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33. GRAIN SIZE AND GRAIN MORPHOLOGY OF THE LOWER AND MIDDLE MIOCENE SANDY SEDIMENTS OF THE CONTINENTAL SLOPE OFF NORTHWESTERN AFRICA

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INTRODUCTION

We studied the grain size and grain morphology of 86 samples selected from the 670 to 930 meter interval in Hole 397, and 72 samples from the 707 to 1277 meter interval in Hole 397A.

Some samples could not be studied according to the standard program that we have adopted at the Lithological Laboratory of VSEGEI. Insufficient sample material, a high content of fine particles and/or of organic matter and carbonaceous material (both in the cement and in the form of fragments) allowed morphometric analysis of only 70 samples. In 100 samples, the fraction 0.315 to 0.25 mm was too small for meaningful analysis (< 0.15 g).

The results of grain-size analyses (19 fraction sieve) and grain-morphometry analyses (14 fraction) are given in Tables 1 to 4.

PROGRAM OF GRANULOMETRIC AND MORPHOMETRIC STUDY OF SAMPLES FROM DSDP, LEG 47A

Methods

Preparation of samples for screen analysis (without removal of carbonates) involved eight procedural steps. First, samples were dried in the drying chamber for 5 hours at + 105°C. Second, samples were weighed within an accuracy of 0.01 g. The third step was removal of organic matter and disintegration of rock; the samples were treated with 10 per cent solution of H_2O_2 for 15 hours with heating up to +70°C. The samples then were washed with hot water on the filter, until H_2O_2 was completely removed. The fifth step was grinding the sample with a rubber pestle in a porcelain cup. The next step was removal of particles < 0.01 mm, according to Sabanin's method (Rukhin, 1969). Drying the samples in the drying chamber for 2 hours at +50°C was the seventh step, followed by weighing within an accuracy of 0.01 grams.

The grain-size analyses involved the following 19 fractions (in mm): > 2.5, 2.5-2.0, 2.0-1.6, 1.6-1.25, 1.25-1.0, 1.0-0.8, 0.8-0.63, 0.63-0.50, 0.50-0.40, 0.40-0.315, 0.315-0.25, 0.25-0.20, 0.20-0.16, 0.16-0.125, 0.125-0.10, 0.10-0.08, 0.08-0.063, 0.063-0.050, and <0.05.

The analysis of the 19 fractions listed above was conducted utilizing a set of sieves corresponding to the standard DIN 4188 and an electromagnetic sieving machine "Analysette-3" by A. Fritsch (BRD). The conditions of analysis were dry sieving for 25 minutes with amplitude of 1.5-mm oscillations of an electromagnetic vibrator.

The grain-morphometry analyses employed the methods of Rukhina et al. (1962) and the range of roundness units of Wadell (1933). The grain-morphometry analyses included the following 14 fractions (in mm): > 0.490, 0.420, 0.360, 0.310, 0.275, 0.245, 0.220, 0.200, 0.185, 0.171, 0.160, 0.154, 0.151, and < 0.149.

A vibrational separator K-1780 was used to conduct the 14 fraction morphometric analyses. The analyzed grains ranged from 0.315 to 0.25 mm; analysis time was 10 minutes; and 0.15 grams was the smallest weighed portion included in analyses.

For the purpose of investigating grain size and morphometric characteristics, 19 fraction sieve analysis and 14 fraction morphometric analysis for 59 samples were done twice (i.e., before and after extraction of carbonaceous material). In other samples, grain-size and morphometric attributes were studied only after carbonate extraction. In Tables 1 through 4, data are given for samples after extraction of carbonaceous material.

The carbonaceous material was removed from the above-listed samples by means of a six-step procedure. First, the samples were treated with a 5 per cent solution of HCl for 15 hours at 20°C. Second, samples were washed with hot water on the filters until the HCl was completely removed. The third step was grinding each samples with a rubber pestle in a porcelain cup. Using Sabanin's method (Rukhin, 1969), the next step was removal of the particles < 0.01. Fifth, the samples were dried in the drying chamber for two hours at 50°C; and finally, the samples were weighed within an accuracy of 0.01 g.

For precise genetic definition of the lower and middle Miocenic sandy sediments, a morphoscopic study of the surface of sandy grains was conducted on several samples according to the methods of Cailleux (1972).

Data Processing

The primary analytical data of grain-size and grain-morphology studies were processed on a "Minsk-32" computer. In programming these data, registration was expressed in grams and normalization in mass per cent. The statistical estimates were calculated as follows:

Mathematical expectation

$$\bar{x} = \sum_{i=1}^{k} n_i x_i$$

TABLE 1
Primary Analytical Data of 19 Fractions of Sieved Grain-Size Analysis (mass %)

Sample (Interval in cm)	Grain-Size Fractions (mm)																				
	>2.50	2.50 – 2.00	2.00 – 1.60	1.60 – 1.25	1.25 – 1.00	1.00 – 0.80	0.80 – 0.63	0.63 – 0.50	0.50 – 0.40	0.40 –0.315	0.315– 0.25	0.25 – 0.20	0.20 – 0.16	0.16 – 0.125	0.125 – 0.100	0.100 – 0.080	0.080 – 0.063	0.063 – 0.050	0.050 – 0.040	0.040 – 0.010	<0.01
397-77-3, 88-91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.17	0.22	0.39	0.82	1.46	2.02	1.77	3.96	89.06
397-78-3, 111-113	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.12	0.12	0.06	0.06	0.12	0.41	0.47	0.29	0.47	97.77
398D-33-1, 56-59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10	0.05	0.10	0.30	0.40	0.40	0.25	0.60	97.75
397A-23-2, 126-129	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.13	0.13	0.13	0.26	0.29	0.36	0.29	0.68	97.62
397-76-3, 112-115	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.13	0.51	2.19	7.62	7.69	3.56	1.05	2.00	75.22
397-89-3, 60-63	0.00	0.00	0.05	0.05	0.05	0.05	0.10	0.20	0.35	0.60	0.60	0.65	1.89	1.20	1.29	2.74	3.69	2.39	0.75	2.89	80.48
397-86-2, 9-12	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.13	1.41	4.60	7.06	8.67	17.14	4.91	3.09	3.09	2.18	1.51	0.64	0.97	44.56
397A-24-1, 148-150	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.07	0.25	3.36	8.79	12.83	4.34	7.85	62.40
397A-23-3, 16-18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.16	0.25	0.58	1.65	2.89	2.39	1.40	1.15	89.37
398D-36-3, 127-129	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.08	0.15	0.86	0.64	0.75	2.63	5.18	4.47	1.46	2.48	81.24
397-88-4, 60-63	0.00	0.00	0.00	0.00	0.04	0.12	0.21	0.33	1.33	2.58	3.16	3.41	5.65	1.45	0.96	1.16	1.21	1.04	0.62	1.75	74.98
397-72-4, 11-13	0.21	0.13	0.30	0.47	0.72	0.59	0.30	0.72	2.16	3.18	2.63	1.78	1.99	0.51	0.38	0.55	0.64	0.42	0.30	0.47	81.55
397A-32-3, CC	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.11	0.29	0.29	0.29	0.51	0.29	0.33	0.80	1.02	0.73	0.95	2.30	91.92
397A-23-1, 124-127	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.04	0.92	1.81	4.26	9.84	7.50	3.77	0.82	1.42	69.45
397A-7-2, 16-19	2.34	0.94	1.88	1.06	2.03	2.11	2.40	2.28	3.77	3.00	2.23	1.86	3.57	1.66	1.74	3.40	4.11	4.08	1.60	3.63	50.31
397-75-2, 83-85	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.06	0.22	0.61	1.21	2.26	10.71	5.01	4.20	3.59	1.99	1.16	0.66	1.38	65.93
397A-32-2, 143-145	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.03	0.21	0.36	0.71	5.46	7.43	7.57	3.30	5.94	68.90
397A-18-1, 43-48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.07	0.23	9.53	16.51	5.81	0.91	2.42	64.50
397-89-2, 98-102	0.00	0.03	0.12	0.16	0.12	0.12	0.19	0.22	0.34	0.31	0.31	0.31	0.90	0.53	0.53	0.90	0.90	0.97	0.59	1.34	91.08
397-78-3, 20-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.07	0.50	1.34	0.90	2.94	94.16
397A-6-2, 28-31	0.22	0.00	0.76	0.66	1.33	1.04	1.33	1.20	2.12	1.80	1.39	1.23	2.47	1.14	1.20	2.03	2.44	2.88	2.72	8.80	63.22
397-65-1, 94-96	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.24	0.27	0.40	0.91	1.04	0.71	0.34	0.77	95.12
397A-5-2, 25-29	1.99	0.00	0.42	0.45	1.05	0.94	1.11	0.98	1.74	1.50	1.11	1.01	2.20	1.25	1.60	4.36	6.86	5.71	2.13	5.40	58.19
397-71-2, 14-17	0.00	0.00	0.06	0.06	0.26	0.26	0.39	0.58	1.09	1.16	1.03	0.77	1.22	0.51	0.45	0.71	0.71	0.64	0.58	1.67	87.86
397A-31-3, 6-9	2.54	0.96	2.44	1.92	4.07	4.12	4.94	4.41	8.15	7.29	5.37	4.60	7.57	2.83	2.59	3.26	2.49	1.87	0.86	1.20	26.51
397A-20-2, 50-54	0.48	0.12	0.36	0.60	0.87	0.83	1.11	1.15	2.30	2.19	1.91	1.91	4.17	2.19	2.38	3.77	3.69	2.50	0.95	4.17	62.34
397-71-1, 126-130	0.00	0.00	0.07	0.07	0.07	0.04	0.04	0.04	0.14	0.25	0.43	0.68	2.22	1.14	0.97	1.22	1.00	0.82	0.39	3.08	87.33
397-95-4, 70-74	5.17	0.82	1.55	2.10	1.90	2.17	2.33	1.90	2.99	2.45	1.67	1.36	2.99	1.59	1.94	3.57	4.89	5.71	2.14	4.47	46.29
397A-32-1, 99-101	2.81	1.32	3.17	2.29	4.00	3.72	4.44	4.13	7.66	6.56	4.77	4.19	7.14	2.73	2.37	3.11	2.40	1.60	0.44	1.30	29.85
398D-7-1, 42-44	0.00	0.00	0.00	0.19	0.10	0.00	0.10	0.00	0.10	0.10	0.10	0.10	0.19	0.29	0.48	2.20	11.38	10.04	2.49	2.87	69.31
397-93-3, 15-19	1.07	1.22	1.90	1.32	2.10	2.20	2.00	1.46	2.05	1.51	1.02	0.93	1.90	1.41	1.17	2.29	3.71	3.32	1.02	2.44	63.95
397-72-5, 28-30	0.00	0.00	0.10	0.10	0.30	0.35	0.40	0.55	1.59	1.98	1.64	1.34	1.83	0.55	0.45	0.59	0.55	0.59	0.45	0.99	85.67
398D-20-3, 131-134	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.14	0.09	0.23	3.99	4.27	2.96	2.44	1.32	1.03	0.66	1.97	80.84
397-93-2, 130-133	1.74	1.22	1.39	1.31	2.31	1.92	2.00	1.39	2.05	1.31	0.87	0.78	1.57	0.87	0.92	2.18	3.09	3.49	1.66	3.01	64.92
397A-3-2, 8-11	0.35	0.31	0.18	0.26	0.31	0.26	0.22	0.26	0.53	0.57	0.53	0.61	1.75	1.18	1.88	4.25	6.00	6.26	1.97	5.78	66.54
397-90-1, 97-100	0.00	0.34	0.17	0.27	0.21	0.24	0.21	0.24	0.72	0.99	0.96	1.27	2.68	1.13	0.96	1.54	1.88	1.71	1.03	3.15	80.40
397A-22-1, 13-16	0.00	0.00	0.00	0.10	0.27	0.27	0.60	0.74	1.91	2.45	2.38	2.62	6.11	3.02	2.72	4.29	3.89	3.12	2.31	7.38	55.82
397-96-2, 8-12	2.90	1.34	1.88	1.88	2.90	2.76	2.93	2.50	4.12	3.07	2.05	1.73	3.47	1.79	1.96	3.78	5.17	6.28	2.73	5.46	39.29
397A-102-1, CC	3.10	0.56	0.63	0.39	0.99	0.85	0.99	0.92	1.69	1.59	1.20	1.27	3.03	1.66	1.76	3.99	7.05	7.80	3.99	8.68	47.87
397A-6-1, 91-94	1.05	1.09	0.81	1.01	1.89	1.85	2.29	2.09	3.38	2.62	1.93	1.85	3.74	1.81	1.93	3.06	3.82	3.82	1.93	8.90	49.11
397A-5-2, 88-92	0.00	0.24	0.44	0.58	1.29	1.19	1.36	1.26	2.18	1.94	1.50	1.53	3.41	1.63	1.50	2.72	2.69	2.72	1.60	4.22	65.97
397-72-3, 104-106	0.00	0.14	0.37	0.51	0.69	0.74	1.16	1.39	3.66	4.12	3.53	2.55	3.06	0.83	0.60	0.83	0.79	0.60	0.60	0.65	73.38
397A-21-2, 98-102	1.55	1.46	1.38	1.33	2.75	2.67	3.61	3.22	6.02	5.16	3.91	3.57	6.79	3.18	3.27	4.64	3.18	1.72	0.60	1.81	38.18
397-78-4, 0	0.00	0.00	1.20	0.64	0.52	0.43	0.34	0.26	0.47	0.52	0.43	0.34	0.82	0.43	0.43	0.90	1.55	1.76	0.99	2.45	85.53
397A-18-5, 55-60	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.06	0.19	0.19	0.25	0.93	2.04	2.04	2.04	3.71	86.32
397-94-1, 81-84	2.53	0.49	1.61	0.88	1.66	1.32	1.32	0.88	1.22	0.83	0.58	0.49	1.22	0.83	0.97	3.02	3.85	5.70	2.83	6.19	61.60
397-93-1, 60-63	2.77	1.62	3.13	2.80	4.31	3.83	3.06	2.21	3.02	1.29	1.11	1.11	1.99	1.00	1.07	2.25	3.17	3.13	1.25	3.69	52.18
397-96-1, 26-29	2.09	0.90	1.45	1.19	1.97	1.90	2.09	1.97	2.84	2.29	1.45	1.48	3.06	1.71	1.80	4.16	6.35	6.96	3.13	6.74	44.47
397A-31-1, 77-81	1.49	1.60	1.81	1.71	4.11	3.90	4.96	4.48	7.95	7.26	5.02	4.48	7.31	2.93	2.40	3.26	2.56	1.49	0.43	2.93	27.91

398D-26-1, 44-45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09	0.09	0.18	0.18	0.18	0.35	0.62	0.79	0.79	0.53	96.13
397-84-1, 132-134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.59	0.82	1.89	2.18	1.12	0.41	1.06	91.34
397A-28-3, CC	0.00	0.18	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09	0.18	1.38	5.60	7.89	3.30	10.28	70.92
398D-24-6, 92-94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.12	0.12	0.17	0.87	1.33	0.81	0.52	1.04	94.93
397A-31-2, 10-13	0.85	1.50	2.00	2.49	4.19	4.29	5.04	4.69	8.58	7.28	5.19	4.59	7.83	2.84	2.49	3.64	2.59	1.80	0.85	1.95	25.34
397-95-5, 6-8	4.73	0.47	1.51	1.13	1.89	1.75	1.89	1.65	2.51	1.84	1.28	1.28	2.41	1.32	1.56	3.50	4.73	6.48	3.40	5.53	49.13
397-71-4, 71-73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.56	4.10	6.14	4.52	1.84	4.38	78.25
397-97-1, 24-29	2.28	0.59	1.18	0.82	1.82	1.96	2.28	1.96	2.92	2.19	1.46	0.50	2.28	1.32	1.50	3.19	4.42	5.33	2.37	5.38	54.26
397-95-2, 6-8	1.25	0.36	0.59	0.53	0.59	0.53	0.83	0.77	1.25	1.01	0.77	0.65	1.48	0.83	0.83	1.90	3.44	3.32	2.20	2.61	74.24
397-75-3, CC	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.09	0.22	1.66	1.75	1.97	2.80	1.79	1.40	0.61	1.53	85.98
397-76-4, 5-9	0.00	0.00	0.00	0.25	0.20	0.44	1.08	1.47	3.83	4.03	3.19	2.80	5.40	2.06	1.47	1.72	1.47	1.18	0.49	1.42	67.50
397-77-2, 135-138	0.00	0.00	0.04	0.04	0.00	0.00	0.04	0.00	0.04	0.11	0.49	1.28	6.41	3.77	2.71	2.45	1.51	1.24	0.57	3.54	75.77
397-78-3, 63-65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.86	3.45	7.60	14.34	6.91	2.42	0.86	2.16	61.31
397-80-3, 27-30	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.17	0.35	1.07	0.62	0.73	1.52	1.70	2.11	1.42	6.92	83.25
397-85-1, 15-18	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.07	0.47	0.93	2.80	1.54	1.40	2.14	1.80	2.40	1.07	8.88	76.37
397-88-4, 75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.07	0.14	0.07	0.14	0.24	0.34	0.37	0.24	1.26	97.08
397A-7-1, 91-94	0.98	0.61	0.72	1.02	1.59	1.66	1.97	1.70	2.84	2.46	1.78	1.78	3.97	2.19	2.38	4.58	4.31	5.52	1.89	8.55	47.48
397A-23-4, 35-38	0.00	0.00	0.00	0.05	0.00	0.05	0.05	0.00	0.05	0.05	0.10	0.05	0.16	0.31	0.47	2.44	3.89	2.02	0.73	3.12	86.45
397A-28-2, 89-92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.12	0.12	0.24	1.08	2.69	4.13	1.32	7.42	82.83
397A-30-1, 63-66	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.08	0.08	0.08	0.08	0.00	0.47	0.63	0.87	1.97	2.68	4.72	1.65	14.72	71.89
397A-31-1, 45-50	0.52	1.23	2.77	2.40	4.18	4.77	6.28	6.18	10.77	8.65	5.94	4.71	7.75	2.86	2.49	3.14	2.37	1.91	0.40	2.55	18.12
397A-32-2, 43-47	1.86	1.36	2.45	2.66	4.31	4.39	5.56	5.19	9.50	8.04	6.01	5.19	8.33	3.22	2.77	3.33	2.66	2.05	0.37	3.46	17.30
398D-2-1, 101-105	0.00	0.00	0.04	0.00	0.00	0.04	0.00	0.04	0.04	0.04	0.04	0.04	0.19	0.16	0.16	0.27	0.39	0.78	0.31	1.71	95.75
398D-2-2, 100-104	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.13	0.13	0.13	0.29	0.29	0.42	0.21	0.59	97.64
398D-2-3, 28-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.07	0.07	0.25	0.18	0.14	0.25	0.32	0.89	0.14	0.61	96.97
398D-23-1, 67-69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.15	0.52	3.25	5.54	2.44	0.66	0.96	86.27
398D-32-4, 59-61	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.31	0.43	1.24	1.86	4.96	1.30	7.56	82.15
397A-20-3, 31-36	0.09	0.09	0.41	0.80	1.86	2.54	3.69	3.69	7.84	7.73	5.87	5.01	8.91	3.72	3.45	4.31	3.33	2.36	0.71	4.07	29.55
398A-7-4, 99-110	0.00	0.02	0.02	0.04	0.13	0.11	0.13	0.15	0.23	0.19	0.28	0.15	0.36	0.26	0.15	0.79	0.98	1.23	0.68	1.53	92.58
397A-24-2, 24-29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.16	0.22	0.82	6.27	13.02	14.05	3.70	9.47	52.13
397-88-2, 40-46	0.00	0.00	0.00	0.00	0.03	0.00	0.03	0.03	0.03	0.00	0.03	0.03	0.39	0.42	0.70	1.26	2.10	4.23	1.26	4.07	85.39
397A-19-3, CC	0.00	0.06	0.06	0.14	0.40	0.49	0.80	0.72	1.49	1.58	1.46	1.52	3.75	2.15	2.21	4.21	3.81	4.35	0.74	8.39	61.68
397A-22-2, 100-105	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.03	0.03	0.03	0.03	0.10	0.23	0.45	1.59	2.72	4.50	1.84	5.63	82.79
397-71-1, 119-123	0.00	0.00	0.03	0.00	0.03	0.03	0.14	0.14	0.17	0.17	0.35	0.66	2.81	2.47	3.82	5.25	3.82	2.26	1.04	6.53	70.26
397-71-2, 10-19	0.00	0.08	0.04	0.04	0.16	0.33	0.41	0.41	1.23	1.15	0.98	0.82	1.56	0.61	0.57	0.98	1.39	2.09	1.80	4.92	80.41
397-71-4, 65-70	0.00	0.00	0.20	0.20	0.22	0.20	0.22	0.29	0.41	0.20	0.16	0.10	0.31	0.20	0.22	1.02	1.43	1.84	0.84	2.65	89.27
397-72-3, 100-104	0.00	0.00	0.03	0.06	0.12	0.14	0.23	0.32	1.12	1.41	1.18	0.89	1.30	0.43	0.29	0.72	0.81	0.89	0.43	0.98	88.66
397-72-4, 5-11	0.00	0.03	0.14	0.24	0.27	0.22	0.24	0.27	0.95	1.36	1.20	0.76	0.82	0.27	0.27	0.52	0.65	0.79	0.27	1.06	89.66
397-72-5, 20-2	0.00	0.04	0.15	0.04	0.40	0.51	0.73	1.10	2.56	2.70	1.75	1.24	1.42	0.40	0.29	0.69	0.73	1.24	0.51	2.01	81.49
397-73-2, 100-106	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.13	0.48	0.96	0.96	0.61	0.80	0.29	0.26	0.64	0.93	1.32	0.64	2.73	89.12
397-73-3, 0-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.16	0.44	0.72	0.96	0.40	2.81	94.35
397-73-3, 64-69	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.12	0.16	0.44	1.41	7.75	9.65	5.00	1.56	3.28	70.38
397-74-1, 4-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.14	0.14	0.14	0.31	0.17	0.65	98.29
397-75-1, 74-77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.14	0.54	0.76	0.76	0.40	2.17	95.12
397-75-2, 79-82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.38	1.27	9.31	6.80	5.74	4.46	2.12	1.06	0.17	1.87	66.77
397-76-3, 100-104	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.05	0.19	0.24	1.00	0.90	1.33	3.09	2.43	2.38	1.00	8.28	78.96
397-76-4, 1-10	0.00	0.00	0.00	0.04	0.04	0.17	0.21	0.46	1.24	1.29	1.00	0.79	1.45	0.58	0.46	1.00	1.04	1.04	0.62	4.52	84.07
397-77-1, 42-48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.19	1.37	2.36	3.35	1.89	7.79	83.01
397-77-2, 128-134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.41	4.61	4.84	4.38	4.33	2.07	1.38	0.83	4.05	72.87
397-77-3, 83-88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.18	0.23	0.50	1.37	2.06	3.39	1.60	9.39	81.22
397-78-3, 11-18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.04	0.19	2.06	4.32	2.25	8.03	82.92
397-78-4, 11-17	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.19	0.37	1.27	2.75	1.48	7.11	86.42
397-79-1, 50-55	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.17	0.03	0.03	0.03	0.03	0.03	0.03	0.28	1.38	3.42	1.66	8.42	84.27
397-80-7, 93-98	0.00	0.00	0.00	0.05	0.00	0.00	0.05	0.05	0.00	0.20	0.44	0.73	2.44	1.22	0.98	1.66	1.95	1.90	1.22	6.54	80.57

TABLE 1 – *Continued*

Sample (Interval in cm)	Grain-Size Fractions (mm)																				
	>2.50	2.50 – 2.00	2.00 – 1.60	1.60 – 1.25	1.25 – 1.00	1.00 – 0.80	0.80 – 0.63	0.63 – 0.50	0.50 – 0.40	0.40 –0.315	0.315– 0.25	0.25 – 0.20	0.20 – 0.16	0.16 – 0.125	0.125 – 0.100	0.100 – 0.080	0.080 – 0.063	0.063 – 0.050	0.050 – 0.040	0.040 – 0.010	0.010 – <0.01
397-84-1, 17-21	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.16	0.83	0.40	0.44	0.79	0.99	2.58	1.79	13.51	78.30
397-84-2, 50-55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.15	0.34	1.49	1.12	1.27	2.61	2.80	4.62	1.86	17.55	66.16
397-84-3, 110-113	0.00	0.00	0.00	0.00	0.05	0.26	0.21	0.48	0.53	1.59	2.06	1.85	2.33	0.74	0.53	0.58	1.01	1.85	1.85	14.81	69.26
397-85-1, 11-15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.28	1.67	1.67	3.14	2.79	3.76	2.02	16.03	68.43
397-85-2, 80-81	0.00	0.00	0.00	0.00	0.04	0.18	0.62	0.62	1.74	1.56	1.12	0.89	1.38	0.49	0.45	0.89	1.34	3.97	1.34	16.47	66.87
397-85-3, 116-120	0.00	0.00	0.00	0.04	0.16	0.20	0.59	0.82	1.96	1.96	1.37	1.18	2.55	1.37	1.61	2.40	2.36	3.73	1.77	12.57	63.35
397-85-4, 44-49	0.03	0.00	0.03	0.03	0.15	0.34	0.64	0.85	2.07	2.47	2.44	2.74	5.64	2.44	2.59	4.57	5.76	7.89	2.68	13.44	43.19
397-86-1, 130-135	0.00	0.00	0.04	0.00	0.04	0.04	0.15	0.30	1.14	1.89	2.27	2.65	6.06	3.37	3.71	6.59	8.41	7.95	2.61	9.28	43.48
397-87-1, 100-105	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.22	0.35	0.48	0.87	1.53	2.80	1.09	4.42	88.15
397-88-2, 55-60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.21	0.78	1.60	2.12	0.93	2.59	91.62
397-88-4, 100-105	0.00	0.00	0.15	0.04	0.04	0.15	0.18	0.15	0.40	0.29	0.29	0.37	1.02	0.55	0.69	1.10	1.65	5.27	1.28	10.02	76.38
397-91-2, 14-18	1.15	0.08	0.15	0.31	0.42	0.54	0.42	0.31	0.35	0.19	0.19	0.15	0.38	0.35	0.38	1.12	1.46	3.65	3.00	12.31	73.08
397-92-1, 71-75	0.88	0.04	0.17	0.21	0.17	0.17	0.17	0.21	0.21	0.34	0.34	0.21	0.63	0.42	0.63	1.59	2.94	5.41	2.43	12.79	70.05
397-92-2, 100-106	0.00	0.04	0.40	0.16	0.20	0.20	0.16	0.16	0.16	0.16	0.20	0.16	0.61	0.40	0.57	1.57	2.38	5.45	2.18	7.87	76.95
397-92-3, 100-104	0.86	0.34	0.65	0.60	1.20	0.86	0.86	0.47	0.82	0.43	0.34	0.22	0.60	0.43	0.43	2.80	4.22	5.77	2.37	13.08	62.65
397-93-1, 76-80	4.15	0.73	1.09	1.09	1.38	1.24	1.02	0.69	0.91	0.73	0.51	0.51	1.09	0.87	1.24	2.51	4.77	7.83	2.73	12.56	52.35
397-93-3, 21-25	1.52	0.58	0.94	0.99	1.10	1.10	0.99	0.94	1.05	0.52	0.26	0.26	0.58	0.58	0.58	1.46	2.88	3.14	1.46	8.36	70.73
397-94-1, 65-70	0.00	0.04	0.16	0.32	0.43	0.32	0.83	0.55	1.38	1.19	1.19	1.15	2.96	1.58	2.17	3.56	5.53	7.71	2.17	11.38	55.38
397-97-1, 94-99	1.27	0.35	0.92	0.88	1.05	0.88	0.83	0.66	1.23	0.88	0.66	0.61	1.49	0.88	1.10	2.41	3.51	4.83	2.24	8.69	64.62
397-95-3, 15-20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	1.06	1.77	3.32	8.45	8.66	7.46	2.76	9.72	56.68
397-95-5, 15-19	0.53	0.38	0.72	0.67	1.15	1.20	1.44	1.01	1.97	1.68	1.15	1.15	2.60	1.64	2.16	4.57	6.01	10.82	2.93	11.78	44.40
397-96-1, 33-39	1.17	1.47	1.51	1.84	2.35	2.35	2.48	2.04	3.35	2.51	1.68	1.51	3.15	1.68	1.51	4.19	6.07	8.08	2.01	9.99	39.08
397-96-2, 0-4	1.33	0.93	1.06	1.77	2.66	2.62	2.88	2.26	3.72	2.84	1.82	1.55	3.28	1.55	1.82	3.95	5.76	6.65	2.70	8.91	39.94
397-97-1, 15-20	2.15	0.20	1.37	1.56	2.31	2.27	2.66	2.31	3.83	2.77	1.99	1.76	3.56	1.88	1.95	4.06	6.06	7.97	2.54	9.38	37.44
397A-1-3, 41-45	0.00	0.00	0.04	0.04	0.15	0.15	0.73	1.40	4.07	3.71	1.98	1.14	1.51	0.37	0.29	0.51	0.40	0.51	0.29	1.06	81.64
397A-1-6, 47-53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.41	3.33	2.93	2.70	3.15	1.35	1.13	0.41	3.61	80.89
397A-2-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.44	1.00	2.01	0.74	0.59	0.91	1.18	2.36	1.48	11.04	78.10
397A-3-2, 15-20	0.00	0.03	0.13	0.13	0.17	0.17	0.17	0.17	0.27	0.27	0.30	0.34	1.04	0.84	1.01	2.86	4.70	5.85	1.85	8.23	71.47
397A-5-2, 91-96	0.04	0.04	0.52	0.37	1.27	1.16	1.53	1.31	2.28	2.06	1.68	1.80	3.93	1.68	2.02	2.99	3.33	4.49	1.87	6.51	59.11
397A-6-1, 91-95	0.85	0.99	1.16	1.29	2.01	2.04	2.01	1.84	3.44	2.89	2.04	2.04	4.08	2.18	2.18	4.56	5.79	7.66	2.86	11.40	36.69
397A-7-1, 83-89	2.11	0.81	0.97	0.81	1.91	1.43	1.95	1.88	3.41	2.76	1.95	1.65	2.85	1.14	1.27	2.24	3.28	5.97	2.27	13.10	46.25
397A-7-2, 25-30	1.44	0.82	0.95	1.15	1.80	1.47	2.29	1.96	3.60	2.78	1.93	1.60	2.91	1.44	1.57	2.88	4.58	6.58	2.32	16.86	39.05
397A-11-6, 57-62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.18	1.34	3.12	5.75	2.01	8.83	78.56
397A-12-3, 48-53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.21	1.03	0.52	4.14	94.05
397A-15-4, 73-80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.15	0.34	0.38	0.57	0.34	1.56	96.45
397A-20-3, 38-43	0.00	0.14	0.22	0.42	1.13	1.49	2.24	2.21	4.98	5.12	3.98	3.43	6.39	2.79	2.77	3.04	2.32	2.49	1.13	5.64	48.04
397A-21-2, 106-110	0.52	0.91	1.17	1.56	3.16	3.86	1.56	3.76	6.65	5.84	4.30	3.78	7.56	3.39	3.65	4.12	2.61	1.67	0.63	2.61	36.67
397A-22-1, 16-22	0.00	0.00	0.03	0.03	0.03	0.15	0.34	0.34	1.04	1.23	1.38	1.54	4.30	2.00	2.46	3.19	3.22	3.41	1.66	11.30	62.35
397A-22-1, 77-82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.30	1.64	1.00	1.47	4.15	5.52	4.82	2.17	11.74	67.12
397A-28-2, 84-90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.80	2.59	4.39	1.64	7.74	82.72
397A-31-1, 47-50	1.45	0.93	1.65	2.12	4.10	3.97	4.66	4.33	8.43	7.63	5.65	4.66	6.77	2.64	2.02	2.97	2.64	2.35	0.96	4.13	25.94
397A-31-1, 78-83	2.25	1.46	2.14	2.14	4.10	3.84	4.79	4.60	8.47	7.62	5.42	4.50	6.88	2.65	1.98	3.04	2.78	2.12	0.93	3.68	24.61
397A-31-2, 31-35	4.13	1.19	1.91	2.64	4.21	4.21	5.01	4.59	8.57	7.46	5.13	4.59	7.69	2.87	2.22	3.25	2.87	2.07	0.77	3.83	20.81
397A-31-3, 18-23	2.11	1.16	1.41	1.45	2.48	2.48	2.89	2.69	5.17	4.55	3.35	2.81	5.00	1.82	1.70	2.48	2.48	2.85	1.45	6.99	42.68
397A-32-1, 90-93	3.74	1.79	2.93	3.09	4.92	4.56	5.34	4.56	7.98	7.16	5.34	4.36	7.65	2.77	2.54	3.06	2.74	2.31	0.65	3.42	19.08
397A-32-2, 31-35	3.30	1.04	2.53	2.67	4.40	3.57	4.75	4.58	8.59	7.55	5.47	4.58	7.37	2.67	2.41	2.91	2.53	1.93	1.04	3.86	22.28
397A-33-1, 118-122	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.04	0.33	0.20	0.20	0.20	1.43	3.97	2.00	13.12	78.29
397-90-1, 90-96	0.00	0.00	0.05	0.00	0.05	0.05	0.05	0.05	0.18	0.23	2.52	0.23	0.69	0.41	0.46	1.42	2.48	5.69	1.88	5.96	77.61
397-93-2, 120-124	0.21	0.43	0.90	1.03	1.46	1.33	1.07	0.77	0.86	0.47	0.17	0.21	0.47	0.43	0.90	1.07	2.10	8.14	2.49	16.20	59.30
397-95-4, 85-90	0.00	0.00	0.03	0.14	0.14	0.31	0.31	0.35	0.49	0.35	0.35	0.28	0.17	0.38	0.38	0.70	2.62	7.17	4.37	17.14	64.28

397A-2-2, 20-24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.38	1.68	2.99	1.47	10.52	82.58
397A-5-2, 34-40	0.00	0.00	0.00	0.00	0.12	0.12	0.12	0.47	0.59	0.47	0.47	0.59	0.59	0.59	4.00	12.69	23.27	9.99	45.24
397A-6-2, 20-26	3.71	1.36	1.11	0.71	1.43	1.00	1.43	1.07	2.28	2.18	1.79	1.43	2.50	1.07	2.78	5.00	2.50	11.78	52.02
397A-9-1, 27-33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.21	2.33	2.54	16.44	78.01
397A-10-3, 61-66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.23	3.91	4.83	1.42	8.23	79.55
397A-20-2, 52-60	0.22	0.24	0.34	0.51	0.92	0.84	1.16	1.16	2.29	2.17	1.81	1.69	3.83	2.17	4.10	3.37	4.77	1.93	10.12	54.21
397A-22-2, 97-101	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.10	0.27	0.49	1.84	4.42	10.18	4.27	13.74	64.67
397A-23-1, 121-124	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.16	0.16	0.31	0.82	1.17	2.50	0.98	4.07	89.79
397A-23-2, 112-116	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.12	0.29	0.44	1.18	1.47	2.35	1.41	9.56	83.14
397A-23-3, 25-29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.11	0.14	0.23	0.60	1.08	2.14	1.25	7.12	87.30
397A-24-1, 140-144	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.14	0.23	0.79	6.88	12.13	14.39	5.22	12.98	47.18
397A-30-1, 68-71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.20	0.26	0.26	0.41	0.72	0.77	1.23	0.92	7.36	87.78
397A-32-2, 131-140	0.00	0.16	0.00	0.04	0.00	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.33	0.20	0.20	0.61	1.23	3.72	2.01	12.85	78.39
397A-13-3, 58-62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.31	1.14	2.36	0.94	7.27	87.89
397A-18-1, 36-40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.12	3.97	11.64	5.50	1.83	6.39	70.48

where

x_i = interval means
n_i = dots frequency in the "i" interval
i = 1, 2, . . . k, and

$$\sum_{i=1}^{k} n_i = 1$$

Dispersion

$$S^2 = \sum_{i=1}^{k} (x_i - \bar{x})^2 \, n_i$$

Standard deviation

$$S = \sqrt{S^2}$$

Asymmetry (skewness)

$$A = \frac{1}{S^3} \sum_{i=1}^{k} (x_i - \bar{x}_i)^3 \, n_i$$

Excess (kurtosis)

$$E = \frac{1}{S^4} \sum_{i=1}^{k} (x_i - \bar{x})^4 \, n_i^{-3}$$

For the grain-size analyses, quartile estimates were calculated for γ_n - n per cent quartile (Folk and Ward, 1957).

Median

$$m = \gamma_{50}$$

Average

$$m_k = \frac{1}{3} (\gamma_{16} + \gamma_{50} + \gamma_{84})$$

Dispersion

$$S_k^2 = \frac{\gamma_{84} - \gamma_{16}}{4} + \frac{\gamma_{95} - \gamma_5}{6.6}$$

Skewness

$$A_k = \frac{1}{2}\left[\frac{\gamma_{84} + \gamma_{16} - 2\gamma_{50}}{\gamma_{84} - \gamma_{16}} + \frac{\gamma_{95} + \gamma_5 - 2\gamma_{50}}{\gamma_{95} - \gamma_5}\right]$$

Kurtosis

$$E_k = \frac{\gamma_{95} - \gamma_5}{2.44\,(\gamma_{75} - \gamma_{25})}$$

TABLE 2
Statistical Estimates of 19 Fractions of Sieved Grain-Size Analysis (in scale γ)

Sample (Interval in cm)	Mean	Dispersion	Standard	Skewness	Kurtosis	Quartile Estimates				
						Median	Mean	Sorting	Skewness	Kurtosis
397-77-3, 88-91	11.175	2.561	1.600	-1.643	2.947	11.595	11.338	1.474	-0.389	1.116
397-78-3, 111-113	10.298	6.165	2.483	-0.957	-0.464	11.340	10.279	2.529	-0.589	0.777
398D-33-1, 56-59	10.852	2.744	1.657	-1.092	0.397	11.228	10.980	1.652	-0.333	1.175
397A-23-2, 126-129	10.310	4.302	2.074	-0.904	0.085	10.787	10.367	2.120	-0.337	0.889
397-76-3, 112-115	11.003	1.021	1.011	-0.525	0.653	11.021	11.043	1.016	-0.000	1.002
397-89-3, 60-63	9.406	8.112	2.848	-1.220	1.426	10.308	9.680	2.639	-0.413	0.926
397-86-2, 9-12	7.374	4.119	2.030	0.493	0.150	7.273	7.354	2.110	0.108	1.342
397A-24-1, 148-150	11.813	0.880	0.938	-4.057	42.594	12.016	11.903	0.827	-0.265	0.881
397A-23-3, 16-18	11.159	1.903	1.380	-1.561	3.064	11.414	11.321	1.288	-0.245	1.130
398D-36-3, 127-129	11.037	2.526	1.589	-1.529	2.432	11.416	11.220	1.489	-0.342	1.254
397-88-4, 60-63	7.053	6.239	2.498	0.297	-0.008	7.015	7.138	2.594	0.107	1.295
397-72-4, 11-13	5.186	10.481	3.237	-0.041	0.172	5.106	5.165	3.151	0.027	1.418
397A-32-3, CC	9.147	8.811	2.968	-0.885	0.100	10.176	9.309	2.883	-0.427	0.823
397A-23-1, 124-127	10.599	1.827	1.352	-1.325	4.985	10.684	10.658	1.311	-0.083	1.171
397A-7-2, 16-19	5.957	20.856	4.567	-0.146	-1.157	5.943	6.020	4.835	-0.033	0.736
397-75-2, 83-85	8.433	3.562	1.887	-0.314	2.199	8.109	8.531	1.795	0.273	1.070
397A-32-2, 143-145	11.386	1.625	1.275	-3.884	33.648	11.538	11.486	1.040	-0.131	0.859
397A-18-1, 43-48	11.350	0.531	0.729	-0.167	0.363	11.360	11.323	0.802	-0.007	0.986
397-89-2, 98-102	7.894	15.761	3.970	-0.849	-0.110	8.684	8.011	4.067	-0.318	0.954
397-78-3, 20-23	11.985	0.963	0.981	-2.684	8.023	12.258	12.105	0.815	-0.424	1.236
397A-6-2, 28-31	6.312	20.015	4.474	-0.229	-1.101	6.704	6.454	4.693	-0.111	0.749
397-65-1, 94-96	10.360	4.389	2.095	-1.799	4.070	10.826	10.532	1.814	-0.312	1.156
397A-5-2, 25-29	8.241	18.095	4.254	-0.870	-0.488	10.174	8.470	4.213	-0.589	0.794
397-71-2, 14-17	6.348	12.597	3.549	-0.006	-0.696	6.101	6.573	3.711	0.111	0.911
397A-31-3, 6-9	4.735	14.486	3.806	0.093	-0.705	4.536	4.630	4.004	0.048	0.950
397A-20-2, 50-54	7.178	15.018	3.875	-0.539	-0.593	7.627	7.330	3.960	-0.179	0.838
397-71-1, 126-130	8.516	7.763	2.786	-1.128	2.502	8.478	8.766	2.501	0.056	1.027
397-95-4, 70-74	6.328	23.583	4.856	-0.258	-1.291	7.034	6.438	5.028	-0.190	0.664
397A-32-1, 99-101	4.582	15.270	3.908	0.071	-0.761	4.411	4.448	4.144	0.024	0.944
398D-7-1, 42-44	11.425	3.638	1.907	-4.496	24.013	11.767	11.784	0.982	-0.190	1.313
397-93-3, 15-19	5.646	25.242	5.024	-0.087	-1.418	5.614	5.659	5.190	-0.025	0.623
397-72-5, 28-30	5.921	10.251	3.202	0.092	-0.112	5.686	6.052	3.269	0.131	1.237
398A-20-3, 131-134	9.106	2.895	1.702	-0.389	3.523	8.901	9.086	1.615	0.226	0.881
397-93-2, 130-133	5.594	25.671	5.067	-0.017	-1.462	5.067	5.503	5.214	0.069	0.607
397A-3-2, 8-11	9.751	10.951	3.309	-1.752	2.722	10.909	10.142	2.927	-0.543	1.316
397-90-1, 97-100	7.812	12.806	3.579	-0.742	0.176	7.838	7.938	3.656	-0.090	0.980
397A-22-1, 13-16	8.013	9.474	3.078	-0.463	-0.366	7.927	7.988	3.158	-0.024	0.867
396-96-2, 8-12	6.034	23.048	4.801	-0.135	-1.312	6.052	6.049	5.011	-0.043	0.661
397A-102-1, CC	6.472	17.431	4.175	-0.965	-0.176	10.227	8.688	4.146	-0.569	0.879
397A-6-1, 91-94	6.250	19.277	4.391	-0.179	-1.143	6.589	6.396	4.585	-0.088	0.725
397A-5-2, 88-92	6.613	17.675	4.204	-0.319	-0.978	7.188	6.742	4.404	-0.167	0.770
397-72-3, 104-106	5.182	9.902	3.147	0.065	0.137	5.011	5.088	3.109	0.051	1.273
397A-21-2, 98-102	5.542	15.266	3.907	-0.111	-0.885	5.546	5.627	4.126	-0.001	0.881
397-78-4, 0	6.230	29.114	5.396	-0.377	-1.352	7.423	6.108	5.589	-0.305	0.599
397A-18-5, 55-60	10.934	5.382	2.320	-2.960	10.265	11.535	11.367	1.549	-0.381	1.464
397-94-1, 81-84	7.041	27.794	5.272	-0.517	-1.291	9.394	7.239	5.325	-0.539	0.620
397-93-1, 60-63	4.160	24.999	5.000	0.382	-1.275	2.960	4.353	5.228	0.312	0.662
397-96-1, 26-29	6.997	22.738	4.768	-0.448	-1.155	7.847	7.000	4.866	-0.273	0.693
397A-31-1, 77-81	4.773	13.934	3.733	0.109	-0.708	4.536	4.664	3.886	0.068	0.929
398D-26-1, 44-45	10.428	5.106	2.260	-1.092	0.192	11.191	10.490	2.295	-0.499	0.992
397-84-1, 132-134	10.583	2.109	1.452	-0.657	-0.367	10.818	10.596	1.527	-0.244	1.087
397A-28-3, CC	11.780	1.749	1.323	-6.430	59.105	12.036	11.939	0.812	-0.264	0.933
398D-24-6, 92-94	10.969	2.222	1.491	-1.600	2.803	11.262	11.207	1.367	-0.248	1.403
397A-31-2, 10-13	4.726	14.448	3.801	0.115	-0.738	4.477	4.611	3.993	0.063	0.935
397-95-5, 6-8	6.803	24.010	4.900	-0.389	-1.239	7.645	6.829	5.030	-0.257	0.674
397-71-4, 71-73	11.394	0.928	0.963	-1.065	2.892	11.458	11.440	0.943	-0.027	0.823
397-97-1, 24-29	6.517	22.999	4.796	-0.240	-1.330	7.193	6.673	4.880	-0.178	0.649
397-95-2, 6-8	7.511	21.105	4.594	-0.632	-0.868	8.801	7.632	4.637	-0.395	0.738
397-75-3, CC	9.744	3.771	1.942	-1.028	2.578	10.015	9.841	1.822	-0.104	0.857
397-76-4, 5-9	6.340	9.092	3.015	0.100	-0.413	6.301	6.445	3.110	0.071	1.038

TABLE 2 – *Continued*

Sample (Interval in cm)	Mean	Dispersion	Standard	Skewness	Kurtosis	Quartile Estimates				
						Median	Mean	Sorting	Skewness	Kurtosis
397-77-2, 135-138	8.739	3.672	1.916	-0.382	3.092	8.420	8.791	1.811	0.285	0.935
397-78-3, 63-65	10.334	1.291	1.136	-0.291	0.120	10.394	10.368	1.193	-0.054	1.166
397-80-3, 27-30	10.191	4.778	2.186	-0.968	0.650	10.716	10.233	2.172	-0.329	0.779
397-85-1, 15-18	9.445	5.670	2.381	-0.928	2.523	9.654	9.647	2.239	-0.043	0.721
397-88-4, 75	10.329	4.624	2.150	-0.957	-0.020	10.969	10.338	2.210	-0.425	0.954
397A-7-1, 91-94	7.013	19.229	4.385	-0.441	-0.997	7.654	7.061	4.543	-0.218	0.744
397A-23-4, 35-38	10.841	3.986	1.997	-3.265	13.754	11.253	11.191	1.350	-0.259	1.488
397A-28-2, 89-92	11.669	1.248	1.117	-1.926	4.693	11.972	11.795	1.000	-0.359	1.035
397A-30-1, 63-66	10.974	4.412	2.100	-2.606	9.675	11.564	11.211	1.622	-0.428	1.070
397A-31-1, 45-50	4.463	13.592	3.687	0.203	-0.549	4.127	4.284	3.802	0.084	0.979
397A-32-2, 43-47	4.685	14.210	3.770	0.111	-0.671	4.466	4.552	3.946	0.051	0.962
398D-2-1, 101-105	9.971	10.525	3.244	-1.806	3.315	11.125	10.359	2.804	-0.549	1.099
398D-2-2, 100-104	10.145	5.697	2.387	-1.080	0.427	10.761	10.262	2.408	-0.397	0.983
398D-2-3, 28-32	10.264	6.635	2.576	-1.070	0.324	11.200	10.412	2.467	-0.512	0.799
398D-23-1, 67-69	11.212	1.146	1.070	-1.784	6.334	11.329	11.285	0.973	-0.099	1.072
398D-32-4, 59-61	11.562	2.651	1.628	-4.139	27.170	12.101	11.739	1.194	-0.531	1.075
397A-20-3, 31-36	5.861	12.064	3.473	-0.005	-0.653	5,736	5,977	3.647	0.062	1.003
398A-7-4, 99-110	8.828	15.262	3.907	-1.006	-0.106	10.498	8.977	3.904	-0.588	0.864
397A-24-2, 24-29	11.605	1.041	1.020	-2,346	12.852	11.744	11.669	0.919	-0.153	0.866
397-88-2, 40-46	11.212	3.271	1.809	-2.434	9.048	11.806	11.397	1.518	-0.498	1.078
397A-19-3, CC	8.326	12.274	3.503	-0.743	-0.258	9.037	8.437	3.594	-0.295	0.904
397A-22-2, 100-105	11.472	2.172	1.474	-2.989	14.308	11.865	11.635	1.157	-0.382	1.021
397-71-1, 119-123	9.635	4.661	2.159	-1.389	3.513	10.045	9.772	1.988	-0.218	0.970
397-71-2, 10-19	7.551	14.081	3.752	-0.254	-0.970	7.500	7.684	3.879	-0.018	0.709
397-71-4, 65-70	8.333	22.050	4.696	-0.946	-0.529	10.630	8.452	4.631	-0.670	0.741
397-72-3, 100-104	6.810	11.370	3.372	0.087	-0.664	6.411	7.044	3.511	0.186	0.811
397-72-4, 5-11	6.138	14.446	3.801	-0.031	-0.528	5.678	6.572	3.974	0.183	1.059
397-72-5, 20-	5.661	12.039	3.470	0.421	-0.346	4.940	5.923	3.683	0.318	1.191
397-73-2, 100-106	8.041	11.188	3.345	-0.116	-1.086	7.571	8.048	3.339	0.138	0.628
397-73-3, 0-8	11.285	2.207	1.486	-1.808	3.717	11.632	11.463	1.350	-0.347	1.151
397-73-3, 64-69	11.069	1.917	1.384	-3.651	24.275	11.213	11.209	1.041	-0.066	1.037
397-74-1, 4-8	10.424	5.150	2.269	-1.105	0.357	10.969	10.549	2.248	-0.392	1.070
397-75-1, 74-77	11.277	1.556	1.247	-1.410	2.681	11.463	11.398	1.150	-0.173	0.930
397-75-2, 79-82	8.880	2.371	1.540	0.412	-0.409	8.682	8.864	1.551	0.215	0.851
397-76-3, 100-104	10.300	3.833	1.958	-1.270	2.228	10.634	10.374	1.880	-0.238	0.993
397-76-4, 1-10	7.200	11.322	3.365	0.008	-0.991	7.100	7.354	3.479	0.073	0.710
397-77-1, 42-48	11.697	0.780	0.883	-0.831	0.071	11.872	11.731	0.925	-0.239	0.825
397-77-2, 128-134	9.332	2.491	1.578	0.197	-0.642	9.260	9.270	1.611	0.079	0.849
397-77-3, 83-88	11.416	1.666	1.291	-1.343	1.624	11.753	11.532	1.244	-0.363	0.986
397-78-3, 11-18	11.960	1.231	1.109	-4.023	20.080	12.220	12.095	0.717	-0.326	0.959
397-78-4, 11-17	11.247	6.798	2.607	-3.181	10.156	12.102	11.783	1.793	-0.619	2.479
397-79-1, 50-55	11.227	8.341	2.888	-3.006	8.477	12.179	11.975	1.874	-0.597	3.213
397-80-7, 93-98	9.406	5.790	2.406	-0.691	0.860	9.685	9.614	2.305	-0.099	0.746
397-84-1, 17-21	10.541	5.660	2.379	-1.574	3.545	11.363	10.580	2.141	-0.494	0.753
397-84-2, 50-55	10.618	3.532	1.879	-0.807	-0.333	11.045	10.599	1.936	-0.342	0.830
397-84-3, 110-113	7.359	9.866	3.141	0.131	-0.652	6.990	7.677	3.340	0.194	0.905
397-85-1, 11-15	10.750	2.464	1.570	-0.821	0.623	10.904	10.790	1.570	-0.145	0.821
397-85-2, 80-81	7.892	14.755	3.841	-0.134	-1.409	7.599	7.848	3.868	0.019	0.586
397-85-3, 116-120	8.015	12.322	3.510	-0.341	-1.009	8.204	8.045	3.640	-0.102	0.690
397-85-4, 44-49	8.684	10.582	3.253	-0.576	-0.577	9.213	8.794	3.277	-0.225	0.773
397-86-1, 130-135	9.360	7.262	2.695	-0.731	-0.148	10.095	9.563	2.688	-0.331	0.825
397-87-1, 100-105	11.271	2.313	1.521	-1.355	1.365	11.755	11.385	1.466	-0.459	1.033
397-88-2, 55-60	11.561	1.306	1.143	-1.743	4.139	11.806	11.656	1.054	-0.290	0.999
397-88-4, 100-105	9.914	11.978	3.461	-1.525	1.780	11.442	10.288	3.041	-0.657	0.961
397-91-2, 14-18	8.513	23.219	4.819	-0.946	-0.647	10.902	8.337	4.826	-0.706	0.720
397-92-1, 71-75	9.991	13.479	3.671	-1.820	2.508	11.480	10.371	3.218	-0.682	1.646
397-92-2, 100-106	9.894	16.081	4.010	-1.867	2.472	11.558	10.443	3.411	-0.706	1.870
397-92-3, 100-104	8.214	25.250	5.025	-0.902	-0.786	10.842	8.081	5.015	-0.721	0.686
397-93-1, 76-80	7.922	26.223	5.121	-0.805	-0.910	10.527	7.874	5.161	-0.679	0.684
397-93-3, 21-25	6.417	28.882	5.374	-0.281	-1.525	7.871	6.589	5.337	-0.328	0.586

TABLE 2 – *Continued*

Sample (Interval in cm)	Mean	Dispersion	Standard	Skewness	Kurtosis	Quartile Estimates				
						Median	Mean	Sorting	Skewness	Kurtosis
397-94-1, 65-70	9.005	13.549	3.681	-1.081	0.313	10.350	9.181	3.615	-0.518	0.951
397-95-1, 94-99	7.454	24.330	4.933	-0.657	-0.988	9.419	7.517	5.046	-0.520	0.713
397-95-3, 15-20	10.908	1.876	1.369	-0.977	1.419	11.052	11.001	1.388	-0.150	1.048
397-95-5, 15-19	8.418	19.370	4.401	-0.917	-0.416	10.301	8.607	4.342	-0.583	0.783
397-96-1, 33-39	6.721	23.924	4.891	-0.337	-1.286	7.459	6.751	5.012	-0.225	0.659
397-96-2, 0-4	6.413	22.761	4.771	-0.210	-1.336	6.934	6.503	4.906	-0.147	0.644
397-97-1, 15-20	6.733	22.488	4.742	-0.320	-1.235	7.352	6.815	4.871	-0.192	0.679
397A-1-3, 41-45	5.138	7.227	2.688	0.909	0.873	4.519	5.046	2.561	0.374	1.293
397A-1-6, 47-53	9.361	2.678	1.636	0.168	-0.699	9.314	9.293	1.666	0.065	0.822
397A-2-3	9.505	5.925	2.434	-0.127	-1.386	9.612	9.628	2.438	-0.043	0.621
397A-3-2, 15-20	10.197	9.764	3.125	-2.065	4.152	11.266	10.510	2.695	-0.580	1.566
397A-5-2, 91-96	7.106	17.568	4.191	-0.425	-0.888	7.539	7.195	4.363	-0.163	0.760
397A-6-1, 91-95	7.036	20.864	4.568	-0.439	-1.055	7.664	7.066	4.709	-0.219	0.718
397A-7-1, 83-89	6.439	21.152	4.599	-0.159	-1.198	6.410	6.576	4.774	-0.017	0.691
397A-7-2, 25-30	6.691	21.384	4.624	-0.257	-1.208	7.060	6.836	4.751	-0.122	0.691
397A-11-6, 57-62	11.777	1.238	1.113	-2.910	12.888	12.084	11.913	0.872	-0.350	0.908
397A-12-3, 48-53	12.264	0.271	0.520	-2.048	3.301	12.383	12.313	0.556	-0.303	1.250
397A-15-4, 73-80	10.870	3.680	1.918	-1.614	2.359	11.332	11.123	1.781	-0.374	1.306
397A-20-3, 38-43	6.221	12.206	3.494	-0.054	-0.667	6.224	6.403	3.644	0.035	0.950
397A-21-2, 106-110	5.434	14.562	3.816	-0.113	-0.822	5.428	5.347	4.096	-0.024	0.959
397A-22-1, 16-22	8.656	8.696	2.949	-0.620	-0.130	8.998	8.799	2.982	-0.157	0.931
397A-22-1, 77-82	10.767	2.677	1.636	-0.990	0.277	11.129	10.851	1.663	-0.318	1.145
397A-28-2, 84-90	11.908	0.650	0.806	-1.729	4.813	12.107	11.979	0.795	-0.305	0.908
397A-31-1, 47-50	4.788	14.260	3.776	0.168	-0.640	4.530	4.656	3.960	0.077	0.983
397A-31-1, 78-83	4.712	14.480	3.805	0.155	-0.650	4.450	4.582	3.994	0.071	0.983
397A-31-2, 31-35	4.730	14.624	3.824	0.138	-0.719	4.466	4.593	4.017	0.068	0.949
397A-31-3, 18-23	5.258	16.727	4.090	0.065	-0.859	4.946	5.305	4.420	0.091	0.981
397A-32-1, 90-93	4.521	15.660	3.957	0.150	-0.782	4.310	4.382	4.182	0.053	0.915
397A-32-2, 31-35	4.614	14.614	3.823	0.115	-0.674	4.414	4.447	4.028	0.040	0.972
397A-33-1, 118-122	11.439	4.054	2.013	-2.594	7.147	12.177	11.754	1.463	-0.632	1.806
397-90-1, 90-96	9.950	9.454	3.075	-1.063	0.240	11.344	9.877	2.915	-0.622	0.637
397-93-2, 120-124	7.484	30.874	5.556	-0.554	-1.393	10.562	7.726	5.374	-0.682	0.561
397-95-4, 85-90	10.110	14.441	3.800	-1.593	1.239	12.016	10.041	3.589	-0.831	1.645
397A-2-2, 20-24	11.794	1.073	1.036	-1.864	3.573	12.098	11.952	0.956	-0.399	1.192
397A-5-2, 34-40	10.983	7.663	2.768	-2.088	3.596	12.160	11.187	2.338	-0.770	2.426
397A-6-2, 20-26	6.596	21.652	4.653	-0.280	-1.104	6.917	6.739	4.883	-0.118	0.730
397A-9-1, 27-33	11.829	2.709	1.646	-2.916	8.161	12.362	12.070	1.261	-0.642	3.431
397A-10-3, 61-66	11.684	0.880	0.938	-1.328	2.269	11.854	11.756	0.903	-0.211	0.890
397A-20-2, 52-60	7.535	15.963	3.995	-0.564	-0.652	7.944	7.654	4.097	-0.181	0.815
397A-22-2, 97-101	11.849	0.965	0.982	-1.847	4.006	12.157	11.958	0.887	-0.410	0.980
397A-23-1, 121-124	11.453	1.847	1.359	-1.445	1.705	11.937	11.602	1.307	-0.488	1.056
397A-23-2, 112-116	11.293	1.766	1.329	-1.092	0.736	11.592	11.416	1.305	-0.308	0.948
397A-23-3, 25-29	11.512	1.739	1.319	-1.545	2.070	11.979	11.652	1.264	-0.494	1.140
397A-24-1, 140-144	11.623	0.877	0.936	-1.222	2.930	11.757	11.663	0.931	-0.168	0.831
397A-30-1, 68-71	10.537	4.021	2.005	-0.976	0.156	11.004	10.580	2.030	-0.360	0.940
397A-32-2, 131-140	11.252	5.203	2.281	-2.852	9.675	12.122	11.633	1.549	-0.637	1.498
397A-13-3, 58-62	11.975	0.605	0.778	-1.670	3.329	12.182	12.035	0.781	-0.351	0.958
397A-18-1, 36-40	11.543	0.512	0.716	-0.475	1.091	11.548	11.574	0.795	0.012	1.104

TABLE 3
Primary Analytical Data of 14 Fractions of Grain-Morphometry Analysis of Sand, 0.315 to 0.25 mm in Size (mass %)

Sample (Interval in cm)	Morphometry Fractions													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
397-86-2, 9-12	0.76	0.95	4.33	9.04	18.56	20.56	25.61	13.23	3.05	2.00	1.67	0.14	0.05	0.05
397-88-4, 60-63	0.41	0.41	3.94	9.51	19.29	22.42	21.06	14.81	3.53	2.45	2.04	0.14	0.00	0.00
397-72-4, 11-13	0.00	0.16	2.07	3.66	8.44	8.92	11.46	12.42	5.41	6.21	13.22	26.11	1.75	0.16
397A-7-2, 16-19	0.38	0.88	4.29	9.22	17.55	21.97	20.08	15.15	3.79	3.54	2.27	0.63	0.25	0.00
397-75-2, 83-85	0.00	0.47	2.80	5.61	17.29	19.16	18.22	18.22	5.61	5.14	5.61	1.87	0.00	0.00
397A-6-2, 28-31	0.46	1.37	5.71	11.42	21.92	22.83	15.53	12.56	2.74	2.74	1.37	1.37	0.00	0.00
397A-5-2, 25-29	2.84	2.84	6.31	13.88	23.34	23.03	11.99	9.46	3.47	1.26	0.95	0.63	0.00	0.00
397-71-2, 14-17	0.00	0.00	0.43	1.29	9.01	12.88	15.88	18.03	4.72	5.58	7.30	7.73	10.73	6.44
397A-31-3, 6-9	0.00	0.52	2.51	5.88	12.19	17.03	25.41	19.97	6.66	3.46	4.41	1.64	0.35	0.00
397A-20-2, 50-54	0.00	0.00	1.82	4.85	11.92	19.60	23.64	20.00	5.25	4.65	4.85	2.42	0.61	0.40
397-71-1, 126-130	0.00	0.00	0.76	4.58	10.69	12.21	19.08	22.14	5.34	6.11	8.40	6.87	3.05	0.76
397-95-4, 70-74	0.95	1.43	1.67	4.77	14.56	20.05	23.39	18.62	4.06	3.58	4.53	1.67	0.48	0.24
397A-32-1, 99-101	0.23	0.81	2.83	6.01	12.36	15.19	25.42	19.64	7.97	4.39	4.10	0.92	0.12	0.00
397-93-3, 15-19	0.00	0.00	2.23	7.14	12.50	17.41	20.09	20.98	4.46	6.25	5.80	0.89	1.79	0.45
397-72-5, 28-30	0.28	0.28	0.56	1.69	6.78	9.60	15.54	24.01	16.38	10.73	10.17	3.39	0.56	0.00
397-93-2, 130-133	2.06	3.09	4.12	7.22	11.86	21.13	22.68	17.53	3.09	5.15	2.06	0.00	0.00	0.00
397-90-1, 97-100	0.00	0.00	0.36	2.14	11.39	14.59	21.71	22.42	8.19	5.69	9.61	3.56	0.36	0.00
397A-22-1, 13-16	0.12	0.62	1.85	4.94	11.25	11.00	15.95	20.15	19.78	4.94	4.08	4.45	0.74	0.12
397-96-2, 8-12	0.83	1.11	4.72	9.15	15.53	22.88	21.22	16.37	3.74	2.08	2.36	0.00	0.00	0.00
397A-102-1, CC	0.57	0.29	3.14	6.57	15.43	20.57	21.14	18.86	4.29	4.86	2.00	2.00	0.29	0.00
397A-6-1, 91-94	0.00	0.00	1.23	5.10	13.71	18.28	18.80	17.40	14.76	5.27	3.51	1.23	0.70	0.00
397A-5-2, 88-92	0.00	0.65	2.16	4.33	13.42	18.83	19.48	4.33	5.63	11.47	17.32	1.52	0.87	0.00
397-72-3, 104-106	0.00	0.00	0.27	1.72	4.77	6.90	9.28	14.85	6.63	6.23	12.60	30.64	5.97	0.13
397A-21-2, 98-102	0.00	0.66	2.20	7.47	15.38	21.21	20.55	19.89	4.62	3.74	3.08	0.99	0.22	0.00
397-94-1, 81-84	0.00	0.00	2.86	6.67	19.05	21.90	19.05	19.05	4.76	4.76	0.95	0.95	0.00	0.00
397-93-1, 60-63	0.00	0.67	1.68	6.04	16.78	23.49	19.80	16.78	3.36	4.70	3.36	2.35	0.67	0.34
397-96-1, 26-29	0.00	0.00	0.67	3.58	10.74	17.90	19.24	25.50	7.38	4.70	6.94	3.36	0.00	0.00
397A-31-1, 77-81	0.00	0.09	2.18	5.20	11.92	26.87	19.96	19.96	5.20	3.31	3.78	1.32	0.19	0.00
397-95-5, 6-8	1.50	2.25	7.49	15.36	22.47	21.35	11.61	10.86	3.00	0.75	1.87	1.12	0.37	0.00
397A-31-2, 10-13	0.10	0.57	2.85	4.75	13.59	19.01	22.15	19.01	8.27	5.23	3.71	0.67	0.10	0.00
397-97-1, 24-29	0.00	0.67	1.67	9.03	21.40	24.08	20.07	14.38	0.67	3.68	4.01	0.33	0.00	0.00
397-76-4, 5-9	0.16	0.16	1.93	4.82	12.54	18.81	18.17	19.29	7.72	5.79	8.68	1.77	0.16	0.00
397A-7-1, 91-94	0.42	1.05	4.81	9.21	19.25	20.08	16.53	14.23	4.18	3.56	4.60	1.26	0.63	0.21
397A-31-1, 45-50	0.15	0.46	2.27	5.10	10.05	12.32	18.87	17.37	9.33	7.11	7.78	8.87	0.26	0.05
397A-32-2, 43-47	0.57	1.32	4.39	8.78	14.67	18.40	20.25	14.14	6.28	5.88	4.26	0.97	0.09	0.00
397A-20-3, 31-36	0.89	1.68	4.85	9.31	14.65	16.93	21.83	14.46	6.58	4.95	3.27	0.54	0.05	0.00
397A-19-3, CC	0.00	0.39	3.74	7.68	14.96	20.47	18.31	17.72	6.69	4.92	4.53	0.59	0.00	0.00
397-71-1, 119-123	0.00	0.00	1.24	4.96	15.70	15.70	20.66	21.49	9.09	4.96	4.13	2.07	0.00	0.00
397-72-3, 100-104	0.00	0.00	0.89	2.67	12.22	10.67	18.89	22.22	7.78	7.78	11.11	5.56	0.22	0.00
397-72-4, 5-11	0.00	0.22	1.76	3.30	13.19	14.51	21.32	21.76	6.59	6.15	8.35	2.64	0.22	0.00
397-72-5, 20-23	0.00	0.20	0.78	0.78	6.25	7.23	10.94	14.45	5.86	7.23	15.63	27.54	2.93	0.20
397-73-2, 100-106	0.00	0.32	0.95	3.81	12.70	13.33	19.05	21.27	9.52	7.30	8.57	2.86	0.32	0.00
397-76-4, 1-10	1.22	0.41	1.63	5.31	16.33	16.73	22.04	18.78	8.16	3.67	4.08	1.22	0.41	0.00
397-85-2, 80-81	0.00	0.40	2.37	4.74	15.81	15.81	21.74	20.95	6.72	5.14	5.53	0.40	0.40	0.00
397-85-3, 116-120	0.00	0.27	2.44	6.23	18.97	17.34	20.33	17.34	5.42	3.25	5.42	2.71	0.27	0.00
397-85-4, 44-49	0.00	0.13	1.76	4.89	14.55	15.68	21.58	21.96	7.28	4.39	6.27	1.38	0.13	0.00
397-86-1, 130-135	0.00	0.17	2.35	5.20	15.94	16.78	21.31	20.30	6.88	4.53	5.03	1.34	0.17	0.00
397-94-1, 65-70	0.00	0.00	2.01	4.70	15.44	17.79	20.13	19.46	6.71	4.03	6.38	3.36	0.00	0.00
397-96-5, 15-19	0.00	0.00	2.34	6.25	15.63	17.19	19.53	19.92	5.47	5.08	4.30	3.91	0.39	0.00
397-96-1, 33-39	0.00	0.00	2.55	6.79	16.14	18.05	19.96	19.75	4.88	3.40	6.37	1.49	0.42	0.21
397-96-2, 0-4	0.00	0.00	1.99	5.74	16.56	19.65	21.63	18.32	5.52	4.42	4.42	1.10	0.44	0.22
397-97-1, 15-20	0.00	0.00	3.15	5.91	17.72	19.69	19.88	19.29	5.91	3.54	3.94	0.79	0.20	0.00
397A-1-3, 41-45	0.17	0.17	1.73	5.55	15.60	19.93	22.01	20.97	6.41	3.81	3.47	0.17	0.00	0.00
397A-2-3	0.00	0.00	12.21	22.90	35.11	16.03	6.11	3.82	1.53	0.76	0.76	0.76	0.00	0.00
397A-5-2, 91-96	0.00	0.00	2.91	7.38	22.37	21.03	19.69	16.55	4.03	3.13	2.46	0.22	0.22	0.00
397A-6-1, 91-95	0.66	0.82	5.59	11.35	18.42	21.22	19.90	13.82	3.78	2.63	0.99	0.66	0.16	0.00
397A-6-2, 20-26	0.22	1.12	6.73	11.88	22.42	23.32	17.04	10.31	2.69	2.24	1.35	0.45	0.22	0.00
397A-7-1, 83-89	1.65	0.99	4.95	9.90	19.80	21.95	19.31	13.53	3.80	2.31	1.65	0.17	0.00	0.00
397A-7-2, 25-30	0.50	1.66	5.32	11.63	19.77	20.60	18.11	13.29	3.99	3.16	1.33	0.50	0.17	0.00
397A-32-2, 31-35	0.28	0.72	3.63	7.26	13.76	17.23	22.29	17.61	7.43	5.17	3.96	0.66	0.00	0.00
397A-32-1, 90-93	1.04	1.49	4.81	11.11	19.17	15.59	21.44	14.17	5.26	3.18	2.14	0.45	0.13	0.00
397A-20-2, 52-60	0.80	1.86	5.31	10.09	17.66	22.97	19.12	13.28	3.98	2.66	1.99	0.13	0.13	0.00
397A-20-3, 38-43	0.55	0.62	2.88	5.49	10.99	15.66	20.81	16.41	8.72	6.87	7.97	2.88	0.14	0.00
397A-21-2, 106-110	0.73	1.39	5.15	10.11	15.01	18.83	21.19	14.77	6.17	4.18	2.24	0.24	0.00	0.00
397A-22-1, 16-22	0.22	1.34	5.12	10.91	17.37	23.16	16.26	12.92	4.68	3.79	3.79	0.45	0.00	0.00
397A-31-1, 47-50	0.56	1.25	3.70	8.41	14.55	12.42	22.90	17.19	7.34	5.65	5.14	0.88	0.00	0.00
397A-31-1, 78-83	1.32	1.51	4.92	9.26	14.29	17.75	21.06	16.04	6.05	4.88	2.49	0.39	0.05	0.00
397A-31-2, 31-35	1.21	1.97	5.90	11.12	16.94	19.74	20.42	13.46	3.78	2.87	2.42	0.15	0.00	0.00
397A-31-3, 18-23	0.98	2.32	7.33	12.47	18.70	22.49	16.14	12.22	3.18	2.44	1.22	0.49	0.00	0.00

TABLE 4
Statistical Estimates of Data of 14 Fractions of Grain-Morphometry Analysis of Sand, 0.315 to 0.25 mm in Size (mass %)

Sample (Interval in cm)	Mean	Dispersion	Standard	Skewness	Kurtosis
397-86-2, 9-12	0.249	0.003	0.052	1.336	3.006
397-88-4, 60-63	0.247	0.002	0.048	1.022	2.124
397-72-4, 11-13	0.200	0.003	0.052	1.198	0.988
397A-7-2, 16-19	0.245	0.003	0.051	1.023	1.871
397-75-2, 83-85	0.232	0.002	0.048	0.746	0.800
397A-6-2, 28-31	0.255	0.003	0.054	0.861	1.401
397A-5-2, 25-29	0.270	0.004	0.064	1.214	1.928
397-71-2, 14-17	0.201	0.002	0.044	0.603	-0.208
397A-31-3, 6-9	0.230	0.002	0.046	1.025	1.586
397A-20-2, 50-54	0.226	0.002	0.043	0.671	0.631
397-71-1, 126-130	0.213	0.002	0.045	0.655	0.080
397-95-4, 70-74	0.235	0.003	0.053	1.658	4.809
397A-32-1, 99-101	0.231	0.002	0.049	1.328	2.765
397-93-3, 15-19	0.227	0.002	0.046	0.653	0.186
397-72-5, 28-30	0.206	0.002	0.042	1.932	7.291
397-93-2, 130-133	0.248	0.004	0.064	1.636	2.938
397-90-1, 97-100	0.215	0.002	0.039	0.536	0.079
397A-22-1, 13-16	0.219	0.002	0.049	1.331	2.473
397-96-2, 8-12	0.248	0.003	0.054	1.348	2.803
397A-102-1, CC	0.237	0.002	0.050	1.234	3.135
397A-6-1, 91-94	0.225	0.002	0.043	0.671	0.178
397A-5-2, 88-92	0.221	0.003	0.052	0.789	0.698
397-72-3, 104-106	0.187	0.002	0.040	1.336	1.380
397A-21-2, 98-102	0.236	0.002	0.046	0.874	1.269
397-94-1, 81-84	0.238	0.002	0.044	0.615	0.238
397-93-1, 60-63	0.234	0.002	0.046	0.700	1.295
397-96-1, 26-29	0.219	0.002	0.040	0.634	0.388
397A-31-1, 77-81	0.231	0.002	0.042	0.742	1.022
397-95-5, 6-8	0.266	0.004	0.061	0.905	1.405
397A-31-2, 10-13	0.231	0.002	0.047	1.147	2.173
397-97-1, 24-29	0.243	0.002	0.045	0.566	1.013
397-76-4, 5-9	0.224	0.002	0.047	0.951	1.788
397A-7-1, 91-94	0.245	0.003	0.055	0.851	1.325
397A-31-1, 45-50	0.218	0.003	0.051	1.154	1.916
397A-32-2, 43-47	0.241	0.003	0.056	1.131	1.891
397A-20-3, 31-36	0.244	0.003	0.059	1.251	2.101
397A-19-3, CC	0.236	0.002	0.049	0.784	0.578
397-71-1, 119-123	0.226	0.002	0.042	0.634	0.159
397-72-3, 100-104	0.212	0.002	0.043	0.756	0.342
397-72-4, 5-11	0.221	0.002	0.044	0.879	1.176
397-72-5, 20-23	0.190	0.002	0.043	1.491	2.724
397-73-2, 100-106	0.218	0.002	0.044	0.907	1.205
397-76-4, 1-10	0.233	0.003	0.052	1.692	5.322
397-85-2, 80-81	0.229	0.002	0.046	0.909	1.192
397-85-3, 116-120	0.233	0.002	0.047	0.587	0.425
397-85-4, 44-49	0.226	0.002	0.044	0.776	0.715
397-86-1, 130-135	0.230	0.002	0.045	0.766	0.697
397-94-1, 65-70	0.227	0.002	0.045	0.599	0.262
397-96-5, 15-19	0.229	0.002	0.046	0.586	0.114
397-96-1, 33-39	0.232	0.002	0.046	0.571	0.109
397-96-2, 0-4	0.231	0.002	0.044	0.553	0.232
397-97-1, 15-20	0.235	0.002	0.045	0.651	0.307
397A-1-3, 41-45	0.232	0.002	0.043	1.024	2.323
397A-2-3	0.280	0.002	0.046	-0.157	-0.029
397A-5-2, 91-96	0.241	0.002	0.044	0.481	0.081
397A-6-1, 91-95	0.252	0.003	0.053	1.049	1.840
397A-6-2, 20-26	0.257	0.003	0.052	0.742	0.906
397A-7-1, 83-89	0.253	0.003	0.057	1.408	3.124
397A-7-2, 25-30	0.253	0.003	0.055	0.981	1.485
397A-32-2, 31-35	0.235	0.003	0.051	1.154	2.016
397A-32-1, 90-93	0.250	0.003	0.058	1.176	2.081
397A-20-2, 52-60	0.252	0.003	0.056	1.193	2.100
397A-20-3, 38-43	0.226	0.003	0.053	1.365	3.076
397A-21-2, 106-110	0.246	0.003	0.056	1.193	1.962
397A-22-1, 16-22	0.248	0.003	0.054	0.824	1.009
397A-31-1, 47-50	0.236	0.003	0.056	1.244	2.161
397A-31-1, 78-83	0.246	0.004	0.060	1.374	2.521
397A-31-2, 31-35	0.254	0.004	0.060	1.209	1.965
397A-31-3, 18-23	0.260	0.004	0.059	1.034	1.399

Calculation of statistical estimates for grain-size analysis was conducted on the basis of three scales:

Logarithmic scale $\lg X_i$; logarithmic scale γ (accepted in the USSR), where $\gamma = -10 \log_{10} X$; and logarithmic scale ζ (accepted in the USA), where $\zeta = -\log_2 X$. The calculation of statistic estimates in Table 2 was done in the γ scale.

RESULTS

The aims of this investigation include a study of lithologic characteristics as well as understanding the genesis of the lower and middle Miocene sandy sediments on the continental slope offshore from the western Sahara Desert.

Periodicity of Sedimentogenesis

Within the stratigraphic studied interval, the cycles of three orders can be distinguished with a certain degree of conventionality (Figure 1).

On the basis of changes in grain-size composition, third-order symmetrical cycles are clearly distinguished. They reflect the pulsating character of the supply of clastics from the shelf to the continental slope. Each cycle is characterized by successive changes in average size (Ma) of sandy grains and of their standard deviation (σ). A tendency toward an increase of values of these grain-size parameters uphole is observed at the beginning of the cycle. Toward the end of each cycle, there is a tendency toward a decrease in values.

In the lower and middle parts of the third-order cycles, there is no obvious correlation between the average size of clastic grains (Ma) and their sorting (δ). This indirectly indicates an absence of differentiation processes of the clastic grains during their downslope transport as suspension flows (Figure 2, Field II).

The transport of clastic particles apparently was carried out by rolling and saltation, as well as by suspension. This is one of the most likely explanations of the presence of three subdominant modes reflecting the coarse, medium, and fine fractions on the sediment distribution curves. However, it is possible that the transport of part of the sandy material was not related to processes of sedimentary differentiation. The presence in the coarse-grained fraction of a minor admixture of clastic material, which constitutes the "tail," testifies to

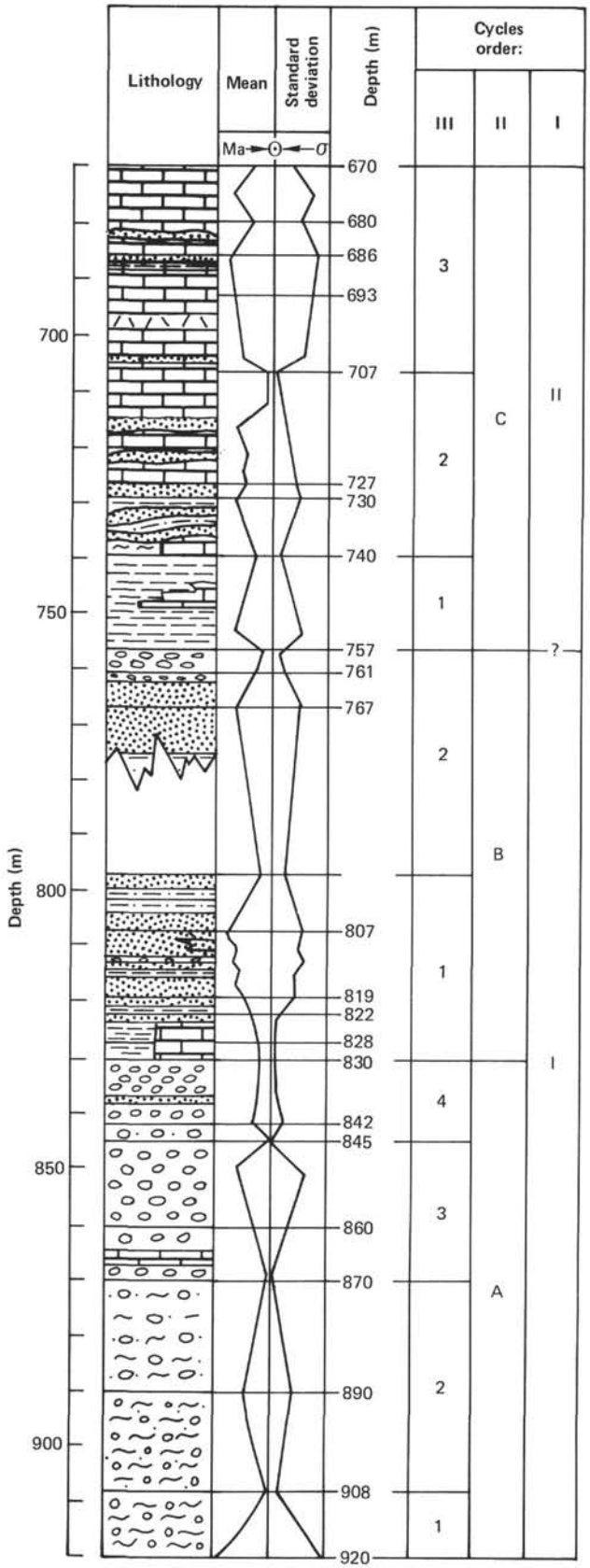

Figure 1. *Scheme of changes of grain-size parameters of the mean (Ma) and standard deviation (σ) of sandy fractions from samples from Hole 397.*

the existence of an additional source of clastic material. This material could be supplied by landslides, eolian transport, or igneous activity.

Each cycle of the third-order ends in a clayey-aleurite deposit with a minor admixture of well-sorted sandy material. The prevailing particle size (Ma) in these deposits is usually 0.06 to 0.05 mm. The sandy part of the distribution is characterized by clearly defined skewness and high kurtosis values. Stable linear dependence, manifested by improved sorting and a decrease in average size (Figure 2, Field I), most probably testifies to the differentiation of clastic material during conditions of "progressive" sorting (Swift, 1970).

In the middle Miocene part of the section, sedimentary cycles of the third order are less clearly defined. The relatively rapid pulsations which determined the periodicity of the third-order cycle were taking place against a background of more prolonged and stable vertical oscillatory crustal movements. These movements were reflected in the alternation of the larger second order cycles, i.e., A, B, and C.

The change in grain-size composition of the lower Miocene deposits within Cycle A reflects a general tendency towards uplift in the source area. In the upper portion of this cycle (870 to 860 m sub-bottom), in addition to the appearance of limestone and dolomite interlayers, a relative increase in sandy material could imply continental slope erosion. In the interval 850 to 845 meters, sand interbeds with distinct features of dynamic processing of clastic material occur (Sample 397-88-4, 60-63 cm). Apparently, at the temporal end of Cycle A, bottom flows existed in the near-slope area. This serves as indirect evidence of proximity of the shelf edge.

The boundary between Cycles A and B is based on the appearance of the first features of prolonged general subsidence, accompanied by the accumulation of clayey-aleurite and carbonate material. Cycles of the third order in this part of the section become less distinct. This indicates attenuation of pulsating movements, controlled by persistent subsidence of the Earth's crust.

At the boundary between Cycles B and C, a notable revival of pulsating movements is observed. Their manifestations uphole gradually become less distinct. Cycle C ends in a series of predominantly carbonate deposits which were formed under conditions of continuing general subsidence.

The largest lithostratigraphic limits in Hole 397 (Figure 1) are confined to the boundaries of Cycles A and B (830 m) and Cycles B and C (757 m). Apparently, the boundary between the lower and the upper Miocene can be confined to one of these limits. The available data are not enough for adequately solving this problem; conditionally, this boundary in Figure 1 is drawn at 757 meters.

Genetic Types of Clastic Material

It has been assumed that the possibility existed of a periodic supply of eolian and volcanogenic material to

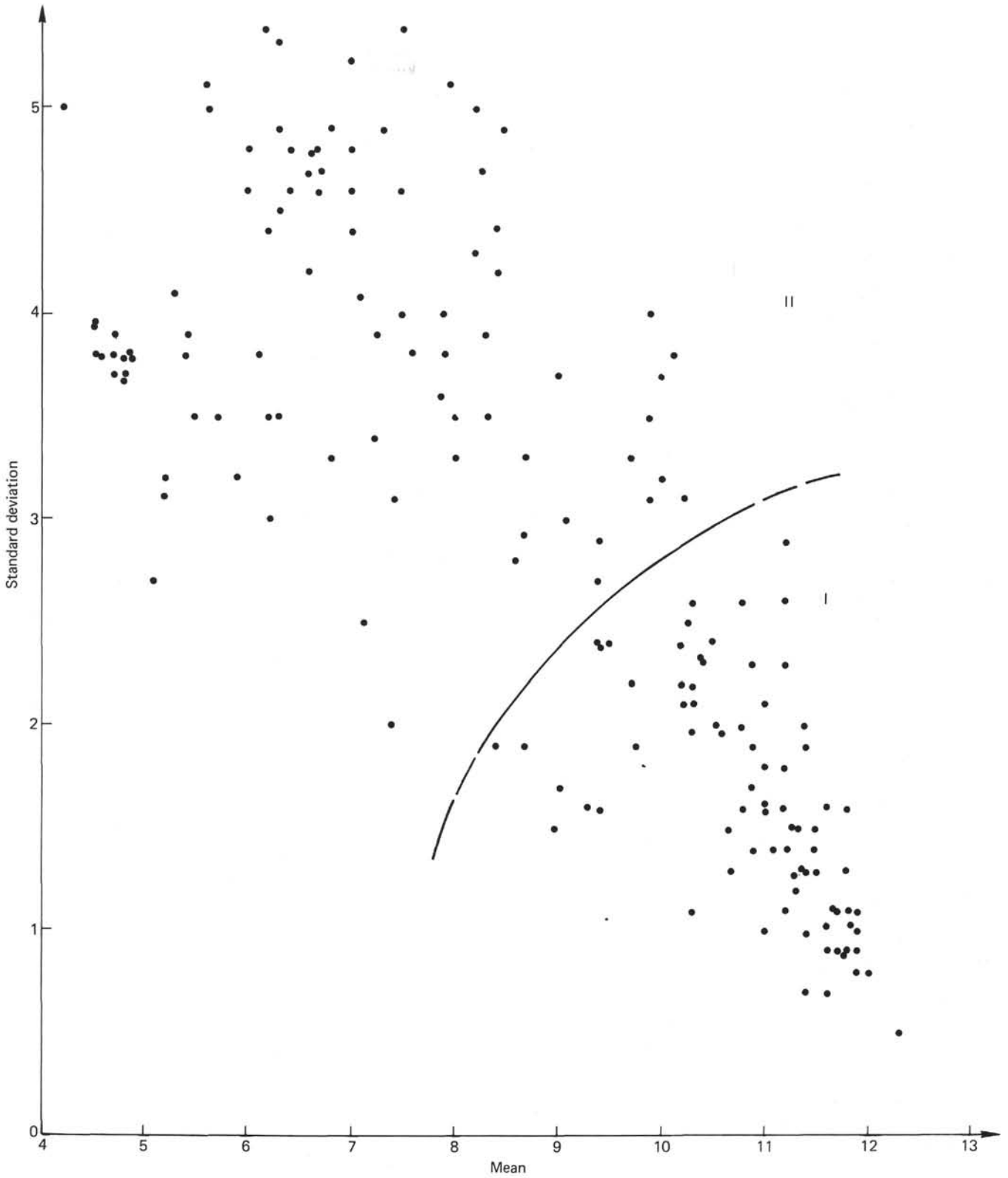

Figure 2. *Diagram of mean (Ma) and standard (σ) (in logarithmic scale) on the basis of grain-size data analysis of sediment from Holes 397 and 397A. Field I corresponds to well-sorted, fine sandy sediments from the upper parts of cycles. Within limits, the linear relationships between Ma and σ is clearly seen. Field II corresponds to poorly sorted non-equigranular sandy sediments from the lower and middle parts of the cycles. There is no distinct relationship between the size and sorting.*

the foot of the continental slope. In Figure 3A, the distribution of sand grains from Sample 397-72-3, 104-106 cm is given (686 m). To determine the causes of a polymodal distribution of this type, a morphoscopical study of the surface of sand grains was carried out on the basis of the Cailleux (1972) method with a quantitative calculation of grains of various types.

Types of sand grains (established in Sample 397-72-3, 104-106 cm) are shown on Plate 1. The content of eolian grains in this sample (Plate 1, Figures 1 and 2) is 40.5 per cent; well-rounded grains of marine origin (Plate 1, Figure 3) comprise 18.9 per cent; and angular quartz and feldspar grains of polygenetic origin (Plate 1, Figure 4) comprise 21.7 per cent. A quantitative plot of these types of grains, based on morphometric classes, is shown in Figure 3B.

Distribution of eolian material through the section is extremely irregular. In Sample 397-85-3, 116-120 cm, their amount is 11 per cent; in Sample 397-93-2, 130-133 cm, it is < 1 per cent; and in Samples 397A-20-2, 50-54 cm and 397-96-1, 33-39 cm, eolian material is absent.

In some samples confined to the base of the third-order cycles, the presence of volcanogenic material was established (Plate 2). In Sample 397-73-2, 100-106 cm (the base of Cycle C-3), the amount of non-rounded euhedral feldspar grains (Plate 2, Figure 2) is 30 per cent. The content of non-rounded amphibole grains with a vesicular surface, extremely characteristic of volcanigenetic particles (Plate 2, Figure 1), is nearly 1 per cent in this sample.

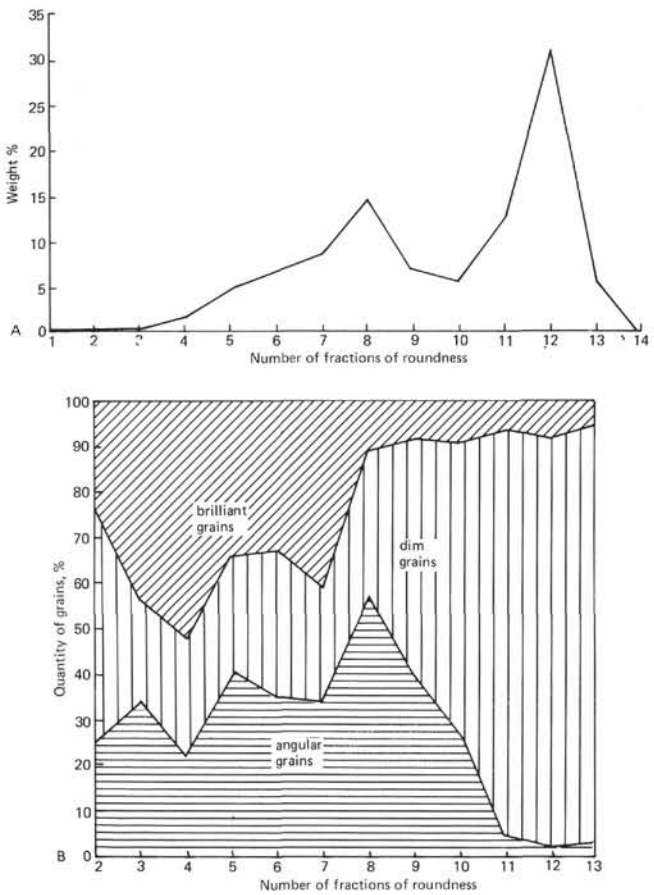

Figure 3. *(A) Frequency (distribution curve based on grain-morphology analysis) of sandy grains ranging in size from 0.315 to 0.25 mm, from Sample 397-72-3, 104-106 cm. (B) Correlation between marine (rounded, brilliant; Plate 1, Figure 3), eolian (rounded, dim; Plate 1, Figures 1 and 2), and angular polygenetic (Plate 1, Figure 4) sandy grains in the grain-morphology study fractions. Sample 397-72-3, 104-106 cm; 0.315 to 0.25 mm fraction.*

SUMMARY

As a result of an investigation of the grain-size and grain-morphologic composition of lower and middle Miocene sandy sediments of the continental slope off northwestern Africa, the following were established:

1). A cyclic structure for the lower and middle Miocene deposits is present in Holes 397 and 397A.

2). There is a development of a second-order cyclic recurrence by long-time stable epeirogenic movements, and of third-order cyclic recurrence due to a pulsating supply of clastic material from the shelf to the continental slope.

3) There is heterogeneity of the sandy material, controlled by a periodically increasing supply of eolian and volcanogenic material to the continental slope.

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PLATE 1
Sand grains of size fraction 0.315 to 0.25 mm
from Sample 397-72-3, 104-106 cm.

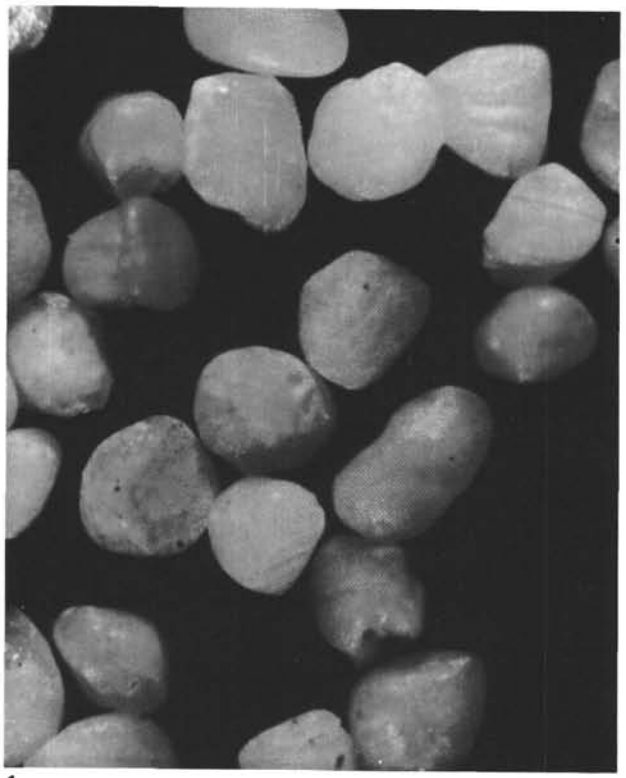
Figure 1 — Well-rounded quartz grains with a dim surface, typical of eolian origin (×50).

Figure 2 — Well-rounded feldspar grains with a dim surface, typical of eolian origin (×50).

Figure 3 — Well-rounded quartz and feldspar grains with smooth, brilliant surface, typical of marine origin (×50).

Figure 4 — Angular quartz and feldspar grains of polygenetic origin (×50).

PLATE 1



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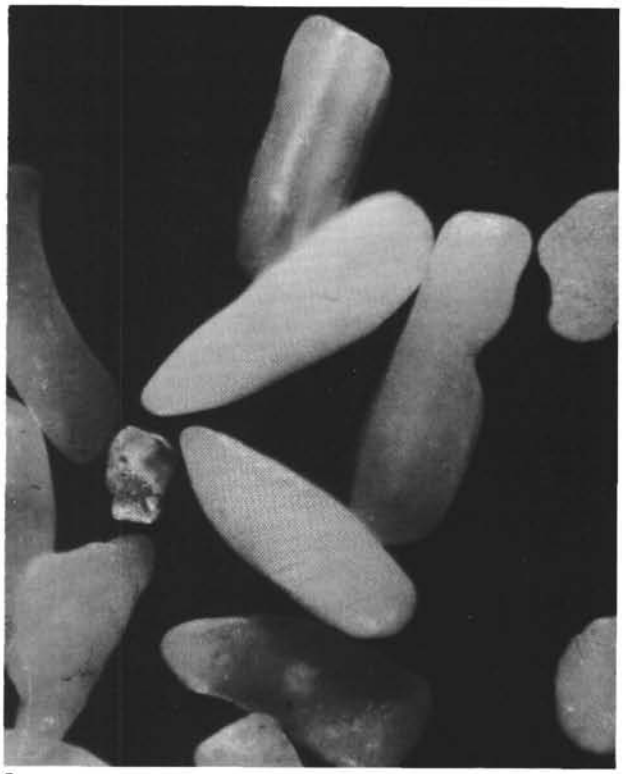

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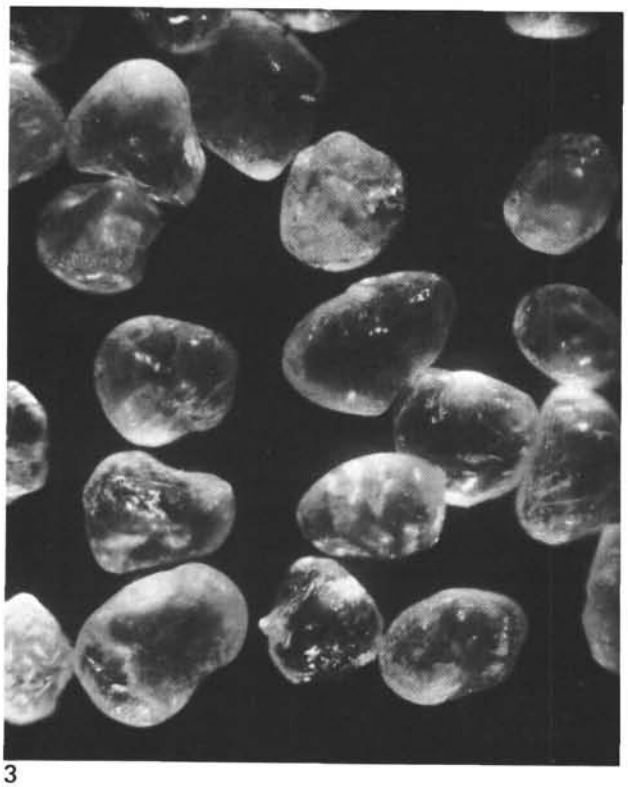

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PLATE 2

1

2

PLATE 2
Volcanogenic material. Sample 397-73-2, 100-106 cm.
Size 0.315 to 0.25 mm.

Figure 1 — Vesicular amphibole grains. In the upper part of the figure: a non-rounded quartz grain (×50).

Figure 2 — Non-rounded feldspar grains with clearly defined roundness (×50).