29. CHEMICAL ANALYSES OF RED SEA SEDIMENTS

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One of the prime motives for exploring the deeper subsurface sediments of the Red Sea floor was to gain information on the geochemical systems controlling the hot brine-metalliferous deposits. Accordingly, a strong effort was made to provide both shipboard and laboratory means of analysis of the recovered phases. Shipboard spectrographic analyses (semiquantitative) provided both detailed surveys of chemical properties of the cores and the ability to analyze small subsamples and separated particles such as pyrite, sphalerite, organisms, and similar minute objects. Over 5000 such analyses are provided in Tables 1 to 5. Some supplementary data provided by subsequent analyses for K, Zn, and Ag in the Denver field laboratories of the U. S. Geological Survey have been added to the tables.

A second body of data is provided in Table 6, which gives quantitative data on major and minor constituents, performed by the Washington analytical laboratories of the U. S. Geological Survey. A third group of analyses are partial analyses on evaporitic rocks (anhydrite and rock salt) (Table 18, in Manheim Chapter 38, this volume).

In addition to the above, a number of the collaborating laboratories are providing more specific chemical data on special phases and constituents of the Red Sea materials. Most of these data are included in chapters in the Geochemical section of this volume.

The significance of the data is discussed in Manheim (Chapter 38, this volume) and in the respective reports of shipboard workers and cooperating shore laboratories.

TABLE 1A
Semiquantitative Spectrographic Analyses of Samples from Site 225

Sample	Depth (m)	Major Elements (%)								Minor and Trace Elements (ppm)																Description
		Si	K	Al	Fe	Ti	Ca	Mg	Mn	Pb	Ag	Cu	Zn	Sn	Cd	Mo	Ni	Co	V	Ba	Sr	B	As	Zr	Cr	
1-2, 100-101	2.5	10	0.6*	4	15	0.3	15	3	0.1	10	N	10	60*	N	N	N	70	7	20	50	500	20	N	70	70	Yw brn soupy carb mud
1-3, 60	3.6	5		2.5	0.5	0.2	20	1.5	0.01	≤10	N	20	N	N	N	N	15	10	20	N	>5000	30	N	15	20	Yw brn lithified limestone crust
1-4, 70-73	5.2	10		4	0.7	0.2	20	1.5	0.02	≤10	N	5	N	N	N	N	10	5	15	N	>5000	10	N	15	50	Yw brn cream wh limestone and (kidney-shaped chert not analyzed)
1-4, 105	5.5	5	0.3*	2.5	0.5	0.15	20	1	0.01	≤10	N	5	40*	N	N	N	7	≤5	10	N	>5000	10	N	20	20	Yw brn lithified limestone crust
1-5, 85	6.8	10		4	0.5	0.2	>20	1.5	0.01	≤10	N	5	N	N	N	N	10	≤5	10	N	>5000	10	N	20	70	Yw brn lithified limestone crust
1-6, 10	7.6	10		4	0.5	0.2	>20	1.5	0.015	≤10	N	5	80*	N	N	N	50	10	20	N	>5000	10	N	20	50	Gy grn lithified limestone
3-3, 100-101	20.5	12		5	3	0.3	20	5	0.2	10	N	20	N	N	N	N	50	10	30	70	100	10	N	50	100	Yw gy grn carb mud
3-3, 102-103	22.0	12		5	5	0.5	20	5	0.2	≤10	N	20	N	N	N	N	50	10	30	100	1000	10	≤10	70	100	Gy grn carb mud
3-4, 0-10	22.5	<2		0.3	>20	0.005	1.5	0.02	0.07	N	N	100	N	N	N	300	500	100	≤10	N	≤100	20	3000	10	N	Slv wh pyrite "branch" concretion: also, 500 ppm Sb
4-3, 60-61	26.6	12		0.5	2	0.3	20	5	0.2	10	N	10	N	N	N	N	70	10	20	20	1000	50	N	50	10	Lt gy grn carb mud
4-4, 90-91	28.9	15		5	3	0.3	10	5	0.3	10	N	50	N	N	N	N	20	10	20	70	1000	20	N	70	100	Gy grn brn carb mud
4-5, 80-81	29.8	10		>5	1	0.2	20	1.5	0.1	10	0.5	100	200*	N	N	200	200	20	700	1000	1500	20	N	20	70	Dk grn bk pyrite mud
4-5, 110-111	30.1	15		>5	5	0.3	20	7	0.15	≤10	N	70	N	N	N	5	150	20	50	100	1000	20	N	50	10	Lt gy grn carb mud
4-6, 30-31	30.8	10		5	5	0.3	15	2	0.2	10	N	50	80	N	N	30	50	50	300	300	1000	20	15	30	100	Dk grn brn clay and pyrite rich mud
5-1, 85-86	27.9	12		5	5	0.3	15	2	0.15	10	N	70	N	N	N	50	100	20	500	300	1000	20	N	30	100	Dk grn bk clay and pyrite-rich mud
5-2, 80-81	29.3	12		5	5	0.3	20	5	0.2	10	N	50	N	N	N	5	100	20	50	100	1000	20	N	50	100	Gy grn calcareous mud

Table 1A - Continued

Sample	Depth (m)	Major Elements (%)							Minor and Trace Elements (ppm)																	Description
		Si	K	Al	Fe	Ti	Ca	Mg	Mn	Pb	Ag	Cu	Zn	Sn	Cd	Mo	Ni	Co	V	Ba	Sr	B	As	Zr	Cr	
6-1, 130-133	37.2	10	>5	1	0.2	>20	5	0.1		<10	N	5	N	N	N	N	20	7	20	N	3000	10	N	30	N	Cream to brn lithified rounded limestone grains
8-3, 52-53	48.5	15	>5	5	0.3	20	5	0.5		10	N	50	N	N	N	N	100	20	30	100	1000	20	N	50	150	Gy brn pasty carb mud
8, CC	54	N	N	N	N	0.1	N	N		N	N	N	N	N	N	N	N	N	100	N	N	N	N	N	N	Amber "glassy" fragments also 70 ppm Bi
9-3, 75-77	57.8	15	>5	5	0.5	20	5	0.3		10	N	20	N	N	N	N	70	20	20	70	500	10	N	50	100	Lt gy grn pyrite mud
9-6, 90-92	62.4	15	5	5	0.3	20	2	0.1		10	N	100	150*	N	N	300	150	20	1000	1500	1000	30	10	30	100	Dk brn bk pyrite mud
9-6, 112-114	62.5	15	>5	3	0.5	20	5	0.3		<10	N	20	N	N	N	N	100	15	20	100	1000	10	N	70	100	Lt grn gy carb mud
9-6, 118-120	62.6	15	>5	2	0.3	>20	5	0.3		<10	N	15	N	N	N	N	50	7	20	50	1000	10	N	50	150	Lt grn gy carb mud
9, CC	63	N	<0.3	>20	N	1.5	<0.03	0.15		N	N	300	N	N	N	20	500	150	<15	N	N	N	N	N	N	Small pyrite fragments
10-2, 104-105	65.5	12	5	3	0.5	20	2	0.2		<10	N	20	N	N	N	N	50	10	30	100	700	10	N	70	100	Gy brn gritty carb mud
11, CC	77	7	1.5	>20	0.01	1.5	0.02	0.007		N	N	70	N	N	N	500	10	5	5	N	N	20	N	N	N	Pyrite; flat plate 2 x 3 mm consisting of minute crystalite
12-1, 115-116	78.1	12	4	5	0.3	20	5	0.2		<10	N	100	N	N	N	15	70	15	70	150	1000	10	N	70	70	Gritty olive mud; soupy
13-6, 0-10	84.5	7	5	0.3	0.15	20	2	0.015		<10	N	5	N	N	N	N	5	N	10	N	>5000	10	N	15	150	Yw lithified crust
13-6, 45-46	85	12	5	5	0.5	20	5	0.3		<10	N	10	N	N	N	N	70	15	30	50	1000	10	N	70	70	Lt gy grn carb mud
14-2, 30-31	87.8	15	5	3	0.3	20	5	0.2		10	N	100	N	N	N	N	100	20	30	50	700	10	N	50	100	Gy grn carb mud
14-2, 80	88.4	10	3	>20	0.2	7	0.3	0.015		N	N	30	N	N	N	20	150	50	10	N	150	10	N	10	20	Pyrite concretions
14-2, 125-126	88.8	10	4	3	0.3	20	1.5	0.1		10	N	50	50*	N	N	150	70	15	700	300	1000	10	10	20	50	Dk olive pyrite mud
14-2, 141-142	88.9	12	4	5	0.3	20	5	0.2		<10	N	10	N	N	N	20	70	15	30	50	1000	10	N	20	70	Gy carb mud
14-3, 39-40	89.4	15	5	5	0.5	20	7	0.2		10	N	70	N	N	N	N	100	15	50	70	1000	30	N	50	00	Med gy carb mud
14-3, 80-81	89.8	12	5	3	0.2	20	1.5	0.2		10	N	20	46*	N	N	30	70	10	500	700	1000	20	N	15	70	Dk brownish to olive pyrite mud
14-4, 59-60	91.1	12	5	3	0.3	20	3	0.5		10	N	10	N	N	N	N	50	10	20	50	700	10	N	20	70	Lt cream gy grn carb mud
14-4, 109-110	91.6	12	5	5	0.3	20	2	0.15		<10	N	50	65*	N	N	200	100	20	700	700	1000	30	N	20	70	Dk brn bk pyritic mud
14, CC	95	5	0.7	20	0.005	2	0.07	0.15		N	N	150	N	N	N	50	500	150	20	N	N	<20	N	N	200	Pyrite; small tube fillings plus organic replacements
15-2, 133-134	97.8	12	4	3	1.3	>20	3	0.2		<10	N	5	N	N	N	N	15	7	20	50	1000	10	N	20	50	Lt buff carb mud
16-3, 98-99	108	10	4	3	0.2	15	5	0.2		<10	N	30	N	N	N	N	20	7	20	50	300	10	N	15	70	Lt gy brn carb mud
16, CC	113	<2	<6	<0.005	N	>20	0.2	0.05		N	N	N	N	N	N	N	N	N	<200	N	N	N	N	N	N	Planktonic forams "fresh" looking
16, CC	113	5	7	0.1	0.01	>20	0.07	0.3		<20	N	200	N	N	N	N	<20	N	20	<50	300	N	N	20	200	Sugary recrystallized organisms and some echinoderm fragments; also, trace of Bi < 20 ppm
17-2, 61-61	115.1	12	5	3	0.3	20	5	0.2		N	N	15	N	N	N	N	20	7	20	50	500	10	N	50	70	Lt gy brn carb mud
18-1, 82-83	122.8	15	>5	7	0.5	15	5	0.15		10	N	50	N	N	N	N	100	20	50	100	700	30	N	50	100	Gy carb mud
18-3, 55-56	125.5	7	5	7	0.3	20	1.5	0.2		10	N	70	N	N	N	100	100	20	500	500	700	10	N	30	70	Dk brn bk pyrite mud
18-3, 119-120	126.2	15	5	5	0.3	15	2	0.2		10	N	70	<200	N	N	N	100	50	50	100	700	20	N	50	100	Medium gy carb mud
18-4, 30-31	126.8	15	5	5	0.5	15	2	0.2		<10	N	70	N	N	N	N	100	20	50	100	500	20	N	70	100	Medium gy carb mud

TABLE 1A - Continued

Sample	Depth (m)	Major Elements (%)								Minor and Trace Elements (ppm)																		Description
		Si	K	Al	Fe	Ti	Ca	Mg	Mn	Pb	Ag	Cu	Zn	Sn	Cd	Mo	Ni	Co	V	Ba	Sr	B	As	Zr	Cr			
18-4, 70-71	127.2	12		5	5	0.2	20	1.5	0.2	10	N	100	50*	N	N	20	70	20	200	700	1000	10	N	20	70	Dk grn bk carb mud		
22-3, 77-79	161.8	20		5	5	0.5	10	2	0.15	N	N	100	N	N	N	N	150	50	70	150	500	30	N	70	150	Lt gy grn firm mud		
22-6, 126-127	166.8	7		2	20	0.015	0.7	0.02	0.005	50	N	200	N	N	N	200	500	20	10	N	100	20	N	10	N	Pyrite; yellowish brassy fragments		
22, CC	167	15		3	20	0.15	>20	7	0.005	N	N	300	N	N	N	15	200	30	15	N	150	15	N	N	20	Pyrite		
22, CC	167	30		5	1.5	0.07	>20	7	7.5	N	N	N	N	N	100	N	50	N	10	N	500	N	N	N	N	Sugary dolomite uniform crystals with some pyrite		
23-1, 102	168	15		5	7	0.7	1.5	2	0.07	10	N	200	N	N	N	N	150	50	100	150	100	50	N	50	100	Grn brn bk firm mud		
23-2, 67	169.2	13		3	5	0.2	15	10	0.5	10	N	100	N	N	N	N	50	10	20	20	150	10	10	20	50	Olive grn dense shale		
24-1, 60	176.6	15		5	2	0.5	10	10	0.2	10	N	70	N	N	N	5	50	10	30	100	200	50	N	50	100	Gy dolomite limestone		
24, CC	185	<2	0.1*	1.5	0.15	0.007	20	1	0.2	N	N	N	N	N	N	N	N	N	10	N	1000	100	N	20	50	Gy anhydrite rods		
25-1, 57	185.6	25		5	7	0.7	3	10	0.15	10	N	150	170*	N	N	5	100	30	70	150	100	700	10	70	150	Bk shale		
25-1, 102	186	15	2.5*	5	5	0.3	10	10	0.2	10	N	70	150*	N	N	5	70	15	70	100	150	300	N	50	100	Gy dolomite limestone salt residue from interstitial water		
26-1		N2		0.3	N	0.003	1	2	N	N	N	N	N	N	N	N	N	N	10	N	150	10	N	N	N	Dk grn gy shale		
26-1	194	20		5	5	0.5	10	10	0.15	10	N	100		N	N	N	70	20	70	100	150	300	N	50	100	Wh-mottled-nodular anhydrite		
26-1, 144	195.4	<2		1	0.005	0.002	20	0.1	0.001	N	N	N	N	N	N	N	N	N	10	N	3000	10	10	N	N			
26-1, 60	194.6	20		5	3	0.5	2	2	0.02	10	N	150	400*	N	N	N	70	15	70	100	100	700	N	50	70	Bk shale		
26-1, 107	195	N	0.1*	1	0.005	0.002	20	0.1	N	N	N	N	20*	N	N	N	N	N	10	N	3000	10	N	N	N	Anhydrite		
27-2	203	N2		0.3	N	N	0.3	0.02	N	N	N	N	N	N	N	N	N	N	10	N	N	N	N	N	N	Salt crystal from core liner		
28-1, 90	212.9	N < 0.1*		1	0.05	0.003	20	0.3	0.002	N	N	N	20*	N	N	N	N	N	10	N	2000	10	N	N	N	Salt layer and anhydrite		
28-3, 100	216	<2		1.5	2	0.002	0.15	1.5	0.005	N	N	50	N	N	N	N	50	N		N	3000	10	N	N	N	Mixture of anhydrite and halite		
29-1, 63	221.6	25		5	5	0.2	7	3	0.3	N	N	200	100	N	N	N	150	70	70	100	100	20	N	50	100	Bk shale layer		
29-2, 86	233.4	20		>5	10	0.2	1	10	0.5	N	N	200	150*	N	N	N	70	20	150	150	100	50	N	70	50	Bk shale layer		

Note:

Analyst David F. Siems. N = not detected. For list of detection limits see end of Table 1B.

Abbreviations: bk = black, brn = brown, gy = gray, grn = green, yw = yellow, wh = white, slv = silver, dk = dark, carb = carbonate, mont = montmorillonite, crys = crystal, lt = light. All samples on air-dry basis (including dried interstitial water). Asterisk indicates supplementary field analysis of K, Zn, and Ag by atomic absorption, Denver U.S.G.S. laboratories.

TABLE 1B
Analysis of Separated Grains, Chiefly Pyrite, from Table 1A

Sample	Depth (m)	Major Elements (%)								Minor Elements (ppm)																Description
		Si	K	Al	Fe	Ti	Ca	Mg	Mn	Pb	Ag	Cu	Zn	Sn	Cd	Mo	Ni	Co	V	Ba	Sr	B	As	Zr	Cr	
3-4, 0-10	22.5	≤2		0.3	>20	0.005	1.5	0.02	0.07	N	N	100	N	N	N	300	500	100	≤10	N	≤100	20	3000	10	N	Slv wh pyrite “branch” concretions: also, 500 ppm Sb Small pyrite fragments Pyrite; flat plate 2 x 3 mm consisting of minute crystallites Pyrite; small tube filling plus organic replacements Pyrite; yellowish “brassy” fragments Pyrite Sugary dolomite uniform crystals with same pyrite
9, CC	63	N		≤0.3	>20	N	1.5	≤0.03	0.15	N	N	300	N	N	N	20	500	150	≤15	N	N	N	N	N	N	
11, CC	77	7		1.5	>20	0.01	1.5	0.02	0.007	N	N	70	N	N	N	500	10	5	10	N	N	20	N	N	N	
14, CC	95	5		0.7	20	0.005	2	0.07	0.15	N	N	150	N	N	N	50	500	150	20	N	N	≤20	N	N	200	
22-6, 126-127		7		2	>20	0.015	0.7	≤0.02	0.005	50	N	200	N	N	N	200	500	20	≤10	N	≤100	20	N	≤10	N	
22, CC	167	15		3	>20	0.15	<20	7	0.005	N	N	300	N	N	N	15	200	30	15	N	150	15	N	N	20	
22, CC	167	30		5	1.5	0.07	<20	7	<0.5	N	N	N	N	N	<100	N	<50	N	10	N	500	N	N	N	N	
Below detection limits (N)		1		0.3	0.002	0.001	0.025	0.01	0.005	5	0.1	2	—	3	—	2	2	2	5	10	50	5	—	5	5	
Lower limit of analysis		2		0.3	0.05	0.002	0.05	0.02	0.001	10	0.5	5	200	10	20	5	5	5	10	20	100	10	100	10	10	

TABLE 2
Semiquantitative Spectrographic Analyses of Samples from Site 226 (Atlantis II Deep)

Sample	Depth (m)	Major Elements (%)								Minor Elements (ppm)																		Description
		Si	K	Al	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Cd	Co	Cr	Cu	Mo	Ni	Pb	Sn	Sr	V	W	Zn	Zr		
1-1	1st	12		3	>20	0.15	15	0.015	0.7	70	N	20	2000	70	200	10	7000	100	20	3000	N	500	70	<50	10000	10	Squeezed bk cake from red salt material	
1-1	1st	N		0.3	N	0.3	2	N	0.01	N	N	N	N	N	N	N	N	N	N	N	N	150	N	N	N	N	Salt residue	
1-2, 15-17	1.6	12		5	10	2	5	0.7	0.2	50	N	N	1000	50	100	200	5000	10	100	2000	N	200	200	≤50	1000	15	Dk anhydrite-goethite	
1-2, 110	2.6	10		2	15	1.5	5	0.005	0.1	50	N	N	200	N	50	10	3000	5	15	3000	N	200	≤10	≤50	500	N	Red salt material – hematite	
1-3, 20-22	3.2	2		1	5	0.3	20	≤0.002	0.015	30	N	≤10	5000	20	30	N	5000	30	5	300	N	1000	10	N	500	N	Anhydrite layer–mixed	
1-3, 30-32	3.3	7		2.5	15	1	5	0.005	0.02	100	N	10	200	100	70	≤10	7000	70	10	5000	N	200	10	N	10000	N	Mixed-mont-anhydrite	
1-3, 85-87	3.9	7		2.5	10	2	3	0.007	0.02	70	N	10	75000	70	100	≤10	7000	70	15	3000	N	1000	15	≤50	10000	N	Hematite layer–mixed	
1-4, 60-62	5.1	≤2		1	1.5	0.3	>20	<0.002	0.007	3	N	≤10	150	N	15	N	1000	50	N	70	N	700	≤10	N	1000	N	Anhydrite layer–mixed	
1-4, 70-72	5.2	7		2.5	10	0.5	10	0.005	0.02	50	N	10	100	20	70	≤10	7000	50	10	700	N	300	15	≤50	10000	N	Bk-mont-hematite	
1-4, 100-102	5.5	2		2	20	0.5	3	0.002	0.02	30	N	10	N	5000	70	N	5000	200	≤5	1000	N	150	10	≤50	1500	N	Hematite-rich layer–mixed	
1-4	6	20		5	10	5	10	0.7	0.3	N	N	N	N	N	70	300	200	N	150	N	N	100	500	50	N	50	Fresh glassy looking basalt	
1-4	6	25		>5	101	10	10	0.7	0.3	2	N	N	20	N	70	500	200	N	200	N	N	100	500	N	N	30	Altered-looking basalt	
1, CC	6	2		1.5	0.3	1	20	0.002	0.02	N	N	N	2000	N	N	N	700	50	N	70	N	1000	<10	N	N	N	Anhydrite crystals	

Note:

See Table 1 for explanation of abbreviations.

Sample 1-1 refers to sample squeezed for pore fluid analysis, removing more than 3/4 of contained brine. Other samples contain dried pore fluid whose salts may greatly dilute sediment.

TABLE 3A
Semiquantitative Spectrographic Analyses of Samples from Site 227

Sample	Depth (M)	Major Elements (%)								Minor Elements (ppm)																		Description
		Si	K	Al	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Cd	Co	Cr	Cu	Mo	Ni	Pb	Sn	Sr	V	Zn	Zr			
1, CC	3	N		N	N	<0.02	7	<0.002	N	N	N	N	N	N	N	N	N	N	N	N	N	3000	10		N	Radial fibrous "calcite"		
1, CC	3	3		2.5	0.7	10	<20	0.03	0.15	N	N	≤10	N	N	5	15	50	N	15	≤10	N	1000	15	N	10	Mixed lithified carb		
2-1, 24	18.4	5		2	>20	0.02	2	0.015	0.005	N	≤30	50	N	N	5	7	30	500	20	N	N	1.0	20	N	10	Pyrite "brassy"		
2-1, 140	19.4	15		5	5	5	20	0.5	0.5	N	≤10	20	100	N	20	100	50	N	100	10	N	1000	30	N	50	Lt gy carb mud		
3-1, 30	27.3	15		5	2	7	20	0.3	0.3	N	≤10	20	100	N	10	100	70	N	50	≤10	N	1000	30	N	50	Bk gy carb mud		
3-1, 120	28.2	15		5	2	5	20	0.3	0.3	N	N	15	10	N	10	100	50	N	70	10	N	1000	30	N	30	Olive gy carb mud		
3-1, 145	28.4	15	0.5	5	5	5	20	0.5	0.5	N	≤10	20	200	N	200	100	700	30	300	15	N	1000	500	400*	50	Bk gy mud		
3-1, 148	28.5	15		>5	5	7	20	0.5	0.5	N	N	≤10	100	N	20	100	30	N	70	10	N	70	20	N	50	Lt gy carb mud		
3, CC1	36	20		3	>20	0.05	1.5	0.15	0.2	N	500	20	100	N	100	30	300	150	300	7000	N	N	20	700	N	HC1 treatment--no bromoform		
3, CC	36	25		>5	15	1.5	2	0.5	0.07	N	N	10	300	N	50	100	150	7	150	≤10	N	150	30	≤200	70	Bromoform separation + HC1 (lights); also ≤ 5 ppm W		
3, CC	36	7		1.5	>20	≤0.02	0.7	0.15	0.1	N	1000	10	N	N	150	50	200	50	200	≤10	10	N	10	200	100	Bromoform separation plus HC1 (heavies)		
6-1, 80-81	45.8	15		>5	5	5	20	0.5	0.5	N	N	10	100	N	20	100	30	N	70	≤10	N	100	30	N	70	Olive grn carb mud		
6-2, 112-113	47.6	12		5	5	2	20	0.3	0.2	N	N	10	130	N	50	70	100	20	150	20	N	1500	50	N	20	Lt gy carb mud		
11, CC	81	7		1	>20	0.02	1	0.005	0.015	N	200	30	N	N	70	N	200	30	300	N	N	N	10	500	≤20	Pyrite conglomerate (wh)		
12-2, 0-10	82.6	20		>5	7	2	15	0.5	0.2	N	<10	15	200	N	20	150	100	5	100	N	N	700	70	≤200	50	Squeezed cake from interstitial water sample		
12-2, 20-21	82.7	20		>5	5	2	10	0.7	0.15	N	N	20	200	N	20	200	100	N	150	N	N	300	100	N	70	Gy carb mud		
12-2, 77	83.3	12		5	5	1.5	20	0.3	0.15	0.5*	N	20	50	N	20	70	70	500	100	10	N	1000	300	45	50	Bk mud		
12-2, 100-101	83.5	20		>5	5	2	15	0.5	0.15	N	N	20	150	N	10	200	50	N	100	≤10	N	1000	30	N	70	Gy carb mud		
13-1, 24-26	90.2	12		5	3	1.5	15	0.3	0.5	N	≤10	15	500	N	15	100	50	5	70	N	N	1500	70	N	50	Olive gy carb chalk		
13-2, 32	91.8	15	0.7*	>5	5	1.5	20	0.3	0.15	0.5*	N	20	500	N	20	100	100	50	100	≤10	N	1000	200	70	50	Dk gy carb mud		
13-2, 50-52	92	15		5	5	2	15	0.5	0.1	N	N	30	150	N	20	200	100	N	150	≤10	N	500	150	N	70	Lt gy carb mud		
13, CC	99	25		>5	5	0.1	0.5	0.15	0.007	N	N	10	20	20	20	10	150	5	70	10	N	300	15	1500	10	Bromoform separation + HC1 (lights); also ≤50 ppm W		
13, CC	99	12		1.5	20	≤0.02	≤0.05	0.02	0.2	1.5	500	20	N	50	150	N	700	50	300	15	N	≤100	≤10	>10000	N	Bromoform separation + HC1 (heavies)		
13, CC	99	20		5	5	1.5	1	0.5	0.01	N	N	50	150	<500	10	100	500	N	100	10	N	100	50	>10000	50	HC1 treatment--no bromoform		
15, CC	113	≤10		≤10.5	20	N	1	0.005	0.002	≤1	2000	20	N	N	100	N	70	70	300	N	N	N	20	2000	N	Pyrite conglomerate (wh)		
15-1, 93-94	108.9	15		5	7	2	15	0.3	0.2	N	N	50	100	N	50	150	100	N	100	≤10	N	1500	50	N	50	Dk olive grn carb mud		
16-2, 20-21	114.7	15		5	5	2	20	0.3	0.3	N	N	30	500	N	50	100	50	N	100	≤10	N	1000	100	N	50	Dk gy mud		
16-2, 98-99	115.5	15		5	5	3	20	0.3	0.5	N	N	15	50	N	15	100	20	N	70	≤10	N	700	30	N	50	Lt gy carb mud		
16-2, 110	115.6	15		5	3	2	20	0.5	0.5	N	N	15	100	N	15	100	50	N	70	10	N	500	30	N	7	Olive gy carb chalk		
17-1, 85	122.8	12		>5	2	1.5	>20	0.2	0.2	n N	10	10	300	N	20	100	50	N	70	≤10	N	1500	150	200	20	Dk carb layer		
18-2, 122	133.7	15		>5	3	2	10	0.5	0.15	<0.5*	<10	20	150	N	20	150	100	N	150	≤10	N	700	300	160*	70	Dk gy carb mud; also ≤50 ppm W		

TABLE 3A – Continued

Sample	Depth (m)	Major Elements (%)							Minor Elements (ppm)																		Description
		Si	K	Al	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Cd	Co	Cr	Cu	Mo	Ni	Pb	Sn	Sr	V	Zn	Zr		
18-3, 130	135.8	12	>5	2	1.5	20	0.2	0.15	0.5*	N	15	70	N	10	100	70	20	100	≤10	N	1500	500	75*	20	Bk carb mud		
19-2, 15	141.7	15	>5	5	1.5	15	0.5	0.15	N	N	20	150	N	15	150	70	N	100	≤10	N	1000	70	N	50	Lt gy carb mud		
20-2, 82	151.3	12	>5	2	1.5	15	0.3	0.15	N	N	20	200	N	15	70	70	7	70	≤10	N	1500	100	N	20	Dk carb chalk		
20-3, 77	152.8	15	>5	10	1.5	15	0.3	0.15	N	N	30	100	N	50	150	100	50	200	10	N	1000	200	N	30	Gy dk chalk? also ≤50 ppm W		
20-3, 77	152.8	15	>5	10	1	10	0.3	0.1	0.5*	N	20	70	N	50	100	100	30	15	15	N	700	100	200* ≤200	20	Dk carb chalk; also ≤50 ppm W		
20-3, 90	152.9	15	>5	7	1.5	15	0.3	0.1	N	N	20	100	N	20	100	100	70	100	10	N	1000	500	N	20	Dk gy carb chalk		
20-3, 143	153.4	20	>5	5	2	10	0.5	0.1	N	<10	30	150	N	20	200	100	N	100	≤10	N	300	150	N	100	Lt gy carb chalk		
20-4, 53	154	12	>5	15	1	15	0.3	0.1	N	<10	20	50	N	100	50	150	200	300	50	N	500	150	N	20	Dk gy carb chalk; also ≤50 ppm W		
20-5, 36	155.4	15	0.6* >5	7	1.5	10	0.3	0.07	0.5*	N	30	500	N	20	100	100	200	100	≤10	N	500	500	60*	30	Dk gy carb chalk		
22-2, 100	160.5	12	>5	7	1.5	20	0.3	0.1	N	N	20	100	N	20	100	100	50	100	≤10	N	1000	500	N	20	Dk gy carb chalk		
22-4, 40	162.9	15	>5	5	1.5	15	0.3	0.5	N	N	20	500	N	30	100	100	100	100	≤10	N	1500	300	N	30	Gy chalk		
22-4, 69	163.2	15	>5	7	2	10	0.5	0.07	N	N	20	150	N	20	200	100	N	150	N	N	500	200	N	70	Gy chalk		
22-4, 100	163.5	7	2	>20	0.02	1	0.03	0.05	N	N	20	N	N	20	10	70	300	150	10	N	≤100	20	N	70	Pyrite		
24-6, 50	184	12	3	3	1	15	0.2	0.3	N	N	15	500	N	15	50	100	20	50	≤10	N	700	300	N	30	Dk chalk		
25-2, 39	186.9	20	5	5	1	10	0.3	0.3	N	N	30	100	N	30	100	150	5	70	≤10	N	1500	50	N	50	Dk chalk		
25, CC	194	7	1.5	>20	≤0.1	2	≤0.01	0.3	N	N	N	N	N	7	N	100	N	50	N	N	N	10	N	N	Yw nodular pyrite agglomerates		
26-2, 114	196.5	20	>5	7	1.5	2	0.7	0.015	N	N	50	150	N	30	150	150	5	100	N	N	150	150	N	50	gr gy chalk? also ≤50 ppm W		
28-2, 46	214	15	0.9* >5	5	10	5	0.5	0.1	N	<10	30	100	N	20	150	100	N	70	N	N	100	20	60*	30	Dk dolomite claystone also ≤50 ppm W		
29-2, 70	223.2	15	>5	5	7	10	0.3	0.3	N	N	30	100	N	15	200	100	30	100	≤10	N	300	30	N	30	Med gy grn carb mud; also ≤50 ppm W		
31-1, 110	236.1	15	>5	5	5	10	0.3	0.3	N	N	500	100	N	20	100	100	5	70	≤10	N	1000	70	N	30	Olive gy mud; also ≤50 ppm W		
31-1, 120	236.2	15	1.1* >5	5	5	7	0.3	0.2	N	N	200	100	N	15	100	70	5	70	≤10	N	500	50	80	50	Bk shale; also ≤50 ppm W		
31-, CC	244	N	≤0.3	N	5	0.3	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	≤10	N	N	Reddish material in salt		
31, CC	244	N	1	N	>10	2	N	0.001	N	N	≤10	N	N	N	N	20	N	N	N	N	150	≤10	N	N	Salt		
32-2, 77	246.3	25	1.5* 2.5	1.5	1	1	0.07	0.01	N	N	300	20	N	≤5	20	100	7	10	N	N	200	50	60*	10	Dk shale; also ≤50 ppm W		
32-2, 136	246.9	N	≤0.3	N	0.3	1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	≤10	N	N	Salt		
32-5, 83	250.8	N	≤0.3	N	0.05	0.2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	≤10	N	N	Salt		
33-2, 103	255.5	N	≤0.3	N	0.03	0.1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	≤10	N	N	Salt		
36-2, 106	282.6	30	2.4* 5	7	2	2	0.3	0.07	N	<10	700	100	N	20	70	200	20	100	N	N	150	150	550*	50	Bk shale		
36-3, 3	283	30	3	2	1.5	2	0.3	0.015	N	<10	300	50	N	10	50	150	7	50	≤10	N	100	150	N	30	Bk shale		
36-3, 3-14	285	15	0.1	N	0.05	20	≤0.002	N	N	N	≤10	N	N	N	N	5	N	N	N	N	N	2000	10	N	N	Quartz-bearing anhydrite	
37, 2	290.5	N	<0.1* 0.1	N	1	20	0.005	0.002	N	<10	15	N	N	N	N	N	N	N	N	N	2000	10	100*	N	Anhydrite K-ar special		
40-2, 30	306.8	15	<5	7	2	10	0.3	0.2	N	N	20	150	N	20	150	100	5	70	10	N	500	100	N	30	Shale gravel		
44, CC	350	20	2.0* <5	10	7	1	0.5	0.3	N	N	500	150	N	50	100	300	5	100	≤10	N	150	100	2000	30	Bk shale; also ≤50 ppm W		
		N	≤0.3	N	10	2	N	0.003	N	N	1000	N	N	N	N	N	N	N	N	N	700	≤10	N	N	Salt residue from interstitial water		

TABLE 3B
Analysis of Separated Heavy Minerals (from Table 3A)

Core	Sec	Interval (cm)	Depth (m)	Fe (%)	Mn (%)	Cu	Ag	Pb	Zn	Cd	As	Mo	Ni	Co	Description
2		CC	3	>20	0.005	30	N	N	N	N	N	500	20	5	Brassy pyrite
3		CC	36	>20	0.2	300	N	7000	700	N	500	150	300	100	Residue after HCl treatment (chiefly framboidal pyrite)
3		CC	36	>20	0.1	200	N	≤10	200	N	1000	50	200	150	Bromoform and HCl separation mainly pyrite. Also 10 ppm Sn
11		CC	81	>20	0.015	200	N	N	500	N	200	30	300	70	Silver white pyrite aggregate (layer)
13		CC	99	5	0.01	500	N	10	>1%	>500	N	N	100	10	Sphalerite (HCl residue)
13		CC	99	>20	0.2	700	1.5	15	>1%	50	500	50	300	150	Sphalerite (bromoform & HCl) and pyrite
15		CC	113	>20	0.002	70	≤1	N	2000	N	2000	70	300	100	Silver white pyrite
22	4		163	>20	0.005	300	N	10	N	N	N	300	150	20	Pyrite, yellowish
25		CC	194	>20	0.3	100	N	N	N	N	N	N	50	7	Yellow nodular pyrite agglomerates

TABLE 4
Semiquantitative Spectrographic Analyses of Samples from Site 228

Sample	Depth (M)	Major Elements (%)								Minor Elements (ppm)																		Description
		Si	K	Al	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Cd	Co	Cr	Cu	Mo	Ni	Pb	Sn	Sr	V	Zn	Zr			
1-1, 96	1	15		5	7	3	10	0.5	0.2	N	≤10	15	200	N	20	100	100	N	70	10	N	700	100	N	100	Gy carb ooze		
1-2, 46	2	25		>5	10	5	5	0.7	0.15	N	N	20	500	N	20	200	100	N	100	10	N	500	150	N	200	Dk gy carb ooze		
1-3, 51	3.5	15		5	5	5	20	0.3	0.2	N	N	15	150	N	15	100	50	N	70	10	N	1000	70	N	100	Lt gy carb ooze		
1-3, 86	3.9	15		5	5	3	20	0.3	0.2	N	N	20	150	N	20	150	50	N	100	10	N	1000	50	N	70	Lt gy carb ooze		
1-5, 81-82	6.8	15		5	7	7	20	0.5	0.5	N	N	20	150	N	15	150	50	N	100	10	N	1000	50	N	100	Lt brn carb ooze		
1, CC	5	30		5	5	3	2	0.5	0.07	N	N	N	700	N	15	100	100	N	70	15	N	300	70	N	100	Bromoform + HC1 separation (lights)		
1, CC	5	15		5	20	5	5	0.7	0.3	N	N	10	70	N	50	500	100	N	100	10	N	500	500	N	1000	Bromoform + HC1 separation (heavies)		
6-5, 93-95	48.9	25		5	7	5	20	0.7	0.15	N	10	20	300	N	30	150	100	N	150	10	N	500	300	N	500	Gy detrital sandy silt		
7-6, 125-127	59.2	20		5	7	3	15	0.5	0.5	N	N	15	200	N	15	150	50	N	70	≤10	N	1000	150	N	100	Lt gy ooze		
8-3, 140-141	63.9	25		5	7	3	10	0.5	0.2	N	N	20	200	N	20	150	100	N	100	10	N	700	150	N	200	Gy ooze		
10-6, 85-86	77.4	15		5	5	5	15	0.5	0.5	N	≤10	20	100	N	10	150	30	N	70	≤10	N	1000	100	N	70	Lt gy ooze		
11-4, 120-121	83.7	20		>5	7	3	10	0.5	0.2	N	≤10	20	200	N	15	150	50	N	70	≤10	N	700	100	N	70	Lt brn ooze		
12-4, 56	92.1	20		5	7	3	10	0.5	0.5	N	≤10	20	200	N	20	150	70	N	100	10	N	1000	200	N	150	Reddish brn carb ooze		
12-6, 75	95.2	20		>5	10	3	10	0.7	0.3	N	N	20	300	N	30	200	100	N	100	≤10	N	700	200	N	150	Med gy carb ooze		
13-2, 10	97.6	12		5	1.5	2	0.3	0.05	N	N	10	50	N	N	70	15	N		100	10	N	5000	30	N	50	Lithified carb		
13-2, 110	98.6	20		>5	7	5	10	0.7	0.2	N	N	20	500	N	20	150	70	N	100	≤10	N	500	200	N	200	Lt gy carb chalk also; ≤ 50 ppm V		
13-2, 145	98.9	12	0.7*	5	1	20	15	0.3	0.3	N	≤10	30	300	N	100	150	70	100	300	15	N	1500	300	95*	50	Bk gy d Bk gy carb chalk		
14-1, 120-121	106.2	15		>5	5	5	15	0.5	0.3	N	N	30	150	N	15	150	50	N	100	10	N	1000	50	N	70	Lt gy siltstone		
14-2, 44-45	106.9	15		>5	5	5	20	0.5	0.5	N	N	30	150	N	15	150	50	N	100	10	N	700	50	N	100	Lt gy carb chalk		
14-3, 8 18-19	108.2	15		5	7	2	20	0.5	0.3	N	N	30	100	N	50	100	50	5	200	15	N	1000	100	N	70	Dk gy siltstone		
14-3, 100	109	20		5	5	2	15	0.7	0.2	N	N	30	300	N	20	150	50	N	100	10	N	700	100	N	150	Gy carb siltstone		
14-4, 82	110.3	15		>5	5	7	20	0.5	0.7	N	<10	30	100	N	15	150	20	N	70	10	N	1000	50	N	70	Lt reddish gy carb siltstone		
15-1, 98	115	12		5	3	2	20	0.2	0.1	N	N	≤15	100	N	10	70	30	15	50	10	N	>5000	50		50	Pteropod ooze		
15-6, 114-115	122.6	12		>5	7	1.5	15	0.3	0.5	N	N	30	300	N	30	100	100	100	200	10	N	1500	700	N	50	Cloudy carb chalk		
15, CC	123	7		1	>20	0.02	1.5	0.015	0.007	N	3000	30	N	N	20	10	50	200	300	N	N	≤100	10	N	10	Pyrite		
16-1, 125-126	124.3	15		>5	5	0.5	20	0.3	0.5	N	N	20	200	N	15	150	100	N	70	10	N	1000	20	N	70	Lt gy carb chalk		
16-3, 22-23	126.2	25		>5	10	3	15	0.7	0.3	N	N	30	300	N	50	200	70	N	150	N	N	1000	300	N	200	Med gy carb chalk		
16-5, 73-74	129.7	25		>5	15	5	15	0.7	0.5	N	N	30	300	N	70	200	100	N	150	N	N	1000	200	N	200	Greenish gy carb chalk		
16-5	129	N		≤0.3	2	2	N	N	N	N	15	N	N	N	N	N	N	N	N	N	N	700	10	N	N	Salt from interstitial water sample		
18-1, 132-133	142.3	30		5	10	5	10	0.7	0.5	N	<10	20	500	N	30	200	100	N	100	N	N	700	200	N	200	Olive carb siltstone		
18, CC	150	12		3	5	3	20	0.3	0.15	N	N	101	50	N	10	100	20	50	30	10	N	>5000	30	N	30	Pteropod shell ooze		
19-1, 75	150.7	12	0.6*	5	5	1.5	15	0.2	0.5	N	<10	30	700	N	50	70	70	150	300	20	N	1000	700	20*	50	Bk claystone		
19-2, 112	152.6	25		>5	20	1.5	7	0.5	0.5	N	<10	50	700	N	30	150	100	50	100	10	N	500	300	200	200	Reddish brn chalk		
19-2	151.5	N		25	N	1.5	2	≤0.002	N	N	N	N	N	N	N	N	N	N	N	N	N	700	10	N	N	Salt from interstitial water sample		
20-4, 120-121	160.7	15		5	7	2	10	0.3	0.7	N	N	50	150	N	50	100	70	N	150	10	N	1500	100	N	50	Dk gy carb chalk		

TABLE 4 - Continued

Sample	Depth (m)	Major Elements (%)								Minor Elements (ppm)																		Description
		Si	K	Al	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Cd	Co	Cr	Cu	Mo	Ni	Pb	Sn	Sr	V	Zn	Zr			
21-4, 61-64	169.1	20	>5	7	1.5	15	0.3	0.5	N	<10	70	2000	N	50	150	150	300	200	10	N	1000	1500	140	70	Bk claystone			
21, CC	173	7	2	>20	0.03	3	0.02	0.05	N	700	50	20	N	150	10	50	20	500	N	N	150	10	N	N	Pyrite "fine grained"			
22-3, 70-71	176.7	25	>5	7	3	15	0.5	0.5	N	N	30	200	N	15	150	50	N	70	≤10	N	1000	70	N	50	carb			
22-4, 70-72	178.2	15	>5	5	1.5	15	0.3	1	N	N	30	1000	N	50	100	70	10	100	15	N	2000	500	180*	50	Organic bk shale			
23-2, 3-5	183.5	20	>5	5	2	15	0.3	0.5	N	N	30	150	N	20	100	70	N	70	10	N	1500	70	N	100	Dk gy carb chalk			
24, CC	200	2	1.5	>20	0.02	3	0.01	0.03	N	200	20	N	N	20	5	150	500	100	N	N	≤100	20	500	≤10	Pyrite			
24-2, 140-142	193.4	20	>5	5	2	7	0.7	0.2	N	N	20	300	N	20	150	100	N	100	≤10	N	500	150	100*	300	Bk organic pyrite-rich chalk			
25-3, 4	203	12	3	7	1.5	15	0.2	0.5	N	N	15	1000	30	30	100	200	300	150	50	N	1000	1000	380*	50	Bk organic pyrite-rich chalk			
26-3, 150	213.5	N	1	N	2	3	≤0.002	N	N	N	N	N	N	N	N	N	N	N	N	N	500	≤10	N	N	Salt from interstitial water sample			
27-3, 110-111	222.1	20	>5	7	2	10	0.7	0.2	N	N	10	500	N	30	150	100	N	70	≤10	N	500	200	130*	200	Dk olive carb chalk			
28-2, 101-104	229.5	20	>5	7	2	10	0.5	0.15	N	N	10	500	N	20	150	100	N	70	≤10	N	500	100	N	70	Greenish gy siltstone			
28-4, 104-105	232.5	15	>5	5	2	15	0.3	0.15	N	N	15	200	N	15	150	70	N	70	10	N	700	50	85*	100	Greenish gy siltstone			
29-3, 70	239.7	20	5	2	3	1	0.3	0.007	N	N	N	50	N	7	50	10	N	70	N	N	100	200	N	70	Vein of serpentine siltstone			
29-3, 70-80	239.8	20	5	10	2	7	0.7	0.07	N	N	10	500	N	30	150	100	N	100	≤10	N	700	200	N	200	Gr siltstone			
30-5, 37-38	251.4	15	5	7	3	10	0.5	0.15	N	N	15	300	N	20	150	70	70	100	15	N	500	200	130*	100	Dk gy silty claystone			
31-1, 110-111	255.1	15	5	7	1.5	15	0.7	0.15	N	N	15	100	N	70	150	70	N	150	10	N	700	50	N	100	Dk siltstone			
32-2, 8-0	261.6	20	5	7	2	10	0.7	0.1	N	N	15	50	N	20	150	70	7	70	≤10	N	500	150	N	100	Bk claystone			
32-2, 126-127	265.7	20	>5	7	2	5	1	0.07	N	N	10	70	N	30	200	70	N	100	≤10	N	300	150	N	200	Greenish gy siltstone			
33-3, 100-101	272	12	5	3	2	15	0.3	0.5	N	N	≤10	100	N	10	100	15	N	50	N	N	300	30	N	50	Lt gy chalk			
34-1, 69-70	277.7	20	>5	7	7	7	0.5	0.3	N	N	10	200	N	15	150	70	N	70	≤10	≤N	150	100	N	100	Gr siltstone			
34-3, 50-51	280.5	25	5	10	2	0.5	0.7	0.015	N	<10	70	500	N	50	200	150	N	200	N	N	100	200	90*	200	Bk clayey chalk			
35-1, 110	287.1	25	>5	7	2	1.5	0.7	0.03	N	<10	50	500	N	50	200	100	N	150	10	N	150	150	190*	200	Bk shale			
35-1, 122	287.2	25	>5	7	2	1.5	0.7	0.03	N	<10	50	500	N	30	200	100	N	150	≤10	N	150	200	80*	200	Greenish shale			
35-2, 80	288.2	25	>5	7	1.5	1.5	0.7	0.02	N	N	50	500	N	30	150	100	N	100	10	N	200	200	75*	300	Bk shale			
37-1, 125	306.2	25	>5	7	2	0.1	0.7	0.01	N	<10	500	300	N	20	200	7	N	100	10	N	100	500	300*	150	Dk gn shale			
37-2, 110	306.6	20	>5	7	2	0.1	0.7	0.01	N	N	700	500	N	20	200	15	N	100	20	N	300	300	100*	200	Dk brn shale			
37-2, 110	306.6	20	>5	7	2	0.07	1	0.01	N	N	700	100	N	15	150	15	N	70	10	N	100	200	120*	150	Dk gn sa shale			
38-1, 95	313.9	30	>5	7	2	3	0.7	0.5	N	N	100	700	N	10	100	70	N	70	N	N	100	200	110*	200	Dk brn shale			
38, CC	322	7	2.5	3	1	20	0.1	0.15	N	N	30	N	N	20	15	10	10	10	20	N	5000	15	200	10	Anhydrite			
39-1, 32	322	20	5	10	5	3	0.5	1.5	N	N	700	200	N	20	150	200	5	70	70	N	300	150	1010	70	Gr siltstone			
39-1, 60	323	15	5	10	10	15	0.3	1.5	N	N	150	700	N	30	100	200	7	100	70	N	300	500	200	70	Gr siltstone			
39-1, 70	323	20	3	7	10	10	0.5	2	N	N	150	500	N	15	100	150	≤5	70	70	N	150	50	N	70	Gr siltstone			
39-1, 85	323	12	5	10	7	20	0.3	1.5	N	N	500	150	20	15	100	500	30	70	100	N	3000	70	3%	50	Bk shale			
39-1, 90	323	30	3	10	2	5	0.7	1	N	N	500	1000	N	15	150	70	N	100	10	N	1000	200	300	100	Bk shale			
39-1, 105	323	12	0.8*	5	7	10	0.3	2	N	N	200	70	30	15	70	200	5	70	100	N	200	150		50	Bk shale			
39-1, 114	323.1	12	0.7*	2.5	3	1.5	0.15	0.5	N		100	N		5	30	50	10	15	70	N	5000	50	5000	10	Bk shale			

TABLE 4 – Continued

Sample	Depth (m)	Major Elements (%)								Minor Elements (ppm)																Description
		Si	K	Al	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Cd	Co	Cr	Cu	Mo	Ni	Pb	Sn	Sr	V	Zn	Zr	
39-1, 115	33.1	15	0.6* 1.8*	5	15	5	0.5	0.2	1.5	N	10	200	30	N	20	000	100	70	100	100	N	2000	100	1300* 2000	20	Bk shale
39-1, 115	323	20		3	10	5	3	0.5	1	N	N	700	200	N	50	100	300	7	150	100	N	200	200	100	100	Bk shale
39-1, 122	323	20		5	7	5	5	0.5	1	N	N	300	300	N	10	50	150	≤5	50	50	N	200	100	N	150	Gr siltstone
39-1, 126	323	20		5	10	5	3	0.5	1.5	N	N	700	500	N	20	150	200	≤5	100	50	N	150	200	300	100	Gr siltstone
39-1, 130	323	15		5	10	5	5	0.3	3	N	N	500	500	N	20	70	200	≤5	50	70	N	150	100	300	70	Gr siltstone
39-1, 140	323	20		5	7	7	7	0.7	1	N	N	700	300	L	20	150	150	≤5	70	70	N	1500	200	1500	150	Gr siltstone
39-1, 145	323	20		5	7	5	3	0.5	0.5	N	N	500	500	L	15	100	150	≤5	70	30	N	1500	150	1000	70	Gr siltstone

Note:

See Table 1A for explanation of abbreviations.

TABLE 5

Semiquantitative Spectrographic Analyses of Samples from Site 229

Sample	Depth (m)	Major Elements (%)								Minor Elements (ppm)																		Description
		Si	K	Al	Fe	Mg	Ca	Ti	Mn	Ag	As	B	Ba	Cd	Co	Cr	Cu	Mo	N	Pb	Sn	Sr	V	Zn	Zr			
Hole 229																												
2-2, 100	49.5	12		5	3	3	15	0.3	0.02	N	N	5	70	N	10	150	20	N	100	10	N	3000	30	N	70	Grn gy carb mud		
3, CC	93	15		5	5	3	7	0.5	0.03	N	N	≤10	50	N	20	300	50	N	100	N	N	3000	150	N	70	Palagonite tuff		
Hole 229A																												
1-1, 100	20	12		5	15	3	20	0.3	0.1	N	N	15	50	N	7	100	20	N	100	<10	N	2000	30	N	50	Lt grn gy carb mud		
1-2, 30	20.8	15		>5	3	5	20	0.5	0.05	N	N	15	100	N	15	150	20	5	100	≤10	N	2000	50	N	100	Gr carb mud		
1-2, 85	21.3	20		>5	5	5	20	0.7	0.15	N	N	15	150	N	20	300	50	5	100	10	N	2000	70	N	200	Gy carb mud		
1-2, 100	21.5	15		>5	3	5	20	0.5	0.07	N	N	20	100	N	15	200	20	100	100	≤10	N	2000	100	N	100	Lt grn carb mud		
1-4, 40	23.9	20		>5	3	7	15	0.5	0.1	N	N	20	150	N	15	200	30	N	100	≤10	N	1500	50	N	100	Lt gy carb mud		
1-4, 110	24.6	12		>5	3	5	20	0.5	0.05	N	N	30	70	N	10	200	20	N	100	≤10	N	3000	50	N	100	Lt grn carb mud		
1-5, 75	25.7	15		>5	3	5	20	0.5	0.1	N	N	20	100	N	15	150	30	N	150	10	N	2000	50	N	100	Lt grn carb mud		
1-6, 140	27.9	20		>5	5	7	20	0.7	0.07	N	N	20	150	N	20	300	30	N	150	10	N	1500	70	150*	150	Lt gy carb mud		
2-2, 100	30.5	12		>5	2	5	20	0.3	0.05	N	N	20	50	N	10	150	20	N	100	≤10	N	2000	20	100*	70	Lt olive grn gy carb mud		
2-3, 90-91,	31.9	12		5	2	7	20	0.5	0.05	N	N	20	70	N	10	150	20	N	100	≤10	N	3000	20	100*	70	Lt olive grn gy carb mud		
2-3, 100	32	15		>5	3	7	20	0.5	0.05	N	N	20	100	N	10	200	20	N	100	≤10	N	2000	30	100*	70	Grn carb mud		
3-3, 54	40.5	12		>5	3	5	20	0.5	0.05	N	N	20	70	N	10	150	30	N	100	≤10	N	1500	30	100*	70	Olive grn carb ooze		
2-3, 75	34.7	12		>5	3	5	20	0.5	0.03	N	N	20	50	N	10	150	20	N	100	≤10	N	2000	20	N	70	Olive grn carb ooze		
3-5, 85	43.8	15		5	3	5	20	0.5	0.07	N	N	20	70	N	10	150	20	N	100	≤10	N	2000	20	N	70	Lt grn carb ooze		
3-6, 130-135	45.8	15		>5	5	7	20	0.5	0.07	N	N	20	100	N	15	200	20	N	150	10	N	2000	30	N	150	Grn gy carb ooze		
3-1, 140	38.7	7		3	0.5	1.5	7	0.15	0.01	N	N	30	N	N	N	20	5	N	10	≤10	N	300	10	N	10	Lt grn carb ooze		
4-1	56	N		0.3	N	0.05	20	0.005	0.001	N	N	N	N	N	N	N	N	N	N	N	N	3000	10	N	N	Otoliths		
4-1, 30-31	56.3	20		5	5	5	15	0.7	0.1	N	N	20	200	N	20	300	70	N	100	≤10	N	2000	50	N	150	Gy carb ooze		
4-1, 130-131	57.3	12		5	3	3	20	0.3	0.07	N	N	10	50	N	10	200	30	N	100	≤10	N	3000	50	N	70	Olive grn carb ooze		
4-2, 140-141	58.9	15		5	3	5	20	0.5	0.07	N	N	20	100	N	10	200	30	N	100	10	N	2000	50	N	70	Olive grn carb mud		
4-3, 110-111	60.1	15		5	3	7	20	0.5	0.07	N	N	20	150	N	10	200	50	N	100	10	N	3000	50	N	100	Lt gy carb ooze		
4-4, 60-61	61.1	15		5	3	5	20	0.3	0.1	N	N	02	70	N	10	150	30	N	100	10	N	3000	50	N	70	Lt gy carb ooze		
5-4, 62-63	70.1	30		>5	7	1.5	10	0.5	0.2	N	N	10	100	N	10	150	70	5	100	15	N	500	30	100	700	Dk grn carb ooze		
7-3, 90-91	86.9	12		3	2	3	15	0.3	0.05	N	N	20	20	N	10	100	30	N	100	10	N	1000	30	N	70	Dk grn carb chalk		
7-6, 85-86	91.4	12		5	3	5	20	0.3	0.05	N	N	20	50	N	10	150	50	N	150	≤10	N	3000	30	N	100	Olive grn carb ooze		
8-1, 86	113.9	20		>5	7	5	15	0.7	0.07	N	N	20	100	N	20	300	50	N	150	≤10	N	1000	100	N	100	Lithified grn siltstone		
8-2, 30	114.8	7		3	0.2	1.5	>20	0.15	0.3	2	N	N	N	N	N	30	N	N	7	N	N	200	20	N	10	Calcite coarse crys in tuff		
9-1, 70	122.7	12		3	2	2	15	0.5	0.2	N	N	10	100	N	10	150	5	N	50	≤10	N	700	30	N	100	Lt gy lithified carb chalk		
9-1, 99-100	123	15		5	5	3	10	0.7	0.02	N	N	20	100	N	20	150	50	N	50	≤10	N	1000	200	N	100	Bluish gy mud		
10-6, 135	138	15		5	5	1.5	10	0.3	0.03	N	N	20	150	N	5	70	20	7	70	10	N	1000	30	N	500	Bk grn chalk		

Note:

See Table 1A for explanation of abbreviations.

TABLE 6
Major Element Analysis of Sediments from Selected Leg 23 Sediments

Site 225								
	225-3-4, 0-10	225-5-6, 0-10	225-13-6, 0-10	225-18-4, 140-150	225-21-3, 0-10	225-23-2, 140-150	225-26-1, top	225-29-2
Major Elements (%)								
SiO ₂	20.0	17.9	16.1	24.3	21.5	31.2	39.2	46.5
Al ₂ O ₃	6.1	5.4	4.9	7.4	6.3	10.3	8.6	10.6
Fe ₂ O ₃	2.2	1.7	1.8	2.2	3.0	2.7	2.6	6.8
FeO	1.1	1.3	0.68	2.1	1.2	2.8	1.2	3.8
MgO	4.7	4.3	4.5	4.2	6.9	8.4	8.7	8.2
CaO	31.7	33.5	35.3	27.5	25.6	13.4	9.6	1.1
SrO	0.08	0.08	—	0.10	—	0.02	0.02	0.02
Na ₂ O	1.1	1.1	1.1	1.5	2.0	3.0	3.8	5.1
K ₂ O	0.97	0.86	0.87	1.2	0.94	1.5	1.4	1.8
H ₂ O ⁺	3.2	2.4	1.9	2.8	3.4	5.0	4.6	4.7
H ₂ O ⁻	1.3	1.3	1.3	1.9	2.3	2.8	3.4	5.3
TiO ₂	0.36	0.31	0.27	0.43	0.28	0.44	0.43	0.64
P ₂ O ₅	0.20	0.25	0.21	0.30	0.19	0.19	0.37	0.17
MnO	0.12	0.14	0.17	0.20	0.23	0.14	0.08	0.21
CO ₂	26.8	28.8	30.0	23.3	25.2	17.1	13.3	<0.05
Other Volatiles than CO ₂ and H ₂ O	—	—	—	—	—	—	1.0	4.0
Sum	100	99	99	99	99	99	98	99
Cl	0.53	0.50	—	0.58	—	0.95	2.50	3.3
S	0.04	0.05	1.0	0.05	1.9	1.3	1.2	2.6
Trace Elements (ppm)								
Pb	—	—	—	7.0	—	6.0	5.0	—
Zn	—	—	—	36.0	—	84.0	51.0	—
Mo	—	—	—	<4	—	7.0	<4	—
V	—	—	—	120.0	—	110.0	9.0	—
B	—	—	—	20.0	—	50.0	280 (c) 180 (s)	—
Ni	—	—	—	24.0	—	18.0	20.0	—
Cu	—	—	—	46.0	—	130.0	76.0	—
U	—	1.4	—	2.4	—	4.8	1.0	1.0

Site 227								
	227-3-1, 18-27	227-5-2, 0-7	227-12-2, 0-10	227-20-3, 0-10	227-23-1 0-5	227-27-1, 0-8	227-30-1, 135-140	
Major Elements (%)								
SiO ₂	29.1	18.0	29.8	35.6	16.5	43.0	44.7	
Al ₂ O ₃	9.3	5.7	10.0	10.8	4.5	13.8	12.5	
Fe ₂ O ₃	4.1	1.5	4.3	2.5	1.5	5.3	4.4	
FeO	1.1	1.6	1.4	1.7	1.6	2.7	1.5	
MgO	5.2	4.8	2.6	3.4	1.3	4.5	5.8	
CaO	20.7	31.7	22.2	18.7	34.4	4.7	5.0	
SrO	0.08	0.14	0.08	0.06	0.10	<0.01	—	
Na ₂ O	1.8	1.0	2.2	3.1	2.7	5.4	4.0	
K ₂ O	1.4	1.2	1.4	1.5	0.63	2.1	1.8	
H ₂ O ⁺	5.0	3.6	2.6	3.9	3.8	6.5	4.9	
H ₂ O ⁻	3.1	1.8	2.4	2.2	2.0	2.7	4.2	
TiO ₂	0.27	0.41	0.58	0.20	0.56	0.83	0.70	
P ₂ O ₅	0.17	0.26	0.19	0.23	0.22	0.36	0.21	
MnO	0.14	0.24	0.14	0.12	0.22	0.14	0.16	
CO ₂	17.9	28.2	16.6	15.1	26.4	4.6	6.2	

TABLE 6 – Continued

Site 227 (Cont)								
	227-3-1, 18-27	227-5-2, 0-7	227-12-2, 0-10	227-20-3, 0-10	227-23-1, 0-5	227-27-1, 0-8	227-30-1, 135-140	
Other Volatiles than CO ₂ and H ₂ O	—	—	—	—	1.6	—	—	
Sum	99	100	96	99	98	97	96	
Cl	0.65	0.60	1.05	1.95	2.0	2.0		
S	1.7	0.04	2.2	0.23	0.84	2.2	2.9	
Trace Elements (ppm)								
Pb	—	—	—	—	3.0	5.0	5.0	
Zn	—	—	—	—	24.0	49.0	35.0	
Cu	—	—	—	—	58.0	220.0	48.0	
Ni	—	—	—	—	28.0	38.0	44.0	
Mo	—	—	—	—	28.0	4.0	<4.0	
V	—	—	—	—	150.0	240.0	100.0	
B	—	—	—	—	<20(s)	70(s)	50.0	
U	2.2	6.4	1.4	8.8	51(c) 4.4	96(c)	—	

Site 228								
	228-5-3, 0-10	228-10-6, 0-10	228-16-5, 0-10	228-24-3, 140-150	228-30	228-33-1, top	228-35-1, 140/150	228-39,CC
Major Elements (%)								
SiO ₂	38.4	46.3	38.2	46.1	50.4	50.6	56.4	35.3
Al ₂ O ₃	10.3	13.3	10.9	13.5	15.7	16.6	15.6	9.6
Fe ₂ O ₃	3.6	4.6	3.8	4.1	4.4	4.1	3.5	3.3
FeO	1.5	2.2	2.5	2.0	2.6	2.7	2.8	2.3
MgO	3.0	3.4	3.0	3.0	3.3	3.1	3.1	3.0
CaO	19.9	11.1	17.9	11.5	6.0	4.5	1.4	14.5
SrO	0.08		0.08	0.06	0.05	0.04	0.01	0.12
Na ₂ O	2.2	2.7	2.8	3.0	3.2	3.2	4.2	2.0
K ₂ O	1.3	1.6	1.4	1.8	2.2	2.2	2.3	2.0
H ₂ O+	2.8	4.4	3.4	4.2	5.0	6.0	5.0	3.5
H ₂ O-	1.1	1.5	1.3	1.2	1.9	2.4	2.2	1.0
TiO ₂	0.90	0.71	0.81	0.87	0.98	0.92	1.0	0.66
P ₂ O ₅	0.24	0.25	0.27	0.22	0.24	0.18	0.18	0.15
MnO	0.11	0.16	0.21	0.16	0.14	0.06	0.06	0.43
CO ₂	13.9	7.0	12.5	7.7	3.6	2.4	<0.05	2.8
Other Volatiles than CO ₂ and H ₂ O	—	—	—	—	—	—	2.0	1.0
Sum	99	99	99	99	100	99	100	82
Cl	0.28	—	0.70	0.65	0.66	0.62	1.35	1.10
S	0.00	0.21	0.13	0.07	0.20	0.50	0.88	8.2
Trace Elements (ppm)								
Pb	—	6.0	—	5.0	—	5.0	6.0	14.0
Zn	—	56.0	—	65.0	—	85.0	180.0	540.0
Cu	—	52.0	—	38.0	48.0	53.0	46.0	33.0
Mo	—	38.0	—	<4	<4	<4	<4	<4
V	—	<4	—	120.0	140.0	120.0	110.0	90.0
Ni	—	200.0	—	28.0	42.0	38.0	22.0	15.0
B	—	40.0	—	40(s)	40(s)	50(s)	40(s)	110(s)
U	1.6	—	—	41(c) 1.2	24(c) 2.4	100(c) 2.4	1.6	1.2

TABLE 6 — Continued

Sites 229 and 230						
	229-3-5, 140-150	229A-8-1, 35-37	229A-8-1, 84-86	229A-8-3, 20-30	229A-18-5, 70-75	230-1, CC
Major Elements (%)						
SiO ₂	11.3	33.5	29.2	36.4	18.0	8.6
Al ₂ O ₃	4.2	10.3	8.5	11.7	5.1	2.7
Fe ₂ O ₃	1.7	3.0	2.7	4.3	1.5	0.48
FeO	0.92	2.8	2.5	2.8	1.3	0.84
MgO	2.3	6.2	5.5	6.7	2.6	3.1
CaO	40.3	9.8	20.4	9.9	34.8	42.1
SrO	0.21	0.08		0.09	0.19	0.32
Na ₂ O	0.98	2.9	2.2	3.3	1.2	0.98
K ₂ O	0.51	0.93	1.1	0.92	0.87	0.46
H ₂ O ⁺	3.0	6.0	4.7	7.3	3.5	2.5
H ₂ O ⁻	1.6	16.4	5.8	7.9	2.2	1.0
TiO ₂	0.26	1.2	0.91	1.5	0.36	0.18
P ₂ O ₅	0.36	0.31	0.32	0.33	0.42	0.24
MnO	0.10	0.07	0.08	0.09	0.08	0.09
CO ₂	31.6	6.5	15.2	6.0	27.0	34.7
Other Volatiles than CO ₂ and H ₂ O	—	—	—	—	—	—
Sum	99	100	99	100	99	
Cl	0.55	0.43	—	0.35	0.56	98.0
S	0.95	0.65	0.67	0.67	0.77	0.57 0.59
Trace Elements (ppm)						
Pb	—	7.0	—	—	—	—
Zn	—	36.0	—	—	—	—
Cu	—	72.0	—	—	—	—
Ni	—	26.0	—	—	—	—
Mo	—	<4	—	—	—	—
V	—	170.0	—	—	—	—
B	—	20.0	79.0	—	—	—
U	7.6	1.6	—	1.8	6.4	6.4

Note:

"Rapid rock analyses" performed by the U.S. G.S., Washington, Leonard Shapiro, Supervising analyst. Quantitative spectrochemical analyses by laboratory under leadership of C. Ansell; supplementary analyses (Cl, SrO, B, U, by wet chemical laboratory under leadership of J.I. Dinnin).