

17. GRAIN-SIZE AND CARBON/CARBONATE ANALYSES, LEG 39

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GRAIN-SIZE ANALYSIS

Sand-silt-clay distribution was determined on 10-cc sediment samples collected at the time the cores were split and described. The grain-size analyses results for Leg 39 are listed in Table 1.

Standard sieve and pipette methods were used to determine the grain-size distribution. For detailed step-by-step procedures, see Volume 4 of the Initial Reports of the Deep Sea Drilling Project (Bader, Gerard, et al., 1970). Sampling depths and times utilized in the standard pipette analysis 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/sec²*
- 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)
- η = viscosity of distilled water in poises at different temperatures (Hodgman et al., 1960, p. 2181)

The sediment classification used in Table 1 is that of Shepard (1954) with the sand, silt, and clay boundaries based on the Wentworth (1922) scale (Figure 1). Note that this classification is applied regardless of sediment type and origin. The sand, silt, and clay fractions are composed of particles whose diameters range from 2000 to 62.5 μm , and less than 3.91 μm , respectively.

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 sand-silt-clay fractions is $\pm 2.5\%$ (absolute).

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

TABLE 1
Grain-Size Determination, Leg 39, Site 353

Sample (Interval in cm)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
Hole 353					
2-1, 118	119.68	2.4	68.6	29.0	Clayey silt
2-2, 35	102.35	0.5	23.7	75.7	Clay
Hole 353A					
1-1, 66	0.66	0.2	28.5	71.3	Silty clay
1-2, 123	2.73	0.0	30.6	69.4	Silty clay
Site 354					
1-2, 59	2.09	6.9	20.5	72.6	Silty clay
3-2, 123	95.23	11.4	25.0	63.6	Silty clay
Site 355					
1-4, 70	58.40	0.0	8.8	91.2	Clay
1-5, 60	59.80	0.0	8.4	91.6	Clay
Hole 356					
2-2, 14	11.54	29.8	29.9	40.3	Sand-silt-clay
3-1, 120	41.20	1.3	49.0	49.6	Silty clay
4-3, 82	61.12	0.3	43.2	56.4	Silty clay
5-5, 118	93.08	8.8	59.2	32.1	Clayey silt
6-4, 25	118.75	2.0	28.1	70.0	Silty clay
7-4, 10	138.10	0.8	29.0	70.2	Silty clay
8-2, 100	164.00	2.7	31.0	66.4	Silty clay
9-2, 115	192.65	4.0	26.8	69.2	Silty clay
10-3, 54	222.04	1.7	40.6	57.7	Silty clay
12-1, 33	247.33	0.2	52.7	47.0	Clayey silt
16-1, 87	285.87	0.4	49.5	50.1	Silty clay
17-3, 60	298.50	0.1	41.8	58.2	Silty clay
23-2, 80	354.30	2.0	32.6	65.5	Silty clay
24-3, 145	365.80	3.2	33.3	63.5	Silty clay
24-5, 119	368.54	8.0	5.8	86.2	Clay
25-2, 102	373.02	3.5	23.2	73.3	Silty clay
26-2, 85	382.70	4.3	36.3	59.4	Silty clay
29-2, 80	410.80	1.0	29.6	69.5	Silty clay
29-6, 50	416.50	3.4	29.1	67.4	Silty clay
31-5, 45	443.85	1.0	23.9	75.1	Clay
33-2, 54	486.94	2.9	37.7	59.4	Silty clay
34-2, 70	515.55	3.3	43.8	52.9	Silty clay
35-2, 90	544.40	6.2	42.5	51.3	Silty clay
36-1, 145	571.45	4.9	30.6	64.4	Silty clay
37-4, 84	604.19	13.5	32.2	54.2	Silty clay
38-3, 67	649.67	6.1	35.3	58.6	Silty clay
39-5, 21	680.71	0.2	42.5	57.4	Silty clay
40-6, 54	701.99	0.0	26.9	73.1	Silty clay
41-2, 73	705.23	1.5	44.8	53.7	Silty clay
41-5, 148	710.48	4.8	46.3	48.9	Silty clay
42-3, 146	716.96	2.7	46.9	50.4	Silty clay
43-4, 7	726.97	4.2	47.2	48.6	Silty clay
43-5, 97	729.37	26.1	46.2	27.7	Sand-silt-clay
44-4, 100	737.00	24.4	40.9	34.7	Sand-silt-clay

TABLE 1 - Continued

Sample (Interval in cm)	Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
Hole 356A					
1-4, 88	24.73	0.1	39.4	60.6	Silty clay
1-5, 100	26.35	0.7	46.0	53.3	Silty clay
2-5, 19	34.69	0.9	40.1	59.0	Silty clay
Site 357					
1-2, 118	2.68	62.9	16.2	20.9	Clayey sand
6-5, 61	53.11	17.5	47.8	34.7	Clayey silt
43.6, 61	729.54	10.2	35.6	54.2	Silty clay
Site 358					
1-4, 53	52.93	0.0	23.7	76.3	Clay
5-1, 19	351.69	0.2	41.7	58.0	Silty clay
6-3, 97	421.97	0.1	38.5	61.4	Silty clay
7-2, 13	486.13	0.3	40.0	59.6	Silty clay
8-3, 60	554.60	0.1	20.8	79.2	Clay
10-4, 71	642.11	0.0	0.1	99.8	Clay
11-3, 12	706.12	0.5	13.6	85.9	Clay
11-4, 105	708.55	0.0	27.3	72.7	Silty clay
12-5, 114	757.64	0.4	23.9	75.8	Clay
13-4, 58	784.08	0.1	28.1	71.9	Silty clay
14-4, 140	794.40	0.0	86.1	13.9	Silt
16-2, 105	819.55	0.1	2.1	97.9	Clay
Hole 359					
2-6, 110	37.10	54.9	24.2	20.9	Sand-silt-clay
Hole 359A					
-4, 30	13.80	48.2	26.5	25.3	Sand-silt-clay

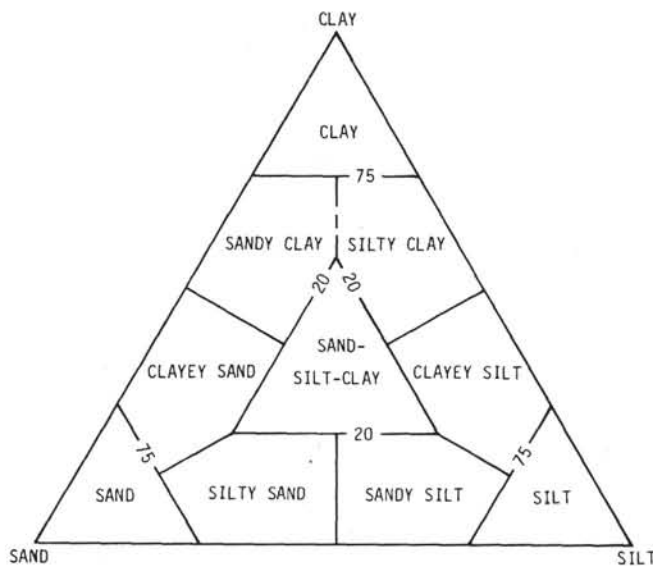


Figure 1. Sediment classification after Shepard (1954) with the sand, silt, and clay size fractions based on the Wentworth (1922) Grade Scale; Sand, silt, and clay size particles having respective diameters of 2000 to 62.5 μ m, 62.5 to 3.91 μ m, and less than 3.91 μ m. Shepard's (1954) sediment classification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

CARBON-CARBONATE ANALYSIS

Data for samples run at DSDP are listed in Table 2; these data are also presented on core forms and are included in data compilations appearing as appendices to the site report chapters (see Chapter 1 for explanation).

Leg 39 sediments were analyzed for total carbon and acid-insoluble (organic) carbon using a LECO WR-12* analyzer. The 3-cc sediment samples were dried, ground into a homogeneous powder, and redried at 105°-110°C. Two samples, a 0.1-g and a 0.5-g sample, were weighed into LECO clay crucibles. The 0.1-g sample was analyzed for total carbon without further treatment. If the sample contained less than 10% CaCO₃, and additional 0.5-g sample was analyzed for greater accuracy. The calcium carbonate percentages were calculated as follows: (% total C - % organic C) \times 8.33 = % CaCO₃. Although other carbonates may be present, all acid-soluble carbon was calculated as calcium carbonate. All carbon/carbonate results are given in weight percent. For detailed step-by-step procedure and theory, see Volume 4 of the Initial Reports of the Deep Sea Drilling Project (Bader, Gerard, et al., 1970) and Volume 9 of the Initial Reports of the Deep Sea Drilling Project (Boyce, Bode, et al., 1972).

For control purposes standard sediments were made up from Deep Sea Drilling material and analyzed for total carbon at predetermined intervals with regular samples. Listed below are the data from these standards:

DSDP Standard	No. of Samples	Total Carbon as % of CaCO ₃	Standard Deviation (%)	Maximum Range (%)
2	2	79.80	0.43	0.75
9	3	26.57	0.12	0.17

TABLE 2
Carbon and Carbonate Analyses, Leg 39

Sample (Interval in cm)	Hole Depth (m)	Total Carbon	Organic Carbon	CaCO ₃
Hole 353				
2-2, 115	121.2	0.8	0.4	3
2-3, 99	122.5	0.9	0.5	3
3-2, 110	263.6	0.2	0.1	1
3-2, 125	263.8	0.1	0.1	0
3-2, 144	263.9	0.7	0.3	3
Hole 353A				
1-2, 51	2.0	1.0	0.6	3
Site 354				
1-1, 86	0.9	2.4	0.2	18
1-2, 178	3.3	3.4	0.3	27
3-1, 130	93.8	5.4	0.1	44

TABLE 2 - Continued

Sample (Interval in cm)	Hole Depth (m)	Total Carbon	Organic Carbon	CaCO ₃
Site 354 - Continued				
4-1, 120	141.7	7.3	0.1	60
4-6, 20	148.2	3.9	0.1	32
4-6, 60	148.6	8.2	0.1	68
5-2, 65	189.7	5.3	0.1	43
5-2, 138	190.4	8.2	0.1	67
6-2, 22	236.7	8.0	0.1	66
6-3, 65	238.7	4.5	0.1	36
6-3, 96	239.0	9.0	0.1	74
6-3, 102	239.0	9.1	0.1	75
6-3, 139	239.4	4.4	0.1	36
7-1, 139	283.9	8.9	0.1	73
7-4, 96	288.0	9.7	0.1	80
8-1, 106	340.6	9.0	0.1	74
8-2, 6	341.1	2.2	0.2	17
9-2, 95	399.0	6.9	0.1	57
10-2, 6	455.6	5.8	0.3	46
10-3, 21	457.2	9.4	0.1	77
11-2, 11	522.1	9.7	0.1	80
11-4, 145	526.5	11.5	0.1	95
12-1, 98	607.0	7.8	0.1	64
12-5, 89	612.9	6.3	0.2	51
13-1, 149	693.0	7.6	0.1	62
13-6, 124	700.2	7.9	0.1	65
14-1, 107	702.1	8.9	0.1	73
14-5, 27	707.3	6.7	0.1	55
15-2, 26	816.3	7.7	0.1	63
15-3, 71	818.2	7.6	0.2	62
16-3, 48	837.0	8.0	0.1	66
16-6, 121	842.2	5.3	0.1	43
17-3, 80	856.3	7.1	0.1	58
18-1, 90	872.9	6.6	0.2	54
18-4, 128	877.8	4.6	0.3	36
Site 355				
1-3, 70	56.9	0.1	0.1	0
2-3, 70	113.7	0.6	0.1	4
2-4, 70	115.2	1.7	0.1	14
2-5, 70	116.7	1.1	0.1	8
2-5, 110	117.1	7.7	0.1	64
3-2, 50	169.0	2.2	0.1	17
3-3, 110	171.1	3.1	0.2	24
3-5, 90	173.9	0.1	0.1	0
4-3, 140	218.9	0.1	0.1	0
5-1, 10	423.5	0.2	0.1	0
5-5, 90	250.3	0.1	0.1	0
6-2, 20	264.1	0.3	0.2	1
7-2, 60	283.1	1.4	0.1	11
7-3, 75	284.8	0.1	0.1	0
8-2, 145	303.0	0.1	0.1	0
9-3, 7	322.1	0.1	0.1	0
9-5, 110	326.1	0.2	0.1	1
Site 355				
11-3, 42	350.9	0.1	0.1	0
12-4, 102	363.5	0.1	0.1	0
13-2, 70	368.7	0.1	0.1	0
14-5, 140	383.4	0.1	0.1	0
15-1, 98	386.5	0.1	0.1	0
15-1, 130	386.8	0.1	0.1	0
17-2, 9	406.1	1.8	0.0	15
17-2, 37	406.4	5.2	0.0	43
17-3, 146	409.0	9.7	0.0	80
17-4, 25	409.3	9.1	0.0	76
18-1, 32	414.3	10.0	0.0	83
18-2, 65	416.2	10.0	0.0	83
18-3, 120	418.2	6.1	0.0	50

TABLE 2 - Continued

Sample (Interval in cm)	Hole Depth (m)	Total Carbon	Organic Carbon	CaCO ₃
Site 355 - Continued				
19-2, 88	425.9	11.2	0.0	93
19-3, 70	427.2	9.7	0.0	81
20-2, 18	434.7	10.2	0.0	84
Hole 356				
2-2, 11	11.5	9.9	0.1	82
3-2, 118	41.2	6.0	0.1	50
4-3, 86	61.2	5.4	0.2	44
5-5, 120	93.1	5.6	0.1	46
6-4, 10	118.6	3.6	0.2	29
7-4, 20	138.2	2.8	0.2	21
8-2, 90	163.9	4.3	0.1	34
9-2, 104	192.5	5.1	0.2	41
10-3, 42	221.9	4.0	0.2	32
11-1, 27	237.8	3.3	0.2	26
12-1, 35	247.4	2.9	0.1	23
14-1, 37	266.4	2.6	0.1	21
16-1, 96	286.0	3.0	0.1	24
17-3, 50	298.4	2.2	0.4	15
19-4, 40	318.4	5.2	0.1	43
23-2, 50	354.0	3.8	0.2	30
24-3, 45	364.8	5.9	0.2	48
24-3, 100	365.4	2.5	0.1	20
24-4, 34	366.2	8.1	0.1	67
24-5, 120	368.6	5.3	0.1	43
26-2, 108	382.9	6.0	0.2	49
29-2, 90	410.9	4.3	0.2	34
29-3, 149	413.0	8.4	0.1	69
29-4, 44	413.4	5.7	0.1	47
29-6, 60	416.6	8.2	0.1	68
31-5, 96	444.4	8.1	0.1	67
33-2, 55	487.0	4.4	0.1	36
34-2, 70	515.6	5.1	0.1	42
35-3, 100	546.0	3.8	0.1	31
36-1, 130	571.3	5.4	0.1	44
37-3, 83	604.2	5.8	0.1	48
38-3, 86	649.9	5.7	0.1	46
39-5, 21	680.7	1.9	1.8	0
40-5, 57	700.5	5.5	0.1	45
40-6, 55	702.0	4.1	2.5	14
41-2, 74	705.2	5.3	4.8	4
41-5, 148	710.5	6.9	0.6	52
42-3, 146	717.0	2.5	0.1	20
43-4, 7	727.0	4.1	0.1	33
43-5, 97	729.4	3.5	0.1	28
44-4, 100	737.0	5.3	0.1	44
Hole 356A				
1-4, 80	24.7	4.0	0.1	32
1-5, 95	26.3	5.1	0.1	42
2-5, 12	34.6	5.6	0.1	45
Site 357				
1-2, 100	2.5	10.7	0.1	89
3-3, 100	22.0	10.8	0.0	90
4-6, 90	35.9	9.6	0.0	79
5-5, 70	43.7	9.9	0.1	82
6-6, 41	54.4	9.4	0.0	78
8-4, 82	70.8	10.4	0.0	87
9-4, 60	80.5	10.6	0.1	88
10-1, 110	95.1	10.4	0.0	86
11-2, 94	105.9	10.1	0.0	84
14-1, 100	152.0	9.1	0.1	75
17-3, 80	192.8	9.3	0.1	77
18-2, 86	210.4	10.0	0.1	83

TABLE 2 - Continued

Sample (Interval in cm)	Hole Depth (m)	Total Carbon	Organic Carbon	CaCO ₃
Site 357 - Continued				
19-2, 119	239.2	9.4	0.1	78
20-3, 131	259.8	9.9	0.0	82
22-4, 90	308.4	9.3	0.1	77
24-1, 148	352.0	10.4	0.1	86
26-6, 34	387.2	7.7	0.1	64
27-4, 96	413.5	4.0	0.1	33
28-3, 124	440.7	9.2	0.1	76
31-2, 125	495.8	9.1	0.1	75
31-3, 95	497.0	9.2	0.0	76
33-5, 94	528.4	8.4	0.1	69
34-4, 37	555.3	8.4	0.1	70
34-6, 10	558.0	5.7	0.1	47
35-2, 33	580.3	8.0	0.1	66
36-1, 70	607.7	5.4	0.1	44
36-5, 24	613.2	9.0	0.1	75
40-3, 106	696.6	5.0	0.1	41
41-4, 17	707.7	5.3	0.1	44
42-2, 32	713.3	4.9	0.2	39
43-2, 4	723.0	7.0	0.1	57
44-2, 24	732.2	7.2	0.2	58
46-3, 30	746.3	7.3	0.1	60
47-2, 13	751.6	3.8	0.1	31
48-2, 18	760.7	8.3	0.1	68
50-6, 5	785.9	4.6	0.1	37
51-6, 78	795.8	6.6	0.2	53
Site 358				
1-5, 78	54.7	0.2	0.2	0
2-2, 40	125.4	0.2	0.2	0
3-2, 93	202.4	0.3	0.3	0
3-5, 90	206.9	0.1	0.1	0
4-1, 112	276.6	0.3	0.2	0
5-2, 37	353.4	0.3	0.1	1
6-1, 19	418.2	0.2	0.2	0
7-1, 130	485.8	0.2	0.2	0
8-2, 26	552.8	0.7	0.2	4
9-2, 64	591.1	0.2	0.1	0
10-4, 70	642.1	0.2	0.2	0
11-2, 66	705.2	0.1	0.1	0
11-4, 5	707.6	5.8	0.1	48
12-3, 80	754.3	8.3	0.0	69
12-5, 114	757.6	4.5	0.1	37
13-1, 136	780.4	3.6	0.1	30
14-1, 22	788.7	6.2	0.1	51
14-4, 140	794.4	5.7	0.1	47
15-1, 70	798.7	0.1	0.0	0

TABLE 2 - Continued

Sample (Interval in cm)	Hole Depth (m)	Total Carbon	Organic Carbon	CaCO ₃
Site 358 - Continued				
15-2, 140	800.9	2.7	0.0	22
16-2, 106	819.6	2.1	0.0	17
Hole 359				
1-1, 119	1.2	11.4	0.0	94
2-2, 100	31.0	10.6	0.0	88
2-6, 122	37.2	8.7	0.0	72
4-2, 26	86.8	1.4	0.0	12
Hole 359A				
1-6, 120	17.7	10.6	0.0	88
2-4, 110	24.1	11.2	0.0	93

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