

Compositional Data for Bengal Delta Sediment Collected from Boreholes at Srirampur, Kachua, Bangladesh

Open-File Report 2006-1222



In cooperation with the Geological Survey of Bangladesh and Bangladesh Water Development Board

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By George N. Breit, James C. Yount, Md. Nehal Uddin, Ad. Atual Muneem, Heather A. Lowers, Rhonda L. Driscoll, and John W. Whitney

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SI to Inch/Pound

Multiply	By	To obtain
Length		
centimeter (cm)	0.3937	inch (in.)
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
kilometer (km)	0.5400	mile, nautical (nmi)
meter (m)	1.094	yard (yd)
Volume		
milliliter	0.03382	ounce, fluid (fl. oz)
milliliter	0.002113	pint (pt)
milliliter	0.001057	quart (qt)
milliliter	0.06102	cubic inch (in ³)
Mass		
gram (g)	0.03527	ounce, avoirdupois (oz)
kilogram (kg)	2.205	pound avoirdupois (lb)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F}=(1.8\times^{\circ}\text{C})+32$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$^{\circ}\text{C}=(^{\circ}\text{F}-32)/1.8$$

Horizontal coordinate information is referenced to World Geodetic System 1984 (WGS 84)

Chemical Symbols

Abbreviation	Chemical Species
Ag	silver
Al	aluminum
As	arsenic
Au	gold
B	boron
Ba	barium
Be	beryllium
Bi	bismuth
C	carbon
C-total	total carbon
C-carbonate	carbonate carbon
Ca	calcium
Cd	cadmium
Ce	cerium
Co	cobalt
Cs	cesium
EDTA	ethylene diamine tetra-acetic acid
Er	erbium
Fe	iron
Ga	gallium
Ge	germanium
Ho	holmium
K	potassium
La	lanthanum
Li	lithium
Mg	magnesium
Mn	manganese
Mo	molybdenum
Na	sodium
Nb	niobium
Nd	neodymium
Ni	nickel
P	phosphorous
Pb	lead
Rb	rubidium
S	sulfur
Sb	antimony
Se	selenium
Sn	tin
Sr	strontium

Abbreviation	Chemical Species
Ta	tantalum
Th	thorium
Ti	titanium
U	uranium
V	vanadium
W	tungsten
Y	yttrium
Yb	ytterbium
Zn	zinc
Zr	zirconium

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Abstract

Processes active within sediment of the Bengal delta have attracted world concern because of the locally high content of arsenic dissolved in ground water drawn from that sediment. Sediment samples were collected from two boreholes in Srirampur village, Kachua upazila, Chandphur district, Bangladesh, to investigate the processes contributing to arsenic contamination. The samples were mineralogically and chemically analyzed to determine compositional variations related to the arsenic content of the sediment. Mineralogy of the sediments was determined using powder X-ray diffraction. Bulk chemical composition was measured by Combustion, Inductively Coupled Plasma Atomic Emission Spectroscopy, Energy Dispersive X-ray Fluorescence, and Hydride Generation Atomic Absorption Spectrophotometry. Solutions produced by four chemical extractions — 0.1 molar strontium chloride, 0.5 normal hydrochloric acid, titanium(III)-EDTA, and a solution of hydrogen peroxide and hydrochloric acid — were analyzed to evaluate the chemical reactivity of the sediment with an emphasis on arsenic residence. Acid-volatile sulfide, acid-soluble sulfate, and reducible sulfide were also measured.

Sediment sampled at Srirampur is typically un lithified, gray, micaceous, feldspathic, arenaceous silt and sand. Arsenic content of the sediment ranges from <1 to 210 ppm, with the highest contents measured in sediment collected at a depth of 320 meters. Samples with high arsenic contents typically contain high concentrations of sulfur. The greatest amount of arsenic was extracted using the oxidative hydrogen peroxide and hydrochloric acid extraction solution. The extraction results are consistent with the apparent association of arsenic in sulfur in the bulk chemical analyses. Pyrite is typically the most abundant form of sulfur in the sediment and is dissolved by the oxidative extraction.

Introduction

The ingestion of arsenic-rich ground water was first proposed in 1983 as the cause for a range of health problems experienced by residents of the Bengal basin (Gorair and others, 1984; Saha, 1984; 1995). Subsequent testing of wells in the basin has determined that ground water across the basin locally contains high concentrations of arsenic. An estimated 40 million residents (20% of the population of Bangladesh) currently consume water that exceeds local drinking water standards of 50 $\mu\text{g/L}$ arsenic (World Bank, 2005). In addition, this contaminated water is used to irrigate farms needed to supply food for the residents. Explanations for the contamination have consistently proposed that naturally occurring arsenic is released from ferric oxyhydroxide grain

coatings in response to microbially facilitated reduction in the subsurface (Nickson and others, 2000; Kinniburgh, and Smedley, 2001; Harvey and others, 2002; Horneman and others, 2004; Ravenscroft and others, 2004). This report presents the results of characterization of sediment samples collected in the area of Srirampur village in southeastern Bangladesh (fig. 1).

Interpretation of these results will be presented in manuscripts currently in preparation. Funding for this work was provided by the U.S. Agency for International Development and the World Bank.

A primary concern for aid agencies seeking to alleviate the health crisis caused by the consumption of arsenic-rich water is to identify methods or sources that will supply safe drinking water. One of the mitigation strategies proposed is to install water wells to depths below 150 m. Water analyses summarized by the National Arsenic Mitigation Information Center (NAMIC) and other databases (www.bamwsp.org) show that the frequency of wells that produce water exceeding the drinking water standard decrease with increasing depth. A small fraction of existing wells deeper than 150 m produce water that exceeds the 50 µg/L drinking water standard (www.bamwsp.org). Although the lack of arsenic in water produced by these deeper wells has been attributed to removal of arsenic in the sediment by ground water flow, no evidence has been offered to verify the loss of arsenic. This investigation determined the composition of sediment from depths as great as 400 meters to provide the data necessary to evaluate the viability of deeper aquifers to sustain production of water with low arsenic contents.

Setting

Srirampur village is located approximately 45 kilometers southeast of the capital city of Dhaka in Kachua upazila, Chandpur District (fig. 1). Testing of 17,400 tubewells in the Kachua upazila determined that 98% produce water containing more than 50 µg/L of arsenic (www.bamwsp.org). Srirampur is 18 km east of the Meghna Estuary, which is currently the principal discharge for the Ganges, Brahmaputra, and Meghna River drainage basins. The study area is located physiographically on the Tippera surface (Morgan and McIntire, 1959) within and adjacent to the Meghna river floodplain. Much of the sediment transported by the rivers and deposited in the basin originates in crystalline rocks of the high Himalayas, with lesser additions from the Indian Shield to the west, the Shillong Plateau to the north, and Tertiary-age sedimentary rock that are exposed in the Indo-Burman Range to the east. The Tertiary rock is composed mostly of sediment originally shed from the ancestral Indian Shield and early Himalaya uplift, which was buried along the paleo-Indian continental margin, lithified, and tectonically uplifted into the weathering zone during the India-Asia collision. Holocene sediment accumulation rates for the Bengal delta range up to 1 cm year⁻¹ as a result of the large amount of sediment transport, sea level rise, and accommodation space created by subduction (Goodbred and Kuehl, 2000).

Methods

Sample Collection

Sediment samples were collected in the spring and summer of 2003 from two boreholes by coring selected depth intervals. The borehole drilled by the Geological Survey of Bangladesh (GSB), SH-1, was located at 23.33933° N latitude and 90.92603° E longitude and was drilled to a total depth of 405 meters. Drilling fluid used by GSB was a mix of water and bentonite with the addition of barite when drilling advanced below 260 m depth. The upper 125 m of sediment collected during drilling of a well by the Bangladesh Water Development Board (BWDB), BWDB-

1, was also sampled. BWDB-1 is located at 23.33933° N and 90.92253° E, approximately 370 m west of SH-1. Forty-three samples were collected from SH-1, and 14 from BWDB-1. Samples were described in the field (appendix 1). Bulk samples were air-dried prior to analysis and are designated as –AD in the appendices.

Aliquots of 42 sediment samples recovered from the SH-1 borehole were placed in glass vials filled with argon gas at the drill site to preserve the oxidation state of iron and arsenic in the sample. These preserved samples are identified as –P in subsequent tables. Some preserved samples were collected at different depth intervals than the –AD samples, as listed in appendix 2. Preserved samples were collected using a detipped 10 mL syringe that was used to extract sediment in the lowest section of the core barrel (immediately above the coring bit). This material was considered to be the least contaminated by drilling fluid. The sediment collected in the detipped syringe was then transferred to an amber glass vial equipped with a Teflon coated septum. Sediment was transferred into the vial while the vial was purged with flowing argon gas. The vial was then capped, and purged for an additional five minutes by using needles to pass argon through the septum. After purging, the vial was frozen until shipment to the United States for analysis. During shipment the vials thawed but were promptly refrozen upon arrival at the USGS laboratories.



Figure 1. Map of Bangladesh showing the location of the Srirampur study site. Srirampur is located approximately 50 kilometers west of the border with India, 80 kilometers north of the Bay of Bengal and 18 kilometers east of the Meghna estuary.

Grain-size Analysis

Aliquots of 43 bulk sediment samples were analyzed to determine grain-size using a Malvern Mastersizer S long bed laser refraction instrument. Approximately 0.3 gram splits of sediment were soaked overnight in 40 mL of distilled water amended with 20 mL of 0.25 weight percent sodium hexametaphosphate to enhance particle dispersion. The disaggregation treatments were intended to separate individual mineral particles. Consistent with the observed lack of cementation, Srirampur sediment samples dispersed easily. Grain-size characteristics of the samples are presented in appendix 3.

Mineralogy

To determine the mineral composition, splits of 57 bulk samples were ground to $< 50 \mu\text{m}$ in an agate shatterbox prior to analysis by X-ray diffraction. Side-packed mounts were prepared by loading the powdered sample against frosted glass to minimize preferential orientation. The mounts were analyzed using Ni-filtered, Cu $K\alpha$ radiation on a Siemens D500 equipped with a graphite monochromator. Samples were scanned from 4 to 64 degrees 2θ with a 0.02 degree step size and count time of 2 seconds per step.

Seven samples were prepared according to the methods described in Eberl (2002) for quantitative mineral analysis. This method requires micronizing the sample with ZnO as an internal standard. The ROCKJOCK (Eberl, 2002) program was then used to calculate the abundance of major mineral constituents. Analytical precision of the ROCK JOCK method is estimated to be within ten relative percent. Results of the qualitative and quantitative XRD analyses are listed in appendices 4 and 5.

Bulk Chemical Analyses

Fifty-seven air-dried samples were analyzed to determine chemical composition by Combustion, Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES), Energy Dispersive X-ray Fluorescence (EDXRF), and Hydride Generation Atomic Absorption Spectrophotometry (HGAAS). All samples were homogenized in a mortar and pestle, split, and ground in an agate shatterbox prior to analysis. The combustion procedure of Brown and Curry (2002a, 2002b) determined the total carbon and sulfur concentrations. Carbonate carbon was measured by evolution of carbon dioxide using the Chittick method (Dreimanis, 1962). Samples analyzed by ICP-AES were first dissolved using the four acid digestion as described in Briggs (2002). ICP-AES determined the concentration of 40 elements. EDXRF analyses followed the procedure of Siems (2002), in which a pressed powder pellets were analyzed directly for 30 elements. Arsenic concentrations were also obtained using HGAAS according to the method of Hageman and others (2002). HGAAS was used because of its lower detection limit, and higher precision and accuracy. Detection limits, accuracy, and precision of all methods were consistent with those described in references listed above. Results of the chemical analyses of the bulk samples are listed in appendices 6 through 9.

Extraction Chemical Analyses

Selected sediment samples were treated with chemical reagents to extract constituents of the sediment. Extractions were conducted to evaluate the exchangeable cations, the solid phase residence of iron and arsenic, and the speciation of sulfur. A strontium chloride (SrCl_2) solution was used to determine the abundance of soluble and exchangeable cations. Acid, reducible, and

oxidizable extractions were applied sequentially to evaluate the distribution of arsenic among the solid phases. Acid-volatile sulfide (AVS), acid-soluble sulfate, and disulfide (DI) were extracted from only selected samples.

Exchangeable major ions were extracted by transferring 5 to 10 gram aliquots of sixteen preserved sediment samples into an acid-washed, amber serum vial containing 40 mL of a 0.1 M solution of SrCl_2 . The vial and SrCl_2 solution were flushed with flowing, high-purity nitrogen prior to and during addition of the sediment. Nitrogen continued to purge the vial for 5 minutes following addition of the sediment. The vial was sealed with a rubber septum and wrapped with aluminum foil to exclude light. All wrapped vials were agitated on a wrist shaker for one hour to disaggregate and disperse the sediment. The vials were then shaken by hand intermittently during the 24 hour reaction period. After reaction, 30 mL of solution was withdrawn from the serum vial using a syringe. The solution was then filtered through a 0.2 μm filter and acidified with high-purity nitric acid to a pH <2. Acidified solutions were analyzed by ICP-AES for calcium, magnesium, potassium, and sodium and spectrophotometrically for total iron using the Orthophenanthroline method of Clesceri and others (1998). Results of the analyses are presented in appendix 10. Duplicate extractions with strontium chloride solution were reproduced within 20 relative percent for all measured constituents. The variability was attributed to visible grain-size heterogeneity within the frozen samples. Although variable in absolute concentration, the relative abundance of exchangeable cations within each sample was within 5 relative percent for all ions.

Chemical extractions applied to estimate the solid-phase residence of arsenic were selected to dissolve phases detected in the sediment samples. The acid (0.5N HCl) and reducible extractions (trivalent titanium chloride (TiCl_3) and ethylenediaminetetraacetic acid (EDTA)) were based on methods described by Heron and Christensen (1995). Treatment of sediment with 0.5N HCl was expected to dissolve carbonate minerals (calcite, dolomite, rhodocrosite, and siderite), vivianite, and amorphous FeS phases. The Ti(III)-EDTA reagent was selected for its ability to dissolve goethite and hematite with minimal impact of silicate minerals (Ryan and Gschwend, 1991). Hydrogen peroxide (H_2O_2) in a solution of HCl provided the oxidative extraction intended to dissolve arsenic bound to more refractory sulfide minerals (pyrite) and organic matter.

A 3 to 5 gram aliquot of each of 42 frozen, preserved sediment samples was transferred to an acid-washed amber serum vial under flowing high-purity nitrogen. The sediment was exposed to air for a few minutes during the transfer but experiments determined that a minimum of 30 minutes of exposure of the cold sediment was needed before iron oxidation was detectable in the 0.5 N HCl extract solutions. Forty mL of 0.5 N hydrochloric acid was added; the vial was sealed with a rubber septum and purged with nitrogen gas, wrapped with aluminum foil, and shaken periodically. Following 24 hours, 30 mL of the acid solution was withdrawn through the septum and filtered through a 0.2 μm syringe filter. An aliquot of the solution was immediately analyzed to determine the concentration of dissolved ferrous iron and dissolved total iron using the Orthophenanthroline method (Clesceri and others, 1998). A second aliquot of the remaining solution was analyzed by ICP-AES for 25 elements and for arsenic by HGAAS. The 0.5 N HCl extraction also was applied to 33 of the air-dried samples. The extracts from the acid solutions were only analyzed to measure the oxidation state of dissolved iron to estimate the magnitude of change to the iron redox state caused by exposing the samples to air. Results of the analyses of both sets of 0.5N HCl extractions are presented in appendices 11 through 13. Measured concentrations of extractions with 0.5 N HCl of replicate samples of the sediment typically reproduced within 15 percent, but ratios of ferrous to total extractable iron were reproduced within 3 percent. Variations in element concentrations in the replicates are attributed to sample heterogeneity.

The sediment remaining after the 0.5N HCl extraction of the preserved sediment was filtered, rinsed thoroughly with distilled water, and air-dried at 50 °C prior to reaction with the reducing solution. Because the most reactive constituents of the sample were removed by 0.5 N HCl, drying was determined to have a minimal effect on the redox condition of the remaining solids. Approximately 2 to 3 grams of the dried solid was mechanically split from the residue and combined with 40 mL of 0.008 molar TiCl_3 in 0.05 molar EDTA with a pH adjusted to 6 using sodium hydroxide. The reducing solution was prepared under flowing nitrogen. The serum vial was sealed, purged with nitrogen for 5 additional minutes, wrapped with foil to exclude light, and shaken intermittently over the reaction period. Following 24 hours of reaction, 30 mL of solution was removed using a syringe. The solution was then filtered through a 0.2 μm syringe filter. The Ti(III)-EDTA solution has a distinct magenta color prior to reaction. This color was maintained, although it was less intense, at the completion of the reaction time indicating that the Ti(III) was not consumed. The filtered solutions were analyzed for iron, aluminum, magnesium, and manganese using standard methods of atomic absorption spectrophotometry. Hydride generation atomic fluorescence spectrometry was used to determine the concentration of dissolved arsenic. Results of the analyses of the Ti(III)-EDTA extract solutions are presented in appendix 14. Duplicate analyses of the sediment with Ti(III)-EDTA were typically within 4 percent.

Approximately 0.5 grams of the air-dried residue remaining for each sample after the Ti(III)-EDTA extraction was combined with 5 mL of 2.4 molar HCl and 10 percent H_2O_2 . The solution and sediment reacted for 2 hours, and then 3 mL of 20% H_2O_2 was added. Following two additional hours of reaction, the resulting mixtures were slowly heated to 40 °C in a water bath for approximately 14 hours. The resulting solutions were then filtered through a 0.45 μm filter and diluted to a total volume of 25 mL. The method was intended to dissolve sulfide minerals in the sediment and was tested using coarse-grained hydrothermal pyrite. Approximately 95% of the hydrothermal pyrite dissolved during this procedure. Hydride generation atomic fluorescence spectrometry was used to measure the arsenic content of the solutions as presented in appendix 15. Duplicate sediment analyses with the H_2O_2 -HCl extraction were consistently within 10 percent.

The abundances of AVS, acid-soluble sulfate, and DI were determined following the extraction scheme of Tuttle and others (1986). Sulfur speciation was determined on a 2 to 5 gram aliquot of preserved sediment that was transferred while only partially thawed into the reaction vessel. Under flowing nitrogen the sample was combined with 80 milliliters of 6 N HCl that contained 2 grams of stannous chloride (SnCl_2). The SnCl_2 was added to reduce ferric iron in the samples that might oxidize evolved hydrogen sulfide (H_2S) (Rice and others, 1993). After 15 to 30 minutes, the reaction vessel was heated to boiling to increase the reaction rate. The evolved H_2S was carried in flowing nitrogen through a reservoir of pH 4 buffer to remove HCl and bubbled through a trap containing 1 N silver nitrate (AgNO_3) until the reaction was complete. The resulting silver sulfide (Ag_2S) was collected by filtration, air-dried, and weighed to measure the abundance of AVS. The acid solution was separated from the residual solid by filtration, and the residual solid was air-dried and weighed. The solution was reacted with 10 mL of 10% barium chlorite to precipitate dissolved sulfate as barium sulfate, which is considered acid-soluble sulfate. The residual sediment from the AVS extraction was placed in a reaction vessel under flowing nitrogen and combined with 50 mL of 1M chromous chloride (CrCl_2) in 4 N HCl containing 10 milliliters of ethanol. Chromium (II) converts reducible sulfide minerals (i.e., pyrite) to H_2S . The H_2S is carried to a 1N AgNO_3 trap as described for the AVS extraction and precipitated as Ag_2S . The CrCl_2 solution is boiled for approximately 1 hour or until evolution of H_2S has stopped. Results of the sulfur speciation are listed in appendix 16.

Results

Physical and mineralogical characteristics.

Sediment samples from the Srirampur boreholes are typically gray and micaceous ranging from silt to sand. Samples collected at depths of 46 to 48 meters are distinctly brown relative to other samples and may be Pleistocene sediment near the Holocene-Pleistocene unconformity (Goodbred and Kuehl, 2000). The relative grain size distribution of the sample materials from the GSB bore-hole are plotted in figure 2. XRD analyses identified quartz, plagioclase, and potassium feldspar as the major constituents of the sediment, with minor amounts of chlorite, muscovite, biotite and amphibole (appendices 4 and 5). Confirmed authigenic phases detected by XRD in some samples include siderite and pyrite; calcite was not detected.

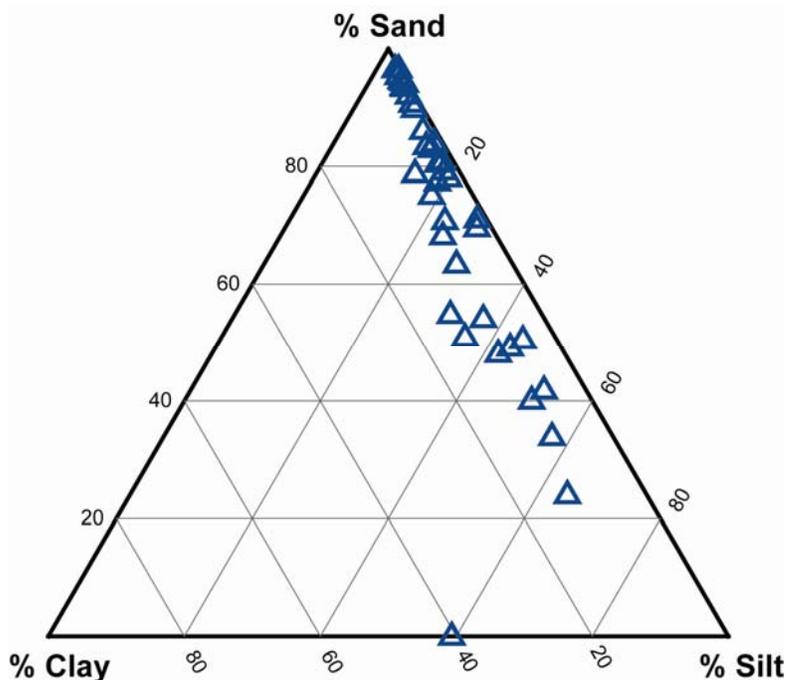


Figure 2. Ternary diagram of results of grain size analyses (appendix 3) in sediment samples recovered from the GSB borehole in Srirampur, Kachua.

Bulk Chemical Composition

The median, minimum, and maximum concentration of chemical constituents measured in bulk air-dried sediments from the two bore holes are listed in table 1. Precision of duplicate splits of the same sample were within 10 relative percent for elements with concentrations greater than 3 times the detection limit for combustion, Chittick, ICP-AES, and EDXRF methods. Elements present in lower concentrations were reproduced within 30 relative percent. Duplicate total arsenic measurements by HGAAS were consistently within 4 relative percent. Analyses of solid and rock standards submitted with the samples yielded results within the precision and accuracy described in Taggart (2002).

Total arsenic concentrations of the sediment range from 0.6 to 210 ppm as measured by HGAAS. The highest concentrations occur between 307 and 310 meters depth. Samples within this depth interval are also distinguished by high concentrations of sulfur. Concentrations of other elements in the high arsenic interval were similar to other samples from the boreholes.

Unusually high concentrations of barium (>400 ppm) were detected in sediment collected from the GSB borehole below depths of approximately 240 meters. The drilling engineer reported that 240 m was the depth at which barite was added to the drilling fluid. A scanning electron microscope (SEM) examination of sediment below 240 m revealed the presence of uniform, small prisms of barite (BaSO_4) identical to those added to the drilling fluid. Because sulfur is an important component of the processes active within the sediment, we subtracted the contaminant barite from the bulk sulfur analyses using the following procedure.

Potassium and barium have a recognized geochemical association in potassium feldspars and micas (Puchelt, 1978). This association is evident in the sediment collected at Srirampur. Samples recovered from depths less than 230 meters (uncontaminated with barite) have a strong correlation of barium and potassium ($r^2 = 0.9$). The amount of excess barium in the deeper samples was then calculated based on the amount of barium expected for the measured amount of potassium (equation 1). Because of the uncertainty in the analytical data and the expected variance from an ideal correspondence between Ba and K, only samples with greater than 200 ppm excess barium were considered to have sufficient contamination to merit correction. In addition, barium contents of 200 ppm, if contained in barite, would correspond to approximately 0.005 weight percent sulfur, which is close to the detection limit of the sulfur analyses. Accordingly, sulfur concentrations in the samples were corrected by using equation 2. Results of the recalculation of sulfur concentration are plotted in figure 3. Note that the very high sulfur concentrations in some samples are unaffected by the barite correction.

$$\text{Ba (ppm) excess} = \text{Ba (ppm) measured} - (174 * \text{K (wt. \%)} + 76) \quad (1)$$

$$\text{Sulfur (ppm) corrected} = \text{Sulfur (ppm) measured} - (0.233 * \text{Ba (ppm) excess}) \quad (2)$$

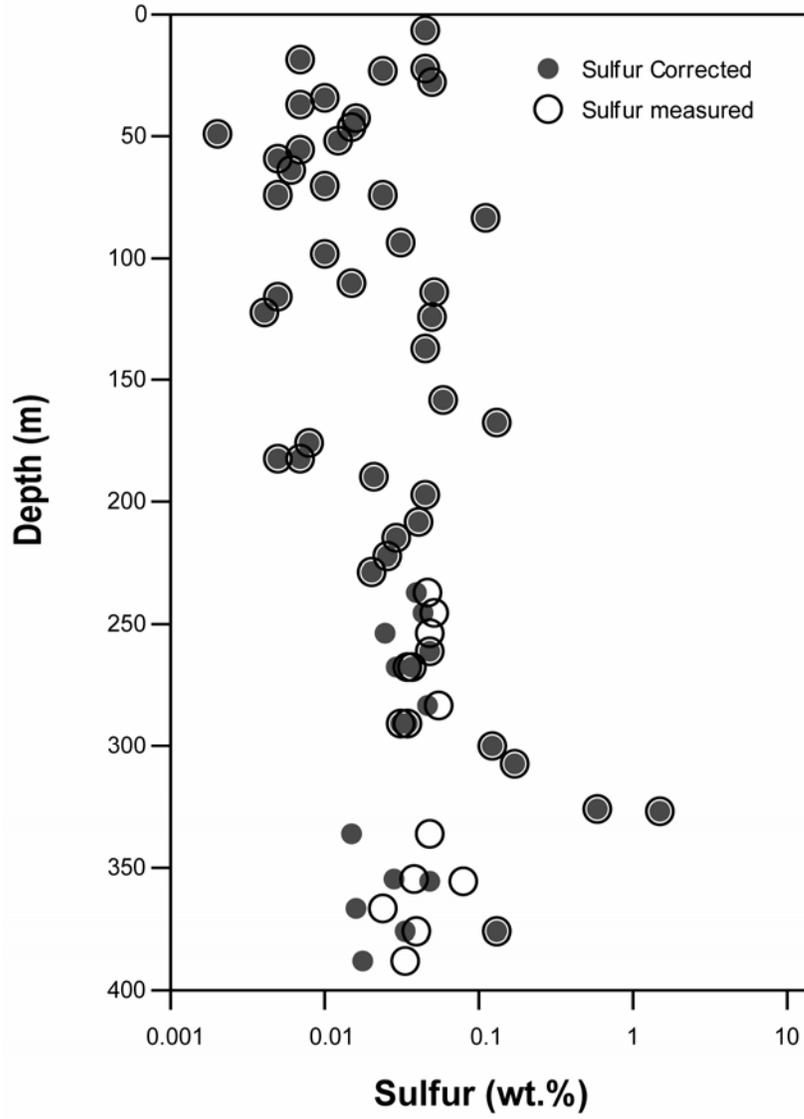


Figure 3. Comparison of the sulfur concentration measured in the sediment with concentrations corrected for barite contamination of the samples. Significant differences between measured and corrected sulfur contents are apparent in most samples deeper than 240 meters.

Table 1. Median, minimum, and maximum concentrations of chemical constituents of sediment recovered from the two boreholes in Srirampur, Kachua, Bangladesh.

[ICP-AES, Inductively Coupled Plasma Atomic Emission Spectroscopy; EDXRF, Energy Dispersive X-ray Fluorescence Spectrometry; HGAAS, Hydride Generation Atomic Absorption Spectrophotometry; *, sulfur concentrations listed as corrected values as described in the text; detection ratio is the number of analyses above the detection limit/total number of analyses]

Element (units)	Analytical Method	Median	Minimum	Maximum	Detection Ratio
Al (wt.%)	ICP-AES	4.8	2.7	9.8	57/57
Ca (wt.%)	ICP-AES	0.68	0.26	1.4	57/57
Fe (wt.%)	ICP-AES	2.2	0.87	7.4	57/57
K (wt.%)	ICP-AES	1.7	1.2	2.9	57/57
Mg (wt.%)	ICP-AES	0.39	0.16	1.9	57/57
Na (wt.%)	ICP-AES	1.0	0.52	1.4	57/57
P (wt.%)	ICP-AES	0.03	0.007	0.074	57/57
Ti (wt.%)	ICP-AES	0.22	0.093	0.55	57/57
C-total (wt.%)	Combustion	0.19	0.05	1.5	55/57
C-carbonate (wt.%)	Chittick	0.07	0.05	0.33	43/43
S (wt.%)*	Combustion	0.027	<0.005	1.47	57/57
Ag (ppm)	ICP-AES	<2	<2	<2	0/57
Ag (ppm)	EDXRF	<1	<1	<1	0/57
As (ppm)	ICP-AES	<10	<10	230	8/57
As (ppm)	EDXRF	3	<2	190	35/57
As (ppm)	HG-AAS	2.7	0.6	210	57/57
Au (ppm)	ICP-AES	<8	<8	<8	0/57
Ba (ppm)	ICP-AES	420	270	1700	57/57
Ba (ppm)	EDXRF	420	290	1700	57/57
Be (ppm)	ICP-AES	1.8	<1	3.4	57/57
Bi (ppm)	ICP-AES	<10	<10	<10	0/57
Bi (ppm)	EDXRF	<5	<5	<5	0/57
Br (ppm)	EDXRF	<1	<1	3	5/57
Cd (ppm)	ICP-AES	<2	<2	2.9	1/57
Cd (ppm)	EDXRF	<1	<1	3	2/57
Ce (ppm)	ICP-AES	58	29	110	57/57
Ce (ppm)	EDXRF	68	40	120	57/57
Co (ppm)	ICP-AES	7.2	1.4	120	57/57
Cr (ppm)	ICP-AES	32	19	130	57/57
Cr (ppm)	EDXRF	40	23	140	57/57
Cs (ppm)	EDXRF	6	<5	18	48/57
Cu (ppm)	ICP-AES	5.2	1.4	190	57/57
Cu (ppm)	EDXRF	9	3	190	57/57
Eu (ppm)	ICP-AES	<2	<2	<2	0/57
Ga (ppm)	ICP-AES	10	4.3	24	55/57
Ga (ppm)	EDXRF	11	5	24	57/57
Ge (ppm)	EDXRF	<2	<2	2	1/56
Ho (ppm)	ICP-AES	<4	<4	<4	0/57
La (ppm)	ICP-AES	30	14	56	57/57
La (ppm)	EDXRF	37	20	67	57/57

Table 1. Median, minimum and maximum of chemical constituents—Continued.

Element (units)	Analytical Method	Median	Minimum	Maximum	Detection Ratio
Li (ppm)	ICP-AES	14	8.2	83	57/57
Mn (ppm)	ICP-AES	570	82	2700	57/57
Mo (ppm)	ICP-AES	<2	<2	4.8	19/57
Mo (ppm)	EDXRF	<2	<2	4	3/57
Nb (ppm)	ICP-AES	9.4	2	23	57/57
Nb (ppm)	EDXRF	9	4	18	57/57
Nd (ppm)	ICP-AES	25	12	43	57/57
Nd (ppm)	EDXRF	33	16	59	57/57
Ni (ppm)	ICP-AES	13	8	84	57/57
Ni (ppm)	EDXRF	16	9	87	57/57
Pb (ppm)	ICP-AES	17	12	38	57/57
Pb (ppm)	EDXRF	18	12	33	57/57
Rb (ppm)	EDXRF	87	58	240	57/57
Sb (ppm)	EDXRF	<2	<2	<2	0/57
Sc (ppm)	ICP-AES	7	3.5	19	57/57
Se (ppm)	EDXRF	<1	<1	<1	0/57
Sn (ppm)	ICP-AES	<5	<5	19	15/57
Sn (ppm)	EDXRF	3	<2	6	42/57
Sr (ppm)	ICP-AES	120	67	170	57/57
Sr (ppm)	EDXRF	130	69	160	57/57
Ta (ppm)	ICP-AES	<20	<20	<40	0/57
Th (ppm)	ICP-AES	12.5	4	24	56/57
Th (ppm)	EDXRF	11	4	21	55/57
U (ppm)	ICP-AES	<100	<100	<100	0/57
U (ppm)	EDXRF	<4	<4	6	15/57
V (ppm)	ICP-AES	44	25	140	57/57
V (ppm)	EDXRF	46	27	140	57/57
W (ppm)	EDXRF	<5	<5	40	1/57
Y (ppm)	ICP-AES	16	6	31	57/57
Y (ppm)	EDXRF	22	10	39	57/57
Yb (ppm)	ICP-AES	1.6	<1	3.6	54/57
Zn (ppm)	ICP-AES	35	17	150	57/57
Zn (ppm)	EDXRF	41	20	140	57/57
Zr (ppm)	EDXRF	180	78	360	57/57

Chemical Extractions

The strontium chloride extraction determined that calcium, magnesium, and sodium are the dominant exchangeable cations, with smaller abundances of potassium (appendix 10). Exchangeable iron is relatively abundant in the shallowest sediment samples (< 80 m depth), decreases to low concentrations between 80 and 180 m, and is generally below detection in samples deeper than 180 m. Considered on the basis of equivalents: sodium ranges from 17 to 60 percent, calcium; 16 to 40 percent, magnesium; 11 to 44 percent; potassium 1 to 9 percent; and iron less than 6 percent of the measured exchangeable ions. The relative abundance of exchangeable cations other than iron does not vary systematically with depth.

Analyses of the 0.5N HCl extraction solutions verified that the sediment is chemically reduced with respect to iron. Greater concentrations of iron were extracted by the acid treatment than any other measured constituent (0.12 to 6.6 wt.%; appendix 13). Together with Fe^{2+}/Fe_{total} values that are typically greater than 0.9, the amounts of extracted iron are attributed primarily to

dissolution of siderite. The lowest $\text{Fe}^{2+}/\text{Fe}_{\text{total}}$ value (0.62) was measured on the sediment collected at 46.5 m, which is the brown sand tentatively identified as sediment oxidized during the Holocene-Pleistocene unconformity. As expected, iron dissolved from the air-dried sediment using 0.5 N HCl typically contained lower $\text{Fe}^{2+}/\text{Fe}_{\text{total}}$ values than the preserved samples.

Substantial amounts of aluminum, calcium, magnesium, manganese, potassium, sodium, and silicon were also dissolved by 0.5 N HCl. These elements are attributed to dissolution of detrital silicates and siderite. Reaction of the acid with portions of feldspars, micas, and other detritus weathered during transport and shallow burial likely accounts for Al, Si, K, Na, and some of the Ca, Mg, and Mn. Dissolution of siderite likely released substantial amounts Ca, Mg, and Mn as well as iron based on preliminary electron microbeam analyses of siderite grains.

Wilkin and Ford (2002) noted a decrease in the amount of dissolved arsenic when sulfidic sediment treated with HCl solutions. This challenges the ability of HCl extracts to reliably estimate the abundance of labile arsenic. Wilkin and Ford (2002) attributed the arsenic loss to precipitation of amorphous orpiment (As_2S_3) by reaction of dissolved arsenic and H_2S evolved by reaction of the AVS with HCl. Therefore, the arsenic concentrations of the 0.5N HCl extract solutions in this study should be viewed with caution. The potential of orpiment precipitation in the 0.5N HCl extraction was evaluated using Geochemist's Workbench with the LLNL V8 R6 combined database that was modified with the thermodynamic data of Nordstrom and Archer (2003) and Pokrovski and others (2002). Results of AVS extraction (appendix 16) and the abundance of arsenic and iron in the 0.5N HCl solutions (appendices 12 and 13) were used to evaluate the degree of saturation of amorphous orpiment. The amount of AVS extracted by the 0.5N HCl is likely to be smaller than the AVS extracted by hot 6N HCl, so the calculations are considered to indicate the maximum saturation values. Five of the 16 samples were oversaturated with respect to amorphous orpiment although the maximum saturation index (saturation index = $\log(\text{ion activity product} / \text{equilibrium constant})$) was 2. Because the samples selected for sulfur speciation generally contain greater contents of sulfur than most of the sediment samples, the number of samples oversaturated with amorphous orpiment is likely to be proportionally smaller. Similar equilibrium calculations with the closed-system results of Wilkin and Ford (2002) determined that more than 80% of dissolved arsenic remained in solution when amorphous orpiment SI values were <2 . Less than 20% of the arsenic remained in solution when solution compositions exceeded SI values >4 . This comparison does not eliminate the concern for orpiment precipitation in the Srirampur sediment, but the problem is likely to be less significant than in the sediment evaluated by Wilkin and Ford (2002).

Approximately a tenth of the amount of iron, manganese, aluminum, and arsenic extracted by 0.5 N HCl were dissolved by the Ti(III)-EDTA extraction (appendix 14). The amount of iron dissolved was the largest of the four measured constituents. Greater amounts of iron and arsenic extracted by this reducing treatment were measured on shallow sediment (<80 m) than from the deeper samples. Aluminum was typically dissolved in greater amounts from samples with smaller grain size; this is attributed to greater abundance of micas and clays in those samples.

Only arsenic concentration was determined in the solutions produced by the oxidative extraction (H_2O_2 -HCl) (appendix 15). The amount of arsenic extracted by this treatment, 0.3 to 6 ppm, was consistently greater than the contents extracted by the 0.5N HCl or Ti(III)-EDTA (appendices 13, 14).

Sulfur speciation extractions detected AVS, acid-soluble sulfate, and reducible sulfur in the borehole sediment (appendix 16). Concentrations of AVS ranged from 10 to 280 ppm, acid-soluble sulfate measured <10 to 110 ppm, and reducible sulfur was typically the most abundant form, 20 to 1170 ppm. Reducible sulfide is attributed to pyrite, which is consistent with detection of pyrite by XRD and optical microscopy. The acid-soluble sulfate extracted from the deeper samples may

reflect a contribution from the drilling fluids, and this will be tested with future sulfur isotope analyses. For several samples the total amount of sulfur extracted is substantially different than the total sulfur concentrations measured for the bulk, air-dried sediment (appendix 6). The speciation scheme was evaluated with synthetic standards and determined to be reliable; therefore, the contrasting values between the air-dried and preserved samples are attributed to sample heterogeneity.

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Appendix 1. Depth and description of air-dried sediment samples from the BWDB (TH/S) and GSB (SH-1/) boreholes, Srirampur, Kachua.

Sample	Depth (meters)	Description
TH/S 20-AD	6.1 – 6.7	dark gray clayey silt
TH/S 60-AD	18.3 – 18.9	light gray-green fine to medium sand
TH/S 110-AD	33.5 – 34.1	gray-green fine to medium sand
TH/S 120-AD	36.6 – 37.2	dark gray-green clayey fine sand
TH/S 140-AD	42.7 – 43.3	gray-green fine to medium sand
TH/S 160-AD	48.8 – 49.4	brown clayey silt
TH/S 170-AD	51.8 – 52.4	light gray-green medium sand
TH/S 180-AD	54.9 – 55.5	gray-green fine to medium sand
TH/S 210-AD	64.0 – 64.6	light gray-green medium sand
TH/S 230-AD	70.1 – 70.7	gray-green medium sand
TH/S 320-AD	97.5 – 98.1	light gray-green medium sand
TH/S 360-AD	109.7 – 110.3	light gray-green medium sand
TH/S 380-AD	115.8 – 116.4	light gray-green medium sand
TH/S 400-AD	121.9 – 122.5	light gray-green medium sand
SH-1/1-AD	21.3 – 22.6	gray-green clayey fine sand
SH-1/2-AD	22.6 – 23.3	gray-green fine sand
SH-1/3-AD	27.4 – 28.2	gray-green very fine sandy clay
SH-1/4-AD	45.7 – 46.9	light brown clayey medium to fine sand
SH-1/5-AD	58.7 – 59.8	gray-green clayey silt
SH-1/6-AD	73.7 – 73.9	gray-green medium sand
SH-1/7-AD	74.1	light gray-green clayey fine sand
SH-1/8-AD	82.9 – 83.8	dark gray-green very fine sandy clay
SH-1/9-AD	93.3 – 94.2	gray-green clayey medium sand
SH-1/10-AD	113.7 – 114.6	gray-green clayey fine to medium sand
SH-1/11-AD	123.8 – 124.4	light gray-green pebbly clayey medium sand
SH-1/12-AD	137.2 – 138.0	dark gray very fine clayey sand
SH-1/13-AD	157.9 – 158.5	gray-green silty fine sand
SH-1/14-AD	167.4 – 167.7	gray-green very fine sandy silt
SH-1/15-AD	175.9 – 176.1	light gray-green medium sand
SH-1/16-AD	182.5 – 182.8	light gray-green medium sand
SH-1/17-AD	182.8 – 182.9	mottled gray and light gray-green silty clay, partially lithified?
SH-1/18-AD	189.5 – 190.4	light gray-green medium sand
SH-1/19-AD	196.3 – 197.3	light gray-green medium to coarse sand
SH-1/20-AD	207.8 – 208.2	light gray-green medium sand
SH-1/21-AD	214.3 – 215.6	light gray-green medium sand
SH-1/22-AD	221.7 – 222.6	light gray-green medium sand
SH-1/23-AD	228.7	light gray-green medium sand
SH-1/24-AD	236.3 – 237.2	light gray-green medium sand

Appendix 1. Depth and description of air-dried sediment samples—Continued

Sample	Depth (meters)	Description
SH-1/25-AD	245.1 – 146.3	light gray-green medium to coarse sand
SH-1/26-AD	253.7 – 254.6	light gray-green clayey fine to medium sand
SH-1/27-AD	260.1 – 261.3	light gray-green fine sand
SH-1/28a-AD	267.4 – 268.6	light gray-green medium sand
SH-1/28b-AD	283.2 – 283.8	gray-green clayey fine sand
SH-1/29-AD	289.9 – 290.9	light gray-green medium sand
SH-1/30-AD	290.9	light gray-green fine sand
SH-1/31-AD	299.7 – 300.1	light gray-green fine sand
SH-1/32-AD	307.3 – 308.2	gray-green very fine sandy clay
SH-1/33-AD	321.4 – 322.6	gray-green silty clay
SH-1/34m-AD	326.4	gray-green micaceous medium to coarse sand
SH-1/34b-AD	325.8 – 326.4	dark gray-green micaceous silty fine sand
SH-1/35-AD	335.9 – 336.8	gray-green fine to medium sand
SH-1/36-AD	353.9 – 354.6	gray-green medium sand
SH-1/37-AD	354.8 – 355.7	gray-green medium sand
SH-1/38-AD	365.7 – 366.4	gray green medium sand
SH-1/39a-AD	375.80 – 376.7	dark gray-green silt
SH-1/39b-AD	375.80 – 376.7	gray silty fine sand
SH-1/40-AD	387.3 – 388.0	gray-green medium sand

Appendix 2. Depth and description of sediment samples that were preserved in glass vials, flushed with argon, and frozen after collection from the GSB borehole, Srirampur, Kachua.

Sample	Depth (meters)	Description
SH-1/1-P	22.6	gray-green clayey fine sand
SH-1/2- P	23.3	gray-green fine sand
SH-1/3- P	27.4	gray-green very fine sandy clay
SH-1/4- P	39.3	gray-green clayey fine sand
SH-1/5- P	46.5	light brown clayey medium to fine sand
SH-1/6- P	49.7	gray-green clayey silt
SH-1/7- P	59.8	gray-green clayey silt
SH-1/8- P	73.9	gray-green medium sand
SH-1/9- P	83.8	dark gray-green very fine sandy clay
SH-1/10-P	93.3	gray-green fine to medium sand
SH-1/11-P	104.6	gray-green clayey fine sand
SH-1/12-P	114.5	gray-green clayey fine to medium sand
SH-1/13-P	124.4	light gray-green clayey medium sand
SH-1/14-P	137.5	gray-green very fine sandy silt
SH-1/15-P	146.6	gray-green medium sand
SH-1/16-P	158.5	gray-green silty fine sand
SH-1/17-P	168.0	gray-green silty fine sand
SH-1/18-P	176.1	light gray-green medium sand
SH-1/19-P	182.8	light gray-green medium to coarse sand
SH-1/20-P	189.9	light gray-green medium sand
SH-1/21-P	197.3	light gray-green medium sand
SH-1/22-P	207.9	light gray-green fine to medium sand
SH-1/23-P	215.5	light gray-green fine to medium sand
SH-1/24-P	222.6	light gray-green medium sand
SH-1/25-P	228.7	light gray-green medium to coarse sand
SH-1/26-P	237.2	light gray-green fine to medium sand
SH-1/27-P	245.7	light gray-green medium to coarse sand
SH-1/28-P	253.8	light gray-green medium to coarse sand
SH-1/29-P	260.7	light gray-green fine sand
SH-1/30-P	268.3	light gray-green medium sand
SH-1/31-P	283.7	light gray-green clayey fine sand
SH-1/32-P	290.7	gray-green very fine sand
SH-1/33-P	300.1	gray-green silty fine sand
SH-1/34-P	307.8	gray-green fine sand

Appendix 2. Depth and description of preserved sediment samples—Continued

Sample	Depth (meters)	Description
SH-1/35-P	316.2	gray-brown medium sand
SH-1/36-P	326.5	gray, micaceous silty sand
SH-1/37-P	336.6	gray-green fine to medium sand
SH-1/38-P	354.3	gray green fine to medium sand
SH-1/39-P	355.6	gray-green medium sand
SH-1/40-P	366.6	gray-green medium sand
SH-1/41-P	376.2	gray silty fine sand
SH-1/42-P	388.0	gray silty medium sand

Appendix 3. Results of grain size analysis of air-dried sediment samples collected from the GSB borehole, Srirampur, Kachua. Designations as sand, silt, and clay follow the size definitions of Wentworth (1922).

[Eric Fisher, Analyst; nd, not determined]

Sample	Sand (wt.%)	Silt (wt.%)	Clay (wt.%)	Description
SH-1/1-AD	48.4	41.8	9.8	silty sand
SH-1/2-AD	50.8	44.2	5.0	silty sand
SH-1/3-AD	34.2	56.8	9.0	sandy silt
SH-1/4-AD	77.7	18.2	4.1	sand
SH-1/5-AD	0.3	59.0	40.7	clayey silt
SH-1/6-AD	83.8	13.5	2.7	sand
SH-1/7-AD	71.1	22.6	6.3	silty sand
SH-1/8-AD	24.3	64.0	11.7	sandy silt
SH-1/9-AD	55.1	31.4	13.5	silty sand
SH-1/10-AD	79.0	14.2	6.7	sand
SH-1/11-AD	68.6	23.6	7.9	silty sand
SH-1/12-AD	54.4	36.6	9.0	silty sand
SH-1/13-AD	80.8	16.7	2.5	sand
SH-1/14-AD	42.1	51.6	6.2	sandy silt
SH-1/15-AD	86.4	11.7	1.9	sand
SH-1/16-AD	83.3	14.5	2.2	sand
SH-1/17-AD	49.5	43.0	7.5	silty sand
SH-1/18-AD	96.9	2.4	0.7	sand
SH-1/19-AD	93.9	5.1	1.0	sand
SH-1/20-AD	75.4	18.5	6.1	silty sand
SH-1/21-AD	91.0	7.8	1.2	sand
SH-1/22-AD	96.8	2.9	0.2	sand
SH-1/23-AD	95.0	4.2	0.8	sand
SH-1/24-AD	92.4	6.6	1.0	sand
SH-1/25-AD	93.7	5.3	1.0	sand
SH-1/26-AD	63.7	28.0	8.3	silty sand
SH-1/27-AD	95.7	3.4	0.9	sand
SH-1/28a-AD	94.7	4.6	0.7	sand
SH-1/28b-AD	nd	nd	nd	--
SH-1/29-AD	90.1	8.6	1.3	sand
SH-1/30-AD	94.4	5.1	0.5	sand
SH-1/31-AD	nd	nd	nd	--
SH-1/32-AD	40.4	50.7	8.9	sandy silt
SH-1/33-AD	51.2	35.5	13.3	silty sand
SH-1/34m-AD	nd	nd	nd	micaceous sand
SH-1/34b-AD	71.4	27.2	1.4	silty sand

Appendix 3. Results of grain size analysis—Continued

Sample	Sand (wt.%)	Silt (wt.%)	Clay (wt.%)	Description
SH-1/35-AD	84.3	14.4	1.3	silty sand
SH-1/36-AD	78.4	19.5	2.1	silty sand
SH-1/37-AD	79.5	18.3	2.2	silty sand
SH-1/38-AD	69.9	27.9	2.2	silty sand
SH-1/39a-AD	nd	nd	nd	--
SH-1/39b-AD	81.1	17.2	1.7	silty sand
SH-1/40-AD	80.9	16.9	2.2	silty sand

Appendix 4. Major minerals detected by X-ray diffraction analysis of air-dried sediment samples from the BWDB (TH/S) and GSB (SH-1) boreholes, Srirampur, Kachua.

[XX, major constituent; X, minor constituent; <, not detected; Plag., plagioclase; K-spar, potassium feldspar; Amph., amphibole]

Sample	Quartz	Plag.	K-spar	Mica	Chlorite	Amph.	Siderite	Pyrite
TH/S 20-AD	XX	X	X	X	X	X	X	<
TH/S 60-AD	XX	X	X	X	X	X	<	<
TH/S 110-AD	XX	X	X	X	X	X	<	<
TH/S 120-AD	XX	X	X	X	X	X	<	<
TH/S 140-AD	XX	X	X	X	X	X	<	<
TH/S 160-AD	XX	X	X	X	X	<	X	<
TH/S 170-AD	XX	X	X	X	X	X	<	<
TH/S 180-AD	XX	X	X	X	<	X	<	<
TH/S 210-AD	XX	X	X	X	X	X	<	<
TH/S 230-AD	XX	X	X	X	X	X	<	<
TH/S 320-AD	XX	X	X	X	X	X	<	<
TH/S 360-AD	XX	X	X	X	X	X	<	<
TH/S 380-AD	XX	X	X	X	X	X	<	<
TH/S 400-AD	XX	X	X	X	X	X	<	<
SH-1/1-AD	XX	X	X	X	X	X	<	<
SH-1/2-AD	XX	X	X	X	X	X	<	<
SH-1/3-AD	XX	X	<	X	X	X	<	<
SH-1/4-AD	XX	X	<	<	<	<	<	<
SH-1/5-AD	XX	X	X	X	X	<	<	<
SH-1/6-AD	XX	X	X	X	<	<	<	<
SH-1/7-AD	XX	X	X	X	X	X	X	<
SH-1/8-AD	XX	X	X	X	X	<	X	<
SH-1/9-AD	XX	X	X	X	X	X	X	<
SH-1/10-AD	XX	X	X	X	X	X	X	<
SH-1/11-AD	XX	X	X	X	X	<	X	<
SH-1/12-AD	XX	X	X	X	X	X	X	<
SH-1/13-AD	XX	X	X	X	X	<	X	<
SH-1/14-AD	XX	X	X	X	X	<	X	<
SH-1/15-AD	XX	X	X	X	<	<	<	<
SH-1/16-AD	XX	X	X	X	<	X	X	<
SH-1/17-AD	XX	X	X	X	X	<	X	<
SH-1/18-AD	XX	X	X	X	X	<	<	<
SH-1/19-AD	XX	X	X	X	X	<	X	<
SH-1/20-AD	XX	X	X	X	<	X	X	<
SH-1/21-AD	XX	X	X	X	X	X	X	<
SH-1/22-AD	XX	X	X	X	X	<	X	<
SH-1/23-AD	XX	X	X	X	<	X	X	<
SH-1/24-AD	XX	X	X	X	X	X	<	<

Appendix 4. Major minerals present in air-dried sediment samples as determined by X-ray diffraction analysis—Continued

Sample	Quartz	Plag.	K-spar	Mica	Chlorite	Amph.	Siderite	Pyrite
SH-1/25-AD	XX	X	X	X	X	X	X	<
SH-1/26-AD	XX	X	X	X	X	X	<	<
SH-1/27-AD	XX	X	X	X	X	X	X	<
SH-1/28a-AD	XX	X	X	X	X	X	X	<
SH-1/28b-AD	XX	X	X	X	X	X	X	<
SH-1/29-AD	XX	X	X	X	X	X	X	<
SH-1/30-AD	XX	X	X	X	X	X	X	<
SH-1/31-AD	XX	X	X	X	X	X	<	<
SH-1/32-AD	XX	X	X	X	<	<	X	<
SH-1/33-AD	XX	X	X	X	<	<	<	<
SH-1/34m-AD	XX	X	X	X	X	<	X	X
SH-1/34b-AD	XX	X	X	X	X	X	<	X
SH-1/35-AD	XX	X	X	X	X	X	<	<
SH-1/36-AD	XX	X	X	X	X	X	X	<
SH-1/37-AD	XX	X	X	X	X	X	X	<
SH-1/38-AD	XX	X	X	X	X	X	<	<
SH-1/39a-AD	XX	X	X	X	X	X	X	<
SH-1/39b-AD	XX	X	X	X	X	X	<	<
SH-1/40-AD	XX	X	X	X	X	X	X	<

Appendix 5. Results of quantitative mineralogical analysis by X-ray diffraction of air-dried sediment samples from the GSB borehole at Srirampur, Kachua. Abundances determined using the ROCKJOCK procedure of Eberl (2002).

[K-spar, potassium feldspars, Plag., plagioclase; Amph., amphibole]

Sample	Quartz (wt.%)	K-spar (wt.%)	Plag. (wt.%)	Siderite (wt.%)	Smectite (wt.%)	Amph. (wt.%)	Muscovite (wt.%)	Biotite (wt.%)	Chlorite (wt.%)	Total (wt.%)
SH-1/1-AD	40	10	23	<1	1	3	9	5.	9	101
SH-1/7-AD	63	9	13	1	3	2	3	6	2	101
SH-1/13-AD	57	11	13	1	2	<1	5	2	8	100
SH-1/18-AD	54	14	20	<1	<1	<1	3	2	4	97
SH-1/22-AD	53	15	16	2	2	1.6	2	3	4	99
SH-1/30-AD	57	12	20	1	<1	<1	2	<1	6	98
SH-1/33-AD	39	8	11	<0.5	10	<1	10	1	16	95

Appendix 6. Results of carbon and sulfur analyses of air-dried sediment samples from the BWDB (TH/S) and GSB (SH-1) boreholes, Srirampur, Kachua. Sulfur and total carbon determined by Combustion. Carbonate carbon determined using the Chittick method. Sulfur was corrected (Sulfur (corr)) for barite contamination as described in the text.

[nd, not determined]

Sample	Sulfur (wt.%)	Sulfur (corr) (wt.%)	Total Carbon (wt.%)	Carbonate Carbon (wt.%)
TH/S 20-AD	0.045	0.045	0.35	nd
TH/S 60-AD	0.007	0.007	0.06	nd
TH/S 110-AD	0.010	0.010	0.07	nd
TH/S 120-AD	0.007	0.007	0.08	nd
TH/S 140-AD	0.016	0.016	0.11	nd
TH/S 160-AD	<0.005	<0.005	0.99	nd
TH/S 170-AD	0.012	0.012	0.09	nd
TH/S 180-AD	0.007	0.007	0.03	nd
TH/S 210-AD	0.006	0.006	0.11	nd
TH/S 230-AD	0.010	0.010	0.10	nd
TH/S 320-AD	0.010	0.010	0.05	nd
TH/S 360-AD	0.015	0.015	0.09	nd
TH/S 380-AD	0.005	0.005	0.11	nd
TH/S 400-AD	<0.005	<0.005	0.08	nd
SH-1/1-AD	0.045	0.045	0.22	0.06
SH-1/2-AD	0.024	0.024	0.17	0.09
SH-1/3-AD	0.049	0.049	0.54	0.14
SH-1/4-AD	0.015	0.015	0.32	0.27
SH-1/5-AD	0.005	0.005	0.65	0.08
SH-1/6-AD	0.005	0.005	0.09	0.05
SH-1/7-AD	0.024	0.024	0.37	0.12
SH-1/8-AD	0.110	0.110	0.69	0.17
SH-1/9-AD	0.031	0.031	0.30	0.08
SH-1/10-AD	0.051	0.051	0.33	0.09
SH-1/11-AD	0.049	0.049	0.69	0.32
SH-1/12-AD	0.044	0.044	0.60	0.18
SH-1/13-AD	0.058	0.058	0.23	0.09
SH-1/14-AD	0.130	0.130	0.45	0.14
SH-1/15-AD	0.008	0.008	0.08	0.04
SH-1/16-AD	0.005	0.005	0.12	0.04
SH-1/17-AD	0.007	0.007	0.62	0.06
SH-1/18-AD	0.021	0.021	0.09	0.03
SH-1/19-AD	0.045	0.045	0.46	0.08
SH-1/20-AD	0.041	0.041	0.91	0.30
SH-1/21-AD	0.029	0.029	0.25	0.08
SH-1/22-AD	0.025	0.025	0.22	0.05
SH-1/23-AD	0.020	0.020	0.15	0.05

Appendix 6. Results of carbon and sulfur analyses—Continued

Sample	Sulfur (wt.%)	Sulfur (corr) (wt.%)	Total Carbon (wt.%)	Carbonate Carbon (wt.%)
SH-1/24-AD	0.046	0.040	0.12	0.05
SH-1/25-AD	0.051	0.043	0.19	0.04
SH-1/26-AD	0.048	0.024	0.14	0.07
SH-1/27-AD	0.048	0.048	0.24	0.05
SH-1/28a-AD	0.034	0.029	0.30	0.05
SH-1/28b-AD	0.037	0.037	0.30	nd
SH-1/29-AD	0.055	0.046	0.28	0.1
SH-1/30-AD	0.031	0.031	0.12	0.04
SH-1/31-AD	0.034	0.034	0.09	nd
SH-1/32-AD	0.120	0.120	0.40	0.12
SH-1/33-AD	0.170	0.170	0.30	0.14
SH-1/34b-AD	0.57	0.57	0.70	0.04
SH-1/34m-AD	1.47	1.47	1.50	nd
SH-1/35-AD	0.047	0.015	0.05	0.05
SH-1/36-AD	0.038	0.028	0.15	nd
SH-1/37-AD	0.079	0.048	0.13	0.05
SH-1/38-AD	0.024	0.016	0.06	0.05
SH-1/39a-AD	0.131	0.131	0.43	0.12
SH-1/39b-AD	0.039	0.033	0.05	0.05
SH-1/40-AD	0.033	0.017	0.08	0.07

Appendix 7. Results of Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) analyses of air dried samples from the BWDB (TH/S) and GSB (SH-1/) boreholes from Srirampur, Kachua.

[Paul Briggs, Analyst]

Sample	Al wt. %	Ca wt. %	Fe wt. %	K wt. %	Mg wt. %	Na wt. %	P wt. %	Ti wt. %	Ag ppm	As ppm	Au ppm	Ba ppm	Be ppm	Bi ppm
TH/S 20-AD	6.6	1.1	4.0	2.1	1.1	1.2	0.074	0.37	<2	<10	<8	460	2.3	<10
TH/S 60-AD	4.7	1.4	2.0	1.6	0.60	1.3	0.056	0.26	<2	<10	<8	340	1.6	<10
TH/S 110-AD	4.6	1.4	2.1	1.6	0.59	1.2	0.059	0.27	<2	<10	<8	340	2.0	<10
TH/S 120-AD	5.6	1.1	2.4	2.0	0.78	1.4	0.035	0.24	<2	<10	<8	420	2.0	<10
TH/S 140-AD	4.7	1.3	2.4	1.6	0.64	1.2	0.065	0.29	<2	<10	<8	350	1.7	<10
TH/S 160-AD	8.5	0.32	4.9	2.1	0.67	0.61	0.037	0.47	<2	11	<8	540	2.9	<10
TH/S 170-AD	3.8	1.0	1.8	1.4	0.42	1.0	0.036	0.21	<2	<10	<8	310	1.4	<10
TH/S 180-AD	4.8	1.4	2.2	1.6	0.65	1.2	0.058	0.28	<2	<10	<8	340	1.7	<10
TH/S 210-AD	4.0	1.2	2.1	1.4	0.49	1.0	0.047	0.25	<2	<10	<8	310	1.4	<10
TH/S 230-AD	3.5	0.99	2.1	1.3	0.39	0.90	0.044	0.24	<2	<10	<8	300	1.3	<10
TH/S 320-AD	3.1	0.78	1.5	1.3	0.32	0.77	0.030	0.2	<2	<10	<8	280	1.1	<10
TH/S 360-AD	2.9	0.53	1.3	1.3	0.28	0.63	0.020	0.17	<2	<10	<8	280	1.1	<10
TH/S 380-AD	2.7	0.58	1.5	1.2	0.26	0.61	0.032	0.17	<2	<10	<8	380	1.0	<10
TH/S 400-AD	2.7	0.56	1.3	1.3	0.26	0.60	0.020	0.17	<2	<10	<8	270	<1	<10
SH-1/1-AD	6.6	1.3	3.5	2.2	1.2	1.4	0.051	0.36	<2	<10	<8	450	2.4	<10
SH-1/2-AD	6.5	1.2	3.4	2.2	1.1	1.4	0.048	0.35	<2	<10	<8	440	2.3	<10
SH-1/3-AD	7.6	1.4	4.5	2.3	1.6	1.2	0.068	0.48	<2	<10	<8	480	2.7	<10
SH-1/4-AD	3.6	0.61	4.2	1.4	0.43	0.55	0.064	0.24	<2	<10	<8	300	1.6	<10
SH-1/5-AD	9.8	0.39	5.1	2.3	0.92	0.63	0.043	0.52	<2	<10	<8	540	3.4	<10
SH-1/6-AD	3.1	0.26	0.87	1.5	0.16	0.52	0.008	0.09	<2	<10	<8	300	1.1	<10
SH-1/7-AD	4.8	0.68	2.5	1.8	0.34	1.1	0.026	0.15	<2	<10	<8	370	2.0	<10
SH-1/8-AD	8.1	0.32	4.4	2.1	0.86	0.56	0.030	0.46	<2	10	<8	410	2.8	<10
SH-1/9-AD	4.4	0.5	1.6	1.8	0.28	0.84	0.019	0.16	<2	<10	<8	380	1.7	<10
SH-1/10-AD	4.3	0.52	2.4	1.6	0.32	0.80	0.026	0.20	<2	<10	<8	310	1.7	<10
SH-1/11-AD	3.8	0.47	4.0	1.6	0.24	0.68	0.024	0.17	<2	<10	<8	300	2.0	<10
SH-1/12-AD	5.8	0.82	3.6	1.9	0.75	1.00	0.039	0.29	<2	<10	<8	550	2.2	<10

Appendix 7. Results of ICP-AES analyses—Continued

Sample	Al wt. %	Ca wt. %	Fe wt. %	K wt. %	Mg wt. %	Na wt. %	P wt. %	Ti wt. %	Ag ppm	As ppm	Au ppm	Ba ppm	Be ppm	Bi ppm
SH-1/13-AD	4.8	0.53	2.4	1.7	0.52	0.93	0.029	0.25	<2	<10	<8	340	1.8	<10
SH-1/14-AD	7.0	0.48	4.2	2.2	0.97	0.89	0.051	0.40	<2	<10	<8	430	2.5	<10
SH-1/15-AD	3.7	0.46	1.4	1.5	0.21	0.78	0.016	0.13	<2	<10	<8	470	1.5	<10
SH-1/16-AD	5.0	0.68	2.1	1.8	0.30	1.20	0.022	0.16	<2	<10	<8	360	2.0	<10
SH-1/17-AD	8.0	0.37	6.9	2.2	1.20	0.53	0.019	0.44	<2	<10	<8	430	3.3	<10
SH-1/18-AD	4.9	0.63	1.2	1.9	0.27	1.20	0.017	0.14	<2	<10	<8	380	2.1	<10
SH-1/19-AD	4.7	0.58	2.8	1.8	0.29	1.10	0.018	0.14	<2	10	<8	360	2.2	<10
SH-1/20-AD	4.5	0.65	4.3	1.6	0.29	1.00	0.022	0.14	<2	<10	<8	310	2.1	<10
SH-1/21-AD	5.0	1.00	2.2	1.6	0.38	1.10	0.043	0.29	<2	<10	<8	340	1.8	<10
SH-1/22-AD	4.7	0.76	1.9	1.7	0.32	1.10	0.022	0.16	<2	<10	<8	320	1.8	<10
SH-1/23-AD	4.3	0.64	1.4	1.6	0.28	1.00	0.019	0.14	<2	<10	<8	320	1.7	<10
SH-1/24-AD	4.5	0.92	2.2	1.4	0.36	0.99	0.032	0.28	<2	<10	<8	570	1.8	<10
SH-1/25-AD	4.2	0.47	1.4	1.8	0.26	0.99	0.017	0.11	<2	<10	<8	710	1.8	<10
SH-1/26-AD	4.7	0.79	1.5	1.6	0.36	1.10	0.026	0.17	<2	<10	<8	1300	1.8	<10
SH-1/27-AD	5.3	1.00	2.7	1.8	0.47	1.20	0.05	0.36	<2	<10	<8	490	2.1	<10
SH-1/28a-AD	4.8	0.76	2.4	1.7	0.36	1.10	0.027	0.20	<2	<10	<8	550	1.8	<10
SH-1/28b-AD	4.9	0.79	2.3	1.8	0.36	1.10	0.028	0.20	<2	<10	<8	550	1.8	<10
SH-1/29-AD	4.8	0.59	2.0	2.0	0.33	1.10	0.023	0.15	<2	<10	<8	800	1.8	<10
SH-1/30-AD	4.8	0.73	1.4	1.8	0.34	1.20	0.026	0.16	<2	<10	<8	430	1.8	<10
SH-1/31-AD	4.9	0.92	1.6	1.7	0.38	1.20	0.035	0.22	<2	<10	<8	320	1.7	<10
SH-1/32-AD	7.1	0.51	3.9	2.2	1.00	0.76	0.051	0.34	<2	<10	<8	420	2.4	<10
SH-1/33-AD	7.4	0.45	4.1	2.2	1.10	0.75	0.036	0.39	<2	10	<8	560	2.4	<10
SH-1/34m-AD	7.4	0.60	7.4	2.9	1.90	0.97	0.033	0.55	<2	230	<8	440	3.0	<10
SH-1/34b-AD	5.9	0.63	4.3	2.1	1.10	0.98	0.032	0.36	<2	74	<8	410	2.3	<10
SH-1/35-AD	4.9	1.20	2.3	1.6	0.56	1.20	0.042	0.29	<2	<10	<8	1700	1.7	<10
SH-1/36-AD	4.9	0.63	1.5	2.2	0.31	1.30	0.02	0.12	<2	14	<8	870	1.8	<10
SH-1/37-AD	4.4	0.69	1.6	1.6	0.34	0.98	0.021	0.16	<2	10	<8	1600	1.7	<10
SH-1/38-AD	4.4	0.98	1.9	1.6	0.40	1.00	0.028	0.22	<2	<10	<8	670	1.7	<10
SH-1/39a-AD	7.2	0.54	4.5	2.3	1.00	0.88	0.044	0.37	<2	<10	<8	480	2.4	<10
SH-1/39b-AD	4.6	0.79	1.6	1.6	0.40	1.00	0.026	0.21	<2	<10	<8	590	1.7	<10
SH-1/40-AD	4.0	0.69	1.6	1.4	0.34	0.88	0.024	0.20	<2	<10	<8	960	1.6	<10

Appendix 7. Results of ICP-AES—Continued

Sample	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cu ppm	Eu ppm	Ga ppm	Ho ppm	La ppm	Li ppm	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm
TH/S 20-AD	<2	76	15	76	22	<2	15	<4	40	32	990	2.7	4.3	34	35
TH/S 60-AD	<2	71	6.2	41	2.5	<2	10	<4	38	12	470	<2	<4	31	14
TH/S 110-AD	<2	81	3.4	35	3.1	<2	10	<4	43	12	500	<2	<4	34	15
TH/S 120-AD	<2	41	9.7	38	4.6	<2	12	<4	23	20	390	<2	10	18	25
TH/S 140-AD	<2	86	8.4	48	5.4	<2	10	<4	46	14	560	<2	6.0	36	17
TH/S 160-AD	<2	79	13	96	24	<2	19	<4	39	42	530	2.5	11	33	52
TH/S 170-AD	<2	66	4	31	2.3	<2	8.0	<4	35	9.5	570	<2	<4	28	11
TH/S 180-AD	<2	83	4.2	43	3.1	<2	10	<4	44	13	500	<2	<4	35	16
TH/S 210-AD	<2	75	4.8	41	3.6	<2	8.3	<4	41	10	570	<2	<4	32	13
TH/S 230-AD	<2	74	4.3	40	3.1	<2	6.9	<4	39	9.2	760	<2	<4	30	11
TH/S 320-AD	<2	59	2.2	26	2	<2	6.2	<4	31	8.5	420	<2	<4	25	9.2
TH/S 360-AD	<2	45	2.8	24	2.4	<2	6.0	<4	25	9.4	310	<2	<4	19	9.3
TH/S 380-AD	<2	52	3.7	22	3.3	<2	5.6	<4	28	8.2	570	<2	<4	21	9.1
TH/S 400-AD	<2	55	1.4	21	2.3	<2	5.6	<4	29	8.4	360	<2	<4	22	8.3
SH-1/1-AD	<2	63	15	66	24	<2	13	<4	32	29	600	2.0	16	29	35
SH-1/2-AD	<2	57	16	58	19	<2	13	<4	30	27	580	2.0	14	26	34
SH-1/3-AD	<2	93	20	95	50	<2	17	<4	48	38	910	2.9	16	42	45
SH-1/4-AD	<2	80	12	43	9	<2	5.8	<4	40	15	1200	<2	5.0	35	21
SH-1/5-AD	<2	94	21	128	30	<2	24	<4	48	56	560	3.0	23	42	65
SH-1/6-AD	<2	29	5.3	25	4.1	<2	7.9	<4	14	9.8	82	<2	6.0	12	12
SH-1/7-AD	<2	34	7.8	24	187	<2	9.8	<4	18	14	890	<2	7.4	15	13
SH-1/8-AD	<2	84	21	112	30	<2	18	<4	42	49	840	<2	18	39	60
SH-1/9-AD	<2	48	8.4	32	5.1	<2	11	<4	24	13	420	2.0	8.0	19	14
SH-1/10-AD	<2	53	16	32	66	<2	9.0	<4	27	15	1000	<2	7.0	22	17
SH-1/11-AD	<2	58	12	26	111	<2	8.1	<4	30	13	2700	<2	<4	24	13
SH-1/12-AD	<2	60	21	53	26	<2	12	<4	31	23	1200	2.0	10	27	26

Appendix 7. Results of ICP-AES—Continued

Sample	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cu ppm	Eu ppm	Ga ppm	Ho ppm	La ppm	Li ppm	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm
SH-1/13-AD	<2	53	11	46	6.7	<2	9.1	<4	27	21	530	<2	9.4	25	25
SH-1/14-AD	<2	70	17	87	22	<2	15	<4	35	42	840	2.0	14	32	42
SH-1/15-AD	2.9	40	5.7	20	3.8	<2	9.3	<4	20	12	470	<2	6.6	16	9
SH-1/16-AD	<2	38	6.9	23	4.1	<2	12	<4	20	16	840	<2	8.4	17	11
SH-1/17-AD	<2	75	18	84	34	<2	23	<4	39	48	1800	2.8	13	35	39
SH-1/18-AD	<2	39	6	23	2.0	<2	12	<4	21	15	240	<2	9.9	17	11
SH-1/19-AD	<2	33	10	24	4.9	<2	10	<4	17	15	1000	<2	6.2	15	16
SH-1/20-AD	<2	38	122	20	40	<2	8.3	<4	20	13	1900	<2	<4	18	12
SH-1/21-AD	<2	96	6.3	39	19	<2	12	<4	50	14	740	<2	11	40	13
SH-1/22-AD	<2	44	7	25	2.8	<2	11	<4	23	13	570	<2	8.5	20	12
SH-1/23-AD	<2	42	5.9	23	4.0	<2	9.9	<4	22	13	380	<2	8.3	18	10
SH-1/24-AD	<2	110	6.5	36	2.4	<2	9.9	<4	56	13	950	<2	8.1	43	11
SH-1/25-AD	<2	34	6.2	19	2.6	<2	9.7	<4	18	14	340	<2	7.7	15	10
SH-1/26-AD	<2	51	6.6	28	5.2	<2	11	<4	27	14	340	<2	9.7	23	13
SH-1/27-AD	<2	99	8	44	3.7	<2	12	<4	52	19	850	<2	12	42	16
SH-1/28a-AD	<2	49	7.2	29	8.8	<2	10	<4	26	14	760	<2	8.2	22	13
SH-1/28b-AD	<2	53	7.4	31	7.6	<2	11	<4	28	15	760	<2	8.3	23	13
SH-1/29-AD	<2	34	6.3	24	6.2	<2	11	<4	18	16	620	<2	8.8	15	12
SH-1/30-AD	<2	36	5.7	26	2.7	<2	11	<4	19	14	330	<2	9.5	16	12
SH-1/31-AD	<2	59	5.6	32	1.8	<2	11	<4	31	14	420	<2	9.7	26	12
SH-1/32-AD	<2	64	16	85	28	<2	14	<4	33	48	830	2.1	14	29	44
SH-1/33-AD	<2	66	17	99	42	<2	14	<4	33	55	530	2.3	18	30	50
SH-1/34m-AD	<2	46	40	94	33	<2	<4	<4	24	83	800	4.8	16	24	84
SH-1/34b-AD	<2	44	22	72	19	<2	5.1	<4	22	44	560	3.0	13	22	47
SH-1/35-AD	<2	98	7.4	50	2.5	<2	4.4	<4	49	14	600	2.5	11	43	15
SH-1/36-AD	<2	30	7	20	7.9	<2	6.4	<4	15	16	430	2.6	7.4	12	11
SH-1/37-AD	<2	40	6.5	28	3.0	<2	4.3	<4	20	11	390	2.6	8.5	17	12
SH-1/38-AD	<2	86	5.8	31	1.4	<2	<4	<4	42	12	630	<2	8.2	36	11
SH-1/39a-AD	<2	67	18	77	14	<2	4.4	<4	34	45	1000	3.3	12	31	40
SH-1/39b-AD	<2	61	6.6	30	5.2	<2	5.5	<4	30	14	390	2.6	9.4	26	14
SH-1/40-AD	<2	52	6.3	30	4.4	<2	4.5	<4	25	11	380	<2	8.6	21	12

Appendix 7. Results of ICP-AES analyses—Continued

Sample	Pb ppm	Sc ppm	Sn ppm	Sr ppm	Ta ppm	Th ppm	U ppm	V ppm	Y ppm	Yb ppm	Zn ppm
TH/S 20-AD	17	11	<5	140	<20	17	<100	79	20	2.3	64
TH/S 60-AD	15	7.4	<5	150	<20	15	<100	51	21	2.4	35
TH/S 110-AD	12	7.6	<5	150	<20	18	<100	51	22	2.4	32
TH/S 120-AD	18	7.2	<5	150	<20	9.2	<100	53	12	1.3	45
TH/S 140-AD	14	8	<5	150	<20	20	<100	54	21	2.4	41
TH/S 160-AD	27	14	<5	82	<20	21	<100	113	18	2.4	75
TH/S 170-AD	15	5.5	<5	130	<20	14	<100	38	15	1.6	27
TH/S 180-AD	14	8	<5	150	<20	18	<100	54	21	2.3	35
TH/S 210-AD	15	6.6	<5	140	<20	22	<100	44	19	2.2	32
TH/S 230-AD	14	5.5	<5	120	<20	17	<100	39	17	1.7	27
TH/S 320-AD	13	4.5	<5	100	<20	16	<100	32	13	1.5	22
TH/S 360-AD	13	3.6	<5	81	<20	9.4	<100	26	10	1.1	20
TH/S 380-AD	12	3.7	9.9	84	<20	10	<100	28	11	1.2	19
TH/S 400-AD	12	3.6	19	80	<20	12	<100	25	12	1.2	17
SH-1/1-AD	19	12	5	150	<40	13	<100	77	19	1.9	76
SH-1/2-AD	19	11	<5	150	<40	11	<100	72	17	1.6	66
SH-1/3-AD	24	16	7.3	140	<40	19	<100	104	27	2.7	95
SH-1/4-AD	15	6.3	<5	80	<40	22	<100	47	16	1.5	37
SH-1/5-AD	27	19	5.9	90	<40	18	<100	135	29	2.7	95
SH-1/6-AD	16	3.5	<5	67	<40	4.4	<100	27	6.3	<1	18
SH-1/7-AD	16	6	<5	120	<40	6.3	<100	39	11	1.2	120
SH-1/8-AD	24	16	6.2	77	<40	15	<100	110	25	2.3	94
SH-1/9-AD	18	5.7	<5	96	<40	8.5	<100	34	13	1.3	25
SH-1/10-AD	16	6.2	<5	93	<40	10	<100	40	12	1.2	76
SH-1/11-AD	15	6	<5	75	<40	12	<100	36	16	1.8	90
SH-1/12-AD	19	10	<5	120	<40	11	<100	64	18	1.8	72

Appendix 7. Results of ICP-AES analyses—Continued

Sample	Pb ppm	Sc ppm	Sn ppm	Sr ppm	Ta ppm	Th ppm	U ppm	V ppm	Y ppm	Yb ppm	Zn ppm
SH-1/13-AD	17	7.9	<5	95	<40	11	<100	52	18	1.5	130
SH-1/14-AD	22	13	6.3	96	<40	13	<100	93	20	1.9	86
SH-1/15-AD	17	4.7	<5	90	<40	7.5	<100	28	12	1.2	30
SH-1/16-AD	20	5.6	<5	130	<40	7.4	<100	34	12	1.1	29
SH-1/17-AD	24	16	6.7	75	<40	16	<100	104	25	2.5	94
SH-1/18-AD	19	5.3	<5	130	<40	7.4	<100	34	9.9	1.0	30
SH-1/19-AD	19	5.5	<5	120	<40	7.3	<100	34	11	1.1	27
SH-1/20-AD	16	5.9	<5	110	<40	7.5	<100	32	13	1.3	47
SH-1/21-AD	19	8.8	<5	140	<40	19	<100	52	27	2.8	36
SH-1/22-AD	16	5.8	<5	120	<40	8.0	<100	35	13	1.3	23
SH-1/23-AD	17	5.2	<5	120	<40	8.0	<100	31	12	1.2	22
SH-1/24-AD	15	9.4	<5	130	<40	20	<100	47	31	3.6	26
SH-1/25-AD	18	4.4	<5	110	<40	6.8	<100	28	8.9	<1	20
SH-1/26-AD	16	6.8	<5	160	<40	9.6	<100	42	14	1.4	26
SH-1/27-AD	18	10	<5	140	<40	23	<100	68	28	2.8	37
SH-1/28a-AD	15	7.0	<5	140	<40	11	<100	44	15	1.5	32
SH-1/28b-AD	15	7.1	<5	140	<40	10	<100	44	15	1.5	30
SH-1/29-AD	17	5.6	<5	130	<40	7.0	<100	34	9.5	1.0	31
SH-1/30-AD	15	5.8	<5	130	<40	7.9	<100	38	10	1.0	26
SH-1/31-AD	16	7.1	<5	140	<40	15	<100	45	17	1.7	27
SH-1/32-AD	22	13	<5	98	<40	13	<100	90	20	1.9	79
SH-1/33-AD	22	14	5.5	100	<40	13	<100	100	19	2.0	91
SH-1/34m-AD	38	16	14	120	<20	9.0	<100	120	23	2.4	150
SH-1/34b-AD	22	12	7.9	110	<20	15	<100	78	17	1.7	90
SH-1/35-AD	13	9.1	<5	170	<20	24	<100	56	24	2.6	41
SH-1/36-AD	34	4.3	<5	150	<20	<4	<100	28	7.5	<1	32
SH-1/37-AD	17	5.0	<5	140	<20	8.9	<100	34	12	1.2	36
SH-1/38-AD	14	7.1	<5	130	<20	19	<100	42	22	2.5	28
SH-1/39a-AD	18	13	8.0	100	<20	14	<100	87	17	1.7	74
SH-1/39b-AD	19	5.8	6.0	130	<20	11	<100	38	14	1.4	32
SH-1/40-AD	19	5.3	6.1	120	<20	14	<100	35	14	1.6	39

Appendix 8. Results of Energy Dispersive X-ray Fluorescence (EDXRF) analyses of air-dried sediment samples recovered from the BWDB (TH/S) and GSB (SH-1/) boreholes at Srirampur, Kachua.

[David Siems and Tammy Hannah, Analysts]

Sample	Ag ppm	As ppm	Ba ppm	Bi ppm	Br ppm	Cd ppm	Ce ppm	Cr ppm	Cs ppm	Cu ppm	Ga ppm	Ge ppm	La ppm
TH/S 20-AD	<1	6	440	<5	<1	<1	84	72	8	26	15	<2	41
TH/S 60-AD	<1	<2	360	<5	<1	<1	91	40	6	9	11	<2	51
TH/S 110-AD	<1	<2	350	<5	<1	<1	88	41	<5	9	10	<2	45
TH/S 120-AD	<1	<2	360	<5	<1	<1	97	44	<5	14	11	<2	52
TH/S 140-AD	<1	8	490	<5	<1	<1	85	110	10	28	18	<2	44
TH/S 160-AD	<1	<2	330	<5	<1	<1	71	41	<5	8	10	<2	36
TH/S 170-AD	<1	<2	360	<5	<1	<1	95	46	6	10	10	<2	52
TH/S 180-AD	<1	2	330	<5	<1	<1	93	43	5	9	8	<2	52
TH/S 210-AD	<1	<2	430	<5	<1	<1	47	38	9	10	12	<2	27
TH/S 230-AD	<1	<2	320	<5	<1	<1	88	39	<5	9	8	<2	48
TH/S 320-AD	<1	<2	300	<5	<1	<1	76	32	<5	8	9	<2	38
TH/S 360-AD	<1	<2	300	<5	<1	<1	65	30	6	6	7	<2	37
TH/S 380-AD	<1	<2	300	<5	<1	<1	70	27	<5	8	6	<2	36
TH/S 400-AD	<1	<2	290	<5	<1	<1	74	25	6	6	5	<2	43
SH-1/1-AD	<1	7	450	<5	<1	<1	65	76	9	26	18	<2	33
SH-1/2-AD	<1	3	450	<5	<1	<1	64	66	10	24	16	<2	32
SH-1/3-AD	<1	7	480	<5	<1	2	95	120	11	56	21	<2	50
SH-1/4-AD	<1	6	320	<5	<1	<1	87	73	<5	14	9	<2	44
SH-1/5-AD	<1	6	530	<5	<1	<1	98	140	11	31	24	<2	49
SH-1/6-AD	<1	<2	340	<5	<1	<1	42	27	7	6	7	<2	23
SH-1/7-AD	<1	<2	400	<5	<1	<1	44	29	6	190	11	<2	24
SH-1/8-AD	<1	10	410	<5	<1	<1	93	140	11	39	21	2	47
SH-1/9-AD	<1	3	420	<5	<1	<1	63	35	7	9	10	<2	34
SH-1/10-AD	<1	4	340	<5	<1	<1	55	40	7	74	11	<2	29
SH-1/11-AD	<1	4	330	<5	<1	<1	62	35	<5	73	10	<2	32
SH-1/12-AD	<1	5	550	<5	<1	<1	63	65	8	34	14	<2	35

Appendix 8. Results of EDXRF analyses—Continued.

Sample	Ag ppm	As ppm	Ba ppm	Bi ppm	Br ppm	Cd ppm	Ce ppm	Cr ppm	Cs ppm	Cu ppm	Ga ppm	Ge ppm	La ppm
SH-1/13-AD	<1	6	370	<5	<1	<1	65	63	7	10	11	<2	31
SH-1/14-AD	<1	9	430	<5	<1	<1	80	110	9	20	15	<2	40
SH-1/15-AD	<1	2	500	<5	<1	3	49	23	8	5	10	<2	29
SH-1/16-AD	<1	2	390	<5	<1	<1	44	28	6	7	11	<2	24
SH-1/17-AD	<1	<2	430	<5	<1	<1	74	120	11	38	22	<2	38
SH-1/18-AD	<1	<2	410	<5	<1	<1	50	23	8	3	11	<2	30
SH-1/19-AD	<1	5	380	<5	<1	<1	42	33	5	8	10	<2	23
SH-1/20-AD	<1	3	340	<5	<1	<1	40	32	<5	38	9	<2	20
SH-1/21-AD	<1	3	370	<5	<1	<1	119	42	7	21	11	<2	65
SH-1/22-AD	<1	2	360	<5	<1	<1	55	34	6	6	11	<2	31
SH-1/23-AD	<1	<2	360	<5	<1	<1	58	27	7	6	10	<2	31
SH-1/24-AD	<1	3	590	<5	<1	<1	120	44	7	5	11	<2	67
SH-1/25-AD	<1	4	750	<5	<1	<1	44	23	9	4	11	<2	26
SH-1/26-AD	<1	<2	1400	<5	<1	<1	63	38	15	8	11	<2	40
SH-1/27-AD	<1	4	510	<5	<1	<1	120	60	6	7	12	<2	62
SH-1/28a-AD	<1	2	580	<5	1	<1	64	36	8	11	11	<2	33
SH-1/28b-AD	<1	2	580	<5	<1	<1	71	39	11	9	12	<2	44
SH-1/29-AD	<1	3	820	<5	<1	<1	47	29	11	11	11	<2	27
SH-1/30-AD	<1	<2	460	<5	2	<1	47	33	8	5	11	<2	28
SH-1/31-AD	<1	<2	350	<5	2	<1	67	40	6	3	11	<2	39
SH-1/32-AD	<1	8	430	<5	3	<1	73	104	12	30	16	<2	41
SH-1/33-AD	<1	11	560	<5	<1	<1	81	120	14	42	19	<2	43
SH-1/34m-AD	<1	190	410	<5	2	<1	43	120	18	34	21	nd	22
SH-1/34b-AD	<1	67	420	<5	<1	<1	48	86	10	22	16	<2	24
SH-1/35-AD	<1	<2	1700	<5	<1	<1	110	53	8	9	13	<2	64
SH-1/36-AD	<1	2	890	<5	<1	<1	49	25	14	11	10	<2	30
SH-1/37-AD	<1	5	1700	<5	<1	<1	60	34	18	8	9	<2	37
SH-1/38-AD	<1	<2	690	<5	<1	<1	95	40	6	4	9	<2	55
SH-1/39a-AD	<1	11	480	<5	<1	<1	68	92	8	18	15	<2	33
SH-1/39b-AD	<1	2	600	<5	<1	<1	72	39	7	8	12	<2	37
SH-1/40-AD	<1	<2	990	<5	<1	<1	72	34	12	8	9	<2	42

Appendix 8. Results of EDXRF analyses—Continued

Sample	Mo ppm	Nb ppm	Nd ppm	Ni ppm	Pb ppm	Rb ppm	Sb ppm	Se ppm	Sn ppm	Sr ppm	Th ppm	U ppm
TH/S 20-AD	<2	14	33	45	23	128	<2	<1	4	140	18	5
TH/S 60-AD	<2	10	39	23	16	79	<2	<1	5	160	10	<4
TH/S 110-AD	<2	10	39	21	18	80	<2	<1	2	160	17	6
TH/S 120-AD	<2	12	39	31	17	83	<2	<1	3	160	17	4
TH/S 140-AD	<2	17	32	59	28	138	<2	<1	4	86	20	5
TH/S 160-AD	<2	8	33	14	15	69	<2	<1	<2	140	11	<4
TH/S 170-AD	<2	10	38	25	17	82	<2	<1	2	160	12	<4
TH/S 180-AD	<2	9	42	22	14	71	<2	<1	3	150	16	<4
TH/S 210-AD	<2	9	23	32	18	120	<2	<1	<2	150	7	<4
TH/S 230-AD	<2	9	36	20	14	63	<2	<1	<2	130	9	<4
TH/S 320-AD	<2	7	38	21	14	62	<2	<1	<2	109	11	<4
TH/S 360-AD	<2	7	36	13	13	64	<2	<1	<2	89	9	<4
TH/S 380-AD	<2	6	33	14	13	58	<2	<1	<2	92	8	<4
TH/S 400-AD	<2	6	40	11	12	60	<2	<1	<2	86	9	<4
SH-1/1-AD	<2	13	25	37	21	139	<2	<1	4	150	12	<4
SH-1/2-AD	<2	13	31	34	20	139	<2	<1	3	150	11	<4
SH-1/3-AD	<2	18	37	47	26	152	<2	<1	4	140	19	5
SH-1/4-AD	<2	8	33	24	20	76	<2	<1	2	84	17	5
SH-1/5-AD	<2	18	45	68	28	165	<2	<1	5	90	21	6
SH-1/6-AD	<2	4	24	12	14	70	<2	<1	<2	69	4	<4
SH-1/7-AD	<2	6	20	13	20	90	<2	<1	4	130	6	<4
SH-1/8-AD	<2	18	40	67	26	140	<2	<1	4	82	19	5
SH-1/9-AD	<2	7	31	13	19	90	<2	<1	2	102	8	<4
SH-1/10-AD	<2	8	25	19	19	83	<2	<1	3	99	8	<4
SH-1/11-AD	<2	8	16	15	20	80	<2	<1	2	82	10	<4
SH-1/12-AD	<2	11	24	27	23	120	<2	<1	3	120	12	<4

Appendix 8. Results of EDXRF—Continued

Sample	Mo ppm	Nb ppm	Nd ppm	Ni ppm	Pb ppm	Rb ppm	Sb ppm	Se ppm	Sn ppm	Sr ppm	Th ppm	U ppm
SH-1/13-AD	<2	10	30	28	19	95	<2	<1	2	99	11	<4
SH-1/14-AD	<2	15	36	42	24	140	<2	<1	4	98	16	<4
SH-1/15-AD	<2	6	18	9	18	78	<2	<1	<2	93	8	<4
SH-1/16-AD	<2	7	25	13	21	94	<2	<1	<2	130	7	<4
SH-1/17-AD	<2	15	25	40	29	150	<2	<1	4	78	18	<4
SH-1/18-AD	<2	6	33	12	19	94	<2	<1	<2	130	6	<4
SH-1/19-AD	<2	6	22	16	20	89	<2	<1	<2	120	7	<4
SH-1/20-AD	<2	6	18	9	19	81	<2	<1	2	120	7	<4
SH-1/21-AD	<2	10	56	13	19	80	<2	<1	3	140	18	<4
SH-1/22-AD	<2	7	29	12	18	82	<2	<1	<2	130	8	<4
SH-1/23-AD	<2	5	28	9	16	78	<2	<1	<2	120	6	<4
SH-1/24-AD	<2	11	47	12	17	74	<2	<1	3	130	21	4
SH-1/25-AD	<2	5	22	12	18	92	<2	<1	2	120	<4	<4
SH-1/26-AD	<2	7	50	12	18	84	<2	<1	3	160	8	<4
SH-1/27-AD	<2	14	44	20	19	97	<2	<1	3	150	21	4
SH-1/28a-AD	<2	8	36	15	17	91	<2	<1	3	140	10	5
SH-1/28b-AD	<2	9	36	14	17	89	<2	<1	2	140	11	<4
SH-1/29-AD	<2	7	31	13	18	98	<2	<1	2	130	6	<4
SH-1/30-AD	<2	7	30	12	16	87	<2	<1	<2	140	7	<4
SH-1/31-AD	<2	9	33	13	17	80	<2	<1	3	140	12	<4
SH-1/32-AD	<2	13	28	44	26	130	<2	<1	3	99	15	5
SH-1/33-AD	<2	14	47	50	26	130	<2	<1	3	100	11	4
SH-1/34m-AD	4	16	19	87	33	240	<2	<1	6	90	9	4
SH-1/34b-AD	<2	15	16	52	24	160	<2	<1	4	110	10	<4
SH-1/35-AD	<2	11	59	21	18	75	<2	<1	5	160	20	6
SH-1/36-AD	<2	6	43	10	18	90	<2	<1	2	130	<4	<4
SH-1/37-AD	<2	6	43	16	17	81	<2	<1	3	140	7	<4
SH-1/38-AD	2	8	39	15	15	72	<2	<1	5	130	17	<4
SH-1/39a-AD	<2	15	26	43	21	140	<2	<1	4	99	14	<4
SH-1/39b-AD	2	8	28	15	17	84	<2	<1	2	130	9	<4
SH-1/40-AD	<2	7	44	14	17	78	<2	<1	3	130	9	<4

Appendix 8. Results of EDXRF analyses—Continued

Sample	V ppm	W ppm	Y ppm	Zn ppm	Zr ppm
TH/S 20-AD	87	<5	34	66	230
TH/S 60-AD	49	<5	28	44	280
TH/S 110-AD	52	<5	32	40	280
TH/S 120-AD	60	<5	31	50	330
TH/S 140-AD	120	<5	33	76	250
TH/S 160-AD	35	<5	23	35	240
TH/S 170-AD	57	<5	30	42	300
TH/S 180-AD	44	<5	27	41	300
TH/S 210-AD	54	<5	17	48	120
TH/S 230-AD	37	<5	25	36	320
TH/S 320-AD	35	<5	20	31	230
TH/S 360-AD	29	<5	16	27	170
TH/S 380-AD	32	<5	15	28	190
TH/S 400-AD	31	<5	17	27	200
SH-1/1-AD	81	<5	26	78	190
SH-1/2-AD	73	<5	22	70	170
SH-1/3-AD	110	<5	37	99	270
SH-1/4-AD	55	<5	26	43	360
SH-1/5-AD	139	<5	37	93	190
SH-1/6-AD	27	<5	10	20	86
SH-1/7-AD	36	<5	14	130	100
SH-1/8-AD	120	<5	39	96	280
SH-1/9-AD	37	<5	16	29	110
SH-1/10-AD	43	<5	17	86	140
SH-1/11-AD	39	<10	20	80	140
SH-1/12-AD	72	40	25	93	180

Appendix 8. Results of EDXRF analyses—Continued

Sample	V ppm	W ppm	Y ppm	Zn ppm	Zr ppm
SH-1/13-AD	52	<5	22	140	250
SH-1/14-AD	110	<5	32	89	270
SH-1/15-AD	32	<5	15	35	100
SH-1/16-AD	34	<5	14	35	110
SH-1/17-AD	110	<5	34	110	190
SH-1/18-AD	35	<5	13	33	100
SH-1/19-AD	40	<5	15	33	98
SH-1/20-AD	35	<10	14	54	100
SH-1/21-AD	59	<5	32	46	220
SH-1/22-AD	39	<5	16	29	110
SH-1/23-AD	29	<5	15	27	100
SH-1/24-AD	53	<5	38	39	230
SH-1/25-AD	29	<5	12	24	96
SH-1/26-AD	46	<5	18	33	100
SH-1/27-AD	77	<5	38	47	350
SH-1/28a-AD	47	<5	19	36	150
SH-1/28b-AD	46	<5	20	35	160
SH-1/29-AD	37	<5	13	36	110
SH-1/30-AD	37	<5	15	31	120
SH-1/31-AD	46	<5	22	30	180
SH-1/32-AD	100	<5	29	88	220
SH-1/33-AD	110	<5	27	96	230
SH-1/34m-AD	120	<5	29	130	140
SH-1/34b-AD	81	<10	23	88	190
SH-1/35-AD	59	<5	33	47	270
SH-1/36-AD	28	<10	10	31	78
SH-1/37-AD	36	<5	15	39	140
SH-1/38-AD	38	<5	27	34	140
SH-1/39a-AD	96	<5	28	75	230
SH-1/39b-AD	42	<5	19	34	160
SH-1/40-AD	35	<5	22	38	160

Appendix 9. Results of arsenic analyses by Hydride Generation Atomic Absorption Spectrophotometry (HGAAS) of air-dried sediment samples from the BWDB (TH/S) and GSB (SH-1/) boreholes sediment from Srirampur, Kachua.

[Zoe Ann Brown, Analyst]

Sample	As ppm	Sample	As ppm
TH/S 20-AD	7.8	SH-1/15-AD	1.9
TH/S 60-AD	1.8	SH-1/16-AD	2.1
TH/S 110-AD	2.0	SH-1/17-AD	1.2
TH/S 120-AD	2.1	SH-1/18-AD	1.6
TH/S 140-AD	2.9	SH-1/19-AD	4.3
TH/S 160-AD	11	SH-1/20-AD	3.0
TH/S 170-AD	1.4	SH-1/21-AD	2.8
TH/S 180-AD	2.1	SH-1/22-AD	1.9
TH/S 210-AD	1.8	SH-1/23-AD	1.9
TH/S 230-AD	1.8	SH-1/24-AD	3.3
TH/S 320-AD	1.7	SH-1/25-AD	3.2
TH/S 360-AD	1.8	SH-1/26-AD	1.9
TH/S 380-AD	1.7	SH-1/27-AD	3.3
TH/S 400-AD	1.3	SH-1/28a-AD	2.3
		SH-1/28b-AD	2.4
SH-1/1-AD	6.4	SH-1/29-AD	3.7
SH-1/2-AD	3.3	SH-1/30-AD	1.6
SH-1/3-AD	7.6	SH-1/31-AD	1.8
SH-1/4-AD	5.7	SH-1/32-AD	8.4
SH-1/5-AD	5.9	SH-1/33-AD	12
SH-1/6-AD	0.6	SH-1/34m-AD	210
SH-1/7-AD	2.1	SH-1/34b-AD	71
SH-1/8-AD	11	SH-1/35-AD	1.6
SH-1/9-AD	2.7	SH-1/36-AD	3.1
SH-1/10-AD	3.9	SH-1/37-AD	5.8
SH-1/11-AD	4.4	SH-1/38-AD	1.6
SH-1/12-AD	6.2	SH-1/39a-AD	12
SH-1/13-AD	5.3	SH-1/39b-AD	2.7
SH-1/14-AD	9.2	SH-1/40-AD	1.3

Appendix 10. Concentrations of major cations extracted from preserved sediment samples from the GSB borehole at Srirampur, Kachua, with an aqueous solution of 0.1 molar SrCl₂. Concentrations measured by ICP-AES.

[Cyndi Rice, analyst]

Sample	Ca (ppm)	Mg (ppm)	K (ppm)	Na (ppm)	Fe ppm
SH-1/2-P	280	310	59	210	32
SH-1/3-P	440	400	62	420	64
SH-1/6-P	760	550	100	640	110
SH-1/7-P	1540	730	94	700	350
SH-1/8-P	200	63	25	200	0.3
SH-1/10-P	260	75	21	230	0.3
SH-1/12-P	150	44	130	300	3.1
SH-1/13-P	260	61	85	340	5.4
SH-1/16-P	250	200	85	500	0.6
SH-1/17-P	700	480	110	740	<0.3
SH-1/26-P	150	84	100	250	0.3
SH-1/29-P	270	180	46	460	<0.3
SH-1/30-P	140	97	38	370	<0.3
SH-1/33-P	1400	920	170	960	<0.3
SH-1/35-P	190	93	64	330	<0.3
SH-1/41-P	460	280	74	170	<0.3

Appendix 11. Total iron and ferrous iron extracted from air-dried sediment samples from the GSB bore-hole at Srirampur, Kachua, using an acid solution of 0.5N HCl. Concentrations determined spectrophotometrically.

[nd, not determined.]

Sample	Total Iron (wt. %)	Ferrous (wt.%)	Ferrous / Total Iron (wt. / wt.)
SH-1/1-AD	0.91	0.66	0.72
SH-1/2-AD	0.93	0.65	0.70
SH-1/3-AD	1.21	0.85	0.71
SH-1/4-AD	2.51	1.48	0.59
SH-1/5-AD	1.09	0.43	0.40
SH-1/6-AD	0.14	0.09	0.60
SH-1/7-AD	1.35	1.25	0.93
SH-1/8-AD	1.26	0.83	0.66
SH-1/9-AD	0.48	0.34	0.71
SH-1/10-AD	1.22	1.15	0.94
SH-1/11-AD	3.31	3.03	0.92
SH-1/12-AD	1.77	1.55	0.88
SH-1/13-AD	0.78	0.66	0.85
SH-1/14-AD	1.14	1.04	0.91
SH-1/15-AD	0.48	0.38	0.79
SH-1/16-AD	1.02	0.95	0.93
SH-1/17-AD	2.05	1.79	0.87
SH-1/18-AD	0.32	0.26	0.83
SH-1/19-AD	1.37	1.42	1.01
SH-1/20-AD	2.62	2.67	1.01
SH-1/21-AD	0.50	0.45	0.90
SH-1/22-AD	0.52	0.44	0.84
SH-1/23-AD	0.30	0.25	0.84
SH-1/24-AD	0.38	0.33	0.87
SH-1/25-AD	0.48	0.42	0.89
SH-1/26-AD	0.36	0.34	0.95
SH-1/27-AD	0.97	0.9	0.93
SH-1/28a-AD	1.23	1.22	0.99
SH-1/28b-AD	1.12	1.05	0.94
SH-1/29-AD	nd	nd	nd
SH-1/30-AD	0.46	0.43	0.94
SH-1/31-AD	0.36	0.33	0.93
SH-1/32-AD	1.14	0.96	0.85
SH-1/33-AD	0.93	0.79	0.86
SH-1/34m-AD	nd	nd	nd
SH-1/34b-AD	nd	nd	nd
SH-1/35-AD	nd	nd	nd
SH-1/36-AD	nd	nd	nd
SH-1/37-AD	nd	nd	nd
SH-1/38-AD	nd	nd	nd
SH-1/39a-AD	nd	nd	nd
SH-1/39b-AD	nd	nd	nd
SH-1/40-AD	nd	nd	nd

Appendix 12. Total and ferrous iron extracted from preserved sediment samples from the GSB bore-hole, Srirampur, Kachua, using an acid solution of 0.5N HCl. Concentrations determined spectrophotometrically.

[concentrations on dry weight basis following extraction]

	Total Iron (wt. %)	Ferrous (wt.%)	Ferrous / Total Iron (wt. / wt.)
SH-1/1-P	0.76	0.74	0.98
SH-1/2-P	0.90	0.89	0.98
SH-1/3-P	1.33	1.25	0.94
SH-1/4-P	1.52	1.35	0.89
SH-1/5-P	0.48	0.29	0.62
SH-1/6-P	2.15	2.16	1.00
SH-1/7-P	2.62	2.59	0.99
SH-1/8-P	0.11	0.11	0.93
SH-1/9-P	1.84	1.87	1.01
SH-1/10-P	0.22	0.22	0.99
SH-1/11-P	2.36	2.42	1.01
SH-1/12-P	0.15	0.15	1.00
SH-1/13-P	2.87	2.78	0.97
SH-1/14-P	1.42	1.40	0.99
SH-1/15-P	0.85	0.83	0.98
SH-1/16-P	0.63	0.61	0.96
SH-1/17-P	1.07	1.08	1.01
SH-1/18-P	0.49	0.48	0.98
SH-1/19-P	0.18	0.17	0.97
SH-1/20-P	0.29	0.28	0.97
SH-1/21-P	0.86	0.85	0.99
SH-1/22-P	6.25	6.29	1.01
SH-1/23-P	0.71	0.69	0.97
SH-1/24-P	0.21	0.20	0.92
SH-1/25-P	0.39	0.38	0.99
SH-1/26-P	0.45	0.45	1.01
SH-1/27-P	0.52	0.51	0.98
SH-1/28-P	0.44	0.43	0.98
SH-1/29-P	1.77	1.77	1.00
SH-1/30-P	0.71	0.66	0.94
SH-1/31-P	0.91	0.85	0.94
SH-1/32-P	0.43	0.43	0.99
SH-1/33-P	1.41	1.38	0.98
SH-1/34-P	1.19	1.13	0.95
SH-1/35-P	0.57	0.55	0.96
SH-1/36-P	1.58	1.48	0.94
SH-1/37-P	0.39	0.37	0.96
SH-1/38-P	0.48	0.46	0.96
SH-1/39-P	0.45	0.44	0.96
SH-1/40-P	0.22	0.21	0.96
SH-1/41-P	0.93	0.93	1.00
SH-1/42-P	0.15	0.13	0.91

Appendix 13. Element concentrations extracted from preserved sediment samples from the GSB borehole, Srirampur, Kachua, using an acid solution of 0.5 N HCl. Concentrations determined by ICP-AES unless otherwise indicated.

[*, determined by HG-AAS, # determined by atomic absorption spectrophotometry. Values calculated based on dry weight of the post-extraction residue.]

Sample	Al (ppm)	As* (ppm)	B (ppm)	Ba (ppm)	Be (ppm)	Ca (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (ppm)	K (ppm)
SH-1/1-P	3000	0.25	2.0	25	0.21	1400	<0.2	5.4	4.8	6.9	7600	570
SH-1/2-P	2800	0.35	2.2	19	0.20	2200	<0.2	6.0	4.9	6.0	8900	340
SH-1/3-P	4300	1.4	3.3	46	0.43	3500	<0.2	8.4	6.8	23	14200	300
SH-1/4-P	4400	1.7	4.0	27	0.49	2400	<0.2	9.1	7.4	27	15100	370
SH-1/5-P	790	0.57	1.4	6.9	0.15	160	<0.2	1.8	2.5	1.8	4900	100
SH-1/6-P	3200	0.21	4.8	56	0.73	1900	<0.2	7.7	6.9	0.7	22000	380
SH-1/7-P	6000	0.18	4.6	100	1.03	2500	<0.2	10.0	13.0	1.3	24000	400
SH-1/8-P	380	0.06	0.4	4.1	0.08	320	<0.2	1.2	1.5	0.5	1200	54
SH-1/9-P	2900	0.06	4.2	26	0.93	2200	<0.2	6.4	5.8	<0.2	19000	280
SH-1/10-P	730	0.14	0.7	9.2	0.12	470	<0.2	3.2	3.0	0.8	2200	69
SH-1/11-P	1300	0.21	4.8	8.9	0.43	830	0.69	4.5	0.4	59	25000	390
SH-1/12-P	710	0.45	0.7	5.0	0.14	450	<0.2	2.5	2.0	0.7	1600	190
SH-1/13-P	1300	0.59	6.8	17	0.51	1100	0.86	5.5	<0.2	41	28000	250
SH-1/14-P	1100	0.10	4.1	7.9	0.33	610	<0.2	2.9	0.9	2.5	14600	310
SH-1/15-P	1900	0.21	3.2	16	0.38	1200	<0.2	4.8	4.2	2.5	12600	250
SH-1/16-P	1300	0.68	2.3	24	0.33	860	<0.2	3.6	2.7	2.6	6300	270
SH-1/17-P	2700	1.7	4.1	18	0.45	1600	<0.2	8.2	5.1	8.9	11200	430
SH-1/18-P	480	0.56	2.1	65	0.14	480	2.11	2.5	1.1	2.1	5100	140
SH-1/19-P	520	0.20	1.2	22	0.11	580	<0.2	1.5	1.6	1.1	1890	120
SH-1/20-P	630	0.24	1.6	4.1	0.12	540	<0.2	2.2	1.9	0.6	3000	140
SH-1/21-P	420	0.39	1.7	3.5	0.13	480	<0.2	2.0	0.8	1.0	4100	120
SH-1/22-P	1200	0.41	14.4	43	0.75	1700	1.49	8.1	<0.2	33	66000	320
SH-1/23-P	1500	0.39	1.9	11	0.24	1700	<0.2	3.2	2.9	6.1	8200	400
SH-1/24-P	430	0.34	0.8	17	0.11	660	<0.2	1.7	1.5	1.1	2300	110
SH-1/25-P	610	0.33	2.5	3.5	0.16	460	<0.2	2.5	0.8	0.7	8700	140
SH-1/26-P	940	0.20	1.6	6.6	0.15	530	<0.2	1.8	1.7	2.3	4400	270

Appendix 13. Concentrations of elements extracted using 0.5 N HCl—Continued

Sample	Al (ppm)	As* (ppm)	B (ppm)	Ba (ppm)	Be (ppm)	Ca (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (ppm)	K (ppm)
SH-1/27-P	400	0.49	1.6	100	0.13	430	<0.2	2.1	0.6	0.9	5200	94
SH-1/28-P	680	0.42	1.5	130	0.15	710	<0.2	2.5	1.5	2.3	4500	150
SH-1/29-P	1800	1.3	4.9	8.7	0.40	1600	<0.2	5.8	3.0	2.7	20000	230
SH-1/30-P	600	0.28	2.0	5.5	0.13	680	<0.2	2.2	1.5	1.0	7100	150
SH-1/31-P	1000	0.32	3.2	130	0.17	760	<0.2	2.7	1.3	58	9000	290
SH-1/32-P	680	0.13	1.5	2.3	0.11	710	<0.2	1.7	1.5	0.7	4300	130
SH-1/33-P	3400	1.7	5.0	6.6	0.66	2900	<0.2	8.6	6.0	23	14700	440
SH-1/34-P	2500	1.9	3.6	14.8	0.36	1800	<0.2	6.8	4.4	8.4	12300	330
SH-1/35-P	610	0.11	1.6	230	0.12	710	<0.2	1.7	1.9	1.1	6100	140
SH-1/36-P	4400	0.54	3.8	87.0	0.55	1200	<0.2	11.9	9.3	6.2	15800	490
SH-1/37-P	840	0.18	1.2	260	0.11	1000	<0.2	2.2	3.2	1.5	4100	190
SH-1/38-P	750	0.23	1.6	230	0.11	480	<0.2	3.2	1.9	7.7	4900	230
SH-1/39-P	700	0.24	1.3	290	0.11	610	<0.2	2.1	2.8	2.0	4600	200
SH-1/40-P	430	0.15	0.7	250	0.07	410	<0.2	1.4	1.7	1.0	2200	120
SH-1/41-P	2200	1.1	3.0	15.0	0.26	1200	<0.2	6.7	4.1	3.3	9200	30
SH-1/42-P	500	0.12	0.8	280	0.08	470	<0.2	1.5	2.4	1.6	1600	140

Appendix 13. Concentrations of elements extracted using 0.5 N HCl—Continued

Sample	Li (ppm)	Mg (ppm)	Mn (ppm)	Mn# (ppm)	Mo (ppm)	Na (ppm)	Ni (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Si (ppm)
SH-1/1-P	3.8	2000	170	170	0.3	280	10	350	2.8	<1	2100
SH-1/2-P	3.6	2500	220	220	<0.2	230	11	490	2.4	<1	2000
SH-1/3-P	5.0	3800	530	500	0.5	550	14	550	9.1	<1	2800
SH-1/4-P	6.1	3700	610	560	0.5	710	16	400	12	<1	2700
SH-1/5-P	0.6	410	25	23	<0.2	240	2.9	50	2.6	<1	660
SH-1/6-P	3.0	1800	670	640	<0.2	910	11	270	6.2	<1	1300
SH-1/7-P	3.3	2600	600	600	0.3	880	18	200	8.9	<1	1700
SH-1/8-P	0.3	210	12	11	<0.2	200	4.0	27	2.2	<1	370
SH-1/9-P	3.5	1700	760	700	0.4	930	12	180	8.7	<1	1200
SH-1/10-P	0.7	400	21	20	<0.2	270	4.4	85	2.7	<1	500
SH-1/11-P	1.6	840	1200	1200	<0.2	320	5.1	160	<1	<1	1000
SH-1/12-P	0.9	340	31	29	<0.2	300	4.3	120	2.2	<1	620
SH-1/13-P	1.2	650	2300	2400	<0.2	540	5.1	180	<1	<1	900
SH-1/14-P	1.3	560	930	890	<0.2	380	4.6	130	1.5	<1	780
SH-1/15-P	2.5	1200	570	530	<0.2	600	8.0	340	<1	<1	1100
SH-1/16-P	1.8	1100	240	230	<0.2	730	6.2	230	3.0	<1	1000
SH-1/17-P	3.5	2300	340	330	<0.2	1100	15	260	8.3	<1	1500
SH-1/18-P	0.7	340	250	240	<0.2	320	3.4	130	2.4	<1	440
SH-1/19-P	0.7	340	54	52	<0.2	420	2.4	190	1.4	<1	480
SH-1/20-P	0.9	400	100	99	<0.2	220	3.7	180	2.0	<1	530
SH-1/21-P	0.6	300	190	180	<0.2	220	2.8	140	2.3	<1	410
SH-1/22-P	1.2	1200	3300	3200	0.7	750	6.1	280	<1	<1	960
SH-1/23-P	1.9	810	320	320	<0.2	430	4.9	590	1.8	<1	1200
SH-1/24-P	0.6	300	75	68	<0.2	420	2.5	250	2.0	<1	440
SH-1/25-P	0.9	460	380	360	<0.2	280	3.0	120	<1	<1	520
SH-1/26-P	1.2	460	170	160	0.2	340	2.9	150	1.3	<1	670

Appendix 13. Concentrations of elements extracted using 0.5 N HCl—Continued

Sample	Li (ppm)	Mg (ppm)	Mn (ppm)	Mn# (ppm)	Mo (ppm)	Na (ppm)	Ni (ppm)	P (ppm)	Pb (ppm)	Sb (ppm)	Si (ppm)
SH-1/27-P	0.5	310	220	210	<0.2	440	2.6	110	1.4	<1	340
SH-1/28-P	0.9	520	150	150	<0.2	540	4.1	220	1.8	<1	540
SH-1/29-P	2.5	1500	830	780	0.3	660	8.2	510	1.5	<1	1100
SH-1/30-P	0.9	450	320	300	<0.2	450	3.4	240	<1	<1	490
SH-1/31-P	1.1	630	420	410	<0.2	660	3.4	180	<1	<1	800
SH-1/32-P	0.9	530	180	170	<0.2	600	2.8	230	<1	<1	480
SH-1/33-P	5.0	3400	530	500	0.5	1500	17	310	20	<1	1500
SH-1/34-P	3.9	2400	460	430	<0.2	510	12	240	8.7	<1	1400
SH-1/35-P	0.7	590	220	210	<0.2	350	2.3	190	2.9	<1	580
SH-1/36-P	7.8	4000	360	360	<0.2	430	21	190	11	<1	1900
SH-1/37-P	1.3	600	130	120	<0.2	330	4.0	350	1.5	<1	740
SH-1/38-P	1.0	480	240	230	<0.2	240	3.2	130	<1	<1	670
SH-1/39-P	1.0	530	210	200	<0.2	410	3.5	180	<1	<1	690
SH-1/40-P	0.6	320	82	80	<0.2	250	2.2	120	<1	<1	430
SH-1/41-P	3.6	1900	290	280	0.3	160	11	270	4.2	<1	1200
SH-1/42-P	0.7	350	29	27	<0.2	330	2.5	150	1.5	<1	530

Appendix 13. Concentrations of elements extracted using 0.5 N HCl—Continued

Sample	Sr (ppm)	Ti (ppm)	V (ppm)	Zn (ppm)
SH-1/1-P	5.4	210	8.2	17
SH-1/2- P	5.6	270	8.3	17
SH-1/3- P	11	230	15	25
SH-1/4- P	14	170	14	27
SH-1/5- P	1.8	25	4.9	4.6
SH-1/6- P	12	51	13	22
SH-1/7- P	21	22	17	30
SH-1/8- P	2.1	3	0.9	4.0
SH-1/9- P	14	40	8.0	28
SH-1/10-P	2.6	18	1.4	6.6
SH-1/11-P	2.9	77	12	40
SH-1/12-P	2.0	36	1.7	6.4
SH-1/13-P	4.4	<0.5	7.0	54
SH-1/14-P	2.6	56	7.2	12
SH-1/15-P	4.6	72	8.4	20
SH-1/16-P	5.4	44	4.5	35
SH-1/17-P	11	78	8.8	28
SH-1/18-P	3.7	17	2.7	8.5
SH-1/19-P	3.3	21	1.8	5.2
SH-1/20-P	2.0	56	2.4	8.0
SH-1/21-P	1.7	25	1.7	7.1
SH-1/22-P	8.0	<0.5	6.8	25
SH-1/23-P	6.2	100	7.1	15
SH-1/24-P	3.6	20	1.7	4.4
SH-1/25-P	1.9	72	4.8	6.5
SH-1/26-P	2.5	50	4.0	7.9

Appendix 13. Concentrations of elements extracted using 0.5 N HCl—Continued

Sample	Sr (ppm)	Ti (ppm)	V (ppm)	Zn (ppm)
SH-1/27-P	5.2	16	2.3	4.2
SH-1/28-P	8.1	33	4.0	7.5
SH-1/29-P	5.4	150	13	15
SH-1/30-P	2.5	50	5.4	6.2
SH-1/31-P	8.8	<0.5	4.2	44
SH-1/32-P	2.9	53	3.4	5.5
SH-1/33-P	21	<0.5	7.5	32
SH-1/34-P	13	11	5.9	22
SH-1/35-P	9.5	13	2.5	13
SH-1/36-P	9.3	270	16	38
SH-1/37-P	11	63	3.1	18
SH-1/38-P	7.5	48	2.5	16
SH-1/39-P	10	53	2.7	18
SH-1/40-P	8.0	18	1.3	9.3
SH-1/41-P	7.0	130	5.5	23
SH-1/42-P	9.9	22	1.1	13

Appendix 14. Concentrations of iron, manganese, aluminum and arsenic extracted from preserved sediment samples from the GSB borehole Srirampur, Kachua using the reductive extract solution of Ti(III)-EDTA.

[iron, manganese, and aluminum determined by atomic absorption spectrophotometry; arsenic determined by hydride generation atomic fluorescence spectrometry]

Sample	Fe (ppm)	Mn (ppm)	Al (ppm)	As (ppm)
SH-1/1-P	1900	14	100	0.6
SH-1/2-P	1500	10	60	0.6
SH-1/3-P	2300	17	170	1.3
SH-1/4-P	2900	23	240	1.8
SH-1/5-P	630	2	15	0.6
SH-1/6-P	1100	14	260	0.6
SH-1/7-P	2400	32	nd	0.4
SH-1/8-P	380	2	58	<0.1
SH-1/9-P	1300	22	460	0.3
SH-1/10-P	490	4	83	0.3
SH-1/11-P	670	19	35	0.3
SH-1/12-P	340	5	66	0.3
SH-1/13-P	1000	45	92	0.2
SH-1/14-P	310	7	35	<0.1
SH-1/15-P	340	5	54	0.2
SH-1/16-P	830	76	120	0.3
SH-1/17-P	1200	90	290	1.3
SH-1/18-P	300	3	35	0.1
SH-1/19-P	440	5	48	0.3
SH-1/20-P	180	1	35	<0.1
SH-1/21-P	230	2	36	<0.1
SH-1/22-P	1400	43	73	0.2
SH-1/23-P	520	7	93	<0.1
SH-1/24-P	290	3	67	0.1
SH-1/25-P	250	4	17	<0.1
SH-1/26-P	220	1	48	0.1
SH-1/27-P	260	3	17	0.1
SH-1/28-P	410	5	120	0.1
SH-1/29-P	580	6	85	0.5
SH-1/30-P	160	1	49	<0.1
SH-1/31-P	1000	8	1300	0.3
SH-1/32-P	130	1	69	0.2
SH-1/33-P	2200	35	650	0.4
SH-1/34-P	1200	17	410	0.5
SH-1/35-P	710	3	87	0.2
SH-1/36-P	1800	17	100	<0.1
SH-1/37-P	780	5	50	0.2
SH-1/38-P	400	2	55	0.1
SH-1/39-P	680	4	51	0.1
SH-1/40-P	280	1	17	<0.1
SH-1/41-P	660	6	150	0.5
SH-1/42-P	400	2	35	0.1

Appendix 15. Concentration of arsenic extracted from preserved sediment samples from the GSB borehole, Srirampur, Kachua, using an oxidative extract solution of H₂O₂ and HCl.
[arsenic determined by hydride generation atomic fluorescence spectrometry]

Sample	As (ppm)
SH-1/1-P	1.2
SH-1/2-P	1.3
SH-1/3-P	3.2
SH-1/4-P	5.0
SH-1/5-P	0.3
SH-1/6-P	1.8
SH-1/7-P	1.2
SH-1/8-P	0.1
SH-1/9-P	1.0
SH-1/10-P	0.5
SH-1/11-P	1.0
SH-1/12-P	1.3
SH-1/13-P	2.2
SH-1/14-P	1.6
SH-1/15-P	0.7
SH-1/16-P	1.9
SH-1/17-P	6.2
SH-1/18-P	0.7
SH-1/19-P	0.4
SH-1/20-P	1.1
SH-1/21-P	0.3
SH-1/22-P	1.2
SH-1/23-P	0.5
SH-1/24-P	0.4
SH-1/25-P	0.4
SH-1/26-P	1.5
SH-1/27-P	0.8
SH-1/28-P	0.4
SH-1/29-P	3.1
SH-1/30-P	0.4
SH-1/31-P	1.7
SH-1/32-P	0.5
SH-1/33-P	4.1
SH-1/34-P	5.2
SH-1/35-P	0.2
SH-1/36-P	6.0
SH-1/37-P	0.7
SH-1/38-P	1.1
SH-1/39-P	0.6
SH-1/40-P	0.4
SH-1/41-P	4.6
SH-1/42-P	0.2

Appendix 16. Concentration of acid-volatile sulfide (AVS), pyritic sulfur (DI), and acid-soluble sulfate (SO₄) in selected preserved sediment samples from the GSB borehole, Srirampur, Kachua.

[nd, not determined]

Sample	Sulfide -AVS (ppm)	Acid-soluble-SO ₄ (ppm)	Sulfide -DI (ppm)
SH-1/1-P	65	10	70
SH-1/2-P	60	10	220
SH-1/3-P	50	<10	310
SH-1/5-P	30	<10	120
SH-1/7-P	30	<10	20
SH-1/9-P	30	10	110
SH-1/12-P	280	80	1090
SH-1/14-P	nd	nd	38
SH-1/16-P	20	<10	520
SH-1/18-P	20	<10	330
SH-1/20-P	10	<10	200
SH-1/23-P	96	nd	128
SH-1/28-P	10	40	220
SH-1/33-P	20	110	590
SH-1/34-P	120	15	90
SH-1/36-P	40	70	1170
SH-1/41-P	80	<10	1540