

### III. GRAIN-SIZE AND CARBON/CARBONATE ANALYSES, LEG 36

Donald H. Cameron, Scripps Institution of Oceanography, La Jolla, California

#### GRAIN-SIZE ANALYSES

Sand-silt-clay distribution was determined on 10-cc sediment samples collected at the time the cores were split and described. The results are listed in Table 1.

The sediment classification used here is that of Shepard (1954) with the 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 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 cm/sec<sup>2</sup>\*

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

$d_1$  = density of solid particles arbitrarily set at 2.675 g/cc

$d_2$  = absolute density of distilled water at different temperatures (Hodgman et al., 1960, p. 2129)

$\eta$  = viscosity of distilled water in poises at different temperatures (Hodgman et al., 1960, p. 2181)

TABLE 1  
Grain-Size Determination for Leg 36

Sample (Interval in cm)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
<b>Hole 327</b>					
1-1, 73	0.73	91.4	0.9	7.7	Sand
1-1, 123	1.23	91.8	3.6	4.5	Sand
<b>Hole 327A</b>					
1-2, 3	1.54	86.7	1.2	12.1	Sand
<b>Hole 328</b>					
1-4, 110	5.60	8.6	31.2	60.1	Silty clay
1-5, 55	6.55	7.5	21.4	71.1	Silty clay
1-5, 110	7.10	9.7	28.6	61.7	Silty clay
2-2, 110	2.61	40.2	29.9	29.9	Sand-silt-clay
2-3, 80	3.81	55.0	24.2	20.8	Sand-silt-clay
2-3, 110	4.11	26.9	26.3	46.8	Sand-silt-clay
2-4, 124	5.75	6.9	29.1	64.0	Silty clay
2-5, 10	6.11	11.0	33.1	56.0	Silty clay
2-5, 110	7.11	5.2	33.1	61.7	Silty clay
2-6, 10	7.61	1.9	35.9	62.2	Silty clay
2-6, 110	8.61	1.8	32.8	65.3	Silty clay
3-1, 10	0.12	2.1	40.2	57.7	Silty clay
3-1, 110	1.12	0.8	32.7	66.5	Silty clay
3-2, 114	2.66	0.7	32.2	67.2	Silty clay
3-3, 110	4.12	1.3	24.7	74.0	Silty clay
3-4, 110	5.62	0.7	26.1	73.3	Silty clay
3-5, 110	7.12	0.5	22.2	77.3	Clay
3-6, 112	8.64	0.5	24.2	75.2	Clay
4-2, 110	2.65	0.8	25.4	73.8	Silty clay
5-3, 50	3.60	0.1	20.1	79.8	Clay
6-2, 50	2.15	0.0	19.8	80.1	Clay
7-4, 113	5.82	0.0	7.5	92.5	Clay
8-2, 120	2.94	0.1	19.9	80.0	Clay
9-5, 78	7.07	0.1	14.4	95.6	Clay
10-6, 78	8.62	0.1	11.2	88.8	Clay
<b>Hole 328A</b>					
1-1, 100	1.00	13.9	39.3	46.8	Silty clay
1-2, 20	1.70	14.0	32.5	53.4	Silty clay
1-2, 100	2.50	20.3	30.3	49.4	Sand-silt-clay
1-3, 20	3.20	9.2	32.3	58.4	Silty clay
1-3, 100	4.00	13.9	32.3	53.8	Silty clay
1-4, 20	4.70	16.0	28.4	55.5	Silty clay
1-4, 102	5.52	19.1	30.3	50.6	Silty clay
<b>Hole 328B</b>					
1-1, 85	0.86	27.3	28.6	44.1	Sand-silt-clay
1-2, 20	1.71	11.9	39.0	49.1	Silty clay
1-2, 100	2.51	5.6	38.2	56.2	Silty clay
1-3, 20	3.21	7.1	41.4	51.5	Silty clay
1-3, 100	4.01	5.7	32.5	61.8	Silty clay
1-4, 20	4.71	2.0	37.1	60.8	Silty clay
1-4, 100	5.51	10.0	39.2	50.9	Silty clay
1-5, 20	6.21	4.4	35.5	60.0	Silty clay
1-5, 100	7.01	1.5	30.6	67.9	Silty clay
1-6, 20	7.71	2.3	33.4	64.3	Silty clay

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

TABLE 1 – Continued

Sample (Interval in cm)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
<b>Hole 328B – Continued</b>					
1-6, 100	8.51	2.4	34.7	62.9	Silty clay
2-1, 20	0.22	1.1	32.8	66.2	Silty clay
2-1, 100	1.02	0.6	32.0	67.3	Silty clay
2-2, 20	1.72	1.3	31.1	67.6	Silty clay
2-2, 100	2.52	2.5	25.1	72.4	Silty clay
2-3, 20	3.22	0.6	26.9	72.5	Silty clay
2-3, 100	4.02	0.9	28.5	70.6	Silty clay
2-4, 20	4.72	0.4	23.5	76.0	Clay
2-4, 100	5.52	2.4	26.2	71.4	Silty clay
2-5, 18	6.20	0.4	24.2	75.4	Clay
2-5, 100	7.02	0.5	24.4	75.0	Clay
2-6, 20	7.72	0.8	25.1	74.1	Silty clay
2-6, 100	8.52	0.8	22.6	76.6	Clay
3-1, 20	0.23	1.1	24.3	74.7	Silty clay
3-1, 100	1.03	0.5	24.9	74.7	Silty clay
3-2, 20	1.73	0.7	24.6	74.7	Silty clay
3-2, 100	2.53	0.8	24.8	74.5	Silty clay
3-3, 20	3.23	0.7	25.3	74.0	Silty clay
3-3, 100	4.03	0.5	25.7	73.8	Silty clay
3-4, 20	4.73	0.6	26.0	73.4	Silty clay
3-4, 100	5.53	0.9	33.1	66.0	Silty clay
3-5, 20	6.23	1.0	26.3	72.7	Silty clay
3-5, 100	7.03	2.0	33.0	65.0	Silty clay
3-6, 20	7.73	0.5	22.2	77.3	Clay
3-6, 100	8.53	0.8	23.6	75.6	Clay
4-1, 100	1.04	0.3	23.2	76.5	Clay
4-6, 20	7.74	0.8	27.3	71.9	Silty clay
5-1, 98	1.03	0.2	17.0	82.8	Clay
5-6, 100	8.55	0.1	2.4	97.5	Clay
6-6, 55	8.11	0.1	13.2	86.8	Clay
7-6, 55	8.49	0.0	5.5	94.5	Clay
<b>Site 329</b>					
1-2, 100	2.50	63.6	20.7	15.7	Silty sand
1-3, 20	3.20	66.1	18.8	15.0	Silty sand
1-3, 100	4.00	50.0	23.9	26.1	Sand-silt-clay
1-4, 20	4.70	4.3	39.5	56.2	Silty clay
1-4, 100	5.50	11.6	37.4	50.9	Silty clay
1-5, 20	6.20	7.4	35.1	57.6	Silty clay
1-5, 100	7.00	8.3	35.3	56.4	Silty clay
1-6, 20	7.70	1.6	32.3	66.1	Silty clay
1-6, 80	8.30	2.4	37.4	60.1	Silty clay
2-1, 128	1.29	21.3	37.7	41.0	Sand-silt-clay
2-1, 128	1.29	26.1	33.6	40.2	Sand-silt-clay
2-3, 82	3.83	28.2	37.7	34.1	Sand-silt-clay
2-4, 72	5.23	30.9	36.9	32.2	Sand-silt-clay
2-5, 128	7.29	0.8	37.6	61.6	Silty clay
2-6, 128	8.79	1.0	34.0	65.0	Silty clay
3-1, 124	1.26	4.3	40.9	54.8	Silty clay
3-2, 125	2.77	3.0	40.5	56.5	Silty clay
3-3, 125	4.27	3.5	38.0	58.5	Silty clay
3-5, 80	6.82	0.9	35.9	63.2	Silty clay
3-6, 125	8.77	1.0	42.1	56.9	Silty clay
<b>Site 330</b>					
11-5, 100	7.44	7.8	49.9	42.3	Clayey silt
12-2, 54	2.51	0.4	33.7	65.8	Silty clay
12-3, 99	4.46	21.3	43.4	35.3	Sand-silt-clay
12-4, 99	5.96	2.4	42.0	55.5	Silty clay
12-5, 119	7.66	1.8	46.0	52.2	Silty clay
12-6, 98	8.95	10.8	43.7	45.5	Silty clay
13-1, 90	1.39	4.0	51.1	44.8	Clayey silt
13-2, 120	3.19	14.8	44.5	40.7	Clayey silt
13-3, 90	4.39	22.5	38.3	39.2	Sand-silt-clay
13-4, 73	5.72	33.6	40.6	25.8	Sand-silt-clay
14-1, 92	1.44	4.0	82.0	14.0	Silt

TABLE 1 – Continued

Sample (Interval in cm)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
<b>Site 330 – Continued</b>					
14-2, 1	2.03	6.1	69.9	23.9	Clayey silt
15-1, 30	0.85	62.7	19.8	17.5	Silty sand
15-1, 53	1.08	24.9	56.1	19.1	Sandy silt
15-1, 97	1.52	42.1	40.3	17.6	Silty sand
15-2, 126	3.31	48.3	29.3	22.4	Sand-silt-clay
<b>Site 331</b>					
1-1, 99	0.99	0.2	39.1	60.7	Silty clay
1-3, 111	4.11	0.1	30.7	69.1	Silty clay
1-5, 111	7.11	0.4	44.1	55.5	Silty clay
1-6, 44	7.94	0.1	79.7	20.2	Silt

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  $\pm 2.5\%$  (absolute). For detailed step-by-step procedures, see Volume 4 of the Initial Reports of the Deep Sea Drilling Project.

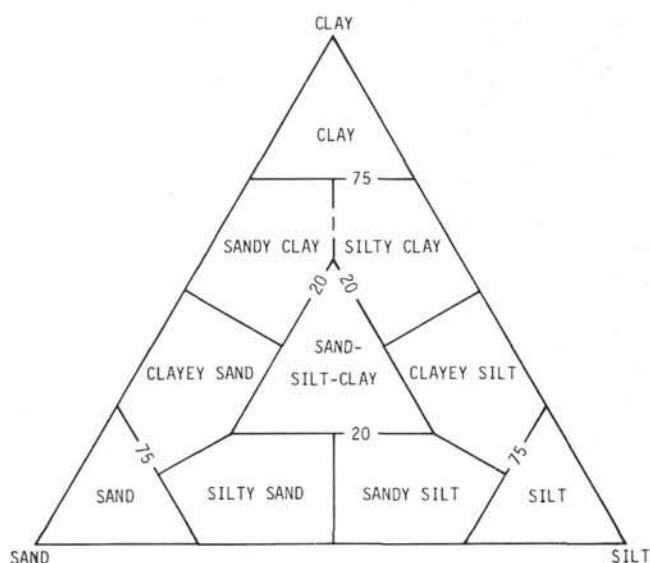


Figure 1. Sediment classification after Shepard (1954) with the sand, silt, and clay size fractions based on the Wentworth (1922) Grade Scale: Sand, silt, and clay size particles having respective diameters of 2000 to 62.5 $\mu$ m, 62.5 to 3.91 $\mu$ m, and less than 3.91 $\mu$ m. Shepard's (1954) sediment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

## CARBON AND CARBONATE ANALYSES

Leg 36 sediments 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 Leg 36 and also in standards run for subsequent legs.

The 3-cc 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% 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% CaCO<sub>3</sub>, an additional 0.5-g sample was analyzed for greater accuracy. The calcium carbonate percentages were calculated as follows: (% total C - % organic C) × 8.33 = % CaCO<sub>3</sub>. Although other carbonates may be present, all acid-soluble carbon was calculated as calcium carbonate. All results are given in weight percent (Table 2).

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

TABLE 2  
Carbon and Carbonate Analyses, Leg 36

Sample (Interval in cm)	Depth (m)	Total Carbon	Organic Carbon	CaCO <sub>3</sub>
<b>Hole 327</b>				
1-3, 52	3.5	0.2	0.2	0
<b>Hole 327A</b>				
1-3, 25	7.3	1.9	0.2	14
2-3, 99	17.5	0.1	0.1	0
3-2, 106	25.6	0.2	0.1	1
5-5, 97	49.5	2.0	0.4	13
6-4, 78	57.1	0.7	0.4	3
7-2, 115	63.7	0.5	0.5	0
8-3, 103	74.5	0.9	0.9	0
9-5, 108	87.6	1.9	1.5	3
10-3, 102	93.5	6.4	0.3	51
11-1, 99.3	99.3	6.6	0.3	52
12-2, 20	110.2	6.1	0.2	49
12-4, 114	114.0	8.6	0.3	69
13-2, 97	139.5	7.6	0.1	62
14-6, 90	154.9	0.8	0.1	5
15-2, 111	177.6	4.8	0.1	39
16-3, 44	187.9	2.3	0.2	18
16-5, 105	191.6	5.1	0.2	41
18-4, 101	228.5	4.8	0.2	38
19-2, 60	253.1	5.3	0.1	43
20-2, 76	281.8	7.0	0.1	57
21-3, 134	312.3	4.8	0.1	39
22-1, 137	337.9	2.5	0.3	19
22-3, 120	340.7	1.9	1.1	7
23-1, 105	366.1	0.9	0.7	1
24-1, 50	394.0	6.0	2.2	32
25-3, 126	426.3	7.8	3.5	37
26-1, 120	451.7	1.7	1.4	2
27-2, 30	461.8	4.0	2.6	12
<b>Hole 328</b>				
3-1, 113	18.1	0.1	0.1	0
4-3, 22	48.7	0.1	0.1	0
4-5, 62	52.1	0.1	0.1	0
5-3, 48	96.5	0.4	0.1	3
6-2, 48	142.5	0.4	0.4	0
7-4, 115	193.7	0.4	0.3	0
8-2, 123	238.2	0.3	0.3	0

TABLE 2 - Continued

Sample (Interval in cm)	Depth (m)	Total Carbon	Organic Carbon	CaCO <sub>3</sub>
<b>Hole 328 - Continued</b>				
9-5, 77	290.1	0.3	0.3	0
10-6, 72	338.7	0.4	0.4	0
11-1, 77	359.8	0.4	0.4	0
11-6, 70	367.2	0.5	0.4	0
12-1, 130	388.8	0.5	0.5	0
12-2, 7	389.1	0.2	0.2	0
12-2, 17	389.2	0.5	0.5	0
<b>Hole 328B</b>				
4-5, 15	42.2	0.1	0.1	0
5-3, 10	49.1	0.1	0.1	0
5-3, 134	50.3	0.1	0.1	0
6-6, 63	63.1	0.1	0.1	0
7-1, 61	436.1	0.4	0.3	0
7-3, 102	439.5	0.4	0.3	0
7-5, 40	441.9	0.4	0.4	0
7-6, 63	443.6	0.3	0.1	1
<b>Site 329</b>				
1-2, 120	2.7	0.5	0.3	2
1-5, 120	7.2	3.5	0.2	28
2-3, 126	12.8	7.0	0.2	57
3-4, 50	23.0	4.4	0.3	34
3-6, 100	26.5	8.5	0.1	70
4-2, 120	30.2	6.4	0.2	51
4-5, 80	34.3	1.4	0.4	9
5-3, 80	40.8	1.6	0.4	10
6-1, 100	47.5	2.8	0.3	21
6-4, 100	52.0	2.1	0.5	13
7-4, 107	61.6	4.7	0.2	37
7-5, 107	63.1	3.5	0.3	27
7-6, 107	64.6	3.7	0.3	28
8-2, 100	68.0	5.5	0.3	43
8-3, 30	68.8	7.7	0.2	62
8-5, 100	72.5	7.7	0.2	62
9-4, 100	80.8	2.4	0.4	17
9-6, 80	83.6	3.9	0.4	29
10-1, 30	85.1	4.4	0.3	34
10-5, 100	91.8	6.4	0.3	51
10-6, 100	93.3	5.9	0.4	46
11-3, 70	97.7	5.5	0.2	44
11-6, 70	102.2	3.0	0.4	22
12-4, 70	109.2	9.5	0.1	78
12-6, 10	111.6	3.6	0.4	27
13-1, 70	114.2	2.7	0.3	20
13-6, 70	121.7	8.3	0.1	68
14-3, 80	126.8	3.6	0.3	27
14-5, 80	129.8	9.4	0.1	78
15-6, 70	140.7	7.9	0.1	65
16-1, 90	142.9	5.9	0.1	48
16-4, 87	147.4	9.9	0.1	82
16-6, 81	150.3	9.2	0.1	76
17-4, 90	156.9	8.6	0.1	71
18-2, 30	162.8	6.9	0.2	56
18-4, 100	166.5	7.7	0.1	63
18-6, 100	169.5	4.3	0.3	33
19-3, 65	173.7	4.1	0.2	33
19-4, 65	175.2	4.5	0.3	35
20-2, 100	192.0	2.9	0.4	21
20-4, 100	195.0	6.2	0.2	50
20-6, 100	198.0	4.4	0.2	35
21-3, 85	211.9	2.9	0.4	21
21-4, 86	213.4	6.2	0.2	50
22-2, 68	238.7	0.9	0.5	3
22-4, 124	242.2	3.2	0.7	21
23-3, 104	269.0	7.9	0.2	64

TABLE 2 - Continued

Sample (Interval in cm)	Depth (m)	Total Carbon	Organic Carbon	CaCO <sub>3</sub>
<i>Site 329 - Continued</i>				
24-2, 69	286.2	8.1	0.2	66
26-2, 85	333.9	5.0	0.4	38
27-1, 113	361.1	8.4	0.1	69
28-1, 64	389.1	8.0	0.1	66
29-1, 60	398.6	10.4	0.1	86
30-2, 30	409.3	8.0	0.1	65
32-4, 120	451.2	9.4	0.1	78
<i>Site 330</i>				
1-4, 60	134.6	5.5	0.1	45
1-4, 120	135.2	2.3	0.1	19
2-2, 108	179.1	5.0	0.1	41
3-2, 40	225.9	5.8	5.8	0
4-1, 82	272.3	5.3	5.3	0
5-2, 109	302.6	3.5	2.9	5
5-3, 109	304.1	4.9	2.8	17
6-1, 80	310.3	3.6	2.9	6
6-2, 80	311.8	3.4	2.8	5
6-3, 80	313.3	4.6	3.1	12
6-4, 80	314.8	4.2	3.5	6
6-5, 80	316.3	4.5	3.7	6
6-6, 80	317.8	4.6	4.4	2
7-1, 100	320.0	4.0	3.6	4
7-2, 100	321.5	4.0	3.3	6
7-3, 100	323.0	3.9	3.3	5
7-4, 100	324.5	4.0	3.2	7
7-5, 100	326.0	4.2	3.0	10
7-6, 100	327.5	4.1	2.8	11
8-1, 101	348.5	4.3	2.9	11
8-2, 101	350.0	3.9	3.0	7
8-3, 75	351.3	5.5	3.6	15
9-1, 114	377.1	3.4	3.0	4
9-2, 80	378.3	2.8	2.8	0
10-1, 99	405.5	2.9	2.9	0
10-2, 66	406.7	1.9	1.9	0
11-2, 100	435.5	1.9	1.9	0
11-4, 100	438.5	1.6	1.6	0
12-2, 10	463.1	1.2	1.2	0

TABLE 2 - Continued

Sample (Interval in cm)	Depth (m)	Total Carbon	Organic Carbon	CaCO <sub>3</sub>
<i>Site 330 - Continued</i>				
12-4, 10	466.1	1.2	1.2	0
12-6, 10	469.1	1.3	1.2	1
13-1, 80	490.8	1.3	1.3	1
13-1, 86	490.9	1.3	1.2	1
13-3, 80	493.8	0.9	0.8	0
13-3, 86	493.9	0.9	0.8	1
13-4, 70	495.2	1.0	0.8	1
14-2, 81	520.8	1.2	1.0	2
14-4, 118	524.2	8.2	0.4	65
14-4, 130	524.3	1.6	1.7	0

## REFERENCES

- Bader, R.G., Gerard, R.D., et al., 1970. Initial Reports of the Deep Sea Drilling Project, Volume 4: Washington (U.S. Government Printing Office).
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