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Textural and mineralogic analyses of surficial sediments
offshore of Myrtle Beach, South Carolina

by

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INTRODUCTION

As part of a larger effort to assess the mineral resource potential of U.S. Exclusive Economic Zone sediments, textural data and heavy-mineral concentrations and compositions were determined for 111 surface grab samples that were collected from the inner continental shelf offshore of Myrtle Beach, South Carolina (Fig. 1). These data will be used in an attempt to decipher the depositional history in the area and the effects of inner shelf sediment dynamics on heavy-mineral deposition, texture, mineralogy, and economic geology.

Data presented in this report indicate that the sediments offshore of Myrtle Beach may be sources for a number of strategic and critical heavy minerals if concentrations and compositions of heavy-mineral assemblages measured in surficial sediments are persistent with depth. The assemblages include ilmenite, rutile, zircon, and monazite as well as species of lesser economic importance such as garnet, staurolite, sillimanite, kyanite, andalusite, sedimentary phosphate (probably a carbonate fluorapatite), and others.

SAMPLE ACQUISITION

The boundaries of the study area were determined on the basis of bathymetry. Depths from NOAA charts (11535 and 11532) were utilized to locate features noted by Swift and others (1972). Four physiographically

Figure 1.--Map showing the locations of samples collected offshore of Myrtle Beach, South Carolina.

distinct areas were outlined between Myrtle Beach and Winyah Bay, South Carolina. All of the areas are in water depths less than 20 m. A grid was established to sample the bathymetric features; sample sites were chosen at approximately 2,500 meter intervals along 12 transects perpendicular to the coast extending up to 26 km offshore, in mean low water depths ranging from 4.6 to 18.9 m (average 12.2 m). The transects were spaced about 3000-4000 m apart. The locations of samples were determined by Loran C navigation methods and depth profiles were collected between sample stations along cruise tracks for control.

The grab samples were obtained by use of a Peterson grab sampler. Where determinable, the depth of penetration was less than 10 cm. Two to three liters of sediment were generally recovered; about two liters were retained for laboratory analyses.

SAMPLE ANALYSES

Grain-size distribution and carbonate content were determined from 50 g aliquots of homogenized sediment. Silt and clay content (<0.063 mm) was determined on the basis of weight loss after wet-sieving (correction was made for sea salt loss during this procedure, however, wet-sieving may not be accurate for clay content determination because of water surface tension). Sediment grain-size distributions were determined by dry-sieving for 10 minutes with half-phi sieve intervals ranging in openings from 4.00 to 0.063 mm. Moment measure statistics (mean size, sorting, skewness, and kurtosis) were calculated following the methods given by (Carver, 1971). The carbonate content was determined by weight loss measurements following application of 10% HCl to the samples recovered from the wet-sieving procedure. The insoluble residue was sieved again to determine the carbonate-free grain-size distribution. These analyses are incomplete with respect to the

determination of the carbonate content of the <0.063 mm fraction, however, the low overall clay content of these sediments would not significantly affect the overall CO₃ content. The textural data are summarized in Appendix I.

Large volumes of sediment (an average of 868.0 g in a range of 216.5 to 1947.1 g) were utilized for the separation of heavy minerals to compensate for the bias introduced by the particle-sparsity-effect (Clifton and others, 1969). The samples were initially dried and weighed. Microscopic examination of a number of samples indicated that the heavy minerals were (with few exceptions) <1.00 mm in size; consequently the entire sample was dry-screened (10 minute duration) through 18- and 325-mesh (1.00 and 0.044 mm) U.S. Standard stainless steel sieves. The >18 mesh fractions (>1.00 mm size-fraction; labeled as gravel in Appendix I) were weighed to calculate weight percentages, however, they were not processed for their heavy-mineral content. The <10 to >325-mesh fractions (<1.00 to >0.044 mm size-fractions; labeled as sand in Appendix I) were processed in bromoform (specific gravity >2.85) for their heavy-mineral contents. The <325-mesh fractions (<0.044 mm size-fractions including silt and clay; labeled as clay in Appendix I) were weighed to calculate clay percentages, however, they were not processed for their heavy-mineral content. In this context it is noteworthy that both the gravel and the clay fractions may contain heavy-mineral species [garnet and phosphate (probably a carbonate fluor-apatite) in the gravel fractions; zircon and rutile in the clay fractions]; therefore, the reported weight percent heavy-mineral contents (Appendix I) may not be fully representative of the total heavy-mineral assemblage in the samples. It is expected that this effect is of minimal importance to the weight percent heavy minerals (calculated on a dry-weight basis as a function of the initial bulk sample weight) reported in Appendix I.

The heavy-mineral concentrate was split into 4 magnetic fractions to facilitate the mineral identification and quantification process, first by use of a hand-held magnet to isolate ferromagnetic species, followed by use of a Frantz Isodynamic Magnetic Separator set at 15 degrees forward- and 25 degrees side-slopes at amperage settings of 0.5 and 1.0. This procedure resulted in ferromagnetic, magnetic at 0.5, 1.0, and non-magnetic at 1.0 ampere fractions for each heavy-mineral concentrate.

Each magnetic fraction was examined by use of binocular and petrographic microscopes to estimate mineral abundances. Comparison charts for visual estimation of percentage composition (for example, Terry and Chillingar, 1955) were used for this purpose along with a modified point-counting method. Petrographic and X-ray diffraction analyses aided the identification of problematic non-opaque and opaque minerals. An "others" category was also estimated, and included quartz, unidentified opaques, polyminerallic grains, clay balls, and unidentified non-opaques. The identification of zircon and monazite was aided by the use of long- and short-wave (respectively) ultra-violet illumination. The mineralogic data given in Appendix I are not compensated for the densities of different heavy-mineral species.

RESULTS

The average gravel content for the 111 surface grab samples is 4.46 weight percent in a range of 0.09 to 30.43 percent. With few exceptions, the larger particles in this size-fraction are composed of carbonate (shells and shell fragments). The sand-size fraction (<1.00 to >0.044 mm) constitutes an average of 94.78 weight percent in a range of 65.19 to 99.68 percent of the bulk sample. Locally, a significant portion of this size-fraction consists of carbonate. The clay-size fraction (<0.044 mm fraction) is, on the average, 0.77 weight percent in a range of 0.00 to 4.38 percent.

The carbonate content of this size-fraction is unknown. The carbonate content of the samples (determined for the >0.063 mm size-fraction) averages 11.52 weight percent in a range of 2.06 to 50.50 percent.

Summary statistics for minimum, average, and maximum grain size, sorting, skewness, and kurtosis values for the samples on a with carbonate (+CO₃) and carbonate-free basis (-CO₃) are given below; the data for individual samples are given in Appendix I.

	+CO ₃ Grain size (mm)	-CO ₃ Grain size (mm)	+CO ₃ Sorting (phi)	-CO ₃ Sorting (phi)	+CO ₃ Skewness (phi)	-CO ₃ Skewness (phi)	+CO ₃ Kurtosis (phi)	-CO ₃ Kurtosis (phi)
Minimum	0.16	0.16	0.50	0.45	-3.70	-2.55	0.02	0.01
Average	0.39	0.36	1.01	0.87	-0.29	-0.08	4.59	2.37
Maximum	0.74	0.63	1.76	1.79	8.02	0.85	93.88	31.12

The weight percentage of heavy minerals (calculated as a weight percentage of the bulk sample on a dry weight basis) ranges from 0.16 to 6.16, averaging 1.23 percent. The heavy-mineral assemblage consists (in decreasing order of abundance) of ilmenite, epidote, pyroboles (undifferentiated pyroxenes and amphiboles), glauconite, sedimentary phosphate (probably a carbonate fluorapatite), staurolite, aluminosilicates (sillimanite, kyanite, and andalusite), tourmaline, zircon, rutile, leucoxene (altered ilmenite), garnet, monazite, and limonite. An "others" group was also estimated and may contain unidentified opaques and non-opaques, quartz, clay balls, polyminerallic grains, and sulfides (authigenic pyrite and marcasite). The standard deviation associated with these variables is very high; not all samples contain every heavy-mineral phase.

DISCUSSION AND CONCLUSIONS

Sedimentologic, geomorphologic, and mineralogic criteria enabled us to define a number of depositional environments within the study area. These include channel deposits of the Pee Dee River prior to the migration

of the River's depocenter to its present location to the south, ebb tidal deltas, distributary mouth bars, and submerged bars at an angle to the beach.

The samples from the study area contain an average of 1.23 weight percent heavy minerals with a maximum of 6.16 percent. The heavy-mineral species of economic interest are ilmenite, leucoxene (altered ilmenite), rutile, zircon, and monazite. These minerals constitute as much as 70.3 weight percent of the heavy-mineral assemblage and as much as 4.13 weight percent of the bulk samples and average 39.8 and 0.51 weight percent for the heavy-mineral assemblage and bulk samples, respectively. The heavy-mineral assemblage of river-channel thalweg samples contain the largest amount of ilmenite and monazite (42.7 and 2.60 weight percent, respectively). Modern beach sediments contain the highest average amounts of heavy minerals in the bulk samples (1.95 weight percent); sediments from ebb tidal deltas contain an average of 1.60 weight percent heavy minerals in the bulk sample; and the lowest average amount of heavy minerals in the bulk samples (0.79 weight percent) are associated with sediments from regions of low bathymetric relief and smooth surficial expression with few steep slopes.

The results from this study area also indicate a tendency for heavy-mineral species to partition according to depositional environment. For example, the average ilmenite content in samples from relict, ebb-tidal-delta, and modern beach sediments are 31.0, 24.0, and 21.6 weight percent respectively; rutile contents are 3.9, 4.2, and 3.7; zircon contents are 4.6, 3.7, and 5.0 percent; tourmaline values are 6.6, 4.8, and 2.0 weight percent; and pyribole values are 8.0, 13.9, and 4.5 weight percent.

Inasmuch as these data were derived from surficial grab samples, their application to resource assessment is severely limited. They do, however,

provide effective guides for the selection of heavy-mineral exploration targets in the study area. In addition to the commonly occurring heavy-mineral species in the study area, cernyite (a copper-cadmium-tin sulfide) was tentatively identified in the heavy-mineral assemblage of one sample from a former channel of the Pee Dee River.

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APPENDIX I¹

Table showing textural and mineralogic data for 111
surface grab samples collected from offshore of
Myrtle Beach, South Carolina

¹ Heavy-liquid and magnetic separations were done by D.M. Demichaelis,
in USGS laboratories in Reston, VA.

Explanation of footnotes in Appendix I

- 1 Latitude and longitude are given in degrees and minutes
- 2 Mean low tide
- 3 >18 mesh (>1.00 mm) size fraction
- 4 <18 to >325 mesh (<1.00 to >0.044 mm) size fraction, includes some silt
- 5 <325 mesh (<0.044 mm) size fraction, includes some silt
- 6 NV; data not valid
- 7 Magnetite determined on the basis of magnetic susceptibility, luster, and streak
- 8 T; trace, <0.01 percent
- 9 P; present >0.01 to <0.6 percent
- 10 Aluminosilicates (may include sillimanite, kyanite, and andalusite)
- 11 N; not detected
- 12 Undifferentiated pyroxenes and amphiboles
- 13 EHM; Economic heavy minerals (ilmenite + rutile + zircon + monazite) expressed as a percentage of the heavy-mineral assemblage
- 14 EHM expressed as a percentage of the bulk sample

SAMPLE NUMBER	LATITUDE NORTH	LONGITUDE WEST	WATER DEPTH (m)	BULK WEIGHT (g)	WT % GRAVEL	WT % SAND	WT % CLAY	WT % CARBONATE
16	33 33.368	79 00.436	7.0	467.7	2.21	95.80	1.99	13.20
17	33 35.146	78 58.822	7.6	382.9	2.11	96.33	1.56	11.60
18	33 36.730	78 57.055	7.9	377.6	9.37	89.75	0.88	25.80
19	33 38.556	78 55.321	8.5	216.5	14.28	84.02	1.70	39.20
20	33 40.182	78 53.846	7.0	291.6	30.43	65.19	4.38	50.50
22	33 37.755	78 50.500	12.8	414.8	0.90	98.51	0.59	7.20
23	33 36.385	78 48.557	14.6	275.9	1.82	97.00	1.18	5.40
24	33 35.043	78 46.635	16.5	484.6	10.50	87.68	1.82	8.00
25	33 33.240	78 44.096	18.0	401.2	4.73	92.78	2.49	10.79
26	33 32.500	78 43.064	17.1	497.9	4.82	94.20	0.98	3.14
27	33 31.766	78 46.860	17.7	494.3	4.16	94.27	1.57	5.16
28	33 33.262	78 48.741	15.8	496.9	3.42	95.56	1.02	6.72
29	33 34.820	78 50.704	14.3	519.7	1.05	97.69	1.26	6.77
30	33 36.265	78 52.542	13.1	463.5	1.69	97.08	1.23	12.50
31	33 37.520	78 54.172	11.3	482.1	7.03	91.30	1.67	23.88
32	33 32.219	78 59.137	11.0	525.6	5.09	94.52	0.39	14.20
33	33 33.678	78 57.441	10.4	476.4	0.36	99.37	0.27	5.53
34	33 35.864	78 55.853	11.3	390.5	9.77	89.84	0.39	28.03
35	33 34.453	78 54.309	12.2	492.1	3.11	96.37	0.52	13.47
36	33 32.936	78 52.529	13.1	363.1	0.75	98.99	0.26	6.76
37	33 32.189	78 51.777	15.8	617.4	12.48	87.35	0.47	19.47
38	33 31.471	78 50.814	15.2	466.3	0.43	99.49	0.08	5.60
39	33 29.825	78 48.982	16.5	501.0	1.47	98.35	0.18	2.44
40	33 28.100	78 46.950	17.7	512.7	0.23	99.56	0.21	5.19
41	33 30.202	78 44.638	18.9	506.3	3.17	96.33	0.50	2.22
42	33 25.918	78 45.964	18.0	483.4	1.20	98.35	0.45	3.91
43	33 24.337	78 48.100	15.5	391.2	0.27	99.52	0.21	4.84
44	33 26.303	78 49.720	14.3	385.4	0.18	99.34	0.48	4.64
45	33 27.720	78 51.144	13.7	335.3	0.52	99.30	0.18	3.43
46	33 29.432	78 52.730	11.6	408.6	0.90	98.92	0.18	4.01
47	33 30.752	78 54.077	9.1	355.8	0.44	99.56	0.00	2.54
48	33 31.320	78 54.632	10.1	304.7	0.51	99.47	0.02	7.77
49	33 31.994	78 55.321	8.5	431.0	1.15	98.83	0.02	5.66
50	33 32.458	78 55.844	8.8	402.3	1.42	98.56	0.02	6.08
51	33 30.894	78 57.807	9.4	565.4	10.92	89.06	0.02	23.89
52	33 30.712	79 00.783	5.5	426.4	0.39	99.57	0.04	2.06
55	33 29.779	79 01.565	9.1	374.2	0.63	98.74	0.63	6.25
56	33 28.704	79 00.311	10.4	384.6	9.09	90.60	0.31	30.54
57	33 27.270	78 58.408	12.8	287.3	5.64	93.18	1.18	20.44
58	33 26.608	78 57.756	13.4	409.5	5.86	92.84	1.30	21.62
59	33 25.603	78 56.529	13.4	394.0	12.70	87.14	0.16	16.84
60	33 23.952	78 55.275	14.0	347.8	0.50	98.70	0.80	9.70

SAMPLE NUMBER	LATITUDE NORTH	LONGITUDE WEST	WATER DEPTH (m)	BULK WEIGHT (g)	WT % GRAVEL	WT % SAND	WT % CLAY	WT % CARBONATE
61	33 22.990	78 54.686	16.2	365.6	1.61	96.98	1.41	3.50
62	33 21.682	78 53.504	16.8	366.3	1.55	98.14	0.31	3.94
63	33 20.851	78 52.103	17.1	338.3	6.47	93.47	0.06	2.21
64	33 19.835	78 53.426	14.3	422.7	1.33	98.62	0.05	2.65
65	33 21.107	78 54.493	14.0	366.6	0.57	99.38	0.05	3.43
66	33 22.365	78 55.561	12.8	406.2	0.92	99.00	0.08	3.86
67	33 23.341	78 56.419	12.8	299.8	0.42	98.76	0.82	7.54
68	33 24.360	78 57.265	11.0	365.5	0.68	97.73	1.59	6.45
69	33 25.348	78 57.940	10.4	382.0	1.95	98.05	0.00	8.71
70	33 25.579	78 58.056	9.8	400.2	6.86	92.97	0.17	13.64
71	33 26.144	78 58.418	9.1	450.1	4.42	95.42	0.16	12.71
72	33 29.560	78 59.220	8.2	1692.9	0.24	99.62	0.14	3.86
73	33 27.889	78 57.145	10.7	1496.4	0.13	99.68	0.19	5.25
74	33 26.308	78 55.839	12.2	1638.7	0.37	99.44	0.19	6.35
75	33 24.548	78 54.429	12.8	1947.1	1.61	98.16	0.23	6.75
76	33 23.482	78 53.706	14.0	1577.0	2.27	96.56	1.17	11.08
77	33 22.276	78 52.731	13.7	1659.0	0.86	98.96	0.18	3.35
78	33 20.574	78 51.314	15.8	1439.2	0.32	99.34	0.34	3.15
79	33 20.917	78 51.013	15.2	1569.4	0.16	99.61	0.23	2.62
80	33 21.563	78 50.385	15.8	1794.8	1.65	98.10	0.25	4.12
81	33 22.558	78 49.497	18.3	1774.0	4.04	95.14	0.82	2.61
82	33 23.589	78 48.264	18.3	1616.2	7.89	91.68	0.43	17.63
83	33 24.038	78 50.616	15.5	1663.4	2.30	97.48	0.22	3.43
84	33 25.193	78 51.742	16.5	936.2	0.40	99.27	0.33	7.24
85	33 26.150	78 52.712	14.0	1106.2	3.01	96.80	0.19	4.80
86	33 27.314	78 54.055	14.0	1145.5	3.33	96.30	0.37	8.00
87	33 28.590	78 55.322	11.9	1124.1	3.57	95.94	0.49	12.23
88	33 29.444	78 56.245	11.0	1168.4	8.63	91.07	0.30	14.79
89	33 28.541	79 02.648	7.6	1291.5	7.81	91.98	0.21	22.99
90	33 27.633	79 01.395	8.2	1190.7	0.64	99.26	0.10	5.03
91	33 26.975	79 00.256	10.4	1152.9	10.80	88.93	0.27	18.50
92	33 25.792	79 00.720	12.2	970.0	0.83	98.91	0.26	6.06
93	33 30.375	79 02.492	5.5	1010.6	1.05	97.48	1.47	5.97
94	33 29.355	79 03.971	6.7	1028.7	0.70	98.40	0.90	5.92
95	33 28.364	79 05.090	6.4	981.5	21.57	76.42	2.01	26.15
96	33 25.736	79 06.813	6.7	806.0	1.26	97.28	1.46	11.29
97	33 23.780	79 07.787	7.3	1036.1	16.01	81.64	2.35	26.20
98	33 18.742	79 05.158	14.0	1174.4	6.87	91.57	1.56	10.15
99	33 14.797	79 01.025	14.9	935.5	4.61	94.44	0.95	2.90
100	33 16.339	78 59.648	14.0	1180.5	2.74	96.97	0.29	6.04
101	33 17.164	78 57.582	15.2	1139.2	1.11	98.50	0.39	6.47
102	33 18.343	78 55.362	15.5	1339.4	2.21	97.01	0.78	3.57
103	33 20.890	78 52.343	15.5	1356.1	1.28	98.43	0.29	2.41

SAMPLE NUMBER	LATITUDE NORTH	LONGITUDE WEST	WATER DEPTH (m)	BULK WEIGHT (g)	WT % GRAVEL	WT % SAND	WT % CLAY	WT % CARBONATE
104	33 20.173	78 56.773	16.5	1407.0	4.68	94.64	0.68	6.01
105	33 21.943	78 57.938	17.1	1329.4	8.58	88.96	2.46	11.19
106	33 23.739	78 59.109	14.3	1282.1	1.24	98.00	0.76	9.05
107	33 24.814	78 59.906	14.6	1275.0	4.13	94.61	1.26	19.99
108	33 26.639	79 02.208	11.6	1243.3	1.31	98.24	0.45	6.99
109	33 27.098	79 04.134	11.0	1234.7	23.41	75.67	0.92	23.61
110	33 24.155	79 05.706	9.8	1222.0	2.33	97.46	0.21	15.88
111	33 21.269	79 08.349	4.6	1256.1	0.09	98.59	1.32	4.57
112	33 18.227	79 08.646	6.4	1257.6	2.60	97.19	0.21	6.45
113	33 16.417	79 09.563	7.0	823.2	2.13	93.49	4.38	15.30
114	33 15.924	79 09.232	7.0	1283.0	25.17	74.27	0.56	35.81
115	33 15.073	79 08.598	9.1	1253.6	7.08	92.69	0.23	13.89
116	33 19.244	78 58.929	13.7	1261.1	6.87	92.80	0.33	6.53
117	33 20.677	78 59.939	11.3	1275.5	1.76	97.96	0.28	13.85
118	33 22.219	79 00.958	12.2	1348.0	6.60	92.93	0.47	29.55
119	33 23.876	79 02.007	11.3	1229.5	18.56	79.21	2.23	44.91
120	33 25.107	79 02.808	9.8	1257.6	0.56	98.25	1.19	28.74
121	33 22.456	79 04.400	9.4	1288.6	15.25	84.69	0.06	38.88
122	33 20.842	79 03.115	11.0	1275.9	4.53	94.76	0.71	22.46
123	33 19.063	79 01.777	14.3	1331.5	2.70	96.13	1.17	9.93
124	33 17.953	79 00.800	14.3	1249.1	1.22	97.21	1.57	8.54
125	33 16.183	79 02.082	12.5	1169.5	4.62	94.03	1.35	12.36
126	33 16.961	79 02.862	13.4	1236.2	3.53	94.47	2.00	7.85
127	33 18.252	79 03.814	10.4	1340.4	2.01	97.25	0.74	6.13
128	33 19.453	79 04.782	10.1	1305.9	4.76	94.50	0.74	10.74
129	33 20.064	79 05.261	12.5	1000.1	4.40	94.25	1.35	17.52

SAMPLE NUMBER	+C03 MEAN SIZE (mm)	-C03 MEAN SIZE (mm)	+C03 SORTING (Phi)	-C03 SORTING (Phi)	+C03 SKEWNESS (Phi)	-C03 SKEWNESS (Phi)	+C03 KURTOSIS (Phi)	-C03 KURTOSIS (Phi)	WT % HM
16	0.236	0.201	1.061	0.816	-0.168	-0.037	0.357	0.085	2.99
17	0.231	0.205	0.933	0.664	-0.165	-0.029	0.380	0.100	1.88
18	0.441	0.350	1.449	1.273	-0.922	-0.359	5.858	1.529	2.77
19	0.402	0.233	1.673	1.024	-1.691	-0.059	7.603	0.201	1.89
20	NV	0.195	NV	0.964	NV	0.000	NV	0.118	1.06
22	0.360	0.350	0.953	0.920	-0.010	0.030	0.650	0.488	1.15
23	0.519	0.519	0.962	0.951	0.469	0.591	4.959	4.853	0.40
24	0.598	0.587	1.362	1.360	0.453	0.508	35.534	31.117	1.03
25	0.271	0.270	1.433	1.436	-0.410	-0.406	1.091	1.079	1.25
26	0.557	0.553	1.006	0.998	0.207	0.242	8.689	7.832	0.16
27	0.477	0.475	1.140	1.135	0.067	0.080	4.681	4.531	0.91
28	0.588	0.580	0.989	0.984	0.887	0.851	13.734	12.366	0.95
29	0.448	0.444	1.031	1.020	0.237	0.240	2.114	2.019	0.46
30	0.385	0.349	1.002	0.910	-0.051	0.065	1.143	0.525	0.64
31	0.402	0.302	1.354	1.008	-0.656	-0.021	3.777	0.395	1.62
32	0.330	0.263	1.207	0.831	-0.517	-0.057	1.470	0.122	1.18
33	0.197	0.193	0.646	0.514	-0.034	-0.011	0.063	0.016	2.19
34	0.344	0.243	1.389	0.696	-1.047	-0.049	3.089	0.116	2.69
35	0.380	0.345	1.080	0.876	-0.345	-0.083	1.613	0.373	1.04
36	0.337	0.336	0.896	0.824	-0.080	-0.064	0.414	0.240	0.50
37	0.506	0.426	1.503	1.307	-1.009	-0.390	12.310	2.863	1.21
38	0.369	0.362	0.818	0.812	-0.088	-0.074	0.355	0.295	0.50
39	0.525	0.526	0.840	0.834	-0.068	-0.054	2.287	2.256	0.24
40	0.442	0.448	1.000	1.028	-0.154	-0.192	1.298	1.700	0.68
41	0.517	0.522	1.022	1.012	-0.102	-0.088	3.969	4.103	0.43
42	0.428	0.432	0.970	0.932	-0.139	-0.088	1.186	1.016	0.48
43	0.245	0.244	0.781	0.758	-0.071	-0.054	0.115	0.081	1.15
44	0.257	0.253	0.789	0.787	-0.051	-0.045	0.102	0.087	0.95
45	0.408	0.411	0.882	0.876	-0.119	-0.112	0.635	0.628	0.49
46	0.453	0.452	0.855	0.839	-0.084	-0.063	1.027	0.936	0.29
47	0.421	0.413	0.736	0.735	-0.087	-0.067	0.403	0.346	0.45
48	0.346	0.328	0.824	0.756	-0.097	0.045	0.297	0.153	0.75
49	0.353	0.337	0.929	0.850	-0.191	-0.111	0.508	0.269	0.93
50	0.279	0.263	0.826	0.649	-0.147	-0.039	0.278	0.060	0.97
51	0.735	0.631	1.179	1.111	-2.278	-0.317	>100	21.454	0.69
52	0.200	0.187	0.577	0.465	-0.033	-0.008	0.049	0.011	1.42
55	0.185	0.170	0.665	0.490	-0.050	-0.011	0.077	0.015	2.94
56	0.435	0.273	1.410	0.909	-1.111	-0.088	4.978	0.177	0.68
57	0.252	0.198	1.305	0.808	-0.483	-0.064	0.882	0.097	1.64
58	0.333	0.271	1.375	1.121	-0.043	-0.142	1.639	0.392	1.07
59	0.616	0.495	1.296	1.020	-3.701	-0.425	34.589	3.486	1.66
60	0.192	0.187	0.775	0.632	-0.067	-0.025	0.097	0.035	1.78

SAMPLE NUMBER	+C03 MEAN SIZE (mm)	-C03 MEAN SIZE (mm)	+C03 SORTING (Phi)	-C03 SORTING (Phi)	+C03 SKEWNESS (Phi)	-C03 SKEWNESS (Phi)	+C03 KURTOSIS (Phi)	-C03 KURTOSIS (Phi)	MT % HM
61	0.461	0.460	0.951	0.934	0.104	0.130	2.300	2.142	1.31
62	0.397	0.393	0.934	0.994	-0.127	-0.066	0.904	0.674	1.15
63	0.552	0.545	1.034	1.011	-1.028	-0.856	8.224	7.117	5.88
64	0.423	0.421	0.919	0.900	-0.181	-0.160	0.915	0.824	0.85
65	0.403	0.391	0.788	0.764	-0.084	-0.051	0.466	0.326	0.82
66	0.424	0.412	0.839	0.792	-0.118	-0.036	0.776	0.446	0.59
67	0.233	0.226	0.773	0.685	-0.057	-0.022	0.108	0.047	1.35
68	0.261	0.252	0.752	0.642	-0.048	0.005	0.162	0.058	1.05
69	0.399	0.365	0.863	0.681	-0.296	-0.027	0.961	0.148	0.60
70	0.475	0.387	1.112	0.771	-1.228	-0.070	4.892	0.345	0.70
71	0.478	0.406	1.004	0.824	-0.714	-0.122	3.089	0.579	1.43
72	0.263	0.248	0.565	0.499	-0.029	-0.008	0.059	0.017	0.81
73	0.262	0.256	0.616	0.555	-0.031	-0.011	0.058	0.027	0.75
74	0.264	0.266	0.721	0.649	-0.057	-0.024	0.110	0.056	0.96
75	0.419	0.403	0.859	0.761	-0.165	-0.032	0.890	0.392	0.39
76	0.341	0.313	0.981	0.809	-0.149	0.032	0.742	0.178	1.03
77	0.384	0.374	0.818	0.771	-0.063	-0.002	0.449	0.258	0.52
78	0.223	0.219	0.631	0.576	-0.028	-0.010	0.050	0.017	0.97
79	0.200	0.199	0.497	0.464	-0.011	-0.003	0.022	0.008	3.06
80	0.421	0.406	0.908	0.855	-0.161	-0.043	1.100	0.612	0.77
81	0.526	0.524	1.007	0.996	-0.207	-0.192	5.476	5.101	1.10
82	0.342	0.265	1.358	0.898	-0.841	-0.090	2.388	0.188	1.69
83	0.488	0.476	0.899	0.842	-0.305	-0.082	2.286	1.266	0.88
84	0.199	0.193	0.675	0.634	-0.047	-0.032	0.071	0.043	5.22
85	0.543	0.533	0.900	0.885	-0.290	-0.244	3.693	3.189	0.65
86	0.458	0.421	0.995	0.801	-0.577	0.076	3.340	0.580	0.70
87	0.384	0.353	1.024	0.867	-0.386	-0.110	1.365	0.457	1.04
88	0.582	0.557	1.120	1.120	-1.006	-0.890	11.980	8.878	2.21
89	0.443	0.311	1.170	0.557	-1.313	-0.003	4.406	0.061	1.06
90	0.272	0.255	0.598	0.448	-0.062	0.000	0.121	0.012	0.50
91	0.381	0.265	1.406	0.670	-1.432	-0.029	4.221	0.066	0.76
92	0.228	0.220	0.691	0.530	-0.068	-0.010	0.118	0.023	1.28
93	0.163	0.159	0.809	0.625	-0.079	-0.025	0.128	0.035	6.16
94	0.172	0.170	0.658	0.492	-0.049	0.000	0.093	0.008	2.92
95	0.626	0.526	1.761	1.790	-2.989	-2.554	93.880	29.698	0.83
96	0.241	0.221	0.895	0.730	-0.091	0.010	0.279	0.038	1.05
97	0.535	0.405	1.630	1.556	-1.554	-0.858	24.576	5.626	1.73
98	0.423	0.393	1.346	1.294	-0.660	-0.402	4.102	2.503	1.21
99	0.570	0.568	1.009	1.007	-0.244	-0.259	10.617	10.427	1.69
100	0.512	0.505	0.948	0.920	-0.216	-0.069	3.118	2.425	0.42
101	0.388	0.385	0.824	0.832	-0.107	-0.075	0.597	0.514	0.71
102	0.447	0.454	0.987	0.974	-0.106	-0.073	1.837	1.881	0.96
103	0.445	0.446	0.924	0.914	-0.086	-0.053	1.244	1.206	0.49

SAMPLE NUMBER	+C03 MEAN SIZE (mm)	-C03 MEAN SIZE (mm)	+C03 SORTING (Phi)	-C03 SORTING (Phi)	+C03 SKEWNESS (Phi)	-C03 SKEWNESS (Phi)	+C03 KURTOSIS (Phi)	-C03 KURTOSIS (Phi)	WT % HM
104	0.611	0.611	0.976	0.965	0.357	0.533	14.141	13.578	0.62
105	0.439	0.403	1.470	1.404	-0.806	-0.367	6.594	3.500	1.07
106	0.278	0.253	0.879	0.729	-0.119	-0.025	0.284	0.073	0.60
107	0.310	0.250	1.206	0.910	-0.364	-0.053	1.052	0.152	1.15
108	0.218	0.193	0.761	0.471	-0.103	-0.004	0.195	0.011	1.14
109	NV	NV	NV	NV	NV	NV	NV	NV	0.71
110	0.270	0.228	0.915	0.564	-0.223	-0.007	0.489	0.018	1.48
111	0.186	0.179	0.675	0.632	-0.026	-0.017	0.041	0.028	2.91
112	0.266	0.240	0.971	0.665	-0.242	-0.010	0.558	0.032	1.16
113	0.235	0.186	1.037	0.722	-0.148	0.004	0.429	0.034	2.20
114	NV	0.531	NV	1.362	NV	-0.160	NV	11.262	0.45
115	0.421	0.339	1.188	0.795	-1.122	-0.105	3.776	0.305	0.99
116	0.557	0.539	1.036	0.997	-0.963	-0.617	8.292	5.602	0.53
117	0.465	0.432	0.871	0.763	-0.168	-0.001	1.448	0.590	0.68
118	0.687	0.582	1.007	0.941	0.767	0.525	41.543	8.067	0.24
119	0.694	0.454	1.606	1.545	8.019	0.141	>100	7.287	0.76
120	0.356	0.225	1.448	0.684	-1.144	-0.029	3.388	0.092	1.92
121	0.478	0.261	1.612	1.044	-1.647	-0.244	9.178	0.398	0.47
122	0.541	0.472	1.072	0.950	-0.225	0.135	7.242	1.948	0.54
123	0.379	0.354	0.996	0.841	-0.211	0.016	1.194	0.397	2.33
124	0.370	0.365	0.869	0.788	-0.017	0.076	0.679	0.429	0.62
125	0.490	0.445	1.083	0.922	-0.501	0.031	4.844	1.618	0.86
126	0.435	0.427	1.075	1.056	-0.176	-0.091	2.631	2.226	0.97
127	0.389	0.372	0.879	0.759	-0.270	-0.026	1.168	0.388	1.88
128	0.512	0.481	1.098	1.007	-0.508	-0.082	5.547	2.588	0.62
129	0.260	0.220	1.232	1.009	-0.390	-0.186	0.825	0.355	1.51

SAMPLE NUMBER	MAGNETITE %	ILMENITE %	RUTILE %	LEUCOXENE %	PHOSPHATE %	EPIDOTE %	ZIRCON %	TOURMALINE %	GARNET %	ALSIL %
16	T	30.9	5.0	7.1	5.6	15.9	8.5	T	3.0	5.3
17	P	27.8	3.2	4.2	10.0	16.4	4.9	1.5	1.3	8.5
18	T	7.6	0.7	1.0	20.9	3.0	3.3	T	0.6	1.6
19	P	21.9	2.8	2.6	22.1	14.0	6.0	0.7	1.6	2.8
20	T	29.4	3.6	1.3	9.7	20.3	4.5	T	1.3	2.3
22	T	21.7	2.7	1.9	27.4	18.1	2.7	3.6	1.7	2.7
23	P	28.2	2.7	1.8	19.1	24.6	2.7	4.5	1.8	P
24	T	32.0	3.2	1.6	20.0	14.0	3.2	6.6	1.0	1.4
25	P	24.3	3.4	2.8	5.8	20.6	5.8	1.7	0.9	2.6
26	T	25.0	5.3	2.6	5.3	23.7	5.3	6.6	1.3	2.6
27	P	39.4	5.2	2.5	6.5	10.6	6.5	7.4	2.3	2.0
28	P	28.6	3.7	1.3	11.7	12.6	3.7	13.4	2.6	3.5
29	P	19.2	4.6	1.3	14.2	19.2	4.6	7.5	P	5.4
30	T	13.4	3.8	1.0	22.0	16.2	3.8	4.5	1.0	4.1
31	P	17.2	5.8	1.2	17.6	7.6	7.7	2.7	4.7	3.5
32	P	27.3	5.3	1.8	9.3	19.1	5.3	2.9	2.9	4.3
33	T	23.3	4.5	2.7	4.3	11.7	5.7	4.5	1.0	7.2
34	P	10.2	4.2	3.1	18.2	10.1	4.1	4.1	P	6.7
35	P	13.9	2.9	2.6	17.1	19.6	2.9	3.7	2.4	3.5
36	P	15.9	3.4	2.3	16.5	25.6	3.4	7.4	0.6	7.4
37	T	34.7	3.6	2.0	6.0	17.7	4.8	3.7	1.6	6.5
38	T	26.8	1.3	1.7	2.2	25.5	1.7	11.3	1.3	5.6
39	T	39.2	2.5	4.2	3.3	14.2	1.7	7.5	2.5	9.2
40	P	28.6	2.3	0.6	11.4	17.1	3.4	9.4	0.6	3.7
41	T	36.4	2.3	2.7	1.8	23.6	3.2	4.1	1.8	5.5
42	T	22.7	3.3	3.3	4.4	23.0	3.3	8.0	0.7	8.2
43	T	10.8	2.3	3.9	2.3	23.9	4.6	5.0	P	7.5
44	T	6.8	2.0	1.8	2.0	21.6	1.3	5.0	P	6.7
45	T	34.0	1.4	2.2	0.9	23.2	1.4	5.5	P	3.2
46	P	26.2	2.4	3.6	3.6	16.0	1.8	11.8	0.9	8.2
47	T	18.3	2.1	2.6	3.1	21.4	2.1	11.3	3.0	9.4
48	T	25.5	2.4	2.9	2.0	21.9	3.7	7.6	0.7	9.0
49	T	17.1	4.1	6.5	8.2	16.3	8.2	5.8	0.7	11.1
50	T	25.2	3.6	2.8	3.1	23.7	3.6	4.9	0.8	9.7
51	T	29.7	2.5	2.9	3.7	12.6	5.0	6.1	1.4	9.2
52	P	23.8	2.8	2.8	0.6	24.4	2.8	3.8	P	8.5
55	T	21.7	1.9	4.4	4.8	16.8	2.9	3.6	0.8	7.5
56	T	15.7	4.2	4.2	3.6	18.2	4.2	5.2	0.6	10.9
57	T	26.5	3.8	3.2	2.1	21.5	2.9	3.0	1.2	8.4
58	P	41.7	P	1.7	P	25.0	P	3.4	2.0	2.6
59	T	35.1	8.2	3.4	4.5	5.5	3.8	8.3	5.9	8.8
60	T	10.1	3.0	1.8	2.0	21.9	0.8	2.0	1.6	5.8

SAMPLE NUMBER	MAGNETITE %	ILMENITE %	RUTILE %	LEUCOXENE %	PHOSPHATE %	EPIDOTE %	ZIRCON %	TOURMALINE %	GARNET %	ALSIL %
61	T	35.4	4.6	3.4	P	15.5	4.2	7.8	0.9	8.5
62	T	29.2	4.6	1.9	P	22.1	3.1	5.0	1.2	6.6
63	T	47.2	7.1	1.3	1.7	8.0	5.9	5.4	1.4	6.2
64	T	27.2	4.4	1.9	P	20.0	2.6	12.4	1.5	7.6
65	T	28.0	5.0	2.0	5.1	19.3	2.0	6.9	0.6	7.7
66	T	18.1	5.0	2.8	15.8	22.3	3.8	8.6	1.4	6.3
67	T	4.0	4.6	2.5	13.4	19.6	2.1	3.0	P	8.3
68	T	20.8	3.4	2.1	8.1	23.4	2.2	4.9	1.7	6.9
69	T	29.5	4.2	1.5	2.1	21.5	3.6	9.4	1.0	9.0
70	T	20.7	5.8	2.7	11.7	16.2	5.8	7.4	0.6	10.4
71	P	24.6	3.2	1.4	32.4	11.0	4.5	5.0	P	4.8
72	P	34.2	4.9	3.7	1.7	13.6	6.2	8.5	1.5	2.0
73	P	22.7	1.8	4.3	1.2	15.7	3.5	8.3	1.3	9.2
74	P	24.4	3.7	2.8	0.9	17.7	3.7	7.6	0.9	9.5
75	P	21.5	2.5	2.8	2.5	26.9	2.5	5.8	1.3	7.8
76	P	17.2	2.0	1.9	8.3	28.2	2.0	4.8	1.1	1.8
77	T	24.0	3.6	2.2	7.2	20.4	2.4	12.4	P	8.9
78	P	23.1	2.2	2.9	1.0	27.4	3.7	4.6	0.8	2.3
79	T	10.2	10.6	3.9	7.2	20.2	10.6	3.8	0.9	7.3
80	T	21.7	3.6	2.2	3.6	24.6	6.5	8.4	0.9	2.1
81	P	23.1	3.0	1.7	15.4	19.0	3.0	6.4	1.4	4.9
82	P	22.5	6.9	P	26.9	17.9	P	1.8	0.9	4.3
83	P	21.8	6.3	1.6	21.7	15.2	4.2	3.4	0.6	4.8
84	P	9.3	4.6	2.0	45.2	9.9	3.3	1.6	0.6	4.0
85	P	21.1	3.3	1.5	29.2	13.4	3.3	4.5	1.3	4.9
86	P	36.2	5.8	0.8	3.5	17.8	3.0	3.8	1.5	8.4
87	P	30.7	4.6	2.0	4.6	19.8	3.4	4.5	0.6	7.7
88	P	16.2	5.8	2.2	39.4	11.4	5.8	3.7	0.5	4.5
89	T	5.8	4.0	1.1	66.3	5.5	5.6	2.0	P	2.5
90	P	36.1	1.4	1.0	0.7	23.9	2.5	3.7	0.8	2.5
91	T	30.3	4.5	1.5	5.4	24.5	2.6	5.1	1.3	3.4
92	P	32.6	1.7	1.5	0.6	30.0	1.7	4.0	0.6	4.3
93	P	30.5	5.2	2.0	2.6	12.0	5.2	6.0	1.3	9.5
94	P	35.4	8.7	2.4	10.9	5.3	6.6	0.8	1.3	8.9
95	T	29.1	4.2	1.9	7.4	20.4	4.2	3.7	3.4	10.5
96	P	14.3	2.7	1.6	24.0	15.6	3.9	2.0	1.2	5.1
97	P	25.3	3.1	2.3	3.1	18.0	3.1	4.7	5.3	7.7
98	P	29.9	3.2	1.8	1.9	21.0	3.4	6.7	2.3	8.4
99	T	32.0	5.0	1.2	P	23.0	4.2	6.1	2.7	8.7
100	P	22.4	4.5	1.0	P	32.4	3.8	5.4	1.4	5.3
101	P	20.4	3.1	1.2	P	32.9	2.4	8.9	0.8	5.1
102	T	29.1	5.1	1.0	P	22.3	3.4	7.9	1.7	6.9
103	T	9.6	4.0	0.6	P	25.4	3.3	11.6	1.5	6.1

SAMPLE NUMBER	MAGNETITE %	ILMENITE %	ROUTILE %	LEUCOXENE %	PHOSPHATE %	EPIDOTE %	ZIRCON %	TOURMALINE %	GARNET %	ALSIL %
104	P	18.8	4.4	P	T	25.6	4.4	10.2	3.2	7.6
105	T	15.8	4.8	1.0	P	19.1	3.9	7.6	2.3	8.4
106	P	13.8	1.1	1.0	P	24.3	1.1	3.0	1.3	5.3
107	P	11.5	2.6	1.3	1.7	23.3	3.4	3.8	1.3	8.0
108	T	10.6	2.6	1.0	1.7	19.8	2.7	1.7	1.5	9.6
109	P	10.5	3.4	1.1	19.5	16.6	3.4	2.0	2.4	4.2
110	T	24.1	4.6	2.3	6.7	14.4	4.6	2.3	3.2	12.5
111	P	24.0	5.7	5.6	0.9	15.3	4.3	2.6	2.4	11.7
112	T	21.3	3.0	2.7	1.4	19.4	2.0	4.5	1.6	11.3
113	P	22.9	5.2	3.9	P	15.3	3.1	2.8	3.9	8.7
114	P	25.1	3.9	2.9	P	26.1	3.9	3.3	1.6	9.2
115	P	20.1	3.3	1.9	0.8	18.9	3.3	8.1	2.9	7.5
116	T	25.1	3.6	0.8	T	29.4	2.2	7.1	1.5	7.3
117	T	23.1	4.0	1.5	P	24.3	2.4	10.1	1.6	7.2
118	T	23.8	4.2	0.9	1.1	19.0	4.2	6.5	4.5	10.0
119	T	19.5	4.9	1.3	3.7	10.7	4.9	6.2	6.4	9.7
120	T	24.8	6.9	1.3	3.5	11.1	10.4	3.4	5.9	9.6
121	T	17.5	3.0	P	2.3	25.0	2.3	2.1	0.6	7.1
122	P	27.6	4.3	P	2.6	17.9	3.3	8.3	5.7	5.6
123	T	26.7	6.4	1.0	1.5	13.5	6.4	5.0	5.2	5.3
124	T	12.8	2.3	1.5	P	29.7	2.3	6.5	2.3	7.1
125	T	13.1	2.0	0.9	P	30.6	2.0	5.8	3.2	5.4
126	T	22.3	2.2	0.8	P	21.7	3.7	11.0	4.7	7.3
127	T	30.5	2.8	1.6	P	19.6	3.5	7.1	3.1	5.3
128	T	27.2	2.5	0.8	0.9	23.2	4.1	9.6	2.3	8.1
129	T	15.4	4.0	2.3	P	15.8	5.1	8.3	1.6	7.3

SAMPLE NUMBER	MICA %	GLAUCONITE %	MONAZITE %	STAUROLITE %	PYROBOLES %	LIMONITE %	OTHERS %	EHM/C %	WT% EHM
16	N	1.0	1.6	9.1	1.4	T	5.6	58.4	1.75
17	N	4.2	0.8	9.0	4.9	N	3.3	49.4	0.93
18	T	52.2		2.4	T	T	6.7	14.2	0.39
19	N	3.3	T	13.3	3.7	N	5.2	36.1	0.68
20	N	2.1	T	21.3	1.3	T	2.9	41.1	0.44
22	T	P	T	8.4	4.0	N	5.1	31.7	0.36
23	N	T	T	10.2	0.9	T	3.5	35.4	0.14
24	T	T	T	10.4	2.4	T	4.2	41.4	0.43
25	T	T	T	10.1	19.5	T	2.5	38.9	0.49
26	N	T	T	11.8	9.2	T	1.3	40.8	0.07
27	T	T	T	7.9	5.4	T	4.3	55.6	0.51
28	T	T	T	12.8	3.7	T	2.4	40.8	0.39
29	N	2.5	T	10.8	5.4	T	5.3	35.1	0.16
30	N	11.3	T	7.6	6.2	T	5.1	26.1	0.17
31	T	11.4	P	11.2	3.9	P	5.5	35.4	0.57
32	N	0.8	P	7.2	7.9	T	5.9	44.0	0.52
33	T	P	0.9	10.5	18.8	T	4.9	44.3	0.97
34	T	20.4	P	5.8	3.8	T	9.3	28.3	0.76
35	T	10.5	T	11.4	4.3	T	5.2	25.8	0.27
36	N	T	T	4.0	9.7	N	3.8	32.4	0.16
37	N	T	T	6.8	8.3	N	4.3	51.6	0.62
38	N	T	T	6.1	10.8	T	5.7	37.1	0.19
39	N	T	T	9.7	2.5	T	3.5	56.8	0.14
40	N	T	T	7.4	10.0	T	5.5	38.6	0.26
41	N	N	T	7.7	7.7	T	3.2	50.1	0.22
42	N	T	T	4.0	14.4	T	4.7	40.8	0.20
43	T	N	T	2.8	30.5	N	6.4	29.1	0.33
44	N	N	T	4.0	44.4	T	4.4	18.6	0.18
45	N	N	T	12.1	14.3	T	1.8	42.2	0.21
46	N	N	T	10.5	12.1	T	2.9	42.2	0.12
47	N	3.9	T	11.9	5.1	T	5.8	34.5	0.16
48	T	T	T	10.7	9.0	N	4.6	43.5	0.33
49	N	T	T	8.0	7.8	T	6.2	47.0	0.44
50	N	P	T	8.9	10.0	T	3.7	44.9	0.44
51	N	T	T	13.6	9.6	T	3.7	49.3	0.34
52	N	N	T	5.5	17.9	N	7.1	40.7	0.58
55	T	N	T	6.1	24.2	T	5.3	38.4	1.13
56	T	N	P	5.9	22.0	T	5.3	39.2	0.27
57	T	T	P	5.8	18.0	T	3.6	44.8	0.73
58	T	T	T	5.8	13.5	T	4.3	46.0	0.49
59	N	T	1.1	6.5	1.9	T	7.0	60.4	1.00
60	T	N	T	10.5	35.9	T	4.6	21.5	0.38

SAMPLE NUMBER	MICA %	GLAUCONITE %	MONAZITE %	STAUROLITE %	PYROBOLES %	LIMONITE %	OTHERS %	EHM% %	WT% EHM
61	T		P	8.0	6.2	0.9	4.6	56.1	0.73
62	N		1.4	8.3	12.3	T	4.3	46.8	0.54
63	N		2.6	9.0	P	T	4.2	70.3	4.13
64	N		T	8.1	8.5	T	5.8	43.7	0.37
65	N		T	7.8	11.4	T	4.2	44.7	0.37
66	T		T	3.6	7.8	T	4.5	36.0	0.21
67	T		T	5.0	30.1	T	7.4	21.5	0.29
68	T		T	5.7	14.9	T	5.9	35.4	0.37
69	N		T	8.7	5.5	T	4.0	47.8	0.29
70	N		T	8.8	3.6	T	6.3	45.4	0.32
71	T		1.3	5.8	1.8	T	4.2	39.8	0.57
72	N		1.3	13.3	3.7	T	5.4	52.3	0.42
73	T		T	12.7	13.5	T	5.8	41.5	0.31
74	N		P	9.7	13.8	T	5.3	44.1	0.42
75	T		T	10.3	11.1	T	5.0	37.1	0.14
76	T		0.6	7.1	18.8	T	6.2	25.5	0.26
77	T		T	8.6	5.2	T	5.1	41.1	0.21
78	P		T	4.8	19.4	T	7.8	34.2	0.33
79	P		1.4	3.8	14.6	T	5.5	44.0	1.35
80	T		T	6.6	13.7	T	6.1	36.1	0.28
81	T		P	5.5	9.5	0.9	6.2	35.7	0.39
82	T		T	4.9	9.0	T	4.9	33.7	0.57
83	T		T	7.3	7.5	T	5.6	38.7	0.34
84	1.3		P	1.8	7.5	T	8.9	23.2	1.21
85	N		T	6.5	3.6	T	7.4	34.1	0.22
86	N		T	12.1	3.1	T	4.0	54.2	0.38
87	N		T	9.6	6.0	T	6.5	48.4	0.50
88	N		P	4.2	1.4	T	4.9	34.5	0.76
89	T		P	4.4	0.8	T	2.0	19.0	0.20
90	N		T	8.9	15.1	N	3.4	43.5	0.22
91	N		T	10.5	5.9	T	5.0	42.3	0.32
92	T		T	6.6	9.3	P	7.1	41.8	0.54
93	T		1.6	8.7	7.7	T	7.7	54.0	3.33
94	T		P	3.2	9.0	T	7.5	62.0	1.81
95	N		P	6.9	3.4	T	4.9	49.9	0.41
96	T		T	5.1	16.2	T	8.3	27.6	0.29
97	T		1.3	16.4	3.8	T	5.9	42.8	0.74
98	T		T	6.7	9.0	T	5.7	46.7	0.57
99	N		T	3.2	8.8	N	5.1	51.1	0.86
100	T		T	3.1	16.5	T	4.2	37.0	0.16
101	N		T	2.5	17.0	T	5.7	32.2	0.23
102	T		P	3.5	11.6	P	7.5	45.5	0.44
103	T		T	6.6	26.9	T	4.4	23.6	0.12

SAMPLE NUMBER	MICA %	GLAUCONITE %	MONAZITE %	STAUROLITE %	PYROBOLES %	LIMONITE %	OTHERS %	EHM% %	WT% EHM
104	T		N	P	5.9	14.6	T	5.3	35.2
105	T		N	P	9.3	20.4	T	7.4	33.9
106	T		N	0.6	6.7	34.6	T	7.2	22.9
107	T		T	P	5.6	30.8	P	6.7	26.8
108	T		T	P	7.3	35.4	T	6.1	26.5
109	N	2.1		0.8	9.6	19.2	T	5.2	23.4
110	N			1.0	12.5	6.4	T	5.4	49.1
111	N		T	2.6	12.6	7.0	T	5.3	53.9
112	T		T	1.3	15.4	10.1	T	6.0	41.6
113	T		N	1.6	10.7	15.7	T	6.2	45.4
114	N		N	1.4	12.6	6.3	T	3.7	46.4
115	T		N	2.6	13.5	9.7	T	7.4	38.7
116	N		N	6.4	13.5	13.5	T	3.1	39.0
117	P		T	9.8	10.0	10.0	T	6.0	38.2
118	N		T	12.3	10.4	10.4	T	3.1	43.1
119	T		T	13.6	13.3	13.3	N	5.8	40.3
120	N		T	10.5	7.6	7.6	N	5.0	53.0
121	N		N	4.3	31.9	31.9	N	3.9	29.9
122	T		T	9.1	10.6	10.6	T	5.0	40.8
123	T		T	10.0	14.2	14.2	T	3.8	46.8
124	N		T	4.8	23.4	23.4	N	7.3	26.0
125	N		N	7.2	24.4	24.4	T	5.4	23.4
126	T		N	5.7	14.7	14.7	1.0	4.9	36.3
127	T		T	11.1	10.6	10.6	P	4.8	43.7
128	N		T	8.1	8.6	8.6	T	4.6	42.7
129	T		T	6.4	26.0	26.0	T	7.8	34.1