9. SITE 350

The Shipboard Scientific Party[1]
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SITE DATA

Position: 67°03.34'N; 08°17.68'W

Water Depth (from sea level): 1275.0 corrected meters (echo sounding)

Bottom Felt at: 1289.0 meters (drill pipe)

Penetration: 388.0 meters

Number of Holes: 1

Number of Cores: 16

Total Length of Cored Section: 150.5 meters

Total Core Recovered: 49.5 meters

Percentage of Core Recovery: 32.9%

Oldest Sediment Cored:
Depth below sea floor: 370 meters
Nature: Mudstones
Age: Late Eocene (Core 14-2)
Measured velocity: 2.1 km/sec (Core 13).

Basement:
Depth below sea floor: 361.7 meters (drilled)
Nature: Basalt breccia/diabase basalt
K/Ar age: 41 m.y. (late Eocene).

Principal Results: A total of 388 meters was penetrated at this site, of which 362 meters was in sediments, and the remainder in basaltic basement. "Glacial" sediments extend from the top to about 36 meters. They consist principally of sandy muds and muds, with admixtures of various amounts of volcanic ash and some foraminiferal oozes. Below the glacial sediments, a lithologic unit has been defined which extends from about 55 to 264 meters. It is middle Miocene in age at the top and extends into the Oligocene at the bottom (264 m). Alternating layers of unconsolidated and indurated to lithified sediments, dominantly terrigenous clays and muds, make up this unit. The underlying lithologic unit extends from 264 meters to the basalt at 362 meters. This unit is dominated by lithified sediments, particularly mudstone, claystone, limestone, breccia, and some sandstone. Turbidites are well developed towards the base of the unit. Near the boundary with the basement, the sediments become highly lithified breccias. Tuff breccias comprise the top portion of the igneous basement (from 362 to 380 m), and overly basalt which extends to the bottom of the hole at 388 meters. The tuff breccia is altered, but the basalt is very fresh compared to that from other sites of Leg 38. The basalts are normal tholeiites. The radiometric date on the basalts as well as the paleontologically determined date on the overlying sediments is late Eocene.

BACKGROUND AND OBJECTIVES

A series of ridges appears to represent the morphologic extension of the Jan Mayen Ridge to the south. Of these ridges, the ones to the west appear to represent the structural continuation of the Jan Mayen Ridge. In particular, they interrupt the otherwise ubiquitous opaque layer of the Icelandic Plateau. The ridges to the east are, however, somewhat different in character. They do not interrupt the opaque layer, but conversely, the opaque layer appears to form the basement of these ridges and is continuous to the east to the extinct axis of the Norway Basin.

The ridge on which Site 350 is located is typical of the eastern ridges. A principal objective of the hole is to try and establish the tectonic relationship of these ridges to: (a) the main part of the Jan Mayen Ridge to the north and to the west, and (b) the mid-oceanic type ridge which was active in the Norway Basin in the past, and which lies to the east. Another objective was to sample the opaque layer which seems to cover or form basement at this site.

OPERATIONS

Approach to Site 350

Site 350 was approached from the north on course 181° at normal speed (10 knots, 210 rpm) on 15 September after steaming 130.0 n mi, including surveying, in 15 hr, 17 min at an average speed of 8.5 knots from Site 349. At 0920Z, 15 September, the course was corrected to 194°, and at 1111Z, changed to 303° (Figure 1). The speed reduced at the same time to 6 knots (145 rpm). The beacon was dropped at 1153Z, and the ship continued on the same course and speed until 1221Z. At this time the ship maneuvered to return to the site of the beacon drop (Figure 2).

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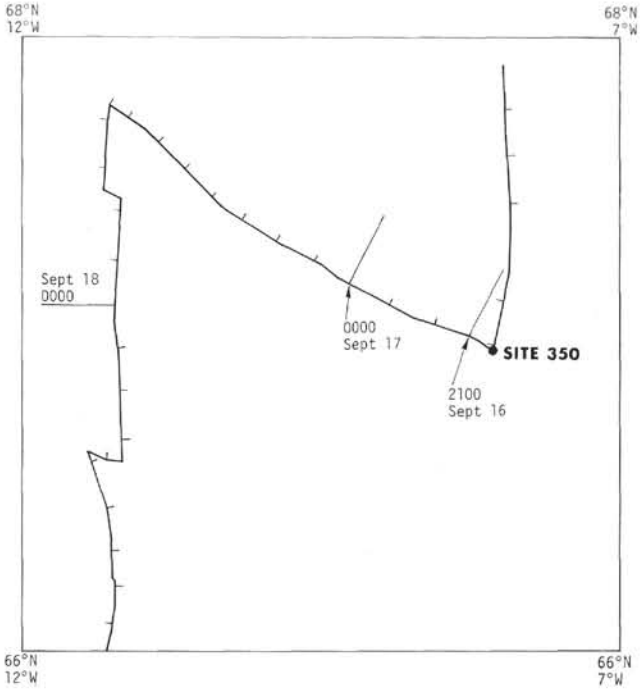


Figure 1. *Track chart – Site 350.*

Drilling Operations

A long compact bit was run to exploit the additional BHA available weight and achieve a higher AROP. An initial core was taken to confirm sea bed at 1289 meters. A continuous wash and control core program was employed to a depth of 359.5 meters BSB.

From the wash and cored interval, recovery was 34% from 13 cores with an AROP of 25.2 m/hr (Table 1). Basalt was cored for 26 meters, with a 35% recovery, at an AROP of 4 m/hr.

The hole remained clean throughout; no hydrocarbon indications were encountered. The hole was abandoned accordingly.

LITHOLOGY

Unit Descriptions

At Site 350, 361.7 meters of sediment were penetrated, which were subdivided into three units (Table 2 Figure 3). Volcanic ash is present in all units; bioturbation is present mainly in Units 2 and 3.

Unit 1 (Pliocene or Pleistocene and Pleistocene, 0-55.5 m)

This unit consists predominantly of sandy muds and muds, with admixtures of volcanic ash and foraminiferal oozes. Volcanic ash is present also in specific layers (e.g., Cores 1-3) as well as in "blebs," streaks, and smears. This may represent some original depositional features, but is to a large part the result of drilling deformation. Lithified ash is present in Core 2, Section 5. Foraminifera are conspicuous sediment components, particularly in Core 1, Section 3 and Core 2, Section 1.

Most of this material is interpreted as glacial-marine, terrigenous material deposited by a variety of processes, while glacial (or periglacial) conditions prevailed on land. The actual Pliocene-Miocene boundary may lie in the uncored interval between Cores 2 and 3.

Unit 2 (middle Miocene and Oligocene, 55.5-226.5 m)

Alternating layers of unconsolidated and indurated to lithified sediments (sedimentary rocks) characterize Unit 2. Volcanic ash exists in conspicuous layers (e.g., in Core 3, Section 1), or as admixture to the terrigenous, nonvolcanic materials. These terrigenous sediments are largely clays (claystone) and mud (mudstone). The lower portion of Unit 2 (Core 5, Section 1 and below), plus the upper two cores of Unit 3, are the finest grained of the entire sediment column.

Bioturbation exists in the fine-grained lithologies of Unit 2, but is not predominant. In the lowest core of this unit, the first turbidites have been identified, and these assume an increasing importance in the lower segments of the sediment column.

Unit 3 (Oligocene-late Eocene[?], 226.5-364 m)

Unit 3 is predominated by lithified sediments, particularly mudstone, also claystone, limestone, breccia, and some sandstone (in turbidite sequences). Turbidites are important toward the base of the unit, particularly in Cores 13 and 14 where they are described at "proximal" turbidites, and are associated with sediments deposited by grain-boundary flows, "sand falls." Near the boundary with the basement the sediments become breccias and are highly lithified.

Additional characteristics of Unit 3, besides ash layers and calcareous lithologies, are the ubiquitous bioturbation in the fine-grained materials, as well as pyrite concretions (predominantly associated with fine-grained lithologies).

Interpretation

The sedimentary sequence at this site, although sketchy because of discontinuous drilling, shows a progression from relatively coarse grained sediments at the base, to fine-grained materials in the center, and a return to coarser grained deposits at the top. Only tentative conclusions can be drawn from these relationships.

The sequence begins in the Eocene with breccias above the basalt, interpreted as slump deposits to be succeeded by "proximal" turbidites, "grain-boundary-flow" deposits, and similar sediments of Unit 3, all of which indicate a relative proximity to the sediment source. The environment of deposition is interpreted to have been a steep submarine slope, perhaps in the vicinity of a submarine canyon. Limestones in this sequence are perhaps oozes, originally deposited on the upper parts of a "continental" slope, above the CCD, redeposited by turbidity currents, broken during transport, and recrystallized after deposition.

In Oligocene time (upper Unit 3 and lower Unit 2), terrigenous sediments continued to be deposited, but turbidity currents became less frequent and changed in character to "distal" deposits. The increasing fineness of these sediments indicates either that water depth in-

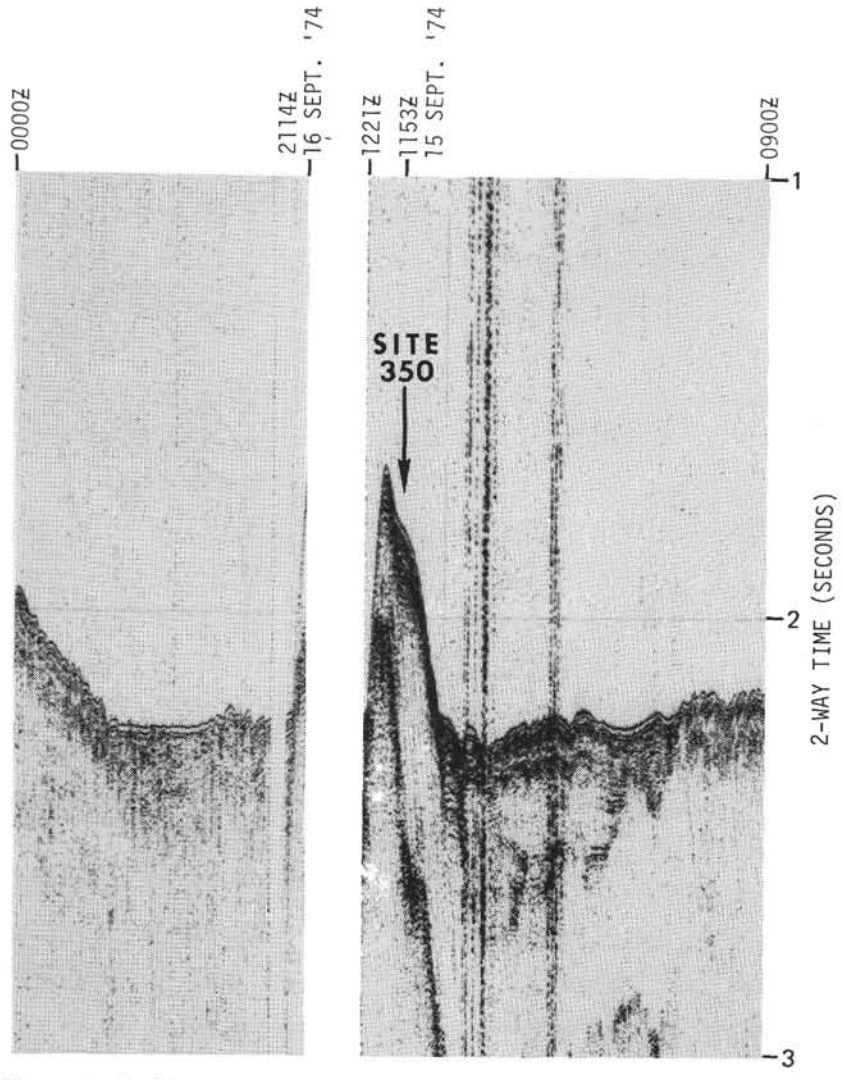


Figure 2. *Profiler record – Site 350.*

creased, that the available transport energy was reduced, that the supply of source material was impeded, or that all these factors acted together. Bioturbation indicates that quiet-water conditions prevailed, and ubiquitous pyritization suggests that reducing conditions existed below the life zone of the burrowing organisms.

Volcanism occurred intermittently throughout the period but trends as to changing rates of intensity are not clear. Some diminution may have taken place in middle Miocene time, but this is speculative.

Unit 2 shows a trend towards slightly increasing grain size. Perhaps Neogene tectonism in the source areas, accompanied by climatic deterioration, were factors contributing to an increased influx of terrigenous sediments into the marine environment.

The influx of terrigenous materials in Unit 1 was strong because of continental-glacial conditions which prevailed through much of this time on the surrounding land masses. Intermittent, milder conditions are indicated by minor foraminiferal ooze. Volcanism played an important role as sediment contributor, and continued to do so up to the present time.

IGNEOUS PETROGRAPHY-PETROLOGY-GEOCHEMISTRY

General Description

Rocks of acoustic basement at Site 350 were penetrated at a depth of 361.7 meters (BSB). Basement was drilled an additional 26.3 meters to a total hole depth of 388 meters. Five cores (Sections 14-2, 14-3, 14, CC, 16-1, 16-2, 16-3) contained basement rocks.

At 361.7 meters, the boundary between acoustic rocks and the overlying sedimentary unit is present. Sedimentary rocks above this boundary are represented by slightly lithified clay breccia, mudstone with rare angular fragments of weathered (?) basalt, and chlorite. Crystals of barite (0.1-1 cm) were present in Sample 14-2, 40-60 cm. Pyrite nodules (0.3-0.5 cm) were also observed.

Below the acoustic basement boundary, breccia and basalt are present. The breccia is present to a depth of 379.4 meters (Sample 16-1, 92 cm). It consists of angular and round basalt fragments (0.2-10 cm), chlorite, and siltstone, bonded by a sandy and silty

TABLE 1
Coring Summary, Site 350

Core	Date (September 1974)	Time	Depth From Drill Floor (m)	Depth Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovery (%)
1	15	2010	1289.0-1297.0	0-8.0	8.0	4.5	56.2
Washed			1297.0-1316.0	8.0-27.0			
2	15	2115	1316.0-1325.5	27.0-36.5	9.5	6.7	70.5
Washed			1325.5-1344.5	36.5-55.5			
3	15	2210	1344.5-1354.0	55.5-65.0	9.5	1.1	11.1
Washed			1354.0-1373.0	65.0-84.0			
4	15	2310	1373.0-1382.5	84.0-93.5	9.5	6.2	65.2
Washed			1382.5-1401.5	93.5-112.5			
5	16	0014	1401.5-1411.0	112.5-122.0	9.5	2.7	28.4
Washed			1411.0-1430.0	122.0-141.0			
6	16	0115	1430.0-1439.5	141.0-150.5	9.5	0.5	0
Washed			1439.5-1458.5	150.5-169.5			
7	16	0215	1458.5-1468.0	169.5-179.0	9.5	0.2	0
Washed			1468.0-1487.0	179.0-198.0			
8	16	0318	1487.0-1496.5	198.0-207.5	9.5	3.5	37
Washed			1496.5-1515.5	207.5-226.5			
9	16	0425	1515.5-1525.0	226.5-236.0	9.5	2.1	22
Washed			1525.0-1544.0	236.0-255.0			
10	16	0535	1544.0-1553.5	255.0-264.5	9.5	3.8	40
Washed			1553.5-1572.5	264.5-283.5			
11	16	0710	1572.5-1582.0	283.5-293.0	9.5	1.5	16
Washed			1582.0-1601.0	293.0-312.0			
12	16	0830	1601.0-1610.5	312.0-321.5	9.5	4.5	53
Washed			1610.5-1629.5	321.5-340.5			
13	16	0945	1629.5-1639.0	340.5-350.0	9.5	4.0	47
Washed			1639.0-1648.5	350.0-359.5			
14	16	1245	1648.5-1658.0	359.5-369.0	9.5	4.5	47
15	16	1445	1658.0-1667.5	369.0-378.5	9.5	0	0
16	16	1745	1667.5-1677.0	378.5-388.0	9.5	3.7	44
Totals			1677.0	388.0	150.5	49.5	32.9

matrix. The basalt fragments are fine grained, and have a medium dark gray to dark gray and black color. The basalt fragments in the upper portion of the cored section (Core 14, Section 2) have a lighter color than those of the lower portion of the cored section (Core 14, Section 3).

On the periphery of the basalt fragments there is a thin, light colored rim. Numerous branched, short, white, and brown-yellowish calcite veins (thickness 0.1-2 cm) cut the breccia. Sometimes small pyrite crystals are observed in the calcite veins. Commonly, calcite replaces the breccia cement and forms cavities between the fragments, which are filled with calcite crystals. The breccia fragments also contain internal, thin calcite-chlorite veins (0.5-2 mm), which do not cut fragment boundaries.

The amount of the breccia matrix decreases gradually from 30% at the top to 5% at the bottom of the section. The matrix in the upper portion is olive-gray and is black in the lower portion. Gradually, through the cored section, the basalt breccia changes to a massive basalt. The basalt (Sections 16-1, 16-2, 16-3) has a grayish-black to black color. It is holocrystalline, fine to medium grained, with rare plagioclase and pyroxene phenocrysts (2-5 mm). Single round amygdules (up to 3 mm), filled with white calcite are observed. Thin chlorite-calcite veins (1-3 mm), and slickensides with calcite-chlorite crusts (0.5-1 mm) on their walls cut the basalt.

The basalt of Core 16, Section 2 and Core 16, Section 3 is very fresh, massive, black, homogeneous, and has a high density.

Petrography

Two types of basement rocks are present at Site 350. These are: (1) basalt (tuff) breccia, and (2) basalt (diabase-basalt).

Basalt (tuff) Breccia

This is present in the top portion of the cored section (Sections 14-2, 14-3, 16-1). These are very coarse grained rocks, and have the following composition: (1) coarse angular fragments of phyric hyalobasalt with plagioclase (labradorite), and pyroxene phenocrysts (2) angular and round fragments of altered basalt with calcium carbonate; (3) angular, small (0.05-2 mm) pieces of volcanic glass, replaced by smectite, chlorite, and calcite with a zeolite and smectite matrix; (4) fresh plagioclase crystals (labradorite), and altered (chloritized, calcified) olivine (?) crystals; and (5) round, small fragments (0.05-0.5 mm) of a brown isotropic mineral (palagonite ?).

Nearly 95% of all the fragments are basalts. The basalt fragments usually have a thin chlorite-calcite-zeolite-smectite edging (0.05-1 mm), which surrounds the fragments evenly on all sides. The breccia matrix has a compound composition. It contains small pieces of basalt, zeolite, calcite, chlorite, palagonite, smectite,

TABLE 2
Lithologic Summary, Site 350

Unit	Depth (m) and Core Numbers	Age	Characteristics
1	0-55.5 (1-1 to 2-5)	Pleistocene Pliocene	Sandy mud, in places mixed with foraminiferal ooze; mud (mainly Section 2); volcanic ash in layers, or as admixture to terrigenous and terrigenous-biogeneous sediments; drilling deformation very high to intense
2	55.5-226.5 (3-1 to 8-3)	Middle Miocene and Oligocene	Clay and claystone, mud and mudstone, in alternating units; volcanic ash either in discrete layers or as admixtures to terrigenous sediments; Bioturbation exists in several sections; turbidites appear in Core 8
3	226.5-about 364 (9-1 to 14-2)	Oligocene-late Eocene	Claystone, mudstone (predominate), breccia; ash either in layer or as admixture; limestone; bioturbation is common in claystone and mudstone, in particular, composite and rhomboidal burrows exist in Section 4; turbidites are present in this unit and are prominent in the lower 3 sections, grading into breccia near basement contact

with an isotropic zeolite(?)-clay matrix. Usually the matrix is replaced to a considerable extent by secondary calcite (calcite veins). This calcite has striped and rosetted textures. Early formed calcite has a yellowish color, while the later formed calcite is white. Very rare pyrite veins are observed.

Basalt (diabase basalt)

Basalt is present in lower portion at the cored section (Sections 16-1, 16-2, 16-3). This is homogeneous, fine to medium grained (Section 16-2) with, microporphytic, subophitic, intersertal and rare poikilophitic, tholeiitic, and trachytoid textures. The basalt is very fresh in comparison with those recovered from other sites of Leg 38. The basalt has interstitial unaltered brown glass (average 3%-5%, $N = 1.54$) of a labradorite composition. The framework consists of plagioclase laths (0.3-1 mm). The plagioclase (An 62-72, average 50%) is usually twinned by low albite. Interstitial pyroxene (0.1-0.3 mm) and rare brown glass are also present. Glomeroporphyritic clusters of fresh plagioclase-labradorite (average 2%), subhedral, and euhedral pyroxene crystals ($2V = +70°$, low interference colors, strong dispersion) with poikilitic plagioclase laths, and altered olivine phenocrysts (0.2-0.3 mm, average 2%) are also observed. Opaque minerals are represented by skeletal and subhedral crystals of magnetite (0.1-0.3 mm, average 8%-10%). This is a very high concentration of magnetite in comparison with that found in the basalts recovered from other sites of Leg 38.

Secondary minerals are not abundant, however olive-green smectite (average 6%), chlorite (2%-3%), calcite (3%-5%), and amphibole(?) (1-2%) are present. Only two specimens (Samples 16-3, 13-20 cm and 44-47 cm) show a high concentration of smectite (15%-20%). Rare calcite veins with chlorite-smectite, and chlorite-smectite-calcite amygdules are observed. Sometimes, within the amygdules, there is a rosette-shaped mineral, probably natrolite — ($Ng(\gamma) - Np(\alpha) = 0.012$ — parallel extinction).

Summary

Rocks of acoustic basement at Site 350 are basalt (tuff) breccia and basalt (diabase-basalt). The tuff breccia is altered (chloritized, zeolitized, calcified). The basalt is very fresh (with rare interstitial glass), in comparison with basalts from other sites of Leg 38. This may be due to: (1) the basalt is a young intrusive, or (2) very slight hydrothermal and tectonic activity occurred in this area. The first explanation seems most probable.

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

The upper part of Site 350 basement, a tuff breccia, was analyzed but not noted in the tables because of its unfreshness. The three samples of quartz tholeiite from the lower part (Core 16) are very fresh and very inhomogeneous: average content of total H_2O: 1.15%, iron oxidation $100\ FeO/FeO + Fe_2O_3 = 76.2$. (Table 3).

There are characteristic differences in geochemistry to the basalts from nearby Site 348 on the Icelandic Plateau: The iron enrichment ($FeO/MgO = 2.21$) is more extreme. The K_2O and Na_2O contents are within the range of Cann's (1971) ocean floor basalts, and not depleted as in the Site 348 basalts. The main differences however, are the very high TiO_2 contents with an average of 2.25% (Tables 3 and 4).

PHYSICAL PROPERTIES

Physical properties — (sonic velocity, and GRAPE (wet) density) — allow a generalized subdivision of the sediments (Table 5). Due to incompleteness of coring, stratigraphic boundaries are arbitrarily placed midway between units in which discontinuities are present.

The sediments consist of an upper unit of terrigenous sandy muds and muds, extending to approximately 45 meters. Miocene to Oligocene transistional biogenic siliceous oozes, showing characteristic low bulk densities extend to approximately 220 meters.

A variable Oligocene-late Eocene unit extends to 361.5 meters, where it overlies brecciated basalt. No evidence of sill intrusion is seen, rather the sediments appear to overly the basalt with a normal contact. Density increases slightly in the sediments just above the basalt, possibly due to the addition of barite. The barite is present as large and small crystals noted in the last few tens of centimeters in Core 13.

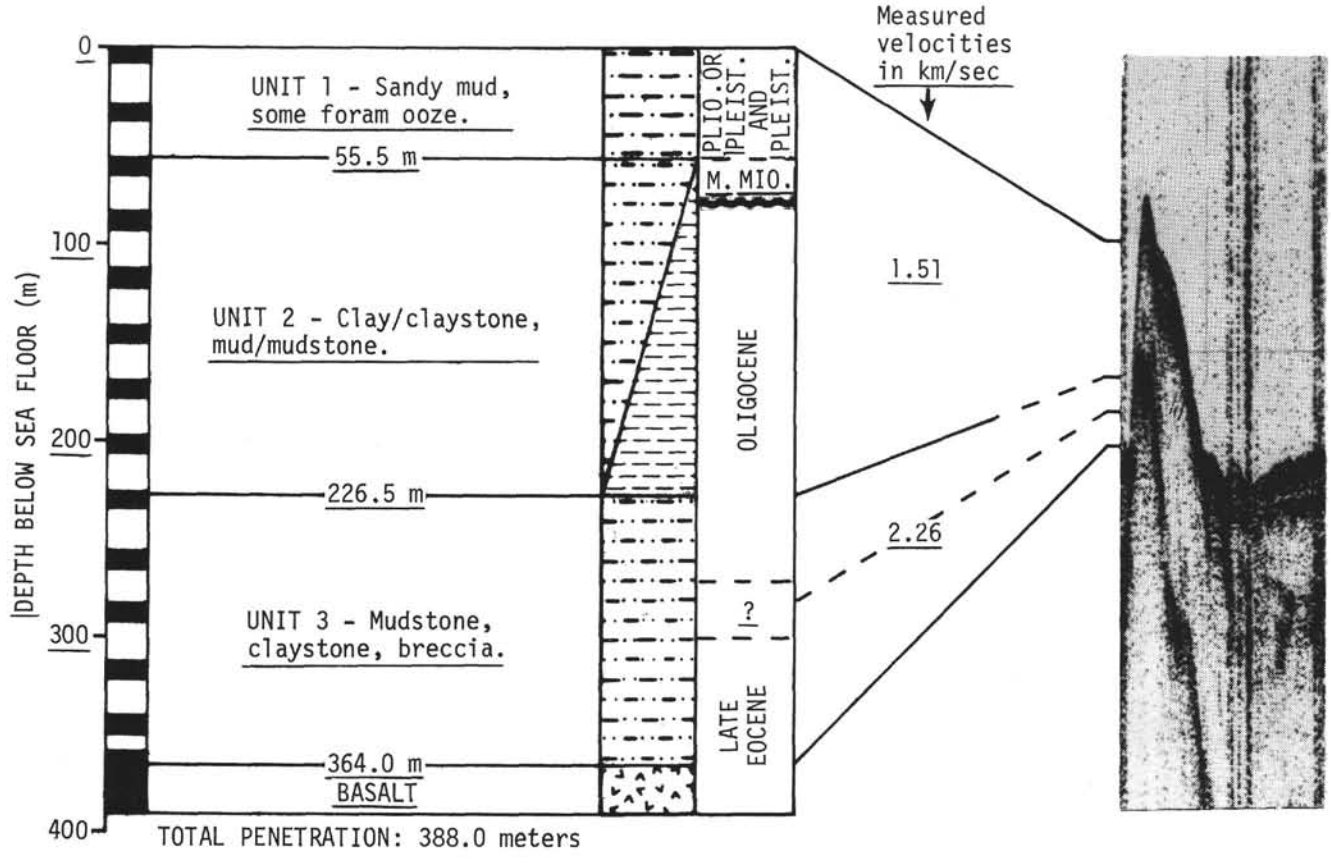


Figure 3. *Lithologic summary and seismic profile – Site 350.*

Perhaps the most interesting aspect of the site deals with the nature of the change in acoustic properties which is present between 220 and 280 meters. Cores 11 and 12 revealed a turbidite sandstone sequence, alternating with consolidated mudstones and limestones which gave high velocities. Several high velocity limestones had been encountered earlier in the section (Core 9, Section 2), but did not significantly alter the acoustic characteristics of the unit at that level. Figure 4 shows the cumulative effect of these various lithologies.

GEOCHEMISTRY

Inorganic Geochemistry

The results of analyses on interstitial water samples are found in Table 6.

Organic Geochemistry

Neither the presence of gas nor hydrocarbons were detected at Site 350.

BIOSTRATIGRAPHY

Biostratigraphic Summary

Pliocene to Pleistocene sediments (Core 1 to Core 2, 0-36.5 m) are poor in nannofossils and foraminifera. *Globigerina pachyderma* is the only planktonic species found. Siliceous microfossils are rare.

Age determination below this sequence becomes difficult due to the scarcity of fossils; it is based mainly on arenaceous foraminifera (Middle Miocene: Core 3, no age for Cores 4 to 6, 84.0-150.5 m), Oligocene: Cores 7 to 10 (169.5-264.5 m). Core 12 to Core 14, Section 2 belong to the late Eocene based on the presence of few foraminifera, nannofossils, and dinoflagellates, while diatoms give an Oligocene age for Core 12.

Foraminifera

"Glacial," Pleistocene, Cores 1 and 2

Abundant presence of sinistrally coiling *Neogloboquadrina pachyderma* characterizes Core 1. Washed residues with little ice-rafted material nearly consist entirely of this species. Except for a very few specimens of *Globigerina quinqueloba* no other planktonic foraminifera were seen despite rather close sampling (eight samples from Core 1).

Benthonic foraminifera constitute less than 3% of the fauna. The assemblage is of low diversity with *Islandiella teretis* predominant in most samples, and with "*Cibicides*" *wuellerstorfi* being second in abundance. Other species present are *Melonis zaandamae*, *Eponides umbonatus*, *Pullenia quinqueloba*, dentalinids, *Cyclammina*, *Recurvoides*, and other arenaceous forms. The relative amount of ice-rafted material (quartz, sedimentary and metamorphic rock fragments, rare *Inoceramus* prisms) increases from 5% at the top of the core to about 90% near the base.

Core 2 is considerably poorer in fauna; ice-rafted clastics constitute more than 99% of the residue of all

TABLE 3
Analyses of Site 350 Basalts

	3-2, 30-33 cm	3-3, 73-76 cm	3-3, 120-140 cm
	RF 9866	RF 9867	RF 9868
SiO_2	48.59	48.88	49.00
TiO_2	2.24	2.27	2.23
Al_2O_3	13.68	13.73	13.89
Fe_2O_3	3.44	3.19	2.95
FeO	9.99	10.26	0.34
MnO	0.20	0.20	0.20
MgO	5.83	5.97	6.02
CaO	10.67	10.51	10.48
Na_2O	2.70	2.59	2.66
K_2O	0.30	0.28	0.27
H_2O_{tot}	1.48	1.27	0.74
SO_3	0.02	0.00	0.00
P_2O_5	0.24	0.26	0.24
Total	99.38	99.41	99.02
C.I.P.W. Norms[a]			
Qz	1.55	2.41	2.08
Or	1.81	1.69	1.62
Ab	23.33	22.32	22.88
An	24.84	25.47	25.58
Di	22.67	21.24	21.05
Hy	15.31	16.30	16.41
Ol	0.00	0.00	0.00
Mt	5.54	5.57	5.50
Il	4.35	4.39	4.31
Ap	0.58	0.63	0.58
Pr	0.04	0.00	–
Norm. Plag. An	51.57	53.30	52.79
Diff. Ind.	26.70	26.42	26.59
Norm. C.I.	48.48	48.13	47.85

[a]Norms are based on analyses recalculated to 100% H_2O free and with % Fe_2O_3 standardized at % TiO_2 + 1, 5 (Irvine and Baragar, 1971).

TABLE 4
Trace Elements of
Site 350 Basalts (ppm)

	RF 9866	RF 9867	RF 9868
Sr	221	206	204
Nb	17	13	17
Zr	156	156	158
Y	37	36	40
Ni	69	68	73
Co	43	46	55
V	366	359	365
Zn	123	121	165
Cu	192	190	164
Cr	93	92	103
Ce	48	32	60
Sc	43	36	40

samples except for Sample 2-4, 40-42 cm which is largely made up of ash and volcanic glass. Samples below Section 2 are practically barren; the small residues have 0-8 specimens of *N. pachyderma* which are considered to be downhole contamination. The barren nature probably is due to both carbonate dissolution and low to nonproductivity.

TABLE 5
Physical Properties (Averages–Site 350)

Unit	GRAPE ρ(g/cc)	GRAPE η(%)	Sonic Velocity (km/sec)	Impedance (ρc)
1 $\bar{x}$	1.53	73.62	1.50	2.30
s	0.08	5.58	0.05	0.21
2 $\bar{x}$	1.31	87.75	1.52	1.80
s	0.04	2.91	0.03	0.40
3 $\bar{x}$	1.70	62.12	2.26	3.44
s	0.06	3.83	0.59	1.19

Miocene, Cores 3 and 4

The small, washed residues of Cores 3 and 4 consist largely or entirely of volcanic ash which is shiney in Core 3 and dull in Core 4. Core 4 is barren, but Core 3 yielded, apart from siliceous spiculae, diatoms and radiolarians, a few arenaceous foraminifera: *Haplophragmoides* sp., *Cyclammina* sp., *Bathysiphon* sp., and *Martinotiella communis*. The latter was found in the upper and middle Miocene at other sites.

Undiagnostic Interval, Cores 5 through 9

This interval is practically barren of foraminifera. Very rare specimens of *Rhabdammina* sp. were found in two samples, a *Tolypammina* and a small *Haplophragmoides* in two others. Other fossils present are a few fish teeth, fecal pellets, and radiolarians.

The washed residues of Cores 5 through 7 consist of often brilliant grains of quartz, rock fragments, and volcanic ash. The residues of Cores 8 and 9 have very little quartz, but mica, pyrite, and, at some levels, ash, are common. Several samples have a few specimens of *N. pachyderma*, which is considered to be downhole contamination.

Eocene, Cores 10 through 14

Most samples are fossiliferous and have an arenaceous formainiferal assemblage in varying relative abundance. *Cyclammina* sp. and *Haplophragmoides* spp. can be abundant; *Rhabdammina* sp., *Ammodiscus* sp., and *Spiroplectammina spectabilis* are rare. The latter, Eocene marker, is found in Samples 10-2, 12-14 cm; 10, CC; 12-1, 42-44 cm; 12, CC; and 13-1, 90-92 cm. A few badly preserved calcareous specimens were recovered from 13, CC (*Lenticulina* sp., *Marginulina* sp.) and 12, CC (*Cibicides* sp.). Pyritized diatoms (*Coscinodiscus*) are common in Cores 13 and 14 where fish remains and pellets were also found.

Pyrite is the most important constituent of the small washed residues. In addition, a few quartz grains and some volcanic glass can be found. The quartz may be contamination like *N. pachyderma*, of which specimens were found down to the lowest sample, 14-2, 39-42 cm.

Nannoplankton

Sediments recovered at Site 350 are extremely poor in nannofossils. They were found only in the Quaternary sediments of Core 1. *Coccolithus pelagicus* is very abundant in Sample 1-1, top, while *Gephyrocapsa ericsonii* is

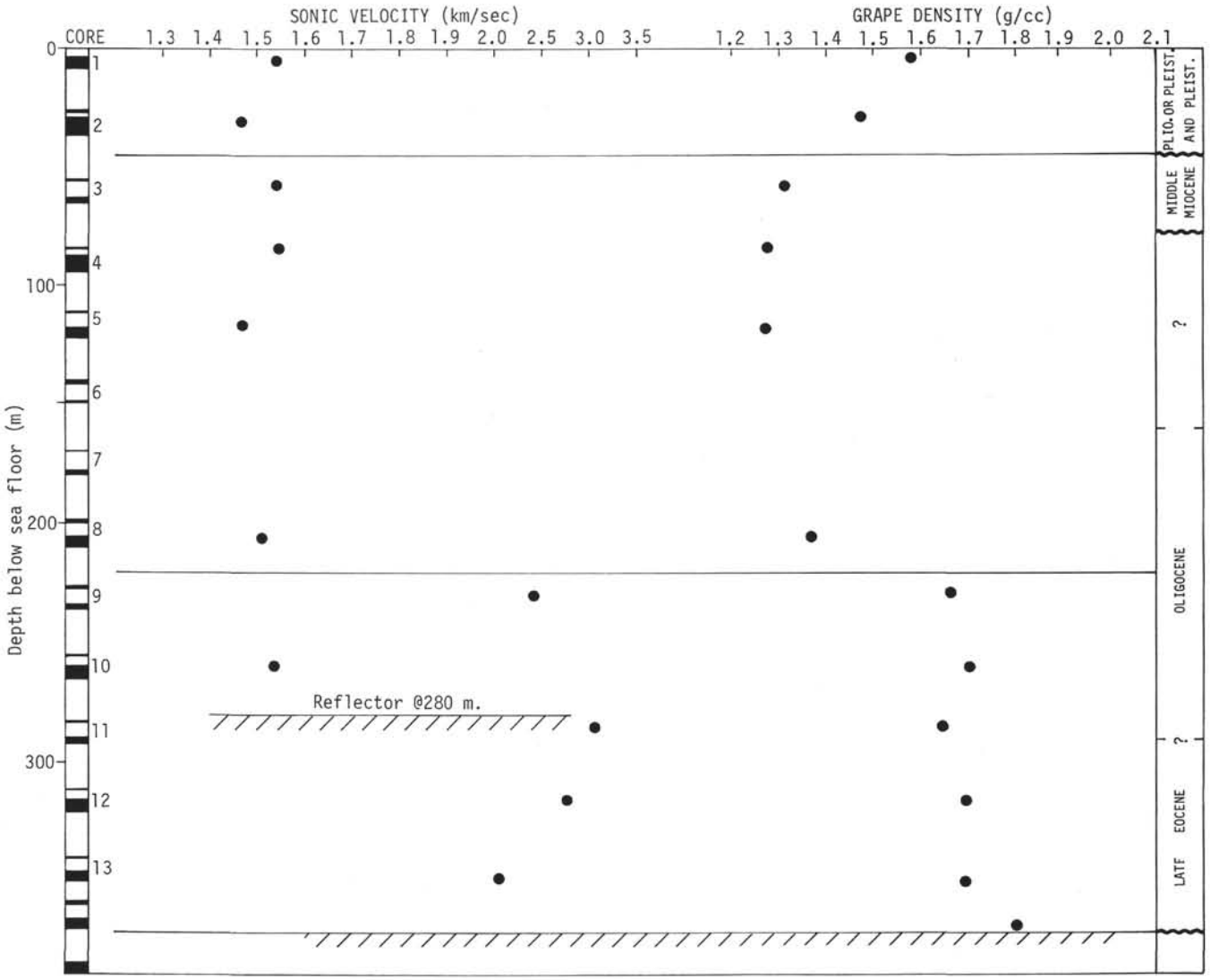


Figure 4. *Velocity, density – Site 350.*

the only species found in Sample 1-2, 48-49 cm. Reworked Cretaceous and Eocene species are present in all samples, but they are missing in the layers of nannofossil ooze. These layers probably indicate an influx of warmer water. In Sample 14-2, 43-44 cm, a few specimens of *Isthmolithus recurvus* and *Reticulofenestra umbilica* were found indicating a late Eocene to early Oligocene age.

Diatoms (H.-J.S.)

Only Sample 350-12-1, 38-40 cm contained a badly preserved diatom assemblage with *Stephanopyxis turris*, *Pyrgopyxis oligocaenica*, *Thalassionema* aff. *Nitzschioides*, *Sceptroneis* spp. (broken pieces), and few corroded sponge spicules. The above-mentioned species did allow dating of this sample as Oligocene. Sponge spicules were also found in Sample 10-3, 95-97 cm.

Radiolarians

Siliceous microfossils were observed in Cores 1 through 3. In Sample 1, CC, *Amphimelissa setosa* and *Cycladophora davisiana* were observed in the glacial-marine sediments indicating a Plio-Pleistocene age. In Sample 2, CC, only rare diatoms and fragmented sponge spicules were present. Sample 3, CC has rare radiolarians, but a faunal assemblage similar to the *Actinomma holtedahli* Zone was obtained, indicating an age of lower middle Miocene. The rest of the cores (Cores 4-13) are barren in siliceous microfossils in the size fraction examined.

Silicoflagellates

Silicoflagellates were observed only in Sample 3, CC (65.0 m), indicating a probable middle Miocene age. The assemblage consists of few specimens of *Distephanus crux*, *Distephanus speculum*, and *Dictyocha* cf. *fibula*.

Palynology (S.B.M.)

Dinocysts

None of the samples gave a workable cyst assemblage. However, very scattered specimens of *Deflandrea phosphoritica* and *Thalassiphora pelagica* in

TABLE 6
Summary of Shipboard Geochemical Data, Site 350

Sample (Interval in cm)	Subdepth (m)	pH	Alkalinity (meq/kg)	Salinity (‰)	Ca++ (mmoles/1)	Mg++ (mmoles/1)
Surface Seawater		8.10	2.30	34.4	10.18	51.47
1-2, 144-150	3.0	7.46	2.64	35.2	12.35	49.67
4-2, 144-150	87.0	7.95	1.41	34.9	19.77	43.90
8-2, 140-150	201.0	7.73	0.87	35.5	29.19	41.63
10-3, 140-150	259.5	6.98	0.47	35.5	38.86	40.34
12-2, 140-150	315.0	6.61	0.38	36.0	46.87	37.88

Core 8, Section 3 to Core 14, Section 1 indicate cyst Zones IV to VII for this part, possibly restricted to IV to V for the interval 8-3 to 11-1 by the occurrence of cf. *Gonyaulacysta giuseppei* in Core 11, Section 1.

Debris, Reworked Material

Preparations from Cores 8 to 14 are dominated by relatively small fragments (<100 μm) of slightly corroded and thermally altered tracheidal and cuticular matter, opaque tracheidal matter being absent. Pollen present is of similar preservation and appears to be of early Tertiary age. Reworking from older sediments is not apparent.

Samples from Sections 5-1, 4-3, 4-1, 2-3, 2-1, and 1-3 are virtually barren of acid-resistant plant matter, while Core 1, Section 1 contains carbonized tracheidal matter.

SUMMARY AND CONCLUSIONS

A total of 388 meters was penetrated at this site, of which 362 meters was in sediments, and the remainder in basaltic basement.

"Glacial" sediments extend from the top to about 36.5 meters. They consist principally of sandy muds and muds, with admixtures of various amounts of volcanic ash and some foraminiferal oozes. Fossils are generally poor in the "glacial" section. Left-coiling *Neogloboquadrina pachyderma* is the only planktonic foraminifera found. Also present are some benthonic and arenaceous foraminifera and some siliceous fossils. Nannoplankton were found only in Core 1.

Below the "glacial" sediments, a lithologic unit has been defined which extends from about 55.5 to 226.5 meters. It is middle Miocene in age at the top and extends into the Oligocene(?) at the bottom. Alternating layers of unconsolidated and indurated to lithified sediments, dominantly terrigenous clays and muds, make up this unit. It also contains volcanic ash in conspicuous layers. The Miocene sediments contain silicoflagellates, ebridians, and siliceous foraminifera. The age is assigned on the basis of diagnostic silicoflagellates. Only an impoverished assemblage of siliceous foraminifera was found in the Oligocene.

The underlying lithologic unit extends from 226.5 meters to the basalt at 362 meters. This unit is dominated by lithified sediments, particularly mudstone, claystone, limestone, breccia, and some sandstone. At the top boundary of this unit, there is a sudden downward increase in density. The velocity also increases, but alternates between high and/or low values (corresponding to lithified and nonlithified layers), until uniformly high values are reached below 280 meters. Fauna is poor, and arenaceous foraminifera are used to assign a tentative late Eocene age.

Turbidites are well developed towards the base of the unit. Near the boundary with the basement, the sediments become highly lithified breccias.

Tuff breccias comprise the top portion of the igneous basement (from 362 to 380 m) and overlies basalt which extends to the bottom of the hole at 388 meters. The tuff breccias are altered, but the basalt is very fresh compared to that from other sites of Leg 38. The basalts are normal tholeiites.

The following calculation is made to compare reflection profiler travel time to basement to that obtained from velocity measurements on samples.

a) Lithologic Units 1 and 2; Cores 1-8; 0 to 226.5 meters; Average velocity = 1.516 km/sec; Travel time = 0.3 sec.

b) Corresponds to interval 226.5 to 280 meters; Cores 9, 10 defined by physical properties as possessing velocities more akin to Units 1 and 2 than to Unit 3. Representative velocity is 1.55 km/sec (ignoring measurement in narrow limestone block); Travel time = 0.069 sec.

c) Including the remainder of Lithologic Unit 3 from 280 to 364 meters; Cores 11-13; Average velocity = 2.666 km/sec; Travel time = 0.063 sec.

The total travel time = 0.432 sec which compares favorably with data from the reflection record.

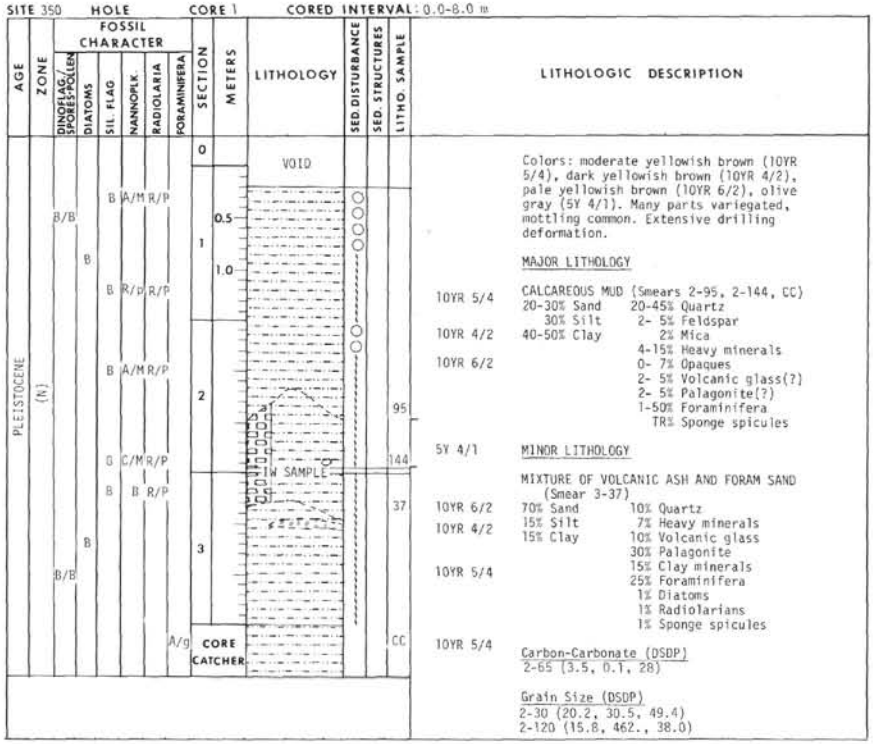
There is considerable scatter in the radiometric age, but values of 40-44 m.y. are indicated. These are not in conflict with the age of late Eocene determined paleontologically from the overlying sediments.

REFERENCES

Cann, J.R., 1971. Major element variation in ocean floor basalts: Phil. Trans. Roy. Soc. London, v. 268A, p. 495-506.

Irvine, J.N. and Baragar, W.R.A., 1971. A guide to the chemical classification of the common volcanic rocks: Canadian J. Earth Sci., v. 8, p. 523-548.

SITE 350 HOLE CORE 1 CORED INTERVAL: 0.0-8.0 m



Colors: moderate yellowish brown (10YR 5/4), dark yellowish brown (10YR 4/2), pale yellowish brown (10YR 6/2), olive gray (5Y 4/1). Many parts variegated, mottling common. Extensive drilling deformation.

MAJOR LITHOLOGY

10YR 5/4 CALCAREOUS MUD (Smears 2-95, 2-144, CC)
20-30% Sand 20-45% Quartz
30% Silt 2- 5% Feldspar
10YR 4/2 40-50% Clay 2% Mica
4-15% Heavy minerals
10YR 6/2 0- 7% Opaques
2- 5% Volcanic glass(?)
2- 5% Palagonite(?)
1-50% Foraminifera
TR% Sponge spicules

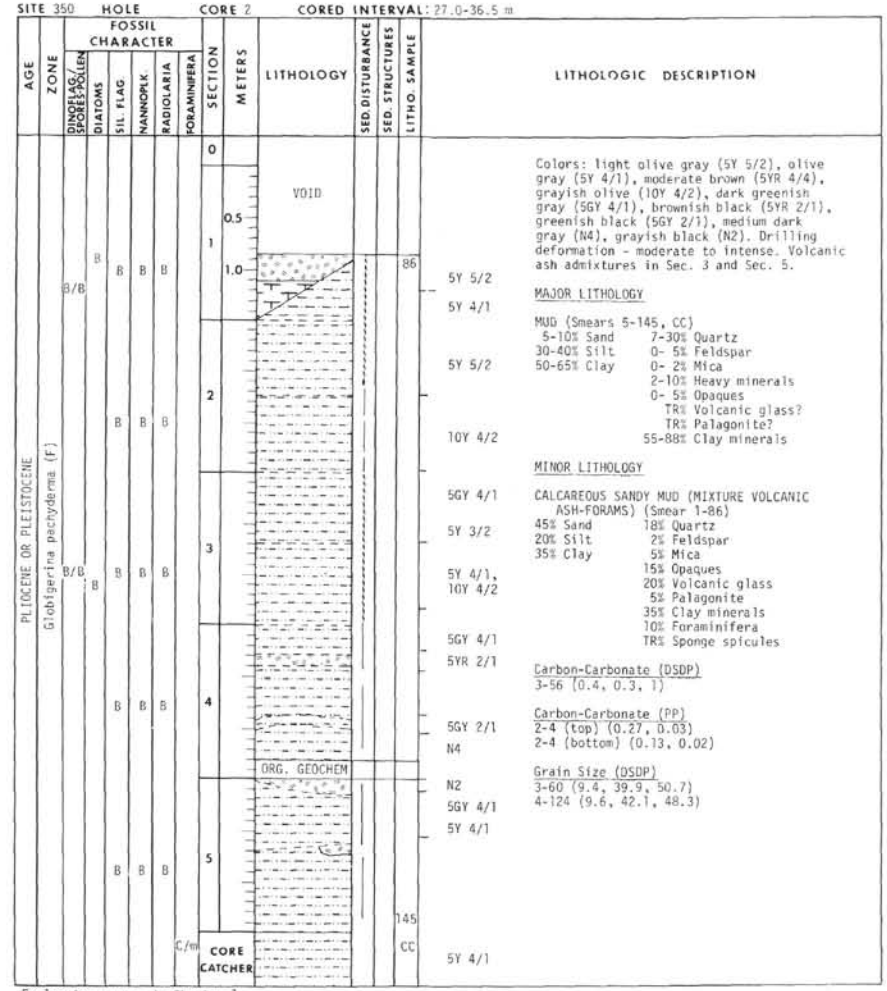
5Y 4/1 MINOR LITHOLOGY

MIXTURE OF VOLCANIC ASH AND FORAM SAND (Smear 3-37)
10YR 6/2 70% Sand 10% Quartz
10YR 4/2 15% Silt 7% Heavy minerals
15% Clay 10% Volcanic glass
30% Palagonite
10YR 5/4 15% Clay minerals
25% Foraminifera
1% Diatoms
1% Radiolarians
1% Sponge spicules

10YR 5/4 Carbon-Carbonate (DSDP)
2-65 (3.5, 0.1, 28)

Grain Size (DSDP)
2-30 (20.2, 30.5, 49.4)
2-120 (15.8, 462., 38.0)

SITE 350 HOLE CORE 2 CORED INTERVAL: 27.0-36.5 m



Colors: light olive gray (5Y 5/2), olive gray (5Y 4/1), moderate brown (5YR 4/4), grayish olive (10Y 4/2), dark greenish gray (5GY 4/1), brownish black (5YR 2/1), greenish black (5GY 2/1), medium dark gray (N4), grayish black (N2). Drilling deformation - moderate to intense. Volcanic ash admixtures in Sec. 3 and Sec. 5.

MAJOR LITHOLOGY

5Y 5/2, 5Y 4/1, 5Y 5/2, 10Y 4/2 MUD (Smears 5-145, CC)
5-10% Sand 7-30% Quartz
30-40% Silt 0- 5% Feldspar
50-65% Clay 0- 2% Mica
2-10% Heavy minerals
0- 5% Opaques
TR% Volcanic glass?
TR% Palagonite?
55-88% Clay minerals

MINOR LITHOLOGY

5GY 4/1, 5Y 3/2, 5Y 4/1, 10Y 4/2, 5GY 4/1, 5YR 2/1, 5GY 2/1, N4, N2, 5GY 4/1, 5Y 4/1, 5Y 4/1 CALCAREOUS SANDY MUD (MIXTURE VOLCANIC ASH-FORAMS) (Smear 1-86)
45% Sand 18% Quartz
20% Silt 2% Feldspar
35% Clay 5% Mica
15% Opaques
20% Volcanic glass
5% Palagonite
35% Clay minerals
10% Foraminifera
TR% Sponge spicules

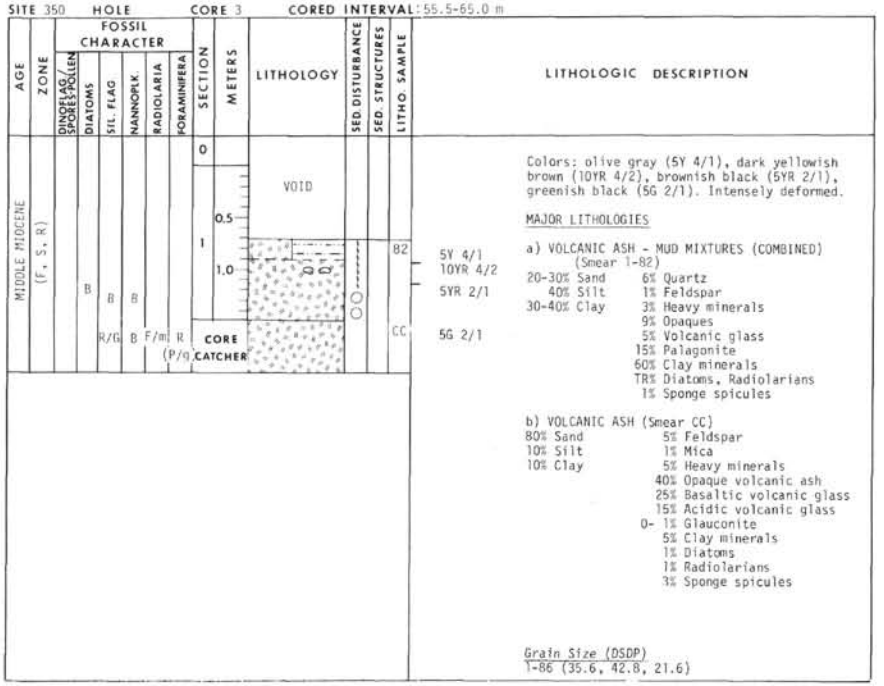
Carbon-Carbonate (DSDP)
3-56 (0.4, 0.3, 1)

Carbon-Carbonate (PP)
2-4 (top) (0.27, 0.03)
2-4 (bottom) (0.13, 0.02)

Grain Size (DSDP)
3-60 (9.4, 39.9, 50.7)
4-124 (9.6, 42.1, 48.3)

Explanatory notes in Chapter 1

SITE 350 HOLE CORE 3 CORED INTERVAL: 55.5-65.0 m



LITHOLOGIC DESCRIPTION

Colors: olive gray (5Y 4/1), dark yellowish brown (10YR 4/2), brownish black (5YR 2/1), greenish black (5G 2/1). Intensely deformed.

MAJOR LITHOLOGIES

a) VOLCANIC ASH - MUD MIXTURES (COMBINED)
(Smear 1-82)

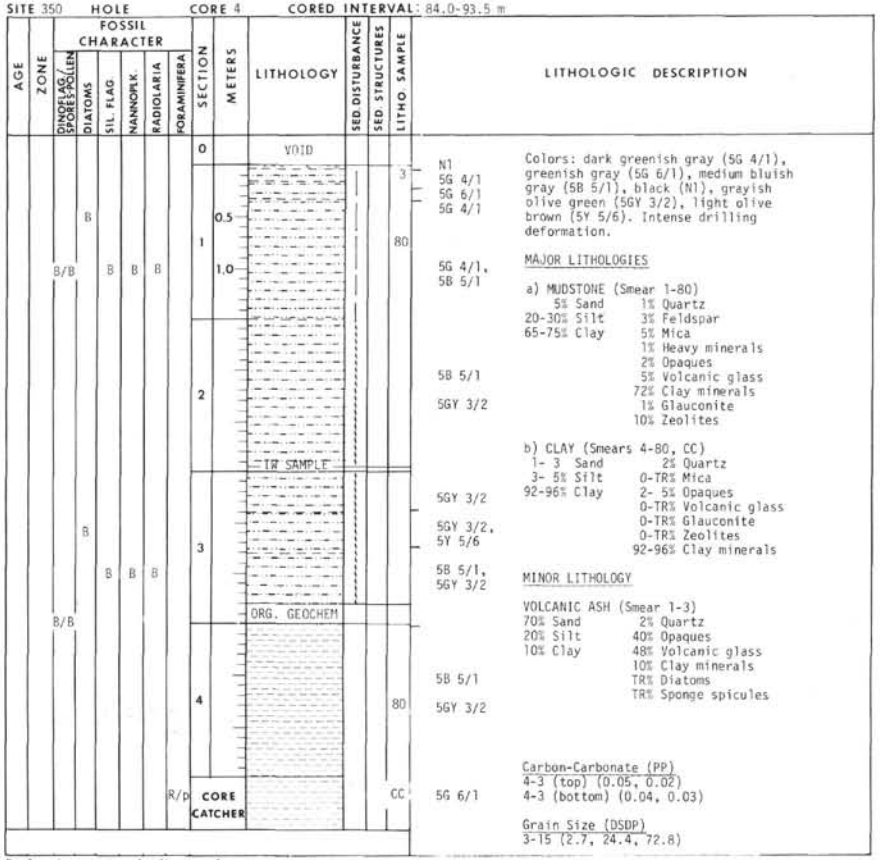
20-30% Sand	6% Quartz
40% Silt	1% Feldspar
30-40% Clay	3% Heavy minerals
	9% Opaques
	5% Volcanic glass
	15% Palagonite
	60% Clay minerals
	TR% Diatoms, Radiolarians
	1% Sponge spicules

b) VOLCANIC ASH (Smear CC)

80% Sand	5% Feldspar
10% Silt	1% Mica
10% Clay	5% Heavy minerals
	40% Opaque volcanic ash
	25% Basaltic volcanic glass
	15% Acidic volcanic glass
	0- 1% Glauconite
	5% Clay minerals
	1% Diatoms
	1% Radiolarians
	3% Sponge spicules

Grain Size (DSDP)
1-86 (35.6, 42.8, 21.6)

SITE 350 HOLE CORE 4 CORED INTERVAL: 84.0-93.5 m



LITHOLOGIC DESCRIPTION

Colors: dark greenish gray (5G 4/1), greenish gray (5G 6/1), medium bluish gray (5B 5/1), black (N1), grayish olive green (5GY 3/2), light olive brown (5Y 5/6). Intense drilling deformation.

MAJOR LITHOLOGIES

a) MUDSTONE (Smear 1-80)

5% Sand	1% Quartz
20-30% Silt	3% Feldspar
65-75% Clay	5% Mica
	1% Heavy minerals
	2% Opaques
	5% Volcanic glass
	72% Clay minerals
	1% Glauconite
	10% Zeolites

b) CLAY (Smears 4-80, CC)

1- 3 Sand	2% Quartz
3- 5% Silt	0-TR% Mica
92-96% Clay	2- 5% Opaques
	0-TR% Volcanic glass
	0-TR% Glauconite
	0-TR% Zeolites
	92-96% Clay minerals

MINOR LITHOLOGY

VOLCANIC ASH (Smear 1-3)

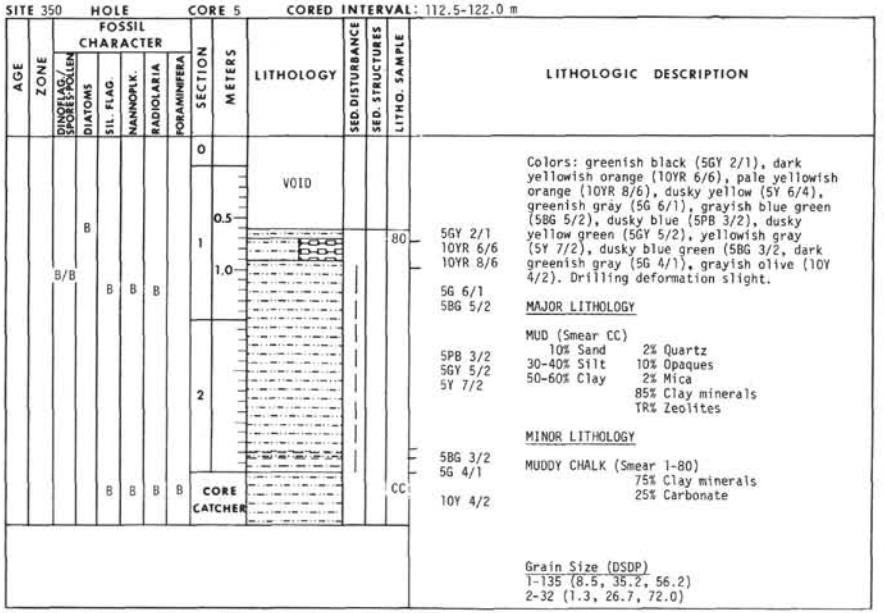
70% Sand	2% Quartz
20% Silt	40% Opaques
10% Clay	48% Volcanic glass
	10% Clay minerals
	TR% Diatoms
	TR% Sponge spicules

Carbon-Carbonate (PP)
4-3 (top) (0.05, 0.02)
4-3 (bottom) (0.04, 0.03)

Grain Size (DSDP)
3-15 (2.7, 24.4, 72.8)

Explanatory notes in Chapter 1

SITE 350 HOLE CORE 5 CORED INTERVAL: 112.5-122.0 m



LITHOLOGIC DESCRIPTION

Colors: greenish black (5GY 2/1), dark yellowish orange (10YR 6/6), pale yellowish orange (10YR 8/6), dusky yellow (5Y 6/4), greenish gray (5G 6/1), grayish blue green (5BG 5/2), dusky blue (5PB 3/2), dusky yellow green (5GY 5/2), yellowish gray (5Y 7/2), dusky blue green (5BG 3/2, dark greenish gray (5G 4/1), grayish olive (10Y 4/2). Drilling deformation slight.

5GY 2/1
10YR 6/6
10YR 8/6
5G 6/1
5BG 5/2
5PB 3/2
5GY 5/2
5Y 7/2
5BG 3/2
5G 4/1
10Y 4/2

MAJOR LITHOLOGY

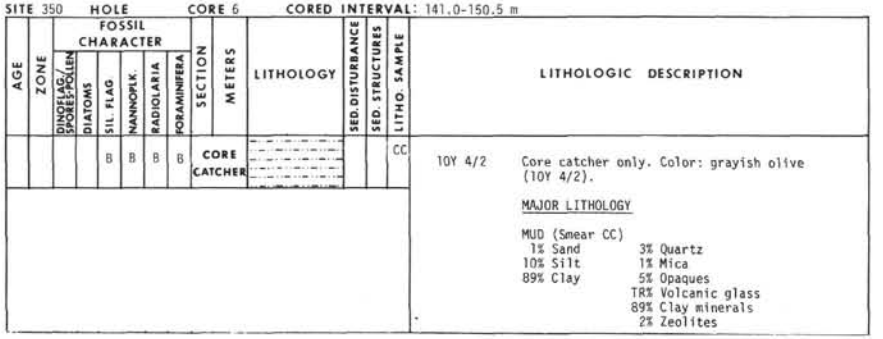
MUD (Smear CC)
10% Sand 2% Quartz
30-40% Silt 10% Opaques
50-60% Clay 2% Mica
85% Clay minerals
TR% Zeolites

MINOR LITHOLOGY

MUDDY CHALK (Smear 1-80)
75% Clay minerals
25% Carbonate

Grain Size (DSDP)
1-135 (8.5, 35.2, 56.2)
2-32 (1.3, 26.7, 72.0)

SITE 350 HOLE CORE 6 CORED INTERVAL: 141.0-150.5 m



LITHOLOGIC DESCRIPTION

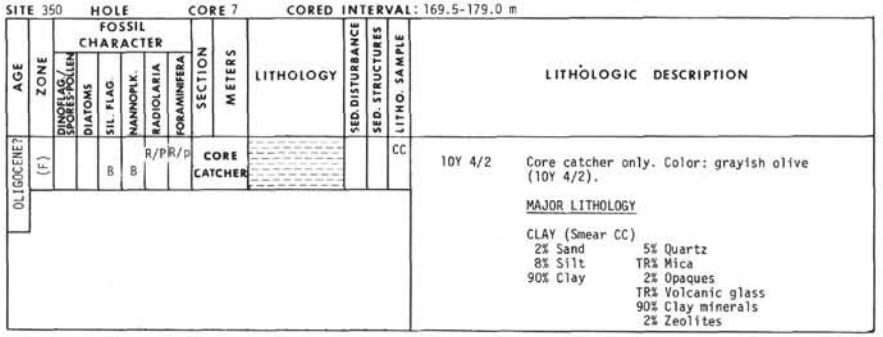
10Y 4/2

Core catcher only. Color: grayish olive (10Y 4/2).

MAJOR LITHOLOGY

MUD (Smear CC)
1% Sand 3% Quartz
10% Silt 1% Mica
89% Clay 5% Opaques
TR% Volcanic glass
89% Clay minerals
2% Zeolites

SITE 350 HOLE CORE 7 CORED INTERVAL: 169.5-179.0 m



LITHOLOGIC DESCRIPTION

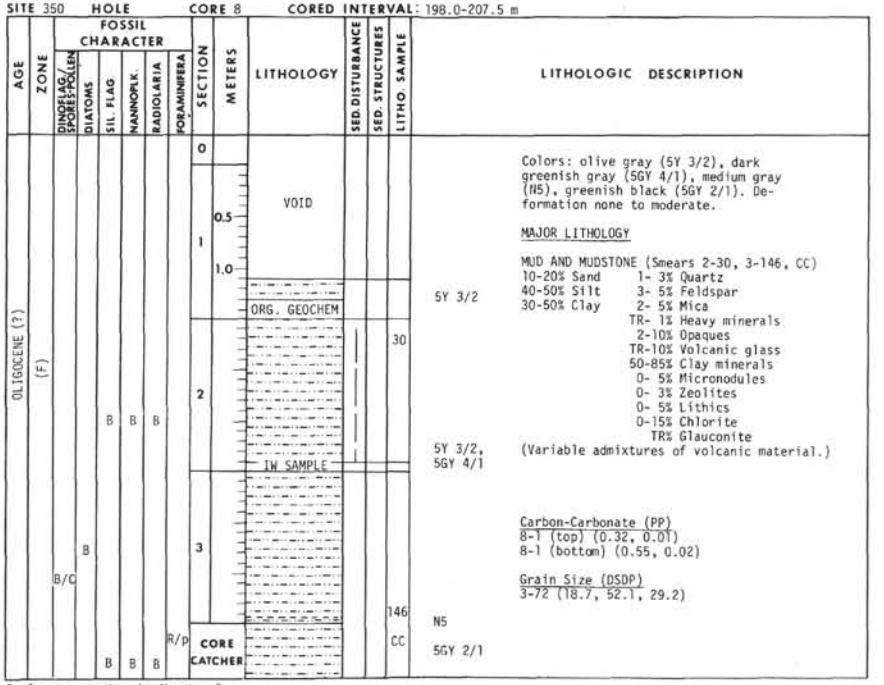
10Y 4/2

Core catcher only. Color: grayish olive (10Y 4/2).

MAJOR LITHOLOGY

CLAY (Smear CC)
2% Sand 5% Quartz
8% Silt TR% Mica
90% Clay 2% Opaques
TR% Volcanic glass
90% Clay minerals
2% Zeolites

SITE 350 HOLE CORE 8 CORED INTERVAL: 198.0-207.5 m



LITHOLOGIC DESCRIPTION

Colors: olive gray (5Y 3/2), dark greenish gray (5GY 4/1), medium gray (N5), greenish black (5GY 2/1). Deformation none to moderate.

5Y 3/2
5Y 3/2, 5GY 4/1
N5
5GY 2/1

MAJOR LITHOLOGY

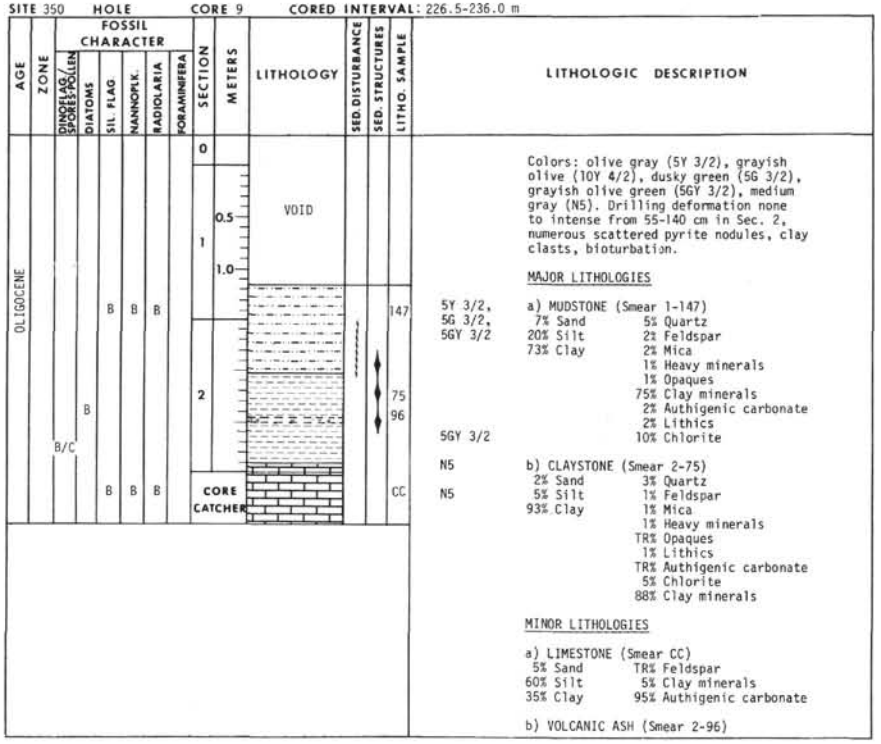
MUD AND MUDSTONE (Smears 2-30, 3-146, CC)
10-20% Sand 1- 3% Quartz
40-50% Silt 3- 5% Feldspar
30-50% Clay 2- 5% Mica
TR- 1% Heavy minerals
2-10% Opaques
TR-10% Volcanic glass
50-85% Clay minerals
0- 5% Micronodules
0- 3% Zeolites
0- 5% Lithics
0-15% Chlorite
TR% Glauconite
(Variable admixtures of volcanic material.)

Carbon-Carbonate (PP)
8-1 (top) (0.32, 0.01)
8-1 (bottom) (0.55, 0.02)

Grain Size (DSDP)
3-72 (18.7, 52.1, 29.2)

Explanatory notes in Chapter 1

SITE 350 HOLE CORE 9 CORED INTERVAL: 226.5-236.0 m



LITHOLOGIC DESCRIPTION

Colors: olive gray (5Y 3/2), grayish olive (10Y 4/2), dusky green (5G 3/2), grayish olive green (5GY 3/2), medium gray (N5). Drilling deformation none to intense from 55-140 cm in Sec. 2, numerous scattered pyrite nodules, clay clasts, bioturbation.

MAJOR LITHOLOGIES

5Y 3/2, 5G 3/2, 5GY 3/2

a) MUDSTONE (Smear 1-147)

7% Sand	5% Quartz
20% Silt	2% Feldspar
73% Clay	2% Mica
	1% Heavy minerals
	1% Opaques
	75% Clay minerals
	2% Authigenic carbonate
	2% Lithics
5GY 3/2	10% Chlorite

N5

b) CLAYSTONE (Smear 2-75)

2% Sand	3% Quartz
5% Silt	1% Feldspar
93% Clay	1% Mica
	1% Heavy minerals
	TR% Opaques
	1% Lithics
	TR% Authigenic carbonate
	5% Chlorite
	88% Clay minerals

N5

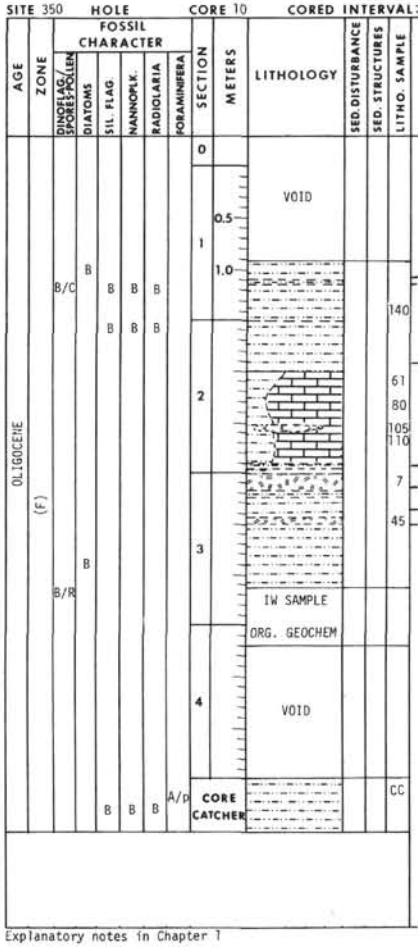
MINOR LITHOLOGIES

a) LIMESTONE (Smear CC)

5% Sand	TR% Feldspar
60% Silt	5% Clay minerals
35% Clay	95% Authigenic carbonate

b) VOLCANIC ASH (Smear 2-96)

SITE 350 HOLE CORE 10 CORED INTERVAL: 255.0-264.5 m



LITHOLOGIC DESCRIPTION

Colors: olive gray (5Y 3/2), dusky yellow brown (10YR 2/2), greenish black (5GY 2/1), medium dark gray (N4), dark greenish gray (5G 4/1). Calcite veins in Sec. 2 (140-150 cm).

MAJOR LITHOLOGIES

5Y 3/2, 10YR 2/2, 5GY 2/1

a) LIMESTONE (Smear 2-80)

5% Sand	3% Quartz
5% Silt	1% Volcanic glass
90% Clay	20% Clay minerals
	76% Authigenic carbonate

10YR 2/2

N4

b) MUDSTONE (Smears 1-140, CC)

5-30% Sand	0- 2% Volcanic glass
30% Silt	0- 3% Palagonite
40-65% Clay	50-83% Clay minerals
	1- 2% Carbonate
2- 3% Quartz	0- 5% Lithics
3- 4% Feldspar	0-25% Chlorite
1- 3% Mica	0- 2% Micronodules
TR- 2% Heavy minerals	2- 3% Opaques

10YR 2/2, 5G 4/1, 10YR 2/2, 10YR 2/2

c) CLAYEY LIMESTONE (Smears 2-61, 2-110)

5% Sand	1% Opaques
5% Silt	0-TR% Volcanic glass
90% Clay	25-30% Clay minerals
	TR- 1% Zeolites
2% Quartz	64-70% Carbonate
1- 2% Mica	TR% Heavy minerals
0- 1% Feldspar	

5Y 3/2

d) ALTERED ASH (Smears 2-105, 3-7, 3-45)

0- 5% Sand	20% Clay minerals
5-35% Silt	0- 1% Opaques
60-95% Clay	54-64% Altered ash
	0-10% Volcanic glass
2% Quartz	0-TR% Glauconite
5% Feldspar	0- 1% Authigenic carbonate
5- 7% Mica	
0- 1% Heavy minerals	0- 3% Zeolite

Carbon-Carbonate (PP)
10-3 (top) (0.96, 0.01)
10-3 (bottom) (1.03, 0.01)

Grain Size (DSDP)
3-3 (33.5, 38.9, 27.6)
3-78 (0.7, 35.4, 63.9)

Explanatory notes in Chapter 1

SITE 350 HOLE CORE 11 CORED INTERVAL: 283.5-293.0 m

AGE	ZONE	FOSSIL CHARACTER: DINOFLAG./SPORES-POLLEN	DIATOMS	SIL. FLAG	NANNOFLK.	RADIOLARIA	FORAMINIFERA	SECTION	METERS	LITHOLOGY	SED. DISTURBANCE	SED. STRUCTURES	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
								0		VOID				
		T/C	B	B	B	B		1	0.5				10YR 2/2	Colors: dusky yellowish brown (10YR 2/2) dark gray (N3), medium dark gray (N4). At 97-113 cm calcite veining. Layer at 113-115 assume same composition as layer above. Layer at 115 cm-120 cm non-calc. mudstone, limestone.
									1.0				N3/N4	MAJOR LITHOLOGY
				B	B	B							100	LIMESTONE (Smear 1-140)
													10YR 2/2	5% Sand 5% Quartz
													140	15% Silt 1% Feldspar
														80% Clay 5% Mica
														TR% Opaques
														10% Clay minerals
														79% Authigenic carbonate
														MINOR LITHOLOGY
														CALCAREOUS MUDSTONE (Smear 1-100)
														10% Silt 5% Quartz
														90% Clay 1% Feldspar
														5% Mica
														TR% Heavy minerals
														5% Volcanic glass
														54% Clay minerals
														30% Authigenic carbonate

SITE 350 HOLE CORE 12 CORED INTERVAL: 312.0-321.5 m

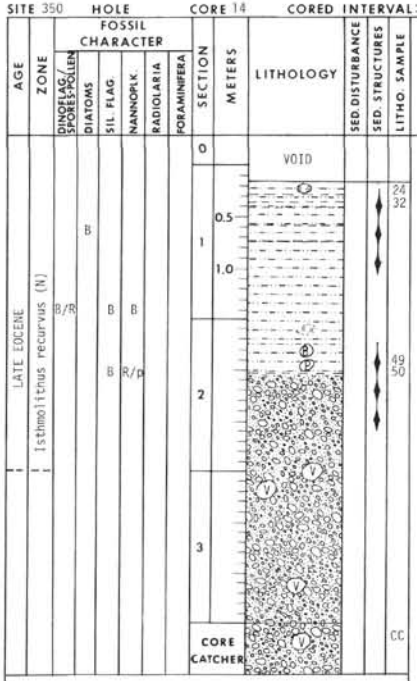
AGE	ZONE	FOSSIL CHARACTER: DINOFLAG./SPORES-POLLEN	DIATOMS	SIL. FLAG	NANNOFLK.	RADIOLARIA	FORAMINIFERA	SECTION	METERS	LITHOLOGY	SED. DISTURBANCE	SED. STRUCTURES	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE EOCENE	Spiropleciamina spectabilis (F)							0		VOID				
		R/p		B	B	B		1	0.5				5Y 3/2	Colors: olive gray (5Y 3/2), greenish gray (5G 6/1), dusky yellow brown (10YR 2/2), medium dark gray (N4). Some intense drilling deformation.
													55	5G 6/1
													81	10YR 2/2
		B/C		B	B	B			1.0				5G 6/1	MAJOR LITHOLOGIES
													115	5Y 3/2
													145	N4
								2					75	a) MUDSTONE (Smears 1-55, 1-115, 2-75, CC)
													10YR 2/2	0-10% Sand 1- 5% Quartz
														15-35% Silt 2- 7% Feldspar
														55-85% Clay 10-15% Mica
														TR% Heavy minerals
														0- 3% Opaques
														TR- 5% Volcanic glass
														0-10% Altered ash
														0-TR% Glauconite
														1- 5% Micronodules
														0- 2% Zeolites
														0- 1% Authigenic carbonate
														61-72% Clay minerals
										TW SAMPLE				b) LIMESTONE (Smear 1-145)
													10YR 2/2	5% Sand 2% Quartz
														5% Silt 5% Mica
													5G 6/1	90% Clay TR% Opaques
														15% Clay minerals
														78% Authigenic carbonate
			B					3					10YR 2/2	c) ALTERED ASH (Smear 1-81)
		B/R												5% Silt 1% Quartz
													5G 6/1	95% Clay 2% Feldspar
													10YR 2/2	5% Mica
														3% Opaques
				B	B	B	A/p	CORE CATCHER					CC	1% Volcanic glass
													5Y 3/2	3% Micronodules
														1% Zeolites

SITE 350 HOLE CORE 13 CORED INTERVAL: 340.5-350.0 m

AGE	ZONE	FOSSIL CHARACTER: DINOFLAG./SPORES-POLLEN	DIATOMS	SIL. FLAG	NANNOFLK.	RADIOLARIA	FORAMINIFERA	SECTION	METERS	LITHOLOGY	SED. DISTURBANCE	SED. STRUCTURES	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE EOCENE	(F)							0		VOID				
		B/R	B	B	B	B		1	0.5				5G 4/1	Colors: olive gray (5Y 4/1, 5Y 3/2), dark greenish gray (5G 4/1), dusky yellowish brown (10YR 2/2), pale yellow brown (10YR 6/2), light blue gray (5B 7/1), medium dark gray (N4), light olive gray (5Y 6/1). Moderate to intense deformation. Sec. 2: (90-100 cm) - possible syn.-sed. deformation; Sec. 3 (140-150 cm) - bioturbation, brecciation.
									1.0				5Y 4/1	
													106	5Y 3/2
													5Y 6/1	MAJOR LITHOLOGY
													10YR 2/2	MUDSTONE (Smears 1-106, 2-40, 2-75, CC)
													10YR 6/2	2- 5% Sand 2- 5% Quartz
													40	10-25% Silt 2- 3% Feldspar
													10YR 2/2	70-88% Clay 0-10% Mica
								2					75	1- 5% Heavy minerals
														(may include mica)
														0- 2% Opaques
													N4	0- 2% Volcanic glass
													10YR 2/2	76-88% Clay minerals
													5Y 6/1	0- 1% Micronodules
														0- 3% Zeolites
								3					10YR 2/2	
								CORE CATCHER					CC	5Y 4/1

Explanatory notes in Chapter 1

SITE 350 HOLE CORE 14 CORED INTERVAL: 359.5-369.0 m



5GY 4/1
5Y 4/1
N5

5GY 4/1

Colors: dark greenish gray (5GY 4/1), grayish black (N2), dark greenish gray (5Y 4/1), medium gray (N5), medium light gray (N6). Sec. 1 (16-28 cm) - massive, with claystone fragments (basalt [N2]); (35-40 cm) - mudstone (N5), calcareous(?); (58-76 cm) - brecciated (calc.?) mudstone; Secs. 1 and 2 - mudstone unit. Extensively bioturbated (comp. and rhomboid. burrows. In Sec. 2, angular claystone fragments (N2 and N6).

MAJOR LITHOLOGY

MUDSTONE (Smears 1-24, 1-32, 2-50)

5% Sand	0- 2% Volcanic glass
10-15% Silt	
80-85% Clay	0-10% Chlorite
	0-TR% Palagonite
0- 2% Quartz	0- 5% Zeolites
3- 5% Feldspar	3- 8% Authigenic carbonate
3- 4% Mica	
1- 2% Heavy minerals	0- 2% Chert
0-TR% Opaques	0- 1% Barite
0- 3% Lithics	69-79% Clay minerals

MINOR LITHOLOGY

MUDSTONE (pebble in mudstone, perhaps derived from basalt) (Smear 2-49)

3% Sand	10% Feldspar
12% Silt	2% Mica
85% Clay	50% Clay minerals
	20% Volcanic glass (recrystallized)
15% Zeolites	
5% Lithics	TR% Opaques

BASALT BRECCIA

Sec. 2 (50-75 cm) - drilling breccia of sedimentary rock (claystone); (75-150 cm) - breccia: angular and round fragments of claystone and basalt (sizes up to 10 cm). Cemented by olive gray to olive black calcite-chlorite-smectite matrix.

Thin Section (73-75 cm) - highly altered (calcified, chloritized, albitized) basalt. Plag.-30%, pyroxene-20%, olivine-5%, magnetite-2%, altered glass-30%, smectite, chlorite, zeolite, albite, sphene(?); (90-93 cm, 108-110 cm) breccia with coarse angular fragments, calcified basalts, hyalobasalts, zeolite, chlorite, palagonite.

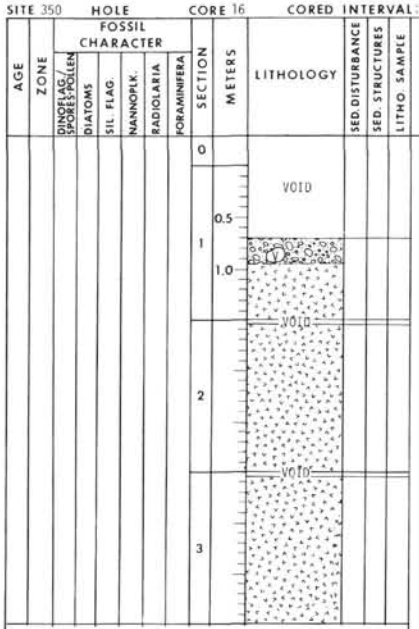
Sec. 3 - branching white calcite veins. Cavities up to 2 cm in a breccia composed from angular and round fragments of fine grained basalt, grayish black to black with thin rims (0.5-1 mm) of calcite and chlorite. Breccia cement is olive black to greenish black fine grained chlorite-smectite matrix.

Thin Section - breccia with coarse, angular fragments of phyric-hyalobasalt. Plagioclase (An_{68-72}) fresh. Small rounded fragments (0.1-2 mm) of palagonite and glass replaced by chlorite, smectite(?), zeolite. Chlorite, smectite, calcite rims on fragments - cement istropic-zeolite, clay(?).

Core catcher - breccia as above.

Core 15 (369.0-378.5 m) - No recovery.

SITE 350 HOLE CORE 16 CORED INTERVAL: 379.5-388.0 m



BASALT BRECCIA - BASALT

Sec. 1 (70-90 cm) - breccia: angular fragments of medium dark gray basalt cemented by black clay matrix; (90-150 cm) - basalt: grayish black (N2) to black (N1) fine-grained with phenocrysts of plagioclase and pyroxene and white calcite amygdules and cavities. Rare calcite veins with yellowish-green chlorite.

Thin Section (74-77 cm) - calcitized. Tuff with angular small (0.05-0.1 mm) piece of volcanic glass replaced by chlorite, zeolite and cemented by isotropic, very fine, zeolite matrix; (112-117, 114-117 cm) - dolerite basalt, subophitic, trachytachyoid, fine grained with glomeroporphyritic clusters of plagioclase and orthopyroxene. Plagioclase 40-50%, pyroxene 40-50%, altered olivine-3%, magnetite-5%, smectite, carbonate, amphibole, albite, plagioclase = An_{70}.

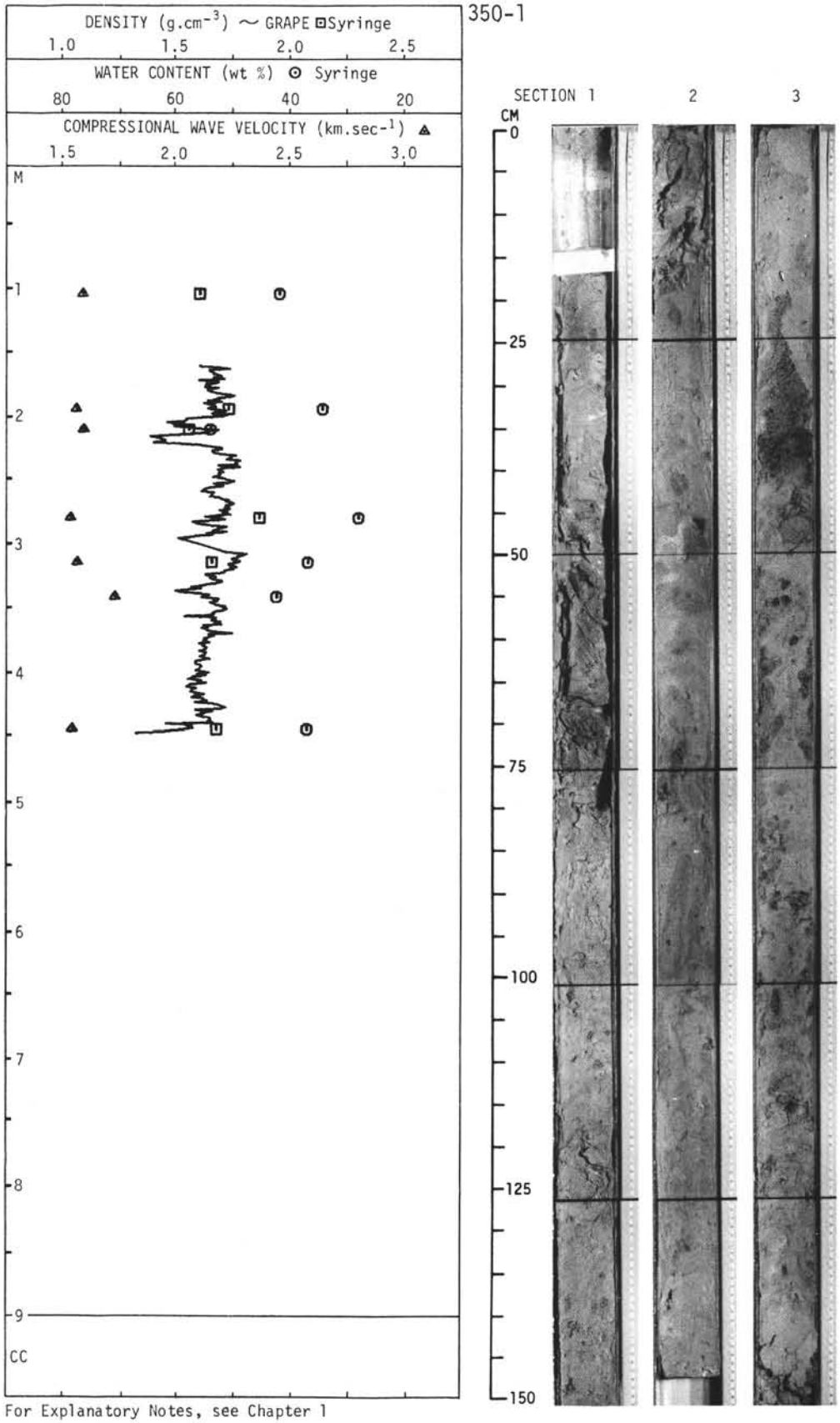
Sec. 2 (5-50 cm) - massive basalt, with calcite veins with chlorite. Slickenside surfaces; (50-125 cm) - black (N1) to grayish black (N2) fine grained basalt with glomeroporphyritic plagioclase (up to 3 mm long). Rare round calcite amygdules with thin chlorite edgings. Calcite vein with chlorite; (125-150 cm) - massive basalt.

Thin Section - basalt as per Sec. 1, coarser (med. grained), twinned pyroxene with poikilitic plagioclase.

Sec. 3 - black (N1) massive phyric medium-grained basalt. Rare phenocrysts of plagioclase and clinopyroxene and round calcite amygdules. Slickensides with white calcite and yellowish green chlorite on walls.

Thin Section - dolerite basalt (as per Sec. 2) but with abundant smectite (15-20%), plagioclase (An_{66-72}) 40-55%, pyroxene (augite, ortho) 40-50%. Altered olivine-3%, magnetite 3-6%, smectite, chlorite, calcite, amphibole, albite(?).

Explanatory notes in Chapter 1



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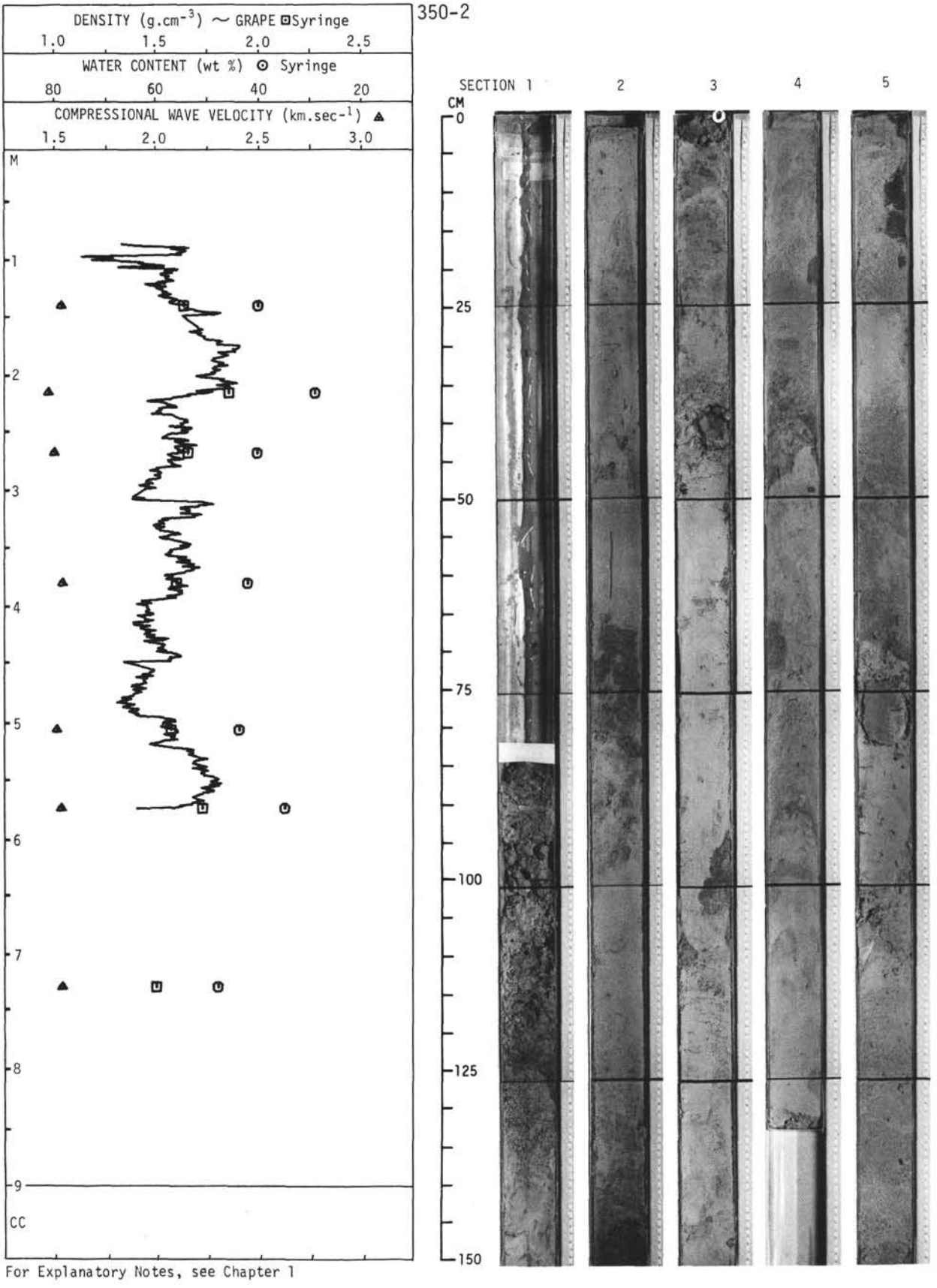

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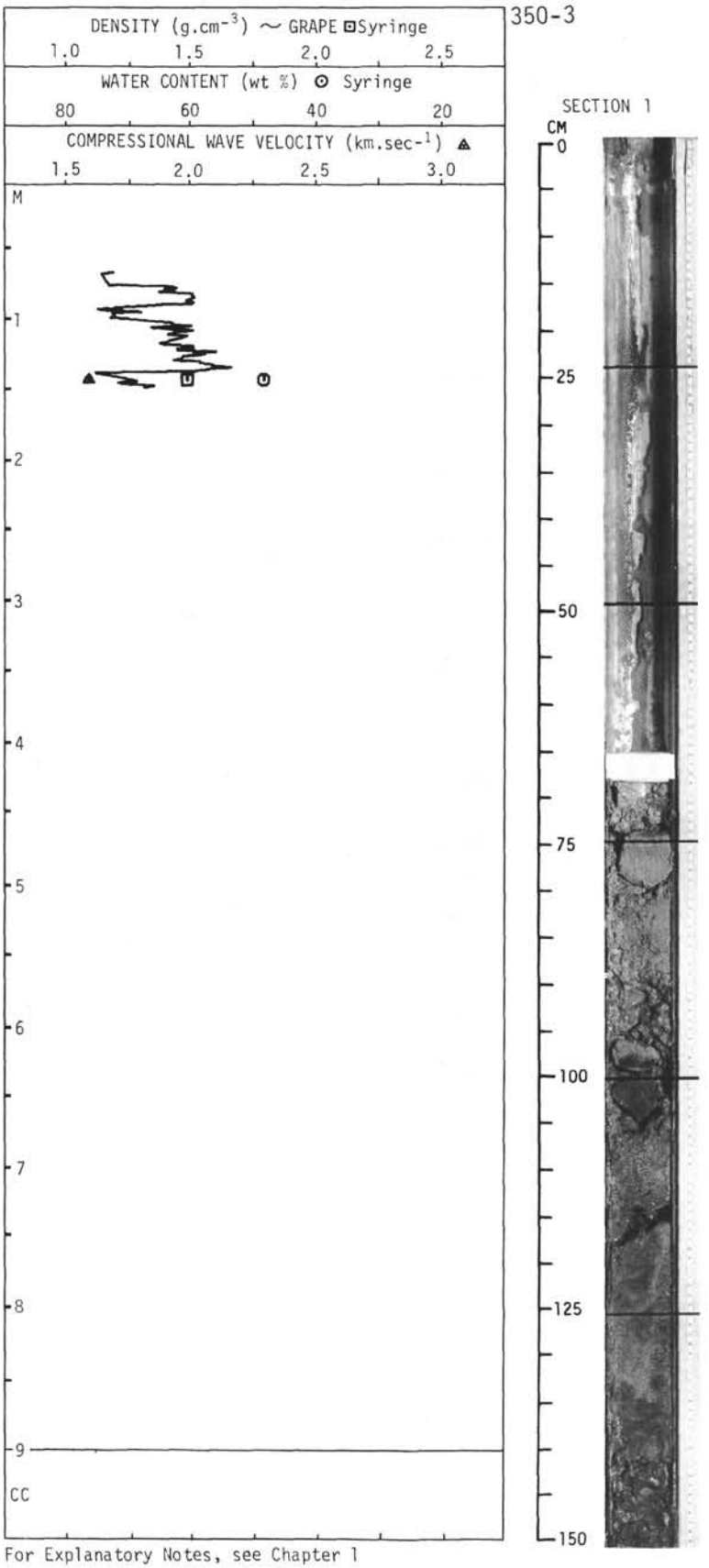

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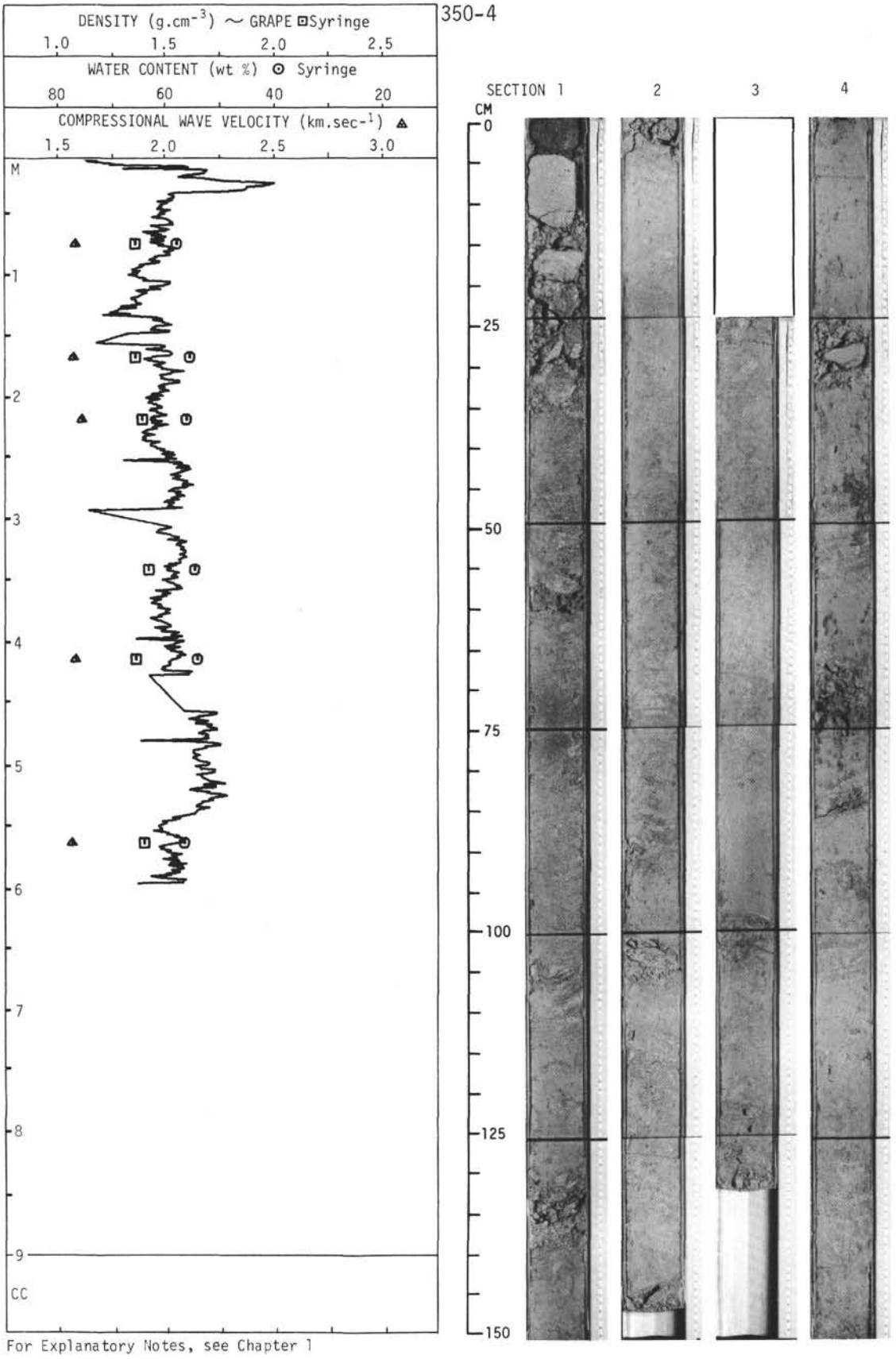

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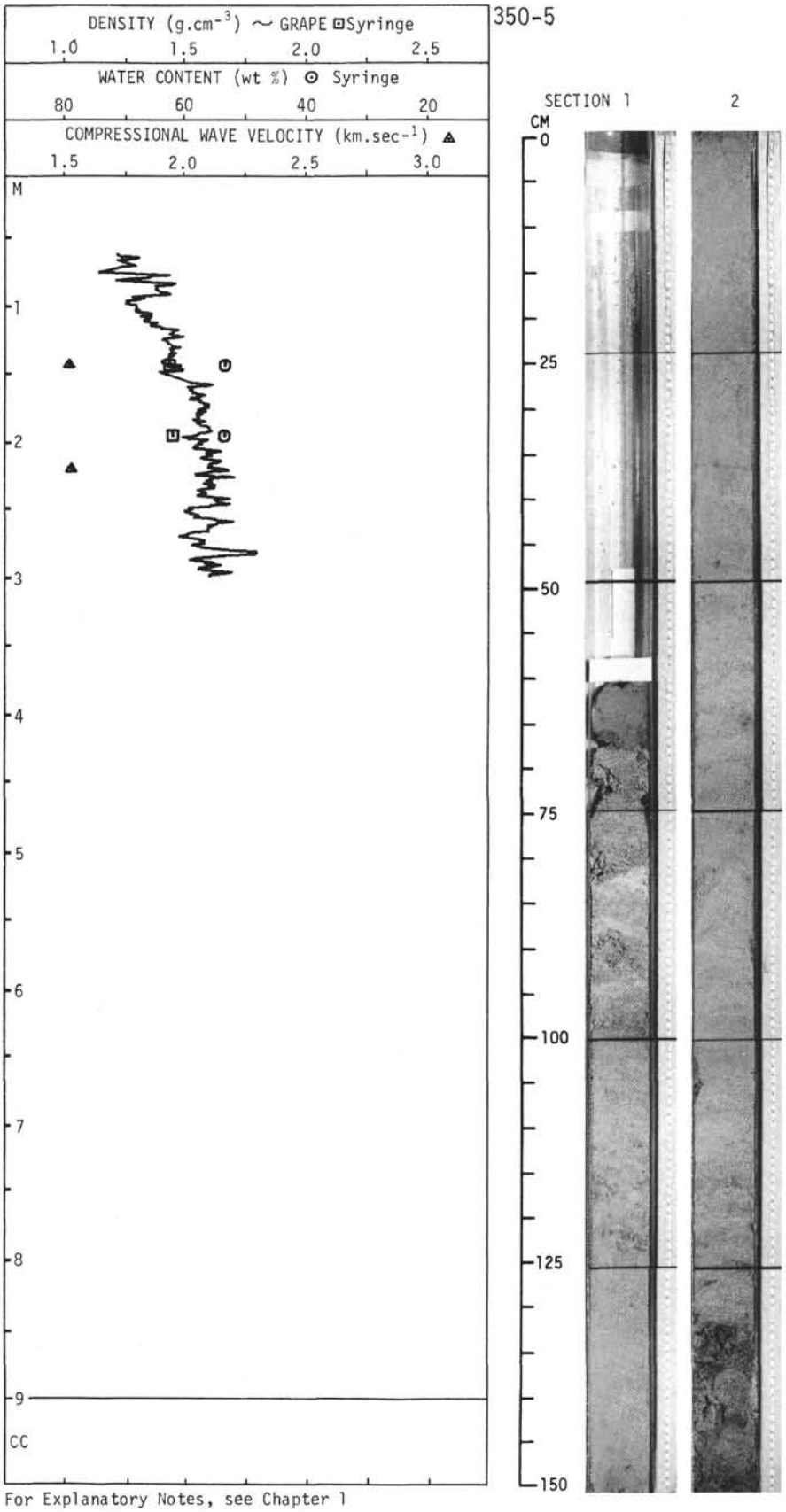

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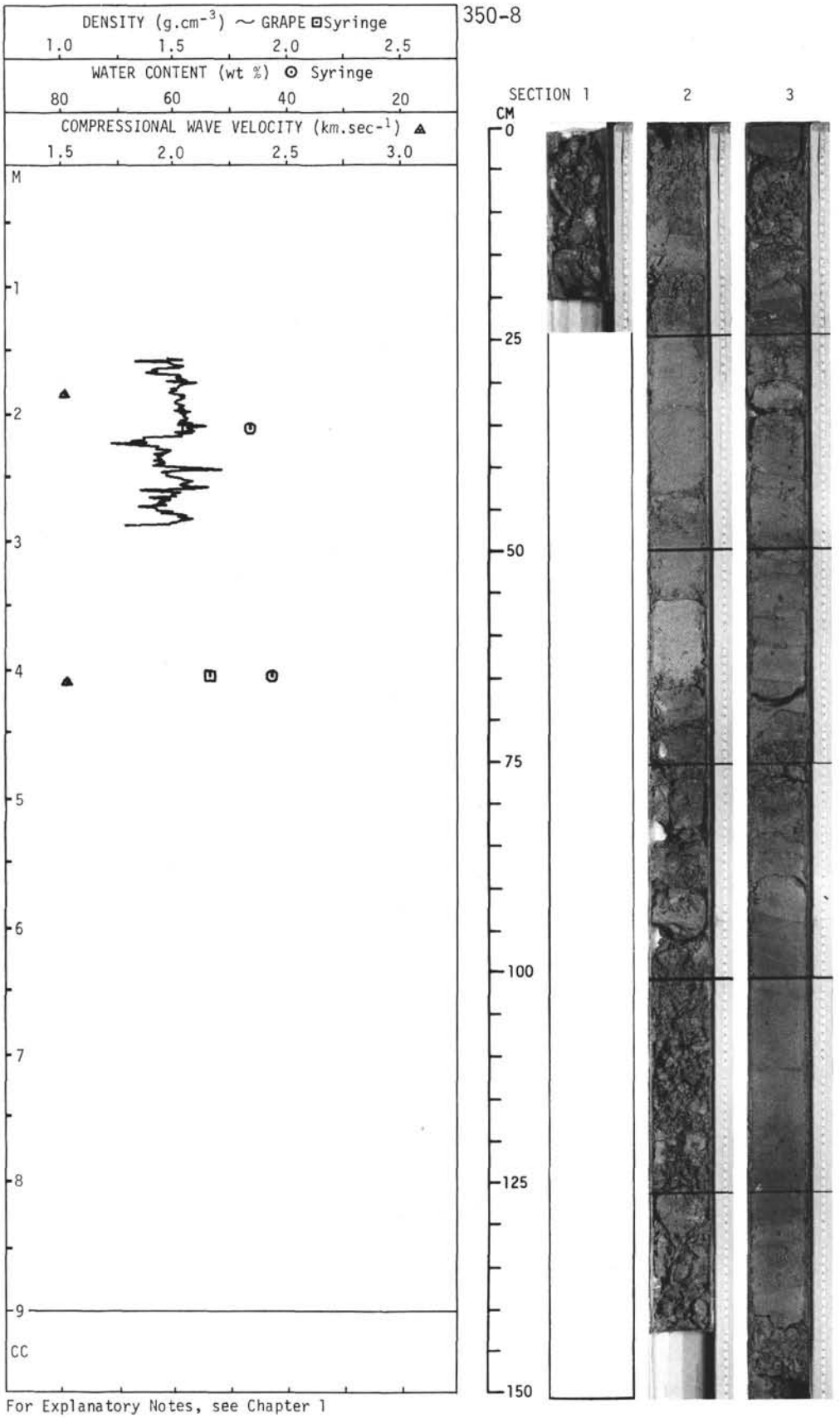

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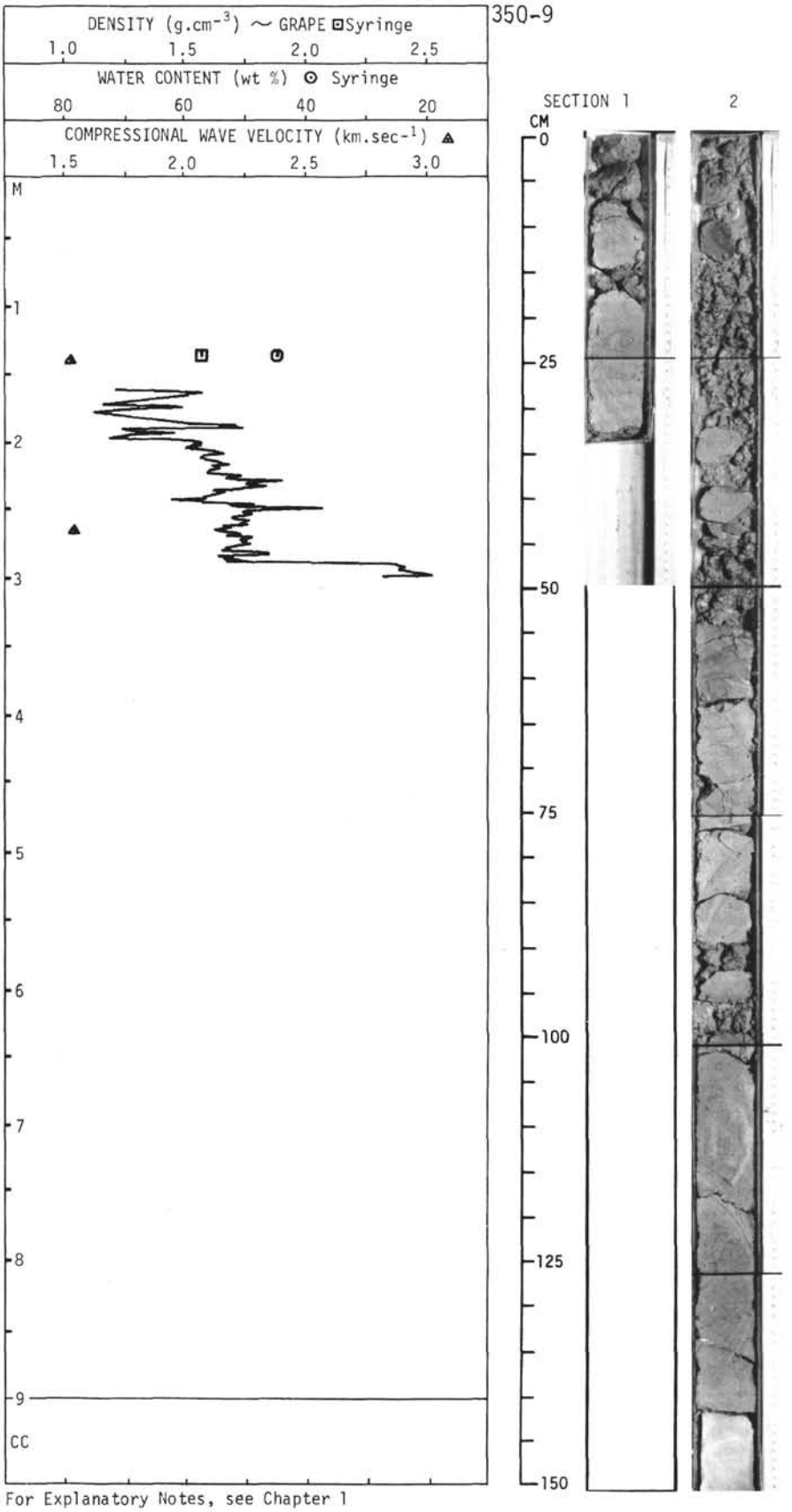

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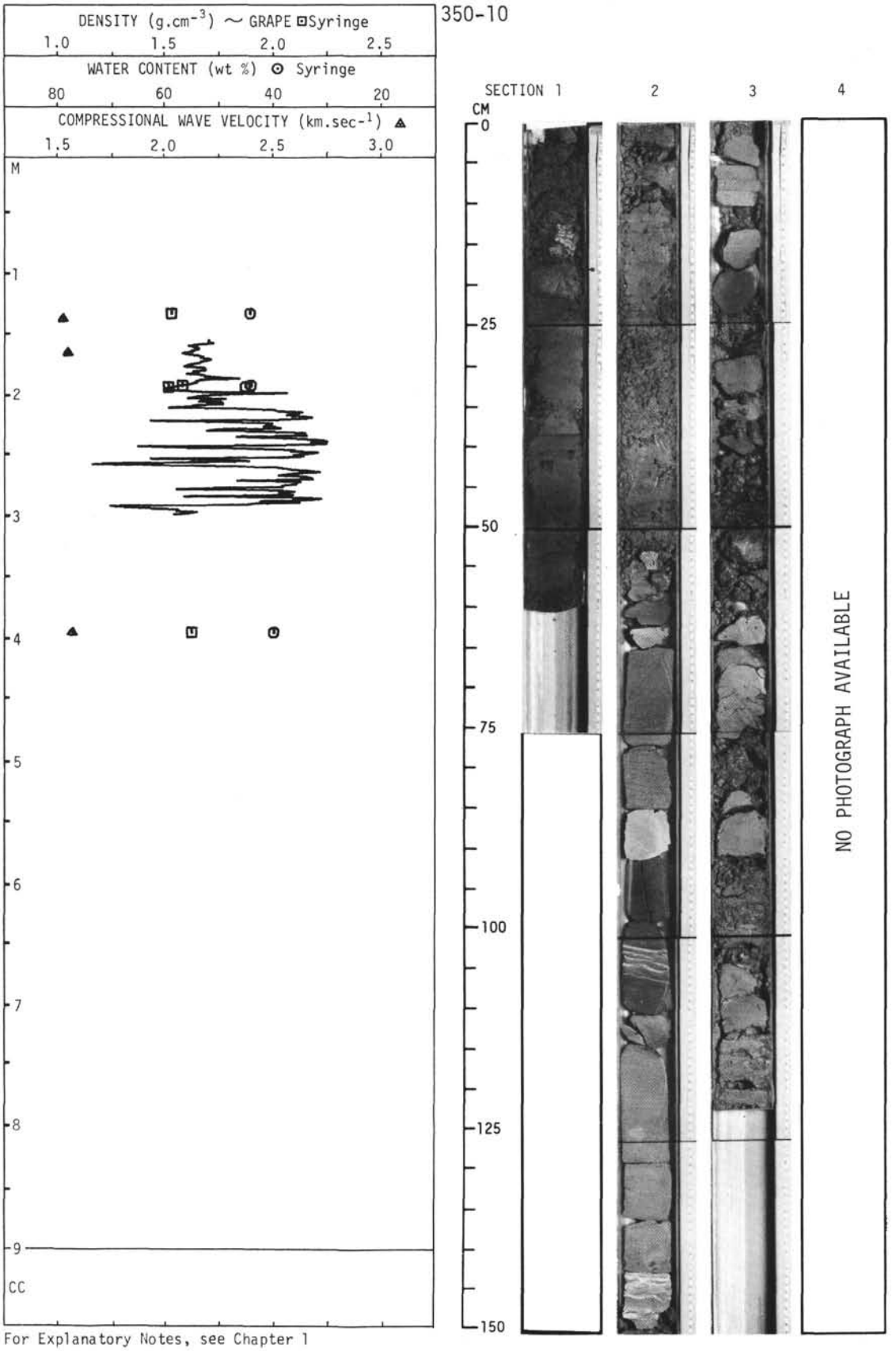

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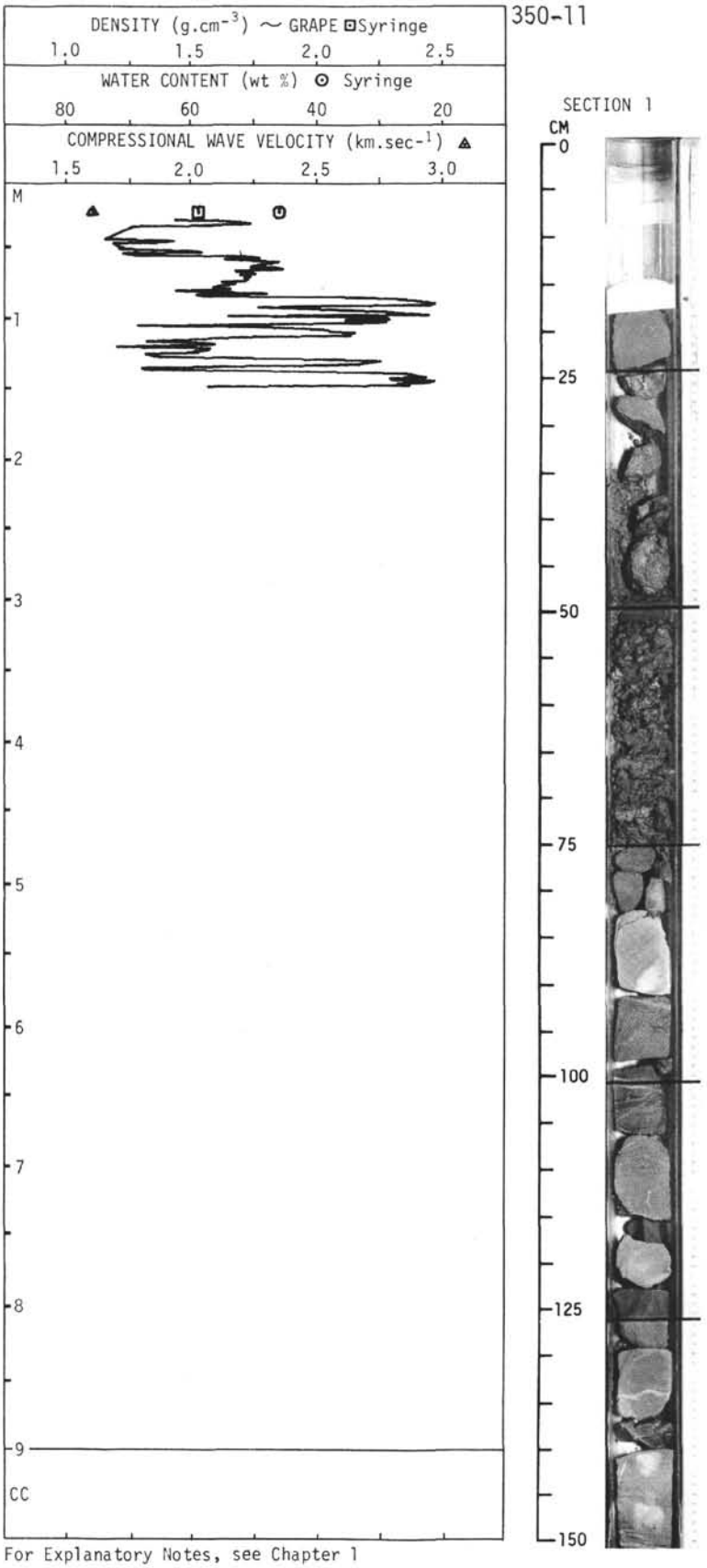

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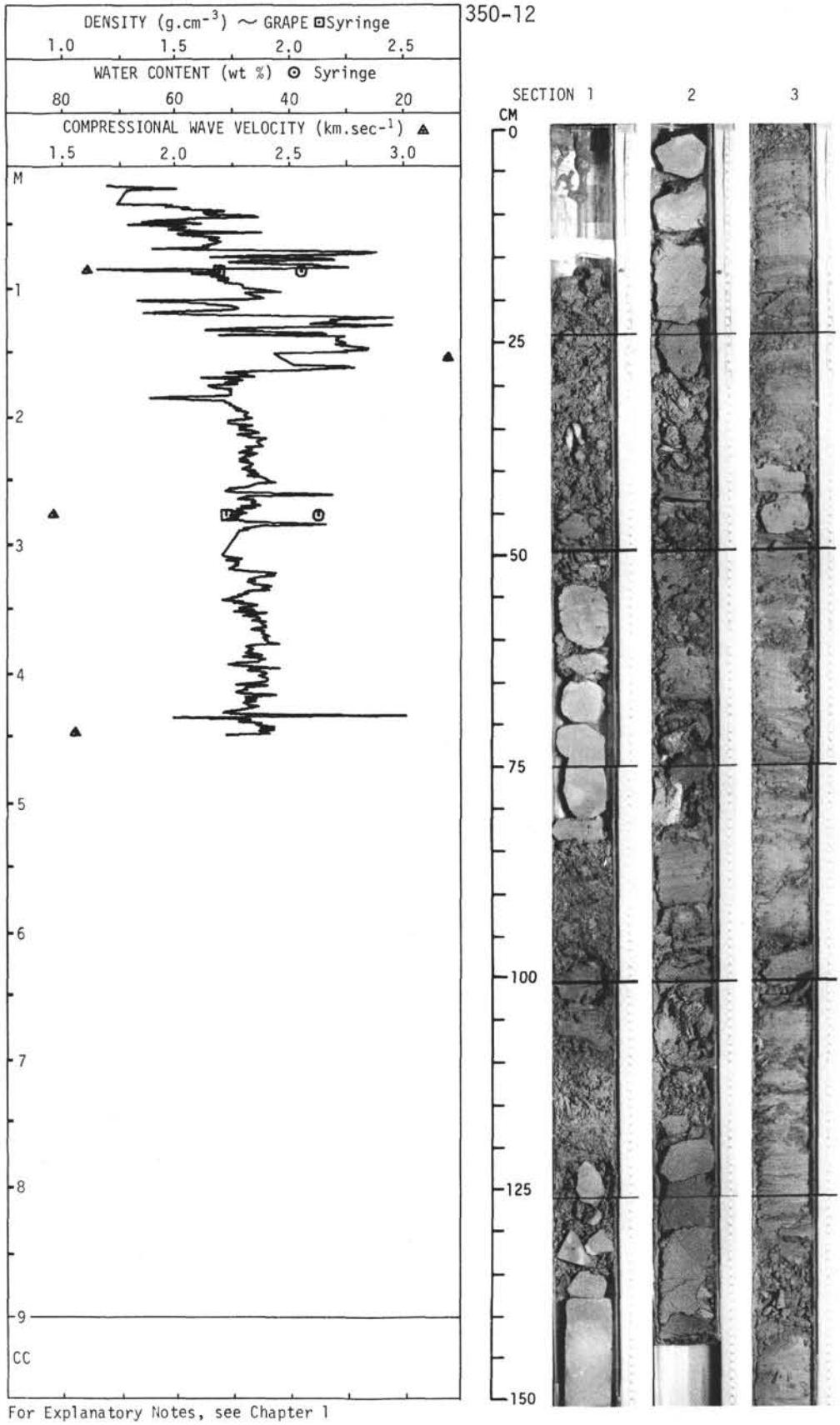

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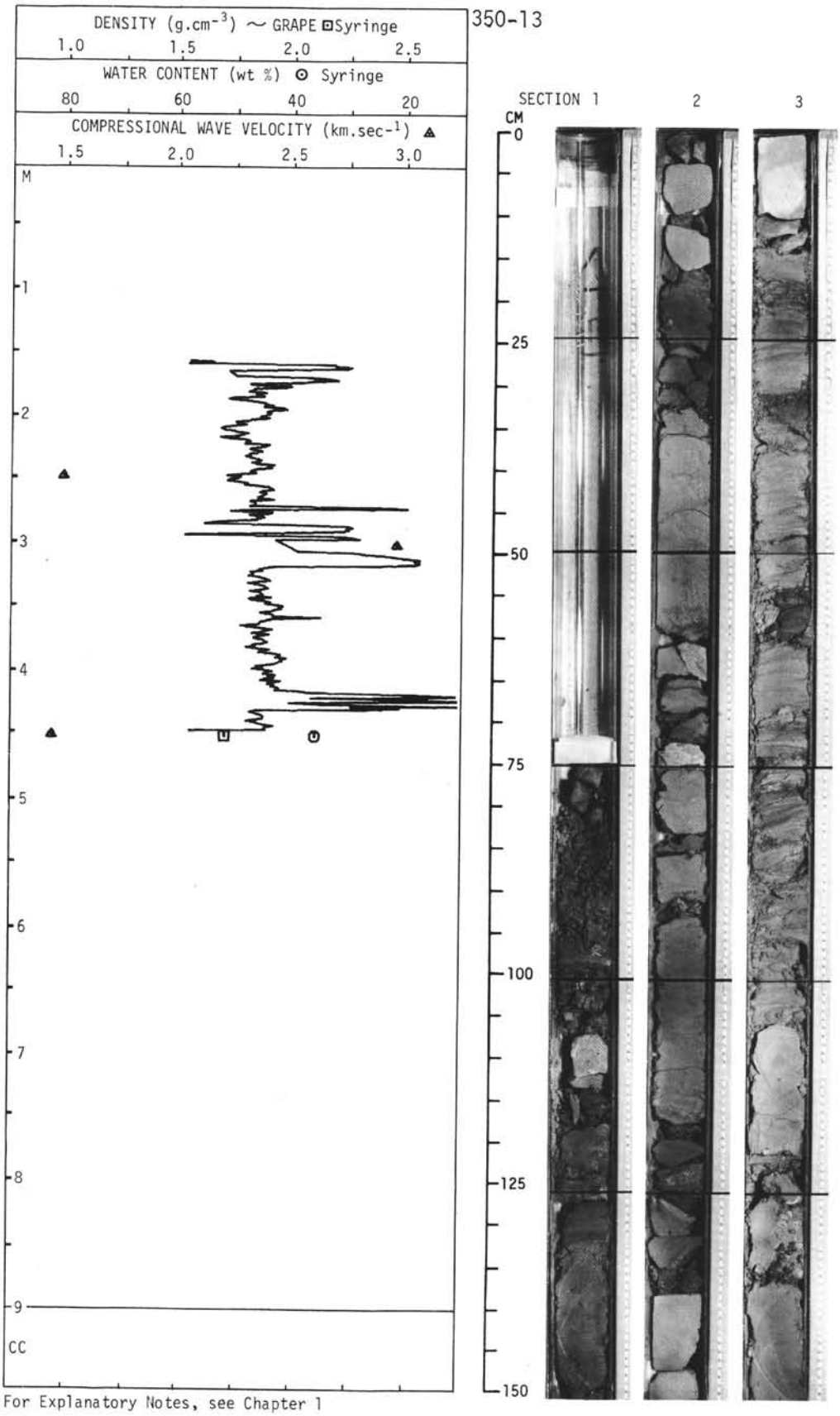

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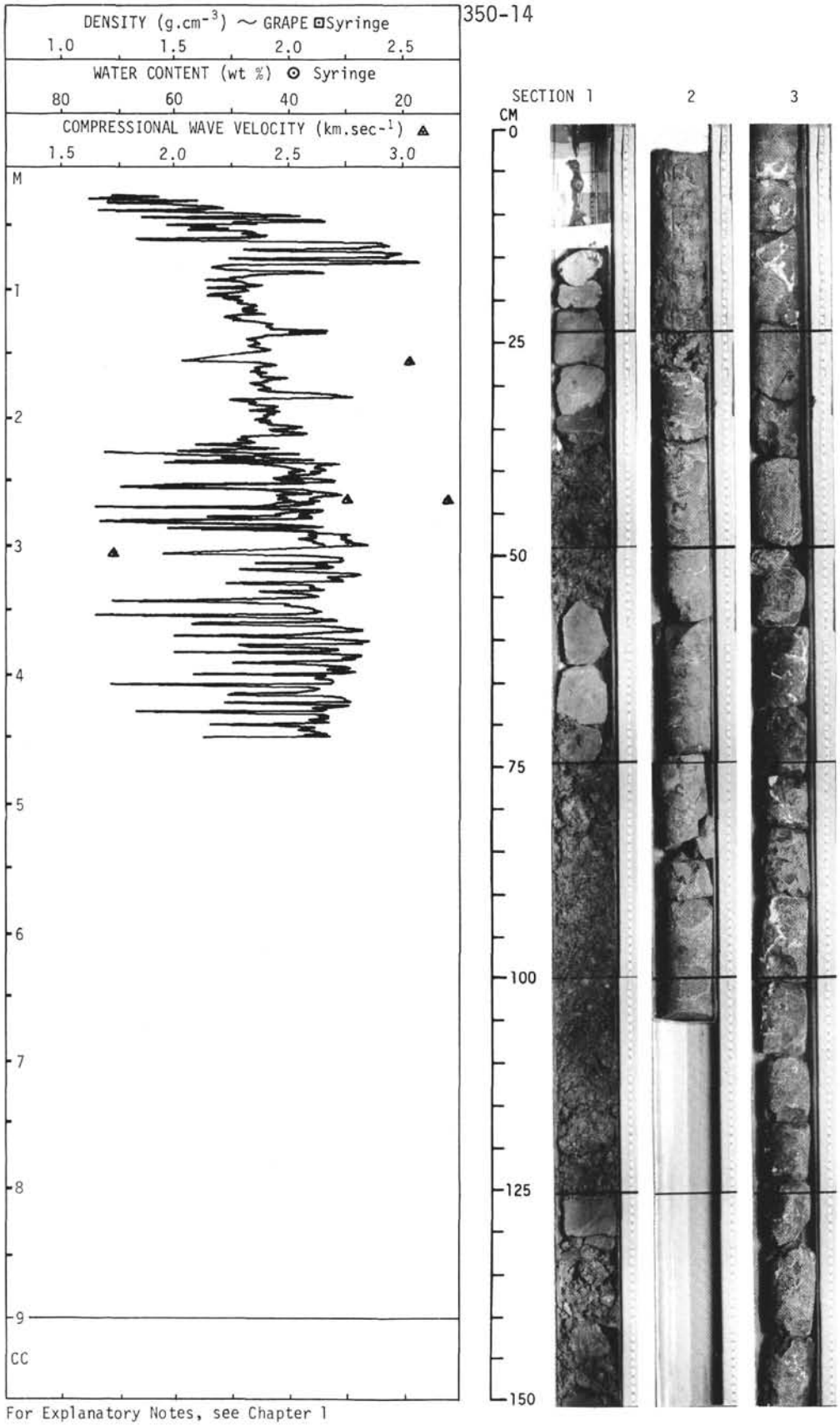

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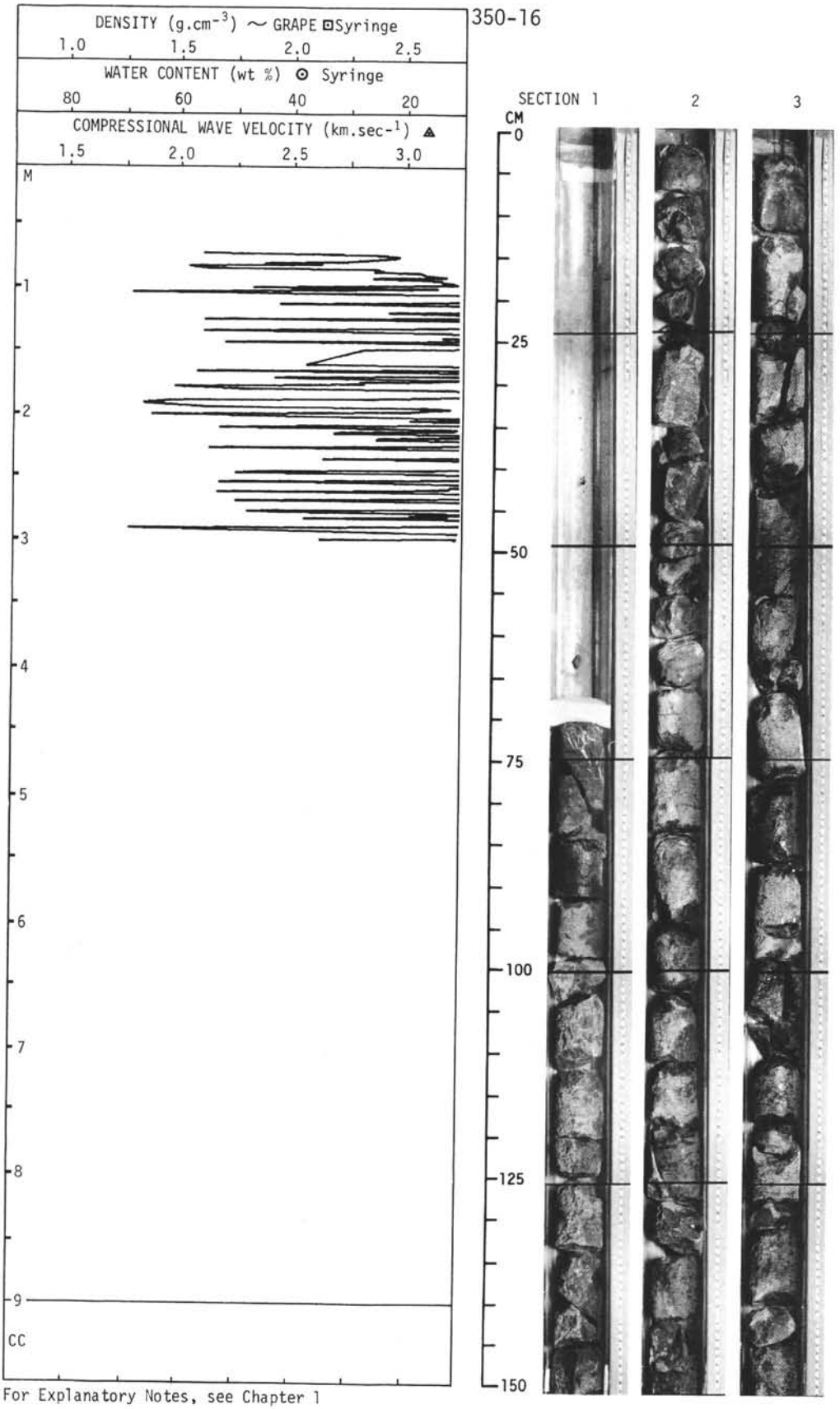

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