Backman, J., Duncan, R. A., et al., 1988
Proceedings of the Ocean Drilling Program, Initial Reports, Vol. 115

13. SITE 716[1]

Shipboard Scientific Party[2]

HOLE 716A

Date occupied: 1735 L, 28 June 1987

Date departed: 0100 L, 29 June 1987

Time on hole: 7 hr, 25 min

Position: 04°56.0′N, 73°17.0′E

Water depth (sea level; corrected m, echo-sounding): 544.3

Water depth (rig floor; corrected m, echo-sounding): 554.8

Bottom felt (m, drill pipe): 543.8

Penetration (m): 257.1

Number of cores: 27

Total length of cored section (m): 257.1

Total core recovered (m): 262.7

Core recovery (%): 102

Oldest sediment cored:
Depth (mbsf): 257.1
Nature: foraminifer-bearing nannofossil ooze
Age: late Miocene
Measured velocity (km/s): not measured

HOLE 716B

Date occupied: 0250 L, 29 June 1987

Date departed: 1000 L, 29 June 1987

Time on hole: 7 hr, 10 min

Position: 04°56.0′N, 73°17.0′E

Water depth (sea level; corrected m, echo-sounding): 544.3

Water depth (rig floor; corrected m, echo-sounding): 554.8

Bottom felt (m, drill pipe): 543.8

Penetration (m): 264.4

Number of cores: 28

Total length of cored section (m): 264.4

Total core recovered (m): 267.4

Core recovery (%): 101

Oldest sediment cored:
Depth (mbsf): 264.4
Nature: foraminifer-bearing nannofossil ooze
Age: late Miocene
Measured velocity (km/s): not measured

Principal results: Site 716 is located in the center of the Maldives Ridge at 4°56.0′N and 73°17.0′E, in water depths of 533.3 m (Fig. 1). The site lies in flat terrain on a broad, shallow basin which is filled with 1–1.5 km of sediments and sedimentary rocks. Our primary objective for drilling at this site was to retrieve a complete late Neogene sequence for studies of aragonite-bearing periplatform oozes (see "Background and Objectives" sections, "Site 714" chapter, this volume, and this chapter).

We cored two holes continuously with the advanced hydraulic piston corer (APC): Hole 716A to 257.1 mbsf and Hole 716B to 267.4 mbsf. The recovery rate was 102% in Hole 716A and 101% in Hole 716B. Site 716 was the last site we drilled in the Leg 115 program. Knowing that about 55 cores (>500 m of sediment) were to be brought on board just a few days (<3) before the port call at Colombo, we decided to eliminate several work stations in the core lab in order to pursue the lithostratigraphic descriptions without any interruption in the flow of cores. The only samples taken were for geochemistry, in addition to the standard core-catcher samples taken for micropaleontologic age determination.

Under these circumstances, we were fortunate to encounter uncomplicated lithologies. Indeed, the recovered sequence represents a single lithologic unit, consisting of foraminifer-bearing nannofossil ooze, grading into chalk downhole, from the mud line to 267.4 mbsf. Fairly large lumps of celestite occur occasionally in the deeper part of the section, and this site appears to contain a fascinating history of diagenetic processes. The cored stratigraphic sequence is summarized in Figure 2.

We made a dozen carbonate-content measurements, which indicated that the sequence contains more than 90% carbonate throughout. These few measurements consequently do not reveal any fine-scale variability in carbonate content. Calculations of mass accumulation rates have been postponed until further shore-based sampling and determination of dry-bulk densities.

Petrographic observation and X-ray diffraction (XRD) results indicate that aragonite is present throughout the entire sequence. Although the sequence is consistently dark greenish gray in color, with shades of paler color toward the bottom of the section, the clays are a minor component. Diatoms and radiolarians are virtually absent, and the minor amounts of opaline silica present are composed of sponge spicules. The biostratigraphy suggests that the recovered sequence is stratigraphically continuous and that deposition occurred at a relatively high rate. Sedimentation rates average about 38 m/m.y. and 22 m/m.y. in the Pleistocene and late Pliocene, respectively. In the early Pliocene and latest Miocene, sedimentation rates increased to about 56 m/m.y. As a consequence, the bottom of the sequence ends in sediment not older than 5.5–6.0 Ma.

We anticipate that the time control will improve during the shore-based studies. Nevertheless, it is apparent that the sediments cored at Site 716 offer an unique opportunity for high-resolution studies of the late Neogene which, in turn, should have a profound impact on our understanding of the paleoenvironmental development both on a regional and global scale.

BACKGROUND AND OBJECTIVES

The present-day distribution of aragonite-bearing sediments in the Indian Ocean has received little attention, implying that the information available on the depths of the aragonite-compensation depth and the aragonite lysocline is limited. When longer time intervals are considered, the available information becomes even more restricted. Experiments from the southwest Atlantic, for example, show that the aragonite lysocline is positioned at least 1 km higher in the water column than the position of the foraminiferal lysocline (Broecker and Takahashi, 1978). We therefore expect a similar relationship in the present-day Indian Ocean. If differences exist between the South Atlan-

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[1] Backman, J., Duncan, R. A., et al., 1988. *Proc. ODP, Init. Repts.*, 115: College Station, TX (Ocean Drilling Program).

[2] Shipboard Scientific Party is as given in the list of Participants preceding the contents.

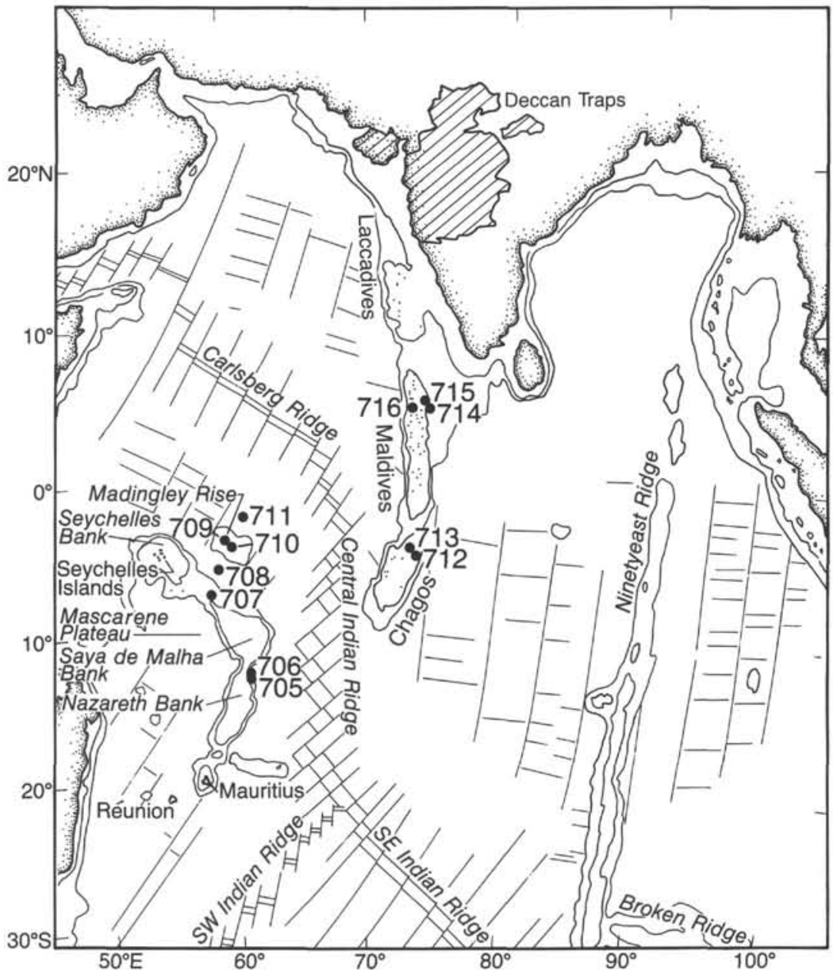

Figure 1. Bathymetric features of the central Indian Ocean. Site 716 is located in the center of the Maldives Ridge, at a water depth of 533.3 m.

Studies of late Neogene aragonite variability from periplatform oozes in the Maldives Archipelago area (see "Background and Objectives" section, "Site 714" chapter, this volume) require that two sites be drilled above the aragonite lysocline/compensation depth, and that these sites be separated substantially in terms of water depth. We expected the deeper of these sites (Site 714) to contain a late Neogene record of greater variability in aragonite content. According to current models of aragonite accumulation in periplatform oozes, such changes reflect either primarily time-dependent differences in input (Boardman et al., 1986) or dissolution-induced cycles overprinting the input signal (Droxler et al., 1983).

In order to distinguish between these mechanisms, we had to drill a complementary site in periplatform oozes deposited at such a shallow water depth that dissolution would be negligible, or where only extreme excursions in the aragonite lysocline/compensation depth could have influenced the aragonite content. Site 716, located on the broad central plateau of the Maldives Ridge at a water depth of 533.3 m, met this requirement for a shallow aragonite-bearing site.

Our most important objective was to investigate if there were downcore changes in carbonate mineralogy and, if such changes tic and the Indian Ocean, these critical chemical boundary conditions should occur at shallower water depths in the latter ocean basin, due to its lower carbonate ion concentration in the intermediate- and deep-water masses (Broecker and Peng, 1982). occurred, to establish the cause-and-effect relationships. Unpublished data from piston cores taken on the plateau near Site 716 indicated that sedimentation rates are substantially higher than what is normal for the deep ocean (A. Droxler, pers. comm., 1987), suggesting that winnowing has had little influence on the deposition of these periplatform oozes. These sediments, therefore, were suitable for a study of the variability of terrigenous influx, its dilution effects on the carbonate periplatform oozes, and possible connections between influx and climate (or other time-dependent processes affecting the physical environment).

Another interesting aspect of studying the accumulation of nonbiogenic components was the investigation of the possible effects of the later stages of India's collision with Asia and the resulting rapid uplift of the Himalayas. Finally, we hoped that high sedimentation rates at a near-continental site would yield a good magnetostratigraphic record and a highly resolved biostratigraphy. If so, we could use the sediments retrieved at Site 716 to improve the biochronologic precision of late Neogene datum events.

OPERATIONS

Site 715 to Site 716 (MLD-1)

Site MLD-1 was approved by the Maldivian authorities while the *JOIDES Resolution* was in Male and was scheduled for coring only if time permitted. With extra drilling time available,

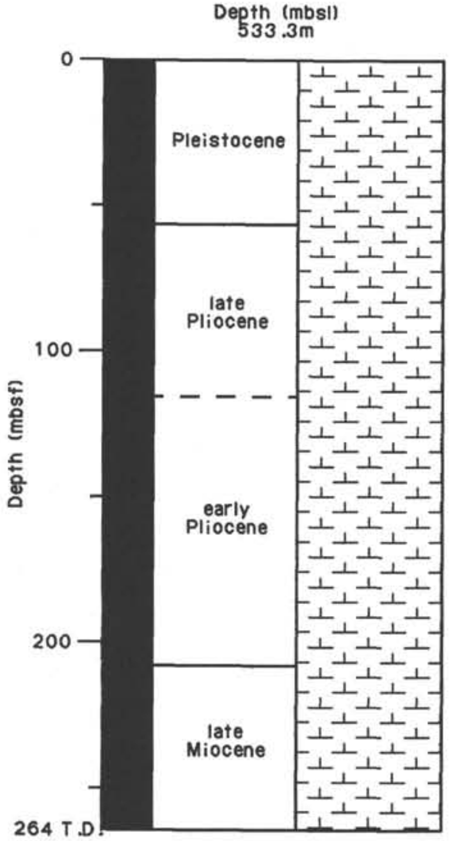

Figure 2. Stratigraphic summary of Site 716. Sediment recovery (black column) exceeded 100% at this final site of the Leg 115 program.

the drill floor was secured, the thrusters were raised, and the ship was under way for the 30 nmi west-southwest transit to site MLD-1 at 0745 hr, 28 June 1987.

Hole 716A

We lowered to the seafloor a standard APC/XCB bottom-hole assembly (BHA) with the same bit used on the previous holes and established the mud line at 533.3 m. Cores came up so fast that two teams of scientists were assigned to describe them in an effort to keep up. The hole was advanced to 790.4 m (257.1 mbsf) with 27 APC-coring runs. With the 250-m penetration objective achieved, we pulled the BHA clear of the mud line, and the ship was offset 10 m to initiate Hole 716B. Total penetration was 257.1 mbsf to 790.4 m with 262.7 m of core recovered for a recovery rate of 102% (Table 1).

Hole 716B

We lowered the BHA back to the seafloor and established the mud line at 533.3 m. Coring continued to 797.7 m (264.4 mbsf) with 28 APC-coring runs. With the 250-m penetration objective filled, we once again halted coring. Total penetration was 264.4 mbsf to 797.7 m with 267.4 m of core recovered for a recovery rate of 101% (Table 1).

Site 716 to Male, Maldive Islands

At 0100 hr, 30 June 1987, the ship was under way for Male to return the two observers. The clock was advanced 1 hr at the beginning of the transit. After a transit of 58 nmi, the ship arrived at Male at 0645 hr. The ship was not anchored and held its position approximately 1 nmi south of the island.

Table 1. Coring summary, Site 716.

Core no.	Date (June 1987)	Time (local)	Depth (mbsf)	Cored (m)	Recovered (m)	Recovery (%)
115-716A-						
1H	28	1741	0-6.9	6.9	6.93	100.0
2H	28	1800	6.9-16.5	9.6	9.88	103.0
3H	28	1821	16.5-26.1	9.6	9.85	102.0
4H	28	1840	26.1-35.8	9.7	10.01	103.2
5H	28	1855	35.8-45.5	9.7	9.24	95.2
6H	28	1920	45.5-55.1	9.6	10.10	105.2
7H	28	1937	55.1-64.7	9.6	10.05	104.7
8H	28	1952	64.7-74.3	9.6	9.98	104.0
9H	28	2008	74.3-83.9	9.6	9.63	100.0
10H	28	2021	83.9-93.6	9.7	9.97	103.0
11H	28	2039	93.6-103.2	9.6	9.98	104.0
12H	28	2055	103.2-112.8	9.6	9.52	99.1
13H	28	2112	112.8-122.5	9.7	9.69	99.9
14H	28	2130	122.5-132.1	9.6	9.98	104.0
15H	28	2146	132.1-141.8	9.7	9.80	101.0
16H	28	2158	141.8-151.4	9.6	9.89	103.0
17H	28	2215	151.4-161.0	9.6	9.95	103.0
18H	28	2230	161.0-170.7	9.7	9.95	102.0
19H	28	2250	170.7-180.4	9.7	10.01	103.2
20H	28	2315	180.4-190.1	9.7	9.82	101.0
21H	28	2330	190.1-199.8	9.7	9.65	99.5
22H	28	2345	199.8-209.5	9.7	9.68	99.8
23H	29	0000	209.5-219.2	9.7	9.86	101.0
24H	29	0015	219.2-228.8	9.6	9.90	103.0
25H	29	0030	228.8-238.5	9.7	9.67	99.7
26H	29	0045	238.5-248.1	9.6	9.89	103.0
27H	29	0100	248.1-257.1	9.0	9.80	109.0
115-716B-						
1H	29	0300	0-3.9	3.9	3.05	78.2
2H	29	0315	3.9-13.5	9.6	9.47	98.6
3H	29	0330	13.5-23.1	9.6	9.02	93.9
4H	29	0345	23.1-32.8	9.7	9.10	93.8
5H	29	0400	32.8-42.5	9.7	10.12	104.3
6H	29	0415	42.5-52.1	9.6	10.10	105.2
7H	29	0430	52.1-61.7	9.6	9.67	101.0
8H	29	0445	61.7-71.4	9.7	9.63	99.3
9H	29	0500	71.4-81.1	9.7	9.59	98.8
10H	29	0510	81.1-90.7	9.6	9.63	100.0
11H	29	0525	90.7-100.3	9.6	9.79	102.0
12H	29	0540	100.3-110.0	9.7	9.59	98.8
13H	29	0555	110.0-119.7	9.7	9.97	103.0
14H	29	0610	119.7-129.3	9.6	9.83	102.0
15H	29	0625	129.3-138.9	9.6	9.61	100.0
16H	29	0640	138.9-148.6	9.7	10.07	103.8
17H	29	0651	148.6-158.3	9.7	9.89	102.0
18H	29	0707	158.3-167.9	9.6	9.63	100.0
19H	29	0721	167.9-177.5	9.6	9.84	102.5
20H	29	0735	177.5-187.2	9.7	10.00	103.1
21H	29	0749	187.2-196.9	9.7	9.97	103.0
22H	29	0803	196.9-206.5	9.6	9.98	104.0
23H	29	0817	206.5-216.1	9.6	9.80	102.0
24H	29	0832	216.1-225.8	9.7	9.94	102.0
25H	29	0846	225.8-235.5	9.7	9.82	101.0
26H	29	0857	235.5-245.1	9.6	10.26	106.9
27H	29	0918	245.1-254.7	9.6	9.81	102.0
28H	29	1000	254.7-264.4	9.7	10.18	104.9

Male, Maldive Islands

While waiting for clearance from the Maldivian officials, the drill line was cut and slipped. The platform over the drill-line spool was removed, and preparations were made to install a new spool in Colombo. The Maldivian immigration and customs officials boarded the ship and gave us clearance.

Male to Colombo, Sri Lanka

We put the immigration and customs officials ashore along with the two observers. At 1100 hr, 30 June, the ship was under way for the 422 nmi transit to Colombo, Sri Lanka, ETA 0600 hr, 2 July.

Summation of Leg 115

Leg 115 was a fruitful leg for core recovery. Total core recovered was 3075 m, including 124 m of basement rock, with an overall recovery rate of 77.7%.

LITHOSTRATIGRAPHY

Introduction

Site 716 is located in water depths of 533.3 m in the center of a broad, shallow, enclosed morphologic depression between the double atoll chain of the Maldive Archipelago.

We recovered a single lithologic unit at Site 716 consisting mainly of a foraminifer-bearing nannofossil ooze and a foraminifer-bearing nannofossil calcareous ooze, without any distinct turbidite layers. The carbonate content of the sediment was always 90% or higher. We observed the first indurated chalky levels between 70 and 80 mbsf. The sedimentary sequence at Site 716 represents a continuous late Miocene through Pleistocene record without any apparent hiatus and with high sedimentation rates ranging between 23 and 56 m/m.y.

Unit I: Cores 115-716A-1H through -27H (0–257.10 mbsf) and Cores 115-716B-1H through -28H (0–267.36 mbsf); Age: Pleistocene to late Miocene.

Unit I consists mainly of a foraminifer-bearing nannofossil ooze and a foraminifer-bearing nannofossil calcareous ooze. The term "calcareous" has been added to characterize a nannofossil ooze with a fine carbonate fraction consisting chiefly of shallow bank-derived particles, such as aragonite needles, micrite (unidentifiable fine carbonate), and microbioclasts. Quantification of bank-derived particles in the carbonate fine fraction is based on smear slide estimates. The nannofossil oozes and nannofossil calcareous oozes always contain foraminifer tests as a minor component (10%–25%), with the only recorded exceptions being in Samples 115-716A-3H, 80 cm, and 115-716B-3H, 80 cm, where the foraminifer content makes up only 5% and 8%, respectively, of the bulk sediment.

Pteropod tests occur in the top three cores of both Holes 716A and 716B and were estimated to form between 10% and 25% of the bulk sediment. Thus, these sediments become a pteropod-bearing nannofossil ooze. Pteropods are absent or in minor abundance further downcore. Large broken shells (up to a few centimeters in diameter) and coral fragments, as well as a few centimeter-long scaphopod tests, were found scattered throughout the sediments.

Most of the sediments recovered in Unit I are homogeneous, featureless, and very monotonous in appearance. The sediments are surprisingly dark for their carbonate content, which was always higher than 90%. Their colors exhibit different shades of olive (5Y 4/3, 4/4, 5/3, and 5/4) throughout Holes 716A and 716B, with subtle changes toward pale olive (5Y 6/3 and 6/4) and olive gray (5Y 5/2). Color transitions are gradational most of the time. Bioturbation and color mottling are seldom obvious.

Nannofossil oozes and calcareous oozes in the top six cores of Hole 716A were extremely wet, and sediments in several sections were somewhat disturbed, mainly as a result of the core-splitting procedures. More careful handling in Hole 716B minimized disturbances of the top 60 m. Although the first appearance of chalky levels was relatively shallow (75 mbsf), a complete transformation from ooze to chalk was not evident, even at the bottom of Site 716 (around 260 mbsf). The chalk proportions ranged between 10% and 60% and were highly varied from one core to another in the bottom half of Site 716.

In the vicinity of hard chalky horizons, the intervening ooze can remain very soft and the water content high. It is conceivable that some of the hard chalky horizons were formed at the water/sediment interface by seafloor cementation during certain time intervals, instead of being related to early burial diagenesis. The strong H_2S smell during core splitting indicates that some microbial sulfate reduction has taken place. The rather common occurrence of celestite ($SrSO_4$) nodules provides evidence that the transformation of high-strontium, aragonite-rich sediment to calcite sediment during early burial diagenesis had already occurred in the bottom half at Site 716. For example, an 8 × 2-cm cylindrical chunk of celestite was found in Sample 115-716A-20H-4, 132–138 cm.

BIOSTRATIGRAPHY

Introduction

Two holes drilled at Site 716 in water depths of 533.3 m recovered an expanded continuous sequence (264.4 m thick) of nannofossil and calcareous oozes ranging in age from Pleistocene to late Miocene. Calcareous nannofossils are abundant throughout, being well preserved in upper Pleistocene sediments, moderately well preserved in middle Pleistocene sediments, and poorly preserved in the remainder of the section. Planktonic foraminifers are abundant and moderately well preserved throughout the entire sequence, whereas benthic foraminifers were common and moderately well to well preserved in all recovered cores. Siliceous microfossils are notably absent from Site 716 sediments.

A biostratigraphic summary for Site 716 is presented in Figure 3.

Calcareous Nannofossils

Hole 716A

The 27 cores drilled from Hole 716A yielded abundant calcareous nannofossil assemblages ranging in age from the late Miocene to the latest Pleistocene. The preservation state is good in the late Pleistocene, moderately good in the middle Pleistocene, and poor from the early Pleistocene to the bottom.

Discoasters and ceratoliths, which provide marker species for the biostratigraphic classification of the late Miocene and early Pliocene, are very rare and poorly preserved. Thus, zonal assignments and detailed stratigraphic controls within the lower part of the sequence are tentative.

Pleistocene

Emiliania huxleyi is present at the top and in Section 115-716A-1H, CC, and therefore the late Pleistocene is represented in this sequence. The last occurrence (LO) of *Pseudoemiliania lacunosa* occurs in Section 115-716A-3H, CC, and the first occurrence (FO) of *Gephyrocapsa oceanica*, which approximates the Pliocene/Pleistocene boundary, occurs in Section 115-716A-6H, CC.

Pliocene and Upper Miocene

In spite of their low abundance and poor preservation, discoasters provide a consistent biostratigraphic sequence of events in the upper Pliocene. In fact, we observed the successive LOs of *Discoaster brouweri* (in Section 115-716A-7H, CC), of *D. pentaradiatus* (in Section 115-716A-8H, CC), and of *D. tamalis* (in Section 115-716A-10H, CC). The LOs of *Sphenolithus abies* and of *Reticulofenestra pseudoumbilica*, which are used to approximate the boundary between the lower and the upper Pliocene, are identified respectively in Sections 115-716A-12H, CC, and 115-716A-13H, CC.

The FO of *Ceratolithus rugosus* was observed in Section 115-716A-14H, CC. We are confident that this sample is close to the FO of this species since we found *Ceratolithus acutus* in the same sample, a taxon known to become extinct in the earliest range of *C. rugosus*.

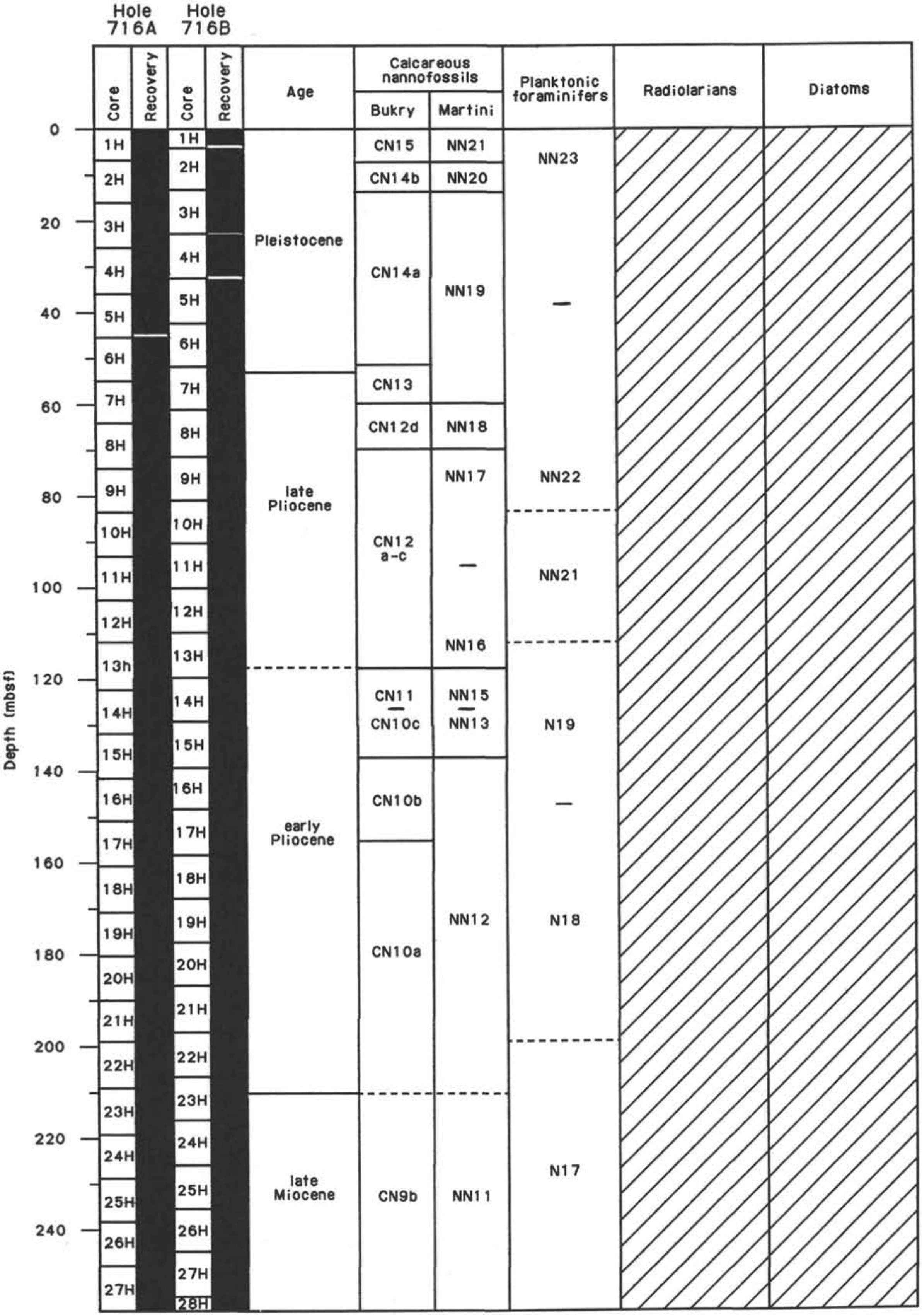

Figure 3. Biostratigraphic summary of Site 716. Foraminiferal biozonation is based on our study of Hole 716A; nannofossil zonation is derived from our study of Hole 716B. Recovery in Holes 716A and 716B is indicated by black bars.

The FO of *C. acutus* and the LO of *Discoaster quinqueramus*, used to recognize the boundary between the Miocene and the Pliocene, are difficult to locate in the sequence because of the very poor preservation state. However, we positively recognized *C. acutus* in Section 115-716A-16H, CC, where it co-occurs with *Triquetrorhabdulus rugosus*, known to become extinct very close to the FO of *C. acutus*. Both of these events were used to define the CN10a–CN10b zonal boundary, which is correlated with the lowermost Pliocene.

In the underlying cores, several heavily overgrown five-rayed discoasters were observed which we identified tentatively as *D. quinqueramus*. A positive identification of this species was not possible, however, except in the sample from the bottom of the hole, Section 115-716A-27H, CC. *Amaurolithus primus* is present in the latter sample; thus, the bottom of the sequence belongs to the CN9b subzone and is latest Miocene in age.

Hole 716B

The occurrence and preservation of nannofossils in Hole 716B are identical to that observed at Hole 716A. Preservation is good in the upper Pleistocene, moderately good in the middle Pleistocene, and poor in the lower Pleistocene to upper Miocene sequence.

We investigated one or two samples per section for the Pleistocene sequence retrieved at this hole. The FO of *Emiliania huxleyi* was tentatively placed between Samples 115-716B-2H-2, 75 cm, and 115-716B-2H-3, 75 cm. We easily identified the LO of *Pseudoemiliania lacunosa* between Section 115-716B-2H, CC, and Sample 115-715B-3H-1, 75 cm, but not the top of the small *Gephyrocapsa* Zone. The LO of *Helicosphaera sellii* was placed tentatively between Samples 115-716B-5H-6, 75 cm, and 115-716B-5H-7, 75 cm. The LO of *Calcidiscus macintyrei*, which is easily recognizable even in heavily overgrown samples, was identified between Samples 115-716B-6H-6, 75 cm, and 115-716B-6H-7, 75 cm.

We had difficulty in detecting the FO of *Gephyrocapsa oceanica* in the heavily recrystallized samples, although we did identify the event tentatively between Sample 115-716B-7H-6, 75 cm, and Section 115-716B-7H, CC. The latter sample does not seem to contain *G. oceanica*, but we did observe a few specimens which are similar to overgrown *Gephyrocapsa caribbeanica*. Section 115-716B-7H, CC, therefore, was tentatively assigned to Subzone CN13b, within which the Pliocene/Pleistocene boundary lies.

We have summarized the zonal assignments below Core 115-716B-6H as shown in Table 2.

Planktonic Foraminifers

Planktonic foraminifers are abundant and moderately well preserved throughout all the core catchers recovered in Hole 716A. Pteropods and pteropod fragments are abundant in Section 115-716A-1H, CC, and rare in Sections 115-716A-2H, CC, through 115-716A-4H, CC. We did not find them below this.

The tropical Pleistocene and Pliocene assemblages, although similar to those obtained at nearby Sites 714 and 715, appear to be less diverse, probably as a consequence of the shallow water depth (533.3 m) at the site and the more restricted environment. Such specimens as *Pulleniatina* spp. and *Sphaeroidinellopsis* spp., common in the Pliocene of the previous open-ocean sites, are rare here.

The sequential order of planktonic foraminiferal datums, defining a local Pliocene-Pleistocene biostratigraphy, is as follows: (1) LO *Globorotalia limbata* (2.2 Ma) in Section 115-716A-8H, CC (74.3 mbsf), (2) FO *Globigerinoides fistulosus* (2.9 Ma) in Section 115-716A-9H, CC (83.9 mbsf), (3) LO *Dentoglobigerina altispira* (2.9 Ma) in Section 115-716A-10H, CC (93.6 mbsf), (4) LO *Sphaeroidinellopsis* spp. (3.0 Ma) in Section 115-716A-12H, CC (112.8 mbsf), and (5) FO *Globorotalia tumida* (5.2 Ma) in Section 115-716A-16H, CC (151.4 mbsf). The FO of *G. tumida* is not clearly defined. Section 115-716A-16H, CC, is the lowest sample that contains typical common specimens. However, rare specimens of *G. tumida* occasionally occur below that level as far down as Section 115-716A-21H, CC (near 200 mbsf).

Table 2. Calcareous nannofossil zonal assignments in Hole 716B below Core 115-716B-6H.

Section interval	Zone	Time period
115-716B-		
7H, CC	Subzone CN14a (lower part)	early Pleistocene
8H, CC	Subzone CN12d	late Pliocene
9H, CC	Subzone CN12b–12c	late Pliocene
10H, CC	Subzone CN12a–12b	late Pliocene
11H, CC	Subzone CN12a–12b	late Pliocene
12H, CC	Subzone CN10c–11b	early Pliocene
13H, CC	Subzone CN10c–11b	early Pliocene
14H, CC	Subzone CN10c–11b	early Pliocene
15H, CC	Subzone CN10c–11b	early Pliocene
16H, CC	Subzone CN10c–11b	early Pliocene
17H, CC	Subzone CN10c–11b	early Pliocene
18H, CC	Subzone CN10b	early Pliocene
19H, CC	Subzone CN10b	early Pliocene
20H, CC	Subzone CN10b?	early Pliocene
21H, CC	Subzone CN9b–10a	Miocene/Pliocene
22H, CC	Subzone CN9b–10a	Miocene/Pliocene
23H, CC	Subzone CN9b–10a	Miocene/Pliocene
24H, CC	Subzone CN9b–10a	Miocene/Pliocene
25H, CC	Subzone CN9b–10a	Miocene/Pliocene
26H, CC	Subzone CN9b–10a	Miocene/Pliocene
27H, CC	Subzone CN9b?	late Miocene?
28H, CC	Subzone CN9b?	late Miocene?

Benthic Foraminifers

We recovered moderately preserved benthic foraminifers from all cores in Hole 716A. These unique upper bathyal faunas contained entirely different species, and even genera, from those of all other Leg 115 sites. Faunas contained a moderate number of bolivinids, abundant in only a few samples, but enough to interpret moderately low oxygen at the bottom from the latest Miocene through the Pleistocene. Most benthic foraminifers were in place, and we found only a few reefal or carbonate platform benthic species in the core catchers.

Numerous other invertebrate remains are present in these samples. Pteropods, common in the first three cores, persist into the fourth. Otoliths are common at the top of the section. Fish teeth occur in numerous samples, ostracodes are frequent throughout, and siliceous spicules are present in the last four cores.

Benthic faunal composition at the generic level is similar throughout the sequence. Typical specimens are *Uvigerina proboscidea, U. schwageri, U. auberiana, Cibicidoides matanzasensis*, the striate *Rectobolivina pacifica, Amphistegina lessonii, Lenticulina calcar*, the discanomalinids, *Bulimina marginata, Hoeglundina elegans*, and the miliolid genera, *Articulina* and *Massilina*. The relatively shallow water depths are indicated by the presence of species of *Tretomphalus* and *Ceratobulimina*. The diversity of brizalinids, which were cancellate or flanged, and their moderate abundance suggests moderately low oxygen bottom conditions prior to the Pleistocene.

We noted a major faunal break in the middle Pliocene early in Zone NN16 (Sections 115-716A-9H, CC, and 115-716A-10H, CC). Above this level the modern Indo-Pacific upper bathyal fauna was established. The *Cibicidoides haidinger*-planulinid association also included *Uvigerina schwageri, U. porrecta, U. hispidocostata, Ceratobulimina pacifica*, and *Bulimina acule-*

ata. As in intermediate depth sites, the major faunal change of the Pliocene occurred before 2.5–2.6 Ma.

A new association, characterized by *Eponides subhaidingeri* and the lenticulinids, typifies the middle to early Pliocene (Cores 115-716A-11H through 115-716A-17H). Below, in the early Pliocene to latest Miocene (Cores 115-716A-18H through 115-716A-27H), the cibicidid-planulinid-type fauna recurs. This association is similar to that of the late Pliocene–Pleistocene.

Radiolarians

We examined all core-catcher samples and found them barren of identifiable radiolarians, although sponge spicules become increasingly common in Cores 115-716A-21H through -27H (199.8–257.1 mbsf).

Diatoms

Diatoms or fragments of diatom valves are not present in any of the recovered core-catcher samples of Hole 716A.

Heavily silicified sponge spicules are common to abundant in the acid residue of Sections 115-716A-21H, CC, through 115-716A-27H, CC. The Pleistocene section (Sections 115-716A-1H, CC, through 115-716A-6H, CC) is also characterized by the presence of organic matter in a quantity not observed in any of the previous sites of Leg 115. The organic matter is present as pollen, vitrinite, and cuticles.

PALEOMAGNETICS

Introduction

We performed pass-through magnetometer measurements on the eight deepest cores from Hole 716A. Although the paleomagnetic data are consistent within each core, we could not detect any polarity reversals. Two possible explanations suggest themselves: either there are no reversals within the measured cores, or else the measured directions record only a recent overprint.

Results

The poorly consolidated sediment from the topmost 18 cores could not be measured; however, almost without exception, the measured cores (115-716A-19H through -27H) provide consistent remanence directions (an example of which is shown in Fig. 4). Moreover, the inclination of magnetization is almost uniformly shallow; that is, it is appropriate for this site position at 5°N. The average inclination in each of the measured cores is consistently shallow but positive. The exception to these general observations is Core 115-716A-23H, where the intensity is quite low (about 1×10^{-7} emu/c^3) and the directions are largely erratic.

Discrete sampling was not allowed at this site. Thus, we cannot report on the results of any progressive demagnetization experiments.

Discussion

The remarkable consistency of data obtained from the sequence of nine cores attests to the presence of some uniformity in the manner in which the magnetization was acquired. If this magnetization is primary, then it would seem that no polarity reversals are present in the recovered sediment. Since the recovery rate is quite high at this site, the chance of missing a reversal (at the core boundaries) is slim. The chance of missing multiple reversals is slimmer still. Nevertheless, biostratigraphic analyses of these sediments show high sedimentation rates; and it appears plausible that much, if not all, of the sediment examined may have been deposited during just one or two polarity chrons.

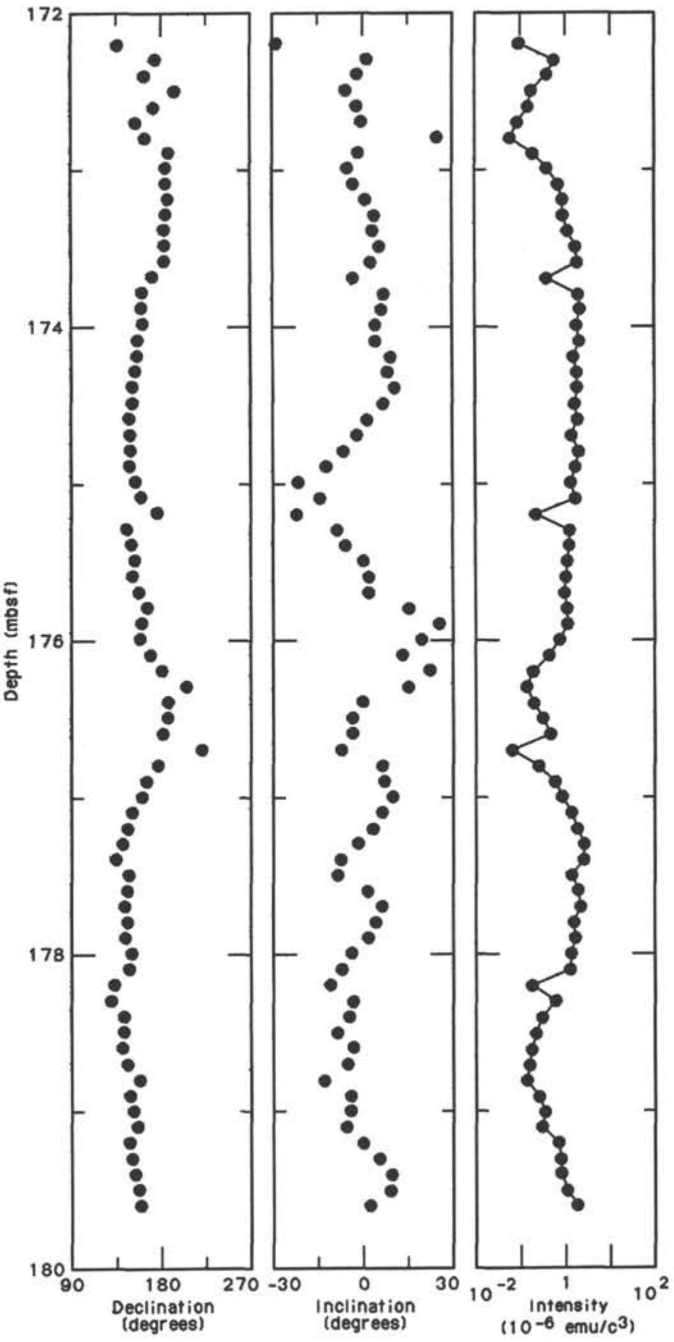

Figure 4. Example of highly consistent paleomagnetic directions obtained from lower portions of Hole 716A.

Biostratigraphic analyses bracketing this measured interval suggest that these sediments were deposited during the time represented by calcareous nannoplankton zones CN9b and CN10a. The period represented by these sediments, then, could be as long as 1.5 m.y.; however, it might be much shorter. In the latter case, few if any reversals would be expected within this interval. For instance, much of the sediment examined may have been deposited during Chron C3AR. Thus, despite the lack of demonstrated reversals, it is possible that the magnetization is, in fact, primary. There is, however, another explanation for the uniformity: these sediments may have been remagnetized by the present-day field.

Magnetic Susceptibility

Magnetic susceptibility measurements were made at intervals of 10 cm on all sections of cores recovered from Hole 716B to a depth of 71.25 mbsf (Cores 115-716B-1H through -8H). Measurements were made with a Bartington Susceptibility Meter (Model MS1) and a whole-core, pass-through sensor coil of 80-mm inner diameter (Model MS2C). The results of these measurements are shown in Figure 5.

Throughout the measured section of Hole 716B, magnetic susceptibility values were extremely low, that is, generally $< 1 \times 10^{-6}$ cgs, which is approximately equal to the limit of resolution of the whole-core sensor coil. The only exceptions to these uniformly low values are a series of small peaks in susceptibility between 2 and 5×10^{-6} cgs, each of which probably corresponds to an interval of sediment contaminated by drilling artifacts (e.g., pipe rust). This is suggested by the regular spacing of susceptibility peaks, and by the fact that each peak occurs at the top of individual cored intervals of the sequence (Fig. 5). The magnitude of these peaks, however, is much lower than the susceptibility values associated with pipe-rust contamination in previous holes drilled during Leg 115 (e.g., see "Paleomagnetics" section, "Site 707" chapter, this volume).

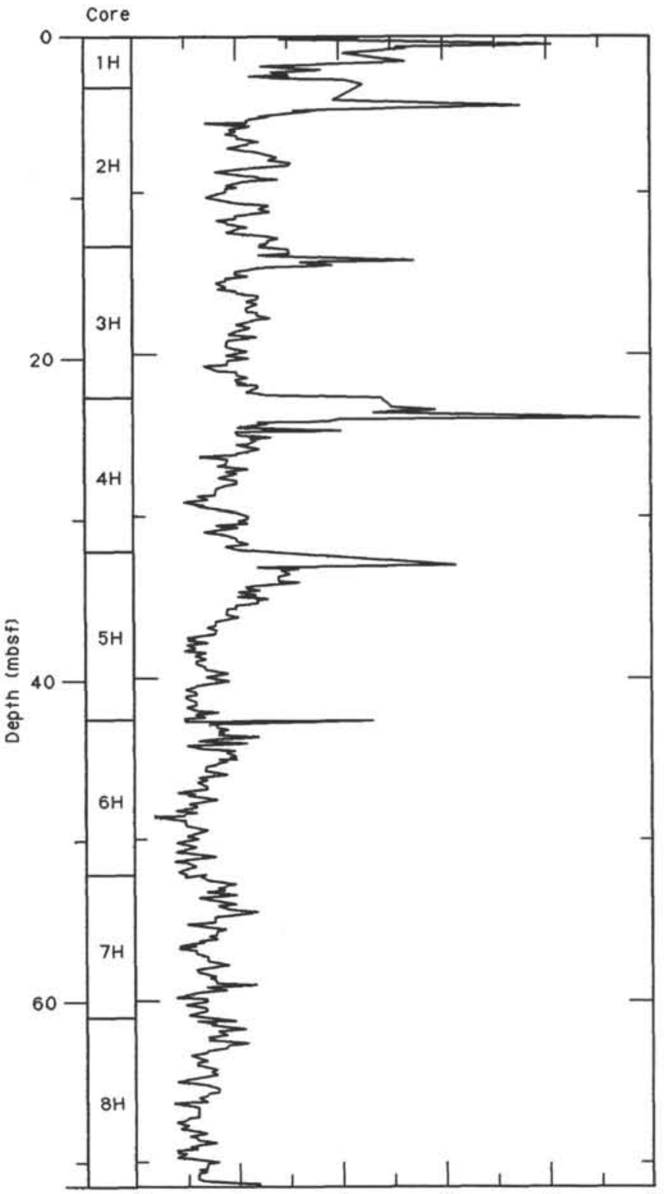

Figure 5. Whole-core magnetic susceptibility profile of Hole 716B to a depth of 71.25 mbsf. Peaks in susceptibility probably correspond to contamination by drilling artifacts (pipe rust?) at the top of individual cored intervals of the sequence.

The sequence recovered from Hole 716B consists of foraminifer- and pteropod-bearing (and sometimes clay-bearing) nannofossil oozes, passing into chalky oozes with increasing depth below the seafloor (see "Lithostratigraphy" section, this chapter). The uniformly low susceptibility values of this sequence (excepting contaminated horizons) are due partly to the high carbonate and low lithogenic clay content of the sediment and partly to the effects of "dissolution" (bacterial dissociation) of iron oxides and oxyhydroxides originally in the sediment during early diagenesis (see "Paleomagnetics" section, "Site 714" chapter, this volume, for details of the possible processes involved). The uniform olive green/gray color of virtually all of the sediment recovered from Site 716, and also the strong, sulfurous odor (presumably hydrogen sulfide) effused when the cores were split (see "Lithostratigraphy" section, this chapter), strongly suggests that these sediments are highly reduced—most probably as a result of bacterially mediated processes of suboxic organic matter diagenesis in the sediment (e.g., Froelich et al., 1979; Krumbein, 1983, p. 270).

Under strongly reducing conditions (i.e., involving bacterial sulfate reduction), all magnetic (NRM-carrying), ferric iron oxides and oxyhydroxides, and Fe(II)/Fe(III) oxides are unstable, and will ultimately be replaced by paramagnetic ferrous iron sulfides and structural Fe(II) in clay minerals as the stable forms of iron in the sediment (e.g., Berner, 1978; Canfield and Berner, 1987). The transition from Fe(III) to Fe(II) as the stable form of structural iron in clay minerals (particularly smectites), is thought to be the source of the change in color from brown to green, which deep-sea sediments undergo upon reduction during early diagenesis (Lyle, 1983). Paralleling this color change, therefore, is a decrease in susceptibility values of the sediment, as magnetic (NRM-carrying) ferric iron oxides and oxyhydroxides are replaced by mainly nonmagnetic ferrous-iron-bearing phases (e.g., Karlin and Levi, 1983, 1985). The more strongly magnetic (NRM-carrying) iron sulfide, pyrrhotite, may form under certain restricted Eh/pH and Eh/pS^{2-} conditions (see Berner, 1978). However, the susceptibility values of Hole 716B sediments suggest that pyrrhotite formation has not occurred at this site.

SEDIMENTATION RATES

The nannofossil datum levels used to compute sedimentation rates in Hole 716B are given in Table 3. The resulting plot (Fig. 6) suggests a sedimentation rate averaging 38 m/m.y. in the Pleistocene, 22–23 m/m.y. in the late Pliocene, and about 56 m/m.y. in the latest Miocene and early Pliocene. Further biostratigraphic studies may refine this general picture.

GEOCHEMISTRY

Interstitial Water Studies

Water samples were taken from 13 cores in Hole 716A. Data are presented in Table 4 and Figures 7 and 8.

Calcium and Magnesium

Although calcium and magnesium exhibit downhole gradients typical of basement alteration, we do not believe that this is the mechanism controlling the development of the Ca^{2+} and Mg^{2+} profiles. Overall, one can divide the downhole variation in Ca^{2+} and Mg^{2+} into two parts, separated by the Pliocene-

Table 3. Calcareous nannofossil datum levels used to compute sedimentation rates for Hole 716B.

Species event		Depth (mbsf)	Age (Ma)
FO	*E. huxleyi*	4.7–6.2	0.27
LO	*P. lacunosa*	13.5–14.4	0.46
FO	*G. oceanica*	60.4–61.7	1.60
LO	*D. brouweri*	61.7–71.4	1.89
LO	*D. pentaradiatus*	71.4–81.1	2.35
LO	*R. pseudoumbilica*	100.3–110.0	3.56
FO	*C. rugosus*	158.3–167.9	4.60
FO	*A. primus*	264.4– —	6.5

Note: FO = first occurrence and LO = last occurrence.

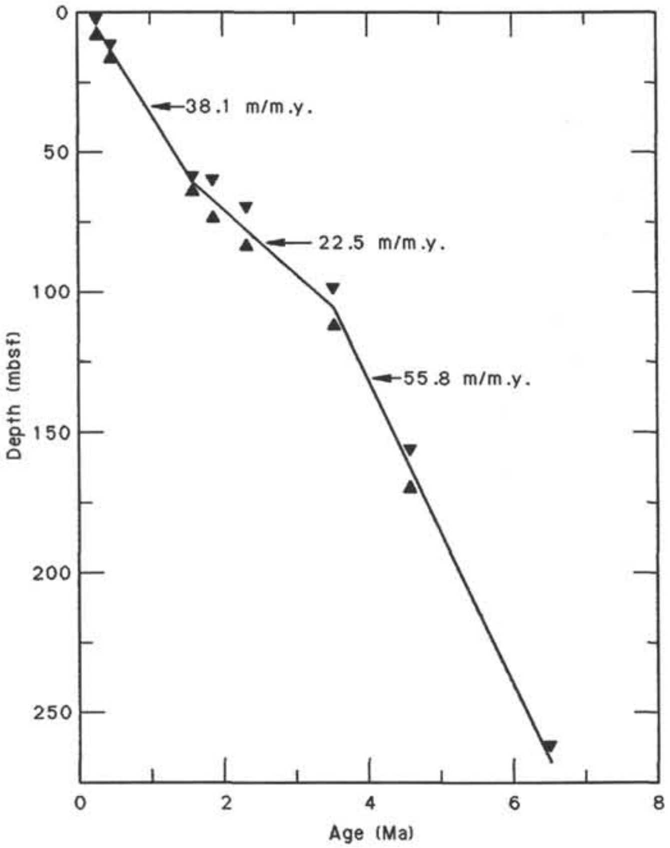

Figure 6. Sedimentation rates computed for Hole 716B using nannofossil datum levels discussed in text.

Pleistocene boundary. In the upper 50 m, corresponding to sediments Pleistocene in age, both Ca^{2+} and Mg^{2+} increase in concentration: Ca^{2+} from 10.71 mmol/L at 4.45 mbsf to 11.26 mmol/L at 51.2 mbsf, and Mg^{2+} from 53.11 mmol/L at 4.45 mbsf to 54.45 mmol/L at 41.75 mbsf. These differences produce a Ca^{2+} gradient of 0.011 mmol/L/m and a Mg^{2+} gradient of 0.035 mmol/L/m (Fig. 9). The positive covariance between these two parameters suggests that the behavior of these elements is controlled by dissolution and precipitation of calcium carbonate. One must remember that contributions of Sr^{2+} to the apparent Ca^{2+} concentration will depress the eventual true Ca^{2+} concentration.

Below Core 115-716A-6H, the interstitial gradient of both calcium and magnesium changes dramatically. The Ca^{2+} gradient between 51.2 and 166.65 mbsf increases to 0.05 mmol/L/m, while the Mg^{2+} gradient changes from 0.035 to -0.0693 mmol/L/m. With increasing sub-bottom depth, the gradients of both these elements become less severe. The change in relationship between Ca^{2+} and Mg^{2+} in the lower portion of the core is possibly related to the precipitation of high-magnesium calcite, which appears to be responsible for the formation of abundant clasts in the sediment. As aragonite dissolves, Sr^{2+} and Ca^{2+} increase in concentration in the pore fluids; and as high-magnesium calcite precipitates, magnesium is consumed (see "X-ray Diffraction" discussion, this section).

Alkalinity, Sulfate, Phosphate, and Ammonia

We can also separate the behavior of alkalinity into a Pleistocene and pre-Pleistocene period. In the Pleistocene, alkalinity remains at an approximately constant concentration between 2.9 and 3.2 mmol/L (Fig. 8). The concentration of sulfate similarly also exhibits only a slight variation, with a small decrease to 25.7 mmol/L at 12.85 mbsf. Phosphate and ammonia likewise do not change significantly over the upper 50 meters. In the Pliocene portion of Hole 716A, alkalinity increases to a maximum value of 6.04 mmol/L at 254.0 mbsf, while sulfate gradually decreases. Ammonia and phosphate increase to maximum concentrations of 451 and 17.25 μmol/L, respectively.

Chlorinity

Chlorinity exhibits a gradual increase from surface values of 535.3 to 550.5 mmol/L at a depth of 22.2 mbsf (Fig. 7). Below this depth, concentrations decrease to 531.5 mmol/L before increasing again to 564.7 mmol/L at 80 mbsf.

X-ray Diffraction, Carbonate, and Organic Content

All samples squeezed for interstitial waters were analyzed by X-ray diffraction to determine the principal minerals present. No quantitative mineralogy was attempted because of equipment malfunction.

In the upper 22.2 m of Hole 716A, the sediments are composed of varying proportions of calcite, aragonite, and quartz. The remainder of the Pleistocene is principally low-magnesium calcite with no aragonite detected in Cores 115-716A-4H, -5H, and -6H. The Pliocene portion of Hole 716A is characterized by the presence of such minerals as celestite, barite, and high-magnesium calcite (see "Lithostratigraphy" section, this chapter). It is believed that these minerals have formed, or are forming today, by precipitation from the interstitial pore fluids. High concentrations of strontium and barium are imparted to the pore fluids by the dissolution of aragonite and biogenic silica. In addition to low-magnesium calcite and high-magnesium calcite, some aragonite was present in Cores 115-716A-12H and -15H.

The carbonate content of Hole 716A varies between 88.08 and 97.64 wt% (Fig. 10 and Table 5), the remainder being composed of organic carbon, quartz, and various diagenetic minerals already mentioned. Although there is clear evidence of greater amounts of oxidation of organic material in the lower portion of Hole 716A, there appears to be no significant change in the organic content (Table 5). Therefore, the nature of the organic material in the Pliocene section must be of a more easily biodegradable form than the organic material in the upper 50 mbsf. Evidence for greater microbial activity was also evident in higher than normal methane (Fig. 10) and ethane concentrations. The ethane detected in Cores 115-716A-24H and -27H is probably bacterial in origin and not related to the maturation of organic material.

PHYSICAL PROPERTIES

Introduction

Site 716 is situated 65 km southwest of Site 715 in the center of a shallow basin dividing two atoll chains in the Maldives at a

Table 4. Interstitial water analyses, Hole 716A.

Sample interval (cm)	Depth (mbsf)	Ca (mmol/L)	Mg (mmol/L)	Cl (mmol/L)	Al (mmol/L)	pH	Salinity (‰)	Si (μmol/L)	SO_4 (mmol/L)	NH_4 (μmol/L)	PO_4 (μmol/L)
Seawater	0	10.42	54.37	535.3	2.53	8.5	34.5	0	26.80	81.4	2.47
115-716A-											
1H-3, 145-150	4.45	10.71	53.11	538.2	2.90	7.9	34.2	88.1	28.60	75.7	3.21
2H-4, 145-150	12.85	10.77	53.62	544.8	2.95	7.5	34.5	75.0	25.70	93.0	2.47
3H-4, 120-125	22.20	10.72	53.99	550.5	3.00	7.6	34.8	81.0	28.17	108.0	3.39
4H-4, 145-150	32.05	10.91	54.05	534.4	3.15	8.0	35.0	96.0	28.60	109.0	3.39
5H-4, 145-150	41.75	10.91	54.45	531.5	3.00	7.7	35.2	86.0	29.00	110.0	3.39
6H-4, 120-125	51.20	11.26	53.54	546.7	3.19	7.7	35.5	90.0	28.80	102.0	5.05
9H-4, 120-125	80.00	13.12	53.14	564.7	4.70	7.6	35.5	0	28.55	252.0	5.79
12H-4, 120-125	108.90	14.81	51.13	541.9	5.11	7.6	35.2	448.0	27.85	275.0	6.35
15H-4, 120-125	137.80	16.36	47.54	533.4	5.71	7.5	35.2	362.0	27.80	286.0	8.01
18H-4, 115-125	166.65	17.04	46.45	536.3	5.49	7.4	34.2	534.0	26.20	451.0	9.67
21H-4, 115-125	195.75	17.59	46.64	536.3	5.92	7.3	35.2	686.0	26.95	334.0	14.30
24H-4, 140-150	225.10	17.93	45.16	531.5	5.80	7.3	34.8	1004.0	26.30	358.0	17.25
27H-4, 140-150	254.00	17.97	46.01	540.1	6.04	7.3	34.8	774.0	26.40	388.0	13.55

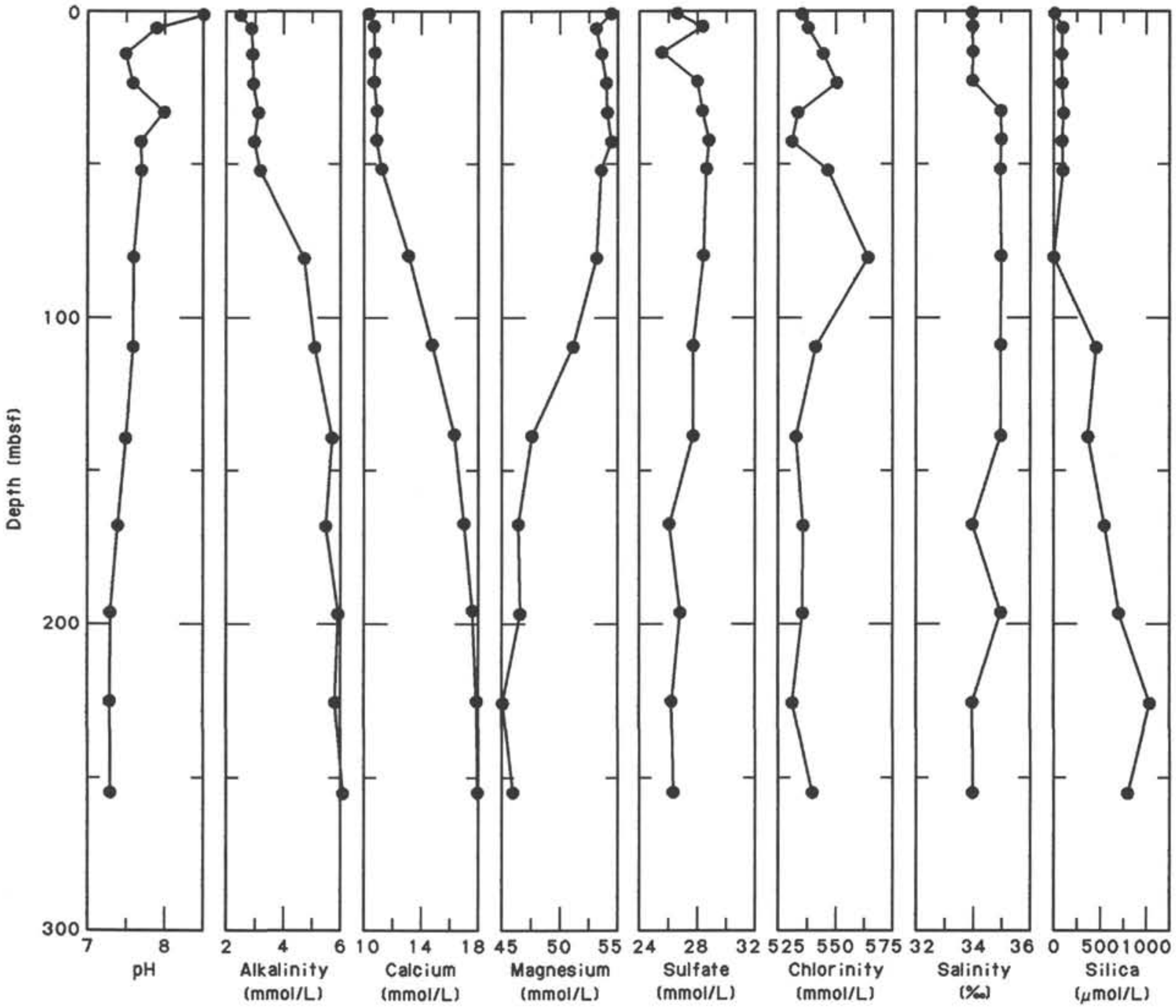

Figure 7. Summary of interstitial water analyses, Hole 716A, as a function of sub-bottom depth. Surface seawater is plotted at 0 mbsf.

water depth of 533.3 m. Hole 716A was drilled to a depth of 258 mbsf. Hole 716B reached a depth of 264 mbsf, one of the deepest APC holes ever drilled. The high sedimentation rate in this region resulted in a homogeneous foraminifer-, clay-, and pteropod-bearing nannofossil ooze, which graded downhole into a foraminifer-bearing nannofossil chalk (see "Lithostratigraphy" section, this chapter). The ooze contained a number of cemented horizons (2-6 cm thick), whose frequency increased

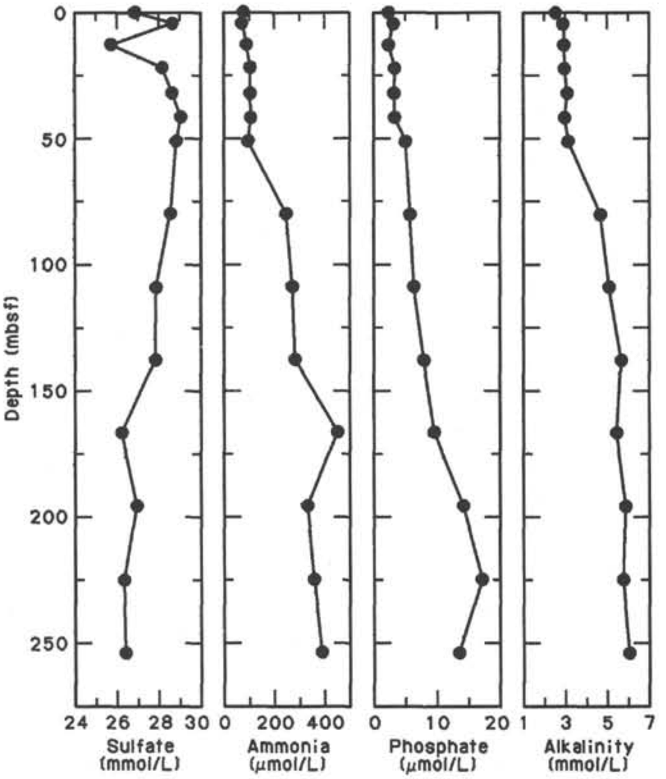

Figure 8. Variations of sulfate, ammonia, phosphate, and alkalinity with depth in Hole 716A.

with depth. When the cores were split, the pores released H_2S gas.

Due to time limitations, we obtained only GRAPE wet-bulk density and *P*-wave logger (PWL) measurements from the sediment sections of Site 716. The new vertical GRAPE tracking system installed at Site 714 was still causing problems. Wet-bulk density measurements were not possible on the first 120 m of Hole 716A due to failure of the new GRAPE software. Also, electrical pick-up on the PWL pulse-detection electronics from the motor of the new vertical GRAPE track resulted in a low signal-to-noise ratio and in deterioration of the *P*-wave measurements. These data will need processing and filtering before they can be presented.

Results

The results for wet-bulk density determined by GRAPE at Site 716 are shown in Figure 11. We measured one section per core in Hole 716A and three sections per core in Hole 716B. The first appearance of cemented horizons at 45 mbsf is expressed in the GRAPE record of Hole 716B as an increase of wet-bulk density above 1.6 g/cm^3, which levels off until a depth of 75 mbsf. At 124 mbsf there is an obvious increase again of wet-bulk density related to the transition from ooze with chalk horizons to chalk. The increase of wet-bulk density is most likely related to a decrease in porosity in the cemented and lithified parts of the sedimentary section. The general trend of the lower part of the Hole 716B record correlates well with the upper part of the record for Hole 716A (see Fig. 11), although we measured only one section per core in Hole 716A.

Summary

Due to time limitations, physical properties investigations were restricted to GRAPE and PWL measurements at Site 716.

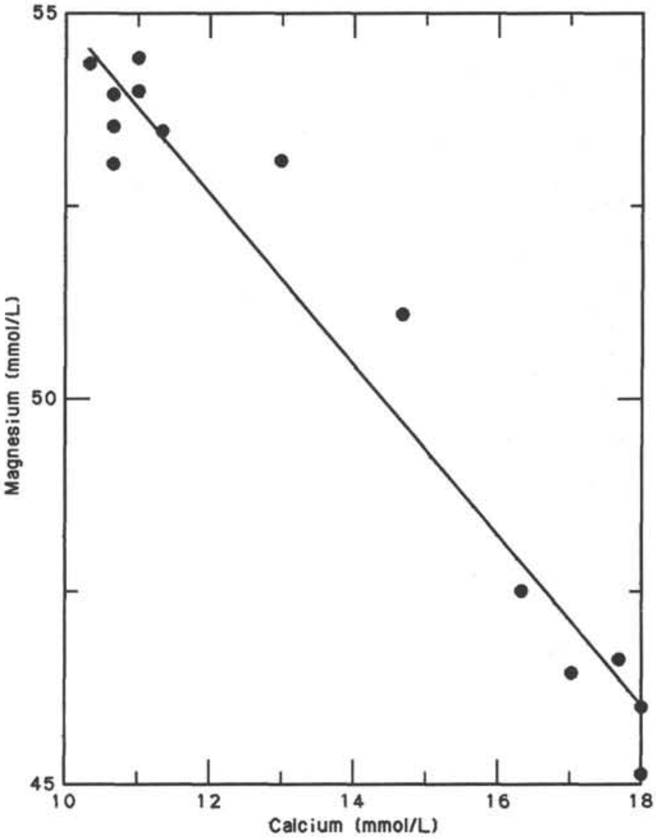

Figure 9. Relationship between calcium and magnesium, Hole 716A.

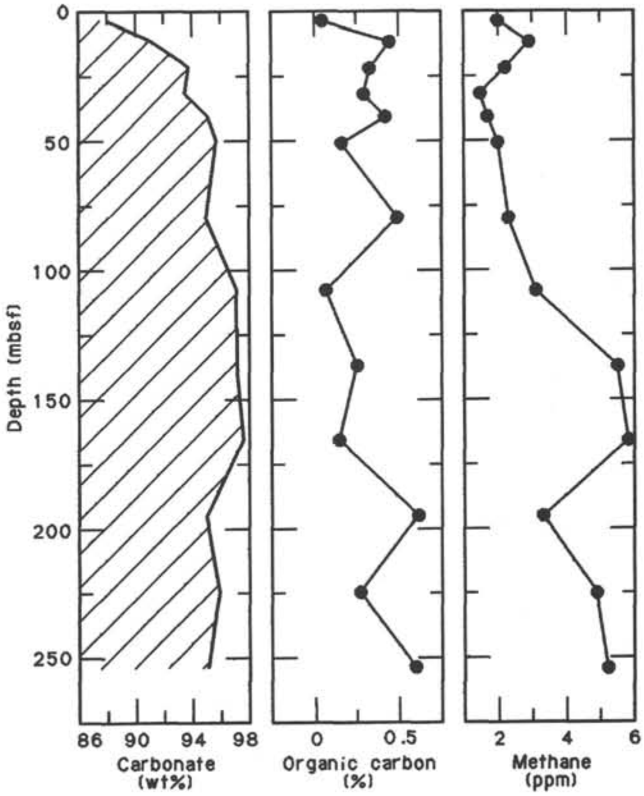

Figure 10. Changes in carbonate content, organic carbon, and methane with depth in Hole 716A.

Table 5. Carbonate content, organic carbon, methane (C_1), ethane (C_2), and C_1/C_2 ratios measured from Hole 716A. Analyses were made on the interstitial water samples.

Sample interval (cm)	Depth (mbsf)	Carbonate (wt%)	Organic carbon (%)	C_1	C_2	C_1/C_2
115-716A-						
1H-3, 145–150	4.45	88.08	0.06	2.06	0	0
2H-4, 145–150	12.85	91.14	0.44	2.96	0	0
3H-4, 120–125	22.20	93.74	0.33	2.20	0	0
4H-4, 145–150	32.05	93.49	0.30	1.56	0	0
5H-4, 145–150	41.75	95.00	0.42	1.76	0	0
6H-4, 120–125	51.20	95.71	0.18	2.06	0	0
9H-4, 120–125	80.00	94.97	0.49	2.32	0	0
12H-4, 120–125	108.90	97.16	0.09	3.16	0	0
15H-4, 120–125	137.80	97.16	0.26	5.53	0	0
18H-4, 115–125	166.65	97.64	0.16	5.88	0	0
21H-4, 115–125	195.75	95.02	0.61	3.30	0	0
24H-4, 140–150	225.10	95.90	0.28	4.90	0.29	0.06
27H-4, 140–150	254.00	95.16	0.59	5.25	0.51	0.10

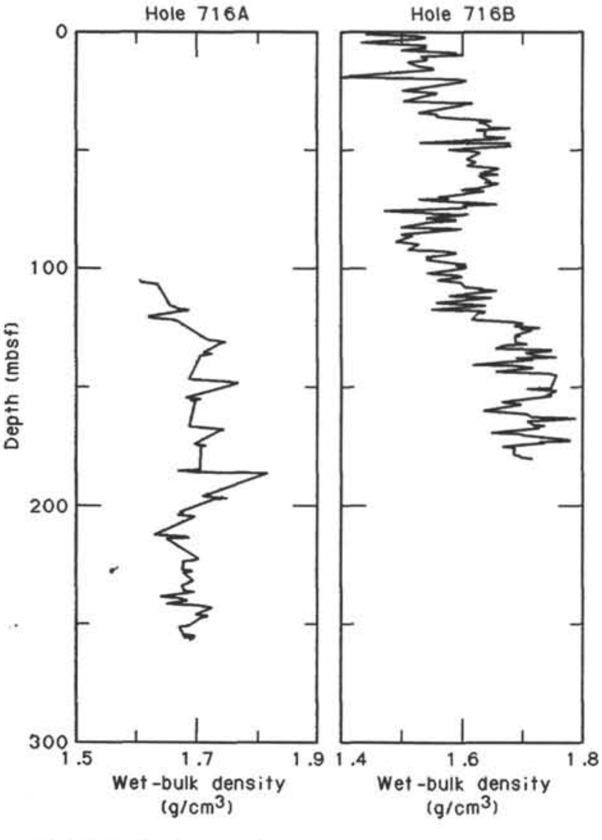

Figure 11. Wet-bulk densities for Holes 716A and 716B measured with GRAPE at Site 716.

The raw PWL data were distorted by noise and are not presented. The wet-bulk density measurements determined from the GRAPE vary with the transition from ooze to chalk.

SEISMIC STRATIGRAPHY

Site 716 is located on a broad, shallow basin in the center of the Maldives Ridge, at 4°56.0′N and 73°17.0′E (Fig. 12). The water depth is 533.3 m, and the seafloor is flat within a 10-nmi radius, sloping up to a ring of coral atolls roughly 15 nmi away. Seismic profiles across the Maldives Ridge (e.g., Fig. 13) reveal massive accumulation, on the order of 1–1.5 km, of sediments and sedimentary rocks on top of the volcanic basement.

We chose this site in order to study the late Neogene history of deposition of aragonite-bearing (periplatform) oozes. At this depth, we expected that dissolution would not significantly disguise the aragonite production signal. Thus, it was important to identify a position where sediments had accumulated at a constant rate without significant disruption by turbidite activity. Such a site was selected at the intersection of two multichannel seismic reflection profiles, made available by ELF-Aquitaine (48-channel, unpubl. data, 1973). These show a series of continuous reflectors down to 2.4 s (two-way traveltime) below the seafloor. There are clear prograding sedimentary sequences derived from the atolls. Near the top of the section, however, reflectors are flat lying and undisturbed.

The *JOIDES Resolution* single-channel seismic (SCS), watergun reflection profile over Site 716 appears as Figure 14. A prograding sequence of sediments is evident to the northeast of the site which is continuous with reflectors about 0.5 s below the seafloor beneath the site. Below that is a strong reflector at about 0.8 sbsf which is also prominent on the multichannel profiles. This irregular surface is possibly an old reef, exposed and eroded during a low sea-level stand. Basement is well below this reflector. The uppermost sediments show weak, parallel reflectors down to 0.5 sbsf, with no evidence of disruption. Our drilling confirmed that a continuous 6-m.y. record of carbonate sedimentation had accumulated at a nearly constant rate at this site.

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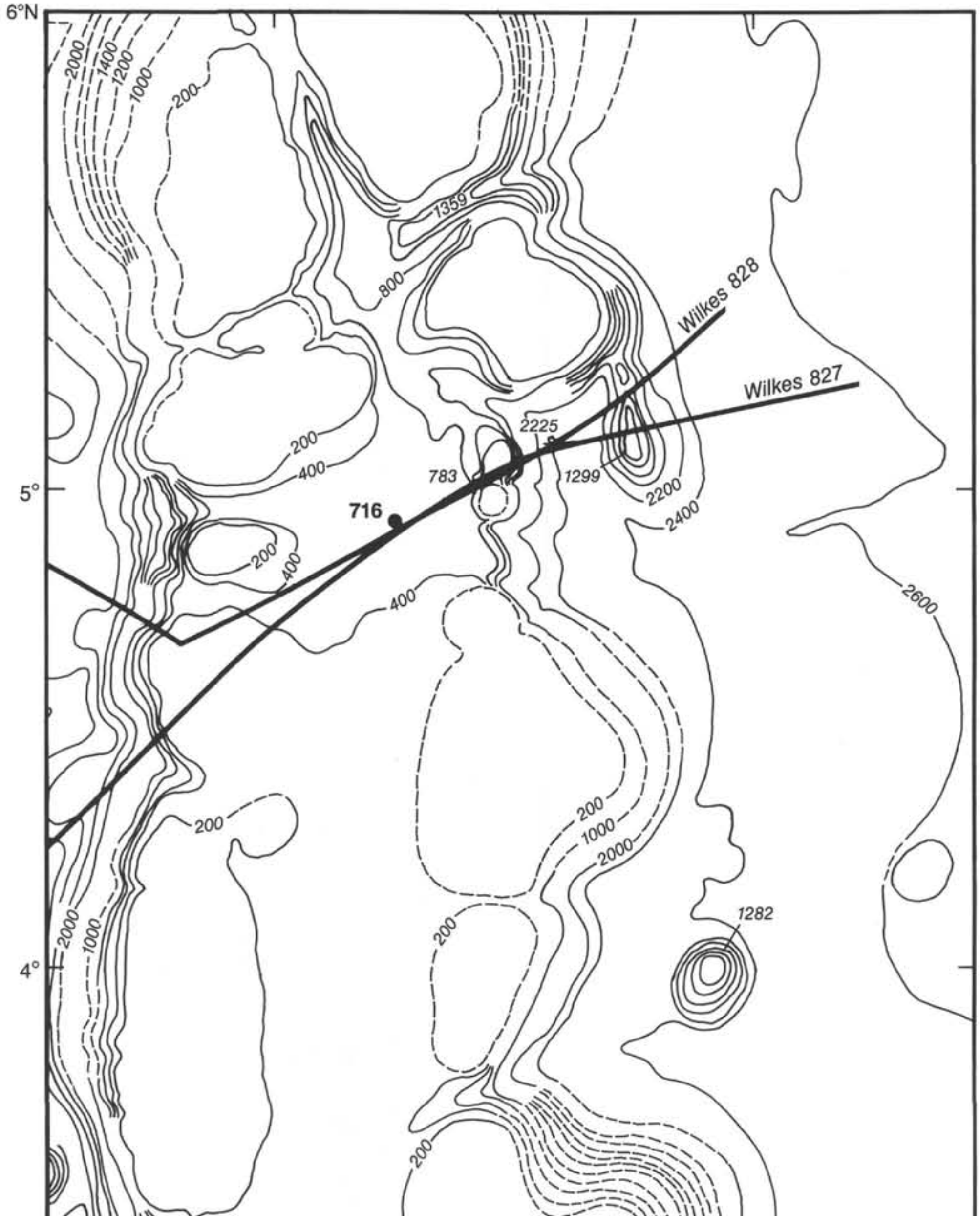


Figure 12. Bathymetric map of the region around Site 716, central Maldives Ridge (after unpublished data from NAVOCEANO, U.S. Navy surveys). Depth in meters.

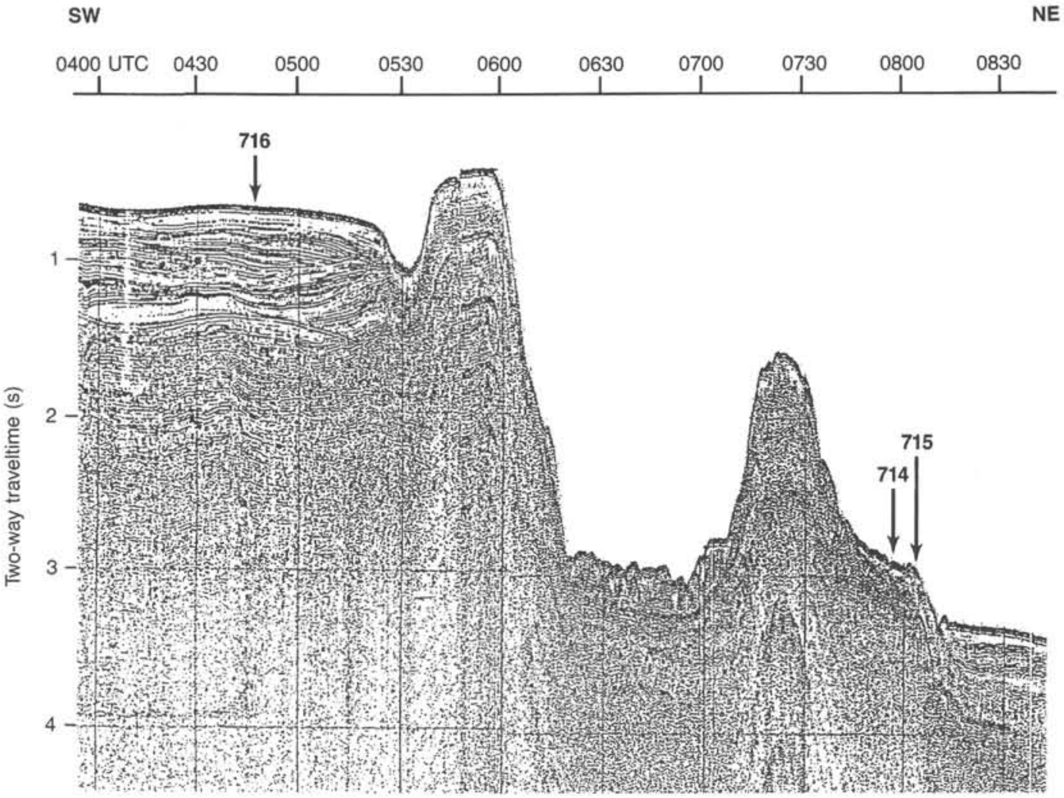


Figure 13. Wilkes 827 (17 September 1976) single-channel seismic (SCS) reflection profile across Site 716. Carbonate sediments have accumulated to thicknesses in excess of 1.5 km in this shallow basin bounded by coral atolls.

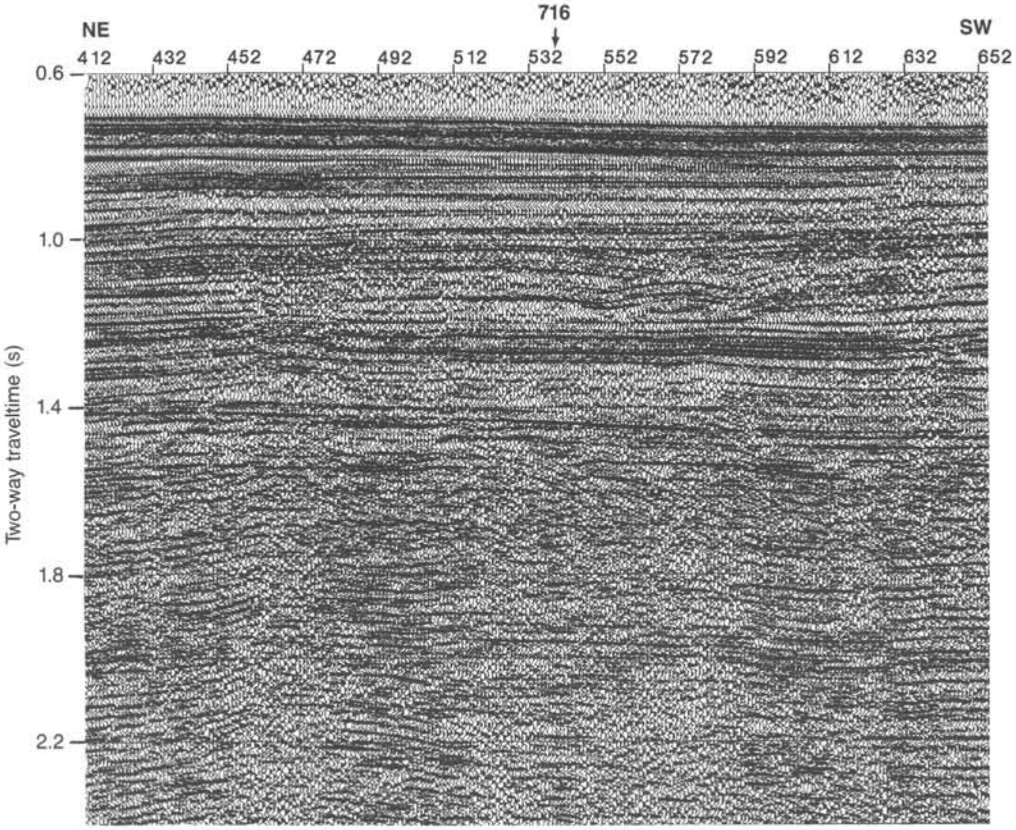
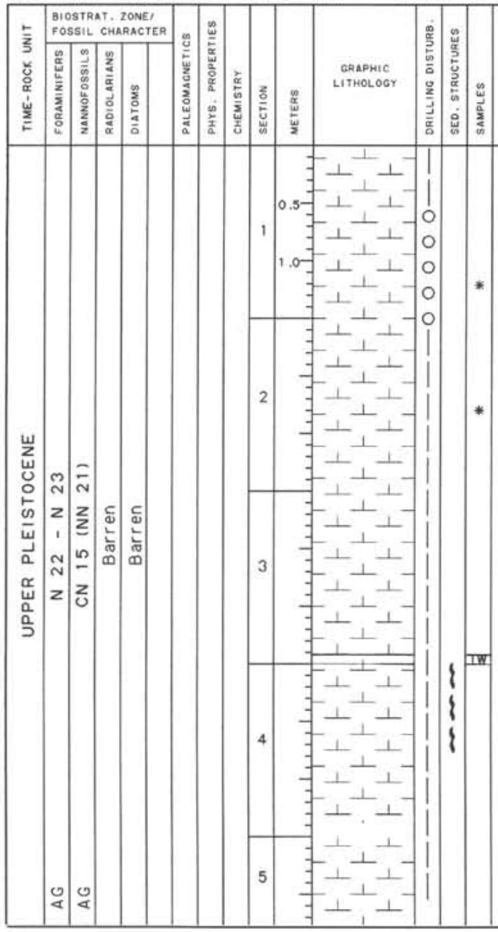


Figure 14. The *JOIDES Resolution* single-channel seismic (SCS), water-gun reflection profile over Site 716. A prograding sedimentary sequence appears to the northeast, shed from a drowned atoll. Directly beneath the site is about 0.5 s of semitransparent, parallel-layered soft sediments.

SITE 716 HOLE A CORE 1H CORED INTERVAL 533.3-540.2 mbsl; 0.0-6.9 mbsf



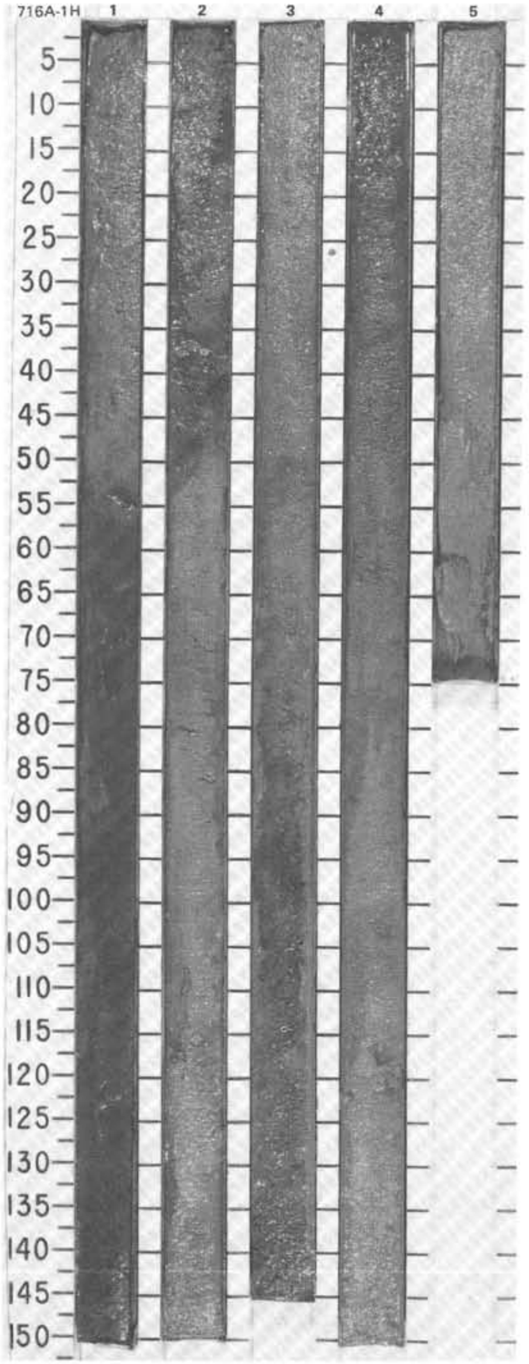
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING PTEROPOD-BEARING NANNOFOSSIL OOZE

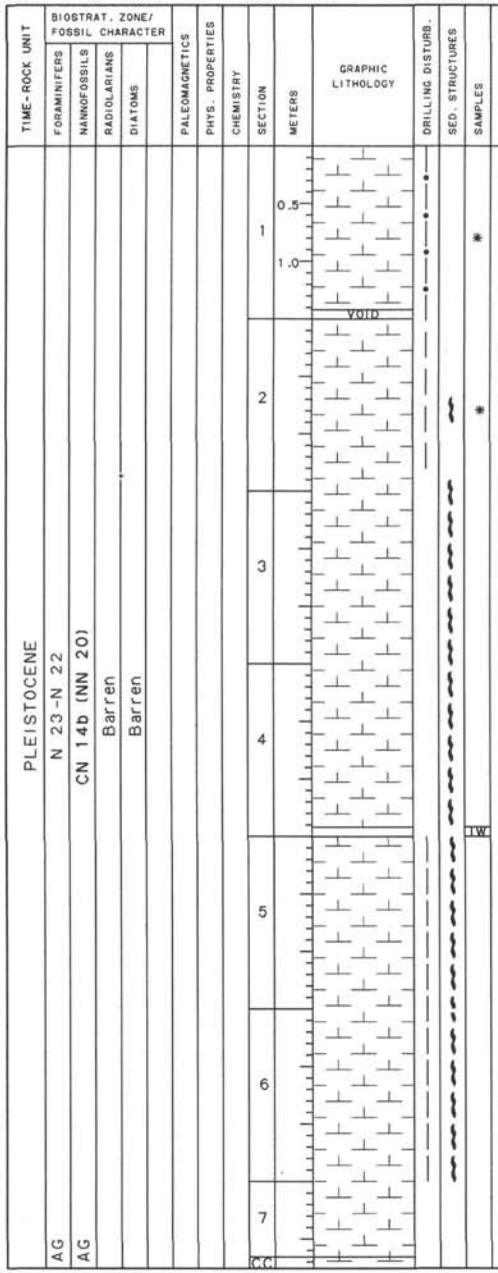
Major lithology: Foraminifer-bearing pteropod-bearing nannofossil ooze, homogeneous, with subtle gradational olive color changes (5Y 5/4, 4/4, 5/3), soupy and slightly disturbed throughout.

SMEAR SLIDE SUMMARY (%):

	1, 120 D	2, 80 D
TEXTURE:		
Sand	35	30
Silt	15	20
Clay	50	50
COMPOSITION:		
Quartz	2	1
Clay	15	15
Foraminifers	25	15
Nannofossils	33	46
Aragonite needles	—	2
Pteropod (mollusk debris)	20	20
Bioclasts	5	1



SITE 716 HOLE A CORE 2H CORED INTERVAL 540.2-549.8 mbsl; 6.9-16.5 mbsf



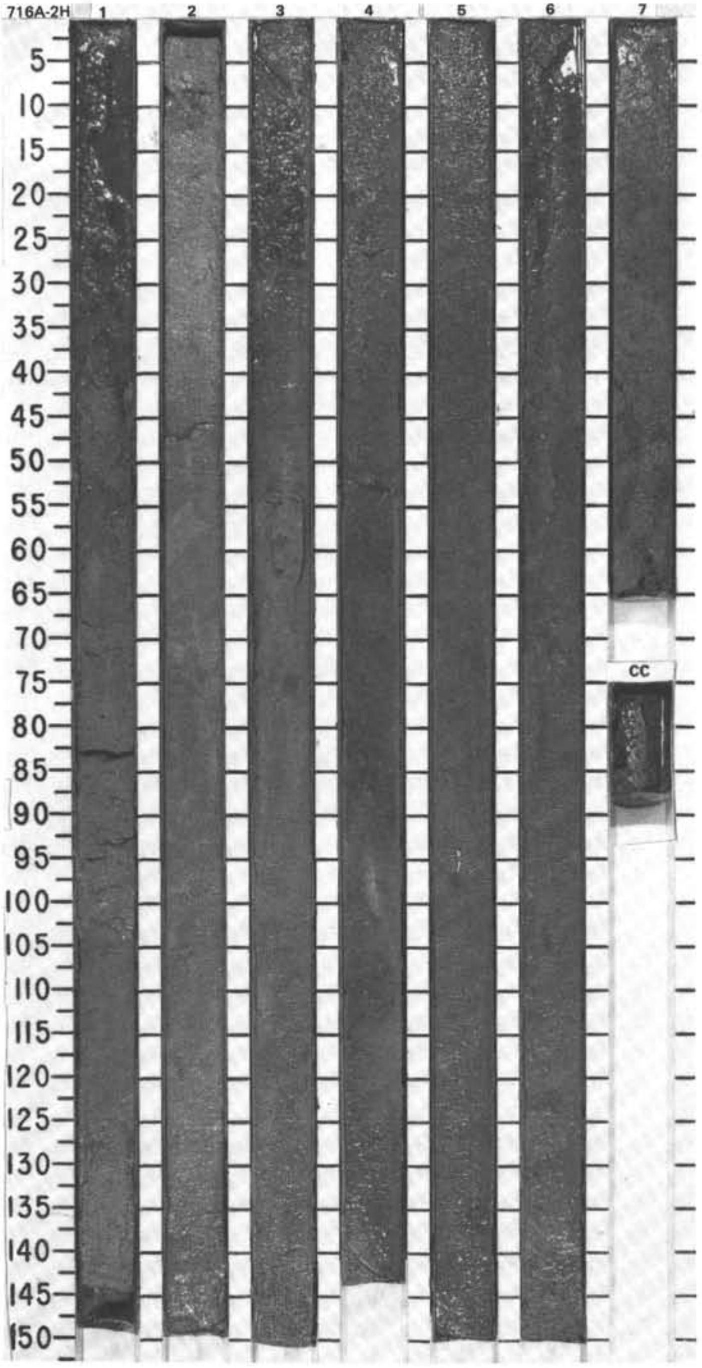
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING PTEROPOD-BEARING NANNOFOSSIL OOZE

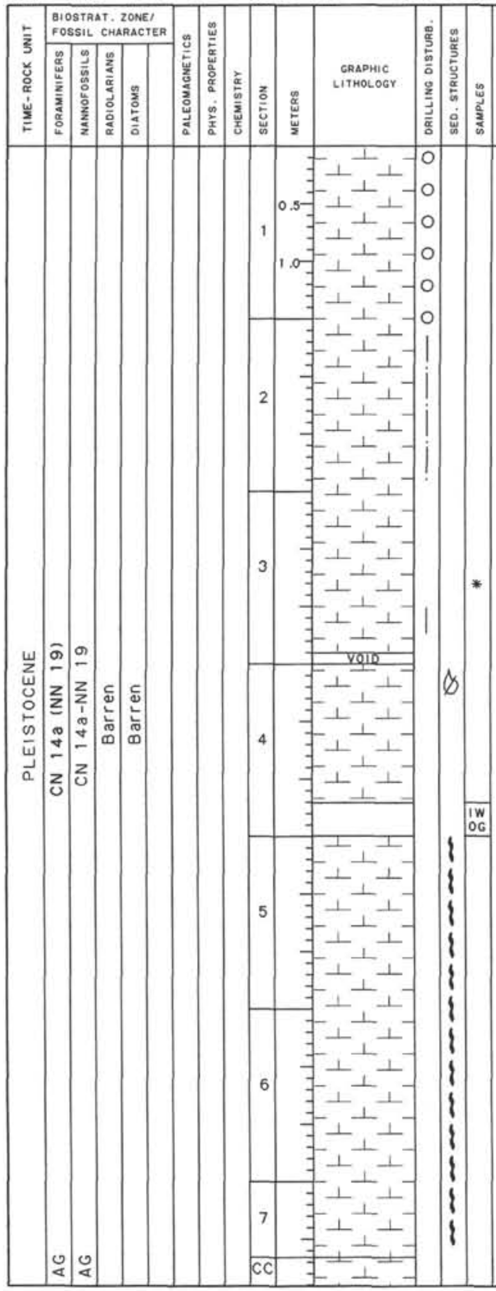
Major lithology: Foraminifer-bearing pteropod-bearing nannofossil ooze, homogeneous, olive (5Y 4/3, 5/3, 6/3), soupy and disturbed at top, weakly bioturbated throughout.

SMEAR SLIDE SUMMARY (%):

	1, 80 D	2, 80 M
TEXTURE:		
Sand	25	25
Silt	15	20
Clay	60	55
COMPOSITION:		
Quartz	—	Tr
Clay	15	15
Foraminifers	15	10
Nannofossils	53	50
Aragonite needles	2	5
Mollusks	15	20



SITE 716 HOLE A CORE 3H CORED INTERVAL 549.8-559.4 mbsl; 16.5-26.1 mbsf



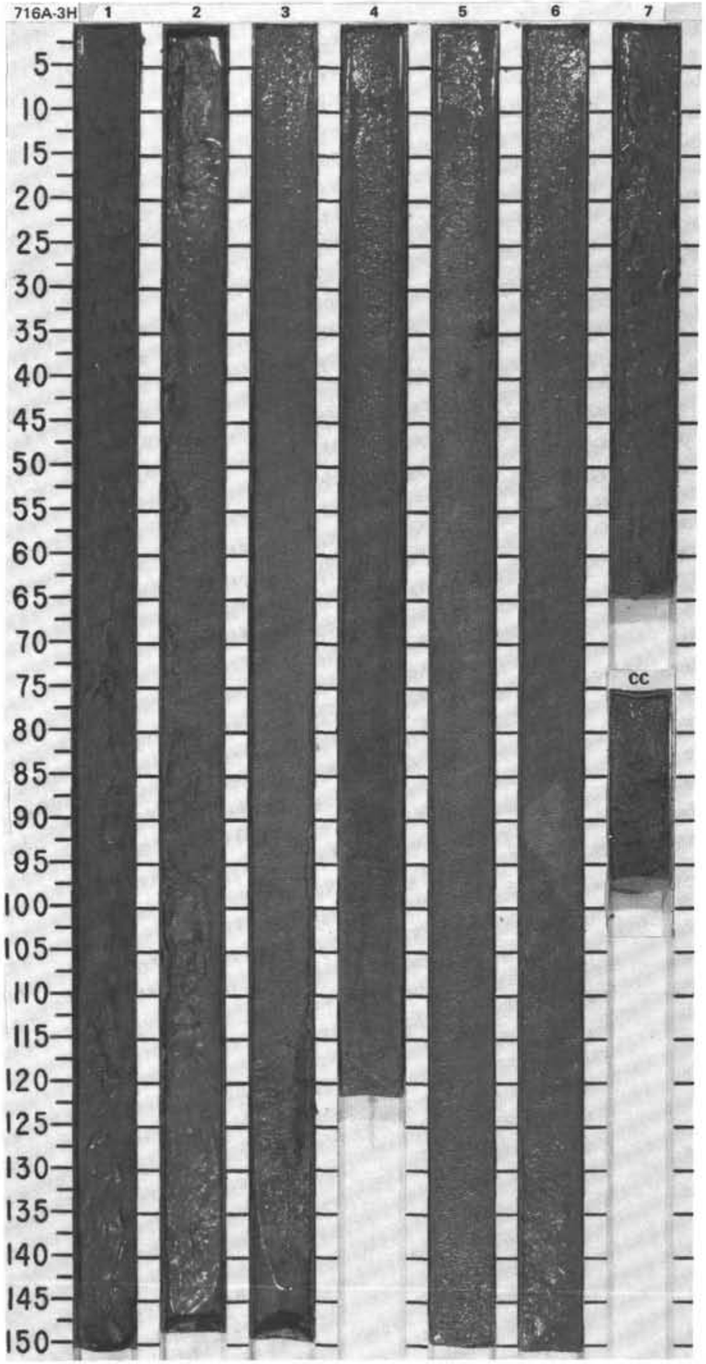
LITHOLOGIC DESCRIPTION

PTEROPOD-BEARING FORAMINIFER-BEARING NANNOFOSSIL OOZE

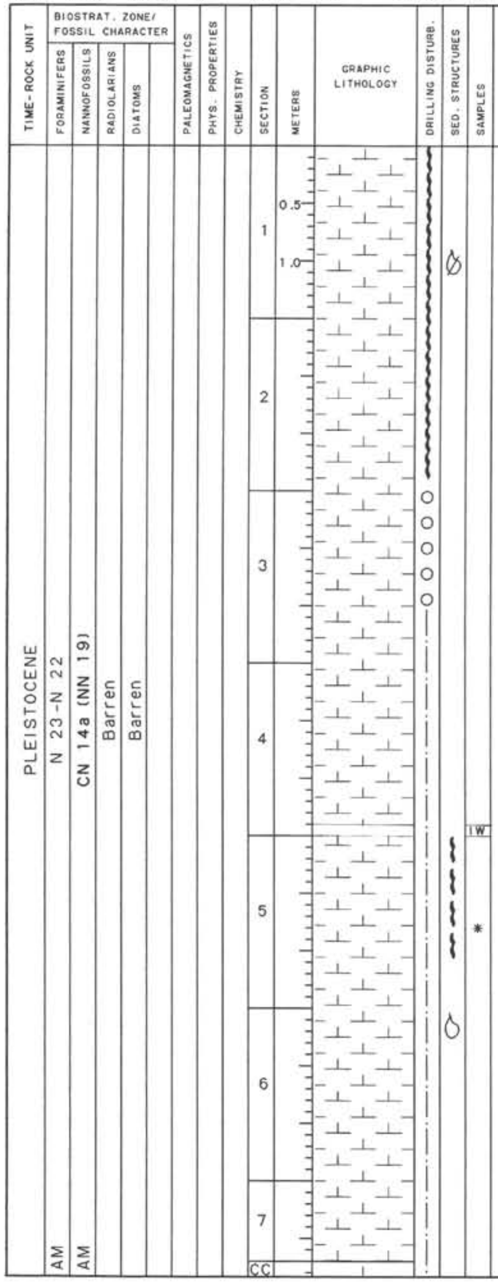
Major lithology: Pteropod-bearing foraminifer-bearing nannofossil ooze, olive (5Y 5/3, 6/3) to olive gray (5Y 5/2), homogeneous, very soupy at top, weak smell of hydrogen sulfide.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	35
Silt	15
Clay	50
COMPOSITION:	
Foraminifers	30
Nannofossils	40
Aragonite needles	20
Pteropods	10



SITE 716 HOLE A CORE 4H CORED INTERVAL 559.4-569.1 mbsl; 26.1-35.8 mbsf



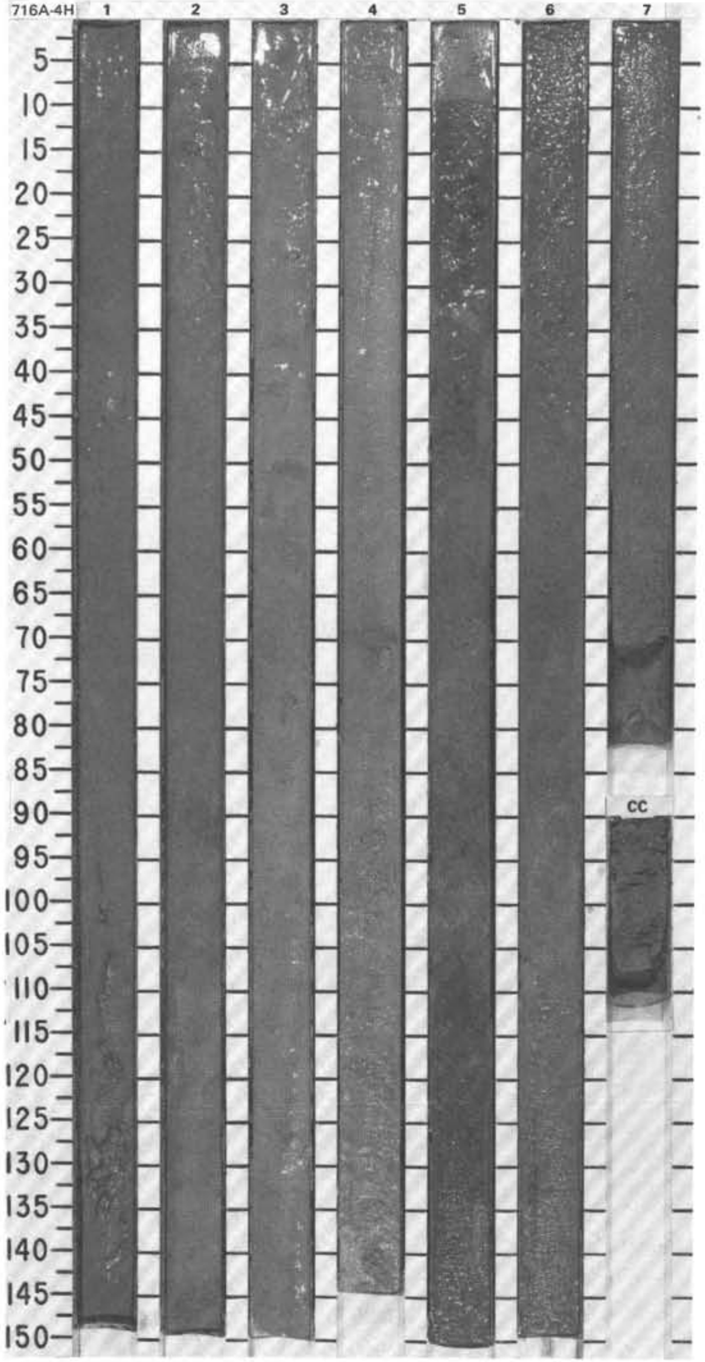
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

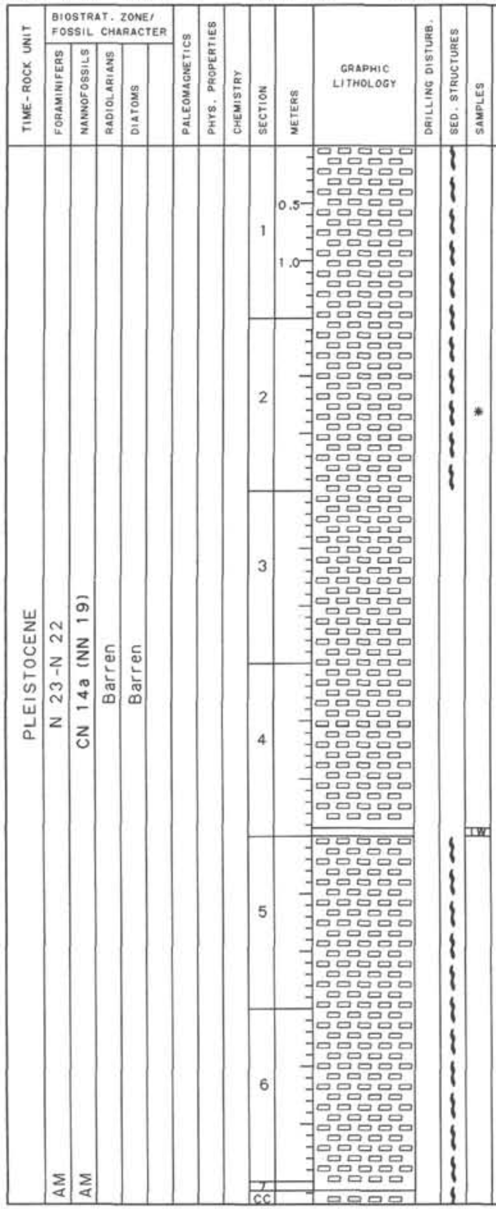
Major lithology: Foraminifer-bearing calcareous nannofossil ooze, homogeneous, olive (5Y 5/4, 4/4, 6/4), soupy and moderately to badly disturbed throughout. Mollusk fragments and a small (1 cm) intact brachiopod found at Section 1, 100 cm, and Section 6, 20 cm, respectively.

SMEAR SLIDE SUMMARY (%):

	5, 80 D
TEXTURE:	
Sand	20
Silt	15
Clay	65
COMPOSITION:	
Foraminifers	20
Nannofossils	40
Aragonite needles	30
Bioclasts	10



SITE 716 HOLE A CORE 5H CORED INTERVAL 569.1-578.8 mbsl; 35.8-45.5 mbsf



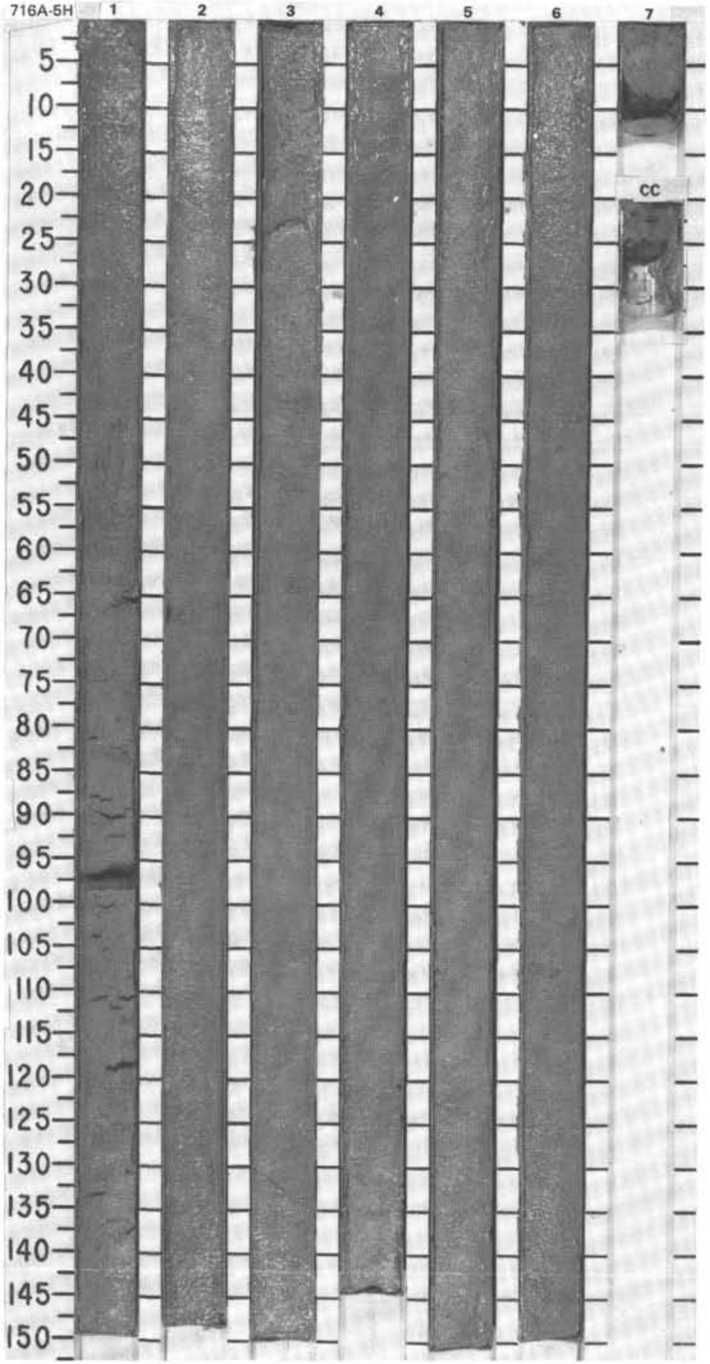
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS OOZE

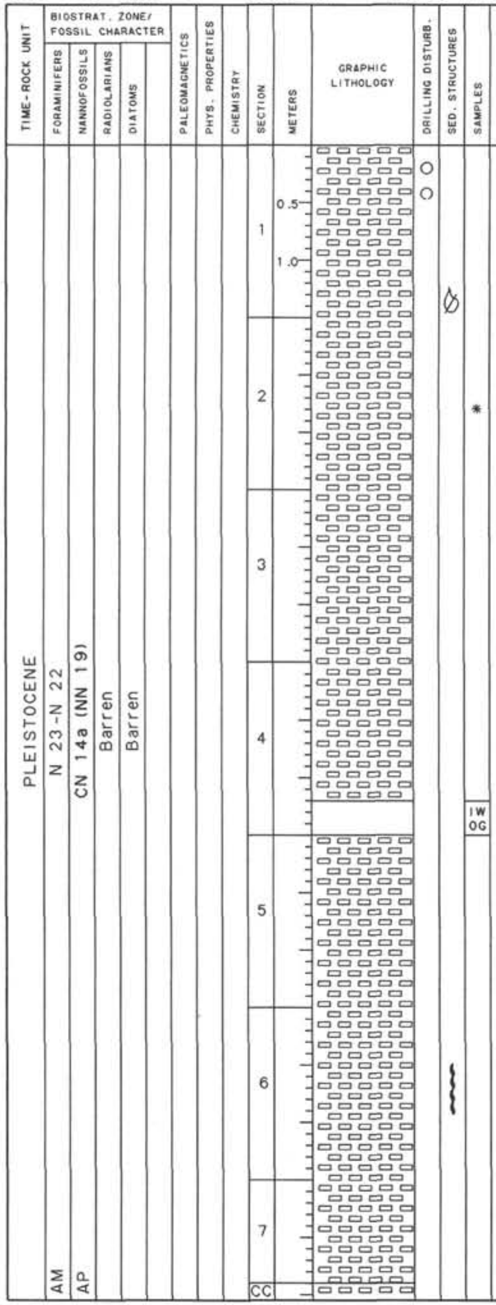
Major lithology: Foraminifer-bearing nannofossil calcareous ooze, pale olive (5Y 6/3), homogeneous, weakly bioturbated, mild hydrogen sulfide smell.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	30
Silt	20
Clay	50
COMPOSITION:	
Foraminifers	20
Nannofossils	30
Aragonite needles	30
Bioclasts	20



SITE 716 HOLE A CORE 6H CORED INTERVAL 578.8-588.4 mbsl; 45.5-55.1 mbsf



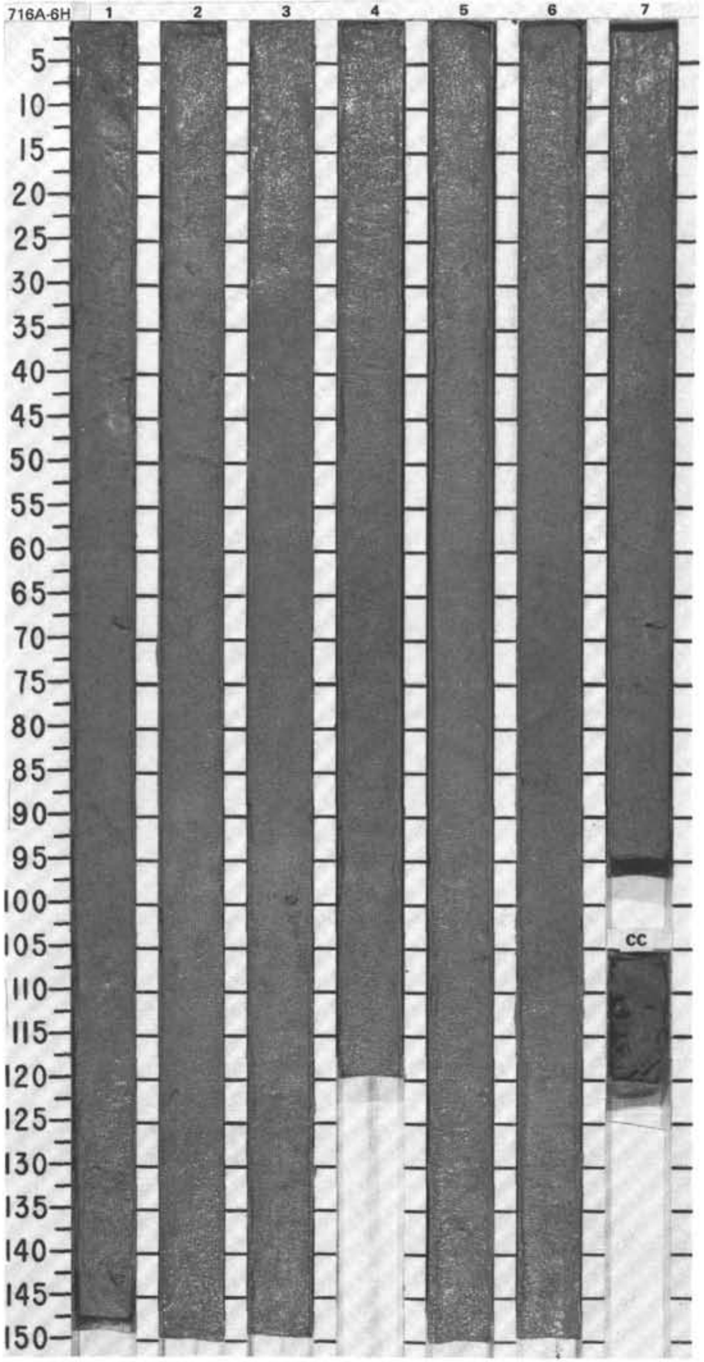
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS OOZE

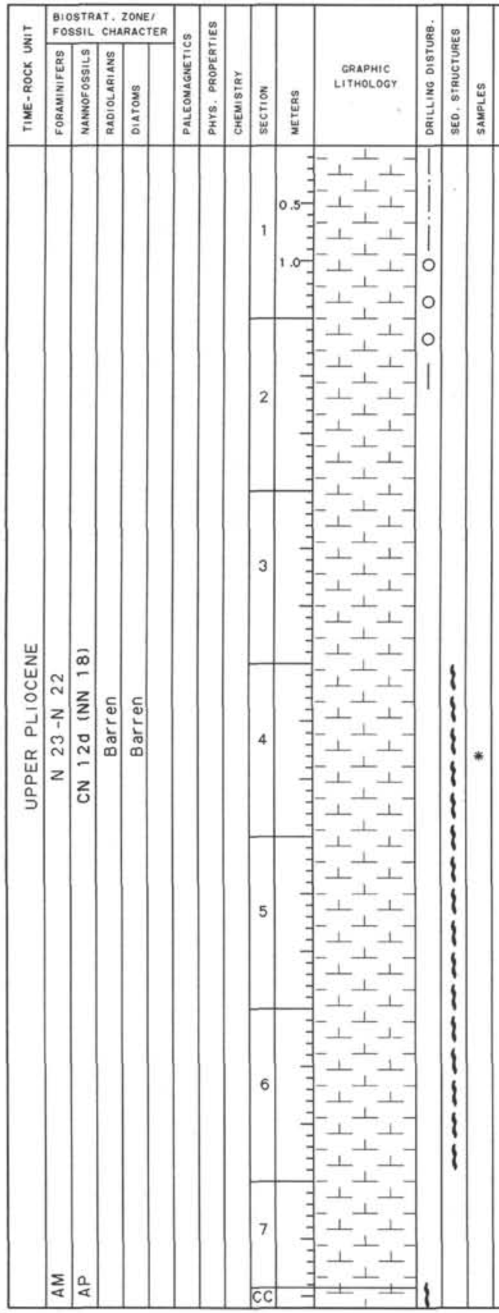
Major lithology: Foraminifer-bearing nannofossil calcareous ooze, pale olive (5Y 6/3), homogeneous, mollusk debris in Section 1, 135 cm.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	30
Silt	20
Clay	50
COMPOSITION:	
Quartz	Tr
Foraminifers	20
Nannofossils	30
Bioclasts	15
Micrite	35



SITE 716 HOLE A CORE 7H CORED INTERVAL 588.4-598.0 mbsl; 55.1-64.7 mbsf



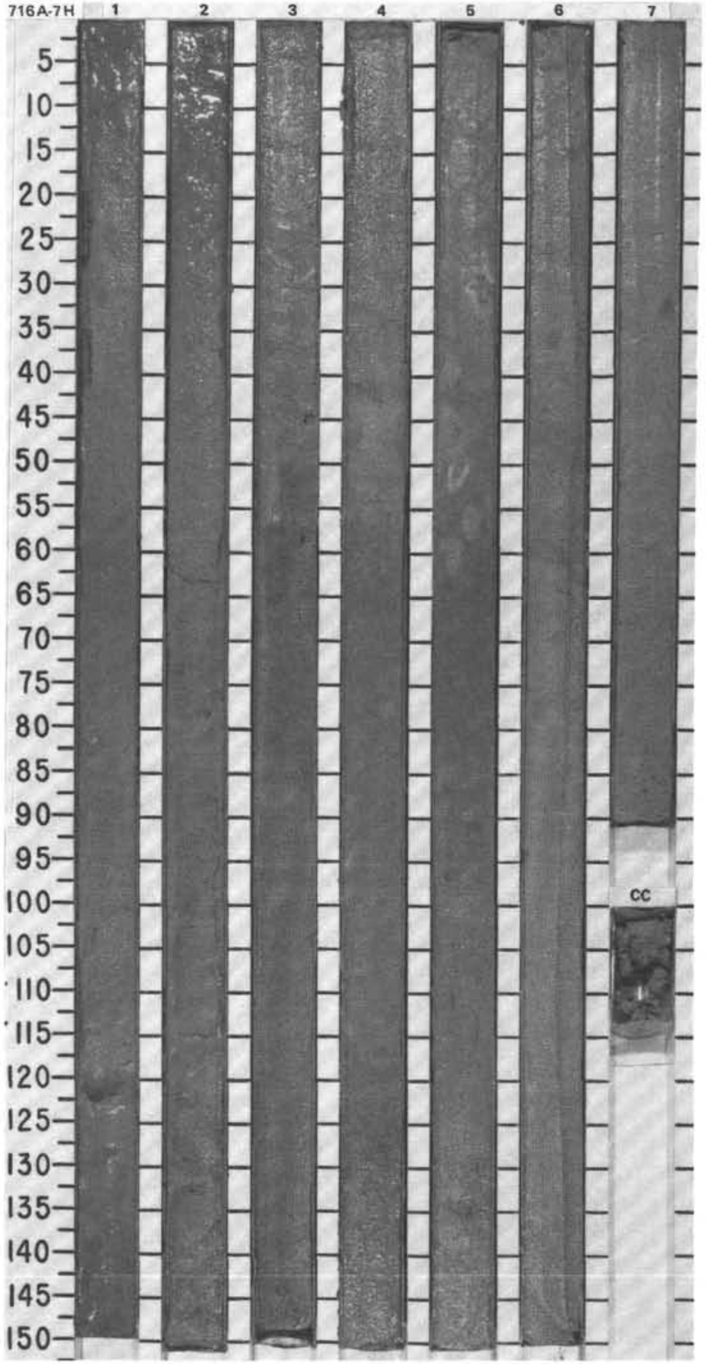
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

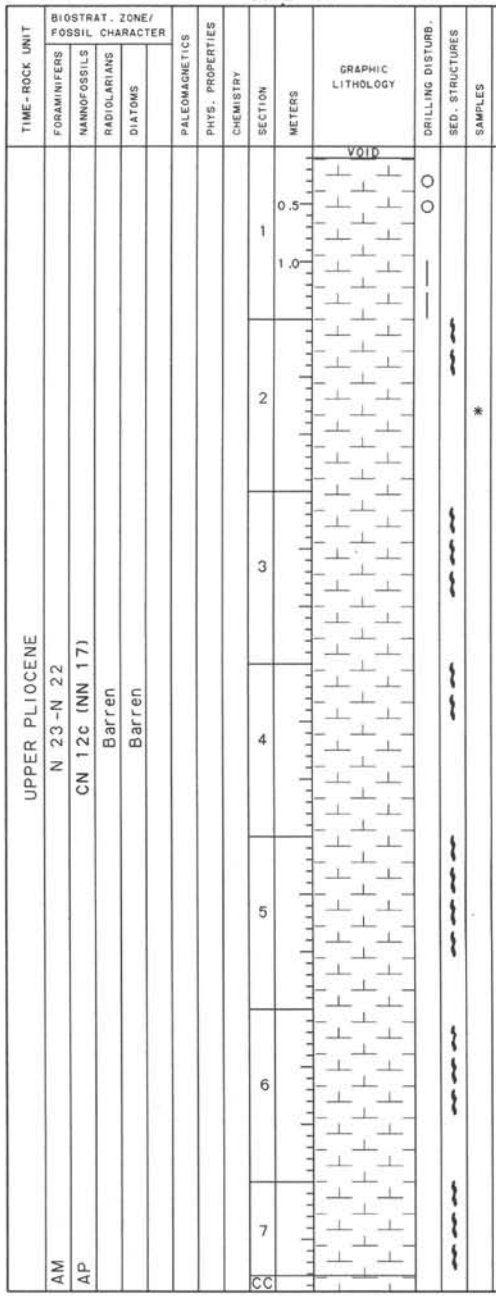
Major lithology: Foraminifer-bearing calcareous nannofossil ooze, olive (5Y 5/4, 6/4), very homogeneous, soupy and disturbed in Section 1, weakly bioturbated in Sections 4-6.

SMEAR SLIDE SUMMARY (%):

	4, 80 D
TEXTURE:	
Sand	20
Silt	20
Clay	60
COMPOSITION:	
Foraminifers	15
Nannofossils	50
Bioclasts	25
Micrite	10



SITE 716 HOLE A CORE 8H CORED INTERVAL 598.0-607.6 mbsl; 64.7-74.3 mbsf



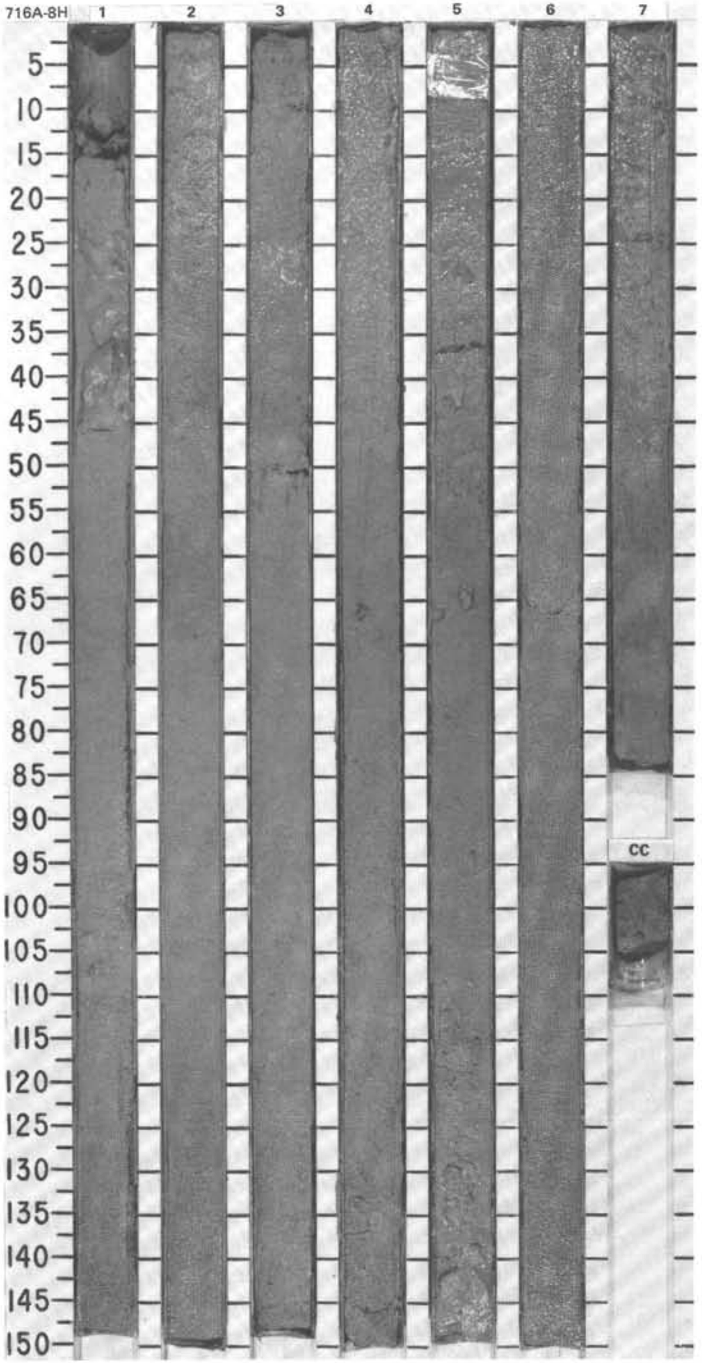
LITHOLOGIC DESCRIPTION

CALCAREOUS NANNOFOSSIL OOZE

Major lithology: Calcareous nannofossil ooze, pale olive (5Y 6/3), homogeneous, weakly bioturbated, lithification over short intervals with chalk <5%.

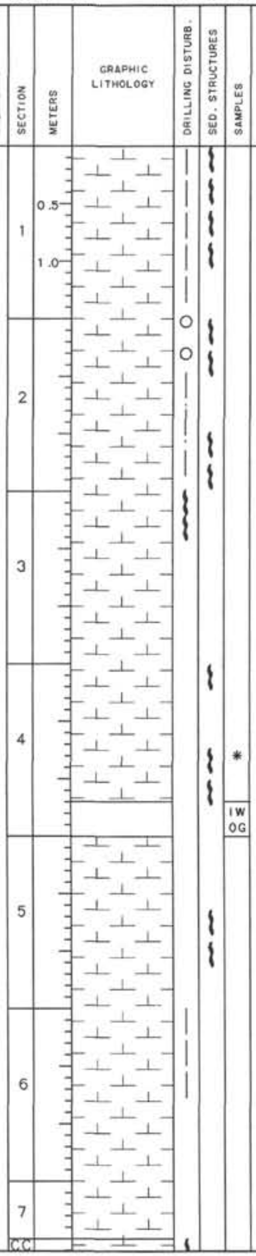
SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	15
Silt	10
Clay	75
COMPOSITION:	
Quartz	Tr
Clay	5
Volcanic glass	1
Foraminifers	5
Nannofossils	77
Aragonite needles	2
Bioclasts	10



SITE 716 HOLE A CORE 9H CORED INTERVAL 607.6-617.2 mbsl; 74.3-83.9 mbsf

TIME-ROCK UNIT	BIOSTRAT. ZONE/ FOSSIL CHARACTER					PALEOMAGNETICS	PHYS. PROPERTIES	CHEMISTRY
	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS				
UPPER PLIOCENE	N 23-N 22	CN 12a-b (NN 16)	Barren	Barren				
	AM	AP						



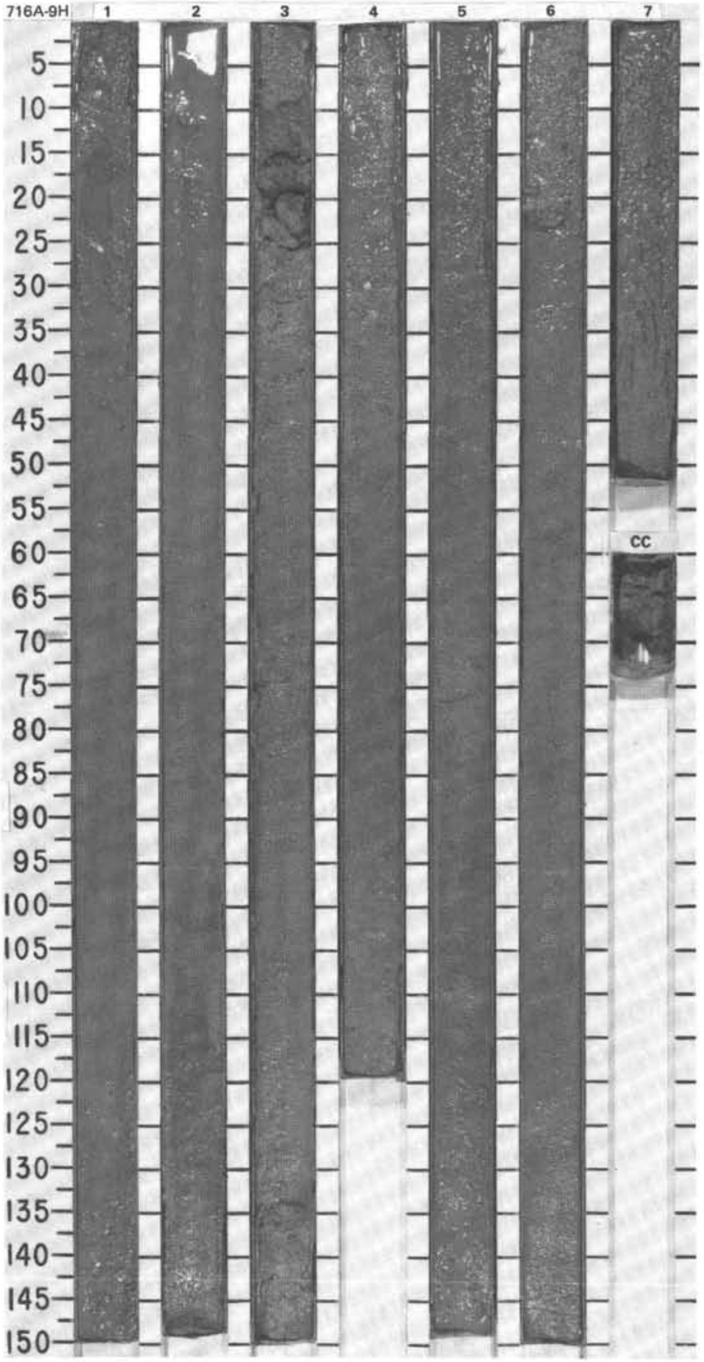
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE

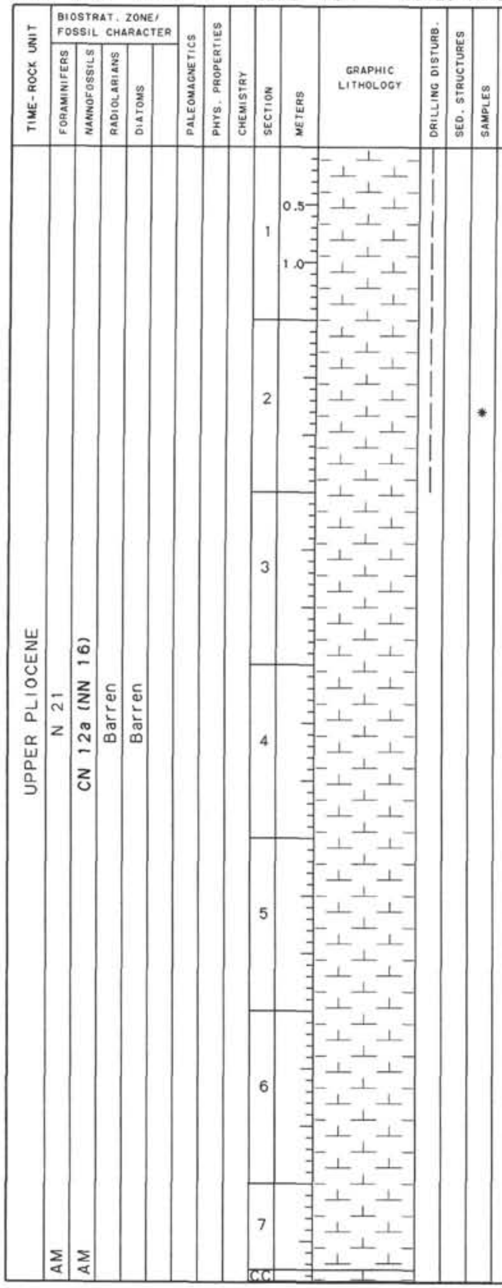
Major lithology: Foraminifer-bearing nannofossil ooze, olive (5Y 5/4, 6/4), disturbed and soupy near top, weakly bioturbated, chalk nodules at irregular intervals (5% of core).

SMEAR SLIDE SUMMARY (%):

	4, 80 D
TEXTURE:	
Sand	35
Silt	15
Clay	50
COMPOSITION:	
Quartz	Tr
Clay	5
Volcanic glass	Tr
Accessory minerals:	
Pyrite	Tr
Foraminifers	25
Nannofossils	66
Aragonite needles	1
Bioclasts	3



SITE 716 HOLE A CORE 10H CORED INTERVAL 617.2-626.9 mbsl; 83.9-93.6 mbsf



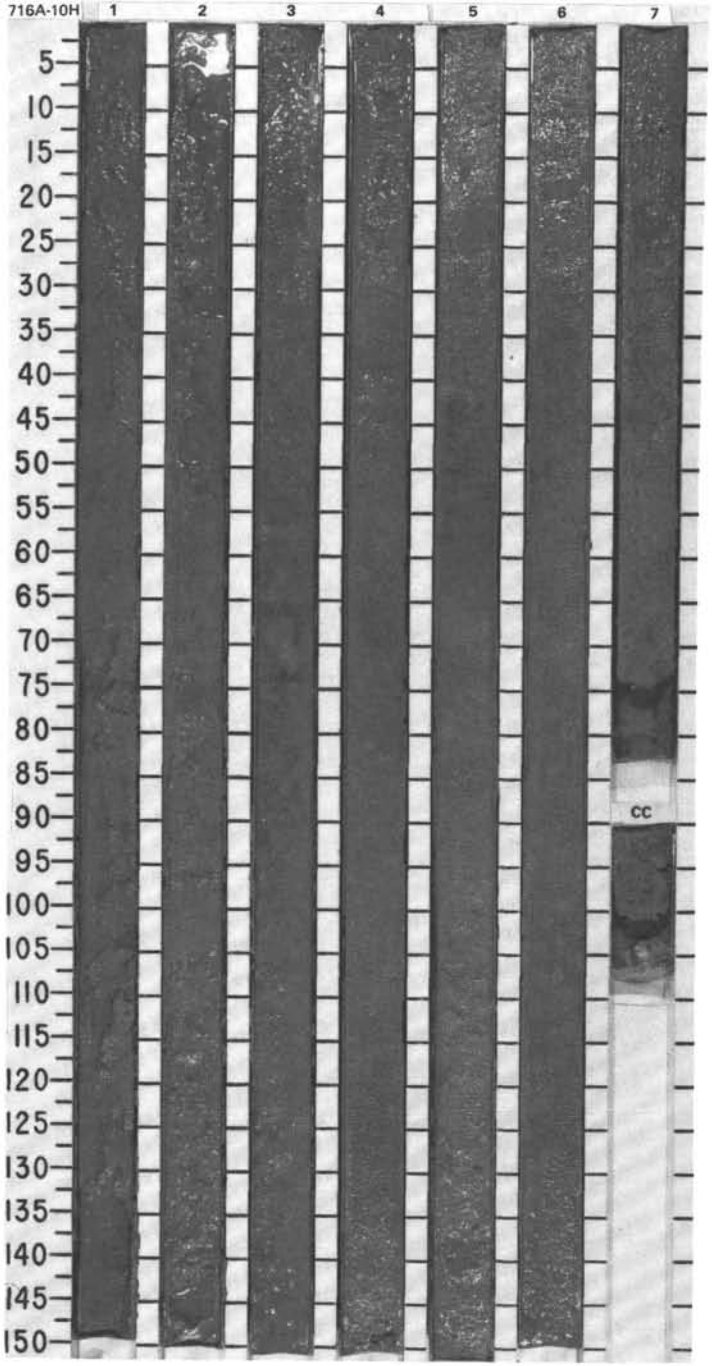
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

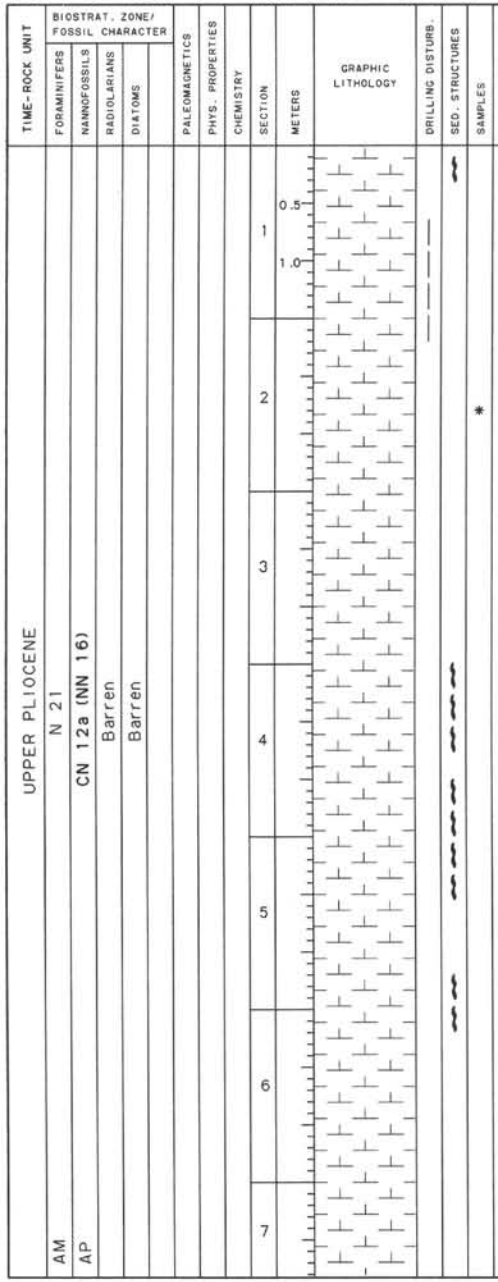
Major lithology: Foraminifer-bearing calcareous nannofossil ooze, olive (5Y 5/3), homogeneous, somewhat soupy and disturbed in top 2 sections, chalk is <5% of core.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	20
Clay	80
COMPOSITION:	
Foraminifers	20
Nannofossils	60
Micrite (needles)	20



SITE 716 HOLE A CORE 11H CORED INTERVAL 626.9-636.5 mbsl; 93.6-103.2 mbsf



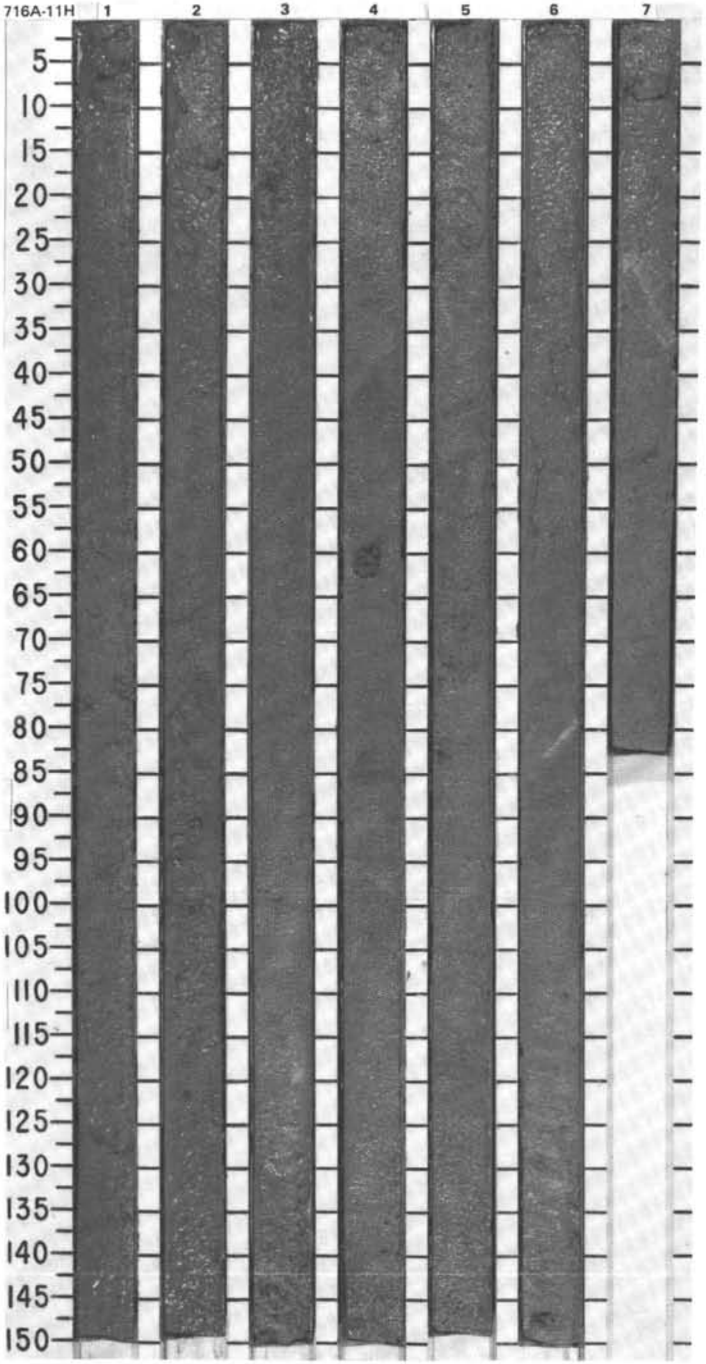
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

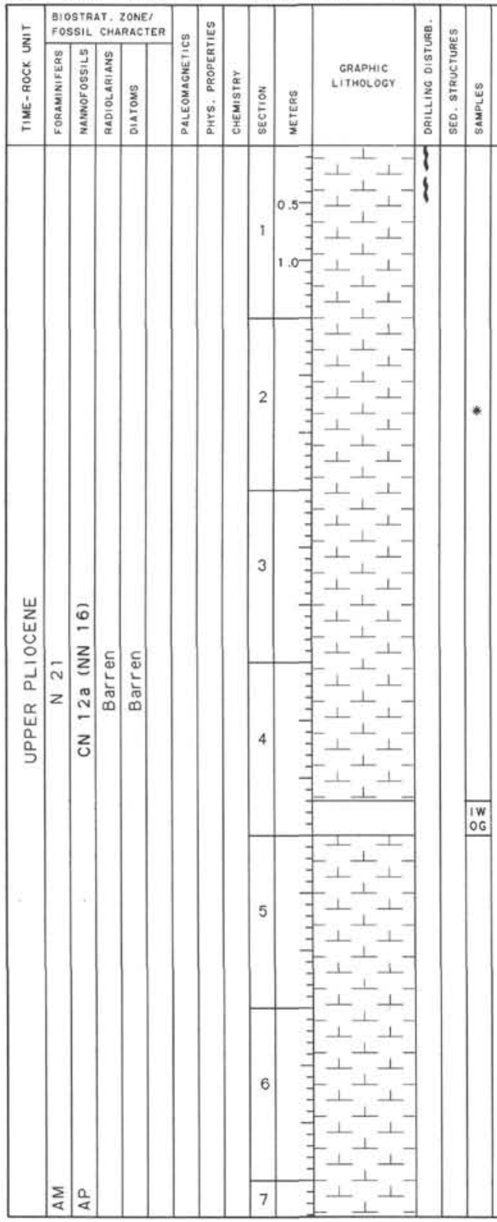
Major lithology: Foraminifer-bearing calcareous nannofossil ooze, olive (5Y 5/4), very homogeneous, weakly bioturbated; an irregularly shaped celestite nodule (3 cm) was found in Section 4, 61 cm; chalk is <5% of core.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	25
Silt	20
Clay	55
COMPOSITION:	
Foraminifers	20
Nannofossils	55
Aragonite needles	25



SITE 716 HOLE A CORE 12H CORED INTERVAL 636.5-646.1 mbsl; 103.2-112.8 mbsf



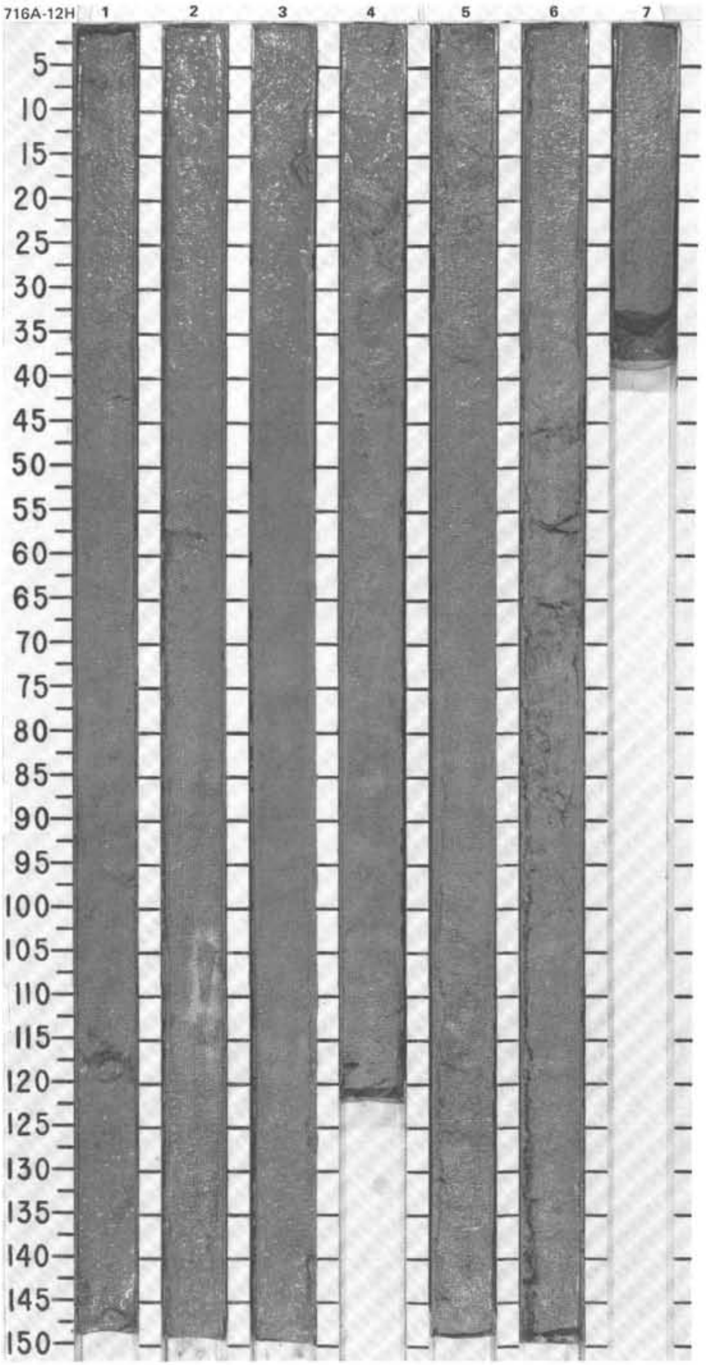
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

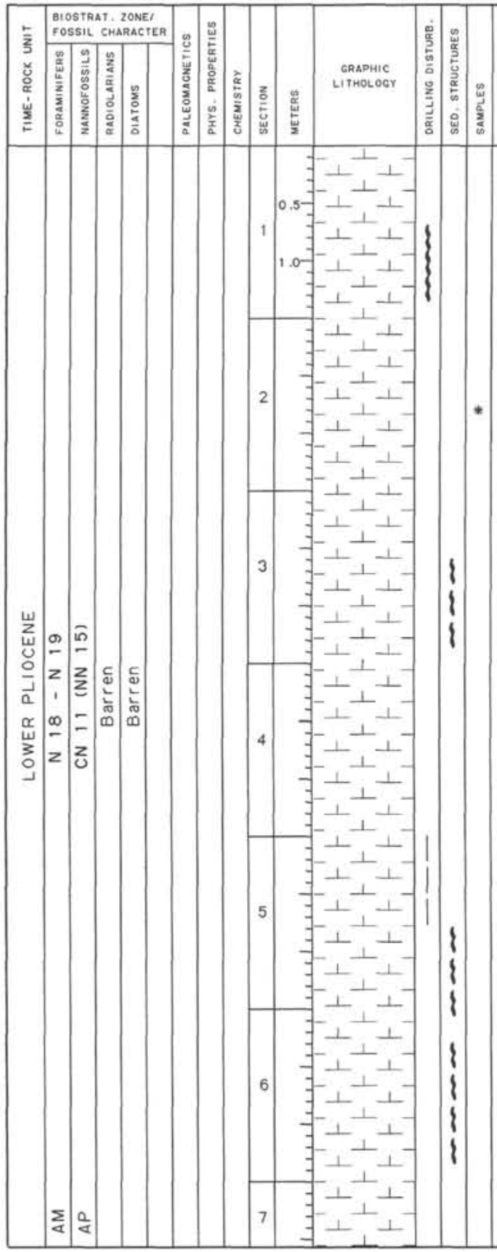
Major lithology: Foraminifer-bearing calcareous nannofossil ooze, pale olive (5Y 6/3), very homogeneous, approximately 10% chalk.

SMEAR SLIDE SUMMARY (%):

	2, 80
	D
TEXTURE:	
Sand	20
Silt	10
Clay	70
COMPOSITION:	
Foraminifers	20
Nannofossils	50
Aragonite needles	30



SITE 716 HOLE A CORE 13H CORED INTERVAL 646.1-655.8 mbsl; 112.8-122.5 mbsf



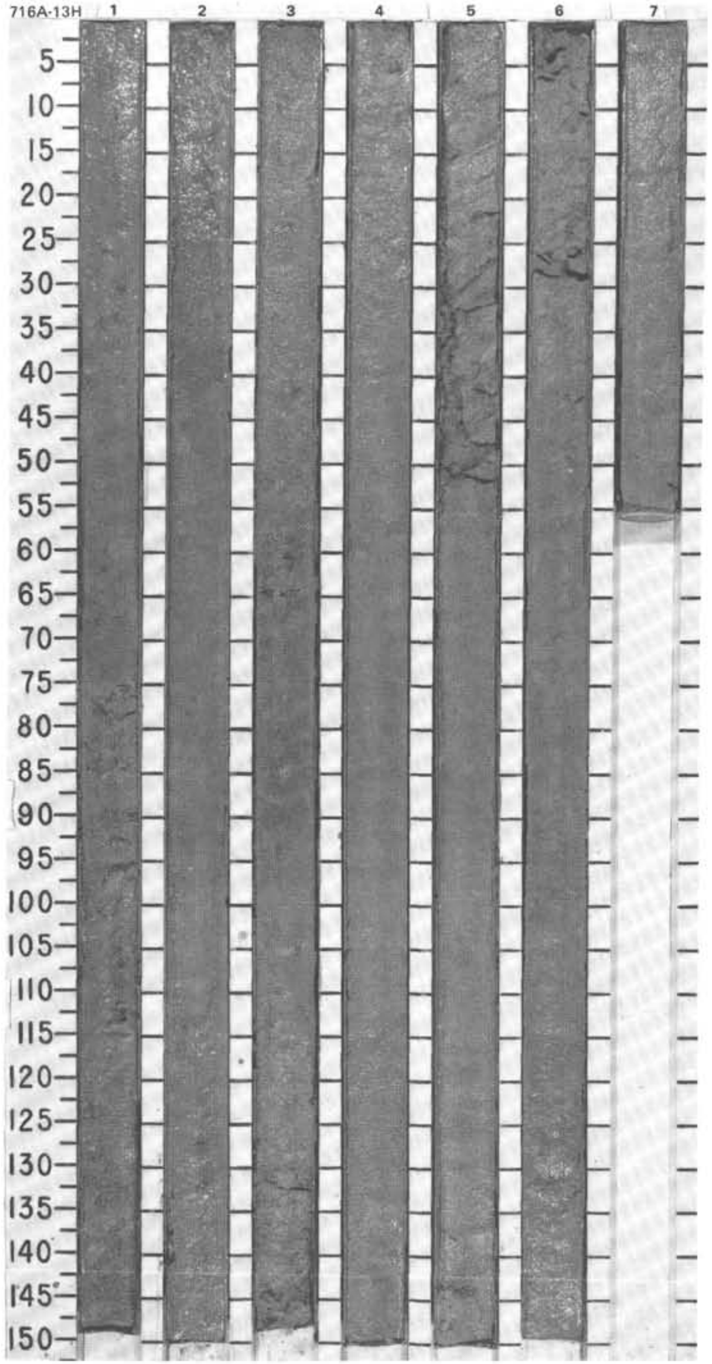
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE

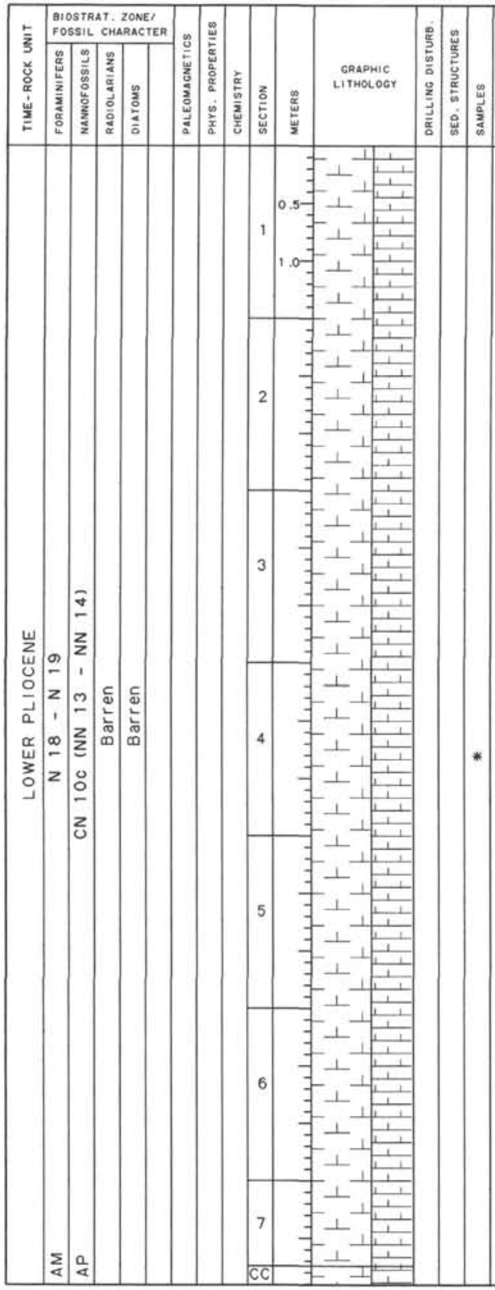
Major lithology: Foraminifer-bearing nannofossil ooze, pale olive (5Y 6/3), very homogeneous, weakly bioturbated, approximately 10% chalk.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	20
Silt	20
Clay	60
COMPOSITION:	
Quartz	1
Clay	5
Volcanic glass	4
Foraminifers	15
Nannofossils	66
Mollusk debris	8
Aragonite needles	1



SITE 716 HOLE A CORE 14H CORED INTERVAL 655.8-665.4 mbsl; 122.5-132.1 mbsf



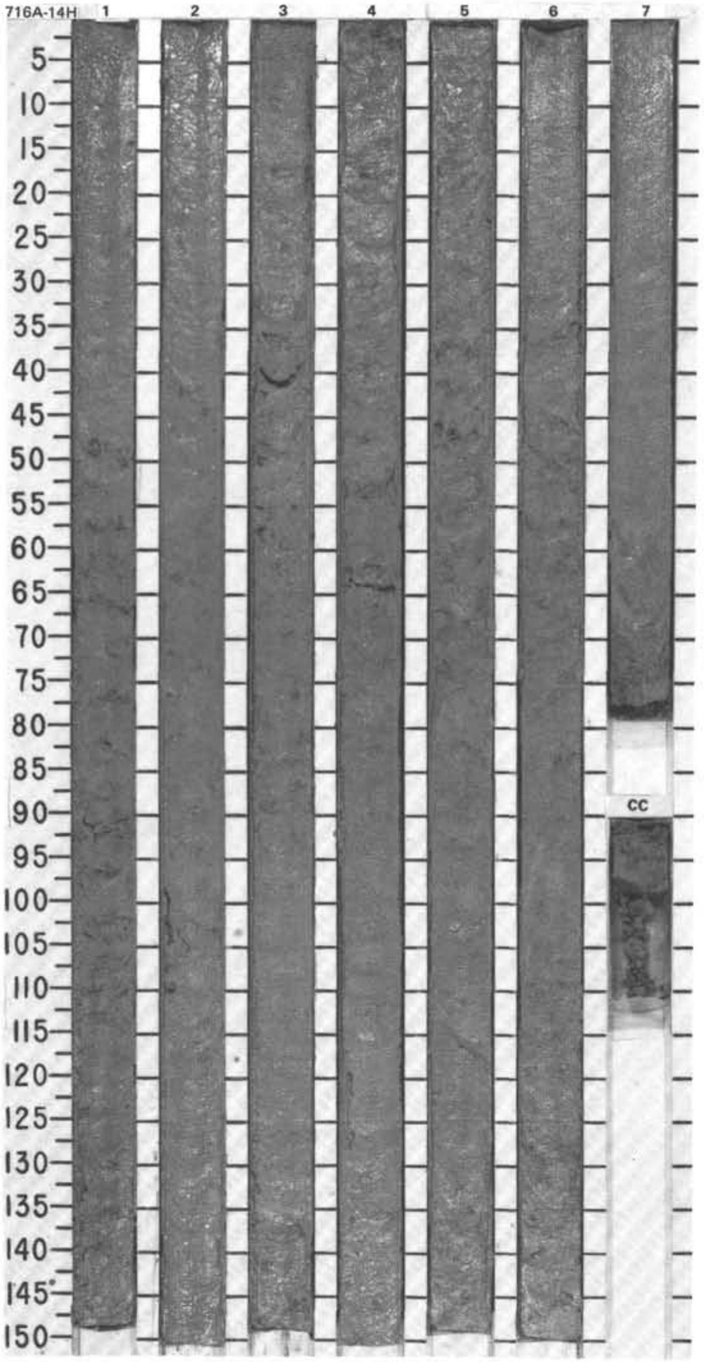
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

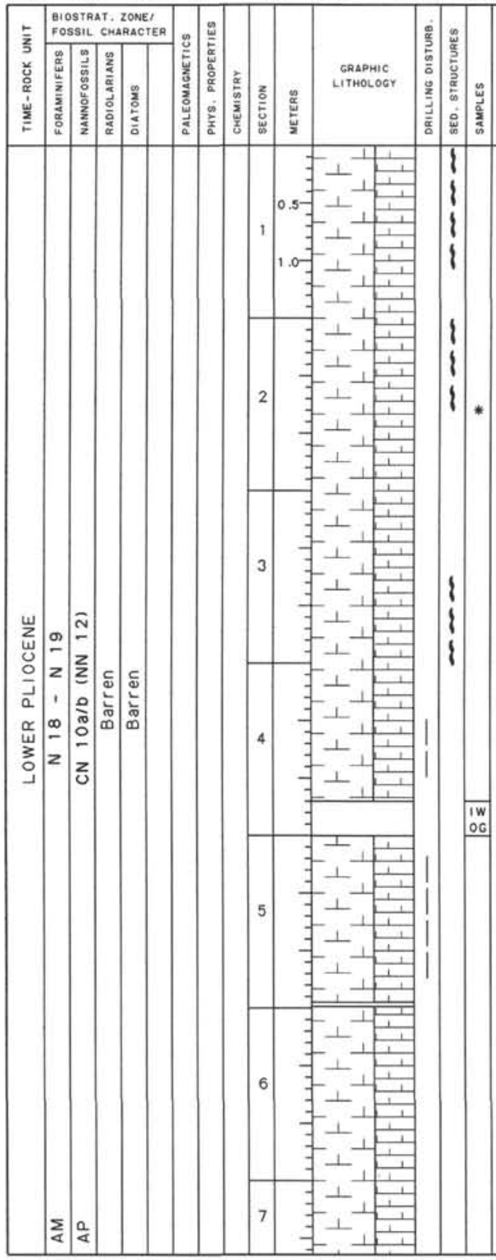
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3), very homogeneous, weak hydrogen sulfide smell; chalk makes up 45% of core.

SMEAR SLIDE SUMMARY (%):

	4, 82 D
TEXTURE:	
Sand	15
Silt	20
Clay	65
COMPOSITION:	
Clay	5
Volcanic glass	Tr
Foraminifers	15
Nannofossils	74
Mollusk debris	5
Aragonite needles	1



SITE 716 HOLE A CORE 15H CORED INTERVAL 665.4-675.1 mbsl; 132.1-141.8 mbsf



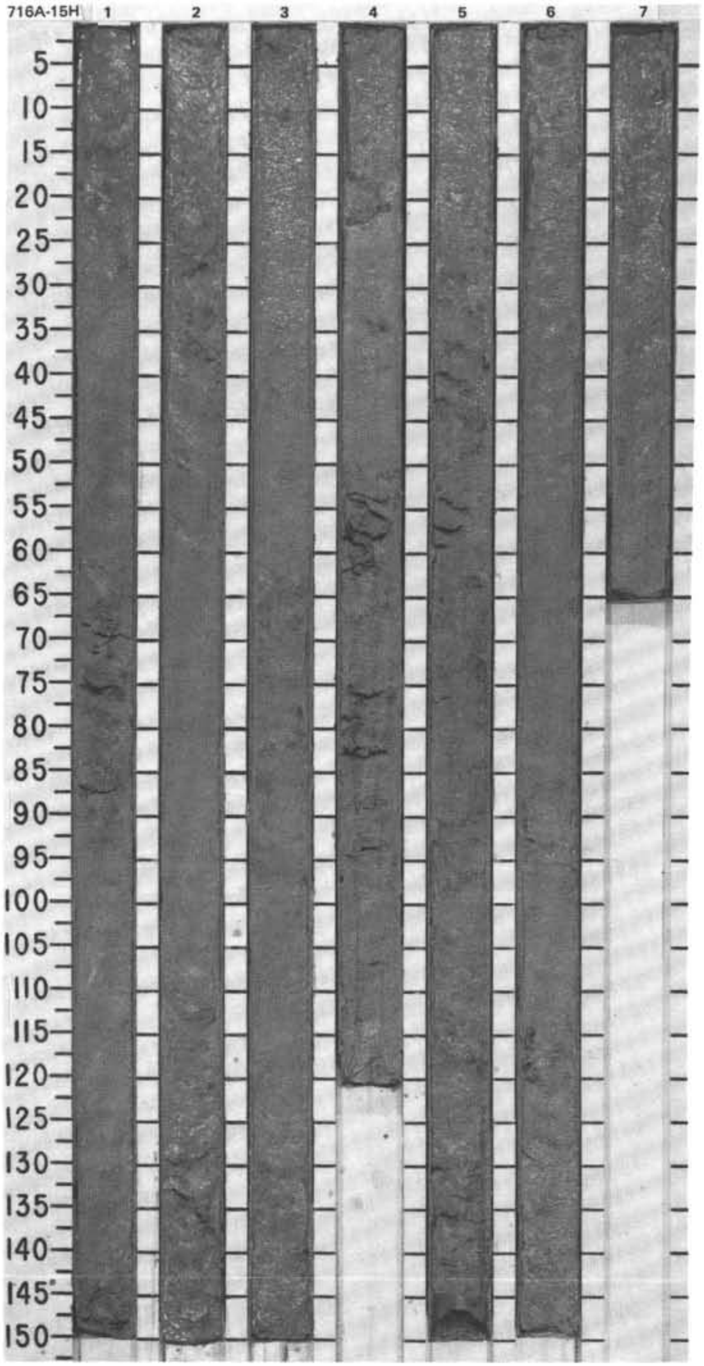
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, olive (5Y 5/4) to pale olive (5Y 6/3), homogeneous, strong hydrogen sulfide smell; chalk makes up 35% of core.

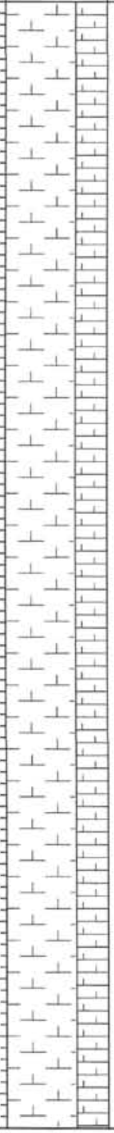
SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	20
Silt	30
Clay	50
COMPOSITION:	
Clay	8
Dolomite	Tr
Accessory minerals:	
Opaques	Tr
Foraminifers	20
Nannofossils	63
Mollusk debris	8
Aragonite needles	1



SITE 716 HOLE A CORE 16H CORED INTERVAL 675.1-684.7 mbsl; 141.8-151.4 mbsf

TIME-ROCK UNIT	BIOSTRAT. ZONE/ FOSSIL CHARACTER					PALEOMAGNETICS	PHYS. PROPERTIES	CHEMISTRY	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURB.	SED. STRUCTURES	SAMPLES
	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS										
LOWER PLIOCENE	N 18 - N 19 AM	CN 10a/b (NN 12) AP	Barren	Barren					1 2 3 4 5 6 7	0.5 1.0				*



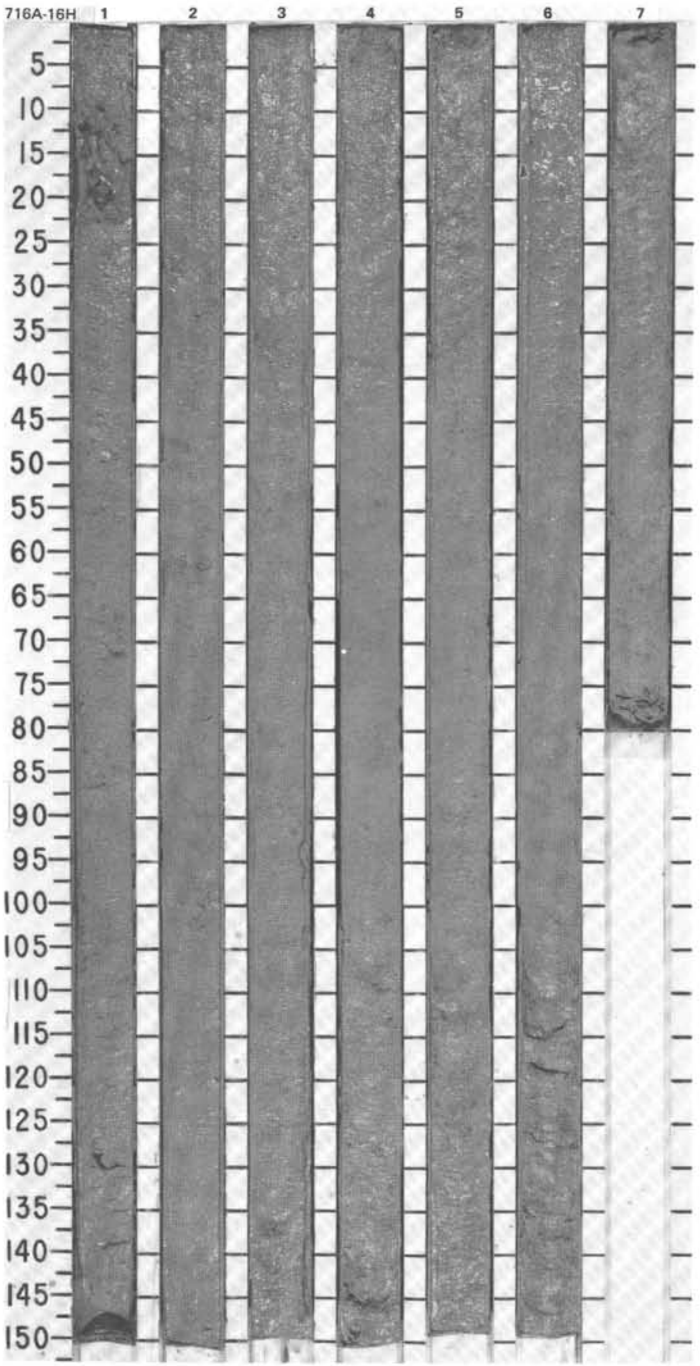
LITHOLOGIC DESCRIPTION

CALCAREOUS NANNOFOSSIL OOZE and CALCAREOUS NANNOFOSSIL CHALK

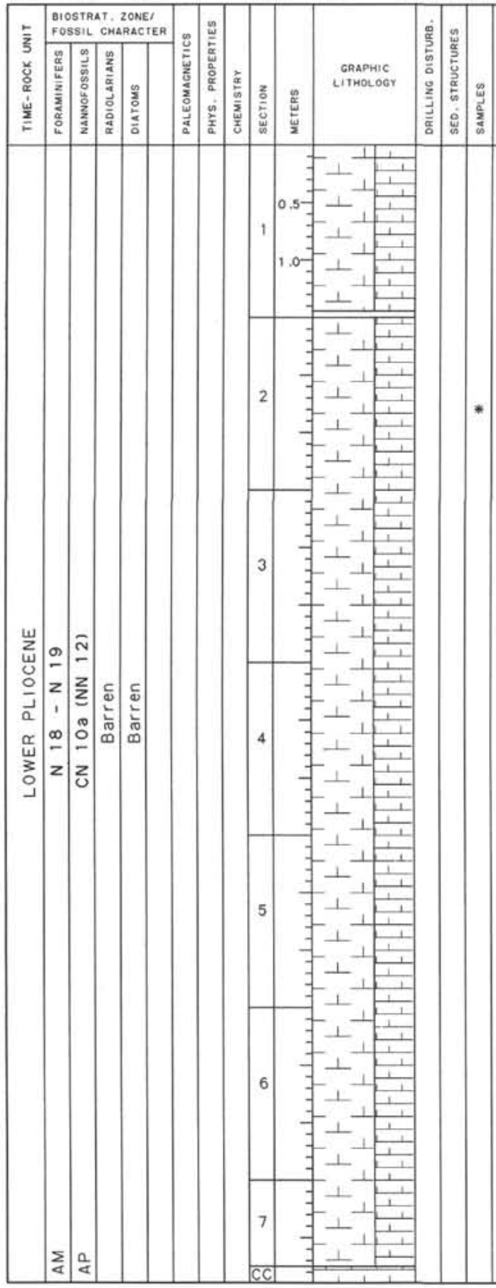
Major lithologies: Calcareous nannofossil ooze and calcareous nannofossil chalk, alternating, pale olive (5Y 6/3), homogeneous, with a 5 cm celestite nodule in Section 1, 15 cm; chalk makes up 35% of the core.

SMEAR SLIDE SUMMARY (%):

	4, 90 D
TEXTURE:	
Sand	5
Silt	30
Clay	65
COMPOSITION:	
Clay	5
Foraminifers	8
Nannofossils	49
Intraclasts	8
Micrite	30



SITE 716 HOLE A CORE 17H CORED INTERVAL 684.7-694.3 mbsl; 151.4-161.0 mbsf



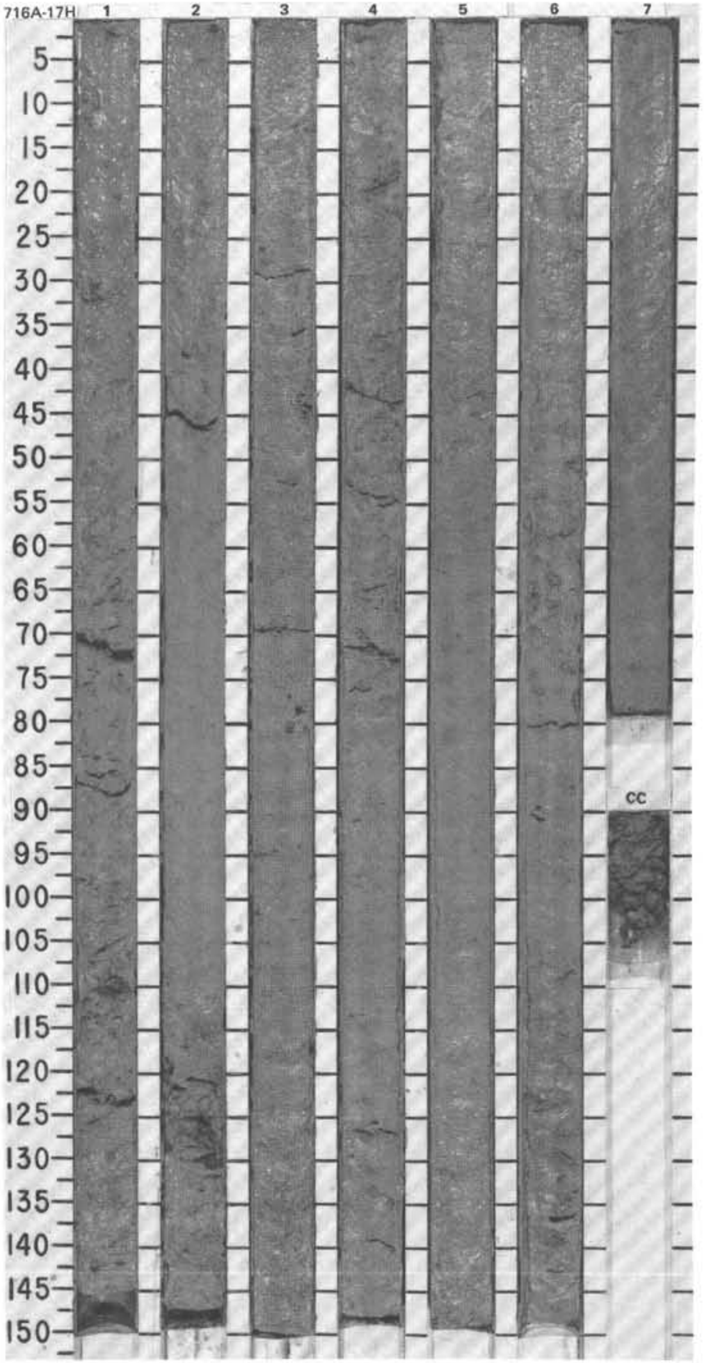
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

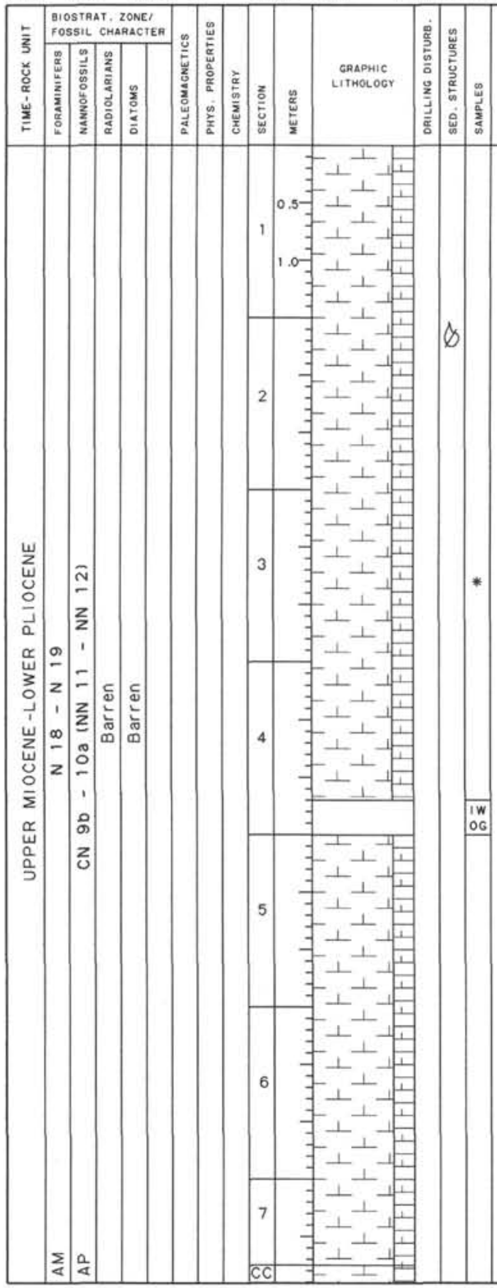
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, alternating, pale olive (5Y 6/3), very homogeneous; chalk makes up 45% of core.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	15
Silt	10
Clay	75
COMPOSITION:	
Clay	5
Foraminifers	15
Nannofossils	67
Bioclasts	8
Micrite (needles)	5



SITE 716 HOLE A CORE 18H CORED INTERVAL 694.3-704.0 mbsl; 161.0-170.7 mbsf



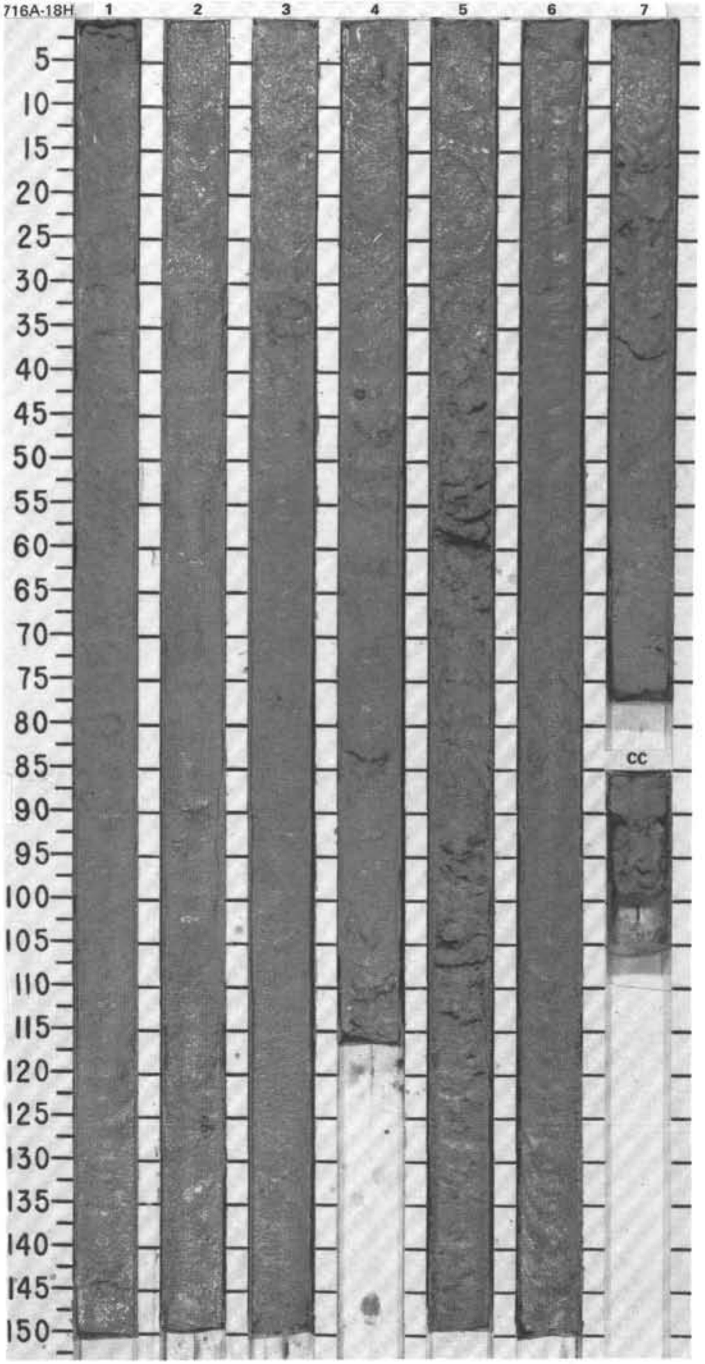
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

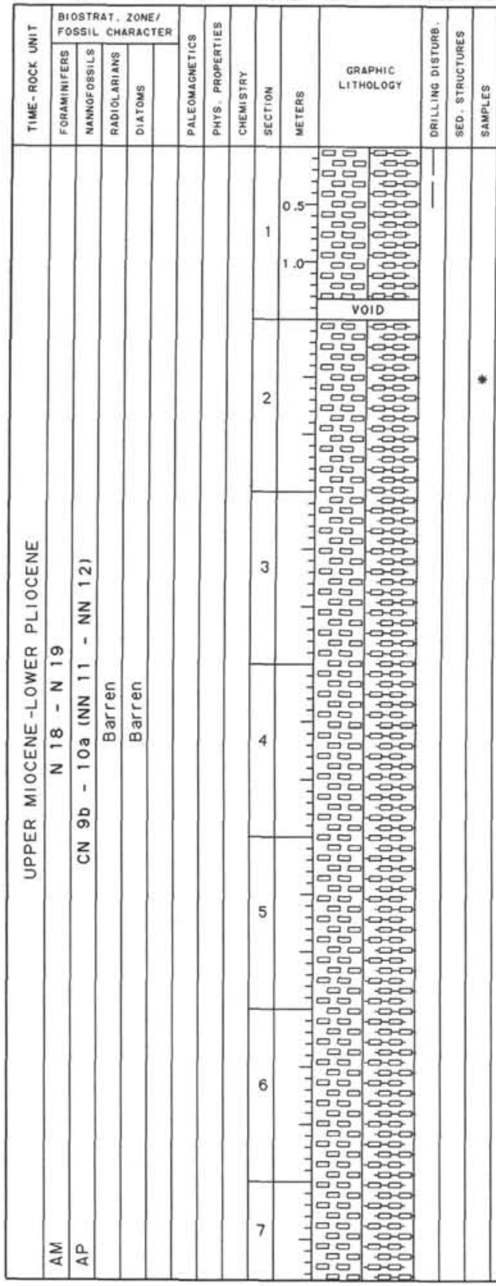
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, alternating, pale olive (5Y 6/3), homogeneous, with chalk making up 20% of the core; small brachiopod shell (1 cm) was found in Section 2, 24 cm.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	15
Silt	10
Clay	75
COMPOSITION:	
Clay	5
Volcanic glass	Tr
Foraminifers	20
Nannofossils	70
Bioclasts	5
Aragonite needles	Tr



SITE 716 HOLE A CORE 19H CORED INTERVAL 704.0-713.7 mbsl; 170.7-180.4 mbsf



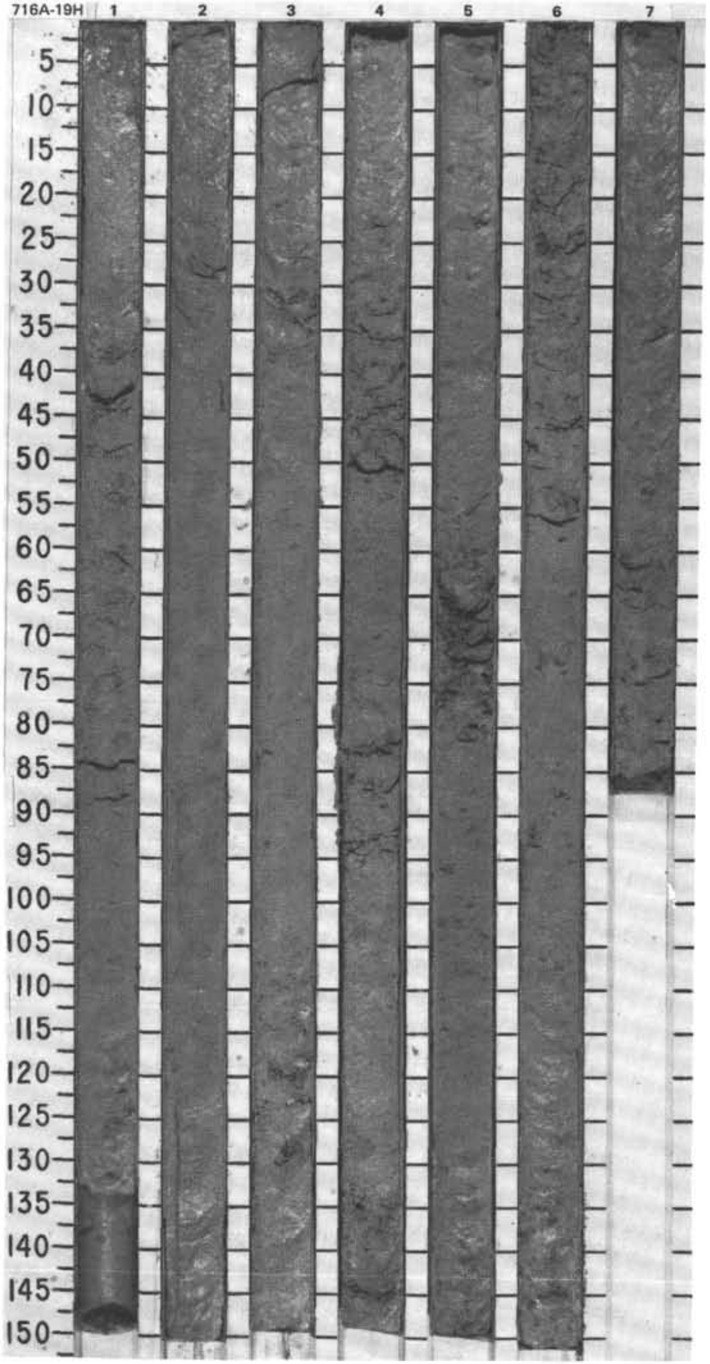
LITHOLOGIC DESCRIPTION

NANNOFOSSIL CALCAREOUS OOZE and NANNOFOSSIL CALCAREOUS CHALK

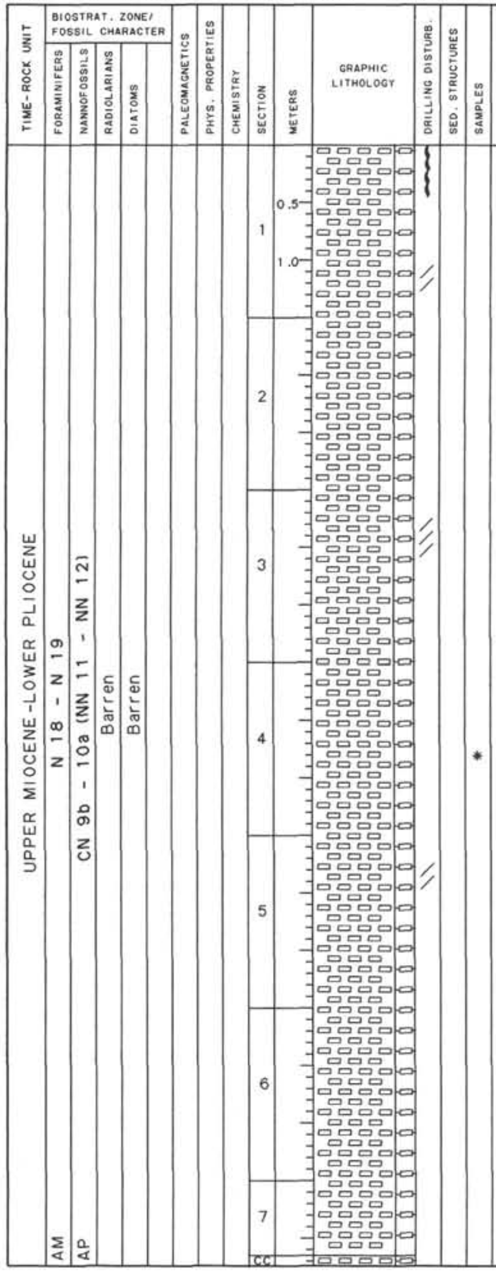
Major lithologies: Nannofossil calcareous ooze and nannofossil calcareous chalk, alternating, pale olive (5Y 6/3), very homogeneous, with ooze and chalk in roughly even proportions.

SMEAR SLIDE SUMMARY (%):

	2, 50 D
TEXTURE:	
Sand	5
Silt	40
Clay	55
COMPOSITION:	
Clay	8
Foraminifers	8
Nannofossils	30
Intraclasts	8
Micrite	46



SITE 716 HOLE A CORE 20H CORED INTERVAL 713.7-723.4 mbsl; 180.4-190.1 mbsf



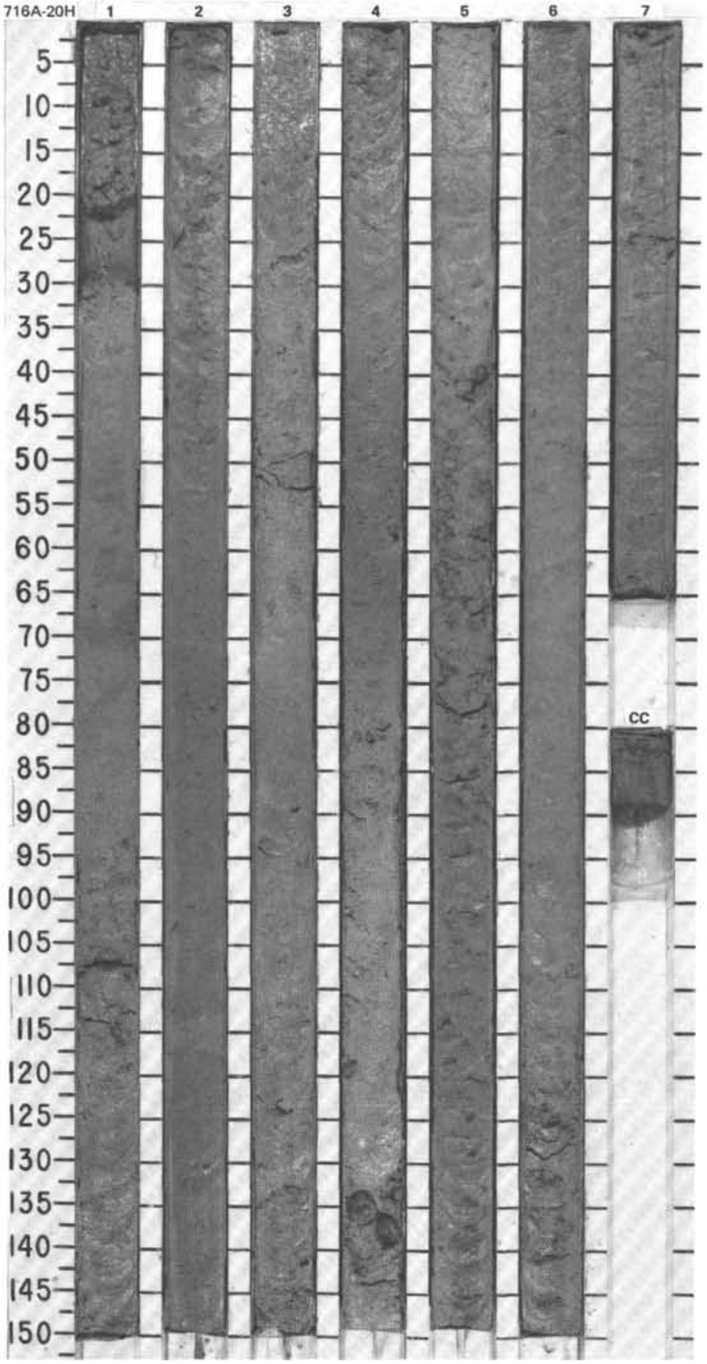
LITHOLOGIC DESCRIPTION

NANNOFOSSIL CALCAREOUS OOZE and NANNOFOSSIL CALCAREOUS CHALK

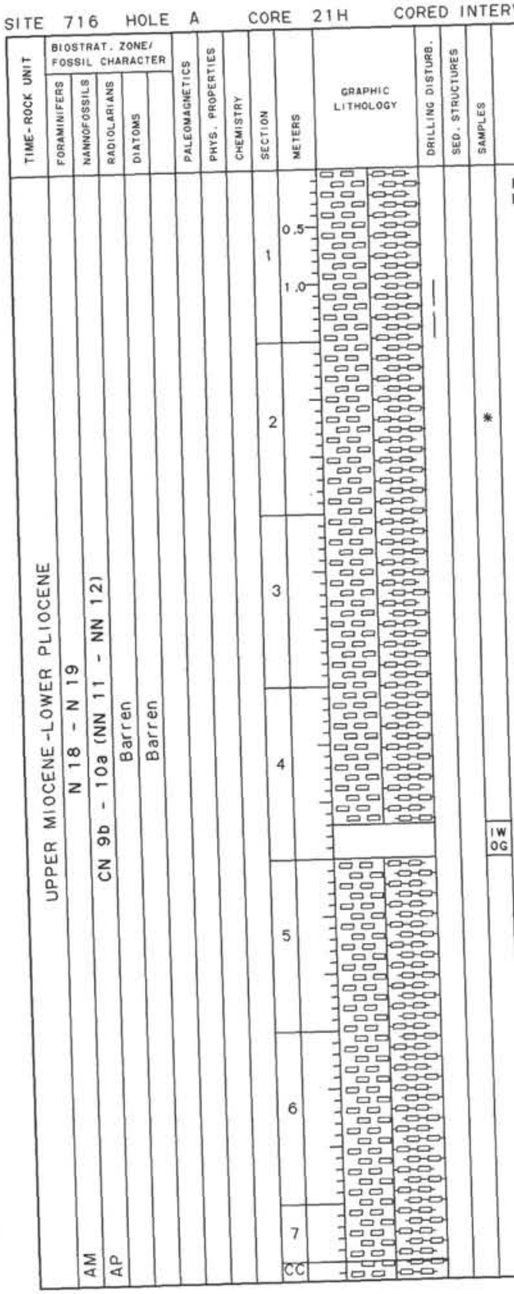
Major lithologies: Nannofossil calcareous ooze and nannofossil calcareous chalk, alternating, pale olive (5Y 6/3), homogeneous, slight fracturing in chalk layers; chalk makes up 20% of core.

SMEAR SLIDE SUMMARY (%):

	4, 80 D
TEXTURE:	
Sand	15
Silt	30
Clay	55
COMPOSITION:	
Clay	5
Dolomite	Tr
Accessory minerals:	
Opaques	Tr
Foraminifers	7
Nannofossils	35
Intraclasts	8
Micrite	45
Aragonite needles	Tr



SITE 716 HOLE A CORE 21H CORED INTERVAL 723.4-733.1 mbsl; 190.1-199.8 mbsf



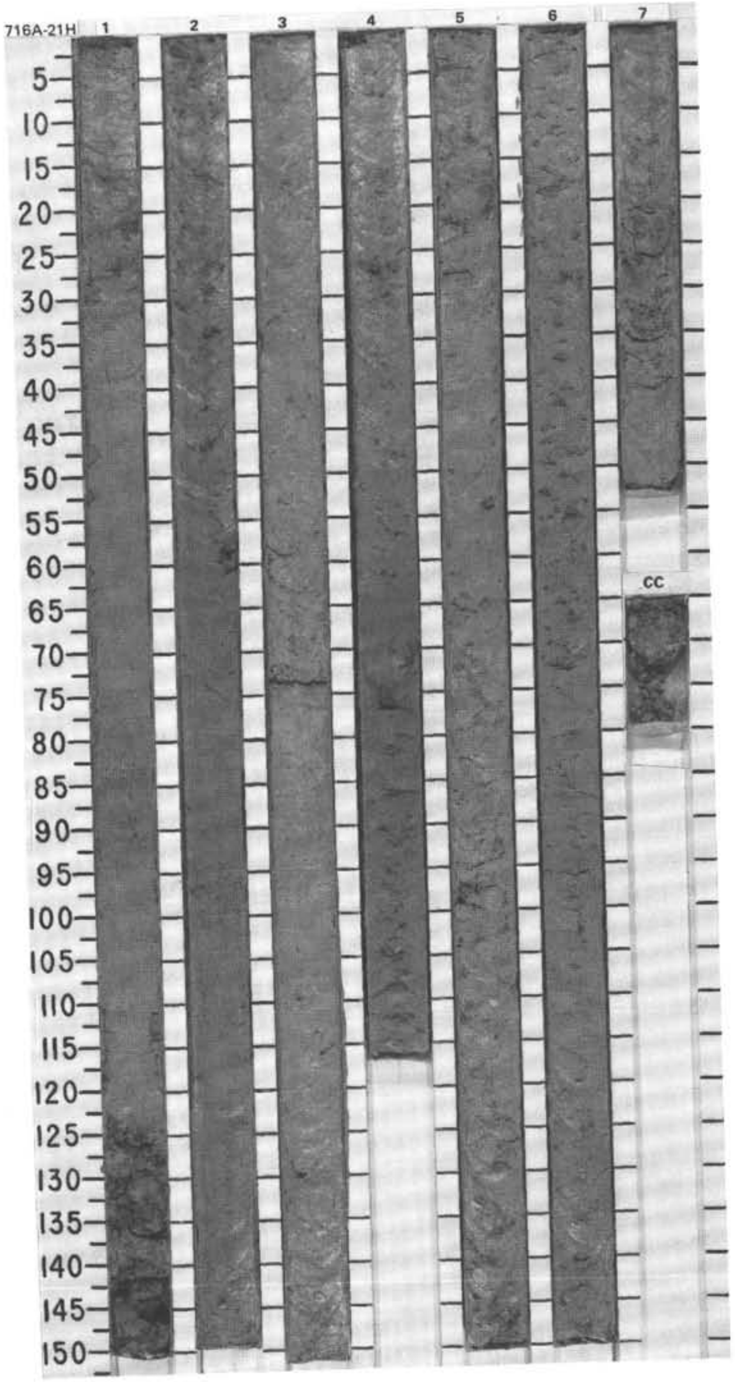
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS OOZE and FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS CHALK

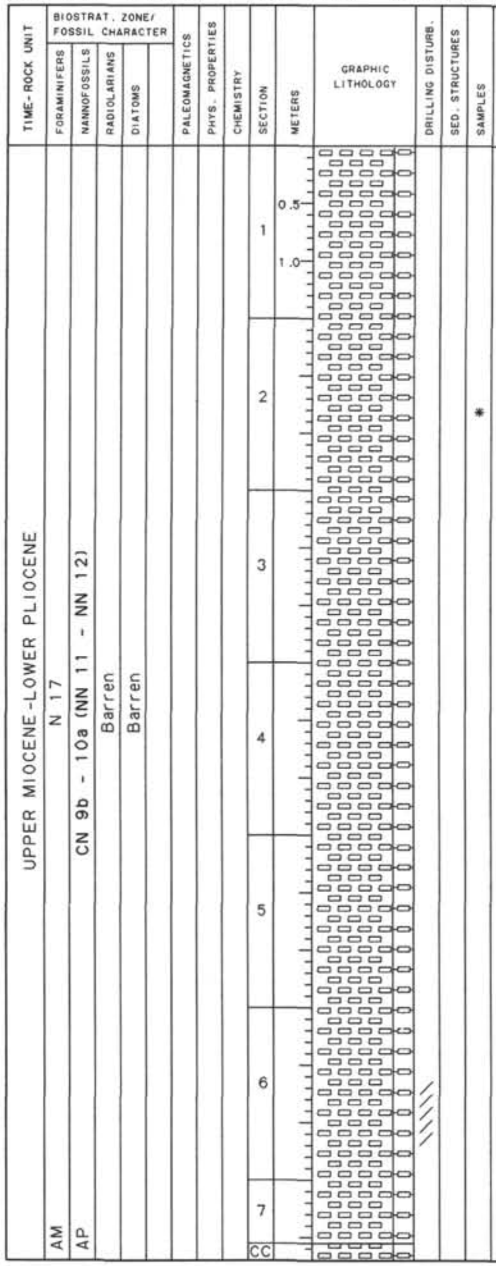
Major lithologies: Foraminifer-bearing nannofossil calcareous ooze and foraminifer-bearing nannofossil calcareous chalk, alternating, gradational color changes from olive (5Y 5/3) to pale olive (5Y 6/3), homogeneous, chalk makes up 50% of core; celestite nodule (1 cm) was found in Section 5, 53 cm.

SMEAR SLIDE SUMMARY (%):

	2, 70 D
TEXTURE:	
Sand	15
Silt	30
Clay	55
COMPOSITION:	
Clay	9
Volcanic glass	Tr
Foraminifers	18
Nannofossils	26
Intraclasts	7
Micrite	40



SITE 716 HOLE A CORE 22H CORED INTERVAL 733.1-742.8 mbsl; 199.8-209.5 mbsf



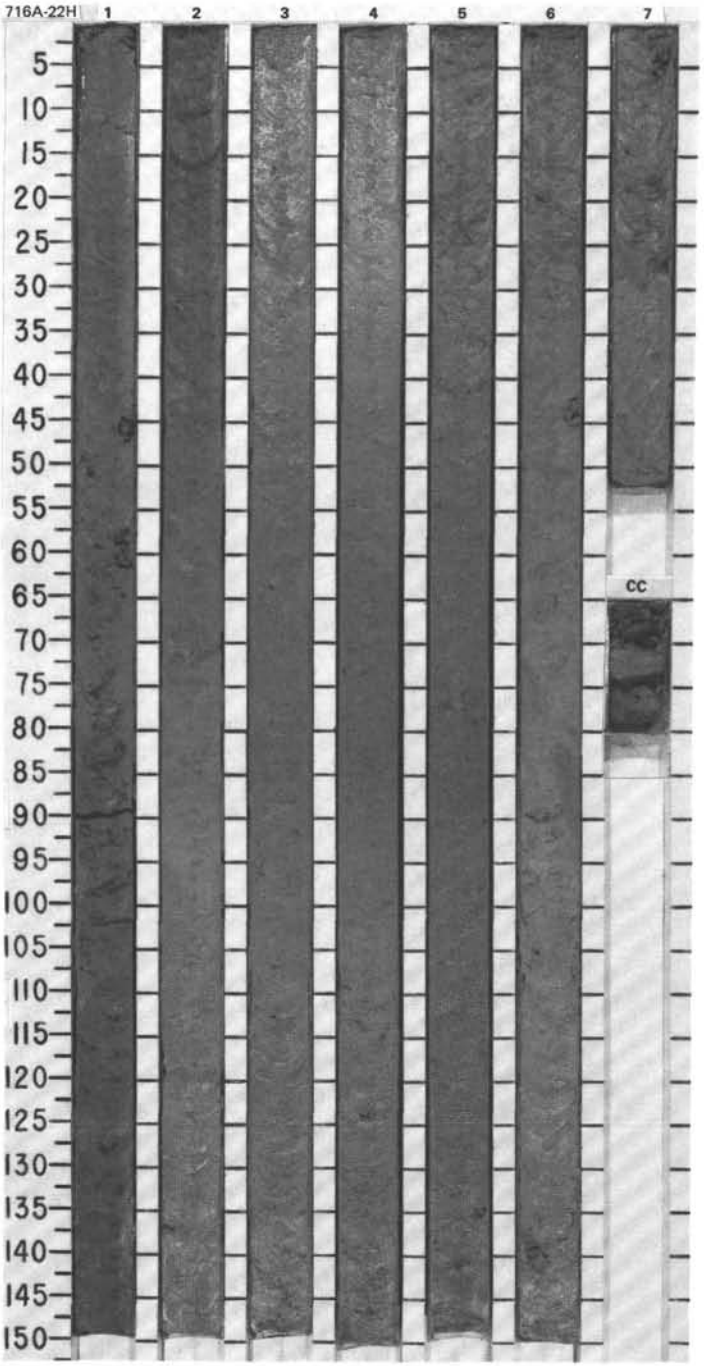
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS OOZE and FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS CHALK

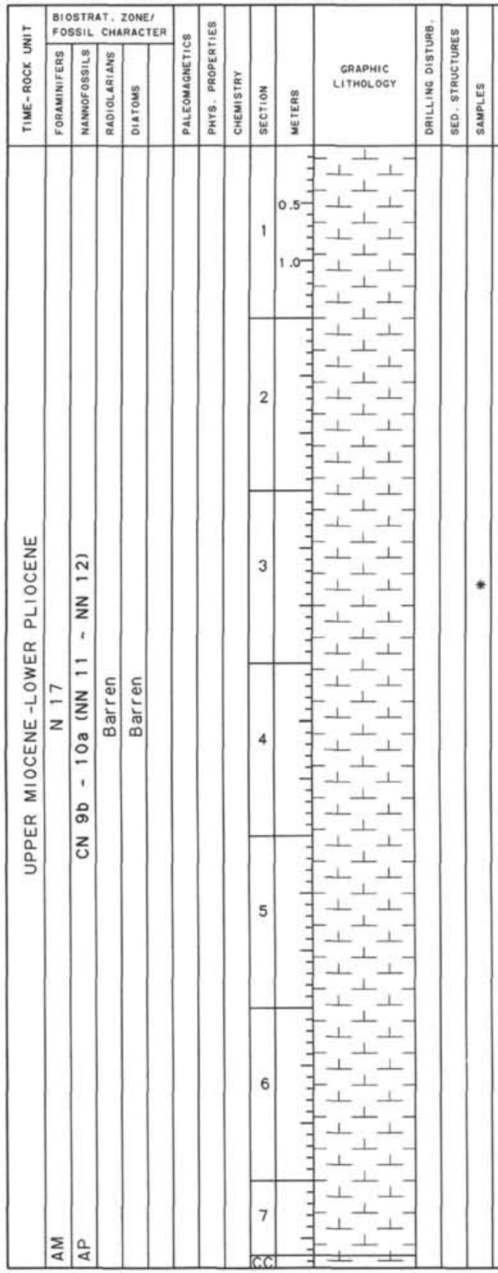
Major lithologies: Foraminifer-bearing nannofossil calcareous ooze and foraminifer-bearing nannofossil calcareous chalk, alternating, olive (5Y 5/3) in Section 1, grading into pale olive (5Y 6/3) downcore, homogeneous; chalk makes up 20% of core.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	15
Silt	30
Clay	55
COMPOSITION:	
Quartz	Tr
Clay	5
Volcanic glass	Tr
Foraminifers	15
Nannofossils	35
Sponge spicules	Tr
Intraclasts	5
Micrite	40
Aragonite needles	Tr



SITE 716 HOLE A CORE 23H CORED INTERVAL 742.8-752.5 mbsl; 209.5-219.2 mbsf



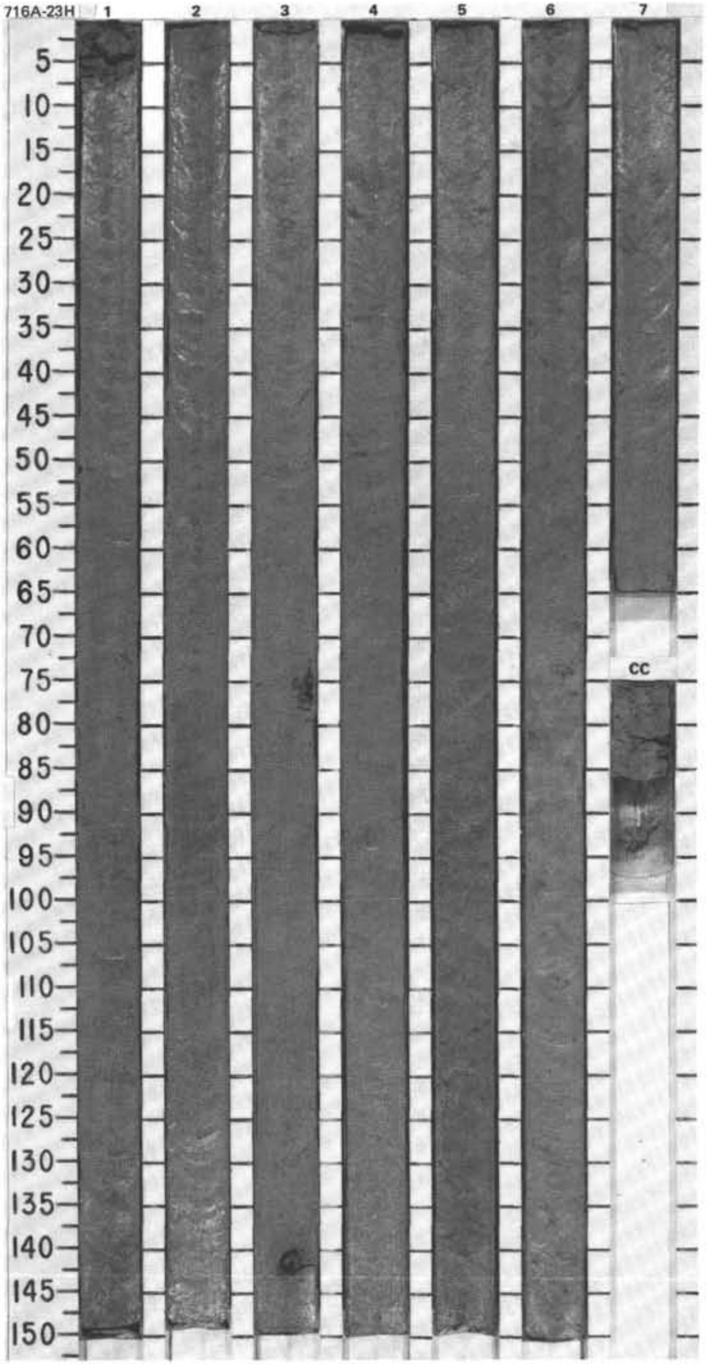
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE

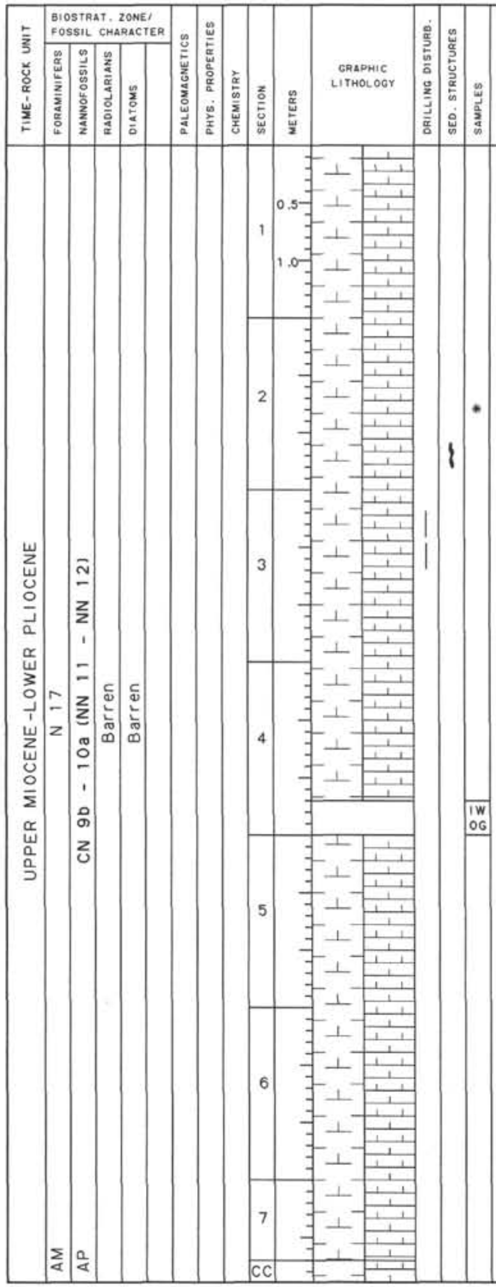
Major lithology: Foraminifer-bearing nannofossil ooze, olive gray (5Y 5/2) to light olive gray (5Y 6/2), homogeneous; chalk is a minor lithology in this core; celestite nodule (3×2 cm) was found in Section 3, 142–145 cm.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	15
Silt	40
Clay	45
COMPOSITION:	
Clay	5
Foraminifers	15
Nannofossils	66
Intraclasts	5
Micrite	9



SITE 716 HOLE A CORE 24H CORED INTERVAL 752.5-762.1 mbsl; 219.2-228.8 mbsf



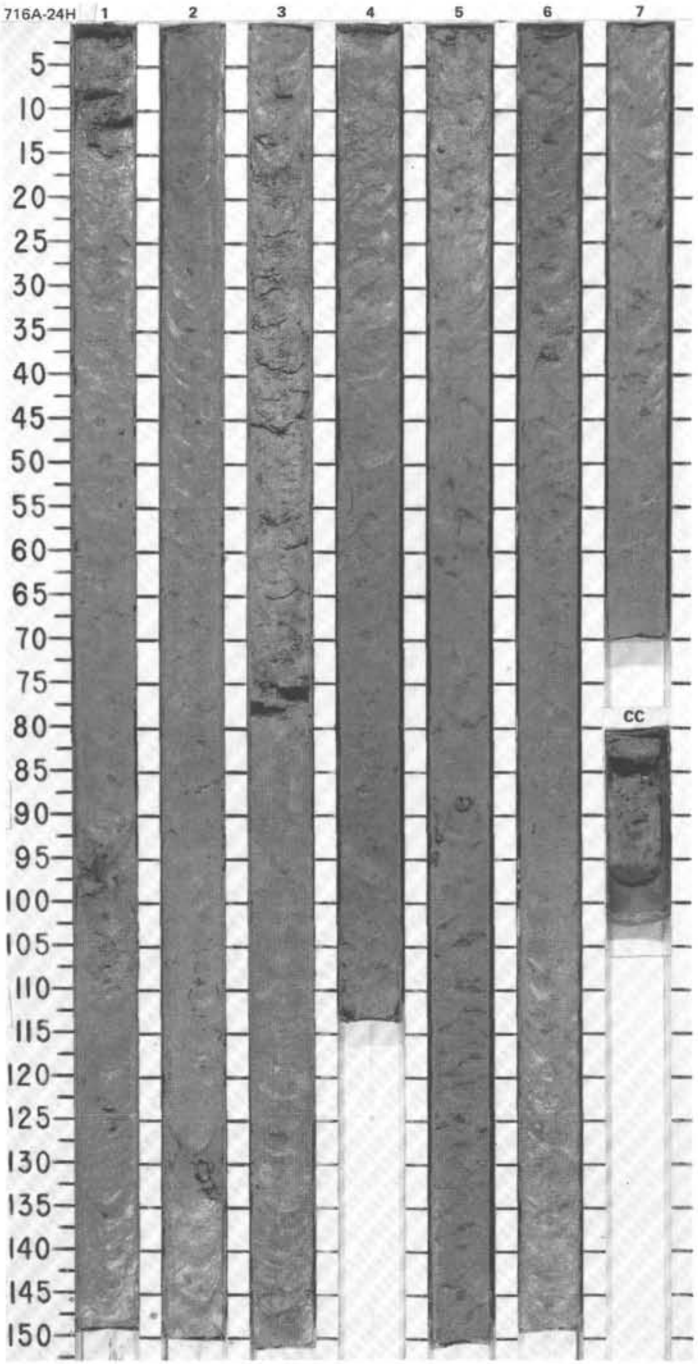
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

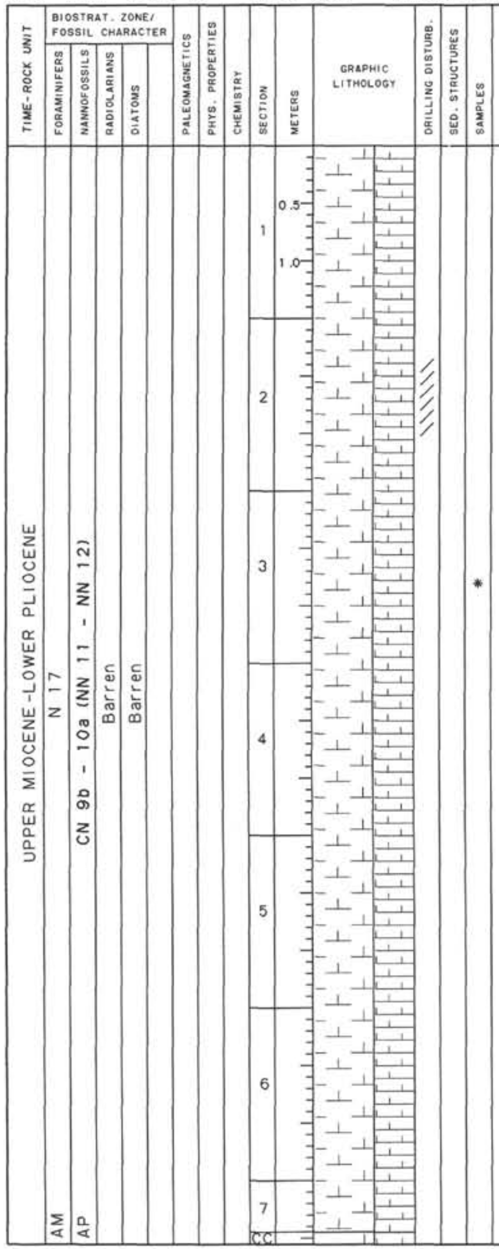
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, alternating, pale olive (5Y 6/3) to light olive gray (5Y 6/2), homogeneous; chalk and ooze in roughly even proportions; celestite identified in Section 2, 135 cm.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	15
Silt	30
Clay	55
COMPOSITION:	
Clay	5
Accessory minerals:	
Opaques	Tr
Foraminifers	18
Nannofossils	67
Intraclasts	5
Micrite	5



SITE 716 HOLE A CORE 25H CORED INTERVAL 762.1-771.8 mbsl; 228.8-238.5 mbsf



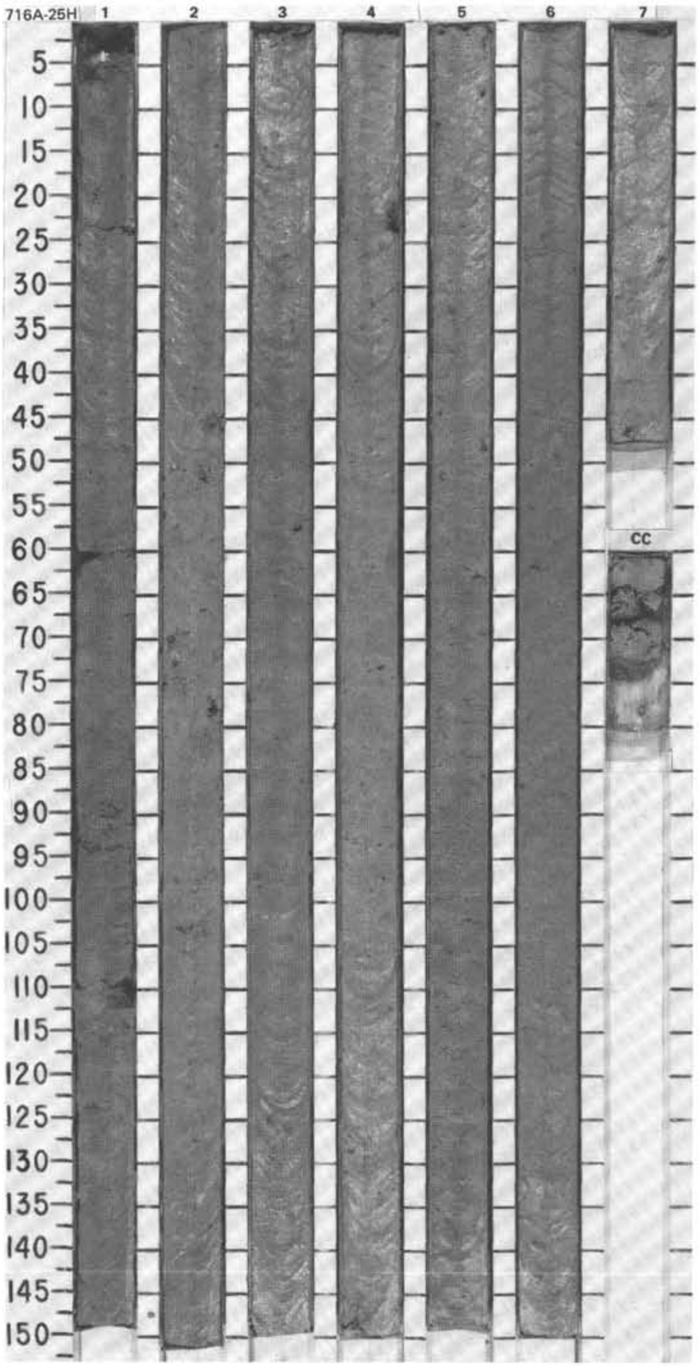
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

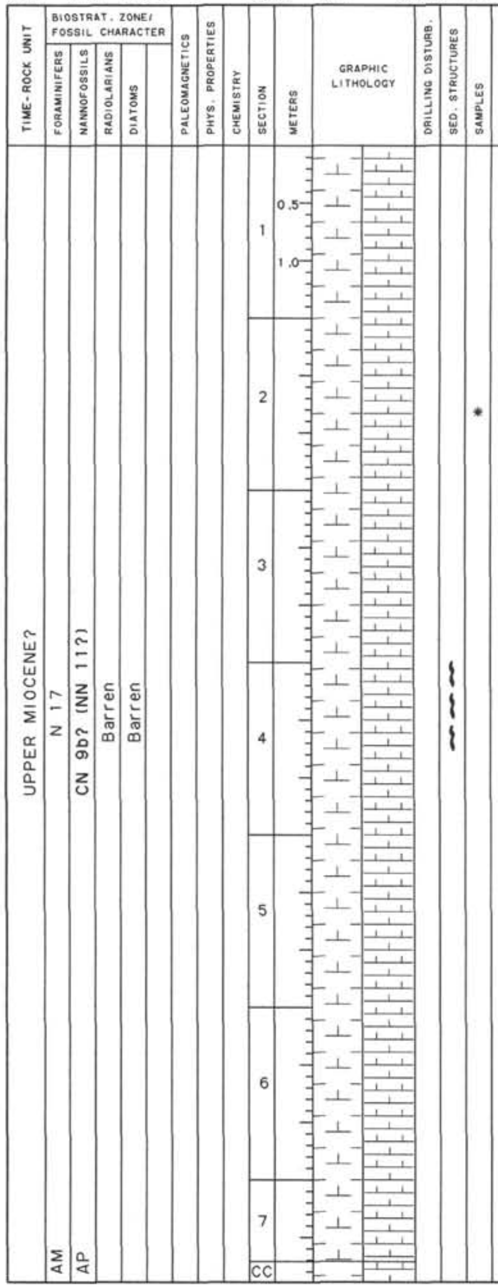
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, alternating, olive (5Y 5/3) to olive gray (5Y 5/2), homogeneous, with chalk making up 40% of the core.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	15
Silt	30
Clay	55
COMPOSITION:	
Quartz	Tr
Clay	5
Volcanic glass	Tr
Foraminifers	12
Nannofossils	70
Intraclasts	8
Micrite	5



SITE 716 HOLE A CORE 26H CORED INTERVAL 771.8-781.4 mbsl; 238.5-248.1 mbsf



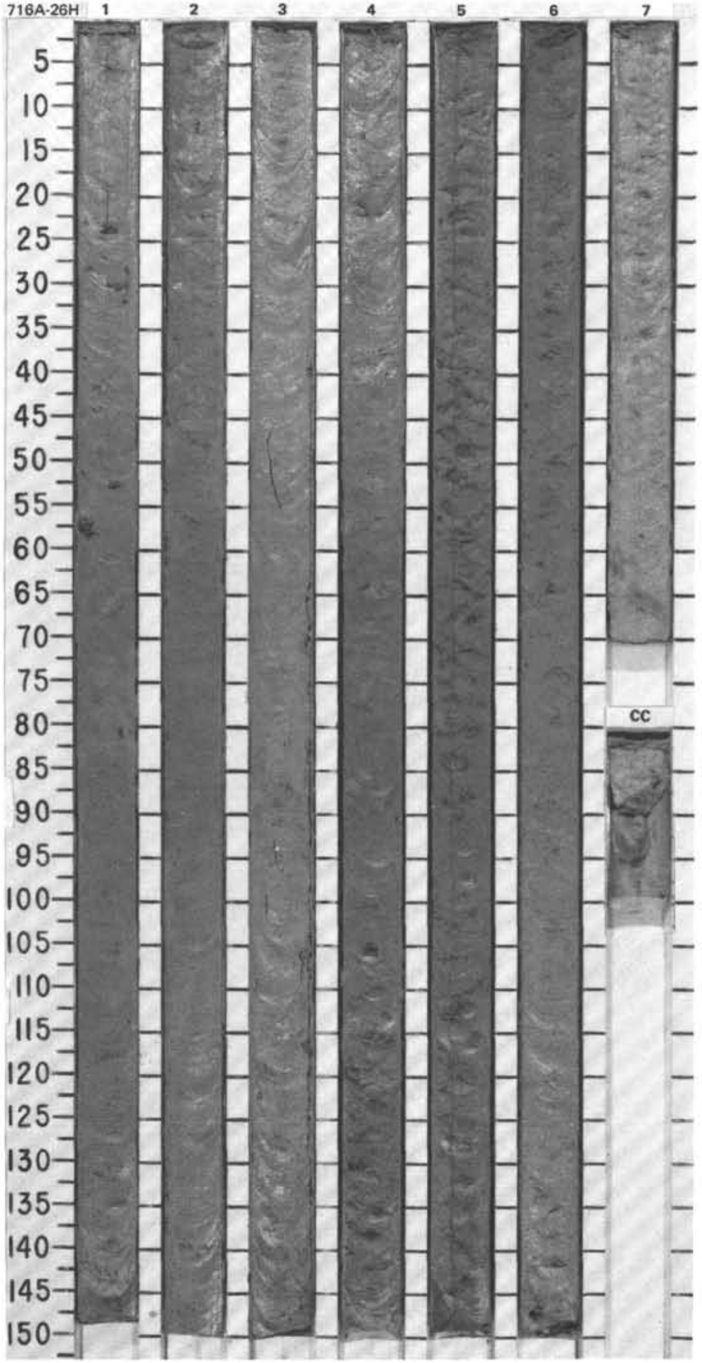
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

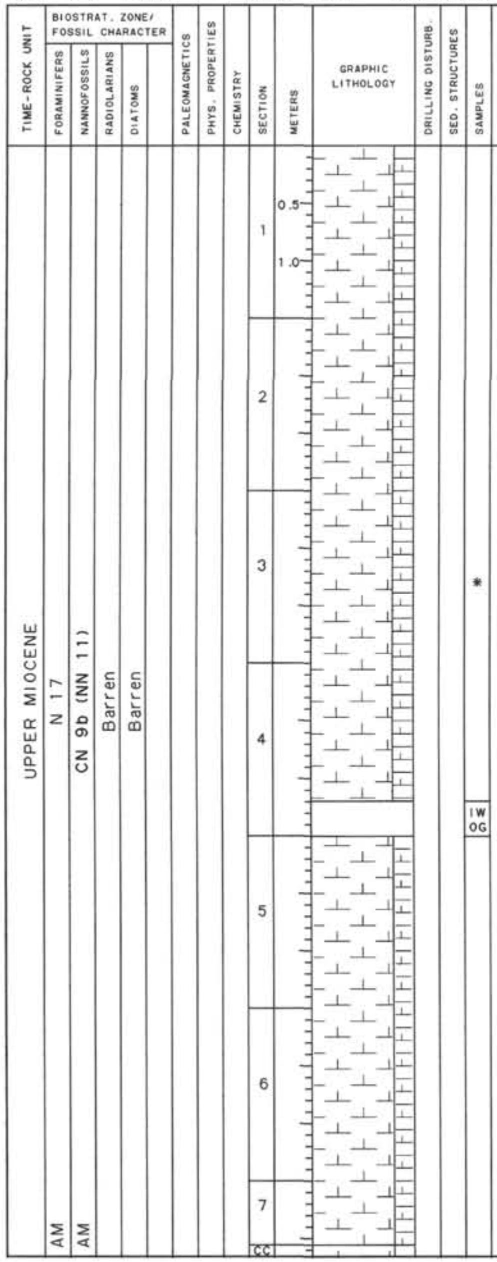
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, alternating, olive (5Y 5/3) to olive gray (5Y 5/2), homogeneous, with chalk making up 50% of the core.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	15
Silt	35
Clay	55
COMPOSITION:	
Volcanic glass	Tr
Foraminifers	17
Nannofossils	80
Intraclasts	3



SITE 716 HOLE A CORE 27H CORED INTERVAL 781.4-790.4 mbsl; 248.1-257.1 mbsf



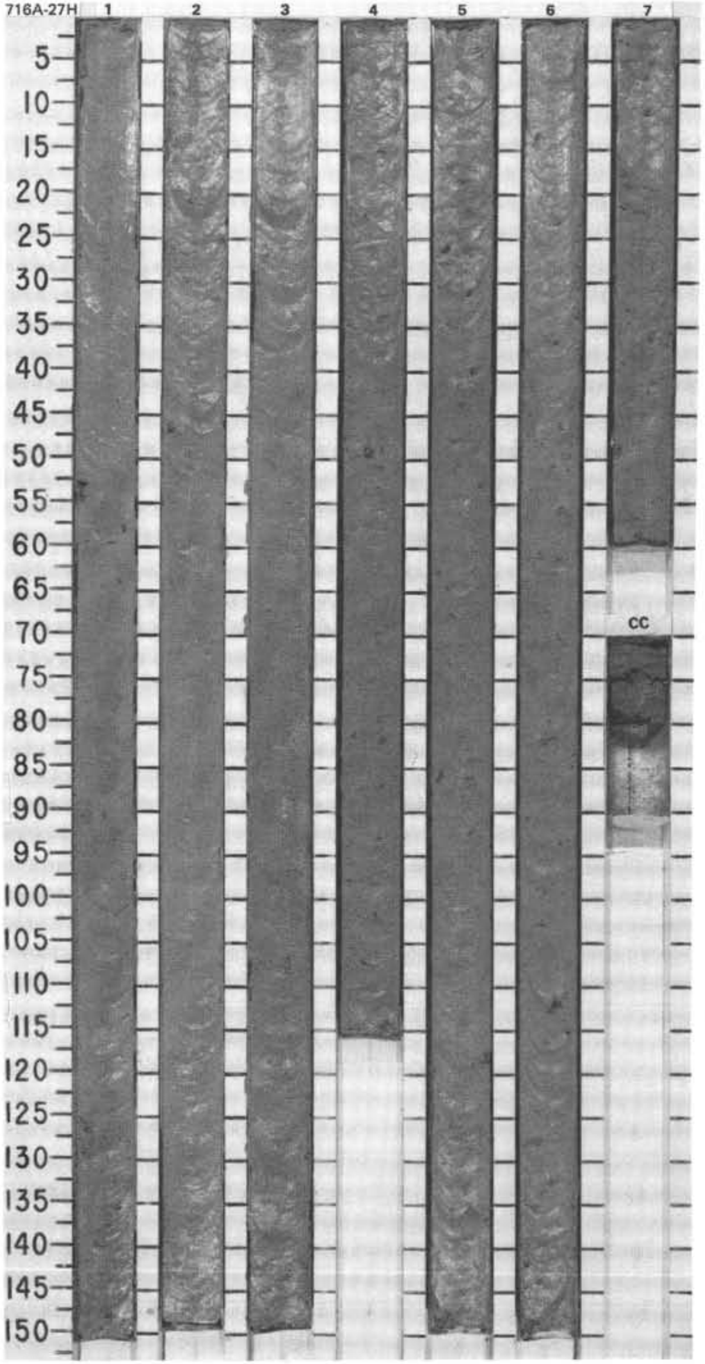
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

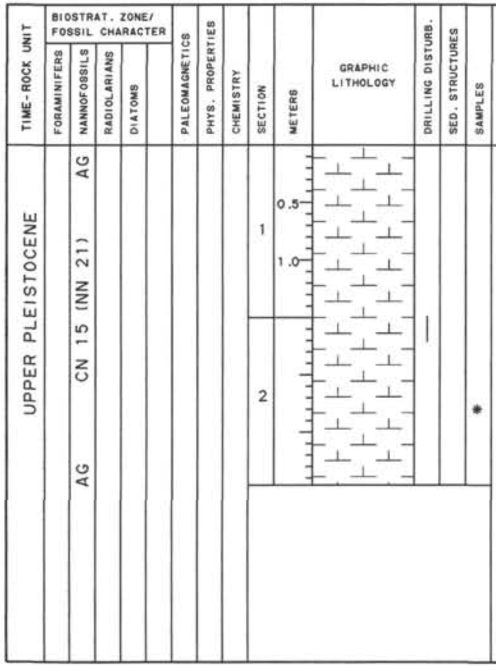
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, alternating, olive gray (5Y 5/2), homogeneous throughout; chalk makes up 20% of core.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	18
Silt	20
Clay	62
COMPOSITION:	
Clay	5
Volcanic glass	Tr
Foraminifers	18
Nannofossils	75
Sponge spicules	Tr
Micrite	2



SITE 716 HOLE B CORE 1H CORED INTERVAL 533.3-537.2 mbsl; 0.0-3.9 mbsf



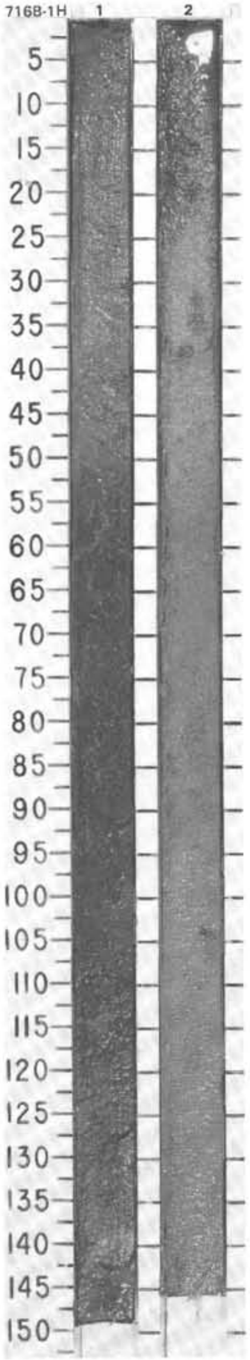
LITHOLOGIC DESCRIPTION

PTEROPOD-BEARING FORAMINIFER-BEARING NANNOFOSSIL OOZE

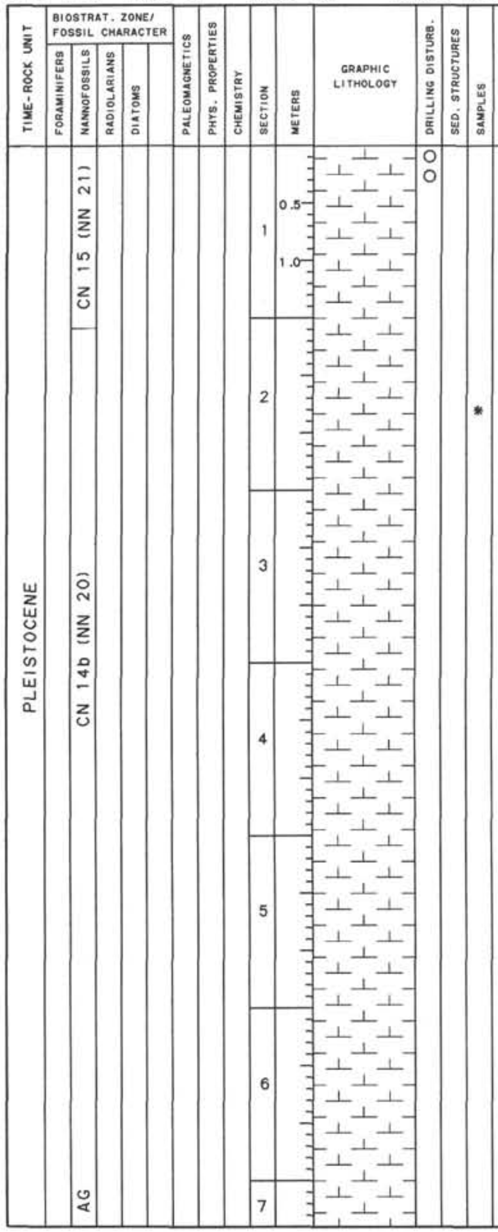
Major lithology: Pteropod-bearing foraminifer-bearing nannofossil ooze, two gradational color changes: olive (5Y 5/3) and olive gray (5Y 4/2); sandy, high water content.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	30
Silt	30
Clay	40
COMPOSITION:	
Clay	15
Volcanic glass	1
Foraminifers	15
Nannofossils	48
Aragonite needles	1
Mollusk debris, pteropods	20



SITE 716 HOLE B CORE 2H CORED INTERVAL 537.2-546.8 mbsl; 3.9-13.5 mbsf



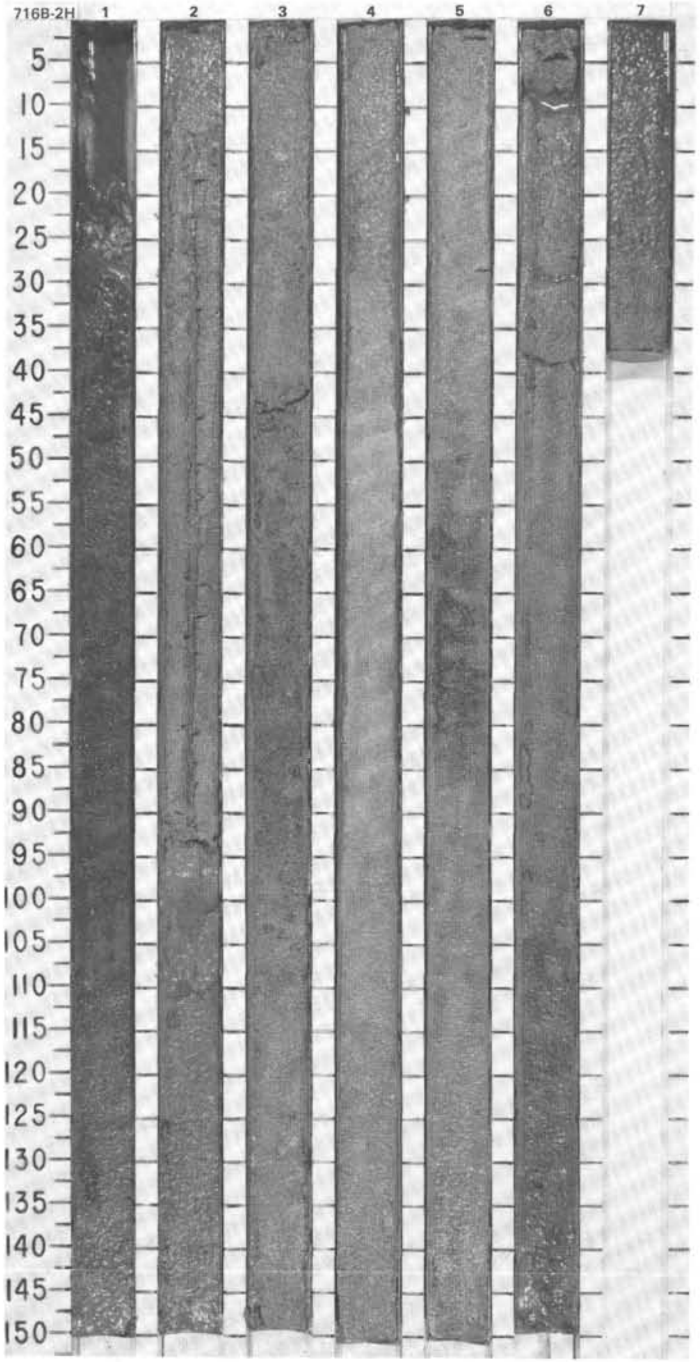
LITHOLOGIC DESCRIPTION

PTEROPOD-BEARING FORAMINIFER-BEARING NANNOFOSSIL OOZE

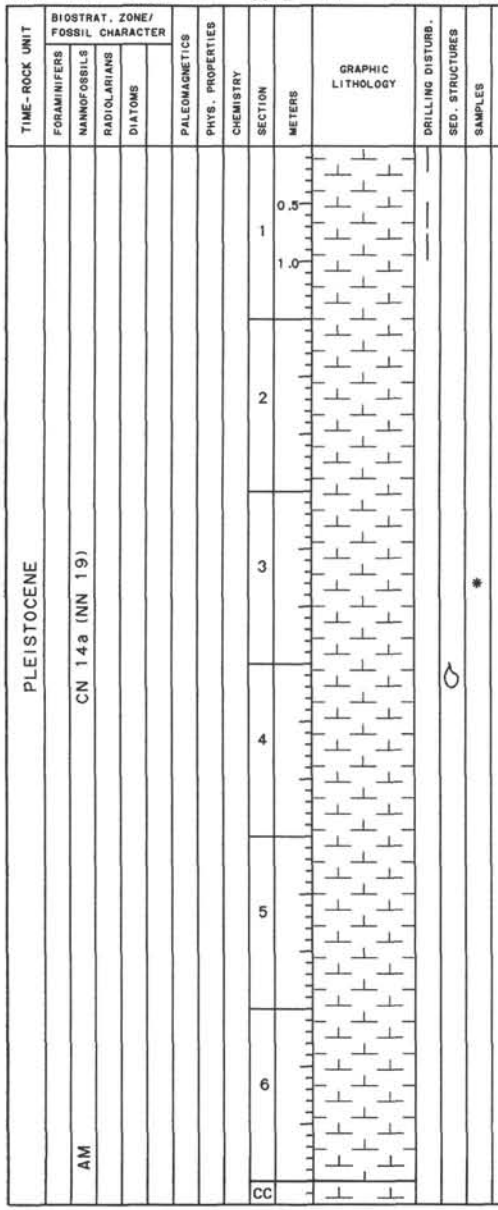
Major lithology: Pteropod-bearing foraminifer-bearing nannofossil ooze, olive (5Y 5/3), light olive gray (5Y 6/2), and olive gray (5Y 4/2); 7 gradational color changes, high water content, large pteropods common.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	30
Silt	30
Clay	40
COMPOSITION:	
Clay	8
Foraminifers	20
Nannofossils	56
Aragonite needles	1
Mollusk debris, pteropods	15



SITE 716 HOLE B CORE 3H CORED INTERVAL 546.8-556.4 mbsl; 13.5-23.1 mbsf



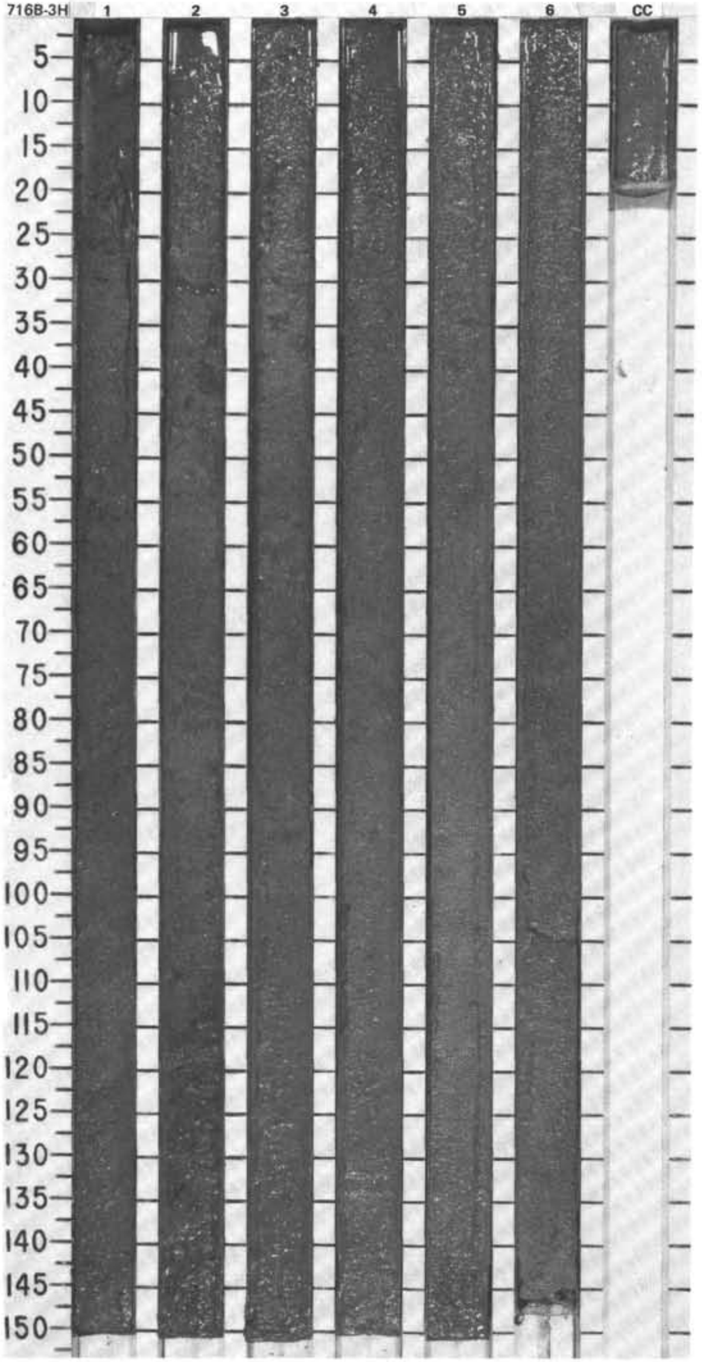
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING PTEROPOD-BEARING NANNOFOSSIL OOZE

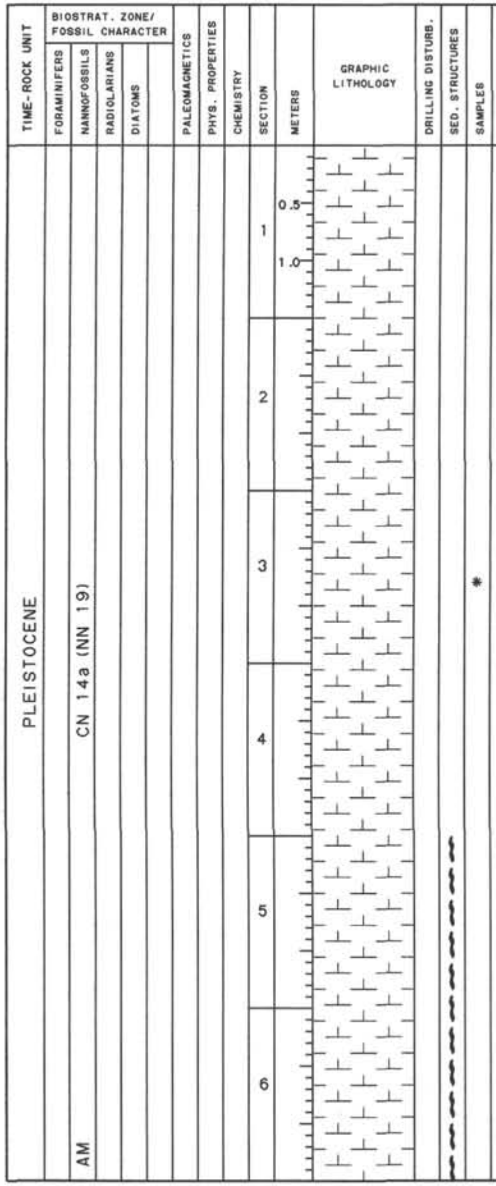
Major lithology: Foraminifer-bearing pteropod-bearing nannofossil ooze, olive (5Y 5/3), homogeneous throughout.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	20
Silt	30
Clay	50
COMPOSITION:	
Clay	5
Foraminifers	20
Nannofossils	54
Aragonite needles	1
Pteropods	20



SITE 716 HOLE B CORE 4H CORED INTERVAL 556.4-566.1 mbsl; 23.1-32.8 mbsf



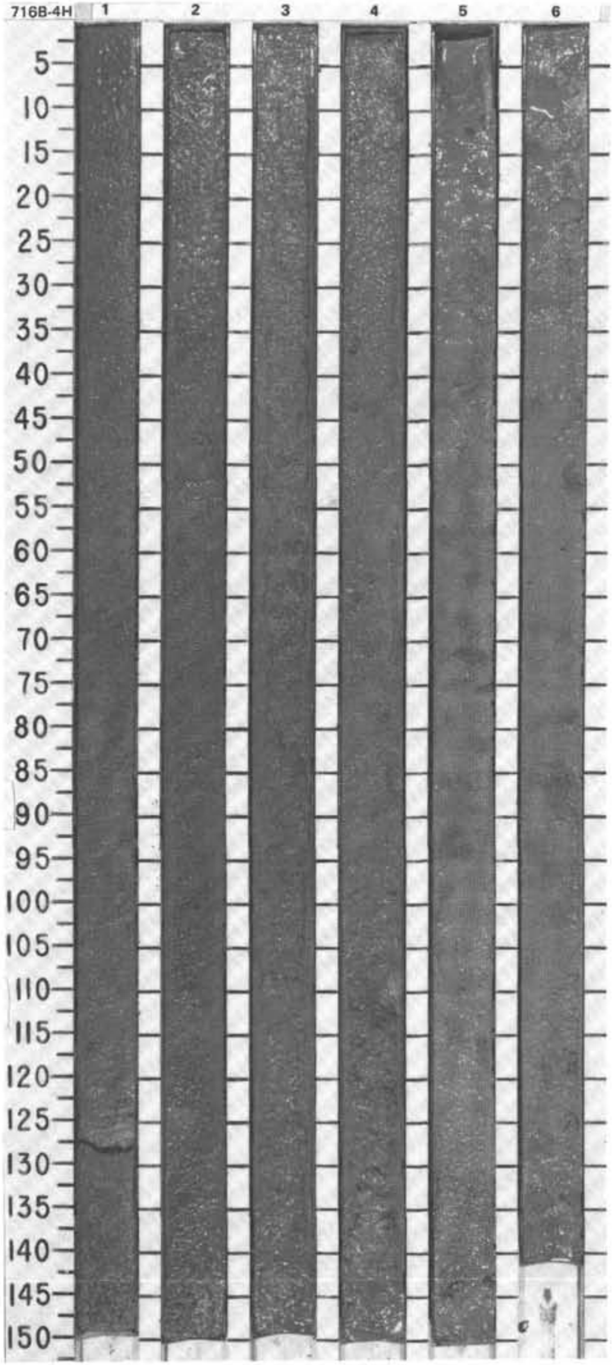
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

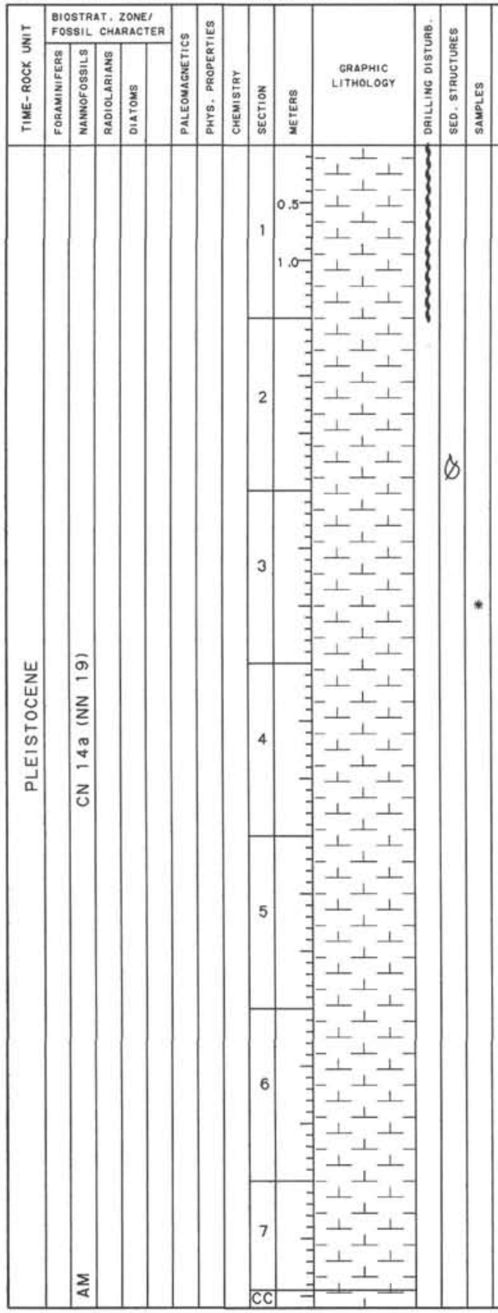
Major lithology: Foraminifer-bearing calcareous nannofossil ooze, olive gray (5Y 4/2, 5/2), homogeneous, high water content.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	30
Silt	40
Clay	30
COMPOSITION:	
Foraminifers	20
Nannofossils	54
Mollusk fragments	26
Aragonite needles	Tr



SITE 716 HOLE B CORE 5H CORED INTERVAL 566.1-575.8 mbsl; 32.8-42.5 mbsf



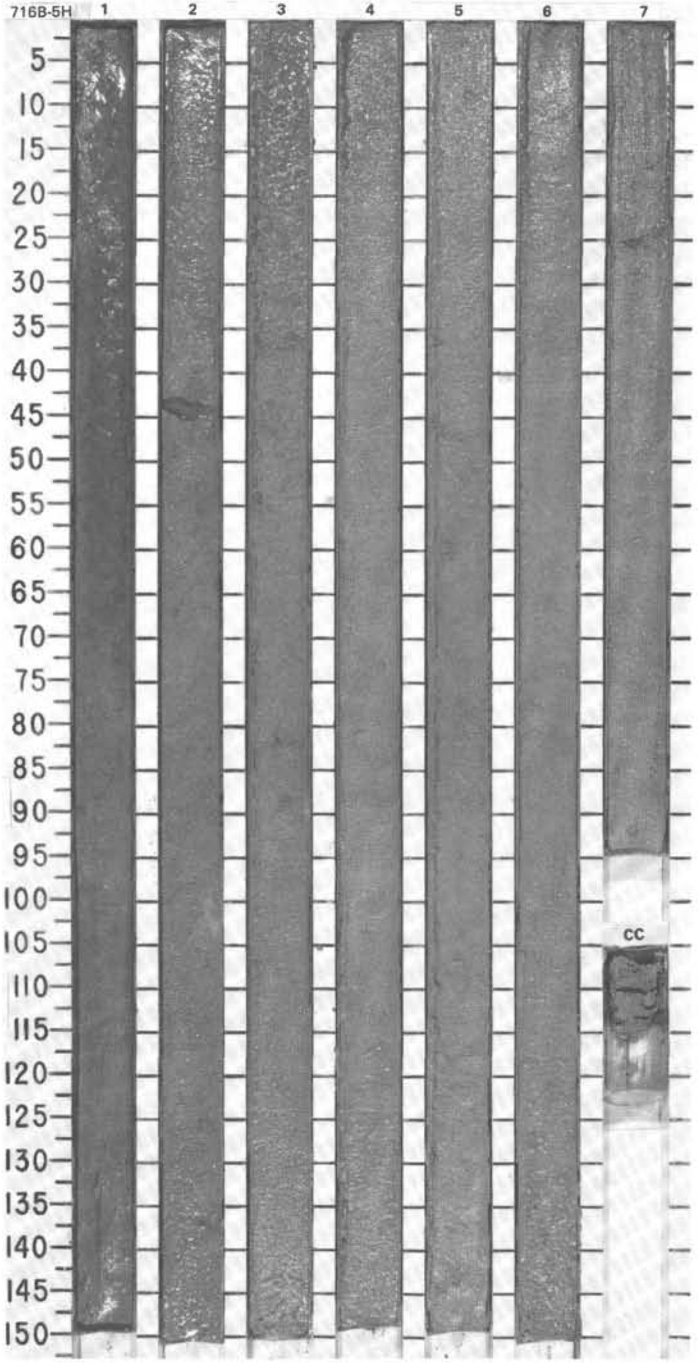
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

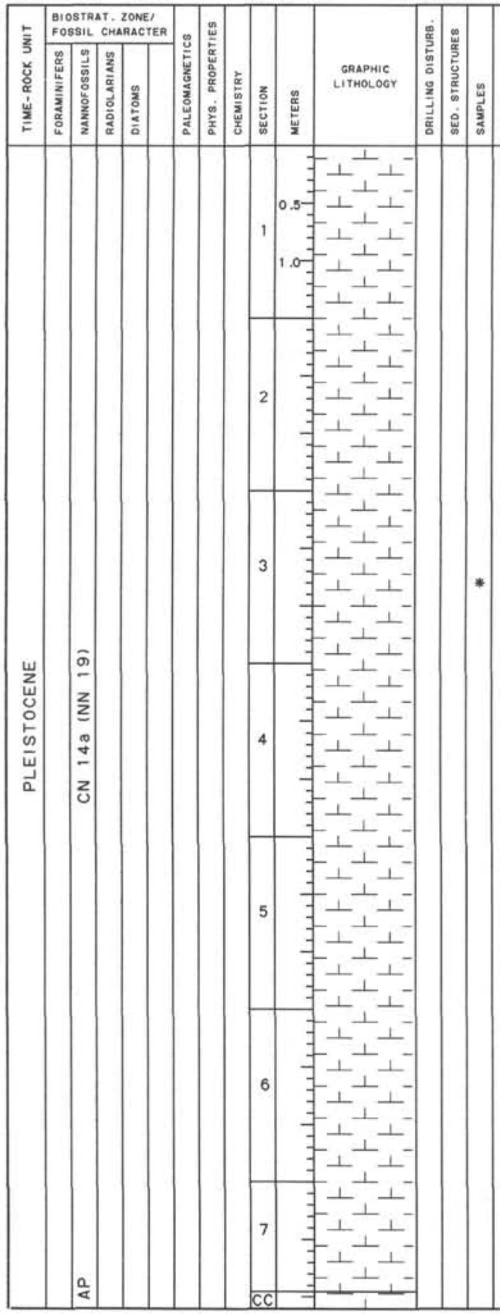
Major lithology: Foraminifer-bearing calcareous nannofossil ooze, olive gray (5Y 4/2) and olive (5Y 5/3), homogeneous, very sandy. Section 1 badly disturbed.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	25
Silt	40
Clay	35
COMPOSITION:	
Foraminifers	15
Nannofossils	49
Mollusk fragments	35
Aragonite needles	1



SITE 716 HOLE B CORE 6H CORED INTERVAL 575.8-585.4 mbsl; 42.5-52.1 mbsf



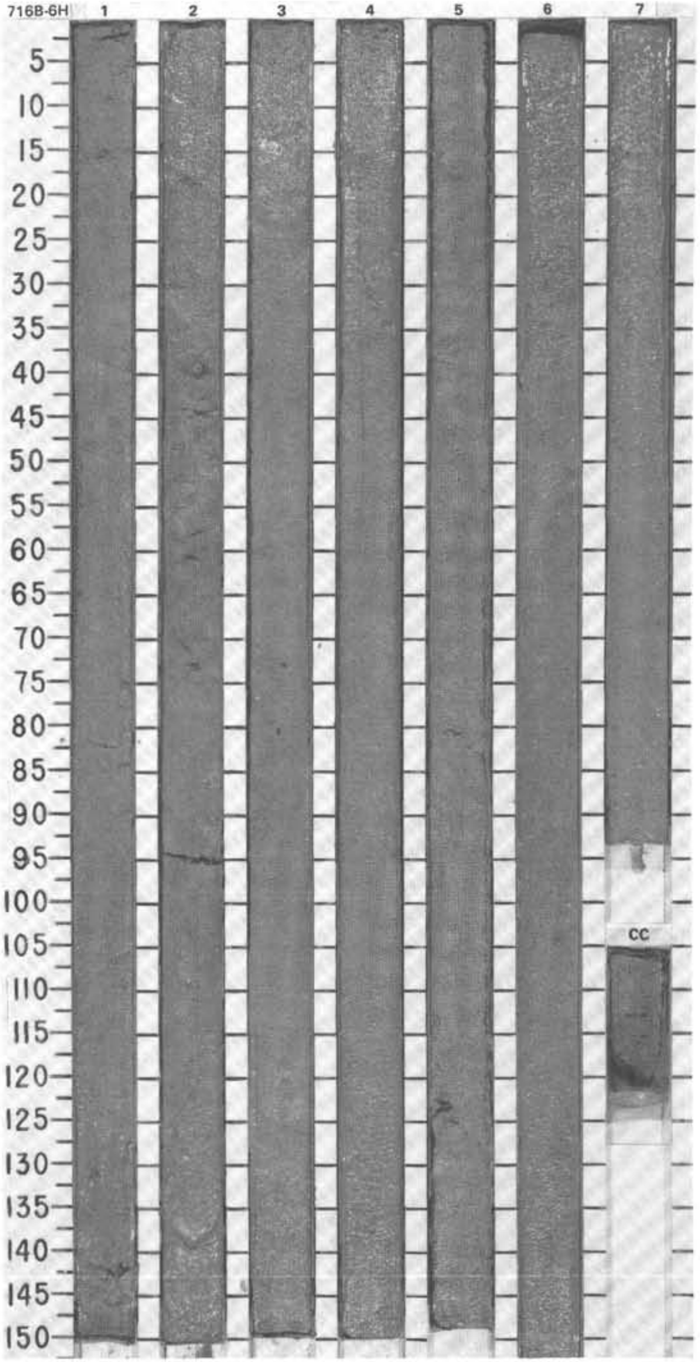
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS OOZE

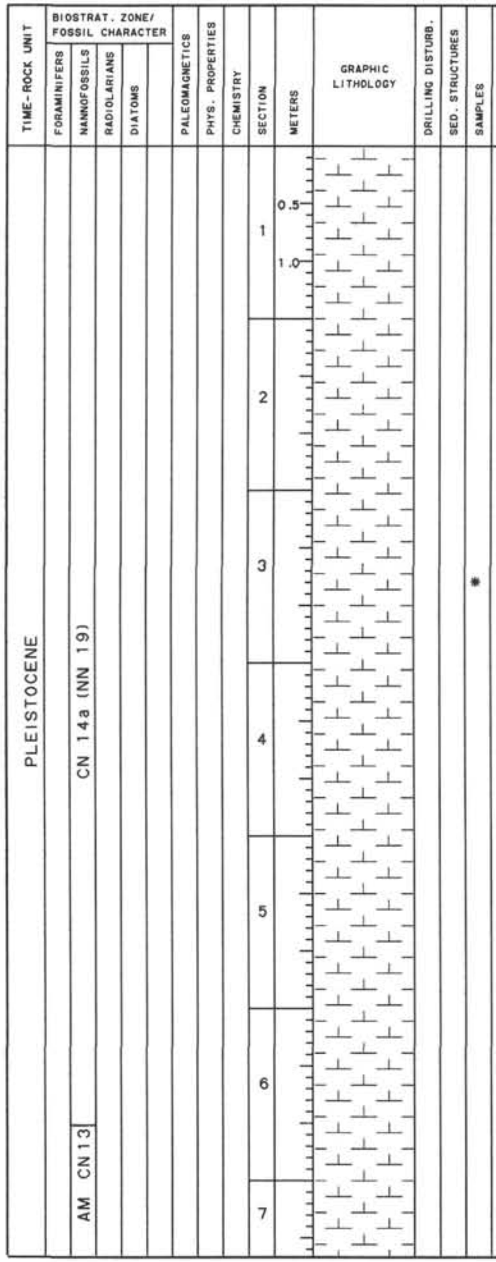
Major lithology: Foraminifer-bearing nannofossil calcareous ooze, olive (5Y 5/3), homogeneous, high water content.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	10
Silt	30
Clay	60
COMPOSITION:	
Foraminifers	9
Nannofossils	60
Bioclasts	1
Micrite	30



SITE 716 HOLE B CORE 7H CORED INTERVAL 585.4-595.0 mbsl; 52.1-61.7 mbsf



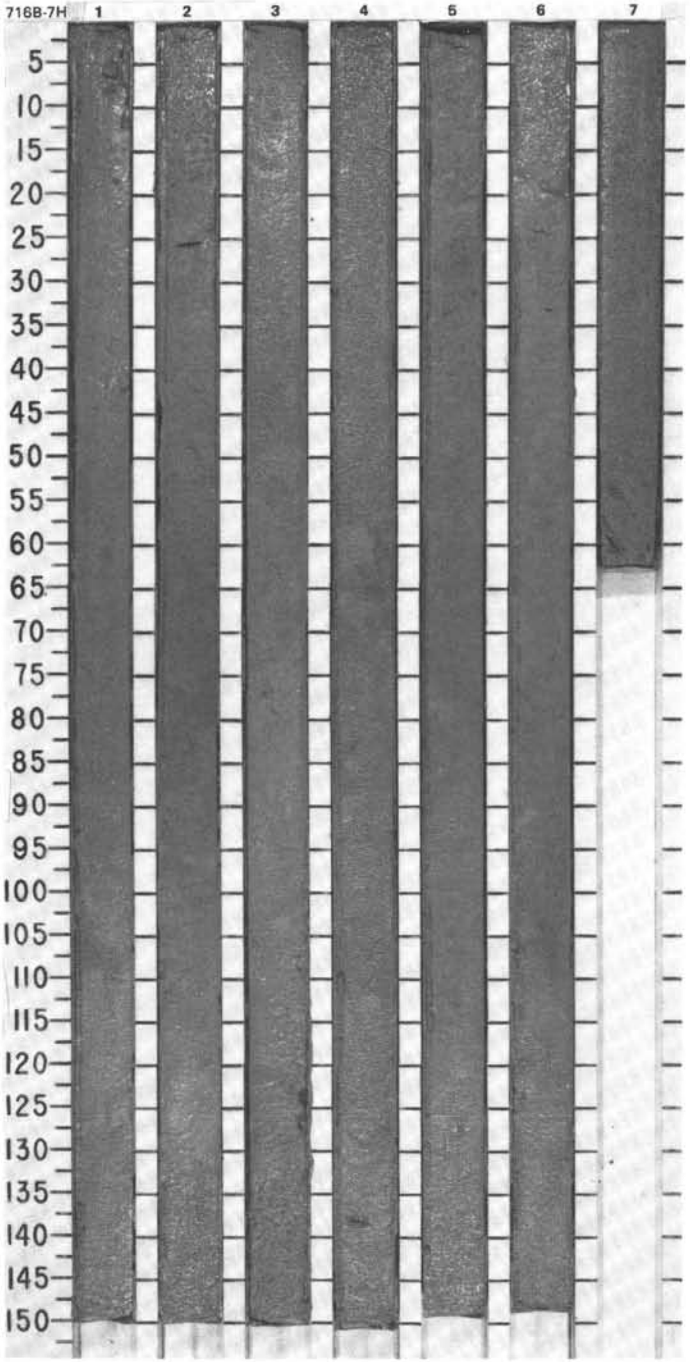
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

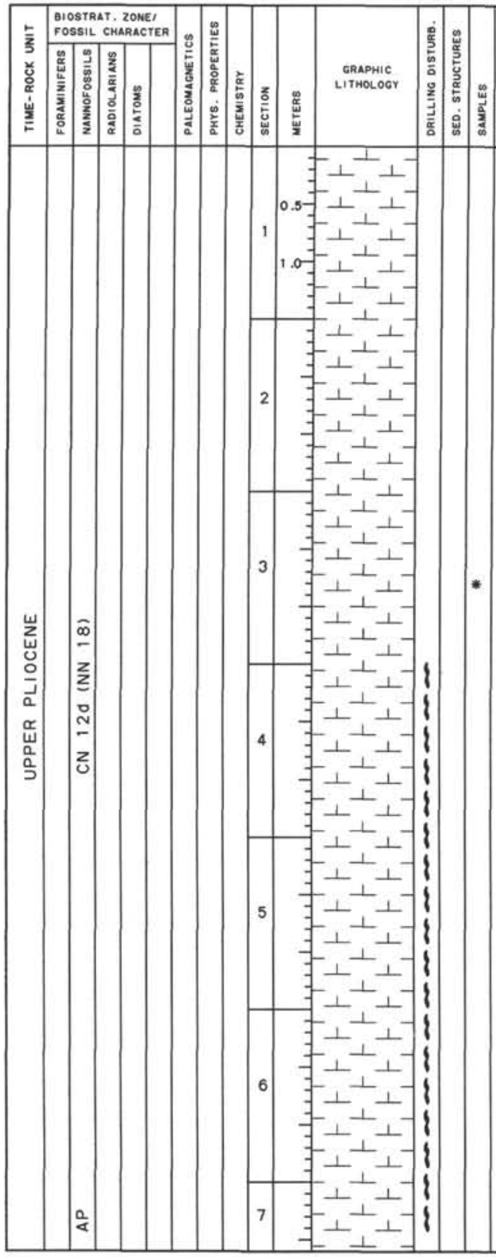
Major lithology: Foraminifer-bearing calcareous nannofossil ooze, olive (5Y 5/3), homogeneous.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	15
Silt	30
Clay	55
COMPOSITION:	
Volcanic glass	Tr
Foraminifers	12
Nannofossils	63
Micrite	25
Aragonite needles	Tr



SITE 716 HOLE B CORE 8H CORED INTERVAL 595.0-604.7 mbsl; 61.7-71.4 mbsf



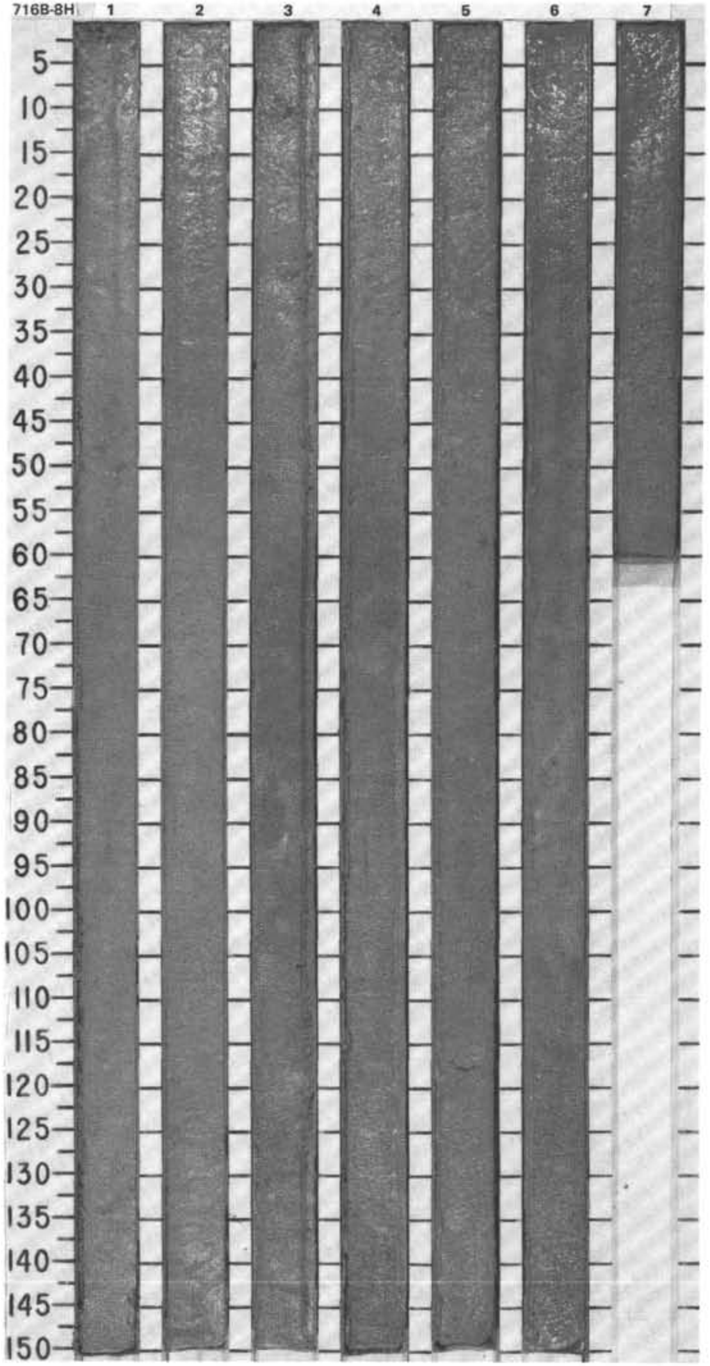
LITHOLOGIC DESCRIPTION

CALCAREOUS NANNOFOSSIL OOZE

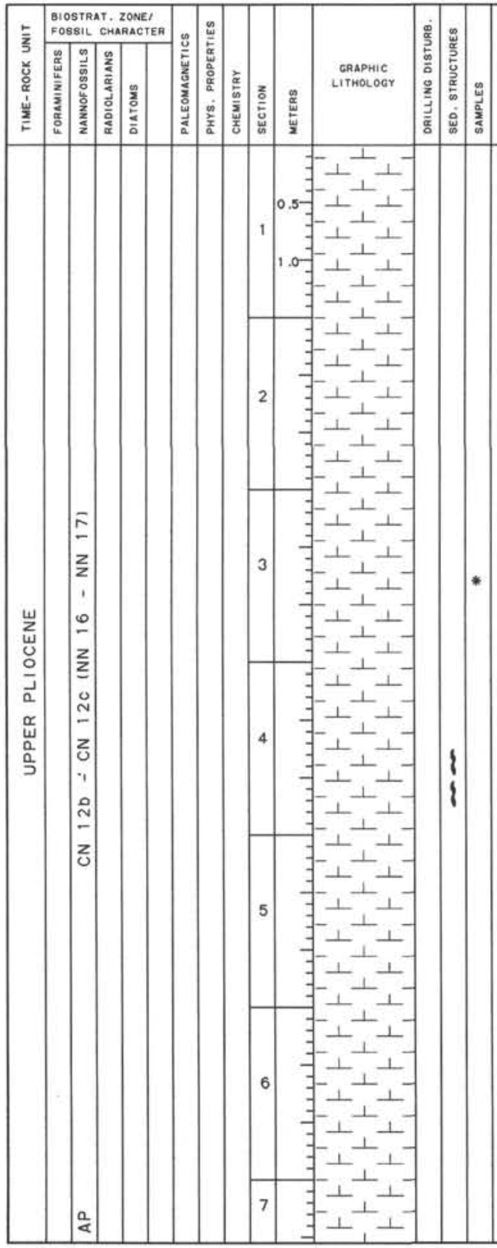
Major lithology: Calcareous nannofossil ooze, pale olive (5Y 6/3), some firm ooze, minor color mottling.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	10
Silt	30
Clay	60
COMPOSITION:	
Clay	8
Foraminifers	8
Nannofossils	49
Micrite	35
Aragonite needles	Tr



SITE 716 HOLE B CORE 9H CORED INTERVAL 604.7-614.4 mbsl; 71.4-81.1 mbsf



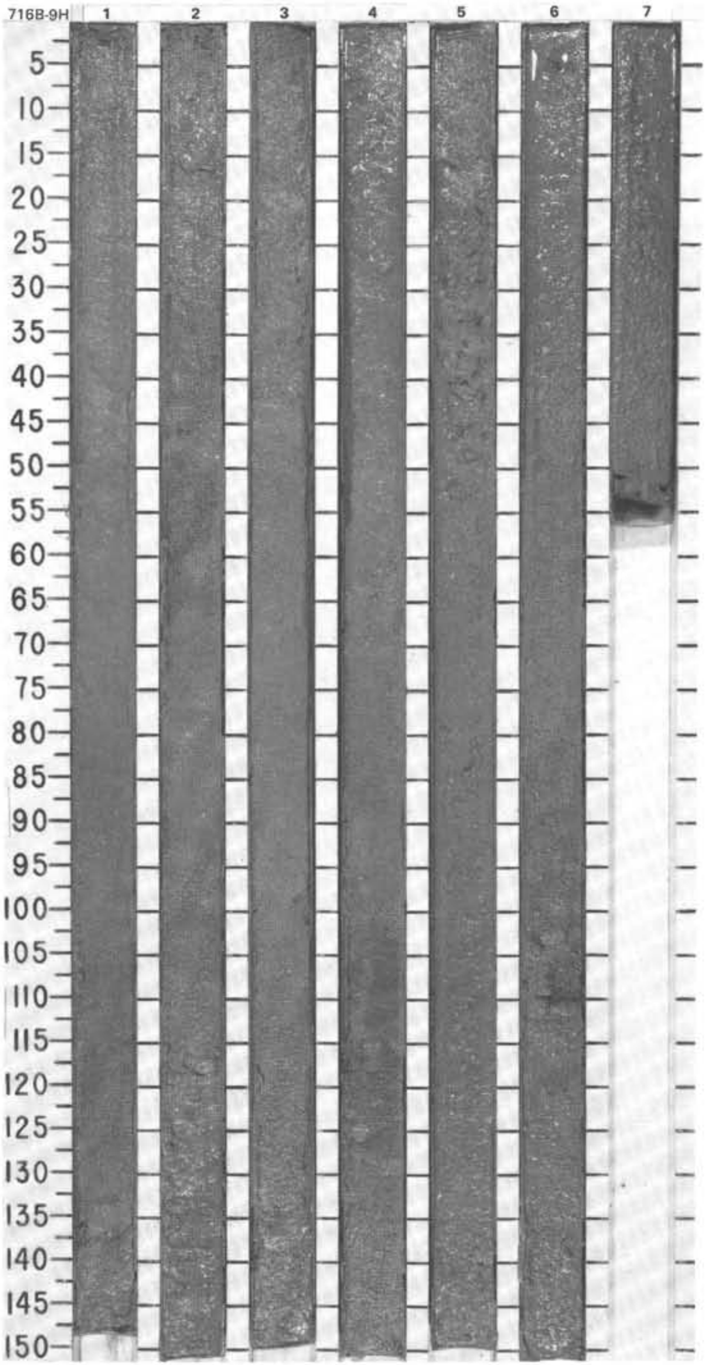
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE

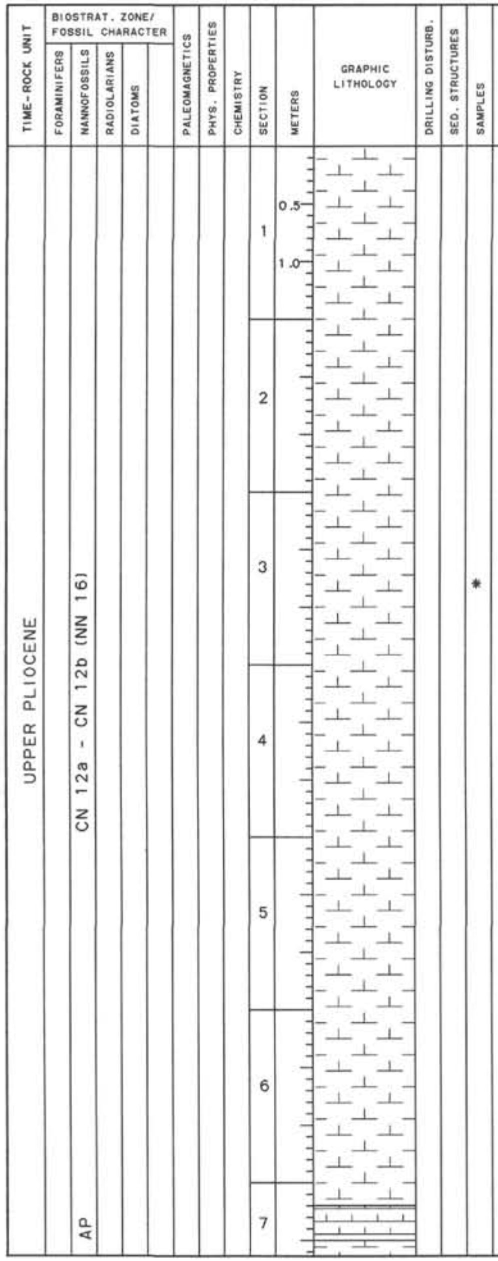
Major lithology: Foraminifer-bearing nannofossil ooze, olive (5Y 5/3), homogeneous, minor bioturbation, occasional lumps of harder chalk (<5%).

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	10
Silt	30
Clay	60
COMPOSITION:	
Foraminifers	12
Nannofossils	53
Bioclasts	35
Aragonite needles	Tr



SITE 716 HOLE B CORE 10H CORED INTERVAL 614.4-624.0 mbsl; 81.1-90.7 mbsf



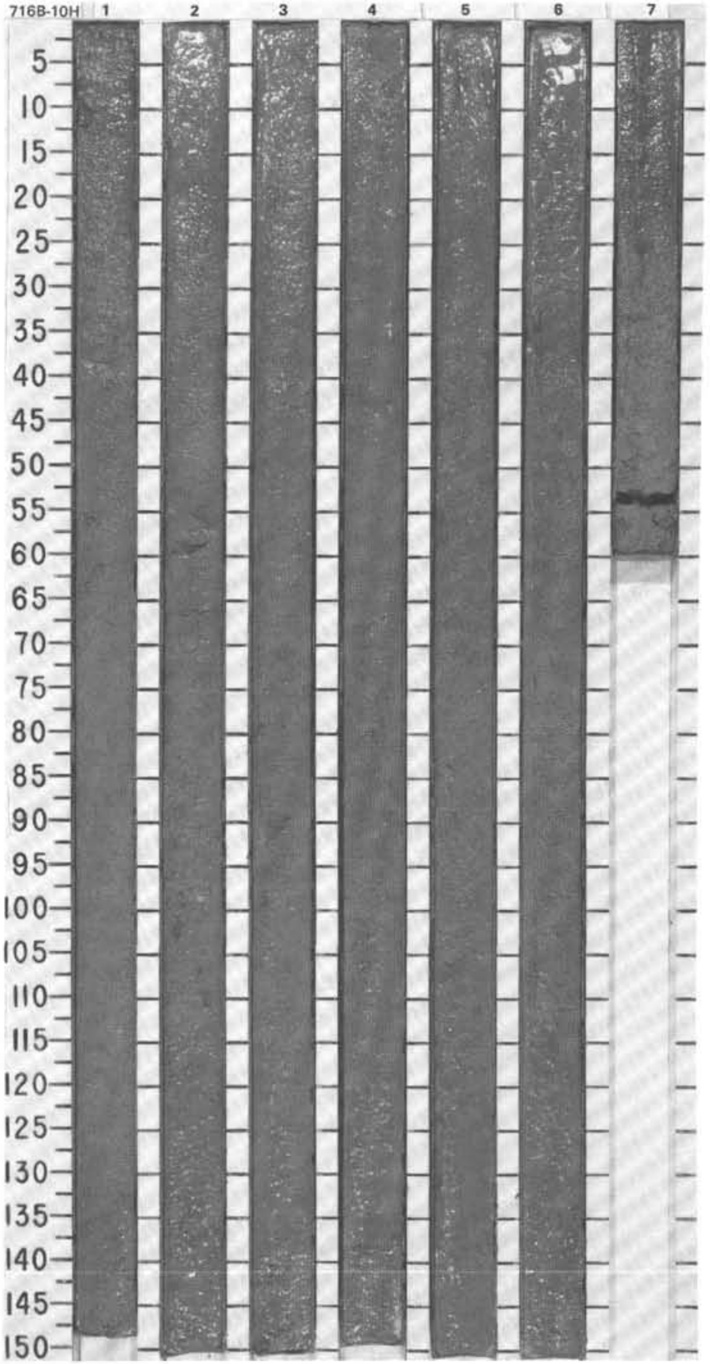
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

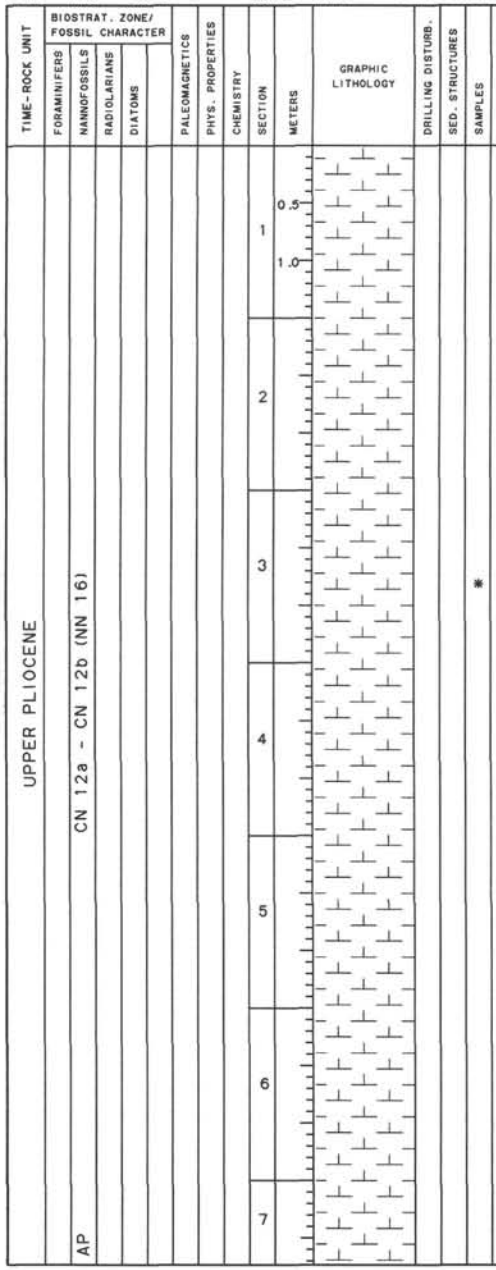
Major lithology: Foraminifer-bearing calcareous nannofossil ooze, olive (5Y 5/3), 5% chalky intervals, homogeneous.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	25
Silt	30
Clay	45
COMPOSITION:	
Foraminifers	20
Nannofossils	48
Aragonite needles	1
Micrite	26
Clay	5



SITE 716 HOLE B CORE 11H CORED INTERVAL 624.0-633.6 mbsl; 90.7-100.3 mbsf



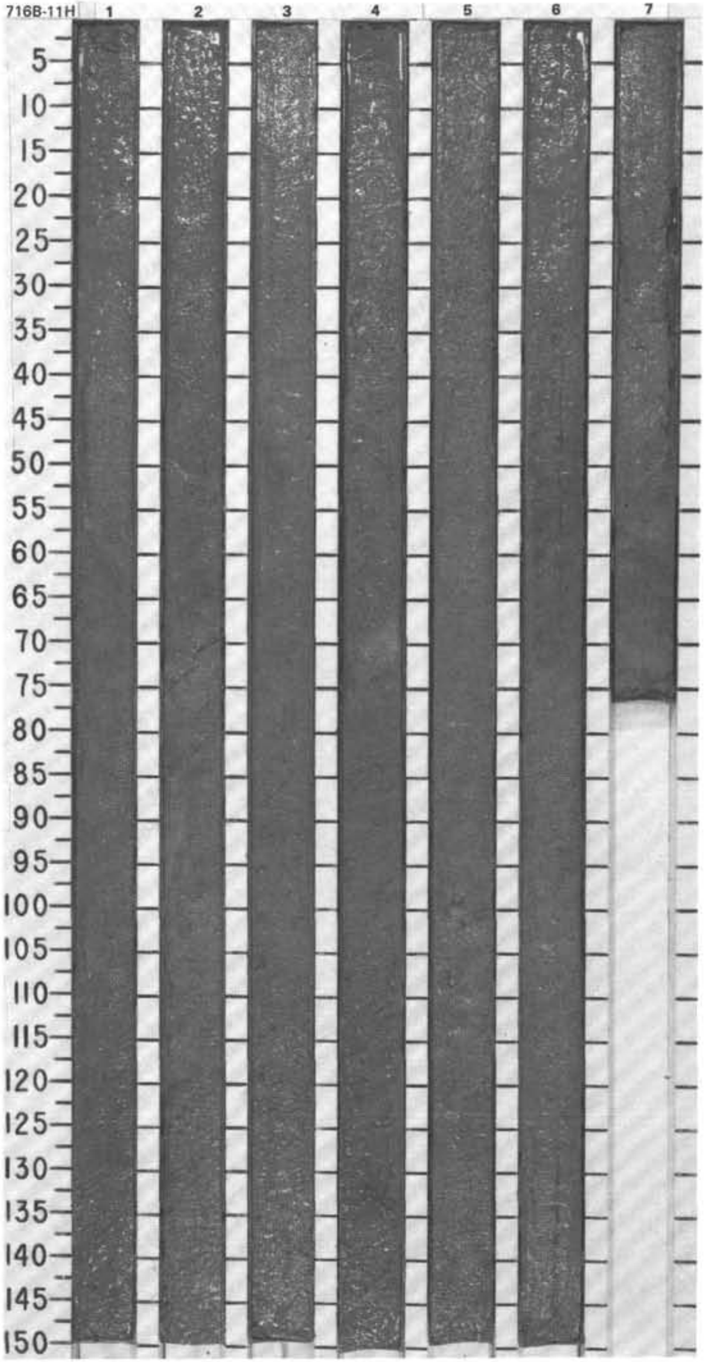
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

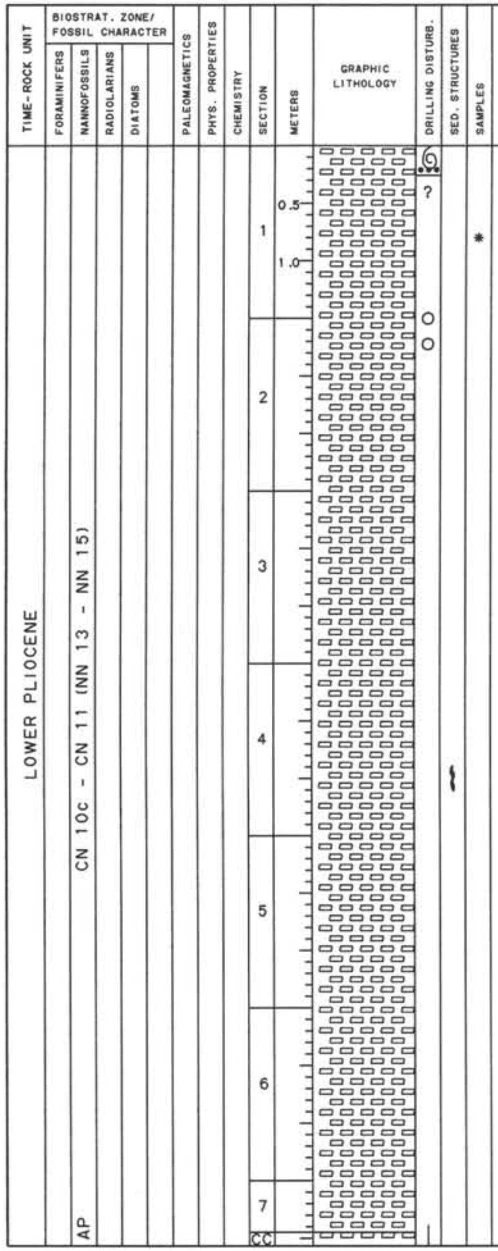
Main lithology: Foraminifer-bearing calcareous nannofossil ooze, olive (5Y 5/3), 5% chalky intervals, homogeneous.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
TEXTURE:	
Sand	20
Silt	30
Clay	50
COMPOSITION:	
Foraminifers	20
Nannofossils	54
Aragonite needles	Tr
Micrite	26



SITE 716 HOLE B CORE 12H CORED INTERVAL 633.6-643.3 mbsl; 100.3-110.0 mbsf



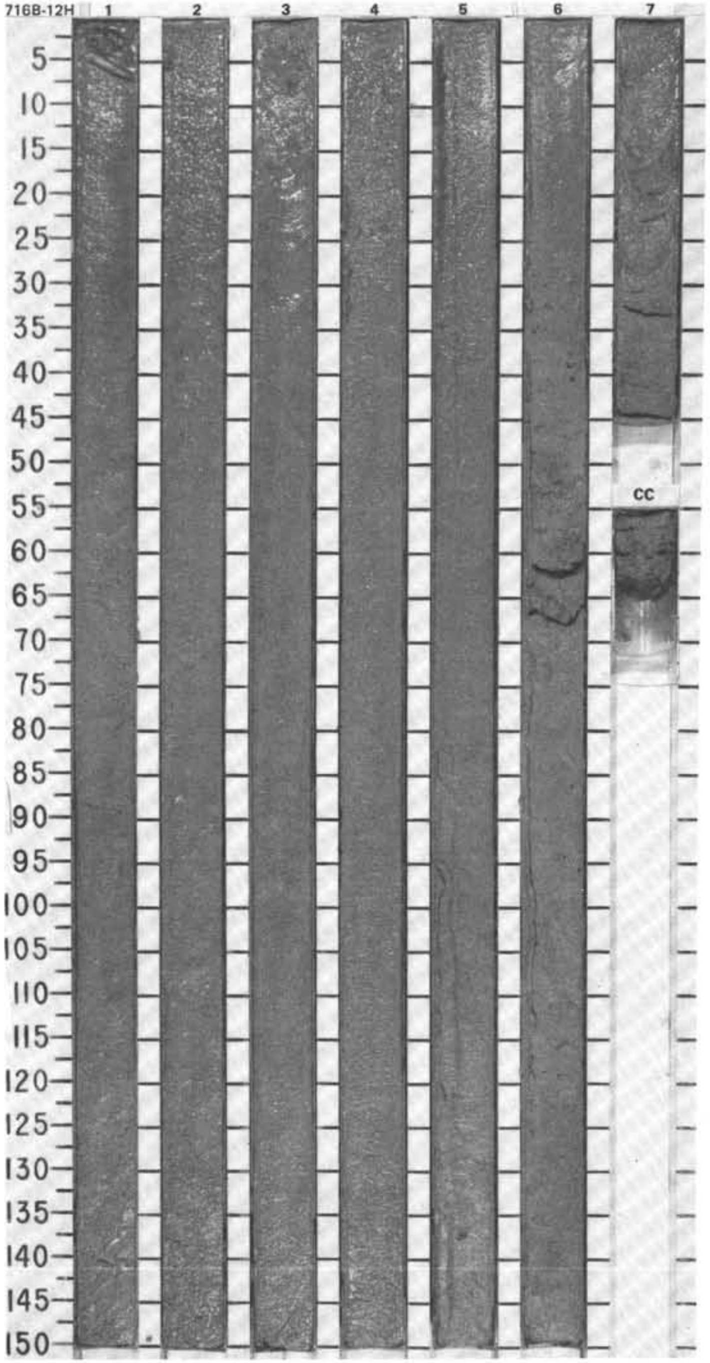
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS OOZE

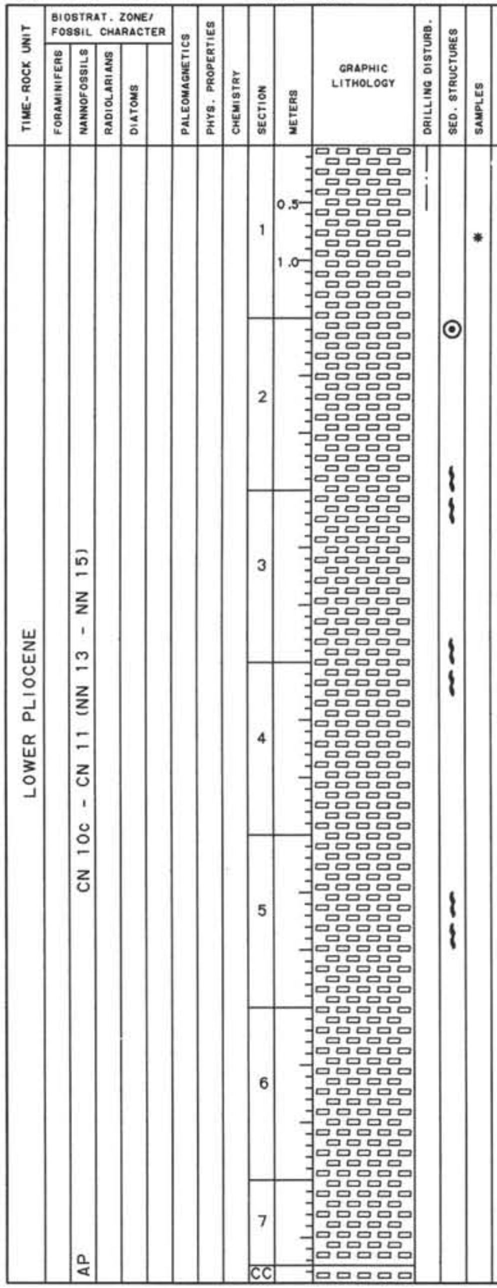
Main lithology: Foraminifer-bearing calcareous nannofossil ooze, olive (5Y 5/3), 5% chalky intervals, homogeneous.

SMEAR SLIDE SUMMARY (%):

	1, 80 D
TEXTURE:	
Sand	15
Silt	25
Clay	60
COMPOSITION:	
Clay	5
Foraminifers	15
Nannofossils	30
Aragonite needles	1
Micrite	49



SITE 716 HOLE B CORE 13H CORED INTERVAL 643.3-653.0 mbsl; 110.0-119.7 mbsf



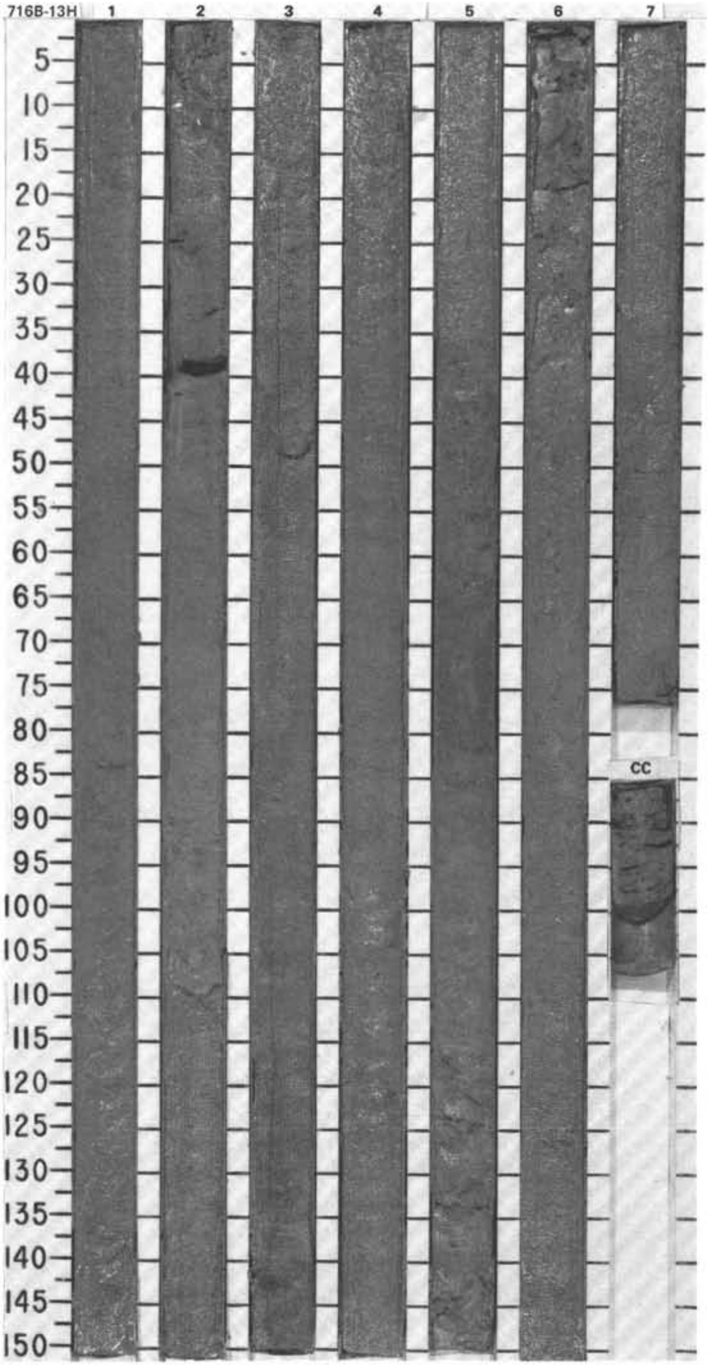
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS OOZE

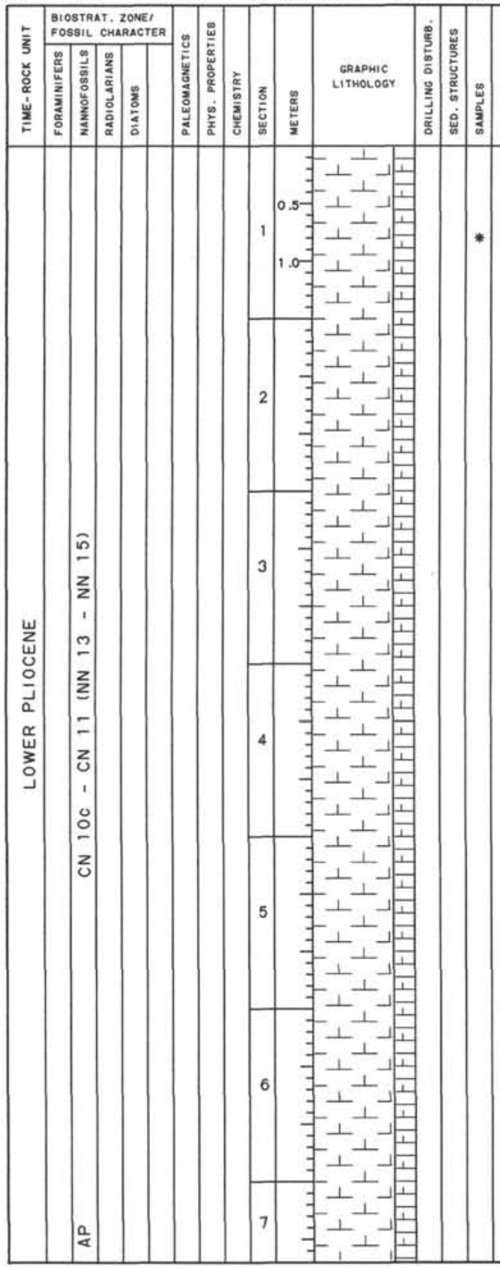
Major lithology: Foraminifer-bearing nannofossil calcareous ooze, pale olive (5Y 6/3), 5-10% chalk, homogeneous, hydrogen sulfide odor detectable, possible celestite in Section 2, 5-15 cm.

SMEAR SLIDE SUMMARY (%):

	1, 80 D
TEXTURE:	
Sand	20
Silt	20
Clay	60
COMPOSITION:	
Clay	5
Volcanic glass	Tr
Foraminifers	20
Nannofossils	30
Fish remains	Tr
Mollusk debris	5
Micrite	40



SITE 716 HOLE B CORE 14H CORED INTERVAL 653.0-662.6 mbsl; 119.7-129.3 mbsf



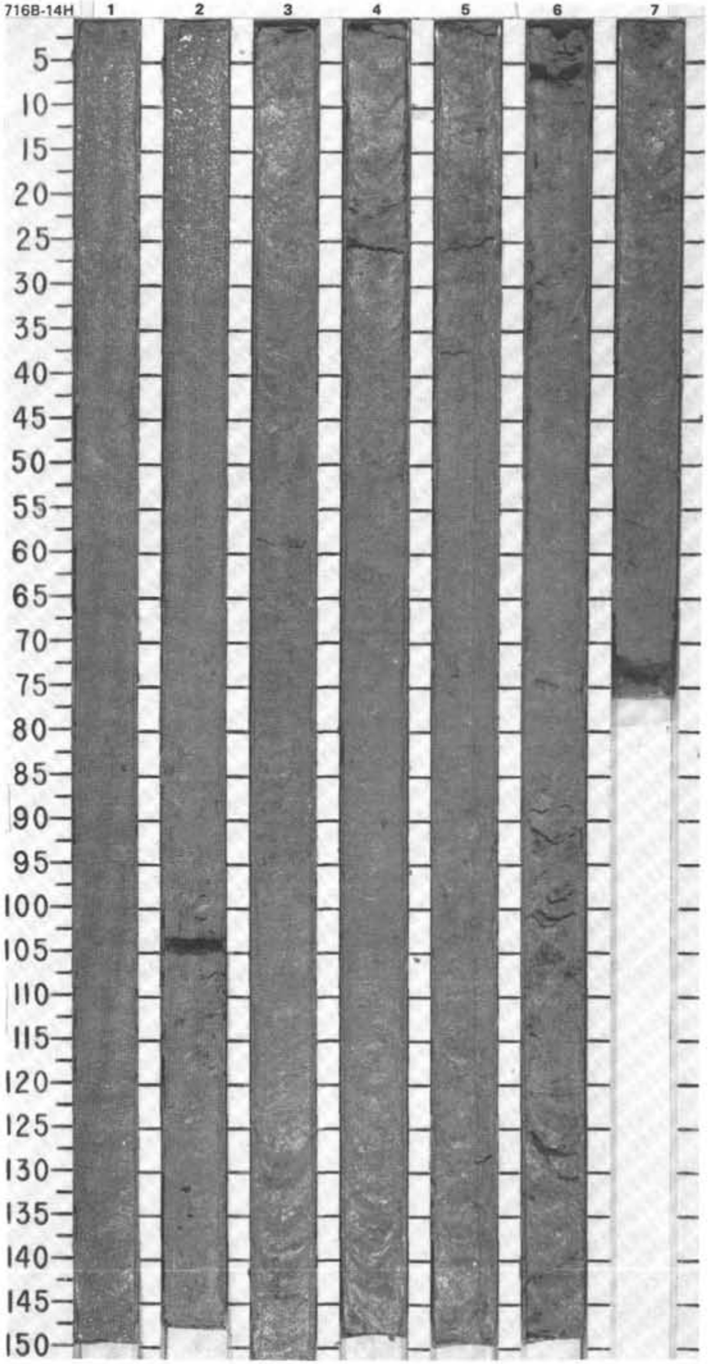
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE

Major lithology: Foraminifer-bearing calcareous nannofossil ooze, pale olive (5Y 6/3), 20% chalk, homogeneous, strong hydrogen sulfide odor detectable.

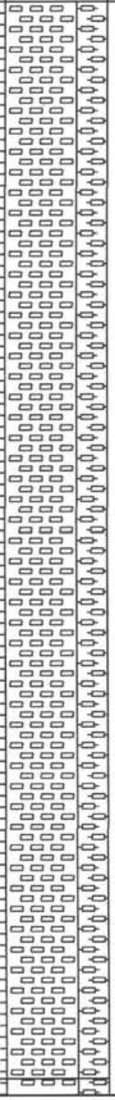
SMEAR SLIDE SUMMARY (%):

	1, 80 D
COMPOSITION:	
Quartz	Tr
Feldspar	Tr
Mica	Tr
Volcanic glass	Tr
Foraminifers	20
Nannofossils	45
Mollusk bioclasts	2
Micrite	30
Aragonite needles	3



SITE 716 HOLE B CORE 15H CORED INTERVAL 662.6-672.2 mbsl; 129.3-138.9 mbsf

TIME-ROCK UNIT	BIOSTRAT. ZONE/ FOSSIL CHARACTER				PALEOMAGNETICS	PHYS. PROPERTIES	CHEMISTRY	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURB.	SED. STRUCTURES	SAMPLES
	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS									
LOWER PLIOCENE		CN 10c - CN 11 (NN 13 - NN 15) AP						1 2 3 4 5 6 7 CC	0.5 1.0			⊙ ⊙ ⊙ ⊙	*

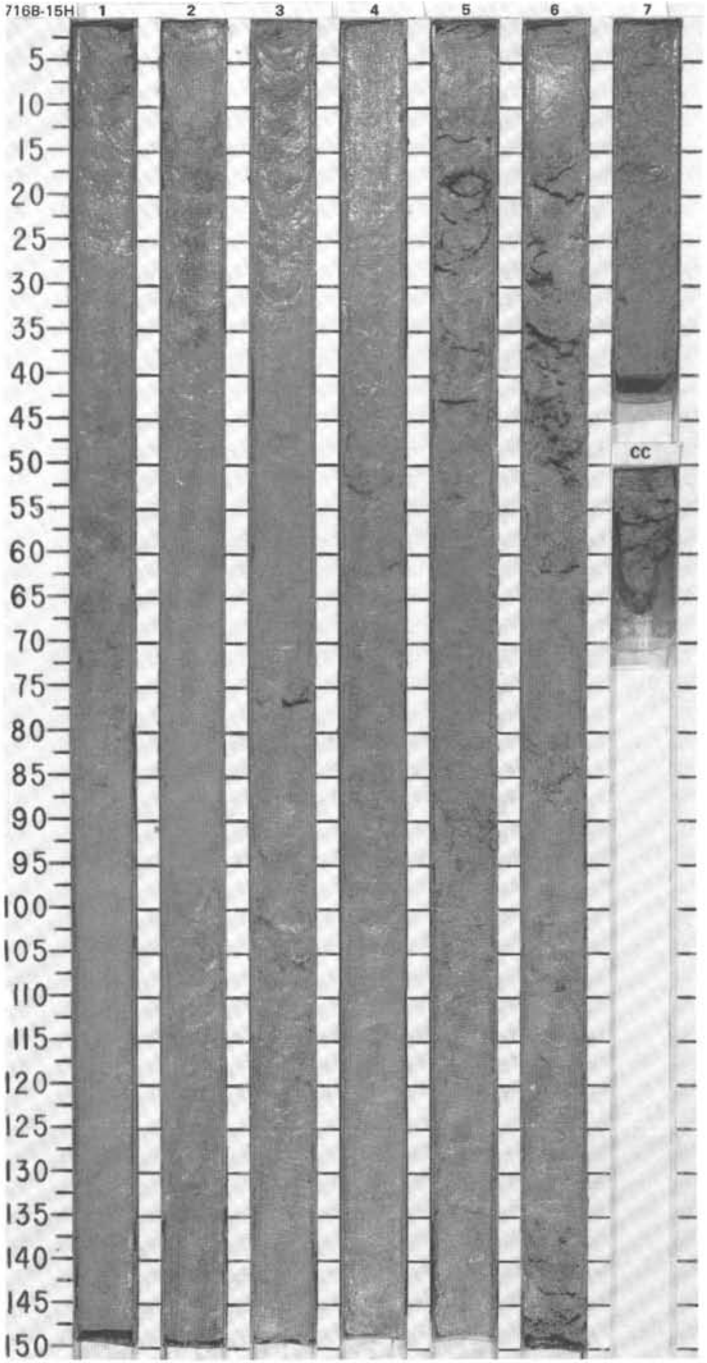


FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS OOZE and FORAMINIFER-BEARING NANNOFOSSIL CALCAREOUS CHALK

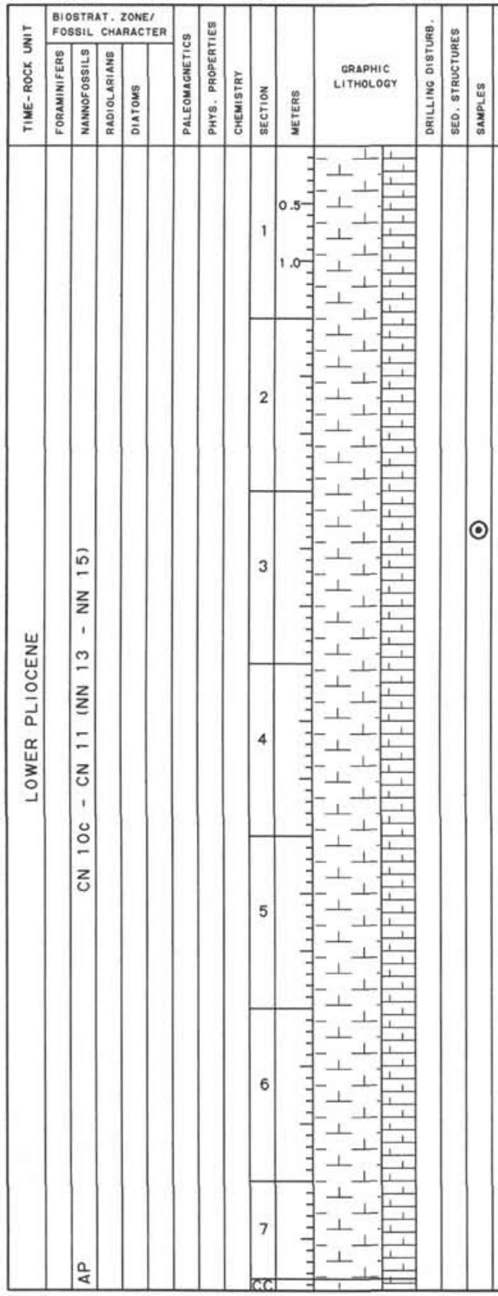
Major lithologies: Foraminifer-bearing nannofossil calcareous ooze and foraminifer-bearing nannofossil calcareous chalk, pale olive (5Y 6/3), 30% chalk, homogeneous.

SMEAR SLIDE SUMMARY (%):

	2, 80 D
TEXTURE:	
Sand	20
Silt	15
Clay	65
COMPOSITION:	
Quartz	Tr
Clay	8
Accessory minerals:	
Opaques	Tr
Foraminifers	15
Nannofossils	20
Bioclasts	8
Micrite	49



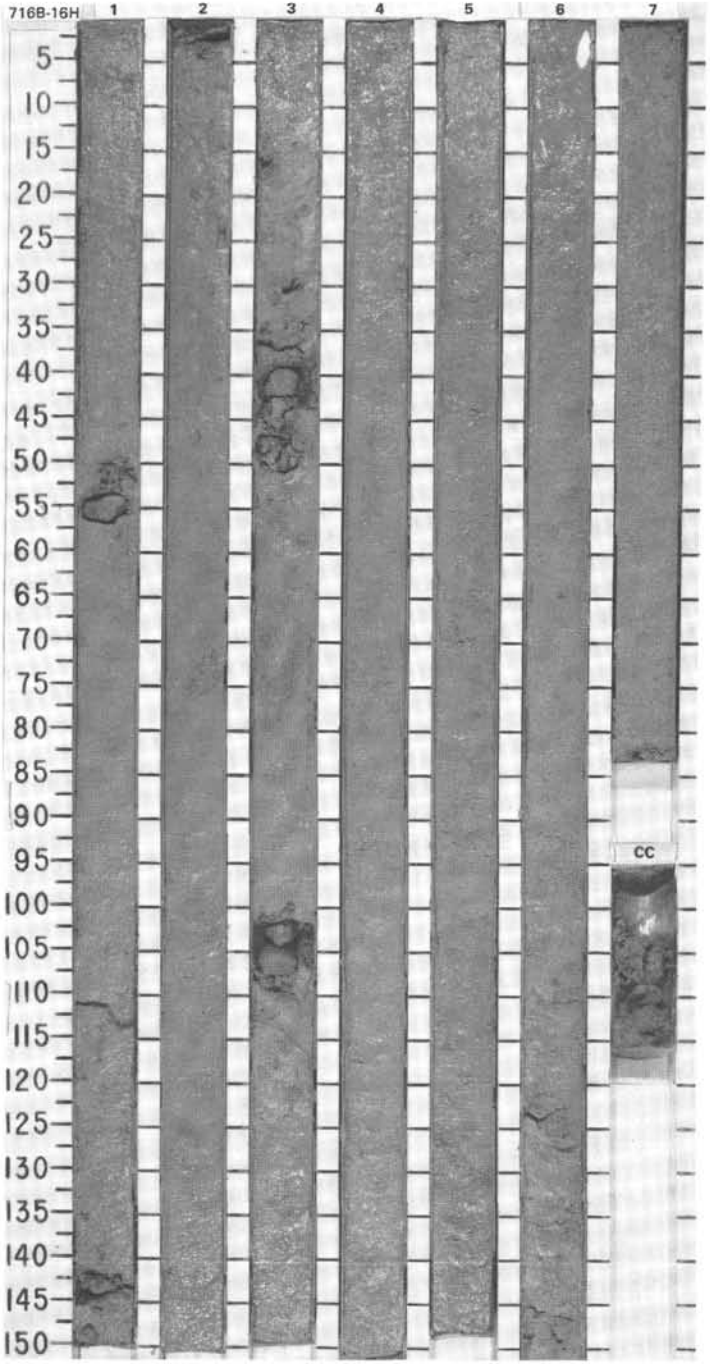
SITE 716 HOLE B CORE 16H CORED INTERVAL 672.2-681.9 mbsl; 138.9-148.6 mbsf



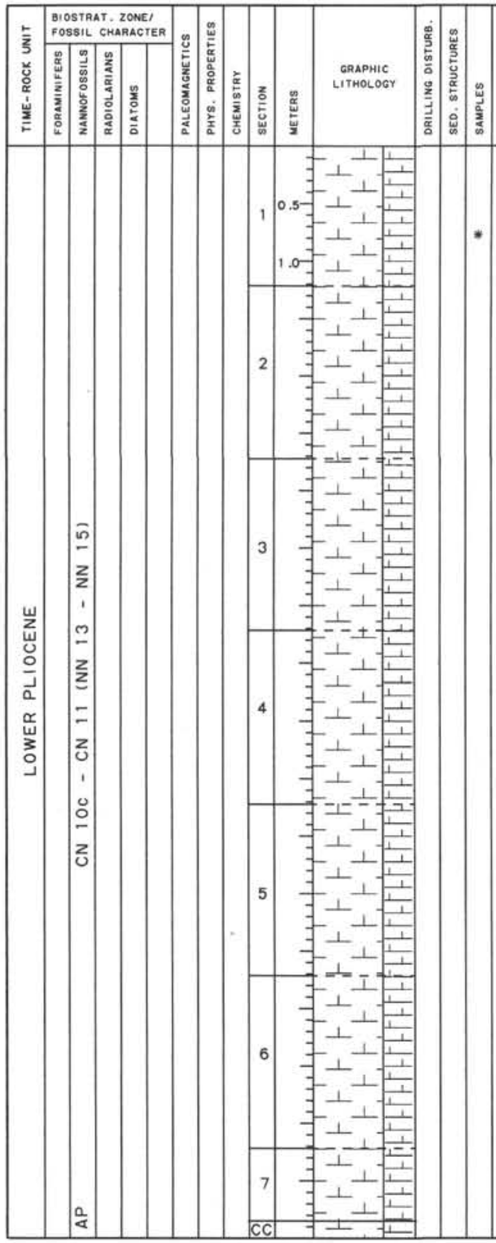
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL OOZE and FORAMINIFER-BEARING CALCAREOUS NANNOFOSSIL CHALK

Major lithologies: Foraminifer-bearing calcareous nannofossil ooze and foraminifer-bearing calcareous nannofossil chalk, pale olive (5Y 6/3), 25% chalk, stiff texture.



SITE 716 HOLE B CORE 17H CORED INTERVAL 681.9-691.6 mbsl; 148.6-158.3 mbsf



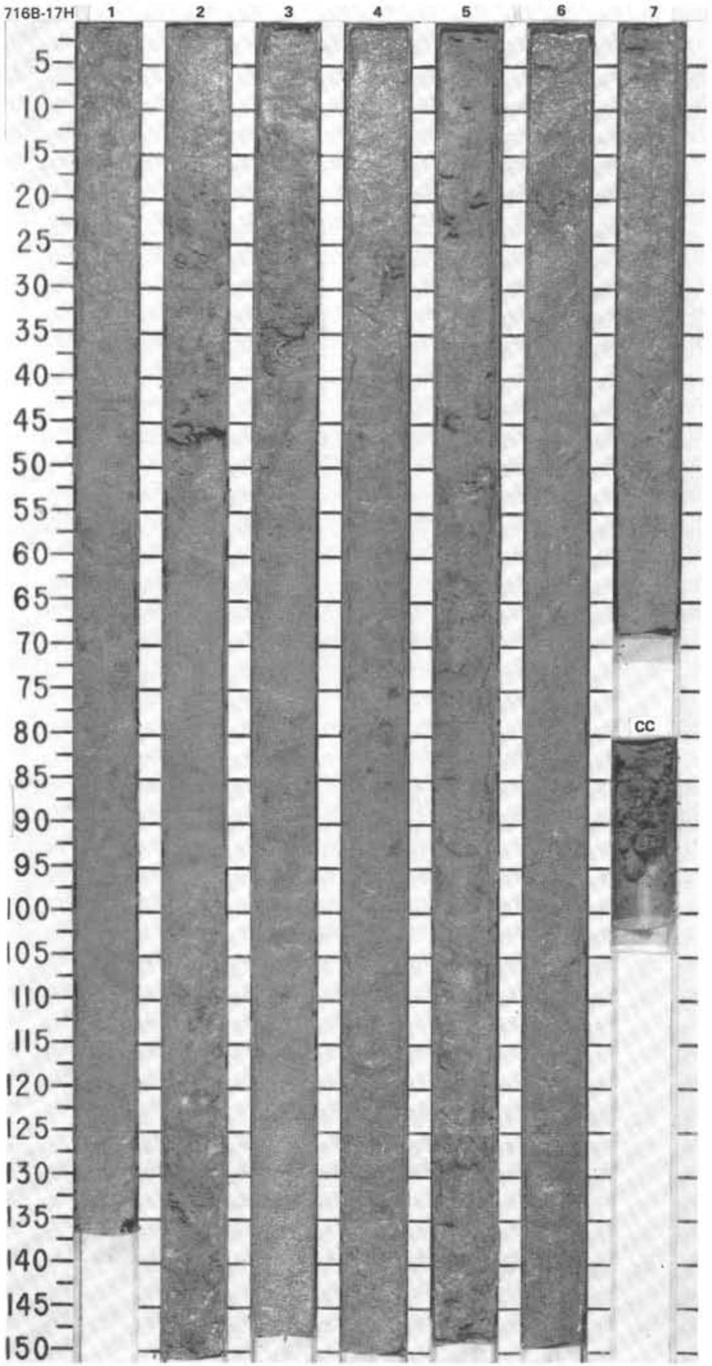
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

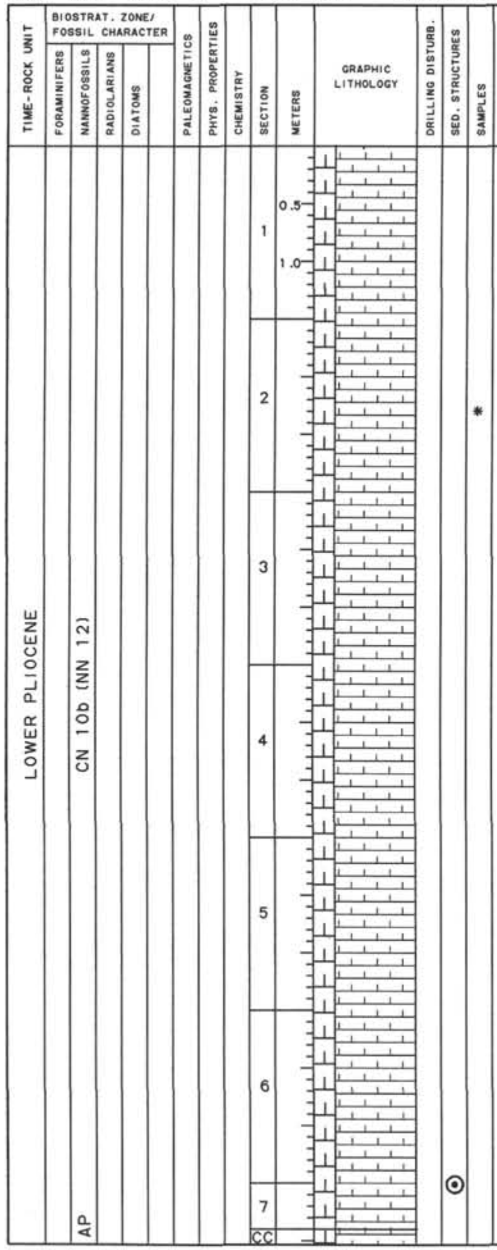
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3), 30% chalk, homogeneous, strong hydrogen sulfide smell, stiff texture.

SMEAR SLIDE SUMMARY (%):

	1, 80 D
TEXTURE:	
Sand	25
Silt	10
Clay	65
COMPOSITION:	
Quartz	Tr
Clay	5
Foraminifers	15
Nannofossils	40
Bioclasts	4
Micrite	35
Aragonite needles	1



SITE 716 HOLE B CORE 18H CORED INTERVAL 691.6-701.2 mbsl; 158.3-167.9 mbsf



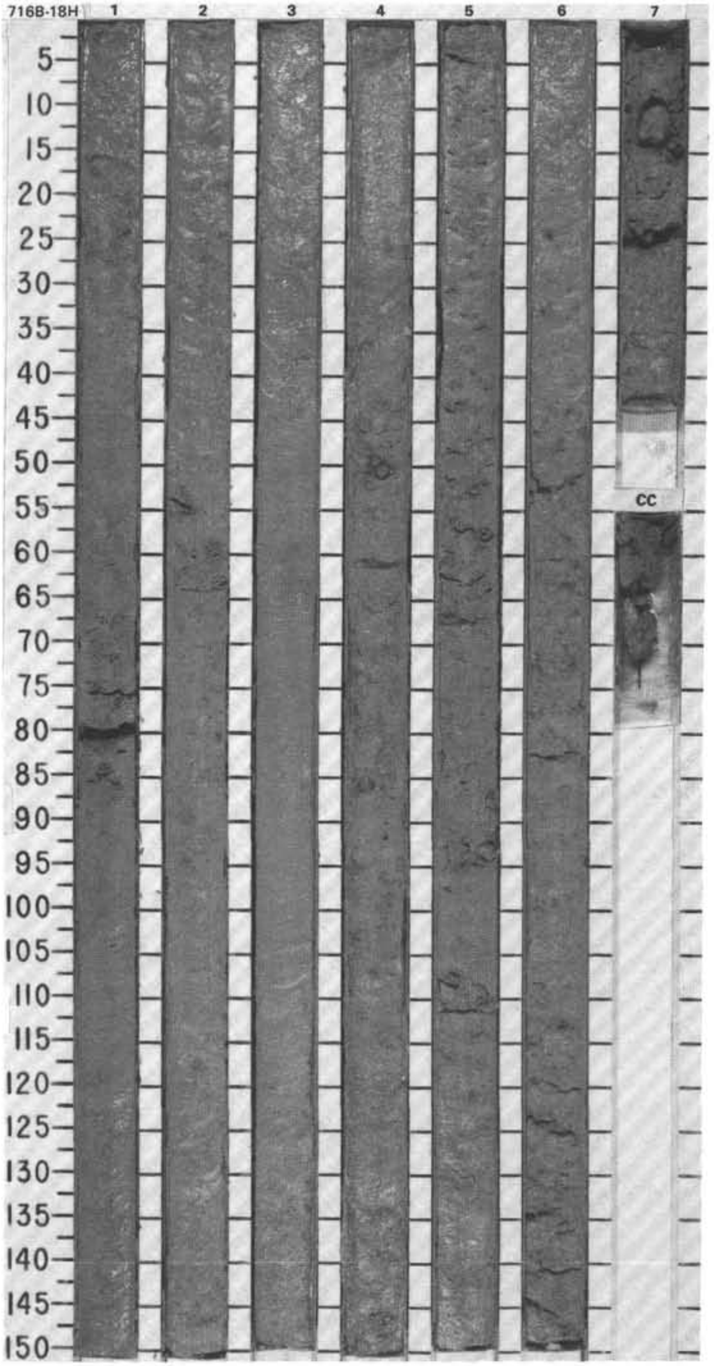
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3), 30% chalk, homogeneous, strong hydrogen sulfide smell, stiff texture.

SMEAR SLIDE SUMMARY (%):

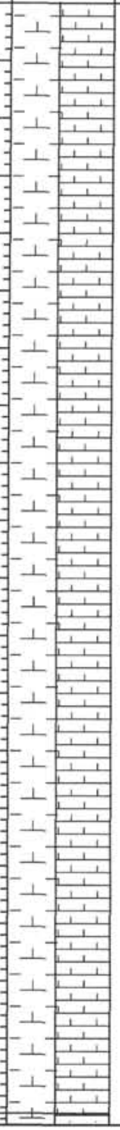
	2, 80 D
TEXTURE:	
Sand	15
Clay	85
COMPOSITION:	
Foraminifers	15
Nannofossils	85
Fish remains	Tr



SITE 716 HOLE B CORE 19H CORED INTERVAL 701.2-710.8 mbsl; 167.9-177.5 mbsf

TIME-ROCK UNIT	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	PALEOMAGNETICS	PHYS. PROPERTIES	CHEMISTRY	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURB.	SED. STRUCTURES	SAMPLES
LOWER PLIOCENE		CN 10b (NN 12) AP						1 2 3 4 5 6 7 CC	0.5 1.0				*

BIOSTRAT. ZONE/ FOSSIL CHARACTER



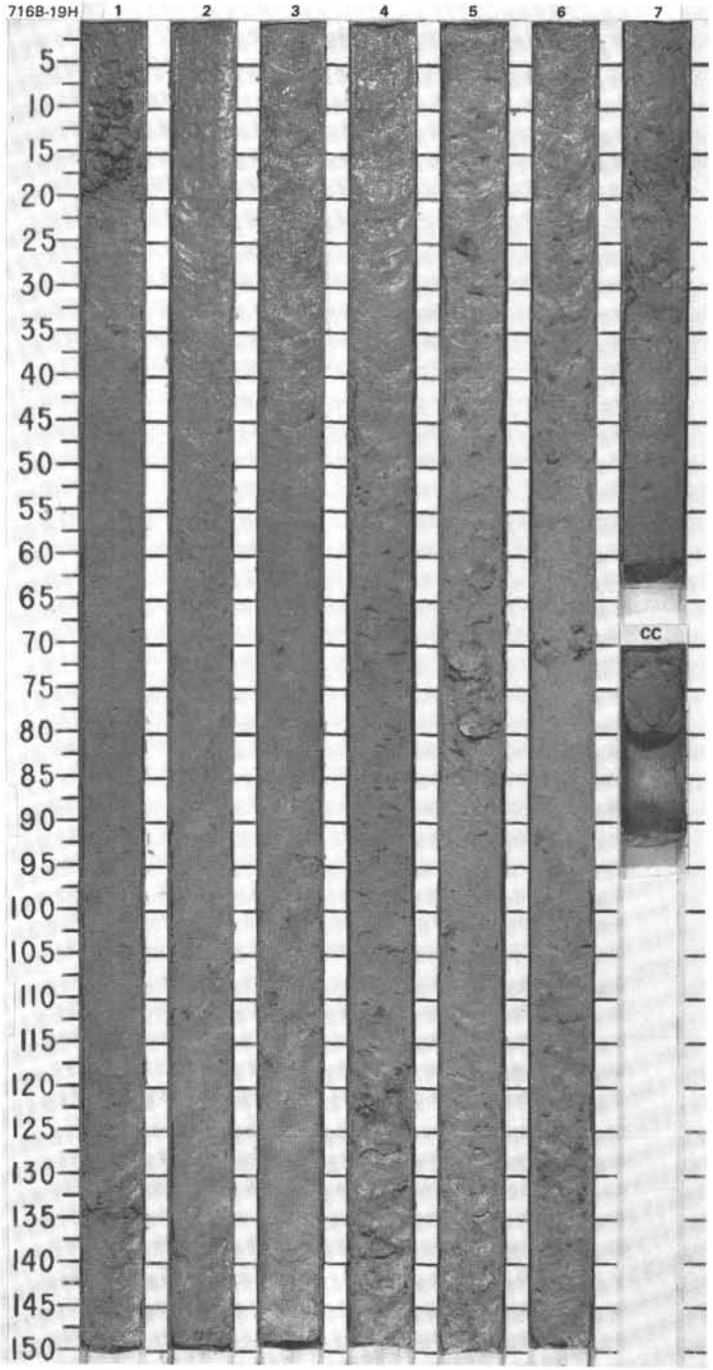
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

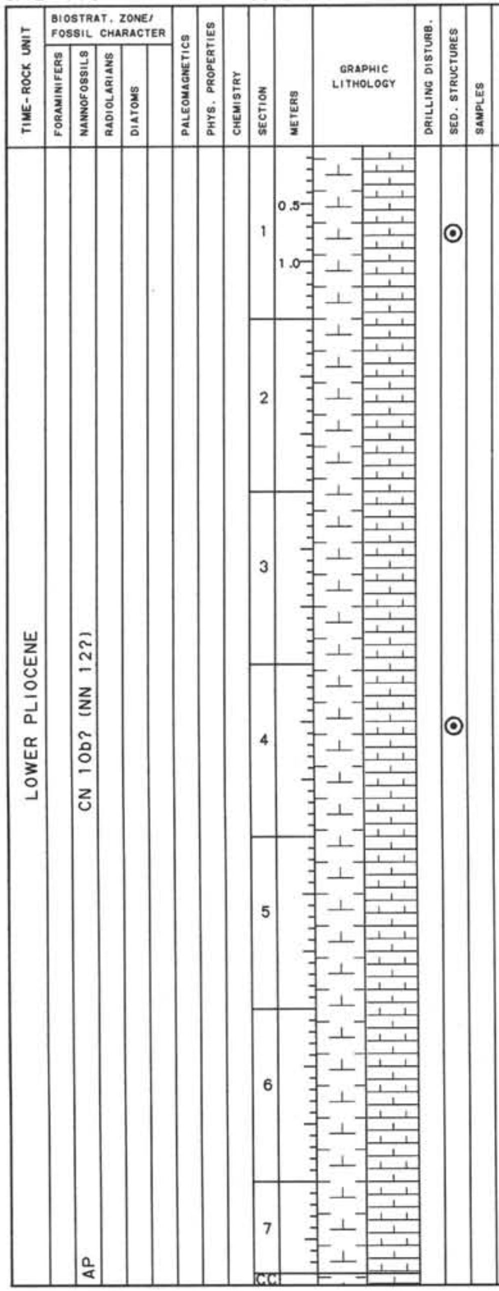
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3), 50% chalk, homogeneous, strong hydrogen sulfide smell, stiff texture.

SMEAR SLIDE SUMMARY (%):

	1, 80 D
TEXTURE:	
Sand	25
Silt	15
Clay	60
COMPOSITION:	
Quartz	Tr
Clay	8
Volcanic glass	2
Foraminifers	20
Nannofossils	65
Mollusk debris	5



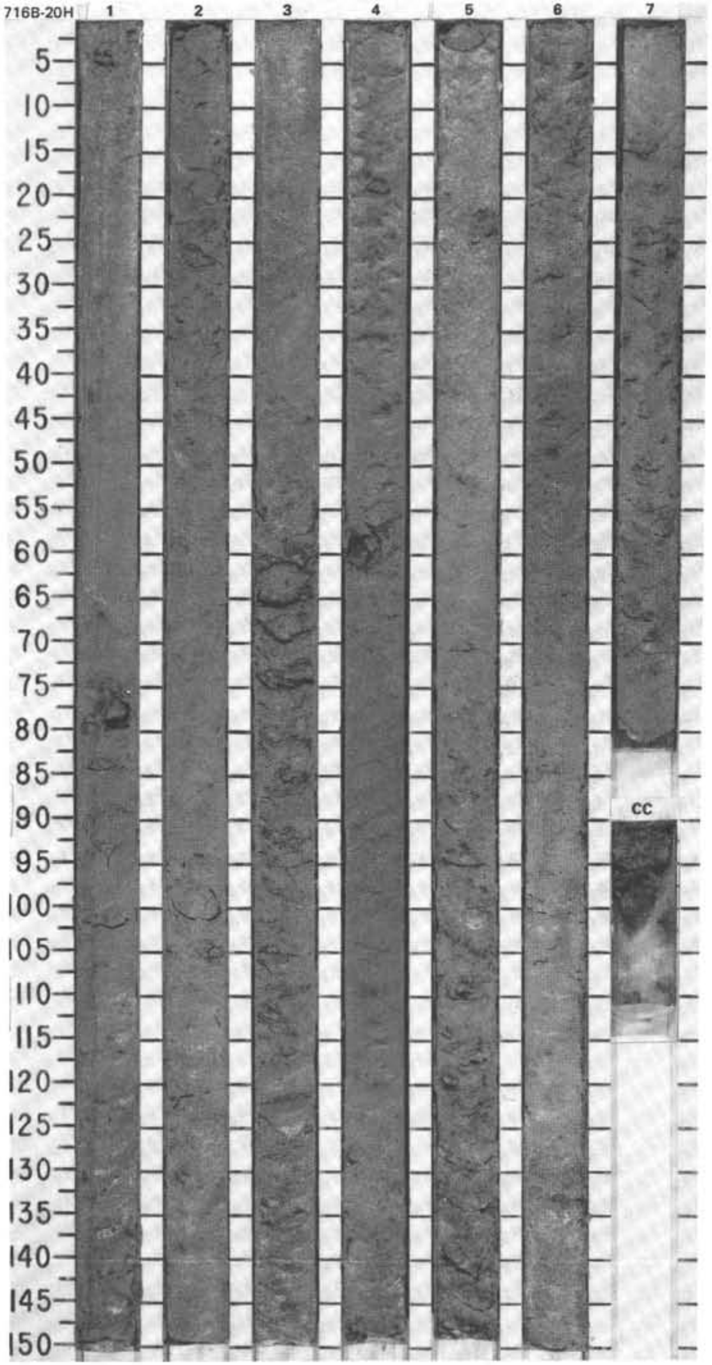
SITE 716 HOLE B CORE 20H CORED INTERVAL 710.8-720.5 mbsl; 177.5-187.2 mbsf



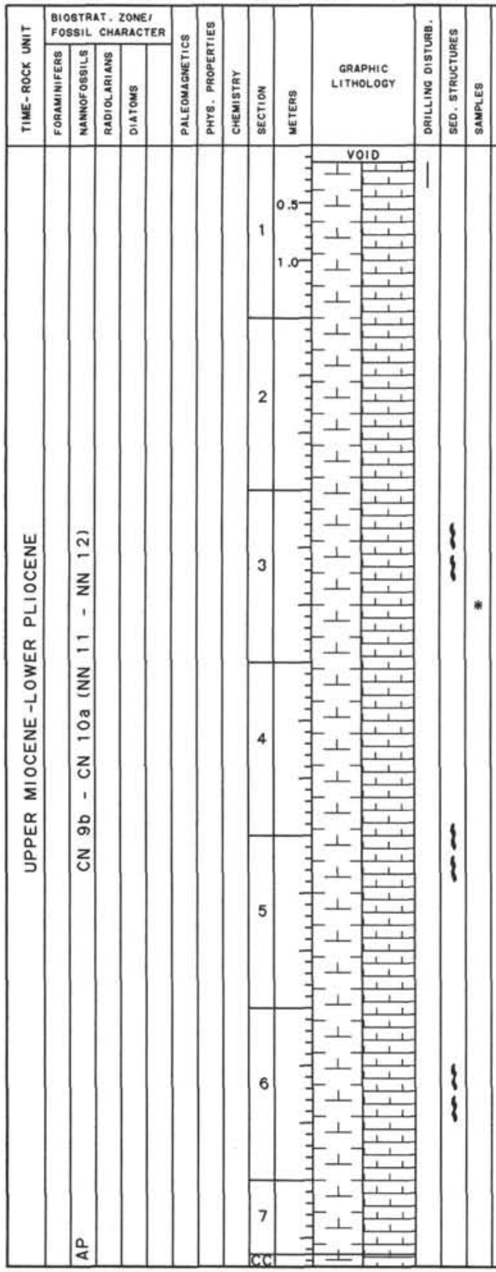
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL CHALK and FORAMINIFER-BEARING NANNOFOSSIL OOZE

Major lithologies: Foraminifer-bearing nannofossil chalk and foraminifer-bearing nannofossil ooze, pale olive (5Y 6/3), 50% chalk, homogeneous; celestite nodule, Section 4, 58 cm.



SITE 716 HOLE B CORE 21H CORED INTERVAL 720.5-730.2 mbsl; 187.2-196.9 mbsf



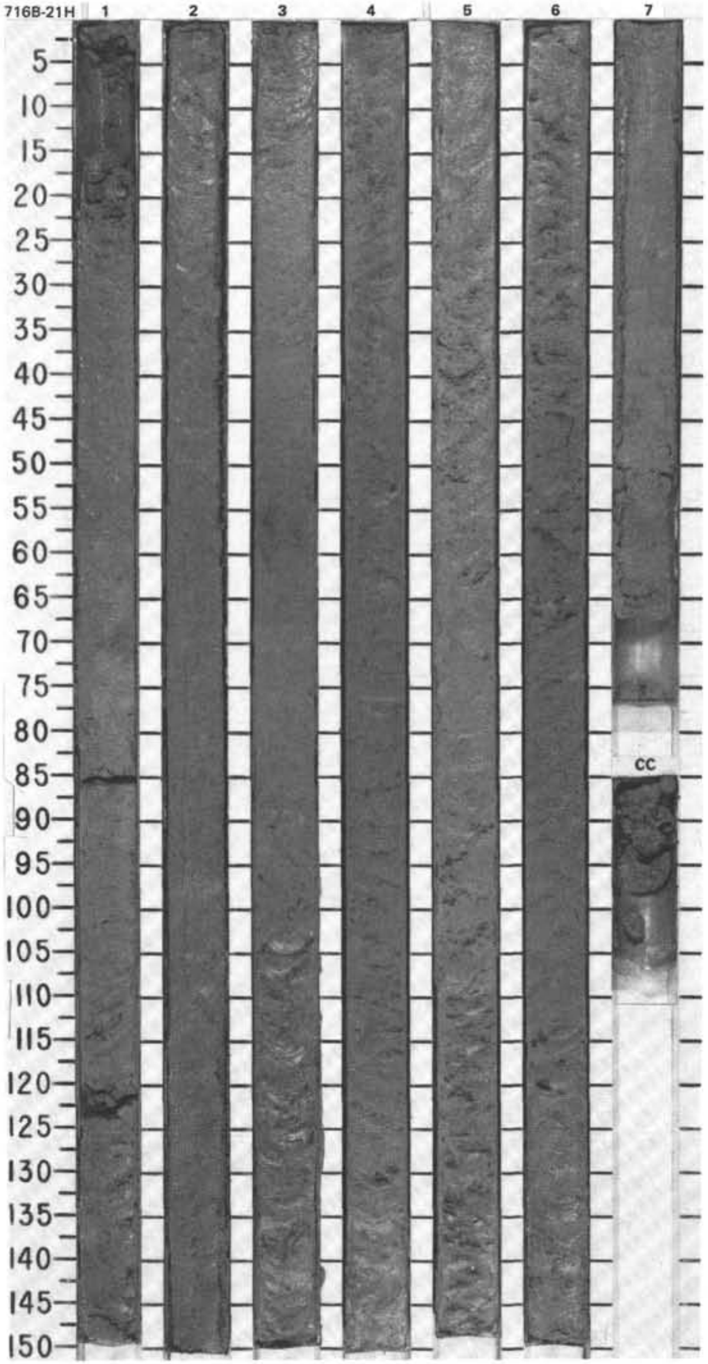
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

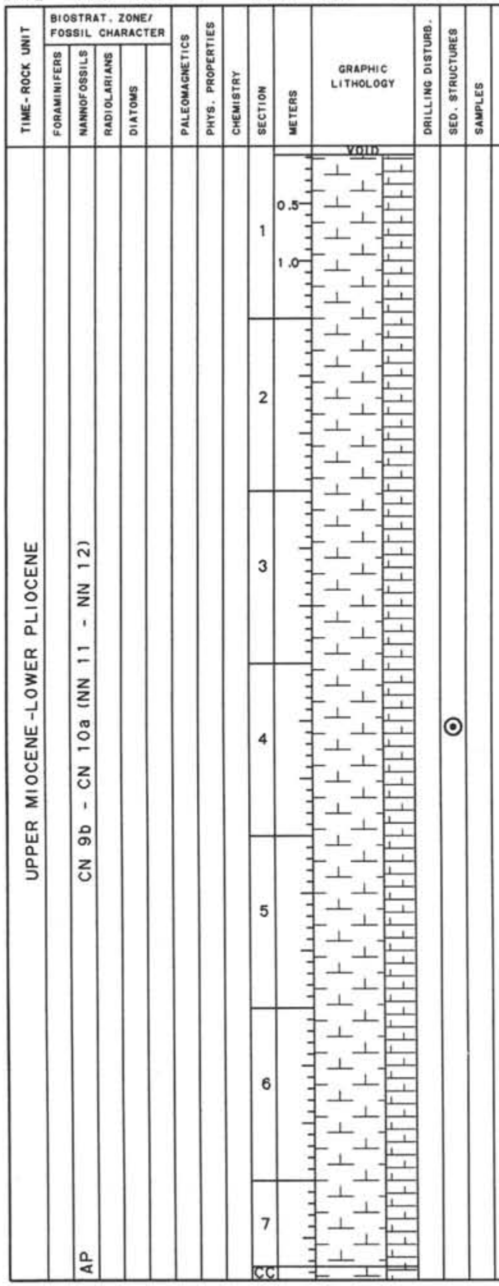
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3), 45% chalk, homogeneous, minor bioturbation.

SMEAR SLIDE SUMMARY (%):

	3, 80 D
COMPOSITION:	
Quartz	Tr
Clay	5
Volcanic glass	Tr
Foraminifers	20
Nannofossils	61
Bioclasts	8
Micrite	5
Aragonite needles	1



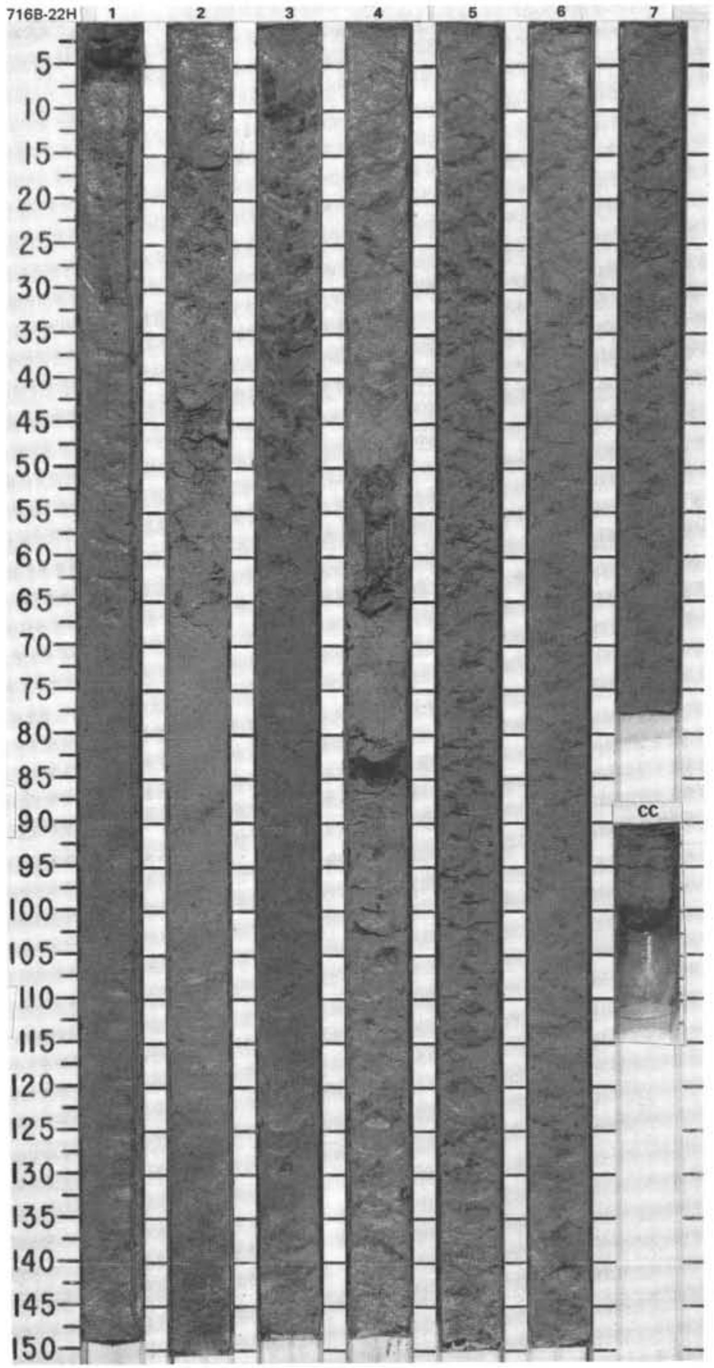
SITE 716 HOLE B CORE 22H CORED INTERVAL 730.2-739.8 mbsl; 196.9-206.5 mbsf



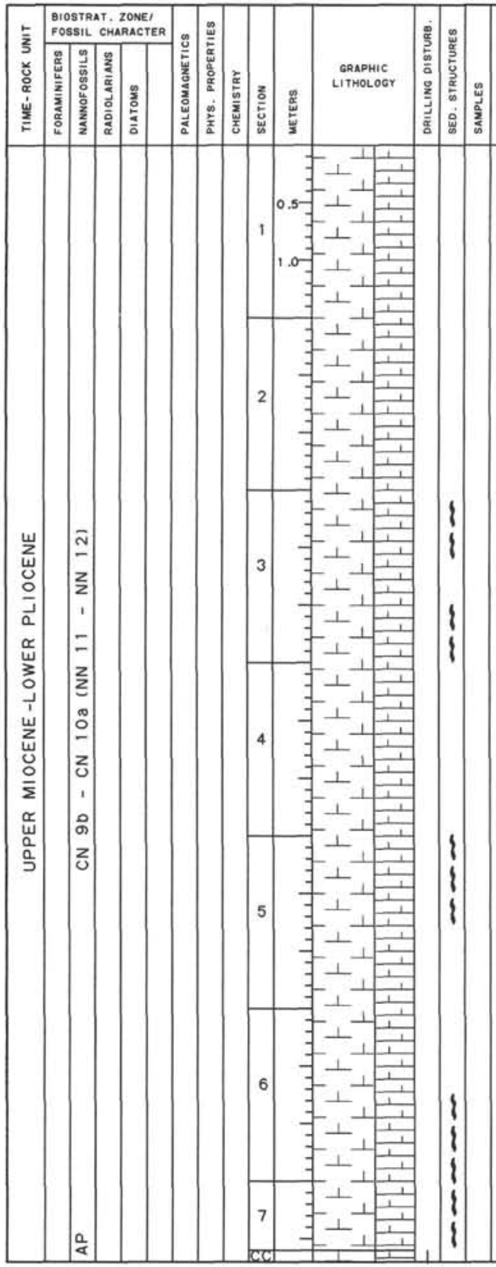
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3), 30% chalk, homogeneous.



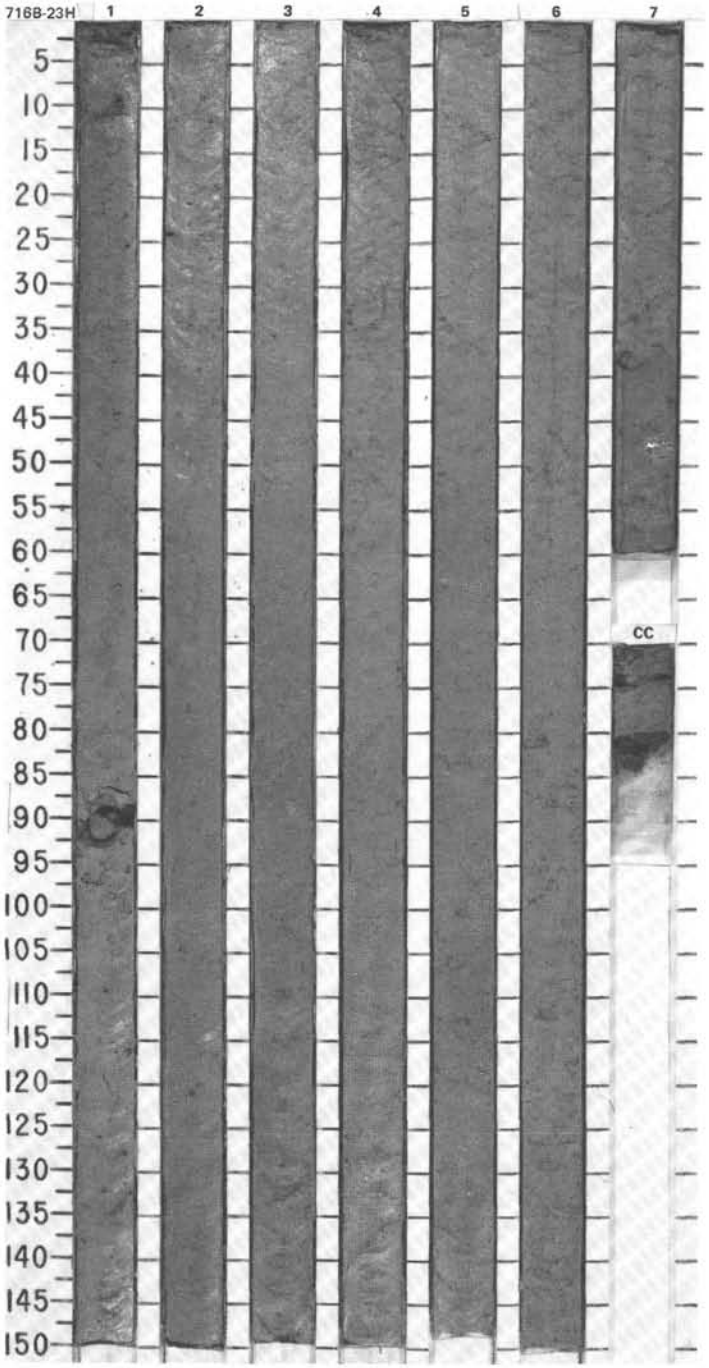
SITE 716 HOLE B CORE 23H CORED INTERVAL 739.8-749.4 mbsl; 206.5-216.1 mbsf



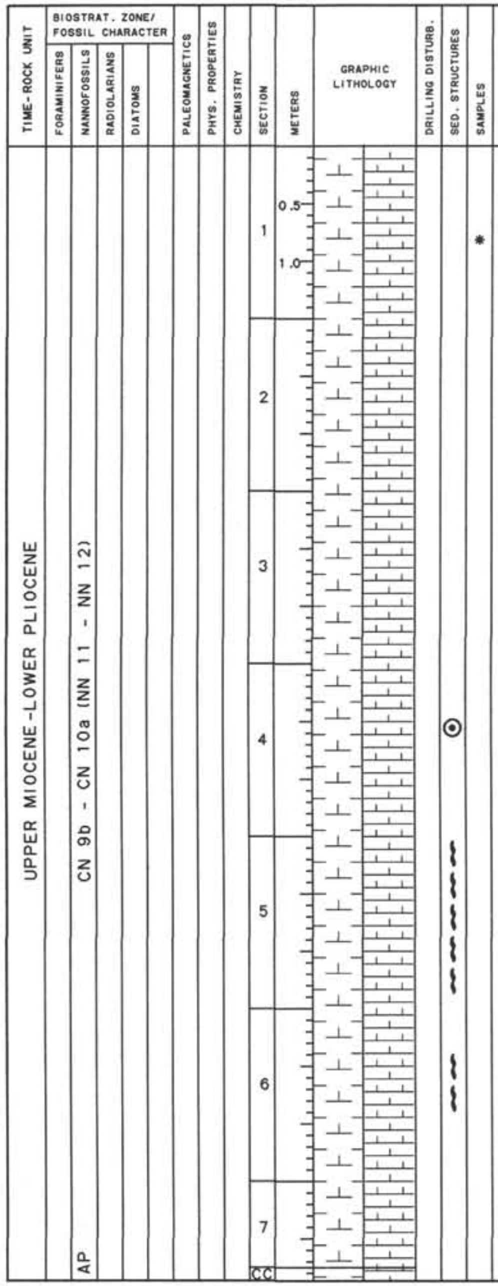
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3) and olive (5Y 5/3), 40% chalk, homogeneous.



SITE 716 HOLE B CORE 24H CORED INTERVAL 749.4-759.1 mbsl; 216.1-225.8 mbsf



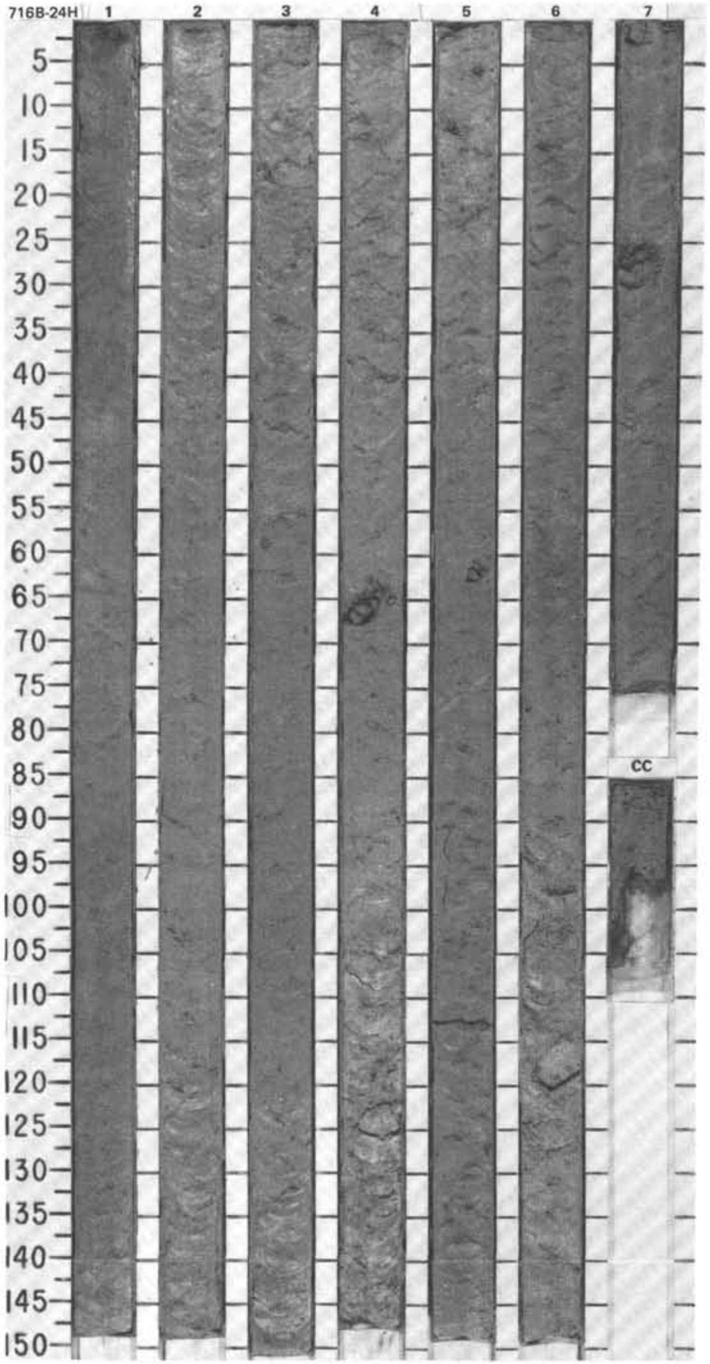
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

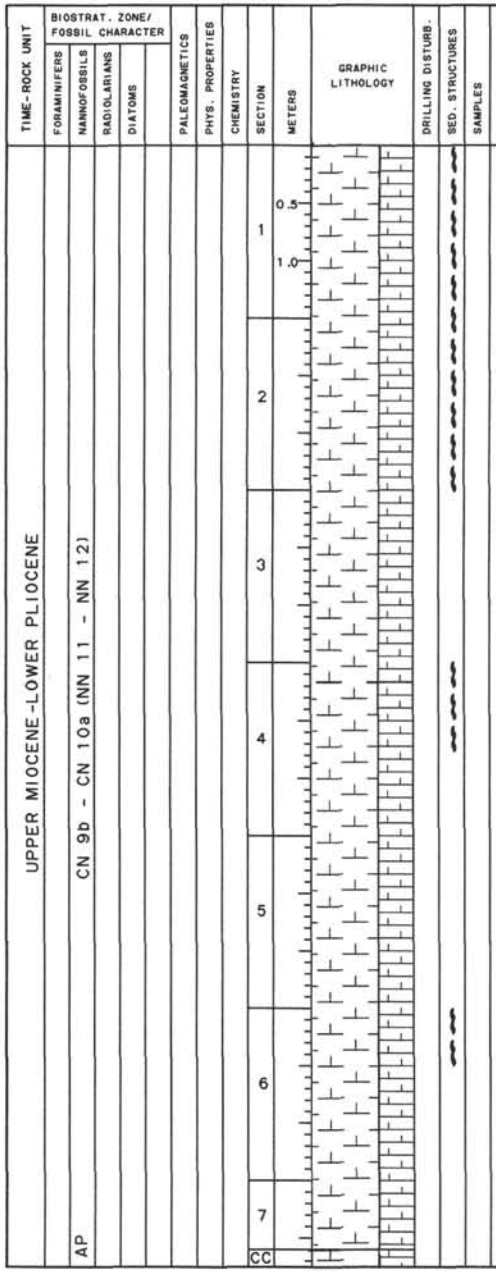
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3) and light gray (5Y 7/2), 45% chalk, homogeneous, hydrogen sulfide smell; celestite nodule, Section 4, 65 cm; minor bioturbation and subtle color changes.

SMEAR SLIDE SUMMARY (%):

	1, 80 D
COMPOSITION:	
Volcanic glass	Tr
Foraminifers	15
Nannofossils	75
Bioclasts	10



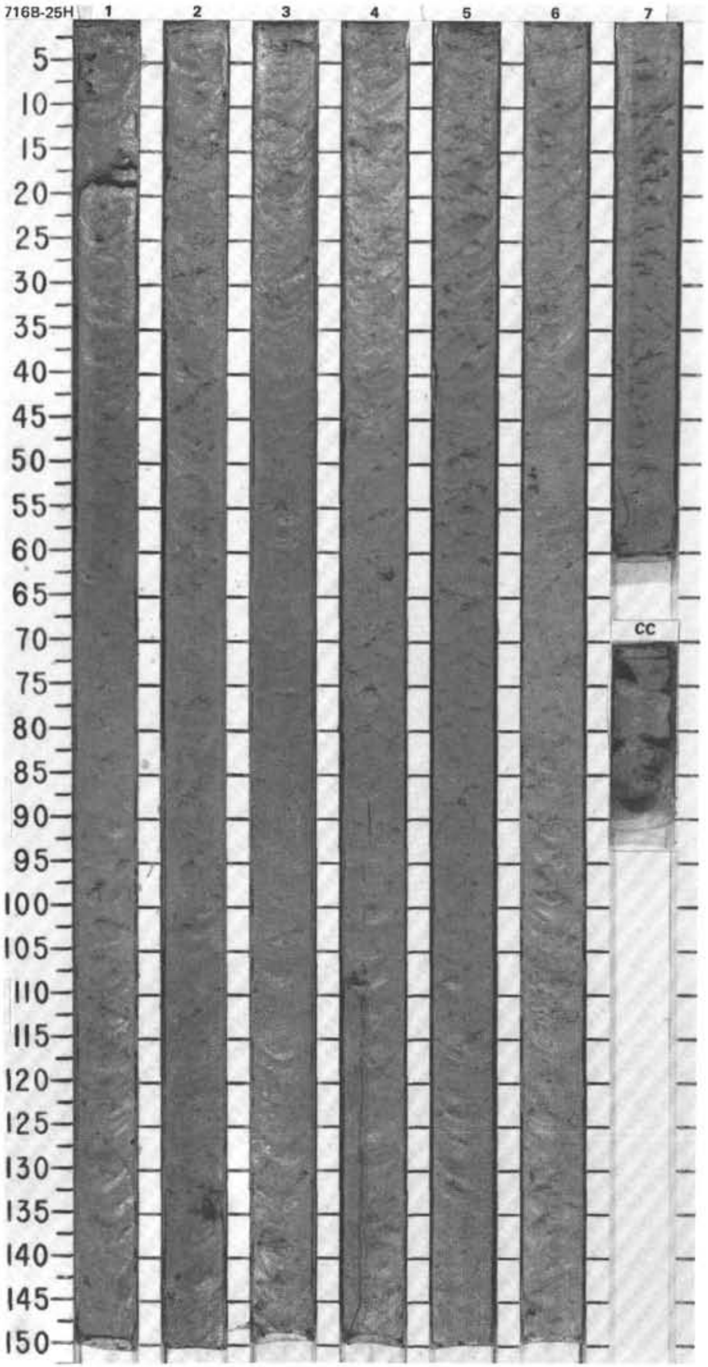
SITE 716 HOLE B CORE 25H CORED INTERVAL 759.1-768.8 mbsl; 225.8-235.5 mbsf



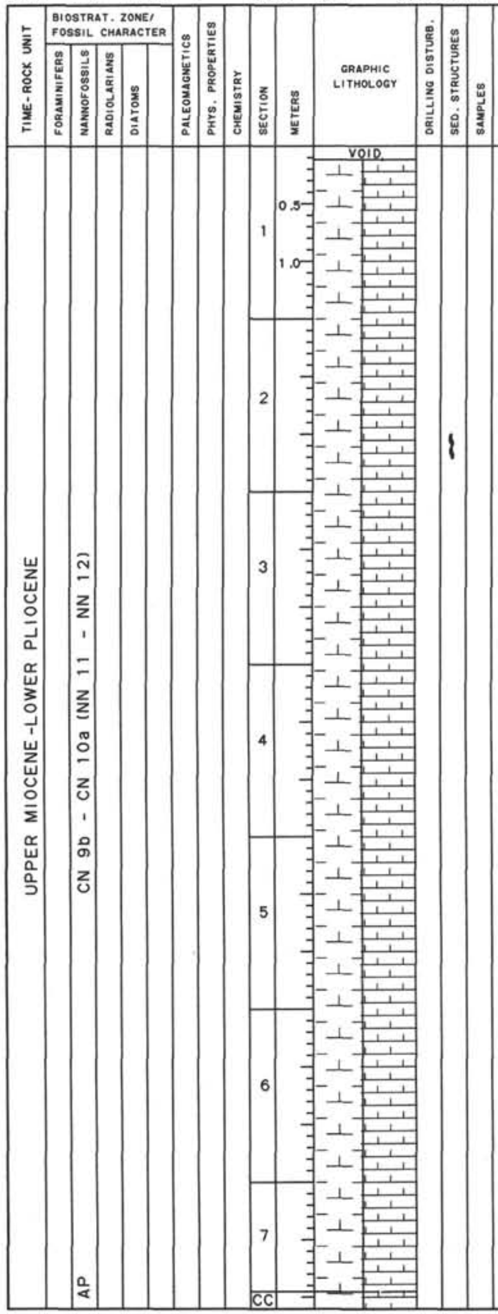
LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3) and pale olive gray (5Y 6/2), 30% chalk, homogeneous, minor bioturbation, subtle color changes.



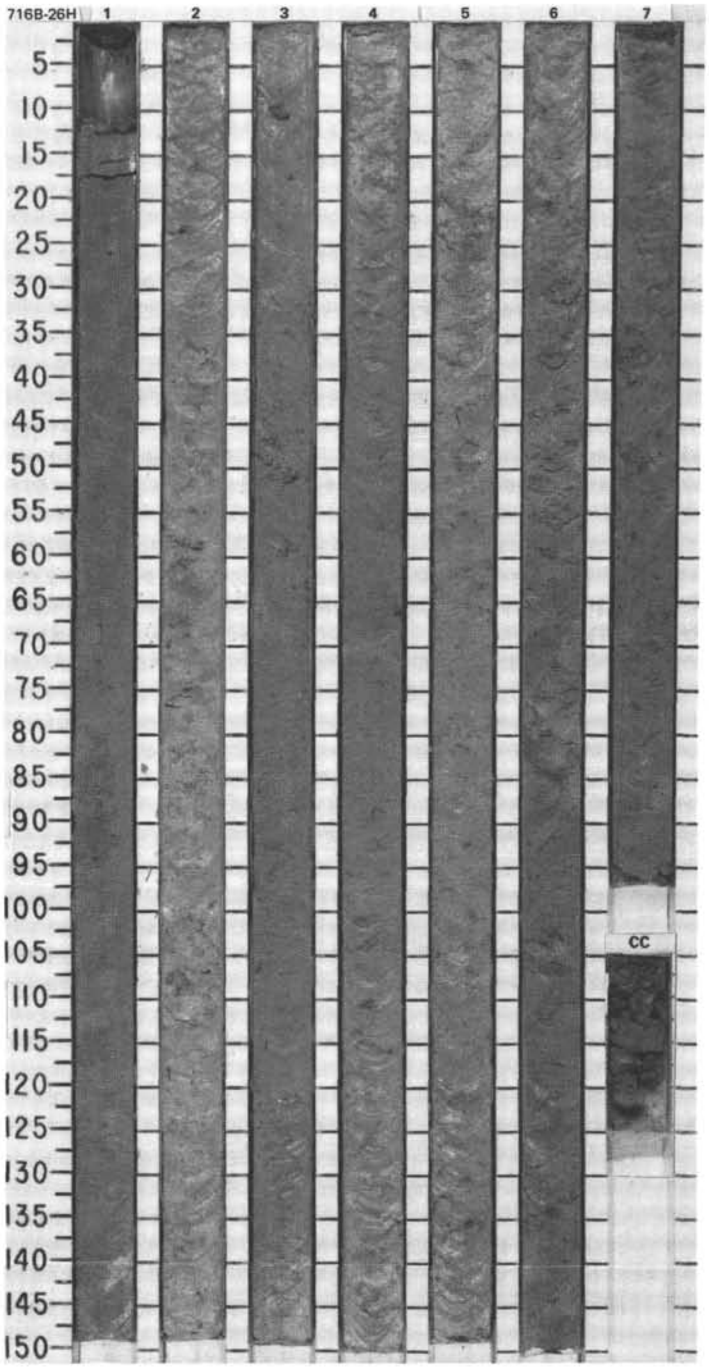
SITE 716 HOLE B CORE 26H CORED INTERVAL 768.8-778.4 mbsl; 235.5-245.1 mbsf



LITHOLOGIC DESCRIPTION

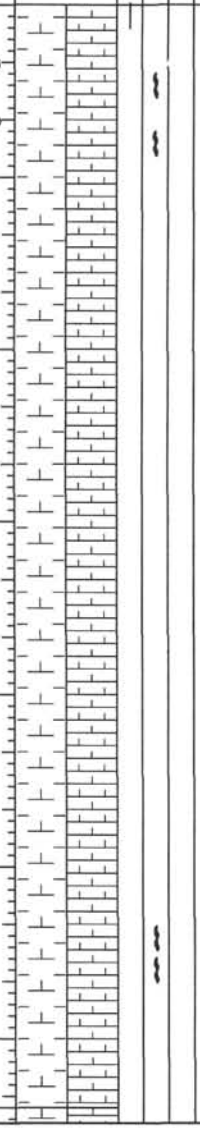
FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK

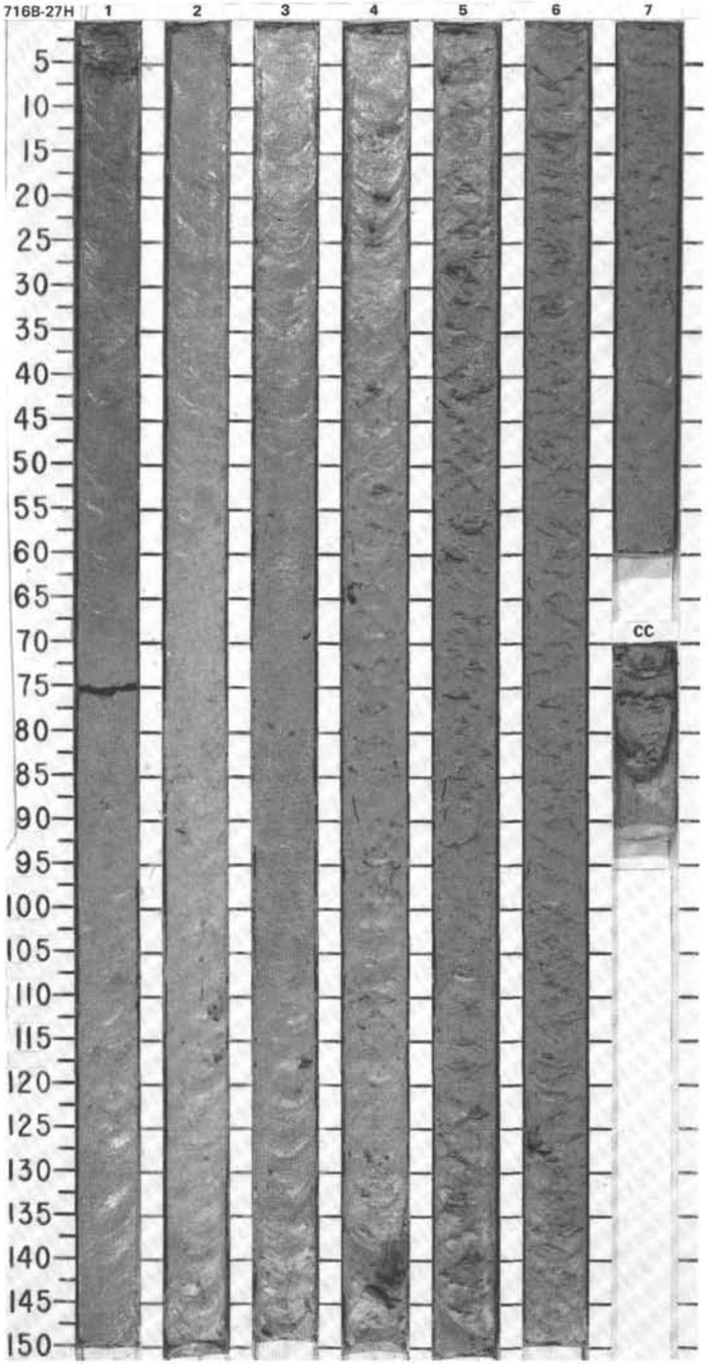
Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3) and light gray (5Y 7/2), 50% chalk, homogeneous, minor bioturbation, subtle color changes.



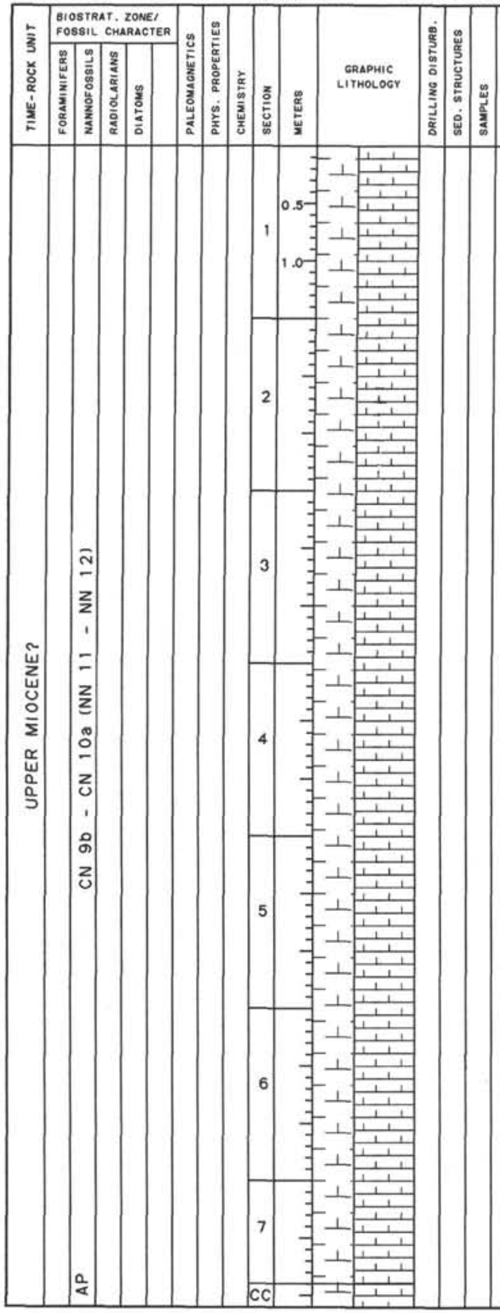
SITE 716 HOLE B CORE 27H CORED INTERVAL 778.4-788.0 mbsl; 245.1-254.7 mbsf

TIME-ROCK UNIT	BIOSTRAT. ZONE/ FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	PALEOMAGNETICS	PHYS. PROPERTIES	CHEMISTRY	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURB.	SED. STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
UPPER MIOCENE?		CN 9b - CN 10a (NN 11 - NN 12) AP						1 2 3 4 5 6 7 CC	0.5 1.0					FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-BEARING NANNOFOSSIL CHALK Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3), 45% chalk, homogeneous, minor bioturbation.





SITE 716 HOLE B CORE 28H CORED INTERVAL 788.0-797.7 mbsl; 254.7-264.4 mbsf



LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL CHALK and FORAMINIFER-BEARING NANNOFOSSIL OOZE

Major lithologies: Foraminifer-bearing nannofossil ooze and foraminifer-bearing nannofossil chalk, pale olive (5Y 6/3) and light gray (5Y 7/2), 60% chalk, homogeneous, subtle color changes.