7. SITE 7[1]

The Shipboard Scientific Party[2]

SITE REPORT

Setting and Purpose

Since a thick sequence of cherts was encountered in Hole 6 and only a short time was available, it was decided to return about 50 miles along the *Glomar Challenger* track, to a location where the section was greatly reduced in thickness. In this way it was hoped that the thickness of cherts to be penetrated would be less and since all layers were closer to the ocean floor, the drilling time would be reduced.

Hole 7 was therefore drilled a little farther to the southwest at a location closely similar to the setting of Hole 6, except for the thickness of the section. Hole 7 was drilled at 30° 08.04′N, 68° 17.80′W, in a water depth of 5185 meters (17,012 feet) corrected for sound velocity in sea water and transducer head-depth. After two cores were taken, a severe swell (to which the ship was allowed to remain broadside) caused the drill string to be bounced on the bottom of the hole, damaging the core barrel. It therefore became necessary to recover the drill string and replace the core barrel. Hole 7A was then drilled to a depth of 296.2 meters (971 feet) subbottom. The cherts of layer A were finally penetrated after a long-continued effort, and nonfossiliferous sediments were encountered and cored beneath it. At this point in time, the ship's navigator judged that departure for port was necessary in order to have an adequate margin for maintaining a necessarily inflexible schedule. The hole had to be abandoned at this point.

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Summary of Drilling and Coring at Site 7.

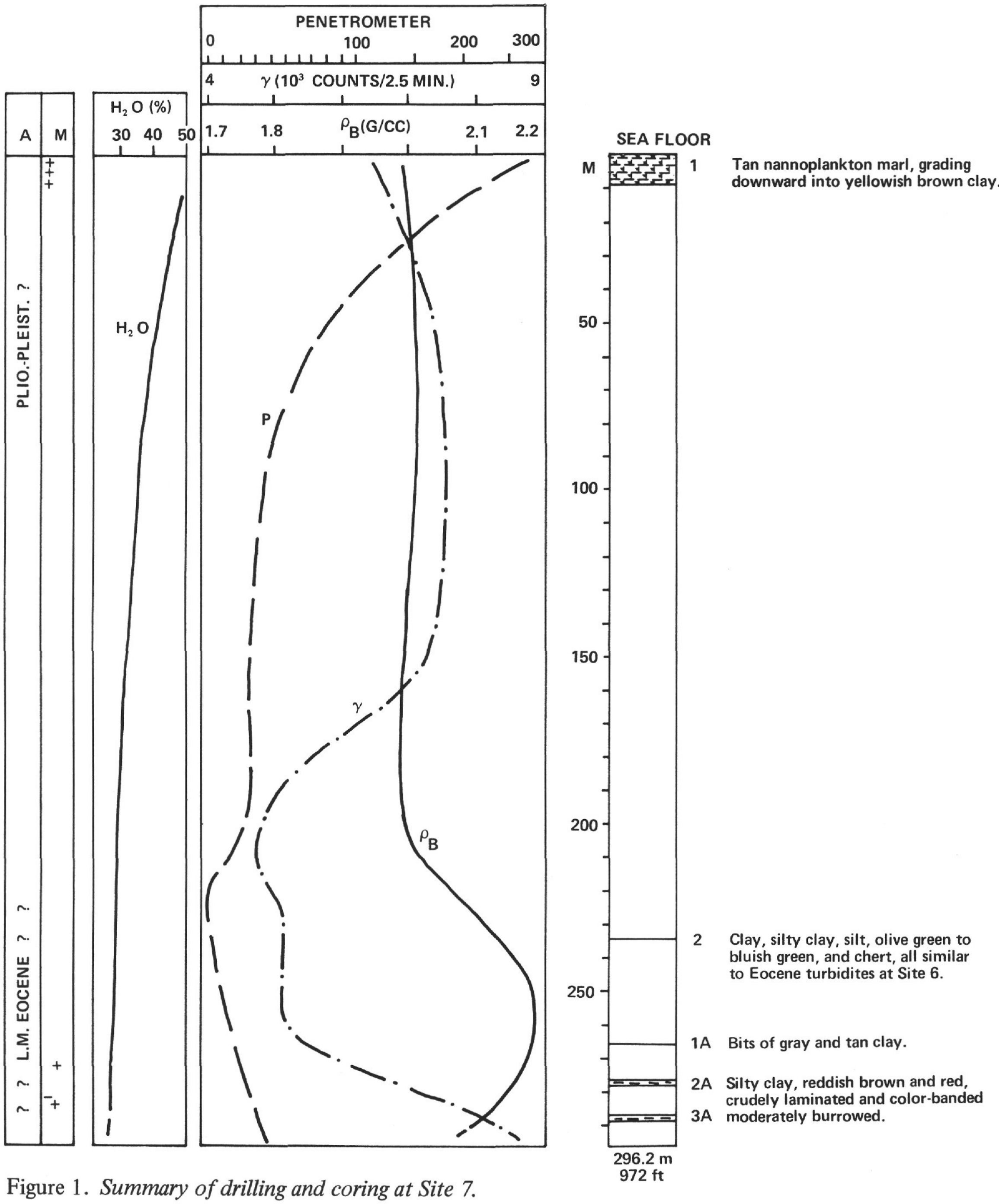


Figure 1. *Summary of drilling and coring at Site 7.*

The Cores Recovered from Site 7

Figures 2 through 6 are the graphic summaries of the cores recovered at Site 7.

These figures show, for each core:

(1) The stratigraphic age.
(2) The paleomagnetic results–normal (+) or reversed (-).
(3) The natural gamma radiation (full line).
(4) The bulk density as determined by the GRAPE (Gamma Ray Attenuation Porosity Evaluator) equipment (broken line).
(5) The length of the core in meters measured from the top of the core, and the subbottom depth of the top of the cored interval.
(6) The lithology (see key with Site 1 report).
(7) The positions of the tops of each core section.
(8) Some notes on the lithology.

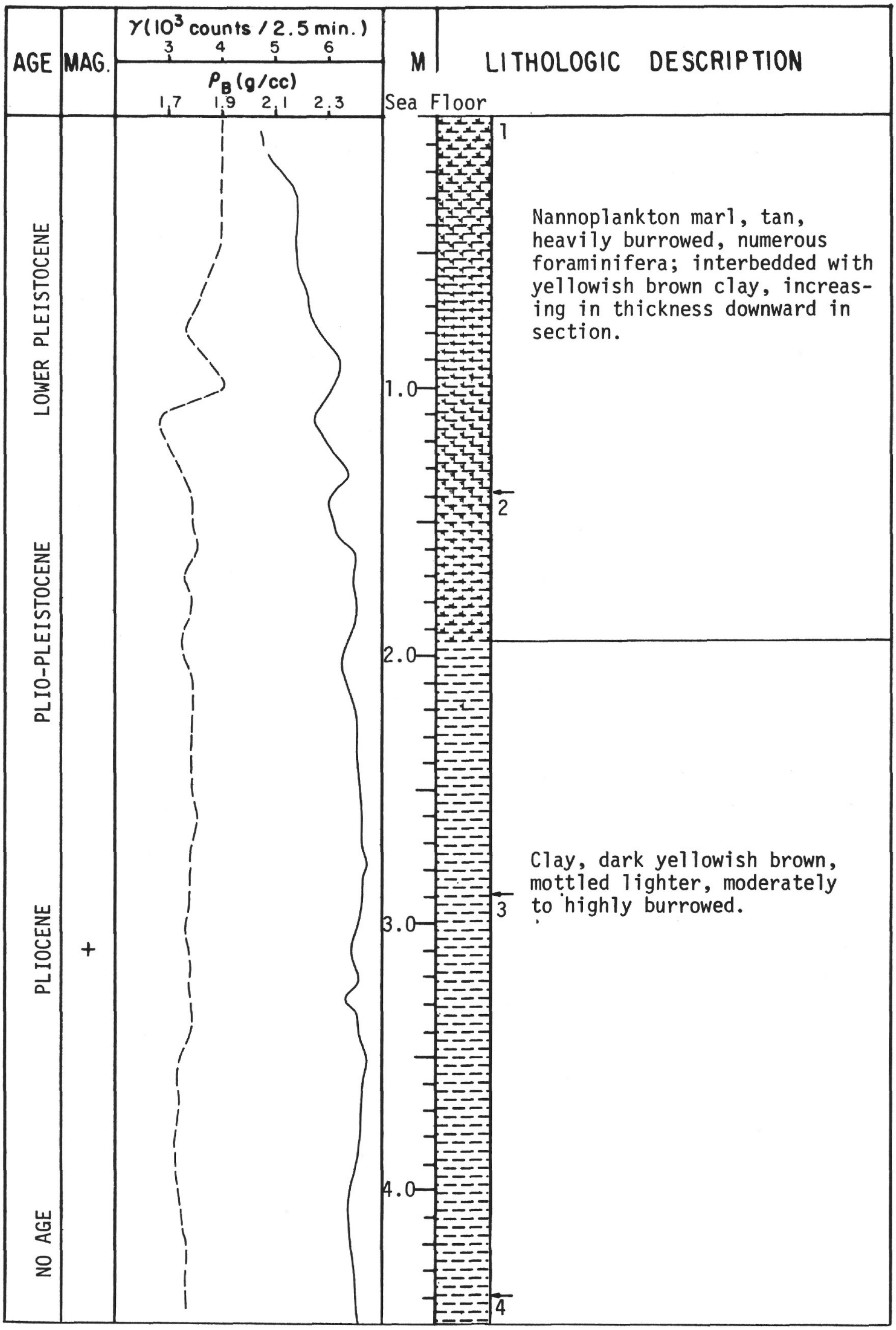


Figure 2. *Hole 7, Core 1.*

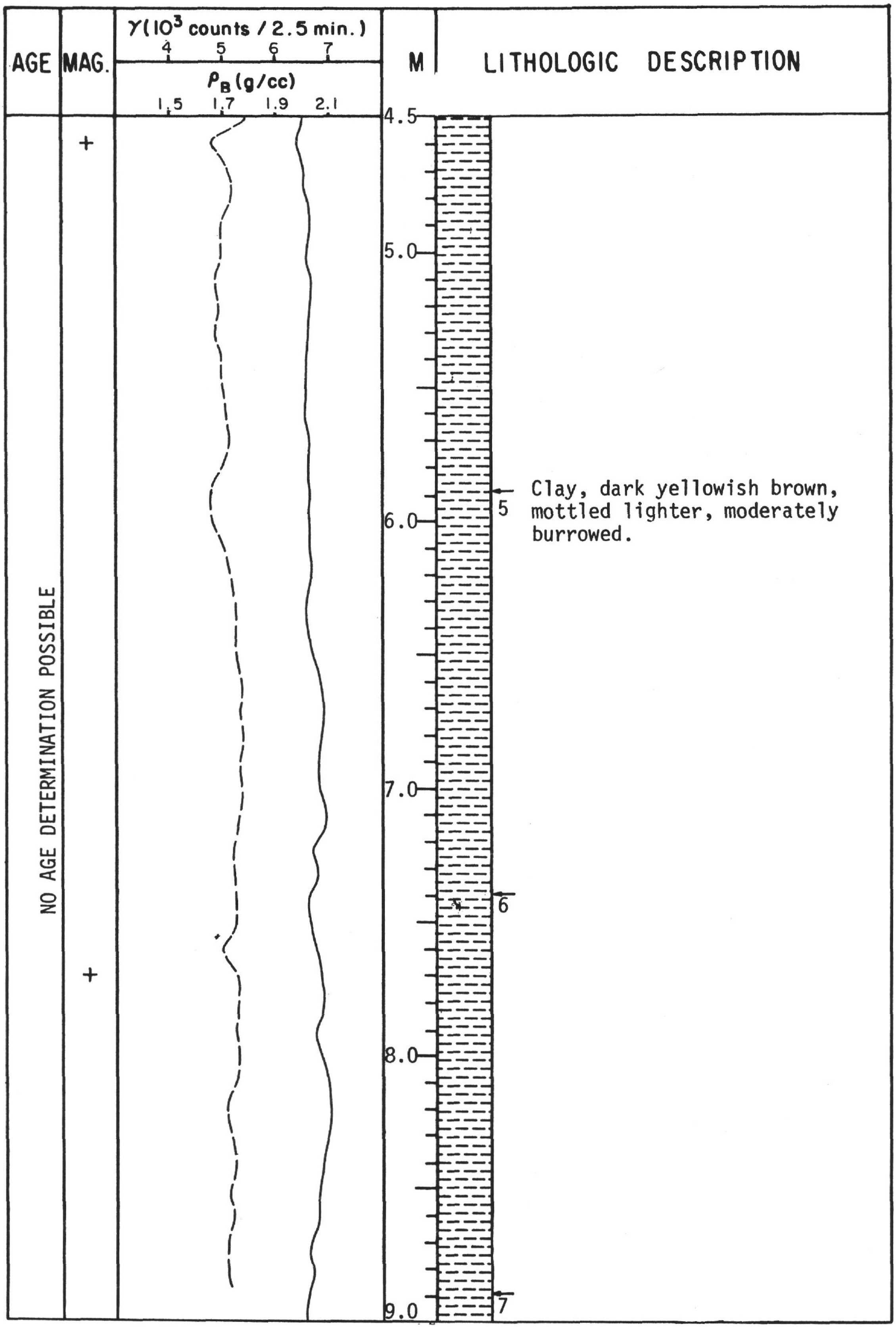


Figure 2. *Continued.*

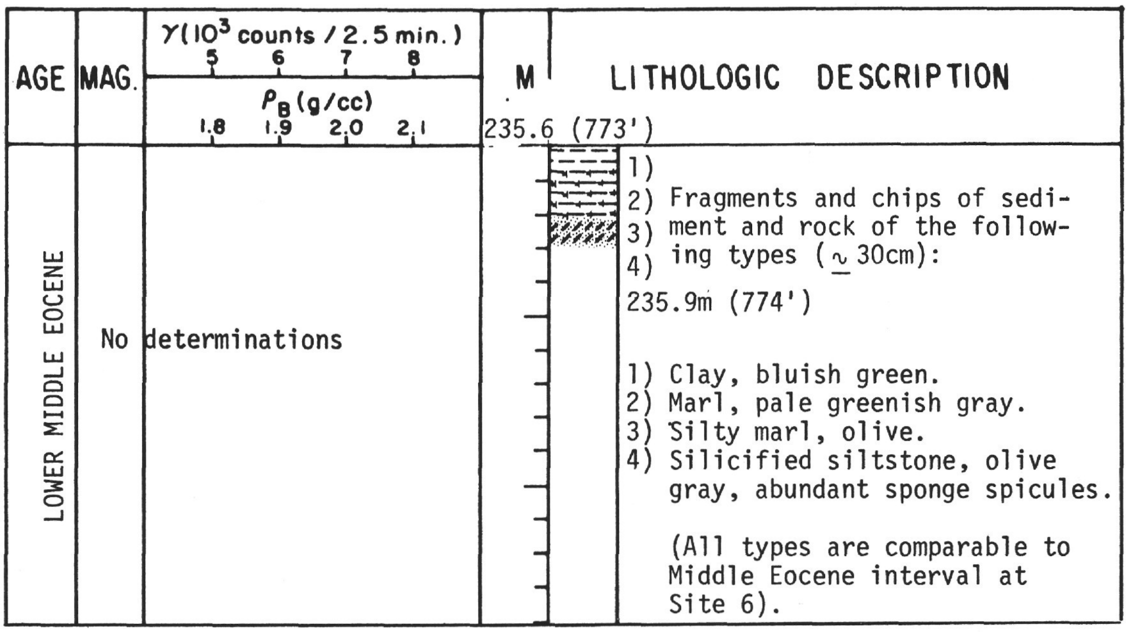


Figure 3. *Hole 7, Core 2.*

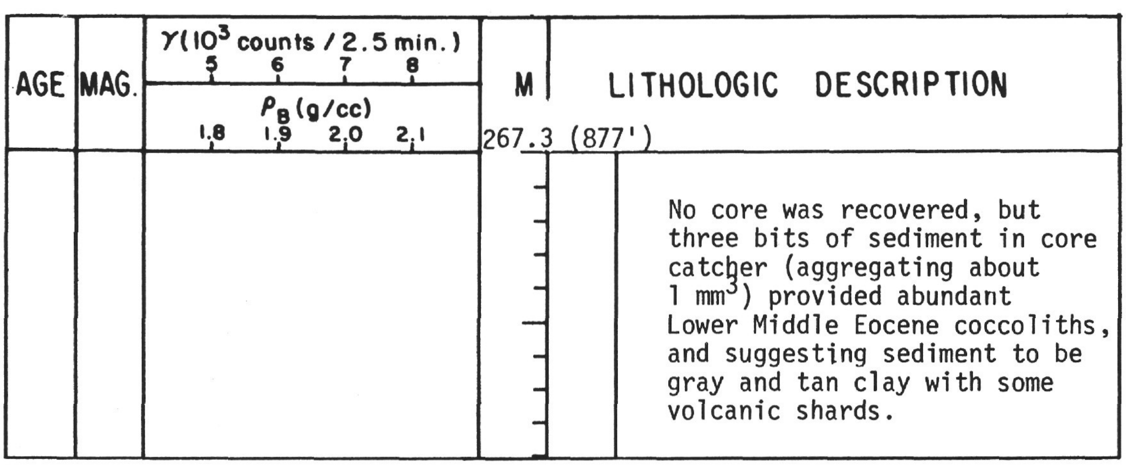


Figure 4. *Hole 7A, Core 1.*

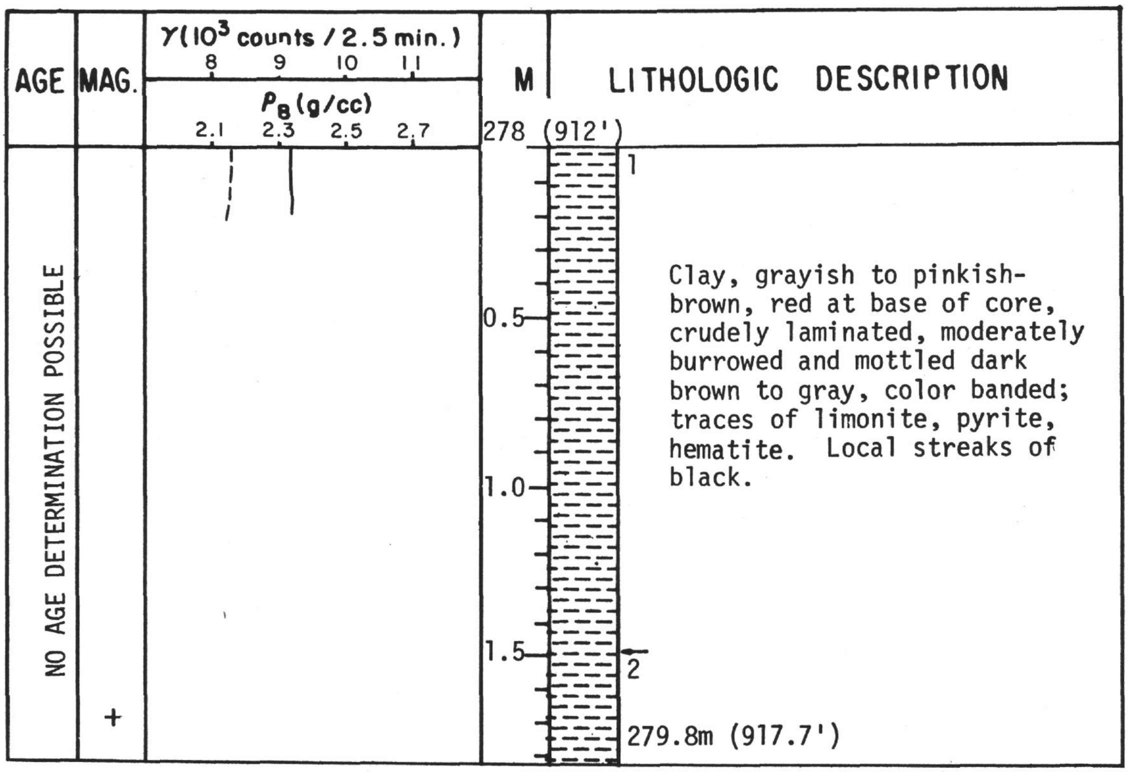


Figure 5. *Hole 7A, Core 2.*

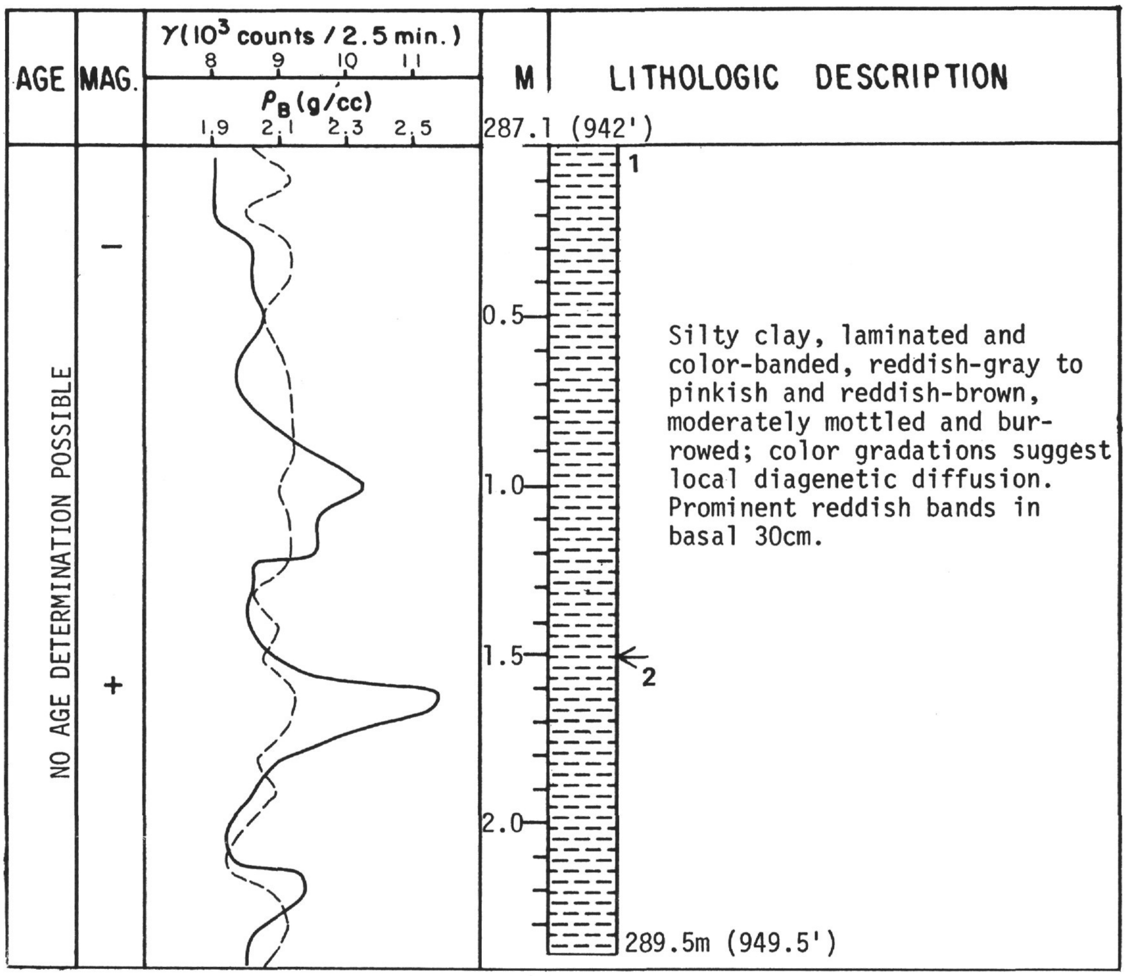
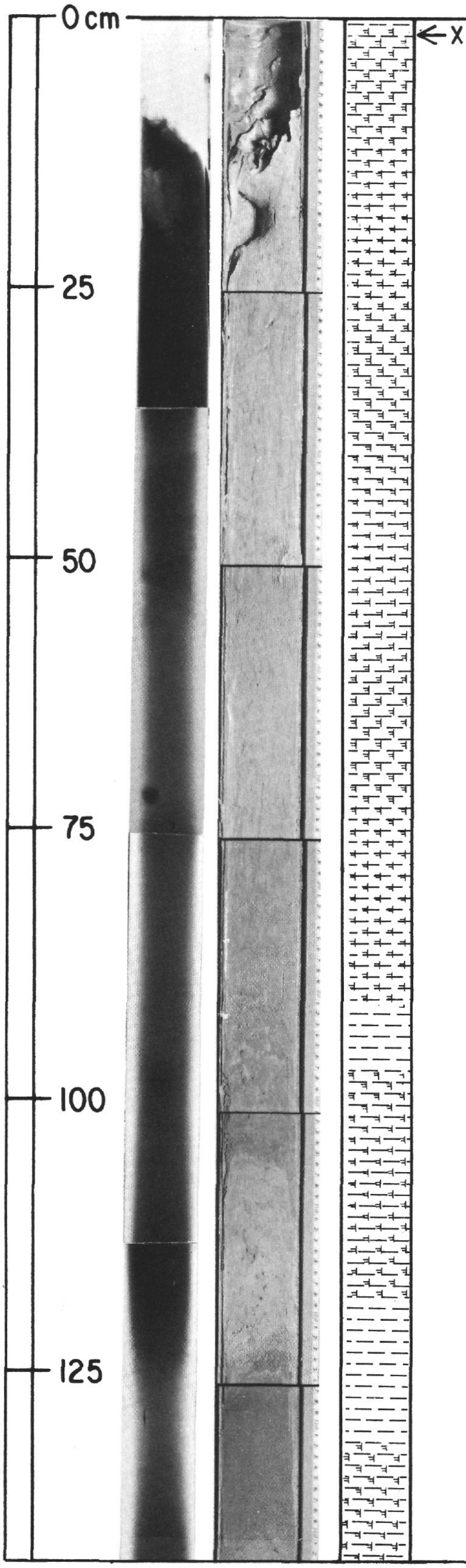


Figure 6. *Hole 7A, Core 3.*

Figures 7 through 18 show details of the individual core sections of the cores from Site 7.

Each figure shows:

(1) A scale of centimeters from the top of each section.
(2) An X radiograph of the core section.
(3) A photograph of the core section.
(4) The lithology (see key with Site 1 report).
(5) The positions of smear slides (x).
(6) Notes on the lithology, carbon content, expressed as a percentage of total sediment (see Chapter 11), the water content (see Chapter 10) and the grain size (see Chapter 9). Colors are given with reference to the GSA Rock Color Chart.



Nannoplankton marl, tan (10YR 8/4), heavily burrowed; foraminifera numerous.

Total C 6.8; Org. C 0.1; $CaCO_3$ 56.4.
Water content 42.8.

Sand 0.6; silt 25.5; clay 73.9.

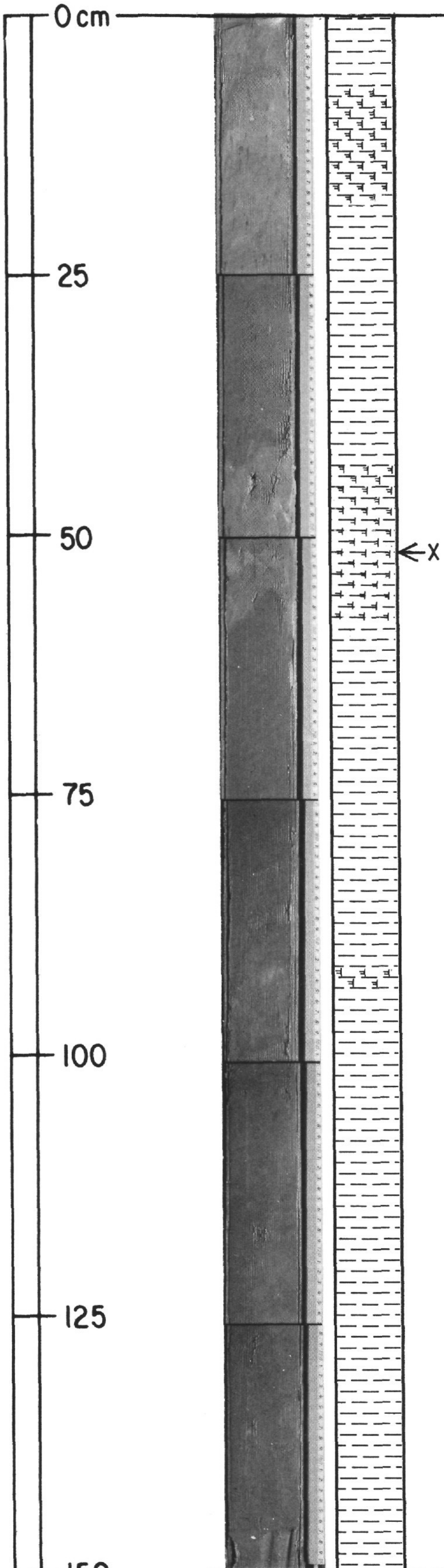
Darker (10YR 6/4), less calcareous downward; not as intensely burrowed.

Lighter (10YR 8/4), heavily burrowed.

Darker (10YR 5/4), less calcareous, slightly to moderately burrowed.

Lighter (10YR 7/4), moderately to strongly burrowed.

Figure 7. *Hole 7, Core 1, Section 1.*



Clay, yellowish-brown (10YR 5/4), upper part contains foraminifera.

Total C 2.9; Org. C. 0.2; $CaCO_3$ 22.4. Water content 45.3.

Sand 0.1; silt 15.9; clay 84.0.

Nannoplankton marl, with some forams; light yellowish-brown (10YR 6/4).

Clay, dark yellowish-brown (10YR 4/4).

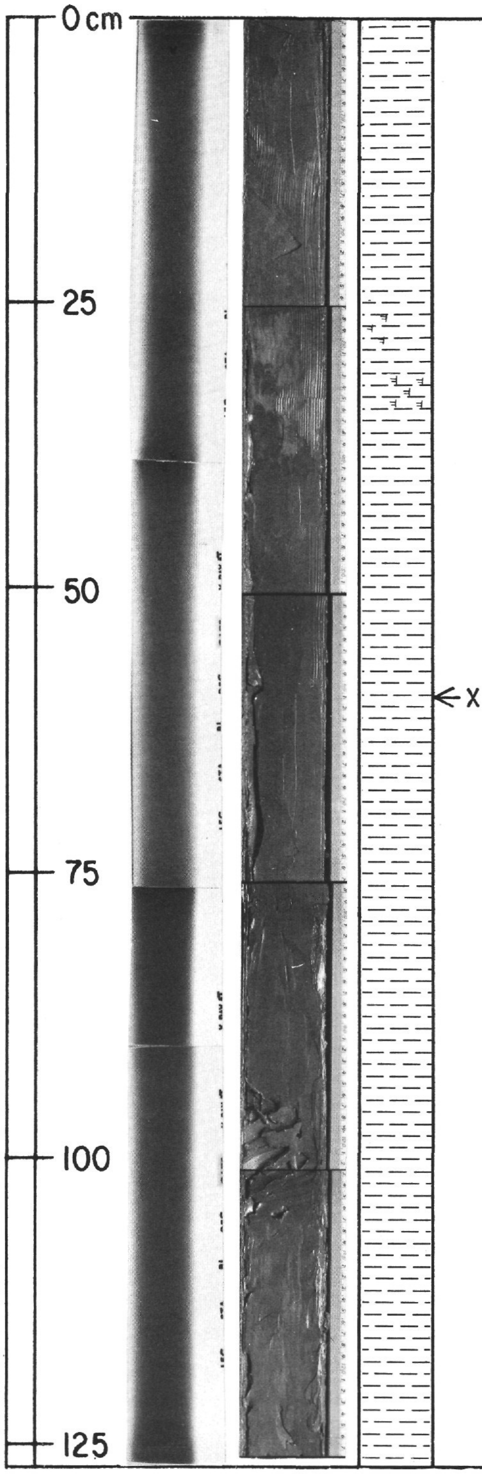
Yellowish-brown (10YR 5/4).

Dark yellowish-brown (10YR 4/4).

Yellowish-brown (10YR 5/4).

Dark yellowish-brown (10YR 4/4).

Figure 8. *Hole 7, Core 1, Section 2.*



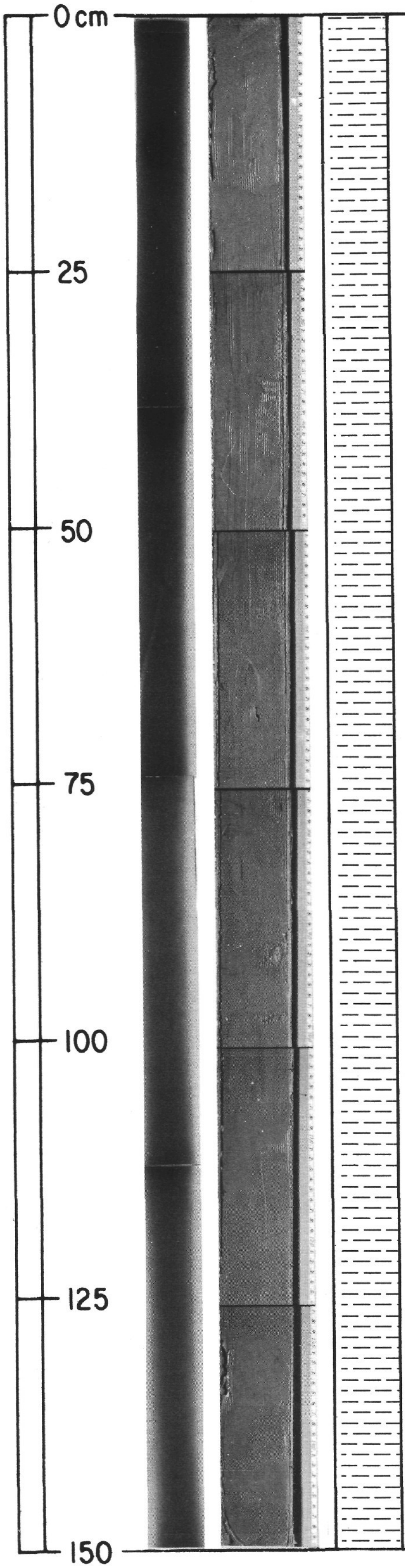
Clay, dark yellowish-brown (10YR 4/4), with lighter mottles.

Water content 52.2.

Sand 0.0; silt 7.5; clay 92.5.

(6/3); moderately to greatly burrowed; the lighter mottles are nannoplankton-filled burrows.

Figure 9. *Hole 7, Core 1, Section 3.*



Water content 50.4.

Sand 0.1; silt 8.7; clay 91.2.

Clay, dark yellowish-brown (10YR 4/4), moderately burrowed; elongate particles (burrow-fillings?) of dark material.

Figure 10. *Hole 7, Core 1, Section 4.*

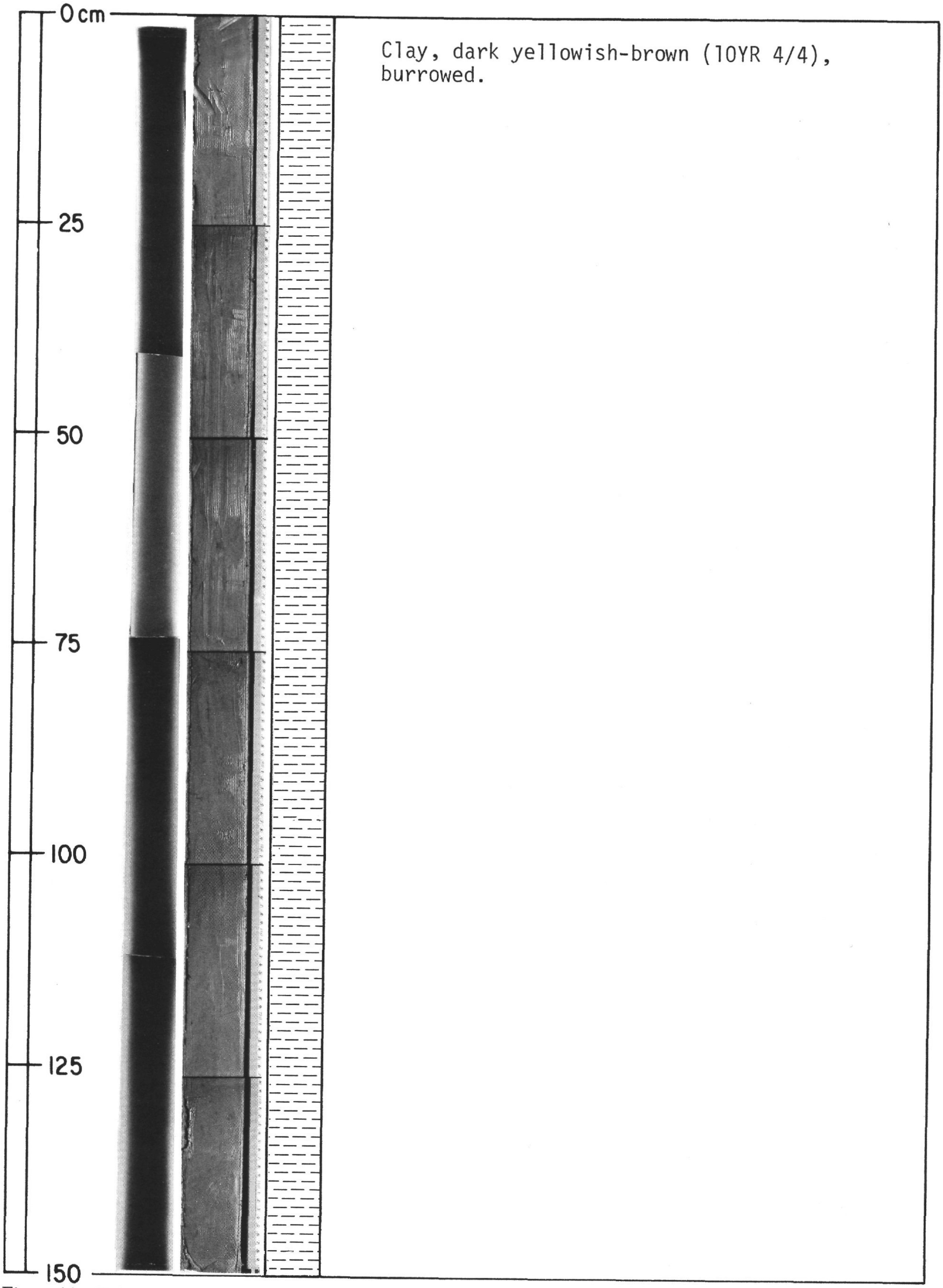
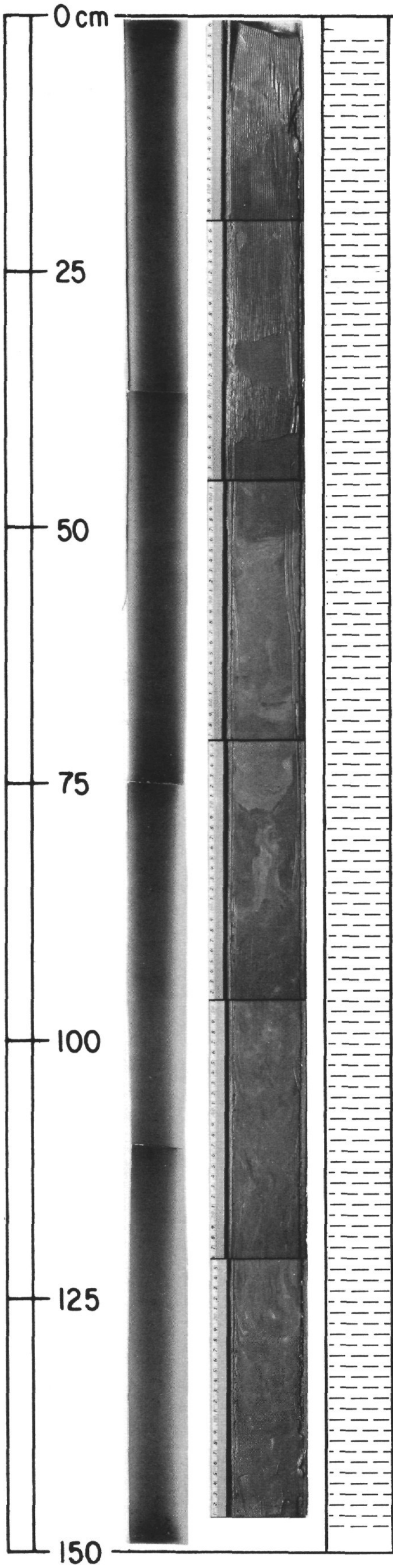


Figure 11. *Hole 7, Core 1, Section 5.*



Clay, dark yellowish-brown (10YR 4/4), moderately burrow-mottled throughout. Total C 0.3; Org. C 0.1; $CaCO_3$ 1.7. Water content 49.3.

Dark specks (3/2).

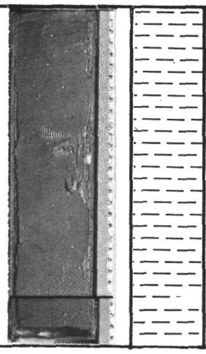
Clay lighter (10YR 6/4).

Clay darker (4/4) with reddish tinge.

Figure 12. *Hole 7, Core 1, Section 6.*

0 cm

25



Clay, dark yellowish-brown (10YR 4/4).

Figure 13. *Hole 7, Core 1, Section 7.*

0 cm

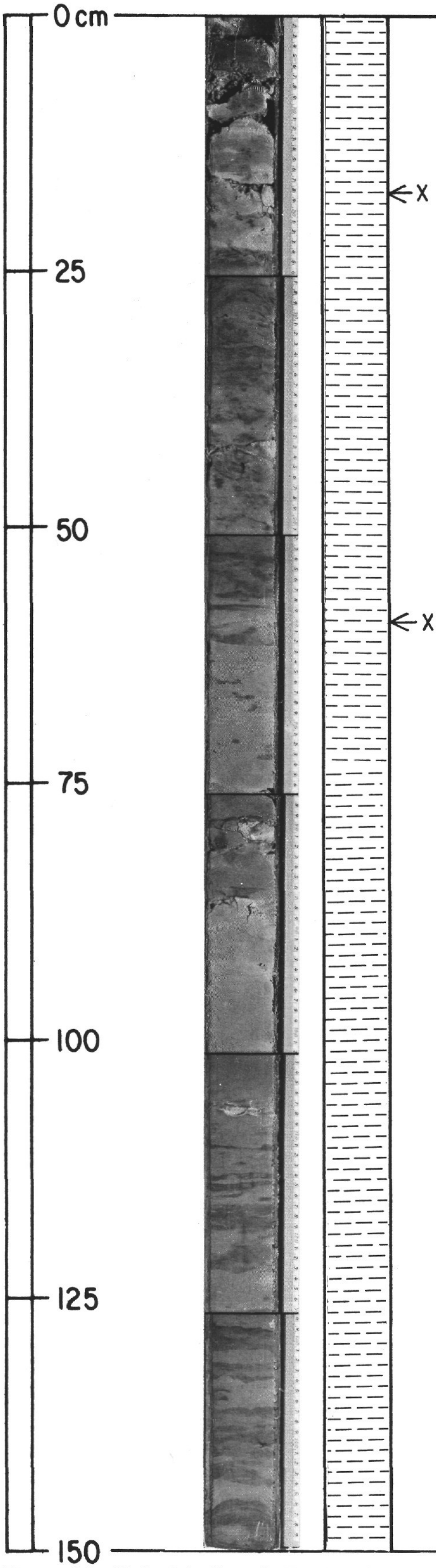
25

50

Fragments and chips of sediment, not a coherent core, total aggregate about 25 cm. The following sediment types:

1) Clay, bluish-green (5BG 6/2) - much like the diatomaceous clays in Eocene at Site 6.
2) Marl, pale greenish-gray (5GY 7/1) - much like marls in Eocene at Site 6.
3) Marls, silty, olive (10GY 6/2) - much like those in Eocene at Site 6.
4) Siltstone, olive, silicified (cherty), finely laminated: sponge spicules visible - much like the cherty siltstone in Eocene at Site 6.

Figure 14. *Hole 7, Core 2.*



Clay, pale brown (10YR 6/3) color banded very dark brown (10YR 2/1), slightly burrowed.

Total C 3.2; Org. C 0.1; $CaCO_3$ 25.8.
Water content 28.9.
Sand 0.0; silt 20.3; clay 79.7.

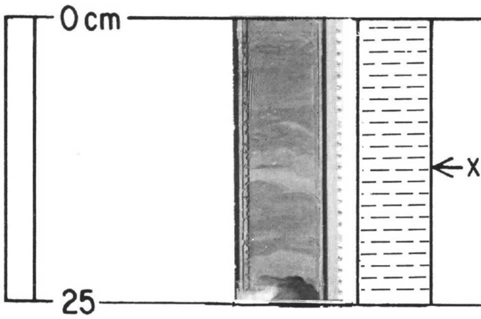
Clay, grayish-brown (10YR 5/2), crudely laminated, moderately mottled and burrowed dark brown (10YR 2/1).

Clay, light pinkish-brown (10R 6/4) laminated and mottled gray (N5).

More gray (N5) mottling and banding. Some of color banding sharply defined, some diffuse.

Local concentrations of black nodules, possibly MnO_2.
Limonitic granules, pyrite grains and red flakes of hematite.

Figure 15. *Hole 7A, Core 2, Section 1.*

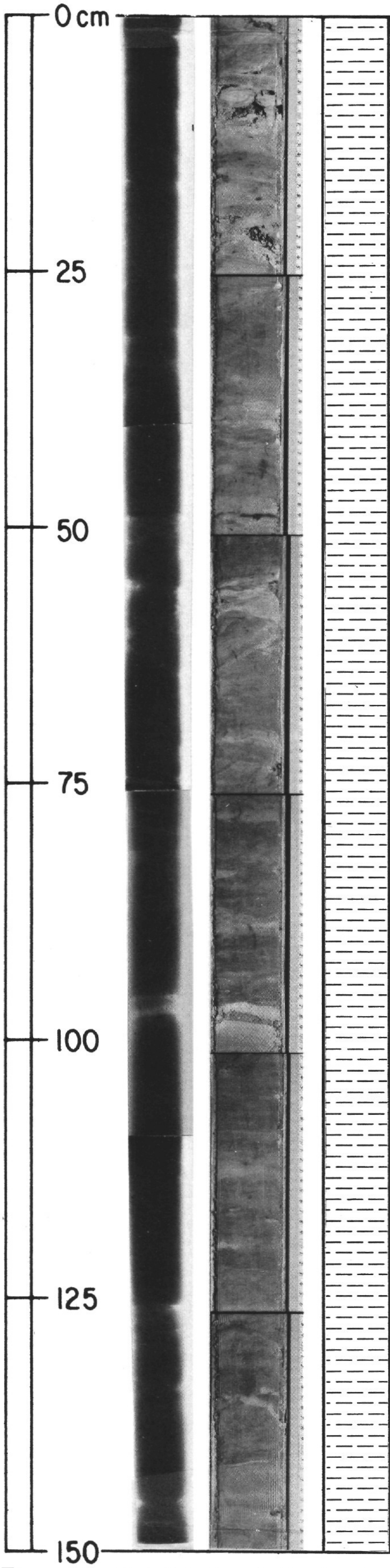


Clay, dark reddish-brown (10R 5/4) with lighter and darker color bands (10R 3/4).

Fe mainly present as hematite.

Sand 0.4; silt 12.2; clay 87.4.

Figure 16. *Hole 7A, Core 2, Section 2.*



Clay, laminated and irregularly banded reddish-gray (5YR 4/2) to pinkish-gray (7.5YR 7/2) to light reddish-brown (5YR 6/4), with minor dark mottling of (7.5YR 2/).

Total C 2.8; Org. C 0.1; $CaCO_3$ 15.8.
Water content 26.1.

Sand 0.3; silt 12.8; clay 86.9.

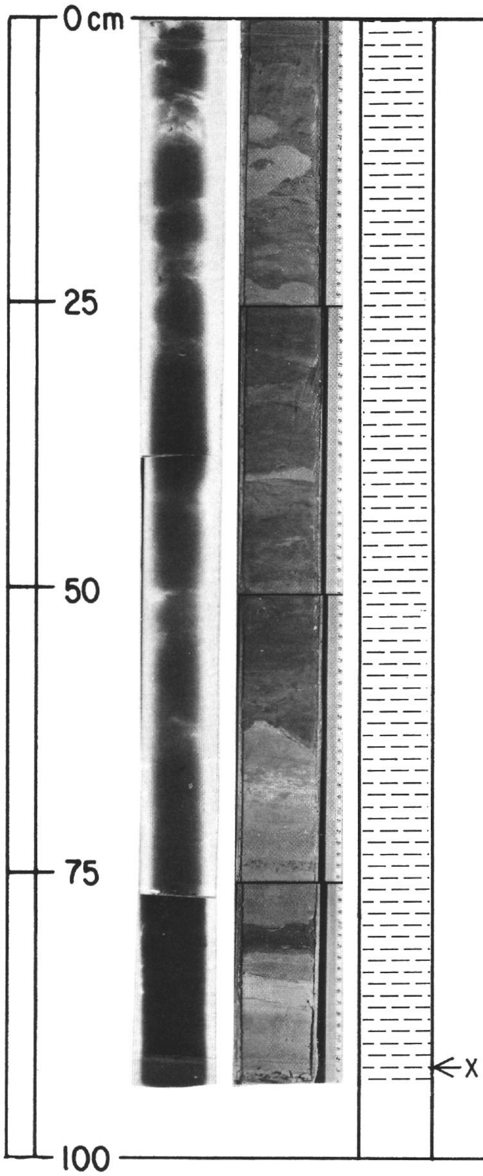
Some of mottling crosses laminae, and must be result of diagenetic diffusion processes. Dark mottling of small harder nodules, possibly burrow fills (MnO_2?).

X Limonite in granular aggregates, trace of hematite.

Reddish-brown (2.5YR 5/4) with mottling of (6/8).

Dark reddish-gray (5YR 4/2) mottled with pinkish-gray (7.5YR 7/2) and black.

Figure 17. *Hole 7A, Core 3, Section 1.*



Total C 0.1; Org. C 0.1; $CaCO_3$ 0.0.
Water content 32.1.

Sand 4.9; silt 23.2; clay 72.9.

Clay, laminated and singularly banded reddish-gray (5YR 4/2) to light reddish-brown (5YR 6/4) laminated with pale yellowish-white (5Y 8/2); mottling only partly due to burrows. Some of it diffusely crosses laminations, suggesting a diagenetic chemical diffusion origin.

Slightly to moderately burrowed.
Zone of bleached burrow-mottling.
Light reddish-brown (2.5YR 6/4) mottled with black and dark reddish-brown (5YR 3/2), as well as yellowish-white.

Figure 18. *Hole 7A, Core 3, Section 2.*

Nature of the Sediments

General Description of the Sediments

The stratigraphic sequence at Site 7 resembles that at Site 6, but the drill penetrated a little farther.

The oldest material recovered (Core 7A, Sections 2 and 3) consists of reddish-brown to red clay with diffuse gray banding. The clay is massive and somewhat burrowed, and contains dark megascopic granules which are at least in part manganiferous; such nodules from Core 7A-3-1, 49 to 51 centimeters were examined by Beall and analyzed by X-ray diffraction, X-ray fluorescence and neutron activation techniques. They show a concretionary aspect with a sharply defined core and diffuse rim, and contain crystalline manganese oxides. The diffuse black and gray stains in these cores may likewise be attributed to manganese. The red cast of these cores is due to presence of hematite flakes, clearly discernible in smear slides, though not appearing in the X-ray diffraction analyses (Rex, Chapter 13). In places this hematite is distributed in concentric diffusion bands.

Above this red clay lies the Mid-Eocene turbidite sequence encountered at Site 6, as shown by Core 7-2, which encountered olive green to gray, laminated silicified spicule-bearing siltstone, intercalated with marls and clays containing coccoliths and siliceous skeletal remains (sponge spicules and diatoms).

The uppermost core (7-1) yielded brown deep-sea clay, of Pleistocene and Pliocene age, which contains in its upper parts irregular streaks of tan, marly, coccolith and foraminifera-rich clay; these may be burrow-filling or beds (turbidites?) which mingled with the brown clay in drilling.

The brown clay itself is burrowed and the smaller burrows are filled with very dark material judged, from X-ray analysis, to be amorphous.

Discussion

Sites 6 and 7 are separated laterally by only about 50 miles, and are thought to be stratigraphically correlative. Thickness above reflector "A" is comparable, and the stratigraphic sequence at Site 6 can be extrapolated to Site 7 with some degree of accuracy as judged by paleontological determinations.

Combining data from Sites 6 and 7, postulated curves for gamma-radiation, GRAPE, and penetrometer measurements can be drawn which are thought to be representative for both localities. The somewhat thick cherty unit has been assigned values as determined by very uneven data and extrapolation.

The basal section of pelagic deep-sea red clay encountered at Site 7 is interpreted to represent the previously postulated earlier cycle of pelagic sedimentation. Conditions were evidently quite similar to late Tertiary deposition.

If reflector β, which is present throughout much of the Bermuda Rise region, also consists of siliceous turbidites, then the gross similarities of the cycles must be considered significant. The problem of turbidity current movement up-slope versus a postulated episodic movement of the Bermuda Rise has been reviewed for Site 6, and is not being reiterated here. It would appear, on the basis of these data, that the Bermuda Rise area has a complex history of formation, and that initial movements and formation of the Rise may well have started in Mesozoic time.

It is possible that by detailed study of interval thicknesses, one might arrive at definite conclusions regarding volcanogenic depocenters for the deep-sea red clays in the Bermuda region. It could be that earlier depocenters are clearly separated from later ones, thus possibly indicating something of the evolution and genesis of the Bermuda Rise. More tests to penetrate basement are clearly called for.

Physical Properties of the Sediments

Determinations of natural gamma-radiation and bulk density for Core 7-1 are quite comparable in general lack of character to those of similar sediments from Site 6. Notable exceptions exist in the uppermost 150 centimeters, where intercalated bands of calcareous sediment are reflected by lower gamma-ray counts and higher bulk density values. Below that level, a consistent increase, albeit slight, can be discerned in gamma-ray count.

The above can be contrasted with results from Core 7A-3, where marked variations in gamma-ray count can by observed. Bulk densities are also somewhat more variable in spite of the lithological similarities. The high values of gamma-ray count are interpreted as reflecting diagenetic concentrations of radioactive elements. The presence of manganese oxides has been mentioned previously. Significant percentages of volcanic rock fragments in the coarse fraction of these sediments suggest that some of the high radioactivity may be due to a high volcanogenic contribution. A detailed study of chemical variation is suggested for this material.

As noted previously, gamma-radiation, GRAPE, and penetrometer values for the uppermost core at Site 7 are quite comparable to data obtained at Site 6. Slightly lower gamma-ray values reflect the higher concentrations of calcareous material in the upper two sections of Core 7-1 along with the less consolidated condition of the core, thought to represent surface or near surface sediment. The net result is a lower average bulk density and lower penetrometer value as compared to Site 6.

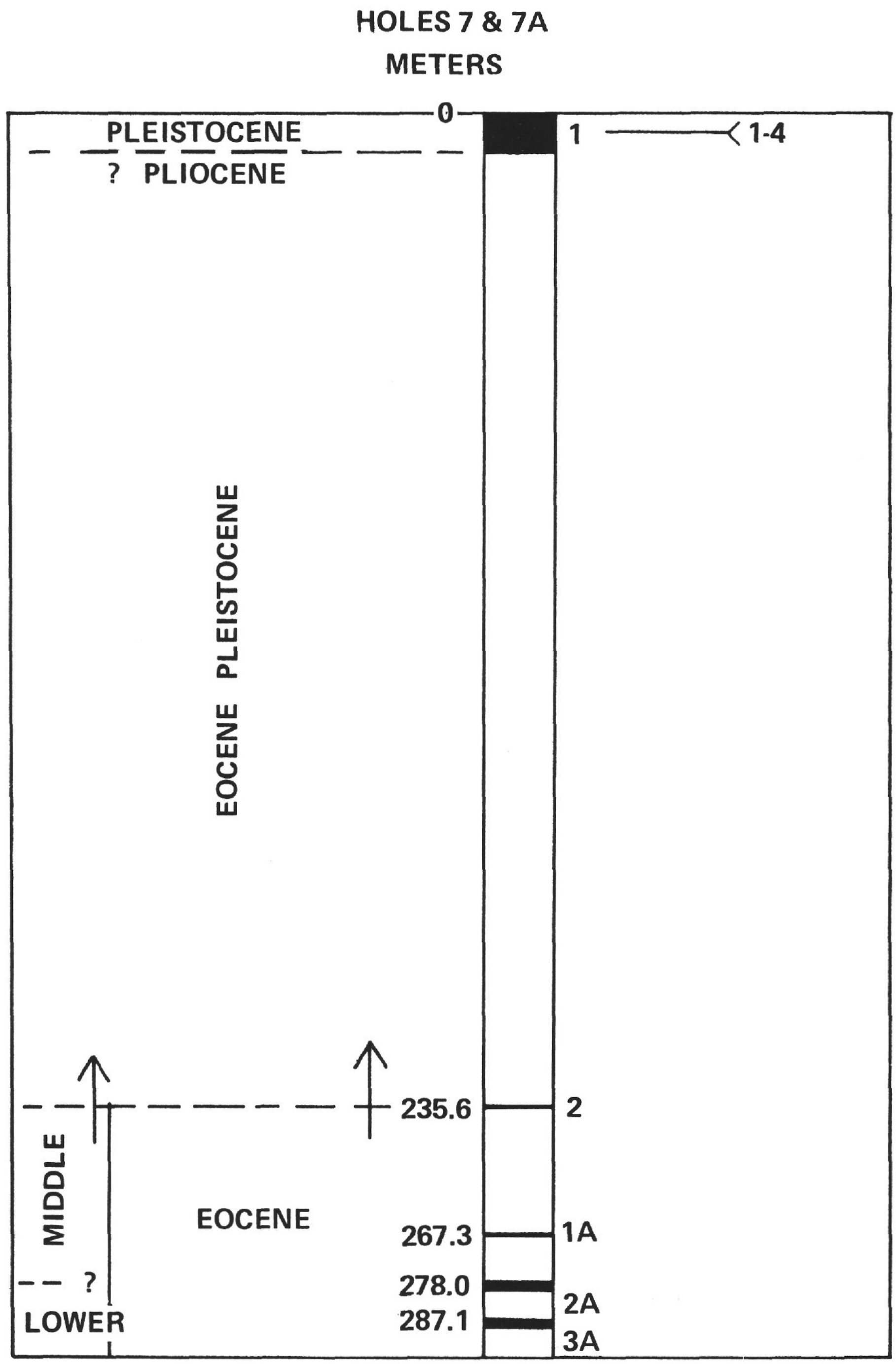


Figure 19. *Biostratigraphy of Site 7 as deduced from the foraminifera.*

The two basal cores (7A-2 and 7A-3) show a significant departure from previously cored material in their extremely high gamma-ray count. Bulk densities are also somewhat high as compared to basal cores from Site 6. It is suggested that Cores 7A-2 and 7A-3 represent highly consolidated analogues to the upper, deep-sea red clay observed at Sites 6 and 7. Extrapolation of physical measurements from these shallow analogues would yield values not overly different from those actually measured. Diagenetic modification may account for some of the observed difference.

Biostratigraphy

Foraminifera

The biostratigraphy of Site 7, as deduced from the planktonic foraminifera, is shown in Figure 19. The faunas of the samples listed in Figure 19 are discussed below. As with previous sites, the faunal lists are not necessarily complete or representative, but show only the most abundant or stratigraphically significant species. In the listings (D) and (S) stand for dextral and sinistral, respectively.

Sample 1 (1-7-1-1, top):
Globorotalia trauncatulinoides, G. tosaensis, G.tosaensis-G. truncatulinoides transition, *G. hirsuta, G. inflata, Globigerinoides conglobata, G. rubra, G. sacculifera, Orbulina universa, Pulleniatina obliquiloculata, Sphaeroidinella dehiscens.*
Age: Pleistocene (basal).

Remarks: Forms transitional between *G. tosaensis* and *G. truncatulinoides* and the small umbilicus in specimens of *G. truncatulinoides* suggest that this level is at or near the Pliocene-Pleistocene boundary.

Sample 2 (1-7-1-1, 100-103 cm):
Globorotalia hirsuta, G. inflata, Globigerinoides conglobata, Orbulina universa, Sphaeroidinella dehiscens.
Age: Pleistocene.

Remarks: *Globorotalia tosaensis* and/or *G. truncatulinoides* was not found in this sample.

Sample 3 (1-7-1-2, 52-55 cm):
Globorotalia hirsuta, G. inflata, G. truncatulinoides, Globigerinoides conglobata, Orbulina universa, Sphaeroidinella dehiscens, Globigerina digitata.
Age: Pleistocene.

Remarks: This sample exhibits signs of solution (partial-strong dissolution of foraminiferal tests). Moderately abundant benthonic (rotaliid) foraminiferal fauna suggests displacement by turbidy currents. No Pliocene markers were found in this sample, however,

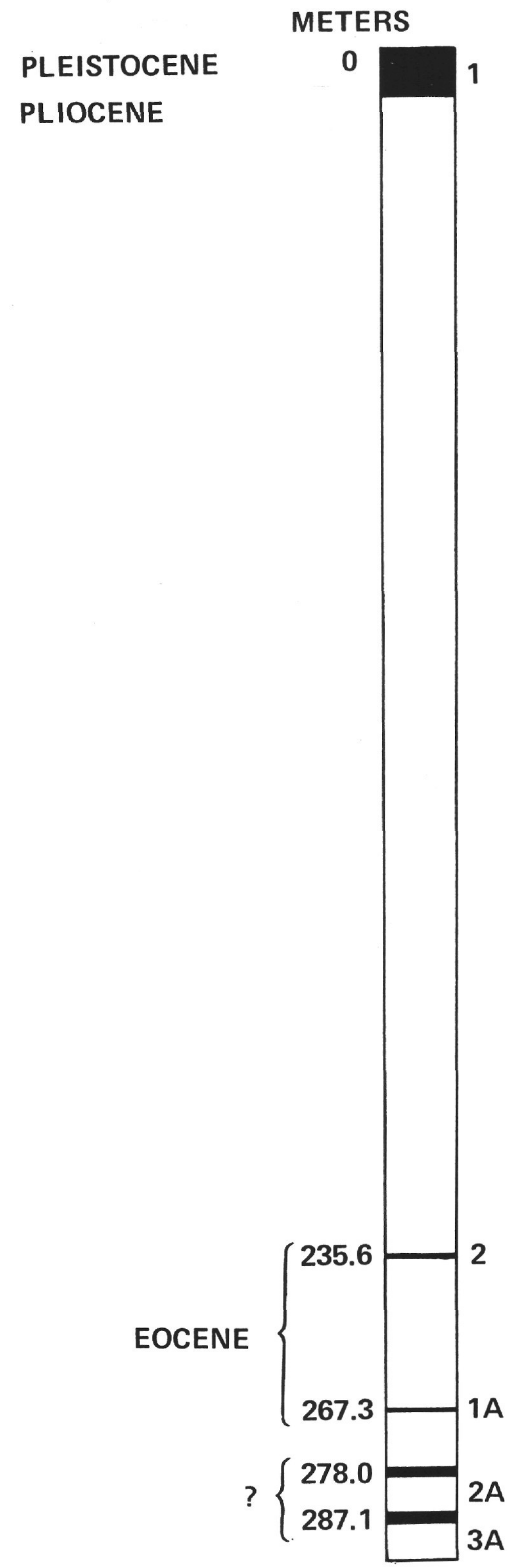


Figure 20. *Biostratigraphy of Site 7 as deduced from the calcareous nannoplankton.*

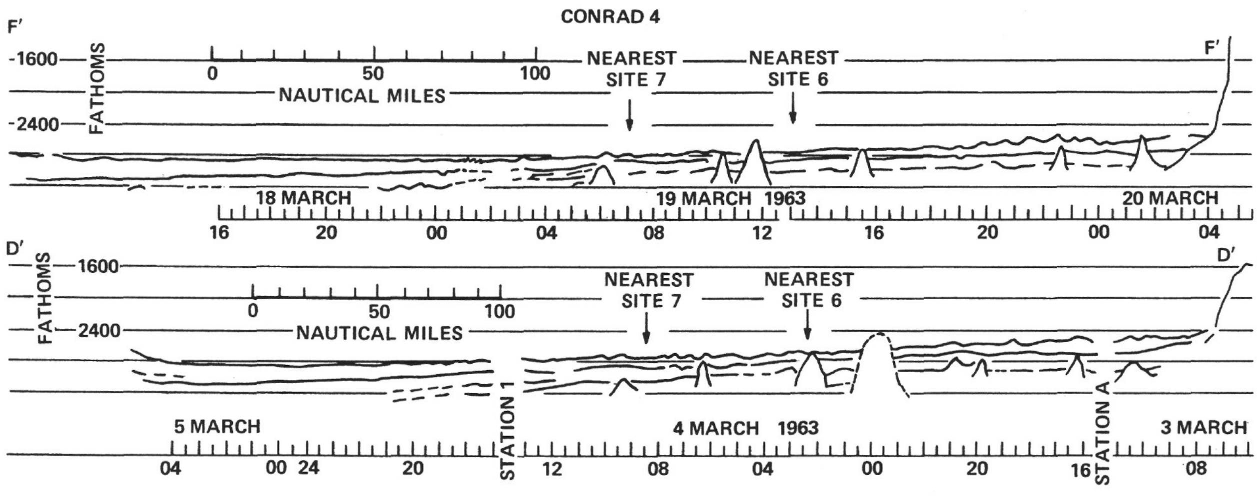


Figure 21. *Profiler traverse near Site 7. Location is indicated in Chapter 6, Figure 40.*

Sample 4 (1-7-1-2, 125-127 cm):
Globigerina spp., *Globigerinita* spp., *Globigerinoides* spp.

Remarks: A few very small planktonic foraminifera occur in this sample. The sediment is transitional from a carbonate lutite to a red clay.

Discussion:
Planktonic and benthonic foraminifera were recovered only in Core 1 in sediments of basal Pleistocene age. No evidence of the Pliocene was seen in Sections 1 or 2 of Core 1 (cf. Bukry & Bramlette, this volume).

Calcareous Nannoplankton

The biostratigraphy of Site 7, as deduced from the calcareous nannoplankton, is summarized in Figure 20. For a detailed account of the faunas, see Bukry and Bramlette, Chapter 15.

SUMMARY: HISTORICAL AND REGIONAL ASPECTS

The background discussion for Site 6 is equally applicable to Site 7. Both are located well up on the southwest flank of the Bermuda Rise. Site 7 is situated about 50 nautical miles southwest of Site 6 and approximately 200 nautical miles southwest of Bermuda in an area where the seismic reflection data indicated that the total section between Horizons A and β were much thinner, with the objective of trying to sample the sediment below Horizon A in the few remaining hours of this first leg of the cruise. Site 7 was located in 5185 meters (17,011 feet) of water and the deepest penetration below the sea floor was 296 meters (972 feet) before the departure deadline.

Brown deep-sea clay was recovered from near the sea floor, with a lighter coccolith ooze in the upper two meters which apparently represented the Pleistocene and Upper Pliocene. The first deep core, at 235 meters, is of mid-Eocene age and corresponds to the deepest part of Site 6 and consists of identical cherty turbidites, with a mixture of olive and green clays bearing sponge spicules, coccoliths and diatoms, and silicified spiculite siltstone. There is much evidence of solution in the siliceous skeletal debris: diatoms are reduced to a mere trace, and the spicules are perforated and pitted with enlarged central canals and corroded outer surfaces. A very small sample at 267 meters recovered similar diatom-coccolith ooze, rich in volcanic shards and still of mid-Eocene age.

The base of the cherty turbidite section was apparently reached at 272 meters, and the last two cores recovered nonfossiliferous deep-sea clays. These clays are generally similar to those of the Plio-Pelistocene at the top of the hole, except in being less monotonous, and more compacted, with prominent color banding (red, brown and black) and crude layering. The sediment is rich in hematite, apparently due to the dehydration of limonite; this is the only hole on Leg 1 where ferric clays were found. The age is uncertain since the only fossils noted are some recrystallized sponge spicules. It is possible that these sediments are the normal result of compaction and dewatering of deep-sea clays. It is also possible that there was more current action during deposition of these older clays. These mid-Eocene cherty turbidites represent Layer A in this area, as at Site 6.

The regional history indicated at Site 7 appears to be identical to that at Site 6, that is: widespread abyssal plain turbidite deposition below the depth of carbonate compensation during the mid-Eocene, followed probably by an uplift of the broad Bermuda Rise. However, the older deep-sea clays of Site 7 can be interpreted to be of regional or only local importance. Since Site 7 was situated on a local topographic high in the basement, it is possible that the older deep-sea clay corresponds to a thinned and pelagic sedimentary section over this high and that the thicker sediments around it may very well be abyssal plain turbidites of identical age. In this interpretation the topographic lows would have been filled with sediments by mid-Eocene, at which time the turbidites finally reached Site 7.

Alternatively, if any general pattern of deep-ocean sedimentation can be estimated from all the holes of the first leg, it is that there appear to be surges of turbidite deposits gradually becoming thinner and less frequent with time and, finally, giving way to largely pelagic sedimentation. The mid-Eocene turbidites, in this case, may represent the start of such a cycle, and the underlying pelagic clays may be the waning phase of the preceding cycle. The facts that Layer A is widespread in this area, is the same age at both Sites 6 and 7, and is underlain throughout by acoustically transparent beds: suggest that this older pelagic clay is of regional rather than just local importance. If Horizon β which is present throughout much of this region also consists of turbidites, the broader importance of these older clays must be considered as the most reasonable alternative. The truth may well be somewhere between these alternatives.