

# I. GRAIN-SIZE AND CARBON/CARBONATE ANALYSES, HOLES 417, 418, LEGS 51, 52, 53

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## GRAIN-SIZE ANALYSES

Sand-silt-clay distribution was determined on 10-cm<sup>3</sup> sediment samples collected at the time the cores were split and described. The results are listed in Tables 1 and 2.

The sediment classification used here is that of Shepard (1954) with sand, silt, and clay boundaries based on the Wentworth (1922) scale (Figure 1). Thus the sand, silt, and clay fractions are composed of particles whose diameters range from 2000 to 62.5  $\mu\text{m}$ , 62.5 to 3.91  $\mu\text{m}$ , and less than 3.91  $\mu\text{m}$ , respectively. This classification is applied regardless of sediment type and origin; therefore, the sediment names used in this table may differ from those used elsewhere in this volume, e.g., a silt composed of nannofossils in this table may be called a nanno ooze in a site chapter.

Standard sieve and pipette methods were used to determine the grain-size distribution. The sediment sample was dried and dispersed in a Calgon solution. If a sediment sample failed to disaggregate, it was treated

TABLE 1  
Grain-Size Determination for Site 417, Legs 51-52

Sample (Interval in cm)	Sub-Bottom Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
<b>Hole 417</b>					
1-3, 4	3.04	0.2	10.4	89.4	Clay
<b>Hole 417A</b>					
2-1, 70	9.20	0.0	7.5	92.5	Clay
3-1, 39	18.39	0.0	6.0	94.0	Clay
5-1, 18	37.18	0.0	7.3	92.7	Clay
6-1, 46	46.96	0.1	6.3	93.6	Clay
9-1, 70	75.70	0.2	3.7	96.1	Clay
10-1, 40	84.90	0.4	3.5	96.1	Clay
11-1, 40	94.40	1.0	4.2	94.8	Clay
11-3, 80	97.80	1.5	4.4	94.1	Clay
11-5, 62	100.62	0.9	5.2	93.9	Clay
12-1, 4	103.54	0.7	3.6	95.7	Clay
13-3, 30	116.30	0.1	1.3	98.6	Clay
14-2, 50	124.50	2.4	14.2	83.5	Clay
15-1, 19	132.19	2.1	11.5	86.5	Clay
16-1, 78	142.28	2.7	28.2	69.1	Silty clay
19-1, 30	170.30	0.0	9.6	90.4	Clay
20-1, 28	179.78	0.0	25.7	74.3	Silty clay
21-1, 96	189.96	0.2	25.2	74.6	Silty clay
22-1, 67	199.17	0.9	19.2	79.8	Clay
24-1, 11	217.61	20.0	19.9	60.2	Sandy clay
<b>Hole 417D</b>					
1-3, 22	3.22	0.0	9.4	90.5	Clay
9-1, 28	220.78	0.4	29.8	69.9	Silty clay
10-1, 54	230.44	0.6	14.8	84.7	Clay

TABLE 2  
Grain-Size Determination for Site 418, Legs 52-53

Sample (Interval in cm)	Sub-Bottom Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
<b>Hole 418</b>					
1-1, 79	0.79	0.0	8.9	91.1	Clay
1-4, 80	5.30	1.1	12.9	86.0	Clay
<b>Hole 418A</b>					
1-2, 90	113.40	0.0	2.4	97.6	Clay
2-1, 109	121.59	0.7	7.8	91.5	Clay
3-2, 104	132.54	1.5	3.7	94.9	Clay
3-6, 103	138.53	2.1	3.3	94.7	Clay
4-5, 62	146.12	0.9	3.2	95.9	Clay
5-4, 106	154.56	0.0	5.1	94.9	Clay
6-1, 73	159.23	1.6	11.4	87.0	Clay
7-2, 60	170.10	0.0	27.3	72.7	Silty clay
7-4, 23	172.73	0.0	18.1	81.9	Clay
7-5, 102	175.02	0.0	21.2	78.8	Clay
10-1, 97	273.47	2.0	33.4	64.6	Silty clay
12-1, 60	292.10	0.1	16.9	83.0	Clay
13-2, 18	302.68	7.3	20.2	72.5	Silty clay
13-2, 88	303.38	0.0	27.7	72.2	Silty clay
<b>Hole 418B</b>					
2-1, 40	7.20	0.0	6.8	93.2	Clay
3-2, 40	18.20	0.0	4.9	95.1	Clay
3-4, 40	21.20	0.2	6.2	93.6	Clay
4-2, 40	27.80	0.0	8.2	91.8	Clay
4-4, 40	30.80	0.0	6.8	93.2	Clay
5-2, 40	37.30	0.0	4.9	95.1	Clay
5-4, 40	40.30	0.0	5.9	94.1	Clay
6-2, 40	46.80	0.0	5.8	94.2	Clay
6-4, 40	49.80	0.0	5.2	94.8	Clay
7-5, 40	60.80	0.0	6.4	93.6	Clay
8-4, 40	68.80	0.0	7.6	92.4	Clay
9-2, 40	75.20	0.0	6.6	93.4	Clay
9-5, 40	79.70	0.0	6.6	93.4	Clay
10-2, 38	84.58	1.0	6.7	92.3	Clay
11-2, 40	94.00	0.0	3.4	96.6	Clay
11-4, 30	96.90	0.0	2.6	97.4	Clay
12-4, 40	106.40	3.0	5.6	91.4	Clay
13-1, 40	111.30	0.0	3.4	96.6	Clay
15-2, 40	131.50	1.2	4.6	94.3	Clay
16-1, 40	139.50	0.0	3.5	96.5	Clay
17-2, 40	150.50	0.0	4.7	95.3	Clay
19-1, 40	168.10	2.5	32.6	64.9	Silty clay
20-2, 40	179.10	0.0	8.4	91.6	Clay
21-1, 40	187.10	0.0	9.4	90.6	Clay
22-2, 110	198.90	0.4	30.4	69.2	Silty clay
23-1, 60	206.40	0.2	8.5	91.3	Clay
24-1, 40	215.70	1.1	16.9	82.0	Clay
25-2, 40	226.80	0.0	9.2	90.8	Clay
28-2, 61	255.51	0.1	37.4	62.5	Silty clay
29-1, 114	264.04	0.0	25.0	75.0	Clay
30-2, 40	274.30	0.1	25.3	74.6	Silty clay
31-2, 40	283.80	7.4	42.6	50.0	Silty clay
32-1, 64	292.04	2.6	31.6	65.8	Silty clay
33-1, 70	301.70	4.3	19.8	75.9	Clay

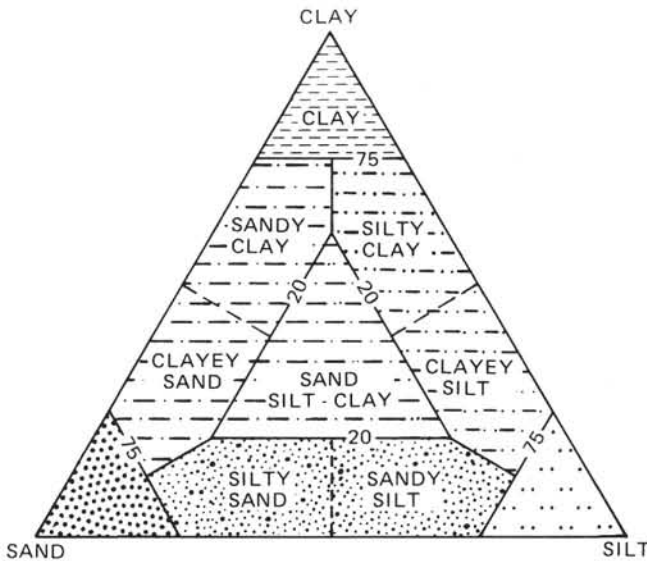


Figure 1. Sediment classification after Shepard (1954) with the sand, silt, and clay size fractions based on the Wentworth (1922) Grade Scale: Sand, silt, and clay size particles having respective diameters of 2000 to 62.5  $\mu\text{m}$ , 62.5 to 3.91  $\mu\text{m}$ , and less than 3.91  $\mu\text{m}$ . Shepard's (1954) sediment classification is a function of sand, silt, and clay size percentages and not composition.

with a sonic probe and, if necessary, hydrogen peroxide. Sediment samples which resisted the above treatment were not analyzed.

The sand fraction was removed by wet sieving using a 63  $\mu\text{m}$  sieve, and the silt and clay fractions were analyzed by standard pipette analysis. Sampling depths and times were calculated using equations derived from Stokes settling velocity equation (Krumbein and Pettijohn, 1938, p. 95-96):

$$\frac{D}{t} = V = \frac{2gr^2(d_1 - d_2)}{9\eta}$$

$$t = \frac{9D\eta}{2gr^2(d_1 - d_2)}$$

where

$V$  = velocity, in cm/sec

$t$  = time, in sec\*

$D$  = depth pipette is inserted, in cm

$g$  = gravity, in  $\text{cm}/\text{sec}^2$ \*

$r$  = radius of individual particles, in cm\*

$d_1$  = density of solid particles arbitrarily set at 2.675 g/cc  
absolute density of distilled water at different temperatures (Hodgman et al., 1960, p. 2129).

\*Five figures were used in calculations to avoid rounding off variations.

The reproducibility of the grain-size analysis has been previously tested (Boyce, 1972), and it was found that over a period of time with several operators the reproducibility for the sand-silt-clay fractions is  $\pm 2.5$  per cent (absolute). For detailed step-by-step procedures, see Volume 4 of the *Initial Reports of the Deep Sea Drilling Project*.

### CARBON AND CARBONATE ANALYSES

Sediments recovered during Legs 51-53 were analyzed for total carbon and acid-insoluble (organic) carbon using the new LECO WR-12 Analyzer according to the standard technique outlined below. Because there were only 38 samples, no control standards were run. But the reproducibility of the LECO was verified in extensive tests prior to Legs 51-53 and also in standards run for subsequent legs.

The 3-cm<sup>3</sup> sediment samples were first dried and ground into a homogeneous powder. The ground sediment was redried at 105°-110°C and two samples, a 0.1-g and a 0.5-g sample, were weighed into LECO clay crucibles. The 0.5-g sample was acidified with 10 per cent hydrochloric acid and washed with distilled water. The sample was then dried and analyzed for acid-insoluble carbon. The 0.1-g sample was analyzed for total carbon without further treatment. If the sample contained less than 10 per cent  $\text{CaCO}_3$ , an additional 0.5-g sample was analyzed for greater accuracy. The calcium carbonate percentages were calculated as follows:  $(\% \text{ total C} - \% \text{ organic C}) \times 8.33 = \% \text{ CaCO}_3$ . Although other carbonates may be present, all acid-soluble carbon was calculated as calcium carbonate. All results are given in weight per cent (Tables 3 and 4).

Detailed descriptions of the technique and theory may be found in Bader, Gerard, et al. (1970) and Boyce and Bode (1972).

TABLE 3  
Carbon and Carbonate Analyses,  
Site 417, Legs 51 and 52

Sample (Interval in cm)	Depth (m)	Total Carbon (%)	Organic Carbon (%)	$\text{CaCO}_3$
<b>Hole 417</b>				
1-3, 2	3.02	0.3	0.1	1
<b>Hole 417A</b>				
1-1, 71	0.71	4.4	0.1	36
1-3, 80	3.80	0.2	0.1	1
1-5, 80	6.80	0.1	0.1	0
2-1, 77	9.27	0.1	0.1	0
2-3, 120	12.70	0.1	0.1	0
3-1, 100	19.00	0.1	0.1	0
3-3, 34	21.34	0.1	0.1	0
3-5, 30	24.30	0.1	0.1	0
5-1, 26	37.26	0.1	0.1	0
6-1, 38	46.88	0.1	0.1	0
6-3, 10	49.60	0.1	0.1	0
6-4, 36	51.36	0.1	0.1	0
6-5, 59	53.09	0.1	0.1	0
8-1, 89	66.39	0.1	0.1	0

TABLE 3 – Continued

Sample (Interval in cm)	Depth (m)	Total Carbon (%)	Organic Carbon (%)	CaCO <sub>3</sub>
<b>Hole 417A – Continued</b>				
8-3, 50	69.00	0.1	0.1	0
8-5, 30	71.80	0.1	0.1	0
9-1, 73	75.73	0.1	0.1	0
9-3, 40	78.40	0.1	0.1	0
9-5, 20	81.20	0.1	0.1	0
10-1, 43	84.93	0.1	0.1	0
10-3, 40	87.90	0.3	0.1	1
11-1, 41	94.41	0.2	0.1	1
11-3, 34	97.34	0.2	0.1	1
11-5, 64	100.64	0.1	0.1	0
12-1, 95	104.45	0.3	0.1	2
12-3, 33	106.83	0.1	0.1	0
13-3, 32	116.32	0.0	0.1	0
13-5, 80	119.80	0.1	0.1	0
14-2, 52	124.52	0.1	0.1	0
15-1, 21	132.21	0.1	0.1	0
15-3, 28	135.28	0.1	0.1	0
16-1, 81	142.31	0.0	0.1	0
16-3, 66	145.16	0.1	0.1	0
16-5, 62	148.12	0.1	0.1	0
18-1, 96	161.46	0.1	0.1	0
18-3, 107	164.57	0.1	0.1	0
19-1, 32	170.32	0.1	0.1	0
19-3, 20	173.20	0.1	0.1	0
19-5, 81	176.81	0.1	0.1	0
20-1, 20	179.70	0.1	0.1	0
20-3, 40	182.90	0.1	0.1	0
20-5, 70	186.20	0.1	0.1	0
21-1, 53	189.53	0.1	0.1	0
22-1, 72	199.22	0.1	0.1	0
<b>Hole 417B</b>				
1-1, 30	0.30	0.3	0.1	1
1-1, 80	0.80	0.2	0.1	1
<b>Hole 417D</b>				
1-3, 19	3.19	0.2	0.1	1
1-3, 123	4.23	1.8	0.1	15
9-1, 74	221.24	0.1	0.1	0
9-2, 52	222.52	0.1	0.1	0
10-1, 88	230.78	0.1	0.1	0
10-3, 11	233.01	0.1	0.1	0
10-3, 66	233.56	0.1	0.1	0
11-1, 54	239.74	0.1	0.1	0
12-3, 19	251.79	0.1	0.1	0
13-1, 5	258.25	0.1	0.1	0
13-2, 20	259.90	0.1	0.1	0
14-1, 40	268.10	0.1	0.1	0
14-3, 143	272.13	0.1	0.1	0
14-5, 20	273.90	0.1	0.1	0
15-1, 74	278.04	0.1	0.1	0
15-2, 36	279.16	0.1	0.1	0
16-1, 105	287.85	0.4	0.2	2
17-1, 90	297.20	5.9	1.6	36
17-4, 5	300.85	6.4	5.5	8
18-1, 57	306.47	0.1	0.1	0
18-2, 70	308.10	2.3	2.1	2
19-1, 16	315.56	0.1	0.1	0
19-1, 134	316.74	4.6	0.4	35
20-1, 19	325.19	8.5	0.0	70
20-1, 42	325.42	7.3	0.0	61
20-2, 21	326.71	3.7	0.0	31
21-2, 99	336.99	0.1	0.1	0
21-3, 78	338.28	1.9	1.3	5
21-4, 26	339.26	10.5	0.8	80

TABLE 4  
Carbon and Carbonate Analyses,  
Site 418, Legs 52 and 53

Sample (Interval in cm)	Depth (m)	Total Carbon (%)	Organic Carbon (%)	CaCO <sub>3</sub>
<b>Hole 418</b>				
1-1, 71	0.71	0.3	0.1	2
1-4, 75	5.25	1.1	0.1	9
<b>Hole 418A</b>				
1-2, 92	113.42	0.1	0.1	0
2-1, 112	121.62	0.2	0.2	0
3-2, 113	132.63	0.3	0.1	2
3-6, 101	138.51	0.3	0.1	2
4-5, 61	146.11	0.2	0.1	1
5-4, 97	154.47	0.1	0.1	0
6-1, 77	159.27	0.1	0.1	0
7-2, 58	170.08	0.0	0.1	0
7-4, 26	172.76	0.0	0.0	0
7-5, 101	175.01	0.0	0.1	0
10-1, 118	273.68	4.1	3.0	10
10-2, 12	274.12	0.1	0.1	0
12-1, 64	292.14	0.3	0.0	2
13-2, 21	302.71	0.9	0.1	7
13-2, 86	303.36	0.2	0.2	0
<b>Hole 418B</b>				
2-1, 60	7.40	0.2	0.1	0
3-2, 60	18.40	0.1	0.1	0
4-4, 60	31.00	0.1	0.1	0
5-2, 60	37.50	0.2	0.1	0
5-4, 60	40.50	0.1	0.2	0
6-2, 60	47.00	0.1	0.1	0
6-4, 60	50.00	0.1	0.1	0
7-5, 60	61.00	0.2	0.2	0
8-4, 60	69.00	0.2	0.2	0
9-2, 60	75.40	0.3	0.1	1
9-5, 60	79.90	0.1	0.2	0
10-2, 60	84.80	0.3	0.2	1
11-2, 60	94.20	0.3	0.2	0
11-4, 50	97.10	0.2	0.2	0
12-4, 60	106.60	0.3	0.2	1
13-1, 60	111.50	0.2	0.2	0
15-2, 60	131.70	0.2	0.1	1
16-1, 60	139.70	0.1	0.1	0
17-2, 60	150.70	0.1	0.1	0
19-1, 60	168.30	0.1	0.1	0
20-2, 60	179.30	0.1	0.1	0
21-1, 60	187.30	0.0	0.0	0
22-2, 120	199.00	—	0.1	—
23-1, 80	206.60	0.1	0.1	0
24-1, 60	215.90	0.0	0.1	0
25-2, 60	227.00	0.1	0.1	0
27-1, 40	244.40	3.2	0.2	25
27-1, 60	244.60	3.3	0.1	27
28-2, 34	255.24	7.4	3.0	37
29-1, 34	263.24	6.3	2.7	29
30-2, 74	274.64	0.1	0.1	0
31-2, 60	284.00	0.5	0.4	0
32-1, 78	292.18	8.6	0.0	71
33-1, 80	301.80	1.0	0.1	8

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