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Atlantic Margin Coring Project 1976

Preliminary Report on Shipboard and Some Laboratory Geotechnical Data

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

Atlantic Margin Coring Project 1976

Preliminary Report on Shipboard and

Some Laboratory Geotechnical Data

by

Adrian F. Richards[1]

December 1977

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[1] Address: Marine Geotechnical Laboratory
Lehigh University, #17
Bethlehem, Pa. 18015

FOREWORD

This report contains the results of shipboard and laboratory tests to evaluate some index and other physical properties of cores taken by the Atlantic Margin Coring Project, a 60-day expedition to obtain core samples by drilling beneath the Continental Shelf and Slope of the eastern United States. The coring took place in July, August, and September, 1976, aboard the D/V GLOMAR CONCEPTION, and penetrated as much as 310 meters below the sea floor at 19 sites (Figure 4) along the continental margin from Georgia to Georges Bank off New England in water depth ranging from 20 to 300 meters.

A summary containing positions of the sites, shipboard operations, and field descriptions of the cores recovered is given in Hathaway and others, 1976, Preliminary Summary of the 1976 Atlantic Margin Coring Project of the U. S. Geological Survey: U.S. Geol. Survey Open-file Report 76-844, 217 p., obtainable from:

Open-File Services Section
Branch of Distribution
U. S. Geological Survey
Box 25425, Federal Center
Denver, CO 80225
(Telephone: (303) 234-5888)

Sections of some cores were selected for shore-based laboratory triaxial and consolidation geotechnical tests. These results are presented in U. S. Geol. Survey Open-file Report 78-124, obtainable from the Open-File Services Section.

The data presented in the report that follows below were obtained from:

(a) shipboard tests including down hole density and on-deck measurements of bulk density and simple undrained shear strength.

(b) laboratory tests by U. S. Geological Survey personnel to evaluate soil identification parameters.

(c) laboratory tests at the Marine Geotechnical Laboratory, Lehigh University, where check tests on water content and bulk density were done.

Specimens for the tests in (b) and (c) above were retained as disturbed samples from the coring program.

Other data relevant to the engineering properties of Atlantic Margin sediments have also been collected as part of the Atlantic Margin Coring Project, including triaxial compression tests, consolidation-compression tests, response to cyclic loading and some other strength and compressibility tests. An overall evaluation of all of these data, including those contained in this report, is presently underway.

Users of this report should be cautioned not to take these test results out of context. Two factors must be borne in mind. The first is that these tests were done on somewhat disturbed samples compared with those obtained through high-quality sampling programs onshore. Much disturbance is inevitable offshore but the significance of the disturbance on these test results has not yet been evaluated. The second factor is that these data are only part of the total set available from this project. A complete analysis of all data may lead to conclusions different from those based on this set of data only.

This report was made in fulfillment of Contract 14-08-0001-15689 of the U. S. Geological Survey.

John C. Hathaway[1]

Dwight A. Sangrey[1]

[1] U. S. Geological Survey

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INTRODUCTION

This report presents reduced shipboard geotechnical data collected during the 1976 Atlantic Margin Coring Project; results of laboratory tests of specific gravity, water content, bulk density, and Atterberg limits; and sedimentation-compression e log p curves showing consolidation. A description of the procedures used at sea and in the laboratory and a short preliminary summary of the shipboard results also is included.

The involvement of Marine Geotechnical Laboratory (MGL), Lehigh University, personnel in the 1976 Atlantic Margin Coring Project can be divided into two phases. In Phase One, the Lehigh nuclear-transmission densitometer was rebuilt to process cores at sea more rapidly than previously had been done in the laboratory, the equipment was assembled and tested aboard the Glomar Conception, and at-sea geotechnical measurements were made during the duration of the cruise.

Data sheets were prepared for both unopened core sections (Appendix III) and split-core samples (Appendix IV). Completed data forms are on file at the MGL and at the Geological Survey in Woods Hole.

Phase Two included reduction of the shipboard data, testing of all geotechnical samples taken from cores split aboard the ship, and certain other analytical work ashore utilizing the geotechnical measurements. Water content and weight/volume bulk density tests were performed at the MGL. Specific gravity and Atterberg limit tests and certain calculations were performed by Geological Survey personnel at the Corpus Christi, Texas, laboratory.

During Phase One, 37 unopened, 1.5-m-long core sections were selected by Lehigh personnel for subsequent static and dynamic triaxial and consolidation testing ashore. The disposition of these cores is controlled by Geological Survey Project personnel; they are not further discussed in this report.

A depth convention has been adopted in this report for the convenience of labeling core sections and analyzing the data. Each 9.2-m-long (30 ft) core liner had a maximum penetration depth referenced to the water-sediment interface; these data are given in Hathaway, et al. (1976). Each 9.2-m-long core liner was cut into six or fewer sections, each 1.5 m (5 ft) in length, aboard the ship. To the maximum penetration depth, 0.2 m was subtracted to obtain the depth at the bottom of the first 1.5 m section above the core catcher. To obtain values at the bottom of the remaining 1.5 m sections, an additional 1.5 m was added for each section. The depth of the bottom of each core section was used for all values obtained using the nuclear densitometer. Tests within core sections and samples collected from core sections were assigned depths based on the location of the test or sample within the core section. It should be clearly recognized that all depths within a 9.2-m-long core are estimates of the true depth, which cannot be uniquely calculated because of the uncertainty of the relationship of sediment contained within the core liner to true in situ depths.

This report is considered to be preliminary because the author has not had access to the final lithologic logs or paleontological results, upon which a more accurate description of geotechnical results could be based. It would be inappropriate to comment on geological hazards until this information is made available.

Acknowledgements

Data collection at sea was undertaken or supervised by A. F. Richards (Leg 1), R. M. Coad (Leg 2), and M. Perlow, Jr. (Leg 3). We thank the core sampling teams for assistance in making most of the Torvane tests and acknowledge with appreciation the occasional help of our shipboard colleagues at various times. Chief scientists J. C. Hathaway and J. S. Schlee did everything possible to assist the geotechnical program at sea. Data reduction and computations ashore at Lehigh were performed by J. V. Lore, R. Scott Hughes, P. C. Lemmond, and D. Volk; geotechnical testing ashore was by C. L. Davis, K. Peterson, M. A. Surdoval and others; J. M. Parks assisted in computer programming; and D. Volk reviewed the report and made helpful suggestions. Specific gravity and Atterberg limit data were provided by J. Booth, U.S.G.S. Corpus Christi, who also furnished salt corrections to the Lehigh water-content measurements.

Particular gratitude is accorded Project Manager J. C. Hathaway for his unflagging support of the geotechnical program and for the many courtesies he gave Lehigh personnel during both phases of this investigation.

CORE QUALITY EVALUATION

After each 9.2-m-long core liner had been cut into six 1.5-m-long sections and had caps placed over both ends, the unopened sections were brought immediately into the ship's laboratory van, where they were racked horizontally until tested for bulk density. This nondestructive test preceded all other tests at sea. At the time of the nuclear bulk-density analysis, the principal geotechnical analyst evaluated the core quality for later use when analyzing the bulk density data. These evaluations may also be useful to other scientists and engineers.

Four major core-quality categories were subjectively selected: excellent, good, fair, and bad. "Excellent" denoted a 1.5-m-long core, contained in an unopened liner, that completely filled the liner and appeared to be undisturbed. It should be understood that many cores, particularly those largely composed of sand-size materials, may have been severely disturbed in the rotary-drilling process; nevertheless, if the core fully filled the liner when it was inspected the core would usually be evaluated as "excellent", unless it was known to be disturbed in which case a lesser quality category would be assigned. "Good" usually was applied to a core that completely filled or almost filled its liner but showed evidence of some disturbance. The usual signs of disturbance were small cracks in the core. Much, but not all, of the core would probably yield valid bulk density measurements. "Fair" was used for a core that only partly filled its liner, may have had large cracks in the core, and which showed signs of being severely disturbed. Small, short sections of the core, however, might yield a valid bulk density measurement. "Bad" denoted disturbance sufficiently severe to indicate that only a very small part of the core might yield a valid bulk density measurement. Some cores were clearly disturbed to the extent that a nuclear densitometer determination of bulk density would be worthless; such cores were not tested nondestructively.

Core-quality information was logged on the nuclear densitometer summary sheets that constitute Appendix IX. On these sheets, a core-quality evaluation intermediate between the major categories was indicated by placing an "X" on the dividing-line between categories.

SHIPBOARD GEOTECHNICAL TESTS

The basic shipboard geotechnical testing program is outlined in Appendices I and II. The geotechnical flow of tests and sampling was as follows: Torvane shear strength tests were taken at the ends of suitable 1.5-m-long core sections almost immediately after the sections were cut from a 9.2-m-long core. A length of about 50 to 100 mm of the core within its liner usually was cut from the bottom 1.5-m-long section, obtained from a 9.2-m-long core, for salinity measurement and for subsequently water-content and weight/volume bulk density measurement in a laboratory ashore. Sediment contained in each unopened liner was nondestructively analyzed for bulk density as rapidly as possible after the core section was brought into the laboratory van. Each 1.5-m-long core section was split into two halves along its axis. Laboratory vane tests were made on suitable materials in the "working" half and samples were taken for subsequent specific gravity and Atterberg limit laboratory testing ashore. Methods of geotechnical sample preparation aboard the ship are given in Appendix V.

Bulk Density

Lehigh Nuclear-Transmission Densitometer -- The theory behind the Lehigh laboratory densitometer, which measures the bulk density of sediments contained within unopened core liners or barrels, has been given by Preiss (1968) and Meyers, et al. (1974). A comparison, using the Lehigh model I densitometer, of bulk density obtained from weight/volume measurements and derived from nuclear measurements was made by Chough and Richards (1974). A model III densitometer system was constructed for this project; general system data are summarized in Table 1.

Table 1. Lehigh Nuclear-Densitometer System Summary

Source: 10 mCi ^{137}Cs

Source lead exit-port collimator: 6 mm diameter

Detector: Harshaw 7.6 cm (3 in.) square NaI(TL)-PM scintillation detector

Detector lead entry-port collimator: 5 mm wide by 26 mm high

Gamma-ray beam path distance, collimator to collimator: about 230 mm

Multichannel analyzer: Northern NS-710, modified for up to a 10-s MCS dwell time

Analyzer dwell time: 6 s (corresponding to an axial core distance of about 30 mm)

Spectrum gain stabilizer: Northern NS-409 (electronically centered over the ^{137}Cs photopeak)

X-Y recorder: Hewlett-Packard 7004A (Legs 1 and 2 and part of Leg 3) or 7044A (part of Leg 3)

Speed core translated through gamma-ray beam: 5.2 mm/s

Calibration: fluids contained in core liners (distilled H_2O, $CaCl_2$, $ZnCl_2$)

Measurement accuracy: estimated to be a reading obtained from the X-Y recorder graph $\pm$ between about 0.03 (estimated best case) and 0.06 Mg/m^3 (estimated worst case)

Figure 1 shows the installation of the system in the laboratory van. The core-translating carriage was elevated above the bench top to avoid cutting a hole in the top for the motor assembly. In operation, a core section was placed on supports in the carriage so that the gamma-ray beam passed through the center of the core. The carriage and core section could be translated in either direction past the source and detector by means of the rack attached to the carriage and a geared-drive assembly mounted to a reversible, synchronous stepping motor. The frequency of the current supplied to the motor and X-Y recorder was continuously monitored; the frequency remained almost constant.

Counts from the three calibration fluids contained in short sections of core liner were stored in three-quarters of the active memory bank of the multichannel analyzer. One-quarter of the memory was used to record counts from a core section. This enabled the core counts and the calibration counts to be inputted to the X-Y recorder directly from the analyzer. Counts from the calibration fluids were corrected using the Preiss (1968) formula to correct for the chemical differences between fluids and sediments. Although the calibration fluids covered only the range of 0.99 to 1.865 Mg/m^3, subsequent to this Project densities extending in range to well above 2 Mg/m^3 were measured in steel core tubes using the nuclear densitometer. When the densities of the sediments in these liners were measured by conventional methods, the higher densities determined by both methods were almost the same.

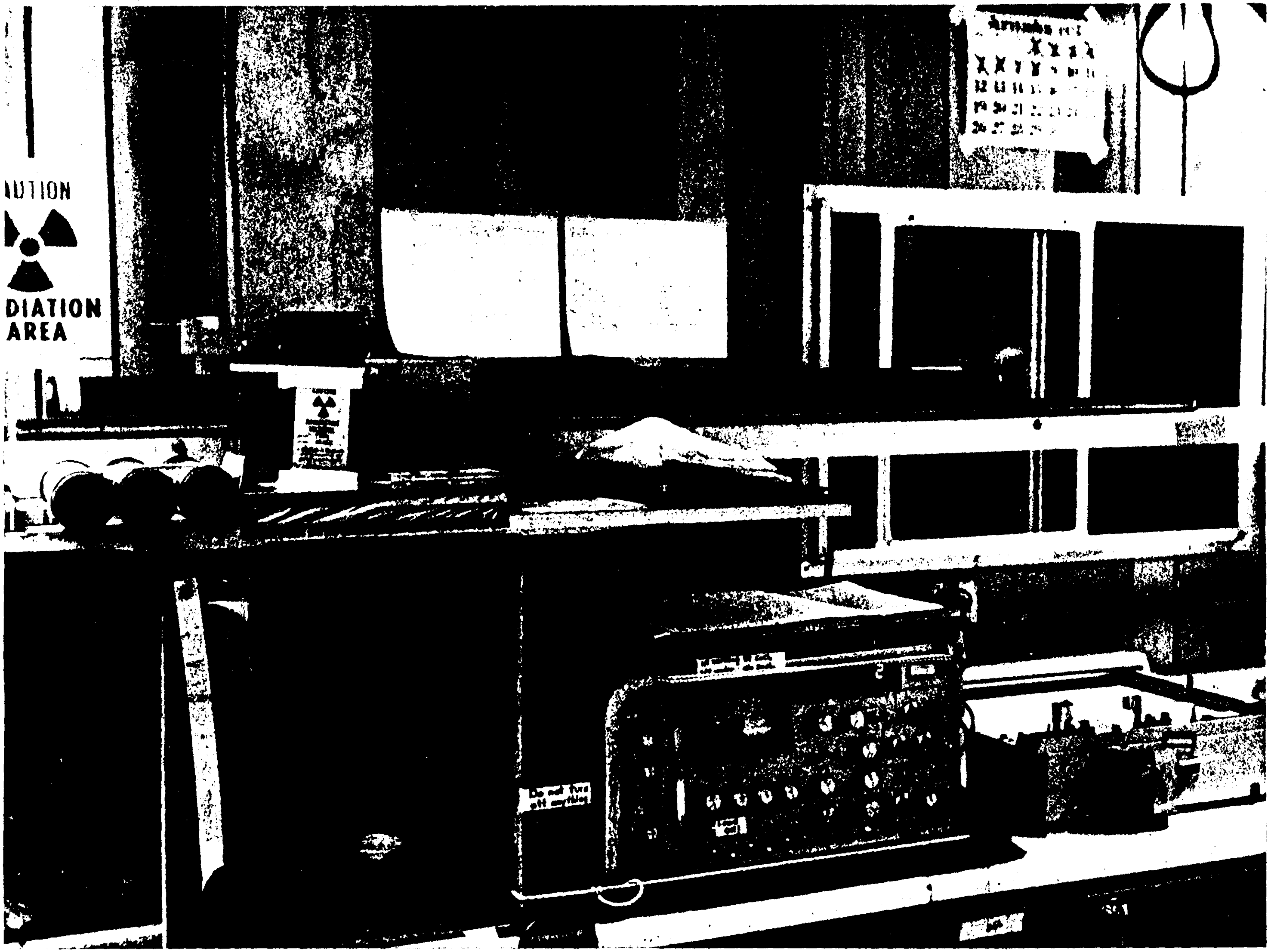

Fig. 1. Lehigh model III nuclear-transmission densitometer installed in the Glomar Conception laboratory van. The source and detector are in the center left; a 1.5-m-long core lies on the carriage tray; calibration samples shown for center left: in the lower right is the multichannel analyzer and the X-Y recorder.

On the basis of this latter project, it is concluded that the calibration can be extended at least to 2.5 Mg/m^3.

The system functioned very well. Two problems in use were encountered. The H-P 7004A recorder malfunctioned during Leg 3 of the cruise and was replaced with the spare H-P 7044A recorder. The analyzer developed a minor active-memory malfunction that necessitated reloading the active memory with calibration counts more frequently than would otherwise have been necessary. Neither of these problems are believed to have affected the quality of bulk density measurements.

Test Procedure--Appendix VI outlines the Lehigh model III nuclear-transmission densitometer test procedure. In brief, a core was placed on the carriage tray and the translating motor started at the same time that the start-analysis switch of the analyzer was turned on. The multiscale count (MSC) mode of the analyzer was utilized and the logarithm of the count was stored in the memory. After the core had been analyzed the contents of the memory of the analyzer were inputted immediately to the X-Y recorder.

An entire analysis, including set-up time, logging pertinent data in a log book, and identifying the recorder graph, usually took less than 10 minutes per 1.5-m-long core section.

Data Reduction--The evaluated core quality was highly variable, ranging from "excellent" to "bad". More cores were rated nearer the "bad" end of the scale than the "excellent" end (Appendix IX). It was assumed, for reasons given previously, that it was likely that in the "fair" and higher categories, and possibly in the "bad" category, that at least one or more bulk densities would have validity. Consequently, since each density value recorded represented a core-section axial distance of about 30 mm, a single high value should have a relatively high probability of being valid. As only one bulk density value per 1.5-m-long core section could be easily plotted using the 1 inch equals 100 feet graph scale specified by the Project Director, it was decided to select only the single highest value for each core section. This value was recorded at sea on the working log sheet.

Ashore, all original bulk density records were reexamined and the highest single values considered correct were plotted on the geotechnical data graphs to be presented later. These data are tabulated in Appendix IX together with the standard depth for the core section calculated according to the procedure described previously. In addition, a line was eye-fitted to each graphical record and an average bulk density value selected. This average value is listed to the right of the maximum value for each core section in Appendix IX. A comparison of the highest and average bulk density values from "excellent" and "good" core sections would be instructive, but this analysis has not yet been performed.

The rationale for selecting the maximum rather than the average bulk density is twofold. (1) An individual density value represents about a 30 mm length of core, which is considered to represent an adequate volume for a valid nuclear-density test. (2) Only a portion of the sediment core section may be of adequate quality to yield a valid density measurement in the more disturbed cores, and there is no acceptable method to select satisfactory and unsatisfactory sediment core sections for nondestructive analysis. On basis of these conditions, it was concluded that the higher density values had the greatest probability of being valid. With greater analytical time available for data processing, perhaps alternative methods such as utilizing the average density for high quality core sections and the maximum density for poor quality sections, might have been selected? The method chosen, however, was expedient and is considered the best compromise commensurate with the existing time and budgetary constraints.

Shear Strength

Torvane--This device, manufactured by Soiltest, was used extensively for the estimation of shear strength in materials predominantly composed of silt-and clay-sized particles with not too many sand-sized particles. For all tests, the sediment-sample tested was reasonably confined. When a measurement was taken in the end of a core section the liner contained the sample. When measurements were made on half of a split core-section, the test was performed above a core-liner support (Fig. 2) to minimize lateral sediment movement during the test.

All Torvane measurements, originally made in engineering units, were converted to SI units at sea and all conversion data were checked, and corrected if necessary ashore. In this report, Torvane measurements on core ends and at right angles to the core axis (Fig. 2) on split core sections are combined in the data graphs. The test method is believed to be sufficiently approximate, when performed by a number of different people, that it was considered inappropriate to distinguish between axial and perpendicular to the axis measurements. Data are in Appendix X.

Laboratory Vane--A Wykeham-Farrance vane-shear device, motorized for a vane-rotation speed of 23 mrad/s (78°/min), was used for all tests. The vane had the dimensions of 13 x 13 mm

Fig. 2. Torvane shear strength test being made on the "working" half of a core section.

(0.5 x 0.5 in.); the standard 26 mm high x 13 mm diameter vane could not be used because of the shallow depth of one-half of a core section. The springs furnished by the manufacturer were calibrated before this investigation. It was not possible to use a strain-gaged load cell in this study because the MGL load cell was not designed for the stiff sediments expected, and there was inadequate time to order or to build a load cell suitable for the Project sediments. A detailed discussion on the conversion of applied torque to shear strength is given in Appendix VII. Test data were recorded on a special form (Appendix VIII).

Operation of the test is shown in Fig. 3. Tests were made as close as possible to a core-section support, but even so some lateral displacement of stiff sediments sometimes occurred as the vane was inserted. Remolded tests were made by rapidly rotating the vane back and forth a number of times and rerunning the test as quickly as possible after the vane remolding. None of the samples were hand remolded.

Very few of the tests can be considered to be of high quality. The general coarseness of the sediment grain size, the shallow depth of one-half of the core, and the lack of support underneath the part of the core being tested all contributed towards generally poor test conditions. Consequently, most sediment sensitivities (ratio of the "undisturbed" strength to the remolded strength at the same water content) probably should be considered conservative estimates. Data are listed in Appendix X.

Fig. 3. Laboratory vane shear strength test being made on the "working" half of a core section.

LABORATORY GEOTECHNICAL TESTS

Tests Made by Geological Survey Personnel

Samples were collected at sea for specific gravity and Atterberg limit tests, which were made by Geological Survey personnel at the Corpus Christi, Texas, laboratory, The sediments were not dried prior to testing. The liquid limit device was motorized, the three-point method was used, and water contents were adjusted with seawater. These data have been salt-corrected for the measured salinity of the interstitial water reported in Hathaway, et al. (1976). Specific gravity data were salt corrected only where measured water-content data were available; uncorrected specific gravity values will be about 0.01 or 0.02 units higher than corrected values.

Replicates were run on limits and specific gravity values judged to be unusual; apparently aberrant data have been checked and confirmed according to J. S. Booth (1977, written communication). All data, relevant calculations, and formulas for salt corrections are reported in Appendix XI.

Tests Made by Lehigh Personnel

The samples collected at sea specifically for water content and bulk density were analyzed by Lehigh University personnel to ensure that a minimum amount of time elapsed between the time the samples were brought ashore and when they were tested. All samples were protected against desiccation (Appendix V, preparation "B") and refrigerated until tested.

The water-content tests were run following American Society for Testing and Materials (ASTM) standard D 2216-71. Water-content results were salt-corrected by Geological Survey personnel in Corpus Christi.

The bulk density tests were made using the weight/volume procedure described by Richards (1973) and Chough and Richards (1974), in which a thin-wall, stainless-steel, right cylinder 27 mm in diameter and 40 mm long, having a volume of 23 cm^3 and one end sharpened, is forced into the sediment and the excess material carefully trimmed away. The sediments tested were sufficiently stiff that it was not usually possible to avoid trapping a little air together with the sediment in the tests. Such tests will have densities lower than they should have. All weight/volume densities are reported, even though most of them appear to be in error, because an inequivocal procedure was not adopted to segregate good from poor or bad tests.

All data are reported in Appendix XI.

DOWNHOLE DENSITY LOGGING

A team from Schlumberger performed downhole logging operations whenever possible aboard the Glomar Conception. One of the logs was a compensated-formation density (gamma-gamma) log.

All density log data were copied by Lehigh personnel directly from the field prints, plotted at the standardized scale of one inch equals one foot, supplied aboard the ship. One exception was Hole 6002. The log from this hole was not plotted by Schlumberger at the specified scale; consequently, data from a field print made at a different scale were converted to the standardized scale and supplied to Lehigh by Dr. Hathaway. Determination of the depth scale for all logs was based on data contained on the field print and water depths reported in Hathaway, _et al_. (1976).

SEDIMENTATION-COMPRESSION CURVE ANALYSIS

This type of void ratio - effective overburden stress or pressure, or e log p curve is a very useful way of portraying the state of consolidation in sediments. In the curves that will be presented later, the following analytical procedures were used.

The effective overburden pressure, σ'_{vo} (also p'), at any depth was calculated from the general formula

$$\sigma'_{vo} = \sum_{i=1}^{n} (\gamma - \gamma_{sw}) \Delta z_i \qquad \text{eq. 1.}$$

where γ is the measured bulk density, γ_{sw} is the density of sea-water (calculated from the salinity to be 1.02 Mg/m^3 for all holes except 6009, which contained a brine of low salinity and where a value of 1.01 Mg/m^3 was used), Δz_i is the increment of depth change between n and n-1 density measurements, and n is the total number of depth increments in the core above the depth at which σ'_{vo} was computed. Nuclear densitometer bulk density, γ, maximum values were used without extrapolation from core sections having core-quality evaluations of "good" or "excellent". Void ratio, e, was calculated using eq. 2, from bulk density

$$e = \frac{\gamma - G_s}{\gamma_{sw} - \gamma} \qquad \text{eq. 2.}$$

in which G_s is the specific gravity, which was not corrected for salt content.

In all e log p calculations, it was assumed that the sediments were normally consolidated, in the geotechnical sense, and did not contain excess pore pressures above or below hydrostatic pressure. In the e log p data-graphs presented later, the equivalant water-content scale, which is related to the void ratio, is based on eq. 3 calculations using a specific gravity value representing the average value for each hole

$$e = \frac{G_s\ w}{100} \qquad \text{eq. 3.}$$

where w is the water content in precent dry weight, which was not salt corrected.

There are at least three problems in the construction of accurate e log p curves from the existing data. One is due to restrictions imposed by the need to have all measured values, γ, G_s, and salinity, available at the same depth. The second is to select valid density values. The third is to have a sufficient number of data points to represent the in situ consolidation behavior of the sediment for interpretative purposes. In this investigation, only densities from core sections rated "good" and "excellent" were used. This probably was an unnecessarily conservative approach that turned out to be partly self defeating because there were a minimal number of density values for interpretative purposes. It has not been possible to reanalyze all of the density data in this report; this work, however, is underway and will be available at a later date.

RESULTS

Table 2 stipulates where shipboard and ashore geotechnical data are presented in this report. The location of the holes is shown in Fig. 4.

The principal data presentation is by data graphs, in which geotechnical data are plotted with respect to depth for all holes except 6005, 6006, 6016, and 6-18, where too few data existed to warrant a graphical presentation. Data from these holes appear in Appendices IX, and X, and XI. In Appendix XI, test depths in sections indicated as "top" were plotted at 0 m, in a 1.5-m-long core section, and "bottom" values were plotted at 1.5 m. Data graph figure numbers for individual holes are listed in Table 2. Symbols used on the data graphs also are explained in Table 3.

The accuracy of the assumed depth below the seafloor assignments made for all geotechnical data plotted in the data graphs is unknown; however, all data, except the downhole densities, have a known location in each core and core-section and thus the depth assignments for individual values are directly comparable. It is estimated that the accuracy of the depth assignments made for all of the data, exclusive of the downhole densities, may be about one core length or ± 10 m of the values plotted on the data graphs. Depth values listed in Appendices

Table 2. Geotechnical Data Presentation

Hole	Data Graph, Fig.	Sedimentation-Compression Curve, Fig.	Nuclear Max. & Ave. Bulk Density, Appendix IX	Tabulated Physical Property Data, exclusive of Shear Strength, Appendix XI	Tabulated Shear Strength Data, Appendix X
6002	5	6	X	X	X
6003		no hole was drilled			
6004-4B	7	8	X	X	X
6005-5B	none	none	none	X	none
6006	none	none	X	X	none
6007-7B	9	10	X	X	X
6008	11	12	X	X	X
6009-9B	13	14	X	X	X
6010	15	16	X	X	X
6011	17	none	X	X	X
6012	18	19	X	X	X
6013-13B	20	21	X	X	X
6014	22	none	X	X	X
6015	23	none	X	X	X
6016B	none	none	X	X	X
6017	24	25	X	X	X
6018	none	none	X	X	none
6019-19B	26	none	X	X	X
6020	27	none	X	X	X
6021-21C	28	none	X	X	X

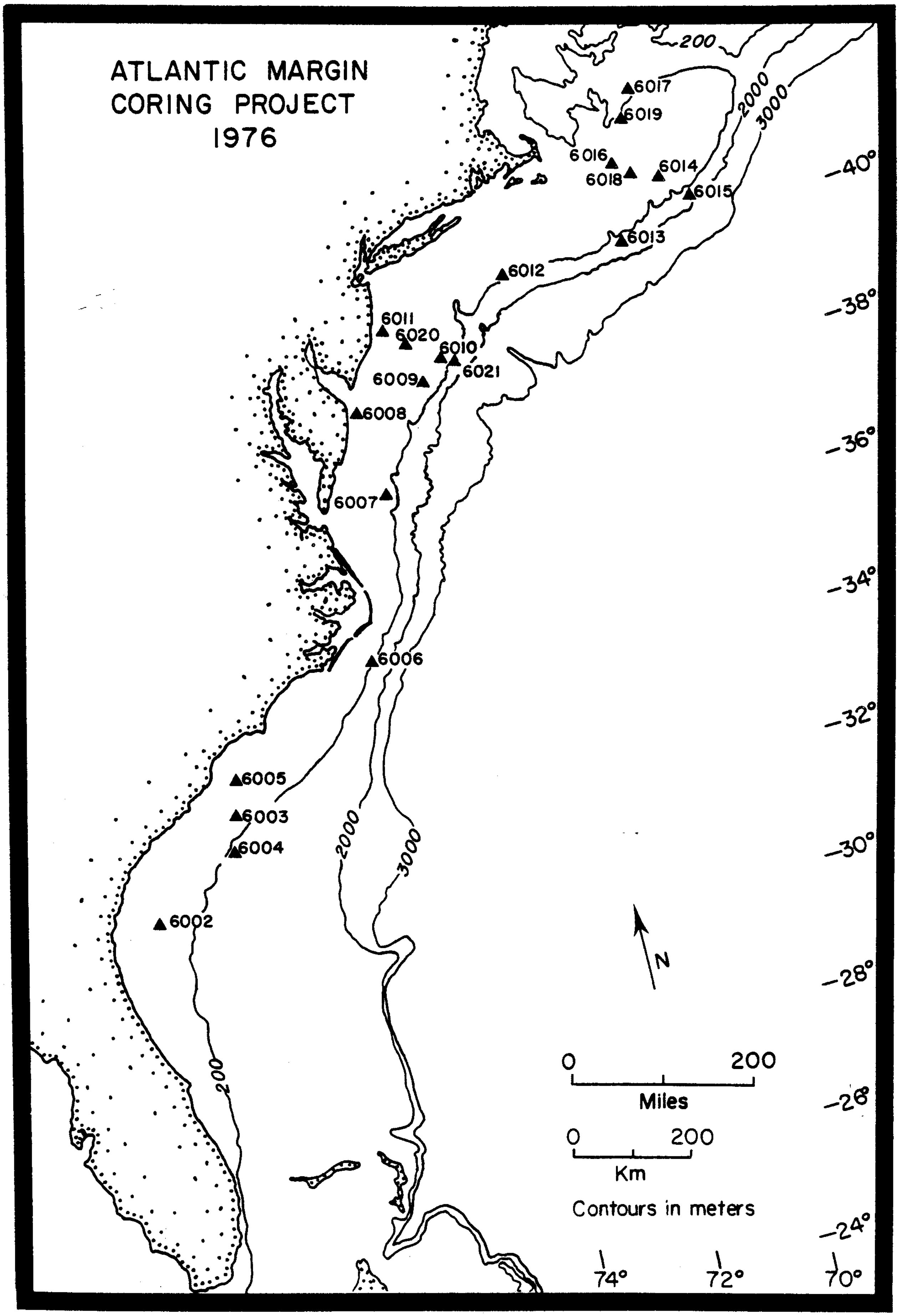

Fig. 4. Location of holes. Hole 6003 was not drilled.
(From Hathaway et al., 1976)

Table 3. Explanation of Symbols Used in Graphs

Geotechnical Property Data Graphs

Parameter	Plotted Symbol	Notes
Specific Gravity	●	
Downhole Density		copied from Schlumberger field print; Hole 6002, see text
Bulk density		
Maximum value from core-section shipboard analysis	●	see text for discussion
Value from laboratory measurement	○	see text for discussion of low values, which are assumed incorrect
Water content	●	
Liquid limit	△	
Plastic limit	▽	
Combination water content and Atterberg limit	▲	
Shear strength		
Torvane test	●	
Torvane test exceeding value plotted	●→	
Laboratory vane test, "undisturbed"	□	
Laboratory vane test, remolded	■	
Sensitivity	○	from laboratory vane tests

Sedimentation-Compression e log p Curves

Parameter	Plotted Symbol	Notes
Data calculated from text equations 1 and 2	△	

Table 4. Range of Geotechnical Property Data by Hole

Hole	Data Over Interval, m	Specific Gravity	Downhole Density, Mg/m^3 (1)	Shipboard Density, Maximum, Mg/m^3 (1)	Water Content, %	Liquid Limit, %	Plastic Limit, %	Shear Strength: Lab. Vane, kPa	Shear Strength: Torvane, kPa	Sensitivity: Lab. Vane
6002	6-180	2.38-2.58	1.50-2.34	1.30-2.16	-	106-203	36-103	3-54	2-67	2-5
6004-4B	7-290	2.60-2.75	-	1.52-1.96	31-95	42-101	40-79	5-10	7>96	4-9
6005-5B	Too few data to graph									
6006	Too few data to graph									
6007-7B	24-231	2.68-270	1.69-2.32	1.32-2.33	25-45	39-58	21-28	11-57	5-101	3-4
6008	4-117	2.62-2.69	-	1.91-2.24	27-43	20-59	13-27	11	16-27	4
6009-9B	9-204	2.65-2.71	1.81-2.28	1.78-2.45	15-43	31-58	10-26	-	19>96	-
6010	8-235	2.54-2.75	1.56-2.37	1.81-2.36	18-40	33-58	17-24	5-37	7>91	1-5
6011	9-146	2.52-2.71	1.53-2.34	1.57-2.30	35-49	39-97	26-64	45	25-45	12
6012	7-199	2.66-2.71	-	1.75-2.28	24-60	49-68	15-29	20-47	10>86	3-10
6013-13B	36-233	2.63-2.70	1.88-2.54	1.73-2.44	22-42	26-56	19-29	70-75	14>91	5

(1) Values are estimated from the data graphs.

Hole	Data Over Interval, m	Specific Gravity	Downhole Density, Mg/m^3	Shipboard Density, Maximum, Mg/m^3 (1)	Water Content, %	Liquid Limit, %	Plastic Limit, %	Shear Strength: Lab. Vane, kPa	Shear Strength: Torvane, kPa	Sensitivity: Lab. Vane
6014	62-102	2.63-2.68	-	1.77-2.42	27	30-32	20-25	-	5-43	-
6015	42-63	2.66-2.71	-	2.01-2.36	18	28-64	19-30	-	90>91	-
6016-16B	Too few data to graph									
6017	13-90	2.61-2.72	-	1.88-2.41	20-55	27-61	14-27	2-53	3-67	3-7
6018	Too few data to graph									
6019-19B	1-70	2.55-2.76	-	1.21-2.27	20-91	47-104	20-44	1-35	-	3-5
6020	7-43	2.66-2.70	-	1.80-2.22	19-46	37-59	17-35	20-45	11-60	-
6021-21C	4-196	2.62-2.74	1.75-2.28	1.70-2.29	20-68	34-56	16-27	3-80	5-91	2-6

IX, X, and XI are presented to the nearest 0.1 m only for ease of identification; they must not be considered this accurate in terms of in situ depth. The accuracy of the downhole densities depth assignments is not known.

Table 4 reports the range of geotechnical property values measured or computed for each of the 15 holes having data graphs. Caution must be exercised in using Table 4 because (1) some holes have many data and some holes have only a few data and (2) the depths below the seafloor at which data were acquired are highly variable from hole to hole; consequently, the range of data listed may be considered indicative but not definitive. Despite these caveats, several trends can be noted. The Miocene and Oligocene calcareous silty clays in Hole 6002 have lower specific gravities and densities and higher Atterberg limits than the non-calcareous sediments in any of the other holes. The Miocene calcareous sands and clays in Hole 6004-4B also show high values of water content and Atterberg limits compared to Pliocene strata above and Paleocene strata below, although fewer data exist from this hole to document well this similar trend. Relationships and geotechnical values of significance from individual holes will be discussed later.

occurring below about 183 m, was not geotechnically sampled. The sediments of this hole (Fig. 5) are characterized by low specific gravity and bulk density and high Atterberg limits and plasticity index; water content data are lacking. Bulk density values, measured by both the nuclear densitometer and the downhole tool, show moderate scatter in the calcareous sediments. The downhole tool densities in the limestone were relatively uniform within the range of about 2.0 to 2.1 Mg/m^3. A marked change in shipboard nuclear density marks the boundary between the Upper and Middle Miocene and between the Lower Miocene and Oligocene. The slope of the sedimentation-compression curve (Fig. 6) is variable, following a similar variation in bulk density. The major inflections in the curve appear related to the transition from Upper to Middle Miocene at a burial depth of 27 m and from Middle to Lower Miocene at 65 m. At the base of the deposits laid down during each age, the water content of the sediments increases with increasing depth; while below this boundary, normal consolidation (decreasing water content with increasing depth) occurs. This sequence also is repeated for the Oligocene sediments occurring below 75 m.

Hole 6004-4B is composed of calcareous sands, silty clays, and clays ranging in age from Pleistocene to Upper Cretaceous. Most geotechnical information extends only to the Middle Paleocene. The sediments of this hole (Fig. 7) are characterized by lower densities and higher water contents in the Pliocene and

Sedimentation-compression curves are presented in the Figures listed in Table 2. Of the holes investigated by this method, a general observation is that sediments of the inner and middle shelf tended to show little change in void ratio or water content with increasing effective overburden pressure or burial depth. The one exception was Hole 6002, which is a middle shelf hole having sediments composed of calcareous materials. Sediments from holes drilled on the outer shelf and upper slope showed a greater variability in the shape of their e log p curves, indicating that the depositional environments were less uniform than the depositional environments of the inner and middle shelf. Other relationships will be discussed later.

Lithologic information is from the preliminary data reported in Hathaway, et al. (1976); final lithology was unavailable when this report was written.

Hole Summaries

Hole 6002 is composed of Miocene, Oligocene, and Upper Eocene calcareous sands and silty clays; the Upper Eocene limestone,

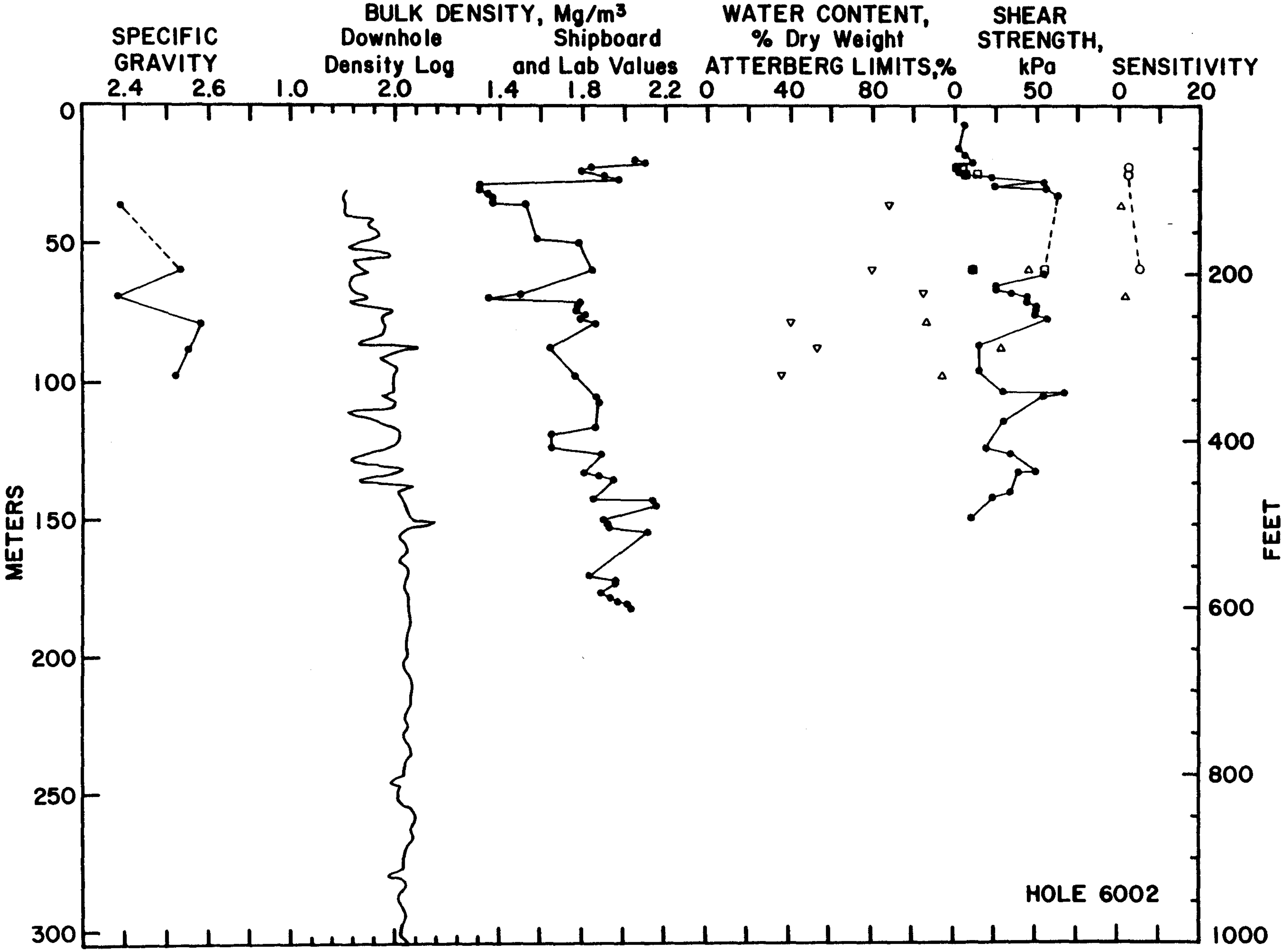

Fig. 5. Geotechnical data graph, Hole 6002.

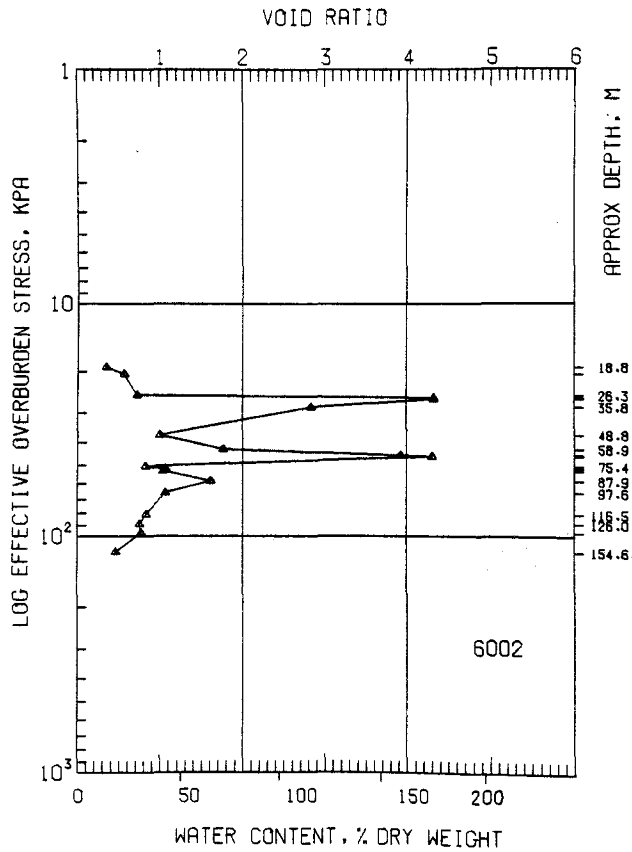

Fig. 6. Sedimentation-compression e log p curve, Hole 6002.

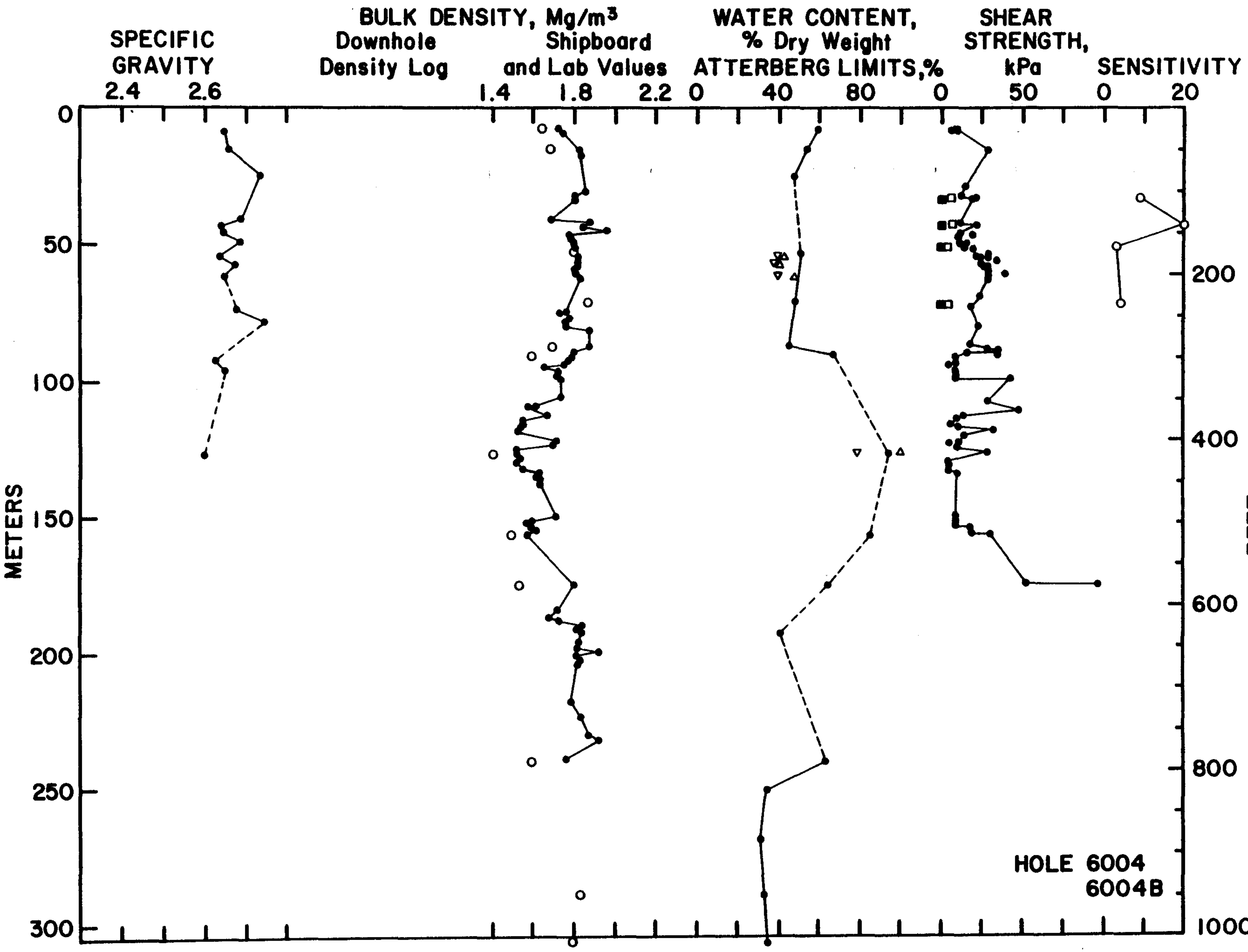

Fig. 7. Geotechnical data graph, Hole 6004-4B.

Miocene calcareous sands compared to similar Pleistocene sediments. Above a depth of about 75 m, water contents probably are higher than the liquid limit; the transition depth is uncertain because of the few data. At a depth between about 50 and 70 m. Pleistocene calcareous sands have plasticity indices ranging from only 1 to 8. Materials having small plasticity indices often have unusually high sensitivities. Sensitivities are not available over the depth range of the very small plasticity indices. The sensitivity values in the general depth vicinity, ranging from 4 to 20, are high, but should be considered with some skepticism because neither the laboratory vane nor the Torvane tests have general validity in sandy materials. The sedimentation-compression curve (Fig. 8) shows a generally increasing void ratio with increasing depth in the Pleistocene, Pliocene, and Miocene calcareous sands, indicating that consolidation is not occurring within this depth interval. Unfortunately, the e log p curve does not cover a sufficient depth range to include the Lower Miocene and Middle Paleocene clays.

Holes 6005 and 6006 had too few geotechnical data to warrant a graphical presentation.

Holes 6007-7B are composed of alternating sands, silty and clayey sands, silty clay and clay of Pleistocene, Pliocene (?), and Miocene age. The sediments of these holes (Fig. 9) have geotechnical properties generally similar to the other holes at higher latitudes, except holes 6011 and 6019. Downhole densities

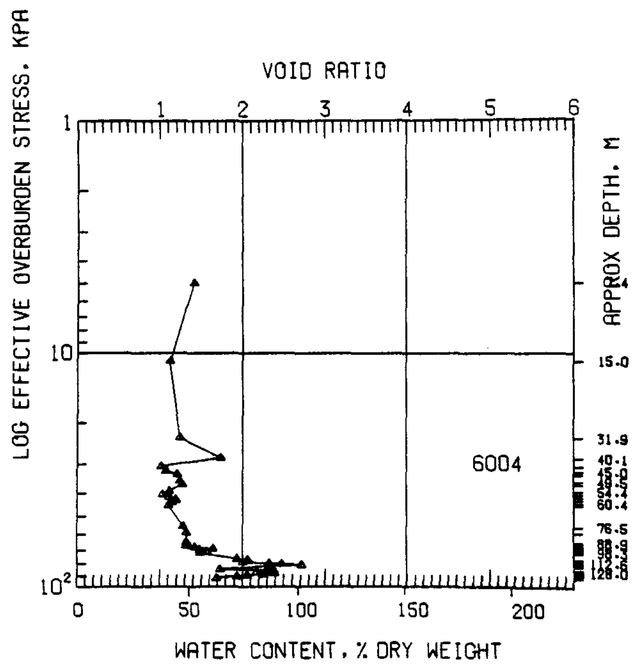

Fig. 8. Sedimentation-compression e log p curve, Hole 6004-4B.

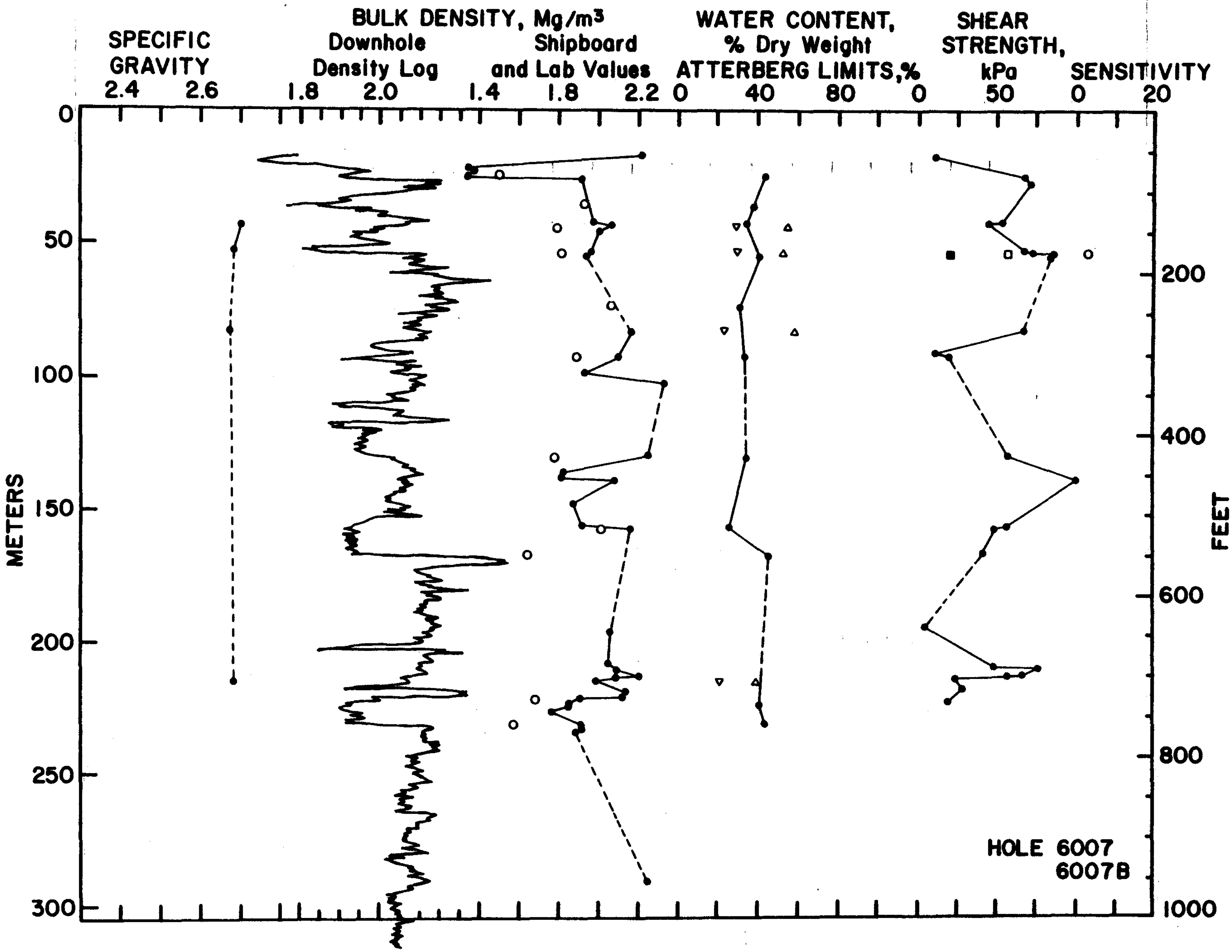

Fig. 9. Geotechnical data graph, Hole 6007-7B.

in the Miocene sandy sediments of Hole 6007B decreased slightly, from 2.15 to 2.05 Mg/m^3, from about 170 m to the bottom of the hole; the silty and clayey sediments throughout the hole showed considerably greater variability in density than did the sandy sediments. The water contents were all less than the liquid limit, except that at the greatest depth sediment was tested the water content might be at or slightly higher than the liquid limit. Shear strength values should be considered only as estimates, because of the generally sandy character of most of the sediments sampled. The sedimentation-compression curve (Fig. 10) showed very little change of void ratio with increasing depth. The high void ratio of about 5 is related to the unusually low densities near 25 m, which occurs close to the top of the Pleistocene clay layer. These low densities are considered valid because they were measured both aboard the ship and with the downhole tool; consequently, a significant amount of consolidation has occurred in this clay layer. The other void ratio maximum of 2.2 corresponds to the low densities measured by both methods at a depth of about 225 m in a Miocene clay layer.

Hole 6008, which penetrated only a little deeper than 100 m, is composed of sands and silty clays of questionable Pleistocene age. The sediments of this hole (Fig. 11) show a gradual increase in density with increasing depth to about 25 m, below which the density is nearly constant at 2.2 Mg/m^3. Water content is greater than the

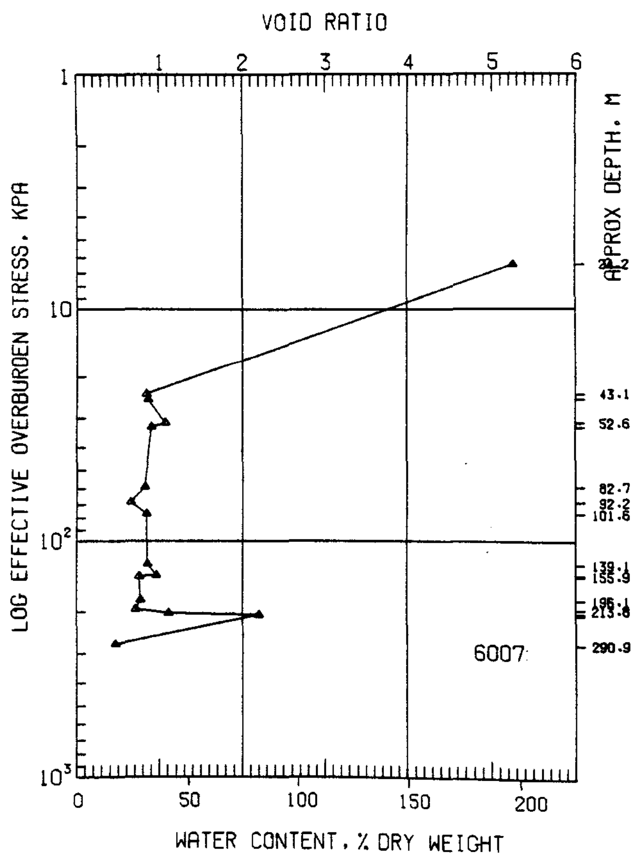

Fig. 10. Sedimentation-compression e log p curve, Hole 6007-7B.

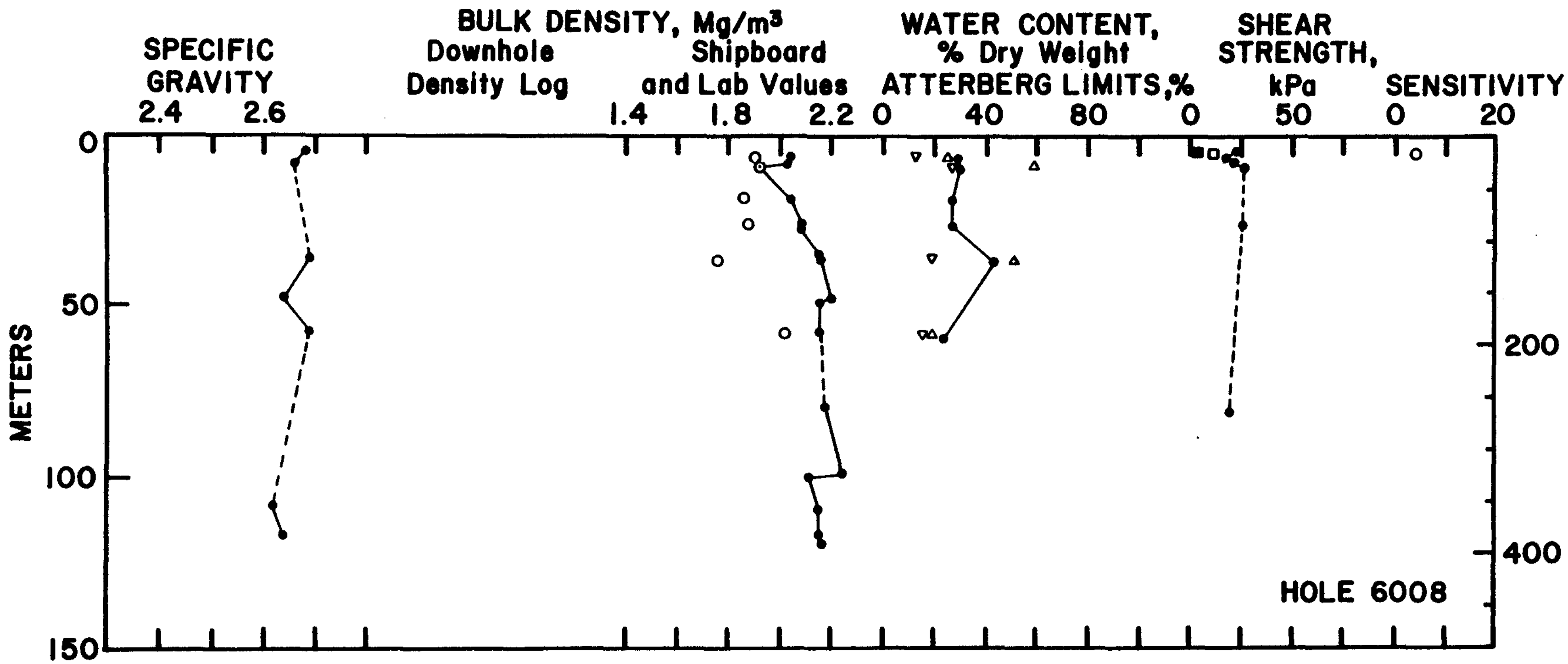

Fig. 11. Geotechnical data graph, Hole 6008.

liquid limit in the silty clays and not in the sands. The sedimentation-compression curve (Fig. 12), while based on few data, shows little change in void ratio with increasing depth. None of the measured geotechnical data appear to reflect the very low salinity values occurring in the sediments sampled.

Holes 6009-9B are composed of sands and silty clays ranging in age from Pleistocene to Miocene. The water content is consistently less than the liquid limit, except at the shallowest depth tested where the water content may be less than the plastic limit; however, the water content and Atterberg limit values are of slightly different depths and a comparison may be meaningless The low downhole densities at depths of less than about 35 m are not reflected in the shipboard nuclear values. The sediments of this hole (Fig. 13) have geotechnical properties that show small to moderate changes with burial depth. The sedimentation-compression curve (Fig. 14) has too few data to reflect accurately the consolidation history. All measured water contents were lower than corresponding liquid limits.

Hole 6010 is composed of sands and silty clays ranging in age from Pleistocene to Miocene. The sediments of this hole (Fig. 15) also have geotechnical properties that show little change with increasing depth. There is a small increase in density and decrease in water content from the surface to a depth of about 100 m. Measured water contents were below the

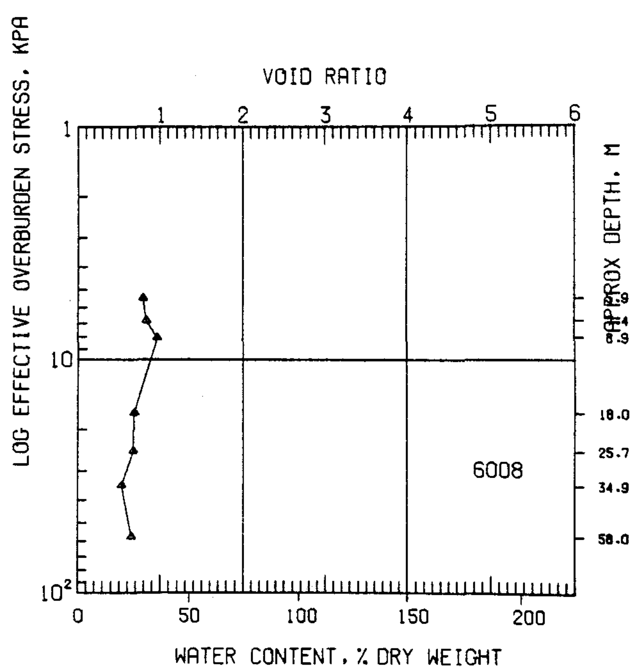

Fig. 12. Sedimentation-compression e log p curve, Hole 6008.

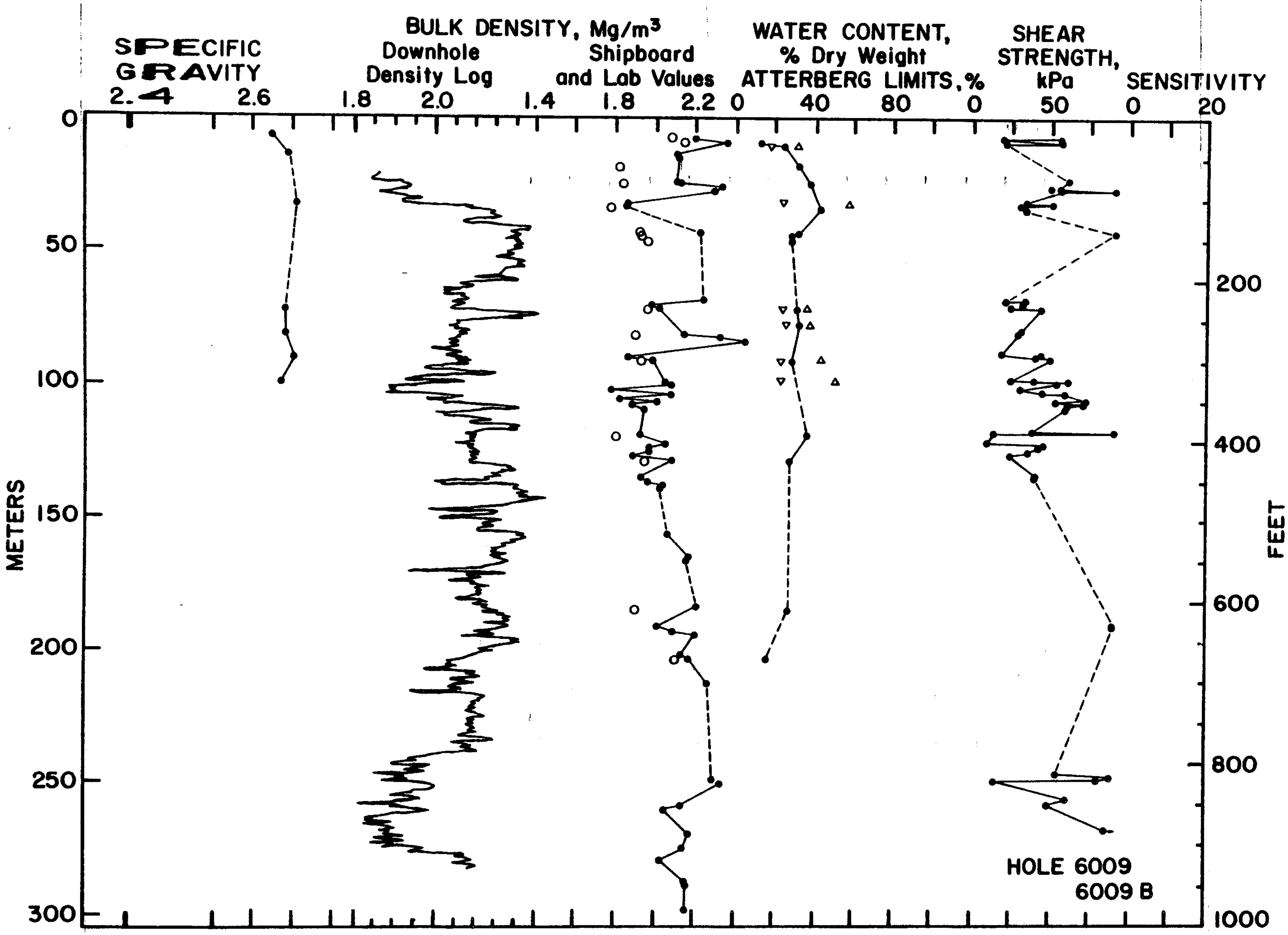

Fig. 13, Geotechnical data graph, Hole 6009-9B.

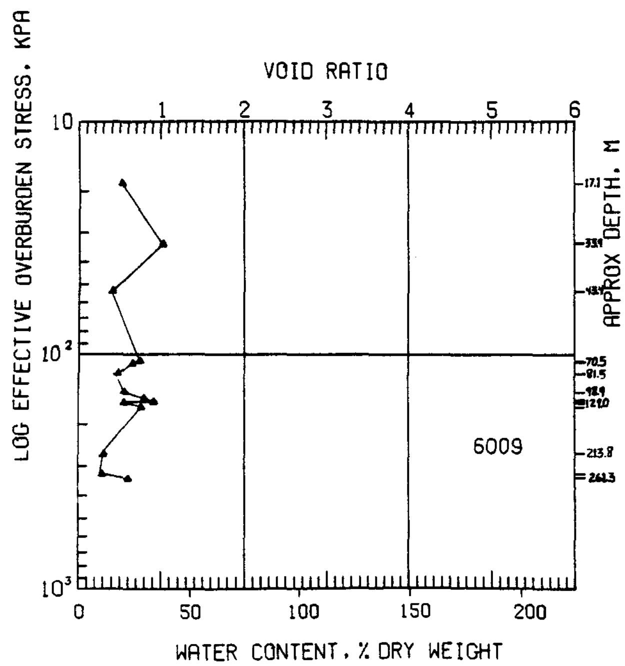

Fig. 14. Sedimentation-compression e log p curve, Hole 6009-9B.

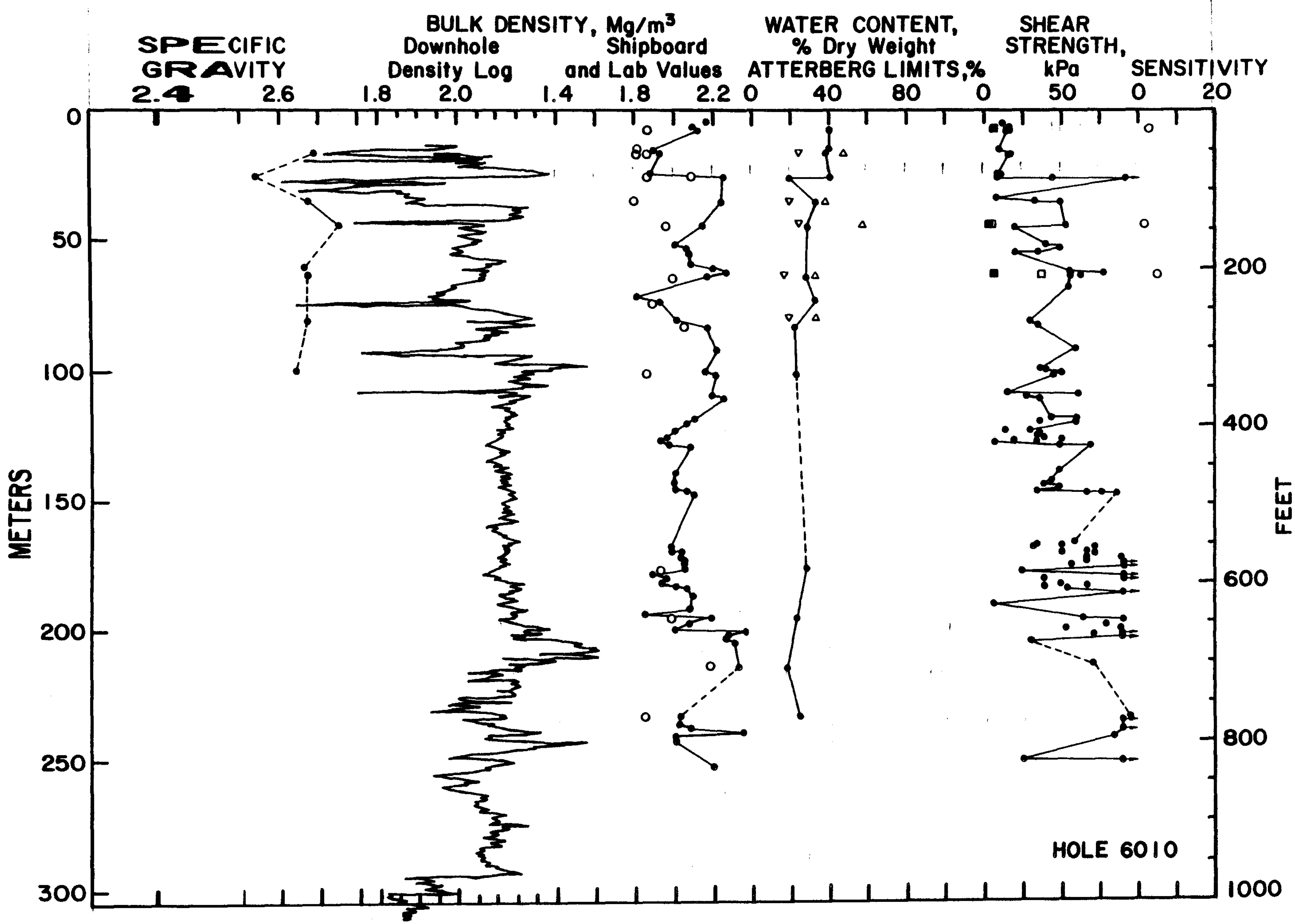

Fig. 15. Geotechnical data graph, Hole 6010.

liquid limit. Shear strength appears to gradually increase with depth, although there is much scatter in the Torvane data. Many strength values exceeded the measurement capability of the machine. High strength values often, but not always, corresponded to high densities. The sedimentation-compression curve (Fig. 16) shows little change in void ratio with increasing effective overburden pressure.

Hole 6011 is composed of alternating sands, silty clays, and clays ranging in age from Pleistocene to Eocene, with no sediments of Oligocene age represented. The sediments of this hole (Fig. 17) are characterized with different geotechnical properties compared to sediments from adjacent holes. It is noteworthy that pore-fluid salinity was in the 2 to 3 °/oo range from 71 to 194 m (Hathaway et al., 1976). The downhole tool measured densities that showed a variable distribution. The two water contents measured were well below the liquid limit. The liquid and plastic limits exhibited a significantly higher range of values, particularly in the Pliocene, compared to sediments from all adjacent holes; only the Pleistocene sediments from Hole 6014 that is located on the north flank of Georges Bank had Atterberg limit values correspondingly high. The one laboratory vane shear strength measurement, about 60 m in the Pliocene silty clay, yielded a sensitivity of 12, which is to believed to be valid; this value represents a slightly quick condition, according to the nomenclature of Rosenqvist (1953). There

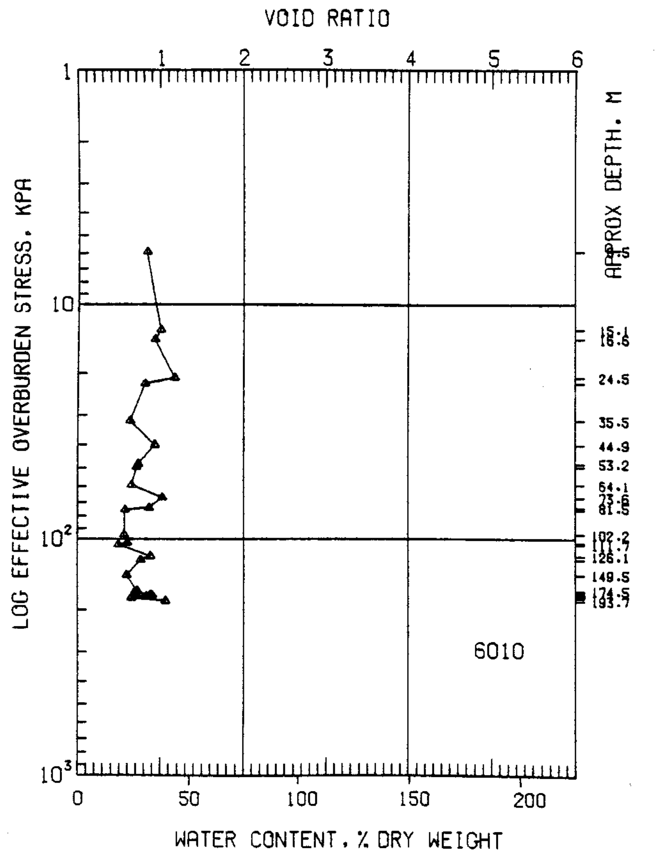

Fig. 16. Sedimentation-compression e log p curve, Hole 6010.

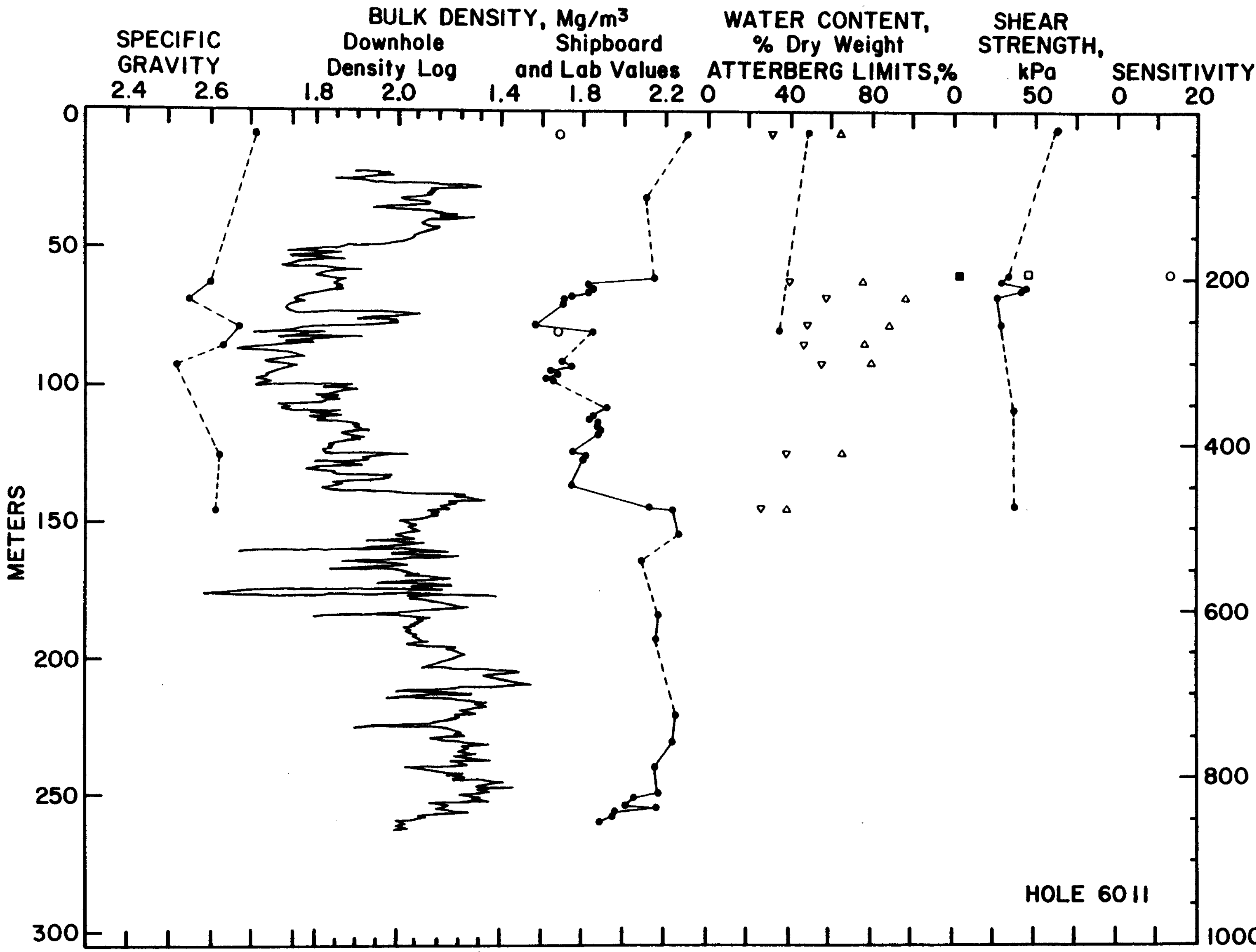

Fig. 17. Geotechnical data graph, Hole 601I.

is no sedimentation-compression curve for sediments of this hole.

Hole 6012 is predominantly composed of Pleistocene silty and sandy clays, with a questionable boundary of Miocene occurring at a depth of about 292 m. Geotechnical properties (Fig. 18) showed little variability with respect to depth. Measured water contents were below the liquid limit. Torvane shear strength increased slightly over the depth of the hole; these data exhibited a large amount of scatter, and between a depth of about 230 to 275 m many strength values were higher than 86 kPa by an unknown amount. Two of the four sensitivities were about 10, or slightly quick on the Rosenqvist (1953) scale. The sedimentation-compression curve (Fig. 19) shows only a very small part of the data. The sediments above about 19 m show no consolidation, while below this depth, to the maximum depth for which data exists (29 m) consolidation occurs.

Holes 6013-13B are composed of alternating sands, silty sands, and silty clays of Pleistocene age. The geotechnical properties (Fig. 20) showed very little change with depth; however, abrupt changes in bulk density, measured by the downhole tool occurred at 90, 280, and about 295 m. Measured water contents were lower than liquid limit values. Over the depth range of about 50 to a little less than 60 m in a silty-clay layer, unusually low plasticity indices ranged from 3 to 7. Laboratory vane shear strength measurements were not made over this interval; consequently, sensitivity values are not available. The sedimentation-compression

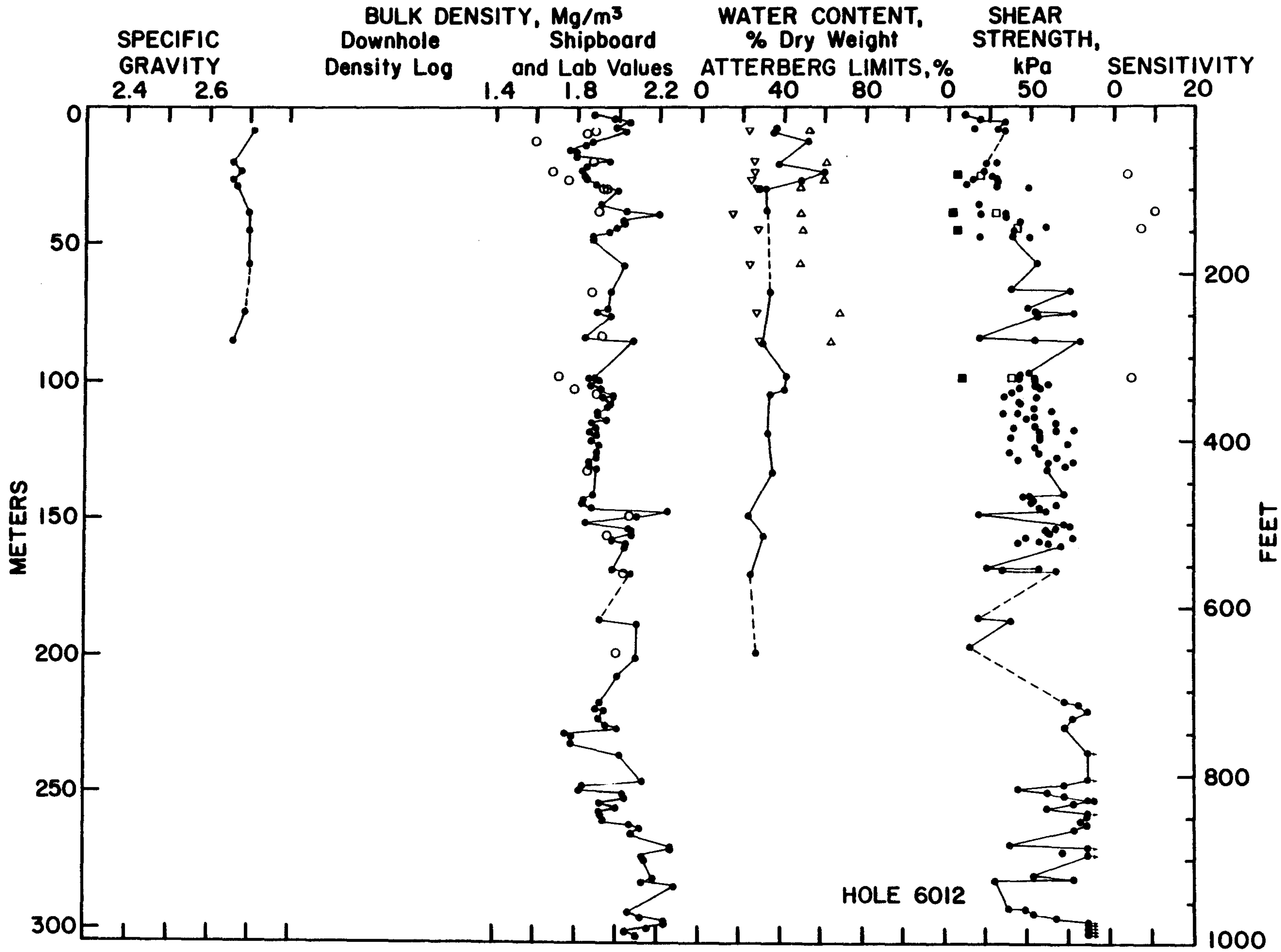

Fig. 18. Geotechnical data graph, Hole 6012,

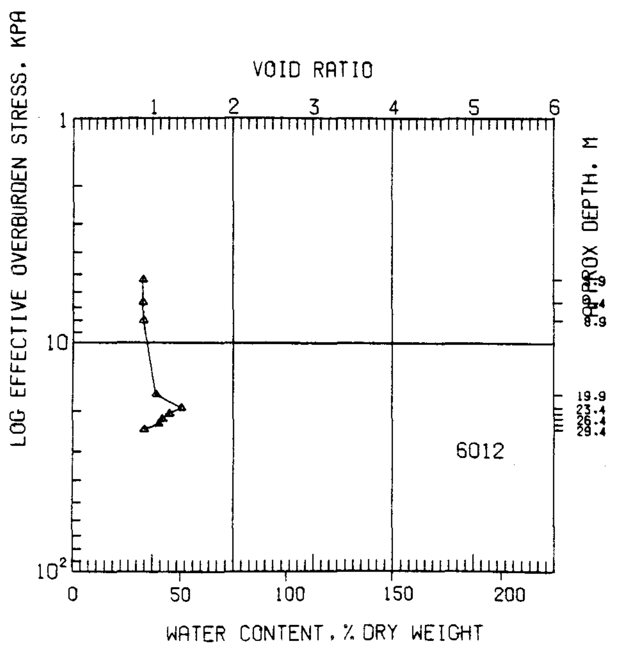

Fig. 19. Sedimentation-compression e log p curve, Hole 6012.

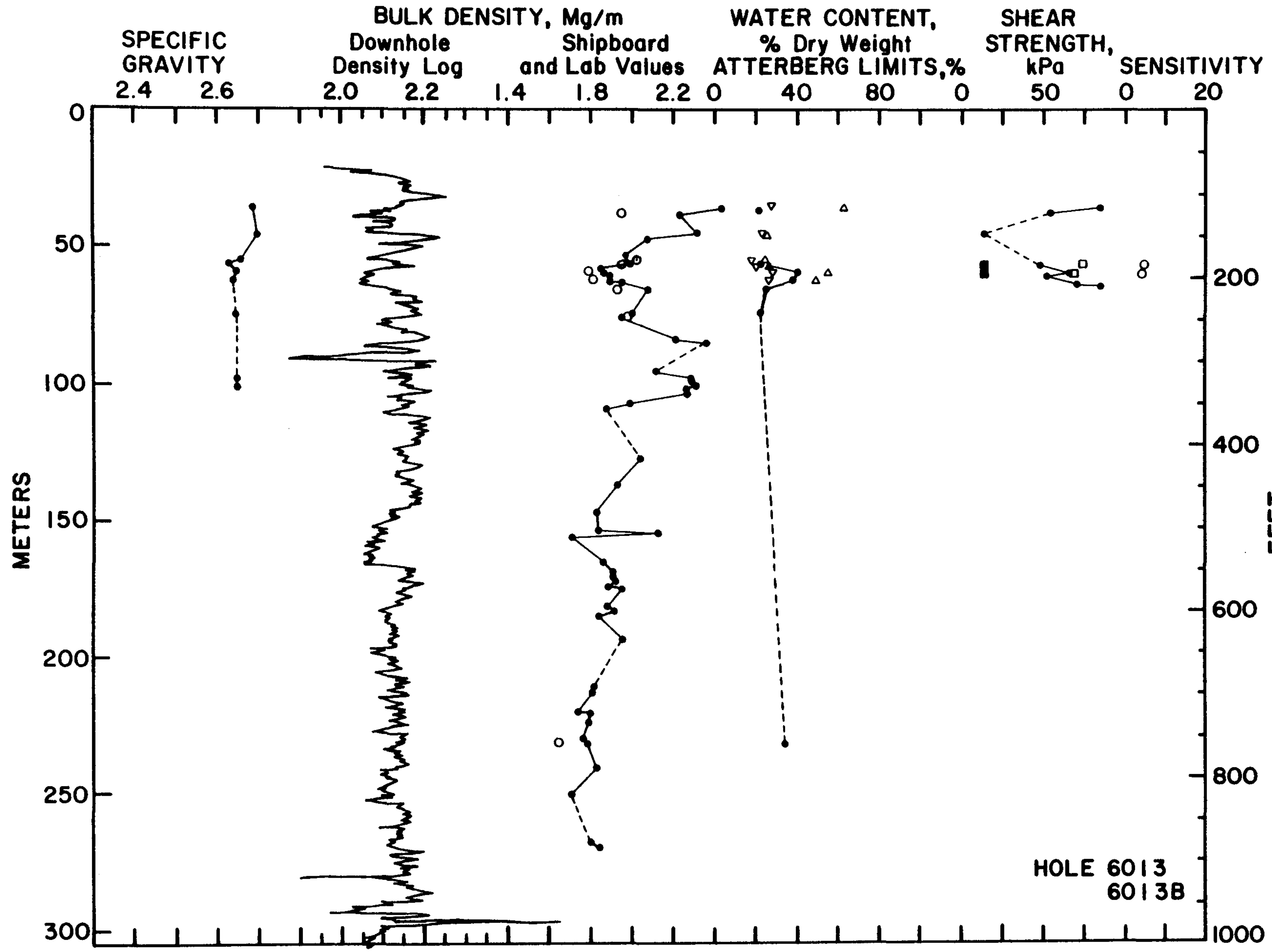

Fig. 20 Geotechnical data graph, Hole 6013-13B.

curve (Fig. 21) again shows only few data.

Hole 6014 is composed of Pleistocene silty sands and clays. The geotechnical property data (Fig. 22) are few in number. The single water-content value was lower than the liquid limit. All shear strength measurements were made in clay layers. There is no sedimentation-compression curve.

Hole 6015 is composed of sand to a depth of about 38 m, below which silty sands extended to the maximum depth drilled at slightly greater than 43 m; all sediments are Pleistocene in age. Geotechnical property data (Fig. 23) are few in number. The single water-content value was the same as the plastic limit. All three measured shear strengths were above 90 kPa. There is no sedimentation-compression curve.

Hole 6016 had too few geotechnical data to warrant a graphical presentation.

Hole 6017 is composed of Pleistocene sandy and silty clays to the maximum depth of 90.5 m drilled. Geotechnical properties (Fig. 24) showed comparatively little change with depth. Near the seafloor the single water content at a depth of about 13.5 m was higher than the liquid limit measured at a depth of 15 m. At depths greater than 40 m, where the next Atterberg measurements were made, measured water contents were less than liquid limit values. The few data comprising sedimentation-compression curve (Fig. 25) do not reflect the distribution of density or water content

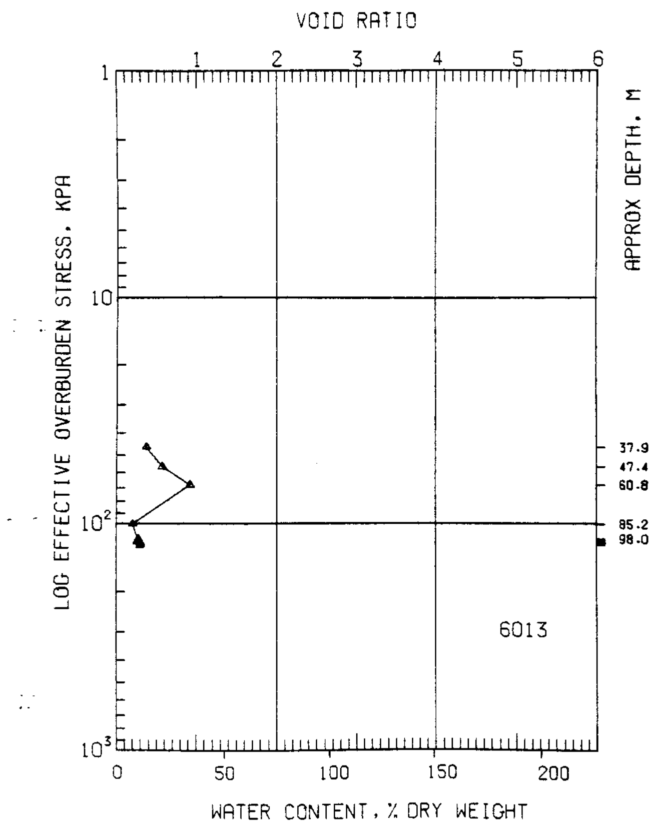

Fig. 21. Sedimentation-compression e log p curve, Hole 6013-13B.

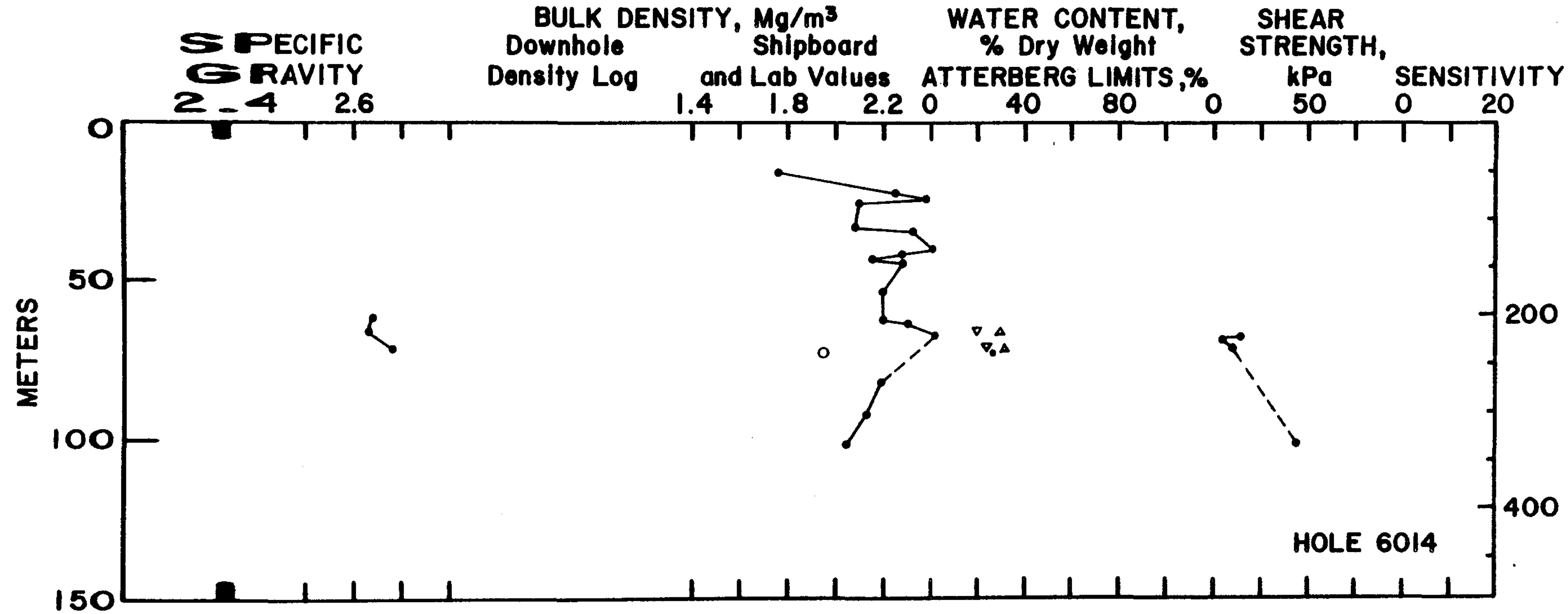

Fig. 22 Geotechnical data graph, Hole 6014.

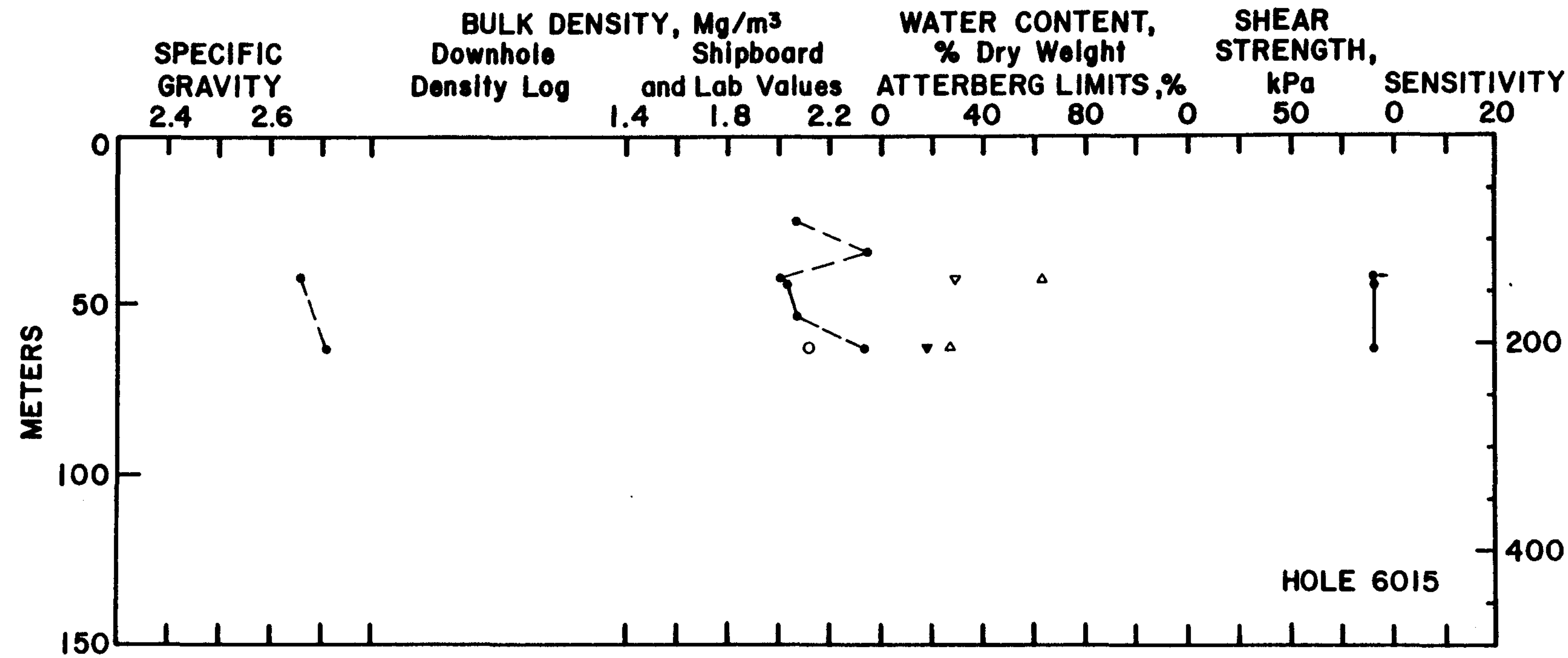

Fig. 23. Geotechnical data graph, Hole 6015.

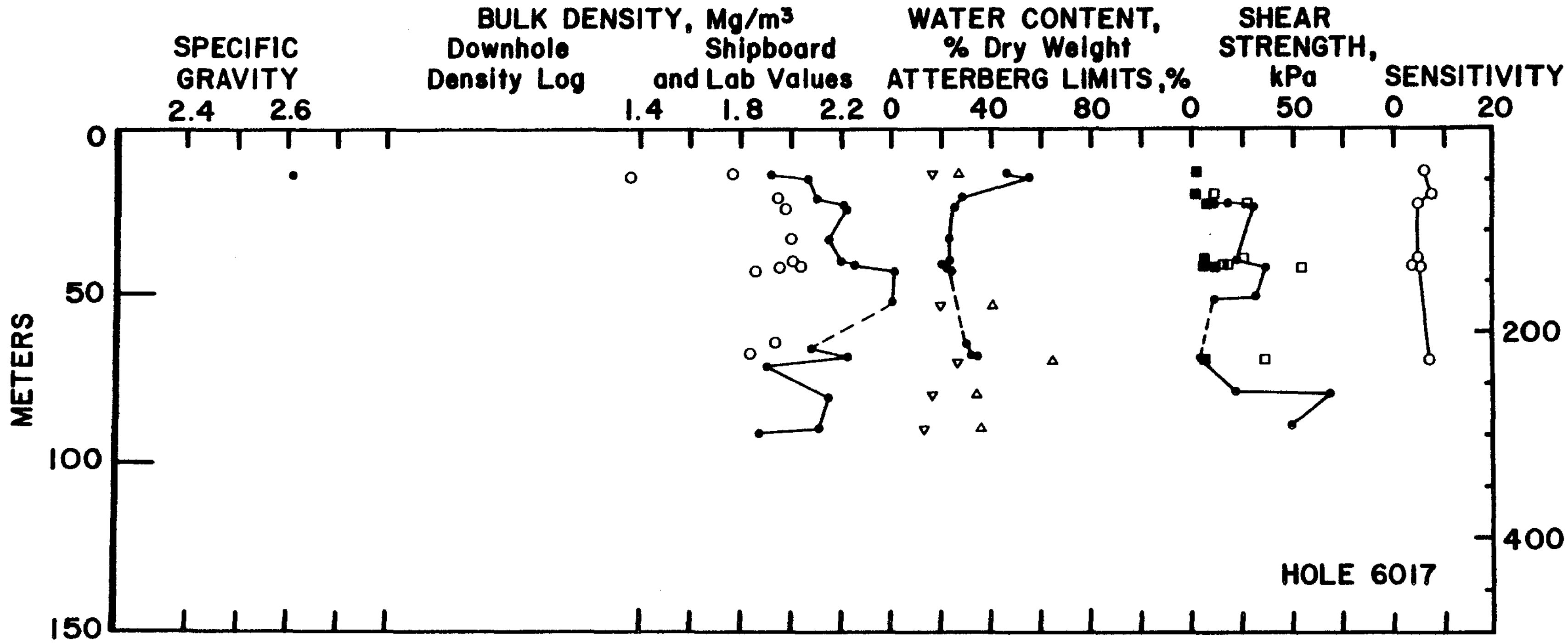

Fig. 24. Geotechnical data graph, Hole 6017.

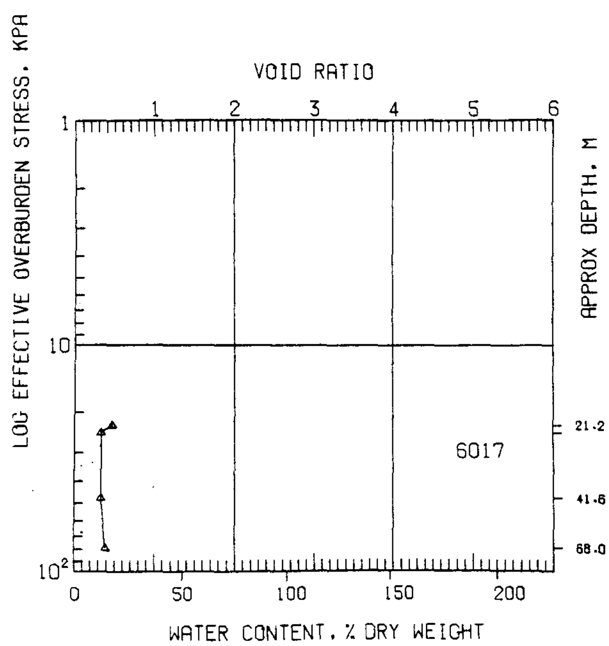

Fig. 25. Sedimentation-compression e log p curve, Hole 6017.

in the hole (Fig. 24).

Hole 6018 had too few geotechnical data to warrant a graphical presentation.

Holes 6019-19B are composed of silty and sandy clays and clays of Pleistocene age to a depth of about 55 m, below which Middle Eocene limestone was drilled. The geotechnical properties (Fig. 26) were predominantly measured in the Pleistocene section. Geotechnical properties in this hole, located on the North flank of Georges Bank, exhibited different characteristics compared to all other non-carbonate sediments, except those sampled in Hole 6011 located a short distance off Barnegat Inlet, New Jersey. In Hole 6019, the density values fluctuate over the unusually wide range of 1.21 to 2.27 Mg/m^3, and the water contents reflect these changes. High values of water content and liquid limit are atypical of non-carbonate sediments sampled during the Atlantic Margin Coring Project. The explanation for these anomalous values is not known, but may well be related to the reported (Hathaway et al., 1976) rich reworked assemblage of Middle Eocene micro- and nannofossils. All measured values of water content, except the one occurring in the sand layer between 30 and 40 m, were lower than the liquid limits. Torvane values in the silty clays were low. There is no sedimentation-compression curve for this hole.

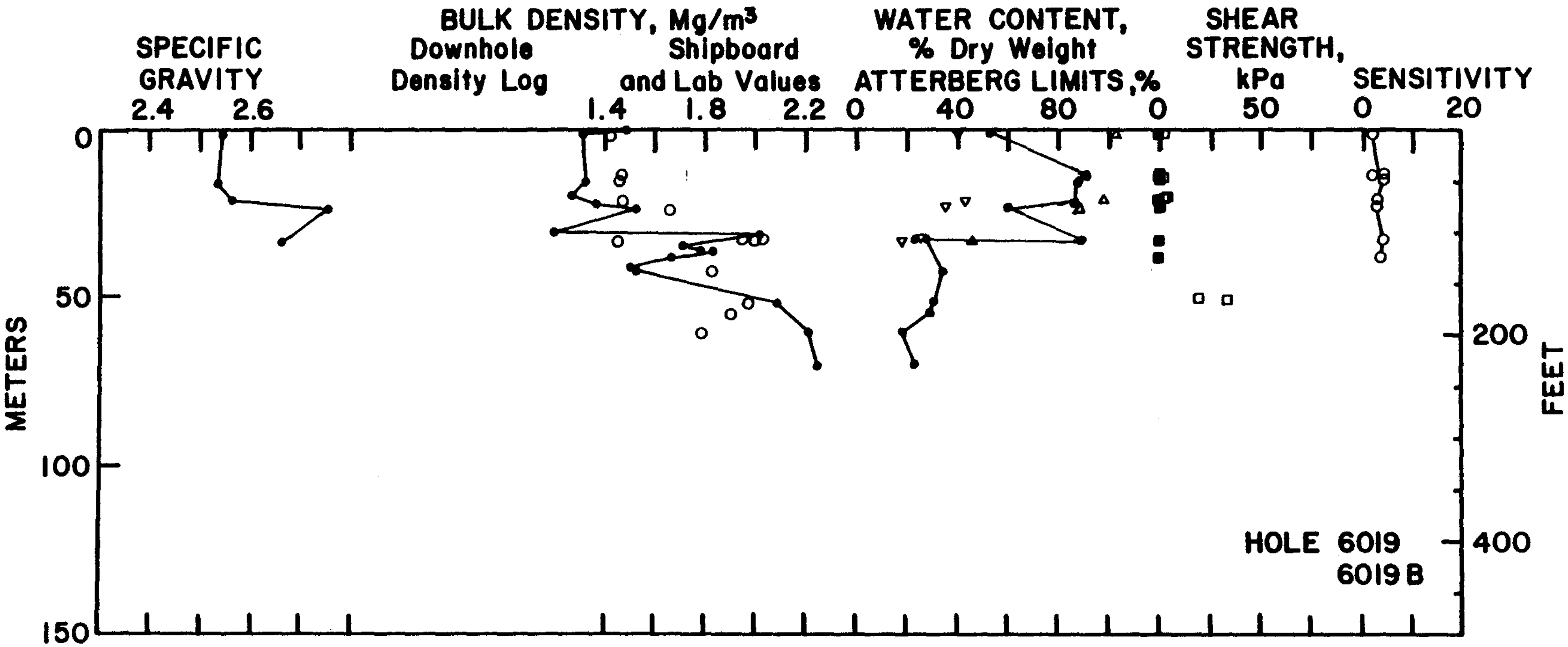

Fig. 26. Geotechnical data graph, Hole 6019B.

Hole 6020 is composed of Pleistocene silty and sandy clays; only 43.9 m were penetrated. Geotechnical properties (Fig. 27) showed an increase in bulk density and shear strength with respect to depth. In this hole, there was a reduction in salinity from about 33 $^{\circ}/_{\circ\circ}$ near the surface to about 5 $^{\circ}/_{\circ\circ}$ at a depth of 40 m. Measured water contents were all below liquid limit values, except near the surface. There is no sedimentation-compression curve for this hole.

Holes 6021-21C are composed of silty clays of Pleistocene age. Geotechnical properties (Fig. 28) are similar to those of sediments sampled in adjacent holes landward on the continental shelf. The variable shipboard density and water content values between the seafloor and a depth of about 15 m probably reflects, in part, the overlap of two holes drilled. The downhole log was made in a third hole. Most measured water contents are less than the liquid limits. Torvane shear strength appears to decrease from the seafloor to depth of about 50 m, below which there is a small increase with increasing depth. There is no sedimentation-compression curve for this hole.

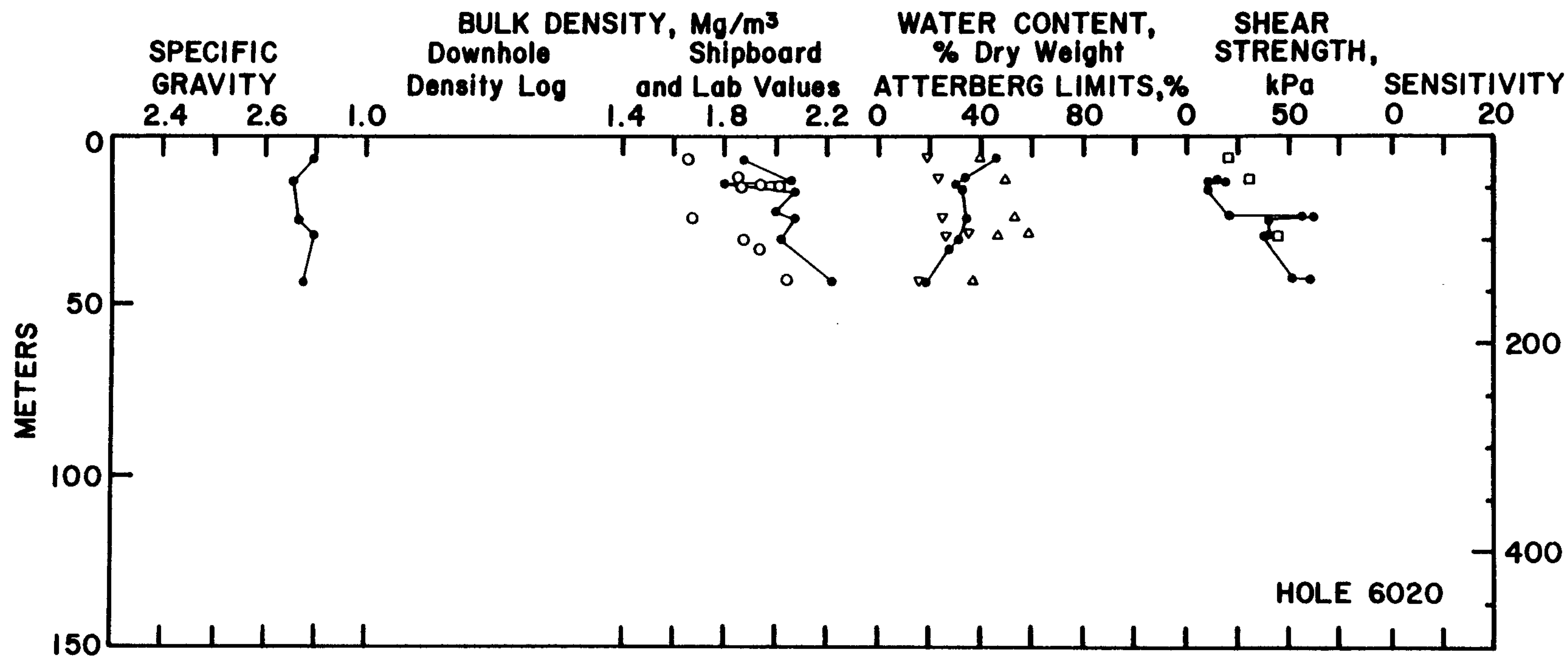

Fig. 27. Geotechnical data graph, Hole 6020.

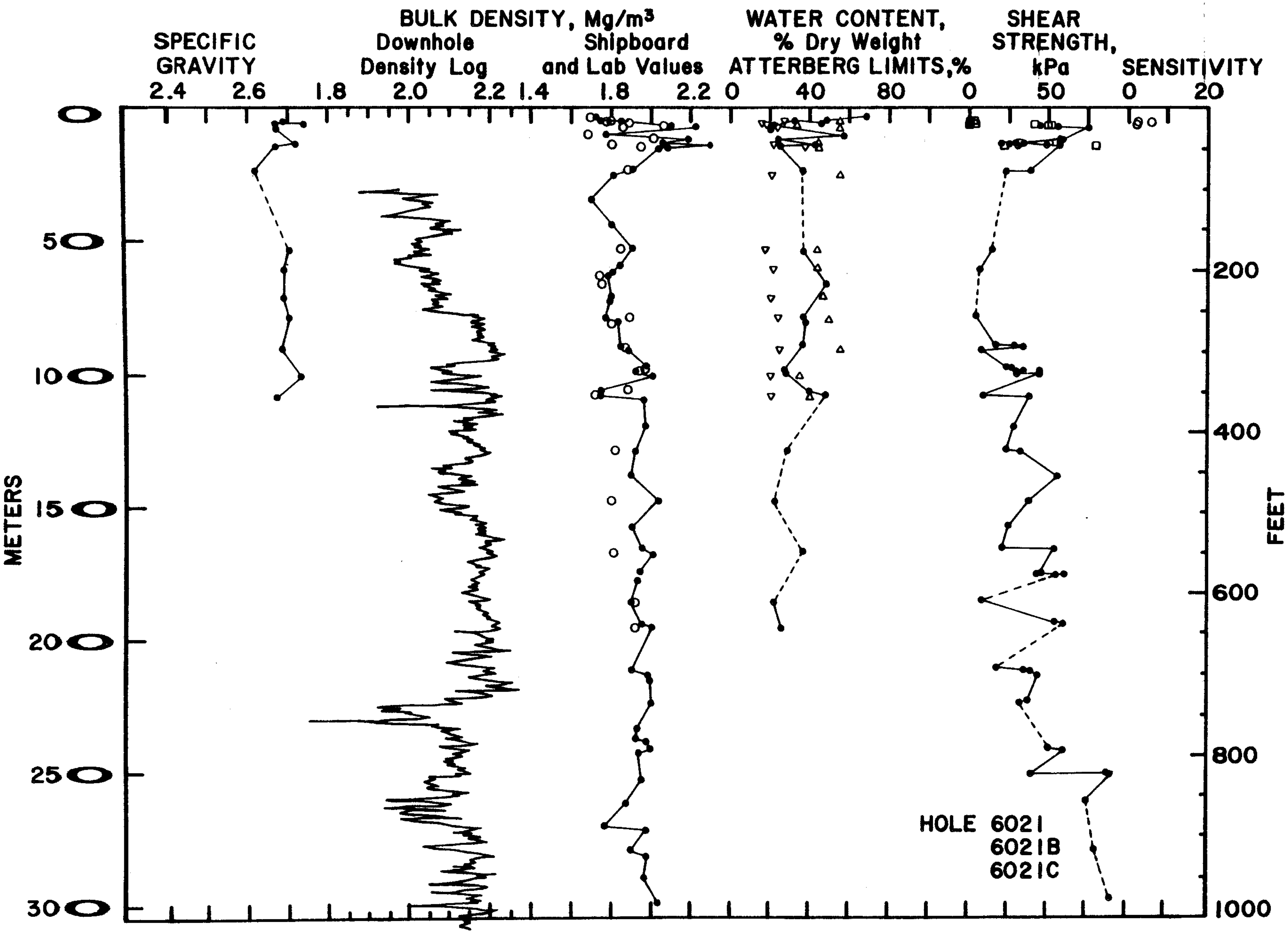

Fig. 28. Geotechnical data graph, Hole 6021-21C.

REFERENCES

Chough, S. K., and Richards, A. F., 1974, Comparison of sedimentation-compression curves obtained by nuclear and gravimetric methods for Wilkinson Basin, Gulf of Maine sediments: Marine Geol., v. 17, p. 249-261.

Hathaway, J. C. and others, 1976, Preliminary summary of the 1976 Atlantic margin coring project of the U. S. Geological Survey: U. S. Geological Survey Open File Rept. No. 76-844, 217 p.

Meyers, P. V., Van Sciver, W. J., and Richards, A. F., 1974, Theory of nuclear transmission densitometry applied to sedimentology and geotechnology: Jour. Sed. Petrology, v. 44, p. 1010-1015.

Preiss, K., 1968, Non-destructive laboratory measurement of marine sediment density in a core barrel using gamma radiation: Deep-Sea Res., v. 15, p. 401-407.

Richards, A. F., 1973, Geotechnical properties of submarine soils, Oslofjorden and vicinity, Norway: Norwegian Geotechnical Inst. Tech. Rept. No. 13, 107 p.

Rosenqvist, I. Th., 1953, Considerations on the sensitivity of Norwegian quick-clays: Géotechnique, v. 3, p. 195-200.

Appendix I

GEOTECHNICAL PROGRAM

27 July 1976
Rev. 8 August 1976

I. Sampling

A. 5 ft unsplit sections (for triaxial and consolidation tests)

1. Every good-quality 30 ft core of mud or sand (incl. shells) having two or more 5 ft sections to a depth of 100 m

2. One section between 100 and 120 m

B. 2-cm unsplit sections (for water content and bulk density)

1. Every 5 ft section to 20 m

2. Every other 5 ft section to 100 m

3. Every other 30 ft core from 100 to 200 m (with "water" sample)

C. 50-cm of 1/4 section--every other 5 ft section to 100 m (for general geotechnical classification and consistency tests)

II. Testing

A. Nuclear densitometer--every suitable* unsplit section

B. Torvane

1. At bottom of every suitable** section of unsplit section

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* Having at least 3-cm along axis of liner in contact with liner.

** Silt and/or clay. (not on sand or shells)

B. Torvane (continued)

   2. Close to wood support of each suitable split section.

C. Laboratory vane--every suitable** split section to 100 m

Appendix II

PROGRAM FOR GEOTECHNICAL REPRESENTATIVE 7 August 1976

1. Run all suitable core* sections thru densitometer (all sections having at least 3 cm of sediment almost filling liner)

2. After densitometry, decide if the entire 1.5 m (5 ft.) core is suitable for triaxial-consolidation testing. If it is, and if there are at least two sections from the core, then set the section aside; within 12 h the paleontologists should release it if it does not contain a critical stratigraphic boundary. When released, prepare it for storage ASAP. Select 1.5 m (5 ft.) sections as follows: a. every good-quality core to 100 m (330 ft.); b. one additional section between 100 and 200 m (330-660 ft.) Method "A" preparation for each section. Log all cores taken on the USGS "taken sample" log.

3. Insure that a Torvane test is taken at the bottom of each core section of suitable (silt and/or clay) sediment to a depth of 100 m (330 ft.) (n.b. data to be recorded in TSF--when transcribing worksheets divide by 10 for the true reading.)

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* Core = 30 ft of uncut plastic liner. Section = 1.5 m (5 ft length) of a 30 ft core.

4. Obtain a 2-cm section from the bottom of the unsplit sections as follows for ashore water content and bulk density:

a. in conjunction with the water-chemists sample (8 cm for geochemistry, 2 cm for geotechnology, every other core)

b. every section to 20 m.

c. every other section per 30 ft core to 100 m (330 ft.)

d. every other 30 ft core between 100 and 300 m (330-1000 ft), but only if not hard rock

e. log all samples, except those obtained from the geochemist, on the "taken sample" log.

Method "B" preparation for each water-bulk density sample.

5. On split core sections, insure that:

a. a Torvane test is made over a wooden support of each section to a depth of 100 m (330 ft.) or to a great depth if deemed advisable

b. a lab vane test is taken at least every core (30 ft.) and more often if possible on every suitable sample

c. a sample of 1/2 of the split core at least 50 cm long every other section to 100 m (330 ft.) for physical property testing.

Method "C" preparation for each sample.

6. Obtain a copy of the FDC (density) log about 24 h after logging operations are completed. If the hole looks particularly interesting, ask for copies of the other logs. (Don't abuse this priviledge).

7. When the core-log blackboard is erased, pick up from the typist the geotechnical copy of the core log summary. Make certain that the hole numbers, latitude, longitude, water depth, core number, number of sections, and penetration (ft and m) are clearly readable--if not, ink in this information. Complete all geotechnical forms using the information contained in this summary. For depth assume that the bottom of the deepest section corresponds to the penetration depth. To obtain the depth of the bottom of sections of the same core, subtract 1.5 m per section.

8. From time to time, obtain an update of the hole preliminary summary sheet.

9. Prepare a graphic geotechnical log, if possible in your "spare" time. A master template is in one of the drawers to show scale information required, etc. The left-hand side will be prepared in the attached standard format. We suggest using a dot for good density data and a dot and a small circle for poor or suspect density data. Engineering judgment decides which.

10. Any other tabular or graphical data reduction you would like to make is encouraged.

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Bethlehem, PA 18015

GEOTECHNICAL SAMPLE SELECTION DATA FORM A. UNOPENED CORES

USGS Core Ident. No. ________________ Geotechnical Sample No. U-_________

Date Core Collected: ___________________________, GLOMAR CONCEPTION

Location: ____________________ N. Lat.__________________________ W. Long.

Water Depth: ___________ meters Uncorrected, U, or Corrected, C?________

Depth Below Seafloor: from ______ m (top) to _______ m (bottom of sample)

Sample: Triaxial ________ Consolidation __________ Dynamic ______________

Sample Preparation Date ________________ Prepared by ____________________

Sample Condition or Quality:
Top of core:

Bottom of core:

Stratigraphy and/or Geological Age:

Other Notes:

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GEOTECHNICAL SAMPLE SELECTION DATA FORM B. SPLIT CORES

USGS Core Ident. No. ______________ Geotechnical Sample No. S-______

Date Core Collected: ______________________, GLOMAR CONCEPTION

Location: ________________ N. Lat. ________________W. Long.

Water Depth __________ meters Uncorrected, U, or Corrected, C?_____

Depth Below Seafloor: from ______ m (top) to ______ m (bottom of sample)

Stratigraphic Section/Geological Age? ________________________

USGS Core Ident. No. ______________ Geotechnical Sample No. S-______

Date Core Collected: ______________________, GLOMAR CONCEPTION

Location: ________________N. Lat. ________________ W. Long.

Water Depth __________ meters Uncorrected, U, or Corrected, C?_____

Depth Below Seafloor: from ______ m (top) to ______ m (bottom of sample)

Stratigraphic Section/Geological Age?________________________

USGS Core Ident. No. ______________ Geotechnical Sample No. S-______

Date Core Collected: ______________________, GLOMAR CONCEPTION

Location: ________________N. Lat. ________________ W. Long.

Water Depth __________ meters Uncorrected, U, or Corrected, C?_____

Depth Below Seafloor: from ______ m (top) to ______ m (bottom of sample)

Stratigraphic Section/Geological Age?________________________

USGS Core Ident. No. ______________ Geotechnical Sample No. S-______

Date Core Collected: ______________________, GLOMAR CONCEPTION

Location: ________________ N. Lat. ________________ W. Long.

Water Depth __________ meters Uncorrected, U, or Corrected, C?_____

Depth Below Seafloor: from ______ m (top) to ______ m (bottom of sample)

Stratigraphic Section/Geological Age? ________________________

Appendix V

GEOTECHNICAL SAMPLE PREPARATION METHODS 7 August 1976

METHOD "A": ENTIRE CORE

NOTE: Store upright after densitometry

1. Place flat cardboard carton on deck and turn wax-bath control to 225 (when wax melts reduce to 212).
2. Inscribe the hole, core, and section plus the word TOP in the red top cap; then remove cap and clean and dry on inside and outside.
3. Carefully dig out about 15 mm (1/2 in.) of sediment, dry inside and outside of plastic core liner.
4. Pour melted wax into liner, bringing wax level even with top of core (try not to dribble on hand--it's hot!) let wax harden.
5. Replace cap firmly and tape onto liner with black plastic tape. Apply tape under tension.

5b. Wax cap of core*

6. Turn core upside down and repeat steps 3 - 5.

---

* This step added towards end of leg 1.

7. Place aluminum foil on table top and lay core section on top of foil. Wrap tightly and carefully. Cup hand around foil-covered liner and slide hand down tube to crimp foil tight against tube. Repeat with two additional layers, each layer to overlap the previous joint. Attach several core-section labels over edge of tape after last wrap to keep foil from unwrapping.

8. Tape ends with grey duct tape.

9. Pick up a 1.5 m (5 ft.) long piece of 1 x 2 lath from outside the van and attach core-section to lath. Observe labeling and taping from examples stored in the core refrigerator van.

10. Take labeled core section to refrigerator van and secure, with top upright.

METHOD "B": WATER-BULK DENSITY SAMPLES FROM UNSPLIT SECTIONS

NOTE: Expedite preparation to minimize desiccation.

1. Place 2 cm or more of sediment in a labeled plastic bag; squeeze bag tightly around sample to exclude as much air as possible; twist top of bag and attach a rubber bans as shown in illustration.

2. Place in a second bag, twist top, and secure with rubber band (label not required).

3. Place bagged sample in a third bag containing a wet folded paper towel. Clearly label third bag before inserting bagged sample. Twist top and secure with a rubber band.

4. Probably at a latter time, when you are not pressed for time, carefully label a fourth at the top, and place bagged sample in it. See illustration for labeling.
5. Log all data on the form for split cores, but add w - γ under the data entry. Include the sample number (from the form) on the outside bag.
6. Refrigerate sample in the water content-bulk density box in the core refrigerator.
7. File the completed log sheet in the blue notebook.

METHOD "C": ATTERBERG LIMIT SAMPLES FROM SPLIT SECTIONS

1. Place sediment sample in a labeled plastic bag, twist top, and secure with a rubber band. Note: The core-section describers probably will do the work through step one.
2. At a convenient time carefully label a second bag at the top, see illustration for labeling.
3. Log all data on the form for split cores. Include the sample number (from the form) on the outside bag.
4. Refrigerate sample in the box for the classification tests, etc. in the core refrigerator.
5. File the completed log sheet in the blue notebook.

Appendix VI

NUCLEAR - TRANSMISSION DENSITOMETER OPERATIONAL INSTRUCTIONS

2 August 1976

Rev. 8 August 1976

I. Pre-operational

Before each hole or site, do the following:

A. Take core-section transporter off; wash main channel and skids of transporter (the green "tuffy" in the top-right drawer will help remove crud); dry; and lightly spray a film of teflon on the main channel and bottom of skids.

B. Check that bolts are tight (do not over-tighten metal scintillation tube assembly).

C. Check gear-reducer box oil level (about every other hole). Top up using oil syringe and 90 weight oil (in gallon plastic jug to the left of the motor).

D. About every 3-4 hole, clean slider wires of H-Y recorder. Read instructions in manual first. If in doubt, don't.

E. Prepare a pre-operational sheet to be inserted in the densitometer log book. On this sheet note position of all analyzer, stabilizer, recorder controls (serves as a check list); note which memory is being used for working and calibrations; note if any calibration channels are "lost" (unfortunately, due to a minor malfunction, one or more channels may loose all data and read zero when interrogated); note which calibrations will be used in reducing the data; and any other information that is relevant.

F. If necessary, erase calibration data in memory 2/4, 3/4, and 4/4, and reload memory with data (let analyzer run until it automatically switches from START ANALYSIS to START READOUT).

1. Two calibration graphs must be prepared:
   a. A plot of counts vs. bulk density (see example in log book)
   b. An overlay graph (see example in log book).
2. On a sheet of lined paper (to be inserted in log book) record for each calibration:
   a. channels having data (full quarter memory)
   b. eye-averaged counts (turn DISPLAY SELECTOR to DATA and visually inspect by running bug through the data accumulated).
   c. integrated counts (take first 100 counts, e.g. channels 3 - 102)
   d. manually hunt thru first 100 channels to identify the one channel having a count most similar to the integrated count obtained--identify and record the channel number.
3. To determine the ± values, manually hunt thru each

calibration memory for the smallest and the largest count/channel. (The density of this count is determined from the graph of counts vs. bulk density).

4. To prepare the overlay graph, the integrated value for each calibration can be plotted-out by the following procedure, best performed by two people. Set the Y_2 filter to zero. Let one person call out the channels as the second one operates the recorder by leaving the pen up and swiftly tapping the pen down with the finger when the one channel representing the integrated count is outputed to the recorder (you have 0.5 seconds to do this and the pen button is too slow). Use the USGS Gerber scale to divide the density values on the overlay graph paper (see example of the overlay graph in log book). Don't forget to reset the Y_2 filter to the -55 db position.

5. If in doubt, think and use engineering judgment!

II. Check position of analyzer switches (all are identified in the blue instruction book). Principal switches: A "LOG"; B. "MCS"; C. PRESET = "1MCS DWELL TIME"; D. MULTIPLIER = "6"; E. DISPLAY SCALE = "100k" (n.b. core set-up is given in Part VII).

III. Preparation for analysis

A. Set analyzer switches

1. READ MODE = "CRT"

2. MEMORY GROUP = "1/4"

B. Erase data from memory 1/4 only!!!

1. Press START READOUT Button (illuminates)

2. Simultaneously press both red memory ERASE buttons (CRT goes blank)

3. Press STOP button (illuminates).

IV. Analysis

A. Press START ANALYSIS button to start analysis

1. Yellow RATE light illuminates on stabilizer and correction meter reads about zero.

2. Analyzer crt bug rises and falls.

B. Press STOP button to stop analysis.

n.b. hold button in until STOP illuminates and yellow RATE light goes off.

C. Press START READOUT to display analyzed data in crt (crt +4 position expands scale) and record in log the last channel in which analyzed data is stored.

V. Record

A. Analyzer set up

Turn READ MODE switch to "pen/print" (STOP light illuminates)

B. Recorder set up

1. Insert clean paper, write TOP in upper left-hand corner, stamp MGL stamp at top of paper to right of

"4", and manually move moveable y-sliding part to far left (X_1 = 10 mV/in. Y_1 = 50 mV/in, Y_2 = 55 db)

2. You may adjust X and Y zero, but do not, under penalty of instant death, tough the x or y verniers!!! (if you do, stop, and perform a complete recalibration)

C. Record data

1. Simultaneously push

   Analyzer: START READOUT Button (illuminates)

   Recorder: SERVO and PEN buttons (illuminates)

2. When last data channel is displayed on the analyzer, simultaneously and quickly press the PEN button off (light goes off).

D. Record calibrations

Turn MEMORY GROUP switch to "2/4"

Press PEN button on, let data print out for a few seconds

Press PEN button off and turn MEMORY GROUP switch to "3/4"

Press PEN button on and let data print out for a few seconds.

Ditto for 4/4

Press SERVO and PEN buttons off, press analyzer STOP button off

E. Remove and replace x-y paper

1. Press CHART button off

2. Remove paper and carefully align newly inserted paper

3. Press CHART button on

F. Between holes, always leave a sheet of graph paper on the bed of the recorder; however, the CHART button need not be on.

VI. Obtain average density for a core section

A. Set analyzer switches: Turn DISPLAY SELECTOR to "CHANNEL NO.,"

Turn read MODE to "CRT+4", turn MEMORY GROUP to "1/4", and press START READOUT button.

B. Carefully observe the data displayed on the crt

1. Select the portion of data to be averaged or integrated.
2. Set the bug before the selected data, press the CHANNEL ENTRY "STOP" red button to activate the passive memory system, then press the yellow "ERASE" button until all intensified channels are eliminated.
3. Set the bug on the first data channel to be integrated and press the green START button (all channels to right of bug intensify in brightness).
4. Turn the bug to the last channel to be integrated and press the red stop button (all channels to right of bug deintensify).
5. Turn READ MODE switch to integrate, press START READ OUT button, turn DISPLAY SELECTOR to "MSD INTREGAL" and note reading, if any, on nixie display. Then turn DISPLAY SELECTOR to "LSD INTREGAL" and read remainder

of nixie display. Divide number displayed by the channels integrated (e.g. 2- 101 = 100 channels 2 - 11 = 10 channels 570 - 669 = 100 channels)

6. Note display number of counts in log, enter data on calibration graph to obtain density, and note average value obtained in log.

VII. Core set up

A. Turn on motor and drive core-carrier to far right.

B. Place core on core carrier (remove excess labels first). Top of core must be to left (top <u>always</u> closest to source)

C. Turn on motor, drive core-carrier to left.

D. When red end-cap of core reaches the vertical line between 2 and 1 marked on cardboard, start analysis.

E. After analysis, reattach excess labels and remove core (the core-carrier is now on far left).

F. Place core on core carrier with top to right.

G. Turn on motor, drive core to right.

H. Repeat D and E, above, (the core carrier is now on far right)

Repeat B-E.

Michael Perlow, Jr.
9 July 1976
13 Aug. revised

Appendix VII

Laboratory Vane Conversion Data

1. Calculate shear strength in the following manner

$$T = \tau \times K \qquad \text{(ASTM)}$$

where T = torque, lbf-ft (or N-m)
τ = shear strength, lbf/ft^2 (or N/m^2), and
K = vane blade constant, ft^3 (or m^3).

2. Assuming the distribution of the shear strength is uniform across the ends of the failure cylinder and around the perimeter, K is given by:

$$K = \left(\frac{\pi}{1728}\right) \times \left(\frac{D^2 H}{2}\right) \times \left[1 + \frac{D}{3H}\right] \qquad \text{(US)}$$

where

D = measured diameter of the vane, in. and
H = measured height of the vane, in.

thus for a 0.5 x 0.5 in. vane, we have that

K = 0.0001515 ft^3 (reciprocal = 6600 ft^{-3})

and for a 0.5 x 1.0 in. vane,

K = 0.0002651 ft^3 (reciprocal = 3772 ft^{-3})

3. Since the undrained shear strength (τ) is required it is more useful to write the vane equation as follows

$$\tau = T \times k$$

where

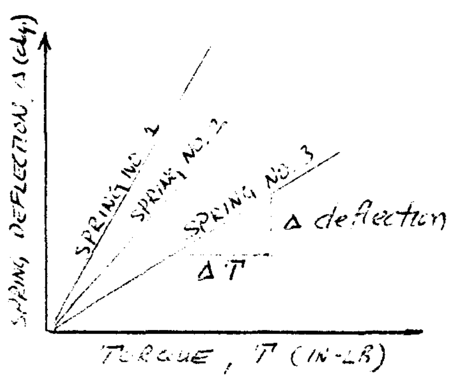
$k = \frac{1}{K}$ and

0.5" x 0.5" vane
k_1 = 6600 ft^{-3}

0.5" x 1.0" vane
k_2 = 3772 ft^{-3}

T = measured torque in (ft-lb)

4. Since vane torque will be measured utilizing a standard [Wykeham-Farrance] vane shear device by noting the deflection of springs with known constants, a relationship between vane torque and spring deflection can be established as follows:



$$B = \text{slope} = \frac{\Delta\ \text{deflection}}{\Delta\ \text{torque}}$$

ex. No. 2 spring

$$B = \frac{151\ \text{deg}}{2.5\ \text{in-lb}}$$

$$B = 60.4\ \frac{\text{deg}}{\text{in-lb}}$$

5. By relating the spring deflection to torque, the shear strength can be computed as follows

$$\tau = T \times k$$

where T = torque expressed in lbf-ft

However T can also be expressed in terms of spring deflection in degrees

$$T = (\Delta)\frac{1}{(B)(12)}$$

where T = torque in lbf-ft, and
B = slope of calibration curve in deg/in.-lb

Therefore, the shear strength τ can be computed by the following equation

$$\tau = (\Delta)\ (b)\ k$$

where τ = undrained shear strength, lbf/ft^2
Δ = spring deflection, degrees
b = (1/12B), ft-lbf/deg
k = 1/K, ft^{-3}

6. For the five MGL springs, the spring deflection and torque relationship is given by

SPRING NO.	B	b
WEAKEST	$\frac{193}{1.0}$ = 193.0	$\frac{1}{193(12)}$ = 0.0004318
NO. 1	$\frac{126°}{1.0}$ = 126.0	$\frac{1}{126(12)}$ = 0.0006614
NO. 2	$\frac{120}{2.0}$ = 60.0	$\frac{1}{60.0(12)}$ = 0.001389
NO. 3	$\frac{73.5}{2.0}$ = 36.75	$\frac{1}{36.75(12)}$ = 0.002268
NO. 4	$\frac{80}{3.5}$ = 22.857	$\frac{1}{22.851(12)}$ = 0.003646

7. Thus, for a 1:1 or 2:1 vane blade shear strength can be computed by the following

$$\tau = (\Delta)\ R$$

where τ = shear strength in lbf/ft^2 (kPa)
Δ = deflection in degrees, and
R = bk constant

VANE SIZE	1:1	2:1
SPRING NO.	$R = bk_1$	$R = bk_2$
WEAKEST	2.85* (0.136)+	1.63 (0.0780)
NO. 1	4.37 (0.209)	2.49 (0.119)
NO. 2	9.17 (0.439)	5.24 (0.251)
NO. 3	15.0 (0.718)	8.55 (0.409)
NO. 4	24.1 (1.15)	13.8 (0.661)

* in U.S. units, yields τ in psf
+ in S.I. units, yields τ in kPa

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Bethlehem, PA 18015

LABORATORY VANE SHEAR STRENGTH DATA FORM

(0.5 x 0.5 in. vane blades motor-rotated at 78°/min; formula: $\tau = (\Delta)\ R$; τ = shear strength in kPa, Δ = Deflection in degrees, and R is related to spring number: weakest, R = 0.136, No. 1 = 0.209, No. 2 = 0.439, No. 3 = 0.718, No. 4 = 1.15 for τ in kPa using a 0.5 x 0.5 in. vane)

Core Identification ____________________ Date Collected ______________
Person Testing ____________________ Date Tested ______________
Vane Test No. ____________ Depth Below Seafloor ______________ m
Strength: "Undisturbed" _____ kPa Remolded _____ kPa Sensitivity ____
Spring No. ____________

"Undisturbed" Test			Remolded Test		
Vane Rot., degree	Deflect.,(Δ), degree	τ, kPa	Vane Rot., degree	Deflect.,(Δ), degree	τ, kPa
0			0		
2			2		
4			4		
6			6		
8			8		
10			10		
12			12		
14			14		
16			16		
18			18		
20			20		
22			22		
24			24		
26			26		

Core Identification ____________________ Date Collected ______________
Person Testing ____________________ Date Tested ______________
Vane Test No. ____________ Depth Below Seafloor ______________ m
Strength: "Undisturbed" _____ kPa Remolded _____ kPa Sensitivity ____
Spring No. ____________

"Undisturbed" Test			Remolded Test		
Vane Rot., degree	Deflect.,(Δ), degree	τ, kPa	Vane Rot., degree	Deflect.,(Δ), degree	τ, kPa
0			0		
2			2		
4			4		
6			6		
8			8		
10			10		
12			12		
14			14		
16			16		
18			18		
20			20		
22			22		
24			24		
26			26		

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.		Good		Fair		Bad	Notes
<u>6002</u>												
3-1	18.8	62	2.05	2.04			X					
3-2	20.3	67	2.10	1.90		X						
3-3	21.8	72	1.84	1.81				X				
3-4	23.3	76	1.79	1.58						X		
3-5	24.8	81	1.86	1.67					X			
3-6	26.3	86	1.97	1.82			X					
4-1	28.3	93	1.30	1.28			X					
4-2	29.8	98	1.30	1.28			X					
4-3	31.3	103	1.34	1.28				X				
4-4	32.8	108	1.36	1.32					X			
4-5	34.3	112	1.36	1.30				X				
4-6	35.8	117	1.52	1.38	X							
6-1	47.3	155	1.58	1.42					X			
6-2	48.8	160	1.78	1.71	X							
7-2	58.9	193	1.84	1.57	X							
8-2	67.5	221	1.50	1.33			X					
8-3	69.0	226	1.34	1.28					X*			no core quality data
9-1	70.9	232	1.78	1.42				X				
9-2	72.4	237	1.77	1.76					X			
9-3	73.9	242	1.76	1.74				X				
9-4	75.4	247	1.81	1.77			X					
9-5	76.9	252	1.78	1.78			X					
9-6	78.4	257	1.86	1.79	X							
10-2	87.9	288	1.64	1.61	X							
11-2	97.6	320	1.77	1.75							X	first 50 cm omitted
12-2	105.6	346	1.86	1.83				X				first 50 cm omitted
12-3	107.1	351	1.87	1.83				X				

* Estimated from log

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Core Quality Good	Core Quality Fair	Core Quality Bad	Notes
6002									
13-1	116.5	382	1.85	1.84	X				
14-1	118.5	389	1.65	1.62				X	(40-100 cm)
14-5	124.5	408	1.65	1.62			X		(40-100 cm) assumed that 14-2 graph actually is 14-5
14-6	126.0	413	1.89	1.88	X				
15-2	132.4	434	1.81	1.75				X	(top 75 cm excluded)
15-3	133.9	439	1.88	1.84			X		
15-4	135.4	444	1.94	1.87	X				
16-1	141.9	465	1.85	1.84			X		
16-2	143.4	470	2.14	2.02			X		
16-3	144.9	475	2.15	1.96			X		(first 46 cm omitted)
17-1	150.1	492	1.89	1.85			X		(first 40 cm omitted)
17-2	151.6	497	1.91	1.85			X		
17-3	153.1	502	1.93	1.89			X		
17-4	154.6	507	2.11	2.05	X				
19-2	170.5	559	1.83	1.81			X		
19-3	172.0	564	1.96	1.93			X		
19-4	173.5	569	1.96	1.93		X			
20-1	177.0	580	1.89	1.87				X	(first 10 cm omitted)
20-2	178.5	585	1.94	1.91			X		
20-3	180.0	590	1.97	1.92			X		
20-4	181.5	595	2.02	1.92			X		
20-5	183.0	600	2.03	1.96		X			(first 40 cm omitted)

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6004									
1-1	7.4	24	1.73	1.70	X				
1-2	8.9	29	1.75	1.72		X			
2-3 possibly 2-2	15.0	49	1.84	1.79			X		confusion regarding core: 2.3 or 2.2?
4-2	30.4	100	1.85	1.76			X		(first 30 cm omitted)
4-3	31.9	105	1.81	1.75	X				
4-4	33.4	110	1.81	1.76			X*		no core quality data
5-2	40.1	132	1.68	1.65	X				
5-3	41.6	136	1.88	1.73			X		
5-4	43.1	141	1.85	1.83	X				
6-1	45.0	148	1.96	1.81	X				(first 20 cm omitted)
6-2	46.5	152	1.78	1.76	X				
6-3	48.0	157	1.79	1.76	X				
6-4	49.5	162	1.81	1.77	X				
6-5	51.0	167	1.81	1.76	X				
7-1	54.4	178	1.82	1.79		X			(first 50 cm omitted)
7-2	55.9	183	1.82	1.82	X				
7-3	57.4	188	1.82	1.81	X				
7-4	58.9	193	1.81	1.78	X				
7-5	60.4	198	1.82	1.80	X				
7-6	61.9	203	1.83	1.80	X				
9-1	73.5	241	1.77	1.73		X			
9-2	75.0	246	1.73	1.71			X		
9-3	76.5	251	1.78	1.75	X				
9-4	78.0	256	1.77	1.76		X			
9-5	79.5	261	1.77	1.43		X			
9-6	81.0	266	1.87	1.77	X				

* Estimated from log

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Core Quality Good	Core Quality Fair	Core Quality Bad	Notes
6004									
10-2	87.4	287	1.88	1.79				X	(first 30 cm omitted)
10-3	88.9	292	1.80	1.76	X				
10-4	90.4	296	1.79	1.76	X				
11-1	92.3	303	1.78	1.72		X			
11-2	93.8	308	1.75	1.69	X				
11-3	95.3	312	1.66	1.64		X			
11-4	96.8	318	1.73	1.68	X				
11-5	98.3	322	1.71	1.66	X				
11-6	99.8	327	1.74	1.68	X				
12-2	106.2	348	1.74	1.72			X*		no core quality data
12-3	107.7	353	1.62	1.58	X				
12-4	109.2	358	1.58	1.54	X				
13-2	112.6	369	1.67	1.55	X				
13-3	114.1	374	1.55	1.50	X				
13-4	115.6	379	1.55	1.48	X				
13-5	117.1	384	1.54	1.45	X				
13-6	118.6	389	1.53	1.50	X				
14-2	122.0	400	1.72	1.66		X			(first 30 cm omitted)
14-3	123.5	405	1.70	1.60	X				
14-4	125.0	410	1.53	1.49	X				
14-5	126.5	415	1.53	1.50	X				
14-6	128.0	420	1.53	1.52	X				
15-1	130.7	429	1.53	1.49	X				(first 20 cm omitted)
15-2	132.2	434	1.55	1.51	X				
15-3	133.7	438	1.63	1.54	X				
15-4	135.2	443	1.60	1.56	X				
15-5	136.7	448	1.64	1.59			X		(last 20 cm omitted)

* Estimated from log

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Appendix IX

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
<u>6004</u>									
15-6	138.2	453	1.64	1.61	X				
<u>6004B</u>									
2-1	149.6	491	1.72	1.62	X				
2-2	151.1	496	1.61	1.51	X				
2-3	152.6	500	1.58	1.51	X				
2-4	154.1	505	1.59	1.53	X				
2-5	155.6	510	1.62	1.56	X				
2-6	157.1	515	1.58	1.55	X				
4-1	175.6	576	1.81	1.61	X				(first 35 cm only)
5-1	185.1	607	1.73	1.71	X				(20-90 cm only)
6-1	187.1	614	1.68	1.60		X			
6-2	188.6	619	1.73	1.69		X			
6-3	190.1	624	1.85	1.76			X		
6-4	191.6	628	1.82	1.76			X		
6-5	193.1	633	1.84	1.76			X		
7-1	197.1	646	1.83	1.77			X		
7-2	198.6	651	1.82	1.80			X		
7-3	200.1	656	1.93	1.80			X		
7-4	201.6	661	1.82	1.80			X		
7-5	203.1	666	1.83	1.79			X		
7-6	204.6	671	1.82	1.77			X		
10-1	218.7	717	1.79	1.77			X		(10-20 cm only)
11-1	223.2	732	1.84	1.79			X		
12-1	231.2	758	1.87	1.67			X		
12-2	232.7	763	1.91	1.88			X		
13-1	239.1	784	1.77	1.72			X		

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident. No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
<u>6006</u>									
6-3	56.0	183	2.18	2.11			X		
6-4	57.5	189	2.16	2.10			X		
6-5	59.0	194	2.16	2.09			X		
<u>6007</u>									
2-3	17.2	56	2.17	2.05				X	(below 85 cm)
3-3	21.2	70	1.33	1.28			X		
3-4	22.7	74	1.36	1.28			X		(below 120 cm omitted)
3-5	24.2	79	1.30	1.29		X			
3-6	25.7	84	1.90	1.80			X		
5-1	41.6	136	1.96	1.86			X		
5-2	43.1	141	2.06	1.93	X				
5-3	44.6	146	1.99	1.92	X				
6-2	52.6	172	1.93	1.83	X				
6-3	54.1	177	1.93	1.89	X				
9-1	82.7	271	2.15	1.93			X		(below 65 cm only)
10-1	92.2	302	2.09	2.02		X			(0-25 cm only)
11-1	100.1	328	1.90	1.85			X		(graph only 0-15 cm)
11-2	101.6	333	2.32	1.92	X				

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6007B									
1-1	130.3	427	2.24	1.94			X		
2-1	136.1	446	1.81	1.41				X	
2-2	137.6	451	1.80	1.60				X	
2-3	139.1	456	2.07	1.92		X			(below 28 cm only)
3-2	148.2	486	1.86	1.70			X		
4-2	155.9	511	1.90	1.87		X			
4-3	157.4	516	2.14	1.97	X				
8-2	196.1	643	2.03	1.96		X			
10-2	209.3	687	2.03	1.96			X		
10-3	210.8	691	2.09	1.96			X		
10-4	212.3	696	2.15	2.01			X		
10-5	213.8	701	2.08	1.99			X		
10-6	215.3	706	1.98	1.95			X		
11-2	219.1	719	2.13	1.98			X		
11-3	220.6	724	2.12	1.86				X	
11-4	222.1	728	1.90	1.82			X		
11-5	223.6	733	1.85	1.81			X		
11-6	225.1	738	1.84	1.75			X		
12-1	227.0	744	1.76	1.37				X	
12-4	231.5	759	1.91	1.54				X	
12-5	233.0	764	1.91	1.80				X	
12-6	234.5	769	1.88	1.81				X	(below 25 cm only)
18-1	287.9	944	2.24	2.16	X				(below 70 cm only)
18-2	289.4	949	2.34	2.25		X			
18-3	290.9	954	2.30	2.27	X				

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Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Core Quality Good	Core Quality Fair	Core Quality Bad	Notes
6008									
1-2	5.9	19	2.04	1.95			X		
1-3	7.4	24	2.03	1.93	X				
1-4	8.9	29	1.92	1.86		X			
2-1	18.0	59	2.05	2.00		X			
3-1	25.7	84	2.08	2.01			X		(below 50 cm only)
3-2	27.2	89	2.07	2.04			X*		no core quality data
4-1	34.9	114	2.15	2.11				X	(between 35-75 cm only)
4-2	36.4	119	2.16	1.95			X		
5-1	47.1	154	2.20	2.12				X	
5-2	48.6	159	2.16	2.05				X	
6-1	58.0	190	2.16	2.01				X	
9-1	79.7	261	2.18	2.03				X	
11-1	98.6	323	2.25	2.03				X	
11-2	100.1	328	2.12	2.00				X	
12-2	109.5	359	2.15	2.06				X	
13-1	117.8	386	2.16	2.04				X	(below 65 cm only)
13-2	119.3	391	2.17	2.10			X		
6009									
1-1	8.9	29	2.35	2.26			X		
3-1	24.2	79	2.10	2.04				X	
3-2	25.7	84	2.33	2.05		X			
3-3	27.2	89	2.29	1.98		X			
9-1	82.7	271	2.31	2.20				X	
9-2	84.2	276	2.43	2.26			X		

* Estimated from log

Appendix IX

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.		Good		Fair		Bad	Notes
6009B												
1-1	7.4	24	2.19	2.01						X		
2-1	13.8	45	2.10	2.01							X	
2-2	15.3	50	2.11	1.98						X*		no core quality data
3-2	24.5	80	2.12	1.94			X					
4-1	32.4	106	1.85	1.82					X			
4-2	33.9	111	1.85	1.82			X					
5-1	43.4	142	2.22	1.84					X			
8-1	69.0	226	2.23	2.00						X		
8-2	70.5	231	1.98	1.93		X						
8-3	72.0	236	2.01	1.95		X						
9-2	81.5	267	2.14	1.96		X						
10-2	89.4	293	1.86	1.83				X				
10-3	90.9	298	1.98	1.90				X				
11-1	98.9	324	2.04	1.93				X*				no core quality data (below 65 cm only)
11-2	100.4	329	2.08	1.96		X						
12-1	102.6	336	1.78	1.72						X		
12-2	104.1	341	2.08	1.82						X		
12-3	105.6	346	1.81	1.75				X				
12-4	107.1	351	2.01	1.82				X				
12-5	108.6	356	1.88	1.83				X				(below 15 cm only)
12-6	110.1	361	1.94	1.84				X				
13-1	119.6	392	2.12	2.03						X		(below 60 cm only)
14-1	123.0	403	2.05	1.88						X		(short section used)
14-2	124.5	408	1.97	1.89				X				
14-3	126.0	413	1.97	1.87		X						
14-4	127.5	418	1.88	1.84		X						
14-5	129.0	423	2.08	1.91			X					

* Estimated from log

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6009B									
15-1	135.5	444	1.92	1.85			X		(below 30 cm only)
15-2	137.0	449	1.96	1.89		X			
15-3	138.5	454	2.03	1.90			X		
16-1	147.9	458	2.02	1.94				X	(only a short section used)
17-1	157.4	516	2.06	1.96				X	(between 0-25 cm only)
18-1	165.3	542	2.17	2.10				X	
18-2	166.8	547	2.15	2.10				X*	no core quality data
19-1	176.3	578	-	-				X*	no core quality or valid density data
20-1	185.4	608	2.21	2.18				X	
21-1	191.8	629	2.02	1.98				X	
21-2	193.3	634	2.09	2.00			X		
21-3	194.8	639	2.20	2.12			X		
22-1	202.8	665	2.11	2.04				X	(below 30 cm only)
22-2	204.3	670	2.17	2.10				X	
23-2	213.8	701	2.26	2.16				X	
27-1	250.1	820	2.29	2.14		X			
27-2	251.6	825	2.31	2.17	X				
28-1	259.8	852	2.13	1.98			X		
28-2	261.3	857	2.05	1.97		X			
29-1	270.8	888	2.16	2.08				X	(below 40 cm only)
30-1	378.7	1242	2.14	1.98			X		(between 94-106 cm)
30-2	280.2	919	2.03	1.97			X		
31-1	288.5	946	2.15	2.10			X		(below 30 cm only)
31-2	290.0	951	2.16	2.11			X		
32-1	299.4	982	2.15	2.09				X	

* Estimated from log

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Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.		Good		Fair		Bad	Notes
6010												
1-1	5.0	16	2.13	1.97						X		
1-2	6.5	21	2.08	1.93		X						
1-3	8.0	26	1.90	1.88						X		(between 0-110 cm only)
2-1	15.1	50	1.89	1.85					X			
2-2	16.6	54	1.91	1.88					X			
3-1	24.5	80	1.87	1.84						X		
3-2	26.0	85	2.23	1.86					X			
4-2	35.5	116	2.23	2.03				X				
5-1	44.9	147	2.14	1.91						X		
6-1	51.7	170	2.00	1.95						X		
6-2	53.2	174	2.06	2.00			X					
6-3	54.7	179	2.07	2.01		X						
7-1	59.6	195	2.09	2.01						X		
7-2	61.1	200	2.19	2.10						X		
7-3	62.6	205	2.26	2.02						X		(below 40 cm only)
7-4	64.1	210	2.16	2.02				X				
8-1	72.1	236	1.81	1.76				X				
8-2	73.6	241	1.92	1.84					X			
9-2	81.5	267	2.01	1.91					X			(below 40 cm only)
9-3	83.0	272	2.16	2.07		X						
10-1	92.5	303	2.21	2.00							X	data presentation very poor: density not plotte
11-2	100.7	330	2.14	2.07				X				
11-3	102.2	335	2.21	2.08				X				(below 20 cm only)
12-2	110.2	361	2.18	2.05			X					
12-3	111.7	366	2.25	2.13			X					
13-1	119.6	392	2.10	1.91						X		
13-2	121.1	397	2.05	1.95				X				

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Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Core Quality Good	Core Quality Fair	Core Quality Bad	Notes
6010									
14-2	124.6	409	2.00	1.87			X		
14-3	126.1	414	1.95	1.90		X			
14-4	127.6	418	1.92	1.89		X			
14-5	129.1	423	1.96	1.92		X			
14-6	130.6	428	2.07	1.96		X			
15-1	140.3	460	1.98	1.93			X		
16-1	145.0	476	1.99	1.90			X		
16-2	146.5	480	2.00	1.95		X			
16-3	148.0	485	2.06	1.97		X			
16-4	149.5	490	2.10	2.06		X			
18-1	168.4	552	1.97	1.89		X			
19-1	170.0	558	1.98	1.93			X		
19-2	171.5	562	2.02	1.98			X		
19-3	173.0	567	2.03	1.96		X			
19-4	174.5	572	2.03	1.98	X				
19-5	176.0	577	2.05	2.00			X		
19-6	177.5	582	2.27 2.05	1.99		X			very high peak
20-1	179.8	590	1.88	1.86				X	
20-2	181.3	595	1.95	1.90		X			
20-3	182.8	600	1.93	1.89		X			
20-4	184.3	604	2.01	1.92		X			
20-5	185.8	609	2.22 2.06	2.02		X			very high peak
20-6	187.3	614	2.09	2.02		X			
21-2	193.7	635	1.98	1.82		X			
21-3	195.2	640	1.85	1.80			X		(between 60-100 cm only)
21-4	196.7	645	2.18	2.05				X	
22-1	198.7	652	2.05	1.93			X		(between 5-65 cm only)

Appendix IX

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident. No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Good	Fair	Bad	Notes
6010									
22-2	200.2	657	2.00	1.93			X		
22-3	201.7	662	2.36	2.01			X		
22-4	203.2	666	2.27	2.00		X			
22-5	204.7	671	2.26	2.01			X		
22-6	206.2	676	2.28	2.18			X		
23-1	215.6	707	2.32	2.21				X	(between 55-63 cm only)
25-1	234.5	769	1.95	1.92				X	
26-2	238.0	781	2.02	1.88				X	
26-3	239.5	786	2.07	1.94				X	
26.4	241.0	790	2.35	2.01				X	
26-5	242.5	795	2.00	1.93				X	
26-6	244.0	800	2.00	1.91				X	
27-1	253.4	831	2.20	2.01				X	(above 80 cm only)

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Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6011									
1-1	8.9	29	2.30	1.93			X	X	
4-1	32.4	106	2.10	2.10				X	
7-1	61.1	200	2.14	1.92			X		
8-1	63.0	207	1.79	1.73			X		
8-2	64.5	212	1.84	1.78			X		
8-3	66.0	216	1.81	1.70				X	
8-4	67.5	221	1.74	1.68			X		
8-5	69.0	226	1.70	1.65			X		
8-6	70.5	231	1.68	1.63			X		
9-1	78.8	258	1.56	1.37				X	
9-2	80.3	263	1.84	1.72			X	X	
11-1	91.4	300	1.68	1.59			X		
11-2	92.9	305	1.72	1.60			X	X	
11-3	94.4	310	1.63	1.59			X	X	
11-4	95.9	315	1.68	1.58			X	X	
11-5	97.4	319	1.61	1.58			X	X	
11-6	98.9	324	1.65	1.57			X	X	
12-1	108.3	355	1.88	1.80				X	value from 70-100 cm
13-1	110.3	362	1.85	1.74			X	X	
13-2	111.8	367	1.83	1.74			X	X	
13-3	113.3	372	1.85	1.78			X		
13-4	114.8	376	1.87	1.79			X	X	
13-5	116.3	381	1.89	1.82			X	X	
13-6	117.8	386	1.85	1.75			X	X	
14-1	124.5	408	1.75	1.65				X	
14-2	126.0	413	1.81	1.74				X	
14-3	127.5	418	1.79	1.73			X	X	

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident. No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Core Quality Good	Core Quality Fair	Core Quality Bad	Notes
6011									
15-2	137.0	449	1.70	1.66				X	
16-1	144.9	475	2.12	2.00				X	
16-2	146.4	480	2.22	1.97			X		
17-2	155.9	511	2.26	1.90			X		
18-1	165.3	542	2.09	1.98				X	
20-1	184.5	605	2.17	2.10				X	
21-1	194.0	636	2.15	2.05			X		
24-1	222.0	728	2.25	2.10			X		
25-1	231.5	759	2.21	2.10				X	
26-2	240.9	790	2.13	2.05			X		
27-1	250.3	821	2.16	2.10				X	
28-1	252.3	828	2.05	1.97			X		
28-2	253.8	832	1.98	1.91			X		
28-3	255.3	837	2.12	2.00			X		
28-4	256.8	842	1.95	1.89			X		
28-5	258.3	847	1.94	1.86			X		
28-6	259.8	852	1.88	1.83					

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Lehigh Nuclear Densitometer Summary Sheet

Hole Ident. No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Core Quality Good	Core Quality Fair	Core Quality Bad	Notes
<u>6012</u>									
1-1	2.9	10	1.84	1.76			X		
1-2	4.4	14	1.96	1.90			X		
1-3	5.9	19	2.06	1.92		X			
1-4	7.4	24	1.98	1.92		X			
1-5	8.9	29	2.03	1.92	X				
2-1	12.4	41	1.87	1.75				X	
2-2	13.9	46	1.83	1.72			X		
2-3	15.4	50	1.77	1.70				X	
2-4	16.9	55	1.79	1.70				X	(excludes 20-40 cm)
2-5	18.4	60	1.80	1.48				X	
2-6	19.9	65	1.96	1.83				X	
3-1	21.9	72	1.85	1.73				X	
3-2	23.4	77	1.81	1.72				X	
3-3	24.9	82	1.83	1.76			X		
3-4	26.4	86	1.85	1.79			X		
3-5	27.9	92	1.90	1.81		X			
3-6	29.4	96	2.00	1.89			X		
4-1	35.8	117	1.89	1.84				X	
4-2	37.3	122	2.03	1.92		X			
4-3	38.8	127	2.19	1.98			X		
5-1	40.5	133	2.02	1.95				X	
5-2	42.0	138	2.02	1.97				X	(excludes 20-60 cm)
5-3	43.5	143	1.99	1.99				X	
5-4	45.0	148	1.95	1.85				X	(excludes bottom 30 cm)
5-5	46.5	152	1.86	1.84				X	(excludes 20-110 cm)
5-6	48.0	157	1.88	1.79				X	(excludes 60-150 cm)
6-1	57.4	188	2.03	1.96		X			

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Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6012									
7-1	67.2	220	1.95	1.91			X		
8-1	73.3	240	1.95	1.87				X	
8-2	74.8	245	1.90	1.83				X	
8-3	76.3	250	1.96	1.87				X	
9-1	84.0	276	1.85	1.76			X		
9-2	85.5	280	2.06	1.85			X		
10-1	98.6	323	1.89	1.76				X	
11-1	98.3	322	1.86	1.79				X	
11-2	99.8	327	1.91	1.86				X	
11-3	101.3	332	1.87	1.84				X	
11-4	102.8	337	1.93	1.85				X	
11-5	104.3	342	1.91	1.85				X	
12-1	106.2	348	1.93	1.85				X	(excludes 30-40 & 60-110 cm)
12-2	107.7	353	1.95	1.89				X	
12-3	109.2	358	1.95	1.97				X	(excludes 40-110 cm)
12-4	110.7	363	1.91	1.87				X	
12-5	112.2	368	1.91	1.85				X	
12-6	113.7	373	1.95	1.86				X	
13-1	115.7	379	1.88	1.81			X		
13-2	117.2	384	1.90	1.84			X		
13-3	118.7	389	1.86	1.83			X		
13-4	120.2	394	1.90	1.83			X		
13-5	121.7	399	1.91	1.84			X		
13-6	123.2	404	1.91	1.85			X		
14-1	125.2	411	1.87	1.83			X		
14-2	126.7	416	1.90	1.84		X			
14-3	128.2	420	1.90	1.83			X		

000100

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident. No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6012									
14-4	129.7	425	1.86	1.82		X			
14-5	131.2	430	1.85	1.82		X			
14-6	132.7	435	1.91	1.86			X		
15-1	142.1	466	1.89	1.81				X	
16-1	143.2	470	1.84	1.79			X		
16-2	144.7	475	1.83	1.80			X		
16-3	146.2	480	1.88	1.83			X		
16-4	147.7	484	2.25	1.96			X		
16-5	149.2	489	2.10	1.97			X		
17-1	151.5	497	1.85	1.74				X	
18-1	153.5	503	2.06	1.92				X	
18-2	155.0	508	2.06	1.98				X	
18-3	156.5	513	2.08	1.99		X			
18-4	158.0	518	1.98	1.90			X		
18-5	159.5	523	2.05	1.94			X		
18-6	161.0	528	2.03	1.93		X			
19-1	169.0	554	1.98	1.88				X	
19-2	170.5	559	2.07	1.96				X	
21-1	187.9	616	1.92	1.81				X	
21-2	189.4	621	2.10	1.98		X			
22-1	199.1	653	2.10	1.98		X			
23-1	208.5	684	2.00	1.94			X		
24-1	218.3	716	1.90	1.83				X	
25-1	218.5	717	1.92	1.80				X	
25-2	220.0	721	1.90	1.83			X		
25-3	221.5	726	1.93	1.87			X		
25-4	224.5	736	1.91	1.87		X			

000101

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6012									
25-5	226.0	741	1.93	1.88				X	
25-6	227.5	746	2.01	1.93				X	
26-1	229.4	752	1.75	1.75				X	
26-2	230.9	757	1.76	1.62				X	
26-4	233.9	767	1.72	1.65				X	
26-5	235.4	772	1.38	1.15				X	value considered invalid and not plotted
26-6	236.9	777	2.02	1.91			X		
27-1	246.7	809	2.13	2.03				X	
28-1	248.6	815	1.84	1.78			X		
28-2	250.1	820	1.82	1.79			X		
28-3	251.6	825	2.02	1.91		X			
28-4	253.1	830	2.03	1.90			X		
28-5	254.6	835	1.92	1.90			X		
28-6	256.1	840	2.00	1.88			X		
29-1	258.1	846	1.92	1.83				X	
29-2	259.6	851	1.93	1.87				X	
29-3	261.1	856	1.92	1.90				X	
29-4	262.6	861	2.06	1.98				X	
29-5	264.1	866	2.12	1.97				X	
29-6	265.6	871	2.08	1.96				X	
30-1	270.5	887	2.12	1.90				X	may have been mixed up?
30-2	272.0	892	2.26	1.98			X		
30-3	273.5	897	2.12	2.02				X	
30-4	275.0	902	2.13	2.08				X	
31-1	281.8	924	2.18	1.89		X			
31-2	283.3	929	2.12	2.06			X		
31-3	284.8	934	2.28	1.96				X	

Appendix IX

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident. No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6012									
32-1	294.2	965	2.06	1.98				X	
33-1	296.2	972	2.12	2.05			X		
33-2	297.7	976	2.23	2.08		X			
33-3	299.2	981	2.23	2.00		X			
33-4	300.7	986	2.15	2.00		X			
33-5	302.2	991	2.05	1.88		X			
33-6	303.7	996	2.10	1.93			X		

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident. No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Good	Fair	Bad	Notes
6013									
4-1	36.4	119	2.44	2.20		X			
4-2	37.9	124	2.24	2.13		X			
5-1	45.9	150	2.31	2.31				X	
5-2	47.4	155	2.09	2.04		X			
6-1	53.8	176	1.98	1.90			X		
6-2	55.3	181	2.03	1.94			X		
6-3	56.8	186	2.00	1.94				X	
7-1	57.8	190	1.85	1.80			X		
7-2	59.3	194	1.87	1.84			X		
7-3	60.8	199	1.87	1.85		X			
7-4	62.3	204	1.88	1.85			X		
7-5	63.8	209	1.96	1.91			X		
7-6	65.3	214	2.09	1.98			X		
8-1	74.2	243	2.01	1.91				X	
8-2	75.7	248	1.96	1.86				X	
9-1	83.7	274	2.22	2.05				X	
9-2	85.2	279	2.37	2.32		X			
11-1	96.5	316	2.13	2.07				X	
11-2	98.0	321	2.30	2.22		X			(above 30 cm)
11-3	99.5	326	2.30	2.27		X			
11-4	101.0	331	2.32	2.27		X			
11-5	102.5	336	2.27	2.20		X			
11-6	104.0	341	2.28	2.06		X			
6013B									
11-1	107.4	352	2.00	1.97				X	(below 60 cm only)
11-2	108.9	357	1.88	1.77			X		
13-1	128.1	420	2.00	1.80				X	

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6013B									
14-1	137.9	452	1.93	1.86				X	
15-1	147.3	483	1.82	1.68				X	
16-1	155.3	509	2.14	2.04				X	
16-2	156.8	514	1.72	1.40				X	
16-3	153.8	504	1.81	1.42				X	
17-1	166.5	546	1.85	1.79				X	
18-1	170.0	558	1.90	1.85				X	
18-2	171.5	562	1.91	1.85				X	
18-3	173.0	567	1.93	1.84				X	
18-4	174.5	572	1.89	1.80				X	
18-5	176.0	577	1.96	-				X	
19-1	182.1	597	1.87	1.83				X	
19-2	183.6	602	1.93	1.73				X	
19-3	185.1	607	1.85	-				X	
20-1	194.9	639	1.96	1.87				X	
22-2	212.3	696	1.83	1.68				X	
22-3	213.8	701	1.82	-				X	
23-1	220.2	722	1.75	1.57				X	
23-2	221.7	727	1.81	-				X	
23-3	223.2	732	1.81	-				X	
24-1	231.2	758	1.78	-				X	
24-2	232.7	763	1.80	-			X		
25-1	242.1	794	1.83	-				X	
26-1	251.6	825	1.72	-				X	
28-1	269.3	883	1.81	1.67				X	
28-2	270.8	888	1.86	1.73			X		

000105

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
<u>6014</u>									
1-1	16.3	53	1.73	-				X	
2-1	22.7	74	2.25	-				X	
2-2	24.2	79	2.38	2.03				X	
2-3	25.7	84	2.09	2.04				X	
3-1	33.7	110	2.08	2.03				X	
3-2	35.2	115	2.32	2.13				X	
4-1	40.4	132	2.41	-				X	
4-2	41.9	137	2.28	2.11				X	
4-3	43.4	142	2.15	2.04				X	
4-4	44.9	147	2.28	2.15			X		
5-1	54.4	178	2.20	-				X	
6-2	62.3	204	2.10	1.96				X	
6-3	63.8	209	2.30	2.15				X	
7-1	67.3	221	2.42	1.99				X	
8-1	83.0	272	2.14	1.94		X			
9-1	92.8	304	2.13	2.05				X	
10-1	102.2	335	2.05	1.98			X		
<u>6015</u>									
2-1	24.8	81	2.07	-				X	
3-1	34.2	112	2.35	2.17				X	
4-1	42.2	138	2.01	1.96			X		
4-2	43.7	143	2.03	1.98		X			
5-1	53.1	174	2.07	1.98				X	
6-1	62.6	205	2.34	-				X	

Appendix IX

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6016B									
1-1	21.4	70	2.09	2.00				X	
6-1	68.7	225	1.90	1.81			X		
6017									
1-1	13.5	44	1.92	1.88			X		
1-2	15.0	49	2.07	1.90			X		
2-1	21.2	70	2.10	2.03	X				
2-2	22.7	74	2.21	2.07	X				
2-3	24.2	79	2.22	2.11			X		
3-1	33.3	109	1.95	1.92			X		
4-1	40.1	132	2.20	2.02			X		
4-2	41.6	136	2.25	2.14		X			
4-3	43.1	141	2.42	2.09			X		next highest value 2.20
5-1	52.5	172	2.40	2.00			X		
6-1	66.5	218	2.08	1.92				X	
6-2	68.0	223	2.22	2.02		X			
7-1	71.1	233	1.90	1.82			X		(large void omitted)
8-1	80.6	264	2.15	1.95			X		
9-1	90.3	296	2.11	2.00			X		
10-1	90.3	296	1.87	1.85				X	
6018									
4-1	36.7	120	1.99	1.99				X	
6-1	46.8	154	2.33	2.12			X		
6-2	48.3	158	2.16	2.07			X		

000107

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident. No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6019									
1-1	14.2	46	1.49	1.39			X		
1-2	15.7	51	1.34	1.17				X	
2-1	20.3	66	1.28	1.20				X	
2-2	21.8	72	1.38	1.30			X		
2-3	23.3	76	1.54	1.32				X	
3-1	31.2	102	1.21	1.10				X	
3-2	32.7	107	2.03	1.90			X		
4-1	34.7	114	1.73	1.65				X	(excludes lower half)
4-2	36.2	119	1.85	1.76			X		
4-3	37.7	124	1.68	1.34				X	
4-4	39.2	128	1.80	1.63			X		
4-5	40.7	133	1.52	1.23				X	
4-6	42.2	138	1.54	1.26				X	
5-1	51.6	169	2.10	2.02				X	
7-1	61.1	200	2.22	1.75				X	
8-1	70.5	231	2.26	1.82			X		
6019B									
1-1	0?	0?	1.50	1.42			X		
1-2	1.3	4	1.33	1.20			X		

Appendix IX

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident. No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Core Quality Good	Core Quality Fair	Core Quality Bad	Notes
6020									
1-1	7.7	25	1.87	1.80			X		
2-1	13.3	44	2.06	1.96				X	(below 30 cm)
2-2	14.8	48	2.56	2.17			X		(lower value plotted)
2-3	16.3	53	2.18	1.95		X			
3-1	23.6	77	2.00	1.95			X*		no core quality data
3-2	25.1	82	2.07	1.97			X		
4-2	31.2	102	2.02	1.90			X		
6-1	43.7	143	2.22	2.08			X		

* Estimated from log

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6021									
1-1	3.8	12	1.71	1.66			X		
1-2	5.3	17	1.74	1.67				X*	no core quality data
1-3	6.8	22	2.10	1.92		X			
2-1	10.5	34	1.77	1.65			X	X	
2-2	12.0	39	2.18	1.72		X	X		
2-3	13.5	44	2.29	2.07		X	X		
2-4	15.0	49	2.08	1.98		X	X		
6021C									
1-1	5.9	19	1.85	1.72			X		
1-2	7.4	24	2.22	1.97			X		
2-1	14.1	46	2.05	1.86			X	X	
2-2	15.6	51	2.03	1.92			X		
3-1	23.9	78	1.86	1.85			X		
3-2	25.4	83	1.81	1.76			X		
4-1	34.9	114	1.69	1.69			X	X	
5-1	44.3	145	1.75	1.64			X	X	
6-1	53.8	176	1.90	1.83		X	X		
7-1	61.7	202	1.80	1.73			X		
7-2	63.2	207	1.78	1.66			X		
8-2	71.1	233	1.80	1.75		X			
8-3	72.6	238	1.79	1.70		X	X		
9-1	79.1	259	1.77	1.68		X	X		
9-2	80.6	264	1.83	1.73			X		
9-3	82.1	269	1.81	1.69		X	X		
10-1	90.0	295	1.84	1.79			X	X	
10-2	91.5	300	1.87	1.64			X	X	
11-1	98.3	322	1.96	1.81			X		

* Estimated from log

000110

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	Assumed Depth ft	Bulk Density, Mg/m^3 Maximum	Bulk Density, Mg/m^3 Average	Core Quality Excel.	Core Quality Good	Core Quality Fair	Core Quality Bad	Notes
6021C									
11-2	99.8	327	1.92	1.86				X	
11-3	101.3	332	2.01	1.86			X		
12-1	106.8	350	1.75	1.66			X		
12-2	108.3	355	1.73	1.61				X	
12-3	109.8	360	1.97	1.79			X		
13-1	120.2	394	1.96	1.89			X		
14-1	129.6	425	1.92	1.79			X		
15-1	139.4	457	1.89	1.86			X		
16-1	148.9	488	2.03	1.83			X		
17-1	158.3	519	1.90	1.79			X		
18-1	166.6	546	1.95	1.82			X		
18-2	168.1	551	2.01	1.88			X		
19-1	176.0	577	1.94	1.87			X		
19-2	177.5	582	1.93	1.87			X		
20-1	187.0	613	1.91	1.84			X		
21-1	195.2	640	1.95	1.92			X		
21-2	196.7	645	2.00	1.92		X			
23-1	212.6	697	1.90	1.85		X			
23-2	214.1	702	1.98	1.92			X		
23-3	215.6	707	1.99	1.92			X		
24-1	225.4	739	2.00	1.88			X		
25-1	234.8	770	1.93	1.72			X		
26-1	238.3	782	1.92	1.85				X	
26-2	239.8	786	1.97	1.90			X		
26-3	241.3	791	1.97	1.88			X		
26-4	242.8	796	1.99	1.93			X		
26-5	244.3	801	1.94	1.88			X		

000111

Lehigh Nuclear Densitometer Summary Sheet

Hole Ident.No.	Assumed Depth m	ft	Bulk Density, Mg/m^3 Maximum	Average	Core Quality Excel.	Good	Fair	Bad	Notes
6021C									
27-1	253.7	832	1.95	1.88			X		
28-1	263.2	863	1.88	1.83		X			
29-1	271.4	890	1.77	1.71				X	
29-2	272.9	895	1.98	1.82			X		
30-1	280.9	921	1.90	1.80				X	
30-2	282.4	926	1.98	1.81			X		
31-1	291.5	956	1.97	1.90				X	
32-1	300.6	986	2.03	1.92				X	

Appendix X Shear Strength Data

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6002								
1-1	5	6.5	21	5				
2-1	5	15.7	51	2				
3-1	5	17.3	57	5				
3-3	5	20.3	67	10				
3-4	20	22.0	72		3.0	1.5	2.0	
3-5	5	23.3	76	2				
3-5	115	24.5	80		13	6.9	1.9	
3-6	113	25.9	85	21				
4-1	85	27.6	90	53				
4-1	91	27.6	90		42			too stiff to remold
4-2	10	28.4	93	24				too low; not plotted
4-3	45	30.1	98	55				
4-4	44	31.7	98	62				
4-5	5	32.9	108	19				
4-6	5	34.4	112	34				too low, vanes not fully inserted; not plotted
5-1	5	39.5	129	21				
7-1	5	56.0	183	5				
7-2	130	58.7	192		54	11	4.7	
7-2	145	58.9	193	53				
8-1	35	64.9	212	24				
8-2	5	66.1	216	24				
8-3	5	67.6	221	34				
9-1	15	69.6	228	43				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6002(cont'd)								
9-2	10	71.0	232	43				
9-3	5	72.9	238	48				
9-4	5	74.0	242	48				
9-5	5	75.5	247	48				
9-6	5	77.0	252	57				
10-2	5	86.5	283	14				
11-2	5	96.2	315	14				
12-1	100	103.6	339	29				
12-2	5	104.2	341	67				
12-3	5	105.7	346	53				
13-1	10	115.1	376	29				
14-6	top	124.5	407	19				
14-6	bot.	126.0	412	34				
15-3	84	133.2	436	48				
15-4	11	134.0	438	38				
16-1	41	140.8	460	34				
16-2	5	142.0	464	24				
17-1	130	149.9	490	10				greater depths too hard to test

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6004								
1-1	104	6.9	23	10				
1-1	bot.	7.4	24	10				
1-2	10	7.5	25	7				
2-2	135	14.9	49	29				
4-1	140	28.9	94	14				
4-3	bot.	31.9	104	12				may have been wet?
4-4	100	32.9	108	22				
4-4	110	33.0	108		6.5	0.7	9	
4-4	bot.	33.4	109	19				
5-4	70	42.3	138	12				
5-4	135	43.0	140		7.2	0.4?	20?	
5-4	bot.	43.1	141	22				
6-2	bot.	46.5	152	12				
6-3	20	46.7	153	19				
6-3	bot.	48.0	157	10				
6-4	bot?	49.5	162	12				
6-5	5	49.6	162	14				
6-5	135	50.9	166		4.8	1.3	3.7	
6-5	bot.	51.0	167	14				
6-6	5	51.1	167	19				
6-6	bot.	52.5	172	29				
7-1	107	54.0	176		9.7	1.3	7.5	all valves questionable; not plotted
7-1	112	54.0	177	22				
7-1	bot.	54.4	178	29				
7-2	5	54.5	178	24				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6004 (cont'd)								
7-2	bot.	55.9	183	34				
7-3	110	57.0	186	24				
7-3	115	57.1	186		14	2.6	5.4	all values questionable; not plotted
7-3	bot.	57.4	188	27				
7-4	110	58.5	191	29				
7-4	bot.	58.9	192	29				
7-5	bot.	60.4	197	38				
7-6	110	61.5	201	29				
7-6	117	61.6	201		29	0.9	32	all values questionable; not plotted
7-6	bot.	61.9	202	29				
8-1	120	69.5	227	24				
9-1	80	72.8	238		5.7	1.3	4.4	
9-1	113	73.1	239	17				
9-6	110	80.6	263	24				
10-2	145	87.4	285	17				
10-3	105	88.5	289	29				
10-3	bot.	88.9	291	36				
10-4	130	90.2	295	17				
10-4	bot.	90.4	295	36				
11-1	105	91.9	300	9				
11-2	90	93.2	305	9				
11-3	90	94.7	309	5				
11-4	100	96.3	315	9				
11-5	95	97.8	319	9				
11-6	100	99.3	325	9				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane,kPa Undist.	Remold.	Sensitivity	Notes
Hole 6004 (cont'd)								
11-6	bot.	99.8	326	43				
12-4	bot.	109.2	357	29				
13-2	82	111.9	366	48				
13-3	64	113.2	370	14				
13-4	115	115.3	377	10				
13-5	105	116.7	381	7				
13-6	80	117.9	385	12				
13-6	bot.	118.6	388	33				
14-2	37	120.9	395	14				
14-3	74	122.7	401	12				
14-4	78	124.3	406	5				
14-5	56	125.6	410	10				
14-6	100	127.5	417	29				
15-1	110	130.3	426	5				
15-2	110	131.8	431	5				
15-3	110	133.3	436	5				
15-4	110	134.8	441	10				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6004B								
2-2	110	150.7	492	10				
2-3	110	152.2	497	10				
2-4	110	153.7	502	10				
2-5	110	155.2	507	19				
2-6	110	156.7	512	19				
2-6	bot.	157.1	513	31				
4-1	110	175.2	573	53				
4-1	bot.	175.6	574	>96				
Hole 6007								
2-3	100	16.7	55	9				
3-5	bot.	24.2	79	67				
3-6	bot.	25.7	84	72				
5-1	bot.	41.6	136	53				
5-2	75	42.4	138	43				
6-2	90	52.0	170	67				
6-2	bot.	52.6	172	72				
6-3	80	53.4	175		57	19	3	
6-3	100	53.6	175	86				
6-3	bot.	54.1	177	83				
9-1	110	82.3	269	67				
10-1	25	91.0	297	10				
10-1	145	92.2	301	21				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6007B								
1-1	146	130.3	426	57				
2-3?	bot.	139.1	455	101				
4-3	80	156.7	512	57				
4-3	bot.	157.4	514	48				
5-1	140	167.3	547	42				
8-2	110	195.7	640	5				
10-2	110	208.9	685	48				
10-3	45	209.8	688	77				
10-4	100	210.3	690	67				
10-5	50	211.3	693	57				
10-5	140?	213.7	701	24				
10-6	100	214.8	704	38				
10-6	bot.	215.3	706	24				
11-2	110	218.7	715	29				
11-5	bot.	223.6	731	19				
12-5	70	232.2	759	>24				invalid test; not plotted
Hole 6008								
1-1	100	3.9	13	22				
1-2	63	5.0	16		11	3	4	
1-2	bot.	5.9	19	16				
1-3	bot.	7.4	24	21				
1-4	bot.	8.9	29	27				
3-1	bot.	25.7	84	26				
9-2	bot.	81.2	265	20				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Undist.	Vane,kPa Remold.	Sensi-tivity	Notes
Hole 6009								
1-1	143	8.8	29	22				
1-1	bot.	8.9	29	57				
3-2	bot.	25.7	84	50				
3-3	4	25.7	84	56				
3-3	131	27.0	88	57				
3-3	bot.	27.4	89	91				
Hole 6009B								
1-1	100	6.9	23	19				
1-1	141	7.3	24	56				
3-2	60	23.6	77	62				
4-1	100	31.9	104	34				
4-1	bot.	32.4	106	52				
4-2	48	32.9	107	31				
4-2	bot.	33.9	111	34				
5-1	bot.	43.4	142	91				
8-1	146	69.0	225	34				
8-1	bot.	69.0	225	22				
8-2	bot.	70.5	230	32				
8-3	48	71.0	232	25				
8-3	bot.	72.0	235	44				
9-2	48	80.5	263	32				
9-2	bot.	81.5	266	29				
10-2	98	88.9	290	19				
10-2	bot.	89.4	292	43				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Undist.	Vane,kPa Remold.	Sensitivity	Notes
Hole 6009B (cont'd)								
10-3	47	89.8	294	41				
10-3	bot.	90.9	297	50				
11-1	100	98.4	322	25				
11-1	bot.	98.9	323	40				
11-2	99	99.9	326	62				
11-2	bot.	100.4	328	54				
12-1	100	102.1	334	31				
12-2	100	103.6	339	45				
12-3	100	105.1	343	59				
12-4	bot.	107.1	350	73				
12-5	46	107.6	352	53				
12-5	bot.	108.6	355	71				
12-6	52	109.1	357	61				
12-6	bot.	110.1	360	59				
13-1	42	118.5	387	38				
13-1	57	118.7	388	14				
13-1	bot.	119.6	391	91				
14-1	140	122.9	402	10?				questionable
14-2	100	124.0	405	46				
14-3	47	125.0	408	43				
14-4	46	126.5	413	36				
14-5	47	128.0	418	25				
15-1	100	134.8	441	41				
15-2	100	136.5	446	40				
21-2	100	192.8	630	91				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6009B (cont'd)								
21-3	8	193.4	632	91				
27-1	47	249.1	814	55				
27-2	47	250.6	819	89				
27-2	100	251.1	821	81				
27-2	129	251.4	822	15				
28-1	100	259.3	847	36				
28-2	100	260.8	852	25				
29-1	142	270.7	885	>86				
30-1	bot.	378.7	1238	>96				
30-2	70	379.4	1240	91				
30-2	bot.	380.2	1242	34				
Hole 6010								
1-1	bot.	5.0	16	10				
1-2	bot.	6.5	21	16				
1-3	80	7.3	24	17				
1-3	?	7.5*	25*		14	5.7	2.4	
1-3	bot.	8.0	26	14				
2-1	bot.	15.1	49	8				
2-2	100	16.1	53	17				
2-2	bot.	16.6	54	16				
3-1	134	24.3	80	8				
3-1	bot.	24.5	80	10				
3-2	100	25.5	83	8				
3-2	143	25.9	85	>91				

* Estimated

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane,kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6010 (cont'd)								
3-2	bot.	26.0	85	43				
4-1	140	33.9	111	13				
4-2	100	35.0	114	32				
4-2	bot.	35.5	116	48				
5-1	80	44.2	144		5.0	3.6	1.4	
5-1	100	44.2	145	52				
5-1	bot.	44.9	147	19				
6-1	144	51.6	169	39				
6-2	bot.	53.2	174	48				
6-3	143	54.6	179	34				
6-3	bot.	54.7	179	19				
7-3	100	62.1	203	54				
7-3	bot.	62.6	205	56				
7-4	47	63.1	206	77				
7-4	124	63.8	209		37	7.2	5.1	
7-4	140	64.0	209	62				
7-4	bot.	64.1	209	56				
8-1	100	71.6	234	53				
9-3	47	82.0	268	29				
9-3	bot.	83.0	271	34				
10-1	120	92.2	301	59				
11-2	144	100.6	329	36				
11-2	bot.	100.7	329	40				
11-3	47	101.2	331	50				
11-3	140	102.1	334	46				bottom

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane,kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6010 (cont'd)								
12-2	100	109.7	358	14				
12-2	bot.	110.2	360	61				
12-3	47	110.7	362	27				
12-3	bot.	111.7	365	36				
13-1	123	119.3	390	43				
13-1	bot.	119.6	391	59				
13-2	100	120.6	394	36				
13-2	140	121.0	395	59				bottom
14-2	100	124.1	406	29				
14-2	bot.	124.6	407	13				
14-3	100	125.6	410	36				
14-3	bot.	126.1	412	34				
14-4	100	127.1	415	38				
14-4	bot.	127.6	417	50				
14-5	47	128.1	419	19				
14-5	135	129.0	421	7				
14-5	bot.	129.1	422	33				
14-6	45	129.6	423	48				
14-6	140	130.5	426	69				bottom
15-1	120	140.0	458	48				
16-1	65	144.2	471	43				
16-2	100	146.0	477	38				
16-2	bot.	146.5	479	48				
16-3	90	147.4	482	34				
16-3	bot.	148.0	484	77				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Undist.	Vane, kPa Remold.	Sensi-tivity	Notes
Hole 6010 (cont'd)								
16-4	46	148.5	485	67				
16-4	139	149.4	488	86				bottom
18-1	100	167.9	549	58				
19-1	25	168.8	551	34				
19-1	40	168.9	552	51				
19-1	bot.	170.0	556	72				
19-2	47	170.5	557	31				
19-2	bot.	171.5	560	67				
19-3	47	172.0	562	50				
19-3	bot.	173.0	565	72				
19-4	100	174.0	569	67				
19-4	bot.	174.5	570	88				
19-5	47	175.0	572	67				
19-5	bot.	176.0	575	>91				
19-6	100	177.0	578	57				
19-6	130	177.3	579	>91				bottom
20-1	140	179.7	587	24				
20-2	bot.	181.3	592	>91				
20-3	100	182.3	596	38				
20-3	bot.	182.8	597	>91				
20-4	bot.	184.3	602	48				
20-5	12	184.4	603	67				
20-5	bot.	185.8	607	38				
20-6	47	186.3	609	53				
20-6	bot.	187.3	612	>91				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6010 (cont'd)								
21-2	5	192.3	628	7				
22-1	100	198.2	648	64				
22-1	bot.	198.7	649	91				
22-2	bot.	200.2	654	79				
22-3	142	201.6	659	53				
22-3	bot.	201.7	659	88				
22-4	bot.	203.2	664	>91				
22-5	100	204.2	667	72				
22-5	bot.	204.7	669	>91				
22-6	bot.	206.2	674	31				
23-1	142	215.5	704	72				
24-4	5			57				no record of this section in Hathaway et al. (1976)
26-1	100	236.0	771	96				
26-2	47	237.0	774	>91				
26-4	145	241.0	787	>91				
26-6	46	243.0	794	86				
27-1	87	252.8	826	26				
27-1	137	253.3	828	>91				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6011								
1-1	100	8.4	27	63				
1-1	bot.	8.9	29	62				
7-1	?	60.6*	199*		46	3.6	13	sample part. brittle
7-1	142	61.0	199	34				
8-1	100	62.5	204	29				
8-2	bot.	64.5	211	46				
8-3	bot.	66.0	216	43				
8-5	bot.	69.0	225	27				
9-2	47	79.3	259	29				
13-1	100	109.8	359	38				
16-2	100	145.9	477	38				
Hole 6012								
1-1	bot.	2.9	9	10				
1-2	135	4.3	14	19				
1-3	80	5.2	17	34				
1-4	bot.	7.4	24	16				
1-5	43	7.8	26	29				
1-5	140	8.8	29	34				bottom
2-6	142	19.8	65	29				
2-6	bot.	19.9	65	23				
3-2	90	22.8	75	22				
3-3	116	24.6	80		20	5.7	3.5	
3-3	146	24.9	81	27				
3-4	110	26.0	85	15				

* Estimated

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6012 (cont'd)								
3-4	bot.	26.4	86	29				
3-5	100	27.4	90	31				
3-5	bot.	27.9	91	12				
3-6	100	28.9	94	29				
3-6	bot.	29.4	96	48				
4-1	100	35.3	115	19				
4-1	bot.	35.8	117	18				
4-3	105	38.4	125	36				
4-3	?	38.5*	126*		29	2.9	10	
4-3	140	38.7	126	20				
5-1	100	40.0	131	35				
5-2	100	41.5	136	43				
5-3	140	43.4	142	59				
5-4	106	44.6	146	40				
5-4	?	44.7*	147*		47	5.7	8.3	
5-5	142	46.4	152	38				
5-5	bot.	46.5	152	19				
5-6	9	46.6	152	49				
6-1	100	56.9	186	54				
7-1	100	66.7	218	38				
7-1	140	67.1	219	75				
8-1	143	73.2	239	48				
8-1	bot.	73.3	240	48				
8-2	100	74.3	243	53				
8-2	bot.	74.8	244	54				

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* Estimated

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6012 (cont'd)								
8-3	94	75.7	248	77				
8-3	bot.	76.3	249	54				
9-1	100	83.5	273	19				
9-2	100	85.0	278	53				
9-2	bot.	85.5	279	81				
10-1	57	97.7	319	44				
10-1	?	98.5*	323*		39	9.3	4.2	
11-1	47	97.3	318	50				
11-2	70	99.0	324	53				
11-2	100	99.3	325	43				
11-3	47	100.3	328	53				
11-3	bot.	101.3	331	62				
11-4	75	102.1	333	53				
11-4	bot.	102.8	336	57				
11-5	47	103.3	337	44				
11-5	bot.	104.3	341	38				
12-1	130	106.0	346	34				
12-2	70	106.4	348	54				
12-2	bot.	107.7	352	43				
12-3	32	108.0	353	45				
12-4	100	110.2	360	53				
12-4	bot.	110.7	362	63				
12-5	100	111.7	365	43				
12-5	bot.	112.2	367	34				
12-6	100	113.2	370	53				

* Estimated

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane,kPa Undist.	Remoid.	Sensi-tivity	Notes
Hole 6012 (cont'd)								
12-6	bot.	113.7	372	48				
13-1	bot.	115.7	378	67				
13-2	100	116.7	381	53				
13-2	bot.	117.2	383	40				
13-3	100	118.2	386	77				
13-3	bot.	118.7	388	56				
13-4	47	119.2	389	67				
13-4	bot.	120.2	393	57				
13-5	100	121.2	396	38				
13-5	bot.	121.7	398	56				
13-6	47	122.2	399	57				
13-6	bot.	123.2	403	73				
14-1	100	124.7	408	53				
14-2	100	126.2	412	38				
14-2	bot.	126.7	414	57				
14-3	100	127.7	417	57				
14-3	bot.	128.2	419	67				
14-4	100	129.2	422	43				
14-4	bot.	129.7	424	77				
14-5	100	130.7	427	62				
14-6	47	131.7	430	72				
14-6	140	132.6	433	62				bottom
15-1	100	141.6	463	72				
16-1	98	142.7	466	51				
16-1	bot.	143.2	468	47				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane,kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6012 (cont'd)								
16-2	100	144.2	471	53				
16-2	bot.	144.7	473	52				
16-3	100	145.7	476	67				
16-3	bot.	146.2	478	66				
16-4	47	146.7	479	57				
16-4	bot.	147.7	483	61				
16-5	100	148.7	486	19				
18-1	100	153.0	500	72				
18-1	bot.	153.5	502	75				
18-2	100	154.5	505	67				
18-2	bot.	155.0	507	61				
18-3	100	156.0	510	62				
18-3	bot.	156.5	511	63				
18-4	100	157.5	515	77				
18-4	bot.	158.0	516	48				
18-5	100	159.0	520	57				
18-5	bot.	159.5	521	43				
18-6	47	160.0	523	62				
18-6	140	160.9	526	79				bottom
19-1	100	168.5	551	24				
19-1	bot.	169.0	552	57				
19-2	47	169.5	554	34				
19-2	140	170.4	557	67				
21-1	100	187.4	612	19				
21-2	100	188.9	617	38				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane,kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6012 (cont'd)								
22-1	47	198.1	647	14				
25-1	100	218.0	712	72				
25-2	100	219.5	717	81				
25-3	100	221.0	722	86				
25-4	100	224.0	732	77				
25-5	100	225.5	737	67				
25-6	100	227.0	742	72				
26-6	100	236.4	773	>86				
27-1	100	246.2	805	>86				
28-1	100	248.1	811	72				
28-2	100	249.6	816	43				
28-3	100	251.1	821	62				
28-4	100	252.6	825	72				
28-5	100	254.1	830	>86				
28-6	47	255.1	834	77				
29-1	47	257.1	840	62				
29-2	100	259.1	847	>86				
29-3	47	260.1	850	86				
29-4	46	261.6	855	82				
29-5	46	263.1	860	>86				
29-6	47	264.6	865	77				
30-1	100	270.0	882	38				
30-2	100	271.5	887	>86				
30-3	98	273.0	892	71				
30-4	47	274.0	895	>86				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6012 (cont'd)								
31-1	130	281.6	920	53				
31-2	100	282.8	924	77				
31-3	47	293.8	927	29				
32-1	80	293.5	959	38				
32-1	120	293.9	960	48				
33-1	100	295.7	966	53				
33-2	47	296.7	970	67				
33-3	47	298.2	974	>86				
33-4	47	299.7	979	>86				
33-4	137	300.6	982	>86				
33-5	100	301.7	986	>86				
33-6	47	302.7	989	>86				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensi-tivity	Notes
Hole <u>6013</u>								
4-1	bot.	36.4	119	86				
4-2	bot.	37.9	124	56				
5-2	top	45.9	150	14				
7-1	100	57.3	187	48				
7-1	?	57.4*	188*		75	15	5.0	
7-3	100	60.3	197	67				
7-3	?	60.4*	198*		70	15	4.7	
7-4	47	61.3	200	53				
7-5	113	63.4	207	72				
7-6	53	64.3	210	86				
Hole <u>6013B</u>								
1-1 to 9-1				>91				not plotted
17-1	143	166.4	544	57				
19-2	47	182.6	597	34				
Hole <u>6014</u>								
7-2	115	68.5	224	14				
7-3	107	69.9	228	5				
7-5	45	72.3	236	10				
10-1	125	102.0	333	43				

* Estimated

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
<u>Hole 6015</u>								
4-1	100	41.7	136	>91				
4-1	bot.	42.2	138	91				
4-2	bot.	43.7	143	91				
6-1	bot.	62.6	205	91				
<u>Hole 6016B</u>								
6-1	40	67.6	221		34			
6-1	47	67.7	221	48				
6-1	68	67.9	222	53				
6-1	100	68.2	223	53				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6017								
1-1	bot.	13.5	44	0?				core disturbed
1-2	75	14.3	47		2.3	0.4	5.8	
2-1	100	20.7	68		10	1.4	7.1	too soft for Torvane
2-1	bot.	21.2	69	0?				
2-2	bot.	22.7	74	0?				
2-3	48	23.2	76	17				
2-3	75	23.5	77		27	6.5	4.1	
2-3	100	23.7	77	10				
2-3	140	24.1	79	29				
4-1	123	39.8	130		25	5.7	4.4	
4-1	143	40.0	131	22				
4-1	bot.	40.1	131	24				
4-2	bot.	41.6	136	10?				
4-3	25	41.9	137		14	4.3	3.2	
4-3	47	42.1	137	19				
4-3	67	42.3	138		17	5.0	3.4	
4-3	100	42.6	139	36				
4-3	127	42.9	140		53	11	4.8	
5-1	38	51.4	168	31				
5-1	110	52.1	170	10				
7-1	55	70.2	229	3				
7-1	70	70.3	230		36	5.7	6.3	
8-1	90	80.0	261	21				sandy clay
8-1	bot.	80.6	263	67				
9-1	100	89.8	293	48				

000136

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6019								
1-1	46	13.2	43		0.7			too weak to remold
1-1	96	13.7	45		2.3	0.5	4.6	
1-2	45	14.7	48		2.7	1.1	2.5	
1-2	115	15.4	50		1.9	0.4	4.8	
2-2	50	20.8	68		4.2			sample cracked during test
2-2	100	21.3	70		3.7	1.0	3.7	tests questionable
2-3?	100	22.8	75		1.0	0.3	3.3	section uncertain
4-1	19	33.4	109		1.8	0.4	4.5	
4-4	116	38.9	127		1.2	0.3	4.0	
5-1	75	50.9	166		21			sample cracked during test
5-1	112	51.2	167		35			sample cracked during test
Hole 6019B								
1-2	100	0.8	3		3.6	1.4	2.6	

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensi-tivity	Notes
Hole <u>6020</u>								
1-1	95	7.2	23		20			sample cracked during test
2-2	37	13.7	45		31			sample cracked during test
2-2	47	13.8	45	15				
2-2	140	14.7	48	18				
2-2	bot.	14.8	48	12				
2-3	140	16.2	53	11				
3-2	47	24.1	79	21				
3-2	110	24.7	81	57				
3-2	125	24.9	81	62				
3-2	140	25.0	82	40				
4-2	50	30.2	99	40	45			sample cracked during test
4-2	100	30.7	100	38				
6-1	60	42.8	140	52				
6-1	85	43.1	141	60				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6021								
1-3	40	5.7	19		3.1	0.1?	31	sensitivity unlikely; not plotted
1-3	47	5.8	19	0?				
1-3	75	6.1	20		42			sample cracked during test
1-3	100	6.3	21	45				
1-3	110	6.4	21		50			sample cracked during test
2-2	135	11.9	39	59				
2-3	5	12.1	39	57				
2-3	48	12.5	41	57				
2-3	90	12.9	42		55			sample cracked during test
2-3	100	13.0	42	20				
2-3	135	13.4	44		32			sample cracked during test
2-3	143	13.4	44	25				
2-3	bot.	13.5	44	34				
2=4	3	13.5	44	29				
2-4	48	14.0	46	32				
2-4	70	14.2	46		23			sample cracked during test
2-4	100	14.5	47	48				
2-4	106	14.6	48		80			sample cracked during test
2-4	130	14.8	48	57				

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensitivity	Notes
Hole 6021C								
1-1	75	5.2	17		2.9	1.1	2.6	
1-1	125	5.7	18		4.2	0.7	6.0	
1-2	35	6.3	20		2.9	1.4	2.1	
1-2	103	6.9	23	56				
1-2	122	7.1	23		52			sample cracked during test
1-2	135	7.3	24	75				
3-1	118	23.6	77	24				
3-1	125	23.7	77	38				
6-1	100	53.3	174	15				
7-1	47	60.7	198	7				
9-1	118	78.8	257	5				
10-1	91	89.4	292	17				
10-2	5	90.1	294	29				
10-2	100	91.0	297	34				
10-2	143	91.4	299	8				
11-1	114	97.9	320	24				
11-2	4	98.3	321	27				
11-2	116	99.5	325	34				
11-2	142	99.7	326	40				
11-3	5	99.9	326	31				
11-3	55	100.4	328	40				
11-3	90	100.7	329	31				
12-3	48	108.8	355	9				
12-3	140	109.7	358	38				
13-1	130	120.0	392	29				

000140

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane,kPa Undist.	Remold.	Sensi- tivity	Notes
Hole 6021C (cont'd)								
14-1	83	128.9	421	24				
14-1	125	129.4	423	34				
15-1	142	139.3	455	57				
16-1	90	148.3	485	38				
17-1	127	158.1	517	26				
18-1	133	166.4	544	22				
18-2	40	167.0	546	55				
19-1	145	176.0	575	46				
19-2	47	176.5	577	73				
19-2	100	177.0	578	61				
19-2	103	177.0	579	56				
20-1	130	186.8	610	9				
21-1	142	195.1	638	55				
21-2	40	195.6	639	61				
23-1	110	212.2	693	18				
23-2	40	213.0	696	36				
23-2	140	214.0	699	39				
23-3	100	215.1	703	45				
24-1	90	224.8	735	38				
24-1	110	225.0	735	34				
26-1	130	239.6	783	17?				questionable; not plotted
26-3	100	242.3	792	52				
26-4	100	243.8	797	62				
27-1	50	252.7	826	88				
27-1	80	253.0	827	91				

000141

Core Section	Test Depth in Section, cm	Assumed Depth Below Seafloor, m	ft	Torvane, kPa	Laboratory Vane, kPa Undist.	Remold.	Sensi-tivity	Notes
Hole 6021C (cont'd)								
27-1	100	253.2	827	40				
28-1	115	262.9	859	75				
30-2	40	281.3	919	81				
32-1	80	299.9	980	91				

Appendix XI. Ashore Test Results of Physical Properties (1)

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	Assumed Depth Below Seafloor m	Lab. Bulk Density, Mg/m^3 (2)	Water Content, % Dry Weight Meas.	Water Content, % Dry Weight Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/₀₀ (3)
Hole 6002															
4-6	4	1.25-1.50	117	35.7						200	87		113	2.39	32.0
7-2	1	1.10-1.35	192	58.6						156	79		77	2.53	33.4
8-3	6	1.25-1.50	226	68.9						203	103		100	2.38	33.4
9-6	5	1.25-1.50	257	78.3						106	40		66	2.58	
10-2	3	1.00-1.27	287	87.5						143	53		90	2.55	34.3
11-2	2	1.00-1.27	319	97.2						114	36		78	2.52	

(1) Data measured or calculated by personnel from Lehigh University and U.S. Geological Survey.

(2) Lower values may not be valid, see text.

(3) Measured or calculated by U.S. Geological Survey personnel, Corpus Christi, Texas. Salt content corrections made for water content, void ratio, porosity, liquid limit, plastic limit, and specific gravity (only where water-content data were available).

A bar over a value of void ratio, porosity, liquidity index, or specific gravity indicates that the data were derived from the next water content measurement above the derived data. A bar under these numbers indicates that the data were derived from the next water content measurement below the derived data.

cc = core catcher sample: depth in core section generally was about 1.50 to 1.52 m.

Core Section	Sample No.,S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab.Bulk Density, Mg/m^3(2)	Water % Dry Meas.	Content, Weight Corr.(3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/°° (3)
Hole 6004															
1-1	7	core bot.	24	7.4	1.65	56	59								
1-2	23	1.15-1.40	28	8.6				1.56	.61					2.65	
2-2	24	0.95-1.20	48	14.6				1.43	.59					2.66	36.1
2-2	8	core bot.	49	15.0	1.69	51	54								
3-1	25	1.15-1.50	80	24.3				1.29	.56					2.74	36.0
3-1	9	core bot.	80	24.5	-	45	47								
5-2	26	1.25-1.50	131	39.9										2,69	
5-4	27	0.62-1.37	139	42.5										2,64	
6-2	28	0.50-1.00	150	45.8										2.65	
6-4	29	1.00-1.50	161	49.2										2.69	
6-6	10	1.38-1.50	172	52.4	1.80	48	51								
7-1	30	1.00-1.50	177	54.1						43	41		2	2.64	
7-3	31	1.00-1.50	187	57.1						42	41		1	2.68	
7-6	32	1.00-1.50	202	61.6						48	40		8	2.65	
8-2	11	1.38-1.50	233	71.2	1.87	46	49								
9-1	33	1.00-1.50	240	73.2										2.68	
9-4	34	1.00-1.50	255	77.7										2.75	
10-3	12	0-0.10	287	87.5	1.70	44	46								
10-4	13	1.40-1.50	296	90.4	1.60	64	68								
11-1	35	0.75-1.50	301	91.8										2.63	
11-4	36	0.75-1.50	316	96.3										2.65	
14-6	14 & 37	0-0.10	415	126.5	1.41	89	95	2.54	.72	101	79	1.38	22	2.60	35.9
B2-6	20	1.25-1.40	515	156.9	1.50	80	86								
B4-1	15	1.40-1.50	576	175.5	1.54	61	65								
B6-5	16	1.40-1.50	633	193.0	-	40	42								
B13-2	17	1.30-1.40	789	240.5	1.60	60	64								
B14-6	18	1.40-1.50	826	251.8	-	32	34								
B16-3	19	1.40-1.50	887	270.4	-	34	31								
B19-1	22	1.40-1.50	951	289.9	1.84	31	33								
B20-1	21	1.40-1.50	1009	307.6	data missing										

000144

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab. Bulk Density, Mg/m^3 (2)	Water Content, % Dry Meas.	Weight Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/₀₀ (3)
Hole 6005															
2-1	39	?	57	17.3										2.65	
Hole 6006															
3-2	40	0.50-1.00	98	29.8										2.65	
3-4	42	0-0.50	101	30.8										2.64	
5-2	43	0.50-1.00	155	47.2										2.65	
5	41	cc	168	51.2	2.00	22	23								

Core Section	Sample No.,S-	Depth in Section, m	Assumed Depth Below Seafloor ft	Assumed Depth Below Seafloor m	Lab.Bulk Density, Mg/m^3(2)	Water Content, % Dry Meas.	Water Content, Weight Corr.(3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/°° (3)
Hole 6007															
3-5	45	1.40-1.50	79	24.1	1.49	40	42								
4-5	44	1.50	116	35.4	1.91	35	36								
5-2	48	0.90-1.40	140	42.8				.89	.47	54	27	.22	27	2.70	23.6
5-2	46	bottom trim.	141	43.0	1.78	32	33								
6-2	49	0.98-1.50	171	52.3						55	28		27	2.68	23.5
6-3	47	1.40-1.50	177	54.0	1.80	37	39								
8-1	50	1.40-1.50	239	72.9	2.05	29	30								
9-1	52	1.00-1.50	270	82.4						58	22		36	2.67	
10-1	51	1.40-1.50	302	92.1	1.88	31	32								
B-1	53	cc	428	130.5	1.77	32	33								
B4-3	54	1.45-1.50	516	157.3	2.01	24	25								
B5	55	cc	550	167.6	1.63	43	45								
B10-5	56	1.40-1.50	706	215.2						39	21		18	2.68	30.7
B11-5	57	1.40-1.50	733	223.5	1.67	39	41								
B12-4	58	1.40-1.50	759	231.4	1.57	41	43								

Core Section	Sample No.,S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab.Bulk Density, Mg/m^3(2)	Water Content, % Dry Meas.	Weight Corr.(3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, ‰ (3)
Hole 6008															
1-2	65	0.98-1.48	18	5.6				.78	.44	25	13	1.33	12	2.68	27.6
1-2	60	1.48-1.50	19	5.8	1.90	28	29								
1-4	62	1.00-1.50	28	8.6				.79	.44	59	27	.09	22	2.66	27.6
1-4	59	cc	30	9.1	1.92	29	30								
2-1	61	cc	60	18.2	1.86	26	27								
3-1	63	1.40-1.50	84	25.6	1.87	26	27								
4-2	67	0.70-1.40	118	36.1				1.16	.54	52	19	.73	33	2.69	9.7
4-2	64	cc	120	36.6	1.76	42	43								
5-1	68	1.00-1.50	153	46.8										2.64	
6-1	69	0.90-1.40	189	57.6				.62	.38	20	17	3.00	3	2.69	1.6
6-1	66	cc	191	58.2	2.02	23	23								
12-2	70	0-0.50	355	108.2										2.62	
13-1	71	1.00-1.50	385	117.5										2.64	

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab. Bulk Density, Mg/m^3 (2)	Water Content, % Dry Meas.	Weight Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/oo (3)
Hole 6009															
1-1	72	cc	30	9.1	2.14	15	15								
2-1	73	cc	60	18.3	1.82	31	32								
5	74	cc	152	46.3	1.96	29	29								
B1-1	84	0.64-0.99	22	6.7						31	18		13	2.65	33.3
B1-1	75	1.48-1.50	24	7.3	2.07	24	25								
B2-1	80	1.00-1.50	44	13.5										2.69	
B3	76	cc	81	24.7	1.84	37	38								
B4-1	85	0.90-1.40	105	32.1						58	24		34	2.71	10.5
B4-2	77	1.38-1.40	111	33.8	1.78	42	43								
B5-1	79	1.48-1.50	142	43.3	1.91	32	32								
B5	78	cc	143	43.6	1.93	29	29								
B8-3	88	0.90-1.40	235	71.6				.83	.45	37	25	.50	12	2.68	6.9
B8	81	cc	237	72.2	1.96	31	31								
B9-2	90	0.40-0.90	264	80.6				.89	.47	38	26	.58	12	2.68	7.2
B9	82	cc	268	81.7	1.90	33	33								
B10-2	89	0.80-1.30	297	90.5				.78	.44	44	23	.29	21	2.70	7.5
B10	83	cc	299	91.1	1.93	29	29								
B11-1	91	0.80-1.30	323	98.4						51	23		28	2.67	
B13	86	cc	393	119.8	1.80	37	37								
B14	87	cc	424	129.2	1.94	28	28								
B20	92	cc	609	185.6	1.90	27	27								
B22	93	cc	671	204.5	2.10	16	16								

Core Section	Sample No.,S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab.Bulk Density, Mg/m³(2)	Water Content, % Dry Meas.	Weight Corr.(3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/oo (3)
Hole 6010															
1	94	cc	27	8.2	1.86	38	40								
2-1	97	1.48-1.50	49	15.0	1.81	38	40								
2-2	105	0.94-1.44	53	16.3				1.05	.51	47	24	.65	23	2.69	27.5
2-2	98	1.48-1.50	54	16.5	1.81	37	38								
2	95	cc	55	16.8	1.86	36	37								
3-2	107	0.80-1.30	83	25.3				1.04	.51					2.54	26.7
3-2	99	1.48-1.50	85	25.9	1.86	39	41								
3	96	cc	86	26.2	2.08	18	19								
4-2	108	0.80-1.30	115	35.0				.88	.47	38	19	.74	19	2.67	25.1
4-2	101	1.48-1.50	116	35.4	1.79	32	33								
5-1	109	0.60-1.10	145	44.2				.79	.44	58	24	.15	34	2.75	23.5
5	100	cc	148	45.1	1.95	28	29								
6-2	no 6-2 sample logged for this hole									41	21		20	2.71	23.5
7-2	110	0.80-1.30	199	60.8										2.66	23.4
7-4	111	1.00-1.50	209	63.8				.75	.43	33	17	.69	16	2.67	23.4
7	102	cc	211	64.3	1.99	27	28								
8	103	cc	242	73.8	1.89	32	33								
9-2	113	0.60-1.10	265	80.8						33	19		14	2.67	23.3
9	104	cc	273	83.2	2.05	21	22								
11-2	115	0.50-1.00	328	99.9										2.64	24.3
11-3	106	1.40-1.43	335	102.1	1.86	22	23								
19-6	112	1.38-1.40	582	177.4	1.93	27	28								
21	114	cc	646	196.9	1.98	22	23								
23	116	cc	708	215.8	2.18	18	18								
25	117	cc	770	234.7	1.85	24	25								

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	Assumed Depth Below Seafloor m	Lab. Bulk Density, Mg/m^3 (2)	Water Content, % Dry Meas.	Water Content, % Dry Weight Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/₀₀ (3)
Hole 6011															
1-1	119		29	8.9				1.33	.57	65	31	.53	34	2.71	28.9
1-1	118	1.48-1.50	29	8.8	1.69	47	49								
8-1	121	0.50-1.00	204	62.2						75	40		35	2.60	1.5
8-3	122	0.50-1.00	280	65.3						77	47		30	2.63	1.5
8-5	123	0.50-1.00	223	68.2						97	58		39	2.55	1.5
9-1	124	1.00-1.50	257	78.5				.94	.48	87	47		40	2.67	2.2
9-2	120	1.48-1.50	263	80.1	1.68	35	35								
11-2	125	0.50-1.00	302	92.1						85	59		26	2.52	
11-5										94	64		30	2.61	
14-2	127	0.50-1.00	411	125.2						66	39		27	2.62	
16-2	126	0.90-1.40	479	146.1						39	26		13	2.61	

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab. Bulk Density, Mg/m^3 (2)	Water Content, % Dry Weight Meas.	Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/₀₀ (3)
Hole 6012															
1-4	128	1.48-1.50	24	7.3	1.89	35	37								
1-5	133	0.70-1.20	27	8.4				.95	.49	53	23	.40	30	2.71	32.7
1	129	cc	30	9.1	1.85	33	35								
2-1	132	1.45-1.50	40	12.3	1.60	49	52								
2-6	145	0.50-1.00	63	19.1				1.02	.50	61	26	.34	35		32.9
2	130	cc	66	20.1	1.88	36	38								
3-2	146	0.70-1.20*	74	22.7											
3-2	134	1.48-1.50	76	23.3	1.68	57	60	1.61	.62	59	26	1.03	33	2.68	31.8
3-4	147	0.80-1.30	85	25.9				1.30	.57	60	25	.69	35	2.66	31.8
3-4	137	1.46-1.50	86	26.3	1.76	47	49								
3-6	148	0.60-1.10	94	28.7				.82	.45	49	27	.18	22	2.67	31.8
3-6	135	1.47-1.50	96	29.3	1.93	30	31								
3	131	cc	97	29.6	1.94	28	29								
4-3	157	0-0.04	122	37.3	1.91	31	32								
4-3	149	0.74-1.24	126	38.3				.87	.46	49	15	.50	34	2.70	30.2
5-4	150	0.80-1.30	146	44.5						50	28		22	2.70	30.8
6-1	151	0.80-1.30	187	56.9						49	24		25	2.70	30.8
7-1	138	1.47-1.50	220	67.1	1.88	33	34								
8-2	153	0.90-1.40	244	74.3				.92	.48	68	27	.17	41	2.69	31.7
9-2	152	0.90-1.40	279	85.2				.79	.44	64	29	.03	35	2.66	
9	136	cc	281	85.7	1.93	29	30								
11-1	140	1.47-1.50	322	98.3	1.71	40	42								
11-4	141	1.47-1.50	337	102.7	1.79	39	41								
11	139	cc	342	104.5	1.90	33	34								
13-3	143	1.47-1.50	389	118.6	1.89	32	33								
14	142	cc	436	132.9	1.86	33	35								
16-5	154	1.28-1.31	489	149.2	2.07	23	24								
18-3	155	1.48-1.51	513	156.4	1.96	30	31								
19	144	cc	560	170.7	2.04	24	25								
22-1	156	1.35-1.38	653	199.0	2.00	26	27								

* Depth from sample log sheet; cc marked on sample.

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	Assumed Depth Below Seafloor m	Lab. Bulk Density, Mg/m^3 (2)	Water Content, % Dry Weight Meas.	Water Content, % Dry Weight Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/∘∘ (3)
Hole 6013															
4-1	159	1.20-1.50	119	36.3				.59	.37	44	22		21	2.69	33.9
4-2	158	1.30-1.35	124	37.8	1.96	21	22								
5-2	169	0-0.04	151	45.9						27	24		3	2.70	
6-2	162	1.00-1.50	180	55.0				.64	.39	26	19	.86	7	2.66	34.0
6-2	160	1.48-1.57	181	55.2	2.03	23	24								
6-3	164	0.50-1.00	184	56.1				.71	.41	27	22	1.00	5	2.63	34.0
6-3	161	1.48-1.50	186	56.7	1.96	26	27								
7-2	163	1.47-1.50	194	59.2	1.80	40	42								
7-3	167	0.50-1.00	196	59.9				1.11	.53	56	29	.48	27	2.65	34.0
7-4	165	1.47-1.50	204	62.1	1.82	37	39								
7-5	170	0.10-0.60	205	62.6				1.03	.51	50	27	.52	23	2.64	34.0
7-6	166	1.37-1.40	214	65.2	1.94	25	26								
8-2	171	0.80-1.30	247	75.2				.61	.38					2.65	
8-2	168	1.29-1.33	248	75.6	1.99	22	23								
11-2	172	?	321?	97.9?										2.65	
11-4	173	?	331?	100.9?										2.65	
B24-2	174	1.38-1.41	763	232.6	1.66	34	36								
Hole 6014															
6-2	176	0.60-1.10	202	61.6										2.64	
7-2	177	0.48-0.98	218	66.6						30	20		10	2.63	30.2
7-4	178	0.56-1.06	235	71.7				.72	.42	32	25	.29	7	2.68	30.2
7-5	175	1.45-1.50	240	73.3	1.95	26	27								

Core Section	Sample No.,S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab.Bulk Density, Mg/m^3(2)	Water Content, % Dry Meas.	Weight Corr.(3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/₀₀ (3)
Hole <u>6015</u>															
4-1	180	1.00-1.50	137	41.9						64	30		34	2.66	34.8
6-1	181	0.95-1.45	204	62.3				<u>.49</u>	<u>.33</u>	28	19		9	2.71	32.7
6	179	cc	206	62.8	2.13	17	18								
Hole <u>6016B</u>															
6-1	182	?	225	68.7						51	22		29	2.66	31.9

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab. Bulk Density, Mg/m^3 (2)	Water % Dry Meas.	Content, Weight Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/oo (3)
Hole 6017															
1-1	183	1.48-1.50	44	13.4	1.77	44	46								
1-2	184A	0.50-1.00	47	14.3				1.43	.59	27	17	3.90	10	2.61	34.6
1-2	184	1.48-1.50	49	14.9	1.37	52	55								
2-1	185	1.48-1.50	69	21.1	1.94	27	28								
2-3	186	1.38-1.40	79	24.1	1.98	24	25								
3-1	187	1.48-1.50	109	33.2	2.00	22	23								
4-1	188	1.48-1.50	131	40.0	2.01	22	23								
4-2	189	1.30-1.32	136	41.4	2.04	19	20								
4-2	189	bottom trim.	136	41.6	1.95	20	21								
4-3	190	1.48-1.50	141	43.0	1.86	23	24								
5-1	191	1.22-1.50	172	52.4						41	20		21	2.70	
6-2	192	top trim.	213	65.0	1.94	29	30								
6-2	192	1.40-1.42	223	67.9	1.84	31	32								
6-2	192	bottom trim.	223	68.0	1.84	33	34								
7-1	193	0.20-0.70	230	70.1						65	27		38	2.68	
8-1	194	1.00-1.30	263	80.2						35	17		18	2.67	22.4
9-1	195	1.23-1.46	295	90.1						37	14		23	2.69	
Hole 6018															
6-2	197	0-0.50	154	47.0				.47	.32					2.72	31.8
6-2	196	0.90-0.92	156	47.7	1.69	16	17								

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab. Bulk Density, Mg/m^3 (2)	Water Content, % Dry Meas.	Weight Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/oo (3)
Hole 6019															
1-1	198	1.40-1.42	46	14.1	1.49	85	91								
1-2	199	1.48-1.50	51	15.6	1.48	83	89								
1	200	cc	52	15.9						100	31		69		34.9
2-2	201	1.00-1.37	70	21.5				2.23	.69	99	44	.80	55	2.57	32.5
2-2	202	1.38-1.40	71	21.7	1.49	82	87								
2-3	203	1.00-1.45	78	23.7				1.68	.63	89	37	.46	52	2.76	32.5
2-3	204	1.48-1.50	78	23.7	1.68	58	61								
3-2	205	1.31-1.33	107	32.5	1.97	28	29								
3-2	206	top trim.	107	32.7	1.47	85	90								
3-2	206	1.48-1.50	107	32.7	2.05	24	25								
3-2	206	bottom trim.	107	32.7	2.02	25	26								
4-1	207	0.20-0.40	110	33.5						47	20		27	2.67	30.5
4	208	cc	139	42.4	1.84	34	35								
5	209	cc	170	51.8	1.99	31	32								
6	210	cc	180	54.9	1.92	30	31								
7-1	211	1.40-1.42	200	61.0	1.80	19	20								
8-1	212	1.48-1.50	231	70.4	-	24	25								
B1-2	214	1.00-1.37	5	1.5						104	42		62	2.55	
B1	213	cc	5	1.5	1.44	51	54	1.37	.58			.19			

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab. Bulk Density, Mg/m^3 (2)	Water Content, % Dry Weight Meas.	Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, ‰ (3)
Hole 6020															
1-1	216	0.70-1.00	23	7.0						39	19		20	2.70	
1	215	cc	26	7.9	1.66	44	46								
2-1	218	1.48-1.50	43	13.2	1.86	33	34								
2-2	219	0-0.50	44	13.5				.79	.44	50	23	.26	27	2.66	26.3
2-2	220	1.48-1.51	48	14.7	2.02	29	30								
2-3	229	top trim.	48	14.8	1.94	29	30								
2	217	cc	54	16.5	1.87	32	33								
3-2	222	1.00-1.30	81	24.7				.90	.47	53	25	.32	28	2.67	23.4
3	221	cc	83	25.3	1.68	33	34								
4-2	224	0-0.30	98	29.8						59	35		24	2.70	
4-2	225	0.30-1.50	99	30.1				.83	.45	46	26	.25	20	2.70	
4	223	cc	103	31.4	1.88	30	31								
5	226	cc	112	34.1	1.94	27	28								
6-1	228	0.55-0.90	141	42.9				.51	.34	37	17	.10	20	2.68	5.8
6-1	227	1.28-1.30	143	43.5	2.05	19	19								

Core Section	Sample No., S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab. Bulk Density, Mg/m^3 (2)	Water Content, % Dry Weight Meas.	Corr. (3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/oo (3)
Hole 6021															
1-1	230	1.48-1.50	12	3.7	1.70	65	68								
1-2	239	1.48-1.50	17	5.3	1.78	47	49								
1-3	232	0-0.20	18	5.4				1.31	1.57	55	27		28	2.69	30.8
1-3	233	1.05-1.25	21	6.4						34	18		16	2.74	30.8
1-3	231	1.28-1.30	22	6.6	2.06	21	22								
2-1	234	1.48-1.50	34	10.4	1.69	54	57								
2-2	238	1.48-1.50	39	11.9	2.01	22	23								
2-3	235	1.00-1.50	43	13.2						44	22		22	2.72	32.1
2-4	236	1.27-1.30	48	14.8	1.95	24	25			38	21		17	2.67	32.1

Core Section	Sample No.,S-	Depth in Section, m	Assumed Depth Below Seafloor ft	m	Lab.Bulk Density, Mg/m^3(2)	Water Content, % Dry Meas.	Weight Corr.(3)	Void Ratio (3)	Porosity (3)	Liquid Limit, % (3)	Plastic Limit, % (3)	Liquidity Index (3)	Plasticity Index (3)	Specific Gravity (3)	Salinity, °/oo (3)
Hole 6021c															
1-1	240	1.38-1.40	19	5.8	1.79	44	46								
1-2	242A	0-0.25	20	6.0	1.89	32	33	.53	.47	34	16		18	2.67	32.1
1-2	242B	1.00-1.25	23	7.0				.53	.35	55	24	.13	31	2.67	32.1
1-2	241	1.38-1.40	24	7.3	1.86	19	20								
2-1	243	1.48-1.50	46	14.0	1.81	41	43								
2-2	244	1.00-1.25	50	15.2				.60	.37	44	21	.09	23	2.62	
3-1	245	1.48-1.50	78	23.8	1.88	34	36								
3-2	246	1.00-1.30	82	25.1						55	18		37	2.70	21.7
6-1	248	0.90-1.36	175	53.4				1.00	.50	44	18	.73	26	2.70	31.5
6-1	247	1.38-1.40	176	53.7	1.85	35	37								
7-1	249	0.18-0.58	198	60.5						48	22		26	2.69	31.4
7-2	250	1.48-1.50	207	63.1											
8-3	252	0.04-0.50	234	71.3				1.31	.57	47	21	1.08	26	2.69	31.5
8-3	253	1.48-1.50	219	72.6	1.75	47	49								
9-1	253	1.48-1.50	259	79.0	1.89	35	37								
9-2	254	0-0.50	260	79.3				1.00	1.50	50	24	.50	26	2.70	31.5
9-3	255	1.28-1.31	264	80.4	1.80	36	38								
10-1	256	1.48-1.50	295	89.9	1.87	34	36								
10-2	257	1.15-1.40	299	91.2				.96	.49	56	25	.35	39	2.68	
11-1	258	1.48-1.50	322	98.2	1.97	26	27								
11-2	259	1.48-1.50	327	99.7	1.95	27	28								
11-3	260	1.00-1.40	331	101.0						35	21		14	2.73	
12-1	261	1.48-1.50	350	106.7	1.88	37	39								
12-2	262	1.48-1.50	355	108.2	1.72	46	48								
12-3	263	0.50-0.90	357	109.0				1.28	.56	40	21	1.42	19	2.67	
14-1	264	1.38-1.40	425	129.5	1.82	28	29								
16-1	265	1.48-1.50	488	148.8	1.80	22	23								
18-2	266	1.38-1.40	551	168.0	1.81	35	37								
20-1	267	1.48-1.50	613	186.9	1.93	21	22								
21-2	268	1.28-1.30	644	196.5	1.92	25	26								

Formulas used by U.S. Geological Survey to obtain values listed in this appendix (Booth, 1977, written communication):

1. Water content salt correction:

$$w_{corrected} = \frac{w_{measured}/S}{1 - (1/S - 1)}$$

where S = 1 - S °/₀₀, with S °/₀₀ expressed as a decimal.

2. Specific gravity salt correction:

$$G_{s\,corrected} = \frac{W_s - [(Sw/1 + Sw)\ W_s]}{V - \dfrac{(Sw/1 + Sw)}{2.18}}$$

where W_s = total weight of solids

S = S °/₀₀ expressed as a decimal

w = salt corrected water content

V = total volume of solids

2.18 = average specific gravity of seawater salts

3. Void ratio and porosity calculations:

$$e = \frac{G_s \gamma w V}{W_s} - 1$$

$$n = \frac{e}{e + 1}$$

where G_s = salt-corrected specific gravity

γ = wet bulk density (probably the laboratory weight/volume measurements that are considered of questionable accuracy--see text)

w = salt-corrected water content

V = volume of sample

W_s = total weight of solids