FIELD AND LABORATORY DATA DESCRIBING PHYSICAL AND CHEMICAL CHARACTERISTICS OF METAL-CONTAMINATED FLOOD-PLAIN DEPOSITS DOWNSTREAM FROM LEAD, WEST-CENTRAL SOUTH DAKOTA

By Donna C. Marron

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CONVERSION FACTORS

International System (SI) units in this report may be converted to metric (inch-pound) units by using the following conversion factors:

Multiply metric unit	*By*	*To obtain inch-pound unit*
gram (g)	0.002205	pound, avoirdupois
kilogram (kg)	2.205	pound, avoirdupois
megagram (Mg)	1.102	ton, short
meter (m)	3.281	foot
millimeter (mm)	0.03937	inch

The following terms and abbreviations also are used in this report:

micrometer (μm)
microgram per gram (μg/g)

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ABSTRACT

Samples from metal-contaminated flood-plain sediments at 9 sites downstream from Lead, in west-central South Dakota, were collected during the summers of 1985-87 to characterize aspects of the sedimentology, chemistry, and geometry of a deposit that resulted from the discharge of a large volume of mining wastes into a river system. Field and laboratory data include stratigraphic descriptions, chemical contents and grain-size distributions of samples, and surveyed flood-plain positions of samples. This report describes sampling-site locations, and methods of sample collection and preservation, and subsequent laboratory analysis. Field and laboratory data are presented in 4 figures and 11 tables in the "Supplemental Data" section at the back of the report.

INTRODUCTION

The discharge of a large volume of mine tailings into a river system in west-central South Dakota resulted in the overbank deposition of millions of megagrams (metric tons) of contaminated sediments on flood plains downstream from the gold-mining area (Marron, 1987). Large arsenic concentrations in the deposits have caused controversy and concern (U.S. Environmental Protection Agency, 1973; Cherry and others, 1986; Goddard, 1987). The affected area was designated a priority site for intensive interdisciplinary study by the U.S. Geological Survey. In this report, data are presented that were collected as part of this research effort.

Purpose and Scope

The study for which the data presented in this report were collected had two major objectives. One objective was to examine the efficiency of the fluvial system downstream from the mining area in storing the sediment that was introduced by the mining activities. The other objective was to relate physical and chemical characteristics of the metal-contaminated flood-plain deposit to sediment transport, sediment mixing, and chemical transformation processes that have affected the mine tailings during fluvial transport, flood-plain deposition, and subsequent exposure to weathering.

Background

The mine tailings discussed in this report resulted from gold mining in and around Lead, which is located in the Black Hills of South Dakota (fig. 1).

Samples from metal-contaminated flood-plain sediments at 11 sites downstream from Lead were collected during the summers of 1985, 1986, and 1987, and were analyzed in the laboratory either within a few days or during the winter following sample collection.

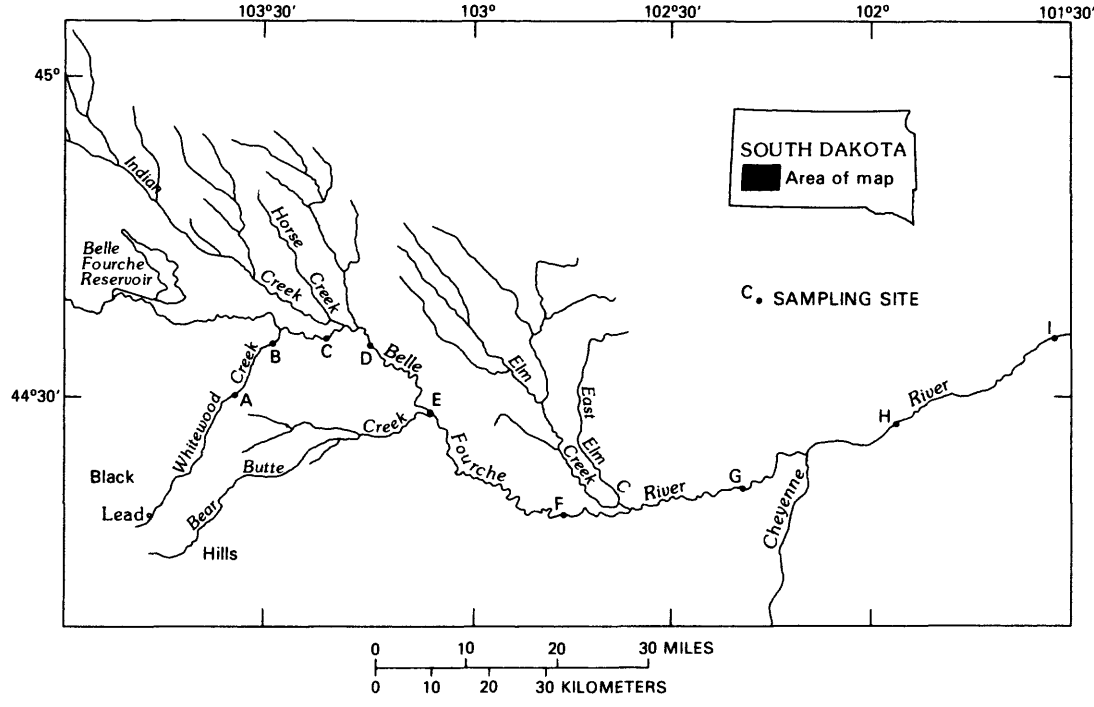

Figure 1.--Location of study area and sampling sites.

Description of the Study Area

Between the late 1890's and 1977, milled tailings were discharged into Whitewood Creek by way of a small tributary. Much of the Whitewood Creek channel downstream from Lead is steep and incised into bedrock. In contrast, the Belle Fourche River is a meandering stream with an alluvial flood plain. The deposition of mine tailings along Whitewood Creek was somewhat limited in extent by the incised nature of much of the Whitewood Creek channel downstream from Lead. The deposits along the Cheyenne River have relatively small metal concentrations. The majority of the data presented in this report pertains to flood-plain sediments that were deposited along reaches of the Belle Fourche River downstream from Whitewood Creek. Sampling sites were located in reaches where lateral migration of the channel during the last century was minimal. The sediments that were sampled were in overbank rather than lateral accretion deposits.

Methods of Data Collection and Analysis

Two sets of samples were collected for this study. The first set was collected during the summers of 1985 and 1986 to obtain precise information on

chemical and physical characteristics of the contaminated flood-plain sediments at varying distances downstream from Lead. The other, more extensive, set was collected during the summer of 1987 to approximately characterize the spatial variability of arsenic concentrations and grain-size characteristics in the deposit. The methods used for sample collection, grain-size analysis, and chemical analysis differed considerably for the two sets. Duplicate samples were submitted or processed for all of the laboratory procedures used.

The first set of samples was collected from 1-m-deep soil pits that were dug along a transect that was perpendicular to Whitewood Creek, the Belle Fourche River, or the Cheyenne River at sites A through I (fig. 1). The stratigraphy exposed in pit walls was described and recorded at each locality. A variety of sediment types was sampled in each pit. Before sampling, the side of the pit was scraped using a plastic utensil. The samples were collected with plastic spoons and stored in plastic containers. The scraping and collection utensils and the plastic containers had been soaked overnight in 5-percent hydrochloric acid and air dried. The samples were put in a freezer at the end of each day and were freeze-dried at the end of the field season. Splits of the dried samples were obtained using a stainless steel splitter.

Several types of digestions and analytical methods were used to obtain chemical data for the samples collected from soil pits. Total concentrations of selected chemical constituents were obtained for all of the samples using a hydrofluoric-perchloric acid digestion and inductively coupled plasma atomic-emission spectrometry. Various partial digestion and analytical procedures were used to obtain chemical information for some of the samples collected from soil pits. Details of these procedures are provided in the "Supplemental Data" section at the back of the report. Analyses of chemical contents of different grain-size fractions of samples were obtained using an air elutriator to separate the size fractions and the total digestion procedure. Grain-size analyses were done using settling tubes for the larger than 64-μm fraction, and pipettes were used for the finer than 64-μm fraction.

The second set of samples was collected from auger holes that were dug along transects that were perpendicular to the Belle Fourche River at sites C, E, F, and G (fig. 1). Three transects extend away from the channel on the insides of two consecutive meander bends at each site. Transect and auger-hole locations were surveyed using a level and tagline. Stainless steel implements were used to scrape samples from the sides of the auger holes at 0.4 m or smaller depth intervals. Samples were stored in plastic bags and were air dried. Arsenic concentrations were obtained using a semiquantitative colorimetric method (O'Leary and Meier, 1986). The colorimetric method yielded values of 1,400 μg/g and 2,100 μg/g for samples for which total digestion arsenic values were determined to be 1,800 μg/g and 2,400 μg/g. Grain-size information was obtained using wet sieving to separate the fraction that is larger than 64 μm, and pipettes were used for the fraction that is smaller than 64 μm.

Acknowledgments

Sara L. Rathburn (University of Arizona, Tucson), Kristin L. Gunckel (Colorado State University, Fort Collins), and Susan J. Sobczak (Colorado School of Mines, Golden) assisted in the collection of the data presented in this report. Logistical support was provided by Kimball E. Goddard (U.S. Geological Survey). John S. Zogorski (South Dakota School of Mines and Technology, Rapid City) generously provided laboratory space and equipment for colorimetric arsenic analyses. Metal analyses that used a total digestion procedure were performed by Paul H. Briggs (U.S. Geological Survey).

PRESENTATION OF DATA

Stratigraphic information collected from soil pits along Whitewood Creek and the Belle Fourche River is presented in table 1 in the "Supplemental Data" section at the back of the report. Chemical and grain-size information obtained by analyzing samples that were collected in soil pits is presented in tables 2 through 6 in the "Supplemental Data" section at the back of the report. Duplicate values for grain-size analysis and chemical analysis, following partial digestion, also are shown in tables 2 through 6. Duplicate values for chemical analysis following total digestion are listed in table 4.

The relation of flood-plain and channel morphology to auger holes is shown in figures 2 through 5. Arsenic concentrations of samples collected from auger holes also are shown in figures 2 through 5. Grain-size information on samples collected from auger holes at sites C, E, F, and G is included in tables 7 through 10 ("Supplemental Data" section at the back of the report). Duplicate values of grain-size parameters are listed in table 11 ("Supplemental Data" section at the back of the report). Duplicate values of arsenic concentration of samples collected from auger holes are included in tables 7, 8, and 9.

REFERENCES CITED

Cherry, J.A., Morel, F.M.M., Rouse, J.V., Schnoor, J.L., and Wolman, M.G., 1986, Hydrogeochemistry of sulfide and arsenic-rich tailings and alluvium along Whitewood Creek, South Dakota: Mineral and Energy Resources, v. 29, no. 4-6, 44 p.

Goddard, K.E., 1987, Composition, distribution, and hydrologic effects of contaminated sediments resulting from the discharge of gold mining wastes to Whitewood Creek at Lead and Deadwood, South Dakota: U.S. Geological Survey Water-Resources Investigations Report 87-4051, 75 p.

Fishman, M.J., and Friedman, L.C., eds., 1985, Methods of determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A1, 709 p.

Marron, D.C, 1987, Floodplain storage of metal-contaminated sediments downstream of a gold mine at Lead, South Dakota, *in* Averett, R.C., and McKnight, D.M., eds., Chemical quality of water and the hydrologic cycle: Chelsea, Mich., Lewis Publishers, Inc., p. 193-209.

O'Leary, R.M., and Meier, A.L., 1986, Analytical methods used in geochemical exploration, 1984: U.S. Geological Survey Circular 948, p. 6-8.

U.S. Environmental Protection Agency, 1973, Mercury, zinc, copper, arsenic, selenium, and cyanide content of selected waters and sediment collected along Whitewood Creek, the Belle Fourche River, and the Cheyenne River in western South Dakota: Surveillance and Analysis Division, Technical Support Branch, Region VIII SA/TSB-17, 96 p.

Wershaw, R.L., Fishman, M.J., Grabbe, R.R., and Lowe, L.E., eds., 1983, Methods for the determination of organic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A3, 173 p.

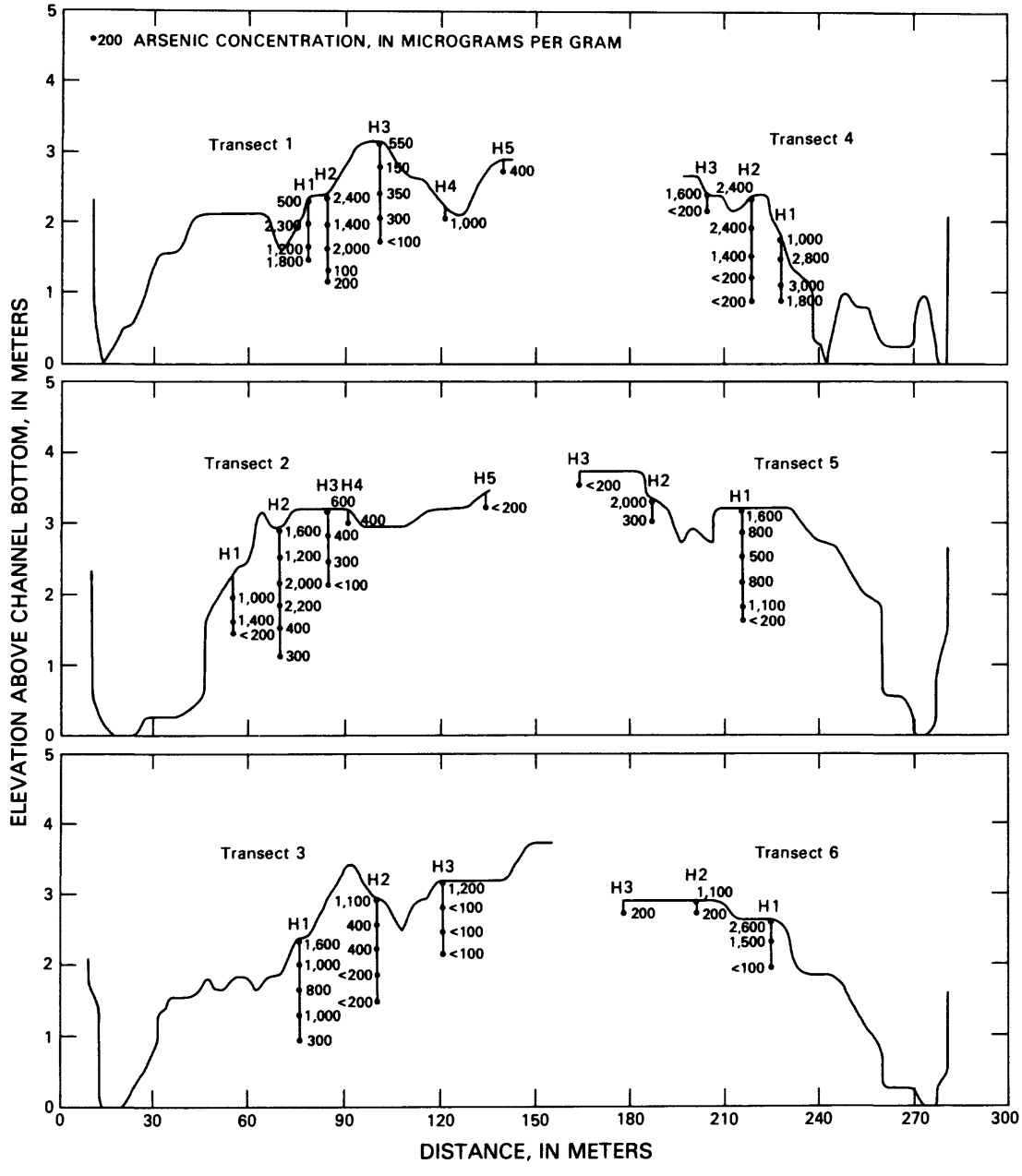

Figure 2.--Transect profiles, auger-hole locations, and depths and arsenic concentrations of sediment samples at site C.

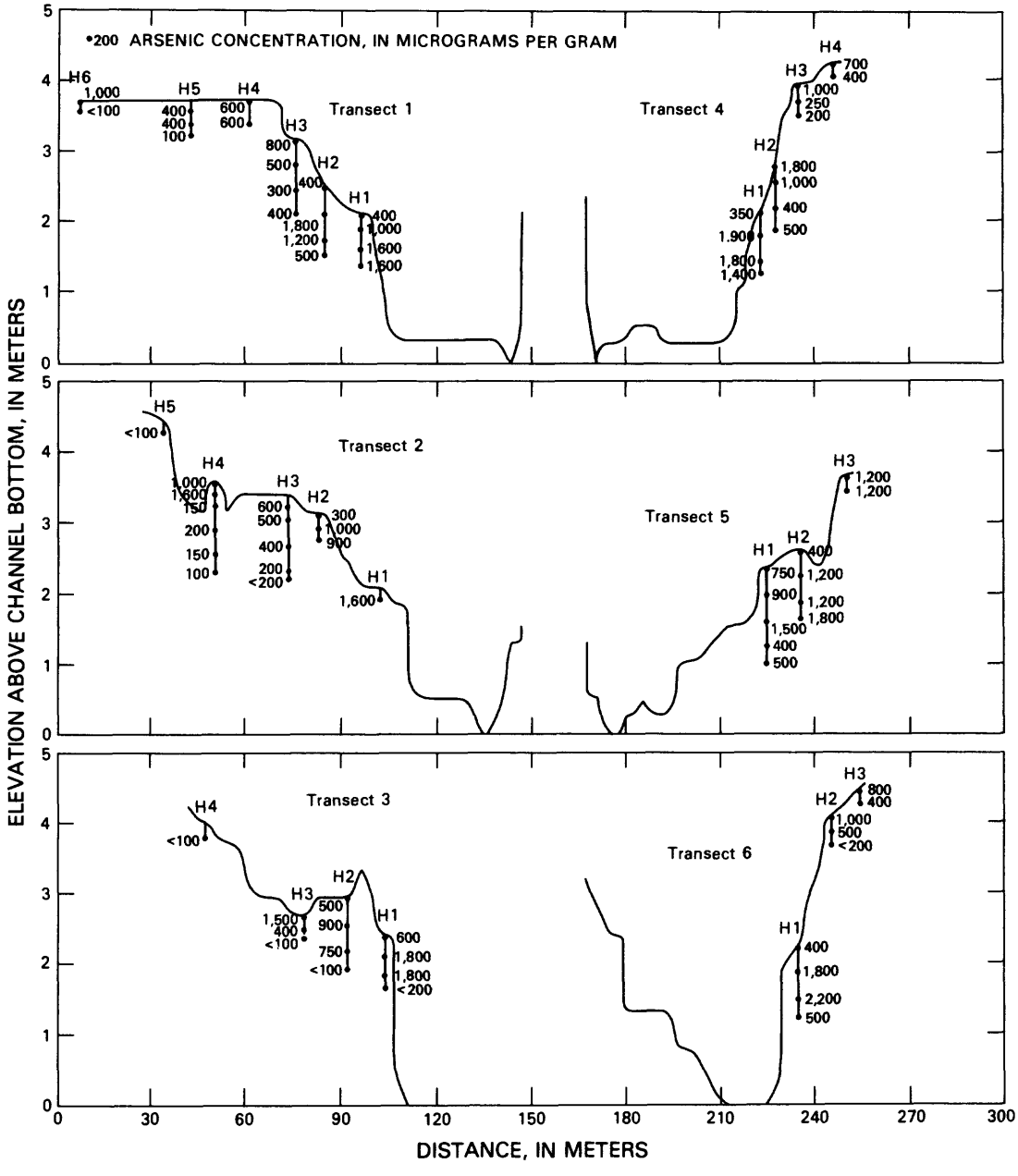

Figure 3.--Transect profiles, auger-hole locations, and depths and arsenic concentrations of sediment samples at site E.

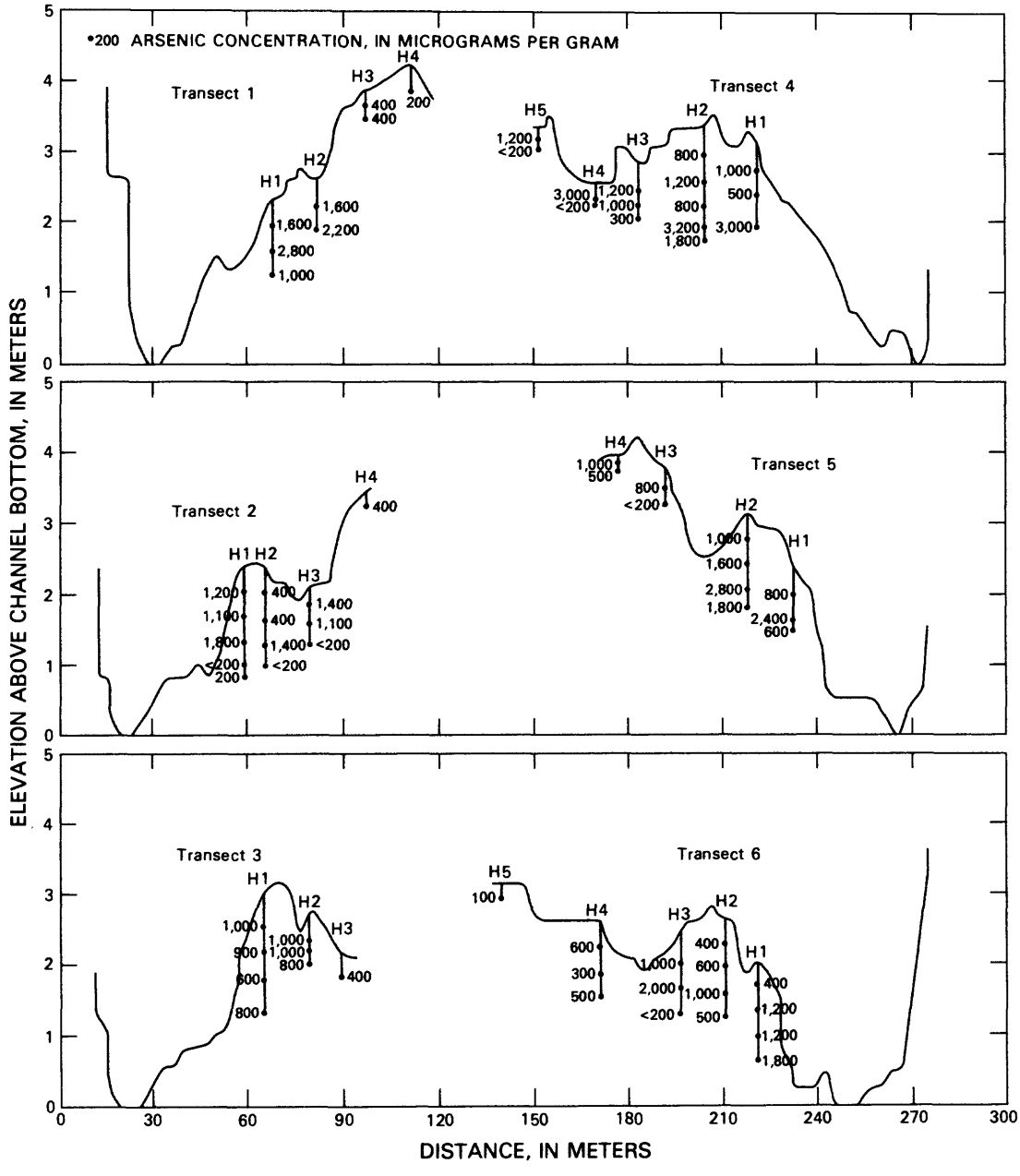

Figure 4.--Transect profiles, auger-hole locations, and depths and arsenic concentrations of sediment samples at site F.

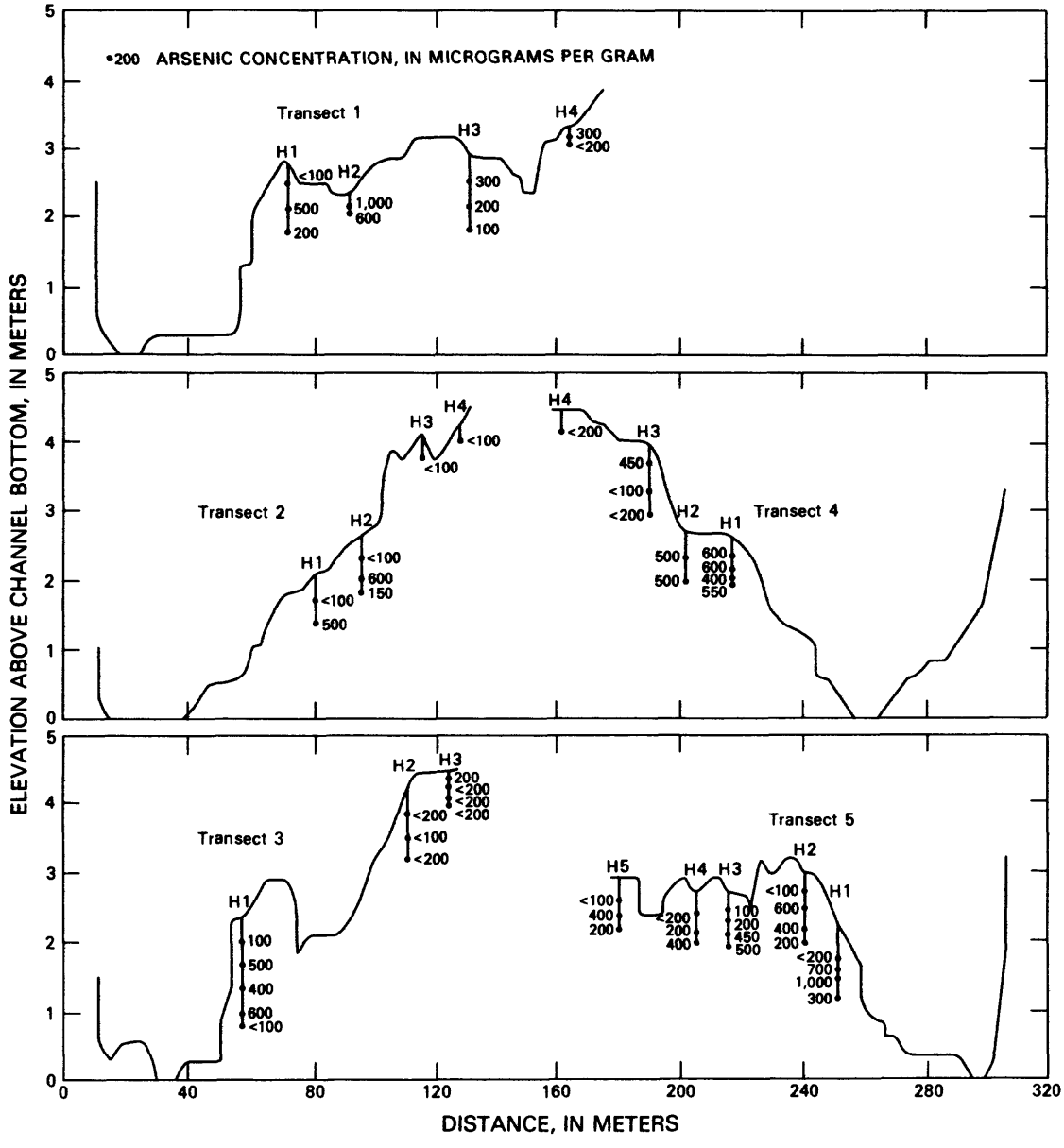

Figure 5.--Transect profiles, auger-hole locations, and depths and arsenic concentrations of sediment samples at site G.

SUPPLEMENTAL DATA

Table 1.--*Stratigraphic description of soil pits along Whitewood Creek and Belle Fourche River*

[Sample identifiers are in parentheses]

Depth (meters)	Description (color, texture)
	SITE A, PIT 1
0.00-0.16	Brown, fine-grained sand
0.16-0.21	Orange-brown, fine-grained sand
0.21-0.25	Brown, fine-grained sand and silt
0.25-0.30	Brown, fine-grained sand
0.30-0.34	Orange-brown, fine-grained sand and silt (A1-1)
0.34-0.36	Brown, medium-grained sand
0.36-0.43	Orange-brown, fine-grained sand and silt
0.43-0.77	Brown and orange-brown, medium-grained sand and coarse-grained sand (A1-2)
0.77-0.82	Gray and orange-brown, silt and fine-grained sand (A1-3)
0.82-0.92	Orange-brown, fine-grained sand and medium-grained sand
0.92-1.00	Brown and orange, fine-grained sand
0.00-0.29	Orange-brown, medium-grained sand (A2-1)
0.29-0.36	Gray, silt
0.36-0.44	Orange-brown, fine-grained sand (A2-2)
0.44-0.55	Maroon-brown, medium-grained sand and coarse-grained sand, pebbles, and cobbles
0.55-0.65	Maroon-brown, pebbles and cobbles, medium-grained sand and coarse-grained sand
	SITE A, PIT 3
0.00-0.12	Brown, fine-grained sand
0.12-0.28	Orange-brown and brown, fine-grained sand and medium-grained sand
0.28-0.40	Brown, medium-grained sand
0.40-0.42	Gray, silt
0.42-0.55	Brown, medium-grained sand (A3-1)
0.55-0.65	Orange-brown, fine-grained sand
0.65-0.68	Brown, fine-grained sand (A3-2)
0.68-0.71	Orange-brown, fine-grained sand and medium-grained sand

Table 1.--*Stratigraphic description of soil pits along Whitewood Creek and Belle Fourche River*--Continued

Depth (meters)	Description (color, texture)
	SITE B, PIT 1
0.00-0.42	Gray and orange-brown, medium-grained sand and fine-grained sand (B1-1)
0.42-0.67	Orange-brown, fine-grained sand (B1-2)
0.67-0.75	Orange-brown, medium-grained sand
0.75-0.90	Orange-brown, fine-grained sand (B1-3)
0.90-1.00	Gray, silt and clay
	SITE B, PIT 2
0.00-0.20	Orange-brown, fine-grained sand
0.20-0.21	Brown, fine-grained sand
0.21-0.35	Orange-brown, fine-grained sand (B2-1)
0.35-0.38	Brown, silt
0.38-0.63	Orange-brown, medium-grained sand (B2-2)
0.63-0.64	Gray, silt
0.64-0.70	Orange-brown, fine-grained sand
0.70-0.81	Orange-brown and gray, fine-grained sand and silt (B2-3)
0.81-0.98	Brown, fine-grained sand
0.98-1.00	Gray, fine-grained sand and silt (B2-4)
	SITE C, PIT 1
0.00-0.17	Brown, fine-grained sand and silt
0.17-0.30	Gray and orange, fine-grained sand and silt
0.30-0.40	Brown, fine-grained sand and silt
0.40-0.44	Gray, silt and fine-grained sand (C1-1)
0.44-0.59	Brown, medium-grained sand (C1-2)
0.59-0.70	Gray-brown, fine-grained sand
0.70-0.75	Gray, silt and fine-grained sand
0.75-0.89	Orange-brown, fine-grained sand (C1-3)
	SITE C, PIT 2
0.00-0.10	Brown, fine-grained sand
0.10-0.15	Brown and orange, fine-grained sand and silt
0.15-0.30	Brown and orange, fine-grained sand
0.30-0.33	Brown and orange, fine-grained sand
0.33-0.50	Orange-brown, fine-grained sand and medium-grained sand
0.50-0.54	Gray, silt (C2-2)
0.54-0.60	Orange and gray, silt and fine-grained sand
0.60-1.00	Orange, fine-grained sand medium-grained sand (C2-3)

Table 1.--*Stratigraphic description of soil pits along Whitewood Creek and Belle Fourche River*--Continued

Depth (meters)	Description (color, texture)
	SITE C, PIT 3
0.00-0.09	Gray, fine-grained sand and silt
0.09-0.15	Orange-brown and gray, fine-grained sand and silt
0.15-0.18	Brown, silt and fine-grained sand
0.18-0.34	Brown and orange, fine-grained sand (C3-1)
0.34-0.39	Brown, silt and fine-grained sand
0.39-0.47	Gray, silt and clay (C3-2)
0.47-0.50	Brown, fine-grained sand and silt
0.50-0.70	Brown, gravel and cobbles
	SITE D, PIT 1
0.00-0.10	Brown and gray, silt
0.10-0.28	Orange-brown, fine-grained sand (D1-1)
0.28-0.35	Brown, medium-grained sand
0.35-0.40	Orange-brown, fine-grained sand and medium-grained sand
0.40-0.64	Gray-brown, fine-grained sand and silt
0.64-0.67	Orange-brown, coarse-grained sand and medium-grained sand
0.67-1.00	Brown and orange, fine-grained sand (D1-2)
	SITE D, PIT 2
0.00-0.17	Brown and gray, silt and fine-grained sand
0.17-0.28	Orange-brown, fine-grained sand
0.28-0.31	Gray, silt
0.31-0.41	Orange-brown, fine-grained sand (D2-1)
0.41-0.81	Gray and brown, cobbles, sand, silt, and clay
0.81-0.95	Gray and brown, fine-grained sand and silt (D2-2)
0.95-1.00	Brown, cobbles
	SITE D, PIT 3
0.00-0.18	Brown, silt and fine-grained sand
0.18-0.29	Orange-brown, silt and fine-grained sand
0.29-0.35	Gray, fine-grained sand and silt (D3-1)
0.35-0.58	Orange-brown, silt and fine-grained sand (D3-2)
0.58-0.69	Maroon-brown, silt and medium-grained sand
0.69-1.00	Orange-brown and gray, fine-grained sand and silt (D3-3)

Table 1.--*Stratigraphic description of soil pits along Whitewood Creek and Belle Fourche River*--Continued

Depth (meters)	Description (color, texture)
	SITE D, PIT 4
0.00-0.07	Gray, fine-grained sand
0.07-0.15	Gray, silt and fine-grained sand
0.15-0.26	Orange-brown, fine-grained sand
0.26-0.29	Gray, silt and clay
0.29-0.39	Orange-brown and gray, fine-grained sand
0.39-0.44	Gray, fine-grained sand and silt (D4-2)
0.44-0.56	Orange-brown and gray, fine-grained sand and medium-grained sand
0.56-0.59	Gray, silt and fine-grained sand
0.59-0.69	Orange-brown, medium-grained sand
0.69-0.74	Gray, fine-grained sand and silt
0.74-1.00	Gray and orange-brown, fine-grained sand and medium-grained sand (D4-3)
	SITE E, PIT 1
0.00-0.10	Gray and brown, silt
0.10-0.28	Orange-brown, fine-grained sand (E1-1)
0.28-0.31	Orange-brown, coarse-grained sand and pebbles
0.31-0.49	Orange-brown, fine-grained sand and silt
0.49-0.70	Gray and brown, gravels, clay, and sand (E1-2)
	SITE E, PIT 2
0.00-0.10	Gray, fine-grained sand
0.10-0.35	Orange-brown, fine-grained sand (E2-1)
0.35-0.39	Gray-brown, silt and fine-grained sand
0.39-0.48	Brown, fine-grained sand and medium-grained sand
0.48-0.51	Orange-brown, fine-grained sand and medium-grained sand
0.51-0.66	Orange-brown, fine-grained sand
0.66-0.71	Orange-brown, medium-grained sand
0.71-1.00	Orange, brown, and gray, fine-grained sand, silt and coarse-grained sand (E2-2)
	SITE F, PIT 1
0.00-0.05	Brown, silt
0.05-.0.11	Gray-brown, fine-grained sand and silt
0.11-0.18	Gray, silt
0.18-0.25	Brown, fine-grained sand
0.25-0.29	Orange-brown, fine-grained sand

Table 1.--*Stratigraphic description of soil pits along Whitewood Creek and Belle Fourche River*--Continued

Depth (meters)	Description (color, texture)
	SITE F, PIT 1--Continued
0.29-0.45	Brown and orange-brown, fine-grained sand
0.45-0.62	Gray, medium-grained sand and coarse-grained sand (F1-1)
0.62-0.83	Orange-brown and gray, fine-grained sand and medium-grained sand
0.83-1.00	Gray, silt and clay
	SITE F, PIT 2
0.00-0.08	Brown-gray, silt
0.08-0.18	Gray, silt and clay
0.18-0.38	Brown, medium-grained sand and coarse-grained sand
0.38-0.55	Orange-brown and brown, medium-grained sand and coarse-grained sand (F2-1)
0.55-0.63	Brown and gray, pebbles, cobbles, and coarse-grained sand
0.63-0.67	Gray, silt and clay
0.67-0.79	Brown, medium-grained sand and coarse-grained sand
0.79-1.00	Brown and orange, fine-grained sand (F2-2)
	SITE G, PIT 1
0.00-0.10	Gray, fine-grained sand
0.10-0.17	Gray, silt and clay
0.17-0.29	Brown, fine-grained sand (G1-1)
0.29-0.34	Orange-brown, fine-grained sand and silt
0.34-0.43	Orange-brown and brown, fine-grained sand and medium-grained sand
0.43-0.47	Gray-brown, fine-grained sand and silt (G1-2)
0.47-0.54	Brown and orange-brown, medium-grained sand
0.54-0.69	Orange-brown and brown, fine-grained sand (G1-3)
0.69-0.80	Gray-brown, fine-grained sand and silt
0.80-1.00	Gray, silt and clay (G1-4)

Table 1.--*Stratigraphic description of soil pits along Whitewood Creek and Belle Fourche River*--Continued

Depth (meters)	Description (color, texture)
	SITE G, PIT 2
0.00-0.08	Brown, silt
0.08-0.13	Gray, silt and clay
0.13-0.15	Brown, fine-grained sand and medium-grained sand
0.15-0.21	Brown, fine-grained sand
0.21-0.22	Brown, medium-grained sand
0.22-0.30	Brown, fine-grained sand and silt (G2-1)
0.30-0.39	Brown, fine-grained sand and silt
0.39-0.55	Brown, fine-grained sand
0.55-0.67	Orange-brown, fine-grained sand (G2-2)
0.67-0.95	Orange-brown, fine-grained sand and silt
0.95-1.00	Orange-brown and brown, fine-grained sand and silt (G2-3)

Table 2.--*Grain-size distributions of selected samples from soil pits*

[Grain-size-distribution units are weight percent less than size class, in millimeters]

Sample identifier	Grain-size distributions									
	1.00	0.500	0.250	0.125	0.062	0.031	0.016	0.008	0.004	0.002
A2-1	100.0	97.3	50.2	15.8	9.5	6.8	4.9	3.4	2.3	1.4
A2-2	100.0	98.3	92.8	86.6	44.3	20.1	9.5	5.9	4.1	3.0
A3-1	98.9	91.6	73.1	30.9	12.8	8.2	5.5	3.8	2.5	1.8
A3-2	100.0	98.4	95.8	84.3	47.8	20.2	8.9	5.3	3.2	2.3
B1-1	100.0	100.0	99.5	92.7	55.4	30.9	21.2	16.3	11.8	9.3
B1-3	100.0	99.5	96.6	89.7	52.2	20.9	12.7	9.0	5.8	3.7
[1]B1-3	100.0	100.0	97.6	90.8	51.5	22.6	13.5	9.1	6.1	3.9
B2-1	100.0	100.0	99.5	95.3	47.8	22.9	16.0	12.3	9.3	8.0
B2-3	99.8	98.7	97.5	94.8	85.3	51.7	23.9	13.8	7.9	6.8
[1]B2-3	99.5	98.7	96.5	93.1	82.7	53.3	24.9	13.9	8.3	6.7
C1-2	100.0	100.0	98.5	61.0	26.3	17.7	14.0	11.5	9.5	7.6
C1-3	100.0	100.0	98.4	63.1	21.5	13.6	10.3	7.9	5.9	4.8
C2-2	100.0	100.0	99.3	97.5	91.5	63.3	38.3	27.3	21.0	15.4
C2-3	100.0	100.0	99.2	76.7	16.8	8.1	5.3	3.8	2.7	2.3
C3-1	100.0	98.7	96.2	92.5	79.3	40.1	16.2	9.7	6.2	5.2
E1-1	100	97.6	94.2	89.1	57.0	32.5	21.9	17.1	14.2	11.7
[1]E1-1	100	99.2	95.3	90.3	61.5	30.3	20.0	15.5	11.9	10.4
E1-2	100	99.3	98.3	96.0	94.8	90.7	85.5	78.0	68.2	56.9
E2-1	100	100	100	96.4	60.1	34.1	22.2	16.5	12.9	9.5
E2-2	100	99.7	98.9	93.0	72.0	48.8	27.7	17.8	12.7	8.9
F2-1	100	100	99.7	97.6	66.1	40.2	29.2	24.3	20.7	17.1
G1-1	100	100	99.7	98.5	87.5	50.8	34.5	24.9	16.5	8.8
G2-1	100	100	100	98.7	78.4	50.8	35.8	28.9	24.7	20.6
G2-3	100	100	100	97.2	84.5	39.7	21.5	15.1	12.5	9.7
G3-1	100	100	99.8	99.3	90.1	69.2	55.2	45.8	39.1	32.8
G3-2	100	100	99.4	96.5	68.9	44.7	34.3	29.2	24.1	21.7

[1]Duplicate values.

Table 3.--*Total concentration of selected chemical constituents of samples collected from soil pits*

[Ca, calcium; Mg, magnesium; K, potassium; Na, sodium; P, phosphorus; Al, aluminum; Fe, iron; Mn, manganese; Ti, titanium; As, arsenic; Ba, barium; Ce, cerium; Co, cobalt; Cr, chromium; Cu, copper; Ga, gallium; La, lanthanum; Pb, lead; Li, lithium; Nd, neodymium; Ni, nickel; Sc, Scendium; Sr, strontium; Th, thorium; V, vanadium; Y, yttrium; Zn, zinc; wt %, weight percent; µg/g, micrograms per gram; <, less than]

Sample identifier	Constituent													
	Ca (wt %)	Mg (wt %)	K (wt %)	Na (wt %)	P (wt %)	Al (wt %)	Fe (wt %)	Mn (wt %)	Ti (wt %)	As (µg/g)	Ba (µg/g)	Ce (µg/g)	Co (µg/g)	Cr (µg/g)
A1-1	1.1	1.4	1.6	0.31	0.07	4.1	11.0	0.25	0.19	1,400	420	51	20	75
A1-2	0.14	.89	.63	.15	.07	1.6	17	.17	.12	2,100	240	59	10	36
A1-3	2.0	1.7	.80	.19	.05	3.4	13	.12	.17	1,300	280	35	8	56
A2-1	.06	.90	.65	.14	.07	1.6	17	.12	.11	1,900	200	36	12	34
A2-2	.76	.78	1.2	.23	.06	3.1	13	.096	.16	970	300	36	16	47
A3-1	.62	.95	.72	.15	.06	1.8	13	.11	.11	1,900	220	28	8	25
A3-2	1.1	1.3	.69	.16	.03	2.3	9.4	.11	.14	760	250	29	6	30
B1-1	2.5	1.1	.98	.22	.05	2.9	11	.20	.14	3,400	300	36	17	35
B1-2	1.8	1.3	.81	.19	.05	2.8	13	.38	.14	4,100	270	39	22	44
B1-3	1.5	1.4	.65	.17	.05	2.5	15	.23	.13	6,500	210	31	14	32
B1-4	1.3	1.7	.91	.18	.05	3.2	15	.18	.14	4,600	260	36	10	51
B2-1	.34	1.0	1.1	.22	.05	2.6	14	.14	.13	3,800	280	28	8	33
B2-2	.74	.88	.96	.17	.06	2.3	11	.14	.10	1,500	250	45	12	37
B2-3	.76	1.2	1.1	.19	.08	3.7	14	.34	.17	1,400	320	29	22	58
B2-4	2.6	.37	1.4	.39	.08	5.1	2.5	.42	.17	40	340	57	61	52
C1-1	1.7	.83	1.5	.35	.06	4.2	4.4	.10	.19	320	570	48	11	50
C1-2	1.5	.62	1.1	.22	.05	2.8	5.8	.14	.12	590	440	37	11	28
C1-3	1.2	.86	1.2	.21	.04	2.6	11	.15	.11	1,100	310	39	12	28
C2-2	2.4	2.0	1.4	.29	.07	4.5	12	.29	.20	2,100	400	50	19	73
C2-3	1.3	.97	1.1	.21	.04	2.4	10	.14	.09	1,400	290	23	7	25
C3-1	1.4	2.1	.73	.22	.05	3.0	16	.33	.16	3,100	230	26	18	42
C3-2	2.1	2.5	1.4	.27	.07	5.1	12	.33	.21	2,300	390	52	16	81
D1-1	.27	1.2	1.1	.30	.05	3.1	12	.16	.15	2,000	400	32	8	46
D1-2	1.4	2.2	1.3	.26	.06	4.6	12	.30	.19	720	380	40	14	65
D2-1	1.1	1.4	.94	.27	.04	2.7	12	.18	.13	1,600	290	35	7	40
D2-2	1.4	1.4	1.1	.24	.06	3.3	11	.24	.15	670	340	39	14	46
D3-1	1.0	1.8	1.2	.34	.06	4.3	11	.34	.19	1,700	440	46	18	59
D3-2	1.4	1.2	.72	.21	.04	2.6	14	.13	.13	2,200	240	29	10	42
D3-3	1.5	1.4	.61	.20	.04	2.6	11	.25	.12	1,400	240	26	11	39
D4-2	1.5	.90	1.6	.49	.06	5.1	5.9	.16	.22	450	680	54	16	63
D4-3	0.87	0.93	1.1	0.26	0.06	2.9	9.7	0.21	0.15	770	450	49	14	38
D6-1	1.5	.85	1.7	.49	.06	5.6	2.9	.049	.25	10	760	52	12	65
D7-1	1.6	.96	1.7	.51	.06	5.4	2.7	.040	.25	20	760	54	11	53
D7-2	4.4	.88	1.5	.45	.06	3.7	1.7	.035	.16	<10	670	43	8	34

E1-1	2.0	1.3	.65	.30	.04	2.3	16	.17	.14	5,000	230	27	6	31
E1-2	1.3	1.4	1.7	.54	.05	7.6	4.8	.36	.31	260	500	43	27	82
E2-1	1.3	1.5	.75	.25	.04	3.0	14	.18	.14	1,700	250	27	10	41
E2-2	1.4	2.0	.87	.22	.06	3.8	13	.39	.18	2,800	320	34	15	47
F1-1	1.1	1.6	1.1	.33	.06	4.0	11	.30	.17	1,800	490	42	16	56
F1-3	1.6	1.3	1.5	.43	.06	5.8	6.9	.22	.24	570	690	44	18	71
F2-1	.68	.95	1.4	.41	.06	4.3	7.0	.18	.19	640	650	41	16	47
F2-2	1.6	.71	1.9	.62	.15	4.8	4.9	.28	.15	80	790	43	12	41
F2-3	.75	.91	1.2	.31	.05	3.6	7.4	.22	.16	710	670	49	18	42
F2-4	1.4	.91	1.2	.29	.05	3.5	6.4	.19	.14	410	530	42	15	53
F3-1	1.7	2.0	.82	.25	.05	3.8	12	.42	.17	1,700	300	32	15	56
F3-2	1.3	1.7	.91	.30	.05	3.6	10	.29	.16	1,400	420	36	13	49
G1-1	.86	1.3	1.5	.43	.07	5.2	7.8	.20	.23	850	640	42	17	58
G2-1	.99	1.7	1.1	.35	.06	4.3	11	.29	.19	1,300	500	36	18	52
G2-2	.86	2.1	1.1	.36	.05	4.9	11	.28	.21	1,200	440	37	14	68
G2-3	1.6	1.6	.86	.31	.06	3.3	12	.27	.16	1,900	400	34	13	40
G2-4	1.0	1.4	1.7	.54	.07	6.4	6.2	.13	.26	490	1,000	57	17	82
G3-1	1.6	1.4	1.5	.41	.07	5.6	7.1	.18	.24	650	600	39	16	67
G3-2	1.3	1.4	.99	.35	.06	4.1	12	.20	.18	1,700	490	32	16	49
G3-3	1.1	1.9	.96	.36	.06	4.0	11	.35	.18	1,300	560	37	15	59
H1-1	3.1	.91	1.8	1.0	.07	5.5	3.7	.10	.20	200	940	50	10	45
H1-2	2.2	1.3	1.7	.85	.07	5.5	5.8	.16	.22	410	850	49	13	56
H1-3	1.7	1.5	2.1	.57	.08	8.4	5.5	.12	.33	260	710	60	16	100
H1-4	2.2	1.6	1.5	.76	.07	5.1	7.8	.22	.22	830	780	51	13	58
I2-1	2.1	.72	1.6	.77	.06	4.4	3.4	.093	.17	170	1,000	54	11	32
I2-2	1.9	.70	1.6	.82	.06	4.3	3.6	.099	.18	180	1,000	48	11	37
I2-3	2.1	.75	1.7	.87	.06	4.4	3.8	.099	.16	190	1,100	46	11	37

Table 3.--*Total concentrations of selected chemical constituents of samples collected from soil pits*--Continued

Sample identifier	Constituent												
	Cu (µg/g)	Ga (µg/g)	La (µg/g)	Pb (µg/g)	Li (µg/g)	Nd (µg/g)	Ni (µg/g)	Sc (µg/g)	Sr (µg/g)	Th (µg/g)	V (µg/g)	Y (µg/g)	Zn (µg/g)
A1-1	78	13	28	31	28	25	40	8	120	11	14	13	130
A1-2	57	7	33	19	10	27	12	4	42	9	45	4	62
A1-3	30	13	19	17	18	17	10	7	43	7	60	5	67
A2-1	65	5	21	36	10	17	14	4	35	9	46	3	80
A2-2	79	11	20	21	19	19	29	6	79	14	63	6	96
A3-1	38	6	17	19	11	14	7	4	49	9	55	2	70
A3-2	20	8	17	13	13	14	8	5	46	12	49	6	60
B1-1	57	10	20	18	18	18	28	5	93	7	57	10	83
B1-2	73	12	22	19	16	19	25	6	71	7	50	7	80
B1-3	92	10	19	16	13	16	15	5	62	8	49	7	97
B1-4	120	12	19	26	17	17	15	7	59	8	54	6	100
B2-1	44	10	17	18	13	13	12	5	67	10	51	5	71
B2-2	55	8	25	18	15	21	15	4	96	10	52	7	81
B2-3	91	14	17	14	21	16	25	7	59	13	78	4	100
B2-4	190	12	30	12	52	26	78	6	160	10	80	13	110
C1-1	31	10	27	17	26	25	34	7	93	8	70	17	82
C1-2	31	8	21	16	16	17	23	4	80	7	48	11	66
C1-3	53	8	22	13	15	19	18	5	74	10	45	7	80
C2-2	89	14	28	30	30	23	35	8	110	9	81	13	110
C2-3	20	8	15	10	10	11	11	4	60	6	38	4	54
C3-1	80	13	16	13	16	13	18	6	54	8	60	8	87
C3-2	99	17	29	49	35	25	31	9	120	11	92	13	130
D1-1	50	9	19	13	15	15	12	6	64	7	59	6	62
D1-2	60	15	22	18	35	20	22	8	120	10	80	9	140
D2-1	43	9	20	12	15	17	10	5	63	7	49	5	61
D2-2	51	11	22	15	24	18	24	6	110	9	63	10	97
D3-1	70	14	25	22	31	23	31	8	90	9	85	13	100
D3-2	70	9	16	14	13	14	13	5	61	7	48	4	60
D3-3	52	10	16	11	15	13	18	5	57	5	47	5	68
D4-2	40	13	31	18	33	27	66	8	110	9	98	22	97
D4-3	48	9	27	19	20	23	25	5	95	9	56	12	78
D6-1	23	12	29	19	37	26	31	9	140	9	100	19	83
D7-1	21	12	30	17	37	27	30	8	150	9	97	18	76
D7-2	12	8	23	13	22	22	17	5	130	7	52	14	39

E1-1	45	8	16	16	11	13	7	5	120	8	47	7	49
E1-2	37	20	24	19	41	22	66	13	110	12	170	14	130
E2-1	63	10	16	13	15	14	14	6	61	8	59	7	70
E2-2	76	14	20	10	25	17	26	7	87	9	74	9	93
F1-1	65	11	24	20	24	21	28	7	94	9	76	12	90
F1-3	44	16	24	20	39	21	45	10	120	8	120	15	110
F2-1	41	12	23	18	26	21	35	7	110	9	86	14	92
F2-2	24	12	27	16	26	22	38	7	190	8	88	16	88
F2-3	47	10	27	15	23	23	36	6	96	9	69	13	84
F2-4	40	9	23	16	24	20	39	6	93	7	66	10	79
F3-1	68	14	18	13	23	15	38	7	73	8	70	8	96
F3-2	55	12	20	14	24	17	23	7	96	7	69	8	87
G1-1	44	15	23	16	32	23	38	9	120	11	110	15	110
G2-1	53	13	20	16	26	19	35	8	94	9	90	12	110
G2-2	56	15	21	19	31	19	28	9	87	8	97	11	100
G2-3	65	12	20	14	18	18	22	6	99	8	65	9	91
G2-4	39	15	32	23	42	28	41	11	150	10	130	19	120
G3-1	41	14	22	20	35	20	39	10	140	10	120	16	100
G3-2	59	13	18	17	23	17	24	8	110	8	89	11	96
G3-3	60	13	21	19	27	19	33	7	99	7	83	11	96
H1-1	21	12	29	17	27	24	22	6	290	9	66	16	64
H1-2	32	14	28	18	31	24	29	7	220	9	82	16	79
H1-3	39	20	34	22	59	30	45	14	180	12	160	20	120
H1-4	41	13	29	18	28	26	24	7	220	10	76	15	79
I2-1	21	10	31	17	23	27	25	5	200	8	62	16	66
I2-2	21	10	28	17	22	24	23	5	200	7	60	15	66
I2-3	26	10	28	19	22	23	26	6	220	8	64	15	69

Table 4.--*Duplicate values of total concentration of selected chemical constituents*

[Ca, calcium; Mg, magnesium; K, potassium; Na, sodium; P, phosphorus; Al, aluminum; Fe, iron; Mn, manganese; Ti, titanium; As, arsenic; Ba, barium; Ce, cerium; Co, cobalt; Cr, chromium; Cu, copper; Ga, gallium; La, lanthanum; Pb, lead; Li, lithium; Nd, neodymium; Ni, nickel; Sc, Scendium; Sr, strontium; Th, thorium; V, vanadium; Y, yttrium; Zn, zinc; wt %, weight percent; µg/g, micrograms per gram; <, less than]

Sample identifier	Constituent													
	Ca (wt %)	Mg (wt %)	K (wt %)	Na (wt %)	P (wt %)	Al (wt %)	Fe (wt %)	Mn (wt %)	Ti (wt %)	As (µg/g)	Ba (µg/g)	Ce (µg/g)	Co (µg/g)	Cr (µg/g)
A3-1	0.62	0.95	0.72	0.15	0.06	1.8	13.0	0.11	0.11	1,900	220	28	8	25
(Duplicate)	.66	1.1	.88	.16	.06	2.0	14	.12	.10	1,700	250	34	7	29
C3-1	1.4	2.1	.73	.22	.05	3.0	16	.33	.16	3,100	230	26	18	42
(Duplicate)	1.2	2.2	.83	.23	.05	3.3	16	.31	.15	2,700	250	33	15	49
D7-2	4.4	.88	1.5	.45	.06	3.7	1.7	.035	.16	<10	670	43	8	34
(Duplicate)	4.6	.96	1.9	.45	.06	4.0	1.9	.037	.16	<10	680	44	8	37
E2-2	1.4	2.0	.87	.22	.06	3.8	13	.39	.18	2,800	320	34	15	47
(Duplicate)	1.2	2.1	.96	.23	.06	4.0	13	.40	.17	2,400	340	37	14	53
F3-1	1.7	2.0	.82	.25	.05	3.8	12	.42	.17	1,700	300	32	15	56
(Duplicate)	1.7	2.1	.93	.25	.06	4.1	13	.42	.17	1,800	340	32	14	69
H1-2	2.2	1.3	1.7	.85	.07	5.5	5.8	.16	.22	410	850	49	13	56
(Duplicate)	2.1	1.3	1.7	.81	.07	5.6	6.0	.15	.22	430	890	46	13	55

Sample identifier	Constituent												
	Cu (µg/g)	Ga (µg/g)	La (µg/g)	Pb (µg/g)	Li (µg/g)	Nd (µg/g)	Ni (µg/g)	Sc (µg/g)	Sr (µg/g)	Th (µg/g)	V (µg/g)	Y (µg/g)	Zn (µg/g)
A3-1	38	6	17	19	11	14	7	4	49	9	55	2	70
(Duplicate)	43	7	21	15	13	15	8	4	51	11	55	5	60
C3-1	80	13	16	13	16	13	18	6	54	8	60	8	87
(Duplicate)	87	12	20	15	18	15	18	6	56	6	62	8	90
D7-2	12	8	23	13	22	22	17	5	130	7	52	14	39
(Duplicate)	15	8	27	13	24	24	19	6	140	7	58	15	43
E2-2	76	14	20	10	25	17	26	7	87	9	74	9	93
(Duplicate)	81	14	23	14	28	17	27	7	87	7	75	9	100
F3-1	68	14	18	13	23	15	38	7	73	8	70	8	96
(Duplicate)	76	15	20	15	24	14	38	7	82	8	76	8	100
H1-2	32	14	28	18	31	24	29	7	220	9	82	16	79
(Duplicate)	32	13	29	20	32	22	28	8	240	9	87	16	82

Table 5.--*Total concentration of selected chemical constituents of different grain-size fractions of selected samples collected from soil pits*

[μm, micrometer; Ca, calcium; Mg, magnesium; K, potassium, Na, sodium; P, phosphorus; Al, aluminum, Fe, iron; Mn, manganese; Ti, titanium; As, arsenic; Ba, barium; Ce, cerium; Co, cobalt; Cr, chromium; Cu, copper; Ga, gallium; Hg, mercury; La, lanthanum; Pb, lead; Li, lithium; Nd, neodymium; Ni, nickel; Sc, Scandium; Sr, strontium; Th, thorium; V, vanadium; Y, yttrium; Zn, zinc; wt %, weight percent; μg/g, micrograms per gram; <, less than; >, greater than; ---, data not available]

Sample identifier	Grain size (μm)	Constituent													
		Ca (wt %)	Mg (wt %)	K (wt %)	Na (wt %)	P (wt %)	Al (wt %)	Fe (wt %)	Mn (wt %)	Ti (μg/g)	As (μg/g)	Ba (μg/g)	Ce (μg/g)	Co (μg/g)	Cr (μg/g)
A3-2	<4	3.3	2.2	1.4	0.13	0.10	5.0	15.0	0.10	0.29	2,800	650	54	11	82
	4-64	.49	1.7	0.69	0.23	0.04	2.8	12	.16	0.23	750	280	37	8	49
	>64	.42	1.0	0.64	0.17	0.02	1.8	7.8	.10	0.10	480	140	22	5	26
B1-2	<4	4.5	1.2	1.0	.11	.08	3.7	20	.27	.15	13,000	370	42	21	58
	4-16	1.3	1.8	.95	.19	.08	3.8	20	.30	.20	8,100	310	40	19	58
	16-64	0.99	1.2	.69	.24	.07	2.3	13	.26	.18	4,000	270	41	12	39
	>64	1.2	1.2	.78	.21	.05	2.5	13	.32	.14	3,800	240	32	21	34
G2-2	<4	1.7	1.6	1.7	0.40	0.06	7.3	8.3	.15	0.30	2,300	570	50	16	89
	4-16	.81	2.4	1.1	.38	.06	5.2	13	.31	.24	1,700	430	35	16	66
	16-64	.60	1.7	.67	.35	.05	2.9	9.6	.30	.13	810	340	29	11	38
	>64	.67	2.1	.72	.27	.03	3.5	11.0	.28	.14	490	290	24	15	44
G3-2	<4	.99	1.4	1.6	.39	.08	6.9	12	.11	.29	2,700	580	46	16	85
	4-16	.52	1.6	1.2	.53	.08	5.1	14	.20	.26	2,400	570	40	19	69
	16-64	.42	1.4	.80	.43	.06	3.3	12	.28	.19	1,400	710	38	13	45
	>64	1.5	1.3	.71	.31	.05	2.8	11	.24	.14	1,100	470	32	15	32

Sample identifier	Grain size (μm)	Constituent												
		Cu (μg/g)	Ga (μg/g)	Hg (μg/g)	La (μg/g)	Pb (μg/g)	Li (μg/g)	Nd (μg/g)	Ni (μg/g)	Sc (μg/g)	Sr (μg/g)	Th (μg/g)	V (μg/g)	Y (μg/g)	Zn (μg/g)
A3-2	<4	480	20	20.0	34	63	29	23	170	14	130	29	100	6	350
	4-64	52	10	3.2	21	12	15	17	18	7	45	12	58	4	97
	>64	14	6	0.55	11	4	11	10	7	4	31	7	38	3	44
B1-2	<4	440	14	10	25	62	24	20	100	8	130	10	76	10	270
	4-16	180	14	6.0	24	25	22	21	39	7	73	10	76	7	160
	16-64	81	8	2.7	23	15	12	19	26	5	65	7	44	8	83
	>64	63	9	2.4	18	12	14	16	23	5	63	7	48	6	79
G2-2	<4	350	18	2.5	29	42	48	24	66	13	150	10	160	15	290
	4-16	89	16	1.5	19	19	31	15	36	9	87	7	110	10	130
	16-32	83	9	---	16	14	17	13	31	5	64	6	58	7	100
	>64	30	2	0.44	12	9	20	9	26	6	50	6	68	5	94
G3-2	<4	320	16	2.0	26	40	42	22	62	13	140	11	160	13	250
	4-16	120	15	---	22	22	29	19	48	9	110	9	120	12	140
	16-64	59	10	0.64	22	12	16	18	25	6	98	7	68	13	96
	>64	42	9	0.48	17	9	14	13	20	5	96	6	56	8	81

Table 6.--*Concentration of selected chemical constituents, obtained using partial digestion procedures, of selected samples from soil pits*

[Al, aluminum; Fe, iron; Mn, manganese; As, arsenic; Cu, copper; Hg, mercury; Zn, zinc; C, carbon; wt %, weight percent; µg/g, micrograms per gram; ---, data not available; (Dup.), duplicate]

Sample identifier	Constituent							
	Al[1] (wt %)	Fe[1] (wt %)	Mn[1] (wt %)	As[2] (µg/g)	Cu[1] (µg/g)	Hg[3] (µg/g)	Zn[1] (µg/g)	C[4] (µg/g)
A2-1	0.21	4.6	88	1,500	44	0.58	14	3.3
A2-2	0.53	5.0	500	700	63	2.7	42	5.9
A3-1	0.33	4.4	85	1,500	23	1.1	12	3.6
A3-2	0.59	2.0	91	560	12	2.6	14	5.1
B1-1	0.45	4.6	1,100	3,300	39	1.3	40	14
B1-3	0.52	5.1	1,300	5,700	61	3.9	37	9.1
B2-1	0.39	4.5	97	3,200	27	1.1	22	5.6
B2-3	0.72	4.5	3,200	1,200	73	3.2	49	6.6
C1-2	---	---	---	---	---	0.20	---	7.3
C1-3	---	---	---	---	---	---	---	4.7
C1-3 (Dup.)	---	---	---	---	---	0.28	---	5.2
C2-3	---	---	---	---	---	0.40	---	3.8
C3-1	0.80	6.2	1,700	2,900	68	3.2	44	7.2
E1-1	0.46	5.7	130	4,000	43	3.0	19	6.4
E1-2	0.72	1.8	1,900	250	32	0.45	93	8.0
E2-1	0.65	4.5	260	1,800	49	0.28	33	6.4
E2-2	0.75	4.9	2,600	3,600	59	2.9	48	17
F2-1	0.58	3.3	1,300	620	35	0.30	63	6.8
G1-1	0.66	3.2	1,200	770	39	0.41	69	9.5
G2-1	0.64	4.9	1,600	1,000	43	0.33	54	10
G2-3	0.55	5.1	1,400	1,300	45	1.3	43	9.1
G3-1	0.69	3.2	1,300	470	37	0.36	73	12
G3-1 (Dup.)	0.76	3.5	1,400	480	38	0.30	79	---
G3-2	0.67	5.1	900	1,400	51	.67	58	5.6
G3-2 (Dup.)	0.59	4.8	1,000	1,200	48	.70	50	---

[1]A weak acid digestion method [method I-5485-85 in Fishman and Friedman (1985)] was used. Atomic absorbtion spectrometry followed digestion.

[2]Method I-6062-85 (Fishman and Friedman, 1985) was used. This method uses nitric and sulfuric acid digestion and atomic absorbtion spectrometry.

[3]Method I-5462-85 (Fishman and Friedman, 1985) was used. This method uses nitric and sulfuric acid digestion and atomic absorbtion spectrometry.

[4]Method 0-5101-83 (Wershaw and others, 1983). This method analyzes for organic and inorganic carbon.

Table 7.--*Grain-size distribution and arsenic concentration of selected samples collected from auger holes at site C*

[<, less than; ---, data not available]

Transect and hole numbers	Depth (meters)	Weight percent less than 16 micrometers	Weight percent 16 to 64 micrometers	Weight percent greater than 64 micrometers	Arsenic content (micrograms per gram)
T1-H1	Surface	15	9	76	500
	0.4	23	28	49	2,000
	[1]0.4	---	---	---	2,600
	0.8	22	33	45	1,200
	1.0	21	23	56	1,800
T1-H2	Surface	16	22	62	2,400
	0.4	30	28	42	1,400
	0.8	23	25	52	2,000
	1.2	16	2	82	100
	1.4	16	28	56	200
T1-H3	Surface	30	11	59	550
	0.4	28	29	43	150
	0.8	25	29	46	350
	1.0	33	37	30	300
T1-H4	0.2	31	32	37	1,000
T1-H5	0.2	22	24	54	400
T2-H1	Surface	41	26	33	1,000
	0.4	20	46	34	1,000
	0.8	12	7	81	1,400
	1.0	18	19	63	<200
T2-H2	Surface	24	15	61	1,600
	0.4	17	20	63	1,200
	0.8	17	10	73	2,000
	1.2	17	11	72	2,200
	1.6	16	17	67	400
	2.0	18	30	52	300

Table 7.--*Grain-size distribution and arsenic concentration of selected samples collected from auger holes at site C*--Continued

Transect and hole numbers	Depth (meters)	Weight percent less than 16 micrometers	Weight percent 16 to 64 micrometers	Weight percent greater than 64 micrometers	Arsenic content (micrograms per gram)
T2-H3	Surface	33	30	37	600
	0.4	24	20	56	400
	0.8	41	45	14	300
	1.2	35	31	34	<100
T2-H4	0.2	35	23	42	400
T2-H5	0.2	19	15	66	<200
T3-H1	Surface	28	27	45	1,600
	0.4	20	29	51	1,000
	0.8	18	28	54	800
	1.2	22	23	55	1,000
	1.6	20	27	53	300
	[1]1.6	---	---	---	400
T3-H2	Surface	15	20	65	1,100
	0.4	27	17	56	400
	0.8	31	43	26	400
	1.2	12	25	63	<200
T3-H3	Surface	19	---	---	1,200
	0.4	30	23	47	<100
T4-H1	Surface	41	33	26	1,000
	0.4	25	38	37	2,800
	0.8	19	58	23	3,000
	1.0	18	28	54	1,800
T4-H2	Surface	18	20	62	2,400
	0.4	21	26	53	2,400
	0.8	14	24	62	1,400
	1.2	41	31	28	<200
	1.6	48	15	37	<200
T4-H3	Surface	22	22	56	1,600
	0.4	26	17	57	<200

[1]Duplicate value.

Table 8.--*Grain-size distribution and arsenic concentration of selected samples collected from auger holes at site E*

[<, less than; ---, data not available]

Transect and hole numbers	Depth (meters)	Weight percent less than 16 micrometers	Weight percent 16 to 64 micrometers	Weight percent greater than 64 micrometers	Arsenic content (micrograms per gram)
T1-H1	Surface	47	24	29	400
	0.3	40	32	28	1,000
	0.6	35	34	31	1,600
	0.8	67	27	6	1,600
T1-H2	Surface	30	18	52	400
	0.4	28	28	44	1,800
	0.8	13	11	76	1,200
	1.0	57	31	12	500
T1-H3	Surface	32	27	41	800
	0.4	17	20	63	500
	0.8	26	32	42	200
	1.2	25	43	32	400
T1-H4	Surface	39	21	40	600
	Surface[1]	---	---	---	400
T1-H5	0.2	38	28	34	400
	0.4	45	25	30	400
	0.5	30	6	64	100
T1-H6	Surface	30	29	41	1,000
	0.2	58	34	8	<100
T3-H1	Surface	36	14	50	600
	0.3	26	26	48	1,800
	0.6	30	38	32	1,800
	0.8	29	16	55	<200
T3-H2	Surface	16	4	80	500
	0.4	32	22	46	900
	0.8	37	17	46	750
	1.1	27	10	63	<100

Table 8.--*Grain-size distribution and arsenic concentration of selected samples collected from auger holes at site E*--Continued

Transect and hole numbers	Depth (meters)	Weight percent less than 16 micrometers	Weight percent 16 to 64 micrometers	Weight percent greater than 64 micrometers	Arsenic content (micrograms per gram)
T3-H3	Surface	45	36	19	1,500
	0.2	13	9	78	400
	0.3	18	0	82	<100
T3-H4	0.2	16	2	82	<100
T4-H1	Surface	35	30	35	350
	0.4	22	33	45	1,900
	0.8	24	40	36	1,800
	1.0	27	16	57	1,400
T4-H2	Surface	18	24	58	1,800
	0.4	20	29	51	1,000
	0.8	26	40	34	400
	1.2	33	38	29	500
T4-H3	Surface	33	22	45	1,000
	0.3	27	3	70	250
	0.5	28	2	70	200
T4-H4	Surface	25	13	62	700
	0.2	29	53	18	400

[1]Duplicate value.

Table 9.--*Grain-size distribution and arsenic concentration of selected samples collected from auger holes at site F*

[---, data not available; <, less than]

Transect and hole numbers	Depth (meters)	Weight percent less than 16 micrometers	Weight percent 16 to 64 micrometers	Weight percent greater than 64 micrometers	Arsenic content (micrograms per gram)
T1-H1	0.4	36	---	---	1,600
	0.8	29	37	34	2,800
	1.2	49	33	18	1,000
T1-H2	0.4	31	46	23	1,600
	0.8	33	28	39	2,200
T1-H3	0.3	21	38	41	400
	0.5	27	18	55	400
T1-H4	0.2	30	16	54	200
T3-H1	0.4	31	18	51	1,000
	0.8	17	22	61	900
	1.2	21	16	63	600
	1.7	54	38	8	800
T3-H2	0.4	19	18	63	400
T3-H3	0.2	23	52	25	1,000
	0.4	40	31	29	1,000
	0.6	35	17	48	800
T4-H1	0.4	30	33	37	1,000
	0.8	28	14	58	500
	1.3	---	---	---	3,000
T4-H2	0.4	45	21	34	800
	0.8	27	23	50	1,200
	1.2	27	10	63	800
	1.6	23	14	63	3,200
	1.8	24	27	49	1,800

Table 9.--*Grain-size distribution and arsenic concentration of selected samples collected from auger holes at site F*--Continued

Transect and hole numbers	Depth (meters)	Weight percent less than 16 micrometers	Weight percent 16 to 64 micrometers	Weight percent greater than 64 micrometers	Arsenic content (micrograms per gram)
T4-H3	0.4	32	34	34	1,200
	0.6	33	37	30	1,000
	0.8	71	19	10	300
T4-H4	0.2	36	34	30	3,000
	0.3	19	5	76	<200
T4-H5	0.2	40	48	12	1,200
	0.3	38	1	61	<200
T6-H3	1.2	---	---	---	500
	[1]1.2	---	---	---	400

[1]Duplicate value.

Table 10.--*Grain-size distribution and arsenic concentration of selected samples collected from auger holes at site G*

[<, less than; ---, data not available]

Transect and hole numbers	Depth (meters)	Weight percent less than 16 micrometers	Weight percent 16 to 64 micrometers	Weight percent greater than 64 micrometers	Arsenic content (micrograms per gram)
T1-H1	0.4	37	4	59	<100
	0.8	---	---	---	500
	1.0	56	21	23	200
T1-H2	0.2	32	25	43	1,000
	0.3	38	30	32	600
T1-H3	0.4	44	18	38	300
	0.8	46	6	48	200
	1.2	41	9	50	100
T1-H4	0.3	30	42	28	300
	0.4	76	17	7	<200
T3-H1	0.4	7	25	68	100
	0.8	28	20	52	500
	1.2	34	18	48	400
	1.6	40	46	14	600
	1.8	65	30	5	<100
T3-H2	0.4	19	6	75	<200
	0.8	37	11	52	<100
	1.2	44	11	45	<200
T3-H3	0.1	61	16	23	200
	0.3	10	4	86	<200
	0.4	40	19	41	<200
	0.5	50	31	19	<200
T4-H1	0.4	50	27	23	600
	0.6	39	36	25	600
	0.7	37	28	35	400
	0.8	41	32	27	550
T4-H2	0.4	45	32	23	500
	0.8	37	34	29	500
T4-H3	0.4	39	19	42	450
	0.8	58	28	14	<100
	1.2	50	17	33	<200
T4-H4	0.2	---	---	---	<200

Table 11.--*Duplicate values of grain-size distribution*

Transect and hole numbers	Depth (meters)	Weight percent less than 16 micrometers	Weight percent 16 to 64 micrometers	Weight percent greater than 64 micrometers
T1-H1	0.4	23	28	49
T1-H1	0.4	26	34	40
T1-H2	1.2	16	2	82
T1-H2	1.2	13	5	82
T4-H1	0.8	19	58	23
T4-H1	0.8	23	45	32
T1-H1	0.6	35	34	31
T1-H1	0.6	45	31	24
T1-H4	Surface	39	21	40
T1-H4	Surface	34	34	32
T1-H6	0.2	58	34	8
T1-H6	0.2	59	35	6
T3-H2	0.4	32	22	46
T3-H2	0.4	26	22	52
T4-H1	0.8	24	40	36
T4-H1	0.8	21	38	41
T1-H4	0.2	30	16	54
T1-H4	0.2	31	16	53
T4-H1	1.3	18	37	45
T4-H1	1.3	15	43	42
T1-H1	0.8	32	35	33
T1-H1	0.8	42	30	28
T1-H4	0.3	30	42	28
T1-H4	0.3	37	36	27
T4-H2	0.8	37	34	29
T4-H2	0.8	45	30	25
T4-H4	0.2	48	21	31
T4-H4	0.2	53	24	23