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Data Report: Pump Sampling and Sediment Analysis in Support of the Sensor Insertion System Duck, N.C. April and October, 1997

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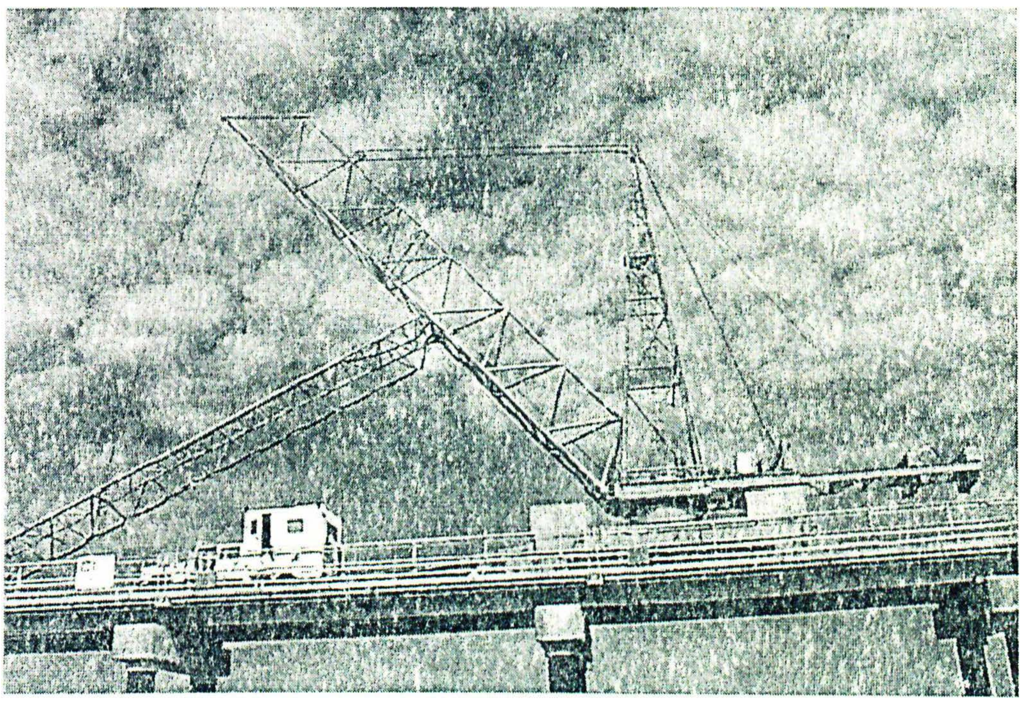

VIMS Data Report Number 56

School of Marine Science
Virginia Institute of Marine Science
College of William and Mary
Gloucester Point, VA 23062

January 1998

Research sponsored by the U.S. Army Corps of Engineers, Waterways Experiment Station, Contract DACW39-97-M-0814, by the National Science Foundation, Ocean Sciences Division Grant OCE-9504198, and the Department of Physical Geography, Utrecht Univerisity, The Netherlands

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1. Introduction

In April and October 1997, a group of scientists and graduate students coordinated by Grace Battisto of the Virginia Institute of Marine Science collected and analyzed pumped samples of suspended sediment across the surf zone in support of the Sensor Insertion System (SIS). The pump sampling field experiment was a component of a larger experiment entitled "Sediment Transport Rates During Storms" run by the “Storm Team” led by Carl Miller and Don Resio of the U.S. Army Corps of Engineers Waterways Experiment Station (USACE/WES). The participants in the April pump sampling field component were Grace Battisto, Carl Friedrichs, David Fugate, Guan-hong Lee, and Wayne Reisner; the participants in the October field component were Grace Battisto, Arno de Kruif, Daan Rijks, Billy Cartwright, Charles “Lyle” Thompson and Robert Ferguson. In addition, Eric Grant, Todd Nelson, and Steve Snyder helped assemble, install and test the pump system.

The objectives of this study were to (i) construct a pumping system, (ii) operate the system and collect samples of suspended sediment across the width of the surf zone during two major field experiments planned for the SIS in 1997, and (iii) analyze the resulting samples for sand concentration, sand size distribution, total percent sand, total percent mud, and organic content. The purpose was to provide a high quality data set of pump samples with which to later test the sensitivity of indirect measurements of suspended sand concentration to the presence of suspended mud. The response of OBSs is known to be particularly sensitive to the presence of suspended mud ("turbidity") due to the inverse response of OBS output to grain size. Without better constraints on the proper interpretation of OBS time series, the overall conclusions with regards to net along-shelf transport of sand during storms may be in doubt (see following section).

This data report describes the methodology used to pump, collect and analyze suspended sediment as part of the larger Storm Team experiment. The complete results of sediment filtering (1645 weighed samples) are provided in tabular form and are plotted as a function of position across individual transects. For October, samples at individual stations are also shown as a function of time. Graphic comparisons of duplicate samples are provided to assess the precision of the methodology. Graphic comparison between the two methodologies utilized to determine the total sand content in October and graphic presentation of percent organic matter is also provided. Because of the very large data sets involved, size distributions of sand samples run through the RSA are provided in graphical form only. Digital data will be available through a compact disk being prepared by the Storm Team.

2. Background

Proper design of inlet maintenance and beach nourishment projects requires an ability to reasonably predict along-shore sand transport in the near shore. At this point the scientific and engineering communities still do not have the ability to adequately predict the expected rate of along-shore sand transport based on physical "first principles". Rather, calculations must rely on semi-empirical equations "tuned" by direct field observation and experience. Until recently, direct field observations of suspended sand transport in the surf zone have been too few and too localized to be of much use in predicting along-shore sediment transport with statistical confidence, especially during storms when the majority of sand transport is presumed to occur.

The SIS developed by Carl Miller at WES's Field Research Facility in Duck, N.C., provides a quantum leap in the accuracy, duration, and variety of conditions over which scientists and engineers can now integrate direct measurements of along-shore currents and sediment concentration in the near shore. For the first time, closely spaced measurements of along-shore velocity and turbidity can be collected across the entire surf zone throughout the duration of a series of major storms. These unique measurements begin to provide the quantity and quality of data necessary to establish reliable, field tested predictions of along-shore transport of sand. However, a major ground-truthing measurement had been missing from the SIS, namely direct measurements of suspended sand concentration via pump sampling.

The SIS infers suspended sand concentration primarily from the strength of the optical backscatter off particles in the water column. Unfortunately, material that is not very important to total along-shore sand transport, such as mud and organic matter, tends to scatter light particularly well. For example, if one were to assume that the OBS levels measured by the SIS were a direct function of sand concentration alone, then under many conditions, SIS measurements of concentration times along-shore velocity would predict that more sand transport occurs in the upper part of the water column than near the bed. Clearly this is not the case.

Before installation of sediment sampling pumps on the SIS, estimates of suspended sand concentration and transport were made by subtracting out a "reasonable" background turbidity based on the level present in the water between intermittent suspension events when suspended sand transport was presumed to be negligible. Although this method appears to work well, the critical background turbidity level is based more on common sense than quantitative measurement. Furthermore, it is not well known how the background turbidity changes between fair weather and storms and between different stages of a single storm. In addition, various size distributions of suspended sand (which may occur at different locations across the surf zone under various wave conditions) may also impact the translation of OBS measurement into sediment concentration.

By direct sampling, this data report provides the additional information necessary to calculate more reliable estimates of along-shore sediment sand transport from OBS measurements. This data report represents completion of the first stage of a planned longer-term collaboration with Carl Miller and Don Resio of USACE/WES to establish a more well-founded, quantitative and practical formulation for determining suspended sand concentration and background turbidity from OBS measurements in the near shore.

3. Sampling Technique

3.1. Pump system

In this study, four "Teel Industrial Series" Model 1P809A submersible pumps produced by the Dayton Electric Manufacturing Company were employed. Figure 1 shows their mounting arrangement during the October experiment. They operate with 115 V A/C and draw 4.5 amps under full load. Their advantages include their small size (approximately 5"x 5"x 7") and low price (~$100) relative to their relatively strong pumping ability and durability. They also have standard 3/4" garden hose intakes and outlets, which allowed deployment of the pumps in series and remotely from the actual sampling location. This was crucial because flow disturbance in the vicinity of the electronic concentration and velocity sensors had to kept at a minimum.

The Model 1P809A's pump rate according to the manufacturer is 900, 800 and 570 gallons/hour at 1, 9 and 20 ft of head, respectively, dropping off quickly to complete shut-off at 30 ft of head. Because the distance from mean sea level to the high point of the intake hose on the SIS was more like 40 ft, priming the pumps occasionally caused problems during the field experiments, particularly during April. The head limitations were overcome to some degree in April by installing two pumps in series. In October maintaining head was only a minor problem, in that all four pumps were installed in series. The largest problem in October was jamming of the pump impeller with coarse sand and large organic material (this may have been an additional unrecognized problem in April). Fortunately, another advantage of the Model 1P809A is ease of maintenance. It is quickly disassembled with a screwdriver for internal cleaning and part replacement.

In April, we used two intakes, one located 62 cm below the cross-bar on the instrument sensor frame, and the other positioned 64 cm above the cross-bar. On the lower intake a "T" was placed to prevent suction of sediment straight up from directly below the intake. The opening of each end of the "T" was about the same size as the internal diameter of the hose leading up to the pier, namely 3/4". With a maximum pump rate of about 5 gallons/minute (often in April it was significantly less), this meant that in April the velocity flowing into each side of the "T" was less than or equal to about 58 cm/s. This was sufficient to accurately sample the mud content of the water but may not have been fast enough to accurately sample suspended sand. In October, we pumped samples from only one elevation at a time, located from 61 cm below the cross-bar for transects 1-15 and 56 cm below the cross-bar for transects 17-29. The intake, positioned adjacent to the 6 OBS sensor cluster maintained by the Storm Team, consisted of four 4 mm diameter holes drilled horizontally around the perimeter of the end of a plugged, downward facing PCV tube. With a consistent pump rate in October of about 5 gallons/minute, this meant that in October the velocity flowing into each of the four holes was ~ 6.6 m/s.

Two 3/4" internal diameter heavy duty hoses and four submersible 115 V A/C power cables extended from the seaward end of the SIS, up through the turn-table of the SIS (also known as the "snake pit"), terminating near the rear end of the truck towing the SIS. In April, both hoses were used during portions of the experiment to alternatively or simultaneously pump sediment, depending on the particular transect, from two heights above the bed; in October only one of the hoses was active. The A/C current were kept as far as possible from the communication cables to the electronic sensors on the SIS to minimize potential 60 Hz interference due to the power cables. In April, the pumps were turned on and off by plugging them directly into the power outlet on the outside of the truck. By October, a safer splash-proof control box with ground fault interrupts had been assembled so that the pumps could remain plugged in at all times and a single switch turned the pumps on and off.

3.2. Sampling procedure

The general sampling procedure for the entire Storm Team group was to transect the surf zone moving landward from the seaward end of the FRF pier. Sampling was done straddling low or high tide in order to keep water level relatively constant. The entire transect generally took about three hours. About every 200 feet, the SIS was deployed to collect a five minute burst of backscatter and current meter data along with pump samples. The pump sampling was performed on a subset of the total number of SIS transects in April and October 1997.

In April it was difficult to maintain head on the pumps, so the procedure was to use the fresh water hose attached to the truck to push water backwards through the sampling hose along the SIS boom. The pumps were turned on just before the fresh water hose was disconnected in an effort to maintain pressure. The success of pumping was then checked before the SIS was lowered all the way to the bottom. Overall, this technique did a reasonable job at maintaining flow, given that only two pumps were being used in series. However it interfered with and slowed the overall SIS progress. With four pumps in series in October it was no longer necessary to prime the pumps with fresh water or begin pumping before the SIS settled on the bottom.

Nonetheless, the pumps were still turned on several minutes before sediment samples were taken. With approximately 40 m of hose and a water velocity within the hose of about 117 cm/s, we can expect about a 34 second delay between water intake and appearance of the pumped sample at the barrel. In addition, the signal is expected to be blurred relative to the "spiky" OBS response by shear of the flow within the hose itself.

In April, one or two hoses (depending on the particular station -- see Table 1) were used simultaneously to each fill two barrels corresponding to the first and second halves of the OBS burst collected by the personnel in the SIS truck. In April, the samples were collected in 4 to 5 gallon plastic barrels. Four gallon barrels were consistently used in October. In April, the barrels were filled over a period of about two minutes by more or less randomly moving the hose back and forth over the opening to the barrel. The goal was to extend the sampling period to avoid extreme biases associated with short, intense bursts of suspended sediment. The times of sampling were noted for later correlation to times within individual OBS bursts and are listed in Table 1.

In October, the one hose split used terminated in a "Y", with one branch passing through a laser in-situ scattering and transmissometry (LISST) instrument mounted on the SIS just behind the truck and the other leading into a barrel. Figure 2 shows a schematic representation of the sample handling in October. As in April, two samples were collected corresponding to periods within the first and second halves of the OBS burst. Times of sampling were again noted for later correlation to times within the OBS bursts (Table 2). In October continuous rather than "random" flow into the barrel was maintained. Because of the "Y" split in the flow, it consistently took about 1.6 minutes to fill a 4 gallon barrel (i.e., indicating a total flow rate of ~5 gallons/minute).

In April a VIMS truck moved along the pier with the SIS, storing barrels as they were filled. In October, the barrels were carried on the SIS itself.

3.3. Subsample and filtering procedure (see figure 2)

In April, 2 liter sub-samples or "aliquots" of suspended sediment plus water were collected from each barrel by physically shaking the barrel and transferring the whole sample into a larger barrel. The larger barrel was continually shaken while the aliquot was drawn from a spigot located at the bottom. In October the splitting procedure was improved through construction of a churn splitter in the larger barrel such that the entire 4 gallon sample could be transferred and mixed with a paddled plunger before the 2 liter aliquot was taken. In April most of the barrels were transported back to VIMS before being subsampled. The process of taking all the April subsamples took several days during which time the contents of the 4-5 gallon sample barrels may have been affected somewhat by algae growth (although the resulting organic content doesn't indicate significant contamination). This procedure was improved in October by consistently subsampling in Duck within a few hours of sample collection. The aliquots were then immediately filtered to prevent algae growth. In both April and October, duplicate 2 liter aliquots were taken on 10% of the barrels. In October, the portion of the sample left in the churn splitter after the aliquots were removed was used for further sand analysis (see 3.4).

In both April and October, a measured portion of the 2 liter aliquot , figure 2, was filtered through a pre-weighed 47 mm diameter filter stamped out of 60 micron mesh in an aluminum dish. The mesh filter was then dried at 103-105 C and reweighed. The difference in weight on the mesh filter plus dish divided by the volume filtered is the filtered sand concentration reported in grams/liter (g/l). The sand was brushed off the filter into the dish and weighed again. The dish and sand were then muffled at 550 C to volatilize organic matter before the dish and sand were weighed again. The ratio of the weight of sand scraped off the dried filter before and after muffling was used to calculate the fixed weight of the sand. This weight was divided by the volume filtered to give the concentration of the fixed sand in g/L. The difference between the total sand concentration and fixed sand concentration is the concentration of the organic matter.

An aliquot of the filtrate was immediately passed through a 47 mm diameter glass fiber filter (pore size approximately 0.8 microns) which had been pre-muffled at 550 C and pre-weighed. The glass fiber filter, now with fine sediment attached, was dried at 103-105 C and reweighed. The additional weight on the filter divided by the volume filtered is the "total" suspended mud portion reported in g/l. Next the filter plus attached mud was muffled at 550 C and reweighed. The weight lost divided by the volume filtered is the volatile organic matter in the mud portion in g/l; the resulting weight of the muffled mud is termed the "fixed" weight of the mud.

3.4. Sand size analysis (see Figure 2)

After subsampling for filtering in October, the remaining water in each barrel (approximately 3.5 gallons) was measured for volume and passed through a 63 micron sieve. (In April too little sand was collected to run a significant number of sand size analyses.) The trapped sand was transferred to a pre-weighed sand storage bag, air dried, and reweighed. For all but the first station on the first transect, the samples from the two barrels collected at each station were combined to yield one larger sand sample for sand size analysis. The total weight of the sand from each station divided by the total volume of the remaining water in the two barrels provided another measure of the "total" sand concentration in addition to the previous filter based estimate.

The Rapid Sand Analyzer (RSA) was used to determine the size distribution of the sand collected. The RSA utilizes the known fall velocities of natural particles to classify the particles in the sample into size classes. For evenly spaced intervals of phi, where phi = $-\log_2 D$ and D is the intermediate diameter in millimeters, the fall velocity (W_n) of natural grains in fresh water have been calculated:

$$W_n = 0.76\ c\ D^2$$

where c = 89.8 at 20°C for quartz particles (from Stokes Law), and 0.76 accounts for the effect of the natural shape of the particles.

The sample particles are uniformly dispersed at the top of the 150 cm column of water. The particles fall onto a tared balance pan located at the bottom of the column. The cumulative weight of the particles is recorded over time at 1 second intervals. The weight of the particles that have fallen in the amount of time it would take a particle for each phi size class is subtracted from the cumulative weight and called the immersed weight. A histogram of the immersed weight by phi class is then made to show the grain size distribution of the sample.

4. Data

4.1 Concentration estimates

Table 1 displays all the filter weights for sediment samples pumped during the April 1997 field experiment. The columns in order from left to right contain (1) the surf zone Storm Team transect number during which pump sampling was performed, (2) the day in April 1997, (3) the station number in feet seaward from the pier's landward benchmark, (4) the time in Eastern Standard Time that the pump sample collection began (in April the sample collection duration was typically 2 min), (5) total suspended fines concentration in grams/liter (g/l), (6) fixed suspended fines concentration in g/l, (7) total suspended sand concentration in g/l, (8) fixed suspended sand concentration in g/l, and (9) position of intake (H = high, i.e., above cross-bar; L = low, i.e., below cross-bar). Because of the low speed of the intake velocity in April, we feel the sand concentrations may be significant underestimates. The sand concentrations for April appear erratic without obvious patterns corresponding to sensible wave forcing variations in time and space. The mud estimates, in contrast, appear much more sensible. There is much less variation in mud concentration with position across the surf zone, and increases or decreases in space and time appear to be much smoother.

Table 2 displays all the filter weights for sediment samples pumped during the October 1997 field experiment. The columns in order from left to right contain (1) the surf zone Storm Team transect number during which pump sampling was performed, (2) the day in April 1997, (3) the station number in feet seaward from the pier's landward benchmark, (4) the time in Eastern Standard Time that the pump sample collection began (in October the sample collection duration was typically 1.6 min), (5) total suspended fines concentration in grams/liter (g/l), (6) fixed suspended fines concentration in g/l, (7) total suspended sand concentration in g/l determined from filters, (8) fixed suspended sand concentration in g/l determined from filters, and (9) total suspended sand concentration in g/l determined from the barrels. In column (9), one measurement for a station indicates two barrels were combined to yield a single larger sand sample for estimate of total sand concentration and sand size distribution.

4.2 Concentration as a function of position across the surf zone.

Section 1 contains a series of graphs of the fixed fines and the fixed sand concentrations presented by transect for the samples collected in April. Most transects had samples collected out of the upper inlet and the lower inlet. The graphs of the lower inlets are grouped together on one page and the next contains the graphs of the upper inlet. Each graph uses the station number in feet seaward from the pier's landward benchmark as the X axis. The left y axis is the fixed fines concentration in g/L. The bottom set of lines correspond to this axis. The right axis and the top set of lines are the fixed sand concentrations in g/L. In each set of lines, the dark solid line is the average concentration between the two containers sampled. The broken lines above and below the solid line represent the actual concentration found in each of the containers.

Section 2 contains a series of graphs of the fixed fines and the fixed sand concentrations presented by transect for the samples collected in October. The lower inlet was the only one used in October so the graphs are not grouped by inlet. Each graph uses the station number in feet seaward from the pier's landward benchmark as the X axis. The left y axis is the fixed fines concentration in g/L. The bottom set of lines correspond to this axis. The right axis and the top set of lines are the fixed sand concentrations in g/L. In each set of lines, the dark solid line is the average concentration between the two containers sampled. The broken lines above and below the solid line represent the actual concentration found in each of the containers.

4.3 Concentration as a function of time at a single station

Section 3 contains a series of graphs of the fixed fines and the fixed sand concentrations presented by station for the samples collected in October. The samples collected in April did not have enough transects taken to be presented in this manner. Each graph uses the Storm Team transect number as the x axis. The left y axis is the fixed fines concentration in g/L. The bottom set of lines correspond to this axis. The right axis and the top set of lines are the fixed sand concentrations in g/L. In each set of lines, the dark solid line is the average concentration between the two containers sampled. The broken lines above and below the solid line represent the actual concentration found in each of the containers.

4.4 Sand size distribution

Section 4 contains a series of histograms of the RSA sand grain size distributions found from the combined sand sieved from the two containers at each station. Each histogram represents a station. All of the stations are grouped by transect. If there was insufficient sand at any of the individual stations to run an RSA a composite of the sand collected at those stations on that transect was run. The X axis of the graphs are grain sizes in Phi and the Y axis are the % immersed weight of the total immersed weight of the sand sampled that correspond to each of the Phi sizes.

4.5 Organic Matter Concentration

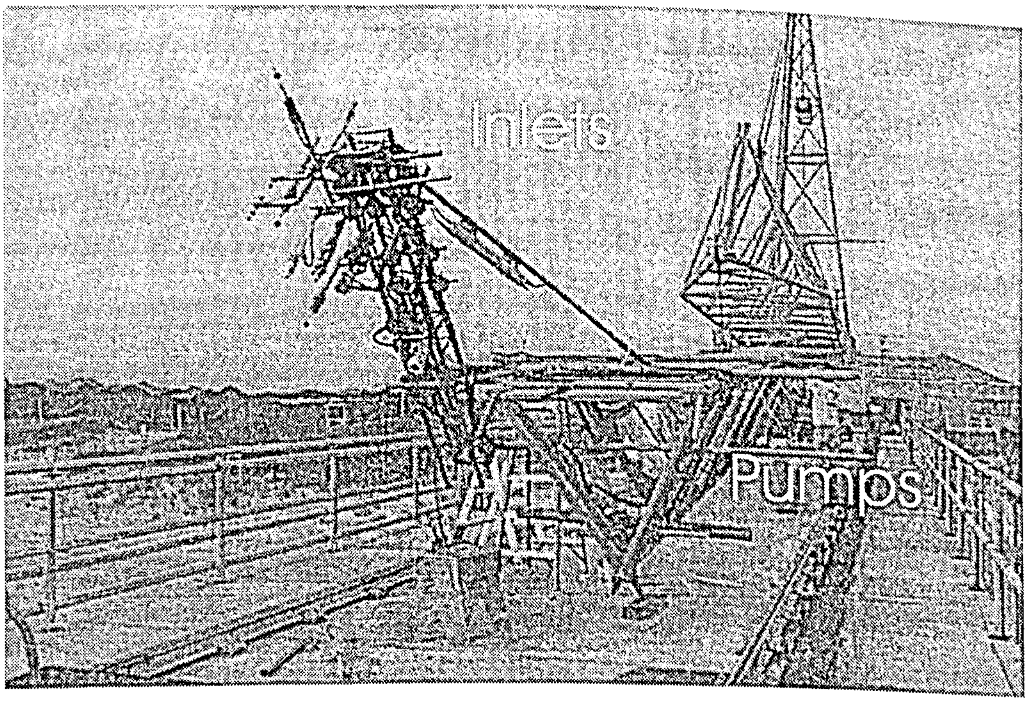
Section 5 contain graphs of the percentage of organic matter in the total fines and total sands concentrations for all the samples collected in October and in the total fines concentration for all the samples collected in April. The total sands concentration was not graphed for April because of the sampling inefficiency for sand during that time period. The X axis of each graph is the total concentration of fines or sands of all the samples taken that month and sorted from low to high. These concentrations are graphed against the percentage of organic matter in that concentration on the Y axis. The solid line on the graph represents the average percent organic content in the fines or sands for that month. The average percent organic content for April total fines is 12.6%. The average percent organic content for the October total fines and total sands are 24.2% and 3.64% respectively.

4.6 Method precision and methodology comparison

Section 6 contains graphs of method precision for the April fixed fines and the October fixed fines and sands. It also contains a graph of the comparison of the two different methods used to measure total sands in October.

The method precision graphs represent the absolute percent difference of each of the duplicates from their average concentration. The duplicates are two aliquots taken from the same container and are used to estimate the amount of error involved with sample handling and processing. The X axis of the graph represents the average concentration of each pair of duplicates sampled and processed for fixed fines and fixed sand concentration in October and fixed fines in April. The Y axis is the percent difference of each of those duplicates from their average. The solid line represents the average percent difference for the fixed concentration for that month. The average percent difference for April fixed fines is 9.3%. The average percent organic content for the October total fines and total sands are 13.9% and 23.3% respectively.

The last graph in this section is a comparison of the two methods used for analysis of total sand concentration in October, the sample passed through the 63 micron sieve or the aliquot filtered through a 60 micron mesh filter. The X axis represents the average concentration found by both methods at each station, and the Y axis is the percent difference for each method from the average concentration for that station. The average percent difference, represented by the solid line, for either method from the average total sand concentration is 24.6%.



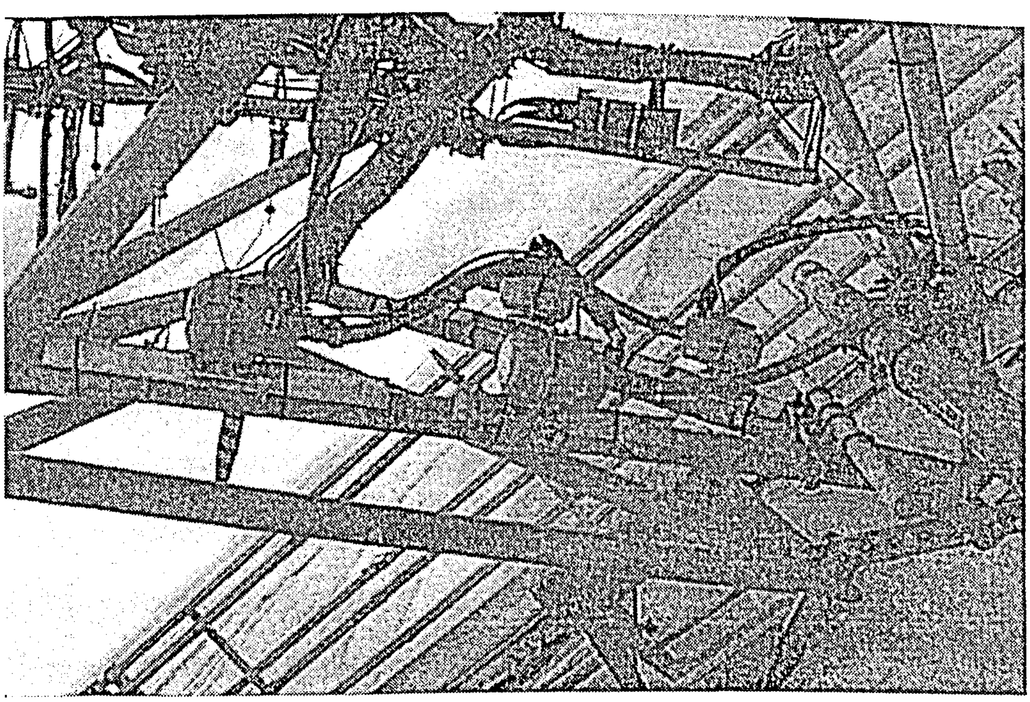


Figure 1

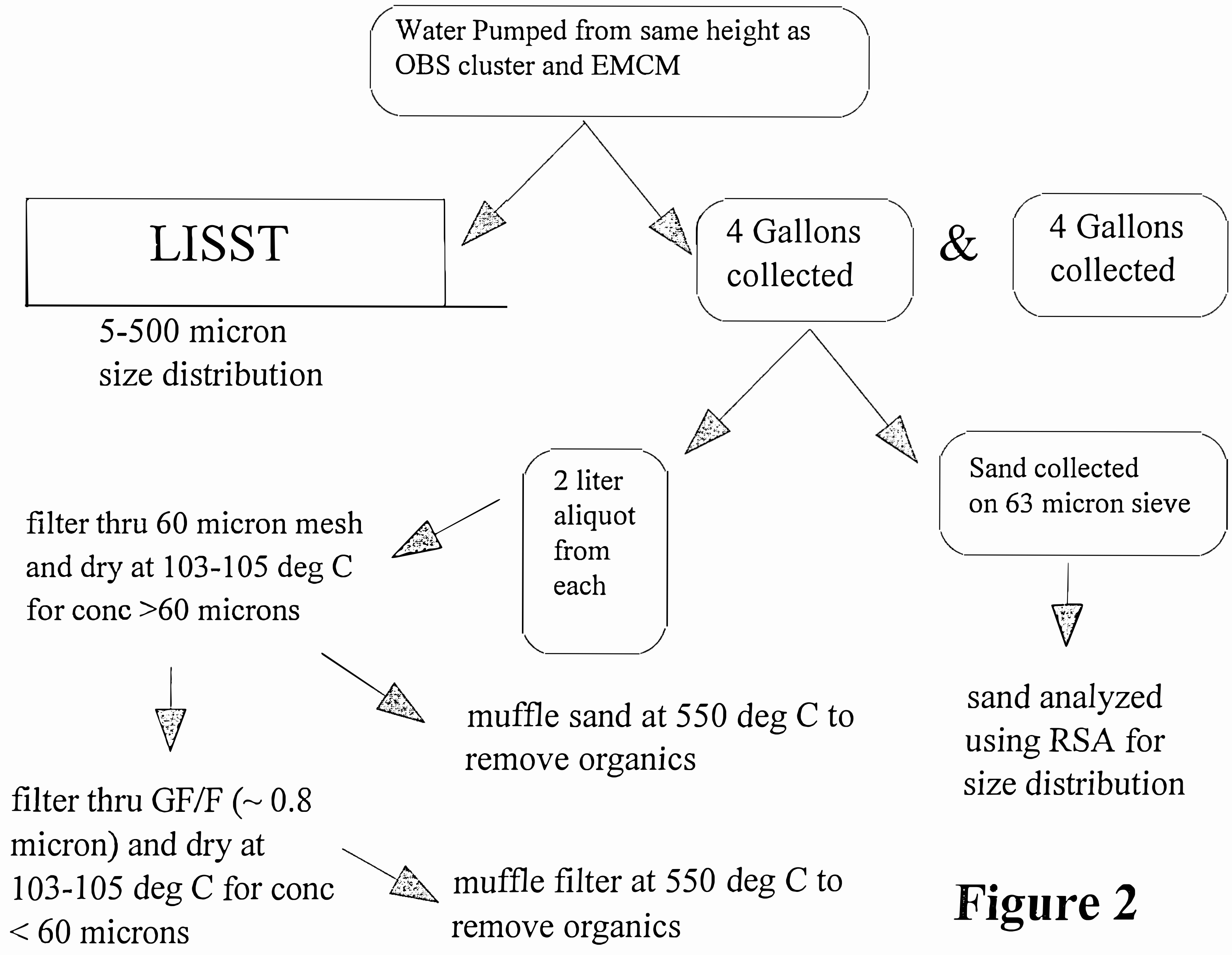

Water Pumped from same height as OBS cluster and EMCM
LISST
5-500 micron size distribution
4 Gallons collected
&
4 Gallons collected
2 liter aliquot from each
Sand collected on 63 micron sieve
filter thru 60 micron mesh and dry at 103-105 deg C for conc >60 microns
muffle sand at 550 deg C to remove organics
sand analyzed using RSA for size distribution
filter thru GF/F (~ 0.8 micron) and dry at 103-105 deg C for conc < 60 microns
muffle filter at 550 deg C to remove organics

Figure 2

Table 1

Fines/Sand Concentration
April 1997

April 1997 Storm Fines/Sand Concentrations

(ALL results in g/L)

Transect	Date April 1997	Station	Time in EST	Total Fines	Fixed Fines	Total Sand	Fixed Sand	Inlet
4	1	870	1438	0.046	0.041	0.011	0.010	H
4	1	870	1442	0.045	0.041	0.012	0.011	H
5	1	1580	1919	0.049	0.045	0.086	0.084	H
5	1	1580	1923	0.056	0.051	0.167	0.165	H
8	2	1700	1413	0.068	0.062	0.005	0.004	H
8	2	1700	1422	0.330	0.302	0.231	0.226	H
8	2	1520	1441	0.478	0.437	0.526	0.522	H
8	2	1520	1444	0.245	0.220	0.148	0.146	H
8	2	1380	1504	0.098	0.088	0.031	0.029	H
8	2	1380	1507	0.210	0.189	0.011	0.010	H
8	2	1260	1527	0.101	0.091	0.057	0.055	H
8	2	1260	1530	0.082	0.073	0.039	0.038	H
8	2	1135	1552	0.074	0.067	0.162	0.159	H
8	2	1135	1555	0.070	0.063	0.132	0.127	H
8	2	920	1615	0.069	0.063	0.022	0.022	H
8	2	920	1618	0.082	0.074	0.036	0.035	H
8	2	780	1638	0.081	0.064	0.014	0.014	H
8	2	780	1641	0.094	0.072	0.008	0.008	H
9	2	1710	1958	0.038	0.022	0.006	0.005	H
9	2	1710	2001	0.067	0.060	0.005	0.005	H
9	2	1500	2030	0.127	0.111	0.004	0.004	H
9	2	1500	2033	0.073	0.065	0.016	0.015	H
9	2	1260	2127	0.034	0.029	0.025	0.024	H
9	2	1260	2130	0.033	0.028	0.009	0.008	H
9	2	1130	2148	0.045	0.039	0.126	0.126	H
9	2	1130	2152	0.037	0.033	0.023	0.023	H
9	2	980	2227	0.066	0.059	0.031	0.030	H
9	2	880	2246	0.058	0.052	0.073	0.072	H
9	2	880	2249	0.054	0.047	0.094	0.093	H
9	2	760	2319	0.054	0.047	0.023	0.023	H
9	2	760	2322	0.054	0.047	0.031	0.030	H

Table 2

Fines/Sand Concentration
October 1997

October 1997 Fines/Sand concentrations

Estimated Average duration of typical pumping = 1.6 minutes/ 4 gallons

The following transects and stations had only 1 container analyzed due to various conditions:
Transect, station (11,1500), (14,780), (15,650), (17,1250), (19,1060), (21,1700), (27,1500), (28,1710)

Fixed Sand concentraiton for Transect 17, station 1490@1952 hours was lost...concentration from duplictate was used for graphing purposes.

(All results in g/L)

						FILTER		CONTAINER
Transect	**Date Oct 1997**	**Station**	**Time in EST**	**Total fines**	**Fixed fines**	**Total sands**	**Fixed sands**	**Total sands**
1	7	1700	909	0.054	0.042	0.021	0.021	0.015
1	7	1700	913	0.041	0.031	0.009	0.009	0.009
1	7	1490	932	0.040	0.027	0.014	0.014	0.004
1	7	1490	935	0.043	0.029	0.008	0.007	
1	7	1250	957	0.028	0.019	0.009	0.009	0.005
1	7	1250	1001	0.027	0.016	0.005	0.005	
1	7	1040	1026	0.115	0.091	0.026	0.024	0.008
1	7	1040	1030	0.066	0.051	0.014	0.013	
1	7	890	1053	0.044	0.028	0.005	0.005	0.005
1	7	890	1057	0.038	0.024	0.006	0.006	
1	7	890	1057	0.038	0.023	0.005	0.005	
1	7	770	1119	0.087	0.062	0.003	0.003	0.004
1	7	770	1123	0.028	0.016	0.011	0.011	
1	7	660	1145	0.032	0.019	0.008	0.008	0.040
1	7	660	1149	0.026	0.016	0.007	0.006	
1	7	530	1222	0.016	0.007	0.017	0.017	0.027
1	7	530	1225	0.018	0.009	0.019	0.019	
1	7	530	1225	0.016	0.008	0.040	0.040	
2	8	1700	1028	0.022	0.014	0.057	0.056	0.023
2	8	1700	1032	0.056	0.042	0.031	0.031	
2	8	1490	1102	0.054	0.039	0.055	0.054	0.039
2	8	1490	1105	0.018	0.011	0.004	0.004	
2	8	1250	1132	0.016	0.010	0.051	0.051	0.058
2	8	1250	1135	0.045	0.032	0.125	0.124	
2	8	1050	1203	0.027	0.020	0.047	0.046	0.035
2	8	1050	1206	0.024	0.016	0.032	0.032	
2	8	900	1233	0.019	0.012	0.053	0.051	0.114
2	8	900	1236	0.022	0.015	0.313	0.311	
2	8	900	1236	0.019	0.011	0.263	0.262	
2	8	780	1300	0.015	0.009	1.343	1.340	2.605
2	8	780	1303	0.020	0.012	6.097	6.086	
2	8	650	1324	0.010	0.004	1.623	1.620	0.977
2	8	650	1328	0.026	0.002	0.807	0.805	
2	8	530	1357	0.013	0.007	0.384	0.380	0.247
2	8	530	1401	0.017	0.011	0.301	0.301	
2	8	530	1401	0.022	0.016	0.216	0.216	
3	9	1700	1042	0.123	0.098	0.022	0.019	0.054
3	9	1700	1045	0.079	0.062	0.060	0.059	

October 1997 Fines/Sand concentrations

(All results in g/L)

						FILTER		CONTAINER
Transect	Date Oct 1997	Station	Time in EST	Total fines	Fixed fines	Total sands	Fixed sands	Total sands
3	9	1500	1116	0.125	0.102	0.057	0.054	0.048
3	9	1500	1120	0.051	0.038	0.082	0.081	
3	9	1260	1145	0.065	0.048	0.081	0.080	0.012
3	9	1260	1149	0.042	0.031	0.042	0.041	
3	9	1030	1239	0.053	0.041	0.038	0.037	0.015
3	9	1030	1243	0.042	0.033	0.020	0.019	
3	9	900	1322	0.050	0.037	0.272	0.270	0.109
3	9	900	1326	0.061	0.046	0.026	0.016	
3	9	900	1326	0.048	0.036	0.032	0.031	
3	9	770	1406	0.020	0.014	2.601	2.597	2.073
3	9	770	1410	0.047	0.035	4.521	4.513	
4	10	1700	1120	0.071	0.054	0.120	0.118	0.013
4	10	1700	1123	0.105	0.085	0.022	0.020	
4	10	770	1417	0.060	0.044	0.857	0.855	0.759
4	10	770	1427	0.056	0.040	0.009	0.008	
4	10	650	1441	0.042	0.028	0.805	0.804	0.614
4	10	650	1445	0.032	0.020	2.241	2.238	
6	13	1700	907	0.071	0.054	0.087	0.086	0.045
6	13	1700	910	0.015	0.009	0.023	0.023	
6	13	1700	920	0.014	0.009	0.016	0.016	0.025
6	13	1700	923	0.017	0.010	0.013	0.012	
6	13	780	1022	0.014	0.008	0.017	0.017	0.059
6	13	780	1026	0.011	0.006	0.059	0.058	
6	13	780	1039	0.015	0.009	0.071	0.070	0.063
6	13	780	1043	0.015	0.009	0.089	0.088	
6	13	780	1043	0.017	0.012	0.043	0.042	
7	14	1690	1600	0.022	0.013	0.007	0.006	0.007
7	14	1690	1605	0.015	0.009	0.022	0.022	
7	14	1500	1634	0.019	0.012	0.018	0.018	0.018
7	14	1500	1638	0.016	0.010	0.023	0.023	
7	14	1240	1700	0.015	0.009	0.016	0.015	0.005
7	14	1240	1704	0.010	0.006	0.007	0.006	
7	14	1030	1731	0.013	0.008	0.017	0.016	0.020
7	14	1030	1734	0.008	0.003	0.006	0.005	
7	14	900	1812	0.014	0.009	0.024	0.023	0.014
7	14	900	1816	0.013	0.008	0.037	0.036	
7	14	900	1816	0.013	0.007	0.006	0.005	
7	14	770	1835	0.015	0.008	0.238	0.237	0.203
7	14	770	1839	0.018	0.013	0.181	0.179	
7	14	660	1851	0.039	0.031	0.028	0.027	0.029
7	14	660	1856	0.017	0.011	0.081	0.080	
7	14	540	1908	0.022	0.015	0.017	0.017	0.011
7	14	540	1912	0.042	0.034	0.021	0.020	
7	14	540	1912	0.043	0.035	0.011	0.010	
8	15	1700	1743	0.028	0.022	0.012	0.011	0.021
8	15	1700	1746	0.026	0.020	0.018	0.017	

October 1997 Fines/Sand concentrations

(All results in g/L)

Transect	Date Oct 1997	Station	Time in EST	Total fines	Fixed fines	FILTER Total sands	FILTER Fixed sands	CONTAINER Total sands
8	15	1500	1809	0.029	0.023	0.021	0.020	0.010
8	15	1500	1812	0.025	0.019	0.008	0.008	
8	15	1360	1827	0.032	0.025	0.008	0.007	0.006
8	15	1360	1830	0.019	0.014	0.007	0.007	
8	15	1260	1843	0.043	0.034	0.049	0.049	0.019
8	15	1260	1846	0.026	0.021	0.016	0.016	
8	15	1140	1902	0.054	0.045	0.019	0.018	0.014
8	15	1140	1905	0.029	0.022	0.016	0.015	
8	15	1140	1905	0.049	0.039	0.021	0.021	
8	15	1030	1924	0.034	0.027	0.013	0.013	0.014
8	15	1030	1927	0.046	0.038	0.027	0.026	
8	15	900	1941	0.029	0.023	0.019	0.018	0.017
8	15	900	1944	0.060	0.050	0.029	0.028	
8	15	770	1958	0.060	0.048	0.016	0.015	0.016
8	15	770	2001	0.062	0.051	0.021	0.020	
8	15	770	2001	0.032	0.024	0.014	0.012	
8	15	650	2015	0.056	0.046	0.671	0.668	0.874
8	15	650	2018	0.036	0.028	1.470	1.465	
10	16	1700	525	0.051	0.043	0.171	0.169	0.179
10	16	1700	530	0.059	0.050	0.322	0.318	
10	16	1530	546	0.055	0.045	0.033	0.032	0.018
10	16	1530	552	0.051	0.042	0.021	0.020	
10	16	1530	552	0.068	0.057	0.019	0.019	
11	16	1730	1753	0.055	0.038	0.506	0.493	0.090
11	16	1730	1753	0.176	0.154	0.444	0.435	
11	16	1730	1755	0.132	0.104	0.093	0.085	
11	16	1500	1810	0.067	0.053	0.131	0.127	0.188
11	16	1250	1826	0.120	0.101	0.100	0.093	0.126
11	16	1250	1827	0.090	0.073	0.113	0.106	
11	16	1250	1827	0.063	0.051	0.564	0.549	
11	16	1140	1842	0.132	0.111	0.115	0.101	0.113
11	16	1140	1845	0.028	0.020	0.148	0.140	
11	16	1040	1900	0.062	0.051	0.149	0.144	0.115
11	16	1040	1903	0.059	0.047	0.147	0.142	
11	16	900	1917	0.097	0.082	0.058	0.055	0.418
11	16	900	1920	0.045	0.036	0.991	0.978	
11	16	900	1920	0.123	0.101	0.046	0.041	
11	16	770	1935	0.045	0.035	0.192	0.190	0.104
11	16	770	1937	0.073	0.058	0.139	0.137	
11	16	650	1952	0.034	0.026	1.566	1.556	1.337
11	16	650	1954	0.043	0.032	1.158	1.147	
13	17	1700	1219	0.104	0.082	0.164	0.158	0.375
13	17	1700	1221	0.124	0.088	0.361	0.356	
13	17	1500	1251	0.067	0.047	0.196	0.191	0.304
13	17	1500	1254	0.130	0.092	0.136	0.132	
13	17	1280	1316	0.054	0.032	0.101	0.098	0.312

October 1997 Fines/Sand concentrations

(All results in g/L)

Transect	Date Oct 1997	Station	Time in EST	Total fines	Fixed fines	FILTER Total sands	FILTER Fixed sands	CONTAINER Total sands
13	17	1280	1322	0.102	0.069	0.147	0.144	
13	17	1140	1341	0.069	0.048	0.154	0.150	0.224
13	17	1140	1345	0.048	0.030	0.067	0.064	
13	17	1030	1404	0.055	0.037	0.328	0.324	0.310
13	17	1030	1408	0.107	0.072	0.202	0.198	
13	17	1030	1408	0.052	0.035	0.368	0.364	
13	17	900	1430	0.105	0.029	0.459	0.455	0.370
13	17	900	1434	0.061	0.079	0.323	0.321	
13	17	780	1454	0.042	0.026	0.959	0.955	0.756
13	17	780	1457	0.084	0.051	0.632	0.630	
13	17	780	1457	0.051	0.032	0.645	0.643	
14	17	1700	1852	0.049	0.030	0.363	0.361	0.245
14	17	1700	1856	0.047	0.029	0.174	0.172	
14	17	1610	1910	0.083	0.051	0.044	0.043	0.039
14	17	1610	1914	0.055	0.034	0.045	0.044	
14	17	1500	1937	0.053	0.033	0.172	0.170	0.117
14	17	1500	1942	0.052	0.034	0.133	0.130	
14	17	1360	2009	0.036	0.021	0.092	0.091	0.143
14	17	1360	2012	0.073	0.044	0.234	0.232	
14	17	1250	2028	0.069	0.050	0.252	0.250	0.181
14	17	1250	2031	0.045	0.032	0.103	0.102	
14	17	1250	2031	0.067	0.047	0.115	0.114	
14	17	1120	2047	0.055	0.036	0.728	0.724	0.664
14	17	1120	2050	0.053	0.033	1.091	1.086	
14	17	1040	2103	0.026	0.017	0.421	0.418	0.499
14	17	1040	2106	0.038	0.020	0.607	0.603	
14	17	900	2118	0.038	0.020	0.552	0.548	0.706
14	17	900	2121	0.045	0.025	0.873	0.868	
14	17	900	2121	0.073	0.045	0.553	0.550	
14	17	780	2137	0.061	0.043	0.554	0.547	0.378
14	17	650	2150	0.039	0.019	0.364	0.362	0.466
14	17	650	2152	0.075	0.054	0.644	0.642	
14	17	650	2152	0.094	0.068	0.751	0.749	
15	18	1700	655	0.025	0.019	0.037	0.037	0.007
15	18	1700	659	0.019	0.014	0.022	0.023	
15	18	1500	726	0.040	0.031	0.014	0.009	0.026
15	18	1500	730	0.031	0.024	0.051	0.051	
15	18	1260	757	0.035	0.028	0.046	0.046	0.022
15	18	1260	801	0.044	0.035	0.016	0.017	
15	18	1140	830	0.039	0.031	0.025	0.025	0.016
15	18	1140	833	0.045	0.038	0.012	0.014	
15	18	1050	857	0.041	0.034	0.053	0.054	0.087
15	18	1050	902	0.040	0.034	0.144	0.144	
15	18	1050	902	0.045	0.038	0.128	0.128	
15	18	890	929	0.051	0.043	0.059	0.058	0.032
15	18	890	933	0.060	0.052	0.012	0.009	

October 1997 Fines/Sand concentrations

(All results in g/L)

Transect	Date Oct 1997	Station	Time in EST	Total fines	Fixed fines	FILTER Total sands	FILTER Fixed sands	CONTAINER Total sands
15	18	770	1001	0.051	0.044	0.108	0.101	0.056
15	18	770	1005	0.050	0.042	0.071	0.061	
15	18	650	1033	0.027	0.021	0.305	0.299	0.661
17	18	1730	1918	0.036	0.027	0.295	0.273	0.445
17	18	1730	1919	0.151	0.132	0.677	0.654	
17	18	1610	1934	0.142	0.125	0.333	0.314	0.359
17	18	1610	1937	0.210	0.186	0.216	0.145	
17	18	1490	1952	0.081	0.070	0.106	0.214	0.291
17	18	1490	1955	0.167	0.147	0.229	0.214	
17	18	1350	2009	0.117	0.101	0.169	0.166	0.476
17	18	1350	2013	0.081	0.069	0.282	0.276	
17	18	1250	2026	0.072	0.060	0.043	0.041	0.535
17	18	1250	2030	0.043	0.034	0.290	0.288	
17	18	1050	2113	0.060	0.050	0.103	0.102	0.515
17	18	1050	2117	0.067	0.057	0.173	0.172	
17	18	900	2135	0.131	0.115	0.112	0.111	0.399
17	18	900	2138	0.057	0.049	0.326	0.325	
17	18	900	2138	0.121	0.106	0.908	0.900	
19	19	1770	731	0.104	0.092	0.166	0.163	0.230
19	19	1770	735	0.135	0.120	0.203	0.196	
19	19	1700	752	0.109	0.096	0.294	0.291	0.462
19	19	1700	755	0.082	0.072	0.486	0.481	
19	19	1540	809	0.078	0.068	0.245	0.243	0.204
19	19	1540	813	0.108	0.096	0.239	0.237	
19	19	1400	827	0.109	0.096	0.731	0.726	0.608
19	19	1400	830	0.108	0.093	0.808	0.803	
19	19	1260	847	0.083	0.072	0.828	0.822	1.963
19	19	1260	851	0.111	0.097	1.070	1.065	
19	19	1260	851	0.112	0.098	1.443	1.438	
19	19	1140	904	0.104	0.091	0.687	0.685	1.910
19	19	1140	906	0.808	0.071	1.960	1.954	
19	19	1060	922	0.107	0.094	2.158	2.151	2.193
19	19	900	940	0.061	0.053	1.114	1.101	0.842
19	19	900	942	0.099	0.086	1.674	1.670	
19	19	900	942	0.092	0.078	1.329	1.325	
21	19	1750	2003	0.080	0.068	0.192	0.190	0.826
21	19	1750	2006	0.082	0.069	1.924	1.914	
21	19	1700	2027	0.108	0.094	1.588	1.579	1.678
21	19	1500	2100	0.118	0.104	1.620	1.612	0.551
21	19	1500	2102	0.115	0.099	1.520	1.514	
21	19	1500	2102	0.123	0.106	2.158	2.150	
23	20	1770	841	0.148	0.128	1.538	1.484	0.807
23	20	1770	844	0.329	0.290	0.628	0.599	
23	20	1700	916	0.230	0.203	0.219	0.207	0.175
23	20	1700	922	0.307	0.276	0.164	0.153	
23	20	1530	942	0.183	0.160	0.076	0.068	0.029

October 1997 Fines/Sand concentrations

(All results in g/L)

Transect	Date Oct 1997	Station	Time in EST	Total fines	Fixed fines	FILTER Total sands	FILTER Fixed sands	CONTAINER Total sands
23	20	1530	950	0.153	0.134	0.041	0.036	
23	20	1420	1019	0.159	0.136	0.193	0.185	0.633
23	20	1420	1022	0.140	0.117	0.481	0.469	
23	20	1140	1137	0.146	0.122	1.529	1.518	1.296
23	20	1140	1140	0.137	0.116	0.958	0.948	
24	20	1600	1535	0.212	0.187	0.437	0.410	0.943
24	20	1600	1538	0.224	0.198	0.880	0.838	
24	20	1500	1550	0.144	0.125	0.131	0.125	0.348
24	20	1500	1553	0.149	0.127	0.382	0.366	
24	20	1380	1611	0.150	0.129	0.206	0.201	0.760
24	20	1380	1613	0.153	0.128	0.207	0.201	
24	20	1260	1627	0.140	0.119	1.814	1.803	1.807
24	20	1260	1630	0.152	0.130	1.304	1.292	
24	20	1260	1630	0.165	0.143	1.584	1.569	
26	21	1760	939	0.177	0.153	0.564	0.553	0.831
26	21	1760	941	0.172	0.146	0.560	0.545	
26	21	1700	1052	0.161	0.135	0.233	0.227	0.111
26	21	1700	1054	0.164	0.142	0.092	0.088	
26	21	1520	1114	0.143	0.122	0.038	0.037	0.035
26	21	1520	1116	0.137	0.117	0.065	0.064	
26	21	1280	1133	0.131	0.109	0.191	0.189	0.298
26	21	1280	1135	0.129	0.109	0.599	0.593	
26	21	1140	1150	0.146	0.122	0.105	0.104	0.090
26	21	1140	1152	0.139	0.117	0.053	0.052	
26	21	1140	1152	0.139	0.118	0.065	0.063	
26	21	900	1208	0.139	0.117	0.090	0.088	0.154
26	21	900	1210	0.141	0.118	0.288	0.285	
26	21	900	1210	0.139	0.115	0.300	0.297	
27	21	1700	1615	0.158	0.131	0.072	0.065	0.177
27	21	1700	1619	0.165	0.141	0.166	0.159	
27	21	1600	1636	0.142	0.120	0.788	0.772	0.303
27	21	1600	1639	0.149	0.126	0.309	0.295	
27	21	1500	1652	0.115	0.094	0.137	0.133	0.401
27	21	1370	1711	0.126	0.105	0.430	0.413	0.987
27	21	1370	1715	0.116	0.097	0.173	0.168	
27	21	1250	1735	0.117	0.095	0.247	0.244	0.359
27	21	1250	1737	0.123	0.100	0.500	0.495	
27	21	1250	1737	0.117	0.096	0.472	0.467	
27	21	1130	1753	0.137	0.112	0.968	0.960	1.199
27	21	1130	1756	0.114	0.094	1.878	1.864	
27	21	900	1810	0.116	0.095	0.309	0.307	0.368
27	21	900	1812	0.124	0.101	0.587	0.582	
27	21	770	1827	0.130	0.107	1.070	1.064	0.551
27	21	770	1830	0.115	0.095	0.273	0.270	
27	21	770	1830	0.130	0.103	0.000	0.000	

October 1997 Fines/Sand concentrations

(All results in g/L)

Transect	Date Oct 1997	Station	Time in EST	Total fines	Fixed fines	FILTER Total sands	FILTER Fixed sands	CONTAINER Total sands
28	22	1710	1022	0.197	0.166	0.046	0.039	0.037
28	22	1500	1048	0.193	0.165	0.072	0.067	0.036
28	22	1500	1050	0.150	0.126	0.073	0.063	
28	22	1250	1112	0.150	0.127	0.073	0.064	0.089
28	22	1250	1114	0.147	0.122	0.126	0.119	
28	22	1140	1135	0.137	0.114	0.017	0.015	0.020
28	22	1140	1138	0.134	0.108	0.047	0.044	
28	22	1050	1201	0.126	0.103	0.045	0.041	0.033
28	22	1050	1203	0.118	0.098	0.061	0.058	
28	22	1050	1203	0.145	0.119	0.032	0.030	
28	22	900	1232	0.104	0.085	0.019	0.018	0.013
28	22	900	1235	0.110	0.087	0.018	0.016	
28	22	770	1258	0.127	0.104	0.172	0.168	0.083
28	22	770	1300	0.082	0.067	0.049	0.046	
28	22	770	1300	0.117	0.096	0.035	0.033	
29	23	1760	1113	0.119	0.099	0.087	0.083	0.037
29	23	1760	1115	0.109	0.090	0.085	0.082	
29	23	1500	1135	0.106	0.087	0.046	0.045	0.008
29	23	1500	1139	0.103	0.085	0.011	0.010	
29	23	1250	1154	0.112	0.091	0.023	0.022	0.002
29	23	1250	1157	0.121	0.099	0.014	0.013	
29	23	1130	1213	0.107	0.087	0.017	0.016	0.007
29	23	1130	1216	0.116	0.094	0.042	0.041	
29	23	1050	1232	0.123	0.100	0.033	0.031	0.013
29	23	1050	1235	0.090	0.071	0.036	0.034	
29	23	1050	1235	0.127	0.105	0.027	0.024	
29	23	900	1248	0.121	0.100	0.166	0.162	0.010
29	23	900	1251	0.137	0.113	0.040	0.038	
29	23	770	1315	0.131	0.106	0.036	0.034	0.000
29	23	770	1318	0.122	0.100	0.034	0.031	
29	23	650	1344	0.116	0.102	0.110	0.084	0.133
29	23	650	1346	0.115	0.085	0.078	0.058	
29	23	650	1346	0.109	0.088	0.125	0.099	

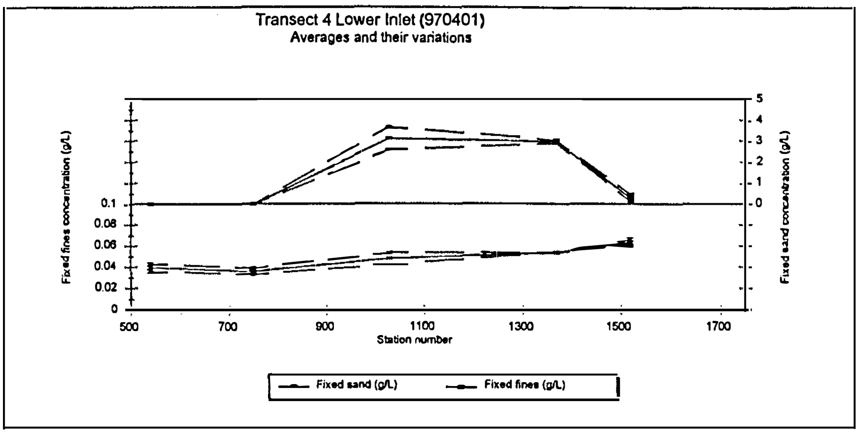
Section 1

Fixed Fines/Sand
Graphs
by Transect

April 1997

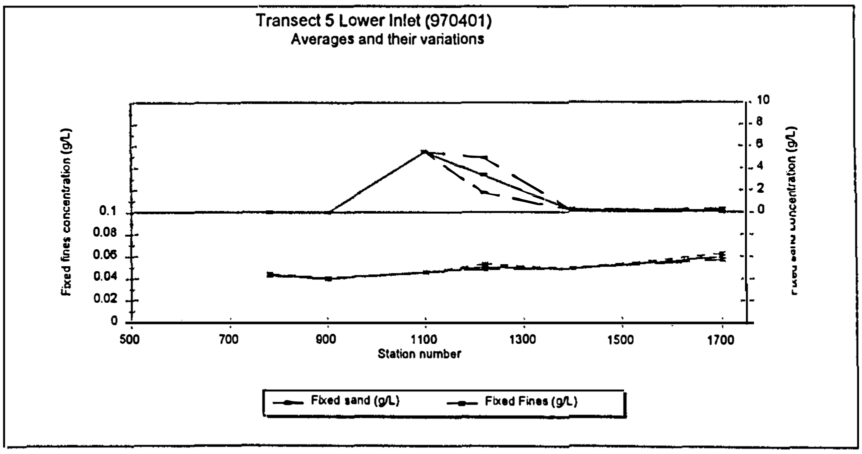
Averaged Fixed Concentrations : Transects

Transect 4
Lower



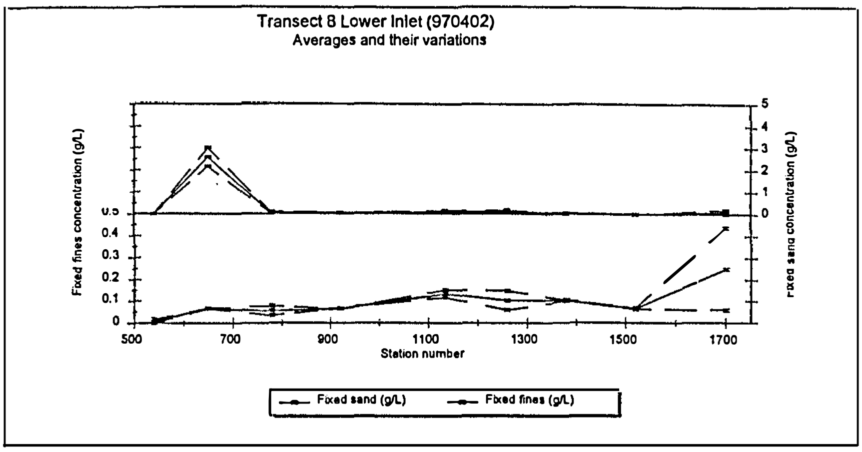
Transect 4 Lower Inlet (970401)
Averages and their variations

Transect 5
Lower



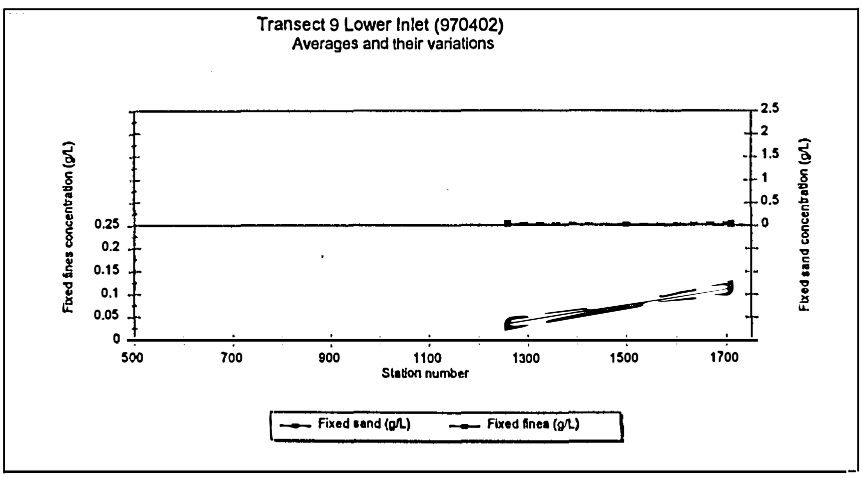
Transect 5 Lower Inlet (970401)
Averages and their variations

Transect 8
Lower



Transect 8 Lower Inlet (970402)
Averages and their variations

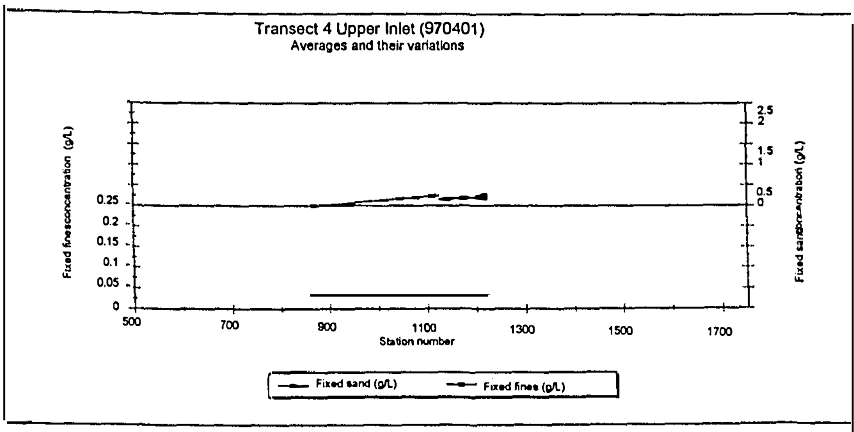
Transect 9
Lower



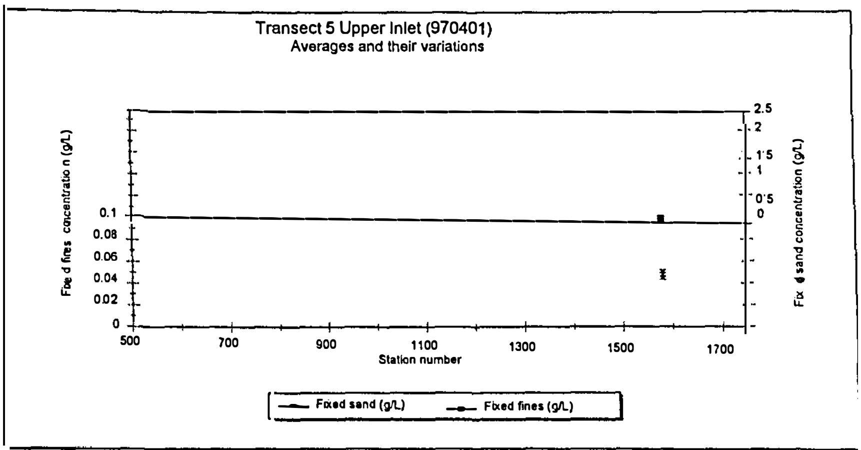
Transect 9 Lower Inlet (970402)
Averages and their variations

Averaged Fixed Concentrations : Transects

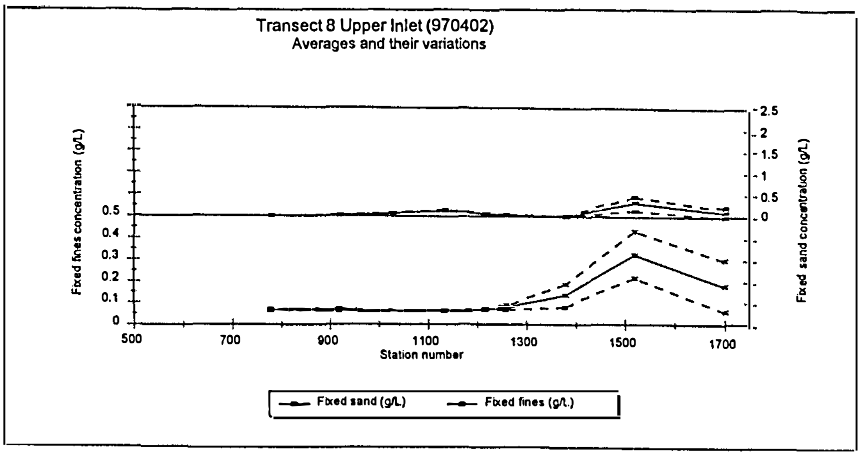
Transect 4 Upper



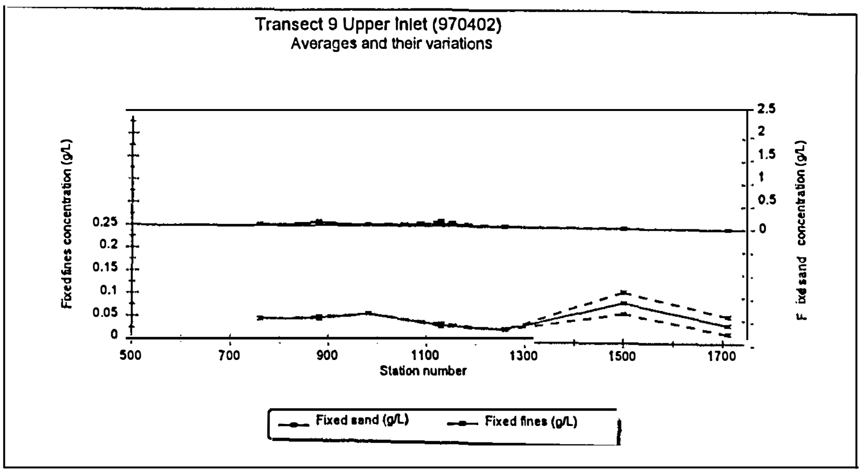
Transect 5 Upper



Transect 8 Upper



Transect 9 Upper



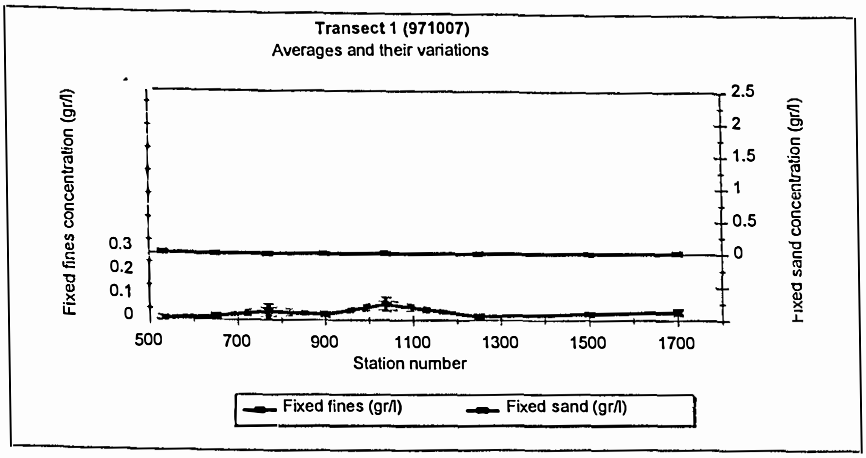
Section 2

Fixed Fines/Sand Graphs by Transect

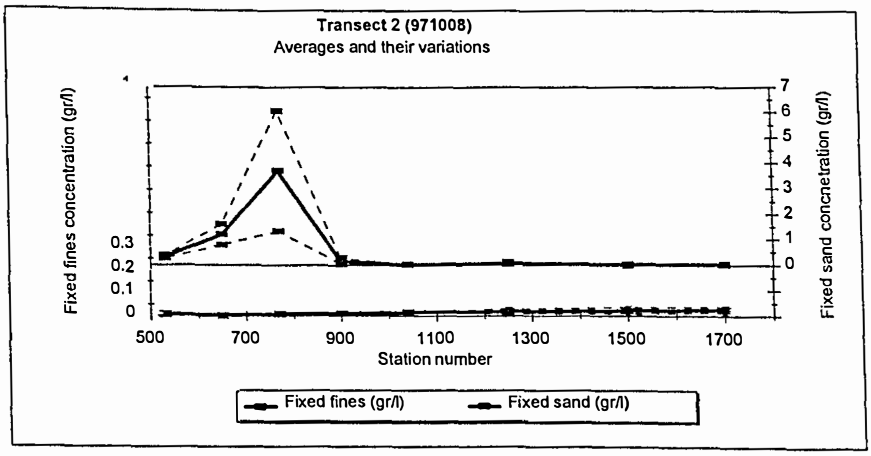
October 1997

Averaged Fixed Concentrations : Transects

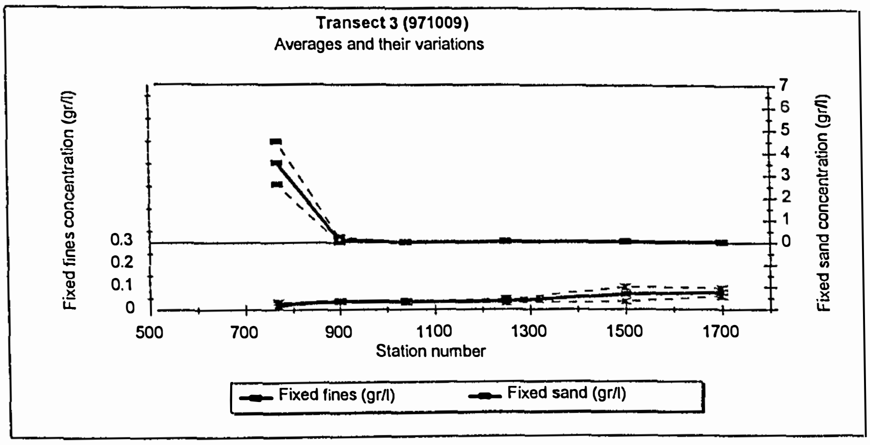
Transect 1



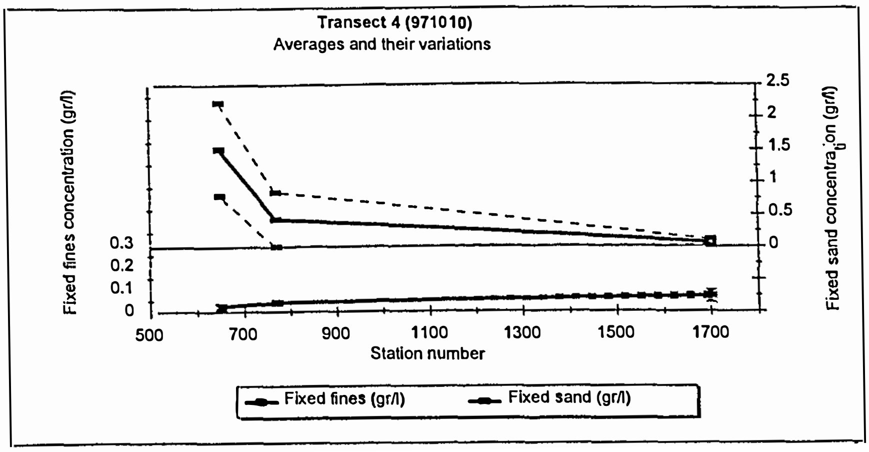
Transect 2



Transect 3

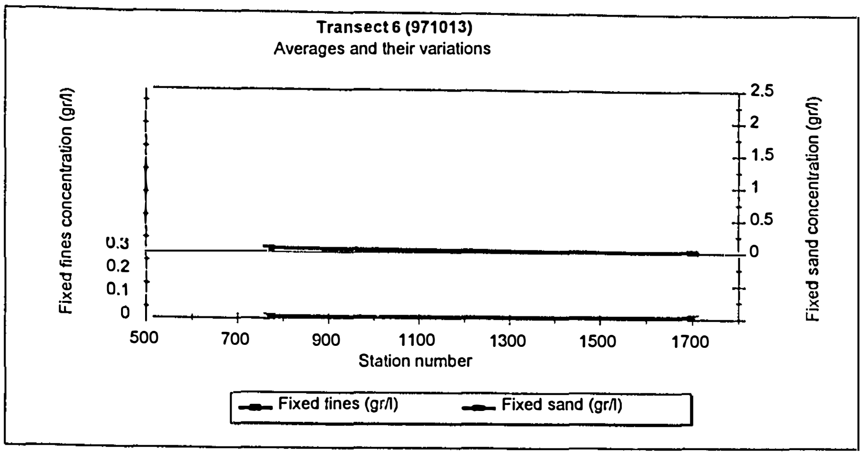


Transect 4

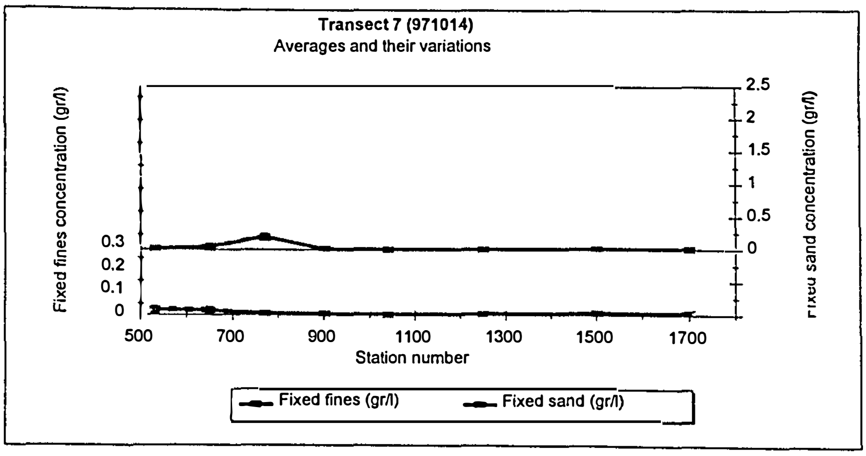


Averaged Fixed Concentrations : Transects

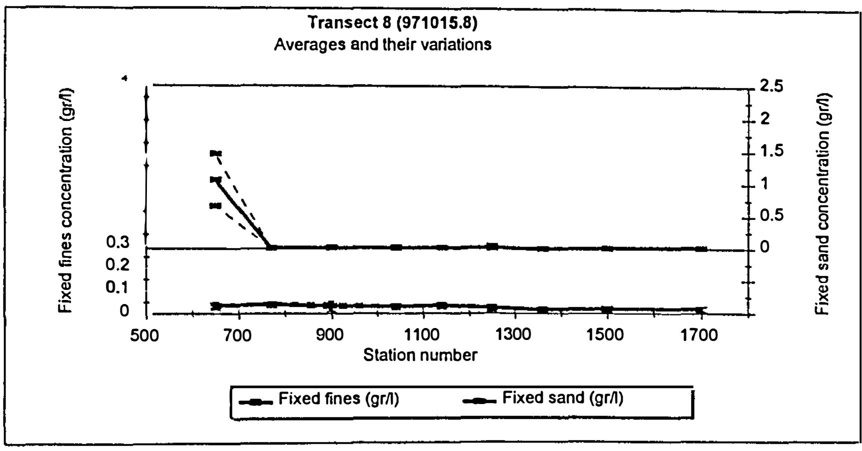
Transect 6



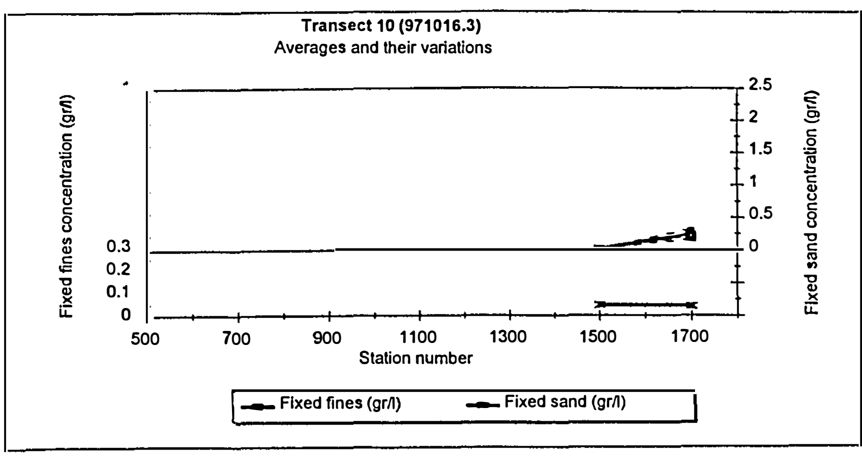
Transect 7



Transect 8

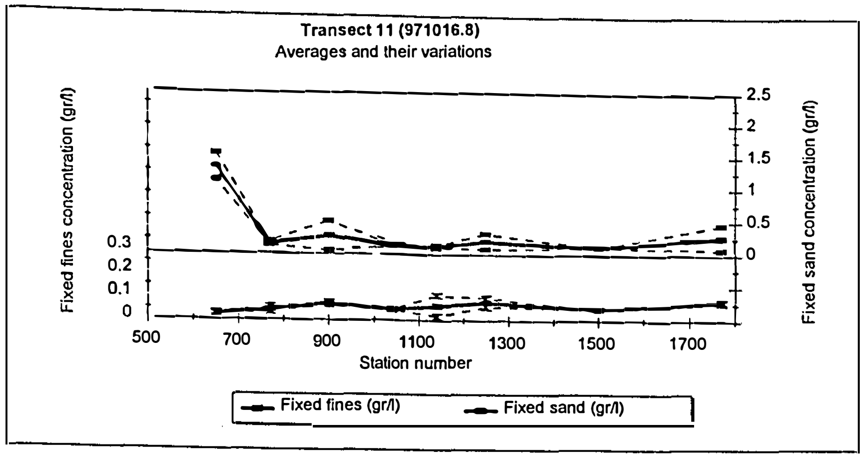


Transect 10

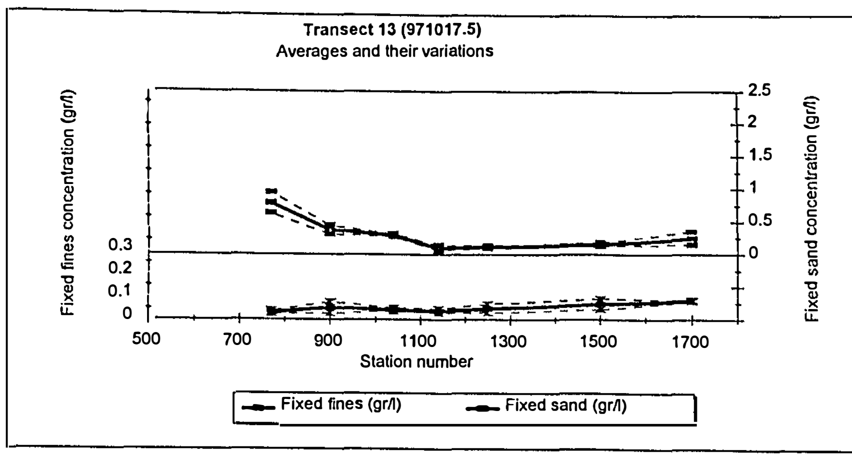


Averaged Fixed Concentrations : Transects

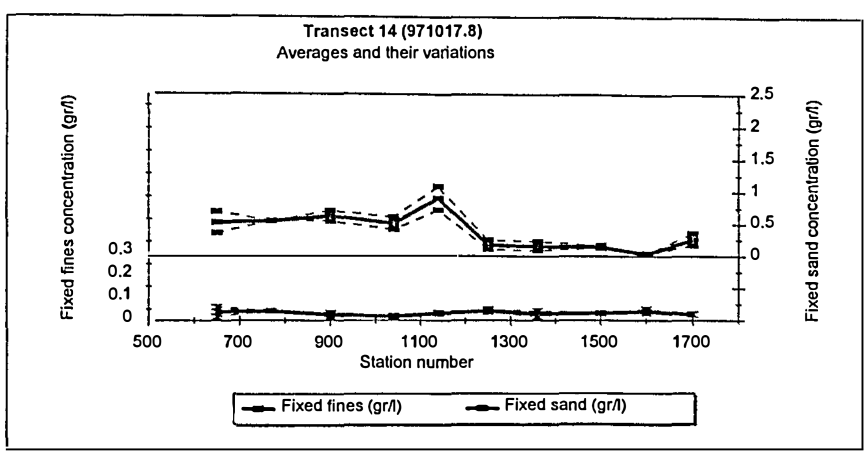
Transect 11



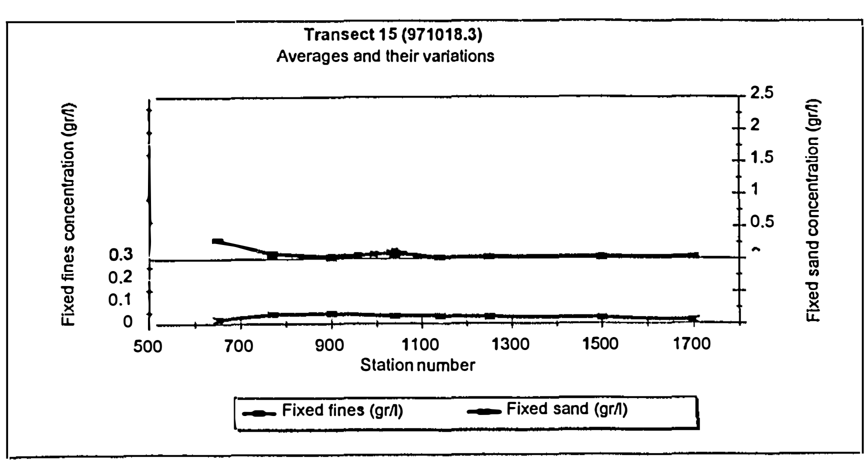
Transect 13



Transect 14

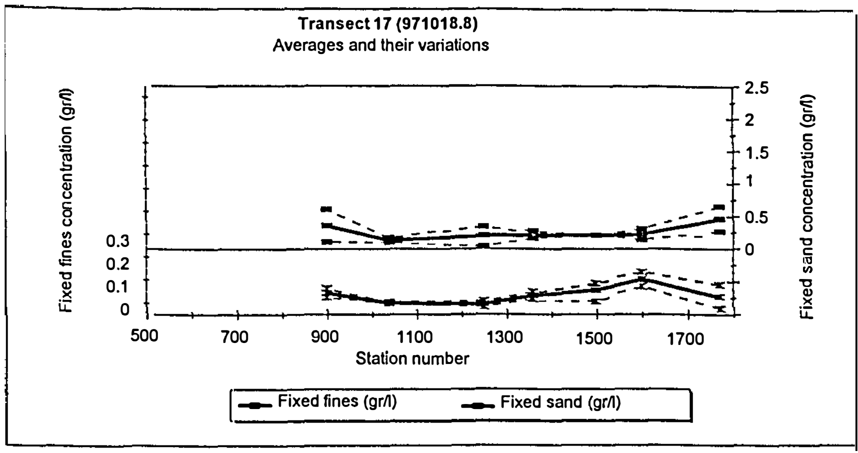


Transect 15

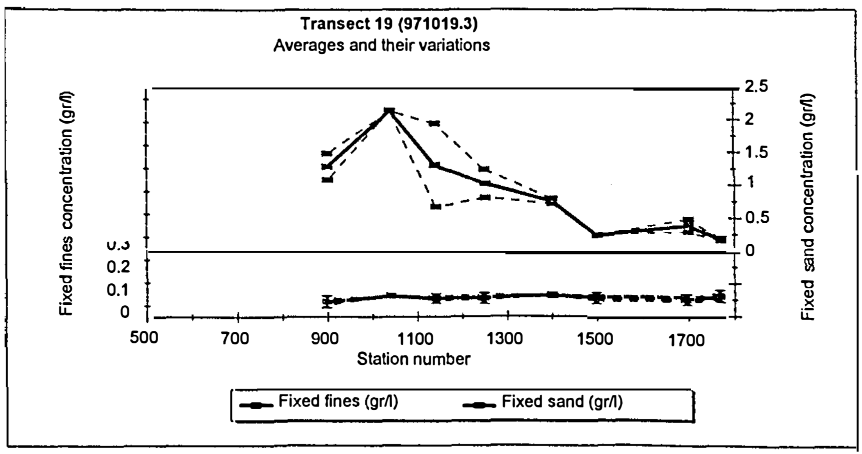


Averaged Fixed Concentrations : Transects

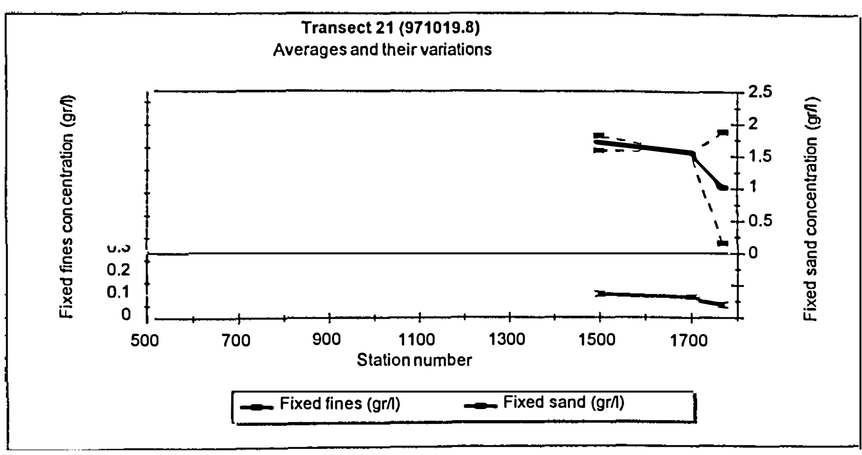
Transect 17



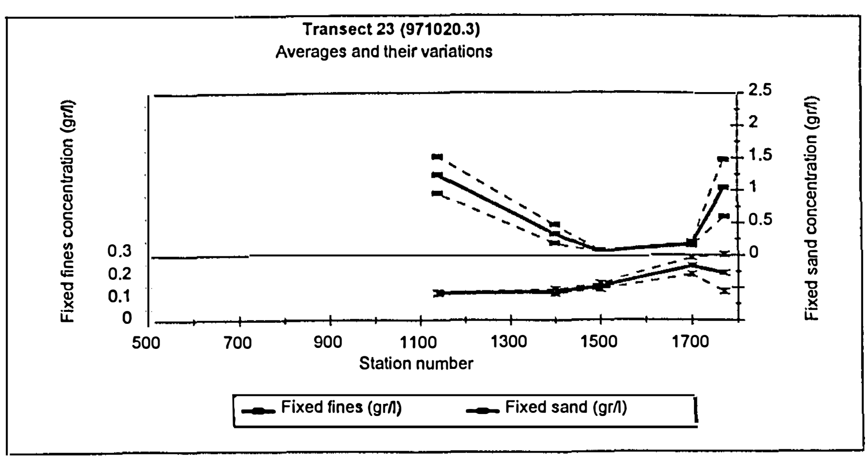
Transect 19



Transect 21

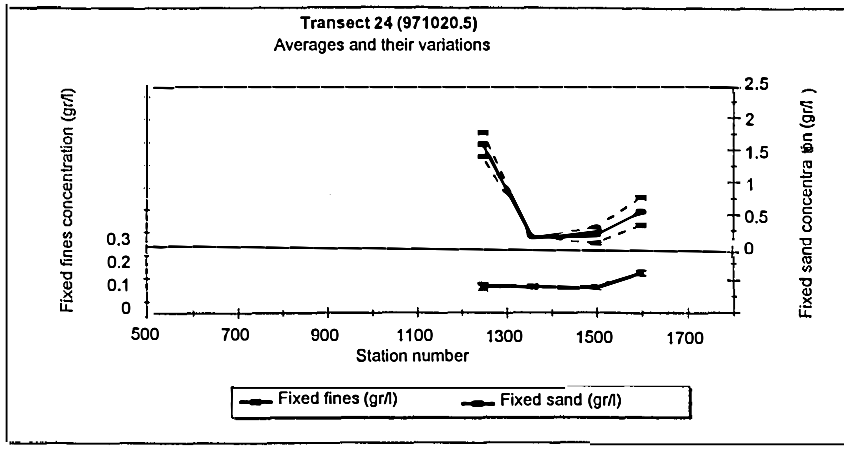


Transect 23

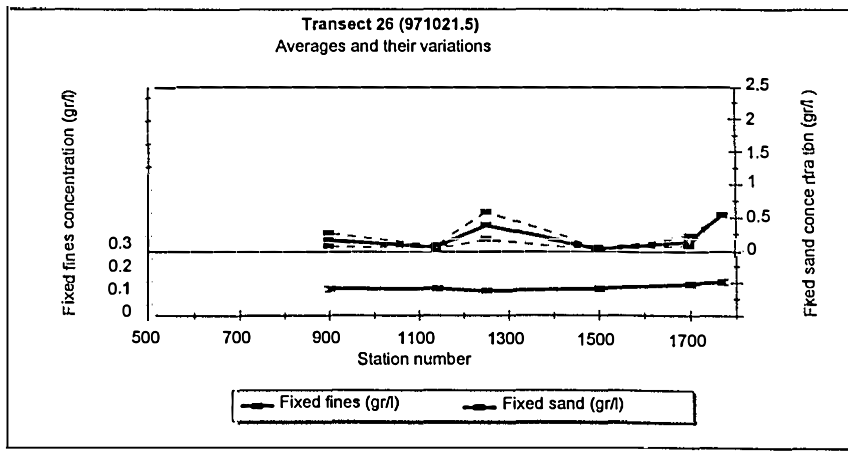


Averaged Fixed Concentrations : Transects

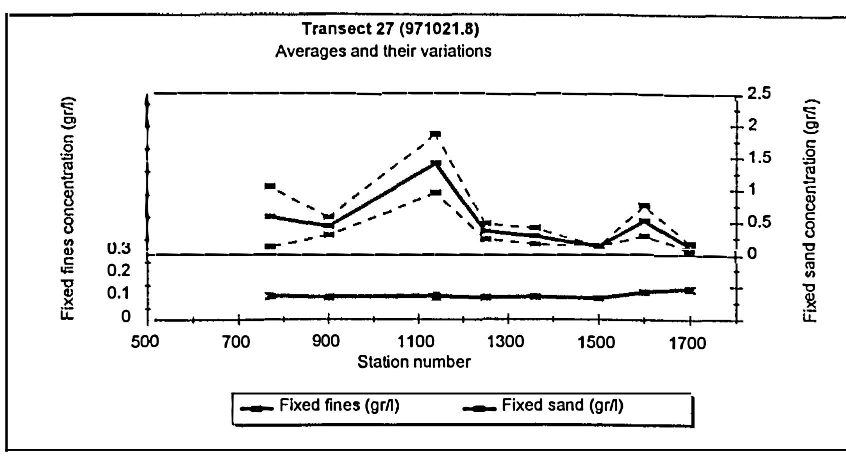
Transect 24



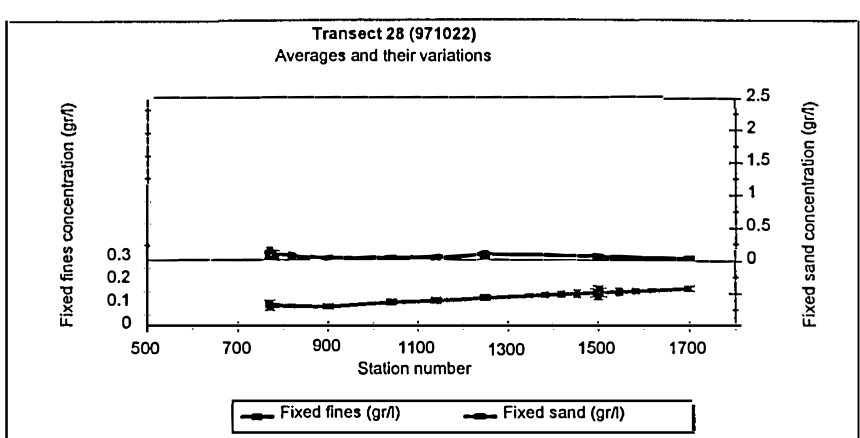
Transect 26



Transect 27

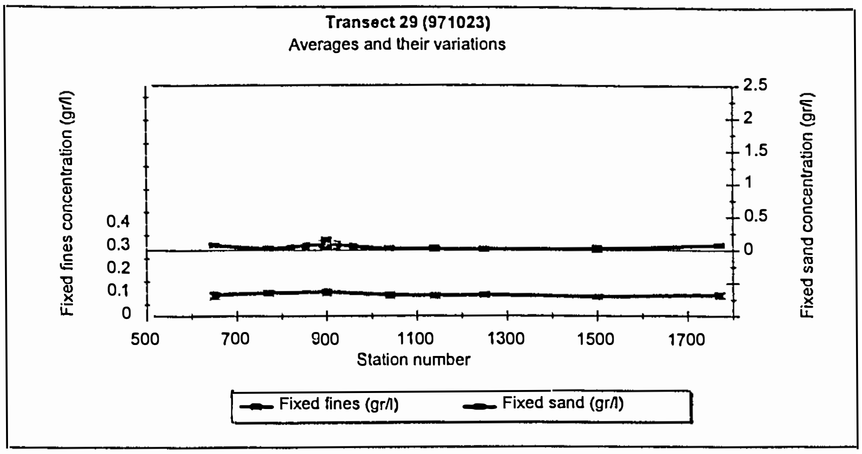


Transect 28



Averaged Fixed Concentrations : Transects

Transect 29

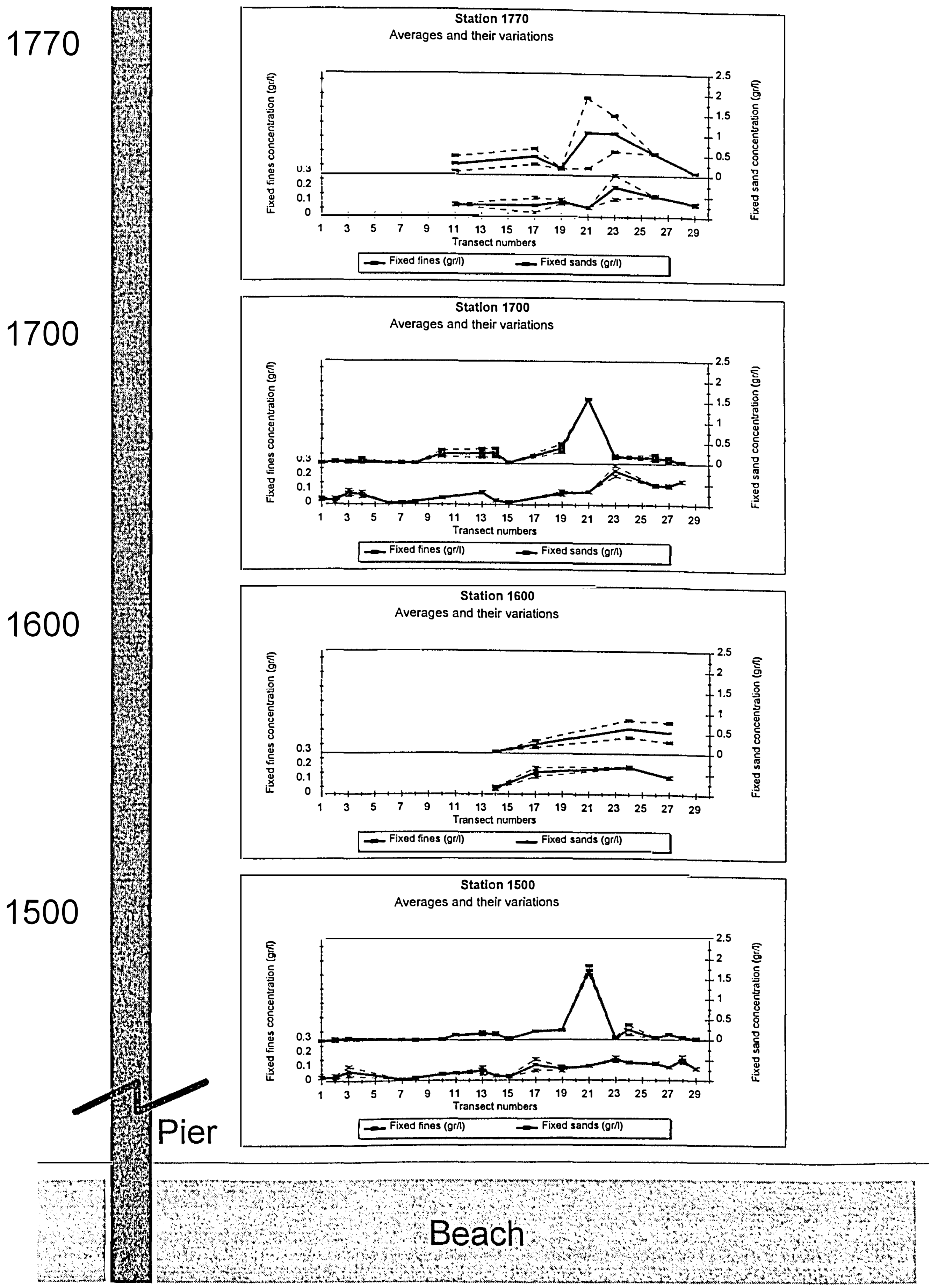


Section 3

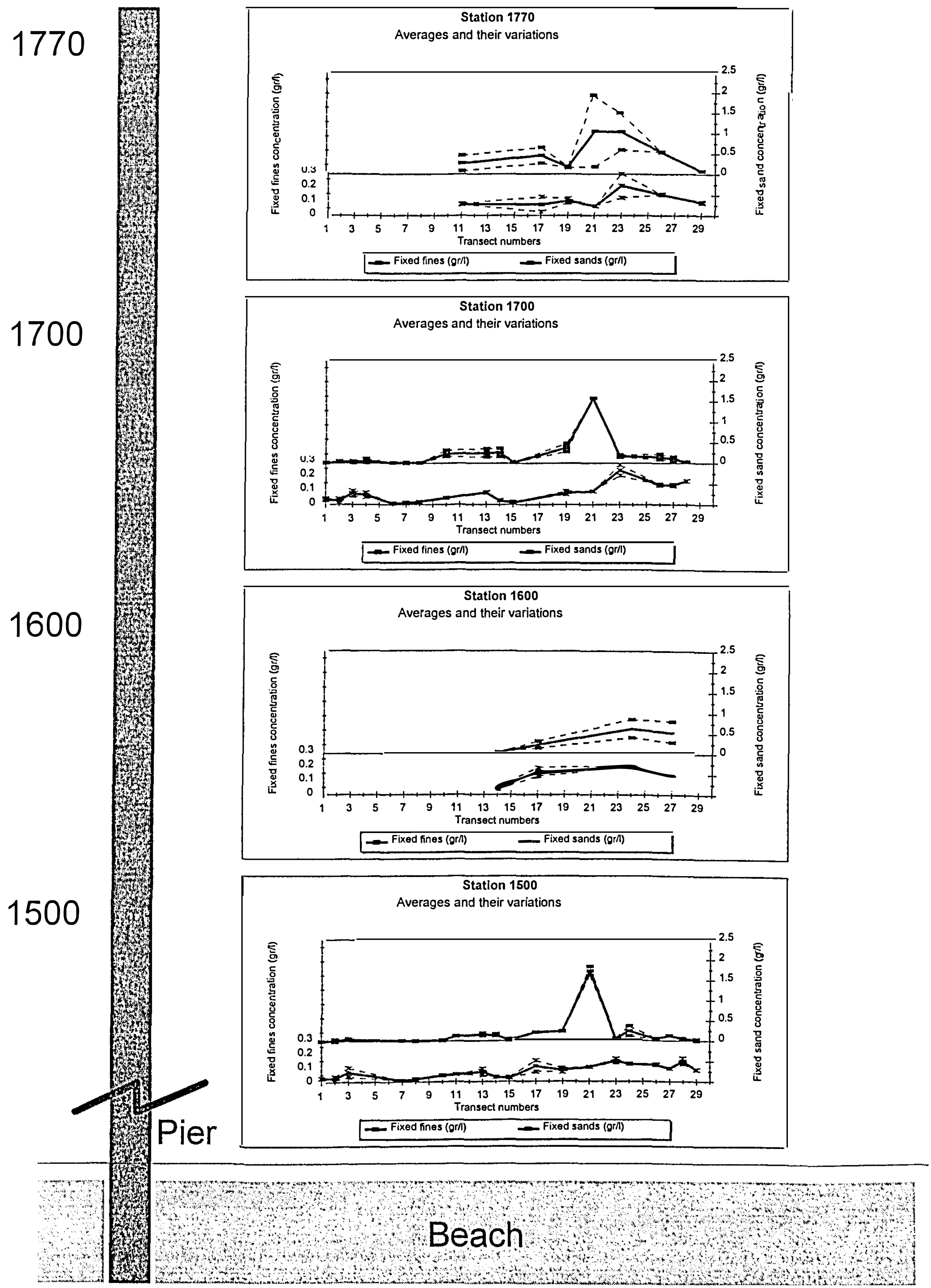
Fixed Fines/Sand
Graphs
by Station

October 1997

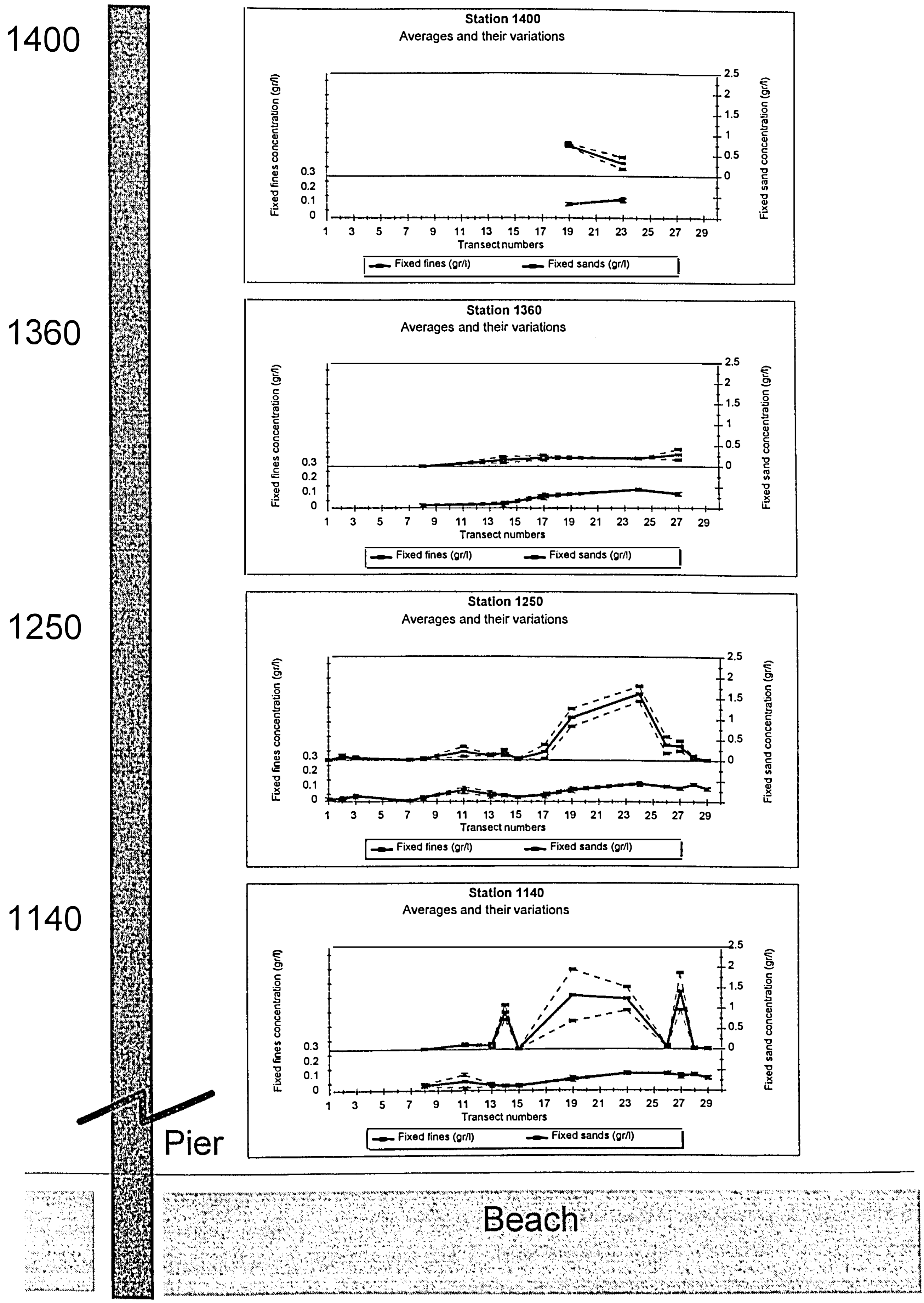
Averaged Fixed Concentrations : Stations



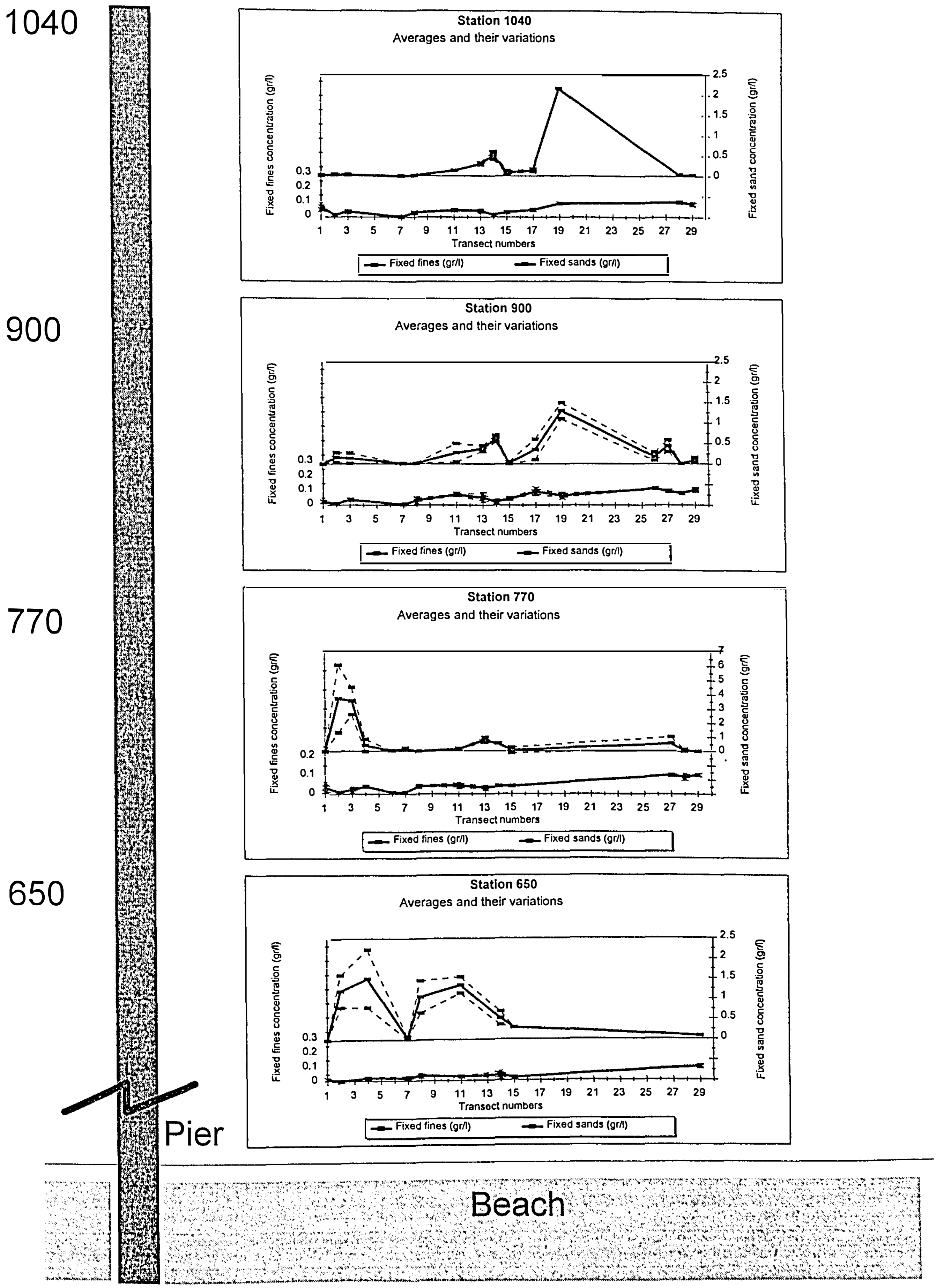
Averaged Fixed Concentrations : Stations



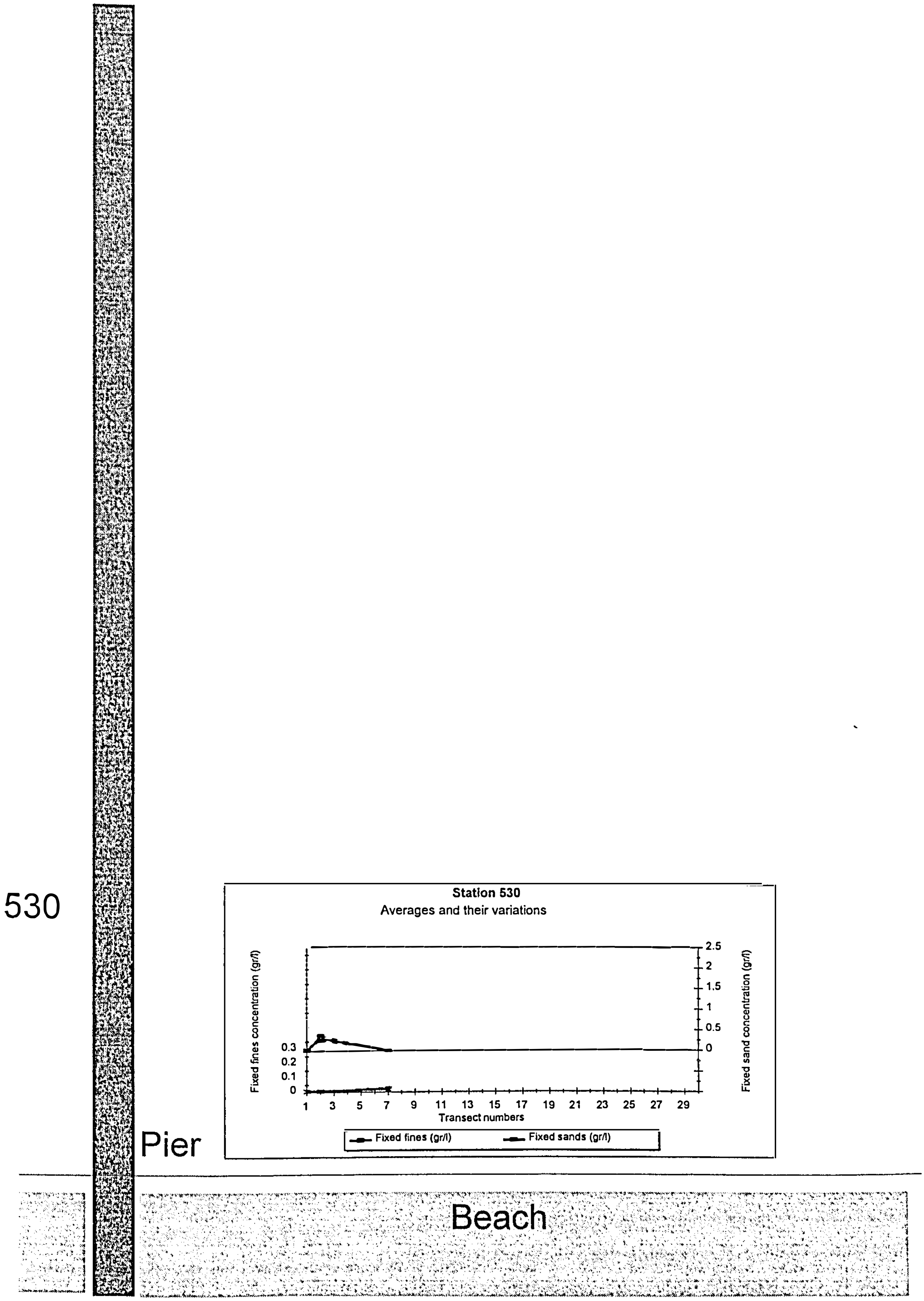
Averaged Fixed Concentrations : Stations



Averaged Fixed Concentrations : Stations



Averaged Fixed Concentrations : Stations



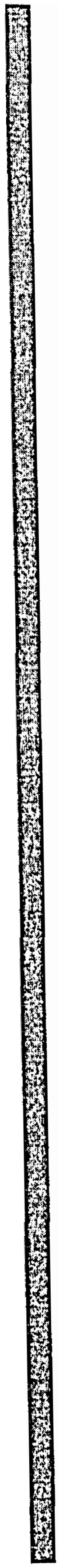
Section 4

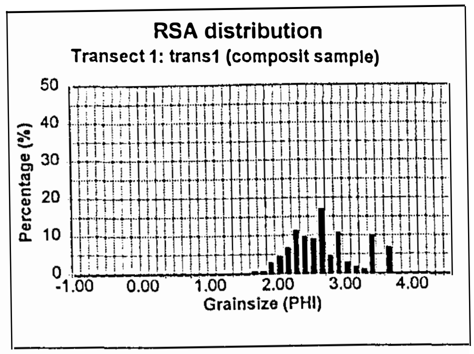
Rapid Sand Analysis Histograms by Transect

October 1997

Sand distribution: transect 1

Composite :
Station 1700
Station 1500
Station 1250
Station 1040
Station 900
Station 770
Station 650
Station 530





Sand distribution: transect 2

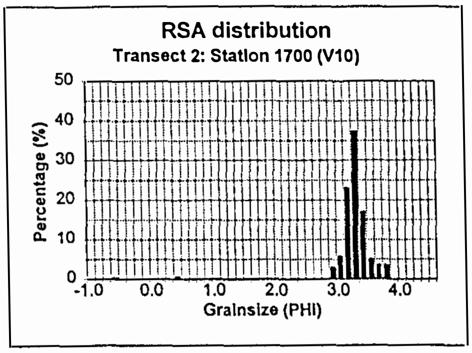
Station 1700

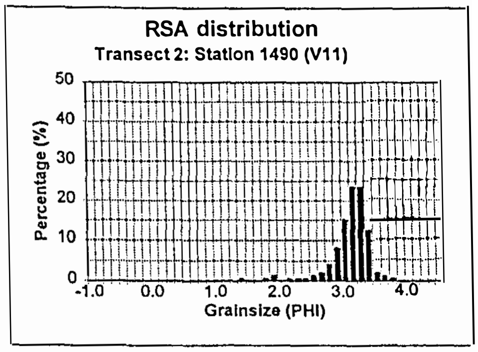
Station 1490

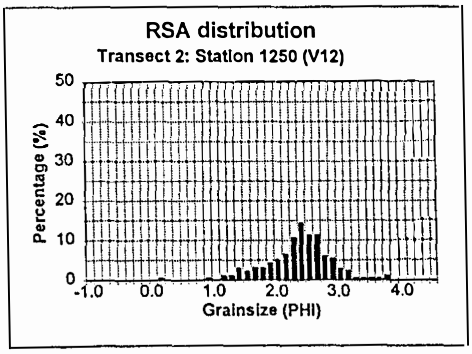
Station 1250

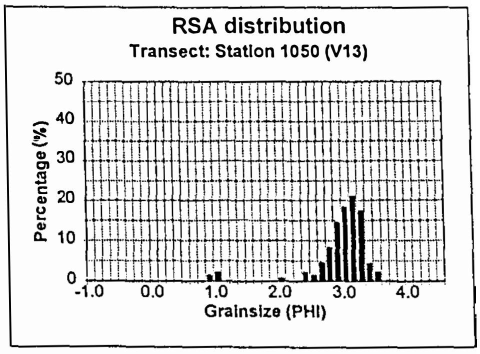
Station 1050

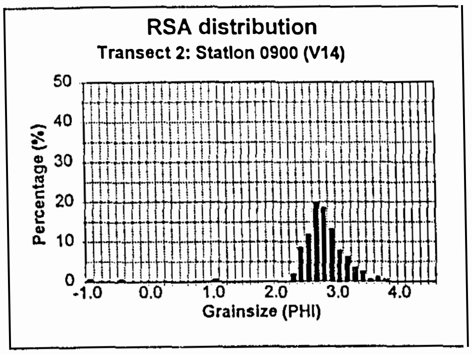
Station 900





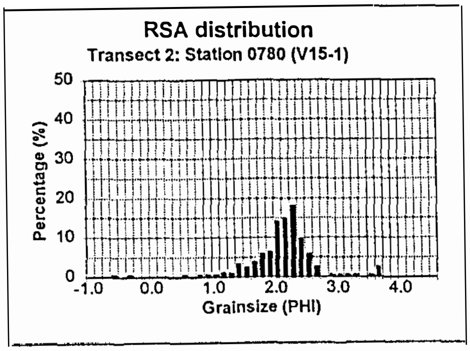


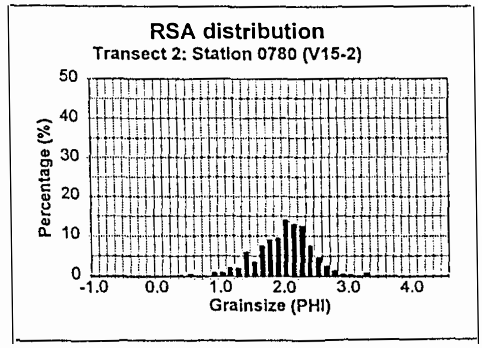


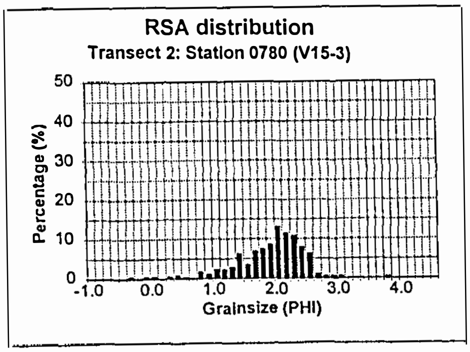


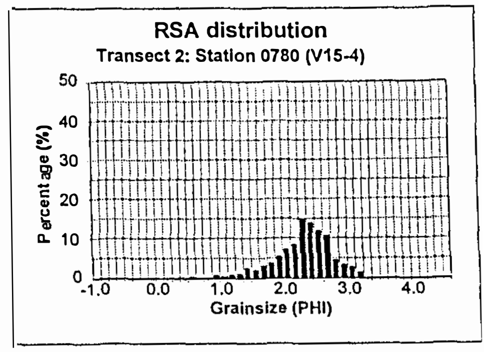
Sand distribution: transect 2

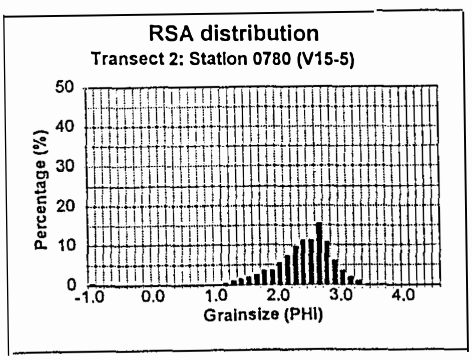
Station 780

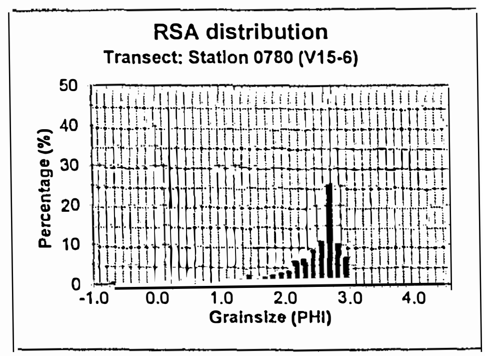


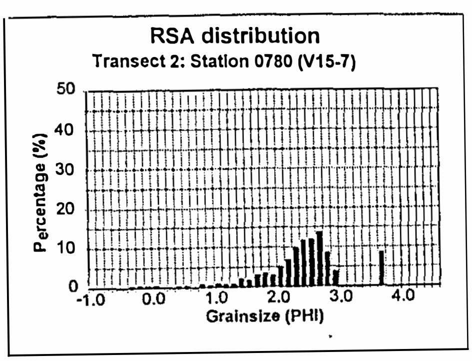






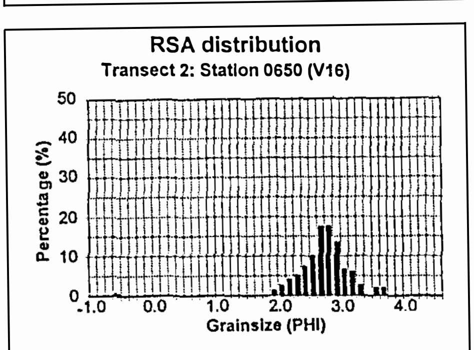


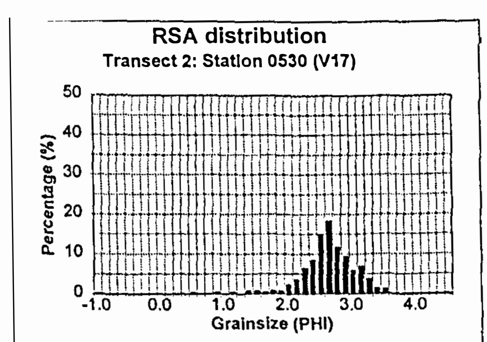




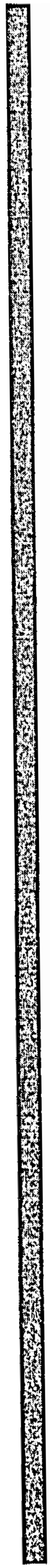
Station 650

Station 530

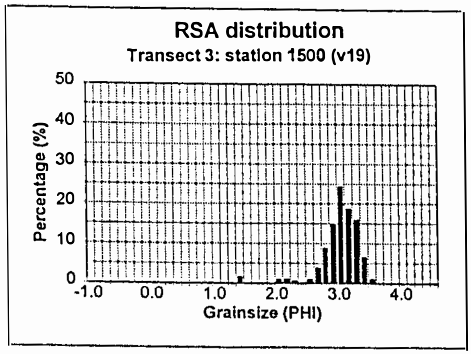




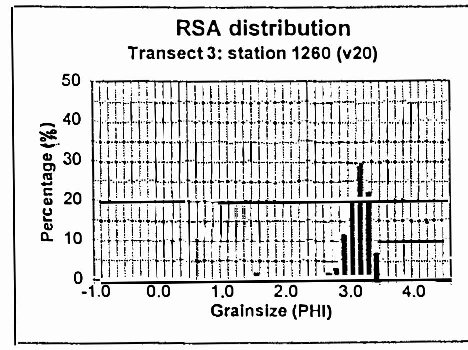
Sand distribution: transect 3



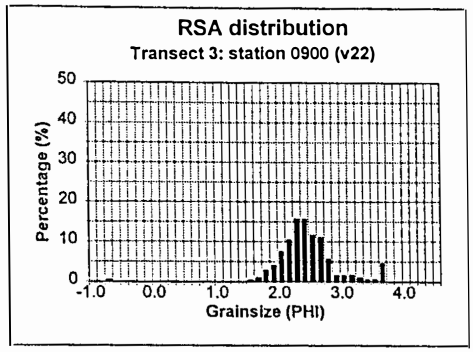
Station 1500



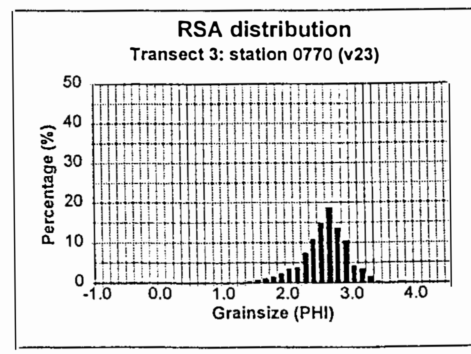
Station 1260



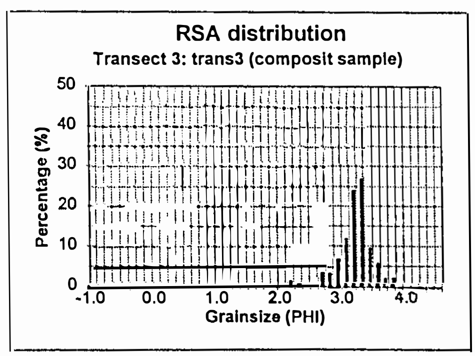
Station 900



Station 770



Composite :
Station 1700
Station 1040

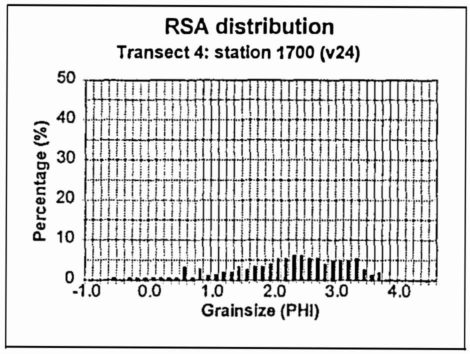


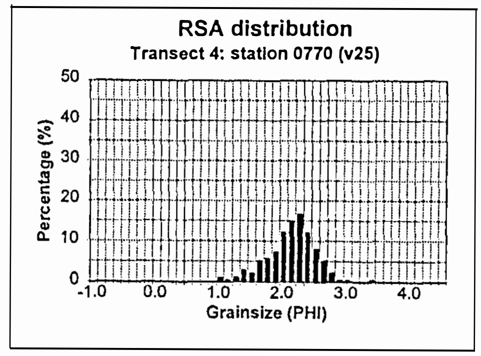
Sand distribution: transect 4

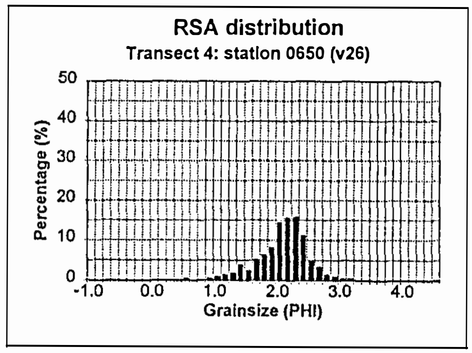
Station 1700

Station 770

Station 650

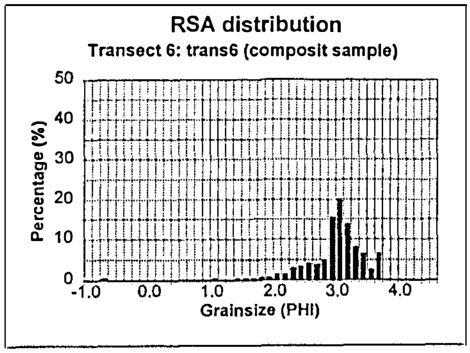




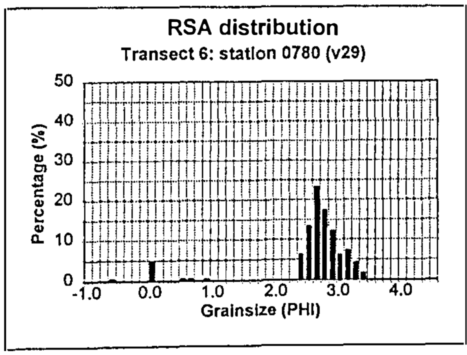


Sand distribution: transect 6

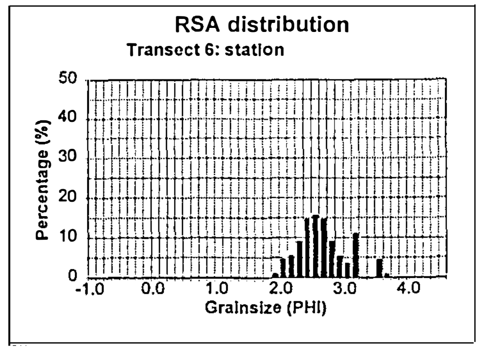
Composite :
Station 1700a
Station 1700b



Station 780a

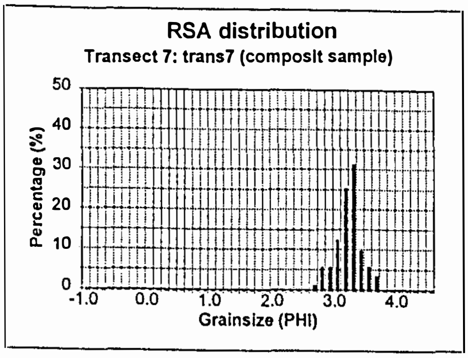


Station 780b

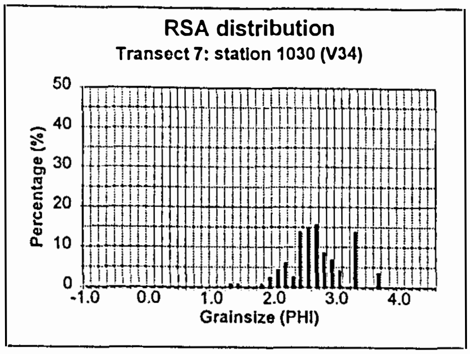


Sand distribution: transect 7

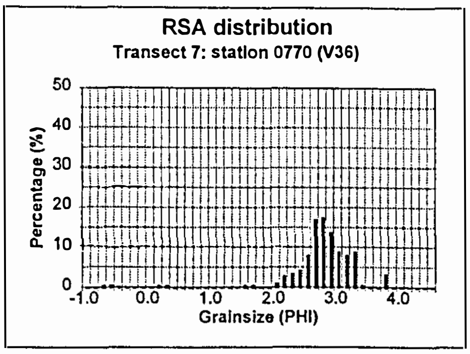
Composite :
Station 1690
Station 1500
Station 1240
Station 900
Station 540



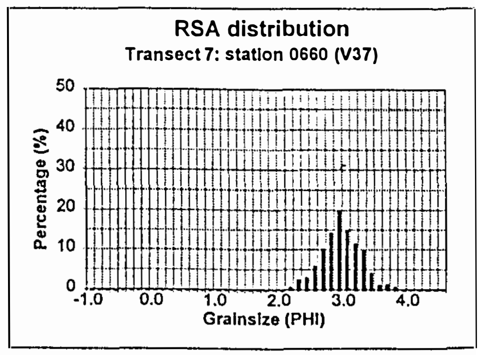
Station 1040



Station 770

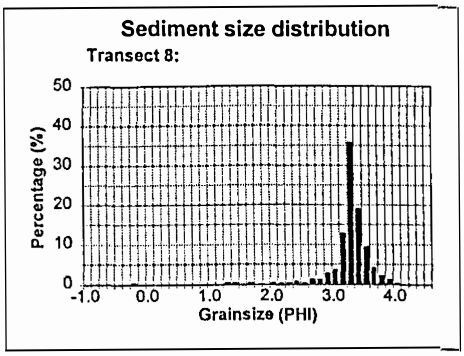


Station 660



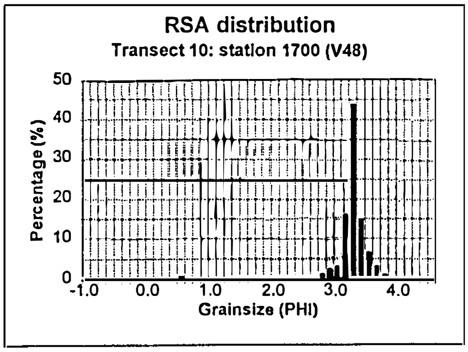
Sand distribution: transect 8

Composite :
Station 1700
Station 1500
Station 1360
Station 1260
Station 1400
Station 1030
Station 900
Station 770
Station 650

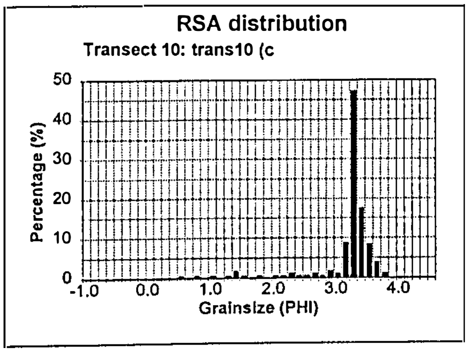


Sand distribution: transect 10

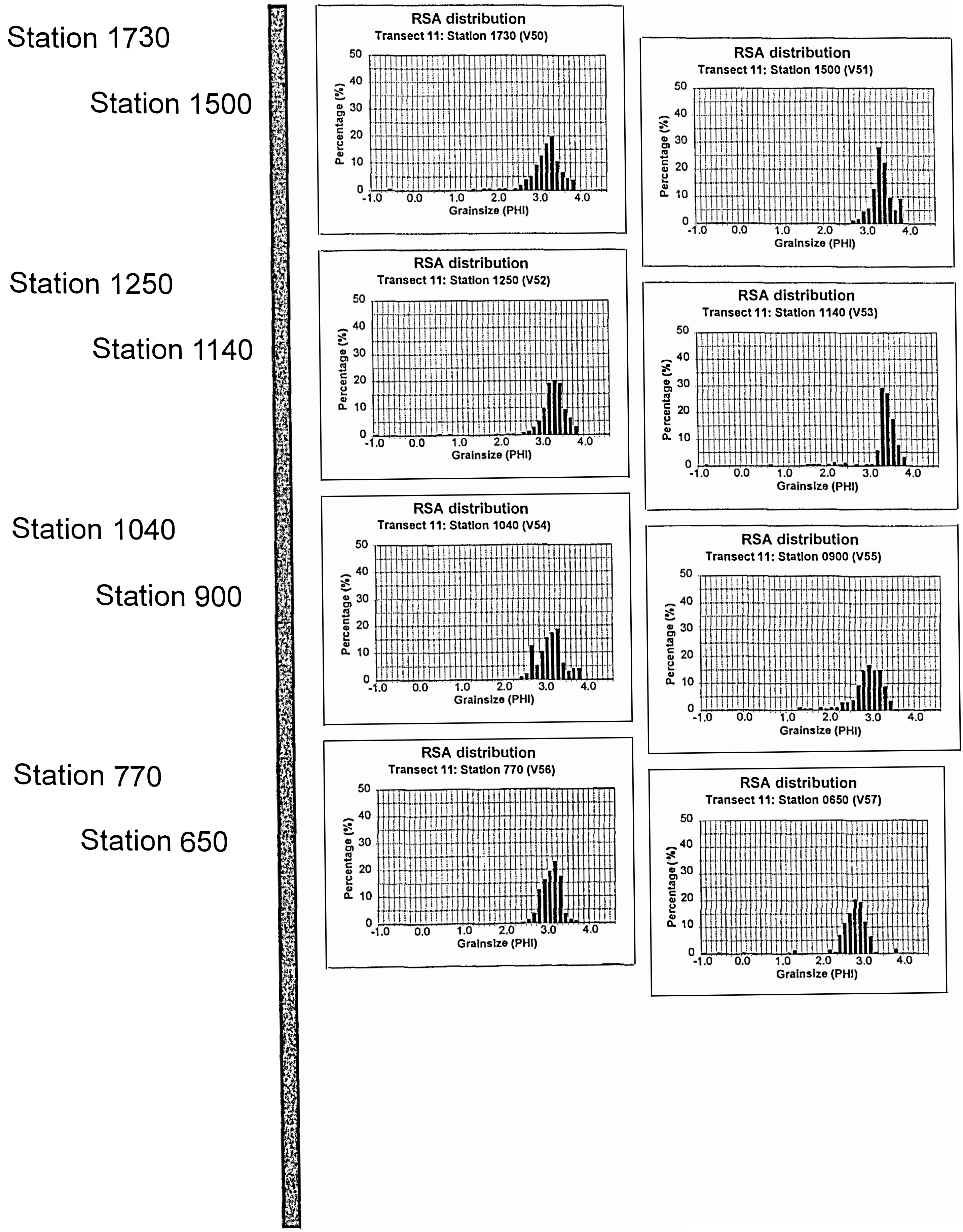
Station 1700



Composite :
Station 1700
Station 1530



Sand distribution: transect 11



Sand distribution: transect 13

Station 1700

Station 1500

Station 1280 - 1

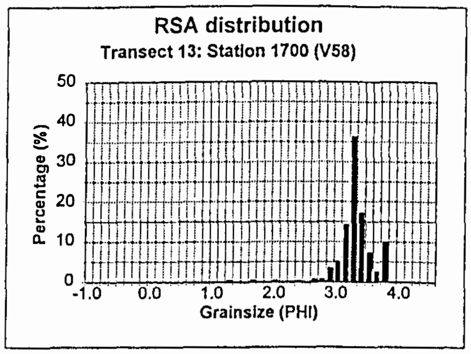
Station 1280 - 2

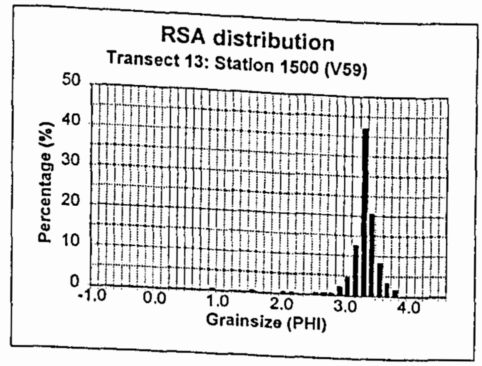
Station 1140

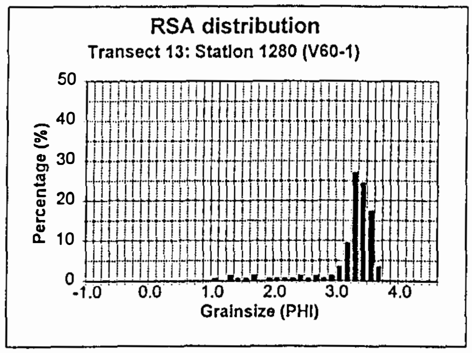
Station 1030

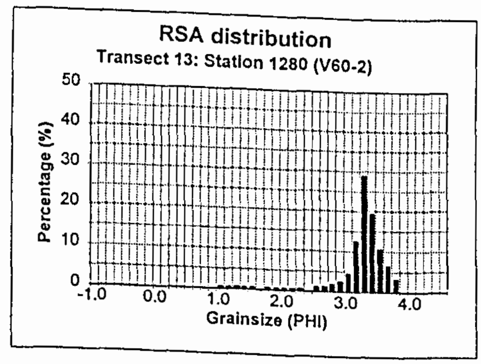
Station 900

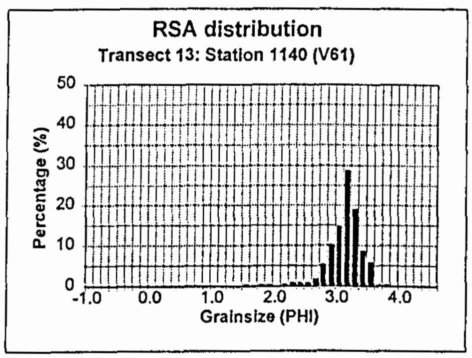
Station 780

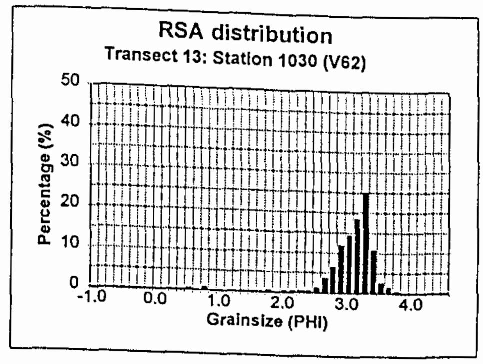


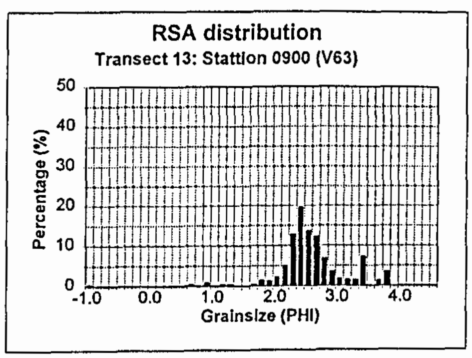


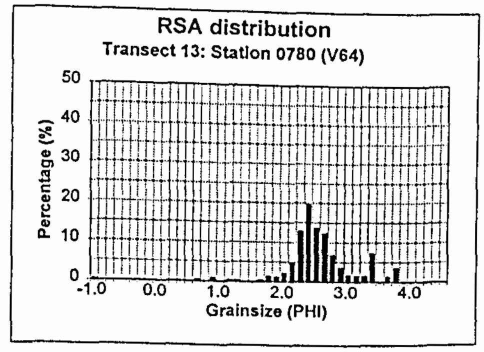




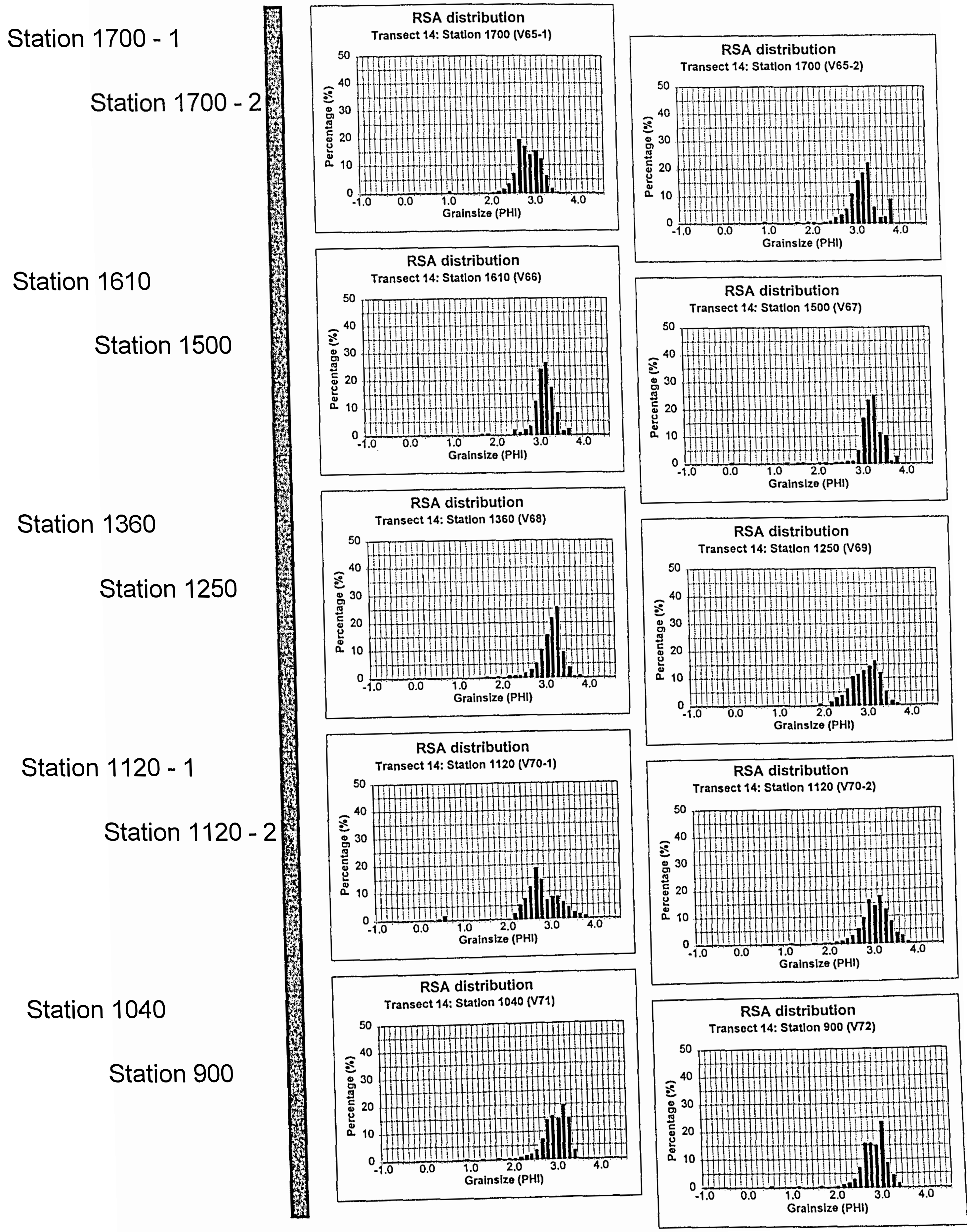








Sand distribution: transect 14

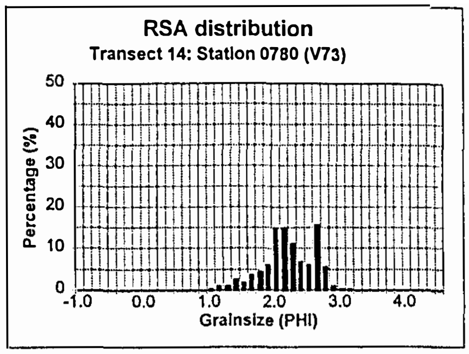


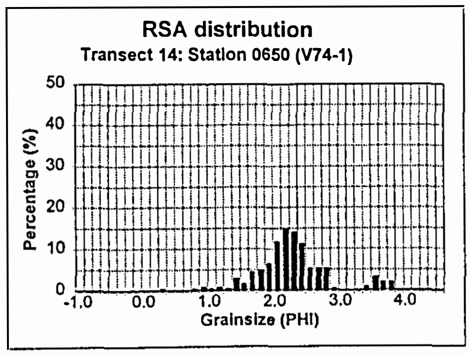
Sand distribution: transect 14

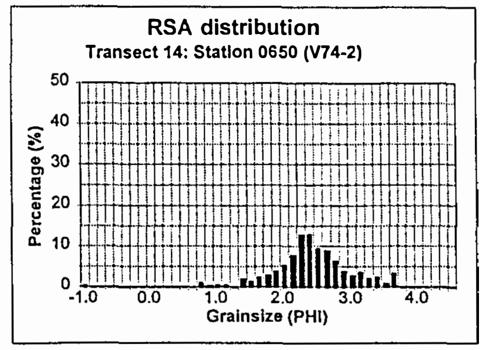
Station 780

Station 650 - 1

Station 650 - 2







Sand distribution: transect 15

Composite :
Station 1700
Station 1140

Station 1500

Station 1260

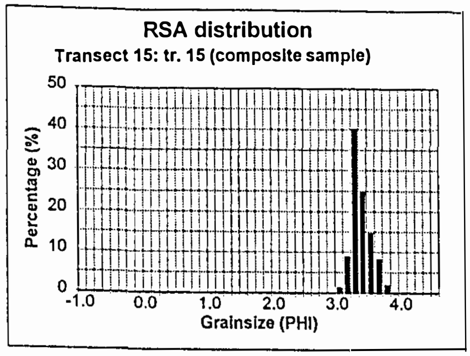
Station 1050

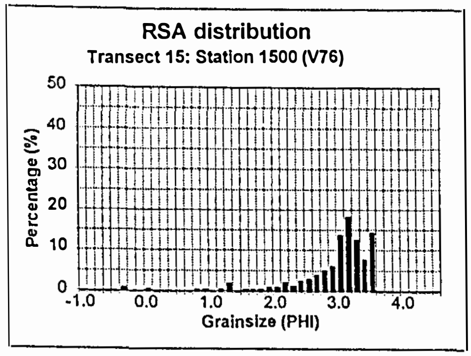
Station 890 - 1

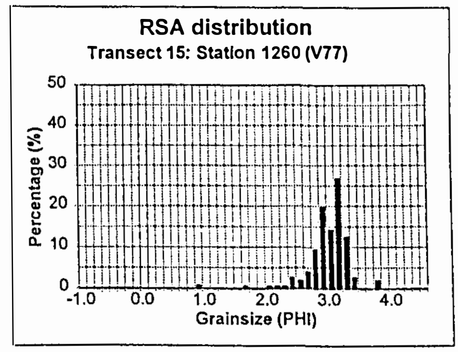
Station 890 - 2

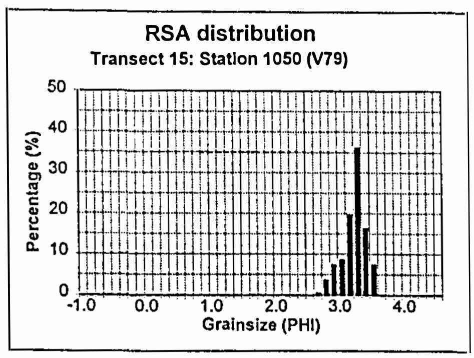
Station 770

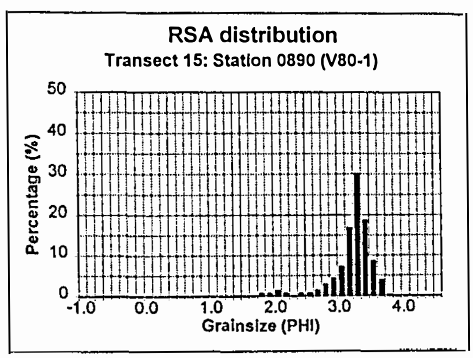
Station 650

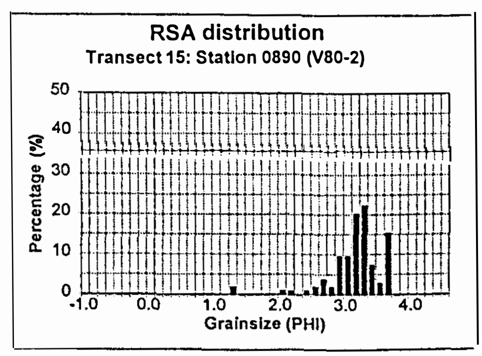


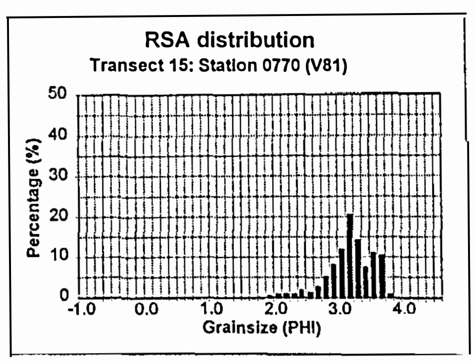


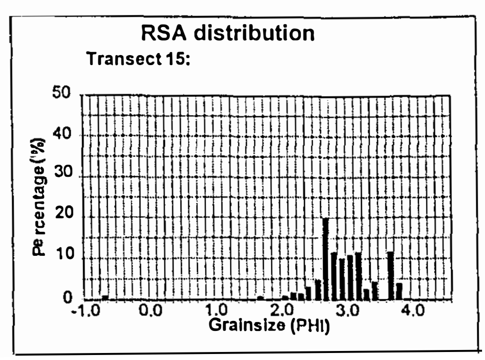












Sand distribution: transect 17

Station 1730

Station 1610

Station 1490 - 1

Station 1490 - 2

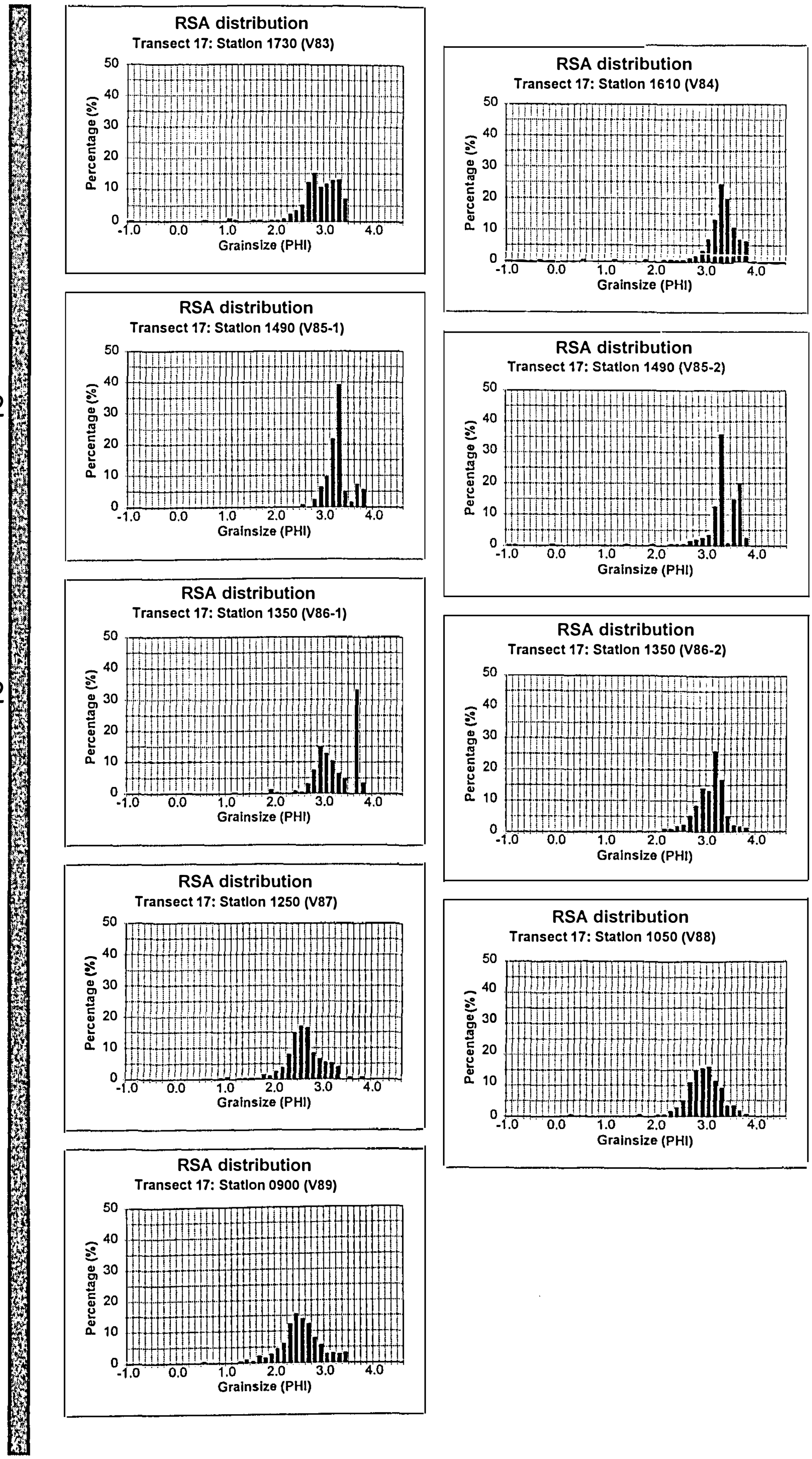
Station 1350 - 1

Station 1350 - 2

Station 1250

Station 1050

Station 900



Sand distribution: transect 19

Station 1770 - 1

Station 1770 - 2

Station 1700

Station 1540

Station 1400 - 1

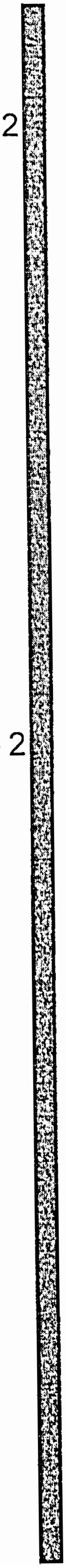
Station 1400 - 2

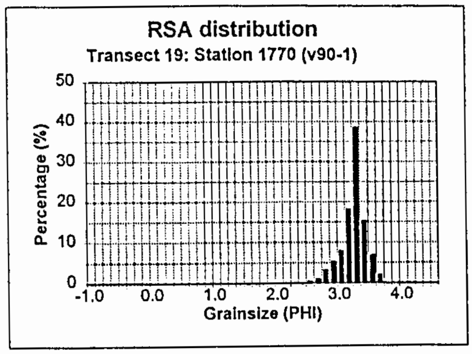
Station 1260

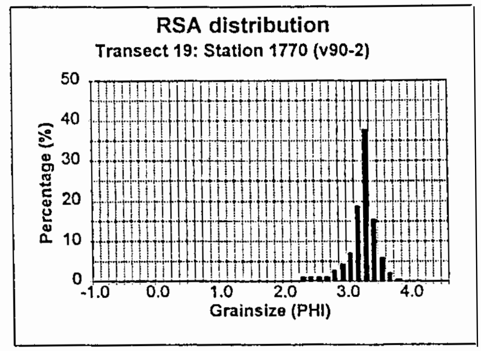
Station 1140

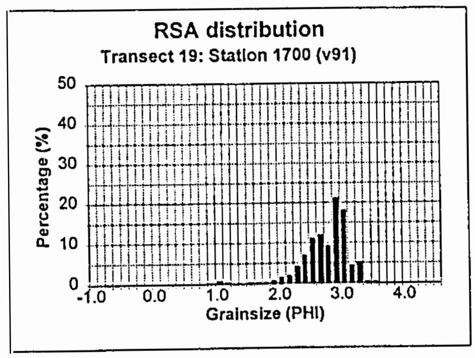
Station 1060

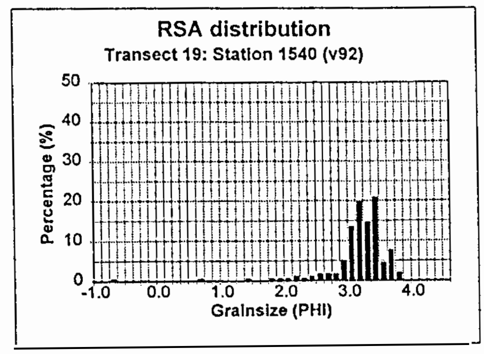
Station 900

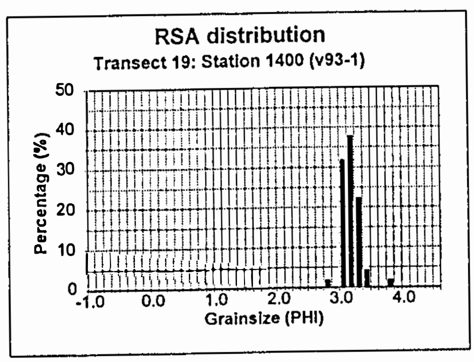


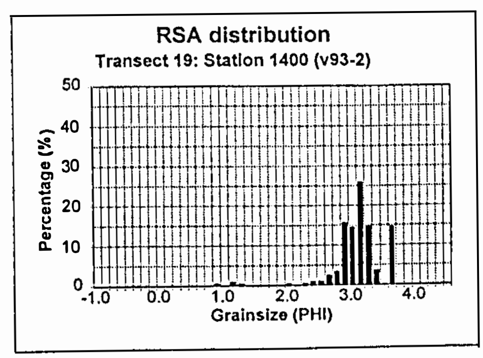


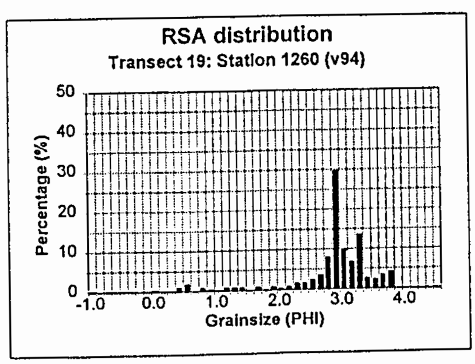


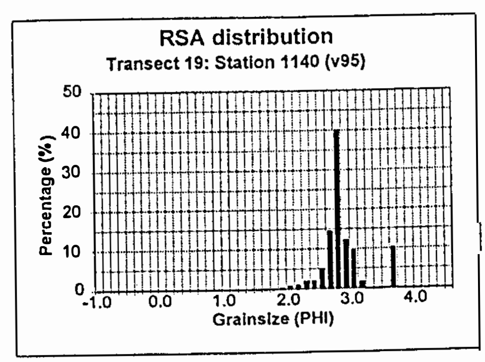


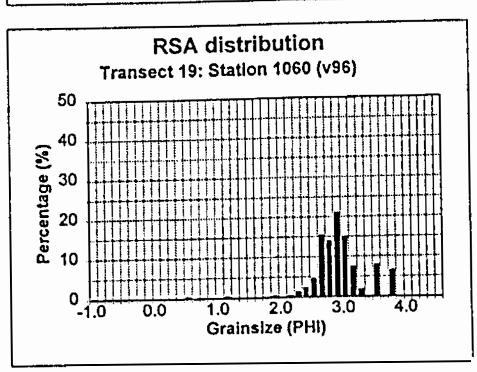


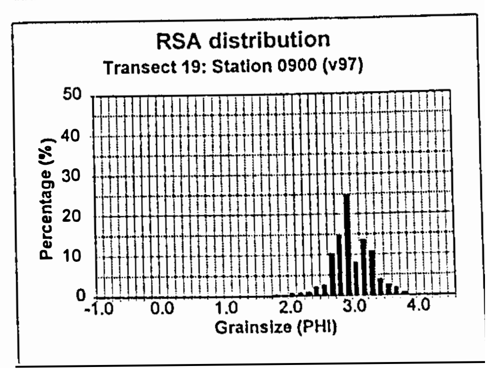












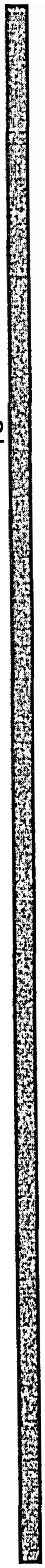
Sand distribution: transect 21

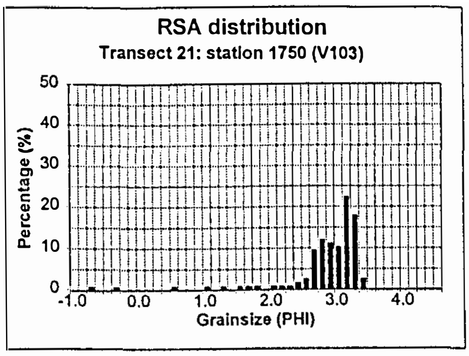
Station 1750

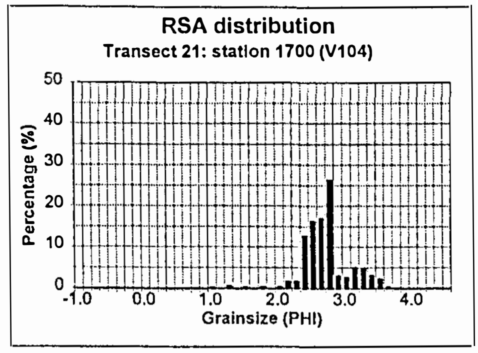
Station 1700

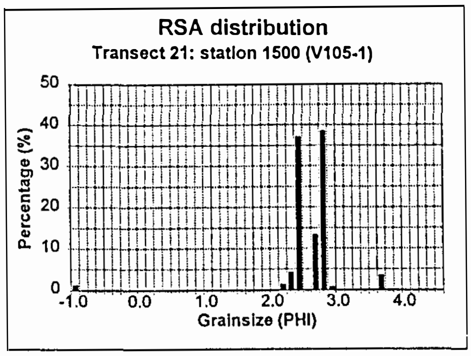
Station 1500 - 1

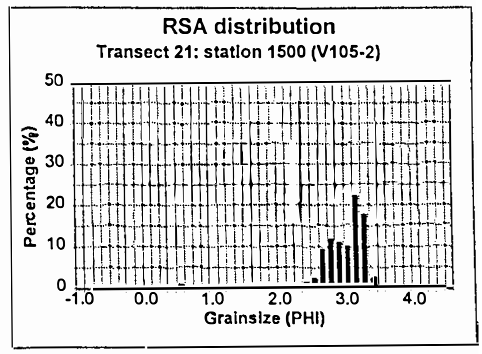
Station 1500 - 2











Sand distribution: transect 23

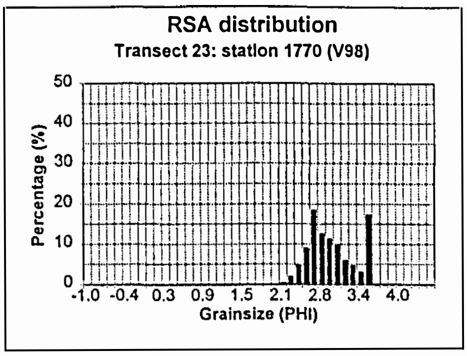
Station 1770

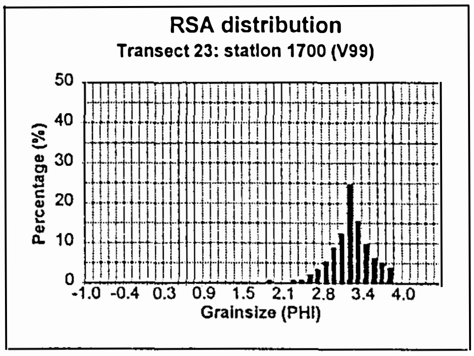
Station 1700

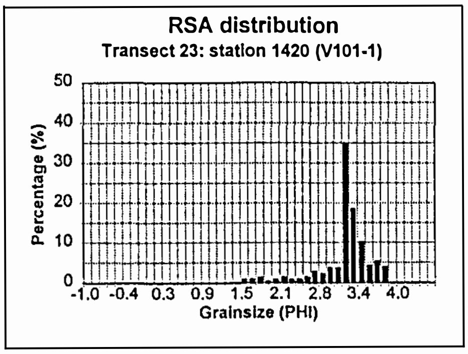
Station 1420 - 1

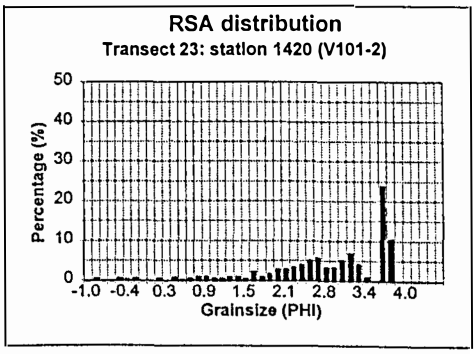
Station 1420 - 2

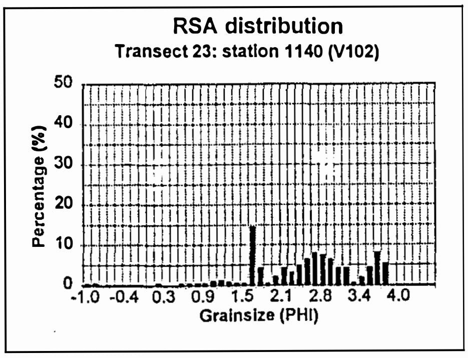
Station 1140











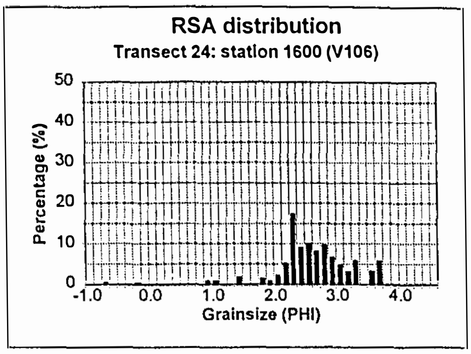
Sand distribution: transect 24

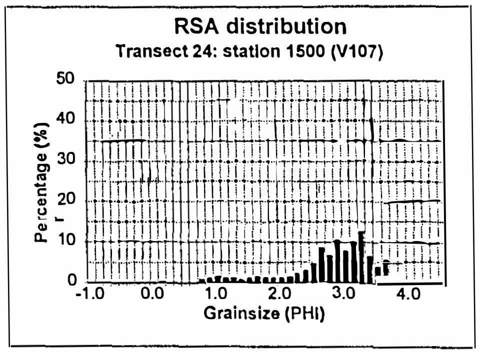
Station 1600

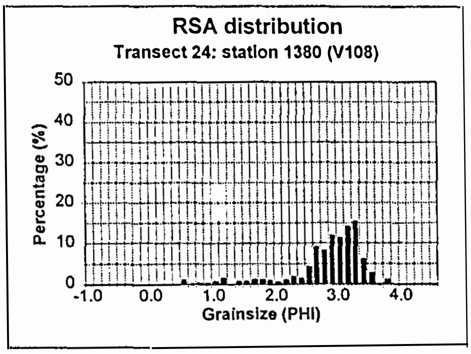
Station 1500

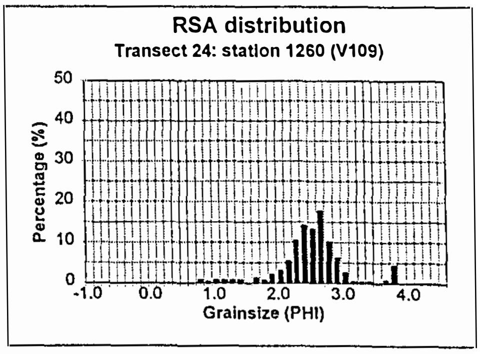
Station 1380

Station 1260









Sand distribution: transect 26

Station 1760 - 1

Station 1760 - 2

Station 1700

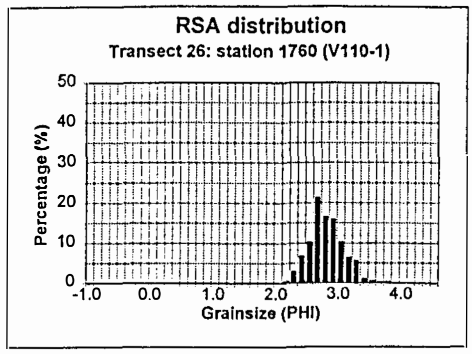
Station 1520

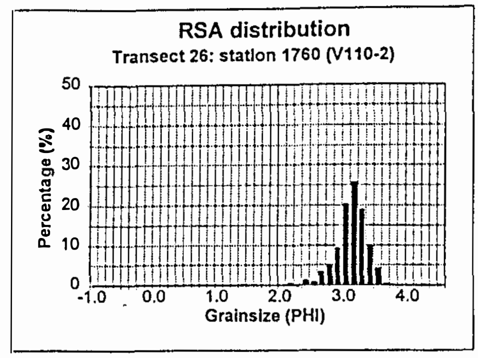
Station 1280

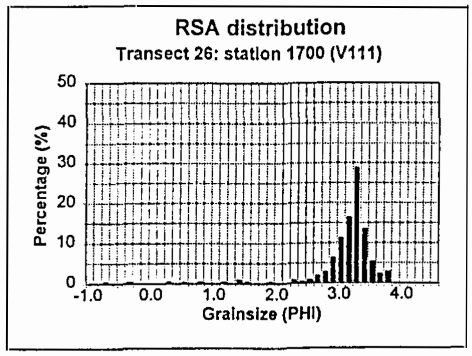
Station 1140

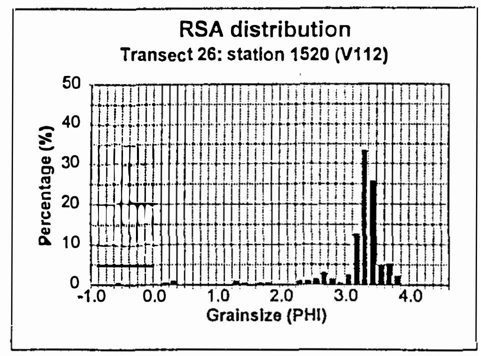
Station 930 - 1

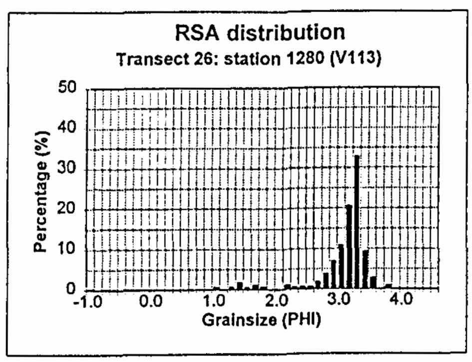
Station 930 - 2

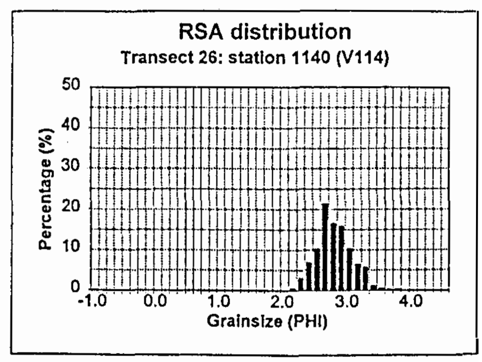


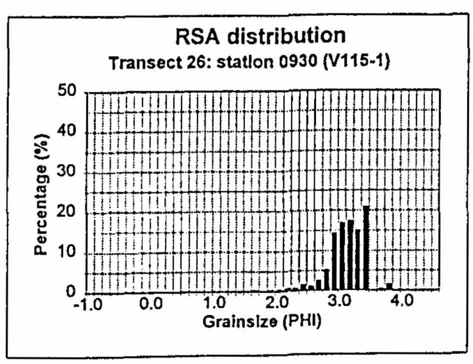


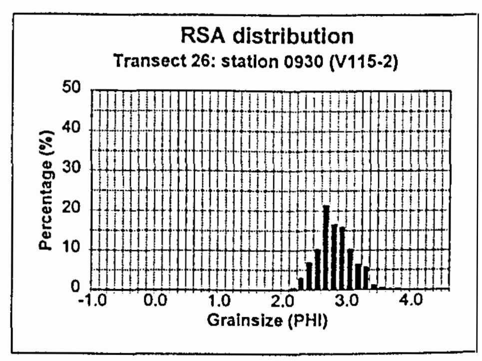




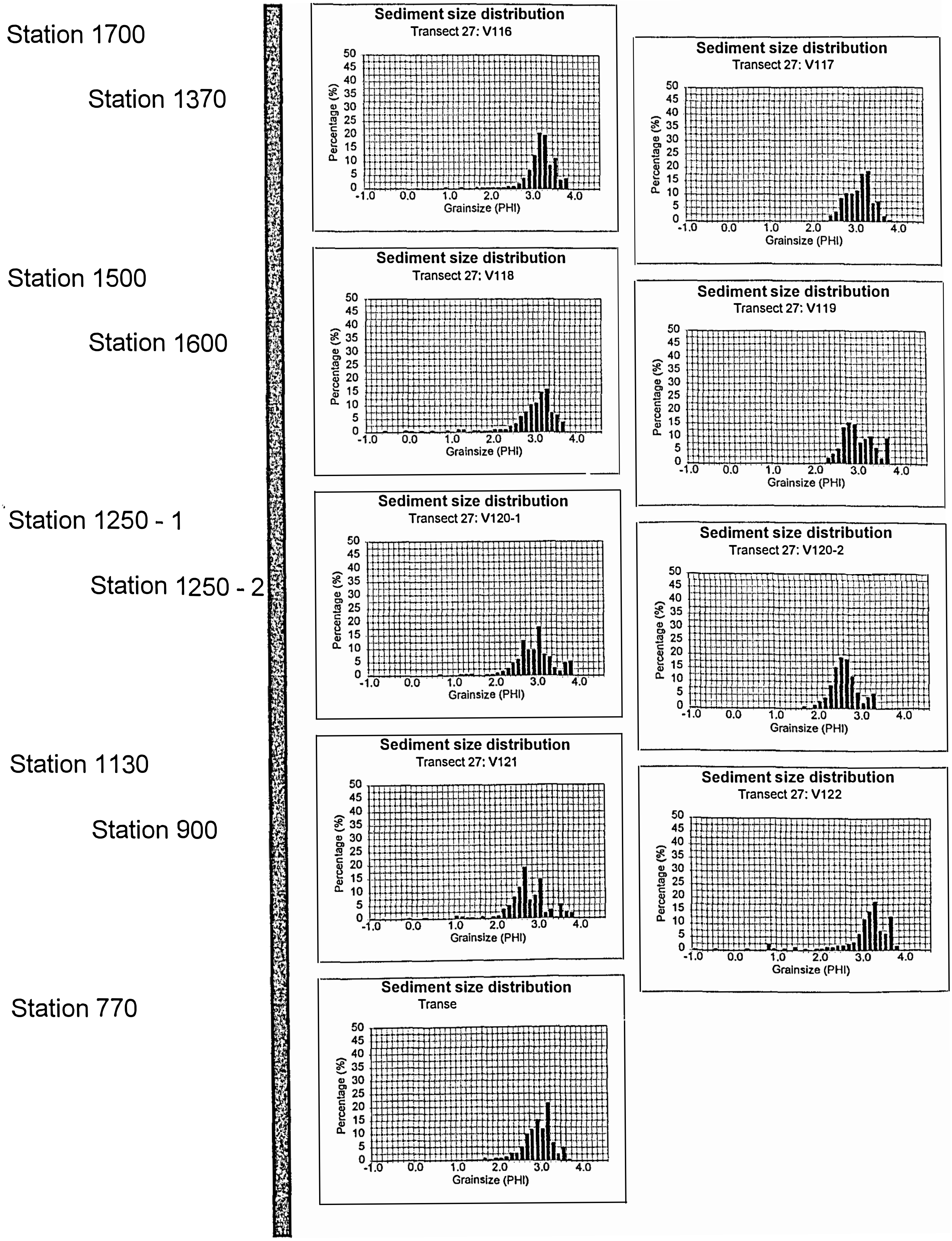






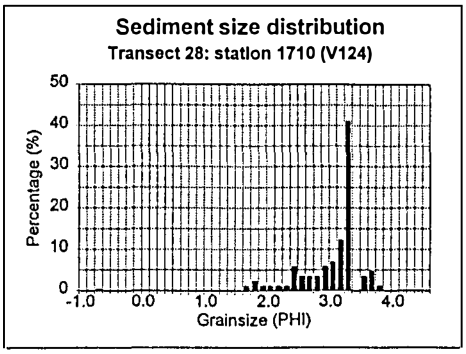


Sand distribution: transect 27

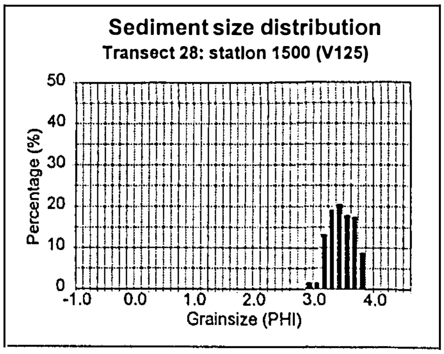


Sand distribution: transect 28

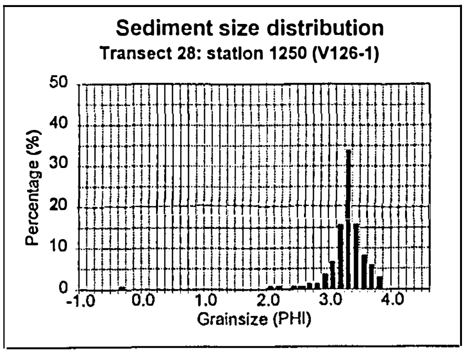
Station 1710



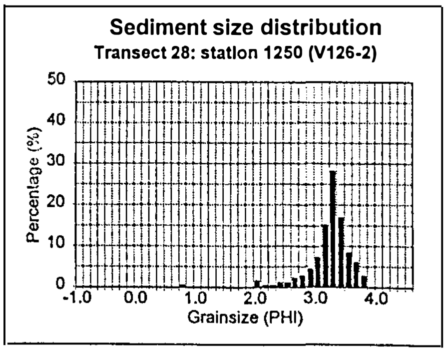
Station 1500



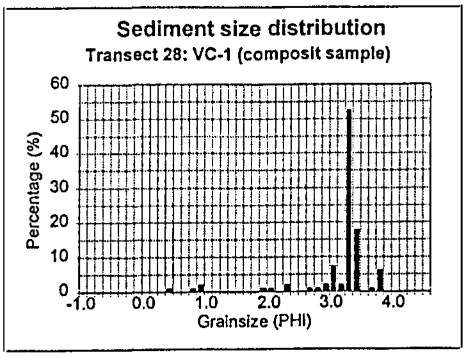
Station 1250 - 1



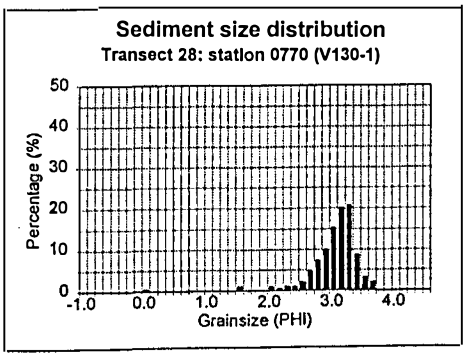
Station 1250 - 2



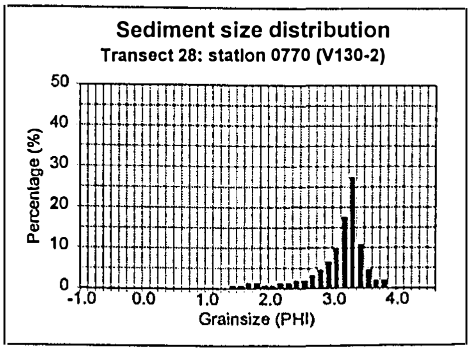
Composite :
Station 1140
Station 1050
Station 900



Station 770 - 1

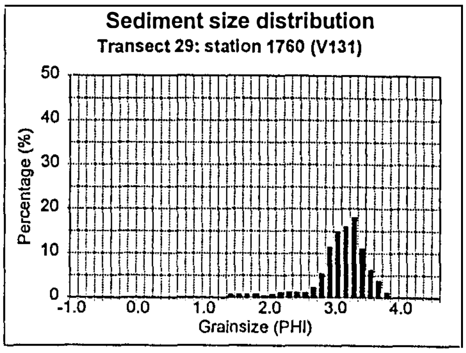


Station 770 - 2

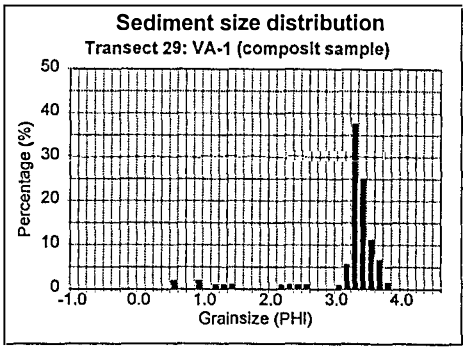


Sand distribution: transect 29

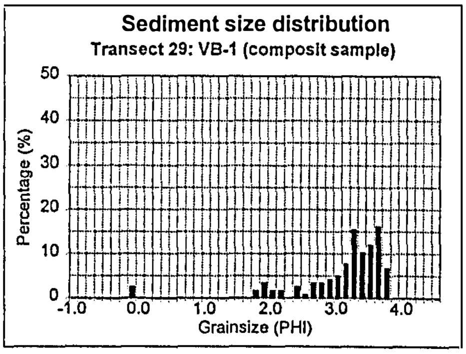
Station 1760



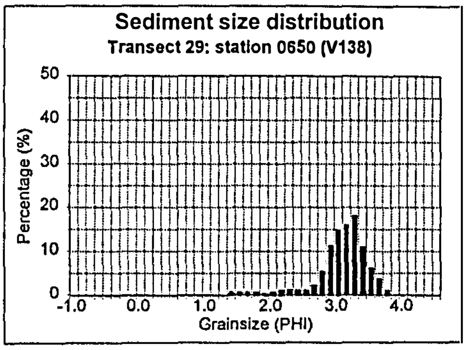
Composite :
Station 1130
Station 1050



Composite :
Station 900
Station 770
Station 650



Station 650



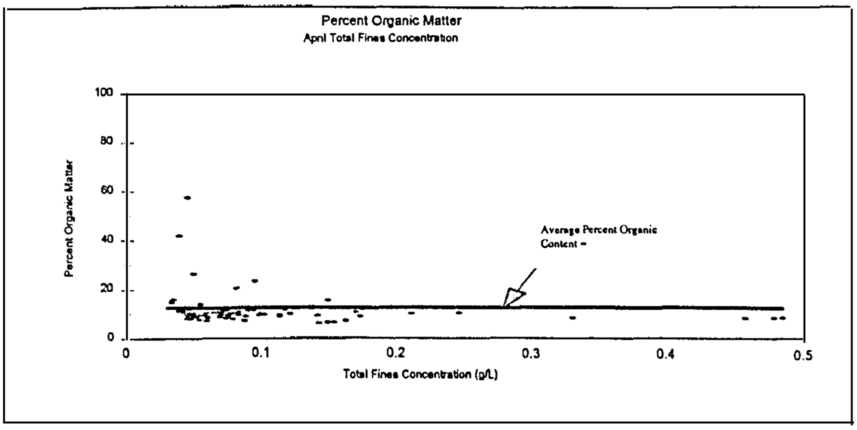
Section 5

Percent Organic Content Graphs

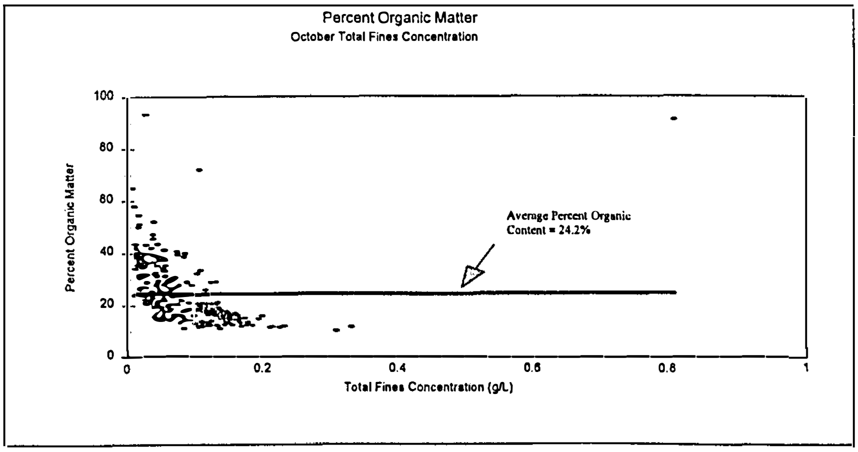
April 1997
&
October 1997

Percent Organic Content

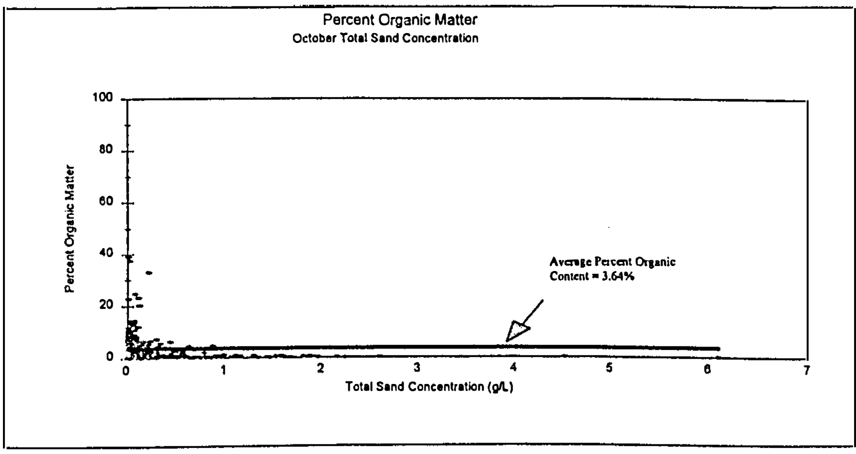
April
Fines



October
Fines



October
Sand



Section 6

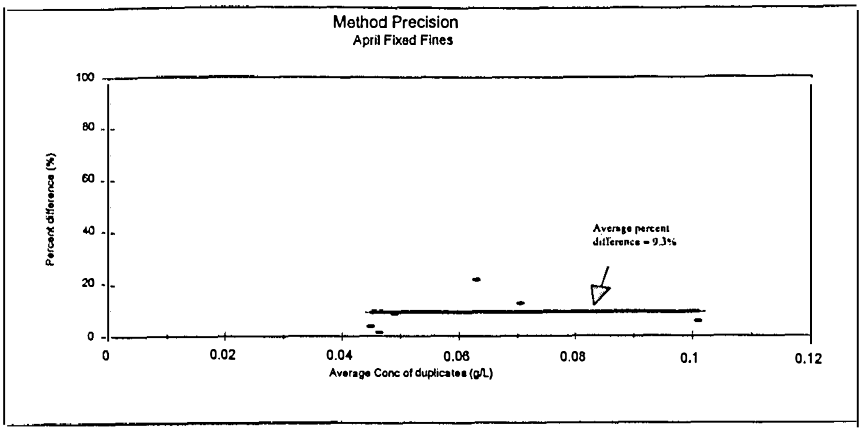
Quality Control
&
Methodology check
Graphs

April 1997
&
October 1997

Method Precision And Methology check

Precision

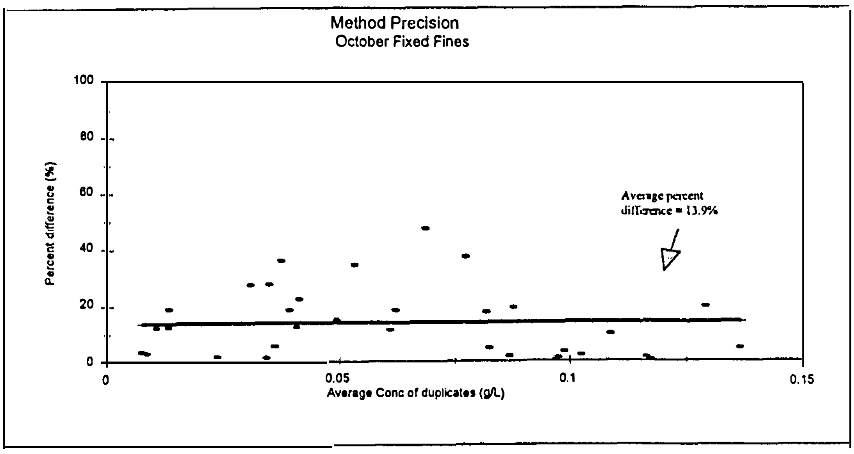
April
Fines



Method Precision
April Fixed Fines

Precision

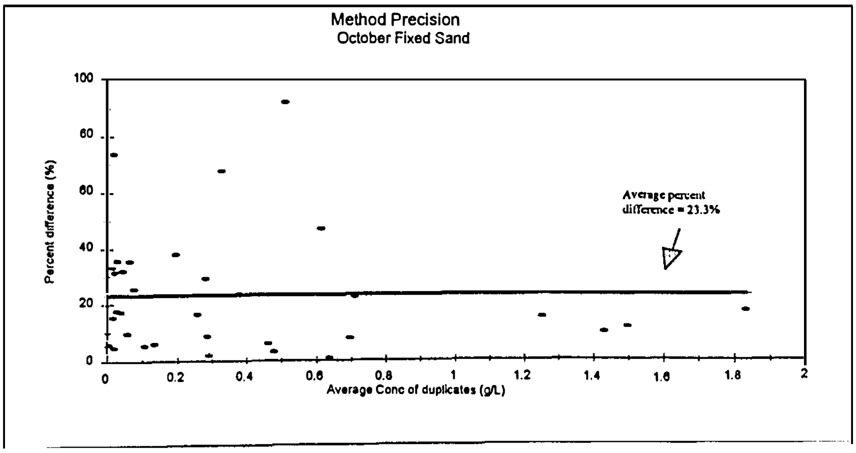
October
Fines



Method Precision
October Fixed Fines

Precision

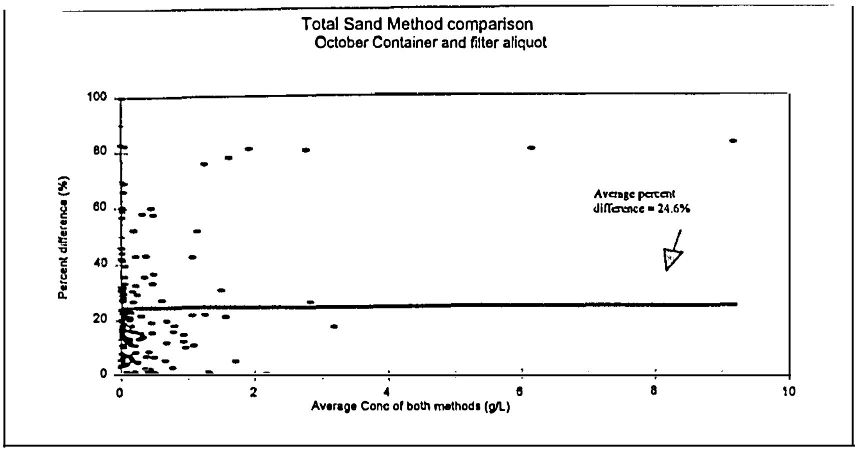
October
Sand



Method Precision
October Fixed Sand

Method
Comparison

October
Sand



Total Sand Method comparison
October Container and filter aliquot