USDA UNITED STATES DEPARTMENT OF AGRICULTURE

Agricultural Research Service

National Sedimentation Laboratory
Oxford, Mississippi 38655

Assessing Sedimentation Issues Within the Large Woody Debris Plug Along the Yalobusha River, Calhoun County, MS

By Sean J. Bennett and Fred E. Rhoton

Research Report No. 34 January 2003

EXECUTIVE SUMMARY

Streams in the Yalobusha River basin of north-central Mississippi have experienced severe erosion, bed incision, and channel widening due to channelization projects during the early 1900s and again in the 1950s and 1960s. Straightening of the Yalobusha River and Topashaw Creek has markedly altered the base level of these streams and promoted basin-wide degradation of the river channels. Changes in base level caused channel incision, bank destabilization, and channel widening. As a result, large volumes of sediment and woody riparian vegetation were delivered to the flow and subsequently transported through the river network. At the point where the channelized, straightened Yalobusha River met the natural, unchannelized meanders downstream, the woody debris in transport were deposited. These processes, left unrequited for decades, resulted in the rapid and progressive accumulation of large woody debris plug on the lower Yalobusha River downstream of Calhoun City, MS. As much as 5 m of sediment and debris have accumulated vertically since 1967 and input of vegetative debris due to bank failure in the vicinity of major knickpoints is around 28 m^3/yr. This debris accumulation has significantly increased the magnitude, frequency, and severity of flooding in the Calhoun City area. Before the U.S. Army Corps of Engineers initiates debris plug removal and channel improvements, an assessment of sedimentation within the plug and the channel upstream of the plug is required. This report summarizes research data collected to meet this need.

Six continuous sediment cores, ranging in length from 0.65 to 2.14 m, were collected within the channel of the Yalobusha River upstream of the debris plug using a vibracore system. Particle size analyses show that these cores are primarily composed of sand, up to 98% by mass. Ten continuous sediment cores, ranging in length from 1.37 to 2.59 m, were collected within the debris plug along a 2.6 km reach of the Yalobusha River. These cores are composed of a near-surface sediment horizon and a lower sediment horizon. The upper horizon is 0.5 to 1.0-m thick and composed primarily of silt (40 to 70% by mass) and clay (10 to 30% by mass). The lower horizon is composed primarily of sand (80 to 90% by mass).

Bulk chemical analysis of the sediment samples shows that the concentrations of major elements (aluminum, calcium, iron, potassium, magnesium, sodium, phosphorus, and sulfur) and select environmentally important elements (arsenic, chromium, copper, mercury, lead, and zinc) increase with silt and clay content. Hence these elements are more abundant, 5 to 10 times higher, in the near-surface silt and clay sediments of the debris plug. Elements such as arsenic and mercury seem generally to have higher concentrations in the upper reaches of the debris plug as compared to elsewhere.

All sediment cores were analyzed for 25 agrichemicals and PCBs. Within the Yalobusha River channel deposits, BHC-beta, aldrin, dieldrin, DDD, DDE, and heptachlor are found in measurable concentrations (from 1 to 100 ppb). BHC-beta is found in nearly all channel sediment samples in comparable concentrations. Within the debris plug deposits, BHC-alpha, BHC-beta, BHC-gamma, BHC-delta, aldrin, dieldrin, DDD, DDE, DDT, endosulfan sulfate, heptachlor, and heptachlor epoxide are found in measurable concentrations (from 1 to 100 ppb). Compounds such as dieldrin, DDD, and DDE are found in nearly all sediment samples at comparable concentrations. The concentrations of elements and agrichemicals observed here are typical for agricultural watersheds in Mississippi.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

ACKNOWLEDGEMENTS

We gratefully acknowledge the technical assistance of Glenn Gray, Vince Cambell, Dan McChesney, Will Beard, Corey Patrick, Collin Anderson. Scott Knight kindly lent us a canoe to assist in field reconnaissance, and Terry Welch shipped some sediment samples to the University of Louisiana at Monroe for analysis. Financial and programmatic support was provided by Mr. Thomas L. Hengst, Senior Project Manager, Demonstration Erosion Control Project, U.S. Army Corps of Engineers (COE), Vicksburg District, MS.

1. INTRODUCTION

This report summarizes research results collected, tabulated, and analyzed by Dr. Sean J. Bennett, Geologist, and Dr. Fred E. Rhoton, Soil Scientist, USDA-ARS National Sedimentation Laboratory, Oxford, MS, along the Yalobusha River near Calhoun City, MS. This field data collection program was initiated at the direct request of Mr. Thomas L. Hengst, Senior Project Manager, Demonstration Erosion Control Project, U.S. Army Corps of Engineers (COE), Vicksburg District, MS. Communications between the USDA-ARS and the COE began in January, 2002. The field data collection program took place between March and May, 2002.

1.1 Background

A large number of stream channels in the Midwestern United States have been subjected to severe erosion and incision due to channelization programs during the early 1900s and again in the 1950s and 1960s (Simon and Rinaldi, 2000). These erosional processes, caused in many cases by migrating knickpoints several meters in height, were exacerbated by the low cohesive strength of the loess-derived soils. The streams within the Yalobusha River basin, located in north-central Mississippi within the bluff hills region of the state, have also experienced severe erosion, bed incision, and channel widening (Simon, 1998). Straightening of the Yalobusha River and Topashaw Creek, most recently as 1967, has markedly altered the base level of these streams and promoted basin-wide degradation of the river channels.

The primary results of changing base level within the Yalobusha River basin are channel incision, bank destabilization, and channel widening (Simon and Thomas, 2002). Large volumes of sediment and woody riparian vegetation were delivered to the flow and were transported through the river network (Downs and Simon, 2001). When the channelized, straightened Yalobusha River reaches met the natural, unchannelized meanders, the woody debris in transport would became snagged and deposited. These processes, left unrequited for decades, resulted in the rapid accumulation of a large woody debris plug on the lower Yalobusha River downstream of Calhoun City, MS. This is the third known debris accumulation in the last 60 years. Estimates by Simon (1998) and Downs and Simon (2001) suggest that as much as 5 m of sediment and debris has accumulated vertically since 1967 and input of vegetation due to bank failure in the vicinity of major knickpoints is around 28 m^3/yr. This debris accumulation has significantly increased the magnitude, frequency, and severity of flooding in the Calhoun City area.

1.2 Problem Statement

Before the Corps of Engineers initiates debris plug removal and channel improvements, an assessment of sedimentation within the plug and the channel upstream of the plug is required. To meet this need, the following work was proposed (January, 2002).

1. Samples of the sediment trapped within the woody debris plug as well as upstream of the plug will be collected using various coring technology.
2. All sediment samples will be analyzed for particle size and bulk density, historical agrichemicals, and heavy metals and chemical elements.

3. The primary deliverable is a report summarizing sediment thickness, stratigraphy, and chemical and physical characteristics of the sediment impounded immediately above and within the plug.

This report summarizes the main findings of the field data collection program along the debris plug along the Yalobusha River and within the channel upstream of the plug. Descriptions of the methods and procedures as well as sample locations are also presented and discussed.

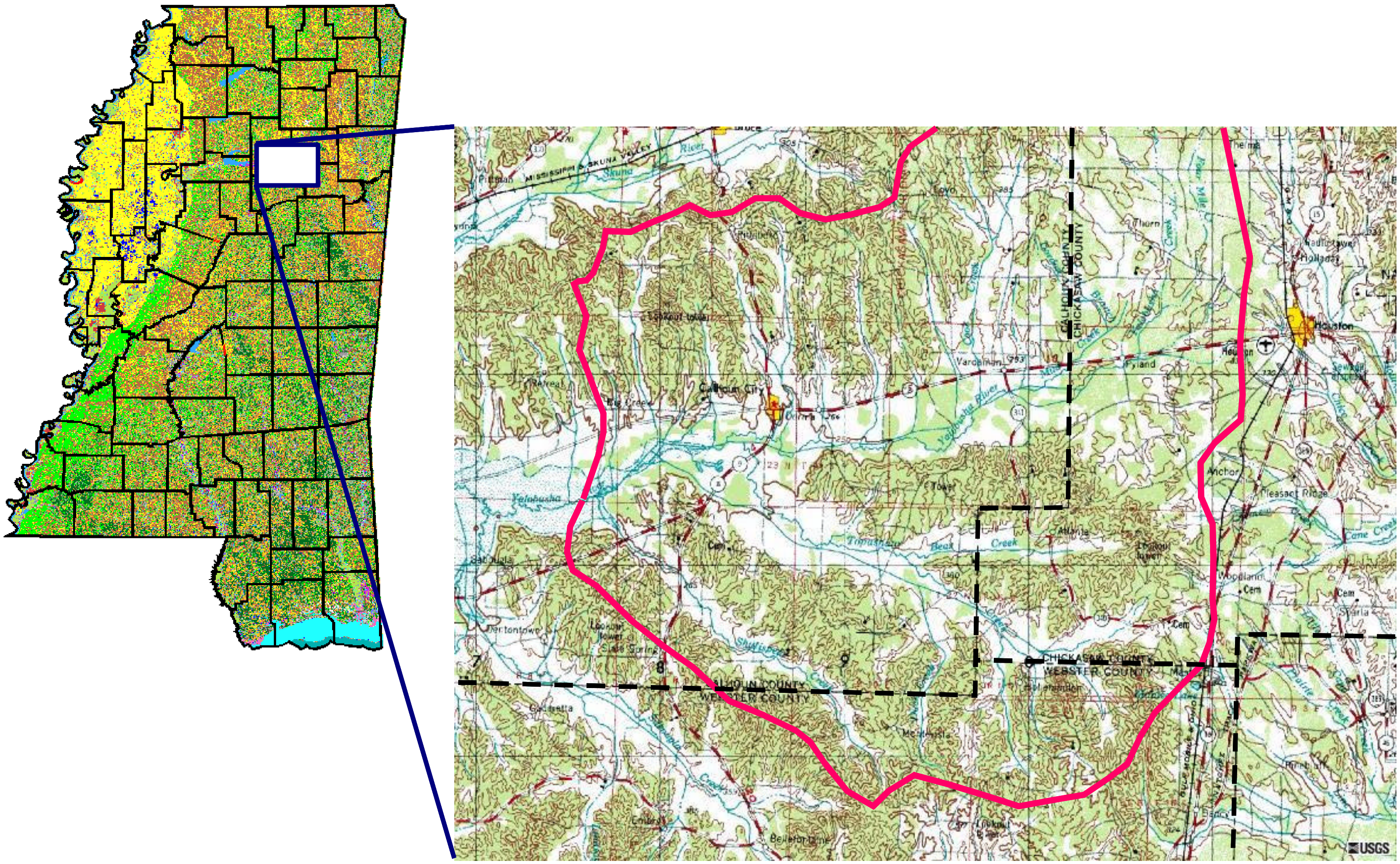


Figure 1-1. Location of the Yalobusha River Basin in Mississippi. Also shown is the outline (in red) of the Yalobusha River upstream of Grenada Lake.

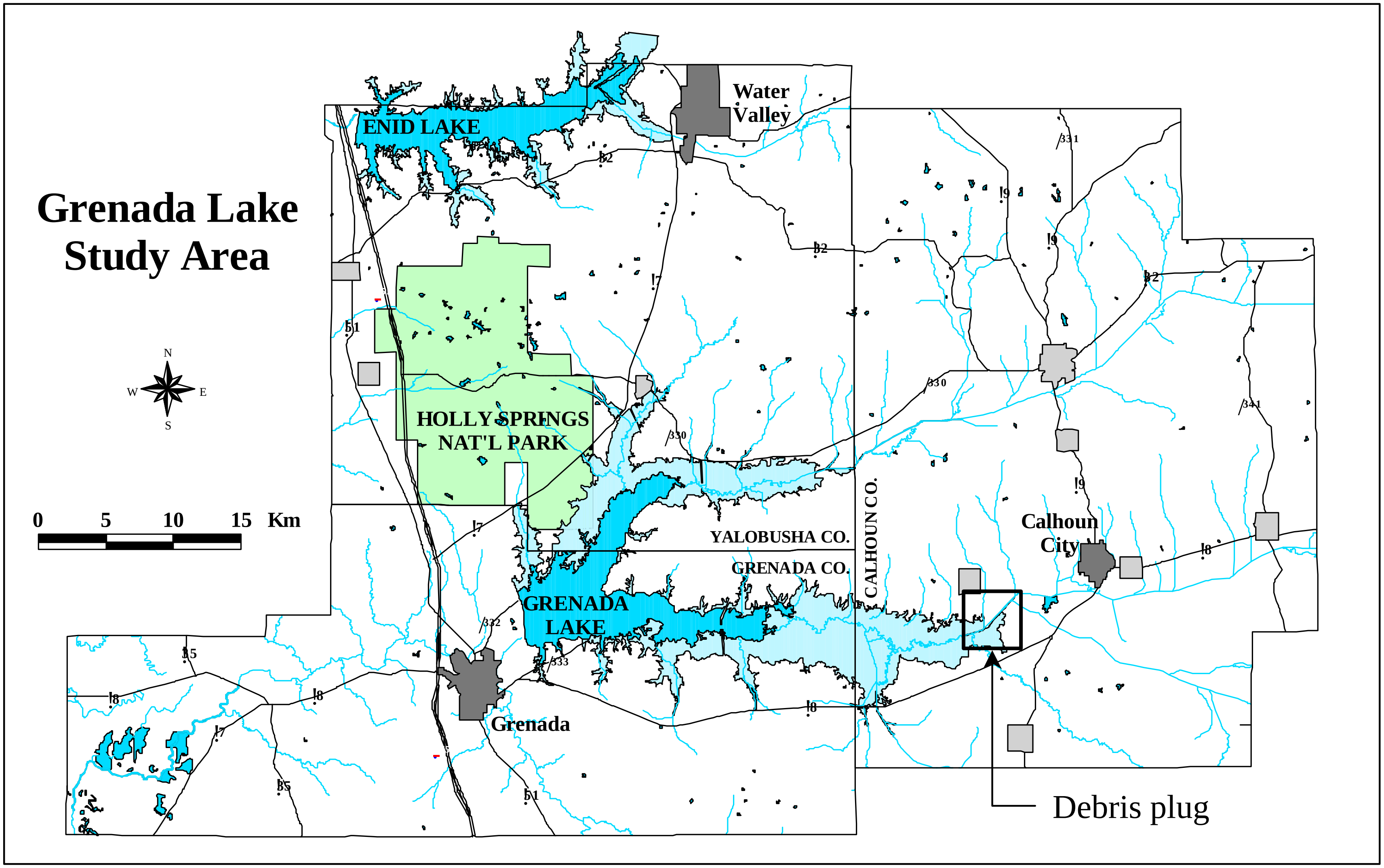


Figure 1-2. Map of Grenada Lake and local environs. Inset shows the location of the debris plug on the Yalobusha River.

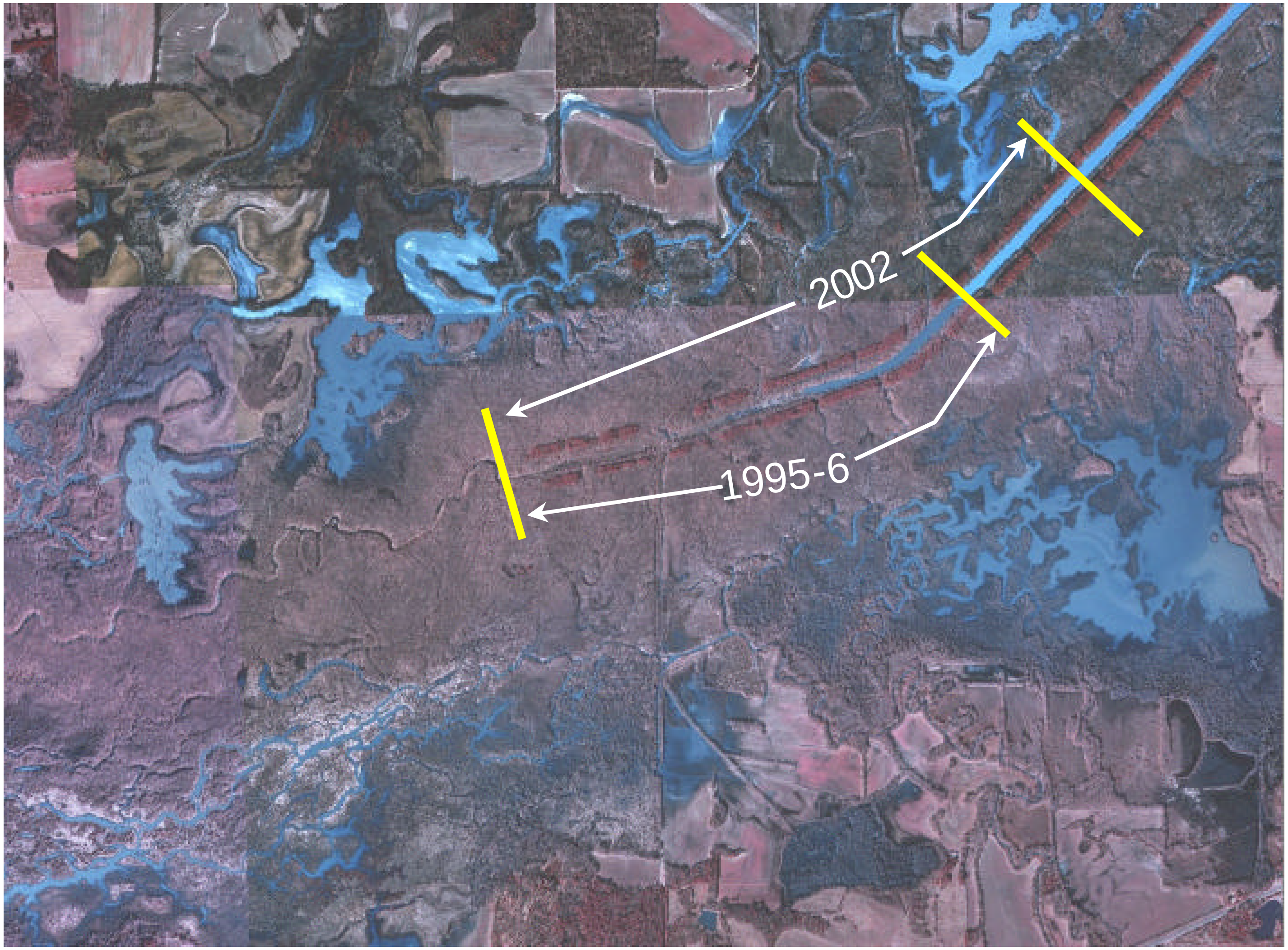


Figure 1-3. Aerial photograph (digital orthogonal quarter quadrangle) of the Yalobusha River showing the upstream extent of the debris plug in 1995-1996 and in 2002. The debris plug currently extends a distance of 3 km. Source of image is Mississippi Automated Resource Information System (MARIS), Jackson, MS.

2. PROCEDURES

2.1 Sediment Coring

A commercially available vibracoring system was used to core sediments within the Yalobusha River upstream of the debris plug (Figures 2-1 to 2-4). Vibracoring is a common approach for obtaining undisturbed cores of unconsolidated sediment in saturated or nearly saturated conditions (Lanesky et al., 1979; Smith, 1984). This system uses a 1-HP motor that drives a pair of weights (masses) eccentrically mounted on two shafts, and it is housed within a watertight aluminum chamber so it can be immersed in water (Figure 2-1). The chamber (driver) was connected to the top of an aluminum irrigation pipe 1.5-mm in thickness and 76-mm in diameter that was cabled to a 4.2-m high aluminum tripod fitted with a battery-operated winch. The driver is equipped with a 50-ft power cord, thus limiting the depth of operation. Lengths of core pipe 4-m long were used, although longer lengths are possible. The tripod was mounted to a raft that could be easily carried and assembled on site, towed with a small boat, and anchored into position (Figures 2-1 to 2-4).

A slide hammer was used to core sediments within the debris plug. This coring device uses a rubber-coated, sliding steel handle (0.7 m closed and 1.1 m extended) threaded to a stainless steel coring tube 0.3 m long and 0.05 m in diameter (Figure 2-5a and 2-5b). For deeper holes, 1.5 m-long extensions would be added to the slide hammer (Figure 2-5c). During core extraction, the core tube would be pounded into the subsurface to a distance of 0.3 m. The core would be lifted from the hole and its entire contents extruded into a plastic sample bag (Figures 2-5d and 2-5e). Due to groundwater flow into the hole and sidewall collapse, a peat sampler was used to evacuate the hole during core processing (Figure 2-5e). The stainless steel peat sampler used has a plate fin and a rotating half-circular sampler with a cutting edge along one side. During operation, the sampler was pushed into the core hole to the desired depth and turned 180° clockwise. This turning caused the fin to remain in position as the sampler completed the circle, thereby capturing all sediment sloughed into the hole.

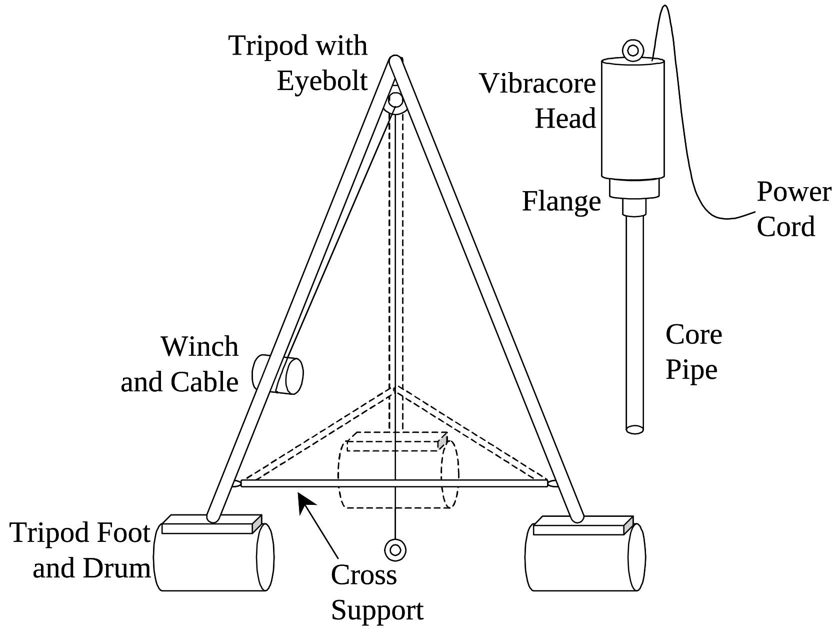


Figure 2-1. Schematic diagram of vibracoring system.

Figure 2-2. Picture of vibracorer taken on the Yalobusha River just above the debris plug looking upstream.

Figure 2-3. Picture of the vibracorer taken during operation on the Yalobusha River just above the debris plug. Core pipe is fully extended.

Figure 2-4. Picture of the vibracorer taken during operation on the Yalobusha River just above the debris plug. Core pipe is being lowered into channel.


(a)


(b)


(c)


(d)


(e)


(f)

Figure 2-5. Coring devices used in the debris plug along the Yalobusha River. Shown are (a) the slide hammer, (b) core tubes, (c) slide hammer extensions, (d) and (e) slide hammer field applications, and (f) the peat sampler. Photos of the slide hammer corer are courtesy of Forestry Suppliers, and photo of peat sampler is courtesy of Ben Meadows Company.

2.2 Bulk Density, Particle Size Analysis, and Total Organic Carbon

Selected physical and chemical characteristics were determined for each of the sediment samples. Bulk density of each sediment sample was determined by weighing the wet samples secured from known volumes, oven-drying the material, and re-weighing the sample. For grain size analysis, approximately 10 g of sediment was treated in H_2O_2 and shaken overnight in sodium hexametaphosphate for complete dispersion. Total percent clay (<2 μm) by mass was determined by siphoning off 5-mL of the dispersed sediment and using the pipette method (Method 3A1, Soil Survey Staff, 1992). Total percent sand by mass was determined by wet sieving the remaining sample through a 53-μm sieve and weighing the dried sediment retained. Total percent silt by mass was calculated by subtracting the masses of sand and clay from the original sample mass. Amounts of total organic carbon (TOC; % by mass) were determined with a Leco CN 2000 carbon analyzer using a 2-g sediment sample. The TOC data presented given here are normalized by the bulk density of the sediment (mass per unit area).

2.3 Agrichemical Analysis

All sediment used in quality assessment was sent to an independent laboratory (Soil-Plant Analysis Laboratory, University of Louisiana at Monroe) for analysis. Wet, unaltered sediment samples were collected from the cores, placed into aluminum foil, packed into coolers with ice, and shipped to the laboratory. Agrichemical concentrations were determined using standard methods approved by the U.S. Environmental Protection Agency (US-EPA, 1997). Table 2-1 lists the compounds examined in this study and their detection limits. The Appendix lists current US-EPA standards for select pesticides and herbicides.

2.4 Bulk Chemical Analysis

All sediment used in bulk chemical assessment was sent to an independent laboratory (Activation Laboratories, LTD., Ontario, Canada). Approximately 5 g of oven-dried, crushed sediment was sent to the laboratory. A small subsample was digested using four acids (hydrofluouric HF, perchloric $HClO_4$, nitric HNO_3, and hydrochloric HCL; a near total digestion process) and analyzed for (1) 48 elements using an inductively coupled plasma spectrometer and (2) mercury using cold-vapor atomic absorption (cold vapor-flow injection mercury system). Table 2-2 lists the elements examined in this study and their detection limits. The Appendix lists current US-EPA standards for select elements.

2.5 Geospatial Data

In order to construct geospatial maps, global positioning satellite system (GPS) technology was employed. A commercially-available, hand-held global positioning receiver was used to determine the location of all cores. Geospatial data were differentially corrected (DGPS) using base station data from either Jackson or Okolona, MS and commercially-available software. Maps created using geographic information systems software were made available by the Mississippi Automated Resource Information System, Jackson, MS (http://www.maris.state.ms.us/). All geospatial data presented herein uses the Mississippi State

Transverse Mercator (MSTM) coordinates. All data collected using the hand-held receiver were converted from Universal Transverse Mercator (UTM) coordinates to MSTM coordinates.

Table 2-1. List of agrichemicals examined in this study with their detection limits and the method of detection (US-EPA, 1997).

Compound	Units	Detection Limit	Method
		Pesticides	
Aldrin	ppb	1	SW-846 8081a, gas chromatography
BHC-alpha	ppb	1	SW-846 8081a, gas chromatography
BHC-beta	ppb	1	SW-846 8081a, gas chromatography
BHC-delta	ppb	1	SW-846 8081a, gas chromatography
BHC-gamma	ppb	1	SW-846 8081a, gas chromatography
Chlordane	ppb	1	SW-846 8081a, gas chromatography
DDD	ppb	1	SW-846 8081a, gas chromatography
DDE	ppb	1	SW-846 8081a, gas chromatography
DDT	ppb	1	SW-846 8081a, gas chromatography
Dieldrin	ppb	1	SW-846 8081a, gas chromatography
Endrin	ppb	1	SW-846 8081a, gas chromatography
Endrin aldehyde	ppb	1	SW-846 8081a, gas chromatography
Endosulfan I	ppb	1	SW-846 8081a, gas chromatography
Endosulfan II	ppb	1	SW-846 8081a, gas chromatography
Endosulfan sulfate	ppb	1	SW-846 8081a, gas chromatography
Heptachlor	ppb	1	SW-846 8081a, gas chromatography
Heptachlor epoxide	ppb	1	SW-846 8081a, gas chromatography
Toxaphene	ppb	1	SW-846 8081a, gas chromatography
		PCBs	
Aroclor 1016	ppb	1	SW-846 8082, gas chromatography
Aroclor 1221	ppb	1	SW-846 8082, gas chromatography
Aroclor 1232	ppb	1	SW-846 8082, gas chromatography
Aroclor 1242	ppb	1	SW-846 8082, gas chromatography
Aroclor 1248	ppb	1	SW-846 8082, gas chromatography
Aroclor 1254	ppb	1	SW-846 8082, gas chromatography
Aroclor 1260	ppb	1	SW-846 8082, gas chromatography

Table 2-2. List of agrichemicals examined in this study with their detection limits and the method of detection (US-EPA, 1997). * denotes elements that may only be partially digested.

Element	Symbol	Units	Detection Limit
Silver	Ag	ppm	0.3
Aluminum*	Al	%	0.01
Arsenic	As	ppm	0.5
Gold	Au	ppb	2
Barium	Ba	ppm	50
Berylium	Be	ppm	1
Bismuth	Bi	ppm	2
Bromine	Br	ppm	0.5
Calcium	Ca	%	0.01
Cadmium	Cd	ppm	0.3
Cerium	Ce	ppm	3
Cobalt	Co	ppm	1
Chromium	Cr	ppm	2
Cesium	Cs	ppm	1
Copper	Cu	ppm	1
Europium	Eu	ppm	0.2
Iron	Fe	%	0.01
Hafnium	Hf	ppm	1
Mercury	Hg	ppb	5
Iridium	Ir	ppb	5
Potassium	K	%	0.01
Lanthanum	La	ppm	0.5
Lutetium	Lu	ppm	0.05
Magnesium	Mg	%	0.01
Manganese	Mn	ppm	1
Molybdenum	Mo	ppm	1
Sodium	Na	%	0.01
Neodymium	Nd	ppm	5
Nickel	Ni	ppm	1
Phosphorus	P	%	0.001
Lead	Pb	ppm	3
Rubidium	Rb	ppm	15
Sulfur	S	%	0.001
Antimony	Sb	ppm	0.1
Scandium	Sc	ppm	0.1
Selenium	Se	ppm	3
Samarium	Sm	ppm	0.1
Tin	Sn	%	0.01
Strontium	Sr	ppm	1
Tantalum	Ta	ppm	0.5
Terbium	Tb	ppm	0.5
Thorium	Th	ppm	0.2
Titanium	Ti	%	0.01
Uranium	U	ppm	0.5
Vanadium	V	ppm	2
Tungsten	W	ppm	1
Yttrium*	Y	ppm	1
Ytterbium	Yb	ppm	0.2
Zinc	Zn	ppm	1

3. CORE SAMPLE LOCATIONS

3.1 Core Sample Locations

Figure 3-1 shows the location of the Yalobusha River debris plug in relation to Grenada Lake and local communities. The purpose of site location for the sampling program was to collect up to 10 sediment cores along the length of the large woody debris plug, restricted in space to the channelized section of the river, and to collect up to 6 sediment cores upstream of the plug within the active stream channel. The latter cores were collected for comparative purposes. A hand-held GPS receiver was used to define the geospatial coordinates for all sample locations.

Figure 3-2 shows all sample locations and Table 3-1 provides the exact UTM coordinates for each site. Those locations within the debris plug are designated DP1 to DP10, going from downstream to upstream, except for DP9 and DP10. Core locations within the active Yalobusha River channel are designated Y1 to Y6, going from downstream to upstream.

3.2 Physical Description of Sample Site Locations Within the Debris Plug

Figures 3-3 to 3-12 show both upstream- and downstream-facing photographs of all sample site locations within the debris plug, starting at the most downstream location and moving upstream. In the most downstream reaches of the debris plug, little to no woody debris is present at or near the sediment surface (Figures 3-3 and 3-4). The area is overgrown with woody vegetation, has little to no standing water, and has little to no accumulation of human detritus, which includes garbage, plastic bottles and containers, appliances, tin cans, etc.

Moving upstream, the amount of both human detritus (Figures 3-5 and 3-8) and standing water (Figures 3-7 and 3-8) increases significantly. In addition, the amount of live woody vegetation within the channel decreases while the occurrence of tall grasses and reeds increased (Figures 3-6 and 3-7). The live woody vegetation within the channel all but disappears by DP8 (Figure 3-10), located near the bend in the channel planform (Figure 3-2). At this location and farther upstream, the amount of large woody debris and human detritus as well as standing water increases significantly (Figures 3-10, 3-11, and 3-12).

During the sampling program, water depth in the upstream reaches of the debris plug was generally less than 1 m. Numerous distributary channels, a few meters wide and 1 to 2 meters deep, were observed on both sides of the debris plug. These channels were actively draining water from the channels to the nearby floodplain.

Table 3-1. Summary of core locations.

Core ID	Date Collected	Coordinates (UTM): NAD 83/False Easting =500000 m	
		x	y
Y1	3/27/2002	278161.192397	3744898.891193
Y2		278257.230515	3744991.326697
Y3		278509.602617	3745241.406841
Y4	3/28/2002	278849.708820	3745581.137451
Y5		279254.222845	3745973.686874
Y6		279464.751415	3746182.747437
DP1	4/3/2002	275805.014323	3743683.166164
DP2		276132.165779	3743762.564045
DP3	4/4/2002	276370.166718	3743833.318965
DP4		276607.850422	3743892.257814
DP5		276838.175487	3743972.787360
DP6	4/10/2002	277100.383358	3744032.557712
DP7		277299.659067	3744085.618128
DP8		277484.815067	3744213.021096
DP9	4/18/2002	277983.983885	3744720.056294
DP10		277677.768187	3744430.481493

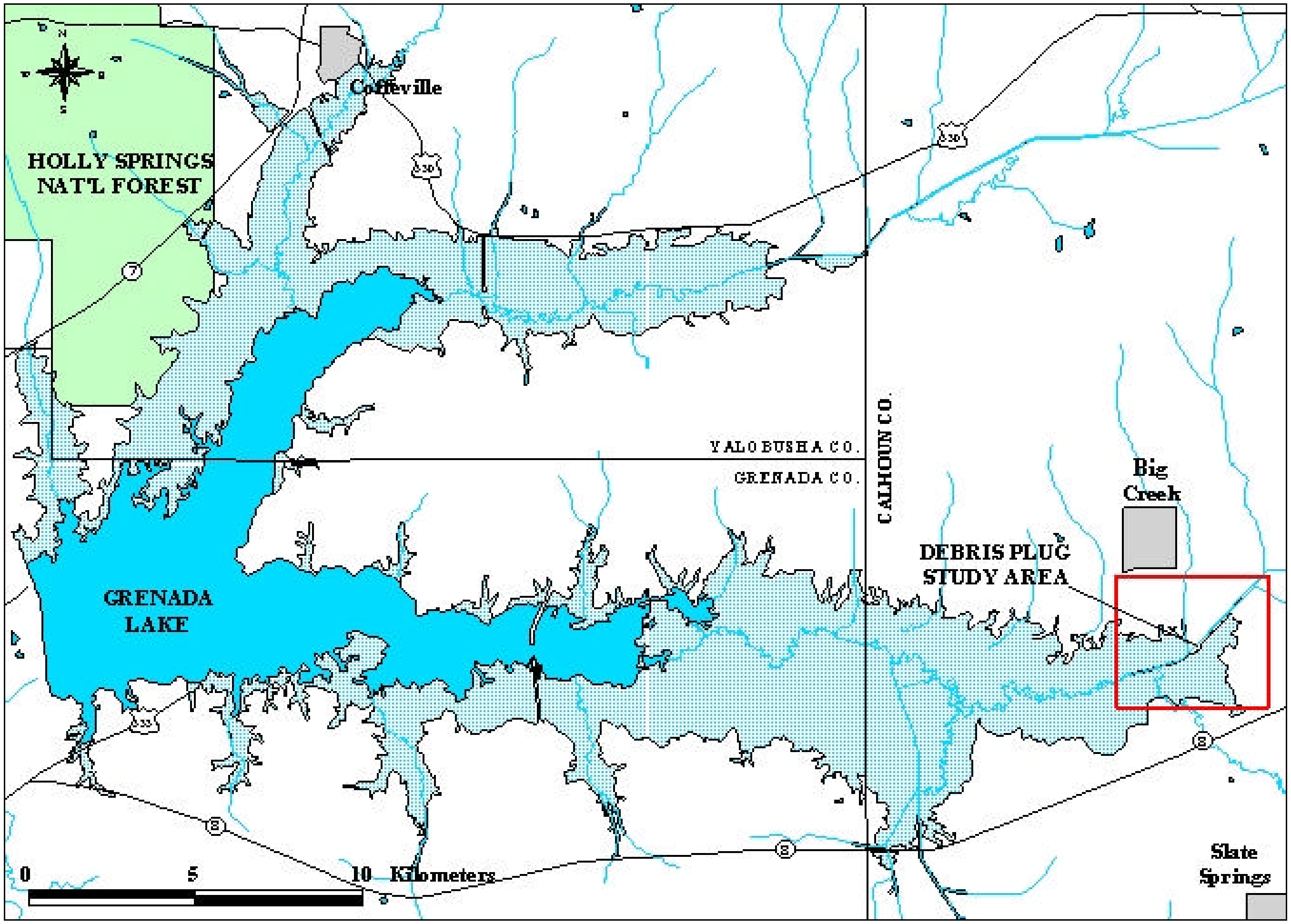


Figure 3-1. Location of the Yalobusha River debris plug study area.

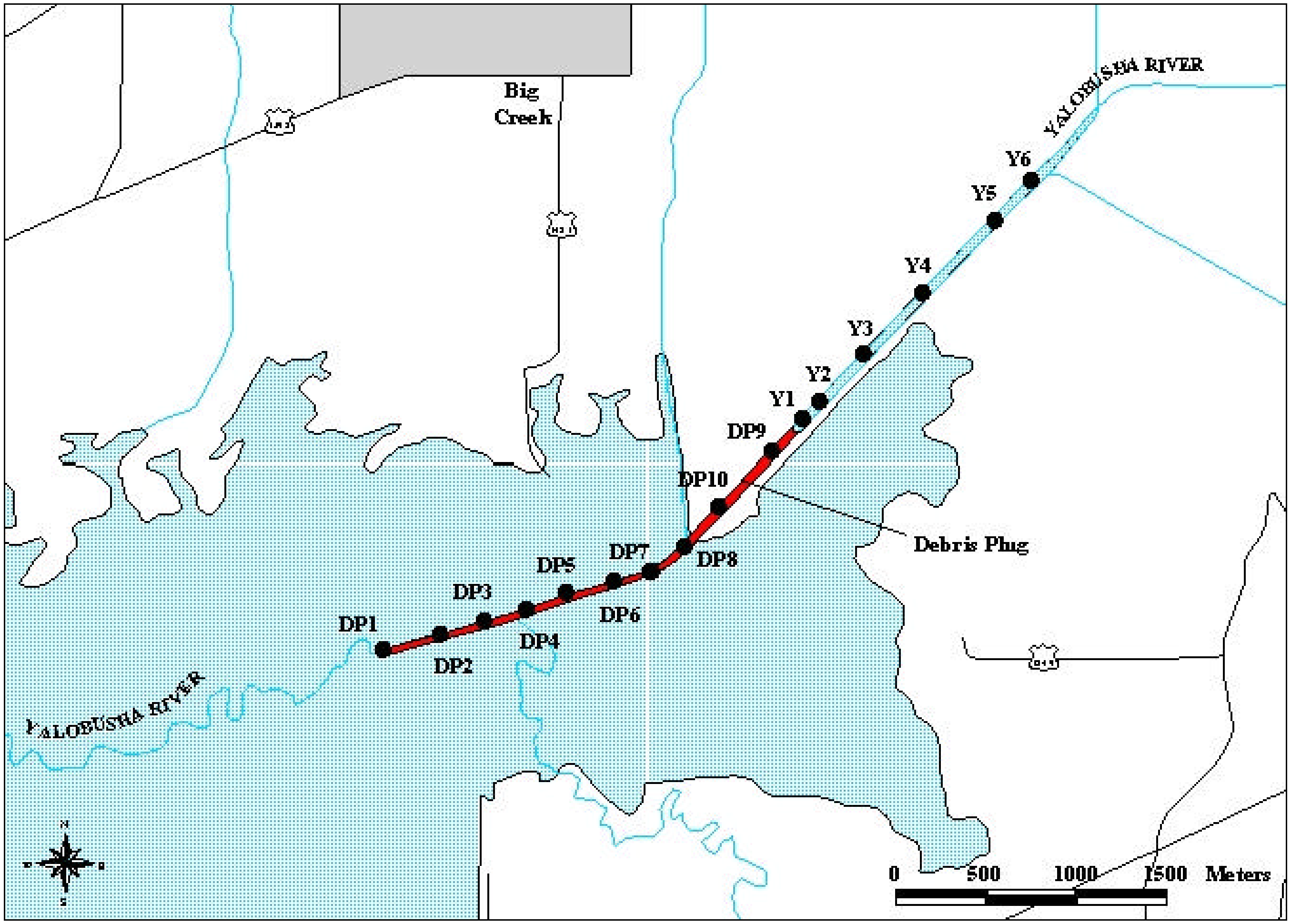


Figure 3-2. Core locations in the Yalobusha River debris plug (DP1 to DP10) and upstream of the plug (Y1 to Y6). Extent of debris plug is shown in red.

(a)

(b)

Figure 3-3. Photographs of core location DP1 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

(a)

(b)

Figure 3-4. Photographs of core location DP2 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

(a)

(b)

Figure 3-5. Photographs of core location DP3 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

(a)

(b)

Figure 3-6. Photographs of core location DP4 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

(a)

(b)

Figure 3-7. Photographs of core location DP5 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

(a)

(b)

Figure 3-8. Photographs of core location DP6 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

(a)

(b)

Figure 3-9. Photographs of core location DP7 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

(a)

(b)

Figure 3-10. Photographs of core location DP8 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

(a)

(b)

Figure 3-11. Photographs of core location DP10 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

(a)

(b)

Figure 3-12. Photographs of core location DP9 looking (a) downstream and (b) upstream. Refer to Figure 3-2 for exact location.

4. RESULTS

4.1 Particle Size, Bulk Density, and Total Organic Carbon: Yalobusha River Channel

Particle size, bulk density, and total organic carbon results for all cores obtained in the Yalobusha River channel upstream of the debris plug are given in Table 4-1 and Figures 4-1, 4-2, and 4-3, respectively. These determinations were made at 0.1 m increments, and are plotted graphically at their mid-point.

Within the Yalobusha River channel upstream of the debris plug, the cores range in length from 0.65 to 2.14 m (Table 4-1). Near the debris plug, the upper 0.5 m of the cores have relatively high silt (up to 50% by mass) and clay (up to 20% by mass) contents (Table 4-1, Figure 4-1). Below a depth of 0.5 m in these cores, the sediments are dominated by sand, up to 98% by mass. Moving upstream away from the plug, the deposits within the channel are composed primarily of sand, typically 98% by mass, with small amounts of clay (about 2% by mass). Core Y6, taken near the confluence of the Yalobusha River and Topashaw Creek, has a silt and clay layer at depth (Figure 4-1). This deposit may represent a previous high-stand of water since the last channelization in the 1960s. In general, the textural compositions of the Yalobusha River channel deposits show little variation with depth (Figure 4-1).

For the silt and clay deposits within the Yalobusha River channel, values for bulk density range from 700 to 1200 kg/m^3 (Table 4-1, Figure 4-2). For the sand deposits, values for bulk density range from 1100 to 1500 kg/m^3, with a typical value of about 1400 kg/m^3 (or a porosity of 49%).

Total organic carbon (TOC) within these sediments ranges from 0.04 to 0.9% by mass, or 0.1 to 2.0 kg/m^2 (Table 4-1, Figure 4-3). Higher values of TOC occur in the silt and clay-dominated sediments.

4.2 Particle Size, Bulk Density, and Total Organic Carbon: Debris Plug

Particle size, bulk density, and total organic carbon results for all cores obtained in the debris plug are given in Table 4-1 and Figures 4-1, 4-2, and 4-3, respectively. These determinations were made at 0.3 m increments, and are plotted graphically at their mid-point.

Within the debris plug, the cores range in length from 1.37 to 2.59 m (Table 4-1). In the upper portion of each core, from the surface down to a depth of 0.5 to 1.0 m, the sediment is composed primarily of silt (40 to 70% by mass) and clay (10 to 30% by mass; Table 4-1, Figure 4-1). Below these depths, the sediment is composed primarily of sand (80 to 90% by mass), with minor amounts of silt (5 to 20% by mass) and clay (5 to 10% by mass). The thickness of the near-surface silt and clay horizon tends to increase toward the upstream portion of the debris plug (Figure 4-1).

For the silt and clay deposits within the Yalobusha River channel, values for bulk density range from 300 to 1000 kg/m^3 (Table 4-1). For the sand deposits, values for bulk density range from 900 to 2000 kg/m^3. These bulk density values are lower than expected, due in part to the inability of the slide hammer corer to collect undisturbed sediment samples, and are considered unreliable. Total organic carbon (TOC) within these sediments ranges from 0.06 to 2.8% by mass (Table 4-1). Higher values of TOC occur in the silt and clay-dominated sediments.

Table 4-1. Particle size, bulk density, and total organic carbon results for the cores taken in the debris plug (DP1 to DP10) and within the Yalobusha River channel (Y1 to Y6). Refer to Figure 3-2 for core locations.

Core ID	Depth (m)	Parameter				
		Sand (%)	Silt (%)	Clay (%)	Bulk Density (kg/m^3)	Carbon (%)
DP1	0.15	48.41	36.07	15.52	1093.24	1.17
	0.46	95.03	2.07	2.90	2022.10	0.15
	0.76	96.46	1.20	2.34	1546.33	0.16
	1.07	97.57	0.33	2.10	1448.94	0.19
	1.37	96.53	0.49	2.98	970.86	0.07
DP2	0.15	62.48	23.87	13.64	909.80	1.22
	0.46	96.47	0.63	2.90	1224.90	0.07
	0.76	96.68	0.41	2.91	1579.05	0.06
	1.07	96.84	0.00	3.46	1572.22	0.06
	1.37	96.64	1.03	2.33	1639.21	0.06
DP3	0.15	5.55	68.27	26.17	735.09	1.73
	0.46	14.99	54.58	30.43	522.36	2.50
	0.76	69.98	16.82	13.20	1182.28	0.66
	1.07	83.22	7.94	8.84	1145.35	0.28
	1.37	92.73	1.87	5.40	1402.35	0.13
	1.68	95.29	0.00	4.74	834.83	0.21
	1.98	94.59	1.46	3.95	1262.93	0.29
	2.29	96.07	0.14	3.79	459.66	0.19
DP4	0.15	22.22	53.15	24.63	427.93	1.65
	0.46	79.77	11.46	8.77	536.92	0.40
	0.76	86.37	6.83	6.80	1275.95	0.21
	1.07	91.43	3.08	5.49	1098.39	0.17
	1.37	95.12	0.44	4.43	845.10	0.12
DP5	0.15	19.45	59.23	21.32	344.08	2.63
	0.46	19.76	57.42	22.81	400.10	1.43
	0.76	86.25	8.58	5.17	672.65	0.28
	1.07	89.09	6.22	4.69	928.42	0.24
	1.37	89.32	6.41	4.27	560.13	0.18
	1.68	78.21	14.08	7.70	996.08	0.38
	1.98	83.68	10.26	6.06	805.70	0.25
	2.29	96.06	1.68	2.25	316.14	0.09
DP6	0.15	3.82	70.13	26.05	287.02	1.71
	0.46	11.19	61.41	27.40	237.62	2.30
	0.76	10.88	65.09	24.02	396.09	1.27
	1.07	26.34	54.08	19.58	488.46	1.18
	1.37	58.67	27.80	13.54	567.69	0.76
	1.68	71.70	17.45	10.84	872.34	0.65
	1.98	75.28	14.98	9.73	310.23	0.36
	2.29	80.82	12.05	7.12	783.69	0.24
	2.59	84.58	9.14	6.27	492.38	0.37

Table 4-1 continued

Core ID	Depth (m)	Parameter				
		Sand (%)	Silt (%)	Clay (%)	Bulk Density (kg/m^3)	Carbon (%)
DP7	0.15	5.29	69.08	25.63	293.77	2.38
	0.46	71.41	17.64	10.95	282.34	2.79
	0.76	54.01	32.81	13.18	445.94	1.40
	1.07	70.39	11.51	18.10	445.33	0.96
	1.37	63.28	24.68	12.04	1005.93	1.05
	1.68	72.41	17.89	9.70	784.76	0.46
	1.98	83.99	9.55	6.47	553.86	0.27
	2.29	83.36	9.61	7.02	159.04	0.39
	2.59	80.21	13.65	6.14	363.28	0.31
DP8	0.15	35.96	47.10	16.94	442.36	1.13
	0.46	32.33	49.96	17.71	441.23	2.03
	0.76	18.32	62.55	19.13	485.52	1.22
	1.07	57.88	33.24	8.89	474.28	0.59
	1.37	72.54	18.69	8.77	1179.25	0.56
	1.68	73.63	18.56	7.81	1213.86	0.39
	1.98	90.20	5.53	4.27	915.28	0.13
	2.29	59.96	29.17	10.87	436.58	0.46
	2.59	90.18	5.95	3.87	623.78	0.12
DP9	0.15	23.34	58.44	18.22	355.21	2.14
	0.46	32.70	48.81	18.49	395.80	2.18
	0.76	53.34	33.36	13.30	273.97	2.71
	1.07	43.26	41.10	15.63	560.14	1.50
	1.37	84.80	9.95	5.25	1227.53	0.27
	1.68	71.25	20.05	8.70	707.06	0.56
	1.98	88.35	6.29	5.36	876.37	0.31
	2.29	89.19	6.21	4.60	1099.51	0.23
DP10	0.15	84.95	9.04	6.01	484.72	0.38
	0.46	89.86	4.50	5.64	326.80	0.53
	0.76	87.09	6.92	5.99	187.03	1.37
	1.07	79.54	12.85	7.61	484.37	0.73
	1.37	74.70	16.22	9.09	558.66	0.29
	1.68	79.60	12.25	8.15	594.78	0.23
	1.98	89.28	5.29	5.44	920.61	0.48
	2.29	88.91	6.01	5.08	653.41	0.23

Table 4-1 continued

Core ID	Depth (m)	Parameter				
		Sand (%)	Silt (%)	Clay (%)	Bulk Density (kg/m^3)	Carbon (%)
Y1	0.05	33.21	50.31	16.48	900.98	0.84
	0.15	73.65	17.81	8.55	697.75	0.72
	0.25	65.95	26.33	7.71	1034.53	0.59
	0.35	33.63	47.41	18.96	1065.60	0.68
	0.45	94.80	2.14	3.06	1277.77	0.08
	0.55	86.85	8.63	4.52	1382.69	0.15
	0.65	94.51	3.00	2.49	1353.03	0.06
	0.75	72.87	18.26	8.87	1223.39	0.32
	0.85	95.80	1.14	3.06	1460.06	0.06
	0.95	96.09	1.18	2.74	1368.44	0.06
	1.05	75.05	16.92	8.02	1312.88	0.25
	1.15	78.35	13.40	8.25	1353.45	0.49
	1.25	86.38	8.30	5.32	1321.51	0.15
	1.35	96.66	0.68	2.65	1275.85	0.05
	1.45	98.64	0.00	2.01	1393.76	0.02
	1.55	97.72	0.00	2.45	1520.22	0.04
	1.65	97.32	0.00	3.06	1047.76	0.07
	1.75	96.56	0.14	3.30	1194.56	0.09
	1.85	95.38	0.87	3.75	871.28	0.76
	1.96	98.45	0.00	3.27	NA	0.91
Y2	0.05	80.66	12.56	6.78	1292.80	0.14
	0.15	96.58	0.00	3.55	1409.21	0.08
	0.25	96.09	0.13	3.78	1295.51	0.06
	0.35	97.47	0.00	3.41	1430.15	0.05
	0.45	90.14	5.83	4.03	1321.71	0.18
	0.55	69.55	20.99	9.45	1153.46	0.35
	0.65	96.94	0.68	2.38	1374.34	0.06
	0.75	97.74	0.00	2.66	1353.22	0.05
	0.85	96.52	0.07	3.41	1449.01	0.06
	0.95	96.14	0.16	3.70	1436.12	0.06
	1.05	93.81	1.96	4.23	1331.92	0.22
	1.15	96.14	0.20	3.66	1382.14	0.07
	1.25	95.69	0.52	3.79	1345.90	0.09
	1.35	95.88	0.00	4.67	1380.43	0.06
	1.45	80.54	11.27	8.19	1491.78	0.27
	1.55	92.73	2.39	4.88	1338.62	0.14
	1.65	93.64	2.58	3.78	1492.95	0.10
	1.75	96.78	0.00	3.26	1465.82	0.13
	1.85	95.21	0.85	3.94	1418.74	0.12
	1.95	97.86	0.00	3.46	1481.27	0.10
	2.05	97.60	0.00	3.22	1308.02	0.07
	2.14	96.56	0.00	3.45	1162.35	0.07

Table 4-1 continued

Core ID	Depth (m)	Parameter				
		Sand (%)	Silt (%)	Clay (%)	Bulk Density (kg/m^3)	Carbon (%)
Y3	0.05	73.71	16.19	10.10	1070.60	0.51
	0.15	95.82	0.03	4.14	1206.82	0.11
	0.25	93.97	1.02	5.01	1219.87	0.32
	0.35	96.49	0.00	3.98	1472.34	0.06
	0.45	96.08	0.00	3.99	1513.86	0.08
	0.55	97.48	1.07	1.45	1539.21	0.07
	0.65	96.54	1.46	2.01	1506.93	0.04
	0.75	97.21	0.67	2.13	1452.58	0.04
	0.85	97.78	0.00	2.61	1525.52	0.04
	0.95	97.55	0.00	2.50	1496.29	0.05
	1.05	97.98	0.00	2.29	1530.43	0.05
	1.15	98.51	0.00	2.41	1403.85	0.04
	1.25	97.23	0.12	2.65	1551.45	0.04
	1.35	96.11	0.87	3.02	1503.83	0.06
	1.45	95.98	0.93	3.10	1405.21	0.05
	1.57	97.20	0.00	2.98	1461.87	0.08
Y4	0.05	95.47	0.97	3.56	1158.16	0.09
	0.15	95.73	0.86	3.42	1173.62	0.11
	0.25	96.53	0.33	3.14	1367.58	0.06
	0.35	96.63	0.38	2.99	1498.18	0.08
	0.45	96.17	0.65	3.18	1523.53	0.06
	0.55	97.83	0.00	2.82	1463.28	0.07
	0.65	98.49	0.00	2.98	1527.88	0.06
	0.75	97.57	0.00	3.21	1503.74	0.08
	0.85	96.67	0.00	3.88	1543.17	0.09
	0.95	93.34	1.38	5.28	1394.90	0.11
	1.05	97.21	0.00	3.94	1566.54	0.08
	1.15	96.24	0.00	4.00	1517.16	0.10
	1.27	95.40	0.03	4.57	1438.64	0.10
Y5	0.05	96.91	1.23	1.86	1410.09	0.11
	0.15	96.25	1.07	2.68	1528.70	0.12
	0.25	96.27	0.98	2.76	1414.52	0.37
	0.35	98.25	0.00	2.10	1489.33	0.08
	0.45	98.84	0.00	2.26	1440.22	0.07
	0.55	98.44	0.00	2.01	1461.83	0.07
	0.65	92.60	4.02	3.38	1339.25	0.12

Table 4-1 continued

Core ID	Depth (m)	Parameter				
		Sand (%)	Silt (%)	Clay (%)	Bulk Density (kg/m^3)	Carbon (%)
Y6	0.05	98.29	0.00	2.17	1419.94	0.05
	0.15	98.46	0.00	2.33	1474.54	0.05
	0.25	98.23	0.00	2.33	1496.79	0.04
	0.35	59.57	26.16	14.27	1163.33	0.43
	0.45	3.07	67.90	29.03	985.85	0.94
	0.55	75.92	12.25	11.83	1290.33	0.29
	0.65	48.10	33.41	18.49	1497.31	0.21
	0.75	91.71	3.01	5.28	1187.47	0.50
	0.85	97.23	0.00	3.34	1408.65	0.07
	0.95	98.01	0.00	3.38	1366.69	0.04
	1.05	98.08	0.00	3.39	1458.62	0.05
	1.15	95.18	0.29	4.53	1428.21	0.07
	1.25	94.80	0.18	5.02	1446.03	0.11

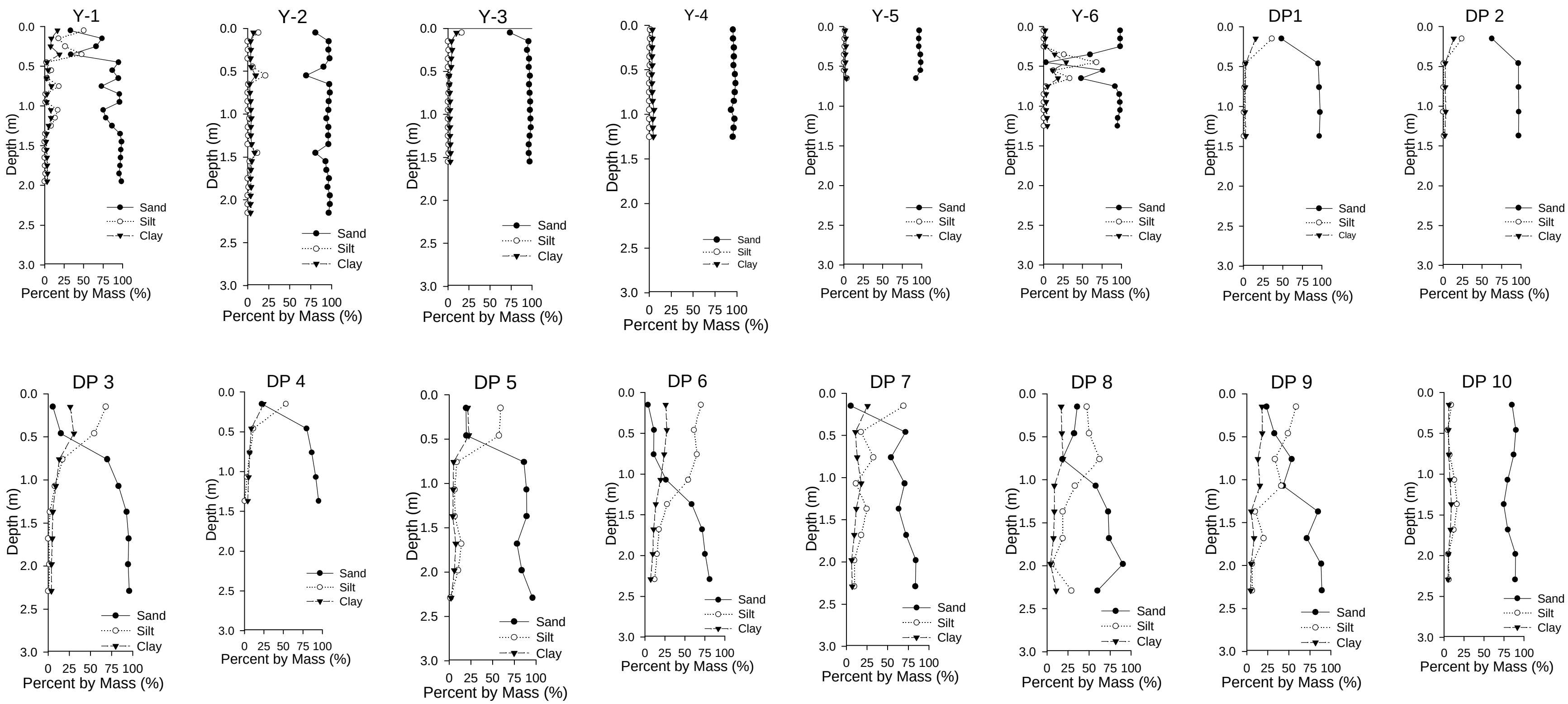


Figure 4-1. Vertical profiles of sediment texture for all sediment cores. Refer to Figure 3-2 for core locations.

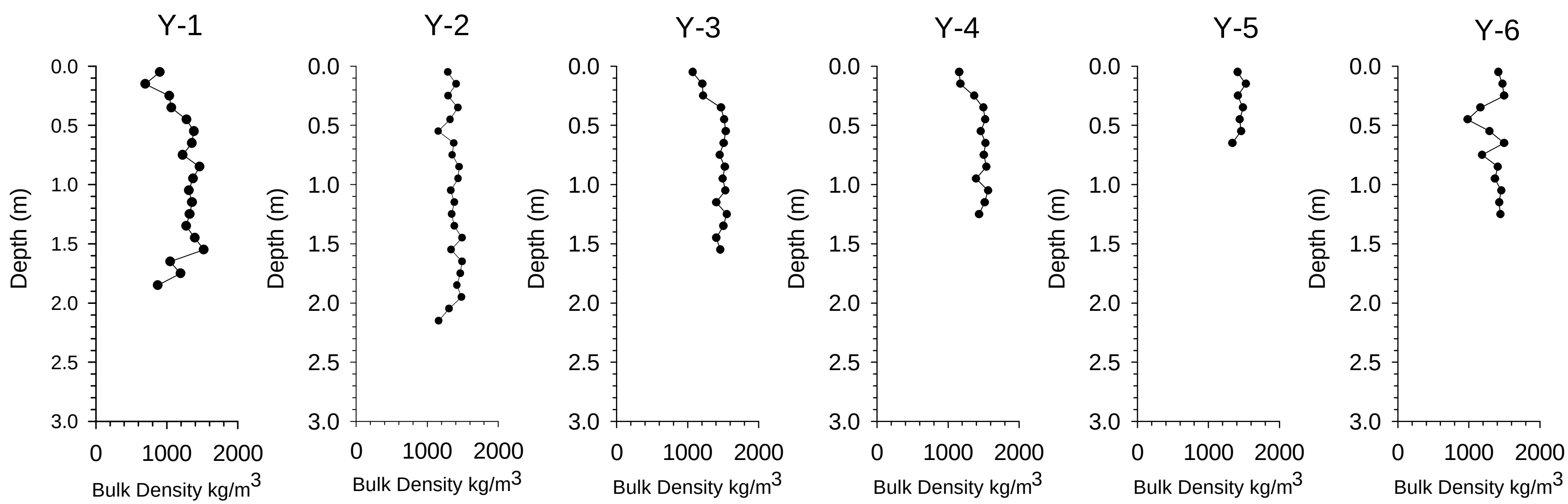


Figure 4-2. Vertical profiles of sediment bulk density for all cores in the Yalobusha River channel. Refer to Figure 3-2 for core locations.

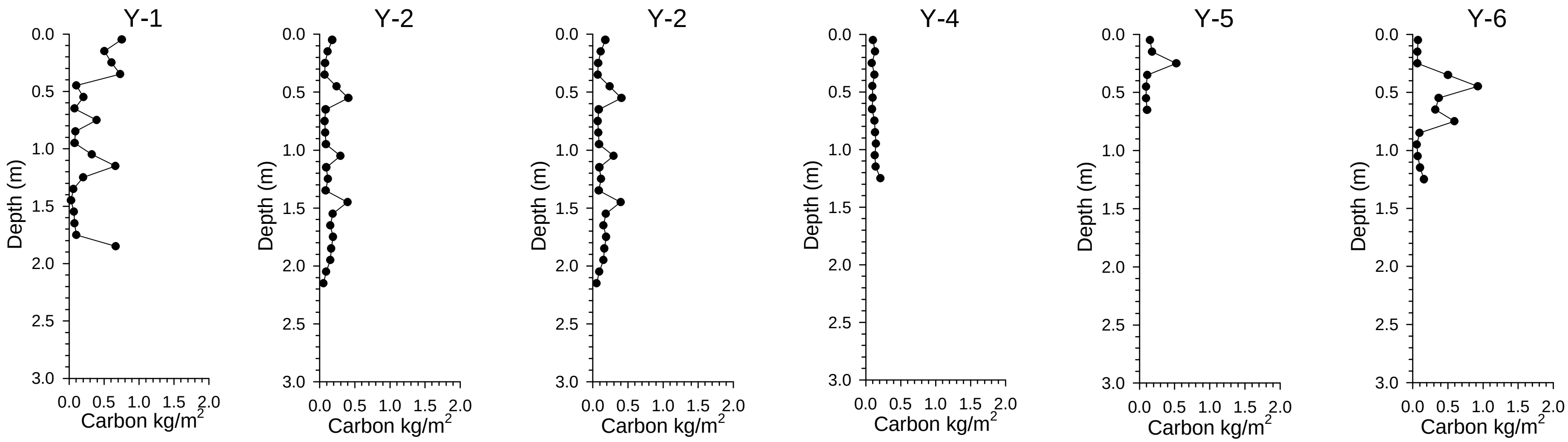


Figure 4-3. Vertical profiles of total organic carbon for the sediment cores from the Yalobusha River channel. Refer to Figure 3-2 for core locations.

4.3 Bulk Chemical Analysis of Sediment: Major Elements

Tables 4-2 and 4-3 show the results of the bulk chemical analysis performed on all sediment samples taken in the Yalobusha River channel and debris plug, respectively. These tables list the specific core and depth of sample, the equipment used, and the 49 elements analyzed. Figures 4-4 to 4-19 show the variation of concentration for select elements plotted with depth within individual cores from the most upstream core within the Yalobusha River channel (Y6) to the most downstream core within the debris plug (DP1). Figures 4-20 to 4-24 show the variation of concentration for select elements as a function of sediment texture for all cores (Yalobusha River channel and debris plug combined).

The major elements further examined here are aluminum (Al), calcium (Ca), iron (Fe), potassium (K), magnesium (Mg), sodium (Na), phosphorus (P), and sulfur (S). The concentrations of most major elements show very good correlation with sediment texture (Figure 4-20 to 4-24). As sand content decreases and silt and clay contents increase, the concentrations of Al, Ca, Fe, K, Mg, Mn, Na, P, and S increase by as much as 5 to 10 times. The concentration of some elements, specifically P and S (Figure 4-24), show more scatter when plotted against sediment texture compared to other elements. These variations are probably related to organic contributions to total element concentration in addition to mineralogical (inorganic).

The concentrations of all elements are higher near the upper portions of the sediment cores, especially within the debris plug (Figures 4-4 to 4-19). This increase in concentration is directly related to the increase in silt and clay in the near-surface horizons.

4.4 Bulk Chemical Analysis of Sediment: Environmentally Important Elements (EIE)

Tables 4-2 and 4-3 and Figures 4-4 to 4-24 show the variations with depth and sediment texture of environmentally important elements (EIE) that includes arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), lead (Pb), and zinc (Zn). The concentrations of EIE show good correlations with sediment texture. Elements such as Cr and Zn (Figures 4-20 and 4-21) show that as sand content decreases and silt and clay contents increase, the concentrations of these elements increase. EIE concentrations are typically 5 to 10 times higher in the silt and clay dominated horizons as compared to the sand dominated horizons (Tables 4-2 and 4-3). Elements such as As, Cu, Pb, and Hg also show similar trends with sediment texture (Figures 4-20, 4-21, 4-22, and 4-24, respectively), but display more scatter. In addition, elements such as As (Figure 4-5) and Hg (Figure 4-11) seem generally to have higher concentrations in the upstream reaches of the debris plug as compared to the downstream reaches. Very little Cd was observed in the sediment (Figure 4-7).

The concentrations of these elements are not atypical for agricultural watersheds in Mississippi. Comparable concentrations of elements such as As, Cd, Cr, Cu, Hg, Pb, and Zn have been observed in soil and lake sediment samples in Otoucalofa Creek watershed, located in Yalobusha County (Knight and Cooper, 1996) and Hubbard-Murphree Lake, located in Tallahatchie County, MS (Bennett, 2001).

Table 4-2. Summary of bulk chemical characteristics of sediment samples taken within the Yalobusha River channel upstream of the debris plug. ND—not detected, ppm—parts per million, %—percent by mass, ppb—parts per billion.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ag (ppm)	Al (%)	As (ppm)	Au (ppb)	Ba (ppm)	Be (ppm)	Bi (ppm)	Br (ppm)	Ca (%)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Eu (ppm)	Fe (%)	Hf (ppm)	Hg (ppb)
		ICP	ICP	NA	NA	NA	ICP	ICP	NA	ICP	ICP	NA	NA	NA	NA	ICP	NA	NA	NA	AA
Y1	0.05	ND	2.53	10.7	7	470	1	3	2.5	0.21	ND	70	12	55	3	7	1.2	2.5	14	24
	0.15	ND	1.51	6.8	11	420	ND	ND	1.4	0.12	ND	63	7	37	2	ND	1	1.7	17	15
	0.25	ND	1.58	6.1	3	380	ND	ND	1.4	0.12	ND	60	6	39	2	2	0.9	1.4	17	26
	0.35	ND	2.65	8.6	ND	570	2	ND	1.7	0.20	ND	81	12	61	3	8	1.4	2.4	16	33
	0.45	ND	0.60	3.3	ND	220	ND	ND	ND	0.04	ND	35	3	20	ND	ND	0.4	0.6	13	11
	0.55	ND	0.91	3.4	ND	210	ND	3	ND	0.06	ND	39	4	24	ND	2	0.5	0.8	14	14
	0.65	ND	0.55	2.8	2	200	ND	ND	ND	0.04	ND	37	2	21	ND	1	0.5	0.6	15	9
	0.75	ND	1.57	4.1	ND	300	ND	ND	ND	0.11	ND	51	4	32	1	6	0.8	1.1	16	22
	0.85	ND	0.76	4.2	ND	240	ND	ND	ND	0.06	ND	18	3	12	ND	2	0.3	0.7	3	6
	0.95	ND	0.66	3.3	ND	230	ND	ND	ND	0.05	ND	48	3	18	ND	2	0.6	0.8	14	6
	1.05	ND	1.36	4.3	ND	320	ND	ND	ND	0.10	ND	54	6	35	1	4	0.9	1.3	12	13
	1.15	ND	1.64	5.3	ND	340	ND	ND	1	0.12	ND	65	6	34	2	6	0.9	1.4	15	14
	1.25	ND	1.01	4.5	ND	240	ND	ND	ND	0.08	ND	33	5	24	ND	3	0.5	1	8	10
	1.35	ND	0.37	2.9	ND	130	ND	ND	ND	0.03	ND	19	2	23	ND	2	0.4	0.5	9	6
	1.45	ND	0.35	1.3	ND	95	ND	ND	ND	0.02	ND	9	2	11	ND	2	ND	0.2	2	5
	1.55	ND	0.66	1.9	ND	120	ND	ND	ND	0.03	ND	23	2	14	ND	2	0.3	0.4	9	5
	1.65	ND	0.58	3.1	ND	83	ND	ND	ND	0.04	ND	19	3	11	ND	3	0.3	0.5	5	8
	1.75	ND	0.58	3.3	ND	150	ND	ND	ND	0.04	ND	23	4	17	ND	3	0.4	0.7	6	7
	1.85	ND	0.54	4	ND	140	ND	ND	0.7	0.04	ND	30	5	11	ND	3	ND	0.7	4	7
	1.95	ND	0.56	3.2	ND	99	ND	ND	ND	0.04	ND	15	4	8	ND	3	0.3	0.6	3	6

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ir (ppb)	K (%)	La (ppm)	Lu (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Nd (ppm)	Ni (ppm)	P (%)	Pb (ppm)	Rb (ppm)	S (%)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sm (ppm)	Sn (%)
		NA	ICP	NA	NA	ICP	ICP	ICP	NA	NA	ICP	ICP	ICP	NA	ICP	NA	NA	NA	NA	NA
Y1	0.05	ND	1.25	38	0.51	0.20	495	2	0.4	33	13	0.022	17	76	0.028	0.7	7.7	ND	7	ND
	0.15	ND	0.83	33.9	0.45	0.10	290	ND	0.2	29	7	0.012	14	36	0.012	0.5	4.7	ND	6	ND
	0.25	ND	0.77	32.8	0.45	0.11	289	1	0.2	29	8	0.015	14	46	0.019	0.4	4.7	ND	5.9	ND
	0.35	ND	1.27	42.5	0.58	0.22	451	ND	0.3	31	16	0.027	20	58	0.034	0.6	8.7	ND	7.5	ND
	0.45	ND	0.37	17.1	0.23	0.03	189	ND	0.1	12	3	0.002	11	18	0.004	0.3	1.7	ND	3.1	ND
	0.55	ND	0.47	19.1	0.3	0.05	181	ND	0.1	14	4	0.006	11	15	0.006	0.4	2.5	ND	3.1	ND
	0.65	ND	0.35	20.4	0.3	0.03	116	ND	0.1	18	2	0.002	7	16	0.003	0.2	1.7	ND	3.6	ND
	0.75	ND	0.78	30.1	0.44	0.10	232	ND	0.2	24	7	0.012	11	28	0.014	0.3	3.6	ND	5.3	ND
	0.85	ND	0.56	8.3	0.11	0.03	180	ND	0.1	8	3	0.008	7	21	0.005	0.2	1.3	ND	1.4	ND
	0.95	ND	0.48	22.3	0.36	0.03	218	ND	0.1	20	3	0.003	9	ND	0.003	0.3	1.7	ND	3.8	ND
	1.05	ND	0.77	26.6	0.42	0.08	211	ND	0.2	20	6	0.013	12	27	0.011	0.3	3.7	ND	4.6	ND
	1.15	ND	0.81	30.7	0.41	0.11	270	ND	0.2	18	8	0.015	15	33	0.015	0.5	4	ND	5.3	ND
	1.25	ND	0.58	14.8	0.25	0.05	216	ND	0.1	10	5	0.008	11	ND	0.008	0.3	2.3	ND	2.5	ND
	1.35	ND	0.23	9.1	0.18	0.02	85	ND	0.1	7	2	0.003	8	ND	0.004	0.2	1.2	ND	1.5	ND
	1.45	ND	0.20	4.3	0.07	0.01	63	ND	0	ND	1	0.002	9	ND	0.003	0.2	0.6	ND	0.7	ND
	1.55	ND	0.25	11.2	0.13	0.02	75	ND	0.1	6	2	0.004	6	ND	0.004	0.1	1	ND	1.7	ND
	1.65	ND	0.30	8.6	0.13	0.03	135	ND	0	8	4	0.007	12	ND	0.004	0.2	0.9	ND	1.4	ND
	1.75	ND	0.30	10.2	0.19	0.03	90	ND	0.1	11	4	0.009	9	ND	0.007	0.2	1.3	ND	1.8	ND
	1.85	ND	0.26	13.7	0.14	0.03	88	ND	0.1	13	4	0.010	8	ND	0.011	0.2	1.3	ND	2.7	ND
	1.95	ND	0.29	7.3	0.09	0.03	130	ND	0	6	6	0.010	12	ND	0.006	0.1	1	ND	1.3	ND

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods										
		Sr (ppm)	Ta (ppm)	Tb (ppm)	Th (ppm)	Ti (%)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Yb (ppm)	Zn (ppm)
		ICP	NA	NA	NA	ICP	NA	ICP	NA	ICP	NA	ICP
Y1	0.05	77	0.9	0.9	9.8	0.38	4.1	61	2	19	3.2	52
	0.15	49	1	ND	9	0.25	3.6	21	1	13	2.9	30
	0.25	47	ND	0.7	8.2	0.41	3.3	40	2	14	2.9	35
	0.35	78	1.1	1	10.8	0.53	4.2	82	ND	21	3.9	57
	0.45	23	0.5	ND	5	0.20	1.7	5	ND	11	1.4	24
	0.55	29	ND	ND	5.6	0.22	2.2	7	ND	12	2	24
	0.65	21	0.6	ND	5.4	0.17	2.3	4	ND	5	1.9	15
	0.75	48	ND	0.6	7.2	0.32	3.2	31	ND	12	2.9	30
	0.85	31	ND	ND	2.1	0.16	1.1	10	ND	7	0.7	17
	0.95	28	ND	ND	6.3	0.11	2.3	3	ND	21	2.3	23
	1.05	44	ND	0.5	7.2	0.26	2.2	23	ND	12	2.6	28
	1.15	48	ND	0.7	8.3	0.21	2.5	29	ND	13	2.7	31
	1.25	34	ND	ND	3.9	0.12	1.4	12	ND	7	1.5	20
	1.35	15	0.9	ND	2.4	0.19	0.8	4	ND	3	1.2	13
	1.45	14	ND	ND	1	0.13	ND	3	ND	3	0.4	11
	1.55	17	ND	ND	3	0.15	1	6	ND	4	0.9	13
	1.65	19	ND	ND	2.4	0.18	0.7	7	ND	7	0.8	19
	1.75	19	ND	ND	2.7	0.08	1.2	7	ND	6	1.2	18
	1.85	17	ND	ND	3.2	0.14	1.3	15	ND	6	0.9	16
	1.95	19	ND	ND	1.9	0.15	0.8	10	ND	7	0.6	19

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ag (ppm)	Al (%)	As (ppm)	Au (ppb)	Ba (ppm)	Be (ppm)	Bi (ppm)	Br (ppm)	Ca (%)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Eu (ppm)	Fe (%)	Hf (ppm)	Hg (ppb)
		ICP	ICP	NA	NA	NA	ICP	ICP	NA	ICP	ICP	NA	NA	NA	NA	ICP	NA	NA	NA	AA
Y2	0.05	ND	0.94	4.6	ND	290	ND	ND	0.6	0.08	ND	39	3	25	ND	5	0.5	0.9	10	14
	0.15	ND	0.50	2.1	ND	130	ND	ND	ND	0.04	ND	15	3	13	ND	2	0.3	0.5	5	8
	0.25	ND	0.57	2.3	8	200	ND	ND	ND	0.04	ND	29	2	18	ND	2	0.5	0.6	12	9
	0.35	ND	0.49	1.9	ND	170	ND	ND	ND	0.04	ND	21	3	17	ND	1	0.3	0.4	8	8
	0.45	ND	0.75	3	ND	200	ND	ND	ND	0.06	ND	46	3	24	ND	2	0.6	0.8	13	13
	0.55	ND	1.46	5.8	2	290	ND	ND	ND	0.10	ND	57	9	40	1	4	0.8	1.5	14	21
	0.65	ND	0.47	2.7	ND	190	ND	ND	ND	0.04	ND	18	2	12	ND	2	0.3	0.5	4	11
	0.75	ND	0.45	2.6	ND	160	ND	ND	ND	0.03	ND	27	3	17	ND	1	0.4	0.5	11	8
	0.85	ND	0.53	3.7	ND	170	ND	ND	ND	0.05	ND	24	3	15	ND	1	0.4	0.7	7	11
	0.95	ND	0.64	2.7	ND	230	ND	ND	ND	0.05	ND	28	3	18	ND	1	0.5	0.6	11	11
	1.05	ND	0.76	3.3	ND	240	ND	ND	ND	0.06	ND	24	4	16	ND	2	0.4	0.8	6	18
	1.15	ND	0.59	3	ND	180	ND	ND	ND	0.04	ND	17	2	13	ND	1	0.3	0.6	3	11
	1.25	ND	0.55	3.4	ND	190	ND	ND	ND	0.04	ND	17	3	15	ND	ND	0.3	0.6	4	16
	1.35	ND	0.52	3.2	ND	200	ND	ND	ND	0.04	ND	35	3	15	ND	ND	0.5	0.7	11	12
	1.45	ND	1.20	4.2	ND	330	ND	ND	ND	0.09	ND	46	5	27	ND	ND	0.7	1.2	11	21
	1.55	ND	0.80	3.2	3	300	ND	ND	0.7	0.06	ND	56	4	27	ND	4	0.8	0.9	19	15
	1.65	ND	0.49	3	ND	200	ND	ND	ND	0.03	ND	27	4	11	ND	ND	0.4	0.6	7	16
	1.75	ND	0.35	2.9	ND	87	ND	ND	ND	0.02	ND	16	3	8	ND	ND	0.3	0.5	4	10
	1.85	ND	0.41	3.3	ND	140	ND	ND	ND	0.03	ND	17	4	9	ND	ND	0.3	0.6	3	12
	1.95	ND	0.34	3.2	ND	110	ND	ND	ND	0.02	ND	15	2	11	ND	ND	0.3	0.5	3	7
	2.05	ND	0.28	2.7	ND	89	ND	ND	ND	0.02	ND	13	2	8	ND	ND	0.2	0.4	3	6
	2.15	ND	0.28	2.5	ND	92	ND	ND	ND	0.01	ND	13	2	7	ND	ND	0.2	0.3	2	6

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ir (ppb)	K (%)	La (ppm)	Lu (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Nd (ppm)	Ni (ppm)	P (%)	Pb (ppm)	Rb (ppm)	S (%)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sm (ppm)	Sn (%)
		NA	ICP	NA	NA	ICP	ICP	ICP	NA	NA	ICP	ICP	ICP	NA	ICP	NA	NA	NA	NA	NA
Y2	0.05	ND	0.53	15.8	0.25	0.06	155	ND	0.2	15	4	0.007	11	17	0.009	0.4	2.7	ND	2.9	ND
	0.15	ND	0.33	7.3	0.13	0.02	102	ND	0.1	7	2	0.002	11	ND	0.003	0.2	1.1	ND	1.2	ND
	0.25	ND	0.38	12.4	0.24	0.03	107	ND	0.1	9	3	0.003	8	ND	0.004	0.3	1.5	ND	2.2	ND
	0.35	ND	0.35	9.9	0.17	0.02	117	ND	0.1	7	2	0.002	8	ND	0.004	0.2	1.2	ND	1.6	ND
	0.45	ND	0.47	19	0.3	0.04	147	ND	0.1	16	4	0.007	9	16	0.006	0.3	2.3	ND	3.5	ND
	0.55	ND	0.75	26.3	0.41	0.10	230	ND	0.2	25	7	0.012	10	35	0.014	0.5	4.5	ND	4.7	ND
	0.65	ND	0.30	7.1	0.11	0.03	177	ND	0.1	9	3	0.002	12	ND	0.002	0.2	1.3	ND	1.3	ND
	0.75	ND	0.32	13.7	0.21	0.02	85	ND	0.1	11	2	0.001	7	ND	0.003	0.2	1.4	ND	2.5	ND
	0.85	ND	0.38	10.6	0.21	0.03	233	ND	0.1	10	1	0.002	10	ND	0.003	0.3	1.4	ND	1.8	ND
	0.95	ND	0.48	13.7	0.25	0.03	150	ND	0.1	12	3	0.003	8	21	0.003	0.2	1.6	ND	2.5	ND
	1.05	ND	0.50	10.1	0.21	0.04	185	ND	0.1	10	4	0.007	11	16	0.010	0.2	1.6	ND	1.5	ND
	1.15	ND	0.42	7	0.11	0.03	112	ND	0.1	6	3	0.005	7	17	0.005	0.3	1.2	ND	0.9	ND
	1.25	ND	0.39	7.8	0.13	0.03	87	ND	0.1	7	3	0.004	7	19	0.005	0.2	1.3	ND	1.1	ND
	1.35	ND	0.37	14.7	0.26	0.02	118	ND	0.1	13	3	0.003	8	18	0.002	0.2	1.5	ND	2	ND
	1.45	ND	0.72	23.4	0.35	0.07	204	ND	0.2	19	5	0.010	12	32	0.008	0.3	3.2	ND	3.1	ND
	1.55	ND	0.53	23.9	0.46	0.04	183	ND	0.1	20	3	0.004	9	24	0.004	0.4	2.5	ND	3.2	ND
	1.65	ND	0.28	11	0.16	0.02	83	ND	0.1	10	4	0.007	6	ND	0.005	0.2	1.5	ND	1.5	ND
	1.75	ND	0.13	6.8	0.1	0.01	65	ND	0	ND	3	0.008	6	ND	0.004	0.2	0.8	ND	0.9	ND
	1.85	ND	0.23	7.1	0.11	0.02	57	ND	0.1	7	3	0.006	6	ND	0.005	0.1	1	ND	1	ND
	1.95	ND	0.20	6.1	0.09	0.01	46	1	0	ND	2	0.005	5	ND	0.004	0.2	0.8	ND	0.8	ND
	2.05	ND	0.16	5.9	0.11	0.01	26	ND	0	ND	2	0.004	6	ND	0.004	0.1	0.7	ND	0.8	ND
	2.15	ND	0.10	5.7	0.07	ND	28	ND	0	ND	2	0.005	6	ND	0.004	0.1	0.6	ND	0.7	ND

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods										
		Sr (ppm)	Ta (ppm)	Tb (ppm)	Th (ppm)	Ti (%)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Yb (ppm)	Zn (ppm)
		ICP	NA	NA	NA	ICP	NA	ICP	NA	ICP	NA	ICP
Y2	0.05	35	0.6	ND	4.5	0.25	2	20	ND	7	1.8	22
	0.15	22	ND	ND	1.9	0.17	0.9	4	ND	5	0.8	16
	0.25	23	ND	ND	3.7	0.15	2	5	ND	5	1.5	15
	0.35	21	ND	ND	2.7	0.19	1	4	ND	7	1.1	15
	0.45	27	1	ND	5.6	0.28	2.3	8	ND	9	1.9	18
	0.55	45	0.8	ND	7.1	0.26	3.2	30	ND	11	2.6	28
	0.65	20	ND	ND	2.3	0.19	1.1	4	ND	14	0.8	19
	0.75	21	0.8	ND	3.9	0.14	1.3	3	ND	4	1.3	13
	0.85	24	ND	ND	2.8	0.20	1.6	4	ND	13	1.3	19
	0.95	28	0.8	ND	4.4	0.17	2	4	ND	9	1.6	16
	1.05	29	ND	ND	2.7	0.18	0.9	7	ND	12	1.3	19
	1.15	24	0.9	ND	2	0.21	0.7	8	ND	6	0.7	14
	1.25	23	ND	ND	2.4	0.15	0.8	6	ND	4	0.8	12
	1.35	22	ND	ND	4.6	0.15	1.5	5	ND	6	1.7	13
	1.45	41	1	ND	6.8	0.16	2.5	14	ND	11	2.3	23
	1.55	31	1.2	ND	7.2	0.19	2.9	6	ND	12	2.9	19
	1.65	17	0.8	ND	3.1	0.09	0.8	13	ND	3	1.1	11
	1.75	9	ND	ND	1.8	0.04	1	12	ND	4	0.7	12
	1.85	15	ND	ND	2	0.06	0.8	11	ND	4	0.7	19
	1.95	13	ND	ND	1.8	0.07	0.5	9	ND	3	0.6	16
	2.05	12	ND	ND	1.4	0.07	0.8	7	ND	2	0.7	13
	2.15	8	ND	ND	1.2	0.03	0.6	7	ND	3	0.4	12

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ag (ppm)	Al (%)	As (ppm)	Au (ppb)	Ba (ppm)	Be (ppm)	Bi (ppm)	Br (ppm)	Ca (%)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Eu (ppm)	Fe (%)	Hf (ppm)	Hg (ppb)
		ICP	ICP	NA	NA	NA	ICP	ICP	NA	ICP	ICP	NA	NA	NA	NA	ICP	NA	NA	NA	AA
Y3	0.05	ND	2.59	6.4	2	330	1	2	1.2	0.18	ND	49	7	36	1	6	0.9	1.5	7	21
	0.15	ND	0.53	2.9	ND	160	ND	ND	ND	0.04	ND	15	3	12	ND	ND	0.3	0.5	3	ND
	0.25	ND	0.65	5.2	ND	220	ND	ND	0.8	0.05	ND	27	7	13	ND	ND	0.5	0.9	4	8
	0.35	ND	0.44	2.5	ND	150	ND	ND	ND	0.03	ND	14	3	9	ND	ND	0.2	0.5	2	ND
	0.45	ND	0.43	2.9	ND	140	ND	ND	ND	0.03	ND	20	3	14	ND	ND	0.3	0.5	7	ND
	0.55	ND	0.62	2.2	ND	120	ND	ND	ND	0.03	ND	14	3	9	ND	3	0.2	0.4	4	5
	0.65	ND	0.48	2.3	ND	120	ND	ND	ND	0.03	ND	16	2	12	ND	1	0.3	0.5	5	ND
	0.75	ND	0.40	2	ND	140	ND	ND	ND	0.03	ND	11	2	8	ND	4	ND	0.3	3	ND
	0.85	ND	0.41	2.2	ND	120	ND	ND	ND	0.03	ND	11	2	7	ND	ND	0.2	0.4	2	6
	0.95	ND	0.43	2.5	ND	130	ND	ND	ND	0.03	ND	11	2	10	ND	ND	0.2	0.4	2	8
	1.05	ND	0.37	1.7	ND	120	ND	ND	ND	0.02	ND	11	2	10	ND	ND	0.3	0.3	4	5
	1.15	ND	0.38	2	ND	140	ND	ND	ND	0.03	ND	12	1	10	ND	ND	0.3	0.3	5	ND
	1.25	ND	0.40	2.2	ND	120	ND	ND	0.6	0.03	ND	9	2	7	ND	ND	0.2	0.3	2	ND
	1.35	ND	0.48	2.8	ND	160	ND	ND	ND	0.03	ND	13	2	10	ND	ND	0.2	0.4	4	ND
	1.45	ND	0.46	2.9	ND	130	ND	ND	ND	0.03	ND	16	2	11	ND	ND	0.3	0.5	7	5
	1.55	ND	0.30	2.1	ND	100	ND	ND	ND	0.02	ND	14	2	9	ND	ND	0.3	0.4	5	ND

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ir (ppb)	K (%)	La (ppm)	Lu (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Nd (ppm)	Ni (ppm)	P (%)	Pb (ppm)	Rb (ppm)	S (%)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sm (ppm)	Sn (%)
		NA	ICP	NA	NA	ICP	ICP	ICP	NA	NA	ICP	ICP	ICP	NA	ICP	NA	NA	NA	NA	NA
Y3	0.05	ND	0.96	20.5	0.31	0.18	398	1	0.2	19	13	0.024	15	36	0.024	0.3	4.2	ND	2.9	ND
	0.15	ND	0.31	7.2	0.11	0.03	81	ND	0.1	6	4	0.006	7	ND	0.006	0.2	1.1	ND	0.9	ND
	0.25	ND	0.37	10.2	0.16	0.04	122	ND	0.1	10	4	0.008	6	19	0.008	0.2	1.7	ND	1.5	ND
	0.35	ND	0.28	5.4	0.07	0.02	52	ND	0.1	5	3	0.005	6	ND	0.005	0.1	0.9	ND	0.7	ND
	0.45	ND	0.27	7.9	0.15	0.02	61	ND	0.1	6	2	0.006	4	ND	0.005	0.2	1.2	ND	1	ND
	0.55	ND	0.26	6.2	0.09	0.02	83	ND	0	ND	4	0.006	6	ND	0.005	0.1	1	ND	0.8	ND
	0.65	ND	0.27	6.6	0.13	0.02	55	ND	0.1	7	3	0.005	6	ND	0.005	0.2	1	ND	0.9	ND
	0.75	ND	0.25	5.6	0.08	0.02	46	ND	0.1	ND	2	0.005	6	ND	0.004	0.2	0.8	ND	0.7	ND
	0.85	ND	0.23	5.4	0.07	0.02	58	ND	0.1	5	3	0.006	6	ND	0.004	0.1	0.8	ND	0.8	ND
	0.95	ND	0.27	5.2	0.08	0.02	55	ND	0.1	5	3	0.007	6	ND	0.004	0.2	0.8	ND	0.7	ND
	1.05	ND	0.26	5.3	0.08	0.01	43	ND	0.1	ND	2	0.003	5	ND	0.004	0.2	0.8	ND	0.8	ND
	1.15	ND	0.25	5.9	0.09	0.01	35	ND	0.1	ND	2	0.004	4	ND	0.004	0.1	0.8	ND	0.8	ND
	1.25	ND	0.27	4.6	0.06	0.02	33	ND	0.1	ND	2	0.004	5	ND	0.004	0.1	0.8	ND	0.6	ND
	1.35	ND	0.32	6.1	0.1	0.02	53	ND	0.1	ND	3	0.006	9	ND	0.004	0.2	1	ND	0.8	ND
	1.45	ND	0.26	8.1	0.15	0.02	58	ND	0.1	ND	3	0.007	6	ND	0.004	0.1	1.1	ND	1.2	ND
	1.55	ND	0.13	7	0.1	0.02	39	ND	0	ND	2	0.005	4	ND	0.006	0.2	1	ND	1.1	ND

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods										
		Sr (ppm)	Ta (ppm)	Tb (ppm)	Th (ppm)	Ti (%)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Yb (ppm)	Zn (ppm)
		ICP	NA	NA	NA	ICP	NA	ICP	NA	ICP	NA	ICP
Y3	0.05	65	ND	ND	5.5	0.34	1.9	65	ND	19	2	46
	0.15	18	ND	ND	1.8	0.07	0.8	13	ND	4	0.7	15
	0.25	23	ND	ND	2.3	0.19	1.1	16	ND	5	1	17
	0.35	16	ND	ND	1.6	0.08	ND	10	ND	3	0.5	11
	0.45	16	ND	ND	2.5	0.11	1	11	ND	3	1	12
	0.55	17	0.6	ND	1.6	0.11	0.8	12	ND	3	0.6	14
	0.65	17	ND	ND	2.1	0.10	1.1	10	ND	3	0.8	12
	0.75	16	ND	ND	1.5	0.08	0.5	10	ND	3	0.5	14
	0.85	16	ND	ND	1.2	0.08	0.5	11	ND	3	0.5	12
	0.95	16	ND	ND	1.4	0.08	0.5	11	ND	4	0.5	12
	1.05	16	ND	ND	1.5	0.10	0.7	8	ND	2	0.5	10
	1.15	16	ND	ND	1.7	0.06	0.7	8	ND	2	0.6	10
	1.25	17	ND	ND	1	0.08	0.7	8	ND	2	0.4	9
	1.35	18	ND	ND	1.6	0.10	0.8	11	ND	3	0.6	11
	1.45	14	ND	ND	2.2	0.09	0.8	12	ND	3	0.9	12
	1.55	9	ND	ND	2.1	0.09	ND	8	ND	3	0.6	11

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ag (ppm)	Al (%)	As (ppm)	Au (ppb)	Ba (ppm)	Be (ppm)	Bi (ppm)	Br (ppm)	Ca (%)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Eu (ppm)	Fe (%)	Hf (ppm)	Hg (ppb)
		ICP	ICP	NA	NA	NA	ICP	ICP	NA	ICP	ICP	NA	NA	NA	NA	ICP	NA	NA	NA	AA
Y4	0.05	ND	0.73	6.2	ND	160	ND	ND	ND	0.05	ND	17	4	12	ND	ND	0.3	1	2	7
	0.15	ND	0.70	4.3	ND	130	ND	ND	ND	0.05	ND	16	3	9	ND	1	0.3	0.7	5	8
	0.25	ND	0.58	5.1	ND	110	ND	ND	ND	0.04	ND	15	4	11	ND	1	0.3	0.8	2	10
	0.35	ND	0.40	3.6	ND	110	ND	ND	ND	0.03	ND	12	2	11	ND	ND	0.3	0.6	3	8
	0.45	ND	0.56	3.2	ND	130	ND	ND	ND	0.03	ND	10	3	11	ND	3	0.2	0.5	3	7
	0.55	ND	0.41	2.6	ND	130	ND	ND	ND	0.02	ND	11	2	7	ND	ND	0.2	0.5	2	5
	0.65	ND	0.32	2.5	ND	100	ND	ND	0.7	0.02	ND	14	2	14	ND	ND	0.2	0.4	5	ND
	0.75	ND	0.33	4	ND	100	ND	ND	ND	0.02	ND	14	3	10	ND	ND	0.3	0.7	3	6
	0.85	ND	0.61	4	ND	150	ND	ND	ND	0.04	ND	14	2	11	ND	ND	0.3	0.7	4	7
	0.95	ND	1.05	5.4	ND	200	ND	ND	ND	0.07	ND	24	4	18	ND	ND	0.5	1	7	9
	1.05	ND	0.48	3	ND	130	ND	ND	ND	0.03	ND	10	2	8	ND	ND	0.3	0.5	3	5
	1.15	ND	0.55	4.9	ND	130	ND	ND	0.8	0.04	ND	18	3	12	ND	ND	0.3	0.8	4	9
	1.25	ND	0.50	4.9	ND	150	ND	ND	ND	0.03	ND	22	5	15	ND	ND	0.5	0.9	6	8
Y5	0.05	ND	0.57	6.9	ND	94	ND	ND	0.5	0.04	ND	17	5	11	ND	ND	0.3	1.1	2	14
	0.15	ND	0.98	16.5	2	150	2	2	0.9	0.07	ND	32	13	16	ND	2	0.6	2.6	3	14
	0.25	ND	0.52	10.1	ND	120	ND	ND	0.6	0.03	ND	21	9	16	ND	ND	0.4	1.6	3	18
	0.35	ND	0.33	5.4	ND	77	ND	ND	ND	0.02	ND	13	4	10	ND	ND	0.3	0.9	3	6
	0.45	ND	0.24	2.2	ND	77	ND	ND	ND	0.01	ND	10	2	8	ND	ND	ND	0.4	3	7
	0.55	ND	0.25	2.8	ND	71	ND	ND	ND	0.02	ND	8	2	ND	ND	ND	ND	0.5	2	7
	0.65	ND	0.82	4.6	ND	110	ND	ND	ND	0.04	ND	16	4	10	ND	2	0.3	0.8	4	12

Table 4-2 continued.

Core ID	Depth (m)	Ir (ppb)	K (%)	La (ppm)	Lu (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Nd (ppm)	Ni (ppm)	P (%)	Pb (ppm)	Rb (ppm)	S (%)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sm (ppm)	Sn (%)
		NA	ICP	NA	NA	ICP	ICP	ICP	NA	NA	ICP	ICP	ICP	NA	ICP	NA	NA	NA	NA	NA
Y4	0.05	ND	0.34	7.6	0.11	0.04	154	ND	0.1	7	7	0.017	11	ND	0.006	0.3	1.3	ND	1.3	ND
	0.15	ND	0.29	6.9	0.12	0.05	172	ND	0.1	6	7	0.020	11	ND	0.006	0.2	1.1	ND	1.1	ND
	0.25	ND	0.25	7.5	0.09	0.03	129	ND	0	5	5	0.014	10	ND	0.005	0.2	1	ND	1	ND
	0.35	ND	0.26	6.2	0.08	0.02	61	ND	0	5	2	0.005	6	ND	0.003	0.1	0.9	ND	0.9	ND
	0.45	ND	0.26	5.6	0.09	0.02	86	ND	0.1	ND	3	0.008	5	ND	0.006	0.1	0.9	ND	0.8	ND
	0.55	ND	0.22	5.9	0.08	0.02	46	ND	0	ND	3	0.005	6	ND	0.005	0.1	0.9	ND	0.9	ND
	0.65	ND	0.19	7.1	0.08	0.01	50	ND	0	ND	2	0.004	6	ND	0.004	0.2	0.9	ND	0.9	ND
	0.75	ND	0.19	7.1	0.08	0.01	46	ND	0	ND	3	0.005	5	ND	0.004	0.2	0.9	ND	1.1	ND
	0.85	ND	0.40	7.5	0.09	0.02	86	ND	0.1	5	3	0.007	7	ND	0.006	0.2	1.2	ND	1.2	ND
	0.95	ND	0.55	11.6	0.22	0.06	191	ND	0.1	8	7	0.021	13	17	0.012	0.2	1.8	ND	2	ND
	1.05	ND	0.25	5.7	0.08	0.02	76	ND	0.1	ND	4	0.010	7	ND	0.005	0.1	0.9	ND	0.9	ND
	1.15	ND	0.29	7.7	0.13	0.03	91	ND	0.1	6	4	0.012	10	ND	0.005	0.2	1.1	ND	1.4	ND
	1.25	ND	0.27	10.8	0.16	0.03	98	ND	0.1	8	3	0.009	5	ND	0.005	0.2	1.5	ND	1.8	ND
Y5	0.05	ND	0.24	7.3	0.08	0.03	179	1	0	6	7	0.017	14	ND	0.006	0.2	1.1	ND	1.2	ND
	0.15	ND	0.34	13.1	0.21	0.06	489	ND	0.1	12	16	0.043	27	15	0.010	0.4	2.1	ND	2.4	ND
	0.25	ND	0.24	9.4	0.15	0.03	176	ND	0.1	7	8	0.019	8	ND	0.005	0.3	1.4	ND	1.7	ND
	0.35	ND	0.16	6.3	0.09	0.02	86	ND	0	5	3	0.009	7	ND	0.004	0.2	0.9	ND	1.1	ND
	0.45	ND	0.13	4.8	0.1	0.01	37	ND	0	ND	2	0.004	4	ND	0.005	0.1	0.7	ND	0.7	ND
	0.55	ND	0.12	4.6	0.06	ND	50	ND	0	ND	2	0.005	5	ND	0.003	0.1	0.6	ND	0.7	ND
	0.65	ND	0.24	7.8	0.1	0.05	152	ND	0	5	8	0.016	12	ND	0.006	0.2	1.3	ND	1.3	ND

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods										
		Sr (ppm)	Ta (ppm)	Tb (ppm)	Th (ppm)	Ti (%)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Yb (ppm)	Zn (ppm)
		ICP	NA	NA	NA	ICP	NA	ICP	NA	ICP	NA	ICP
Y4	0.05	22	ND	ND	1.9	0.07	0.6	26	ND	8	0.7	21
	0.15	19	ND	ND	1.8	0.07	0.8	30	ND	7	0.7	23
	0.25	17	ND	ND	1.5	0.08	0.5	21	ND	6	0.6	17
	0.35	16	ND	ND	1.6	0.13	0.6	10	ND	3	0.6	11
	0.45	14	ND	ND	1.6	0.07	0.7	13	ND	4	0.6	12
	0.55	16	ND	ND	1.5	0.06	0.8	9	ND	3	0.5	10
	0.65	13	ND	ND	1.8	0.11	ND	7	ND	2	0.5	7
	0.75	13	ND	ND	1.7	0.09	0.8	9	ND	3	0.5	10
	0.85	23	ND	ND	2.1	0.19	0.7	15	ND	4	0.6	17
	0.95	32	0.5	ND	3.1	0.12	1.3	32	ND	9	1.4	23
	1.05	17	ND	ND	1.4	0.05	0.6	15	ND	4	0.5	12
	1.15	18	ND	ND	2.3	0.08	1	19	ND	5	0.8	15
	1.25	17	ND	ND	2.8	0.11	1.4	15	ND	4	0.9	13
Y5	0.05	17	ND	ND	1.4	0.09	0.7	23	ND	6	0.6	21
	0.15	24	ND	ND	3.3	0.11	1.4	51	ND	17	1.2	41
	0.25	16	ND	ND	2.5	0.06	0.9	22	ND	7	0.9	21
	0.35	10	ND	ND	1.7	0.05	1.2	13	ND	4	0.6	13
	0.45	9	ND	ND	1.6	0.06	ND	7	ND	2	0.6	9
	0.55	8	ND	ND	1.1	0.03	0.6	8	ND	3	0.4	9
	0.65	18	ND	ND	2	0.08	0.8	26	ND	8	0.7	22

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ag (ppm)	Al (%)	As (ppm)	Au (ppb)	Ba (ppm)	Be (ppm)	Bi (ppm)	Br (ppm)	Ca (%)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Eu (ppm)	Fe (%)	Hf (ppm)	Hg (ppb)
		ICP	ICP	NA	NA	NA	ICP	ICP	NA	ICP	ICP	NA	NA	NA	NA	ICP	NA	NA	NA	AA
Y6	0.05	ND	0.35	1.5	ND	81	ND	ND	ND	0.03	ND	9	2	11	ND	ND	0.2	0.3	4	5
	0.15	ND	0.32	1.7	ND	70	ND	2	ND	0.02	ND	9	2	12	ND	ND	0.2	0.3	5	ND
	0.25	ND	0.26	2.5	ND	66	ND	ND	ND	0.02	ND	12	2	11	ND	ND	0.3	0.4	5	ND
	0.35	ND	2.07	6.4	ND	290	1	ND	1.4	0.13	ND	54	8	47	2	4	0.9	1.7	14	19
	0.45	ND	3.04	12.1	3	690	2	2	2.6	0.21	ND	93	15	93	4	9	2	3.4	14	39
	0.55	ND	1.75	8.1	ND	220	1	ND	1.5	0.09	ND	39	8	31	1	6	0.8	1.6	11	18
	0.65	ND	2.83	11.5	ND	440	2	ND	2.3	0.16	ND	63	11	54	3	11	1.3	2.5	9	22
	0.75	ND	1.06	20	ND	190	2	ND	ND	0.08	ND	41	16	27	ND	5	0.7	3.1	5	25
	0.85	ND	0.39	6.2	ND	60	ND	ND	ND	0.02	ND	13	4	12	ND	ND	0.3	0.9	3	7
	0.95	ND	0.39	4	ND	77	ND	ND	0.5	0.02	ND	16	3	12	ND	ND	0.3	0.7	6	8
	1.05	ND	0.32	3.5	ND	63	ND	ND	ND	0.01	ND	10	3	8	ND	ND	0.3	0.6	4	6
	1.15	ND	3.69	9.1	ND	87	2	ND	ND	0.13	ND	19	8	15	ND	9	0.3	1.4	3	7
	1.25	ND	0.53	14	ND	140	ND	ND	0.6	0.03	ND	27	11	20	ND	ND	0.5	2.4	4	11

Table 4-2 continued.

Core ID	Depth (m)	Ir (ppb)	K (%)	La (ppm)	Lu (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Nd (ppm)	Ni (ppm)	P (%)	Pb (ppm)	Rb (ppm)	S (%)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sm (ppm)	Sn (%)
		Element Concentrations, Units, and Methods																		
		NA	ICP	NA	NA	ICP	ICP	ICP	NA	NA	ICP	ICP	ICP	NA	ICP	NA	NA	NA	NA	NA
Y6	0.05	ND	0.20	5.4	0.08	0.02	115	ND	0	ND	2	0.001	8	ND	0.002	0.1	0.9	ND	0.7	ND
	0.15	ND	0.19	5.1	0.09	0.01	67	ND	0	ND	2	0.003	8	ND	0.004	0.1	0.8	ND	0.7	ND
	0.25	ND	0.10	6.1	0.11	0.01	41	ND	0	ND	2	0.004	4	ND	0.003	0.1	0.8	ND	0.8	ND
	0.35	ND	0.75	26.8	0.41	0.15	384	ND	0.2	21	12	0.018	15	23	0.019	0.5	5.6	ND	4.2	ND
	0.45	ND	1.45	47.3	0.7	0.24	562	2	0.4	39	22	0.034	19	85	0.031	1	12.6	ND	7.7	ND
	0.55	ND	0.57	18.3	0.3	0.11	220	ND	0.1	13	12	0.024	14	21	0.012	0.4	4	ND	3	ND
	0.65	ND	1.08	31.2	0.44	0.19	462	1	0.3	25	18	0.039	23	49	0.022	0.6	7.8	ND	5.1	ND
	0.75	ND	0.35	17.9	0.24	0.06	294	1	0.1	15	15	0.040	28	ND	0.008	0.6	2.5	ND	3.7	ND
	0.85	ND	0.11	5.6	0.09	0.02	70	ND	0	ND	5	0.012	7	ND	0.004	0.2	0.9	ND	1.1	ND
	0.95	ND	0.15	8	0.09	0.02	77	ND	0	6	5	0.013	9	ND	0.010	0.1	1	ND	1.3	ND
	1.05	ND	0.08	5.2	0.09	0.01	83	ND	0	ND	5	0.011	5	ND	0.002	0.2	0.7	ND	1	ND
	1.15	ND	1.76	7.6	0.12	0.22	634	ND	0	6	16	0.025	17	ND	0.008	0.3	1.2	ND	1.5	ND
	1.25	ND	0.22	10.8	0.25	0.03	188	ND	0.1	9	7	0.017	15	ND	0.006	0.4	1.8	ND	2.1	ND

Table 4-2 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods										
		Sr (ppm)	Ta (ppm)	Tb (ppm)	Th (ppm)	Ti (%)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Yb (ppm)	Zn (ppm)
		ICP	NA	NA	NA	ICP	NA	ICP	NA	ICP	NA	ICP
Y6	0.05	15	ND	ND	1.6	0.19	ND	4	ND	5	0.5	14
	0.15	14	ND	ND	1.4	0.23	ND	9	ND	2	0.5	12
	0.25	8	ND	ND	1.6	0.04	0.7	7	ND	2	0.6	8
	0.35	47	1	ND	6.9	0.33	2.2	49	ND	15	2.6	40
	0.45	80	1.9	0.8	12.5	0.54	4.9	101	ND	21	4.8	68
	0.55	35	0.5	ND	5.3	0.24	2	52	ND	13	2	37
	0.65	64	0.7	ND	8.1	0.44	2.5	87	ND	20	2.9	59
	0.75	27	ND	ND	4.2	0.14	1.6	51	ND	18	1.6	41
	0.85	9	ND	ND	1.5	0.06	0.9	18	ND	4	0.5	15
	0.95	11	ND	ND	2.8	0.06	0.9	21	ND	5	0.6	14
	1.05	8	ND	ND	1.4	0.03	0.6	15	ND	4	0.5	12
	1.15	80	ND	ND	2.3	0.52	1.1	69	ND	25	0.8	55
	1.25	14	ND	ND	3.3	0.08	1.1	24	ND	7	1.8	30

Table 4-3. Summary of bulk chemical characteristics of sediment samples taken within the debris plug. ND—not detected, ppm—parts per million, %—percent by mass, ppb—parts per billion.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ag (ppm)	Al (%)	As (ppm)	Au (ppb)	Ba (ppm)	Be (ppm)	Bi (ppm)	Br (ppm)	Ca (%)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Eu (ppm)	Fe (%)	Hf (ppm)	Hg (ppb)
		ICP	ICP	NA	NA	NA	ICP	ICP	NA	ICP	ICP	NA	NA	NA	NA	ICP	NA	NA	NA	AA
DP1	0.15	ND	3.72	8.6	ND	530	2	ND	2.8	0.27	ND	71	11	49	2	11	1.2	2.2	13	28
	0.46	ND	0.41	2.2	ND	130	ND	ND	ND	0.03	ND	15	3	10	ND	ND	0.3	0.5	5	7
	0.76	ND	0.41	1.4	ND	82	ND	ND	ND	0.02	ND	12	2	6	ND	ND	0.2	0.4	3	6
	1.07	ND	0.25	2	ND	95	ND	ND	ND	0.02	ND	11	2	11	ND	ND	0.2	0.4	3	21
	1.37	ND	0.28	2.4	ND	80	ND	ND	ND	0.01	ND	10	2	8	ND	2	ND	0.4	3	5
DP2	0.15	ND	2.75	6.2	2	390	1	ND	2.8	0.22	ND	54	9	43	2	10	0.9	1.7	9	28
	0.46	ND	0.41	2.5	2	140	ND	ND	ND	0.02	ND	16	2	15	ND	2	0.2	0.5	4	6
	0.76	ND	0.35	2.4	ND	110	ND	ND	ND	0.02	ND	14	2	12	ND	ND	0.3	0.4	4	5
	1.07	ND	0.30	2	ND	87	ND	ND	ND	0.02	ND	12	2	9	ND	ND	0.2	0.4	4	5
	1.37	ND	0.31	2.2	ND	81	ND	ND	ND	0.02	ND	13	2	13	ND	ND	0.3	0.4	5	5
DP3	0.15	ND	4.95	11.2	ND	540	2	ND	3.7	0.31	0.4	75	15	71	4	12	1.4	2.6	10	37
	0.46	ND	4.64	12.9	4	550	2	ND	3.3	0.29	ND	85	18	77	4	14	1.5	3	10	40
	0.76	ND	2.28	6.4	ND	280	1	ND	1.4	0.15	ND	40	8	37	2	6	0.7	1.4	9	18
	1.07	ND	1.13	4.2	ND	210	ND	ND	0.8	0.07	ND	28	5	28	ND	3	0.5	0.9	6	12
	1.37	ND	0.81	3.7	ND	130	ND	ND	0.5	0.05	ND	16	3	15	ND	1	0.3	0.6	4	12
	1.68	ND	0.35	3.9	ND	100	ND	ND	ND	0.02	ND	15	3	13	ND	ND	0.3	0.5	4	7
	1.98	ND	0.42	4.2	2	150	ND	ND	ND	0.03	ND	24	4	21	ND	ND	0.5	0.7	9	9
	2.29	ND	0.39	3.1	ND	130	ND	ND	ND	0.02	ND	23	3	20	ND	ND	0.4	0.5	9	9
DP4	0.15	ND	4.91	11.7	ND	500	2	ND	2.7	0.26	ND	86	13	73	3	12	1.5	2.6	12	36
	0.46	ND	1.67	5.6	ND	270	1	ND	0.7	0.09	ND	40	6	35	1	4	0.7	1.2	8	16
	0.76	ND	1.21	4.4	ND	220	ND	ND	0.7	0.07	ND	29	4	21	ND	2	0.5	0.9	6	12
	1.07	ND	0.51	3.5	ND	140	ND	ND	1	0.03	ND	23	3	18	ND	ND	0.4	0.6	6	7
	1.37	ND	0.41	2.8	ND	110	ND	ND	ND	0.02	ND	15	2	17	ND	ND	0.3	0.5	4	6

Table 4-3 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ir (ppb)	K (%)	La (ppm)	Lu (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Nd (ppm)	Ni (ppm)	P (%)	Pb (ppm)	Rb (ppm)	S (%)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sm (ppm)	Sn (%)
		NA	ICP	NA	NA	ICP	ICP	ICP	NA	NA	ICP	ICP	ICP	NA	ICP	NA	NA	NA	NA	NA
DP1	0.15	ND	1.23	34.2	0.53	0.25	957	1	0.3	32	20	0.032	10	64	0.018	0.6	7	ND	6.8	ND
	0.46	ND	0.16	7.9	0.16	0.02	65	ND	0	7	2	0.006	3	ND	0.002	0.1	1.1	ND	1.4	ND
	0.76	ND	0.15	5.3	0.07	0.02	42	ND	0	5	2	0.005	ND	ND	0.003	0.1	0.8	ND	1.1	ND
	1.07	ND	0.09	5.3	0.08	ND	19	ND	0	ND	2	0.004	4	ND	0.003	0.1	0.8	ND	1	ND
	1.37	ND	0.08	4.2	0.09	0.01	18	ND	0	ND	2	0.005	7	ND	0.002	0.1	0.7	ND	0.8	ND
DP2	0.15	ND	0.90	27.1	0.37	0.20	849	2	0.3	27	15	0.033	10	54	0.015	0.6	5.9	ND	4.9	ND
	0.46	ND	0.19	7.6	0.1	0.02	41	ND	0.1	7	2	0.005	6	ND	0.003	0.2	1.1	ND	1.4	ND
	0.76	ND	0.15	6.8	0.09	0.02	37	ND	0	ND	3	0.005	ND	ND	0.004	0.2	0.9	ND	0.8	ND
	1.07	ND	0.13	6.8	0.09	0.01	16	ND	0	5	2	0.004	4	ND	0.003	0.2	0.8	ND	0.8	ND
	1.37	ND	0.14	6.2	0.11	0.01	20	ND	0	6	2	0.004	3	ND	0.003	0.2	0.9	ND	0.8	ND
DP3	0.15	ND	1.31	39.1	0.56	0.30	1213	2	0.4	32	18	0.041	14	85	0.015	0.9	9.3	ND	5.5	ND
	0.46	ND	1.34	42.9	0.55	0.31	1094	ND	0.4	34	23	0.044	16	89	0.028	1	10	ND	6	ND
	0.76	ND	0.71	21.2	0.33	0.16	524	1	0.2	21	12	0.024	9	31	0.015	0.6	4.2	ND	2.8	ND
	1.07	ND	0.37	13.5	0.21	0.07	237	ND	0.1	11	6	0.013	10	19	0.008	0.3	2.5	ND	1.8	ND
	1.37	ND	0.28	8.1	0.11	0.05	142	ND	0.1	ND	5	0.010	5	16	0.006	0.3	1.3	ND	1	ND
	1.68	ND	0.14	7	0.11	0.02	37	ND	0	6	2	0.005	4	ND	0.004	0.2	1	ND	1	ND
	1.98	ND	0.16	13.3	0.23	0.02	61	ND	0.1	12	4	0.006	4	17	0.011	0.3	1.5	ND	1.7	ND
	2.29	ND	0.16	12.2	0.19	0.02	51	ND	0.1	12	2	0.004	7	ND	0.006	0.2	1.3	ND	1.5	ND
DP4	0.15	ND	1.37	42.8	0.64	0.30	560	2	0.4	34	20	0.042	13	70	0.019	0.9	8.9	ND	6.2	ND
	0.46	ND	0.62	18.5	0.28	0.11	239	ND	0.2	18	9	0.018	11	45	0.010	0.5	3.5	ND	2.7	ND
	0.76	ND	0.43	15.2	0.21	0.08	174	1	0.1	9	7	0.013	11	22	0.009	0.3	2.3	ND	2	ND
	1.07	ND	0.21	11.6	0.16	0.03	83	ND	0.1	10	3	0.006	ND	ND	0.004	0.3	1.5	ND	1.6	ND
	1.37	ND	0.15	7.5	0.1	0.02	56	ND	0	ND	3	0.005	5	ND	0.004	0.2	1	ND	1.1	ND

Table 4-3 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods										
		Sr (ppm)	Ta (ppm)	Tb (ppm)	Th (ppm)	Ti (%)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Yb (ppm)	Zn (ppm)
		ICP	NA	NA	NA	ICP	NA	ICP	NA	ICP	NA	ICP
DP1	0.15	84	ND	0.8	8.6	0.58	3.3	82	ND	29	3.5	63
	0.46	11	ND	ND	2.2	0.11	1.1	10	ND	4	1	11
	0.76	11	ND	ND	1.5	0.09	0.6	8	ND	3	0.5	8
	1.07	8	ND	ND	1.5	0.04	0.6	6	ND	2	0.5	7
	1.37	7	ND	ND	1.2	0.04	0.7	7	ND	3	0.6	6
DP2	0.15	63	ND	0.5	7.3	0.43	2.9	63	ND	19	2.5	48
	0.46	12	ND	ND	1.8	0.18	0.5	11	ND	3	0.6	9
	0.76	10	ND	ND	1.9	0.07	0.8	8	ND	4	0.6	7
	1.07	10	ND	ND	1.8	0.03	0.7	7	ND	2	0.6	5
	1.37	9	ND	ND	1.8	0.08	0.8	8	ND	2	0.7	6
DP3	0.15	99	ND	0.9	10.2	0.64	4.1	95	2	26	3.8	70
	0.46	90	0.7	1	10.9	0.59	4.3	104	ND	28	3.7	79
	0.76	48	0.5	0.5	6.1	0.35	2.1	54	ND	16	2.2	42
	1.07	25	ND	ND	3.2	0.18	1.4	27	ND	9	1.3	21
	1.37	18	ND	ND	2.4	0.12	0.9	20	ND	6	0.7	15
	1.68	9	ND	ND	2.1	0.06	0.7	9	ND	3	0.7	9
	1.98	13	ND	ND	3.5	0.09	1.2	10	1	5	1.5	11
	2.29	10	0.6	ND	3.7	0.09	1.1	9	ND	3	1.2	7
DP4	0.15	86	1.5	0.9	10.6	0.66	4.1	98	5	32	4.2	64
	0.46	37	1	ND	4.7	0.30	1.5	39	ND	13	1.9	28
	0.76	26	0.5	ND	4	0.19	1.5	28	ND	9	1.4	21
	1.07	14	ND	ND	3.1	0.09	1.2	11	ND	4	1.1	10
	1.37	11	ND	ND	2	0.07	0.7	10	ND	3	0.6	8

Table 4-3 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ag (ppm)	Al (%)	As (ppm)	Au (ppb)	Ba (ppm)	Be (ppm)	Bi (ppm)	Br (ppm)	Ca (%)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Eu (ppm)	Fe (%)	Hf (ppm)	Hg (ppb)
		ICP	ICP	NA	NA	NA	ICP	ICP	NA	ICP	ICP	NA	NA	NA	NA	ICP	NA	NA	NA	AA
DP5	0.15	ND	6.70	10.5	4	540	2	ND	3.6	0.36	ND	83	12	71	3	10	1.4	2.6	12	34
	0.46	ND	5.02	11	2	620	2	ND	1.6	0.28	ND	81	12	76	3	11	1.4	2.7	13	33
	0.76	ND	0.99	5.5	ND	240	ND	ND	0.5	0.06	ND	31	4	26	ND	ND	0.5	0.9	8	10
	1.07	ND	0.83	4.8	2	230	ND	ND	0.6	0.05	ND	23	4	19	ND	16	0.5	0.8	6	11
	1.37	ND	0.73	3.9	ND	140	ND	ND	ND	0.04	ND	19	3	16	ND	ND	0.4	0.6	5	10
	1.68	ND	1.13	5.2	ND	240	ND	ND	0.8	0.07	ND	38	5	35	1	2	0.7	1	9	13
	1.98	ND	0.80	3.8	ND	220	ND	ND	ND	0.05	ND	27	4	24	ND	ND	0.5	0.9	5	10
	2.29	ND	0.35	2.3	ND	84	ND	ND	ND	0.02	ND	15	2	17	ND	ND	0.3	0.5	5	9
DP6	0.15	ND	4.42	13.5	ND	640	2	ND	3.5	0.26	ND	92	15	92	4	11	1.6	3	12	33
	0.46	ND	4.50	7.3	ND	600	2	ND	2.1	0.25	ND	78	8	79	4	10	1.5	2.4	12	43
	0.76	ND	4.11	10.6	2	600	2	ND	1.3	0.26	ND	88	14	82	4	10	1.5	2.9	12	36
	1.07	ND	4.04	10.1	ND	630	2	ND	1.4	0.23	ND	81	15	77	3	10	1.5	2.8	12	34
	1.37	ND	2.54	5.8	2	390	1	ND	0.8	0.16	ND	55	7	48	2	6	0.9	1.6	11	21
	1.68	ND	2.41	4.5	ND	260	1	ND	1	0.14	ND	35	5	34	1	6	0.7	1.1	7	15
	1.98	ND	1.98	4.5	2	230	1	ND	0.7	0.11	ND	34	4	32	1	4	0.6	1	8	18
	2.29	ND	1.57	4.3	ND	200	ND	ND	0.6	0.09	ND	36	4	33	1	3	0.6	1	8	14
	2.59	ND	0.68	3.5	3	180	ND	ND	ND	0.04	ND	28	3	23	1	ND	0.5	0.7	6	13
DP7	0.15	ND	4.40	10.7	3	580	2	ND	3	0.25	ND	80	14	79	4	11	1.4	2.8	9	34
	0.46	ND	2.09	8.6	ND	470	2	ND	ND	0.18	ND	67	12	47	1	9	1.3	1.7	10	43
	0.76	ND	2.68	8.1	3	510	1	ND	1.9	0.19	ND	63	9	57	2	6	1.2	2	11	29
	1.07	ND	3.52	8.7	4	520	2	ND	ND	0.21	ND	70	10	64	3	8	1.3	2.3	11	35
	1.37	ND	2.40	6.6	ND	380	1	ND	0.9	0.15	ND	53	8	45	2	6	0.9	1.6	9	19
	1.68	ND	1.95	4.5	2	310	1	ND	ND	0.13	ND	39	6	34	1	4	0.7	1.2	7	20
	1.98	ND	0.97	9	ND	210	ND	ND	0.6	0.06	ND	29	4	20	ND	1	0.5	0.9	8	13
	2.29	ND	1.09	3.9	ND	230	ND	ND	ND	0.07	ND	38	5	31	1	ND	0.7	1	9	18
	2.59	ND	1.28	5	ND	250	ND	3	ND	0.07	ND	39	5	37	1	2	0.7	1.2	8	15

Table 4-3 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ir (ppb)	K (%)	La (ppm)	Lu (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Nd (ppm)	Ni (ppm)	P (%)	Pb (ppm)	Rb (ppm)	S (%)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sm (ppm)	Sn (%)
		NA	ICP	NA	NA	ICP	ICP	ICP	NA	NA	ICP	ICP	ICP	NA	ICP	NA	NA	NA	NA	NA
DP5	0.15	ND	1.33	40.9	0.61	0.36	861	3	0.4	40	19	0.043	16	82	0.032	0.9	8.7	ND	6.1	ND
	0.46	ND	1.34	40.9	0.61	0.30	489	2	0.4	30	21	0.036	17	71	0.023	0.9	8.8	ND	6.1	ND
	0.76	ND	0.42	15	0.23	0.06	147	1	0.1	13	5	0.011	11	29	0.007	0.4	2.3	ND	2	ND
	1.07	ND	0.39	11.6	0.22	0.05	115	1	0.1	10	4	0.011	7	31	0.009	0.4	1.9	ND	1.6	ND
	1.37	ND	0.29	10.9	0.14	0.04	109	ND	0.1	11	4	0.008	9	15	0.007	0.2	1.6	ND	1.4	ND
	1.68	ND	0.45	18.6	0.3	0.07	174	ND	0.2	15	5	0.013	8	33	0.008	0.5	3.1	ND	2.6	ND
	1.98	ND	0.29	13.7	0.22	0.05	96	ND	0.1	11	5	0.009	7	22	0.006	0.3	2.4	ND	1.8	ND
	2.29	ND	0.16	7.7	0.13	0.02	46	ND	0	5	2	0.004	ND	ND	0.005	0.2	1	ND	1	ND
DP6	0.15	ND	1.33	46.6	0.71	0.29	1565	ND	0.5	36	21	0.039	12	77	0.016	1.2	10.6	ND	6.6	ND
	0.46	ND	1.32	43.7	0.69	0.28	399	3	0.4	39	17	0.032	17	71	0.026	1	10	ND	6	ND
	0.76	ND	1.34	44.5	0.69	0.30	572	3	0.4	36	18	0.037	12	53	0.025	1	10.1	ND	6.3	ND
	1.07	ND	1.32	41.3	0.68	0.27	518	2	0.4	35	18	0.035	15	80	0.038	1	9.3	ND	6	ND
	1.37	ND	0.90	27.4	0.41	0.18	379	2	0.2	22	12	0.021	11	36	0.016	0.6	5.3	ND	3.8	ND
	1.68	ND	0.76	18.4	0.26	0.17	284	1	0.2	18	11	0.023	9	36	0.022	0.5	3.7	ND	2.5	ND
	1.98	ND	0.64	17.3	0.27	0.14	259	2	0.1	16	9	0.019	8	22	0.011	0.3	3.1	ND	2.3	ND
	2.29	ND	0.50	18	0.25	0.11	240	ND	0.1	13	7	0.014	7	29	0.011	0.5	3.1	ND	2.3	ND
	2.59	ND	0.25	13.6	0.24	0.04	123	1	0.1	13	4	0.007	ND	22	0.008	0.3	2.4	ND	2	ND
DP7	0.15	ND	1.34	40.4	0.6	0.28	623	2	0.4	32	19	0.039	12	81	0.018	0.9	9.8	ND	6.1	ND
	0.46	ND	0.86	31	0.45	0.13	347	ND	0.3	27	23	0.029	16	25	0.077	0.7	4.9	ND	5.1	ND
	0.76	ND	1.10	31.9	0.55	0.17	470	ND	0.3	24	13	0.025	6	59	0.027	0.8	6	ND	5	ND
	1.07	ND	1.25	34.4	0.54	0.24	457	ND	0.4	32	16	0.030	16	59	0.024	0.9	7.6	ND	5.3	ND
	1.37	ND	0.89	27.4	0.43	0.15	334	1	0.3	19	11	0.022	13	34	0.020	0.6	4.9	ND	4.1	ND
	1.68	ND	0.74	18.8	0.32	0.13	260	ND	0.2	11	10	0.020	10	30	0.018	0.5	3.5	ND	2.8	ND
	1.98	ND	0.36	14.8	0.23	0.06	153	ND	0.1	12	5	0.009	8	23	0.007	0.4	2.3	ND	2.2	ND
	2.29	ND	0.45	17.6	0.32	0.06	133	1	0.2	16	6	0.010	11	18	0.010	0.4	2.9	ND	2.8	ND
	2.59	ND	0.49	18.7	0.31	0.08	143	ND	0.2	14	7	0.012	8	26	0.008	0.4	3.1	ND	2.8	ND

Table 4-3 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods										
		Sr (ppm)	Ta (ppm)	Tb (ppm)	Th (ppm)	Ti (%)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Yb (ppm)	Zn (ppm)
		ICP	NA	NA	NA	ICP	NA	ICP	NA	ICP	NA	ICP
DP5	0.15	104	1.4	ND	10.4	0.51	3.7	82	ND	42	4	64
	0.46	89	0.9	0.9	10.6	0.61	4.1	95	ND	32	4.1	65
	0.76	25	0.5	ND	4.2	0.19	1.5	19	ND	7	1.5	17
	1.07	23	ND	ND	3.4	0.15	1.6	18	ND	6	1.3	14
	1.37	19	ND	ND	3.1	0.15	1	14	ND	6	0.9	13
	1.68	30	0.8	ND	4.7	0.20	2.1	25	ND	10	1.9	19
	1.98	20	ND	0.5	3.5	0.13	1.8	17	2	6	1.4	13
	2.29	11	ND	ND	1.9	0.07	0.8	8	ND	2	0.8	6
DP6	0.15	89	ND	1.2	11.6	0.65	5	97	4	24	4.7	66
	0.46	85	1.2	0.9	11.5	0.62	4.2	92	ND	26	4.4	62
	0.76	87	ND	1.3	11.3	0.60	4.6	92	ND	27	4.5	63
	1.07	84	ND	0.8	10.9	0.60	4.4	91	4	25	4.5	61
	1.37	57	1.3	0.6	7.1	0.44	2.9	56	ND	18	2.7	39
	1.68	49	0.9	ND	4.6	0.38	1.7	55	ND	16	1.7	38
	1.98	41	0.5	ND	4.4	0.31	1.7	47	2	14	1.8	34
	2.29	33	0.7	ND	4.8	0.26	1.8	36	ND	12	1.7	25
	2.59	17	0.7	ND	3.6	0.12	1.4	15	ND	5	1.5	12
DP7	0.15	88	1.1	0.8	9.9	0.60	3.9	95	ND	24	4.1	63
	0.46	59	ND	0.8	6.6	0.34	3.1	57	ND	35	3	55
	0.76	69	ND	0.9	8	0.44	3.6	58	3	20	3.7	39
	1.07	77	ND	0.6	8.6	0.55	3.9	78	ND	23	3.7	51
	1.37	56	ND	0.5	6.7	0.40	2.5	53	2	17	2.8	43
	1.68	46	ND	0.5	5.4	0.31	2.1	46	ND	15	2	35
	1.98	23	ND	ND	4	0.12	1.6	16	ND	7	1.5	20
	2.29	28	ND	ND	4.9	0.20	2	21	ND	8	2	20
	2.59	30	0.9	0.5	5	0.23	1.8	26	ND	9	2	23

Table 4-3 continued.

Core ID	Depth (m)	Ag (ppm)	Al (%)	As (ppm)	Au (ppb)	Ba (ppm)	Be (ppm)	Bi (ppm)	Br (ppm)	Ca (%)	Cd (ppm)	Ce (ppm)	Co (ppm)	Cr (ppm)	Cs (ppm)	Cu (ppm)	Eu (ppm)	Fe (%)	Hf (ppm)	Hg (ppb)
		Element Concentrations, Units, and Methods																		
		ICP	ICP	NA	NA	NA	ICP	ICP	NA	ICP	ICP	NA	NA	NA	NA	ICP	NA	NA	NA	AA
DP8	0.15	ND	3.49	7.8	ND	510	2	ND	1.8	0.20	0.3	69	10	63	3	9	1.2	2.2	11	25
	0.46	ND	3.56	8.5	ND	550	2	ND	1.3	0.19	ND	64	9	62	3	24	1.2	2.1	10	32
	0.76	ND	3.75	9.3	ND	570	2	ND	2.3	0.22	ND	77	10	68	3	9	1.4	2.4	14	34
	1.07	ND	2.21	5	3	460	1	ND	1.6	0.14	ND	53	7	45	2	4	0.9	1.5	13	23
	1.37	ND	1.57	5.1	ND	310	ND	ND	ND	0.11	ND	43	5	31	1	4	0.7	1.2	12	16
	1.68	ND	1.45	4.2	2	310	ND	2	0.7	0.10	ND	33	4	29	ND	6	0.6	1	8	14
	1.98	ND	0.40	4.6	ND	130	ND	ND	ND	0.03	ND	18	3	17	ND	3	0.3	0.8	5	10
	2.29	ND	1.64	5.6	ND	370	ND	3	1.4	0.12	ND	46	7	43	2	7	0.9	1.5	11	23
	2.59	ND	0.73	3.6	ND	180	ND	ND	ND	0.05	ND	20	3	15	ND	5	0.3	0.6	5	10
DP9	0.15	ND	3.02	12.1	ND	660	1	3	2.5	0.25	ND	72	12	62	2	12	1.3	2.4	14	26
	0.46	ND	3.58	9.2	ND	510	2	3	1.4	0.22	ND	79	11	60	3	12	1.4	2.3	13	32
	0.76	ND	2.29	9.9	ND	450	1	2	1.1	0.21	ND	64	16	43	2	10	1.1	1.9	11	30
	1.07	ND	2.61	8.8	3	580	1	2	1.3	0.18	ND	70	11	55	3	8	1.3	2.1	15	28
	1.37	ND	1.06	4.4	ND	330	ND	ND	ND	0.08	ND	47	3	26	1	4	0.7	0.9	15	10
	1.68	ND	1.51	5.9	ND	380	ND	3	ND	0.11	ND	49	6	31	1	5	0.8	1.4	13	18
	1.98	ND	0.87	3.8	ND	250	ND	ND	0.6	0.06	ND	30	4	19	1	3	0.5	0.8	7	11
	2.29	ND	0.80	4	ND	200	ND	2	ND	0.06	ND	22	3	17	ND	3	0.4	0.7	6	10
DP10	0.15	ND	1.10	6.1	ND	320	ND	ND	1.4	0.09	ND	35	6	25	2	4	0.7	1.2	9	16
	0.46	ND	1.18	6.8	2	280	ND	ND	ND	0.10	ND	43	7	21	2	6	0.7	1.2	10	25
	0.76	ND	1.00	9.9	ND	310	ND	2	1.3	0.11	ND	48	12	21	1	5	1	1.4	5	20
	1.07	ND	1.28	6.8	ND	320	ND	ND	ND	0.11	ND	51	8	30	2	5	1.1	1.3	10	27
	1.37	ND	1.30	5.7	2	320	ND	ND	ND	0.09	ND	54	6	36	1	3	1.1	1.4	17	18
	1.68	ND	1.19	6.6	ND	410	ND	2	ND	0.09	ND	47	7	30	1	3	0.8	1.4	11	23
	1.98	ND	1.06	4.7	ND	300	ND	ND	0.7	0.08	ND	31	5	22	1	3	0.5	0.9	8	11
	2.29	ND	0.95	3.9	ND	280	ND	ND	ND	0.07	ND	32	4	20	ND	3	0.6	0.8	9	11

Table 4-3 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods																		
		Ir (ppb)	K (%)	La (ppm)	Lu (ppm)	Mg (%)	Mn (ppm)	Mo (ppm)	Na (%)	Nd (ppm)	Ni (ppm)	P (%)	Pb (ppm)	Rb (ppm)	S (%)	Sb (ppm)	Sc (ppm)	Se (ppm)	Sm (ppm)	Sn (%)
		NA	ICP	NA	NA	ICP	ICP	ICP	NA	NA	ICP	ICP	ICP	NA	ICP	NA	NA	NA	NA	NA
DP8	0.15	ND	1.17	32.4	0.52	0.22	483	1	0.3	29	14	0.029	14	75	0.014	0.9	7.3	ND	5.1	ND
	0.46	ND	1.19	33.1	0.51	0.21	407	ND	0.4	29	15	0.031	13	61	0.025	0.8	6.9	ND	5	ND
	0.76	ND	1.28	37.6	0.56	0.24	478	2	0.4	34	16	0.030	16	66	0.035	0.8	8.5	ND	7	ND
	1.07	ND	0.95	27.8	0.38	0.14	259	ND	0.3	23	9	0.019	12	47	0.027	0.5	5.1	ND	5.4	ND
	1.37	ND	0.78	20.7	0.3	0.10	179	ND	0.2	19	9	0.016	14	31	0.019	0.3	3.5	ND	3.8	ND
	1.68	ND	0.76	16.3	0.25	0.09	197	ND	0.2	13	7	0.015	12	17	0.015	0.5	3.3	ND	3.2	ND
	1.98	ND	0.19	8.8	0.13	0.02	51	ND	0.1	8	3	0.009	8	ND	0.005	0.2	1.4	ND	1.8	ND
	2.29	ND	0.86	24.2	0.34	0.11	201	ND	0.3	22	8	0.015	13	50	0.014	0.3	4.7	ND	4.7	ND
	2.59	ND	0.42	10	0.15	0.04	97	ND	0.1	7	5	0.009	7	ND	0.007	0.2	1.5	ND	1.8	ND
DP9	0.15	ND	1.36	36.6	0.55	0.20	485	ND	0.4	32	15	0.028	20	64	0.025	0.6	7.6	ND	7.4	ND
	0.46	ND	1.37	38.5	0.55	0.21	363	2	0.4	36	15	0.028	20	71	0.032	0.8	8	ND	7.3	ND
	0.76	ND	1.21	30.4	0.41	0.15	444	ND	0.4	30	17	0.024	17	58	0.090	0.6	5.8	ND	6.5	ND
	1.07	ND	1.28	35.1	0.52	0.17	339	ND	0.4	30	14	0.022	15	68	0.042	0.5	6.8	ND	6.7	ND
	1.37	ND	0.69	23.5	0.39	0.05	210	ND	0.2	17	5	0.010	13	26	0.010	0.3	2.8	ND	4.7	ND
	1.68	ND	0.85	25.1	0.4	0.09	216	ND	0.2	23	7	0.014	11	29	0.018	0.5	4.1	ND	5.1	ND
	1.98	ND	0.51	14.3	0.21	0.05	146	ND	0.1	12	4	0.009	8	ND	0.009	0.3	2.2	ND	2.9	ND
	2.29	ND	0.46	11.7	0.19	0.04	142	ND	0.1	10	5	0.009	10	ND	0.007	0.3	2	ND	2.4	ND
DP10	0.15	ND	0.64	16.8	0.25	0.07	174	ND	0.2	13	6	0.012	13	29	0.008	0.4	2.8	ND	3.7	ND
	0.46	ND	0.68	21.2	0.3	0.07	261	ND	0.2	21	7	0.017	14	18	0.013	0.4	2.5	ND	4.6	ND
	0.76	ND	0.62	20.8	0.28	0.06	193	ND	0.2	20	7	0.014	10	ND	0.022	0.5	2.9	ND	5.3	ND
	1.07	ND	0.74	24.8	0.33	0.08	248	ND	0.2	21	7	0.014	14	31	0.023	0.5	3.6	ND	5	ND
	1.37	ND	0.68	27.3	0.41	0.08	212	1	0.2	23	6	0.010	12	31	0.010	0.4	4.2	ND	5.4	ND
	1.68	ND	0.75	23.3	0.36	0.07	203	1	0.2	22	7	0.011	12	32	0.008	0.4	3.7	ND	4.7	ND
	1.98	ND	0.65	15.5	0.24	0.06	204	ND	0.2	11	5	0.011	14	31	0.009	0.4	2.4	ND	3	ND
	2.29	ND	0.59	16.4	0.24	0.05	190	ND	0.1	12	5	0.009	10	22	0.007	0.4	2.3	ND	2.9	ND

Table 4-3 continued.

Core ID	Depth (m)	Element Concentrations, Units, and Methods										
		Sr (ppm)	Ta (ppm)	Tb (ppm)	Th (ppm)	Ti (%)	U (ppm)	V (ppm)	W (ppm)	Y (ppm)	Yb (ppm)	Zn (ppm)
		ICP	NA	NA	NA	ICP	NA	ICP	NA	ICP	NA	ICP
DP8	0.15	74	0.9	0.7	9.4	0.53	4	74	3	21	3.4	54
	0.46	73	ND	0.8	8.4	0.52	3.2	73	ND	24	3.3	54
	0.76	80	1.6	1	10.3	0.51	3.8	76	ND	26	3.8	53
	1.07	56	ND	0.7	7.4	0.37	3.4	45	ND	15	2.6	33
	1.37	45	ND	0.5	5.7	0.30	2.3	40	ND	11	2	41
	1.68	44	0.6	ND	4.6	0.33	2.1	36	ND	11	1.7	36
	1.98	13	ND	ND	2.3	0.10	1	13	ND	3	0.9	20
	2.29	50	ND	0.6	7	0.33	2.9	41	ND	12	2.3	38
	2.59	25	ND	ND	2.4	0.19	0.9	18	ND	6	1	24
DP9	0.15	89	ND	0.8	9.6	0.50	4.2	75	ND	21	3.7	58
	0.46	86	1.3	1	9.5	0.49	3.5	80	ND	23	3.7	62
	0.76	75	ND	0.9	7.8	0.38	2.9	59	ND	21	2.8	55
	1.07	76	ND	0.8	9.6	0.41	4	61	ND	20	3.5	49
	1.37	39	0.9	ND	6.6	0.33	3	22	ND	10	2.6	26
	1.68	50	1	0.5	6.6	0.34	2.9	37	ND	12	2.7	32
	1.98	31	ND	ND	3.8	0.24	1.5	20	ND	7	1.3	22
	2.29	27	ND	ND	3.1	0.25	0.9	19	ND	8	1.2	22
DP10	0.15	38	ND	ND	4.6	0.25	2.2	23	ND	10	1.7	25
	0.46	42	ND	ND	5.2	0.37	1.9	33	1	12	2	30
	0.76	35	ND	ND	3.9	0.23	1.7	28	ND	11	1.9	27
	1.07	45	ND	0.6	6.3	0.36	2.5	33	ND	12	2.2	32
	1.37	40	0.8	0.6	8.3	0.20	2.9	17	1	11	2.7	28
	1.68	43	0.7	0.6	6.3	0.26	2.2	20	ND	12	2.4	27
	1.98	38	0.7	ND	4.4	0.30	1.7	22	ND	10	1.6	24
	2.29	36	ND	ND	4.2	0.32	1.6	19	ND	10	1.6	22

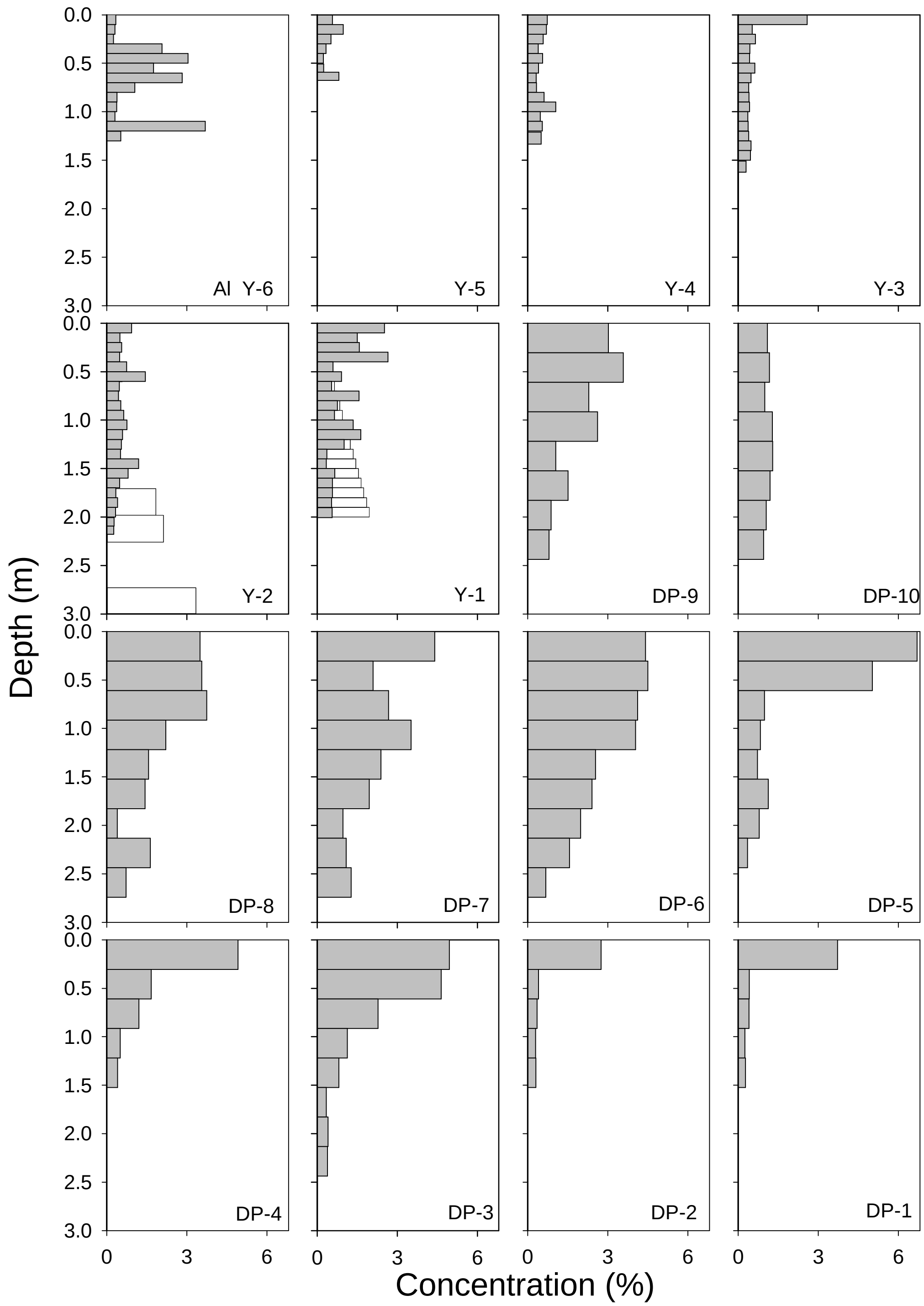


Figure 4-4. Variation is the concentration of aluminum (Al; % by mass) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

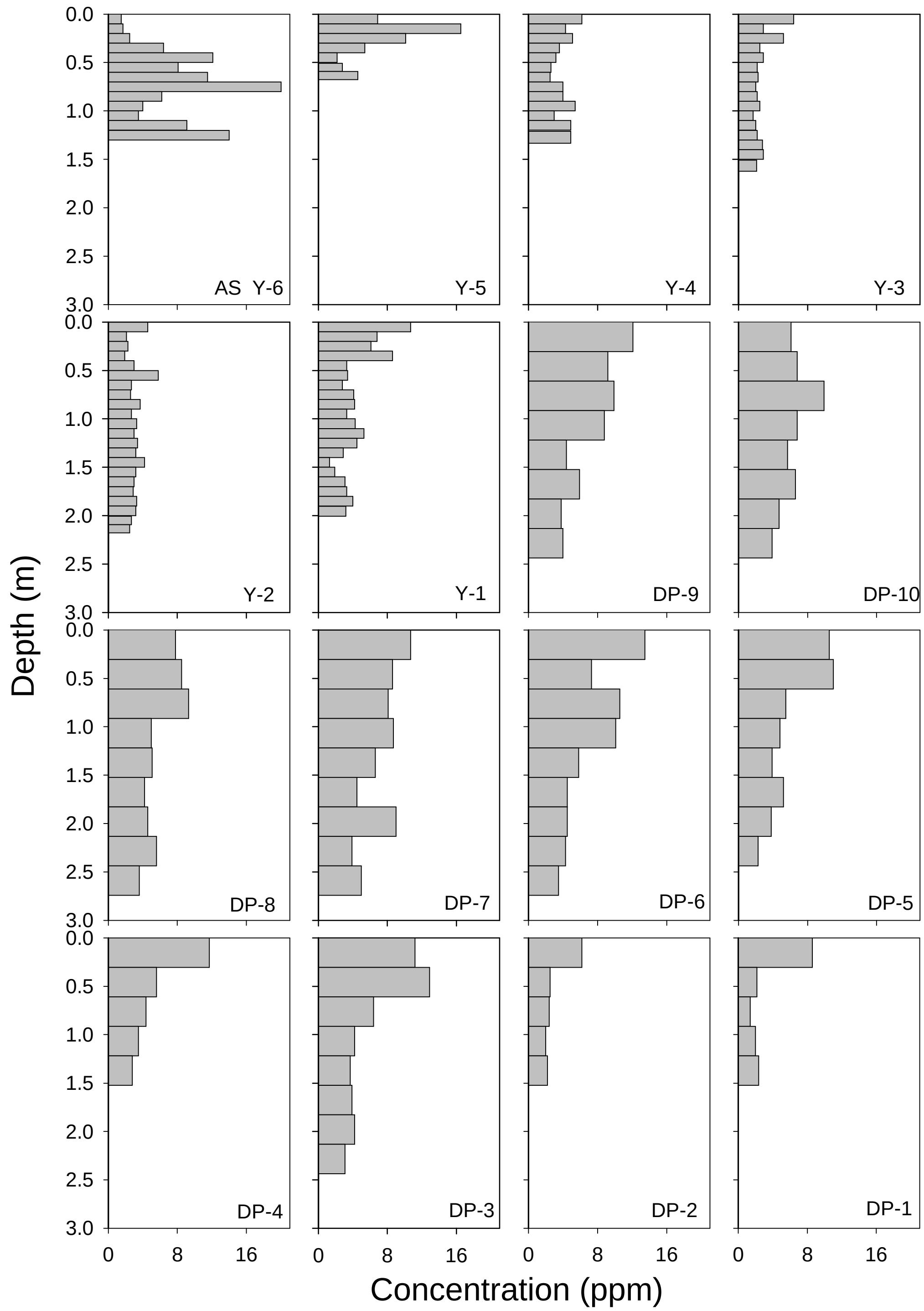


Figure 4-5. Variation is the concentration of arsenic (As; parts per million) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

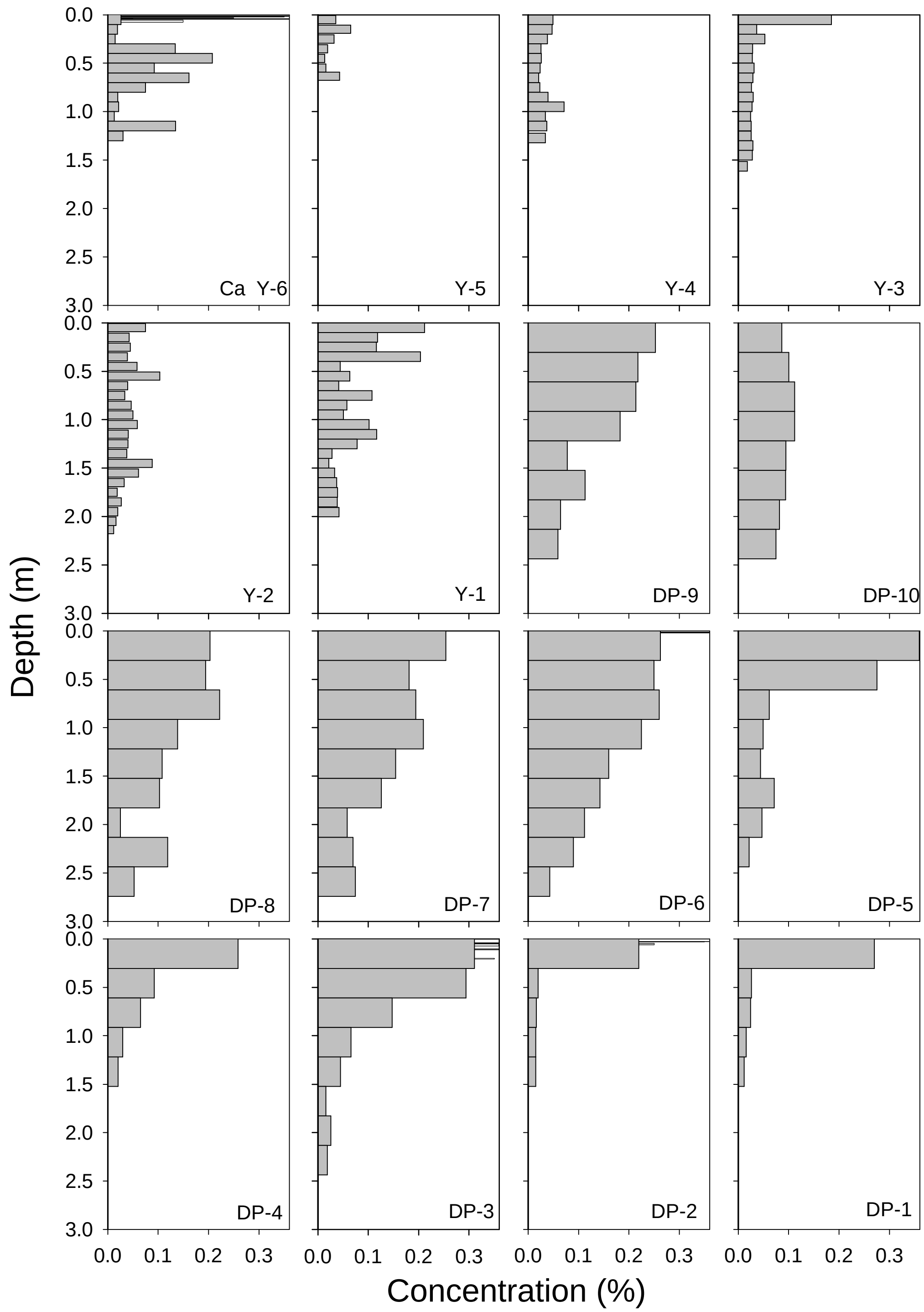


Figure 4-6. Variation is the concentration of calcium (Ca; % by mass) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

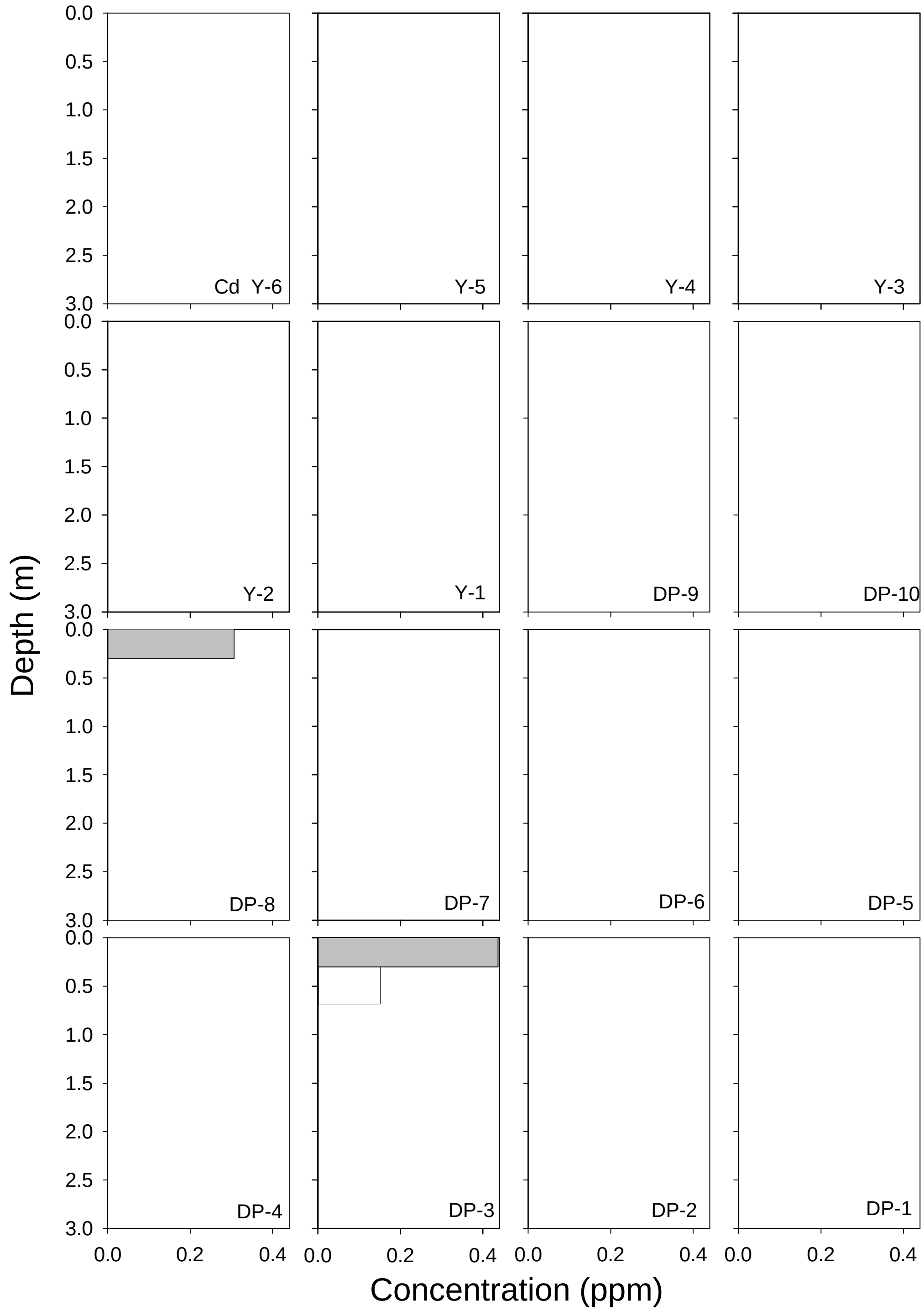


Figure 4-7. Variation is the concentration of cadmium (Cd; parts per million) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

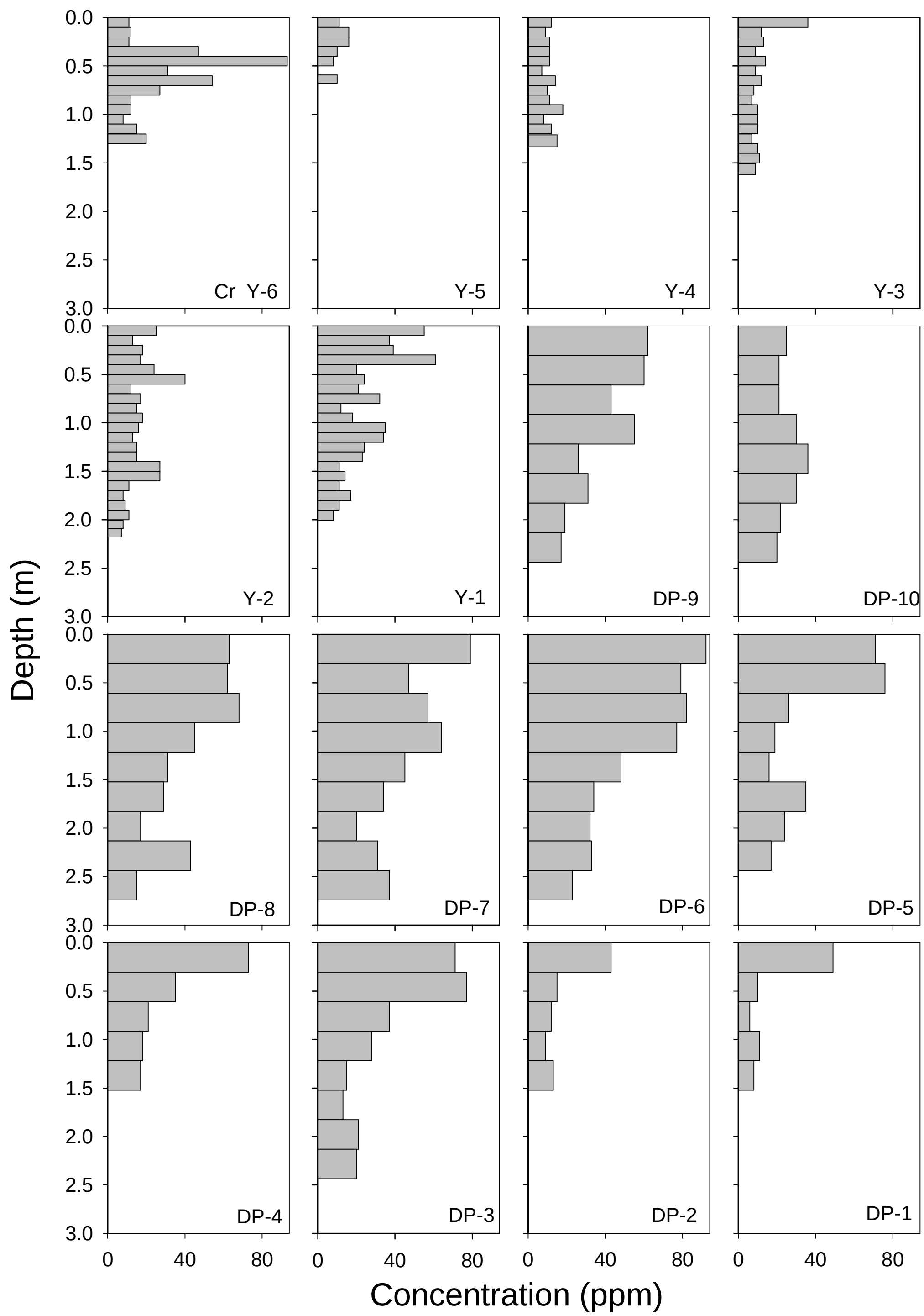


Figure 4-8. Variation is the concentration of chromium (Cr; parts per million) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

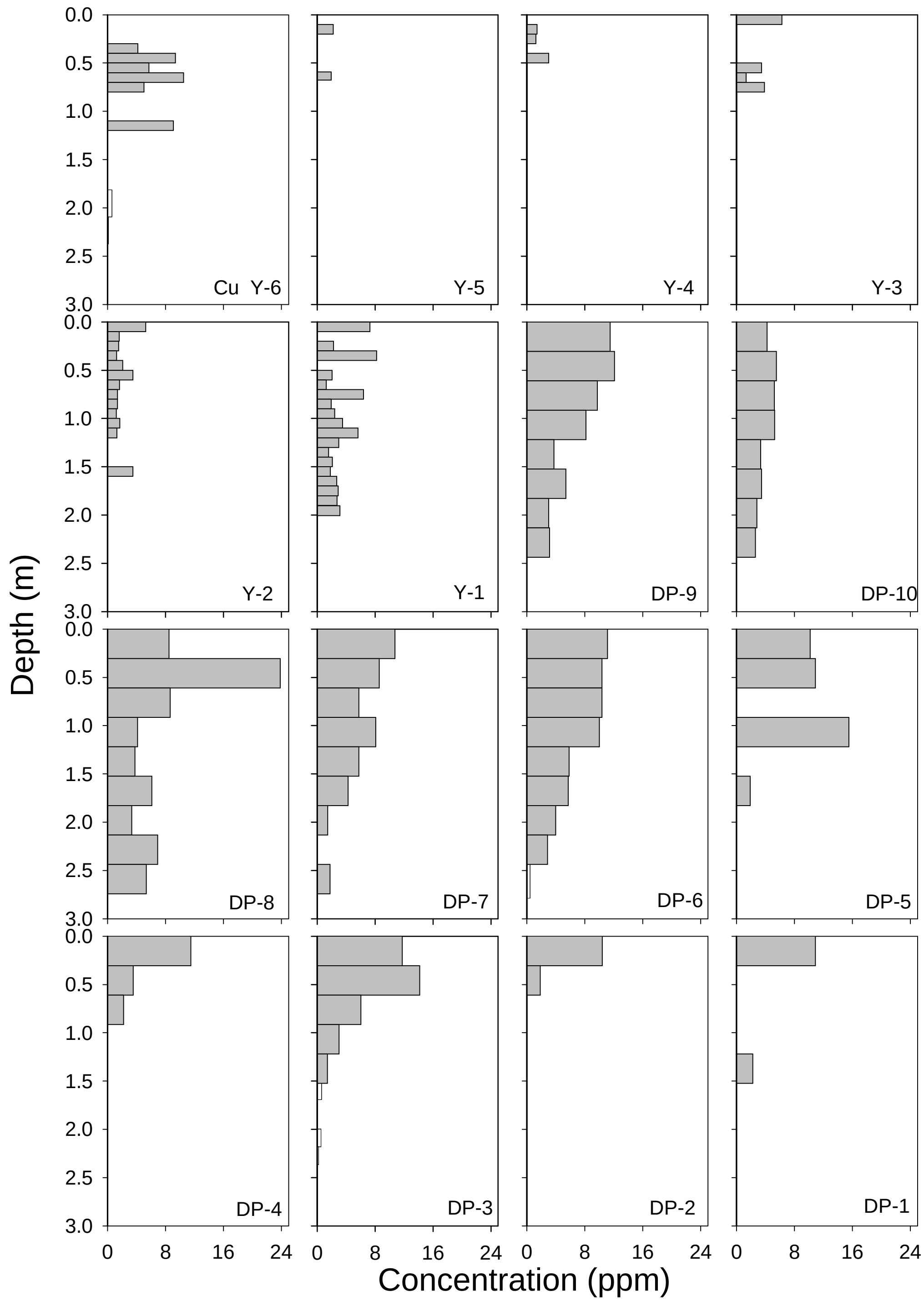


Figure 4-9. Variation is the concentration of copper (Cu; parts per million) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

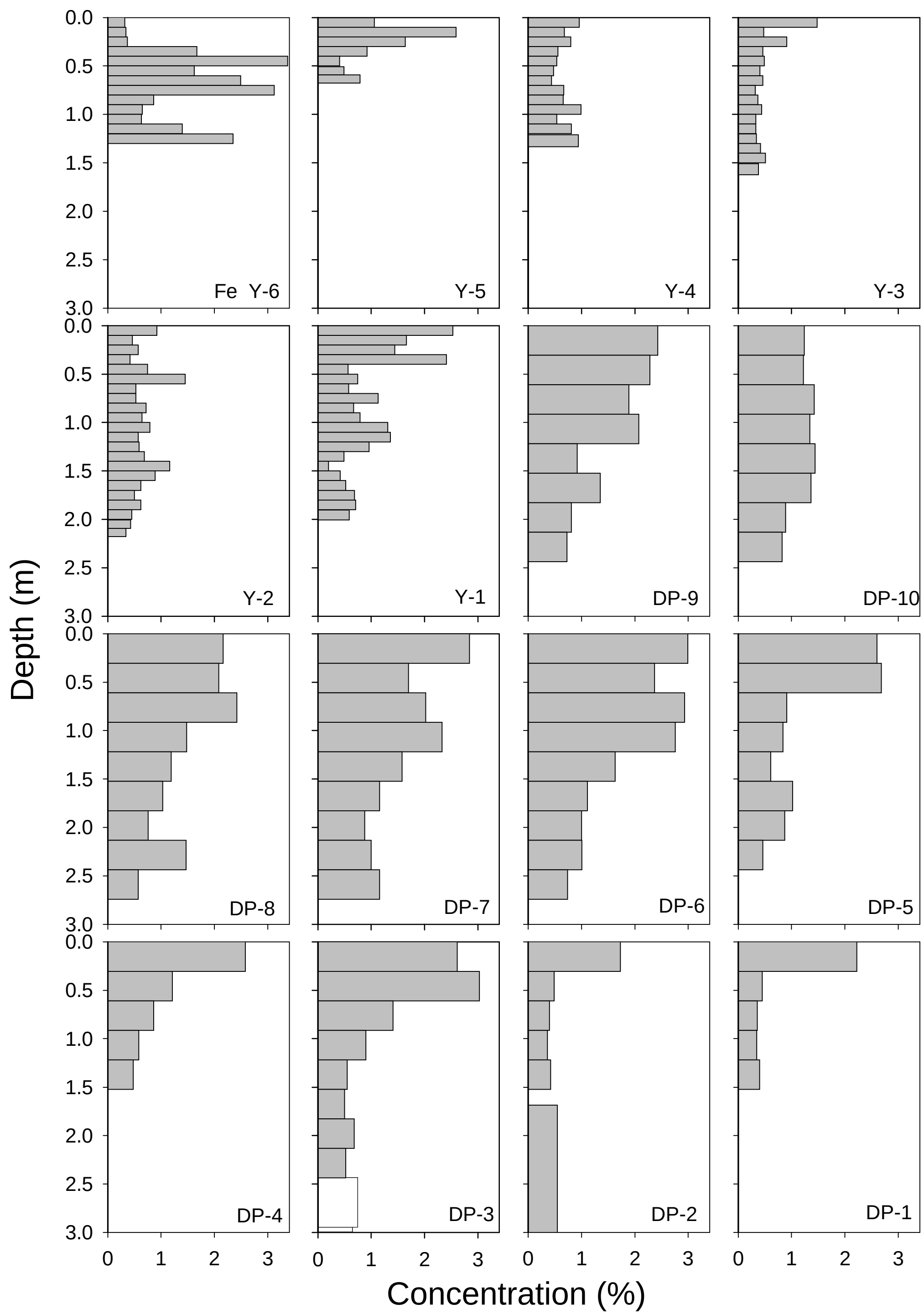


Figure 4-10. Variation is the concentration of iron (Fe; % by mass) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

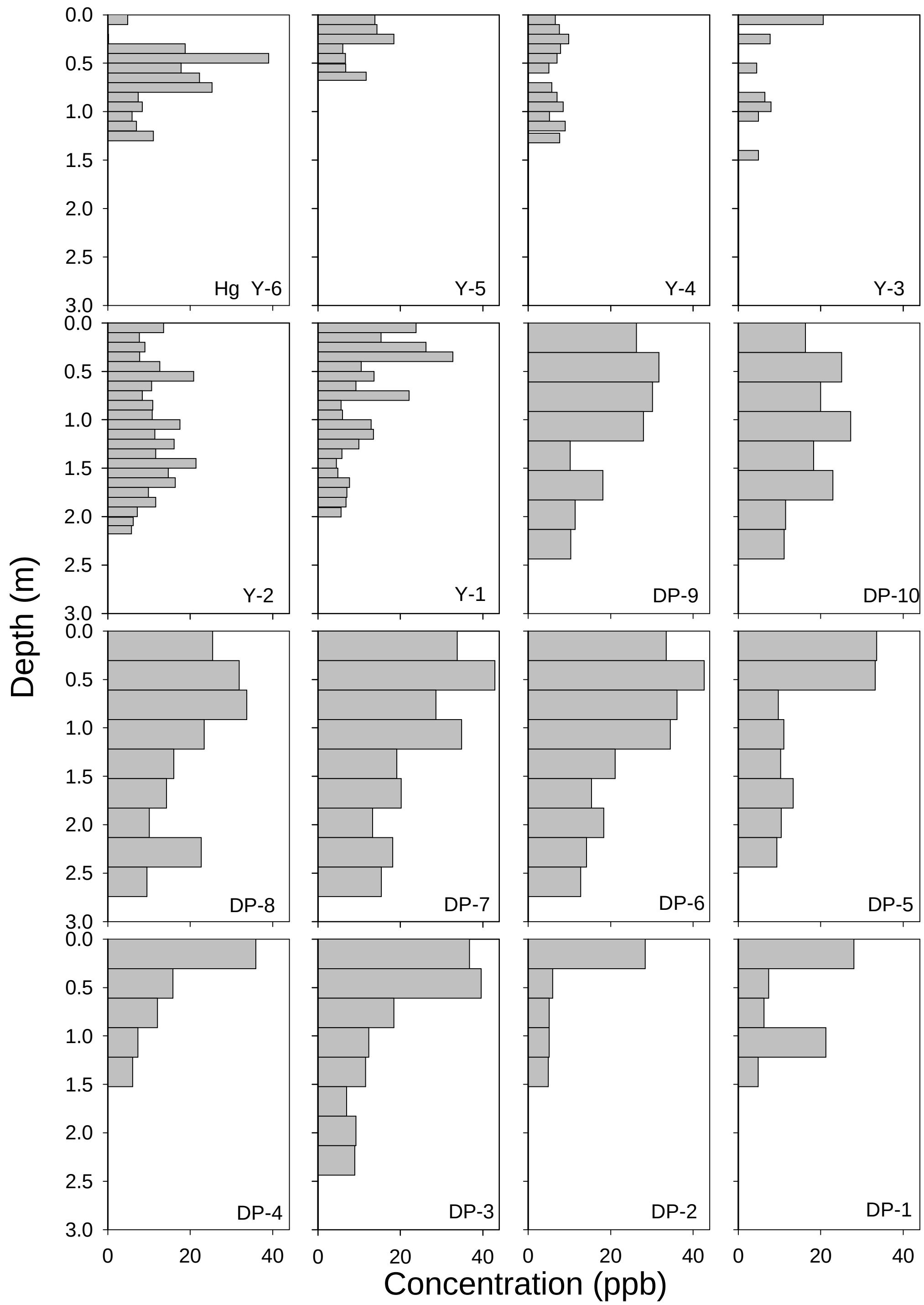


Figure 4-11. Variation is the concentration of mercury (Hg; parts per billion) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

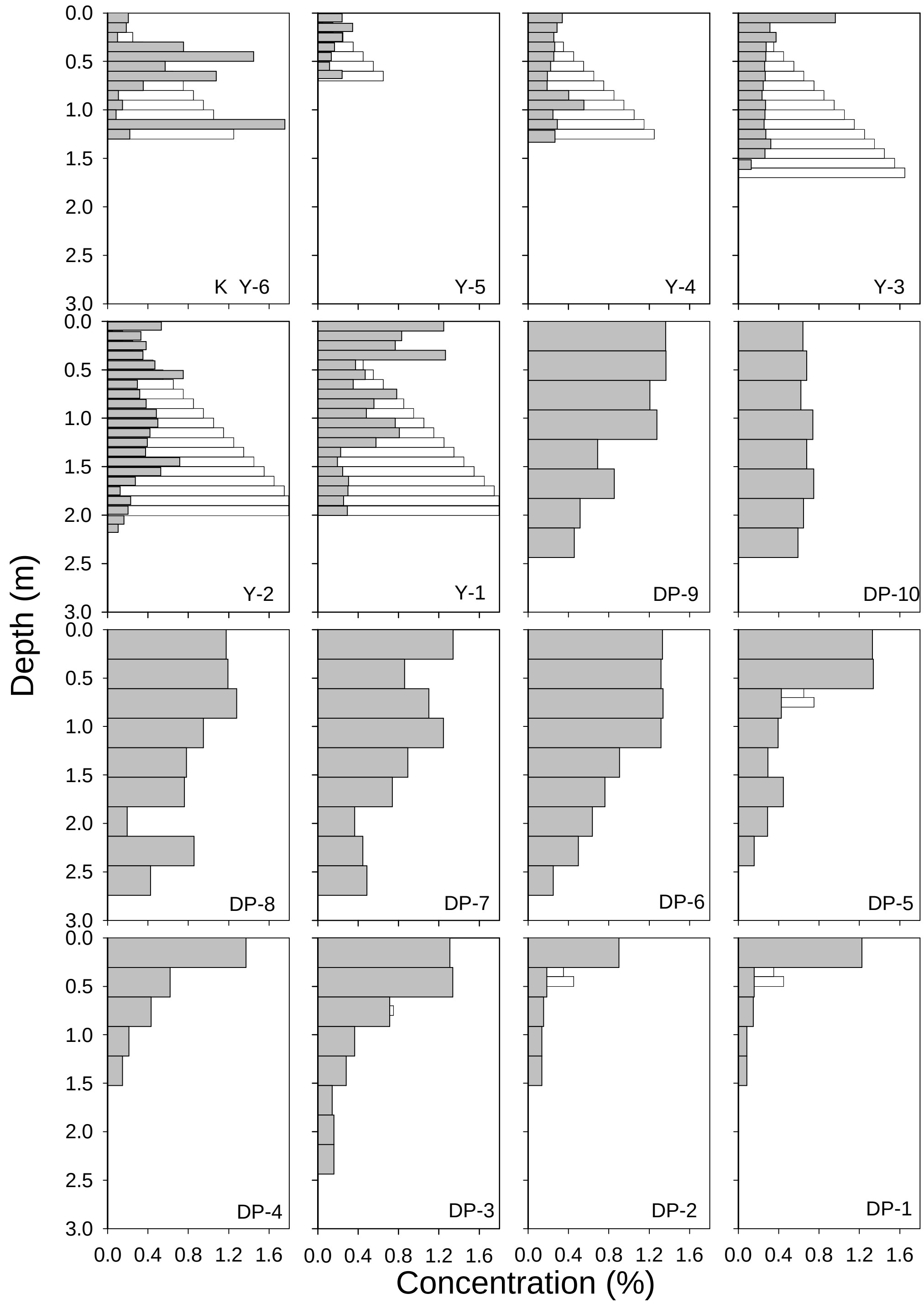


Figure 4-12. Variation is the concentration of potassium (K; % by mass) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

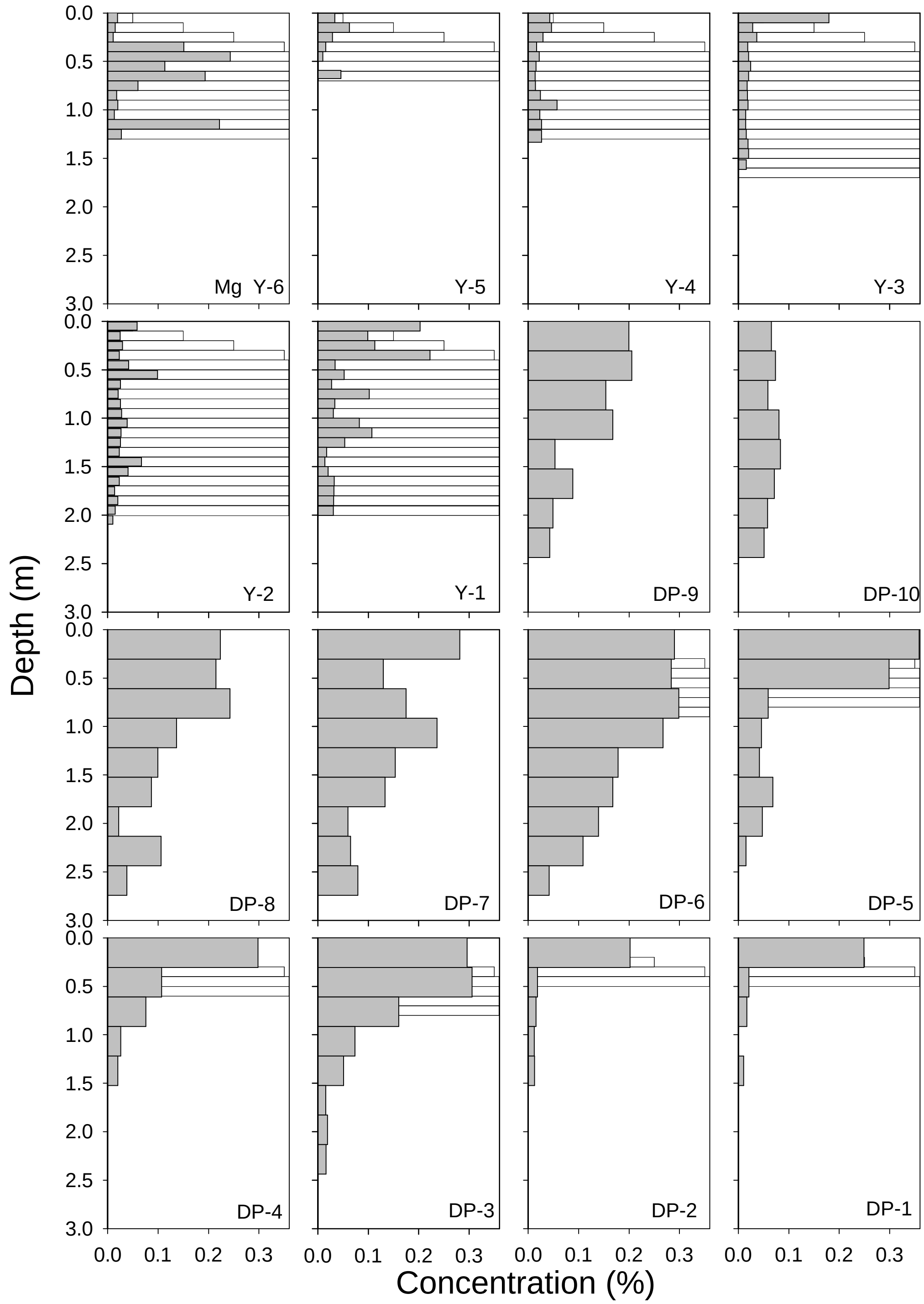


Figure 4-13. Variation is the concentration of magnesium (Mg; % by mass) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

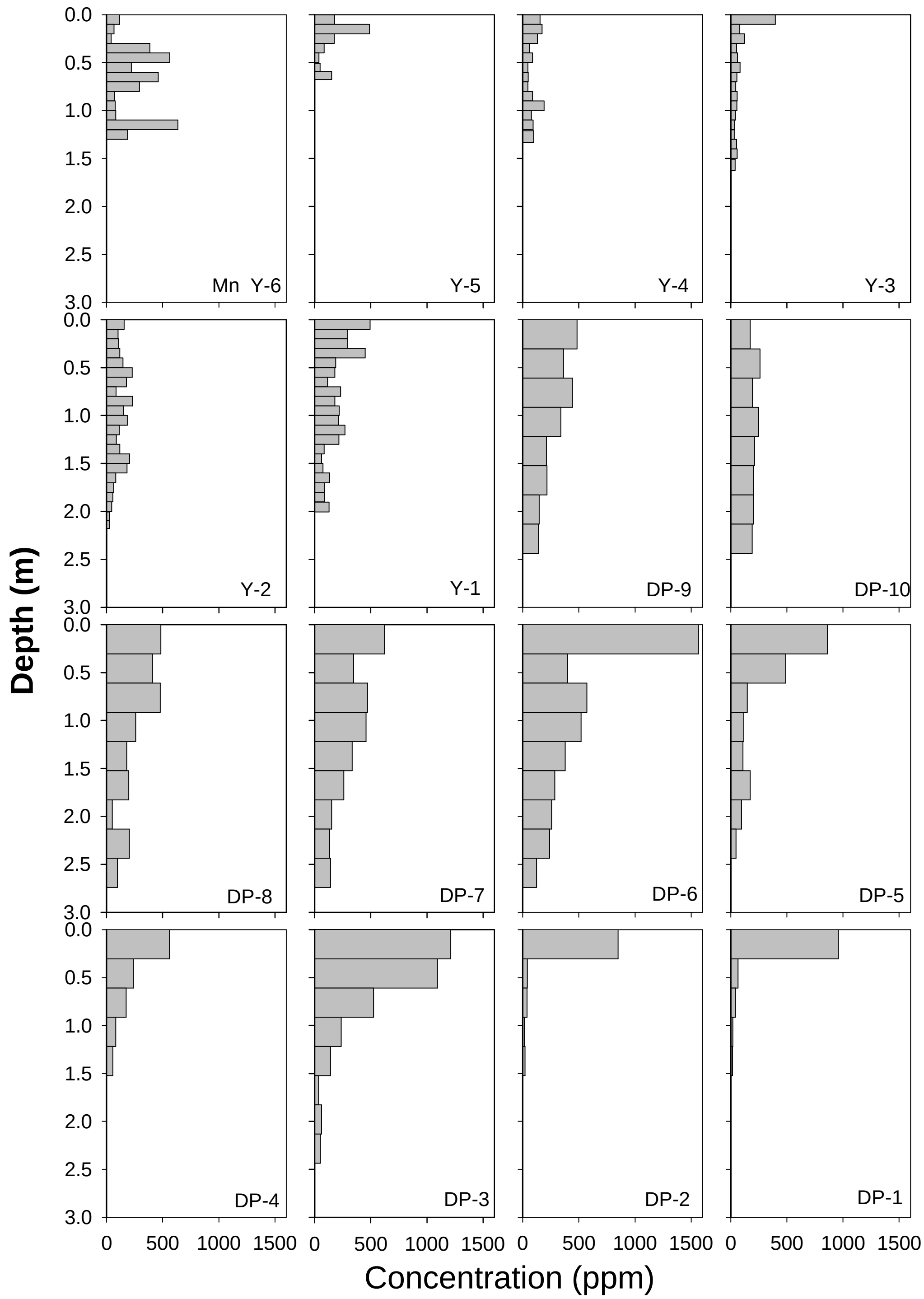


Figure 4-14. Variation is the concentration of manganese (Mn; parts per million) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

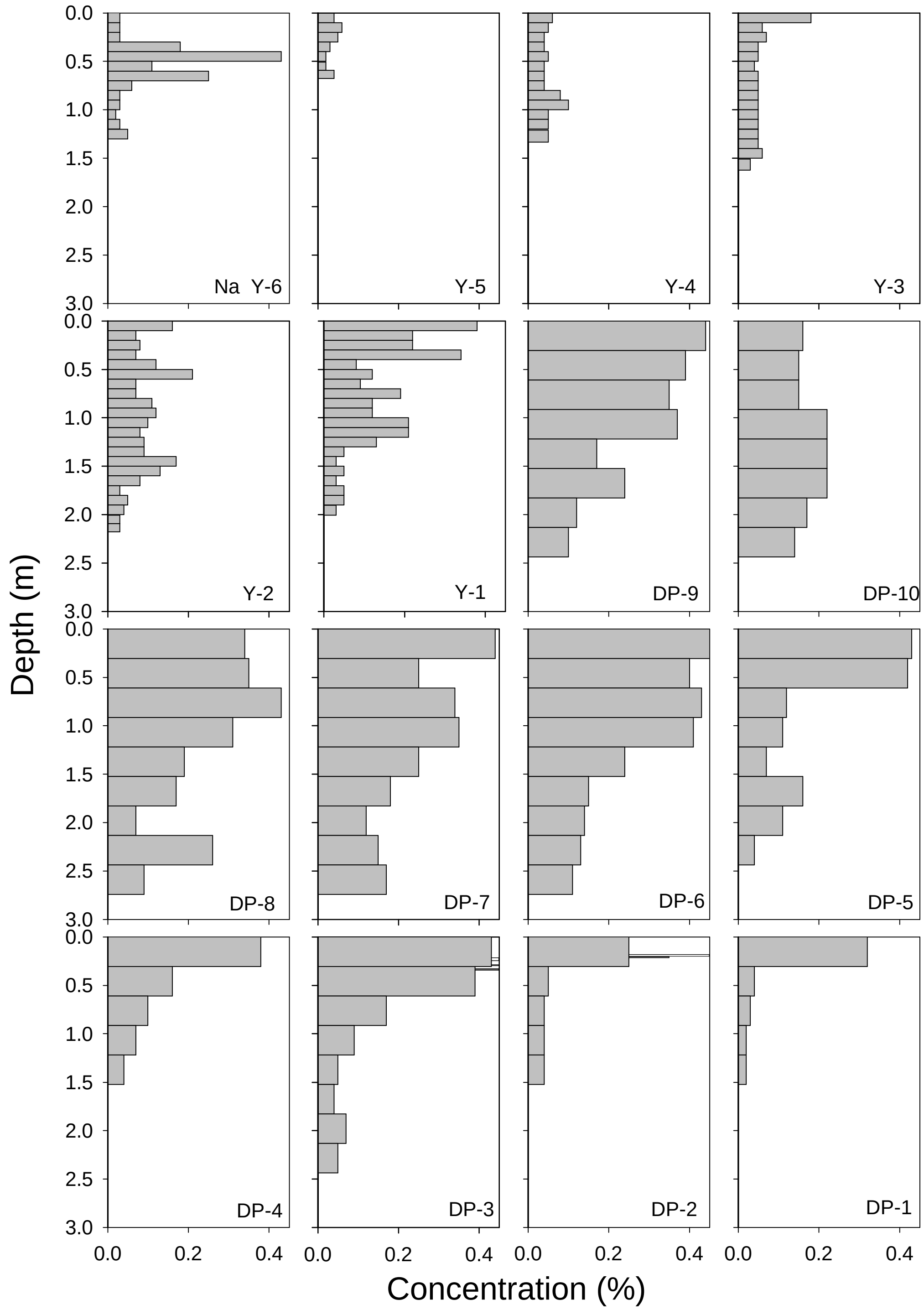


Figure 4-15. Variation is the concentration of sodium (Na; % by mass) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

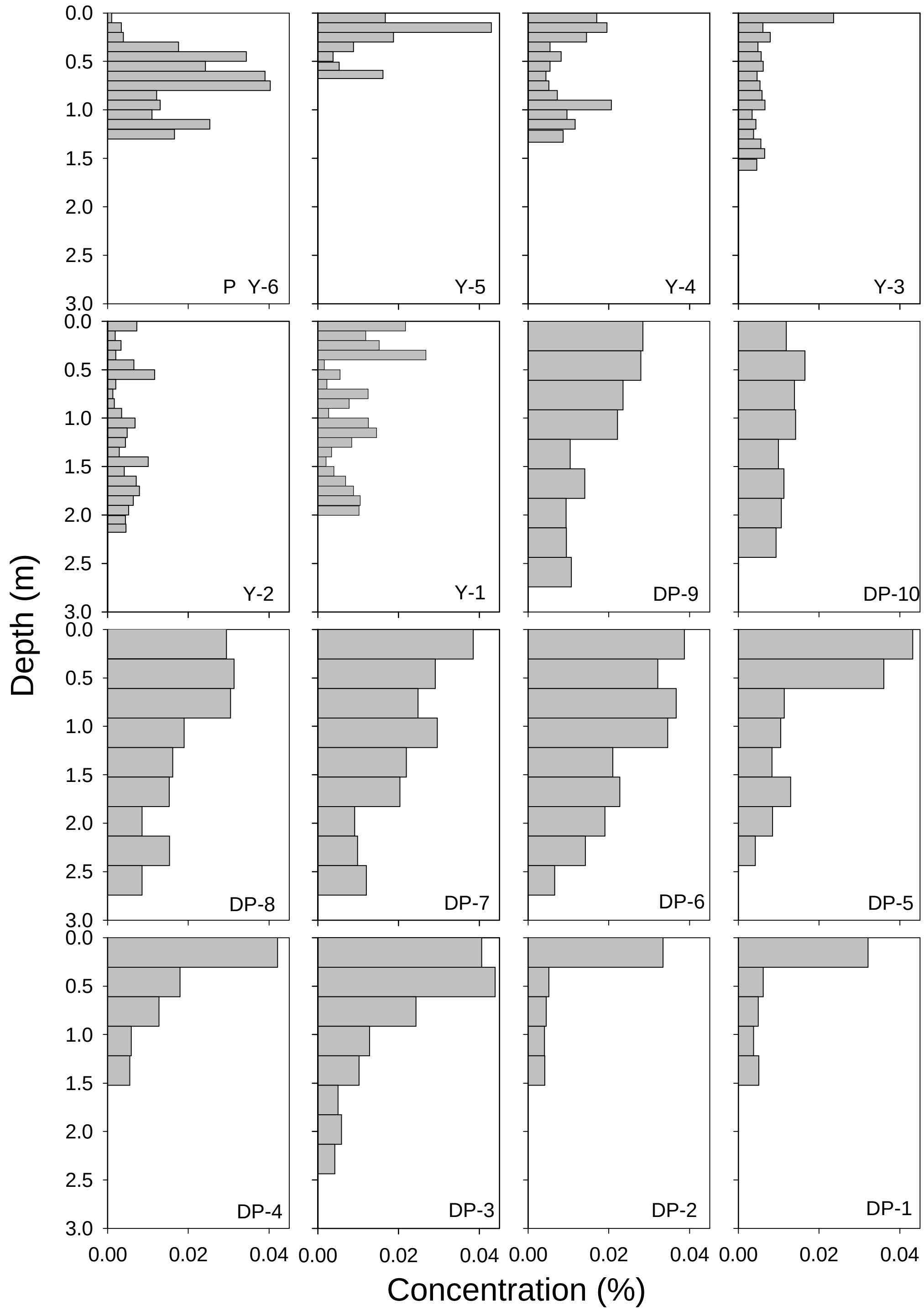


Figure 4-16. Variation is the concentration of phosphorus (P; % by mass) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

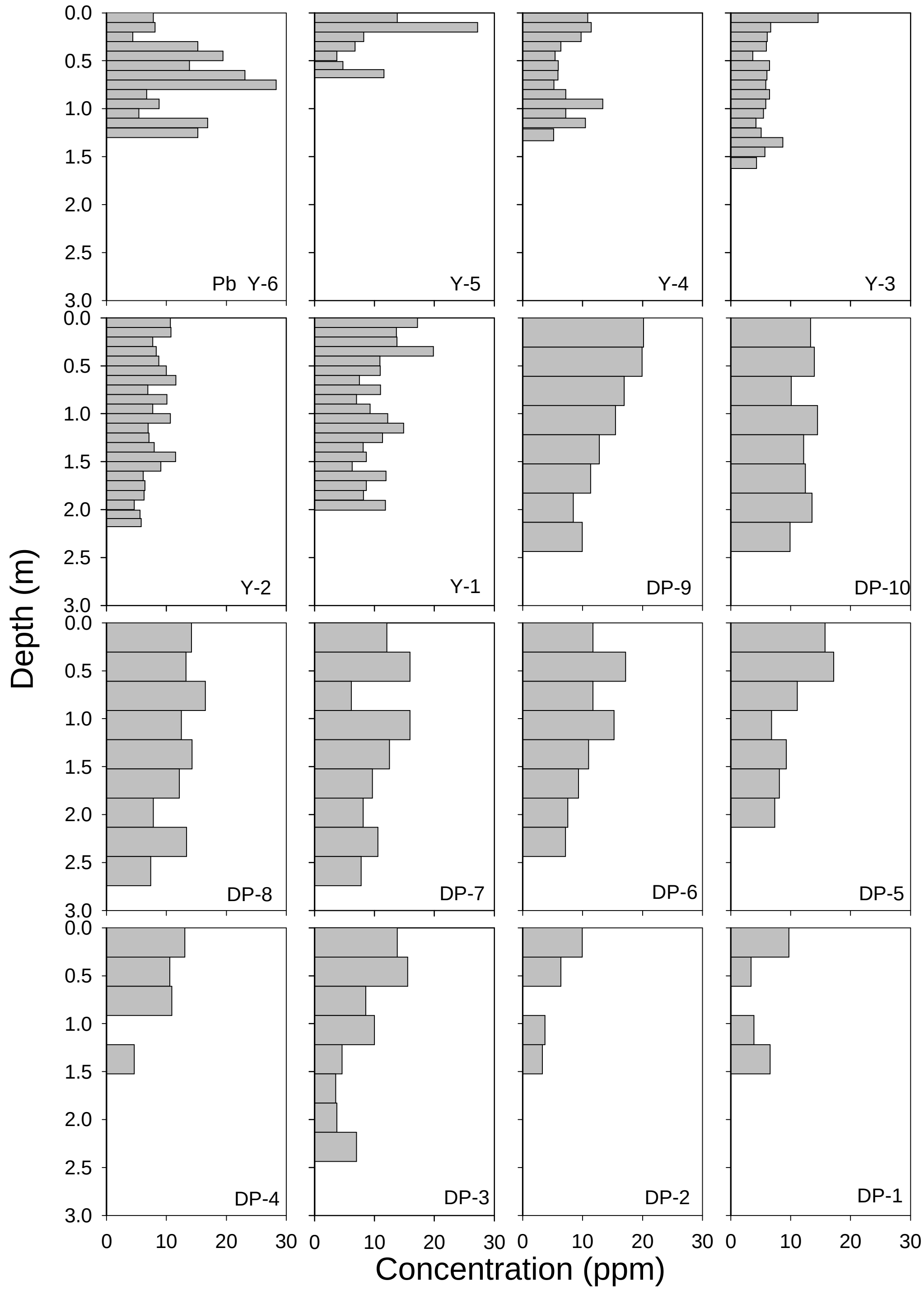


Figure 4-17. Variation is the concentration of lead (Pb; parts per million) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

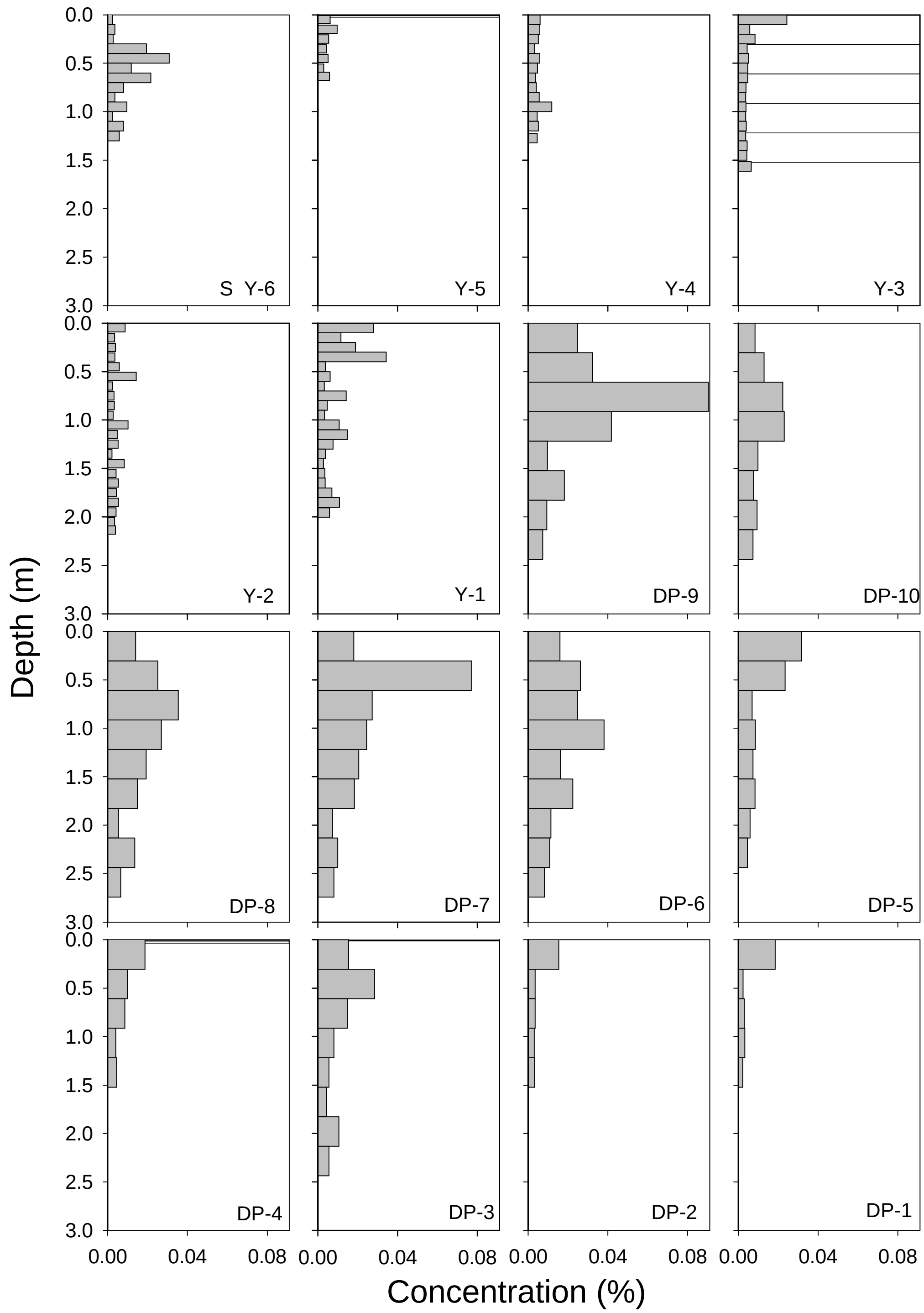


Figure 4-18. Variation is the concentration of sulfur (S; % by mass) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

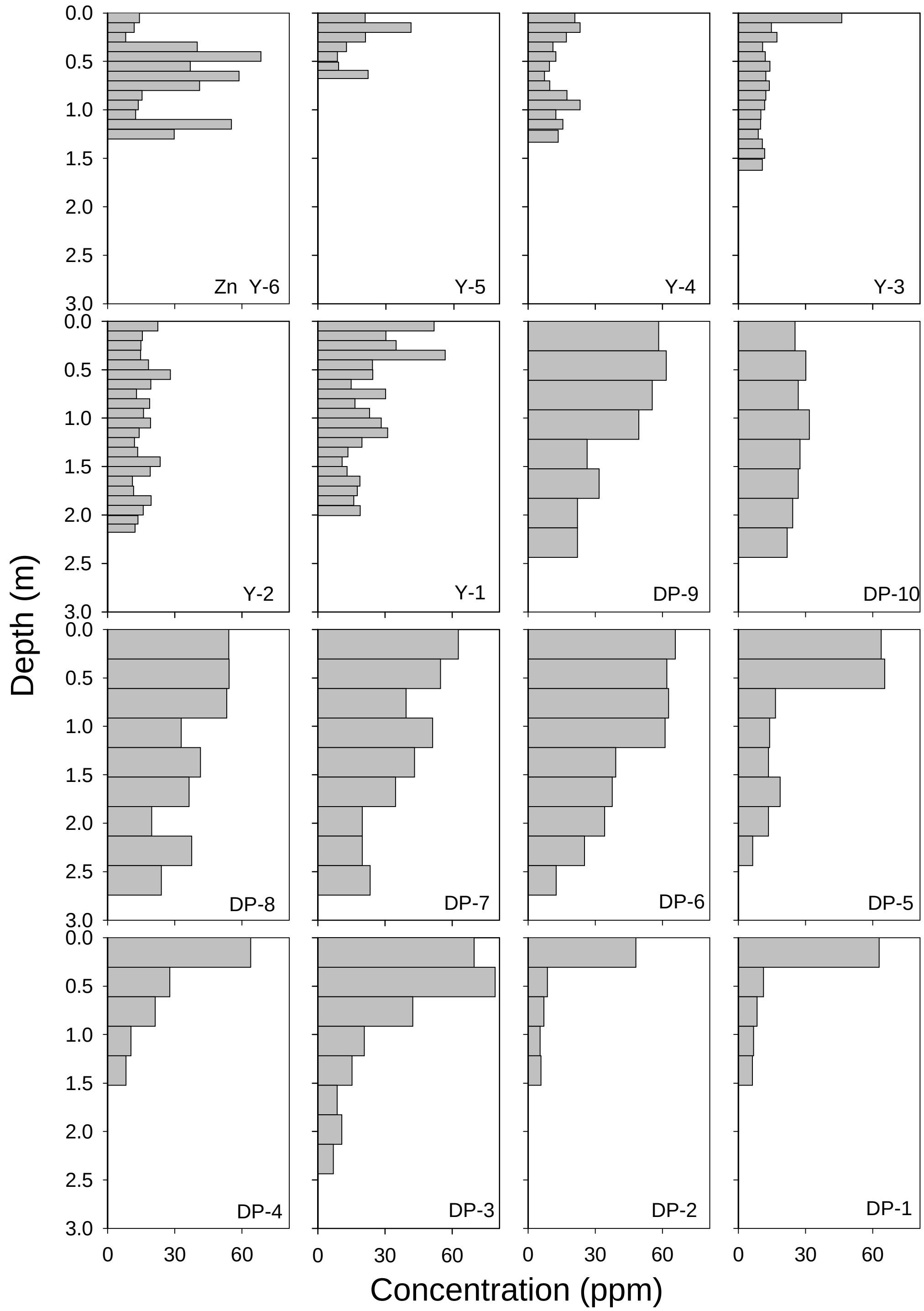


Figure 4-19. Variation is the concentration of zinc (Zn; parts per million) within the sediments of all cores, moving in space from the most upstream core (Y6) to the most downstream core (DP1). Refer to Figure 3-2 for core locations.

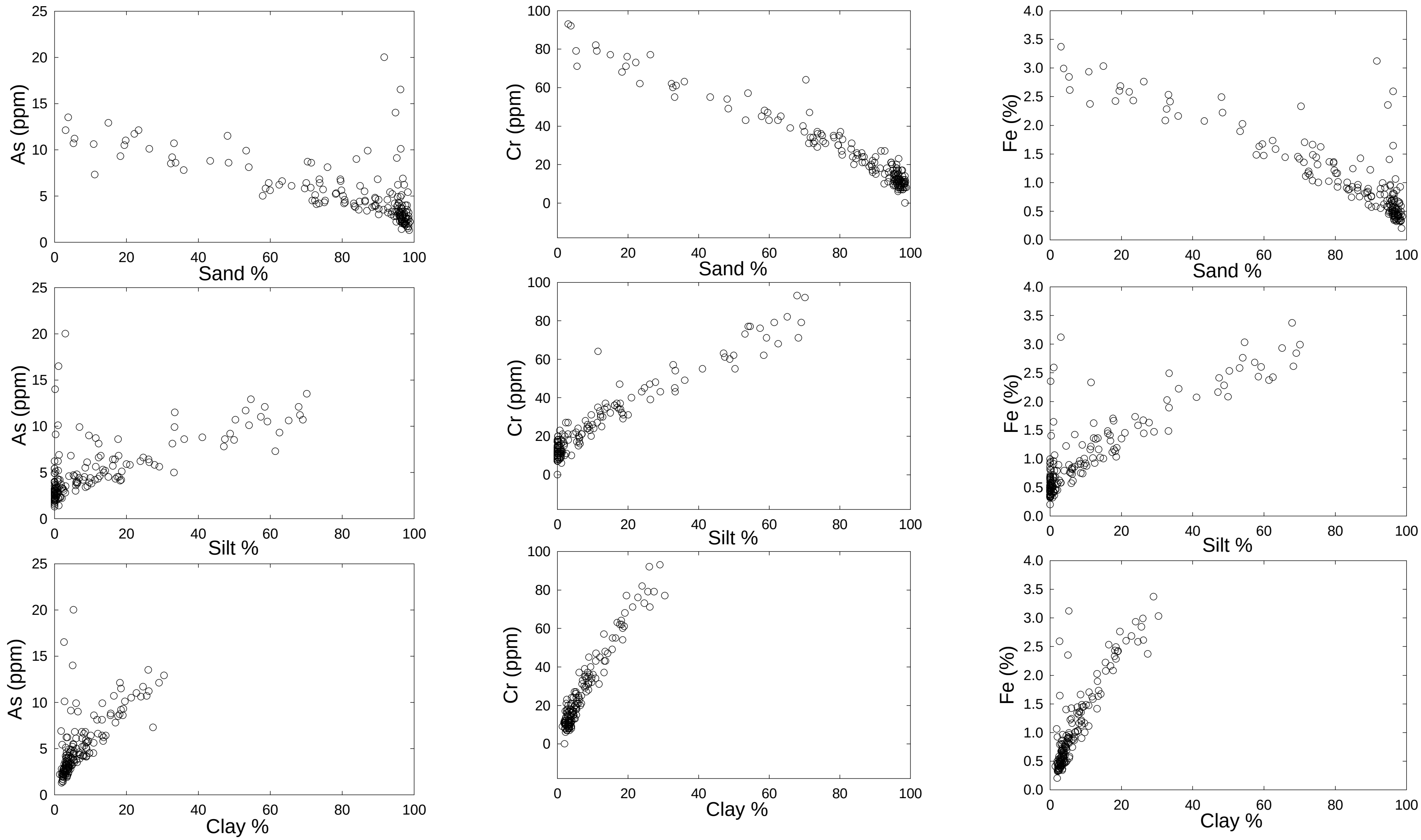


Figure 4-20. Variation of arsenic (left), chromium (center), and iron (right) concentration with sediment texture for all cores.

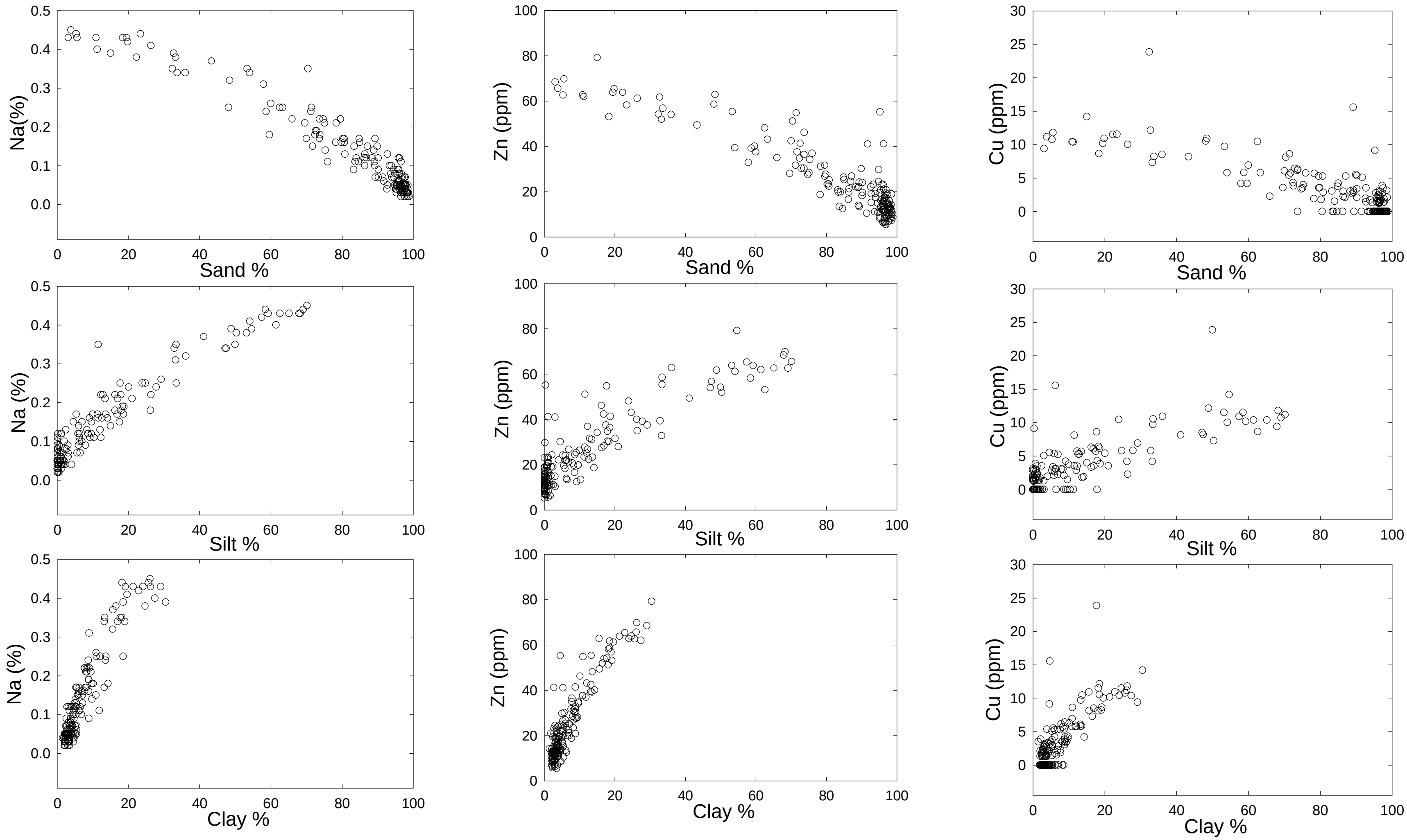


Figure 4-21. Variation of sodium (left), zinc (center), and copper (right) concentration with sediment texture for all cores.

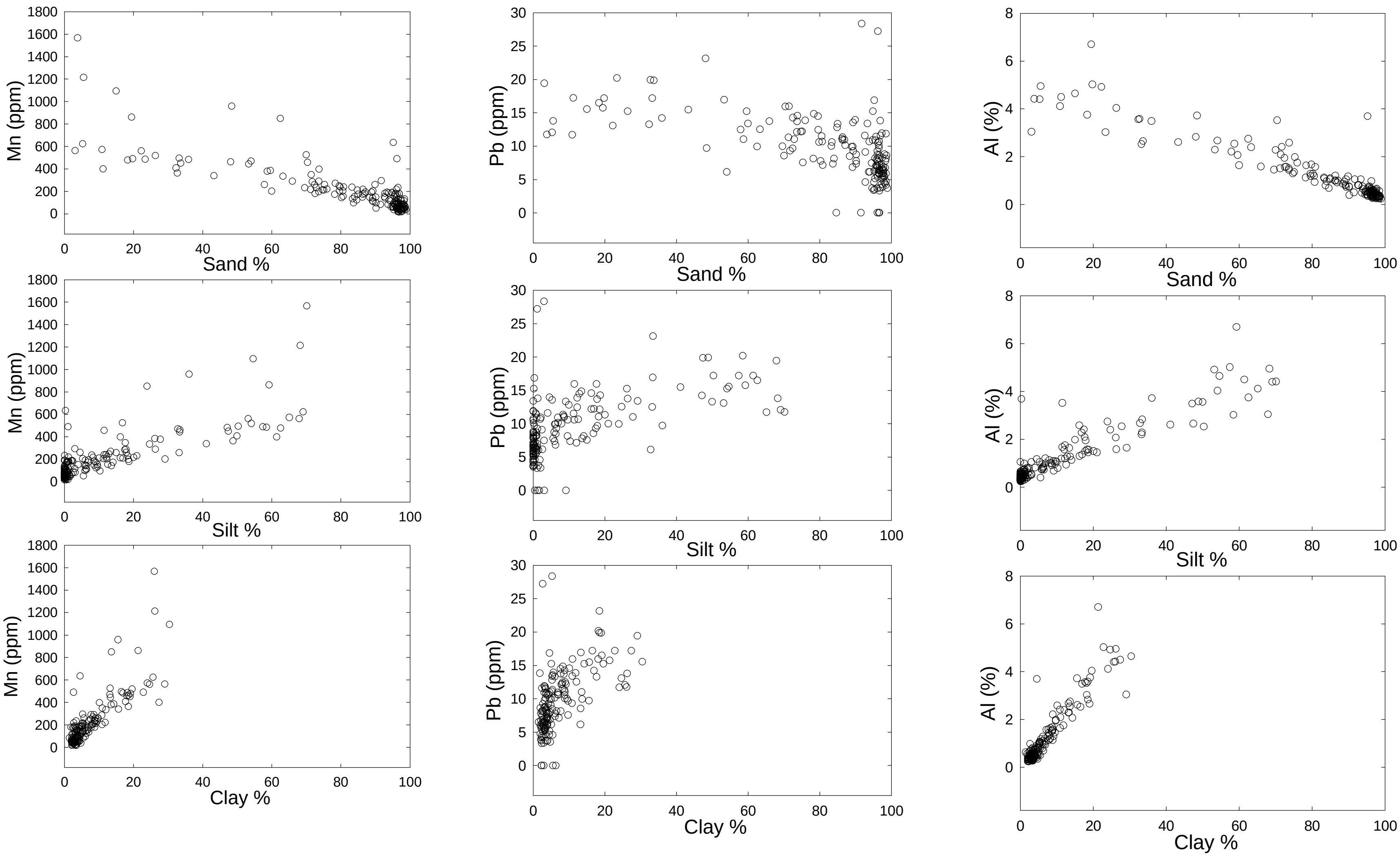


Figure 4-22. Variation of manganese (left), lead (center), and aluminum (right) concentration with sediment texture for all cores.

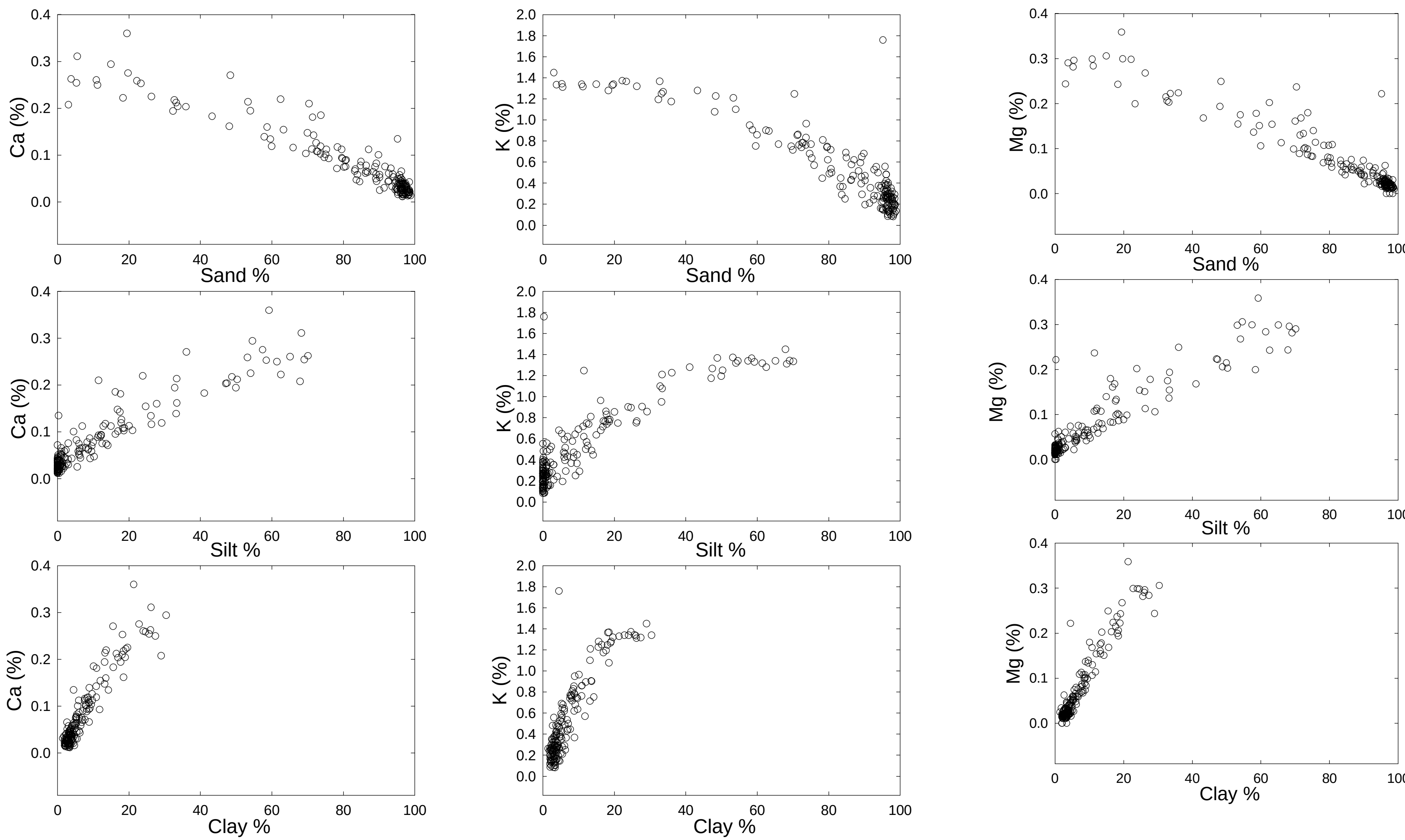


Figure 4-23. Variation of calcium (left), potassium (center), and magnesium (right) concentration with sediment texture for all cores.

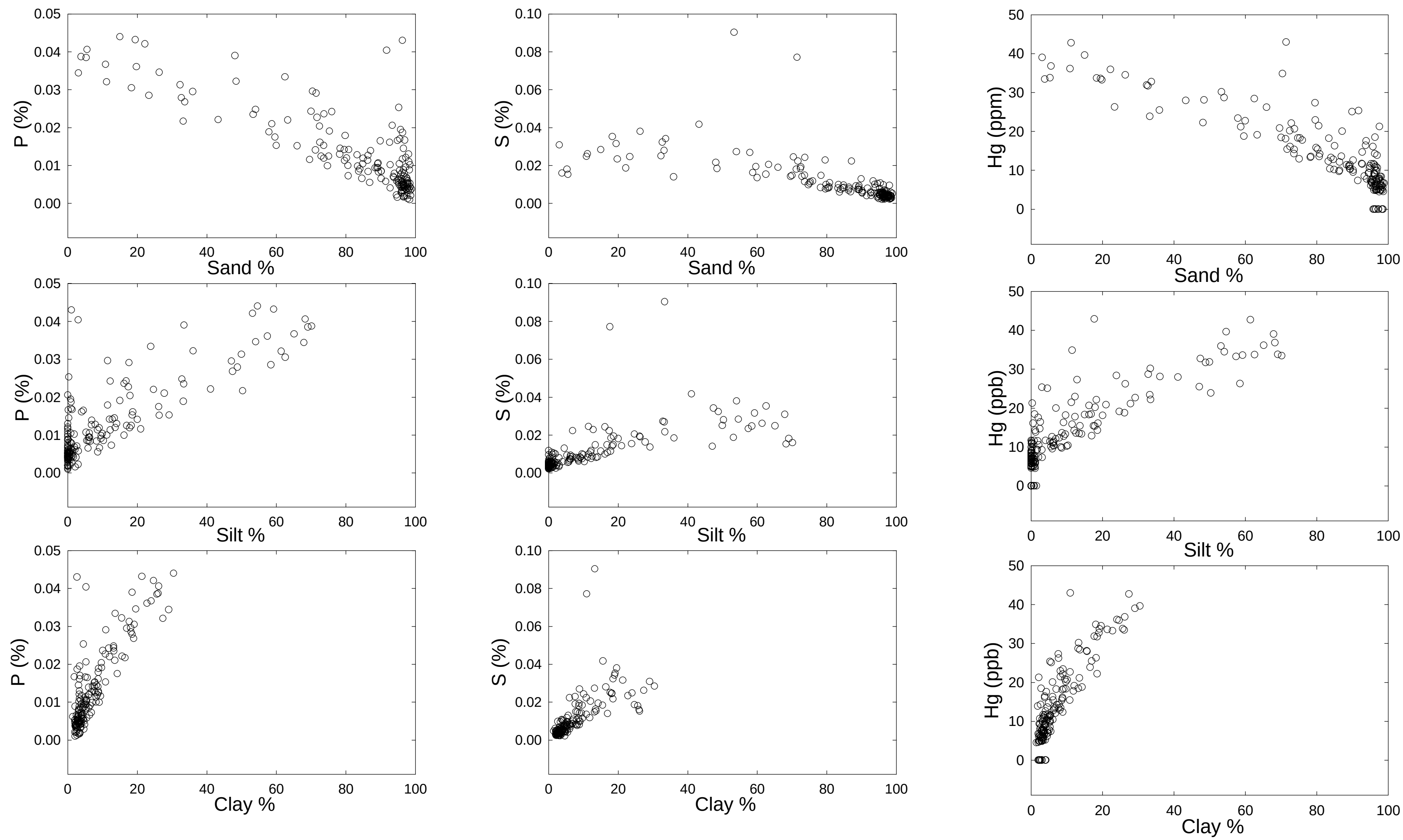


Figure 4-24. Variation of phosphorus (left), sulfur (center), and mercury (right) concentration with sediment texture for all cores.

4.5 Agrichemical Results

Table 4-5 summarizes the results of all agrichemical and PCB analyses performed on the collected sediments. Figures 4-26, 4-27, and 4-28 show the spatial variation in compound concentrations for select agrichemicals, starting at the most upstream core location (Y6) and extending nearly 5 km downstream (DP1; see Figures 4-25 and 3-2).

Within the Yalobusha River channel deposits, BHC-beta, aldrin, dieldrin, DDD, DDE, and heptachlor are found in measurable concentrations (from 1 to 100 ppb; Table 4-5, Figures 4-26, 4-27, and 4-28). BHC-beta is found in nearly all sediment samples in comparable concentrations (Figure 4-26).

Within the debris plug deposits, BHC-alpha, BHC-beta, BHC-gamma, BHC-delta, aldrin, dieldrin, DDD, DDE, DDT, endosulfan sulfate, heptachlor, and heptachlor epoxide are found in measurable concentrations (from 1 to 100 ppb). Compounds such as dieldrin, DDD, and DDE are found in nearly all sediment samples at comparable concentrations (Figure 4-27).

The concentrations of these agrichemicals are not atypical for agricultural watersheds in Mississippi. Comparable concentrations of compounds such as aldrin, DDT, DDD, DDE, dieldrin, heptachlor, and heptachlor epoxide have been observed in soil and lake sediment samples in Bear Creek watershed, located in Humphreys, Sunflower, and Leflore Counties (Cooper et al., 1987), Moon Lake, located in Coahoma County (Cooper, 1991), and Otoucalofa Creek watershed, located in Yalobusha County (Knight and Cooper, 1996).

Table 4-4. Summary of agrichemical analyses performed on all cores within the debris plug. Analyses were performed on depth-integrated samples except for DP3 and DP5, where the upper and lower halves were analyzed separately. ND—not detected, TR—trace, ppb—parts per billion.

Parameter	Units	Core ID											
		DP1	DP2	DP3		DP4	DP5		DP6	DP7	DP8	DP9	DP10
				0-1.2 m	1.2-2.4 m		0-1.2 m	1.2-2.4 m					
Aldrin	ppb	TR	TR	TR	10	TR	TR	TR	14	4	ND	2	ND
BHC-alpha	ppb	ND	ND	TR	TR	ND	ND	ND	3	ND	1	ND	ND
BHC-beta	ppb	TR	TR	TR	TR	TR	TR	TR	7	ND	ND	ND	2
BHC-delta	ppb	6	ND	13	13	14	15	5	ND	ND	ND	ND	ND
BHC-gamma	ppb	TR	ND	TR	TR	TR	TR	TR	ND	518	ND	2	138
Chlordane	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDD	ppb	ND	ND	TR	ND	ND	ND	ND	5	4	2	3	2
DDE	ppb	ND	ND	TR	TR	ND	TR	ND	5	6	3	2	3
DDT	ppb	ND	ND	ND	ND	ND	ND	ND	8	2	ND	ND	2
Dieldrin	ppb	4	2	9	2	9	11	3	ND	3	ND	ND	ND
Endrin	ppb	TR	TR	TR	TR	TR	1	TR	ND	ND	ND	ND	ND
Endrin Aldehyde	ppb	ND	TR	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ppb	TR	ND	ND	TR	TR	TR	ND	ND	ND	ND	ND	ND
Endosulfan II	ppb	TR	TR	TR	TR	TR	TR	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	ppb	TR	ND	2	ND	2	3	TR	ND	ND	ND	ND	ND
Heptachlor	ppb	TR	TR	TR	3	TR	TR	TR	ND	4	3	ND	2
Heptachlor Epoxide	ppb	ND	ND	TR	ND	TR	TR	ND	1	3	5	ND	ND
Aroclor 1016	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1221	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1232	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1242	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 4-5. Summary of agrichemical analyses performed on all cores within the Yalobusha River channel. Analyses were performed on (1) depth-integrated samples for Y4, Y5, and Y6, (2) upper and lower half samples for Y2 and Y3, and (3) for each 0.3 m increment in Y1. ND—not detected, TR—trace, ppb—parts per billion.

Parameter	Units	Core ID														
		Y1								Y2		Y3		Y4	Y5	Y6
		0-0.3 m	0.3-0.6 m	0.6-0.9 m	0.9-1.2 m	1.2-1.5 m	1.5-1.8 m	1.8-2.1 m	2.1-2.4 m	0-1.1 m	1.1-2.2 m	0-0.8 m	0.8-1.6 m			
Aldrin	ppb	TR	89	TR	TR	TR	136	TR	2	3	ND	TR	TR	TR	TR	8
BHC-alpha	ppb	ND	ND	ND	ND	ND	ND	ND	ND	TR	ND	TR	ND	TR	ND	ND
BHC-beta	ppb	13	186	76	21	ND	ND	51	144	254	70	31	28	9	TR	332
BHC-delta	ppb	TR	TR	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	TR	9
BHC-gamma	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	TR	ND	TR	4
Chlordane	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DDD	ppb	10	22	TR	ND	ND	ND	ND	ND	TR	1	TR	TR	ND	ND	5
DDE	ppb	12	10	3	TR	TR	2	TR	TR	TR	1	TR	TR	ND	ND	64
DDT	ppb	10	8	TR	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	TR
Dieldrin	ppb	TR	4	ND	ND	60	14	ND	ND	ND	ND	ND	ND	ND	TR	6
Endrin	ppb	TR	TR	ND	ND	ND	ND	ND	ND	ND	ND	TR	ND	TR	TR	1
Endrin Aldehyde	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ppb	ND	TR	ND	ND	ND	TR	TR	ND	ND	ND	TR	TR	ND	TR	TR
Endosulfan II	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	TR	ND	TR	ND	ND

Endosulfan Sulfate	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	TR	ND	ND	ND	ND
Heptachlor	ppb	ND	60	2	TR	2	61	TR	1	2	TR	TR	TR	TR	TR	13
Heptachlor Epoxide	ppb	TR	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1016	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1221	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1232	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1242	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

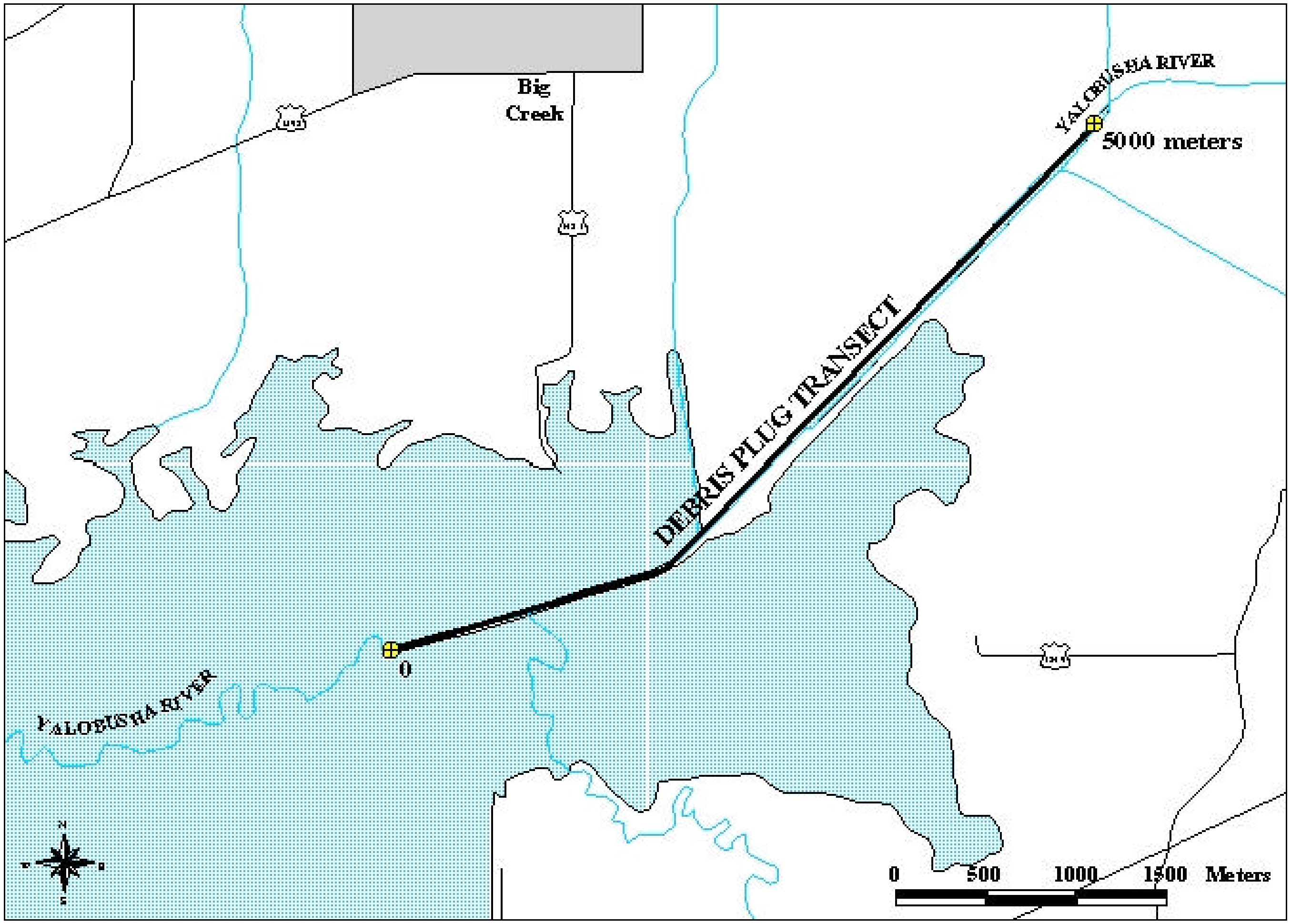
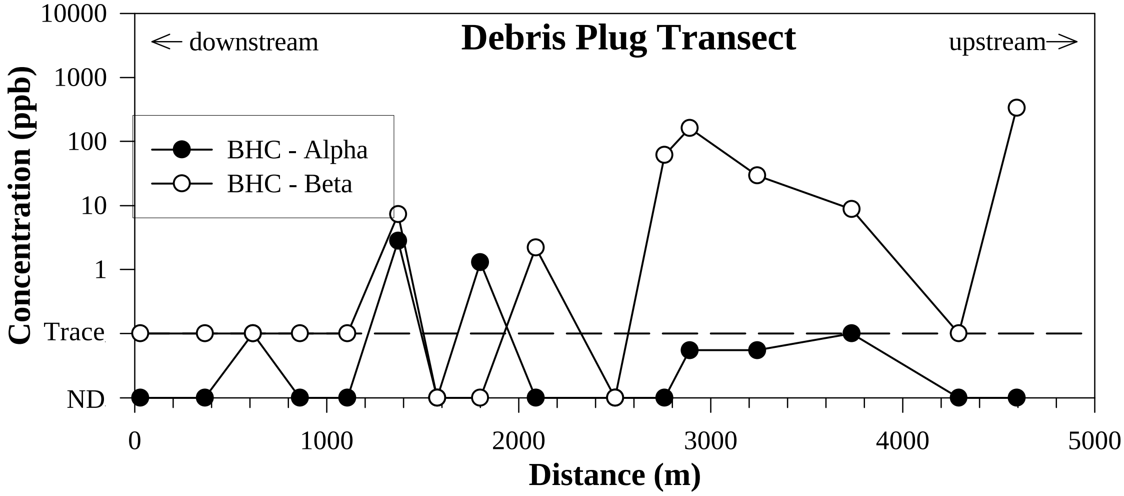


Figure 4-25. Transect used to construct plots of agrichemical variations along Yalobusha River channel and debris plug (see Figures 4-26, 4-27, and 4-28).



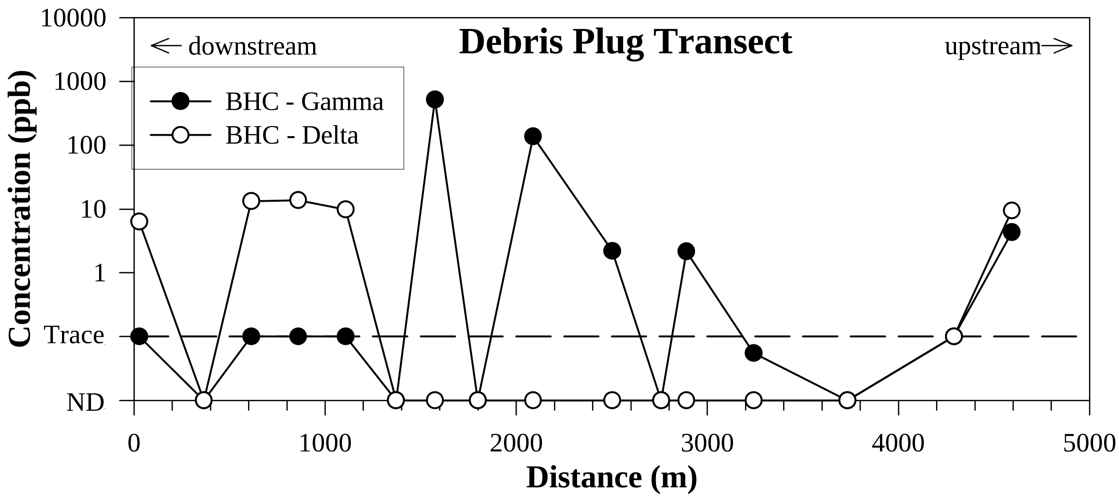
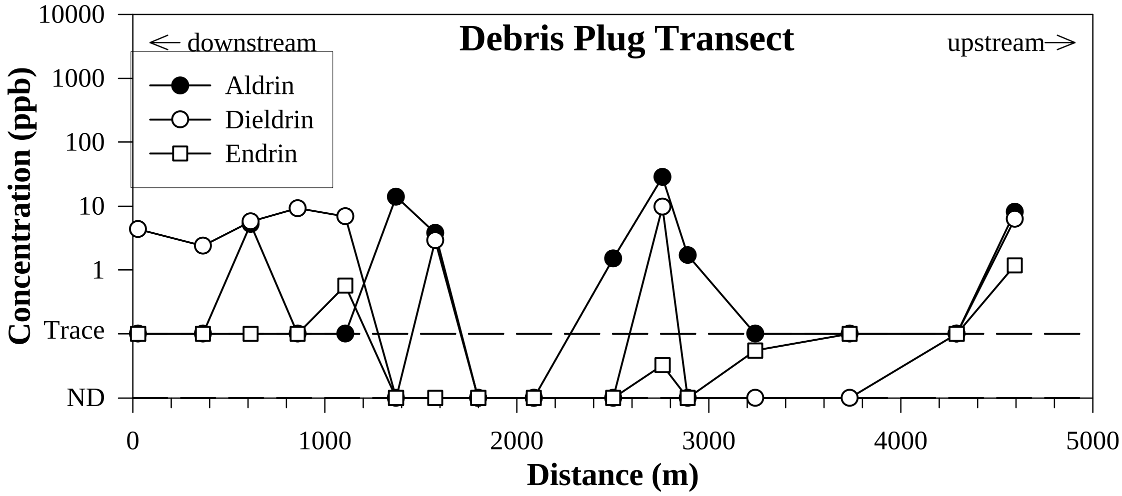


Figure 4-26. Spatial variation in the concentration of BHC-alpha, BHC-beta, BHC-gamma, and BHC-delta within the Yalobusha River channel and debris plug (see Figure 4-25). Upstream is to the right and downstream is to the left.



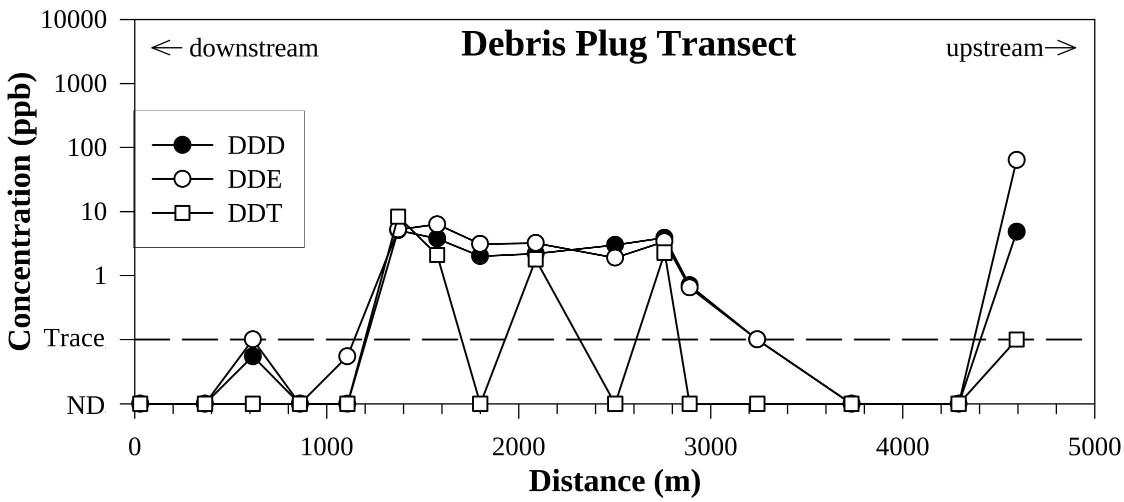


Figure 4-27. Spatial variation in the concentration of aldrin, dieldrin, endrin, DDD, DDE, and DDT within the Yalobusha River channel and debris plug (see Figure 4-25). Upstream is to the right and downstream is to the left.

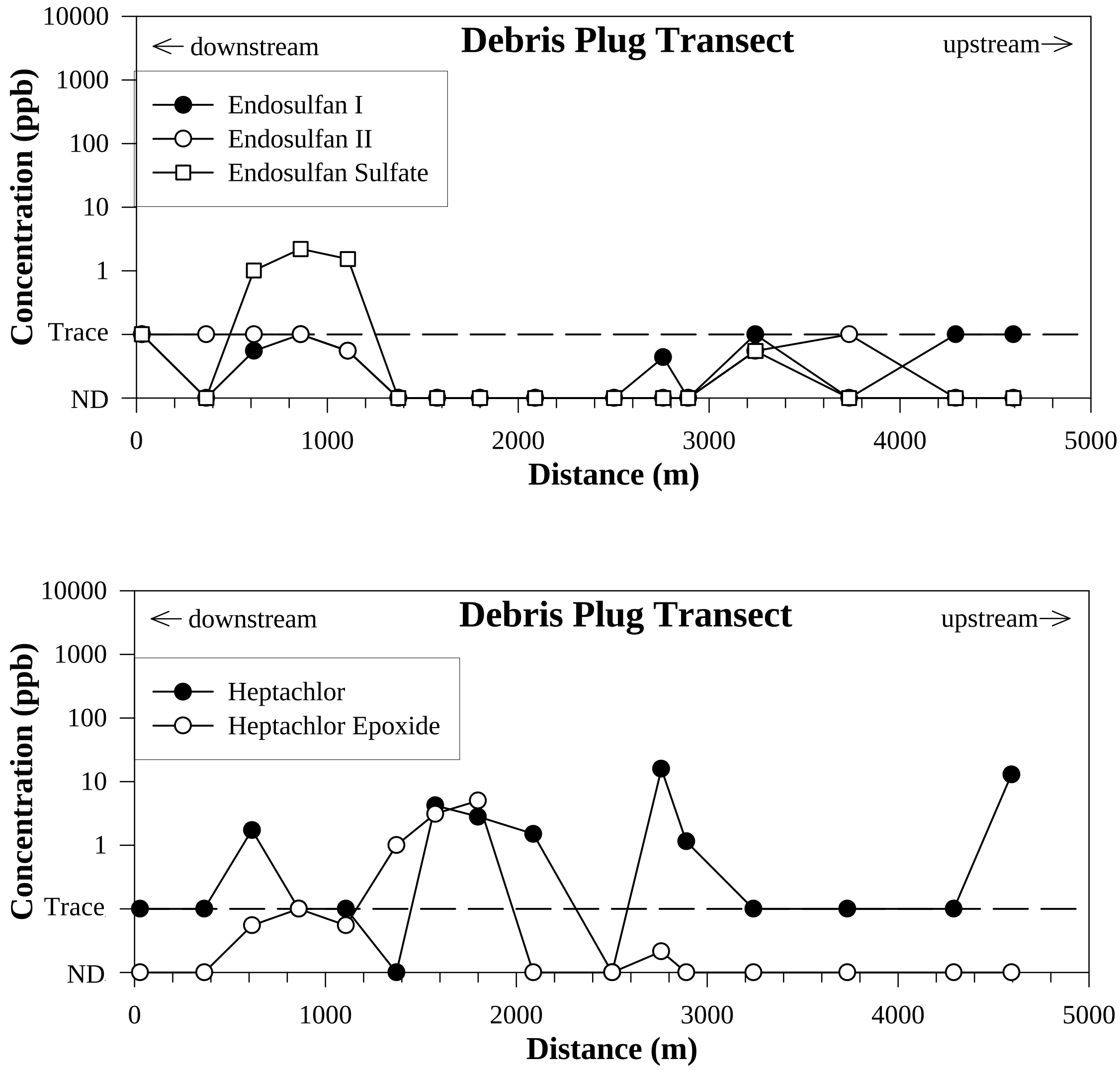


Figure 4-28. Spatial variation in the concentration of endosulfan I, endosulfan II, endosulfan sulfate, heptachlor, and heptachlor epoxide within the Yalobusha River channel and debris plug (see Figure 4-25). Upstream is to the right and downstream is to the left.

5. CONCLUSIONS

Streams and rivers within the Yalobusha River basin, located in north-central Mississippi, have experienced severe erosion, bed incision, and channel widening due to channelization projects during the early 1900s and again in the 1950s and 1960s. Straightening of the Yalobusha River and Topashaw Creek has markedly altered the base level of these streams and promoted basin-wide degradation of the river channels. The primary results of this base level change were channel incision, bank destabilization, and channel widening. Large volumes of sediment and woody riparian vegetation were delivered to the flow and were transported through the river network. When the channelized, straightened Yalobusha River reaches met the natural, unchannelized meanders, the woody debris in transport was deposited. These processes, left unrequited for decades, resulted in the rapid accumulation of a large woody debris plug on the lower Yalobusha River downstream of Calhoun City. As much as 5 m of sediment and debris has accumulated vertically since 1967 and input of vegetation due to bank failure in the vicinity of major knickpoints is around 28 m^3/yr. This debris accumulation has significantly increased the magnitude, frequency, and severity of flooding within Calhoun City, MS.

Before the U.S. Army Corps of Engineers initiates debris plug removal and channel improvements, an assessment of sedimentation within the plug and the channel upstream of the plug is required. This report summarizes research results collected to meet this need. The main conclusions are listed below.

1. Six continuous sediment cores, ranging in length from 0.65 to 2.14 m, were collected within the channel of the Yalobusha River upstream of the debris plug using a vibracore system. The most downstream core location is near the debris plug, and the most upstream core location is near the confluence of the Yalobusha River and Topashaw Creek. Particle size analyses show that these cores are primarily composed of sand, up to 98% by mass.

2. Ten continuous sediment cores, ranging in length from 1.37 to 2.59 m, were collected within the debris plug along a 2.6 km reach of the Yalobusha River. These cores are composed of a near-surface sediment horizon and a lower sediment horizon. The upper horizon is 0.5 to 1.0-m thick and composed of primarily silt (40 to 70% by mass) and clay (10 to 30% by mass). The lower horizon is composed of primarily sand (80 to 90% by mass). The thickness of the upper horizon tends to increase toward the upstream portion of the debris plug.

3. Bulk chemical analysis of the sediment samples were performed incrementally on all cores. The concentrations of major elements (aluminum, calcium, iron, potassium, magnesium, sodium, phosphorus, and sulfur) and selected, potential environmental contaminants (arsenic, chromium, copper, mercury, lead, and zinc) increase with silt and clay content. Hence, these elements are more abundant, 5 to 10 times higher, in the near-surface silt and clay sediments of the debris plug. Elements such as arsenic and mercury seem generally to have higher concentrations in the upper reaches of the debris plug as compared to elsewhere. Elements concentrations reported here are of similar magnitude to previous studies of soil and lake sediments in Mississippi.

4. All sediment cores were analyzed for 25 agrichemicals and PCBs. These analyses were performed on composite (depth-averaged) sediment samples. Within the Yalobusha River channel deposits, BHC-beta, aldrin, dieldrin, DDD, DDE, and heptachlor are found in measurable concentrations (from 1 to 100 ppb). BHC-beta is found in nearly all channel sediment samples in comparable concentrations. Within the debris plug deposits, BHC-alpha, BHC-beta, BHC-gamma, BHC-delta, aldrin, dieldrin, DDD, DDE, DDT, endosulfan sulfate, heptachlor, and heptachlor epoxide are found in measurable concentrations (from 1 to 100 ppb). Compounds such as dieldrin, DDD, and DDE are found in nearly all sediment samples at comparable concentrations. Agrichemical concentrations reported here are of similar magnitude to previous studies of soil and lake sediments in Mississippi.

6. REFERENCES

Bennett, S.J., 2001, Sediment Quality Issues within a Flood Control Reservoir, Tallahatchie County, MS. USDA-ARS National Sedimentation Laboratory Research Report 23, 131 pp.

Cooper, C.M., 1991. Persistent organochlorine and current use insecticide concentrations in major watershed components of Moon Lake, USA. Archiv fur Hydrobiologie, 121:103-113.

Cooper, C.M., F.E. Dendy, J.R. McHenry, and J.C. Ritchie, 1987. Residual pesticide concentrations in Bear Creek, Mississippi, 1976 to 1979. Journal of Environmental Quality, 16:69-72.

Downs, P.W., and A. Simon, 2001. Fluvial geomorphological analysis of the recruitment of large woody debris in the Yalobusha River network, Central Mississippi, USA. Geomorphology, 37, 65-91.

Lanesky, D.E., B.W. Logan, R.G. Brown, and A.C. Hine, 1979. A new approach to portable vibracoring underwater and on land. Journal of Sedimentary Petrology, 49:654-657.

Knight, S.S., and C.M. Cooper, 1996. Insecticide and metal contamination of a mixed cover agricultural watershed. Water Science and Technology, 33:227-243.

Simon, A., 1998. Processes and forms of the Yalobusha River System: A detailed geomorphic evaluation. USDA-ARS National Sedimentation Laboratory Research Report 9, 131 pp.

Simon, A., and M. Rinaldi, 2000. Channel instability in the loess area of the Midwestern United States. Journal of the American Water Research Association, 36, 133-155.

Simon, A., and R.E. Thomas, 2002. Processes and forms of an unstable alluvial system with resistant, cohesive streambeds. Earth Surface Processes and Landforms, 27, 699-718.

Smith, D.G., 1984. Vibracoring fluvial and deltaic sediments: Tips on improving penetration and recovery. Journal of Sedimentary Petrology, 54:660-663.

Soil Survey Staff, 1992. Procedures for collecting soil samples and methods of analysis for soil survey. USDA-SCS Soil Survey Investigation Report 42, U.S. Government Printing Office, Washington, D.C.

U.S. Environmental Protection Agency, 1997. Test methods for evaluating solid waste, physical/chemical methods. U.S. EPA Integrated Manual SW-846.

Appendix: Summary of carcinogenic levels for chemicals and compounds.

*****<u>IMPORTANT DISCLAIMER</u>*****

The USDA-ARS National Sedimentation Laboratory does not advocate nor enforce the suggested regulatory levels for the chemicals and compounds listed. Other federal and state regulatory bodies with proper authority and jurisdiction can and will supersede the information provided herein. These data should not be used for any purpose other than for background information. The USDA-ARS National Sedimentation Laboratory is exonerated from any errors or inaccuracies reported herein.

Introduction

Summarized in table form is a listing of all chemicals and compounds analyzed in the report. There is no definitive source for toxicity levels for the chemicals and compounds, only sparse recommendations. The majority of the information comes from the U.S. Environmental Protection Agency Office of Water and can be found at the web address www.epa.gov/safewater/mcl.html (see also www.epq.gov/reg6rcei). Additional information can be obtained from Linda Faulk, EPA Region 6, falk.linda@epa.gov, tel. 214-665-8535.

Tables are subdivided into use of chemical (H is a herbicide, I is an insecticide), where and in what capacity the material is located (residential soils, Table A-1; industrial soils for an indoor worker, Table A-2; industrial soils for an outdoor worker, Table A-3; and ambient air and tap water, Table A-4), and the type of exposure (inhalation, application to skin (dermal), and ingestion). If there are no values listed for a particular chemical of compound, there are three possible reasons: (1) it may not be regulated by the EPA, and/or (2) it may be on the National Recommended Water Quality Criteria, and/or (3) it may be on the Final Revisions to the Unregulated Contaminant Monitoring List.

Key Definitions

The **National Primary Drinking Water Regulations** (NPDWRs or primary standards) are legally enforceable standards that apply to public water systems. Primary standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health and are known or anticipated to occur in public water systems.

Contaminants not included in the primary standards may be found in the **National Secondary Drinking Water Regulations** (NSDWRs or secondary standards). These standards are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

MCLG – Maximum Contaminant Level Goal is the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health effect of persons would occur, and which allows for and adequate margin of safety. MCLGs are non-enforceable health goals.

MCL – Maximum Contaminant level is the permissible level of a contaminant in water, which is delivered to any user of a public water system. MCLs are enforceable standards. The margins of safety in MCLGs ensure that exceeding the MCL slightly does not pose significant risk to public health.

Cancer Risk – All levels reported are based on carcinogenicity risk of 10^{-6}. Alternate risk levels may be obtained by moving the decimal point.

Table A-1. Summary of carcinogenic levels for chemicals and compounds found in residential soils.

Compound/Chemical Name	Trade Name	Use	Inhale (ppm)	Dermal (ppm)	Ingest (ppm)
Alachlor	Lasso	H	110000	25	8
Aldrin	Aldrex	I	520	0.12	0.038
Arsenic (noncancer endpoint)					
Arsenic (cancer endpoint)			590	4.5	0.43
Atrazine	(multiple)	H	40000	9.1	2.9
Barium and compounds					
BHC Alpha		I			
BHC Beta		I			
BHC Delta		I			
BHC Gamma	Lindane	I			
Bifenthrin	Talstar	I			
Cadmium and compounds			1400		
Chlordane	(multiple)	I	25000	14	1.8
Chlorfenapyr	Pirate				
Chlorpyrifos	Lorsban	I			
Total Chromium (1/6 ratio Cr VI/ Cr III)			210		
Cyanazine		H	11000	2.4	0.76
λ-Cyhalothrin	Karate	I			
DDD	TDE	I	37000	28	2.7
DDE		I	26000	20	1.9
DDT	(multiple)	I	26000	20	1.9
Dieldrin	Dieldrex	I	550	0.13	0.04
Endosulfan-alpha	Endosulfan	I			
Endosulfan-beta		I			
Endosulfan Sulfate					
Endrin	Endrex	I			
Endrin Aldehyde					
Heptachlor	(same)	I	1900	0.45	0.14
Heptachlor Epoxide	(same)	I	970	0.22	0.70
Lead					
Mercury and compounds					
Mercury (elemental)					
Methyl Parathion	(same)	I			
Metolaclor	Dual	I			
Pendimethalin	Prowl	H			
Polychlorinated Biphenyls			4400	0.72	0.32
Aroclor 1016	PCBs		130000	21	9.1
Aroclor 1221	PCBs		4400	0.72	0.32
Aroclor 1232	PCBs		4400	0.72	0.32
Aroclor 1242	PCBs		4400	0.72	0.32

Table A-1 continued

Compound/Chemical Name	Trade Name	Use	Inhale (ppm)	Dermal (ppm)	Ingest (ppm)
Aroclor 1248	PCBs		4400	0.72	0.32
Aroclor 1254	PCBs				
Aroclor 1260	PCBs		4400	0.72	0.32
Selenium					
Silver and compounds					
Toxaphene	(multiple)	I	7900	1.8	0.58
Trifluralin	Treflan	H			
Zinc					

Table A-2. Summary of carcinogenic levels for chemicals and compounds found in industrial soils for an indoor worker.

Chemical/Compound Name	Trade Name	Use	Inhale (ppm)	Ingest (ppm)
Alachlor	Lasso	H	240000	100
Aldrin	Aldrex	I	1100	0.48
Arsenic (noncancer endpoint)				
Arsenic (cancer endpoint)			1300	5.5
Atrazine	(multiple)	H	86000	37
Barium and compounds				
BHC Alpha		I		
BHC Beta		I		
BHC Delta		I		
BHC Gamma	Lindane	I		
Bifenthrin	Talstar	I		
Cadmium and compounds			3000	
Chlordane	(multiple)	I	54000	23
Chlorfenapyr	Pirate			
Chlorpyrifos	Lorsban	I		
Total Chromium (1/6 ratio Cr VI/ Cr III)			450	
Cyanazine		H	22000	9.7
λ-Cyhalothrin	Karate	I		
DDD	TDE	I	78000	34
DDE		I	55000	24
DDT	(multiple)	I	55000	24
Dieldrin	Dieldrex	I	1200	0.51
Endosulfan-alpha	Endosulfan	I		
Endosulfan-beta		I		
Endosulfan Sulfate				
Endrin	Endrex	I		
Endrin Aldehyde				
Heptachlor	(same)	I	4100	1.8
Heptachlor Epoxide	(same)	I	2100	0.90
Lead				
Mercury and compounds				
Mercury (elemental)				
Methyl Parathion	(same)	I		
Metolaclor	Dual	I		
Pendimethalin	Prowl	H		
Polychlorinated Biphenyls			9400	4.1
Aroclor 1016	PCBs		270000	120
Aroclor 1221	PCBs		9400	4.1
Aroclor 1232	PCBs		9400	4.1
Aroclor 1242	PCBs		9400	4.1

Table A-2 continued

Chemical/Compound Name	Trade Name	Use	Inhale (ppm)	Ingest (ppm)
Aroclor 1248	PCBs		9400	4.1
Aroclor 1254	PCBs			
Aroclor 1260	PCBs		9400	4.1
Selenium				
Silver and compounds				
Toxaphene	(multiple)	I	17000	7.4
Trifluralin	Treflan	H		
Zinc				

Table A-3. Summary of carcinogenic levels for chemicals and compounds found in industrial soils for an outdoor worker.

Compound/Chemical Name	Trade Name	Use	Inhale (ppm)	Dermal (ppm)	Ingest (ppm)
Alachlor	Lasso	H	290000	67	44
Aldrin	Aldrex	I	1400	0.32	0.21
Arsenic (noncancer endpoint)					
Arsenic (cancer endpoint)			1600	12	2.4
Atrazine	(multiple)	H	110000	24	16
Barium and compounds					
BHC Alpha		I			
BHC Beta		I			
BHC Delta		I			
BHC Gamma	Lindane	I			
Bifenthrin	Talstar	I			
Cadmium and compounds			3700		
Chlordane	(multiple)	I	67000	39	10
Chlorfenapyr	Pirate				
Chlorpyrifos	Lorsban	I			
Total Chromium (1/6 ratio Cr VI/ Cr III)			560		
Cyanazine		H	28000	6.5	4.3
λ-Cyhalothrin	Karate	I			
DDD	TDE	I	98000	75	15
DDE		I	69000	53	11
DDT	(multiple)	I	69000	53	11
Dieldrin	Dieldrex	I	1500	0.34	0.22
Endosulfan-alpha	Endosulfan	I			
Endosulfan-beta		I			
Endosulfan Sulfate					
Endrin	Endrex	I			
Endrin Aldehyde					
Heptachlor	(same)	I	5200	1.2	0.79
Heptachlor Epoxide	(same)	I	2600	0.60	0.39
Lead					
Mercury and compounds					
Mercury (elemental)					
Methyl Parathion	(same)	I			
Metolaclor	Dual	I			
Pendimethalin	Prowl	H			
Polychlorinated Biphenyls			12000	1.9	1.8
Aroclor 1016	PCBs		340000	55	51
Aroclor 1221	PCBs		12000	1.9	1.8
Aroclor 1232	PCBs		12000	1.9	1.8
Aroclor 1242	PCBs		12000	1.9	1.8

Table A-3 continued

Compound/Chemical Name	Trade Name	Use	Inhale (ppm)	Dermal (ppm)	Ingest (ppm)
Aroclor 1248	PCBs		12000	1.9	1.8
Aroclor 1254	PCBs				
Aroclor 1260	PCBs		12000	1.9	1.8
Selenium					
Silver and compounds					
Toxaphene	(multiple)	I	21000	4.9	3.3
Trifluralin	Treflan	H			
Zinc					

Table A-4. Summary of carcinogenic levels for chemicals and compounds found in ambient air and tap water.

			Ambient Air	Tap Water		
Compound/Chemical Name	Trade Name	Use	Cancer Risk (ppb)	MCLG (ppb)	MCL (ppb)	Cancer Risk (ppb)
Alachlor	Lasso	H	0.084		2.0	0.84
Aldrin	Aldrex	I	0.00039			0.004
Arsenic (noncancer endpoint)					50	
Arsenic (cancer endpoint)			0.00045			0.045
Atrazine	(multiple)	H	0.031	3.0	3.0	0.3
Barium and compounds				2000	2000	
BHC Alpha		I				
BHC Beta		I				
BHC Delta		I				
BHC Gamma	Lindane	I				
Bifenthrin	Talstar	I				
Cadmium and compounds			0.0011	5.0	5.0	
Chlordane	(multiple)	I	0.019		2.0	0.19
Chlorfenapyr	Pirate					
Chlorpyrifos	Lorsban	I				
Total Chromium (1/6 ratio Cr VI/ Cr III)			0.00016	100	100	
Cyanazine		H	0.0080			0.080
λ-Cyhalothrin	Karate	I				
DDD	TDE	I	0.028			0.28
DDE		I	0.020			0.20
DDT	(multiple)	I	0.020			0.20
Dieldrin	Dieldrex	I	0.00042			0.0042
Endosulfan-alpha	Endosulfa n	I				
Endosulfan-beta		I				
Endosulfan Sulfate						
Endrin	Endrex	I		2.0	2.0	
Endrin Aldehyde						
Heptachlor	(same)	I	0.0015		0.10	0.015
Heptachlor Epoxide	(same)	I	0.00074		0.20	0.0074
Lead					15	

Table A-4 continued

Compound/Chemical Name	Trade Name	Use	Ambient Air	Tap Water		
			Cancer Risk (ppb)	MCLG (ppb)	MCL (ppb)	Cancer Risk (ppb)
Mercury and compounds				2.0	2.0	
Mercury (elemental)						
Methyl Parathion	(same)	I				
Metolaclor	Dual	I				
Pendimethalin	Prowl	H				
Polychlorinated Biphenyls			0.0034		0.50	0.034
Aroclor 1016	PCBs		0.096			0.96
Aroclor 1221	PCBs		0.0034			0.034
Aroclor 1232	PCBs		0.0034			0.034
Aroclor 1242	PCBs		0.0034			0.034
Aroclor 1248	PCBs		0.0034			0.034
Aroclor 1254	PCBs					
Aroclor 1260	PCBs		0.0034			0.034
Selenium				50	50	
Silver and compounds						
Toxaphene	(multiple)	I	0.0060		3.0	0.061
Trifluralin	Treflan	H				
Zinc						