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U.S. GEOLOGICAL SURVEY CIRCULAR 915

The Georges Bank Monitoring Program 1983: Analysis of Trace Metals In Bottom Sediments

Prepared in cooperation with the U.S. Minerals Management Service under Interagency Agreement AA851–IA2–18

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CONTENTS

ILLUSTRATIONS

TABLES

The Georges Bank Monitoring Program 1983: Analysis of Trace Metals in Bottom Sediments

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ABSTRACT

From July 1981, when drilling began on Georges Bank, to May 1982, the concentration of barium, a major element in drilling mud, has increased by a factor of 3.5 in bulk sediments 200 m from the drill site in block 410 and by a factor of 2.3 at the drill site in block 312. The postdrilling barium concentrations are within the range of predrilling concentrations measured at other locations on Georges Bank. We estimate that no more than 21 percent of the barite (principal barium-bearing mineral) discharged during drilling remains within 6 km of the drill site in block 312. No drilling-related changes in the concentration of chromium or other metals have been observed in bulk sediments from blocks 410 or 312.

The chemical signal of drilling mud in surficial sediments has been enhanced by separating and analyzing the sediment fraction finer than 60 μm. Barium concentrations in the fine fraction have increased by factors of 36 and 22 at the drill sites in blocks 410 and 312, respectively. At the drill site in block 410, aluminum, chromium, copper, and mercury concentrations in this fraction temporarily increased by approximately a factor of 2 and then decreased to background.

The concentrations of aluminum, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, organic carbon, vanadium, and zinc in surface sediments of Georges Bank both before and after drilling are low compared to concentrations in average crustal rocks and are characteristic of unpolluted, coarse-grained sediments as found in other Continental Shelf areas.

INTRODUCTION

The primary objectives of this study were to establish the levels of trace metals in sediments prior to drilling on Georges Bank and to quantify the magnitude of changes that are related to petroleum exploration activities. Some of the specific questions addressed are (1) Where do discharge drilling muds accumulate on Georges Bank? and (2) How much do trace metals increase as a result of accumulating drilling mud? This effort supports the main thrust of the Georges Bank Monitoring Program; that is, to evaluate adverse effects of drilling effluents on bottom-dwelling organisms. Complementary studies within the Georges Bank Monitoring Program include (1) the analysis of benthic infauna (Blake and others, 1983), (2) the analysis of hydrocarbons in bottom sediments and the analysis of hydrocarbons and trace metals in benthic fauna (Payne and others, 1982), and (3) the analysis of previous benthic infauna samples from Georges Bank (Michael and others, 1983). The concentrations of contaminants in commercially important species of fish and shellfish on Georges Bank have been determined in ongoing programs conducted by the National Oceanic and Atmospheric Administration (Cooper and Uzmann, 1981).

The data base for this report includes results generated during the first year of what is expected to be a 3-year program. On the first four seasonal cruises, samples were collected at 18 regional stations (fig. 1*A*) and 29 site-specific stations (fig. 1*B*). The regional stations were positioned to evaluate changes with time over different environments within the entire region; for example, stations 13 and 13A are thought to be areas of deposition for material winnowed from Georges Bank (Bothner and others, 1981b), as are stations 14 and 14A in the Gulf of Maine and stations 7 and 9 in the heads of the major submarine canyons. Station 15 is in an area of coarse sediment that is being eroded. Given the mean flow to the west on the southern flank of Georges Bank (Butman and others, 1982a), the stations in transect I (stations 1, 2, and 3) are considered to be upstream controls for stations

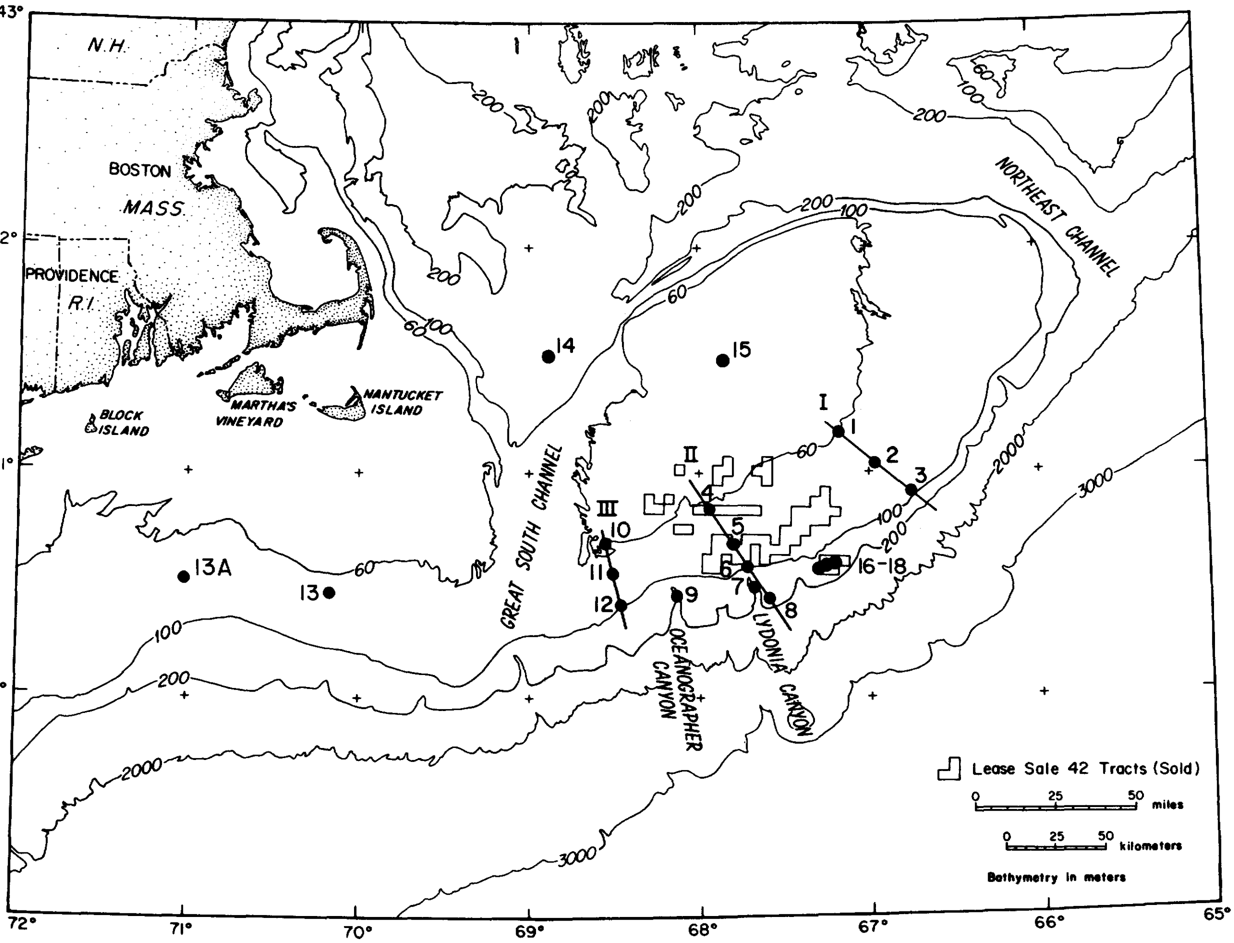

FIGURE 1A.—Regional array of sampling stations. Site-specific array in block 312 is centered at station 5.

among the major lease blocks (transect II) and for stations downstream of the lease blocks (transect III).

The site-specific survey, designed to monitor changes close to a rig, was centered around the platform operated by Mobil in block 312, where drilling took place between December 1981 and June 1982. A less detailed local survey was conducted with three stations (stations 16, 17, and 18) near Shell Oil Company's platform that operated in block 410 between July 1981 and March 1982.

The first cruise occurred just before drilling commenced in July 1981. Subsequent cruises were conducted in November 1981, February 1982, and May 1982. Cruises for the second year of the program, not discussed in this report, are on a similar schedule. The first eight exploratory wells were completed or nearly completed at the time of the fourth monitoring cruise in May 1982. Each of the exploratory wells was classified as a dry hole.

The analysis of trace-metal data completed so far and discussed in this report identifies the general trends that exist both in time and space since exploratory drilling began on Georges Bank. The data have been entered into a computer data base for retrieval and also have been listed onto magnetic tape. Navigation data accompany the chemical data for each sample on tape and are compiled in appendix tables 1A and 1B.

The field numbers (for example, M1–13–G and M2–5–28–BL) identifying samples in each data table have the following code. The first two characters indicate the cruise number; M1 stands for monitoring cruise 1. The station number appears between the first dash and the alpha character(s) at the end. In the examples given, 13 is a station in the regional sample array; station 5–28 is one of the site-specific stations around regional station 5 (see figure 1B). A single alpha character at the end of the field number identifies one of three replicates taken at each station for trace-metal analysis. The notation BL at the end indicates a blended composite sample made up of equal weights from each of the three replicates. Field numbers ending

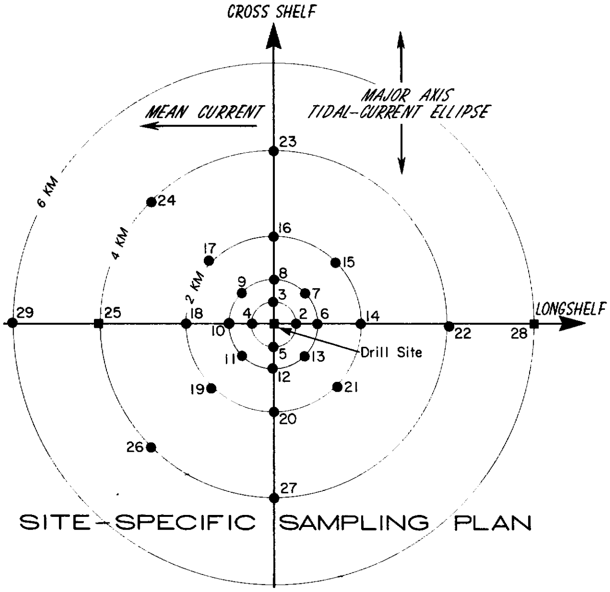

FIGURE 1*B*.—Site-specific sampling array around regional station 5. Stations 5–7, 5–13, 5–15, 5–17, 5–19, 5–21, 5–23, 5–24, 5–26, and 5–27 are secondary stations (of lower priority) and are presently archived.

with X indicate that analyses were performed on the fraction of sediment finer than 60 μm.

FIELD SAMPLING AND SAMPLE PREPARATION

Special steps were taken to minimize contamination of sediment samples at sea. The samples for chemical analyses were collected with a 0.1-m^2 stainless steel Van Veen grab sampler with teflon coating on all surfaces in contact with sediment. A polyethylene-coated cable was used to lower the grab to the seafloor. Upon recovery of a sample, the overlying water was siphoned off with a glass tube, and the upper 2 cm of material were (1) collected with a noncontaminating utensil, (2) placed in an acid-washed polyethylene container, and (3) frozen until analyzed. Because individual grab samples were subsampled for both trace-metal and hydrocarbon analyses, the sampler was rinsed with distilled methanol and hexane before each use.

In the laboratory, the samples were thawed, homogenized, and subsampled under a particle-free hood. Aliquots from individual grabs and sample blends made up of equal weights from the individual grabs were separated for chemical and textural analyses. Samples for chemical analyses were dried to a constant weight at 40°C in an oven with teflon-coated surfaces and a filtered nitrogen atmosphere. Dried samples were ground in an agate grinder after shell or sediment particles larger than 2 mm were removed. Drill cuttings, identified by their angular edges and unusual color, were not removed.

To maximize the analytical resolution in identifying drilling mud components, sand and coarser material were removed from selected samples. Distilled water was used to wash the silts and clays through a nylon sieve with 60-μm openings. The resultant slurry was dried in a teflon-coated oven, then ground and analyzed by the same methods used for whole sediments. Corrections were made for the weight of salt contributed by the interstitial water.

GRAIN-SIZE ANALYSIS TECHNIQUES

Textural analyses were performed on wet sediments to avoid the formation of clay aggregates. Homogenized samples were wet sieved on a 63-μm sieve to remove silt and clay. The coarse fraction was dried, weighed, and then sieved through a 2-mm screen to remove the gravel, which was not further sized. The sand fraction was analyzed with a Rapid Sediment Analyzer (Schlee, 1966). A gravimetric determination of the silts and clays was made by filtering. The size distribution of the silts and clays was determined with a Coulter Counter. Statistical parameters (mean, median, and standard deviation) were determined by the methods of moments (Krumbein and Pettijohn, 1938). All textural data are expressed in phi (ϕ) units, which are defined as $-\text{Log}_2 D$ where D is the grain diameter in millimeters.

TRACE-METAL ANALYSIS PROCEDURES

The analyses of trace metals in marine sediments were carried out by the U.S. Geological Survey Branch of Analytical Laboratories, Reston, Va. Concentrations of the following elements were determined: aluminum (Al), barium (Ba), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), organic carbon (OC), vanadium (V), and zinc (Zn). The various procedures employed in each of the analyses are detailed below.

PREPARATION OF STOCK SOLUTION A

For most samples, 0.5 g of ground sediment was added to a covered teflon beaker and digested overnight with 5 mL of $HClO_4$, 5 mL of HNO_3, and 20 mL of HF at approximately 140°C. The covers were removed, and the temperature was increased to between 180° and 190°C, first producing fumes of $HClO_4$ and then evaporating the solution to dryness. The residue was dissolved and diluted to exactly 25 mL with 8 *N* HCl. This solution is referred to as stock solution A.

Two blanks containing all reagents were analyzed along with samples. All reagents were analyzed for contaminants prior to use, as is always necessary. The Canadian reference sediment standard MESS–1 and the USGS sediment standard MAG–1 also were analyzed in each set of samples. A series of solutions was prepared that approximated the concentration levels expected in the samples and was used as standards in calibrating the inductively coupled plasma (ICP) spectrometer and atomic absorption (AA) spectrophotometer. A summary of methods is presented in table 1.

PREPARATION OF STOCK SOLUTION B

Stock solution B was made by adding 10 mL of butyl acetate (distilled to remove impurities such as copper) to 15 mL of stock solution A in a 60-mL separatory funnel. This solution was vigorously agitated by an automatic shaker for 6 minutes to extract iron. The layers were separated, and the extraction step was repeated with an additional 10 mL of butyl acetate. The aqueous layer was evaporated to dryness at 150°C in a 10-mL beaker. The residue was dissolved and diluted to 25 mL with 1 *N* HCl.

BARIUM

The measurements for Ba were made by ICP spectrometry using 2 mL of stock solution A diluted to 4 mL with distilled H_2O.

ALUMINUM, IRON, CHROMIUM, NICKEL, AND VANADIUM

Concentrations of Al and Fe were determined by ICP spectrometry by using 1 mL of stock solution A diluted to 10 mL with H_2O. The measurements for Cr, Ni, and V were made by injecting 20 μL of diluted (1:10) stock solution A into a graphite furnace AA spectrophotometer.

LEAD, COPPER, AND CADMIUM

Fifteen mL of 0.5-percent (weight:volume) diethyldithiocarbamic acid diethylammonium salt (DDTC) in chloroform were added to 10 mL of solution B in a 60-mL separatory funnel and mixed for 10 minutes by an automatic shaker. The chloroform layer was drained into a 30-mL beaker, and the aqueous layer washed with 10 mL of chloroform. The second chloroform layer was combined with the first, and the total volume of chloroform was evaporated to dryness at 90°C. The organic matter was destroyed by adding 0.1 mL of concentrated HNO_3 and was evaporated to dryness. This residue then was dissolved in 2 mL of warm 1*N* HCl. The beaker was rinsed four times with 2 mL portions of H_2O and was transferred to a small polyethylene container. The measurements for Pb, Cu, and Cd were made by injecting 20 μL of the final solution into a graphite furnace AA spectrophotometer.

MANGANESE AND ZINC

The measurements for Mn were made by ICP spectrometry with a solution made by diluting 2 mL of stock solution B to 4 mL with H_2O. Zinc was measured by flame AA directly from stock solution B.

MERCURY

Mercury concentration was determined on a separate portion of the sample. Two hundred milligrams of sediment were decomposed in a 1-oz teflon screw-top vial with 2 mL of concentrated HNO_3 and 2 mL of $HClO_4$. The mixture was heated in the uncapped vial at 200°C for 1 hour. Immediately, 1 mL of concentrated HNO_3 was added; the vial was filled with H_2O and capped tightly until used. The sample solution then was added to a flask containing 125 mL of H_2O and 4 mL of 10-percent (weight:volume) $SnCl_2$ in 20-percent HCl. Nitrogen was passed through the solution to remove elemental Hg, which was collected on gold foil located in the center of the coils of an induction furnace. Activation of the furnace released the Hg, which was measured by a cold vapor AA technique. Blanks, standard rocks, and internal sediment standards were analyzed with each set of samples. A series of solutions was prepared having the same Hg concentration range expected in the samples.

ORGANIC CARBON

The concentration of organic carbon was determined on samples collected during the first monitoring cruise. Analyses were carried out on a LECO carbon analyzer by combusting the ground sample that had been leached in 1 *N* HCl to remove carbonate.

ADDITIONAL METHODS

Results of Ba and Cr analyses on selected Georges Bank samples were cross-checked by an energy dispersive X-ray fluorescence technique. The determination

TABLE 1.—*Summary of analytical conditions*

Element	Instrument	Instrument conditions	Extraction procedure	Procedure determination limit in sample, µg/g	Average blanks, as measured in µg/g in solution
Al	ICP (argon)	308.2 nm FP (Forward power)=1.1 kw Fixed cross flow nebulizer Spectral band width 0.036 nm Observation height 16 mm.	None	50	0.02
Ba	ICP (argon)	455.4 nm FP=1.1 kw Fixed cross flow nebulizer Spectral band width 0.036 nm Observation height 16 mm.	None	20	.01
Cd	Graphite furnace AA.	110°C dry temperature 250°C char temperature 2100°C atom temperature Regular graphite tube Interrupt gas flow W.l.=228.8 nm Slit=0.7 nm.	Butyl acetate and DDTC.	.02	.0002
Cr	Graphite furnace AA.	110°C dry temperature 900°C char temperature 2700°C atom temperature Regular graphite tube Normal gas flow (low) W.l.=357.9 nm Slit=0.7 nm.	None	3	.003
Cu	Graphite furnace AA.	110°C dry temperature 900°C char temperature 2700°C atom temperature Regular graphite tube Interrupt gas flow W.l.=324.7 nm Slit=0.7 nm.	Butyl acetate and DDTC.	1	.005
Fe	ICP (argon)	259.9 nm FP=1.1 kw Fixed cross flow nebulizer Spectral band width 0.036 nm Observation height 16 nm.	None	50	0.02
Hg	Induction furnace AA.	Wavelength=254 nm Cold vapor AA.	None	.02	.005
Mn	ICP (argon)	257.6 nm FP=1.1 kw Fixed cross flow nebulizer Spectral band width 0.036 nm Observation height 16 nm.	Butyl acetate (removal of iron).	10	.006
Ni	Graphite furnace AA.	110°C dry temperature 900°C char temperature 2700°C atom temperature Pyrolytic curtin tube Normal gas flow (low) W.l.=232.0 nm Slit=0.2 nm.	None	2	.02
Pb	Graphite furnace AA.	110°C dry temperature 900°C char temperature 2700°C atom temperature Regular graphite tube Interrupt gas flow W.l.=283.3 Slit=0.7 nm.	Butyl acetate and DDTC.	2	.02
V	Graphite furnace AA.	110°C dry temperature 1000°C char temperature 2800°C atom temperature Pyrolytic curtin tube Normal gas flow (high) W.l.=318.4 nm Slit=0.7 nm.	None	3	.002
Zn	flame AA	Oxidizing; air-acetylene flame W.L.=213.9 Slit=0.7 nm.	Butyl acetate	1	.01

of Ba concentration was made with a Kevex 0700 energy dispersive X-ray fluorescence spectrometer. Powdered samples of about 1 g were analyzed with a gadolinium secondary target for excitation of the K-alpha line. The ratio of Ba intensity to the gadolinium Compton Scatter intensity was used to correct for absorption effects. This ratio then was compared to a standard calibration curve to determine the concentration of Ba.

The Cr concentration determination is very similar to that of Ba; however, an Fe-secondary target was used to maximize excitation efficiency. Absorption corrections were made in the same way, and the corrected intensity ratio was compared to the standard calibration curve to determine concentrations.

Selected samples were also analyzed for Ba by using a sodium-metaborate fusion technique, followed by direct current (DC) plasma emission spectrometry. Details of this method are reported by Bowker and Manheim (1982).

ANALYTICAL PRECISION AND ACCURACY

Analytical precision was determined by periodically analyzing five replicate aliquots taken from a single sample. Coefficients of variation shown in table 2 indicate that the standard deviation is typically less than 10 percent of the mean value except for concentrations at or near the detection limit of the method.

Accuracy was determined by analyzing rock standards MESS–1 and MAG–1. There is excellent agreement between our results and values established by other laboratories (table 3). There was also excellent agreement among aliquots of samples submitted as blind replicates (appendix table 4).

To maintain our internal quality control and to provide typical sample material for interlaboratory comparisons, four sediment standards representing different textural types were prepared from large samples of Georges Bank sediments. The levels of trace metals are being established by several analytical methods. Splits of these materials are available to those interested in cross-calibration studies.

Barium sulphate ($BaSO_4$), a major component in drilling mud, is well known for its resistance to decomposition by acid attack. To check the effectiveness of our dissolution procedures, we spiked Georges Bank sediments with various amounts of standard drilling-mud solids. The drilling-mud standard was provided by the Environmental Protection Agency Environmental Research Laboratory, Gulf Breeze, Fla. Our results indicate that standard HF, $HClO_4$, and HNO_3 digestion gives high precision and accuracy on all uncontaminated samples and on samples spiked with 0.1-percent drilling mud. In samples containing 1-percent and 10-percent drilling mud, however, dissolution of Ba is only 85 percent and 50 percent, respectively. To circumvent this problem, we have analyzed all samples showing more than 1,000 ppm Ba by X-ray fluorescence (a technique that does not require $BaSO_4$ dissolution) or by a fusion-digestion method that yields 100 percent of the Ba at 10-percent drilling-mud concentrations.

The agreement between the acid decomposition-ICP method for Ba and the fusion-DC plasma methods carried out in independent laboratories is excellent (fig. 2); the linear correlation coefficient is 0.99. Other checks of Ba analyses comparing the acid decomposition technique with X-ray fluorescence yielded a correlation coefficient of 0.98. A comparison of Cr analyses using the graphite furnace atomic absorption method with X-ray fluorescence yielded a correlation coefficient of 0.95. All these correlation coefficients are significant at the 99.9 percent level of confidence.

We also have determined the precision of sediment textural data by analyzing a larger well-mixed sample repeatedly. The results (table 4) show excellent reproducibility for the weight-percent of modal size classes, mean and median ϕ sizes, and for sorting coefficient (σ). Coefficients of variation for these parameters are usually less than 10 percent.

RESULTS AND DISCUSSION

SEDIMENT TEXTURE

The textural data from the four quarterly sampling cruises between July 1981 and May 1982 indicate that the sediments on Georges Bank are typically greater than 95 percent sand with minor amounts of gravel, silts, and clays (appendix tables 2A and 2B). The sand is quartzose, primarily medium to coarse grained, and ranges in coloration from a clear or translucent yellow to a tan iron-oxide stain; it has an angular to subrounded grain shape. Within sampling transects I, II, and III (fig. 1), the content of sediment finer than 62 μm (silt plus clay) increases slightly toward the shelf edge.

The concentration of silts and clays in the regional samples was generally less than 2 percent (appendix tables 2A and 2B). The relative paucity of silts and clays reflects the strong winnowing processes associated with tidal and storm-generated currents on Georges Bank (Butman and others, 1982a). Areas that showed a significant concentration of fine sediments (less than 63

TABLE 2.—*Chemical analysis of replicate whole sediment samples and the separated fine fraction*

[σ, sorting coefficient; CV, coefficient of variation. See introduction for explanation of field number identification code]

Sample	Al (percent)	Ba (ppm)	Cd (ppm)	Cr (ppm)	Cu (ppm)	Fe (percent)	Mn (ppm)	Ni (ppm)	Pb (ppm)	V (ppm)	Zn (ppm)
M4-5-BL----	0.32	90	0.012	8.4	1.0	0.41	270	3.2	6.6	21	6.2
	.32	91	.012	8.8	<.8	.42	270	3.2	7.9	22	6.2
	.32	91	.012	8.4	1.1	.42	260	3.2	7.9	22	6.2
	.32	92	<.01	9.0	<.8	.42	260	2.6	7.1	23	6.6
	.32	93	.017	8.8	<.8	.42	260	2.6	7.5	23	6.2
x̄[1]---------	.32	91.4	[2].013	8.7	[2]1.1	.42	264	3.0	7.4	22.2	6.3
σ----------	.0	1.14	.003	.27	.07	.01	5.5	.33	.56	0.84	.18
CV(%)------	.0	1.25	23.1	3.1	6.4	2.4	2.1	11.0	7.6	3.8	2.9
M4-9-BL----	.90	110	<.01	18	<.8	.66	240	4.0	9.4	22	13
	.87	120	.01	18	<.8	.65	240	4.0	10	24	14
	.90	110	<.01	17	1.1	.65	240	4.0	10	24	14
	.94	110	<.01	18	1.3	.66	240	4.5	9.1	22	14
	.88	110	<.01	18	1.0	.65	240	3.8	9.1	22	13
x̄[1]---------	.90	112	-	17.8	[2]1.13	.65	240	4.1	9.5	22.8	13.6
σ----------	.03	4.47	-	.45	.15	.01	0	.26	.46	1.1	.55
CV(%)------	3.3	3.99	-	2.53	13.3	1.54	0	6.3	4.8	4.8	4.0
M4-13-BL---	2.4	240	.087	43	4.8	1.5	230	18	18	56	34
	2.1	240	.083	44	5.0	1.6	210	19	17	60	33
	2.1	240	.091	44	5.2	1.6	220	19	16	59	34
	2.1	240	.079	44	4.6	1.6	210	18	18	62	33
	2.3	240	.091	43	5.2	1.6	220	19	16	61	34
x̄[1]---------	2.2	240	.086	43.6	5.0	1.6	218	18.6	17	59.6	33.6
σ----------	.14	-	.005	.55	.26	.05	8.4	.55	1.0	2.3	.55
CV(%)------	6.4	-	5.81	1.3	5.2	3.1	3.9	3.0	5.9	3.9	1.6
M4-5-29-BLX	2.7	330	.10	54	12	2.4	370	30	38	86	63
	2.6	330	.097	51	10	2.4	360	30	37	82	63
	2.6	330	.12	51	12	2.4	370	30	39	82	62
x̄[1]---------	2.63	330	.11	52	11.3	2.4	366.7	30	38	83.3	62.7
σ----------	.06	0	.01	1.7	1.2	0	5.8	0	1.0	2.3	.58
CV(%)------	2.3	0	9.1	3.3	10.7	0	1.6	0	2.6	2.8	.93
M4-16-GX---	2.2	1,800	.19	37	13	1.6	670	30	39	62	78
	2.2	1,700	.22	34	12	1.6	660	30	35	60	77
	2.3	1,800	.19	34	11	1.6	640	30	42	56	74
x̄[1]---------	2.23	1,766.7	.2	35.0	12	1.6	656.7	30	38.7	59.3	76.3
σ----------	.06	57.7	.02	1.7	1.0	0	15.3	0	3.5	3.1	2.1
CV(%)------	2.7	3.3	10.0	4.9	8.3	0	2.3	0	9.0	5.2	2.8

[1]Sample ID ending in X indicates the fine fraction.

[2]"Less than" values left out when calculating statistics.

μm) during each sampling cruise were located at regional station 14 (4–18) percent fines) in the Gulf of Maine, regional station 7 (2–4 percent fines) at the head of Lydonia Canyon, and regional stations 13 and 13A (38–50 and 96–97 percent fines, respectively) located south of Nantucket Island. This last area, known as the Mud Patch, is thought to be a major depositional site of sediments from upstream areas on Georges Bank (Bothner and others, 1981b; Twichell and others, 1981).

The gravel fraction is variable, and concentrations range from 0 to almost 30 percent (appendix tables 2A and 2B). The gravel is comprised of rock fragments or shell hash or a mixture of both. Drill cuttings were observed in the gravel fraction at station 16, within 200 m of the drill site in block 410, and at station 5, within 200 m of the drill site in block 312. The cuttings are angular and range in size from 2 to 8 mm, and most are gray in color. These grains effervesce in hydrochloric acid, suggesting calcite, a common subsurface mineral. The cuttings appear to be localized at the drill sites; no evidence of cuttings in the gravel fraction has been found at locations farther from the rigs.

Some seasonal changes in the texture at individual locations are expected because marked changes have been observed in the amount and composition of resuspended sediment related to major storms, which more typically occur in winter months (Bothner and others, 1981a). A careful examination of textural change with time will be conducted during the second year of this program to determine any seasonal patterns.

The within-station textural variability of the replicate sediment samples was very low. Except for regional station 14 in the Gulf of Maine where the bottom photographs show textural contrasts on the scale of meters, the in-station variability was generally less than 2 percent for the major size classes (appendix table 2B). The mean ϕ grain size determined on the blends generally falls within 10 percent of the value determined from individual replicates. This supports the use of blended replicate samples to establish the textural parameters at a given location.

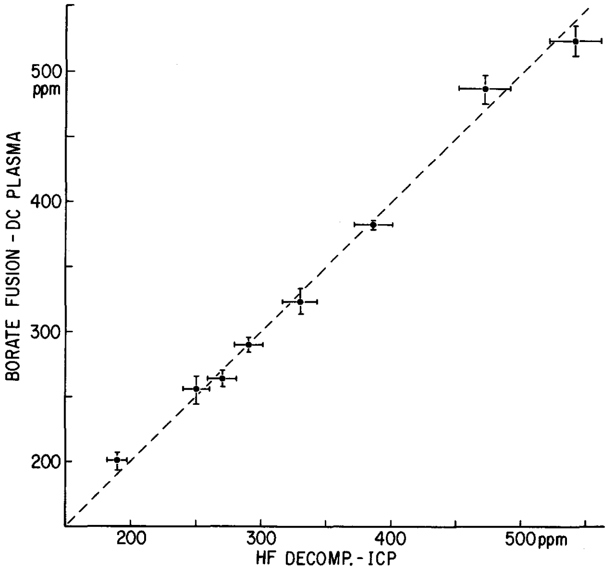

FIGURE 2.—Comparison of barium analyses by different laboratories. Decomposition using HF–$HClO_4$–HNO_3 acids and analyses using inductively coupled plasma emission (ICP) were performed by the USGS, Reston Laboratories. Decomposition using borate fusion and analyses using DC plasma emission were performed by Paul Bowker, USGS, Woods Hole Laboratories (method of Bowker and Manheim, 1982). Dashed line has a slope of 1.

TRACE METALS

The tabulated data for the metals included in this program and for organic carbon (for the first cruise only) are presented in appendix tables 3A and 3B. The samples are sorted according to cruise.

The concentrations of metals in average crustal materials and in average sandstone serve as a comparison to the predrilling metal concentrations measured in the July 1981 samples (fig. 3). In all cases, the highest concentration of metals was found at station 13, which has the finest sediments (56 percent sand, 23 percent silt, and 21 percent clay). With the exception of Pb, the highest value observed in predrilling samples is lower than the concentration found in mean crustal rocks. This suggests that Georges Bank sediments collected on the predrilling cruise are essentially uncontaminated with respect to the heavy metals analyzed. The high levels of Pb in surficial sediments at station 13 have been documented in earlier analyses of cores (Bothner and others, 1981b). The fluxes of stable Pb and the radioactive isotope Pb-210 are higher at this location than at other areas of the shelf, suggesting that this area is a modern sink for pollutants that are reactive with fine-grained organic-rich sediments. The observed increase in Pb is attributed to the use of tetraethyl lead in gasoline, a use that began in 1924 and has dramatically increased since 1940. Station 13 is downwind from the industrialized areas of the northeastern United States.

To illustrate the interelement variability on Georges Bank, we plotted the concentrations of metals, organic carbon, and fine-grained sediments at each regional station of the monitoring program (fig. 4). For contrast, we have included average values measured in Boston Harbor, an area known to be contaminated with industrial and domestic wastes (Fitzgerald, 1980). The stations are listed in the order of increasing water depth. Similar relative changes in the variables at different locations are interpreted to reflect the strong dependence of metal concentration on the amount of organic matter and fine sediments in this uncontaminated environment. By contrast, the sediments of Boston Harbor have much higher concentrations of metals than would be predicted by the apparent metals-carbon-fine sediment relation observed for stations of the monitoring program.

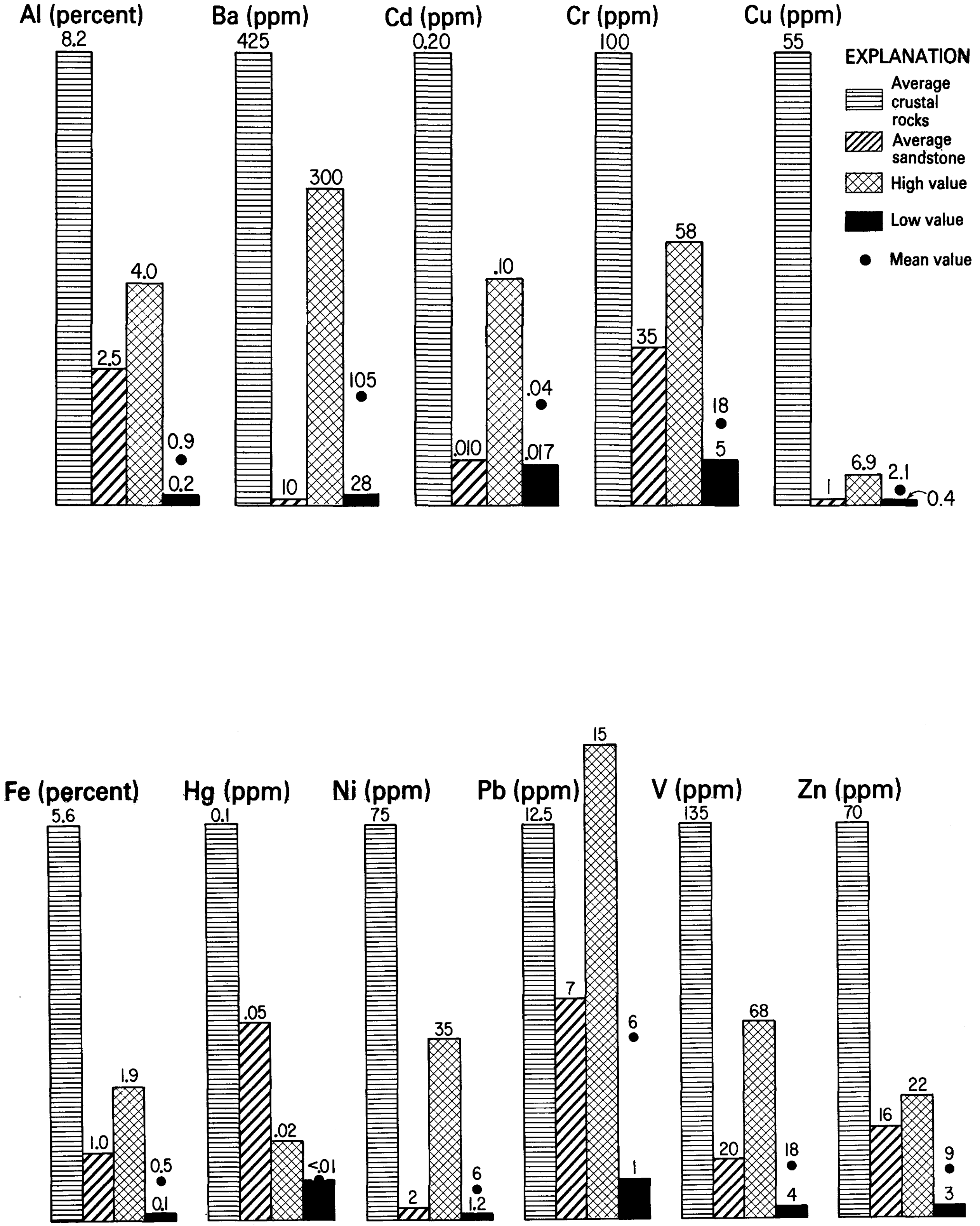

FIGURE 3.—Relative concentrations of metals in average crustal rocks (Krauskopf, 1967) and average sandstone (Turekian and Wedepohl, 1961) and high value, low value, and mean value for sediments collected by the Georges Bank Monitoring Program in July 1981 (predrilling). Numbers above columns are actual concentrations.

TABLE 3.—*Chemical analysis of standard sediment*

[$\bar{X}$, mean; σ, sorting coefficient; CV, coefficient of variation. Reference materials from the National Research Council, Canada (MESS–1) and the U.S. Geological Survey (MAG–1)]

Sample	Al (percent)	Ba (ppm)	Cd (ppm)	Cr (ppm)	Cu (ppm)	Fe (percent)	Mn (ppm)	Ni (ppm)	Pb (ppm)	V (ppm)	Zn (ppm)
MESS-1------	5.7	250	0.63	65	23	3.0	501	38	31	81	179
	5.0	270	.53	68	20	2.9	490	36	30	86	181
	5.6	270	.53	68	26	3.0	500	36	30	86	181
	5.6	270	.54	65	24	2.8	490	40	32	80	183
	5.8	250	.49	64	22	2.6	470	38	34	84	170
	5.8	250	.45	69	23	3.0	501	35	38	72	179
$\bar{X}$-----------	5.6	260	.53	66.5	23	2.8	492	37.2	32.5	81.5	178.8
σ-----------	.30	10.9	.06	2.07	2	.16	11.9	1.84	3.08	5.28	4.58
CV(%)-------	5.4	4.2	11.3	3.1	8.6	5.7	2.4	4.9	9.4	6.4	2.6
Best value[1]-	5.8	270	.59	71	25	3.0	513	30	34	72	191
σ-----------	.2		.10	11	4	.2	25	3	6.1	5	17

Sample	Al (percent)	Ba (ppm)	Cd (ppm)	Cr (ppm)	Cu (ppm)	Fe (percent)	Hg (ppm)	Mn (ppm)	Ni (ppm)	Pb (ppm)	V (ppm)	Zn (ppm)
MAG-1-------	8.6	470	0.15	100	30	4.6	0.050	720	60	26	170	130
	8.6	469	.17	98	31	4.8	.039	710	58	25	175	120
	8.9	440	.17	98	31	4.8	.047	722	58	29	175	130
	8.6	430	.14	95	31	4.6	.039	710	66	29	170	130
	8.7	450	.13	98	30	4.7	.046	722	63	29	160	120
	8.7	430	.13	100	30	4.7	.052	740	63	25	160	130
$\bar{X}$-----------	8.7	448.2	.15	98.2	30.5	4.7	.046	720.7	61.3	27.2	168.3	126.7
σ-----------	.12	18.1	.02	1.83	.55	.09	.005	11.0	3.2	2.04	6.83	5.16
CV(%)-------	1.4	4.	13.3	1.9	1.8	1.9	10.9	1.5	5.2	7.5	4.1	4.1
Best value-	[2]8.9	[3]490	[3].15	[3]100	[3]33	[2]4.9	[3].05	[3]710	[2]53.8	[3]26	[2]141.7	[3]147.8

[1]Values reported by the Marine Analytical Chemistry Standards Program, National Research Council, Canada.

[2]U.S. Geological Survey Professional Paper 840.

[3]Values judged to be most appropriate based on multiple analyses conducted at the USGS Analytical Laboratories.

POSTDRILLING BARIUM AND CHROMIUM CONCENTRATIONS

The concentrations of Ba in bulk samples from the control transect I (fig. 1*A*) and station 7 (Lydonia Canyon) are fairly consistent with time and are measurably different from each other (fig. 5). On the basis of these data, apparently no clear increase in Ba has occurred at these stations. The other metals show similarly uniform levels over the four sampling periods at these locations.

In contrast, there were some measurable changes in the concentration of Ba at the stations in block 410 (stations 16, 17, and 18, fig. 6). Drilling began in this block immediately after the first sampling cruise (M1) in July 1981 and continued (with some interruptions) until March 31, 1982. Since the mean current flow on this part of the Continental Shelf is to the west, stations 17 and 18 are respectively upstream and downstream of the rig position. Although tidal currents and storm currents can reverse the mean current flow, stations to the west of drill rigs in this area can be expected to be more heavily impacted by drilling muds than those to the east.

At station 16, located within 200 m of the drill rig in block 410, average Ba concentrations have increased by a factor of about 3.5. The large standard deviation among the three replicate grab samples indicates that Ba is not distributed homogeneously over the sampling area. There appears to be an increase of smaller magnitude at station 18 and perhaps a slight increase at station 17. To put these results in perspective, however, the Ba levels measured after 6 months of drilling in block 410 do not exceed the concentration range for this element as measured in predrilling samples collected from other areas of the bank.

TABLE 4.—*Replicate textural analyses of standard sediment (SS) to estimate precision*

[$\bar{X}$, mean value of replicate analyses; σ, standard deviation; CV, coefficient of variation]

Sample	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)	Mean (ϕ)	Median (ϕ)	σ (ϕ)
1SS-------	1.37	84.19	10.81	3.63	2.68	2.37	1.87
2SS-------	1.35	83.46	10.49	4.59	2.93	2.54	1.92
3SS-------	.57	85.23	10.00	4.20	2.80	2.38	1.88
4SS-------	2.62	81.80	11.51	4.07	2.78	2.40	1.98
5SS-------	1.64	83.99	10.13	4.24	2.73	2.37	1.95
6SS-------	1.60	83.15	10.76	4.49	2.70	2.27	2.02
7SS-------	3.72	81.18	10.97	4.14	2.61	2.27	2.04
8SS-------	1.35	82.74	10.72	5.19	2.78	2.38	2.07
9SS-------	.77	84.72	9.55	4.96	2.75	2.35	1.99
10SS------	1.92	83.81	10.33	3.94	2.59	2.21	1.95
$\bar{X}$---------	1.69	83.43	10.53	4.35	2.74	2.35	1.97
σ---------	.91	1.26	.55	.47	.10	.09	.07
CV(%)-----	53.85	1.51	5.22	10.81	3.65	3.83	3.55

The analysis of Cr in these same samples (fig. 6) reveals no systematic increases of this metal in the bottom sediments in the vicinity of this well. The preliminary analysis of data on other metals also shows no systematic increase with time.

In block 312, the location of our site-specific survey, increases in Ba were observable following the initiation of drilling on December 8, 1981. Figure 7 shows the rate of increase at the central station closest to the drill site and at selected stations to the north, south, east, and west of it. The magnitude of Ba increase between the first and fourth monitoring cruises for all primary site-specific stations is shown in figure 8. Increases by more than a factor of 2 were observed at the drill site and at station 5–2, 0.5 km to the east, and station 5–8, 1 km to the north. Within a 6-km radius around the drill rig, the distribution of Ba appears to be somewhat more biased to the west than in other directions; analyses of the secondary stations would help to confirm this trend. The apparently higher Ba increases toward the west are consistent with the expected transport of drilling effluents with the mean current flow as defined by Butman and others (1982a).

ANALYSIS OF THE FINE FRACTION

The sediment fraction coarser than 60 μm was removed to concentrate the metals introduced with drilling muds and, thus, to improve our ability to identify changes over time. Within the fine fraction, the average Ba concentrations show an increase of

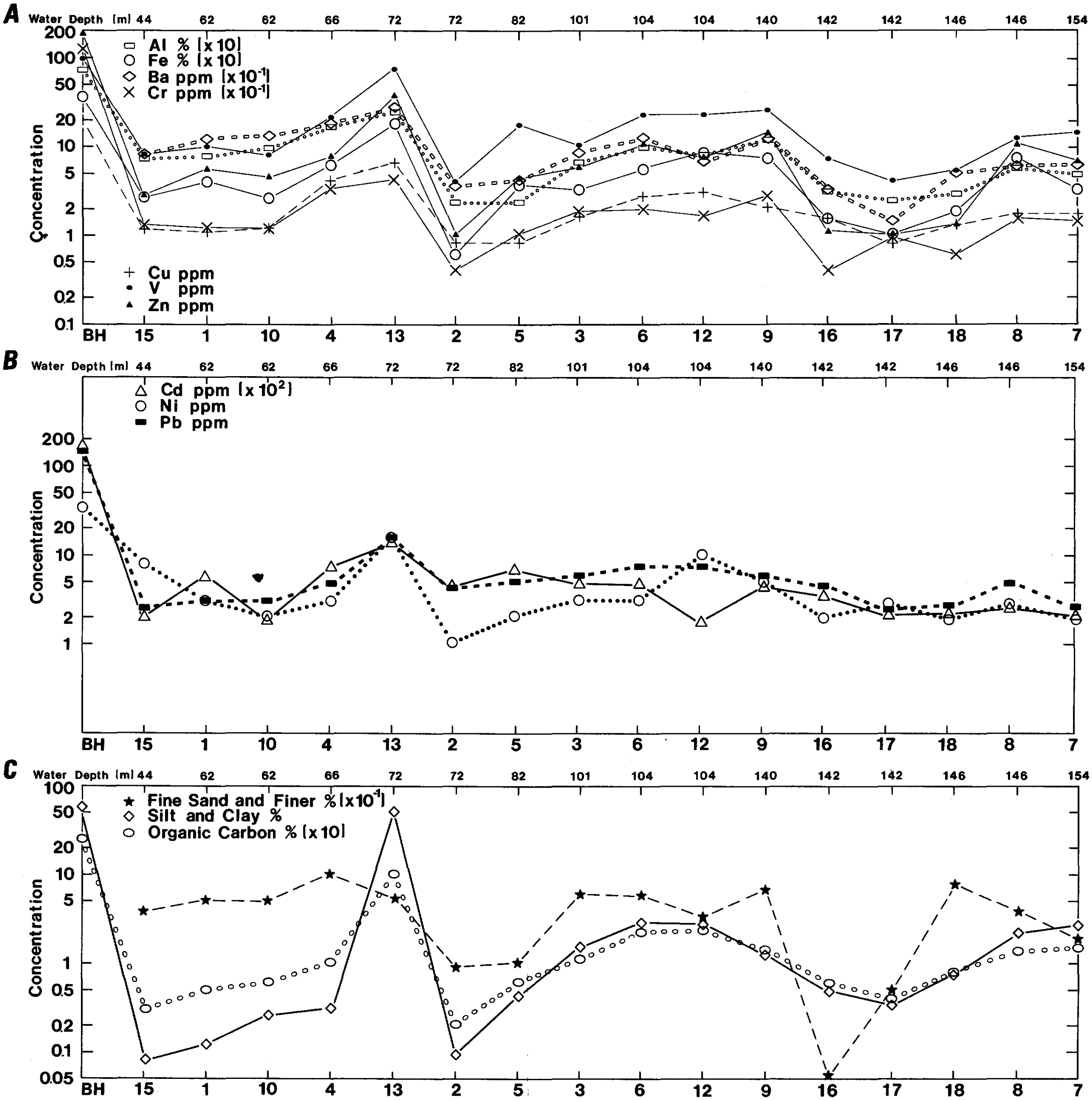

FIGURE 4.—Concentrations of metals and sediment parameters in Boston Harbor (BH) and at various stations on Georges Bank that show similar relative changes from station to station.

about 36 times the predrilling level of about 242 ppm at station 16, with smaller changes at stations 17 and 18 (fig. 9). Increases in Al, Cr (fig. 10), Cu, and Hg concentrations in the fine fraction were observed only at station 16. The increases at the time of the third cruise were about 2 times the concentration measured on samples collected before drilling. The highest concentrations measured were equivalent to the levels in average crustal material. Subsequently, by the time of the fourth cruise (postdrilling), the concentrations of these metals at block 410 had decreased and were similar to predrilling levels.

In the vicinity of drilling at block 312, the analysis of the fine fraction shows a Ba increase by a factor of as much as 22 between the M1 and M4 cruises (fig. 11). This is much higher than the increase measured by analyzing the bulk sediment (fig. 8). The analysis of the fines at block 312 does not show a preferential movement to the west.

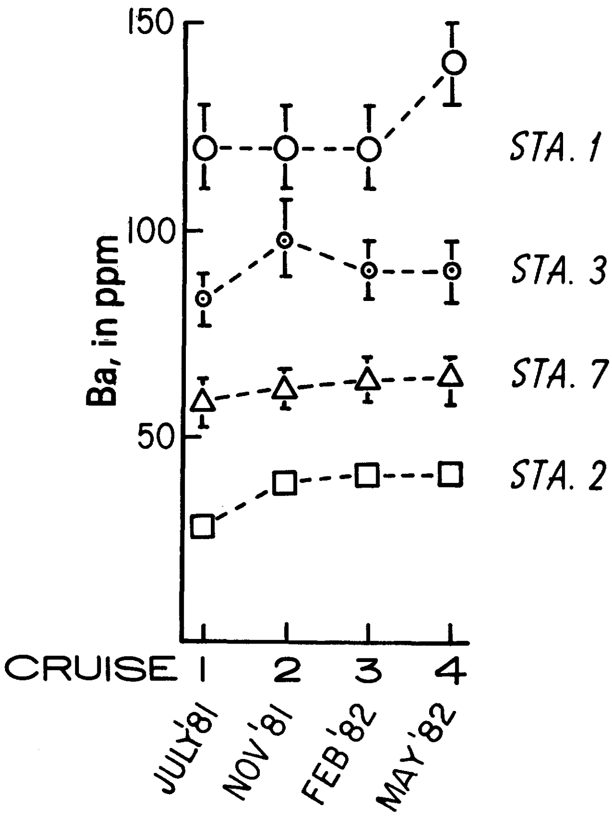

FIGURE 5.—Concentrations of barium in bulk sediment on different sampling occasions. Drilling began after the first cruise. Station locations are shown in figure 1*A*.

INVENTORY OF DRILLING FLUIDS IN SEDIMENTS OF SITE-SPECIFIC SURVEY

From the detailed sample array at block 312, the amount of barite added to the surficial sediment within 6 km of the drill site can be estimated. As of the fourth monitoring cruise (May 13, 1982), the total usage of barite was about 1,980,000 lb, and the amount in circulation (amount in the hole plus amount in the mud pits) was 630,000 lb (E. P. Danenberger, oral commun., July 19, 1982). The difference, 1,350,000 lb, is the amount assumed lost to the local waters during drilling.

The magnitude of Ba increase at each of the primary site-specific locations was determined by subtracting the concentration measured during the predrilling M1 cruise from that measured on the M4 cruise. The magnitude of the increase observed at any given radial distance from the rig (fig. 12) is variable, probably because the drilling muds and cuttings are discharged at a nonuniform rate into a tidal-current field that continuously changes direction. We assume that the average concentration increase at each radial distance from the rig site is representative of the entire annulus (as indicated in fig. 12). We also assume that the increased Ba is contained within the sampling depth interval of 0 to 2 cm. This distribution will be carefully checked during the second year of the program by analyzing undisturbed gravity cores over the interval from 0 to 20 cm.

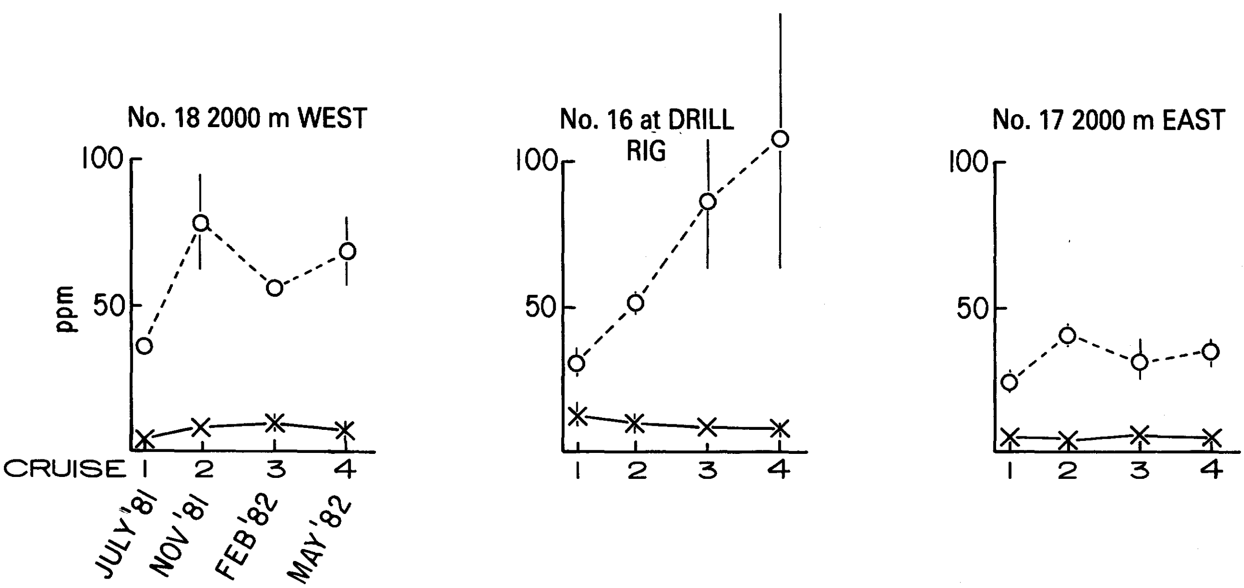

FIGURE 6.—Concentrations of barium (circle) and chromium (x) in bulk sediment on different sampling occasions near the drill site at block 410. Drilling began after the first cruise. Error bars are one standard deviation among three individual samples.

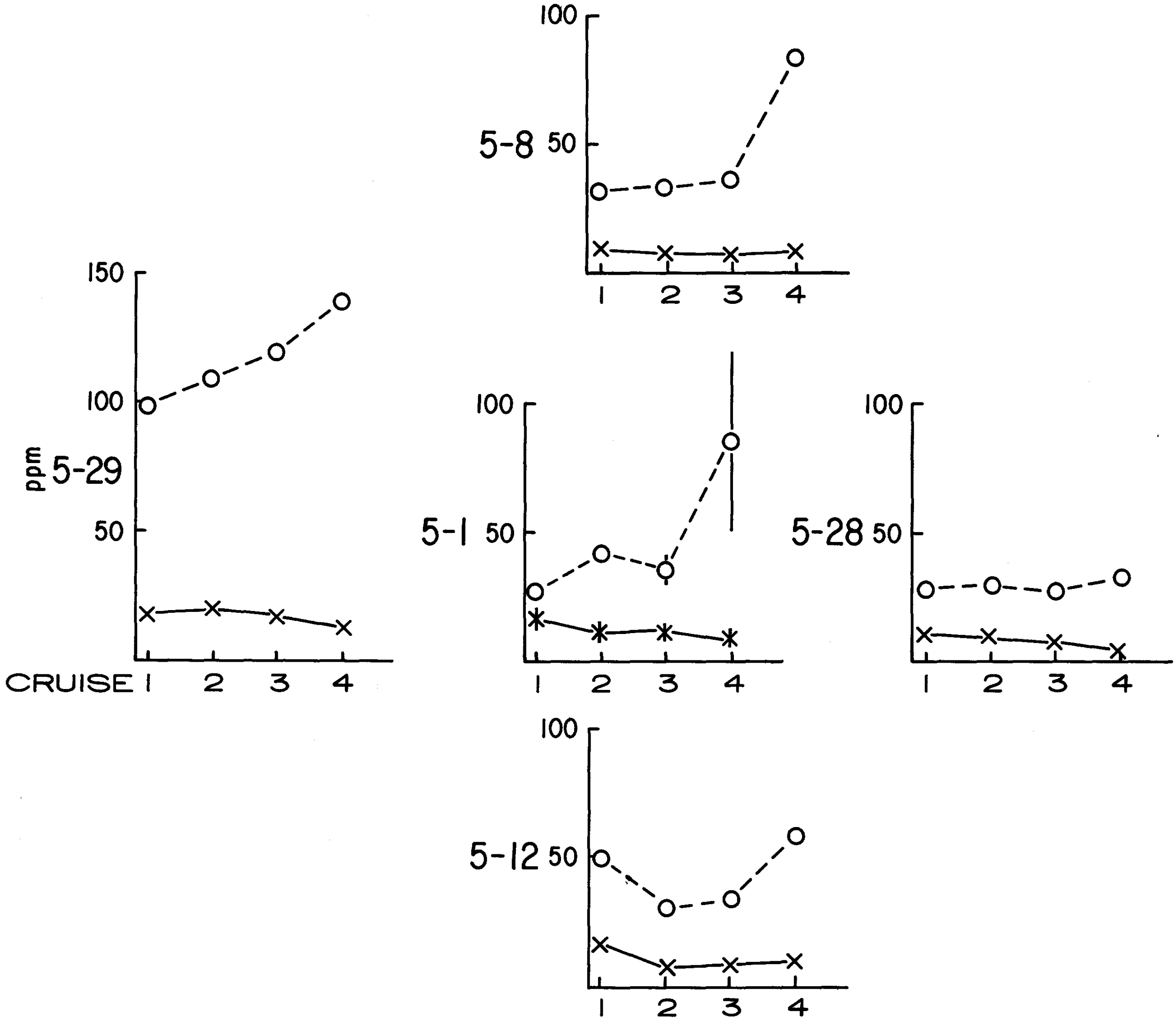

FIGURE 7.—Concentrations of barium (circle) and chromium (x) in bulk sediment on different sampling occasions near the drill site at block 312. Drilling began after the first cruise. Error bars are one standard deviation among three individual samples. Station locations are shown in figure 1*B*.

The inventory of barite is calculated from the field data with the following relation:

$$\text{Total} = \Sigma A \bullet d \bullet Z \bullet Cn \bullet \ BaSO_4/0.85Ba$$

where A = area of each annulus, d = density of dry sediment, Z = depth interval (2 cm), Cn = net concentration increase of Ba, and $BaSO_4/0.85$ Ba is the ratio of molecular weights corrected for the estimated 85 percent $BaSO_4$ concentration in mined barite.

The total barite added to the sediments within 6 km of the drill rig is 281,000 lb, or approximately 21 percent of the 1,350,000 lb lost to the environment. At distances greater than 6 km in both upstream (stations 1–3) and downstream directions (stations 9, 10, 11, 12, 13), we observed no systematic increase in Ba.

With the knowledge that the Ba concentration increases by an average of 36 ppm within 0.5 km of drill rig, the expected increase of Cr and other metals discharged with drilling fluids can be estimated. This approach assumes that the relative increase of metals in sediments will be proportional to their concentration in drilling fluids and that the metals behave chemically and physically like Ba. Because Cr, for example, is associated with chrom-lignosulfonate, which may be more soluble or more easily dispersed than the insoluble and heavy $BaSO_4$, the calculated increase in Cr is likely to be an upper limit.

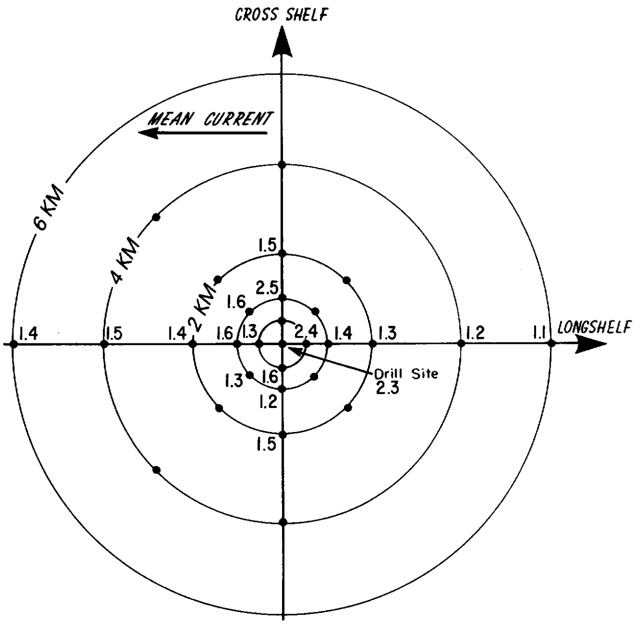

FIGURE 8.—Magnitude of change in barium concentration in bulk samples collected at block 312 on the fourth monitoring cruise compared to those collected on the first (predrilling) monitoring cruise. (Concentration of Ba in fourth-cruise samples ÷ concentration of Ba in first-cruise samples.)

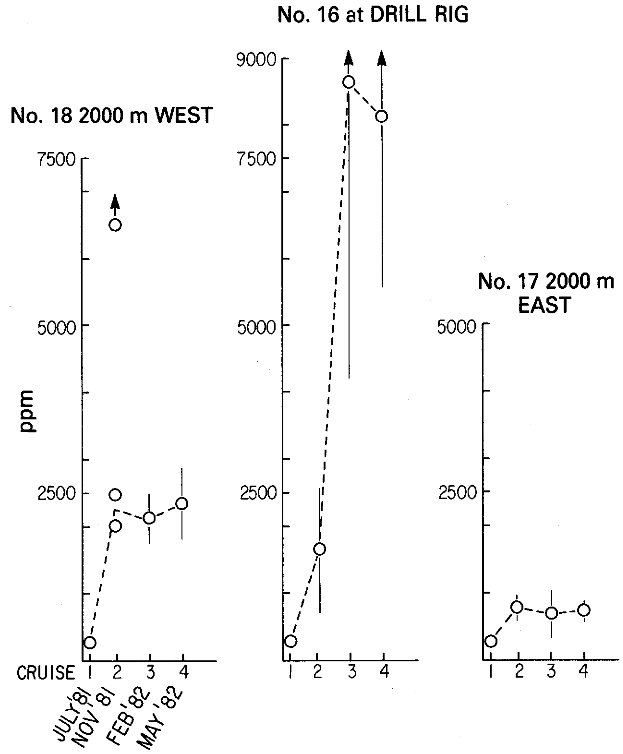

FIGURE 9.—Concentrations of barium in the fine fraction (less than 62 µm) on different sampling occasions near the drill site at block 410. Drilling began after the first cruise. Error bars are one standard deviation among three individual replicates.

Estimated Cr increase is found with the ratio:

$$\text{Cr increase (mg/kg)} = \frac{(493 \text{ kg Cr used})\ (36 \text{ mg /kg Ba increase})}{(449{,}000 \text{ kg Ba in the barite used})}$$

$$\text{Cr increase} = 0.04 \text{ mg/kg (ppm).}$$

This increase is too small to resolve analytically given a background concentration of 10 ppm Cr. The Cr analysis of samples around the rigs shows no increase in Cr as a result of drilling, a finding, that agrees with this calculation.

TRACE-METAL ANALYSIS OF SEDIMENT-TRAP SAMPLES

Sediment traps have been positioned on Georges Bank and in Lydonia Canyon near the seafloor to collect material that is generated in surface waters and material that is resuspended from the bottom. We have analyzed sediment from several traps that were de-

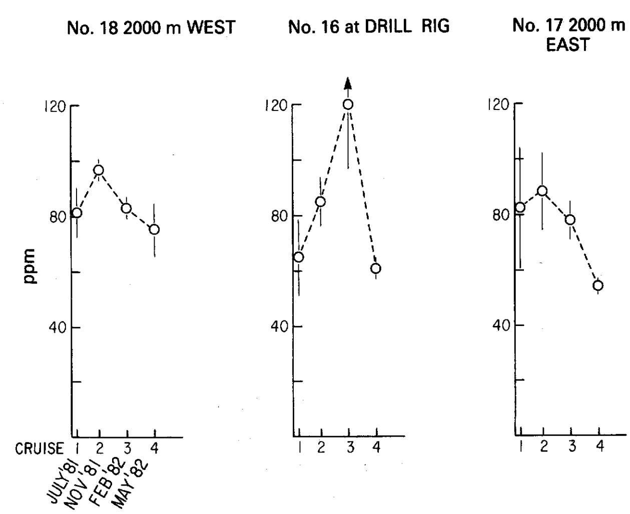

FIGURE 10.—Concentrations of chromium in the fine fraction (less than 62 µm) on different sampling occasions near the drill site at block 410. Drilling began after the first cruise. Error bars are one standard deviation among three individual replicates.

ployed at various locations (table 5) on the bank and in Lydonia Canyon as part of a sediment dynamics program (Butman and others, 1982b). Most of these traps were deployed before drilling began and thus indicate the background levels of the metals analyzed (table 6).

Traps 312–425A and 312–427A were deployed during the drilling on block 312 at positions 1 km to the west and 6 km to the east of the drill site, respectively. The preliminary analytical results on these traps suggest that material discharged from the rigs is carried toward the west. The magnitude of Ba increase in the suspended matter of trap 312–425A is about 3 times background levels, similar to the magnitude of increase observed in the bottom sediments. No corresponding increases in Cr concentrations are observed in the sediment-trap samples (table 6).

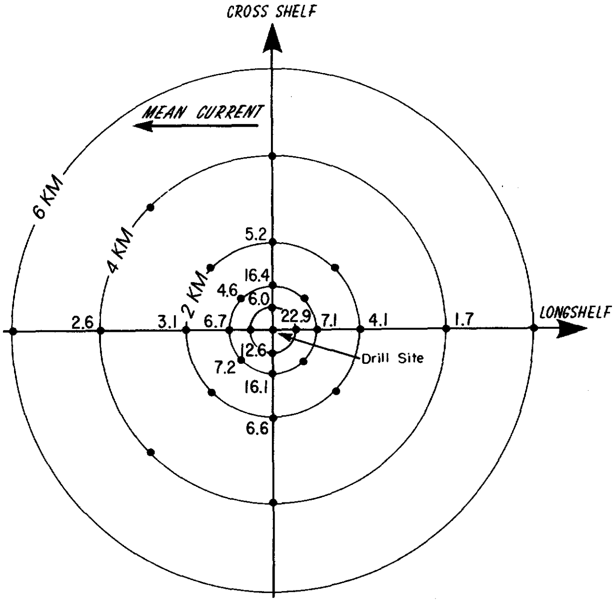

FIGURE 11.—Magnitude of change in barium concentration in the fine fraction (less than 62 μm) of samples collected on the fourth monitoring cruise compared to those collected on the first (predrilling) monitoring cruise. (Concentration of Ba in fourth-cruise samples ÷ concentration of Ba in first-cruise samples.)

SUMMARY OF IMPORTANT PRELIMINARY FINDINGS

Barium (present in barite, a major constituent of drilling mud)has increased by a factor of 3.5 in bulk (unfractionated) sediments 200 m from the drill site in block 410 since drilling began in July 1981. Average Ba concentrations have increased from 30 to 107 ppm. Smaller increases were observed at distances of 2,000 m from this site. In block 312, at the center of a site-specific survey, the Ba concentration in bulk sediment has increased by a factor of 2.3 (40–91 ppm) since drilling began. Increases of smaller magnitude have been measured to a distance of 6 km from the rig. To put the magnitude of Ba increases into perspective, Ba concentrations in excess of 100 ppm have been measured in samples collected at some locations on the bank before drilling began. No drilling-related changes in the concentration of Cr or other metals have been observed in bulk sediments from block 410 or block 312 since drilling began.

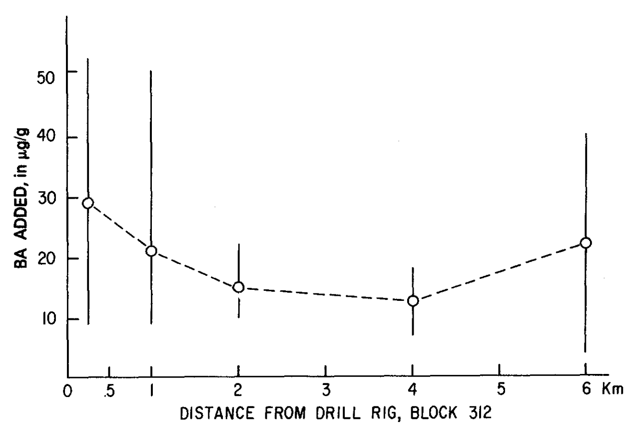

FIGURE 12.—Increase in average barium concentration of bulk sediment at different radial distances from the rig site in block 312 between the first (predrilling) and fourth monitoring cruises. Error bars represent the range of values among different stations at the same radial distance.

Separation and analysis of the sediment fraction finer than 62 μm from generally coarse sediments on Georges Bank have improved our ability to map the distribution of drilling mud in sediments. This fraction typically represents less than 3 percent of the sediments on Georges Bank. Barium in the fine fraction near the rig at block 410 increased by a factor of 36 (242–8,640 ppm), compared to a measured increase of 3.5 times in the bulk sample. An increase of up to 22 times was observed in the Ba concentration of the fine fraction near the drill site at block 312.

Increases in Al, Cr, Cu, and Hg concentrations in the fine fraction were observed only at the drill site in block 410. The increases at the time of the third cruise (during drilling) were about 2 times the concentrations measured on the predrilling cruise. The highest concentrations measured were equivalent to the levels in average crustal material. Subsequently, by the time of the fourth cruise (postdrilling), the concentrations of these metals at block 410 had decreased and were similar to predrilling levels.

TABLE 5.—*Sediment-trap deployments*

Trap no.	Deployment period (yr-mo-d to yr-mo-d)	Mooring position Latitude N.	Longitude W.	Water depth (m)	Trap depth (mab)[1]	General position
101----------	801201-810429	40°22.95′	67°32.94′	250	20	Lydonia Canyon - east slope
102----------	801130-810424	40°34.21′	67°44.55′	100	26	Lydonia Canyon - shelf
103----------	801129-810428	40°31.55′	67°42.82′	290	20	Lydonia Canyon - canyon head
112----------	801129-810425	40°29.47′	67°48.24′	125	26	Lydonia Canyon - shelf west
114----------	810120-810428	40°17.93′	69°39.52′	1,380	20	Lydonia Canyon - canyon axis
120----------	801127-810429	40°21.18′	67°31.98′	535	300	Lydonia Canyon - east slope
T183GBK------	791215-800529	41°02.30′	67°33.49′	64	3	Georges Bank shelf - southern flank
312-425A-----	820202-820611	40°39.16′	67°46.24′	81	10	Lease Block 312 - Georges Bank
312-427A-----	820201-820611	40°39.76′	67°41.54′	78	10	Lease Block 312 - Georges Bank

[1]mab = meters above bottom.

TABLE 6.—*Chemical analysis of sediment traps*

Trap no.	Sample depth (cm)	Al (percent)	Ba (ppm)	Cd (ppm)	Cr (ppm)	Cu (ppm)	Fe (percent)	Hg (ppm)	Mn (ppm)	Ni (ppm)	Pb (ppm)	V (ppm)	Zn (ppm)
101--------	[1]W	1.89	170	0.65	[2]550	25	1.44	-	250	19	[2]200	36	133
102--------	6	2.58	160	.83	77	16	1.90	-	400	34	50	95	400
103--------	20.5	3.63	240	.16	74	15	2.31	0.047	520	53	19	110	60
103--------	40.5	3.52	200	.076	71	19	2.34	.043	610	48	32	120	63
103--------	77.5	3.53	210	.076	69	19	2.22	.054	540	52	47	94	110
112--------	2.2	2.33	170	.70	93	10	1.48	.034	380	25	32	61	130
112--------	6	1.89	110	[2]1.3	64	13	1.32	.060	360	22	49	53	410
114--------	2	3.85	310	.053	68	20	2.24	.033	590	45	35	93	71
114--------	6	3.93	320	.038	69	20	2.33	.045	590	53	32	98	58
114--------	9.8	4.13	330	.093	81	20	2.42	.033	610	57	50	110	88
120--------	11	3.11	240	.22	82	47	1.89	.047	470	43	30	84	63
120--------	18	2.88	240	.16	68	21	1.78	.040	500	39	35	83	79
T183-GBK---	0-26	2.2	230	.10	32	7.5	1.5	-	240	12	24	34	49
312-425A---	[1]W	2.0	760	.87	28	7.8	1.5	-	170	9.5	18	28	68
312-427A---	[1]W	1.7	247	.56	26	7.3	1.2	-	140	7	18	26	59

[1]Whole sample homogenized.
[2]Possibly contaminated.

We estimate that 21 percent of the barite discharged during drilling operations remains within 6 km of the drill site in block 312. Somewhat higher concentrations are found toward the west than toward the east because of a mean westerly flow on this part of the bank.

The trace-metal levels in Georges Bank sediments collected before drilling began are low compared to average crustal abundances and are characteristic of unpolluted coarse-grained sediments. The metals analyzed included Al, Ba, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, V, and Zn, as well as organic carbon. Values of Pb higher than average crustal abundances were measured only at the location south of Martha's Vineyard where fine-grained sediments are accumulating, and previous studies have suggested tetraethyl lead from gasoline as a source of the elevated Pb concentrations in this area.

ACKNOWLEDGMENT

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APPENDIX TABLE 1A.— *Navigation data for station blends analyzed for chemistry*

[T1 (Caribou, Maine) and T4 (Carolina Beach, N.C.) are Loran-C time delay values for the 9960 Loran-C chain]

FIELD NUMBER	DEPTH, METERS	LATITUDE, DEGREES	LONGITUDE, DEGREES	T1, µSECONDS	T4, µSECONDS
M1-1-BL	62	41.206459	-67.24138	13172.5	43614.9
M1-10-BL	62	40.698898	-68.58900	13661.8	43502.7
M1-11-BL	86	40.513100	-68.56190	13697.6	43433.4
M1-12-BL	104	40.369102	-68.49979	13712.8	43378.1
M1-13-BL	72	40.486955	-70.20804	14202.4	43496.3
M1-14-BL	124	41.568199	-68.98080	13554.0	43833.6
M1-15-BL	44	41.456894	-68.00920	13301.8	43733.2
M1-16-BL	142	40.573601	-67.21300	13328.2	43406.0
M1-16-BL	142	40.573601	-67.21300	13328.2	43406.0
M1-16-BL	142	40.573601	-67.21300	13328.2	43406.0
M1-17-BL	142	40.584000	-67.18959	13319.8	43409.8
M1-18-BL	146	40.559097	-67.22780	13335.3	43402.7
M1-2-BL	72	40.983299	-66.93001	13156.1	43531.9
M1-2-BL	72	40.983299	-66.93001	13156.1	43531.9
M1-3-BL	101	40.895004	-66.77499	13144.0	43496.9
M1-4-BL	66	40.845001	-68.00000	13464.4	43529.5
M1-4-BL	65	40.845001	-68.00000	13464.4	43529.5
M1-5-10-BL	81	40.658295	-67.78099	13452.4	43455.4
M1-5-11-BL	83	40.652298	-67.77791	13451.6	43453.2
M1-5-12-BL	80	40.649895	-67.76830	13449.8	43452.0
M1-5-14-BL	81	40.658997	-67.74609	13441.5	43454.3
M1-5-16-BL	73	40.676201	-67.76871	13443.4	43461.0
M1-5-18-BL	81	40.658897	-67.79251	13453.8	43456.0
M1-5-2-BL		40.659706	-67.76309	13446.0	43455.2
M1-5-20-BL	81	40.641098	-67.76840	13451.9	43447.0
M1-5-22-BL	80	40.659706	-67.72279	13435.5	43453.6
M1-5-25-BL	81	40.660202	-67.81580	13459.6	43457.3
M1-5-25-BL	81	40.660202	-67.81580	13459.6	43457.3
M1-5-25-BL	81	40.660202	-67.81580	13459.6	43457.3
M1-5-28-BL	78	40.659401	-67.69901	13429.4	43452.6
M1-5-29-BL	84	40.658897	-67.83980	13466.2	43457.8
M1-5-3-BL	80	40.664291	-67.76950	13446.5	43457.0
M1-5-4-BL	80	40.659103	-67.77480	13449.2	43455.4
M1-5-5-BL	81	40.654404	-67.76930	13448.9	43453.6
M1-5-6-BL	80	40.659103	-67.75749	13444.6	43454.6
M1-5-8-BL	78	40.668297	-67.76859	13445.3	43458.3
M1-5-9-BL	82	40.665398	-67.77849	13448.6	43457.7
M1-5-BL	82	40.658897	-67.77010	13447.8	43455.1
M1-6-BL	104	40.571701	-67.75500	13466.1	43425.8
M1-7-BL	154	40.481300	-67.72121	13478.1	43392.2
M1-8-BL	146	40.452400	-67.62390	13460.0	43379.1
M1-9-BL	140	40.447098	-68.16660	13603.7	43395.0
M2-1-BL	58	41.206461	-67.24135	13172.1	43614.9
M2-10-BL	60	40.698715	-68.58421	13661.7	43502.7
M2-11-BL	80	40.513702	-68.56000	13697.9	43433.8
M2-12-BL	105	40.367607	-68.49506	13712.8	43377.5
M2-13-BL	60	40.487228	-70.20572	14201.6	43495.9

APPENDIX TABLE 1A.—*Navigation data for station blends analyzed for chemistry*—Continued

FIELD NUMBER	DEPTH, METERS	LATITUDE, DEGREES	LONGITUDE, DEGREES	T1, μSECONDS	T4, μSECONDS
M2-13-BL	60	40.487228	-70.20618	14201.7	43496.0
M2-13-BL	60	40.487228	-70.20618	14201.7	43496.0
M2-14-BL	120	41.569107	-68.97893	13553.3	43834.5
M2-15-BL	37	41.456955	-68.01035	13302.4	43735.2
M2-16-BL	134	40.579720	-67.19943	13324.6	43408.8
M2-17-BL	134	40.584610	-67.19200	13321.5	43410.1
M2-18-BL	150	40.557838	-67.20749	13331.9	43401.8
M2-2-BL	70	40.985954	-66.93346	13157.1	43531.6
M2-3-BL	95	40.892334	-66.77390	13144.2	43495.9
M2-4-BL	68	40.846664	-68.00339	13464.4	43529.3
M2-5-1-BL	81	40.658279	-67.76132	13447.1	43454.7
M2-5-10-BL	79	40.658340	-67.77768	13451.3	43455.3
M2-5-11-BL	78	40.651001	-67.77267	13451.8	43452.6
M2-5-12-BL	79	40.647667	-67.76193	13449.9	43451.0
M2-5-14-BL	80	40.659607	-67.74193	13441.7	43454.4
M2-5-16-BL	79	40.677231	-67.76382	13443.1	43461.3
M2-5-18-BL	78	40.659286	-67.78708	13453.5	43456.0
M2-5-2-BL	80	40.658112	-67.75479	13445.4	43454.4
M2-5-20-BL	80	40.637222	-67.76245	13452.5	43447.5
M2-5-22-BL	79	40.658562	-67.72194	13436.8	43453.3
M2-5-25-BL	80	40.660110	-67.81050	13459.4	43457.1
M2-5-25-BL	80	40.660110	-67.81050	13459.4	43457.1
M2-5-25-BL	80	40.660110	-67.81050	13459.4	43457.1
M2-5-28-BL	77	40.659714	-67.69646	13429.9	43452.8
M2-5-29-BL	83	40.662453	-67.83894	13466.3	43459.1
M2-5-3-BL	80	40.663559	-67.76178	13445.9	43456.5
M2-5-4-BL	81	40.658722	-67.76834	13448.8	43455.1
M2-5-5-BL	82	40.652672	-67.76083	13448.3	43452.8
M2-5-6-BL	81	40.657890	-67.74771	13443.6	43454.1
M2-5-8-BL	80	40.669449	-67.76172	13444.4	43458.6
M2-5-9-BL	80	40.667709	-67.77377	13448.0	43458.4
M2-6-BL	93	40.573563	-67.75261	13465.4	43425.3
M2-7-BL	160	40.477676	-67.71411	13478.3	43390.7
M2-8-BL	140	40.452560	-67.61922	13460.0	43379.1
M2-9-BL	140	40.445335	-68.16116	13603.7	43394.3
M2-9-BL	140	40.445335	-68.16116	13603.7	43394.3
M2-9-BL	140	40.445335	-68.16116	13603.7	43394.3
M3-1-BL	59	41.206455	-67.24136	13172.1	43615.3
M3-10-BL	61	40.699234	-68.58482	13661.6	43502.7
M3-11-BL	86	40.513283	-68.55872	13697.7	43433.5
M3-12-BL	105	40.368759	-68.49606	13712.9	43377.9
M3-13-BL	69	40.486832	-70.20700	14202.0	43495.9
M3-14-BL	140	41.568672	-68.97932	13553.5	43834.2
M3-15-BL	43	41.457680	-68.00932	13301.9	43735.5
M3-16-BL	141	40.572006	-67.20950	13328.9	43406.5
M3-17-BL	145	40.582283	-67.18594	13320.6	43409.2
M3-18-BL	146	40.557777	-67.22400	13335.9	43402.3

APPENDIX TABLE 1A.—*Navigation data for station blends analyzed for chemistry*—Continued

FIELD NUMBER	DEPTH, METERS	LATITUDE, DEGREES	LONGITUDE, DEGREES	T1, µSECONDS	T4 µSECONDS
M3-18-BL	146	40.557777	-67.22400	13335.9	43402.3
M3-18-BL	146	40.557838	-67.22421	13335.9	43402.3
M3-2-BL	73	40.987450	-66.93268	13156.5	43532.0
M3-3-BL	97	40.894775	-66.77695	13144.3	43496.8
M3-4-BL	66	40.846390	-68.00345	13464.5	43529.3
M3-4-BL	66	40.846390	-68.00345	13464.5	43529.3
M3-4-BL	66	40.846390	-68.00345	13464.5	43529.3
M3-5-1-BL	80	40.660606	-67.76472	13447.4	43455.7
M3-5-1-BL	80	40.660606	-67.76472	13447.4	43455.7
M3-5-1-BL	80	40.660606	-67.76472	13447.4	43455.7
M3-5-10-BL	81	40.658279	-67.77846	13451.6	43455.4
M3-5-11-BL	81	40.652840	-67.77261	13451.3	43453.3
M3-5-12-BL	80	40.650719	-67.76550	13450.0	43452.3
M3-5-14-BL	80	40.658279	-67.74162	13441.9	43454.0
M3-5-16-BL	79	40.676056	-67.76395	13443.4	43460.9
M3-5-18-BL	82	40.659561	-67.78778	13453.6	43456.2
M3-5-2-BL	81	40.659164	-67.75800	13446.0	43454.9
M3-5-20-BL	82	40.640053	-67.76306	13452.0	43448.5
M3-5-22-BL	81	40.659775	-67.72078	13436.1	43453.7
M3-5-25-BL	84	40.659225	-67.80905	13459.4	43456.9
M3-5-25-BL	84	40.659225	-67.80905	13459.4	43456.9
M3-5-25-BL	84	40.659225	-67.80905	13459.4	43456.9
M3-5-28-BL	77	40.658455	-67.69441	13429.7	43452.3
M3-5-29-BL	85	40.662674	-67.83972	13466.5	43459.2
M3-5-3-BL	80	40.664169	-67.76443	13446.3	43456.9
M3-5-4-BL	80	40.659386	-67.77022	13449.1	43455.4
M3-5-5-BL	81	40.654335	-67.76294	13448.5	43453.4
M3-5-6-BL	79	40.657997	-67.75328	13445.0	43454.3
M3-5-8-BL	81	40.667999	-67.76378	13445.3	43458.1
M3-5-9-BL	82	40.665222	-67.77434	13448.8	43457.7
M3-6-BL	99	40.574509	-67.75563	13465.9	43425.6
M3-7-BL	161	40.478455	-67.71371	13478.0	43391.0
M3-8-BL	148	40.453110	-67.61850	13459.6	43379.3
M3-9-BL	144	40.444389	-68.16129	13604.0	43394.0
M4-1-BL		41.206459	-67.24138	13172.5	43614.9
M4-10-BL	62	40.699997	-68.58490	13661.5	43503.0
M4-11-BL	83	40.513779	-68.55978	13697.9	43433.7
M4-12-BL	110	40.367279	-68.49568	13713.1	43377.3
M4-13-BL	70	40.486954	-70.20804	14202.3	43496.1
M4-13A-BL	83	40.500000	-71.00754	14463.9	43543.9
M4-14-BL	81	41.569511	-68.98065	13553.7	43834.8
M4-15-BL	40	41.458954	-68.01022	13301.9	43735.9
M4-16-BL	140	40.572334	-67.20840	13328.6	43406.6
M4-17-BL	130	40.584167	-67.18755	13320.6	43409.9
M4-18-BL	150	40.558609	-67.22543	13336.1	43402.6
M4-2-BL		40.988281	-66.93401	13156.6	43532.3
M4-3-BL	90	40.893448	-66.77756	13144.8	43496.4

APPENDIX TABLE 1A.—*Navigation data for station blends analyzed for chemistry*—Continued

FIELD NUMBER	DEPTH, METERS	LATITUDE, DEGREES	LONGITUDE, DEGREES	T1, μSECONDS	T4, μSECONDS
M4-4-BL	70	40.845230	-68.00328	13464.7	43528.9
M4-5-1-BL	80	40.658951	-67.76372	13447.5	43455.0
M4-5-10-BL	71	40.658058	-67.77744	13451.4	43455.2
M4-5-11-BL	78	40.652771	-67.77200	13451.2	43453.2
M4-5-12-BL	80	40.650833	-67.76517	13449.9	43452.3
M4-5-14-BL	80	40.658173	-67.74040	13441.6	43453.9
M4-5-16-BL	70	40.675392	-67.76309	13443.3	43460.6
M4-5-18-BL	70	40.659775	-67.78972	13454.1	43456.3
M4-5-2-BL	103	40.659164	-67.76035	13446.6	43455.0
M4-5-20-BL	82	40.639832	-67.76302	13452.0	43448.5
M4-5-22-BL	82	40.658836	-67.71829	13435.8	43453.3
M4-5-25-BL	88	40.659050	-67.80943	13459.5	43456.8
M4-5-25-BL	88	40.659050	-67.80943	13459.5	43456.8
M4-5-25-BL	88	40.659050	-67.80943	13459.5	43456.8
M4-5-28-BL	82	40.657951	-67.69510	13429.9	43452.1
M4-5-29-BL		40.662277	-67.84000	13466.6	43459.0
M4-5-3-BL	84	40.664505	-67.76453	13446.4	43457.0
M4-5-4-BL	71	40.659111	-67.77121	13449.5	43455.4
M4-5-5-BL	70	40.654716	-67.76462	13448.8	43453.6
M4-5-6-BL	110	40.658676	-67.75278	13444.8	43454.5
M4-5-8-BL	110	40.669052	-67.76428	13445.2	43458.7
M4-5-9-BL	65	40.664955	-67.77307	13448.5	43457.5
M4-6-BL	103	40.573669	-67.75545	13466.0	43425.4
M4-7-BL	130	40.480354	-67.71779	13478.6	43391.8
M4-8-BL	150	40.452774	-67.61940	13459.9	43379.2
M4-9-BL	70	40.444565	-68.16154	13604.1	43394.0

APPENDIX TABLE 1B.—*Navigation data for the individual samples analyzed for chemistry*

[T1 (Caribou, Maine) and T4 (Carolina Beach, N.C.) are Loran-C time delay values for the 9960 Loran-C chain]

FIELD NUMBER	DEPTH, METERS	LATITUDE, DEGREES	LONGITUDE, DEGREES	T1, μSECONDS	T4, μSECONDS
M1-13-G	72	40.486955	-70.20805	14202.5	23496.1
M1-13-H	72	40.486955	-70.20804	14202.4	43496.8
M1-13-I	72	40.486955	-70.20804	14202.3	43495.9
M1-14-M	124	41.569168	-68.98083	13554.4	43834.1
M1-14-N	124	41.567833	-68.98068	13553.7	43833.5
M1-14-O	124	41.567490	-68.98083	13553.9	43833.3
M1-16-A	101	40.573669	-67.21367	13328.4	43404.0
M1-16-B	101	40.573669	-67.21249	13328.1	43407.1
M1-16-C	101	40.573502	-67.21266	13328.1	43407.0
M1-17-G	142	40.585342	-67.19017	13319.3	43410.2
M1-17-H	142	40.583176	-67.18933	13320.1	43409.5
M1-17-I	142	40.584518	-67.18864	13319.6	43409.9
M1-18-A	146	40.559509	-67.22800	13335.3	43402.8
M1-18-B	146	40.558670	-67.22748	13335.4	43402.5
M1-18-C	146	40.559166	-67.22784	13335.3	43402.8
M1-2-A	72	40.987511	-66.93050	13156.0	43532.0
M1-2-B	72	40.986671	-66.93018	13156.2	43531.8
M1-2-C	72	40.987167	-66.93001	13156.1	43531.9
M1-4-M	65	40.846665	-68.00380	13464.1	43529.4
M1-4-N	65	40.846664	-68.00383	13464.5	43529.5
M1-4-O	65	40.846664	-67.00382	13464.6	43529.5
M1-5-G	82	40.659325	-67.76999	13447.8	43455.2
M1-5-G	82	40.659325	-67.76999	13447.8	43455.2
M1-5-H	82	40.659836	-67.77049	13447.8	43455.4
M1-5-I	82	40.657669	-67.76967	13447.9	43454.6
M2-16-G	134	40.579330	-67.19882	13324.5	43408.6
M2-16-H	132	40.580002	-67.20016	13324.7	43408.9
M2-16-I	137	40.579834	-67.19933	13324.5	43408.8
M2-17-G	135	40.584000	-67.19133	13321.5	43409.8
M2-17-H	134	40.584671	-67.19133	13321.3	43410.1
M2-17-I	134	40.585167	-67.19333	13321.7	43410.4
M2-18-G	151	40.557175	-67.20732	13332.0	43401.5
M2-18-H	149	40.559341	-67.20932	13332.0	43402.4
M2-18-I	151	40.556999	-67.20584	13331.7	43401.4
M2-4-G	67	40.846336	-68.00302	13464.4	43529.2
M2-4-H	69	40.846664	-68.00383	13464.5	43529.4
M2-4-I	69	40.847000	-68.00333	13464.2	43529.4
M2-5-1-G	81	40.657997	-67.76167	13447.3	43454.6
M2-5-1-H	81	40.657997	-67.76151	13447.1	43454.6
M2-5-1-I	81	40.658836	-67.76083	13446.9	43454.9
M3-16-G	141	40.571671	-67.20866	13328.8	43406.4
M3-16-H	141	40.572006	-67.21049	13329.2	43406.5
M3-16-I	141	40.572334	-67.20932	13328.8	43406.7
M3-17-G	145	40.581673	-67.18550	13320.7	43409.0
M3-17-H	145	40.582504	-67.18582	13320.6	43409.3
M3-17-I	145	40.582672	-67.18649	13320.6	43409.3
M3-18-G	146	40.557999	-67.22467	13336.0	43402.4

APPENDIX TABLE 1B.—*Navigation data for the individual samples analyzed for chemistry*—Continued

FIELD NUMBER	DEPTH, METERS	LATITUDE, DEGREES	LONGITUDE, DEGREES	T1, μSECONDS	T4, μSECONDS
M3-18-H	146	40.557838	-67.22450	13336.0	43402.3
M3-18-I	146	40.557510	-67.22282	13335.7	43402.1
M3-4-G	66	40.846176	-68.00349	13464.6	43529.2
M3-4-H	66	40.846512	-68.00284	13464.3	43529.3
M3-4-I	66	40.846512	-68.00400	13464.6	43529.3
M3-5-1-G	80	40.660675	-67.76550	13447.5	43455.7
M3-5-1-H	80	40.660675	-67.76434	13447.3	43455.7
M3-5-1-I	80	40.660507	-67.76434	13447.3	43455.7
M4-13A-G	83	40.500000	-71.00732	14463.8	43543.9
M4-13A-H	83	40.499672	-71.00749	14463.8	43543.9
M4-13A-I	83	40.500000	-71.00784	14464.0	43543.9
M4-13A-I	83	40.500000	-71.00784	14464.0	43543.9
M4-16-G	140	40.572838	-67.20818	13328.4	43406.8
M4-16-H	140	40.572670	-67.20818	13328.4	43406.7
M4-16-H	140	40.572670	-67.20818	13328.4	43406.7
M4-16-I	140	40.571510	-67.20883	13328.9	43406.3
M4-17-G	130	40.583511	-67.18750	13320.7	43409.7
M4-17-H	130	40.584831	-67.18784	13320.5	43410.1
M4-17-I	130	40.584167	-67.18733	13320.5	43409.8
M4-18-G	150	40.557999	-67.22568	13336.3	43402.4
M4-18-H	150	40.559166	-67.22467	13335.7	43402.7
M4-18-I	150	40.558670	-67.22600	13336.2	43402.6
M4-2-G	66	40.987831	-66.93333	13156.6	43532.1
M4-2-H	66	40.988998	-66.93466	13156.6	43532.7
M4-2-I	66	40.987999	-66.93401	13156.7	43532.2
M4-5-1-G	80	40.658997	-67.76382	13447.5	43455.1
M4-5-1-H	80	40.658997	-67.76367	13447.5	43455.0
M4-5-1-I	80	40.658836	-67.76367	13447.5	43455.0
M4-5-18-G	70	40.658340	-67.78883	13454.2	43455.7
M4-5-18-H	70	40.660339	-67.78983	13454.0	43456.5
M4-5-18-I	70	40.660675	-67.79050	13454.1	43456.6
M4-5-28-G	82	40.657509	-67.69467	13429.9	43452.0
M4-5-28-H	82	40.657997	-67.69467	13429.8	43452.1
M4-5-28-I	82	40.658340	-67.69600	13430.1	43452.3
M4-5-29-G		40.661667	-67.83981	13466.8	43458.9
M4-5-29-H		40.663338	-67.84117	13466.7	43459.4
M4-5-29-I		40.661835	-67.83902	13466.4	43458.8

APPENDIX TABLE 2A.—*Textural analyses of station blends*

SAMPLE ID	GRAVL%	SAND%	SILT%	CLAY%	MEAN ϕ	MEDIAN ϕ	STAND DEV ϕ	% VERY COARSE SAND	% COARSE SAND	% MEDIUM SAND	% FINE SAND	% VERY FINE SAND
M1-1-BL	0.53	99.35	0.05	0.07	2.09	2.10	0.61	0.00	0.00	44.71	49.67	4.97
M1-10-BL	1.43	98.33	.08	.17	2.01	1.99	.74	.00	.00	49.16	44.25	4.91
M1-11-BL	.00	97.95	.88	1.17	3.20	3.18	.82	.00	.00	.00	39.18	58.77
M1-12-BL	.00	97.27	1.10	1.63	1.82	1.63	1.28	.00	19.45	48.64	24.32	4.86
M1-13-BL	.00	52.61	40.95	6.44	4.75	3.95	1.70	.00	.00	.00	2.63	49.98
M1-14-BL	2.55	87.91	2.88	6.67	1.43	.80	2.39	8.79	48.35	30.77	.00	.00
M1-15-BL	5.05	94.87	.04	.04	1.73	1.79	.85	.00	.00	56.92	37.95	.00
M1-16-BL	1.97	97.55	.21	.27	.54	.53	.84	19.51	53.66	24.39	.00	.00
M1-17-BL	.88	98.78	.15	.19	1.05	.99	.83	4.94	44.45	39.51	9.88	.00
M1-18-BL	.00	99.24	.31	.45	2.39	2.41	.63	.00	.00	19.85	74.43	4.96
M1-2-BL	.46	99.45	.05	.04	1.33	1.39	.59	1.99	20.88	67.63	8.95	.00
M1-3-BL	1.87	96.63	.61	.89	2.27	2.22	1.09	.00	.00	38.65	43.48	14.50
M1-4-BL	.00	99.71	.13	.17	2.67	2.59	.37	.00	.00	.00	84.75	14.96
M1-5-10-BL	.33	99.22	.28	.17	.80	.69	.74	5.95	63.50	25.80	3.97	.00
M1-5-11-BL	.00	99.46	.35	.19	1.12	1.11	.76	2.98	41.78	47.73	6.97	.00
M1-5-12-BL	1.52	98.05	.25	.18	1.26	1.30	.89	3.92	30.40	47.06	16.67	.00
M1-5-14-BL	.00	99.57	.26	.17	.98	.88	.69	1.99	54.77	38.83	3.98	.00
M1-5-16-BL	.93	98.53	.34	.20	.63	.54	.91	19.70	54.20	18.72	5.91	.00
M1-5-18-BL	.15	99.27	.36	.22	1.00	.90	.82	4.97	49.63	37.72	6.95	.00
M1-5-2-BL	1.38	98.25	.22	.16	.84	.76	.80	6.88	55.02	31.44	4.91	.00
M1-5-20-BL	1.70	97.91	.24	.16	.76	.66	.75	4.89	65.60	23.50	3.92	.00
M1-5-22-BL	.00	99.70	.18	.11	.95	.84	.59	.00	59.82	36.89	2.99	.00
M1-5-25-BL	.28	99.03	.42	.27	1.05	.93	.84	2.97	50.51	37.63	7.93	.00
M1-5-28-BL	1.03	98.74	.14	.09	.77	.69	.66	4.94	64.18	26.66	2.96	.00
M1-5-29-BL	13.43	83.32	2.24	1.00	1.94	2.24	1.72	.00	3.34	21.66	47.49	10.83
M1-5-3-BL	1.67	97.77	.23	.33	1.92	1.88	.97	.00	9.78	44.00	35.19	8.80
M1-5-4-BL	.64	98.85	.34	.17	.98	.90	.82	5.93	48.43	37.56	6.92	.00
M1-5-5-BL	.32	99.28	.26	.14	1.00	.91	.70	1.99	52.61	39.72	4.96	.00
M1-5-6-BL	1.29	98.31	.27	.13	.89	.81	.77	4.91	54.07	34.41	4.92	.00
M1-5-8-BL	2.78	96.81	.25	.15	.58	.54	.87	17.43	55.18	20.33	3.87	.00
M1-5-9-BL	.74	5.92	.33	.20	.91	.81	.81	5.92	53.32	34.55	4.94	.00
M1-5-BL	.35	99.21	.29	.15	1.04	.92	.84	4.96	48.61	35.72	8.93	.99
M1-6-BL	1.02	96.22	1.13	1.63	2.33	2.27	1.35	.00	9.62	28.86	38.49	19.25
M1-7-BL	2.38	94.88	1.31	1.43	1.51	1.34	1.39	.00	33.20	42.70	14.23	4.75
M1-8-BL	.00	97.79	1.22	.99	1.97	1.80	1.17	.00	14.67	44.00	29.34	9.78
M1-9-BL	.00	98.76	.43	.81	2.57	2.52	.97	.00	.00	29.63	39.50	29.63
M2-1-BL	.00	99.89	.05	.06	1.91	2.00	.63	.00	9.99	39.95	49.95	.00
M2-10-BL	.34	99.58	.04	.04	1.49	1.50	.69	.00	24.90	49.79	24.89	.00
M2-11-BL	.00	99.12	.38	.50	2.95	2.84	.65	.00	.00	.00	59.47	39.65
M2-12-BL	.00	96.47	2.38	1.15	1.96	1.74	1.24	.00	14.47	48.24	26.05	7.71
M2-13-BL	.00	61.33	27.43	11.24	4.77	3.79	2.01	.00	.00	.00	6.13	55.20
M2-14-BL	2.48	91.67	3.26	2.59	1.06	.67	1.76	4.59	64.16	21.09	1.83	.00
M2-15-BL	3.15	96.77	.06	.02	1.63	1.71	.86	3.87	3.87	55.16	33.87	.00
M2-16-BL	7.39	92.23	.19	.18	.65	.66	.96	9.23	50.72	28.59	3.69	.00
M2-17-BL	.98	98.57	.22	.23	.91	.89	.73	4.93	49.28	44.36	.00	.00
M2-18-BL	.28	98.96	.37	.40	1.97	1.96	.74	.00	3.96	47.50	47.50	.00
M2-2-BL	1.53	98.43	.02	.02	1.26	1.32	.64	.00	29.53	59.06	9.84	.00
M2-3-BL	.62	98.27	.39	.72	2.13	2.18	.90	.00	3.93	35.38	56.99	1.97
M2-4-BL	.00	99.88	.05	.07	2.61	2.56	.22	.00	.00	.00	89.89	9.99
M2-5-10-BL	.23	99.18	.28	.30	.74	.65	.87	13.89	55.54	25.79	3.96	.00
M2-5-11-BL	.42	99.06	.27	.26	.87	.77	.86	9.90	51.51	31.70	5.94	.00
M2-5-12-BL	2.04	97.60	.15	.21	.77	.68	.77	4.88	63.45	25.37	3.91	.00

APPENDIX TABLE 2A.—*Textural analyses of station blends*—Continued

SAMPLE ID	GRAVL%	SAND%	SILT%	CLAY%	MEAN φ	MEDIAN φ	STAND DEV φ	% VERY COARSE SAND	% COARSE SAND	% MEDIUM SAND	% FINE SAND	% VERY FINE SAND
M2-5-14-BL	0.51	99.17	0.14	0.17	0.73	0.65	0.70	7.94	63.47	25.78	1.99	0.00
M2-5-16-BL	4.77	94.78	.23	.23	.67	.65	.97	14.21	47.39	28.43	4.74	.00
M2-5-18-BL	.16	99.33	.23	.28	.89	.75	.80	4.96	59.60	28.81	5.96	.00
M2-5-2-BL	1.28	98.40	.17	.15	.91	.84	.79	5.90	51.17	35.43	5.90	.00
M2-5-20-BL	.43	99.01	.31	.24	.78	.70	.90	14.86	49.50	30.70	2.97	.99
M2-5-22-BL	.00	99.61	.21	.18	.92	.77	.78	3.98	59.77	30.88	2.99	1.99
M2-5-25-BL	1.66	97.65	.33	.36	1.17	1.04	.99	1.95	44.92	36.13	12.69	1.96
M2-5-28-BL	2.21	97.52	.12	.15	.55	.53	.82	19.50	53.63	22.43	1.95	.00
M2-5-29-BL	6.51	91.25	1.38	.86	2.05	2.22	1.36	.00	4.57	27.37	52.01	7.30
M2-5-3-BL	2.00	97.53	.31	.17	.88	.87	.88	9.75	43.89	39.01	4.88	.00
M2-5-4-BL	.38	99.17	.22	.23	.98	.90	.79	4.96	49.58	38.68	5.95	.00
M2-5-5-BL	.31	99.11	.31	.27	.86	.73	.89	9.91	54.51	26.76	7.93	.00
M2-5-6-BL	.39	99.26	.15	.20	.97	.90	.76	4.96	49.63	39.71	4.96	.00
M2-5-8-BL	1.59	97.83	.31	.27	.86	.79	.91	9.78	48.92	33.26	5.87	.00
M2-5-9-BL	1.64	97.61	.41	.34	.73	.63	.97	14.64	53.69	23.43	5.85	.00
M2-5-BL	2.01	97.59	.21	.20	.88	.80	.82	4.87	53.68	34.15	4.88	.00
M2-6-BL	.85	96.03	1.78	1.35	2.16	2.08	1.29	.00	9.60	36.49	40.33	9.60
M2-7-BL	11.87	85.21	1.90	1.02	1.18	1.16	1.59	1.70	30.68	35.79	12.78	4.26
M2-8-BL	.00	98.31	1.12	.57	1.72	1.59	1.02	.00	19.66	51.12	22.62	4.91
M2-9-BL	.00	98.51	.98	.51	2.20	2.13	.88	.00	1.97	42.36	44.33	9.85
M3-5-25-BL	.74	98.27	.51	.48	1.32	1.24	1.03	1.97	37.34	41.27	15.72	1.97
M3-1-BL	.00	99.92	.05	.03	1.85	1.82	.52	.00	5.00	54.95	39.97	.00
M3-10-BL	.00	99.04	.60	.36	2.15	2.19	.80	.00	4.95	34.67	54.47	4.95
M3-11-BL	.00	96.74	1.76	1.50	3.13	2.99	.97	.00	.00	.00	50.30	46.44
M3-12-BL	4.72	90.47	2.83	1.97	1.54	1.39	1.60	.00	27.15	47.04	14.48	1.81
M3-13-BL	.00	52.11	30.00	17.89	5.20	3.96	2.33	.00	.00	.00	5.21	46.90
M3-14-BL	9.82	86.12	2.42	1.63	1.01	.77	1.68	1.73	49.95	27.56	3.44	3.45
M3-15-BL	1.81	98.11	.06	.02	2.02	2.06	.69	.00	.00	45.13	49.06	3.92
M3-16-BL	1.06	98.31	.35	.28	1.19	1.18	.93	4.92	36.37	42.27	14.75	.00
M3-17-BL	.00	99.32	.42	.26	1.28	1.25	.90	3.97	35.76	41.72	17.87	.00
M3-18-BL	.00	99.02	.54	.43	2.14	2.11	.74	.00	.00	44.56	50.50	3.96
M3-2-BL	1.15	98.77	.05	.03	1.27	1.32	.63	.00	29.63	59.27	9.87	.00
M3-3-BL	7.90	90.43	.83	.84	1.89	2.11	1.32	.00	1.81	34.36	54.26	.00
M3-4-BL	.00	98.29	.93	.79	2.73	2.60	.72	.00	.00	.00	83.54	14.75
M3-5-10-BL	.27	99.12	.33	.28	1.04	.91	.82	1.98	52.53	36.68	7.92	.00
M3-5-11-BL	.00	99.47	.27	.25	1.29	1.24	.85	1.99	37.80	41.78	17.90	.00
M3-5-12-BL	.00	99.80	.11	.10	1.44	1.46	.71	2.00	22.95	54.89	19.96	.00
M3-5-14-BL	.33	99.20	.26	.22	1.14	1.05	.77	.00	47.61	41.67	9.92	.00
M3-5-18-BL	.78	98.48	.40	.33	1.12	1.00	.96	4.92	44.32	35.45	13.79	.00
M3-5-2-BL	.60	98.39	.67	.34	1.03	.90	.94	4.92	49.20	36.40	7.87	.00
M3-5-20-BL	.00	99.70	.18	.12	1.22	1.21	.73	1.99	37.89	47.86	11.96	.00
M3-5-22-BL	.00	99.51	.26	.23	.96	.85	.78	4.98	52.74	35.82	5.97	.00
M3-5-28-BL	2.57	97.09	.19	.16	.76	.71	.85	9.70	53.40	29.13	4.86	.00
M3-5-29-BL	2.98	93.48	1.89	1.65	2.37	2.35	1.36	.00	1.87	26.17	54.22	11.22
M3-5-3-BL	1.38	98.02	.36	.24	.95	.81	.90	4.91	53.91	29.40	9.81	.00
M3-5-4-BL	.45	98.78	.43	.35	.84	.73	.91	9.87	54.33	29.63	4.94	.00
M3-5-5-BL	.45	99.11	.27	.17	1.15	1.11	.78	1.98	42.61	44.60	9.91	.00
M3-5-6-BL	.20	98.65	.63	.52	1.09	.97	.93	1.97	49.33	41.43	5.92	.00
M3-5-8-BL	2.36	96.90	.41	.33	1.03	1.03	1.00	7.75	38.76	40.70	9.69	.00
M3-5-9-BL	1.95	97.45	.33	.27	.95	.83	.93	5.85	50.67	31.18	9.75	.00
M3-5-BL	.87	98.46	.36	.32	1.16	1.13	.87	1.97	41.35	45.29	9.84	.00

APPENDIX TABLE 2A.—*Textural analyses of station blends*—Continued

SAMPLE ID	GRAVL%	SAND%	SILT%	CLAY%	MEAN ϕ	MEDIAN ϕ	STAND DEV ϕ	% VERY COARSE SAND	% COARSE SAND	% MEDIUM SAND	% FINE SAND	% VERY FINE SAND
M3-6-BL	3.52	93.00	2.00	1.48	2.48	2.45	1.36	0.00	0.00	23.25	51.15	18.60
M3-7-BL	24.71	72.66	1.69	.94	.89	.99	1.89	5.81	19.62	25.44	13.07	8.72
M3-8-BL	.16	97.98	1.18	.68	2.03	1.85	1.07	.00	9.80	47.03	29.40	11.76
M3-9-BL	.00	97.04	2.20	.76	2.51	2.43	.97	.00	.00	29.11	48.52	19.41
M4-1-BL	.58	99.18	.14	.10	2.26	2.34	.54	.00	.00	24.79	72.40	1.98
M4-10-BL	2.37	97.43	.12	.08	1.88	1.98	.77	.00	4.87	43.84	48.72	.00
M4-11-BL	.00	95.70	2.54	1.76	3.05	2.80	1.06	.00	.00	.00	62.21	33.49
M4-12-BL	.34	94.99	3.10	1.56	2.00	1.82	1.39	.00	17.10	39.90	32.30	5.70
M4-13-BL	.00	51.26	35.22	13.52	4.97	3.97	2.09	.00	.00	.00	5.13	46.13
M4-13A-BL	.00	4.55	74.33	21.12	6.36	5.94	1.82	.00	.00	.00	.00	4.55
M4-14-BL	3.67	78.38	11.41	6.54	2.05	.98	2.70	3.92	43.11	21.95	5.48	3.92
M4-15-BL	3.98	95.91	.07	.04	1.75	1.79	.81	.00	1.92	55.63	38.37	.00
M4-16-BL	.75	98.30	.51	.44	1.14	1.00	1.02	4.92	44.23	34.41	14.74	.00
M4-17-BL	2.56	96.88	.32	.24	1.01	.94	.92	3.88	46.50	36.81	9.69	.00
M4-18-BL	.44	98.52	.56	.49	3.03	3.01	.72	.00	.00	.00	49.25	49.26
M4-2-BL	1.45	98.43	.07	.05	1.48	1.49	.74	.00	19.69	59.06	17.71	1.97
M4-3-BL	4.97	93.28	1.03	.72	2.04	2.15	1.21	.00	1.87	35.44	51.31	4.66
M4-4-BL	.00	99.56	.19	.25	2.67	2.59	.43	.00	.00	.00	84.62	14.94
M4-5-10-BL	.00	98.92	.63	.45	1.04	.86	.97	4.95	52.43	31.65	9.89	.00
M4-5-11-BL	.00	99.22	.46	.31	1.22	1.13	.91	2.98	41.67	39.69	14.88	.00
M4-5-12-BL	.00	99.66	.22	.11	1.50	1.49	.64	.00	19.93	61.79	17.94	.00
M4-5-14-BL	.00	98.88	.69	.43	.97	.83	.93	4.94	54.39	34.60	4.95	.00
M4-5-16-BL	5.25	93.71	.62	.42	1.10	1.17	1.17	7.49	29.99	42.17	14.06	.00
M4-5-18-BL	.52	98.43	.65	.40	.93	.75	.95	4.92	59.06	26.58	7.87	.00
M4-5-2-BL	3.56	95.81	.37	.25	.92	.85	1.05	9.59	43.11	33.53	7.67	1.92
M4-5-20-BL	.00	99.54	.29	.17	2.27	2.28	.66	.00	.00	34.84	54.75	9.95
M4-5-22-BL	.00	99.31	.44	.25	1.03	.91	.79	1.99	52.63	38.73	5.96	.00
M4-5-25-BL	.21	99.12	.38	.29	1.30	1.22	.98	3.97	37.66	37.66	17.84	1.99
M4-5-28-BL	1.46	97.91	.36	.27	.80	.69	.87	7.83	58.75	26.43	4.90	.00
M4-5-29-BL	18.44	78.58	1.61	1.37	1.74	2.15	1.90	.00	3.15	22.00	42.44	11.00
M4-5-3-BL	.00	99.20	.50	.30	1.05	.91	.92	4.96	49.60	36.70	5.96	1.98
M4-5-4-BL	.00	99.30	.41	.28	1.02	.82	.92	4.97	54.61	29.79	7.95	1.98
M4-5-5-BL	.46	99.04	.30	.20	1.00	.85	.83	3.97	53.47	31.70	9.90	.00
M4-5-6-BL	.65	98.69	.36	.29	1.01	.90	.88	4.94	49.34	36.52	7.90	.00
M4-5-8-BL	1.82	97.31	.56	.31	.97	.84	.97	5.84	50.60	31.14	9.73	.00
M4-5-9-BL	2.15	96.65	.74	.45	.92	.79	1.09	9.67	48.33	28.99	9.67	.00
M4-5-BL	5.06	93.93	.57	.45	1.01	.95	1.09	2.81	44.15	37.57	9.39	.00
M4-6-BL	.63	95.74	2.29	1.34	2.55	2.44	1.17	.00	.00	26.80	51.70	17.24
M4-7-BL	3.90	91.58	3.01	1.51	1.63	1.41	1.59	.00	32.05	33.89	18.32	7.32
M4-8-BL	.00	97.07	1.64	1.29	2.02	1.82	1.23	.00	11.65	46.59	31.06	7.77
M4-9-BL	.00	96.84	2.27	.89	2.53	2.43	1.02	.00	.00	29.05	48.42	19.37

Appendix table 2B.—*Textural analyses of individual samples*

SAMPLE ID	GRAVL%	SAND%	SILT%	CLAY%	MEAN ϕ	MEDIAN ϕ	STAND DEV ϕ	% VERY COARSE SAND	% COARSE SAND	% MEDIUM SAND	% FINE SAND	% VERY FINE SAND
M1-13G	0.00	47.70	43.86	8.44	4.92	4.17	1.85	0.00	0.00	0.00	4.77	42.93
M1-13H	.00	54.56	39.23	6.21	4.70	3.91	1.73	.00	.00	.00	5.46	49.10
M1-13I	.00	50.42	41.56	8.02	4.91	3.99	1.83	.00	.00	.00	4.03	46.39
M1-14G	.00	97.87	1.23	.90	.75	.60	1.16	14.68	58.72	24.47	.00	.00
M1-14H	.00	75.91	16.80	7.29	2.18	.80	2.92	7.59	53.14	15.18	.00	.00
M1-14I	.00	79.90	12.09	8.01	2.03	.87	2.87	11.98	43.95	23.97	.00	.00
M1-16-B	1.64	97.84	.32	.19	.36	.35	.81	.00	53.81	14.68	.00	.00
M1-16-C	.53	98.86	.38	.23	.53	.50	.80	19.78	59.31	19.78	.00	.00
M1-16A	1.30	97.95	.47	.28	.43	.39	.91	29.38	48.97	19.59	.00	.00
M1-2A	.19	99.72	.05	.04	1.43	1.46	.49	1.00	13.96	75.78	8.98	.00
M1-2B	.59	99.29	.07	.05	1.12	1.18	.62	1.99	37.73	54.61	4.96	.00
M1-2C	.39	99.51	.05	.05	1.23	1.31	.57	1.99	27.86	64.69	4.97	.00
M1-4M	.00	99.68	.18	.14	2.62	2.56	.31	.00	.00	.00	89.71	9.97
M1-4N	.00	99.64	.20	.16	2.57	2.53	.26	.00	.00	.00	94.66	4.98
M1-4O	.00	99.15	.47	.38	2.54	2.50	.51	.00	.00	4.96	89.24	4.95
M1-5-18A	.12	99.46	.26	.15	.92	.82	.74	4.98	54.70	34.81	4.98	.00
M1-5-18B	.68	98.80	.35	.17	.95	.82	.82	4.94	54.34	31.62	7.90	.00
M1-5-18C	.27	98.95	.45	.32	.93	.78	.84	3.96	58.38	31.67	4.95	.00
M1-5-28M	.86	98.94	.12	.07	.85	.76	.66	3.96	59.36	31.67	3.95	.00
M1-5-28N	2.57	97.19	.15	.09	.86	.84	.75	4.86	50.54	38.88	2.91	.00
M1-5-28O	1.70	98.04	.18	.08	.85	.80	.70	4.90	53.92	37.26	1.96	.00
M1-5-29G	9.20	88.35	1.68	.77	1.95	2.11	1.48	.00	1.77	34.46	43.29	8.83
M1-5-29H	16.97	81.37	1.18	.47	1.63	2.09	1.69	1.63	3.25	24.42	43.12	8.95
M1-5-29I	28.60	68.82	1.94	.65	1.22	1.75	1.98	.68	2.76	24.08	34.41	6.88
M1-5G	.35	99.24	.27	.14	.97	.90	.75	4.96	49.62	39.70	4.96	.00
M1-5H	.94	98.45	.43	.18	.95	.86	.85	5.91	50.21	35.44	6.89	.00
M1-5I	.35	98.96	.49	.20	1.00	.89	.86	4.94	50.48	36.61	5.94	.99
M2-13-I	.00	62.07	26.72	11.21	4.67	3.78	1.99	.00	.00	.00	6.21	55.86
M2-13G	.00	57.10	23.37	19.53	5.12	3.86	2.36	.00	.00	.00	5.71	51.39
M2-13H	.00	55.33	33.34	11.34	4.85	3.90	1.96	.00	.00	.00	2.77	52.56
M2-14G	1.15	98.74	.08	.03	.80	.74	.53	1.97	63.20	33.57	.00	.00
M2-14H	3.85	80.84	8.93	6.38	1.72	.85	2.60	6.47	46.89	23.44	4.04	.00
M2-14I	2.89	92.12	2.80	2.19	.93	.62	1.68	11.06	58.03	21.19	1.84	.00
M2-16G	5.72	93.75	.28	.25	.44	.45	.95	20.62	52.50	18.76	1.87	.00
M2-16H	3.22	96.06	.36	.36	1.04	1.17	1.02	9.60	28.82	49.95	7.69	.00
M2-16I	5.16	94.49	.19	.17	.71	.74	.91	11.34	45.35	35.90	1.89	.00
M2-2G	.51	99.41	.04	.04	1.36	1.39	.59	.00	24.85	62.63	11.93	.00
M2-2H	.00	99.92	.04	.04	1.34	1.36	.66	2.00	27.98	54.95	14.99	.00
M2-2I	.52	99.44	.02	.02	1.66	1.60	.51	.00	4.97	74.58	17.90	1.99
M2-4G	.44	99.52	.02	.02	2.51	2.51	.36	.00	.00	4.97	86.59	7.96
M2-4H	4.02	95.86	.04	.08	2.44	2.53	.83	.00	.00	.00	86.28	9.59
M2-4I	.00	99.88	.04	.07	2.56	2.53	.33	.00	.00	4.99	84.91	9.98
M2-5-18G	.47	99.18	.16	.20	.89	.75	.79	4.96	59.51	26.77	7.94	.00
M2-5-18H	.00	99.59	.18	.23	.91	.78	.83	7.97	53.78	29.88	7.97	.00
M2-5-18I	.00	99.45	.25	.30	1.10	1.01	.85	3.98	45.75	39.78	9.94	.00
M2-5-28G	4.68	95.02	.16	.15	.72	.70	.86	7.60	54.16	29.45	3.80	.00
M2-5-28H	3.23	96.43	.16	.18	.65	.63	.83	11.57	55.93	27.00	1.93	.00
M2-5-28I	2.71	96.93	.21	.15	.80	.78	.85	9.70	48.46	34.89	3.88	.00
M2-5-29G	8.59	89.18	1.29	.93	2.04	2.23	1.51	.00	4.46	26.76	44.59	13.38
M2-5-29H	7.46	90.73	1.09	.72	2.04	2.26	1.38	.00	4.53	24.50	52.63	9.07
M2-5-29I	6.77	91.26	1.15	.81	1.98	2.14	1.36	.00	4.57	31.94	47.45	7.31
M2-5G	1.05	98.56	.20	.19	.93	.84	.80	4.92	52.24	35.48	5.91	.00
M2-5H	.64	98.91	.24	.021	0.94	.82	.82	4.95	54.39	31.66	7.91	.00
M2-5I	2.26	97.25	.25	.24	.59	.53	.93	19.45	53.49	19.45	4.86	.00
M3-13-G	.00	59.05	31.48	9.48	4.67	3.84	1.85	.00	.00	.00	2.95	56.10
M3-13-H	.00	46.08	34.43	19.49	5.41	4.34	2.33	.00	.00	.00	2.30	43.78
M3-13-I	.00	34.90	44.17	20.93	5.70	5.05	2.28	.00	.00	.00	1.74	33.16
M3-14-G	.00	99.58	.30	.12	1.01	.96	.73	4.98	46.80	41.82	5.98	.00

APPENDIX TABLE 2B.—*Textural analyses of individual samples*—Continued

SAMPLE ID	GRAVL%	SAND%	SILT%	CLAY%	MEAN ϕ	MEDIAN ϕ	STAND DEV ϕ	% VERY COARSE SAND	% COARSE SAND	% MEDIUM SAND	% FINE SAND	% VERY FINE SAND
M3-14-H	0.00	99.59	0.25	0.15	0.91	0.78	0.67	1.99	61.75	31.87	3.98	0.00
M3-14-I	6.16	77.25	9.52	7.07	1.77	.83	2.82	12.36	37.85	20.86	3.09	3.09
M3-16-G	1.05	98.38	.32	.25	1.38	1.40	.88	1.97	27.55	49.19	19.68	.00
M3-16-H	.49	98.87	.34	.30	1.03	1.00	.95	9.89	39.54	39.55	9.89	.00
M3-16-I	.00	99.20	.38	.42	1.25	1.23	.95	4.96	34.72	44.64	14.88	.00
M3-2G	.00	99.92	.06	.02	1.35	1.39	.52	.00	24.98	64.95	9.99	.00
M3-2H	1.09	98.84	.06	.02	1.27	1.38	.69	4.94	19.76	64.25	9.88	.00
M3-2I	.54	99.38	.06	.02	1.30	1.38	.65	3.97	20.88	64.59	9.94	.00
M3-4G	.00	99.10	.49	.41	2.62	2.55	.53	.00	.00	1.98	87.21	9.91
M3-4H	.00	99.71	.14	.15	2.60	2.55	.35	.00	.00	1.99	87.75	9.97
M3-4I	.57	98.91	.26	.26	2.56	2.53	.56	.00	.00	3.95	85.06	9.90
M3-5-16	1.67	97.97	.19	.16	1.20	1.24	.89	4.90	32.33	46.05	14.69	.00
M3-5-18-G	.43	99.01	.32	.23	1.00	.89	.82	3.96	51.49	35.65	7.92	.00
M3-5-18-H	.47	98.40	.66	.46	1.07	.82	1.09	4.92	54.13	27.55	7.87	3.94
M3-5-18-I	.97	98.22	.45	.36	1.03	.86	.91	1.97	55.00	31.43	9.82	.00
M3-5-28-G	4.63	94.95	.26	.17	.50	.51	.89	18.99	52.22	21.83	1.90	.00
M3-5-28-H	3.10	96.59	.18	.14	.55	.52	.92	24.15	43.46	25.11	3.87	.00
M3-5-28-I	2.93	96.58	.26	.22	.79	.73	.83	4.83	57.95	30.90	2.90	.00
M3-5-29-G	4.31	91.59	2.43	1.67	2.25	2.22	1.51	.00	4.58	32.05	41.22	13.74
M3-5-29-H	3.52	92.91	2.02	1.55	2.46	2.45	1.36	.00	1.86	16.72	61.33	13.00
M3-5-29-I	11.91	85.32	1.54	1.23	1.95	2.24	1.67	.00	4.27	21.33	51.19	8.53
M3-5-G	.52	98.83	.31	.34	1.13	1.11	.90	4.95	39.53	44.47	9.89	.00
M3-5-H	.00	99.35	.32	.33	.93	.76	.86	4.97	59.61	26.82	7.95	.00
M3-5-I	1.44	98.16	.19	.20	.92	.81	.83	4.91	53.99	31.42	7.85	.00
M4-13A-G	.00	3.49	75.97	20.54	6.40	6.06	1.73	.00	.00	.00	.00	3.49
M4-13A-H	.00	3.67	70.97	25.35	6.51	6.11	1.86	.00	.00	.00	.00	3.67
M4-13A-I	.00	4.28	74.30	21.42	6.39	6.01	1.78	.00	.00	.00	.00	4.28
M4-13G	.00	55.88	30.68	13.44	4.82	3.87	2.16	.00	.00	.00	11.18	44.70
M4-13H	.00	50.21	37.33	12.47	4.96	4.00	2.05	.00	.00	.00	5.02	45.19
M4-13I	.00	51.82	34.33	13.85	4.93	3.96	2.12	.00	.00	.00	7.77	44.05
M4-14G	2.62	82.06	8.80	6.52	2.06	1.22	2.55	2.46	38.57	28.72	8.21	4.10
M4-14H	4.97	68.88	16.21	9.95	2.70	1.58	3.05	3.44	27.55	24.11	10.33	3.45
M4-14I	1.67	83.21	8.85	6.27	1.93	.97	2.56	4.16	45.77	24.96	4.16	4.16
M4-16G	.65	98.48	.47	.40	.89	.82	1.03	14.77	42.34	33.49	7.87	.00
M4-16H	.99	98.10	.42	.49	.99	.94	1.11	14.71	36.30	35.31	11.78	.00
M4-16I	.24	99.13	.34	.29	1.06	1.00	.91	7.93	41.63	39.65	9.92	.00
M4-2G	.73	99.19	.05	.03	1.53	1.53	.60	.00	14.88	64.47	19.84	.00
M4-2H	.52	99.32	.09	.07	1.43	1.45	.63	.00	21.85	61.58	15.89	.00
M4-2I	1.68	98.20	.07	.04	1.53	1.53	.72	.00	14.73	63.83	17.68	1.96
M4-4G	.00	99.39	.31	.31	2.83	2.76	.63	.00	.00	4.97	59.63	34.79
M4-4H	.00	99.49	.23	.28	2.58	2.53	.48	.00	.00	4.97	84.57	9.95
M4-4I	.00	99.62	.17	.22	2.62	2.56	.37	.00	.00	.00	89.66	9.96
M4-5-18-G	.00	98.90	.67	.43	.97	.83	.92	4.94	54.40	34.61	4.95	.00
M4-5-18-H	.62	98.59	.44	.35	1.01	.82	.95	4.93	54.23	27.60	11.83	.00
M4-5-18-I	.00	98.93	.67	.40	1.17	1.02	1.00	4.95	44.51	34.63	14.84	.00
M4-5-28-G	2.16	96.80	0.61	0.43	0.94	0.84	0.98	4.84	51.30	35.82	4.84	0.00
M4-5-28-H	1.10	98.48	.26	.16	.88	.80	.82	7.87	51.22	33.48	5.91	.00
M4-5-28-I	.00	99.40	.35	.25	.99	.91	.80	4.97	49.70	39.76	4.97	.00
M4-5-29-G	15.82	81.51	1.59	1.08	1.92	2.32	1.78	.00	1.63	16.31	51.35	12.22
M4-5-29-H	7.11	89.83	1.66	1.41	2.26	2.39	1.50	.00	1.79	17.97	59.29	10.77
M4-5-29-I	2.51	93.64	2.17	1.68	2.35	2.26	1.39	.00	1.87	33.71	44.95	13.11
M4-5G	5.11	93.53	.81	.55	.74	.63	1.14	9.35	56.11	22.45	5.61	.00
M4-5H	10.83	88.16	.60	.41	.72	.72	1.19	4.41	48.49	29.09	6.17	.00
M4-5I	3.93	95.08	.52	.47	.94	.86	1.10	7.60	44.69	33.28	9.51	.00

APPENDIX TABLE 3A.—*Chemical analyses of station blends*

[Units are ppm unless otherwise indicated]

FIELD NO.	LAB NO.	AL%	BA	CD	CR	CU	FE%	HG	MN	NI	PB	V	ZN	OC%
M1-1-BL	W-215470	0.79	120	0.056	12	1.1	0.40	0.01 L	99	3	3.0	10	5.6	0.05
M1-10-BL	W-215488	.95	130	.018	12	1.2	.26	.01 L	87	2	5.1	8	4.6	.06
M1-11-BL	W-215489	1.60	270	.035	31	2.7	.91	.01 L	140	8	7.9	30	13.0	.25
M1-12-BL	W-215490	.79	69	.017	16	3.0	.82	.01 L	170	10	7.1	17	7.5	.23
M1-13-BL	W-215494	2.40	270	.130	43	6.6	1.80	.02	280	15	15.0	74	37.0	.99
M1-14-BL	W-215498	1.90	210	.075	21	4.2	1.00	.01	2100	24	13.0	38	22.0	.33
M1-15-BL	W-215499	.74	80	.020	13	1.2	.27	.01 L	110	8	2.5	8	2.7	.03
M1-16-BL	W-215503	.31	32	.035	4	1.0	.15	.01 L	140	2 L	4.6	7	1.1	.06
M1-17-BL	W-215504	.24	14	.022	9	.8 L	.10	.01 L	83	3	2.5	4	1.0 L	.04
M1-18-BL	W-215505	.28	48	.023	6	1.3	.18	.01 L	83	2	2.8	5	1.3	.08
M1-2-BL	W-215474	.23	35	.043	4	.8	.06	.01 L	44	1 L	4.1 L	4	1.0 L	.02
M1-3-BL	W-215475	.65	84	.045	18	1.6	.32	.01 L	190	3	5.6	10	5.8	.11
M1-4-BL	W-215479	1.20	180	.071	34	4.1	.61	.01 L	140	3	4.7	21	7.7	.10
M1-5-10-BL	W-215705	.21	37	.110	18	1.7	.36	.01 L	220	18	7.6	18	5.8	.06
M1-5-11-BL	W-215706	.20	36	.055	17	2.2	.37	.01 L	230	18	6.1	20	3.7	.06
M1-5-12-BL	W-215707	.28	50	.078	16	.8 L	.34	.01 L	200	18	5.8	16	3.3	.04
M1-5-14-BL	W-215708	.19	35	.010	8	.8 L	.35	.01 L	320	18	5.0	14	3.3	.05
M1-5-16-BL	W-215709	.27	40	.043	10	1.4	.33	.01 L	150	21	6.5	13	3.7	.06
M1-5-18-BL	W-215710	.22	34	.010 L	14	.8 L	.37	.01 L	220	3	6.5	16	4.2	.06
M1-5-2-BL	W-215698	.20	37	.010 L	23	.8	.33	.01 L	280	40	6.1	18	7.5	.05
M1-5-20-BL	W-215711	.18	32	.010 L	8	1.2	.32	.01 L	220	18	6.5	15	2.5	.04
M1-5-22-BL	W-215712	.17	31	.045	8	1.2	.28	.01 L	250	2	4.5	12	3.3	.03
M1-5-25-BL	W-215713	.27	39	.013	15	.8	.40	.01 L	230	5	6.7	18	4.6	.08
M1-5-28-BL	W-215714	.20	29	.017	11	.8 L	.23	.01 L	190	2	4.7	14	2.9	.03
M1-5-29-BL	W-215715	.76	100	.042	19	1.6	.85	.01 L	190	3	7.5	29	12.0	.22
M1-5-3-BL	W-215699	.22	37	.050	20	2.1	.32	.01 L	170	19	5.1	19	8.3	.06
M1-5-4-BL	W-215700	.20	36	.120	13	1.5	.52	.01 L	200	17	5.8	19	5.4	.05
M1-5-5-BL	W-215701	.18	33	.048	14	1.1	.34	.01 L	220	18	5.1	17	7.5	.05
M1-5-6-BL	W-215702	.19	34	.015	13	1.4	.36	.01 L	240	19	5.3	18	7.5	.04
M1-5-8-BL	W-215703	.22	33	.100	10	1.8	.32	.01 L	160	17	5.6	16	10.0	.06
M1-5-9-BL	W-215704	.22	36	.010	14	1.6	.32	.01 L	170	18	6.3	16	4.6	.06
M1-5-BL	W-215483	.23	40	.064	10	.8 L	.36	.01 L	240	2	4.9	17	4.3	.06
M1-6-BL	W-215484	.93	120	.044	19	2.7	.54	.01 L	150	3	7.1	22	10.0	.22
M1-7-BL	W-215485	.47	58	.023	14	1.7	.32	.01 L	78	2	2.9	14	6.6	.15
M1-8-BL	W-215486	.55	58	.027	15	1.7	.71	.01 L	140	3	5.1	12	10.0	.14
M1-9-BL	W-215487	1.20	120	.044	27	2.1	.73	.01 L	240	5	5.7	25	14.0	.14
M2-1-BL	W-215726	.69	120	.073	5	.3	.34	.01 L	80	1	3.0	8	6.2	-
M2-10-BL	W-215733	.83	85	.022	21	.8 L	.31	.01 L	120	6	3.4	10	5.8	-
M2-11-BL	W-215734	1.50	230	.022	26	2.2	.84	.01 L	150	10	7.6	28	12.0	-
M2-12-BL	W-215735	.69	66	.160	20	1.4	.71	.01 L	160	9	6.6	20	12.0	-
M2-13-BL	W-215736	3.30	250	.100	47	6.8	1.60	.20	300	28	14.0	74	37.0	-
M2-14-BL	W-215737	1.40	190	.038	18	1.9	.72	.01 L	1400	23	10.0	33	18.0	-
M2-15-BL	W-215738	.73	87	.015	14	.8 L	.34	.01 L	120	6	2.6	10	5.8	-
M2-16-BL	W-215522	.32	48	.081	7	1.4	.23	.01 L	180	2	4.2	9	5.4	-
M2-17-BL	W-215526	.23	43	.051	5	1.2	.16	.01 L	120	2	3.7	5	4.0	-
M2-18-BL	W-215530	.29	80	.068	5	1.0	.17	.01 L	94	3	2.3	5	5.7	-
M2-2-BL	W-215727	.18	39	.050	2	1.2	.10	.01 L	68	1 L	1.7	2 L	5.8	-
M2-3-BL	W-215728	.71	97	.027	5	1.2	.32	.01 L	150	1 L	6.3	9	7.5	-
M2-4-BL	W-215514	1.10	200	.038	19	1.6	.60	.01 L	130	7	5.7	20	9.3	-
M2-5-1-BL	W-215518	0.20	38	0.078	11	1.7	0.34	0.01 L	290	6	4.3	17	4.6	-
M2-5-10-BL	W-215687	.22	36	.025	12	1.7	.38	.01 L	240	1	5.6	20	6.6	-
M2-5-11-BL	W-215688	.21	37	.014	11	1.7	.38	.01 L	200	1	6.1	16	8.3	-
M2-5-12-BL	W-215689	.17	31	.033	8	2.0	.32	.01 L	180	1	5.3	18	7.5	-
M2-5-14-BL	W-215690	.77	33	.022	7	2.2	.35	.01 L	310	2	5.1	16	4.2	-
M2-5-16-BL	W-215691	.23	37	.010 L	8	2.2	.30	.01 L	150	1	4.2	13	4.2	-
M2-5-18-BL	W-215692	.19	30	.011	13	.3	.34	.01 L	280	2	7.0	16	4.2	-
M2-5-2-BL	W-215680	.20	37	.010 L	8	.8 L	.38	.01 L	270	2	5.5	18	4.2	-
M2-5-20-BL	W-215693	.17	31	.010 L	8	2.1	.31	.01 L	170	1	4.5	14	7.5	-
M2-5-22-BL	W-215694	.17	33	.012	11	.8 L	.33	.01 L	380	3	5.1	16	5.0	-
M2-5-25-BL	W-215695	.25	42	.015 L	6	.8 L	.36	.01 L	210	1	7.1	18	5.8	-
M2-5-28-BL	W-215696	.19	30	.025	10	.8 L	.27	.01 L	250	4	4.0	12	3.7	-
M2-5-29-BL	W-215697	.73	110	.013	20	2.3	.69	.01 L	170	62?	7.3	27	15.0	-
M2-5-3-BL	W-215681	.20	36	.270	8	.8 L	.34	.01 L	190	1	8.1	17	5.8	-
M2-5-4-BL	W-215682	.21	39	.033	9	.8 L	.32	.01 L	240	1	5.1	16	9.1	-
M2-5-5-BL	W-215683	.22	39	.029	10	.8 L	.38	.01 L	260	2	5.5	20	7.5	-
M2-5-6-BL	W-215684	.18	34	.016	8	.8 L	.35	.01 L	290	2	5.3	18	7.5	-
M2-5-8-BL	W-215685	.22	34	.010 L	8	.8 L	.31	.01 L	170	1	5.3	15	6.6	-
M2-5-9-BL	W-215686	.22	34	.012	9	.8	.40	.01 L	200	1	5.1	18	6.6	-
M2-6-BL	W-215729	.76	110	.480	14	1.7	.50	.01 L	140	5	6.9	19	10.0	-
M2-7-BL	W-215730	.53	61	.010	9	1.6	.41	.01 L	130	1 L	4.3	16	8.3	-
M2-8-BL	W-215731	.43	50	.048	10	.8 L	.61	.01 L	140	1 L	3.4	11	10.0	-
M2-9-BL	W-215732	.81	91	.023	13	1.1	.56	.01 L	200	3	5.0	18	11.0	-

FIELD NO.	LAB NO.	AL%	BA	CD	CR	CU	FE%	HG	MN	NI	PB	V	ZN	OC%
M3-1-BL	W-215961	0.72	120	0.012	10	1.7	0.34	0.01 L	83	1 L	2.4	11	5.8	-
M3-10-BL	W-215972	1.00	120	.010	10	1.5	.33	.01 L	100	1	4.5	10	6.2	-
M3-11-BL	W-215973	1.70	230	.040	22	5.5	.93	.01 L	150	5	9.5	29	15.0	-
M3-12-BL	W-215974	.79	76	.010 L	17	2.5	.68	.01 L	170	3	7.7	20	13.0	-
M3-13-BL	W-215975	3.90	270	.065	42	9.0	1.90	.02	280	19	12.0	70	41.0	-
M3-14-BL	W-215976	1.30	180	.023	12	3.2	.61	.01 L	1400	13	9.2	26	15.0	-
M3-15-BL	W-215977	.80	99	.010 L	11	1.0	.53	.01 L	280	1	3.7	18	7.9	-
M3-16-BL	W-215981	.27	76	.061	6	.8 L	.14	.01 L	73	1	4.5	4	3.7	-
M3-17-BL	W-215985	.25	31	.030	6	.8 L	.11	.01 L	78	1 L	3.3	2 L	1.0 L	-
M3-18-BL	W-215989	.37	55	.010	6	1.0	.17	.01 L	100	1	4.2	3	4.2	-
M3-2-BL	W-215962	.24	43	.010 L	7	1.0	.09	.01 L	65	1 L	1.2	4	2.9	-
M3-3-BL	W-215963	.63	91	.035	11	1.0	.31	.01 L	180	2	4.8	10	8.3	-
M3-4-BL	W-215967	1.10	190	.010 L	16	.9	.49	.01 L	120	4	6.0	17	9.1	-
M3-5-1-BL	W-215938	.23	35	.048	5	.3	.39	.01 L	310	3	6.8	18	4.2	-
M3-5-10-BL	W-215946	.20	36	.060	9	3.7	.35	.01 L	220	1 L	5.7	16	7.5	-
M3-5-11-BL	W-215947	.25	45	.420	9	2.0	.31	.01 L	240	1 L	13.0	14	5.8	-
M3-5-12-BL	W-215948	.26	52	.060	9	1.5	.28	.01 L	180	1 L	3.0	15	4.2	-
M3-5-14-BL	W-215949	.20	34	.040	8	1.7	.31	.01 L	240	1 L	3.0	15	5.8	-
M3-5-16-BL	W-215950	.23	38	.010 L	9	.8 L	.24	.01 L	130	1 L	3.0	11	5.0	-
M3-5-18-BL	W-215951	.19	31	.040	14	.8 L	.34	.01 L	260	3	6.3	17	4.0	-
M3-5-2-BL	W-215939	.22	39	.030	7	.9	.32	.01 L	250	1 L	6.1	15	4.2	-
M3-5-20-BL	W-215952	.19	40	.025	7	.8 L	.29	.01 L	280	1	2.4	16	4.2	-
M3-5-22-BL	W-215953	.18	38	.012	20	.8 L	.31	.01 L	410	2	3.3	15	3.7	-
M3-5-25-BL	W-215954	.32	50	.010 L	12	2.0	.44	.01 L	210	2	4.5	20	6.6	-
M3-5-28-BL	W-215955	.19	28	.060	9	.8 L	.22	.01 L	180	1	3.8	10	2.9	-
M3-5-29-BL	W-215956	.89	120	.017	19	1.7	.78	.01 L	210	4	9.5	29	12.0	-
M3-5-3-BL	W-215940	.22	39	.043	8	1.2	.33	.01 L	210	1 L	6.3	17	4.2	-
M3-5-4-BL	W-215941	.23	39	.022	9	1.7	.37	.01 L	270	1 L	6.1	18	5.8	-
M3-5-5-BL	W-215942	.21	39	.010 L	9	.8 L	.34	.01 L	220	1 L	5.1	17	5.4	-
M3-5-6-BL	W-215943	.21	38	.042	8	.8 L	.35	.01 L	290	11	6.0	17	4.6	-
M3-5-8-BL	W-215944	.22	39	.033	8	.8 L	.28	.01 L	210	1 L	4.2	14	4.6	-
M3-5-9-BL	W-215945	.21	36	.010 L	8	.8 L	.33	.01 L	200	1 L	4.2	15	5.0	-
M3-6-BL	W-215968	.94	140	.010 L	15	3.7	.48	.01 L	160	3	6.6	18	10.0	-
M3-7-BL	W-215969	.52	64	.017	11	2.7	.31	.01 L	110	1	2.2	12	7.9	-
M3-8-BL	W-215970	.56	67	.023	17	2.2	.68	.01 L	130	2	3.9	14	12.0	-
M3-9-BL	W-215971	.94	100	.021	17	2.7	.60	.01 L	210	3	5.4	20	11.0	-
M4-1-BL	W-216772	.74	140	.087	35	1.1	.40	.01 L	67	19	5.4	20	6.6	-
M4-10-BL	W-216787	.83	99	.010 L	14	.8	.65	.01 L	490	2	6.2	22	11.0	-
M4-11-BL	W-216788	1.30	240	.730	21	1.8	.86	.01 L	100	6	13.0	25	14.0	-
M4-12-BL	W-216789	.72	73	.010 L	17	3.1	.73	.01 L	180	4	9.5	24	14.0	-
M4-13-BL	W-216790	2.20	240	.090	44	5.0	1.60	.02	220	18	17.0	60	33.0	-
M4-13A-BL	W-216794	3.90	240	.066	79	10.0	2.20	.02	250	33	25.0	82	52.0	-
M4-14-BL	W-216795	1.80	220	.046	24	6.0	1.10	.01	2400	23	30.0	41	30.0	-
M4-15-BL	W-216796	.66	89	.019	11	1.5	.27	.01 L	110	4	5.4	12	5.0	-
M4-16-BL	W-216800	.27	110	.037	24	.9	.16	.01 L	100	1	8.3	9	7.5	-
M4-17-BL	W-216804	.27	35	.010 L	9	.8 L	.14	.01 L	99	4	2.9	8	4.2	-
M4-18-BL	W-216808	.28	65	.010 L	8	.8 L	.17	.01 L	70	2	7.1	9	7.5	-
M4-2-BL	W-216776	.25	42	.020	2	.8 L	.10	.01 L	99	2	3.7	18	2.5	-
M4-3-BL	W-216777	.65	90	.095	9	1.3	.36	.01 L	190	3	12.0	16	8.3	-
M4-4-BL	W-216778	.86	200	.037	18	1.6	.59	.01 L	130	7	6.6	18	11.0	-
M4-5-1-BL	W-216782	.32	91	.015	8	.8 L	.42	.01 L	270	3	7.4	23	6.2	-
M4-5-10-BL	W-216818	.25	60	.020 L	10	.8 L	.39	.01 L	260	2	4.7	20	5.4	-
M4-5-11-BL	W-216819	.23	47	.020 L	11	.8 L	.41	.01 L	280	3	5.3	16	5.0	-
M4-5-12-BL	W-216820	.27	59	.020 L	10	.8	.32	.01 L	200	15	2.2	13	2.9	-
M4-5-14-BL	W-216821	.23	45	.020 L	9	.8 L	.37	.01 L	330	3	4.5	17	4.6	-
M4-5-16-BL	W-216822	.32	61	.020 L	11	.8	.33	.01 L	140	4	3.6	12	5.4	-
M4-5-18-BL	W-216826	.26	48	.020 L	10	1.1	.42	.01 L	260	5	4.4	19	3.1	-
M4-5-2-BL	W-216811	.23	90	.020 L	9	.8 L	.43	.01 L	270	4	5.9	19	6.7	-
M4-5-20-BL	W-216827	.21	47	.020 L	7	.8 L	.31	.01 L	310	4	4.0	15	4.4	-
M4-5-22-BL	W-216828	.21	38	.020 L	7	.8 L	.34	.01 L	280	3	4.4	17	3.1	-
M4-5-25-BL	W-216829	.32	57	.020 L	12	.8 L	.43	.01 L	230	4	6.3	17	5.7	-
M4-5-28-BL	W-216833	.21	33	.020 L	5	.8 L	.24	.01 L	180	2	3.5	11	2.7	-
M4-5-29-BL	W-216837	.89	140	.020 L	14	1.5	.75	.01 L	190	4	7.8	29	12.0	-
M4-5-3-BL	W-216812	.22	48	.020 L	10	1.0	.34	.01 L	170	3	3.6	14	16.0	-
M4-5-4-BL	W-216813	.21	48	.025	11	.8	.40	.01 L	230	5	3.6	20	23.0	-
M4-5-5-BL	W-216814	.21	52	.020 L	12	.8 L	.38	.01 L	250	2	5.1	17	18.0	-
M4-5-6-BL	W-216815	.21	46	.020 L	10	1.1	.41	.01 L	300	4	2.4	17	7.5	-
M4-5-8-BL	W-216816	.24	84	.020 L	9	.8 L	.37	.01 L	150	2	4.0	19	6.5	-
M4-5-9-BL	W-216817	.29	58	.020 L	10	.8	.39	.01 L	220	3	4.9	18	4.6	-
M4-6-BL	W-216783	.90	140	.037	16	2.1	.53	.01 L	180	4	11.0	23	12.0	-
M4-7-BL	W-216784	.52	64	.010 L	29	.8 L	.40	.01 L	130	4	9.1	21	10.0	-
M4-8-BL	W-216785	.50	58	.095	12	1.0	.67	.01 L	130	4	7.5	18	12.0	-
M4-9-BL	W-216786	.86	110	.010 L	18	1.0	.65	.01 L	240	4	9.5	23	13.0	-

APPENDIX TABLE 3B.—*Chemical analyses of individual samples*

[Units are ppm unless otherwise indicated]

FIELD NO.	LAB NO.	AL%	BA	CD	CR	CU	FE%	HG	MN	NI	PB	V	ZN	OC%
M1-13-G	W-215491	4.00	270	0.100	43	6.3	1.90	0.02	290	21	15.0	69	22.0	1.01
M1-13-H	W-215492	4.00	270	.120	41	6.9	1.80	.02	300	24	15.0	64	19.0	.87
M1-13-I	W-215493	3.80	270	.095	46	7.9	1.90	.02	320	23	15.0	68	21.0	1.03
M1-14-M	W-215495	1.20	180	.030	20	1.9	.51	.10 L	620	16	7.8	14	6.3	.03
M1-14-N	W-215496	3.00	240	.073	41	7.1	1.80	.02	3700	45	17.0	55	42.0	.69
M1-14-O	W-215497	2.30	240	.069	24	5.5	1.30	.02	2000	35	15.0	48	29.0	.48
M1-16-A	W-215500	.30	36	.035	5	1.0	.11	.01 L	170	4	3.8	6	1.0 L	.05
M1-16-B	W-215501	.30	36	.038	16	1.2	.15	.01 L	130	8	4.2	7	1.0 L	.06
M1-16-C	W-215502	.31	25	.030	14	1.4	.15	.01 L	100	6	3.4	6	4.2	.06
M1-17-G	W-215720	.25	28	.010	6	1.0	.15	.01 L	55	1	2.9	3	3.7	.05
M1-17-H	W-215721	.22	23	.064	5	.8 L	.07	.01 L	68	1 L	1.5	2 L	2.9	.02
M1-17-I	W-215722	.22	25	.010	6	.8 L	.14	.01 L	120	1 L	2.3	3	3.3	.04
M1-18-A	W-215723	.36	36	.031	5	2.0	.19	.01 L	83	1	3.1	2 L	5.8	.09
M1-18-B	W-215724	.32	34	.060	5	.8 L	.16	.01 L	100	1	3.0	2 L	5.4	.07
M1-18-C	W-215725	.27	38	.010	2	.8 L	.17	.01 L	110	1 L	2.9	2 L	5.4	.07
M1-2-A	W-215471	.24	28	.048	18	.8 L	.04	.01 L	55	5	1.8	7	1.8	.02
M1-2-B	W-215472	.22	28	.030	19	.8 L	.06	.01 L	47	1	2.1	5	1.6	.02
M1-2-C	W-215473	.25	28	.038	5	.8	.08	.01 L	64	5	1.3	5	1.3	.02
M1-4-M	W-215476	.83	160	.053	23	1.1	.62	.01 L	150	3	4.5	21	8.0	.09
M1-4-N	W-215477	1.40	200	.061	17	1.3	.61	.01 L	140	3	5.6	20	8.2	.10
M1-4-O	W-215478	1.30	190	.066	24	1.5	.68	.01 L	160	3	5.6	24	9.2	.10
M1-5-G	W-215480	.22	28	.014	12	.8 L	.36	.01 L	220	2	4.0	14	3.9	.05
M1-5-H	W-215481	.22	28	.027	18	.8 L	.39	.01 L	220	1	5.1	12	4.6	.06
M1-5-I	W-215482	.23	28	.027	20	4.6	.40	.01 L	280	2	4.6	18	5.4	.07
M2-16-G	W-215519	.30	53	.037	7	1.7	.17	.01 L	150	5	4.0	8	4.6	-
M2-16-H	W-215520	.46	53	.028	9	1.2	.23	.01 L	170	3	4.5	7	5.7	-
M2-16-I	W-215521	.34	48	.025	14	1.1	.19	.01 L	170	4	4.2	9	5.7	-
M2-17-G	W-215523	.20	43	.015	4	1.2	.13	.01 L	110	2	3.5	8	3.5	-
M2-17-H	W-215524	.24	43	.032	6	1.0	.17	.01 L	110	2	3.9	7	4.3	-
M2-17-I	W-215525	.24	38	.010	4	1.0	.15	.01 L	160	3	4.0	6	4.0	-
M2-18-G	W-215527	.29	64	.022	8	1.1	.18	.01 L	86	3	4.2	5	5.7	-
M2-18-H	W-215528	.43	75	.045	10	1.5	.19	.01 L	66	5	3.0	5	6.0	-
M2-18-I	W-215529	.28	98	.048	7	1.5	.17	.01 L	110	3	3.0	5	5.7	-
M2-4-G	W-215511	.81	190	.040	18	1.2	.55	.01 L	120	8	5.6	20	4.8	-
M2-4-H	W-215512	.82	180	.045	12	2.4	.60	.01 L	160	5	6.1	11	9.3	-
M2-4-I	W-215513	.53	180	.033	18	3.0	.60	.01 L	170	4	5.9	22	9.6	-
M2-5-1-G	W-215515	.20	43	.020	11	1.1	.31	.01 L	210	4	4.7	15	4.3	-
M2-5-1-H	W-215516	.19	43	.037	14	1.0	.33	.01 L	230	8	3.7	16	4.3	-
M2-5-1-I	W-215517	.17	43	.020	9	1.2	.39	.01 L	330	3	4.2	20	4.8	-
M3-16-G	W-215978	.28	100	.038	7	.8 L	.13	.01 L	83	1	3.8	5	4.6	-
M3-16-H	W-215979	.26	100	.095	8	.8 L	.13	.01 L	76	1	5.5	4	5.8	-
M3-16-I	W-215980	.27	58	.095	6	.8	.14	.01 L	81	1	4.7	4	4.2	-
M3-17-G	W-215982	.12	32	.021	7	.8 L	.26	.01 L	98	2	2.9	2 L	2.7	-
M3-17-H	W-215983	.30	40	.018	7	1.6	.15	.01 L	100	2	4.6	2	1.0 L	-
M3-17-I	W-215984	.23	25	.020	5	.8 L	.07	.01 L	54	1 L	2.8	2 L	1.0 L	-
M3-18-G	W-215986	.30	58	.027	10	.8 L	.15	.01 L	93	1	4.5	2 L	3.3	-
M3-18-H	W-215987	.31	55	.033	11	1.7	.16	.01 L	79	3	5.6	2	5.8	-
M3-18-I	W-215988	.34	57	.014	6	1.0	.17	.01 L	110	1	4.2	3	2.5	-
M3-4-G	W-215964	1.20	200	.028	14	1.0	.46	.01 L	61	5	6.1	13	6.6	-
M3-4-H	W-215965	1.20	170	.028	14	1.7	.47	.01 L	110	4	7.3	15	7.1	-

APPENDIX TABLE 3B.—*Chemical analyses of individual samples*—Continued

FIELD NO.	LAB NO.	AL%	BA	CD	CR	CU	FE%	HG	MN	NI	PB	V	ZN	OC%
M3-4-I	W-215966	0.94	180	0.010 L	16	1.2	0.59	0.01 L	140	4	8.3	19	8.7	-
M3-5-1-G	W-215935	.22	40	.034	12	1.7	.40	.01 L	440	4	7.6	23	4.6	-
M3-5-1-H	W-215936	.20	32	.020	11	.8 L	.31	.01 L	220	2	5.5	14	3.3	-
M3-5-1-I	W-215937	.21	35	.040	12	.8 L	.41	.01 L	280	3	6.7	21	3.7	-
M4-13A-G	W-216791	3.40	220	.062	87	8.3	2.20	.03	240	33	20.0	73	50.0	-
M4-13A-H	W-216792	4.00	260	.170	60	10	2.30	.02	220	31	20.0	77	52.0	-
M4-13A-I	W-216793	3.50	230	.091	58	10	2.40	.02	280	29	24.0	77	52.0	-
M4-16-G	W-216797	.34	110	.048	7	1.2	.19	.01 L	110	4	5.8	10	5.8	-
M4-16-H	W-216798	.28	150	.029	8	.9	.17	.01 L	110	3	6.3	10	5.8	-
M4-16-I	W-216799	.24	62	.025	7	.8 L	.14	.01 L	92	3	5.4	9	5.0	-
M4-17-G	W-216801	.29	38	.029	7	2.0	.16	.01 L	110	1	9.1	9	5.0	-
M4-17-H	W-216802	.27	36	.010 L	5	.8 L	.15	.01 L	100	1 L	3.6	9	5.8	-
M4-17 I	W-216803	.23	31	.010 L	6	.8 L	.10	.01 L	67	7	5.0	8	4.2	-
M4-18-G	W-216805	.31	55	.010 L	8	.8 L	.16	.01 L	57	4	3.3	8	6.6	-
M4-18-H	W-216806	.30	74	.010 L	7	.8 L	.17	.01 L	73	4	7.1	8	5.8	-
M4-18-I	W-216807	.33	77	.029	4	.8 L	.18	.01 L	90	1	14.0	8	7.5	-
M4-2-G	W-216773	.23	42	.012	2	.8 L	.10	.01 L	120	2	1.9	18	2.5	-
M4-2-H	W-216774	.23	42	.012	2	.8 L	.09	.01 L	120	2	2.3	16	3.3	-
M4-2-I	W-216775	.26	42	.050	2	2.8	.10	.01 L	90	2	7.9	16	3.3	-
M4-5-1-G	W-216779	.27	110	.050	8	1.8	.42	.01 L	320	4	6.2	18	8.3	-
M4-5-1-H	W-216780	.34	100	.033	9	1.2	.40	.01 L	230	3	7.5	20	6.6	-
M4-5-1-I	W-216781	.25	46	.050	8	1.3	.40	.01 L	220	3	6.6	20	5.8	-
M4-5-18-G	W-216823	.24	51	.020	11	1.1	.41	.01 L	270	2	5.3	16	3.4	-
M4-5-18-H	W-216824	.25	47	.020 L	11	1.0	.44	.01 L	280	4	6.1	18	3.6	-
M4-5-18-I	W-216825	.28	51	.020 L	10	1.0	.46	.01 L	270	4	5.3	18	4.3	-
M4-5-28-G	W-216830	.23	38	.022	9	1.3	.25	.01 L	150	3	3.0	11	3.3	-
M4-5-28-H	W-216831	.20	31	.020 L	6	.8 L	.25	.01 L	170	2	4.0	13	2.5	-
M4-5-28-I	W-216832	.22	38	.020 L	5	.8 L	.27	.01 L	230	4	6.6	10	2.7	-
M4-5-29-G	W-216834	.90	140	.020 L	14	1.4	.78	.01 L	190	4	7.8	32	12.0	-
M4-5-29-H	W-216835	.92	140	.096	15	2.1	.82	.01 L	190	4	9.2	29	12.0	-
M4-5-29-I	W-216836	.92	140	.020 L	19	1.1	.79	.01 L	190	9	8.2	32	12.0	-

APPENDIX TABLE 4A.—*Chemical analyses of fine fraction (less than 62 μm) from individual replicates*

[Units are ppm unless otherwise indicated. Values are accurate to two significant figures]

FIELD NO.	LAB NO.	AL%	BA	CD	CR	CU	FE%	HG	MN	NI	PB	V	ZN	CL%
M1-16-AX	W-216591	3.094	213	0.161	50	19	2.51	0.03	3674	33	27	77	83	26.7
M1-16-BX	W-216592	3.859	257	.309	69	26	3.34	.06	4117	54	44	123	121	33.8
M1-16-CX	W-216593	3.874	258	.366	77	24	3.23		2367	65	47	90	157	29.6
M1-17-GX	W-216600	6.147	381	.322	108	41	4.98	.13	2634	82	56	158	176	36.4
M1-17-HX	W-216601	2.283	170	.029	70	16	1.87	.04	3512	23	23	82	94	36.4
M1-17-IX	W-216602	3.805	269	.146	70	26	3.51	.07	5269	44	56	111	123	36.4
M1-18-AX	W-216609	4.555	282	.629	91	33	3.25	.10	1518	65	52	91	126	29.8
M1-18-BX	W-216610	4.121	260	.022	80	37	3.25	.07	3471	46	95	87	126	29.8
M1-18-CX	W-216611	4.338	260	.564	74	26	3.25	.08	2603	46	72	91	104	29.8
M2-16-GX	W-216594	4.355	1300	1.002	78	37	3.48	.13	3920	81	111	118	142	29.9
M2-16-HX	W-216595	4.908	925	.415	83	32	3.02	.09	1321	91	40	113	126	26.0
M2-16-IX	W-216596	4.610	2737	.375	95	37	4.03	.07	6915	72	104	121	158	36.1
M2-17-GX	W-216603	3.721	670	.273	74	23	2.73	.11	3225	32	30	84	92	33.0
M2-17-HX	W-216604	4.106	652	.604	89	27	3.14	.06	2657	51	41	87	92	32.4
M2-17-IX	W-216605	5.457	670	.446	102	32	4.46	.11	4465	131	55	119	136	33.0
M2-18-GX	W-216612	4.967	2506	.293	93	34	3.84	.09	2483	70	52	102	151	30.8
M2-18-HX	W-216613	5.822	2019	.561	100	44	3.53	.08	769	75	69	114	162	28.7
M2-18-IX	W-216614	4.467	6467	.596	98	34	3.40	.06	3829	64	68	113	145	29.3
M3-16-GX	W-216597	5.731	10962	.448	127	37	3.74	.11	2193	62	52	110	187	33.1
M3-16-HX	W-216598	7.317	11415	.381	140	50	4.68	.13	2488	82	94	143	322	36.4
M3-16-IX	W-216599	5.298	3539	.339	95	38	3.39	.10	1399	70	66	102	174	29.2
M3-17-GX	W-216606	4.159	749	.728	73	23	2.91	.09	1913	56	31	83	100	28.7
M3-17-HX	W-216607	4.669	503	.503	83	36	3.77	.08	1796	59	75	129	95	24.5
M3-18-GX	W-216615	4.346	2430	.316	79	28	2.96	.09	2568	61	26	89	128	27.3
M3-18-HX	W-216616	4.562	2224	.110	86	29	3.42	.08	2281	67	38	105	131	26.2
M3-18-IX	W-216617	4.577	1764	.439	84	32	2.86	.07	1564	59	42	95	139	26.3
M4-16-GX	W-217779	3.547	6749	.322	56	21	2.58	.06	1080	48	60	95	126	21.0
M4-16-HX	W-217780	3.986	11121	.432	61	20	2.66	.06	1113	50	43	90	135	22.0
M4-16-IX	W-217781	3.444	6518	.588	65	12	2.23	.07	1074	41	83	67	103	28.0
M4-17-GX	W-217782	3.518	567	.410	55	18	2.54	.11	899	49	35	70	80	27.0
M4-17-HX	W-217783	3.398	661	.340	53	17	2.08	.11	1000	47	30	62	81	26.0
M4-17-IX	W-217784	2.963	907	.363	54	13	1.96	.21	1270	27	36	54	78	37.0
M4-18-GX	W-217785	3.647	1746	.507	87	20	2.43	.06	770	51	34	85	101	28.0
M4-18-HX	W-217786	3.596	2394	.308	68	21	2.40	.06	890	51	36	82	85	23.0
M4-18-IX	W-217787	3.713	2898	.391	70	9	2.54	.08	899	59	70	82	106	27.0

APPENDIX TABLE 4B.—*Chemical analyses of fine fraction (less than 62 μm) from station blends*

[Units are ppm unless otherwise indicated. Values are accurate to two significant figures]

FIELD NO.	LAB NO.	AL%	BA	CD	CR	CU	FE%	HG	MN	NI	PB	V	ZN	CL%
M1-12-BLX	W-217758	4.517	244	0.122	78	18	3.30	0.05	977	49	94	122	86.7	10.0
M1-3-BLX	W-217750	4.003	222	.222	62	22	3.41	.07	2521	46	136	135	107	18.0
M1-5-10-BLX	W-216625	4.719	315	.026	94	31	4.19	.04	4981	55	107	157	123	34.2
M1-5-11-BLX	W-216626	2.612	169	.058	49	18	2.46	.06	4148	41	38	92	81.4	19.3
M1-5-12-BLX	W-216627	4.085	253	.103	79	27	3.81	.04	6537	46	101	120	136	35.0
M1-5-14-BLX	W-216628	4.108	301	.027	82	33	4.38	.05	10132	77	93	167	131	35.1
M1-5-16-BLX	W-216629	4.325	273	.023	93	25	4.10	.03	5008	48	71	150	114	31.0
M1-5-18-BLX	W-216630	4.515	293	.023	88	23	4.29	.04	6999	61	61	163	124	30.8
M1-5-2-BLX	W-216618	4.394	310	.026	88	26	4.14	.04	8530	124	49	158	121	33.9
M1-5-20-BLX	W-216631	4.255	293	.101	85	27	3.99	.05	5585	56	56	149	112	34.5
M1-5-22-BLX	W-216632	3.837	384	.640	74	35	4.80	.14	16948	125	141	195	166	38.0
M1-5-25-BLX	W-216633	4.390	285	.637	92	31	4.61	.06	6804	59	116	189	138	30.1
M1-5-3-BLX	W-216619	4.821	304	.127	94	28	4.57	.04	6851	71	58	178	140	33.5
M1-5-4-BLX	W-216620	4.511	285	.593	93	24	4.27	.03	7359	71	59	171	126	32.0
M1-5-5-BLX	W-216621	3.542	240	.027	65	23	3.27	.04	6267	46	54	109	87.2	35.0
M1-5-6-BLX	W-216622	4.149	304	.028	80	28	4.15	.03	8851	83	91	166	119	35.3
M1-5-8-BLX	W-216623	5.378	333	.097	100	28	5.12	.07	6658	54	64	195	136	33.7
M1-5-9-BLX	W-216624	4.379	277	.023	90	28	4.38	03	6684	58	69	141	120	31.3
M1-8-BLX	W-217754	3.661	248	.196	65	14	3.14	.06	1268	33	47	115	85.0	13.0
M2-12-BLX	W-217759	4.468	241	.133	81	18	3.26	.06	712	48	68	114	83.3	9.5
M2-3-BLX	W-217751	4.623	257	.257	63	26	3.08	.09	1644	45	68	151	120	23.0
M2-5-2-BLX	W-216635	5.029	377	.471	101	44	5.03	.04	13516	116	167	189	176	37.7
M2-5-25-BLX	W-216637	5.360	322	.322	114	32	5.36	.09	5360	79	88	180	150	29.5
M2-5-4-BLX	W-216636	4.505	275	.400	78	30	4.00	.10	8760	88	53	138	143	33.2
M2-8-BLX	W-217755	4.043	289	.116	75	16	2.89	.05	1256	36	48	107	82.3	17.0
M3-12-BLX	W-217760	4.439	252	.276	74	9	3.24	.07	612	48	72	120	87.6	9.2
M3-3-BLX	W-217752	4.188	231	.217	69	16	3.03	.08	1588	43	45	127	93.9	17.0
M3-5-10-BLX	W-216741	3.717	306	.262	77	22	3.28	.05	4810	50	39	127	155	30.0
M3-5-11-BLX	W-216742	3.576	358	.548	74	22	3.34	.05	6676	52	48	131	107	32.1
M3-5-12-BLX	W-216743	4.029	631	.442	63	25	4.32	.05	10679	53	39	243	160	43.9
M3-5-14-BLX	W-216744	4.005	350	.250	75	20	3.25	.03	4756	53	25	130	80.1	33.2
M3-5-16-BLX	W-216745	4.157	352	.799	83	19	3.52	.05	3518	35	32	153	89.5	38.0
M3-5-18-BLX	W-216746	3.829	319	.255	77	17	3.40	.05	4255	45	32	128	78.7	29.3
M3-5-2-BLX	W-216734	3.412	305	.104	66	20	2.87	.05	3232	47	25	99	93.4	24.5
M3-5-20-BLX	W-216747	3.780	447	.378	58	18	3.78	.03	9965	79	31	165	110	39.2
M3-5-22-BLX	W-216748	4.097	307	.435	69	17	3.84	.06	11780	95	38	149	136	33.7
M3-5-28-BLX	W-216749	3.911	235	.559	61	26	3.07	.06	6146	75	31	145	134	35.5
M3-5-3-BLX	W-216735	3.554	355	.111	78	20	3.11	.06	3998	49	22	116	104	30.4
M3-5-4-BLX	W-216736	4.255	367	.213	81	19	3.67	.08	5608	54	27	133	112	26.7
M3-5-5-BLX	W-216737	3.796	380	.353	76	24	3.53	.03	6237	52	46	141	100	34.9
M3-5-6-BLX	W-216738	3.755	273	.307	79	19	3.07	.03	2048	43	36	99	76.8	22.9
M3-5-8-BLX	W-216739	4.350	373	.580	122	25	3.52	.03	4143	64	44	139	102	28.6
M3-5-9-BLX	W-216740	4.105	324	.302	82	24	3.67	.03	4105	52	50	130	92.9	29.7
M3-8-BLX	W-217756	3.899	289	.347	66	7	2.89	.07	1386	39	35	113	86.6	17.0
M4-12-BLX	W-217761	4.328	252	.156	75	17	3.01	.04	577	46	76	111	81.8	9.3
M4-3-BLX	W-217753	3.754	231	.202	64	19	2.74	.08	1444	43	66	127	91.0	17.0
M4-5-10-BLX	W-217768	3.596	2110	.205	75	19	3.42	.08	5137	51	104	122	149	23.0
M4-5-11-BLX	W-217769	3.651	1230	.402	73	9	3.47	05	4563	55	37	139	96.7	25.0
M4-5-12-BLX	W-217770	3.471	4061	.398	87	30	3.62	.06	6509	47	69	141	134	40.0
M4-5-14-BLX	W-217771	3.468	1247	.511	62	9	3.10	.05	3468	55	27	108	87.6	25.0
M4-5-16-BLX	W-217772	3.711	1410	.300	74	13	3.00	.07	1484	35	35	106	84.8	24.0
M4-5-18-BLX	W-217773	3.887	901	.459	76	16	3.53	.04	4064	53	46	138	97.2	24.0
M4-5-2-BLX	W-217762	3.518	7063	0.182	78	15	3.32	0.06	5277	49	109	139	107	27.0
M4-5-20-BLX	W-217774	3.542	1940	.381	93	16	3.54	.04	7630	95	79	120	104	35.0
M4-5-22-BLX	W-217775	3.425	634	.377	63	11	3.08	.05	5137	68	62	106	95.9	23.0
M4-5-25-BLX	W-217776	3.651	730	.060	84	15	3.29	.04	2738	55	46	113	87.6	25.0
M4-5-28-BLX	W-217777	3.004	723	.159	60	8		.04	2651	53	28	78	74.2	24.0
M4-5-29-BLX	W-217778	3.321	421	.128	66	15	3.07	.06	472	38	49	107	80.5	12.0
M4-5-3-BLX	W-217763	3.004	1820	.074	60	13	2.65	.10	2474	37	51	99	76.0	24.0
M4-5-5-BLX	W-217764	3.155	3026	.021	72	11	2.94	.04	4627	63	59	105	111	29.0
M4-5-6-BLX	W-217765	3.575	2273	1.577	67	15	3.36	.07	5889	63	82	135	111	29.0
M4-5-8-BLX	W-217766	3.534	5472	.159	74	10	3.00	.05	1944	35	49	110	91.9	24.0
M4-5-9-BLX	W-217767	3.377	1278	.103	65	12	2.96	.06	2814	42	46	115	74.6	16.0
M4-8-BLX	W-217757	4.081	296	.253	68	13	2.96	.05	844	42	35	121	83.0	16.0

Appendix table 5.—*Chemical analyses of blind replicates*

[Units are ppm or percent]

FIELD NO.	LAB NO.	AL%	BA	CD	CR	CU	FE%	HG	MN	NI	PB	V	ZN	BLIND NO.
M1-16-BL	W-215509	0.31	32	0.045	5	1.1	0.15	0.01 L	140	2	4.6	7	1.0 L	BLIND4
M1-16-BL	W-215503	.31	32	.035	4	1.0	.15	.01 L	140	2 L	4.6	7	1.1	
M1-16-BL	W-215508	.32	32	.048	4	1.3	.15	.01 L	140	2	4.6	7	1.0 L	BLIND3
M1-2-BL	W-215506	.21	36	.020	4	.8 L	.08	.01 L	43	1 L	1.8 L	4	1.0 L	BLIND1
M1-2-BL	W-215474	.23	35	.043	4	.8	.06	.01 L	44	1 L	4.1	4	1.0 L	
M1-5-25-BL	W-215717	.26	41	.045	12	.8 L	.39	.01 L	210	2	5.5	18	3.7	BLIND12
M1-5-25-BL	W-215713	.27	39	.013	15	.8	.40	.01 L	230	2	6.7	18	4.6	
M1-5-25-BL	W-215716	.25	39	.037	12	1.0	.39	.01 L	220	2	7.0	17	3.7	BLIND11
M1-5-G	W-215480	.22	28	.014	12	.8 L	.36	.01 L	220	2	4.0	14	3.9	
M1-5-G	W-215507	.19	43	.022	12	1.2	.40	.01 L	220	3	3.7	16	1.1	BLIND2
M2-13-BL	W-215736	3.3	250	.100	47	6.8	1.6	.02	300	28	14	74	37	
M2-13-BL	W-215742	3.2	280	.089	43	6.7	1.6	.02	310	25	14	72	36	BLIND18
M2-13-BL	W-215741	3.4	280	.092	41	6.5	1.7	.02	300	24	15	70	33	BLIND17
M2-5-25-BL	W-215719	.25	41	.015	7	.6 L	.39	.01 L	210	1	6.5	18	5.8	BLIND14
M2-5-25-BL	W-215718	.25	42	.070	7	.7 L	.39	.01 L	210	1	7.0	19	5.8	BLIND13
M2-5-25-BL	W-215695	.25	42	.015	6	.8 L	.36	.01 L	210	1	7.1	18	5.8	
M2-9-BL	W-215739	.78	91	.062	13	1.3	.56	.01 L	200	3	5.0	16	10	BLIND15
M2-9-BL	W-215740	.80	94	.023	14	1.0	.56	.01 L	200	3	4.3	17	10	BLIND16
M2-9-BL	W-215732	.81	91	.023	13	1.1	.56	.01 L	200	3	5.0	18	11	
M3-18-BL	W-215989	.37	55	.010	6	1.0	.17	.01 L	100	1	4.2	3	4.2	
M3-18-BL	W-215990	.35	62	.019	5	1.2	.17	.01 L	95	1 L	4.6	3	5.0	BLIND19
M3-18-BL	W-215991	.34	64	.027	1	1.0	.17	.01 L	95	1 L	5.3	3	5.0	BLIND20
M3-4-BL	W-215992	1.1	180	.010 L	15	1.0	.51	.01 L	110	2	6.0	16	8.7	BLIND21
M3-4-BL	W-215993	1.1	190	.010 L	14	1.0 L	.51	.01 L	110	2	5.1	16	9.1	BLIND22
M3-4-BL	W-215967	1.1	190	.010 L	16	.9	.49	.01 L	120	4	6.0	17	9.1	
M3-5-1-BL	W-215957	.23	38	.062	6	.7	.39	.01 L	300	1	6.3	19	5.0	BLIND23
M3-5-1-BL	W-215958	.20	39	.058	5	.5 L	.38	.01 L	290	1 L	6.3	18	5.0	BLIND24
M3-5-1-BL	W-215938	.23	35	.048	5	.3	.39	.01 L	310	3	6.8	18	4.2	
M3-5-25-BL	W-215954	.32	50	.010 L	12	2.0	.44	.01 L	210	2	8.1	20	6.6	
M3-5-25-BL	W-215959	.32	51	.016	13	1.0	.44	.01 L	210	2	6.8	21	6.2	BLIND25
M3-5-25-BL	W-215960	.32	50	.010	12	2.0	.43	.01 L	210	2 L	8.3	21	6.2	BLIND26
M4-13A-I	W-216793	3.50	230	.091	58	10	2.4	.02	280	29	24	77	52	
M4-13A-I	W-216809	3.50	220	.110	56	8.2	2.3	.02	270	27	27	78	49	BLIND27
M4-16-H	W-216810	.26	140	.011 L	6	.8 L	.16	.01 L	100	1	5.0	10	6.6	BLIND28
M4-16-H	W-216798	.28	150	.029	8	.9	.17	.01 L	110	3	6.3	10	5.8	
M4-5-25-BL	W-216829	.32	57	.020 L	12	.8 L	.43	.01 L	230	4	6.3	17	5.7	
M4-5-25-BL	W-216838	.31	58	.020 L	11	.8 L	.42	.01 L	220	2	6.3	17	4.8	BLIND29
M4-5-28-BL	W-216839	.21	34	.059	9	.8 L	.22	.01 L	180	3	2.6	10	2.5	BLIND30
M4-5-28-BL	W-216833	.21	33	.02 L	5	.8 L	.24	.01 L	180	2.1	3.5	11	2.7	