.7	14.4	86.9	40.1	2.493	2.557	50	0:07:03	238.57	975.0965