CONDITIONS OF SEDIMENT DEPOSITION IN TAYLOR VALLEY, ANTARCTICA FROM DRY VALLEY DRILLING PROJECT CORES 8–12 (EXTENDED ABSTRACT)

Ross D. Powell

*Victoria University of Wellington, New Zealand**

The Dry Valley Drilling Project (DVDP) drilled five holes in lower Taylor Valley that revealed a thick stratigraphic sequence of glacial drift. In preparing for the interpretation of the DVDP core sediment, samples were collected for grain-size analysis from the glacial drift deposits in different Taylor Valley environments. Processes that deposited the sediment in DVDP 8–12 cores have been interpreted from grain-size analyses with the aid of the field samples. The sediments have been divided into six major types based on cumulative frequency curves and histograms of their grain-size distributions. A summary of the sample statistics is presented in Appendix 1.

Type I samples are poorly to very poorly sorted gravel and sandy gravel (Folk classification) and are interpreted as winnowed lag deposits. Similar grain-size distributions were obtained from present day environments of wind- and water-winnowed deposits on top of the Tedrow Glacier, coarse material from the Wales Stream surface, an intertidal surface layer on New Harbor Beach and gravel from the southeast Taylor Glacier marginal stream.

Type II sediment is poorly to very poorly sorted muddy sandy gravel or gravelly muddy sand which has one broad mode. This sediment may have a constructional origin. That is, it formed from a low density gravity flow or a high density traction current. However, it could also originate by winnowing of fine material either while at the sediment/water interface or while being dropped through the water column. A field example of such a sediment is a wind-sorted diamicton on top of the Tedrow Glacier.

Type III sediment is well to poorly sorted sand or gravelly sand which lacks high proportions of mud. These are the most well sorted samples studied and have modes in the coarse to fine sand grain sizes. These samples are interpreted as fluvial or at least traction current deposits, transported mainly as saltating grains. Samples of present day sediment of this type are from the New Harbor Beach face (above and below 'high tide'), Wales Stream, the southeast Taylor Glacier marginal stream and supraglacial streams at the snout of Taylor Glacier.

* Present address: Department of Geology and Mineralogy, and Institute of Polar Studies, The Ohio State University, Columbus, Ohio 43210, U.S.A.

Type IV samples range widely from poorly to very poorly sorted silty, clayey sand to very poorly sorted gravelly sandy mud. They have fine to very fine sand modes with a noticeable fine tail. Sediment of this type was deposited by traction currents which at times had a lower intensity flow than that which deposited the modal grains. Present day sediment of this type was collected from an abandoned braid of the southeast Taylor Glacier stream and supraglacial meltwater rivulet deposits, subsequently frozen into the surface of the Tedrow Glacier.

Type V sediment is mainly very poorly sorted slightly gravelly sandy mud or clay. The modal grain sizes generally lie outside the range of analysis which was for grain sizes coarser than 9ϕ ($1.95\,\mu$). These are interpreted as suspension deposits with erratic material included.

Type VI samples are extremely to very poorly sorted, ranging from gravelly muddy sand to sandy mud. There are three possible interpretations for such sediment; till (subaerial/subaqueous undifferentiated), gravity flow deposits (probably from a till), and waterlain till.

Additional information from other workers about the environment in which organisms found in the cores lived, allows a more detailed comparison of a sediment and its associated environment of deposition to be made. The lowest intervals in both DVDP 10 and 11 (155.26 m–179.97 m/10; 202.45 m–327.96 m/11) contain *in situ* foraminifera (WEBB and WRENN, 1976, 1979) and diatoms (BRADY, 1979). The forams are suggested to be indicative of water depths between 600–900 m and the assemblage has been compared with a "Fresh Water Shelf Facies" indicative of melting-base ice conditions (WEBB and WRENN, 1976, 1979). Lithologies from core 10 indicate a Taylor Valley source for the sediment. Sediment types in this interval in DVDP 11 are mainly Type VI with the next major component Type V, whereas those at site 10 are dominated by Type V. From the textural differences and lithologic evidence, site 11 must have been closer to source than site 10 at this time. Site 10 has a significantly smaller contribution of debris from floating ice and probably has associated turbidite deposits. Site 10 was probably in an outer iceberg zone, while site 11 was in an inner berg zone or continuous ice tongue area.

All of the other grain-size analyses are from the Pleistocene sediment (*i.e.,* above 154.20 m/10 and 202.45 m/11). From textural characteristics and other evidence, some statements can be made with respect to a glaciomarine sedimentation model. McMurdo Volcanics are predominant in this material and it has been suggested that ice from McMurdo Sound was associated with the deposition of these sediments (PORTER and BEGET, 1978).

Microfossil evidence suggests the water depth during deposition of the Pleistocene record was less the 50 m (WEBB and WRENN, 1976, 1979). Assemblages have low diversity, reworked marine microfauna (WEBB and WRENN, 1976, 1979) and fresh water or marginal marine microflora (BRADY, 1979). From the latter, sea level is inferred to have risen as the stratigraphic thickness increased. Thus sedimentary changes must be a result of changes in position and condition of the ice. Ice in the Ross Sea has been suggested to have been grounded at various times during the Pleistocene (DENTON *et al.,* 1969, 1971).

Two intervals of holes 8–10 have been described as basal till deposits based on their microfabric. Texturally this till is very similar to other diamictons within them which have laminated matrices. Matrix lamination has been described not only from intervals that contain only reworked microfossils associated with thick-walled bivalve detritus but also intervals with *in situ* microfossils. Thus lamination in a diamicton does not appear to be a valid criterion for distinguishing a waterlain till from an orthotill or subaquatic flow till.

Floating ice covered the area at times during the Pleistocene and deposited typical Type VI diamictons. Exactly which diamictons are glacial and which are gravity flow deposits can not be clearly defined. However, as noted previously, some diamictons are primay glacial deposits.

Associated with the diamictons are traction current deposits which include lag gravel and breccia of Type I and high-density winnowed flow deposits of Type II. The main deposition from traction currents was from flows highly fluctuating in intensity (Type IV sediment). Rarely present are intervals of Type V sediment where suspension muds contain some erratic debris. The breccia and conglomerate could be supraglacial debris dumped from overturning bergs close to the calving line or submarine ice-marginal outwash deposits from subglacial or englacial streams debouching their load into the sea. Traction current deposits are the result of less intense flows of similar origin—some may be from density currents originating from basal melting of floating ice. Hence the environment is one close to the ice grounding line where outwash streams have powerful flows and full loads. Thick surface ice with no open water has been suggested for the environment from the diatom microflora (BRADY, 1979). There are some suspension deposits with associated erratics which are more indicative of iceberg zone conditions but they could be formed under continuous ice cover.

The upper 119 m of DVDP 11 and 24.86 m in DVDP 10 are predominantly Type III and IV sediments with associated Type I and II material and rare Type V. The environment is dominated by traction deposited sand, which is sometimes cross-bedded, with associated lag deposits. In the modern environment, New Harbor Beach-face sand has the same distribution of grain sizes as does Wales Stream sediment. Therefore fluvial environments cannot be distinguished from beaches that have greatly diminished wave activity due to floating ice. Some of the Type V sediment may be produced when this ice is stranded and melted in the fluvial environment.

The microfossils present are reworked marine and fresh water organisms (WEBB and WRENN, 1976, 1979; BRADY, 1979). The environment is thought to be littoral with deposition fluctuating from above to below sea level. Here there is intermixing of paratill, flow till, gravity flow deposits, proximal and distal traction current deposits and suspension deposits, comprising an ice-marginal wedge of sediment. Deltaic conditions are suggested by the intervals with consistent 20° dips (*e.g.*, 3.65–12.51 m/10). Furthermore prograding conditions are represented by sediment with dips that increase up the core (*e.g.*, 16.34–3.51 m/11).

The sedimentary succession at DVDP 12 represents a series of ice fluctuations farther inland and are considered to be synchronous with those deposited by Ross Sea ice at the valley mouth. A proglacial water body(ies) was present for a significant amount of the time, suggesting that the body was relatively large. All sediment grain-size distribution types are present and the sequence shows fluctuations of the ice front with associated till, paratill, gravity flow deposits and subaerial and subaqueous traction current deposits.

Acknowledgments

This work is part of an Master's Thesis carried out at Victoria University of Wellington, New Zealand, under the supervision of Dr. Peter BARRETT. The New Zealand University Grants Committee provided financial backing for research in Antarctica and the author was also aided by a McKee Trust Scholarship.

Gratitude is extended for support in the field to Antarctic Division (N.Z. D.S.I.R.), NZARP and U.S. Navy personnel during the 1974–75 summer field season. The DVDP co-ordinators allowed the sampling of the drill cores, and Mr. M. CHAPMAN-SMITH sampled DVDP 12.

References

BRADY, H. T. (1979): Late Neogene History of Taylor and Wright Valleys and McMurdo Sound, derived from diatom biostratigraphy and palaeoecology of DVDP cores. To be published in Antarctic Geoscience, ed. by C. CRADDOCK. Madison, University of Wisconsin Press.

DENTON, G. H., ARMSTRONG, R. L. and STUIVER, M. (1969): Histoire glaciaire et chronologie de la region du Detroir de McMurdo, Sud de la Terre Victoria, Antarctide. Rev. Geogr. Phys. Geol. Dyn., **11**, 265–278.

DENTON, G. H., ARMSTRONG, R. L. and STUIVER, M. (1971): The late Cenozoic glacial history of Antarctica. The Cenozoic Glacial Ages, ed. by K. K. TUREKIAN. New Haven, Yale Univ. Press, 267–306.

PORTER, S. C. and BEGET, J. E. (1978): Provenance and depositional environments of late Cenozoic sediments in permafrost cores from lower Taylor Valley, Antarctica. DVDP Bull., **8**, 74–76.

WEBB, P. N. and WRENN, J. H. (1976): Foraminifera from DVDP holes 8, 9, 10, 11 and 12, Taylor Valley. Antarct. J. U. S., **11** (2), 85–86.

WEBB, P. N. and WRENN, J. H. (1979): Late Cenozoic micropaleontology and biostratigraphy of eastern Taylor Valley, Antarctica. To be published in Antarctic Geoscience, ed. by C. CRADDOCK. Madison, University of Wisconsin Press.

(*Received September 28, 1978*)

Appendix 1

This appendix presents a summary of the sample statistics for all samples analyzed for their grain-size distribution. This includes samples from DVDP 8, 9, 10, DVDP 11, DVDP 12 and field samples. Grain-size units are in phi unless stated in millimeters. Listed are the samples number; the major percentiles; the median grain diameter (MD) in millimeters; an arithmetic measure (QD) represented by the equation $(Q_3-Q_1)/2$, where Q_1 and Q_3 and the 25th and 75th percentiles in millimeters respectively; Folk graphical measures (mean, SDEV-standard deviation, SKEW-skewness, KURT-Kurtosis); Inman graphical measures (standand deviation and skewness); and the grain type proportions (GRAV-gravel, sand, SI/M-silt or silt plus clay material when it is present as less than 10% of the sample, clay). The computer program used was written by Dr. Peter BARRETT and modified by Dr. John ADAMS, and is available in Extended Burroughs Algol from the Geology Department, Victoria University of Wellington, N. Z. The program uses a straight line interpolation between data points when plotted on probability paper.

DVDP 8, 9, 10.

DVDP 8, 9, 10	Percentiles								MD (mm)	QD	Folk measures				Inman		Proportions			
	1	5	16	25	50	75	84	95			Mean	SDEV	SKEW	KURT	SDEV	SKEW	GRAV	SAND	SI/M	CLAY
9- 1- 41	−1.57	−0.43	0.80	1.58	2.35	2.85	3.08	4.10	0.20	0.10	2.08	1.26	−0.29	1.44	1.14	−0.36	2.2	92.4	5.3	—
10- 3- 46	0.79	1.38	1.78	1.97	2.37	2.79	2.99	4.45	0.19	0.06	2.38	0.77	0.19	1.53	0.06	0.03	0.4	93.5	6.1	—
10- 6-167	−8.08	−3.59	0.48	0.85	1.53	2.24	2.80	7.00	0.35	0.17	1.60	2.18	0.06	3.12	1.16	0.09	8.0	81.8	10.2	—
10-14-231	−22.15	−17.04	—	−9.76	−4.70	−0.28	0.93	4.36	25.92	—	−5.31	6.51	−0.15	0.92	6.55	−0.14	69.6	25.0	5.4	—
10-29- 30	−3.92	−2.57	−1.02	−0.08	1.35	2.36	2.85	4.74	0.39	0.43	1.06	2.07	−0.15	1.23	1.93	−0.23	16.2	76.7	7.1	—
8-51-149	−5.47	−4.71	−3.99	−3.63	−2.88	−2.13	−1.63	0.32	7.36	4.00	−2.83	1.35	0.17	1.37	1.18	0.06	89.4	8.2	2.4	—
10-66-118	−3.58	−2.28	0.53	1.00	1.67	2.27	2.65	6.79	0.31	0.15	1.62	1.90	0.03	2.92	1.06	−0.07	8.8	82.7	8.5	—
10- 4-193	−4.31	−3.25	−2.24	−1.72	0.02	2.20	3.79	8.99	0.98	1.54	0.52	3.36	0.36	1.28	3.01	0.25	37.1	47.4	9.0	6.5
10-10-168	1.46	1.80	2.14	2.32	2.71	3.16	3.44	8.26	0.15	0.04	2.76	1.31	0.41	3.14	0.65	0.11	0.0	89.7	5.0	5.4
9-11- 31	−1.21	−0.40	0.33	0.67	1.40	2.18	2.87	8.82	0.38	0.20	1.53	2.03	0.38	2.51	1.27	0.16	1.9	85.6	6.1	6.3
10-15-100	−26.22	−8.33	0.68	1.71	3.47	7.55	10.42	16.26	0.09	0.15	4.86	6.16	0.23	1.73	4.87	0.43	9.8	45.4	21.3	23.4
10-16- 94	1.41	1.77	2.10	2.31	2.85	4.13	6.35	10.57	0.14	0.07	3.77	2.39	0.70	1.98	2.12	0.65	0.0	74.2	14.5	11.3
10-18- 15	2.66	3.33	4.67	5.88	8.16	10.24	11.23	13.24	0.00	0.01	8.02	3.14	−0.02	0.93	3.28	−0.06	0.0	10.9	37.0	52.1
8-14- 49	−2.06	−0.73	0.73	1.27	2.30	4.29	6.19	10.27	0.20	0.18	3.07	3.03	0.44	1.49	2.73	0.42	4.0	69.5	17.2	9.3
10-20- 6	−7.21	−2.33	3.74	4.48	6.68	9.77	11.30	14.40	0.01	0.02	7.24	4.43	0.07	1.30	3.78	0.22	5.5	13.3	43.1	38.0
10-20-119	−0.73	0.26	0.90	1.20	1.66	3.15	4.61	11.32	0.27	0.16	2.46	2.60	0.60	2.33	1.86	0.48	0.7	80.5	10.1	8.7
10-25-165	−34.50	−12.77	−0.07	1.69	4.51	7.40	8.81	11.93	0.64	0.15	4.42	5.96	−0.22	1.77	4.44	−0.03	13.1	32.1	34.3	20.5
10-31- 0	−4.65	−3.19	−1.81	−0.96	1.83	3.77	5.14	6.38	0.28	0.94	1.72	3.19	−0.05	0.83	3.47	−0.05	24.6	52.8	20.2	2.5
10-33-130	−12.02	−7.98	−4.12	−2.22	1.04	2.60	3.32	9.17	0.49	2.24	0.08	4.46	−0.22	1.46	3.72	−0.39	30.5	57.3	5.9	6.2
8-27- 84	−1.58	−0.25	0.86	1.29	2.16	3.48	8.80	16.41	0.22	0.16	3.27	4.01	0.64	3.15	2.97	0.56	2.6	75.3	8.3	13.7
10-34-144	0.59	1.24	1.76	2.03	2.83	5.74	8.41	13.02	0.14	0.11	4.34	3.45	0.70	1.30	3.32	0.68	0.0	68.4	14.2	17.4
10-37-164	2.37	3.26	4.44	5.06	7.07	9.16	10.19	12.30	0.01	0.01	7.23	2.81	0.12	0.90	2.88	0.09	0.0	11.0	51.4	37.6
10-39-235	−6.57	−4.15	−1.86	−0.35	2.27	4.83	8.49	9.55	0.21	0.62	2.30	4.16	0.04	1.08	4.17	0.01	21.1	47.4	22.0	9.4
10-42- 88	1.18	3.35	6.26	6.89	8.43	0.28	11.16	12.95	0.00	0.00	8.62	2.68	0.03	1.16	2.45	0.11	0.1	6.1	37.5	56.3
10-46-131	2.56	3.97	4.95	5.40	6.93	9.57	11.08	14.15	0.01	0.01	7.65	3.08	0.39	1.00	3.06	0.36	0.0	5.2	58.1	36.7
10-47- 6	−0.86	2.68	4.47	4.99	5.85	7.06	6.00	9.70	0.02	0.01	6.04	1.95	0.24	1.39	1.77	0.33	0.9	9.1	73.9	16.0
10-51- 40	−9.38	−1.97	−0.41	0.39	2.30	5.52	7.71	13.12	0.20	0.37	3.20	4.32	0.38	1.21	4.06	0.33	10.1	56.4	18.6	15.0
10-52- 71	1.29	2.15	3.02	3.44	4.56	6.32	8.00	11.00	0.04	0.04	5.19	2.58	0.42	1.26	2.49	0.38	0.0	38.2	45.8	16.0
10-52-108	−2.24	−1.44	−0.68	0.67	4.73	8.31	9.91	13.16	0.04	0.31	4.65	4.86	0.07	0.78	5.29	−0.02	10.3	31.0	31.7	27.0
10-52-135	2.10	4.02	5.60	6.30	7.75	9.78	10.77	12.80	0.00	0.01	8.04	2.62	0.16	1.04	2.59	0.17	0.0	4.9	49.2	45.9
10-55- 61	−10.47	−6.37	−2.44	−1.36	0.61	2.49	3.49	8.35	0.65	1.19	0.55	3.71	0.01	1.57	2.97	−0.03	29.3	57.0	8.3	5.3
10-55-193	1.33	1.70	2.03	2.28	3.11	5.38	7.82	13.14	0.12	0.09	4.32	3.18	0.69	1.51	2.90	0.63	0.0	62.6	21.9	15.5
10-57- 45	−1.39	−0.48	1.17	1.88	3.39	6.47	8.19	11.60	0.10	0.13	4.25	3.59	0.36	1.08	3.51	0.37	2.1	54.7	26.4	16.9
8-50-146/1	−14.65	−3.18	−0.75	0.19	2.28	4.75	6.39	9.49	0.21	0.42	2.64	3.70	0.15	1.14	3.57	0.15	13.8	56.7	20.3	9.2
8-50-146/2	−3.59	−2.23	−0.66	0.41	2.53	4.79	6.82	10.63	0.17	0.36	2.90	3.82	0.20	1.21	3.74	0.15	13.4	54.2	20.9	11.5
8-50-147	1.06	2.30	3.12	3.67	6.07	9.20	10.83	14.15	0.01	0.04	6.67	3.72	0.30	0.88	3.85	0.23	0.3	28.9	37.8	33.0
10-61-205	1.78	3.97	5.41	5.97	7.29	9.43	10.56	12.87	0.01	0.01	7.75	2.64	0.26	1.06	2.58	0.27	0.0	5.1	55.6	39.3
8-53-157	2.73	3.37	3.91	4.15	4.65	5.52	8.94	11.43	0.04	0.02	5.17	1.98	0.60	2.42	1.51	0.52	0.0	18.8	68.1	13.1
10-67- 93	−2.96	−0.08	2.93	4.07	8.79	10.75	11.72	13.70	0.00	0.03	7.79	4.28	−0.29	0.85	4.39	−0.31	4.0	20.7	16.2	59.1
10-68-171	−2.00	2.68	5.59	6.86	9.36	11.92	13.14	15.61	0.00	0.00	9.36	3.85	−0.02	1.05	3.77	0.00	1.3	7.3	27.4	63.9
10-69- 73	2.18	3.68	6.52	7.50	9.63	11.72	12.71	14.73	0.00	0.00	9.62	3.22	−0.04	1.07	3.10	−0.00	0.0	6.0	24.0	70.0

DVDP 11.

DVDP 11	Percentiles								MD (mm)	QD	Folk measures				Inman		Proportions			
	1	5	16	25	50	75	84	95			Mean	SDEV	SKEW	KURT	SDEV	SKEW	GRAV	SAND	SI/M	CLAY
11- 8-125	−2.96	−1.51	0.32	0.88	1.77	2.56	2.92	4.06	0.29	0.19	1.67	1.49	−0.15	1.36	1.30	−0.12	6.5	88.2	5.2	—
11- 11- 55	−1.60	−0.99	−0.51	−0.17	1.16	2.43	2.82	3.49	0.45	0.47	1.15	1.52	0.02	0.71	1.68	−0.01	4.8	92.1	3.1	—
11- 23-210	−8.87	−1.03	0.50	0.90	1.57	2.26	2.74	5.15	0.34	0.16	1.60	1.50	0.10	1.87	1.12	0.04	5.1	87.4	7.6	—
11- 30-207	1.88	2.18	2.44	2.57	2.83	3.12	3.28	3.67	0.14	0.03	2.85	0.43	0.09	1.10	0.42	0.06	0.0	97.7	2.3	—
11- 31- 62	−0.18	1.01	1.78	2.08	2.52	2.84	3.00	3.89	0.17	0.05	2.43	0.66	−0.24	1.25	0.61	−0.21	0.4	97.5	2.1	—
11- 51-300	−2.97	−2.28	−0.64	0.05	1.15	2.05	2.50	3.96	0.45	0.36	1.00	1.73	−0.12	1.28	1.57	−0.14	12.2	82.9	4.9	—
11- 66- 60	−7.20	−4.87	−2.63	−1.51	0.83	2.35	3.04	5.82	0.56	1.32	0.41	3.04	−0.14	1.13	2.84	−0.22	30.4	59.5	10.1	—
11- 69-177	−5.92	−4.60	−3.35	−2.73	−1.24	0.47	1.24	2.99	2.37	2.96	−1.12	2.30	0.10	0.97	2.30	0.08	54.2	42.2	3.7	—
11- 78-236	0.15	0.62	1.03	1.23	1.68	2.27	2.76	5.27	0.31	0.11	1.82	1.14	0.40	1.84	0.87	0.25	0.2	91.7	8.1	—
11- 91-100	−6.86	−5.14	−3.50	−2.69	−1.24	0.03	0.57	1.88	2.35	2.73	−1.39	2.07	−0.12	1.05	2.03	−0.11	54.7	42.8	2.5	—
11- 93-248	0.10	0.73	1.19	1.40	1.88	2.51	2.93	5.82	0.27	0.10	2.00	1.21	0.38	1.88	0.87	0.21	0.2	91.3	8.5	—
11- 1-101	1.96	2.34	2.70	2.87	3.29	4.00	5.00	33.30	0.10	0.04	3.66	5.27	0.71	11.27	1.15	0.48	0.0	75.1	18.6	6.4
11- 7- 7	2.20	2.54	2.83	3.06	3.38	3.93	4.66	8.80	0.10	0.03	3.63	1.40	0.57	2.78	0.19	0.41	0.0	77.4	16.8	5.8
11- 7-126	2.36	2.94	3.91	4.74	7.15	10.53	12.14	15.41	0.01	0.02	7.73	3.95	0.27	0.88	4.11	0.21	0.0	17.2	39.7	43.2
11- 10-223	−4.98	−3.38	−1.60	−0.12	1.63	2.79	3.38	8.25	0.32	0.47	1.13	3.01	−0.08	1.64	2.49	−0.30	18.8	69.3	6.7	5.3
11- 12-196	−0.17	1.44	2.37	2.63	3.08	3.51	4.08	6.63	0.12	0.04	3.18	1.21	0.27	2.42	0.85	0.17	0.2	83.2	14.1	2.5
11- 13- 38	−2.83	2.10	5.31	6.11	7.58	9.35	10.30	12.33	0.01	0.01	7.73	2.78	0.01	1.28	2.50	0.09	2.1	6.9	49.7	41.3
11- 20-120	−3.00	−1.63	−0.02	0.77	2.01	3.18	4.10	8.22	0.25	0.24	2.03	2.52	0.14	1.67	2.06	0.01	8.5	75.0	10.9	5.5
11- 28- 66	−6.52	−4.21	−1.99	0.32	2.47	4.07	5.91	12.38	0.18	0.37	2.13	4.49	0.03	1.82	3.95	−0.13	18.6	56.0	13.8	11.6
11- 34-112	−4.96	−3.39	−1.82	−0.38	1.69	2.95	3.79	7.34	0.31	0.59	1.22	3.03	−0.10	1.32	2.80	−0.25	20.6	64.5	10.7	4.2
11- 35-218	−3.08	−2.39	−1.62	−1.00	0.82	3.00	4.48	8.67	0.57	0.94	1.22	3.20	0.31	1.13	3.05	0.20	25.0	56.6	12.2	6.2
11- 35-260	3.10	4.13	5.20	5.80	6.73	7.67	8.23	9.78	0.01	0.01	6.72	1.62	0.04	1.24	1.52	−0.01	0.0	4.2	77.3	18.4
11- 36-243	3.85	4.33	4.71	4.90	5.24	5.57	5.73	6.96	0.03	0.01	5.23	0.65	0.13	1.61	0.51	−0.05	0.0	1.3	95.7	3.0
11- 37- 11	2.34	2.62	2.86	2.96	3.27	3.64	3.93	8.79	0.10	0.02	3.35	1.20	0.51	3.82	0.54	0.23	0.0	85.8	8.2	6.0
11- 38-140	−2.00	−2.00	−0.20	0.35	1.39	2.99	6.13	10.45	0.38	0.33	2.44	3.47	0.48	1.93	3.16	0.50	9.1	70.4	9.1	11.5
11- 41- 37	1.39	1.87	2.39	2.63	3.12	3.88	5.44	9.05	0.12	0.05	3.65	1.85	0.59	2.37	1.53	0.52	0.0	76.9	14.9	8.2
11- 44- 67	1.99	2.65	2.98	3.14	3.49	4.14	4.64	8.70	0.09	0.03	3.70	1.33	0.55	2.49	0.83	0.38	0.0	72.2	21.6	6.2
11- 44-105	−4.90	−3.51	−2.19	−1.66	−0.15	1.52	3.33	8.38	1.11	1.40	0.33	3.18	0.35	1.53	2.76	0.26	35.9	49.3	8.8	6.0
11- 55-135	−8.00	−5.98	−4.06	−3.11	0.42	5.18	7.64	12.43	0.75	4.30	1.33	5.72	0.27	0.91	5.85	0.23	44.6	27.0	14.1	14.7
11- 51-122	0.35	2.22	4.20	6.32	9.18	11.36	12.39	14.48	0.00	0.01	8.59	3.91	−0.18	1.00	4.10	−0.22	0.0	15.0	20.7	64.3
11- 58- 10	−6.68	−2.32	1.23	2.35	4.48	7.88	9.20	11.83	0.04	0.10	4.97	4.14	0.11	1.05	3.99	0.18	7.2	38.4	30.1	24.3
11- 63-276	1.58	2.04	2.65	3.01	4.24	5.90	6.93	10.15	0.05	0.05	4.61	2.30	0.36	1.15	2.14	0.26	0.0	46.0	42.9	11.1
11- 71-108	2.05	3.17	3.90	4.26	5.08	6.99	8.03	10.83	0.03	0.02	5.67	2.19	0.46	1.15	2.07	0.43	0.2	18.2	65.5	16.2
11- 72- 81/1	−7.20	−5.25	−3.39	−2.47	0.95	4.82	7.35	11.81	0.52	2.76	1.64	5.27	0.23	0.96	5.37	0.19	35.8	35.4	15.1	13.7
11- 72- 81/2	−7.84	−5.47	−3.22	−2.11	1.47	4.78	6.59	11.04	0.36	2.14	1.61	4.95	0.10	0.98	4.90	0.04	31.0	39.2	19.1	10.7
11- 77-244	1.64	4.31	6.02	6.81	8.72	10.68	11.62	13.51	0.00	0.00	8.79	2.79	0.04	0.97	2.80	0.04	0.3	3.3	36.6	59.7
11- 80-198	−3.00	−1.57	−0.25	0.78	2.94	7.37	9.41	13.07	0.13	0.30	4.03	4.63	0.36	0.90	4.83	0.34	9.9	49.3	18.1	22.8
11- 89- 98	1.63	3.01	6.41	7.46	9.75	12.08	13.19	15.44	0.00	0.00	9.78	3.58	−0.03	1.10	3.39	0.01	0.0	9.4	21.3	69.3
11- 99- 49	−8.00	−4.78	−1.64	0.16	3.49	5.99	6.69	8.81	0.09	0.44	2.85	4.14	−0.22	0.95	4.17	−0.23	19.0	34.3	39.2	7.6
11-100- 40	−2.00	1.25	5.28	6.35	8.37	10.58	11.63	13.77	0.00	0.01	8.43	3.48	−0.06	1.21	3.18	0.03	3.2	6.3	36.0	54.5
11-107-150/1	−4.85	−3.00	−0.39	1.27	4.22	7.35	8.42	10.31	0.05	0.20	4.08	4.22	−0.07	0.90	4.41	−0.05	13.8	34.3	32.1	19.8
11-107-150/2	−4.87	−3.08	−1.19	0.82	4.29	7.62	9.06	11.87	0.05	0.28	4.06	4.83	−0.03	0.90	5.12	−0.07	17.0	30.6	29.7	22.7
11-118- 55	2.50	5.44	7.25	8.69	11.26	13.84	15.06	17.54	0.00	0.00	11.19	3.78	0.00	0.96	3.90	−0.03	0.0	2.3	17.3	80.4
11-118-134	−7.54	−3.89	−0.06	1.91	5.11	7.62	6.60	10.35	0.03	0.13	4.56	4.32	−0.23	1.02	4.33	−0.19	13.3	26.4	38.4	22.0

DVDP 12.

DVDP 12	Percentiles								MD (mm)	QD	Folk measures				Inman		Proportions			
	1	5	16	25	50	75	84	95			Mean	SDEV	SKEW	KURT	SDEV	SKEW	GRAV	SAND	SI/M	CLAY
12- 5- 13	−2.54	−1.31	−0.02	0.43	1.26	1·95	2.37	4.52	0.42	0.24	1.20	1.48	0.02	1.57	1.19	−0.07	6.4	87.8	5.7	—
12- 7- 19	−1.15	−0.43	0.28	0.61	1.36	2.04	2.39	3.29	0.38	0.21	1.35	1.09	−0.01	1.06	1.06	−0.04	1.8	94.8	3.4	—
12-11- 29	−3.45	−0.97	−0.35	−0.09	0.48	0.96	1.26	2.09	0.76	0.27	0.44	0.86	0.09	1.19	0.80	0.07	4.7	92.9	2.4	—
12-14- 38	−4.38	−3.25	−2.17	−1.64	−0.08	1.70	2.49	4.88	1.06	1.41	0.08	2.40	0.16	1.00	2.33	0.11	35.3	57.6	7.0	—
12-20- 57	−2.59	−1.61	−0.44	0.09	1.11	1.89	2.32	4.43	0.46	0.34	1.00	1.60	−0.01	1.37	1.38	−0.12	9.2	85.1	5.7	—
12-23- 65	−0.99	0.63	1.63	1.91	2.43	2.90	3.15	4.01	0.19	0.07	2.41	0.89	−0.06	1.40	0.76	−0.06	1.0	94.0	5.1	—
12-34- 95	−3.15	−2.51	−1.90	−1.60	−0.58	0.75	1.48	4.58	1.49	1.22	−0.33	1.92	0.33	1.24	1.69	0.21	40.3	53.9	5.8	—
12-36- 99	−1.29	−0.43	0.28	0.61	1.37	2.02	2.37	3.23	0.39	0.20	1.34	1.08	−0.02	1.06	1.05	−0.06	2.0	94.8	3.1	—
12-36-100	−3.03	−2.05	−1.17	−0.77	0.12	1.51	2.25	6.29	0.92	0.67	0.40	2.12	0.37	1.50	1.71	0.25	19.5	72.8	7.7	—
12-47-129	−5.00	−3.79	−2.64	−2.07	−0.75	1.20	2.61	7.19	1.68	1.89	−0.26	2.98	0.36	1.37	2.63	0.28	45.5	43.5	11.1	—
12-58-160	−2.23	−1.67	−0.97	−0.56	0.48	2.73	2.44	7.37	0.72	0.60	0.65	2.22	0.34	1.60	1.71	0.15	15.5	74.8	9.7	—
12- 2- 5	−4.45	−2.93	−1.58	−0.89	0.57	1.91	2.96	10.16	0.67	0.79	0.65	3.13	0.25	1.92	2.27	0.05	23.4	63.3	4.9	8.4
12- 9- 24	−4.27	−2.71	−1.16	−0.23	1.49	3.04	5.27	11.78	0.36	0.53	1.87	3.80	0.30	1.82	3.22	0.18	17.5	63.1	9.0	10.4
12-15- 42	−3.35	−2.05	−0.28	0.63	2.10	4.41	6.96	11.73	0.23	0.30	2.93	3.90	0.37	1.50	3.62	0.34	11.3	62.0	14.4	12.3
12-17- 48	1.91	2.91	4.33	5.03	7.12	10.25	11.78	14.90	0.01	0.01	7.75	3.68	0.27	0.94	3.72	0.25	0.1	12.5	45.6	41.8
12-21- 59	−2.23	−1.03	0.24	0.99	2.62	7.50	9.58	13.51	0.16	0.25	4.14	4.54	0.49	0.91	4.67	0.49	5.2	56.9	14.8	23.1
12-26- 72	−4.19	−3.05	−1.95	−1.39	0.35	2.20	3.18	7.89	0.79	1.20	0.53	2.94	0.24	1.25	2.57	0.10	31.5	57.0	6.7	4.9
12-30- 82	1.78	2.25	2.67	2.91	3.50	4.42	5.19	14.96	0.09	0.04	3.79	2.55	0.57	3.46	1.26	0.34	0.0	67.9	21.6	10.5
12-33- 90/1	−2.27	−0.08	2.05	2.89	4.24	7.29	9.08	12.72	0.05	0.06	5.13	3.69	0.35	1.19	3.51	0.38	2.6	43.9	32.4	21.1
12-33- 90/2	−2.13	−0.55	1.55	2.34	4.02	7.22	9.03	12.74	0.06	0.10	4.87	3.88	0.32	1.12	3.74	0.34	3.7	46.0	29.5	20.8
12-41-114	−3.63	−2.36	−0.60	1.00	4.18	7.20	9.17	13.24	0.06	0.25	4.25	4.81	0.09	1.03	4.88	0.02	13.9	34.2	30.9	20.9
12-46-127	−3.64	−2.51	−1.33	−0.32	1.92	4.50	5.74	8.29	0.26	0.60	2.11	3.40	0.13	0.92	3.53	0.08	18.3	52.4	23.3	5.9
12-48-132	−3.01	−1.76	0.01	1.20	3.27	7.09	9.36	14.55	0.10	0.21	4.21	4.81	0.34	1.14	4.68	0.30	9.9	46.1	23.5	20.5
12-48-134	−1.79	−0.38	1.88	2.61	4.35	9.23	11.69	16.71	0.03	0.08	6.14	5.05	0.39	1.06	4.91	0.39	3.1	40.0	26.6	30.3
12-49-136	−0.86	1.78	3.07	3.54	5.98	9.80	11.91	16.19	0.02	0.04	6.98	4.39	0.38	0.94	4.42	0.34	0.9	30.1	34.6	34.4
12-50-139	−4.22	−2.97	−1.77	−1.15	0.84	2.88	4.54	8.32	0.56	1.04	1.20	3.29	0.25	1.15	3.16	0.17	27.4	54.5	12.4	5.7
12-57-157	−2.94	−2.22	−1.53	−0.87	1.53	6.63	9.81	15.88	0.35	0.91	3.27	5.58	0.52	0.99	5.67	0.46	23.3	44.9	10.7	21.2
12-60-165	−1.69	−0.96	0.28	1.35	3.15	6.17	8.52	13.25	0.11	0.19	3.98	4.21	0.36	1.21	4.12	0.30	4.7	57.4	20.1	17.8

Field samples.

Field samples	Percentiles								MD (mm)	QD	Folk measures				Inman		Proportions			
	1	5	16	25	50	75	84	95			Mean	SDEV	SKEW	KURT	SDEV	SKEW	GRAV	SAND	SI/M	CLAY
Y- 1	−4.25	−3.59	−2.92	−2.30	−0.33	1.69	2.16	2.83	1.26	2.31	−0.37	2.24	−0.02	0.66	2.54	−0.02	42.4	56.9	0.7	—
Y- 2	−3.29	−1.08	0.50	0.95	1.67	2.29	2.57	3.05	0.31	0.16	1.58	1.14	−0.23	1.27	1.03	−0.13	5.4	93.9	0.7	—
Y-14	−4.71	−3.75	−2.87	−2.52	−1.22	1.82	2.39	3.30	2.32	2.72	−0.56	2.38	0.33	0.67	2.63	0.37	51.2	45.7	3.0	—
Y-15	−1.80	−0.87	0.05	0.55	1.55	2.28	2.61	3.28	0.34	0.24	1.40	1.27	−0.17	0.98	1.28	−0.17	4.1	93.3	2.7	—
Y-22	−1.50	0.35	1.66	2.17	2.78	3.25	3.47	4.43	0.15	0.06	2.64	1.07	−0.21	1.55	0.90	−0.23	2.1	89.2	8.7	—
Y-23	−0.07	0.73	1.32	1.60	2.16	2.73	2.99	3.96	0.22	0.09	2.16	0.90	0.05	1.17	0.83	−0.01	0.5	94.7	4.9	—
Y-25	−2.00	−0.98	0.45	1.13	2.06	2.79	3.15	5.08	0.24	0.16	1.89	1.59	−0.10	1.50	1.35	−0.20	4.8	86.8	8.4	—
Y-26	−0.61	0.38	1.08	1.39	1.94	2.49	2.70	3.15	0.26	0.10	1.91	0.83	−0.10	1.04	0.81	−0.07	0.5	98.5	1.0	—
T S-36	−0.26	0.59	1.46	1.80	2.48	3.07	3.43	4.71	0.18	0.08	2.45	1.12	0.04	1.33	0.98	−0.02	0.1	90.3	9.6	—
T S-37	−5.32	−4.22	−3.17	−2.84	−1.01	0.88	1.41	2.10	2.02	2.85	−0.93	2.10	0.02	0.74	2.29	0.06	50.1	49.4	0.5	—
T S-38	−5.22	−4.30	−3.42	−2.99	−1.35	0.79	1.42	2.40	2.56	3.67	−1.12	2.23	0.13	0.73	2.42	0.15	54.5	44.4	1.1	—
T S-39	−0.51	0.42	1.18	1.50	2.04	2.62	2.90	4.30	0.24	0.10	2.04	1.02	0.08	1.42	0.86	−0.01	0.0	93.8	6.2	—
T S-40	−4.43	−3.05	−1.74	−1.05	0.38	1.78	2.29	3.26	0.77	0.89	0.31	1.97	−0.07	0.91	2.02	−0.05	25.8	71.9	2.3	—
T S-41	−2.43	−2.00	−1.59	−1.28	−0.88	0.51	0.96	2.23	1.30	0.87	−0.34	1.28	0.14	0.97	1.27	0.05	33.4	65.1	1.5	—
T G- 3	0.17	0.97	1.57	1.80	2.29	2.77	2.99	3.63	0.20	0.07	2.28	0.78	−0.01	1.12	0.71	−0.02	0.2	96.2	3.6	—
T G- 4	0.05	1.11	1.70	1.94	2.42	2.86	3.08	3.73	0.19	0.06	2.40	0.76	−0.03	1.17	0.69	−0.05	0.0	96.2	3.8	—
T G- 6	−0.54	0.13	0.74	1.04	1.62	2.13	2.38	2.89	0.33	0.13	1.58	0.84	−0.07	1.04	0.82	−0.07	0.3	98.5	1.2	—
Y-24	−0.03	1.31	2.37	2.79	3.41	4.12	4.50	5.90	0.09	0.04	3.43	1.23	0.05	1.42	1.06	0.02	0.3	71.4	24.6	3.6
T S-31	1.58	2.99	4.21	4.65	5.92	8.87	10.53	13.89	0.02	0.02	6.89	3.23	0.46	1.06	3.16	0.46	0.0	12.5	56.9	30.7
T S-35	2.06	2.49	2.93	3.19	3.99	6.48	9.02	13.22	0.06	0.05	5.31	3.15	0.69	1.34	3.05	0.65	0.0	50.2	29.7	20.1
T S-42	−2.60	−1.54	0.38	1.22	2.95	6.24	8.02	9.81	0.13	0.21	3.78	3.63	0.27	0.93	3.83	0.32	7.8	52.8	23.2	16.2
T S-46	−2.66	−1.42	0.30	1.21	2.92	5.97	7.63	10.77	0.13	0.21	3.62	3.68	0.29	1.05	3.67	0.28	7.4	55.5	23.0	14.0
T S-60	−2.12	−1.21	0.34	1.06	2.64	6.22	8.28	12.23	0.16	0.23	3.75	4.02	0.42	1.07	3.97	0.42	5.8	56.0	21.1	17.1
T S-61	−4.29	−2.41	−0.36	0.69	2.38	5.71	7.54	11.87	0.19	0.30	3.19	4.14	0.32	1.17	3.95	0.31	12.2	53.0	19.3	15.6
T G- 1	−5.96	−3.81	−1.46	0.32	2.41	4.99	6.97	11.25	0.19	0.39	2.64	4.39	0.13	1.32	4.22	0.08	17.5	49.7	20.7	12.1
T G-22/1	−14.45	−9.10	−4.00	−1.38	1.92	4.81	7.28	11.96	0.28	1.29	1.74	6.01	−0.05	1.39	5.64	−0.05	27.0	42.1	17.2	13.8
T G-22/2	−14.48	−9.20	−4.16	−1.49	1.50	5.44	8.45	14.52	0.35	1.39	1.93	6.75	0.10	1.41	6.31	0.10	29.2	38.7	14.9	17.2
T G-62	−2.70	−1.68	−0.21	0.64	2.17	4.56	6.69	10.83	0.22	0.30	2.89	3.62	0.35	1.31	3.45	0.31	9.9	61.6	17.0	11.5