5. SITE 344

The Shipboard Scientific Party[1]
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SITE DATA

Position:. 76°08.98'N; 07°52.52'E

Water Depth (from sea level): 2156.0 corrected meters (echo sounding)

Bottom Felt at: 2201.0 meters (drill pipe)

Penetration: 414.0 meters

Number of Holes: 1

Number of Cores: 37

Total Length of Cored Section: 338.0 meters

Total Core Recovered: 140.7 meters

Percentage of Core Recovery: 41.0%

Oldest Sediment Cored:
Depth below sea floor: 377.5 meters
Nature: Sandy mudstone
Age: Miocene or early Pliocene (Core 33)
Measured velocity: 1.86 km/sec

Basement:
Depth below sea floor: 377.5 meters (drilled)
Nature: Diabase, gabbro-diabase, gabbro
K/Ar age: 3 m.y.

Principal Results: The entire 377-meter column of sediments appears to be glacial marine in origin. The age of the basal sediments is not well determined, but probably is lower Pliocene or Miocene, suggesting that glaciation may have started 5 m.y. ago, or even earlier. The underlying igneous rocks have a coarse texture, are highly altered, and possibly originated from a subalkalic basaltic magma. The radiometric age of 3 m.y. confirms the intrusive nature of basement.

BACKGROUND AND OBJECTIVES

Site 344 is located about 9 nmi (16 km) east of the axis of the prominent rift in the Knipovich Ridge. It lies near the foot of the eastern slope of a rift mountain east of the rift, just above the level of an abyssal plain. As originally selected, the reflection profiler records (Figure 1) at the location show a thin sequence of parallel reflectors (often associated with turbidites), overlying an acoustically transparent sediment, which in turn overlie a prominent reflector interpreted as basement.

The Knipovich Ridge is believed to be a spreading ridge (although the direction of spreading makes an acute angle with the strike of the ridge), and a small, but definitely identifiable, positive magnetic anomaly exists over the axial rift on many crossings (See Chapter 34, this volume). However, the magnetic anomalies on either side of the axial rift have not been identified, and the age of the basement away from the axis is not known.

A principal objective of drilling at Site 344 was to obtain a sample of basement and to determine its nature and age. It was also expected to obtain a relatively complete sequence of sediments, and thus to determine in particular the nature of the change from the overlying apparently layered sequence to the homogeneous acoustically transparent sediments. Site 344 was the northernmost planned site, and the sediments were expected to yield evidence about the onset of, as well as cycles, of glaciation.

OPERATIONS

Approach to Site 344

Site 344 was approached from the southeast at 1644Z on 26 August. After steaming 469.2 n mi in 65 hr, 12 min, at an average speed of 8.5 knots from Site 343. The course was altered to 328°, and the number of revolutions reduced to 150 rpm. At 1943Z, the heading was altered to 090°, and the beacon was dropped at 2100Z. The ship continued on the same course at the same speed until 2117Z, when gear was pulled in, and the ship maneuvered to recover the position over the beacon (Figures 1, 2).

Drilling Operations

Position fixing, in conjunction with the selected profile contouring was normal, and a 13.5-kHz beacon was dropped at 2100 hr. While transferring to dynamic positioning, there was a delay in assigning power to one of the forward thrusters, however, full automatic station keeping was achieved at 0500 hr, 27 August.

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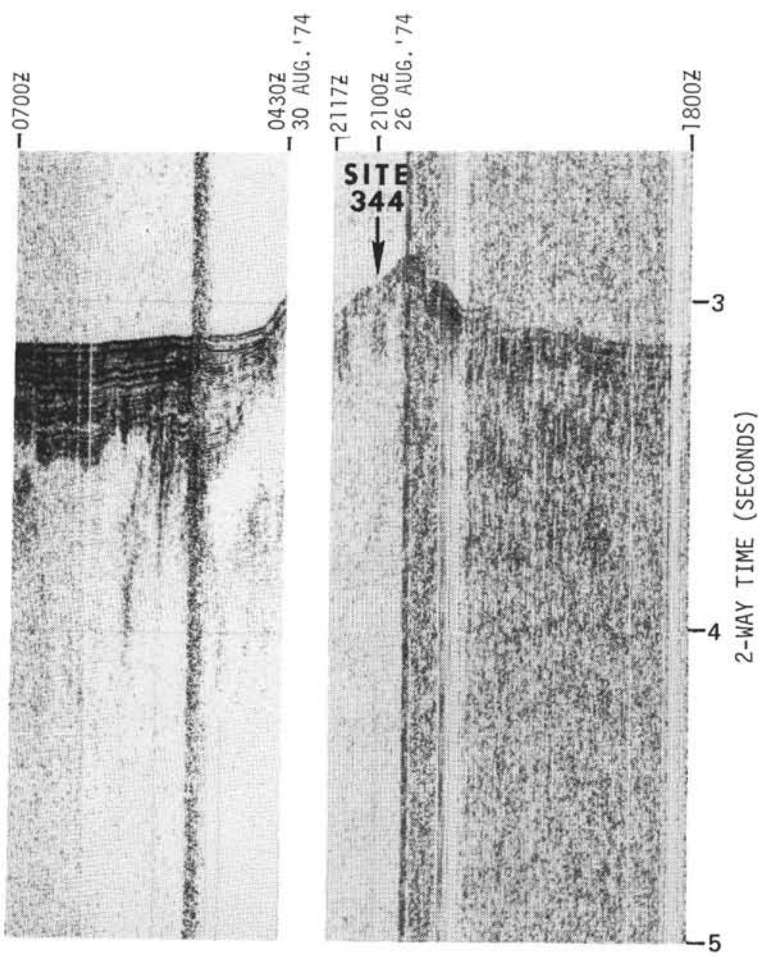

Figure 1. *Profiler record, Site 344.*

Weather forecasts predicted a low front storm for 0300/0500 hr, 27 August, a repetition of one experienced on 26 August. As this had not materialized by 0500, 27 August, the standard 3 × LSB BHA was run. The trip in was suspended between 0930 and 1130 hr as a confused weather state arose.

After recovering a water core, the sea bed was touched at 2201.0 meters (DPM). The relatively large discrepancy between PDR and DPM of (about 45 m) was probably accounted for by a sea bed slope with local depressions. Continuous coring was undertaken to 2449.5 meters.

Poor recoveries in the first few cores were caused by extrusion of the soft slick ooze-like material through the catchers and sock, as there was evidence to show that the barrel had been filled. A series of consistently poor recoveries (average 19%), between 2301 and 2440 meters was probably caused by tough, generally inhomogeneous material compacting and jamming in the catcher neck. It was observed that the torque absorbed by the coring bit over this interval had a general and cyclic increase above normal. All combinations of coring technique and equipment variables were sequentially evaluated without improving either core recovery or AROP.

There was a short delay at 2440 meters when string rotation was prohibited due to *Glomar Challenger*'s off-hole displacement exceeding the 3% depth criteria. The wash and core method, including multiple washes, was adopted from 2449.5 meters, as core evidence dictated.

Basalt was encountered at 2578.5 meters (378.2 m BSB), and 20.2 meters were recovered from 36.5 meters cored, or 55.3%. Coring was terminated at 2210 hr, 29 August. The overall recovery was 140.7 meters or 41% (Table 1).

There was evidence of usual methane faint traces at approximately 2350 meters. The hole was abandoned according to the relevant safety regulations. The BHA was retrieved above the sea bed by 2355 hr, and *Glomar Challenger* strung profiling gear and departed for Site 345 at 0438 hr, 30 August.

LITHOLOGY

The hole penetrated 378 meters of terrigenous sediments: muds, sandy muds and diamictons, and their lithified equivalents. This sediment column can be divided into three units (Table 2, Figure 3).

Unit Descriptions

Unit 1

The unit is divided into two subunits. Subunit A consists of mainly olive-gray and dark gray muds and sandy muds with some volcanic components in Core 5,

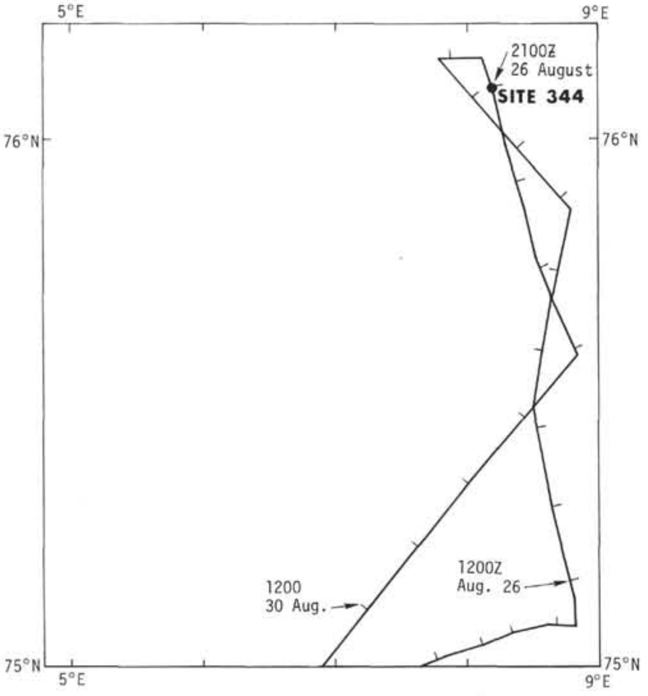

Figure 2. *Track chart, Site 344.*

Section 5. The sediments are interpreted as terrigenous: glacial marine, as well as sediments deposited from suspensoids and other mass-transport mechanisms.

Subunit B consists of generally gray muds and sandy muds, diamictons, and clays. Stringers of sands and volcanic ash are present at various levels (Table 2). Pebbles are unevenly distributed in the cores, although this may reflect their proximity to the cut surface only. Turbidites are reported from the center of the subunit, glauconite(?) is present in minor amounts. This subunit also contains burrows, which were not identified further. Nannofossil ooze is present in Samples 14, CC, 15-4, 15, CC, and 19, CC. The sediments are terrigenous, largely glacial marine.

Unit 2

The dominant lithologies are dark gray, olive-black, and olive-gray sandy muds and diamictons. Pebbles are prominent in Core 27, consisting of basaltic rock types. Foraminifera in the unit show some discoloration, beginning in Core 24, and increasing in intensity downward. In Core 27, discoloration is pronounced, as is a slight recrystallization of the tests. The discoloration of the foraminiferal tests is attributed to baking from an underlying sill. The sediments are largely glacial marine.

Unit 3

The unit is subdivided into two subunits. Subunit A is dominantly mud and sandy mud (sandy mudstone in Cores 31 and 32). Minor lithologies include: muddy sandstone and a series of sandstones (Table 2). Cross-bedding, bioturbation, and the presence of pyrite are characteristic for this subunit. The sediments are interpreted as terrigenous, deposited by turbidity currents and similar transport mechanisms, and by ice rafting.

Subunit B is similar to Subunit A, but does not contain clearly identifiable ice-rafted material (i.e., pebbles). The cores display a series of upward fining sedimentary sequences, beginning with massive coarse beds at Core 33-3, 150 cm, 32-2, 100 cm, and 33-1, 125 cm. These basal sediments grade upward into finer materials. Bioturbation seems to be particularly extensive in the center of Core 33-1. This entire subunit may represent turbidites or a similar type of deposit, produced by the episodic introduction of sediments into the marine environment.

Interpretation

The sequence of depositional processes leading to the accumulation of the above-described sediments can be very approximately deduced from study of a number of smear slides. For this, the largest diameter of the largest grain on each core catcher slide was recorded, and the textural type of the sediment was established, using the classification scheme of Gorsline (1960). This leads to the division of the sediment column as shown in Table 3.

The following history of sediment accumulation is suggested: deposition commenced with the turbidites(?) of Subunit 3B, above the basalt. The original contact is not observed, or may not be observable because of the possible intrusive character of the basalt or diabase. This basalt may represent a sill, which is indicated by the baked nature of the foraminifera in Units 2 and 3, as well as by the relatively coarse grained texture of the igneous rock.

In any event, these "distal" turbidites(?) or similar types of deposits may have been initiated under periglacial conditions, because the immediately overlying Subunit 3A contains pebbles which may have been ice rafted. Slumping or similar depositional processes cannot be excluded, but the graded nature of the sediments in Unit 3 makes this type of depositional process less attractive. It is suggested that the sediments of Unit 3 were deposited mainly by "distal" turbidity currents(?) or related processes, that the nature of these processes was variable as indicated by the various types of texture, and that ice rafting commenced in the time represented by Subunit 3A.

The nature of the finer (than granule size) sediments in Unit 3, and in the entire sediment column, does not furnish positive proof for the above assumption. However, the evident poor sorting and polymodality are, at least, indicative of such processes (Kagami, 1964). Neither the sediments described here nor most other glacial-marine sediments are identical to sediments carried in floating icebergs (for a description, see Warnke and Richter, 1970). Still, the sediments under discussion fall well within the range of glacial-marine sediments described from the near-shore area off the coast of the Antarctic Peninsula (Warnke et al., 1973), keeping in mind that this similarity is established on the basis of smear-slide studies. Sediments with the characteristics of those in Site 344 have been described as modified by "pelagic sedimentation" (Angino and Andrews, 1968), and indeed much of the material at this site may have been deposited by processes other than direct ice rafting.

TABLE 1
Coring Summary, Site 344

Core	Date (August 1974)	Time	Depth From Drill Floor (m)	Depth Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovery (%)
1	27	1655	2201.0-2202.5	0-1.5	1.5	0.1	6.7
2	27	1740	2202.5-2212.0	1.5-11.0	9.5	1.9	14.7
3	27	1835	2212.0-2221.5	11.0-20.5	9.5	7.2	75.8
4	27	1920	2221.5-2231.0	20.5-30.0	9.5	0.1	1.0
5	27	2012	2231.0-2240.5	30.0-39.5	9.5	9.5	100
6	27	2100	2240.5-2250.0	39.5-49.0	9.5	9.2	96.8
7	27	2153	2250.0-2259.5	49.0-58.5	9.5	8.4	88.4
8	27	2252	2259.5-2269.0	58.5-68.0	9.5	7.7	81.0
9	27	2350	2269.0-2278.5	68.0-77.5	9.5	9.7	100
10	28	0052	2278.5-2288.0	77.5-87.0	9.5	7.3	76.8
11	28	0145	2288.0-2297.5	87.0-96.5	9.5	3.7	38.9
12	28	0245	2297.5-2307.0	96.5-106.0	9.5	6.3	66.3
13	28	0345	2307.0-2316.5	106.0-115.5	9.5	1.3	13.7
14	28	0500	2316.5-2326.0	115.5-125.0	9.5	1.7	14.7
15	28	0610	2326.0-2335.5	125.0-134.5	9.5	8.2	86.3
16	28	0750	2335.5-2345.0	134.5-144.0	9.5	2.5	26.3
17	28	0835	2345.0-2354.0	144.0-153.5	9.5	1.4	14.7
18	28	0940	2354.5-2364.0	153.5-163.0	9.5	1.3	13.7
19	28	1040	2364.0-2373.5	163.0-172.5	9.5	0.3	3.1
20	28	1200	2373.5-2383.0	172.5-182.0	9.5	0.7	7.3
21	28	1350	2383.0-2392.5	182.0-191.5	9.5	2.5	26.3
22	28	1420	2392.5-2402.0	191.5-201.0	9.5	1.0	10.5
23	28	1550	2402.0-2411.5	201.0-210.5	9.5	2.4	25.3
24	28	1655	2411.5-2421.0	210.5-220.0	9.5	1.5	15.8
25	28	1814	2421.0-2430.5	220.0-229.5	9.5	1.3	13.7
26	28	1910	2430.5-2440.5	229.5-239.0	9.5	1.2	12.6
27	28	2100	2440.5-2449.5	239.0-248.5	9.5	5.6	58.9
Washed			2449.5-2459.0	248.5-258.0			
28	28	2255	2459.0-2468.5	258.0-267.5	9.5	1.8	18.9
Washed			2468.5-2478.0	267.5-277.0			
29	29	0010	2478.0-2487.5	277.0-286.5	9.5	0.4	0
30	29	0156	2487.5-2497.0	286.5-296.0	9.5	1.0	10.5
Washed			2497.0-2516.0	296.0-315.0			
31	29	0345	2516.0-2525.5	315.0-324.5	9.5	4.5	47.3
Washed			2525.5-2544.5	324.5-343.5			
32	29	0640	2544.5-2554.0	343.5-353.0	9.5	4.5	47.3
Washed			2554.0-2573.0	353.0-372.0			
33	29	1135	2573.0-2578.5	372.0-377.5	5.5	4.3	78.0
34	29	1435	2578.5-2588.0	377.5-387.0	9.5	4.9	51.6
35	29	1610	2588.0-2596.0	387.0-395.0	8.0	5.3	66.2
36	29	1910	2596.0-2605.5	395.0-404.5	9.5	6.3	66.3
37	29	2210	2605.5-2615.0	404.5-414.0	9.5	3.7	38.9
Total			2615.0	414.0	338.0	140.7	41.0

This holds particularly true for the sediments of Unit 2, for which only a few pebbles have been described. The bulk of this sediment may have been settled out from suspensoids, which were introduced into the marine environment if not under glacial, at least under periglacial(?) conditions, because a complete deglaciation of all land at these latitudes seems unlikely.

The variable sediments of Unit 1 are interpreted as being deposited during a changing glacial regime. There is a noticeable coarsening of the material from Core 15 towards the top of this unit, particularly in Subunit 1A. Therefore, the sediments in Subunit A may perhaps reflect the existence of waxing and waning major continental ice sheets.

The deposition of these sediments can only be very grossly placed in a historical framework. If it is assumed, that the nannoflora recorded from Core 14, CC represents the vicinity of the Plio-Pleistocene boundary, this time line can be placed below Core 14. Equating it with the base of the Gilsa (Olduvai) event, an average rate of sedimentation for the sediments above this core, is 6.94 cm/1000 yr. The nannoflora below this level (only recorded in Core 19) are of Pliocene age (although with Miocene affinities). It is, therefore, not unreasonable to equate the postulated possible beginning of ice rafting (base of Subunit 3A) with the beginning of general ice rafting in the North Atlantic, which has been established by Berggren (1972) as being about 3 m.y. (see below).

Using this postulated time line, an average rate of sedimentation for the sediments between the bases of Cores 32 and 14 is 20.5 cm/1000 yr. This more rapid (than Pleistocene) rate of sedimentation for the "glacial" Pliocene corresponds to the situation at Site 113, DSDP Leg 12 (Laughton, Berggren, et al., 1972), and was explained as a result of increased turbidity cur-

TABLE 2
Lithologic Summary, Site 344

Unit	Depth (m) and Core Numbers[a]	Age	Characteristics
1	0-182 (1-1 to 20-1)	Pleistocene and Pliocene	Terrigenous sediments: muds and sandy muds, diamictons: glacial-marine sediments and materials settled from suspensoids; drilling deformation slight to intense
Subunit A	0-40 (1-1 to 5-6)	Plio-Pleist. and Pleistocene	Muds and sandy muds; some volcanic material (in 5-5)
Subunit B	40-182 (6-1 to 20-1)	Pleistocene-Pliocene-Pliocene(?)	Muds and sandy muds, diamictons, clays; minor lithologies: stringers of sand (e.g., 6-1, 7-2, 7-4, 9-1); volcanic ash (?) (7-4, 7-6, 8-1, 8-4, 9-0, 9-1, 9-4, 9-5, 10-1); scattered worm burrows; nannofossil ooze in 15-4; pebbles particularly in 6-2, 7-5, 11-6, 12-3, 15-6, 27-4; turbidites (11-1); some glauconite (?)
2	182-258 (21-1 to 28-1)	Pliocene	Sandy muds and diamictons; little or no drilling deformation; concretion in 27-4, 102 cm; pebbles prominent in 27-4, 123-148 cm
3	258-378 (28-1 to 33-3)	Pliocene -Miocene or early Pliocene	Muds, sandy muds, clays and their lithified equivalents; diamictites; cross-bedding and bioturbation characteristic; foraminifera in all cores are discolored and recrystallized; foraminifera in Core 33 are very dark and recrystallized
Subunit A	258-372 (28-1 to 32-3)	Pliocene-Miocene or early Pliocene	Dominant lithology; mud in 28-1, sandy mud to 30-1; sandy mudstone to base of subunit; minor lithologies: muddy sandstone and sandstone at bottom of 31-1 (approx. 317 m) and a series of sandstones in 31-3 (approx. 318.5-320 m); pyrite, cross-bedding, and bioturbation characteristic for this subunit; pebbles in 31-1, 32-2, 32-3
Subunit B	372-378 (33-1 to 33-3)		Similar to Subunit A, but without pebbles. All the core sections described in this subunit may represent turbidites or another type of fining-upward series of cycles. These cycles begin with massive coarse beds (mudstones or sandy mudstones) at 33-3, 150 cm; 33-2, 100 cm; 33-1, 125 cm. They grade upward into finer grained mudstones and claystones. Chondrites and Helminthoida present. Bioturbation particularly extensive in center of 33-1

[a] Core numbers in parentheses.

rent activity at the beginning of the northern glaciation. Alternatively, or in addition, the model of changing glacier efficiency may be invoked, as discussed in some detail by Warnke (1970). Should further paleontologic investigations confirm a Miocene age of the cores of Unit 3, rates of sedimentation would have to be accordingly adjusted.

IGNEOUS PETROLOGY—PETROGRAPHY—GEOCHEMISTRY

General Description

Rocks of acoustic basement in Hole 344 were penetrated at 378.5 meters. Four cores (34, 35, 36, 37), contained 20.1 meters of igneous rocks, represented by diabase, gabbro-diabase, and gabbro.

In the upper portion of Core 34, Section 1 and Core 34, Section 2, there is a holocrystalline, fine to medium-grained, medium gray (N5) to dark medium gray (N4) diabase. Abundant pyrite and white calcite veins (1-15 mm) were observed. Rare slickensides with calcite, chlorite, and pyrite are also present.

Lower in the section (Sections 34-2, 34-3, 34-4, 35-1, 35-2, 35-3), the texture of the diabase gradually changes from medium to coarse grained. The color is spotty, with dark green and light green spots (size 3-10 mm). There are veins (2-4 cm) and short fissures filled with coarse (10 mm) white to almost colorless calcite crystals. Similar to the upper diabase, small pyrite crystals and aggregates are present.

The rocks of lowermost portion of the hole (Cores 35, Section 4, 36, and 37 have mainly coarse and coarse to medium-grained textures, and a green, light green (spotty) coloration. Angular, black chloritized and light green inclusions are present.

Petrography

There are not any significant mineralogic distinctions between the diabase, gabbro-diabase, and gabbro. They are distinguished mainly by their textures, which

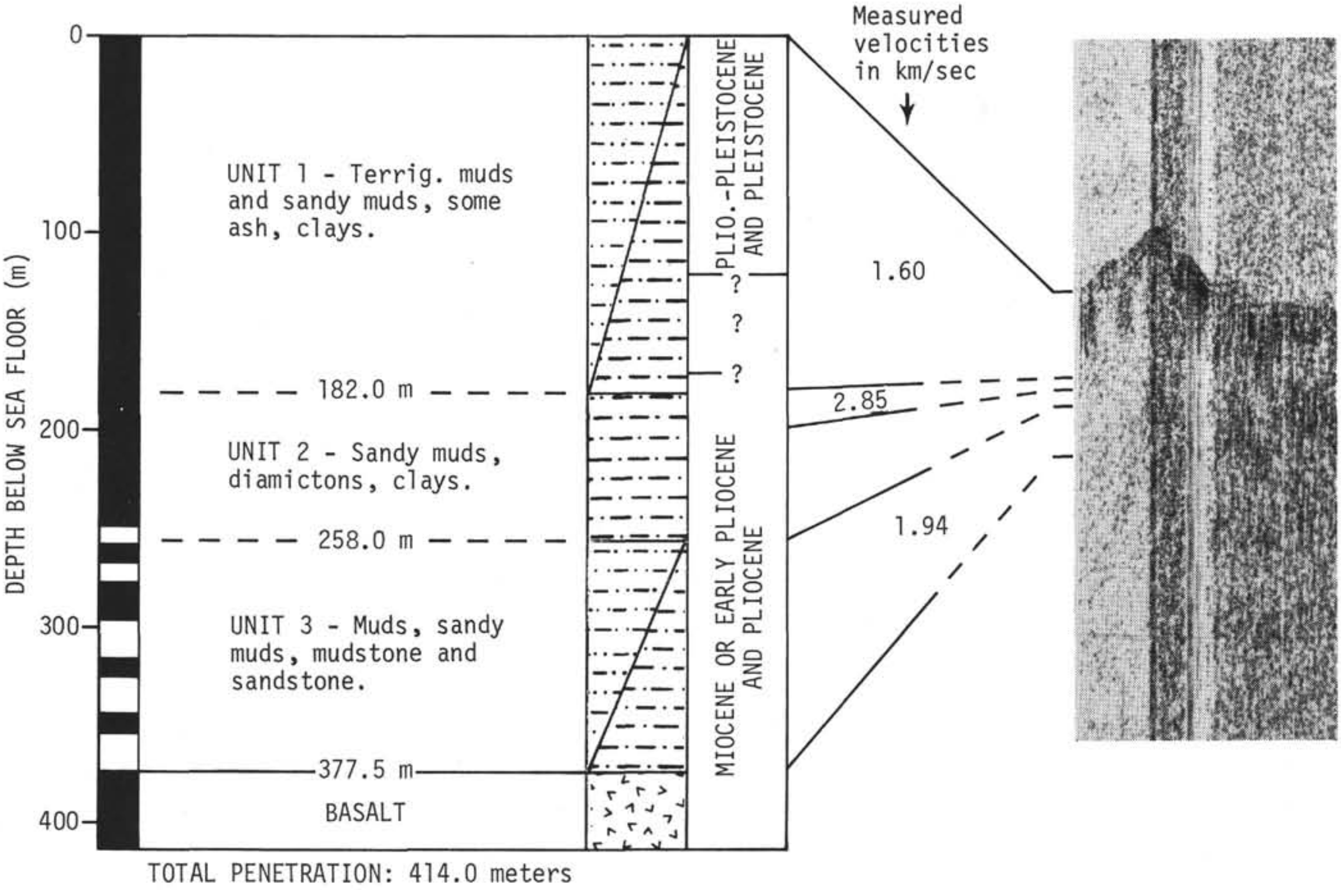

Figure 3. *Lithologic summary and seismic profile, Site 344.*

change gradually, although the diabasic and subophitic textures prevail. Poikilophitic, poikilitic, and hypidiomorphic-granular textures are rare. Slight taxitic heterogeneity is marked.

The diabase has a diabasic, ophitic, subophitic, and poikilophitic texture, is holocrystalline, and fine and medium grained. Idiomorphic plagioclase laths, and table-like grains (0.5-3 mm long), form the basis of the framework. Interstitial pyroxene, small plagioclase crystals, and amphibole-talc(?)-calcite-chlorite aggregates are found between the plagioclase laths. There are large (3-5 mm) euhedral and subhedral clinopyroxene prisms, with poikilitic plagioclase laths.

The clinopyroxene often is a pale green augite (extinction angle C : Ng(γ) from 41° to 45°, Ng(γ) = 1.728 Np(α) = 1.689-1.695). Rare clinopyroxene has a slight violet color typical for titanaugite. The plagioclase very often shows polysynthetic twinning and zonation. Plagioclase laths have maximum extinction angles of 35°-37° $\perp$ 010 corresponding to labradorite (An 60-65). The index of refraction, measured in immersion, shows plagioclase variations from andesine (An 48-50 (Ng(γ) = 1.561 Np(α) = 1.553 Sample 34-1, 114-117 cm) to labradorite (An 60 (Ng(γ) = 1.567 Np = 1.557, Sample 37-3, 135-137 cm). Zonal plagioclase (Sample 35-4, 36-39 cm) has a central core of labradorite (An 56 (Ng(γ) = 1.565), and on the peripheries, oligoclase (An 15 (Np(α) = 1.535).

High content (up to 1%) of accessory minerals represented by needle cyrstals of apatite is present (Sample 35-4, 36-39 cm). Opaque minerals are magnetite (0.5%-1%), and pyrite (up to 4%). Blue-green chlorite and pale green amphibole (uralite-actinolite) replace pyroxene. There is a talc(?)-chlorite matrix and calcite aggregates. Rare small brownish biotite sheets are present. Albite may be present. There are veins enriched by quartz and calcite.

The gabbro-diabase is very similar to the diabase, but the texture is medium to coarse grained (diabasic, ophitic, and poikilitic). The mineral composition is nearly similar to the diabase.

TABLE 3
Range of Maximum Diameters

Unit	Texture	Range of Maximum Diameters
Subunit 1A	Silty clayey sand clayey silts	0.09-0.36
Subunit 1B	Silty clayey sands to clays	0.09-0.4
Unit 2	Silty clay sands	0.19-0.36
Subunit 3A	Silty clayey sands to clays	0.06-0.28
Subunit 3B	Sand	0.22

The gabbro has hypidiomorphic granular, ophitic, and poikilitic textures. It is coarse to medium grained. The mineral composition is similar to the diabase and gabbro-diabase.

Summary

Igneous rocks of acoustic basement at Site 344 are diabase, gabbro-diabase, and gabbro. Most likely, they represent hypabyssal intrusions, or a thick sill.

The absence of hyalotextures and glassy textures at the contact with the overlying sedimentary rock support the argument for a hypabyssal intrusion. However, it may be possible that the overlying sedimentary rock was deposited on an eroded surface of the diabase.

Extensive alteration (amphibolization, chloritization, calcitization) make it very difficult to recognize the primary mineral composition. The presence of biotite and titanaugite may be the best evidence to indicate that this rock originated from a subalkalic basaltic magma.

Geochemistry (H.R. and F.-J.E.)

The intrusive basalt (dike or sill) of Site 344 near the Knipovich Ridge is inhomogeneous compared to the basalts from other sites of Leg 38. They show a lower degree of alteration: total H_2O: 2.17%-3.34%; 100 $FeO/FeO + Fe_2O_3$ = 62.8%-74.9%.

In the OL-DI-Hy-Q-diagram the norms plot within the field of olivine-tholeiite. On the AFM diagram, these basalts lie in the field of calkalkaline basalt characterized by an alkali enrichment in comparison to normal tholeiitic rocks. (See also Tables 4 and 5).

Sample 36-2, 135-137 cm is an extremely differentiated rock (Table 4), a character which is still indicated in the neighboring samples of Core 36. In all samples, there is a rather low normative An-content of plagioclase and a high differentiation index.

PHYSICAL PROPERTIES

Bulk Density, Porosity, and Water Content

A general pattern based on bulk density reveals two massive sedimentary units: the upper is characterized by lower densities, ranging between 1.70 and 2.00 g/cc, with considerable scatter between these values; the lower shows densities ranging between 2.00 and 2.20 g/cc; with relatively low variability. Greatest variability in the lower unit occurs within Cores 30-32, above the basalt. The upper unit comprises Cores 1-16, the lower Cores 17-32. Within the upper unit the density of the "glacial" sediments (Cores 1-5) averages 1.911 g/cc (±0.049).

Porosities are generally quite low through the entire section. Maximum values seldom exceed 55% and average 47.28% (±5.96). Water content shows a gradual but steady decrease, through a range of 10%, from the top to the base of the section. Table 6 shows representative water contents, porosities, and bulk densities, as measured by the rock chip method.

Sonic velocity gradually increased from 1.575 in Core 2, Section 1 to 1.685 km/sec in Core 17, Section 1. No values were recorded between Cores 18-20 due to poor core recovery. Extreme values, 3.15 and 3.38 km/sec, were obtained from Core 21, a more lithified muddy sandstone (densities greater than 2.00 g/cc). Below Core 22, Section 1, velocity values drop to about 2.00 km/sec and continue high until the diabase is reached (Table 7).

Shear Strength

Shear strength values taken in Cores 2-5 showed considerable scatter and low predictability. Values ranged between 0.098 TSF (97.23 g/cm^2) to 0.160 TSF (158.75 g/cm^2). Penetrometer values provided a profile of increasing unconfined compressive strength gain from Cores 6-33. Values slowly increased from 0.55 TSF (5.45 $kilo/cm^2$) to 4.5 TSF (44.64 $kilo/cm^2$), the maximum the apparatus could measure. The data indicated no discontinuities in unconfined compressive strength through the interval. This can be interpreted as a unit of continuous sedimentation throughout the late Tertiary. Figure 4 shows the penetrometer profile.

GEOCHEMISTRY

Inorganic Geochemistry

The results of interstitial water analyses on selected samples from Site 344 are found in Table 8.

Organic Geochemistry

Shipboard Analysis of Dissolved Gas in Tertiary Cores

During the course of coring at Site 344, a single 37-cc gas sample was recovered from the core liner at a depth of 234.5 meters below the mud line. This dissolved gas contained methane and a trace of carbon dioxide (Table 9). A fluoroscopic examination did not indicate any fluorescence. The data suggest that organic diagenesis is not far advanced at this site.

BIOSTRATIGRAPHY

Biostratigraphic Summary

Sediments recovered in this hole are extremely poor in microfossils except for pollen and dinoflagellates, however, these are mainly reworked species. Plant debris are prominant and are of differing compositions. Siliceous microfossils are missing. Nannofossils are present only in some restricted horizons. The low diversified assemblages consist of long-ranging species. Planktonic foraminifers were found also in various intervals, consisting of small compact globigerinoid forms. Arenaceous species are dominant below Core 27. The assemblages of both fossil groups indicate a Miocene to early Pliocene age for the oldest sediments.

Foraminifera

Although more than 190 samples were examined from this hole, a reliable subdivision has to await detailed quantitative analysis of both the planktonic and benthonic fauna. In general, the fauna is very rare, about 80 samples are barren and many others yielded a few foraminiferal specimens only. The presence of *Islandiella teretis*, the absence of right-coiling

TABLE 4
Analyses of Site 344 Basalts

	34-2, 27-30 cm	34-3, 90-93 cm	34-4, 70-73 cm	35-2, 142-145 cm	35-4, 87-90 cm	36-1, 80-82 cm	36-2, 75-77 cm	36-3, 135-137 cm	36-5, 142-144 cm	37-1, 85-87 cm	37-2, 135-137 cm	37-3, 73-75 cm
	RF 9821	RF 9822	RF 9823	RF 9825	RF 9827	RF 9828	RF 9829	RF 9830	RF 9831	RF 9832	RF 9833	RF 9834
SiO_2	48.19	47.41	46.92	48.70	48.94	49.05	50.57	55.15	50.08	49.65	49.23	49.28
TiO_2	1.12	1.13	1.09	1.03	1.21	1.26	1.22	2.18	1.25	1.22	1.17	1.16
Al_2O_3	16.43	16.85	16.40	16.32	16.43	15.83	15.93	14.95	16.07	16.45	16.81	16.78
Fe_2O_3	2.35	2.32	2.46	2.70	2.40	2.07	2.62	3.21	2.64	2.71	2.19	2.50
FeO	5.14	5.27	4.92	4.55	5.41	6.19	5.15	6.13	5.10	4.84	4.99	4.83
MnO	0.13	0.13	0.14	0.13	0.14	0.15	0.14	0.14	0.14	0.13	0.12	0.13
MgO	8.27	7.10	7.62	7.83	7.70	7.37	6.85	3.31	6.99	7.00	7.21	7.23
CaO	9.35	10.52	11.00	9.97	10.58	9.88	10.43	4.90	10.99	11.01	10.89	10.99
Na_2O	2.79	3.06	2.82	2.97	2.93	3.03	3.10	4.59	3.10	3.01	2.99	3.01
K_2O	0.64	0.55	0.54	0.75	0.32	0.68	0.59	1.21	0.57	0.43	0.38	0.46
H_2O_{tot}	3.34	2.71	2.46	3.33	3.22	3.08	2.74	2.37	2.37	2.17	3.14	2.82
SO_3	0.30	0.31	0.48	0.23	0.09	0.00	0.16	0.23	0.10	0.11	0.19	0.11
P_2O_5	0.14	0.15	0.15	0.16	0.17	0.15	0.15	0.42	0.13	0.16	0.15	0.15
Total	98.19	97.51	97.00	98.67	99.63	98.74	99.65	98.79	99.53	98.89	99.46	99.45
C.I.P.W. Norms[a]												
Qz	0.00	0.00	0.00	0.00	0.00	0.00	0.87	9.33	0.00	0.00	0.00	0.00
Or	3.99	3.43	3.38	4.65	1.96	4.20	3.60	7.41	3.47	2.63	2.33	2.81
Ab	24.88	27.31	25.24	26.37	25.71	26.79	27.07	40.27	27.00	26.34	26.26	26.36
An	32.06	32.39	32.25	30.41	31.87	28.82	28.69	17.23	29.08	31.14	32.51	31.99
Di	12.61	17.32	19.41	16.22	17.08	17.12	18.92	4.14	20.89	19.35	17.92	18.65
Hy	15.78	4.61	4.33	10.49	15.34	16.64	13.69	10.30	11.28	13.23	12.78	10.59
Ol	3.42	7.71	7.79	5.07	2.79	3.38	0.00	0.00	1.22	0.21	1.11	2.73
Mt	4.00	4.02	3.97	3.85	4.07	4.18	4.07	5.53	4.10	4.08	4.02	3.99
Il	2.24	2.63	2.19	2.05	2.38	2.50	2.39	4.92	2.44	2.40	2.31	2.28
Ap	0.35	0.38	0.38	0.40	0.42	0.37	0.37	1.03	0.32	0.39	0.37	0.37
Pr	0.59	0.61	0.94	0.45	0.18	0.00	0.31	0.45	0.19	0.21	0.37	0.21
Norm.Plag.An.	56.30	54.18	56.10	53.56	55.35	51.83	51.45	29.97	51.85	54.18	55.32	54.82
Diff.Ind.	28.87	30.73	28.21	31.01	27.67	30.99	31.53	57.00	30.46	28.97	28.59	29.17
Norm.I.C.	39.00	36.91	39.02	38.53	40.45	40.20	39.75	25.74	40.44	39.87	38.87	38.82

[a] Norms are based on analyses recalculated to 100% H_2O free and with %Fe_2O_3 standardized at %TiO_2 + 1.6 (Irvine and Baragar, 1971).

TABLE 5
Trace Elements of Site 344 Basalts (ppm)

	RF 9829	RF 9830	RF 9831	RF 9832	RF 9833	RF 9834		RF 9821	RF 9822	RF 9823	RF 9825	RF 9827	RF 9828
Sr	167	154	174	181	182	177	Sr	185	185	177	179	182	173
Nb	18	47	15	13	10	13	Nb	17	19	14	22	16	18
Zr	102	252	87	86	76	79	Zr	78	92	82	92	76	84
Y	27	61	26	25	22	23	Y	15	23	25	21	19	24
Ni	69	11	76	80	88	91	Ni	116	90	109	67	109	88
Co	34	21	32	31	34	34	Co	36	35	34	31	33	37
V	223	229	240	224	226	218	V	210	216	210	197	217	243
Zn	66	102	62	60	69	62	Zn	54	51	48	69	77	69
Cu	391	62	80	89	90	76	Cu	39	33	65	76	68	67
Cr	182	<3	199	322	330	342	Cr	378	343	312	227	354	236
Ce	35	58	26	27	19	26	Ce	13	26	34	33	41	12
Sc	40	19	42	44	38	35	Sc	38	38	34	41	38	43

TABLE 6
Water Content, Porosity, and Density of Selected Rock Chip Samples

Sample (Interval in cm)	W(%)	η(%)	ρ (g/cc)
13-1, 100-101	28.32	51.79	1.83
14-1, 131-132	26.88	50.64	1.88
16-2, 83-84	26.63	49.49	1.86
17-1, 102-103	21.94	42.94	1.96
20-1, 130-131	32.41	56.63	1.75
21-2, 74-75	29.92	54.88	1.83
23-2, 18-19	21.56	42.58	1.97
24-1, 80-81	21.71	43.93	2.02
25-1, 72-73	21.53	43.82	2.03
26-1, 57-58	24.75	–	–
27-1, 84-85	24.66	48.42	1.96
27-3, 66-67	19.67	41.86	2.13
28-1, 108-109	20.31	–	–
30-1, 98-100	21.59	43.32	2.01
31-1, 101-102	20.75	42.72	2.06
31-2, 120-122	17.20	36.52	2.12
31-3, 122-123	19.06	39.79	2.02
32-1, 72-73	17.61	37.58	2.13
32-2, 70-72	36.97	80.36	2.17
32-3, 50-51	16.22	34.88	2.15
33-2, 118-119	19.07	39.66	2.08
33-3, 140-141	17.49	36.71	2.10

TABLE 7
Average Velocities of Sediment Units (km/sec)

	x (km/sec)	s	η
Cores 1-20	1.597	0.038	33
Core 21-22, Section 1	2.848	0.793	4
Core 22, Section 2 to 33	1.939	0.134	26

Neogloboquadrina, and the size and morphology of *Globigerina quinqueloba* suggest that the base of the section (Core 33) is of Pliocene age.

"Glacial," Pleistocene, Cores 1 through 14, Section 1

The planktonic fauna consists of left-coiling *Neogloboquadrina pachyderma* with rare dextral specimens and rare *Globigerina quinqueloba*. The washed residues have quartz, fragments of metamorphic and sedimentary rock, lignite, Cretaceous *Inoceramus* prisms, and some pelecypod fragments. None of the samples resembles an ooze.

Subzone A, Cores 1 through 5

Sinistral *N. pachyderma* is common in all core-catcher samples (0.8%, 3%, 4%, 5%, and 2% dextral, respectively, in Samples 1, CC to 5, CC). Benthos is rare (less than 6%) and is dominated by *Cibicides wuellerstorfi*; others present are *Islandiella teretis*, *Cassidulina subglobosa*, *Eponides umbonatus*. Very rare and probably redeposited are *Cibicides lobatulus*, *Islandiella norcrossi*, and *Elphidium incertum*.

Core 5 is included in this subzone because its core-catcher sample yielded fauna. However, all other 13 samples of the core are practically barren and it is suspected that the 112 specimens found in 5, CC could be contaminated.

Subzone B, Cores 6 through 14, Section 1

Except for one peak in Core 7, this interval is practically barren. The small washed residues have the same components as above, but are finer and at some levels with abundant pyrite (including some pyritized seed and wood fragments) or common small dolomite or siderite concretions. Radiolarians and diatoms are present. The very rare plankton is small. Benthos generally consists of a few small arenaceous specimens.

Samples of Core 7, Sections 3-5 yielded a calcareous fauna: *I. teretis* and *Islandiella islandica*, *Cassidulina subglobosa*, *C. wuellerstorfi*, and *E. umbonatus*. Sample 7-3, 142-144 cm has abundant plankton and is the richest level of the entire hole. It must represent a period that was as warm as or warmer than today.

"Glacial" Plio-Pleistocene, Cores 14, CC through 32 (33?)

This interval is characterized by the presence of sinistral *Neogloboquadrina atlantica* and a calcareous benthonic fauna with *I. teretis* as the dominant species and *Melonis zaandamae* as second. The following subzones can be distinguished: Subzone C, *N. pachyderma* and rare *N. atlantica* (S); Subzone D, *N. pachyderma* and relatively common *N. atlantica* (S); Subzone E, "baked" subzone D fauna; Subzone F, common arenaceous benthos, plankton common *Globigerina*. Washed residues are generally small and contain un-

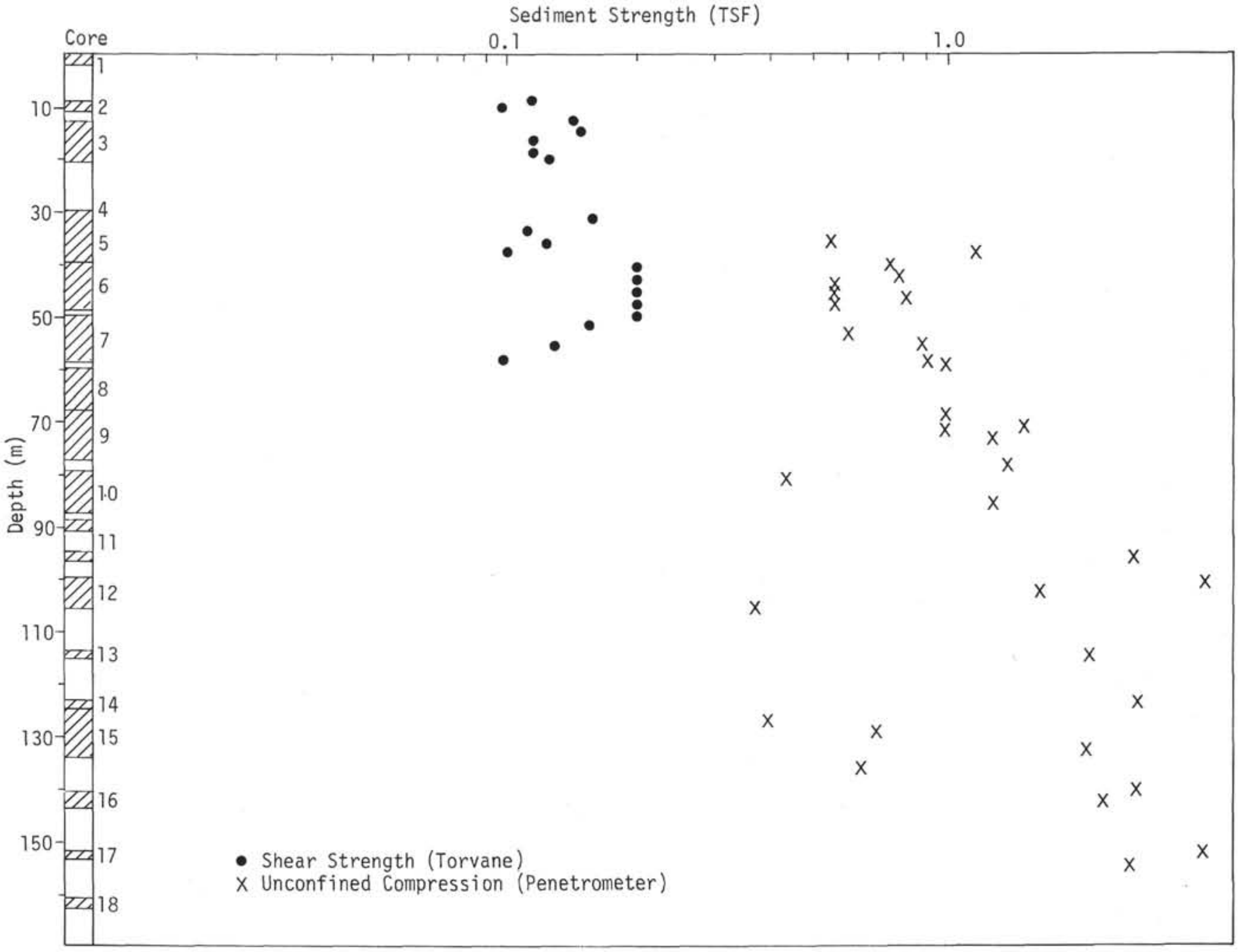

Figure 4. *Shear strength profile.*

TABLE 8
Summary of Shipboard Geochemical Data, Site 344

Sample (Interval in cm)	Subdepth (m)	*p*H	Alkalinity (meq/kg)	Salinity (°/₀₀)	Ca^{++} (mmoles/1)	Mg^{++} (mmoles/1)
Surface Seawater		8.15	2.36	35.2	10.37	52.73
2-1, 144-150	3.0	7.29	4.19	33.8	10.88	42.44
6-4, 143-150	45.5	7.79	6.09	32.4	12.42	31.42
11-1, 144-150	88.5	7.67	4.68	32.4	20.63	23.64
15-5, 140-150	132.5	7.32	4.15	33.0	24.81	22.84
21-1, 140-150	183.5	–	2.88	31.9	27.92	14.77
27-2, 144-150	242.0	–	2.22	32.4	30.42	12.99
31-1, 140-150	316.5	7.55	1.38	32.4	35.00	7.70
33-1, 140-150	373.5	7.38	0.99	33.3	39.38	7.84

sorted rounded and angular quartz, common pyrite, and rare fragments of rocks. Lignite and Cretaceous *Inoceramus* prisms are present in Subzones C and D.

Subzone C, Cores 14, CC through 18

Most samples have some fauna (60%-100% benthonic). The plankton is dominanted by left-coiling *N. pachyderma*, but its morphology is often less compact than in higher cores. Larger specimens with a relatively wide umbilicus can be referred to *N. atlantica*, *Globigerinita* sp., and a *Globigerina bulloides* plexus including such varieties as *G. decoraperta* and *G. apertura* with some other small globigerinids. The few benthonics found in addition to *I. teretis* and *M. zaandamae* are *Pullenia quinqueloba*, *Cibicides* sp., *Oolina* sp., miliolids, lenticulinids, and small simple arenaceous forms.

Subzone D, Cores 19 through 22

Practically all samples from this interval are barren, or nearly barren with one or two small arenaceous forms, *I. teretis* and *N. pachyderma*. Exceptions are 19,

TABLE 9
Shipboard Analysis of Dissolved Gas in Tertiary Cores From DSDP Leg 38, Site 344

Depth (m) Below Mud Line		As Sampled in Liner[a]		
		Air	Carbon Dioxide	Methane
234.5	27-3, 0	98.12	<0.01	1.88

[a] In mol %.

CC and 22, CC from which 554 and 167 specimens could be collected (82% and 53% benthonic, respectively). The *Neogloboquadrina* plexus may have about as many large specimens that can be classified as *N. atlantica* (less than 3% dextral) as it has smaller, mostly not compact *N. pachyderma* (more than 95% sinistral). The *G. bulloides* plexus is well represented also. Two *Globigerina quinqueloba* specimens were found; they are hispid, have a maximum diameter of 187 and 204 μm and morphology type I (Asano et al., 1968). The benthonic fauna contains with *I. teretis* and *M. zaandamae*, *Pullenia quinqueloba*, *Lagena laevis*, *Oolina* sp., *Fissurina* sp., *Cibicides* sp., and miliolids.

Subzone E, Cores 23 through 25

Calcareous tests in this subzone and lower in the section have a yellowish-brown often recrystallized appearance ("baked"). Same fauna as above, but very rare. Some white specimens in core-catcher samples indicate downhole contamination. Pyritized diatoms were found in several samples. Core 26 is practically barren and can be included in this subzone as well as in the one below. The samples of Core 23, Sections 1 and 2 also are barren and the top of the subzone could be drawn between 23-2 and 23, CC. It signifies the top of influence of the emplacement of the basaltic sill in which Hole 344 bottomed. The boundary may either mark the time of emplacement (the material above it being unaltered because it had not been deposited yet) or of the thickness of section affected by the heat. In other words, the top of the subzone is of the same age as the sill or older, it cannot be younger.

Subzone F, Cores 26 through 33

In most of the fossiliferous samples from the top of Core 27 down arenaceous benthos dominates: *Bathysiphon*, "*Haplophragmoides*" (including *Alveophragmium crassimargo*), *Reophax*, *Hormosina*, and *Saccamina*. At some levels these are the only fossils found, but elsewhere (including 33, CC) the calcareous *I. teretis-M. zaandamae* assemblage outnumbers the arenaceous fauna.

Plankton is rare and because the specimens are small only a few specimens of the sinistral *Neogloboquadrina* plexus can be assigned to *N. atlantica*; a few are compact *N. pachyderma* and the rest could be either one of the two species. Small *Globigerina* spp. is always present if plankton is found and can outnumber *Neogloboquadrina*. A total of eight specimens of *G. quinqueloba* was recovered from 30, CC, 32, CC, and 33, CC, their average diameter is 195 μm, all are hispid, four have morphotype I, and four have morphotype II (Asano et al., 1968) indicating a Pliocene age. Further, and equally weak, indications for a Pliocene age are the presence of one dextral *Neogloboquadrina acostaensis* in 31, CC and one small *Globorotalia* sp. cf. *G. puncticulata* in 32, CC. More significant may be the sinistral rather than dextral coiling direction of *N. atlantica* (Poore and Berggren, 1975).

The washed residues of samples of Cores 27, 28-1, 28-2, 31-1, 31-3, 31, CC and all samples of Core 32 have some pyrite and the usual "ice-rafted material"; i.e., unsorted rounded and angular quartz grains and some rock fragments. However, various amounts of fine or very fine sorted sand, silt, and mica seem to be added to most of the samples and the residues of Cores 29, 30, 31-2, and 33 have nothing but this fine terrigenous material. Apparently deposits from turbidity currents alternate with and are mixed with ice-rafted material. The lowest presence of ice-rafted material in Core 32, therefore, does not necessarily mark the beginning of ice rafting. Sections 1, 2, and the upper part of Section 3 of Core 33 have arenaceous forams only, whereas Samples 33-3, 81-83 cm and 33, CC, in addition, have a calcareous fauna that is more diverse than higher in this hole and includes *Globobulimina arctica*, polymorphinids, and *Valvulineria* sp.

It is noteworthy that the presence of sandy turbidites and the common occurrence of arenaceous foraminifera are coincident characteristics for this subzone.

Nannoplankton

Nannofossils are present in only some horizons. Samples 1, CC; 2-2, 37-38 cm; and 2-2, 57-58 cm are abundant in well-preserved nannoplankton (1.5-11 m). The assemblage consists of *Coccolithus pelagicus*, *Gephyrocapsa ericsonii*, *Helicosphaera carteri*, and *Cyclococcolithus leptoporus*. Only few reworked Cretaceous and Eocene species were found.

Cores 3 to 15 (11-134.5 m) are barren of nannofossils. Only in Core 7-4, are abundant *Coccolithus pelagicus* and *Gephyrocapsa caribbeanica* present. The same species were found in Sample 14, CC (125 m) and in some samples of Core 15 (125-134.5 m) in which they are slightly etched.

Cores 16 through 19 (134.5-172.5 m) are without nannoplankton. The assemblage of Sample 19, CC with *Reticulofenestra pseudoumbilica*, *Coccolithus pelagicus*, *Helicosphaera sellii*, *Braarudosphaera bigelowi*, and *Cyclococcolithus leptoporus* indicates an early Miocene to early Pliocene age.

Cores 20 to 29 (172.5-286.5 m) are barren of nannoplankton. In some samples of Cores 30 to 33 (286.5-377.5 m), few nannofossils were observed: *Coccolithus pelagicus*, *Helicosphaera carteri*, *Reticulofenestra pseudoumbilica*, and *Cyclococcolithus leptoporus* indicating that the sediments are at least not older than Miocene.

Diatoms—Radiolarians

All samples were barren of diatoms and radiolarians.

Palynology—(S.B.M.)

Dinocysts

All cysts observed appear reworked, and their abundance varies greatly throughout.

Debris, Reworked Material

Terrestrial plant debris is present throughout. Carbonized tracheidal matter is the dominant component, with varying amounts of cuticular matter. Debris composition changes are frequent and follow no apparent pattern, except possibly in Core 15 and higher, where cuticular matter is absent or rare.

Debris and palynomorphs in the lower part of the hole (up to Core 30) are darker than reworked material from any other hole, and judging from the palynomorphs there appear to be two grades of altered material: one, whose source appears to be lower Tertiary, and which is moderately altered and not severely compressed, and another, which is severely altered, corroded, and flattened with a few species suggestive of a Cretaceous age. In Core 28 and higher less altered material suggestive of a lower Tertiary age dominates, however, in some samples a distinct second source is also apparent, in the main probably Cretaceous (as evidenced by *Odontochitina* sp. and *Gonyaulacysta orthoceras*).

Sections 5-1 and 3-2 have some unaltered Pinus-pollen.

Sedimentation Rates

Estimates of sedimentation rates are speculative since firm age dates are not available. Assuming a 5 m.y. age for the Miocene/Pliocene boundary at the base of the section, the average rate of sediment accumulation for the whole section is 7.6 cm/1000 yr.

SUMMARY AND CONCLUSIONS

Summary

At this site on the Knipovich Ridge at a depth of 2201 meters, a subbottom depth of 414 meters was penetrated, of which 378 meters were in sediments, and the remainder in basalt.

The long bubble pulse sequence in the *Glomar Challenger* airgun used for profiling made it difficult to determine from the seismic records whether any layered reflectors were present. The sediment cores argue against any pronounced change in sedimentation near the top of the section. Rather, they suggest that the entire section at this site corresponds to the acoustically transparent sediments seen on the profile records.

Except for some turbidites at the base of the sedimentary section, the entire section appears to be glacial marine in origin. The exact process of deposition has not been precisely determined, but may have included ice rafting, turbidity currents, and sedimentary suspensions in water.

Lithologically, the sediments have been divided into three units; the division is made more on the basis of increasing lithification downwards, rather than on any remarkable changes in grain size or composition. Unit 1 extends down to 182 meters, Unit 2 to 258 meters, and Unit 3 to the basalt contact at 378 meters. All the units consist principally of terrigenous muds, sandy muds and clays, with lithified equivalent also present in Units 2 and 3. A marked change in physical properties is observed between Units 1 and 2, with a downward increase in sound velocity and a decrease in water content.

The sediments were poor in siliceous fossils throughout. Nannoplankton are also very rare and appear in only a few very restricted horizons. Planktonic foraminifera were found in various intervals at this site, and changes in faunal composition are apparent. However, the fauna consists almost entirely of the small globogerinid forms. In general the fauna is well preserved, but from Core 24 down a yellow-brown coloration is apparent, and from Core 27 down recrystallization is apparent. On the basis of foraminifera, the base of the Plio-Pleistocene may be at about 39.5 meters, and the Pliocene at 296 meters(?). The basal sediments may be early Pliocene or Miocene.

A small amount of gas was recovered from the core at a subbottom depth of 234.5 meters. It consisted of methane and a trace of carbon dioxide.

Igneous rocks recovered at this site appear to range from diabase to gabbro. The coarseness of texture suggests a thick sill. The rocks are extremely altered, which makes the recognition of primary mineral composition of these rocks difficult. The presence of biotite suggests that the rocks originate from a subalkalic basaltic magma. Radiometric ages (Kharin et al., this volume) of basement is 3 m.y. (German group). This age taken together with the paleontological data confirms the intrusive nature of basement.

Conclusions

1. Igneous rocks of coarse texture (diabase to gabbro), that are badly altered, form basement at this site.
2. The age of the overlying sediments is Miocene or early Pliocene.
3. The radiometric age of 3 m.y. confirms the intrusive nature of basement. However, if the overlying sediment is as young as early Miocene, the igneous rocks are intruded into sediment only a few million years older.
4. Because the sedimentary column, even near the bottom, seems to be made up of glacial marine sediments, glaciation must have started here in the late Miocene or early Pliocene, that is 5-7 m.y. ago.
5. Paleontologically, the sedimentary section is poor. Radiolaria are absent, and nannofossils are also very rare.

The seismic profiler record is somewhat indistinct, but appears to show basement at about 0.5 sec.

Lithologic unit A to 182 meters (base of Core 20) corresponds to well defined physical properties unit with average velocity 1.598 km/sec. This gives a two-way travel time of 0.228 sec. Unit B consisting of Cores 21 and 22 (182 to 201 m) has an average velocity of 3.265 km/sec. The two-way travel time is equal to 0.012 sec. Unit C is the remainder of lithologic Unit 2 (Cores 23 to 27, 201 to 258 m) with an average velocity of 1.97 km/sec. The two-way travel time is equal to 0.058 sec. Unit D is equivalent to lithologic Unit 3, (Cores 28 to 33 (258 to 377.5 m). The average velocity equals 1.863 km/sec with a two-way travel time of 0.128 sec.

The total calculated travel time is equal to 0.426 sec. The observed velocities are, therefore, possibly somewhat too high, but the profiler record is not clear enough to be sure of this.

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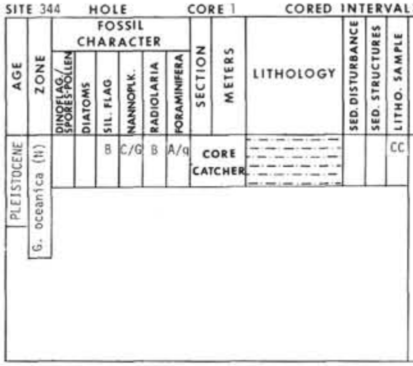
SITE 344 **HOLE** **CORE** 1 **CORED INTERVAL**: 0.0-1.5 m



LITHOLOGIC DESCRIPTION

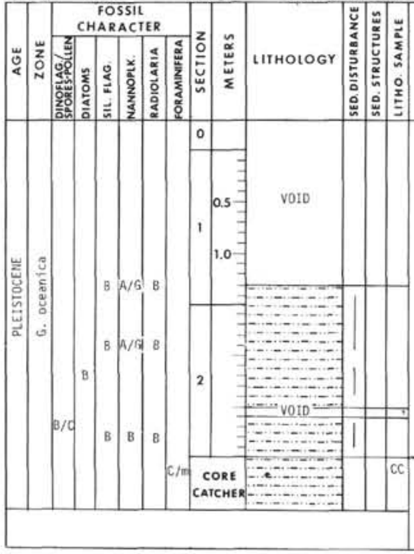
10YR 4/2

No recovery except 0.1 m in CC. Dark yellow brown (10YR 4/2), 3-4 cm pebbles.

MAJOR LITHOLOGY

SANDY MUD (Smear CC)
35% Sand 18-20% Quartz
35% Silt 10% Feldspar
30% Clay 5% Heavy minerals
0- 2% Foraminifera
63% Clay minerals (including Carbonate particles)
2% Opaques
(Pebbles include Schist, sandstone.)

SITE 344 **HOLE** **CORE** 2 **CORED INTERVAL**: 1.5-11.0 m



LITHOLOGIC DESCRIPTION

Colors: medium dark gray (N4), olive gray (5Y 4/1). Mottled, streaks, moderate deformation.

MAJOR LITHOLOGY

MUD (Smear CC)
7% Sand 27% Quartz
23% Silt 10% Feldspar
70% Clay 2% Heavy minerals
59% Clay minerals (including Carbonate particles)
2% Opaques

5Y 4/1

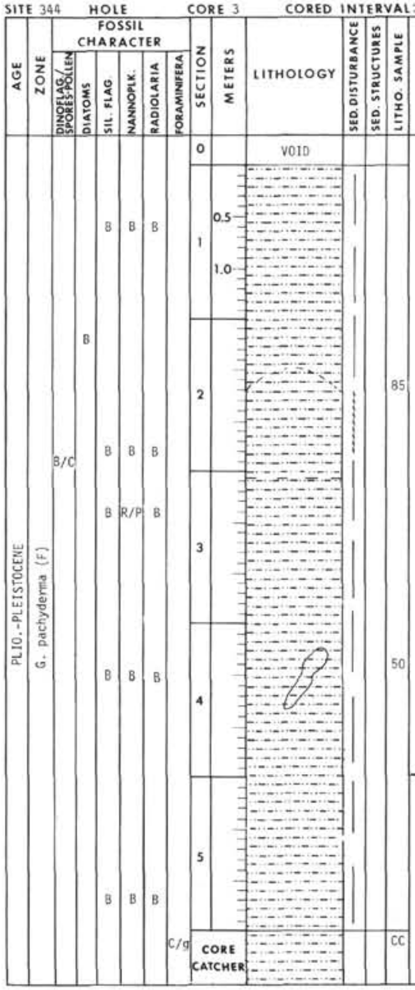
Carbon-Carbonate (DSDP)
2-20 (1.2, 0.9, 2)

Grain Size (DSDP)
2-50 (14.8, 27.4, 57.8)

X-Ray (BP)
2-70
30% Mont.
28% Ill.
16% Kaol.
24% Chlo.
A Quar.
P Micas, Plag.

N4

SITE 344 **HOLE** **CORE** 3 **CORED INTERVAL**: 11.0-20.5 m



LITHOLOGIC DESCRIPTION

Colors: medium gray (N5), olive gray (5Y 4/1), dark yellowish brown (10YR 4/2), dark gray (N3). Variegated, moderate deformation, color streaking.

MAJOR LITHOLOGIES

5Y 4/1

a) SANDY MUD (Smear 2-85)
35% Sand 20% Quartz
35% Silt 15% Feldspar
30% Clay 5% Heavy minerals
60% Clay minerals (including Carbonate particles)

b) MUD (Smears 4-50, CC)
5- 7% Sand 30-37% Quartz, Feldspar
30-35% Silt 2- 5% Heavy minerals
60-65% Clay 58-68% Clay minerals (including Carbonate particles)

Carbon-Carbonate (DSDP)
3-50 (1.3, 1.1, 2)

Grain Size (DSDP)
3-70 (8.1, 30.7, 61.2)

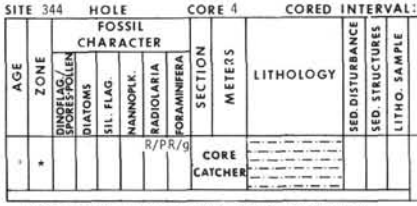
5Y 4/1
with
10YR 4/2

X-Ray (BP)
3-110
19% Mont.
40% Ill.
18% Kaol.
22% Chlo.
A Quar.
P Micas, Plag.

5Y 4/1

N5

SITE 344 **HOLE** **CORE** 4 **CORED INTERVAL**: 20.5-30.0 m



LITHOLOGIC DESCRIPTION

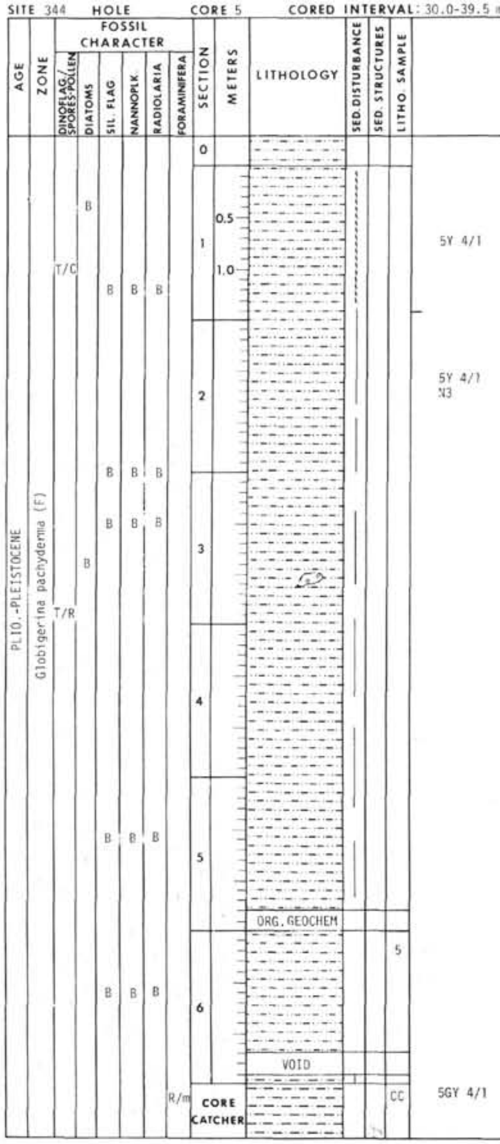
5Y 2/1

Core catcher only: olive gray (5Y 2/1).

SANDY MUD

* Globigerina pachyderma (F) + PLIO.-PLEISTOCENE
Explanatory notes in Chapter 1

SITE 344 HOLE CORE 5 CORED INTERVAL: 30.0-39.5 m



LITHOLOGIC DESCRIPTION

Colors: dark greenish gray (5GY 4/1), olive gray (5Y 4/1). Intense deformation in Sec. 1, moderate to Sec. 6. Variegated, mottling of colors. Lapilli(?) noted in Secs. 3-4.

MAJOR LITHOLOGIES

a) MUD (Smear 6-5, CC)
6-10% Sand (Mixtures of marly
30-40% Silt nannofossil ooze.)
50-65% Clay

b) SANDY MUD (Smear CC)
40% Sand
40% Silt
20% Clay

Carbon-Carbonate (DSDP)
3-20 (1.0, 0.2, 6)

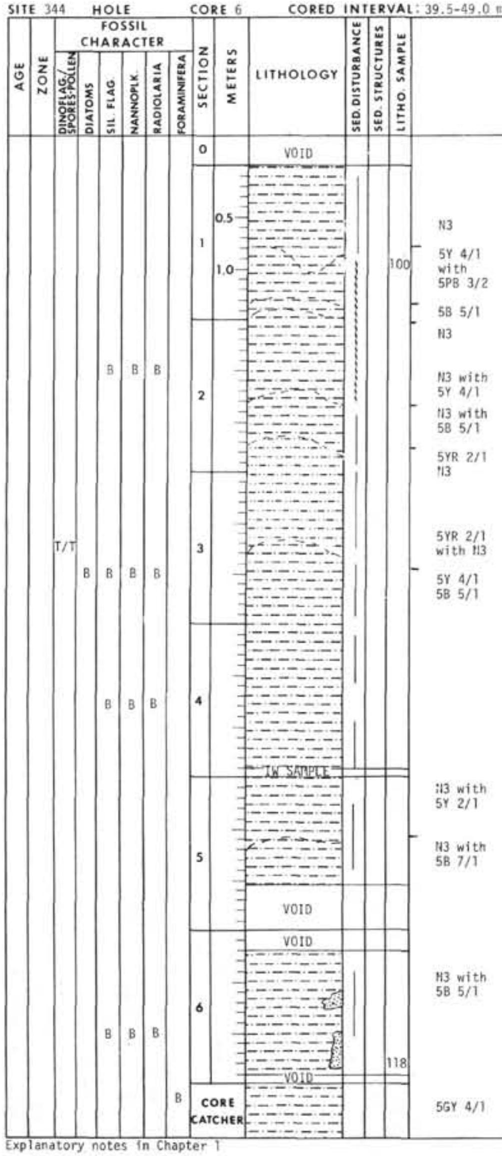
Carbon-Carbonate (PP)
5-5 (top) (1.72, 0.26)
5-5 (bottom) (0.78, 0.11)

Grain Size (DSDP)
3-30 (6.7, 36.6, 56.7)

X-Ray (BP)
3-110

34%	Mont.
30%	Ill.
18%	Kaol.
17%	Chlo.
A	Quar.
P	Micas, Plag.

SITE 344 HOLE CORE 6 CORED INTERVAL: 39.5-49.0 m



LITHOLOGIC DESCRIPTION

Colors: dark greenish gray (5GY 4/1), dark gray (N3), olive gray (5Y 4/1), dusky blue (5PB 3/2), medium bluish gray (5B 5/1), brownish black (5YR 2/1). Moderate deformation, stringers of coarser material throughout, variegated, some pebbles (7x9 mm), all original layering distorted.

MAJOR LITHOLOGY

SANDY MUD (Smears 1-100)

10% Sand	10% Quartz
40% Silt	1% Opaques
50% Clay	5% Volcanic glass
	TR% Glauconite
	1- 3% Authigenic carbonate
	78-80% Clay minerals
	0- 3% Feldspar
	0- 1% Mica

MINOR LITHOLOGY

SAND (Smear 6-118)

90% Sand	90% Quartz
10% Silt	2% Heavy minerals
	TR% Pyroxenes
	5% Opaques
	3% Glauconite

Carbon-Carbonate (DSDP)
3-110 (0.8, 0.6, 1)

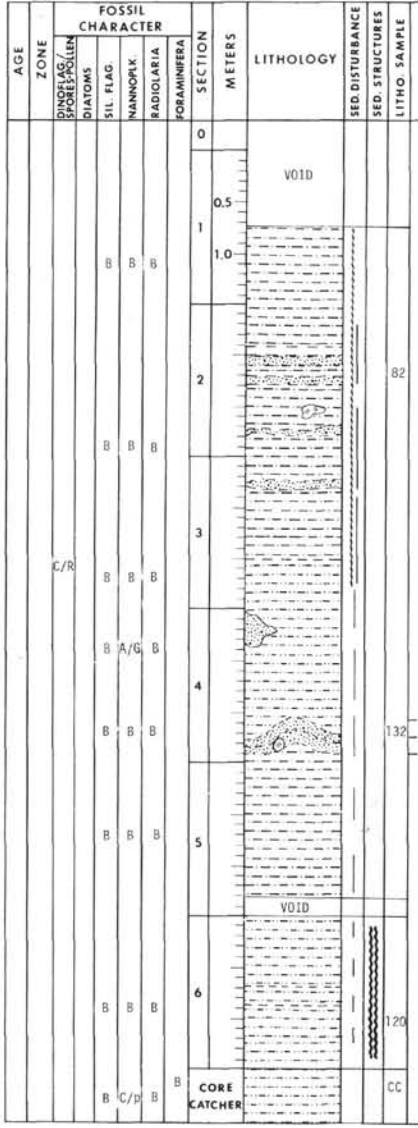
Grain Size (DSDP)
3-10 (5.5, 22.2, 72.3)

X-Ray (BP)
3-90

29%	Mont.
36%	Ill.
17%	Kaol.
17%	Chlo.
A	Quar.
P	Micas, Plag.
TR%	Dolo.

Explanatory notes in Chapter 1

SITE 344 **HOLE** **CORE** 7 **CORED INTERVAL:** 49.0-58.5 m



LITHOLOGIC DESCRIPTION

Colors: dark greenish gray (5GY 4/1), medium dark gray (N4), olive black (5Y 2/1), greenish black (5G 2/1), pale brown (5YR 5/2), light olive gray (5Y 5/1), dusky blue (5PB 3/2). Sec. 1 - fine sand clasts/balls. Generally intense deformation in higher sections, medium-slight lower. Fragments and 1 or 2 clasts throughout, internal flowage apparent. Burrows in Sec. 6 (calcite infilled).

MAJOR LITHOLOGIES

a) SAND (Smears 2-82, 4-132)

80-90% Sand	50-75% Quartz
10-20% Silt	3- 5% Feldspar
0-10% Clay	TR- 3% Heavy minerals
	5-40% Opaques
	3- 5% Glauconite
	2-10% Clay minerals (including Carbonate particles)

b) MUD (Smears 6-120, CC)

10-35% Sand	15-20% Quartz
15-35% Silt	0-15% Feldspar
30-75% Clay	2- 5% Heavy minerals
	TR% Opaques
	65-80% Clay minerals

Carbon-Carbonate (DSDP)
4-69 (0.9, 0.4, 4)

Carbon-Carbonate (PP)
7-5 (top) (0.41, 0.11)
7-5 (bottom) (0.33, 0.05)

Grain Size (DSDP)
4-74 (10.8, 31.9, 57.3)

X-Ray (BP)
4-86

22%	Mont.
42%	Ill.
16%	Kaol.
18%	Chlo.
A	Quar.
P	Micas, Plag.
TR%	Ortho., Calc.

N4 with
5Y 2/1

5Y 2/1
5Y 4/1

5Y 5/1

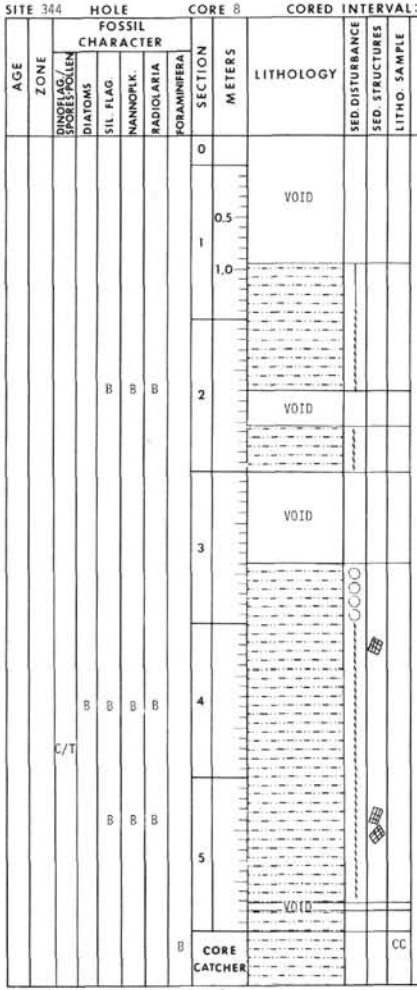
5GY 6/1
5Y 5/1

5PB 5/2
5GY 2/1

5Y 4/1
5YR 4/1

5GY 4/1

SITE 344 **HOLE** **CORE** 8 **CORED INTERVAL:** 58.5-68.0 m



LITHOLOGIC DESCRIPTION

Colors: olive black (5Y 2/1), olive gray (5Y 4/1), medium bluish gray (5B 5/1), dark greenish gray (5GY 4/1), dusky blue (5B 3/2). Sec. 1, small clasts volcanic ash; Sec. 4 (5-10 cm) mudstone clasts; Sec. 5 - mud clasts (>6 mm) diameter.

MAJOR LITHOLOGY

MUD (Smear CC)

5% Sand	20% Quartz
30% Silt	15% Feldspar
65% Clay	2% Heavy minerals
	63% Clay minerals (including Carbonate particles)

Carbon-Carbonate (DSDP)
4-55 (1.1, 1.0, 1)

Grain Size (DSDP)
4-39 (7.0, 29.4, 63.7)

X-Ray (BP)
4-49

24%	Mont.
28%	Ill.
23%	Kaol.
24%	Chlo.
A	Quar.
P	Micas
TR%	Plaq.

5Y 4/1

5Y 4/1
with
5B 5/1

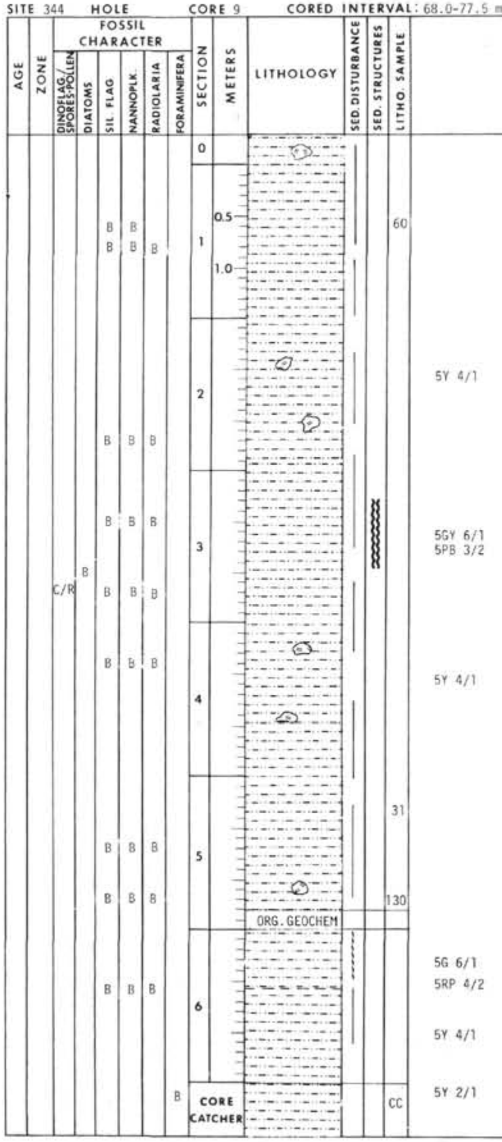
5GY 4/1

5PB 3/2

5Y 2/1

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 9 CORED INTERVAL: 68.0-77.5 m



LITHOLOGIC DESCRIPTION

Colors: olive black (5Y 2/1), olive gray (5Y 4/1), greenish gray (5G 6/1), grayish brown (5YR 3/2), dusky blue (5PB 3/2), grayish red purple (5RP 4/2). Generally moderate deformation, color streaking, mixing, burrow (calcite) 3-65, silt streak in Secs. 5-6.

MAJOR LITHOLOGY

MUD (Smears 1-60, 5-31, 5-130, CC)

0-10% Sand	15-60% Quartz
30-40% Silt	1-20% Feldspar
50-60% Clay	0- 2% Mica
	2-10% Heavy minerals
	3% Opaques
	1- 3% Volcanic glass
	1- 2% Glauconite
	0- 1% Zeolites
	0- 1% Carbonate
	30-73% Clay minerals

Carbon-Carbonate (DSDP)
3-74 (0.6, 0.6, 0)

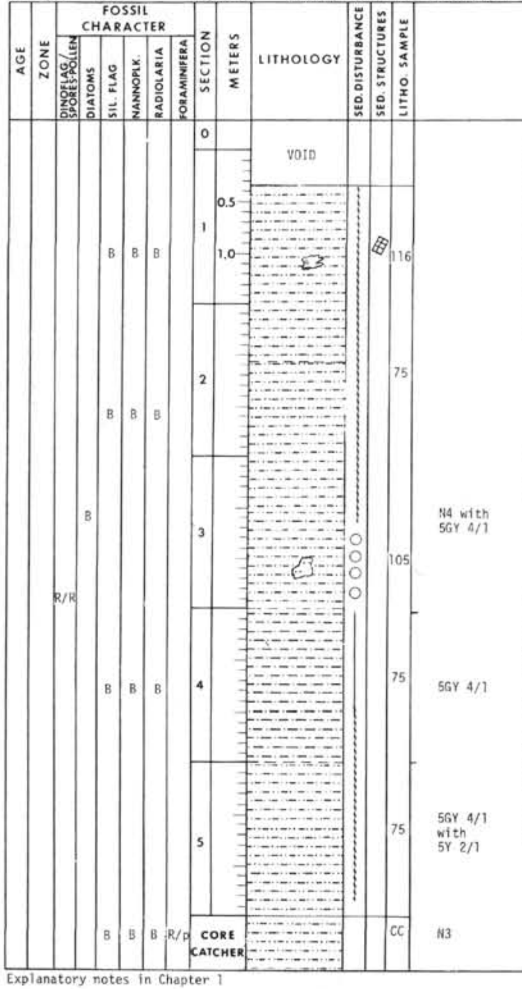
Carbon-Carbonate (PP)
9-5 (top) (0.70, 0.22)
9.5 (bottom) (0.53, 0.07)

Grain Size (DSDP)
3-84 (0.7, 32.4, 66.9)

X-Ray (BP)
3-68

17%	Mont.
37%	Ill.
19%	Kaol.
25%	Chlo.
A	Quar.
P	Micas, Plag.
TR%	Ortho.

SITE 344 HOLE CORE 10 CORED INTERVAL: 77.5-87.0 m



LITHOLOGIC DESCRIPTION

Colors: dark gray (N3), dark greenish gray (5GY 4/1), medium dark gray (N4). Soft, mottled, clay clasts in Sec. 1, scattered 1-2 mm pebbles (sandstone, pyrite) pyrite coated burrows. Firmer in Sec. 4, with pebbles (1.5 cm siltstone, mudstone).

MAJOR LITHOLOGIES

a) SANDY MUD (Smears 1-116, 4-75)

10-15% Sand	15-20% Quartz
10-40% Silt	2- 5% Feldspar
45-80% Clay	0- 5% Mica
	TR- 1% Heavy minerals
	2- 5% Opaques
	TR% Volcanic glass
	52-70% Clay minerals
	1- 5% Zeolites
	0- 1% Glauconite

b) MUD (Smears 2-75, 5-75, CC)

5% Sand	10-20% Quartz
20-30% Silt	2-20% Feldspar
65-75% Clay	0- 4% Mica
	2-10% Heavy minerals
	0- 2% Opaques
	50-75% Clay minerals
	0- 1% Zeolites
	0- 1% Carbonate

MINOR LITHOLOGIES

SILT at 3-105

Carbon-Carbonate (DSDP)
3-9 (0.6, 0.6, 0)

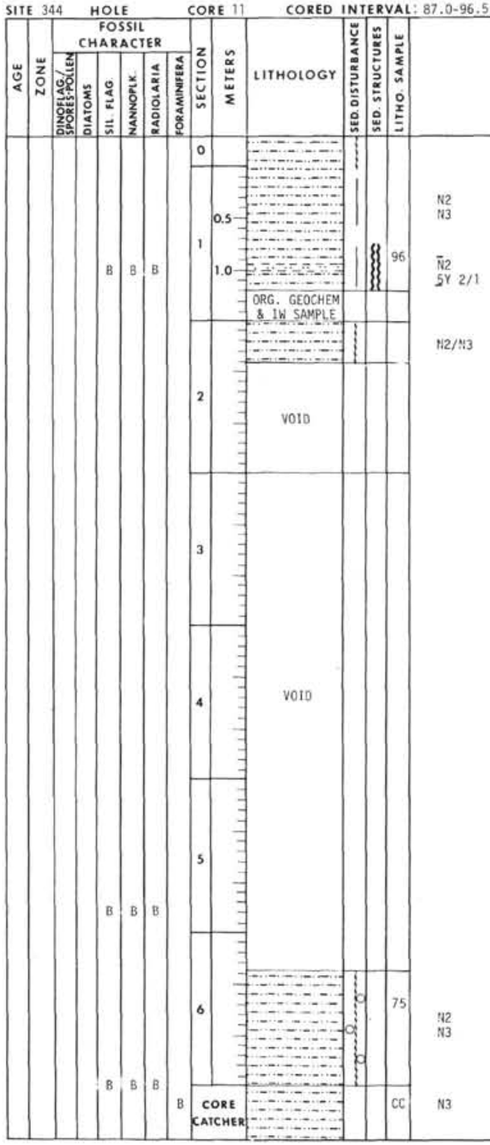
Grain Size (DSDP)
3-39 (4.6, 28.8, 66.5)

X-Ray (BP)
3-19

31%	Mont.
48%	Ill.
9%	Kaol.
10%	Chlo.
A	Quar.
P	Micas, Plag.

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 11 CORED INTERVAL: 87.0-96.5 m



LITHOLOGIC DESCRIPTION

Colors: dark gray (N3), grayish black (N2), olive black (5Y 2/1). Generally intense deformation, moderate in Sec. 1. Sec. 1, soft, color mottling, burrows at 93 cm, layering (3-5 cm) = turbidite?. Grading plus very fine sand streaks, color streaking common; Sec. 2 - similar to Sec. 1; scattered pebbles throughout.

MAJOR LITHOLOGY

CALCAREOUS(?) MUD (Smears 6-75, CC)

10% Sand	20-40% Quartz, Feldspar
60% Silt	1% Heavy minerals
30% Clay	0- 2% Mica
	1% Opaques
	TR% Volcanic glass
	TR- 1% Glauconite
	0- 5% Zeolites
	40-70% Clay minerals (including Clays and Carbonate particles)

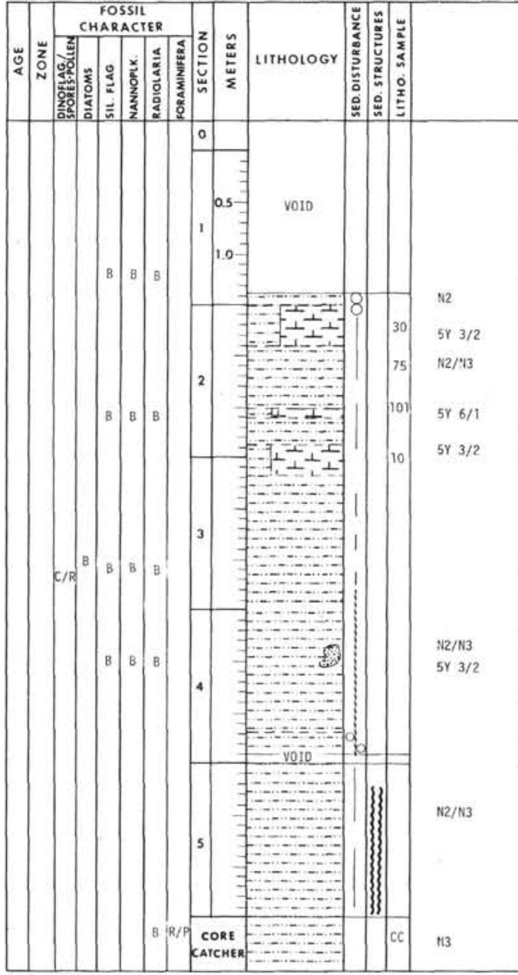
MINOR LITHOLOGY

SILT (Smear 1-96)

5% Sand	70% Quartz, Feldspar
90% Silt	5% Heavy minerals
5% Clay	25% Clay minerals

Carbon-Carbonate (PP)
11-1 (top) (1.61, 0.58)
11-1 (bottom) (0.71, 0.03)

SITE 344 HOLE CORE 12 CORED INTERVAL: 96.5-106.0 m



LITHOLOGIC DESCRIPTION

Colors: dark gray (N3), grayish black (N2), olive gray (5Y 3/2), light olive gray (5Y 6/1). Some drilling breccia, intense → slight deformation. Sec. 1, firm, moderate disturbance, scattered ash, very fine sand patches, pebbles, gradational color contacts; Sec. 3 as per Sec. 2, massive firm; Sec. 4, scattered pebbles; Sec. 5 - silicified-pyrite burrows.

MAJOR LITHOLOGIES

a) MARLY NANNOFOSSIL OOZE (Smears 2-30, 3-10)

0- 50% Silt	10-30% Quartz, Feldspar
50-100% Clay	1- 5% Micas, Heavy minerals
	19% Clay minerals
	50-70% Nannofossils

b) MUD (Smear 2-75, CC)

10% Sand	25-35% Quartz, Feldspar
30% Silt	0-35% Micas, Heavy minerals
60% Clay	0- 5% Opaques
	0- 1% Volcanic glass
	0- 5% Zeolites
	30-65% Clay minerals (including Carbonate particles)

Carbon-Carbonate (DSDP)
3-20 (0.5, 0.5, 0)

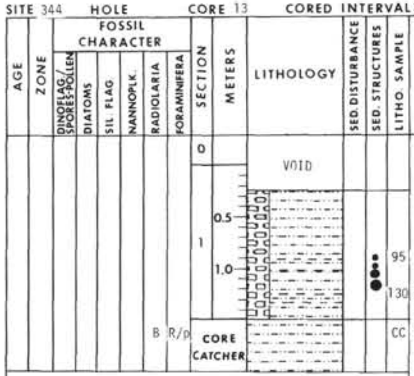
Grain Size (DSDP)
3-59 (11.2, 33.9, 54.9)

X-Ray (BP)
3-49

41%	Mont.
31%	Ill.
13%	Kaol.
13%	Chlo.
A	Quar.
P	Micas, Plag.
TR%?	Calc.

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 13 CORED INTERVAL: 106.0-115.5 m



LITHOLOGIC DESCRIPTION

N2/N3

5Y 4/1

N2/N3
5Y 6/1
5Y 2/1
N2/N3

N3

Colors: dark gray (N3), grayish black (N2), olive gray (5Y 4/1), light olive gray (5Y 6/1), olive black (5Y 2/1). Firm, moderate deformation, color layering, some grading, 130-145 cm.

<u>MAJOR LITHOLOGIES</u>

a) CALCAREOUS MUD (Smear 1-95)

1% Sand	70% Clay minerals
35% Silt	20% Nannofossils
64% Clay	10% Quartz/Heavy minerals

b) CALCAREOUS? MUD (Smear CC)

10% Sand	10% Quartz
25% Silt	2% Feldspar
65% Clay	2% Mica
	1% Heavy minerals
	3% Opaques
	2% Volcanic glass
	79% Clay minerals (including Carbonate particles)
	1% Glauconite
	TR% Diatoms

<u>MINOR LITHOLOGY</u>

NANNOFOSSIL(?) OOZE (Smear 1-130)

5% Sand	3% Quartz
5% Silt	1% Feldspar
90% Clay	6% Mica, Heavy minerals
	90% Nannofossils(?)

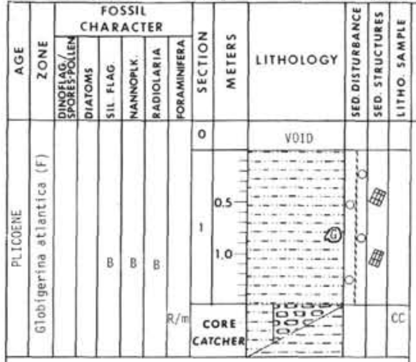
<u>Carbon-Carbonate (DSDP)</u>
1-60 (0.6, 0.6, 0)

<u>Grain Size (DSDP)</u>
1-40 (1.0, 35.9, 63.1)

<u>X-Ray (BP)</u>
<u>1-50</u>

25%	Mont.
43%	Ill.
14%	Kaol.
17%	Chlo.
A	Quar.
P	Micas, Plag.
TR%?	Calc.

SITE 344 HOLE CORE 14 CORED INTERVAL: 115.5-125.0 m



LITHOLOGIC DESCRIPTION

N3/
5Y 4/1

5GY 4/1

Colors: dark greenish gray (5GY 4/1), dark gray (N3), olive gray (5Y 4/1). Intense - brecciated, scattered claystone, mudstone, siltstone pebbles.

<u>MAJOR LITHOLOGY</u>

MUD (Core catcher is mixture with MARLY CALCAREOUS OOZE) (Smear CC)

10% Sand	5% Quartz
40% Silt	1% Heavy minerals
50% Clay	5% Opaques
	30% Clay minerals
	TR% Glauconite
	1% Zeolites
	±58% Carbonate

<u>Carbon-Carbonate (DSDP)</u>
1-60 (1.0, 0.9, 1)

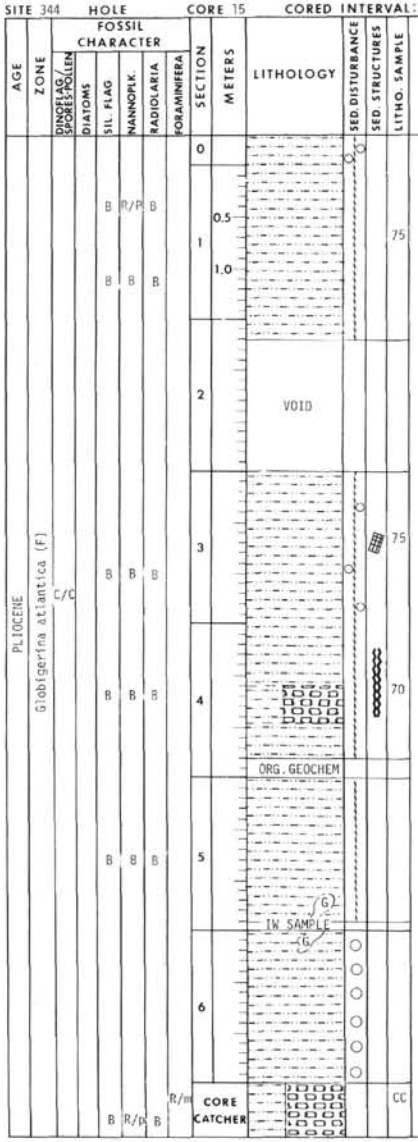
<u>Grain Size (DSDP)</u>
1-40 (11.2, 37.3, 51.4)

<u>X-Ray (BP)</u>
<u>1-50</u>

39%	Mont.
31%	Ill.
11%	Kaol.
17%	Chlo.
A	Quar., Plag.
P	Micas

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 15 CORED INTERVAL: 125.0-134.5 m



LITHOLOGIC DESCRIPTION

Colors: dark greenish gray (5GY 4/1), olive black (5Y 2/1), dark gray (N3), light olive gray (5Y 6/1). Generally intense deformation with breccia. Sec. 1 - scattered clay, sand patches (<1 mm), color mixing; Sec. 3 - few clay, sand patches, shale pebbles (2 cm); Sec. 4 - has soft/hard zones (60-95 cm = hard), few fine sand patches, burrows (silicified), scattered pebbles.

MAJOR LITHOLOGIES

a) MUD (Smears 1-75, 3-75)

3- 5% Sand	60% Quartz, Feldspar
30-40% Silt	5% Mica, Heavy minerals
55-65% Clay	20% Clay minerals
	15% Nannofossils(?)

b) MARLY CALCAREOUS (NANNOFOSSIL) OOZE (Smears 4-70, CC)

0- 5% Sand	1- 5% Quartz
5-15% Silt	1- 4% Heavy minerals
80-95% Clay	0- 5% Opaques
	30% Clay minerals
	59-65% Carbonate (Nannos?)

Carbon-Carbonate (DSDP)
3-60 (1.2, 1.0, 2)

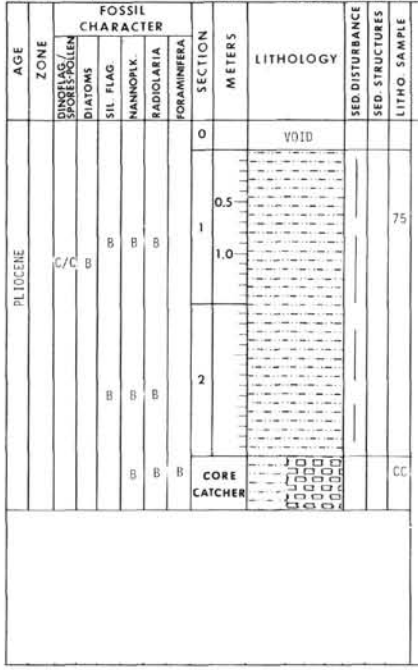
Carbon-Carbonate (PP)
15-4 (top) (0.95, 0.14)
15-4 (bottom) (1.05, 0.11)

Grain Size (DSDP)
3-40 (3.3, 36.2, 60.4)

X-Ray (BP)
3-50

45%	Mont.
31%	Ill.
11%	Kaol.
11%	Chlo.
A	Quar.
P	Micas, Plag.

SITE 344 HOLE CORE 16 CORED INTERVAL: 134.5-144.0 m



LITHOLOGIC DESCRIPTION

Colors: dark greenish gray (5GY 4/1), dark gray (N3), light brownish gray (5YR 6/1). Moderate deformation.

MAJOR LITHOLOGIES

a) MUD (Smear 1-75)

2% Sand	30% Quartz
50% Silt	10% Feldspar
48% Clay	5% Heavy minerals, Mica
	45% Clay minerals (including Carbonate particles)
	10% Nannofossils

b) MARLY CALCAREOUS OOZE (Smear CC)

3% Sand	4% Quartz
70% Silt	1% Feldspar
27% Clay	8% Heavy minerals
	60% Carbonate particles
	27% Clay minerals

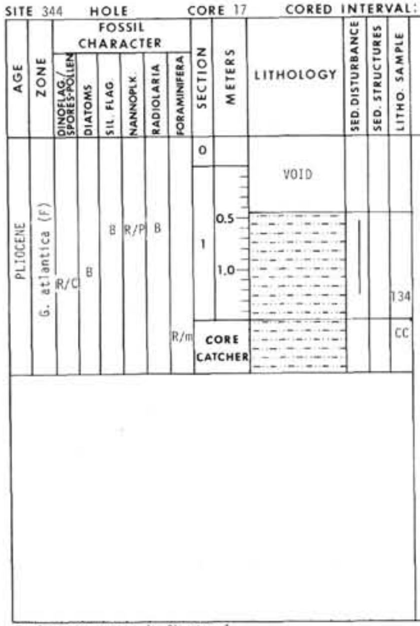
Carbon-Carbonate (DSDP)
2-60 (0.9, 0.7, 2)

Grain Size (DSDP)
2-40 (1.2, 52.8, 46.0)

X-Ray (BP)
2-50

34%	Mont.
35%	Ill.
14%	Kaol.
15%	Chlo.
A	Quar.
P	Micas, Plag.
TR%	Dolo.

SITE 344 HOLE CORE 17 CORED INTERVAL: 144.0-153.5 m



LITHOLOGIC DESCRIPTION

Colors: dark greenish gray (5GY 4/1), olive gray (5Y 4/1), dark gray (N3).

MAJOR LITHOLOGY

MUD (Smears 1-134, CC)

1% Sand	20-45% Quartz
50% Silt	5-10% Feldspar
49% Clay	TR-15% Mica
	5% Heavy minerals
	0- 2% Opaques
	0-TR% Volcanic glass
	30-51% Clay minerals (including Carbonate particles)
	0- 2% Zeolites

Carbon-Carbonate (DSDP)
1-70 (1.1, 0.8, 2)

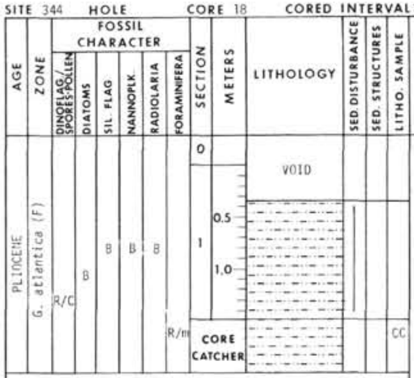
Grain Size (DSDP)
1-60 (0.7, 58.5, 40.8)

X-Ray (BP)
1-50

15%	Mont.
62%	Ill.
5%	Kaol.
16%	Chlo.
A	Quar., Plag.
P	Micas
TR	Dolo.

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 18 CORED INTERVAL: 153.5-163.0 m



LITHOLOGIC DESCRIPTION

Colors: dark greenish gray (5GY 4/1), dark gray (N3), olive gray (5Y 4/1).

MAJOR LITHOLOGY

N3/
5Y 4/1

MUD (Smear CC)
10% Sand
50% Silt
40% Clay

40% Quartz
10% Feldspar
10% Heavy minerals
35% Clay minerals (including Carbonate particles)
5% Palagonite?

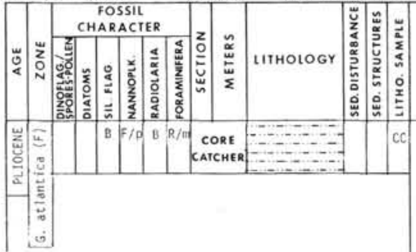
5GY 4/1

Carbon-Carbonate (DSDP)
1-70 (0.9, 0.8, 1)

X-Ray (BP)
1-50
59% Mont.
25% Ill.
7% Kaol.
7% Chlo.
A Quar.
P Micas, Plag.
TR Gyps.

1-60
40% Mont.
19% Ill.
20% Kaol.
20% Chlo.
A Quar.
P Micas, Plag.

SITE 344 HOLE CORE 19 CORED INTERVAL: 163.0-172.5 m



LITHOLOGIC DESCRIPTION

5G 4/1

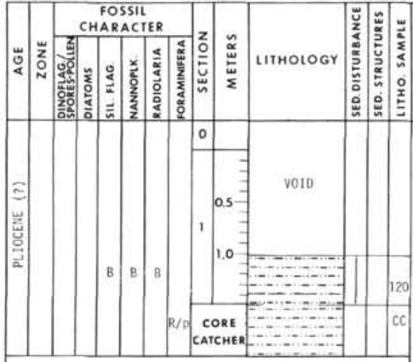
Dark greenish gray (5G 4/1) - Core catcher only:

MAJOR LITHOLOGY

MUD (Smear CC)
10% Sand
50% Silt
40% Clay

37% Quartz
15% Feldspar
3% Mica
10% Heavy minerals
5% Palagonite
20% Nannofossils
10% Clay minerals

SITE 344 HOLE CORE 20 CORED INTERVAL: 172.5-182.0 m



LITHOLOGIC DESCRIPTION

Colors: greenish black (5GY 2/1), olive gray (5Y 4/1), dark gray (N3).

MAJOR LITHOLOGIES

MUD (Smear 1-120)
35% Sand
45% Silt
20% Clay

30% Quartz
10% Feldspar
5% Mica
5% Heavy minerals
50% Clay minerals (including Carbonate particles)

5Y 4/1

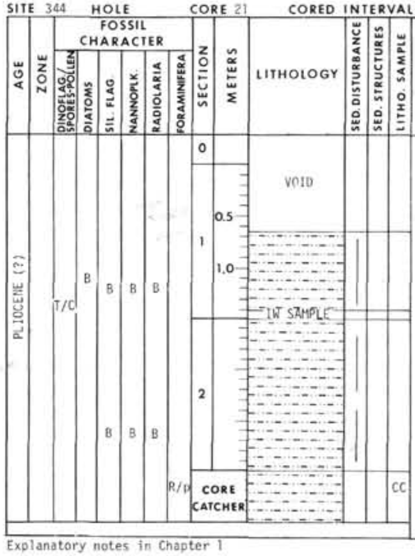
N3

5GY 2/1

MUD (Smear CC)
5% Sand
40% Silt
55% Clay

5% Quartz
15% Feldspar
2- 5% Mica
0- 5% Heavy minerals
50% Clay minerals
1% Opaques
TR% Glauconite
25% Nannofossils? (Carbonate)

SITE 344 HOLE CORE 21 CORED INTERVAL: 182.0-191.5 m



LITHOLOGIC DESCRIPTION

Colors: olive black (5Y 2/1), dark gray (N3).

MAJOR LITHOLOGY

MUD (Smear CC)
2% Sand
40% Silt
58% Clay

40% Quartz
10% Feldspar
10% Heavy minerals, Mica
30-40% Clay minerals
10% Carbonate

Carbon-Carbonate (DSDP)
2-70 (1.5, 1.2, 2)

N3

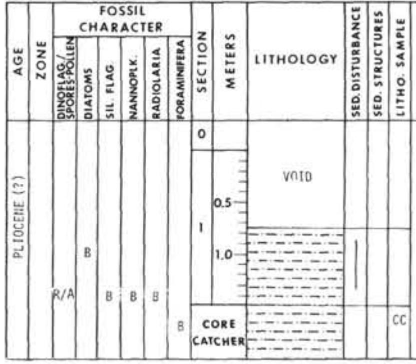
Grain Size (DSDP)
2-60 (1.5, 38.3, 60.2)

X-Ray (BP)
2-50
48% Mont.
33% Ill.
8% Kaol.
9% Chlo.
A Quar.
P Micas, Plag.

5Y 2/1

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 22 CORED INTERVAL: 191.5-201.0 m



LITHOLOGIC DESCRIPTION

N3

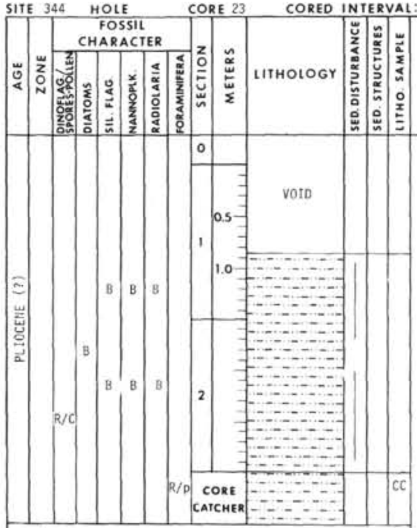
5Y 2/1

Colors: olive black (5Y 2/1), dark gray (N3).

MAJOR LITHOLOGY

MUD (Smear CC)
10% Sand 40% Quartz
50% Silt 10% Feldspar
40% Clay 10% Heavy minerals, Mica
30-40% Clay minerals
10% Carbonate (Nannos?)

SITE 344 HOLE CORE 23 CORED INTERVAL: 201.0-210.5 m



LITHOLOGIC DESCRIPTION

5Y 2/1

5Y 4/1

Colors: olive gray (5Y 4/1), olive black (5Y 2/1).

MAJOR LITHOLOGY

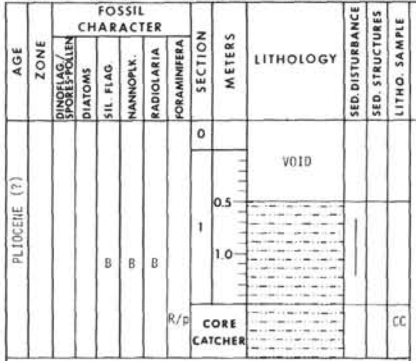
MUD (Smear CC)
10% Sand 40% Quartz
50% Silt 15% Feldspar
40% Clay 10% Heavy minerals, Mica
25-35% Clay minerals
10% Carbonate (Nannos?)

Carbon-Carbonate (DSDP)
2-70 (0.9, 0.0, 8)

Grain Size (DSDP)
2-60 (6.3, 52.6, 41.1)

X-Ray (BP)
2-50
54% Mont.
27% Ill.
7% Kaol.
10% Chlo.
A Quar.
P Micas, Plag.
TR% Ortho, Calc.

SITE 344 HOLE CORE 24 CORED INTERVAL: 210.5-220.0 m



LITHOLOGIC DESCRIPTION

5Y 4/1

5Y 4/1

Colors: olive gray (5Y 4/1).

MAJOR LITHOLOGY

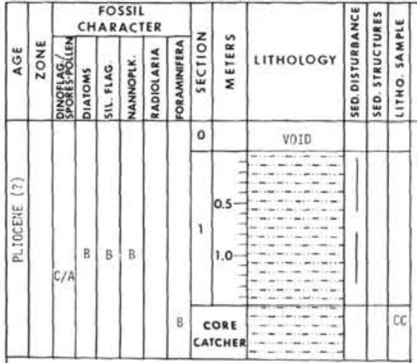
MUD (Smear CC)
5% Sand 40% Quartz
50% Silt 10% Feldspar
45% Clay 3% Mica
5% Heavy minerals
42% Clay minerals (including Carbonate particles)

Carbon-Carbonate (DSDP)
1-69 (0.9, 0.8, 1)

Grain Size (DSDP)
1-110 (4.2, 47.4, 48.4)

X-Ray (BP)
1-120
65% Mont.
26% Ill.
4% Kaol.
4% Chlo.
A Quar.
P Micas, Plag.

SITE 344 HOLE CORE 25 CORED INTERVAL: 220.0-229.5 m



LITHOLOGIC DESCRIPTION

5Y 2/1

5Y 2/1

Colors: olive black (5Y 2/1).

MAJOR LITHOLOGY

MUD (Smear CC)
5% Sand 50% Quartz
40% Silt 30% Feldspar
55% Clay 2% Mica
5% Heavy minerals
38% Clay minerals (including Carbonate particles)

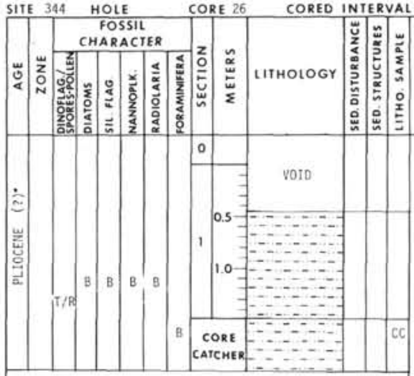
Carbon-Carbonate (DSDP)
1-65 (1.1, 0.9, 1)

Grain Size (DSDP)
1-60 (0.5, 38.4, 61.0)

X-Ray (BP)
1-70
42% Mont.
33% Ill.
10% Kaol.
13% Chlo.
A Quar.
P Micas, Plag.
TR%? Siderite

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 26 CORED INTERVAL: 229.5-239.0 m



LITHOLOGIC DESCRIPTION

5Y 2/1

Colors: olive black (5Y 2/1).

MAJOR LITHOLOGY

MUD (Smear CC)

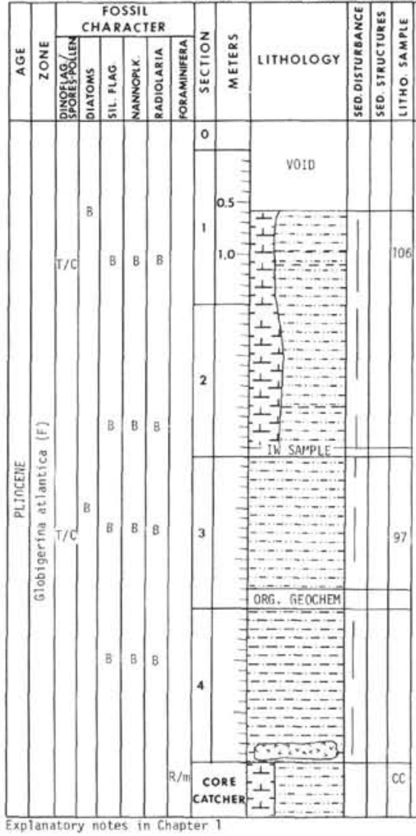
5% Sand	30% Quartz
60% Silt	25% Feldspar
35% Clay	2% Mica
	10% Heavy minerals
	33% Clay minerals (including Carbonate particles)

Carbon-Carbonate (DSDP)
1-85 (1.2, 1.1, 1)

Grain Size (DSDP)
1-70 (4.3, 61.4, 34.3)

X-Ray (BP)
1-140
42% Mont.
11% Ill.
14% Kaol.
17% Chlo.
A Quar.
P Micas, Plag.
TR%? Dolo.

SITE 344 HOLE CORE 27 CORED INTERVAL: 239.0-248.5 m



LITHOLOGIC DESCRIPTION

N3 with 5Y 4/1

N3

N3 with 5Y 5/1

N3

N4

5Y 2/1

Colors: olive black (5Y 2/1), dark gray (N3), light olive gray (5Y 5/1). Moderate deformation.

MAJOR LITHOLOGIES

a) CALCAREOUS MUD (Smears 1-106, 3-97, CC)

1-30% Sand	45-47% Quartz, Feldspar
35-59% Silt	1- 2% Mica
35-40% Clay	1- 2% Heavy minerals
	1- 9% Opaques
	2% Volcanic glass/Palagonite
	15-20% Clay minerals
	TR% Glauconite
	15-25% Carbonate fragments

b) SANDY MUD (Smear 4-103)

Carbon-Carbonate (DSDP)
2-50 (1.4, 1.1, 2)

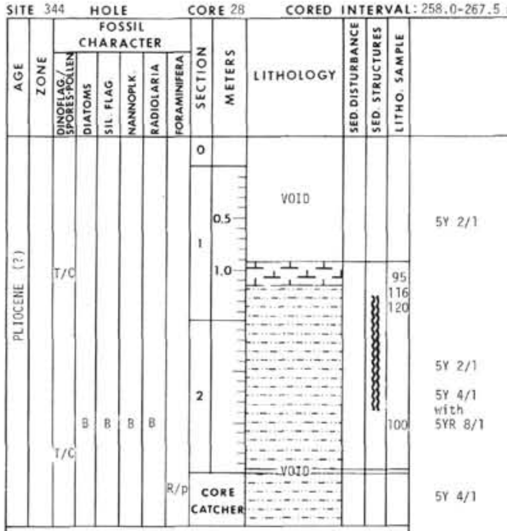
Carbon-Carbonate (PP)
27-3 (top) (1.14, 0.24)
27-3 (bottom) (1.28, 0.31)

Grain Size (DSDP)
2-20 (5.8, 46.8, 47.3)

X-Ray (BP)
2-90
48% Mont.
43% Ill.
20% Kaol.
19% Chlo.
A Quar.
P Micas, Plag.

Explanatory notes in Chapter 1

SITE 344 **HOLE** **CORE** 28 **CORED INTERVAL:** 258.0-267.5 m



LITHOLOGIC DESCRIPTION

Colors: olive gray (5Y 4/1), olive black (5Y 4/1), pinkish gray (5YR 8/1). Pyrite nodule (1.5 cm) in Sec. 1, scattered mudstone fragments, burrows - synsedimentary faulting.

MAJOR LITHOLOGIES

a) MUD (Smears 1-120, 2-100)

5-10% Sand	15-30% Quartz
40-50% Silt	2- 5% Feldspar
50-60% Clay	1- 5% Mica
	TR- 1% Heavy minerals
	5% Opaques
	TR% Volcanic glass
	39-56% Clay minerals
	15-25% Carbonate

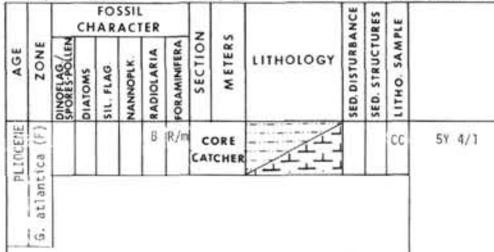
b) NANNOFOSSIL OOZE (Smears 1-95, 1-116)

Carbon-Carbonate (DSDP)
2-60 (1.1, 0.9, 2)

Grain Size (DSDP)
2-40 (1.2, 46.2, 56.2)

X-Ray (BP)
2-50
26% Mont.
40% Ill.
13% Kaol.
17% Chlo.
A Quar.
P Micas, Plag.
TR%? Calc.

SITE 344 **HOLE** **CORE** 29 **CORED INTERVAL:** 277.0-286.5 m



LITHOLOGIC DESCRIPTION

Olive gray (5Y 4/1), Core catcher only.

MAJOR LITHOLOGIES

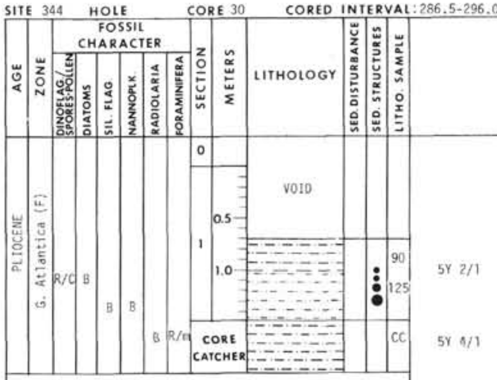
a) MUD (Smear CC)

10% Sand	20% Quartz
45% Silt	5% Feldspar
45% Clay	5% Mica
	1% Heavy minerals
	3% Opaques
	64% Clay minerals
	1% Glauconite
	1% Carbonate

b) NANNOFOSSIL OOZE (Smear CC)

1% Sand	4% Quartz, Feldspar
14% Silt	95% Nannofossils
85% Clay	

SITE 344 **HOLE** **CORE** 30 **CORED INTERVAL:** 286.5-296.0 m



LITHOLOGIC DESCRIPTION

Colors: olive gray (5Y 4/1), olive black (5Y 2/1). Brittle fracturing, lithified. Fragments show synsedimentary structures, convolutes? contorted, random order, possible graded beds. Dolerite pebble (1 cm).

MAJOR LITHOLOGIES

a) SANDY MUD/MUDSTONES (Smears 1-90, 1-125, CC)

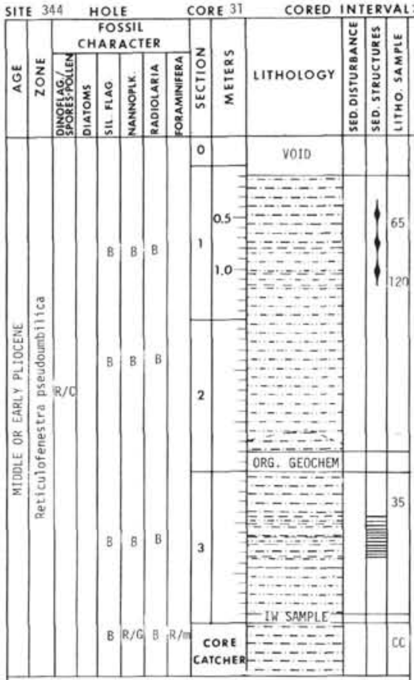
	Texture
at 1-90	40% Sand, 35% Silt, 25% Clay
at 1-125	15% Sand, 25% Silt, 60% Clay
at CC	50% Sand, 30% Silt, 20% Clay

Composition
15-70% Quartz
5-10% Feldspar
2- 5% Mica
TR- 1% Heavy minerals
5-10% Opaques
20-55% Clay minerals
TR- 2% Glauconite
0-15% Carbonate

Carbon-Carbonate (DSDP)
1-120 (1.7, 0.5, 10)

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 31 CORED INTERVAL: 315.0-324.5 m



LITHOLOGIC DESCRIPTION

Colors: grayish black (N2), olive black (5Y 2/1). Probably continuation of Core 30 - core series that is "baked" zone of basalt from Core 34.

Sec. 1 - no deformation, but brittle fracturing (fissile sandy mudstone), internal distortions, bioturbation, synsedimentary structure (all disorientated); (83-102 cm) = 4-5 cm graded beds of sandy muds;

Sec. 2 - massive sandy mud, no structures, with drill blocks;

5Y 2/1

Sec. 3 - clay clast, convolutes, internal fractured; (45-140 cm) - series of sandy muds, variable thicknesses.

MAJOR LITHOLOGY

SANDY MUD/MUDS (MUDSTONES) (Smears 1-65, 1-120, 3-35, CC)

2-10% Sand	25-60% Quartz
20-60% Silt	5-20% Feldspar
40-70% Clay	2- 5% Mica
	2- 5% Heavy minerals
	3-10% Opaques
	5-44% Clay minerals
	1% Glauconite
	2-10% Carbonate
	TR- 5% Nannofossils

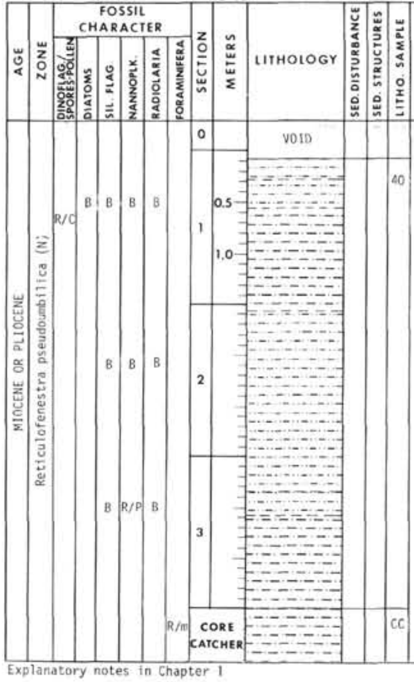
N2

Carbon-Carbonate (PP)
31-2 (top) (0.79, 0.24)
31-2 (bottom) (0.54, 0.42)

Grain Size (DSDP)
1-110 (4.9, 54.3, 40.7)
2-64 (3.5, 55.7, 40.8)
2-124 (2.7, 54.4 42.9)
3-190 (0.6, 50.0, 49.4)

X-Ray (BP)
3-83
40% Ill.
24% Kaol.
36% Chlo.
A Quar.
P Micas, Plag.

SITE 344 HOLE CORE 32 CORED INTERVAL: 343.5-353.0 m



Explanatory notes in Chapter 1

LITHOLOGIC DESCRIPTION

Olive gray (5Y 4/1), olive black (5Y 2/1) continuation of baked zones. Muds show brittle fracture, mudstones with clasts of sandy mud, great internal brecciation with contortions, convolutes, disoriented, claystone clasts, bioturbation. Scattered 1-2 cm pebbles.

MAJOR LITHOLOGIES

a) MUDSTONE (Smear 1-40)

0-10% Sand	10-30% Quartz, Feldspar
20-40% Silt	10% Mica, Heavy minerals
40-80% Clay	40-80% Clay minerals

5Y 2/1

b) SANDY MUDSTONE (Smear CC)

40% Sand	40% Quartz
30% Silt	15% Feldspar
30% Clay	3% Mica
	12% Heavy minerals
	30% Clay minerals

Carbon-Carbonate (DSDP)
2-74 (1.0, 0.9, 1)

5Y 2/1

Grain Size (DSDP)
2-44 (6.9, 52.5, 40.6)

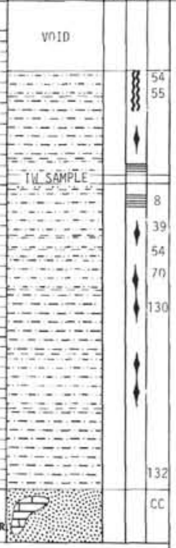
X-Ray (BP)
2-78
43% Ill. Mixed layer (Mont./Ill.)
57% K/C
A Quar.

5Y 4/1

P Micas, Plag.

SITE HOLE CORE 33 CORED INTERVAL: 372.0-377.5 m

AGE	ZONE	DINOFLAG./SPORES-POLLEN	DIATOMS	SIL. FLAG.	NANNOPLK.	RADIOLARIA	FORAMINIFERA	SECTION	METERS	LITHOLOGY	SED. DISTURBANCE	SED. STRUCTURES	LITHO. SAMPLE	
MIOCENE OR EARLY PLIOCENE	Reticulofenestra pseudoumbilica (N)							0		VOID				
								1	0.5				54 55	5Y 2/1
				B	B	B			1.0					5Y 2/1 5YR 2/1
										IW SAMPLE				
		B/B	B					2					8 39 54 70 130	5Y 2/1 5YR 2/1 N3
				B	B	B								
				B	R/p	B		3						5Y 2/1
				B	R/p	B							132	
				B	B	B	R/p	CORE CATCHER					CC	5YR 4/1



LITHOLOGIC DESCRIPTION

Brownish black (5YR 2/1), olive black (5Y 2/1).

Sec. 1 (40-62 cm) - claystone or fine-grained mudstone with irregular spaced thin laminae of calc./phos. mudstone (N3), some fine (<5 mm) burrows extending out from calc. mudstone laminae; (62-125 cm) - massive, extensively bioturbated mudstone, no stratification or layering or structures, coarser than overlying unit. Large variety burrows (1.5 cm), clear halo type (1.5 cm), filled with light/dark material, local diapiric deformation; (125-140 cm) - thinly stratified-laminated mudstone, claystone, lighter areas burrowed. Possible *Chondrites* - synsedimentary folds = wavy lamination.

Sec. 2 (0-75 cm) - very thin stratified-thinly laminated claystone, calcareous laminae, wavy laminations, nodules or concretions in calc. laminae, tabular-shaped burrows filled with calc. material, scattered throughout - possible graded bedding turbidites = DE; (75-100 cm) - massive mudstone, no structures/lamination, except burrows, mottling, including *Chondrites* burrows; (100-150 cm) - claystone with irregular, flat laminae of calc. mudstone/siltstone, small circular oval nodules of calc. sed., some small burrows and calc. fracture fillings (possible *Helminthoida*), calc. nodules ref. calcite from below.

Sec. 3 (15-70 cm) - massive mudstone, structureless, with rhomboid(?) shaped burrows and diapirs?; (70-150 cm) - gradational to massive sandy mudstone, structureless, micaceous mottling, no burrows.

Entire sequence of 33 = turbidites(?) or fining upward cycle. Coarser massive at 33-3-150, 33-2-100, 33-1-125 = density interflows.

LITHOLOGIES
SANDY MUDSTONE (Smears 2-54, 2-130)
MUDSTONE (Smears 1-55, 2-70)
SILT (Smears 2-8, 2-39) (Minor Lithology)
SAND (Smears 3-132, CC)

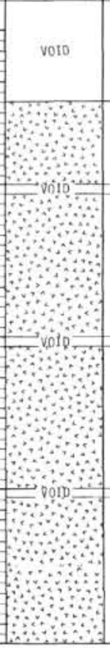
Carbon-Carbonate (DSDP)
2-48 (1.7, 1.5, 1)

X-Ray (BP)

34%	Ill.	Mixed layer (Mont./Ill.)
65%	K/C	
A	Quar.	
P	Micas, Plag.	

SITE 344 HOLE CORE 34 CORED INTERVAL: 377.5-387.0 m

AGE	ZONE	DINOFLAG./SPORES-POLLEN	DIATOMS	SIL. FLAG.	NANNOPLK.	RADIOLARIA	FORAMINIFERA	SECTION	METERS	LITHOLOGY	SED. DISTURBANCE	SED. STRUCTURES	LITHO. SAMPLE
								0					
								1	0.5 1.0	VOID			
										VOID			
								2					
										VOID			
								3					
										VOID			
								4					



LITHOLOGIC DESCRIPTION

BASALT
Sec. 1 (108-150 cm) - medium dark gray (N5) holocrystalline medium-grained diabase (dolerite) with abundant pyrite and rare chlorite amygdules. Calcite veins.

Thin Section (114-117) - diabasic and ophitic (poikilitic) texture, medium-fine grained; plagioclase (35-40%), pyroxene (45-55%), uralite, talc, carbonate.

Sec. 2 (10-150 cm) - medium gray (N5) to dark medium gray (N4) diabase; abundant pyritization. Calcite veins (0.5-15 mm) with small crystals of pyrite. Rare slickensides with calcite and pyrite on walls.

Thin Section - poikilitic (gabbroic), diabase and ophitic textures, fine-medium grained. Plagioclase (40-50%), pyroxene (augite) (30-50%), amphibole, talc, chlorite, calcite.

Sec. 3 (10-150 cm) - medium dark gray holocrystalline diabase with calcification and pyritization. Abundant white calcite veins and slickensides with pyrite.

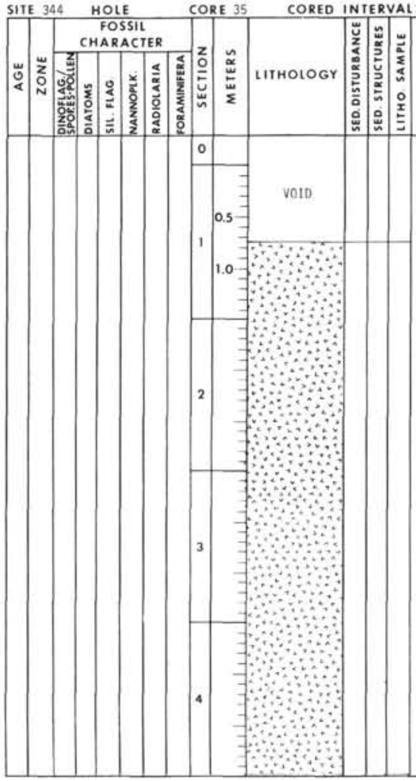
Thin Section - poikilitic, diabasic, ophitic, medium grained. Plagioclase (40-50%), pyroxene (40-55%), amphibole, talc, chlorite, calcite, pyrite.

Sec. 4 - calcite veins (thick = 2-3 cm) with coarse (0.5-1 cm) calcite crystals. Diabase medium grained (on top) and medium- to coarse-grained (on lower part of section). Pyritization and calcification on all sections.

Thin Section - medium grained (1-5 mm), poikilitic, diabasic, ophitic texture. Plagioclase (40-60%), pyroxene (25-50%), amphibole, talc, chlorite, calcite, pyrite.

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 35 CORED INTERVAL: 387.0-395.0 m



LITHOLOGIC DESCRIPTION

BASALT

Sec. 1 (75-125 cm) - diabase is similar to Core 34; (125-150 cm) - drill pebbles of diabase.

Thin Section - medium grained, holocrystalline, poikilitic, ophitic, diabase. Plagioclase (40-50%), pyroxene (40-45%), amphibole, talc(?), chlorite, calcite, pyrite.

Sec. 2 - medium dark gray diabase, calcite veins, slickensides; (100-150 cm) - massive diabase with calcite veins and pyrite.

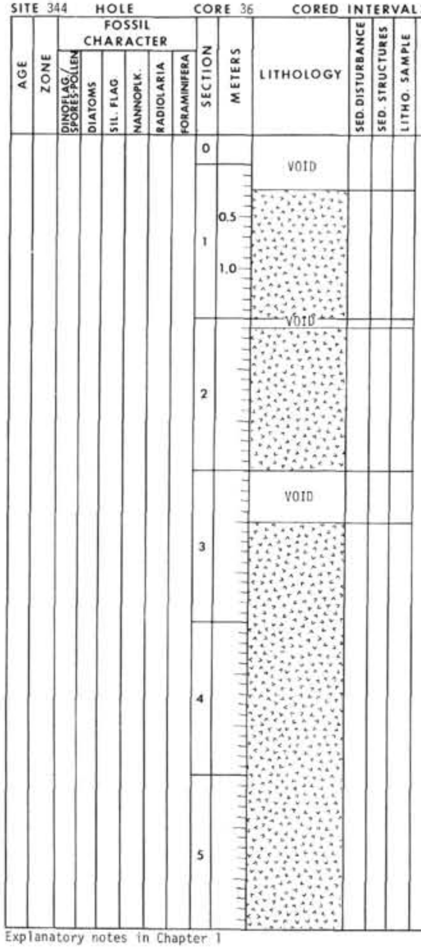
Thin Section - as per Sec. 1, with biotite.

Sec. 3 - massive diabase, medium to medium-coarse grained with rare calcite veins and slickensides; (110-120 cm) - two drills pebbles of fine-grained diabase (basalt) with abundant pyrite.

Thin Section - as per Sec. 1, pyroxene cyrstals (4-6 mm).

Sec. 4 - medium dark gray (N4) diabase, holocrystalline medium to medium-coarse grained with pyroxene crystals (4-6 mm). Pyritization and calcification on all sections plus slickensides with chlorite.

SITE 344 HOLE CORE 36 CORED INTERVAL: 395.0-404.5 m



LITHOLOGIC DESCRIPTION

BASALT

Sec. 1 (23-150 cm) - medium grav (N5) massive diabase, heterogenous, medium- to coarse- grained. Black crystals of pyroxene and light gray calcification areas, pyritization is common. Slickenside.

Thin Section - holocrystalline medium-coarse grained, poikilitic, diabasic, ophitic. Plagioclase (40-45%), pyroxene (45-55%), amphibole, talc(?), chlorite, calcite, pyrite.

Sec. 2 (10-150 cm) - massive diabase, heterogenous to coarse grained with crystals of pyroxene in (5-10 mm) and small laths of plagioclase (2-3 mm long). Calcification and pyritization.

Thin Section - as per Sec. 1, plagioclase (50-60%), pyroxene (35-40%), pyrite, amphibole, talc(?), chlorite, biotite, calcite.

Sec. 3 (50-150 cm) - medium gray to dark gray, heterocrystalline to coarse grained diabase. Pyritization, slickensides.

Thin Section - as per Secs. 1 and 2.

Sec. 4 - dark gray to medium dark gray coarse grained gabbro-diabase (gabbro-dolerite) with dark clinopyroxene aggregates (5-7 mm) and light plagioclase laths (8) cm to bottom is enriched by pyroxene. Pyritization is common.

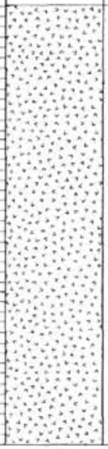
Thin Section - as per Secs. 1-3, amphibole (actimolite), hypidiomorphic granular.

Sec. 5 (17-150 cm) - massive, diabase (gabbro-diabase) is similar to Sec. 4; (17-120 cm) - enriched by pyroxene; (120-150 cm) - amount of pyroxene gradually become less. Pyritization and chloritization are common.

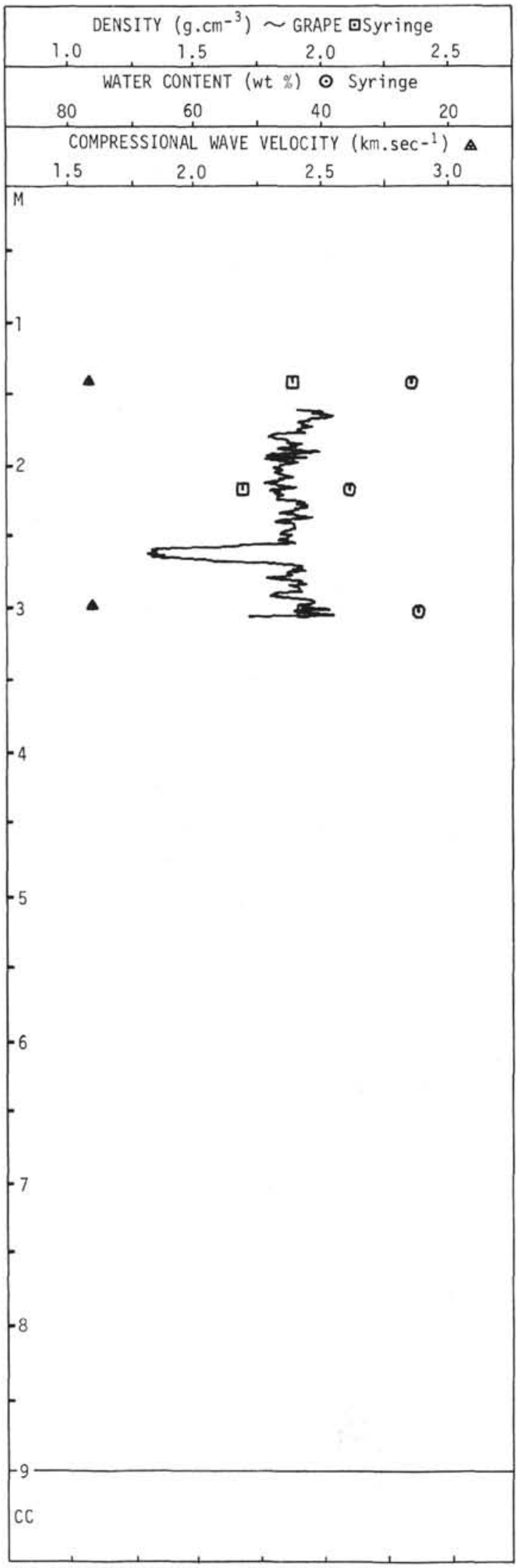
Thin Section - as per Sec. 4.

Explanatory notes in Chapter 1

SITE 344 HOLE CORE 37 CORED INTERVAL: 404.5-414.0 m

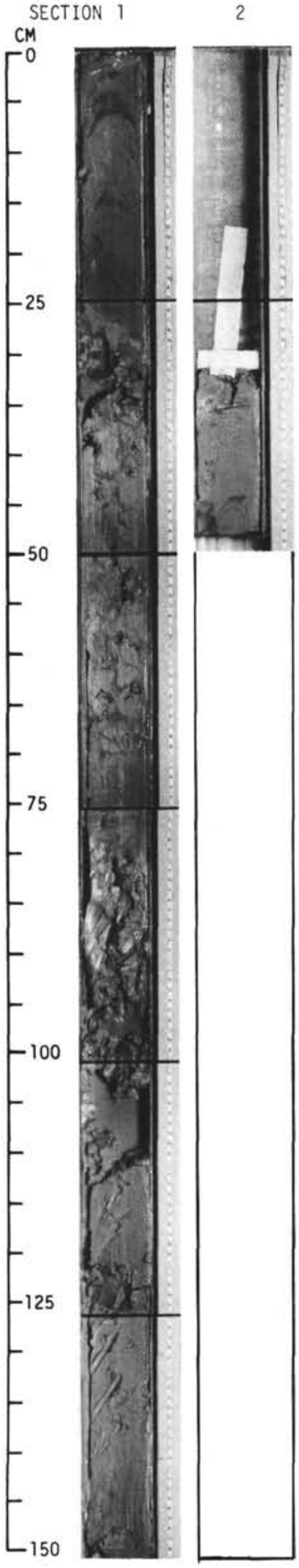
AGE	ZONE	FOSSIL CHARACTER						SECTION	METERS	LITHOLOGY	SED. DISTURBANCE	SED. STRUCTURES	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		DINOFLAG./ SPORES-POLLEN	DIATOMS	SIL. FLAG	NANNOPLK.	RADIOLARIA	FORAMINIFERA							
								0 1 2 3	0.5 1.0	VOID 				BASALT Sec. 1 (20-150 cm) - diabase, coarse grained, heterogenous with pyroxene crystals (3-5 mm) and plagioclase laths. Massive diabase, lower in section. Thin Section - as per Core 36 with magnetite (0-1%). Sec. 2 (60-150 cm) - diabase is the same as above, but with less pyroxene crystals. Pyritized slickensides. Sec. 3 - dark gray, medium-grained, holocrystaline, massive diabase. Pyritization, chloritization, calcification and amphibolization are common. Rare slickensides are observed.

Explanatory notes in Chapter 1



For Explanatory Notes, see Chapter 1

344-2



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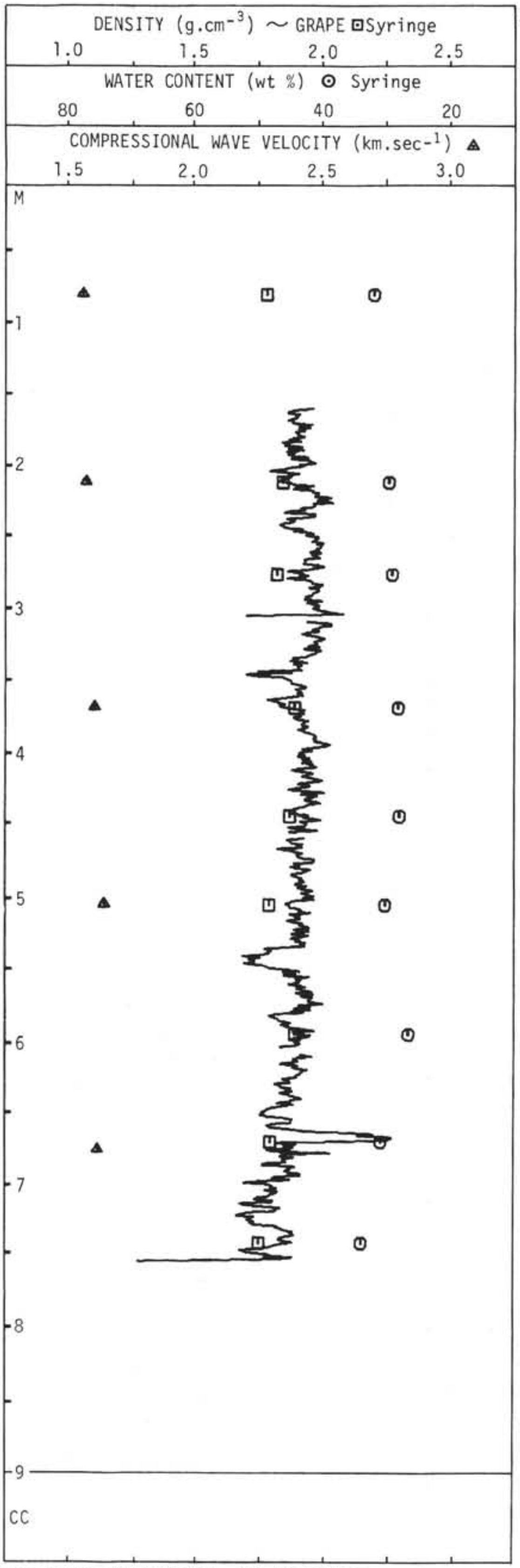
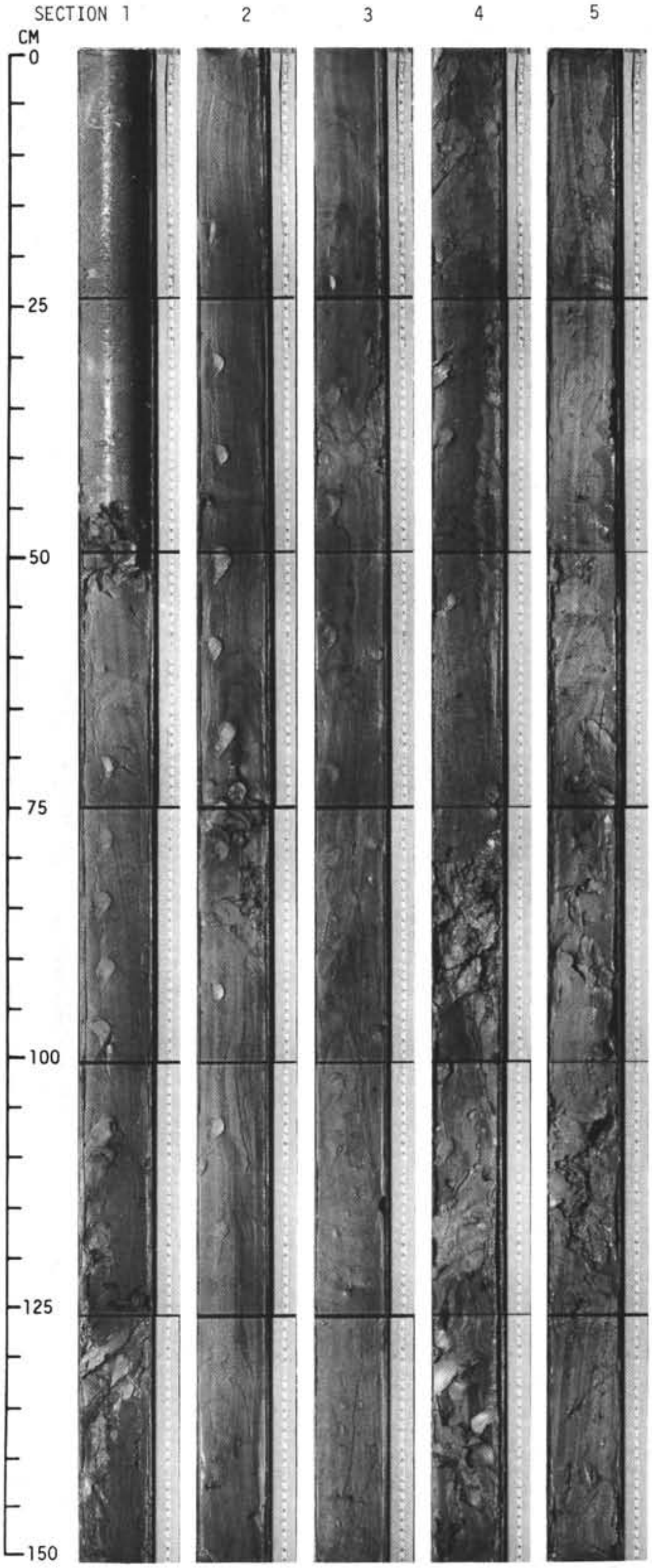


For Explanatory Notes, see Chapter 1



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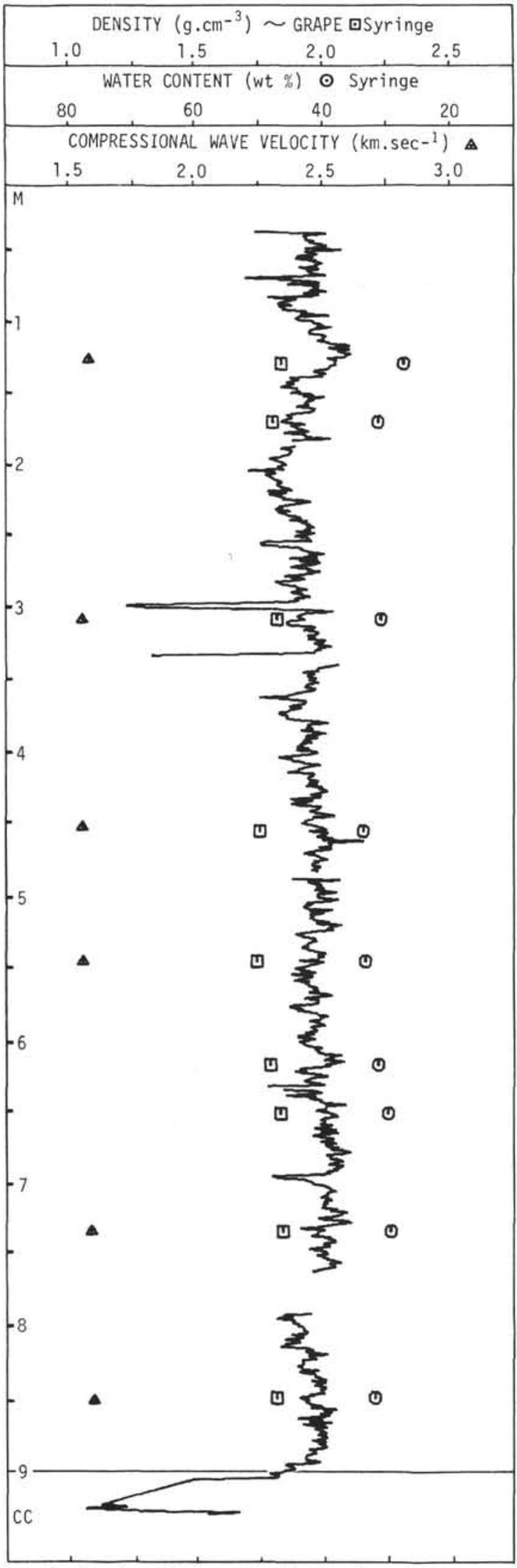
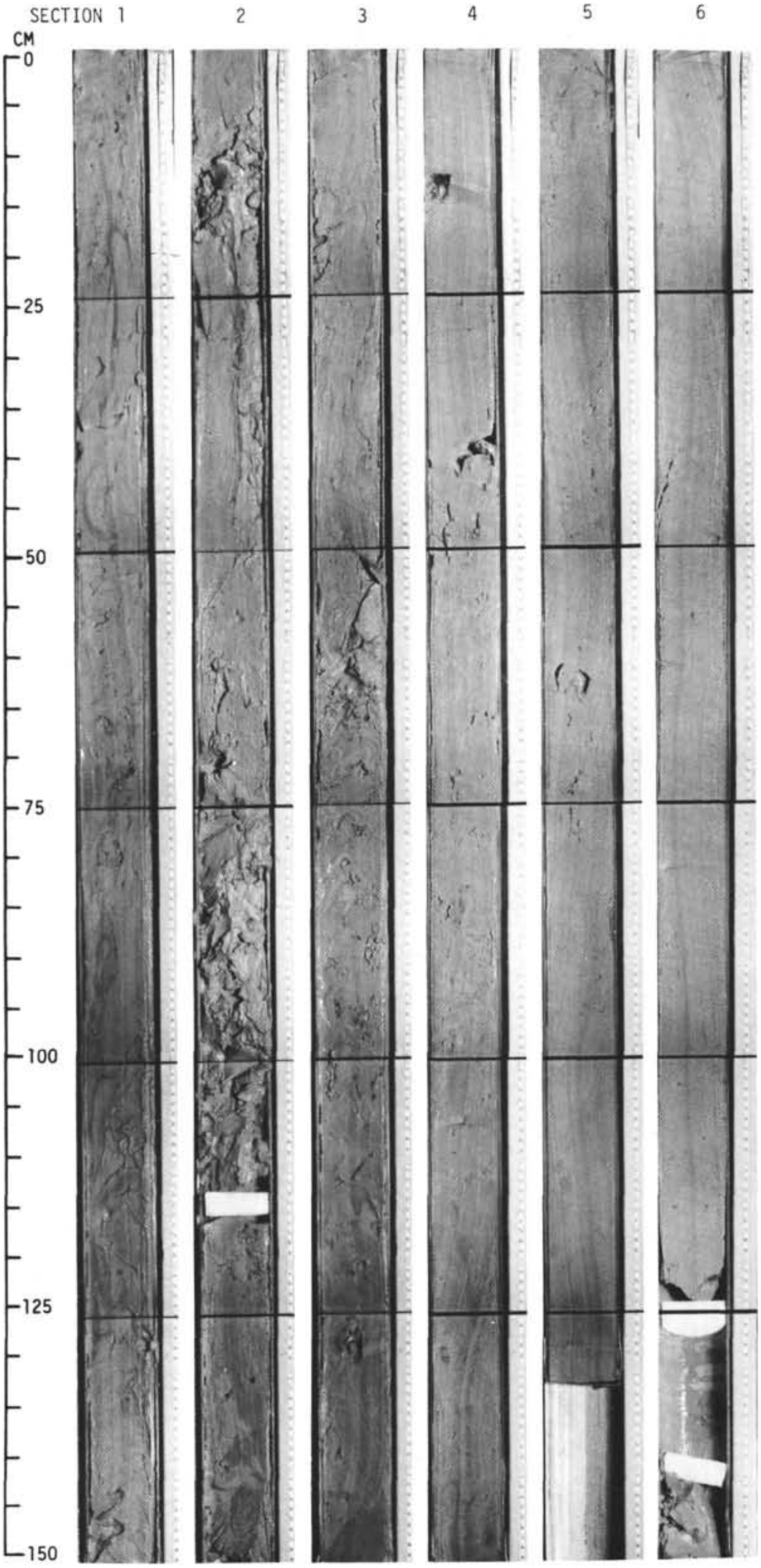
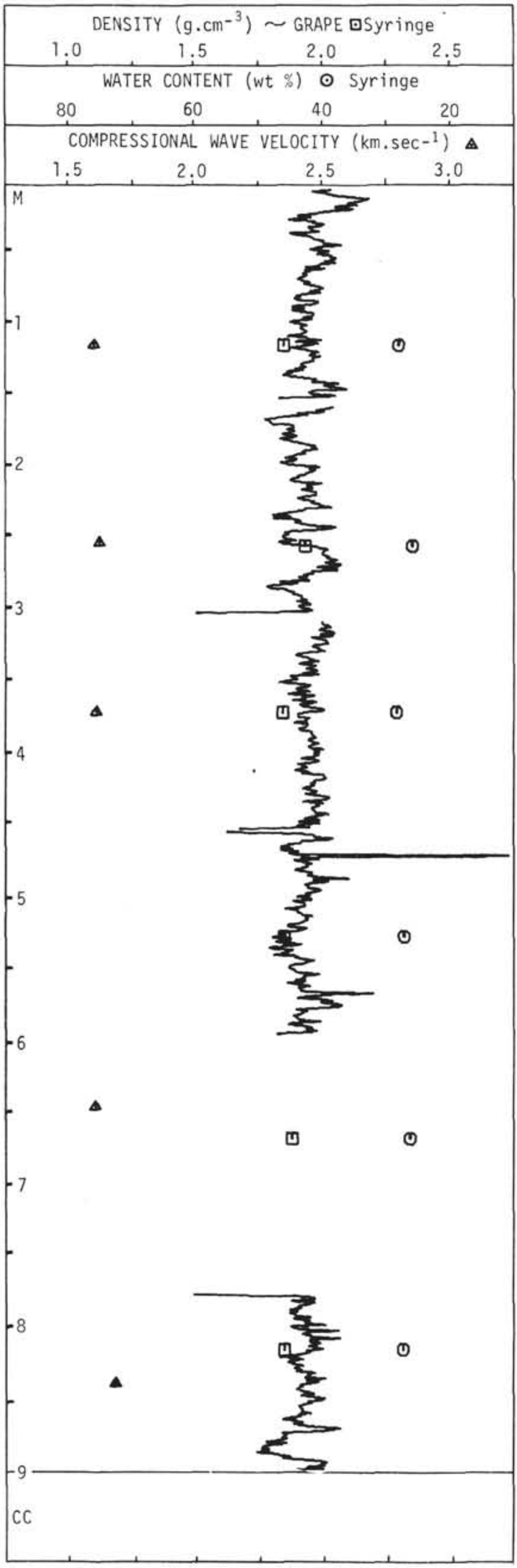


For Explanatory Notes, see Chapter 1





For Explanatory Notes, see Chapter 1

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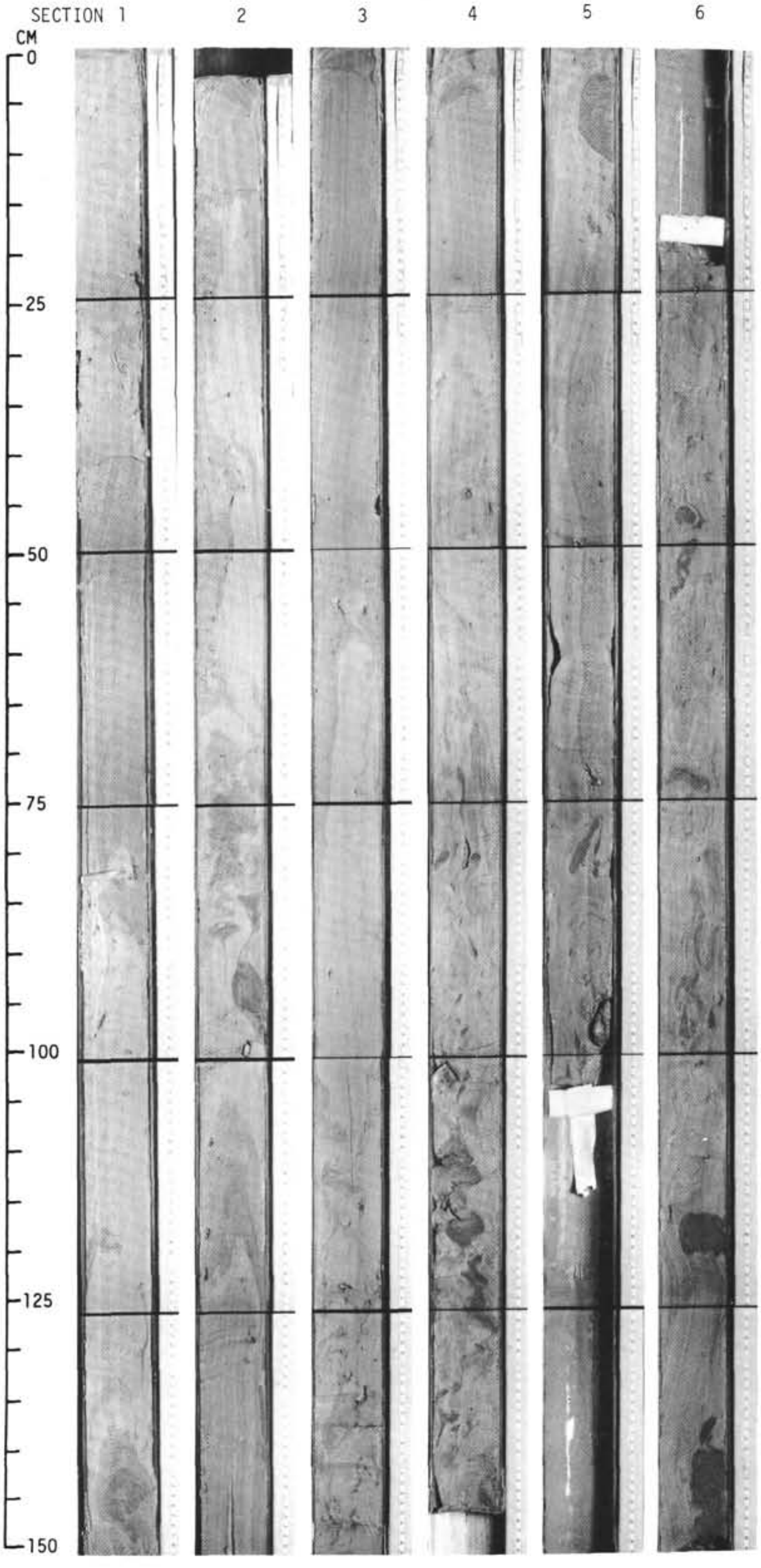

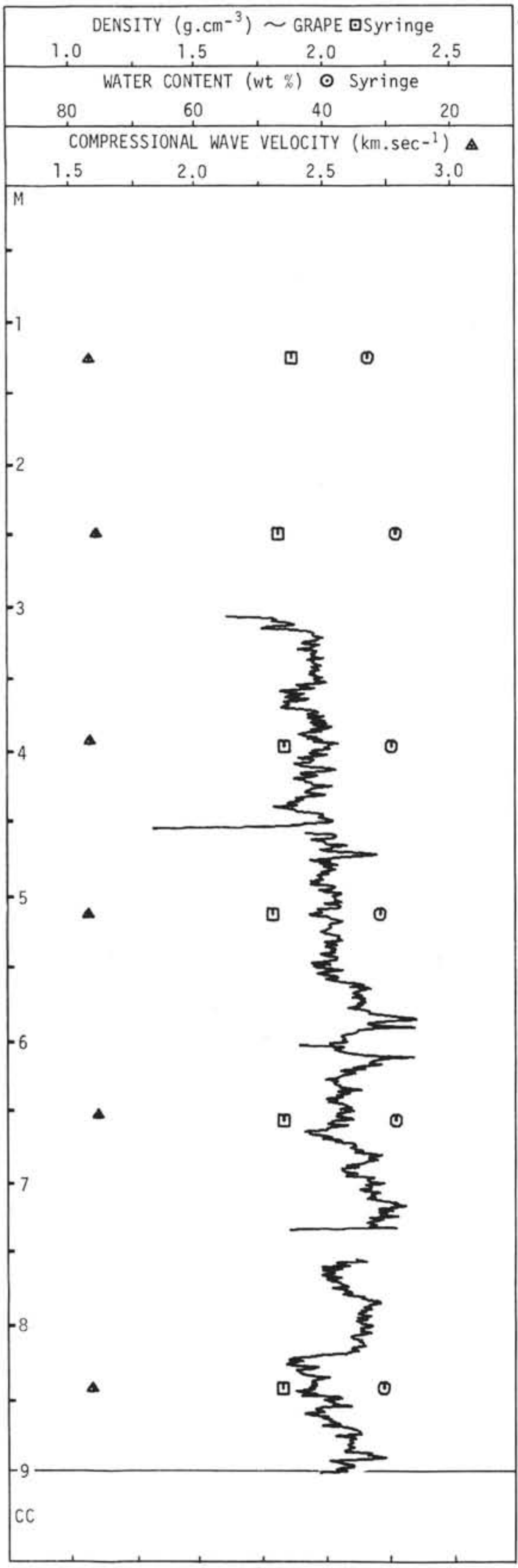

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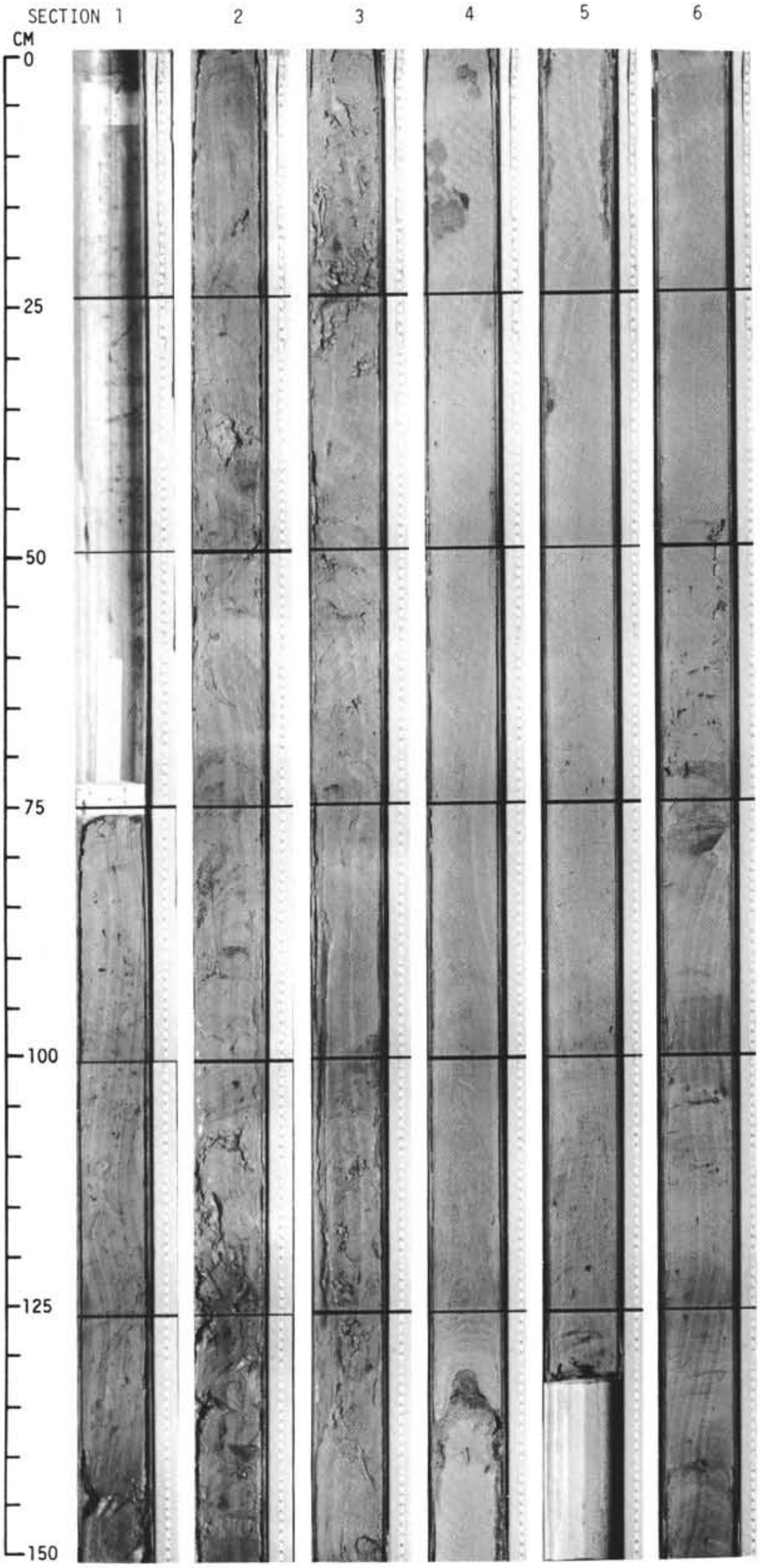

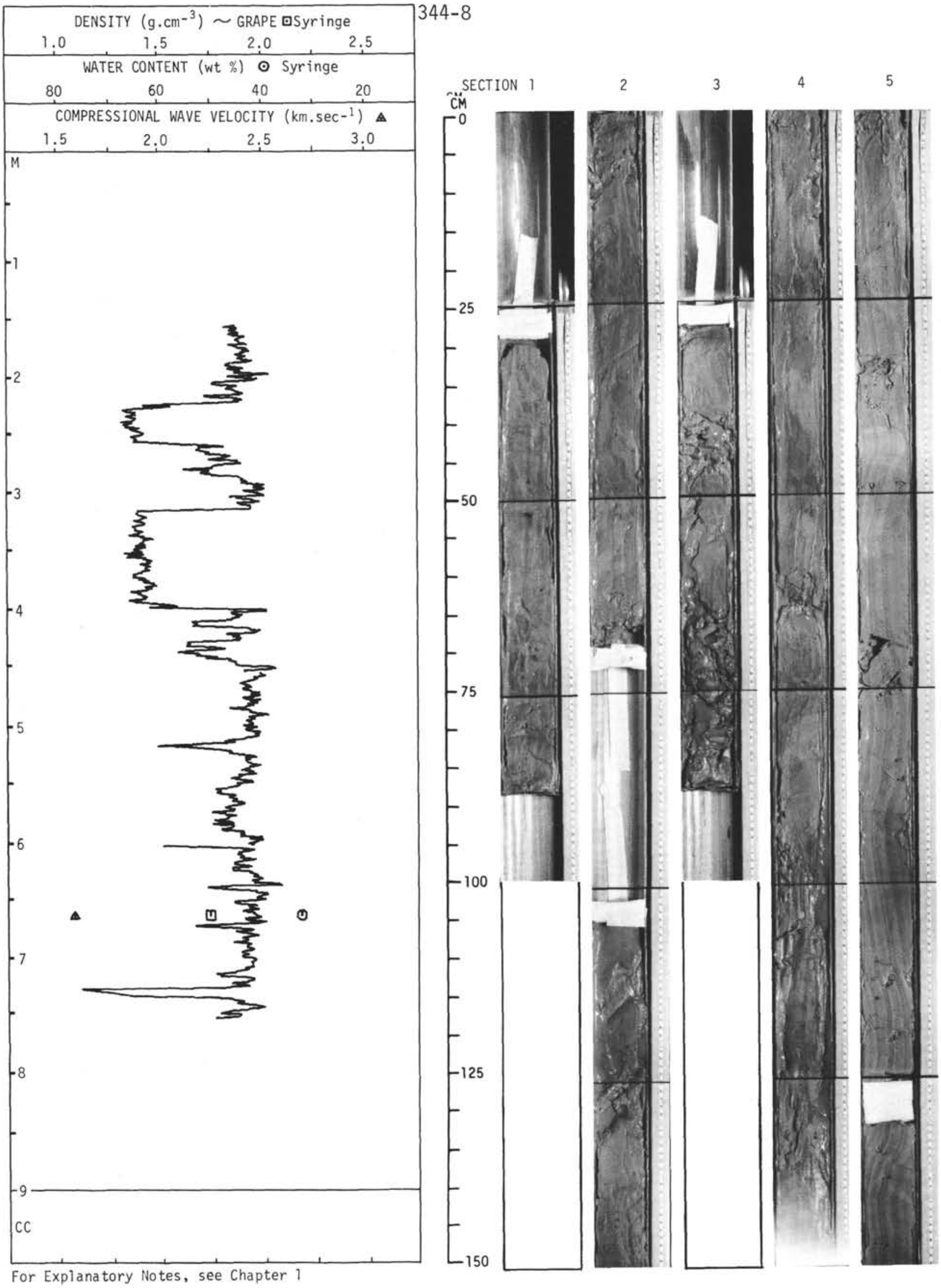

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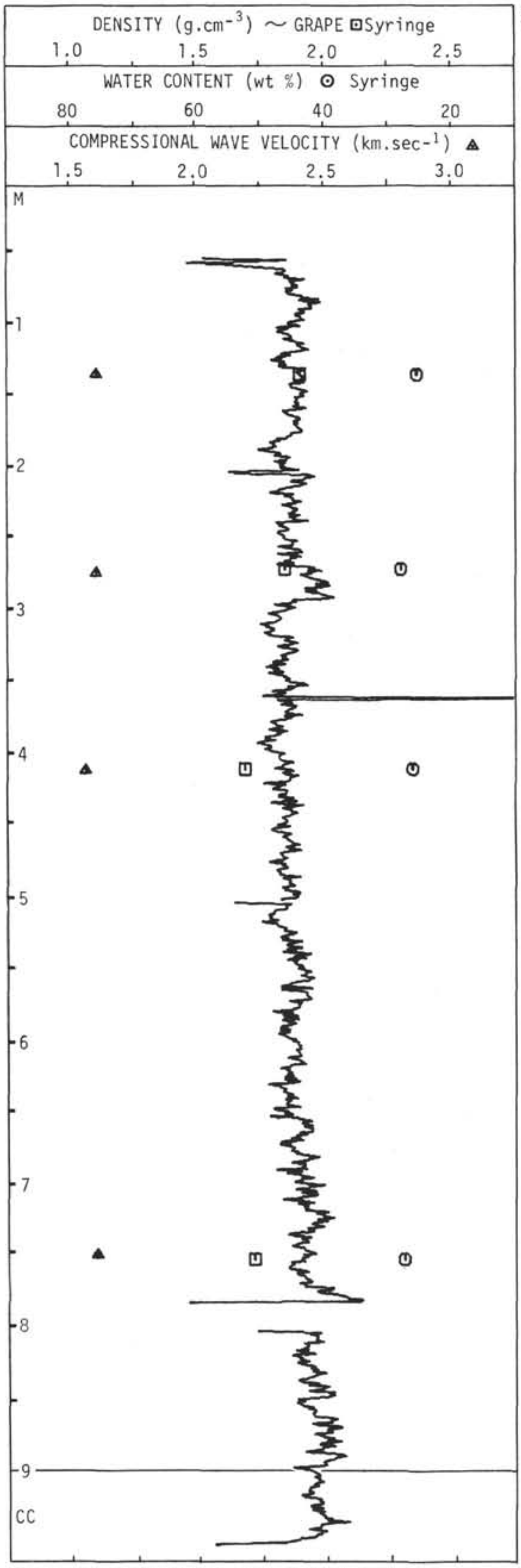
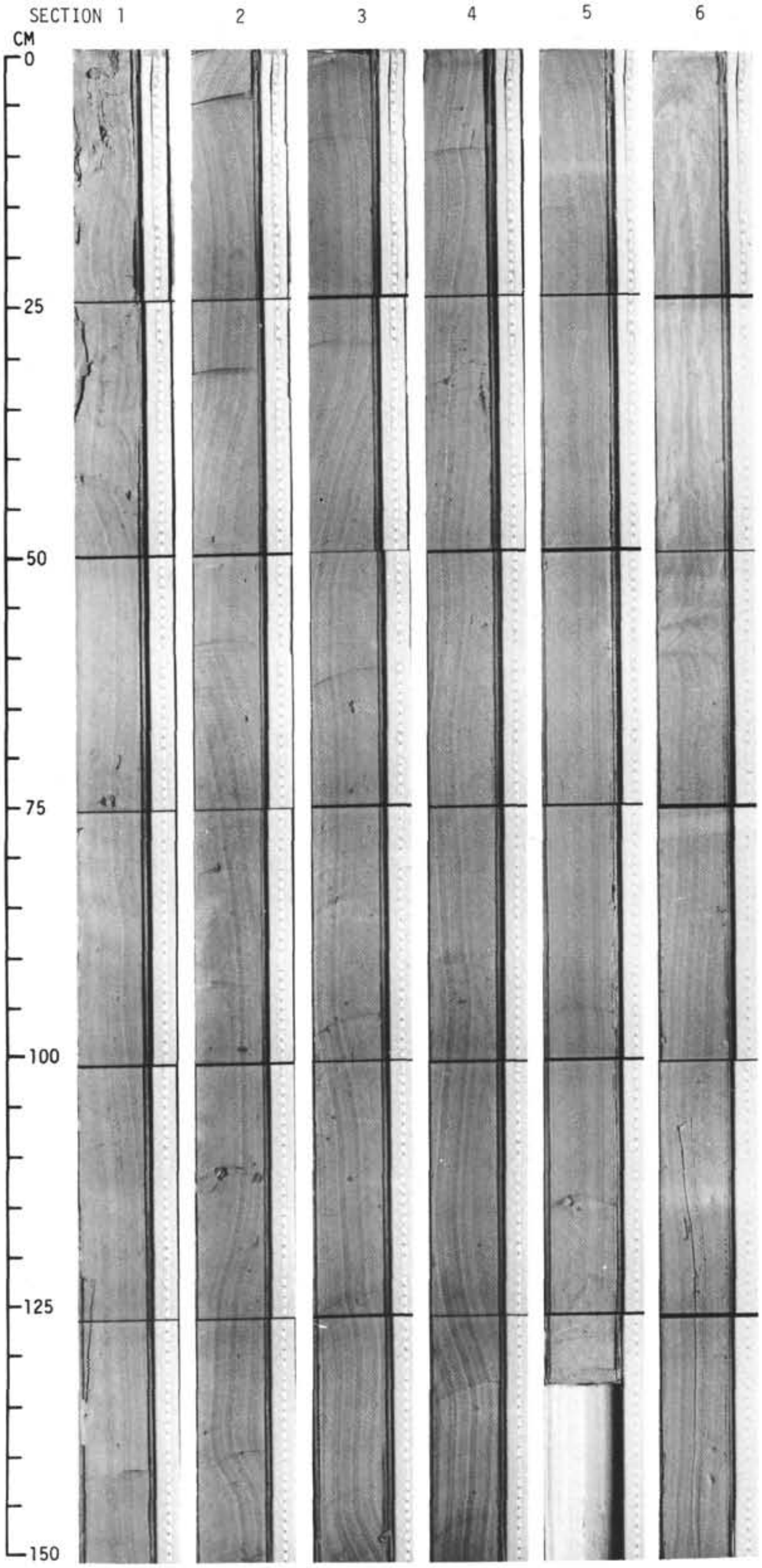
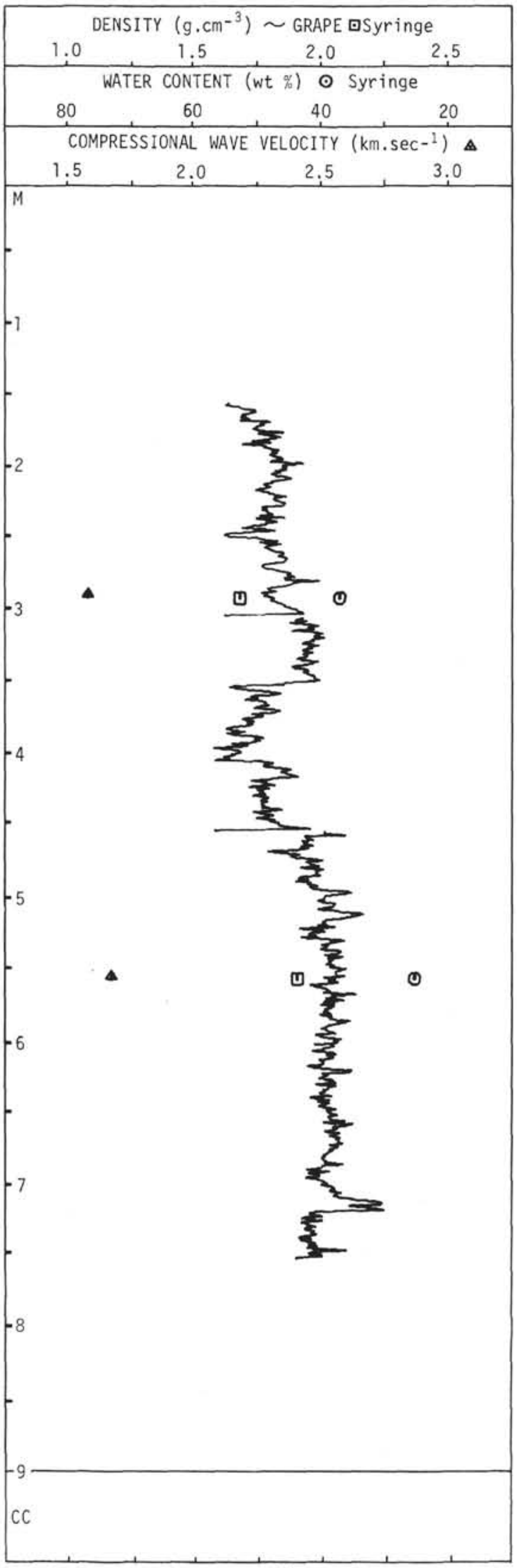
344-9



For Explanatory Notes, see Chapter 1





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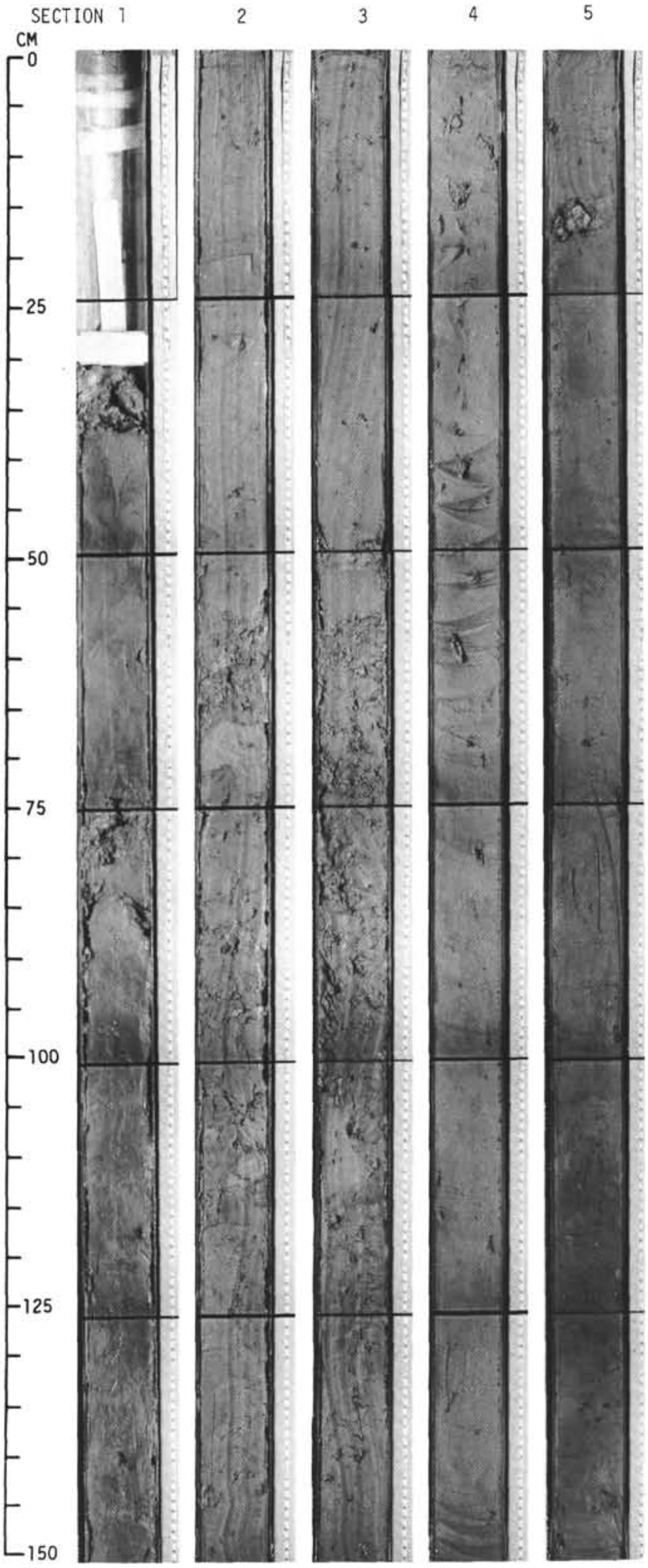
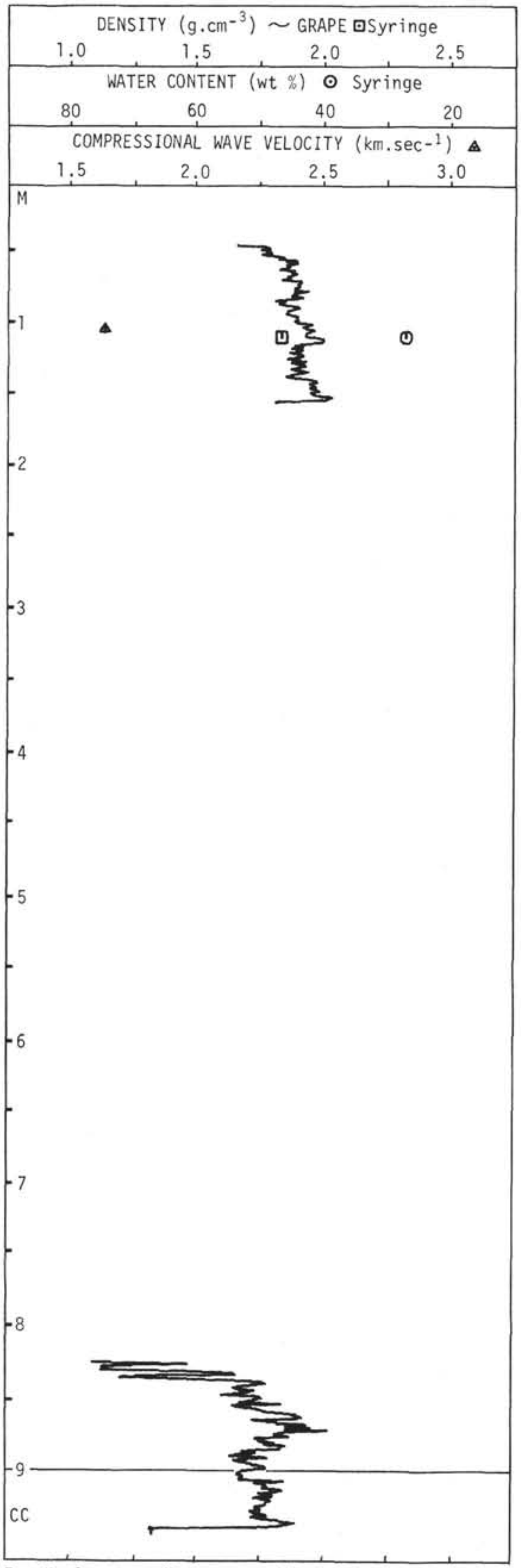
344-10





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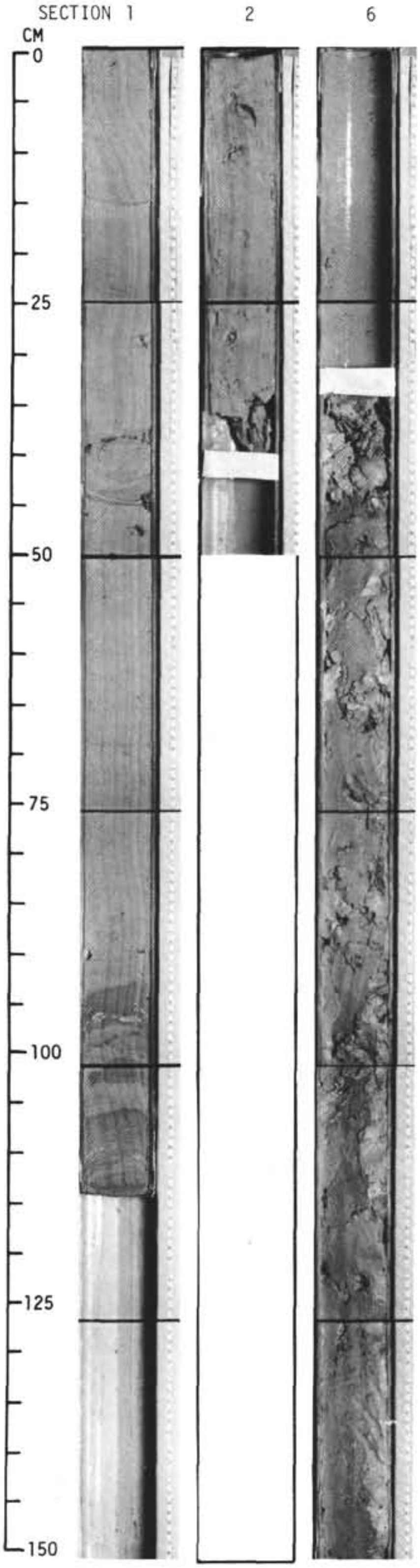
344-11



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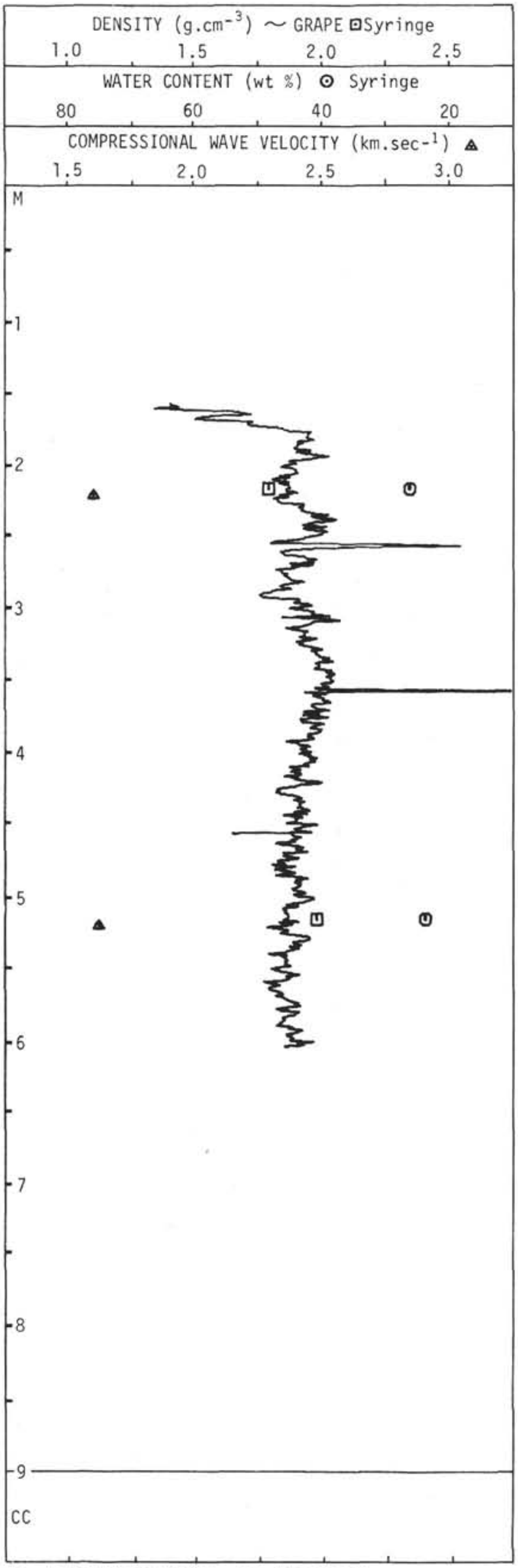

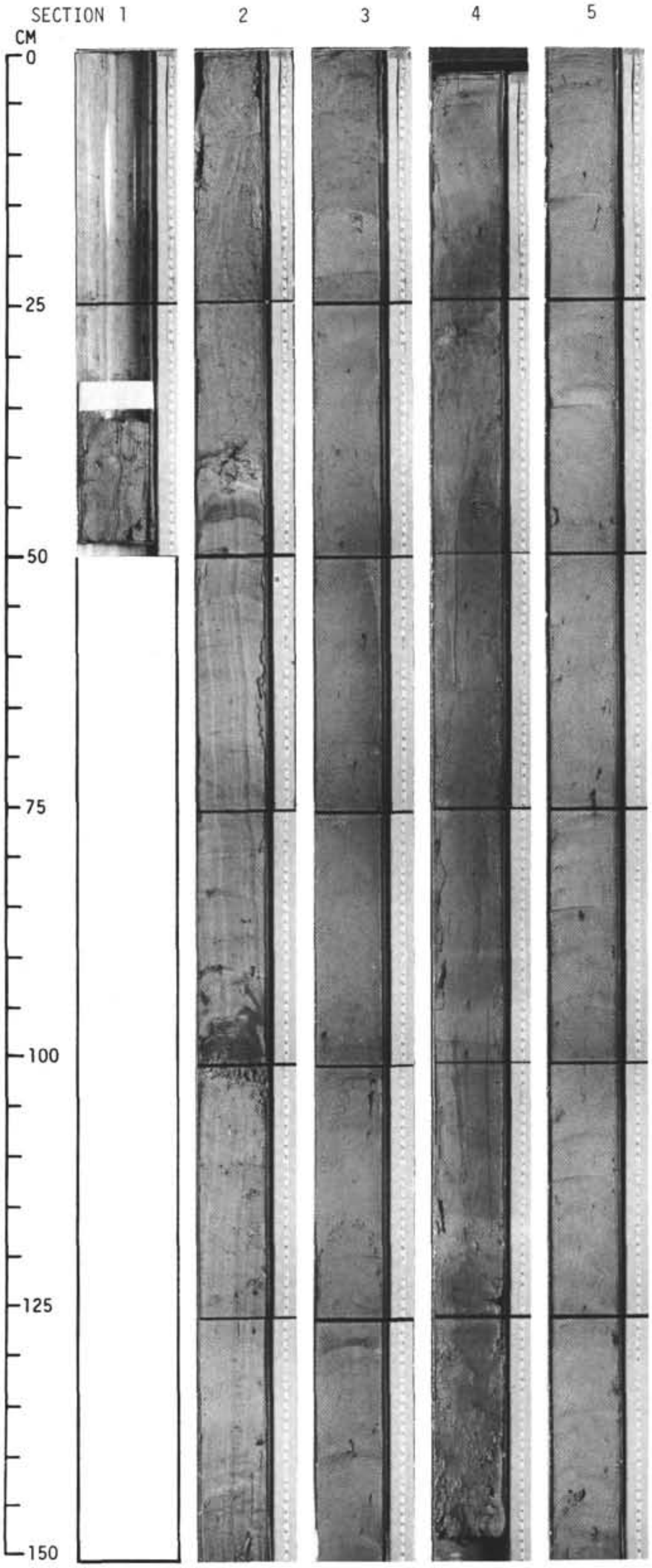

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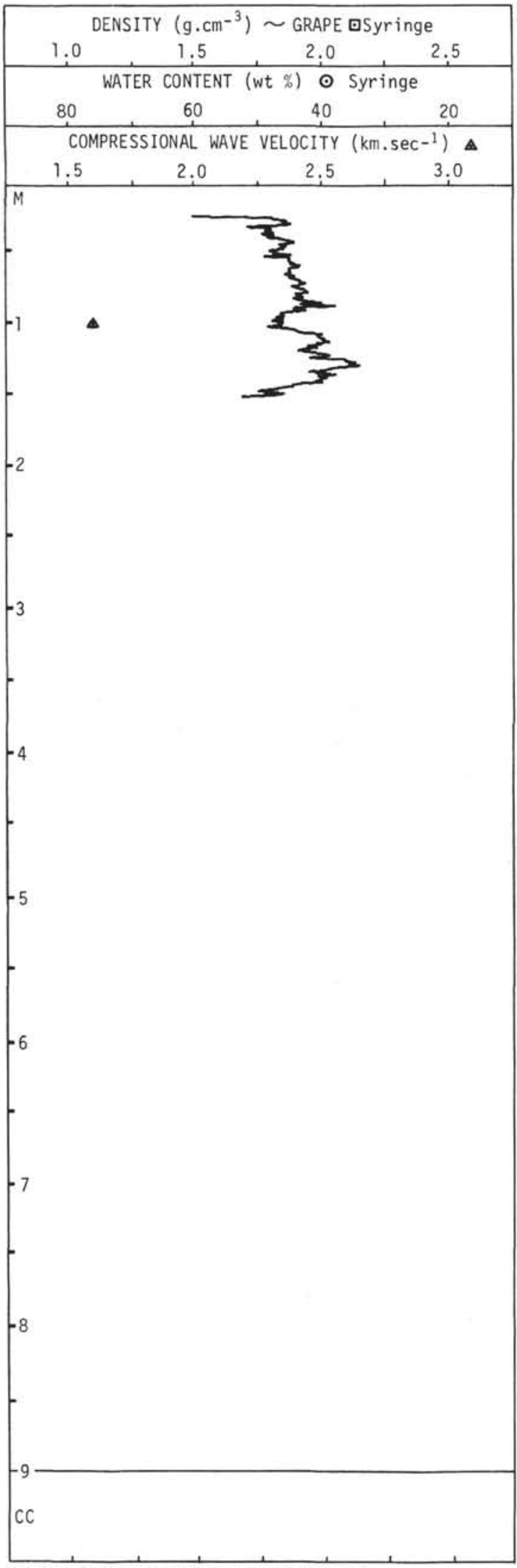
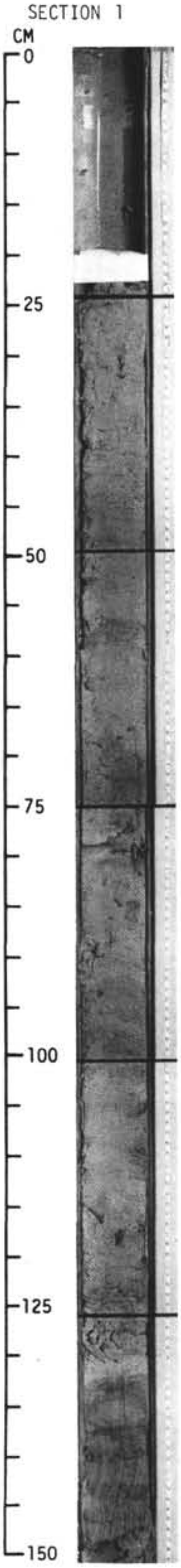
344-13





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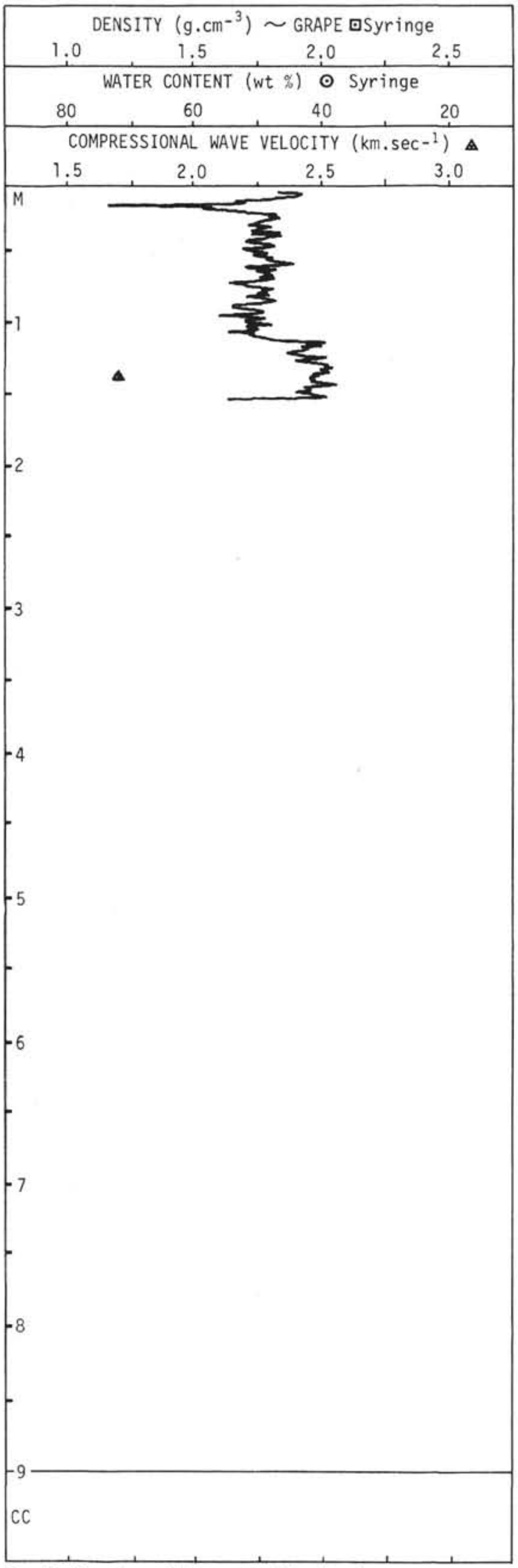

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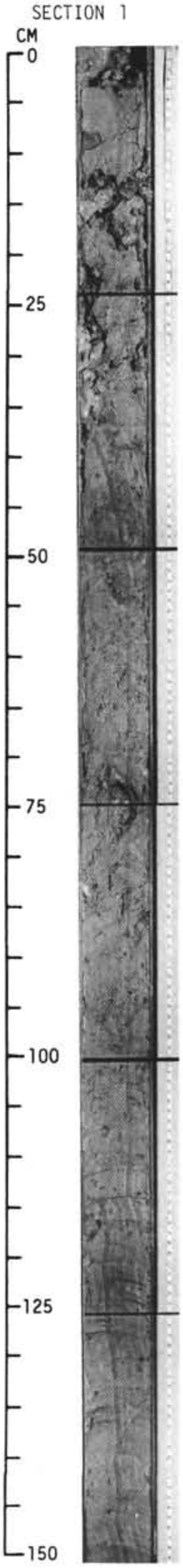

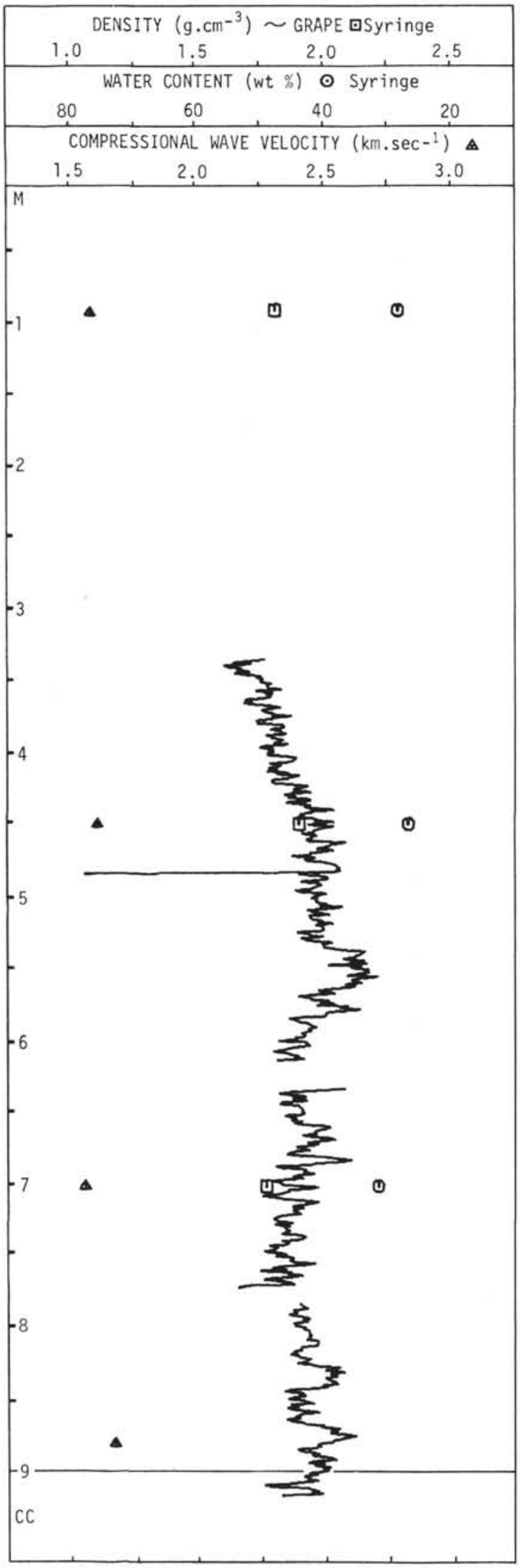

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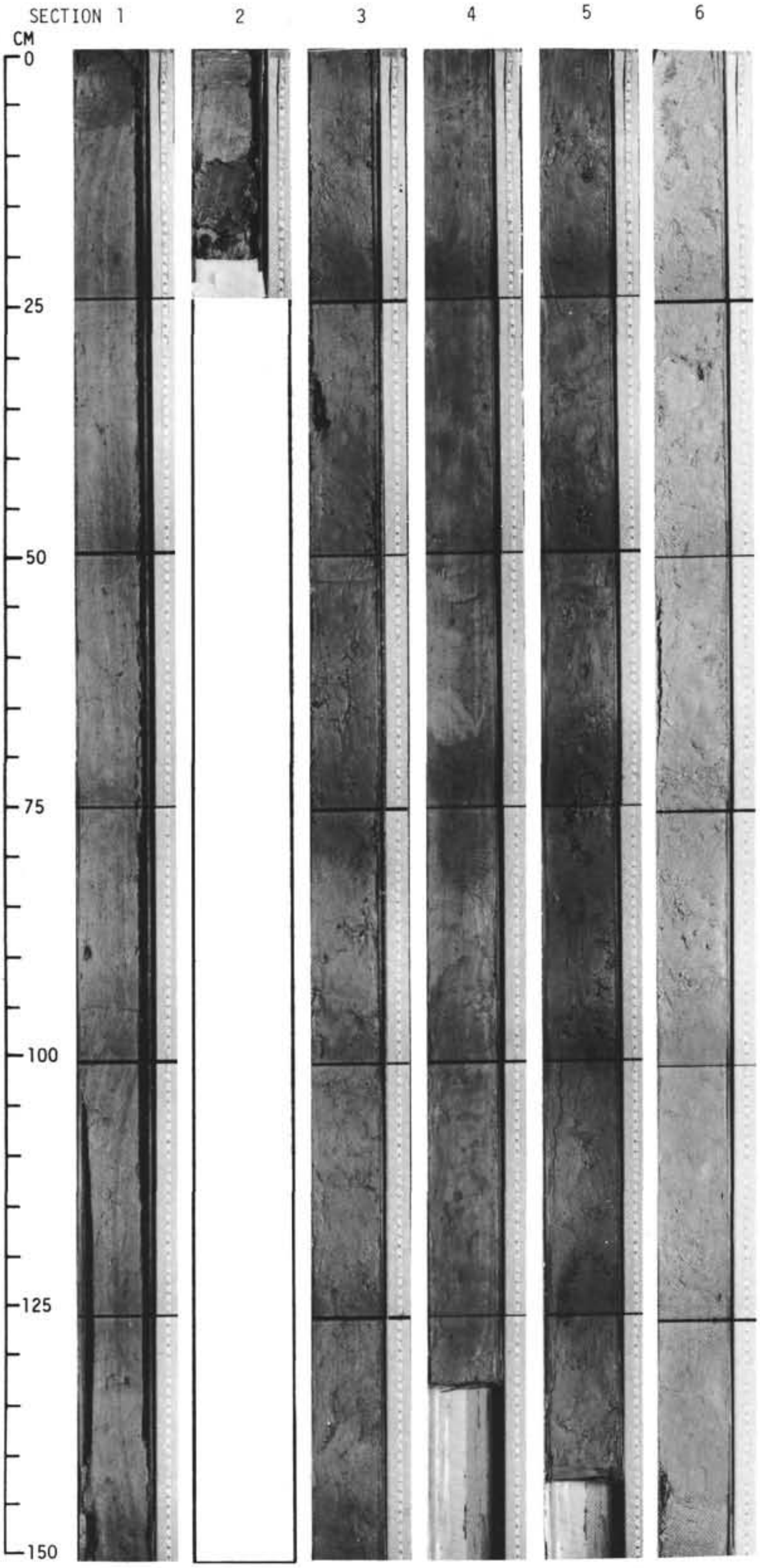
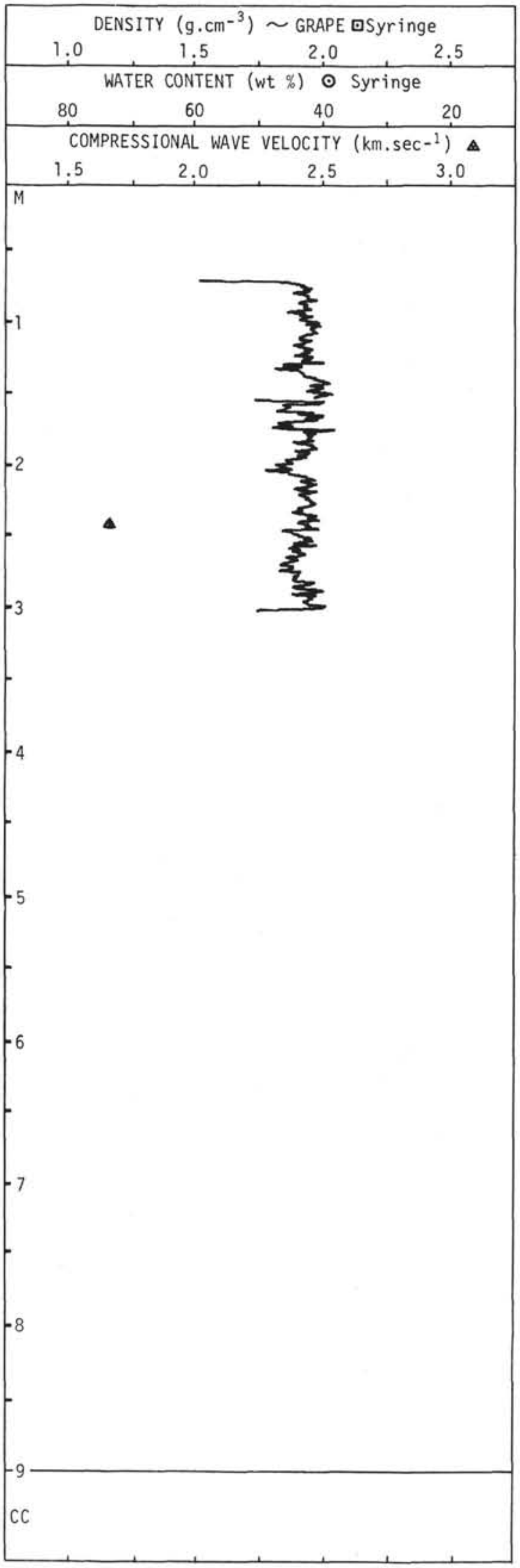
344-15





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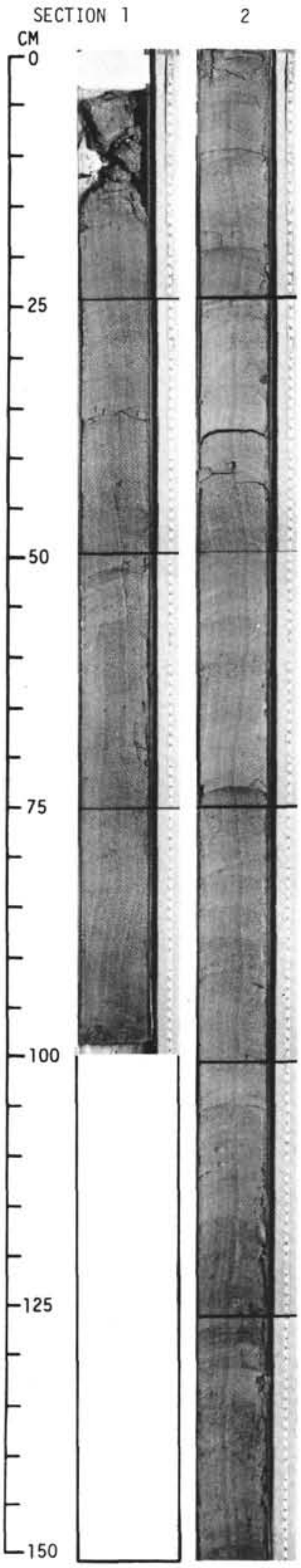
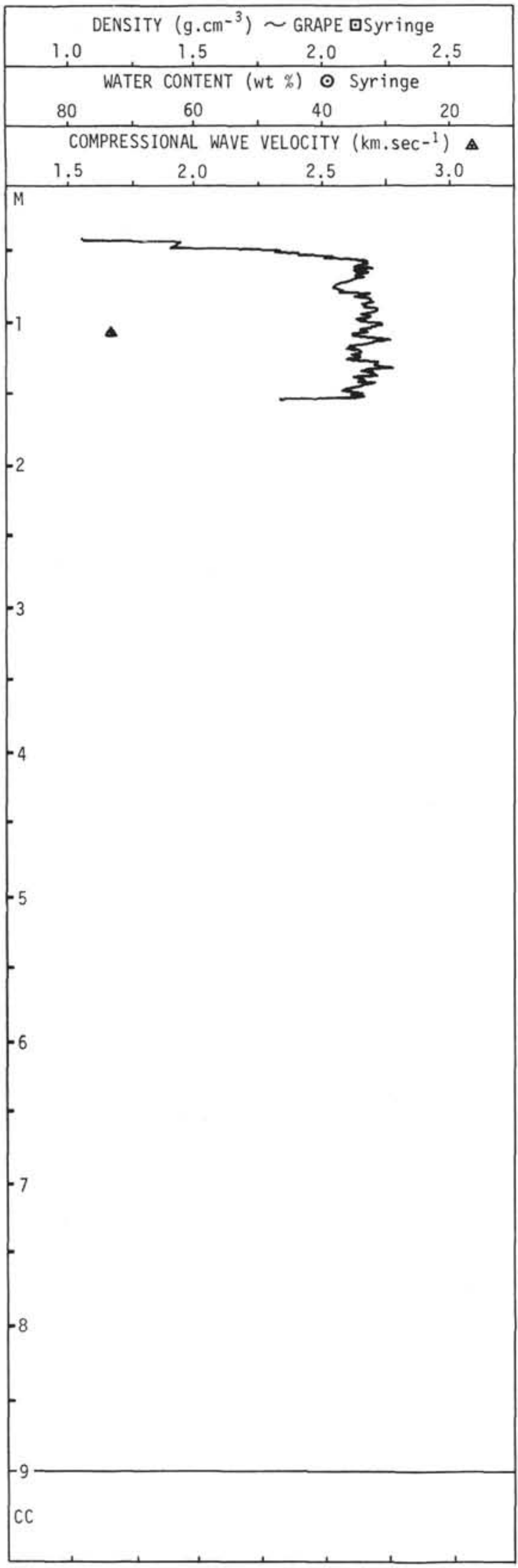
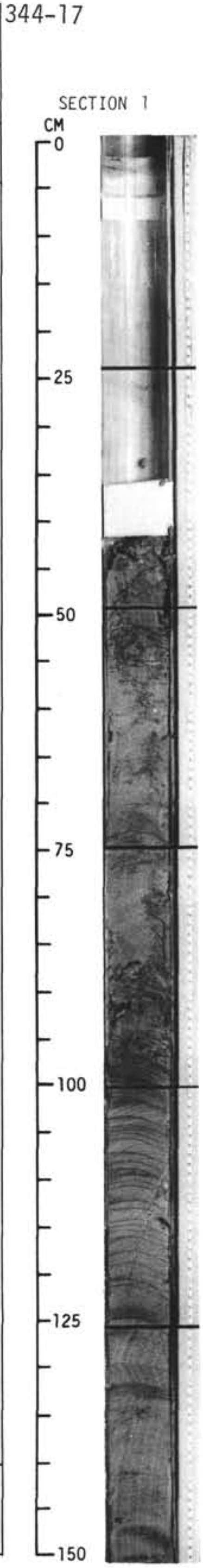
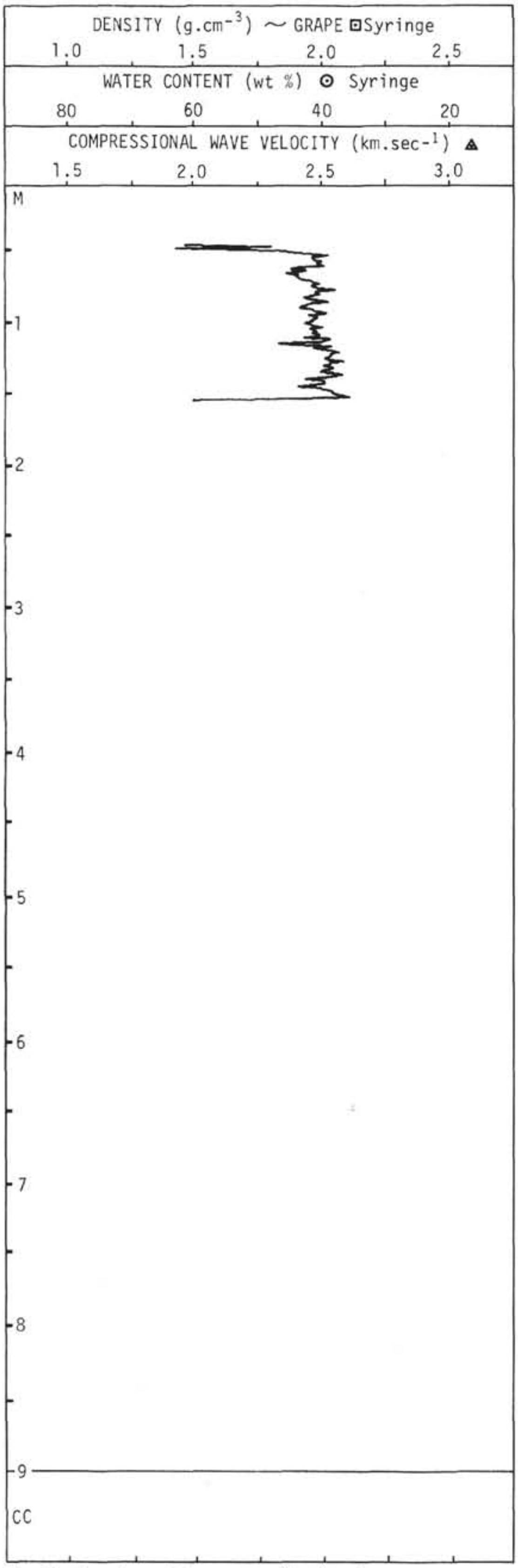
344-16





For Explanatory Notes, see Chapter 1





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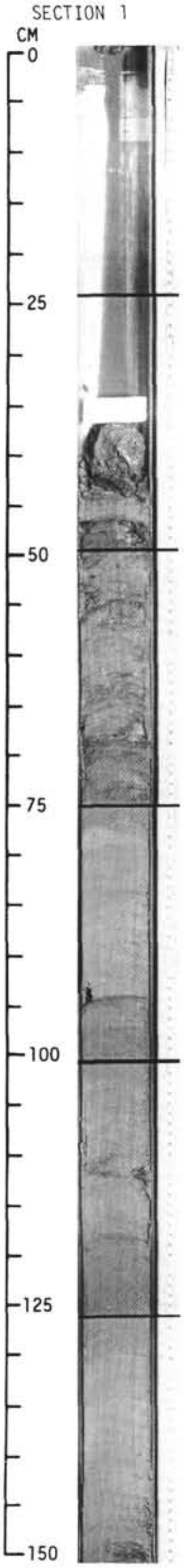
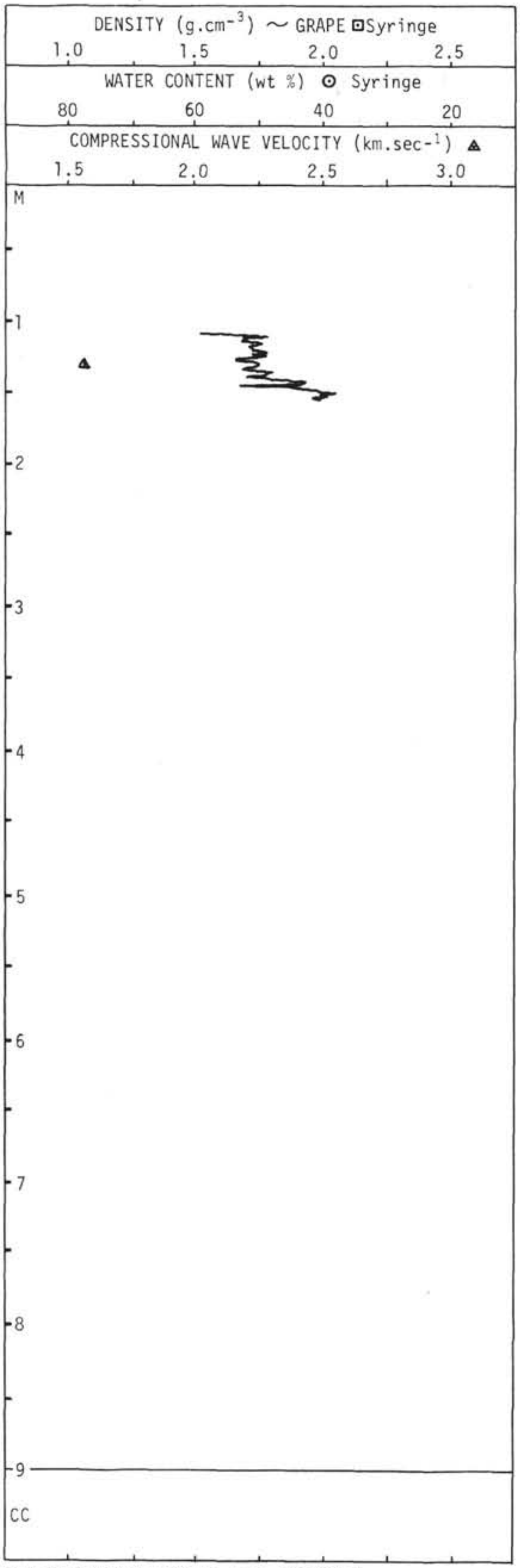
344-18





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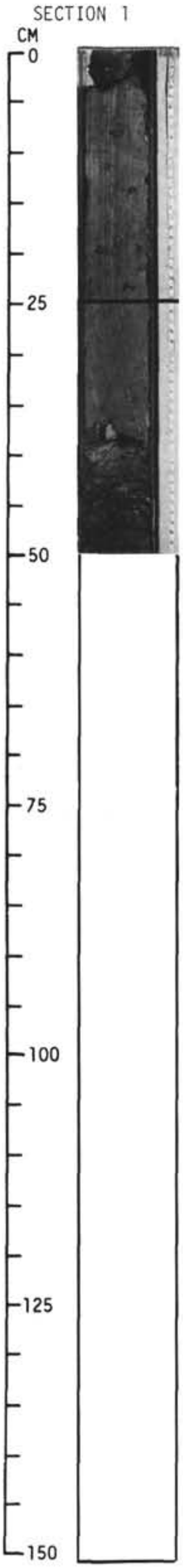
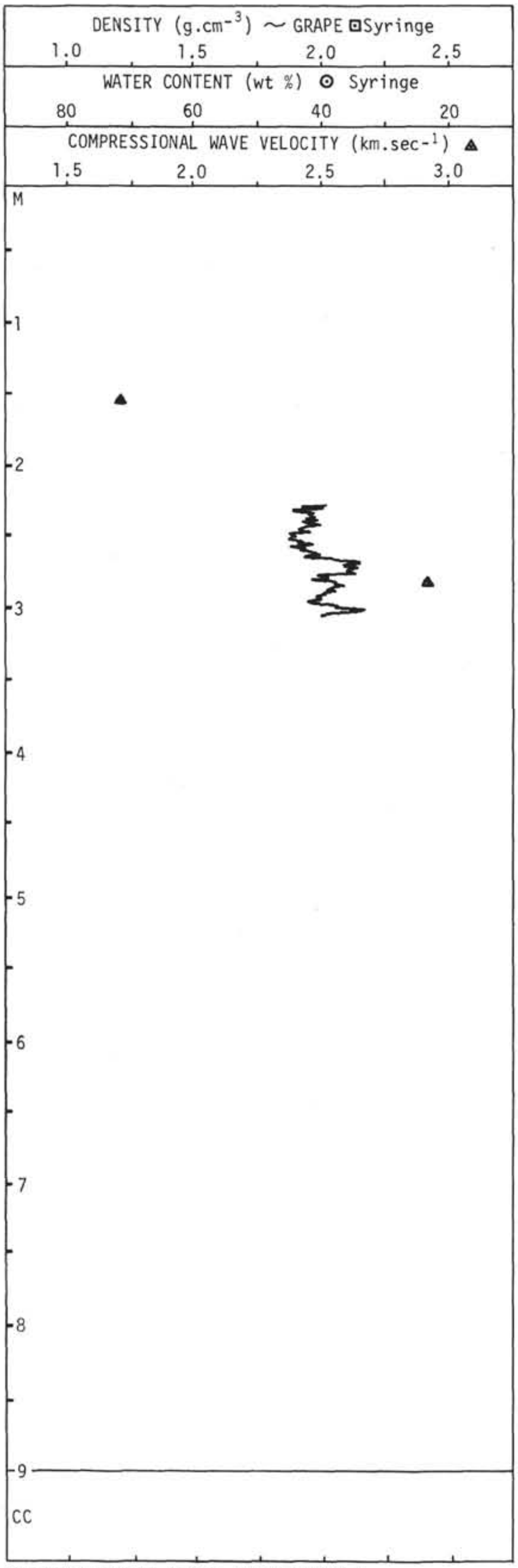
344-20





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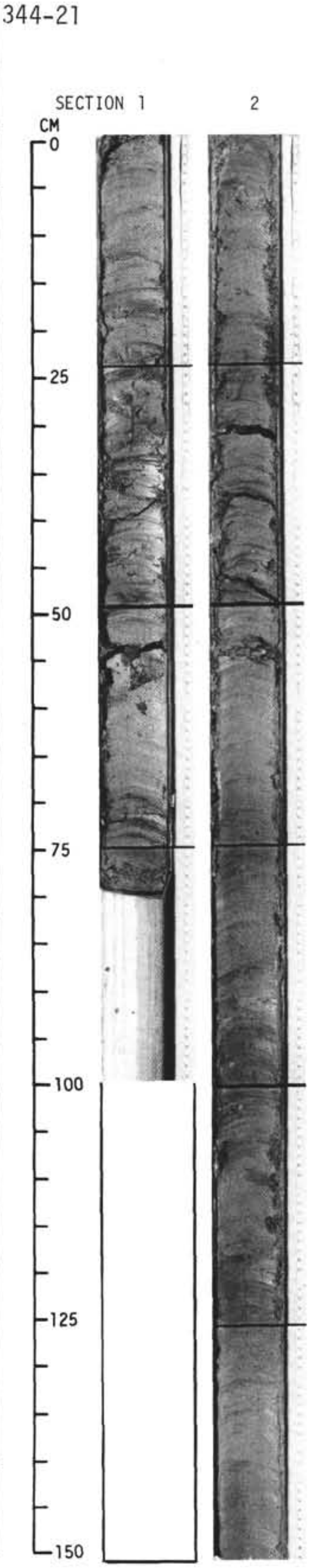

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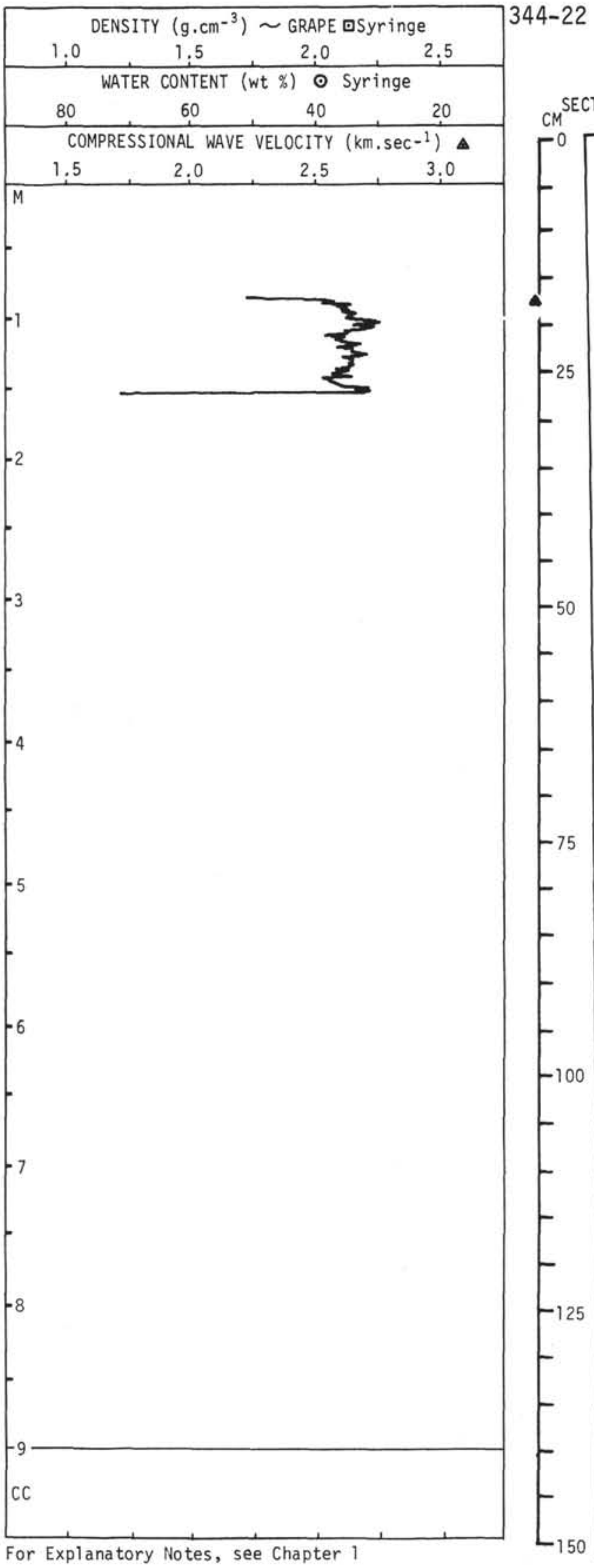

For Explanatory Notes, see Chapter 1

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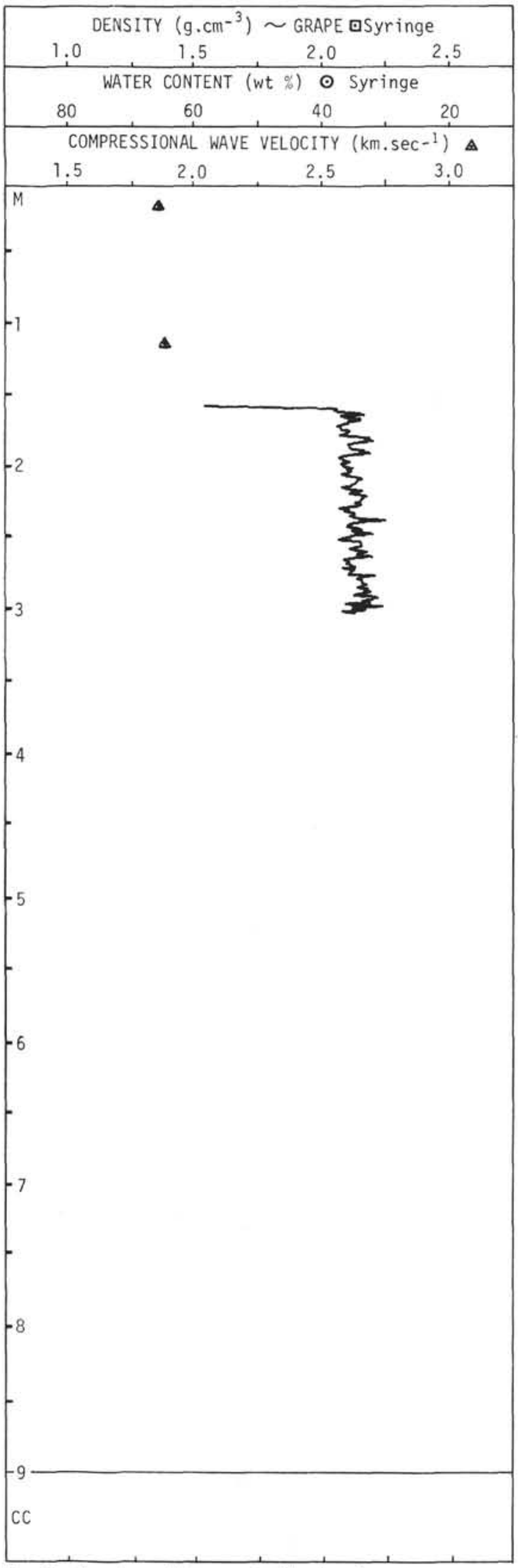
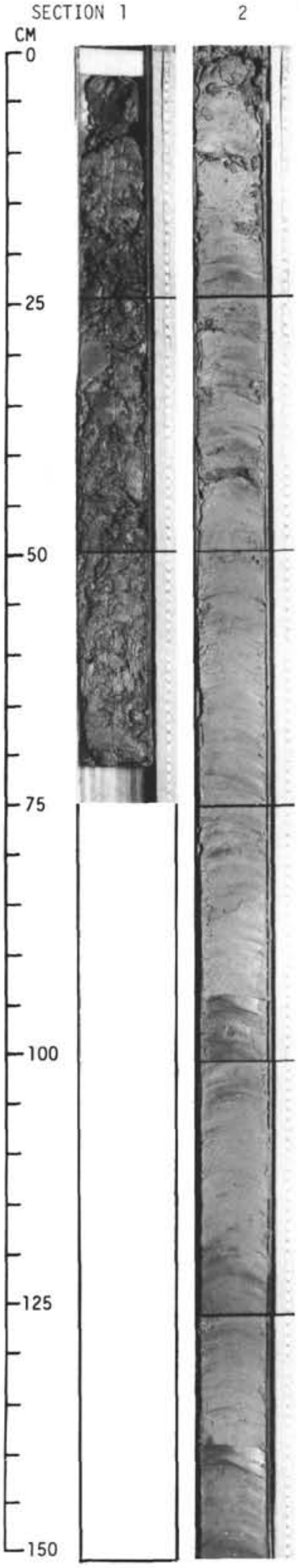
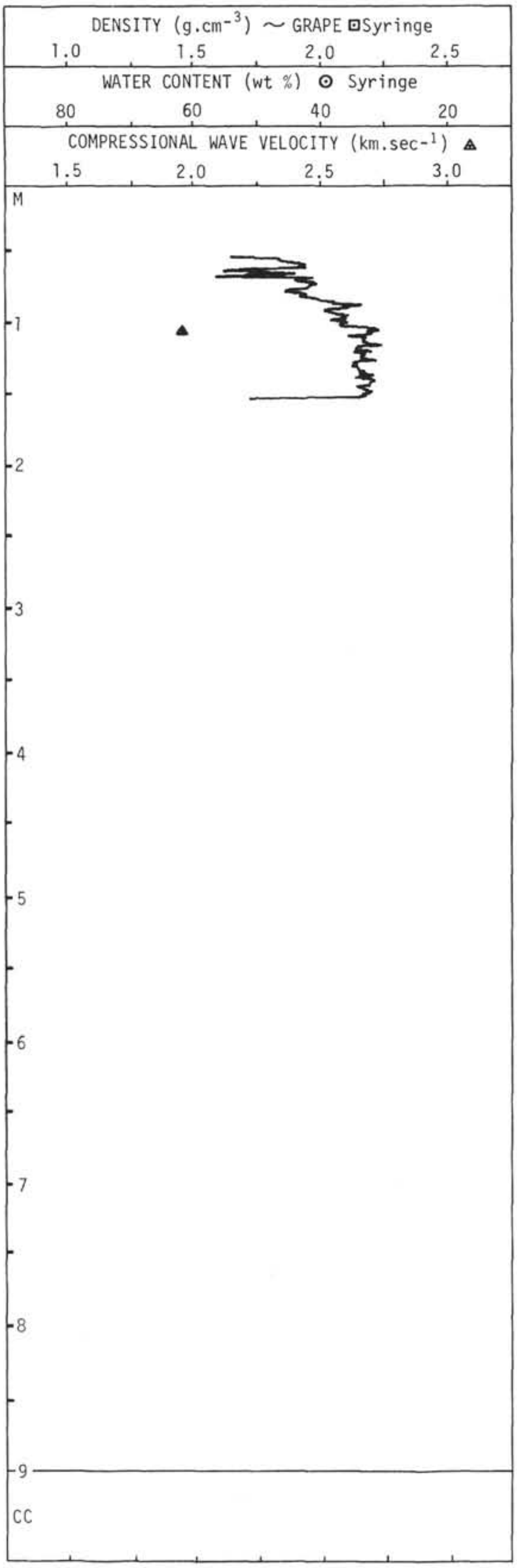


For Explanatory Notes, see Chapter 1

344-23





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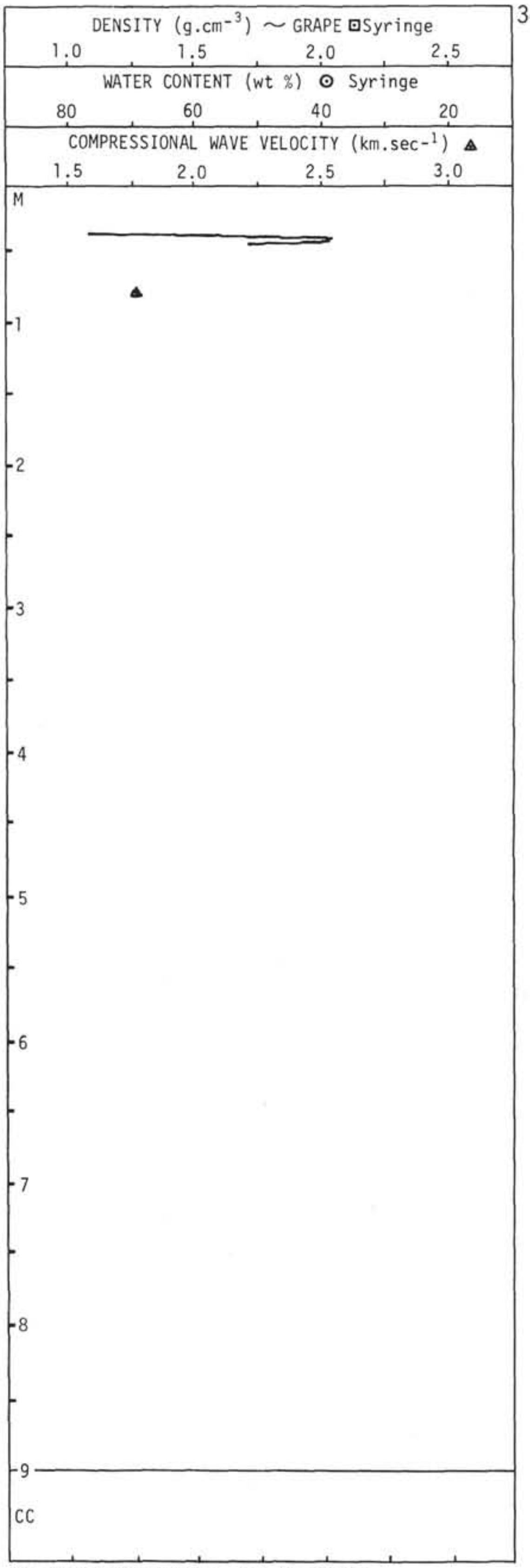
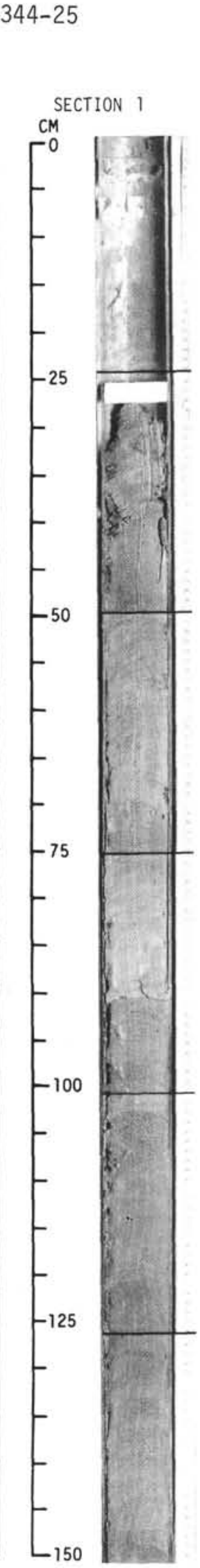
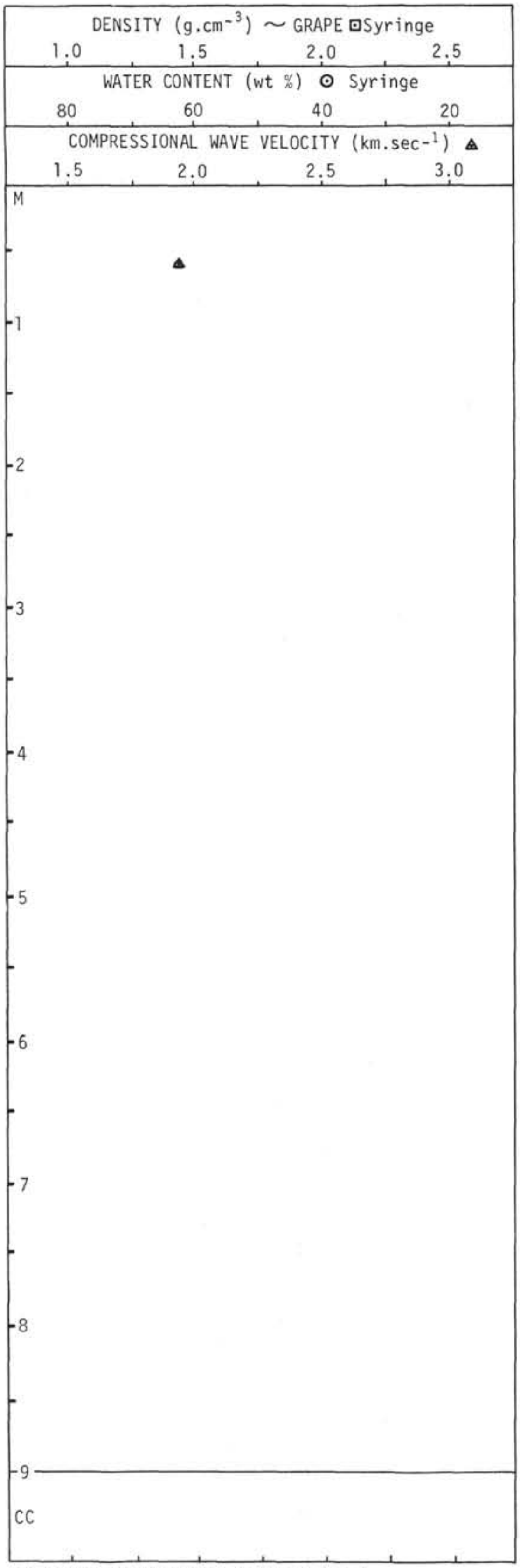


For Explanatory Notes, see Chapter 1





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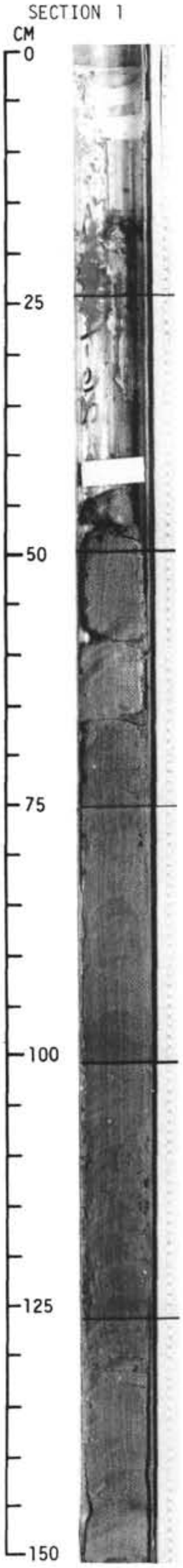
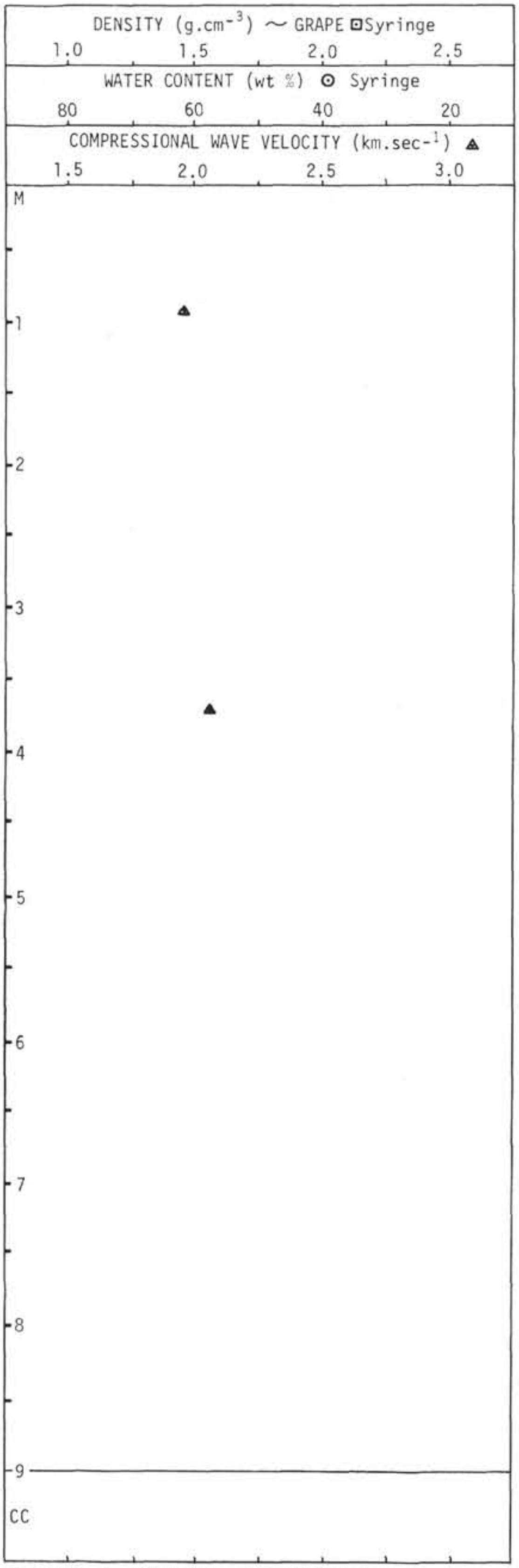
344-26





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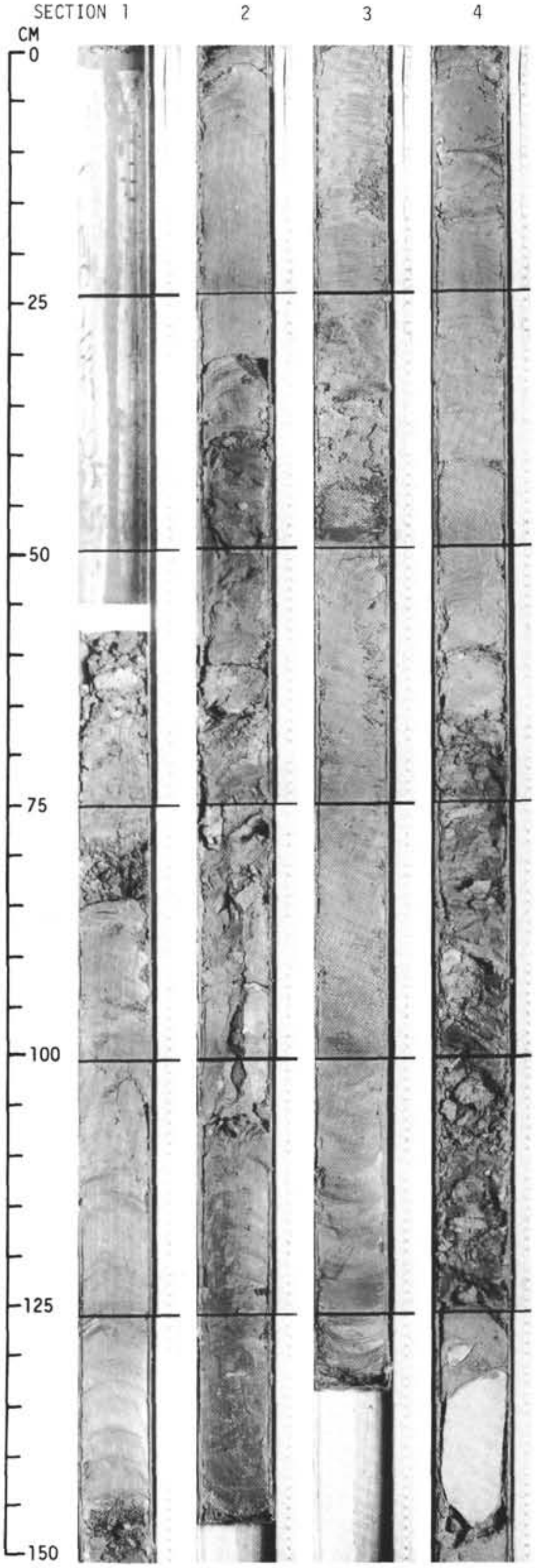
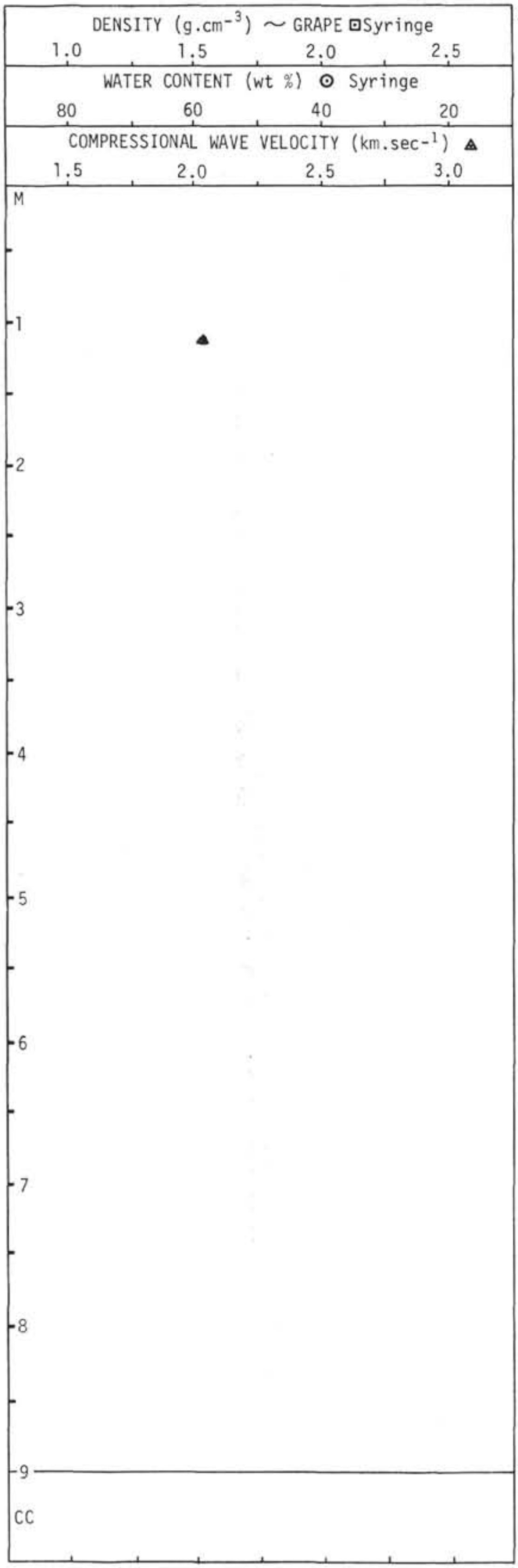
344-27





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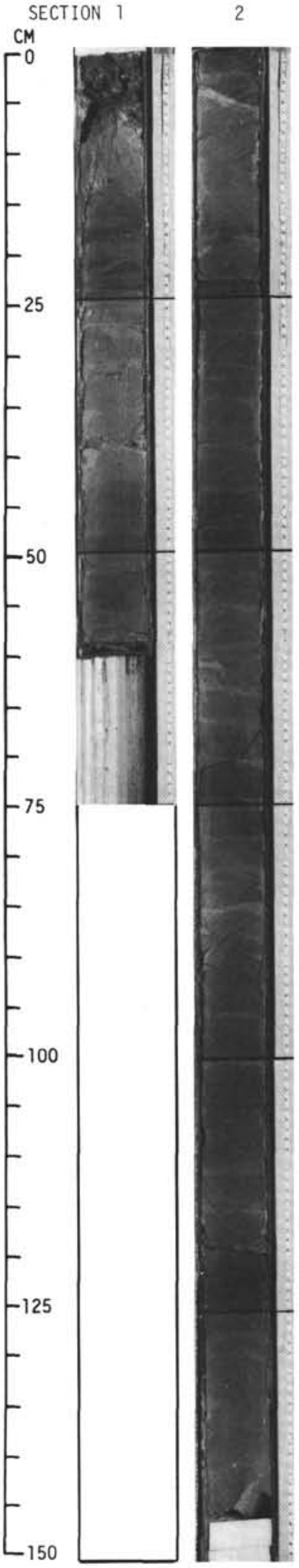

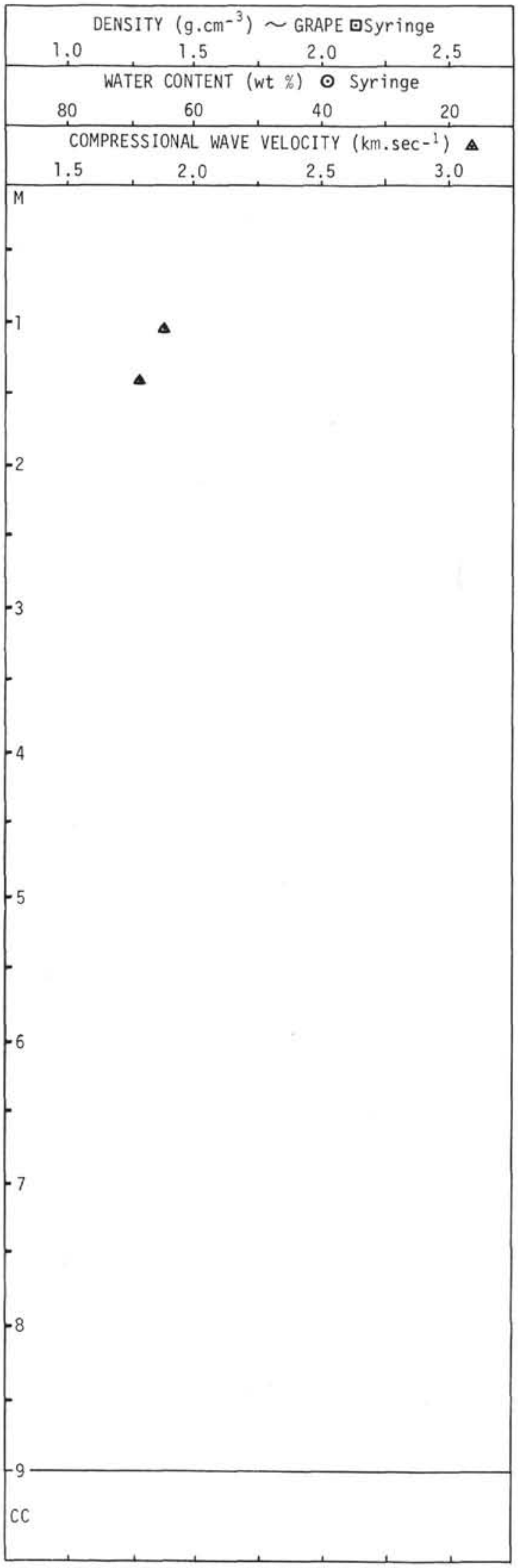

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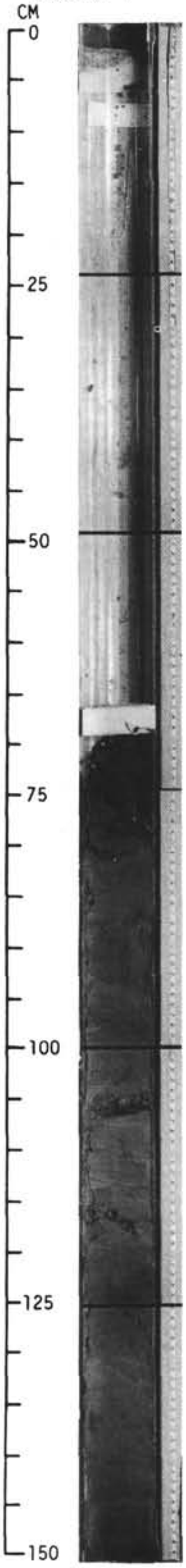
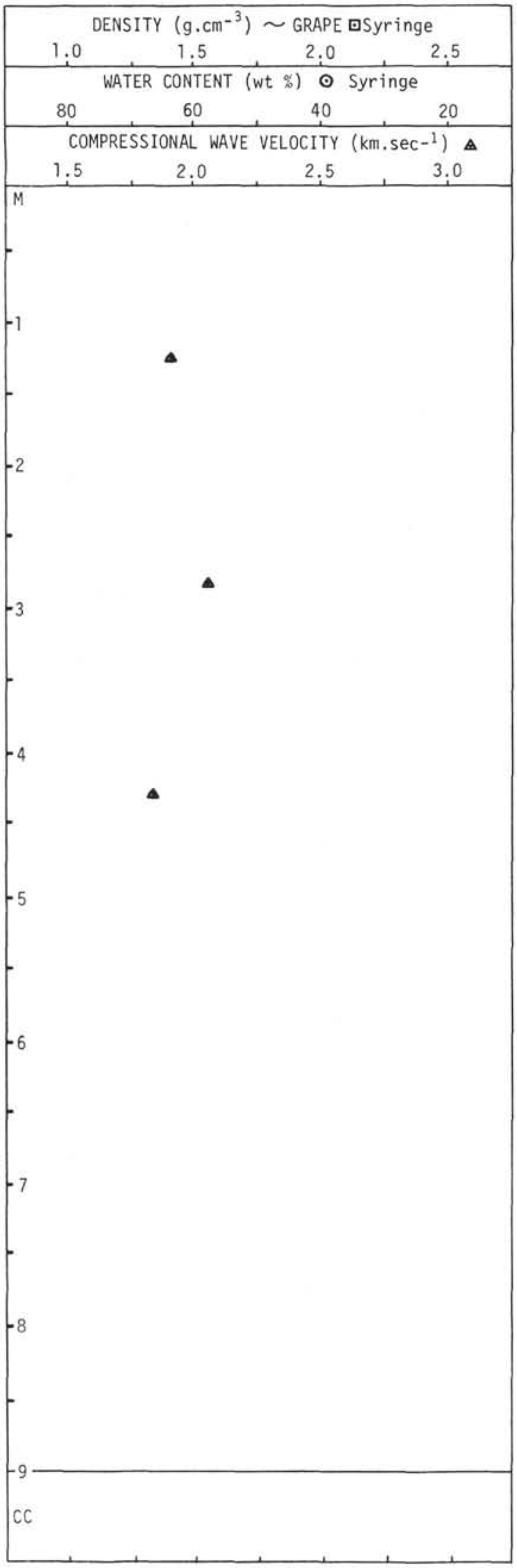
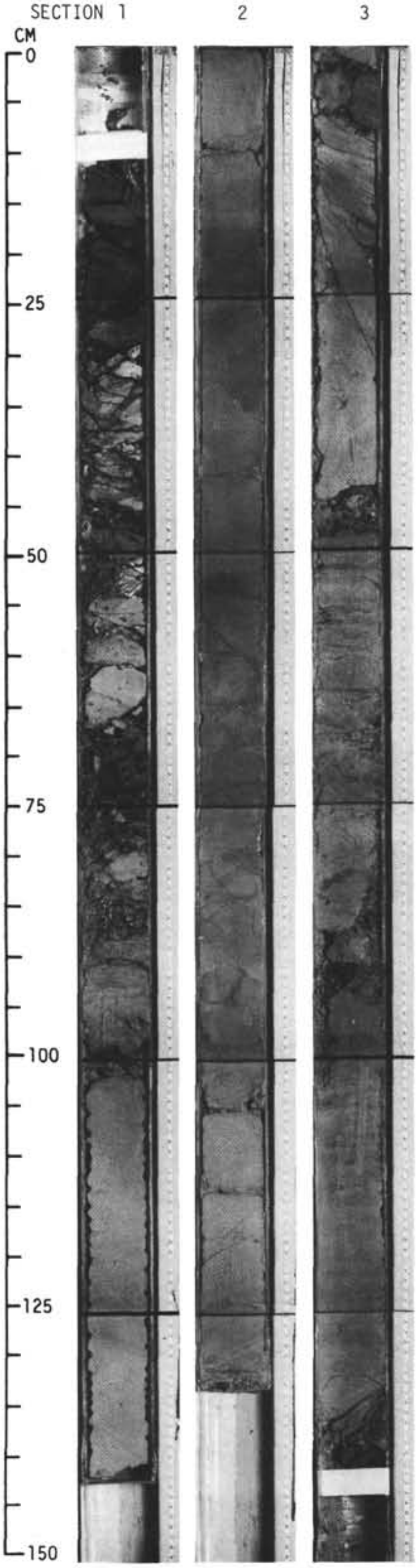
SECTION 1

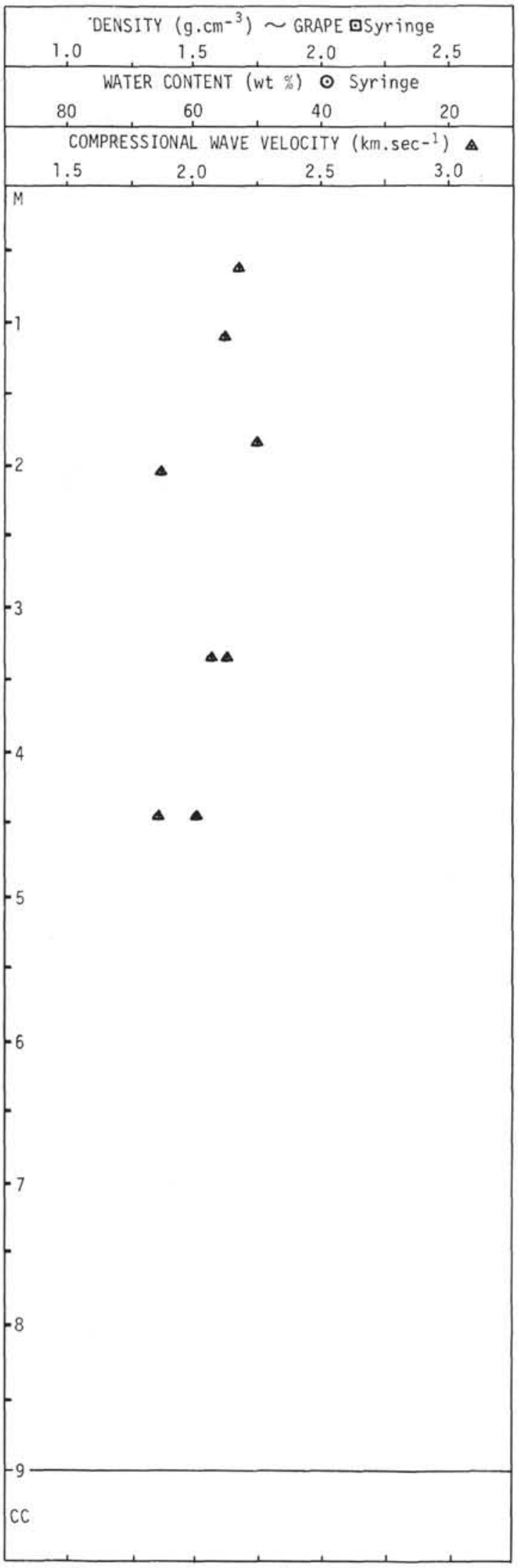




For Explanatory Notes, see Chapter 1

344-31





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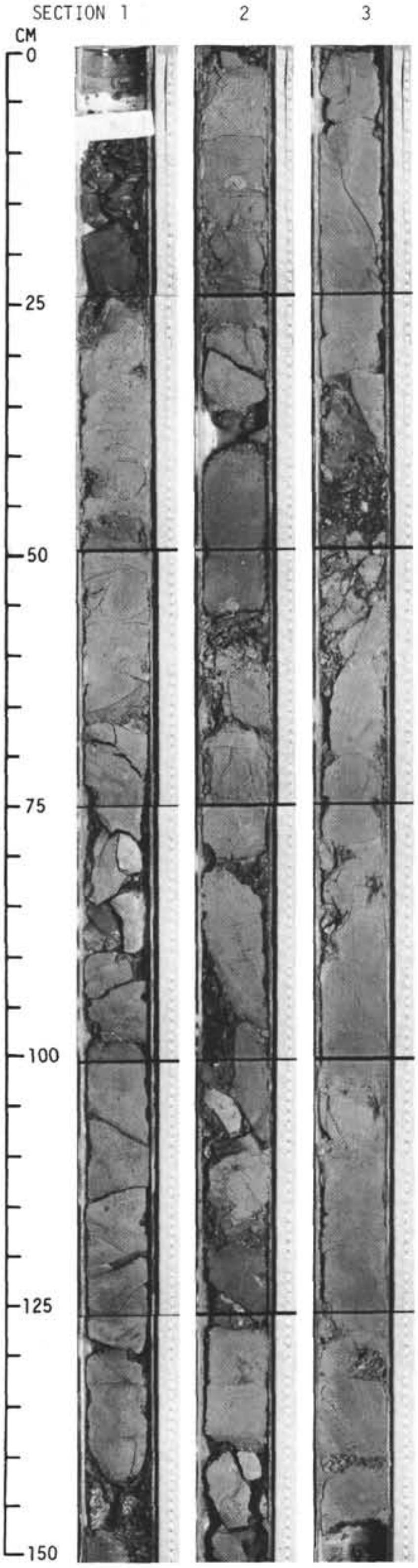
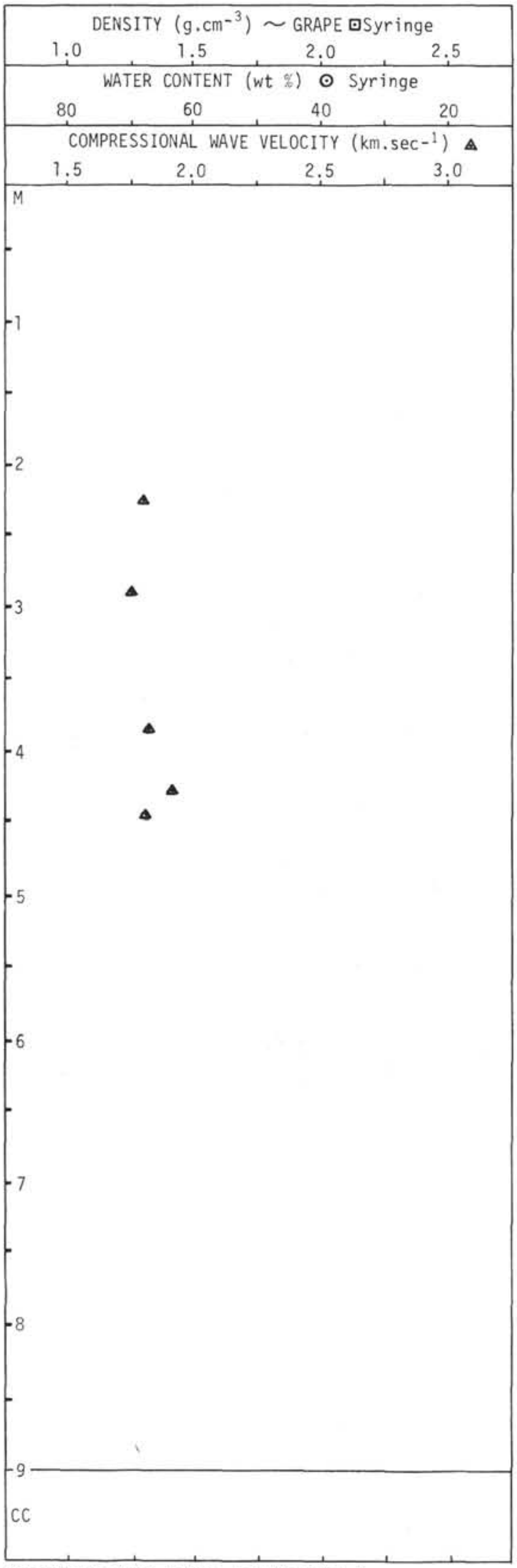
344-32





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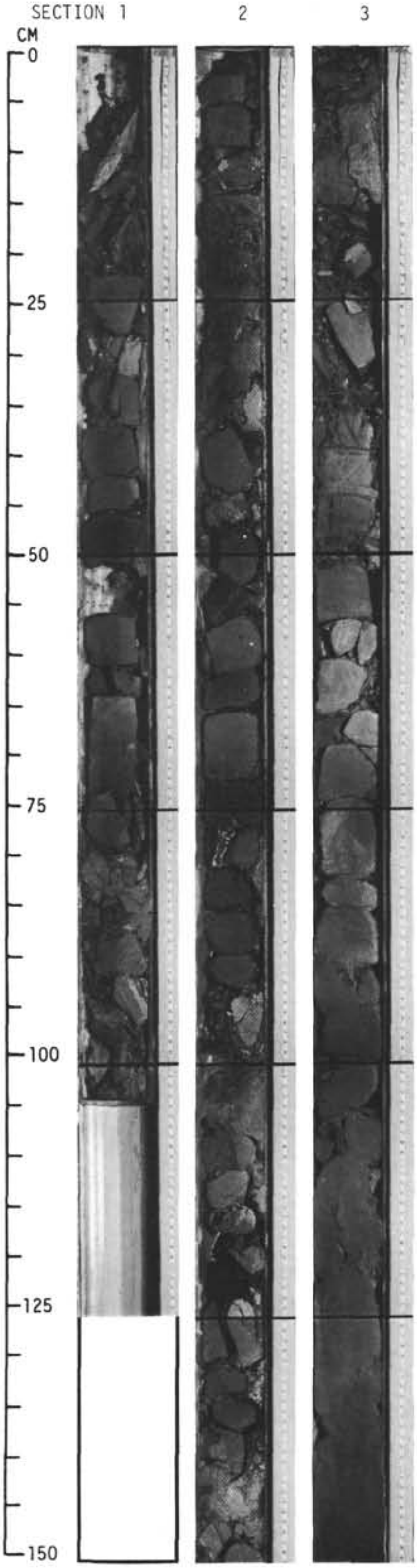

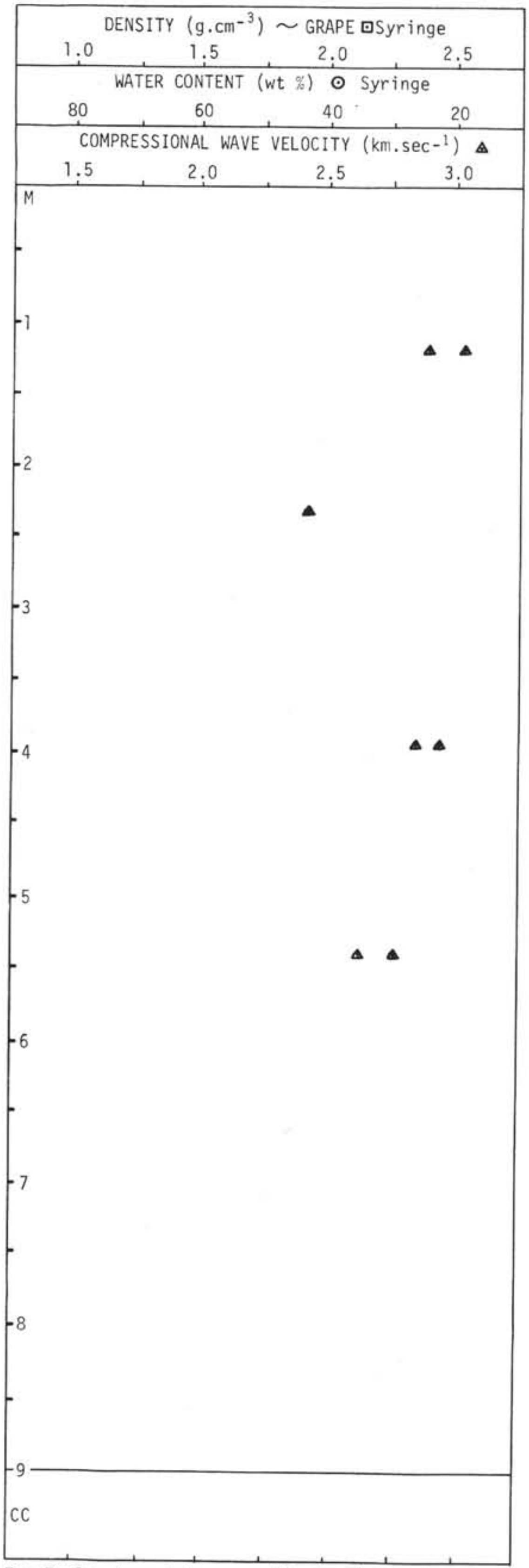

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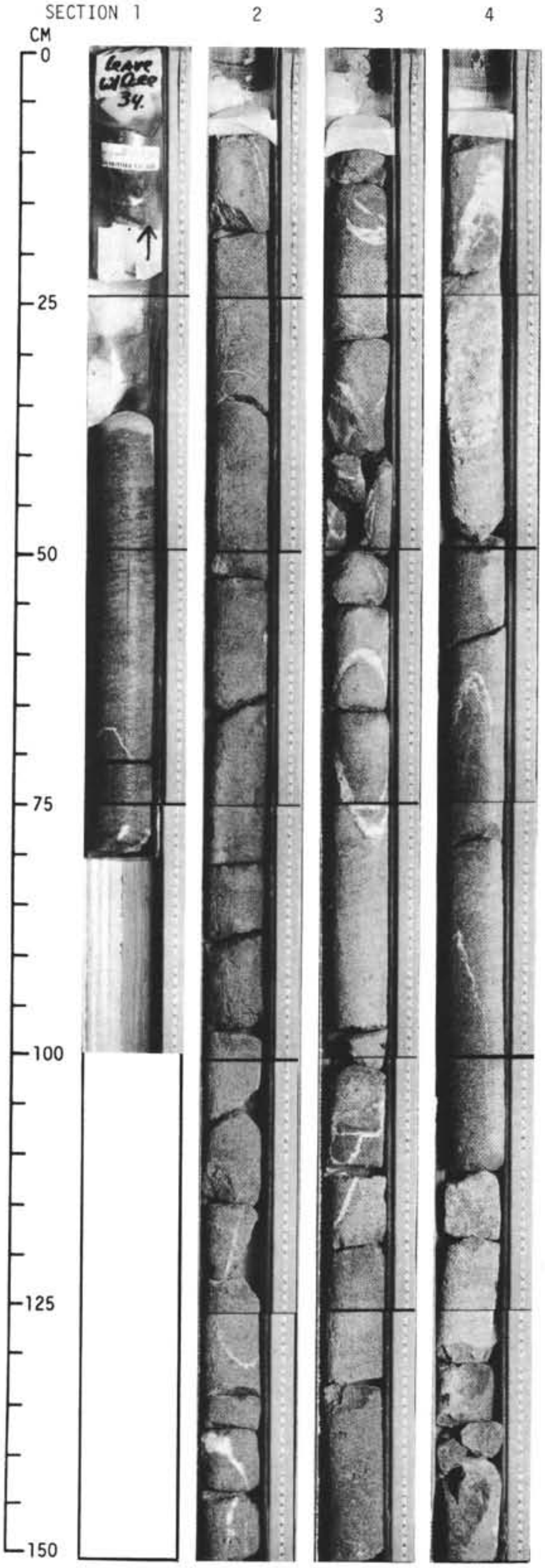

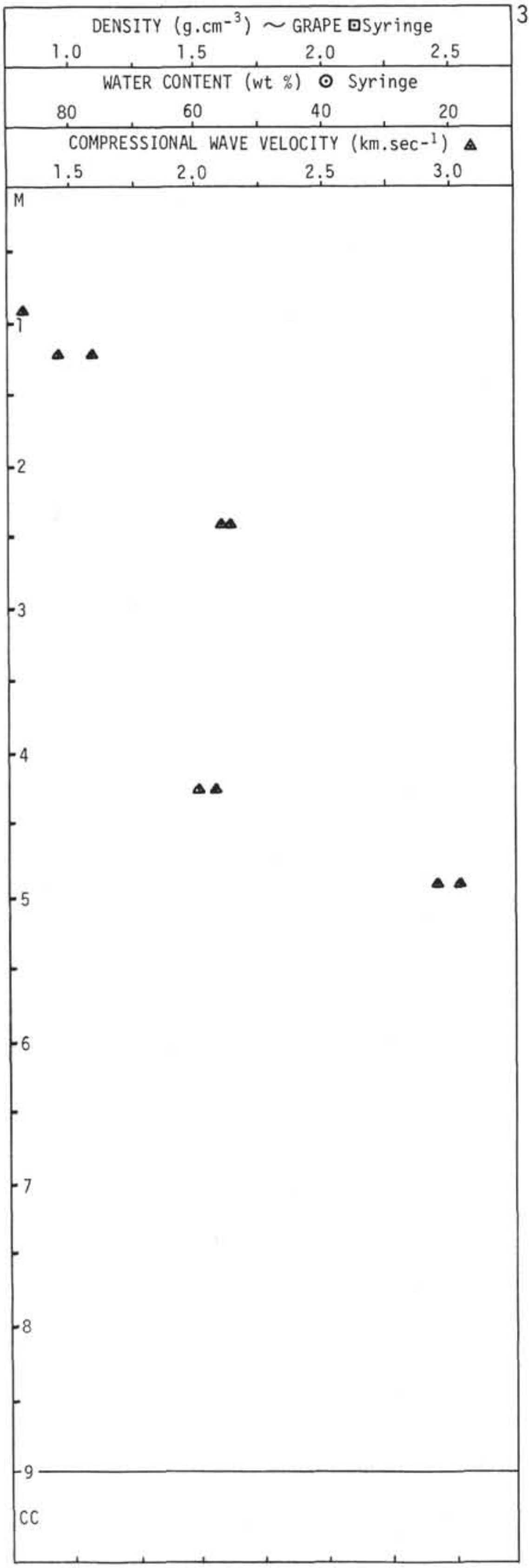

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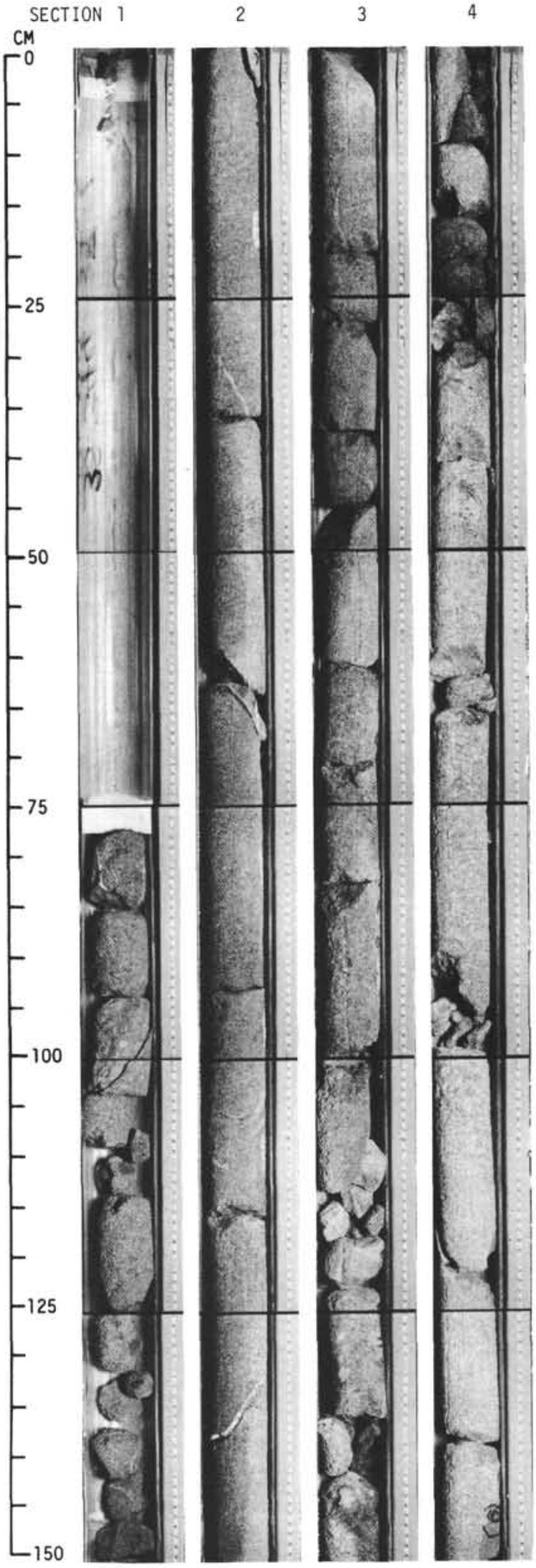

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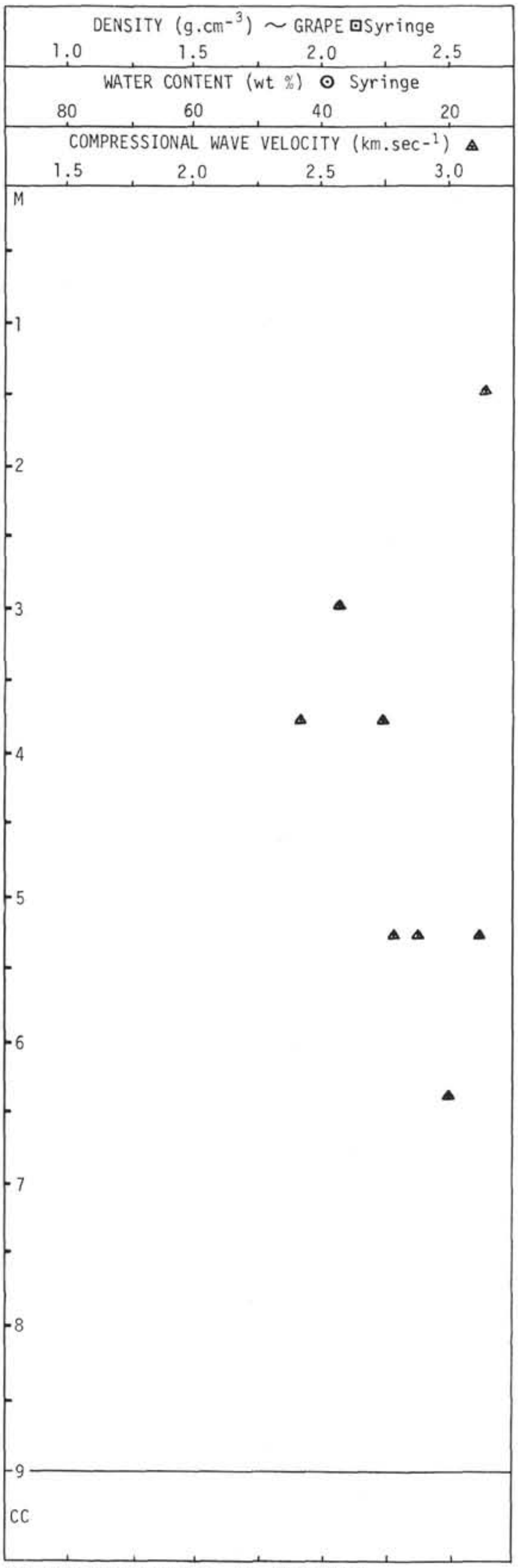

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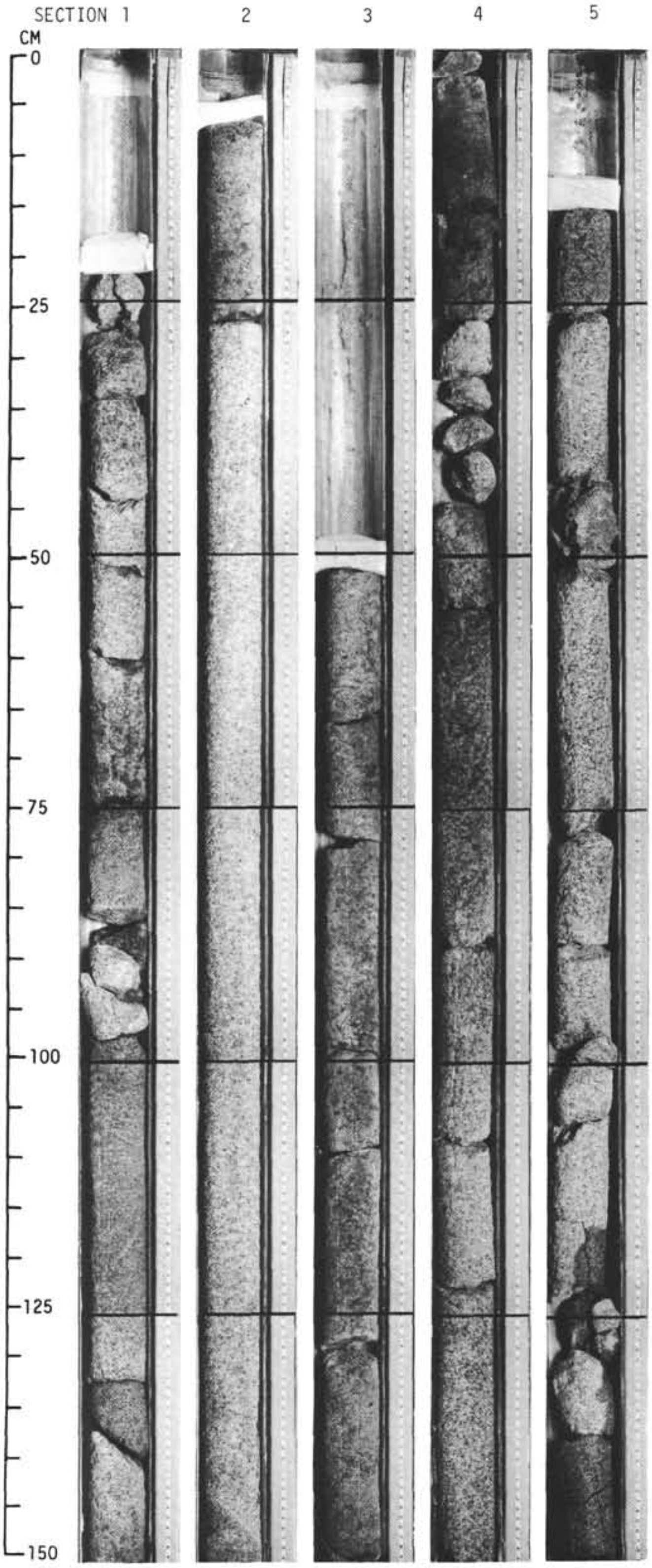

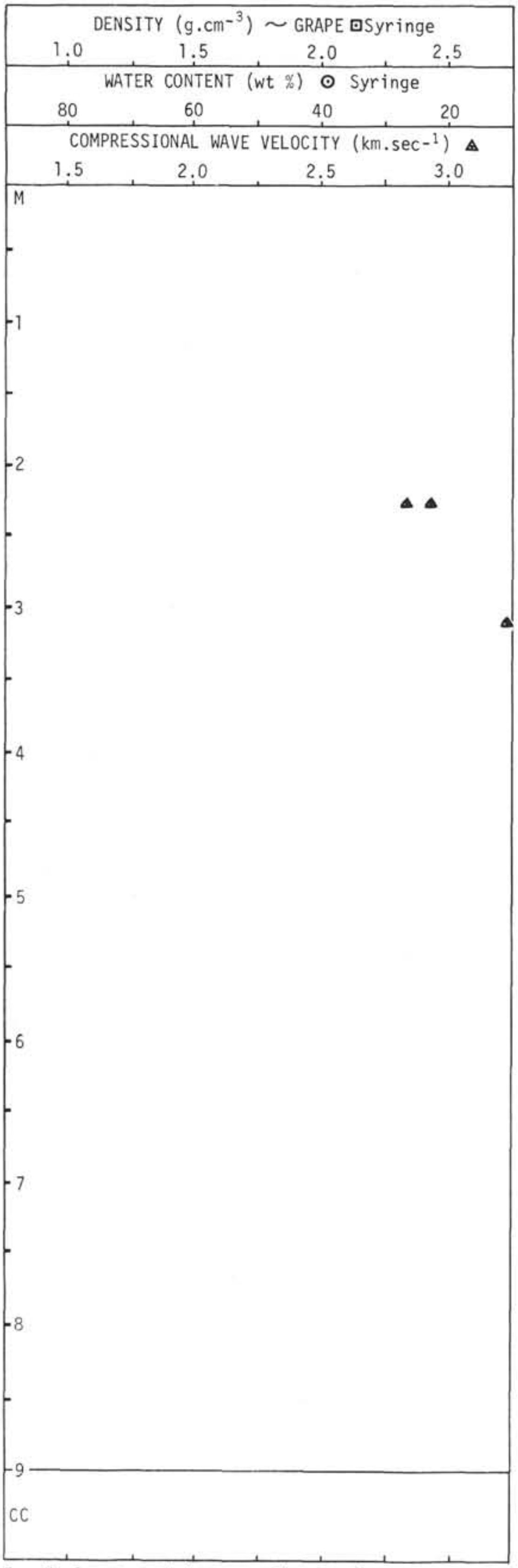

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