10. SITE 283

The Shipboard Scientific Party[1]
With Additional Contributions From
P. N. Webb and Graeme J. Wilson, New Zealand Geological Survey, Lower Hutt, New Zealand

SITE DATA

Location: Central Tasman Sea

Position: 43°54.60'S; 154°16.96'E

Water Depth:
PDR, from sea level: 4729 meters
From drill pipe measurement from derrick floor: 4766 meters (adopted)

Dates Occupied: 10-13 April 1973

Depth of Maximum Penetration:
Hole 283: 592 meters
Hole 283A: 20 meters

Number of Holes: 2

Number of Cores:
Hole 283: 19
Hole 283A: 2

Total Length of Cored Section:
Hole 283: 156.0 meters
Hole 283A: 11.0 meters

Total Recovery:
Length:
Hole 283: 61.6 meters
Hole 283A: 10.5 meters
Percentage:
Hole 283: 39
Hole 283A: 92

Age of Oldest Sediment Cored: Paleocene

Summary: 12.9 meters of fossiliferous late Pliocene-Pleistocene zeolite clay abruptly underlain by 3 meters of possibly late Miocene or Pliocene unfossiliferous zeolite clay separated by a major unconformity from 164 meters of late Eocene diatom ooze with calcareous nannofossils. This is underlain by 225 meters of mid Eocene silty clay and 283 meters of Paleocene poorly fossiliferous silty clay and silty pyritic claystone, underlain by highly altered basalt. Sedimentary sequence represents abyssal sedimentation below or close to calcium carbonate compensation depth with poor biogenic record. Significant fine detrital influence. Major disconformity near surface represents non-deposition surface on very soft late Eocene. Thus lack of Oligocene and Neogene due to persistent bottom currents in central Tasman Sea is genetically related to both Leg 21 Oligocene regional unconformity and circumpolar Neogene unconformity. Giant surface ripples probably on late Eocene surface.

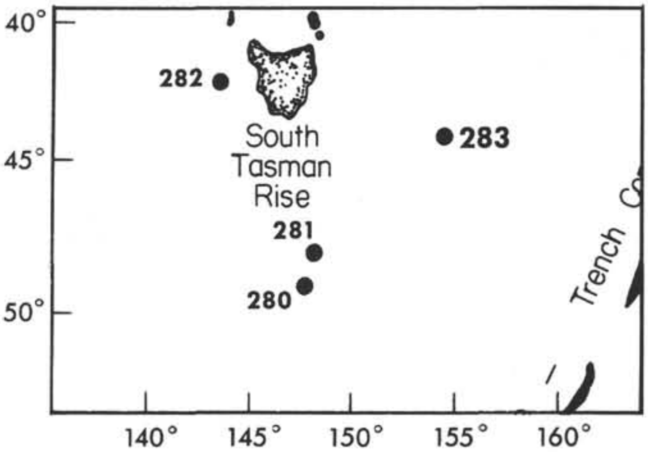

Figure 1. *Location of Site 283, DSDP Leg 29.*

BACKGROUND AND OBJECTIVES

Site 283 was located in the central Tasman Sea (Figure 1) at a water depth of 4729 meters, with a relatively thick sedimentary sequence (630 m) overlying moderate basement topography (Figure 2). In the central Tasman Sea the total sediment blanket is thick and the near absence of internal reflectors with a strong basement return (Figure 3) indicate a restricted environment of hemipelagic sediments. This is in contrast to the south Tasman Sea area which has a thinner sediment cover overlying rougher topography. Giant sea-floor ripples are indicated by the Lamont-Doherty 3.5-kHz data. The ripples must have formed recently or very little sedimentation has occurred since they were formed. Bottom water current activity is inferred at the time of ripple formation.

Hayes and Ringis (1973) have identified magnetic anomaly patterns within the central Tasman Sea with an age range from 60-80 m.y.B.P. From this they have concluded that the central Tasman Sea has evolved through the process of sea-floor spreading between 60 and 80

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[1] James P. Kennett, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island; Robert E. Houtz, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York; Peter B. Andrews, New Zealand Geological Survey, Christchurch, New Zealand; Anthony R. Edwards, New Zealand Geological Survey, Lower Hutt, New Zealand; Victor A. Gostin, University of Adelaide, Adelaide, Australia; Marta Hajós, Hungarian Geological Survey, Budapest, Hungary; Monty Hampton, University of Rhode Island, Kingston, Rhode Island; D. Graham Jenkins, University of Canterbury, Christchurch, New Zealand; Stanley V. Margolis, University of Hawaii, Honolulu, Hawaii; A. Thomas Ovenshine, U.S. Geological Survey, Menlo Park, California; Katharina Perch-Nielsen, Institut for Historisk Geologi, Copenhagen, Denmark.

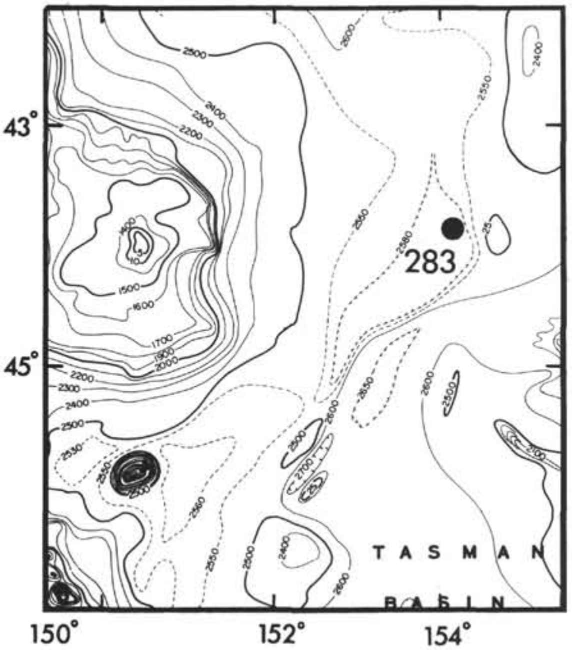

Figure 2. *Bathymetry at Site 283.*

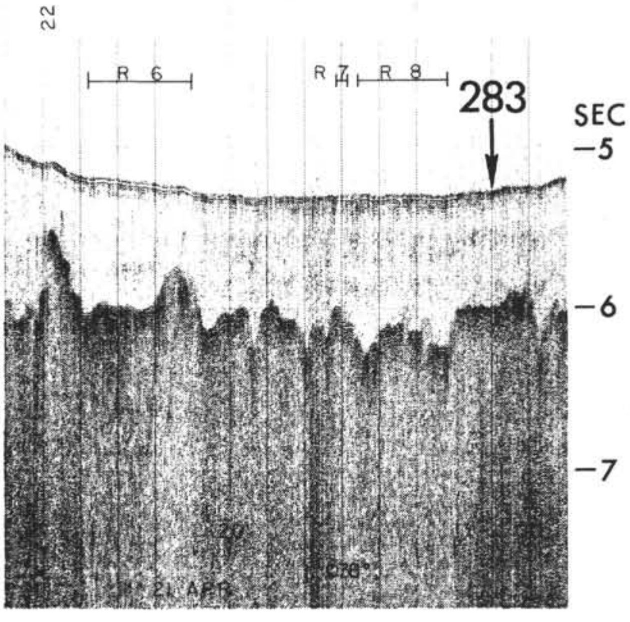

Figure 3. *Profiler section at Site 283.*

m.y.B.P. They also suggest that sea-floor spreading processes have been dormant within the central Tasman Sea for about the last 60 m.y. and that the area is presently aseismic. Site 283 is located over magnetic anomaly 32 (Late Cretaceous, ~76 m.y.B.P.) as identified by Hayes and Ringis (1973).

One of the primary objectives was to establish the age of oceanic basement as it relates to the magnetic anomaly pattern. Confirmation of this anomaly would thus support in detail the theory of structural history of the central Tasman Sea (Hayes and Ringis, 1973).

A second major objective of Site 283 was to establish the general sedimentary history of the central Tasman Sea, establishing the basic record of Paleogene sedimentation as compared with the Neogene. This site is at the margin of major influence of circumpolar current action that is now known to have occurred since the latest Paleogene or earliest Neogene. It is possible that the Neogene sequence is condensed by long-term bottom water activity. Furthermore, the site is near the eastern margin of the Australian-Antarctic continent before it completely split at about the Neogene-Paleogene boundary. A regional unconformity in the early and middle Oligocene occurs in the north Tasman and Coral Sea areas. It has been suggested by Kennett et al. (1972) that this unconformity was formed by a deep western boundary current that flowed through the Tasman and Coral seas at that time. Bottom waters are considered to have formed by glaciation occurring in the Ross Sea. This northward flowing bottom water continued until the circumpolar flow developed and interfered with the basic paleocirculation patterns in the southwest Pacific. Furthermore it is possible that unconformities at Site 283 have resulted from the flow of bottom waters north from the Antarctic.

OPERATIONS

Site 283 in the south central Tasman Sea was approached from the west along an *Eltanin*-53 track (Figure 4). The site was readily recognized and the beacon dropped on the first pass while underway at over 9 km/hr (5 knots).

The bottom hole assembly and drill pipe were run in to 4766.5 meters. A very small sample of mud in the core barrel indicated that the bit encountered an extremely soft sea floor. Based on this sample, water depth was arbitrarily established at 4766 meters. Drilling with intermittent coring proceeded to a total depth of 5358 meters or 592 meters penetration. Basalt was encountered at 5354 meters, 1.5 meters of the 3.5 meters cored was recovered. The drill string was pulled up clear of the mudline, and Hole 283A was spudded to more definitely establish the sea-floor depth, and to core an interval missed at Hole 283.

A core barrel was retrieved after punching to a depth of 4757 meters which recovered 1.3 meters of drilled cuttings from Hole 283 with two manganese nodules in the core catcher. This would indicate that the actual sea floor was very close to 4757 meters; i.e., about 10 meters shallower than logged at Hole 283. Hole 283A was washed and cored to a total depth of 4776 meters. Details of the coring at both Holes 283 and 283A are included in Table 1.

LITHOLOGY

Drilling at Hole 283 penetrated to 592 meters subbottom. At Hole 283A, drilling penetrated to 20.5 meters subbottom. The stratigraphy of the site is summarized in Table 2 and depicted in Figure 5 which also includes data on major sediment components.

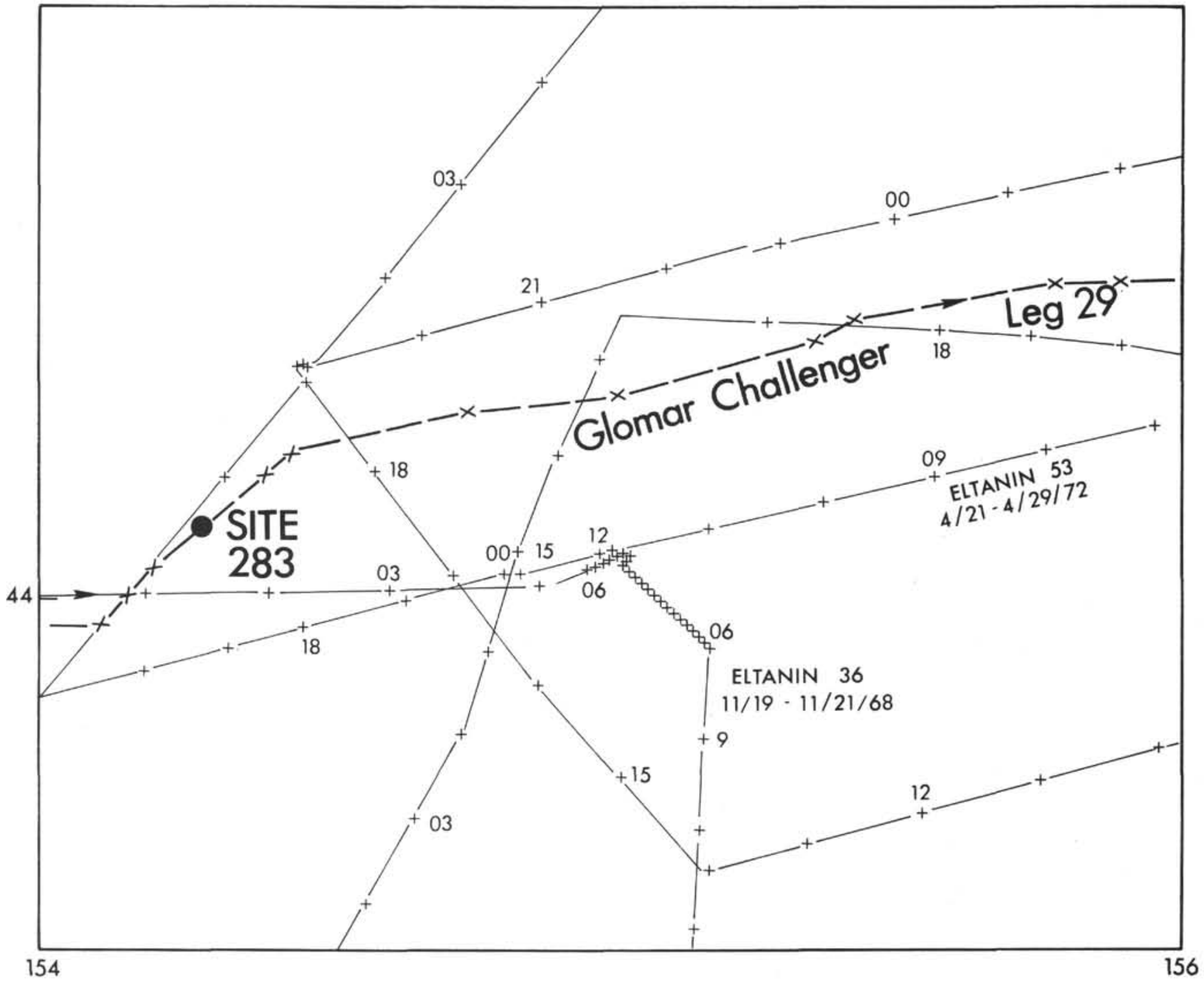

Figure 4. *Track chart.*

Unit 1

The uppermost unit consists of light-colored zeolitic clays which contain appreciable quantities of calcareous nannofossils in places. The top 3 meters of Unit 1 (Subunit 1A) are moderate yellow brown mottled to dark brown. Subunit 1B consists of 10 meters of pale-yellow silty zeolite clay that is considerably less mottled than Subunit 1A. The sharp contact between the subunits is interpreted as a disconformity because a clast of the lower interval occurs in the upper interval, several centimeters above its base. The contact between Units 1 and 2 is also an unconformity in which Plio-Pleistocene strata of Unit 1 overlie late Eocene beds of Unit 2. No indications of erosion or contrast in induration occur across the unconformity.

Unit 2

Unit 2 consists of dark-greenish-gray diatom ooze with minor amounts of quartz silt and detrital clay. In smear slides diatoms comprise 25%-75% of the sediment. Cores of Unit 2 are predominantly homogeneous and only locally faintly mottled. At 96 meters subbottom the sediment consistency of Unit 2 changes from soft to stiff; about the same level calcareous nannofossils first appear in abundance. Nannofossils comprise 4%-55% of the sediment in smear slides taken from Cores 6 (124-133.5 m) and 7 (152.5-162 m). The contact between Units 2 and 3 was not recovered and is arbitrarily located at 176 meters subbottom, midway between Cores 7 and 8.

Unit 3

Unit 3 consists of mottled green and brown silty clay. The upper 20 meters of the unit contains significant proportions of diatoms (10%-25%); the remainder of the unit typically consists of clay (65%), quartz silt (20%), and minor amounts of volcanic glass, palagonite, micronodules, and zeolite crystals. Small (1 × 3 mm) ovoid fecal pellets occur sparingly throughout the unit.

TABLE 1
Coring Summary, Site 283

Core	Cored Interval Below Bottom (m)	Cored (m)	Recovery (m)	Recovery (%)
Hole 283				
1	0.0-0.5	0.5	CC	0
2	10.0-19.5	9.5	4.9	52
3	29.0-38.5	9.5	0.3	3
4	57.5-67.0	9.5	CC	0
5	86.0-95.5	9.5	2.0	21
6	124.0-133.5	9.5	2.0	21
7	152.5-162.0	9.5	5.0	53
8	190.5-200.0	9.5	4.2	44
9	219.0-228.5	9.5	7.1	75
10	238.0-247.5	9.5	CC	0
11	276.0-285.5	9.5	3.5	37
12	323.5-333.0	9.5	2.1	22
13	371.0-380.5	9.5	7.0	74
14	428.0-437.5	9.5	5.4	57
15	485.0-494.5	9.5	5.5	58
16	542.0-551.5	9.5	4.4	46
17	570.5-580.0	9.5	6.2	65
18	588.5-589.5	1.0	0.8	80
19	589.5-592.0	2.5	0.7	28
Total		156.0	61.1	39
Hole 283A				
1	0.0-1.5	1.5	1.3	87
2	11.0-20.5	9.5	9.2	97
Total		11.0	10.5	95

TABLE 2
Lithologic Summary, Site 283

Unit	Lithology	Subbottom Depth (m)	Unit Thickness (m)
1	Zeolitic clay	0-13	13
2	Silty diatom ooze	13-176	163*
3	Silty clay	176-315	139*
4	Olive-black claystone	315-588	273*
5	Altered basalt	588-592	4+

Note: * = Contact not located, thickness inaccurate.

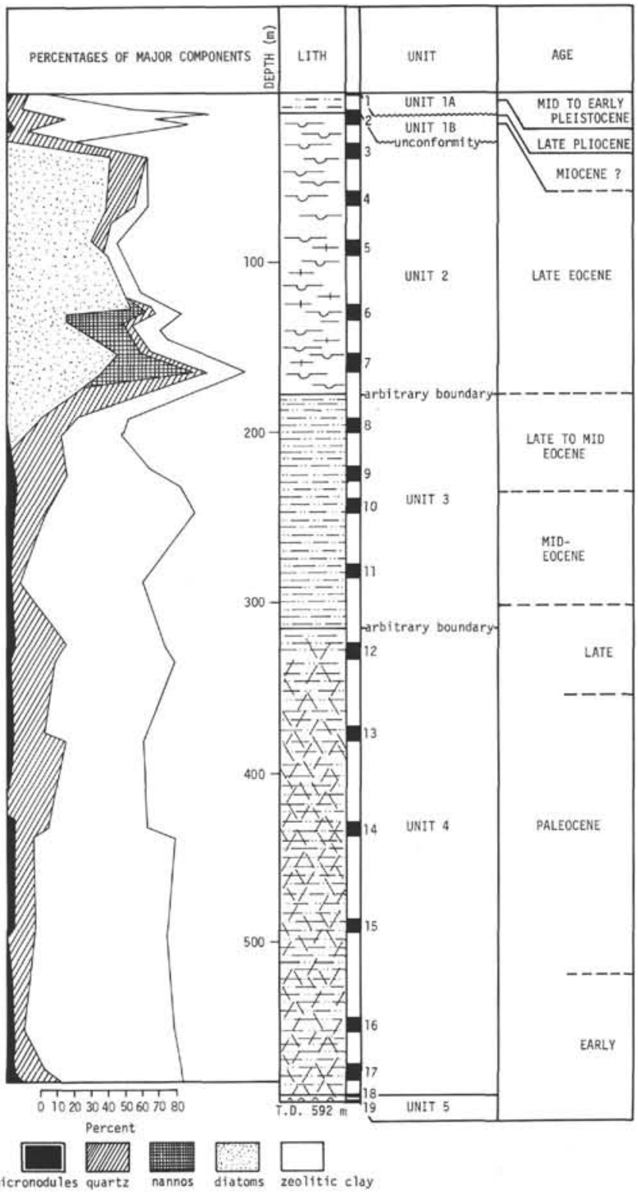

Figure 5. *Stratigraphic succession and major sediment components, Site 283.*

Brownish-gray mottles of biological origin are the principal characteristics of Unit 3. Four types of structures occur (see Andrews and Ovenshine, Chapter 31, this volume). The contact between Units 3 and 4 was not recovered. It is arbitrarily placed midway between Cores 11 (276-285.5 m), and 12 (323.5-333 m).

Unit 4

The lowest sedimentary unit consists of olive-black silty clay and silty claystone. Planktonic fossils are absent or occur only in trace amount in the sediment which consists of clay (65%), quartz silt (15%), micronodules (5%), mica (5%), and minor amounts of volcanic glass, palagonite, glauconite, and dolomite rhombs. Pyrite occurs disseminated in burrows and in granular masses, small nodules, and veinlets. One septarian nodule of barite and dolomite and several concretions of dolomite were encountered. White arenaceous foraminifera, including *Bathysiphon* sp., are recognized throughout Unit 4. The pronounced subhorizontal fabric of the silty claystone results from wispy, irregular lamination that is of bioturbational origin because individual laminations commonly transect both "older" and "younger" layers. The lack of vertical feeding trails is probably the result of their diminution by compaction rather than original absence in the sediment. Induration increases progressively with depth in Unit 4. The upper 100 meters are stiff with rare sublithified zones; at greater depths sediment is strongly compacted and exhibits forms of brittle deformation resulting from the drilling process.

The contact between silty claystone and the altered basalt of Unit 5 was not recovered but is located with reasonable accuracy at 588 meters subbottom. In the lowermost 3.7 meters of Core 17 (570.5-580 m) the sediment of Unit 4 changes color from olive black to dark greenish gray with pale-red feeding trails and fecal pellets. This color change is not accompanied by major changes in the types or proportions of constituents and is therefore interpreted as an alteration effect caused by proximity to the altered basalt.

Unit 5

Unit 5 consists of basalt pervasively altered to serpentine, zeolite, clay, palagonite, and chlorite(?). The basalt was originally either a pillow lava or a broken pillow breccia. The upper 20 cm of the core consists of light-greenish-gray devitrified volcanic glass with abundant veinlets of calcite and serpentine. One tabular mass of dark red palagonite is interpreted as altered interpillow glass. The basalt consists of rare altered feldspar laths (2%) in an altered groundmass consisting of clay minerals, zeolite, and serpentine. The remaining 1.3 meters of core consists of dark-greenish-gray amygdaloidal basalt (80%), calcite veins (15%), and dark fragments of serpentinized(?) glass (5%). In several places the rock exhibits autoclastic or tectonic breccia textures. In thin section the original texture of the fine-grained rock, which may have been intersertal and subophitic, is largely obscured by the radial habit of the alteration products. Altered plagioclase laths comprise 20% of the rock; black opaque minerals, 10%; partially altered olivine/pyroxene, 3%; serpentine(?) after glass, 10%; calcite, 5%; the remainder, clay minerals, serpentine, and zeolite.

The interpretation of the basalt of Unit 5 as pillow lava or broken pillow breccia is not straightforward because the color change in the overlying sediments could indicate weak metamorphism by an intrusion. The interpretation that Unit 5 is extrusive is based on: abundant devitrified glass in the upper part of the core; breccia containing both glass and basalt; amygdules occurring throughout the core; and evidence from one sample [19-1, 6 cm] of the upper surface of a pillow, which shows a glass patina and chilled rim grading downwards to holocrystalline basalt. The pervasive alteration of the basalt and the color changes in the overlying sediment probably result from low temperature hydrothermal activity.

Conclusions

The Paleocene age of the silty claystone overlying basalt does not agree with the 75-80 m.y. age predicted from the study of lineated magnetic anomalies in the Tasman Sea region. The sediments overlying basalt at Site 283 are 10-15 m.y. younger than Anomaly 32, and thus record information on oceanographic conditions in the Tasman Sea during the last approximately 65 m.y.

The depositional episode spanning Paleocene-late Eocene records no change in the nature, and probably the rate of influx, of terrigenous components (quartz, silt, clays) that reached Site 283 from sources in Australia. In the early part (Units 3 and 4) of the episode, however, the depositional site lay at depths greater than the silica and calcium carbonate compensation depths for diatoms and calcareous nannofossils, whereas in the later part (Unit 2), water conditions had changed sufficiently for these fossils to have been preserved in the sedimentary record. The time of this change (mid to late Eocene, Figure 5) coincides with, or follows shortly after, the termination of spreading in the Tasman Sea and the onset of the continental drift of Australia from Antarctica. This suggests that the changing tectonic pattern produced either slight shoaling of the Tasman Sea, or a paleocurrent change that brought waters less undersaturated in calcium carbonate and silica to the location of Site 283. The terrigenous components of the sediments of Unit 2, however, do not record any of the major changes that might be expected if the paleocurrent pattern had altered significantly.

Conditions of nondeposition represented by the late Eocene-late Plio-Pleistocene unconformity prevailed during most of the rest of the Cenozoic at Site 283. The end of the Paleogene deposition probably occurred no later than late Eocene or early Oligocene, because the soft, unconsolidated upper part of Unit 2 could not have been deeply buried and compacted and then exposed by later erosion.

Late Plio-Pleistocene time is represented by less than 15 meters of sparingly fossiliferous zeolitic clays developed by the alteration of fine-grained volcanic constituents.

GEOCHEMICAL MEASUREMENTS

Table 3 and Figure 6 summarize the variations in the geochemical data in comparison with the lithological units at this site. *p*H values increase with depth and in Core 14 exceed the surface seawater reference value. The highest value (8.56) occurs in Core 17. Alkalinities, on the other hand, in general decrease with depth with a low value of 0.88 meq/kg occurring in Core 17. Salinity values are fairly uniform except for lows of 31.9‰ and 31.4‰ found in Cores 13 and 14.

BIOSTRATIGRAPHY

Thirty-six species of agglutinated Paleocene foraminifera were recovered from eight cores in the lowermost 400 meters of sediments. Most samples are characterized by a high abundance of tests and low species diversity. Preservation is good, with only a small proportion of deformed tests. An important feature of the fauna is the total lack of calcareous benthonic taxa. The absence of planktonic foraminifera, and poor preservation of calcareous nannofossils suggests that the sediments were deposited below or close to the calcite compensation depth. All nannofossil assemblages are poorly preserved and vary from very rare to abundant.

Neogene dinoflagellates and miospores were recovered from Core 2 and late Eocene dinoflagellates from Core 4; Core 6 is probably the same age. The middle-late Eocene is represented by Cores 7 and 8, and the middle Eocene by Core 11. Paleocene is represented by Cores 12-16, and the lowermost Core 17 yielded a

TABLE 3
Shipboard Geochemical Data, Site 283

Core	Section	Sample Interval Top (m)	Sample Interval Avg. (m)	pH Punch-in	pH Flow-thru	Alkalinity (meq/kg)	Salinity (°/oo)	Lithologic Unit
Surface Seawater Reference				7.95	7.88	2.35	34.6	
Hole 283								
2	4	10.0	18.03	6.99	7.18	3.62	35.2	2
Hole 283A								
2	6	11.0	19.09	6.96	7.12	3.71	35.2	2
6	2	124.0	132.03	6.75	7.21	5.38	35.2	2
8	3	190.5	208.03	–	7.43	6.94	35.2	3
9	4	219.0	244.53	–	7.53	4.30	34.4	3
11	3	276.0	284.03	–	7.50	4.20	33.0	3
12	2	323.5	331.55	–	7.43	2.83	33.3	4
13	3	371.0	376.05	–	7.81	2.74	31.9	4
14	1	428.0	432.95	–	7.98	1.86	31.4	4
16	3	542.0	550.05	–	8.49	1.08	34.9	4
17	4	570.5	576.97	–	8.56	0.88	35.5	4
Average				6.87	7.71	3.38	34.0	

[a] A cold squeeze (4°C) reported a pH=7.37, Alk.=3.23, and S °/oo=35.2.

mixture of Late Cretaceous and early Tertiary palynomorphs. Pleistocene to late or middle Eocene diatoms were recovered. The late Eocene assemblages are abundant, well preserved and diverse. Radiolaria occur throughout Cores 2-12 in Hole 283. The early Eocene or late Paleocene assemblage in Hole 283A is attributed to reworking.

The biostratigraphy and adopted ages for Site 283 are found in Table 4.

Foraminifera

Core catcher samples 283-2 to 17 and 283A-2 were examined. Only one specimen of the Pliocene-Recent planktonic foraminiferal species *Globorotalia (T.) inflata* was recovered in Sample 283A-2, CC, but Samples 283-9, CC and 283-11, CC to 17, CC yielded agglutinated benthonic taxa. The benthonic species have been examined by Webb (Chapter 22, this volume), and the following is based on his report.

Examination of 37 samples from eight cores of the lowermost 400 meters yielded 36 species of agglutinated foraminifera, with most samples characterized by a high abundance of tests and low species diversity. The dominant taxa are *Bathysiphon cylindrica, Ammodiscus cretaceus, Glomospira charoides, Kalamopsis grzybowskii, Lituotuba lituiformis, Rzehakina epigona, Recurvoides deflexiformis,* and *Bolivinopsis spectabilis.* Stratigraphically important species which yielded a Paleocene age include *Gaudryina whangaia* in Samples 283-12, CC to 17, CC and *Conotrochammina whangaia* in Samples 283-14-2, 36 cm, and 283-16-3, 17 cm.

The presence of moderately good Paleocene faunas at Site 283 is of interest because of remarkably similar Recent assemblages from abyssal depths in the Pacific.

Calcareous Nannofossils

Site 283 yielded Pleistocene, late Pliocene, and late Eocene calcareous nannofossils. Nannofloras are common, but poorly preserved in the Pleistocene and late Pliocene. They are very rare to abundant in the early late Eocene, where their preservation is poor to moderate. The remainder of the sequence was barren of nannofossils except for occasional specimens of small Prinsiaceae which are considered to result from downhole or laboratory contamination.

Pleistocene and Pliocene

Poor mid to early Pleistocene assemblages occur in Cores 283-1 and 283A-1. The presence of *G. oceanica* and *P. lacunosa* suggest mid to early Pleistocene for Sample 283-1, CC, and for the mud attached to a manganese nodule in Sample 283A-1, CC. In the latter sample late Eocene placoliths were also found. This is not surprising considering that Core 283A-1 consists of cuttings from Hole 283, where coccolith-rich late Eocene sediments were penetrated. Sample 283A-2-1, 40 cm contains very abundant Neogene nannofossils including *Coccolithus pelagicus, Cyclococcolithina leptopora, C. macintyrei; Discoaster pentaradiatus, Helizopontosphaera kamptneri; Pseudoemiliania lacunosa,* and abundant small Prinsiaceae together with late Eocene coccoliths. The age of this assemblage is considered to be late Pliocene. The poor assemblages and the corroded state of the nannofossils suggests that the late Pliocene and early to mid Pleistocene sediments were deposited close to the calcite compensation depth, and certainly well below the lysocline.

Eocene

Cores 283-2 to 4, dated by diatoms as late Eocene, were barren of nannofossils, but Cores 5-7 yielded very rare to abundant, poorly to moderately well preserved assemblages. The presence of *Chiasmolithus oamaruensis, Discoaster saipanensis, Reticulofenestra bisecta, R. reticulata,* and *R. placomorpha* without associated *Isthmolithus recurvus* suggests the presence of the early

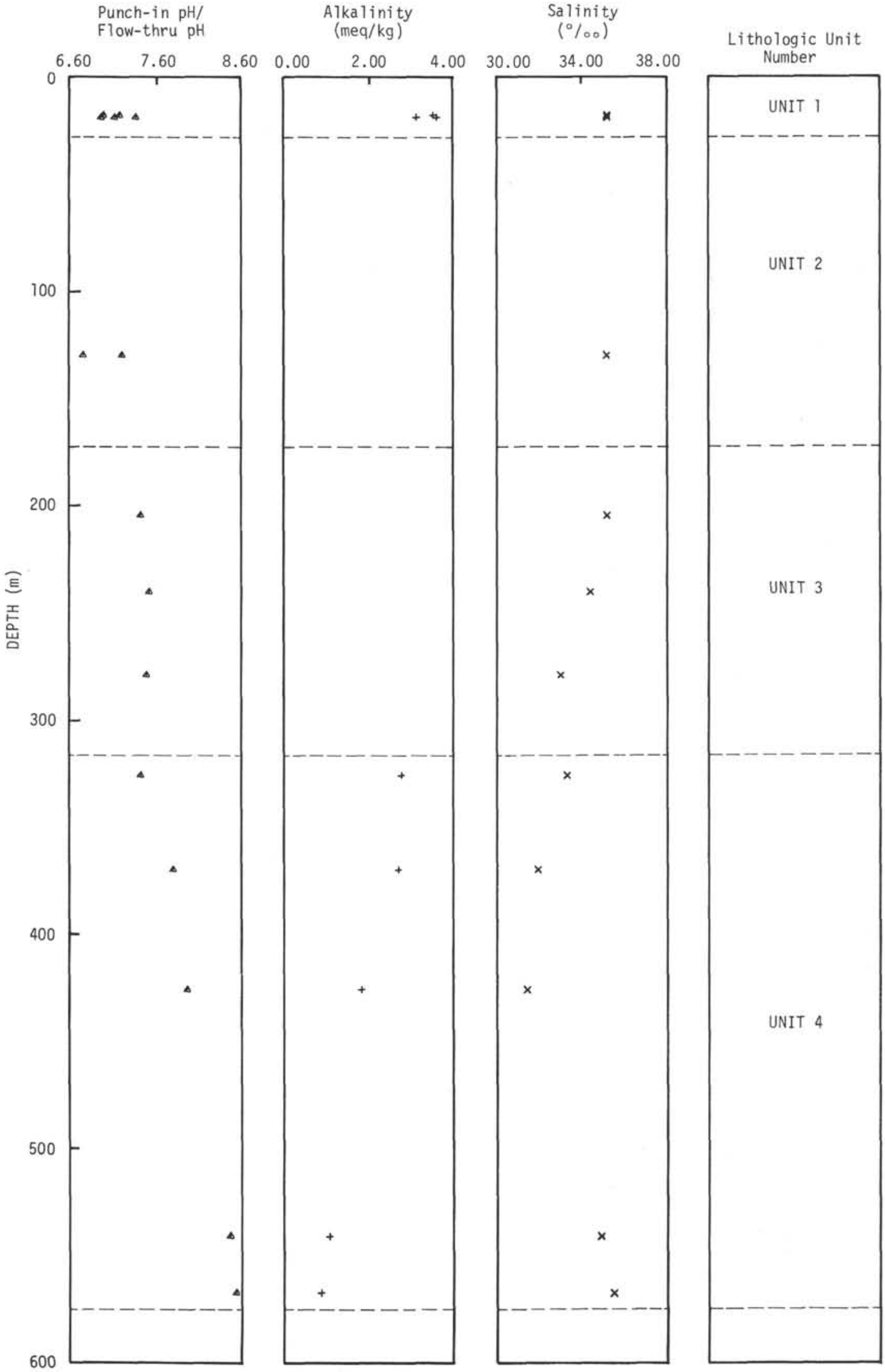

Figure 6. *Shipboard geochemical data versus depth, Site 283.*

TABLE 4
Biostratigraphy and Adopted Ages at Site 283

Site 283 Cores	Palynology	Calcareous Nannofossils	Benthonic Foraminifera	Diatoms	Adopted Age
1A		Mid to early Pleistocene			Mid to early Pleistocene
1				Pleistocene	
2A		Late Pliocene		Late Eocene	Late Pliocene
2	Miocene?				Miocene?
3	?				Late Eocene
4	late Eocene				
5		Early Oligocene to late Eocene			
6	late Eocene	Late Eocene			
7	?			Late to mid Eocene	
8	mid-late Eocene	Almost barren			Late to mid Eocene
9	?				Mid Eocene
10	mid Eocene				
11	mid Eocene				
12	early Eocene to late Paleocene		Paleocene (Teurian)		Late Paleocene
13					Mid Paleocene
14	Paleocene				
15					
16	early Paleocene				Early Paleocene
17	early Paleocene to Late Cretaceous				

late Eocene *Chiasmolithus oamaruensis* Zone of Edwards (1971) for Cores 6 and 7. Core 5 contains a poorer and less typical late Eocene to early Oligocene assemblage (based on the presence of *R. bisecta* and *R. placomorpha*). Diversity is low in the Eocene assemblages probably due to both primary low diversity and solution of taxa more delicate than the Prinsiaceae and Coccolithaceae.

Eocene-Paleocene

At a few levels in Cores 8-17 there occur very rare (or only single) coccoliths which are usually small Prinsiaceae. These coccoliths are considered to be derived from downhole and/or laboratory contamination.

Diatoms

Diatoms were studied from all cores from Holes 283 and 283A (Figure 7). Samples in the upper part of Hole 283 are diatom-rich and are well preserved, but the lower part of the hole was barren of diatoms. The upper diatom-rich sequence at Hole 283 has been divided into 5 intervals; for a discussion of diatom ages and characteristics, see Table 5.

The highest, Interval A (Sample 283-1, CC), consists of a few poorly preserved species, but some of them have characteristic morphologies with short ranges. *Nitzschia* sp., *Synedra* sp., *Thalassionema* sp., and *Thalassiosira* sp. indicate that the age of this sediment is Pleistocene.

Interval B (Cores 2, CC; 3, CC) is distinguished from the subjacent intervals by the presence of *Acanthodiscus rugosus, Aulacodiscus rattrayii, Horodiscus pacificus, Pyxilla (Pterotheca) aculeifera*, and *Triceratium secedens.*

Interval C (Core 4 to Section 5-2) has a high abundance of *Acanthodiscus vulcaniformis, Arachnoidiscus ehrenbergii, Biddulphia rigida, Coscinodiscus stellaris* var. *symbolophora* f. *oamaruensis, Goniothecium odontella, Hemiaulus polymorphus, Melosira architecturalis, Pseudorutilaria monile, Pyrgupyxis katharinae, P. patriciae, Pyxilla danica, Stictodiscus hardmannianus, Triceratium crenulatum, T. pulvinar, Trinacria excavata, T. simulacrum.*

Interval D (Cores 5, CC to 6, CC) contains *Acanthodiscus* sp., *Asterolampra insignis, A. vulgaris, Auliscus gleseri, Eunotogramma weissii, Hannaites quadria, Stictodiscus* sp., and *Triceratium morlandii* which were not found in the overlying Unit 3. Many taxa have not been documented in the available published literature. Intervals C and D contain well-preserved diatoms with high diversity. The thanathocoenosis consist of large, marine siliceous planktons. The abundance of diatoms is correlated with the abundance of Radiolaria, silicoflagellates, and sponge skeletons.

Interval E (Section 7-1 to Sample 8, CC) contains only a few specimens of *Poretzkia decorata, Xauthiopyxis globosa, X. panduraeformis*, and *Acanthodiscus ovalis.*

Samples 283A-2, CC 283-2-2, 40 cm, and 283-2-3, 15 cm are barren of diatoms.

Radiolaria

Radiolaria are common and moderately well preserved in Cores 2, CC to 8, CC, rare in 9, CC to 12, CC, and absent in 13, CC to 17, CC. The Radiolaria of Sample 283A-1-1 (13 cm) include: *Axoprunum pierinae* (Campbell and Clark) group, *Amphicraspedium prolixum* Sanfilippo and Riedel group, *Calocycloma* sp. aff. *C.*

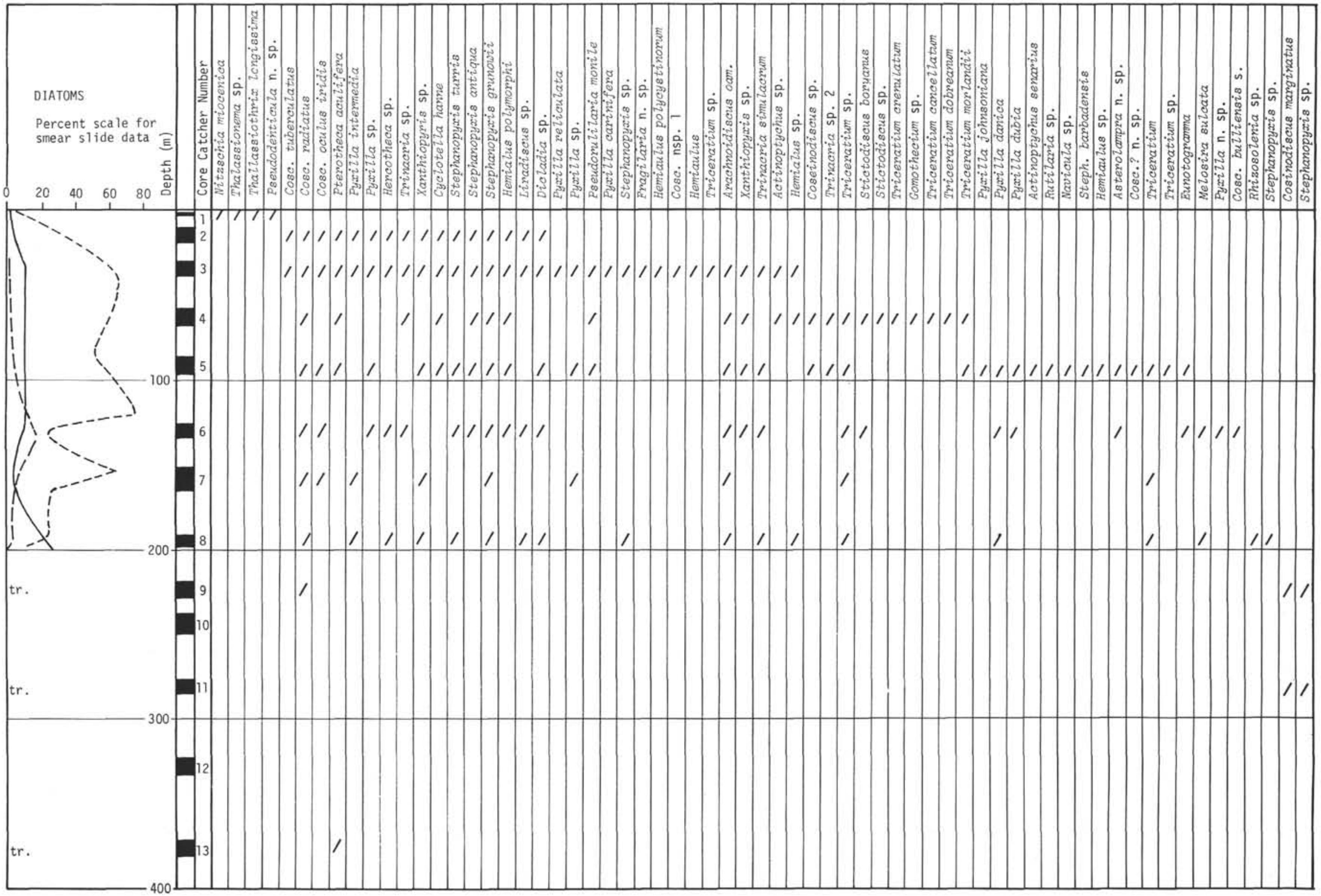

Figure 7. *Diatom distribution, Site 283.*

TABLE 5
Diatom Characteristics and Ages, Site 283

Intervals	Samples		Characteristic Fossils	Age	Abundance	Preservation
	Core	Section				
A	1	CC	*Synedra* sp., *Thalassionema* sp. 1 *Nitzschia* sp., *Thalassiosira* sp.	Pleistocene	Few	Poor
B	2 3	CC CC	*Triceratium secedens, Aulacodiscus rattrayii, Acanthoidiscus rugosus, Pyxilla (Pterotheca) aculeifera, Biddulphia oamaruensis*	Late Eocene	Abundant	Good to moderate
C	4 5 5	CC 1 2	*Pyrgopyxis* n.sp., *Asterolampra* sp., *Hemiaulus polymorphus, Dampriscus aculeatus* n. sp., *Melosirasol, M. oamaruensis, Ethmodiscus obovatus, Biddulphia rigida*		Abundant	Good to moderate
D	5 6 6 6	CC 1 2 CC	*Acanthodiscus* sp., *Stictodiscus* sp. *Asterolampra vulgaris, A. insignis, Stephanopyxis gounoroii (?), Eunotogramma weissei*		Abundant	Good to moderate
E	7 8	1-3, 5-6, CC 1-3, CC	*Poretzkia decorata, Xanthiopyxis panduraeformis, X. globosa, Acanthodiscus ovalis*	Middle to late Eocene	Few	Good to moderate

castum (Haeckel), *Theocampe urceolus* (Haeckel) group, *Periphaena* sp., *Spongurus bilobatus* Campbell and Clark, and early Spyroidea. This fauna indicates the late Paleocene to early Eocene *B. climata* Zone to *P. striata s.s.* Zone.

Silicoflagellates

Rich late Eocene assemblages of silicoflagellates were found in Cores 283-2 to 8. All are dominated by different species of *Naviculopsis*, but *Distephanus crux, Dictyocha fibula,* and *Corbisema triacantha* sometimes reach 10% of the flora. The paleotemperatures indicated by the *Dictyocha/Distephanus* ratio (Mandra, 1969) suggest subtropical conditions during the deposition of Core 283-2, and tropical conditions for the other samples. The paleotemperatures at three of the four sites where late Eocene assemblages of silicoflagellates were found on Leg 29 are comparable, and suggest warm subtropical to tropical conditions. At Site 277, however, the temperature seems to have been considerably lower. The silicoflagellates are discussed in detail in Chapter 15 (this volume).

Palynology

Thirty-two palynological samples were examined from 15 cores of Hole 283, and seven were examined from a single core of Hole 283A. Hole 283A, drilled into the Plio-Pleistocene, proved to be devoid of palynomorphs. Hole 283 yielded rich assemblages of palynomorphs which are briefly summarized below (see also Chapter 16, this volume).

Sample 283-2, CC yielded a moderately rich assemblage of dinoflagellate cysts and miospores. Dinoflagellate cysts are dominated by *Tectatodinium* sp. which is apparently restricted to the Neogene. Other dinoflagellate species include *Hemicystodinium* aff. *zoharyi* (Rossignol), *Operculodinium* sp., *Tuberculodinium* aff. *vancampoae* (Rossignol), *Hystrichokolpoma rigaudae* (Deflandre and Cookson), *Deflandrea phosphoritica* (Eis), and a distinctive undescribed species of *Palaeoperidinium.* The miospore assemblage is dominated by beech pollen (both the *brassi* and *fusca* types). On palynological evidence, Core 283-2 is Neogene (?Miocene), although the presence of *D. phosphoritica* may indicate Oligocene or earlier.

Sample 3, CC lacks most of the typical Neogene species, but contains the same species of *Paleoperidinium* as Core 2; it is the dominant dinoflagellate species. Pollen is rare. Age indeterminate.

Sample 4, CC contains some of the Eocene dinoflagellate species recorded from Antarctica and South America (Wilson, 1967a; Archangelsky, 1969). These include the same species of *Spinidinium, S. aperturum* Wilson and *S. rotundum* Wilson. *Cladopyxidium* aff. *septatum* belongs to a genus which has not been recorded above the Eocene. Miospores are dominated by beech pollen, both the *brassi* and *fusca* types. The palynological age appears to be late Eocene. Core 5 was not examined.

Sample 6, CC yielded a relatively poor palynoflora dominated by *Spinidinium aperturum* and *Palaeoperidinium* sp., both of which are found in overlying rocks. Age is probably late Eocene.

Sample 7, CC is noticeably different from the overlying cores in being completely dominated by *Deflandrea cygniformis* Pöthe de Baldis, previously recorded only from the lower Tertiary of Tierra del Fuego (Pöthe de Baldis, 1966). Age uncertain.

Sample 8, CC contains a typical middle to late Eocene dinoflagellate assemblage including *Deflandrea phosphoritica* (Eis.) and *Spinidinium aperturum* (codominants). Other dinoflagellate species include *Leptodinium* (ornate species), *Deflandrea macmurdoensis* Wilson, and *Aerosphaeridium dictyoplokus* (Klumpp). The latter two are common in Eocene rocks of Antarctica and South America (Wilson, 1967a; Archangelsky, 1969). Pollen species include beech (*brassi* and *fusca*) and the proteaceous species *Proteacidites* cf. *grandis* Cookson. This core is probably mid- to late Eocene. Sample 9, CC yielded one specimen of *Spinidinium aperturum.*

Sample 10, CC yielded quite a good palynoflora dominated by an undescribed species of *Microdinium* (or *Cladopyxidium*). Other important taxa include *Areosphaeridium dictyoplokus, Spinidinium aperturum, Palaeoperidinium* n. sp., *Schematophora* sp., *Operculodinium* sp., and one probable specimen of *Cassidium fragilis* (Harris). Pollen is relatively rare. Age is probably mid Eocene.

Core 11 yielded excellent palynofloras, all dominated by the dinoflagellate *Areosphaeridium dictyoplokus* (Klumpp). Other less common dinoflagellate cysts include *Aiora fenestrata* (Deflandre and Cookson), *Deflandrea phosphoritica* Eis., *Acanthaulax* sp., *Deflandrea* aff. *antarctica* Wilson, *Spinidinium aperturum* Wilson, and *Thalasiphora pelagica* (Eis.). Some excellent specimens of the characteristic middle Eocene dinoflagellate *Wetzeliella (W.) echinosuturata* Wilson, restricted to the Porangan Stage in New Zealand (Wilson, 1967b), were found in Sample 11, CC. Pollen is relatively rare. A fairly definite middle Eocene age can be assigned to this core.

Core 12 yielded poor assemblages but includes the dinoflagellate *Deflandrea* cf. *denticulata* Alberti and the pollen species *Gambierina edwardsi* (Cookson and Pike). It is probably early Eocene or late Paleocene, based on palynology.

Cores 13 to 15 contain fairly similar rich palynofloras and are probably all Paleocene, many of the species occurring in the New Zealand Teurian Stage. Dinoflagellate species include *Svalbardella australina* Cookson, *Turbiosphaera filosa* (Wilson), *Deflandrea denticulata* Alberti, *Acanthaulax* spp., a characteristic ornate species of *Leptodinium, Palaeoperidinium* aff. *pyrophorum* (Ehr.), *Membranilarnacia* sp. *Cleistosphaeridium* sp., *Cassidium fragilis* (Harris), and *Areosphaeridium dictyoplokus* (Klumpp). The Late Cretaceous basal Paleogene colonial alga, *Palambages morulosa* O. Wetzel is rare. Pollen are rare and include some reworked Mesozoic forms, e.g., *Classopollis.*

Core 16 appears to be slightly older and may be early Paleocene. Similar assemblages to those of Cores 13-15 occur with the addition of the characteristic dinoflagellates *Systematophora* sp. and *Glyphanodinium* cf. *facetum* Drugg; the latter species previously recorded only from the Paleocene of California (Drugg, 1964, 1967). Pollen includes *Gambierina edwardsi* (Cookson and Pike).

Core 17 contains a mixture of Late Cretaceous and early Paleogene palynomorphs, and is therefore tentatively assigned to the Mesozoic-Cenozoic boundary. Species include the dinoflagellates *Deflandrea cretacea* Cookson, *D.* aff. *bakeri* Deflandre and Cookson, *Cribroperidinium* cf. *orthoceras* (Eis.), *Glyphanodinium* cf. *facetum* Drugg, *Cleistosphaeridium* sp., *Eisenackia* sp., *Areoligera* aff. *senonensis* Lejeune-Carpentier, *Deflandrea denticulata* Alberti, and *Exochosphaeridium* cf. *striolatum* (Deflandre). *Palambages morulosa* O. We. is fairly common. Pollen is rare.

Other Fossil Groups

The microfossil of unknown affinity described and illustrated in Chapter 25 (this volume) was found in several samples from Cores 2-13 which are late Eocene to late Paleocene. The size of the wormlike to cone-shaped microfossil is $\sim 10\mu$-$\sim 150\mu$.

SEISMIC DATA

The profiler data (Figure 3) show a thick sequence of acoustically transparent sediments with a measured sound velocity that corresponds well with predictions based on nearby Lamont sonobuoy solutions (see Figure 5 in Houtz, Chapter 42, this volume). The sonic log indicates a very uniform velocity distribution, which corresponds well with the observed acoustic transparency. The velocity gradient of about 0.9 sec^{-1} below 140 meters is well within the range observed elsewhere in deep ocean sediments, and at Site 282. The mean sonic velocity is 1.68 km/sec. The uniform appearance of the profiler records anticipates a velocity gradient, i.e., a lack of large velocity discontinuities within the layer. In addition, the almost complete lack of sediments younger than late Eocene suggests that the sediments have had time to stabilize, and hence the sonic velocities could be more accurate.

Giant ripples appear prominently in the 3.5-kHz records near this site (see Figure 6 in Houtz, Chapter 42, this volume). The ripples seem to be associated with the upper Eocene surface, which is covered by only a few meters of more recent sediment. Strong bottom currents associated with the ripples are probably responsible for the 37-m.y. depositional hiatus.

SEDIMENTATION RATES

Biostratigraphic control is rather poor at Site 283. Nevertheless, the ages adopted for each core give sufficient information for a sedimentation rate curve (Figure 8).

Three major events dominate the sedimentary history of the site: clay, silty clay, and silty diatom ooze successively accumulated during the Paleocene and Eocene at a uniform and moderate rate of 2.6-2.8 cm/1000 yr; an extended period of erosion is indicated by a late Eocene-late Miocene disconformity; and finally, zeolite clay accumulated discontinuously during the latest Cenozoic at a slow rate (0.4 cm/1000 yr).

The curve also suggests that the early Eocene was marked by either a period of erosion, or a period of very slow sedimentation. However, it appears that the apparent break in sedimentation is an artifact of compaction. Late Paleocene and early Eocene sediments are silicified. A reduction by 50% of the original thickness of this part of the sequence could produce the break shown on the sedimentation rate curve.

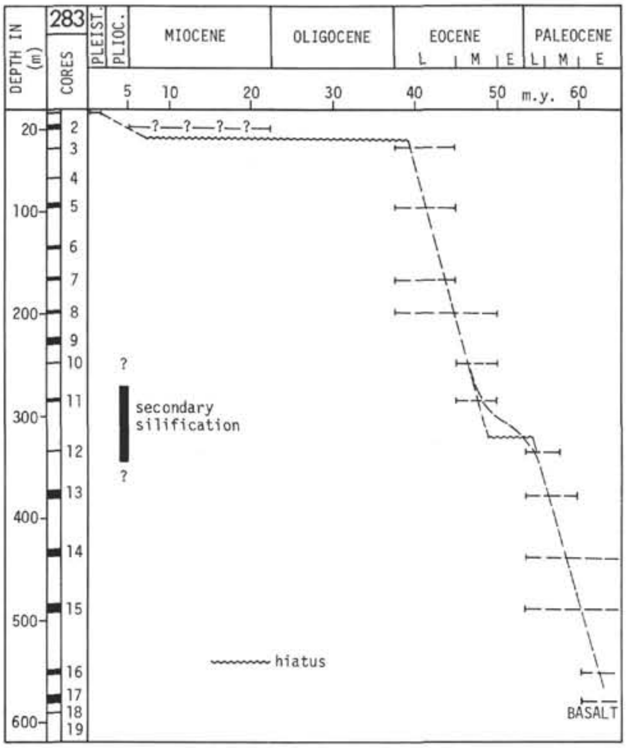

Figure 8. *Sedimentation rate curve for Site 283; ages based on adopted age (Table 4).*

SUMMARY AND CONCLUSIONS

Site 283 is in deep water (4729 meters) in the central Tasman Sea where the age of basement, based on rather poorly identified magnetic anomalies is thought to be 75 m.y. (Hayes and Ringis, 1973).

A total of 21 cores were recovered with 588 meters penetration into sediment and 4 meters penetration into highly altered basalt.

Four sedimentary units are distinguished: a veneer (13 m) of late Pliocene-Pleistocene light-colored zeolitic clays (Unit 1). This unit is separated by a major unconformity from about 163 meters of late Eocene silty diatom ooze (Unit 2) in turn underlain by about 139 meters of middle Eocene mottled green and brown silty clay (Unit 3). From very limited paleontological control it is possible that a latest Paleocene to early middle Eocene disconformity separates Units 3 and 4. Unit 3 is underlain by 297 meters of Paleocene poorly fossiliferous black silty clay and silty claystone (Unit 4).

Basement at Site 283 is a basalt which is highly altered to serpentine, zeolite, clay, palagonite, and chlorite. The basalt was originally either an extrusive pillow lava or a broken pillow breccia. However, alteration of overlying sediments suggest that the volcanics are of intrusive origin.

The late Eocene yielded a very rich diatom sequence, rare to abundant calcareous nannofossils, and common radiolaria; planktonic foraminifera are absent. Well-preserved agglutinated and siliceous benthonic foraminifera occur throughout the Paleocene; other groups are virtually absent.

Conclusions

The earliest Paleocene (64 m.y.B.P.) of the silty claystone overlying basalt is significantly younger than the 75 m.y. predicted by Hayes and Ringis (1973). In this model, sea-floor spreading from a northwest trending spreading axis began at the time of Anomaly 32 (75 m.y.B.P.) or earlier, and continued until Anomaly 24 (60 m.y.B.P.). The lack of agreement is considered by D. E. Hayes (personal communication) to have been caused by dislocations along nearby fracture zones and/or a misidentification of weak magnetic anomalies. Because of this, he does not feel that the proposed history of spreading in the Tasman Sea has been jeopardized by the results of Site 283.

The sediments cored at Site 283 record abyssal sedimentation throughout the Cenozoic, below or close to the calcium carbonate compensation depth, resulting in a very poor biogenic record. Five main episodes of the sedimentary history can be distinguished:

1) Paleocene deposition of uniform terrigenous silty clay in an oxygenated abyssal basin with unrestricted circulation.

2) Early Eocene to earliest middle Eocene nondeposition or erosion, followed by middle Eocene deposition of terrigenous silty clay.

3) Late Eocene deposition of silt clay and nannofossil-bearing diatom oozes.

4) Late Eocene to (?) middle Pliocene-Pleistocene nondeposition.

5) (?)Late Pliocene-Pleistocene deposition of zeolitic clays.

The depositional episode spanning the Paleocene-late Eocene records no change in the nature and probable rate of influx of terrigenous components that reached Site 283 from the Australian region. In the early part of this episode (Units 3, 4), dissolution of almost all calcareous and siliceous biogenic groups indicates deposition below both the calcium carbonate and siliceous compensation depths. In the later part (Unit 2) preservation of some of these forms indicates deposition above the calcium carbonate compensation depth. This probably reflects a deepening of the calcium carbonate compensation depth.

Late Pliocene-Pleistocene time is represented by less than 15 meters of sparingly fossiliferous zeolitic clays developed by the alteration of fine-grained volcanic constituents. Deposition occurred close to the calcium carbonate compensation depth and certainly below the lysocline.

Conditions of nondeposition represented by the late Eocene-late Pliocene-Pleistocene unconformity prevailed during most of the rest of the Cenozoic at Site 283. The end of the Paleogene deposition probably occurred no later than late Eocene or early Oligocene because the soft, unconsolidated upper part of Unit 2 could not have been deeply buried and compacted and then exposed by later erosion.

The extensive unconformity at Site 283 is the result of persistent bottom currents during a period of about 35 m.y. In the earlier part of this episode (latest Eocene-Oligocene) bottom currents flowed northward through the central Tasman Sea creating the regional unconformity (Kennett et al., 1972) that extends as far north as the Coral Sea and New Guinea. A similar episode of current activity also occurred during the early Eocene, creating the hiatus at Site 283 and a disconformity at the Paleocene-Eocene boundary at sites further north such as DSDP Site 207. When circumpolar flow south of Australia was established near the end of the Oligocene, bottom water flow to the northern Tasman Sea region was inhibited. Site 283, however, is located near the northern boundary of circumpolar flow, so post-Oligocene sedimentation has been largely prevented by the circumpolar current. The unconformity at Site 283 represents the successive influence of two major Cenozoic bottom currents.

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APPENDIX A

Summary of X-Ray^a, Grain Size, and Carbon-Carbonate Results, Site 283

Section	Sample Depth Below Sea Floor (m)	Lithology	Age	X-Ray^b									Grain Size			Classification	Carbon Carbonate			Comments
				Bulk Sample Major Constituent			2-20μ Fraction Major Constituent			<2μ Fraction Major Constituent			Sand (%)	Silt (%)	Clay (%)		Total (%)	Organic (%)	CaCO$_3$ (%)	
				1	2	3	1	2	3	1	2	3								
283-2-2	11.7-11.8	Unit 1 Zeolitic clay	Late Pliocene to Picistocene	Quar.	Mica	Kaol	Quar.	Mica	*	Mont.	Kaol.	Mica	2.5	25.6	71.9	Silty Clay	0.5	0.1	4	*K-Fe and Plag. equal in abundance Gyps. – in bulk analysis
283-2-3	13.5	Unit 2 Silty diatom ooze	Late Eocene														0.2	0.1	1	Gyps in bulk
283A-2-3	14.6			Quar.	Mica	Mont.	Quar.	Mica	Plag.	Mont.	Mica	Kaol.	0.2	14.4	85.4	Clay				
283-5-2	88.4-88.5			Quar.	Mont.	Mica	Quar.	Mica	Mont.	Mont.	Mica	Kaol.	0.6	35.7	63.7	Silty clay	4.5	0.8	31	Gyps. in bulk analysis
283-6-2	126.2			Quar.	Mont.	Mica	Quar.	Mica	Kaol.	Mont.	Kaol.	Mica	0.2	38.9	60.9	Silty clay	1.5	0.6	8	
283-7-6	160.9			Calc.	*	Mica	Quar.	Mica	Plag.	Mont.	Kaol.	Quar.	0.2	36.0	63.7	Silty clay	1.9	0.4	13	*Mont. and Quar. equal in abundance
283-8-2	192.6	Unit 3 Silty clay with diatoms	Middle Eocene	Mont.	Quar.	Mica	Quar.	Mica	Plag.	Mont.	Mica	*	0.5	29.6	69.9	Silty clay	2.8	0.5	19	*Gyps in bulk analysis. Hali in <2μ
283-9-2	221.2			Mont.	Quar.	Mica	Quar.	Mica	K-Fe	Mont.	Mica	Quar.	0.2	44.5	55.3	Silty clay	3.7	0.7	25	*Kaol. and Quar. equal in abundance
283-11-2	278.3-278.4			Mont.	Cris.	Quar.	Mica	Quar.	Mont.	Mont.	Cris.	Hali.	0.0	25.0	74.9	Silty clay	1.0	0.2	7	Hali – in <2μ
283-12-2	325.8	Unit 4 Silty clay and silty claystone	Paleocene	Cris.	Mica	Quar.	Quar.	Mica	*	Mont.	Mica	Cris.	0.0	50.2	49.8	Clayey silt	2.3	0.4	16	Gyps in bulk, Hali. in <2μ
283-13-2	373.2-373.3			Mont.	Quar.	Mica	Mica	Quar.	Pyri.	Mont.	Quar.	Mica	0.1	20.2	79.6	Clay	2.4	0.5	16	Cris. and Mont. equal in abundance
283-14-3	431.5-431.6			Quar.	Mont.	Mica	Quar.	Mica	Mont.	Quar.	Mica	Mont.	0.5	25.2	74.3	Silty clay	2.5	0.1	20	Gyps. in bulk, Hali in <2μ
283-15-2	487.3			Quar.	*	K-Fe	Quar.	Mica	Mont.	Quar.	Mont.	Mica	0.3	25.7	73.9	Silty clay	2.2	0.4	15	Gyps. in bulk, Hali in <2μ .
283-16-2	544.5-544.6			Quar.	Mont.	Mica	Quar.	Mica	Mont.	Quar.	Mont.	Mica	0.1	13.5	86.3	Clay	2.1	0.4	14	*Mica and Mont. equal in abundance
283-17-4	575.8-575.9			Quar.	Mica	K-Fe	Quar.	Mica	K-Fe	Quar.	Mica	Mont.	1.0	23.5	75.6	Clay	1.4	0.3	9	Hali – in <2μ

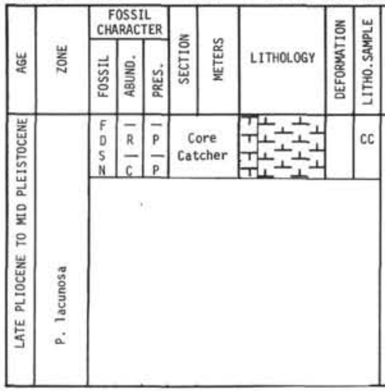
Note: * = see comments column.

[a] Complete results of X-ray, Site 283 will be found in Appendix I.

[b] Legend in Appendix A, Chapter 2.

[c] Narrow peaks at 6.87A, 8.22A, and 4.75A among others for Sample 283-16-2 (5-25%).

Site 283 Hole Core 1 Cored Interval: 0.0-0.5 m

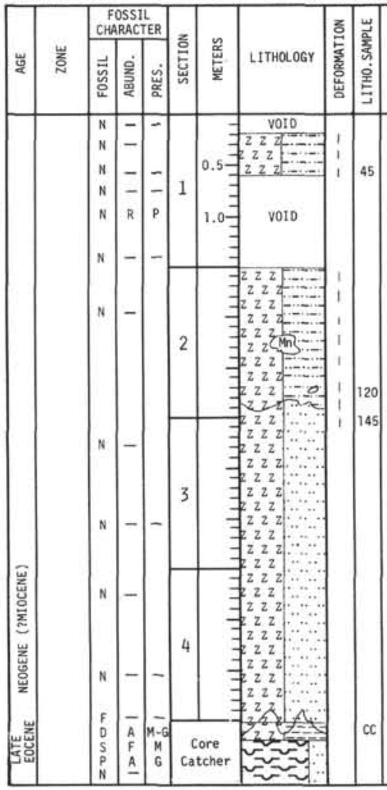


LITHOLOGIC DESCRIPTION

Unit 1A for Site 283 is predominantly a moderate yellowish brown (10YR 5/4), soft, SILTY ZEOLITE CLAY. Core catcher sample in this core is a moderate yellowish brown (10YR 5/4) soft ZEOLITE, IRON MINERAL, SILTY AND CLAY-BEARING, FORAM-RICH NANNO OOZE.

SS CC
Q - 8%
CM -10%
VG - 1%
IM - 5%
MicroN- 1%
Z - 8%
F -15%
N -49%
D - 2%
S - 1%

Site 283 Hole Core 2 Cored Interval: 10.0-19.5 m



LITHOLOGIC DESCRIPTION

Core to 135 cm, Sec. 2 is a yellowish brown (10YR 5/2) MICRONODULE AND DETRITAL SAND SILTY CLAY ZEOLITE OOZE; with moderate lighter (10YR 6/4) and darker (10YR 4/2) yellowish brown mottling. Unit 1B begins with a sharp contact, with clast of Sec. 3 lithology in Sec. 2. The lithology is MICA, MICARB AND GLASS BEARING QUARTZ SILT ZEOLITE OOZE; it is very pale yellowish-brown (10YR 7/2); faintly stratified, slightly mottled. The unit is distinguished from 1A by pale color and subhomogeneous appearance. The contact suggests a disconformity. Another contact occurs in the core catcher: where Unit 1B is found overlying Unit 2 (described in Core 3); deformed contact is very sharp and suggests disconformity. The core catcher lithology is a SILT, MICRONODULE AND SPICULE BEARING CLAY ZEOLITE OOZE.

SS 1-45	SS 2-120	SS 2-145	SS CC (light)
Q -10%	Q - 8%	Q -30%	Q - 7%
F - 2%	F - 1%	Mi - 5%	F - 1%
Mi - 1%	CM -40%	VG - 5%	M - 1%
HM - 2%	MicroN- 4%	M - 5%	HM - 1%
CM -37%	Z -45%	Z -55%	CM -44%
MicroN- 3%			MicroN- 3%
Z -45%			Z -40%
			S - 3%

X-ray 2-25 (Bulk)

Quar - A	Mica - A
K-Fe - P	Mont - P
Plag - P	Clin - TR
Kaol - P	Gyps - TR

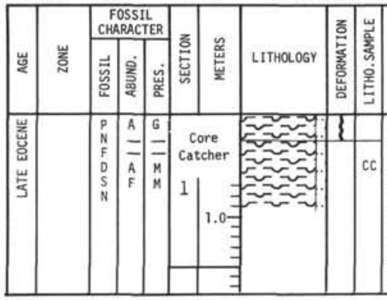
Grain Size 2-22 (2.5, 25.6, 71.9)

Carbon Carbonate 2-20 (0.5, 0.1, 4)

Carbon Carbonate 3-47 (0.2, 0.1, 1)

CC
UNIT 2

Site 283 Hole Core 3 Cored Interval: 29.0-38.5 m

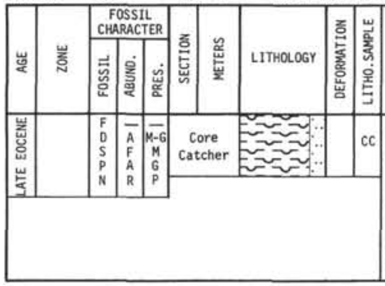


LITHOLOGIC DESCRIPTION

Unit 2 is a dark greenish gray (5GY 4/1), very soft SPICULE-BEARING DETRITAL SILT-RICH DIATOM OOZE.

SS CC
Q -20%
F - 2%
Mi - 3%
VG - 1%
D -63%
S -10%
SI - 1%

Site 283 Hole Core 4 Cored Interval: 57.5-67.0 m



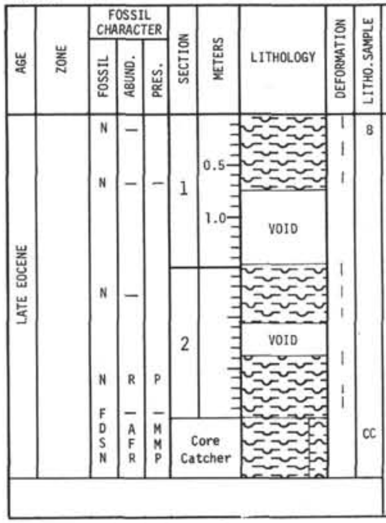
LITHOLOGIC DESCRIPTION

Core catcher is a dark greenish gray (5GY 4/1), semi-stiff, CLAY, RADIOLARIAN AND SPICULE BEARING DETRITAL SILT-RICH DIATOM OOZE.

SS CC
Q -15%
CM - 5%
D -60%
R -10%
S -10%

*Benthonic foraminifera

Site 283 Hole Core 5 Cored Interval: 86.0-95.5 m



LITHOLOGIC DESCRIPTION

Core shows two lithologic variations: a SILICOFLAGELLATE, RADIOLARIAN, DETRITAL SAND AND SILT, SPICULE AND ZEOLITE BEARING DIATOM OOZE, stiff and semi-stiff with moderate mottling in Secs. 1 and 2, to a DETRITAL CLAY AND SILT, SILICOFLAGELLATE AND SPICULE-BEARING RADIOLARIAN-RICH DIATOM OOZE in the core catcher.

SS 1-8	SS CC
Q - 5%	Q - 5%
CM - 5%	CM - 5%
G - 1%	D -60%
Z -10%	R -15%
D -49%	S -10%
R - 5%	SI - 5%
S - 8%	
SI - 4%	

X-ray 2-98 (Bulk)

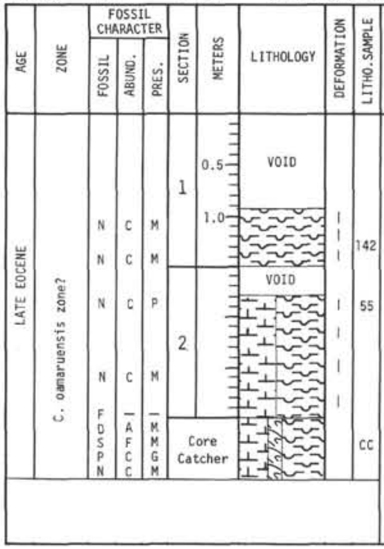
Quar - A	Mica - P
K-Fe - TR	Mont - A
Plag - TR	Pyri - TR
Kaol - P	Gyps - TR

Grain Size 2-95 (0.6, 35.7, 63.7)

Carbon Carbonate 2-93 (4.5, 0.8, 31)

Explanatory notes in Chapter 1

Site 283 Hole Core 6 Cored Interval: 124.0-133.5 m



LITHOLOGIC DESCRIPTION

Core illustrates a NANNO, RADIOLARIAN, SPICULE AND SILICOFLAGELLATE-BEARING DIATOM OOZE; olive gray (5Y 4/1), stiff, subhomogeneous, faint mottling is dark gray (N3) in Sec. 1. A DETRITAL SILT, SILICOFLAGELLATE, SPICULE AND RADIOLARIAN BEARING DIATOM-NANNO OOZE in Sec. 2; and a DETRITAL SILT AND CLAY, SPICULE AND RADIOLARIAN-BEARING SILICOFLAGELLATE RICH DIATOM-NANNO OOZE in core catcher.

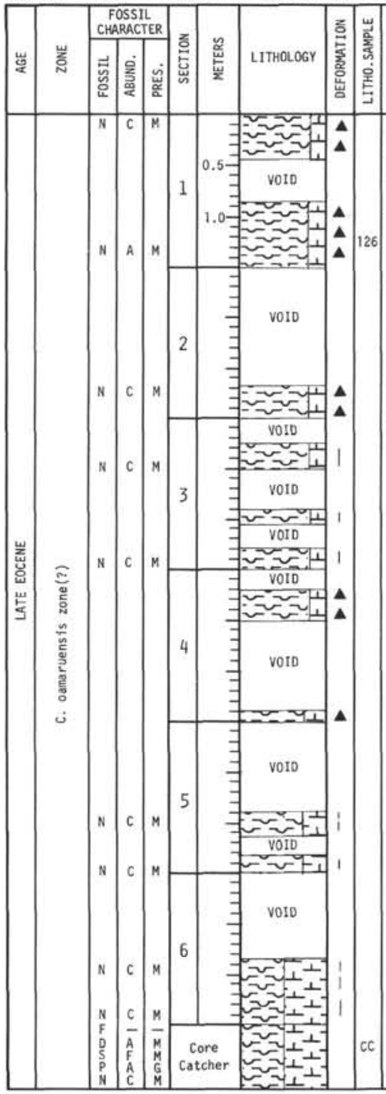
SS 1-142		SS 2-55		SS CC	
CM	- 1%	N	-45%	Q	- 5%
VG	- 1%	D	-25%	CM	- 5%
G	- 1%	R	-10%	N	-30%
MicroN	- 1%	S	-10%	D	-25%
N	- 4%	SI	- 5%	R	-10%
D	-75%	Q	- 5%	S	-10%
R	- 5%			SI	-15%
S	- 5%				
SI	- 5%				

X-ray 2-74 (Bulk)			
Calc	- P	Mica	- P
Quar	- A	Chlo	- TR
Plag	- P	Mont	- P
Kaol	- P	Pyri	- TR

Grain Size 2-71 (0.2, 38.9, 60.9)

Carbon Carbonate 2-70 (1.5, 0.6, 8)

Site 283 Hole Core 7 Cored Interval: 152.5-162.0 m



LITHOLOGIC DESCRIPTION

Core has variations of a CLAY, SILT AND SPICULE-BEARING NANNOFOSSIL-RICH DIATOM OOZE; dark greenish gray (5GY 4/1); soft. The core catcher is a DETRITAL SILT, SILICOFLAGELLATE, SPICULE AND RADIOLARIAN BEARING-DIATOM NANNO OOZE.

SS 1-126		SS CC	
Q	- 4%	N	-55%
CM	- 6%	D	-25%
N	-15%	R	- 5%
D	-65%	S	- 5%
R	- 2%	SI	- 5%
S	- 8%	Q	- 5%

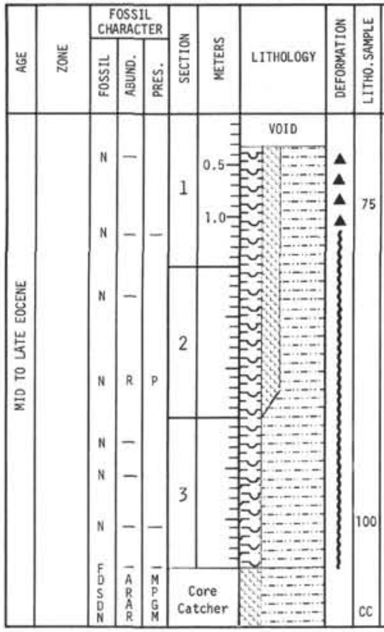
X-ray 6-91 (Bulk)			
Calc	- A	Kaol	- P
Quar	- P	Mica	- P
K-Fe	- TR	Chlo	- TR
Plag	- TR	Mont	- P

Grain Size 6-87 (0.2, 36.0, 63.7)

Carbon Carbonate 6-86 (1.9, 0.4, 13)

Explanatory notes in Chapter 1

Site 283 Hole Core 8 Cored Interval: 190.5-200.0 m



LITHOLOGIC DESCRIPTION

Drilling breccia in Sec. 1 is mixture of Units 2 and 3. Unit 3 is dark greenish gray (5GY 4/1) intensely mottled in greenish gray (5G 6/1) and brownish gray (5YR 4/1) with small dark gray (N3) streaks. The unit is diatomaceous in upper part grading downward to SILTY CLAY. Lithologic variations include: a SILICOFLAGELLATE, AND RADIOLARIAN-BEARING SPICULE-RICH DIATOM DETRITAL SILTY CLAY in Sec. 1; a SILICOFLAGELLATE AND RADIOLARIAN BEARING DIATOM RICH DETRITAL SILTY CLAY in Sec. 3; and a DIATOM-BEARING SPICULE-RICH DETRITAL SILTY CLAY in the core catcher.

SS 1-75		SS 3-100		SS CC	
Q	-20%	Q	-20%	Q	-20%
M	- 2%	CM	-35%	Mi	- 5%
CM	-30%	D	-20%	CM	-36%
D	-25%	R	- 5%	Dolo	- 2%
R	- 5%	S	-15%	D	-10%
S	-15%	SI	- 5%	R	- 2%
SI	- 3%			S	-25%

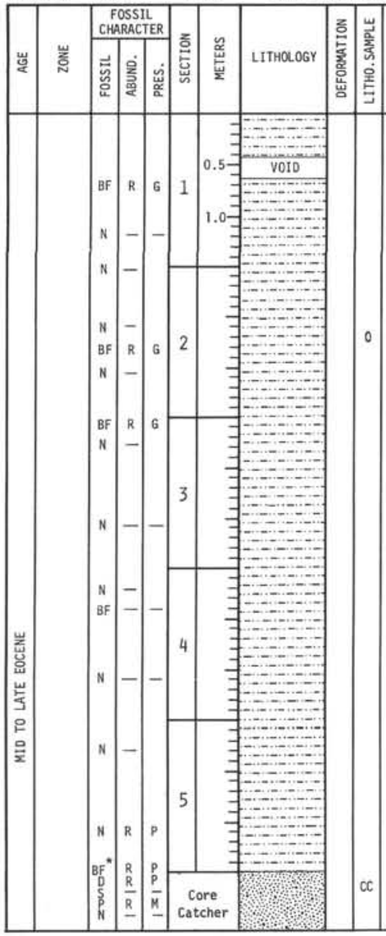
X-ray 2-59 (Bulk)

Quar	- P	Mica	- P
K-Fe	- TR	Mont	- A
Plag	- TR	Gyps	- TR
Kaol	- TR		

Grain Size 2-56 (0.5, 29.6, 69.9)

Carbon Carbonate 2-55 (2.8, 0.5, 19)

Site 283 Hole Core 9 Cored Interval: 219.0-228.5 m



LITHOLOGIC DESCRIPTION

The core is stiff, locally semi-indurated ZEOLITE, MICRONODULE AND GLASS-BEARING SILTY CLAY. Burrows occur, of three types: CF Zoophycus; irregular ≈20 mm and 1-2 mm wide, vertical, greenish burrows. The core catcher is a GLAUCONITE-BEARING SILTY SAND.

SS 2-60		SS CC	
Q	-30%	Q	-22%
Mi	- 5%	Mi	- 1%
CM	-50%	HM	- 1%
VG	- 5%	CM	-70%
MicroN	- 5%	VG	- 1%
Z	- 5%	G	- 5%

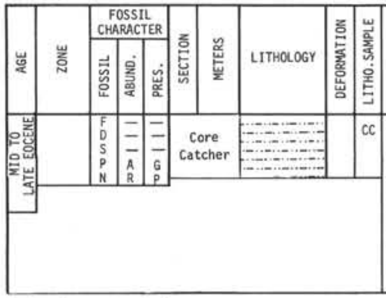
X-ray 2-71 (Bulk)

Quar	- A	Mica	- A
K-Fe	- TR	Chlo	- TR
Plag	- TR	Mont	- A
Kaol	- TR	Gyps	- TR

Grain Size 2-68 (0.2, 44.5, 55.3)

Carbon Carbonate 2-66 (3.7, 0.7, 25)

Site 283 Hole Core 10 Cored Interval: 238.0-247.5 m



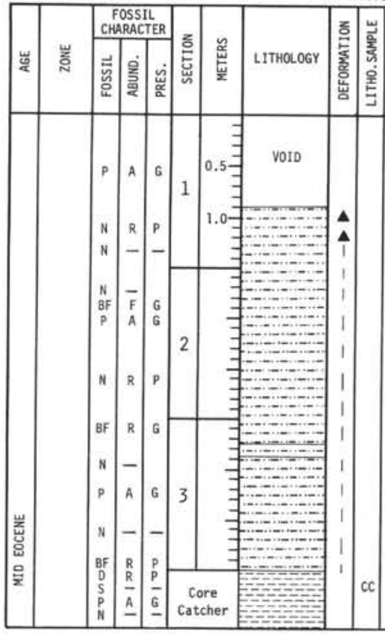
LITHOLOGIC DESCRIPTION

The recovery in core catcher consists of two specimens semi-lithified CLAYSTONE with 1-2% diatoms(?) with pyrite on cut surface. Burrows noted: 3 mm x 40 mm; vertical to inclined, slender with paired galleries: SILTY CLAY.

SS CC	
Q	-15%
CM	-84%
Py	- 1%

Explanatory notes in Chapter 1

Site 283 Hole Core 11 Cored Interval: 276.0-285.5 m



LITHOLOGIC DESCRIPTION

Secs. 1-3, dark greenish gray mottled semi-indurated SILTY CLAYSTONE; with arenaceous forams occurring sparingly: a brown intensely bioturbated interval occurs in Sec. 3 (25-35 cm). Generally in the core, the subhorizontal fabric is bioturbate in origin; segmented in homogeneously inclined intervals probably as a result of drilling deformation. The core catcher is a ZEOLITE AND PALAGONITE-BEARING CLAYSTONE AND CLAY.

SS CC
Q - 5%
Mi - 2%
CM -80%
Pla - 5%
MicroN- 2%
Z - 5%
R - 1%

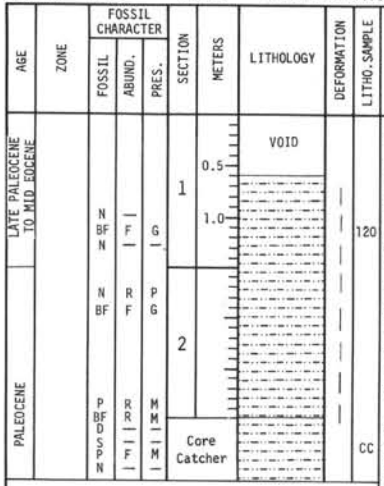
X-ray 2-81 (Bulk)

Quar	- P	Kaol	- TR
Cris	- P	Mica	- P
K-Fe	- TR	Mont	- A
Plag	- TR	Trid	- TR

Grain Size 2-84 (0.0, 25.0, 74.9)

Carbon Carbonate 2-88 (1.0, 0.2, 7)

Site 283 Hole Core 12 Cored Interval: 323.5-333.0 m



LITHOLOGIC DESCRIPTION

The contact between Units 3 and 4 is between Cores 11 and 12; its nature is unknown. Unit 4 consists of a olive-black (5Y 2/1) semilithified undeformed MICRONODULE AND PYRITE-BEARING SILTY CLAYSTONE. Bedding is on a scale of 1 to 10 mm and is wispy, ill-defined and bioturbated. Thicker layers tend to be slightly lighter-colored (5Y 3/1) and siltier; <1% white arenaceous forams. Discrete burrows are rare; mostly small ovoid masses (fecal pellets?) and wispy stratiform zones. The unit is also MICRONODULE AND PALAGONITE BEARING. The core catcher is a MICRONODULE-BEARING SILTY CLAYSTONE.

SS 1-120		SS CC	
Q	-30%	Q	-25%
CM	-55%	Mi	- 2%
VG	- 1%	CM	-69%
Pal	- 5%	G	- 1%
MicroN-	5%	MicroN-	3%
Z	- 2%		
Col	- 2%		

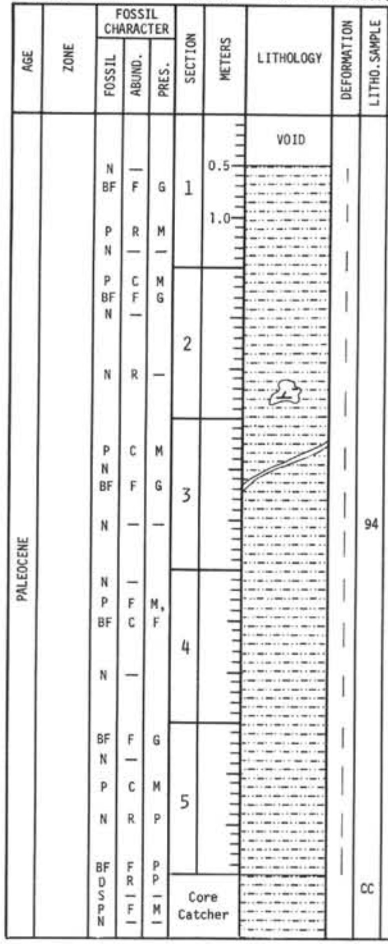
X-ray 2-80 (Bulk)

Quar	- P	Kaol	- TR
Cris	- A	Mica	- A
K-Fe	- TR	Chlo	- TR
Plag	- TR		

Grain Size 2-77 (0.0, 50.2, 49.8)

Carbon Carbonate 2-75 (2.3, 0.4, 16)

Site 283 Hole Core 13 Cored Interval: 371.0-380.5 m



LITHOLOGIC DESCRIPTION

Olive-black SILTY MUDSTONE, subhomogeneous. Sec. 2 at 122-127 cm has septarian concretion composed of barite(?) and dolomite and a 3 mm-wide vein of granular pyrite occurs at Sec. 3 (51-58 cm). Other lithology variations include: a MICRONODULE BEARING SILTY CLAYSTONE in Sec. 3 and a DIATOM AND MICRONODULE BEARING SILTY CLAYSTONE in the core catcher.

SS 3-94		SS CC	
Q	-18%	Q	-30%
Mi	- 1%	F	- 2%
CM	-80%	Mi	- 5%
G	- 1%	HM	- 1%
MicroN-	5%	Ch	- 2%
Z	- 2%	Z	- 1%
		CM	-44%
		VG	- 2%
		Pal	- 1%
		G	- 2%
		MicroN-	5%
		D	- 3%
		R	- 1%
		S	- 1%

X-ray 2-78 (Bulk)

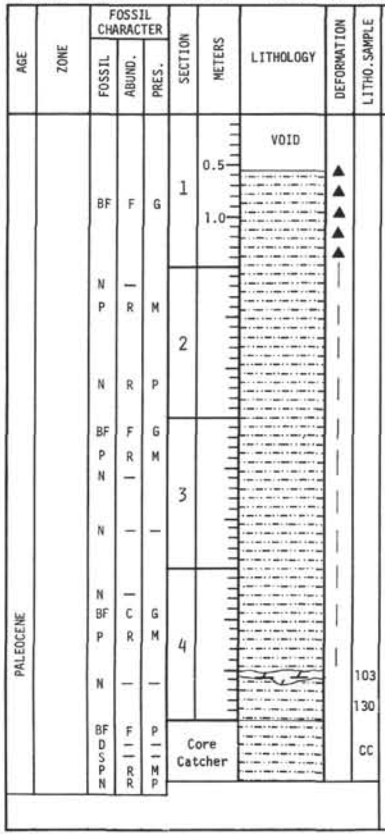
Quar	- A	Mont	- A
K-Fe	- TR	Pyri	- TR
Mica	- P	Gyps	- TR
Chlo	- TR		

Grain Size 2-75 (0.1, 20.2, 79.6)

Carbon Carbonate 2-73 (2.4, 0.5, 16)

Explanatory notes in Chapter 1

Site 283 Hole Core 14 Cored Interval: 428.0-437.5 m



LITHOLOGIC DESCRIPTION

Core is generally a MICRONODULE AND GLAUCONITE-BEARING (sandy) SILTY CLAYSTONE. A concretionary SILTY DOLOMITE occurs at 103 cm in Sec. 4. Sec. 3 contains massive, 0.5 x 3 cm brown plate-like burrows.

SS 4-103		SS 4-130		SS CC	
Q	- 5%	Q	-20%	Q	-10%
CM	-15%	F	- 2%	Mi	- 1%
Dolo	-78%	Mi	- 1%	CM	-80%
Py	- 1%	HM	- 2%	G	- 1%
		CM	-59%	MicroN-	5%
		VG	- 1%		
		Pal	- 1%		
		G	- 8%		
		Py	- 1%		
		MicroN-	5%		

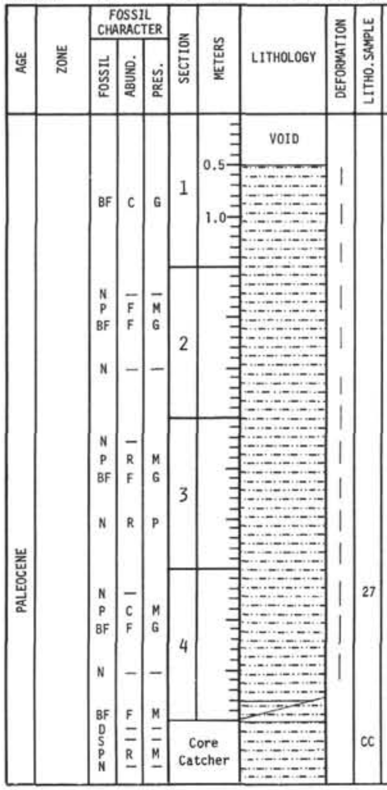
X-ray 3-57 (Bulk)

Quar	- A	Chlo	- TR
K-Fe	- TR	Mont	- A
Plag	- TR	Pyri	- TR
Mica	- P	Gyps	- TR

Grain Size 3-55 (0.5, 25.2, 74.3)

Carbon Carbonate 3-52 (2.5, 0.1, 20)

Site 283 Hole Core 15 Cored Interval: 485.0-494.5 m



LITHOLOGIC DESCRIPTION

Core is a SILTY CLAYSTONE, being GLAUCONITE, MICRONODULE, AND GLASS-BEARING (see SS 4-27). There is also abundant arenaceous foraminifera, a trace of the fossil ZOOPHYCOS and abundant (≤3%) well crystallized pyrite (2-4 mm).

SS 4-27		SS CC	
Q	-15%	Q	-15%
Mi	- 5%	Mi	- 1%
HM	- 3%	HM	- 1%
CM	-50%	CM	-77%
VG	- 5%	Dolo	- 2%
Pal	- 3%	G	- 1%
G	- 7%	MicroN-	1%
Py	- 2%		
MicroN-	5%		
Dolo	- 2%		

X-ray 2-80 (Bulk)

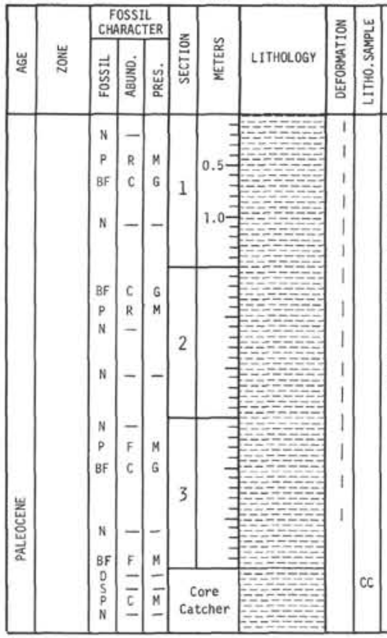
Quar - A
K-Fe - TR
Mica - P
Chlo - TR
Mont - P

Grain Size 2-78 (0.3, 25.7, 73.9)

Carbon Carbonate 2-75 (2.2, 0.4, 15)

Explanatory notes in Chapter 1

Site 283 Hole Core 16 Cored Interval: 542.0-551.5 m



LITHOLOGIC DESCRIPTION

CLAYSTONE with bedding dips up to 20° in Sec. 1 resulting from drilling deformation also in Sec. 3. The core catcher is MICRONODULE-BEARING.

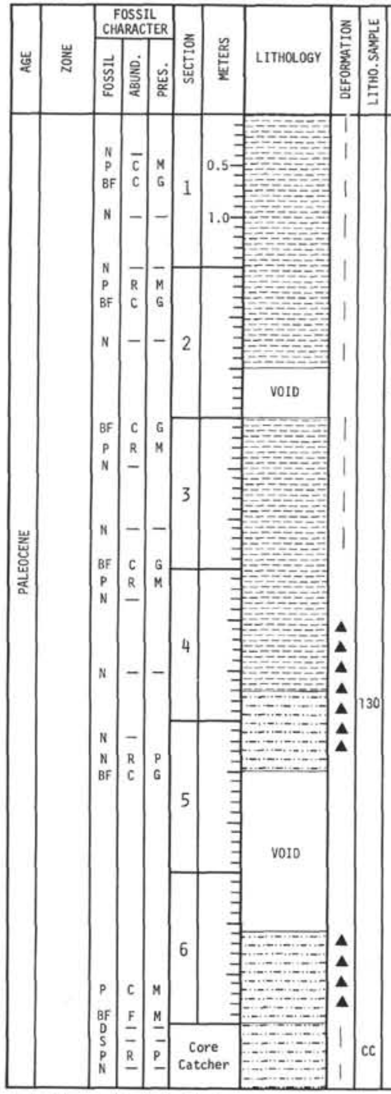
SS CC
Q - 5%
Mi - 1%
MicroN- 5%
CM -88%

X-ray 2-103 (Bulk)
Quar - A Chlo - TR
K-Fe - TR Mont - A
Mica - P Pyri - TR

Grain Size 2-106 (0.1, 13.5, 86.3)

Carbon Carbonate 2-108 (2.1, 0.4, 14)

Site 283 Hole Core 17 Cored Interval: 570.5-580.0 m



LITHOLOGIC DESCRIPTION

CLAYSTONE with pronounced bedding plane parting; about 0.5% with crystallized pyrite, especially in burrows. Core highly segmented with variously inclined bedding up to 30°. At 121 cm, Sec. 4: sediment lightens in color to greenish gray (5GY 4/1); burrows and pellets are pale red (5R 6/2) in a GLASS AND MICRONODULE BEARING SILTY CLAYSTONE. Sec. 6 consists of drilling breccia in which the fragments are tabular and well rounded. The core catcher is a GLASS, PALAGONITE AND MICRONODULE BEARING SILTY CLAYSTONE.

SS 4-130		SS CC	
Q	-15%	Q	-25%
Mi	- 2%	F	- 2%
HM	- 1%	Mi	- 5%
CM	-69%	HM	- 2%
VG	- 5%	CM	-48%
Pal	- 2%	VG	- 3%
Py	- 1%	Pal	- 5%
MicroN	- 5%	MicroN	- 5%
		Z	- 2%
		M	- 1%
		Col	- 2%

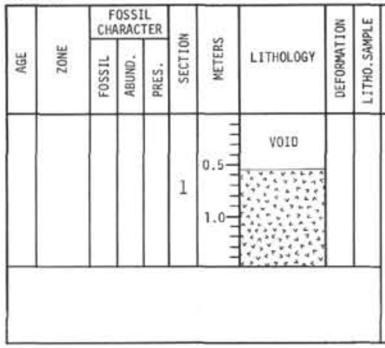
X-ray 4-91 (Bulk)
Calc - TR Mica - A
Quar - A Chlo - TR
K-Fe - P Mont - P
Plag - TR Pyri - TR

Grain Size 4-83 (1.0, 23.5, 75.6)

Carbon Carbonate 4-81 (1.4, 0.3, 9)

Explanatory notes in Chapter 1

Site 283 Hole Core 18 Cored Interval: 588.5-589.5 m



LITHOLOGIC DESCRIPTION

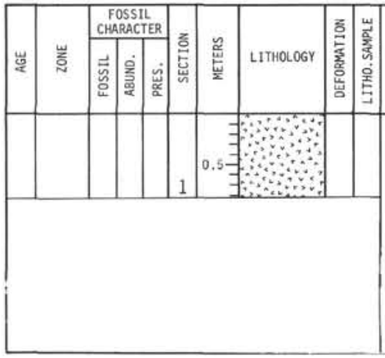
Unit 5. Thirteen core segments and fragments of altered basalt.

60-80 cm: devitrified basaltic glass, light greenish-gray (5G 7/1); calcite and serpentine veinlets; specimen (4) has a 2-cm-wide dark-red palagonite vein which suggests interpillow glass; rock consists of <2% altered feldspar laths in groundmass of clay, zeolite and serpentine.

80-100 cm: altered basaltic breccia, very dark greenish gray (5GY 3/1); tectonic or autoclastic texture; consists of amygdaloidal basalt (80%), calcite veins (15%) and dark devitrified glass fragments (5%) with minor dark green serpentine veinlets; amygdules average ~1.0 mm.

100-150 cm: altered basalt; dark greenish gray (5GY 3/1) cut by calcite-serpentine veinlets up to 1 cm thick.

Site 283 Hole Core 19 Cored Interval: 589.5-592.0 m



LITHOLOGIC DESCRIPTION

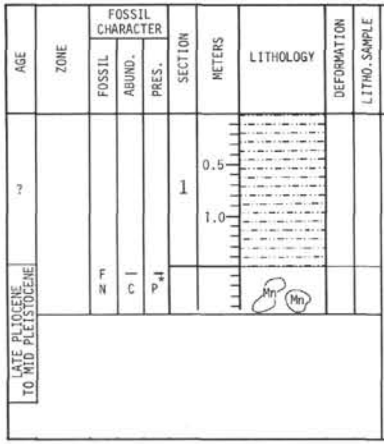
Fifteen core segments and fragments of altered basalt.

Fragment (6) at 32-38 cm is the upper surface of a pillow showing a devitrified glass patina above a chilled rim grading downward to holocrystalline(?) altered basalt.

Thin section of specimen (7): fine grained, original texture largely obscured by radial habit of alteration products; some suggestion of intersertal and subophitic texture; estimated composition:

altered plagioclase laths	20%
black opaque minerals	10%
altered olivine/pyroxene	3%
serpentine(?) after glass	10%
calcite	5%
clay, serpentine, zeolite	52%

Site 283 Hole A Core 1 Cored Interval: 0.0-1.5 m

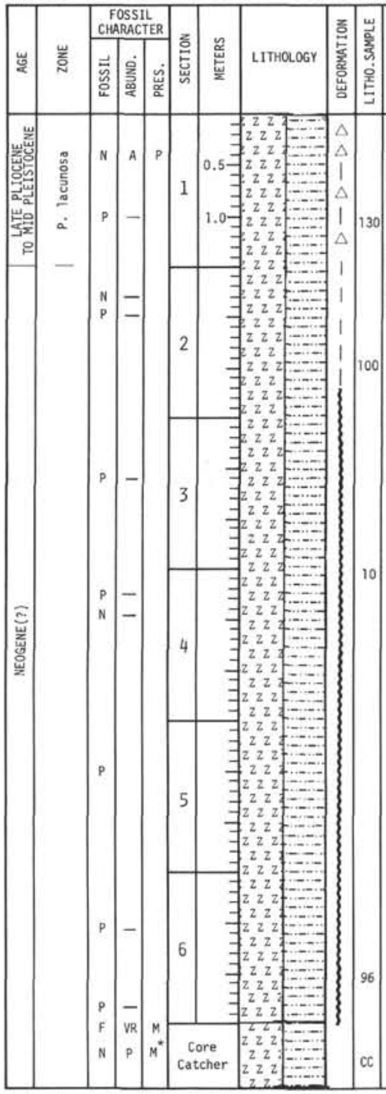


LITHOLOGIC DESCRIPTION

CLAYSTONE DRILL CUTTINGS : roundstone open framework gravel; well graded from 30 mm at base to 3 mm at top. Core catcher: two soft, botryoidal manganese nodules.

*from yellow mud attached to a Mn nodule.

Site 283 Hole A Core 2 Cored Interval: 11.0-20.5 m (?)



LITHOLOGIC DESCRIPTION

moderate yellowish brown (10YR 5/4) mottled dark yellowish brown (10YR 4/2); subhomogeneous at top. Lithologic variations include: MICARB-BEARING MICRONODULE RICH DETRITAL SILTY CLAY (Sec. 1); a ZEOLITE BEARING CLAY (Sec. 2); a ZEOLITE AND MICRONODULE BEARING CLAY (Sec. 4); a SILTY ZEOLITE CLAY (Sec. 6) and a SILTY ZEOLITE CLAY in the core catcher.

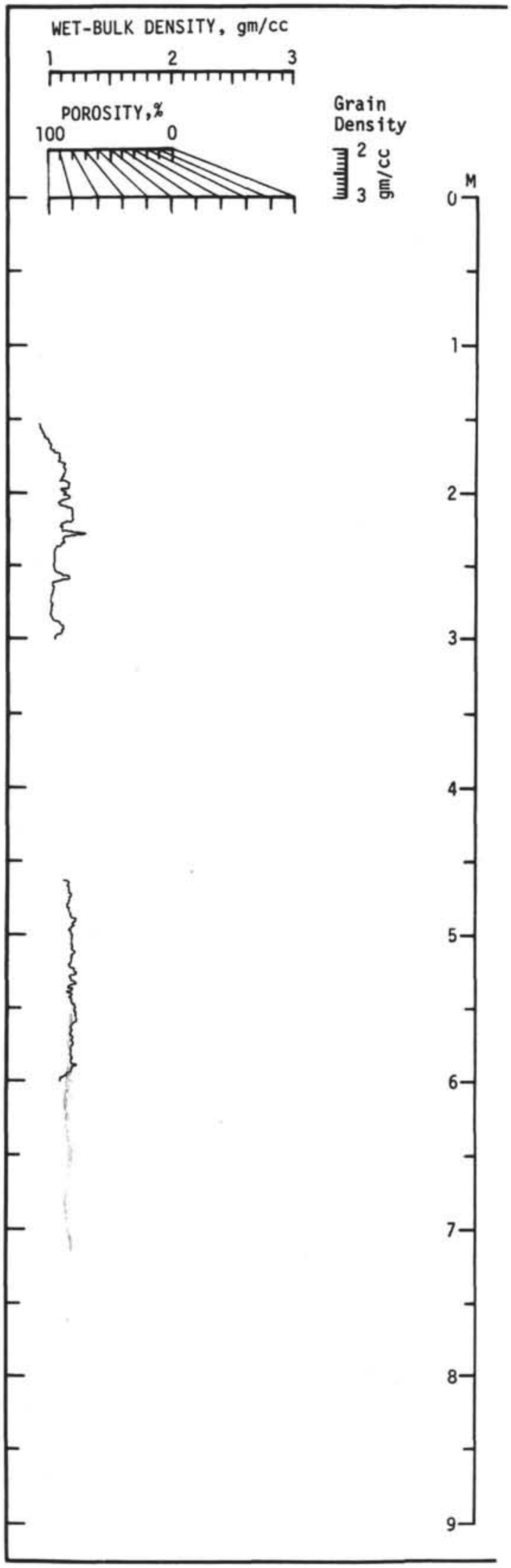
SS 1-130	SS 2-100	SS 4-10	SS 6-96	SS CC
Q -12%	Q - 5%	Q -10%	Q -10%	Q -15%
Mi - 8%	CM -95%	CM -80%	F - 1%	F - 2%
CM -52%	Z - 5%	MicroN- 5%	Mi - 1%	Mi - 3%
MicroN-24%		Z - 5%	CM - 5%	HM - 1%
M - 4%			VG - 5%	CM -20%
			Pal - 5%	VG - 2%
			MicroN- 5%	MicroN- 3%
			Z -70%	Z -54%

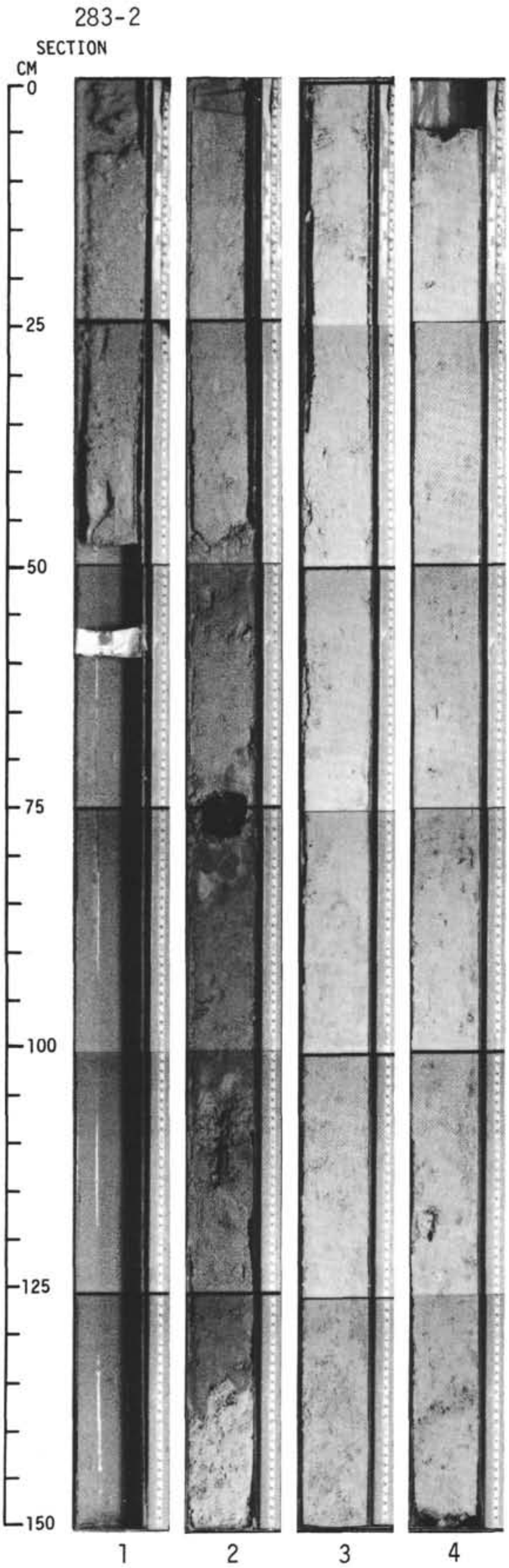
X-ray 3-63 (Bulk)

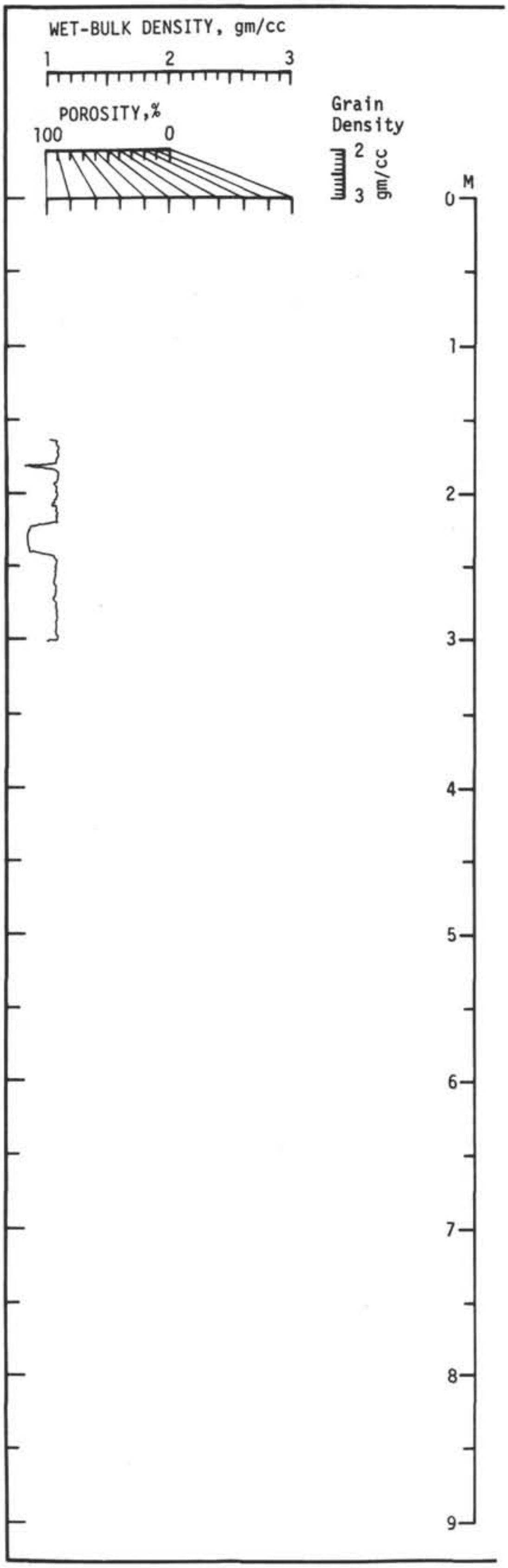
Quar	- A	Mica	- P
K-Fe	- P	Mont	- P
Plag	- P	Gyps	- TR
Kaol	- P		

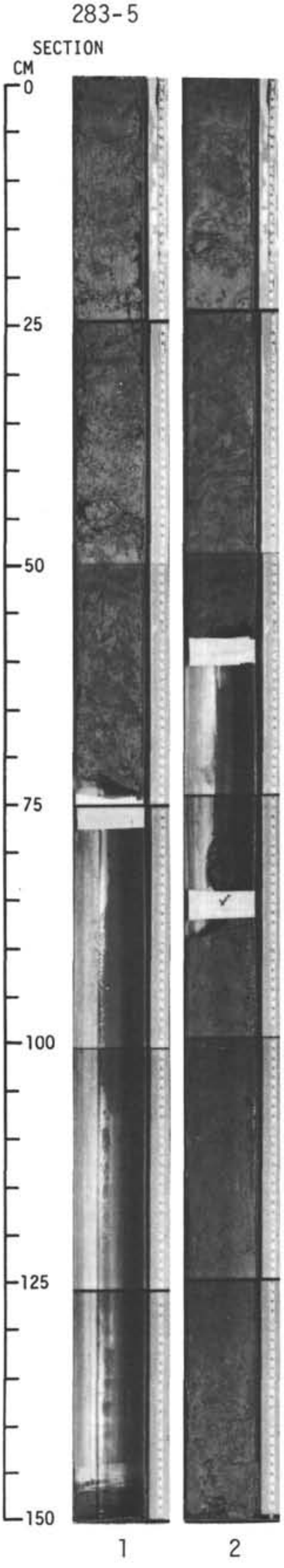
Grain Size 3-55 (0.2, 14.4, 85.4)

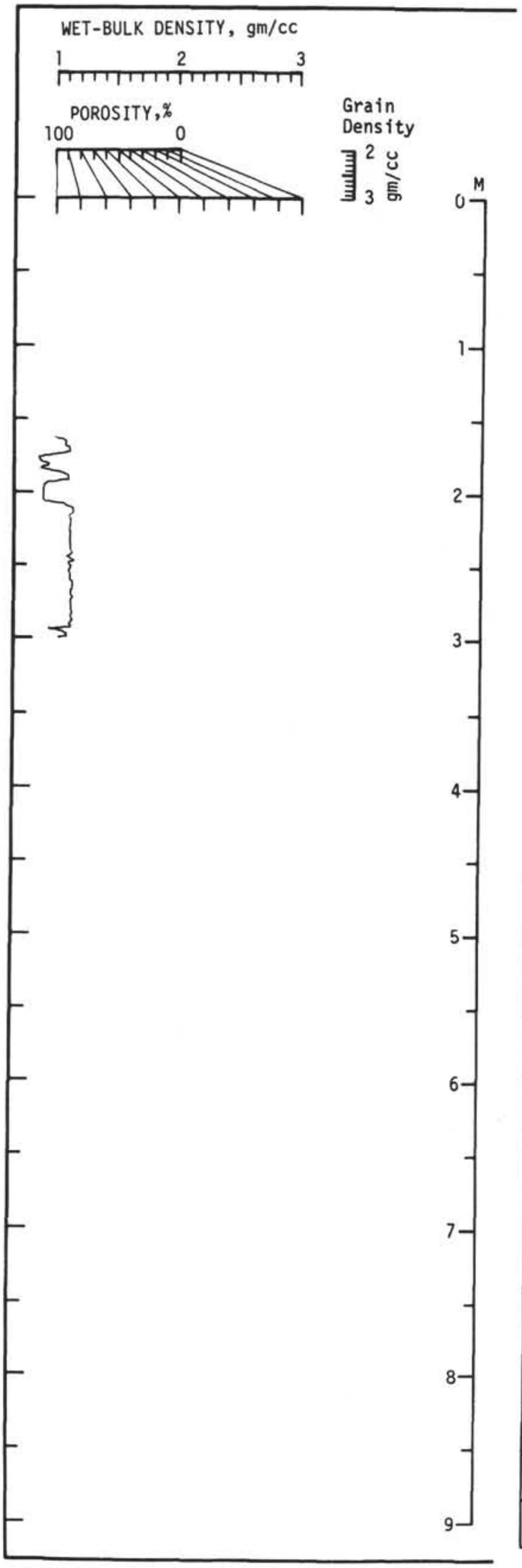
Explanatory notes in Chapter 1
*downhole contamination

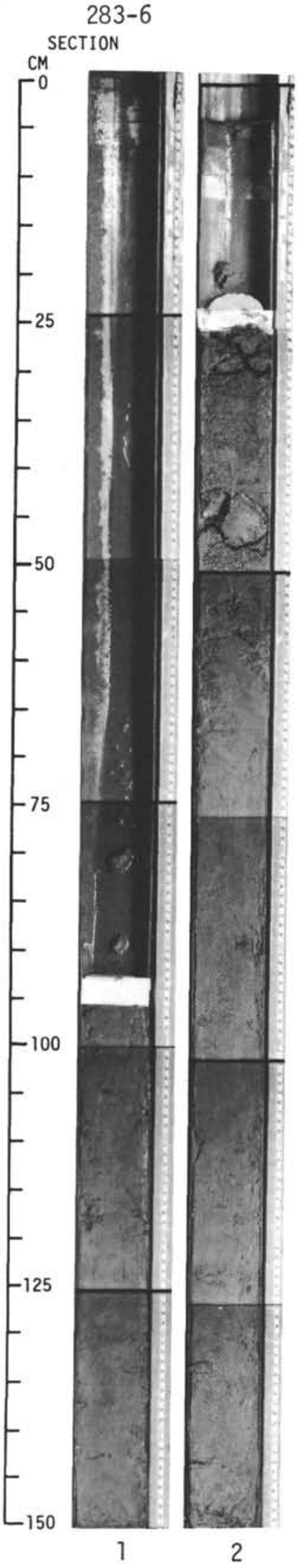

WET-BULK DENSITY, gm/cc
1
2
3
POROSITY,%
100
0
Grain Density
2
3
gm/cc
M
0
1
2
3
4
5
6
7
8
9

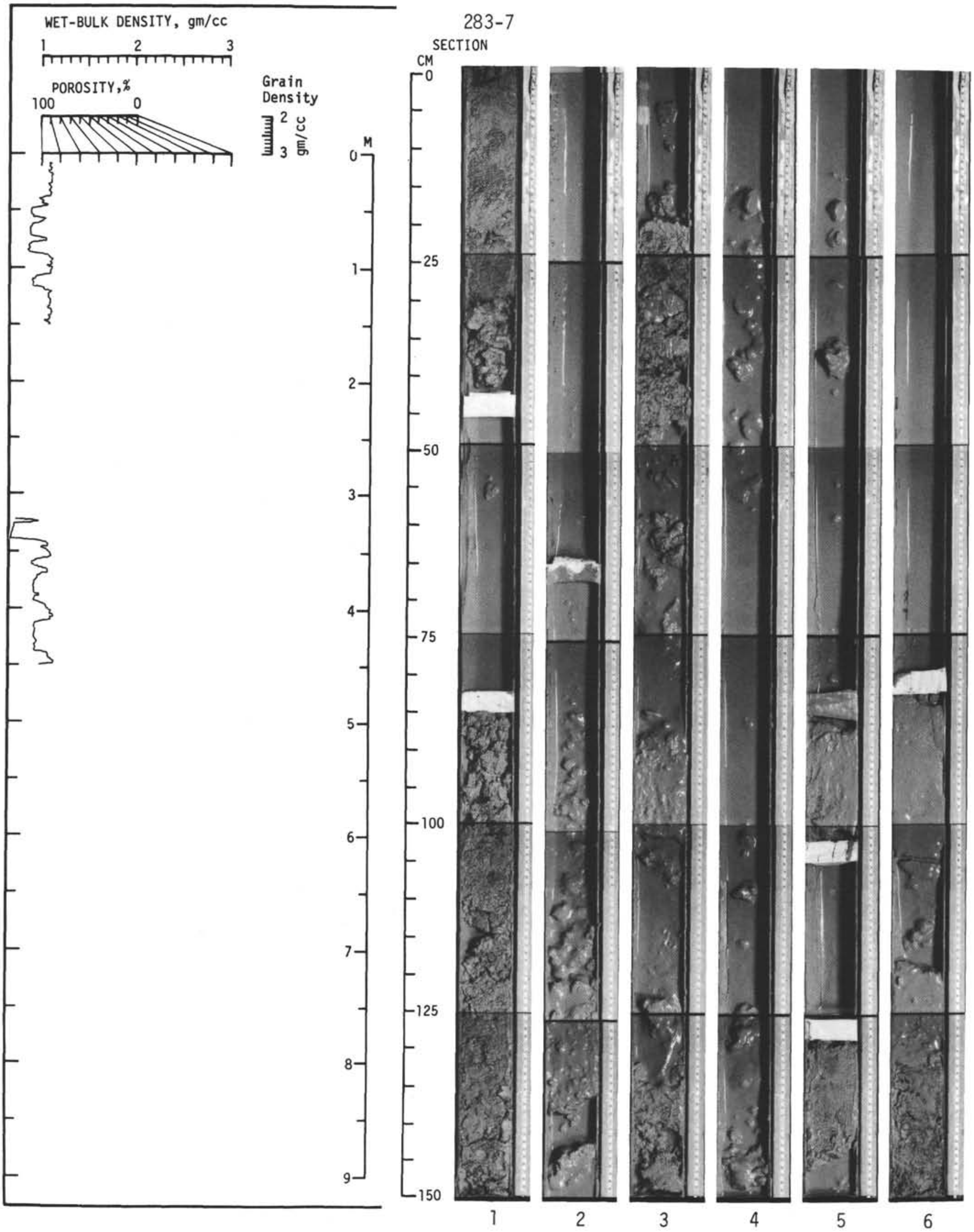

283-2
SECTION
CM
0
25
50
75
100
125
150
1
2
3
4

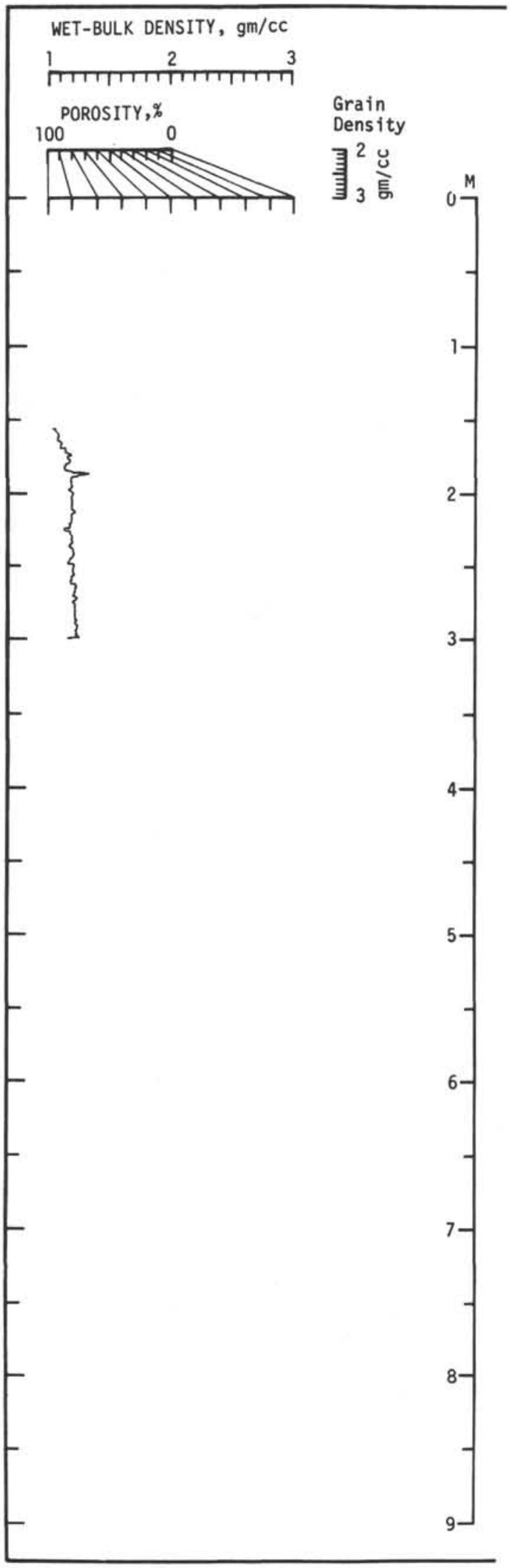

WET-BULK DENSITY, gm/cc
1
2
3
POROSITY,%
100
0
Grain Density
2
3
gm/cc
M
0
1
2
3
4
5
6
7
8
9


283-5
SECTION
CM
0
25
50
75
100
125
150
1
2


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


283-6
SECTION
CM
0
25
50
75
100
125
150
1
2


WET-BULK DENSITY, gm/cc
1
2
3
POROSITY,%
100
0
Grain Density
2
3
gm/cc
M
0
1
2
3
4
5
6
7
8
9
283-7
SECTION
CM
0
25
50
75
100
125
150
1
2
3
4
5
6


WET-BULK DENSITY, gm/cc
1
2
3
POROSITY,%
100
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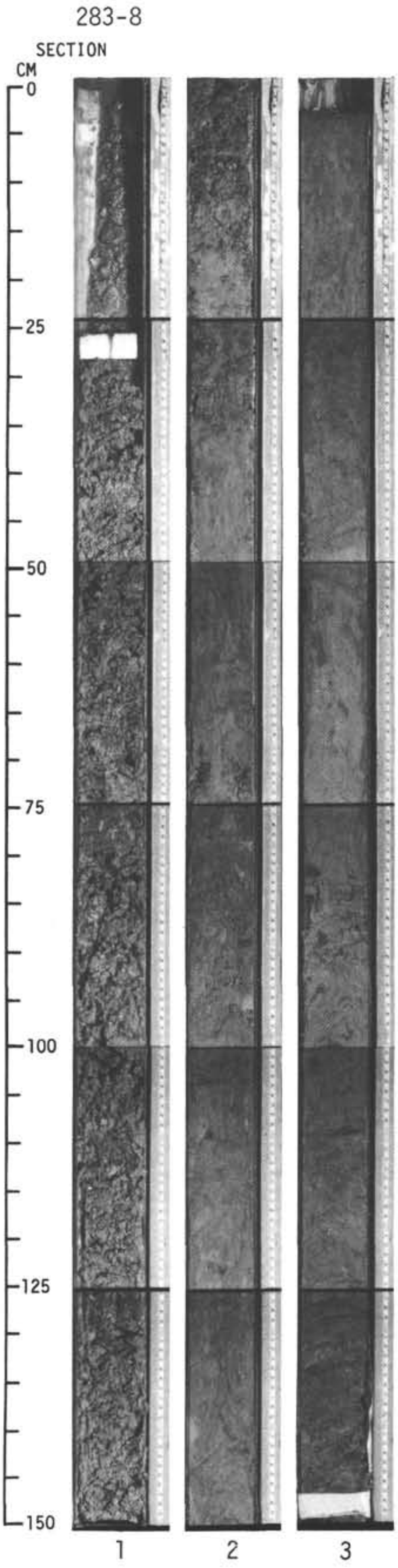
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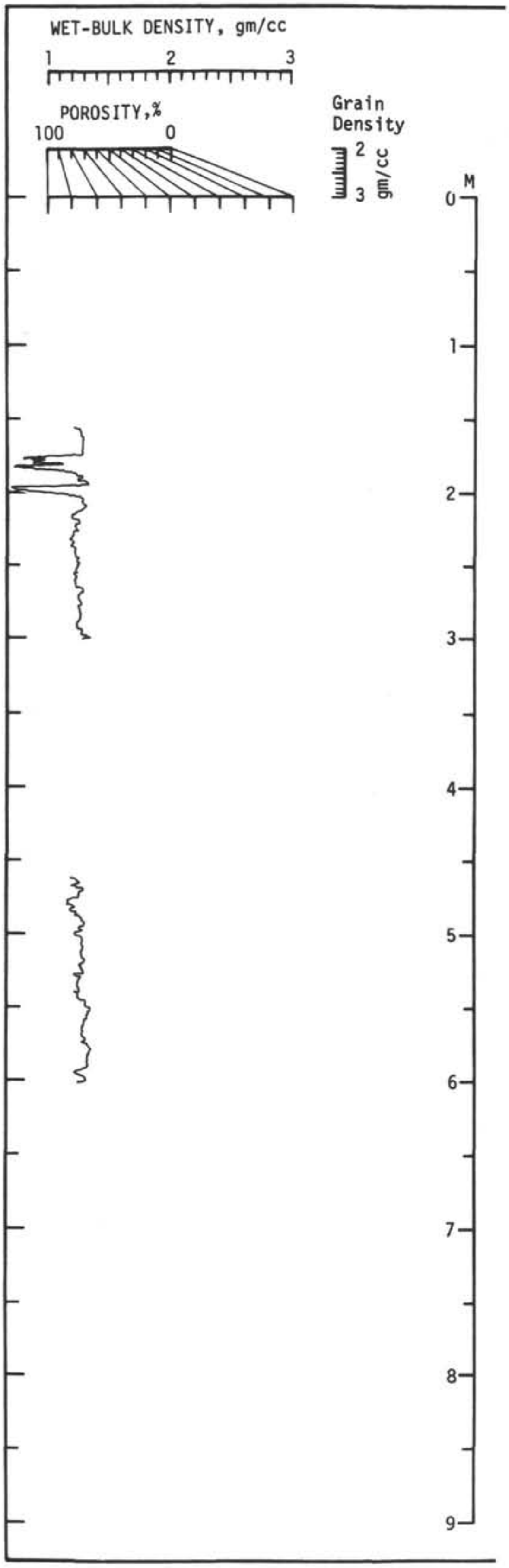
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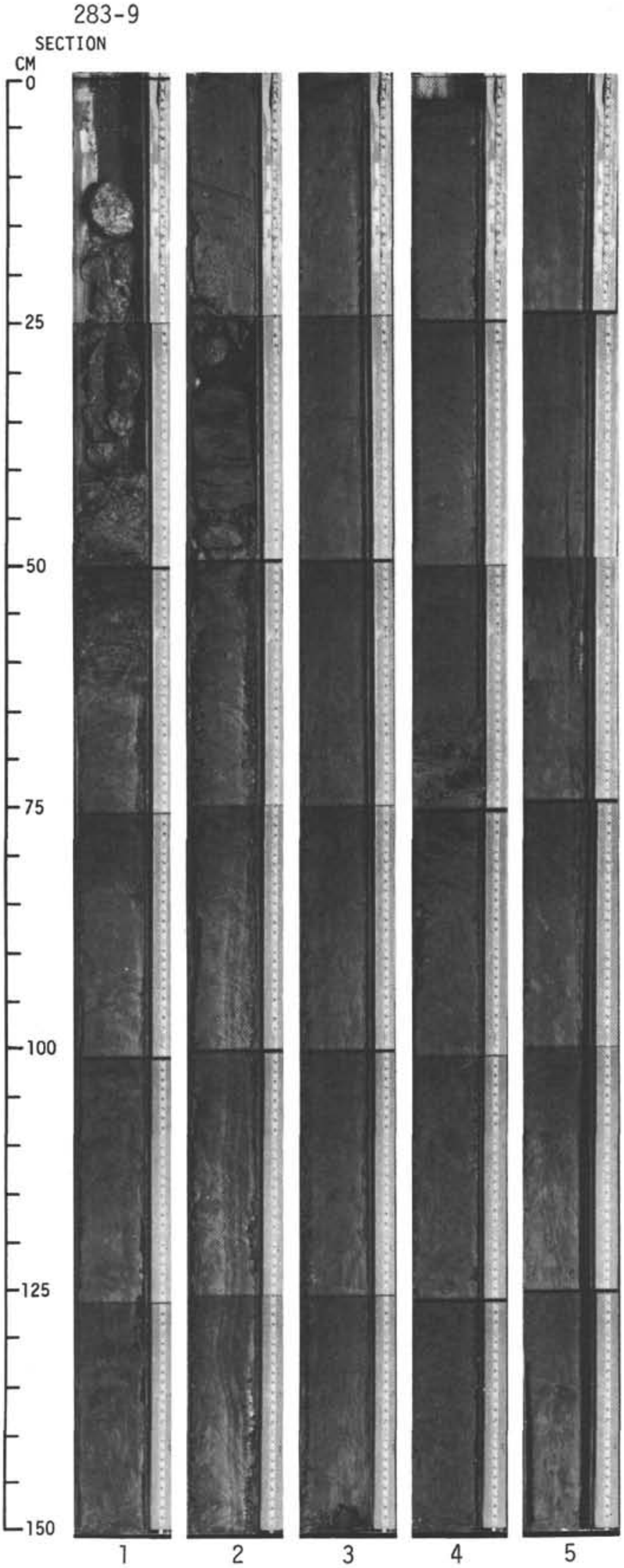
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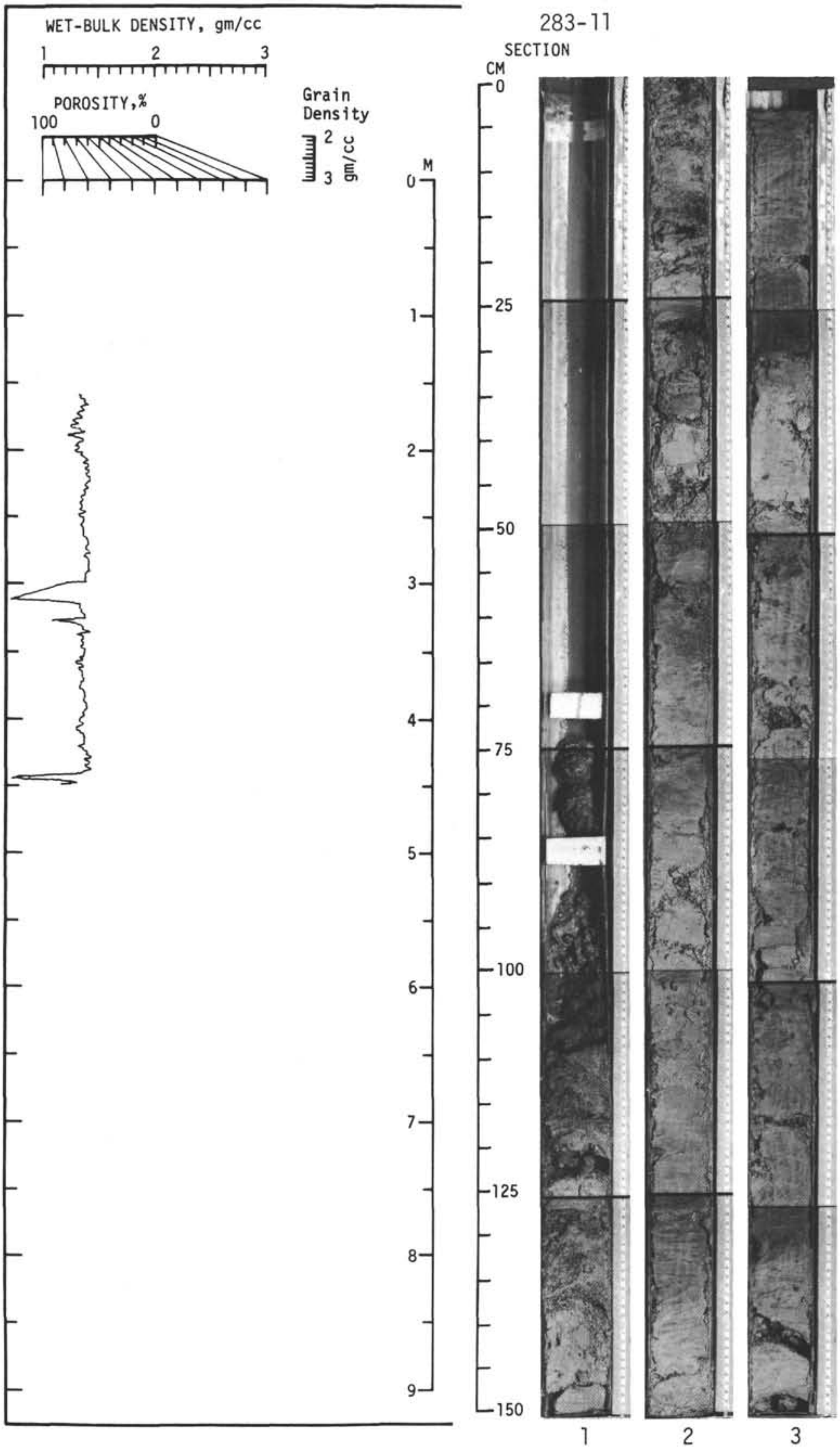
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gm/cc
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283-11
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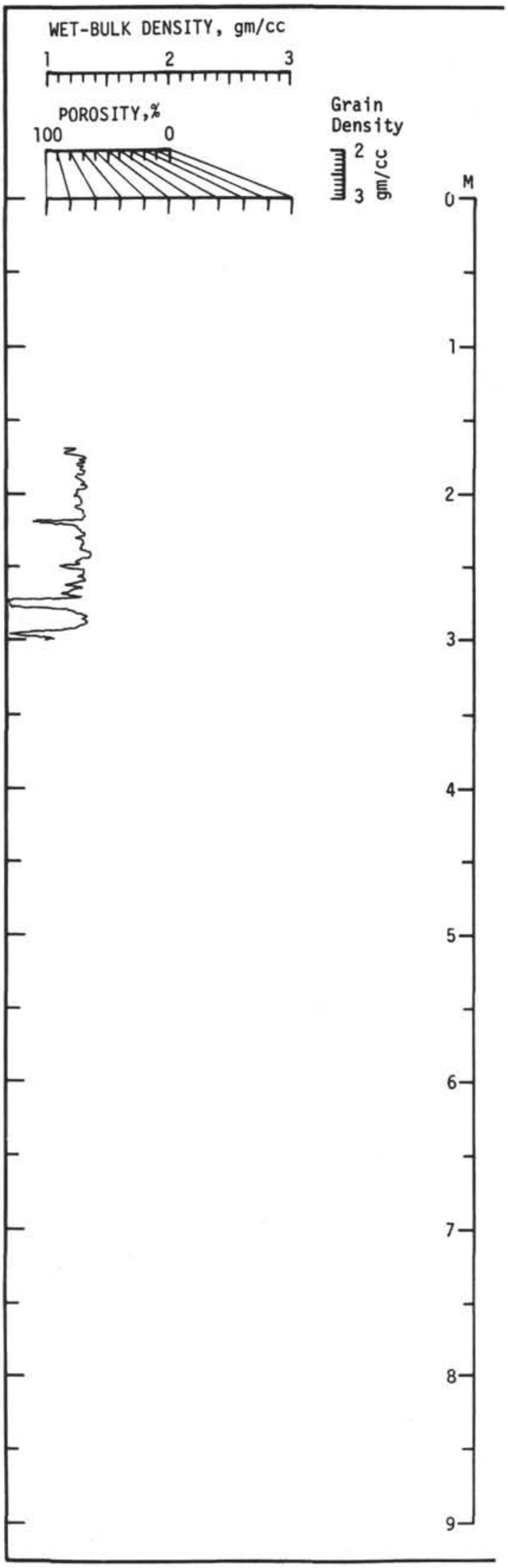
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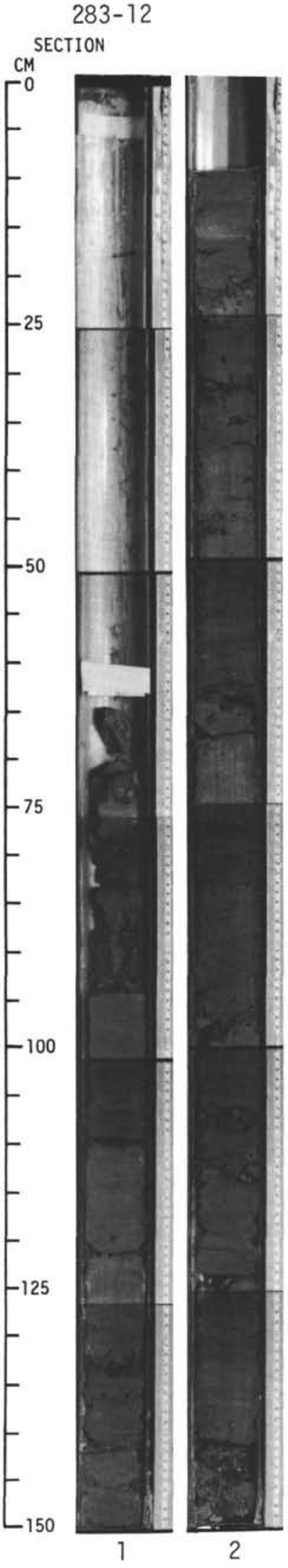
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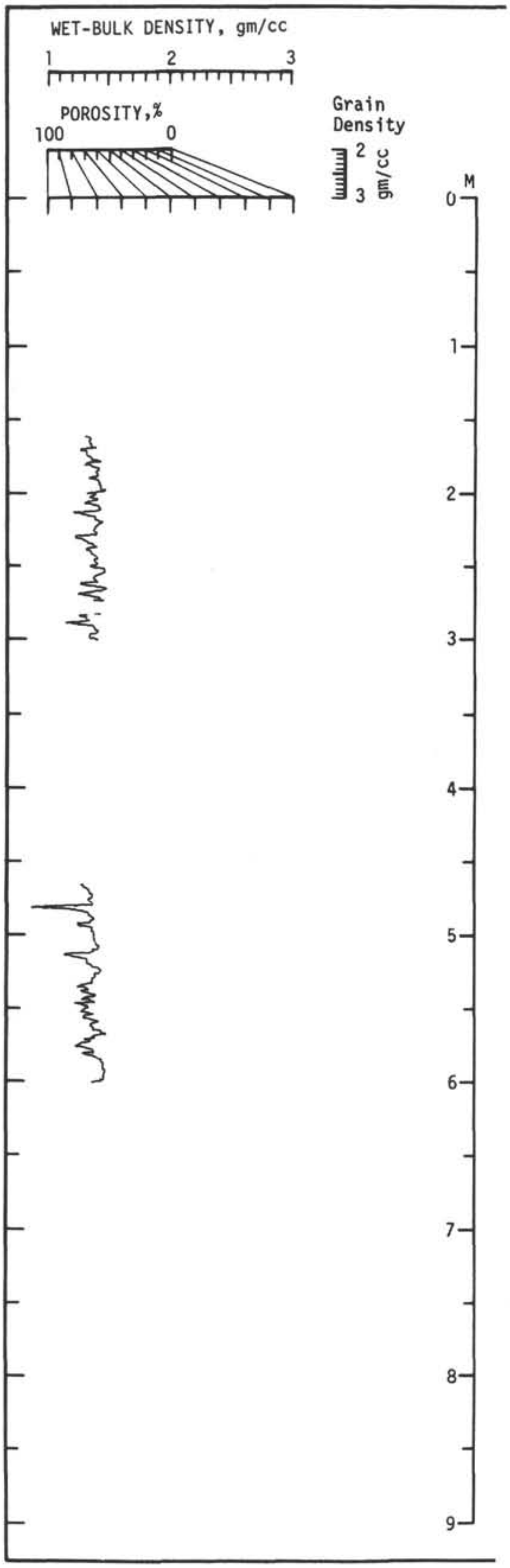
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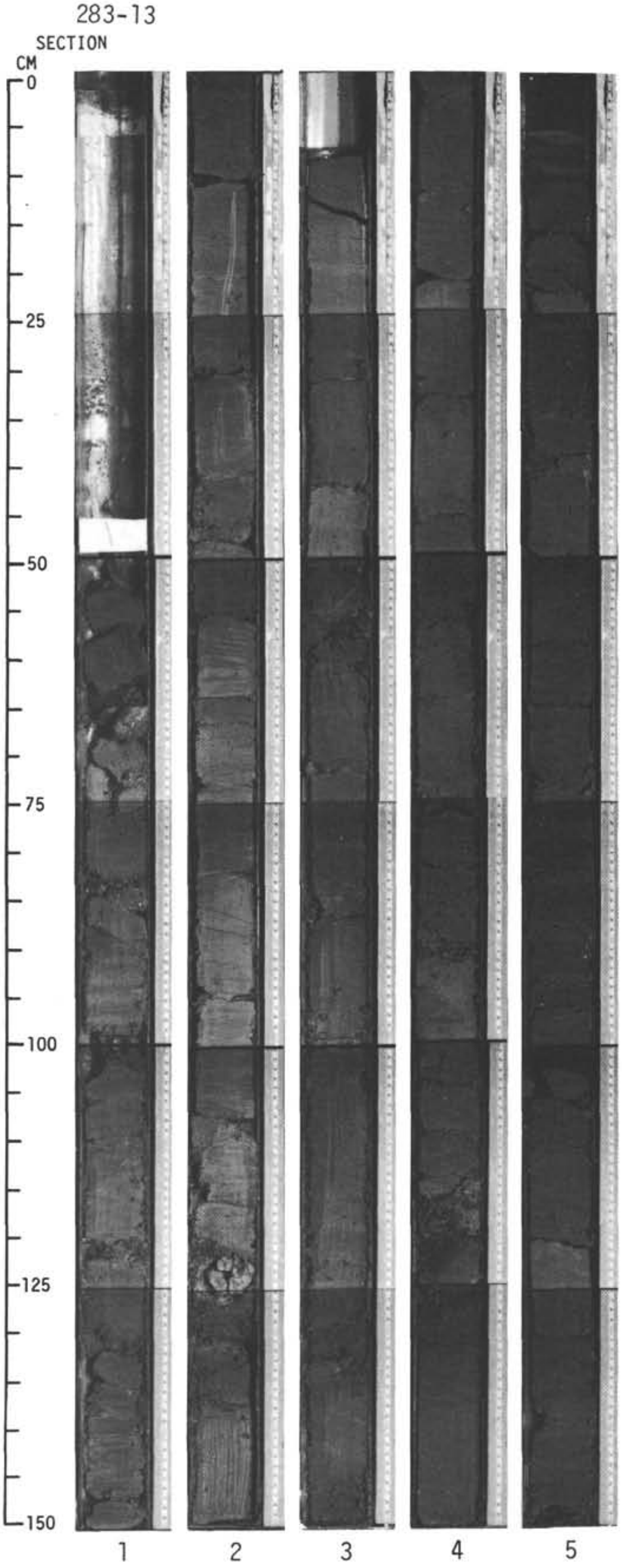
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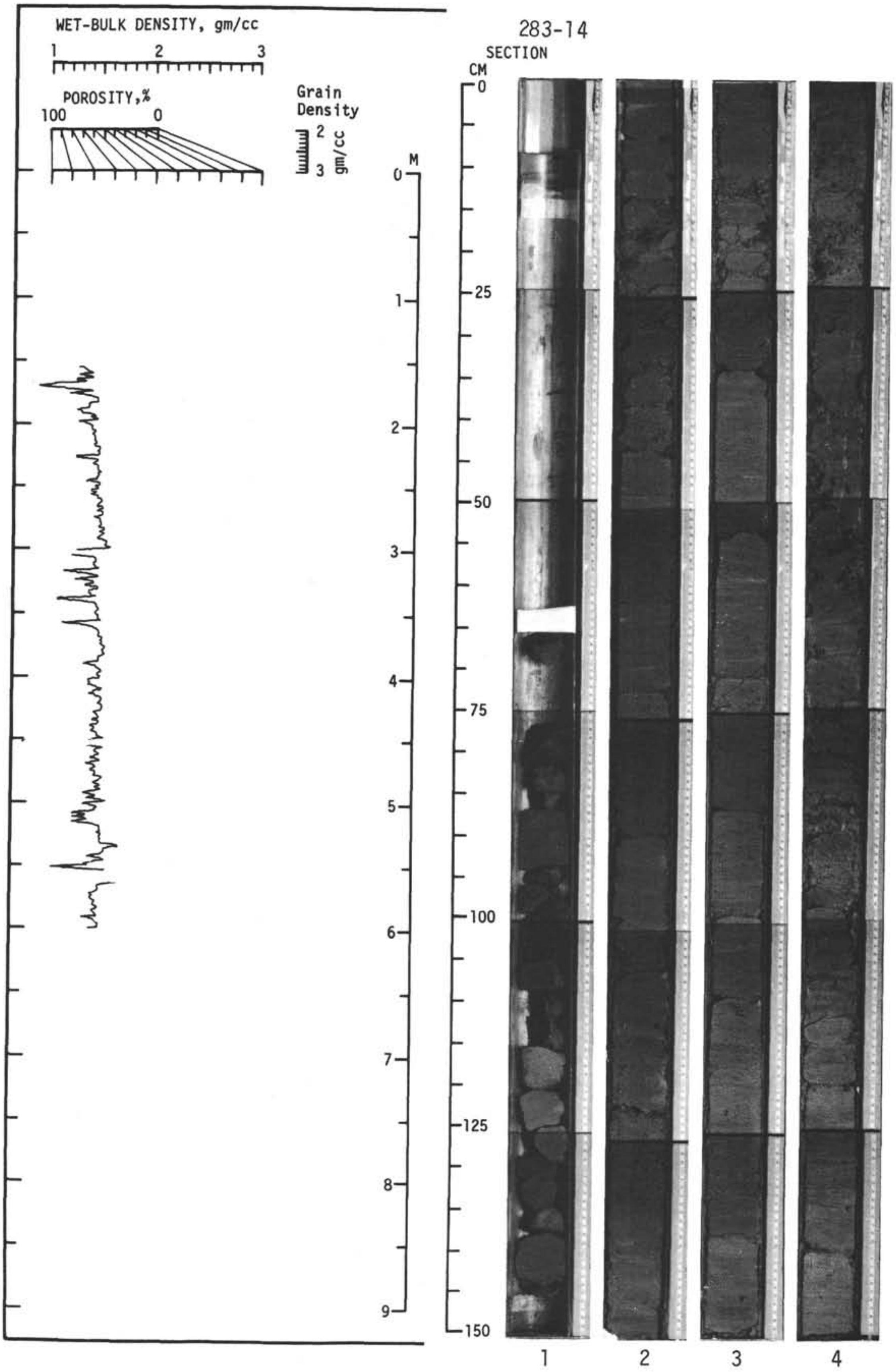
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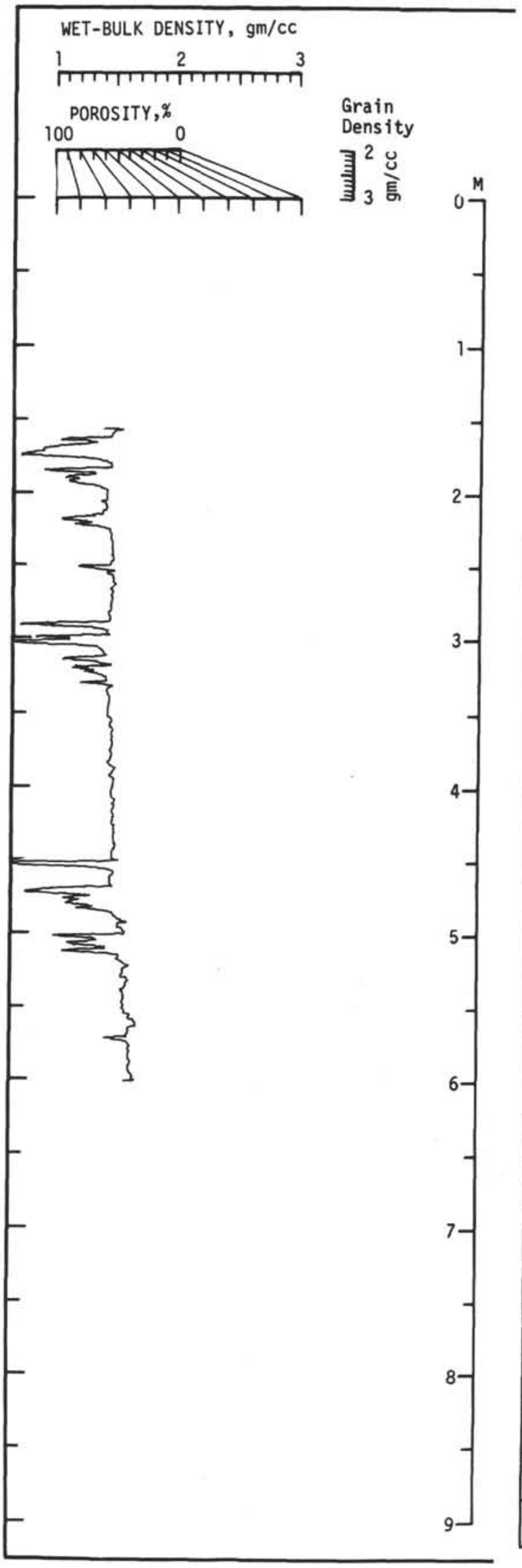
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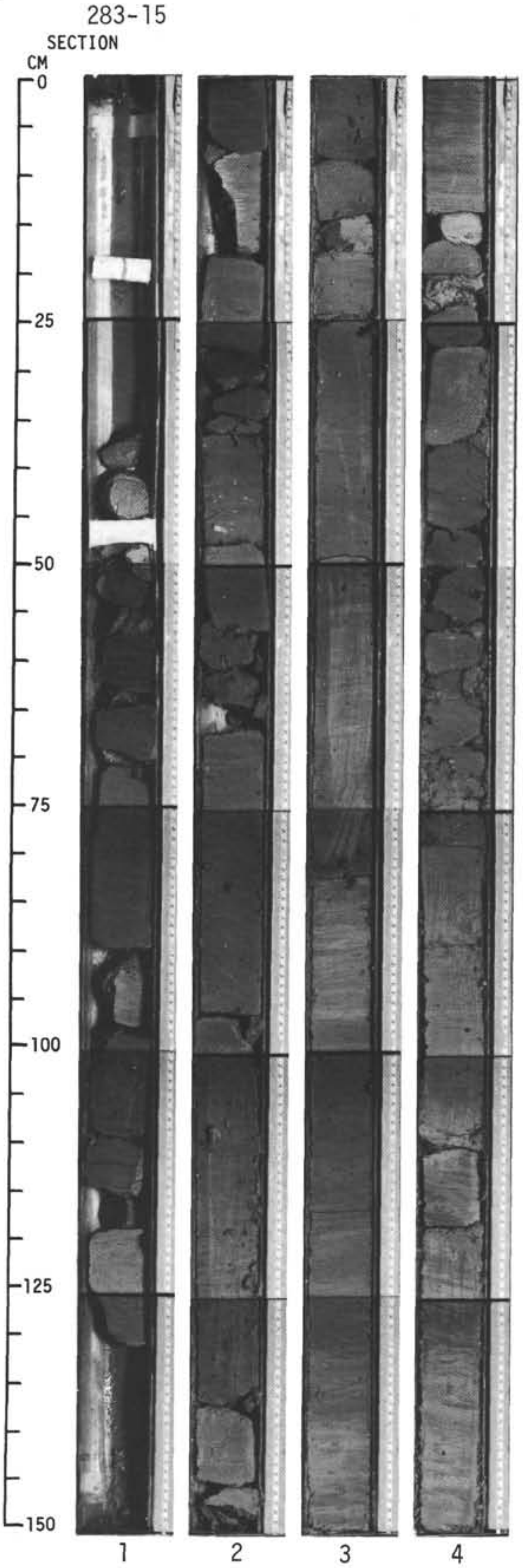
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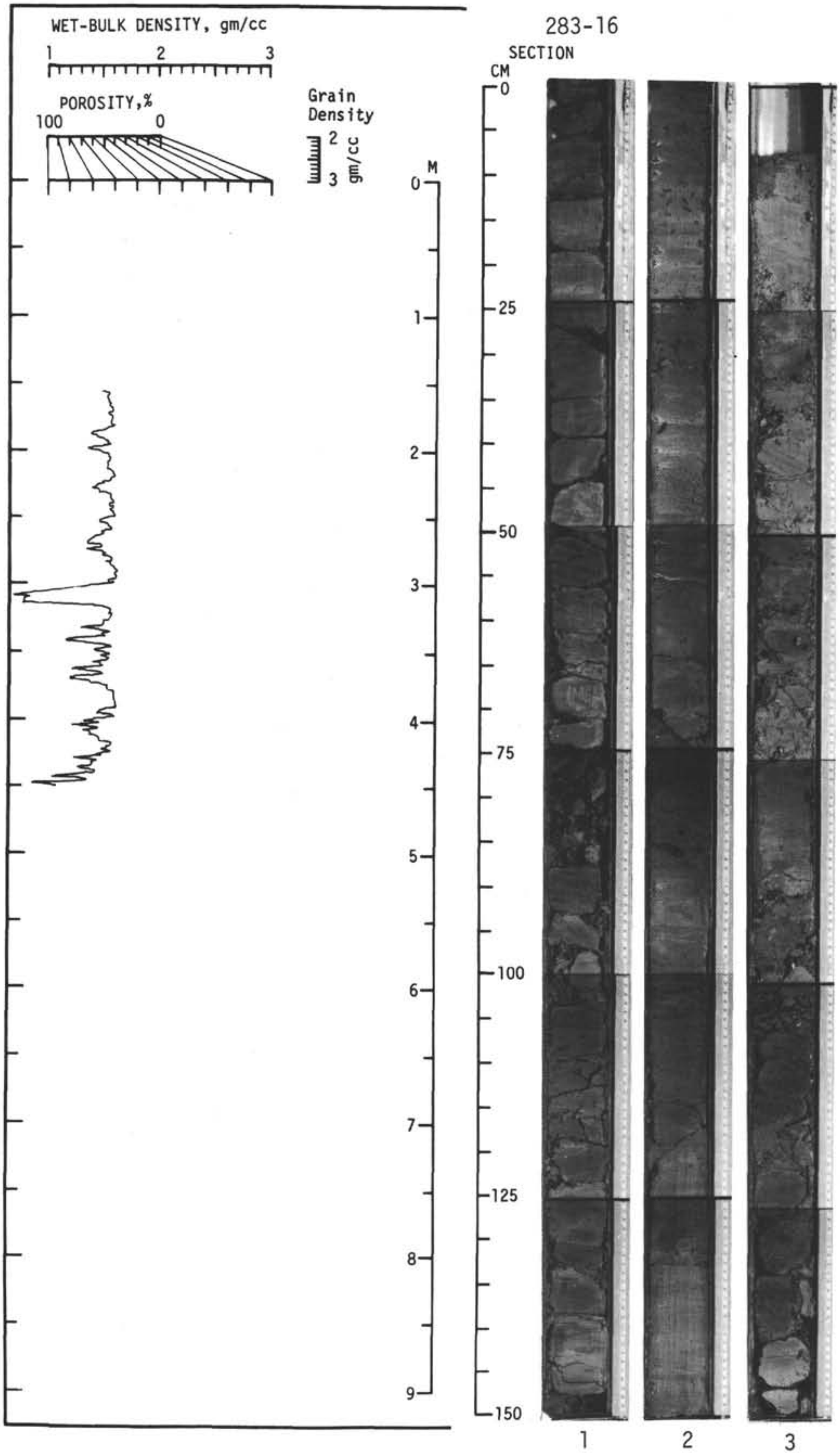
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Density
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3
gm/cc
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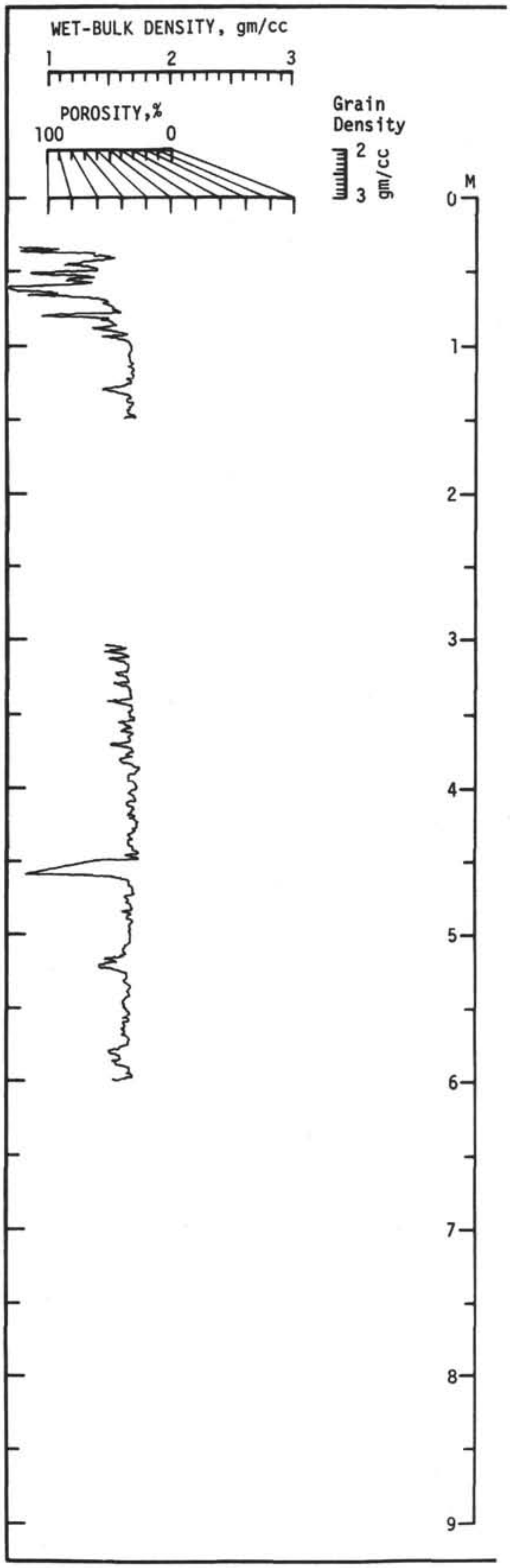
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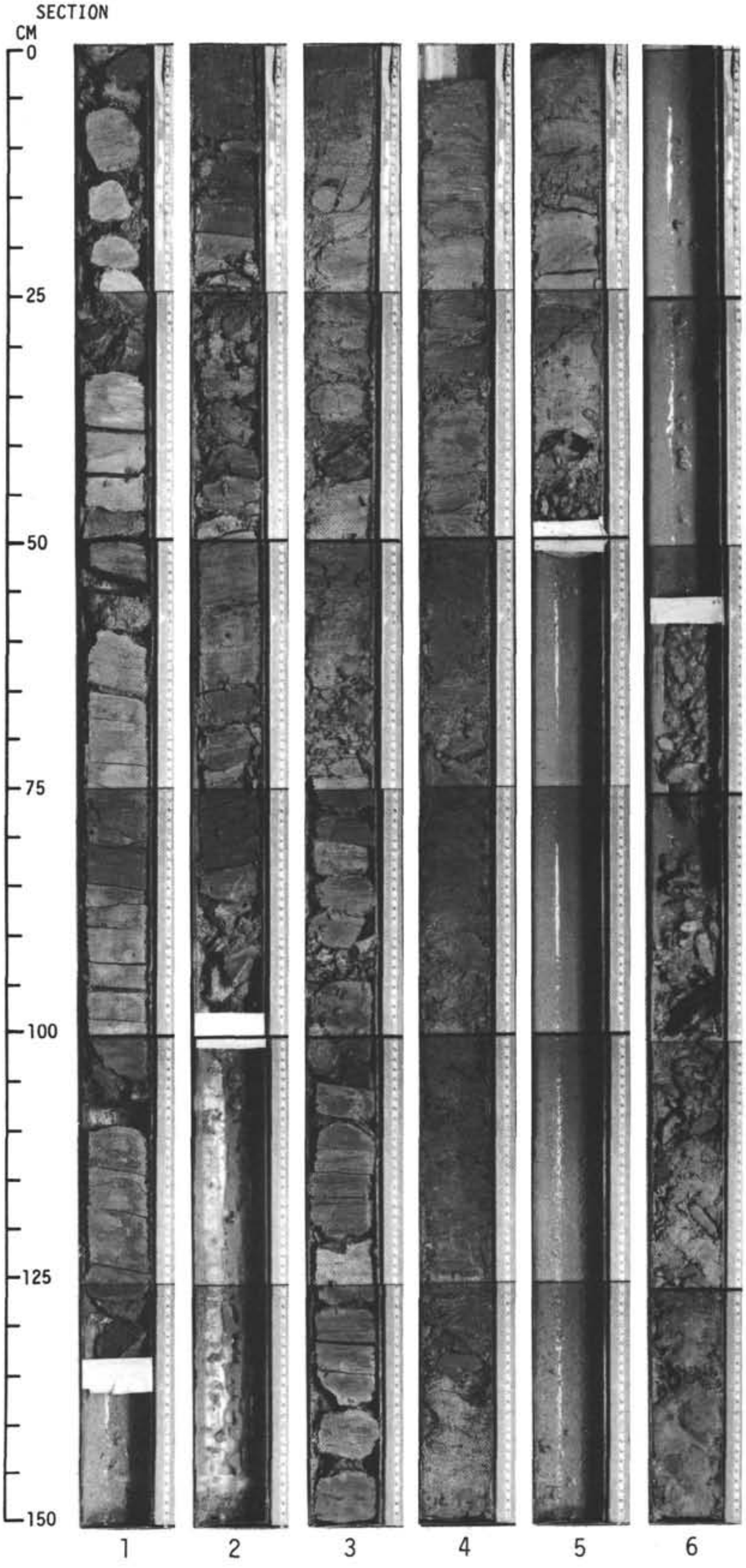
283-17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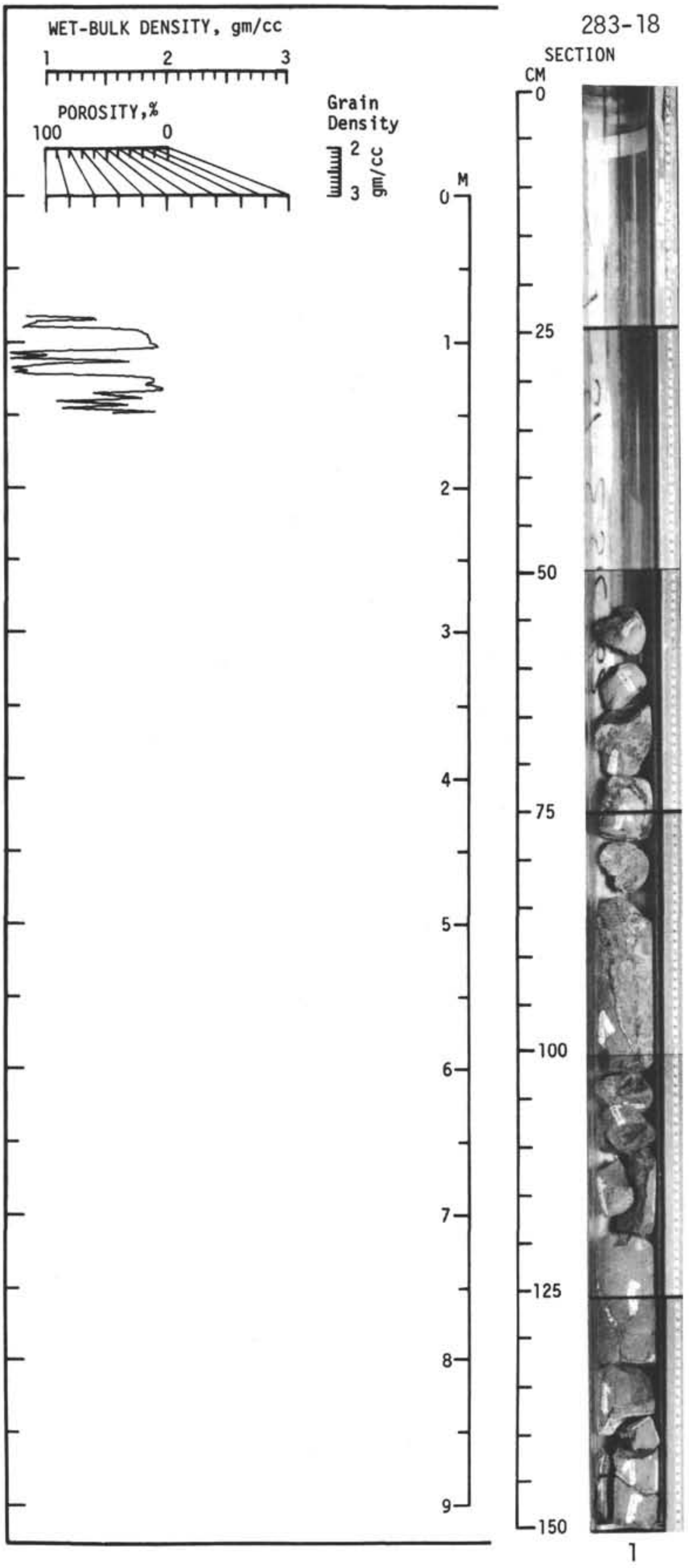
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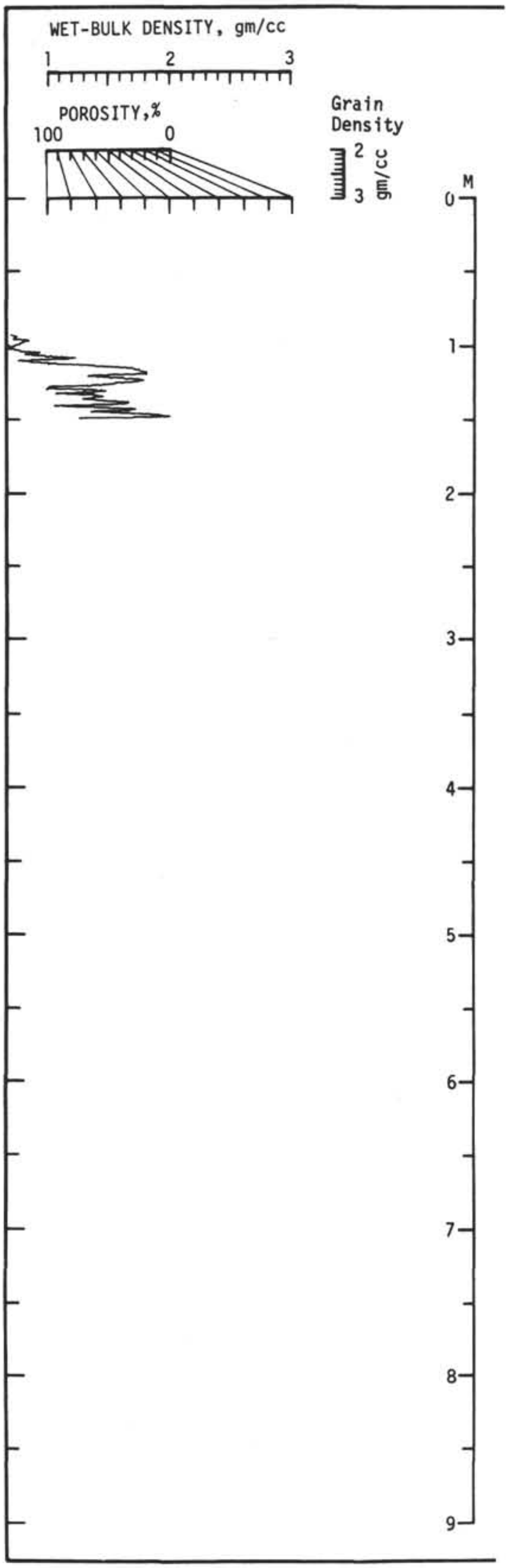
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Density
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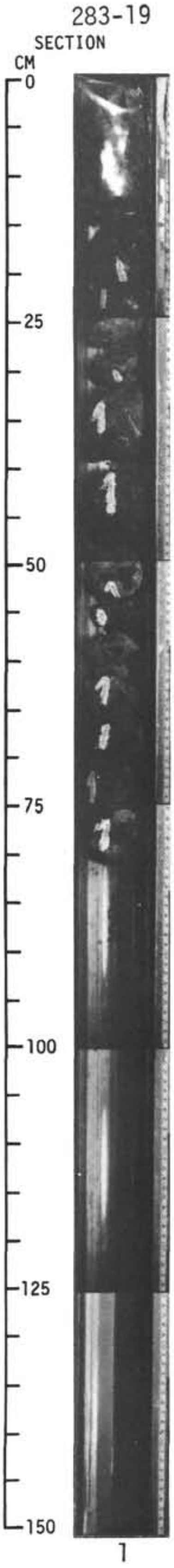
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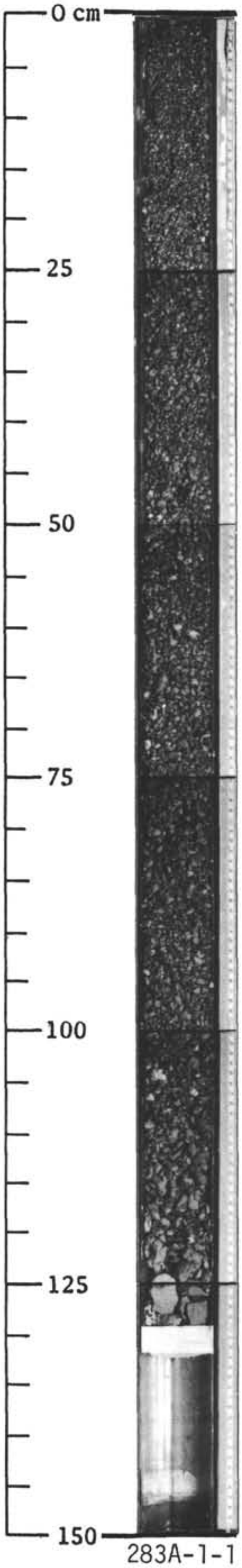
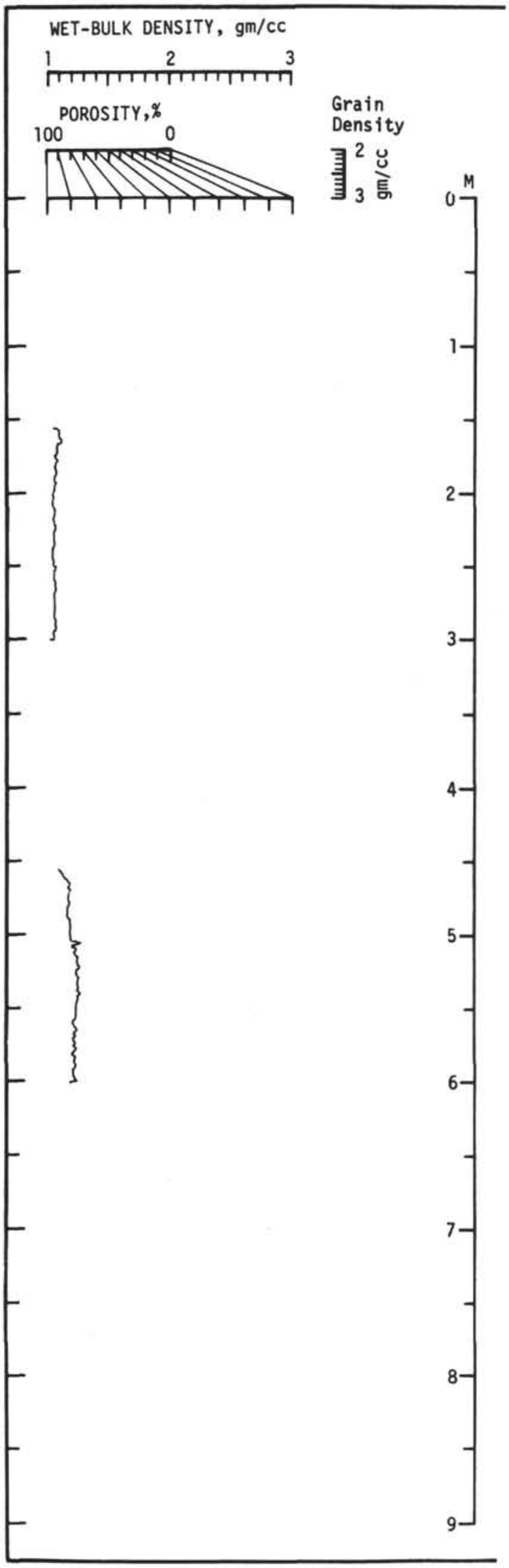


283A-1-1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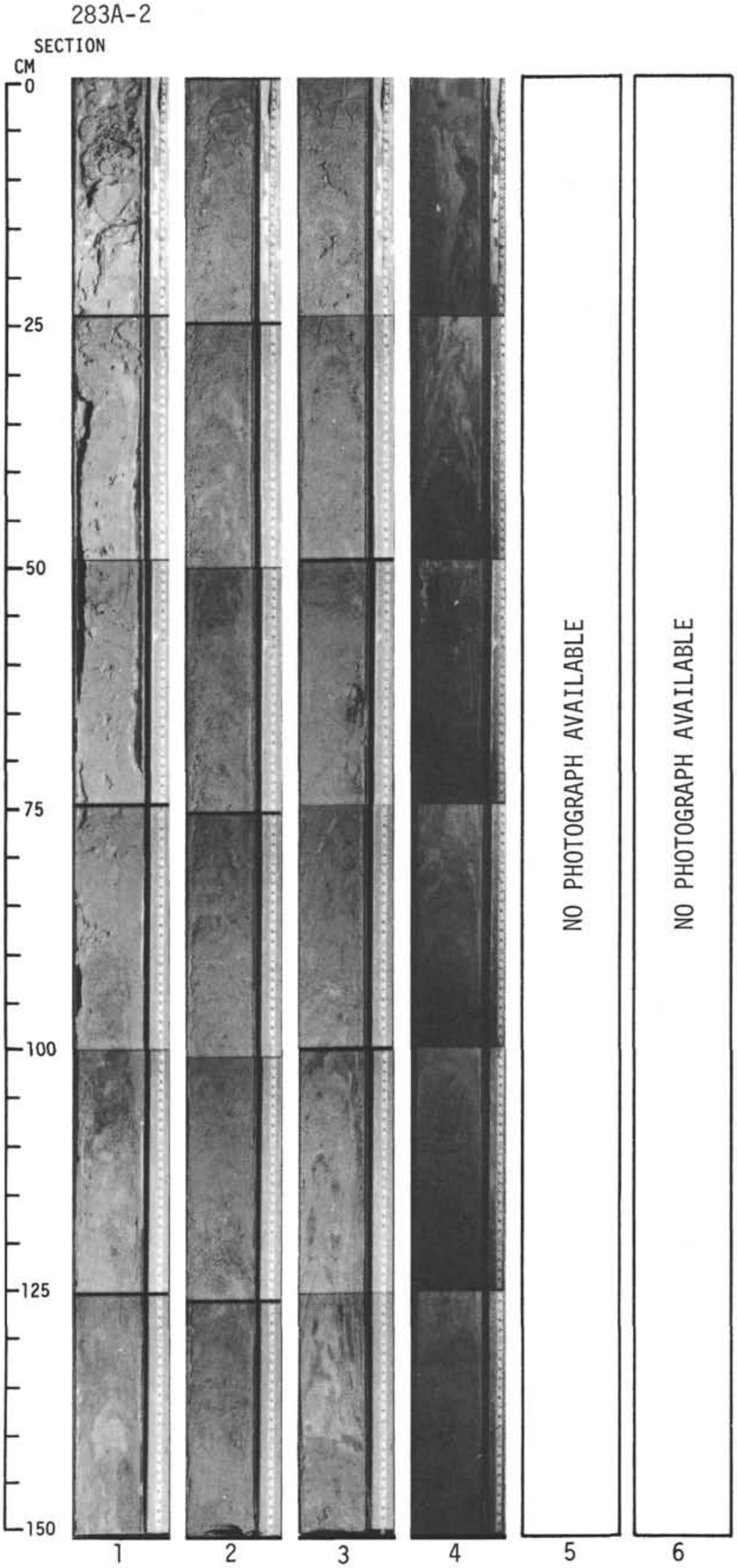
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NO PHOTOGRAPH AVAILABLE