2. SITE 259

The Shipboard Scientific Party[1]

SITE DATA

Data Occupied: 3 November 1972

Data Departed: 7 November 1972

Time on Site: 108 hours

Position:
lat 29°37.05′S
long 112°41.78′E

Water Depth (from sea level): 4696 corrected meters (echo sounding)

Water Depth (from drill floor): 4706 corrected meters (echo sounding)

Bottom Felt At: 4712 meters (drill pipe)

Penetration: 346 meters

Number of Holes: 1

Number of Cores: 41

Total Length of Cored Section: 346 meters

Total Core Recovered: 248.75 meters

Percentage Core Recovery: 71.9

Oldest Sediment Cored:
Depth below sea floor: 304.3 meters
Nature: Green-gray clay
Age: Aptian
Measured velocity: 1.6 km/sec

Basement:
Depth below sea floor:
0.35 sec DT (seismic profiler)
304.3 meters (drilled)
Inferred velocity of basement: 1.75 km/sec
Nature: Altered basalt

Principal Results: The principal result was to determine the basement age is aptian. Another important result is the discovery of the hiatus in the Upper Cretaceous and lower pirt of Paleocene.

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BACKGROUND AND OBJECTIVES

Two different models for the origin of the southeastern Indian Ocean have recently been proposed:

1) by the spreading of the sea floor between Australia and India (Crawford, 1969; Heirtzler, 1971; Veevers et al., 1971) or between Australia and southeast Asia (Ridd, 1971; Audley-Charles et al., 1972). The essence of these reconstructions is that Gondwanaland was continuous westward from southwest Australia.

2) as an original oceanic embayment in Gondwanaland—the *sinus australis* of Dietz and Holden (1971), which is implicit in the classical reconstruction of Du Toit (1937), and which is supported by Smith and Hallam (1970) and McElhinny and Luck (1970). McKenzie and Sclater (1971) reassembled the Gondwanaland fragments back to the Upper Cretaceous (75 m.y. ago) from sea-floor magnetic anomalies, and found that:

> "It is also difficult to understand how the fit proposed by Du Toit (1937) and refined by Smith and Hallem (1970) could evolve to the Upper Cretaceous arrangement proposed in this paper. Recent paleomagnetic observations (McElhinny and Luck, 1970) have strongly supported Du Toit's fit, and it is therefore unlikely that major errors are present in Du Toit's reconstruction. Perhaps the solution of these difficulties will come from the results of the Deep Sea Drilling programme."[2]

The Du Toit reconstruction conflicts with the geological evidence from Western Australia (Veevers et al., 1971) of a Permian to Jurassic facies change from non-marine in the south to marine in the north. Falvey (1972) attempted to reconcile this conflict by adopting an extended eastern margin of India (now beneath the Tibetan Plateau), which lay against the southwest Australian margin.

A common element of these models, as modified above, is that there was land west of Australia and that this land has been dispersed by sea-floor spreading. The next stage is to outline the salient details of the assembly of the continents and the timing of their dispersal.

The geology of Western Australia sets constraints on the timing: rupture occurred in the basal Cretaceous approximately 130 m.y. ago (Veevers et al., 1971), and the first phase of dispersal was completed by the Upper Cretaceous. The geology of Western Australia is not so pertinent in detailing the reassembly and subsequent spreading except for one point, the lineament of the southwest margin and the parallel Perth and Carnarvon

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basins and the Darling Fault. Veevers et al., (1971) and Veevers (1971) relate the development of the Permian-to-Jurassic Perth and Carnarvon basins to rifting along a lineament that became a spreading ridge in the Cretaceous, so that the lineament is normal to subsequent spreading. On the other hand, Falvey (1972) interprets the lineament as the trace of a transform fault, and thus parallel to spreading. From these interpretations, Veevers et al., (1971) imply west-east spreading, whereas Falvey (1972) implies northwest-southeast spreading. It was to test such ideas that Site 259 was drilled.

SITE SURVEY

Details of the site area (Figures 1, 2) are provided by reflection profiles of Lamont-Doherty Geological Observatory (*Conrad*-11), the Australian Bureau of Mineral Resources (BMR 18), and by a survey from *Glomar Challenger,* all navigated by satellite fixes. The site area is bounded by the 4900-meter-depth contour to form a southwest-sloping elevated area with a sharp ridge (4200 m) in the northeast part of the map area, and smaller scarps in the south and west. The sediment on the elevated area is no thicker than 0.4 sec, and is acoustically transparent. Outside the immediate area the transparent layer is thicker ($\geq$1.0 sec) and is overlain by stratified sediments. It was the discovery (by *Conrad*-11) of Paleocene sediment (L. H. Burckle, personal communication) on the elevated area that made this an attractive site for drilling. The basement reflector has the character and the shape of oceanic basalt.

Site 259 is located in an elongate steep-walled depression in the acoustic basement which is filled with 0.35 sec of sediment.

OPERATIONS

The approach to Site 259 was essentially along *Conrad*-11's track out of Fremantle. As the proposed site was approached the track of *Glomar Challenger* was found to be about one mile to the east of *Conard*'s track but parallel to it. Although there was a general similarity to *Conrad*'s seismic record, significant differences were noted. *Glomar Challenger* turned on a southerly, then northeasterly course to cross both *Conrad*'s track and to cross our own track and to observe the east-west extent of the sedimentary cover. It was soon realized that the bottom and subbottom topography were somewhat more complex than originally supposed. The ship turned and made two more runs parallel to *Conrad*'s track before finally selecting a place that appeared to have 350 meters of sediment of the same type as that found on *Conrad*'s track.

The beacon was dropped at 0430, 3 November 1972 while underway at 7.5 km/hr (4 knots). Survey gear was retrieved and the ship positioned over the beacon. The bottom hole assembly and drill pipe were run in and bottom tagged at 4712 meters. The hole was spudded at 1700, 3 November and continuously cored to a total depth of 5058 meters or 346 meters below sea floor. Details of the coring are included in the coring summary, Table 1.

Weather conditions were generally good and positioning was excellent, allowing rig-floor operations to proceed unhindered. Basement was reached at 307.5 meters below sea floor in Core 33 and 38.5 meters of basalt were cored.

A deviation survey was run on Core 39 and indicated a deviation of 2° at 5042 meters. Coring was completed at 0600, 7 November. The drill string was pulled and we were underway to Site 260 at 1630, 7 November.

LITHOLOGY

Site 259 was drilled to a depth of 346 meters. The hole penetrated a sedimentary sequence 304.3 meters thick ranging in age from Quaternary to Lower Cretaceous. The sediments rest on a basement of highly altered basalt breccia that grades downward into relatively fresh, moderatly brecciated basalt.

The sedimentary sequence can be divided into four distinct units based on color and composition (Table 2).

Unit 1 (0.0-60.0 m)

Unit 1 consists of approximately 60 meters of light-orange to light-brown, interbedded, nanno ooze, nanno clay, and zeolite clay. The sediments are stiff, well bedded, and usually highly contorted. Individual beds range from 1 to 5 cm in thickness.

Nanno ooze and zeolite clay are the dominant lithologies. The ooze typically is about 80% nannos, 15% zeolite, 5% clay and mica with minor amounts of dolomite rhombs. Coarse fractions (greater than 62μ in diameter) contain traces of heavy minerals, volcanic glass, and sponge spicules. The zeolite clay has an average composition of 75% clay and 25% zeolite with small quantities of quartz, feldspar, and nannos. Coarse fractions consist chiefly of quartz, forams, and micarb fragments with traces of sponge spicules, fish remains, silicoflagellates, and black micronodules.

Numerous small nodules ranging from 0.5 to 2 cm in diameter are present between 30- and 33-meters depth. Some nodules are dark gray to black, possibly manganese or iron oxide in composition. Others are light gray and consist of dolomite- or zeolite-cemented clay.

Fossils are abundant throughout Unit 1, consisting chiefly of coccoliths, discoasters, forams, and sponge spicules with lesser quantities of Radiolaria, diatoms, and silicoflagellates. Several thin sandy layers in the upper part of the unit consist largely of shallow-water forams and carbonate fragments in a clay matrix. These layers, which range from 2 to 5 cm in thickness, are poorly sorted but show no obvious grading. The presence of shallow-water forams suggests transport of material from the shelf into deeper water.

The upper part of Unit 1 is Quaternary in age whereas the lower part ranges from lower Eocene to upper Paleocene. A major disconformity probably exists in the unit somewhere between 9 and 27 meters in depth. The base of the unit at 60 meters is marked by a fairly distinct color change to dark or dusky yellowish brown and by a marked decrease in the abundance of nannofossils.

Unit 2 (60.0-103.0 m)

Unit 2 consists of about 43 meters of dark or dusky yellow-brown zeolite clay and zeolite-rich clay. The clay is strongly contorted with vertical striping and no

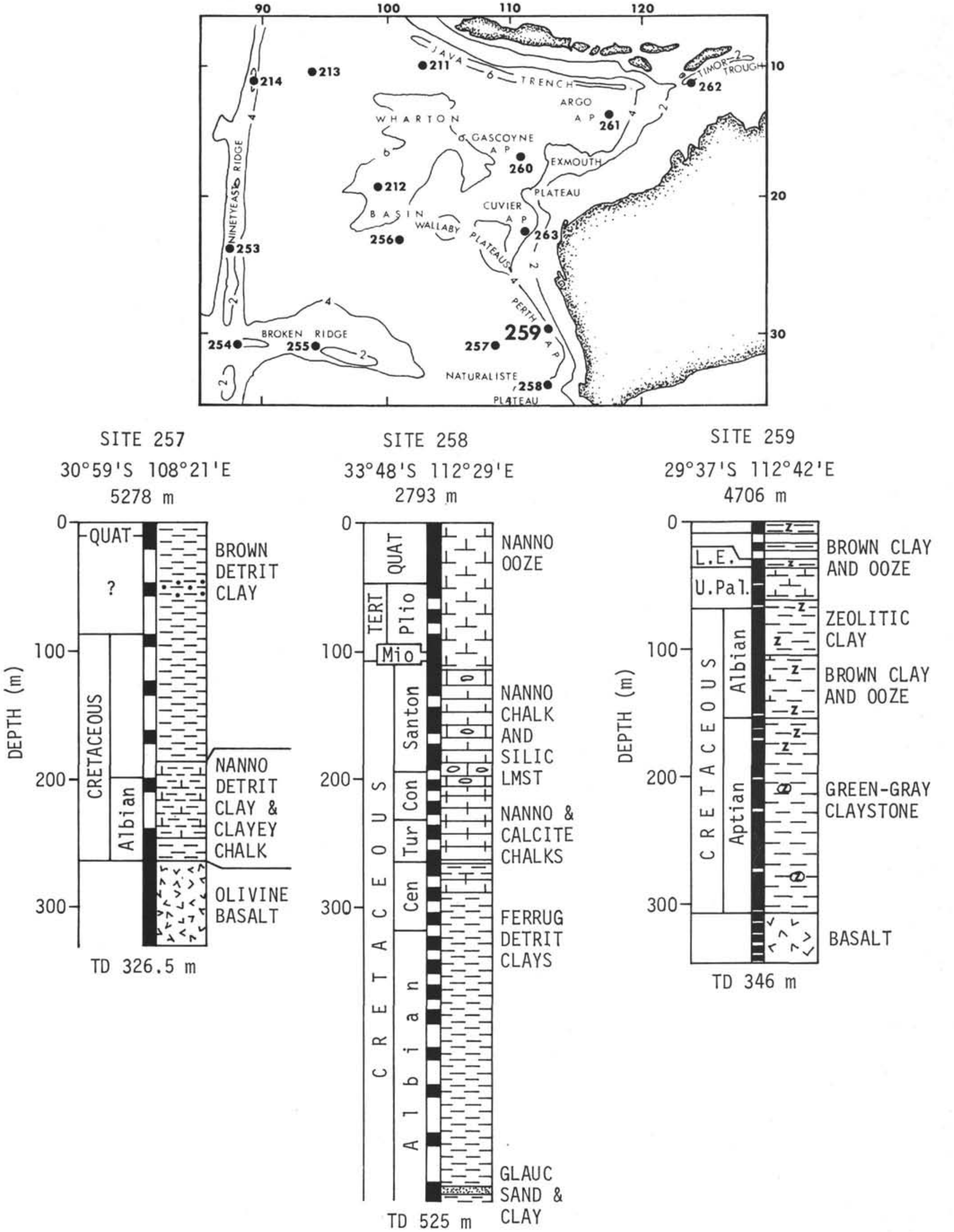

Figure 1. *Location of Site 259 and generalized stratigraphic columns of Site 259 and adjacent sites.*

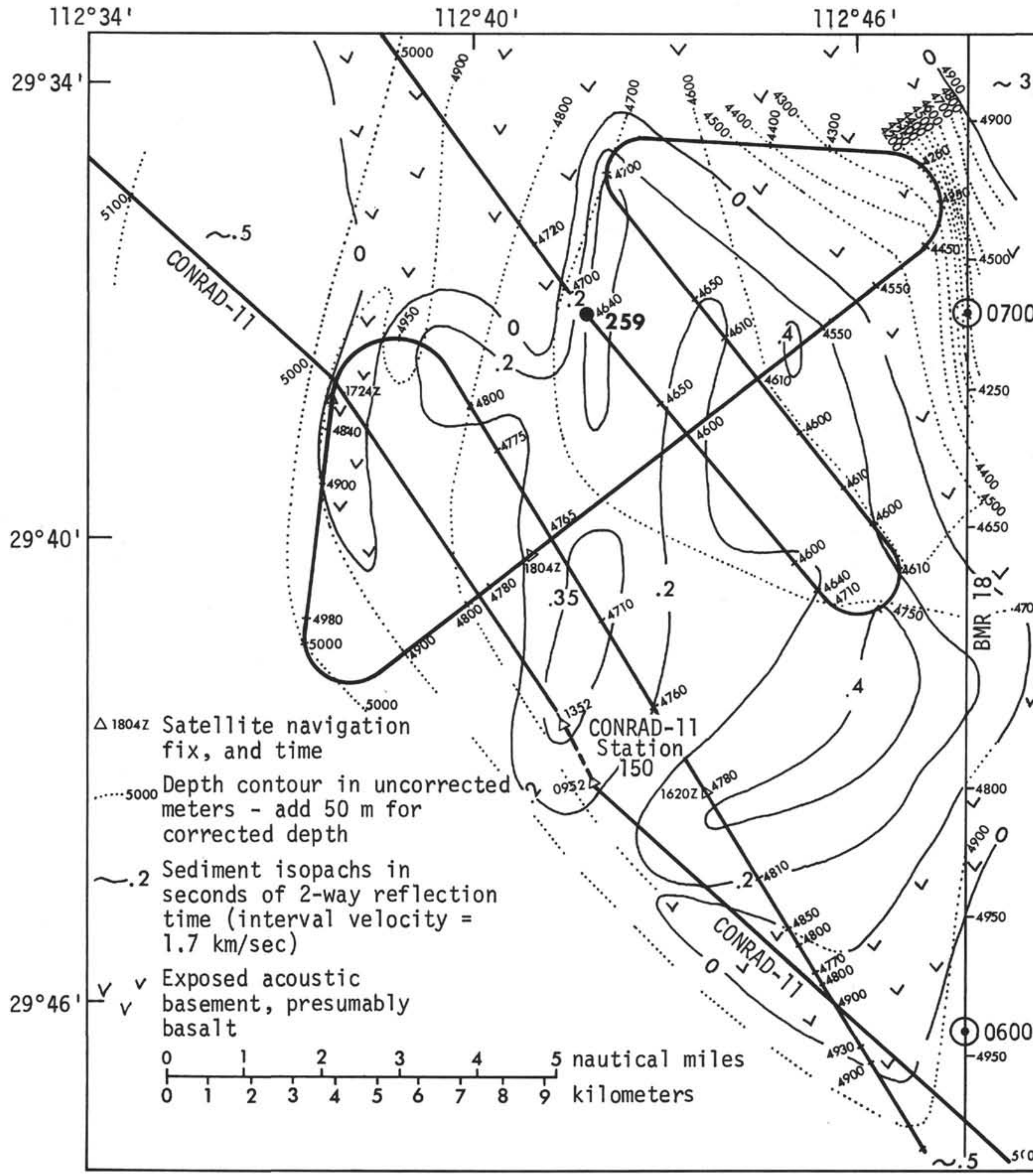

Figure 2. *Site area showing ships' tracks, bathymetry, and sediment isopachs.*

bedding is preserved. Typical specimens are about 50%-65% clay, 20%-25% zeolite, 10%-20% cristobalite and microcrystalline quartz, and a few percent of heavy minerals, quartz, fledspar, and nannos. Fossils are scarce in the clays but forams are present in most coarse fractions. Olive-black nodules are locally present between 80 and 90 meters in depth. These consist of zeolite and opaque material, possibly iron oxide.

Unit 2 is Cretaceous. The base of the unit is marked by a slight color change to yellow brown and light brown and the reappearance of abundant nannofossils.

Unit 3 (103.0-154.0 m)

Approximately 50 meters of zeolite-rich nanno clay with lesser zeolite-rich clayey nanno ooze comprise Unit 3. The sediments are moderate yellowish brown and light brown in color with some greenish-gray zones. Most of the clay has been strongly disturbed and brec-

TABLE 1
Coring Summary, Site 259

Core	Date (Nov 1972)	Time	Depth From Drill Floor (m)	Depth Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovery (%)
1	3	2100	4712.0-4720.0	0.0-8.0	8.0	7.7	96
2		2220	4720.0-4729.5	8.0-17.5	9.5	0.0	0
3	4	0000	4729.5-4739.0	17.5-27.0	9.5	2.8	29
4		0130	4739.0-4748.5	27.0-36.5	9.5	9.4	99
5		0255	4748.5-4758.0	36.5-46.0	9.5	6.7	71
6		0425	4758.0-4767.5	46.0-55.5	9.5	9.5	100
7		0550	4767.5-4777.0	55.5-65.0	9.5	7.5	79
8		0720	4777.0-4786.5	65.0-74.5	9.5	9.0	95
9		0845	4786.5-4796.0	74.5-84.0	9.5	9.5	100
10		1010	4796.0-4805.5	84.0-93.5	9.5	8.5	90
11		1145	4805.5-4815.0	93.5-103.0	9.5	6.5	70
12		1315	4815.0-4824.5	103.0-112.5	9.5	9.5	100
13		1450	4824.5-4834.0	112.5-122.0	9.5	9.5	100
14		1620	4834.0-4843.5	122.0-131.5	9.5	8.9	94
15		1755	4843.5-4853.0	131.5-141.0	9.5	9.4	99
16		1935	4853.0-4862.5	141.0-150.5	9.5	5.3	56
17		2120	4862.5-4872.0	150.5-160.0	9.5	5.3	56
18		2300	4872.0-4881.5	160.0-169.5	9.5	3.5	37
19	5	0045	4881.5-4891.0	169.5-179.0	9.5	7.7	81
20		0220	4891.0-4900.5	179.0-188.5	9.5	8.0	84
21		0400	4900.5-4910.0	188.5-198.0	9.5	6.0	63
22		0550	4910.0-4919.5	198.0-207.5	9.5	2.9	30
23		0715	4919.5-4929.0	207.5-217.0	9.5	9.5	100
24		0900	4929.0-4938.5	217.0-226.5	9.5	5.2	55
25		1040	4938.5-4948.0	226.5-236.0	9.5	8.0	84
26		1225	4948.0-4957.5	236.0-245.5	9.5	9.4	99
27		1410	4957.5-4967.0	245.5-255.0	9.5	6.8	72
28		1550	4967.0-4976.5	255.0-264.5	9.5	8.1	85
29		1735	4976.5-4986.0	264.5-274.0	9.5	4.5	47
30		1925	4986.0-4995.5	274.0-283.5	9.5	9.0	95
31		2120	4995.5-5005.0	283.5-293.0	9.5	8.0	84
32		2255	5005.0-5014.5	293.0-302.5	9.5	5.0	53
33	6	0105	5014.5-5024.0	302.5-312.0	9.5	2.0	21
34		0415	5024.0-5027.0	312.0-315.0	3.0	1.3	43
35		0630	5027.0-5033.5	315.0-321.5	6.5	2.4	37
36		0940	5033.5-5038.5	321.5-326.5	5.0	4.8	96
37		1245	5038.5-5043.0	326.5-331.0	4.5	2.3	51
38		1620	5043.0-5047.5	331.0-335.5	4.5	4.5	100
39		1920	5047.5-5049.0	335.5-337.0	1.5	1.5	100
40	7	0115	5049.0-5052.5	337.0-340.5	3.5	0.3	10
41		0600	5052.5-5058.0	340.5-346.0	5.5	3.1	55

Note: Echo-sounding depth (to drill floor) = 4706 meters; drill-pipe length to bottom = 4712 meters.

ciated by drilling and bedding is rarely apparent. Where present, beds range from 1 to 10 cm in thickness and consist of alternating color bands. Nodules are sparse to absent in Unit 3 but many of the clays contain white specks of carbonate, chiefly dolomite rhombs. An average composition for the ooze is 50%-60% nannos, 20% cristobalite and microcrystalline quartz, 10% clay, 12% zeolite, 2% forams, and 1% dolomite rhombs. Trace amounts of quartz, opaques, gypsum, and dolomite rhombs occur in the coarse fraction.

Unit 3 is Lower Cretaceous (Albian) in age. The base of the unit is indicated by a sharp color break and a virtually complete disappearance of nannofossils.

Unit 4 (154.0-304.3 m)

Unit 4 is a very uniform sequence of dark greenish-gray claystone about 150 meters thick. The claystone is stiff to indurated and usually highly deformed. Rare preserved beds are regular repetitions of 1 cm-thick layers of dark greenish-gray and olive-black clay.

Clay and microcrystalline cristobalite and quartz make up 95% of average specimens; detrital quartz, feldspar, and heavy minerals make up the remainder. Most specimens also contain trace amounts of feldspar and chlorite. The mineralogy suggest a volcanic origin for much of the clay, either by weathering of exposed volcanics or by alteration in situ of pyroclastic material.

Nodules are common throughout Unit 4 and range from 2 mm to 10 cm in diameter. Most are light gray in color and consist of dolomite- or zeolite-cemented clay. A few pyrite nodules, up to 4 cm across, are present and small crystals of pyrite are common in the coarse fraction. Euhedral gypsum crystals, 1-2 mm long, are also present in the clays. Fossils are rare in this unit although forams are usually present in the coarse fraction. Tiny opaque globules generally less than 1 mm in diameter are also present in the clays.

Unit 4 is Lower Cretaceous (Aptian) in age with the upper boundary corresponding to an unconformity between Albian and Aptian.

TABLE 2
Major Lithologic Units of Site 259

Interval (m)	Unit	Description	Age	Thickness (including gaps) (m)	Cores
0.0-60.0	1	Soft, grayish-orange clay-rich nanno ooze and zeolite clay	Quaternary to upper Paleocene	60.0	1-7
60.0-103.0	2	Dark-yellow-brown zeolite clay	Cretaceous	43.0	7-11
103.0-154.0	3	Light-brown zeolite-rich nanno clay and clayey nanno ooze	Lower Cretaceous (Albian)	51.0	12-17
154.0-304.3	4	Greenish-gray zeolite-bearing claystone	Lower Cretaceous (Aptian)	150.3	17-33
304.3-346.0		Basalt		41.7	33-41

Basalt Basement

Basalt basement was encountered at 304.3 meters and drilled to a depth of 346 meters. Approximately 20 meters of basalt were recovered from this interval. The sediments immediately overlying the basalt are somewhat indurated but show no signs of an intrusive contact.

The upper part of the basalt consists of light-gray to greenish-gray breccia. This grades downward into dark-gray fine-grained basalt at about 25 meters below the sediment-basement contact. The breccia consists of angular to subangular fragments of altered basalt up to 50 cm across. The fragments grade from light gray in the center to light green near the margins and are typically separated by zones of black to dark-green altered glass(?) 1-2 cm thick. Veinlets and small masses of calcite and chlorite are common throughout the breccia and a few geodes of quartz are locally present. The solid basalt is dark gray to light gray in color and is generally fresher than the breccia.

The basalt is fine- to medium-grained and sparsely porphyritic with a variolitic, intergranular to intersertal groundmass. The average grain size ranges from 0.3 to 0.5 mm with a few phenocrysts up to 5 mm long. A few small vesicles up to 0.5 mm in diameter are usually present.

Typical specimens consist of small, ragged laths of labradorite set in a matrix of poorly crystallized clinopyroxene, iron oxide, and clay minerals. The clinopyroxene forms radiating, sheaf-like masses indicating incipient crystallization from glass. Rare microphenocrysts of clinopyroxene are augite ($2V_\gamma \simeq 50°$) and the groundmass crystals are probably the same. The iron oxide is chiefly magnetite which occurs in small clusters and fern-like masses of octahedra. Olivine is present in some specimens but never makes up more than 2%-3% by volume. It occurs in small corroded crystals, 0.3-0.5 mm in diameter, which have been replaced by clay minerals and iron oxides.

All of the basalts are altered but the degree of alteration decreases markedly with depth. In the most altered specimens, green montmorillonite makes up 30%-40% by volume and replaces olivine, glass, clinopyroxene, and, occasionally, plagioclase. In the fresher specimens, clay rarely exceeds 10% and occurs chiefly as vesicle fillings and as pseudomorphs after olivine.

The mineralogy of the basalt indicates a tholeiitic composition typical of oceanic basement. The grain size and texture indicate rapid cooling, probably in contact with water, suggesting extrusion onto the sea floor.

Preliminary Interpretation

Site 259 is at a water depth of 4712 meters. Based on the presence of abundant calcareous nannofossils and forams in the uppermost sediments, this depth is above the present carbonate compensation level which averages about 5000 meters in the world's oceans. Carbonate fossils are abundant throughout Unit 1 suggesting that similar conditions existed in the early Tertiary. However, a hiatus occurs in the sequence between the Quaternary and the lower Eocene so most of the Tertiary record is missing.

Terrigenous sand and silt are absent in the sediments at this site; however, a few thin layers of sand-size shallow-water forams occur in Unit 1. These suggest transport of material from a shallow-water-shelf environment into deeper water. The transporting mechanism was presumably turbidity currents and the thinness of the layers and their bimodal grain distribution (sand and clay) suggest deposition at the distal ends of the flows.

Unit 2, which is Cretaceous in age, consists chiefly of zeolite clay and contains only 1%-2% calcareous fossils. The existing fossils show strong dissolution effects suggesting that the scarcity of nannofossils in this unit is due to solution of carbonate below the carbonate compensation level rather than to changes in planktonic production. In contrast, the reappearance of relatively abundant nannofossils in Unit 3 probably reflects a return to shallow water conditions.

Unit 4, consisting of dark greenish-gray and black cristobalite claystone makes up nearly half of the sedimentary sequence. Zeolites generally make up 1%-2% of this unit and trace amounts of quartz, feldspar, heavy minerals, and chlorite are ubiquitous. Calcareous fossils are very rare and there is no evidence of bioturbation in the sediments. Finely divided pyrite is abundant and presumably is responsible for the dark colors. Small, euhedral gypsum crystals are also present throughout the unit.

The paucity of carbonate fossils and absence of terrigenous sand or silt suggest deposition in quiet, deep water. The mineralogy of the clay suggests a volcanic origin for much of the unit, either by weathering of exposed volcanic rocks or by alteration in situ of pyroclastic material. The quartz grains are typically rounded and frosted and probably are windblown in origin.

The contact between the basal sediments and the basaltic basement appears to be normal, with no evidence of baking, hydrothermal alteration, or metasomatism in the sediments. The basement consists of fine-grained tholeiitic basalt typical of oceanic spreading centers.

BIOSTRATIGRAPHY AND PALEONTOLOGY

General

The Cenozoic is represented by only fragmentary material. The top core (0.0-8.0 m) consists of Pleistocene foraminiferal nanno ooze. Cores 2 and 3 (8.0-27.0 m) have no diagnostic fossils. The zeolite nanno ooze of Core 4 (27.0-36.5 m) is lower Eocene, and the interval between Cores 4 and 8 (36.5-65.0 m) is upper Paleocene. The remaining sediments (Cores 8-33; 65-304.3 m), composed largely of claystone and some zeolite nanno ooze, are Cretaceous, mainly Albian and Aptian.

Cores 11-17 (93.5-154.0 m) ore the most interesting paleontologically. These sediments are very rich in calcareous faunas such as benthonic and planktonic foraminifera, nannoplankton, and Calcisphaerulidae. Also present are ostracods and, in one level, bivalvia. Radiolaria are abundant. Of considerable interest is the sudden appearance of this rich fauna within Core 17, apparently not connected with a major lithological change. No calcareous forms are present below this interval; only sparse arenaceous foraminifera and Radiolaria are present. Above this interval the sediment contains chiefly palynomorphs which abound in dinoflagellates, spores, and pollen. See Figure 3.

Biostratigraphy

Quaternary: Core 1 (0.0-8.0 m). *Globorotalia truncatulinoides truncatulinoides* Zone; *Emiliana huxleyi* to *Pseudoemiliania lacunosa* Zone. Foram nanno ooze, partially affected by $CaCO_3$ dissolution. *Globorotalia inflata*, a temperate-water form is predominant, *G. truncatulinoides truncatulinoides* is common. Faunal assemblages indicate that the sediments in the lower part of the core were deposited in waters slightly warmer than those of the upper part.

Age unknown: Cores 2, 3 (8.0-27.0 m). Core 2 had no recovery. Core 3 consists of zeolite clay with very rare, inconclusive, arenaceous foraminifera.

Lower Eocene: Core 4 (27.0-36.5 m). *Globorotalia subbotinae/Globorotalia formosa formosa* Zone; *Discoaster lodoensis* to *Tribrachiatus contortus* Zone. The complete sequence of lower Eocene nannoplankton zones is represented in the zeolite clay and nanno ooze of this interval, which is apparently strongly condensed due to $CaCO_3$ dissolution. Benthonic and planktonic foraminifera such as *Globorotalia aequa, G. formosa*, and some *Acarinina* species, are present. Radiolaria are very rare and poorly preserved.

Upper Paleocene: Core 5-Core 7, Section 3 (36.5-60.0 m). *Globorotalia velascoensis* Zone; *Discoaster multiradiatus* Zone. Only the upper part of the upper Paleocene, consisting of zeolite nanno ooze is present. However, it is considerably thicker than the lower Eocene above. Rare, probably transported, planktonic foraminifera are represented mainly by some *Acarinina* species. Calcareous nannoplankton are common, Radiolaria are rare and poorly preserved.

Cretaceous s.l.: Core 7, Section 4-Core 11, Section 4 (60.0-99.5 m). A lithologic break occurs in Core 7 between Sections 3 and 4. Radiolaria become frequent in Core 7, Section 4, suggesting a Cretaceous age. Paleocene foraminifera continue to the base of Core 7 but are probably due to contamination as a result of drilling disturbance. Below the much reduced and incomplete Tertiary section is an interval that contains almost exclusively Radiolaria, indicating a Cretaceous s.l. age. The Cretaceous-Tertiary boundary is placed within Core 8 based on the Radiolaria.

Lower Cretaceous, Albian: Core 11, Section 5-Core 17, Section 3 (99.5-155.0 m). This interval of zeolite-rich clay contains abundant microfaunas with benthonic and planktonic foraminifera, including different species of *Hedbergella*, nannoplankton, Radiolaria, and Calcisphaerulides. Present in lesser numbers are ostracods, and, in one level, bivalves. The nannoplankton indicate middle Albian (*Prediscosphaera cretacea* Zone), the planktonic foraminifera indicate Albian, and the benthonic foraminifera indicate upper Albian. The composition of the very rich *Hedbergella* fauna, poor in species, indicates comparatively deep open-sea deposition, still above the lysocline, and a temperate climate.

Lower Cretaceous, Aptian: Core 17, Section 4 to Core 33 Section 1; (155.0-304.3 m). A distinct change occurs between Sections 3 and 4 Core 17. Nannoplankton drops from an estimated 55% by volume in the upper interval to zero in the lower unit. The richcalcareous and arenaceous foraminifera are replaced by a monotonous and very poor arenaceous fauna. Arenaceous foraminifera are frequent only in the basal part of the lower unit. Calcisphaerulidae and ostracods are completely absent in the lower unit, but palynomorphs, with dinoflagellates are abundant, indicating a lower Aptian age for Cores 25-33 and an upper Aptian age for Cores 18-24. The absence of calcareous fossils suggests deposition below the lysocline, or possibly somewhat shallower if deposition was in a cold-water environment. The poor arenaceous foraminiferal fauna is of deep-water character, but may also have lived at somewhat shallower depth in colder, higher latitudes. The absence of planktonic organisms and the presence of bottom-living arenaceous foraminifera exclude euxinic conditions.

Paleontology

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

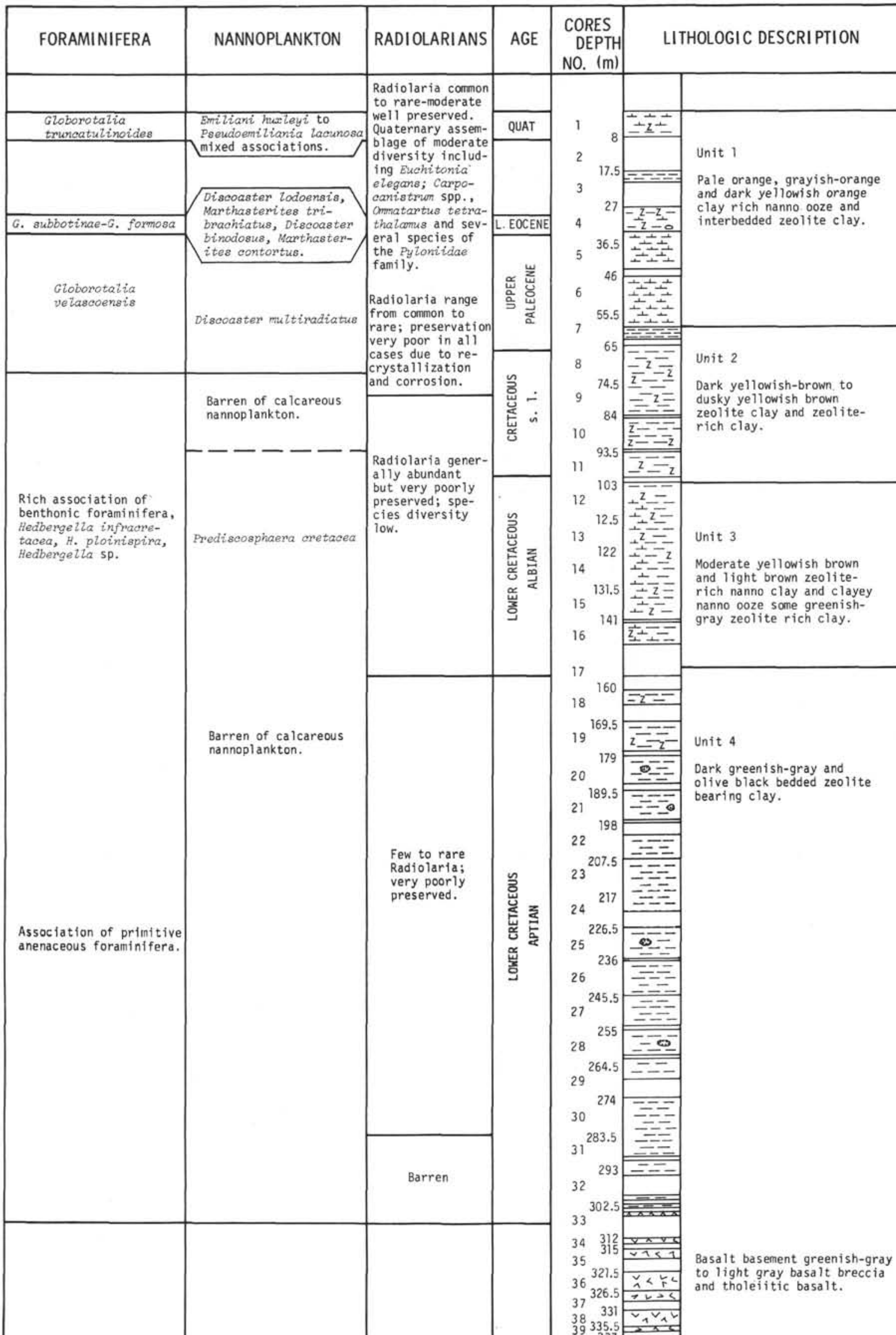

Figure 3. *Biostratigraphic zones, Site 259.*

Foraminifera

All samples of Core 1 (0.0-8.0 m) contain very rich asseblages of predominantly planktonic foraminifera. *Globorotalia inflata* is strongly predominant in most samples. Present in decreasing order of frequency are:

Abundant: *Globorotalia inflata, G. dutertrei, Globigerina bulloides.*

Common: *Globorotalia truncatulinoides truncatulinoides, G. menardii, G. crassaformis, Globigerinoides trilobus s.l., G. conglobatus.*

Rare: *Pulleniatina obliquiloculata, Globorotalia cultrata, Hastigerina siphonifera, Globigerinita glutinata, Globigerinoides ruber.*

Present in only some of the examined samples are: *Orbulina universa, Globorotalia tumida tumida, Candeina nitida, Sphaeroidinella dehiscens.*

Benthonic forms are not numerous, but are rich in species.

Core 3 (17.5-27.0 m) only contains very rare specimens of *Glomospira* and *Haplophragmoides* which are insufficient for an age determination.

Core 4 (27.0-36.5 m) contains a very poor planktonic foraminiferal fauna. In Section 3, casts of the *Globorotalia aequa-G. subbotinae* and the *Globorotalia subbotinae-G. formosa* groups are present along with complete specimens of *Acarinina primitiva, A. soldadoensis,* and *Chiloguembelina* aff. *wilcoxensis.* The planktonic foraminifera are accompanied by numerous benthonic forms.

Core 4, CC, Core 5-Core 7, Section 3 and the top of Core 8 (36.5-60.0 m) contain an assemblage of planktonic and benthonic foraminifera including *Acarinina acarinata, A. mckannai, A.* aff. *primitiva, Globorotalia imitata, Chiloguembelina* aff. *wilcoxensis.* Typical benthonic forms are *Tappanina,* and *Aragonia.*

A rich assemblage of planktonic and benthonic foraminifera is present in Sample 14, CC, including several species of *Hedbergella.* Similar but less abundant foraminifera are also present in Cores 11 (lower part)-13, 15, 16, and upper part of Core 17(103.0-155.0 m). The fauna indicates a temperate water, open-sea environment of deposition, with a water depth equal to shelf slope or deeper, but above the lysocline.

Core 17 Section 4 to Core 30 (155.0-283.5 m) contain poor arenaceous foraminifera of mainly dwarfed *Glomospira* sp., *Ammodiscus* sp., *Bathysiphon* sp., *Trochammina* sp., *Reophax* sp., and *Textularia* sp. The arenaceous foraminifera of Cores 31-33 (283.5-304.5 m) are somewhat richer and more diversified.

Nannoplankton

Rich well-preserved temperate- to warm-water Pleistocene assemblages are present in Core 1. A complete sequence of lower Eocene to upper Paleocene nannoplankton zones (*Discoaster lodoensis, Tribrachiatus orthostylus, Discoaster binodosus, Tribrachiatus contortus, Discoaster multiradiatus*) is present from Core 4-Core 7, Section 3 (27.0-60.0 m). The assemblages are composed of solution-resistant taxa, *Discoaster, Fasciculithus,* and some *Coccolithus.* Based on a typical Albian *Prediscosphaera cretacea* Zone assemblage, present in Cores 13-14, the interval Core 11, Section 5-Core 17, Section 3 (99.5-155.0 m) is referred to the middle Albian. The lower part of the sedimentary section, Core 17, Section 4-Core 33 (155.0 m to the basalt contact at 304.3 m), is barren of calcareous nannofossils.

Radiolaria

Quaternary Radiolaria range from common to absent in Core 1(0-8.0 m). Preservation is moderately good but decreases rapidly with depth in the core.

Cores 3-30 (17.5-283.5 m) contain Radiolaria in fluctuating abundances. Preservation is so poor that few specimens can be identified and none can be used for age determination. Some specimens from Core 8 and lower, however, can be classified on the family or even the generic level indicating the material is Cretaceous, i.e., *Dicolocapsa* spp., *Dictyomitra* spp., and several Spongodiscidae.

Palynomorphs

Only the Cretaceous sediments, Cores 10-33, were investigated for palynomorphs. In the upper part, Cores 10-17 (84.0-160.0 m) are barren. Cores 18-33 (160-304.3 m) contain rich dinoflagellate assemblages typical of the Aptian. *Hystrichosphaera ramosa* var. *reticulata* in Cores 19-23 is suggestive of upper Aptian; *?Oligosphaeridium asterigerum* in Cores 25-27, and *?Dingodinium albertii* in Core 29 to Core 33, Section 1 are indicative of lower Aptian.

Spores and pollen occur in Core 18 to Core 33, Section 1. The presence of *Crybelospirites stylosus* in Core 31 suggests a *C. stylosus* Zone age (Neocomian) for the lower part of the interval. Higher in the section, at least up to Core 20, the flora is correlated with the Microcachryidites-Assemblage of Neocomian to Aptian age.

Calcisphaerulidae

Seven *Pithonella* species which occur exclusively at Site 259 are distinguished in the Albian Cores 12-17 (103.0-160.0 m). These species were not recorded at Site 260, Cores 9-15 (234.0-300.5 m). Based on other fossil evidence, however, this interval at Site 260, which contains a *Pithonella* association of nine different species, is approximately equivalent in age to Cores 12-17, Site 259.

This difference in *Pithonella* species—a similar difference is apparent for the ostracods—indicates a difference in the environment, or a slight age difference within the Albian of the two intervals.

Pithonella is common to abundant in most samples examined in Site 259, Cores 12-17; more frequent than in any other Leg 27 site, except for Cores 31-33 of Site 261, where they occur in floods.

Ostracods

Six species in open nomenclature occur in Cores 12-17 (103.0-160.0 m). *Arculicythere?* sp. A, by far the most numerous, occurs in most of the examined samples. All six species are present in Sample 14, CC, which contains the richest ostracod fauna of the interval. The dominance of smooth forms, mainly Bairdiids and

Cytherella, and the virtual absence of the Cythereis group (only one specimen present), which is indicative of Lower Cretaceous near-shore and shelf deposits, indicates a depth of deposition deeper than the shelf.

Bivalves

Numerous exfoliated fragments of *Aucellina* sp. A (Family Buchiidae) were recovered from Sample 14, CC (131.5 m). A definite species identification is prevented by the small size of the fragments. However, the fragments closely resemble the juvenile phase of *Aucellina* cf. *gryphaeoides* from the Great Artesian Basin of Australia. The fragments are most closely comparable to Aptian-Albian species, particularly with Albian forms. This age is in agreement with the age obtained from foraminifera and nannoplankton.

Fish debris

Fish remains are fairly frequent in the Paleogene, Cores 4-8 (27.0-74.5 m); in Cores 9-33 (74.5-304.3 m) they are rare, and often absent altogether. They are particularly rare in the basal part of the Cretaceous interval.

GEOCHEMICAL MEASUREMENTS

Alkalinity, *p*H, and salinity data are summarized in Table 3 and in Figure 4. Analytical methods used for determining these values are discussed later in this section.

Alkalinity

Alkalinity values at Site 259 are in general low, showing a mean of 2.64 which is close to the mean of 2.49 for seawater at this site. A low alkalinity value is commonly ascribed to a slow rate of deposition (see earlier DSDP reports) and this would also seem to be compatible with the probable slow rate of sedimentation at Site 259. However, the consistent decrease of alkalinity with depth suggests that postdepositional modification of interstitial solutions by such factors as precipitation of minerals from solution and the increase in overburden pressure may also be significant.

pH

Only three "punch-in" values were obtained; consequently, this discussion will be limited to the "flow-through" results. Throughout most of the column, *p*H values are below that of seawater, ranging from 7.24 to 8.09. At most DSDP sites *p*H values are below those of seawater, consequently Site 259 fits into the normal pattern. There is also a consistent increase in *p*H with depth (Figure 4) which is probably the result of diagenetic changes although the nature of the processes involved is unknown.

Salinity

There is a consistent decrease in salinity with depth at Site 259, (Figure 4) with values ranging from 35.5‰ at the top of the hole, to 34.1‰ at a depth of 282 meters. This decrease may result from the removal of ions from solution, particularly Ca^{++} and SO_4^{--}, as gypsum is present in Units 3 and 4. The apparent co-existence of gypsum with a comparatively dilute solution (maximum salinity 35.5‰)is somewhat problematical, particularly as the gypsum may have crystallized out in localized pockets isolated from the bulk of the interstitial fluids.

PHYSICAL PROPERTIES

Bulk-density, sound-velocity, porosity, vane shear-strength, and residual pore-pressure measurements were made on materials recovered at Site 259. 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.

Site 259 produced the largest quantity of sediment suitable for physical properties testing of the five sites drilled. Coring was continuous through the unconsolidated sediment column and in most cases each core had some portion which displayed only mild layer distortion. These areas of relatively low disturbance are toward the bottom of the core, usually in the lowest section. Due to layer color variation, photographs from Cores 1, 8, 14, and 16 show well the wide range of drilling disturbance. Many of these color changes are due to alternating inorganic clay and nanno ooze layers. Since both materials have undergone the same history after deposition, the variation of their properties with depth may be compared.

Density

Wet bulk density was determined on fresh unsplit core sections by continuous GRAPE measurements and by

TABLE 3
Summary of Shipboard Geochemical Data, Site 259

Sample (Interval in cm)	Depth Below Sea Floor (m)	*p*H Punch-in	*p*H Flow through	Alkalinity (meq/kg)	Salinity (‰)	Remarks
		8.00	8.21	2.44	36.0	Reference seawater
1-6, 0-6	6.5-6.56	7.46	7.24	3.13	35.5	
5-5, 0-6	44.5-44.56	7.30	7.35	2.93	35.2	
10-5, 0-6	90.5-90.56	7.13	7.40	2.83	34.9	
15-6, 0-6	139.5-139.56	–	7.15	2.54	35.2	
20-5, 0-6	185.5-185.56	–	7.53	2.83	34.4	
25-3, 0-6	230.0-230.06	–	7.60	2.35	34.1	
30-6, 0-6	282.0-282.06	–	8.09	1.86	34.1	
		8.34	8.29	2.54	35.8	Reference seawater

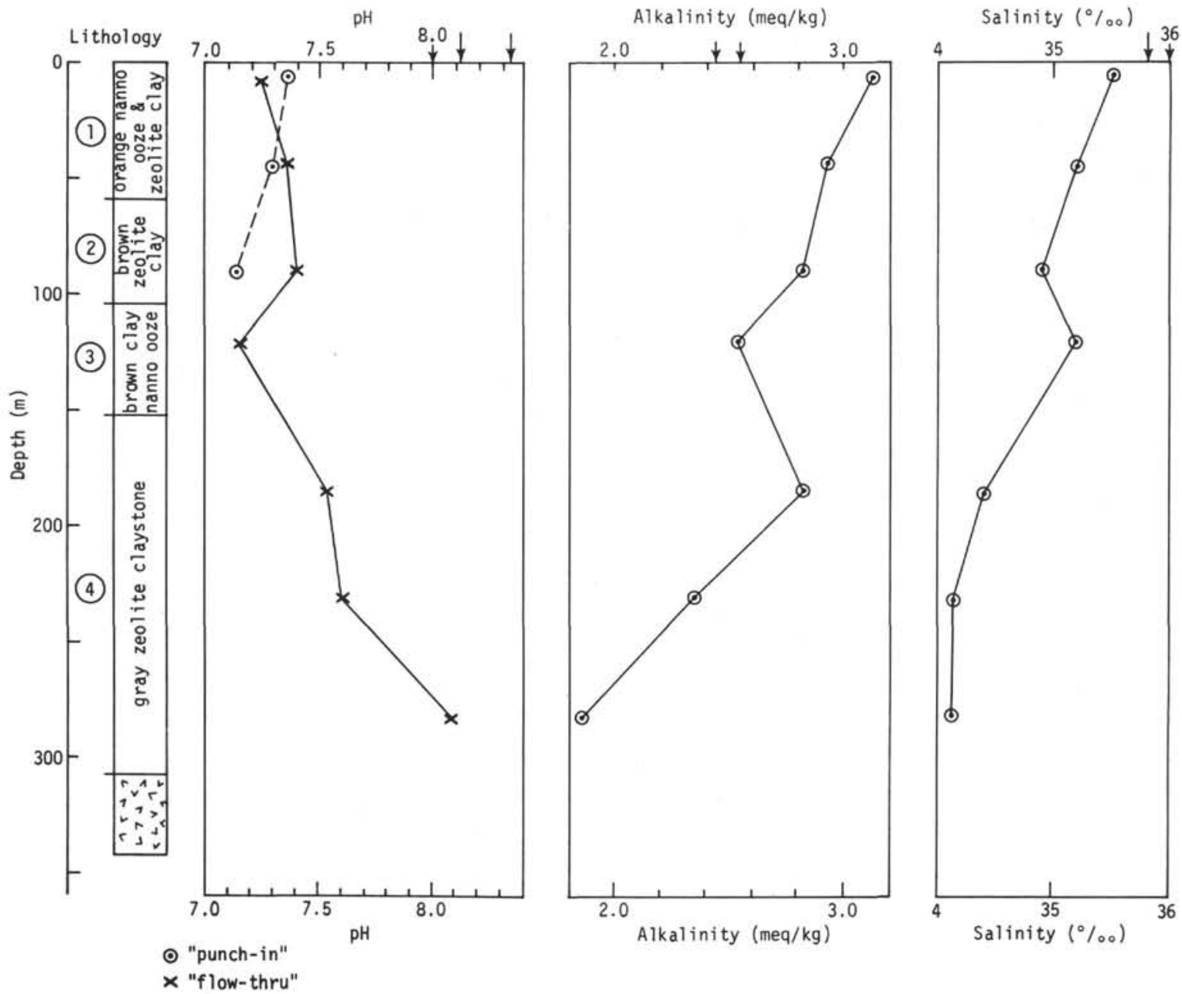

Figure 4. *Geochemical analysis of interstitial water at Site 259.*

weighing each section. A third value was determined from syringe samples taken routinely for water contents or immediately adjacent to each vane shear test, at which point two syringe samples were taken. In eight other locations samples were taken for shore-laboratory determination of density. The profile drawn on the site summary corresponds to GRAPE data from relatively undisturbed sediments, considered the most accurate indicator of in situ density at Site 259. The section-weight determinations are considerably lower than these GRAPE data because although both methods are density averages of a specific sediment volume, the section-weight method includes more low-density disturbed sediment. (In most cases, core sections containing relatively undisturbed sediments also contain large areas of lower density disturbed material and often a slurry of even lower density. The section weight averages all materials within the section. However, even in unusual core sections, which may contain 150 cm of relatively undisturbed sediment, the section weight method should measure a lower density, because of the inevitable higher disturbance of the sediment immediately adjacent to the core liner. While section weight is a total core cross-sectional average, the GRAPE is not and averages a lower percentage of the outer material within its pencil-thin gamma ray beam.) The syringe values, while more accurate than the section weight data, are slightly lower and less accurate than GRAPE determinations.

Major density variations occur at Site 259 within the top 55 meters of the sedimentary column. However, these variations appear more dependent on sediment type than on depth. Adjacent layers of nanno ooze and zeolitic clay do not have the same density. Within the surface core ooze density is 1.50-1.70 g/cc while clay density is only 1.25-1.35 g/cc, even though the clay is in a deeper layer. Nanno clay, found between these sediments, shows an intermediate density of about 1.45 g/cc. Clay density rises to about 1.60 g/cc at 55 meters with most of the increase occurring in a zone of low recovery between 20 and 35 meters. Fewer measurements were made on nanno ooze. Ooze density is approximately 1.70 g/cc at 45 meters and 1.80 g/cc at the 55-meter level. Behavior is difficult to trace because, although layers of each sediment type were found within most cores, much of the material was too highly disturbed for testing.

Below 55 meters the sediment is predominantly inorganic clay. Density variation is less dramatic, even where nanno ooze is abundant in layers between 105 and 154 meters. Density rises steadily to 1.80 g/cc between 55 and 154 meters, then drops to 1.65 g/cc. (Nanno ooze is not found in the clay below 154 meters.) Density then remains relatively constant until 255 meters and again rises gradually to 1.80 g/cc above the basalt.

The density fluctuations correspond closely to the four units identified on the basis of color and composition. These units include the intervals of 0.0-60.0 meters, 60.0-103.0 meters, 103.0-154.0 meters, and 154.0-304.3 meters.

Porosity

Porosity plotted on the site summary sheets was determined from continuous GRAPE readings and from syringe samples. Only those syringe samples which were taken in relatively undisturbed material are shown. Porosity is directly related to wet bulk density and mineral grain density. Variation in porosity follows variation of bulk density very closely. The effect of grain density is as follows. In two sediments with the same bulk density, the sediment with a higher grain density also has the higher porosity. Grain density of most sediments, however, does not vary enough to overcome the close dependence of porosity on bulk density. A continuous readout is available for 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 correct scale to use depends on grain density of the sediment. Although a porosity plot may be computer-produced in a manner similar to GRAPE density plots, it is necessary to specify the grain density for each sediment layer. In some cores mineralogical variations occur often enough to make this procedure approach hand reduction.

Sonic Velocity

Sonic-velocity measurements shown on the site summary sheets were made on relatively undisturbed sediment and on basalt specimens prepared by trimming to produce parallel flat surfaces. Sonic velocity increases gradually from 1.50 km/sec at the sediment surface to 1.60 km/sec at 295 meters. Velocity in basalt ranges from 3.4 to 5.0 km/sec in the deepest basalt recovered. On some specimens, measurements were made in the vertical direction, perpendicular to bedding. (Sonic velocity on *Glomar Challenger* is normally measured in the horizontal direction—parallel to bedding planes.) In another study, velocity was measured on the same basalt specimens at 5°C and at 21°C. Comparison of the measurements in both studies is inconclusive due to data scatter. Poor Hamilton frame transducer contacts and fissures in the basalt are suspected to have caused the scatter.

CORRELATION OF SEISMIC REFLECTION PROFILE WITH DRILLING RESULTS

At this site, drilling records show that 304.3 meters of sediment and 42 meters of basalt were penetrated below the sea floor. The seismic profiles show a single strong reflector at a depth of 0.35 sec. It was assumed that this reflector is basaltic basement. (Figure 5.)

The 0.35-sec DT through 304.3 meters of sediment gives an average velocity of 1.73 km/sec. The velocity measured in the ship laboratory is approximately 1.5-1.6 km/sec.

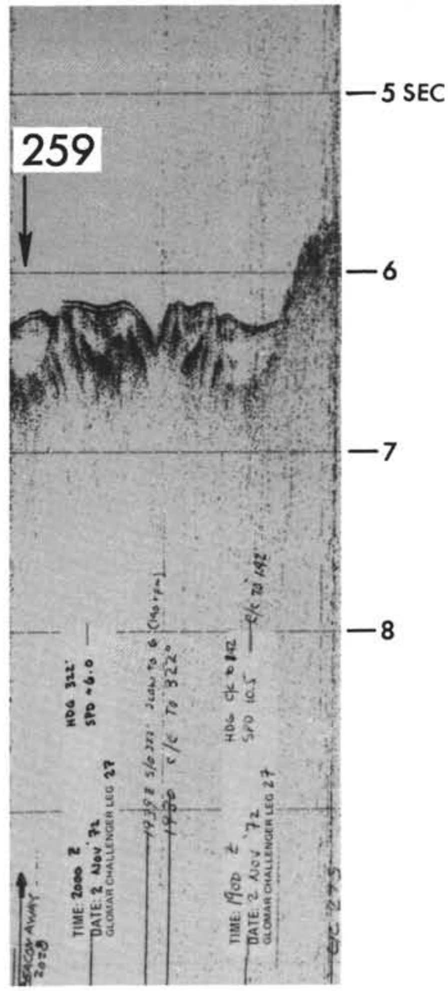

Figure 5. *Seismic profile approaching Site 259.*

A sonobuoy was run while the ship was on-station drilling. Side reflections prevented this record from showing other possible reflectors in the sediment column. The steep slope of the basement is evident from the isopachs shown in the site survey map (Figure 2). Additional evidence for the slope of the basement was provided when the ship left this site. As the seismic gear was placed in the water, the basement depth was found at 0.3 sec, i.e., 0.05 sec less than indicated on the record when the ship came on this station. The incoming profile is regarded as the more reliable so the accepted value is 0.35 sec.

Compressional wave velocities measured for basalt from this site range from 3.4 km/sec at the top of the recovered basalt to about 5.0 km/sec for the lower pieces recovered about 38.5 meters below the sediment-basalt interface. These values are somewhat lower than average basalt and probably result from the fact that the basalt is altered.

SUMMARY AND CONCLUSIONS

Summary

Site 259 is located in 4706 meters of water near the southeastern edge of the Wharton Basin. Near the site, seismic profiles show 0.4 sec or less of transparent sediment over basement, and a piston core taken by Lamont-Doherty Geological Observatory in 1967 shows that the sediment at or near the surface is Paleocene (L. H. Burckle, personal communication). One hole was drilled at Site 259 through 304.3 meters of sediment and 41.7 meters of basalt.

Four sedimentary sequences were recognized. Light-brown nanno clay and ooze and zeolite clay extend from the sea floor to a depth of 60 meters. Then follow 43 meters of dark-yellow-brown zeolite clay, 51 meters of zeolite-rich nanno clay, and finally 150.3 meters of dark-greenish-gray cristobalite claystone overlying basalt breccia with a depositional contact. The greenish-gray basaltic breccia grades 7ownward into dark-gray fine-grained basalt at about 25 meters below the sediment-basalt contact.

Fossils show that all but the top 60 meters of sediment is Cretaceous. The Cenozoic section is subdivided as follows: 8 meters is Quaternary, 8-27 meters is of unknown age, 27.0-36.5 meters is lower Eocene (indicated by a complete sequence of four nannoplankton zones), and 36.5-60.0 meters is upper Paleocene, confirming L. H. Burckle's determination (personal communication) from a piston core. The boundary between the upper Paleocene and the Lower Cretaceous is not visible as a physical break, but this may be due to mixing during coring or to original reworking. The upper, calcareous part of the Cretaceous sequence is Albian, as indicated by nannoplankton and foraminifera. The lower part is Aptian with arenaceous foraminifera.

Accumulation rates calculated from these data are only approximate due to the uncertain location of precise biostratigraphic boundaries in the drilled section. Figure 6 was compiled on the arbitrary assumption that each biostratigraphic division identified was complete. This is demonstrable at the site for the lower Eocene only. The compiled curve therefore should show minimum rates only. The time-scale adopted here is shown in Figure 9.

In the terms of these approximations, the curve shows that the accumulation rate was 1.6 m/m.y. in the lower Eocene, 12 m/m.y. in the upper Paleocene, 14 m/m.y. in the Aptian. The only comment warranted here is that the upper Paleocene and Lower Cretaceous rates are of the same order of magnitude, and the lower Eocene rate is an order of magnitude smaller.

Conclusions

Deposition at Site 259 began in an unknown part of the Aptian with extrusion of basalt and the accumulation of green-gray clay. The basalt was altered before deposition of the overlying sediment, probably by rapid cooling in contact with seawater during extrusion onto the sea floor. A thickness of 150 meters of green-gray clay accumulated during the Aptian at a rate of approximately 25 m/m.y. Stagnation of the bottom water is suggested by the uniformly dark tone of the sediments; uniform, though crude, lamination; fairly abundant pyrite; the impoverished biota of primitive arenaceous foraminifera and rare Radiolaria; and the reduction of the other microfossils. The arenaceous foraminifera indicate cold or deep water, or both. The impoverished biota is probably due to selective solution. The stagnation at the very bottom must have been milde to have allowed the existence of the bottom-dwelling foraminifera but stronger anaerobic conditions must have prevailed a short interval beneath the sediment surface. The composition of the clay suggests a volcanic origin either by alteration in situ of volcanic ash or by inflow of the weathering products of exposed volcanic rocks.

A preliminary interpretation of the Aptian sequence is that it was largely derived from a volcanic source associated with the early stages of continental rupture and drift, represented ashore by the basal Cretaceous Bunbury Basalt (Veevers, 1971); and that it was deposited during the initial opening of an oceanic rift in which oceanic circulation was somewhat inhibited.

Sedimentation in the Albian, led to the accumulation, presumably above the lysocline, of 51 meters of light-colored zeolite-rich nanno clay and nanno ooze similar to part of the approximately equivalent sequence at Site 257 (Leg 26) 500 km to the west-southwest. The sediment of this age at Site 257 rests above 15 meters of barren clay, on basalt, so that the entire unit of green-gray claystone at Site 259 wedges out between these sites, presumably as a result of sea-floor spreading to the west.

The rest of the Albian is yellow-brown zeolitic clay with poorly preserved nannofossils and Radiolaria. The lack of foraminifera probably indicates deposition below the lysocline.

A long hiatus representing most of the Upper Cretaceous and lower part of the Paleocene has no obvious lithological expression, probably due to original reworking or to disturbance during coring. Reworked Upper Cretaceous Radiolaria from near the base of the upper Paleocene caly probably indicate a source on the Australian continental margin. The succession of upper Paleocene yellow-brown clay overlain by pale orange nanno ooze is interpreted as indicating a relative downward movement of the lysocline. Partial dissolution of the nannoplankton in the thin lower Eocene interval may explain its low accumulation rate. After the deposition of clay of unknown age, Quaternary nanno and foraminiferal ooze and zeolitic clay were deposited, and the carbonates were partially affected by dissolution. Ten km southward, at Station 150 of *Conrad*-11 (Figure 2), Paleocene ooze is exposed at the sea floor, showing that the 36.5 meters of Eocene and younger sediments of Site 259 are not preserved everywhere on the elevated area around Site 259.

The elevated position of Site 259 may have caused other gaps in the record. The Upper Cretaceous clay found at Site 257 is lacking at Site 259, and seismic profiles show that a fuller Cenozoic section is possibly present in the deeper part of the Perth Abyssal Plain.

PROGRAM TO STUDY AIR TRANSPORTED DUST AND SEDIMENTS SUSPENDED IN SURFACE WATERS

A limited program to study air-transported dust and suspended surface sediments was undertaken on this

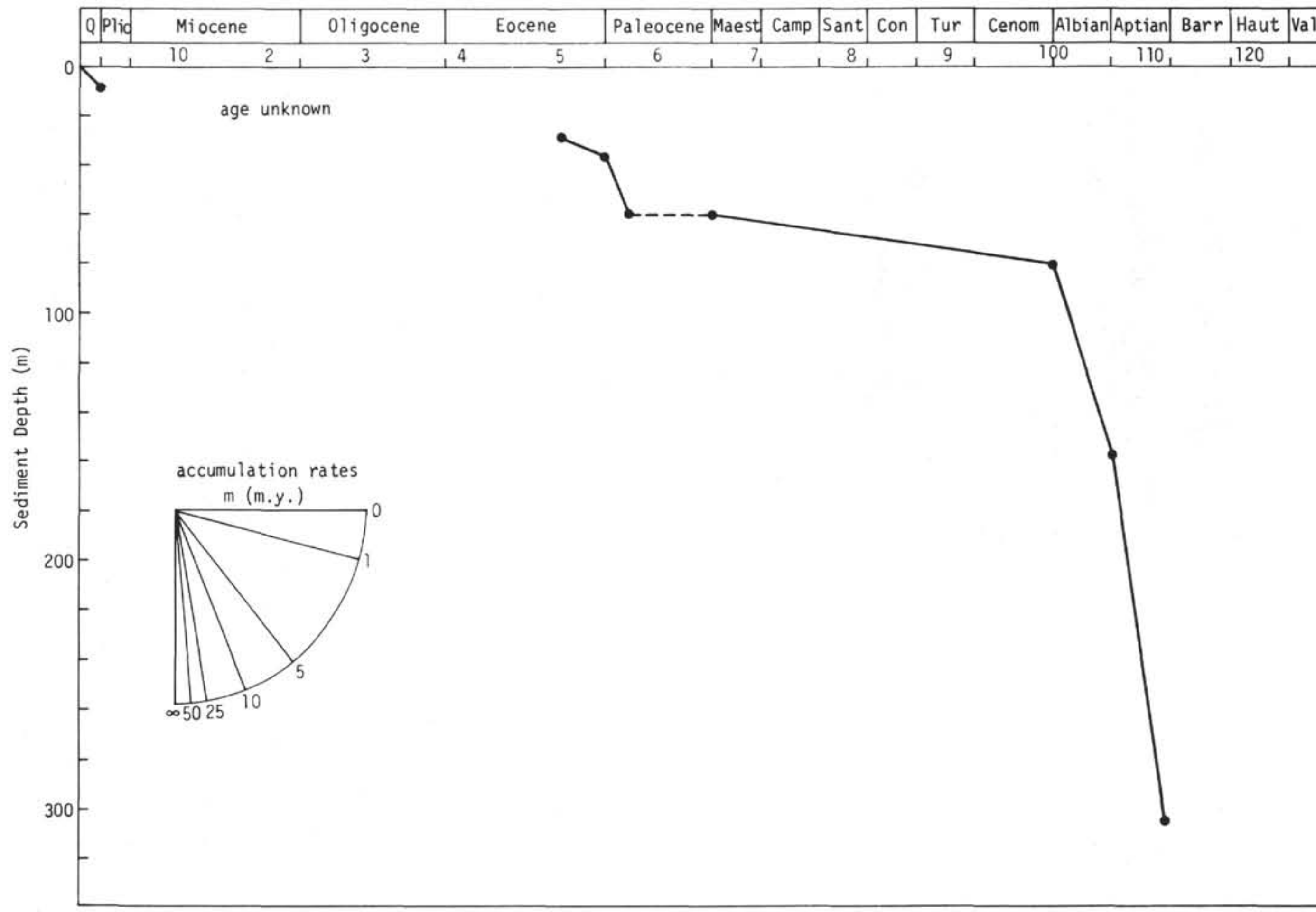

Figure 6. *Sediment accumulation rates, Site 259.*

cruise. The Western Australian coast is one of several areas of the world where a major desert is near the sea coast and off-shore winds are likely to carry considerable dust out to sea. In addition, these winds could blow surface waters off shore, causing an upwelling of nutrient-rich water and stimulating a biogenic component to sediments deposited on the sea floor. A third factor which may influence the nature of the sediments is the discharge of rivers from the Australian drainage basins into the eastern Indian Ocean.

Informal estimates indicate that river discharge of sediments is small on the average, but flash floods may carry a large sediment load near the estuaries. Firm figures should be established for these rates.

It is the opinion of oceanographers that upwelling is not strong off Western Australia but may occur in a more significant manner off northwest Australia or in the Timor Sea area. It may also occur in local areas that may not be significant to the marine biologist or oceanographer but may be significant geologically.

To provide data to study these effects, the following efforts were carried out:

1) The number of dust particles/cc of air was measured 3-4 times each day by the weatherman.

2) Surface observations were made 3-4 times each day by the weatherman. These observations included wind, clouds, pressure, air and sea-surface temperatures, dew point, sea, and swell.

3) Sea and cloud observations were made each 2 hours by the ship's officers.

4) Satellite cloud maps were obtained directly from the satellite by the weatherman approximately once each day.

5) Weather maps for the western Australian region were received by radio approximately twice each day.

6) A sample of surface water was filtered through a preweighed millipore filter each 6 hours. Surface temperature and salinity were also measured at that time. Occasionally, silver filters were used so samples could be analyzed by X-ray spectroscopy.

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Site 259 Hole Core 1 Cored Interval: 0-8 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
QUATERNARY	(F) Globorotalia truncatulinoides truncatulinoides (N) Emiliania huxleyi to Pseudoemiliania lacunosa (mixed assoc.)					1	0.5, 1.0	VOID				
		AG	AG							132, 140		
		AG	AG			2				10, 61, 92, 130		
			AG	CM		3				XR, 48, 59, 66, 110	26-28	
		AG	AG	FM		4				147, 26, 52, 75, 105, 119		
		AG		RM		5				5, 18, 64, GZ, 93	74	
			AG	RM							10YR5/4	
		AG		RVVP								
		CM	NONE	NONE	Fd	6				75		
		CM	AG	RVVP		Core Catcher				CC		

Core is undisturbed to weakly deformed near base. Color chiefly very pale orange (10YR8/2) with alternations and layers of pinkish gray (5YR8/1), light brown (5YR5/6) and moderate orange (5YR8/4).

FORAM BEARING NANNO OOZE
Smear slides 1-140, 2-61, 3-110, 4-26, 5-93

Composition	
Nannos	80%
Forams	9%
Sponge spicules	5%
Rads	2%
Carb. frags.	2%
Diatoms	1%
Silicoflag.	1%

SPONGE SPICULE BEARING NANNO OOZE
Smear slide 5-64

Texture		Composition	
Clay	65%	Nannos	85%
Silt	32%	Sponge spicules	10%
Sand	3%	Micarb	5%
		Opaques	Tr.

ZEOLITIC CLAY
Smear slide 6-75

Composition	
Clay	72%
Zeolite-clinoptilolite?	25%
Quartz	2%
Feldspar	1%
Nannos	Tr.
Opaques	Tr.

BULK X-RAY (3.30 m)

Calcite	96%
Quartz	3%
Mica	1%

Site 259 Hole Core 2 Cored Interval: 8.0-17.5 m

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

Site 259 Hole Core 3 Cored Interval: 17.5-27.0 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
?		NONE	NONE	CVVP		1	0.5, 1.0			75	10YR5/4	
				CVVP		2				GZ, 75	74	
		NONE	NONE									
		RP	NONE	RVVP		Core Catcher					10YR5/4	

Core is weakly deformed, stiff clay. Chiefly moderate yellowish brown (10YR5/4) with streaks and patches of dark yellowish orange (10YR6/6).

ZEOLITE SILTY CLAY
Smear slides 1-75, 2-75, CC

Texture		Composition	
Clay	69%	Clay	75%
Silt	31%	Zeolite	25%
		Quartz	Tr.
		Feldspar	Tr.

Explanatory notes in chapter 1

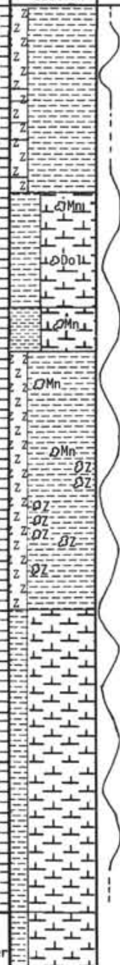
Site 259 Hole Core 4 Cored Interval: 27-36.5 m

AGE: LOWER EOCENE

ZONE: (F) G. subbotinae - G. formosa; (N) Tribrachiatus orthostylus; (N) Discoaster lodoensis; (N) Discoaster binodosus

FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHO. SAMPLE	
NONE	NONE	FVVP	Fd	1	0.5, 1.0	40	10YR5/4
						75	10YR4/2
						120	10YR4/2
	CM	RVVP	Fd	2		GZ 75	74 10YR5/4
RP	AM	RVVP	Fd	3		XR	26-28 10YR5/4
						75	10YR7/4
FM	RP	RVVP	Fd	4		65	
						80	
RM	CM	RVVP	Fd	5		GZ 75	74 10YR8/6
RM, FM	AM	RVVP	Fd	6		75	10YR8/6
FM	AM	RVVP	Fd	Core Catcher		CC	

LITHOLOGY 0.4 m zero section



LITHOLOGIC DESCRIPTION

Core mostly strongly deformed stiff clay or ooze. Colors chiefly moderate yellowish brown (10YR5/4) with streaks and patches of dark yellowish orange (10YR6/6 and a few patches of dark yellowish brown (10YR4/2). Chiefly pale yellowish orange in lower 2 sections.

ZEOLITE SILTY CLAY
Smear slides 1-40, 3-75, 4-65, 1-75, 1-120

Composition	
Clay	72%
Zeolite	25%
Quartz	1%
Nannos	1%
Micarb	1%
Feldspar	Tr.

MICARB RICH NANNO OOZE
Smear slides 5-75, 6-75, CC

Texture		Composition	
Silt	53%	Nannos	70%
Clay	46%	Micarb	20%
Sand	1%	Clay	10%
		Dolomite rhombs	Tr.

ZEOLITE RICH MICARB AND NANNO OOZE
Smear slide 2-75

Texture		Composition	
Clay	49%	Nannos	55%
Silt	46%	Micarb	25%
Sand	5%	Zeolite	15%
		Clay	5%
		Iron Oxide	Tr.
		Feldspar	Tr.
		Dolomite rhombs	Tr.

Core contains numerous dark (N1) nodules of zeolite cemented clay.

BULK X-RAY (30.3 m)

Calcite	51%
Clinoptilolite	22%
Quartz	17%
Phillipsite	4%
Mica	3%
Montmorillonite	3%

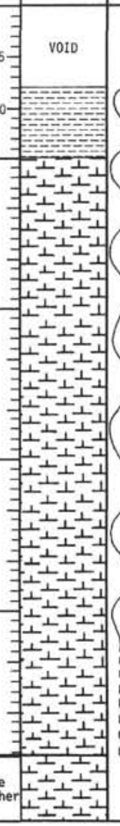
Site 259 Hole Core 5 Cored Interval: 36.5-46 m

AGE: UPPER PALEOCENE

ZONE: (F) Globrotalia velascoensis; (N) D. binodosus; (N) T. contortus; (N) D. multiradiatus

FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHO. SAMPLE	
?	CM			1	0.5, 1.0	110	10YR7/4
FM	CM	RVVP	Fd	2		GZ 75	74 10YR7/4
		NONE	Fd	3		XR	26-28
						75	10YR7/4
FM	CM	NONE	Fd	4		75	10YR7/4
FM	CM	RVVP	Fd	5		GZ 75	10YR8/2 74
CM	CM						10YR7/4
CM	CM	RVVP		Core Catcher		CC	10YR7/4

LITHOLOGY



LITHOLOGIC DESCRIPTION

Highly contorted stiff clay and clay nanno ooze. Chiefly grayish orange (10YR7/4) with streaks of dark yellowish orange (10YR6/6). Grades to very pale orange (10YR8/2) near base.

ZEOLITE RICH CLAY
Smear slide 1-110

Composition	
Clay	84%
Zeolite	14%
Nannos	2%

ZEOLITE BEARING OOZE
Smear slides 2-75, 3-75, 4-75, 5-75, CC

Texture		Composition	
Clay	56%	Nannos	90%
Silt	44%	Zeolite	10%
		Dolomite rhombs	Tr.

Minor dark nodules (N1) at top of core.

BULK X-RAY (39.8 m)

Calcite	76%
Clinoptilolite	16%
Quartz	4%
Mica	2%
Montmorillonite	2%

Explanatory notes in chapter 1

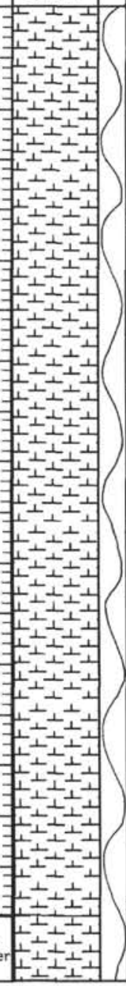
Site 259 Hole Core 6 Cored Interval: 46-55.5 m

AGE: UPPER PALEOCENE

ZONE: (F) Globrotalia velascoensis; (N) Discoaster multiradiatus; (N) T. contortus; (N) D. multiradiatus

Section	Forams	Nannos	Radiolaria	Others
1	CM	CM	RVVP	Fd
2	RM	CM	RVVP	
3	CM	CP	RVVP	Fd
4	CM	CP	RVVP	Fd
5	CM	CM	RVVP	Fd
6	CM	CM	RVVP	Fd
Core Catcher	CM	CM	RVVP	

LITHOLOGY 0.5 m zero section



Section	Litho. Sample	
1	75	10YR7/4
2	GZ 75	74; 10YR8/6
3	XR	26-28
3	75	10YR8/2
4	75	10YR7/4 with streaks of 10YR6/6
5	GZ 75	10YR7/4; 74
5		10YR8/2
6	60	10YR7/4
6	135	10YR6/6
Core Catcher	CC	10YR7/4

LITHOLOGIC DESCRIPTION

Highly contorted stiff clay and ooze. Chiefly grayish orange (10YR7/4) in upper and lower parts and pale yellowish orange (10YR8/6) in middle.

ZEOLITE BEARING NANNO OOZE
Smear slides 1-75, 2-75, 3-75, 4-75, 5-75, 6-60, 6-135, CC

Texture		Composition	
Clay	58%	Nannos	95%
Silt	42%	Zeolite	5%
		Dolomite rhombs	Tr.
		Forams	Tr.

BULK X-RAY (49.3 m)

Calcite	93%
Clinoptilolite	5%
Quartz	2%

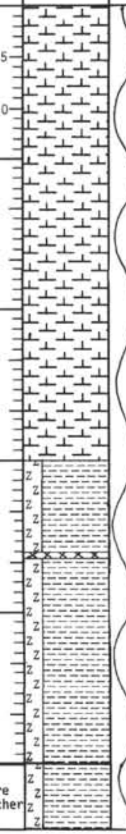
Site 259 Hole Core 7 Cored Interval: 55.5-65 m

AGE: UPPER PALEOCENE (Sections 1-4); CRETACEOUS (based on Radiolaria) (Sections 4-5, Core Catcher)

ZONE: (F) Globrotalia velascoensis; (N) Discoaster multiradiatus. Lower part: (F) Globrotalia velascoensis (contamination from above); (N) Discoaster multiradiatus (contamination from above)

Section	Forams	Nannos	Radiolaria	Others
1	AM	CP	RVVP	Fd
2	CM	CP	RVVP	Fd
3	CM	CP	RVVP	Fd
4	NONE	RP	RVVP	Fd
5	CM	CP	RVVP	Fd
Core Catcher	CM	CM	RVVP	

LITHOLOGY



Section	Litho. Sample	
1		10YR8/2
1		10YR7/4
1	90	10YR7/4
2	GZ 75	74; 10YR7/4
3	XR	26-28
3	75	10YR7/4
3	95	N1
4		10YR6/6
4	75 XR 95	94-96; N1
4		10YR6/6
4		10YR4/2
4		10YR5/4
5		10YR7/4
5	GZ 80	74; 10YR5/4
5	103	10YR7/4; 10YR2/2
Core Catcher	CC	10YR5/4

LITHOLOGIC DESCRIPTION

Strongly disturbed stiff clay and ooze. Colors chiefly grayish orange (10YR7/4) with black streaks (N1) in upper part and dark yellowish orange (10YR6/6) smear with dark yellowish brown (10YR4/2) and black (N1) streaks in middle. Lower part chiefly moderate yellowish brown.

Chiefly zeolite bearing nanno ooze and zeolite rich clay with minor iron oxide.

ZEOLITE BEARING NANNO OOZE
Smear slides 1-90, 2-75, 3-75, 5-80

Texture		Composition	
Clay	56%	Nannos	90%
Silt	43%	Zeolite	10%
Sand	1%	Heavy minerals	Tr.
		Feldspar	Tr.
		Quartz	Tr.

ZEOLITE RICH CLAY
Smear slides 4-75, 5-103, CC

Composition	
Clay	80%
Zeolite	19%
Mica	1%
Feldspar	Tr.
Opaques	Tr.

IRON OXIDE
Smear slide 4-95

Composition	
Iron Oxide	99%
Quartz	1%
Nannos	Tr.
Feldspar	Tr.

BULK X-RAY (58.8 m)

Calcite	87%
Clinoptilolite	7%
Quartz	3%
Mica	2%
Montmorillonite	1%

BULK X-RAY (61.0 m)

Quartz	44%
Clinoptilolite	32%
Mica	9%
Montmorillonite	8%
Phillipsite	6%
Gypsum	1%

Explanatory notes in chapter 1

Site 259 Hole Core 8 Cored Interval: 65-74.5 m

AGE: CRETACEOUS (based on Radiolaria)

ZONE: (N) Discoaster multiradiatus (contamination from above)

Section	Forams	Nannos	Radiolaria	Others	Litho. Sample	
1	CM	RP	RVP		62	10YR4/2
2	RP, NONE	NONE	CVVP	Fd	25; GZ 74	10YR4/2 74
3	NONE	NONE	RVVP		XR 26-28; 75	10YR4/2
4	NONE	NONE	FVVP		75	10YR4/2
5	RM	AP	FVVP	Fd	28; 75	nodule 5YR7/2; 10YR4/2 & 10YR5/4
6		CP	RVVP	Fd	125	10YR4/2 & 10YR5/4; 10YR4/2; 10YR4/2 & 10YR7/4
Core Catcher	NONE	CP	RVVP		CC	10YR4/2

LITHOLOGIC DESCRIPTION

Strongly disturbed stiff clay. Chiefly dark yellowish brown with distorted layers and streaks of grayish orange (10YR7/4) and dusky yellowish brown (10YR2/1).

ZEOLITE CLAY

Smear slides 2-25, 3-75, 4-75, 5-75, 6-125

Texture		Composition	
Clay	76%	Clay	70%
Silt	24%	Zeolite	28%
		Heavy minerals	1%
		Nannos	1%
		Quartz & feldspar	Tr.

BULK X-RAY (68.3 m)

Palygorskite	33%
Clinoptilolite	21%
Mica	13%
Cristobalite	12%
Quartz	11%
Montmorillonite	9%
Gypsum	1%

Site 259 Hole Core 9 Cored Interval: 74.5-84

LITHOLOGY 0.5 m zero section

AGE: CRETACEOUS (based on Radiolaria)

Section	Forams	Nannos	Radiolaria	Others	Litho. Sample	
1			FVVP	Fd	75	10YR2/2 10YR4/2 10YR7/4
2			RVVP		GZ 74; 75	10YR2/2 10YR4/2 10YR7/4
3			AVVP		XR 26-28; 75	10YR2/2
4	NONE	NONE	AVVP		75	10YR2/2
5			CVVP	Fd	GZ 74; 75	10YR2/2
6			FVVP		75	10YR2/2 10YR5/4
Core Catcher			FVVP		CC	10YR5/4

LITHOLOGIC DESCRIPTION

Highly disturbed stiff clay. Color chiefly dusky yellowish brown with smeared layers and patches of dark yellowish brown and grayish orange.

ZEOLITE CLAY

Smear slides 1-75, 2-75, 3-75, 4-75, 5-75, 6-75, CC

Texture		Composition	
Clay	85%	Clay	72%
Silt	14%	Zeolite	25%
Sand	1%	Nannos	3%
		Heavy minerals	Tr.

BULK X-RAY (77.8 m)

Palygorskite	31%
Clinoptilolite	28%
Montmorillonite	18%
Quartz	11%
Mica	8%
Gypsum	2%
Plagioclase	2%

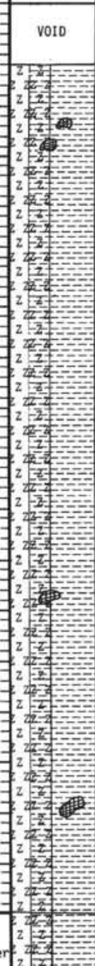
Explanatory notes in chapter 1

Site 259 Hole Core 10 Cored Interval: 84-93.5 m

AGE: CRETACEOUS (based on Radiolaria)

FOSSIL CHARACTER: FORAMS NONE; NANNOS NONE

SECTION	RADIOLARIA	LITHOLOGY	LITHO. SAMPLE
1	AVVP	VOID (0-0.5 m)	-95 10YR5/4 10YR2/2; -120 nodules 5Y2/1
2	AVVP		-49 10YR5/4 10YR4/2; GZ 74; -100 10YR5/4
3	AVVP		XR 26-28; -75 10YR5/4 10YR4/2
4	AVVP		-74 10YR5/4 10YR4/2; nodules 5Y2/1
5	AVVP		-71 10YR5/4 10YR4/2; GZ 74
6	AVVP		-85 10YR5/4 N1; -114 10YR5/4
Core Catcher	CVVP		



LITHOLOGIC DESCRIPTION

Highly contorted stiff clay with some vertical striping. Dark nodules abundant. Chiefly a mixture of moderate yellowish brown and dusky yellowish brown or dark yellowish brown.

ZEOLITE CLAY
Smear slides 1-95, 2-100, 3-75, 4-74, 5-71, 6-85, 6-114, CC

Texture		Composition	
Clay	79%	Clay	70%
Silt	19%	Zeolite	30%
Sand	2%	Nannos	Tr.
		Quartz	Tr.

BULK X-RAY (87.3 m)

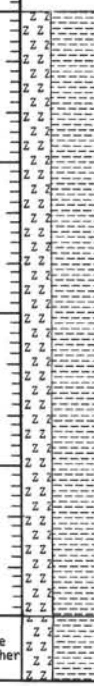
Clinoptilolite	40%
Palygorskite	18%
Montmorillonite	17%
Mica	12%
Quartz	11%
Gypsum	2%

Site 259 Hole Core 11 Cored Interval: 93.5-103 m

AGE: CRETACEOUS (based on Radiolaria); LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN

ZONE: (F) Upper Albian; (N) Prediscosphaera cretacea (Middle Albian)

SECTION	FORAMS	NANNOS	RADIOLARIA	LITHOLOGY	LITHO. SAMPLE
1	?			VOID	-130 10YR5/4 10YR4/2
2	NONE	NONE	AVVP		GZ 74; -75 10YR5/4 10YR4/2
3	NONE	RP	AVVP		XR 26-28; -75 10YR5/4
4	RM	RP	AVVP		-75 10YR5/4
5	RM	AP	AVVP		10YR5/4; GZ 74 -75; 10YR7/4; -145 N1
Core Catcher	FM	CP	CVVP		-CC 10YR5/4



LITHOLOGIC DESCRIPTION

Highly deformed stiff clay. Chiefly moderate yellowish brown with streaks and patches of dark yellowish brown.

ZEOLITE CLAY
Smear slides 1-130, 2-75, 3-75, 4-75, 5-75

Texture		Composition	
Clay	76%	Clay and cristobalite	68%
Silt	23%	Zeolite	30%
Sand	1%	Nannos	1%
		Heavy minerals	1%
		Quartz, feldspar	Tr.
		Iron oxide	Tr.

NANNO BEARING ZEOLITE CLAY
Smear slides 5-145, CC

Composition	
Clay	60%
Zeolite	25%
Opaques	10%
Nannos	5%
Feldspar	Tr.

BULK X-RAY (96.8 m)

Clinoptilolite	29%
Cristobalite	19%
Palygorskite	16%
Montmorillonite	15%
Quartz	13%
Mica	4%
Tridymite	2%
Plagioclase	1%
K-feldspar	1%

Explanatory notes in chapter 1

Site 259 Hole Core 12 Cored Interval: 103.0-112.5 m

AGE: LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN

ZONE: (F) Upper Albian; (N) Prediscosphaera cretacea (Middle Albian)

SECTION	FORAMS	NANNOS	RADIOLARIA	OTHERS	LITHO. SAMPLE	
1	RM	AP	AVVP		-75	10YR5/4
2	RM	AP	AVVP	Cs O	GZ -75	74 10YR5/4
3	RM	AP	AVVP		XR; -75	26-28; 10YR5/4
4	RM	AP	AP		-75	10YR5/4; 10YR5/4
5	NONE	AP	AVVP		GZ -75	74
6	RM	CP	AVVP		-75; -130	10YR5/4; 5Y7/2; 5YR5/6; 5Y5/2
Core Catcher	RM	CM	FVVP		-CC	5GY6/1

METERS: 0.5, 1.0

LITHOLOGIC DESCRIPTION

Highly deformed stiff clay. Chiefly moderate yellowish brown with streaks of grayish orange and light brown. Greenish gray at base. Grades from zeolite clay at top to zeolite and nanno rich clay at bottom.

ZEOLITE AND NANNO RICH CRISTOBALITE CLAY
Smear slides 1-75, 2-75, 4-75, 5-75, 6-75, 6-130, CC

Texture		Composition	
Clay	77%	Clay and cristobalite	60%
Silt	22%	Zeolite	25%
Sand	1%	Nannos	15%
		Heavy minerals	Tr.

BULK X-RAY (106.3 m)

Cristobalite	26%
Clinoptilolite	22%
Calcite	15%
Montmorillonite	12%
Quartz	9%
Palygorskite	9%
Mica	3%
Tridymite	2%
K-feldspar	1%
Plagioclase	1%

Site 259 Hole Core 13 Cored Interval: 112.5-122 m

AGE: LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN

ZONE: (F) Upper Albian; (N) Prediscosphaera cretacea (Middle Albian)

LITHOLOGY 0.5 m zero section

SECTION	FORAMS	NANNOS	RADIOLARIA	OTHERS	LITHO. SAMPLE	
1	RM	AP	AVVP		-80; -89	5GY6/1 5YR5/6
2	RM	AP	AVVP	Cs	GZ	5GY6/1 74 5YR5/6
3					XR	26-28; 5GY6/1 5YR5/6
4						5GY6/1 5YR5/6
5	RM	AM	AVVP		GZ	5GY6/1 5YR5/6 74
6	RM	AM	CVVP	Cs	-50; -100	10YR5/4 5GY6/1; 5GY6/1
Core Catcher	RM	CM	CVVP		-CC	

METERS: 0.5, 1.0

LITHOLOGIC DESCRIPTION

Extremely deformed stiff clay. Fragments of greenish gray clay smeared with light brown clay.

ZEOLITE AND CLAY RICH NANNO OOZE
Smear slides 1-80, 1-89, CC

Texture		Composition	
Clay	76%	Nannos	50%
Silt	23%	Clay and cristobalite	30%
Sand	1%	Zeolite	20%
		Forams	Tr.

BULK X-RAY (115.8 m)

Calcite	35%
Cristobalite	21%
Clinoptilolite	16%
Montmorillonite	8%
Quartz	7%
Palygorskite	5%
Mica	3%
K-feldspar	2%
Tridymite	1%
Plagioclase	1%

Explanatory notes in chapter 1

Site 259 Hole Core 14 Cored Interval: 122-131.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	LITHO. SAMPLE	
LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN	(F) Upper Albian (N) Prediscosphaera cretacea (Middle Albian)	?				1	-75	10YR5/4
		RM	CM	AVVP		2	GZ -75	74 5G6/1
		RM		AVVP	Cs 0	3	XR; -75	26-28; 5G6/1 10YR5/4
		RM		CVVP		4	-75	5G6/1 N1 streaks
		RG		AVVP		5	GZ -75	5G6/1 74
		CG		AVVP		6	-75	5G6/1
		CG	AG	CVVP	Ms 0	Core Catcher	CC	5G6/1 10YR5/4

LITHOLOGY: VOID (top of section 1)

LITHOLOGIC DESCRIPTION

Greatly disturbed stiff clay. Chiefly moderate yellowish brown to 1.5 meters then chiefly greenish gray with some admixed moderate yellowish brown.

ZEOLITE AND CLAY RICH NANNO OOZE
Smear slides 1-75, 2-75, 3-75, 4-75, 5-75, CC

Texture		Composition	
Clay	73%	Nannos	50%
Silt	26%	Clay and cristobalite	30%
Sand	1%	Zeolite	20%
		Dolomite rhombs	1%
		Heavy minerals	Tr.
		Carb. frags.	Tr.

BULK X-RAY (125.3 m)

Calcite	53%
Cristobalite	18%
Palygorskite	8%
Quartz	7%
Montmorillonite	7%
Mica	3%
K-feldspar	2%
Plagioclase	2%

Site 259 Hole Core 15 Cored Interval: 131.5-141 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	LITHO. SAMPLE	
LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN	(F) Upper Albian (N) Prediscosphaera cretacea (Middle Albian)	CM		FVVP	0	1	-75	
		AM		CVVP		2	GZ -75	74
		?				3	XR; -75	26-28
		AM		AVVP	0	4	-75	
		RM		AVVP	Cs 0	5	GZ -75	74
		FM		AVVP	0	6	-75; -119	
		FM	CM	FP	0	Core Catcher	CC	

LITHOLOGY 0.4 m zero section; VOID (in section 3)

LITHOLOGIC DESCRIPTION

Highly deformed and brecciated stiff nanno ooze. Chiefly light brown in upper half and olive gray and greenish gray in lower half.

ZEOLITE RICH CLAY BEARING NANNO OOZE
Smear slides 1-75, 2-75, 3-75, 4-75, 6-75, 6-119, CC

Texture		Composition	
Clay	75%	Nannos	72%
Silt	25%	Zeolite	15%
		Clay and cristobalite	10%
		Forams	2%
		Dolomite rhombs	1%
		Feldspar	Tr.

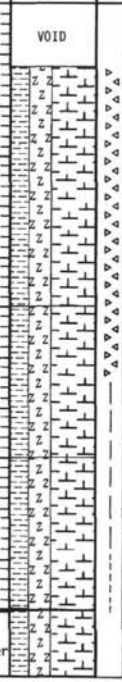
BULK X-RAY (134.8 m)

Calcite	51%
Clinoptilolite	15%
Cristobalite	14%
Montmorillonite	6%
Mica	5%
Quartz	5%
Plagioclase	2%
K-feldspar	1%
Tridymite	1%

Explanatory notes in chapter 1

Site 259 Hole Core 16 Cored Interval: 141-150.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN	(F) Upper Albian (N) Prediscosphaera cretacea (Middle Albian)	?				1	0.5, 1.0	VOID		-102	10YR5/4 5GY6/1
		RM		CVVP	O	2				GZ -74	74 10YR5/4
										XR	26-28
					Cs O	3				-105	10YR5/4
		FM		AVVP						-132	5GY6/1
						4				-75	5Y5/6 5G6/1 layered
		AM		FVVP							
		FM	CM	FVVP	O	Core Catcher				-CC	5YR5/6



Deformed and brecciated stiff ooze. Some layering preserved in Section 4. Chiefly moderate yellowish brown with mixed greenish gray in smears and patches.

CLAY AND ZEOLITE BEARING NANNO OOZE
Smear slides 1-102, 2-74, 3-105, 4-75

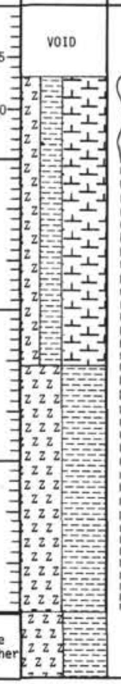
Texture		Composition	
Clay	77%	Nannos	79%
Silt	23%	Zeolite	10%
		Clay and cristobalite	10%
		Forams	1%
		Heavy minerals	Tr.

BULK X-RAY (144.3 m)

Calcite	65%
Cristobalite	9%
Clinoptilolite	8%
Montmorillonite	6%
Palygorskite	5%
Quartz	4%
Mica	3%

Site 259 Hole Core 17 Cored Interval: 150.5-160 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, MIDDLE-UPPER ALBIAN	(F) Upper Albian (N) Prediscosphaera (M. Albian) or younger	benthonic and rare planktonic				1	0.5, 1.0	VOID		-110	5YR5/6
											10YR5/4
			FP	AVVP	Cs O	2				GZ -75	74
											5YR4/4
										XR	10YR5/4 26-28
LOWER CRETACEOUS, UPPER APTIAN (?)		poor arenaceous	NONE	AVVP	Cs	3				-75	5YR4/4
										-141	5Y5/6
						4				-83	5GY5/2
										-111	
LOWER CRETACEOUS, UPPER APTIAN		RP	FP	NONE		Core Catcher				-CC	



Weakly deformed stiff ooze and clay. Chiefly light brown and yellowish brown in upper part and olive brown and yellow green in lower part. Upper part chiefly clay and zeolite rich nanno ooze and lower part clay and zeolite rich clay

ZEOLITE CLAY
Smear slides 3-75, 3-141, 4-83, CC

Composition	
Clay	68%
Zeolite	30%
Dolomite rhombs	1%
Nannos	1%
Quartz, feldspar, heavy minerals	Tr.

CLAY AND ZEOLITE BEARING NANNO OOZE
Smear slides 1-110, 2-75

Texture		Composition	
Clay	73%	Nannos	73%
Silt	27%	Clay	15%
		Zeolites	10%
		Heavy minerals	1%
		Forams	1%
		Dolomite rhombs	Tr.

BULK X-RAY (153.8 m)

Calcite	67%
Montmorillonite	8%
Clinoptilolite	8%
Palygorskite	7%
Quartz	5%
Mica	3%
Plagioclase	2%

Explanatory notes in chapter 1

Site 259 Hole Core 18 Cored Interval: 160-169.5 m

AGE: LOWER CRETACEOUS, APTIAN

SECTION	FORAMS	NANNOS	RADIOLARIA	OTHERS	METERS	LITHOLOGY	LITHO. SAMPLE	
1	poor arenaceous				0.5, 1.0	VOID	-135	5GY5/2, 10GY5/2; 10GY5/2
2	poor arenaceous		FVVP				GZ -75	N2, 5GY2/1, 74
3	poor arenaceous		FP	D Pm			XR; -75	26-28; N2, 5GY2/1
Core Catcher	RP	NONE	CVP	Fd			-CC	N2, 5GY2/1

LITHOLOGIC DESCRIPTION

Weakly deformed stiff clay. Color yellow green at top - sharp break to grayish green at 1-110 cm and to N2 black 2-10 cm.

ZEOLITE CLAY
Smear slide 1-135

Composition	
Clay	73%
Zeolite	25%
Heavy minerals	2%
Glauconite?	Tr.

CRISTOBALITE CLAY
Smear slides 2-75, 3-75, CC

Texture		Composition	
Clay	88%	Clay and cristobalite	96%
Silt	12%	Heavy minerals	3%
		Zeolite	1%

BULK X-RAY (163.3 m)

Montmorillonite	46%
Cristobalite	33%
Quartz	8%
Mica	5%
K-feldspar	4%
Pyrite	2%
Plagioclase	1%

Site 259 Hole Core 19 Cored Interval: 169.5-179 m

AGE: LOWER CRETACEOUS, UPPER APTIAN

SECTION	FORAMS	NANNOS	RADIOLARIA	OTHERS	METERS	LITHOLOGY	LITHO. SAMPLE	
1	poor arenaceous		RP		0.5, 1.0		-87	N2 layered; 10GY3/2; N2
2	poor arenaceous		RP				XR; -72 GZ	26-28; N2; 74; 5Y2/1
3	poor arenaceous		RP				-74	N2; 5Y5/2 streak
4	poor arenaceous		RP	D Fd Pm		VOID; VOID	-76	N2
5	poor arenaceous		RP				-71 GZ	N2 74
Core Catcher	FP	NONE	FP	Fd			-CC	N2

LITHOLOGIC DESCRIPTION

Weakly deformed stiff to very stiff clay. Chiefly grayish black in color with some olive black.

CRISTOBALITE CLAY
Smear slides 1-87, 2-72, 3-74, 4-76, 5-71, CC

Texture		Composition	
Clay	84%	Clay and cristobalite	96%
Silt	16%	Heavy minerals	2%
		Zeolite	1%
		Quartz	1%
		Feldspar, chlorite, glauconite, nannos	Tr.

BULK X-RAY (172.8 m)

Montmorillonite	50%
Cristobalite	27%
Quartz	10%
Mica	6%
K-feldspar	3%
Plagioclase	2%
Chlorite	1%
Pyrite	1%

Explanatory notes in chapter 1

Site 259 Hole Core 20 Cored Interval: 179-188.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, UPPER APTIAN		poor arenaceous		RP		1	0.5, 1.0			-75	5GY4/1 & 5Y2/1; 5Y6/4 clot
				FP		2				GZ 74, -75	5GY4/1 5Y2/1
				FP		3				XR 26-28, -75	
				RP	D Pm	4				-75	5GY4/1 5Y2/1; 5Y7/2 nodule
				RP		5				-75, GZ 85	5GY4/1 5Y2/1
		FP	NONE	FVP		Core Catcher				-CC	

Weakly to moderately deformed stiff clay. Alternating layers of dark greenish gray and olive black.

CRISTOBALITE CLAY

Smear slides 3-75, 4-75, 5-75

Texture		Composition	
Clay	88%	Clay and cristobalite	97%
Silt	12%	Heavy minerals	2%
		Zeolite	1%
		Quartz, feldspar,	Tr.

BULK X-RAY (182.3 m)

Montmorillonite	38%
Cristobalite	23%
Quartz	17%
Mica	8%
K-feldspar	7%
Plagioclase	3%
Kaolinite	2%
Pyrite	1%
Chlorite	1%

Site 259 Hole Core 21 Cored Interval: 188.5-198 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, UPPER APTIAN		poor arenaceous		RVVP		1	0.5, 1.0			-75	5GY4/1 5Y2/1
				FP		2				-32, GZ 74, -75	5Y7/2 nodule
				FVVP	D Fd Pm	3				-15, XR 26-28, GZ 74, -75	5Y7/2 specks
						4					5GY4/1 5Y2/1
						5				GZ 74	
						6		VOID			
		FP	NONE	FP		Core Catcher		VOID		-CC	

Weakly to strongly disturbed clay - soupy in part. Chiefly interlayered greenish gray and olive black clay.

CRISTOBALITE CLAY

Smear slides 1-75, 2-75, 3-75, CC

Texture		Composition	
Clay	86%	Clay and cristobalite	95%
Silt	14%	Zeolite	2%
		Quartz	1%
		Feldspar	1%
		Heavy minerals	1%
		Chlorite, mica	Tr.

BULK X-RAY (191.8 m)

Montmorillonite	43%
Cristobalite	28%
Quartz	12%
Mica	7%
K-feldspar	5%
Plagioclase	3%
Kaolinite	1%
Chlorite	1%

Explanatory notes in chapter 1

Site 259 Hole Core 22 Cored Interval: 198-207.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, UPPER APTIAN		poor arenaceous		RVP		1	0.5 1.0	VOID		-80	5GY4/1 & 5Y2/1
				FP		2		Dol		GZ -80	nodule 5Y6/4 74
		FM	NONE	FP		Core Catcher					

Weakly to strongly deformed mixture of greenish gray and olive black stiff clay. A few dolomite-rich nodules are dusky yellow in color.

CRISTOBALITE CLAY
Smear slides 1-80, 2-80

Texture		Composition	
Clay	82%	Clay and cristobalite	94%
Silt	18%	Zeolite	2%
		Quartz	1%
		Feldspar, heavy minerals, chlorite	Tr.

Site 259 Hole Core 23 Cored Interval: 207.5-217 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY 0.5 m zero section	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, UPPER APTIAN		poor arenaceous		FVVP		1	0.5 1.0			-75	5Y7/2 specks; 5GY4/1 & 5Y2/1; 5Y7/2 specks
				FVP		2				-39 GZ -75	5Y6/4 streak 74
				FVVP	D Pm	3				XR -38 -75	5Y7/2 specks 26-28; 5Y7/2 specks; 5Y7/2 nodule; 5GY4/1 5Y2/1
				FVP		4				-75	5Y7/2 nodule 5Y7/2 nodule
				FVVP		5				-39 GZ -75	5Y6/4 specks 74; 5Y7/2 specks
						6				-70	
		FP	NONE	FVP		Core Catcher					

Weakly to strongly deformed stiff clay. Soupy from 6-77 to 6-121. Chiefly dark greenish gray and olive black layers with specks and nodules of yellowish gray.

CRISTOBALITE SILTY CLAY
Smear slides 1-75, 2-75, 3-75, 4-75, 5-75, 6-70

Texture		Composition	
Clay	69%	Clay and cristobalite	98%
Silt	31%	Zeolite	1%
		Heavy minerals	1%
		Quartz, feldspar, chlorite, dolomite rhombs	Tr.

BULK X-RAY (210.8 m)

Montmorillonite	42%
Cristobalite	25%
Quartz	14%
Mica	8%
K-feldspar	5%
Plagioclase	3%
Chlorite	2%
Pyrite	1%

Explanatory notes in chapter 1

Site 259 Hole Core 24 Cored Interval: 217-226.5 m

AGE: LOWER CRETACEOUS, APTIAN

ZONE:

FOSSIL CHARACTER: FORAMS: poor arenaceous; RADIOLARIA: FVP (Section 1), FP (Section 2)

Core Catcher: CM, NONE, CP

SECTION / METERS: 1 (0.5, 1.0), 2, 3, 4, 5, Core Catcher

LITHOLOGY: VOID

LITHO. SAMPLE: -18, -75, GZ -78, XR, -75

18	5Y7/2 nodules
	5Y7/2 specks
GZ	74
	5Y7/2 specks
XR	26-28
	5Y7/2 nodule
	5Y7/2

LITHOLOGIC DESCRIPTION

Moderately to strongly disturbed stiff clay. Chiefly dark greenish gray and olive black with yellowish gray nodules and specks. Nodules are dolomite cemented clay.

CRISTOBALITE CLAY

Smear slides 1-75, 2-78, 3-75, CC

Texture		Composition	
Clay	85%	Clay and cristobalite	97%
Silt	15%	Zeolite	1%
		Quartz	1%
		Heavy minerals	1%
		Feldspar, chlorite	Tr.

BULK X-RAY (220.3 m)

Montmorillonite	38%
Cristobalite	34%
Quartz	11%
Mica	6%
K-feldspar	4%
Plagioclase	4%
Kaolinite	3%

Site 259 Hole Core 25 Cored Interval: 226.5-236 m

AGE: LOWER CRETACEOUS, LOWER APTIAN

ZONE:

FOSSIL CHARACTER: FORAMS: poor arenaceous; RADIOLARIA: CUP (Section 1), CP (Section 2), FP (Section 3); OTHERS: D Pm (Section 3)

Core Catcher: CM, NONE, CP

SECTION / METERS: 1 (0.5, 1.0), 2, 3, 4, 5, 6, Core Catcher

LITHOLOGY: VOID, VOID

LITHO. SAMPLE: -75, GZ -75, -125, XR, -90, -60

	5Y6/4 nodule
75	5Y7/2 specks
GZ	74
125	5GY4/1 & 5Y2/1
XR	26-28
	5GY4/1 & 5Y2/1
	5GY4/1 & 5Y2/1

LITHOLOGIC DESCRIPTION

Weakly to strongly deformed stiff clay. Locally soupy in lower parts. Chiefly dark greenish gray and olive black with specks and nodules of yellowish gray.

CRISTOBALITE CLAY

Smear slides 1-75, 2-75, 2-125, 3-90, 4-60

Texture		Composition	
Clay	86%	Clay and cristobalite	99%
Silt	14%	Heavy minerals	1%
		Quartz, feldspar, zeolite	Tr.

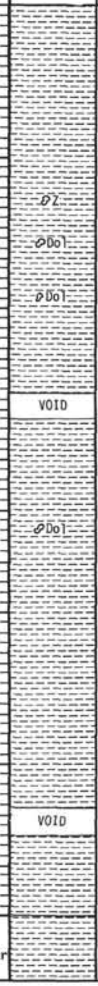
BULK X-RAY (229.8 m)

Montmorillonite	38%
Cristobalite	38%
Quartz	9%
Mica	5%
K-feldspar	4%
Gypsum	3%
Plagioclase	2%
Kaolinite	1%
Halite	Tr.

Explanatory notes in chapter 1

Site 259 Hole Core 26 Cored Interval: 236-245.5 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY 0.4 m zero section	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, LOWER APTIAN		poor arenaceous		FP		1	0.5, 1.0			-89	5Y6/4 smear	
				RVP	D Pm	2		⌀Z, ⌀Dol, ⌀Dol		-43, GZ, -90	74; 5Y7/2 nodule; 5Y7/2 nodules	
						3		VOID		XR, -78	26-28	
				RVP		4		⌀Dol		-105	5Y7/2 nodule	
				FP		5				GZ -75	74	
						6		VOID				
		CM	NONE	FP		Core Catcher				-CC		



Weakly to strongly deformed stiff clay. Locally soupy near base. Chiefly dark greenish gray and olive black with yellowish gray nodules of dolomite-cemented clay.

CRISTOBALITE SILTY CLAY
Smear slides 1-89, 2-43, 2-90, 3-78, 4-105, 5-75, CC

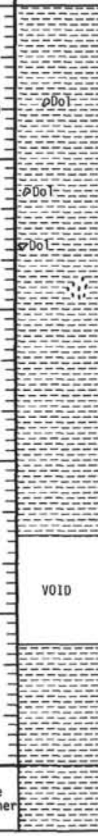
Texture		Composition	
Clay	74%	Clay and cristobalite	99%
Silt	26%	Heavy minerals	1%
		Quartz, feldspar, chlorite, zeolite	Tr.

BULK X-RAY (239.3 m)

Cristobalite	37%
Montmorillonite	32%
Quartz	13%
Mica	8%
K-feldspar	6%
Plagioclase	2%
Kaolinite	1%
Chlorite	1%

Site 259 Hole Core 27 Cored Interval: 245.5-255 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, LOWER APTIAN		poor arenaceous		FP		1	0.5, 1.0	⌀Dol		-110	5Y6/1	
						2		⌀Dol, ⌀Dol		GZ -75	5Y7/2 nodules; 74	
				RP	D Pm	3				XR, -70	5Y6/4 specks; 26-28	
				FP		4		VOID				
				RVP		5				GZ -80	74	
		CM	NONE	RVP		Core Catcher				-CC		



Moderately to strongly deformed stiff clay. Colors chiefly dark greenish gray and olive black with dolomite cemented nodules of yellowish gray. Some specks and patches of dusky yellow clay.

CRISTOBALITE CLAY
Smear slides 1-110, 2-75, 3-70, 5-80, CC

Texture		Composition	
Clay	79%	Clay and cristobalite	98%
Silt	19%	Quartz	1%
Sand	2%	Heavy minerals	1%
		Feldspar, chlorite, dolomite rhombs, zeolites	Tr.

BULK X-RAY (248.8 m)

Montmorillonite	39%
Cristobalite	39%
Quartz	11%
Mica	7%
K-feldspar	4%

Explanatory notes in chapter 1

Site 259 Hole Core 28 Cored Interval: 255-264.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, LOWER APTIAN		poor arenaceous		FP		1	0.5 / 1.0	⊘Dol		-55	N8 streak; 5Y7/2 specks
				RVP	D Pm	2				-70 GZ	74
				CP	Pm	3		⊘Dol, ⊘Dol		XR, -75	26-28; 5Y5/2 streak; N8 nodule
				RP		4					5GY4/1
						5		⊘Dol; VOID			5Y7/2 nodule
						6		VOID; ⊘Dol		-70	N8 nodule; N8 specks
		CM	NONE	RP		Core Catcher					

Weakly to moderately deformed stiff clay. Chiefly dark greenish gray and olive black in color with streaks and nodules of very light gray and yellowish gray.

<u>CRISTOBALITE CLAY</u>
Smear slides 1-55, 2-70, 3-75, 4-75, 6-70

Texture		Composition	
Clay	77%	Clay and cristobalite	98%
Silt	23%	Quartz	1%
		Heavy minerals	1%
		Feldspar, chlorite, zeolites	Tr.

BULK X-RAY (258.3 m)

Montmorillonite	40%
Cristobalite	34%
Quartz	15%
Mica	7%
K-feldspar	4%

Site 259 Hole Core 29 Cored Interval: 264.5-274 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, LOWER APTIAN		poor arenaceous				1	0.5 / 1.0	⊘Dol			5Y7/2 nodule
				FVP	D Pm	2		⊘Dol, ⊘Dol		GZ -75	74; 5Y7/2 nodule; N8
				RVP		3		⊘Dol		XR, -45, -52	26-28 nodule; 10YR5/4 nodule
						4		VOID			
						5					
						6					
		CM	NONE	RVP		Core Catcher				-CC	

Weakly to strongly deformed stiff clay with dolomite-cemented nodules. Chiefly dark greenish gray and olive black with yellowish gray and very light gray nodules.

<u>QUARTZ AND CRISTOBALITE RICH CLAY</u>
Smear slides 2-75, 3-45, CC

Texture		Composition	
Clay	78%	Clay and cristobalite	97%
Silt	22%	Quartz	1%
		Feldspar	1%
		Heavy minerals	1%
		Chlorite, dolomite rhombs, zeolite	Tr.

BULK X-RAY (267.8 m)

Montmorillonite	52%
Quartz	20%
Cristobalite	14%
Mica	11%
K-feldspar	3%

Explanatory notes in chapter 1

Site 259 Hole Core 30 Cored Interval: 274-283.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, LOWER APTIAN		poor arenaceous		RVP		1	0.5, 1.0	Dol, Dol		-70	10YR5/4 nodule; 10YR5/4 nodule
				RVVP		2		Dol, Dol		GZ -74, -95	N8; 10YR5/4 nodules; N8 nodule
				RVVP	D Pm	3		VOID		XR, -83	59-61
				NONE		4				-75	
				RVVP		5				GZ -75	74
				NONE		6				-75	
		CM	NONE	NONE		Core Catcher				CC	

Weakly to moderately disturbed stiff clay with dolomite-cemented nodules. Colors chiefly dark greenish gray and olive black with moderate yellowish brown nodules.

QUARTZ CLAY

Smear slides 1-70, 2-95, 3-83, 4-75, 5-75, 6-75, CC

Texture		Composition	
Clay	90%	Clay and micro-crystalline quartz	98%
Silt	10%	Quartz grains	1%
		Heavy minerals	1%
		Feldspar, chlorite, dolomite rhombs, zeolite	Tr.

BULK X-RAY (277.6 m)

Montmorillonite	50%
Quartz	42%
Mica	4%
K-feldspar	4%

Site 259 Hole Core 31 Cored Interval: 283.5-293 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, LOWER APTIAN	(Pm) Crybelosporites stylosus	poor arenaceous		RVVP		1	0.5, 1.0	Dol		-75	N7 nodule
				RVVP	D	2		Dol		GZ -75	74; 10YR5/4 nodules
				RVVP	Pm	3		Dol		XR, -75	26-28; 5Y5/2 nodule
						4				-75	
						5		VOID			
						6		VOID			
		CM	NONE	NONE		Core Catcher				CC	

Weakly to moderately deformed stiff to very stiff clay. Color chiefly dark greenish gray and olive black with nodules of moderate yellowish brown and light gray.

QUARTZ CLAY

Smear slides 1-75, 2-75, 3-75, 4-75, CC

Texture		Composition	
Clay	93%	Clay and micro-crystalline quartz	97%
Silt	7%	Quartz grains	1%
		Feldspar	1%
		Heavy minerals	1%
		Chlorite, dolomite rhombs, zeolite	Tr.

BULK X-RAY (286.8 m)

Quartz	52%
Montmorillonite	40%
Mica	4%
K-feldspar	4%

Explanatory notes in chapter 1

Site 259 Hole Core 32 Cored Interval: 293-302.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, LOWER APTIAN		poor arenaceous		NONE		1	0.5, 1.0	Dol		-75	5Y7/2 nodules	Moderately deformed stiff to very stiff clay. Chiefly dark greenish gray and olive black colors with yellowish gray and light gray nodules.
				NONE	D Pm	2		Dol, Dol		GZ -75	10YR5/4 nodule 74; N7 nodules	
						3						
						4		VOID				
						5						
						6		VOID				
		CM	NONE	NONE		Core Catcher						

QUARTZ CLAY
Smear slides 1-75, 2-75

Texture		Composition	
Clay	90%	Clay and micro-crystalline quartz	98%
Silt	10%	Feldspar	1%
		Heavy minerals	1%
		Quartz, chlorite, dolomite rhombs, zeolite	Tr.

Site 259 Hole Core 33 Cored Interval: 302.5-312 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
LOWER CRETACEOUS, LOWER APTIAN		poor arenaceous	NONE		D Pm	1	0.5, 1.0	VOID		+7; XR	5Y2/1; 92-94	Brecciated olive black stiff clay to 1-110 cm. Drilling change to basalt at 304.3 meters. Basalt breccia. Fragments highly altered with cores of gray N6 surrounded by altered glass 10GY5/2 grayish green and grayish black (N2). Veinlets and vugs of carbonate.
						2				XR	92-94	
						Core Catcher						

BULK X-RAY (303.4 m) (nodule)

Dolomite	52%
Quartz	28%
Montmorillonite	10%
K-feldspar	4%
Siderite	3%
Mica	2%
Pyrite	1%

BULK X-RAY (304.9 m) (veinlet)

Dolomite	84%
Montmorillonite	8%
Siderite	5%
Plagioclase	2%
Quartz	1%

Site 259 Hole Core 34 Cored Interval: 312-315 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
						1	0.5, 1.0	Q, Opal			5GY8/1 geode	Basalt breccia with fragments having gray core (N6) surrounded by altered glass of grayish green color (10GY5/2). Some zones of dark reddish brown (10R3/4). Veinlets of calcite. A few quartz geodes and opal crusts.
						Core Catcher						

Explanatory notes in chapter 1

Site 259 Hole Core 35 Cored Interval: 315-321.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
						1	0.5, 1.0	VOID			Basalt breccia. Fragments have gray (N7) cores and rims of greenish gray (5GY6/1). Freshest glass is black (N1). Some zones of dark reddish brown (10R2/4). Veinlets of calcite.
						2					10R3/4
						Core Catcher					

Site 259 Hole Core 36 Cored Interval: 321.5-326.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
						1	0.5, 1.0	VOID			Basalt breccia. Chiefly dark gray (N3) with rims of grayish green (10GY5/2). Some zones of dark reddish brown (10R3/4). Veinlets and patches of calcite and opal. Alteration decreases with depth.
						2					
						3					5G2/1
						4					N3

Site 259 Hole Core 37 Cored Interval: 326.5-331 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
						1	0.5, 1.0	VOID			Gray basalt (N3) with some patches of grayish red (10R4/2). Numerous veinlets of calcite.
						2				28	

Site 259 Hole Core 38 Cored Interval: 331-335.5 m

AGE	ZONE	FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
						1	0.5, 1.0			17	Basalt - dark greenish gray with veinlets of calcite. Non-vesicular, slightly porphyritic, fine-grained. Slightly brecciated. 5R4/2 patches
						2				118	
						3				121	

Explanatory notes in chapter 1

Site 259 Hole Core 39 Cored Interval: 335.5-337 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
						1	0.5, 1.0	(P)		85	Basalt - dark greenish gray (5GY4/1) with veinlets of calcite. Fine-grained, non-porphyritic. Rare pyrite crystals in cavities. A few reddish zones (5R4/2).

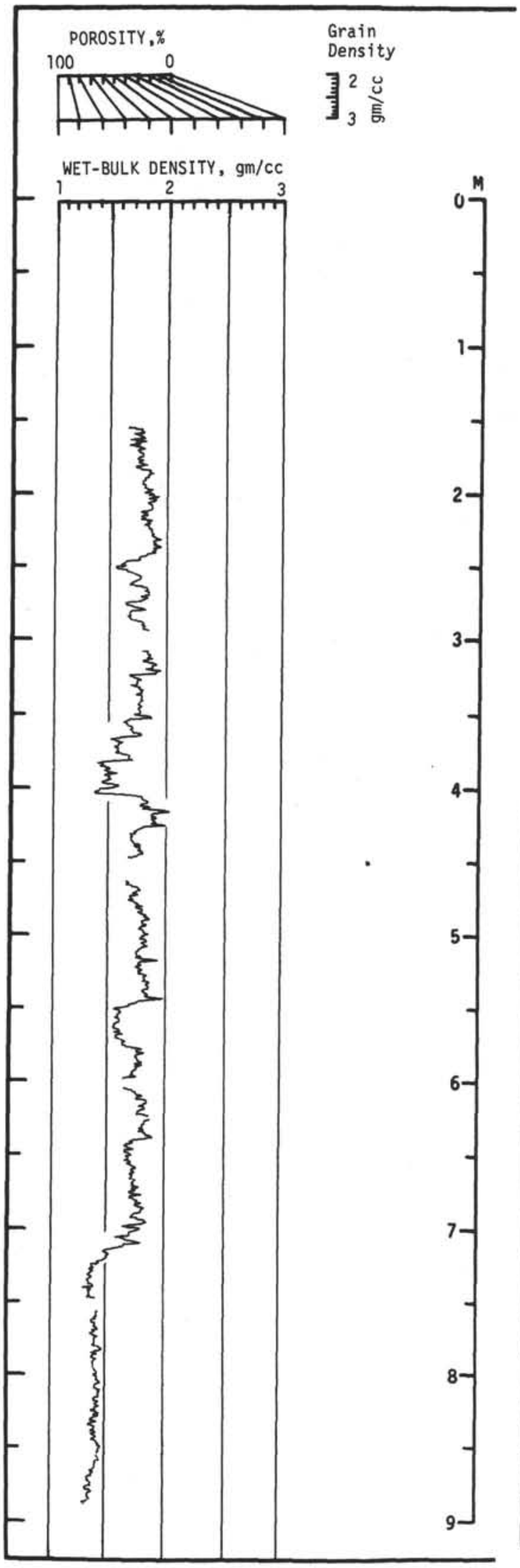
Site 259 Hole Core 40 Cored Interval: 337-340.5 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
						1	0.5, 1.0	VOID		140	Basalt. Dark greenish gray (5GY4/1) with veinlets of carbonate. Non-vesicular, fine-grained, non-porphyritic.
						2		VOID			
						Core Catcher		NOT CORED			

Site 259 Hole Core 41 Cored Interval: 340.5-346 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
						1	0.5, 1.0	VOID			Basalt. Medium light gray (N6) medium grained with a few plagioclase phenocrysts. Microvesicular. Calcite and chlorite(?) veinlets. A few red zones (5R4/2).
						2					
						3					
						Core Catcher		NOT CORED			

Explanatory notes in chapter 1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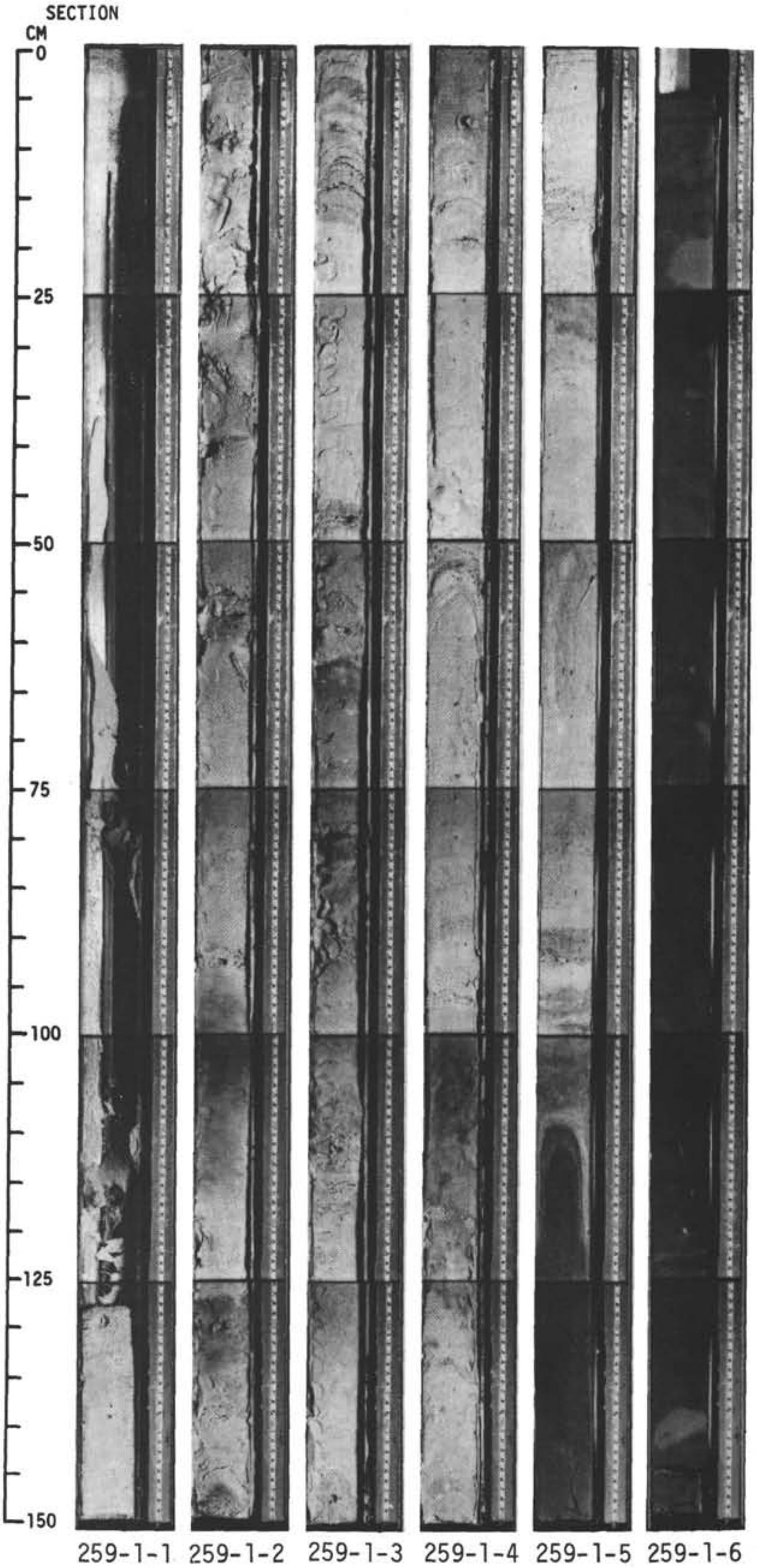
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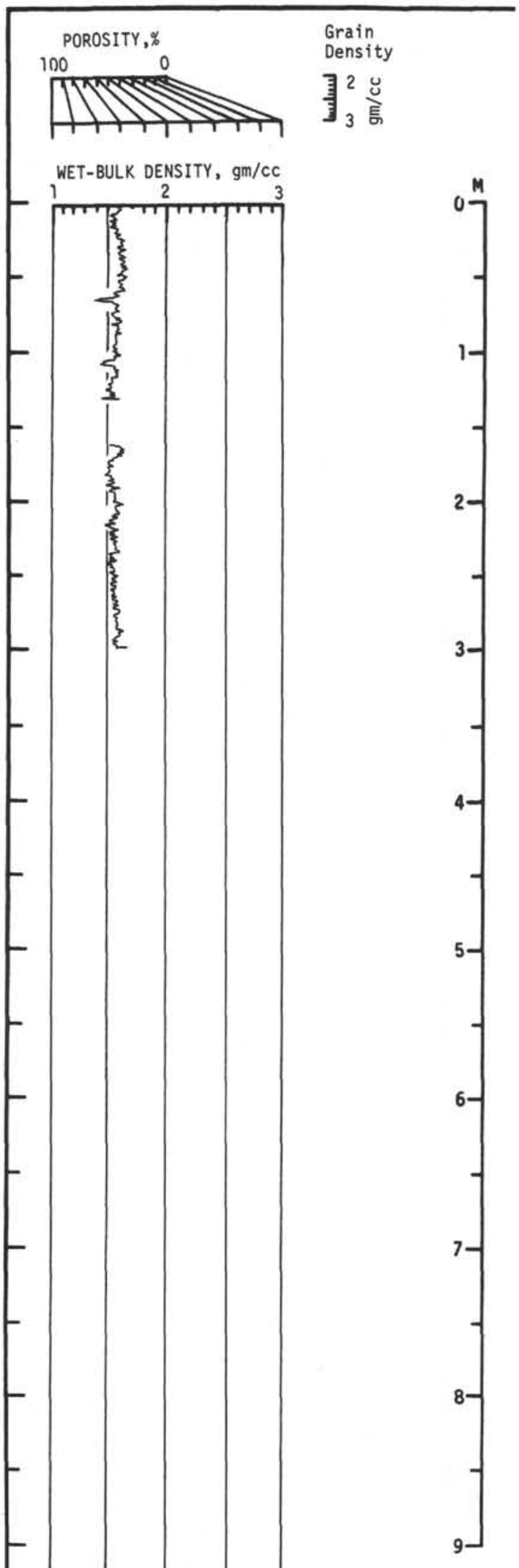
259-1-6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gm/cc
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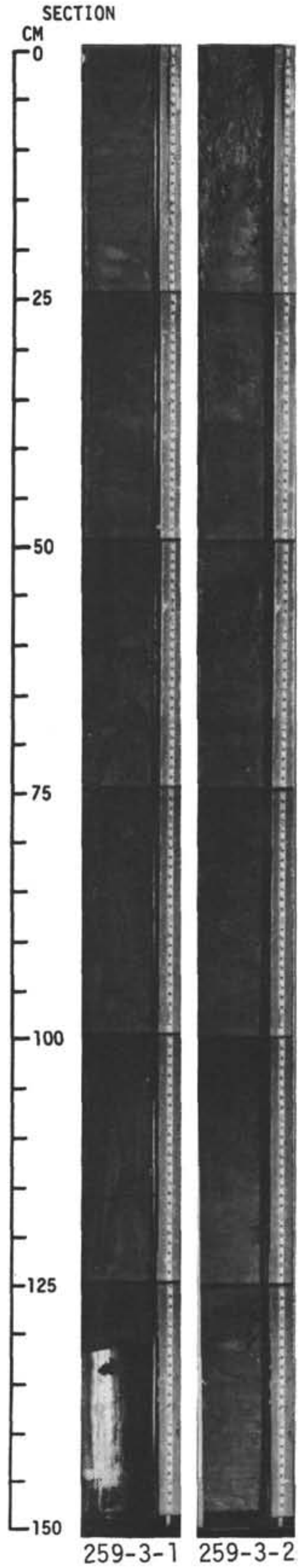
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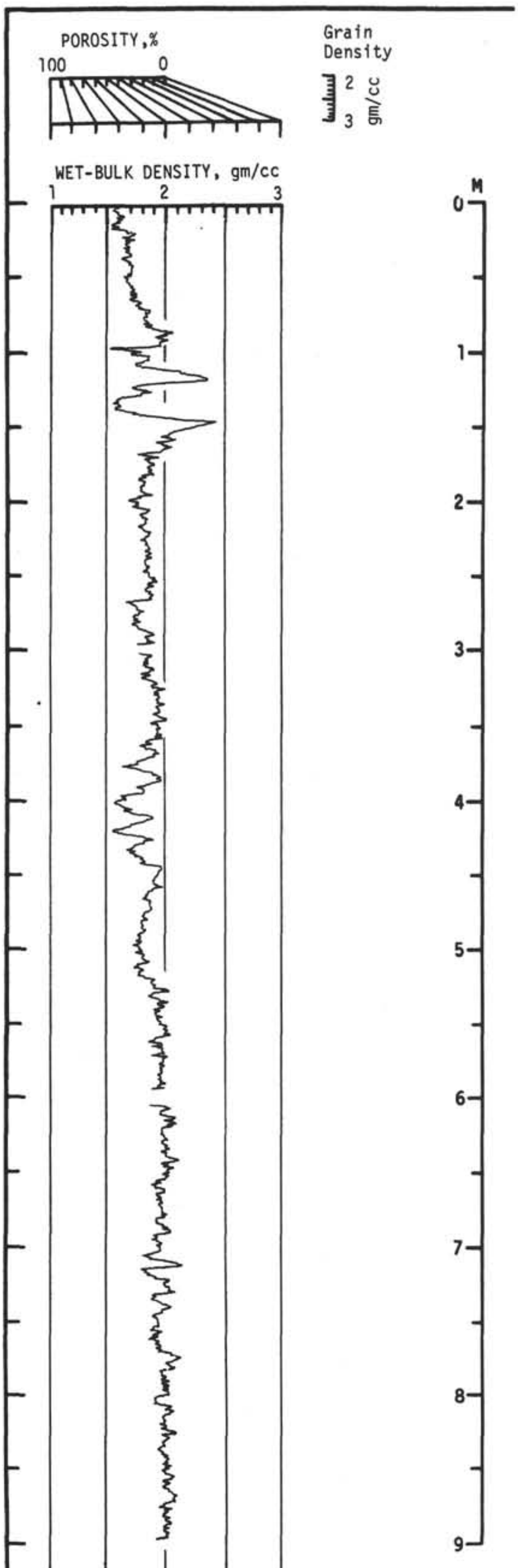

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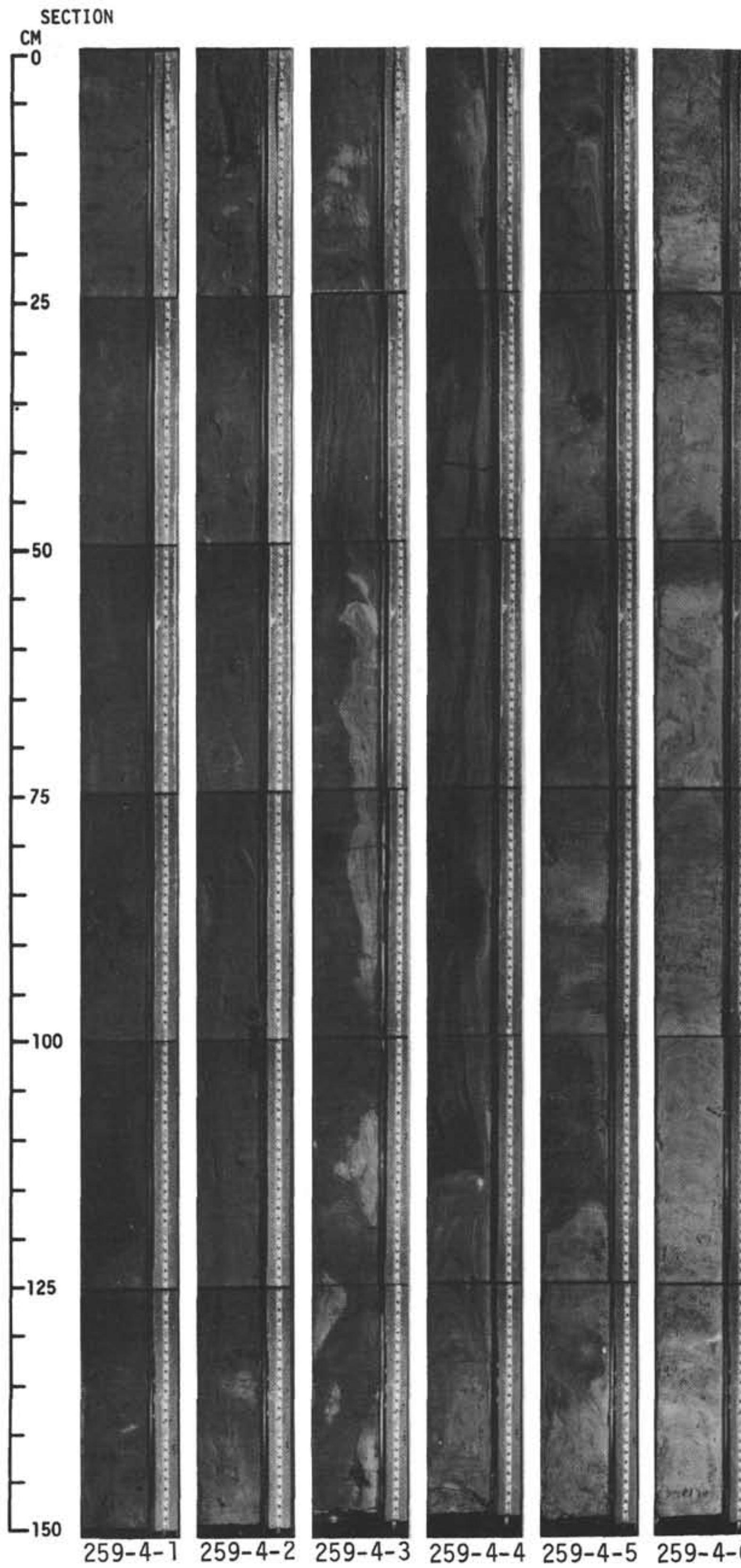

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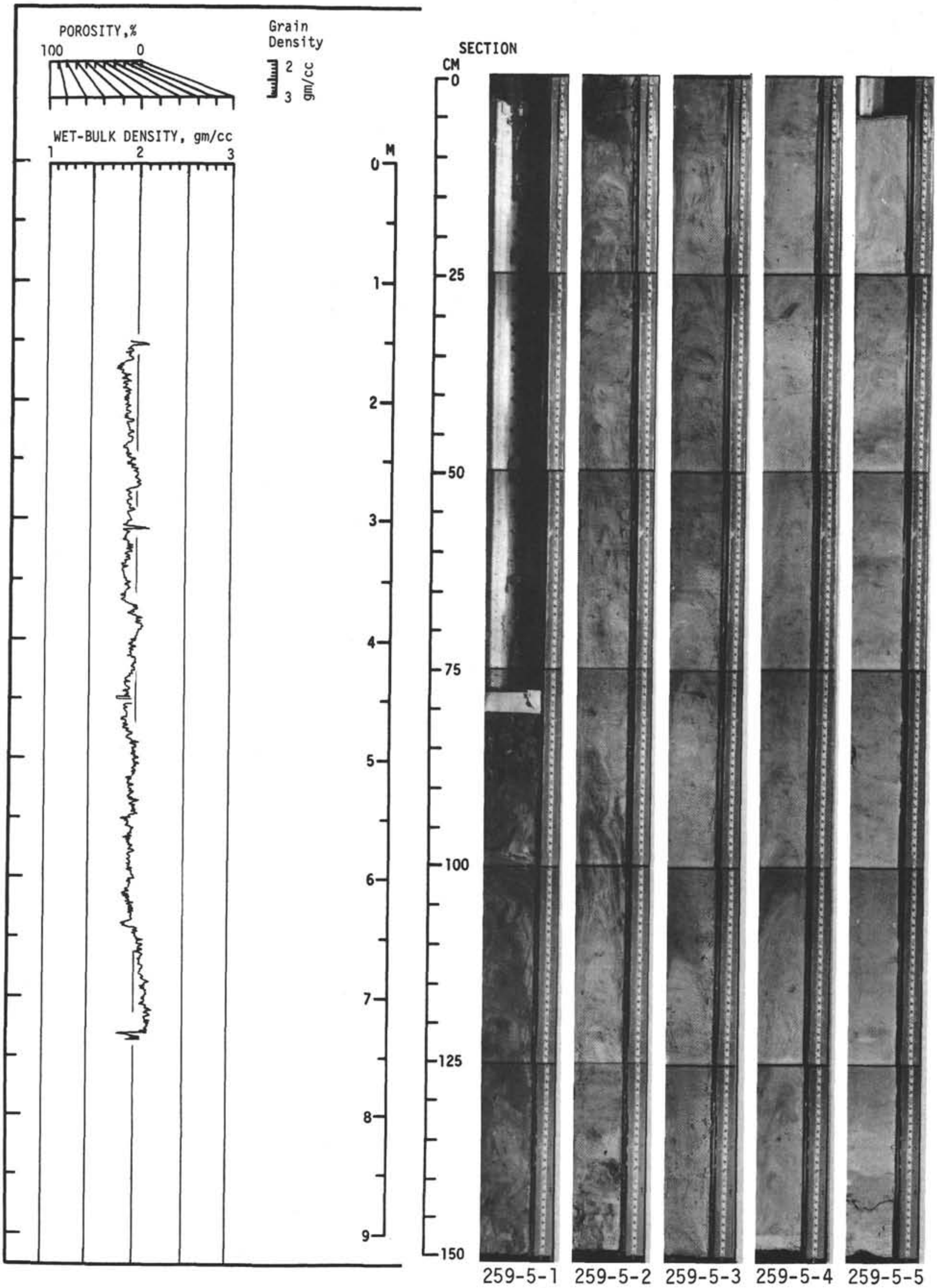
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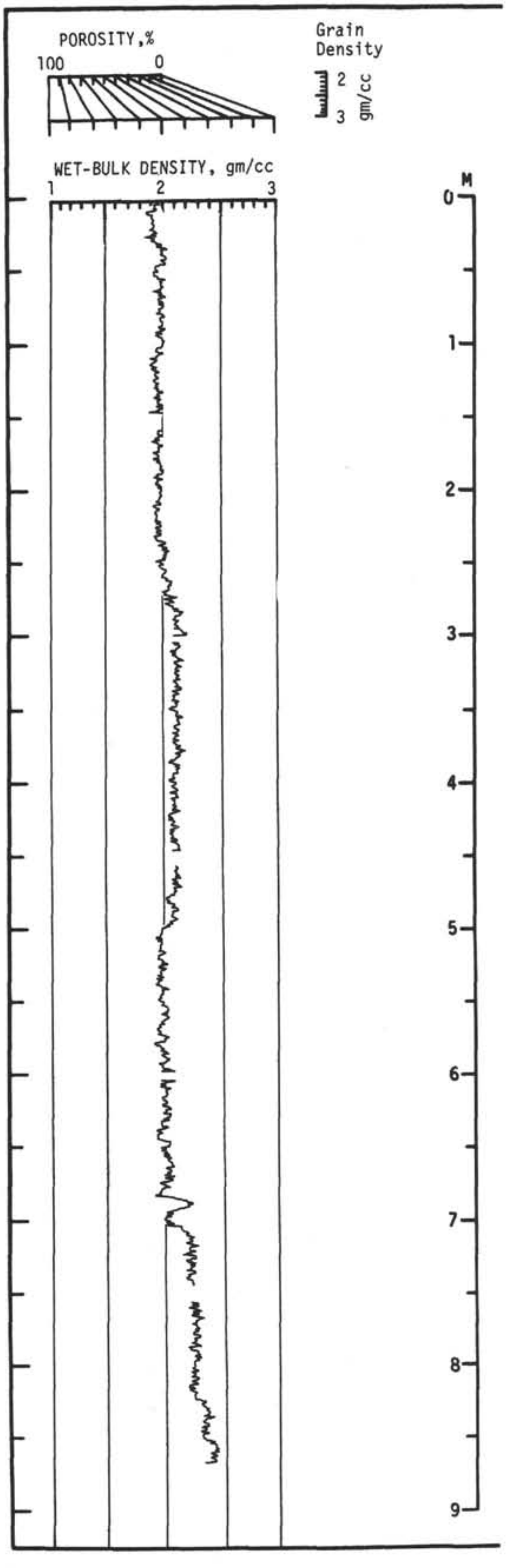

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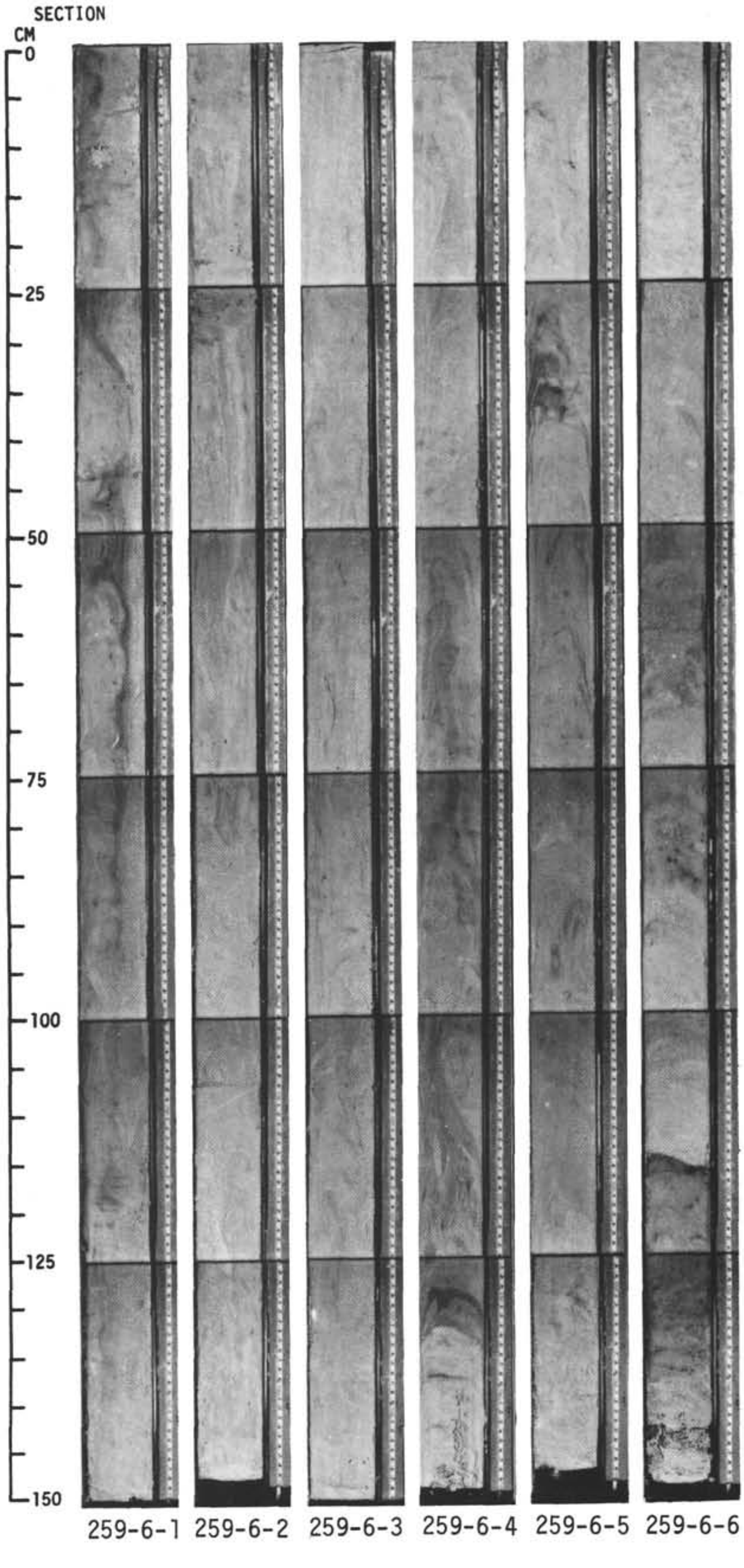

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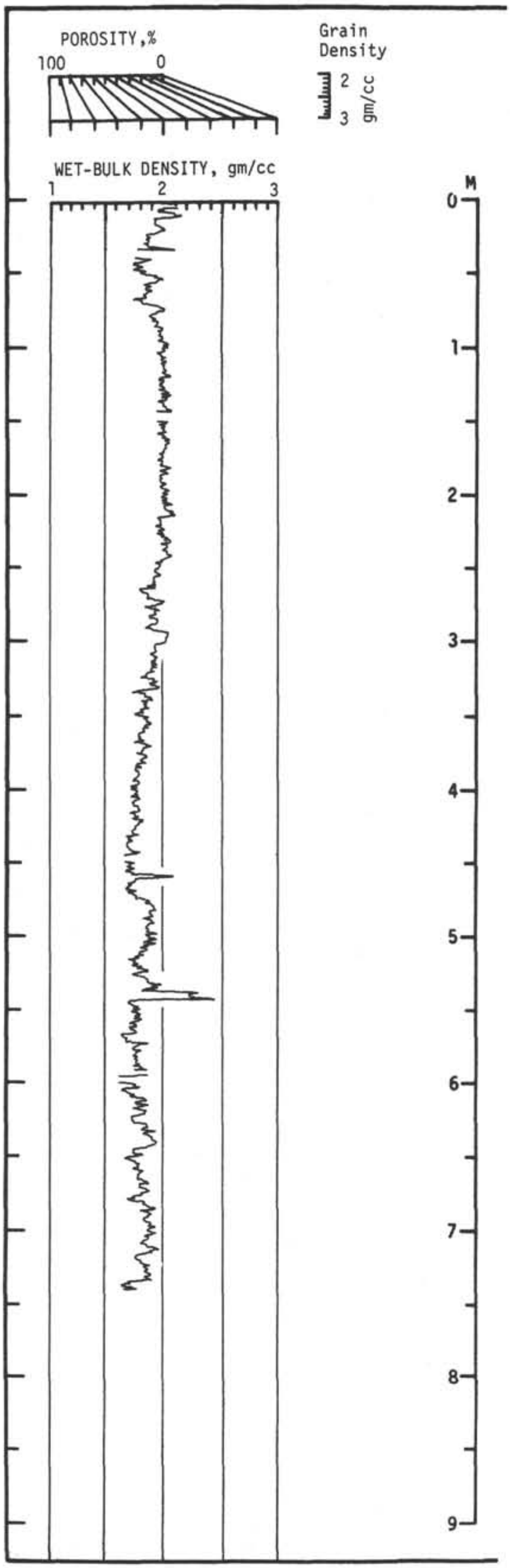
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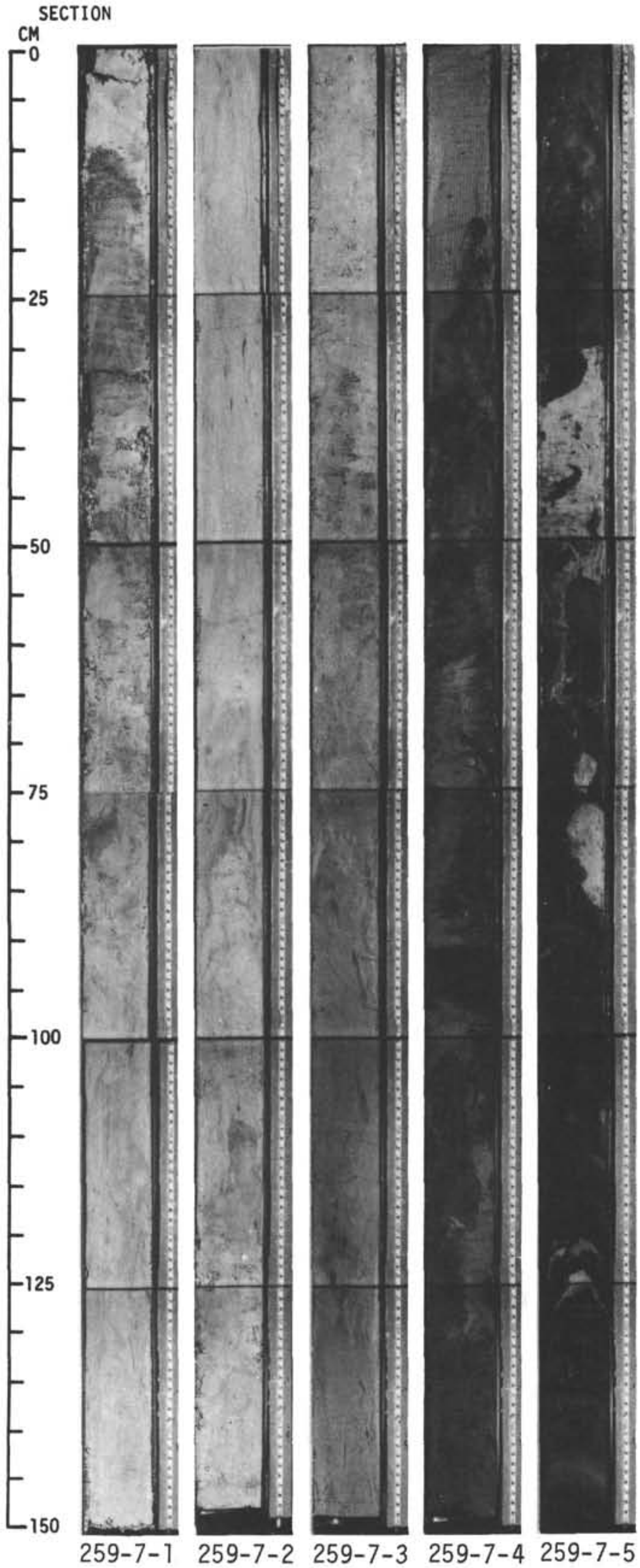
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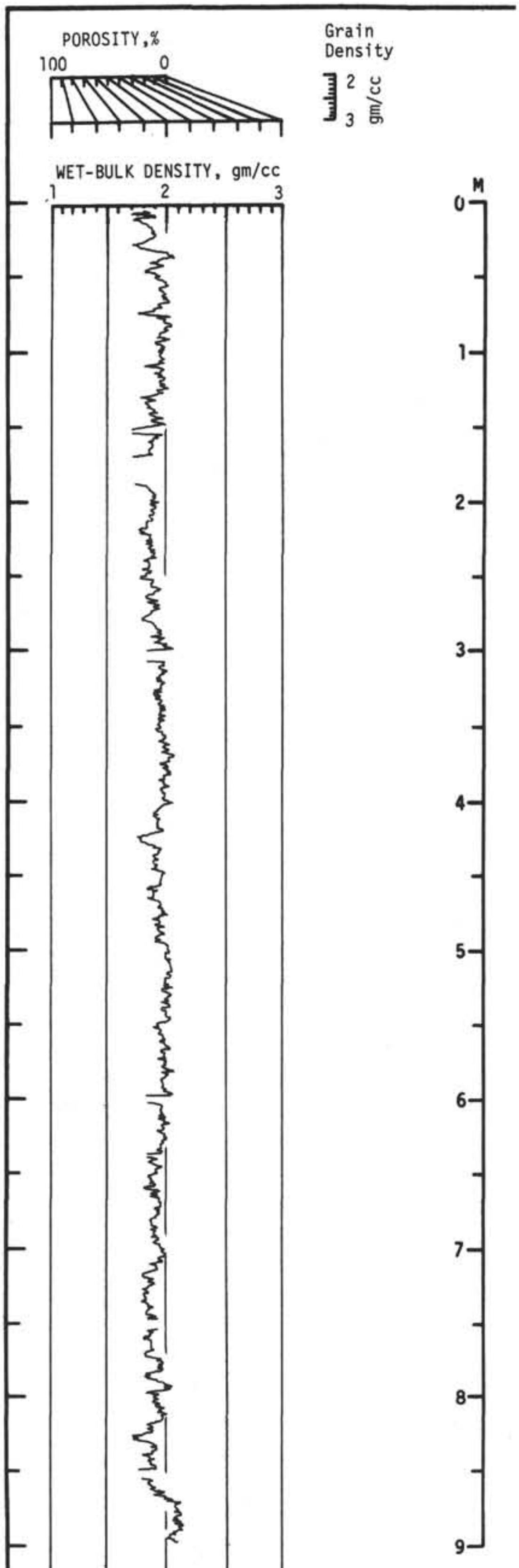

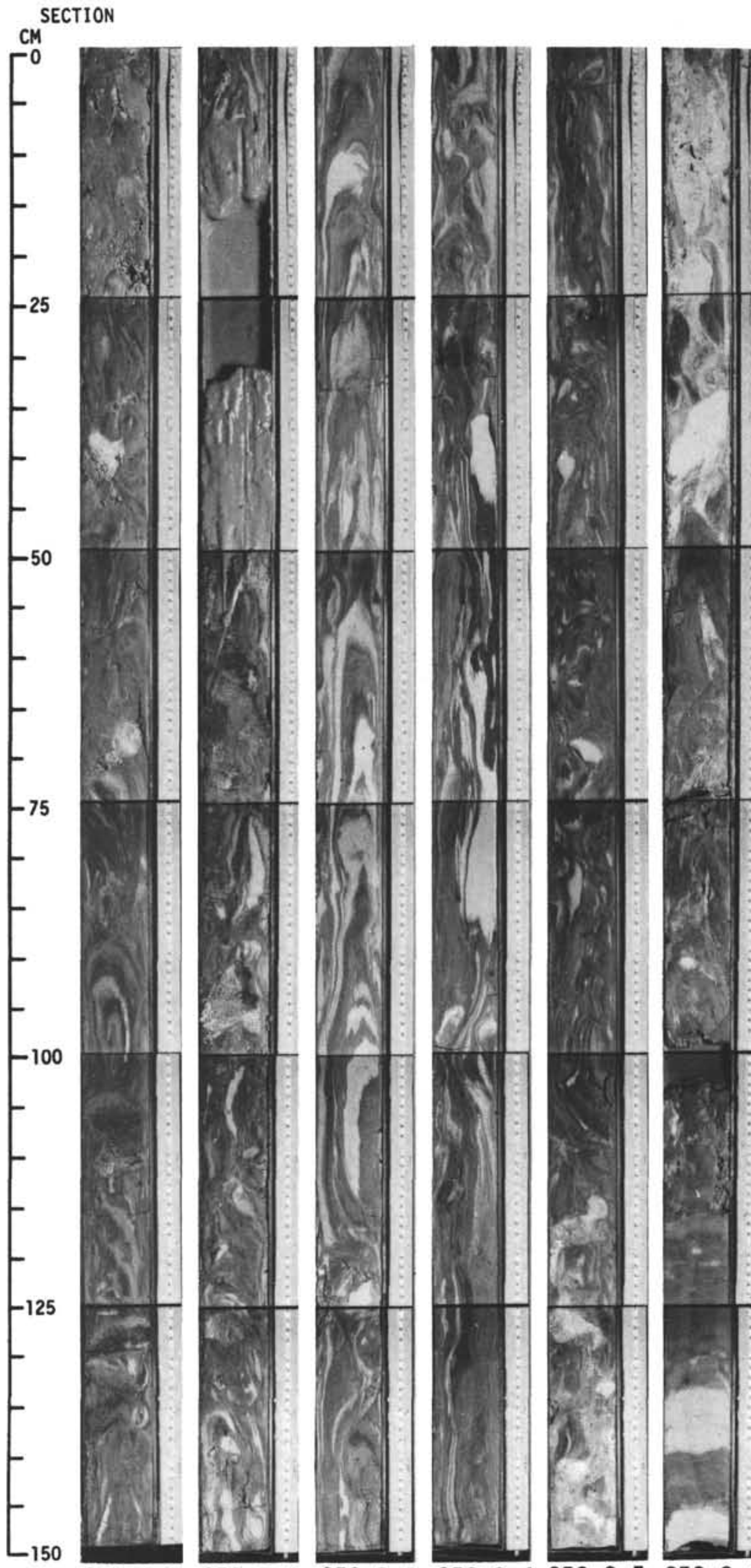

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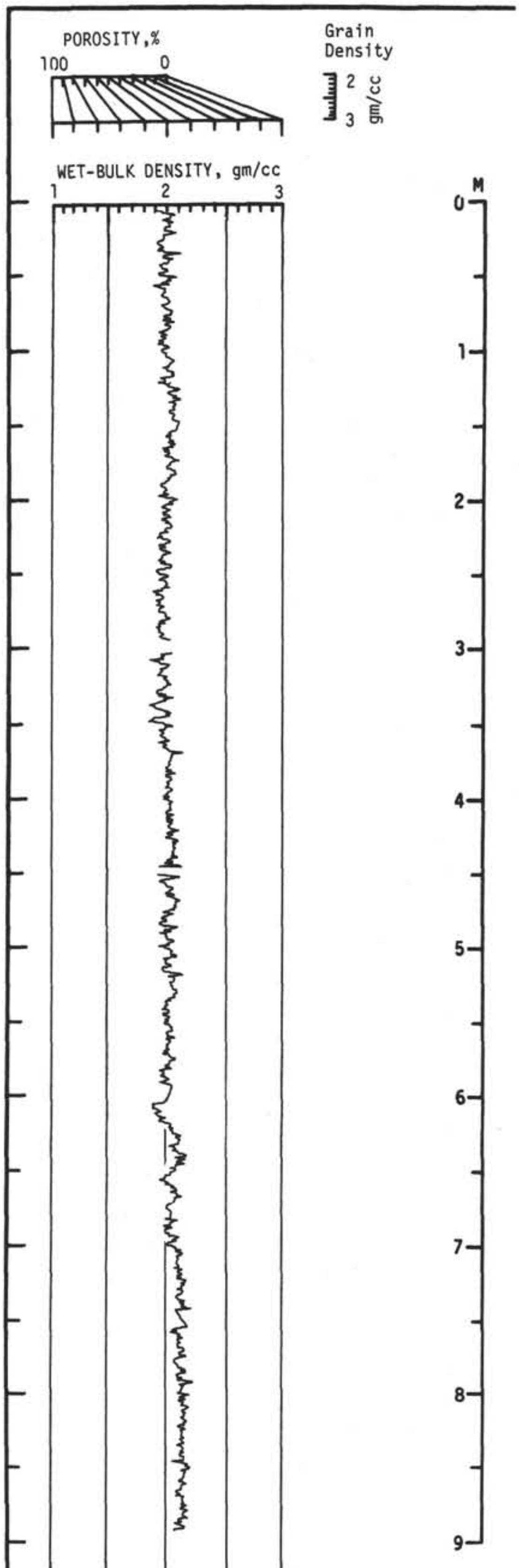
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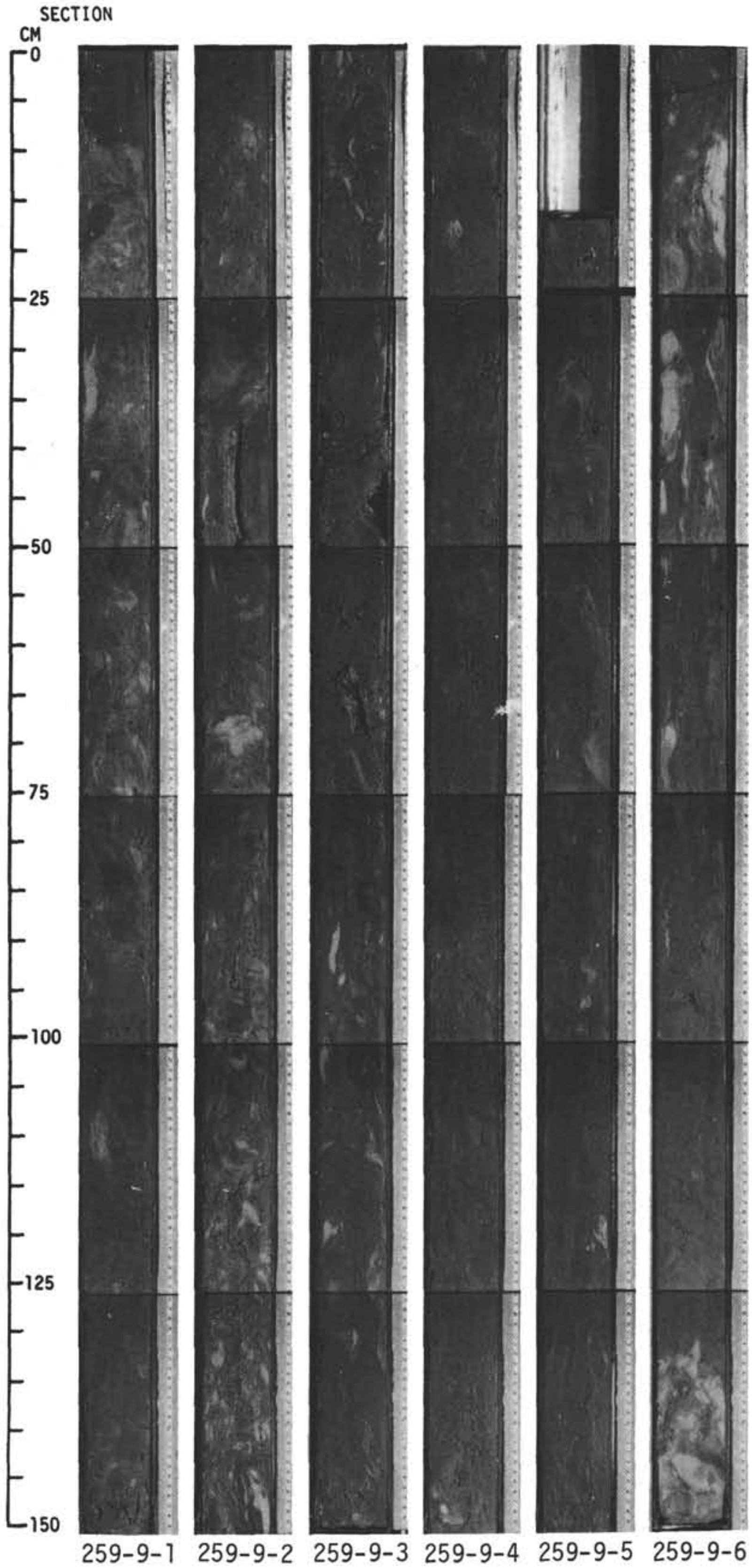
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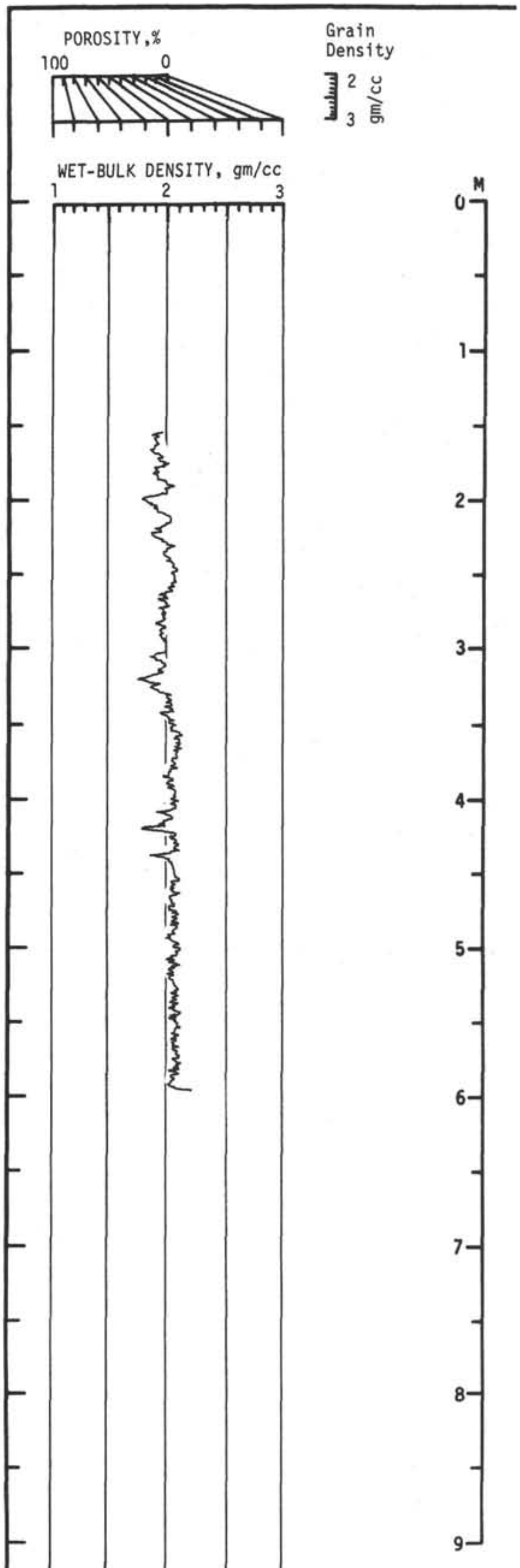

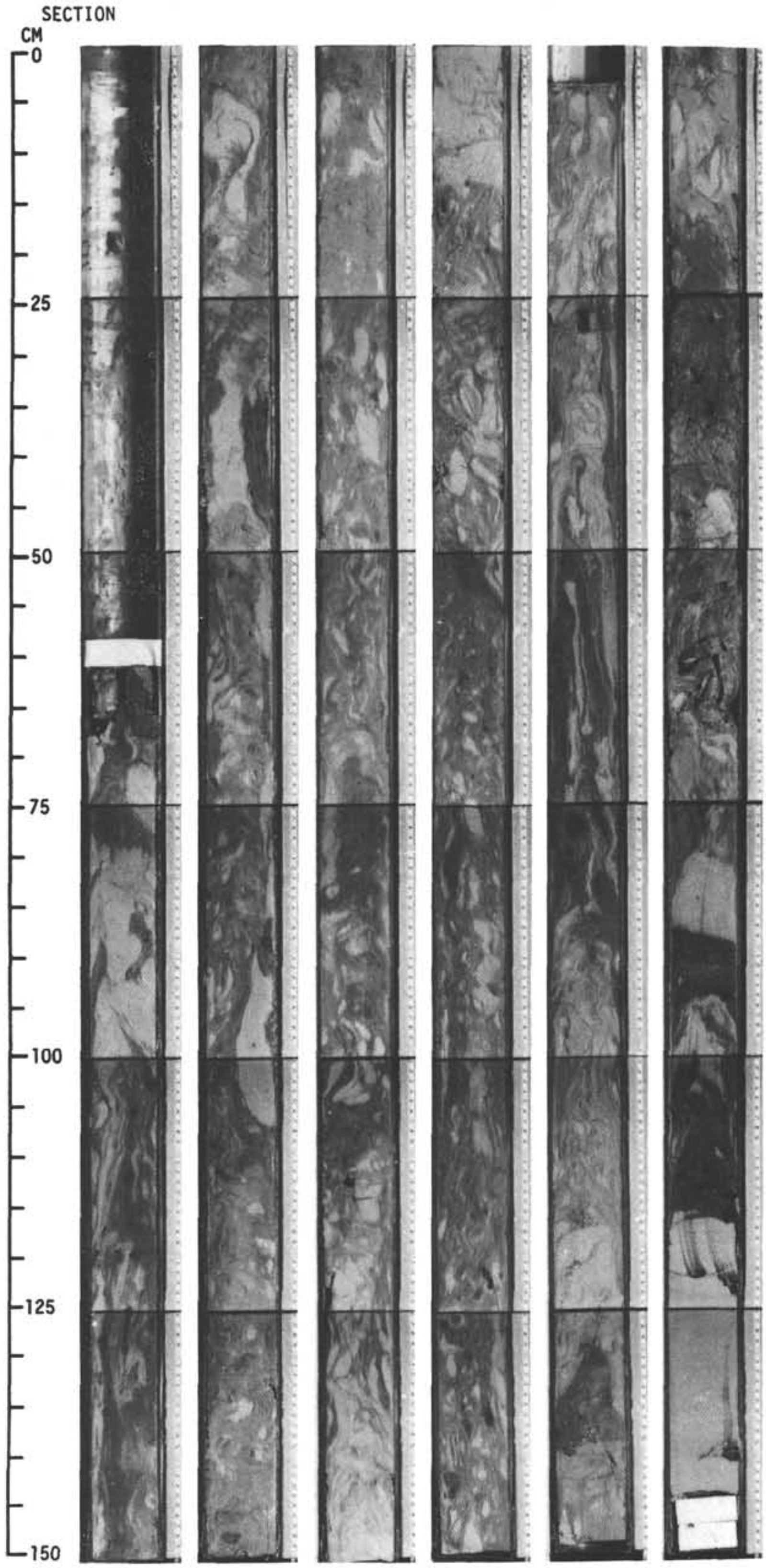

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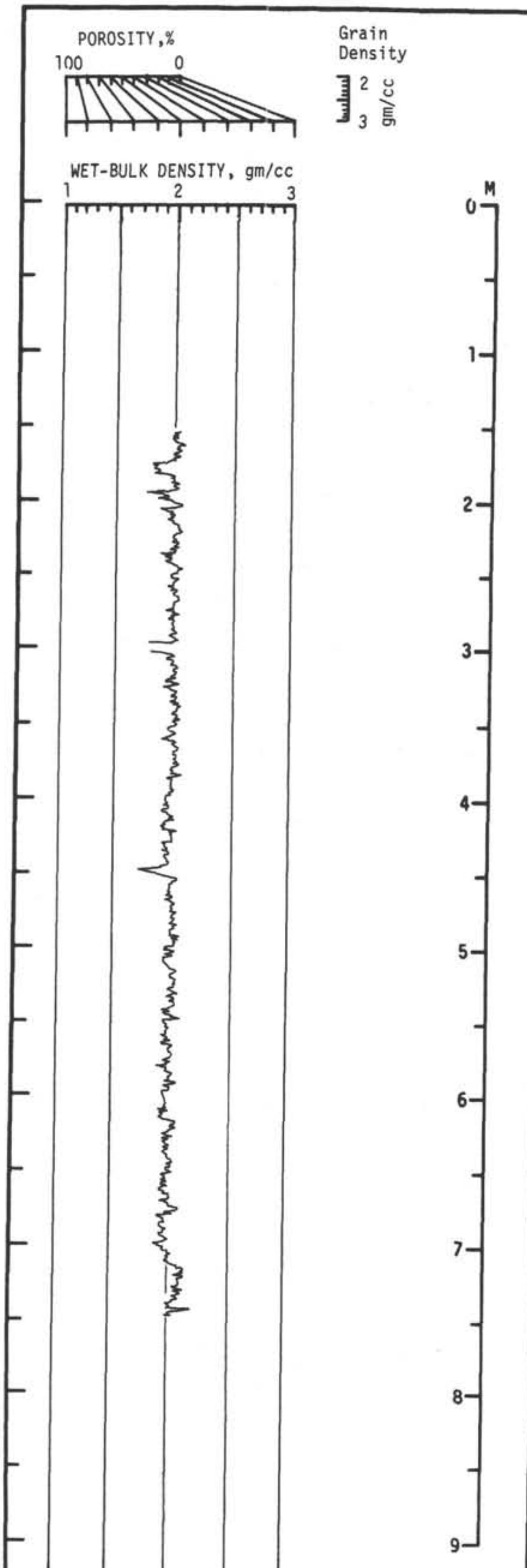

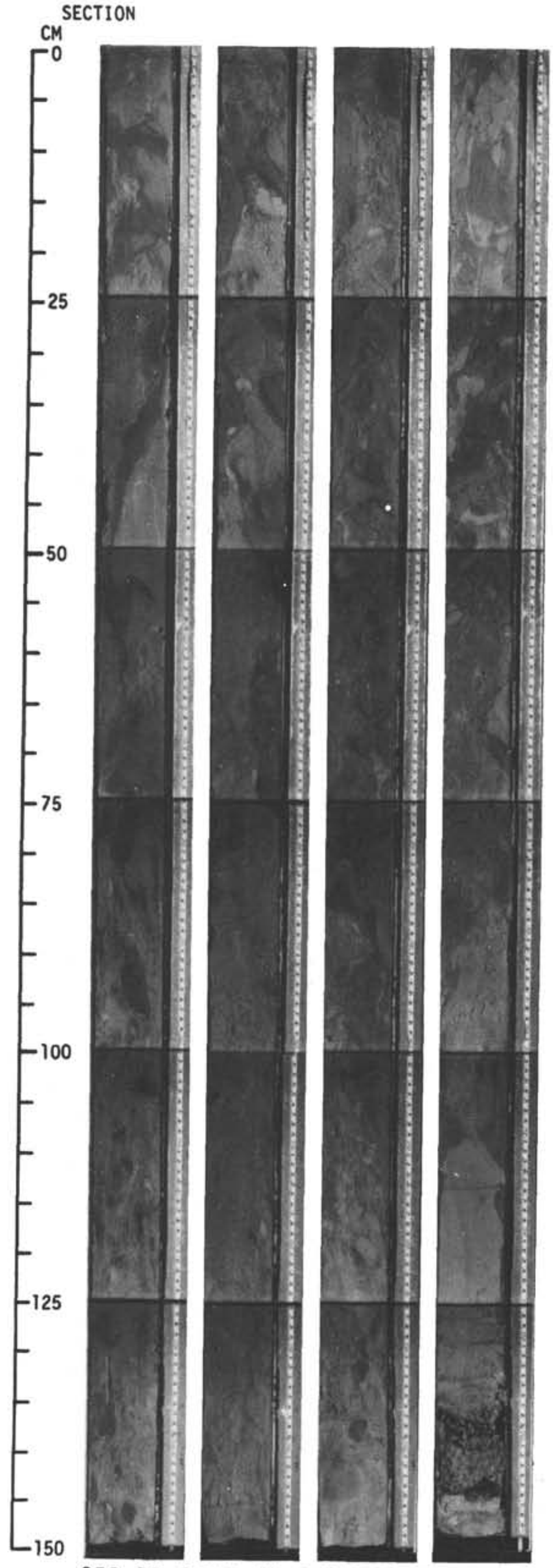

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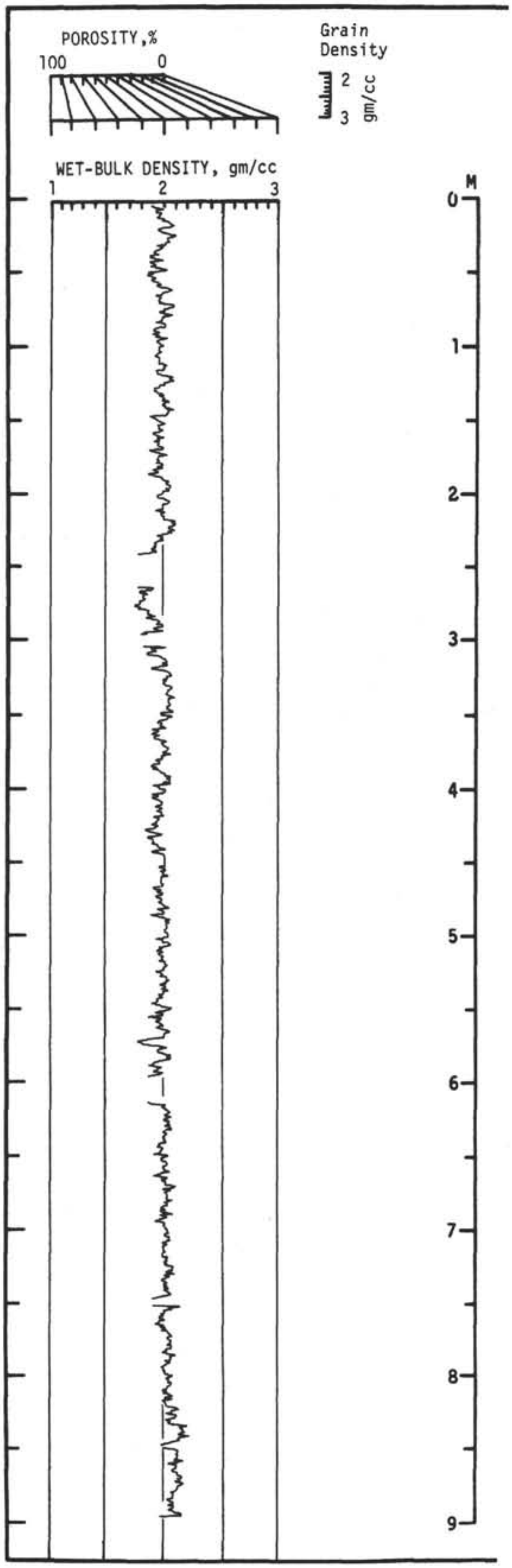
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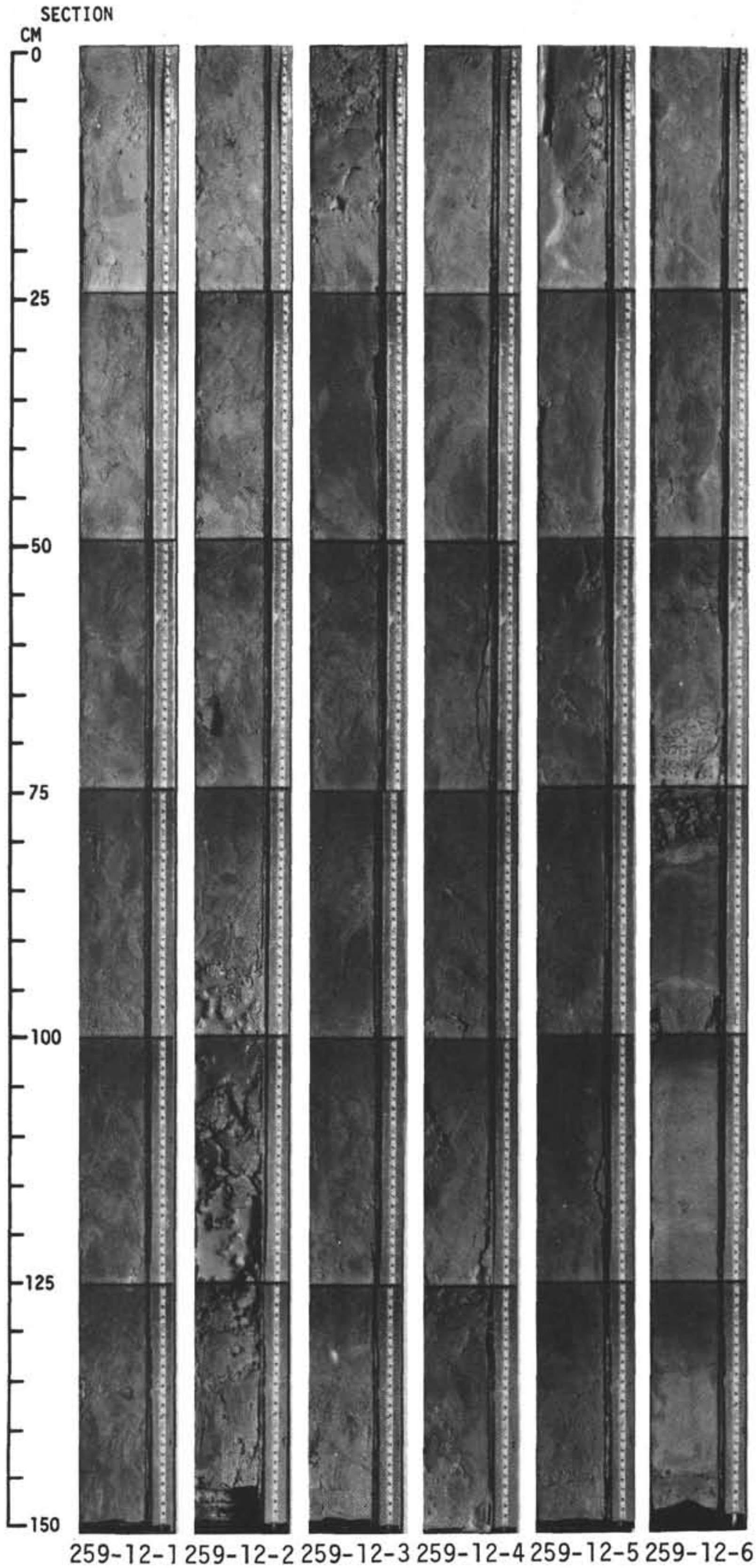
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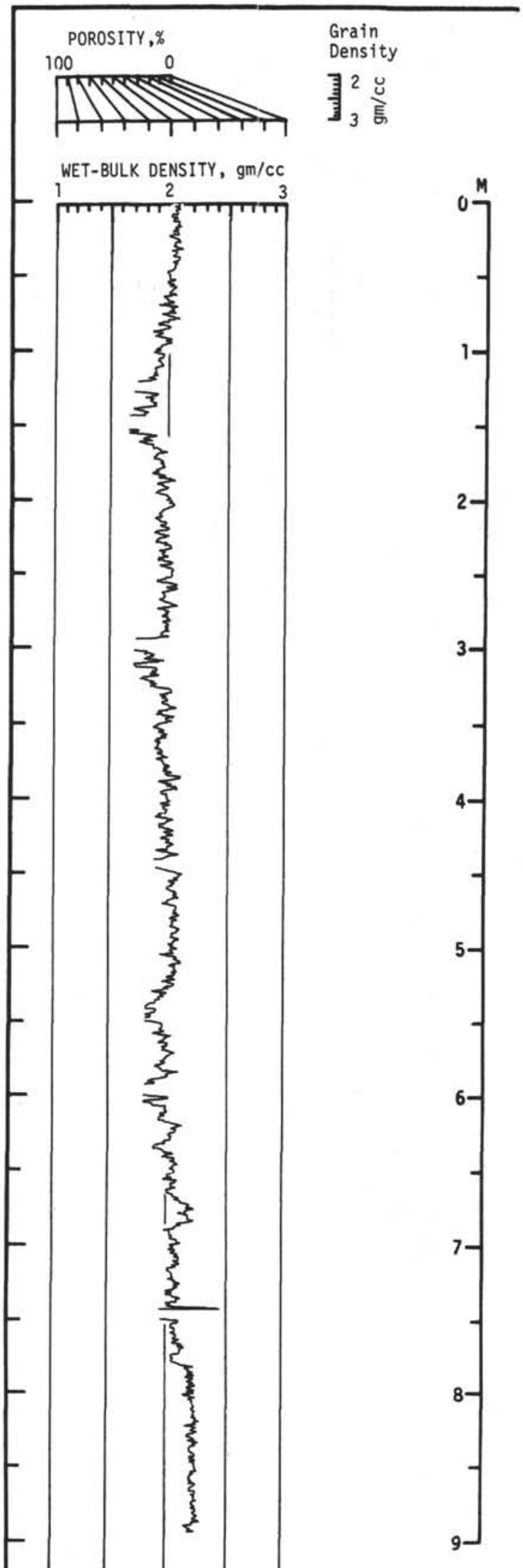

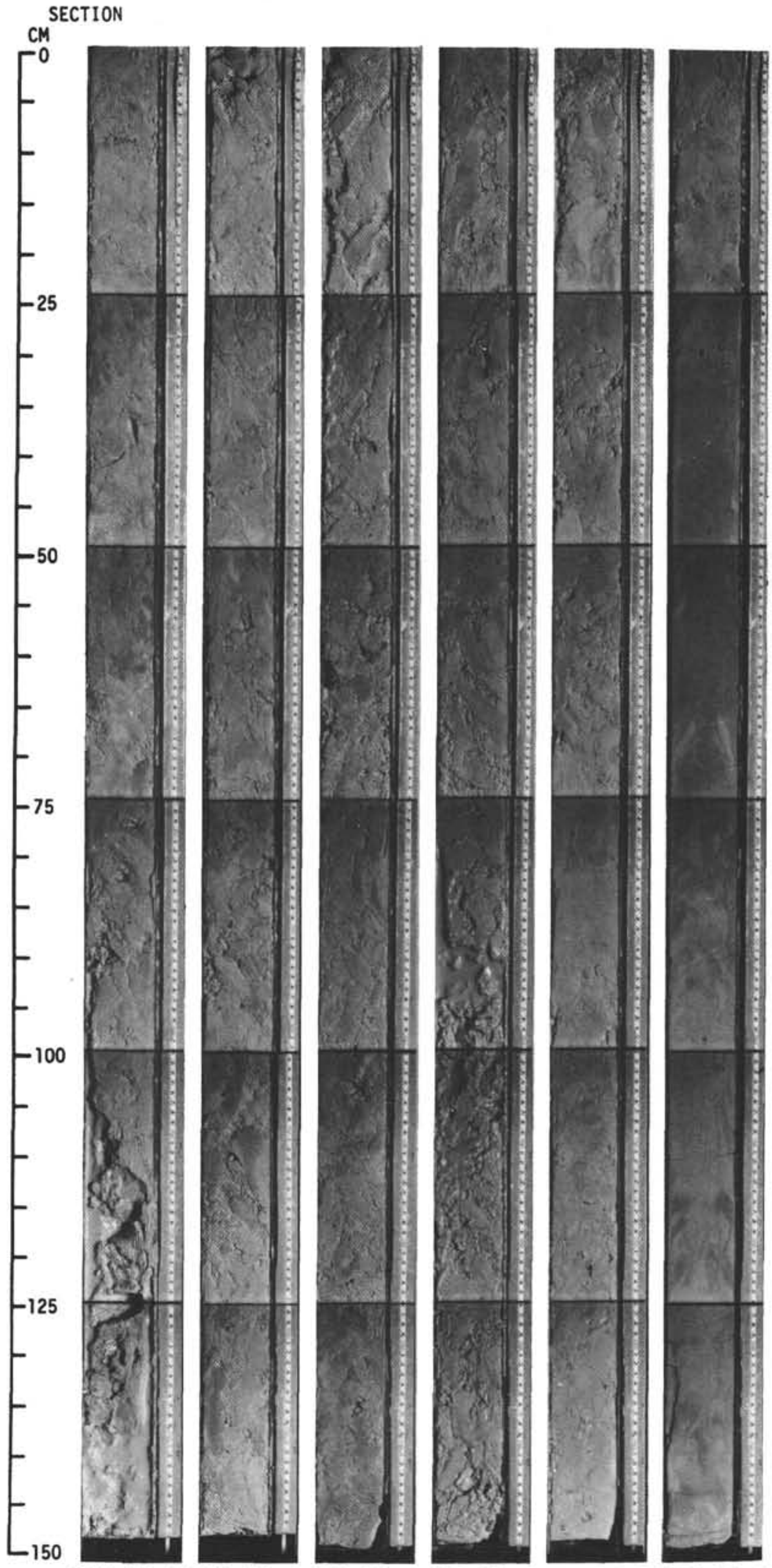

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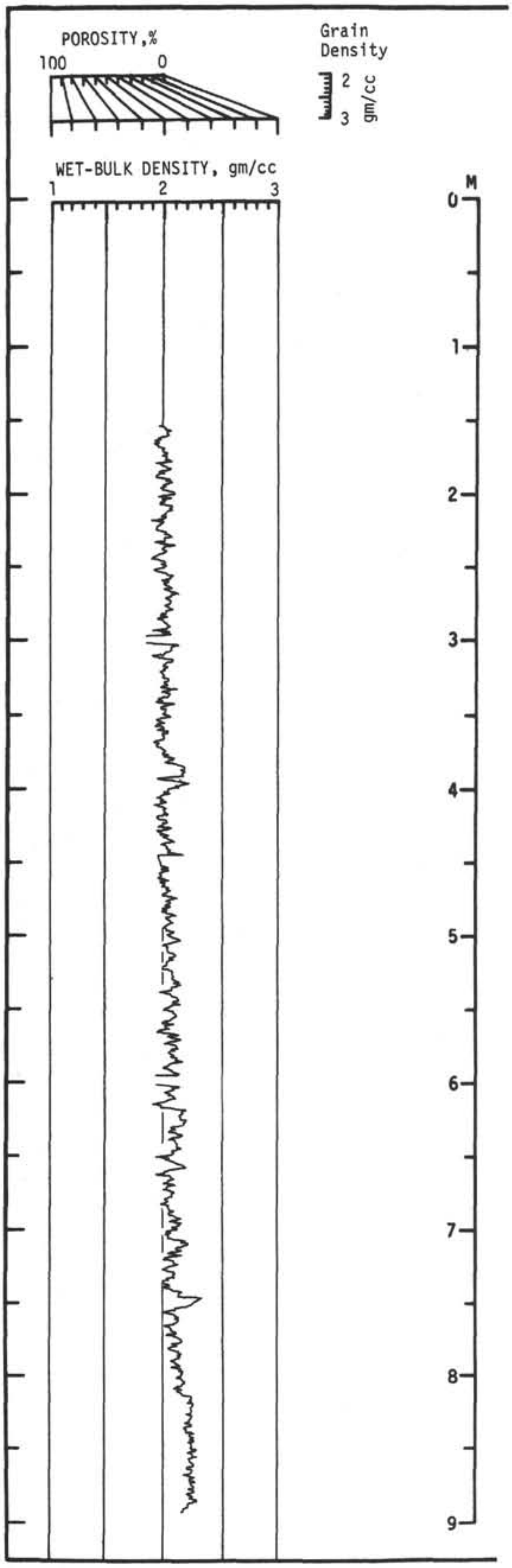

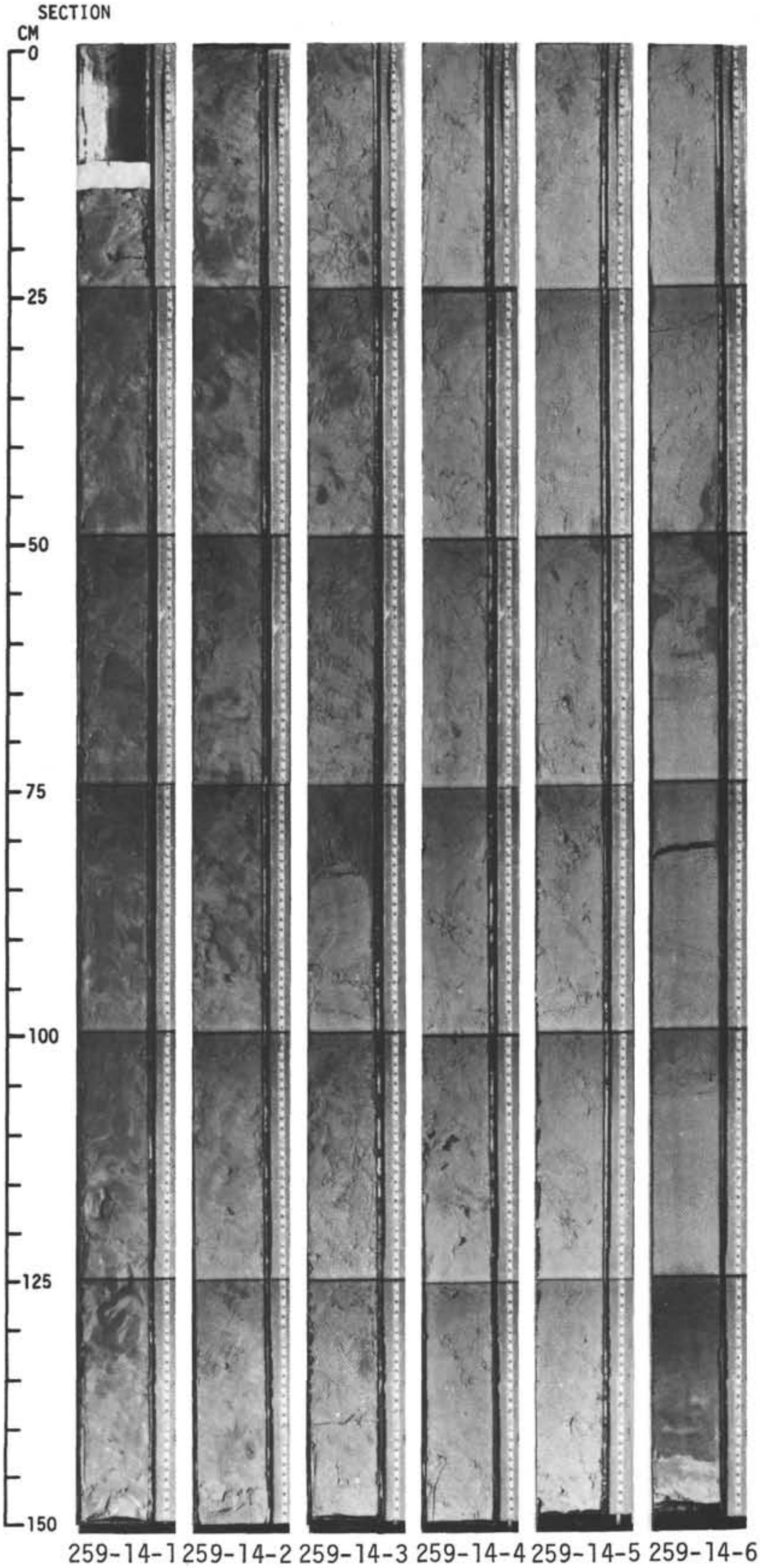

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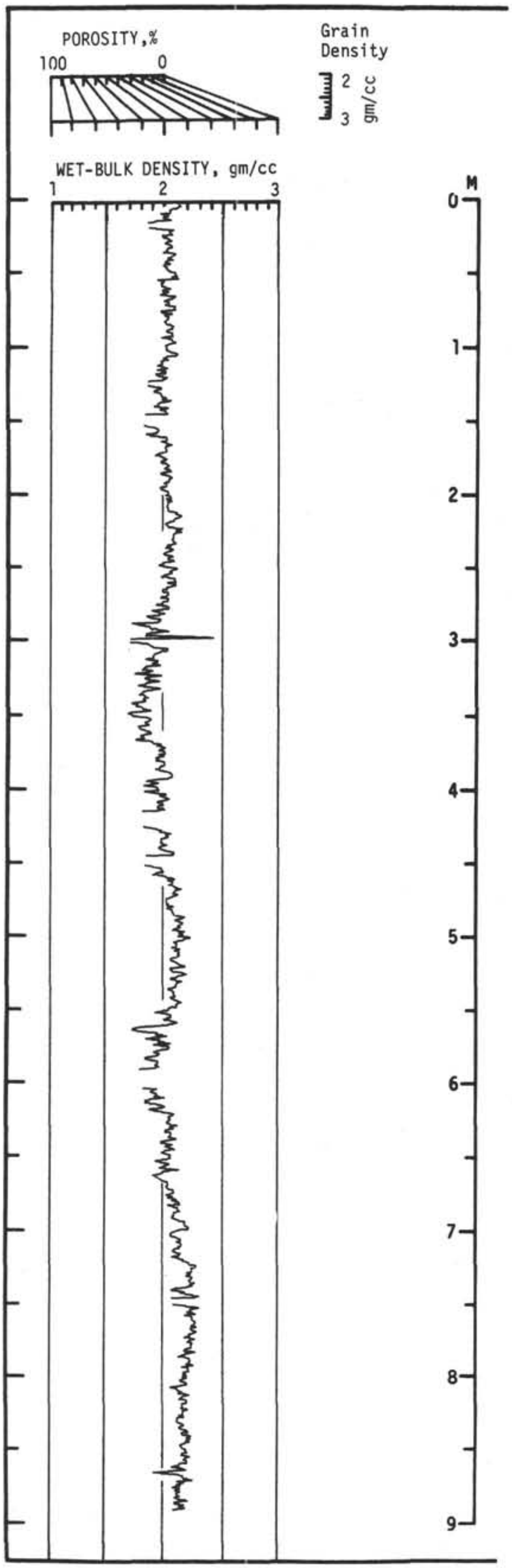
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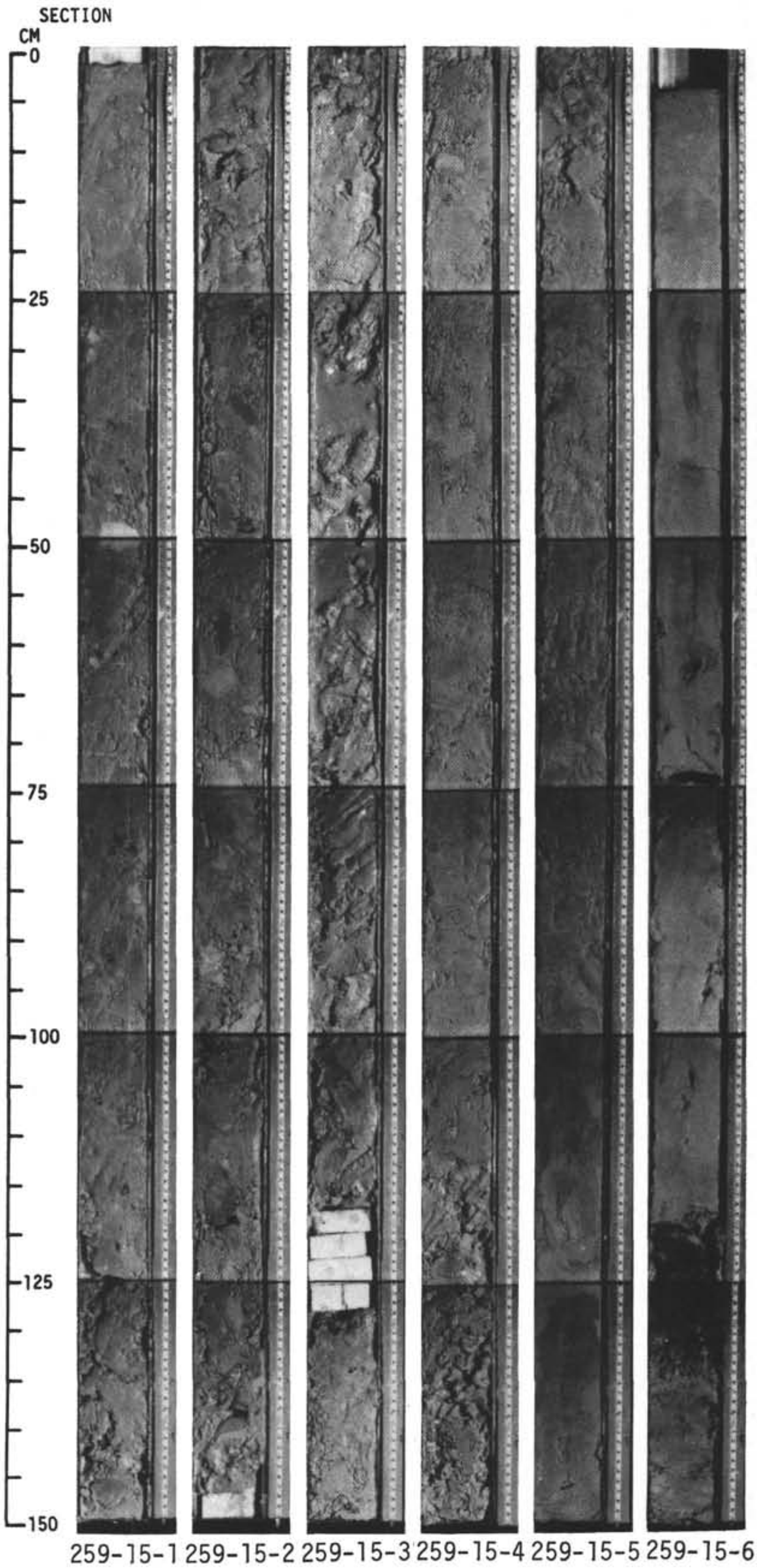
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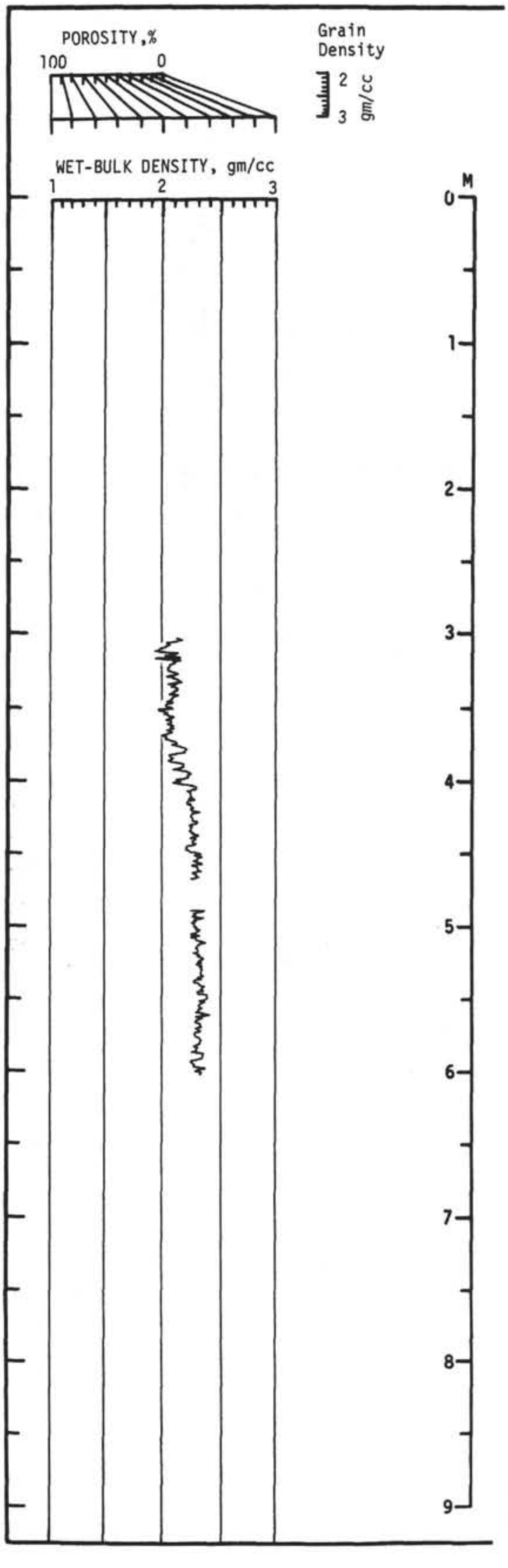

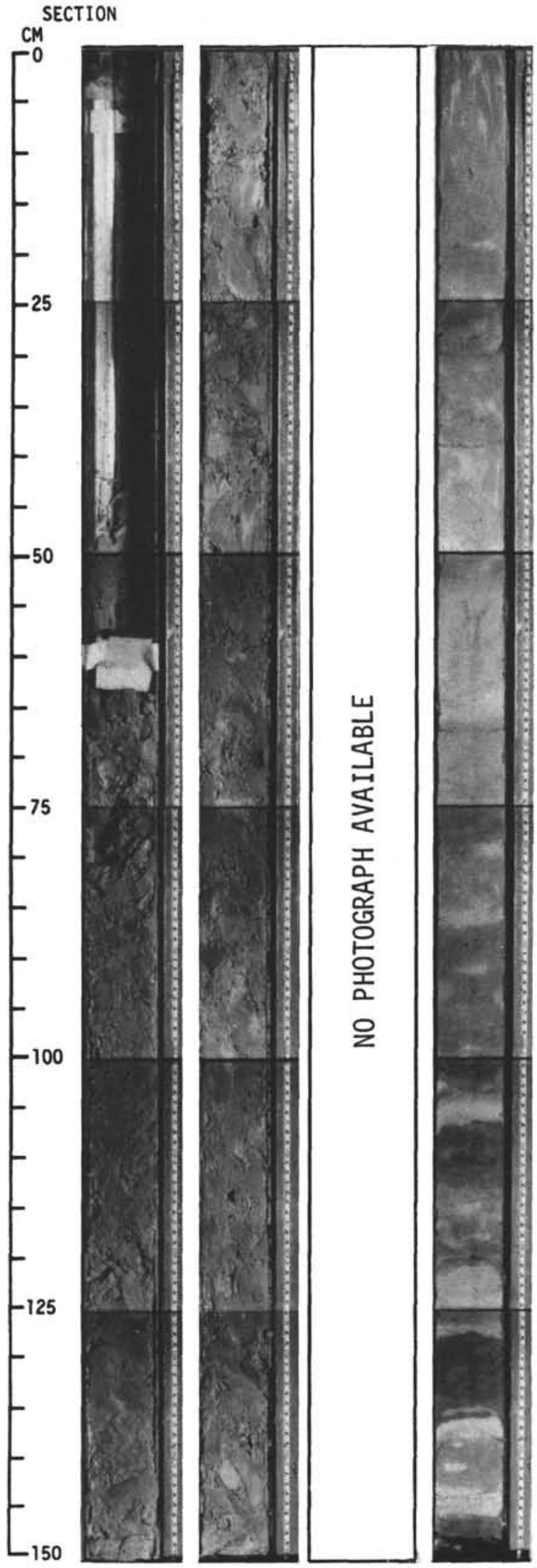

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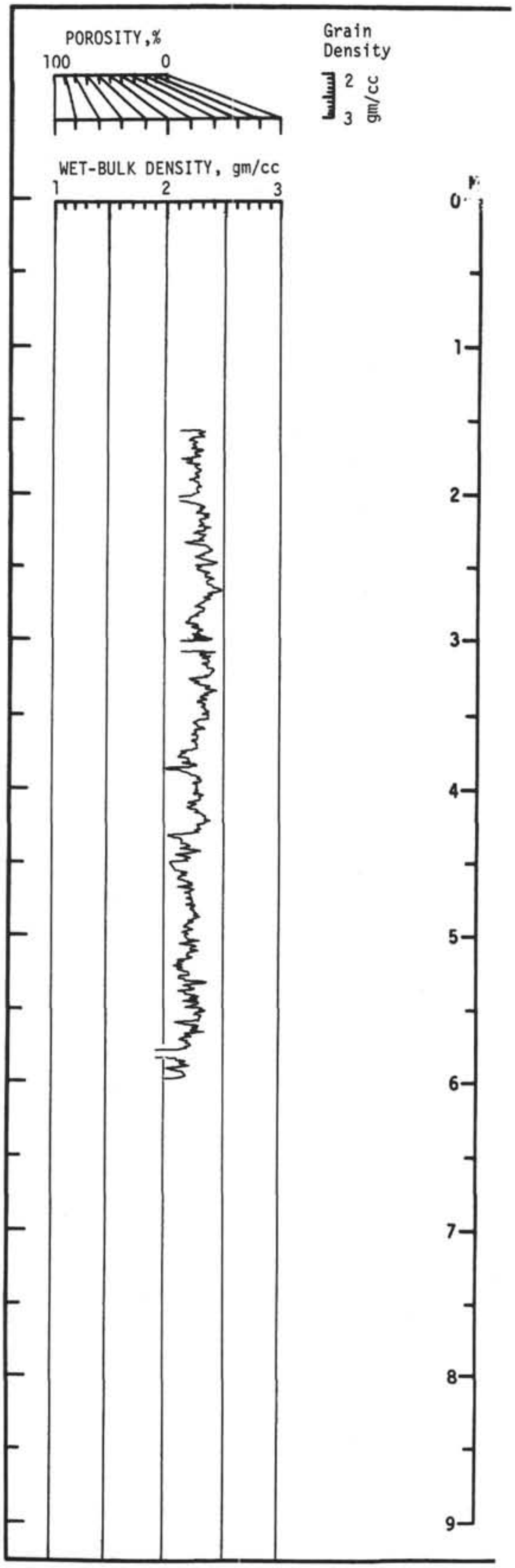
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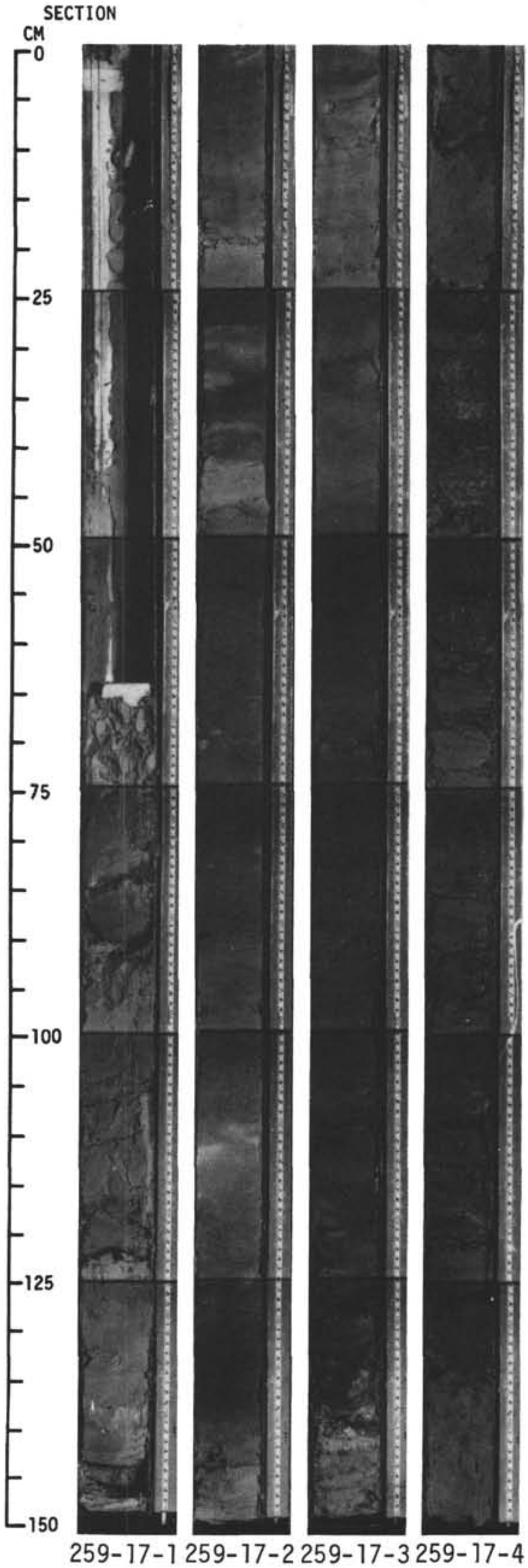
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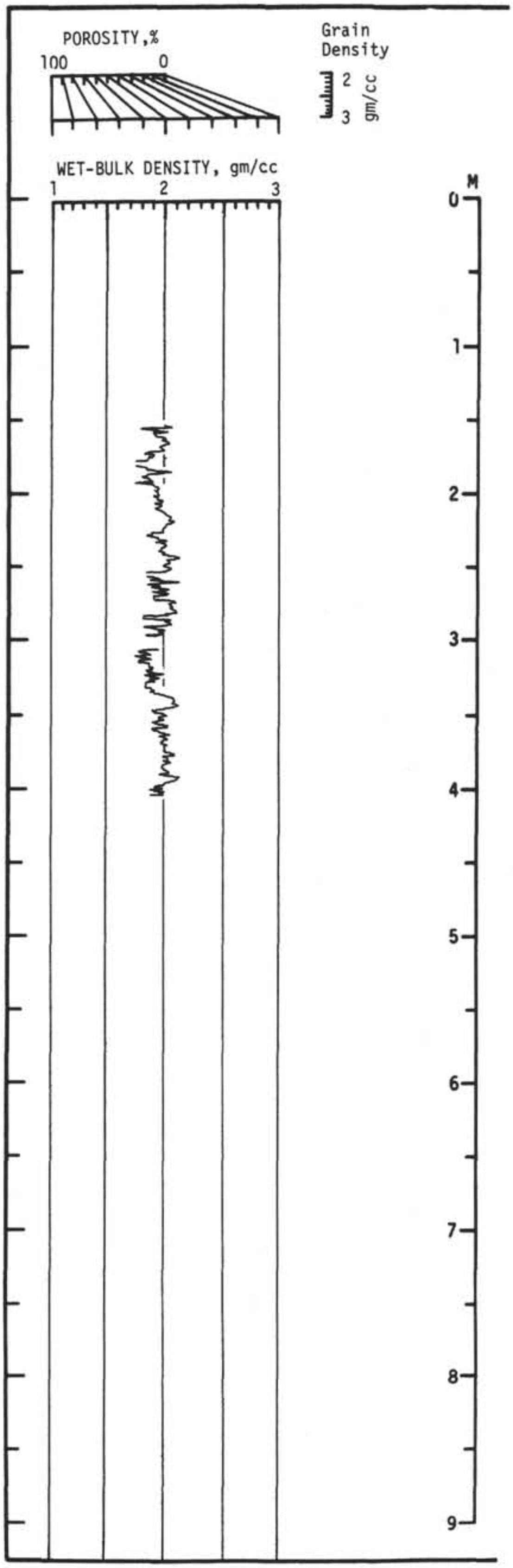

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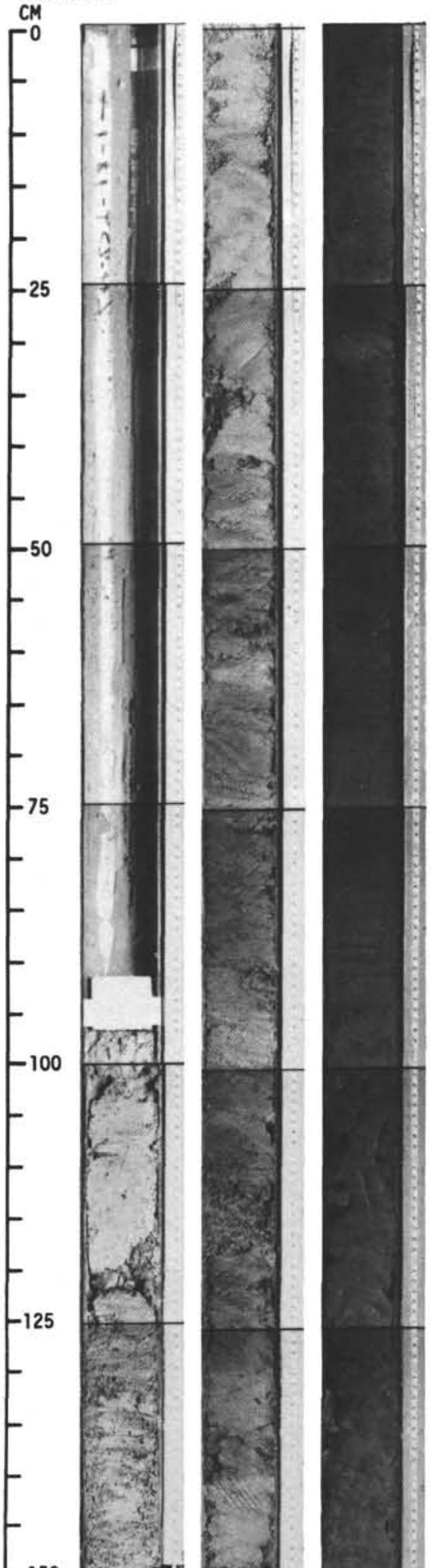

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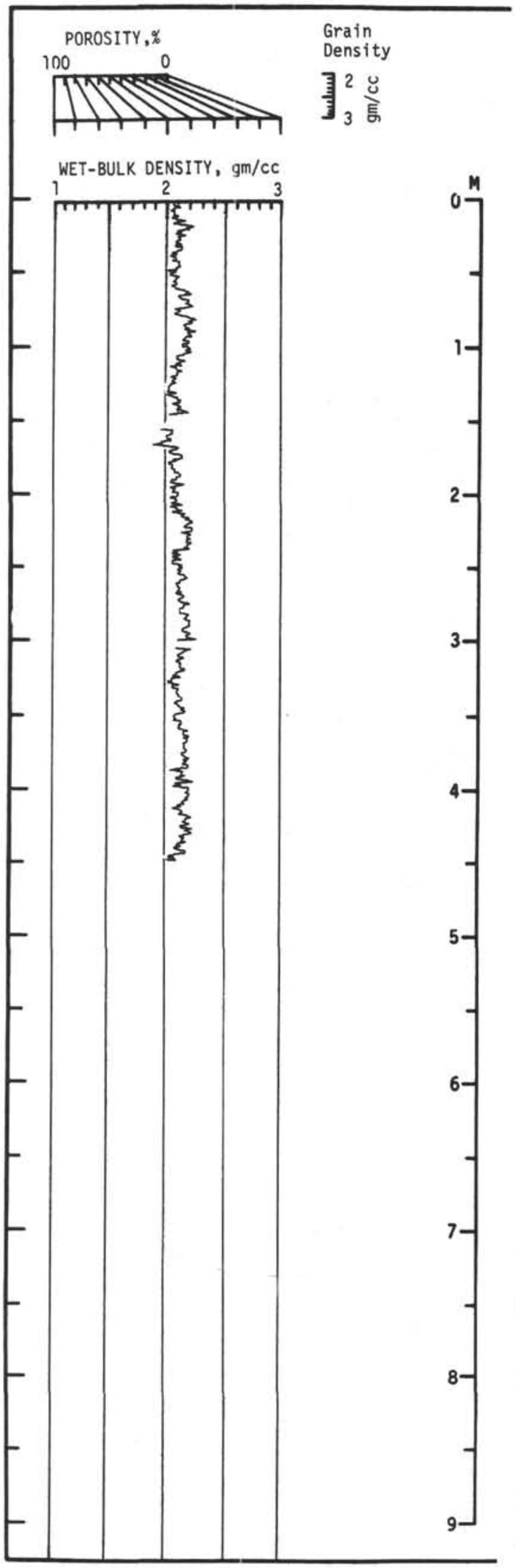

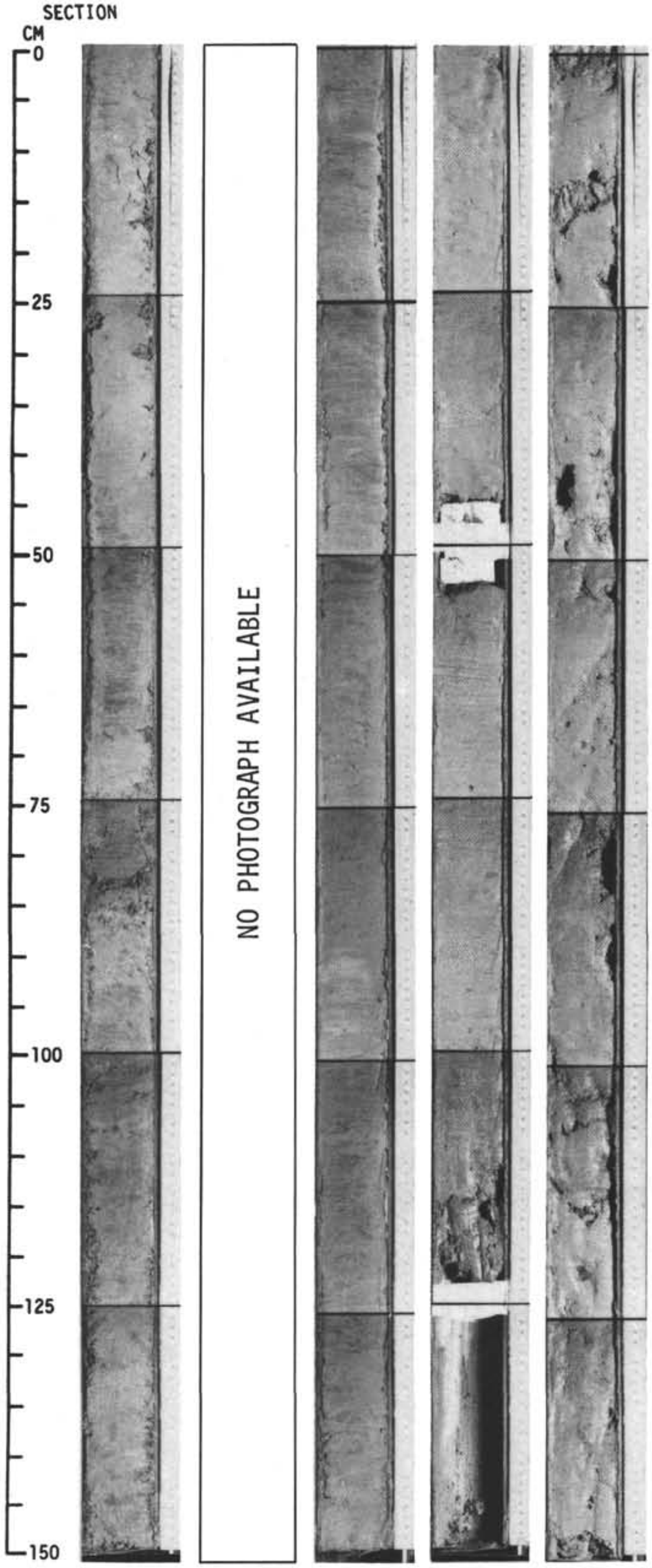

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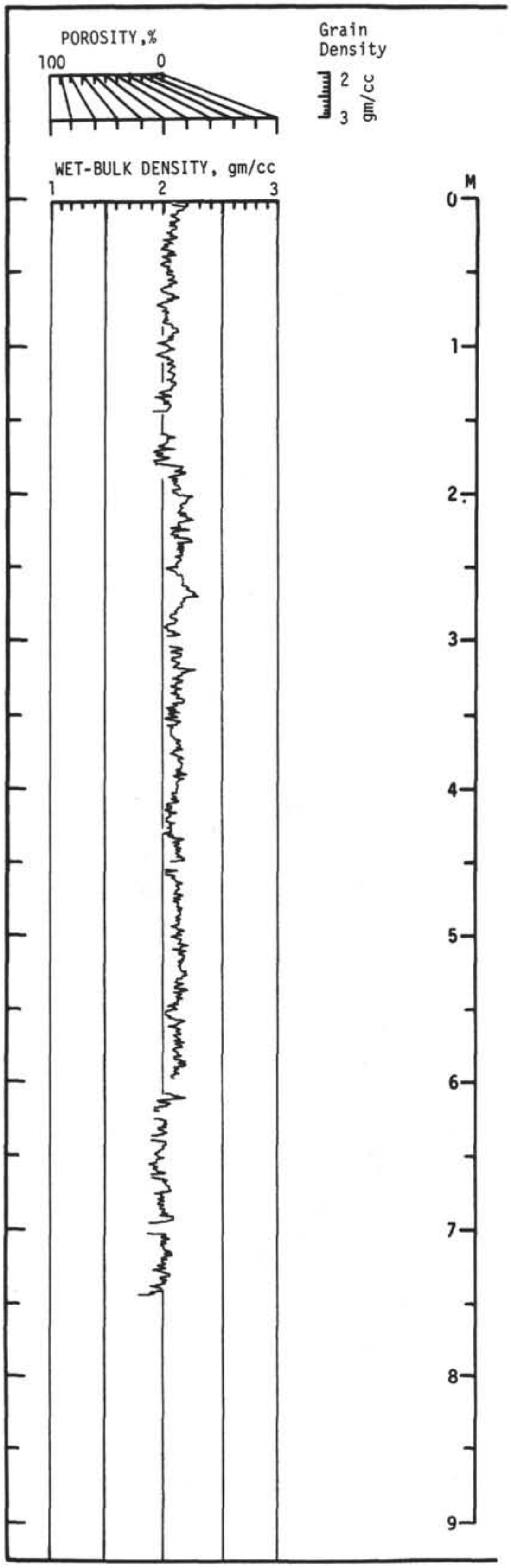

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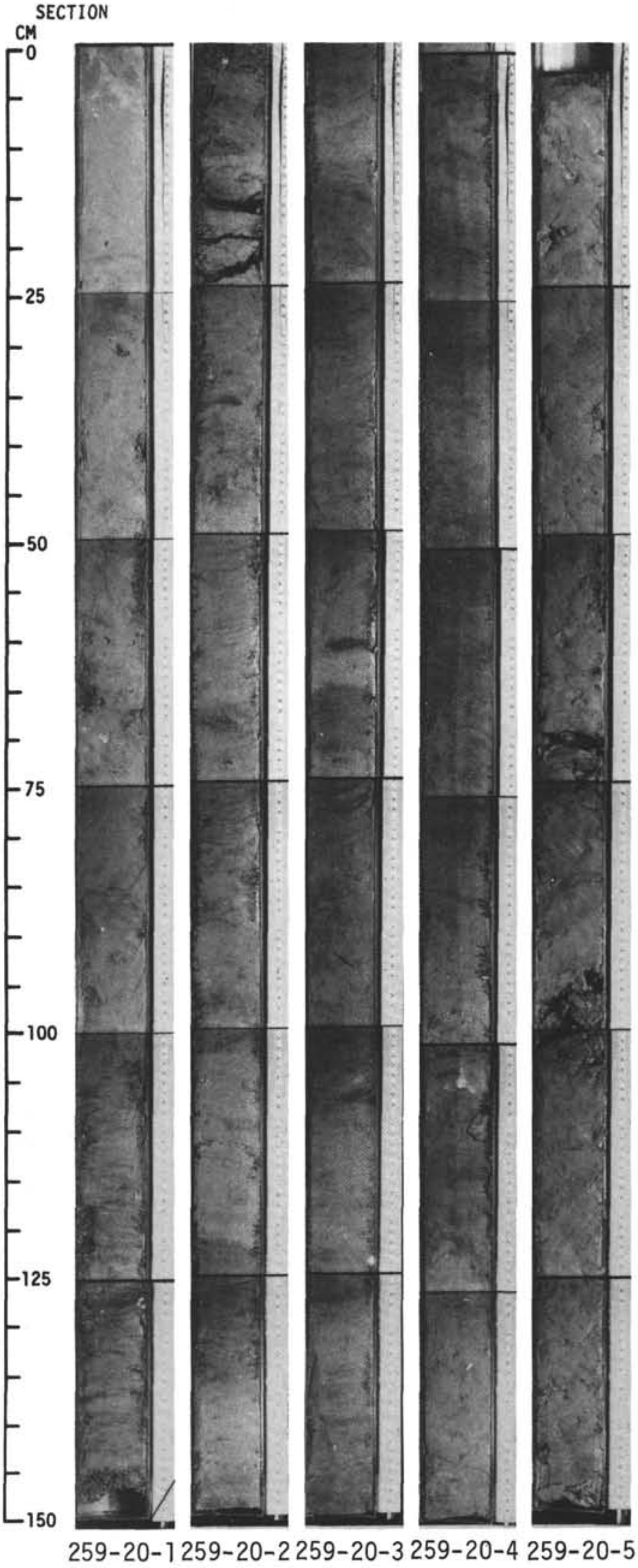

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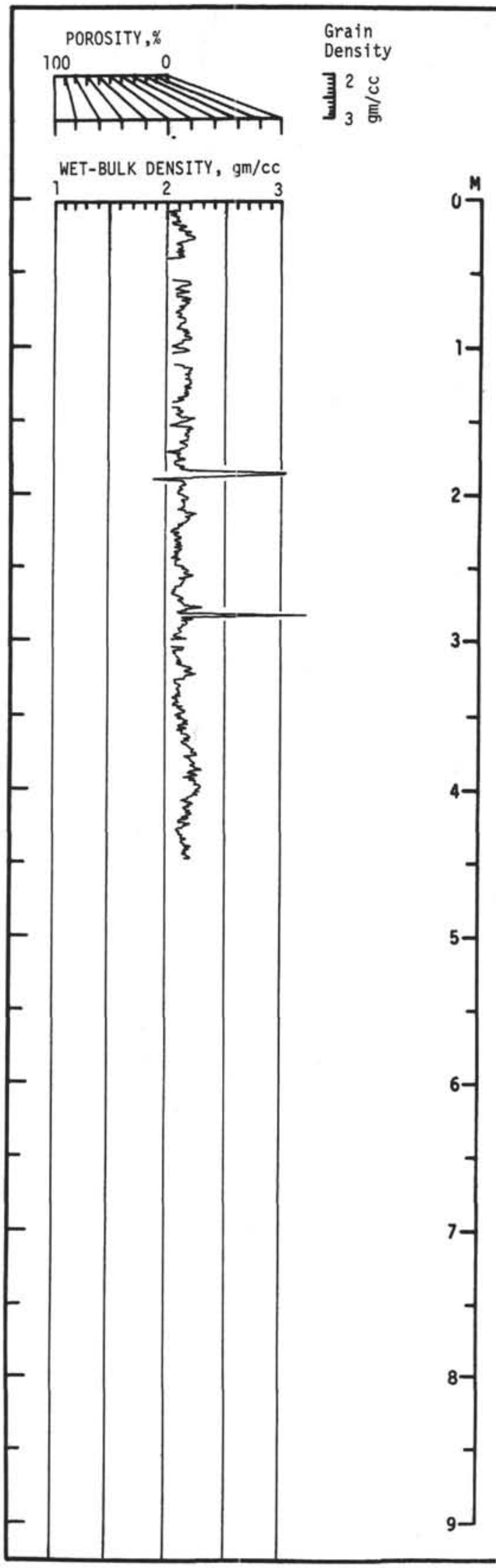
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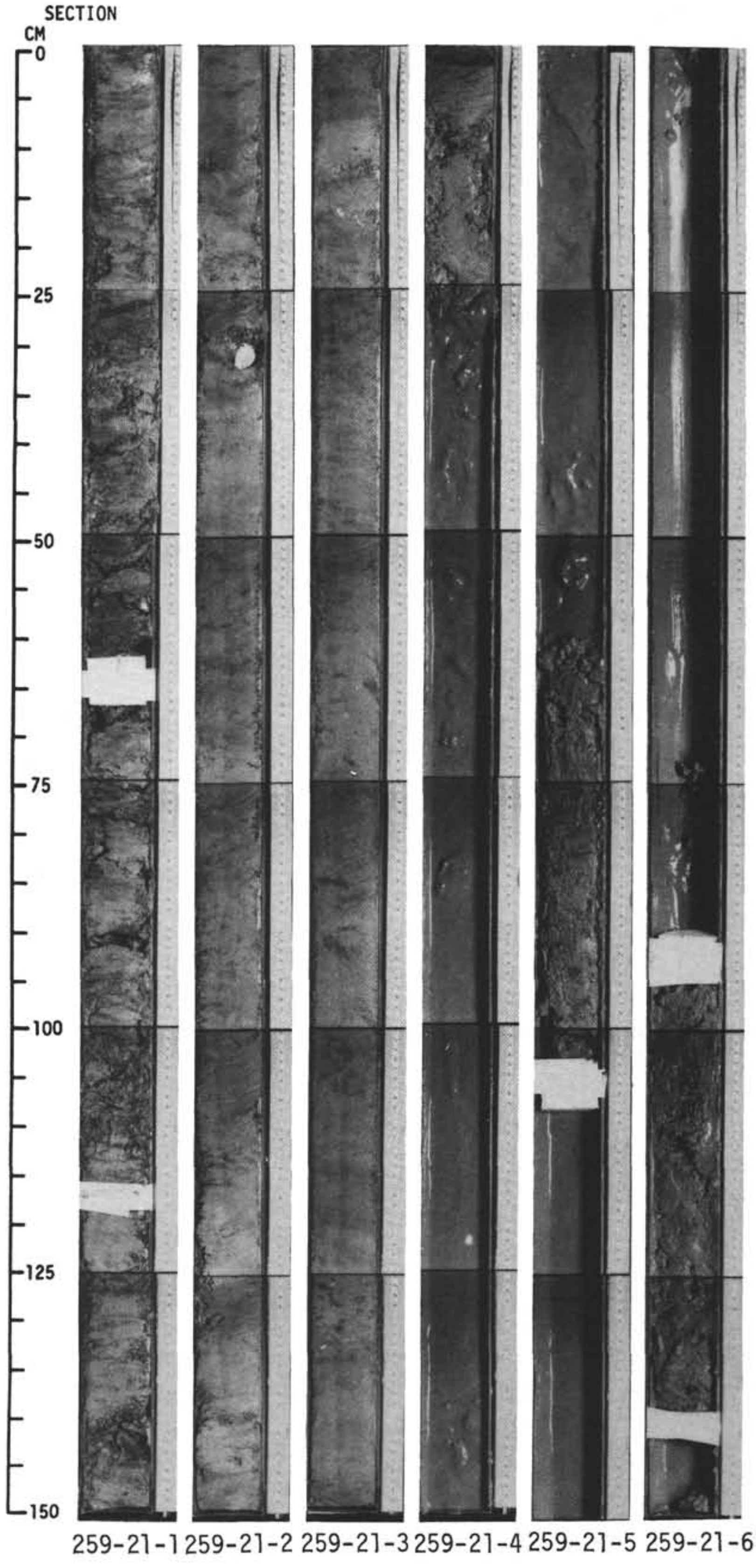
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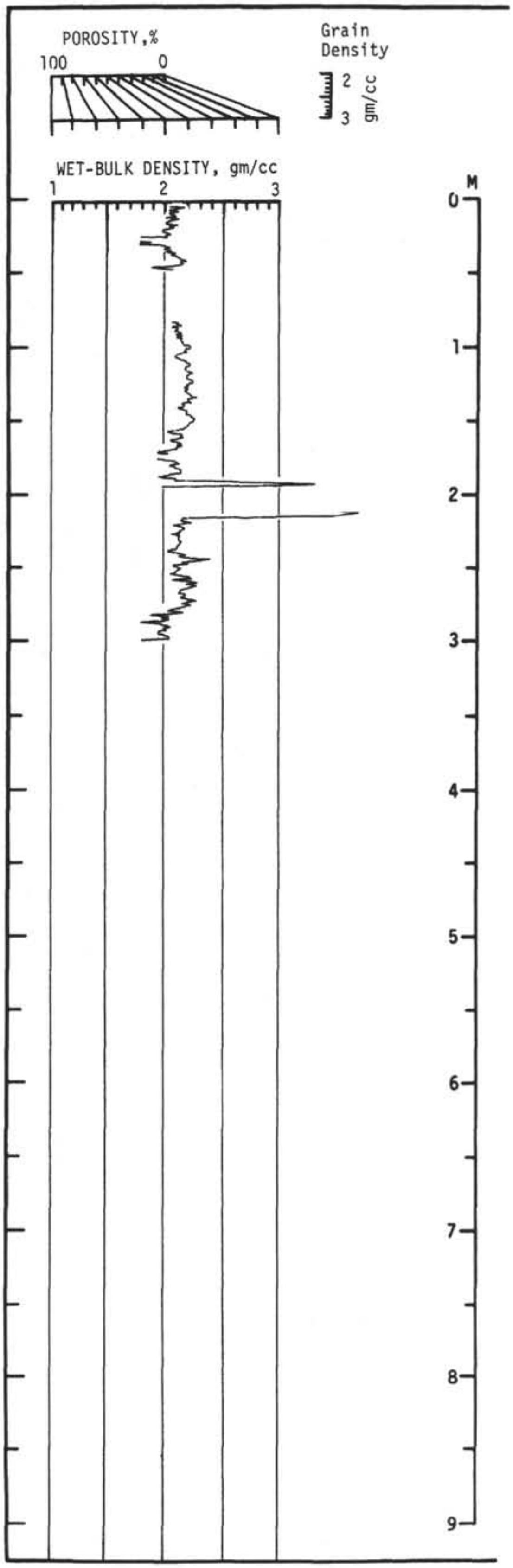

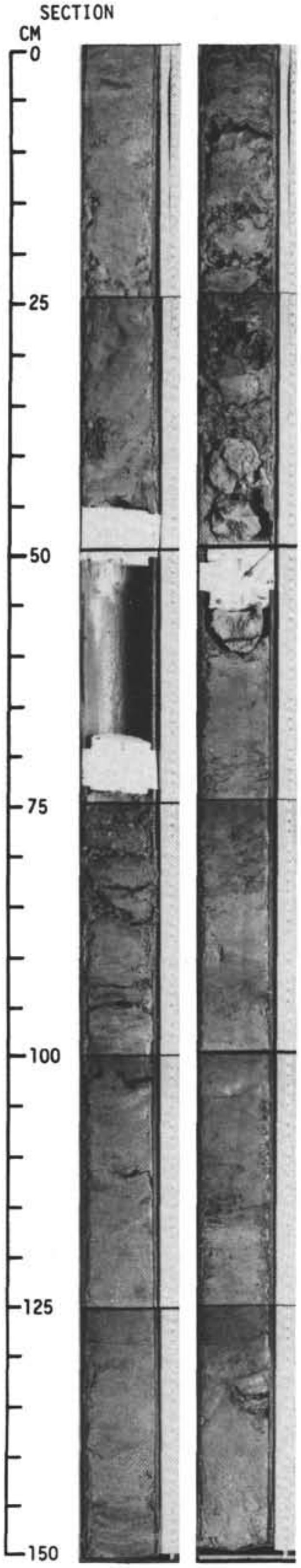

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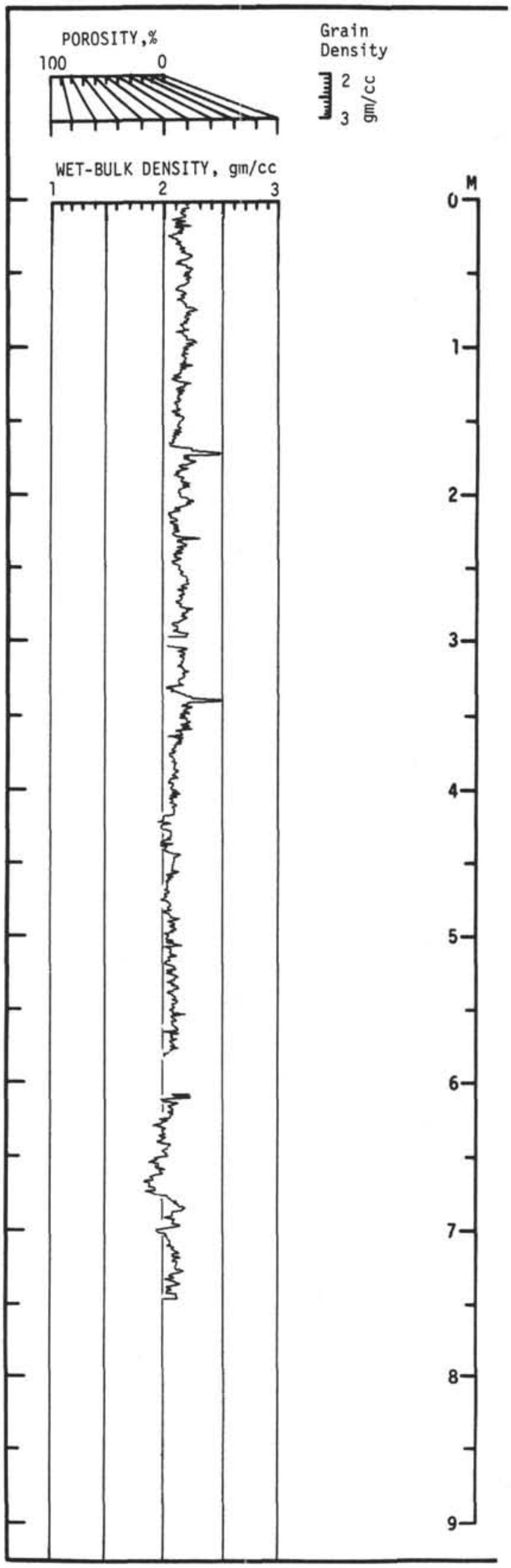

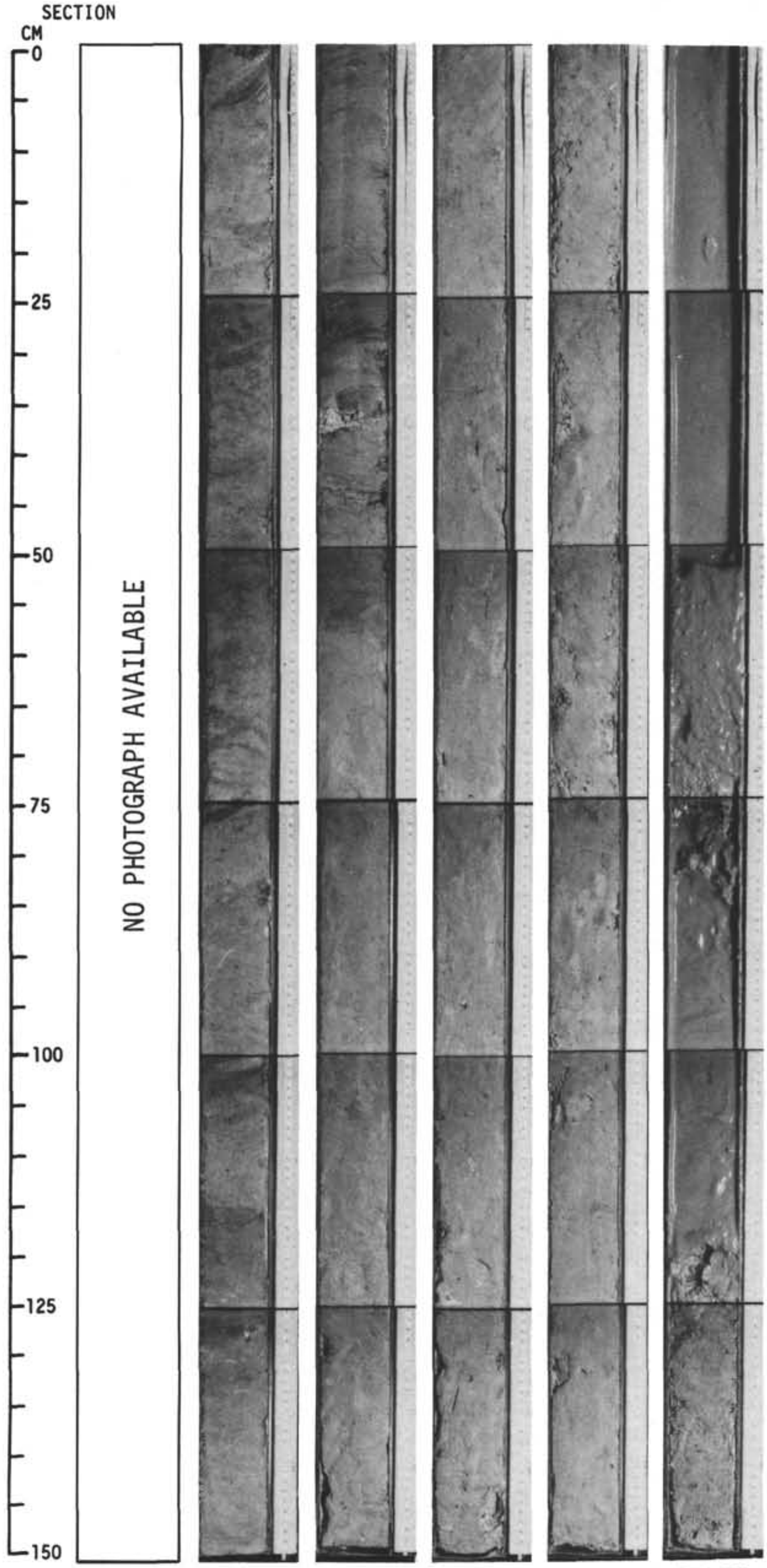

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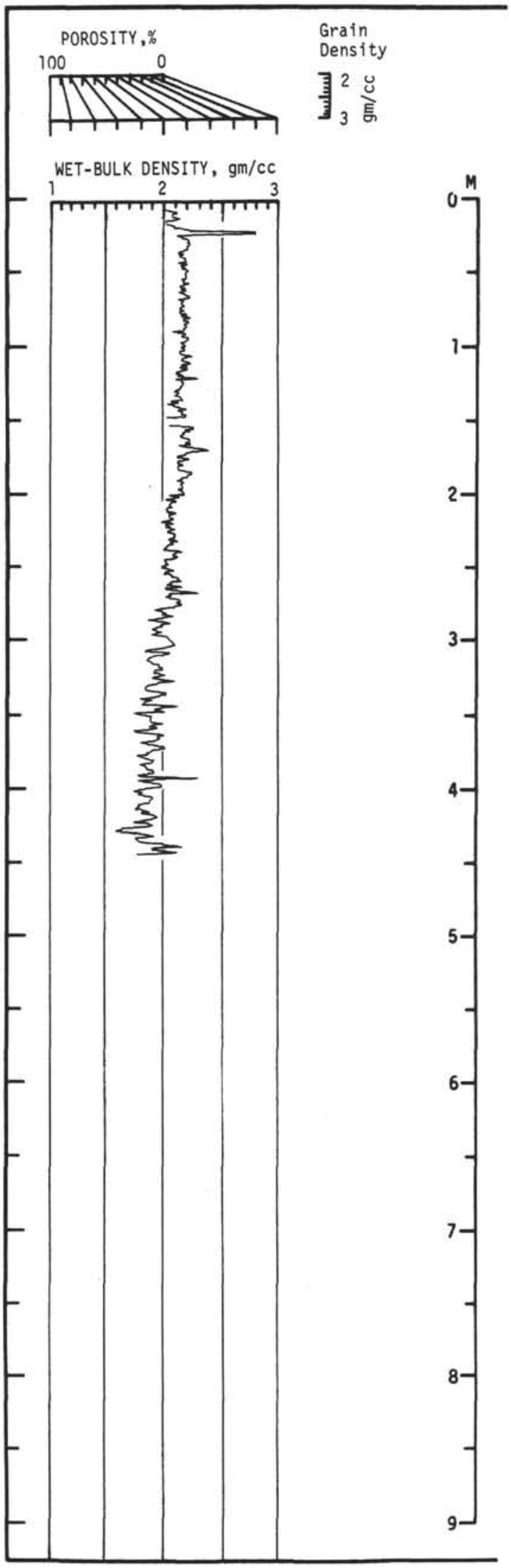

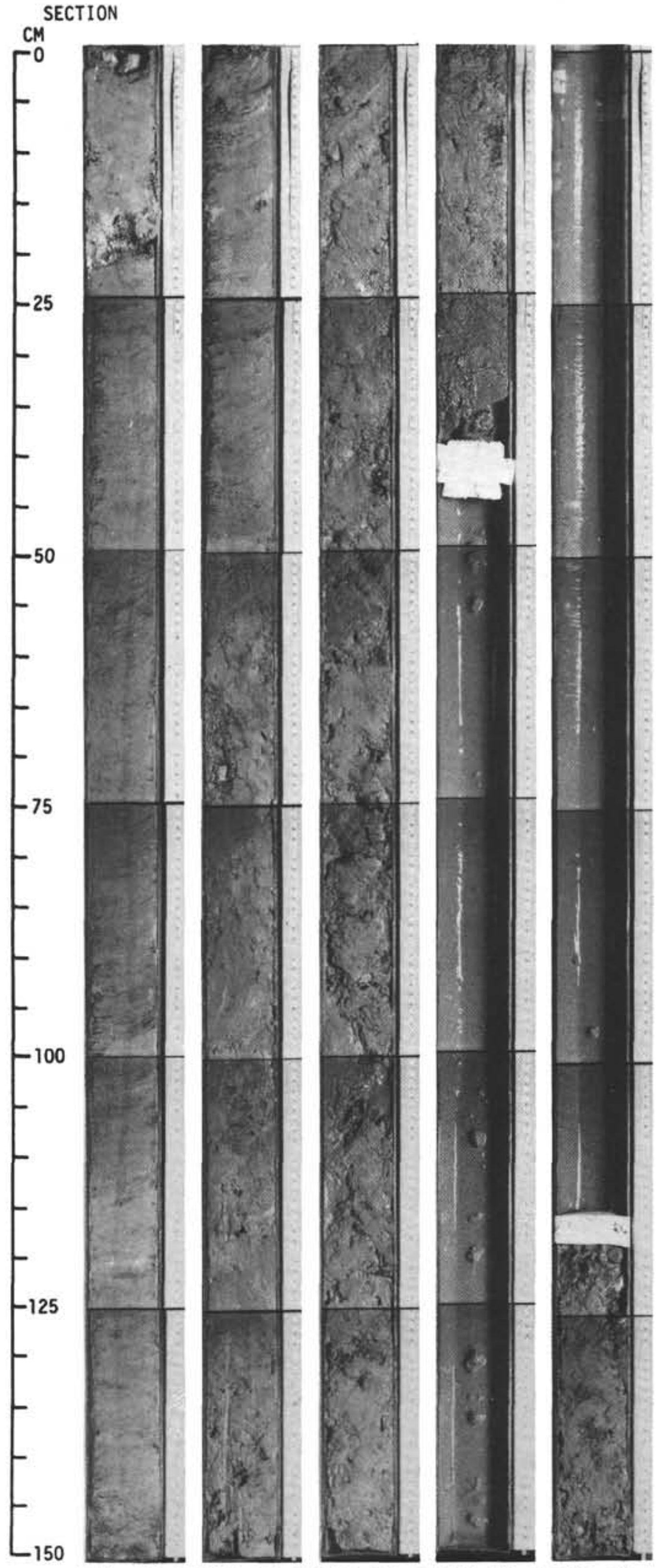

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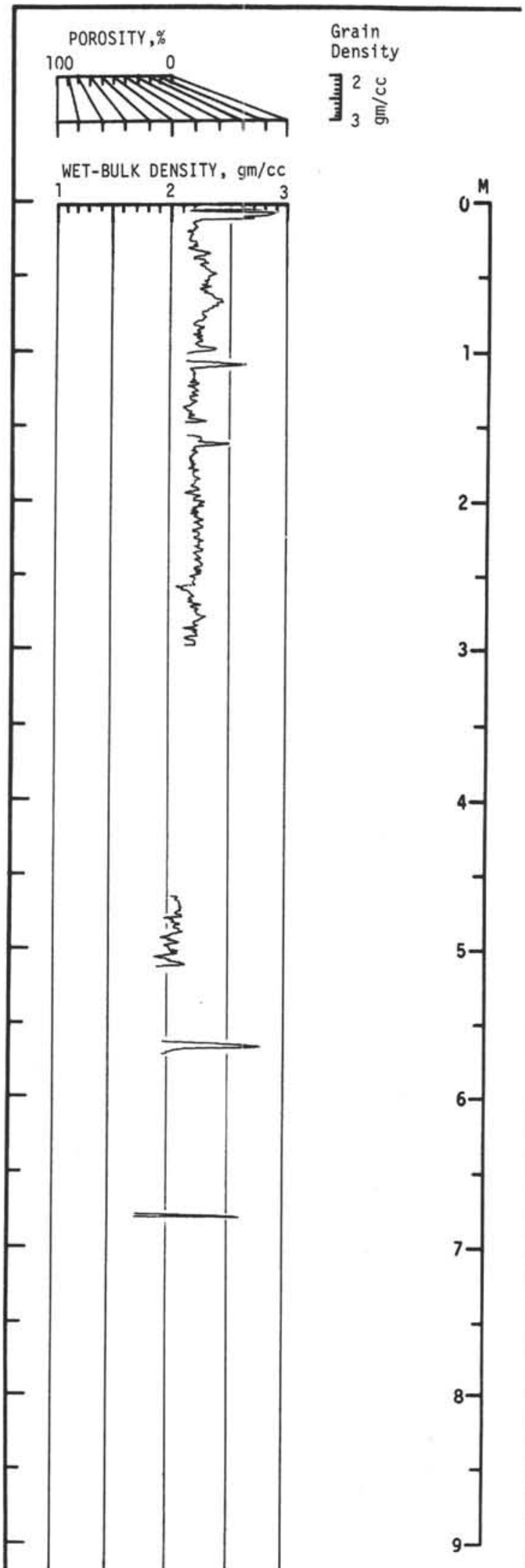

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gm/cc
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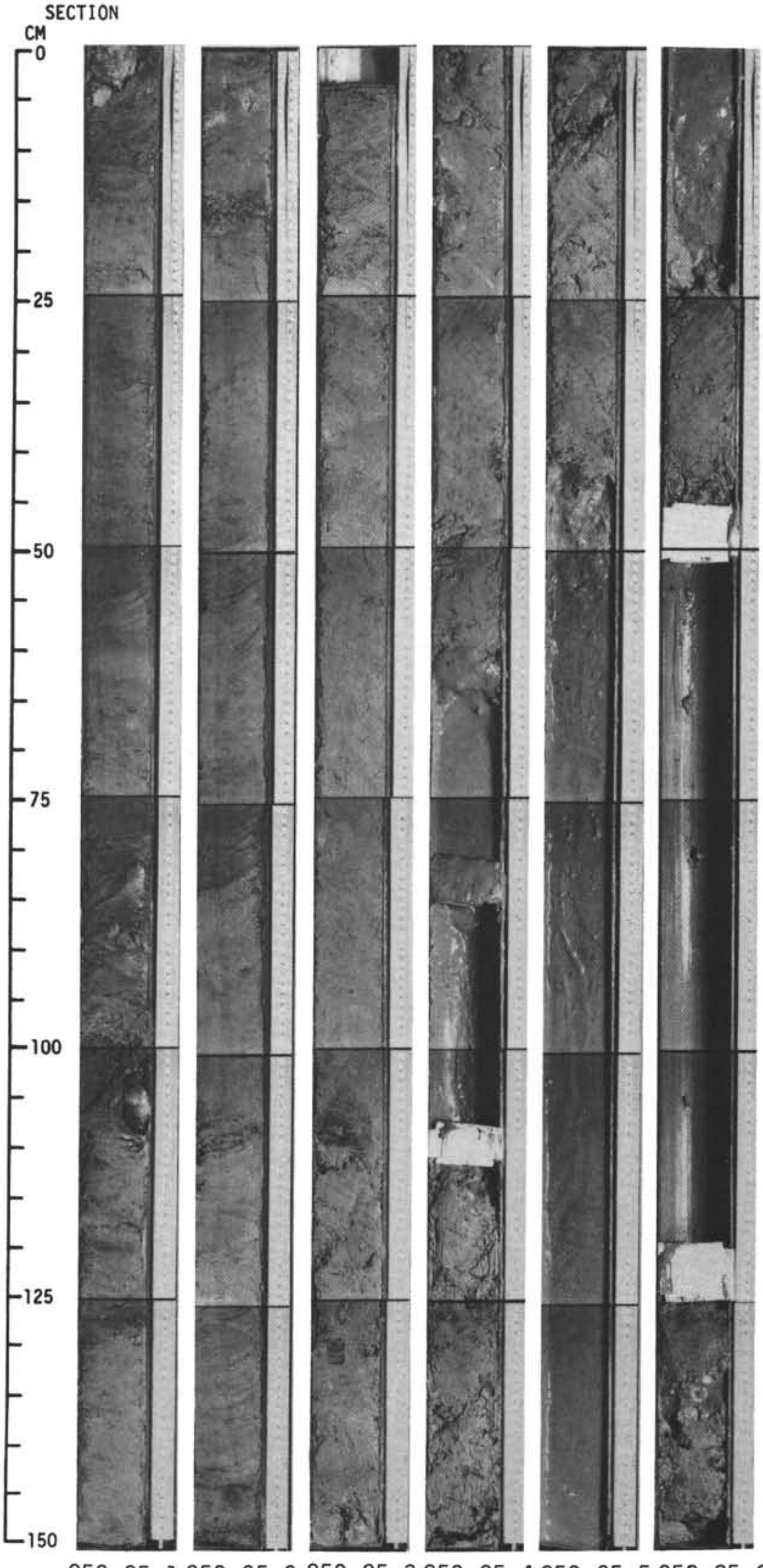

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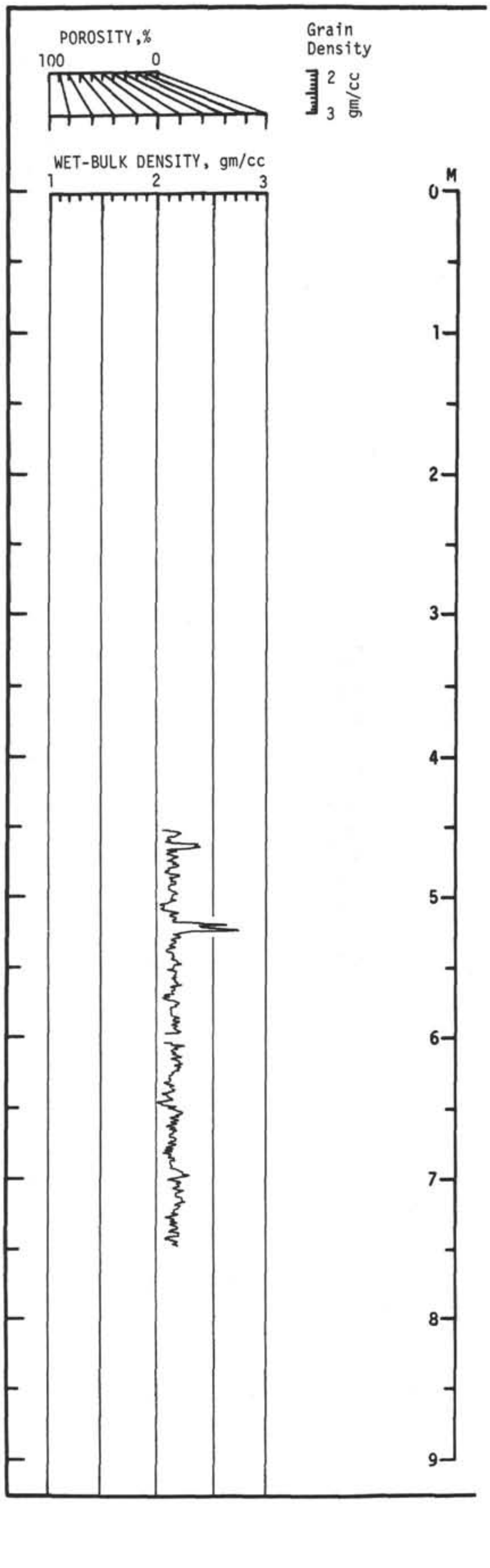
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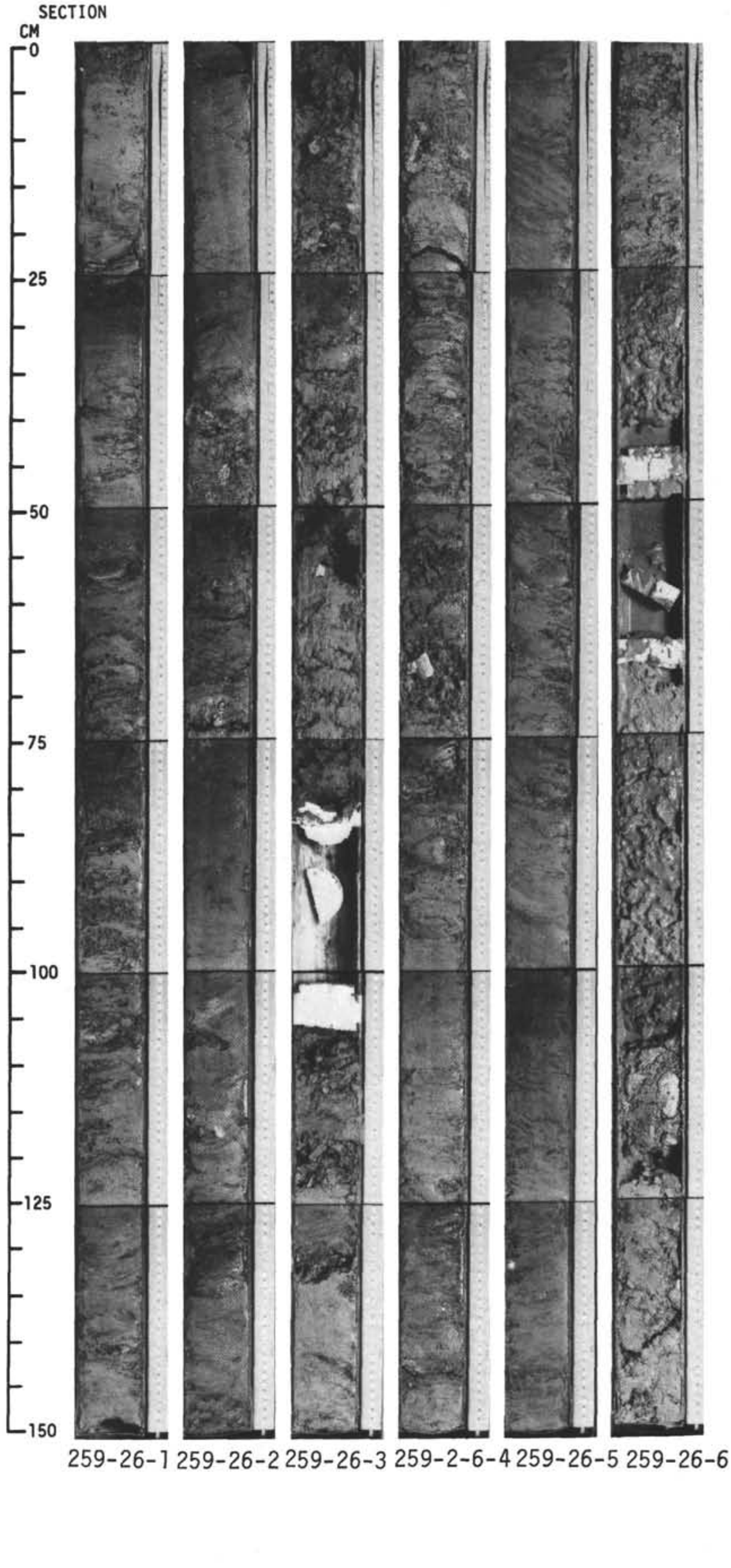
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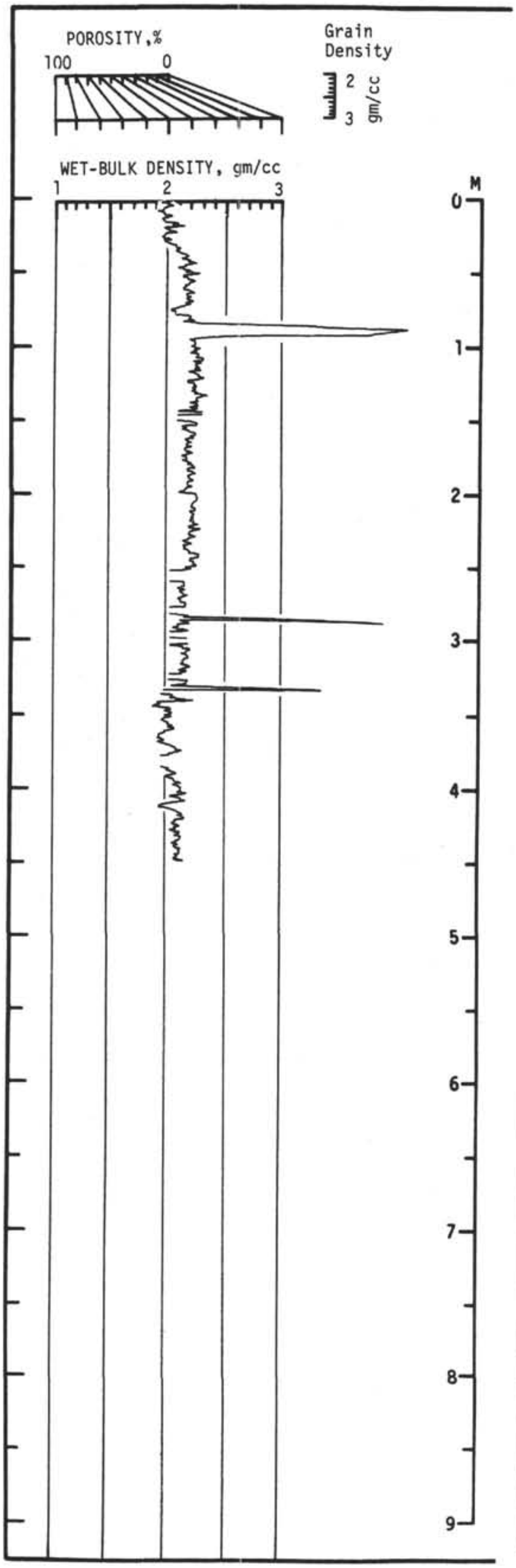

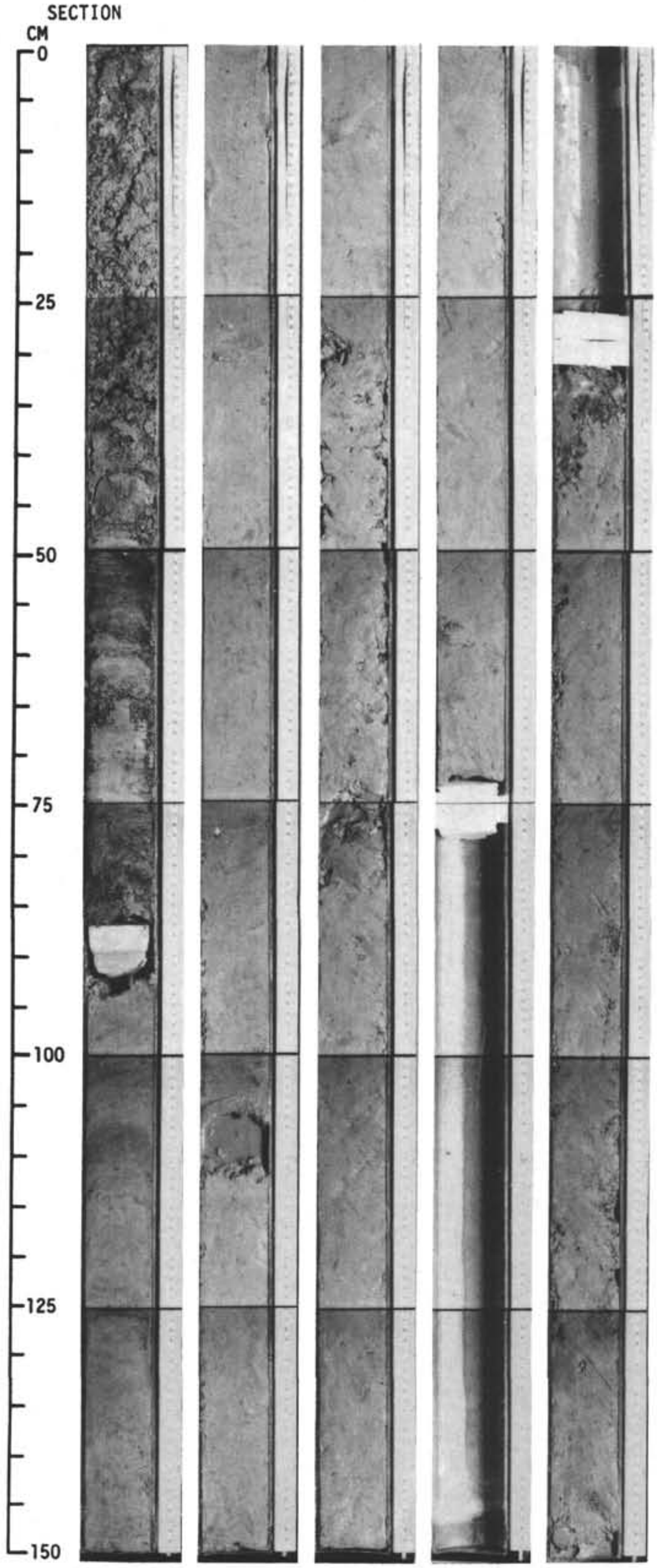

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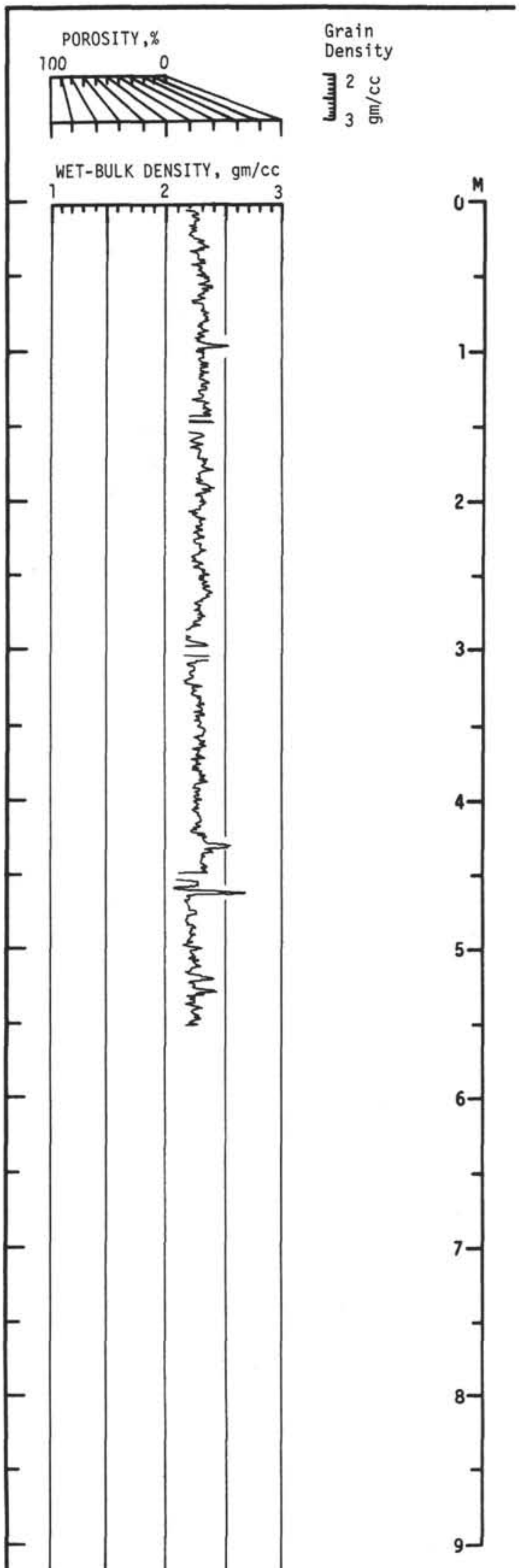
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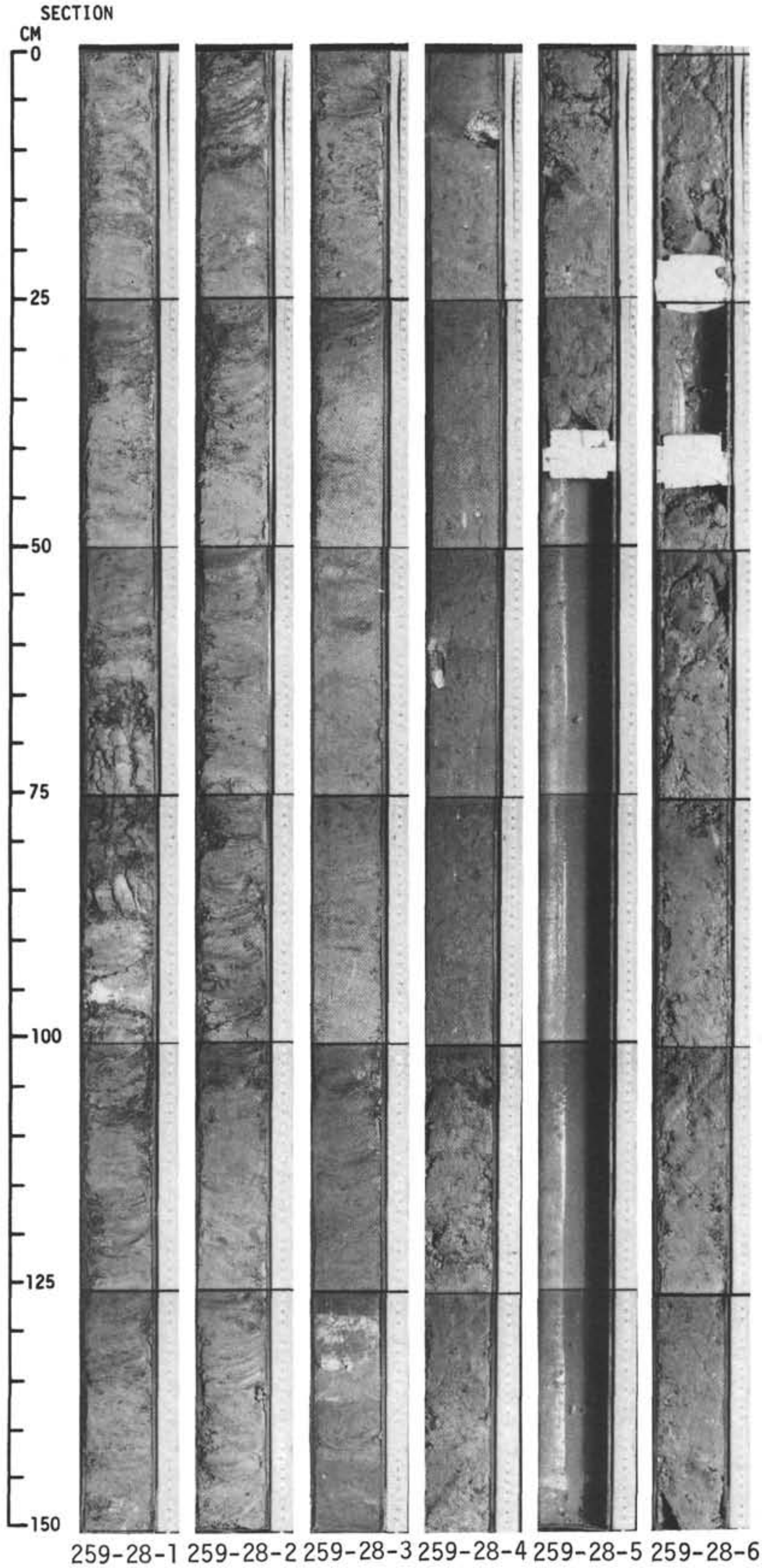
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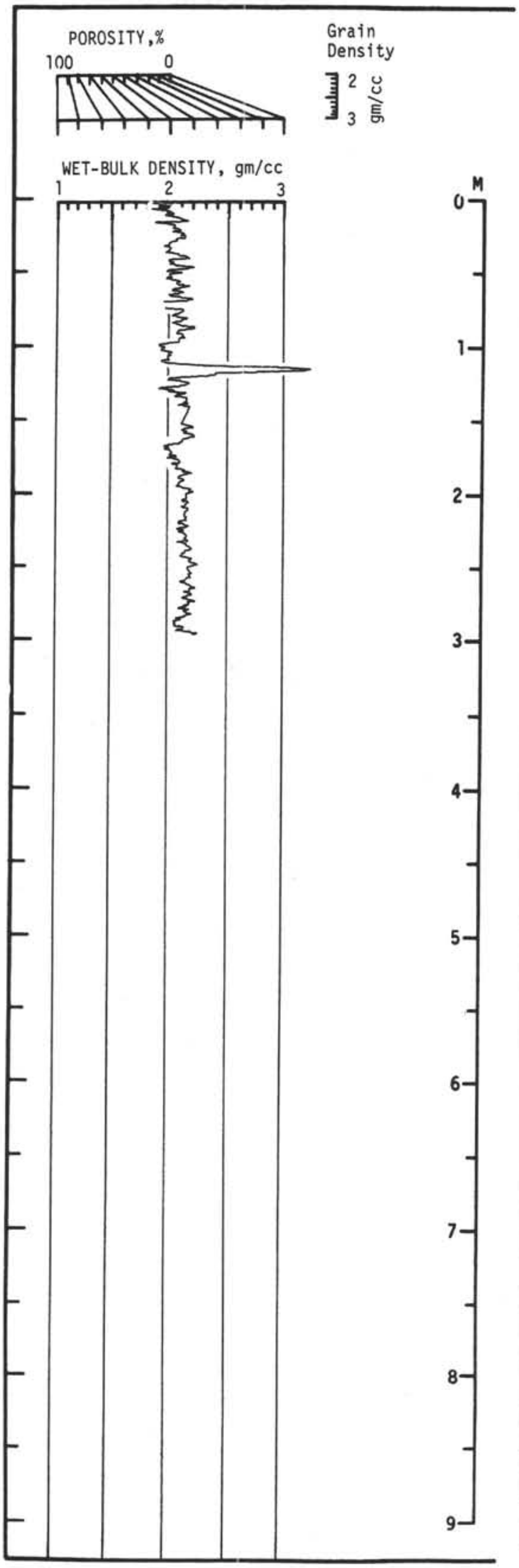

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Density
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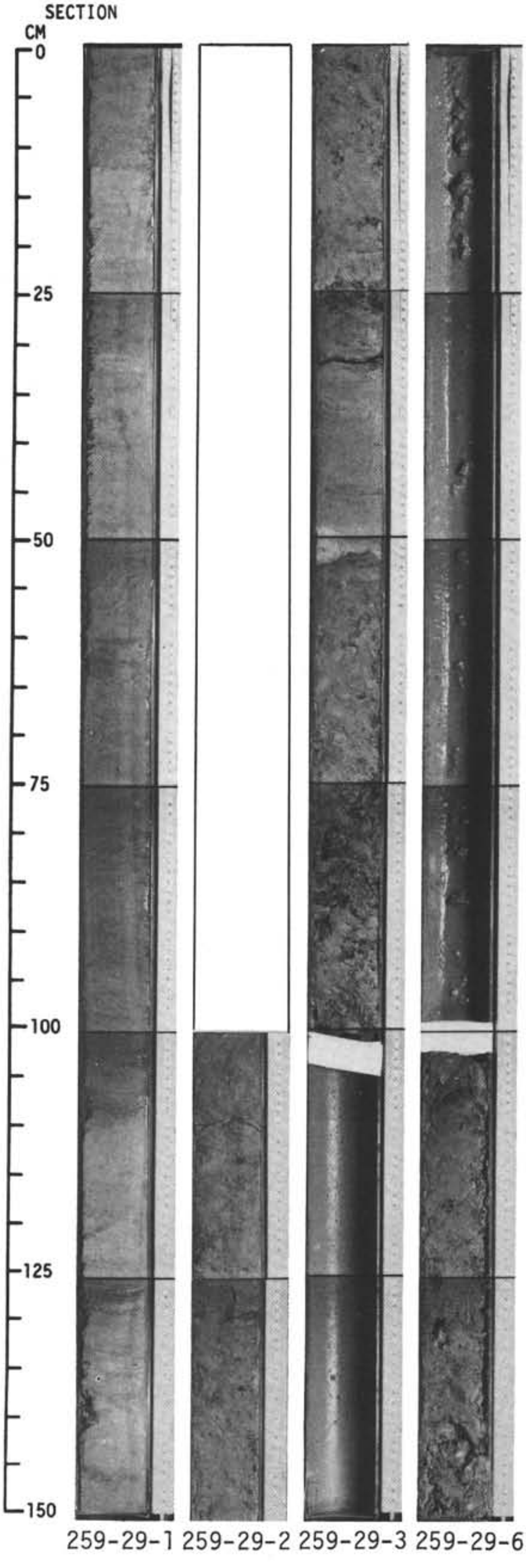

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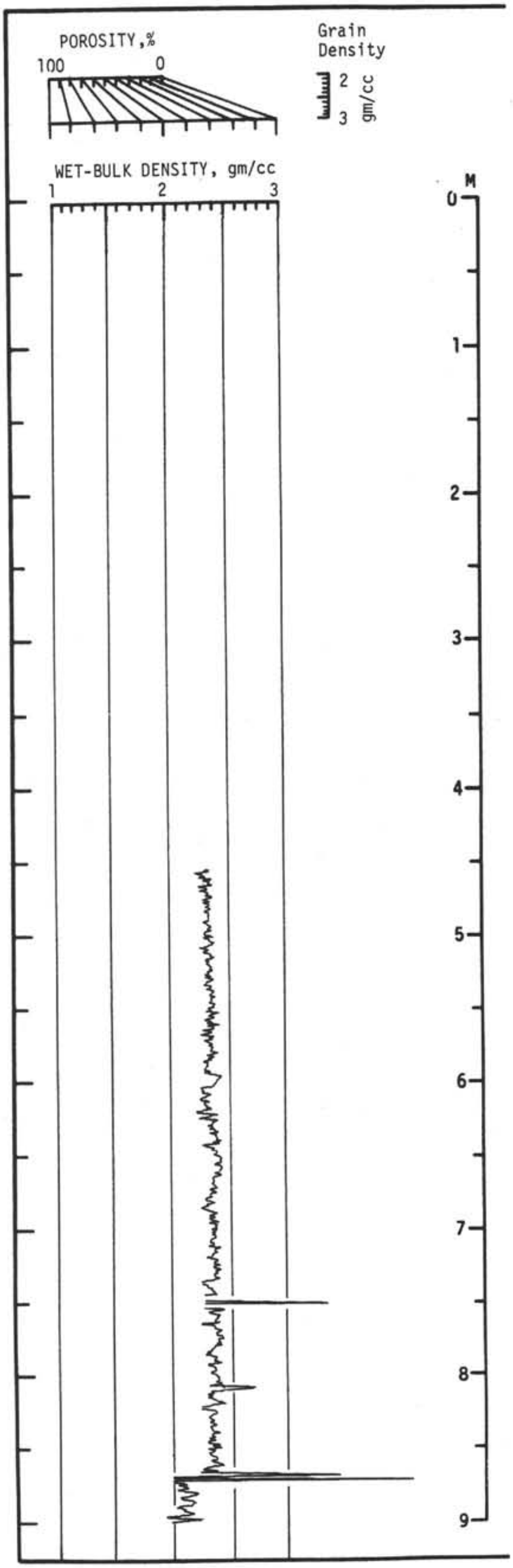
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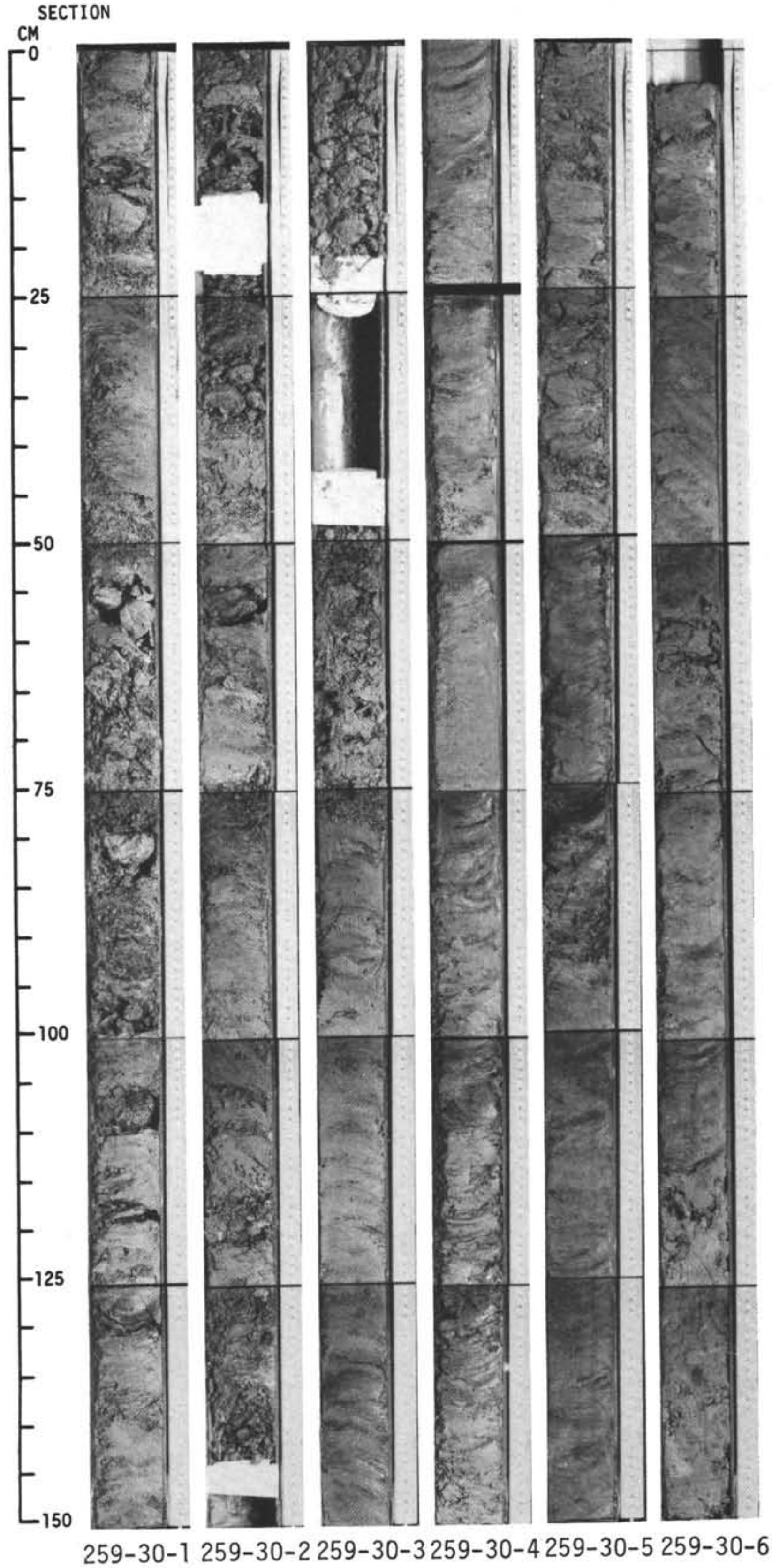
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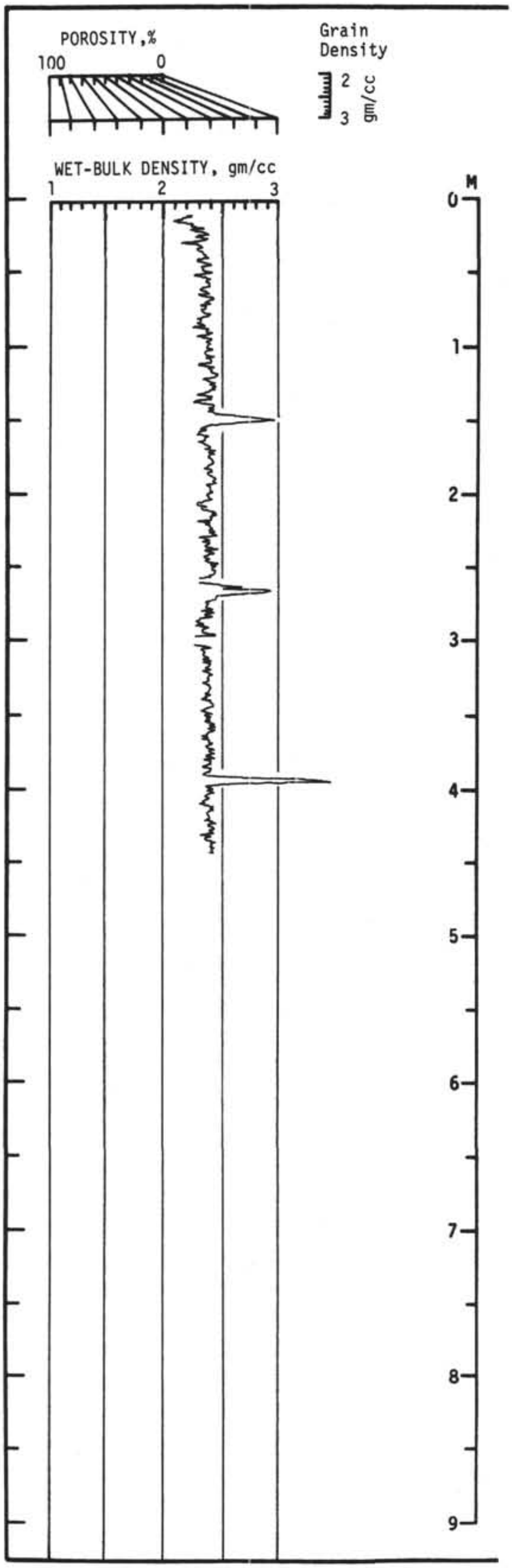

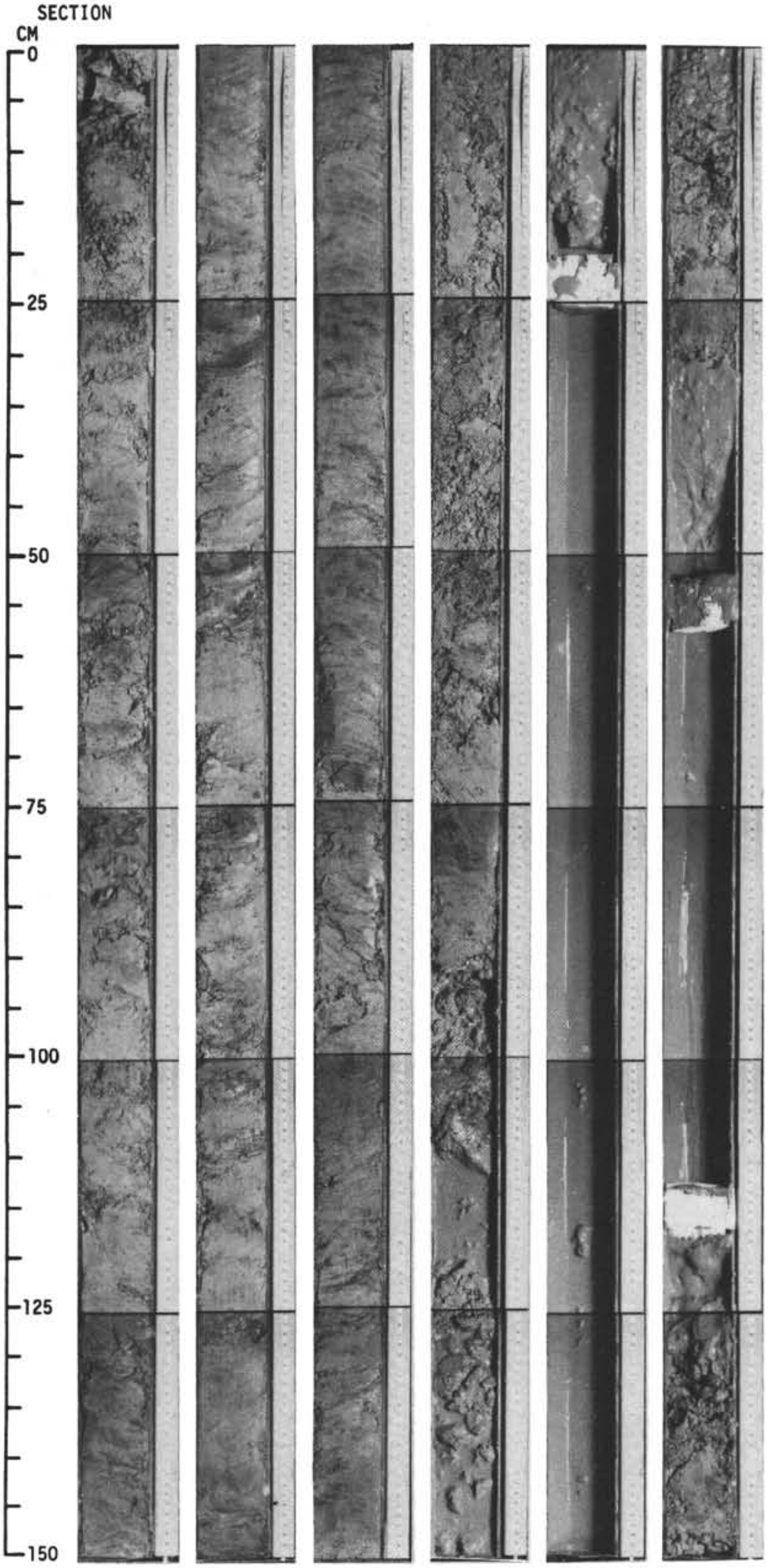

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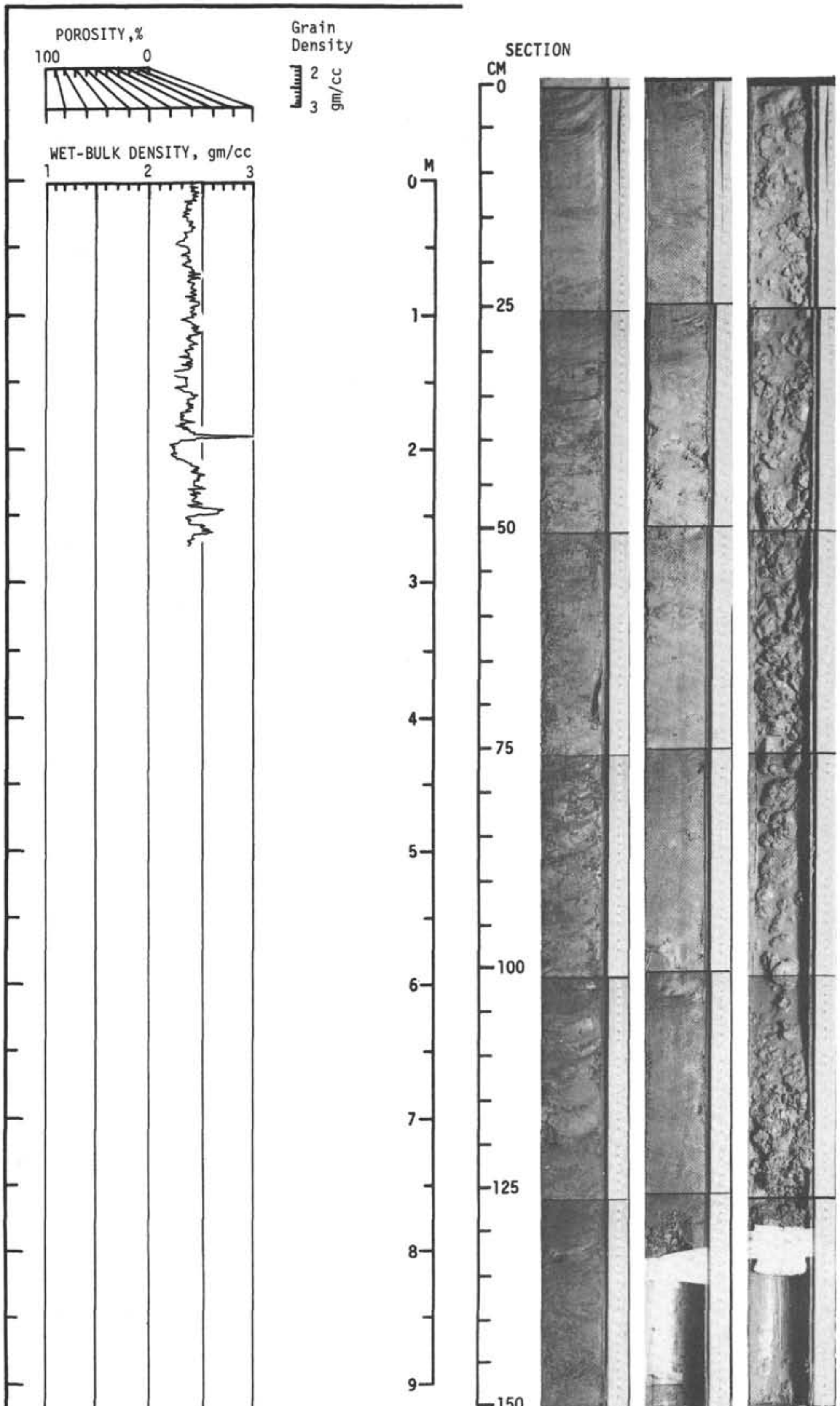

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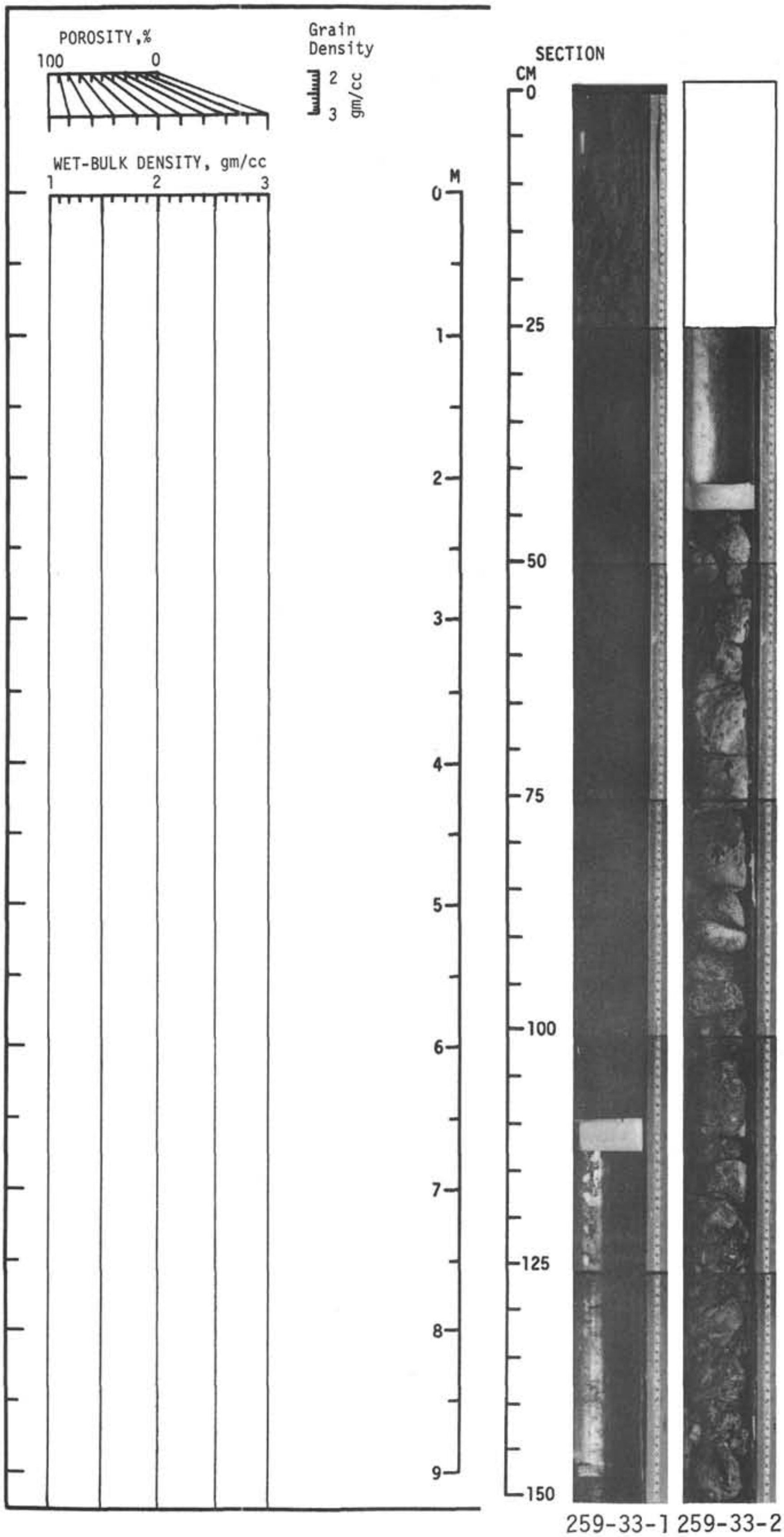
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gm/cc
WET-BULK DENSITY, gm/cc
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SECTION
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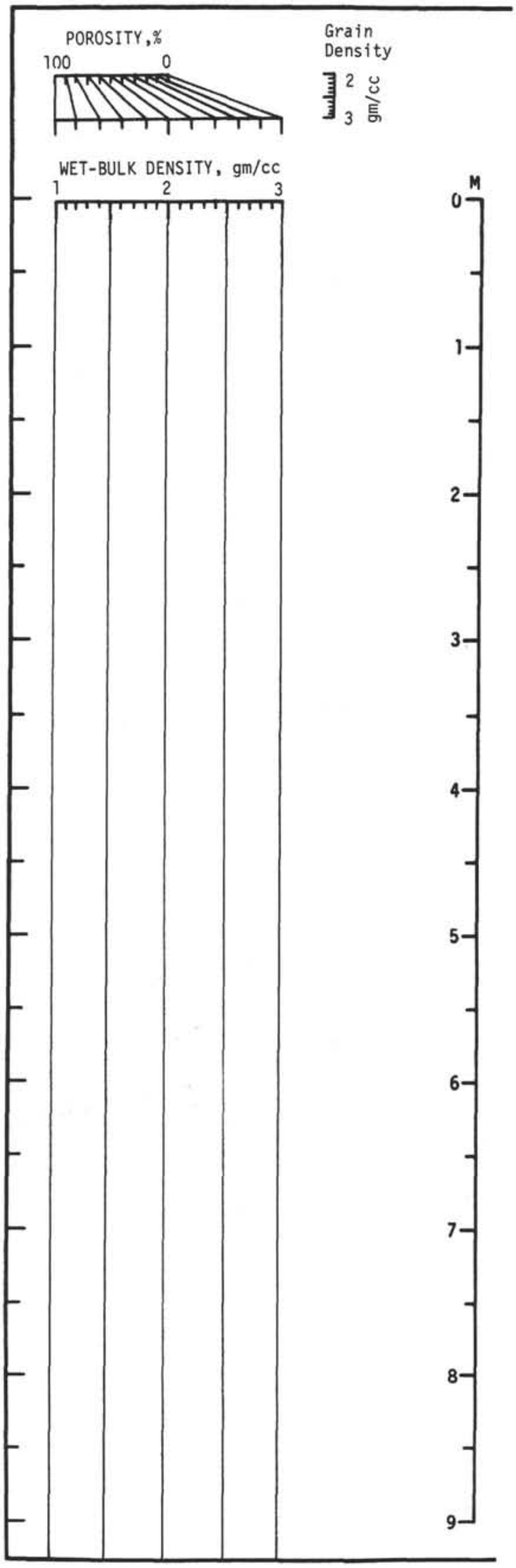
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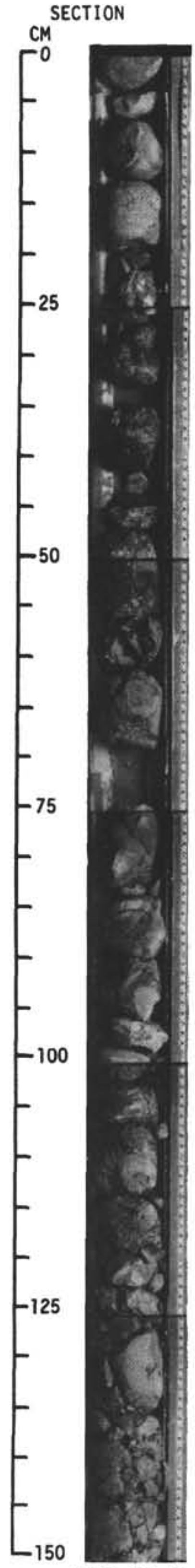
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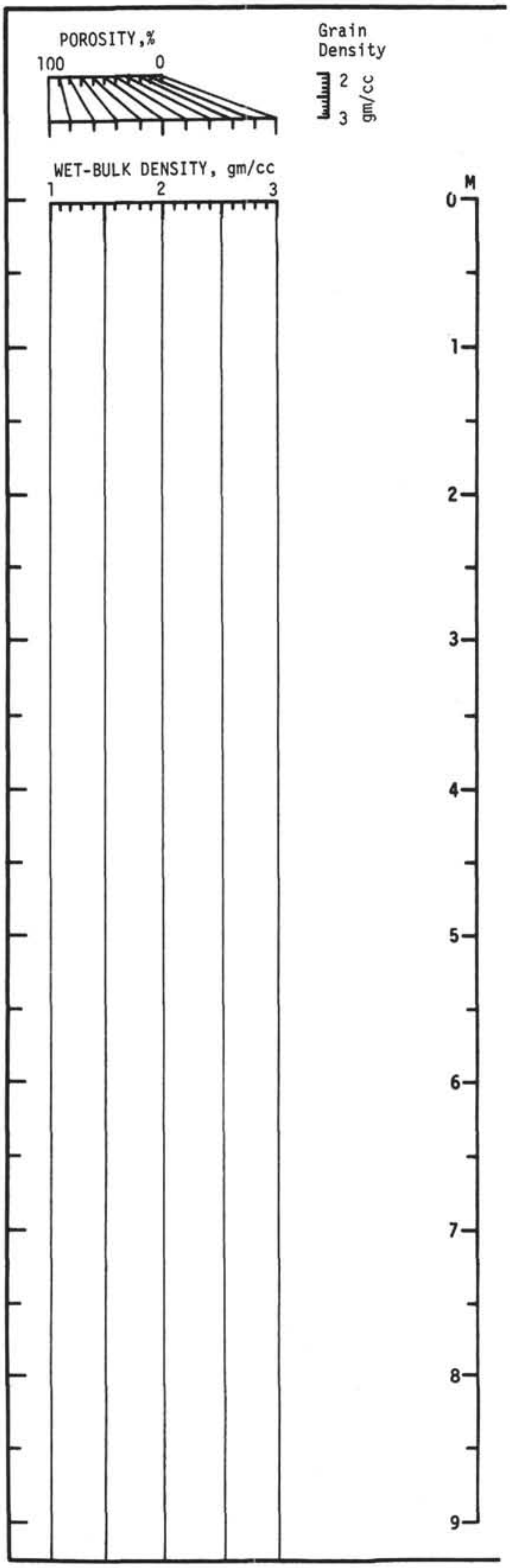

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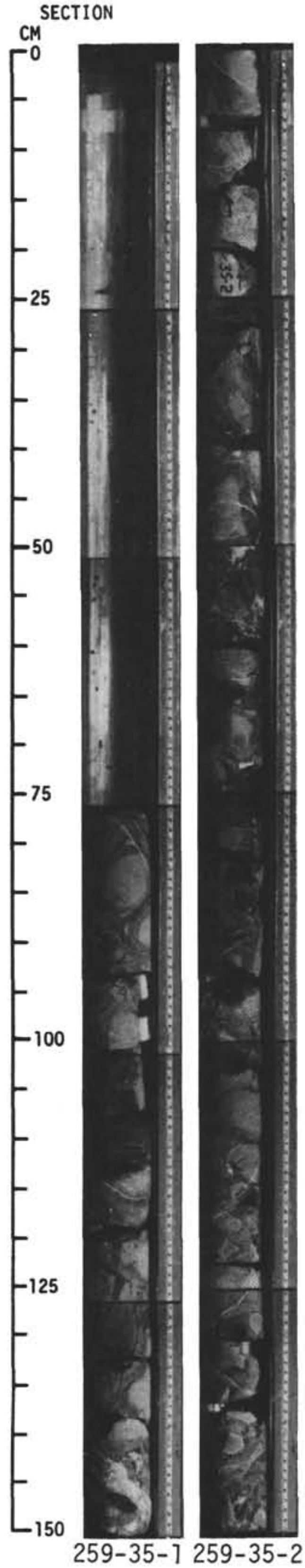

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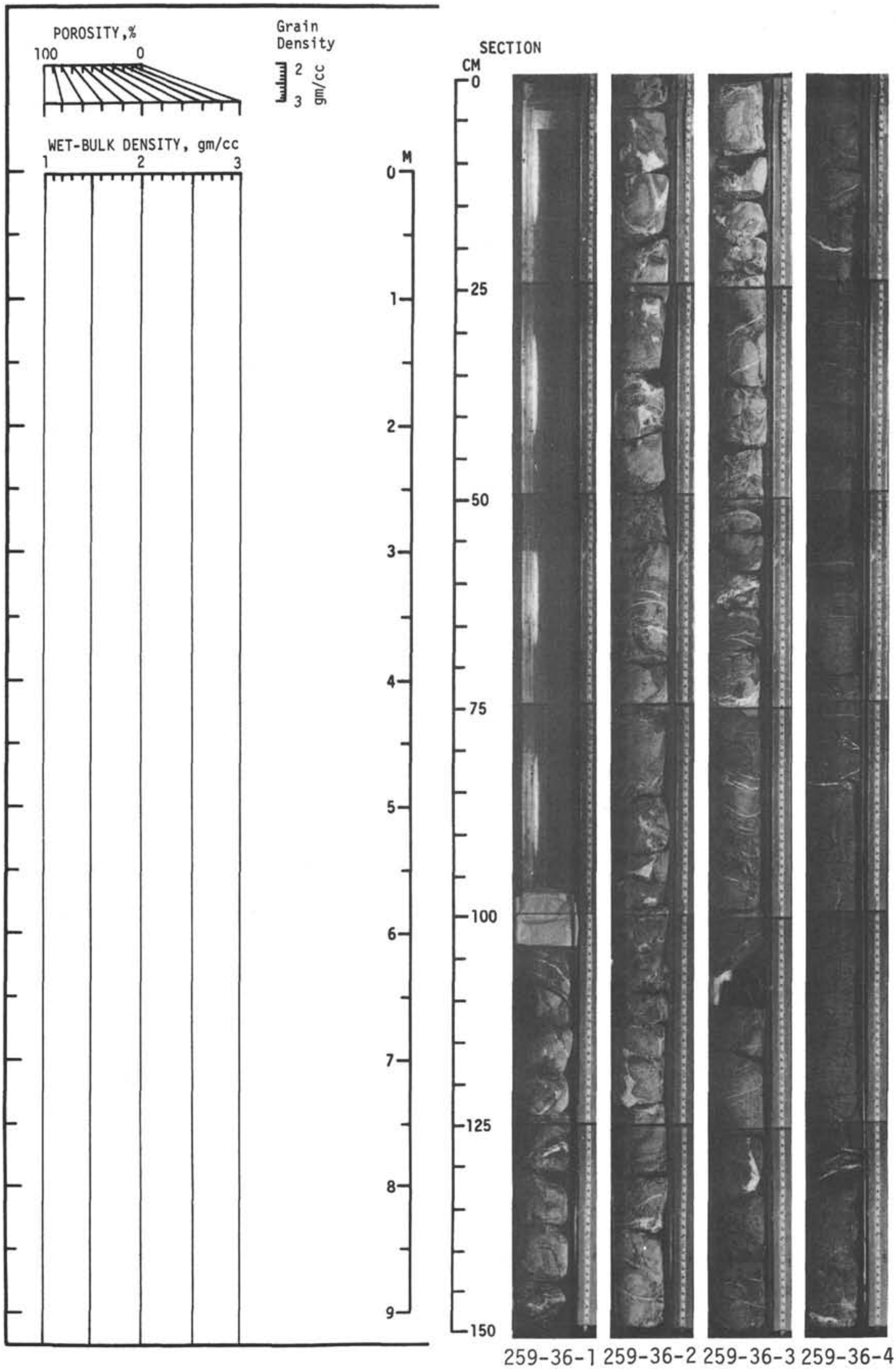
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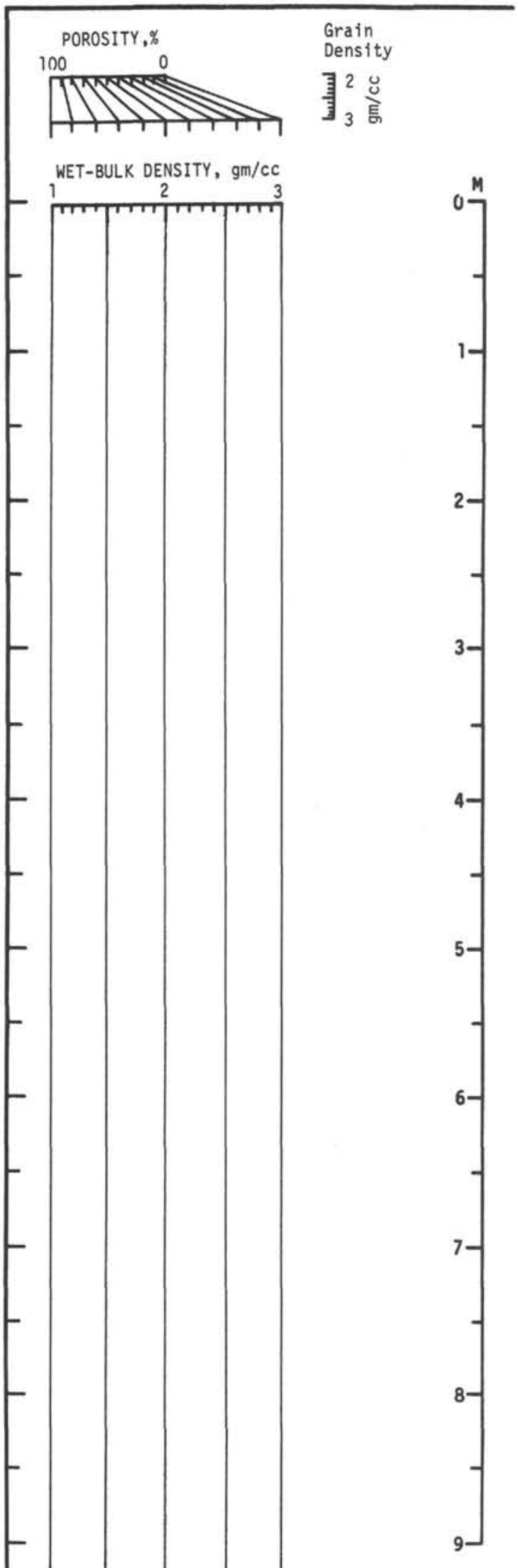
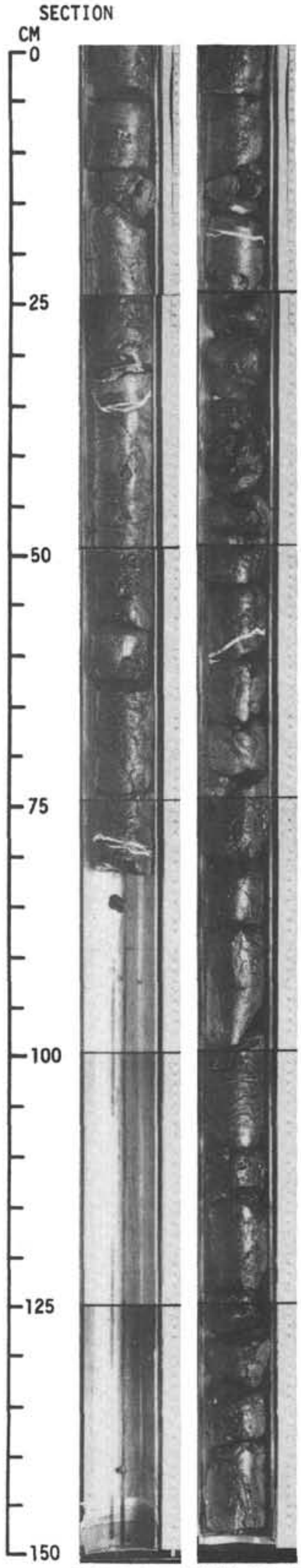
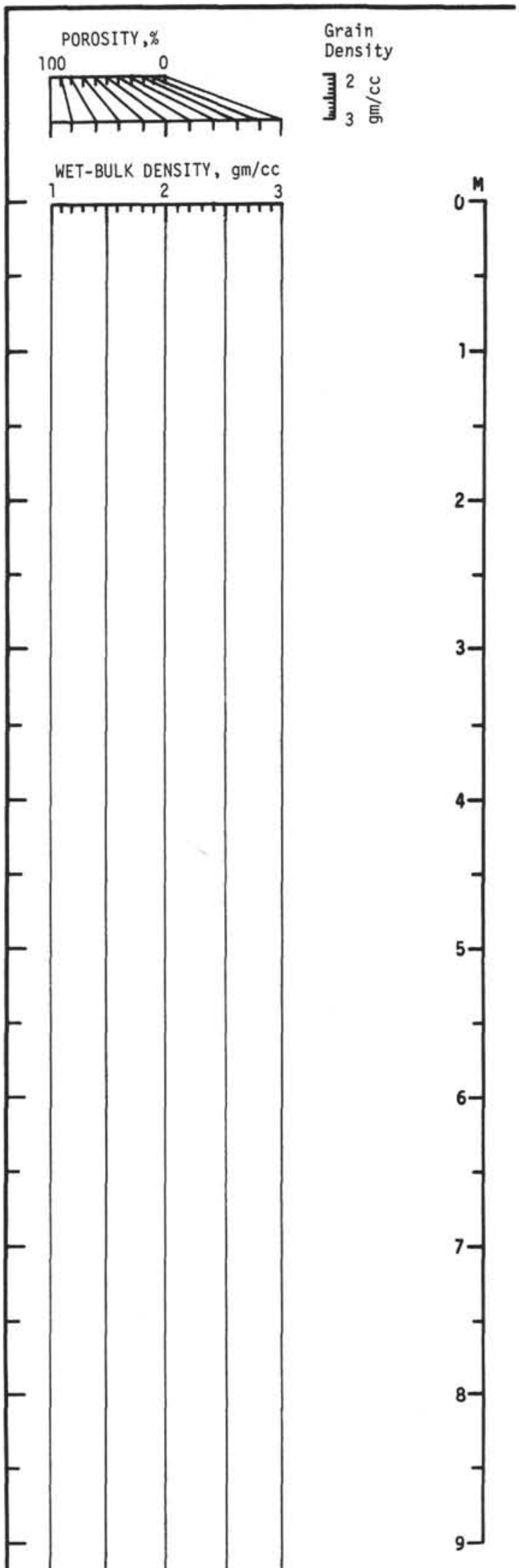
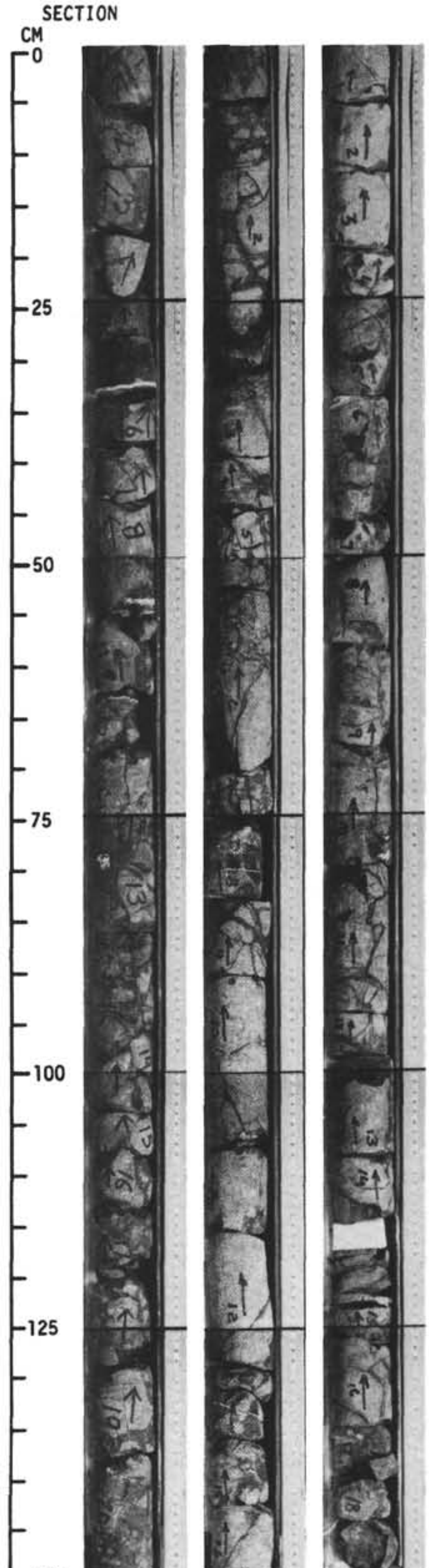




259-37-1 259-37-2





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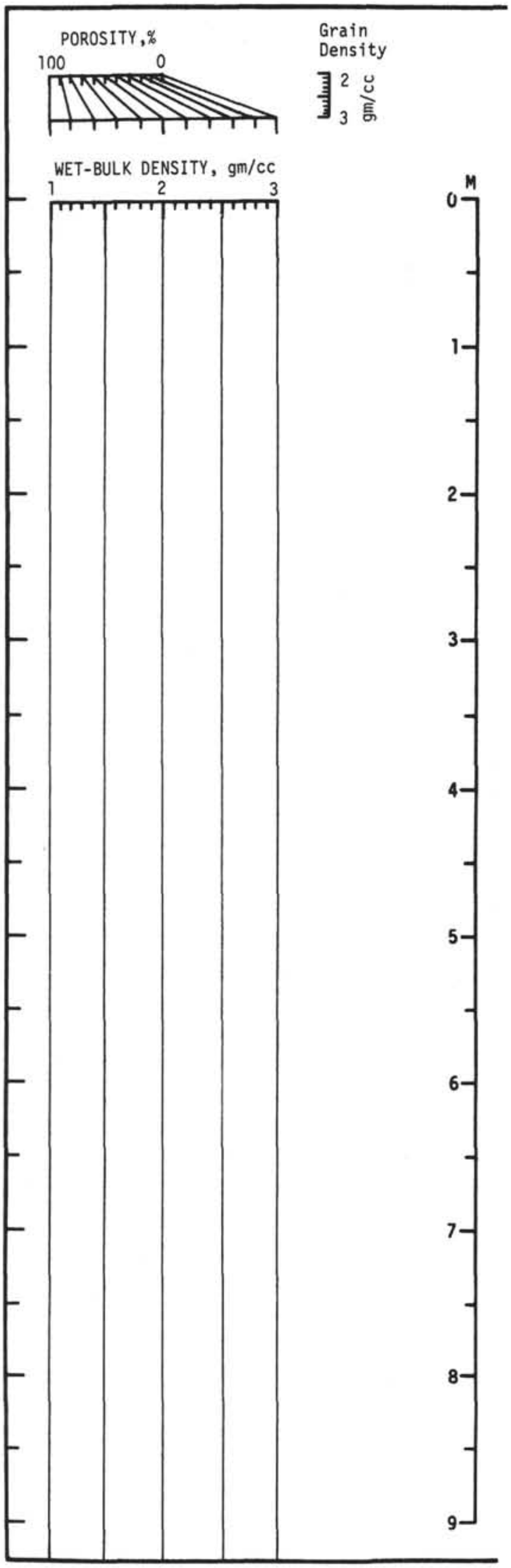
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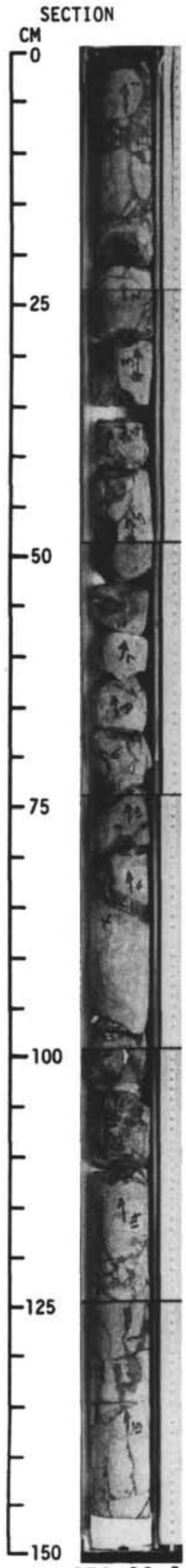
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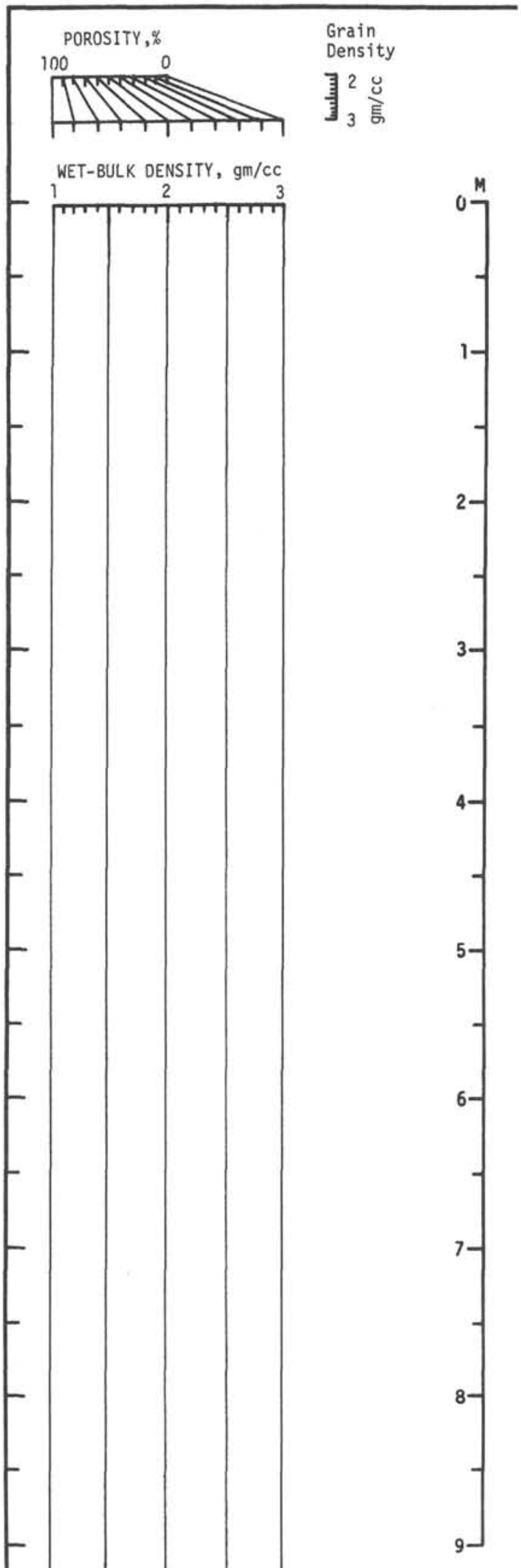
259-39-1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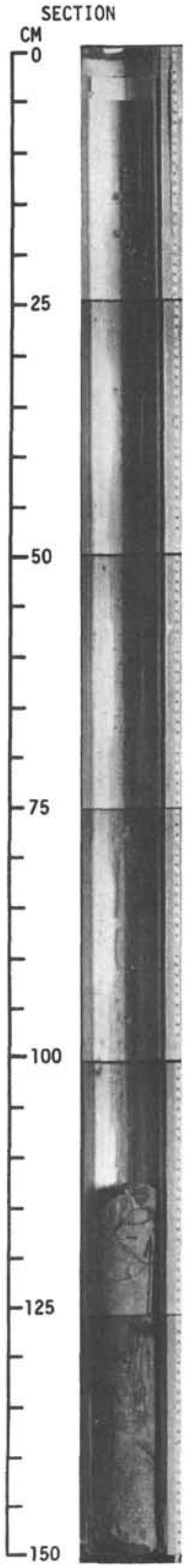
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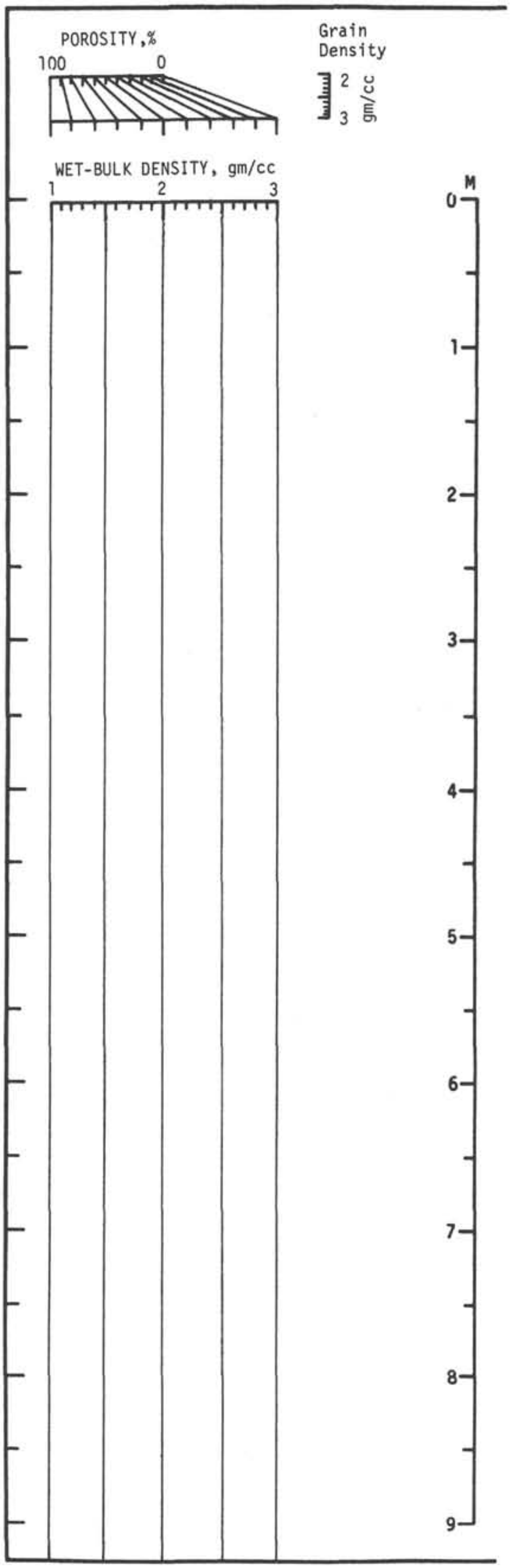

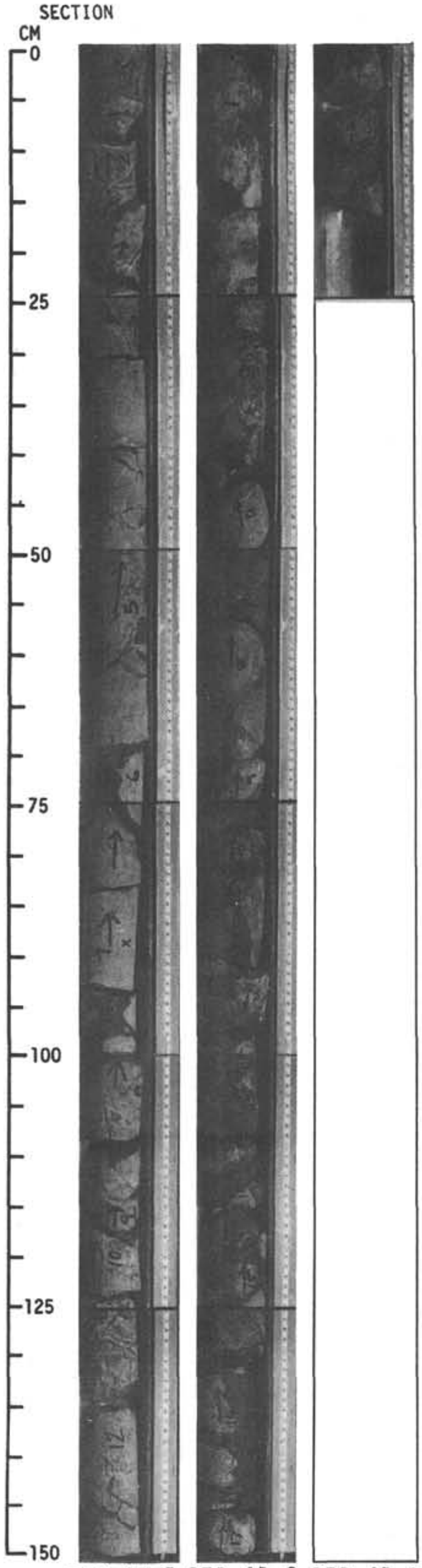

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