6. SITE 263

The Shipboard Scientific Party[1]

SITE DATA

Date Occupied: 1 December 1972
Date Departed: 6 December 1972
Time on Site: 128 hours
Position:
lat 23°19.43'S
long 110°58.81'E
Water Depth (from sea level): 5048 corrected meters (echo sounding)
Water Depth (from drill floor): 5058 corrected meters (echo sounding)
Bottom Felt At: 5065 meters (drill pipe)
Penetration: 746 meters
Number of Holes: 1
Number of Cores: 29
Total Length of Cored Section: 271 meters
Total Core Recovered: 163.5 meters
Percentage Core Recovery: 60.33
Oldest Sediment Cored:
Depth below sea floor: 746 meters
Nature: Quartz-bearing clay
Age: Albian
Measured velocity: 2.4 km/sec
Measured velocity: 2.4 km/sec
Basement: Not penetrated
Principal Results: Beneath 100 meters of Quaternary and upper Pliocene turbiditic foram nanno ooze, which shows in the seismic profile as a well-stratified layer, is an acoustically transparent layer of lower Paleocene to Cretaceous sediments. Those sediments comprise poorly fossiliferous clayey nanno ooze and black claystone that overlie Albian (?) to Hauterivian (?) black kaolinitic quartz-bearing clay.

BACKGROUND AND OBJECTIVES

This site (Figure 1) was chosen with two main objectives in mind:

1) to determine the age of the basement, and

2) to determine the history of sedimentation in this part of the Indian Ocean.

Other sites drilled on Leg 27 and sites drilled on Legs 22 and 26 indicate a general increase in basement age from west to east in the eastern Indian Ocean. This site would fill an important gap in basement ages on the most easterly side of the Indian Ocean adjacent to the Australian continent. There is a good probability that the ocean floor off Western Australia is composed of several small tectonic plates. The scattered earthquake epicenters, the lack of easily correlatable magnetic anomalies, and the prominent topographic features support this idea. To delineate these plates, drill sites must be fairly closely spaced and carefully located. This site should help to identify some of the oldest ocean floor in the Indian Ocean and show that this area is distinct from marginal plateaus, such as the Wallaby Plateau.

Site 263 is located on the edge of the Cuvier Abyssal Plain. Its proximity to the continental slope is such that it should have a top layer of terrigenous sediments, yet yield a full record of paleo-oceanographic conditions since the time Australia rifted from the continent, then to its immediate west. The sediment column should show some resemblance to that of Site 259 further south but may have older sediments in addition.

SITE SURVEY

The drill site was first approached from the north with a track laid out to intersect an existing *Diamantina* track. The seismic airgun began erratic operation as the *Diamantina* line was approached. Rather than risk complete failure of the seismic system just at the time of beacon dropping, it was decided to turn and run parallel to the *Diamantina* track but north of it. The idea was to pick a drill site under the assumption that structures probably strike north-south so an equivalent site could be found just to the north of the site sought. This turned out to be the case, with a basement reflector at a depth of 0.8 sec about 2.4 km (1.5 mi) from the base of the continental rise. The ship reversed course and dropped the beacon at 0856Z, 1 December 1972, in the flat-bottomed Cuvier Abyssal Plain in 5055 meters of water.

The 0.8-sec basement drops away slowly beneath the floor of the abyssal plain to the west (see Figure 2). Flat-lying stratified reflectors, probably turbidites, wedge out against the continental rise. The depth to the bottom of these reflectors is shown by the dotted line in Figure 2.

An on-site sonobuoy was run and additional seismic coverage was obtained as the ship left the site and headed for Fremantle.

---

[1] James R. Heirtzler, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, Co-Chief Scientist; John J. Veevers, Macquarie University, Sydney, Australia, Co-Chief Scientist; Hans M. Bolli, Swiss Federal Institute of Technology, Zurich, Switzerland; Alan N. Carter, University of New South Wales, Kensington, Australia; Peter J. Cook, Bureau of Mineral Resources, Canberra, Australia; Valeri Krasheninnikov, Geological Institute of the Academy of Sciences of the USSR, Moscow; Brian K. McKnight, University of Wisconsin, Oshkosh, Wisconsin; Franca Proto-Decima, Istituto di Geologia dell'Universita, Padua, Italy; G. W. Renz, Scripps Institution of Oceanography, La Jolla, California; Paul T. Robinson, University of California, Riverside, California; Karl Rocker, Jr., Civil Engineering Laboratory, NCBC, Port Hueneme, California; Paul A. Thayer, University of North Carolina, Wilmington, North Carolina.

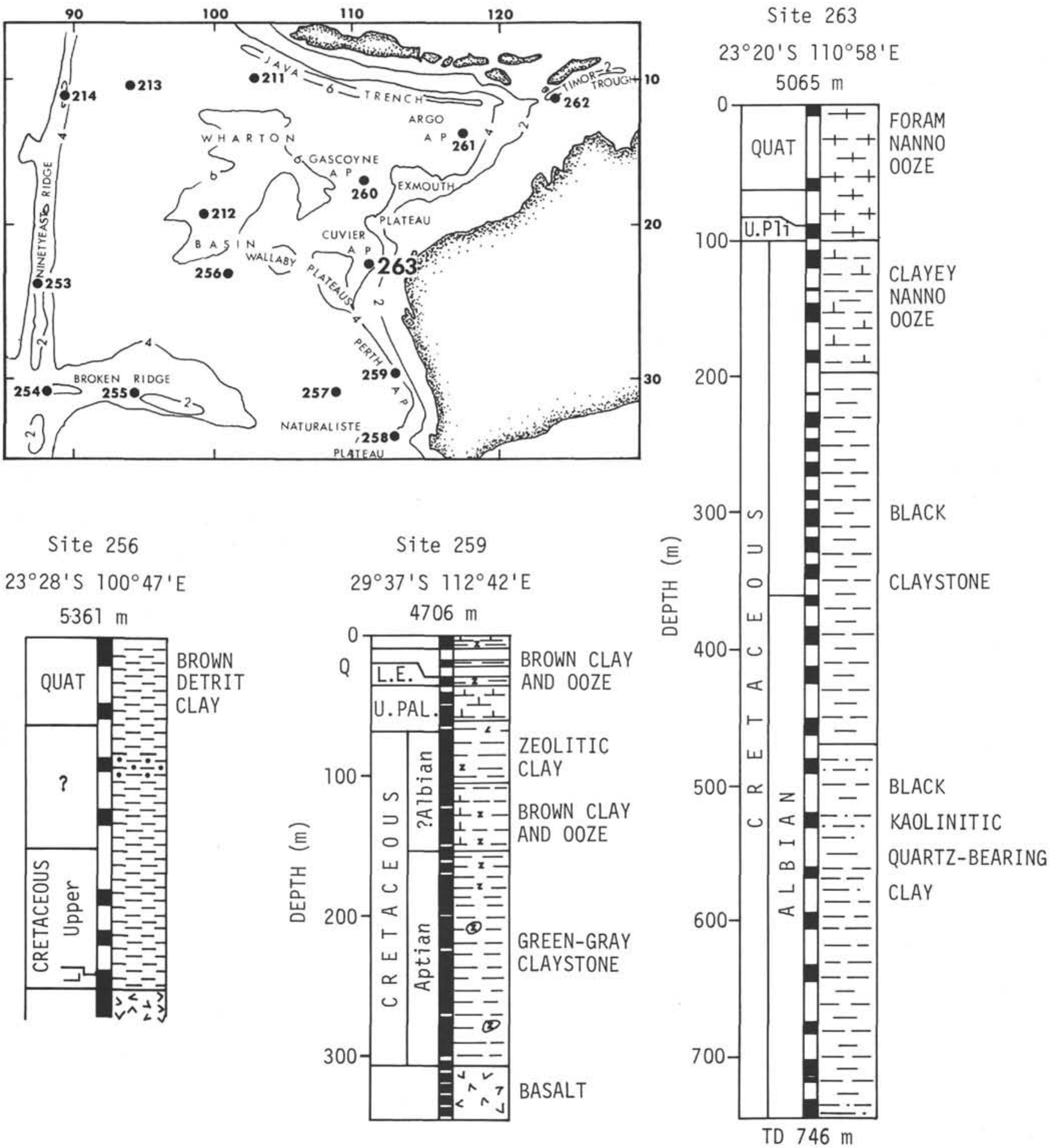


Figure 1. *Location of Site 263 and generalized stratigraphic columns of Site 263 and adjacent sites.*

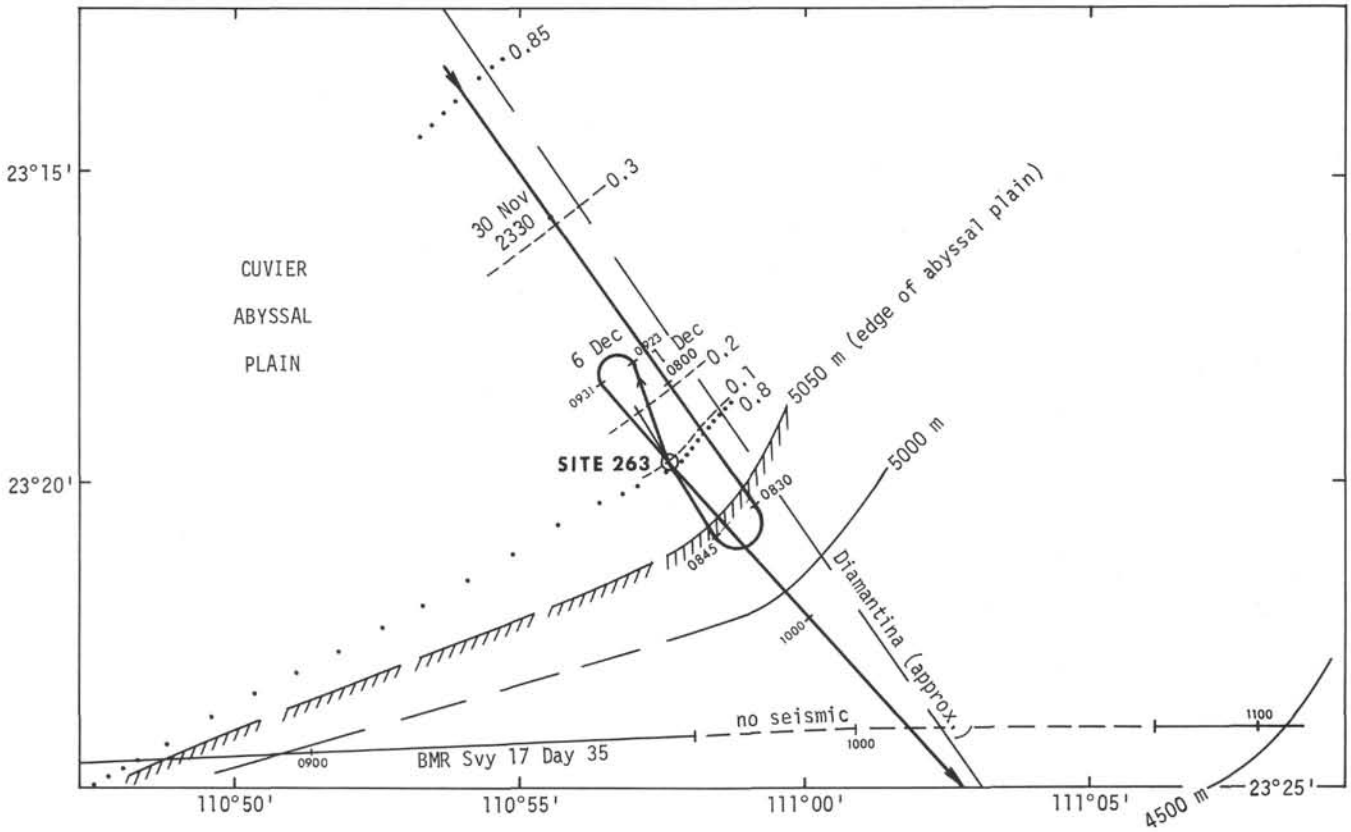


Figure 2. *Site survey for Site 263. Long dashes show depth of basement reflector, in sec, and short dashes show depth to bottom of flat-lying surface reflectors, in sec. A nearly transparent layer exists between these two depths.*

OPERATIONS

Site 263, on the eastern edge of the Cuvier Abyssal Plain was approached from the northeast. The intent was to proceed until the track intercepted a *Diamantina* track, then to turn and follow it along a southeasterly course.

The seismic airgun began intermittent operation before the intersection with *Diamantina*'s track. Rather than lose seismic record and not know where to drill, it was decided to turn immediately and parallel *Diamantina*'s track with the idea that a suitable drilling site, comparable to the original one could be found. This was done a few miles north *Diamantina*'s track. A site with apparent basement at 0.8 sec was found. The ship reversed course and dropped the beacon while underway at over 9 km/hr (5 knots) at 0856Z. 1 December 1972.

Survey gear was retrieved and the ship returned to and positioned over the beacon. The bottom hole assembly and drill pipe were run in and a relatively firm bottom tagged at 5065 meters. The hole was spudded at 2200, 1 December, and drilled and intermittently cored to a depth of 5811 meters or 746 meters below sea floor.

Details of the coring are included in the coring summary, Table 1.

Operations were more or less routine with erratic core recoveries and relatively slow penetration to the final depth of 5811 meters. After recovering Core 29 at this depth, something failed in the drawworks at 1700, 5 December, and dropped the traveling block and drill string. Suspected to be in either the hydromatic or overriding clutch, the actual cause had not been determined when we departed the site. When the string dropped, the Bowen power sub was jammed into the rotary table elevator bushings and the weight of the traveling block forced the outer case of the swivel down onto the top of the Bowen sub, stripping the bearings out of the swivel. The momentum of the free-wheeling drum parted the 1½ in. drilling line at the drum clamp. The free end of the drilling line came over the crown fast sheave and piled up on top of the traveling block. Fortunately, the traveling block remained in the guide rails and did not fall to the rig floor.

The free end of the drilling line was restrung over the crown and new drilling line pulled through to the drawworks drum. The debris was cleared up and the swivel was partially re-assembled to pick up the drill string. At 0100, 6 December, the string was picked up and found to be free and was pulled out of the hole.

Damage to the swivel and Bowen sub were too extensive for shipboard repair, aborting any further drilling at Site 263.

Weather conditions and positioning were generally good. The computer failed once and the ship was positioned in manual mode without difficulty. The beacon weakened and failed as we departed the site at 1700, 6 December, enroute to Fremantle for repairs.

TABLE 1
Coring Summary, Site 263

Core	Date (Dec 1972)	Time	Depth From Drill Floor (m)	Depth Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovery (%)
1	1	2340	5065.0-5070.0	0.0-5.0	5.0	4.9	98
2	2	0215	5117.5-5127.0	52.5-62.0	9.5	5.0	53
3		0415	5155.5-5165.0	90.5-100.0	9.5	9.5	100
4		0605	5174.5-5184.0	109.5-119.0	9.5	9.5	100
5		0810	5193.5-5203.0	128.5-138.0	9.5	0.6	6
6		1010	5212.5-5222.0	147.5-157.0	9.5	8.6	91
7		1310	5241.0-5250.5	176.0-185.5	9.5	2.6	27
8		1540	5269.5-5279.0	204.5-214.0	9.5	1.0	11
9		1755	5288.5-5298.0	223.5-233.0	9.5	6.0	63
10		2030	5307.5-5317.0	242.5-252.0	9.5	4.1	43
11		2240	5326.5-5336.0	261.5-271.0	9.5	5.7	60
12	3	0115	5345.5-5355.0	280.5-290.0	9.5	5.4	57
13		0345	5364.5-5374.0	299.5-309.0	9.5	6.4	67
14		0610	5383.5-5393.0	318.5-328.0	9.5	7.5	79
15		0835	5402.5-5412.0	337.5-347.0	9.5	4.5	47
16		1120	5421.5-5431.0	356.5-366.0	9.5	1.5	16
17		1430	5450.0-5459.5	385.0-394.5	9.5	9.5	100
18		1720	5478.5-5488.0	413.5-423.0	9.5	7.0	74
19		2120	5516.5-5526.0	451.5-461.0	9.5	8.0	84
20	4	0000	5545.0-5554.5	480.0-489.5	9.5	9.5	100
21		0300	5583.0-5592.5	518.0-527.5	9.5	6.4	67
22		0700	5621.0-5630.5	556.0-565.5	9.5	4.1	43
23		1135	5659.0-5668.5	594.0-603.5	9.5	6.8	72
24		1600	5697.0-5706.5	632.0-641.5	9.5	8.6	91
25		2145	5735.0-5744.5	670.0-679.5	9.5	4.7	50
26	5	0425	5763.5-5773.0	698.5-708.0	9.5	6.3	66
27		0840	5773.0-5782.5	708.0-717.5	9.5	0.2	2
28		1325	5792.0-5801.5	727.0-736.5	9.5	4.5	47
29		1655	5801.5-5811.0	736.5-746.0	9.5	5.0	53

Note: Echo-sounding depth = 5058 meters; drill-pipe length to bottom = 5065 meters.

LITHOLOGY

Site 263 was drilled to a total depth of 746 meters. Approximately 100 meters of upper Pliocene to Recent and 646 meters of Cretaceous sediments were penetrated. Basement was not reached due to a drilling equipment malfunction. The sequence may be divided into four lithological units, the major characteristics of which are summarized in Table 2.

Unit 1 (0.0-100.0 m)

Unit 1 consists of approximately 100 meters of greenish-gray soft detrital foram-nanno ooze, with minor nanno ooze and a single lamina of quartz-rich detrital foram sand. Nannoplankton are abundant throughout, generally forming 45% of the total sediment. Foraminifera (predominantly pelagic) range from 35% in the nanno oozes to 45% in the foram sand; micarb (fragmentary calcareous material generally of uncertain affinities though in this unit it is believed to be predominantly of biogenic origin) ranges from 15% to 25%. Grain-size analyses indicate that these sediments range from clayey sand and sand-silt-clay to silty clay. Clay minerals, minor amounts of quartz, and traces of feldspar, heavy minerals, glauconite, dolomite rhombs, and fish fragments are present throughout. The coarse fraction consists overwhelmingly of foraminiferal tests and minor-to-trace quantities of ?ostracods, molluscs, sponge spicules, detrital grains (quartz, feldspar, heavy minerals), and authigenic minerals (glauconite (?), pyrite, and iron oxide).

Bedding ranges from thickly bedded or apparently unbedded in the finer-grained intervals, to laminated or thin bedded in the coarse units. A single graded bed 188 cm in thickness was penetrated in Core 1. The lower boundary of Unit 1 is sharp and defined by a marked color change from gray to black. This boundary corresponds to the boundary between sediments of Pliocene and lower Paleocene ages and consequently, represents an important, though possibly local, disconformity.

Unit 2 (100.0-195.0 m)

Units 2-4 are all black organic-rich claystone in marked contrast to the overlying light-colored coarser grained sediment of Unit 1. Each of the three claystone units does, however, have characteristic lithologic features which allow the 3-fold division to be readily made.

Unit 2 consists of approximately 95 meters of dark-greenish-gray and olive-black stiff clay, nanno-bearing clay, and clayey nanno ooze, with the proportion of nannoplankton decreasing down the section from 50% nannos at the top to only 5% at the base. Montmorillonite is the dominant clay mineral; illite is minor; chlorite and kaolinite are present in trace amounts. Minor amounts of silt-size feldspar (up to 12% in the upper part of the unit), quartz, opaques, and glauconite are present throughout. Traces of zeolites, dolomite rhombs, heavy minerals, and fish fragments are also in evidence. In the coarse fraction, arenaceous

TABLE 2
Major Lithologic Units of Site 263

Interval (m)	Unit	Description	Age	Thickness (including gaps) (m)	Cores
0.0-100.0	1	Greenish-gray detrital foram-nanno ooze with abundant micarb and minor clay and quartz. Graded in places. Lower boundary is sharp.	Quaternary – upper Pliocene	100	1-3
100.0-195.0	2	Greenish-gray to olive-black, stiff, clayey nanno ooze, nanno clay and nanno-bearing clay, with the proportion of nannos increasing up the unit	Lower Paleocene or younger Core 4. Lower Cretaceous (upper Albian) Cores 5-7.	95	4-7
195.0-470.0	3	Greenish-black semilithified claystone, with minor pyrite and trance amounts of quartz, feldspar, zeolites, nannos, fish fragments, and kaolinite	Lower Cretaceous (upper Albian based on nannoplankton)	275	8-19
470.0-746.0	4	Olive-black semilithified silty quartz-bearing to quartz-rich kaolinitic clay. Pyrite and calcite nodules and veins are common. Burrows, mottles, and shell fragments are common	Lower Cretaceous	276	20-29

foraminifera, pyrite, glauconite, and quartz are the dominant constituents. Foraminifera in this fraction are commonly replaced by glauconite or pyrite. Dolomite nodules are common in Unit 2. The cores are highly deformed throughout and consequently the original nature of the bedding is not evident. The base of Unit 2 is placed midway between Core 7 which contains 5% nannoplankton and is greenish gray in color, and Core 8 which contains only trace amounts of nannos and is greenish black in color.

Unit 3 (195.0-470.0 m)

Unit 3 is a greenish-black semilithified claystone with a total thickness of 275 meters. Lenses and laminae of olive-black and grayish-black claystone are common throughout. Clay, (mainly montmorillonite but with minor illite and kaolinite and trace quantities of chlorite) generally makes up more than 90% of the sediment; minor constituents include quartz, feldspar, kaolinitie, opaques, and pyrite. Trace amounts of nannos, heavy minerals, zeolites, dolomite rhombs, glauconite, and fish fragments occur sporadically throughout the unit. Quartz, muscovite, kaolinite, pyrite, and arenaceous foraminifera are abundant in the coarser fractions. Dolomite and barite occur as veinlets and nodules, particularly in the upper half of the unit.

Bedding consists of some poorly defined, contorted laminae and lenses, up to 1 cm in thickness, but bedding is not visible in much of Unit 3. In the lower part of the claystone, splitting is apparent along irregular partings at intervals of 1-10 cm. The boundary between Units 3 and 4 is placed at the change from greenish-black claystone (Unit 3) to olive-black silty claystone. This change occurs between Cores 19 and 20. The boundary is probably gradational, as silty layers do occur sporadically between Cores 16 and 19. Grain-size analysis indicates that there is a change from clay to silty clay at about 420 meters.

Unit 4 (470.0-746.0 m)

Unit 4, which was penetrated to a depth of 276 meters, is an olive-black semilithified silty quartz-bearing to quartz-rich silty claystone. The claystone is generally composed of 70%-80% clay, 10%-30% silt-size quartz with minor silt-size feldspar, opaques, pyrite, dolomite rhombs, heavy minerals, zeolites, muscovite, nannos, and fish fragments. In the coarser fractions, muscovite, foraminifera (both arenaceous and benthonic), quartz, mollusc (particularly *Inoceramus*) fragments, pyrite, and kaolinite are present. Many of these sediments exhibit bioturbidation (Figure 3).

Calcite and dolomite nodules and veinlets are common throughout Unit 4; pyrite nodules are also moderately abundant. Small white spherules and blebs of kaolinite occur in a calcitic cement at a number of horizons throughout Unit 4. A kaolinite sandstone composed predominatly of well-rounded green clasts set in a sparry calcite cement occurs at the base of Core 28 (Figure 4). It is uncertain whether the kaolinite is of primary of secondary origin.

The claystone splits approximately parallel to the bedding plane at about 10-cm intervals. Bedding ranges from thin to laminate; it is commonly lenticular and frequently disturbed by bioturbation. Mottles are also

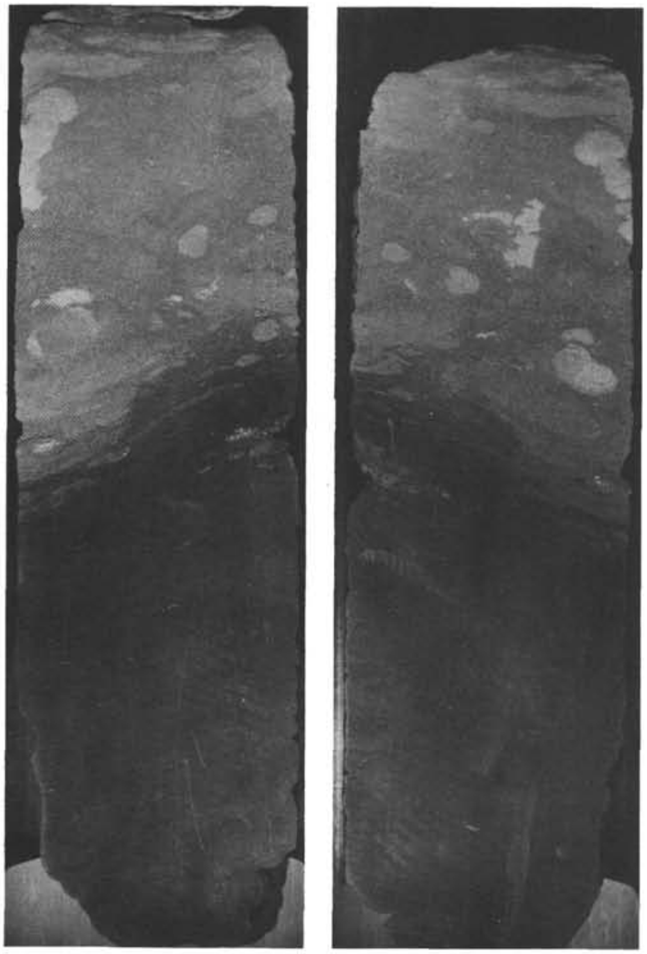


Figure 3. *Sample 21, CC. Irregular contact between light-colored calcitic bioturbated mudstone and the underlying dark lenticular mudstone. Core diameter, 6 cm.*

Figure 4. *Sample 28, CC. Calcitic kaolinite sandstone. Slightly inclined bedding is evident. Core diameter, 6 cm.*

abundant. Burrows range in direction from horizontal to vertical. Greatly inclined bedding (?cross-bedding) is apparent in the kaolinite sandstone at the base of Core 28. The base of Unit 4 was not penetrated.

Interpretation

Unit 4, the lowest unit encountered, is distinguished from the other units by its comparative abundance of terrigenous silt-size grains of quartz, feldspar, muscovite, and heavy minerals (particularly zircon and tourmaline), the occurrence of calcareous and arenaceous foraminifera, the abundance of burrowing organisms, and particularly the presence of a well-sorted cross-bedded kaolinite sandstone. All these features are consistent with comparatively shallow-water conditions, undoubtedly above the carbonate compensation depth, and perhaps on the outer part of the continental shelf or possibly the upper portion of the continental slope. Conditions both above and below the sediment-water interface appear to have been sufficiently aerated for a poor-to-moderate biota to develop. The comparatively high organic-carbon content is probably an indication of comparatively shallow water, allowing little time for oxidation of fine organic material. The abundance of quartz and mica and the lack of volcanic glass and zeolites suggests local continental provenance for the majority of the Unit 4 sediments. During the deposition of Unit 3, the sea floor apparently subsided, perhaps below the lysocline as these sediments are now devoid of calcareous foraminifera and mollusc fragments; the infauna is also impoverished and the organic carbon content is lower. Despite this gradual subsidence of the sea floor, there was apparently little change in the sediment source, as the mineralogical assemblage is predominantly continental, though montmorillonite (possibly of volcanic origin) is still fairly common. Conditions may once again have become somewhat shallower later in the Cretaceous as there is a gradual increase in the percentage of nannoplankton towards the top of Unit 2. As in the two previous units, sedimentation is still overwhelmingly terrigenous in Unit 2.

Thus, throughout much of the Cretaceous, the picture is one of continuous terrigenous sedimentation with a minimal biogenic contribution. The rate of sedimentation was comparatively rapid with approximately 600 meters of sediment being deposited during the Lower Cretaceous. There is no lithologic evidence that mass transport was important in the deposition of these sediments, although there is paleontological evidence to suggest that some reworking (perhaps as a result of turbidity flows or maybe some other form of bottom current) occurred in Unit 3. The most viable model would seem to be that of a comparatively large though sluggish river debouching onto the continental shelf with the suspended load being carried over the edge of the slope. Marine deltaic influences were evident throughout the time of deposition of Unit 3 despite increasing water depth. Later in the Cretaceous there was possibly some uplift which elevated the sea floor above the lysocline. A modern analogy to this Cretaceous situation is perhaps the northern end of the Gulf of California where the Colorado River delta is prograding into a marine gulf which is also an active-spreading center.

At Site 263, there is no record of the depositional conditions prevailing between the Paleocene and the Pliocene though the sharpness of the contact between Units 2 and 1 suggests a pre-Pliocene erosive phase. Site 263 has probably been located on an abyssal plain, at or below the lysocline, from at least the Pliocene to the present day. Despite this, calcareous sediments predominate. This is probably due to mass transport of biogenic calcareous sediments from the slope into the abyssal plain by turbidity flows.

BIOSTRATIGRAPHY/PALEONTOLOGY

General

Four spot cores were taken in the post-Cretaceous section, all consisting of turbidites rich in planktonic foraminifera and nannoplankton, with the material apparently carried down below lysocline from the nearby Australian shelf and slope area. Cores 1 and 2 at 0.0-5.0 meters and 52.5-65.0 meters are Quaternary with reworked older material. Core 3 (90.5-100.0 m) which also shows considerable reworking of older Pliocene Miocene fossils is dated as upper Pliocene or Quaternary. The foraminiferal fauna of sample 4-4, 55-57 cm is heterogeneous. It consists of lower Paleocene planktonic and calcareous benthonic foraminifera; the arenaceous species appear to be identical with those from the underlying cores dated as Lower Cretaceous. This is confirmed by the nannoplankton association which consists of a mixed flora of these two ages. All Radiolaria present in Core 4 are of Cretaceous age and are reworked. The fairly frequent fish debris present indicates deposition below lysocline.

The possibility exists that the sediments of Core 4 are younger than Paleocene with not only the Lower Cretaceous but also the lower Paleocene components being reworked. Of the Core 4 samples examined, that of Sample 4-4, 55-57 cm is the only one with a Paleocene fauna and flora in addition to the Lower Cretaceous elements, which are also present in the other samples of this core. The question thus remains whether or not at least some part of the section immediately below Core 4, with the same kind of Lower Cretaceous fauna and flora as in Core 4, may in fact also be reworked and the sediments be younger. The exact top of the Lower Cretaceous, therefore, is uncertain.

The Cretaceous interval, Cores 5-29, is difficult to date precisely because the different fossil groups present indicate different ages. In the upper part of the interval, Cores 5-10, the possible ages are upper Albian, lower Albian, and upper Aptian. In the lower part, Cores 11-27, ages of upper Albian, Aptian or older, Barremian, and Neocomian are suggested by the different fossils.

The fossil evidence for these diverging age interpretations comes from nannoplankton, benthonic foraminifera, palynomorphs, and molluscs. Radiolaria, which are infrequent in Cores 5-18, allow only for a Cretaceous s.l. dating; they are absent altogether in Cores 19-29.

The stratigraphic ranges of benthonic foraminifera on which some ages are based are still somewhat uncertain. Ages based on the nannoplankton are difficult to dispute because of the presence, particularly in the lower part of the section, of *Eiffelithus turriseiffeli*, an index fossil generally acknowledged to first appear in the upper Albian. It is of interest to note that of all Leg 27 Cretaceous sections drilled, only Site 263 contains upper Albian based on nannoplankton. However, the nearby Sites 256 and 258 of Leg 26, situated west and south of Site 263, also contain upper Albian intervals with *Eiffelithus turriseiffeli.*

If the nannoplankton evidence is accepted, nearly all of the Cretaceous sediments at Site 263 are upper Albian (610 m). Foraminifera and palynomorphs, on the other hand, extend this long interval from Barremian to lower Albian. Figure 5 summarizes the biostratigraphy of Site 263.

Quaternary: Cores 1, 2 (0.0-5.0, 52.5-65 m). *Globorotalia truncatulinoides truncatulinoides* Zone. Rich planktonic foraminiferal fauna with reworked Pliocene species, particularly in Core 2.

Upper Pliocene or Quaternary: Core 3 (90.5-100.0 m). The heterogeneous planktonic foraminiferal fauna includes *Globorotalia truncatulinoides tosaensis* which, in absence of the Pleistocene *G. truncatulinoides truncatulinoides,* is likely indicative for an upper Pliocene age of the sediment.

Lower Paleocene or ?younger: Core 4, (109.5-119.0 m). *?Globigerina eugubina* Zone; *Cruciplacolithus tenuis* Zone. There is a slight discrepancy in the foraminiferal and nannoplankton zonal assignment: The *Globigerina eugubina* Zone which is lowermost Paleocene corresponds to the lower part of the *Markalius inversus* Zone, while the *Cruciplacolithus tenuis* Zone compares with the upper part of the *Globorotalia pseudobulloides* Zone. *Globorotalia pseudobulloides* may in fact be absent for environmental reasons, resulting in dwarfed faunas. It is possible that the Paleocene fauna and flora, like the Lower Cretaceous elements present, are reworked into a still younger sediment.

Lower Cretaceous: Core 5-29 (128.5-746.0 m). Ages within the Lower Cretaceous of this long interval vary considerably, and on the data available now it is not possible to resolve the different age assignments. Based on the presence of *Eiffelithus turriseiffeli* in Cores 22-27, this interval is dated as upper Albian. The upper part of Core 28 is middle Albian (based on nannoplankton), and its lower part and Core 29 are Lower Cretaceous s.l. Benthonic foraminifera on the other hand indicate a sequence ?lower Albian (Cores 5, 6), ?upper Aptian (Cores 7-10) and Aptian or older (Cores 11-29). Dinoflagellates and pollen and spores give ages similar

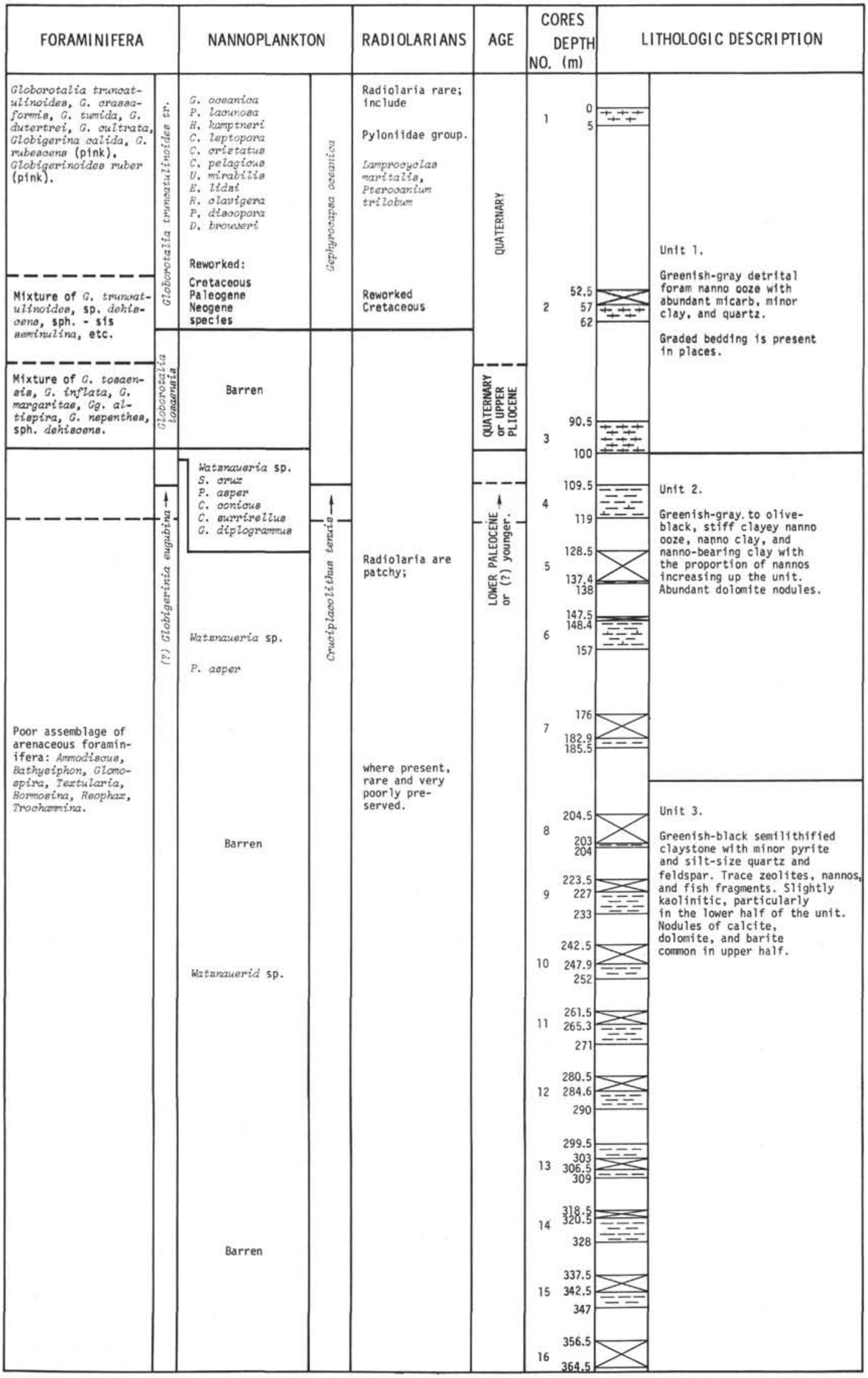
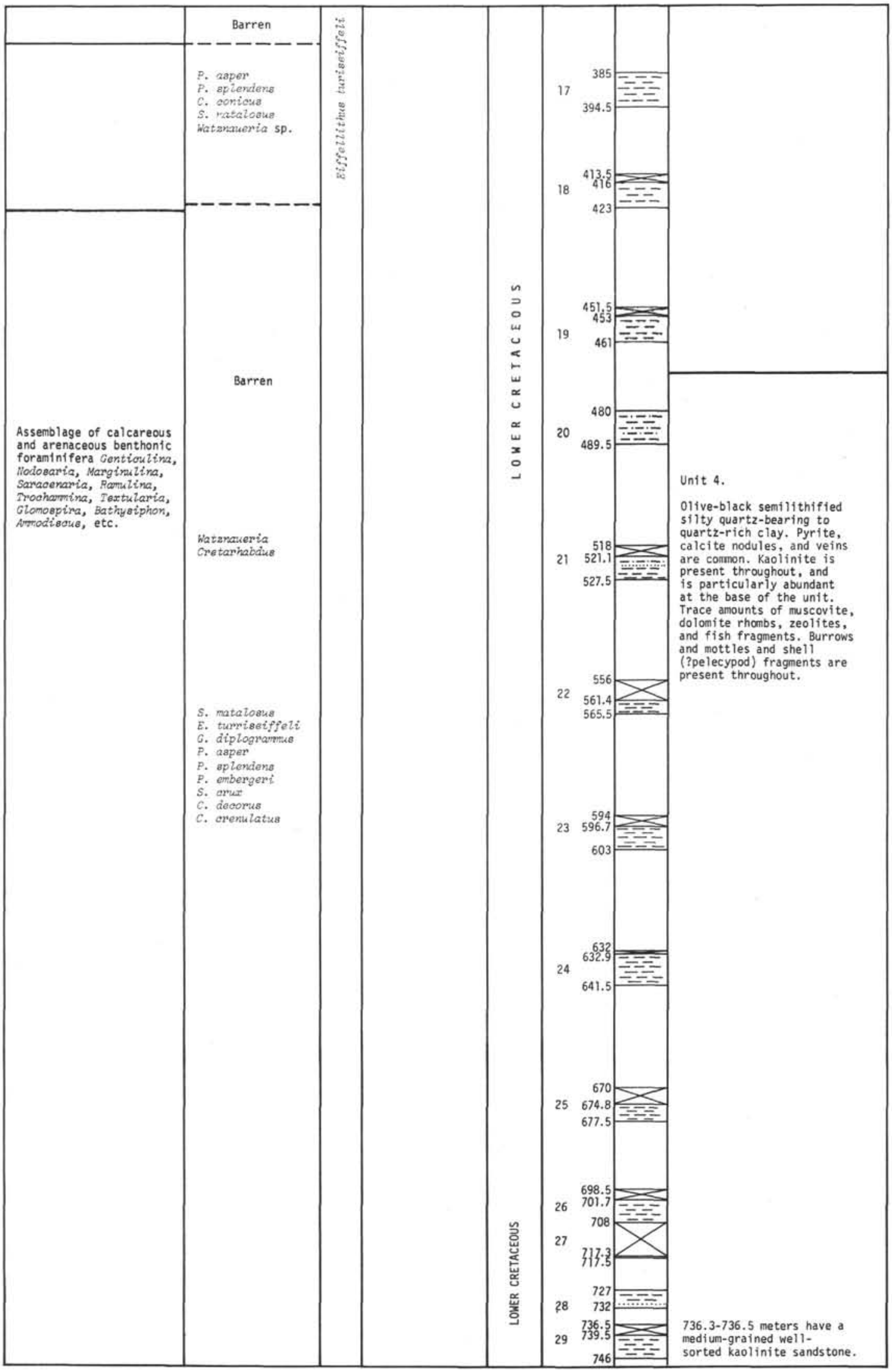


Figure 5. *Biostratigraphic zones, Site 263.*



Barren

P. asper
P. splendens
C. conicus
S. ratalosus
Watznaueria sp.

Assemblage of calcareous and arenaceous benthonic foraminifera *Genticulina*, *Nodosaria*, *Marginulina*, *Saracenaria*, *Ramulina*, *Trochammina*, *Textularia*, *Glomospira*, *Bathysiphon*, *Ammodiscus*, etc.

Barren

Watznaueria
Cretarhabdus

S. matalosus
E. turriseiffeli
G. diplogrammus
P. asper
P. splendens
P. embergeri
S. crux
C. decorus
C. crenulatus

Unit 4.

Olive-black semilithified silty quartz-bearing to quartz-rich clay. Pyrite, calcite nodules, and veins are common. Kaolinite is present throughout, and is particularly abundant at the base of the unit. Trace amounts of muscovite, dolomite rhombs, zeolites, and fish fragments. Burrows and mottles and shell (?pelecypod) fragments are present throughout.

736.3-736.5 meters have a medium-grained well-sorted kaolinite sandstone.

Figure 5. *(Continued).*

to the benthonic foraminifera; Barremian for Cores 19-29, Aptian to probably lower Albian for Cores 5-18; Barremian on dinoflagellates; upper Neocomian-upper Aptian (Cores 11-28) and Neocomian (29) on pollen and spores.

The Ammonite fragment in Core 18 and the Belemnite in Core 26 on the other hand, support an upper Albian age, as also indicated by nannoplankton. The few ostracods, several *Pithonella* species and fish debris are undatable at present. It is possible that *Eiffelithus turriseiffeli* may be older than upper Albian, but no valid evidence for an older age has so far been offered. Noteworthy for the Leg 27 Sites is the fact that *Eiffelithus turriseiffeli* was encountered only in Cores 22-27 of Site 263. Contamination from above or from previously drilled Lower Cretaceous sections in Sites 259-261 can therefore be excluded. The upper Albian age of *Eiffelithus turriseiffeli* is in accord with its occurrence in the neighboring Sites 256 and 258. At Site 258 the species comes in only above the middle Albian *Prediscosphaera cretacea* Zone, and in Site 256 it occurs in cores just above basement.

At this stage, the biostratigraphic value of the benthonic foraminifera used in subdividing the Lower Cretaceous of Site 263 is also uncertain. Mostly primitive arenaceous species are present in Cores 5-16; in Cores 17-29 arenaceous and calcareous benthonic species are more frequent and diverse.

The most important species stratigraphically are *Textularia anacooraensis* in Cores 7-16, *Spiroplectammina cushmani* (Cores 6-29), *Trochammina minuta* and *T.* cf. *minuta* (Cores 19-27), and *Verneuilinoides crespinae* (Cores 11-29). *Textularia anacooraensis* is known from the Aptian of the Canning and Great Artesian basins, and *Spiroplectammina crespinae* from the marine Lower Cretaceous, especially the Aptian, of the Great Artesian Basin. No mention is made, nor any evidence given, that these species must, in fact, be restricted to the Aptian. On the data available now it may therefore be possible that they have more extended ranges, which may also include the Albian.

An ?upper Aptian to ?lower Albian age is assigned to the interval of Cores 5-10 which contains a poor, almost exclusively arenaceous fauna. This age is based on not yet reliably established index fossils such as a *Lenticulina* sp. 1, which is similar to forms known from the Cenomanian of South Africa. Shipboard interpretation of the paleoenvironment for the Cretaceous foraminifera in Cores 5-29 suggested deposition of Cores 17-29 above the lysocline, with gradual deepening from the base upward. Some fluctuation in the upper part of the interval below the lysocline was thought to be indicated by the entirely arenaceous fauna in Core 20. Cores 5-16 with the generally poor, primitive arenaceous fauna (*Hyperammina, Bathysiphon, Ammodiscus, Glomospira,* etc.) were regarded as deposits that accumulated below the lysocline.

After examining and describing the faunas in more detail, Scheibnerova (this volume) concluded that the Cretaceous foraminiferal assemblages of Site 263 indicate a shallow to extremely shallow-water environment. Identical or similar inner-shelf faunas occur in sediments of the Canning Basin and the Great Artesian Basin. The absence or scarcity of calcareous forms in the upper part is attributed to $CaCO_3$ solution shortly after burial, due to a low oxygen content and acid reaction in the sediment. Water temperature during the period of deposition was probably comparatively cool.

Paleontology

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

Foraminifera

Core 1 (0.0-5.0 m) contains a very rich, predominantly Quaternary-Recent planktonic fauna with *Globorotalia truncatulinoides truncatulinoides, G. menardii s.l., G. tumida, G. crassaformis, G. inflata,* and *G. dutertrei.* A few shallow-water calcareous benthonic foraminifera are also present.

Core 2 (52.5-65.0 m) is very rich in predominantly Quaternary-Recent planktonic species that include *Globorotalia truncatulinoides truncatulinoides, G. tumida tumida, G. tumida flexuosa, G. menardii s.l.,* and *G. inflata.* Also present are reworked Miocene-Pliocene species including *Globorotalia margaritae* and *Sphaeroidinellopsis seminulina.*

Core 3 (except for lower part of the core catcher) contains a very rich, very heterogeneous planktonic foraminiferal fauna with *Globorotalia truncatulinoides tosaensis, G. tumida tumida, G. menardii s.l., G. inflata, G. margaritae, Globoquadrina altispira* and *Globigerina nepenthes.*

A minute, well-preserved, fairly rich, predominantly planktonic foraminiferal fauna of lower Paleocene (*?Globigerina eugubina* Zone) age was recovered from Sample 4-4, 55-57 cm. Associated with it, but infrequent compared with the planktonic foraminifera, are small benthonic forms. The most common are *Bathysiphon* sp.; rare are *Ammodiscus* sp., *Textularia* sp., *Lenticulina* sp., and *Vaginulina* sp.. The arenaceous forms are regarded as reworked Lower Cretaceous.

The planktonic foraminifera fauna has tentatively been determined as follows:

Globigerina trivialis Subbotina, (0.1-0.15 mm); *Globigerina* cf. *fringa* Subbotina, (0.1-0.125 mm). The chambers of the Site 263 specimens are more globular and the test higher trochospiral compared with the holotype figures.

Globigerina cf. *sabina* Luterbacher and Premoli Silva, (0.1-0.125 mm). Compared with the holotype, the chambers, in particular the last, increase less rapidly in size. These five-chambered specimens vary from low to medium trochospiral. The specimens figured by Olsson (1969) as *Globigerina edita* Subbotina also seem to compare closely with the Site 263 specimens.

Representatives of the family Heterohelicidae, Subfamily Guembelitriinae are also numerous in the sample. The specimens vary from medium trochospiral forms about 0.1 mm in size to distinctly high trochospiral forms of up to 0.25 mm. They appear to be triserial in the very early stage, becoming rapidly quadriserial. The chambers are distinctly globular throughout, sutures between chambers deep and distinct; the aperture in the last chamber small but high arched, occasionally with a faint lip. The specimens are here tentatively placed in the genus *Gubkinella.*

The *Guembelitria* ?sp. figured by Bang (1970) appears close or identical to the smaller of the Site 263 Heterohelicidae specimens.

All the above-listed species were described from the Danian, or lowermost Paleocene. Because the planktonic foraminifera of Sample 4-4, 55-57 cm were found only during the very late stage of preparation of the Initial Report, there was not time to figure and describe them in more detail.

The Lower Cretaceous interval, Cores 5-29, can be divided into an upper part, Cores 5-16, with an often poor, almost exclusively arenaceous fauna containing predominantly primitive genera such as *Hyperammina, Bathysiphon, Glomospira, Ammodiscus, Textularia,* and *Haplophragmoides,* and a lower part, Cores 17-29, containing a rich arenaceous and benthonic calcareous fauna with, in addition to the above listed genera, *Lenticulina, Marginulina, Dentalina, Nodosaria,* and *Frondicularia.*

Nannoplankton

Abundant, moderately preserved Pleistocene nannoplankton are present in Cores 1 and 2, (0.0-5.0 m and 52.5-65 m). Reworked species of Eocene and Upper Cretaceous age are also present. The heterogeneous association of Core 3 indicates Pliocene or younger.

The assemblage of Sample 4-4, 55-57 cm consists of two distinctly different ages: Lower Cretaceous, including *Watznaueria barnesi, W. communis, Vagalapilla stradneri,* and *Glaucolithus elegans,* and lower Paleocene with *Cruciplacolithus tenuis, Markalius inversus, Ellipsolithus macellus, Coccolithus crassus* and *C.* group *pelagicus.*

From Cores 5-29 (128.5-746.0 m), the sediments are very rich in organic matter and pyrite suggesting a reducing sedimentary environment. The uniformity of the sediment facies of this interval indicates a persistence of such environmental conditions. The calcareous nannoplankton are rarely abundant and show a low specific diversity.

Eiffelithus turriseiffeli is common to rare in Cores 22-27, but seems almost completely absent in Cores 5-21, the upper part of the Cretaceous section. Some Albian markers such as *Tranolithus exiguus, Cretarhabtus coronadventis, Broinsonia signata,* and *Vagalapilla matalosa* are rare to common in scattered samples of this interval. Some assemblages are composed of long-ranging species only, which do not provide any significant stratigraphic information. Cores 5-27 are here referred to the upper Albian. They either contain the marker species *Eiffelithus turriseiffeli* or lie above its last appearance and are at the same time lacking in species appearing in the post-Albian. Some samples contain older species, such as *Nannoconus bucheri, Cretathurbella rothi, Reinhardites fenestratus,* and *Micrantolithus hoschulzi* that, based on their known stratigraphic ranges, are considered reworked.

The possibility of a pre-Albian appearance of *Eiffelithus turriseiffeli* in the Indian Ocean region is not supported by evidence from Sites 259 and 260 where this species is not present in the better preserved and more diversified assemblages of middle Albian age. That the species makes its first appearance in the upper Albian in this general area is shown by its occurrence at Sites 256 and 258.

Core 28, Section 2 contains *Vagalapilla matalosa* and hence is not older than middle Albian. No detailed stratigraphic dating is possible for Core 28, Section 9 to Core 29, Core Catcher which contain *Watznaueria* exclusively and very rare long-ranging species.

Radiolaria

Radiolaria are very rare in Site 263 material. Samples from the top three cores contain sparse Quaternary specimens.

Cretaceous radiolarians are present, though patchy and rare, in Core 4-18. Preservation is extremely poor, making any age determination beyond Cretaceous and any identification beyond Radiolaria impossible.

Palynomorphs

Dinoflagellates: Cores 19-29 are dated Barremian on *?Cordosphaeridium fascinatum, Senoniasphaera* sp. A., *Muderongia* n. sp., and *Phoberocysta neocomica;* Cores 5-18 are Aptian, probably ranging into upper Aptian to lower Albian based on subspecies as *Muderongia tetracantha, M. mcwhaei, M. simplex, Gonyaulacysta episoma,* and *G. muderongensis.* The following species suggestive of upper Albian to lower Albian occur in Cores 5-8: *Cleistosphaeridium ancoriferum, Hystrichoidinium oligacanthum, Hystrichosphaera speciosa,* and *Exochosphaeridium striolatum* var. *truncatum.*

Spores and pollen: They comprise a minor part of the microflora assemblage in the upper part of the Cretaceous at Site 263. Cores 8-11 are assigned to the Microcachryidites Assemblage with the same species as at Site 259, Cores 20-33, together with *Murospora florida* and *Reticuloidesporites arcus.* The occurrence of *Murospora florida* and *Krauselisporites linearis,* and the top of the range of *Contignisporites cooksonii* indicate correlation of Cores 12-29 with lower part of the *D. speciosus* Zone, upper Neocomian to upper Aptian.

Calcisphaerulidae

Pithonella is rare in number of specimens and species and occurs only very sporadically in the Cretaceous cores. Specimens have in fact been observed only in Sample 3, CC and Core 5, both with *P. patriciagreelayae;* Sample 3, CC, in addition, with *P.* sp. A. The specimens in Sample 3, CC are considered reworked from Albian. *P. helentappanae* and *P. nonarenzae* occur in Core 17.

Ostracods

A few ostracods, all poorly preserved, were recorded from four of the Cretaceous samples examined. Among indeterminate forms present are the genera *Bairdia, Arcullicythere,* and *Pontocyprella.* Though not characterisitc, they seem to have similar ecologic characters as those of Sites 259 and 260.

Cephalopods

Belemnites: A single belemnite was obtained from Sample 26-2, 108-110 cm and was determined as cf. *Parahibolites* sp. indet. The genus first appeared in the

Aptian, but species of this age are known only from Germany. During its main evolution in the Albian, *Parahibolites* moved southward and migrated during this time along the Tethyan seaways. The presence of *Parahibolites* at Site 263 can be interpreted as being due to the influx of Tethyan immigrants that occurred in upper Albian time in the northwestern and western regions of Australia. Further, because *Parahibolites* had its main development in the Albian and because it occurs in southern India in the upper Albian, the Site 263 specimen is probably of upper Albian age.

Ammonoides: One test fragment and an internal mold of ?cf. *Prohysteroceras* (Goodhallites) *richardsi* was extracted from Sample 18-5, 105 cm. The genus is known from southern India, South Africa, Madagascar, southern England and Texas. This distribution can be interpreted, like that of *Parahibolites,* as being due to migration along the Tethyan Seaway (its interconnected routes into the Indo-Pacific,) in the upper Albian.

The few available characters of the fragment in fact suggest its placement in the subfamily Mortoniceratinae of the upper Albian and lower Cenomanian.

Bivalves: Bivalve fragments occur in Sample 17, CC.

Fish Debris

Fish debris is absent in the turbidite Cores 1-3, fairly frequent in Core 4, rare in the Cretaceous Cores 5-19, and absent to rare in Cores 20-29. The remains consist almost exclusively of bone fragments.

GEOCHEMICAL MEASUREMENTS

Geochemical samples at Site 263 were somewhat irregularly spaced, as coring was only attempted for one section in three and recovery was frequently poor in the section cored. It was not possible to obtain samples below 458 meters as the sediment is too indurated. The shipboard geochemical data for Site 263 are summarized in Table 3 and in Figure 6. The analytical procedures used are detailed in the discussion on Site 259.

Alkalinity

As at all previous sites, there is a trend of decreasing alkalinity with increasing depth. This is believed to be primarily a function of post-depositional changes within the sediment. Overall values are low: however, some moderately high values occur at the top of the hole, with a maximum of 6.06 meq/kg at a depth of 59 meters (cf. an alkalinity of 2.35 for surface seawater). This is consistent with a comparatively rapid rate of sedimentation in the upper portion of the section.

pH

As only one "punch-in" *p*H reading was obtained, this discussion will be limited to consideration of the "flow-through" determinations.

Values obtained at Site 263 are in general higher than those at previous Leg 27 Sites, with a maximum of 8.46 occurring at a depth of 326 meters. This is significantly higher than values obtained for similar sediments at Site 259. The factors responsible for producing these high *p*H values are unknown at the present time. The comparative lack of calcareous sediments throughout most of the lower part of Site 263 suggests that carbonate solubility is unlikely to be a major factor.

As at Site 259, subsequent to the initial decrease in *p*H immediately below the sediment-water interface, there is an irregular but marked increase in *p*H down the hole. This is believed to be the result of diagenetic changes within the sediment.

Salinity

All salinity values for interstitial water are significantly below the values obtained for surface seawater at this site (as low as 31.4 ‰ in the sediments, compared with 35.5‰ in the surface seawater). This suggests that some "desalting" of the interstitial brines may have taken place as a result of the formation of diagenetic minerals or alternatively there is some fresher water flowing in form the continent via a regional aquifer such as the Birdrong Formation. No apparent regular change of *p*H down the hole is evident. There may be a negative correlation between *p*H and salinity at this site, i.e., salinity decreases as *p*H increases. No correlation between salinity and lithology is apparent.

SUMMARY OF THE SHIPBOARD GEOCHEMICAL PROGRAM, LEG 27

The basic aim of this program was to obtain samples of interstitial waters from all sites, at approximately 50-meter intervals, for subsequent onshore analyses. This aim was met. Alkalinity, *p*H, and salinity determinations were also carried out on all these samples. In addition, a program of detailed sampling (one water sample being obtained from each core) was successfully undertaken at Site 262. All data are presented in tabular and graphical forms in each of the site reports. Consequently, it is necessary here to consider only the broad trends.

Alkalinity

At most sites, alkalinities are low, being equal to or less than the alkalinity of seawater. This is consistent with a low rate of sedimentation. A moderately high alkalinity at the top of Site 263 is suggestive of a slightly higher-than-average rate of sedimentation in the upper sediments of that site. However, the only markedly high alkalinities are at Site 262, particularly in the upper part of the hole. This, together with sedimentologic and paleontologic evidence, is indicative of a very rapid rate of sedimentation in this portion of the Timor Trough.

At all sites there is a tendency for alkalinity to decrease down the hole; this is believed to be a diagenetically induced feature, totally independent of any change in the depositional environment.

pH

No consistent picture of *p*H variation emerged from the Leg 27 analyses. There appears to be no relationship between *p*H and sediment type or between *p*H and depth in the hole. Whereas *p*H decreases with depth at some sites, it increases at others. The only consistent feature appears to be that there is a marked decrease in *p*H immediately below the sediment-water interface. Even this feature is of doubtful validity as no *p*H readings are available for seawater immediately above the sediment-water interface at the various sites. It is believed that

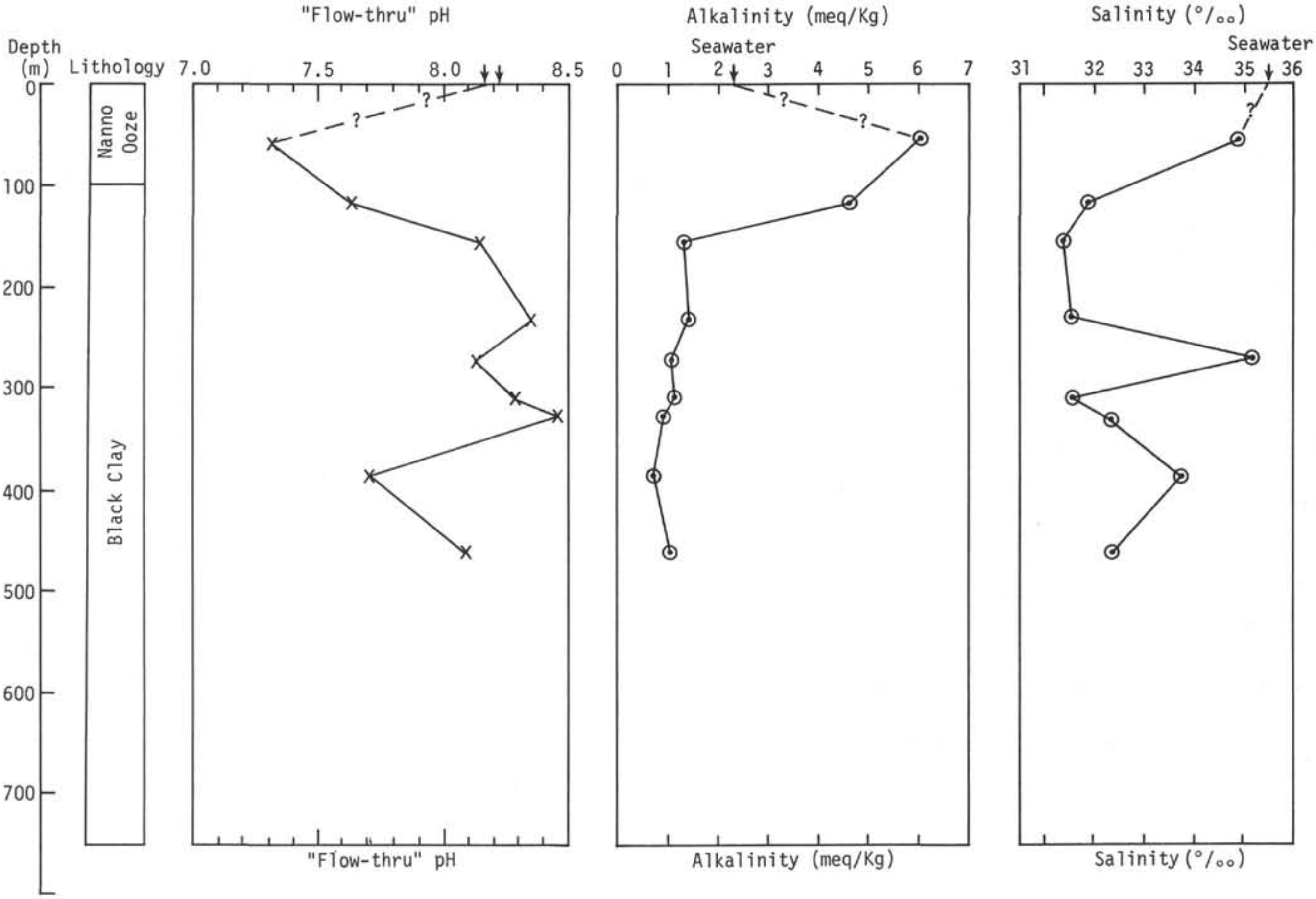


Figure 6. *Geochemical analyses of interstitial water at Site 263.*

TABLE 3
Summary of Shipboard Geochemical Data

Sample (Interval in cm)	Depth Below Sea Floor (m)	*p*H		Alkalinity (meq/kg)	Salinity (°/₀₀)	Remarks
		Punch-in	Flow-through			
		8.39	8.17	2.35	35.5	Reference seawater
2-3, 0-6	59.00-59.06	7.24	7.32	6.06	34.9	
4-6, 0-6	117.50-117.56	–	7.63	4.59	31.9	
6-6, 0-12	155.50-155.62	–	8.16	1.37	31.4	
9-4, 144-150	232.94-233.00	–	8.36	1.47	31.6	
11-3, 144-150	269.44-269.50	–	8.13	1.08	35.2	
13-5, 144-150	307.44-307.50	–	8.29	1.17	31.6	
14-5, 0-6	326.50-326.56	–	8.46	0.98	32.4	
17-1, 0-6	385.50-385.56	–	7.71	0.78	33.8	
19-4, 144-150	457.94-458.00	–	8.10	1.08	32.4	
		8.32	8.22	2.35	35.5	Reference seawater

diagenetic changes within the sediment are the primary control of *p*H variations in the Leg 27 sediments, but the nature of these changes is unknown at the present time.

Salinity

At most sites there is no marked deviation of pore water salinity from seawater salinity. There is also no consistent correlation between salinity, depth in the hole, and lithology. There is a suggestion from Site 263 of a negative correlation between salinity and *p*H. Clear trends emerge only from Site 262 where there is a marked increase in salinity (reaching a maximum of 53.1 °/₀₀) with increasing depth. The most reasonable explanation for this increase is that an evaporite unit is present at some depth below (perhaps hundreds of meters below) the bottom of the hole. As there has been no previous geologic indication of salt in the Timor Trough area, this conclusion is somewhat unexpected. It would perhaps rank as the most important conclusion resulting directly from the geochemical program on Leg 27.

PHYSICAL PROPERTIES

Bulk-density, sound-velocity, and porosity measurements were made on sediments recovered at Site 263. Vane shear tests were not run due to excessive disturbance of the small amount of soft sediments recovered. Infrequent coring over the upper 100 meters and disturbance of recovered materials limited determination of physical properties within this depth range. Below 100 meters a profile of density and sonic velocity is shown although coring was not continuous. 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 procedure, and discussion of wet bulk-density determinations and vane shear results are included in later chapters in Part IV.

Density and Porosity

Wet bulk density was determined at Site 263 by continuous GRAPE, syringe, and water-displacement methods. Density remains constant at about 1.75 g/cc at 65-185 meters although sediment changes from a coarse detrital foram nanno ooze to a clayey nanno ooze (void of forams) at 100 meters and then to a nanno clay between 130 and 150 meters. The sediment becomes a clay and bulk density increases more rapidly to 1.9 g/cc at 220 meters then steadily to a value of 2.2 g/cc at about 600 meters. Below 600 meters wet bulk density remains about 2.2 g/cc. Dolomite nodules of considerably higher density are abundant through some regions of the hole.

The site-summary density profile is drawn to water-displacement test values, considered the most accurate measurements. Most data shown are from 27 samples taken in stiff clay, or claystone, from Cores 8 to 29. Each sample was cut into an elongated block with parallel sides to permit static GRAPE testing and sonic velocity measurements in perpendicular directions. Two water-displacement density measurements were made on each block prior to the GRAPE measurements. A comparison of these methods for determining relative density is made in later chapters in Part IV.

Porosity data plotted on the site summary sheets are primarily from continuous GRAPE readings. Most sediments were too stiff to permit syringe sampling. Because of the few changes in sediment composition, porosity is nearly a reflection of bulk density. A continuous plot of porosity is available from the GRAPE data by using the variable porosity scale to read the GRAPE density trace. Sediment mineral grain density determines the appropriate porosity scale.

Sonic Velocity

Sonic velocity shows a marked increase from 1.5 km/sec at the surface to about 2.5 km/sec (horizontal) and 2.2 km/sec (vertical) at 746 meters. Velocity was measured both parallel (horizontal) and perpendicular (vertical) to the bedding planes on the 27 specially prepared samples below 200 meters. There is a marked difference between these values with horizontal velocity being consistently higher than vertical velocity by 6%-9%. Site summary velocity profiles were drawn using both velocities to illustrate this difference. Moderate variation is noted in horizontal velocity where multiple measurements were made on the same sample. Also, in some locations, the special sample horizontal velocity appears atypically higher or lower than the average for the core. This behavior is suspected to reflect real variation of sonic velocity in adjacent claystone laminae.

CORRELATION OF SEISMIC PROFILE WITH DRILLING RESULTS

Only two coherent reflectors were seen in the vertical incidence (Figure 7) and on-site sonobuoy (Figure 8) profiles: the base of the well-stratified surface layer/top of transparent layer, at 0.12 sec and the base of the transparent layer/acoustic basement at 0.78 sec. The base of the well-stratified layer is a sharp geological boundary at 100 meters; this thickness yields an interval velocity for the layer of 1.67 km/sec compared with onboard determinations of core from this interval of 1.51-1.59 km/sec (see above). Since basement was not reached, deeper correlation must depend on extrapolation from this level using the onboard determinations of velocity. Empirical observations at other sites give in-situ velocities that are approximately 5% greater than the onboard values. A greater in-situ value would be expected since in situ pressures are higher than ambient laboratory pressures. Using these adjusted onboard values of velocity, we calculate the acoustic basement at the site to be as shallow as 750 meters.

SUMMARY AND CONCLUSIONS

Site 263 is located in 5065 meters of water at the eastern edge of the Cuvier Abyssal Plain, immediately at the foot of the continental rise, and about 300 km from land. Near the site, a seismic profile obtained by the University of New South Wales shows the same two acoustic layers seen at Sites 260 and 261: (1) a transparent layer, 1.0 sec or thicker, draping acoustic basement in most parts of the Cuvier Abyssal Plain, slightly thinner on the eastern edge; and (2) a horizontal well-stratified layer that thickens westward, unconformably overlying the transparent layer. Site 263 was chosen at a spot where basement was about 0.8-sec deep, within practical reach of the drill, and the surface stratified layer was thin (about 0.1 sec). The hole penetrated the entire transparent layer but only the upper part of the well-stratified layer. A total of 746 meters of sediment was drilled before a mechanical breakdown intervened. The oldest sediment reached is probably Albian but may be as old as Barremian.

Four sedimentary units are recognized. The top 100 meters consist of greenish-gray detrital foram nanno ooze with abundant micarb and minor clay and quartz. Some beds are graded. The contact with the underlying unit is marked by a sharp color and compositional change. The second unit is 95 meters of greenish-gray to olive-black stiff, clayey nanno ooze, nanno clay, and nanno-bearing clay, with the proportion of nannos increasing upwards. The third unit is 275 meters of greenish-black semilithified claystone, with minor pyrite and trace amounts of quartz feldspar, zeolites, nannos, fish fragments, and kaolinite. The fourth unit, which was

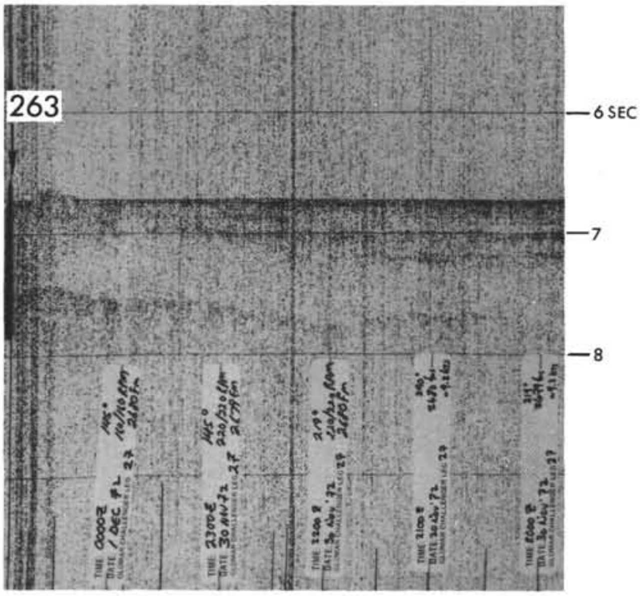


Figure 7. *Seismic profile at Site 263.*

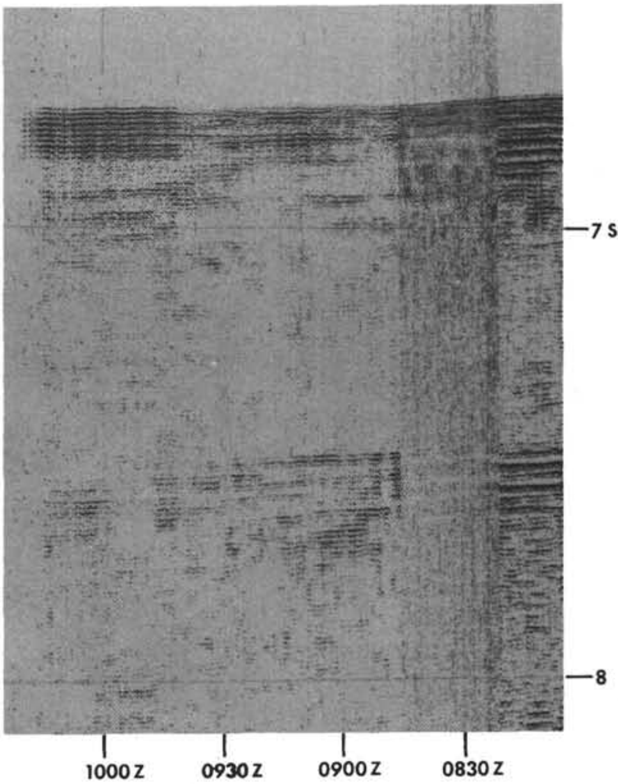


Figure 8. *On-site drifting sonobuoy profile of Site 263.*

penetrated to a thickness of 276 meters, consists of olive-black semilithified silty quartz-bearing to quartz-rich clay. Pyrite nodules, veins of calcite, burrows, mottles, and shell fragments are common. Kaolinite is particularly abundant at the base.

Microfossils show that the top 100 meters are upper Pliocene to Quaternary with some reworked, sorted, and shallow water benthonic foraminifera. Core 4 is lower Paleocene or (?) younger and the rest of the section is Cretaceous. Based on nannoplankton, the Cretaceous section is upper Albian to 717.5 meters and middle Albian-Lower Cretaceous s.l. from 717.5 meters to the base of the hole at 746.0 meters.

Nannoplankton are poorly preserved throughout, but benthonic calcareous and arenaceous foraminifera are fairly frequent and diverse from 385 meters to the bottom of the hole. Radiolaria are rare.

Estimated accumulation rates are 40 m/m.y. in the upper Paleocene to Recent and 17m/m.y. in the Lower Cretaceous (Figure 9).

At the total depth reached at Site 263, in the Lower Cretaceous deposition was in comparatively shallow water, perhaps near the outer edge of the neritic zone in sufficiently well-aerated water for a moderate biota to develop. The provenance of the sediment was overwhelmingly continental. Later in the Cretaceous, the sea floor subsided, perhaps even below the lysocline, but the sediment provenance remained continental. Still later in the Cretaceous, as shown by a gradual increase in the percentage of nannoplankton toward the top of Unit 2, some shallowing may have occurred. From lithological evidence, mass transport has not been an important depositional process (though tentative paleontological data suggest limited reworking of fossils in Unit 3), and we tentatively conclude that deposition during the Cretaceous took place at various depths in a region some distance from, but still subject to, the sedimentary influences of a comparatively large river. This phase was followed, at the latest, in the upper Pliocene at Site 263, but probably earlier in the Cenozoic in the middle of the Cuvier Abyssal Plain, by the mass transport of calcareous turbidites from the continental margin to the abyssal plain.

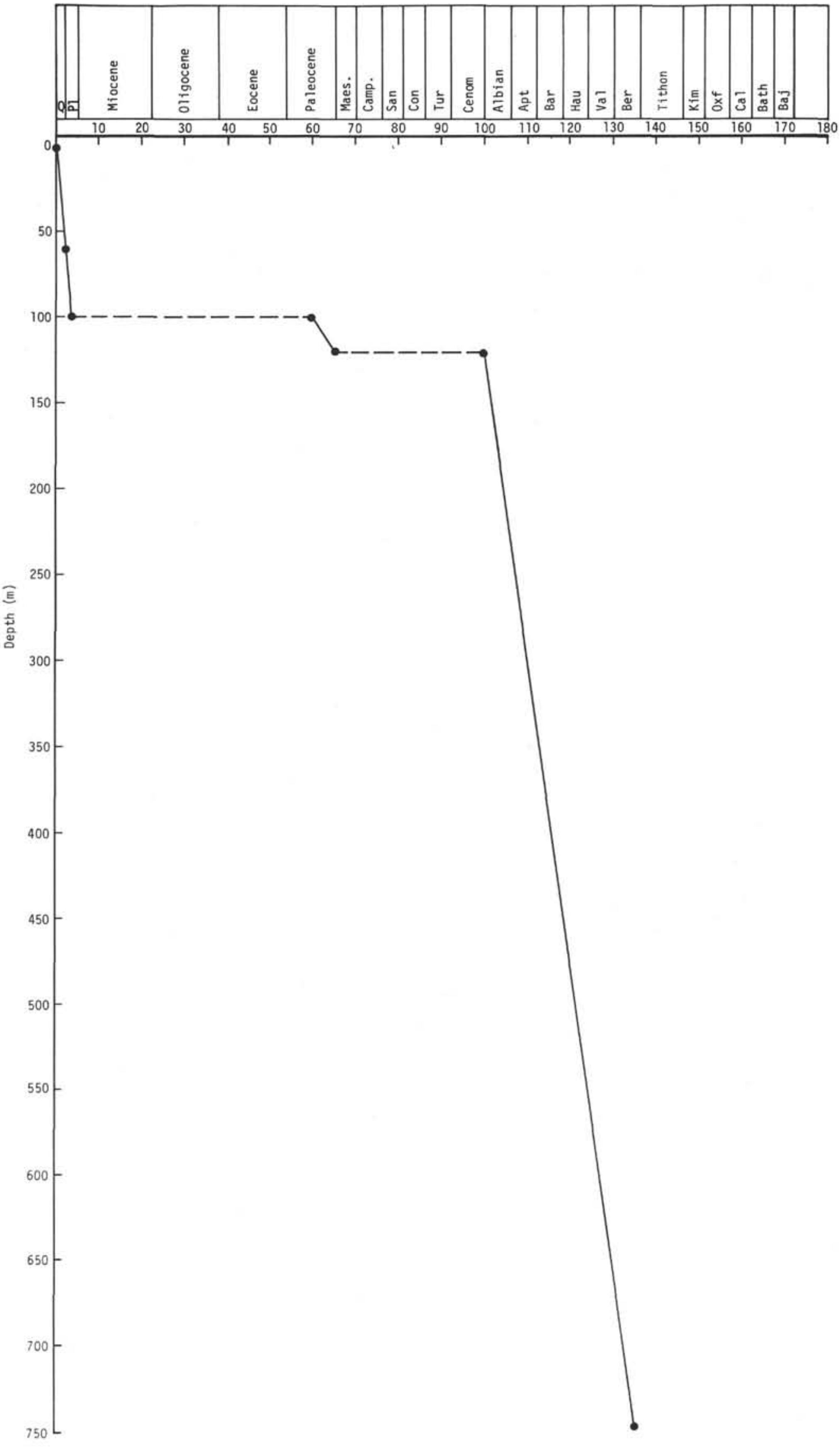
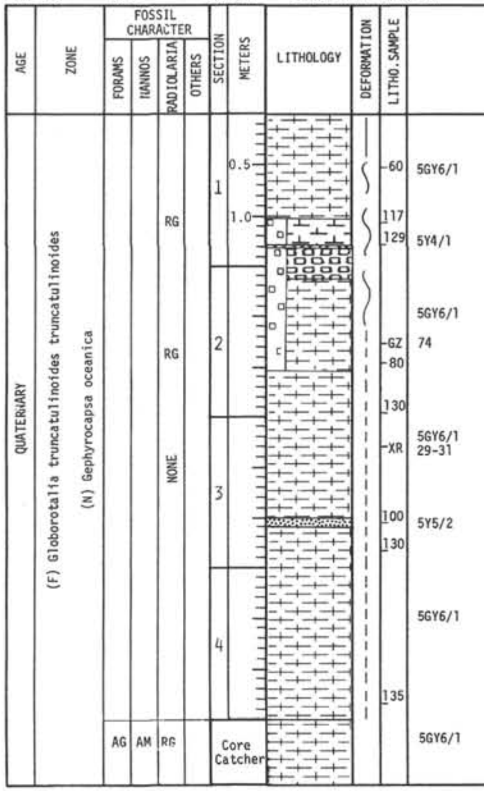


Figure 9. *Sediment accumulation rates for Site 263.*

Site 263 Hole Core 1 Cored Interval: 0-5 m



LITHOLOGIC DESCRIPTION

Chiefly greenish gray, soft sandy nanno and foram oozes. Numerous white specks and black fragments. Graded bed 188 cm thick in Sections 3 and 4. Some thin beds of detrital silt and silty clay.

DETRITAL FORAM NANNO OOZE

Smear slides 1-60, 2-80, 2-130, 3-130

Texture		Composition	
Clay	53%	Nannos	45%
Silt	2%	Forams	35%
Sand	45%	Micarb	15%
		Clay	3%
		Quartz	1%
		Feldspar, heavy minerals, glauconite, pyrite, sponge spicules and fish remains.	Tr.

QUARTZ RICH DETRITAL FORAM SAND

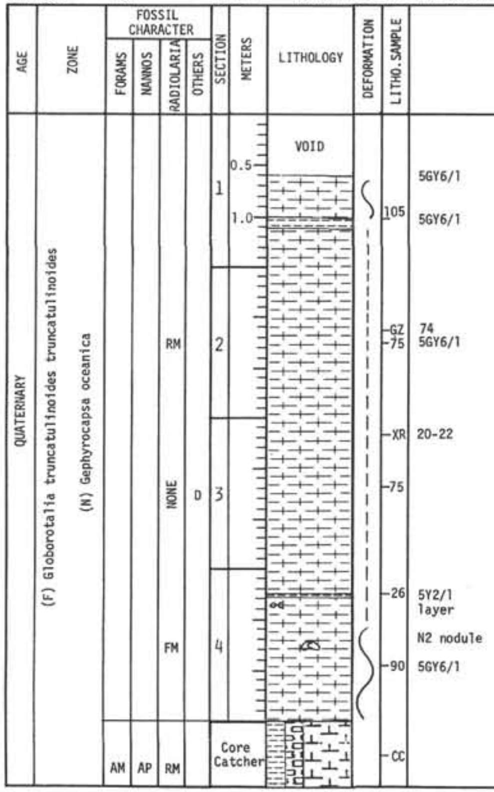
Texture		Composition	
		Forams	45%
Sand	80%	Micarb	25%
Silt	20%	Quartz	12%
		Mollusc fragments	7%
		Nannos	5%
		Feldspar	2%
		Heavy Minerals	2%
		Pyrite	1%
		Glauconite, sponge spicules, ascidions	Tr.

Coarse fraction chiefly forams with small amounts of quartz, feldspar, glauconite, rads, and sponge spicules.

BULK X-RAY (3.3 m)

Calcite	90%
Aragonite	7%
Quartz	3%

Site 263 Hole Core 2 Cored Interval: 52.5-65.0 m



LITHOLOGIC DESCRIPTION

Chiefly greenish gray soft, sandy boze with some grading. Only slight deformation. A few thin beds of black clay and a few black calcareous clay lumps or nodules in lower part.

DETRITAL FORAM NANNO OOZE

Smear slides 2-75, 3-75

Texture		Composition	
Sand	51%	Nannos	45%
Clay	31%	Forams	35%
Silt	18%	Micarb	12%
		Clay	4%
		Quartz	1%
		Feldspar	1%
		Heavy minerals	1%
		Glauconite, dolomite rhombs, mollusc fragments	Tr.

NANNO BEARING CLAY

Smear slides 1-105, 4-26

Composition	
Clay	55-85%
Nannos	5-10%
Quartz	1-15%
Feldspar	1-15%
Forams	1%
Mica, glauconite, opaques, micarb	Tr.

Coarse fraction chiefly forams with lesser amounts of micarb, iron oxides, sponge spicules and mollusc fragments.

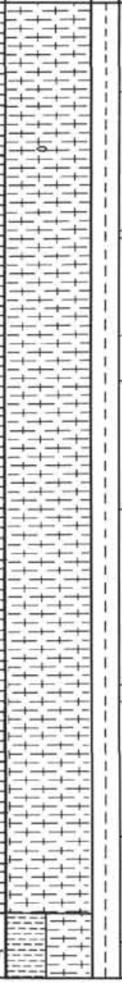
BULK X-RAY (55.7 m)

Calcite	88%
Quartz	6%
Aragonite	2%
Mica	2%
Kaolinite	1%

Explanatory notes in chapter 1

Site 263 Hole Core 3 Cored Interval: 90.5-100.0 m

AGE	ZONE	FOSSIL CHARACTER FORAMS	FOSSIL CHARACTER NANNOS	FOSSIL CHARACTER RADIOLARIA	FOSSIL CHARACTER OTHERS	SECTION	METERS	LITHO. SAMPLE
Not older than UPPER PLIOCENE	(F) Globorotalia tosaensis			NONE		1	0.5 1.0	-75 N6 clay ball
						2		-GZ 74 -75
						3		-XR 26-28 -75 N7
						4		-75
						5		-GZ 74 -75
				NONE		6		-75
		AG	RM	NONE	Cs Fd	Core Catcher		-CC 5Y2/1



LITHOLOGIC DESCRIPTION

Slightly deformed, light gray (N7) sandy ooze. Soft. No internal bedding and no apparent grading. Olive black (5Y2/1) ooze in core catcher.

DETRITAL FORAM NANNO OOZE

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

Texture		Composition	
Sand	54%	Nannos	45%
Silt	24%	Forams	35%
Clay	22%	Clay	10%
		Micarb	8%
		Quartz	1%
		Feldspar, glauconite, pyrite, dolomite rhombs	Tr.

Coarse fraction chiefly forams with traces of glauconite, pyrite, quartz and muscovite. Forams often broken and abraded.

CLAYEY NANNO OOZE

Smear slide CC

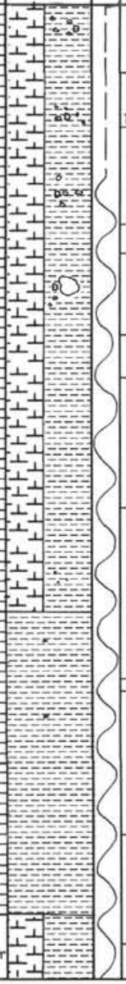
Composition	
Nannos	48%
Clay	45%
Micarb	5%
Quartz	2%
Glauconite	Tr.

BULK X-RAY (93.8 m)

Calcite	95%
Quartz	4%
Mica	1%

Site 263 Hole Core 4 Cored Interval: 109.5-119.0 m

AGE	ZONE	FOSSIL CHARACTER FORAMS	FOSSIL CHARACTER NANNOS	FOSSIL CHARACTER RADIOLARIA	FOSSIL CHARACTER OTHERS	SECTION	METERS	LITHO. SAMPLE
LOWER PALEOCENE or ?younger	?Globigerina eugubina Crucinlucolithus tenuis	poor arenac. (reworked L. Cret.), 1m core 4/4/55-57 Lower Paleocene plankforams	reworked L. Cret., in 4/4/55-57 Lower Paleocene			1	0.5 1.0	nodules dolomite 5Y7/2 -75 N3 113 dolomite nodules 5Y7/2
						2		dolomite nodules 5Y7/2 -65 5GY4/1 & 5Y2/1 -GZ 80 dolomite nodules 5Y7/2
						3		-XR 26-28 -75 5GY4/1 & 5Y2/1
						4		-87 5GY4/1 & 5Y2/1 dolomite nodules 5Y7/2
						5		dolomite 5Y7/2 -75 5GY4/1 & 5Y2/1 -GZ 74 dolomite 5Y7/2
						6		-75 5GY4/1 & 5Y2/1
		Rm	FP	NONE		Core Catcher		-CC 5GY4/1 & 5Y2/1



LITHOLOGIC DESCRIPTION

Chiefly highly disturbed, dark greenish gray, stiff clay and nanno clay with color bands of olive black. Possible original bedding 1 cm thick. Numerous dolomite nodules.

NANNO CLAY

Smear slides 1-75, 2-65, 3-75, 4-55, CC

Texture		Composition	
Clay	81%	Clay	55%
Silt	19%	Nannos	40%
		Opaques	2%
		Feldspar	1%
		Chlorite	1%
		Quartz, heavy minerals, glauconite, pyrite, zeolite and dolomite rhombs	Tr.

QUARTZ RICH CLAY

Smear slides 5-75, 6-75

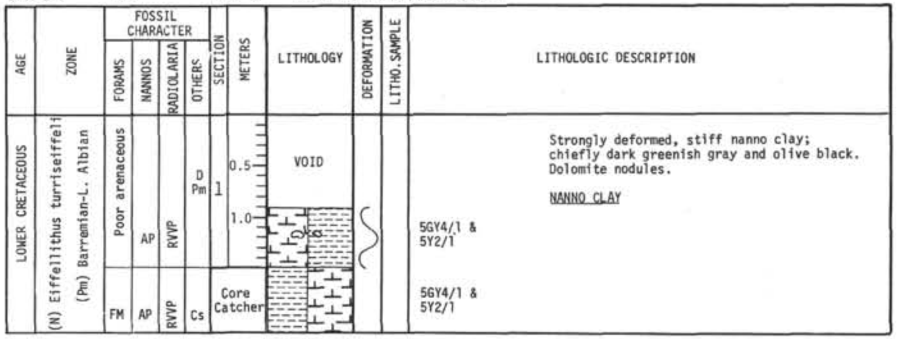
Texture		Composition	
Clay	81%	Clay	78%
Silt	19%	Quartz	12%
		Nannos	4%
		Feldspar	2%
		Opaques	2%
		Glauconite	1%
		Zeolite, dolomite rhombs, micarb, and chlorite	Tr.

BULK X-RAY (112.8 m)

Montmorillonite	46%
Calcite	18%
Quartz	17%
Mica	12%
K-feldspar	5%
Chlorite	1%
Pyrite	1%

Explanatory notes in chapter 1

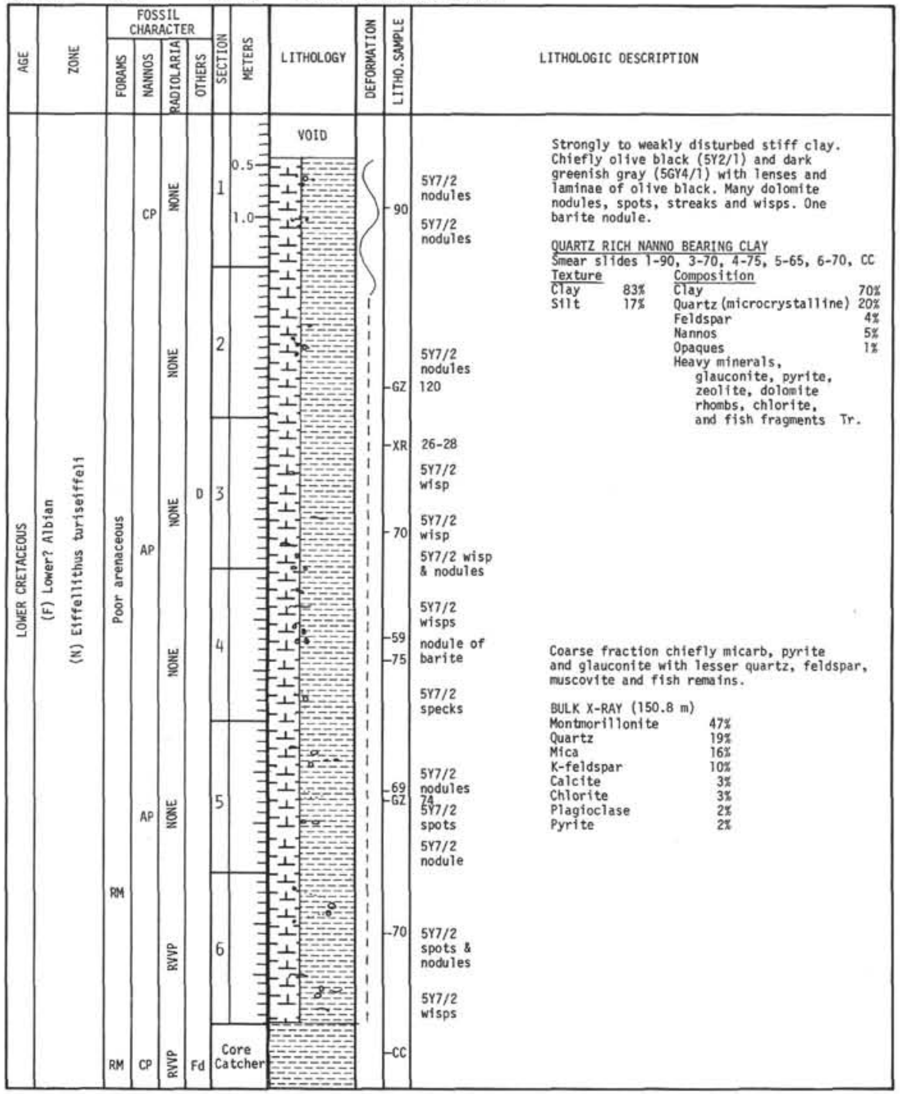
Site 263 Hole Core 5 Cored Interval: 128.5-138.0 m



Strongly deformed, stiff nanno clay; chiefly dark greenish gray and olive black. Dolomite nodules.

NANNO CLAY

Site 263 Hole Core 6 Cored Interval: 147.5-157.0 m



Strongly to weakly disturbed stiff clay. Chiefly olive black (5Y2/1) and dark greenish gray (5GY4/1) with lenses and laminae of olive black. Many dolomite nodules, spots, streaks and wisps. One barite nodule.

QUARTZ RICH NANNO BEARING CLAY

Smear slides 1-90, 3-70, 4-75, 5-65, 6-70, CC

Texture		Composition	
Clay	83%	Clay	70%
Silt	17%	Quartz (microcrystalline)	20%
		Feldspar	4%
		Nannos	5%
		Opaques	1%
		Heavy minerals, glauconite, pyrite, zeolite, dolomite rhombs, chlorite, and fish fragments	Tr.

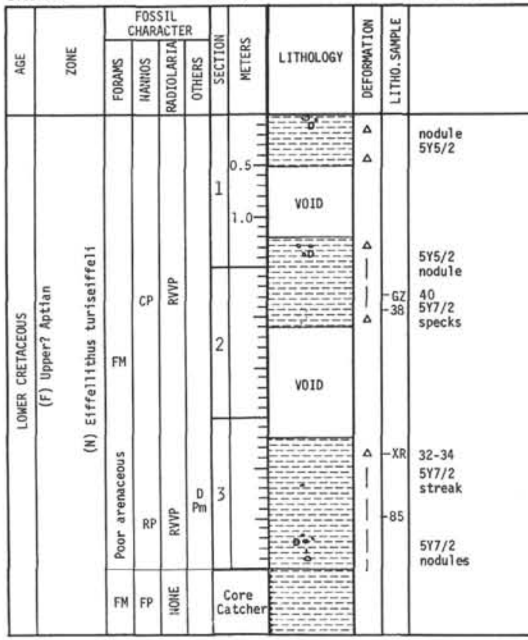
Coarse fraction chiefly micarb, pyrite and glauconite with lesser quartz, feldspar, muscovite and fish remains.

BULK X-RAY (150.8 m)

Montmorillonite	47%
Quartz	19%
Mica	16%
K-feldspar	10%
Calcite	3%
Chlorite	3%
Plagioclase	2%
Pyrite	2%

Explanatory notes in chapter 1

Site 263 Hole Core 7 Cored Interval: 176.0-185.5 m



LITHOLOGIC DESCRIPTION

Highly deformed stiff clay. Greenish black (5G2/1) to olive black (5Y2/1) with lenses and laminae of grayish black (N2). Numerous dolomite nodules.

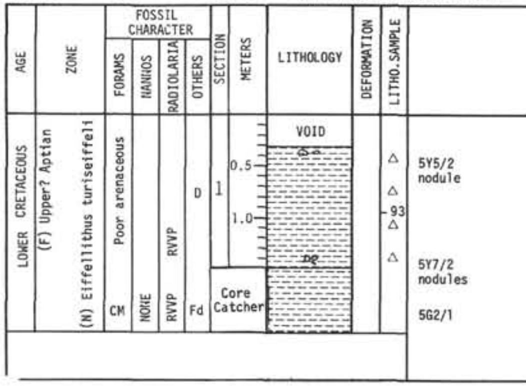
QUARTZ RICH NANNO BEARING CLAY
Smear slides 2-38, 3-85

Texture		Composition	
Clay	84%	Clay	63%
Silt	16%	Quartz (microcrys.)	25%
		Nannos	5%
		Feldspar	4%
		Opaques	1%
		Micarb	1%
		Glauconite, pyrite, dolomite rhombs, zeolite, chlorite, and fish remains	Tr.

Coarse fraction chiefly clay aggregates with small amounts of micarb, pyrite, forams, muscovite, quartz and feldspar.

BULK X-RAY (179.3 m)	
Montmorillonite	44%
Quartz	25%
Mica	15%
K-feldspar	9%
Calcite	2%
Chlorite	2%
Plagioclase	2%
Pyrite	1%

Site 263 Hole Core 8 Cored Interval: 204.5-214.0 m



LITHOLOGIC DESCRIPTION

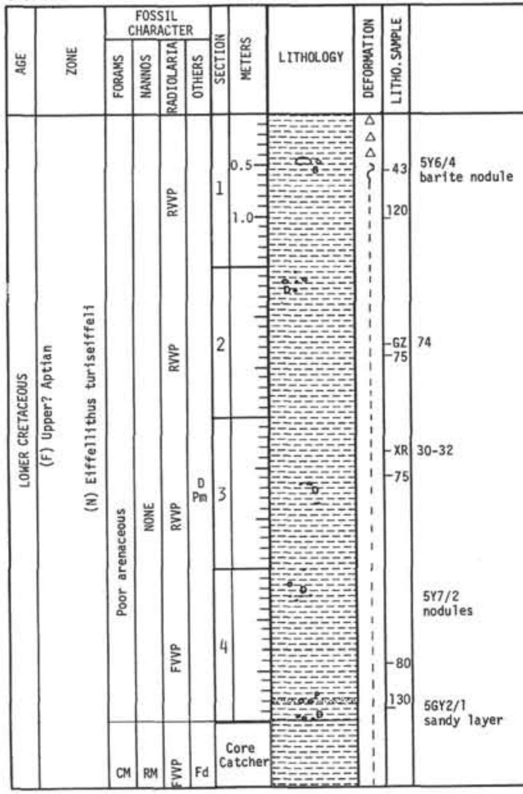
Highly deformed, semi-lithified black (N1) to greenish black (5G2/1) clay.

CLAYSTONE
Smear slide 1-93

Composition	
Clay	98%
Opaques	2%
Quartz, glauconite, pyrite, micarb, nannos, and fish remains.	Tr.

Coarse fraction chiefly clay aggregates and micarb fragments with traces of quartz, feldspar, heavy minerals, pyrite and fish remains.

Site 263 Hole Core 9 Cored Interval: 223.5-233.0 m



LITHOLOGIC DESCRIPTION

Weakly deformed to undeformed semi-lithified claystone. Chiefly greenish black (5G2/1) with lenses and laminae of N2.

QUARTZ RICH CLAY
Smear slides 1-120, 2-75, 3-75, 4-80

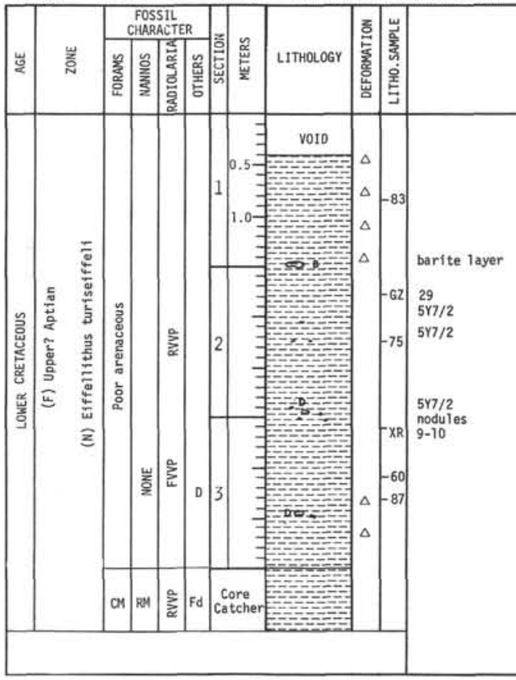
Texture		Composition	
Clay	85%	Clay	50%
Silt	15%	Quartz (microcrys.)	40%
		Opaques	4%
		Feldspar	3%
		Chlorite?	1%
		Muscovite, glauconite, pyrite, dolomite rhombs, zeolite, nannos, and fish fragments.	Tr.

Coarse fraction chiefly clay aggregates, glauconite, micarb, quartz, forams and pyrite with small amounts of feldspar, muscovite, sponge spicules and fish remains.

BULK X-RAY (226.8 m))	
Quartz	43%
Montmorillonite	27%
K-feldspar	6%
Kaolinite	2%
Chlorite	2%
Plagioclase	1%
Pyrite	1%

Explanatory notes in chapter 1

Site 263 Hole Core 10 Cored Interval: 242.5-252.0 m



LITHOLOGIC DESCRIPTION

Weakly disturbed, semi-lithified claystone with abundant dolomite nodules. Chiefly greenish black (5GY2/1) with lenses and laminae of olive black (5Y2/1) to grayish black (N2) up to 1 cm thick. Pyrite crystals abundant.

QUARTZ RICH CLAY

Smear slides 1-83, 2-75

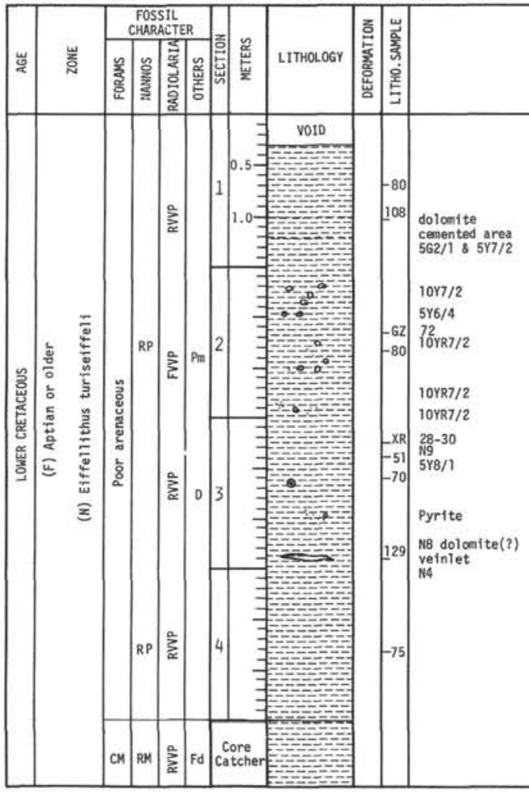
Texture		Composition	
Clay	78%	Clay	60%
Silt	22%	Quartz (microcrys.)	30%
		Feldspar	5%
		Opaques	1%
		Chlorite	1%
		Zeolite	1%
		Micarb	1%
		Pyrite	1%
		Quartz, muscovite, heavy minerals, dolomite rhombs, and fish fragments.	Tr.

Coarse fractions chiefly micarb fragments, quartz, muscovite, clay aggregates and glauconite with small amounts of feldspar, pyrite, iron oxides, forams, and fish fragments.

BULK X-RAY (245.6 m)

Montmorillonite	46%
Quartz	32%
Mica	15%
K-feldspar	3%
Kaolinite	3%
Chlorite	1%

Site 263 Hole Core 11 Cored Interval: 261.5-271.0 m



LITHOLOGIC DESCRIPTION

Semi-lithified, undisturbed claystone. Greenish black (5GY2/1) with lenses and laminae and contorted layers of olive black (5Y2/1) and grayish black (N2).

QUARTZ RICH CLAY

Smear slides 1-80, 2-80, 3-130, 4-75, CC

Texture		Composition	
Clay	93%	Clay	50%
Silt	7%	Quartz (microcrys.)	43%
		Opaques	3%
		Feldspar	2%
		Nannos	1%
		Heavy minerals, pyrite, dolomite rhombs, zeolite, and chlorite	Tr.

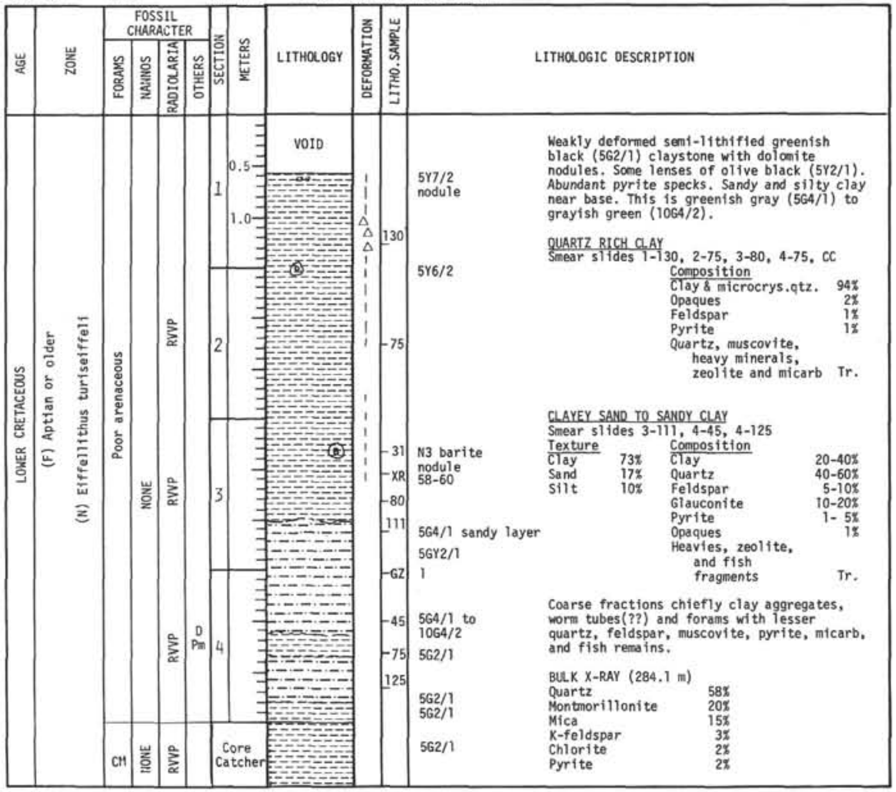
Coarse fraction chiefly micarb, clay aggregates, forams, quartz, and glauconite with small amounts of muscovite, pyrite, and iron oxides.

BULK X-RAY (264.8 m)

Quartz	49%
Montmorillonite	17%
Mica	16%
Siderite	4%
K-feldspar	4%
Kaolinite	3%
Chlorite	3%
Plagioclase	2%
Pyrite	2%

Explanantory notes in chapter 1

Site 263 Hole Core 12 Cored Interval: 280.5-290.0 m



Weakly deformed semi-lithified greenish black (5G2/1) claystone with dolomite nodules. Some lenses of olive black (5Y2/1). Abundant pyrite specks. Sandy and silty clay near base. This is greenish gray (5G4/1) to grayish green (10G4/2).

QUARTZ RICH CLAY
Smear slides 1-130, 2-75, 3-80, 4-75, CC

Composition	
Clay & microcrys.qtz.	94%
Opaques	2%
Feldspar	1%
Pyrite	1%
Quartz, muscovite, heavy minerals, zeolite and micarb	Tr.

CLAYEY SAND TO SANDY CLAY
Smear slides 3-111, 4-45, 4-125

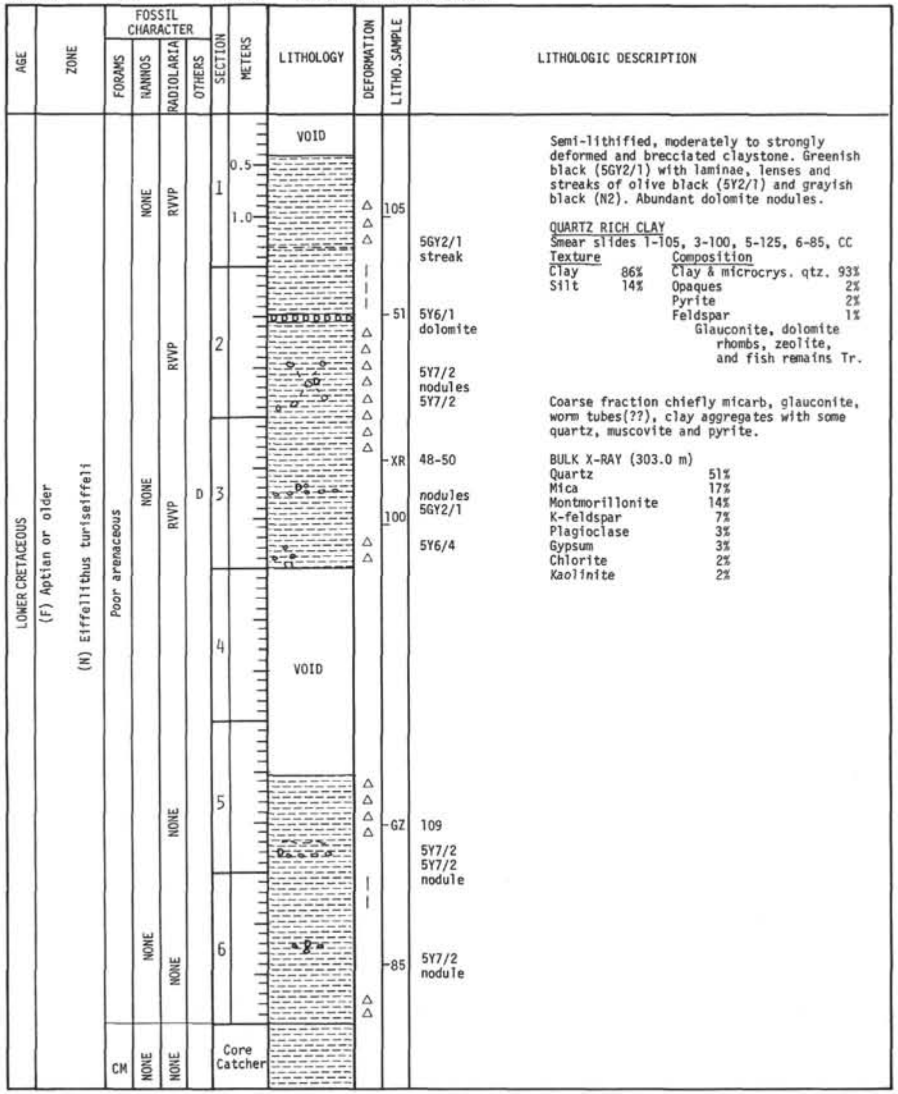
Texture		Composition	
Clay	73%	Clay	20-40%
Sand	17%	Quartz	40-60%
Silt	10%	Feldspar	5-10%
		Glauconite	10-20%
		Pyrite	1- 5%
		Opaques	1%
		Heavies, zeolite, and fish fragments	Tr.

Coarse fractions chiefly clay aggregates, worm tubes(??) and forams with lesser quartz, feldspar, muscovite, pyrite, micarb, and fish remains.

BULK X-RAY (284.1 m)

Quartz	58%
Montmorillonite	20%
Mica	15%
K-feldspar	3%
Chlorite	2%
Pyrite	2%

Site 263 Hole Core 13 Cored Interval: 299.5-309.0 m



Semi-lithified, moderately to strongly deformed and brecciated claystone. Greenish black (5GY2/1) with laminae, lenses and streaks of olive black (5Y2/1) and grayish black (N2). Abundant dolomite nodules.

QUARTZ RICH CLAY
Smear slides 1-105, 3-100, 5-125, 6-85, CC

Texture		Composition	
Clay	86%	Clay & microcrys. qtz.	93%
Silt	14%	Opaques	2%
		Pyrite	2%
		Feldspar	1%
		Glauconite, dolomite rhombs, zeolite, and fish remains	Tr.

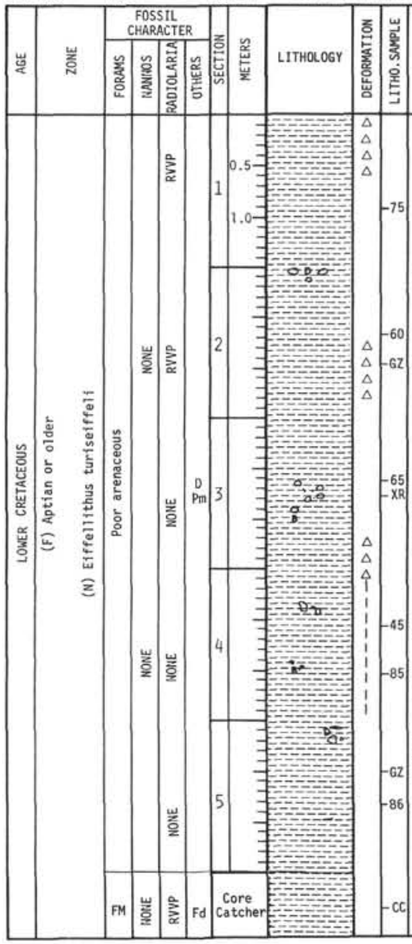
Coarse fraction chiefly micarb, glauconite, worm tubes(??), clay aggregates with some quartz, muscovite and pyrite.

BULK X-RAY (303.0 m)

Quartz	51%
Mica	17%
Montmorillonite	14%
K-feldspar	7%
Plagioclase	3%
Gypsum	3%
Chlorite	2%
Kaolinite	2%

Explanatory notes in chapter 1

Site 263 Hole Core 14 Cored Interval: 318.5-328.0 m



LITHOLOGIC DESCRIPTION

5Y7/2

90

95-100
5Y7/2
barite nodule
N8
5Y7/2

N6
dolomite nodule

barite nodule,
N8

5Y7/2
5Y6/4
52

N8

Semi-lithified, little disturbed claystone with abundant dolomite and barite nodules. Colors chiefly greenish black (5GY2/1) with streaks, lenses and laminae of olive black (5Y2/1) and grayish black (N2).

QUARTZ RICH CLAY
Smear slides 1-75, 3-65, 4-85, 5-86, CC

Texture		Composition	
Clay	91%	Quartz (microcrys.)	50%
Silt	9%	Clay	40%
		Feldspar	3%
		Opaques	2%
		Glauconite(?)	1%
		Pyrite	1%
		Zeolite	1%
		Quartz, muscovite, heavies, dolomite rhombs, micarb, and fish fragments	Tr.

CLAY
Smear slide 2-60

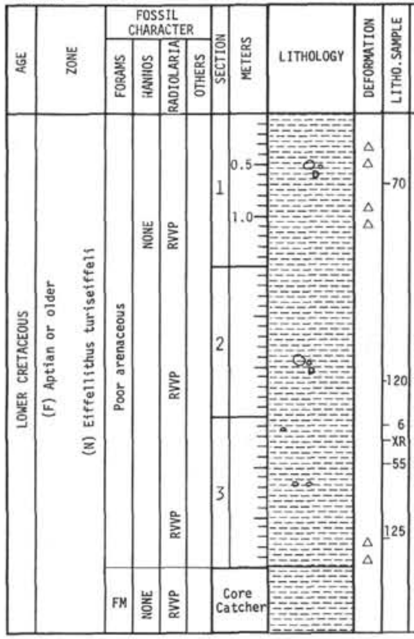
Texture		Composition	
Clay	84%	Clay	57%
Silt	16%	Glauconite(?)	18%
		Quartz	12%
		Feldspar	9%
		Opaques	1%
		Pyrite	1%
		Zeolite	1%
		Heavies, dolomite rhombs, and fish fragments	Tr.

Coarse fractions chiefly micarb, forams, quartz, glauconite and mica with lesser feldspar, heavies, pyrite, fish fragments and worm tubes(??).

BULK X-RAY (322.5 m)

Quartz	50%
Montmorillonite	25%
Mica	15%
K-feldspar	5%
Plagioclase	2%
Chlorite	2%
Pyrite	1%

Site 263 Hole Core 15 Cored Interval: 337.5-347.0 m



LITHOLOGIC DESCRIPTION

5Y7/2
nodule

5Y7/2
nodule

10YR5/4 nodule

27-29

5GY2/1 to
10G4/2

5GY2/1 to
10G4/2

Semi-lithified, little disturbed claystone. Chiefly greenish black (5GY2/1) with lenses and laminae of olive black (5Y2/1). Some grayish green (10G4/2) in lower part. Numerous dolomite nodules. Clay slightly silty in lower part.

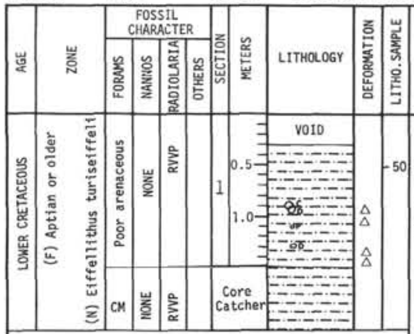
QUARTZ RICH CLAY
Smear slides 1-20, 2-120, 3-6, 3-55, 3-125

Composition	
Quartz (microcrys.)	40-60%
Clay	20-40%
Feldspar	1-10%
Zeolite	1- 2%
Glauconite	1- 5%
Muscovite, heavies, and pyrite	Tr.

BULK X-RAY (340.8 m)

Quartz	56%
Montmorillonite	21%
Mica	12%
Kaolinite	6%
K-feldspar	3%
Plagioclase	2%

Site 263 Hole Core 16 Cored Interval: 356.5-366.0 m



LITHOLOGIC DESCRIPTION

5GY2/1 to
10G4/2

nodule of
calcite &
dolomite

5GY2/1 to
10G4/2

Semi-lithified, somewhat brecciated greenish black (5GY2/1) to grayish green (10G4/2) sandy claystone.

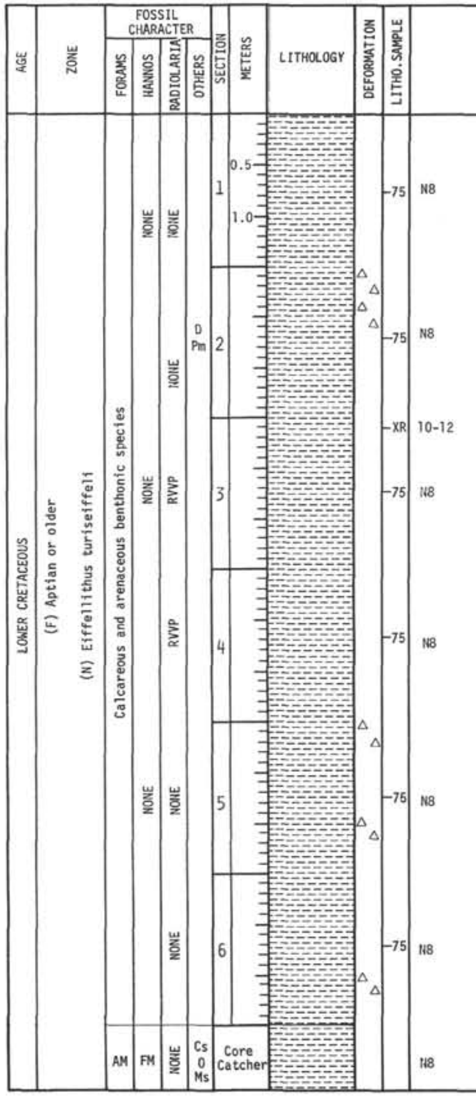
SANDY QUARTZ RICH CLAY
Smear slide 1-50

Texture		Composition	
Clay	61%	Clay	40%
Sand	28%	Quartz (microcrys.)	37%
Silt	11%	Feldspar	12%
		Glauconite(?)	10%
		Pyrite	1%
		Zeolite, micarb, and fish fragments	Tr.

Coarse fraction chiefly clay aggregates, quartz, forams, glauconite with lesser feldspar, muscovite, pyrite, spines and worm tubes(??).

Explanatory notes in chapter 1

Site 263 Hole Core 17 Cored Interval: 385.0-394.5 m



LITHOLOGIC DESCRIPTION

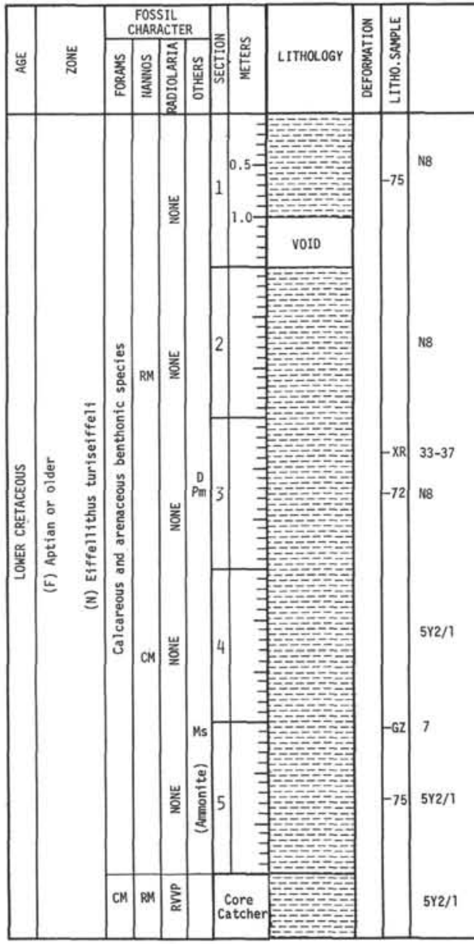
Semi-lithified, little disturbed, *very* uniform black (N8) claystone.

<u>QUARTZ-RICH CLAY</u>
Smear slides 1-75, 2-75, 3-75, 4-75, 5-75

Composition	
Clay	50%
Quartz (microcrys.)	42%
Feldspar	4%
Opaques	2%
Pyrite	2%

BULK X-RAY (388.1 m)	
Quartz	67%
Montmorillonite	18%
Mica	9%
K-feldspar	4%
Pyrite	2%
Chlorite	2%

Site 263 Hole Core 18 Cored Interval: 413.5-423.0 m



LITHOLOGIC DESCRIPTION

Semi-lithified, *undeformed* claystone. Black (N8) in upper part grading down into olive black (5Y2/1).

<u>QUARTZ RICH CLAY</u>
Smear slides 1-75, 3-72, 5-75

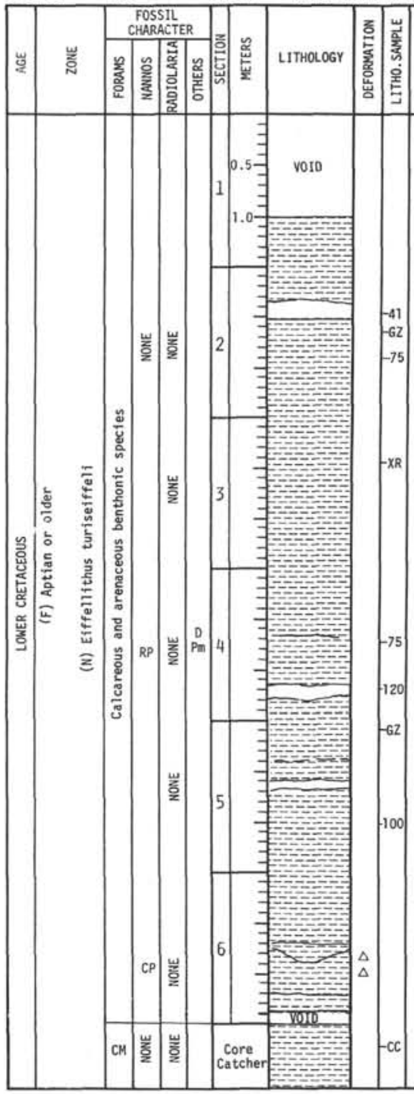
Texture		Composition	
Clay	78%	Clay	50%
Silt	22%	Quartz (microcrys.)	40%
		Feldspar	3%
		Pyrite	2%
		Opaques	2%
		Muscovite, heavy minerals, zeolite, and glauconite	Tr.

Coarse fraction is chiefly clay aggregates, glauconite, quartz, and micarb with lesser muscovite, forams, and fish fragments.

BULK X-RAY (416.8 m)	
Quartz	58%
Montmorillonite	22%
Mica	12%
K-feldspar	3%
Pyrite	2%
Kaolinite	2%
Chlorite	2%

Explanatory notes in chapter 1

Site 263 Hole Core 19 Cored Interval:451.5-461.0 m



LITHOLOGIC DESCRIPTION

calcite specks

N6 calcite or dolomite

64

5Y2/1

50-52

5Y2/1

5Y2/1

5GY2/1

5Y5/2

11

5GY2/1

5Y5/2 calcite rich

5Y2/1

5Y2/1

5Y5/2 calcite

5Y5/2 calcite-rich zone

5Y2/1

Semi-lithified, undisturbed olive black (5Y2/1) claystone.

QUARTZ AND FELDSPAR RICH SILTY CLAY

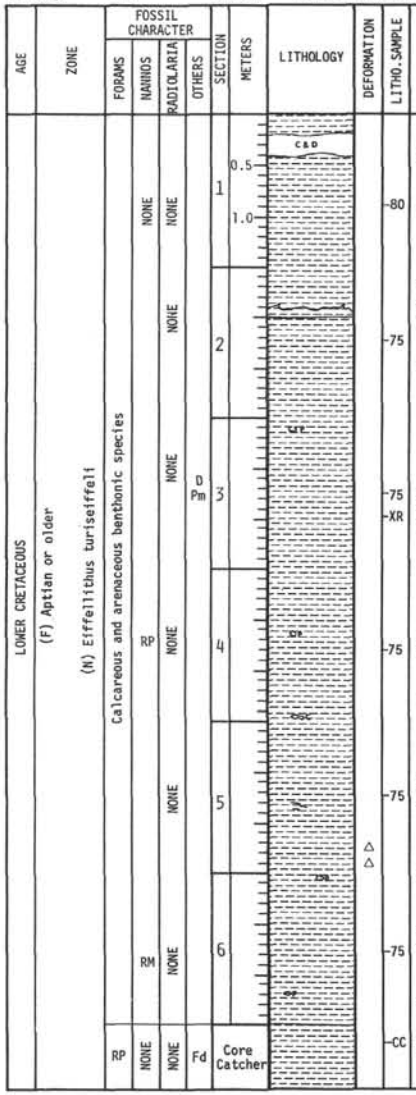
Smear slides 2-75, 4-75, 5-100, CC

Texture		Composition	
Clay	71%	Clay	43%
Silt	29%	Quartz (microcrys.)	30%
		Feldspar	20%
		Opaques	2%
		Pyrite	2%
		Muscovite, heavies, glauconite, zeolite, and chlorite	Tr.

Coarse fraction chiefly clay aggregates, muscovite, quartz, and forams with traces of glauconite, opaques, and fish fragments.

BULK X-RAY (455.8 m)	
Quartz	35%
K-feldspar	22%
Montmorillonite	17%
Mica	16%
Kaolinite	5%
Pyrite	3%
Chlorite	2%

Site 263 Hole Core 20 Cored Interval: 480-489.5 m



LITHOLOGIC DESCRIPTION

5Y5/2
siderite

5YR2/1

5G2/1
Flame structure
10YR4/2

5G2/1

5G2/1 to
5Y2/1,
80-85

5G2/1 to
5Y2/1

N8 calcite

5G2/1 to
5Y2/1
N8 calcitic fossils

pyrite nodule

5G2/1 to
5Y2/1

pyrite nodule

5G2/1 to
5Y2/1

Semi-lithified, underformed clay. Brownish black (5YR7/1) grading into greenish black (5G2/1) and olive black (5Y2/1) with black (N2) streaks and laminae. Slightly silty claystone. Pyrite and siderite nodules.

QUARTZ RICH CLAY

Smear slides 1-80, 2-75, 3-75, 4-75, 5-75, 6-75, CC

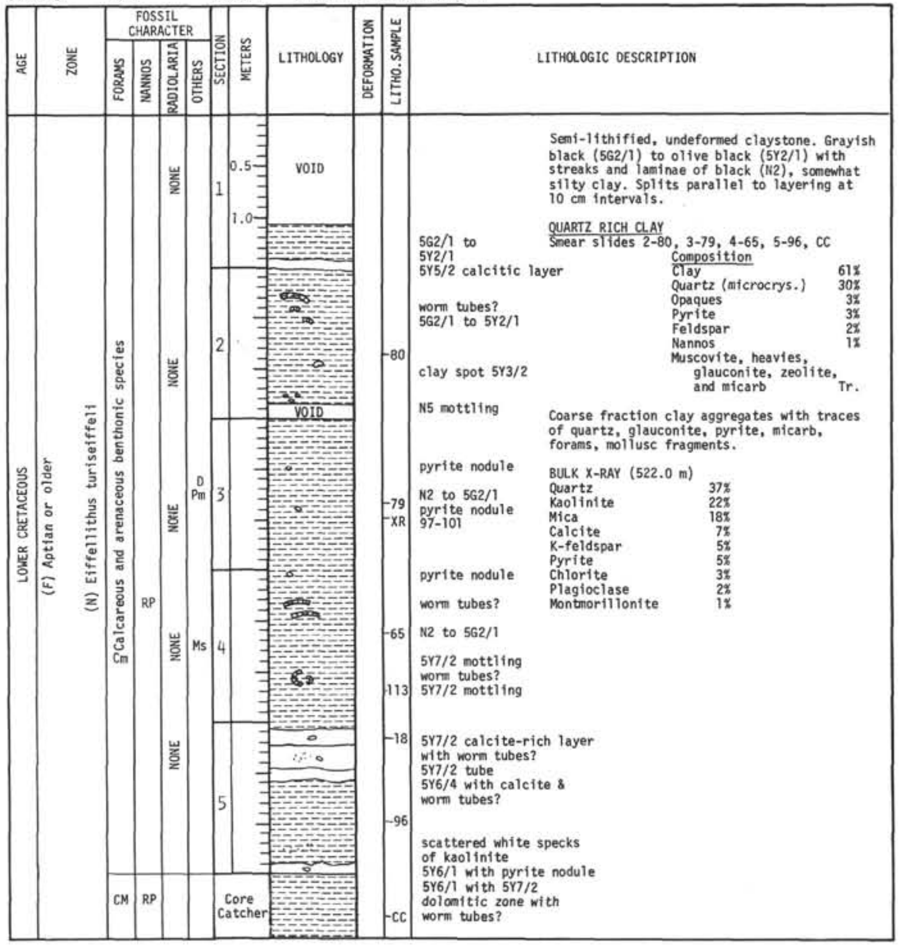
Composition	
Clay	51%
Quartz (microcrys.)	40%
Feldspar	3%
Opaques	3%
Pyrite	2%
Nannos	1%
Muscovite, heavies, glauconite, dolomite rhombs, zeolite, micarb, and fish fragments	Tr.

Coarse fractions chiefly clay aggregates, muscovite, forams, and quartz.

BULK X-RAY (483.8 m)	
Quartz	47%
Mica	22%
Kaolinite	13%
Montmorillonite	9%
K-feldspar	6%
Chlorite	2%
Pyrite	1%

Explanatory notes in chapter 1

Site 263 Hole Core 21 Cored Interval:518-527.5 m



5G2/1 to
5Y2/1
5Y5/2 calcitic layer

worm tubes?
5G2/1 to 5Y2/1

clay spot 5Y3/2

N5 mottling

pyrite nodule

N2 to 5G2/1
pyrite nodule
97-101

pyrite nodule

worm tubes?

N2 to 5G2/1

5Y7/2 mottling
worm tubes?
5Y7/2 mottling

5Y7/2 calcite-rich layer
with worm tubes?
5Y7/2 tube
5Y6/4 with calcite &
worm tubes?

scattered white specks
of kaolinite
5Y6/1 with pyrite nodule
5Y6/1 with 5Y7/2
dolomitic zone with
worm tubes?

Semi-lithified, undeformed claystone. Grayish black (5G2/1) to olive black (5Y2/1) with streaks and laminae of black (N2), somewhat silty clay. Splits parallel to layering at 10 cm intervals.

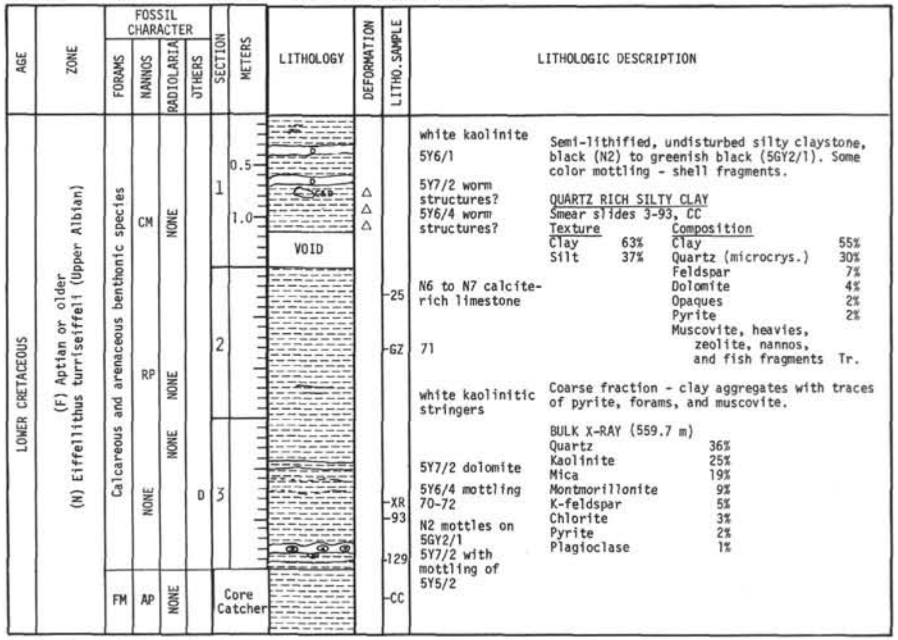
<u>QUARTZ RICH CLAY</u>
Smear slides 2-80, 3-79, 4-65, 5-96, CC

Composition	
Clay	61%
Quartz (microcrys.)	30%
Opaques	3%
Pyrite	3%
Feldspar	2%
Nannos	1%
Muscovite, heavies, glauconite, zeolite, and micarb	Tr.

Coarse fraction clay aggregates with traces of quartz, glauconite, pyrite, micarb, forams, mollusc fragments.

BULK X-RAY (522.0 m)	
Quartz	37%
Kaolinite	22%
Mica	18%
Calcite	7%
K-feldspar	5%
Pyrite	5%
Chlorite	3%
Plagioclase	2%
Montmorillonite	1%

Site 263 Hole Core 22 Cored Interval:556-565.5 m



white kaolinite

5Y6/1

5Y7/2 worm
structures?
5Y6/4 worm
structures?

N6 to N7 calcite-
rich limestone

71

white kaolinitic
stringers

5Y7/2 dolomite

5Y6/4 mottling
70-72

N2 mottles on
5GY2/1
5Y7/2 with
mottling of
5Y5/2

Semi-lithified, undisturbed silty claystone, black (N2) to greenish black (5GY2/1). Some color mottling - shell fragments.

<u>QUARTZ RICH SILTY CLAY</u>
Smear slides 3-93, CC

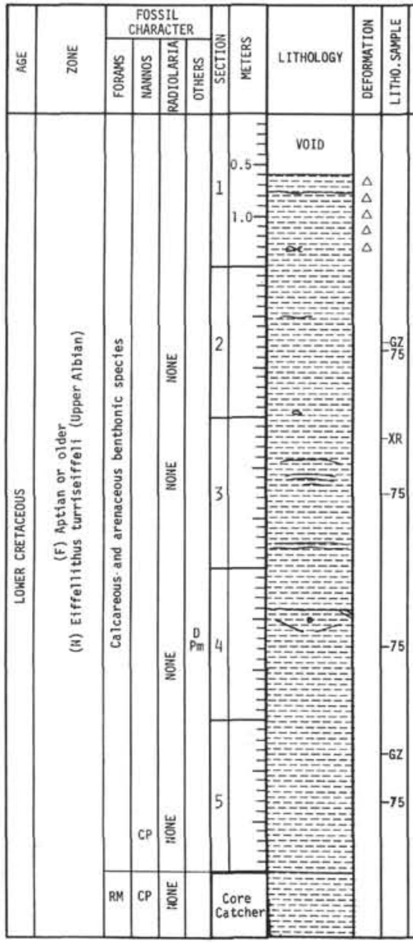
Texture		Composition	
Clay	63%	Clay	55%
Silt	37%	Quartz (microcrys.)	30%
		Feldspar	7%
		Dolomite	4%
		Opaques	2%
		Pyrite	2%
		Muscovite, heavies, zeolite, nannos, and fish fragments	Tr.

Coarse fraction - clay aggregates with traces of pyrite, forams, and muscovite.

BULK X-RAY (559.7 m)	
Quartz	36%
Kaolinite	25%
Mica	19%
Montmorillonite	9%
K-feldspar	5%
Chlorite	3%
Pyrite	2%
Plagioclase	1%

Explanatory notes in chapter 1

Site 263 Hole Core 23 Cored Interval: 594-603.5 m



LITHOLOGIC DESCRIPTION

5Y5/2 with 5Y7/2 mottles

5Y2/1 calcite

white streak of kaolinite
5Y2/1
72

pyrite nodule

20-23

bedding?

5Y2/1

5Y6/1 calcite-rich

5Y6/4 dolomite with calcite

5Y2/1

35

5Y2/1

5Y2/1

Semi-lithified, undisturbed slightly silty claystone; olive black (5Y2/1); no bedding; slightly calcareous; pyrite specks common; white kaolinite specks.

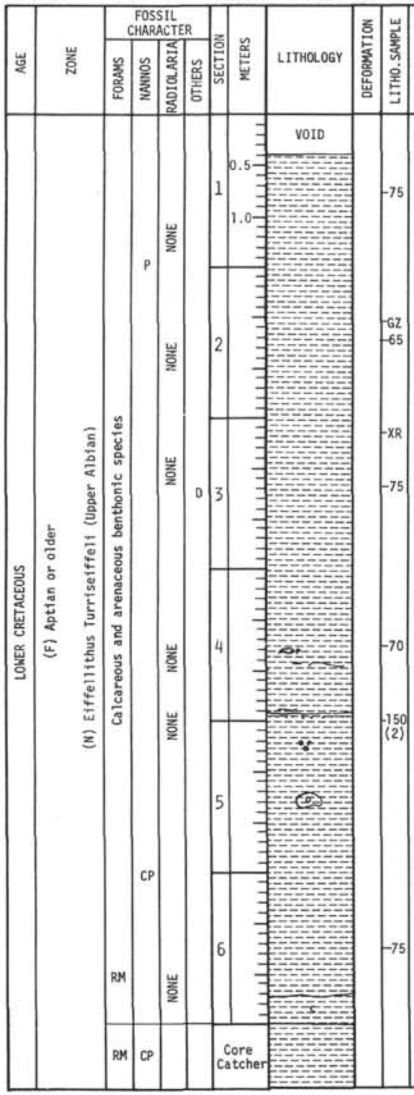
QUARTZ RICH SILTY CLAY
Smear slides 2-75, 3-75, 4-75, 5-75

Texture		Composition	
Clay	52%	Clay and microcrys. quartz	88%
Silt	48%	Quartz	4%
		Opaque	3%
		Feldspar	2%
		Nannos	1%
		Muscovite, heavies, glauconite, dolomite rhombs, zeolite, micarb, and fish fragments	Tr.

Coarse fractions - clay aggregates with traces of quartz, muscovite, glauconite, pyrite, micarb, forams, and fish remains.

BULK X-RAY (597.2 m)	
Quartz	36%
Mica	23%
Kaolinite	23%
Pyrite	6%
Montmorillonite	5%
K-feldspar	4%
Plagioclase	2%
Chlorite	1%

Site 263 Hole Core 24 Cored Interval: 632-641.5 m



LITHOLOGIC DESCRIPTION

5Y2/1

58
5Y2/1

13-17

5Y2/1

5Y2/1
pyrite nodule
white kaolinitic streaks

white kaolinitic streaks
1-2 mm white kaolinitic spheres

pyrite nodules

5Y7/2 nodule

5Y2/1

5Y7/2 calcitic layer

5Y2/1

Semi-lithified, undisturbed slightly silty claystone. Olive black (5Y2/1) with a few streaks of black (N2) and light gray (N7). Pyrite common; white calcareous specks, may be fossils.

QUARTZ RICH SILTY CLAY
Smear slides 1-75, 2-65, 3-75, 4-70, 6-75

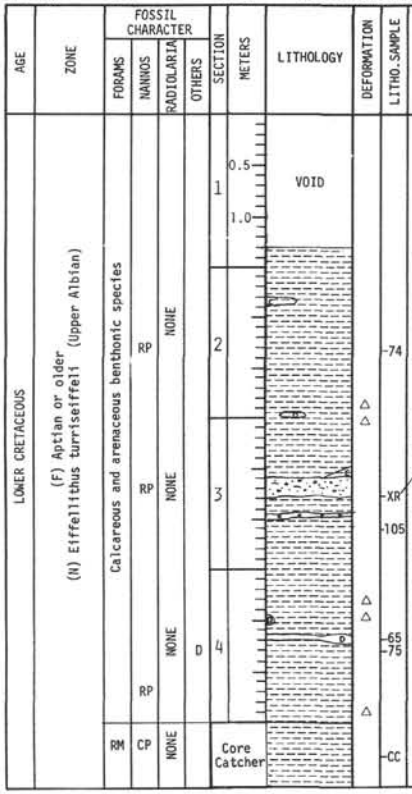
Texture		Composition	
Clay	51%	Clay	61%
Silt	49%	Quartz (microcrys.)	33%
		Feldspar	2%
		Pyrite	1%
		Opaque	1%
		Heavies, muscovite, glauconite, dolomite rhombs, zeolite, micarb, nannos, and fish fragments	Tr.

Coarse fractions - clay aggregates with traces of quartz, muscovite, glauconite, forams, fish remains.

BULK X-RAY (635.1 m)	
Quartz	38%
Kaolinite	26%
Mica	21%
Montmorillonite	5%
K-feldspar	4%
Pyrite	3%
Chlorite	2%
Plagioclase	1%

Explanatory notes in chapter 1

Site 263 Hole Core 25 Cored Interval:670-679.5 m



LITHOLOGIC DESCRIPTION

Semi-lithified, undisturbed slightly silty claystone; olive black (5Y2/1); no bedding; slightly calcareous, pyrite common. Dolomite and calcite nodules and layers.

QUARTZ BEARING CLAY
Smear slides 2-74, 3-105, 4-75, CC

Composition	
Clay	87%
Quartz	3%
Opaques	2-15%
Pyrite	2%
Nannos	1%
Feldspar, heavies, glauconite, dolomite rhombs, micarb, and fish fragments	Tr.

Coarse fraction - clay aggregates with traces of quartz, muscovite, white spheres, pyrite, forams, and fish fragments.

BULK X-RAY (673.7 m)

Kaolinite	88%
Calcite	6%
Quartz	3%
Montmorillonite	2%
Mica	1%

5Y2/1

calcite-rich area
5Y7/2

5Y2/1

dolomite nodule
5Y7/2
5Y2/1

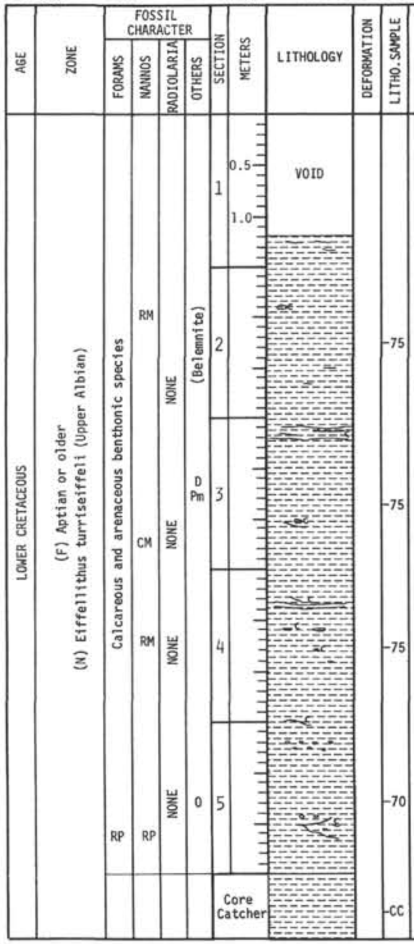
71-72
5Y6/1 with 1-3 mm white spherical to ellipsoidal bodies of kaolinite

5Y6/1 with 1-3 mm white spheres of kaolinite

10YR4/2, slightly calcareous
5Y2/1 dolomite

5Y2/1

Site 263 Hole Core 26 Cored Interval: 698.5-708 m



LITHOLOGIC DESCRIPTION

Semi-lithified, undisturbed, slightly calcareous, slightly silty claystone. Olive black (5Y2/1). Pyrite common, streaks and nodules of calcite and dolomite present.

QUARTZ BEARING CLAY
Smear slide 2-75, 3-75, 4-75, CC

Composition	
Clay	85%
Quartz	1-20%
Opaques	3%
Feldspar	2%
Pyrite	2%
Nannos	1-10%
Muscovite, heavies, glauconite, micarb, and fish fragments	Tr.

Coarse fraction - clay aggregates, a few forams and traces of quartz, feldspar, glauconite, pyrite, and fish fragments.

N7 streaks
5Y2/1

white calcite

5Y2/1

fossil
white shells

5Y4/1
5Y5/2

nodule and veinlet

calcite veinlet

calcite

calcite
5Y2/1

calcite
kaolinitic spheres in calcite-rich matrix

5Y6/1, calcite-rich

5Y2/1

Explanatory notes in chapter 1

Site 263 Hole Core 27 Cored Interval: 708-717.5 m

AGE	ZONE	FOSSIL CHARACTER FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
*	**	RP ***	CP	NONE		Core Catcher					5Y2/1

Semi-lithified, highly deformed, olive black (5Y2/1) slightly calcareous, slightly silty claystone.

QUARTZ BEARING CLAYSTONE

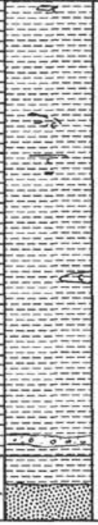
Coarse fraction - clay aggregates, a few forams, opaques, and traces of quartz, muscovite, glauconite, pyrite.

* LOWER CRETACEOUS

**(F) Aptian or older
(N) Eiffellithus turriseiffeli (Upper Albian)

***Calcareous and arenaceous benthonic species

Site 263 Hole Core 28 Cored Interval: 727-736.5 m

AGE	ZONE	FOSSIL CHARACTER FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	
LOWER CRETACEOUS	(F) Aptian or older (N) Not older than Middle Albian	Calcareous and arenaceous benthonic species		NONE		1	0.5 1.0			-75	calcite 5Y2/1
			CM	NONE		2			△ △ △ △ △	-75 -GZ	calcite-rich layer 5Y2/1 87 calcite-rich layer
			RP	NONE	D	3				-50 XR	141-150 N7 with white spheres of kaolinite
		RP	RP	NONE	Fd	Core Catcher				-CC	5Y2/1 and 5BG5/2 green glauconitic sandstone

LITHOLOGIC DESCRIPTION

Semi-indurated, undeformed slightly calcareous, slightly silty clay; olive black (5Y2/1) calcite nodules, layers and wisps. Grayish blue green (5BG5/2) glauconitic sandstone at base.

QUARTZ RICH SILTY CLAY
Smear slides 1-75, 2-75, 3-50

Texture		Composition	
Clay	53%	Clay	68%
Silt	47%	Quartz	22%
		Opaques	2%
		Pyrite	2%
		Micarb	2%
		Feldspar	2%
		Nannos	1%
		Muscovite, heavies, glauconite, and fish fragments	Tr.

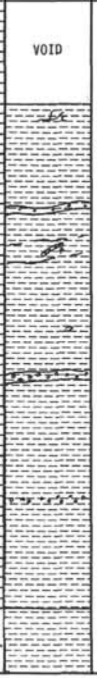
GLAUCONITE SANDSTONE
Smear slide CC

Composition	
Calcite cement	40%
Glauconite	35%
Clay clasts	15%
Chert	7%
Quartz	2%
Feldspar, mica, and opaques	Tr.

BULK X-RAY (731.4 m)

Kaolinite	47%
Quartz	28%
Montmorillonite	20%
Mica	2%
Pyrite	1%
Calcite	1%

Site 263 Hole Core 29 Cored Interval: 736.5-746 m

AGE	ZONE	FOSSIL CHARACTER FORAMS	NANNOS	RADIOLARIA	OTHERS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	
LOWER CRETACEOUS	(F) Aptian or older (Pm) C. stylosus (Neocomian)	Calcareous and arenaceous benthonic species				1	0.5 1.0	VOID 	△ △ △ △		white calcite vein 5Y2/1
			RM	NONE		2				-80 GZ XR	white spheres of kaolinite 5Y2/1 108 pyritized burrow in N4 calcite-rich zone 6-8 pyrite nodule 5Y2/1
			RM	NONE	Pm	3				-66	white spheres of kaolinite
			RM	NONE	D Pm	4			△ △ △ △	-80	white spheres of kaolinite
		CM	RM	RVVP	O	Core Catcher				-CC	5Y2/1

LITHOLOGIC DESCRIPTION

Semi-lithified, undisturbed slightly calcareous, slightly silty claystone. Carbonate veins, zones, and layers.

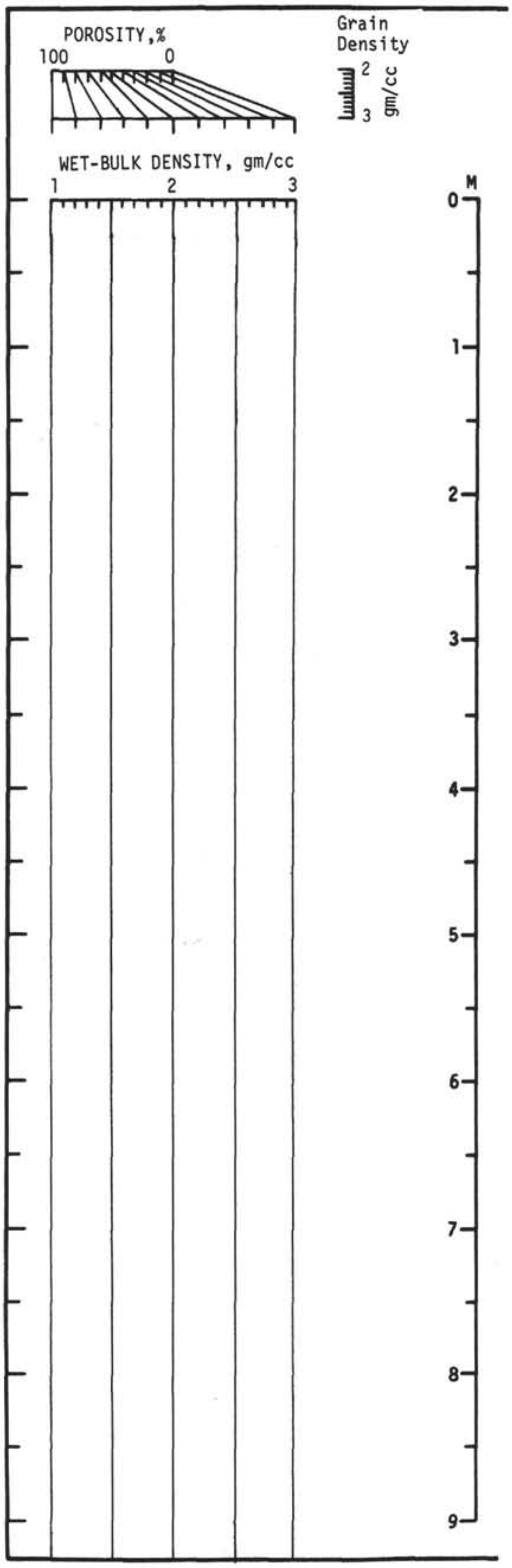
QUARTZ RICH SILTY CLAY
Smear slides 2-80, 4-80, CC

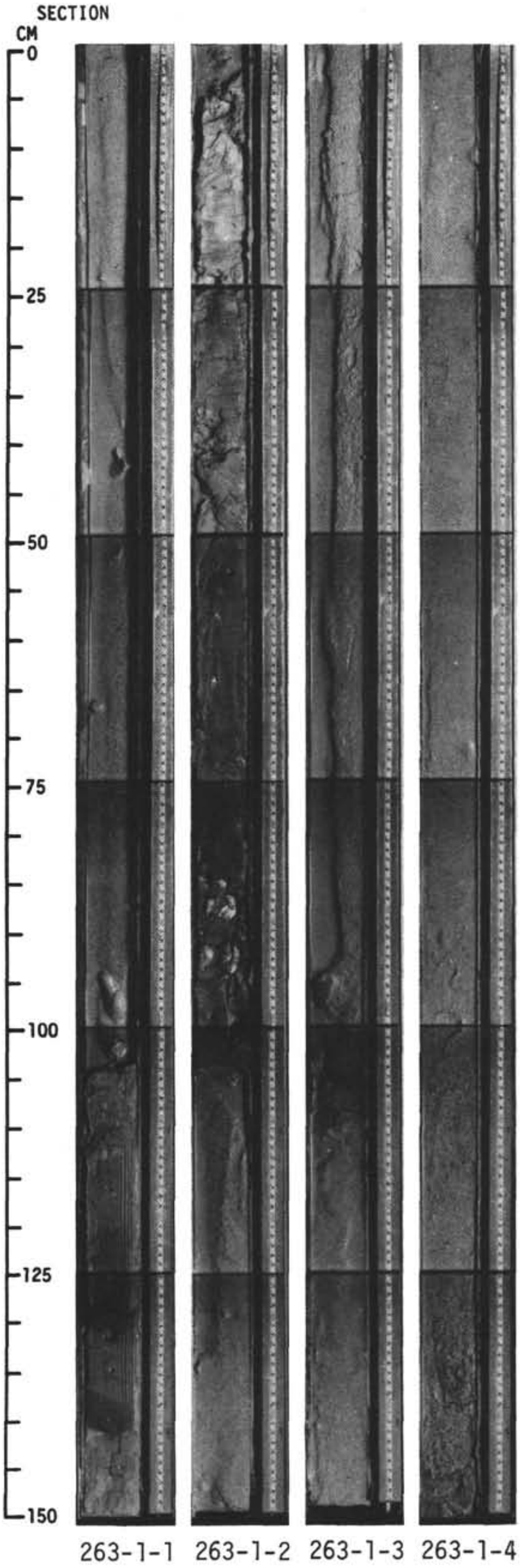
Texture		Composition	
Clay	64%	Clay	47%
Silt	36%	Quartz (microcrys.)	44%
		Opaques	3%
		Feldspar	2%
		Pyrite	2%
		Nannos	1%
		Heavies, zeolite, muscovite, dolomite rhombs, and fish fragments	Tr.

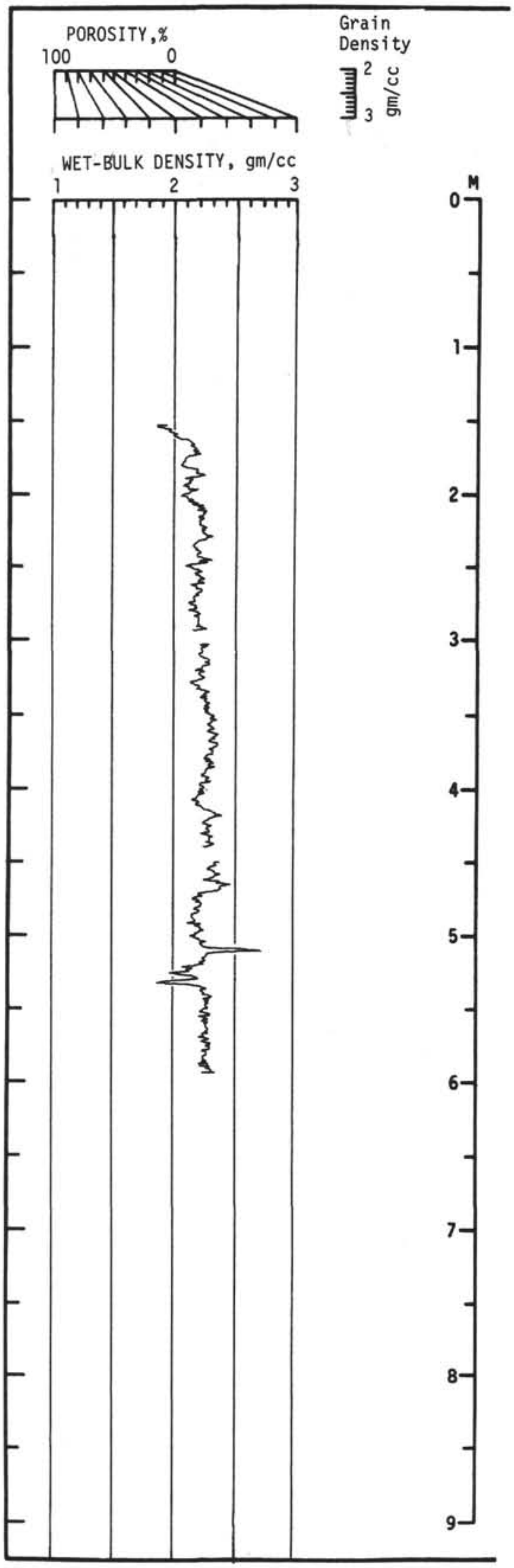
BULK X-RAY (739.6 m)

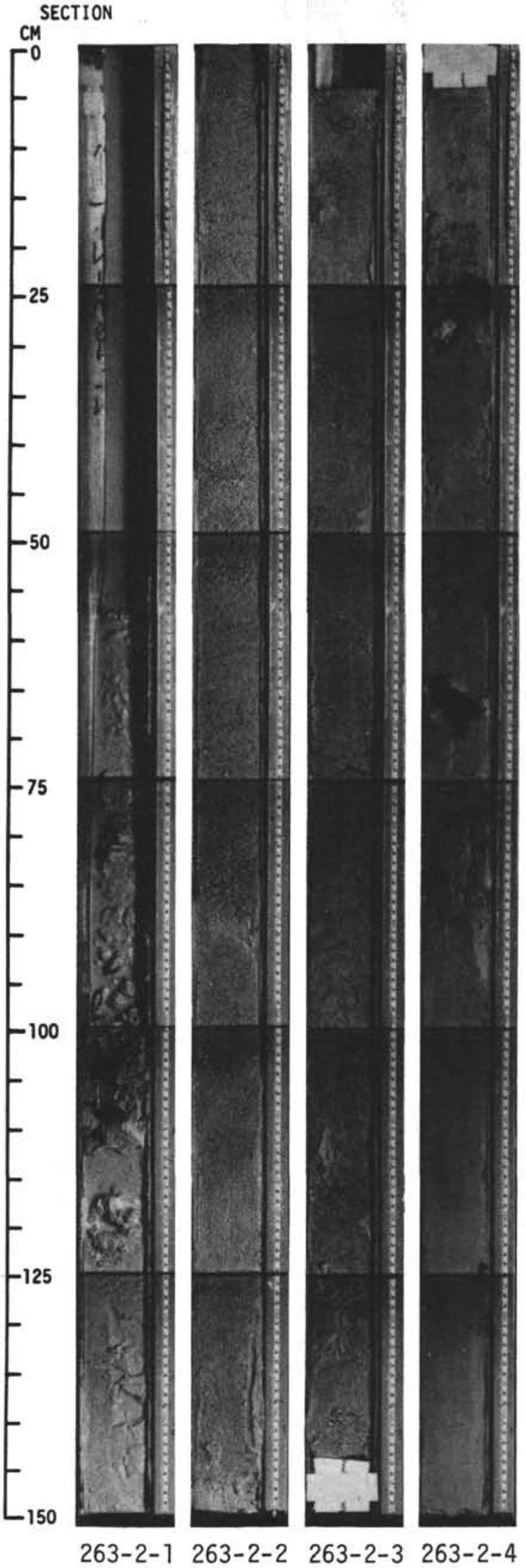
Quartz	46%
Mica	19%
Kaolinite	18%
Pyrite	7%
Montmorillonite	5%
Chlorite	2%
Calcite	2%
Plagioclase	1%

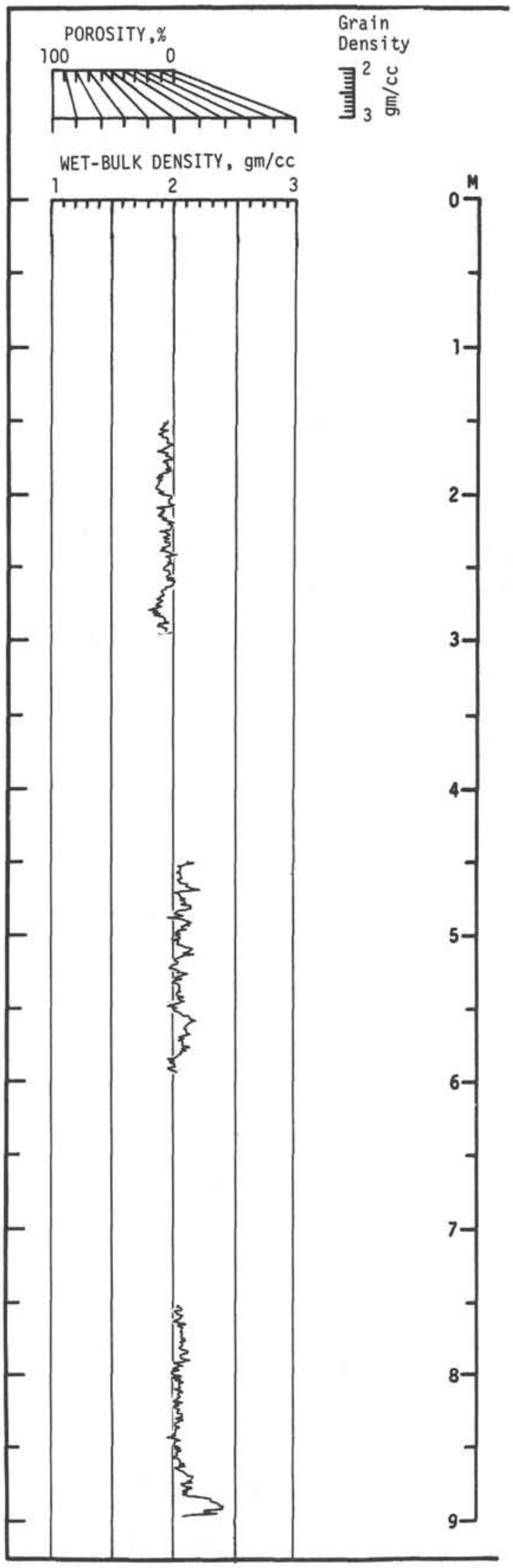
Explanatory notes in chapter 1

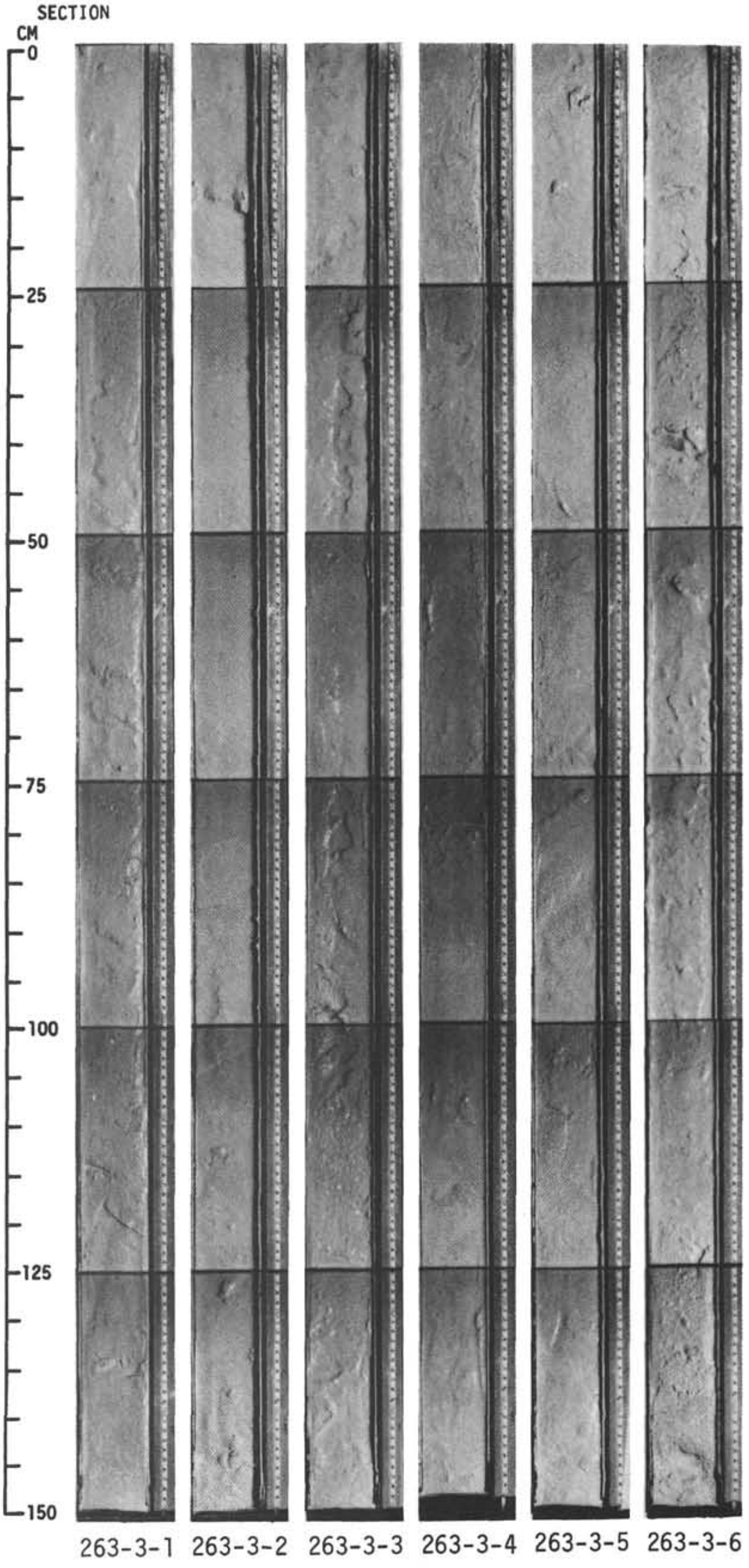

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

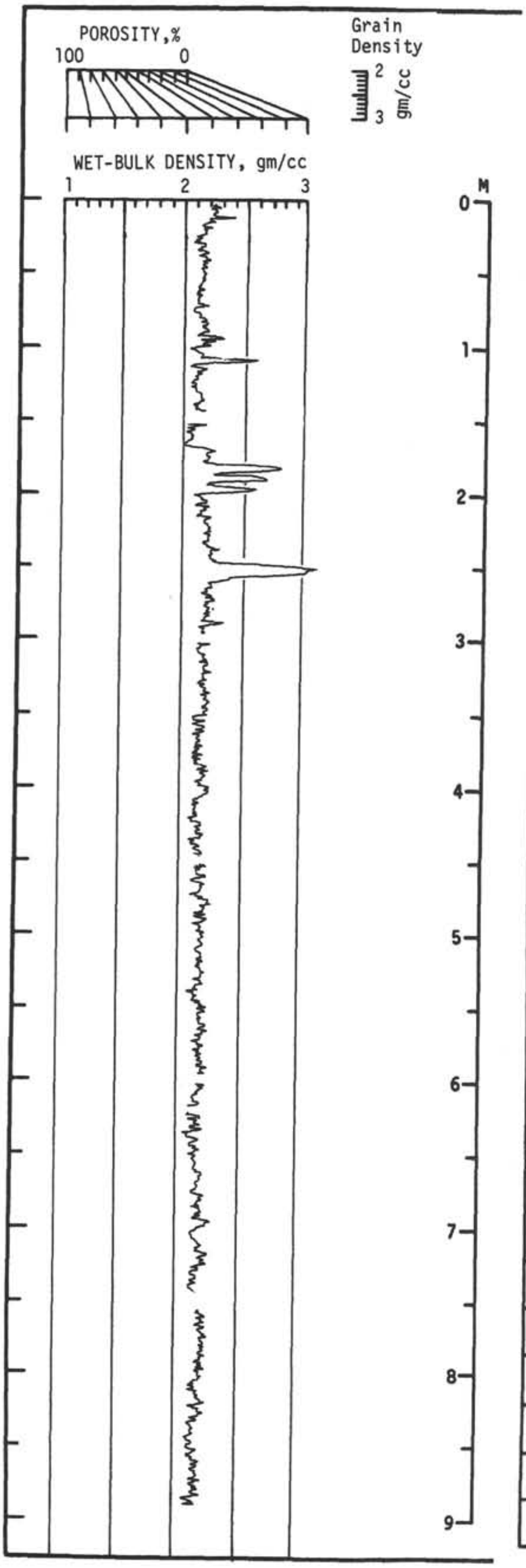

SECTION
CM
0
25
50
75
100
125
150
263-1-1
263-1-2
263-1-3
263-1-4

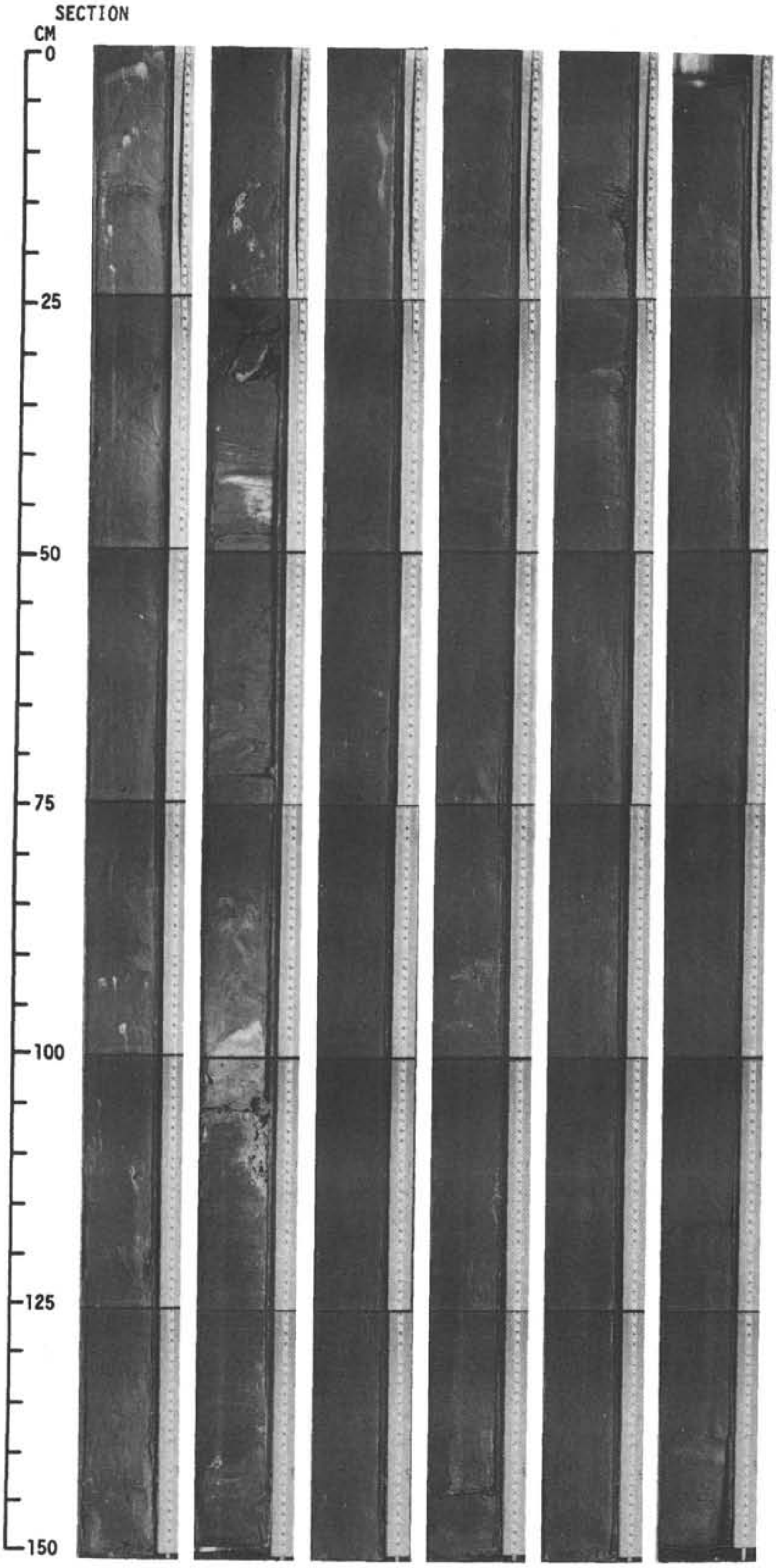

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9


SECTION
CM
0
25
50
75
100
125
150
263-2-1
263-2-2
263-2-3
263-2-4

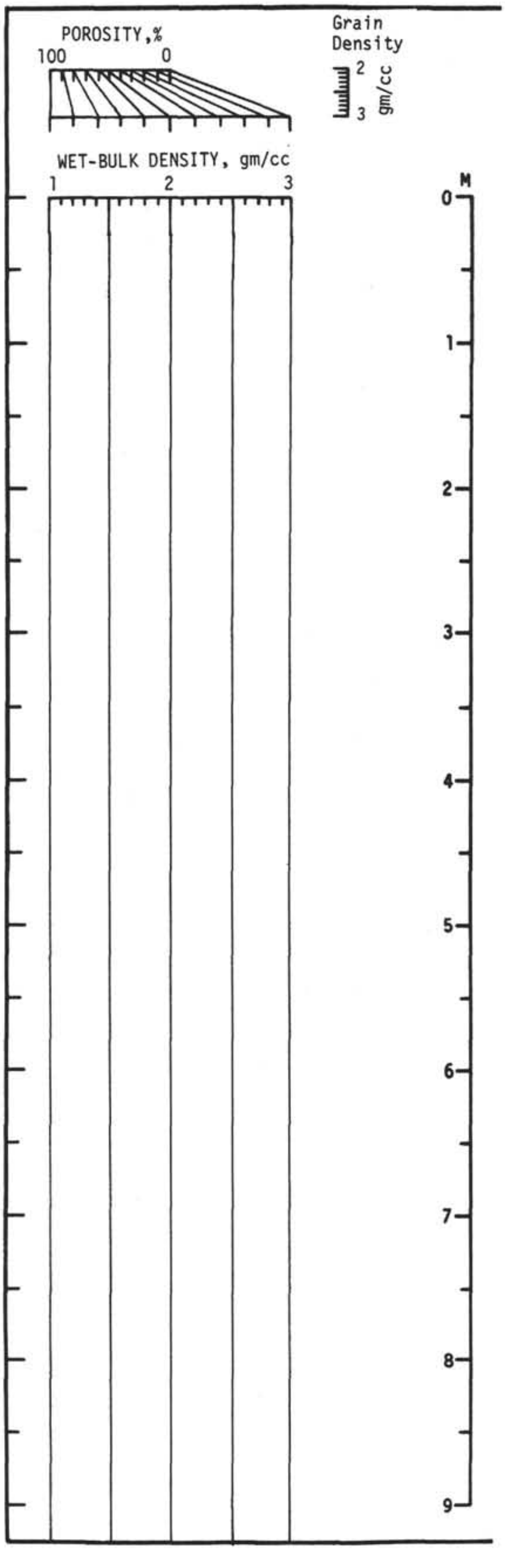

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

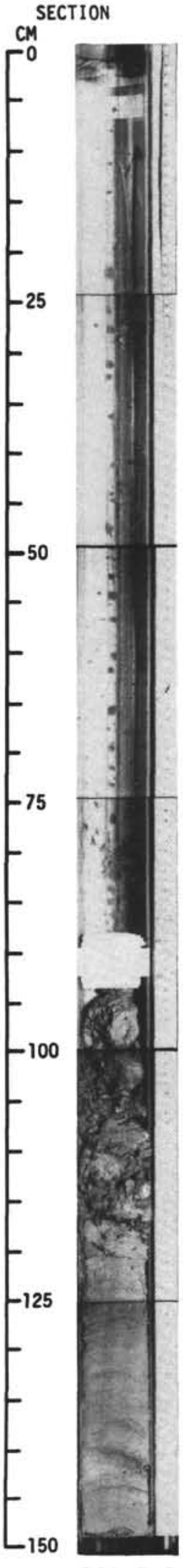

SECTION
CM
0
25
50
75
100
125
150
263-3-1
263-3-2
263-3-3
263-3-4
263-3-5
263-3-6



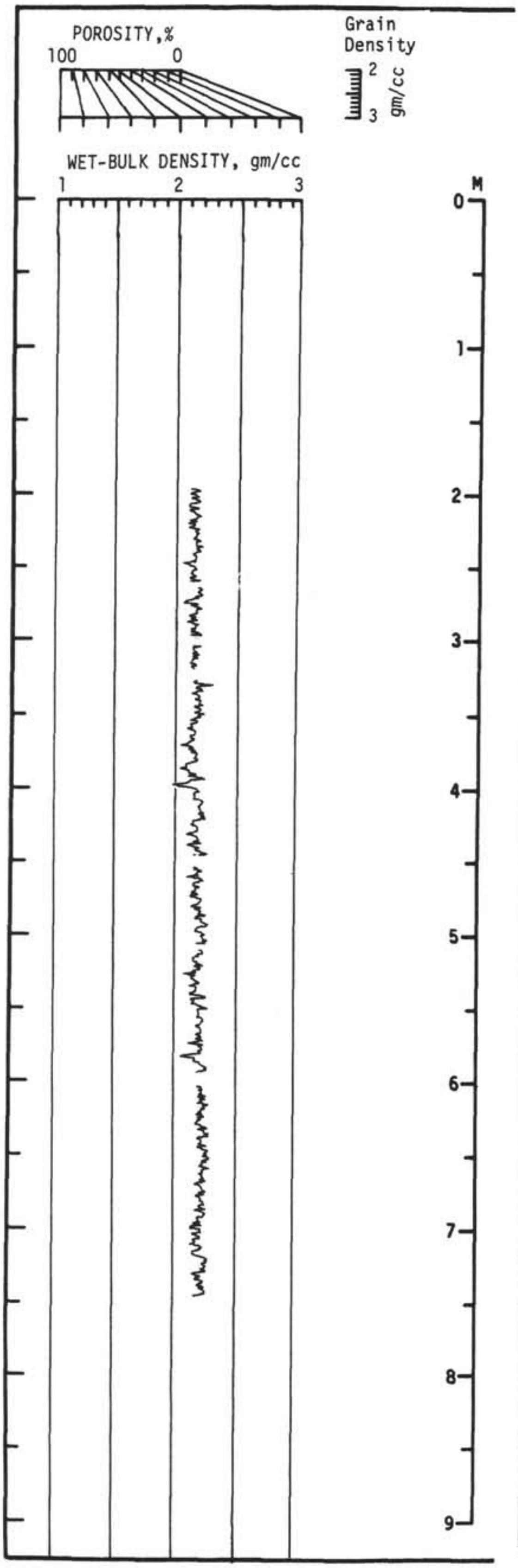


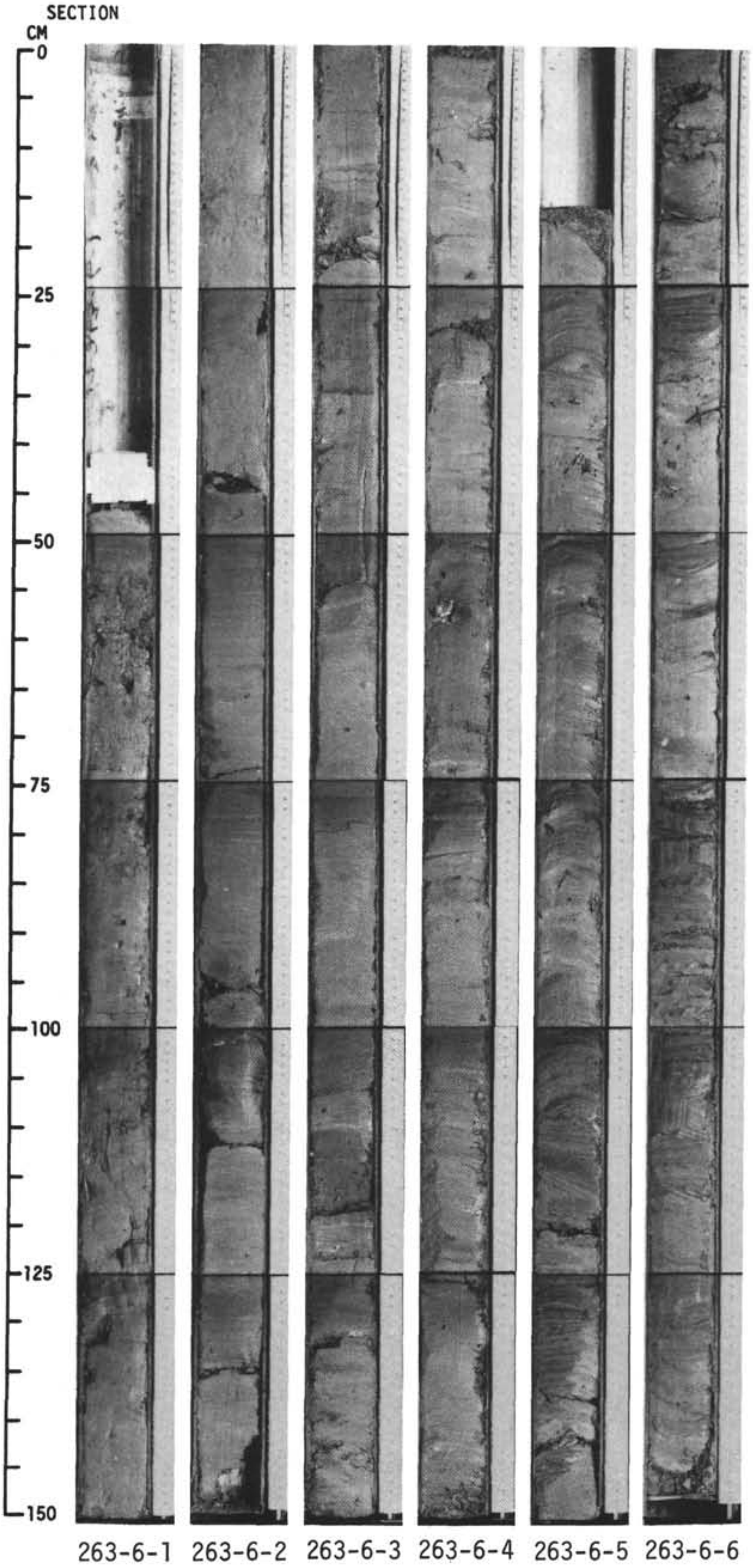
263-4-1 263-4-2 263-4-3 263-4-4 263-4-5 263-4-6

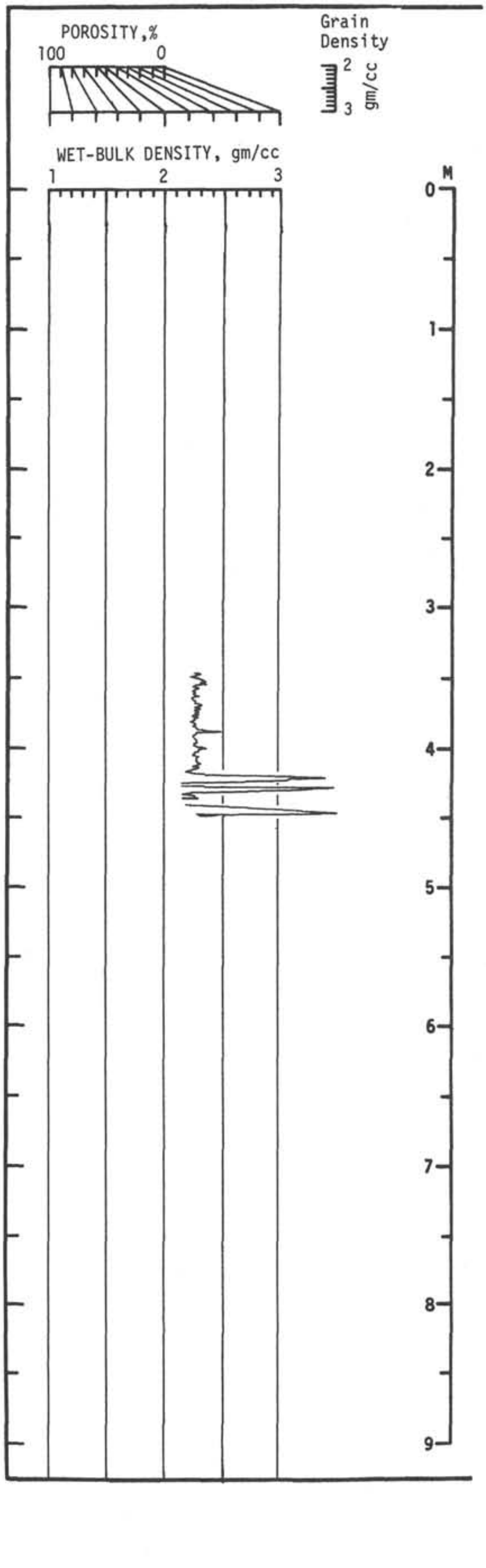

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

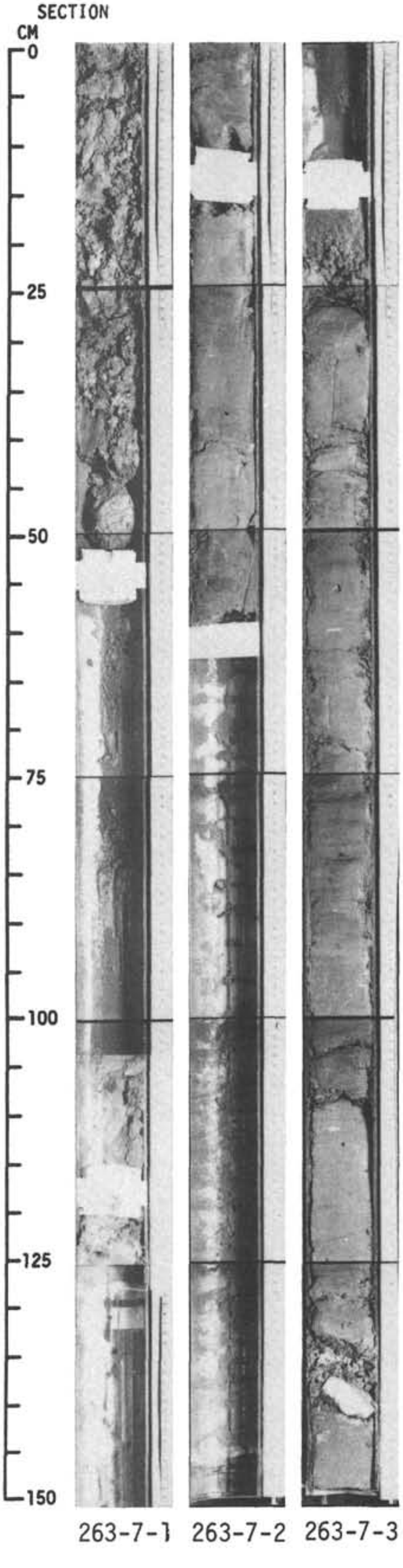

SECTION
CM
0
25
50
75
100
125
150

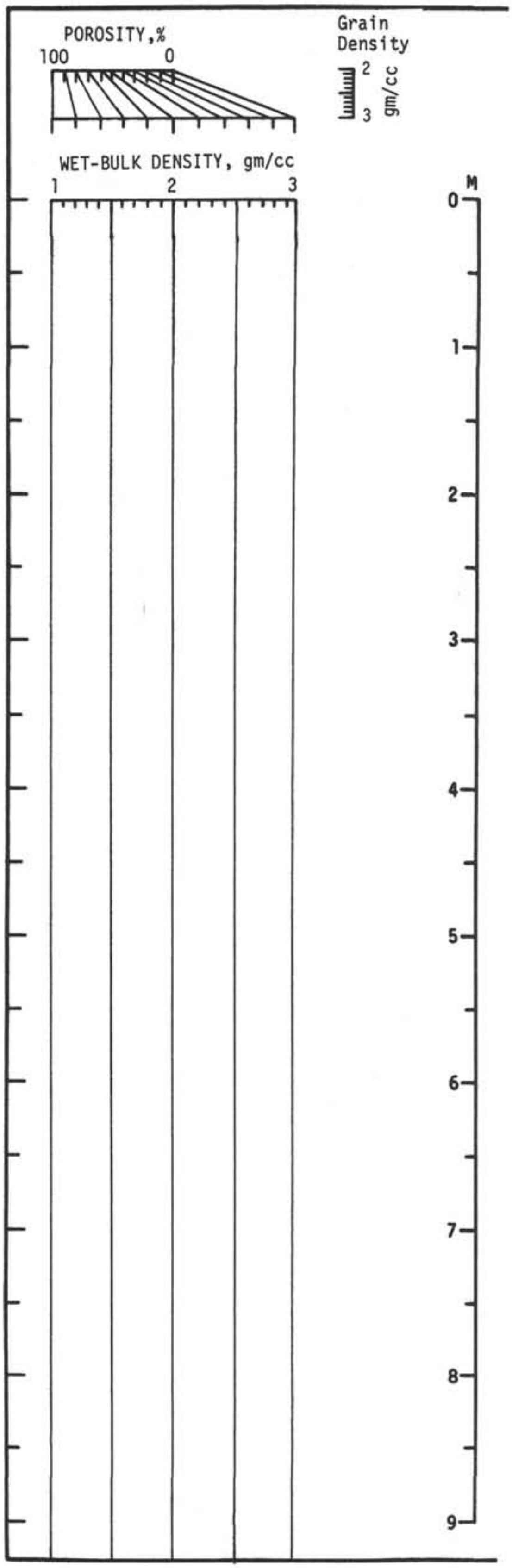
263-5-1

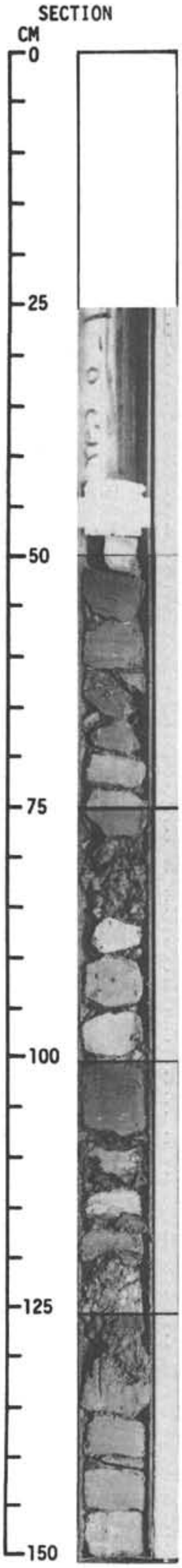

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9


SECTION
CM
0
25
50
75
100
125
150
263-6-1
263-6-2
263-6-3
263-6-4
263-6-5
263-6-6

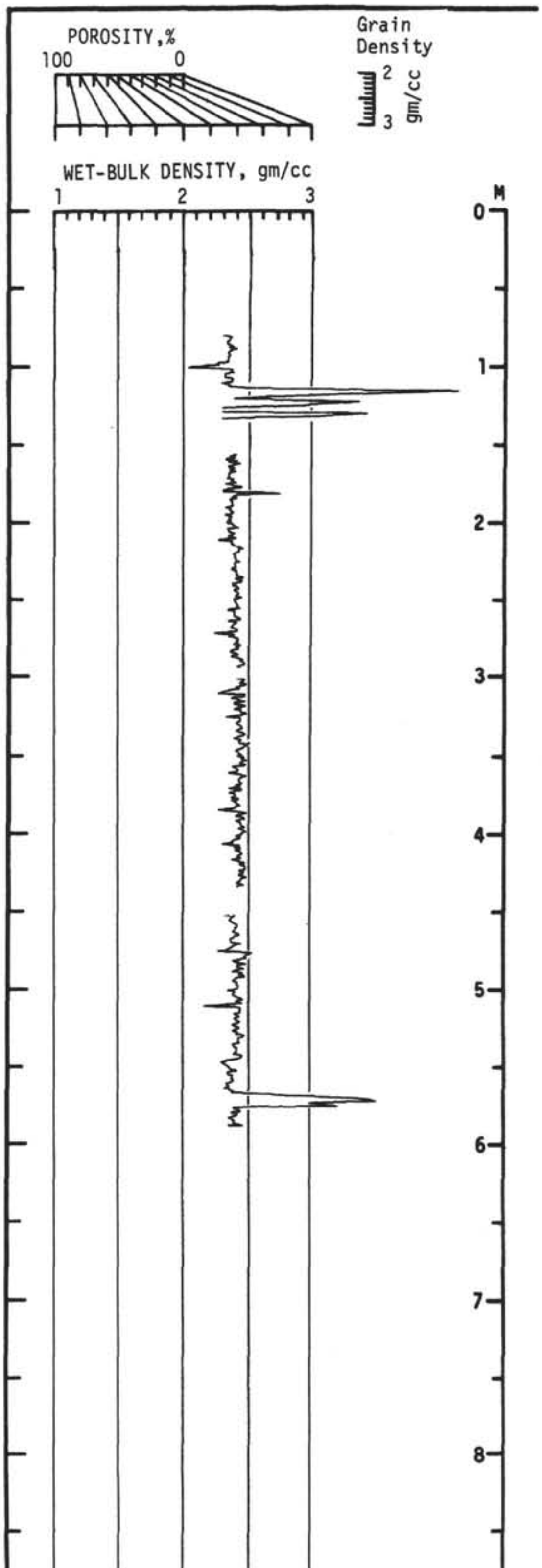

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

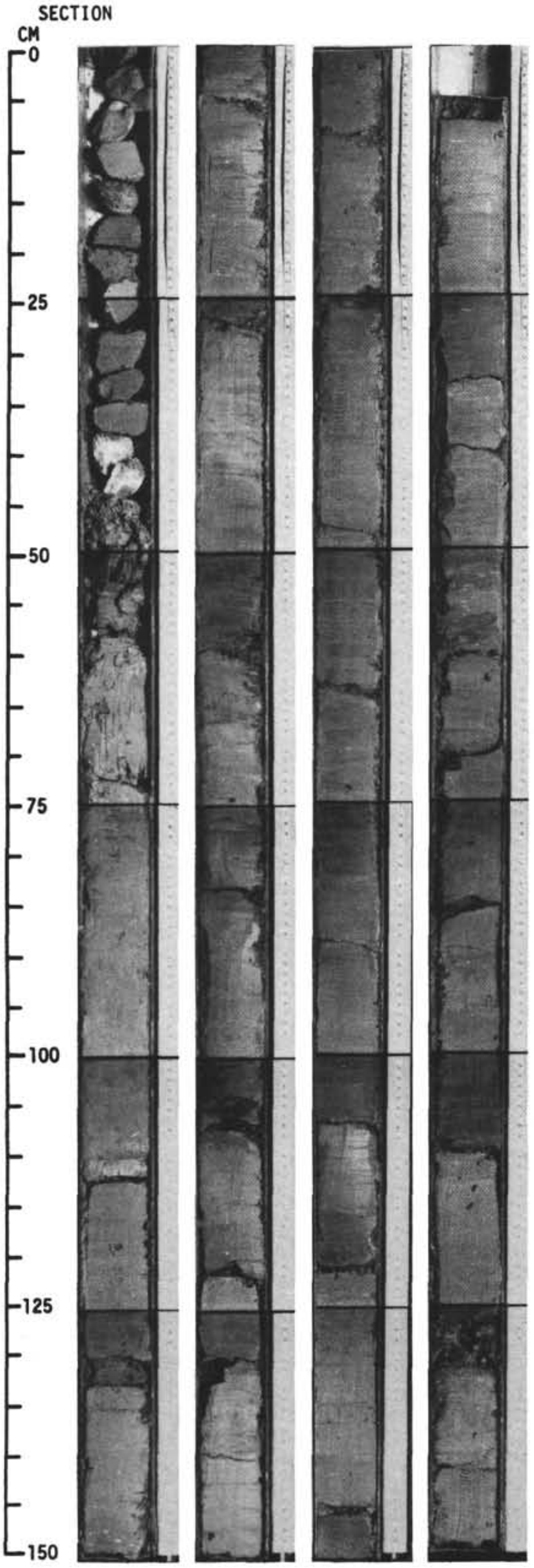

SECTION
CM
0
25
50
75
100
125
150
263-7-1
263-7-2
263-7-3

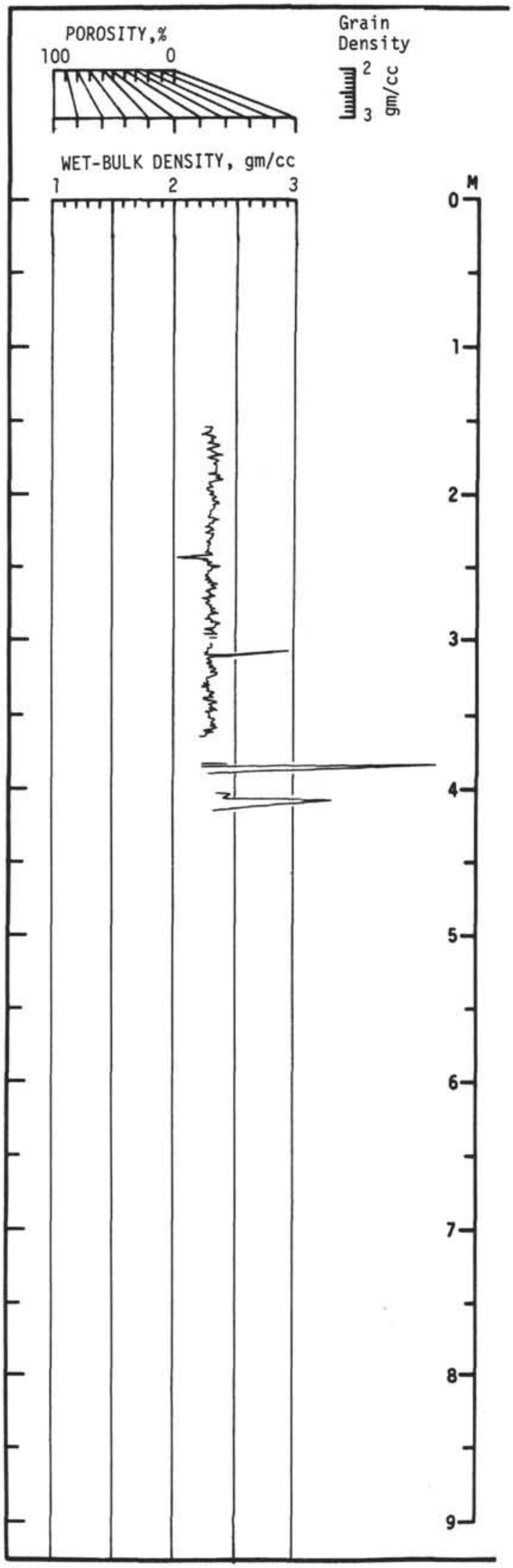

POROSITY,%
100
0
Grain
Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

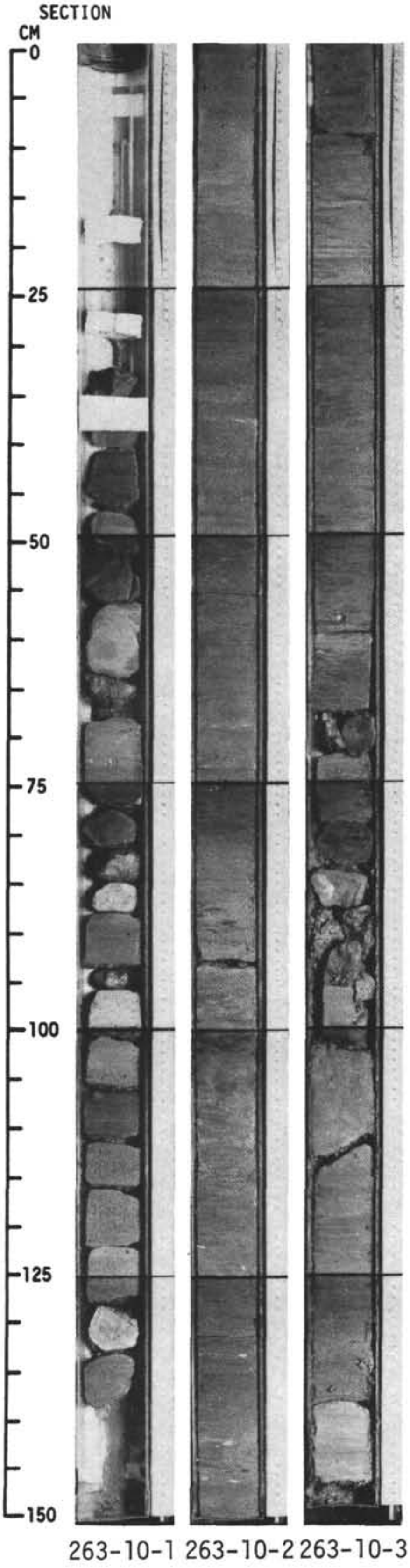

SECTION
CM
0
25
50
75
100
125
150

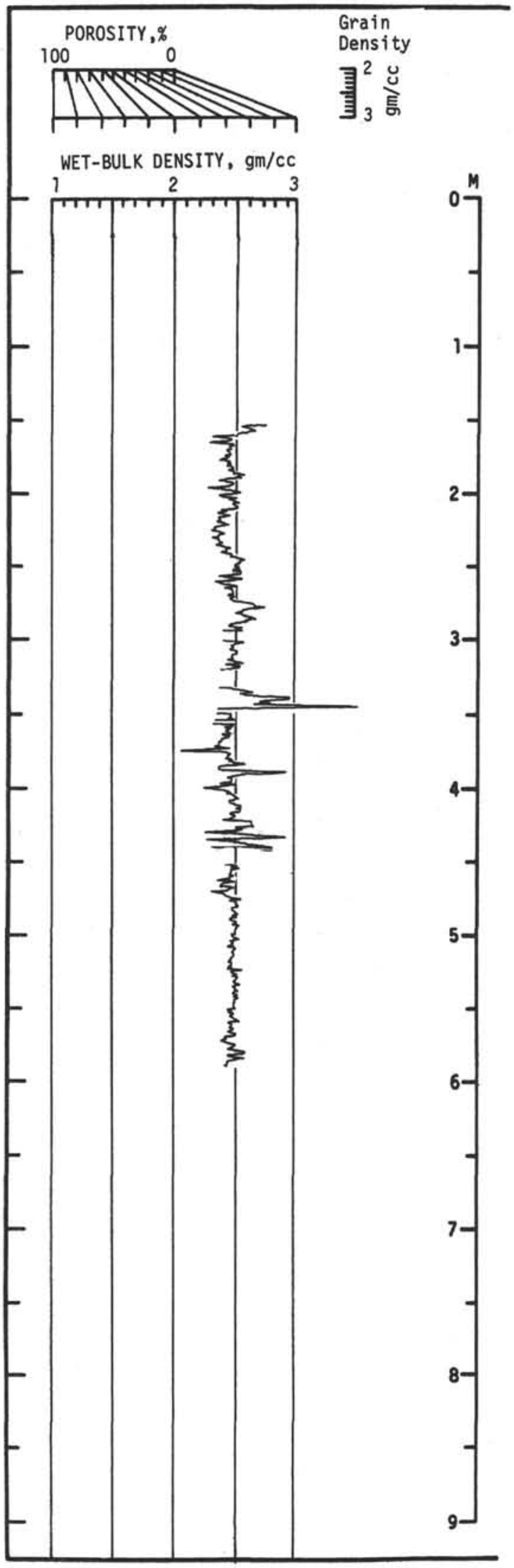
263-8-1

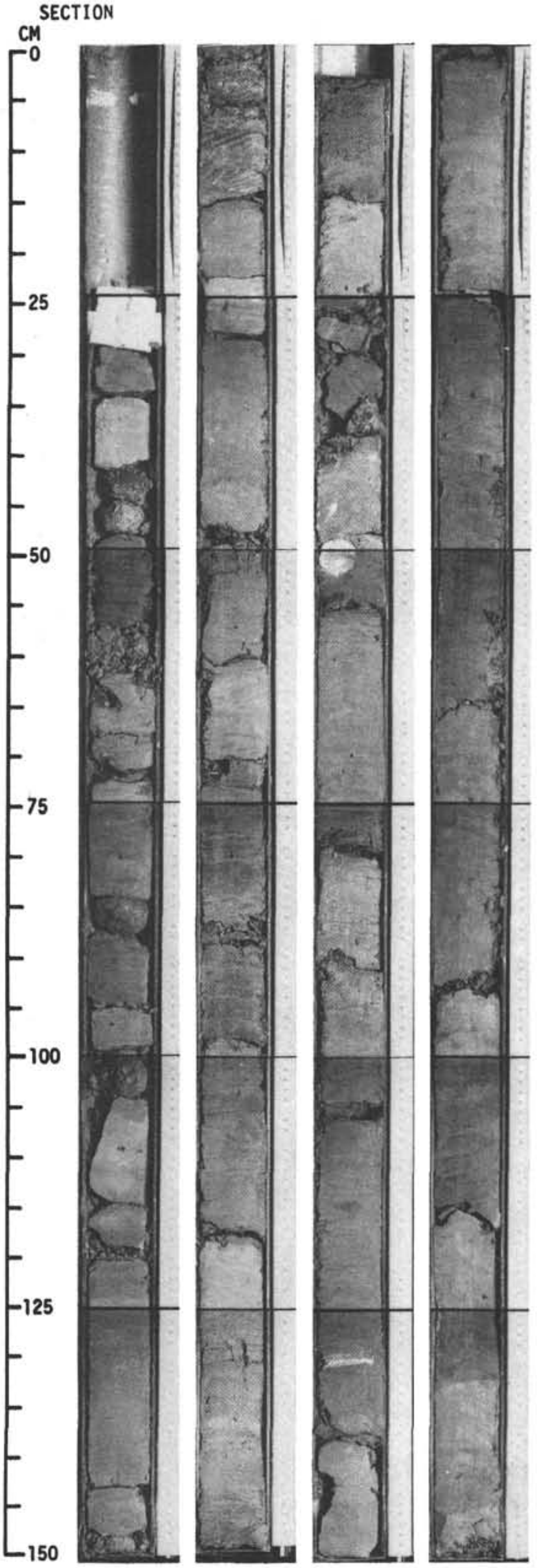

POROSITY,%
100
0
Grain
Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9


SECTION
CM
0
25
50
75
100
125
150
263-9-1
263-9-2
263-9-3
263-9-4

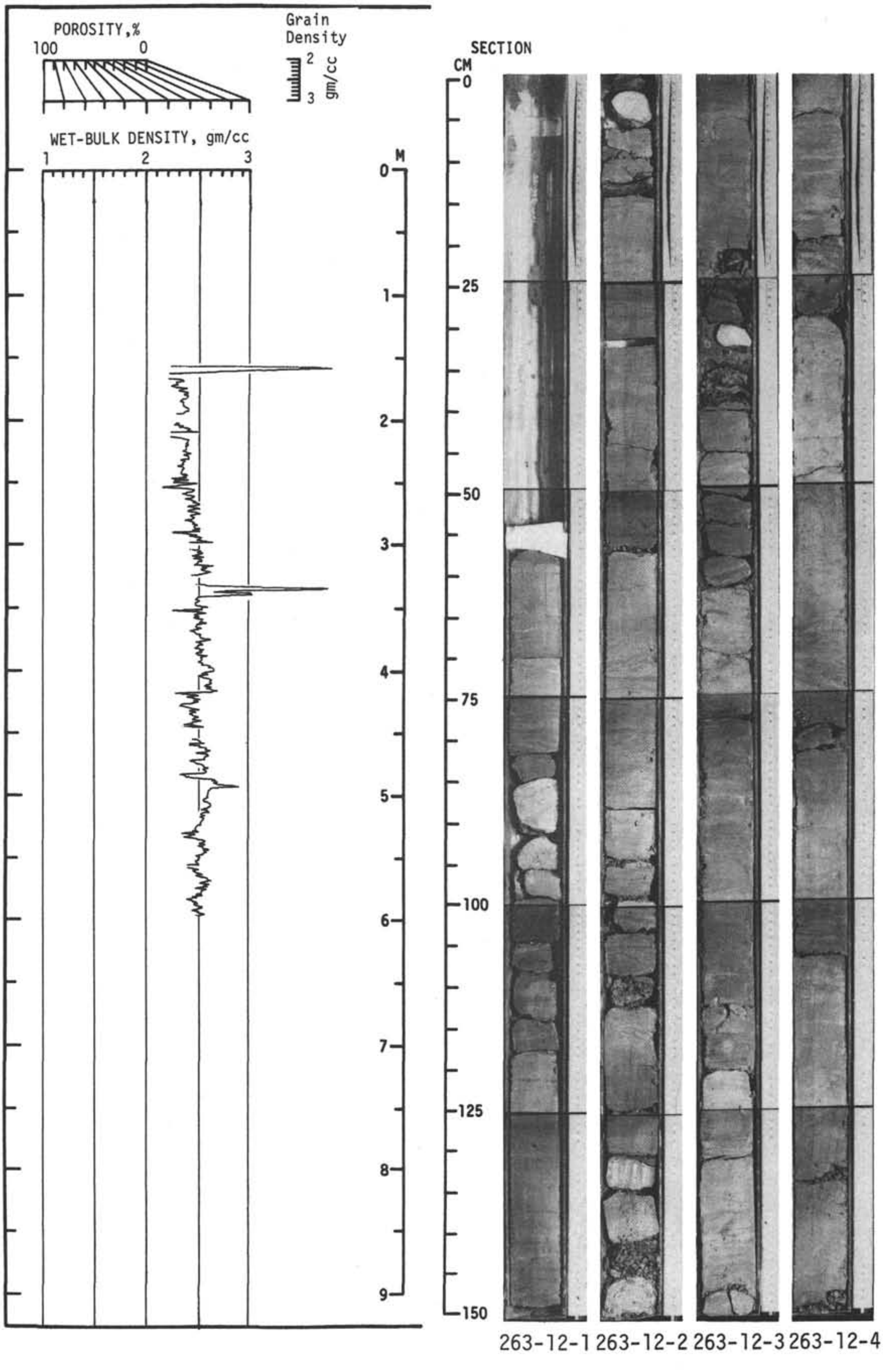

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

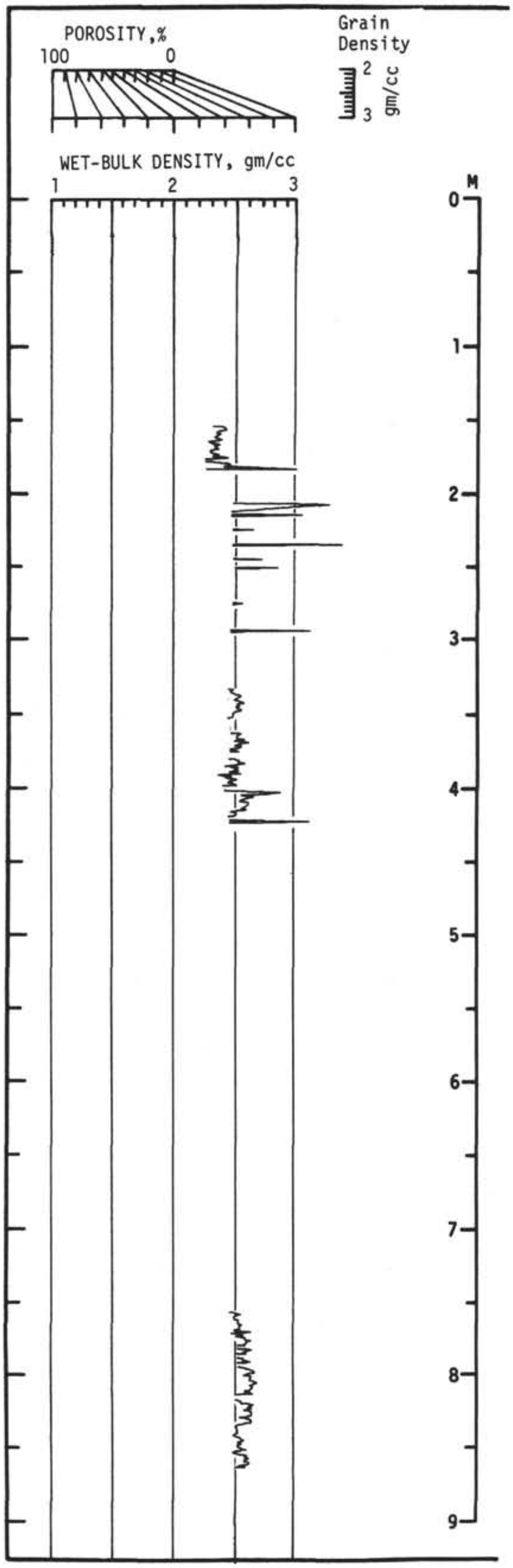

SECTION
CM
0
25
50
75
100
125
150
263-10-1
263-10-2
263-10-3

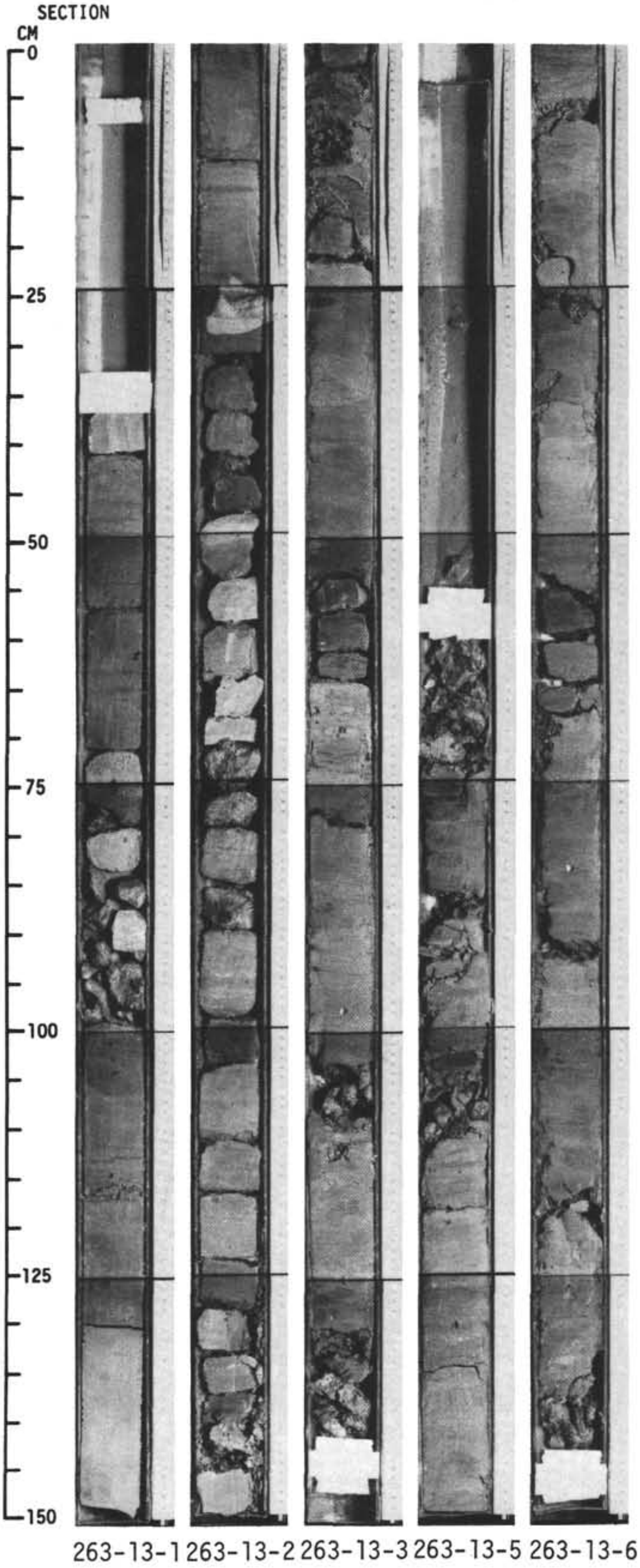


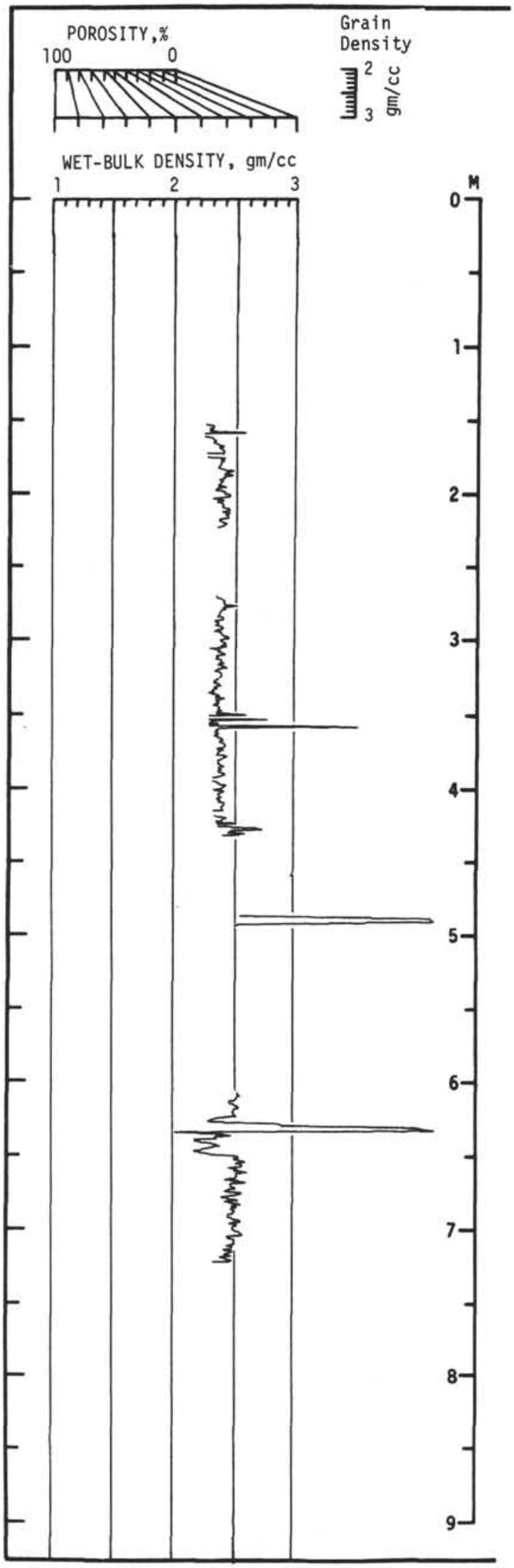


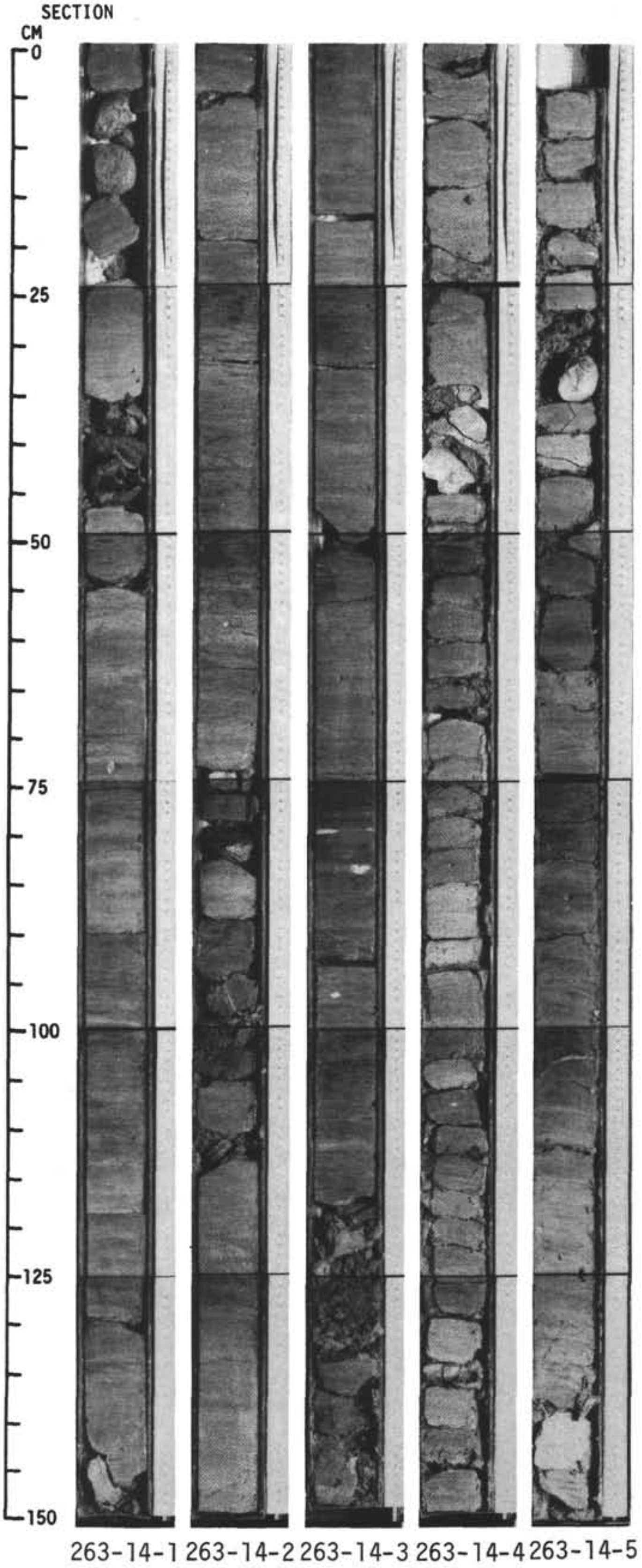
263-11-1 263-11-2 263-11-3 263-11-4

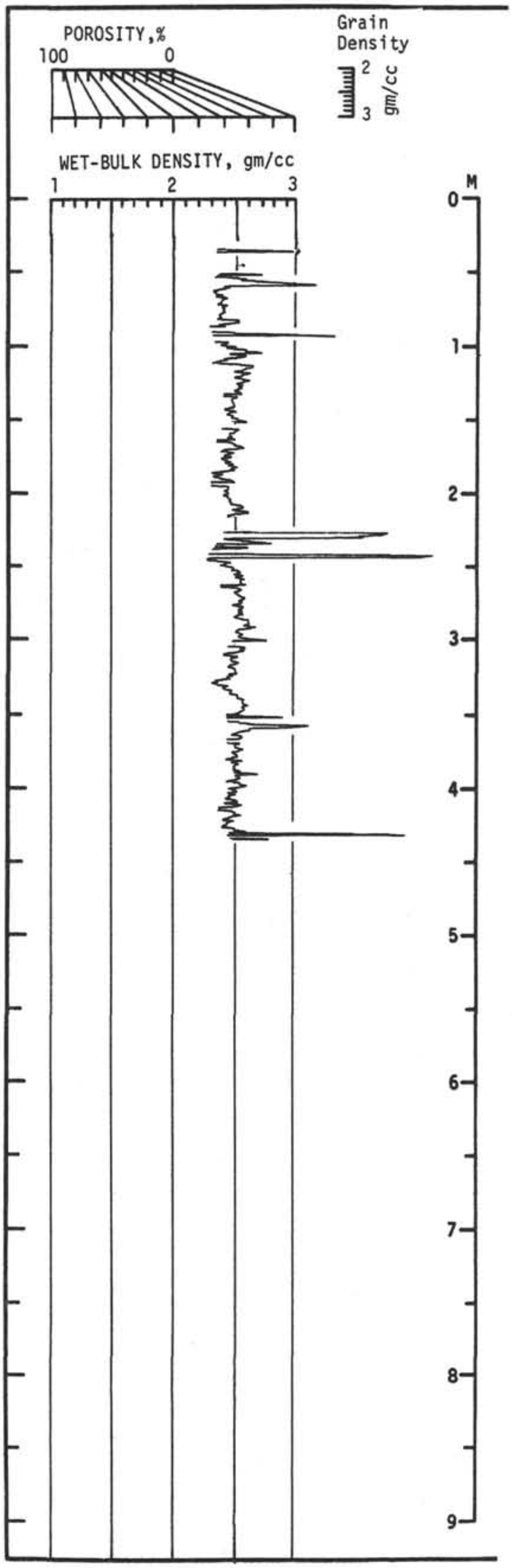

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9
SECTION
CM
0
25
50
75
100
125
150
263-12-1
263-12-2
263-12-3
263-12-4

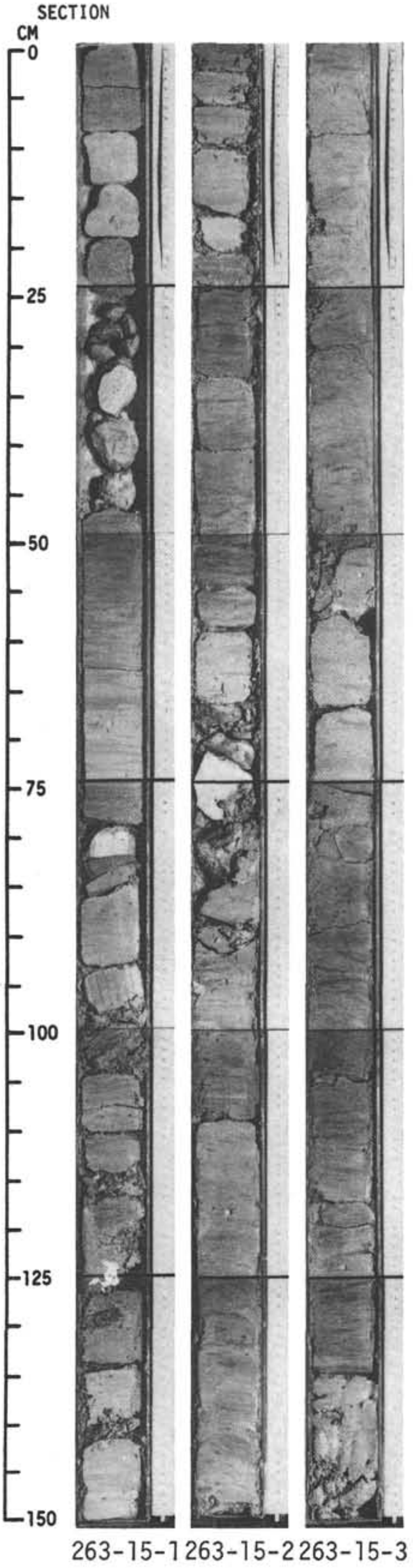

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

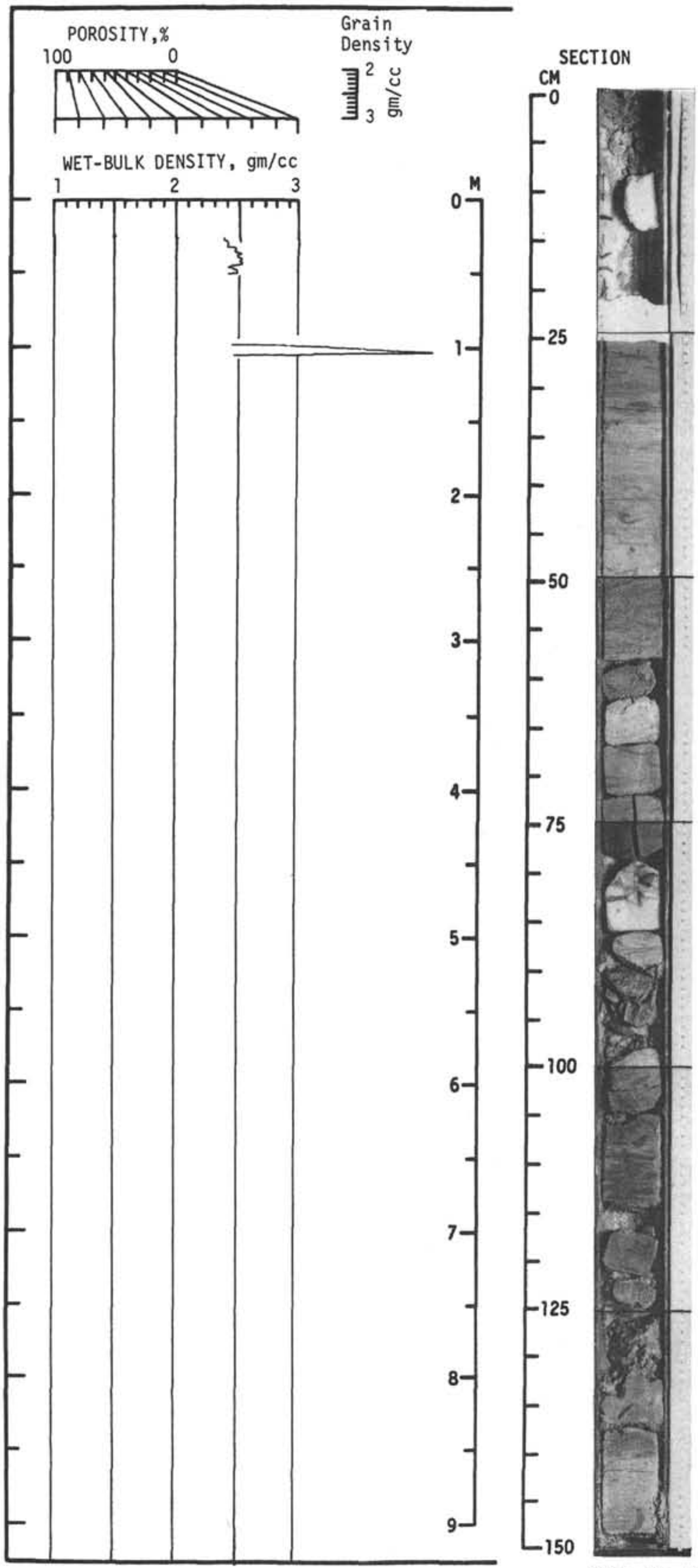

SECTION
CM
0
25
50
75
100
125
150
263-13-1
263-13-2
263-13-3
263-13-5
263-13-6


POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

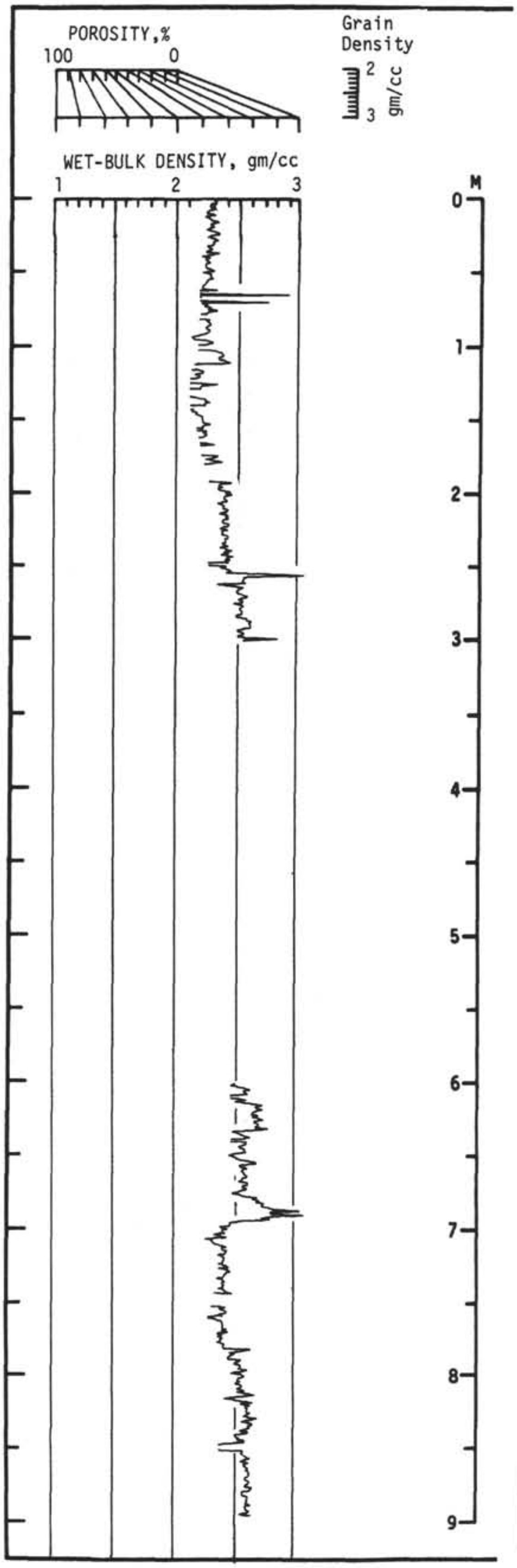

SECTION
CM
0
25
50
75
100
125
150
263-14-1
263-14-2
263-14-3
263-14-4
263-14-5

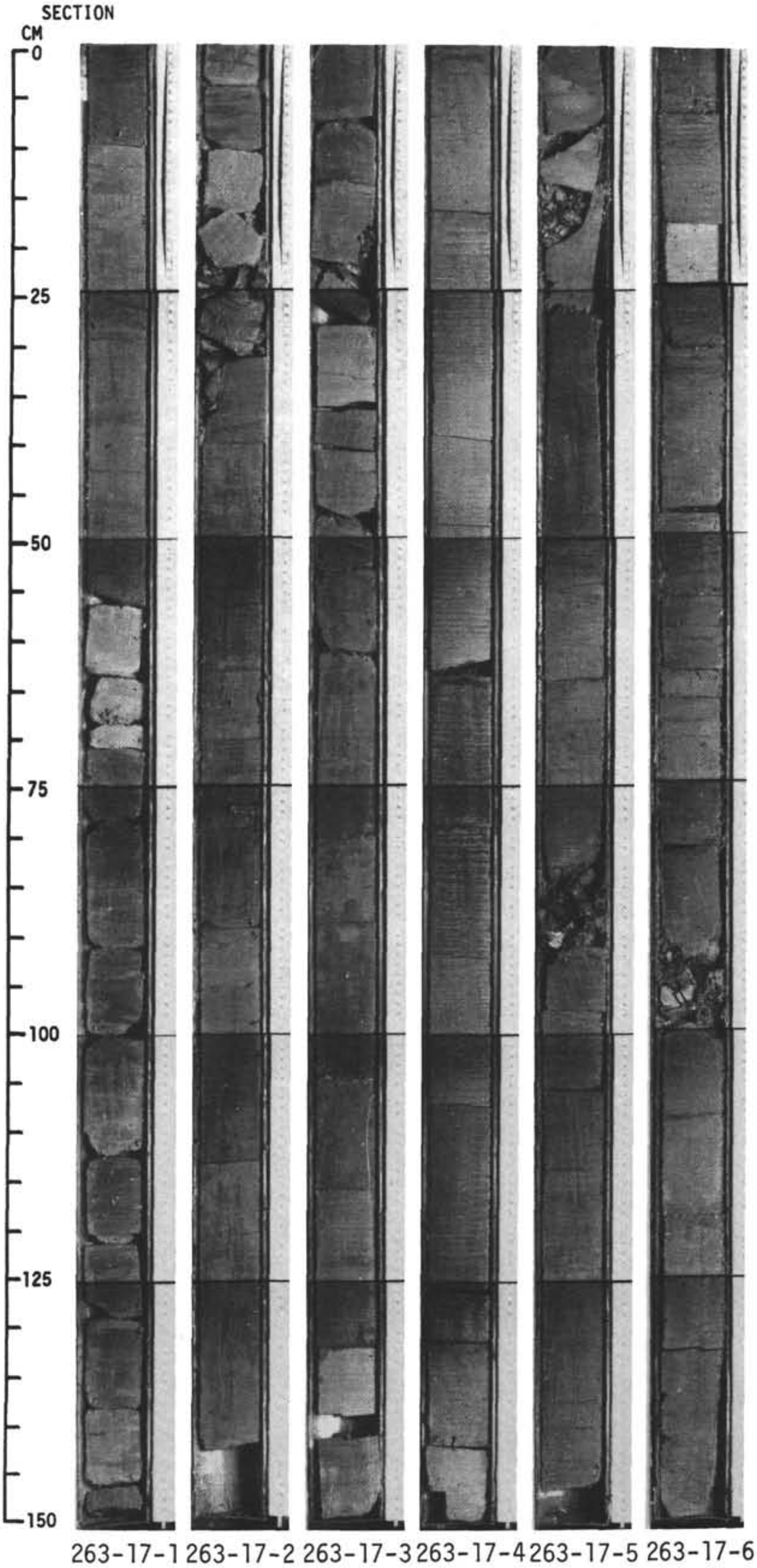

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

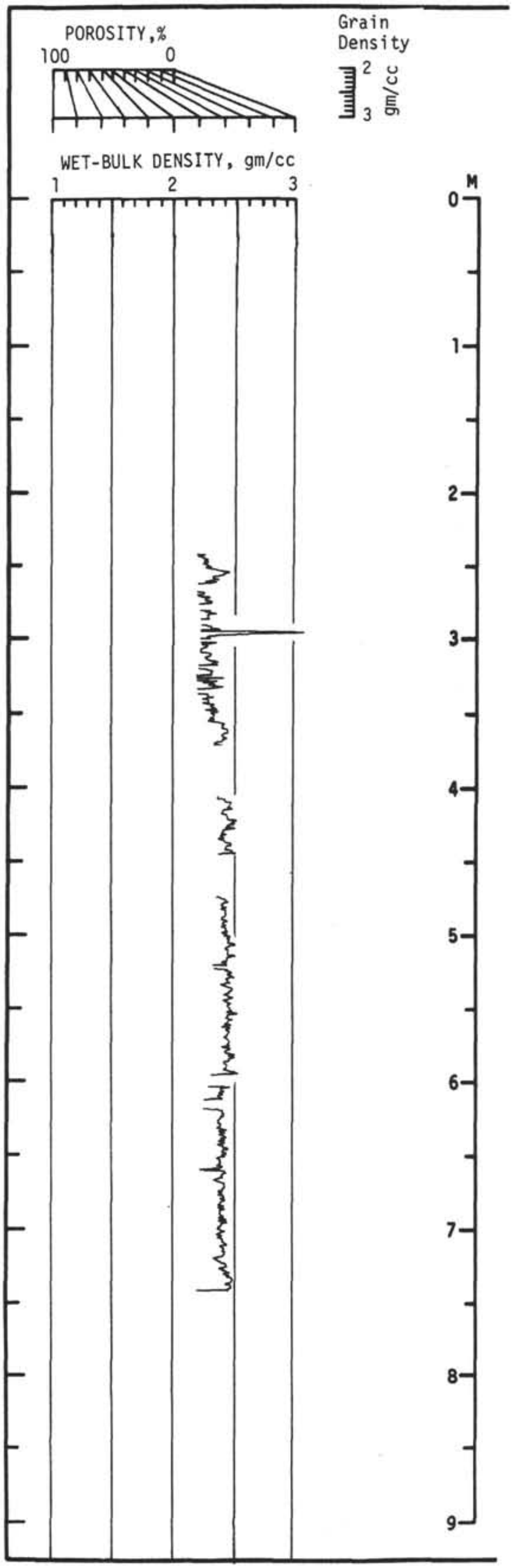

SECTION
CM
0
25
50
75
100
125
150
263-15-1
263-15-2
263-15-3

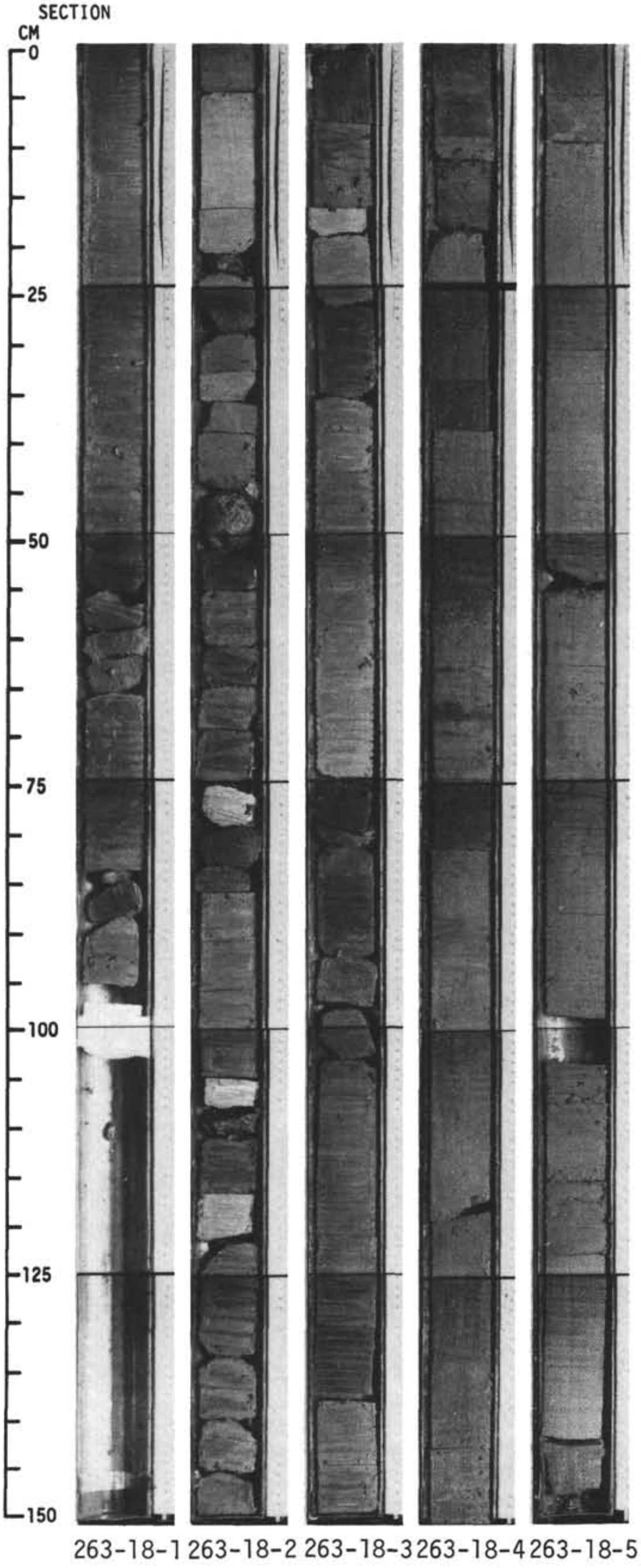

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9
SECTION
CM
0
25
50
75
100
125
150

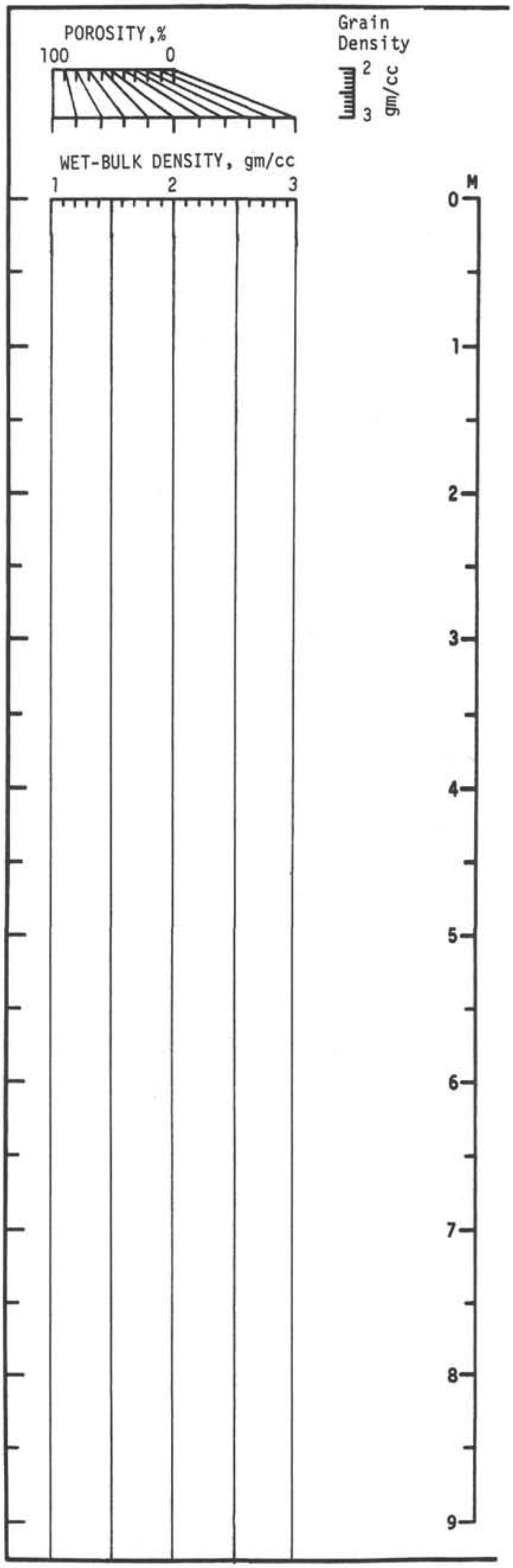
263-16-1

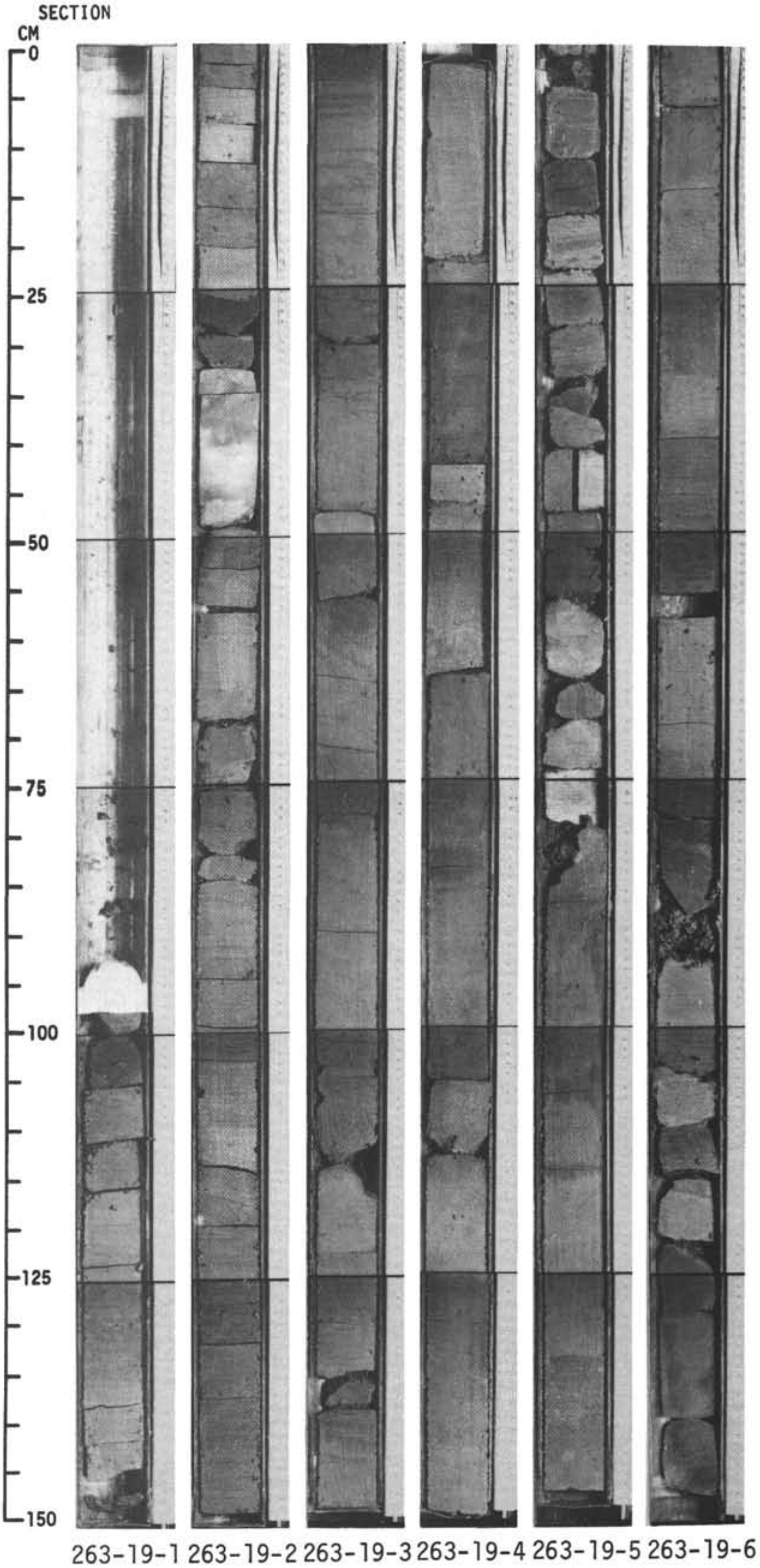

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

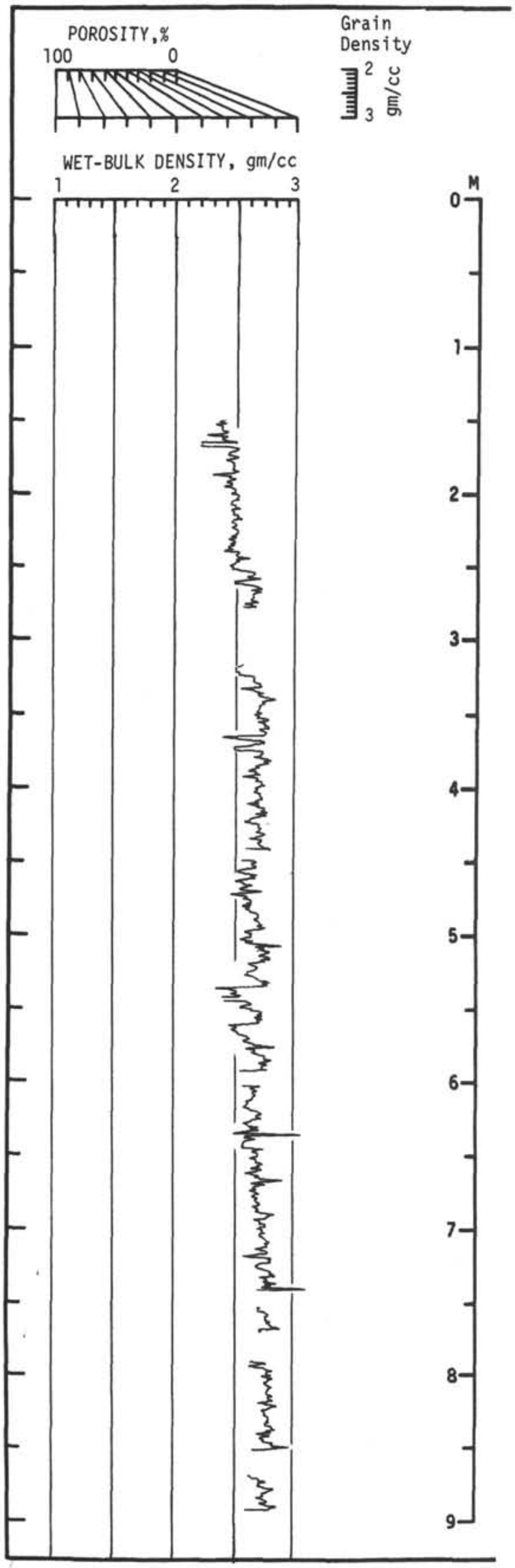

SECTION
CM
0
25
50
75
100
125
150
263-17-1
263-17-2
263-17-3
263-17-4
263-17-5
263-17-6

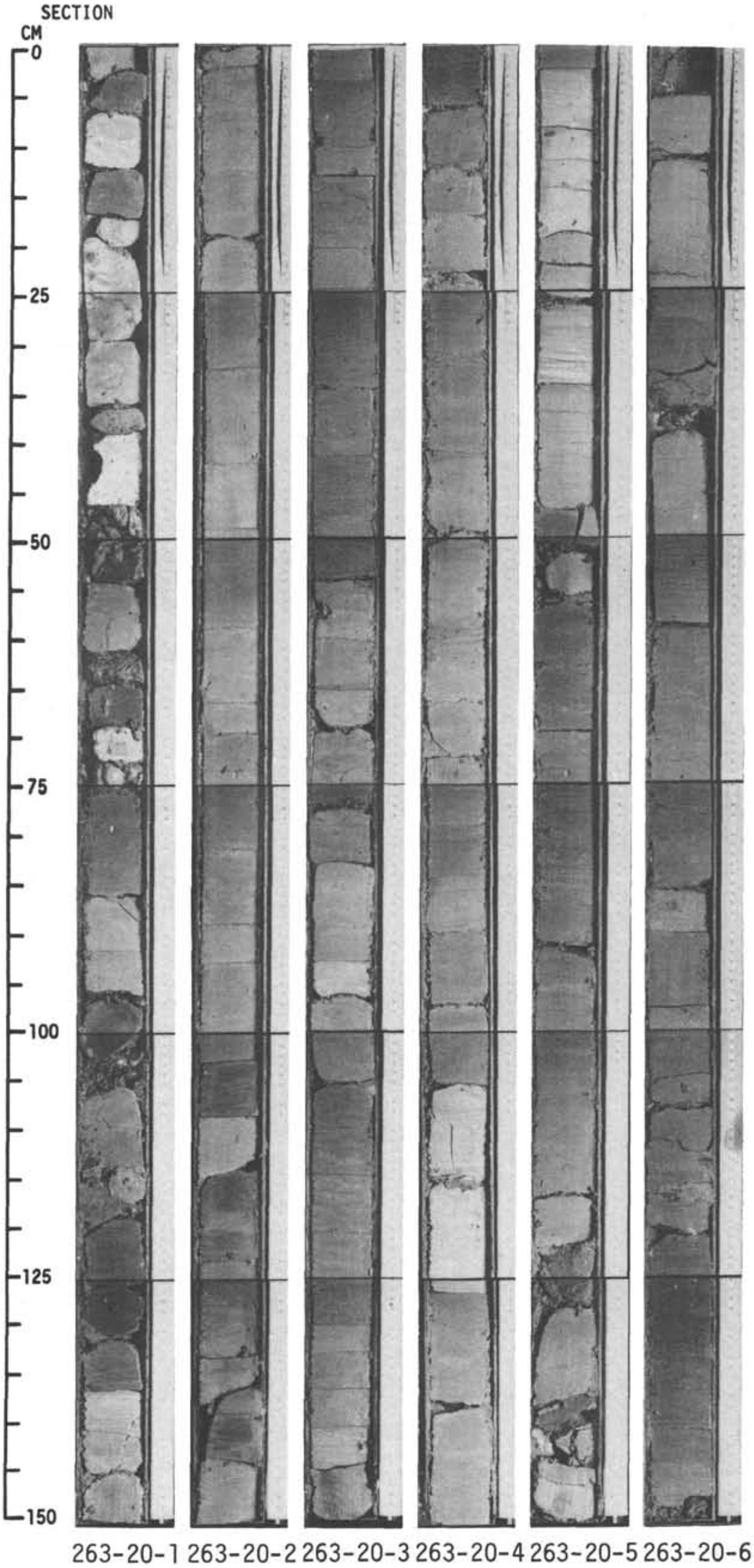

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

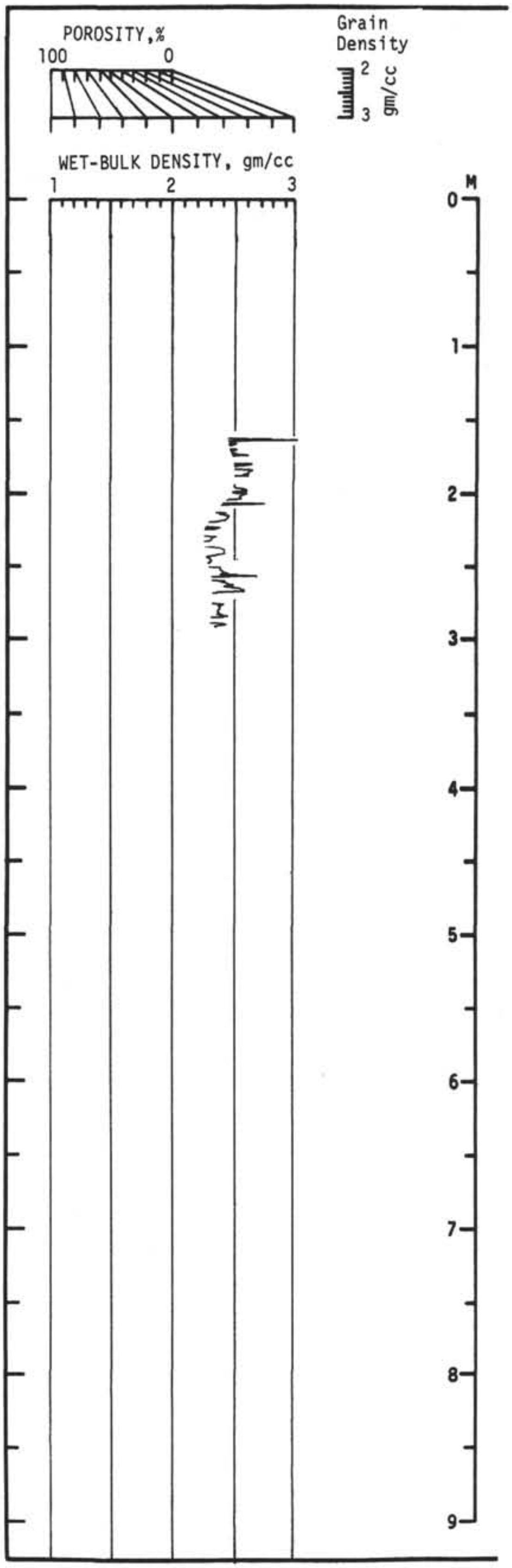

SECTION
CM
0
25
50
75
100
125
150
263-18-1
263-18-2
263-18-3
263-18-4
263-18-5

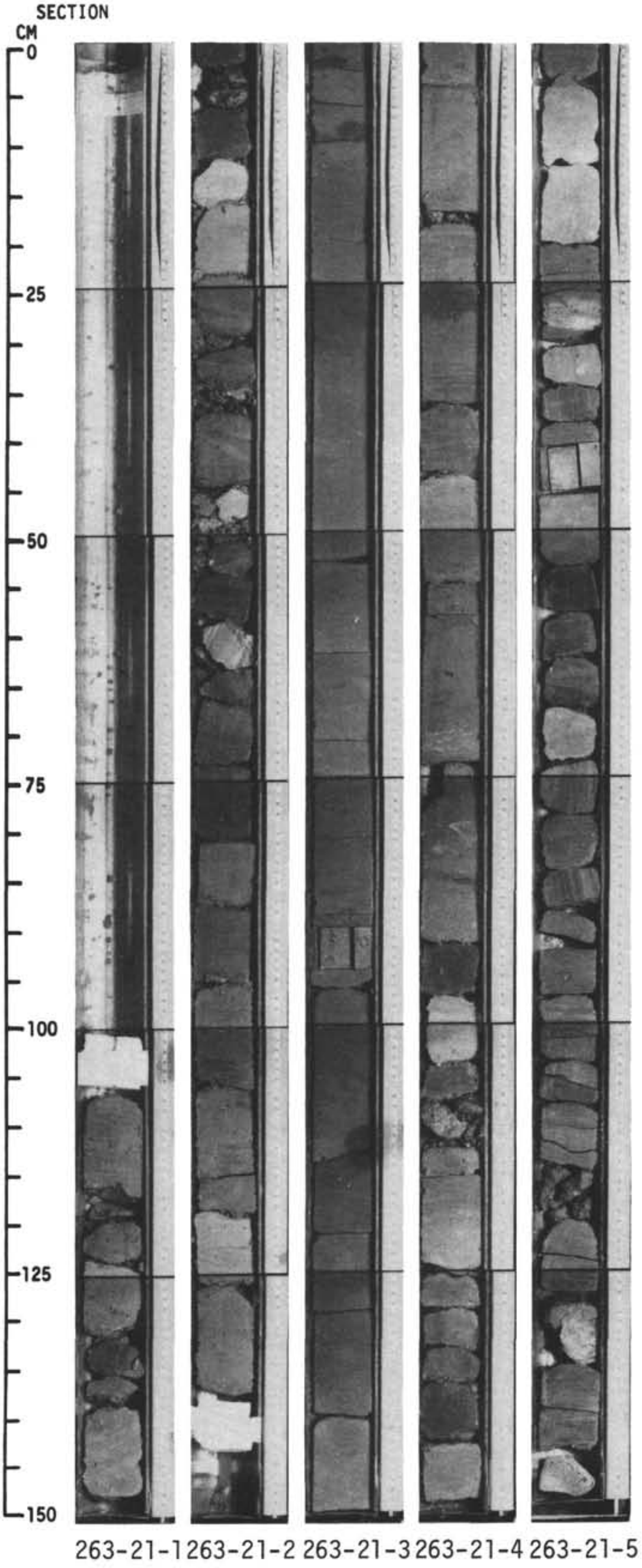

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

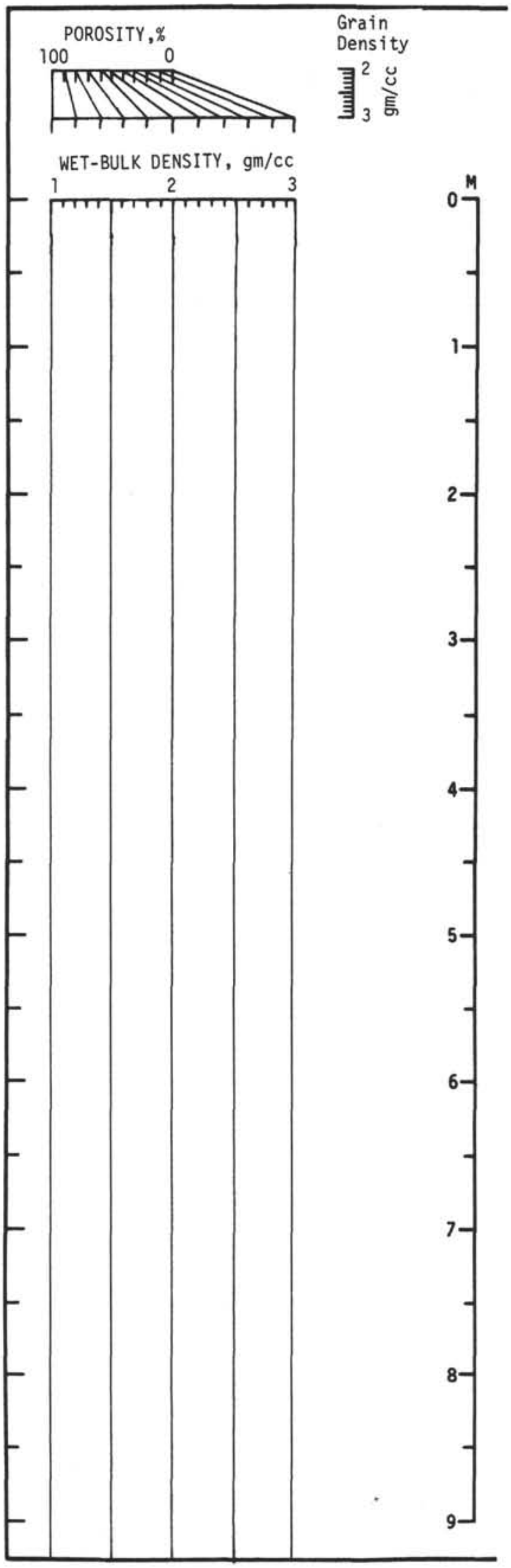

SECTION
CM
0
25
50
75
100
125
150
263-19-1
263-19-2
263-19-3
263-19-4
263-19-5
263-19-6

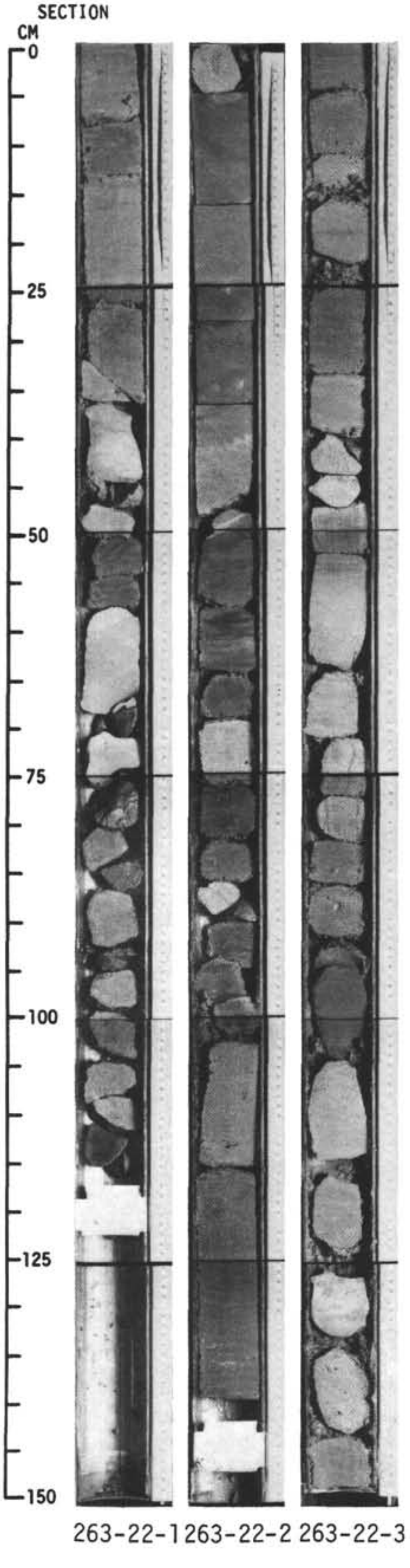

POROSITY,%
100
0
Grain
Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

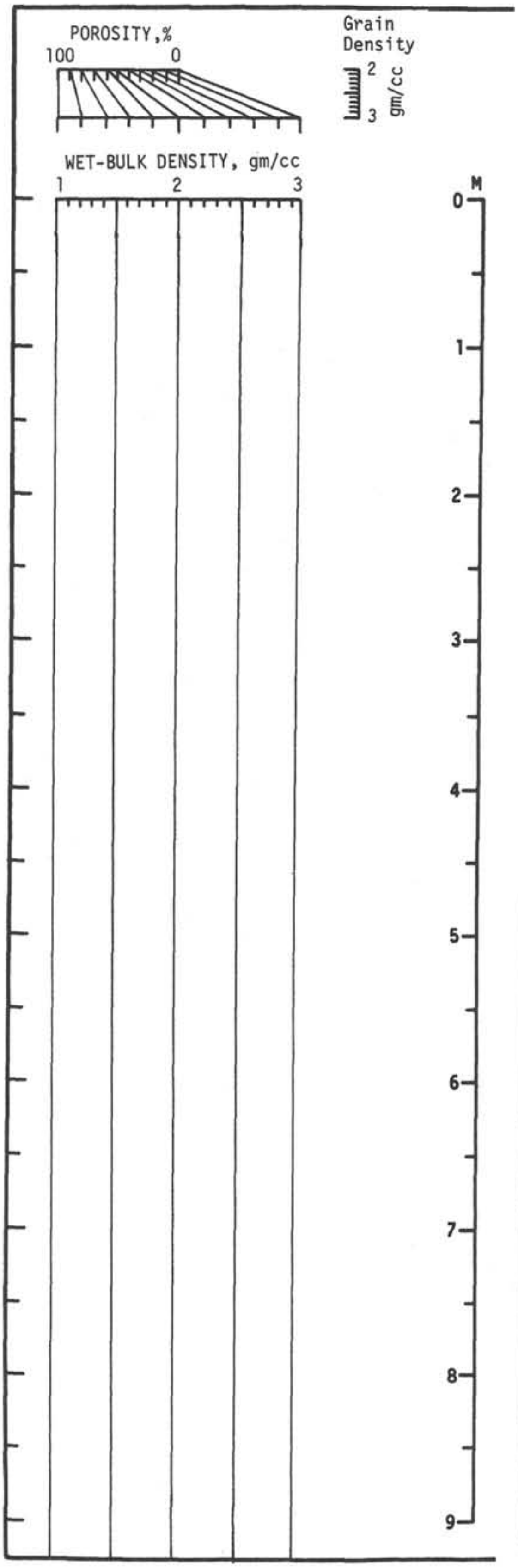

SECTION
CM
0
25
50
75
100
125
150
263-20-1
263-20-2
263-20-3
263-20-4
263-20-5
263-20-6

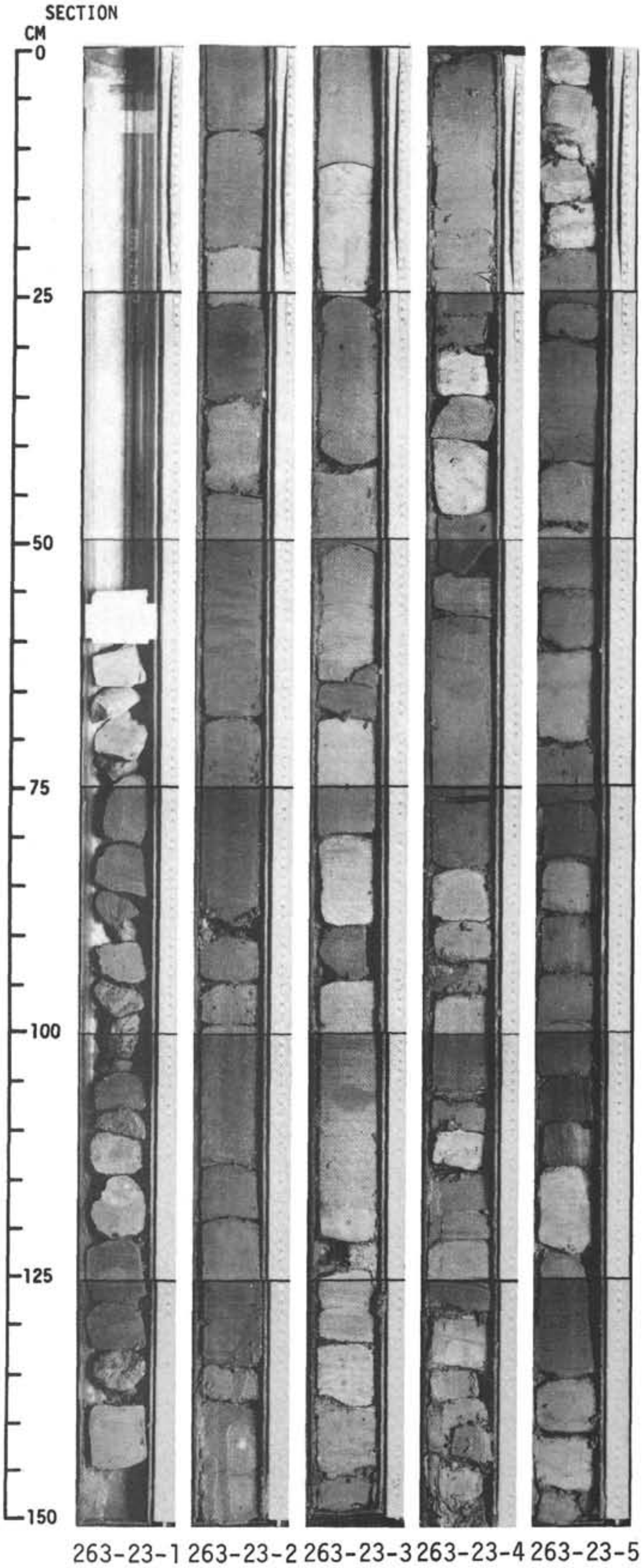

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

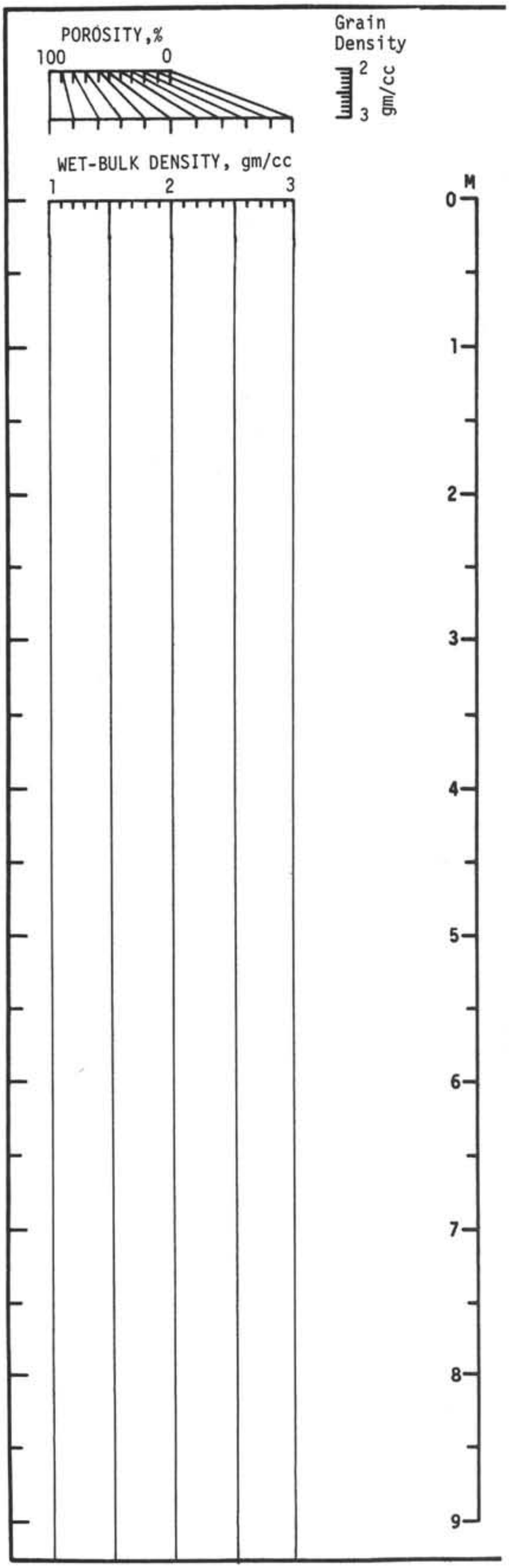

SECTION
CM
0
25
50
75
100
125
150
263-21-1
263-21-2
263-21-3
263-21-4
263-21-5

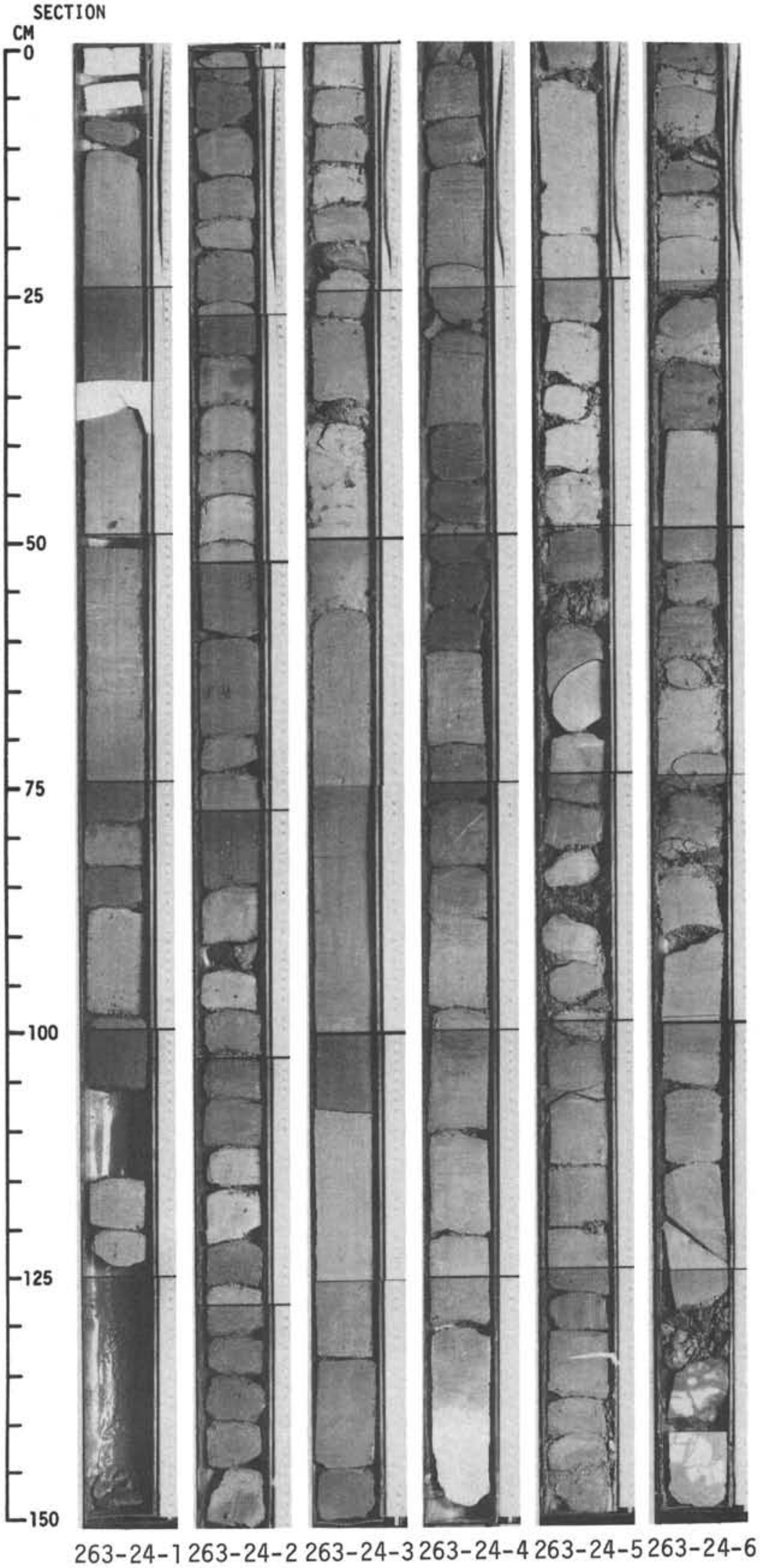

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

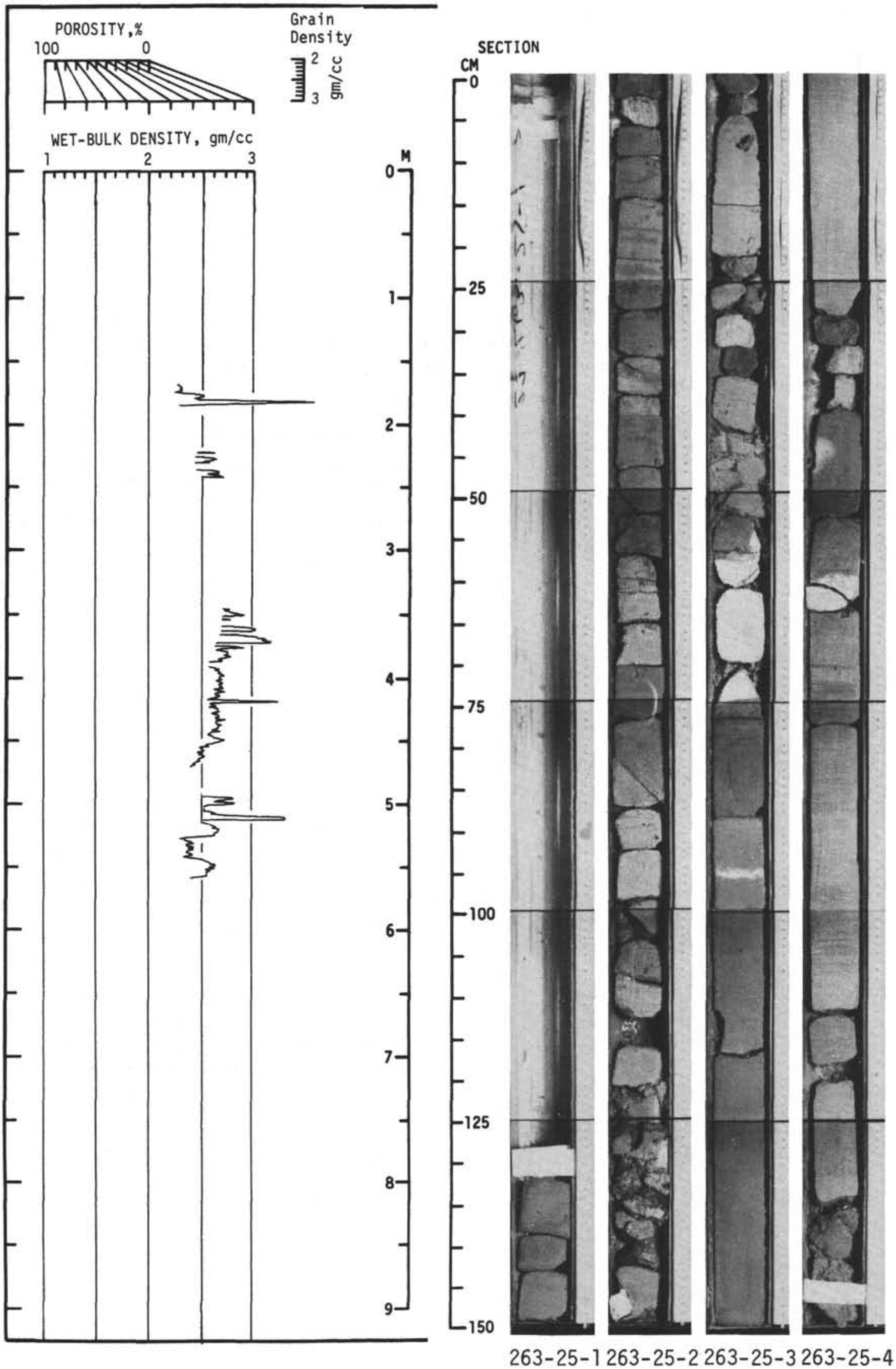

SECTION
CM
0
25
50
75
100
125
150
263-22-1
263-22-2
263-22-3

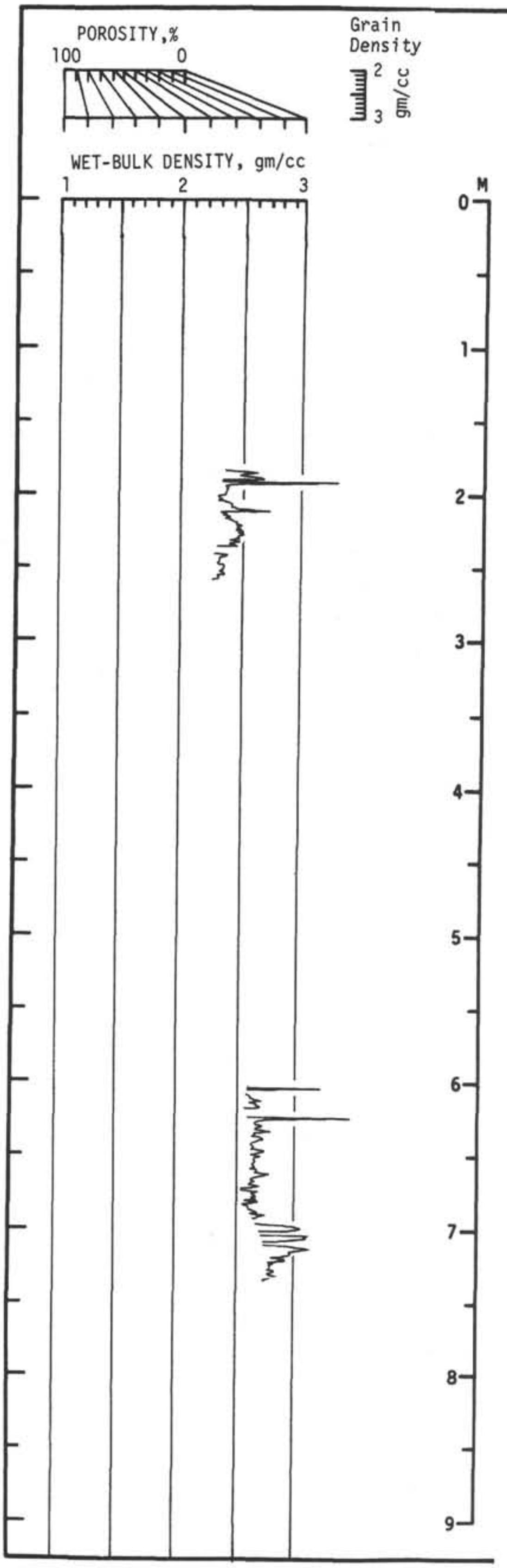

POROSITY,%
100
0
Grain
Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

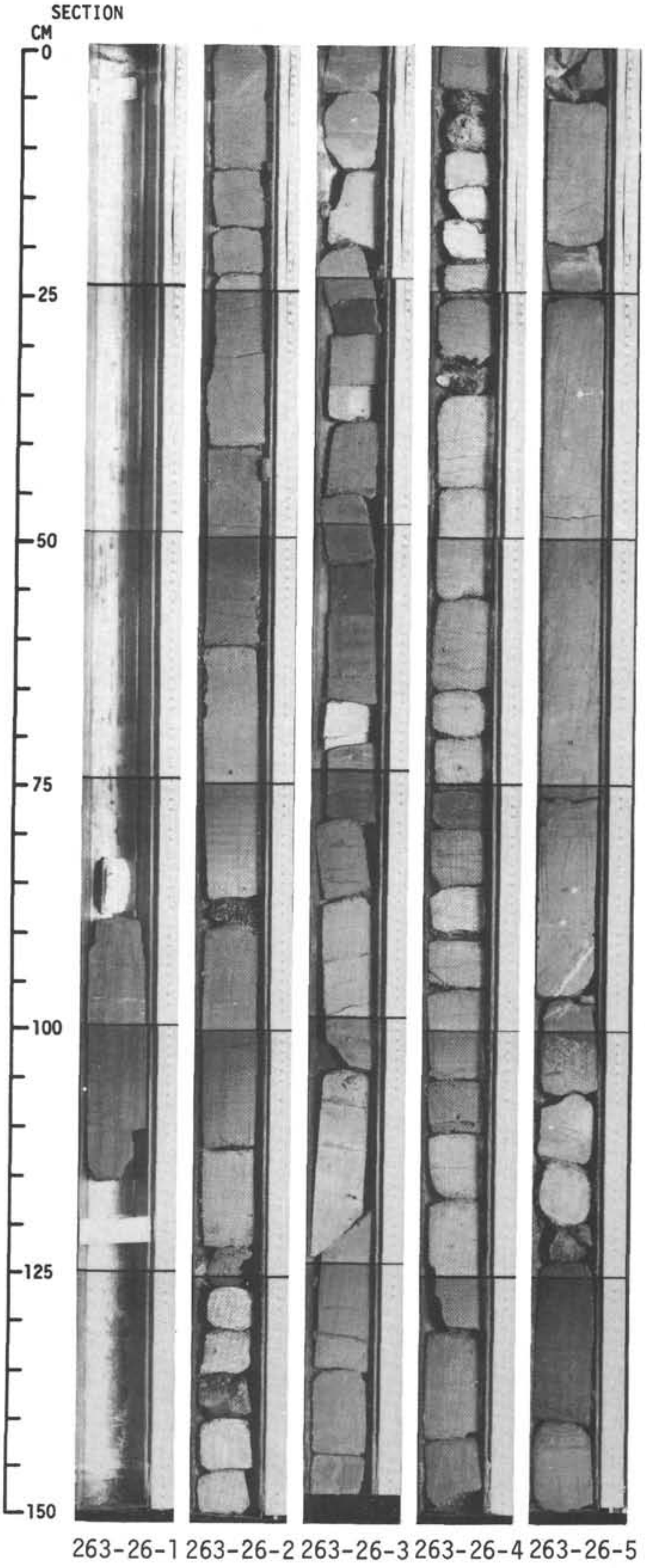

SECTION
CM
0
25
50
75
100
125
150
263-23-1
263-23-2
263-23-3
263-23-4
263-23-5

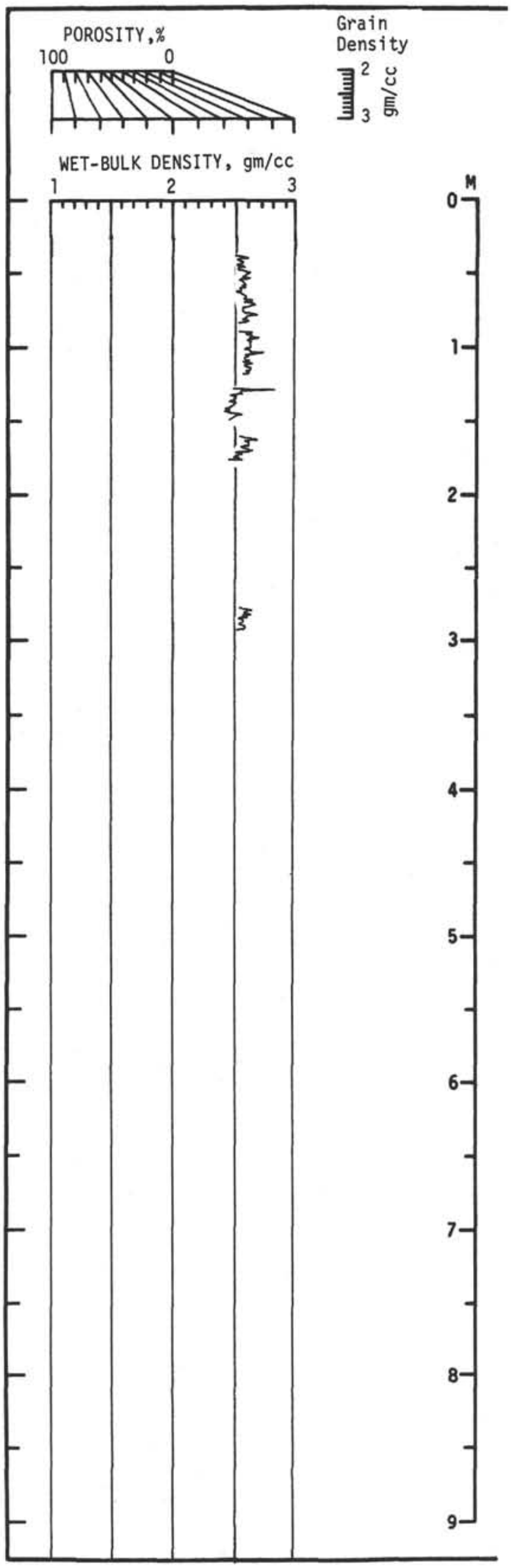

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9

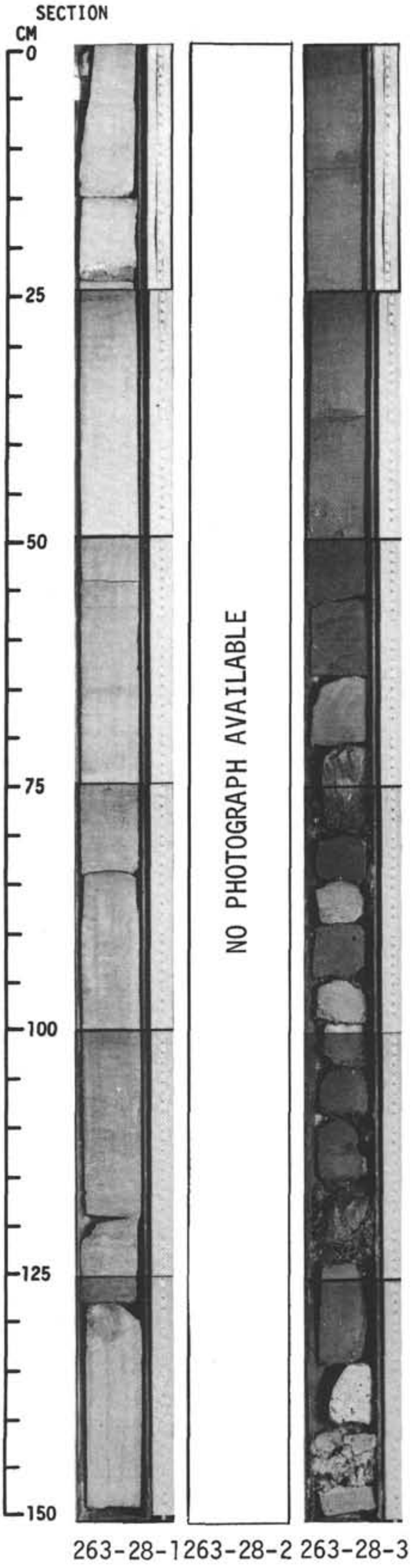

SECTION
CM
0
25
50
75
100
125
150
263-24-1
263-24-2
263-24-3
263-24-4
263-24-5
263-24-6

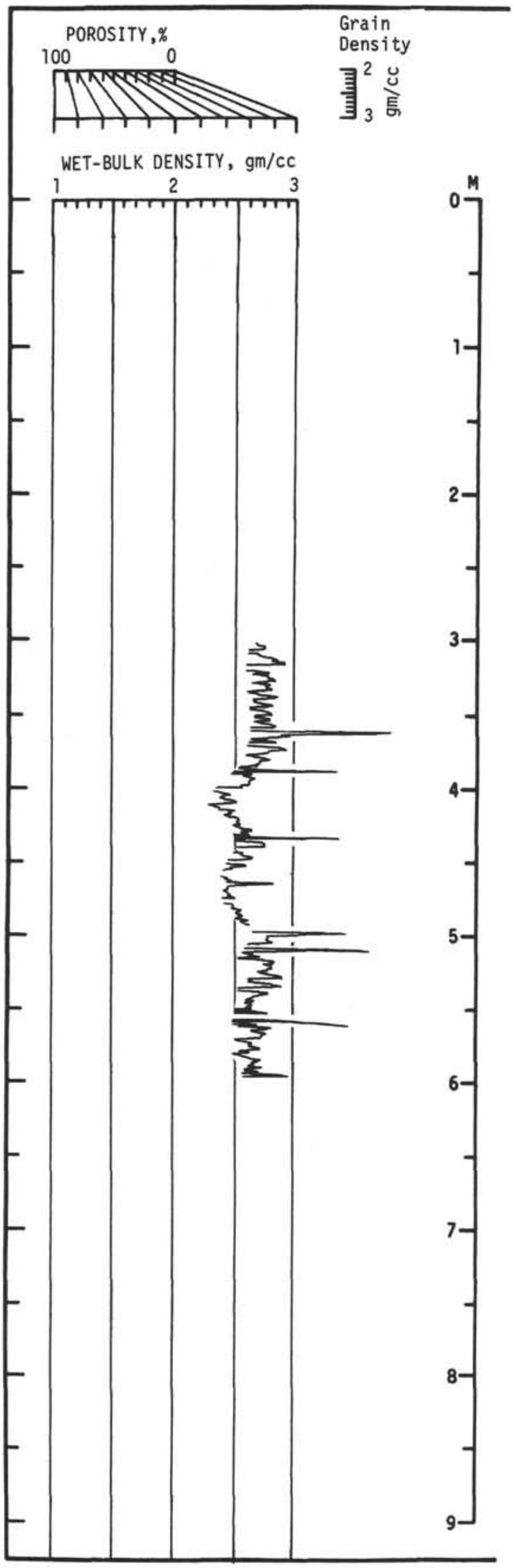

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9
SECTION
CM
0
25
50
75
100
125
150
263-25-1
263-25-2
263-25-3
263-25-4

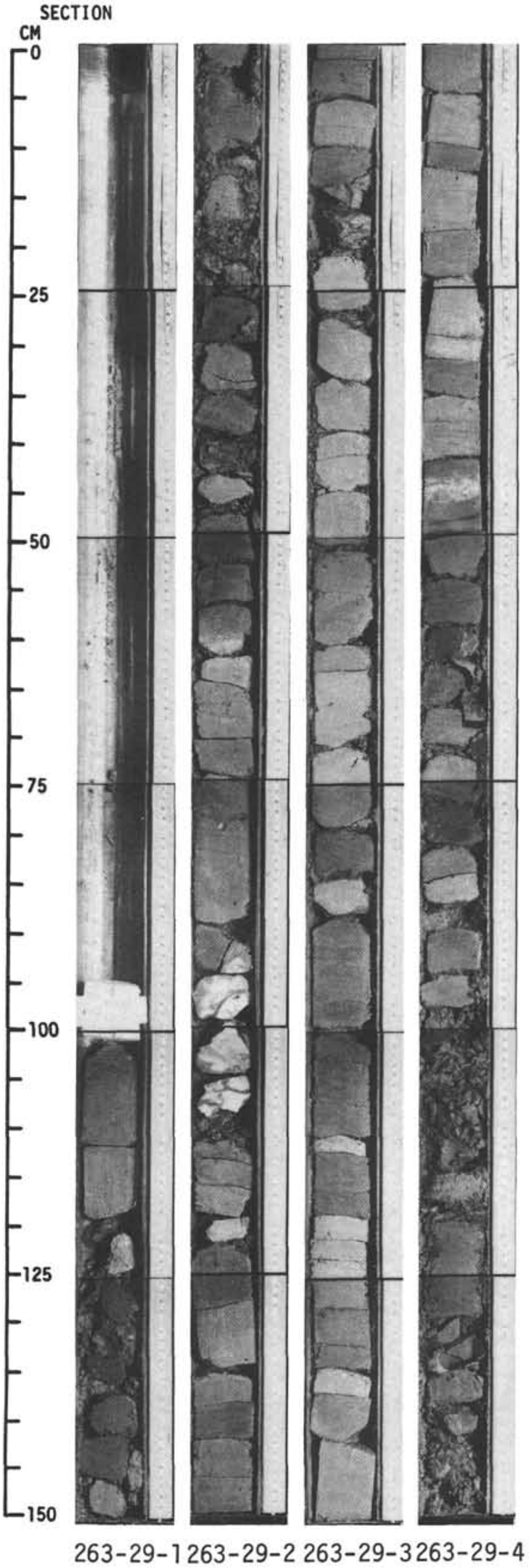

POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9


SECTION
CM
0
25
50
75
100
125
150
263-26-1
263-26-2
263-26-3
263-26-4
263-26-5


POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9


SECTION
CM
0
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
263-28-1
263-28-2
263-28-3


POROSITY,%
100
0
Grain Density
2
3
gm/cc
WET-BULK DENSITY, gm/cc
1
2
3
M
0
1
2
3
4
5
6
7
8
9


SECTION
CM
0
25
50
75
100
125
150
263-29-1
263-29-2
263-29-3
263-29-4