

44. INORGANIC MAJOR, MINOR, AND TRACE ELEMENT GEOCHEMISTRY AND CLAY MINERALOGY OF SEDIMENTS FROM THE DEEP SEA DRILLING PROJECT LEG 96, GULF OF MEXICO¹

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ABSTRACT

Sediment samples collected at DSDP Leg 96 Mississippi Fan Sites 615, 616, 620, 621, and 623, Orca Basin Site 618, and Pigmy Basin Site 619 were analyzed for 22 major, minor, and trace elements. This study was undertaken to document the downhole variability in inorganic geochemistry between sites. The mineralogy of the clays, including those from Sites 614, 617, and 622 on the fan, was determined by X-ray diffraction to define the principal clay minerals present at the sites, examine any downhole trends in clay mineralogy, and aid in the interpretation of the geochemical signature of the sediments. Clay mineral composition at all the sites is smectite:illite:chlorite:kaolinite in the approximate percentage ratio 50:20:20:10. Geochemical results indicate only slight variation between and within the sites, with the exception of a discrete unit of carbonates that occurs near the bottom of Site 615. Variation in the major, minor, and trace element composition can be explained by a change in the relative abundance of quartz, clay minerals, and carbonates.

INTRODUCTION

Eight hundred and twenty-eight samples were collected for inorganic geochemical analyses at the 11 Deep Sea Drilling Project (DSDP) sites visited on Leg 96 (Fig. 1). From this population, 145 samples from Sites 615, 616, 620, 621, and 623 on the Mississippi Fan, Site 618 in Orca Basin, and Site 619 in Pigmy Basin were analyzed for 22 major, minor, and trace elements (Table 1) and (in addition to samples from fan Sites 614, 617, and 622) for clay mineralogy (Table 2). This pilot study was undertaken to document, by sampling at regular downhole intervals, the general inorganic geochemistry of the Pleistocene Mississippi Fan sediments (with a cursory study of the intraslope basin sites for comparative purposes) and to relate this inorganic geochemical data to clay and smear-slide mineralogy.

METHODS

Samples collected for inorganic geochemical studies were air dried at 105°C and then ground in an agate ball mill for 15 min. We diluted 0.5 g of the ground sample to 250 ml using the lithium metaborate fusion technique for major-element analysis (Walsh and Howie, 1980) and 0.5 g of the sample was dissolved in 50 ml using the hydrofluoric perchloric acid digestion technique for minor- and trace-element analysis (Walsh and Howie, 1980). The solutions were analyzed with the Phillips PV8210/ICP Emission Spectrometer at Kings College, University of London. The data were calibrated using igneous and sedimentary U.S. Geological Survey standards GSP-1, BHVO-1, AGV-1, SDC-1, MAG-1, QLO-1, SCo-1, and STM-1. Total iron (FeO + Fe₂O₃) was determined without analyzing for the different oxidation states.

For clay mineralogy analyses, the < 4 μm fine fraction was separated by ultrasonic treatment and settling. Wherever possible the sam-

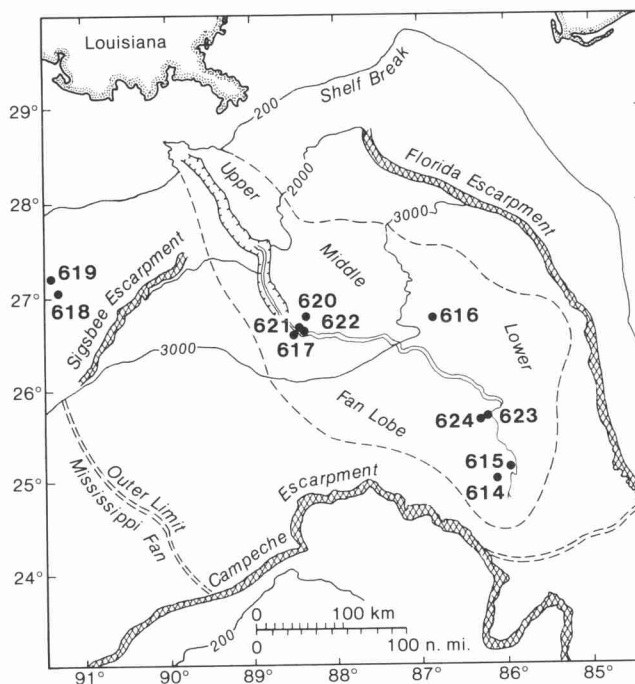


Figure 1. Location map of the sites drilled on DSDP Leg 96.

ples were split from those used to determine the inorganic geochemistry. Oriented aggregates were prepared on glass slides. Both untreated and glycolated (overnight at 60°C) X-ray diffraction (XRD) traces were run from 4 to 40° 2θ for all the samples; a third slow scan run was made, only for selected samples, to separate the kaolinite and chlorite peaks between 24 and 26° 2θ. Focused CuKα radiation was used on all three scans at a scan speed of 1° 2θ per minute. The XRD work was done at Edinburgh University. All mineral identification was made visually on the basis of known d-spacings (Carver, 1971).

The main clay minerals recognized were kaolinite, illite, chlorite, smectite, and an irregular mixed-layer species. Other identified minerals included quartz, feldspars, calcite, and dolomite. Peak heights

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Table 1. Geochemical data for DSDP Leg 96 Sites 615, 616, 620, 621, and 623 (Mississippi Fan), Site 618 (Orca Basin), and Site 619 (Pigmy Basin).^a

Core-Section (interval in cm)	Sub-bottom depth (m)	Major elements (wt. %)											Trace elements (ppm)										
		SiO ₂	Al ₂ O ₃	FeO/Fe ₂ O ₃	MgO	CaO	Na ₂ O	K ₂ O	TiO ₂	P ₂ O ₅	MnO	Ba	Ce	Co	Cr	Cu	La	Li	Ni	Sc	Sr	V	Y
Hole 615																							
1-1, 60.0-65.0	0.63	51.83	15.57	6.37	3.08	2.99	2.68	2.83	0.67	0.16	0.12	497	70	15	116	35	46	55	54	15	143	161	29
3-2, 55.0-59.0	14.17	37.77	16.34	7.16	3.15	3.15	2.08	2.77	0.65	0.17	0.13	513	70	15	128	38	46	58	54	16	151	174	30
3-3, 30.0-35.0	15.43	55.45	9.98	3.66	2.53	4.29	1.79	2.02	0.46	0.11	0.08	559	49	12	88	21	30	29	40	8	163	79	20
4-3, 31.0-36.0	23.43	86.09	6.62	1.93	1.06	2.68	1.69	1.57	0.30	0.05	0.04	571	34	7	47	8	22	11	21	4	196	34	13
5-4, 62.0-66.0	38.14	57.16	14.26	5.66	3.00	4.26	1.74	2.34	0.61	0.15	0.14	557	58	15	123	33	38	50	51	13	160	168	25
6-2, 3.0-8.0	44.06	61.52	6.77	3.08	3.74	7.03	1.97	1.91	0.47	0.12	0.10	588	51	12	95	23	27	25	43	7	187	74	20
7-6, 48.0-54.0	56.41	80.40	6.88	2.20	1.70	3.92	1.76	1.65	0.33	0.06	0.05	612	40	8	50	11	24	12	26	4	199	39	15
8-2, 24.0-26.0	59.45	75.09	11.18	3.75	3.02	4.91	1.93	2.34	0.43	0.11	0.09	619	52	12	100	26	31	33	41	9	182	96	21
9-2, 37.0-42.0	69.21	74.02	8.26	2.17	2.22	4.33	2.16	2.11	0.37	0.09	0.05	680	41	8	54	13	24	16	26	5	207	43	16
9-3, 56.0-61.0	70.90	58.79	16.28	6.53	3.02	3.89	1.72	2.59	0.65	0.17	0.11	585	49	15	140	36	37	54	56	15	143	194	25
12-1, 50.0-55.0	96.70	61.24	13.87	5.06	3.07	4.85	1.53	3.05	0.66	0.10	0.10	1217	72	18	77	31	34	55	55	14	168	133	25
18-1, 93.0-95.0	153.40	76.49	8.31	2.30	1.61	3.28	1.81	2.02	0.35	0.08	0.05	632	41	8	63	15	26	17	28	5	198	50	17
22-4, 62.0-64.0	195.83	60.76	10.85	3.39	2.29	4.10	1.79	2.30	0.42	0.11	0.08	603	52	11	93	23	31	27	37	8	192	84	21
29-1, 128.0-130.0	257.89	71.42	8.24	2.63	2.50	5.11	1.68	2.05	0.40	0.08	0.07	621	44	11	89	20	26	20	35	6	188	61	18
29-5, 70.0-72.0	263.91	85.60	5.96	1.74	1.24	3.11	1.49	1.55	0.29	0.03	0.04	536	37	9	67	10	23	9	22	3	172	32	13
32-1, 68.0-70.0	286.28	68.32	7.18	1.94	1.99	4.52	1.50	1.72	0.29	0.06	0.06	507	41	9	40	14	21	15	28	4	174	42	14
34-1, 130.0-135.0	315.53	66.50	10.37	3.12	2.72	5.23	1.95	2.41	0.46	0.11	0.12	606	53	12	78	25	31	31	43	7	204	75	20
38-1, 51.0-53.0	352.72	55.33	9.12	2.80	2.77	5.40	2.08	2.16	0.42	0.10	0.10	583	47	9	72	19	26	23	32	6	198	61	19
43-3, 80.0-85.0	409.63	77.80	6.85	1.88	1.64	3.90	1.62	1.72	0.30	0.04	0.04	561	37	8	53	10	12	12	24	4	183	35	13
43-3, 80.0-85.0	412.63	57.72	7.49	1.83	2.05	4.22	1.89	1.94	0.32	0.06	0.04	559	36	8	46	13	21	15	24	4	184	38	14
46, CC (11.0-14.0)	428.58	61.35	9.17	3.18	2.79	5.15	1.69	2.13	0.40	0.09	0.07	533	45	15	110	24	27	27	53	8	180	71	20
49-2, 46.0-51.0	477.68	13.68	3.92	1.51	1.70	39.02	0.89	0.69	0.17	0.08	0.07	160	40	14	31	28	0	23	42	6	2175	41	17
50-3, 80.0-85.0	489.03	11.63	2.72	1.05	1.60	40.41	0.90	0.52	0.12	0.06	0.05	116	36	13	18	24	0	15	36	4	2156	29	14
50-6, 80.0-85.0	493.53	16.75	3.02	1.09	1.65	37.68	1.05	0.68	0.13	0.06	0.04	137	35	13	23	24	0	15	38	4	1969	28	14
50, CC (20.0-25.0)	494.60	19.93	3.20	1.15	1.60	36.72	0.96	0.73	0.15	0.06	0.04	163	34	12	22	23	0	13	36	4	1894	28	13
51-2, 28.0-30.0	496.49	27.31	3.22	1.28	1.59	35.19	0.97	0.77	0.17	0.08	0.04	440	35	12	33	21	0	12	36	4	1847	27	13
52-1, 23.0-28.0	504.46	20.70	4.35	1.63	1.02	40.68	1.18	0.73	0.18	0.05	0.11	162	42	14	5	24	0	20	42	6	1300	37	15
Hole 616																							
1-2, 45.0-50.0	1.98	60.74	16.30	5.60	3.21	3.15	2.79	2.91	0.64	0.13	0.10	500	64	15	105	41	36	68	56	16	137	165	26
1-3, 45.0-50.0	3.47	61.87	15.88	5.34	3.21	3.48	2.79	2.86	0.58	0.14	0.10	499	62	14	83	37	34	65	53	15	140	143	24
2-5, 20.0-24.0	12.22	47.65	14.36	4.99	3.21	4.61	2.12	2.55	0.60	0.13	0.13	531	62	14	86	40	33	55	55	14	154	146	23
3-4, 50.0-54.0	20.62	52.20	15.34	5.39	3.17	4.17	2.12	2.62	0.63	0.13	0.12	523	63	14	109	42	34	58	57	15	150	157	25
4-2, 100.0-105.0	27.63	58.34	15.25	5.38	3.10	4.98	1.81	2.75	0.61	0.14	0.18	465	67	15	101	39	35	62	59	14	170	166	26
5-3, 37.0-40.0	37.99	56.46	15.59	5.12	3.00	3.53	1.82	2.64	0.62	0.13	0.14	527	66	14	107	33	35	56	56	15	148	163	25
6-4, 100.0-105.0	49.72	59.17	14.63	5.07	3.05	4.93	1.71	2.49	0.60	0.14	0.16	497	65	14	100	35	33	54	57	14	164	160	25
7-3, 30.0-35.0	56.92	56.54	14.43	4.56	3.09	5.97	1.93	2.73	0.58	0.13	0.19	494	63	13	101	39	32	60	55	13	195	153	25
8-2, 60.0-65.0	65.53	52.54	14.12	5.06	3.00	5.89	1.63	2.42	0.58	0.13	0.18	465	65	15	79	38	31	51	59	13	177	146	24
9-4, 53.0-58.0	78.05	57.74	16.43	5.74	2.93	3.30	1.78	2.81	0.65	0.14	0.10	538	67	14	100	37	36	57	56	16	149	158	26
10-2, 71.0-76.0	84.84	54.27	16.22	5.94	3.27	4.45	1.69	2.88	0.64	0.14	0.10	493	65	14	114	37	35	63	58	15	149	173	26
11-3, 49.0-55.0	95.72	55.63	15.34	5.92	2.90	6.50	1.57	2.45	0.59	0.15	0.20	438	65	16	98	39	32	59	63	14	193	189	26
16-3, 50.0-55.0	145.92	60.65	15.84	5.56	3.29	4.45	1.64	2.91	0.62	0.12	0.11	498	63	14	103	36	35	63	53	15	149	167	25
17-2, 34.0-37.0	153.86	51.66	11.56	3.83	2.91	4.93	1.63	2.25	0.50	0.08	0.09	522	56	12	104	30	28	46	46	10	171	105	22
18-1, 10.0-14.0	162.32	54.81	11.15	3.73	3.21	5.23	1.81	2.29	0.50	0.08	0.09	539	55	12	78	29	27	35	46	9	172	92	22
20, CC (24.0-25.0)	181.29	66.12	9.21	2.73	2.79	5.33	1.92	2.21	0.39	0.05	0.06	600	50	9	55	25	24	23	33	6	201	54	21
21-2, 46.0-49.0	192.18	58.01	14.27	5.96	3.08	5.51	1.67	2.75	0.58	0.12	0.22	488	62	15	96	36	33	58	63	13	185	161	26
22-1, 40.0-45.0	209.72	84.93	7.33	1.92	1.52	3.55	1.98	1.83	0.35	0.01	0.04	612	46	7	46	15	25	13	24	4	213	36	15
24-2, 35.0-38.0	249.57	74.78	8.51	2.19	2.30	4.81	1.99	2.07	0.32	0.04	0.09	612	44	8	68	22	24	19	32	5	223	50	19
28-2, 12.0-18.0	306.95	58.01	14.76	5.47	3.77	6.35	1.37	2.90	0.63	0.11	0.10	454	63	14	110	37	32	60	58	14	159	147	25
30-6, 35.0-38.0	332.16	51.01	15.99	5.79	3.49	5.49	1.43	3.98	0.65	0.11	0.10	471	66	15	118	39	35	64	58	15	162	167	26
32-4, 110.0-113.0	348.71	55.26	16.03	5.07	3.57	5.31	1.64	3.37	0.68	0.14	0.14	478	67	15	101	45	35	70	64	15	169	145	26
33-2, 106.0-107.0	354.10	46.07	14.85	5.25	3.25	5.92	1.39	2.85	0.64	0.1													

Table 1 (continued).

Core-Section (interval in cm)	Sub-bottom depth (m)	Major elements (wt.%)										Trace elements (ppm)											
		SiO ₂	Al ₂ O ₃	FeO/Fe ₂ O ₃	MgO	CaO	Na ₂ O	K ₂ O	TiO ₂	P ₂ O ₅	MnO	Ba	Ce	Co	Cr	Cu	La	Li	Ni	Sc	Sr	V	Y
Hole 620																							
13-2, 60.0-65.0	109.35	53.60	15.53	5.40	3.13	4.54	2.38	2.83	0.64	0.14	0.13	519	68	14	94	37	37	57	52	15	178	149	27
14-2, 60.0-65.0	119.13	53.97	15.71	5.39	3.30	4.45	2.20	2.95	0.63	0.14	0.11	528	68	14	101	38	37	57	52	15	171	146	26
15-2, 60.0-65.0	128.73	56.04	15.12	5.26	2.90	4.08	1.72	2.66	0.62	0.13	0.12	502	70	14	100	31	35	51	51	15	156	138	26
16-2, 60.0-65.0	138.33	52.86	14.46	5.60	2.86	5.34	1.90	2.44	0.59	0.14	0.19	441	69	15	109	34	34	53	57	14	176	165	26
17-2, 60.0-65.0	147.92	54.34	15.55	5.65	2.91	3.54	2.02	2.59	0.61	0.13	0.11	477	68	14	87	33	35	53	52	15	143	151	26
17-6, 60.0-65.0	153.92	54.78	15.81	5.67	2.92	3.50	2.07	2.63	0.62	0.13	0.10	494	67	14	87	33	36	53	51	15	144	144	26
18-2, 60.0-65.0	157.52	55.94	15.54	5.47	2.98	4.16	2.11	2.74	0.63	0.14	0.15	504	67	14	99	35	36	55	53	15	165	161	27
19-1, 60.0-65.0	165.63	56.33	14.90	4.92	3.29	4.74	1.72	2.90	0.61	0.13	0.11	495	66	13	101	32	36	53	54	15	159	148	25
20-4, 60.0-65.0	179.73	55.93	14.90	5.43	2.92	4.60	1.70	2.50	0.62	0.15	0.12	485	68	14	103	32	35	47	55	15	162	165	26
21-2, 60.0-65.0	186.13	54.53	15.51	5.85	3.22	4.16	1.70	2.79	0.64	0.15	0.12	475	69	14	103	33	36	51	59	16	151	156	27
22-2, 60.0-65.0	195.52	56.27	14.80	5.38	2.88	4.30	1.82	2.49	0.60	0.15	0.18	493	66	13	102	34	35	50	56	15	167	167	26
23-2, 59.0-63.0	204.91	57.42	14.80	5.49	3.21	4.78	1.77	2.75	0.61	0.14	0.18	475	67	14	106	33	35	51	61	15	165	152	25
24-1, 60.0-65.0	212.92	57.99	14.20	5.55	3.15	5.02	1.65	2.59	0.62	0.14	0.14	470	67	15	107	32	34	47	58	15	164	161	25
25-1, 50.0-52.0	222.31	57.85	12.38	4.65	3.61	6.33	1.61	2.55	0.57	0.12	0.11	476	62	15	94	31	30	41	52	13	165	123	23
26-2, 60.0-65.0	233.42	55.20	12.93	4.80	3.49	5.90	1.67	2.61	0.59	0.12	0.11	490	64	15	94	30	31	43	52	13	166	130	23
27-1, 60.0-65.0	241.52	54.33	14.56	5.52	2.99	4.89	1.52	2.61	0.60	0.14	0.13	483	67	15	84	33	34	49	57	15	165	154	25
28-2, 45.0-50.0	252.48	57.84	13.23	4.87	3.32	5.95	1.68	2.63	0.59	0.13	0.12	483	66	14	83	30	32	46	52	14	175	138	24
29-1, 60.0-65.0	260.72	59.32	11.99	4.25	3.54	5.34	1.67	2.62	0.54	0.10	0.08	520	63	13	90	28	32	43	46	12	166	97	22
30-2, 60.0-65.0	271.83	53.92	14.42	5.20	3.35	5.31	1.53	2.88	0.61	0.12	0.10	480	68	15	86	31	35	56	54	15	161	130	26
31-2, 60.0-65.0	281.42	53.43	15.24	5.20	3.39	4.95	1.74	3.02	0.62	0.13	0.10	486	71	16	94	33	36	59	55	16	158	140	26
32-2, 60.0-65.0	291.03	53.42	14.06	5.12	3.45	5.39	1.79	2.79	0.61	0.12	0.10	499	68	15	107	32	35	53	54	14	162	134	24
33-2, 60.0-65.0	300.63	52.42	14.89	5.47	3.73	6.02	1.70	3.05	0.63	0.13	0.10	449	72	16	106	32	36	61	58	16	165	144	26
33-5, 60.0-65.0	305.13	51.92	14.57	5.42	3.63	5.88	1.59	2.96	0.63	0.12	0.12	445	70	15	104	33	35	63	56	14	162	141	26
35-2, 60.0-65.0	319.83	52.41	14.88	5.41	3.45	5.48	1.86	3.05	0.63	0.13	0.18	468	68	15	101	37	35	66	57	14	174	150	27
36-2, 60.0-65.0	329.03	54.02	14.98	5.49	3.41	5.26	1.80	3.01	0.63	0.13	0.21	479	69	16	101	38	36	69	58	14	172	150	27
37-2, 60.0-65.0	339.03	53.39	13.40	4.69	3.72	6.26	1.79	2.83	0.58	0.11	0.21	467	67	15	88	35	33	57	53	12	179	124	25
38-2, 60.0-65.0	348.63	52.25	15.18	5.52	3.66	5.46	1.81	3.15	0.63	0.13	0.17	459	70	16	84	37	36	67	57	15	166	144	27
40-2, 60.0-65.0	367.63	50.41	14.06	5.47	3.93	6.68	1.57	2.90	0.64	0.12	0.09	425	74	16	106	33	34	58	57	14	153	127	26
41-4, 60.0-65.0	380.13	48.00	13.65	5.14	4.93	8.17	1.81	3.20	0.61	0.13	0.08	412	71	16	102	37	33	62	55	13	170	113	27
42-2, 60.0-65.0	386.63	52.24	13.75	5.82	4.49	5.96	1.75	2.99	0.63	0.15	0.10	418	74	16	102	33	34	53	55	13	139	117	28
43-1, 35.0-40.0	394.38	49.59	13.82	5.50	4.40	8.21	1.77	3.17	0.63	0.14	0.09	417	75	17	97	36	34	58	56	13	180	115	27
44-3, 60.0-65.0	407.13	52.16	14.66	5.86	3.95	5.39	2.04	3.05	0.67	0.15	0.11	438	77	16	102	35	37	56	55	14	153	126	29
Hole 621																							
1-2, 60.0-65.0	2.13	59.32	15.08	6.57	2.57	2.45	2.06	2.72	0.65	0.12	0.11	534	70	16	93	29	38	48	50	14	139	143	27
2-3, 60.0-65.0	7.13	59.59	15.01	5.34	2.50	2.57	1.92	2.66	0.64	0.13	0.10	540	71	16	78	28	38	46	51	14	143	142	27
3-3, 60.0-65.0	16.73	62.21	14.49	5.17	2.48	2.57	1.90	2.63	0.66	0.13	0.10	579	70	16	79	28	38	45	48	13	153	134	28
4-3, 60.0-65.0	26.33	61.50	15.33	5.60	2.42	2.22	1.80	2.59	0.67	0.14	0.11	568	73	17	93	29	39	48	50	14	148	146	28
5-3, 60.0-65.0	35.93	59.10	15.63	5.52	2.49	2.29	1.95	2.82	0.67	0.13	0.11	580	71	16	88	30	39	51	48	14	153	138	28
6-3, 45.0-50.0	45.38	57.48	15.59	5.57	2.76	2.48	1.85	2.84	0.66	0.14	0.10	543	74	17	93	32	40	133	51	15	149	156	28
7-3, 60.0-65.0	49.82	63.94	15.01	5.54	2.64	2.53	1.66	2.59	0.64	0.14	0.10	511	74	17	103	32	38	48	52	15	138	160	27
8-2, 60.0-65.0	57.82	58.17	14.71	5.46	2.64	2.50	1.67	2.53	0.64	0.14	0.11	512	74	17	97	29	38	47	52	14	141	157	28
9-2, 60.0-65.0	62.32	64.10	16.63	6.05	3.00	2.97	1.84	2.85	0.68	0.16	0.12	585	85	20	95	33	42	53	59	16	161	166	31
10-2, 60.0-65.0	67.32	61.64	14.75	5.30	2.73	2.56	1.83	2.77	0.63	0.14	0.11	562	74	17	89	30	39	52	51	14	149	150	28
11-2, 60.0-65.0	72.52	65.24	14.08	5.23	2.65	2.71	1.81	2.59	0.61	0.13	0.11	530	74	17	90	29	38	48	52	14	145	148	27
12-2, 60.0-65.0	80.93	61.24	14.21	5.05	2.68	2.54	1.86	2.77	0.62	0.13	0.11	571	72	17	91	31	38	53	51	13	150	142	27
13-2, 60.0-65.0	83.52	67.18	14.30	5.10	2.71	2.57	1.93	2.78	0.60	0.13	0.10	583	70	16	87	29	37	55	50	14	148	143	27
14-2, 60.0-65.0	88.82	62.00	14.61	5.12	2.71	2.42	2.01	2.85	0.62	0.13	0.10	569	70	17	63	31	37	54	50	14	148	144	27
15-2, 60.0-65.0	96.32	60.72	14.19	5.23	2.66	2.62	1.66	2.48	0.63	0.13	0.11	550	75	17	90	28	38	46	52	13	150	144	28
16-2, 60.0-65.0	101.82	62.00	13.73	5.18	2.64	2.89	1.62	2.50	0.63	0.13	0.11	538	74	17	89	29	37	43	52	13	149	140	27
17-2, 60.0-65.0	106.82	58.38	13.99	5.38	2.66	2.75	1.77	2.62	0.61	0.13	0.11	553	70	17	69	28	37	48	50	13	153	140	27
19-2, 60.0-65.0	125.82	59.37	13.61	4.98	2.47	2.62	1.73																

Table 1 (continued).

Core-Section (interval in cm)	Sub-bottom depth (m)	Major elements (wt. %)										Trace elements (ppm)											
		SiO ₂	Al ₂ O ₃	FeO/Fe ₂ O ₃	MgO	CaO	Na ₂ O	K ₂ O	TiO ₂	P ₂ O ₅	MnO	Ba	Ce	Co	Cr	Cu	La	Li	Ni	Sc	Sr	V	Y
Hole 621 (Cont.)																							
22-2, 60.0-65.0	135.63	67.17	12.94	4.68	2.36	2.66	1.73	2.47	0.55	0.10	0.10	546	65	16	92	26	34	41	48	12	162	119	24
23-2, 60.0-65.0	139.42	61.79	10.07	4.60	2.23	2.37	1.74	2.48	0.53	0.08	0.09	503	56	14	53	28	28	42	45	8	154	115	20
24-2, 60.0-65.0	149.23	59.17	14.50	5.28	2.73	2.77	1.79	2.79	0.65	0.13	0.11	512	73	17	83	33	38	52	51	13	152	135	27
25, CC (18.0-20.0)	159.51	59.88	14.63	5.04	2.68	2.89	1.86	2.85	0.67	0.11	0.11	525	74	17	80	32	38	54	52	13	148	130	27
26-2, 60.0-65.0	168.42	60.29	12.65	4.55	2.45	2.77	1.77	2.57	0.56	0.10	0.10	543	66	14	69	27	34	42	46	11	162	108	23
27-2, 45.0-50.0	177.88	79.27	8.51	2.28	1.78	3.03	1.95	2.14	0.41	0.04	0.04	559	53	10	52	24	27	54	31	6	192	51	19
29-3, 60.0-65.0	198.73	66.36	10.86	3.77	2.42	3.55	1.74	2.29	0.48	0.07	0.09	539	60	14	81	25	30	37	45	9	168	104	20
31-1, 66.0-70.0	200.88	58.08	13.37	4.61	3.09	4.77	1.63	2.94	0.67	0.09	0.10	1993	69	17	83	32	33	53	55	13	176	123	24
Hole 623																							
1-1, 90.0-95.0	0.92	53.94	17.33	5.62	3.29	2.40	3.15	3.52	0.71	0.18	0.11	481	60	13	107	42	42	69	37	16	144	164	28
1-4, 90.0-95.0	5.43	57.38	16.12	5.35	3.22	3.01	2.69	3.37	0.66	0.16	0.13	486	46	13	118	40	37	64	38	14	144	147	26
2-3, 60.0-65.0	10.23	55.38	15.94	6.03	3.04	3.41	2.24	2.57	0.69	0.19	0.17	514	48	14	112	36	34	57	40	16	146	184	26
2-6, 60.0-65.0	14.73	55.49	15.38	5.81	3.03	3.85	2.07	2.43	0.65	0.16	0.11	493	37	14	125	35	34	58	39	15	142	203	25
3-2, 60.0-65.0	18.33	54.29	14.51	6.05	3.13	4.34	1.84	2.29	0.66	0.17	0.11	475	40	13	145	32	34	51	40	15	142	209	25
3-5, 60.0-65.0	22.83	54.89	16.68	5.93	3.01	2.60	2.13	2.85	0.67	0.17	0.11	506	34	14	106	36	30	57	38	16	136	172	25
4-3, 60.0-65.0	29.42	56.28	16.56	5.81	3.00	3.10	2.18	2.80	0.66	0.16	0.11	527	30	12	114	35	30	60	33	15	137	169	23
5-1, 60.0-65.0	36.03	56.01	14.35	5.68	2.90	3.88	1.77	2.29	0.63	0.15	0.11	499	32	13	126	30	30	49	33	14	134	177	23
5-4, 60.0-65.0	40.53	56.75	15.56	5.54	2.89	3.41	2.02	2.66	0.65	0.15	0.11	532	29	12	96	35	32	58	33	14	146	176	23
6-2, 60.0-65.0	47.13	56.04	15.11	5.24	2.97	3.61	2.00	2.67	0.64	0.16	0.14	499	29	13	99	32	29	58	35	14	149	178	22
6-5, 60.0-65.0	51.63	56.53	15.17	5.58	3.14	4.62	1.97	2.63	0.64	0.16	0.13	511	30	14	93	35	29	58	38	14	155	172	22
7-3, 60.0-65.0	58.22	68.46	9.52	7.88	2.06	3.56	1.93	2.07	0.42	0.09	0.07	505	0	5	40	18	17	26	15	6	175	73	15
8-2, 95.0-100.0	66.68	56.12	14.60	4.78	3.29	4.27	2.20	2.80	0.61	0.15	0.12	490	24	12	90	33	28	53	31	12	159	143	21
9-2, 60.0-65.0	75.93	57.20	11.79	4.07	3.40	5.80	2.11	2.35	0.55	0.14	0.10	575	15	11	87	25	24	51	23	9	170	103	19
10-2, 25.0-30.0	85.17	60.72	9.58	3.12	3.23	5.99	1.86	1.94	0.51	0.13	0.09	572	15	8	71	18	21	27	19	7	188	82	19
11-2, 50.0-65.0	95.13	57.06	10.61	3.92	3.42	6.57	1.75	2.02	0.58	0.14	0.10	577	20	10	79	24	25	33	21	9	171	102	21
12-2, 60.0-65.0	104.73	54.42	15.80	5.33	3.02	3.70	1.92	2.72	0.64	0.16	0.17	454	30	13	101	35	29	59	38	14	148	185	22
12-4, 60.0-65.0	107.73	56.31	15.79	5.09	2.89	3.56	1.79	2.82	0.63	0.15	0.13	524	28	12	109	34	32	58	33	14	146	177	23
14-1, 59.0-64.0	122.01	54.23	15.62	5.73	2.92	5.54	1.75	2.61	0.63	0.17	0.19	467	40	16	119	36	31	60	44	14	175	190	24
15-1, 60.0-65.0	131.42	79.51	6.29	1.87	1.13	2.68	1.80	1.63	0.30	0.05	0.06	495	0	1	0	7	12	11	1	2	174	26	11
16-2, 60.0-65.0	142.23	70.53	7.89	2.23	2.01	4.54	1.84	1.95	0.34	0.09	0.07	574	0	4	28	12	18	17	7	3	189	40	19
17-1, 60.0-65.0	150.02	56.18	15.48	5.38	3.02	4.33	1.80	2.79	0.64	0.16	0.14	480	34	13	101	33	32	59	33	14	155	168	23
Hole 618																							
4-2, 86.0-90.0	28.08	48.15	13.07	4.58	3.07	8.17	3.58	2.76	0.53	0.14	0.10	447	28	13	107	34	28	55	32	11	295	114	20
5-2, 81.0-85.0	37.63	52.29	12.86	4.32	3.57	7.41	2.53	2.78	0.58	0.14	0.09	432	38	13	104	30	29	51	33	11	201	100	20
6-2, 41.0-46.0	46.83	52.14	12.65	4.95	3.47	7.33	2.36	2.84	0.56	0.13	0.09	426	33	13	107	28	28	50	33	11	204	99	19
7-1, 70.0-75.0	51.63	54.16	13.37	4.51	3.53	8.43	2.54	2.87	0.57	0.14	0.09	447	36	13	94	31	29	53	34	11	206	99	20
8-3, 90.0-95.0	60.83	51.10	12.13	4.53	3.37	8.34	2.19	2.58	0.57	0.13	0.09	441	35	13	107	29	31	48	44	11	206	100	21
9-1, 80.0-85.0	70.72	52.14	12.67	4.71	3.57	8.29	2.19	2.74	0.59	0.14	0.10	442	41	13	86	26	31	48	34	11	195	106	22
10-1, 85.0-90.0	77.78	50.60	11.99	4.69	3.37	8.52	2.08	2.47	0.56	0.14	0.10	436	38	13	104	30	27	44	35	11	191	104	21
Hole 619																							
1-1, 50.0-52.0	1.51	47.25	14.25	4.58	3.51	7.32	2.78	3.15	0.59	0.15	0.18	453	37	14	106	61	29	58	37	12	255	127	21
5-3, 116.0-118.0	34.07	52.18	13.70	5.55	2.79	6.98	1.66	2.43	0.62	0.16	0.28	441	44	16	119	31	30	53	41	13	194	190	25
9-1, 116.0-118.0	69.87	44.33	13.77	4.98	4.51	8.60	1.74	3.27	0.65	0.14	0.10	410	44	16	113	30	30	63	38	13	164	119	22
16-4, 57.0-59.0	141.08	50.97	16.33	5.51	2.73	6.66	1.93	3.14	0.62	0.16	0.18	465	54	14	106	34	38	73	44	14	300	139	23
18-2, 81.0-82.0	157.71	56.93	16.46	5.75	2.58	2.01	1.55	3.03	0.79	0.17	0.09	415	61	12	86	27	41	70	30	15	142	140	28
22-2, 46.0-47.0	189.26	59.48	15.00	4.66	2.56	3.27	1.80	3.20	0.68	0.14	0.08	435	41	11	96	28	35	62	30	12	171	111	24

^a Data from Mississippi Fan sites are plotted in Figure 2A-E.

Table 2. X-ray clay diffraction data for Sites 614, 615, 616, 617, 620, 621, 622, and 623 located on the Mississippi Fan.

Core-Section (interval in cm)	Sub-bottom depth (m)	Clay fraction composition (%)							
		Sm	I	Ch	K	Q	F	Ca ^a	Do
Hole 614									
1-3, 93-95	3.92	47	8	15	20	5	4	0	0
2-6, 62-64	17.56	57	5	12	16	7	3	0	0
5-1, 110-112	30.13	49	9	11	15	11	5	0	0
5-2, 100-102	31.52	53	8	13	13	8	5	0	0
5-4, 100-102	34.52	24	9	21	21	26	0	0	0
Hole 614A									
2-1, 11-13	45.14	59	7	9	12	9	4	0	0
3-5, 30-32	60.63	53	9	14	12	8	5	0	0
4-1, 50-52	61.33	58	6	12	12	8	5	0	0
8-1, 62-64	99.15	46	7	14	18	5	3	3	3
8-3, 32-34	101.85	40	11	18	22	9	0	0	0
9-1, 42-44	108.45	36	11	16	20	11	5	0	0
9-1, 80-82	108.82	35	15	18	24	5	0	0	0
9-2, 12-14	109.65	42	11	17	17	14	0	0	0
Hole 615^a									
1-1, 60-62	0.63	25	14	18	28	9	6	0	0
3-2, 55-57	14.17	47	8	14	18	10	3	0	0
5-4, 62-64	38.14	60	7	10	12	8	2	0	0
6-4, 85-87	47.88	48	9	15	15	7	7	0	0
6,CC (0-2)	51.53	39	12	17	21	12	0	0	0
7-6, 48-50	56.41	40	10	15	17	8	10	0	0
9-2, 37-39	69.21	37	12	16	18	10	8	0	0
12-1, 50-52	96.70	51	8	13	17	8	3	0	0
19-1, 100-102	163.21	51	8	13	16	9	2	0	0
29-1, 57-59	172.28	30	16	16	23	12	4	0	0
21-1, 27-29	181.49	26	12	21	22	14	5	0	0
22-4, 62-64	195.83	49	8	13	17	9	4	0	0
29-1, 68-70	257.89	33	14	18	20	12	3	0	0
29-2, 70-72	259.41	37	15	19	15	13	0	0	0
29-3, 70-72	260.91	27	13	22	20	13	5	0	0
29-5, 70-72	263.91	20	15	20	21	11	12	0	0
34-1, 130-132	315.53	45	11	16	17	8	2	0	0
43-1, 40-42	409.63	41	14	16	13	8	9	0	0
43-3, 40-42	412.63	47	11	16	16	7	3	0	0
43-3, 80-82	413.03	0	22	25	27	13	13	0	0
43-5, 40-42	415.63	52	9	17	15	6	0	0	0
46,CC (11-13)	428.58	20	17	22	16	11	9	0	0
56-3, 80-82	489.03	4	2	3	4	2	0	78 (7)	0
50,CC (20-22)	494.60	0	2	4	4	2	0	81 (7)	0
52-1, 23-25	504.46	11	3	10	8	3	4	58 (3)	0
Hole 616									
2-6, 20-22	13.72	56	8	12	16	7	1	0	0
7-1, 30-32	53.92	38	10	14	18	9	2	6	5
10-1, 71-73	83.34	49	10	13	18	6	2	0	2
17-3, 34-36	155.36	65	6	9	12	5	2	0	1
21-1, 46-48	190.68	49	10	16	16	7	2	0	0
28-1, 12-14	305.45	25	16	23	22	6	2	0	6
33,CC (21-23)	357.34	33	14	22	19	9	2	0	0
34-1, 93-95	362.64	47	10	16	17	8	2	0	0
Hole 617									
1-1, 90-92	0.91	45	9	14	19	8	4	0	0
3-6, 60-62	25.72	62	5	12	14	4	2	0	0
5-1, 28-30	37.09	42	11	15	22	6	1	0	2
6-3, 50-52	49.82	45	9	15	19	8	3	0	2
11-1, 44-46	94.57	35	11	19	22	8	2	0	2
15-2, 16-18	133.88	30	13	21	22	5	2	5	3
Hole 620									
13-2, 60-62	109.93	51	8	12	16	6	2	3	3
14-2, 60-62	119.13	42	10	13	15	10	4	0	6
15-2, 60-62	128.73	55	5	8	11	4	1	5	2
16-2, 60-62	138.33	47	9	15	17	8	4	2	2
17-2, 60-62	147.92	55	7	10	14	7	4	0	3
17-6, 60-62	153.92	47	8	13	15	9	3	0	6
18-2, 60-62	157.52	57	7	10	14	5	1	3	2
19-1, 60-62	165.63	43	9	13	14	10	5	0	6
20-4, 60-62	179.73	50	8	10	16	6	2	5	3
21-2, 60-62	186.13	43	10	15	16	9	2	0	3
22-2, 60-62	195.52	49	10	13	16	5	1	4	2
23-2, 59-61	204.91	30	11	21	20	9	3	0	6
24-1, 60-62	212.92	39	11	15	18	5	2	5	4
25-1, 50-52	222.31	32	13	19	16	10	3	0	6
26-2, 60-62	233.42	41	13	17	18	4	2	3	2
27-1, 60-62	241.52	36	12	17	18	8	3	1	5

Table 2 (continued).

Core-Section (interval in cm)	Sub-bottom depth (m)	Clay fraction composition (%)							
		Sm	I	Ch	K	Q	F	Ca ^a	Do
Hole 620 (Cont.)									
28-2, 45-47	252.48	33	14	17	18	5	3	7	4
29-1, 60-62	260.72	44	13	15	16	6	2	0	5
30-2, 60-62	271.83	46	11	15	16	7	2	0	4
31-2, 60-62	281.42	37	14	18	18	7	2	0	5
32-2, 50-52	291.03	37	13	17	18	4	2	5	3
33-2, 60-62	300.63	24	15	22	17	8	3	3	8
33-5, 60-62	305.13	30	15	19	18	4	1	7	5
35-2, 60-62	319.83	30	15	19	19	7	2	1	7
36-2, 60-62	329.42	39	13	17	17	4	1	5	3
37-2, 60-62	339.03	45	10	15		5	2	4	5
38-2, 60-62	348.63	34	16	21	19	3	0	4	4
40-2, 60-62	367.63	27	15	22	19	6	4	0	9
41-4, 60-62	380.13	13	13	23	15	8	6	9	14
42-2, 60-62	386.63	35	9	15	20	11	4	0	7
43-1, 35-37	394.38	15	12	27	19	4	3	11	9
44-3, 60-62	407.13	33	9	20	23	11	4	0	0
Hole 621									
4-1, 60-62	23.33	40	12	16	24	7	2	0	0
14-4, 60-62	91.82	37	12	18	25	7	1	0	0
26-1, 73-75	167.05	32	11	20	26	8	2	0	2
27-1, 90-92	176.82	33	12	19	26	7	3	0	0
32-1, 90-92	202.23	29	14	20	19	6	1	8	4
33-2, 90-92	213.82	34	15	22	0	0	7	0	0
Hole 622									
4-2, 60-62	24.83	39	12	17	20	8	2	0	2
6-4, 60-62	46.82	26	12	21	29	8	3	0	1
10-3, 60-62	93.02	30	13	20	26	7	3	0	1
12-1, 60-62	109.13	34	12	19	25	7	2	0	1
13-3, 60-62	115.93	27	12	20	30	6	3	0	2
16-1, 60-62	133.52	54	7	11	16	9	3	0	0
16-2, 60-62	135.02	26	12	23	28	7	2	0	2
22-1, 60-62	175.33	61	5	12	13	6	3	0	0
22-2, 60-62	176.83	48	11	14	18	5	4	0	0
23-1, 65-67	178.38	62	5	11	12	8	2	0	0
23-2, 65-67	179.88	37	15	17	20	7	5	0	0
Hole 623									
1-1, 90-92	0.92	37	10	12	17	16	7	0	0
1-4, 90-92	5.43	47	8	12	15	12	7	0	0
2-3, 60-62	10.23	53	8	14	15	6	2	0	2
2-6, 60-62	14.73	46	8	12	16	8	5	0	5
3-2, 60-62	18.33	38	12	18	21	5	4	0	3
3-5, 60-62	22.83	58	7	10	14	8	4	0	0
4-3, 60-62	29.42	54	8	13	19	4	2	0	1
5-1, 60-62	36.03	54	6	10	13	8	4	0	5
5-4, 60-62	40.53	50	9	13	16	5	2	1	4
6-2, 60-62	47.13	50	6	11	14	11	4	0	4
6-5, 60-62	51.63	44	8	13	18	6	3	4	5
7-3, 60-62	58.22	65	7	8	11	6	3	0	0
8-2, 95-97	66.68	44	9	13	17	6	2	4	5
9-2, 60-62	75.93	48	9	13	17	7	3	0	3
10-2, 25-27	85.17	46	10	14	18	6	1	1	4
12-2, 60-62	104.73	58	7	12	12	6	5	0	0
14-1, 59-61	122.01	59	6	11	15	6	3	0	0
16-2, 60-62	142.23	57	6	11	15	7	3	0	0

Note. Abbreviations are as follows: Sm = smectite, I = illite; Ch = chlorite, K = kaolinite, Q = quartz, F = feldspar, Ca = calcite, Do = dolomite.
^a Values in Ca column in parentheses are for aragonite.

were measured for all the identified minerals and normalized to 100 without introducing any intensity-weighting factors. The percentages given are, therefore, relative percentages only for comparison within the data set.

RESULTS

Inorganic Geochemistry

Table 1 shows the bulk inorganic geochemistry for all samples analyzed from Sites 615, 616, 620, 621, and 623 in the Mississippi Fan, along with data from Sites 618 and 619 in the intraslope basins. Since this chapter is

concerned primarily with the fan sites, no further mention is made of the data from the intraslope basins although the data are included for comparative purposes.

The inorganic geochemistry data indicate relatively little variability both within and between sites (Fig. 2, Table 1). The most notable variations occur in the six samples from the carbonate interval at the bottom of Site 615 that contain between 35 and 41 weight percent CaO (recalculated to about 62–73 wt.% CaCO₃) and about 1300–2175 ppm Sr, compared to values of 3–5 wt.% CaO and 150–200 ppm Sr, more typical of all the other samples. Macroscopic core descriptions and carbonate bomb tests indicate that the section from which these samples came consists of a nannofossil ooze with 75–80% CaCO₃ (see Site 615 chapter, this volume). The rest of the fan sediments consist of clay, mud, silt, sand, and gravel of terrigenous origin (see site chapters, this volume).

A bivariate analysis for the 22 major, minor, and trace elements from the fan sites, excluding the six carbonate samples at the base of Site 615, was used to aid in the interpretation of the mineralogical source of the oxides and elements (Table 3). On the basis of all the available mineralogical and geochemical data, the following conclusions may be drawn from this analysis:

1. Most of the major element oxides (e.g., Al₂O₃, FeO + Fe₂O₃, MgO, and SiO₂) may be accounted for in the various clay minerals. One example of this is shown by the high correlation coefficient of 0.96 between Al₂O₃ and FeO + Fe₂O₃.

2. The high correlation coefficients between K₂O, TiO₂, P₂O₅, Cu, Co, Li and Sc, and both Al₂O₃ and FeO + Fe₂O₃, suggests that a large proportion of these minor and trace elements are associated with the clay minerals. Also, the high correlation coefficients between most of the base metals suggests that they tend to be associated together, probably within some of the clay minerals.

3. The high absolute abundances of some of the minor and trace elements, such as TiO₂, Cr, Cu, and Ni, may be partly explained by the relatively large amount of accessory and heavy minerals in the fan sediments (Stow et al., this volume). However, sorption of minor and trace elements within clay mineral lattices probably accounts for most of the absolute abundance levels.

4. Above approximately 100 m sub-bottom, as seen in Sites 615, 616, and 621 (Figs. 1, 2), the samples show a greater variation in the abundances of the major, minor, and trace elements than below this depth. Some samples in the uppermost 100 m show larger amounts of the oxides and elements that constitute, and are associated with, the clay minerals. Perhaps this increase in clay mineral content of the sediments in the upper 100 m reflects the rise in sea level and consequent lesser amounts of coarser grained material being deposited on the Mississippi Fan.

Clay Mineralogy

Typical X-ray diffraction analyses of the < 4 μm fraction of all the samples analyzed showed 30–50% smec-

tites, 15–20% kaolinite, 12–18% chlorite, 8–14% illite, 8–12% quartz, 3–6% feldspar (mainly plagioclase), 0.5% calcite (with rare aragonite), and 0.3% dolomite (Table 2). Thus, smectites are clearly the dominant clay minerals present, although their absolute abundance varies considerably between samples. Kaolinite and chlorite are approximately co-equal and of secondary importance. Illite abundances typically range between 0.5 and 0.7 times that of the kaolinite or chlorite abundance.

Subtle variations in mineralogy between the Mississippi Fan sites are evident. The lower fan sites (615 and 623) contain more quartz and feldspar than the middle fan sites (620 and 621). Also, the middle fan overbank site (620) contains greater amounts of calcite and dolomite than either the middle fan channel (621) or any of the lower fan sites (615 and 623).

Although the clay mineralogy varies between sites, there are no obvious horizontal gradients and no consistent downhole variations. However, subtle differences are apparent at Sites 615 and 616. At these sites, a slight and somewhat erratic downhole decrease in smectite occurs, with corresponding increases in kaolinite, chlorite, and illite. The high calcite content at the base of Site 615, and at the top of most sites, is entirely facies controlled (Stow et al., this volume).

Sediment facies control on the mineralogy is particularly apparent in three ways. (1) The ooze at the base of Site 615 and the ooze and calcareous mud at the top of each site naturally have large amounts of calcite, minor aragonite, and no dolomite—the latter mineral being absent, perhaps, because the environment is not sufficiently reducing. (2) Calcite and dolomite abundance increases in the finer grained facies, with these minerals normally being absent from coarse-grained silts and sands. (3) The thicker silts and sands tend to contain a smaller total clay fraction, relatively more quartz and feldspar in the clay fraction, and variable (although commonly greater) chlorite:kaolinite ratios than the finer-grained facies.

MODELS FOR DEPOSITION

The majority of Mississippi Fan DSDP Leg 96 sediments were deposited from turbidity currents and other sediment gravity flows. The inorganic geochemistry and clay mineralogy of these sediments, therefore, reflects resedimentation of the Mississippi, and ancestral Mississippi river and delta sediments, together with the Texas–Louisiana and West Florida Shelf sediments [for a comparison with “average shale” compositions, see Wedepohl (1968)]. Given the extremely rapid rates of sediment accumulation on the fan [typically 5–7 m/1000 yr. for the lower fan at Site 615, nearly 12 m/1000 yr. for the middle fan channel fill, and about 11 m/1000 yr. for the middle fan overbank Site 620 (Wetzel and Kohl, this volume; site chapters, this volume)], the downhole and between-hole similarity in inorganic geochemistry and clay mineralogy data is predictable. At least during the late Pleistocene, the source of the fan sediments did not change; Pleistocene fan sediments reflect a relatively stable and mineralogically mature provenance (Stow et al., this volume). The samples that contain a large amount

of CaCO₃ are principally composed of calcareous foraminifers and nannofossils and therefore most of the carbonate is of biogenic origin.

Three possible models could explain the inorganic geochemical variations and relative minor- and trace-element enrichment in the analyzed sediment samples: (1) bioconcentration in which marine plankton concentrate minor and trace elements as, for example, organometallic compounds (Leinen and Stakes, 1979); (2) postdepositional geochemical mobility, where migrating pore fluids dissolve and reprecipitate relatively mobile oxides, elements, and other element compounds/phases (Dean et al., 1984), and (3) clay mineral sorption (Tourtelot, 1964). Since DSDP Leg 96 samples do not show high concentrations of organic matter, nor is there any reason to believe that marine plankton or bacteria preferentially concentrated minor and trace elements that have remained after decomposition of such organisms, the bioconcentration model is not favored. Also, the samples do not show any evidence of downhole diagenetic changes (although small sulfide concretions occur in many cores) that could explain the absolute and relative minor- and trace-element concentrations. Therefore, the clay mineral sorption model is favored because of the high correlation coefficients between the major clay mineral oxides and many of the minor and trace elements, with any variability being well explained by changing ratios between quartz, carbonate, and clay minerals.

The inorganic geochemistry and clay mineralogy data show no clear early diagenetic trends either downhole or between sites. However, a scanning electron microscope study has not been carried out on these samples and it is possible that the variability in clay minerals, in part, reflects early diagenesis in the sediments that is not recog-

nized by the analytical techniques used in this study. For example, it is possible that the inverse relationship observed between smectites and either dolomite or calcite is a function of smectite authigenesis. Furthermore, much of the dolomite may be early authigenic in origin. Finally, not all the aragonite has inverted to calcite at the base of Site 615 and this may reflect the rapid burial of these sediments.

ACKNOWLEDGMENTS

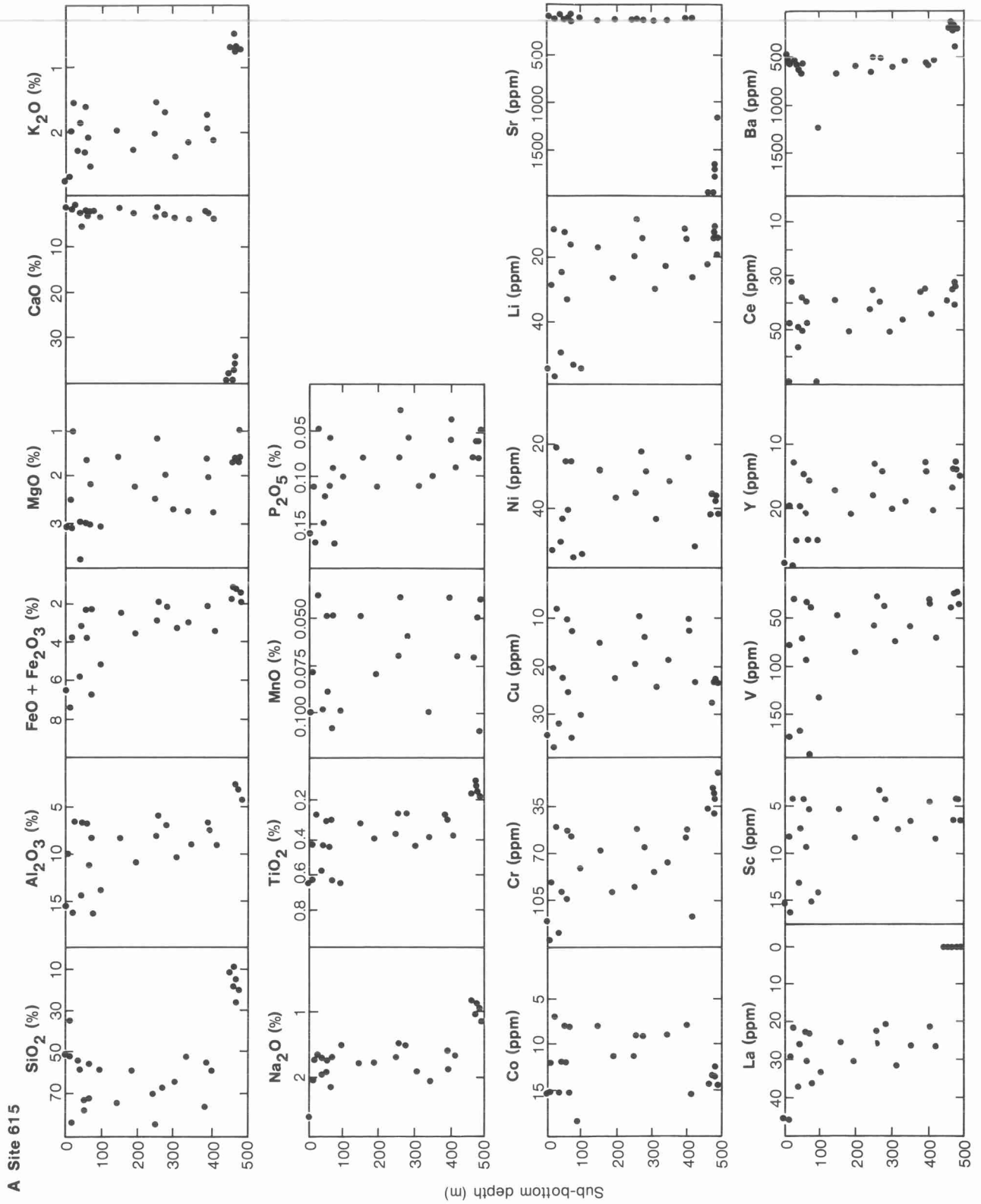
A. J. Fleet and I. Jarvis reviewed an earlier draft of this manuscript.

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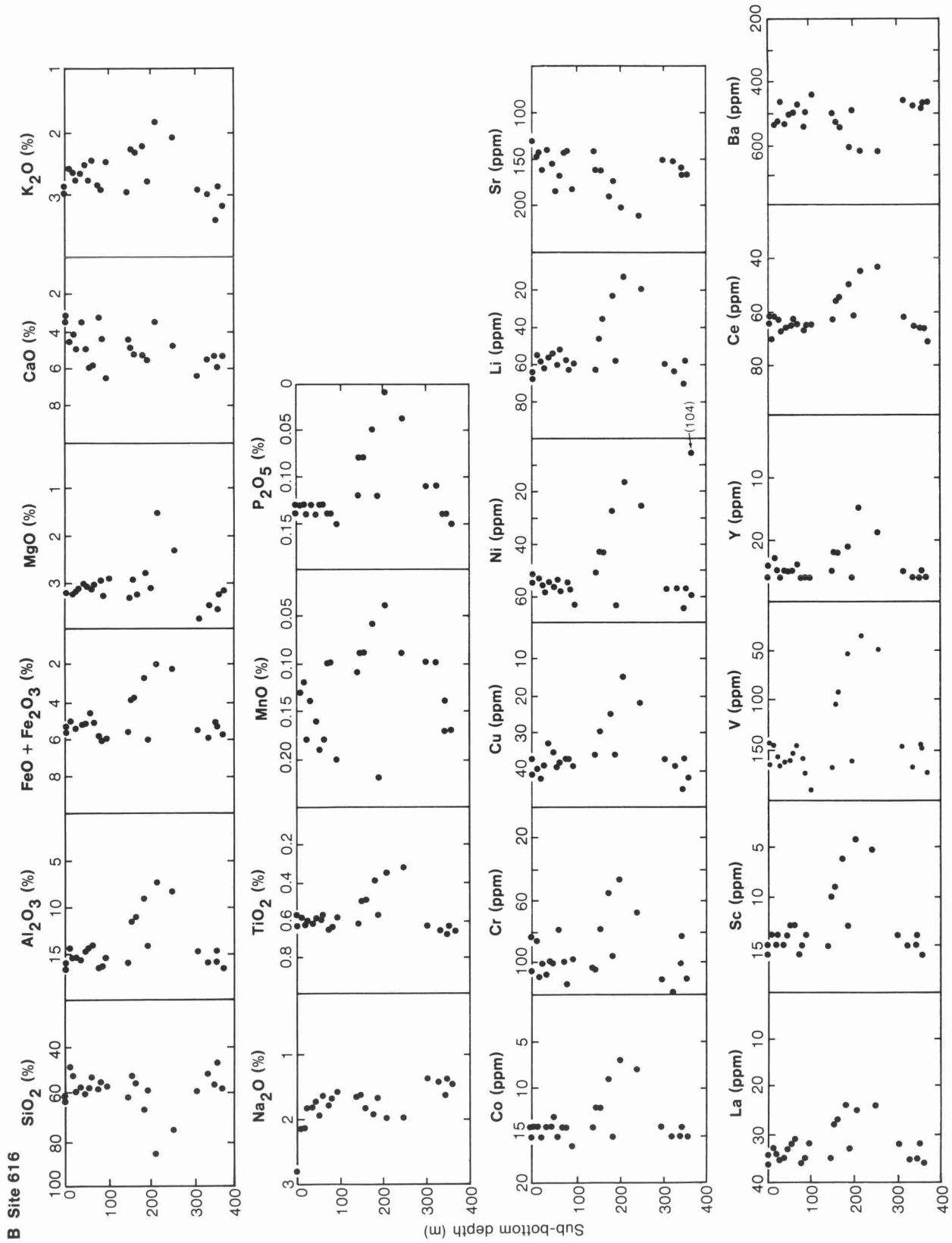
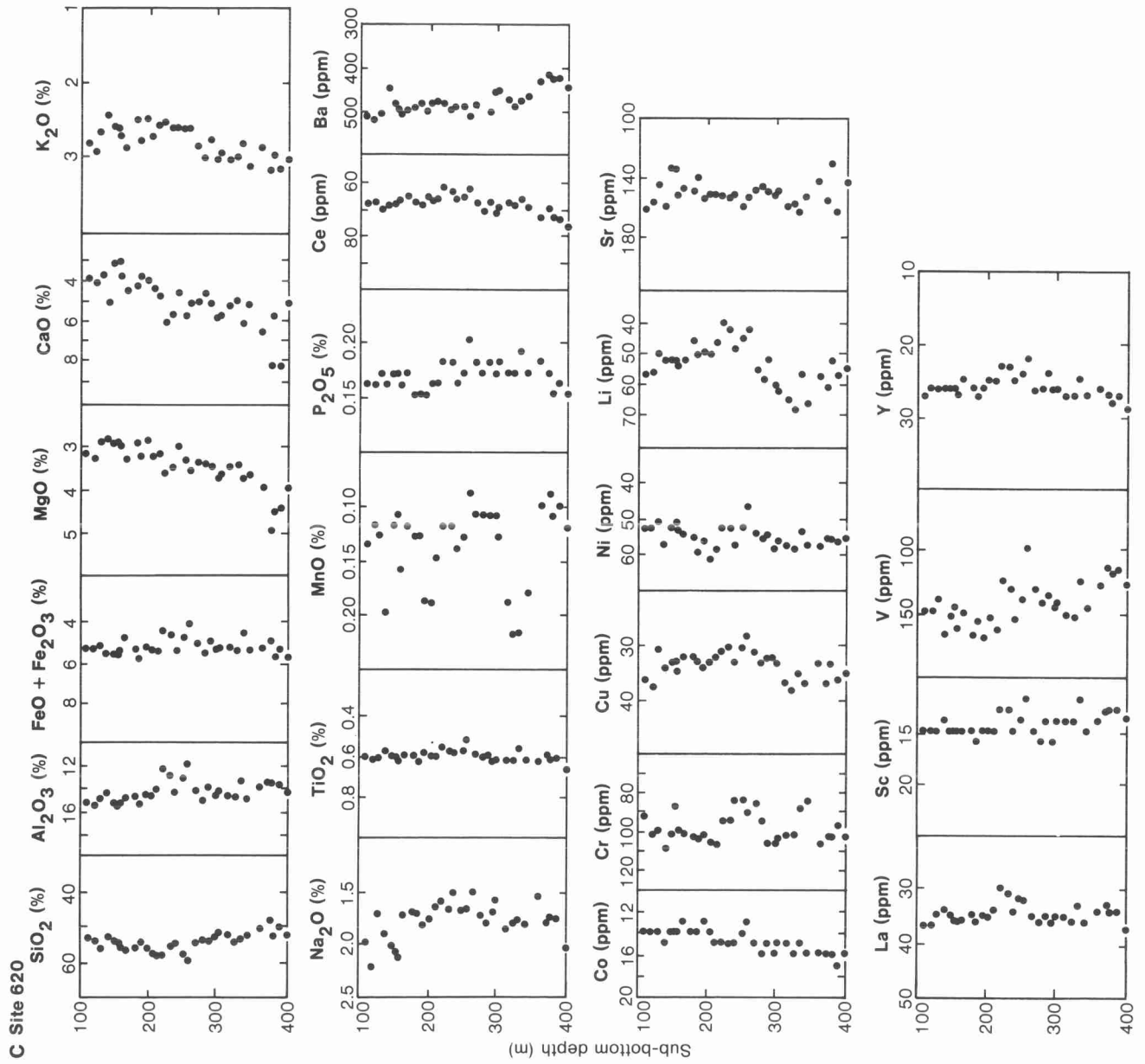


Figure 2. Downhole geochemical trends for various major, minor, and trace elements at sites visited during DSDP Leg 96. See Table 1 for tabulated data.



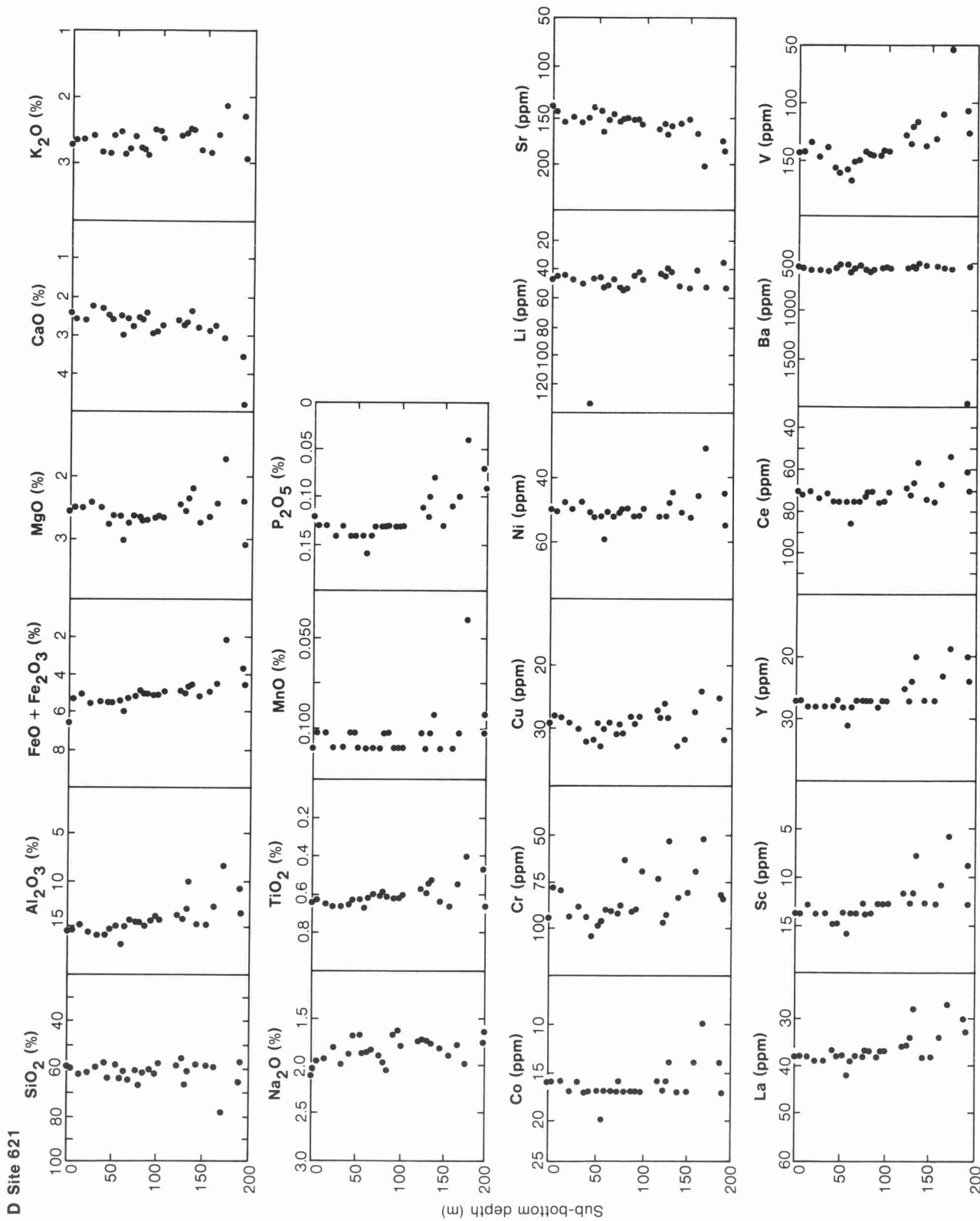


Figure 2 (continued).

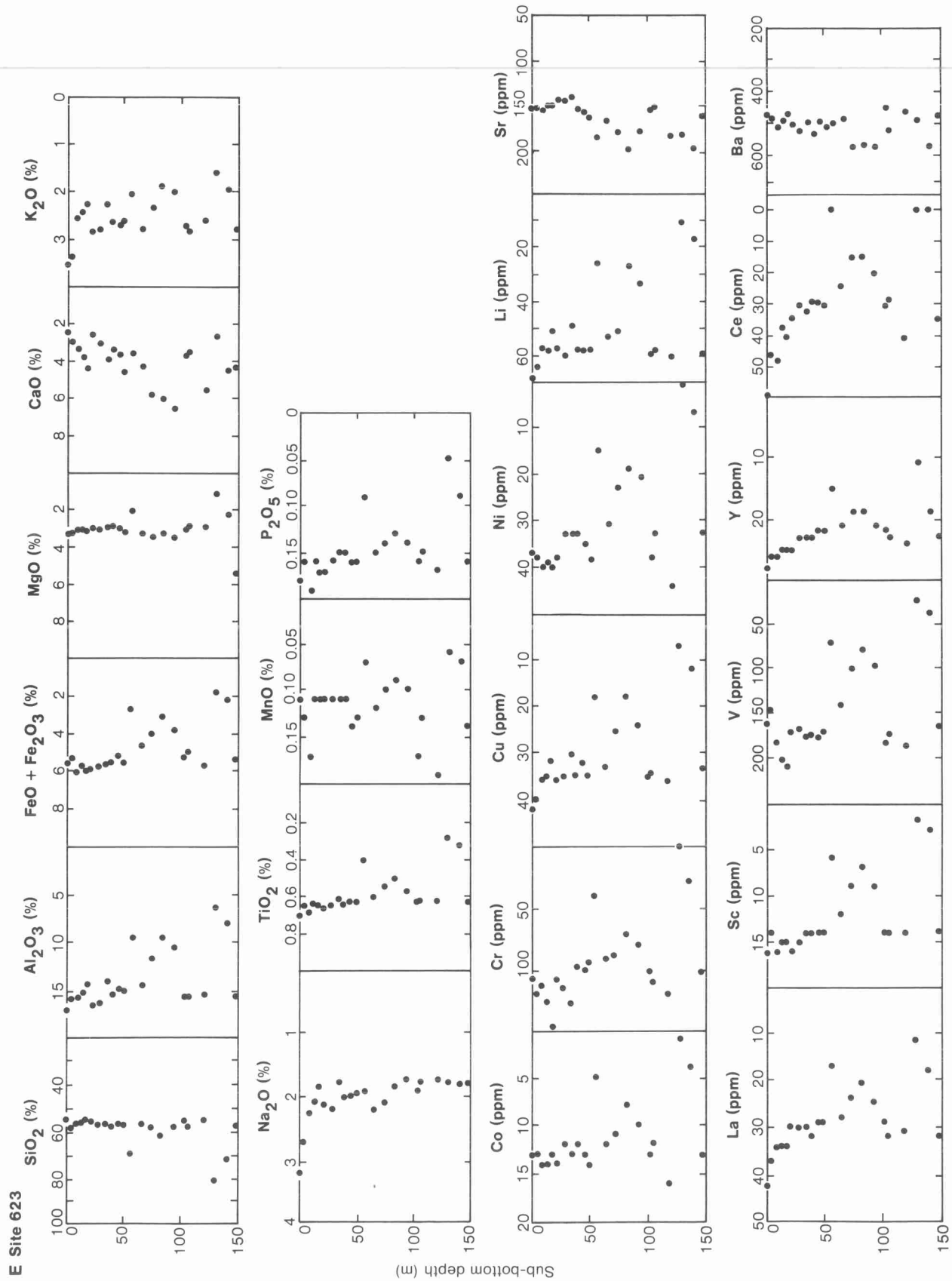


Figure 2 (continued).

Table 3. Correlation coefficient table for bivariant analysis of major, minor, and trace elements for Mississippi Fan Sites 615, 616, 620, 621, and 623.

	Al ₂ O ₃	Fe ^a	MgO	CaO	Na ₂ O	K ₂ O	TiO ₂	P ₂ O ₅	MnO	Ba	Ce	Co	Cr	Cu	Li	Ni	Sc	Sr
SiO ₂	-0.72	-0.75	-0.78	-0.34	-0.07	-0.68	-0.74	-0.72	-0.58	0.63	-0.29	-0.57	-0.67	-0.77	-0.64	-0.60	-0.73	0.46
Al ₂ O ₃		0.96	0.58	-0.10	0.20	0.85	0.95	0.84	0.63	-0.53	0.43	0.74	0.71	0.90	0.84	0.69	0.97	-0.49
Fe ^a			0.61	-0.05	0.12	0.79	0.95	0.85	0.63	-0.57	0.47	0.79	0.77	0.87	0.79	0.72	0.96	-0.73
MgO				0.63	0.04	0.71	0.65	0.60	0.45	-0.57	0.28	0.53	0.61	0.72	0.59	0.59	0.62	-0.28
CaO					-0.31	0.10	-0.04	0.01	0.24	0.40	-0.04	-0.04	0.14	0.17	0.04	0.19	-0.03	0.46
Na ₂ O						0.19	0.14	0.27	0.00	0.13	-0.15	-0.10	0.09	0.19	0.13	-0.17	0.12	-0.21
K ₂ O							0.84	0.65	0.50	-0.57	0.53	0.72	0.55	0.86	0.82	0.69	0.84	-0.51
TiO ₂								0.85	0.60	-0.53	0.44	0.80	0.71	0.87	0.82	0.68	0.95	-0.72
P ₂ O ₅									0.63	-0.44	0.15	0.57	0.75	0.17	0.68	0.46	0.83	-0.63
MnO										-0.51	0.24	0.47	0.51	0.70	0.58	0.56	0.62	-0.16
Ba											-0.28	-0.39	-0.48	-0.61	-0.56	-0.50	-0.57	0.36
Ce												0.74	0.16	0.42	0.40	0.85	0.50	-0.23
Co													0.54	0.70	0.66	0.85	0.80	-0.55
Cr														0.74	0.60	0.55	0.75	-0.53
Cu															0.84	0.76	0.89	-0.50
Li																0.64	0.82	-0.52
Ni																	0.77	-0.34
Sc																		-0.70

Note. Carbonates at base of Site 615 are excluded from this analysis using a least-squares regression line. Sample population is 126 unless otherwise stated. Ce plots exclude Sections 623-7-3, 623-15-1, and 623-16-2; Cr plots exclude Section 623-15-1; Ba plots exclude Sections 615-12-1 and 621-31-1.

^a Fe = FeO + Fe₂O₃.

