Bed-Sediment Grain-Size and Morphologic Data from Suisun, Grizzly, and Honker Bays, CA, 1998-2002

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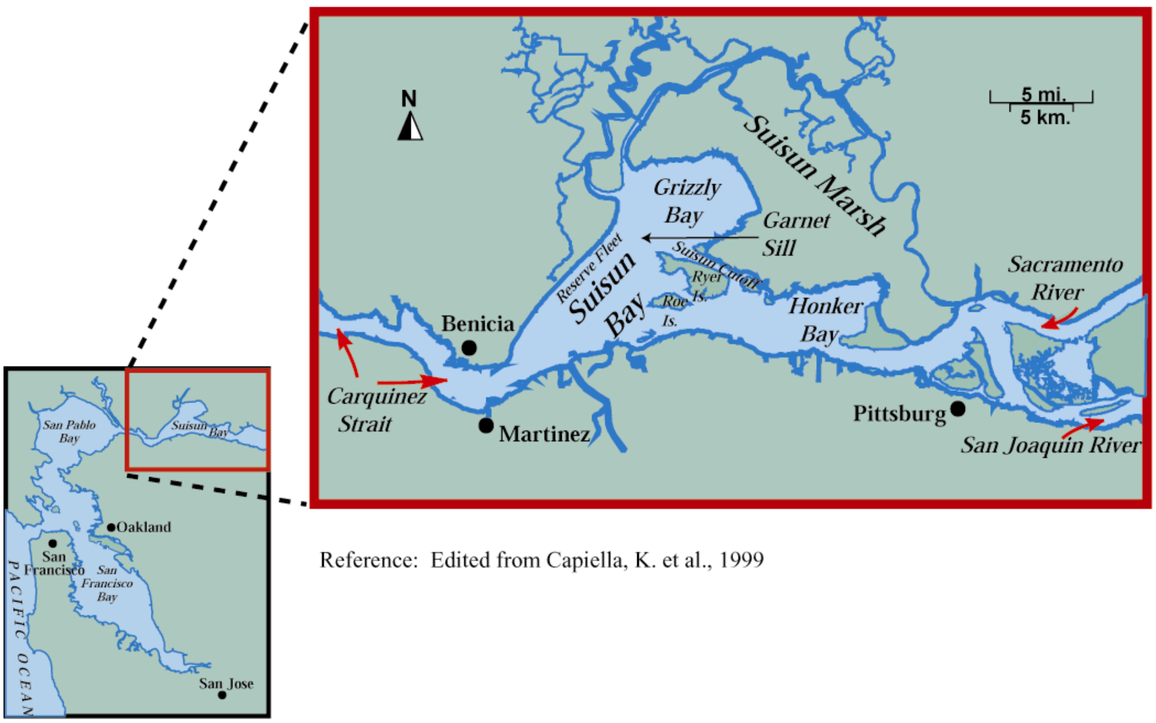
Abstract

The USGS Place Based Studies Program for San Francisco Bay investigates this sensitive estuarine system to aid in resource management. As part of the inter-disciplinary research program, the USGS collected side-scan sonar data and bed-sediment samples from north San Francisco Bay to characterize bed-sediment texture and investigate temporal trends in sedimentation. The study area is located in central California and consists of Suisun Bay, and Grizzly and Honker Bays, sub-embayments of Suisun Bay. During the study (1998-2002), the USGS collected three side-scan sonar data sets and approximately 300 sediment samples. The side-scan data revealed predominantly fine-grained material on the bayfloor. We also mapped five different bottom types from the data set, categorized as featureless, furrows, sand waves, machine-made, and miscellaneous. We performed detailed grain-size and statistical analyses on the sediment samples. Overall, we found that grain size ranged from clay to fine sand, with the coarsest material in the channels and finer material located in the shallow bays. Grain-size analyses revealed high spatial variability in size distributions in the channel areas. In contrast, the shallow regions exhibited low spatial variability and consistent sediment size over time.

Figure 1: Location map



Reference: Edited from Capiella, K. et al., 1999

Introduction

The San Francisco Bay estuary begins at the confluence of the Sacramento and San Joaquin Rivers in central California. Since the discovery of gold in 1848, the region has undergone immense environmental changes. Hydraulic mining activity during the late 1800's in the Sierra Nevada resulted in the influx of large quantities of sediment to the San Francisco Bay estuary (Gilbert, 1917; Cappiella et al., 1999). At the same time, increased development has resulted in the loss of wetlands, re-routing of rivers, and species decline. The USGS Place Based Studies Program is an inter-disciplinary program aimed at understanding the San Francisco Bay estuary system, its response to modern stresses, and disseminating information to aid in resource management of the area.

As part of the San Francisco Place Based Studies Program, the USGS began research in northern San Francisco Bay to characterize bed-sediment texture and investigate temporal trends in sedimentation. The study area comprises approximately 170 km^2 and consists of Suisun Bay, and Grizzly and Honker Bays, sub-embayments of Suisun Bay (Fig. 1). At present, the region is characterized by three channels. The primary navigation channel is situated on the south side of Honker Bay into Suisun Bay, where it passes south of Ryer Island. A smaller channel runs between Roe Island and Ryer Island. The third channel flows through Suisun Cutoff, north of Ryer Island, on the south side of Grizzly Bay, and through the Reserve Fleet Channel on the western side of Suisun Bay. All three channels join at Carquinez Strait where they continue through the southern section of San Pablo Bay and into the Central Bay. The channels and shallows range in depth from 10 to 22 m and 1 to 2 m, respectively.

During the years 1998 through 2002, the USGS collected bed-sediment samples, and performed three side-scan sonar surveys of the region. We completed grain-size and statistical analyses on the sediment samples, which were compiled in a spreadsheet and are included with this report as Tables 2 and 3. The side-scan sonar data (Plate 1) from one survey was digitally mosaiced and interpreted to reveal bed morphology and composition.

Methods

The following section describes sample collection, sediment grain-size analyses, and side-scan sonar data collection.

Sediment Sample Collection

Sediment sampling took place between December 1998 and January 2002 using two USGS research vessels, the RV David Johnston and the RV Polaris. Table 1 summarizes the details regarding each cruise such as the research vessel, cruise ID, cruise dates, the number of samples collected, and whether side-scan sonar data was collected. Additional information on these cruises can be found at the link provided in Table 1.

The goal of the sampling scheme with the RV Johnston was to collect samples before and after the rainy season to investigate possible seasonal changes in bed texture (Table 1). The sample locations using this vessel are displayed on Figures 2-5 with symbols colored to represent percent sand-sized material. Percent sand is emphasized in this report as a means of characterizing the bi-modal distribution of grain sizes in the samples. The sediment sampling locations ranged from Montezuma and Suisun Sloughs to the north, Honker Bay to the east, and Carquinez Strait to the west. Sampling was largely concentrated in the channel area known as Garnet Sill (Fig. 1; Plate 1) due to its location as an important area of estuarine mixing adjacent to the large shallow-water habitat of Grizzly Bay (Schoellhamer, 2001). Sampling depths ranged from 1.17 m to 15.63 m.

Table 1: Sediment sample and side-scan data collection

Vessel	Cruise ID/Information	Cruise Date	Number of Samples	Side-Scan Sonar
RV David Johnston	J-5-98-SF http://walrus.wr.usgs.gov/infobank/j/j598sf/html/j-5-98-sf.fmeta.outline.html	December 1-2, 1998	28	Yes
RV David Johnston	J-2-99-SF http://walrus.wr.usgs.gov/infobank/j/j299sf/html/j-2-99-sf.fmeta.outline.html	March 4-8, 1999	56	Yes
RV David Johnston	J-3-99-SF http://walrus.wr.usgs.gov/infobank/j/j399sf/html/j-3-99-sf.fmeta.outline.html	November 15-18, 1999	85	Yes
RV David Johnston	J-1-00-SF http://walrus.wr.usgs.gov/infobank/j/j100sf/html/j-1-00-sf.fmeta.outline.html	March 13-15, 2000	64	No
RV Polaris	P-1-00-SF http://walrus.wr.usgs.gov/infobank/p/p100sf/html/p-1-00-sf.fmeta.outline.html	August 8-9, 2000	11	No
RV Polaris	P-2-00-SF http://walrus.wr.usgs.gov/infobank/p/p200sf/html/p-2-00-sf.fmeta.outline.html	November 7-8, 2000	12	No
RV Polaris	P-1-01-SF http://walrus.wr.usgs.gov/infobank/p/p101sf/html/p-1-01-sf.fmeta.outline.html	February 6-7, 2001	7	No
RV Polaris	P-2-01-SF http://walrus.wr.usgs.gov/infobank/p/p201sf/html/p-2-01-sf.fmeta.outline.html	February 26-27, 2001	12	No
RV Polaris	P-3-01-SF http://walrus.wr.usgs.gov/infobank/p/p301sf/html/p-3-01-sf.fmeta.outline.html	June 19-20, 2001	12	No
RV Polaris	P-4-01-SF http://walrus.wr.usgs.gov/infobank/p/p401sf/html/p-4-01-sf.fmeta.outline.html	October 16-17, 2001	12	No
RV Polaris	P-1-02-SF http://walrus.wr.usgs.gov/infobank/p/p102sf/html/p-1-02-sf.fmeta.outline.html	January 22-23, 2002	12	No

The RV Polaris was used for seven sampling cruises from 2000 to 2002 as indicated on Table 1. Unlike the Johnston cruises, samples were collected at 12 specific sites (Fig. 6) at variable intervals throughout the year. These locations are part of a network of long-term monitoring sites used by the USGS (see http://sfbay.wr.usgs.gov/access/wqdata/ for more information). Sampling depths ranged from 1.5 m at locations 415, 416, and 417, to 17.4 m at location 8.1 (Fig. 6). The shallow regions in the sloughs and Grizzly Bay were sampled using a smaller boat transported aboard the RV Polaris.

We used two types of equipment for the sampling: a Van Veen grab sampler, and box cores. The grab sampler has a clam-like scoop, and can penetrate about 20 cm deep. Sampling involved careful selection of the surface layer of sediment (top ~1 cm) into two sample bags, one for archive and one for analysis. The majority of the RV Johnston samples and all of the RV Polaris samples were collected using this instrument. A few samples on the RV Johnston cruise were collected by scraping the fine surface sediment from the top of a box core. Occasionally, samples were taken from various intervals below the surface in the grab or core. The specific equipment and interval used for each sample is indicated on Tables 2 and 3. After collection, samples were stored in a refrigerator on board the boat, and then transferred to a refrigerator in Menlo Park where they were stored at 3.8° C.

<u>Sediment Grain-Size Analysis</u>

Grain-size analysis typically lasted about one week for a batch of 30 samples. All instrumentation used for the analysis is located on the USGS Menlo Park campus. The following sections describe the various instruments used and a detailed account of the laboratory procedures.

Differing Grain-Size-Analysis Methodologies

Comparisons between the RV Johnston datasets are hampered by the changing methodologies used for the grain-size analysis. We used three different methods of analysis on the RV Johnston samples during the course of the project. The oldest samples of the data set (J-5-98-SF) were processed using the Rapid Sediment Analyzer (RSA) for the intermediates, and the Micromeritics 5100 Sedigraph[1] for the fine material. 10 samples from the J-2-99-SF cruise were analyzed using the RSA for the intermediates, and the Coulter LS100Q[1] laser particle-size analyzer for the fines. The remaining RV Johnston samples and all of the RV Polaris samples were processed utilizing only the laser particle-size analyzer for both size fractions. It is important to note that the RV Polaris samples were processed by the same individual and used a consistent analysis method, facilitating comparisons between samples throughout the study period. The techniques used to analyze the samples from the RV Johnston and the RV Polaris are indicated on Tables 2 and 3, respectively.

The changing methodologies were due to the limitations of the Sedigraph in processing the finest fraction (<0.0005 mm) of material. As a result, the data for the J-5-98-SF cruise show an increase in this size fraction as seen on Figures 7A and B. The laser particle-size analyzer was ultimately chosen as the best laboratory technique because of its ability to analyze a large range of grain sizes (0.0003 mm to 1.0 mm, 11.5 phi to 0 phi,), resulting in the use of only one instrument.

In order to facilitate comparisons between the samples, we omitted the coarsest material (>1 mm) from the RV Johnston samples for the computer analysis. We made this change for two reasons: 1) this size category was processed using different methods at various times during the study, and therefore not quantitatively comparable; and 2) we found that in nearly every case the coarsest material was predominately composed of shells and not elastic sediment. By omitting this category from the analysis, we aided comparisons between the data sets, and reduced skewing of the statistics by non-bed-sediment material. However, we chose not to omit this size fraction from the RV Polaris analyses due to the consistent methodology used in processing the samples.

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Removal of Organics *(all samples)*

30-80 g of a homogenized sample was placed in a beaker with 400 ml of deionized (DI) water and 20-30 ml of 30% hydrogen peroxide (H_20_2) to oxidize and remove organic matter. The solution was covered over night for sufficient oxidation to occur, and was then boiled for 4-6 hours to evaporate the remaining H_20_2.

Centrifuging *(all samples)*

After oxidation, each sample was poured into a 250-ml bottle(s) and centrifuged at 1700 rpm for 30 minutes. The salts and water were decanted off the top, and the bottle was refilled with DI. The sample was then centrifuged for another 60 minutes, and decanted one more time.

Sieving and Determining Coarse and Intermediate Weights

All RV Johnston samples (J-5-98-SF, J-2-99-SF, J-3-99-SF, and J-1-00-SF)

After removing the salts, each sample was wet sieved into a 1-L graduated cylinder using 2-mm and 0.063-mm sieves. The coarse and intermediate material caught in the 2-mm and 0.063-mm sieves, respectively, was then transferred into pre-weighed crucibles, dried at 70° C, and weighed. The coarse and intermediate weights were determined by subtracting the weight of the crucible.

All Polaris samples

After removing the salts, each sample was wet sieved into a pre-weighed beaker using 2-mm, 1.4-mm, and 1-mm sieves. The material caught in the sieves was transferred to pre-weighed crucibles, dried at 70° C, and weighed. The weight of the material was determined by subtracting the weight of the crucible.

Determining the Weight of the Fines

All RV Johnston samples (J-5-98-SF, J-2-99-SF, J-3-99-SF, and J-1-00-SF)

In order to determine the weight of the fine fraction in the sample, a standard pipette analysis based on settling velocity (Stokes' Law) was used (Carver, 1971).

All Polaris samples

The weight of the material <1 mm was determined after the size-distribution analysis was finished by drying the entire sample at 70º C, and subtracting the weight of the beaker and the dispersant.

Size Distribution for the Intermediates (intermediates and fines for the RV Polaris samples)

All J-5-98-SF samples and 10, J-2-99-SF samples

The intermediate weight percents were determined for every half-phi interval from 0.063 mm to 1.0 mm (4.0 phi to 0 phi) using the Rapid Sediment Analyzer (RSA) settling tubes. Material was released into a 2-m water column where it settled onto a weighing plate. A graph of cumulative weight versus time was recorded on a chart recorder, from which the size distribution could be extracted (Maher, et al., 1991).

Remaining J-2-99-SF samples, J-3-99-SF, and J-1-00-SF samples

The intermediate weight percents were determined using the large volume module laser particle-size analyzer. This instrument counts particles from 0.0003 mm to 1.0 mm (11.5 phi to 0 phi) by using light-scattering theory and lasers to determine the particle-size distribution of a sample (http://walrus.wr.usgs.gov/infobank/programs/html/facilities/mp/15.3/bldg15_m3009a.html). Each sample was agitated for 2 minutes, and then a representative sample was taken using a pipette, and added to the particle-size analyzer. The data were then saved to a computer, and printed according to cumulative weight percent every half-phi interval.

All Polaris samples

5 ml of dispersant was added to the material <1 mm in the pre-weighed beaker. The mixture was then agitated for 1-2 minutes, and sat overnight. 5 ml of dispersant was then added to three pre-weighed aluminum tins, dried, weighed, and averaged. The intermediate and fine weight percents of the material <1 mm were determined using the large volume module laser particle-size analyzer. Each sample was mixed for 2 minutes, and then a representative sample was taken using a pipette, and added to the particle-size analyzer. After the analysis was completed, the sample was flushed out of the particle-size analyzer into pre-weighed beakers, dried at 70° C, and weighed. The remaining sample not analyzed was also dried and weighed. The combined weights minus the averaged weight of the dispersant yielded a total weight of the material <1 mm as described above.

Size Distribution for the Fines

All J-5-98-SF samples

5 ml of dispersant was added to the fine fraction to separate clay-sized particles and inhibit flocculation. The mixture was then agitated for 1-2 minutes, and was allowed to sit overnight. 5 ml of dispersant was also added to three pre-weighed aluminum tins, dried, weighed, and averaged. Individual weight percents for material <0.063 mm were calculated using the Sedigraph. This instrument employs x-ray-attenuation technology to determine the particle-size distribution of a sample (http://walrus.wr.usgs.gov/infobank/programs/html/facilities/mp/15.3/bldg15_m3009a.html). Individual weight percents were recorded every half-phi interval from 0.0005 mm to 0.063 mm (11.0 phi to 4.0 phi).

Remaining J-2-99-SF samples, J-3-99-SF, and J-1-00-SF samples

5 ml of dispersant was added to the fine fraction to separate clay-sized particles and inhibit flocculation. The mixture was then agitated for 1-2 minutes, and was allowed to sit overnight. 5 ml of dispersant was also added to three pre-weighed aluminum tins, dried, weighed, and averaged. Weight percents for material <0.063 mm were determined using the small volume module laser particle-size analyzer. Each sample was mixed thoroughly, and then a representative sample was taken using a pipette, and added to the particle-size analyzer. The data were then saved to a computer and printed according to cumulative weight percent every half-phi interval.

Computer Analysis

SDSZ (McHendrie, 1989), a USGS custom-designed grain-size analysis computer program was used to extract the statistics published in this report. We processed weight and size distribution data acquired from the RSA, Sedigraph, and particle-size analyzer with SDSZ. The output data were then organized into a table containing median grain size, moment statistics, percent gravel, sand, silt, clay, and mud (Tables 2 and 3).

Side-Scan Sonar Collection

We collected side-scan sonar data on three cruises (J-5-98-SF, J-2-99-SF, and J-3-99-SF) in the Suisun Bay study area (including the Grizzly and Honker Bay sub-embayments). Our rationale in acquiring side–scan sonar data was to complement the textural data collected to test the hypothesis that riverine-supplied sediment and seasonal changes might result in changes in the bed morphology and composition (texture). Our purpose was therefore to collect sufficient sonar data over the study area to assess changes in bed morphology and composition. We were limited, though, by equipment availability, data-acquisition malfunctions, and post-processing timing. Due to time constraints and staffing changes we were limited to analysis of the J-5-98-SF data only.

A Klein 2000[1] side-scan sonar system was used on the J-5-98-SF and J-3-99-SF surveys, whereas a Klein 595[1] system was used on J-2-99-SF. We collected 100 kHz sonar data on all three surveys using a swath width of 200 m (100 m on each side of the ship track). Navigation data on all surveys utilized differential global positioning systems (DGPS); navigation data were integrated with sonar data and both were stored digitally on optical disks for archiving. 200 kHz bathymetry and 3.5 kHz sub-bottom data were simultaneously collected with the side-scan sonar data. J-5-98-SF sonar data were collected in the “non-mapping” mode as we intended to post-process the data and mosaic all survey tracks. However, due to time constraints, J-2-99-SF and J-3-99-SF sonar data were collected in the “scale-corrected mapping” mode such that hard-copy sonar profiles were spatially corrected both in the along-track and across-track aspects by integrating both boat speed and DGPS. The sonar towfish on every cruise was towed immediately behind the RV Johnston such that the distance between the DGPS antenna and the towfish was negligible. Horizontal resolution of all sonar data is approximately 1-2 m. Theoretical vertical resolution of the 100 kHz sonar data is approximately 10 cm such that bed features smaller than 10 cm cannot be resolved in detail.

Results

Grain-Size Analysis

RV Johnston samples

The grain-size analyses for the RV Johnston samples yielded median values ranging from 0.0015 mm to 0.46 mm (9.3 phi to 1.1 phi), with an average median grain size of 0.032 mm (4.9 phi). To facilitate comparisons among samples from regions with similar morphology (Plate 1), grain-size distribution graphs from the Garnet Sill and Grizzly Bay regions are shown on Figure 7. We delineated the Garnet Sill and Grizzly Bay samples based on the side-scan sonar data. The sample ID, number of samples in each category, and the average percent sand-sized material are indicated on each graph. Figure 7 does not include all sample data collected on the RV Johnston

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cruises due to a small number of samples collected outside the Garnet Sill and Grizzly Bay regions. Samples collected in the Garnet Sill region (Figs. 7A, C, E, and G), often display a bimodal distribution. These fine sand and silt modes often are the result of distinct, thin (<0.5-1 cm), stratigraphic layers, seen in the grab or box core sampler. In any given sample, the relative abundance of each mode reflects primarily the quantity of each layer subsampled by the operator. This fine-scale stratigraphic heterogeneity is typical of channel samples throughout the study area, and is consistent with the spatial heterogeneity of return strength seen in the side-scan sonar data for Garnet Sill (Plate 1).

The samples collected with the RV Johnston in the shallower regions of Grizzly Bay are dominated by silt and clay as seen on Figures 7B, D, F, and H. A few samples from the channel area on the west side of Grizzly Bay near the mouth of Suisun and Montezuma Sloughs have a fine sand mode (Figs. 7B, D, F, and H, samples 18, 54, 62, 103, 95, 199, 209). As previously mentioned in this report, the emphasis on fine material associated with using the Sedigraph instrument is seen on Figures 7A and 7B as an increase in material at the fine end of the distribution.

RV Polaris samples

The RV Polaris data show grain-size trends at 12 specific locations from August 2000 to January 2002 (Table 1). The results indicate an average median grain size of 0.042 mm (4.6 phi) ranging from 0.006 mm to 0.38 mm (7.4 phi to 1.4 phi). The grain-size distributions for all 12 sites are displayed on Figures 8 and 9. Samples collected in the channel regions (Figs. 8A, B, C, D, E, F and 9A, and E) display a similar bimodal distribution of fine sand and silt to the RV Johnston Garnet Sill samples, with generally consistent distributions during the study period. Location 411.1 (Fig. 9A), on the western side of Garnet Sill exhibits the greatest variability in grain-size distribution, with median size ranging from 0.011 mm to 0.022 mm (6.6 phi to 5.5 phi). This range likely reflects stratigraphic, spatial, and possibly temporal variability of bed-sediment at this sampling site, similar to the other Garnet Sill samples (Fig. 7). This particular location is relatively fine compared to Garnet Sill as a whole.

The samples collected in the shallow areas during the RV Polaris cruises fall into three locations, Montezuma Slough, Grizzly Bay, and Honker Bay. The Montezuma Slough samples (site 415, Fig. 9B) contain the coarsest sediment of those collected in the shallow regions of the study area, and resemble a fine channel sample. The graph on Figure 9B exhibits a dominant mud mode with a prominent fine-sand mode, which is typical of the slough samples from the RV Johnston cruises (Table 2). The grain size distribution of all six samples collected at this site exhibit remarkable similarity. The data results for the samples collected in Grizzly (site 416 and 417, Fig. 9C and D) and Honker Bays (site 433, Fig. 9F) are extremely fine grained with almost no sand present in the samples. These data sets are also noteworthy in their consistency in grain size over time.

<u>Side-Scan Sonar Analysis</u>

J-5-98-SF sonar data were interpreted using bottom morphology (side-scan and fathometer) and relative strength of backscatter (a measure of bottom roughness and type of bed material), these parameters being key indicators of bed morphology and composition. In general, coarse-grained bed-sediments yield higher backscatter (light tones on Plate 1), and fine-grained material yields weak backscatter (dark tones on Plate 1). One can immediately deduce from the predominance of darker tonal patterns on the mosaic (Plate 1) that much of the bayfloor of the study area surveyed is composed of fine-grained material (very fine sand and finer) and is “relatively smooth” (lacking significant bed roughness or relief). This agrees with conclusions derived from the textural data.

5 bottom types can be identified in the J-5-98-SF sonar data.
1) Featureless- where there are no discernible bed features and the tonal pattern is fairly constant across the profile for the specific area mapped. A derivative of this bottom type is the tonal pattern that occurs over Garnet Sill (elaborated on below). Featureless bottom occurs throughout the study area but predominates in the shallowest areas where the texture is typically very fine grained (mud), and the floor is relatively flat to gently sloping. It also occurs in localized areas admixed with other bottom types such as sand waves or furrows. Due to the resolution of the side-scan sonar systems used (10 cm), there could be smaller bed features present but that might appear as "flat" bottom on the sonar profile. In the Garnet Sill area (Fig. 1) the bottom is relatively flat to gently sloping and there is little vertical relief, as determined from fathometer profiles across the area. However, Plate 1 reveals that on the sonar mosaic a distinct demarcation exists between a darker tonal area (on the north side) and a lighter tonal area (on south side). The demarcation roughly coincides with the 4 m isobath. Since the tonal pattern is not due to bottom relief or roughness, we think that it is caused by a compositional difference in the bed-sediments. Figure 2 depicts surface sample locations and also the percent sand of bed sediment over the Garnet Sill area during the period when the sonar data (J-5-98-SF) was acquired. Sediment samples north of the 4 m isobath are predominately mud whereas samples south of the 4 m isobath are predominately sandy sediment. This textural difference in the bed sediment is manifest in the sonar profile by the tonal contrast on each side of the 4 m isobath (dark tone is finer muddier sediment, light tone is coarser sandier sediment).

2) Furrows- a sedimentary bed feature (bedform) that results from the molding of the bed by physical processes (largely tidal flow). Furrows consist of a series of elongate and parallel grooves separated by intervening ridges. They form parallel to the dominant flow, which formed and subsequently maintains them. These bed features were only found on the western side of the Reserve Fleet Channel in westernmost Suisun Bay (Fig. 1; Plate 1). Many vessels of the Reserve Fleet rest at anchor over furrows. Furrows can be traced discontinuously from just east of Benicia northeast to Garnet Sill. To the south they terminate against sand waves and/or bedrock adjacent to the Benicia-Martinez Bridge/SP Railroad Bridge, and to the north they terminate against the western edge of the tonal area on Garnet Sill (Plate 1). Sonar and fathometer profiles reveal that furrows are less than 1 m in height and less than 2-5 m in wavelength and occur mostly in less than 6 m water depth. They exhibit tuning forks, although the forks do not open preferentially in either flood or ebb directions. Sediment samples (surface and box cores) in the furrow field show that they are dominantly cohesive mud. Furrows were present in the same location on all three-sonar surveys; we could not document whether individual furrows had migrated.

3) Sand waves- a sedimentary bed feature (bedform) that results from the molding of the bed by physical processes, such as tidal flow. We mapped two types of sand waves based on their vertical relief (from sonar and fathometer profiles): <1 m and 1-2 m. Wavelengths ranged from 2 m to 10 m. Sand waves in the 1 m and smaller category are ubiquitous and were observed in all of the tidal channels. The 1-2 m size was only observed under the Benicia-Martinez Bridge and in the navigation channels in Suisun Bay. The orientation of sand waves was not recorded, nor was their ebb or flood dominance---both ebb and flood oriented sand waves were observed. Areas where no sand waves were observed include the western margin of the Reserve Fleet Channel, Garnet Sill, Grizzly Bay, and Honker Bay.

4) Machine-made- bottom features that most likely result from mechanical alteration of the bayfloor. These include but are not limited to anchor drag marks, trawl marks, keel marks, and

bridges and/or pipeline supports. Anchor, trawl, and keel marks can commonly be differentiated from natural features in that they usually cross each other, often several times. They also commonly occur adjacent to areas such as docks, navigation channels, and anchored vessels. Pipelines, bridges, bridge support structures, and docks coincide exactly with analogous features on the navigational chart of Suisun Bay (N.O.S. sheet # 18656, 1992 ed., scale 1:40,000). We also observed semi-circular features adjacent to the former Concord Naval Weapons Station (Port Chicago) dock facilities that appear to be the result of dredging.

5) Miscellaneous- include small localized areas of the bayfloor where the side-scan sonar signal was "acoustically blanked out". The features actually occur in the water column above the bed and prevent a return signal from the bayfloor by totally dampening the outgoing sonar signal. These occurred only in the southeastern end of Suisun Cutoff adjacent to the southern tip of Ryer Island in waters up to 22 m deep. Their location coincides with deep but localized depressions that are irregular in shape. The sonar profile appears white or blank with no tonal contrast present.

Spatial and Temporal Trends

One of the goals of this study was to investigate possible temporal trends in bed grain size and morphology associated with river flood events or seasonal winnowing of fine sediment, as seen in some fluvial systems (e.g. Rubin and Topping, 2001). As mentioned above, the shallow-water samples from throughout the study area show remarkable consistency in grain size despite sampling during all seasons (Figs. 7 and 9). Conversely, considerable variability in grain size exists in the channel areas. However, the fine-scale stratigraphic and spatial heterogeneity seen in many of the samples from these areas (Figs. 7-9) hampers the utility of this data set as a record of temporal trends in bed grain size. One way to conduct a more effective investigation of temporal trends would be to sample with greater spatial and temporal density in a few well-defined locations. Another possible future research direction would be to increase sampling density through the use of underwater microscope and digital image analysis technology (e.g. Chezar, 2001; Rubin, D.M., 2004, in press).

Conclusion

Our research on bed morphology and texture in Suisun, Grizzly, and Honker Bays was accomplished by collecting and analyzing side-scan sonar data and bed-sediment samples during 1998-2002. The results of the side-scan sonar analysis reflected fairly uniform and fine-grained bed composition in the study area. Five different bottom types were also identified as part of the analysis, which included featureless, furrows, sand waves, machine-made, and miscellaneous bottom morphologies. Bed-sediment samples from Suisun, Grizzly and Honker Bays show median grain sizes ranging from fine silt to fine sand. Samples from channel regions are generally bimodal with distinct fine sand and silt units, reflecting the high degree of stratigraphic and spatial heterogeneity seen in these areas. Samples from the shallow regions of Grizzly and Honker Bays are silt and clay with little spatial or temporal variability.

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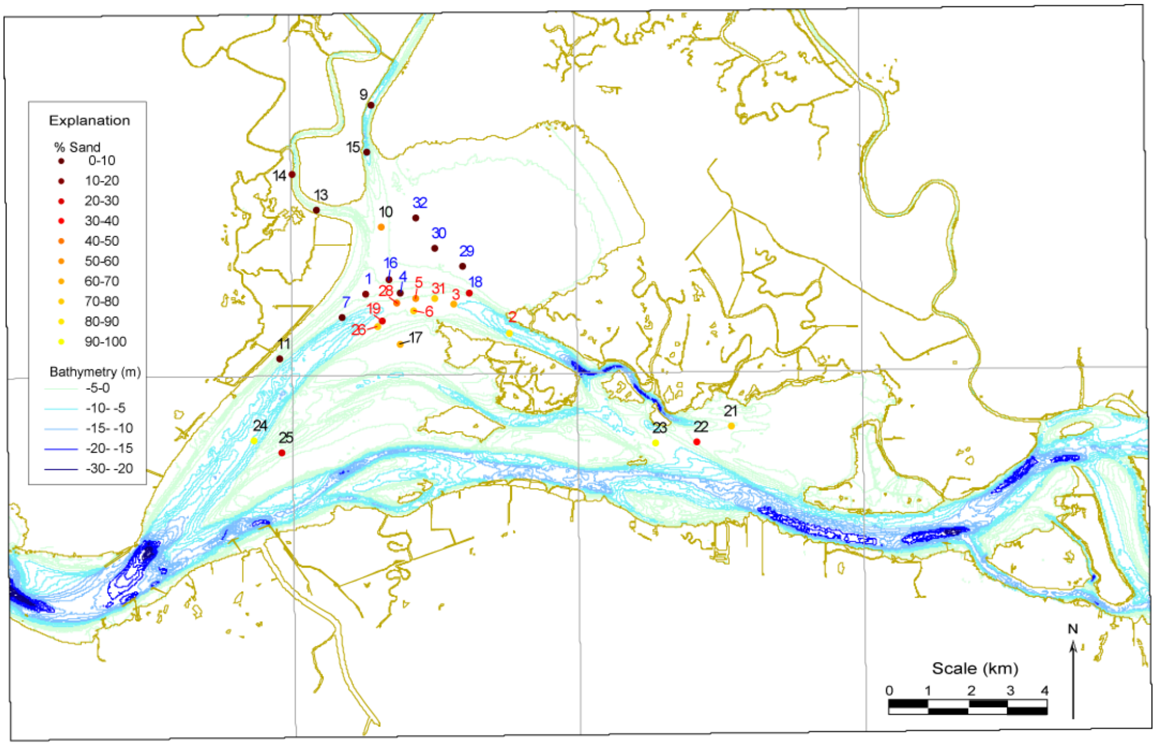

Figure 2: Sample locations for J-5-98 SF cruise (December 1-2, 1998)
Sample numbers are color coded by location (red=Garnet Sill, blue=Grizzly Bay) for comparison with Figure 7.

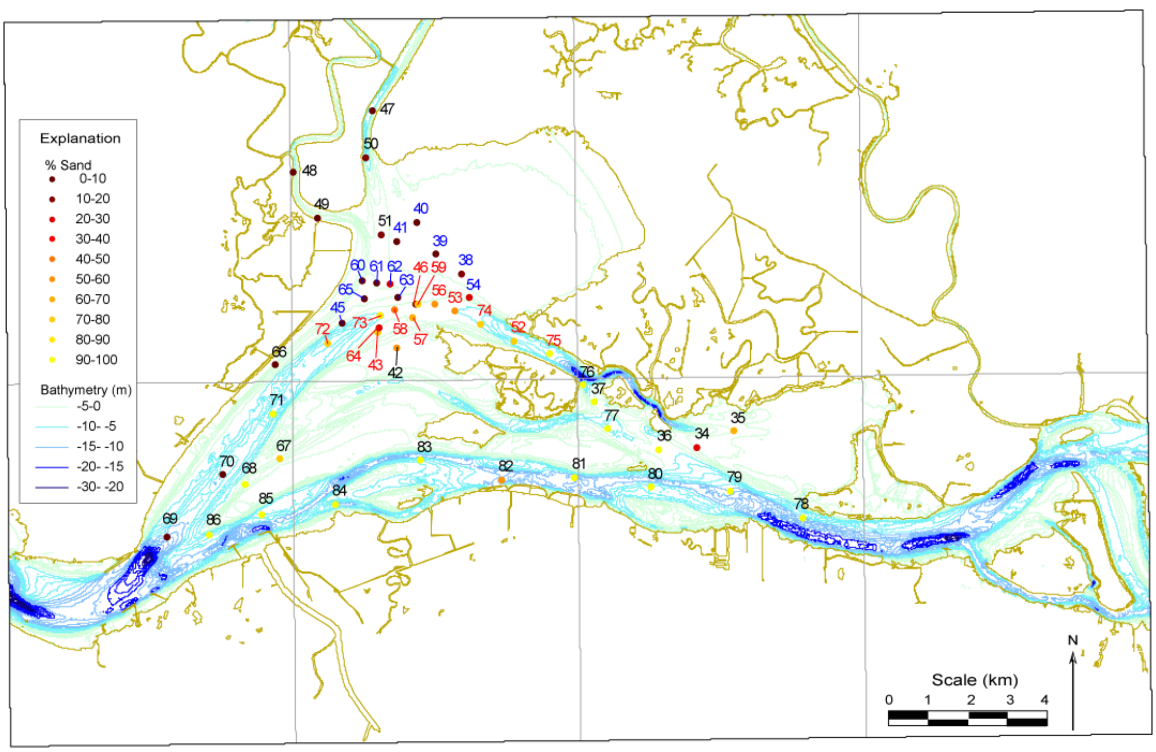

Figure 3: Sample locations for J-2-99 SF cruise (March 4-8, 1999)
See Figure 2 for more information.

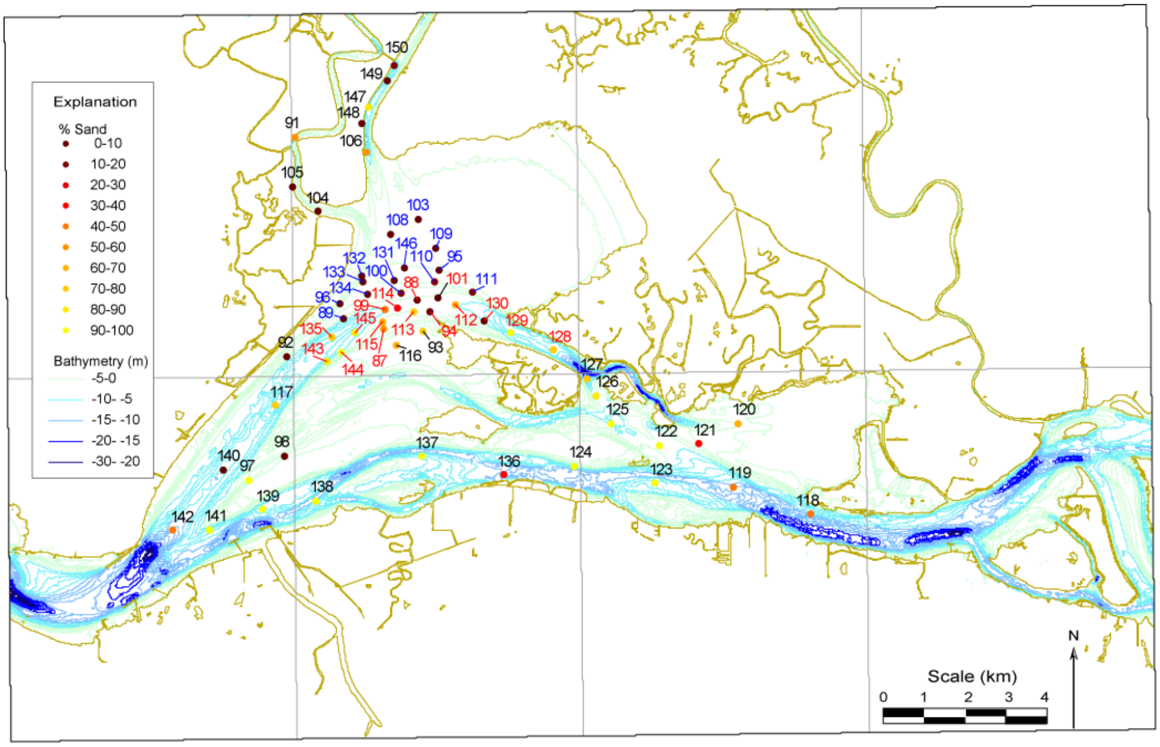

Figure 4: Sample locations for J-3-99 SF cruise (November 15-18, 1999)
See Figure 2 for more information.

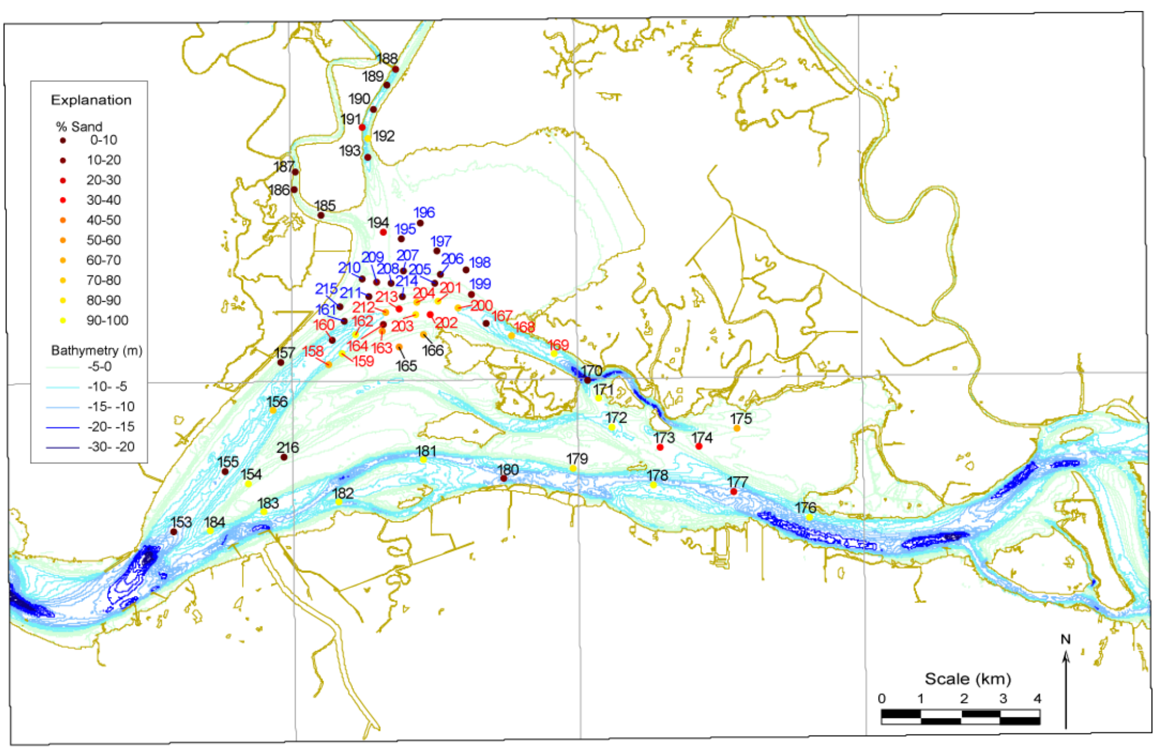

Figure 5: Sample locations for J-1-00 SF cruise (March 13-15, 2000)
See Figure 2 for more information.

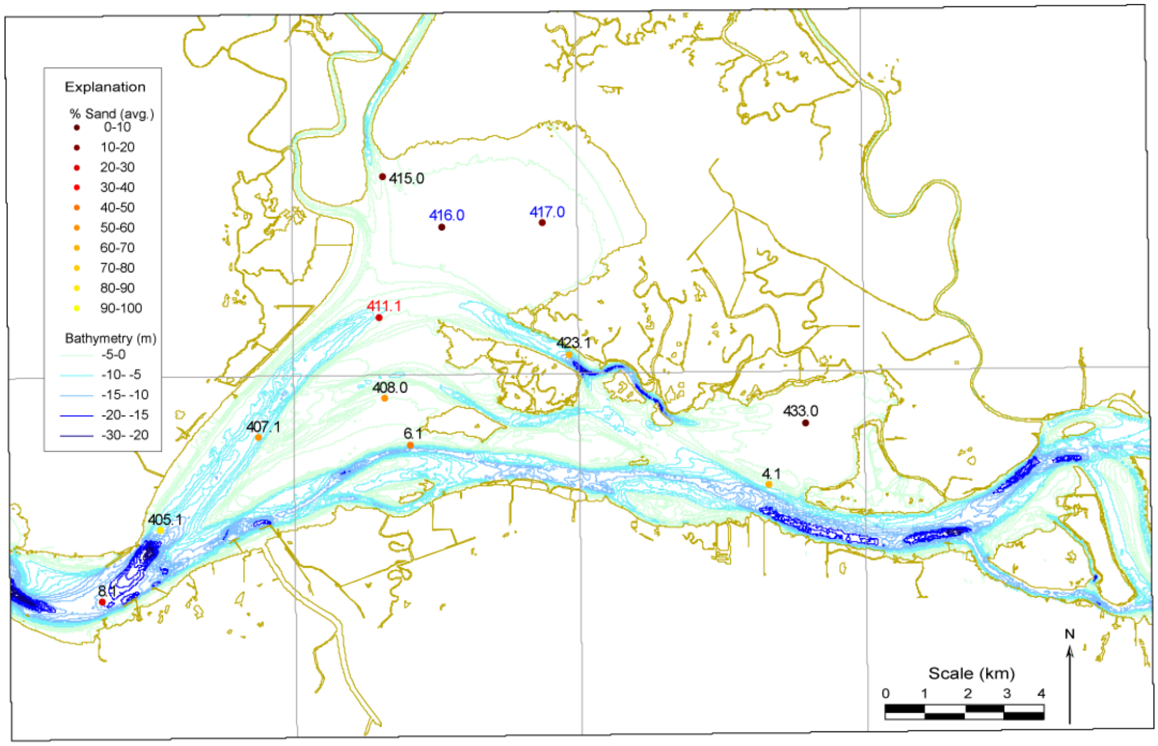

Figure 6: Sample locations for RV Polaris cruises in 2000-2002
Percent sand is averaged for all cruises. See Figures 8-9 for grain-size distributions. Samples from Grizzly Bay (blue) and Garnet Sill (red) are indicated for comparison with Figures 2-5.

Figure 7: Grain-size distributions from RV Johnston Cruises for surface samples from Garnet Sill (channelized region) and Grizzly Bay (shallow water region and slough channels). See Figures 2-5 for general locations.

Note: Red=Garnet Sill samples, Blue=Grizzly Bay samples. Y-axis represents weight percent coarser and scales differ on each graph.

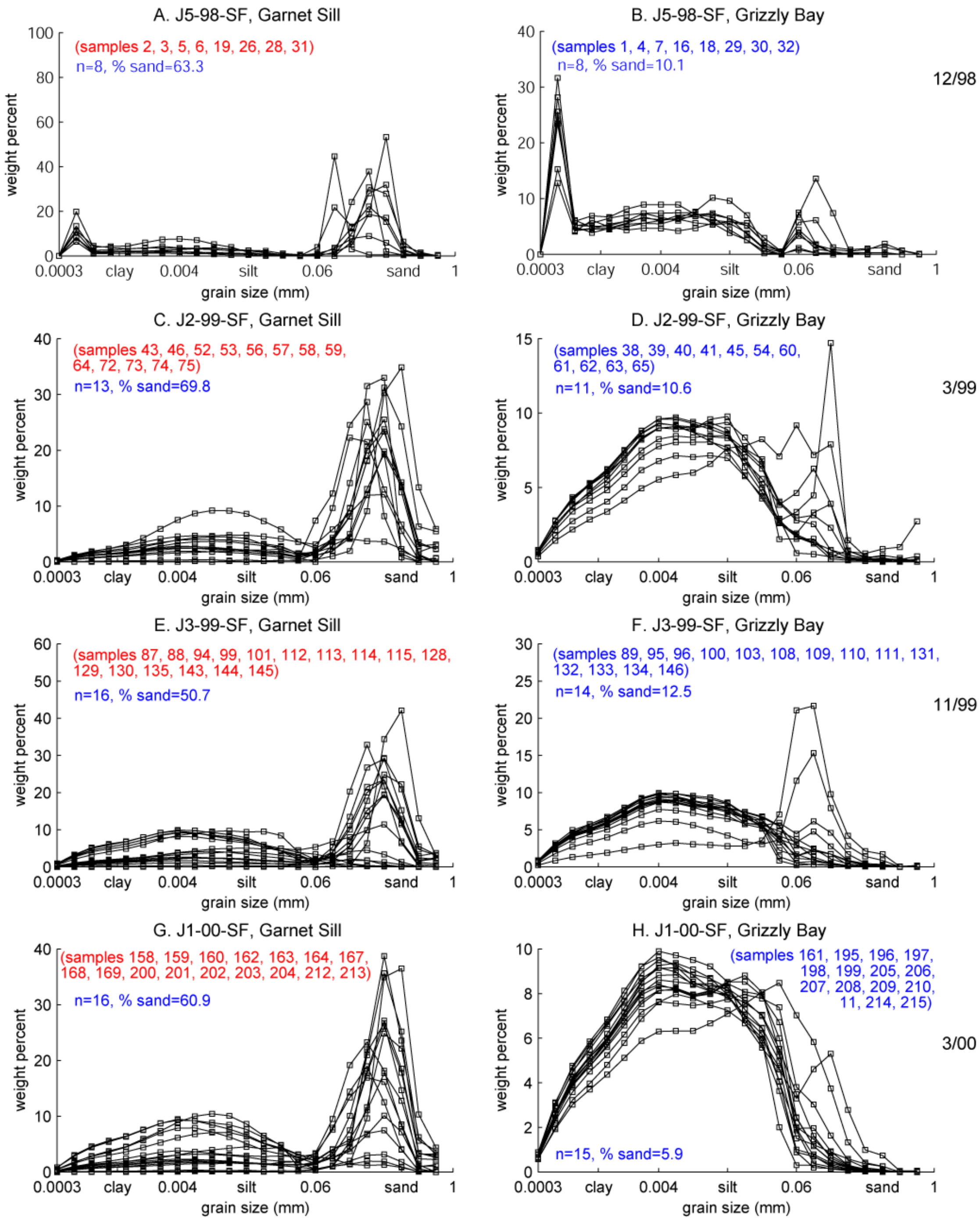

Figure 8: RV Polaris grain-size distributions for stations 4.1 to 408. See Figure 6 for general locations.
Note: Y-axis represents weight percent coarser and scales differ on each graph

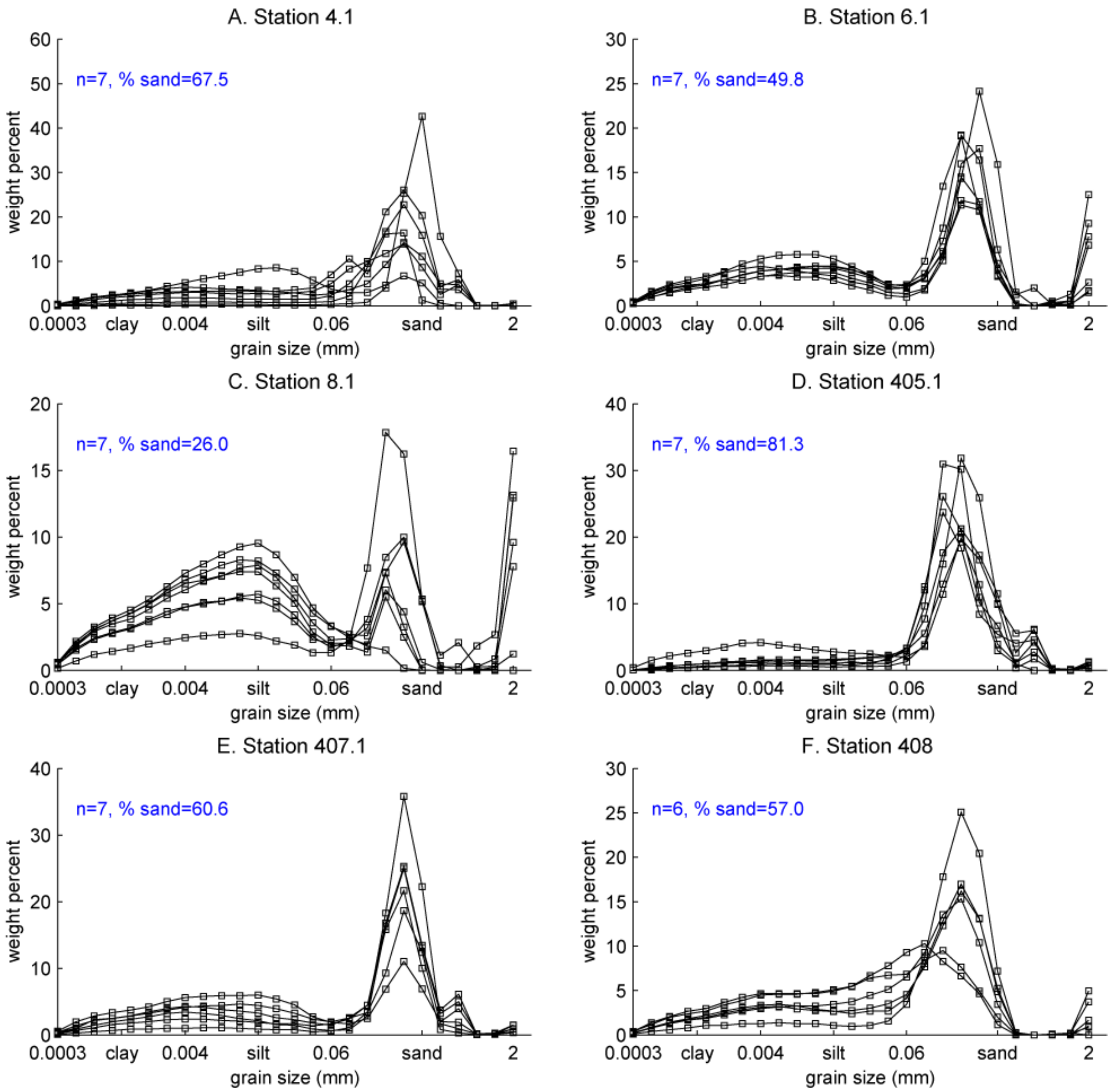

Figure 9: RV Polaris grain size distributions for stations 411.1 to 433. See Figure 6 for general locations.
Note: Y-axis represents weight percent coarser and scales differ on each graph

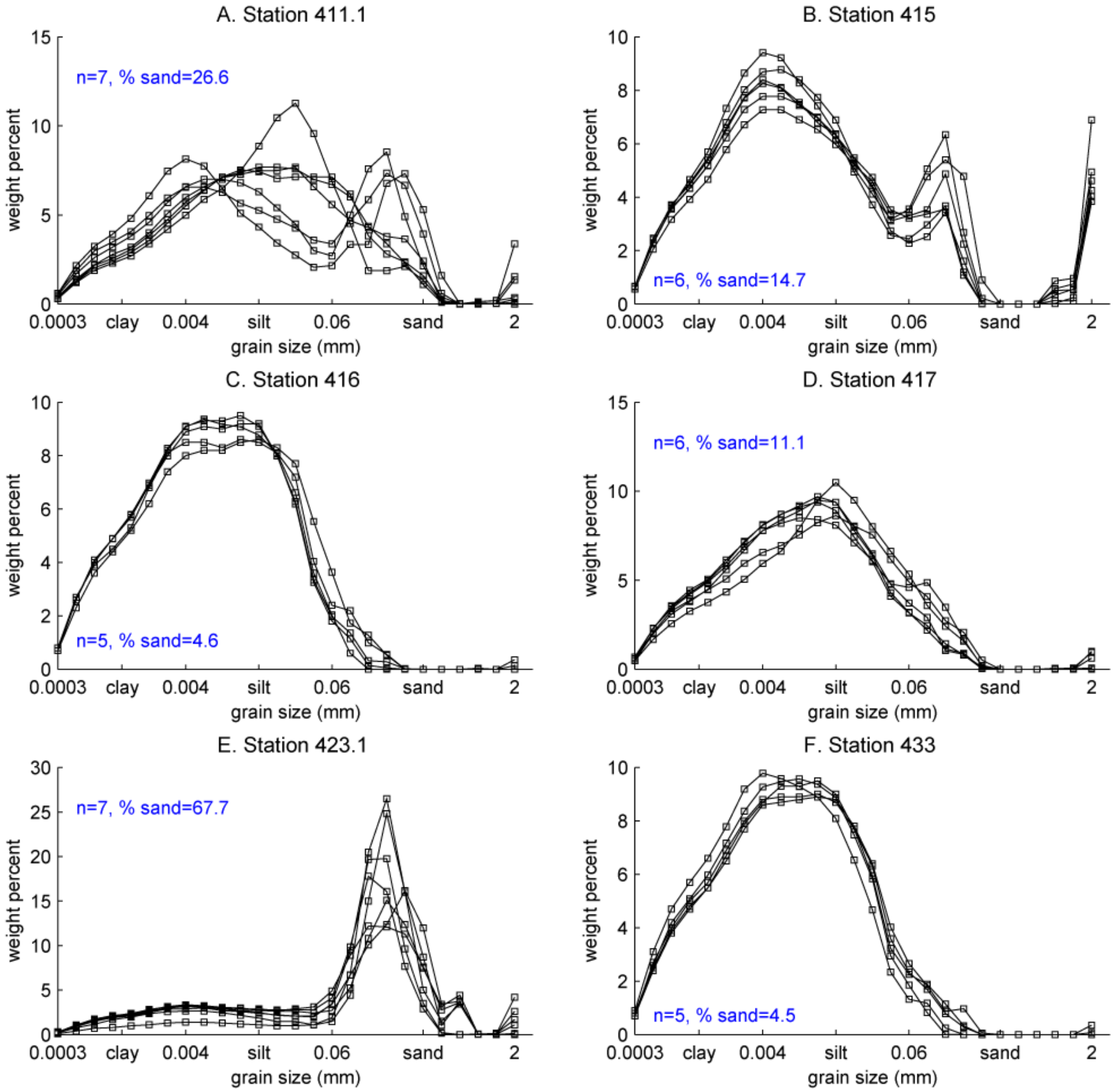

Table 2: Grain-size distributions for 4 RV David Johnston cruises

Note: All statistics in phi units

Cruise	Sample ID	Instrument	Latitude	Longitude	Date/Time	Method	% Gravel >2 mm	% Sand .062 – 2 mm	% Silt .004 - .062 mm	% Clay <.004 mm	% Mud <.062 mm	1st moment (mean)	2nd moment (variance)	Std. deviation	3rd moment (skewness)	4th moment (kurtosis)	Median
J-5-98	1	VV	38.10245	-122.06117	19983291705000	RSA/SG	0	16.97	33.63	49.40	83.03	8.01	10.49	3.24	-0.17	2.01	7.94
J-5-98	2	VV	38.09329	-122.01912	19983291939000	RSA/SG	0	81.88	6.14	11.98	18.12	3.27	9.38	3.06	2.02	5.67	1.94
J-5-98	3	VV	38.09989	-122.03533	19983291805000	RSA/SG	0	65.35	16.67	17.98	34.65	4.56	10.93	3.31	1.18	3.04	2.68
J-5-98	4	VV	38.10283	-122.05109	19983291726000	RSA/SG	0	5.41	38.40	56.19	94.59	8.74	7.26	2.69	-0.05	1.90	8.46
J-5-98	5	VV	38.10139	-122.04623	19983291740000	RSA/SG	0	55.32	15.96	28.72	44.68	5.36	14.42	3.80	0.66	1.92	2.89
J-5-98	6	VV	38.09867	-122.04695	19983291750000	RSA/SG	0	71.40	7.47	21.13	28.60	4.21	13.66	3.70	1.23	2.90	2.06
J-5-98	7	VV	38.09722	-122.06781	19983291650000	RSA/SG	0	1.83	34.88	63.29	98.17	9.18	6.08	2.47	-0.10	1.98	8.92
J-5-98	9	VV	38.14610	-122.05872	19983291901000	RSA/SG	0	1.59	33.07	65.34	98.41	9.12	5.25	2.29	-0.03	2.26	8.83
J-5-98	10	VV	38.11802	-122.05639	19983291838000	RSA/SG	0	58.71	14.45	26.85	41.29	5.28	13.70	3.70	0.75	2.12	3.31
J-5-98	11	VV	38.08770	-122.08621	19983352216000	RSA/SG	0	1.00	34.35	64.65	99.00	9.18	5.67	2.38	-0.08	1.96	8.99
J-5-98	13	VV	38.12188	-122.07501	19983352118000	RSA/SG	0	0.96	29.20	69.85	99.04	9.54	5.38	2.32	-0.24	2.14	9.34
J-5-98	14	VV	38.13018	-122.08226	19983352132000	RSA/SG	0	15.53	17.23	67.24	84.47	8.64	12.13	3.48	-0.83	2.67	9.11
J-5-98	15	BC	38.13521	-122.06045	19983351713000	CC	0	3.65	61.65	34.70	96.35	7.24	3.52	1.88	-0.23	3.23	7.29
J-5-98	16	VV	38.10580	-122.05419	19983352055000	RSA/SG	0	11.10	49.10	39.79	88.90	7.54	8.00	2.83	0.05	2.59	7.17
J-5-98	17	VV	38.09077	-122.05105	19983352039000	RSA/SG	0	60.17	11.35	28.48	39.83	5.79	11.71	3.42	0.85	2.17	3.75
J-5-98	18	VV	38.10257	-122.03058	19983352013000	RSA/SG	0	29.03	34.01	36.96	70.97	6.85	9.62	3.10	0.29	1.93	6.55
J-5-98	19	VV	38.09640	-122.05621	19983352158000	RSA/SG	0	27.88	26.54	45.58	72.12	7.28	12.72	3.57	-0.16	1.83	7.71
J-5-98	21	BC	38.07110	-121.95449	19983351852000	CC	0	70.35	19.24	10.42	29.65	4.03	5.54	2.35	1.34	3.78	3.05
J-5-98	22	BC	38.06762	-121.96468	19983351909000	RSA/SG	0	32.99	37.58	29.43	67.01	6.53	9.90	3.15	0.55	2.15	6.01
J-5-98	23	VV	38.06747	-121.97665	19983351936000	RSA/SG	0	94.54	1.94	3.52	5.46	2.22	3.24	1.80	4.17	20.70	1.91
J-5-98	24	VV	38.06912	-122.09405	19983351621000	RSA/SG	0	97.23	0.95	1.83	2.77	3.54	1.38	1.17	4.23	30.61	3.61
J-5-98	25	VV	38.06607	-122.08596	19983361632000	RSA/SG	0	23.44	22.21	54.35	76.56	7.95	11.32	3.36	-0.26	1.86	8.28
J-5-98	26	VV	38.09494	-122.05748	19983361654000	RSA/SG	0	76.80	8.42	14.78	23.20	4.12	9.88	3.14	1.60	4.28	2.96
J-5-98	28	VV	38.10046	-122.05187	19983361705000	RSA/SG	0	49.66	19.93	30.41	50.34	6.03	10.80	3.29	0.65	2.01	4.32
J-5-98	29	VV	38.10877	-122.03253	19983361723000	RSA/SG	0	9.72	39.04	51.24	90.28	8.31	7.97	2.82	0.03	1.92	8.09
J-5-98	30	VV	38.11283	-122.04075	19983361733000	RSA/SG	0	5.35	41.08	53.57	94.65	8.50	7.25	2.69	0.04	1.96	8.24
J-5-98	31	VV	38.10127	-122.04097	19983361714000	RSA/SG	0	77.73	4.63	17.63	22.27	3.79	11.71	3.42	1.54	3.80	2.13
J-5-98	32	VV	38.11987	-122.04602	19983361742000	RSA/SG	0	1.08	38.91	60.01	98.92	8.89	5.13	2.26	0.18	2.05	8.56
J-2-99	34	VV	38.06775	-121.96454	19990632243000	CC	0	29.43	51.33	19.24	70.57	5.63	5.41	2.33	0.52	2.40	5.10
J-2-99	35	VV	38.07138	-121.95399	19990632255000	RSA/CC	0	62.93	25.09	11.98	37.07	4.54	5.48	2.34	1.03	2.96	3.34
J-2-99	36	VV	38.06740	-121.97562	19990632311000	RSA/CC	0	97.16	1.97	0.87	2.84	2.48	0.86	0.93	4.93	35.04	2.42
J-2-99	37	VV	38.07840	-121.99440	19990632326000	RSA/CC	0	96.01	2.97	1.02	3.99	3.10	0.78	0.89	4.79	33.18	2.97
J-2-99	38	VV	38.10835	-122.03297	19990632350000	CC	0	16.18	55.79	28.02	83.82	6.57	4.94	2.22	0.00	2.33	6.62
J-2-99	39	VV	38.11282	-122.04033	19990632359000	CC	0	2.21	63.64	34.15	97.79	7.19	3.59	1.89	0.03	2.90	7.12
J-2-99	40	VV	38.12027	-122.04594	19990640008000	CC	0	3.47	60.81	35.72	96.53	7.27	3.53	1.88	0.00	2.77	7.26
J-2-99	41	VV	38.11586	-122.05175	19990640016000	CC	0	9.60	60.14	30.26	90.40	6.81	4.48	2.12	-0.08	2.69	6.82
J-2-99	42	VV	38.09128	-122.05217	19990640032000	CC	0	50.34	31.48	18.18	49.66	5.05	6.85	2.62	0.63	2.16	3.96
J-2-99	43sfc	BC	38.09490	-122.05744	19990641630000	CC	0	98.94	0.97	0.09	1.06	1.80	0.67	0.82	1.90	14.24	1.70
J-2-99	43mid	BC	38.09490	-122.05744	19990641630000	CC	0	42.93	40.04	17.03	57.07	5.23	6.41	2.53	0.46	2.15	4.94
J-2-99	43btm	BC	38.09490	-122.05744	19990641630000	CC	0	75.70	17.09	7.21	24.30	3.70	4.56	2.13	1.63	4.87	2.89
J-2-99	45sfc	BC	38.09723	-122.06806	19990641707000	CC	0	3.90	60.91	35.19	96.10	7.25	3.51	1.87	0.03	2.66	7.23
J-2-99	46sfc	BC	38.10139	-122.04624	19990641730000	CC	0	75.96	14.57	9.47	24.04	3.33	6.52	2.55	1.44	3.83	2.17
J-2-99	46btm	BC	38.10139	-122.04624	19990641730000	CC	0	5.95	63.58	30.47	94.05	6.98	3.74	1.93	-0.09	2.93	6.95
J-2-99	47sfc	BC	38.14618	-122.05860	19990641808000	CC	0	5.63	61.60	32.77	94.37	7.12	3.71	1.93	-0.19	3.02	7.16
J-2-99	47btm	BC	38.14618	-122.05860	19990641808000	CC	0	2.48	68.23	29.29	97.52	7.12	2.96	1.72	0.16	3.10	7.01
J-2-99	48sfc	BC	38.13203	-122.08177	19990641847000	CC	0	4.26	62.28	33.46	95.74	7.16	3.55	1.88	-0.09	2.89	7.19
J-2-99	48btm	BC	38.13203	-122.08177	19990641847000	CC	0	2.26	54.47	43.27	97.74	7.66	3.20	1.79	-0.17	3.05	7.70

Cruise	Sample ID	Instrument	Latitude	Longitude	Date/Time	Method	% Gravel >2 mm	% Sand .062 – 2 mm	% Silt .004 - .062 mm	% Clay <.004 mm	% Mud <.062 mm	1st moment (mean)	2nd moment (variance)	Std. deviation	3rd moment (skewness)	4th moment (kurtosis)	Median
J-2-99	49	VV	38.12151	-122.07487	19990642141000	CC	0	5.29	65.58	29.13	94.71	6.96	3.59	1.89	0.02	2.96	6.88
J-2-99	50	VV	38.13530	-122.06047	19990642205000	CC	0	11.04	70.64	18.33	88.96	6.15	4.14	2.03	0.14	3.10	5.97
J-2-99	51	VV	38.11747	-122.05627	19990642220000	RSA/CC	0	17.92	47.76	34.31	82.08	6.81	5.48	2.34	-0.22	2.23	7.09
J-2-99	52	VV	38.09269	-122.01767	19990642244000	RSA/CC	0	73.34	16.54	10.11	26.66	3.51	6.59	2.57	1.39	3.55	2.25
J-2-99	53	VV	38.09983	-122.03505	19990642256000	CC	0	59.40	27.97	12.63	40.60	4.01	8.45	2.91	0.70	2.14	2.41
J-2-99	54	VV	38.10270	-122.03078	19990642304000	RSA/CC	0	26.05	54.71	19.24	73.95	5.82	4.96	2.23	0.41	2.32	5.55
J-2-99	56	VV	38.10139	-122.04082	19990642323000	CC	0	59.25	26.88	13.86	40.75	4.02	8.79	2.97	0.71	2.14	2.38
J-2-99	57	VV	38.09842	-122.04752	19990642333000	RSA/CC	0	65.29	24.53	10.18	34.71	3.93	6.50	2.55	1.04	2.83	2.61
J-2-99	58	VV	38.10026	-122.05268	19990642343000	CC	0	48.05	35.68	16.27	51.95	4.77	7.68	2.77	0.46	2.02	4.28
J-2-99	59	VV	38.10147	-122.04582	19990642352000	CC	0	72.94	16.89	10.17	27.06	3.51	6.82	2.61	1.29	3.40	2.27
J-2-99	60	VV	38.10686	-122.06196	19990671629000	CC	0	9.82	55.39	34.79	90.18	7.05	4.54	2.13	-0.25	2.71	7.18
J-2-99	61	VV	38.10638	-122.05773	19990671637000	RSA/CC	0	5.14	62.23	32.64	94.86	7.06	3.81	1.95	-0.12	3.03	7.03
J-2-99	62	VV	38.10602	-122.05383	19990671646000	CC	0	28.34	48.00	23.66	71.66	5.92	6.81	2.61	-0.09	2.23	6.12
J-2-99	63	VV	38.10287	-122.05146	19990671655000	CC	0	6.65	61.15	32.20	93.35	7.00	3.95	1.99	0.01	2.56	7.02
J-2-99	64	VV	38.09608	-122.05734	19990671705000	CC	0	21.14	59.94	18.92	78.86	5.96	5.52	2.35	-0.23	2.54	6.19
J-2-99	65	VV	38.10270	-122.06143	19990671715000	CC	0	4.94	59.66	35.40	95.06	7.20	3.84	1.96	-0.15	2.96	7.21
J-2-99	66	VV	38.08767	-122.08755	19990671733000	RSA/CC	0	1.55	64.08	34.37	98.45	7.22	3.47	1.86	0.05	2.90	7.16
J-2-99	67	VV	38.06605	-122.08655	19990671754000	CC	0	70.52	18.63	10.86	29.48	3.67	7.17	2.68	1.11	3.01	2.48
J-2-99	68	VV	38.06028	-122.09664	19990671804000	CC	0	95.49	2.92	1.59	4.51	2.38	1.51	1.23	3.96	21.92	2.13
J-2-99	69	VV	38.04825	-122.11991	19990671827000	RSA/CC	0	4.57	68.04	27.39	95.43	6.95	3.23	1.80	0.21	2.88	6.82
J-2-99	70	VV	38.06258	-122.10333	19990671845000	CC	0	4.09	67.38	28.52	95.91	6.97	3.48	1.87	0.18	2.91	6.81
J-2-99	71	VV	38.07655	-122.08846	19990671859000	CC		99.13	0.66	0.21	0.87	2.00	0.41	0.64	4.89	51.34	1.98
J-2-99	72	VV	38.09260	-122.07225	19990671916000	CC	0	79.50	14.73	5.77	20.50	3.22	4.60	2.15	1.62	5.19	2.56
J-2-99	73	VV	38.09889	-122.05696	19990671927000	RSA/CC	0	81.84	11.38	6.78	18.16	3.50	4.25	2.06	1.88	5.67	2.71
J-2-99	74	VV	38.09665	-122.02754	19990671943000	CC	0	74.50	16.68	8.82	25.50	3.27	6.64	2.58	1.37	3.74	2.13
J-2-99	75	VV	38.08959	-122.00731	19990672003000	CC	0	96.79	2.22	0.99	3.21	1.63	1.41	1.19	4.18	25.16	1.47
J-2-99	76	VV	38.08237	-121.99782	19990672019000	CC	0	90.90	7.00	2.10	9.10	2.79	1.95	1.40	2.85	13.59	2.51
J-2-99	77	VV	38.07223	-121.99075	19990672030000	CC	0	97.72	1.70	0.58	2.28	1.98	0.90	0.95	3.97	29.43	1.89
J-2-99	78	VV	38.05119	-121.93398	19990672059000	CC	0	98.98	0.80	0.21	1.02	1.21	0.64	0.80	4.29	36.72	1.10
J-2-99	79	VV	38.05758	-121.95510	19990672110000	CC	0	98.97	0.79	0.24	1.03	1.54	0.63	0.79	4.07	35.65	1.50
J-2-99	80	VV	38.05868	-121.97826	19990672120000	CC	0	99.20	0.53	0.27	0.80	1.77	0.45	0.67	5.74	60.70	1.70
J-2-99	81	VV	38.06110	-122.00046	19990672130000	CC	0	99.51	0.35	0.14	0.49	1.58	0.40	0.63	4.02	46.71	1.53
J-2-99	82	VV	38.06080	-122.02174	19990672141000	CC	0	50.74	41.42	7.84	49.26	4.14	6.14	2.48	0.45	2.47	3.95
J-2-99	83	VV	38.06553	-122.04557	19990672156000	CC	0	96.26	2.48	1.26	3.74	2.03	1.42	1.19	4.17	24.66	1.86
J-2-99	84	VV	38.05545	-122.07033	19990672209000	RSA/CC	0	99.11	0.58	0.31	0.89	2.01	0.54	0.74	4.34	41.13	1.97
J-2-99	85	VV	38.05332	-122.09201	19990672220000	CC	0	90.77	6.37	2.86	9.23	1.78	3.53	1.88	2.80	10.73	1.29
J-2-99	86	VV	38.04869	-122.10746	19990672230000	RSA/CC	0	99.42	0.43	0.14	0.58	1.49	0.33	0.58	5.63	73.13	1.56
J-3-99	87sfc	BC	38.09458	-122.05629	19993191635004	CC	0	49.43	37.41	13.16	50.57	4.61	7.04	2.65	0.55	2.29	4.06
J-3-99	87mid	BC	38.09458	-122.05629	19993191635004	CC	0	52.50	34.46	13.04	47.50	4.76	5.97	2.44	0.75	2.54	3.77
J-3-99	88sfc	BC	38.10118	-122.04636	19993191649004	CC	0	75.82	15.31	8.87	24.18	3.29	6.44	2.54	1.41	3.88	2.20
J-3-99	88mid	BC	38.10118	-122.04636	19993191649004	CC	0	5.33	63.64	31.03	94.67	7.02	3.66	1.91	-0.09	2.96	7.00
J-3-99	89sfc	BC	38.09709	-122.06791	19993191710004	CC	0	7.09	57.93	34.98	92.91	7.11	4.14	2.04	-0.07	2.50	7.17
J-3-99	89mid	BC	38.09709	-122.06791	19993191710004	CC	0	8.20	57.78	34.02	91.80	7.04	4.22	2.05	-0.06	2.47	7.11
J-3-99	91sfc	BC	38.13892	-122.08165	19993191815000	CC	0	1.66	60.78	37.56	98.34	7.43	3.20	1.79	0.05	2.73	7.40
J-3-99	91mid	BC	38.13892	-122.08165	19993191815000	CC	0	55.65	31.00	13.35	44.35	4.68	5.99	2.45	0.80	2.75	3.74
J-3-99	92sfc	BC	38.08847	-122.08445	19993191733004	CC	0	0.93	62.06	37.02	99.07	7.38	3.20	1.79	0.16	2.53	7.33
J-3-99	93mid	BC	38.09389	-122.04478	19993192152400	CC	0	64.82	23.20	11.98	35.18	4.28	6.07	2.46	1.09	2.98	3.02
J-3-99	93btm	BC	38.09389	-122.04478	19993192152400	CC	0	75.01	16.00	8.98	24.99	3.82	5.21	2.28	1.48	4.05	2.83
J-3-99	94sfc	BC	38.09858	-122.04280	19993192141304	CC	0	6.66	54.35	38.99	93.34	7.27	4.45	2.11	-0.34	2.87	7.43
J-3-99	94mid	BC	38.09858	-122.04280	19993192141304	CC	0	5.17	69.86	24.97	94.83	6.74	3.89	1.97	-0.33	3.93	6.70
J-3-99	95sfc	BC	38.10798	-122.04000	19993192128404	CC	0	39.89	37.19	22.92	60.11	5.71	6.50	2.55	0.33	1.94	5.50

Cruise	Sample ID	Instrument	Latitude	Longitude	Date/Time	Method	% Gravel >2 mm	% Sand .062 – 2 mm	% Silt .004 - .062 mm	% Clay <.004 mm	% Mud <.062 mm	1st moment (mean)	2nd moment (variance)	Std. deviation	3rd moment (skewness)	4th moment (kurtosis)	Median
J-3-99	95mid	BC	38.10798	-122.04000	19993192128404	CC	0	2.71	63.37	33.92	97.29	7.18	3.57	1.89	0.06	2.72	7.14
J-3-99	96sfc	BC	38.10058	-122.06906	19993192211100	CC	0	1.39	60.50	38.11	98.61	7.44	3.22	1.80	0.01	3.03	7.40
J-3-99	96mid	BC	38.10058	-122.06906	19993192211100	CC	0	2.11	55.68	42.22	97.89	7.58	3.37	1.84	-0.05	2.64	7.63
J-3-99	97sfc	BC	38.06018	-122.09586	19993192337000	CC	0	95.85	2.75	1.40	4.15	2.45	1.32	1.15	4.19	24.39	2.26
J-3-99	98sfc	BC	38.06569	-122.08568	19993192348000	CC	0	5.01	55.99	39.01	94.99	7.38	3.79	1.95	-0.25	3.02	7.45
J-3-99	98mid	BC	38.06569	-122.08568	19993192348000	CC	0	8.01	53.92	38.07	91.99	7.25	4.36	2.09	-0.29	2.82	7.37
J-3-99	98btm	BC	38.06569	-122.08568	19993192348000	CC	0	2.23	58.92	38.85	97.77	7.46	3.33	1.82	-0.04	2.89	7.46
J-3-99	99sfc	BC	38.09905	-122.05575	19993201619304	CC	0	2.72	57.56	39.72	97.28	7.48	3.50	1.87	-0.06	2.77	7.48
J-3-99	99m/b	BC	38.09905	-122.05575	19993201619304	CC	0	45.55	34.75	19.70	54.45	5.20	7.51	2.74	0.33	1.94	4.88
J-3-99	100sfc	BC	38.10283	-122.05118	19993201635004	CC	0	2.07	60.90	37.03	97.93	7.37	3.31	1.82	0.04	2.74	7.34
J-3-99	100mid	BC	38.10283	-122.05118	19993201635004	CC	0	0.48	59.93	39.59	99.52	7.56	2.96	1.72	0.13	2.72	7.51
J-3-99	100btm	BC	38.10283	-122.05118	19993201635004	CC	0	16.28	51.39	32.33	83.72	6.72	5.74	2.40	-0.37	2.69	6.97
J-3-99	101sfc	BC	38.10152	-122.04027	19993201646504	CC	0	3.61	68.16	28.22	96.39	6.90	3.50	1.87	0.19	2.80	6.77
J-3-99	101mid	BC	38.10152	-122.04027	19993201646504	CC	0	7.74	63.55	28.71	92.26	6.86	3.92	1.98	-0.13	2.99	6.83
J-3-99	101btm	BC	38.10152	-122.04027	19993201646504	CC	0	9.21	62.31	28.48	90.79	6.76	4.38	2.09	-0.12	2.82	6.73
J-3-99	103sfc	BC	38.11980	-122.04574	19993201941203	CC	0	60.63	28.45	10.92	39.37	4.56	4.78	2.19	1.16	3.55	3.65
J-3-99	103m/b	BC	38.11980	-122.04574	19993201941203	CC	0	1.91	60.48	37.61	98.09	7.41	3.31	1.82	0.02	2.88	7.37
J-3-99	104sfc	BC	38.12177	-122.07514	19993202028103	CC	0	47.03	36.72	16.25	52.97	5.16	5.78	2.40	0.69	2.43	4.19
J-3-99	104mid	BC	38.12177	-122.07514	19993202028103	CC	0	0.37	61.58	38.05	99.63	7.51	2.92	1.71	0.19	2.71	7.43
J-3-99	104btm	BC	38.12177	-122.07514	19993202028103	CC	0	2.71	62.97	34.32	97.29	7.25	3.36	1.83	0.02	2.89	7.19
J-3-99	105sfc	BC	38.12756	-122.08233	19993202039103	CC	0	1.14	60.41	38.45	98.86	7.49	3.15	1.77	0.02	2.98	7.43
J-3-99	105mid	BC	38.12756	-122.08233	19993202039103	CC	0	3.20	63.43	33.37	96.80	7.18	3.41	1.85	-0.14	3.09	7.22
J-3-99	105m/b	BC	38.12756	-122.08233	19993202039103	CC	0	2.03	59.80	38.16	97.97	7.46	3.28	1.81	-0.02	2.93	7.42
J-3-99	105btm	BC	38.12756	-122.08233	19993202039103	CC	0	4.25	60.39	35.37	95.75	7.25	3.44	1.85	-0.01	2.52	7.32
J-3-99	106sfc	BC	38.13521	-122.06061	19993202004403	CC	0	57.14	29.13	13.73	42.86	4.20	8.43	2.90	0.60	2.13	2.81
J-3-99	108	VV	38.11636	-122.05379	19993202236000	CC	0	8.08	58.18	33.74	91.92	7.02	4.28	2.07	-0.05	2.47	7.08
J-3-99	109	VV	38.11303	-122.04102	19993202247000	CC	0	5.15	60.85	34.00	94.85	7.08	3.97	1.99	0.08	2.38	7.08
J-3-99	110	VV	38.10527	-122.04136	19993202256000	CC	0	12.19	54.66	33.15	87.81	6.88	4.85	2.20	-0.13	2.40	7.03
J-3-99	111	VV	38.10278	-122.03039	19993202305000	CC	0	17.65	53.28	29.07	82.35	6.51	5.43	2.33	0.00	2.18	6.62
J-3-99	112	VV	38.10000	-122.03526	19993202313000	CC	0	60.08	27.93	11.99	39.92	3.95	8.01	2.83	0.79	2.40	2.50
J-3-99	113	VV	38.09861	-122.04741	19993202323000	CC	0	75.72	16.15	8.13	24.28	3.31	6.04	2.46	1.46	4.07	2.25
J-3-99	114	VV	38.09938	-122.05216	19993202328000	CC	0	17.56	50.35	32.09	82.44	6.59	6.35	2.52	-0.32	2.36	6.89
J-3-99	114btm	VV	38.09938	-122.05216	19993202328000	CC	0	34.27	41.79	23.94	65.73	5.79	6.99	2.64	0.08	1.89	6.00
J-3-99	115	VV	38.09618	-122.05663	19993202336000	CC	0	62.19	26.21	11.61	37.81	3.91	7.86	2.80	0.80	2.36	2.48
J-3-99	116	VV	38.09094	-122.05263	19993202343000	CC	0	54.83	27.90	17.27	45.17	4.85	7.04	2.65	0.72	2.23	3.45
J-3-99	116btm	VV	38.09094	-122.05263	19993202343000	CC	0	68.67	19.35	11.99	31.33	4.06	6.47	2.54	1.17	3.12	2.83
J-3-99	117	VV	38.07717	-122.08796	19993210003000	CC	0	79.61	11.46	8.92	20.39	3.07	6.34	2.52	1.71	4.59	1.99
J-3-99	118	VV	38.05093	-121.93251	19993211701000	CC	0	47.05	39.82	13.13	52.95	4.84	5.61	2.37	0.76	2.75	4.15
J-3-99	119	VV	38.05739	-121.95483	19993211716000	CC	0	44.50	35.28	20.22	55.50	5.07	8.82	2.97	0.28	1.74	5.20
J-3-99	120	VV	38.07196	-121.95313	19993211730000	CC	0	60.89	25.19	13.91	39.11	4.39	6.99	2.64	0.85	2.65	3.19
J-3-99	121	VV	38.06738	-121.96490	19993211742000	CC	0	38.11	43.16	18.72	61.89	5.43	5.88	2.42	0.57	2.30	4.78
J-3-99	122	VV	38.06709	-121.97625	19993211751000	CC	0	93.99	3.91	2.10	6.01	1.79	2.50	1.58	3.22	14.93	1.50
J-3-99	123	VV	38.05851	-121.97761	19993211640000	CC	0	92.52	5.08	2.39	7.48	2.10	2.63	1.62	2.98	13.13	1.75
J-3-99	124	VV	38.06261	-122.00102	19993211627000	CC	0	97.40	1.88	0.72	2.60	2.14	0.95	0.97	4.32	30.44	2.01
J-3-99	125	VV	38.07227	-121.99016	19993211803000	CC	0	97.88	1.53	0.59	2.12	2.09	0.81	0.90	4.62	35.26	1.99
J-3-99	126	VV	38.07874	-121.99447	19993211810000	CC	0	88.28	7.05	4.67	11.72	2.90	3.44	1.85	2.52	9.00	2.39
J-3-99	127	VV	38.08278	-121.99737	19993211817000	CC	0	73.89	16.16	9.96	26.11	3.68	6.16	2.48	1.33	3.73	2.62
J-3-99	128	VV	38.08932	-122.00688	19993211828000	CC	0	73.75	16.08	10.16	26.25	3.19	7.68	2.77	1.29	3.37	1.83
J-3-99	129	VV	38.09341	-122.01932	19993211838000	CC	0	99.27	0.57	0.16	0.73	1.44	0.44	0.66	5.00	53.63	1.46
J-3-99	130	VV	38.09632	-122.02691	19993211845000	CC	0	7.55	56.90	35.55	92.45	7.14	4.20	2.05	-0.11	2.56	7.22
J-3-99	131	VV	38.10570	-122.05307	19993211900000	CC	0	2.86	60.74	36.40	97.14	7.27	3.65	1.91	0.04	2.54	7.28

Cruise	Sample ID	Instrument	Latitude	Longitude	Date/Time	Method	% Gravel >2 mm	% Sand .062 – 2 mm	% Silt .004 - .062 mm	% Clay <.004 mm	% Mud <.062 mm	1st moment (mean)	2nd moment (variance)	Std. deviation	3rd moment (skewness)	4th moment (kurtosis)	Median
J-3-99	132	VV	38.10689	-122.06239	19993211912000	CC	0	7.26	60.63	32.12	92.74	6.96	4.35	2.09	-0.16	2.86	6.99
J-3-99	133	VV	38.10563	-122.06211	19993211915000	CC	0	1.20	60.22	38.59	98.80	7.43	3.37	1.84	0.08	2.52	7.42
J-3-99	134	VV	38.10263	-122.06089	19993211918000	CC	0	6.65	56.74	36.60	93.35	7.20	4.16	2.04	-0.19	2.72	7.29
J-3-99	135	VV	38.09289	-122.07149	19993211931000	CC	0	9.25	55.06	35.68	90.75	7.07	4.80	2.19	-0.35	2.87	7.22
J-3-99	135btm	VV	38.09289	-122.07149	19993211931000	CC	0	73.01	17.60	9.39	26.99	3.76	5.78	2.40	1.35	3.71	2.70
J-3-99	136	VV	38.06074	-122.02180	19993212046000	CC	0	37.07	40.80	22.13	62.93	5.31	9.42	3.07	-0.04	1.80	5.84
J-3-99	137	VV	38.06514	-122.04569	19993212058000	CC	0	98.68	1.05	0.27	1.32	1.92	0.54	0.74	4.86	43.60	1.87
J-3-99	138	VV	38.05519	-122.07645	19993212118000	CC	0	97.84	1.60	0.56	2.16	1.54	1.12	1.06	3.61	24.89	1.45
J-3-99	139	VV	38.05335	-122.09214	19993212126000	CC	0	98.84	0.93	0.23	1.16	1.70	0.70	0.83	2.95	26.28	1.68
J-3-99	140	VV	38.06254	-122.10341	19993221900000	CC	0	6.47	64.13	29.40	93.53	6.91	4.11	2.03	-0.12	3.01	6.84
J-3-99	141	VV	38.04879	-122.10757	19993212135000	CC	0	97.59	1.69	0.72	2.41	1.83	1.04	1.02	4.22	29.77	1.71
J-3-99	142	VV	38.04881	-122.11848	19993221913000	CC	0	40.27	33.88	25.85	59.73	5.41	9.73	3.12	0.06	1.65	5.85
J-3-99	143	VV	38.08726	-122.07272	19993221824000	CC	0	88.11	7.55	4.34	11.89	2.85	3.36	1.83	2.53	9.15	2.33
J-3-99	144	VV	38.08927	-122.06866	19993221818000	CC	0	95.98	2.69	1.33	4.02	2.15	1.62	1.27	3.30	18.71	1.99
J-3-99	145	VV	38.09386	-122.06468	19993221810000	CC	0	83.58	9.65	6.77	16.42	2.69	5.55	2.36	1.93	5.73	1.85
J-3-99	146	VV	38.10863	-122.05007	19993221756000	CC	0	3.43	62.28	34.29	96.57	7.13	3.79	1.95	0.08	2.45	7.12
J-3-99	147	VV	38.14559	-122.06010	19993221725000	CC	0	80.65	13.13	6.22	19.35	3.26	4.42	2.10	1.93	5.93	2.49
J-3-99	148	VV	38.14184	-122.06213	19993221728000	CC	0	5.63	63.31	31.06	94.37	7.06	3.70	1.92	-0.03	2.86	7.01
J-3-99	149	VV	38.15177	-122.05460	19993221716000	CC	0	3.67	72.32	24.01	96.33	6.70	3.47	1.86	0.37	2.87	6.45
J-3-99	150	VV	38.15526	-122.05242	19993221709000	CC	0	11.07	65.05	23.88	88.93	6.45	4.45	2.11	0.09	2.67	6.34
J-1-00	153	VV	38.04894	-122.11838	20000731651000	CC	0	6.32	58.66	35.02	93.68	7.08	4.32	2.08	-0.07	2.53	7.13
J-1-00	154	VV	38.05983	-122.09649	20000731713000	CC	0	96.68	2.51	0.81	3.32	2.27	1.02	1.01	4.06	26.75	2.09
J-1-00	155	VV	38.06270	-122.10334	20000731723000	CC	0	4.18	67.47	28.35	95.82	6.96	3.68	1.92	-0.04	3.23	6.84
J-1-00	156	VV	38.07664	-122.08895	20000731742000	CC	0	75.68	16.40	7.91	24.32	3.25	6.02	2.45	1.52	4.13	2.04
J-1-00	157	VV	38.08783	-122.08658	20000731756000	CC	0	1.15	60.75	38.10	98.85	7.38	3.47	1.86	0.11	2.43	7.37
J-1-00	158	VV	38.08712	-122.07260	20000731809000	CC	0	61.08	25.22	13.70	38.92	4.28	7.09	2.66	0.87	2.49	2.99
J-1-00	159	VV	38.08961	-122.06877	20000731819000	CC	0	96.81	2.15	1.05	3.19	1.91	1.32	1.15	4.08	25.45	1.75
J-1-00	160	VV	38.09277	-122.07153	20000731831000	CC	0	7.84	55.29	36.87	92.16	7.15	4.75	2.18	-0.48	3.21	7.29
J-1-00	161	VV	38.09722	-122.06784	20000731841000	CC	0	2.53	60.06	37.41	97.47	7.30	3.70	1.92	0.04	2.48	7.31
J-1-00	162	VV	38.09416	-122.06467	20000731851000	CC	0	98.30	1.30	0.40	1.70	1.78	0.82	0.91	3.76	29.91	1.70
J-1-00	163	VV	38.09488	-122.05690	20000731901000	CC	0	58.01	31.20	10.79	41.99	3.97	7.57	2.75	0.74	2.43	2.80
J-1-00	164	VV	38.09627	-122.05668	20000731915000	CC	0	12.22	61.02	26.76	87.78	6.61	5.16	2.27	-0.50	3.14	6.79
J-1-00	165	VV	38.09099	-122.05215	20000731929000	CC	0	56.91	27.20	15.89	43.09	4.72	6.69	2.59	0.83	2.46	3.47
J-1-00	166	VV	38.09401	-122.04474	20000731941000	CC	0	67.10	21.21	11.69	32.90	4.08	6.20	2.49	1.19	3.23	2.90
J-1-00	167	VV	38.09644	-122.02662	20000732029000	CC	0	9.89	54.03	36.08	90.11	7.07	4.82	2.20	-0.37	2.85	7.26
J-1-00	168	VV	38.09340	-122.01910	20000732041000	CC	0	76.54	14.32	9.14	23.46	3.04	7.10	2.66	1.43	3.85	1.84
J-1-00	169	VV	38.08918	-122.00664	20000732058000	CC	0	98.55	1.22	0.23	1.45	1.55	0.67	0.82	4.01	33.12	1.50
J-1-00	170	VV	38.08285	-121.99712	20000732111000	CC	0	3.37	63.93	32.69	96.63	7.21	3.41	1.85	-0.03	3.18	7.11
J-1-00	171	VV	38.07874	-121.99368	20000732129000	CC	0	96.75	2.43	0.83	3.25	2.44	0.96	0.98	4.15	28.01	2.31
J-1-00	172	VV	38.07209	-121.99006	20000732141000	CC	0	97.33	2.13	0.55	2.67	2.09	1.02	1.01	3.12	22.03	2.01
J-1-00	173	VV	38.06736	-121.97605	20000732157000	CC	0	31.28	46.03	22.69	68.72	5.57	8.27	2.88	-0.11	1.96	5.95
J-1-00	174	VV	38.06741	-121.96477	20000732209000	CC	0	32.03	47.83	20.14	67.97	5.62	5.63	2.37	0.54	2.30	4.99
J-1-00	175	VV	38.07155	-121.95361	20000732219000	CC	0	65.19	22.59	12.22	34.81	4.16	6.43	2.54	1.08	3.02	3.03
J-1-00	176	VV	38.05071	-121.93249	20000732244000	CC	0	97.95	1.69	0.36	2.05	1.30	0.96	0.98	3.80	26.95	1.18
J-1-00	177	VV	38.05687	-121.95454	20000732258000	CC	0	20.11	52.48	27.42	79.89	6.27	6.87	2.62	-0.36	2.42	6.59
J-1-00	178	VV	38.05860	-121.97814	20000732311000	CC	0	98.21	1.56	0.23	1.79	1.76	0.73	0.85	3.19	24.73	1.68
J-1-00	179	VV	38.06268	-122.00145	20000732324000	CC	0	84.87	11.12	4.01	15.13	3.16	3.04	1.74	2.28	8.53	2.67
J-1-00	180	VV	38.06044	-122.02176	20000732336000	CC	0	14.10	58.37	27.53	85.90	6.53	5.74	2.40	-0.41	2.92	6.69
J-1-00	181	VV	38.06492	-122.04528	20000732351000	CC	0	98.23	1.47	0.30	1.77	1.71	0.76	0.87	3.69	29.22	1.63
J-1-00	182	VV	38.05539	-122.07013	20000740008000	CC	0	97.81	2.00	0.20	2.19	1.66	0.89	0.95	2.62	17.53	1.55
J-1-00	183	VV	38.05320	-122.09191	20000740027000	CC	0	98.54	1.22	0.23	1.46	1.52	0.76	0.87	3.33	26.61	1.49

Cruise	Sample ID	Instrument	Latitude	Longitude	Date/Time	Method	% Gravel >2 mm	% Sand .062 – 2 mm	% Silt .004 - .062 mm	% Clay <.004 mm	% Mud <.062 mm	1st moment (mean)	2nd moment (variance)	Std. deviation	3rd moment (skewness)	4th moment (kurtosis)	Median
J-1-00	184	VV	38.04891	-122.10756	20000740038000	CC	0	98.78	1.04	0.18	1.22	1.58	0.55	0.74	4.25	37.76	1.50
J-1-00	185	VV	38.12175	-122.07451	20000741634000	CC	0	0.17	59.01	40.82	99.83	7.62	2.85	1.69	0.18	2.58	7.57
J-1-00	186	VV	38.12759	-122.08232	20000741645000	CC	0	0.19	59.48	40.33	99.81	7.59	2.89	1.70	0.18	2.54	7.53
J-1-00	187	VV	38.13170	-122.08199	20000741653000	CC	0	0.77	61.06	38.17	99.23	7.43	3.23	1.80	0.13	2.54	7.39
J-1-00	188	VV	38.15529	-122.05220	20000741726000	CC	0	11.37	67.16	21.47	88.63	6.33	4.17	2.04	0.26	2.67	6.14
J-1-00	189	VV	38.15171	-122.05481	20000741741000	CC	0	9.12	68.10	22.78	90.88	6.49	3.95	1.99	0.24	2.74	6.31
J-1-00	190	VV	38.14606	-122.05872	20000741750000	CC	0	1.20	68.71	30.09	98.80	7.12	2.98	1.73	0.29	2.74	6.97
J-1-00	191	VV	38.14198	-122.06207	20000741800000	CC	0	21.99	53.30	24.71	78.01	6.20	5.99	2.45	-0.13	2.37	6.36
J-1-00	192	VV	38.13935	-122.06053	20000741809000	CC	0	82.12	12.83	5.05	17.88	3.26	3.56	1.89	2.17	7.32	2.57
J-1-00	193	VV	38.13494	-122.06068	20000741817000	CC	0	14.83	63.78	21.39	85.17	6.15	5.11	2.26	0.01	2.70	6.04
J-1-00	194	VV	38.11779	-122.05635	20000741835000	CC	0	26.70	46.21	27.09	73.30	6.14	6.82	2.61	-0.11	1.99	6.48
J-1-00	195	VV	38.11613	-122.05111	20000741841000	CC	0	6.15	60.72	33.13	93.85	7.00	4.09	2.02	0.09	2.37	6.98
J-1-00	196	VV	38.11979	-122.04542	20000741850000	CC	0	0.84	61.43	37.74	99.16	7.42	3.13	1.77	0.15	2.52	7.38
J-1-00	197	VV	38.11312	-122.04071	20000741901000	CC	0	3.11	61.88	35.01	96.89	7.21	3.58	1.89	0.10	2.47	7.18
J-1-00	198	VV	38.10878	-122.03235	20000741911000	CC	0	4.74	62.07	33.19	95.26	7.04	3.91	1.98	0.06	2.46	7.02
J-1-00	199	VV	38.10300	-122.03078	20000741921000	CC	0	18.61	56.77	24.62	81.39	6.22	5.13	2.26	0.26	2.25	6.02
J-1-00	200	VV	38.10004	-122.03478	20000741928000	CC	0	79.39	13.37	7.25	20.61	2.96	5.85	2.42	1.64	4.72	2.00
J-1-00	201	VV	38.10156	-122.04061	20000741959000	CC	0	81.75	12.33	5.92	18.25	2.80	5.18	2.28	1.81	5.45	1.97
J-1-00	202	VV	38.09849	-122.04267	20000742005000	CC	0	33.90	45.18	20.92	66.10	5.43	8.31	2.88	-0.03	1.89	5.86
J-1-00	203	VV	38.09862	-122.04710	20000742014000	CC	0	82.33	12.55	5.12	17.67	3.13	4.04	2.01	1.95	6.40	2.49
J-1-00	204	VV	38.10148	-122.04655	20000742021000	CC	0	79.04	13.19	7.77	20.96	3.14	5.76	2.40	1.65	4.59	2.12
J-1-00	205	VV	38.10584	-122.04148	20000742031000	CC	0	9.30	61.08	29.62	90.70	6.72	4.47	2.11	0.12	2.32	6.65
J-1-00	206	VV	38.10777	-122.03964	20000742037000	CC	0	5.34	62.63	32.03	94.66	6.94	4.06	2.01	0.11	2.39	6.89
J-1-00	207	VV	38.10862	-122.05056	20000742047000	CC	0	4.50	64.07	31.42	95.50	6.94	3.92	1.98	0.17	2.37	6.86
J-1-00	208	VV	38.10578	-122.05399	20000742053000	CC	0	4.37	61.41	34.21	95.63	7.12	3.82	1.95	0.07	2.45	7.11
J-1-00	209	VV	38.10622	-122.05843	20000742059000	CC	0	17.83	54.96	27.22	82.17	6.42	5.47	2.34	-0.09	2.33	6.54
J-1-00	210	VV	38.10683	-122.06253	20000742104000	CC	0	1.50	59.73	38.77	98.50	7.40	3.46	1.86	0.05	2.52	7.41
J-1-00	211	VV	38.10276	-122.06074	20000742113000	CC	0	4.86	61.83	33.31	95.14	7.08	3.88	1.97	-0.09	2.74	7.10
J-1-00	212	VV	38.09925	-122.05579	20000742124000	CC	0	68.11	21.11	10.78	31.89	3.82	6.85	2.62	1.05	2.95	2.70
J-1-00	213	VV	38.09991	-122.05208	20000742132000	CC	0	30.07	44.08	25.85	69.93	5.90	7.69	2.77	-0.16	1.90	6.41
J-1-00	214	VV	38.10282	-122.05103	20000742143000	CC	0	2.14	61.02	36.84	97.86	7.30	3.53	1.88	0.06	2.49	7.31
J-1-00	215	VV	38.10046	-122.06934	20000742156000	CC	0	2.73	63.28	33.99	97.27	7.10	3.76	1.94	0.18	2.35	7.04
J-1-00	216	VV	38.06591	-122.08586	20000742226000	CC	0	4.18	57.15	38.68	95.82	7.36	3.80	1.95	-0.18	2.83	7.42

Table Explanation:
Cruise: Name of cruise.
Sample ID: sfc= collected at surface of box core or grab sample, mid= collected in the middle of box core or grab sample, btm= collected at the bottom of box core or grab sample, m/b= collected in the mid/bottom range of box core or grab sample.
Instrument: VV=Van Veen grab sampler, BC=box core sample.
Latitude/Longitude: Displayed as decimal degrees.
Date/Time: year/Julian Day/time
Method: RSA/SG=Rapid Sediment Analyzer (intermediates) and Sedigraph (fines), RSA/CC=Rapid Sediment Analyzer (intermediates) and particle-size analyzer (fines), CC= particle-size analyzer.

Table 3: Grain-size distributions for 7 RV Polaris cruises

Note: All statistics in phi units

Cruise	Sample ID	Station ID	Instrument	Latitude	Longitude	Date/Time	Method	% Gravel >2 mm	% Sand .062 – 2 mm	% Silt .004 - .062 mm	% Clay <.004 mm	% Mud <.062 mm	1st moment (mean)	2nd moment (variance)	Std. deviation	3rd moment (skewness)	4th moment (kurtosis)	Median
P-1-00	217	405.10	VV	38.0483100	-122.1223500	20002210000000	CC	0.31	84.65	9.76	5.28	15.04	3.05	4.08	2.02	1.84	6.66	2.59
P-1-00	218	407.10	VV	38.0694700	-122.0936000	20002210000000	CC	0.94	51.17	31.6	16.29	47.89	4.41	9.32	3.05	0.46	1.98	3.47
P-1-00	219	411.10	VV	38.0967500	-122.0580400	20002210000000	CC	1.35	23.98	56.62	18.05	74.67	5.71	5.81	2.41	-0.04	2.91	5.65
P-1-00	220	423.10	VV	38.0873400	-122.0030700	20002210000000	CC	0.13	67.94	19.96	11.98	31.94	3.7	7.76	2.79	0.97	2.79	2.59
P-1-00	221	4.10	VV	38.0575100	-121.9448100	20002220000000	CC	0.47	55.65	27.66	16.22	43.88	4.22	9.59	3.1	0.54	2.02	3.03
P-1-00	222	408.00	VV	38.0784700	-122.0566700	20002210000000	CC	1.66	83.1	9.93	5.31	15.24	2.99	4.2	2.05	1.84	6.6	2.4
P-1-00	223	415.00	VV	38.1290500	-122.0567500	20002210000000	CC	3.84	18.1	48.52	29.54	78.06	6.29	7.74	2.78	-0.64	3.28	6.67
P-1-00	224	416.00	VV	38.1175000	-121.9433300	20002210000000	CC	0	7.16	63.04	29.8	92.84	6.84	4.07	2.02	0.15	2.43	6.76
P-1-00	225	417.00	VV	38.1180200	-122.0101000	20002210000000	CC	0.95	13.26	64.61	21.17	85.79	6.21	4.78	2.19	-0.06	3.47	6.06
P-1-00	227	6.10	VV	38.0673300	-122.0484000	20002220000000	CC	6.84	49.39	26.02	17.75	43.77	4.23	10.75	3.28	0.36	2.06	2.64
P-1-00	228	8.10	VV	38.0318500	-122.1393700	20002220000000	CC	1.23	9.56	63.11	26.1	89.21	6.55	5.05	2.25	-0.38	3.88	6.5
P-2-00	229	408.00	VV	38.0785000	-122.0566667	20003121320000	CC	0.99	39.44	42.15	17.41	59.57	5.14	6.85	2.62	0.34	2.38	4.71
P-2-00	230	415.00	VV	38.1290500	-122.0567500	20003121348000	CC	6.89	11.48	50.8	30.83	81.63	6.31	8.78	2.96	-0.93	3.71	6.81
P-2-00	231	417.00	VV	38.1180167	-122.0101000	20003121429000	CC	0.63	14.35	59.7	25.33	85.03	6.38	5.16	2.27	-0.04	2.9	6.28
P-2-00	232	433.00	VV	38.0713833	-121.9337500	20003121508000	CC	0.07	2.75	59.21	37.97	97.18	7.39	3.45	1.86	-0.01	2.82	7.38
P-2-00	233	405.10	VV	38.0480833	-122.1225500	20003121314000	CC	0.68	87.21	8.73	3.37	12.1	2.61	3.52	1.88	1.95	7.83	2.27
P-2-00	234	407.10	VV	38.0692167	-122.0936667	20003121355000	CC	1.46	34.89	41.91	21.74	63.65	5.24	9.58	3.1	-0.02	1.94	5.58
P-2-00	235	411.10	VV	38.0968500	-122.0581833	20003121434000	CC	3.37	24.21	55.32	17.09	72.41	5.52	6.7	2.59	-0.27	3.16	5.57
P-2-00	236	423.10	VV	38.0875667	-122.0030167	20003121525000	CC	0.07	63.37	23.88	12.69	36.56	4.02	7.58	2.75	0.84	2.66	3.01
P-2-00	237	4.10	VV	38.0571167	-121.9448500	20003130746000	CC	0.08	64.95	23.08	11.89	34.97	3.87	7.55	2.75	0.89	2.77	2.91
P-2-00	238	6.10	VV	38.0673667	-122.0488833	20003130858000	CC	12.5	41.82	31.04	14.65	45.68	3.97	11.32	3.36	0.2	2.09	3.13
P-2-00	239	8.10	VV	38.0316667	-122.1402667	20003131026000	CC	0	19.2	56.2	24.6	80.8	6.23	5.76	2.4	-0.06	2.35	6.29
P-1-01	240	405.10	VV	38.0480500	-122.1226000	20010371202000	CC	1.24	91.17	5.03	2.56	7.59	2.44	2.57	1.6	2.61	12.3	2.14
P-1-01	241	407.10	VV	38.0688167	-122.0935017	20010371236000	CC	0.94	51.17	31.6	16.29	47.89	4.41	9.32	3.05	0.46	1.98	3.47
P-1-01	242	411.10	VV	38.0960217	-122.0581333	20010371311000	CC	0.09	24.65	56.2	19.06	75.26	5.77	5.76	2.4	0.07	2.42	5.73
P-1-01	243	423.10	VV	38.0877083	-122.0026450	20010371405000	CC	1.08	65.71	20.46	12.75	33.21	4.07	7	2.64	0.98	2.96	2.87
P-1-01	244	4.10	VV	38.0572233	-121.9440617	20010371456000	CC	0	58.71	27.29	14	41.29	4.4	6.92	2.63	0.86	2.57	3.42
P-1-01	245	6.10	VV	38.0673233	-122.0484033	20010380810000	CC	1.68	53.7	29.71	14.91	44.62	4.38	8.35	2.89	0.58	2.26	2.97
P-1-01	246	8.10	VV	38.0319650	-122.1396733	20010380925000	CC	9.61	36.12	36.24	18.03	54.27	4.49	11.71	3.42	-0.01	1.97	4.79
P-2-01	247	408.00	VV	38.0778833	-122.0569500	20010571224000	CC	0.89	58.87	29.47	10.78	40.24	4.19	6.23	2.5	0.84	2.97	3.3
P-2-01	248	415.00	VV	38.1293000	-122.0568333	20010571247000	CC	4.62	15	50	30.38	80.37	6.33	8.15	2.85	-0.81	3.55	6.8
P-2-01	249	416.00	VV	38.1177667	-122.0397833	20010571341000	CC	0	6.16	61.74	32.1	93.84	6.98	4.01	2	0.09	2.5	6.95
P-2-01	250	417.00	VV	38.1179667	-122.0106000	20010571349000	CC	0	14.8	59	26.2	85.2	6.52	4.67	2.16	0.04	2.37	6.54
P-2-01	251	433.00	VV	38.0713500	-121.9350833	20010571420000	CC	0	5.1	61.9	33	94.9	7.08	3.77	1.94	0.08	2.5	7.04
P-2-01	252	405.10	VV	38.0480833	-122.1225500	20010571245000	CC	0.79	79.66	14.02	5.53	19.55	2.88	5.14	2.27	1.48	4.93	2.26
P-2-01	253	407.10	VV	38.0692167	-122.0936667	20010571345000	CC	0.9	87.64	7.12	4.35	11.46	2.33	4.06	2.02	2.37	8.5	1.77
P-2-01	254	411.10	VV	38.0968500	-122.0581833	20010571415000	CC	0.36	32.8	42.91	23.94	66.84	5.66	8.01	2.83	-0.02	1.99	5.91
P-2-01	255	423.10	VV	38.0875883	-122.0032100	20010571536000	CC	0	85.11	9.5	5.4	14.89	2.94	4.26	2.06	1.97	6.61	2.4
P-2-01	256	4.10	VV	38.0574033	-121.9447700	20010580744000	CC	0.45	79.66	12.73	7.16	19.89	2.95	5.73	2.39	1.58	4.7	2.08
P-2-01	257	6.10	VV	38.0672500	-122.0497167	20010580855000	CC	2.64	39.89	38.19	19.29	57.47	5.01	9.25	3.04	0.08	2.04	5.19
P-2-01	258	8.10	VV	38.0314833	-122.1402833	20010581014000	CC	13.15	29.81	38.23	18.81	57.04	4.56	12.22	3.5	-0.12	2	5.04
P-3-01	259	408.00	VV	38.0777333	-122.0569167	20011701224000	CC	4.97	59.6	23.97	11.46	35.43	3.85	7.78	2.79	0.66	2.85	2.89
P-3-01	260	415.00	VV	38.1292000	-122.0568333	20011701247000	CC	4.02	11.17	51.91	32.9	84.81	6.63	7.36	2.71	-1.02	4.22	7.09
P-3-01	261	416.00	VV	38.1172667	-122.0395500	20011701326000	CC	0.13	3.95	62.96	32.96	95.91	7.11	3.71	1.93	0.04	2.9	7.05
P-3-01	262	417.00	VV	38.1180000	-122.0101333	20011701339000	CC	0	8.7	63.22	28.08	91.3	6.77	4.1	2.02	0.1	2.59	6.67
P-3-01	263	433.00	VV	38.0713333	-121.9337667	20011701407000	CC	0	6.38	62.02	31.6	93.62	6.98	3.98	1.99	0.05	2.55	6.94
P-3-01	264	405.10	VV	38.0480000	-122.1225000	20011701241000	CC	1.11	80.52	12.84	5.53	18.37	3.11	4.63	2.15	1.46	5.38	2.65
P-3-01	265	407.10	VV	38.0693417	-122.0936233	20011701320000	CC	0.5	74.19	15.68	9.63	25.31	3.15	7.34	2.71	1.28	3.54	2.02
P-3-01	266	411.10	VV	38.0968333	-122.0581667	20011701352000	CC	1.54	30.16	40.04	28.26	68.3	5.83	9.3	3.05	-0.3	2.03	6.55
P-3-01	267	423.10	VV	38.0875917	-122.0032917	20011701505000	CC	2.6	61.4	22.47	13.52	35.99	3.85	8.75	2.96	0.72	2.53	2.67

Cruise	Sample ID	Station ID	Instrument	Latitude	Longitude	Date/Time	Method	% Gravel >2 mm	% Sand .062 – 2 mm	% Silt .004 - .062 mm	% Clay <.004 mm	% Mud <.062 mm	1st moment (mean)	2nd moment (variance)	Std. deviation	3rd moment (skewness)	4th moment (kurtosis)	Median
P-3-01	268	4.10	VV	38.0570017	-121.9447650	20011701540000	CC	0.5	26.76	56.12	16.62	72.73	5.46	6.42	2.53	-0.02	2.43	5.54
P-3-01	269	6.10	VV	38.0669183	-122.0501250	20011710758000	CC	7.79	54.59	25.72	11.9	37.62	3.86	8.88	2.98	0.47	2.59	2.72
P-3-01	270	8.10	VV	38.0317250	-122.1404683	20011710930000	CC	12.96	13.27	49.44	24.33	73.77	5.5	11.65	3.41	-0.67	2.64	6.14
P-4-01	271	408.00	VV	38.0777667	-122.0569833	20012891256000	CC	3.73	60.58	23.41	12.28	35.69	3.97	7.78	2.79	0.69	2.76	2.9
P-4-01	272	415.00	VV	38.1292667	-122.0569333	20012891320000	CC	4.25	11.13	52.98	31.63	84.61	6.53	7.69	2.77	-0.97	4.07	6.95
P-4-01	273	416.00	VV	38.1175333	-122.0394500	20012891354000	CC	0.36	2.64	63.72	33.28	97	7.14	3.64	1.91	-0.08	3.47	7.09
P-4-01	274	417.00	VV	38.1178333	-122.0102000	20012891404000	CC	1	7.88	61.81	29.3	91.12	6.79	4.66	2.16	-0.37	3.87	6.79
P-4-01	275	433.00	VV	38.0713667	-121.9335667	20012891432000	CC	0.35	2.68	62.79	34.18	96.96	7.21	3.6	1.9	-0.11	3.58	7.15
P-4-01	276	405.10	VV	38.0480000	-122.1225000	20012891245000	CC	1.3	88.05	7.4	3.25	10.65	2.89	2.83	1.68	2.28	10.04	2.52
P-4-01	277	407.10	VV	38.0691667	-122.0938333	20012891336000	CC	0.35	57.38	25.76	16.51	42.27	4.28	9.03	3.01	0.65	2.04	2.57
P-4-01	278	411.10	VV	38.0966000	-122.0580833	20012891420000	CC	0	31.35	46.57	22.08	68.65	5.73	7.06	2.66	0.03	2	5.96
P-4-01	279	423.10	VV	38.0878333	-122.0030000	20012891500000	CC	4.2	58.68	23.72	13.39	37.12	4.13	7.84	2.8	0.63	2.78	3.03
P-4-01	280	4.10	VV	38.0570267	-121.9447367	20012891546000	CC	0	96.7	2.2	1.1	3.3	1.49	1.45	1.2	4.21	24.63	1.36
P-4-01	281	6.10	VV	38.0671667	-122.0497783	20012900830000	CC	9.28	44.76	31.03	14.94	45.96	4.15	10.51	3.24	0.22	2.21	3.25
P-4-01	282	8.10	VV	38.0315000	-122.1398333	20012900945000	CC	7.79	18.25	51.32	22.64	73.96	5.58	9.72	3.12	-0.57	2.81	6.01
P-1-02	283	408.00	VV	38.0777833	-122.0572000	20020221222000	CC	0	40.56	43.48	15.96	59.44	5.15	6.05	2.46	0.53	2.43	4.62
P-1-02	284	415.00	VV	38.1288667	-122.0564833	20020221247000	CC	4.94	21.12	47.09	26.85	73.94	5.91	8.98	3	-0.59	2.92	6.37
P-1-02	285	416.00	VV	38.1171500	-122.0402167	20020221310000	CC	0	3.2	63.72	33.09	96.8	7.16	3.45	1.86	0.15	2.57	7.08
P-1-02	286	417.00	VV	38.1179833	-122.0101833	20020221323000	CC	0.07	7.54	63.53	28.86	92.39	6.84	4.02	2	0.03	2.78	6.76
P-1-02	287	433.00	VV	38.0714167	-121.9331833	20020221400000	CC	0	5.62	62.68	31.7	94.38	7.04	3.73	1.93	0.07	2.6	6.98
P-1-02	288	405.10	VV	38.0481067	-122.1225683	20020221238000	CC	0.44	57.8	24.56	17.2	41.76	4.37	8.85	2.97	0.65	2.15	2.8
P-1-02	289 sfc	407.10	VV	38.0691883	-122.0934767	20020221345000	CC	1.51	67.42	18.13	12.94	31.07	3.48	9.05	3.01	0.96	2.63	2.05
P-1-02	289 btm	407.10	VV	38.0691883	-122.0934767	20020221345000	CC	0	7.17	67.23	25.6	92.83	6.71	3.83	1.96	0.23	2.67	6.54
P-1-02	290	411.10	VV	38.0967767	-122.0582733	20020221430000	CC	0.26	18.78	65.01	15.95	80.96	5.74	4.6	2.14	0.24	3	5.48
P-1-02	291	423.10	VV	38.0876267	-122.0027917	20020221535000	CC	1.69	71.82	15.79	10.69	26.49	3.5	7.18	2.68	1.13	3.35	2.45
P-1-02	292 sfc	4.10	VV	38.0572833	-121.9451667	20020230825000	CC	0.5	89.77	6.45	3.28	9.73	2.27	3.43	1.85	2.43	9.59	1.86
P-1-02	292 btm	4.10	VV	38.0572833	-121.9451667	20020230825000	CC	0	20.9	58.3	20.8	79.1	6.07	4.87	2.21	0.21	2.36	5.99
P-1-02	293	6.10	VV	38.0670917	-122.0498750	20020230947000	CC	1.51	64.16	21.29	13.05	34.34	3.73	8.69	2.95	0.88	2.52	2.14
P-1-02	294 sfc	8.10	VV	38.0316350	-122.1397900	20020231127000	CC	16.45	55.65	18.57	9.33	27.9	2.87	9.92	3.15	0.67	2.72	2.15
P-1-02	294 btm	8.10	VV	38.0316350	-122.1397900	20020231127000	CC	0	23	53.1	23.9	77	6.09	6.13	2.48	-0.04	2.17	6.22
Averaged statistics for all sample locations.		4.10		38.0572310	-121.9447908	20011419710250	CC	0.25	61.64	26.73	11.38	38.11	3.84	5.75	2.33	1.34	6.38	3.27
		6.10		38.0672067	-122.0493117	20010165008286	CC	6.03	49.76	29.00	15.21	44.21	4.19	9.68	3.11	0.40	2.25	3.15
		8.10		38.0316825	-122.1399344	20011423386750	CC	7.65	25.61	45.78	20.97	66.74	5.23	9.02	2.97	-0.15	2.57	5.39
		405.10		38.0480905	-122.1225169	20010155355000	CC	0.84	81.29	11.76	6.10	17.87	3.05	4.52	2.08	1.75	7.04	2.46
		407.10		38.0692006	-122.0936056	20011413660250	CC	0.83	53.88	29.88	15.42	45.30	4.25	7.69	2.74	0.80	3.16	3.43
		408.00		38.0780228	-122.0568978	20010119374333	CC	2.04	57.03	28.74	12.20	40.94	4.22	6.48	2.54	0.82	3.33	3.47
		411.10		38.0966688	-122.0581519	20010155480286	CC	1.00	26.56	51.81	20.63	72.44	5.71	6.75	2.58	-0.04	2.50	5.84
		415.00		38.1291222	-122.0567639	20010119401500	CC	4.76	14.67	50.22	30.36	80.57	6.33	8.12	2.85	-0.83	3.63	6.78
		416.00		38.1174433	-122.0204660	20011519066200	CC	0.10	4.62	63.04	32.25	95.28	7.05	3.78	1.94	0.07	2.77	6.99
		417.00		38.1179700	-122.0102194	20010119474000	CC	0.44	11.09	61.98	26.49	88.47	6.59	4.57	2.13	-0.05	3.00	6.52
		423.10		38.0876079	-122.0030036	20010155572286	CC	1.40	67.72	19.40	11.49	30.89	3.74	7.20	2.67	1.03	3.38	2.72
		433.00		38.0713700	-121.9338700	20011701433400	CC	0.08	4.51	61.72	33.69	95.41	7.14	3.71	1.92	0.02	2.81	7.10

Table Explanation:
Cruise: Name of cruise.
Sample ID: sfc= collected at surface of box core or grab sample, mid= collected in the middle of box core or grab sample, btm= collected at the bottom of box core or grab sample, m/b= collected in the mid/bottom range of box core or grab sample.
Station ID: (*Only for RV Polaris samples)* Indicates the station ID for each sample.
Instrument: VV=Van Veen grab sampler, BC=box core sample.
Latitude/Longitude: Displayed as decimal degrees.
Date/Time: year/Julian Day/time
Method: RSA/SG=Rapid Sediment Analyzer (intermediates) and Sedigraph (fines), RSA/CC=Rapid Sediment Analyzer (intermediates) and particle-size analyzer (fines), CC= particle-size analyzer.