# 3. SITE 260

The Shipboard Scientific Party[1]

## SITE DATA

**Date Occupied:** 11 November 1972

**Date Departed:** 14 November 1972

**Time on Site:** 81 hours

**Position:**
lat 16°8.67′S
long 110°17.92′E

**Water Depth (from sea level):** 5702 corrected meters (echo sounding)

**Water Depth (from drill floor):** 5712 corrected meters (echo sounding)

**Bottom Felt At:** 5709 meters (drill pipe)

**Penetration:** 331 meters

**Number of Holes:** 1

**Number of Cores:** 20

**Total Length of Cored Section:** 169.5 meters

**Total Core Recovered:** 56.7 meters

**Percentage Core Recovery:** 33.5

**Oldest Sediment Cored:**
Depth below sea floor: 323 meters
Nature: Gray-olive clay
Age: Albian
Measured velocity: 1.6 km/sec

**Basement:**
Depth below sea floor:
0.38 sec DT (seismic profiler)
323 meters (drilled)
Inferred velocity to basement: 1.7 km/sec
Nature: Basalt sill

**Principal Results:** A basement age of Albian was found. The mainly Lower Cretaceous sequence is unconformably overlain by a Cenozoic sequence of carbonate oozes that have been redeposited from bottom currents.

## BACKGROUND AND OBJECTIVES

Sea-floor magnetic anomalies in the northeast Wharton Basin have been tentatively identified as trending 60° and ranging from magnetic anomaly 31 at the Gascoyne Abyssal Plain near the Australian continental margin to magnetic anomaly 24 at the rim of the Java Trench (Falvey, 1972). Lamont-Doherty Geological Observatory seismic profiles show that the Gascoyne Abyssal Plain is a suitable area for drilling to determine the age of the basement. Acoustic basement ranges from 0.1-0.6 sec below the sea floor and is overlain by a concordant layer of transparent sediment, 0.1-0.2 sec thick, in turn overlain unconformably by ponded well-stratified sediments. The objective was to determine the age of the basement.

## SITE SURVEY

The latest bathymetric map of the area shows the site is located in the southern part of the Gascoyne Abyssal Plain (Figures 1 and 2). Seismic profiler records of *Vema*-20 and *Vema*-28 show a sedimentary sequence that is less than 0.6 sec thick in the area. The topmost sedimentary layers are well stratified and are probably turbidites; the lower part of the sequence is a transparent layer about 0.2-0.3 sec thick. The transparent layer is generally conformable with the basement but the horizontal stratified layers are not.

The basement and the transparent layer rise to form a small north-south-trending ridge on the sea floor. This ridge is free of the stratified overlying layer and the transparent layer is apparently exposed there. A site was chosen to spud into about 100 meters of the stratified layer and core all of the transparent layer to basement.

Figure 3 shows the generalized depth to basement. In fact, the basement is somewhat rougher than can be shown in Figure 3. Basement is relatively shallow under the ridge with the east face steeper than the west.

## OPERATIONS

Site 260 as originally planned was near the intersection of a *Vema*-20 and a *Vema*-28 track in the Gascoyne Abyssal Plain. The *Glomar Challenger* track from Site 259 was laid out to intersect these two tracks, to get additional survey coverage, and then to run over the *Vema*-20 heading in a west-southwesterly direction (see Figure 3).

Also it was decided to run past the intersection of the tracks and find a place to the southwest that showed less sediment thickness on the *Vema*-20 record. This point was easily located by *Glomar Challenger* since it lay just to the southwest of a 100-meter rise on the sea floor. The selected site was estimated to have about 100 meters of horizontally stratified sediment overlying a transparent layer about 270 meters thick.

The beacon was dropped while underway at over 9 km/hr (5 knots) at 1100, 11 November 1972. After retrieving the trailing survey gear, the ship was

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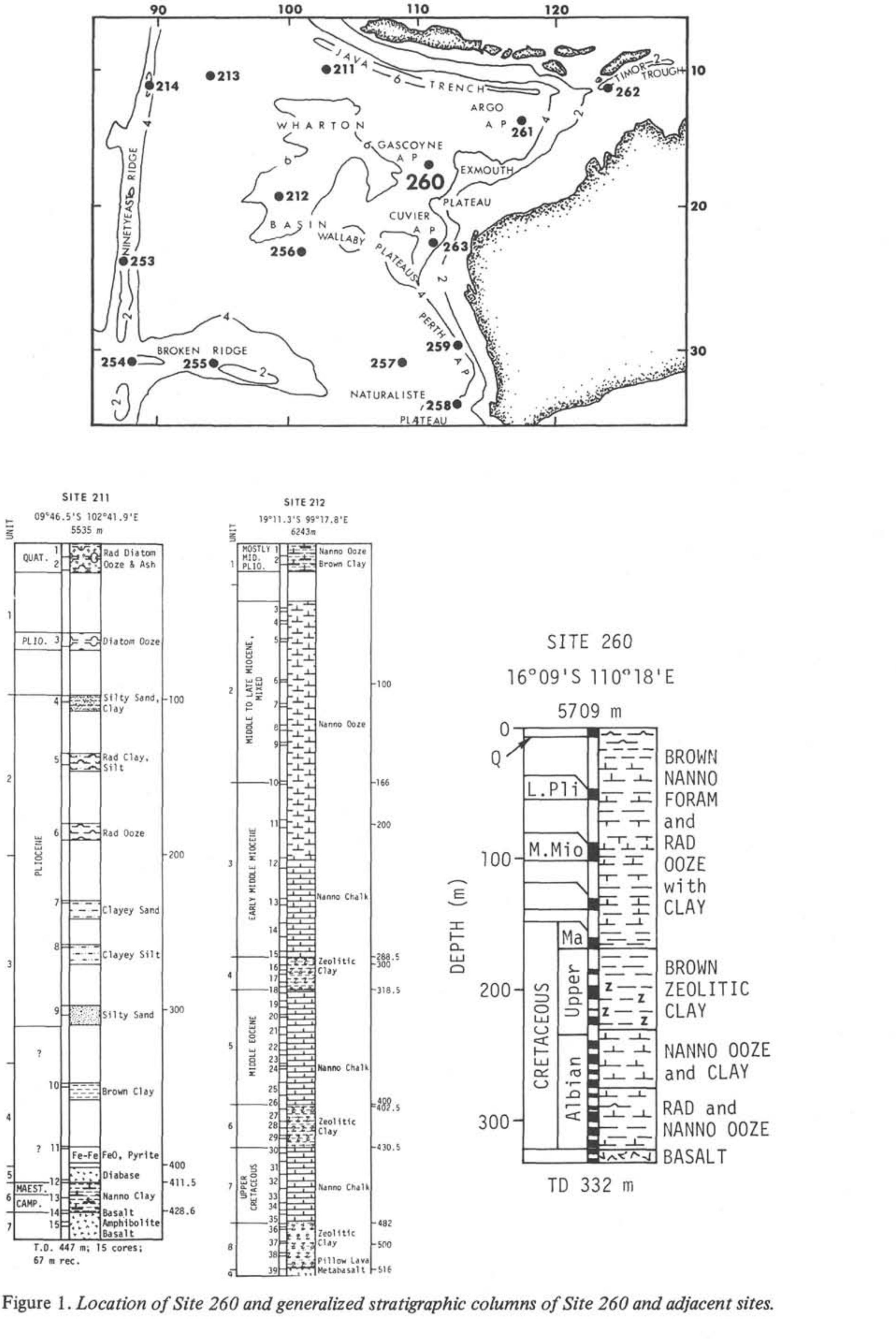


Figure 1. *Location of Site 260 and generalized stratigraphic columns of Site 260 and adjacent sites.*

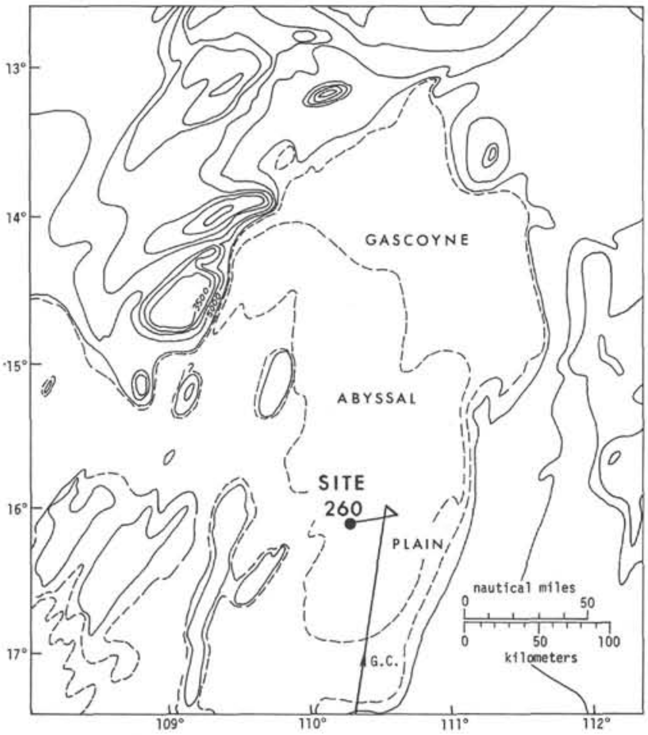


Figure 2. *Approach to Site 260 in Gascoyne Abyssal Plain. Bathymetry after Falvey and Veevers (in press).*

positioned over the beacon. The bottom hole assembly and drill pipe were run in and a relatively firm bottom tagged at 5709 meters. The hole was spudded at 0000, 12 November and drilled intermittently cored to a depth of 5943 meters or 234 meters below the sea floor. From this depth, the hole was continuously cored to a total depth of 6041 meters or 332 meters below sea floor. Details of the coring are included in the coring summary, Table 1.

Operations were routine through the first seven cores except that the torque to rotate the drill pipe continually increased until the pipe was momentarily stuck while making a connection. Fifty barrels of drilling mud were used to clean the hole and no further torque problems were experienced. Core recoveries were erratic and generally poor. Apparently the less consolidated sediments were washed away before entering the core barrel.

Basalt was encountered at 6032 meters in Core 18 which recovered approximately 0.5 meters of basalt. On the wire line trip to recover Core 19, the core barrel was found to be stuck in the drill pipe at 170 meters below the rotary table. Evidently a piece of basalt fell from Core 18 and lodged in a drill-pipe tool joint. The core barrel was jarred free and retrieved. All segments of the core catcher were missing. A center bit was run in to check the drill pipe to bottom and appeared to seat properly on bottom. The center bit was retrieved and a core barrel was dropped which also appeared to seat properly. Core 20 was cut and upon recovering the core barrel, the core catcher was again found to have all 12 segments broken off. Eleven segments were recovered in the upper core catchers. However, there was no core recovery. It was evident that some obstruction was preventing the core barrels from latching in properly on bottom and the decision was made to abandon the hole. Upon pulling the drill string, 0.7 meters of basalt were found on top of the bit.

Weather conditions and positioning were very near ideal throughout the time at Site 260. After securing the drill pipe, the ship got underway to Site 261 at 2100, 14 November.

## LITHOLOGY

Site 260 was drilled to a total depth of 332 meters penetrating a sedimentary sequence 323-meters thick which ranges in age from Quaternary to Lower Cretaceous. Drilling ended after penetrating 9 meters of fresh basalt. Coring was intermittent to 234 meters and then continuous to 332 meters. Low core recovery, coupled with intermittent coring, resulted in samples of only 17% of the stratigraphic column. The sedimentary sequence can be divided into four distinct units based on composition and color (Table 2).

### Unit 1 (0.0-158.0 m)

Unit 1 consists of approximately 158 meters of nanno ooze with lesser amounts of nanno- and zeolite-rich clay and radiolarian ooze. Graded beds of detrital foram nanno ooze are present in Cores 2-4. The sediments are typically stiff with some soft materials in the upper part of the section.

The nanno ooze is moderate brown, grayish orange, and very pale orange. Either homogeneous or very slightly mottled nanno ooze is typical; poorly defined laminations 2-10 cm apart are locally present. The ooze averages about 86% nannos with 1%-4% each of micarb fragments and clay. Coarse fractions (greater than $63\mu$ diameter) consist chiefly of Radiolaria in Core 1 and foraminifera in cores lower in the unit, plus lesser amounts of micarb fragments, sponge spicules, glauconite, quartz, and mica.

Within the nanno oozes are very light-gray to pale yellowish-gray detrital foram sands that grade upward into detrital foram-rich nanno ooze. One graded unit is 95 cm thick, another 110 cm thick, and a third 140 cm thick. The sand fraction is chiefly foraminifera tests and broken fragments of large foraminifera with minor amounts of quartz and feldspar. A few incipient concretions, 2-8 cm in diameter, occur in the graded beds in Core 3, Section 5.

The clay is dark moderate brown to dusky yellowish brown. The nanno-rich clay is lighter in color than either the zeolitic clay or the rad-rich clay. Much of it shows little evidence of bedding other than some poorly defined laminations and pale-orange streaks. Clay in the upper 50 meters contains approximately 25% Radiolaria. The nanno-rich clay is widespread but more abundant in the lower cores. Zeolites are more abundant in the clays 90-100 meters down and average 7% of the clays at that depth. The coarse fraction of the clay differs from that of the nanno ooze in that volcanic glass and pyrite are present, and calcareous fossil material is much less abundant.

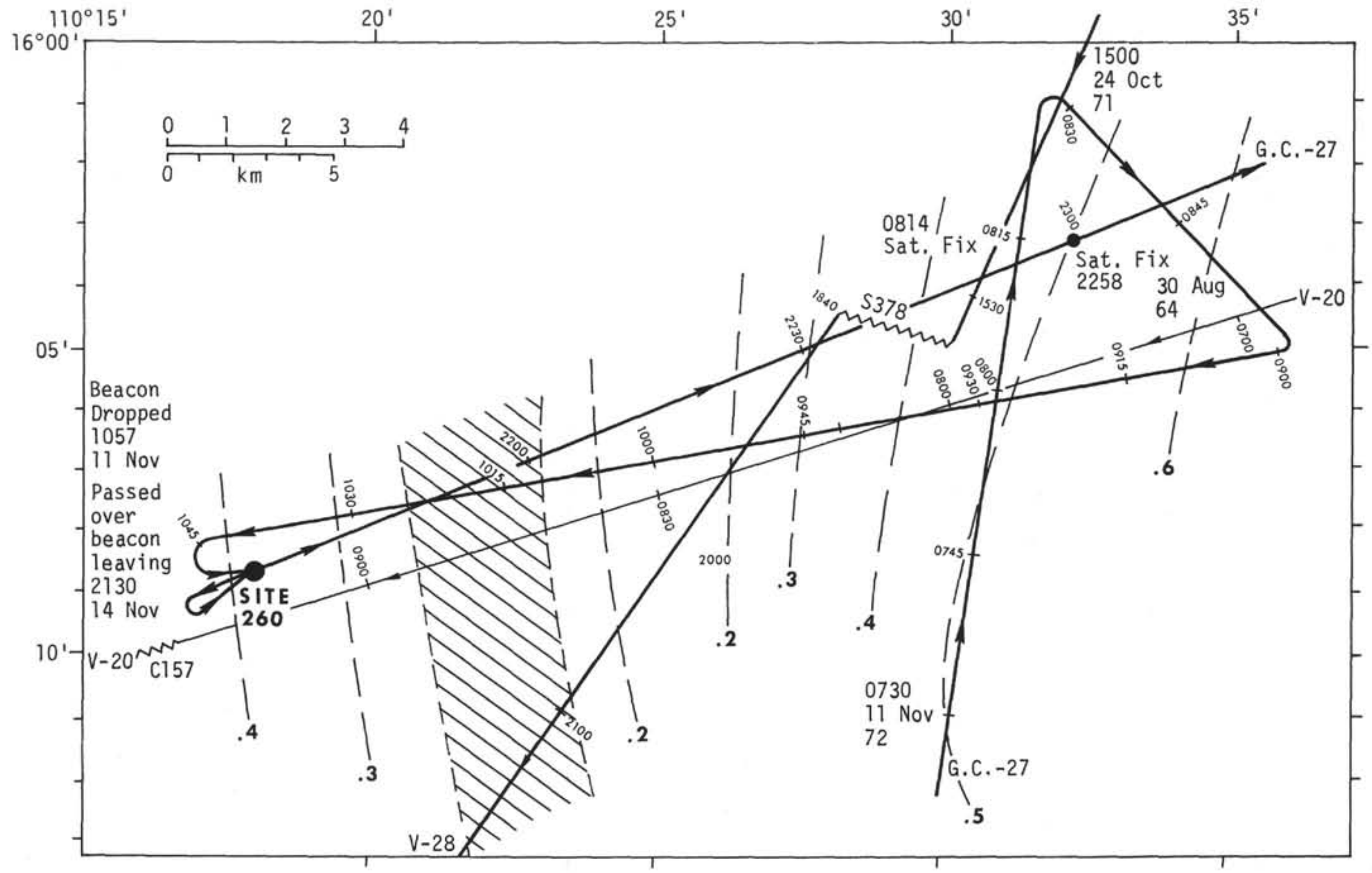


Figure 3. *Depths to basement reflectors, in seconds, for vicinity of Site 260. All water depths are 5500 meters, uncorrected, except for area covered by shading. That area rises approximately 100 meters above the sea floor. All times are local.*

**TABLE 1**
**Coring Summary, Site 260**

| Core | Date (Nov 1972) | Time | Depth From Drill Floor (m) | Depth Below Sea Floor (m) | Cored (m) | Recovered (m) | Recovery (%) |
|---|---|---|---|---|---|---|---|
| 1 | 12 | 0125 | 5709.0-5715.0 | 0.0-6.0 | 6.0 | 5.8 | 97 |
| 2 | | 0340 | 5753.0-5762.5 | 44.0-53.5 | 9.5 | 2.9 | 31 |
| 3 | | 0610 | 5800.5-5810.0 | 91.5-101.0 | 9.5 | 8.9 | 94 |
| 4 | | 0825 | 5838.5-5848.0 | 129.5-139.0 | 9.5 | 4.5 | 47 |
| 5 | | 1030 | 5867.0-5876.5 | 158.0-167.5 | 9.5 | 2.2 | 23 |
| 6 | | 1300 | 5886.0-5895.5 | 177.0-186.5 | 9.5 | 1.2 | 13 |
| 7 | | 1505 | 5905.0-5914.5 | 196.0-205.5 | 9.5 | 5.8 | 61 |
| 8 | | 1745 | 5924.0-5933.5 | 215.0-224.5 | 9.5 | 3.7 | 39 |
| 9 | | 2010 | 5943.0-5952.5 | 234.0-243.5 | 9.5 | 0.7 | 7 |
| 10 | | 2215 | 5952.5-5962.0 | 243.5-253.0 | 9.5 | 3.0 | 32 |
| 11 | 13 | 0035 | 5962.0-5971.0 | 253.0-262.5 | 9.5 | 1.0 | 11 |
| 12 | | 0330 | 5971.0-5981.0 | 262.5-272.0 | 9.5 | 3.0 | 32 |
| 13 | | 0605 | 5981.0-5990.5 | 272.0-281.5 | 9.5 | 1.7 | 18 |
| 14 | | 0800 | 5990.5-6000.0 | 281.5-291.0 | 9.5 | 1.0 | 11 |
| 15 | | 1055 | 6000.0-6009.5 | 291.0-300.5 | 9.5 | 5.0 | 53 |
| 16 | | 1320 | 6009.5-6019.0 | 300.5-310.0 | 9.5 | 2.4 | 25 |
| 17 | | 1530 | 6019.0-6028.5 | 310.0-319.5 | 9.5 | 1.2 | 13 |
| 18 | | 1740 | 6028.5-6032.5 | 319.5-323.5 | 4.0 | 2.3 | 57 |
| 19 | | 2315 | 6032.5-6038.0 | 323.5-329.0 | 5.5 | 0.0 | 0 |
| 20 | | 0800 | 6038.0-6041.0 | 329.0-332.0 | 3.0 | 0.7 | 23 |

Note: Echo-sounding depth = 5712 meters; drill-pipe length to bottom = 5709 meters.

TABLE 2
Major Lithologic Units of Site 260

| Interval (m) | Unit | Description | Age | Thickness (including gaps) (m) | Cores |
|---|---|---|---|---|---|
| 0.0-158.0 | 1 | Light-brown, grayish-orange, pale-orange, and orangish-pink nanno ooze with lesser amounts of moderate brown to dusky yellow-brown clay. Very light-gray detrital foram-rich beds are distinctly graded. | Quaternary – not older than middle Oligocene | 158.0 | 1-4 |
| 158.0-224.5 | 2 | Moderate-brown to dark yellow-brown zeolitic clay with streaks of moderate yellowish-brown and dusky yellowish-brown clay | Upper Cretaceous, Core 5-6 Cretaceous s.l. Cores 7-8 | 66.5 | 5-8 |
| 224.5-272.0 | 3 | Moderate-brown to moderate orange-pink nanno ooze with minor dark yellowish-brown clay | Lower Cretaceous (middle Albian) | 47.5 | 9-12 |
| 272.0-323.0 | 4 | Greenish-gray to moderate-brown rad ooze, nanno ooze, and zeolitic clay. Dark red-brown with grayish-olive clay at the base | Lower Cretaceous (middle Albian) | 51.0 | 13-18 |
| 323.0-332.0 | | Basalt | | | 18-20 |

The radiolarian ooze is moderate brown to dusky yellowish-brown, faintly mottled, and usually contains either nannos or clay. Radiolaria average 85% and nannos and clay make up about 5% each.

Unit 1 contains abundant fossils—chiefly coccoliths, discoasters, Radiolaria, and foraminifera, with lesser amounts of sponge spicules, silicoflagellates, and diatoms. The sediment ranges in age from Quaternary to middle Oligocene. The unit is distinguished from Unit 2 by a sharp decrease in the amount of fossil material and a relative increase in the amount of clay.

**Unit 2 (158.0-224.5 m)**

Unit 2 consists of 67 meters of dark yellowish-brown zeolite-rich clay with minor amounts of zeolite clay and zeolite-bearing clay. The average composition of the sediment is: 80% clay, 15% zeolite, 2% iron oxide, 2% quartz, and traces of feldspar, volcanic glass, and mica. Coarse fractions yield small magnetic spherulites, sponge spicules, Radiolaria, and minor amounts of foraminifera, pyrite, quartz, gypsum, volcanic glass, and ferruginous aggregates.

Most of the unit has been brecciated by drilling but where it is undisturbed, homogeneous to slightly mottled clay is typical. Some parts, however, have irregular lens-shaped laminae, 0.4-1.5 cm thick, moderately yellow brown, and less distinct streaks of dusky yellowish brown.

The top of this unit is Upper Cretaceous and the base is considered Cretaceous s.l. The base of this unit is recognized by a great increase in nannos in the underlying sediments of Unit 3 and an increase in the amount of moderate orange-pink mottles of nanno-rich material.

**Unit 3 (224.5-272.0 m)**

Unit 3 consists of approximately 48 meters of dark yellowish-brown to moderate yellowish-brown nanno ooze with minor nanno clay and chert. The nanno ooze consists of 88% nannos, 7% zeolite, 3% clay, 1% foraminifera, and traces of quartz, iron oxide, and feldspar. The sparse coarse fraction is dominated by foraminifera and Radiolaria with minor sponge spicules, silicoflagellates, gypsum, quartz, ostracods, and ferruginous particles.

Moderate orange-pink mottles and laminations locally contrast with the typical dark yellowish-brown color. High in the unit, the orange-colored material also occurs as distinct beds up to 10 cm thick. Lithified beds up to 13 cm thick occur throughout the section, but are much more abundant in the lowermost several meters.

All of Unit 3 is Albian in age. The lower boundary of this unit is marked by an increase in Radiolaria and a change from dominantly brown to dominantly green tones.

**Unit 4 (272.0-323.0 m)**

Unit 4 consists of 51 meters of nanno ooze and clay with lesser amounts of radiolarian ooze. The unit is typically greenish gray except for the lowermost 2 meters which is moderate brown to dark red brown. The sediments are stiff to semilithified and contain numerous nodules. Thin laminae typical of this unit pass through the nodules and into the matrix. Very small-scale cross-stratification and micro mottling (elliptical-shaped, less than 5 mm long) are also locally present.

The three main sediment types are quite pure. The nanno ooze averages about 93% nannos plus 4% clay, 2% zeolite, and 1% Radiolaria; the clay contains 85%

clay, 4% nannos, 3% Radiolaria, and 2% zeolite; the radiolarian ooze contains 86% rads, 8% nannos, and 5% clay.

The bulk composition of this somewhat heterogeneous unit would correspond closely to a rad-rich clayey nanno ooze with 40% nannos, 39% clay, 18% rads, and 1% zeolite. Coarse fractions contain abundant Radiolaria and gypsum with small amounts of forams, ferriginous aggregates, pyrite, and glauconite.

All of Unit 4 is Albian in age. It directly overlies acoustic basement which is composed of very fresh basalt. The freshness of the basalt suggests a sill rather than true basement and this interpretation is supported by the relatively young age of the basal sediments compared with Sites 259, 261, and 263. Although there is a distinct color change and an increase in iron in the basal sediments, there is no indication of baking. Delicate nannofossils at the lowest part of the section are well preserved and show no hint of alteration.

**Basalt**

Only 9 meters of basalt were cored at Site 260. The contact between the basalt and the overlying sediments was disturbed by drilling and only poorly preserved. There is no evidence of baking of the sediments or chilling of the basalt; however, the lowermost 2 meters of sediment are red whereas the overlying clays are green.

The basalt is light gray, medium grained, and sparsely porphyritic. It is unbrecciated and contains no glassy zones but does have a few fractures lined with calcite and chlorite. Most specimens contain a few small vesicles, 0.25-0.5 mm in diameter, filled with calcite, chlorophaeite, and clay minerals.

In thin section, the basalt has a medium-grained intergranular texture. A typical mode is 60% plagioclase, 30% clinopyroxene, 8% magnetite, and 2% clay and chlorophaeite. The plagioclase occurs in subhedral laths, from 0.5 to 1 mm long, with a few microphenocrysts up to 2 mm in length. Most of the plagioclase crystals are normally zoned, often with a sharp compositional break between the core and the rim. The average composition is sodic labradorite but individual crystals may have cores as calcic as bytownite. The clinopyroxene forms small, colorless, anhedral crystals, from 0.1 to 0.2 mm in diameter. Rare microphenocrysts range up to 1 mm in diameter and are typically subhedral in shape. All of the clinopyroxene is augite ($2V_z \cong 40°$) but some of the larger crystals are noticeably zoned. The iron oxides occur as subhedral octahedra up to 0.05 mm in diameter, often arranged in clusters and linear groups. Montmorillonite occurs as small interstitial patches, as vesicle fillings and as marginal replacements of augite crystals. Some of the vesicles and clay patches have cores of brownish-green, isotropic chlorophaeite. Olivine was not definitely recognized in the basalt; a few clay patches have shapes suggestive of olivine crystals but obvious pseudomorphs are absent.

The mineralogy and chemistry of the basalt indicates a tholeiitic composition. However, the absence of brecciation and glassy zones, as well as the relatively coarse-grained nature and freshness of the basalt, suggest a sill rather than oceanic basement. Unfortunately, drilling ceased before this suggestion could be adequately tested.

**Preliminary Interpretations**

Three different lithologic components, nanno ooze, brown clay, and radiolarian ooze, can be recognized in Unit 1, although the sediment at any one horizon is usually a mixture of at least two of these components. Within the nanno ooze are graded beds rich in sand-size, often broken, foram tests which include shallow-water forms and mixed assemblages. The nature of these beds strongly suggests transport of material from the shelf to deeper water, whereas the radiolarian ooze and brown clay may represent normal deep-sea sedimentation. The critical question is whether the thick sequences of very fine nanno oozes in which the graded beds occur are normal deep-sea oozes deposited above the carbonate compensation depth (CCD) or whether that material was transported from shallower water rapidly enough to be preserved even though the water depths were great. For them to be normal deep-sea oozes would require significant fluctuations in the CCD during the Tertiary. Site 260 was drilled at a water depth of 5707 meters which is well below the present average CCD. If the nanno oozes were transported, it is possible that the sea floor has remained below the CCD since Upper Cretaceous.

The paucity of fossils indicate different conditions of deposition for Unit 2. Depth or circulation pattern differences in the Cretaceous resulted in destruction of all carbonate fossil material. The high zeolite content (up to 35%) may indicate a significant contribution of volcanic-derived material.

Unit 3, composed primarily of nanno ooze with lesser amounts of clay, is interpreted as having been deposited above the CCD because it lacks all evidence of transported fossil material such as that found in Unit 1.

Unit 4 differs from the other units chiefly in its gray-green color. Nannos are abundant throughout this unit but Radiolaria are concentrated in certain horizons. It is not known whether this concentration is the result of selective solution of tests or variations in the original biologic productivity. The green color appears to be the result of reducing conditions either on the sea floor or after burial. There is no abundance of pyrite in this unit or other evidence to indicate extreme reducing or euxinic conditions.

The basal basalt is believed to be a sill that served as acoustical basement. The reasons for suspecting a sill are the freshness, the relatively coarse-grained nature and the lack of brecciation of the basalt, the change in color of the lower 2 meters of sediment from a grayish-green to a red-brown color, and the marked increase in ferruginous clay in the basal sediments. In addition, the basal sediments, which are Albian in age, are considerably younger than the lowest sediments at adjacent sites. This suggests that a considerable section of sediment may underlie the basalt.

## BIOSTRATIGRAPHY AND PALEONTOLOGY

### General

As at Site 259, the Cenozoic is represented by incomplete material. At Site 260 the Cenozoic section is 140-150 meters thick and the sequence may be more complete stratigraphically than indicated by the four spot cores.

The top core (0.00-6.0 m) is Pleistocene radiolarian ooze, interbedded with lesser amounts of foram nanno ooze. Cores 2-4 (44.0-53.5, 91.5-101.0, 129.5-139.0 m) contain very heterogeneous foraminiferal and nannoplankton assemblages, with Radiolaria largely absent. The nanno oozes and zeolite clays are regarded as deep-water deposits with the fossils being carried down from the Exmouth Plateau area by turbidity currents. This explains the intermittent occurrence and heterogeneous composition of the flora and fauna. Cores 2, 3, and 4 are considered lower Pliocene, not older than middle Miocene, and not older than Oligocene, respectively.

Approximately 184 meters of Cretaceous clays and oozes lie between the Cenozoic sediments and the basal basalt. The top two cores of this sequence (5 and 6, 158.0-186.5 m) are assigned to the Upper Cretaceous based on arenaceous and planktonic foraminifera. Some of the faunas, in particular the planktonic forms, are believed to be redeposited, hence some of the clays are regarded as turbidity-current deposits. The Radiolaria in the zeolite-rich clays of Cores 7 and 8 (196.0-205.5 and 215.0-224.5 m) indicate a Cretaceous s.l. age; arenaceous foraminifera are rare and calcareous microfossils are absent altogether.

A fauna comparable in composition and richness with that of Site 259, Cores 11-17, is present in Cores 9-11 (234.0-262.5 m). Arenaceous and calcareous benthonic and planktonic foraminifera are common to abundant, accompanied by less frequent Radiolaria, Calcisphaerulidae, ostracods, and bivalvia. This interval, as well as that of Cores 12-18 (262.5-322.5 m) is dated as middle Albian on nannoplankton. The abundance of calcareous fossils does not decrease as sharply between Cores 11 and 12 as it does in Core 17 of Site 259. Nannoplankton continue to be abundant in the lower sediments to the basalt-sediment contact in Core 18; Calcisphaerulidae first appear in Core 15. The composition of the very rich fauna in Cores 9-11 indicates a temperate, open-sea environment with a depth of deposition above the lysocline. The abundance of calcareous nannoplankton combined with the absence of calcareous foraminifera, suggest either that the water depth was greater or the water temperature lower in Cores 12-18 than in Cores 9-11.

Figure 4 summarizes the biostratigraphy of Site 260.

### Biostratigraphy

**Quaternary:** Core 1 (0.0-6.0 m). *Globorotalia truncatulinoides truncatulinoides* Zone; *Gephyrocapsa oceanica* Zone. Planktonic ooze consisting alternately of planktonic foraminifera, nannoplankton, and Radiolaria. It is assumed that the calcareous warm-water fauna was carried to the abyssal plain by turbidity currents from the Exmouth Plateau.

**Lower Pliocene:** Core 2 (44.0-53.5 m). *Globorotalia margaritae* Zone. Planktonic foram and nannoplankton ooze. Probably also redeposited from the Exmouth Plateau. Radiolaria are absent.

**Not older than middle Miocene:** Core 3 (91.5-101.0 m). The poor foraminiferal fauna is a mixture of Upper Cretaceous, Paleogene, and Miocene planktonic foraminifera, the youngest of which indicates an age not older than middle Miocene. This age assignment is confirmed by a similarly mixed nannoplankton assemblage. With fish debris frequent, the sediments were probably deposited below the lysocline and the calcareous tests were carried in by currents from higher levels.

**Not older than middle Oligocene:** Core 4 (129.39.0 m). Examined samples are very poor in fossils except for the core catcher where planktonic foraminifera are abundant. This heterogeneous fauna represents Upper Cretaceous, Paleogene, and middle Oligocene or younger. The ages agree with nannoplankton evidence. Based on the scarcity of calcareous faunas, except for the core catcher, most of these sediments were probably deposited below the lysocline.

**Upper Cretaceous (Not younger than Maestrichtian):** Core 5 (158.0-167.5 m). Heterogeneous fauna with agglutinated foraminifera of Upper Cretaceous aspect and fragments of Globotruncanides. Nannoplankton are absent and fish debris fairly frequent, indicating a depositional environment within or below the lysocline. The calcareous specimens were presumably carried in by currents.

**Upper Cretaceous (Not older than Coniacian):** Core 6 (177.0-186.5 m). Zeolite clays with numerous characteristic small agglutinated (siliceous) foraminiferal species. These forams occur together with presumably redeposited Senonian and very scarce Cenomanian planktonic foraminifera. Several *Pithonella* species and some fish debris are also present; nannoplankton were not recorded. The absence of in situ planktonic foraminifera, and the presence of small agglutinated foraminifera with homogeneous, semitransparent, thin walls, indicate a depositional depth below the lysocline, with the calcareous specimens being carried in by turbidity currents.

**Cretaceous s.l.:** Core 7 (196.0-205.5 m); Core 8 (215.0-224.5 m). The age is based on Radiolaria which are abundant in Core 7. Arenaceous foraminifera are also sparsely present. Nannoplankton are absent.

**Lower Cretaceous, Albian:** Core 9-18 (234.0-322.5 m). *Prediscosphaera cretacea* Zone. The upper part of this interval, Cores 9-11 (234.0-262.5 m), is rich in benthonic and planktonic foraminifera and nannoplankton. Also present are Radiolaria, Calcisphaerulidae, ostracods and bivalvia, a faunal association similar to that found at Site 259, Cores 11-17. This upper part is dated as middle Albian on nannoplankton evidence, middle-upper Albian on benthonic foraminifera, and Albian, (?upper), on planktonic foraminifera. The ostracods suggest a ?Barremian to Albian age, and the bivalves an Albian age. The lower part, Cores 12-18 (262.5-322.5 m) contains abundant nannoplankton of middle Albian age. Only poor arenaceous and occasional calcareous benthonic foraminifera are present in the lower part, indicating an ?upper Aptian to lower Albian age. Calcisphaerulidae continue down to Core 15.

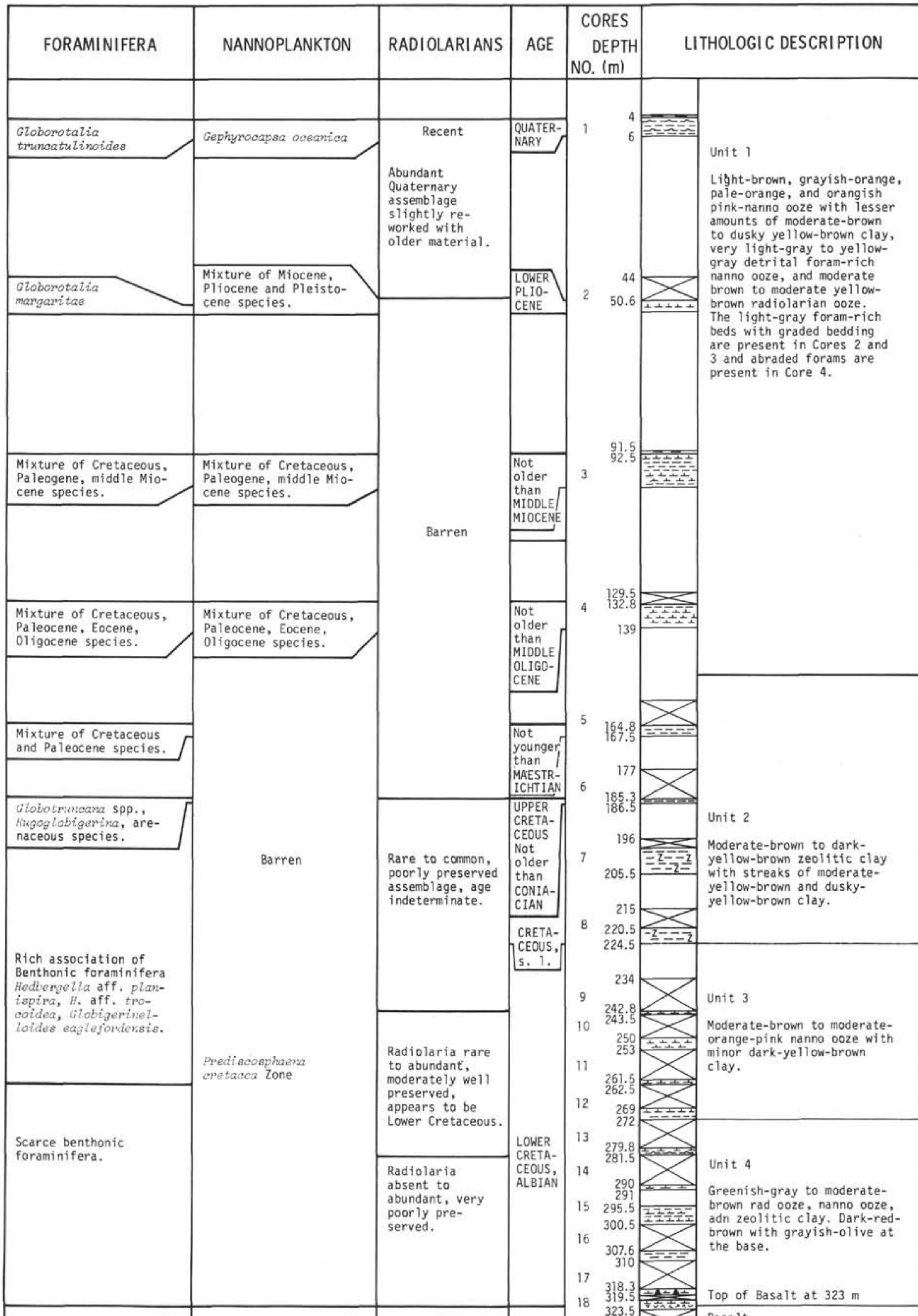


Figure 4. *Biostratigraphic zones, Site 260.*

**Paleontology**

For more information on the individual fossil groups briefly discussed below, refer to the special reports in this volume.

### Foraminifera

Several intervals in Core 1 (0.0-6.0 m) contain a very rich, predominantly planktonic foraminiferal fauna. Radiolaria are exclusively present in others. The most frequent and characteristic planktonic foraminiferal species are: *Globorotalia truncatulinoides truncatulinoides*, *G. menardii*, *G. dutertrei*, *G. crassula*, *Globigerinita glutinata*, and *Globigerinoides ruber*.

Compared with the Quaternary of Site 259, *Globorotalia inflata*, a temperate water form, is very rare. The following Miocene-Pleistocene species are present, indicating some reworking: *Globoquadrina dehiscens*, *Globigerina nepenthes*, and *Globorotalia truncatulinoides tosaensis*.

The very rich planktonic foraminiferal fauna of Core 2 contains: *Globorotalia margaritae s.l.*, *G. tumida tumida*, *G. tumida flexuosa*, *G.* cf. *multicamerata*, *G. menardii s.l.*, *Sphaeroidinella dehiscens*, *Sphaeroidinellopsis seminulina s.l.*, *Globoquadrina altispira*, *G. venezuelana*, *Globigerina nepenthes*, and *Globigerinoides obliquus extremus*.

This open-sea, warm-water association is closely comparable with that occurring in the subsurface section of well Bodjonegoro-1 in Java (Bolli, 1966).

Core 3 and 4 (91.5-101.0, 129.5-139.0 m, respectively) contain strongly heterogeneous planktonic foraminiferal faunas, including *Globotruncana*, *Rugoglobigerina*, *Heterohelix* (Upper Cretaceous), and *Acarinina* (Paleogene). *Globigerina* aff. *nepenthes* indicates an age not older than middle Miocene for Core 3, and *Globoquadrina* sp. indicates an age not older than middle Oligocene for Core 4.

Core 5 (158.0-167.5 m) contains a heterogeneous, mainly agglutinated, foraminiferal fauna with *Aragonia* sp., *Grammostomum incrassatum* and fragments of Globotruncanids, indicating an age not younger than Maestrichtian. A rich agglutinated foraminiferal fauna of some 40 species, characteristic of Upper Cretaceous, is present in Core 6 (177.0-186.5 m) together with presumably redeposited planktonic foraminifera including *Globotruncana lapparenti lapparenti*, *G.* aff. *coronata*, *Praeglobotruncana inflata*, and very scarce, certainly reworked, *Rotalipora apenninica*. The arenaceous foraminifera include *Praecystammina globigerinaeformis*, *Haplophragmoides multicamerus*, *H. fraudulentus*, and *Labrospira pacifica*, all typical for the "upper assemblage of agglutinated Upper Cretaceous foraminifera" (see Krasheninnikov, Chapter 32, this volume).

Cores 7 and 8 (196.0-215.5, 215.5-224.5 m, respectively) are virtually devoid of foraminifera; only some very scarce *Glomospira*, *Ammodiscus*, *Haplophragmoides*, and *Trochammina* were observed. A rich benthonic and palnktonic Albian foraminiferal assemblage including several species of *Hedbergella* is present in Cores 9-11 (234.0-262.5 m). This fauna is similar to that of Cores 12-17 at Site 259, its fauna also indicating a temperate water, open-sea deposition at depths of shelf slope or deeper, but above the lysocline.

Cores 12-18 (262.5-322.5 m) are characterized by poor arenaceous faunas, mainly *Glomospira*, *Ammodiscus*, *Hyperammina*, and an occasional, very scarce, *Lenticulina*.

### Nannoplankton

Calcareous nannoplankton are represented by poor Pleistocene assemblages in Core 1 (0.0-6.0 m). Cores 2-4 (44.0-53.9, 91.5-101.0, 129.5-139.0 m, respectively) contain rich, well-preserved, mixed assemblages, a result of turbidite sedimentation. The probable age is Pliocene, Miocene, and Oligocene, respectively, for Cores 2, 3, and 4. Cores 5-8 (158.0-224.5 m) lack calcareous nannofossils. Cores 9-18 (234.0-322.5 m) contain Lower Cretaceous coccoliths. The nannoplankton are poor, with low specific diversity in some samples, but based on the presence of middle Albian markers in cores above and below, the interval is referred to the *Prediscosphaera cretacea* Zone.

### Radiolaria

A typical Quaternary radiolarian assemblage in which species diversity is high (number of species = 100) and specimens are abundant and well preserved occurs in Core 1 but disappears in Core 2, Section 3. Some of the species represented are (in order of decreasing abundance): *Ommatartus tetrathalamus*, *Pyloniidae* group, *Dictyocoryne profunda*, *Echitonia mülleri*, *Spongaster tetras tetras*, *Pterocanium praetextum*, *P. trilobum*, *Botrycyrtis* spp., and *Carpocanistrum* spp. There appears to be a slight admixture with older Cenozoic sediments.

Core 2, CC through Core 4, Section 6 are barren.

Sparse and poorly preserved, unidentifiable Radiolaria are present in Core 4, CC through Core 7, Section 3.

Core 7, CC contains a poorly preserved but abundant Cretaceous assemblage. The number of specimens declines and becomes patchy through Core 11, Section 1.

Core 11, CC through Core 13 Section 1 contain an abundant, moderate to poorly preserved Cretaceous assemblage quite similar to that of Site 261, Core 12, and therefore assumed to be of the same age (Cenomanian to Aptian). The same distinctive species are present: *Amphipyndax pyrgodes*, *Dictyometra lilyae*, *D. pseudoscalaris*, *D. brouweri*, *Eucyrtis hanni*, *E. bulbosus*, *Lithocampe chenodes*, and *Eucyrtis columbarus*.

From Core 13, CC to the basalt contact there is a wide fluctuation in abundance of Radiolaria but the preservation remains extremely poor. Very abundant assemblages occur at Core 15, Sections 3 and 4; Sample 16-2, 8-10 cm; Sample 17-1, 70-72 cm; Core 18, Section 2, and Sample 18, CC. No age determination is possible.

### Calcisphaerulidae

Two groups of Cretaceous *Pithonella* species are present. One with three species and three species in open nomenclature was observed only in Sample 6-1, 46-49 cm. Here, the elongate *Pithonella krasheninnikovi* is the dominant form. From accompanying fauna and the lithology of the sediments it is assumed that the specimens in Core 6 are redeposited, (possibly reworked from somewhat older sediments.) Their age is indicated by the associated youngest *Globotruncana* species, which are not older than Coniacian. The second group of three species is present in the Albian, Cores 9-15, where their frequency and species distribution is irregular.

#### Ostracods

The ostracods present in Cores 9-11 are essentially Bairdiids; 60% of the isolated specimens belong to indet sp. A. a form reminiscent of *Rubsoniella obovata Kuznetsova,* described from the upper Aptian of southern Russia. As at Site 259, the strong dominance of smooth Bairdiids is an indication for a deeper-than-shelf environment.

#### Bivalves

Samples 9, CC and 10-2, 34-36 cm contain numerous fragments of *Aucellina.* With their projecting radial costae they closely resemble the juvenile phase of the Albian *Aucellina* cf. *gryphaeoides* from the Great Artesian Basin of Australia. In contrast to the exfoliated specimens of Sample 259-14, CC, they show much better preservation, possibly because of a different history of deposition and burial.

#### Fish debris

Remains are frequent to abundant in the sediments of Cores 3-6, apparently deposited below the lysocline. With the exception of Core 18 fish fragments are rare or absent in the Cretaceous Cores 7-18.

## GEOCHEMICAL MEASUREMENTS

Interstitial water was extracted from seven cores at Site 260. Alkalinity, *p*H, and salinity results obtained are given in Table 3 and illustrated in Figure 5. Analytical methods followed are as detailed previously.

### pH

After the usual marked difference of *p*H in the sediment and water (8.3 in the surface water and 7.4-7.5 at 4.5 m below the sediment surface), a small, irregular downhole decrease in *p*H is evident from both the "punch-in" and "flow-through" electrodes. These two sets of values vary by up to 0.2 *p*H units. The small downhole decrease in *p*H is probably the result of minor diagenetic changes in the sediment such as the formation of zeolites.

### Alkalinity

Alkalinity is low throughout the hole and does not deviate significantly from the alkalinity of seawater. This is consistent with a low rate of sedimentation at this site.

### Salinity

The interstitial water salinity does not deviate significantly from the salinity of seawater (mean salinity of 35.1 ‰ in the sediments and 34.9 ‰ in seawater at Site 260). The relative lack of change in geochemical parameters down the hole suggests that diagenetic changes are relatively minor in the sediments of this site.

## PHYSICAL PROPERTIES

Bulk-density, sound-velocity, porosity, and vane shear-strength measurements were made on sediments recovered at Site 260. Two additional means for determining wet bulk density were used. The presence of detrital sediment interbedded with pelagic ooze and the noncontinuous coring procedure limited recovery and the development of a physical properties profile. The coarser-grained detrital sediments are easily disturbed and have low recovery ratios. Consequently, the behavior of density, velocity, and shear strength with depth is masked. Only four cores were taken in the first 160 meters. Disturbance within recovered cores is high, and moderately low recovery was obtained below Core 4 (139 m). Density, porosity, and sonic velocity are plotted alongside the site summary sheets. Continuous GRAPE density (and porosity) are plotted alongside the core photographs. A description of the testing procedures and discussion of wet bulk-density determinations and vane-shear results are included in later chapters in Part IV.

### Density and Porosity

The static GRAPE readings and water-displacement tests were both made on 10 hard or semilithified samples cut and shaped from Cores 11-18. (This is believed to be the first use of the accurate O-Haus scale for determining density by the water-displacement method.)

Bulk density at Site 260 varies considerably with depth and with variation of sediment type at the cored locations above 139 meters. Within this interval are alternating layers of detrital foram nanno ooze (turbidites), clay, radiolarian ooze, and nanno ooze. In the surface core radiolarian ooze and radiolarian clay exhibit continuous GRAPE densities of 1.35-1.40 g/cc and 1.30 g/cc, respectively. (Syringe density of the same materials, however, is only 1.15-1.20 g/cc. The large difference is apparently the result of a higher density in the coarse sediment before the core liner is laterally cut, and an inaccurate tendency of syringe samples to show low density in coarse materials.) The sharp rise in bulk density of Core 2 (45 m) is due to the high density of nanno ooze, which was recovered in a remolded state in the first core. Nanno-ooze density increases only slightly in Core 3 (95 m) and decreases slightly in Core 4 (135 m). Clay density increases at a moderate but erratic rate from 95 meters to just above the basalt where much of the clay is semilithified. In Cores 2-4, where nondetrital nanno ooze is found adjacent to clay or detrital sandy silts within the same core, the nanno ooze is notably more dense. It should be noted that since the coring process disturbs coarse sediments more than fine-grained sediments the coarser materials may be found in situ at a considerably higher density than was measured. Below Core 4, density variation between adjacent sediments is still notable, but is not as great. The turbidites are no longer found and layers have varying percentages of ooze and clay. Below 224 meters (Core 8), percent recovery was low and most material recovered is very hard or semilithified. Although none were recovered, softer sediments may have been present,

TABLE 3
Summary of Shipboard Geochemical Data, Site 260

| Sample (Interval in cm) | Depth Below Sea Floor (m) | pH Punch-in | pH Flow-through | Alkalinity (meq/kg) | Salinity (°/oo) | Remarks |
|---|---|---|---|---|---|---|
| | | 8.33 | 8.19 | 2.25 | 34.9 | Reference seawater |
| 1-4, 0-6 | 4.5-4.56 | 7.52 | 7.42 | 3.23 | 35.2 | |
| 2-3, 0-6 | 52.0-52.06 | 7.76 | 7.54 | 1.96 | 35.8 | |
| 3-6, 0-6 | 99.5-99.56 | 7.56 | 7.37 | 2.44 | 35.2 | |
| 5, CC | 167.5 | – | 7.26 | 2.93 | 35.5 | |
| 7-5, 0-6 | 204.0-204.06 | 7.10 | 7.20 | 2.05 | 34.4 | |
| 8, CC | 224.5 | – | 7.17 | 1.96 | 34.6 | |
| 9, CC | 243.5 | – | 7.23 | 2.25 | 34.9 | |
| | | 8.31 | 8.25 | 2.44 | 34.9 | Reference seawater |

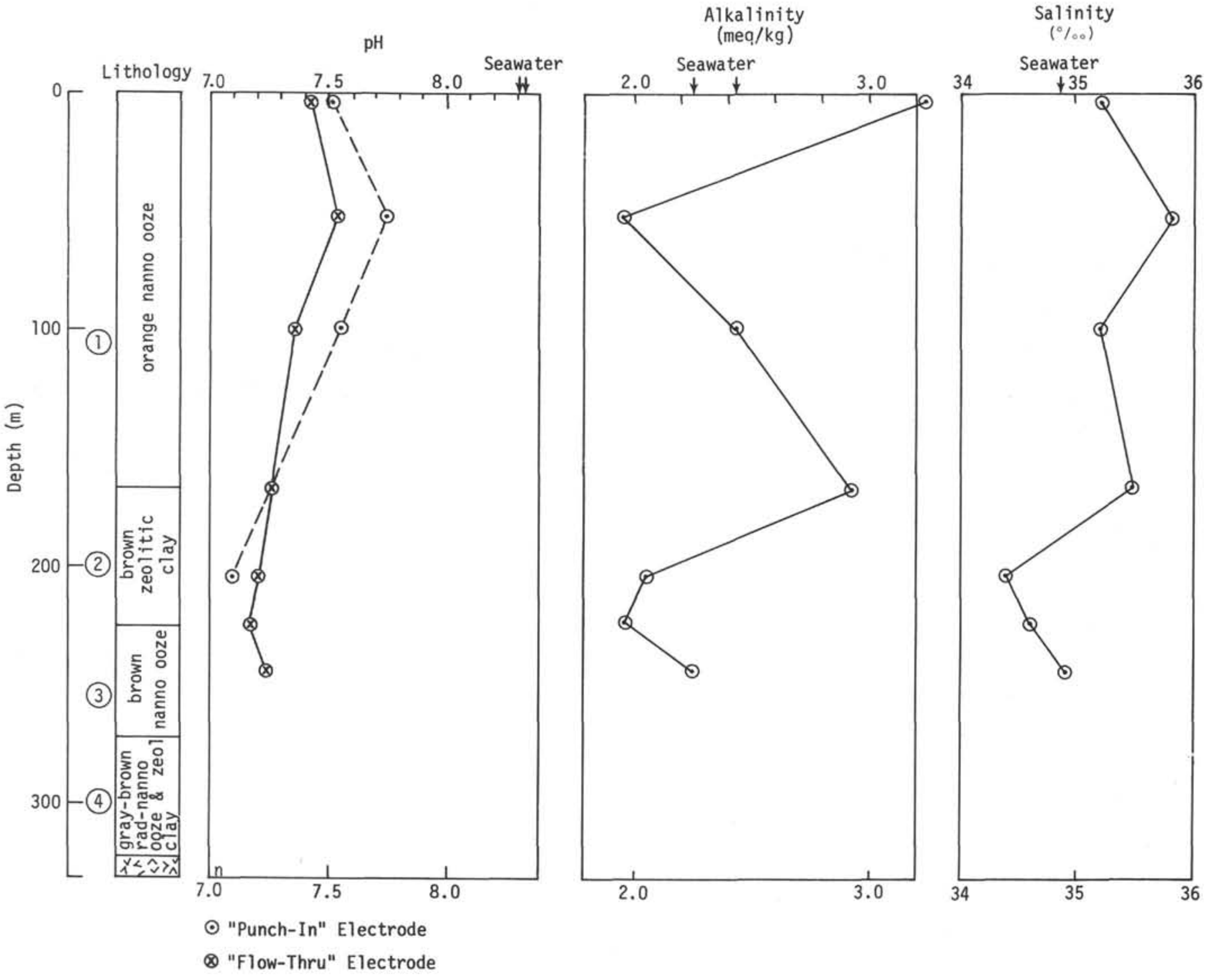


Figure 5. *Geochemical analysis of interstitial water at Site 260.*

interbedded with the stiffer material. Profiles of data at locations where recovery is low are biased toward more dense material and may thus inaccurately portray the in situ condition.

Porosity data plotted on the site summary sheets were determined from continuous GRAPE readings and from syringe samples. Porosity variation follows variation in bulk density very closely. A continuous readout is available from GRAPE measurements by working with the GRAPE density trace shown beside the core photographs. A variable porosity scale has been included above the wet bulk-density scale for this purpose.

The sediment mineral-grain density determines the appropriate porosity scale.

### Sonic Velocity

Sound velocities on nonlithified sediment increase little throughout the Site 260 profile. A consistent 1.50 km/sec is measured down to 160 meters, followed by a slow rise to about 1.70 km/sec at 250 meters. Velocity then decreases to 1.55 or 1.60 km/sec above the basalt. Below 240 meters sound velocities up to 2.30 km/sec were frequently measured on partially lithified clay samples, and a chert piece from the 246-meter level has a velocity of 5.6 km/sec. Recovered basalt displays velocities of 3.4-6.2 km/sec. High sound velocity in indurated sediments below 240 meters and abrupt density variations throughout the site profile could be expected to produce significant impedance changes and multiple reflections on the subbottom seismic profile.

## CORRELATION OF SEISMIC REFLECTION PROFILE WITH DRILLING RESULTS

The seismic profile at Site 260 (Figure 6) shows two sequences: A well-stratified sequence overlying an almost transparent sequence, which in turn overlies acoustic basement. The well-stratified sequence contains a prominent intermediate reflector (1), and the almost-transparent sequence a very faint one (3). The depths of the various reflectors are given in Table 4.

The most obvious correlation is that of acoustic basement with basalt at a depth of 323 meters. The well-stratified sequence is seen to be nanno ooze with turbidite sand layers, and the almost transparent sequence is ooze and chalk. Reflector (3) correlates with the first appearance of chalk, and reflector (1) with a decrease in the drilling penetration rate, presumably caused by a turbidite sand bed, at 95 meters. The subtle lithological boundary between Units 1 and 2 is located at 158.0 meters and this corresponds with reflector (2). The interval velocities of the sediments overlying these correlated reflections fall in the narrow range of 1.6 km/sec for 0-158 meters to 1.7 km/sec for 158-323 meters, except for one anomalous value of 1.9 km/sec for the interval 95-170 meters.

Laboratory measurements of velocity of Site 260 sediment average 1.5-1.6 km/sec or some 0.1-0.2 km/sec less than the in situ values. This parallels Whitmarsh's (1972) conclusion that at Leg 12 sites the laboratory and in situ velocities differ by around 0.2 km/sec at a depth of 500 meters.

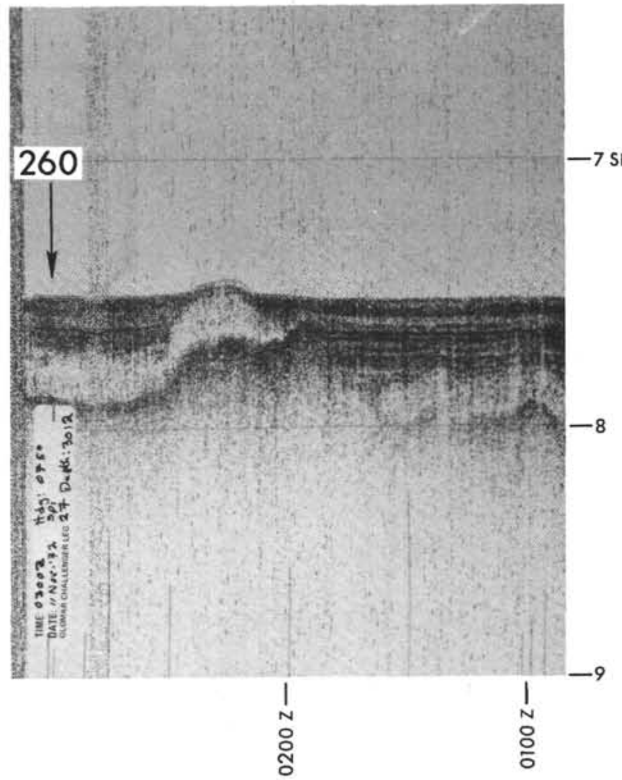


Figure 6. *Seismic profile approaching Site 260.*

## SUMMARY AND CONCLUSIONS

Site 260 is located in 5709 meters of water in the eastern Wharton Basin, about 200 km northwest of the foot of the Exmouth Plateau. Seismic profiles of Lamont-Doherty Geological Observatory show two principal layers near the site: (1) a transparent layer, up to 0.4 sec thick, that drapes an irregular-shaped acoustic basement; (2) a flat-lying well-stratified layer, also up to 0.4 sec thick that overlies the dipping transparent layer. One hole was drilled at Site 260 near the contact between the two layers where only the upper part of the stratified sequence is present. A total of 323 meters of sediments, including all of the transparent layer, and 9 meters of basalt were drilled. The oldest sediment immediately above the basalt is middle Albian.

Four sedimentary units are recognized. The top 158.0 meters consists of light-colored nanno ooze with layers of nanno- and zeolite-rich clay and radiolarian ooze. Some graded beds of detrital foram nanno ooze are also

**TABLE 4**
**Details of Reflectors at Site 260**

| Acoustic Sequence | Reflector | Reflection Time (sec) | Depth (m) | Interval Velocity (km/sec) Overlying Sediment | Interval Velocity (km/sec) Intermediate Layer |
|---|---|---|---|---|---|
| Well-Stratified | Sea floor | 0.00 | 0.0 | | 1.6 |
| | Intermediate | (1) 0.12 | 95.0 | 1.6 | 1.9 |
| | Base | | | | |
| Almost Transparent | Top | (2) 0.20 | 170.0 | 1.7 | 1.7 |
| | Faint | (3) 0.31 | 262.5 | 1.7 | 1.7 |
| | Basement | (4) 0.38 | 323.0 | 1.7 | |

present. This sequence ranges from Quaternary at the top to not older than middle Oligocene at the bottom. The next 66.5 meters, between depths of 158.0 and 224.5 meters, is brown zeolitic clay of Upper Cretaceous age in the top 28.5 meters and Cretaceous s.l. below. Nanno ooze with clay of middle Albian age occurs between 224.5 and 272.0 meters. The lowest sedimentary unit, from 272 to 323 meters, is interlayered greenish-gray to moderate-brown radiolarian ooze, nanno ooze, and zeolitic clay, which becomes dark red brown at its base above basalt. The age is regarded as middle Albian. Despite the color change near its base, this sediment is not baked; nannofossils at the very base are not altered.

The basalt, 9 meters of which was drilled before mechanical difficulties intervened, is notably fresh and coarse grained, suggesting a sill. This interpretation is supported by the middle Albian age of the overlying sediments which are much younger than the basal sediments at adjacent sites. The abundance of Radiolaria and Nannoplankton immediately above the basalt is also unusual because these fossils do not commonly occur on basement at nearby sites.

Fossils show that the top half of the section is Cenozoic and the lower half Cretaceous. The upper part of the section (0.0-158.0 m, Cores 1-4 contains heterogeneous assemblages of planktonic foraminifera and nannofossils, whose youngest elements provide minimum ages that range from Quaternary at the top to not older than Oligocene at the bottom. Radiolaria are rare to absent, except in Core 1. An Upper Cretaceous age is indicated in Cores 5 and 6 by planktonic foraminifera and by distinctive arenaceous foraminifera. The middle Albian interval of Cores 9-18 contains Radiolaria, nannofossils, and Calcispherulids. Cores 9-11 contain frequent to abundant planktonic and benthonic foraminifera as well as ostracods and molluscs.

Accumulation rates calculated from these data are crude due to the uncertain location of biostratigraphic boundaries in the drilled section. As at Site 259, the data were compiled on the arbitrary assumption that each biostratigraphic division identified was complete. The compiled curve thus shows minimum rates only (Figure 7). The overall average rate is 3.1 m/m.y. (323 m in 103 m.y.). The highest rates prevailed in the Albian and upper Miocene-Pliocene. Lower than average rates occurred in the Upper Cretaceous and lower Tertiary.

The oldest sediments drilled at Site 260 are middle Albian oozes and clays. Because the basalt is interpreted as a sill, an unknown thickness of sediment is believed to exist below the basalt.

During the Albian nearly 100 meters of nanno ooze and brown clay were deposited. For the rest of the Cretaceous zeolitic clay accumulated, presumably below the lysocline. The Albian depositional episode is notable for its rapid accumulation rate of nearly 33 m/m.y.

The Cretaceous clay and ooze sequence is succeeded by Cenozoic calcareous sediments. The Cenozoic interval of approximately 158 meters is represented by four widely spaced cores whose ages range from not older than middle Oligocene to Quaternary. Graded bedding and assemblages of heterogeneous microfossils characterize this interval. As mentioned above, the estimated accumulation rates are low in the Paleogene, and increase in the Neogene to a maximum value of 25 m/m.y. in the Pliocene.

A mechanism of bottom currents, from turbidity currents to slow movement of a nepheloid layer, is invoked to displace these carbonate sediments from their original area of deposition which, according to the foraminiferal evidence, was shallower than 4000 meters, and warm. Redeposition after winnowing of the originally deposited sediment is thought to be the immediate mechanism, and the ages represented relate to periods of thick carbonate accumulation in shallower water and depression of lysocline. Such pulsed deposition is not applicable at Site 260, which seems to have received Cenozoic carbonates at a steady rate that accelerated in the upper Miocene.

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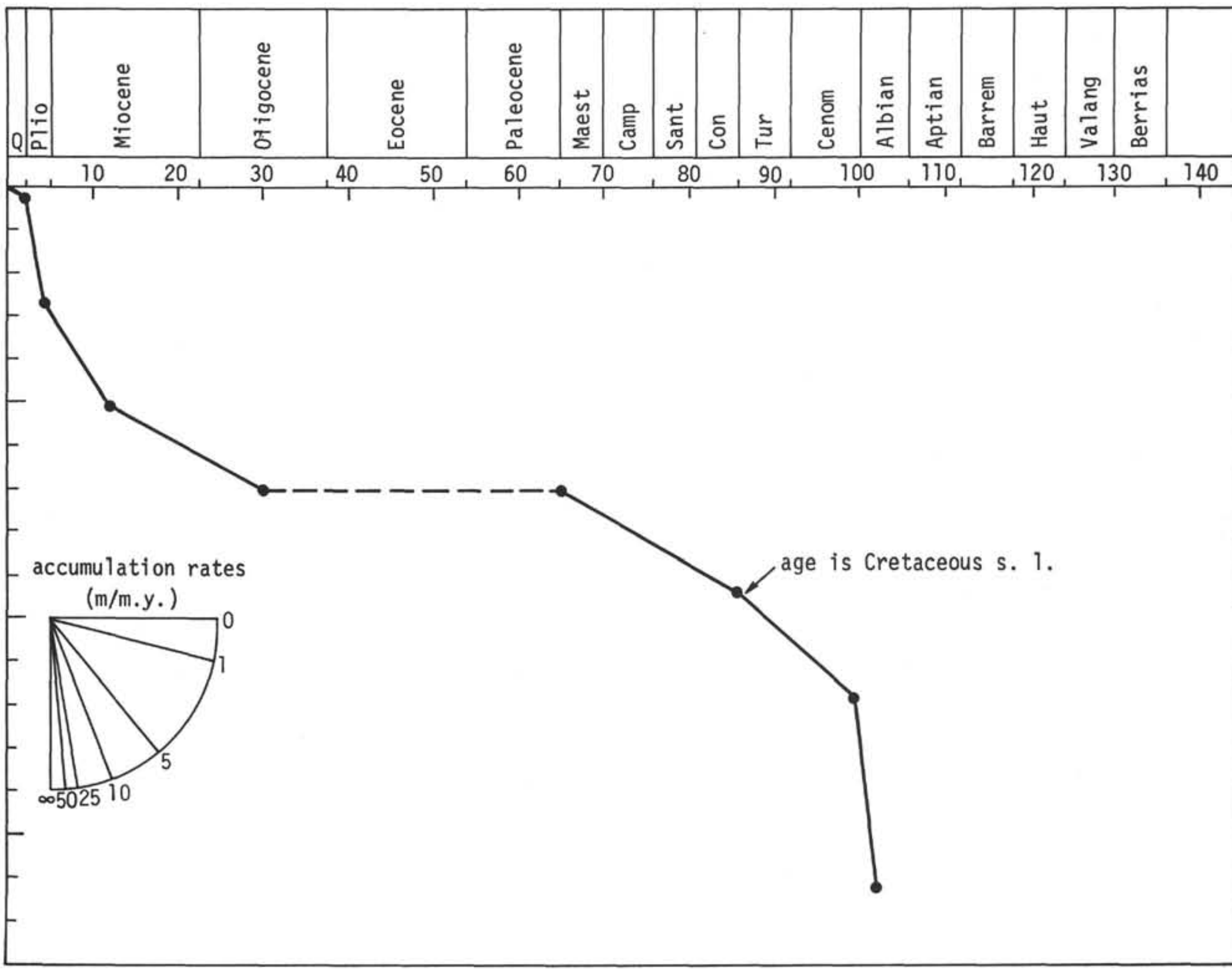
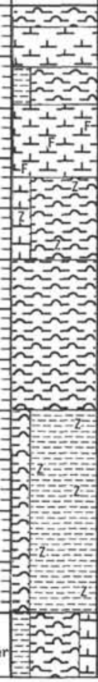



Figure 7. *Sediment accumulation rates, Site 260.*

Site 260 Hole Core 1 Cored Interval: 0-6 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS |
|---|---|---|---|---|---|---|---|
| QUATERNARY | (F) Globorotalia truncatulinoides truncatulinoides (N) Gephyrocapsa oceania | AG | AM | AG | | 1 | 0.5, 1.0 |
| | | | NONE | AG | | 2 | |
| | | | NONE | AG | | 3 | |
| | | | NONE | CG | | 4 | |
| | | RP | RG | AG | | Core Catcher | |

LITHOLOGY



| LITHO. SAMPLE | |
|---|---|
| 5 | 5YR3/4, 5YR3/2 Mottling |
| 40 | 5YR6/4, 5YR8/4, 5YR4/4 |
| 77 | 5YR3/4, 5YR3/2 Mottling |
| 125 | 5YR6/4, 5YR8/4 Mottling |
| 137 | 5YR3/4 |
| 10 | 5YR6/4 |
| GZ | 32 |
| 75 | 5YR4/4 |
| 135 | 5YR5/6 |
| XM | 26-28 |
| 40 | 5YR5/6 Mottling, 5YR3/4 |
| 90 | 5YR4/4 |
| 120 | 10YR2/2 |
| 140 | 5YR5/6 |
| 30 | 5YR4/4, 5YR3/2 Streaks |
| 75 | 5YR4/4 |
| 125 | 5YR3/2 |
| CC | 10YR5/4 |

LITHOLOGIC DESCRIPTION

Undisturbed soft to firm Radiolarian ooze with lesser amounts of nanno ooze. Moderate brown color with indistinct mottles and streaks of darker brown, moderate orange pink, and grayish brown.

RADIOLARIAN OOZE
Smear slides 1-10, 1-77, 2-75, 2-135, 3-40, 3-90

| Texture | | Composition | |
|---|---|---|---|
| Clay | 68% | Rads | 70-93% |
| Silt | 32% | Clay | 2- 5% |
| | | Forams | 0- 5% |
| | | Quartz | 1-12% |
| | | Nannos | 0-10% |
| | | Zeolite | 0- 5% |

RAD RICH CLAY
Smear slides 3-90, 3-120, 3-140, 4-30, 4-75, 4-125

| Texture | | Composition | |
|---|---|---|---|
| Clay | 96% | Clay | 60-77% |
| Silt | 4% | Rads | 20-27% |
| | | Zeolite | 2- 5% |
| | | Quartz | 0-10% |
| | | Iron Oxides | 0- 5% |
| | | Nannos | 0- 5% |

NANNO OOZE
Smear slides 1-40, 1-75, 1-137, 2-10

| Texture | | Composition | |
|---|---|---|---|
| Clay | 98% | Nannos | 53-85% |
| Silt | 2% | Forams | 2-20% |
| | | Rads | 10-20% |
| | | Carb. frags. | 2-10% |
| | | Quartz | 0- 2% |

Coarse Fraction (>63μ): Quartz, Forams, Sponge Spicules, Mica, Radiolaria, Fish remains.

BULK X-RAY (3.3 m)

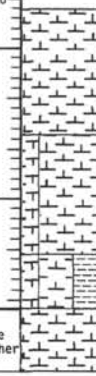
| | |
|---|---|
| Gypsum | 24% |
| Quartz | 23% |
| Mica | 23% |
| Kaolinite | 13% |
| K-feldspar | 7% |
| Montmorillonite | 5% |
| Plagioclase | 5% |

Site 260 Hole Core 2 Cored Interval: 44-53.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS |
|---|---|---|---|---|---|---|---|
| LOWER PLIOCENE | (F) Globorotalia margaritae (N) Miocene and Pliocene species | | | | | 1 | 0.5, 1.0 |
| | | AM | | RG | | 2 | |
| | | AM | | NONE | Fd | 3 | |
| | | AG | AG | NONE | | Core Catcher | |

LITHOLOGY

VOID



| LITHO. SAMPLE | |
|---|---|
| 120 | 10YR5/4 |
| 140 | 10YR4/4, 10YR7/4 Minor |
| | 10YR8/2 |
| GZ 55 | 5YR4/4 Fragments |
| 65 | 10YR8/2 |
| 85 | |
| 95 | N8 |
| 150 | Graded |
| 27 | |
| 56 | |
| 62 | 5YR5/6, 10YR8/2 Mottling |
| 76 | 10YR7/4 |
| 108 | 10YR8/2 |

LITHOLOGIC DESCRIPTION

Soft nanno ooze and minor nanno clay. Strongly disturbed in upper part, undisturbed below. Upper 123 cm and lowermost 58 cm moderate yellow brown, very pale orange, and grayish orange. The middle section is a very light gray graded unit.

DETRITAL FORAM RICH NANNO OOZE
Smear slides 2-95, 2-150, 3-27, 3-56

| Texture | | Composition | |
|---|---|---|---|
| Detrital | | Nannos | 50-68% |
| Foram Sands: | | Forams | 25-40% |
| Sand | 45% | Carb. frags. | 5-10% |
| Silt | 40% | Quartz | 1- 2% |
| Clay | 5% | Glauconite | Tr.- 1% |
| Oozes: | | | |
| Clay | 95-100% | | |
| Silt | 0- 5% | | |

NANNO OOZE
Smear slides 1-140, 2-65, 2-85, 3-108,

| Texture | | Composition | |
|---|---|---|---|
| Clay | 78% | Nannos | 61-98% |
| Silt | 22% | Forams | 1-10% |
| | | Carb. frags. | 0- 5% |
| | | Quartz | 0- 1% |
| | | Clay | 0-10% |

NANNO CLAY
Smear slides 1-120, 3-62, 3-76

| Composition | |
|---|---|
| Clay | 35-88% |
| Nannos | 3-30% |
| Forams | 0-20% |
| Iron Oxides | 0- 2% |
| Quartz | 1- 5% |

Coarse Fractions (>63μ): Quartz, Glauconite, Foraminifera, Radiolaria, Sponge Spicules

Explanatory notes in chapter 1

Site 260 Hole Core 3 Cored Interval: 91.5-101 m

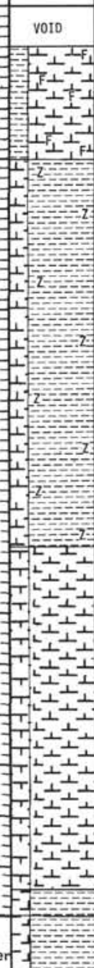
AGE: Not older than upper part of MIDDLE MIOCENE

ZONE: (F) Upper Cretaceous, Paleogene and middle Miocene species (mixed)
(N) Cretaceous, Paleogene and Miocene species (mixed)

| SECTION | FORAMS | NANNOS | RADIOLARIA | OTHERS |
|---|---|---|---|---|
| 1 | | RM | NONE | |
| 2 | | NONE | NONE | |
| 3 | | NONE | NONE | |
| 4 | | AM | NONE | |
| 5 | | AG | NONE | |
| 6 | | | NONE | |
| Core Catcher | CM | AM | NONE | Fd |

METERS: 0.5, 1.0

LITHOLOGY




LITHO. SAMPLE:

-42 5YR8/4
-50 5YR4/4
-56 10YR8/2 Minor
10YR2/4
-120 10YR3/2
5YR5/6 Streaks
XM 130-132
-50
GZ 10YR3/2
74
-131
XM 26-28
-75 10YR2/2
10YR2/2
-80
-100 10YR7/4 thin
10YR8/2 laminae
-147
-15 Graded
-40 nodule
5Y7/2
-115 5Y7/2
-145 10YR8/2
Graded
10YR8/2
10YR2/2
-CC 10YR2/2

LITHOLOGIC DESCRIPTION

Generally stiff nanno ooze and zeolite bearing nanno clay with graded units of softer detrital foram rich nanno ooze containing numerous harder nodules. The *non-graded ooze is mostly dusky yellowish* brown and the graded deposits are yellowish gray with lesser amounts of grayish orange and very pale orange. The upper 5 meters is highly deformed, the lower 4 meters undisturbed.

CLAY AND NANNO CLAY
Smear slides 1-50, 1-120, 2-50, 2-131, 3-75, CC, CC

| Texture | | Composition | |
|---|---|---|---|
| Detrital | | Clay | 45-95% |
| Foram Sands: | | Nannos | 2-40% |
| Sand | 50% | Quartz | 0-10% |
| Silt | 50% | Iron Oxide | 0- 5% |
| | | Zeolite | 0-10% |
| Oozes: | | | |
| Clay | 85% | | |
| Silt | 15% | | |

DETRITAL FORAM NANNO OOZE
Smear slides 5-15, 5-40, 5-115, 5-145

| Composition | |
|---|---|
| Forams | 20-50% |
| Nannos | 48-80% |

NANNO OOZE
Smear slides 1-42, 1-56, 4-80, 4-100, 4-147

| Composition | |
|---|---|
| Nannos | 90% |
| Clay | 10% |

BULK X-RAY (92.8 m)

| | |
|---|---|
| Quartz | 23% |
| Kaolinite | 21% |
| Palygorskite | 15% |
| Montmorillonite | 14% |
| Phillipsite | 11% |
| Mica | 7% |
| K-feldspar | 6% |
| Gypsum | 3% |

Site 260 Hole Core 4 Cored Interval: 129.5-139 m

AGE: Not older than MIDDLE OLIGOCENE

ZONE: (F) Upper Cretaceous, Paleocene, Eocene, and Oligocene species
(N) Cretaceous, Paleocene, Eocene, and Oligocene species with Eocene predominant

| SECTION | FORAMS | NANNOS | RADIOLARIA | OTHERS |
|---|---|---|---|---|
| 1 | | RP | NONE | Fd |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | AM | NONE | |
| 6 | | AM | NONE | |
| Core Catcher | CM | AM | RVVP | |

METERS: 0.5, 1.0

LITHOLOGY


LITHO. SAMPLE:

-5
-15 5YR3/4
10YR7/4
10YR2/2
10YR7/4 Fragments
-100
-15 10YR2/2
-60 10YR7/4
GZ 10YR8/2 thin
74 laminae
-10
10YR7/4
10YR8/2
-CC

LITHOLOGIC DESCRIPTION

Highly deformed to brecciated nanno ooze, nanno clay, and clay. Clay is dusky yellowish brown with fragments of grayish orange. The nanno ooze, with detrital forams, is grayish orange to very pale orange in Section 5 and dusky yellowish brown in Section 6. Most is stiff.

NANNO OOZE
Smear slides 1-5, 1-15, 5-60, 6-10, CC

| Texture | | Composition | |
|---|---|---|---|
| Detrital | | Nannos | 81-98% |
| Foram Sands: | | Forams | 3-15% |
| Sand | 60% | Zeolite | 1- 2% |
| Silt | 40% | | |
| Oozes: | | | |
| Clay | 51% | | |
| Silt | 49% | | |

CLAY
Smear slide 1-100

| Composition | |
|---|---|
| Clay | 88% |
| Nannos | 9% |
| Iron Oxide | 3% |

NANNO CLAY
Smear slide 2-15

| Composition | |
|---|---|
| Clay | 62% |
| Nannos | 30% |
| Iron Oxide | 5% |
| Carb. frags. | 2% |
| Zeolite | 1% |

Coarse Fraction (>63μ): Foraminifera, Radiolaria, Quartz, Sponge Spicules, Pyrite, Volcanic glass.

Explanatory notes in chapter 1

Site 260 Hole Core 5 Cored Interval: 158-167.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UPPER CRETACEOUS not younger than MOASTRICHTIAN | (F) Cretaceous and Paleocene species | | | | | 1 | 0.5, 1.0 | | | | 10YR4/2 10YR8/2 |
| | | | | | | 2 | | | | | |
| | | | | | | 3 | | VOID | | | |
| | | | | | | 4 | | | | | |
| | | | | | | 5 | | | | | |
| | | CM | NONE | RVVP | Fd | 6 | | | | -87 -112 | 10YR3/4 10YR7/4 5YR4/4 clasts; 10YR4/2 5YR4/4 10YR2/2 minor |
| | | CM | NONE | NONE | Fd | Core Catcher | | | | -CC | 10YR4/2 5YR4/4 minor |

Mostly disturbed to brecciated clay with minor nanno clay and nanno bearing clay. The clay is moderate brown to dark yellowish brown and the nanno-rich parts are grayish orange. Mostly stiff.

NANNO BEARING CLAY
Smear slides 6-87, 6-112, CC

| Texture | | Composition | |
|---|---|---|---|
| Detrital | | Clay | 86-97% |
| Foram Sands: | | Nannos | 2% |
| Sand | 90-100% | Quartz | 1- 5% |
| Silt | 0- 10% | Iron Oxide | Tr.- 5% |
| Oozes: | | Feldspar | Tr.- 5% |
| Clay | 90-100% | | |
| Silt | 0- 10% | | |

CLAY
Smear slide 1-20

| Composition | |
|---|---|
| Clay | 93% |
| Quartz | 5% |
| Iron Oxide | 2% |

NANNO OOZE
Smear slide 1-29 (clast of ooze in clay)

| Composition | |
|---|---|
| Nannos | 94% |
| Forams | 5% |
| Quartz | 1% |

Coarse Fraction (>63μ): Radiolaria, Silicoflag., Opaque Spherulites, Iron Oxide Aggregates.

Site 260 Hole Core 6 Cored Interval: 177-186.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| UPPER CRETACEOUS not older than CONIACIAN | | * AG | | NONE | Fd Cs | 1 | 0.5, 1.0 | VOID | | -142 | 10YR4/2 |
| | | AG | NONE | NONE | Fd | Core Catcher | | | | | |

Highly brecciated zeolite bearing clay. Moderate brown to dark yellowish brown. Stiff fragments in soft matrix.

ZEOLITE BEARING CLAY
Smear slide 1-142

| Composition | |
|---|---|
| Clay | 90% |
| Quartz | 5% |
| Zeolite | 2% |
| Feldspar | 2% |
| Iron Oxide | 1% |

Coarse Fraction (>63μ): Sponge Spicules, Radiolaria, Pyrite, Foraminifera, Opaque Spherulites, Iron Oxide Aggregates.

Explanatory notes in chapter 1 *Globotruncana, Rugoglobigerina and arenaceous species

Site 260 Hole Core 7 Cored Interval: 196-205.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CRETACEOUS | rare arenaceous | | | CVVP | Fd | 1 | 0.5, 1.0 | VOID, VOID | | -4, -52 | 10YR4/2; 10YR4/2, 10YR2/2, 10YR5/4 Streaks |
| | | | | RVVP | | 2 | | VOID | | -112, -113, GZ, -118 | 10YR4/2, 10YR2/2, 10YR5/4 Streaks |
| | | | | CVVP | | 3 | | | | XM, -62, -90, -100 | 26-28 |
| | | | | | | 4 | | VOID, VOID | | | 10YR4/2 |
| | | | | | | 5 | | | | | |
| | | | | | | 6 | | VOID | | -125, GZ | 10YR4/2; 130 |
| | | RG | NONE | AVVP | Fd | Core Catcher | | | | | 10YR2/2 |

Top and bottom of core highly disturbed to brecciated zeolitic clay to zeolite bearing clay. Middle of section is composed of undisturbed zeolite bearing clay. The clay is dark yellow brown with streaks of moderate yellow brown and dusky yellow brown. Breccia soft, other is stiff.

ZEOLITE RICH CLAY
Smear slides 1-4, 1-52, 2-112, 2-113, 3-90

| Texture | | Composition | |
|---|---|---|---|
| Clay | 82% | Clay | 64-86% |
| Silt | 18% | Zeolites | 10-20% |
| | | Iron Oxides | 1-20% |
| | | Quartz | 1- 3% |

ZEOLITIC CLAY
Smear slides 3-62, 6-125

| Texture | | Composition | |
|---|---|---|---|
| Clay | 82% | Clay | 62-70% |
| Silt | 18% | Zeolites | 25-35% |
| | | Quartz | 0- 3% |
| | | Iron Oxides | 1- 2% |

Coarse Fraction (>63μ): Quartz, Radiolaria, Iron Oxide, Gypsum

BULK X-RAY (199.3 m)

| | |
|---|---|
| Palygorskite | 31% |
| Clinoptilolite | 23% |
| Quartz | 15% |
| Mica | 11% |
| Montmorillonite | 7% |
| K-feldspar | 5% |
| Plagioclase | 4% |
| Gypsum | 4% |

Site 260 Hole Core 8 Cored Interval: 215-224.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CRETACEOUS | Few arenaceous species | | | | | 1 | 0.5, 1.0 | VOID | | | |
| | | | | | | 2 | | | | | 10YR4/2 |
| | | | | | | 3 | | VOID, VOID | | -65 | 10YR4/2; 10YR4/2 |
| | | | | | | 4 | | VOID | | | |
| | | | | | | 5 | | | | -85, GZ, -105, -88 | 5YR3/4, 5YR4/4, 5YR3/2 laminae |
| | | RM | | FVVP | Fd | 6 | | | | -60, -87 | 5YR3/4, 5YR3/2 minor |
| | | FG | NONE | FVVP | Fd | Core Catcher | | | | -CC | 10YR3/2 |

Mostly undisturbed zeolite rich clay with minor brecciated zeolite bearing clay. General color of the clay is moderate brown with minor grayish brown and dark yellowish brown laminae. Most is stiff.

ZEOLITE RICH CLAY
Smear slides 3-85, 6-60, 6-87

| Texture | | Composition | |
|---|---|---|---|
| Clay | 80% | Clay | 73-87% |
| Silt | 20% | Zeolite | 20-25% |
| | | Quartz | 2- 3% |
| | | Iron Oxides | 1- 2% |
| | | Feldspar | 1- 2% |

ZEOLITE BEARING CLAY
Smear slide 3-65

| Composition | |
|---|---|
| Clay | 88% |
| Zeolite | 7% |
| Quartz | 3% |
| Iron Oxides | 2% |

Coarse Fraction (>63μ): Quartz, Foraminifera, Gypsum, Scoria(?)

Explanatory notes in chapter 1

Site 260 Hole Core 9 Cored Interval: 234-243.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN | (BF) Middle to Upper Albian * | Hedbergella and benthonic species AG | AP | FM | | 1 | 0.5, 1.0 | VOID | | 95, 120 | 10YR4/2; 5YR8/4 minor |
| | | AG | AM | RP | Cs Ms O | Core Catcher | | | | CC | 10YR4/2 |

Stiff, dark yellowish brown nanno ooze with two prominent moderate orangish pink concretions at 95 and 105 cm. Thin laminations present in some samples.

NANNO OOZE
Smear slides 1-95, 1-120

| Composition | |
|---|---|
| Nannos | 95-99% |
| Zeolites | 0- 3% |
| Clay | 0- 2% |

*(N) Middle Albian-Prediscosphaera cretacea

Site 260 Hole Core 10 Cored Interval: 243.5-253 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN | (BF) Middle to Upper Albian (N) Middle Albian - Prediscosphaera cretacea? | AG | AM | FM | Cs O | 1 | 0.5, 1.0 | | | 35, 64, 80, 127, 128 | 10YR4/2; 10YR8/4 Mottling; 10YR2/2; 5YR2/1 minor; 5YR5/6 minor; 5YR5/6 minor |
| | * | AG | AM | RM | Ms O | 2 | | | | 60, GZ 78, 132, 133 | 5YR7/4; 5YR8/4; 10YR4/2 78; 10R6/6 minor |
| | | AG | AM | RM | O | Core Catcher | | | | CC | 10YR6/2; 5YR8/4 |

Stiff and semi-lithified nanno ooze with minor chalk. The pinkish mottles in the core catcher may be silicified. Chert is present at 22-28 cm in Section 2. Zeolites are present in significant amounts. Chiefly dark yellowish brown with thin lamina, mottles, and nodules of moderate orange pink, dusky yellow brown, and light brown.

NANNO OOZE
Smear slides 1-35, 1-80, 1-127, 1-128, 2-60, 2-132, 2-133, CC

| Texture | | Composition | |
|---|---|---|---|
| Clay | 62% | Nannos | 75-98% |
| Silt | 33% | Zeolites | 1-15% |
| Sand | 5% | Clay | 0-10% |
| | | Forams | 0- 1% |

Coarse Fraction (>63μ): Gypsum, Foraminifera, Radiolaria

*Hedbergella and benthonic species

Site 260 Hole Core 11 Cored Interval: 253-262.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN | (BF) Middle to Upper Albian * | ** AG | AM | CM | Cs | 1 | 0.5, 1.0 | VOID; VOID; VOID | | 55, 90 | 5YR7/4; 10YR4/2 minor; 5YR7/4; 5YR3/2 minor; N8 minor |
| | | AG | AM | AP | O Fd | Core Catcher | | | | | |

Stiff nanno ooze and clay rich nanno ooze. Chiefly orange pink with lesser amounts of light brown, grayish brown, and dark yellow brown. Laminations observed but are indistinct. Upper ooze is brecciated, lower one is undisturbed.

NANNO OOZE
Smear slides 1-90, CC

| Composition | |
|---|---|
| Nannos | 88-90% |
| Clay | 2- 5% |
| Zeolites | 1- 2% |
| Forams | Tr.- 5% |

CLAY RICH NANNO OOZE
Smear slide 1-55

| Composition | |
|---|---|
| Nannos | 77% |
| Clay | 20% |
| Zeolites | 2% |

Coarse Fraction (>63μ): Quartz, Radiolaria, Foraminifera, Gypsum, Sponge Spicules, Silcoflag.

*(N) Middle Albian - Prediscosphaera cretacea
**Hedbergella and benthonic species

Site 260 Hole Core 12 Cored Interval: 262.5-272 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS, LOWER-MIDDLE ALBIAN | (F) Upper Aptian? to Lower Albian (N) Middle Albian - Prediscosphaera cretacea | Scarce benthonic species | AM | AM | Cs | 1 | 0.5, 1.0 | | | 23, 65, 100, GZ 35, 40 | 5YR4/4; 5B7/1 minor; 10R6/6; 5YR5/6; 5YR4/4; 5YR5/6 35; 5YR6/4 |
| | | | AM | FM | Cs | 2 | | | | 70, 110, 114 | 5YR8/1; 5YR4/4; N1; 5YR4/4 |
| | | RP | FP | AP | | Core Catcher | | | | CC | 10YR5/4; 10R6/6 minor |

Mostly semi-lithified to lithified material including: chert, chalk, clay, nanno rad ooze. Section 1 contains mostly lithified material that has broken into sections averaging 8-10 cm long. Lower in the core, the material is complete.

NANNO OOZE
Smear slides 1-65, 2-40

| Texture | | Composition | |
|---|---|---|---|
| Clay | 79% | Nannos | 97% |
| Silt | 21% | Zeolites | Tr.- 2% |

CLAY
Smear slides 2-70, 2-110, 2-114

| Composition | |
|---|---|
| Clay | 40-75% |
| Zeolites | 0-25% |
| Iron Oxides | 0-57% |
| Nannos | 0- 5% |
| Feldspar | 0- 2% |

NANNO CHALK
Smear slide CC

| Composition | |
|---|---|
| Nannos | 99% |

CHERT
Smear slides 1-23, 1-100

| Composition | |
|---|---|
| Siliceous matrix | 64-75% |
| Nannos | 3-20% |
| Clay | 10-20% |

Explanatory notes in chapter 1

Site 260 Hole Core 13 Cored Interval: 272-281.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS LOWER-MIDDLE ALBIAN | (F) Upper Aptian? to Lower Albian<br>Middle Albian<br>Prediscosphaera cretacea | | AM | AM | Cs | 1 | 0.5<br>1.0 | | | -70<br>-107 | 5YR3/4<br>10YR6/2<br>5G5/2<br>5Y5/2<br>5GY5/2 |
| | | CM | AM | CP | | Core Catcher | | | | -CC | |

Indurated nanno ooze (chalk) and stiff nanno rad ooze. Colors generally greenish but browns and yellowish browns present. Disturbance is slight.

NANNO RAD OOZE
Smear slide 1-70

| Composition | |
|---|---|
| Radiolaria | 50% |
| Nannos | 30% |
| Clay | 20% |

CHALK

| Composition | |
|---|---|
| Nannos | 93% |
| Zeolites | 7% |

Site 260 Hole Core 14 Cored Interval: 281.5-291 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS LOWER-MIDDLE ALBIAN | (F) Upper Aptian? to Lower Albian<br>(N) Middle Albian<br>Prediscosphaera cretacea | RM | RP | NONE | | 1 | 0.5<br>1.0 | VOID | | -82<br>-118 | 10Y4/2 |
| | | RM | AP | RVVP | | Core Catcher | | | | | |

Greenish gray lithified nodules set in a matrix of semi-lithified material of the same color. Laminations in nodules traced into matrix in one sample indicating they have not been disturbed.

RAD OOZE
Smear slide 1-118

| Composition | |
|---|---|
| Radiolaria | 92% |
| Nannos | 2% |
| Clay | 5% |

ZEOLITE AND NANNO RICH CLAY
Smear slide 1-82

| | |
|---|---|
| Clay | 73% |
| Nannos | 10% |
| Zeolites | 10% |
| Quartz | 3% |
| Feldspar | 3% |

NANNO CHALK
Smear slide CC

| | |
|---|---|
| Nannos | 95% |
| Clay | 3% |
| Zeolites | 2% |

Coarse Fraction (>63μ): Gypsum, Iron Oxide Aggregates.

Site 260 Hole Core 15 Cored Interval: 291-300.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS, LOWER-MIDDLE ALBIAN | (N) Middle Albian<br>(F) Upper Aptian? to Lower Albian<br>Prediscosphaera cretacea | | | | | 1 | 0.5<br>1.0 | VOID | | -115 | 10Y4/2 |
| | | RM | CM | FVVP | Fd | 2 | | | | -45<br>GZ<br>-85<br>-132 | 5G6/1<br>74<br>5G6/1 |
| | | | CM | AVVP | | 3 | | | | -26-28<br>XM<br>-30<br>-100 | 5G6/1<br>5G4/1 minor<br>5G6/1 |
| | | | AP | AVVP | | 4 | | | | -30<br>-130 | 5G6/1 |
| | | RM | AP | FVVP | Cs | Core Catcher | | | | -CC | 5B5/1 |

Stiff to semi-lithified greenish gray nanno ooze and nanno rich clay. Mostly laminated to thinly laminated with faint mottling present locally. Micro scale mottles and cross laminations are present in Section 2. Section 4 has numerous well-laminated nodules with lamina traceable into the matrix.

NANNO OOZE
Smear slides 2-45, 2-85, 2-132, 4-30, 4-130, CC

| Texture | | Composition | |
|---|---|---|---|
| Clay | 79% | Nannos | 82-98% |
| Silt | 21% | Clay | 0-10% |
| | | Zeolites | 1- 2% |

CLAY
Smear slides 3-30, 3-100

| Composition | |
|---|---|
| Nannos | 5-20% |
| Clay | 77-90% |
| Zeolites | 2% |

Coarse Fraction (>63μ): Gypsum, Foraminifera, Radiolaria, Iron Oxide Aggregates

BULK X-RAY (294.3 m)

| | |
|---|---|
| Quartz | 74% |
| Montmorillonite | 14% |
| Mica | 6% |
| K-feldspar | 3% |
| Calcite | 3% |

Site 260 Hole Core 16 Cored Interval: 300.5-310 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS, LOWER-MIDDLE ALBIAN | (F) Upper Aptian? to Lower Albian<br>(N) Middle Albian<br>Prediscosphaera cretacea | RM | NONE | AVP | | 1 | 0.5<br>1.0 | VOID | | -70 | |
| | | | RP | FVVP | | 2 | | | | -9<br>-40<br>GZ<br>-109<br>-143<br>-149 | 5G4/1<br>5G5/2<br>74<br>10YR4/2 |
| | | RM | NONE | FVVP | | Core Catcher | | | | -CC | 10R4/2 chert<br>10Y4/2 clay |

Greenish gray clay, semi-lithified and nodular in upper part and stiff in lower part. Two thin zones of rad rich clay and rad ooze at 16 and 150 cm of Section 2.

CLAY
Smear slides 1-70, 2-40, 2-109, 2-143, CC

| Texture | | Composition | |
|---|---|---|---|
| Clay | 78% | Clay | 88-97% |
| Silt | 22% | Radiolaria | Tr.-10% |
| | | Iron Oxide | 1- 3% |
| | | Chlorite | 0-10% |

RAD OOZE
Smear slides 2-9, 2-149

| Composition | |
|---|---|
| Radiolaria | 100% |

Explanatory notes in chapter 1

Site 260 Hole Core 17 Cored Interval: 310-319.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS LOWER-MIDDLE ALBIAN | (F) Upper Aptian? to Lower Albian (N) Middle Albian Prediscosphaera createa | scarce benthonic | AM | AVP | | 1 | 0.5, 1.0 | VOID | | 35, 52, 95, 135 | 5G6/1; Gradual color change; 5YR4/4; 5YR4/4 |
| | | RG | AM | FVVP | | Core Catcher | | | | | 10R4/2 |

Greenish gray nanno rad ooze grading downward into moderate brown nanno ooze. The upper ooze is stiff but the lower one is a mixture of well indurated and soupy material. Chert was found at 80 cm and in the core catcher.

NANNO OOZE
Smear slides 1-35, 1-95, 1-135

| Composition | |
|---|---|
| Nannos | 97-99% |
| Radiolaria | 0- 2% |
| Iron Oxide | 0- 2% |
| Zeolites | 0- 1% |

NANNO RAD OOZE
Smear slide 1-52

| Composition | |
|---|---|
| Radiolaria | 60% |
| Nannos | 40% |

CHERT

Site 260 Hole Core 18 Cored Interval: 319.5-322.5 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOWER CRETACEOUS, LOWER-MIDDLE ALBIAN | (F) Upper Aptian? to Lower Albian (N) Middle Albian Prediscosphaera cretacea | scarce benthonic | | CVVP | | 1 | 0.5, 1.0 | VOID | | 135 | 5YR4/4 |
| | | | | AP, AP | | 2 | | | | 20, 77, 94, 101, 113, 123 | 5YR2/3 rep.; 10Y5/2; 10G4/2 minor |
| | | FG | AP | FVP | | | | | | | |
| | | | | | | Core Catcher | | | | | 5Y2/1 |

Moderate stiff nanno ooze changing downward to a semi-lithified dark red brown clay. Angular fragments of chert indicate upper part has been brecciated in drilling. The red clay is quite calcareous; the green zones are essentially non-calcareous. Basalt with abundant fractures filled with calcite and chlorite(?) begins at 127 cm of Section 2.

NANNO OOZE
Smear slides 1-135, 2-20, 2-123

| Composition | |
|---|---|
| Nannos | 73-90% |
| Clay | 5-20% |
| Zeolites | 0- 2% |
| Iron Oxide | 3- 5% |

CLAY AND RAD CLAY
Smear slides 2-77, 2-94

| Composition | |
|---|---|
| Clay | 70-79% |
| Radiolaria | 0-30% |
| Iron Oxide | 0-20% |

BASALT
Fresh, fine- to medium-grained, olive black basalt. Chloritic alteration along fractures. Some calcite veinlets have formed in the fractures.

Site 260 Hole Core 19 Cored Interval: 323.5-329 m

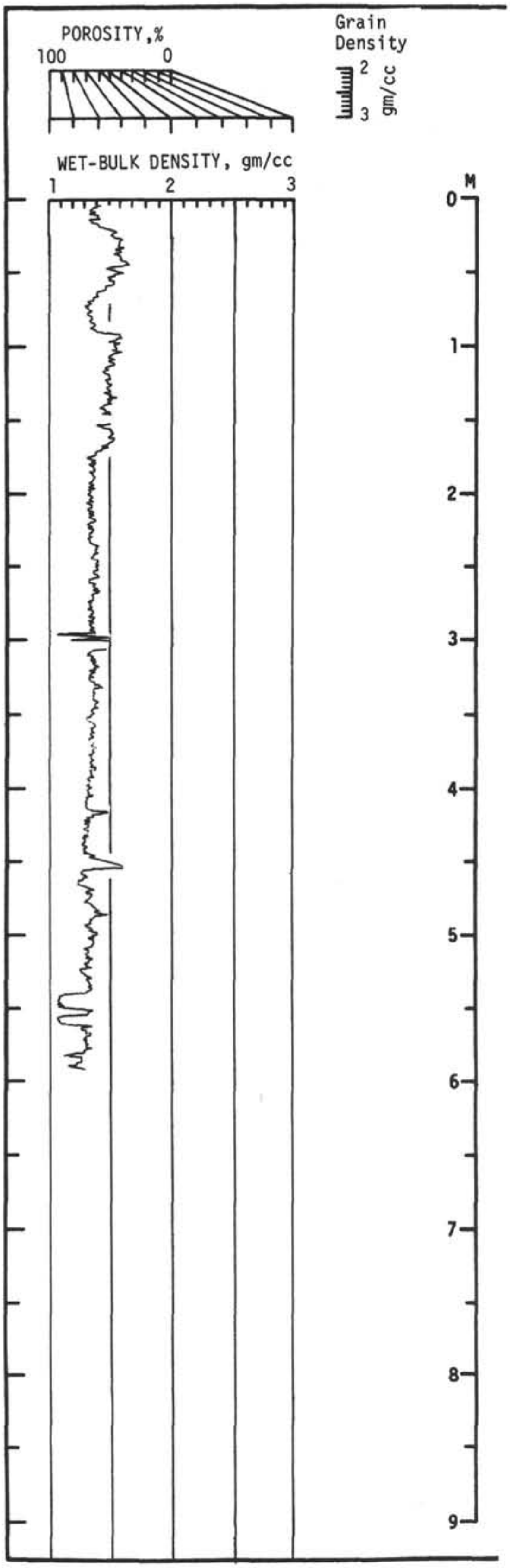
| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Core Catcher | | VOID | | | |

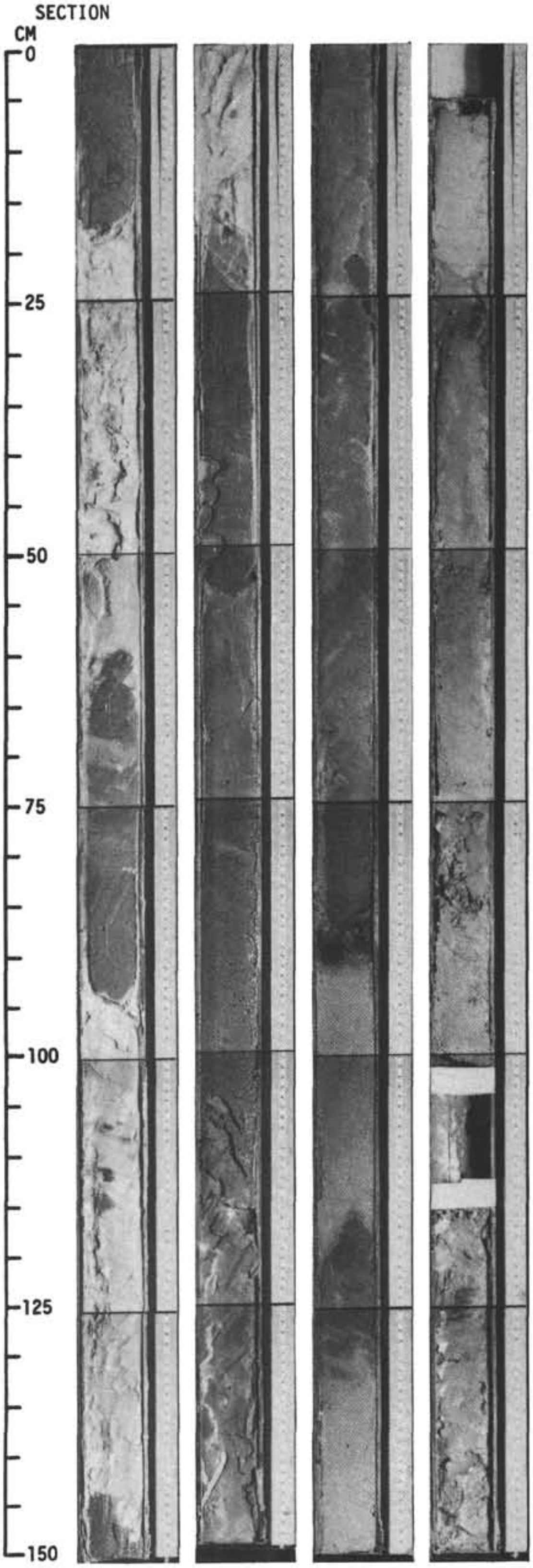
Site 260 Hole Core 20 Cored Interval: 329-332 m

| AGE | ZONE | FORAMS | NANNOS | RADIOLARIA | OTHERS | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0.5 | | | | 5Y2/1 |

BASALT
Fresh, fine- to medium-grained olive black basalt. Chloritic alteration along fractures. Some calcite veinlets have formed in the fractures.

Explanatory notes in chapter 1

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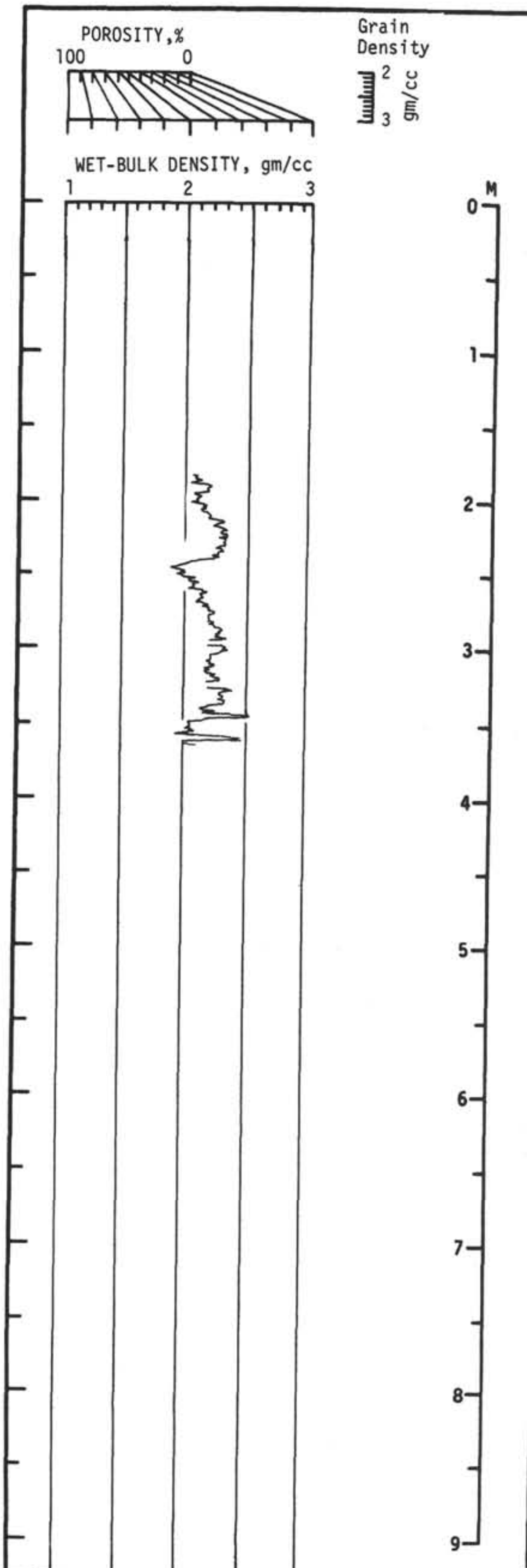
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gm/cc
WET-BULK DENSITY, gm/cc
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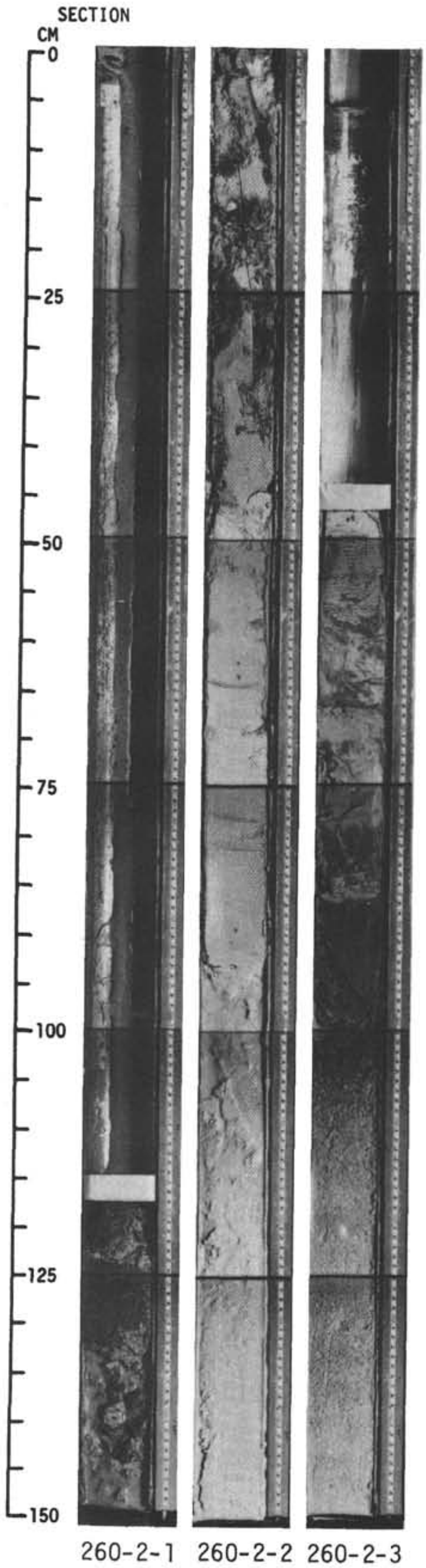
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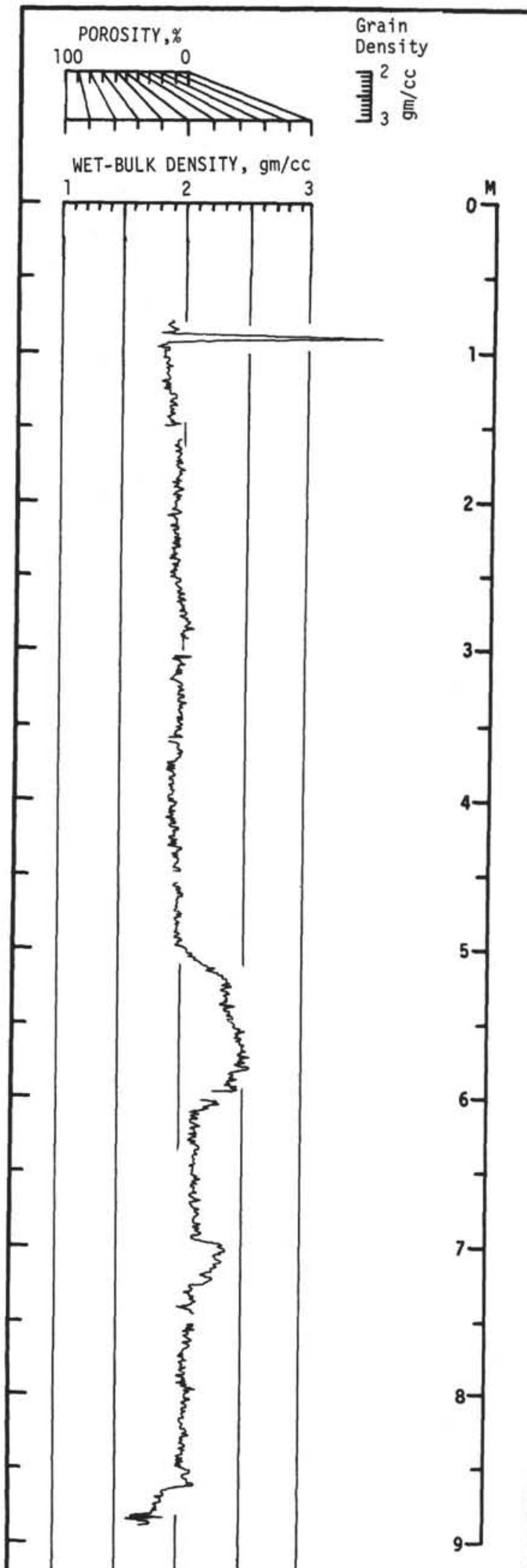
260-2-2
260-2-3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gm/cc
WET-BULK DENSITY, gm/cc
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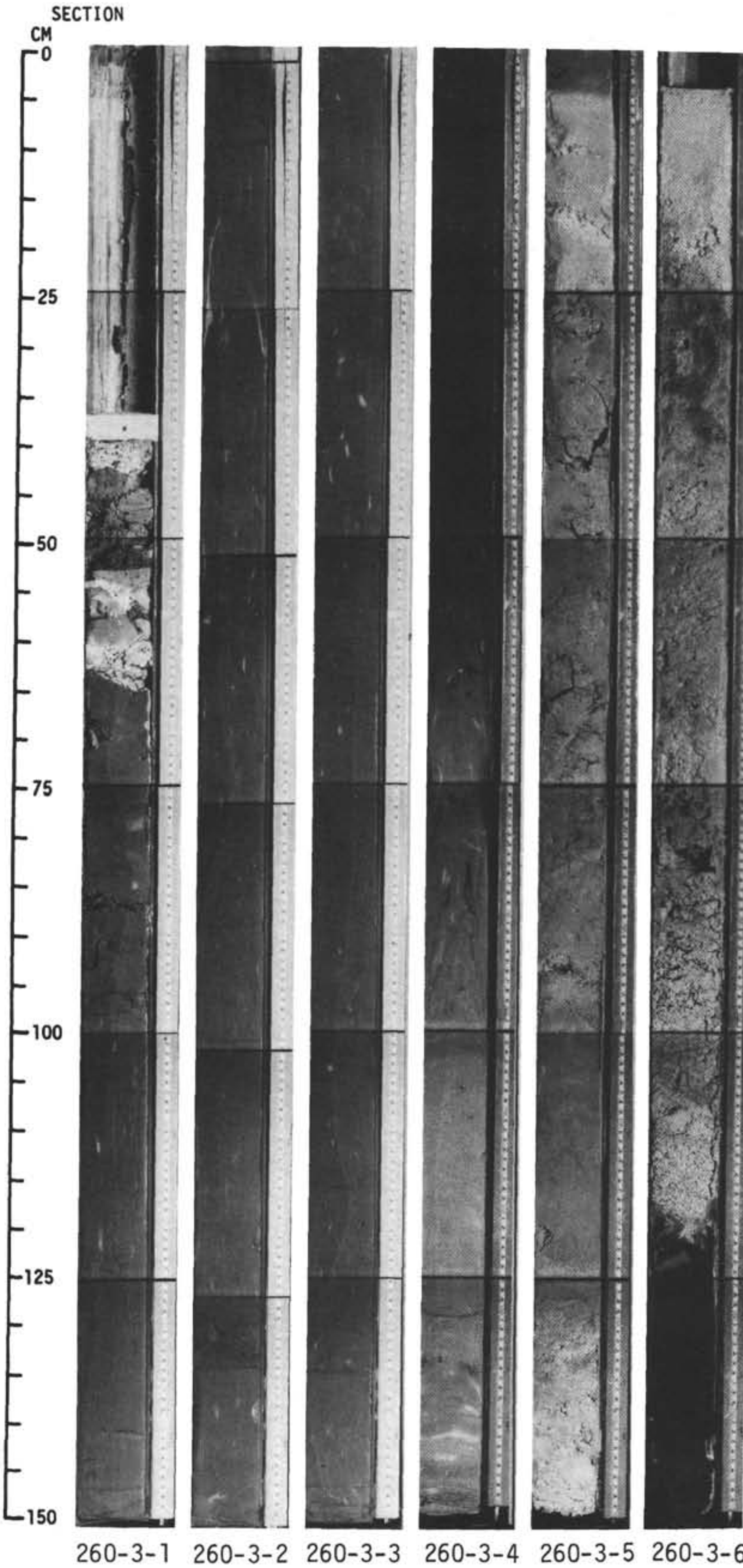
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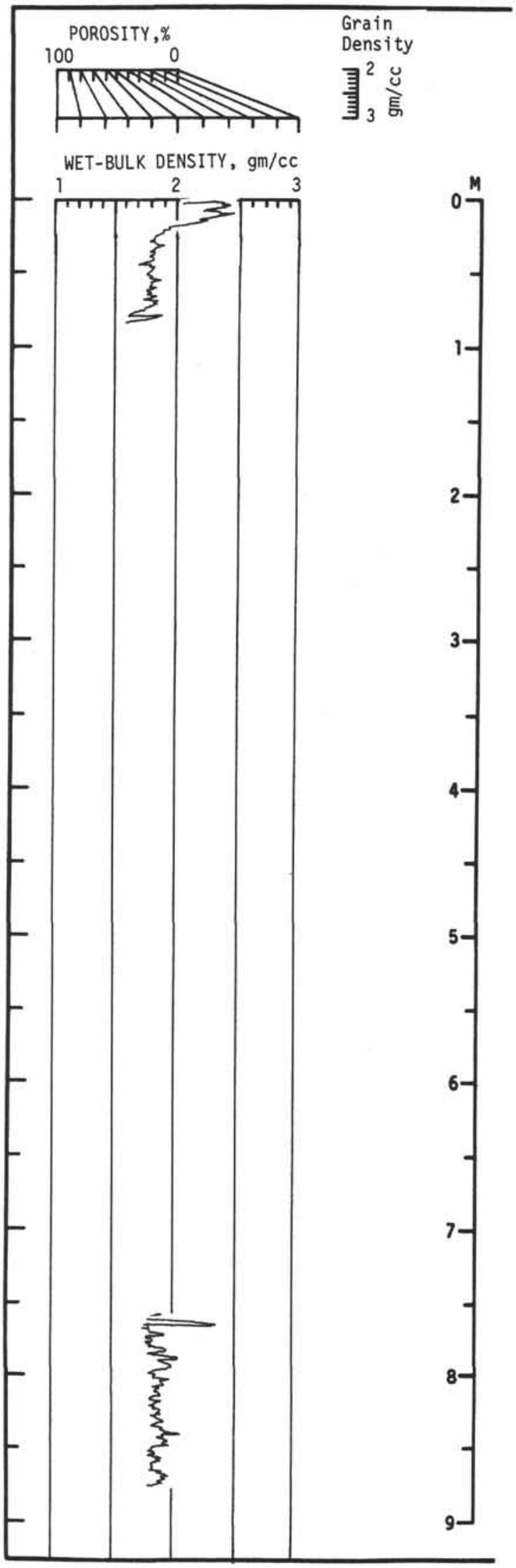


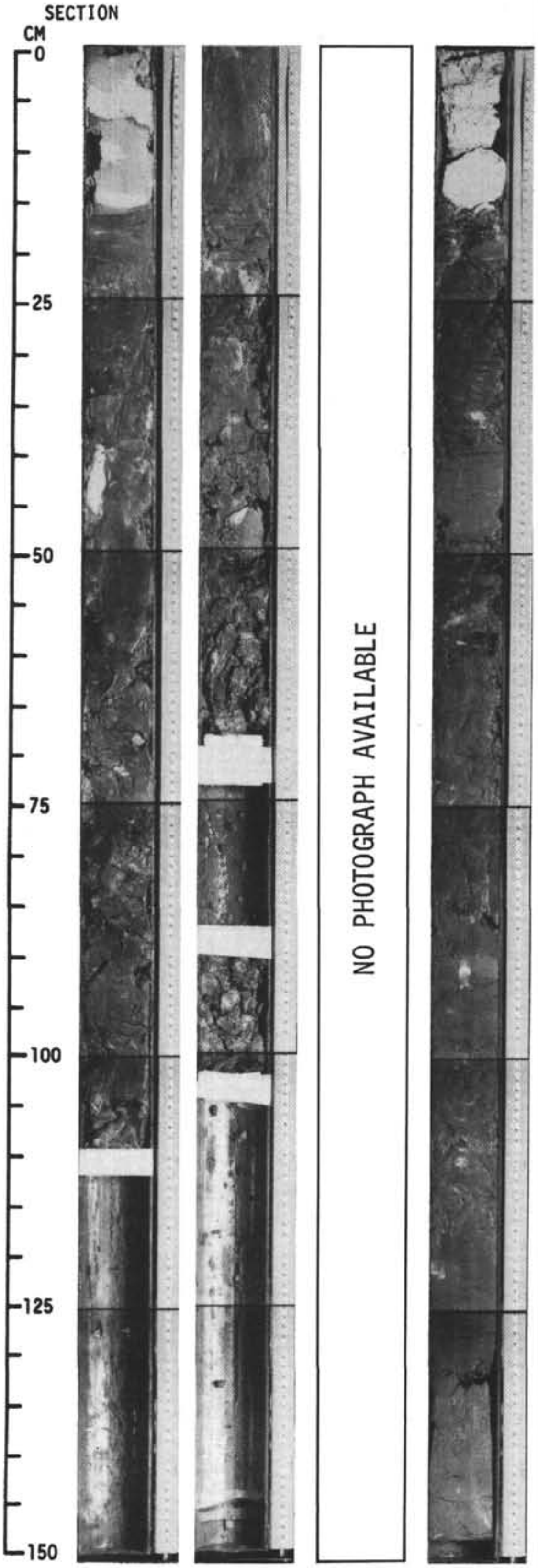


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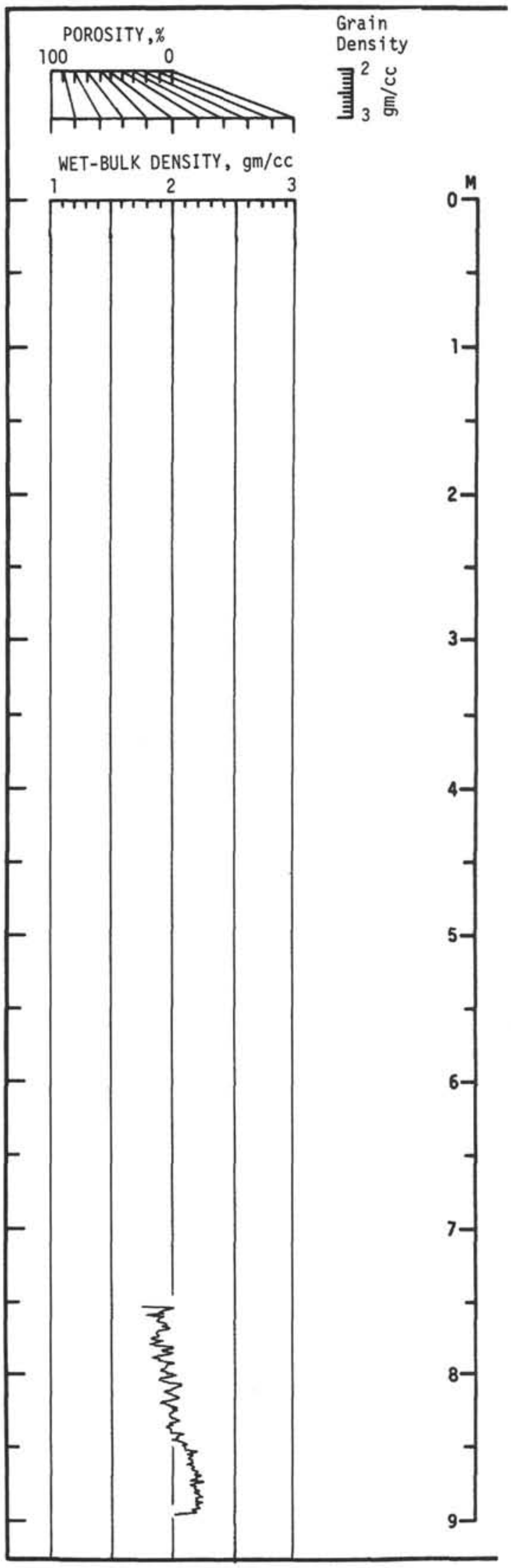


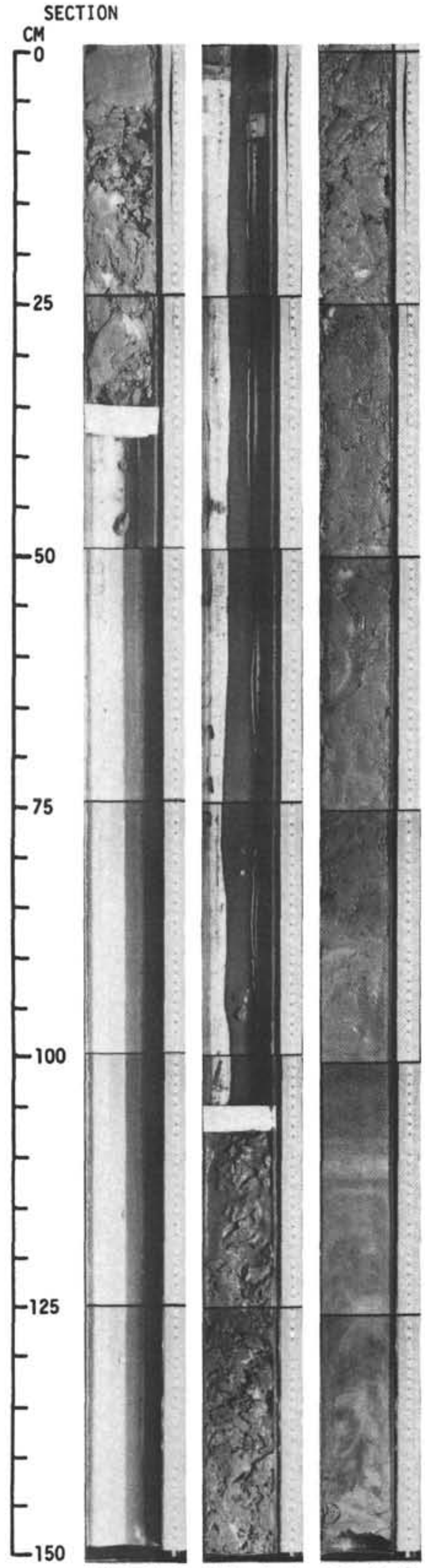


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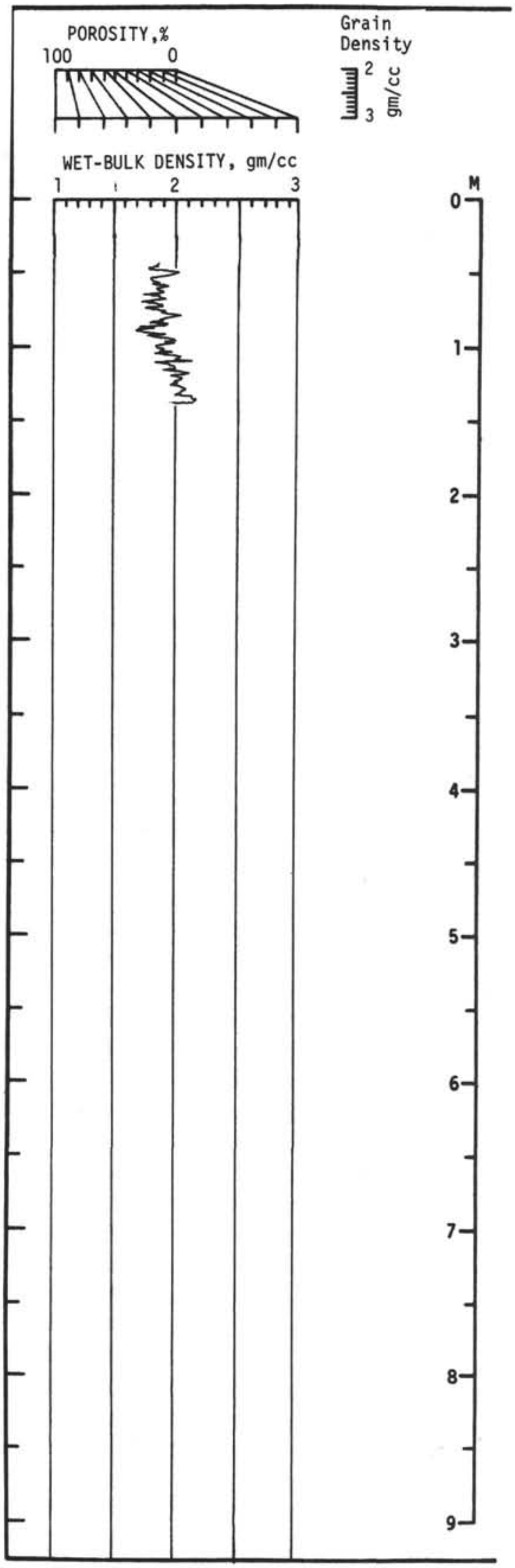
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Grain Density
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gm/cc
WET-BULK DENSITY, gm/cc
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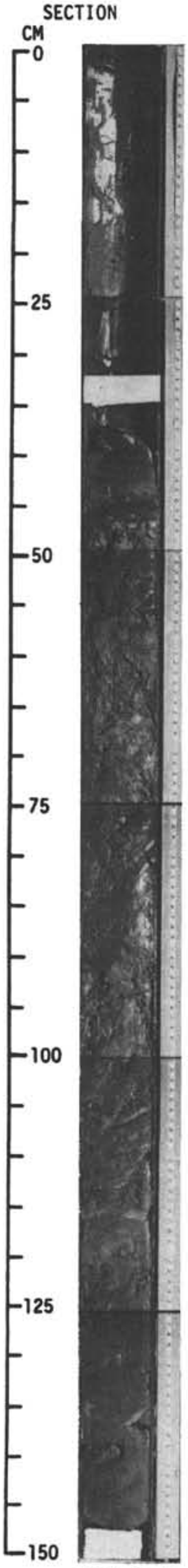
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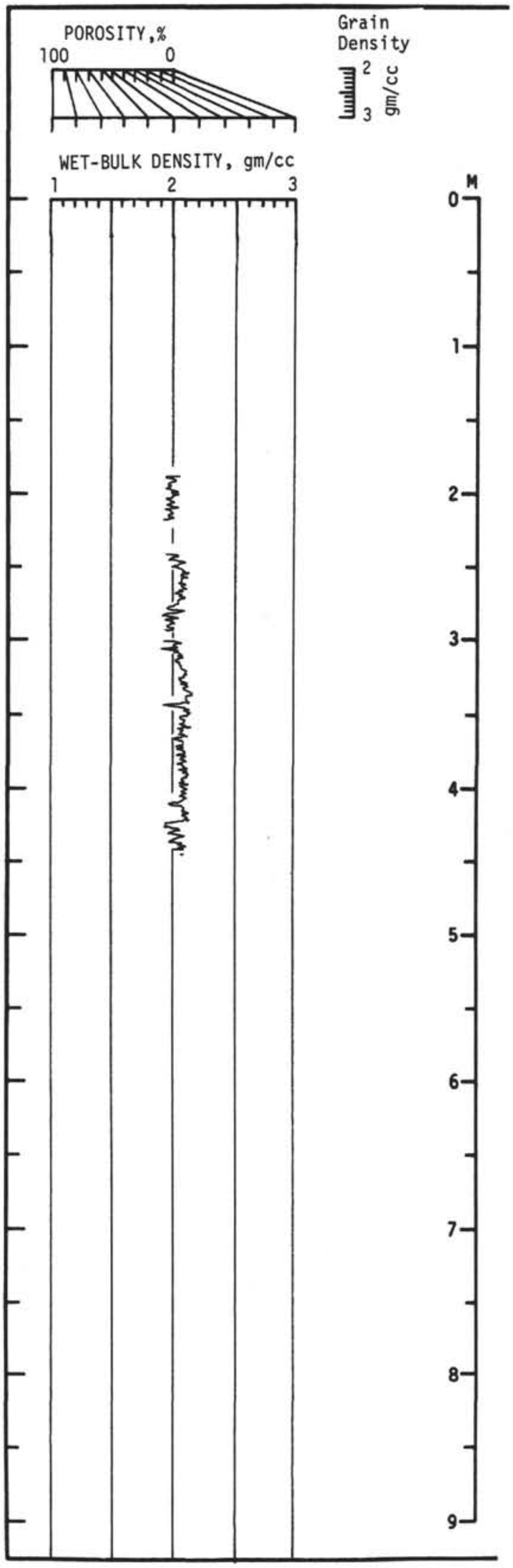
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Density
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gm/cc
WET-BULK DENSITY, gm/cc
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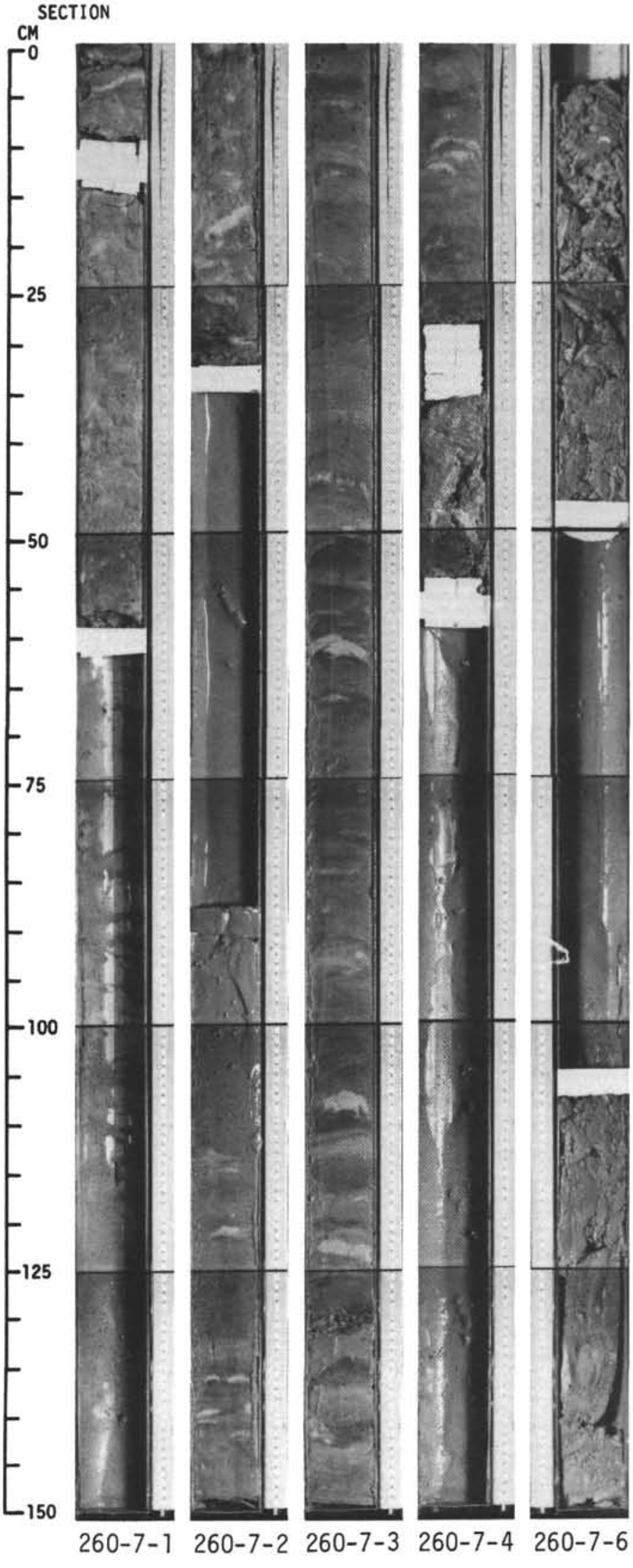
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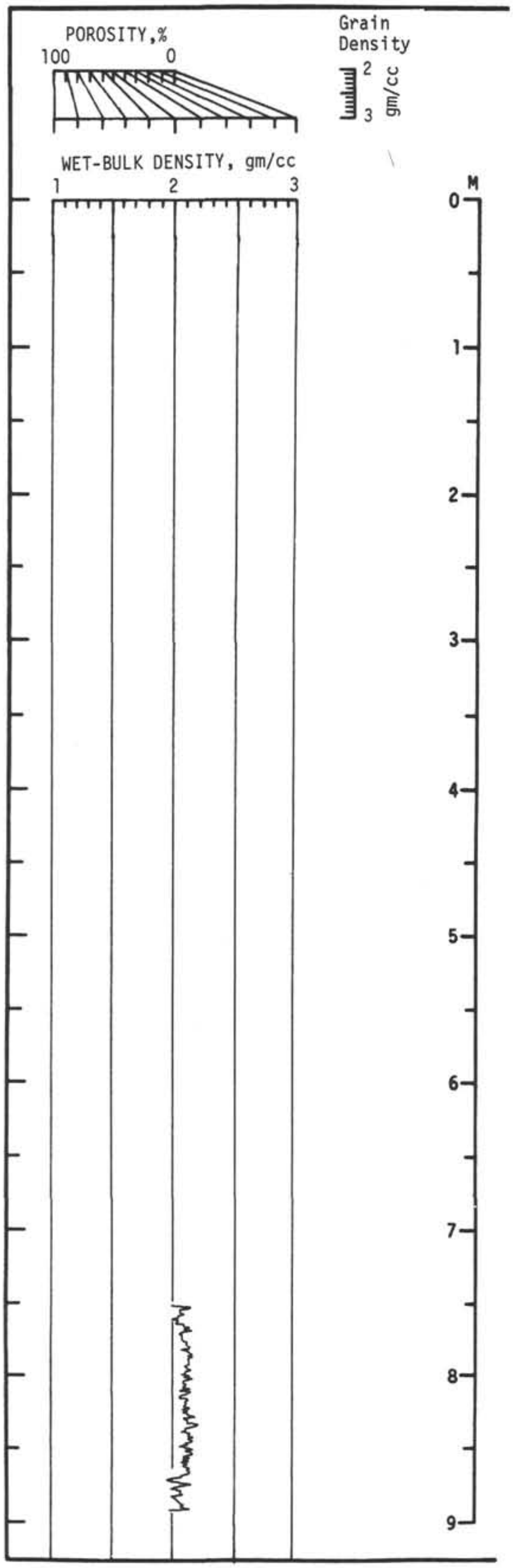


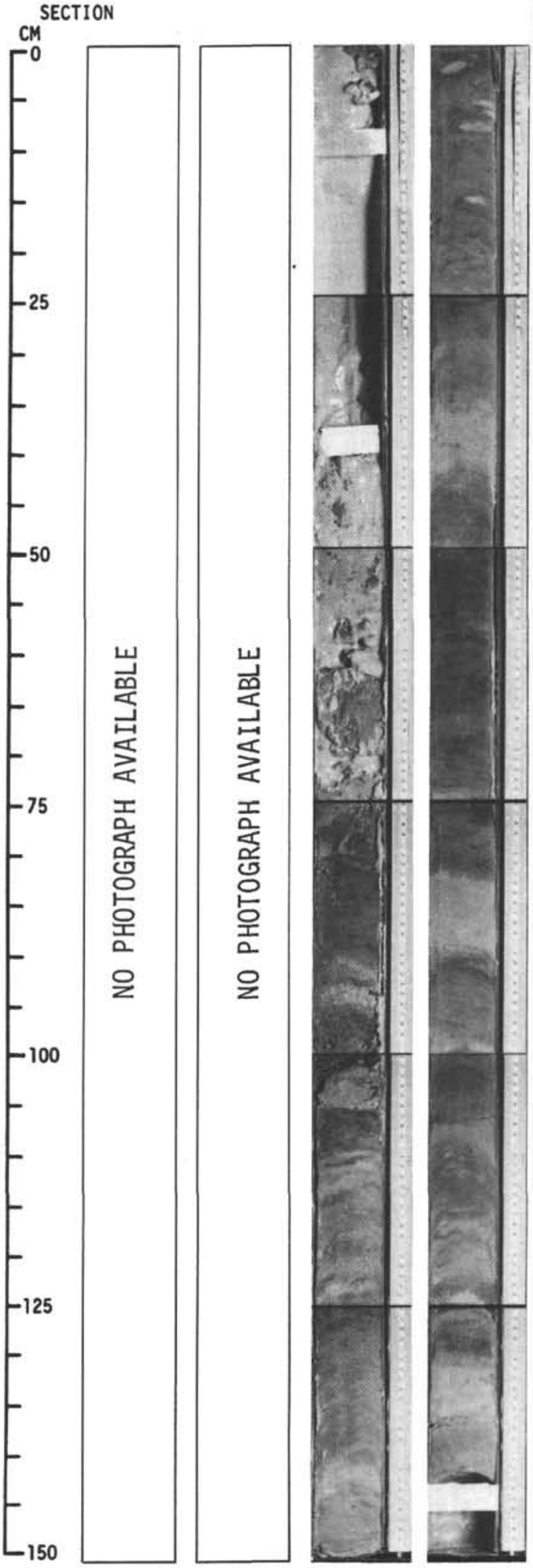


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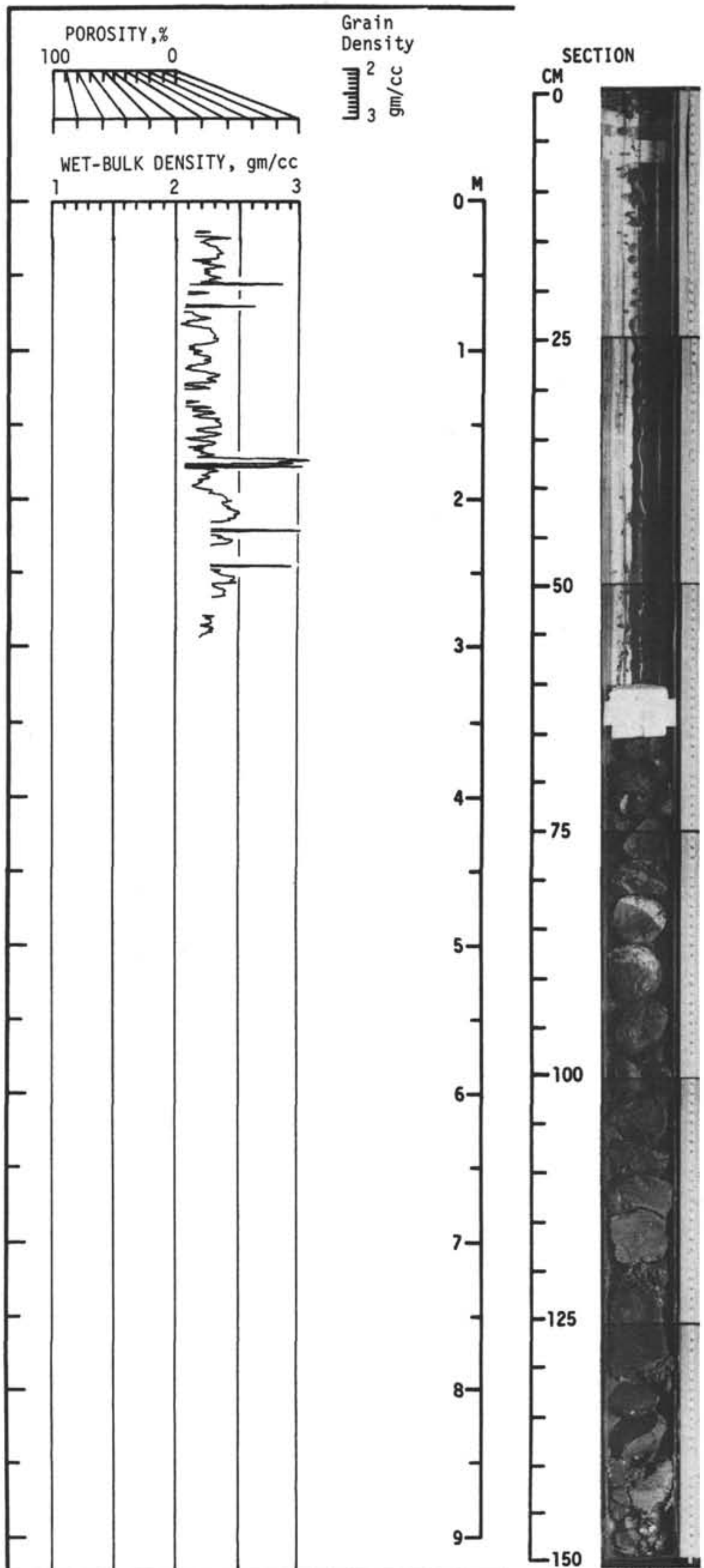
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Density
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gm/cc
WET-BULK DENSITY, gm/cc
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SECTION
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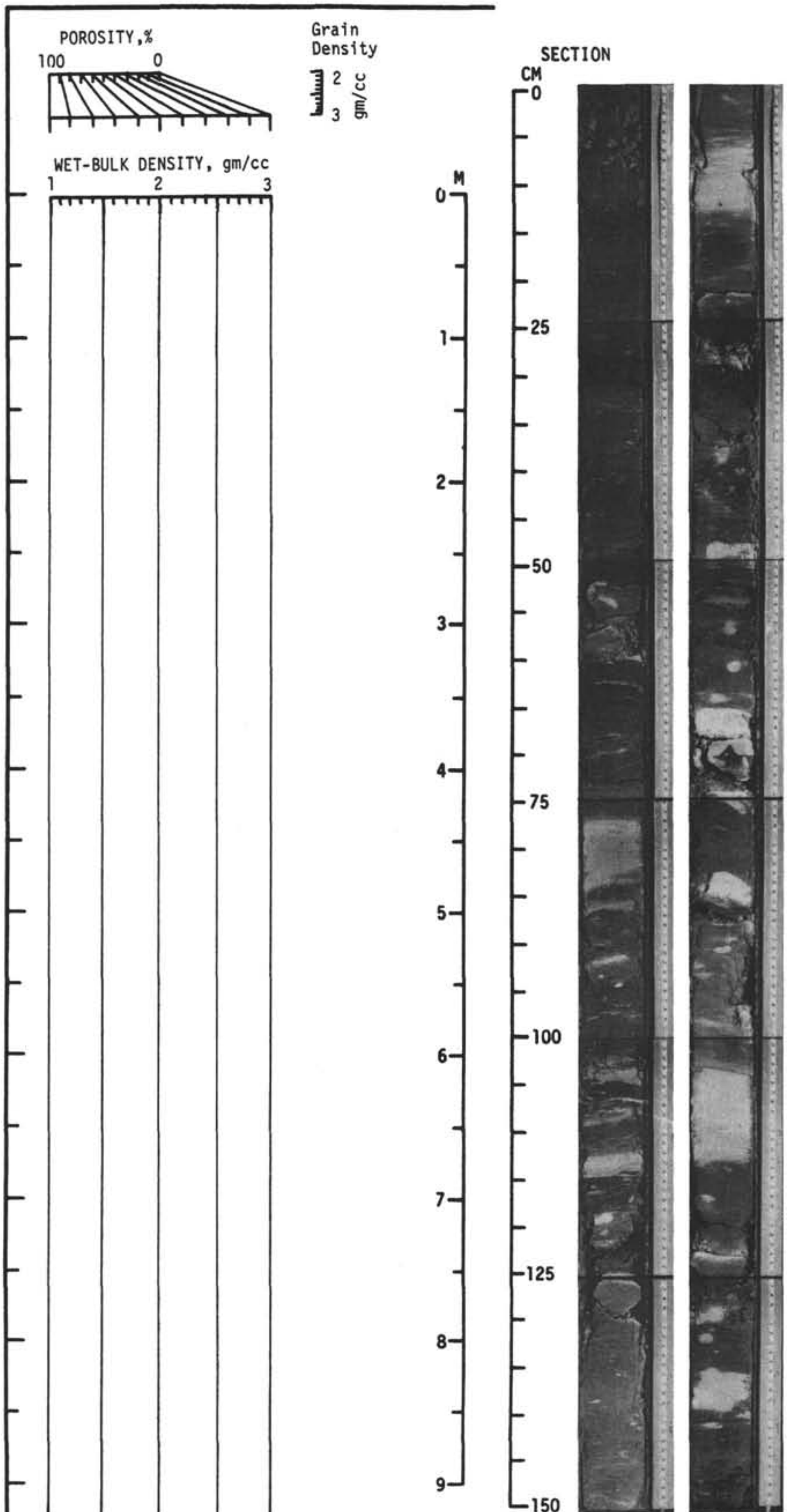


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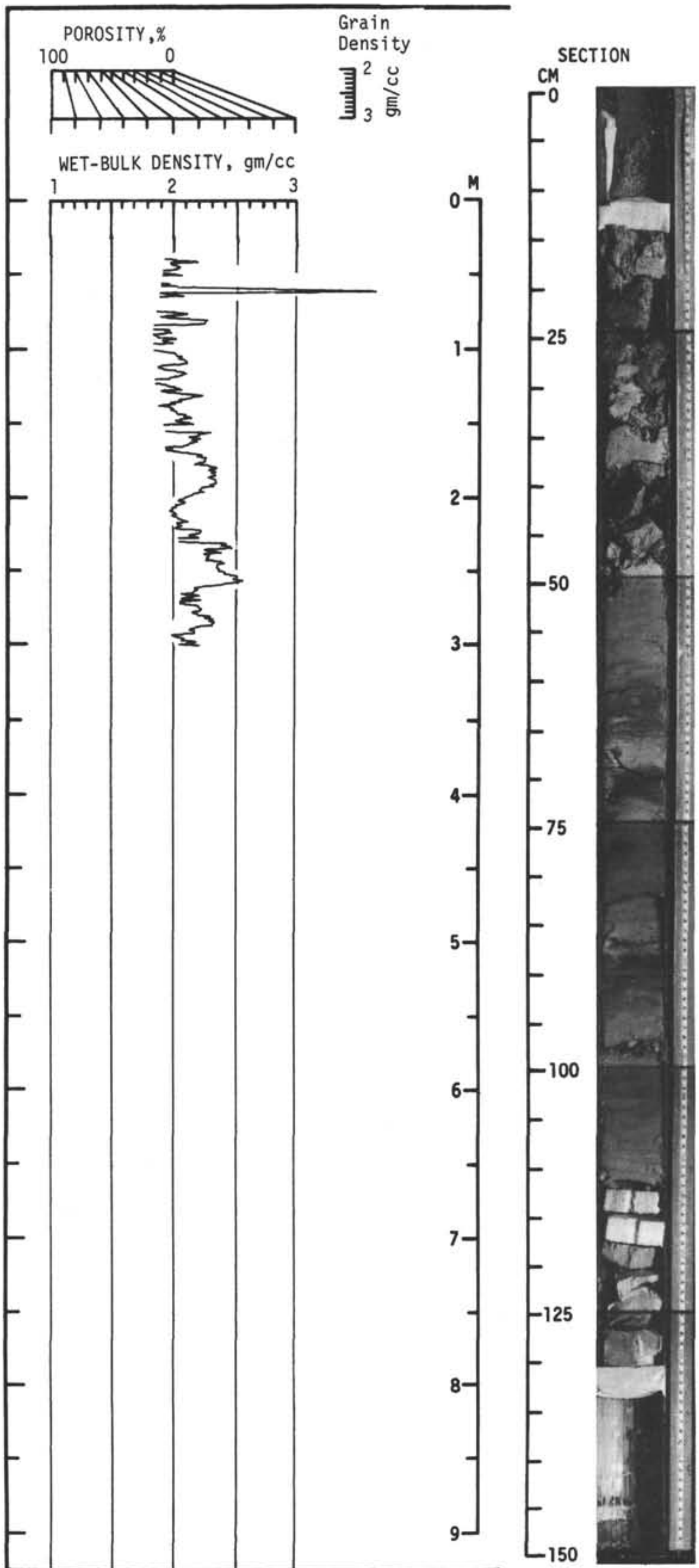
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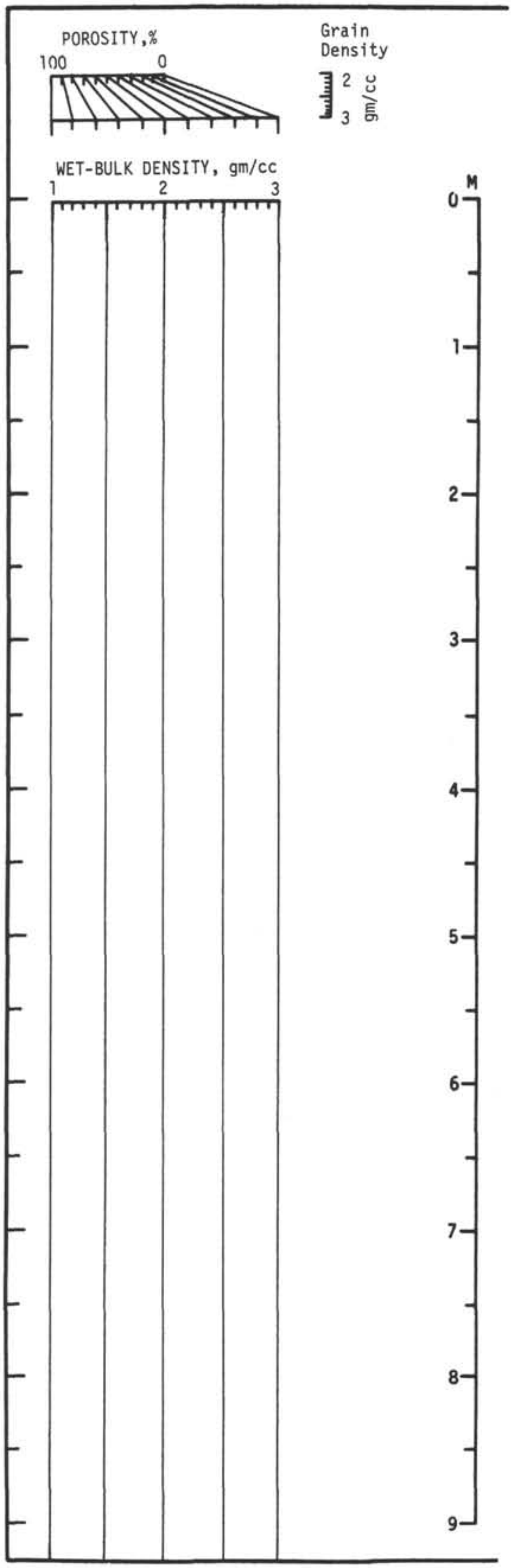


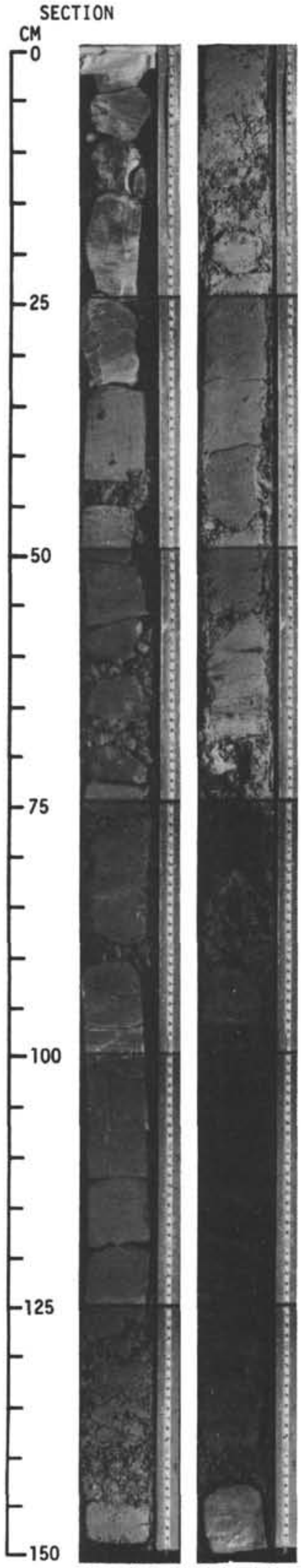


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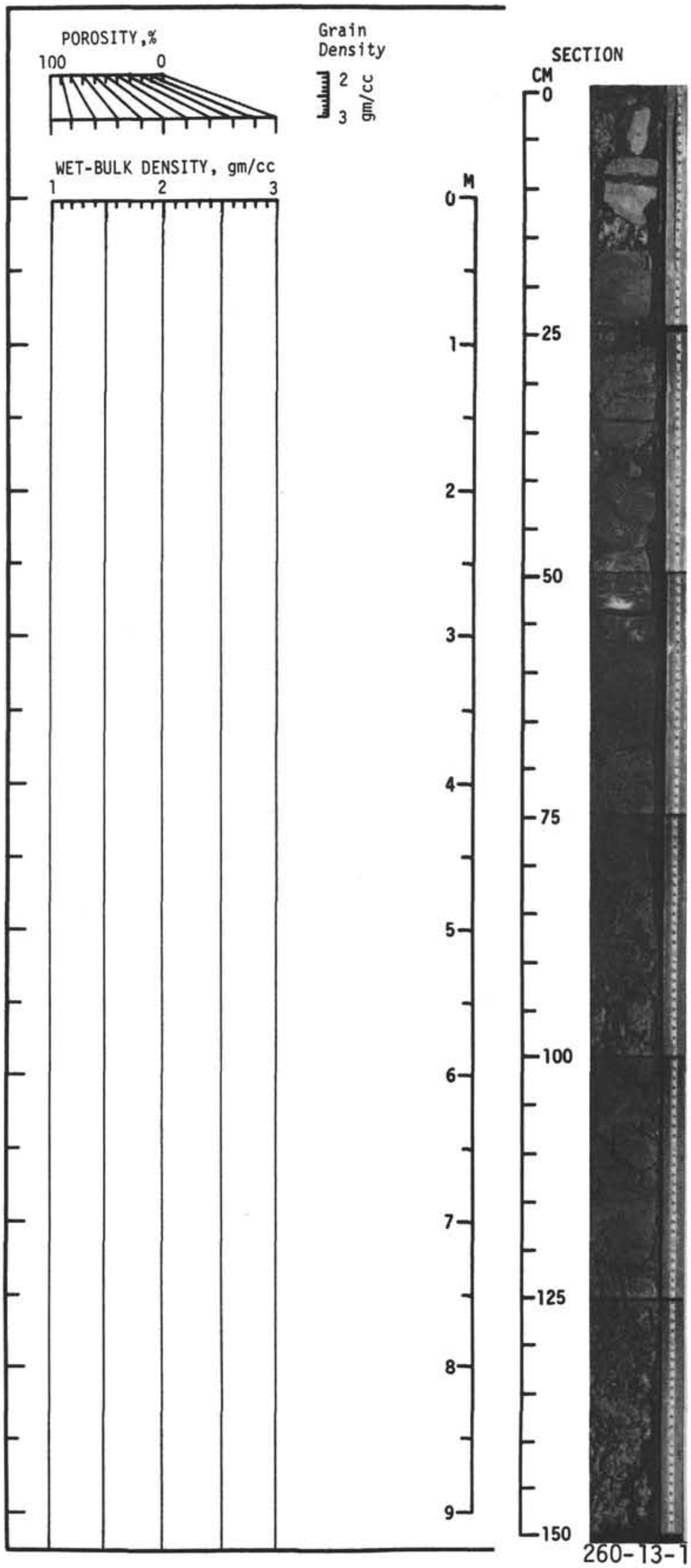
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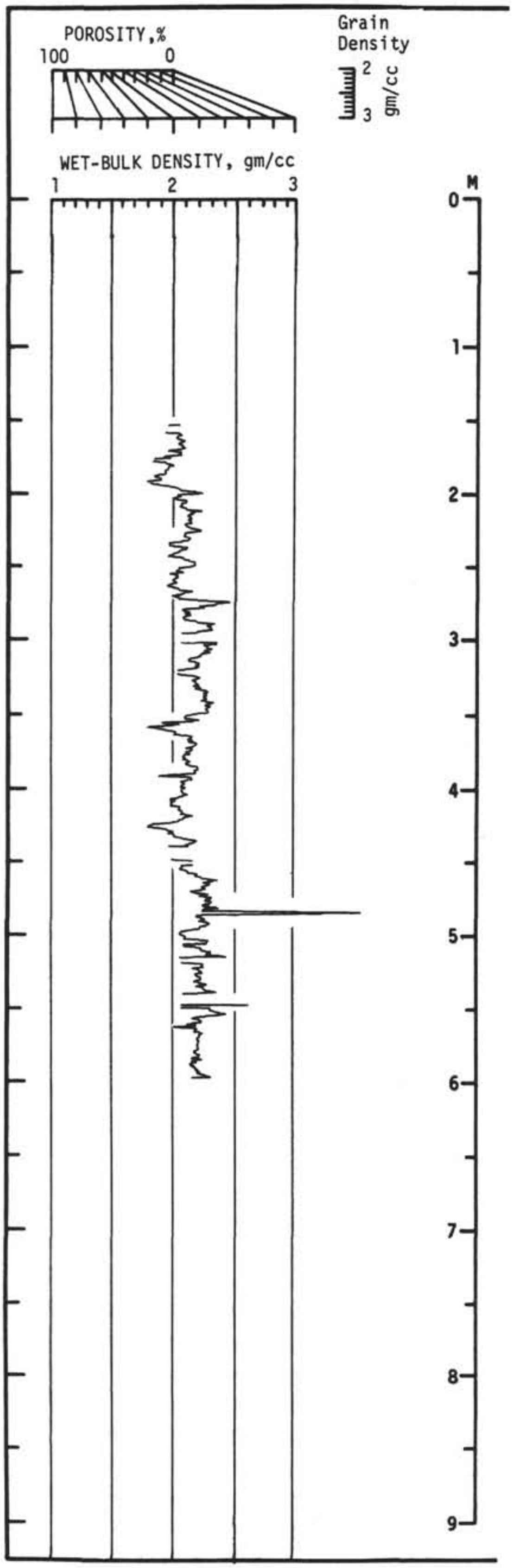
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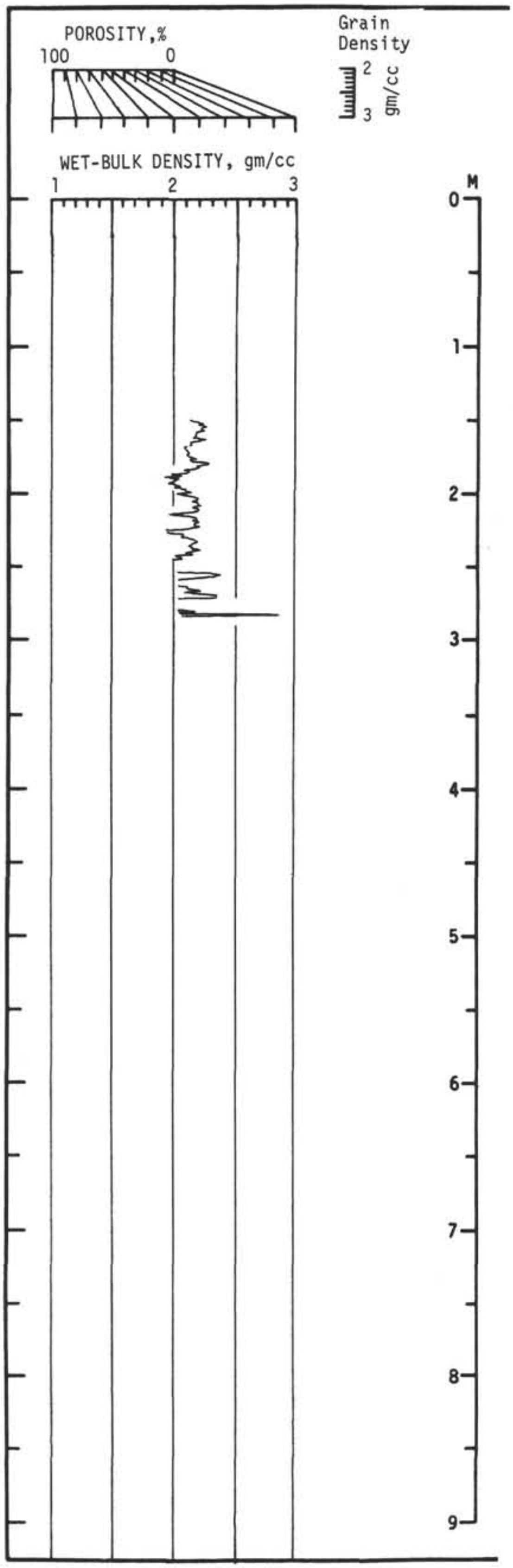


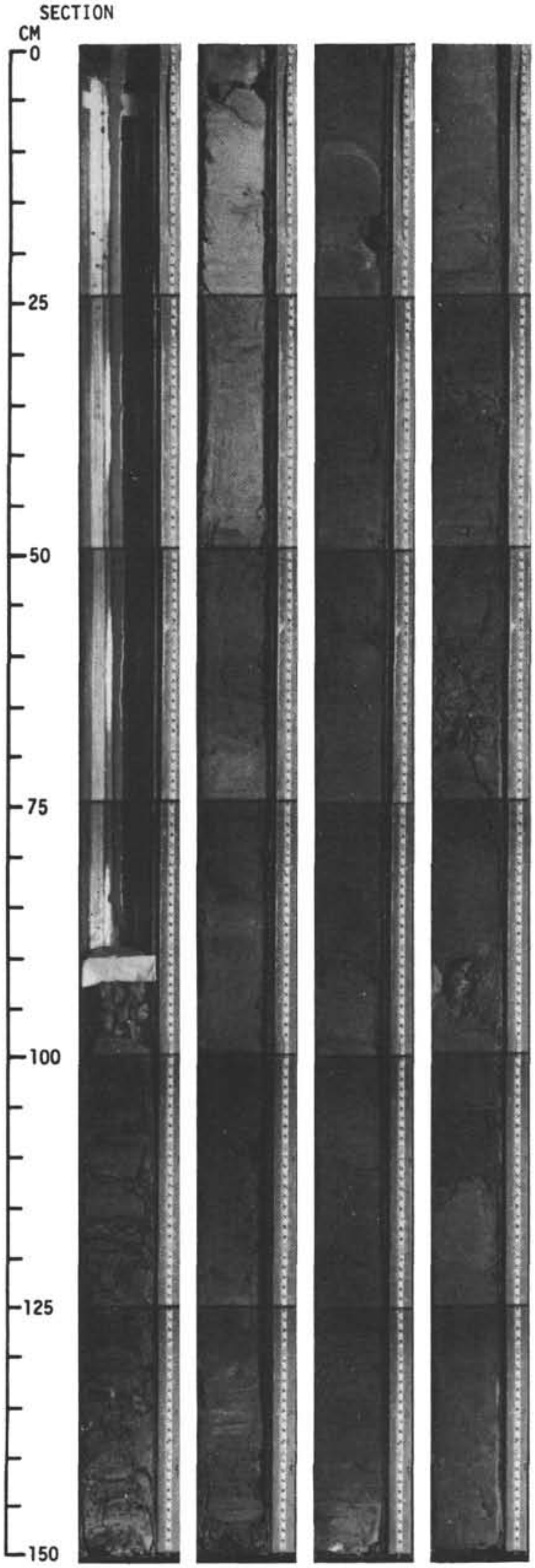


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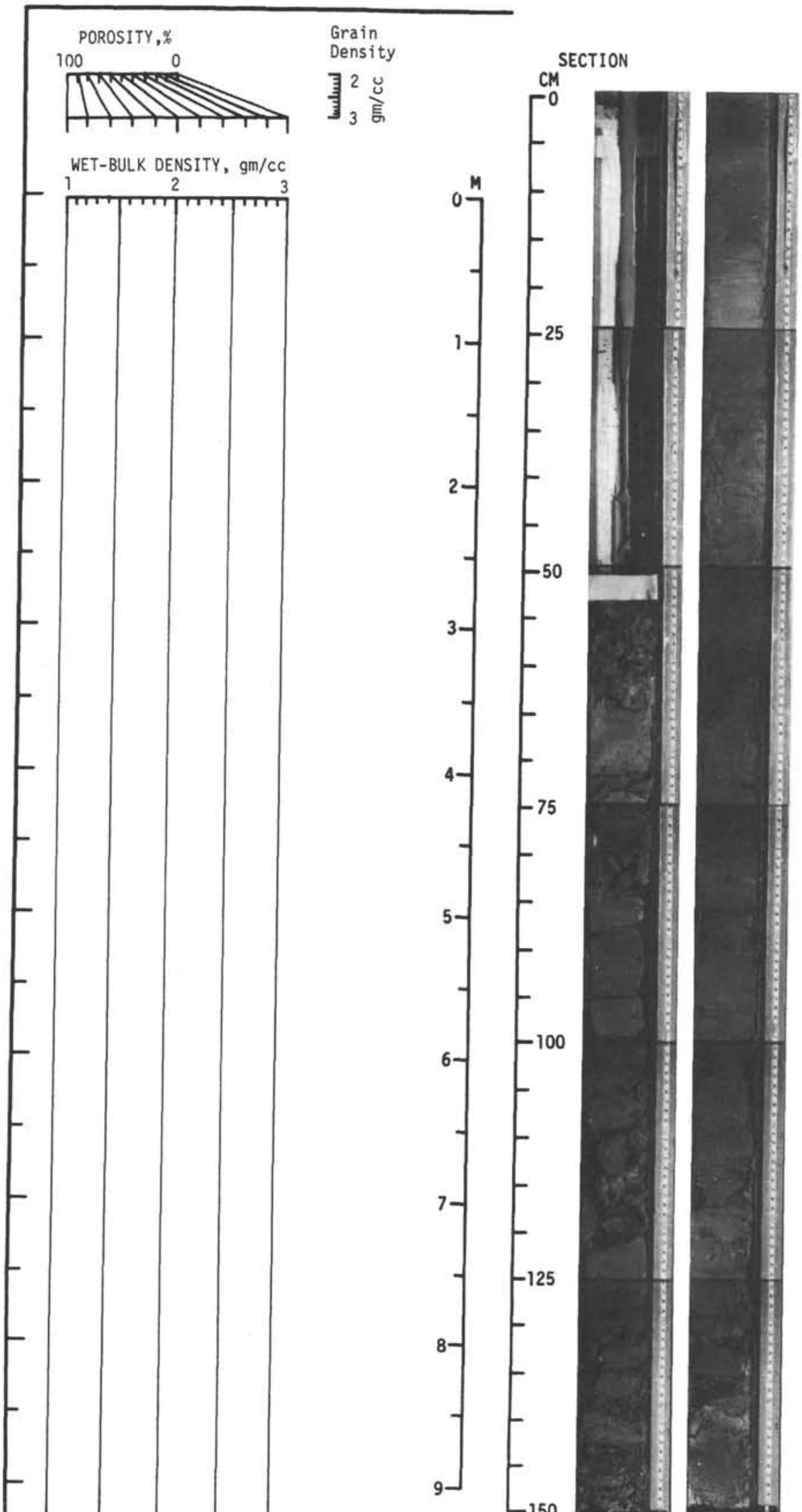


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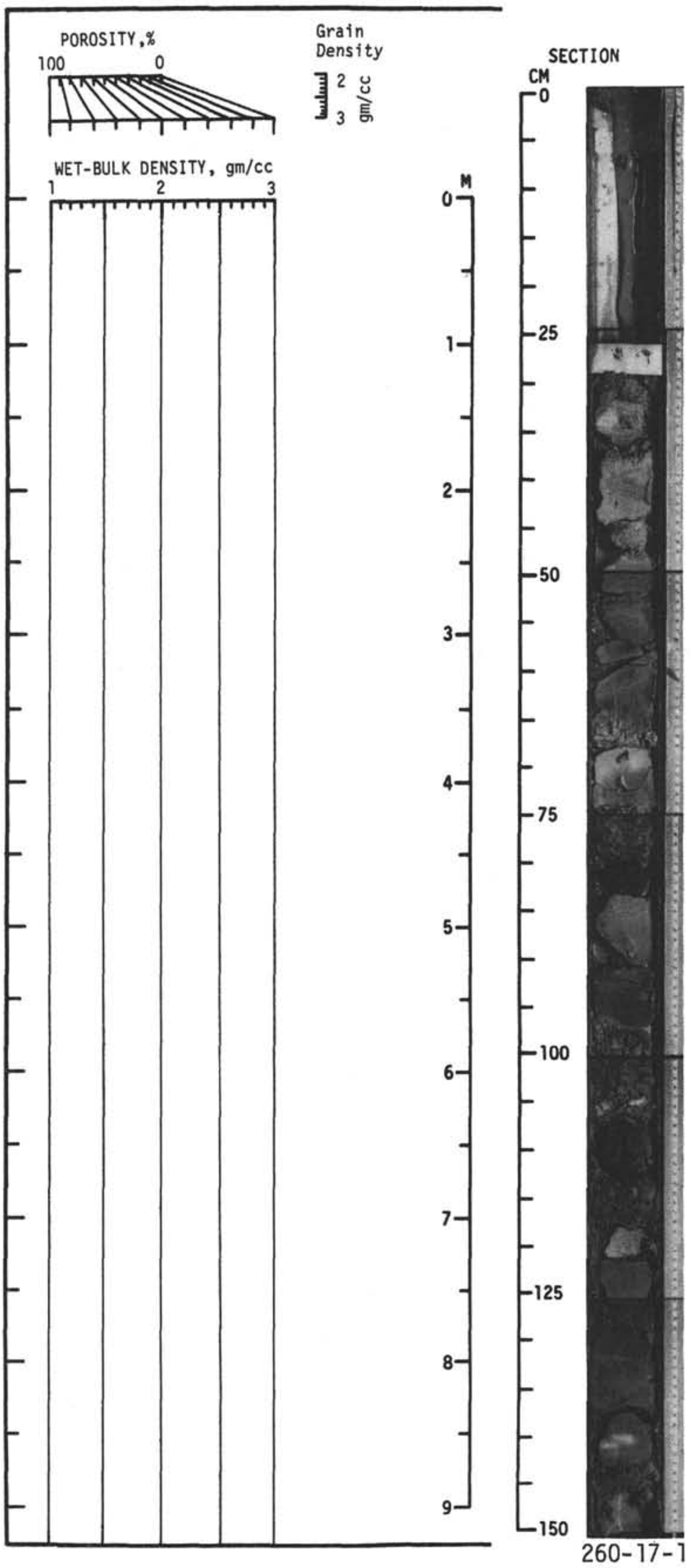
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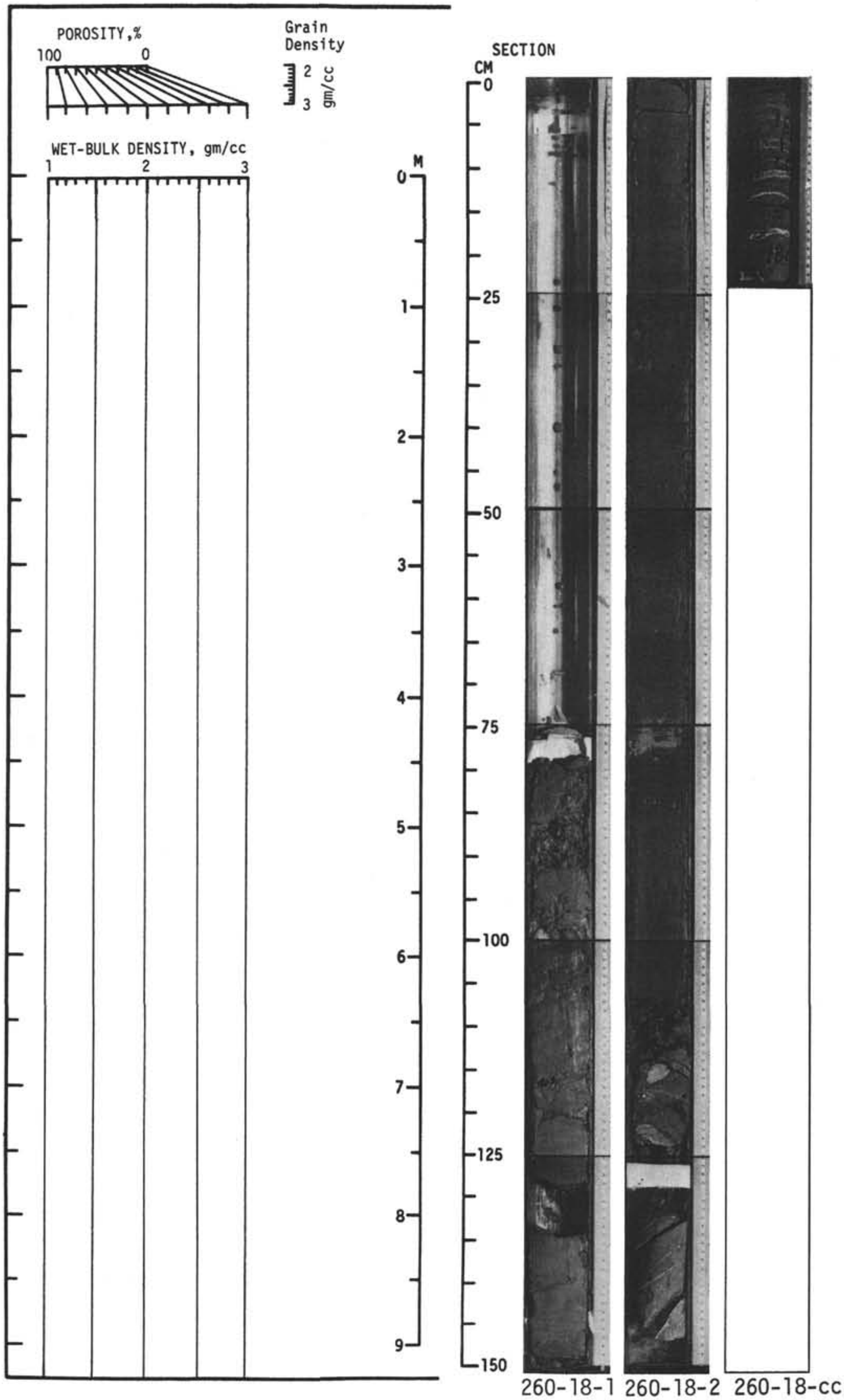
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