8. SITE 663[1]

Shipboard Scientific Party[2]

HOLE 663A

Date occupied: 26 March 1986, 1730 UTC

Date departed: 27 March 1986, 1345 UTC

Time on hole: 20.25 hr

Position: 1°11.87′S, 11°52.71′W

Water depth (sea level; corrected m, echo-sounding): 3706

Water depth (rig floor; corrected m, echo-sounding): 3716.5

Bottom felt (rig floor; m, drill pipe measurement): 3708.1

Distance between rig floor and sea level (m): 10.5

Total depth (rig floor, m): 3855.3

Penetration (m): 147.2

Number of cores (including cores with no recovery): 16

Total length of cored section (m): 147.2

Total core recovered (m): 119

Core recovery (%): 80.8

Oldest sediment cored:
Depth (mbsf): 147.2
Nature: calcareous nannofossil ooze
Age: late Pliocene (2.7 Ma)

HOLE 663B

Date occupied: 27 March 1986, 1345 UTC

Date departed: 28 March 1986, 0945 UTC

Time on hole: 20.0 hr

Position: 1°11.87′S, 11°52.71′W

Water depth (sea level; corrected m, echo-sounding): 3706

Water depth (rig floor; corrected m, echo-sounding): 3716.5

Bottom felt (rig floor; m, drill pipe measurement): 3707.9

Distance between rig floor and sea level (m): 10.5

Total depth (rig floor, m): 3859.9

Penetration (m): 152.0

Number of cores (including cores with no recovery): 16

Total length of cored section (m): 152.0

Total core recovered (m): 153.5

Core recovery (%): 101.0

Oldest sediment cored:
Depth (mbsf): 152.0
Nature: calcareous nannofossil ooze
Age: late Pliocene (2.7 Ma)

Principal results: Site 663 is located in the eastern equatorial Atlantic at 1°11.87′S, 11°52.71′W at a water depth of 3697.6 m on the upper eastern flank of the mid-Atlantic Ridge just south of the Romanche Fracture Zone (see "Background and Scientific Objectives" section, this chapter). This site is situated in a sediment pond with approximately 0.35 s of moderately reflective acoustic layering in a region characterized predominantly by outcropping basement (see "Background and Scientific Objectives" section, this chapter). Our primary objective at this site, as at companion Site 662, was to obtain late Neogene records of the equatorial divergence, advection of the Benguela Current, and eolian sedimentation.

From Holes 663A and 663B, we recovered a total of 32 advanced piston corer (APC) cores to depths of 147.2 and 152.0 meters below seafloor (mbsf), respectively. Both holes were cored continuously. Recovery averaged 80.8% in Hole 663A and 101.0% in Hole 663B.

The entire section cored (0–152.0 mbsf) is one lithologic unit composed of nannofossil and foraminifer-nannofossil oozes of late Pliocene and Pleistocene age. Secondary components include clay, diatoms, and radiolarians.

This lithologic unit includes five slump layers (Fig. 1) at depths of 32.5–38.0, 42.7–44.3, 63.0–72.5, 79.0–98.5, and 119.8–129.0 mbsf. In addition, lesser deformation (minor tilting) characterizes layers at 44.3–47.5 and 59.3–63.0 mbsf.

Although a usable paleomagnetic stratigraphy could not be obtained at Site 663, the nannofossil and planktonic-foraminifer biostratigraphy provided several well-dated datum levels that constrain the age-depth curve (see "Sediment-Accumulation Rates" section, this chapter). Preservation of calcareous fossils is generally good; preservation of diatoms is moderate to poor. The depositional rate of pelagic sediments ranges from about 32 m/m.y. in the uppermost pelagic section to about 40 m/m.y. in the lower two pelagic units ("Sediment-Accumulation Rates" section, this chapter). If slumps and badly disturbed sediments are removed, the intervening pelagic sections also appear to have been deposited at rates in the range of 32 to 40 m/m.y. ("Sediment-Accumulation Rates" section, this chapter). As at Site 662, it appears that the slumps at Site 663 were added as extra sediment to rapidly deposited pelagic sediment sections, with little loss to erosion, but with some disturbance of surrounding layers.

Neither magnetic-susceptibility nor *P*-wave measurements were useful for between-hole correlations, so we used carbonate layering from core photographs to make these links. We succeeded in correlating between the holes in the uppermost and two lowermost intervals of

[1] Ruddiman, W., Sarnthein, M., Baldauf, J., et al., 1988. *Proc., Init. Repts. (Pt. A), ODP*, 108.

[2] William Ruddiman (Co-Chief Scientist), Lamont-Doherty Geological Observatory, Palisades, NY 10964; Michael Sarnthein (Co-Chief Scientist), Geologisch-Paläontologisches Institut, Universität Kiel. Olshausenstrasse 40, D-2300 Kiel, Federal Republic of Germany; Jack Baldauf, ODP Staff Scientist, Ocean Drilling Program, Texas A&M University, College Station, TX 77843; Jan Backman, Department of Geology, University of Stockholm, S-106 91 Stockholm, Sweden; Jan Bloemendal, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02882-1197; William Curry, Woods Hole Oceanographic Institution, Woods Hole, MA 02543; Paul Farrimond, School of Chemistry, University of Bristol, Cantocks Close, Bristol BS8 1TS, United Kingdom; Jean Claude Faugeres, Laboratoire de Géologie-Océanographie, Université de Bordeaux I, Avenue des Facultés Talence 33405, France; Thomas Janacek, Lamont-Doherty Geological Observatory, Palisades, NY 10964; Yuzo Katsura, Institute of Geosciences, University of Tsukuba, Ibaraki 305, Japan; Hélène Manivit, Laboratoire de Stratigraphie des Continents et Océans, (UA 319) Université Paris VI, 4 Place Jussieu, 75230 Paris Cedex, France; James Mazzullo, Department of Geology, Texas A&M University, College Station, TX 77843; Jürgen Mienert, Geologisch-Paläontologisches Institut, Universität Kiel, Olshausenstrasse 40, D-2300 Kiel, Federal Republic of Germany, and Woods Hole Oceanographic Institution, Woods Hole, MA 02543; Edward Pokras, Lamont-Doherty Geological Observatory, Palisades, NY 10964; Maureen Raymo, Lamont-Doherty Geological Observatory, Palisades, NY 10964; Peter Schultheiss, Institute of Oceanographic Sciences, Brook Road, Wormley, Godalming, Surrey GU8 5UG, United Kingdom; Rüdiger Stein, Geologisch-Paläontologisches Institut, Universität Giessen, Senckenbergstrasse 3, 6300 Giessen, Federal Republic of Germany; Lisa Tauxe, Scripps Institution of Oceanography, La Jolla, CA 92093; Jean-Pierre Valet, Centre de Faibles Radioactivités, CNRS, Avenue de la Terrasse, 91190 Gif-sur-Yvette, France; Philip Weaver, Institute of Oceanographic Sciences, Brook Road, Wormley, Godalming, Surrey GU8 5UG, United Kingdom; Hisato Yasuda, Department of Geology, Kochi University, Kochi 780, Japan.

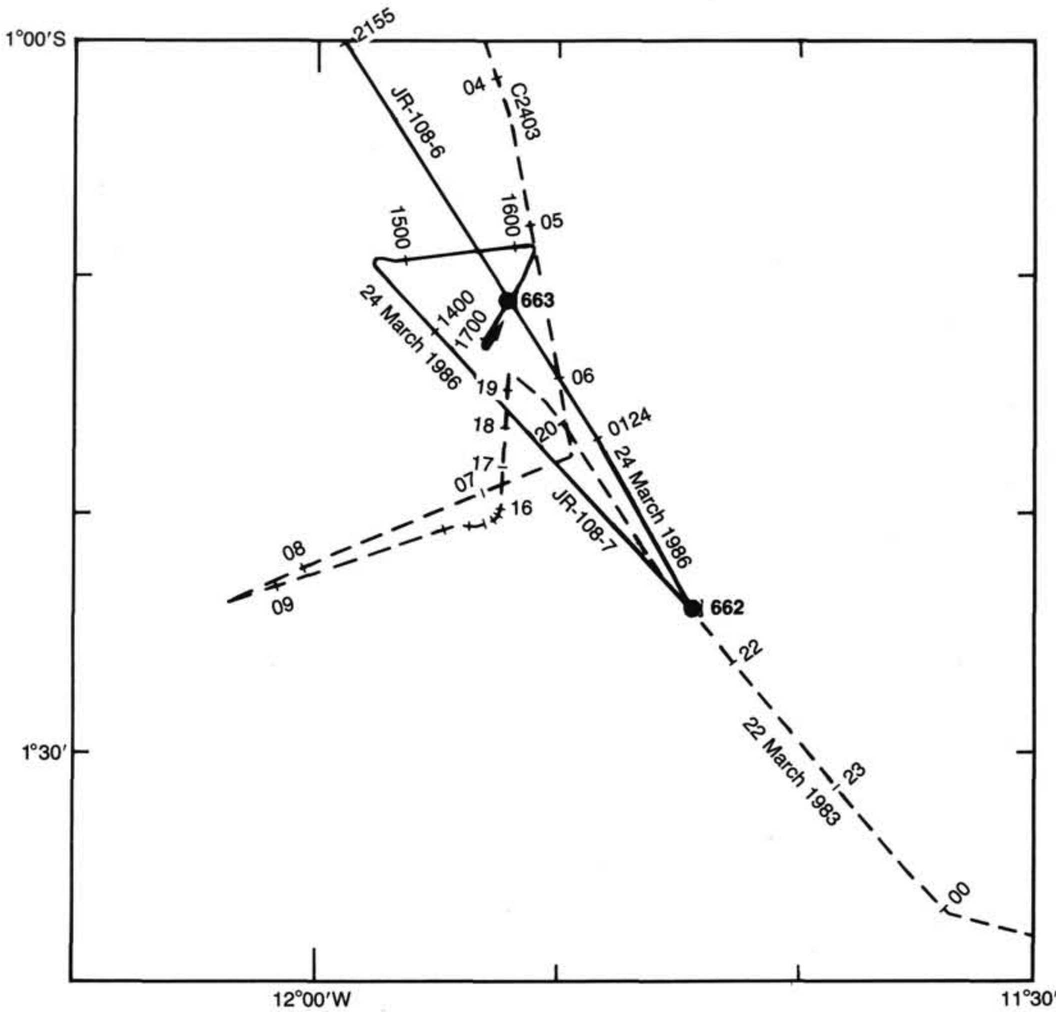

Figure 1. Seismic track lines near Sites 662 and 663.

pelagic deposition (see "Composite-Depth Section," this chapter). This indicates that we have continuous composite-depth sections at Site 663, spanning approximately 0 to 0.95 Ma and 1.75 to 2.6 Ma. Our purpose for drilling at Site 663 was to obtain undisturbed records of intervals interrupted by slumps at Site 662. Combining the sediment records from the two sites, we appear to have obtained a continuous record of the last 3.6 Ma, except possibly for a brief interval around 1.2 Ma that was disturbed by slumps at both sites (see "Composite-Depth Section," this chapter).

As at Site 662, there was an intensification of the amplitude of $CaCO_3$ cycles from the upper Pliocene to the uppermost Pleistocene (see "Inorganic Chemistry" and "Physical Properties" sections, this chapter), with larger percentages of clay and silica and cyclically less carbonate. Because the real $CaCO_3$ signal was hidden by the lower density of shipboard sampling, we were not able to determine whether this increased amplitude was progressive or abrupt, nor when the increased amplitude began. Possible explanations for this change are discussed in the "Site 662" chapter (this volume).

BACKGROUND AND SCIENTIFIC OBJECTIVES

Site 663 was not included in the cruise prospectus, but was added later to Leg 108 cruise operations because of the numerous turbidites and slumps encountered in the upper 100 m at Site 662. Our objectives were identical to those at Site 662 (see "Background and Scientific Objectives" section, Site 662 chapter, this volume), but our major focus was on the upper 150 m of the sediment column (of presumed Pliocene and Pleistocene age) to provide a complementary record for Site 662.

Our major scientific objectives were as follows:

1. To determine the late Neogene history of variations in surface-ocean circulation.
2. To monitor late Neogene variations in African aridity, as indicated by biogenic material and windblown terrigenous dust from the African continent.

Our secondary scientific objectives were the following:

1. To obtain a continuous late Neogene sequence for high-resolution paleomagnetic, biostratigraphic, and stable-isotopic analyses.
2. To obtain a calcareous sequence to monitor late Neogene carbonate dissolution.

Geologic and Topographic Setting

Site 663 is located in the southeastern equatorial Atlantic on the upper eastern flank of the mid-Atlantic Ridge just south of the Romanche Fracture Zone (Fig. 2; see also Fig. 2, "Background and Scientific Objectives" section, Site 662 chapter, this volume). Water-gun records obtained on board *JOIDES Resolution* during our transit to Site 662 had shown small scattered ponds of sediment in an area of outcropping, or thinly covered, basement some 14 nmi northwest of Site 662. As shown in Figure 3, Site 663 was chosen in a part of one of the ponds that ap-

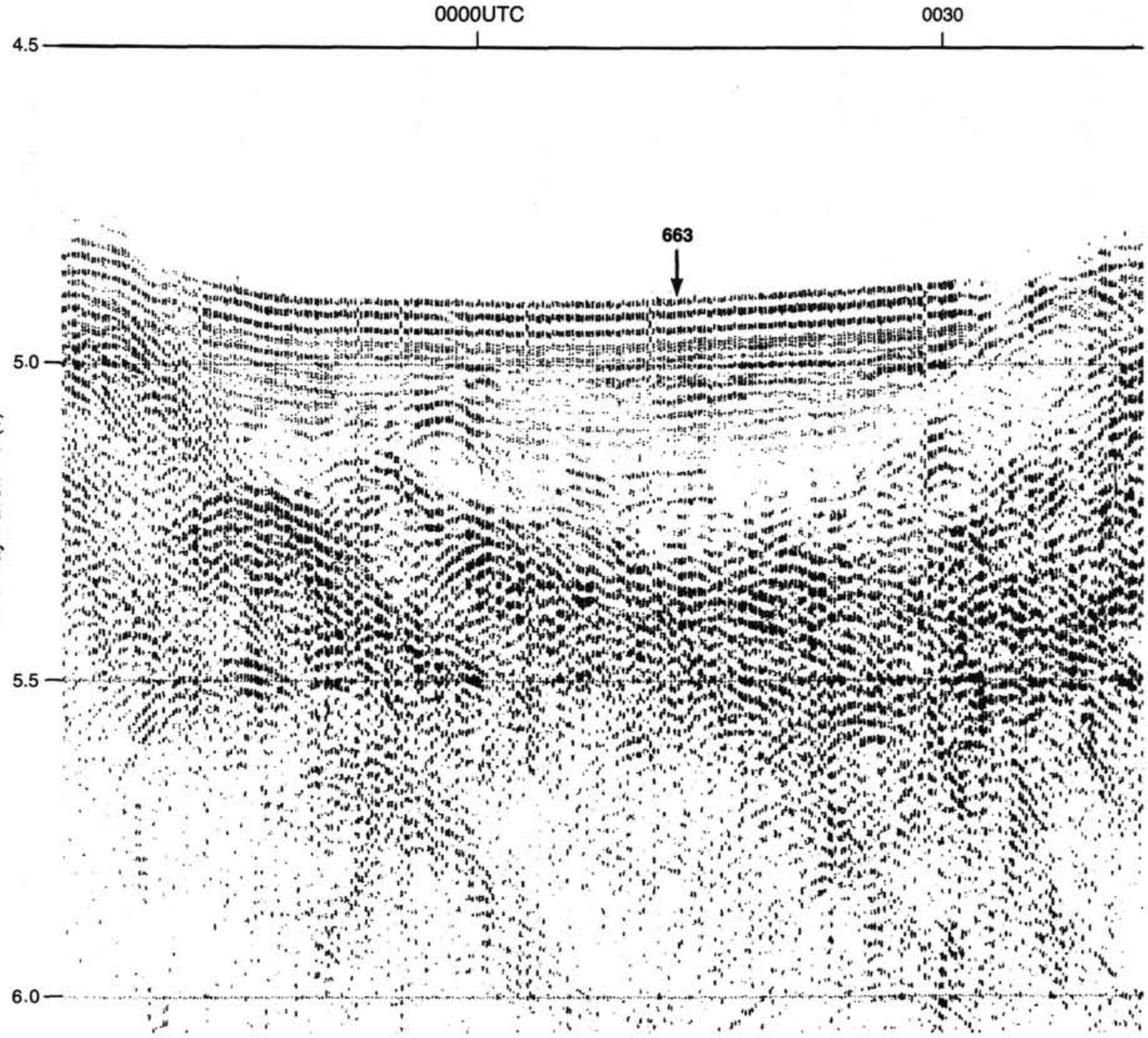

Figure 2. Seismic-reflection record from *JOIDES Resolution* Leg 108, obtained during transit from Site 661 toward Site 662, while crossing the eventual location of Site 663.

peared to minimize possible impacts from the numerous sedimentological complications typical of this region, such as turbidites, slumps, and bottom-current erosion around basement outcrops.

The basement age at Site 663 is late Miocene, inferred from regional magnetic lineations. The anticipated sedimentary section at Site 663 is cyclically alternating upper Miocene to Holocene nannofossil ooze and mud.

OPERATIONS

Departing Site 662, we steamed on a course of 320° at full speed to a way point at 1°14.0′S, 11°53.9′W. Reaching this point at 1330 UTC on 26 March, we slowed to 5.5 kt, streamed out the geophysical gear, including the 80-in.^{3} water guns, and began a detailed survey of the region of Site 663 (Fig. 2), with our gravity positioning system (GPS) in place throughout all but the last 15 min of the operation. The track line of our survey, along with other seismic lines in the area, is shown in Figure 2. (All times are UTC, Universal Time Coordinated, formerly GMT, Greenwich Mean Time.)

With our geophysical gear deployed, we continued along a course of 320° and at 1440 reached a way point at 1°10.0′S, 11°58.0′W. We then turned to a course of 072° and held that course until adjusting to a course of 095° at 1547 at a location of 1°08.9′S, 11°53.0′W. We continued on this course until 1610, when we reached a location of 1°08.9′S, 11°51.3′W and turned to a course of 210°. At 1647, we passed over a region that later would be selected as Site 663, but continued on a course of 210° until 1705, when we reached a turning point at 1°13.1′S, 11°53.2′W.

At this point, with GPS positioning scheduled to be lost within 35 min, we chose a location for Site 663, turned 180° to a course of 030°, and headed back along our own track line to the site. The GPS went down about 15 min before we reached the site location, but dead reckoning and a match of our seismic lines indicated that we had reached our desired location (later fixed by satellites at 1°11.87′S, 11°52.71′W).

We dropped a beacon at 1725, pulled in our geophysical gear, and returned to our station. We stopped over the beacon at 1730 and began running drill pipe into Hole 663A. We finished running drill pipe in by 2330, and the first APC core (108-663A-1H) came on deck at 0030 on 27 March (Table 1). We continued APC coring to the complete penetration depth of Hole 663A (147.2 mbsf). The last APC core (108-663A-16H) came on deck at 1235. Total recovery for Hole 663A was 80.8%, with two cores (108-663A-5H and -663A-7H) recovering nothing, appar-

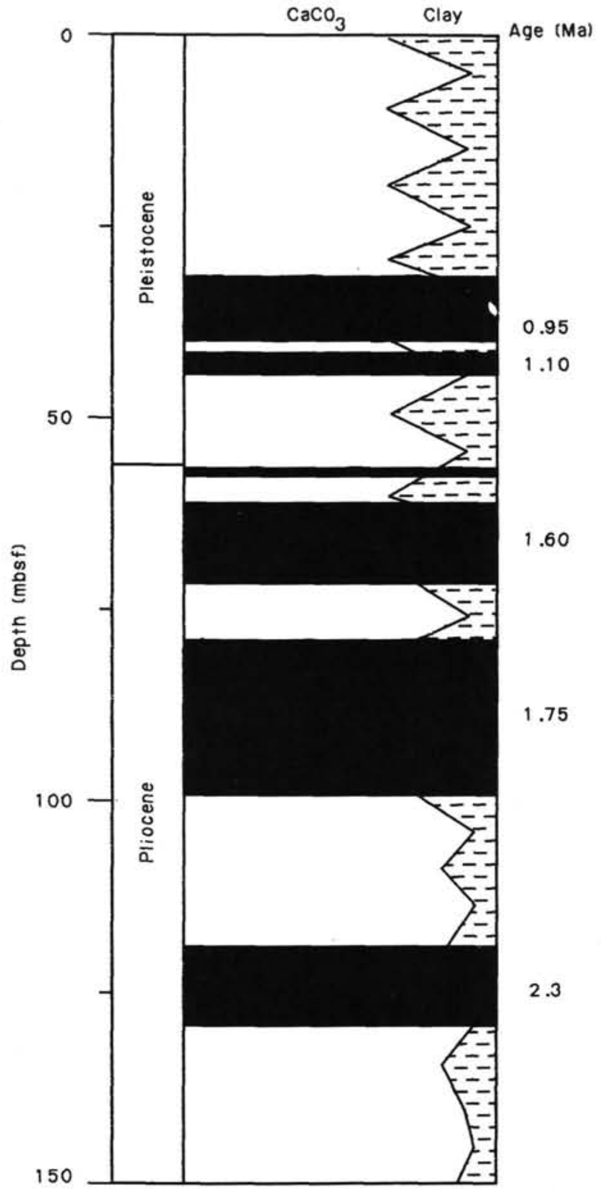

Figure 3. Lithostratigraphic and biostratigraphic summary of Site 663. Black layers are gravity-flow mass deposits (mostly slumps); remainder of section is pelagic-nannofossil ooze. Schematic representation of $CaCO_3$ cycles shows range of percentage of $CaCO_3$ variations increasing upward, but time of change is not well defined from widely spaced shipboard sampling.

ently because two 10-fingered core catchers were used. For all other cores, a flapper valve and one 10-fingered core catcher were used, and recovery was excellent. We began pulling out of Hole 663A at 1300 and cleared the mud line at 1345.

We then moved 15 m south to Hole 663B, spudded in, and retrieved our first APC core at 1428 on 27 March. We cored this hole continuously until the final APC core (108-663B-16H) was brought on deck at 0320 on 28 March. We measured the heat flow from Cores 108-663B-4H, -663B-6H, 663B-9H, and 663B-12H. With a total penetration depth of 152 mbsf, recovery at Hole 663B was 101%. We then pulled out of Hole 663B from 0345 to 0945 on 28 March and got under way to Site 664. The weather was favorable throughout all operations, with weak winds and swell, except for variable currents of moderate strength.

Table 1. Site 663 coring summary (drilling depths).

Core no.	Date (March 1986)	Time (UTC)	Depth (mbsf)	Length cored (m)	Length recovered (m)	Recovery (%)
108-663A-1H	27	0030	0.0-4.7	4.7	4.8	101.0
108-663A-2H	27	0132	4.7-14.2	9.5	9.5	100.0
108-663A-3H	27	0224	14.2-23.7	9.5	9.7	102.0
108-663A-4H	27	0310	23.7-33.2	9.5	9.5	100.0
108-663A-5H	27	0405	33.2-42.7	9.5	0.0	0.0
108-663A-6H	27	0450	42.7-52.2	9.5	7.5	78.9
108-663A-7H	27	0545	52.2-61.7	9.5	0.0	0.0
108-663A-8H	27	0645	61.7-71.2	9.5	8.5	89.9
108-663A-9H	27	0730	71.2-80.7	9.5	8.2	86.4
108-663A-10H	27	0813	80.7-90.2	9.5	8.1	85.5
108-663A-11H	27	0900	90.2-99.7	9.5	8.3	87.3
108-663A-12H	27	0945	99.7-109.2	9.5	9.0	95.1
108-663A-13H	27	1030	109.2-118.7	9.5	8.9	93.1
108-663A-14H	27	1110	118.7-128.2	9.5	8.7	91.3
108-663A-15H	27	1150	128.2-137.7	9.5	9.0	94.4
108-663A-16H	27	1235	137.7-147.2	9.5	9.4	98.5
108-663B-1H	27	1428	0.0-9.5	9.5	9.5	100.0
108-663B-2H	27	1515	9.5-19.0	9.5	9.8	103.0
108-663B-3H	27	1607	19.0-28.5	9.5	9.5	99.7
108-663B-4H	27	1705	28.5-38.0	9.5	9.3	98.2
108-663B-5H	27	1800	38.0-47.5	9.5	9.8	103.0
108-663B-6H	27	1852	47.5-57.0	9.5	9.7	101.0
108-663B-7H	27	1941	57.0-66.5	9.5	9.5	99.6
108-663B-8H	27	2026	66.5-76.0	9.5	9.3	97.7
108-663B-9H	27	2123	76.0-85.5	9.5	9.5	100.0
108-663B-10H	27	2211	85.5-95.0	9.5	9.8	103.0
108-663B-11H	27	2303	95.0-104.5	9.5	9.5	100.0
108-663B-12H	28	0001	104.5-114.0	9.5	9.8	103.0
108-663B-13H	28	0050	114.0-123.5	9.5	9.6	101.0
108-663B-14H	28	0140	123.5-133.0	9.5	9.6	101.0
108-663B-15H	28	0230	133.0-142.5	9.5	9.6	101.0
108-663B-16H	28	0320	142.5-152.0	9.5	9.7	102.0

H = hydraulic piston. UTC = Universal Time Coordinated.

LITHOSTRATIGRAPHY AND SEDIMENTOLOGY

Introduction

One major unit was recognized at Site 663. This unit is composed primarily of 150 m of interbedded nannofossil and foraminifer-nannofossil oozes and is Pliocene to Pleistocene in age. However, normal pelagic sedimentation is interrupted by a series of slumps occurring between 30 and 130 mbsf. The unit is described in detail in the following section.

Unit I

Cores 108-663A-1H through -663A-16H, CC, 13 cm; depth, 0-147.2 mbsf; age, late Pliocene to Pleistocene.

Cores 108-663B-1H through -663B-16H, CC, 20 cm; depth, 0-152.0 mbsf; age, late Pliocene to Pleistocene.

The stratigraphic section recovered at Site 663 is composed primarily of nannofossil and foraminifer-nannofossil oozes. A muddy, siliceous-nannofossil ooze also is scattered in the upper 100 m of the section. The nannofossil and foraminifer-nannofossil oozes are white, light olive gray, olive gray, and gray, depending on the amount of dilution by terrigenous and siliceous materials. The muddy, siliceous-nannofossil ooze is generally light gray to gray. Bioturbation is weak to moderate throughout the section. Grayish green, purple, and black microlaminations are common in all lithologies.

The carbonate content of the sediments gradually increases from an average of 75% at the top of the section to more than 90% at the base (Fig. 4). Greater variability of carbonate concentration exists in the upper 80 m of the section, with increasing percentages of terrigenous material and biogenic silica. Quartz and clay are the primary terrigenous components, with combined concentrations decreasing from 25% near the top of the section to less than 10% at its base. Diatoms, radiolarians, and sponge spicules are the primary biogenic-siliceous components. At the top of the section (approximately 0-30 mbsf), these range

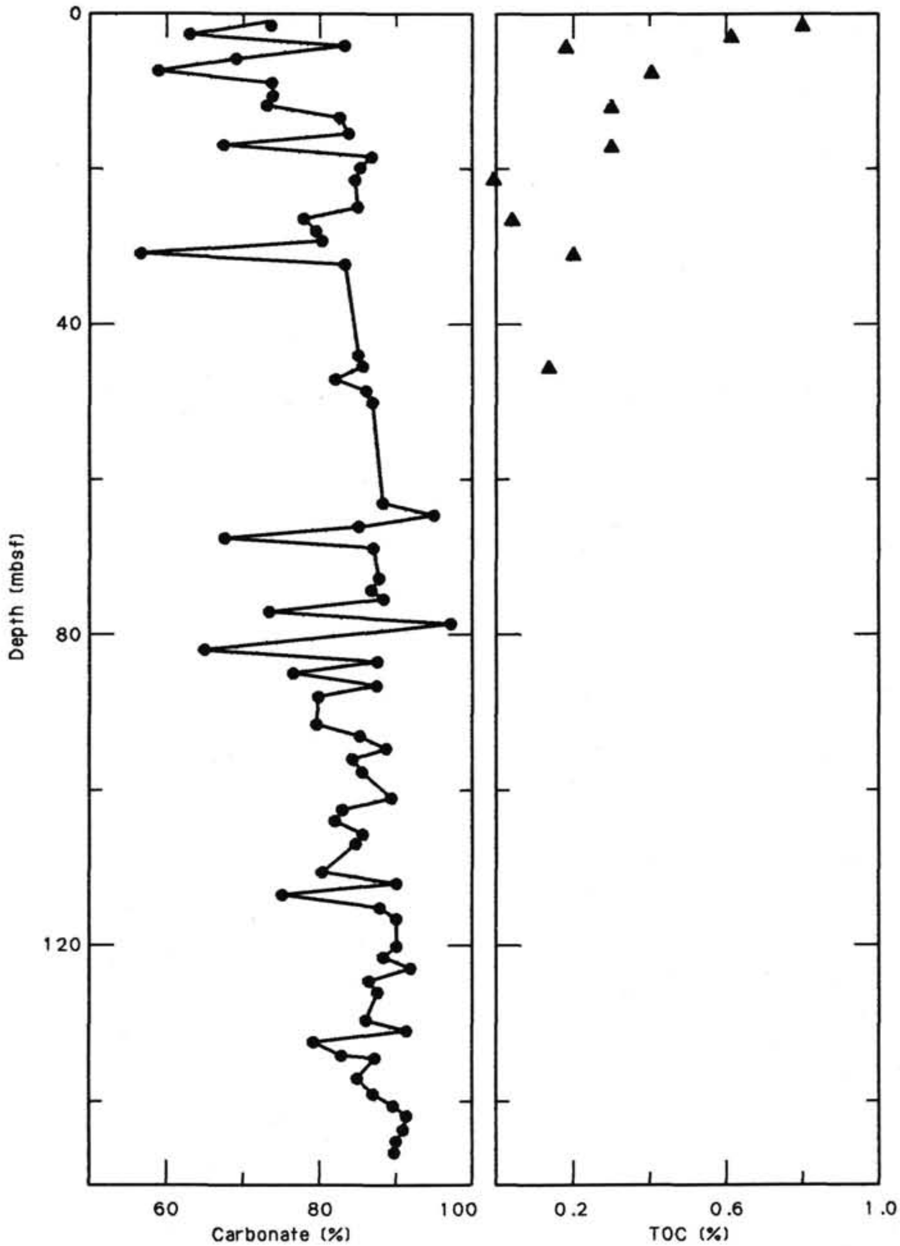

Figure 4. Calcium carbonate and organic-carbon concentrations in Hole 663A.

in concentration between 0% and 25% in the carbonate ooze and up to 35% in the muddy, siliceous-nannofossil ooze. Biogenic-silica concentrations decrease to less than 10% at the base of the section.

A series of slumps interrupts the normal pelagic sedimentation between 32 and 130 mbsf. These slumps are characterized by folded, dipping, and vertically stretched bedding planes. Microfaulting and slide planes are common within the slumped intervals. Erosional contacts and graded bedding (turbidites) are common in the upper slumped intervals (30–70 mbsf). Intervals between the slumps appear to be normal pelagic units (see "Composite-Depth Section," this chapter for a detailed location of slumps).

Depositional History

The depositional history of the stratigraphic section recovered at Site 663 is similar to the stratigraphic section at Site 662 and is characterized by normal calcareous and siliceous pelagic sedimentation typical of high-productivity equatorial locations. These pelagic intervals are interrupted by five slumps of similar lithology that originate from the surrounding topographic highs. The slumps do not appear to deform the underlying pelagic units extensively, and after each slumping episode, normal pelagic sedimentation resumed. Most of the slumping episodes do not correlate with those occurring at Site 662. However, a slump from 44 to 46 mbsf at this site may be time correlative with a slump from 80 to 96 mbsf at Site 662 (see "Composite-Depth Section," this chapter and Site 662 chapter).

BIOSTRATIGRAPHY

Two holes were drilled at Site 663 (a companion site to Site 662) in a water depth of 3697.6 m. Hole 663A was cored to a total depth of 147.2 mbsf, and Hole 663B was cored to a depth of 152.0 mbsf. The oldest sediments recovered are late Pliocene in age, and zonal assignments for these cores are shown in Figures 5 and 6. Both holes are characterized by numerous slumps and turbidites (>45 m in total length), causing many samples to contain reworked specimens and, in some cases, making biostratigraphic assignments ambiguous.

Calcareous nannofossils and planktonic foraminifers are abundant at this site. The nannofossils are well preserved in the upper Pleistocene, but only moderately well preserved farther downhole. As at Site 662, discoaster abundances are surprisingly low, considering the equatorial location, which possibly reflects the influence of the cold Benguela Current or of equatorial divergence. Similarly, the planktonic foraminifers alternate between colder and warmer faunas, with colder species found in green siliceous layers and warm species found in the more well-preserved white ooze layers. These cycles extend back to ~142 mbsf, equal to ~2.6 Ma.

Diatoms are common to abundant at this site and moderately well preserved. Variations between warm and cool taxa may reflect changes in productivity on glacial/interglacial time scales. The windblown *Melosira* spp. occur throughout the sequence. Well-preserved benthic foraminifers are rare to common and, as with all the other microfossil groups, show apparent cyclicity in species composition.

Calcareous Nannofossils

The truly pelagic sedimentation at Site 663 is interrupted by several major slumps or turbidites, creating massive reworking at some levels and inverted stratigraphic orders of biostratigraphic datums within other intervals. About two-thirds of the Pleistocene appears undisturbed, although reworking of Pliocene sediments was evident at many levels. In contrast, some intraslump units seem unaffected by sediment mixing. For example, Core 108-663A-10H displayed sharp, even-angled contacts between white and greenish oozes, but investigation of a dozen samples across such contacts did not show reworked specimens.

The two holes drilled at Site 663 are late Pliocene to Pleistocene in age (0–2.7 Ma). Nannofossil biostratigraphy in this interval is based on the extinctions of *Pseudoemiliania lacunosa, Discoaster brouweri* (and the simultaneous *Discoaster triradiatus*), *Discoaster pentaradiatus* (which appears more reliable, due to higher abundances, than *Discoaster surculus* in the eastern equatorial Atlantic), and *Discoaster tamalis*. The composition,

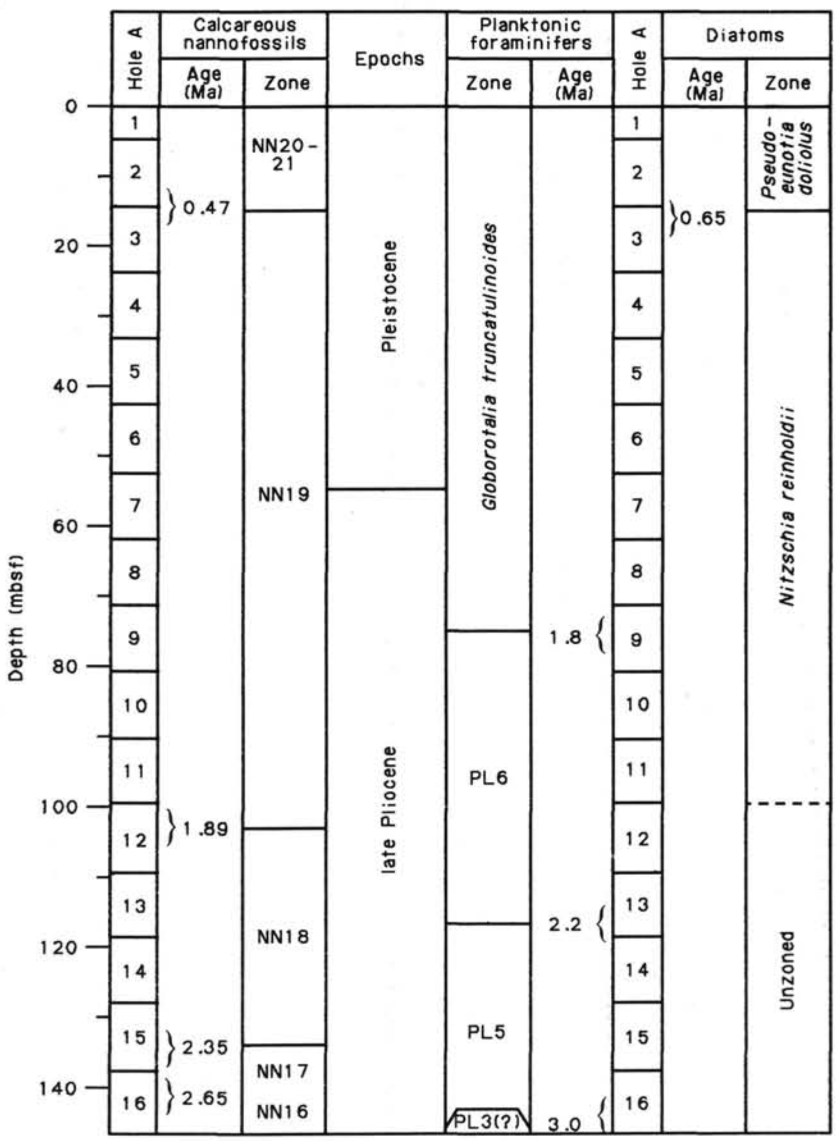

Figure 5. Zonal assignments for cores recovered from Hole 663A.

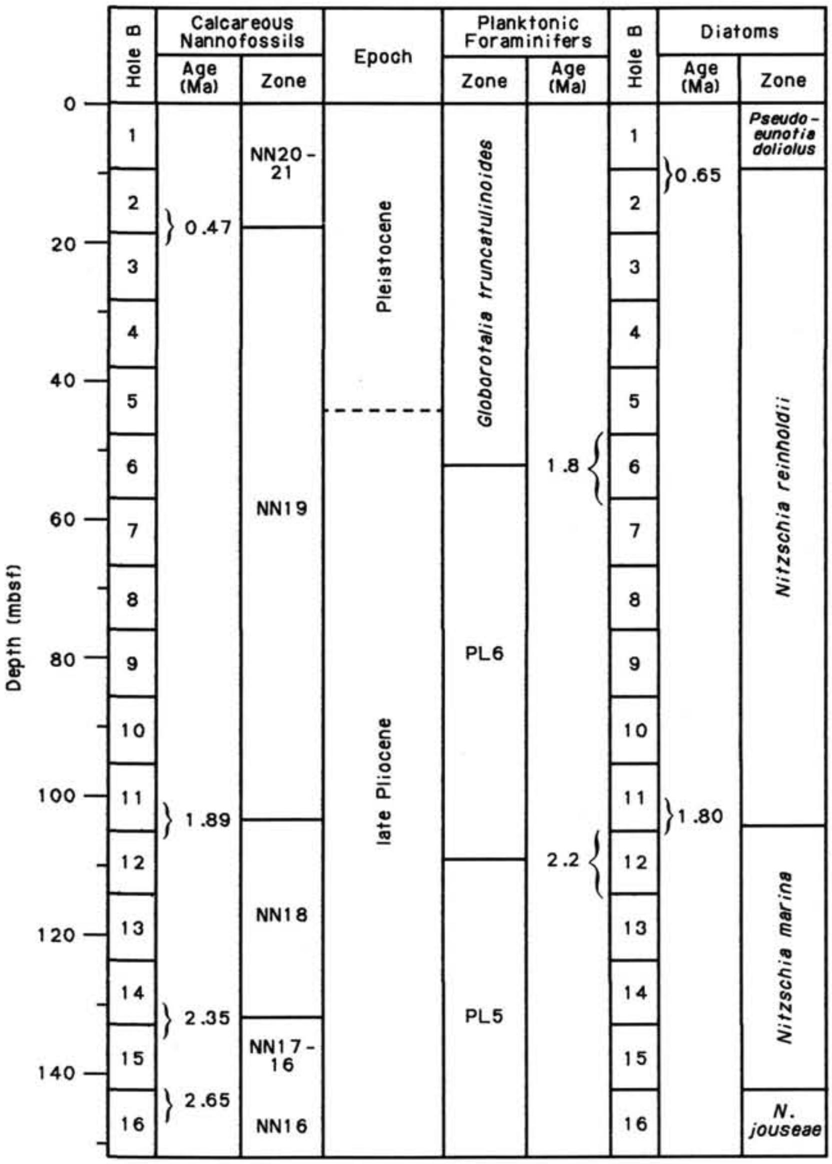

Figure 6. Zonal assignments for cores recovered from Hole 663B.

preservation, and abundance of nannofossil assemblages are similar to findings observed at Site 662 (e.g., generally low discoaster abundances, the absence of *Coccolithus pelagicus* during most of the Pleistocene, and fairly high abundances of helicosphaerids, rhabdosphaerids, and syracosphaerids).

The following account of the biostratigraphic signals is confined to levels considered to represent true pelagic deposition; thus, it excludes the assemblage compositions in the slumped intervals, as identified by shipboard sedimentologists (see "Lithostratigraphy and Sedimentology" and "Sediment-Accumulation Rates" sections, this chapter).

Pleistocene

The extinction of *P. lacunosa* occurs in Sections 108-663A-3H-1 and -663B-2H-6. Cores 108-663A-5H and -663A-7H had no recovery, making the last occurrence (LO) of *Calcidiscus macintyrei* uncertain. However, neither *C. macintyrei* nor *Helicosphaera sellii* were observed in Sample 108-663A-6H-4, 99 cm, but both species were common in Samples 108-663A-8H-1, 20 cm, and -663A-8H-1, 100 cm. These last two samples did not contain Pliocene discoasters, which is noteworthy in view of their proximity to the underlying slump. In Hole 663B, *H. sellii* disappears between Samples 108-663B-6H-7, 10 cm, and -663B-6H-6, 150 cm. The extinction of *C. macintyrei* was determined with less precision because of low abundances toward the end of its range. A conservative estimate suggests that the *C. macintyrei* event occurs between Samples 108-663B-7H-1, 140 cm, and -663B-7H-2, 80 cm.

Pliocene

Discoaster brouweri and *D. triradiatus* were observed in low, but consistent numbers (>one specimen per five fields of view at a particle density of about 200 per field of view) from Sample 108-663A-12H-3, 100 cm, and downward. An extensive search in Sample 108-663A-12H-3, 40 cm, yielded three specimens of *D. brouweri*, but no *D. triradiatus*. Hence, this sample was considered to be located above the range of these two species. The lowermost part of Core 108-663B-11H contains the extinctions of *D. brouweri* and *D. triradiatus*. The beginning of the acme interval of *D. triradiatus* occurs in Sections 108-663B-12H-4 and -663A-13H-2. Strongly fluctuating discoaster abundances at around the extinction level of *D. pentaradiatus* caused definite uncertainty as to its precise position. However, this event is placed tentatively between Samples 108-663A-15H-4, 30 cm, and -663A-15H-6, 80 cm, and between Samples 108-663B-14H-6, 10 cm, and -663B-15H-1, 60 cm. A major reduction in abundance of *Discoaster asymmetricus* was observed in conjunction with the LO of *D. tamalis* between Samples 108-663A-16H-3, 90 cm, and -663A-16H-4, 100 cm. In Hole 663B, the corresponding events occurred between the lower one-half of Section 108-663B-16H-1 and the upper one-half of Section 108-663B-16H-2.

Planktonic Foraminifers

The foraminiferal fauna at Site 663 consists of warm, but not completely tropical species, even though the site is located near the equator. These faunas are directly comparable to those found at Site 662. The most common species are *Globigerinoides ruber, Globigerinoides obliquus, Globigerinoides trilobus, Globigerina decoraperta, Neogloboquadrina dutertrei*, and *Neogloboquadrina humerosa*. From Recent time back to 2.6 Ma, sediments alternate between white calcareous-nannofossil ooze and green siliceous-calcareous-nannofossil ooze. The faunas of these units also differ, with the white units containing abundant, well-preserved specimens and the green units containing less abundant, and sometimes less well-preserved, faunas. The white units also contain higher percentages of tropical species, such as *Globigerinoides sacculifer* and *Pulleniatina* spp., whereas the green units contain more temperate species, such as *Neogloboquadrina pachyderma* (right-coiling) and *Globigerina bulloides*. Small turbidites and slumps are common at this site, and some samples (e.g., 108-663A-4H, CC and -663B-6H, CC) contain numerous reworked specimens of late Pliocene age.

The upper part of the *Globorotalia truncatulinoides* Zone is recognized easily by the presence of the zone fossil; in the early part of its range, however, its occurrence is sporadic. The base of this zone, therefore, is taken at the LO of *G. obliquus*, but this datum also may be unreliable since specimens have been found above its expected range at previous sites. The LO of *G. obliquus* lies between Samples 108-663A-8H, CC and -663A-9H, CC in Hole 663A and between Samples 108-663B-6H, CC and -663B-7H, CC in Hole 663B. The PL5/PL6 boundary lies between Samples 108-663A-13H-4, 107 cm, and -663A-13H, CC in Hole 663A and between Samples 108-663B-12H, CC and -663B-13H, CC in Hole 663B. The first occurrence (FO) of *Globorotalia inflata* at 2.1 Ma occurs between 108-663B-12H, CC and -663B-13H, CC in Hole 663B, but this datum has not been found in Hole 663A. Hole 663B terminates in Zone PL5. The basal sample of Hole 663 (108-663A-16H, CC), however, belongs to Zone PL3, and since this sample contains numerous specimens of *Pulleniatina primalis*, it appears to have an age older than 3.3 Ma (Berggren et al., 1985). The sample immediately above (108-663A-16H-5, 126 cm) belongs to Zone PL5 and has an age younger than 2.9 Ma. Therefore, either a hiatus exists at the base of Hole 663A or the basal sample contains reworked material.

Benthic Foraminifers

Benthic foraminifers occur in all core-catcher samples examined. Except for Sample 108-663A-16H, CC, benthic foraminifers are rare to common and well preserved. Whereas Samples 108-663A-4H, CC and -663A-15H, CC contain a highly diverse assemblage, Samples 108-662A-13H, CC and -663A-14H, CC contain an assemblage with relatively low diversity. Sample 108-663A-10H, CC is characterized by the dominance of *Sphaeroidina bulloides* and *Gyroidinoides soldanii*, while *Oridorsalis tener* and *Planulina wuellerstorfi* dominate Sample 108-663A-12H, CC. Sample 108-663A-13H, CC includes several specimens of *Anomalinoides* sp. and *Favocassidulina* sp., but no uvigerinids. *Siphouvigerina proboscidea* and *Martinotiella* sp. occur only in Sample 108-663A-15H, CC.

Diatoms

Diatoms are common to abundant in all samples examined from Site 663. The assemblage is similar to that observed at Site 662 and again, is dominated by warm- to cool-water taxa indicative of moderate-to-high productivity. Preservation is generally moderate, with a few samples having poor preservation. As at Site 662, the species composition varies and may reflect glacial/interglacial changes. Windblown, freshwater diatoms, predominantly *Melosira* spp., occur in varying numbers throughout the sequence. Although reworking of Pliocene-Pleistocene specimens does occur, it is less extensive than in Hole 662A.

Samples 108-663A-1H, CC and -663A-2H, CC are assigned to the *Pseudoeunotia doliolus* Zone, based on the presence of *P. doliolus* and the absence of *Nitzschia reinholdii. Nitzschia reinholdii* was observed in core-catcher Samples 108-663B-1H and -663B-2H, which suggests placement of these samples into the *Nitzschia reinholdii* Zone. The presence of *N. reinholdii* above this level in Hole 663B is most likely the result of contamination.

Samples 108-663A-3H, CC through -663A-11H, CC and Samples 108-663B-3H, CC through 108-663B-11H, CC are assigned to the *Nitzschia reinholdii* Zone, based on the co-occurrence of *N. reinholdii* and *P. doliolus*. Because no samples were examined from core-catcher Samples 108-663A-12H, -663A-13H, -663A-14H, and -663A-15H, and no sediment was recovered from Cores 108-663A-5H or -663A-7H, the best stratigraphic control is found in Hole 663B.

Based on the FO of *P. doliolus*, Sample 108-663B-11H, CC represents the base of the *Nitzschia reinholdii* Zone. The *Nitzschia marina* Zone (Baldauf, 1984), which is defined as the interval from the LO of *Nitzschia jouseae* to the FO of *P. doliolus*, occurs from Sample 108-663B-12H, CC to -663B-15H, CC. The LO of *Thalassiosira convexa* s. ampl. in Sample 108-663B-14H, CC suggests an age of approximately 2.2 Ma. Rare, reworked specimens of *N. jouseae* occur throughout this interval. The occurrence of *N. jouseae* in core-catcher Samples 108-663A-15H, -663A-16H, and -663B-16H allows us to place these samples into the *Nitzschia jouseae* Zone of Baldauf (1984).

PALEOMAGNETISM

Paleomagnetics

Cores 108-663A-1H through -663A-4H from Hole 663A were measured for magnetic intensity. Results were similar to those from Site 662, and thus measurements were discontinued. Susceptibility results are comparable to data recovered from Site 662; no between-hole correlations were possible.

SEDIMENT-ACCUMULATION RATES

Sediment-accumulation rates were calculated for Hole 663A, based on seven nannofossil and planktonic-foraminifer biostratigraphic events (Tables 2 and 3), and are plotted in Figure 7. We did not use the foraminifer datum, the LO of *Globigerinoides obliquus*, as it consistently has been found unreliable at other Leg 108 sites. The resulting accumulation record looks similar to that from Site 662 and, as at that site, it is characterized by an apparent doubling of accumulation rates in the early to mid-Pleistocene. This interval of increased accumulation is caused by the presence of numerous slumps and turbidites concentrated between 20 and 100 mbsf. In addition, Hole 663A contains 10 m of slumped material between 119 and 129 mbsf.

To understand better the history of pelagic sedimentation at Site 663, the accumulation-rate curve was replotted with sediment identified as turbidites or slumps removed. The distribution of allochthonous material is shown on the left in Figure 7.

Table 2. Biostratigraphic and magnetostratigraphic events, their stratigraphic placement, and estimated ages for Hole 663A.

	Datum	Depth (mbsf)	Age (Ma)
LO	*Pseudoemiliania lacunosa*	14.5–15.8	0.47
LO	*Calcidiscus macintyrei*	48.2–61.9	1.45
LO	*Discoaster brouweri*	103.1–103.7	1.89
FO	*D. triradiatus* acme	109.8–111.7	2.07
LO	*Globorotalia miocenica*	114.8–118.7	2.20
LO	*Discoaster pentaradiatus*	133.0–135.0	2.35
LO	*D. tamalis*	141.6–143.2	2.65

LO = last occurrence. FO = first occurrence.

Table 3. Biostratigraphic and magnetostratigraphic events, their stratigraphic placement, and estimated ages, with identifiable slumps and turbidites removed.

	Datum	Depth (mbsf)	Age (Ma)
LO	*Pseudoemiliania lacunosa*	14.5–15.8	0.47
LO	*Calcidiscus macintyrei*	40.2–53.9	1.45
LO	*Discoaster brouweri*	64.6–65.2	1.89
FO	*D. triradiatus* acme	71.3–73.2	2.07
LO	*Globorotalia miocenica*	76.3–80.2	2.20
LO	*Discoaster pentaradiatus*	84.5–86.5	2.35
LO	*D. tamalis*	93.1–94.7	2.65

LO = last occurrence. FO = first occurrence.

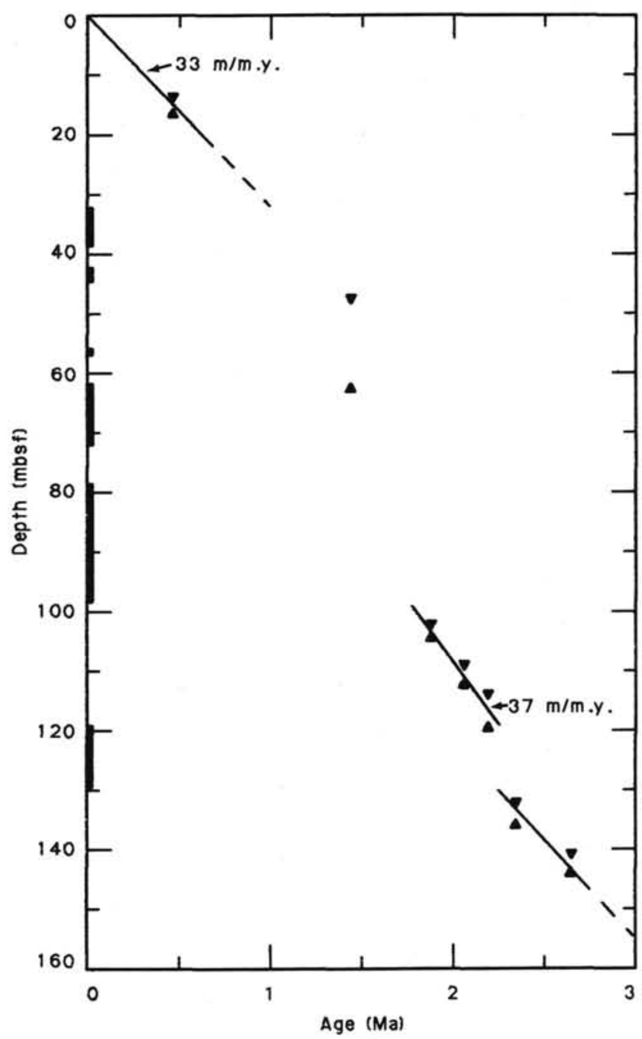

Figure 7. Sediment-accumulation rates for Hole 663A. Identifiable slumps and turbidites indicated by black bars on left. Uncertainties in the depth placement of the datums are delineated by points of the triangles.

The cumulative amount of slumped material identified above each datum was subtracted from the depth of that datum—8 m from the *Calcidiscus macintyrei* datum; 38.5 m from the *Discoaster brouweri, D. triradiatus* acme, and *Globorotalia miocenica* datums; and 48.5 m from the *D. pentaradiatus* and *D. tamalis* datums. The newly generated accumulation rates (plotted in Fig. 8) indicate pelagic sedimentation at ~40 m/m.y. between 3.0 and 1.4 Ma, decreasing to ~32 m/m.y. in the last 1.4 m.y. The *D. pentaradiatus* datum falls slightly off the curve, which may indicate an incorrect age assignment, an unrecognized disturbance in the core, or an increase in accumulation rates at approximately 2.3 Ma. Overall, the pelagic sedimentary record appears to contain no major hiatuses, in spite of the extensive slumping that has occurred.

INORGANIC GEOCHEMISTRY

Interstitial-water samples were squeezed from three sediment samples routinely recovered approximately every 50 m from Hole 663A. Values for pH and alkalinity were measured in conjunction, using a Metrohm 605 pH-meter, followed by titration with 0.1N HCl, and salinities were measured using an optical refractometer. Cl^-, Ca^{2+}, and Mg^{2+} concentrations were determined by the titrations described in Gieskes and Peretsman (1986). SO_4^{2-} analyses were conducted by ion chromatography using a Dionex 2120i instrument. Results from all analyses are presented in Table 4.

ORGANIC GEOCHEMISTRY

At Site 663, Hole 663A, the carbonate contents of 74 physical-properties samples were determined. Of these, 10 samples from the upper part of the section also were analyzed for total-organic-carbon (TOC) contents. No analyses were performed on samples from Hole 663B.

Organic and Inorganic Carbon

Inorganic-carbon (IC) contents were measured using the Coulometrics Carbon Dioxide Coulometer, while total-organic-carbon (TOC) values were determined using the Perkin Elmer 240C Elemental Analyzer. Owing to difficulties with the analyzer, only 10 samples could be analyzed for total organic carbon. TOC values for these samples were calculated by difference. Analytical methods are discussed and data presented in the Appendix (this volume).

Measured TOC values range between 0.0% and 0.8% (Fig. 9). Similar to the case of nearby Site 662, the upper few meters of the sedimentary sequence at Site 663 display relatively high TOC values. No TOC analyses were performed on samples below 46 m.

Carbonate values are generally high throughout the section, fluctuating between 57% and 98% (Fig. 9). Much of the sedimentary sequence is characterized by apparently quasiperiodic variations in carbonate content, although the lowermost part of the sequence (below about 115 mbsf) displays an average carbonate value of around 90%, with only minor fluctuations of low intensity.

Discussion

The sediments at Site 663 display generally high-carbonate content throughout the section. The higher-amplitude variations in carbonate content in most of the section may reflect more dis-

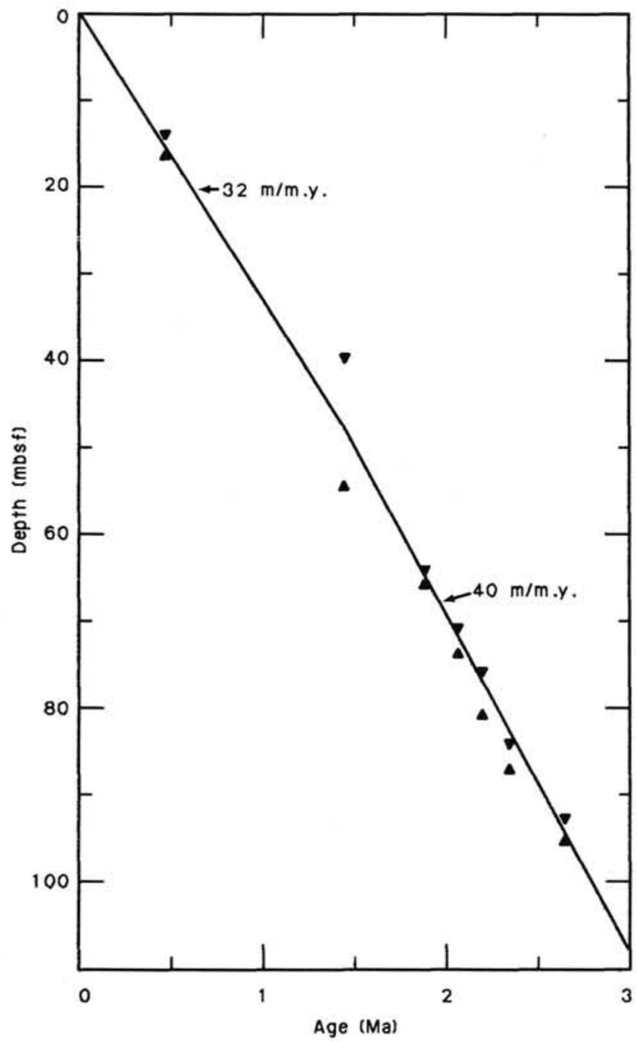

Figure 8. Sediment-accumulation rates for Hole 663A, with slumps and turbidites indicated in Figure 7 removed. Uncertainties in the depth placement of the datums are delineated by points of the triangles.

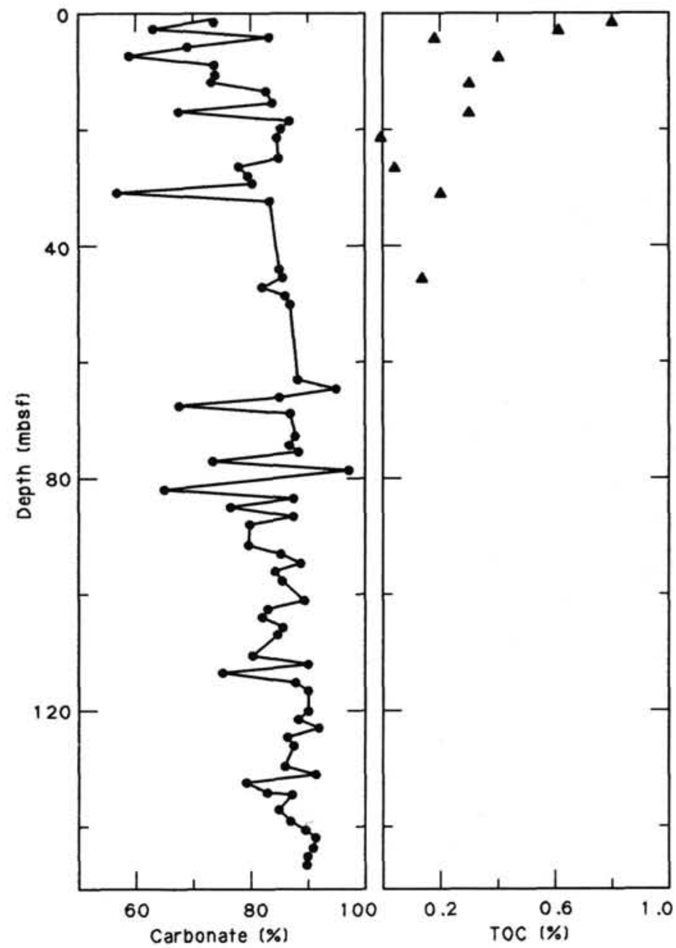

Figure 9. Carbonate and total-organic-carbon (TOC) records from Site 663, Hole 663A.

tinct glacial/interglacial cycles, compared with the lowermost levels, where fluctuations in carbonate content are minimal.

Because of the limited number of samples analyzed, we can say little concerning the organic contents of Site 663 sediments. However, the higher TOC values in the uppermost sections (0–3 mbsf) may indicate increased productivity and/or preservation of organic matter.

PHYSICAL PROPERTIES

The techniques used for shipboard physical-properties measurements at Site 663 are outlined in the "Introduction and Explanatory Notes" (this volume). Sample volumes and grain densities were measured only on cores from Hole 663A. Wet-bulk densities for Hole 663B were calculated by assuming a constant grain density of 2.6 g/cm^3. Tables 5 and 6 show the index-properties and vane-shear-strength data for Holes 663A and 663B, respectively. Figures 10 through 15 show downhole plots of these data. Continuous *P*-wave-velocity records were obtained from both Holes 663A and 663B. Table 7 shows a synthesis of the *P*-wave-logger velocity data for Hole 663A, which are plotted in Figure 15. Table 7 also shows the limited amount of thermal-conductivity data obtained for Hole 663B. These data are plotted in Figure 17. A plot of the calcium carbonate content for Hole 663A is shown in Figure 16. No data presented here were screened for bad data points. Whole-core sections from both holes were logged continuously using the GRAPE.

Wet-bulk density increases downhole from about 1.35 g/cm^3 at the mud line to about 1.6 g/cm^3 at 150 mbsf (Fig. 10). Grain densities remain stable throughout Hole 663A at about 2.6 g/cm^3 (Fig. 15). Vane shear strengths increase downhole from the mud line to about 50 mbsf. Below this depth, the vane-shear-strength values do not increase significantly because of the high carbonate

Table 4. Results of inorganic-geochemical analyses conducted for Site 663.

Core/ section	pH	Alkalinity (mmol/L)	Salinity (‰)	Chlorinity (mmol/L)	SO_4^{2-} (mmol/L)	Mg^{2+} (mmol/L)	Ca^{2+} (mmol/L)
108-663-1-2	7.50	3.16	34.0	557.0	25.13	51.87	9.64
108-663-11-5	7.43	6.53	34.0	560.1	21.31	52.16	8.20
108-663-16-5	7.38	6.36	34.1	568.6	22.37	51.99	9.03

Table 5. Index-properties and vane-shear-strength data for Hole 633A.

Core/ section	Interval (cm)	Depth (mbsf)	Grain density (g/cm³)	Wet-water content (%)	Dry-water content (%)	Wet-bulk density (g/cm³)	Dry-bulk density (g/cm³)	Porosity (%)	Vane shear strength (kPa)
108-663A-1H-1	126	1.26	2.55	68.20	214.49	1.26	0.44	84.55	4.00
108-663A-1H-2	126	2.76	2.47	64.54	182.03	1.29	0.49	81.76	9.00
108-663A-1H-3	126	4.26	2.55	53.24	113.85	1.42	0.70	74.23	21.00
108-663A-2H-1	121	5.91	2.59	64.31	180.21	1.30	0.50	82.31	10.00
108-663A-2H-2	121	7.35	2.29	62.23	164.75	1.29	0.52	79.03	14.00
108-663A-2H-3	121	8.85	2.35	59.20	145.09	1.33	0.59	77.27	15.00
108-663A-2H-4	121	10.35	2.50	58.96	143.66	1.35	0.59	78.16	12.00
108-663A-2H-5	111	11.75	2.33	57.68	136.32	1.34	0.62	75.95	11.00
108-663A-2H-6	121	13.35	2.57	50.49	102.00	1.45	0.76	72.23	19.00
108-663A-3H-1	121	15.38	2.54	52.78	111.77	1.42	0.71	73.80	24.00
108-663A-3H-2	121	16.88	2.57	60.24	151.52	1.34	0.57	79.51	19.00
108-663A-3H-3	121	18.38	2.54	50.05	100.20	1.46	0.77	71.63	19.00
108-663A-3H-4	121	19.88	2.60	50.65	102.64	1.46	0.76	72.54	23.00
108-663A-3H-5	121	21.38	2.53	48.11	92.72	1.48	0.81	69.91	31.00
108-663A-3H-6	121	22.88	2.56	49.04	96.22	1.47	0.80	70.94	25.00
108-663A-4H-1	121	24.91	2.52	50.82	103.33	1.44	0.75	72.06	25.00
108-663A-4H-2	121	26.32	2.50	53.56	115.31	1.41	0.69	74.07	27.00
108-663A-4H-3	121	27.82	2.51	54.57	120.13	1.40	0.67	74.99	27.00
108-663A-4H-4	121	29.32	2.67	51.19	104.86	1.46	0.75	73.49	36.00
108-663A-4H-5	121	30.82	2.49	60.55	153.50	1.33	0.57	79.19	31.00
108-663A-4H-6	106	32.17	2.57	47.01	88.71	1.50	0.84	69.32	27.00
108-663A-6H-1	121	43.91	2.56	49.08	96.39	1.47	0.79	70.94	31.00
108-663A-6H-2	121	45.41	2.55	49.38	97.56	1.46	0.78	71.12	32.00
108-663A-6H-3	121	46.91	2.46	46.91	88.36	1.48	0.83	68.25	46.00
108-663A-6H-4	111	48.31	2.54	44.97	81.73	1.52	0.88	67.22	47.00
108-663A-6H-5	121	49.91	2.62	45.16	82.33	1.53	0.88	68.12	41.00
108-663A-8H-1	121	62.91	2.55	46.26	86.09	1.50	0.84	68.47	37.00
108-663A-8H-2	121	64.41	2.62	44.60	80.52	1.54	0.90	67.57	40.00
108-663A-8H-3	121	65.91	2.55	43.87	78.17	1.54	0.91	66.33	49.00
108-663A-8H-4	121	67.41	2.49	48.40	93.81	1.47	0.80	69.83	66.00
108-663A-8H-5	111	68.81	2.55	42.82	74.89	1.55	0.94	65.36	51.00
108-663A-9H-1	121	72.41	2.54	46.21	85.90	1.50	0.85	68.37	22.00
108-663A-9H-2	121	73.89	2.46	52.28	109.56	1.41	0.71	72.76	13.00
108-663A-9H-3	121	75.39	3.18	50.69	102.78	1.53	0.76	76.40	12.00
108-663A-9H-4	121	76.89	2.58	52.10	108.75	1.44	0.74	73.54	31.00
108-663A-9H-5	121	78.39	2.56	47.97	92.19	1.48	0.81	70.03	25.00
108-663A-10H-1	111	81.81	2.50	51.28	105.26	1.43	0.74	72.31	57.00
108-663A-10H-2	111	83.28	2.60	44.80	81.16	1.53	0.90	67.61	35.00
108-663A-10H-3	111	84.78	2.49	46.79	87.94	1.49	0.82	68.41	53.00
108-663A-10H-4	111	86.28	2.54	40.51	68.09	1.58	0.97	63.13	54.00
108-663A-10H-5	111	87.78	2.52	46.90	88.31	1.49	0.84	68.80	52.00
108-663A-11H-1	121	91.41	2.51	46.30	86.21	1.50	0.84	68.18	58.00
108-663A-11H-2	121	92.82	2.55	42.21	73.05	1.56	0.95	64.84	55.00
108-663A-11H-3	121	94.32	2.53	44.40	79.85	1.53	0.89	66.67	37.00
108-663A-11H-4	121	95.82	2.43	44.77	81.06	1.50	0.88	66.11	52.00
108-663A-11H-5	121	97.32	2.52	43.22	76.13	1.54	0.92	65.54	57.00
108-663A-12H-1	121	100.91	2.51	43.04	75.57	1.54	0.93	65.27	37.00
108-663A-12H-2	121	102.41	2.48	44.93	81.58	1.51	0.88	66.71	33.00
108-663A-12H-3	121	103.91	2.63	41.81	71.85	1.58	0.96	65.10	39.00
108-663A-12H-4	121	105.41	2.46	44.66	80.71	1.51	0.88	66.26	28.00
108-663A-12H-5	106	106.76	2.50	44.75	81.01	1.52	0.88	66.76	30.00
108-663A-13H-1	121	110.41	2.66	42.28	73.24	1.58	0.94	65.80	50.00
108-663A-13H-2	121	111.83	2.47	40.47	67.99	1.57	0.99	62.43	38.00
108-663A-13H-3	121	113.33	2.56	42.58	74.17	1.56	0.93	65.22	79.00
108-663A-13H-4	121	114.83	2.58	40.27	67.43	1.60	0.99	63.27	53.00
108-663A-13H-5	121	116.33	2.52	41.04	69.62	1.57	0.98	63.46	45.00
108-663A-14H-1	121	119.91	2.53	40.96	69.38	1.57	0.97	63.44	32.00
108-663A-14H-2	121	121.41	2.56	39.71	65.87	1.60	1.00	62.51	39.00
108-663A-14H-3	121	122.91	2.52	39.79	66.09	1.59	1.02	62.22	32.00
108-663A-14H-4	121	124.41	2.59	42.28	73.25	1.57	0.95	65.23	36.00
108-663A-14H-5	121	125.91	2.68	42.28	73.26	1.59	0.95	65.98	27.00
108-663A-15H-1	121	129.41	2.54	42.73	74.60	1.55	0.93	65.20	31.00
108-663A-15H-2	121	130.81	2.55	40.66	68.52	1.58	0.98	63.36	24.00
108-663A-15H-3	121	132.31	2.62	42.99	75.40	1.56	0.93	66.13	47.00
108-663A-15H-4	121	133.81	2.65	43.12	75.79	1.57	0.94	66.47	36.00
108-663A-15H-5	111	135.21	2.53	42.24	73.13	1.56	0.95	64.69	28.00
108-663A-15H-6	111	136.41	2.57	40.92	69.28	1.58	0.99	63.76	53.00
108-663A-16H-1	123	138.93	2.60	42.11	72.73	1.57	0.96	65.17	52.00
108-663A-16H-2	121	140.41	2.55	43.66	77.49	1.54	0.91	66.16	29.00
108-663A-16H-3	121	141.91	2.31	46.61	87.31	1.45	0.82	66.66	33.00
108-663A-16H-4	121	143.41	2.57	40.08	66.90	1.60	1.01	62.92	46.00
108-663A-16H-5	93	144.63	2.58	42.21	73.04	1.57	0.96	65.05	32.00
108-663A-16H-6	93	146.00	2.49	41.53	71.04	1.56	0.97	63.64	48.00

Table 6. Index-properties and vane-shear-strength data for Hole 663B.

Core/ section	Interval (cm)	Depth (mbsf)	Wet-water content (%)	Dry-water content (%)	Porosity (%)	Wet-bulk density (g/cm^3)	Dry-bulk density (g/cm^3)	Vane shear strength (kPa)
108-663B-1H-1	121	1.21	58.00	138.11	77.31	1.39	0.60	9.00
108-663B-1H-2	121	2.71	61.78	161.66	79.83	1.35	0.53	9.00
108-663B-1H-3	121	4.21	57.04	132.78	76.65	1.40	0.62	7.00
108-663B-1H-4	121	5.71	66.32	196.92	82.65	1.31	0.46	10.00
108-663B-1H-5	121	7.21	55.43	124.36	75.51	1.42	0.65	20.00
108-663B-1H-6	121	8.71	57.23	133.80	76.78	1.40	0.62	15.00
108-663B-2H-1	121	10.71	52.25	109.42	73.16	1.46	0.71	10.00
108-663B-2H-2	121	12.05	51.48	106.09	72.57	1.47	0.73	15.00
108-663B-2H-3	121	13.55	55.47	124.57	75.54	1.42	0.65	14.00
108-663B-2H-4	121	15.05	46.30	86.23	68.41	1.54	0.84	27.00
108-663B-2H-5	121	16.55	53.39	114.57	74.02	1.45	0.69	21.00
108-663B-2H-6	121	18.05	59.34	145.93	78.22	1.38	0.58	19.00
108-663B-3H-1	121	20.21	50.19	100.78	71.57	1.49	0.75	30.00
108-663B-3H-2	121	21.69	54.25	118.60	74.65	1.44	0.67	22.00
108-663B-3H-3	121	23.19	49.68	98.74	71.17	1.49	0.76	25.00
108-663B-3H-4	121	24.69	48.97	95.97	70.60	1.50	0.78	31.00
108-663B-3H-5	121	26.19	47.76	91.41	69.62	1.52	0.81	31.00
108-663B-3H-6	121	27.69	44.77	81.05	67.09	1.56	0.87	30.00
108-663B-4H-1	121	29.66	51.67	106.93	72.72	1.47	0.72	24.00
108-663B-4H-2	121	31.16	59.01	143.94	78.00	1.38	0.58	29.00
108-663B-4H-3	121	32.66	54.04	117.59	74.50	1.44	0.68	0.00
108-663B-4H-4	121	34.16	45.14	82.27	67.41	1.55	0.86	42.00
108-663B-4H-5	121	35.64	48.20	93.04	69.98	1.51	0.80	40.00
108-663B-5H-1	121	39.21	45.94	84.99	68.10	1.54	0.85	25.00
108-663B-5H-2	121	40.71	43.97	78.47	66.39	1.57	0.89	34.00
108-663B-5H-3	121	42.21	50.17	100.69	71.56	1.49	0.75	30.00
108-663B-5H-4	121	43.71	43.85	78.08	66.28	1.57	0.89	32.00
108-663B-5H-5	121	45.21	51.00	104.09	72.20	1.48	0.74	34.00
108-663B-5H-6	121	46.71	46.88	88.26	68.89	1.53	0.82	36.00
108-663B-6H-1	121	48.71	44.39	79.81	66.76	1.57	0.88	44.00
108-663B-6H-2	121	50.15	45.80	84.50	67.98	1.55	0.85	35.00
108-663B-6H-3	121	51.65	55.25	123.44	75.37	1.43	0.65	40.00
108-663B-6H-4	121	53.15	49.76	99.03	71.23	1.49	0.76	37.00
108-663B-6H-5	121	54.65	51.41	105.82	72.52	1.47	0.73	37.00
108-663B-6H-6	96	55.90	50.65	102.62	71.93	1.48	0.74	34.00
108-663B-7H-1	121	58.21	50.10	100.41	71.50	1.49	0.76	25.00
108-663B-7H-2	121	59.71	46.14	85.66	68.27	1.54	0.84	27.00
108-663B-7H-3	121	61.21	44.43	79.94	66.79	1.56	0.88	37.00
108-663B-7H-4	121	62.71	47.52	90.53	69.42	1.52	0.81	35.00
108-663B-7H-5	121	64.21	45.58	83.77	67.79	1.55	0.85	34.00
108-663B-7H-6	121	65.71	46.93	88.41	68.93	1.53	0.82	49.00
108-663B-8H-1	121	67.71	42.26	73.18	64.86	1.60	0.93	37.00
108-663B-8H-2	121	69.21	44.60	80.49	66.94	1.56	0.88	45.00
108-663B-8H-3	121	70.71	39.35	64.88	62.14	1.64	1.00	39.00
108-663B-8H-4	121	72.21	46.26	86.08	68.37	1.54	0.84	31.00
108-663B-8H-5	121	73.71	47.35	89.93	69.28	1.52	0.81	28.00
108-663B-8H-6	121	75.21	49.65	98.61	71.15	1.49	0.76	25.00
108-663B-9H-1	121	77.21	44.48	80.13	66.85	1.56	0.88	32.00
108-663B-9H-2	121	78.67	51.67	106.90	72.72	1.47	0.72	31.00
108-663B-9H-3	121	80.17	46.37	86.45	68.46	1.54	0.84	22.00
108-663B-9H-4	121	81.67	46.27	86.13	68.38	1.54	0.84	31.00
108-663B-9H-5	121	83.17	45.49	83.47	67.72	1.55	0.86	26.00
108-663B-9H-6	121	84.67	45.83	84.61	68.00	1.54	0.85	48.00
108-663B-10H-1	121	86.71	45.22	82.56	67.49	1.55	0.86	42.00
108-663B-10H-2	121	88.01	45.26	82.70	67.52	1.55	0.86	47.00
108-663B-10H-3	121	89.51	46.33	86.32	68.43	1.54	0.84	34.00
108-663B-10H-4	121	91.01	43.67	77.54	66.13	1.58	0.90	33.00
108-663B-10H-5	121	92.51	41.99	72.39	64.62	1.60	0.94	38.00
108-663B-10H-6	121	94.01	46.66	87.48	68.71	1.53	0.83	31.00
108-663B-11H-1	121	96.21	47.57	90.75	69.47	1.52	0.81	28.00
108-663B-11H-2	121	97.60	51.08	104.39	72.26	1.48	0.74	47.00
108-663B-11H-3	121	99.10	48.70	94.93	70.38	1.51	0.78	41.00
108-663B-11H-4	121	100.60	44.24	79.35	66.63	1.57	0.88	30.00
108-663B-11H-5	121	102.10	46.53	87.04	68.60	1.54	0.83	44.00
108-663B-12H-1	121	105.71	44.29	79.50	66.67	1.57	0.88	41.00
108-663B-12H-2	121	107.17	39.96	66.55	62.72	1.63	0.99	37.00
108-663B-12H-3	121	108.67	45.50	83.48	67.72	1.55	0.86	38.00
108-663B-12H-4	121	110.13	41.71	71.56	64.36	1.60	0.94	30.00
108-663B-12H-5	121	111.63	40.97	69.40	63.67	1.62	0.96	27.00
108-663B-12H-6	121	113.13	42.21	73.05	64.82	1.60	0.93	40.00
108-663B-13H-1	121	115.21	41.91	72.14	64.54	1.60	0.94	42.00
108-663B-13H-2	121	116.71	40.92	69.25	63.62	1.62	0.96	49.00
108-663B-13H-3	121	118.21	40.81	68.94	63.52	1.62	0.97	32.00
108-663B-13H-4	121	119.71	40.86	69.09	63.57	1.62	0.97	32.00
108-663B-13H-5	121	121.21	38.96	63.82	61.76	1.65	1.01	33.00

Table 6 (continued).

Core/ section	Interval (cm)	Depth (mbsf)	Wet-water content (%)	Dry-water content (%)	Porosity (%)	Wet-bulk density (g/cm^3)	Dry-bulk density (g/cm^3)	Vane shear strength (kPa)
108-663B-13H-6	121	122.71	41.53	71.03	64.19	1.61	0.95	33.00
108-663B-14H-1	121	124.71	40.90	69.21	63.61	1.62	0.96	24.00
108-663B-14H-2	121	126.11	44.82	81.21	67.13	1.56	0.87	32.00
108-663B-14H-3	121	127.55	36.66	57.88	59.47	1.68	1.07	27.00
108-663B-14H-4	121	129.05	40.05	66.80	62.80	1.63	0.99	21.00
108-663B-14H-5	111	130.45	41.94	72.24	64.57	1.60	0.94	36.00
108-663B-14H-6	121	132.03	45.25	82.65	67.51	1.55	0.86	51.00
108-663B-15H-1	121	134.21	41.70	71.52	64.35	1.60	0.94	58.00
108-663B-15H-2	121	135.69	41.75	71.68	64.40	1.60	0.94	41.00
108-663B-15H-3	125	137.23	44.75	81.01	67.08	1.56	0.87	74.00
108-663B-15H-4	121	138.69	41.54	71.05	64.20	1.61	0.95	30.00
108-663B-15H-5	121	140.19	40.73	68.71	63.44	1.62	0.97	40.00
108-663B-16H-1	121	143.71	42.18	72.96	64.79	1.60	0.93	37.00
108-663B-16H-2	121	145.18	40.69	68.62	63.41	1.62	0.97	38.00
108-663B-16H-3	121	146.68	40.04	66.79	62.80	1.63	0.99	44.00
108-663B-16H-4	121	148.18	43.32	76.43	65.82	1.58	0.91	44.00
108-663B-16H-5	121	149.68	39.97	66.60	62.73	1.63	0.99	40.00
108-663B-16H-6	121	151.18	40.29	67.49	63.04	1.63	0.98	44.00

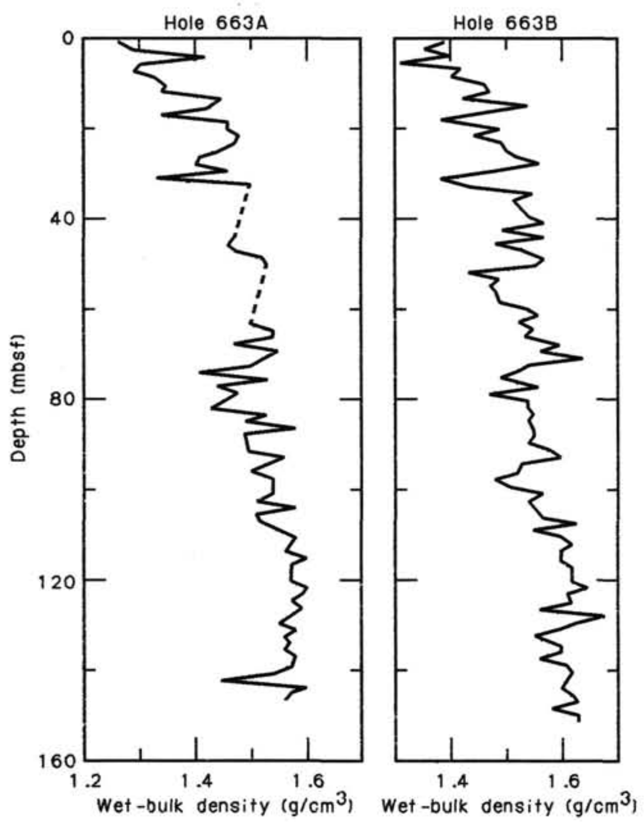

Figure 10. Wet-bulk-density profiles for Holes 663A and 663B.

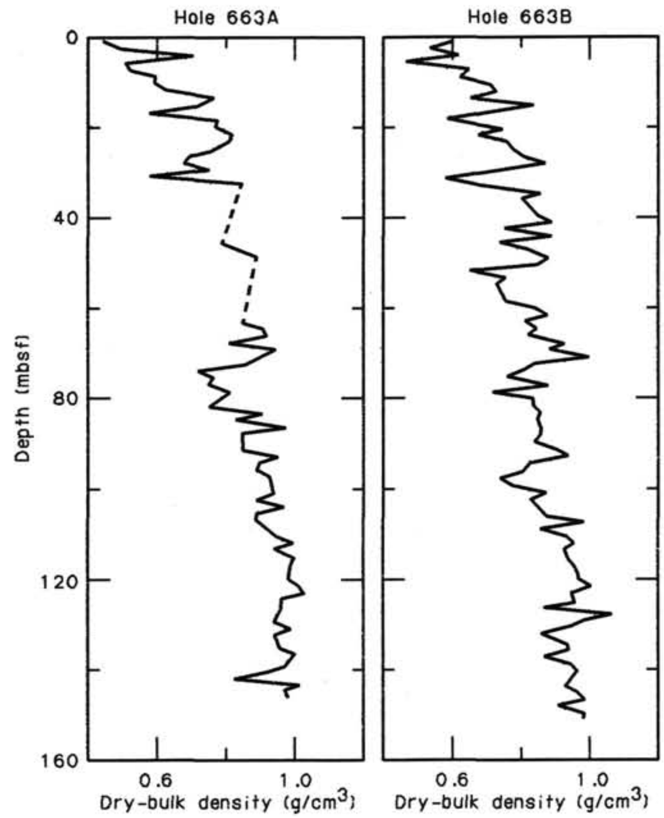

Figure 11. Dry-bulk-density profiles for Holes 663A and 663B.

content. Maximum values only reach 60 to 80 kPa (Fig. 14). A small increase in velocity occurs downhole (Fig. 15) from about 1.52 km/s at the mud line to about 1.54 km/s at 150 mbsf. All velocities recorded were below 1.6 km/s. Downhole-temperature measurements were obtained from three cores in Hole 663B (Fig. 17). The measured temperature gradient in the relatively undisturbed sequence from 50 to 110 mbsf is 0.04°C/m. We stopped measuring thermal conductivity at 40 mbsf because of faulty instruments.

SEISMIC STRATIGRAPHY

Water-gun seismic records obtained while approaching Site 663 (Fig. 18) showed three seismic units within the 0.20-s record (two-way traveltime) equivalent to the interval drilled at that site. Descriptions of the units (Fig. 18) are as follows:

Seismic unit 1: 0–0.05 s, an upper unit with a false acoustic signal caused by the water guns.

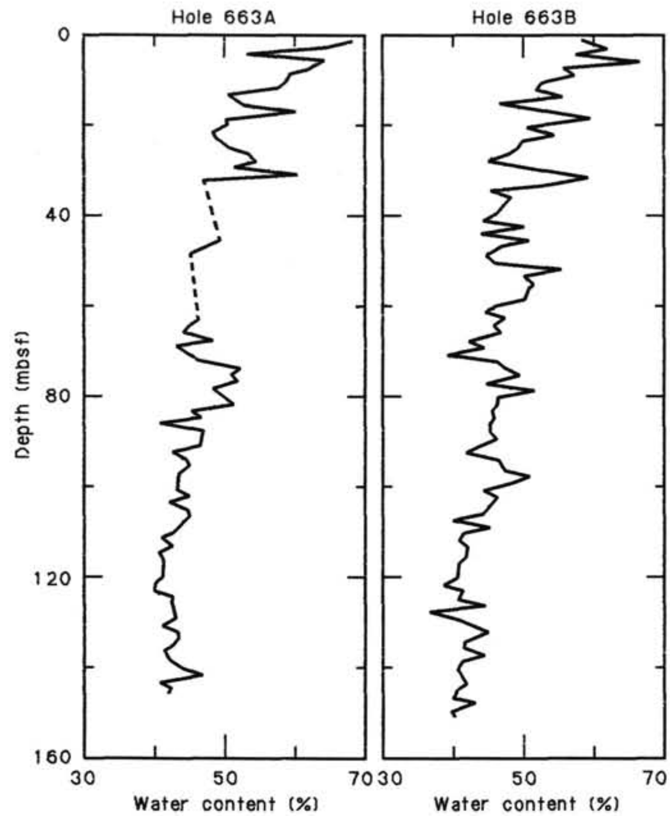

Figure 12. Water-content profiles for Holes 663A and 663B.

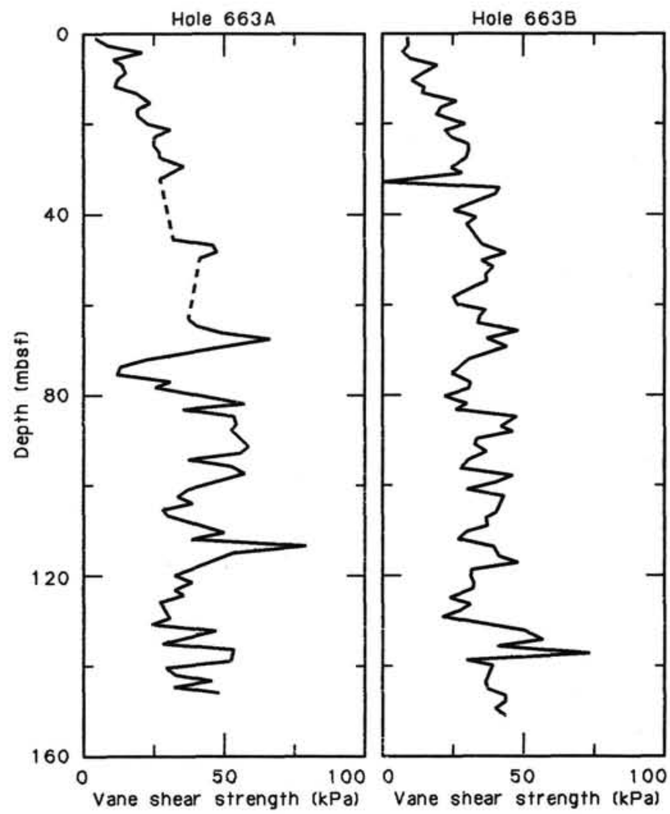

Figure 14. Vane-shear-strength profiles for Holes 663A and 663B.

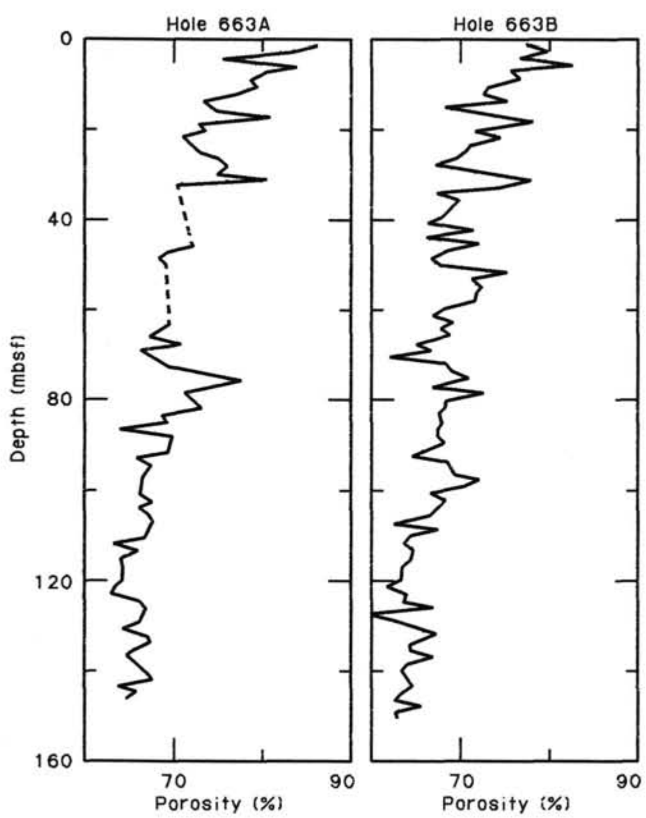

Figure 13. Porosity profiles for Holes 663A and 663B.

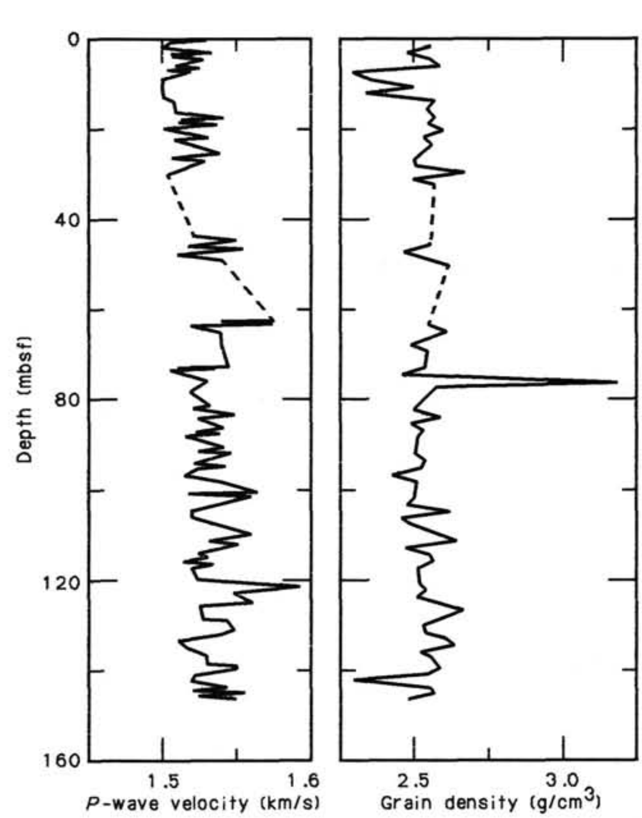

Figure 15. *P*-wave-logger velocity profile and grain-density profile for Hole 663A.

Table 7. *P*-wave-logger velocity data for Hole 663A and thermal-conductivity data for Hole 663B.

Depth (mbsf)	*P*-wave velocity (km/s)	Depth (mbsf)	*P*-wave velocity (km/s)
Hole 663A			
0.30	1.529	83.50	1.550
1.00	1.506	84.20	1.522
2.00	1.500	86.30	1.542
3.00	1.535	87.20	1.520
3.20	1.505	87.60	1.539
3.60	1.524	87.80	1.515
3.90	1.506	90.70	1.542
4.50	1.530	91.40	1.523
5.50	1.518	91.90	1.548
6.00	1.508	94.20	1.520
6.40	1.528	94.70	1.544
6.90	1.503	95.20	1.525
7.10	1.521	96.70	1.515
8.70	1.500	98.20	1.540
10.50	1.500	100.40	1.565
12.70	1.502	100.80	1.517
13.70	1.508	101.30	1.560
16.20	1.510	104.70	1.519
17.30	1.542	106.20	1.520
17.60	1.512	109.90	1.560
17.90	1.530	111.40	1.530
18.40	1.510	111.90	1.552
18.90	1.539	114.20	1.523
19.70	1.500	114.80	1.533
21.80	1.533	115.80	1.513
22.20	1.507	116.60	1.535
25.40	1.540	117.20	1.519
26.20	1.505	119.70	1.525
27.10	1.530	121.40	1.595
30.20	1.503	122.70	1.546
43.70	1.523	124.90	1.563
44.70	1.551	125.70	1.524
46.20	1.517	128.70	1.528
46.70	1.555	129.20	1.543
47.70	1.510	131.20	1.548
49.20	1.540	132.20	1.539
62.40	1.577	133.50	1.510
62.50	1.538	135.20	1.518
63.00	1.576	136.90	1.530
63.70	1.519	138.70	1.530
65.20	1.539	138.90	1.550
67.70	1.540	139.70	1.550
72.70	1.545	141.20	1.521
73.00	1.510	142.70	1.519
73.30	1.535	143.80	1.545
73.50	1.505	144.60	1.519
75.80	1.531	145.00	1.556
78.20	1.518	145.70	1.523
81.30	1.534	146.50	1.550
81.80	1.520		

Core section	Interval (cm)	Depth (mbsf)	Thermal conductivity (W/m/°C)
Hole 663B			
1-2	100	2.50	1.0290
1-3	100	4.00	0.9840
1-4	110	5.60	0.8780
1-5	100	7.00	1.0710
1-6	100	8.50	0.7610
2-2	100	11.84	1.0420
2-3	100	13.34	0.9670
2-4	100	14.84	0.9890
2-5	100	16.34	0.9190
2-6	100	17.84	0.9520
3-2	100	21.48	0.9270
3-3	100	22.98	0.9850
3-4	100	24.48	1.0250
3-5	100	25.98	0.9360
3-6	100	27.48	1.0000
4-2	100	30.95	0.9840
4-3	100	32.45	1.0490
4-4	100	33.95	1.0660
4-5	100	35.43	1.0490
4-6	80	36.73	1.1810

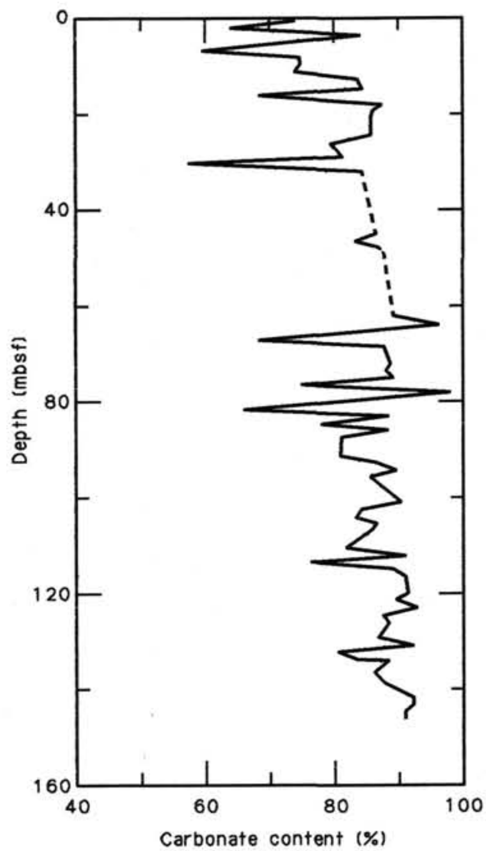

Figure 16. Calcium carbonate profile for Hole 663A.

Seismic unit 2: 0.05–0.08 s, a finely layered unit, with two or three acoustic returns over a very short depth interval. In a second seismic record obtained on the *JOIDES Resolution* during Leg 108, this layer pinches out to the northeast over a basement high.

Seismic unit 3: 0.08–0.20 s, a moderately reflective and partly transparent unit, with relatively flat-lying layering. In the record shown in Figure 18, this unit extends to just below the bottom of the cored interval (152 mbsf). Below that level, the evenly spaced layering continues below unit 3 but gives a much weaker acoustic return. In other Leg 108 records across Site 662, reflectivity is more pronounced in the top 0.03 s of this unit.

We used a mean sound velocity of 760 m/s for the entire sediment section at Site 663 (see "Physical Properties" section, this chapter) to evaluate correlations of both seismic and lithologic units (see "Lithostratigraphy and Sedimentology" section, this chapter; Fig. 18). Seismic unit 1 is an artifact. The top of seismic unit 2 (at a calculated depth of 38 mbsf) is a little deeper than the depth of the top of the first slump cored at 33 mbsf. The boundary between seismic units 2 and 3 (at a calculated depth of 61 mbsf) correlates with the top of a large slump cored at 62 mbsf. The bottom of seismic unit 3 (at a calculated depth of 152 mbsf) occurs just at the limit of the interval cored at Site 663, but decreased reflectivity at this level could reflect in part the weaker $CaCO_3$ variations below 140 mbsf.

We wish to warn those attempting more-detailed correlations—another *JOIDES Resolution* line that crossed the location of Site 663 during our survey showed some differences from the line shown in Figure 18. The major break in seismic character occurred at 0.12 s, or at a calculated depth of 91 mbsf. No cored unit corresponds precisely to this level, although the largest slump spanned the interval from 79 to 97 mbsf. This dis-

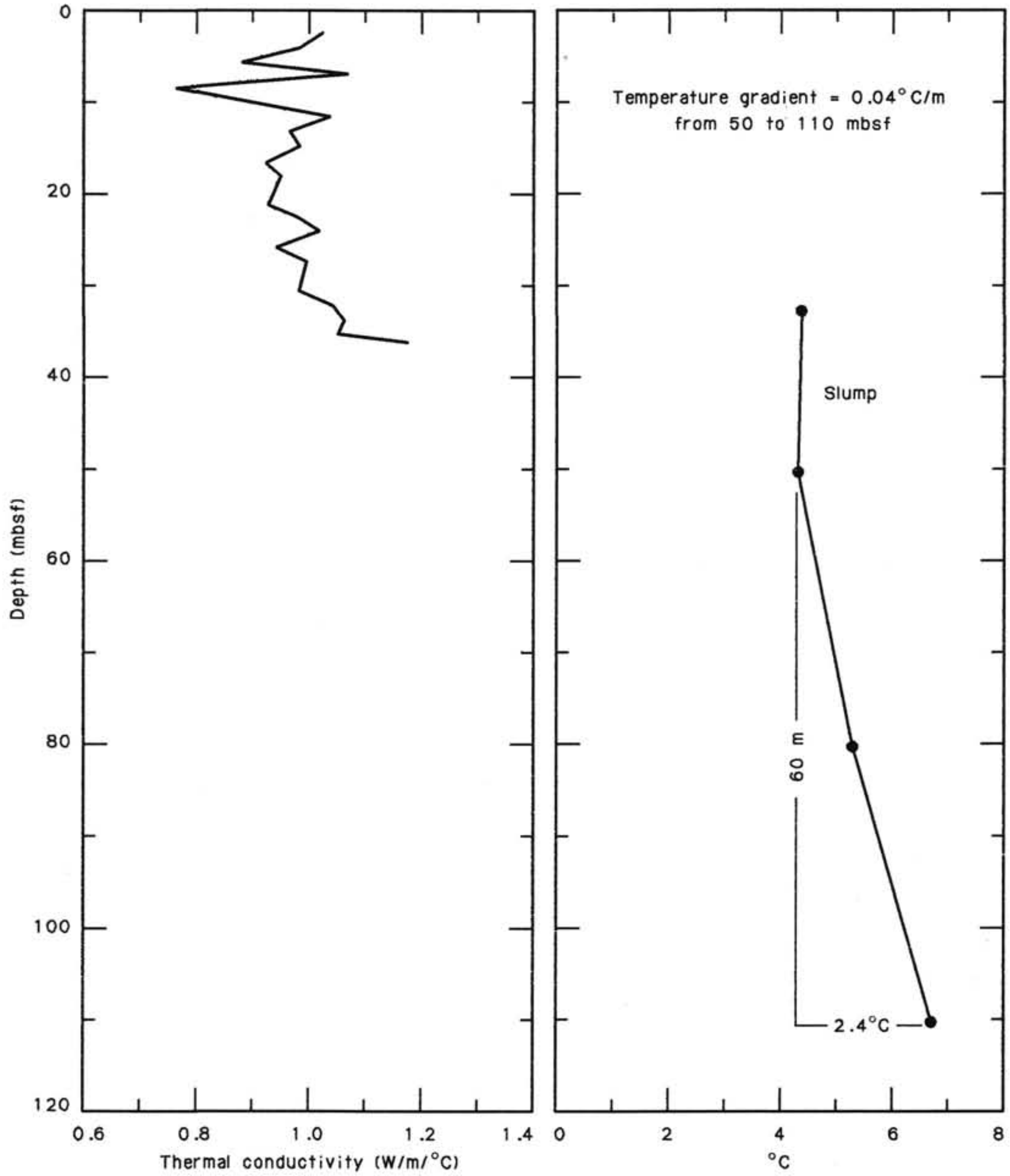

Figure 17. Thermal-conductivity and *in-situ*-temperature profiles for Hole 663B.

agreement in the character of seismic lines over the same site argues against accepting as definitive the correlations shown in Figure 19.

COMPOSITE-DEPTH SECTION

As at Site 662, Site 663 contains a rapidly deposited pelagic section interrupted by several slump units. In Figure 19, depths below seafloor of five slumps are plotted relative to those sections marked by pelagic deposition. The ages of biostratigraphic-datum levels in the pelagic intervals are shown by triangles (information from "Biostratigraphy" section, this chapter).

We attempted to correlate these pelagic sections between Holes 663A and 663B. However, no useful paleomagnetic-susceptibility data existed for this purpose, nor did *P*-wave data appear suitable. Thus, we based these correlations on $CaCO_3$ layering visible in core photographs.

Table 8 shows the correlative levels that we used as a pathway to produce a continuous composite-depth section within several separate intervals of pelagic deposition in Holes 663A and 663B. Our composite-depth section was compiled by using a short sequence in Hole 663B to span core-break gaps in the Hole 663A record.

The first correlated interval spanned the pelagic sequence (0–33.1 mbsf) in the top four cores at each hole and ended at the top of a sequence of slumps (Table 8 and Fig. 19). This interval spans approximately the last 0.95 Ma. Within the underlying complex of slumps between 33.1 and 98.2 mbsf, only one correlation was evident in the photographs—Cores 108-663A-9H and -663B-9H within the small pelagic interval between 72.5 and 79 mbsf. This link is not listed in Table 8 because it does not span core breaks in either hole. Possible correlations between Cores 108-663A-9H and -663B-8H also were suggested by the layering in the photographs, but these were not definitive. Future shore-based studies will be required to establish correlations for spanning the core break between Cores 108-663B-8H and -663B-9H.

The next interval in which correlations were possible began

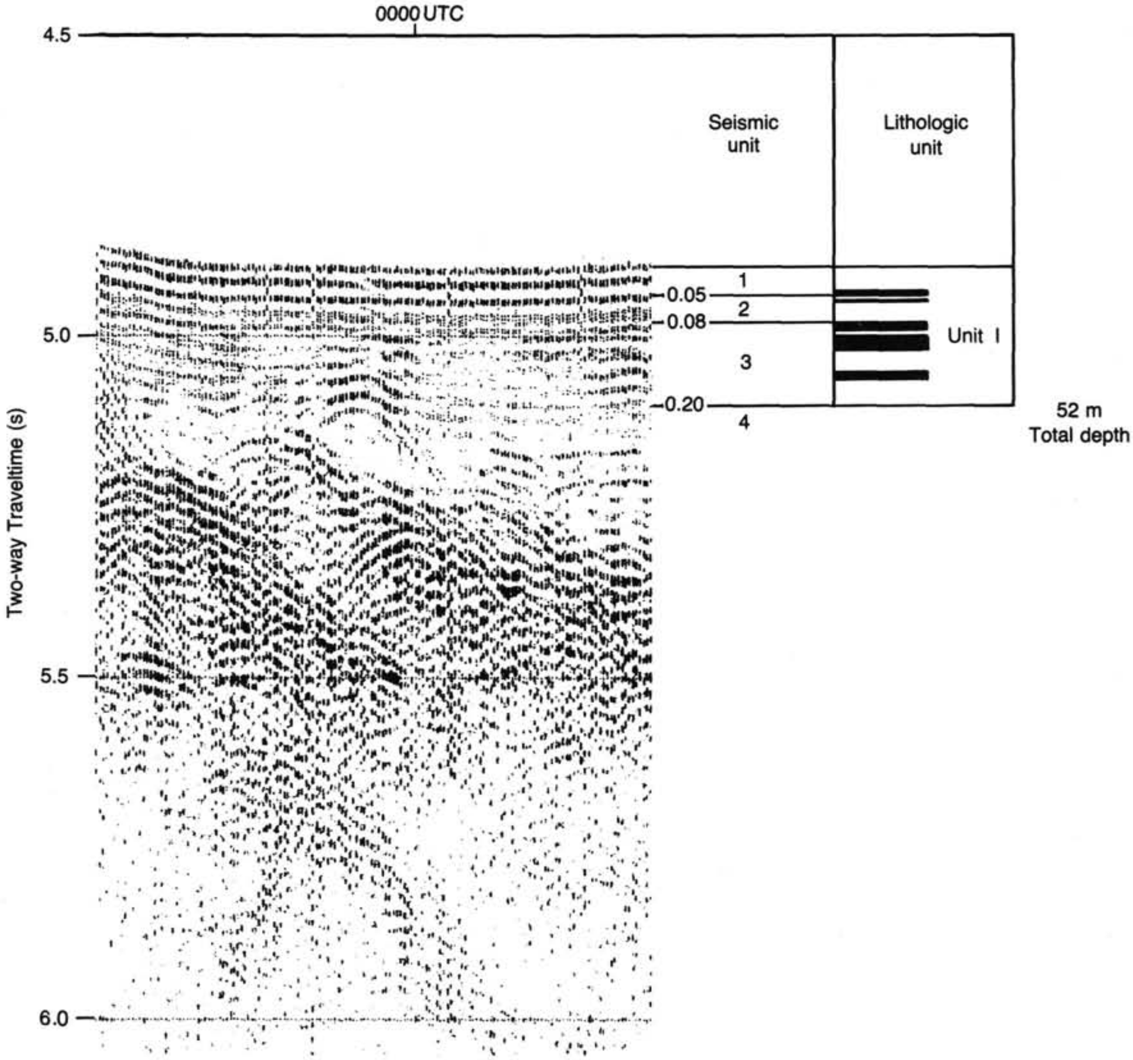

Figure 18. Possible relationship of seismic units and slumps in lithologic Unit I. Slumps are shown in black.

just below the slump in Cores 108-663A-12H and -663B-12H at about 104.7 mbsf, and extended to Cores 108-663A-13H and -663B-13H just above the slump at 119.4–129 mbsf (Table 8). This 14.6-m interval spans at least 400,000 yr of time (Fig. 19).

The final interval extended from Cores 108-663A-15H and -663B-15H just below the bottom of a large slump to Core 108-663A-16H just above a small slump at the bottom of the cored interval at Site 663 (Table 8 and Fig. 19). This 19.62-m interval spans at least 40,000 yr (Fig. 19).

For each interval of confirmed between-hole correlation (except the top one), we used the listed ODP depth below seafloor of the top part of the longest section of good core as the best available reference point for beginning the next composite-depth section.

Discussion

As at Site 662, when the slumps at Site 663 are removed from the downhole-depth sequence, the remaining biostratigraphic-datum levels plotted on an age-depth curve suggest that the pelagic sequence is essentially continuous and complete (see "Sediment-Accumulation Rates" section, this chapter). This finding suggests that the slumps were inserted as extra sediment into a mostly undisturbed pelagic section. It further suggests that various discrete segments of pelagic sediment for which we have provided between-hole correlations may hold much of the late Pliocene and Pleistocene records for this region.

Site 663 was chosen in an attempt to core those sequences interrupted by slumps at Site 662. In Figure 20, we show the ages of the slumps at the two sites plotted vs. time. In general, the slumps at Site 663 predate those at Site 662. Thus, the record before 1.25 Ma is best studied at Site 662, and that after 0.95 Ma is best studied at Site 663. The only part of the last 3.55 Ma in which slump-related disturbances may preclude assembling a complete composite-depth record from these two sites is the interval between 0.95 and 1.25 Ma, but it may be possible to switch back and forth between sites in this interval to obtain a complete sequence, as shown in Figure 20. Whether this strategy will work depends partly on the exact ages of the slumps, especially those with estimated ages of 1.2 and 1.1 Ma. Much also depends on the exact extent of deformation in the pelagic sediments below the slumps. Detailed shore-based studies will be required to resolve this problem.

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Table 8. Composite-depth sections between Holes 663A and 663B.

Hole 663A interval (cm)	Hole 663B interval (cm)	Composite depth (mbsf)
1H-1, 0	—	0
[a]1H-2, 45	1H-2, 127	1.95
2H-2, 20	1H-5, 95	6.13
2H-7, 30	2H-4, 98	13.73
3H-1, 40	2H-5, 44	14.69
3H-7, 30	3H-3, 95	23.59
4H-1, 42	3H-4, 115	25.29
4H-6, 75	4H-3, 80	33.12
—	12H-1, 20	104.70
13H-1, 42	12H-4, 11	109.11
13H-6, 20	13H-2, 103	116.39
—	13H-4, 100	119.36
15H-1, 0	—	128.2
15H-6, 110	15H-3, 110	136.8
16H-1, 70	15H-5, 52	139.22
16H-7, 30	—	147.82

[a] This correlation is approximate and needs refining with shore-based $CaCO_3$ analyses.

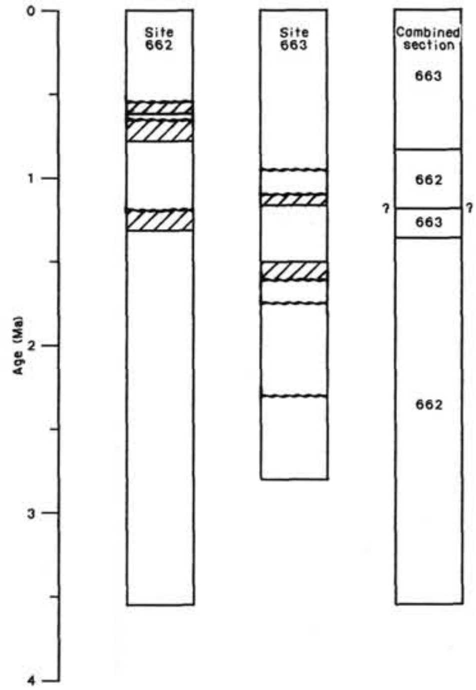


Figure 20. Comparison of timing of slumps (dark wavy lines) with intervals of pelagic deposition (white) at Sites 662 and 663. Diagonal lines mark pelagic intervals slightly disrupted by slumps. Column to right indicates the optimal combination of sections from the two sites for assembling the least disturbed pelagic sequence. A break in continuity may occur near 1.2 Ma.

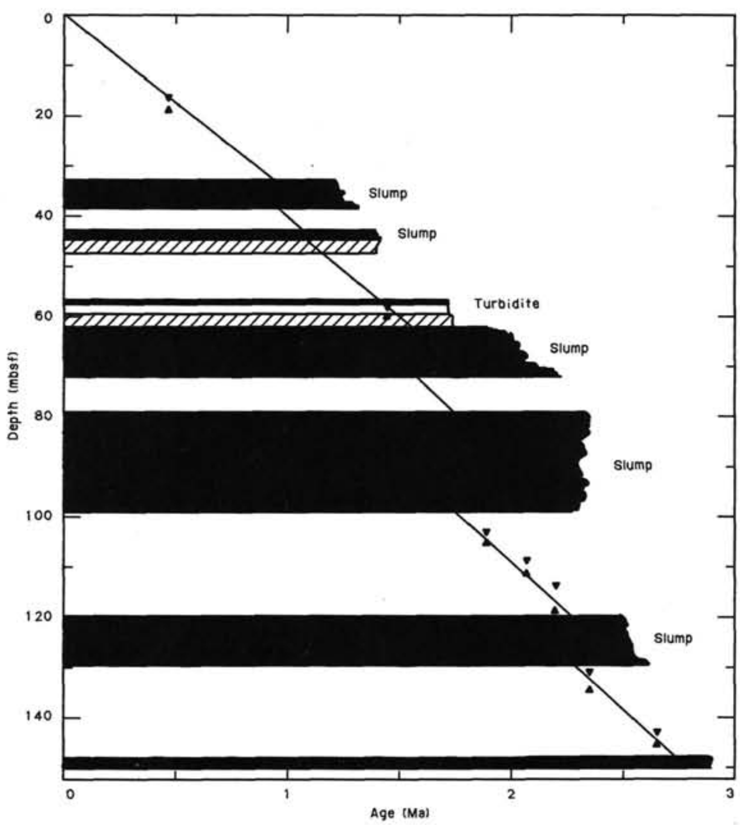
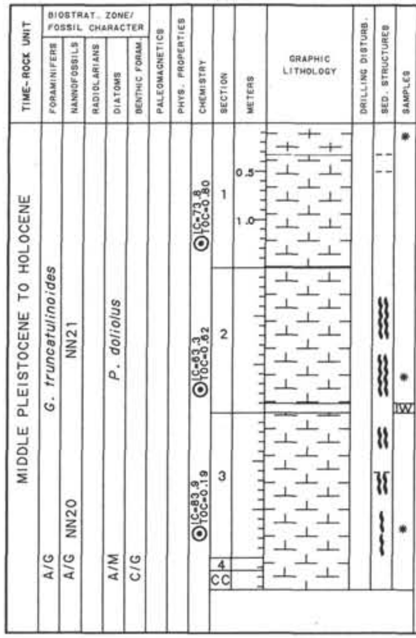


Figure 19. Age-depth curve for Site 663. Black layers are gravity-deposited sediments; white layers indicate pelagic deposition; diagonal pattern indicates slight deformation (tilting) of pelagic sediments. Age-depth biostratigraphic control points are shown by triangles.

SITE 663 HOLE A CORE 1 H CORED INTERVAL 3697.6-37.002.3 mbsl; 0-4.7 mbsf



LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING FORAMINIFER-NANNOFOSSIL OOZE; SILICEOUS-BEARING FORAMINIFER-BEARING NANNOFOSSIL OOZE; and CLAY-BEARING, SILICEOUS-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE

Siliceous-bearing, foraminifer-nannofossil ooze, pale olive (5Y 6/3) in Section 1, 0–35 cm.

Siliceous-bearing, foraminifer-bearing nannofossil ooze, olive-gray, light olive-gray, and gray (10Y 4/2; 5Y 5/2, 6/2, 6/1) in Section 1, 35 cm, and Section 3, 55 cm.

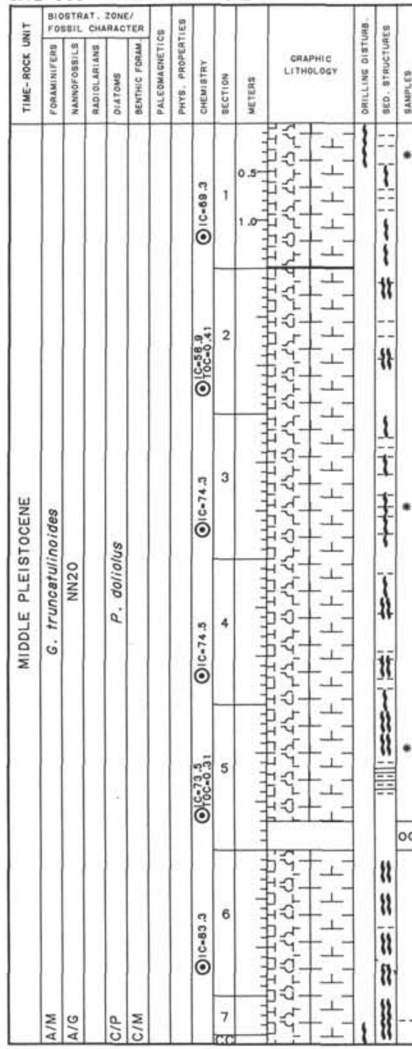
Clay-bearing, siliceous-bearing, foraminifer-bearing nannofossil ooze, light gray (5Y 7/1) in Section 3, 55 cm, through CC. Weak to moderate bioturbation; minor void in Section 1, 147–150 cm.

SMEAR SLIDE SUMMARY (%):

	1, 20 D	2, 120 D	3, 125 D
TEXTURE:			
Sand	30	25	10
Silt	30	25	15
Clay	40	50	75
COMPOSITION:			
Quartz	—	—	5
Clay	—	—	15
Accessory Minerals	5	10	5
Foraminifers	25	20	10
Nannofossils	50	50	45
Diatoms	10	10	10
Radiolarians	10	10	10

Chemistry: IC here refers to weight % $CaCO_3$.

SITE 663 HOLE A CORE 2 H CORED INTERVAL 3702.3-3711.8 mbsl; 4.7-14.2 mbsf



LITHOLOGIC DESCRIPTION

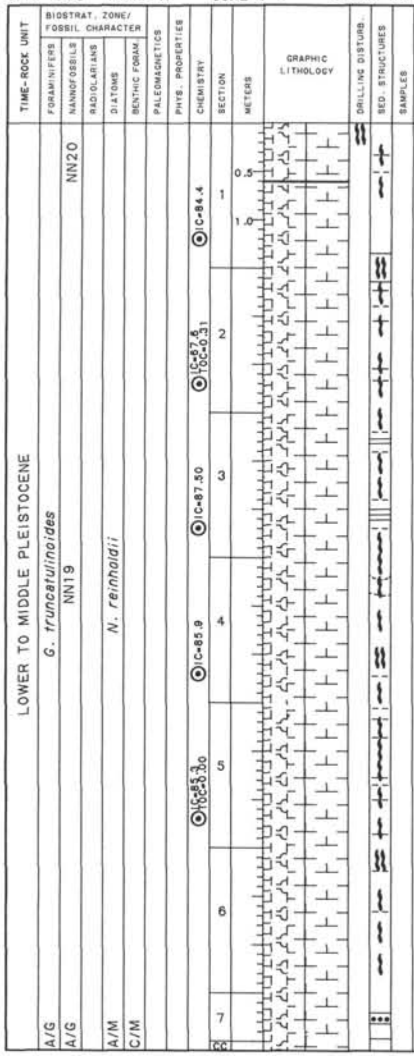
MUDDY, SILICEOUS NANNOFOSSIL OOZE, alternating with MUD-BEARING NANNOFOSSIL OOZE

Muddy, siliceous nannofossil ooze, light gray to gray (5Y 5/1, 6/1, 7/1), alternating with mud-bearing nannofossil ooze, white (5Y 8/1, 7.5YR 8/0); microlaminations in Section 5, 64–83 cm; moderate bioturbation throughout. Minor void in Section 1, 144–150 cm.

SMEAR SLIDE SUMMARY (%):

	1, 30 D	3, 100 D	5, 50 D
TEXTURE:			
Sand	5	5	5
Silt	20	15	15
Clay	75	80	80
COMPOSITION:			
Quartz	10	5	10
Clay	10	15	5
Accessory Minerals	10	10	5
Foraminifers	—	5	5
Nannofossils	45	35	70
Diatoms	15	15	2
Radiolarians	10	15	3

SITE 663 HOLE A CORE 3 H CORED INTERVAL 3711.8-3721.3 mbsl; 74.2-23.7 mbsf

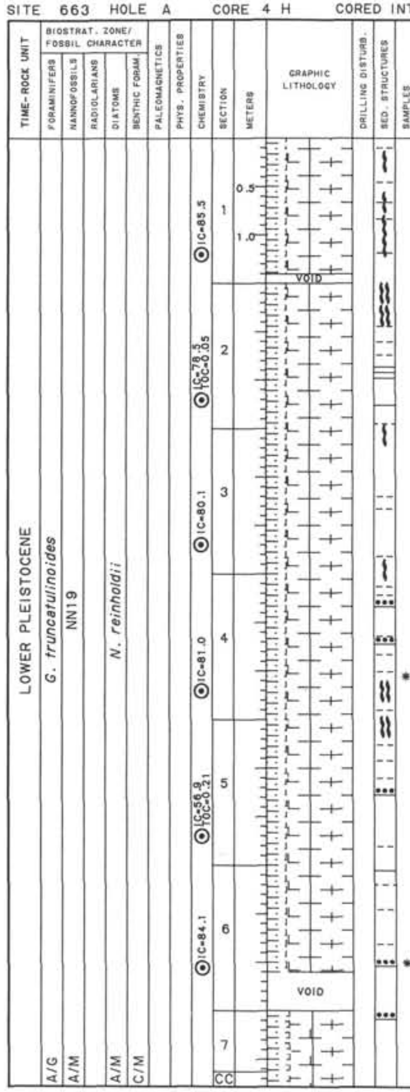


LITHOLOGIC DESCRIPTION

MUDDY, SILICEOUS NANNOFOSSIL OOZE, alternating with MUD-BEARING NANNOFOSSIL OOZE

Muddy, siliceous nannofossil ooze, light gray to gray (5Y 5/1, 6/1, 7/1), alternating with mud-bearing nannofossil ooze, white (5Y 7/1, 8/1; 7.5YR 8/0), moderate bioturbation; *Zoophycus* burrows common; sandy turbidite in Section 7. Minor void in Section 1, 60–63 cm.

SITE 663 HOLE A CORE 4 H CORED INTERVAL 3721.3-3730.8 mbsl; 23.7-33.2 mbsf



LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE alternating with SILICEOUS-BEARING, MUDDY NANNOFOSSIL OOZE

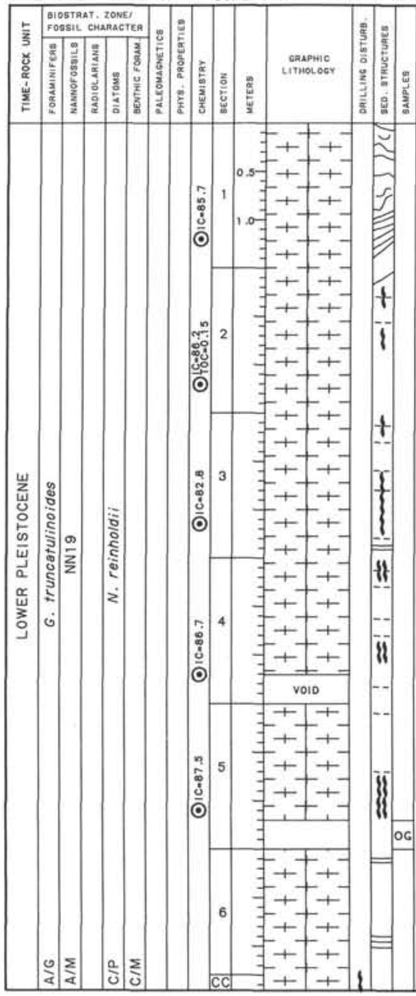
Siliceous-bearing, foraminifer-bearing nannofossil ooze, white (5Y 8/1, 7.5YR 8/0), alternating with siliceous-bearing, muddy nannofossil ooze, gray to light gray (5Y 5/1, 7/2); moderate bioturbation; blue-black laminations in Section 2, 90–100 cm, and Section 4, 50 and 100 cm; turbidites in Section 4, 30 and 75 cm; Section 5, 80 cm; Section 6, 90 cm; all of Section 7, and CC.

SMEAR SLIDE SUMMARY (%):

	4, 110 D	6, 110 D
TEXTURE:		
Sand	10	10
Silt	35	20
Clay	55	70
COMPOSITION:		
Quartz	2	—
Clay	5	20
Accessory Minerals	5	5
Foraminifers	25	10
Nannofossils	48	55
Diatoms	15	10
Radiolarians		

CORE 5H NO RECOVERY

SITE 663 HOLE A CORE 6 H CORED INTERVAL 3740.3-3749.8 mbsl; 42.7-52.2 mbsf



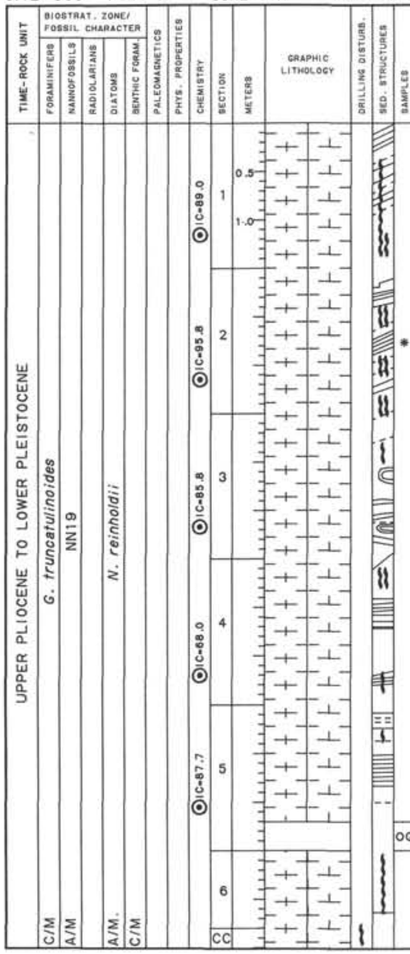
LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, CLAY-BEARING FORAMINIFER-NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING FORAMINIFER-NANNOFOSSIL OOZE

Siliceous-bearing, clay-bearing foraminifer-nannofossil ooze, gray, light gray, or light greenish-gray (5Y 6/1, 7/1; 5GY 7/2), alternating with siliceous-bearing foraminifer-nannofossil ooze, white (7.5YR 8/0); moderate bioturbation; slump structures from top of Section 1 through Section 2, 10 cm; microlaminations in Sections 3 and 6.

CORE 7 H NO RECOVERY

SITE 663 HOLE A CORE 8 H CORED INTERVAL 3759.3-3768.8 mbsl; 61.7-71.2 mbsf



LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, CLAY-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE and FORAMINIFER-NANNOFOSSIL OOZE to CLAY-BEARING FORAMINIFER-NANNOFOSSIL OOZE

Siliceous-bearing, clay-bearing, foraminifer-bearing nannofossil ooze, light gray (5Y 7/1, 7/2), alternating with foraminifer-nannofossil ooze to clay-bearing foraminifer-nannofossil ooze, white (5Y 8/1, 7.5YR 8/0); moderate bioturbation; slump structures in Sections 1, 3, and 5; several slide planes in Section 5, at 8, 24, and 85 cm.

SMEAR SLIDE SUMMARY (%):

	2, 80
	D
TEXTURE:	
Sand	20
Silt	30
Clay	50
COMPOSITION:	
Clay	15
Accessory Minerals	5
Foraminifers	30
Nannofossils	50
Diatoms	Tr
Radiolarians	Tr
Sponge spicules	Tr

SITE 663 HOLE A CORE 9 H CORED INTERVAL 3768.8-3778.3 mbsl; 71.2-80.7 mbsf

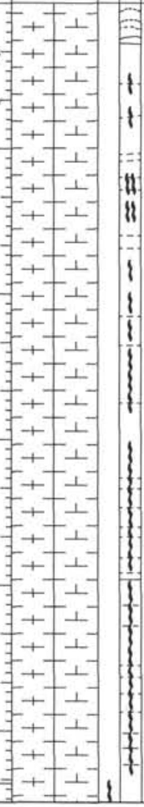
TIME-ROCK UNIT: UPPER PLIOCENE

BIOSTRAT. ZONE/FOSSIL CHARACTER: FORAMINIFERS PL6 A/G; NANNOFOSSILS NN19 A/M; DIATOMS *N. reinholdii* C/M; BENTHIC FORAM. C/M

CHEMISTRY: IC=88.6 (Section 1); IC=87.5 (Section 2); IC=89.2 (Section 3); IC=74.1 (Section 4); IC=97.9 (Section 5)

SECTION: 1, 2, 3, 4, 5, 6, CC

METERS: 0.5, 1.0



LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, CLAY-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE alternating with FORAMINIFER-NANNOFOSSIL OOZE to CLAY-BEARING FORAMINIFER-NANNOFOSSIL OOZE

Siliceous-bearing, clay-bearing, foraminifer-bearing nannofossil ooze, light gray (5Y 7/1, 7/2), alternating with foraminifer-nannofossil ooze to clay-bearing foraminifer-nannofossil ooze, white (5Y 8/1, 7.5YR 8/0); moderate bioturbation; some folding or slumping evident in Section 1.

SITE 663 HOLE A CORE 10 CORED INTERVAL 3778.3-3787.8 mbsl; 80.7-90.2 mbsf

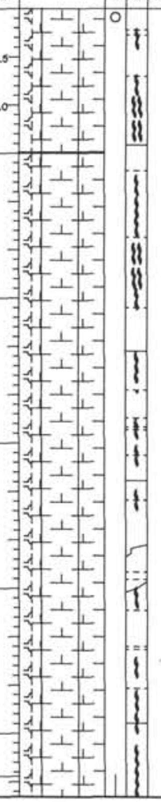
TIME-ROCK UNIT: UPPER PLIOCENE

BIOSTRAT. ZONE/FOSSIL CHARACTER: FORAMINIFERS PL6 A/G; NANNOFOSSILS NN19 A/M; DIATOMS *N. reinholdii* C/P; BENTHIC FORAM. C/M

CHEMISTRY: IC=65.6 (Section 1); IC=88.3 (Section 2); IC=77.4 (Section 3); IC=88.2 (Section 4); IC=80.7 (Section 5)

SECTION: 1, 2, 3, 4, 5, 6, CC

METERS: 0.5, 1.0

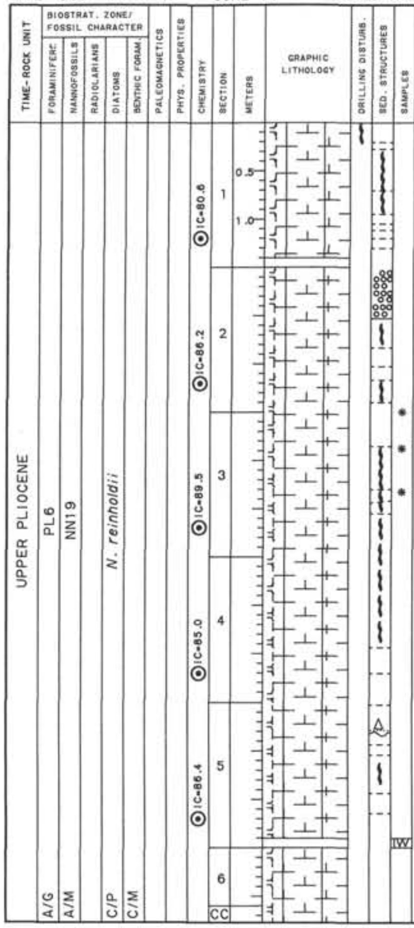


LITHOLOGIC DESCRIPTION

FORAMINIFER-NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING, SILICEOUS NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE

Foraminifer-nannofossil ooze, white (10Y 8/1), alternating with foraminifer-bearing siliceous nannofossil ooze, gray to light olive-gray (5Y 6/1, 6/2), alternating with siliceous-bearing, foraminifer-bearing nannofossil ooze; moderate bioturbation with slide (slump?) planes in Sections 4 and 5. Minor void in Section 1, 147–150 cm.

SITE 663 HOLE A CORE 11 CORED INTERVAL 3787.8-3292.3 mbsl; 90.2-99.7 mbsf



LITHOLOGIC DESCRIPTION

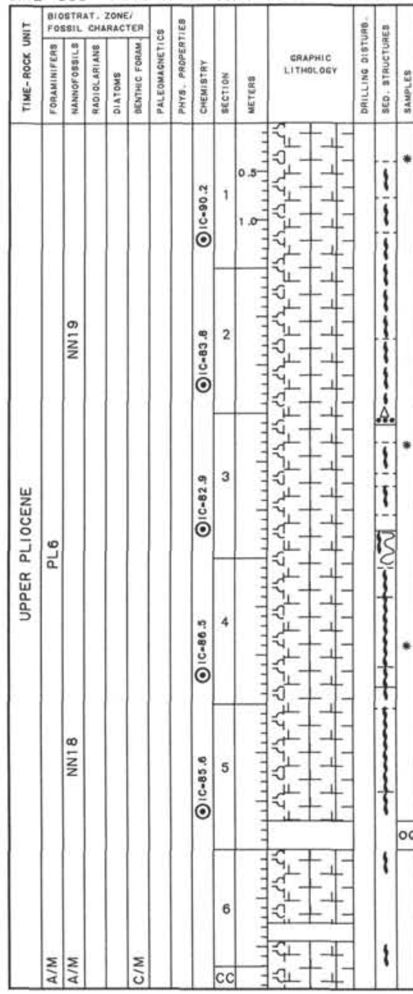
FORAMINIFER-NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING, SILICEOUS NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE

Foraminifer-nannofossil ooze, white (10Y 8/1), alternating with foraminifer-bearing, siliceous-bearing nannofossil ooze, gray to light olive-gray (5Y 6/1, 6/2), and siliceous foraminifer-bearing nannofossil ooze; black and green microlaminations and mottling; debris flow in Section 2, 0–56 cm, and Section 7, 35 cm, through CC; foraminifer sandy turbidite with graded bedding in Section 5, 0–29 cm.

SMEAR SLIDE SUMMARY (%):

	3, 4 D	3, 33 D	3, 86 D
TEXTURE:			
Sand	10	10	25
Silt	25	35	10
Clay	65	55	65
COMPOSITION:			
Clay	—	Tr	—
Accessory Minerals	Tr	—	—
Foraminifers	15	15	50
Nannofossils	65	55	60
Diatoms	Tr	10	5
Radiolarians	10	10	5
Sponge spicules	5	10	Tr

SITE 663 HOLE A CORE 12 H CORED INTERVAL 3797.3-3806.8 mbsl; 99.7-109.2 mbsf



LITHOLOGIC DESCRIPTION

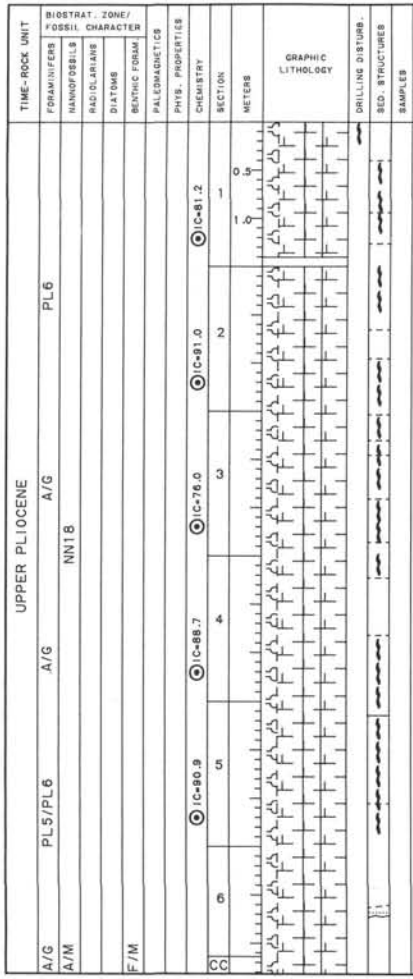
FORAMINIFER-BEARING, SILICEOUS NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING, SILICEOUS-BEARING NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING NANNOFOSSIL OOZE

Foraminifer-bearing, siliceous nannofossil ooze, olive-gray (5Y 5/2), alternating with foraminifer-bearing, siliceous-bearing nannofossil ooze, gray (10Y 6/1), and foraminifer-bearing, nannofossil ooze, white (2.5Y 8/0); weak to moderate bioturbation with slump in Section 3, 125–140 cm, and graded bedding in Section 3, 12 cm.

SMEAR SLIDE SUMMARY (%):

	1, 28 D	3, 27 D	4, 83 D
TEXTURE:			
Sand	5	5	5
Silt	35	25	20
Clay	60	70	75
COMPOSITION:			
Quartz	Tr	—	—
Foraminifers	10	10	15
Nannofossils	55	65	75
Diatoms	15	10	
Radiolarians	15	10	10
Sponge spicules	Tr	5	
Plant Debris	—	Tr	—

SITE 663 HOLE A CORE 13 H CORED INTERVAL 3806.8-3816.3 mbsl; 109.2-118.7 mbsf

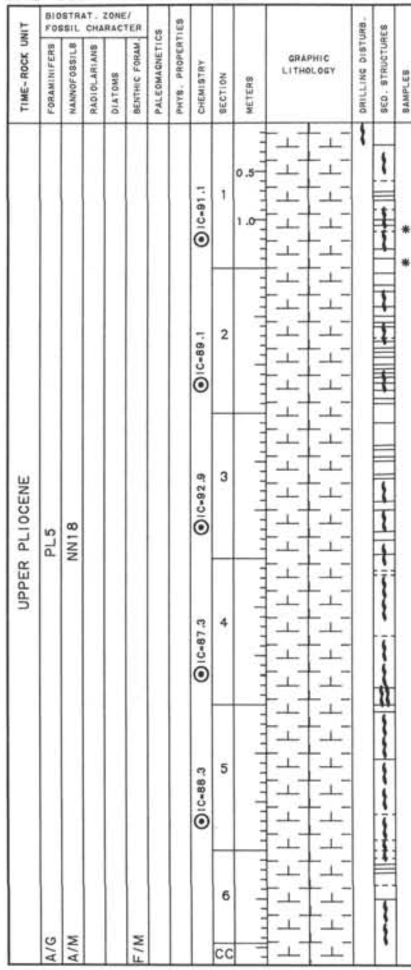


LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING, SILICEOUS NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING, SILICEOUS-BEARING NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING NANNOFOSSIL OOZE.

Foraminifer-bearing, siliceous nannofossil ooze, olive-gray (5Y 5/2), alternating with foraminifer-bearing, siliceous-bearing nannofossil ooze, gray (10Y 6/1), and foraminifer-bearing nannofossil ooze, white (2.5Y 8/0); weakly bioturbated; black, green and purple microlaminations and mottles. Section 6, 70 cm, contains a foraminifer sandy turbidite.

SITE 663 HOLE A CORE 14 H CORED INTERVAL 3816.3-3825.8 mbsl; 118.7-128.2 mbsf



LITHOLOGIC DESCRIPTION

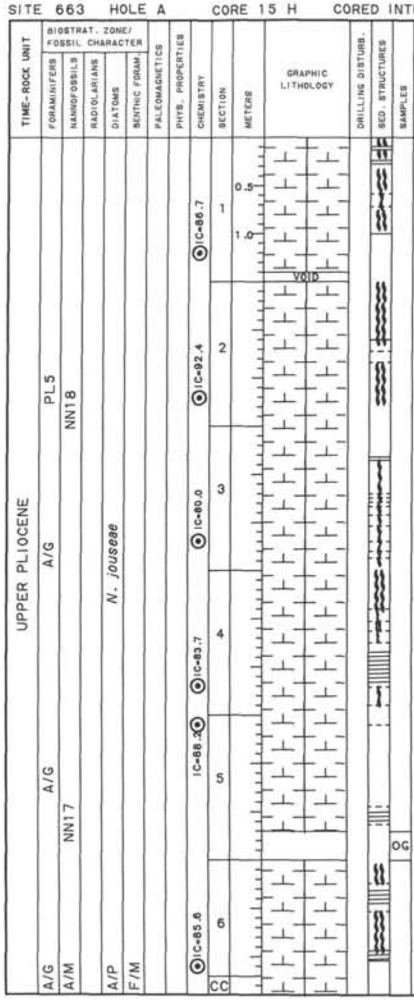
SILICEOUS-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING NANNOFOSSIL OOZE

Siliceous-bearing foraminifer-bearing nannofossil ooze, light gray (5Y 7/2), alternating with foraminifer-bearing nannofossil ooze, white (5Y 8/1); weakly bioturbated throughout; purple and green mottles and microlaminations dipping approximately 10°.

SMEAR SLIDE SUMMARY (%):

	1, 102 M	1, 145 D
TEXTURE:		
Sand	—	—
Silt	20	25
Clay	80	75
COMPOSITION:		
Foraminifers	10	20
Nannofossils	80	75
Diatoms	2	—
Radiolarians	8	5
Sponge spicules	Tr	Tr

SITE 663 HOLE A CORE 15 H CORED INTERVAL 3825.8-3835.3 mbsl; 128.2-137.7 mbsf

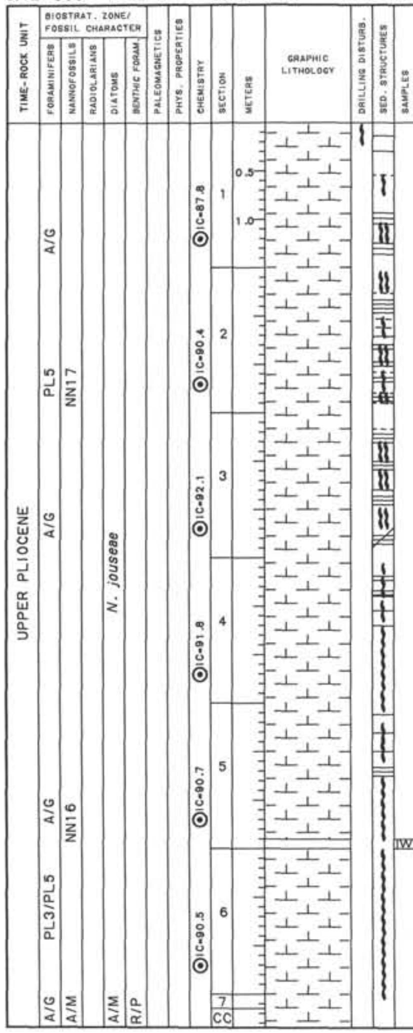


LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING NANNOFOSSIL OOZE

Siliceous-bearing, foraminifer-bearing nannofossil ooze, light gray (5Y 7/2), alternating with foraminifer-bearing nannofossil ooze, white (5Y 8/1); moderately bioturbated; purple microlaminations common throughout core.

SITE 663 HOLE A CORE 16 H CORED INTERVAL 3835.3-3844.8 mbsl; 137.7-147.2 mbsf



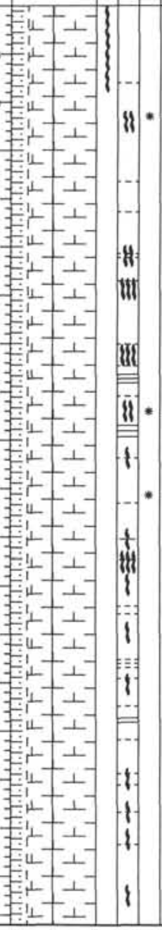
LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING NANNOFOSSIL OOZE

Siliceous-bearing, foraminifer-bearing nannofossil ooze, light gray (5Y 7/2), alternating with foraminifer-bearing nannofossil ooze, white (5Y 8/1); moderately bioturbated; purple, grayish-green, and black microlaminations common throughout core; microfaulting common in Sections 2 and 3.

SITE 663 HOLE B CORE 1 H CORED INTERVAL 3697.4-3706.9 mbsl; 0-9.5 mbsf

TIME-ROCK UNIT	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	PALEOMAGNETICS	PHYS. PROPERTIES	CHEMISTRY	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURB.	SED. STRUCTURES	SAMPLES
PLEISTOCENE TO HOLOCENE	*G. truncatulinoides* A/G	NN20-21 A/G		*N. reinholdii* to *P. doliolus* A/M				1–7, CC	0.5, 1.0				



LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING, SILICEOUS-BEARING NANNOFOSSIL OOZE, alternating with MUDDY NANNOFOSSIL OOZE and SILICEOUS-BEARING, FORAMINIFER-BEARING, MUDDY NANNOFOSSIL OOZE

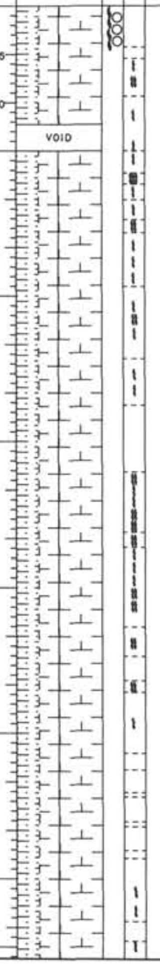
Foraminifer-bearing, siliceous-bearing nannofossil ooze, white (5Y 8/1) to light gray (5Y 7/1), alternating with muddy nannofossil ooze and siliceous-bearing, foraminifer-bearing, muddy nannofossil ooze, gray (5Y 6/1, 5/1); weak to moderate bioturbation with black and green microlaminations throughout core.

SMEAR SLIDE SUMMARY (%):

	1, 130 D	3, 136 D	4, 66 D
TEXTURE:			
Sand	10	10	20
Silt	25	20	20
Clay	65	70	60
COMPOSITION:			
Quartz	10	5	5
Clay	10	5	15
Accessory Minerals	10	5	10
Foraminifers	5	10	15
Nannofossils	60	60	40
Diatoms	2	10	10
Radiolarians	3	5	—
Sponge spicules	Tr	—	<5

SITE 663 HOLE B CORE 2 H CORED INTERVAL 3706.9-3716.4 mbsl; 9.5-19.0 mbsf

TIME-ROCK UNIT	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	PALEOMAGNETICS	PHYS. PROPERTIES	CHEMISTRY	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURB.	SED. STRUCTURES	SAMPLES
MIDDLE PLEISTOCENE	*G. truncatulinoides* A/G	NN20-21 / NN19 A/G		*N. reinholdii* A/M				1–7, CC	0.5, 1.0	VOID			

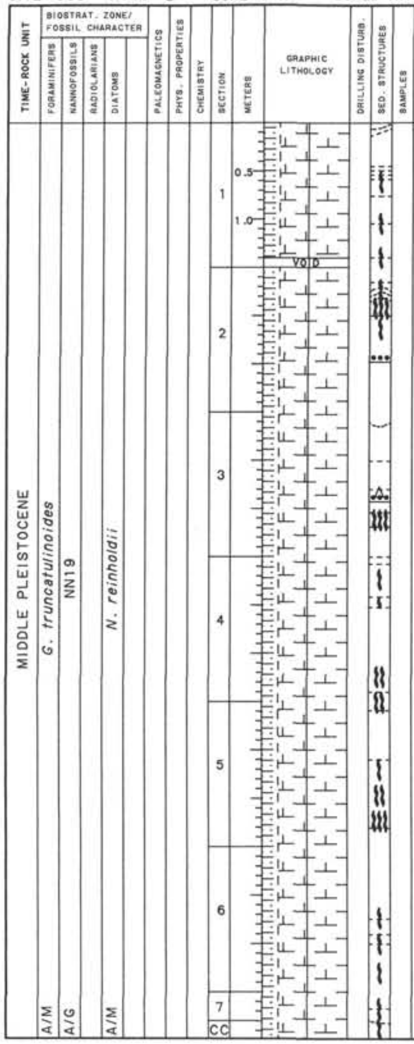


LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING, SILICEOUS-BEARING NANNOFOSSIL OOZE, alternating with MUDDY NANNOFOSSIL OOZE

Foraminifer-bearing, siliceous-bearing nannofossil ooze, white (7.5YR 8/0), alternating with muddy nannofossil ooze, gray to light gray (5Y 6/1, 7/1); weak to moderate bioturbation throughout; *Zoophycus*, *Chondrites*, and halo burrows present. Section 6 contains layers of fine scales.

SITE 663 HOLE B CORE 3 H CORED INTERVAL 3716.4-3725.9 mbsl; 19.0-28.5 mbsf

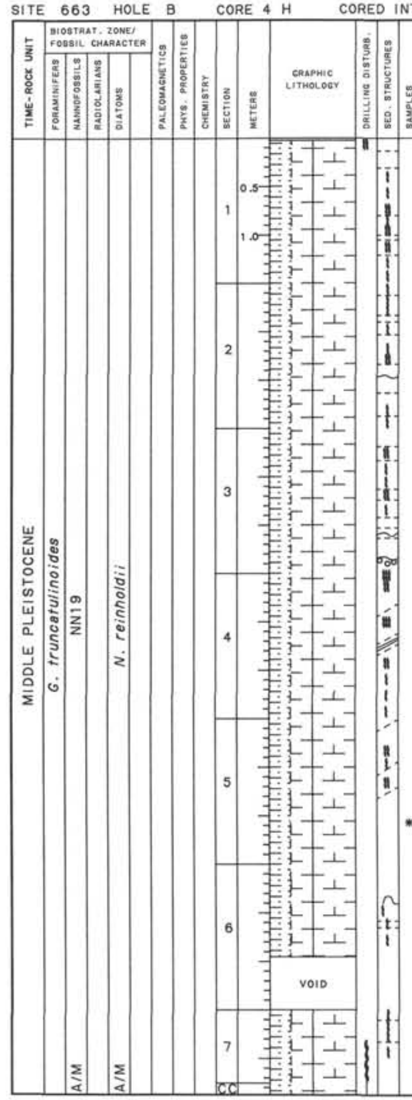


LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING, SILICEOUS-BEARING NANNOFOSSIL OOZE, alternating with MUDDY NANNOFOSSIL OOZE

Foraminifer-bearing, siliceous-bearing nannofossil ooze, white (5Y 8/1, 7.5YR 8/0), alternating with muddy nannofossil ooze, gray to light gray (5Y 6/1, 7/1); foraminifer sandy turbidites in Sections 2 and 3; weakly to moderately bioturbated throughout. Minor void in Section 1, 147–150 cm.

SITE 663 HOLE B CORE 4 H CORED INTERVAL 3725.9-3735.4 mbsl; 28.5-38.0 mbsf



LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING, SILICEOUS-BEARING NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING, MUDDY NANNOFOSSIL OOZE, and MUDDY NANNOFOSSIL OOZE

Foraminifer-bearing, siliceous-bearing nannofossil ooze, white (5Y 8/1, 7.5YR 8/0), alternating with foraminifer-bearing, muddy nannofossil ooze, gray to light gray (5Y 5/1, 6/1, 7/1); and muddy nannofossil ooze, gray to light gray (5Y 5/1, 6/1, 7/1); moderately bioturbated in Sections 1 through 3; foraminifer sandy turbidites in Sections 2 and 3. Beds strongly deformed (and perhaps overturned) in Sections 4 and 5. Minor void in Section 1, 0–8 cm.

SMEAR SLIDE SUMMARY (%):

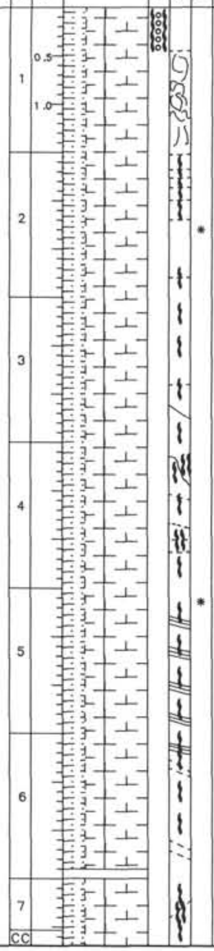
	5, 110 D
TEXTURE:	
Sand	10
Silt	20
Clay	70
COMPOSITION:	
Clay	20
Accessory Minerals	5
Foraminifers	15
Nannofossils	55
Diatoms	2
Radiolarians	3

SITE 663 HOLE B CORE 5 H CORED INTERVAL 3735.4-3744.9 mbsl; 38.0-47.5 mbsf

TIME-ROCK UNIT: LOWER TO MIDDLE PLEISTOCENE

BIOSTRAT. ZONE/FOSSIL CHARACTER: FORAMINIFERS: PL6/G. *truncatulinoides* A/M; NANNOFOSSILS: NN19 A/M; RADIOLARIANS; DIATOMS: *N. reinholdii* A/M

PALEOMAGNETICS | PHYS. PROPERTIES | CHEMISTRY | SECTION | METERS | GRAPHIC LITHOLOGY | DRILLING DISTURB. | SED. STRUCTURES | SAMPLES



LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING, MUDDY NANNOFOSSIL OOZE

Siliceous-bearing, foraminifer-bearing nannofossil ooze, white (5Y 8/1, 7.5YR 8/0), alternating with siliceous-bearing, muddy nannofossil ooze, gray, light gray, and light olive-gray (5Y 6/1, 7/1, 7/2). Beds strongly deformed in Sections 1, 4, 5, and 6; bioturbation weak throughout with typically *Chondrites* burrows.

SMEAR SLIDE SUMMARY (%):

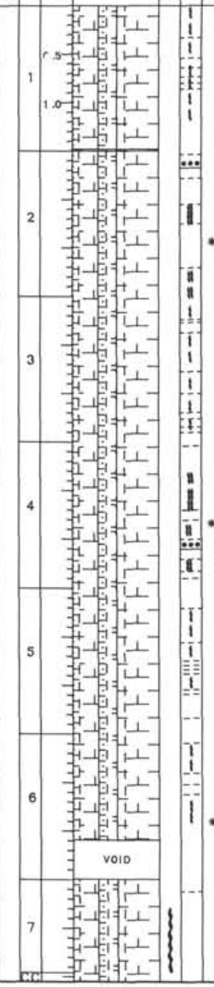
	2, 70 D	5, 20 D
TEXTURE:		
Sand	5	15
Silt	15	20
Clay	80	65
COMPOSITION:		
Quartz	10	5
Clay	20	—
Accessory Minerals	10	5
Foraminifers	Tr	10
Nannofossils	35	70
Diatoms	10	5
Radiolarians	5	5

SITE 663 HOLE B CORE 6 H CORED INTERVAL 3744.9-3754.4 mbsl; 47.5-57.0 mbsf

TIME-ROCK UNIT: LOWER PLEISTOCENE

BIOSTRAT. ZONE/FOSSIL CHARACTER: FORAMINIFERS: PL6 / G. *truncatulinoides* A/G; NANNOFOSSILS: NN19 A/M; RADIOLARIANS; DIATOMS: *N. reinholdii* A/P

PALEOMAGNETICS | PHYS. PROPERTIES | CHEMISTRY | SECTION | METERS | GRAPHIC LITHOLOGY | DRILLING DISTURB. | SED. STRUCTURES | SAMPLES



LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, MUD-BEARING FORMINIFER-NANNOFOSSIL OOZE, alternating with MUDDY, SILICEOUS NANNOFOSSIL OOZE, and FORAMINIFER-BEARING, SILICEOUS-BEARING, MUDDY NANNOFOSSIL OOZE

Siliceous-bearing, mud-bearing foraminifer-nannofossil ooze, white (7.5YR 8/0), alternating with muddy, siliceous nannofossil ooze, gray (10Y 6/1, 5Y 6/1).

Foraminifer-bearing, siliceous-bearing, muddy nannofossil ooze, greenish-gray (5GY 5/1, 6/1); moderate bioturbation; thin turbidites in Section 2, 10 cm, and Section 4, 100 cm. Minor void in Section 1, 144–150 cm.

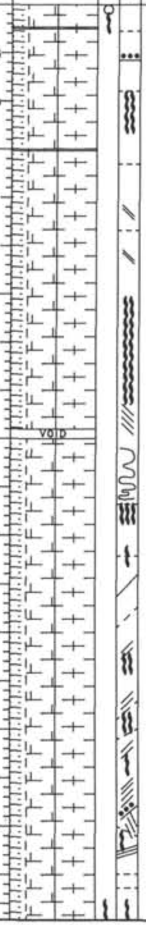
SMEAR SLIDE SUMMARY (%):

	2, 100 D	4, 80 D	6, 90 D
TEXTURE:			
Sand	25	10	10
Silt	15	15	15
Clay	60	75	75
COMPOSITION:			
Quartz	5	Tr	Tr
Clay	5	10	10
Accessory Minerals	5	15	15
Foraminifers	25	10	5
Nannofossils	50	50	45
Diatoms			
Radiolarians	10	15	25
Sponge spicules			

SITE 663 HOLE B CORE 7 H CORED INTERVAL 3754.4-3763.9 mbsl; 57.0-66.5 mbsf

TIME-ROCK UNIT	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	PALEOMAGNETICS	PHYS. PROPERTIES	CHEMISTRY	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURB.	SED. STRUCTURES	SAMPLES
LOWER PLEISTOCENE	PL6 C/M	NN19 A/M		*N. reinholdii* A/M				1, 2, 3, 4, 5, 6, 7, CC	0.5, 1.0	VOID			

BIOSTRAT. ZONE/ FOSSIL CHARACTER



LITHOLOGIC DESCRIPTION

MUD-BEARING, SILICEOUS-BEARING, FORAMINIFER-NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING, FORAMINIFER-BEARING, MUDDY NANNOFOSSIL OOZE

Mud-bearing, siliceous-bearing, foraminifer-nannofossil ooze, white (2.5Y 8/0), alternating with siliceous-bearing, foraminifer-bearing, muddy nannofossil ooze, light olive-gray (5Y 6/2).

Minor lithology: core features slump from middle of Section 2 to CC. A 30-cm turbidite present in Section 1, 30–60 cm. Minor voids in Section 1, 22–26 cm; Section 2, 0–4 cm; and Section 3, 146–150 cm.

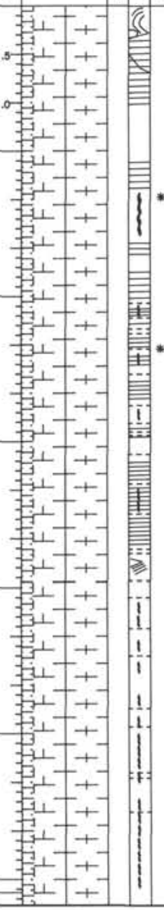
SMEAR SLIDE SUMMARY (%):

	5, 30 D	5, 90 D
TEXTURE:		
Sand	10	25
Silt	30	15
Clay	65	60
COMPOSITION:		
Quartz	5	—
Clay	25	5
Accessory Minerals	5	5
Foraminifers	15	25
Nannofossils	45	50
Diatoms		10
Radiolarians	15	5
Sponge spicules		—

SITE 663 HOLE B CORE 8 H CORED INTERVAL 3763.9-3773.4 mbsl; 66.5-76.0 mbsf

TIME-ROCK UNIT	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	PALEOMAGNETICS	PHYS. PROPERTIES	CHEMISTRY	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURB.	SED. STRUCTURES	SAMPLES
LOWER PLEISTOCENE	PL6 A/M	NN19 A/M		*N. reinholdii* A/M				1, 2, 3, 4, 5, 6, 7, CC	0.5, 1.0				* *

BIOSTRAT. ZONE/ FOSSIL CHARACTER



LITHOLOGIC DESCRIPTION

MUD-BEARING, FORAMINIFER-NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING, MUDDY NANNOFOSSIL OOZE

Mud-bearing, foraminifer-nannofossil ooze, white (7.5YR 8/0, 5Y 8/1), alternating with siliceous-bearing, muddy nannofossil ooze, light gray (5Y 7/2, 7/2). Beds slumped and deformed from top of Section 1 to base of Section 4; remainder of core weakly to moderately bioturbated.

SMEAR SLIDE SUMMARY (%):

	2, 50 D	3, 50 D
TEXTURE:		
Sand	25	10
Silt	15	15
Clay	60	75
COMPOSITION:		
Quartz	5	5
Clay	5	10
Accessory Minerals	10	10
Foraminifers	25	5
Nannofossils	50	55
Diatoms	5	15
Radiolarians		

SITE 663 HOLE B CORE 9 H CORED INTERVAL 3773.4-3782.9 mbsl; 76.0-85.5 mbsf

TIME-ROCK UNIT: LOWER PLEISTOCENE

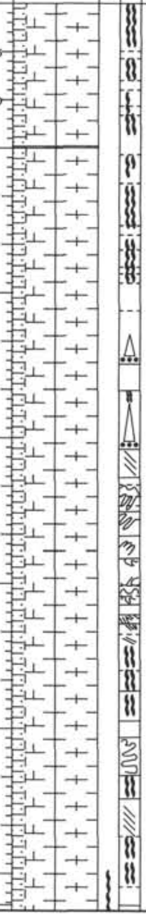
BIOSTRAT. ZONE/FOSSIL CHARACTER:
- FORAMINIFERS: PL6 — A/G
- NANNOFOSSILS: NN19 — A/M
- RADIOLARIANS: —
- DIATOMS: *N. reinholdii* — A/P

PALEOMAGNETICS | PHYS. PROPERTIES | CHEMISTRY

SECTION: 1, 2, 3, 4, 5, 6, 7

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY | DRILLING DISTURB. | SED. STRUCTURES | SAMPLES



LITHOLOGIC DESCRIPTION

MUD-BEARING, FORAMINIFER-NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING, MUDDY NANNOFOSSIL OOZE

Mud-bearing, foraminifer-nannofossil ooze, white (7.5YR 8/0, 5Y 8/1), alternating with siliceous-bearing, muddy nannofossil ooze, light gray (5Y 7/2). Two coarse-grained foraminifer turbidites (44×30 cm) present in Section 3. Sections 4 through 6 characterized by highly deformed and slumped bedding planes. Minor void in Section 1, 145–150 cm.

SITE 663 HOLE B CORE 10 H CORED INTERVAL 3782.9-3792.4 mbsl; 85.5-95.0 mbsf

TIME-ROCK UNIT: UPPER PLIOCENE TO LOWER PLEISTOCENE

BIOSTRAT. ZONE/FOSSIL CHARACTER:
- FORAMINIFERS: PL6 — A/M
- NANNOFOSSILS: NN19 — A/M
- RADIOLARIANS: —
- DIATOMS: *N. reinholdii* — A/P

PALEOMAGNETICS | PHYS. PROPERTIES | CHEMISTRY

SECTION: 1, 2, 3, 4, 5, 6, 7, CC

METERS: 0.5, 1.0

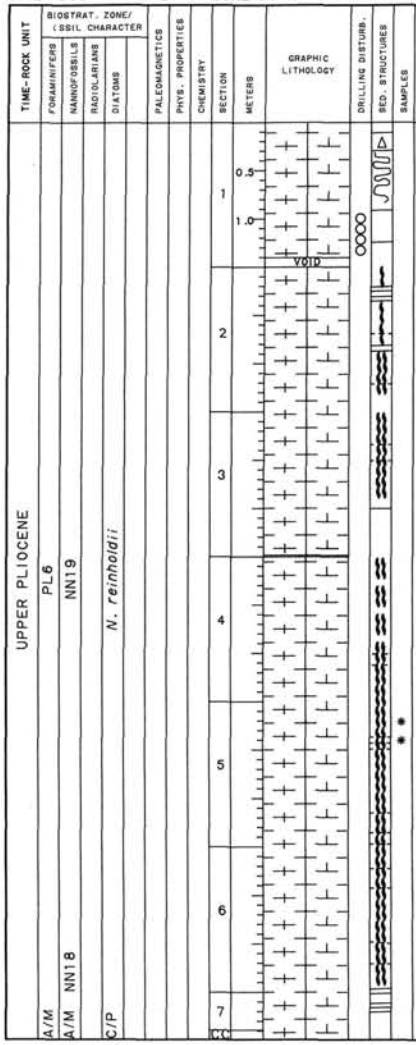
GRAPHIC LITHOLOGY | DRILLING DISTURB. | SED. STRUCTURES | SAMPLES

LITHOLOGIC DESCRIPTION

MUD-BEARING, FORAMINIFER-NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING, MUDDY NANNOFOSSIL OOZE

Mud-bearing, foraminifer-nannofossil ooze, white (7.5YR 8/0, 5Y 8/1), alternating with siliceous-bearing, muddy nannofossil ooze, light gray (5Y 7/2). Slumped and deformed beds occur in most of Sections 1, 3, 4, 6, and 7. Pyrite present in Sections 4 and 6. Minor voids in Sections 5, 146–150 cm, and Section 7, 0–3 cm.

SITE 663 HOLE B CORE 11 H CORED INTERVAL 3792.4-3801.9 mbsl; 95.0-104.5 mbsf



LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, FORAMINIFER-NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING, SILT-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE

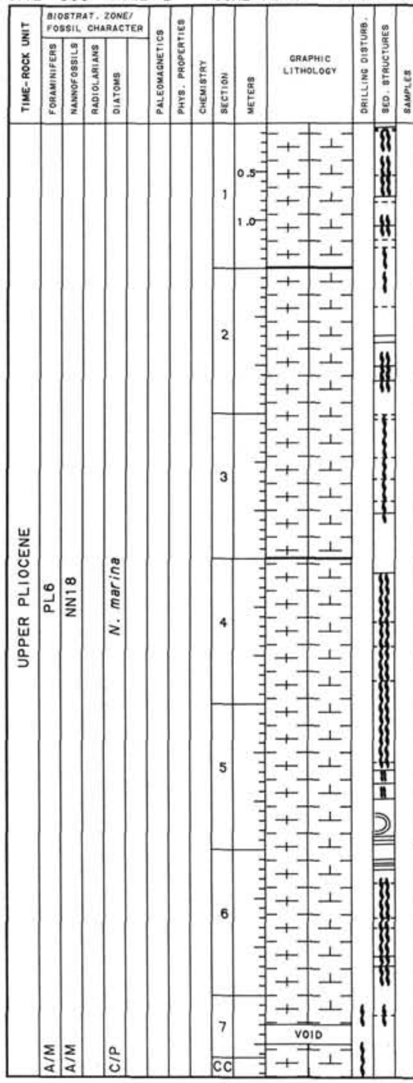
Siliceous-bearing, foraminifer-nannofossil ooze, white (5Y 8/1) to light gray (5Y 7/1), alternating with siliceous-bearing, silt-bearing, foraminifer-bearing nannofossil ooze, gray (5Y 6/1).

Minor lithology: Section 1 highly deformed (debris flow?); Section 2 through CC exhibit moderate to extensive bioturbation. Minor void in Section 3, 149–150 cm.

SMEAR SLIDE SUMMARY (%):

	5, 28 D	5, 45 D
TEXTURE:		
Sand	—	—
Silt	40	30
Clay	60	70
COMPOSITION:		
Quartz	—	10
Foraminifers	30	10
Nannofossils	60	60
Diatoms	5	—
Radiolarians	5	10
Sponge spicules	—	10

SITE 663 HOLE B CORE 12 H CORED INTERVAL 3801.9-3811.4 mbsl; 104.5-114.0 mbsf



LITHOLOGIC DESCRIPTION

SILICEOUS-BEARING, FORAMINIFER-NANNOFOSSIL OOZE, alternating with SILICEOUS-BEARING, SILT-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE

Siliceous-bearing, foraminifer-nannofossil ooze, white (5Y 8/1) to light gray (5Y 7/1), alternating with siliceous-bearing, silt-bearing, foraminifer-bearing nannofossil ooze, gray (5Y 6/1).

Minor lithology: Section 5, 100 cm, and Section 6, 20 cm, is slumped and folded; greenish-gray and purple microlaminations throughout core; bioturbation Moderate to extensive. Minor voids in Section 1, 146–150 cm, and Section 3, 145–150 cm.

SITE 663 HOLE B CORE 13 H CORED INTERVAL 3811.4-3820.9 mbsl; 114.0-123.5 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 PLIOCENE

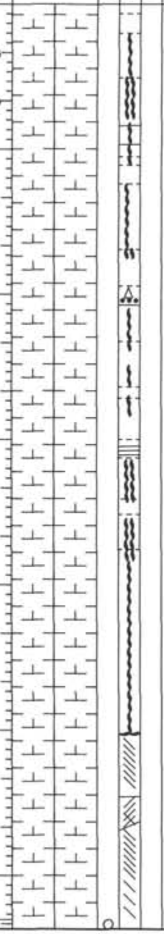
PL5

NN18

N. marina

A/G A/M A/M

Sections: 1 (0.5, 1.0), 2, 3, 4, 5, 6, 7, CC



SILICEOUS-BEARING, FORAMINIFER-BEARING NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING NANNOFOSSIL OOZE

Siliceous-bearing, foraminifer-bearing nannofossil ooze, light olive-gray (10Y 6/2), alternating with foraminifer-bearing nannofossil ooze, white (2.5Y 8/0); sandy foraminifer turbidite present at top of Section 3. Most of Sections 6 and 7 characterized by slumping and folding; the remainder of core is moderately bioturbated.

SITE 663 HOLE B CORE 14 H CORED INTERVAL 3820.5-3830.0 mbsl; 123.5-133.0 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 PLIOCENE

PL5

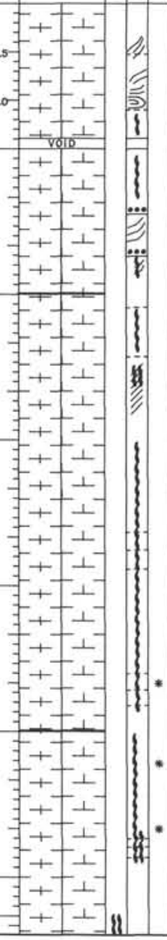
NN18

NN17

N. marina

A/G A/M C/P

Sections: 1 (0.5, 1.0), 2, 3, 4, 5, 6, 7, CC



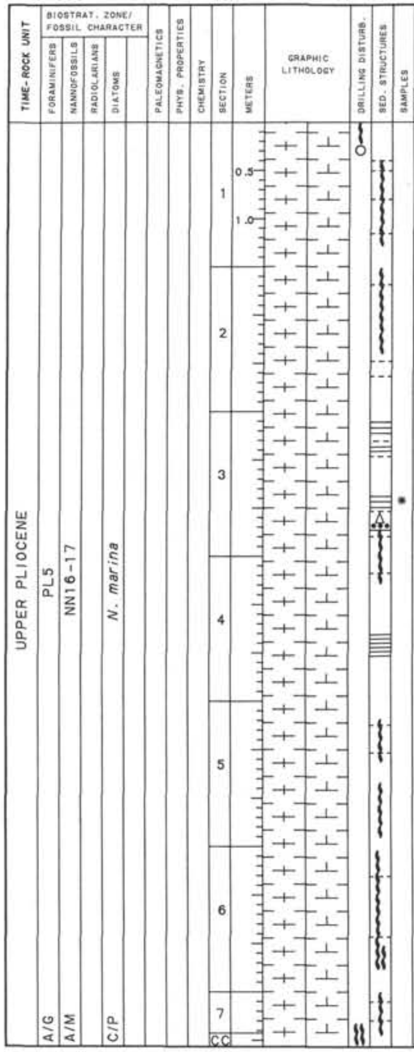
FORAMINIFER-NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING, SILICEOUS-BEARING, NANNOFOSSIL OOZE

Foraminifer-nannofossil ooze, white (10Y 8/1), alternating with foraminifer-bearing, siliceous-bearing, nannofossil ooze. Sections 1 through 3 and CC are slumped and folded; remainder of core weakly bioturbated. Minor voids in Section 2, 140–150 cm, and Section 5, 147–150 cm.

SMEAR SLIDE SUMMARY (%):

	5, 104 D	6, 29 D	6, 103 D
TEXTURE:			
Sand	25	5	30
Silt	10	15	10
Clay	65	80	60
COMPOSITION:			
Foraminifers	20	10	45
Nannofossils	65	75	55
Diatoms	5	—	Tr
Radiolarians	10	—	10
Sponge spicules	Tr	5	Tr

SITE 663 HOLE B CORE 15 H CORED INTERVAL 3830.4-3839.9 mbsl; 133.0-142.5 mbsf



LITHOLOGIC DESCRIPTION

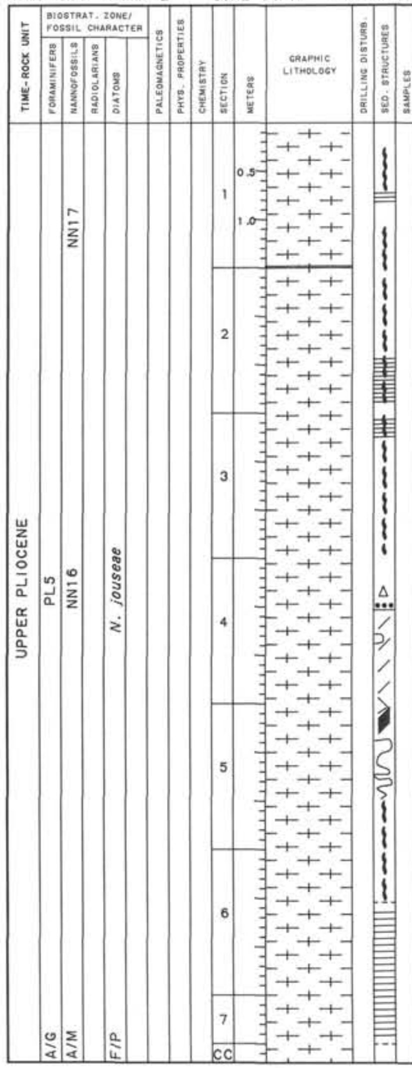
FORAMINIFER-NANNOFOSSIL OOZE, alternating with FORAMINIFER-BEARING, SILICEOUS-BEARING NANNOFOSSIL OOZE

Foraminifer-nannofossil ooze, white (10Y 8/1), alternating with foraminifer-bearing, siliceous-bearing, nannofossil ooze with black microlaminations in Sections 3 and 4. Sandy foraminifer turbidite(?) present in Section 3; remainder of core weakly to moderately bioturbated.

SMEAR SLIDE SUMMARY (%):

	3, 100 M
TEXTURE:	
Sand	15
Silt	10
Clay	75
COMPOSITION:	
Foraminifers	20
Nannofossils	70
Diatoms	
Radiolarians	10
Sponge spicules	

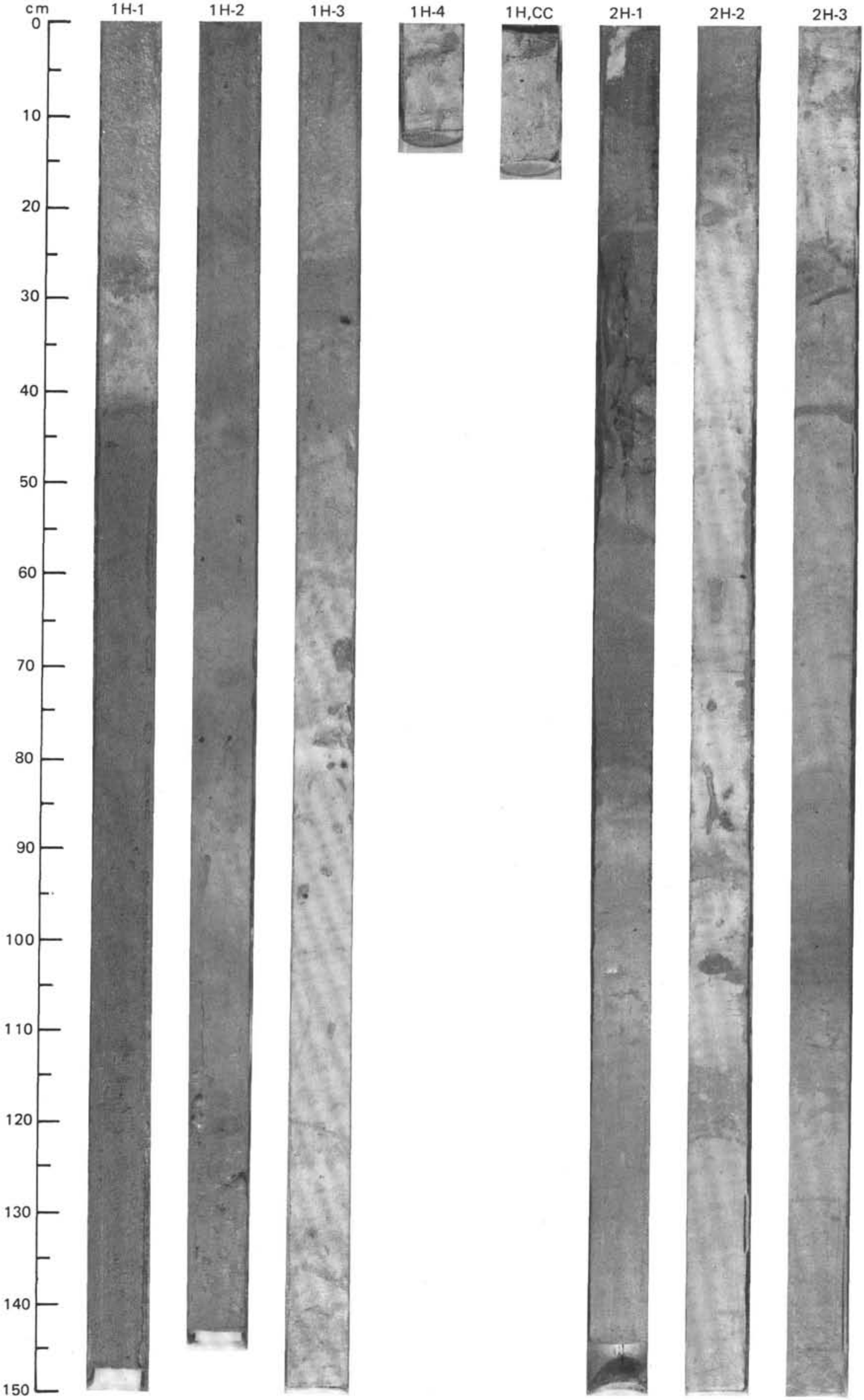
SITE 663 HOLE B CORE 16 H CORED INTERVAL 3839.9-3849.4 mbsl; 142.5-152.0 mbsf



LITHOLOGIC DESCRIPTION

FORAMINIFER-NANNOFOSSIL OOZE

Foraminifer-nannofossil ooze, white (2.5Y 8/0) to light-gray (2.5Y 7/2); black and purple lamination common throughout core; debris flow present in Section 4, 50 cm, through Section 6, 50 cm, truncated by a sandy foraminifer turbidite.


cm
0
10
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50
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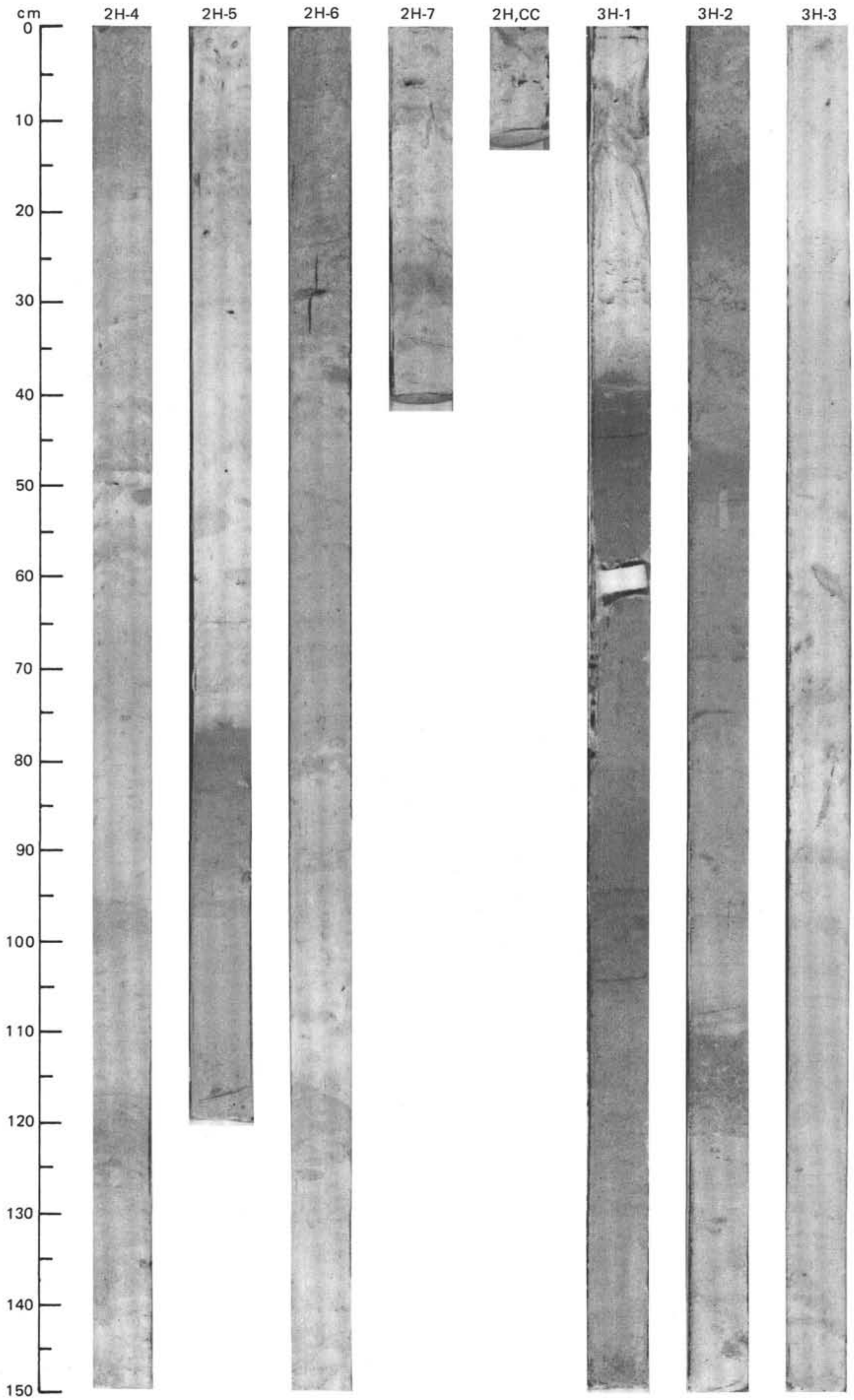
70
80
90
100
110
120
130
140
150
1H-1
1H-2
1H-3
1H-4
1H,CC
2H-1
2H-2
2H-3


cm
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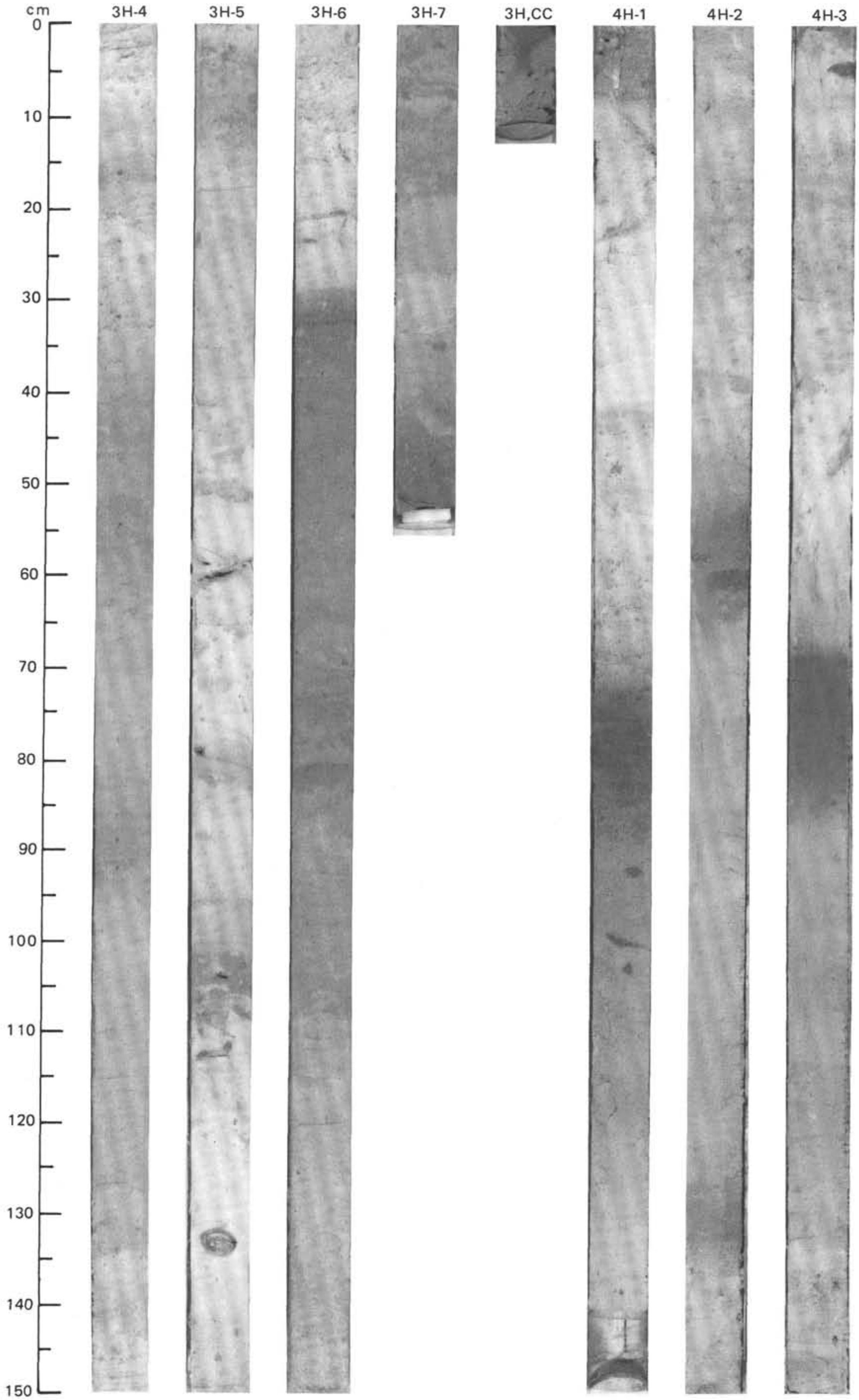
120
130
140
150
2H-4
2H-5
2H-6
2H-7
2H,CC
3H-1
3H-2
3H-3


cm
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3H-4
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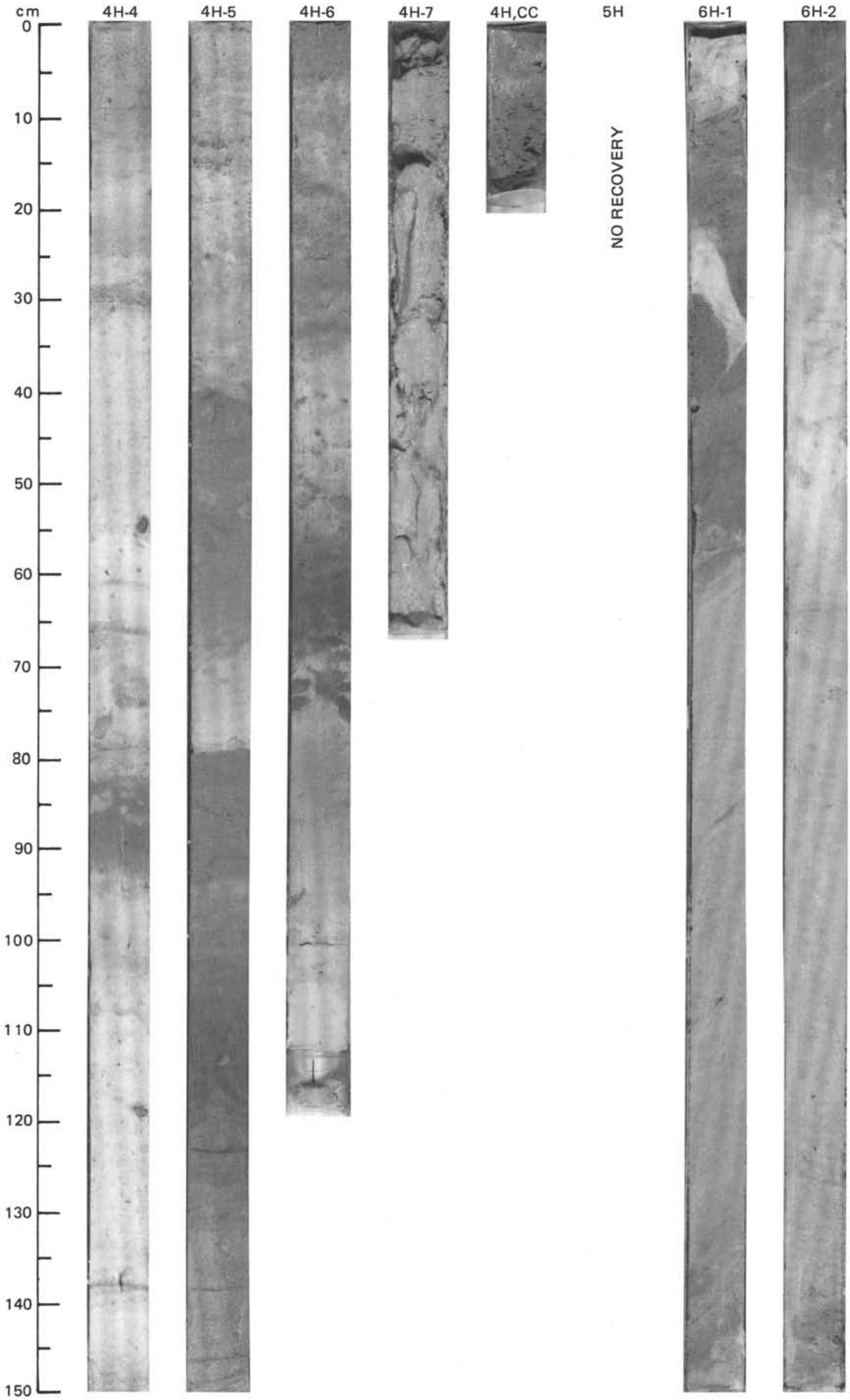
3H,CC
4H-1
4H-2
4H-3



cm
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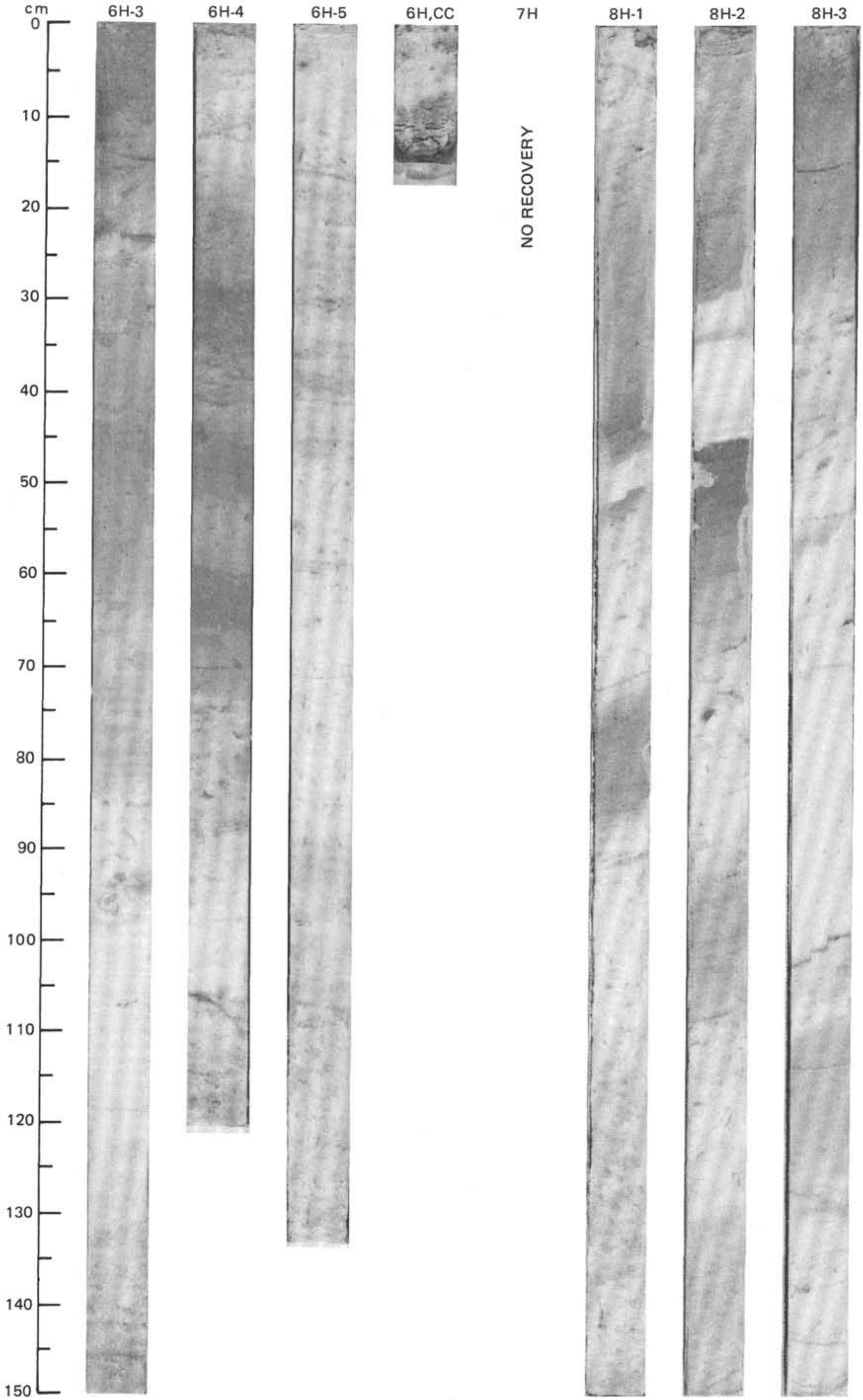
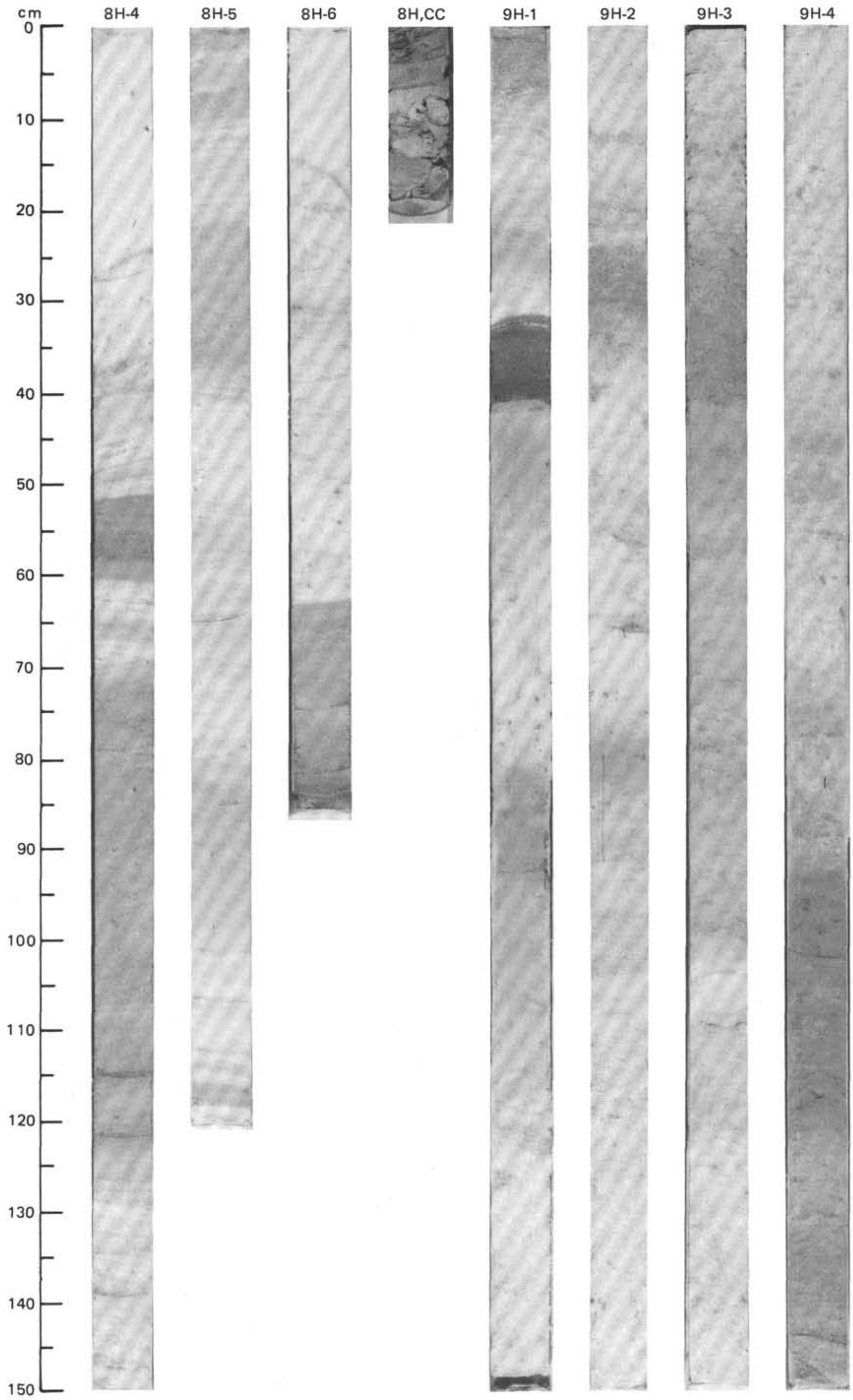
90
100
110
120
130
140
150
4H-4
4H-5
4H-6
4H-7
4H,CC
5H
NO RECOVERY
6H-1
6H-2

SITE 663 (HOLE A)




cm
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80
90
100
110
120
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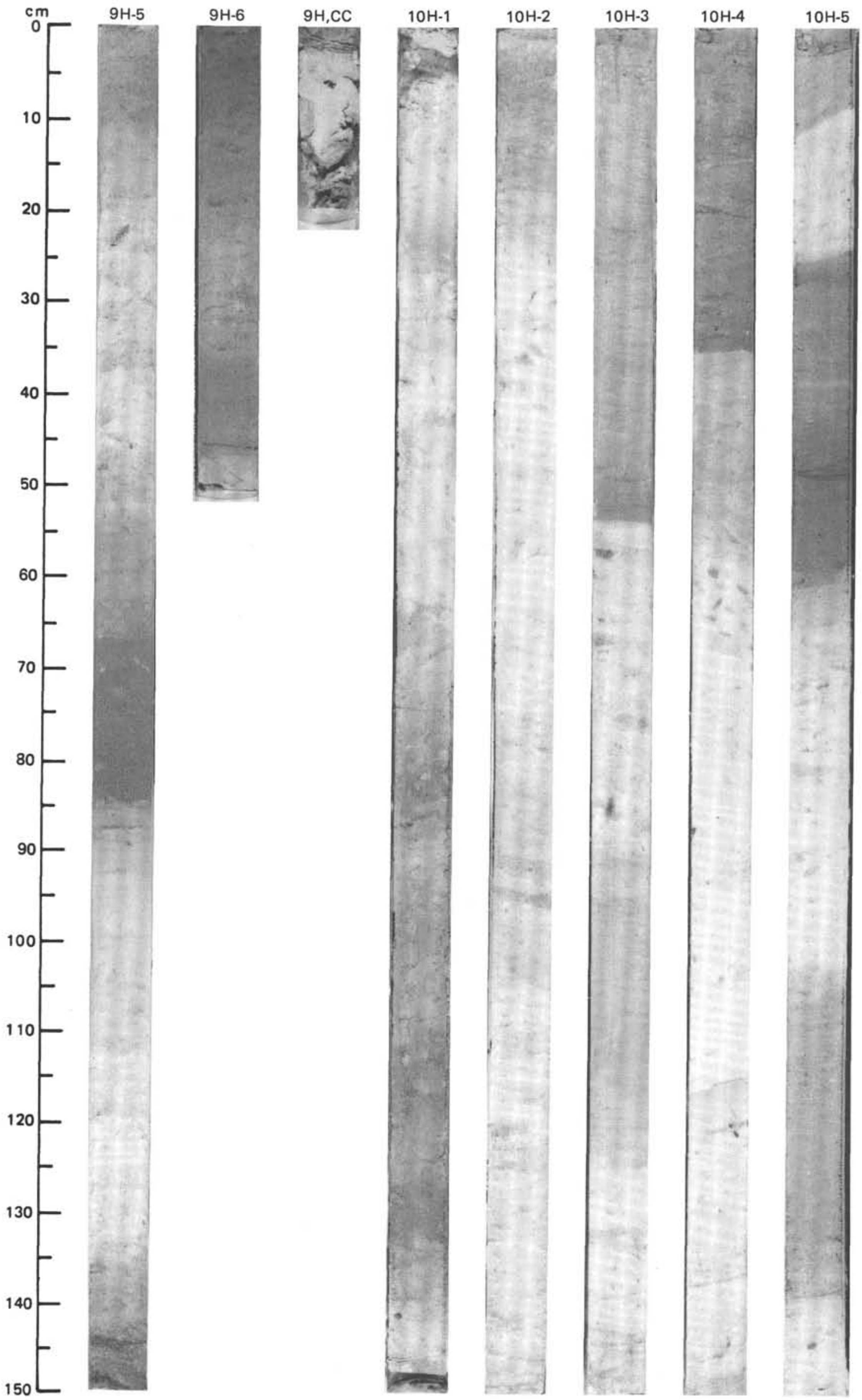
150
8H-4
8H-5
8H-6
8H,CC
9H-1
9H-2
9H-3
9H-4


cm
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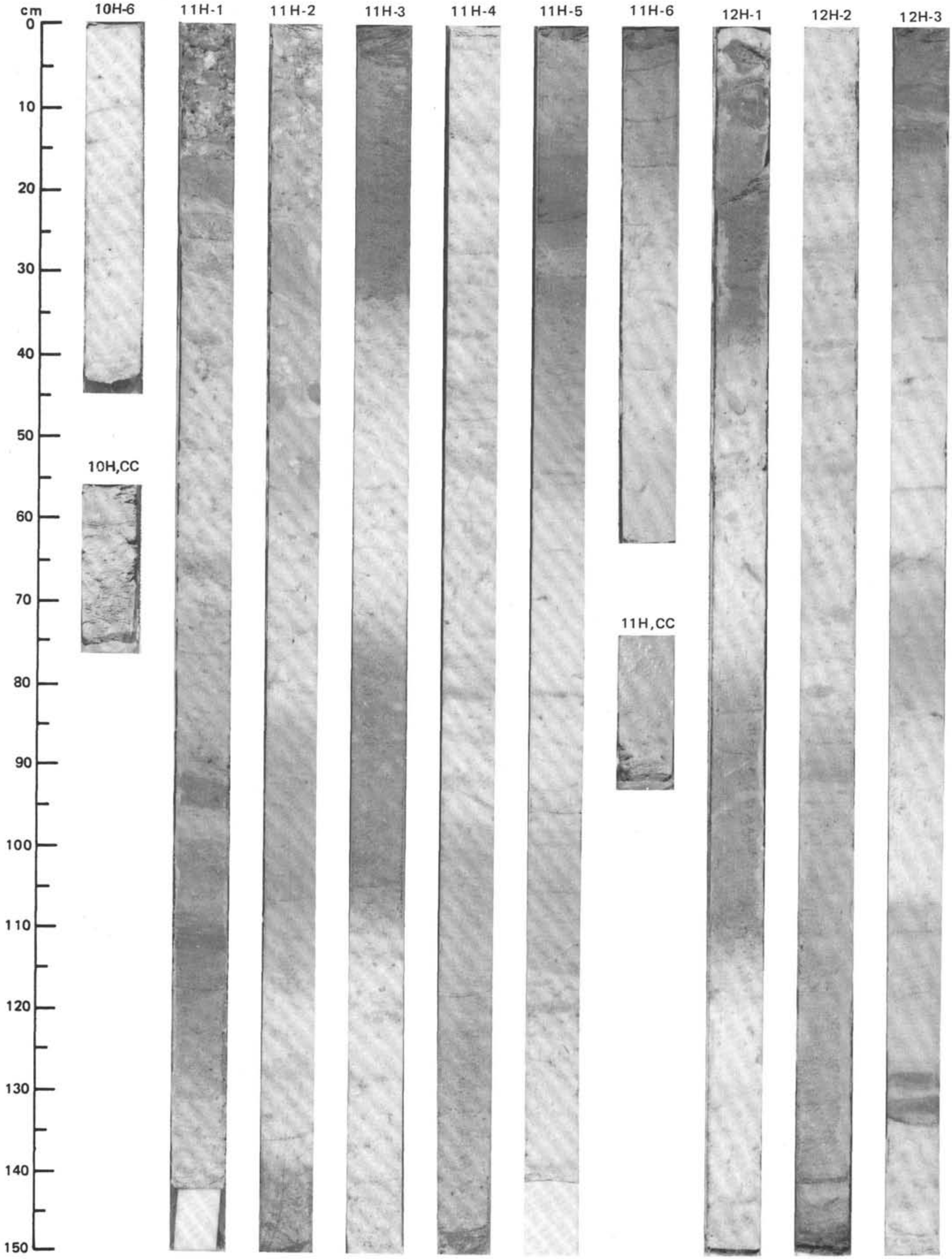
9H,CC
10H-1
10H-2
10H-3
10H-4
10H-5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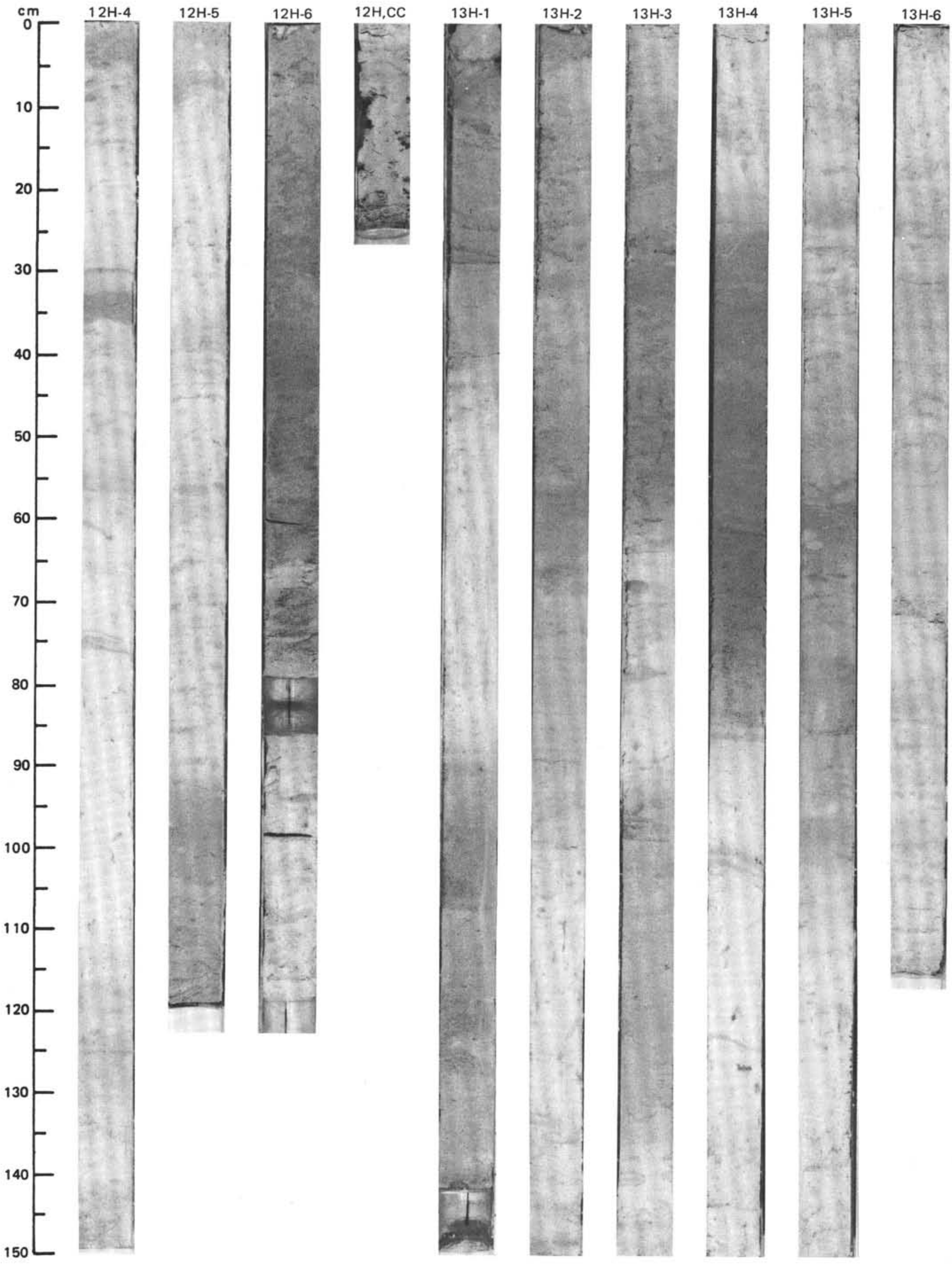
12H-2
12H-3


cm
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80
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120
130
140
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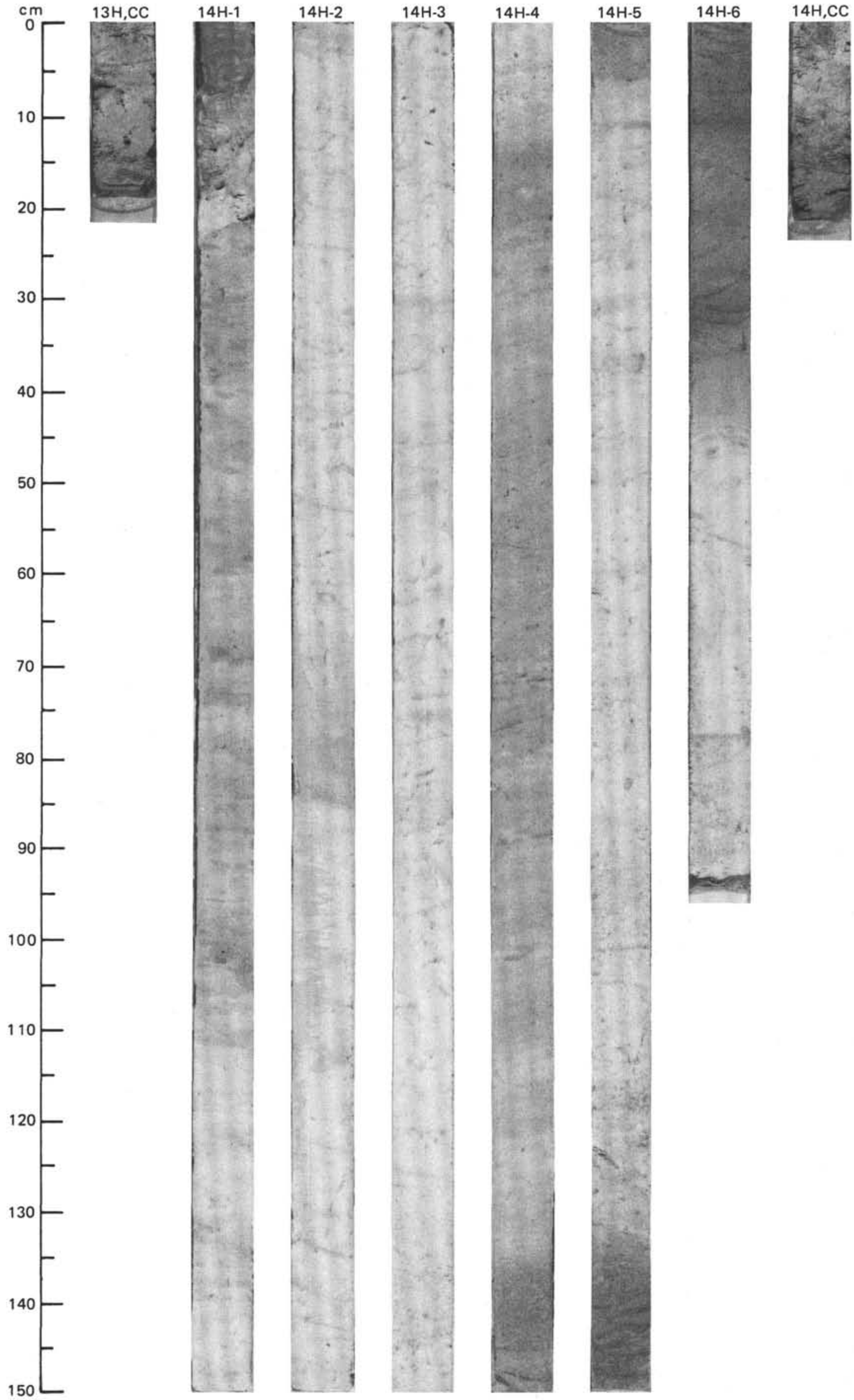
12H-4
12H-5
12H-6
12H,CC
13H-1
13H-2
13H-3
13H-4
13H-5
13H-6


cm
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90
100
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120
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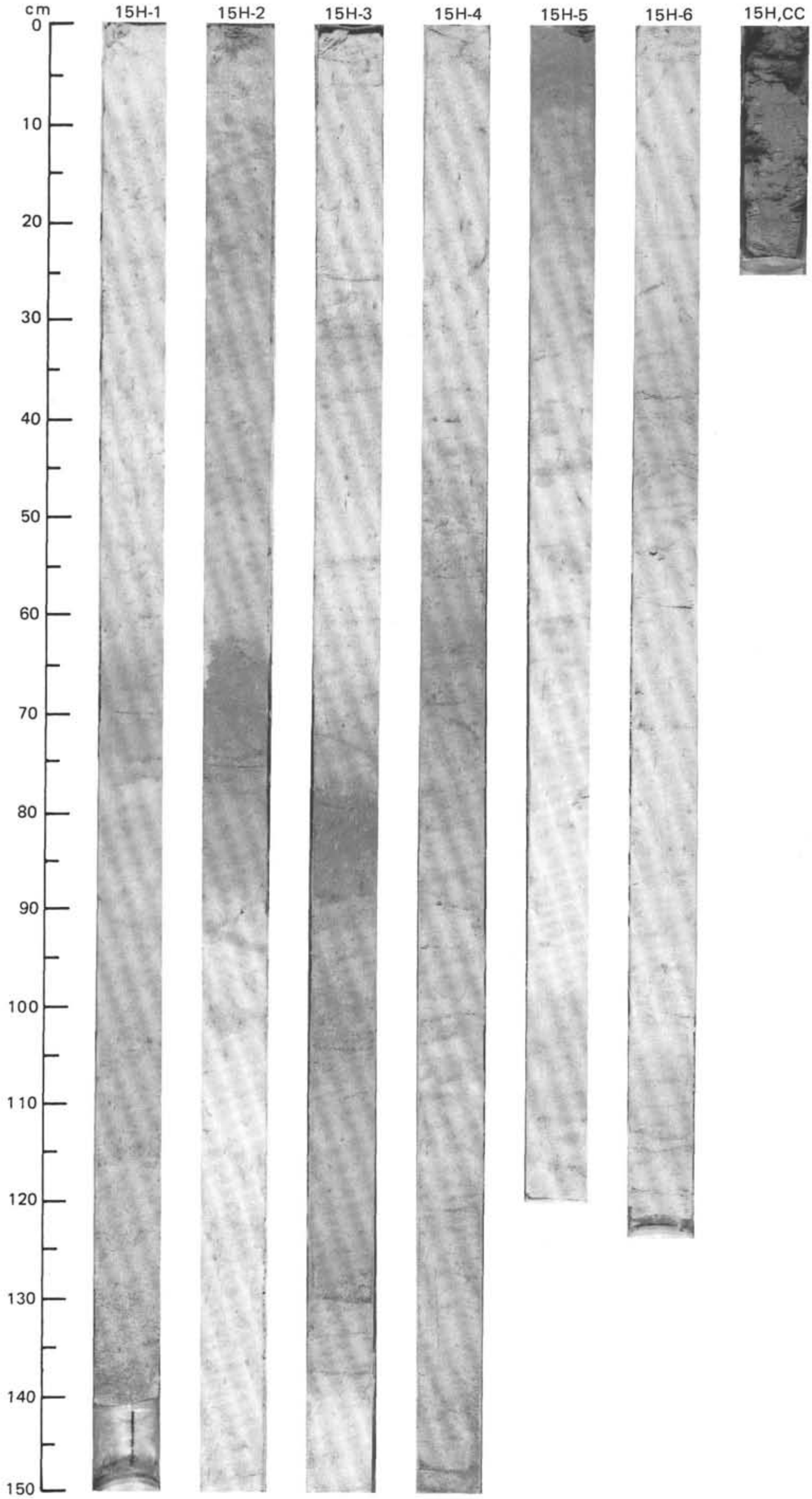
14H-1
14H-2
14H-3
14H-4
14H-5
14H-6
14H,CC


cm
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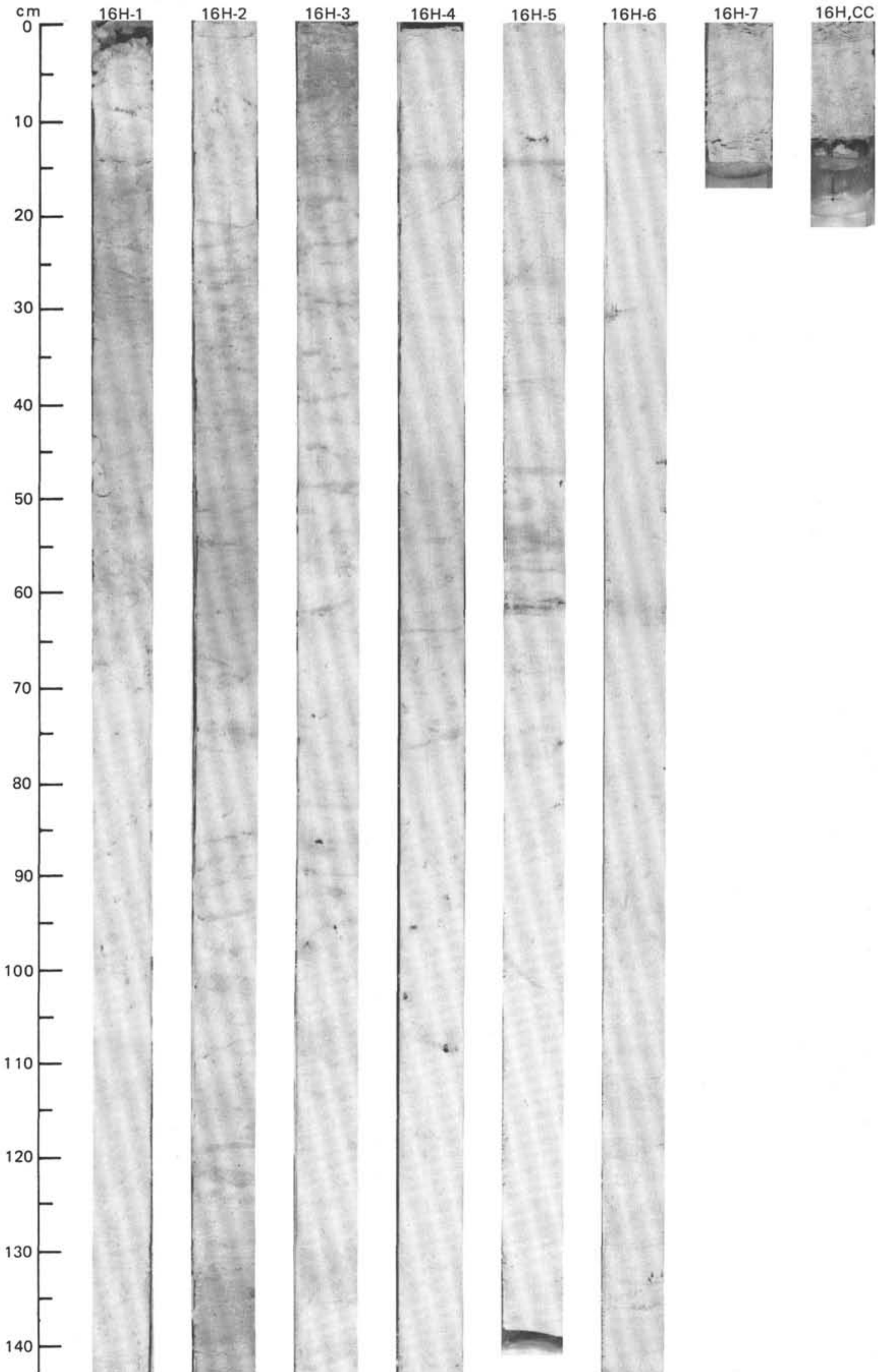
15H-6
15H,CC


cm
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10
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40
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100
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140
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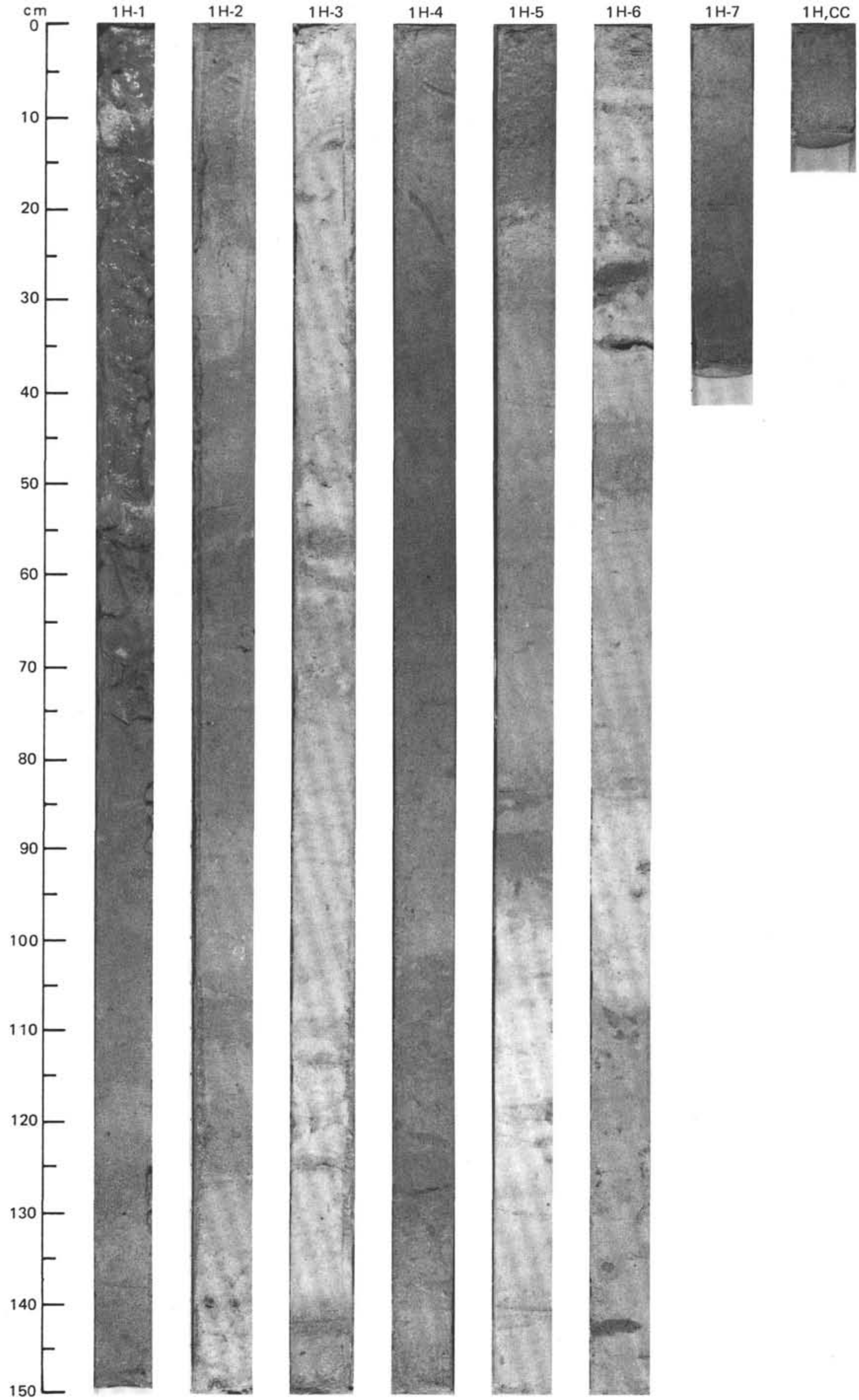
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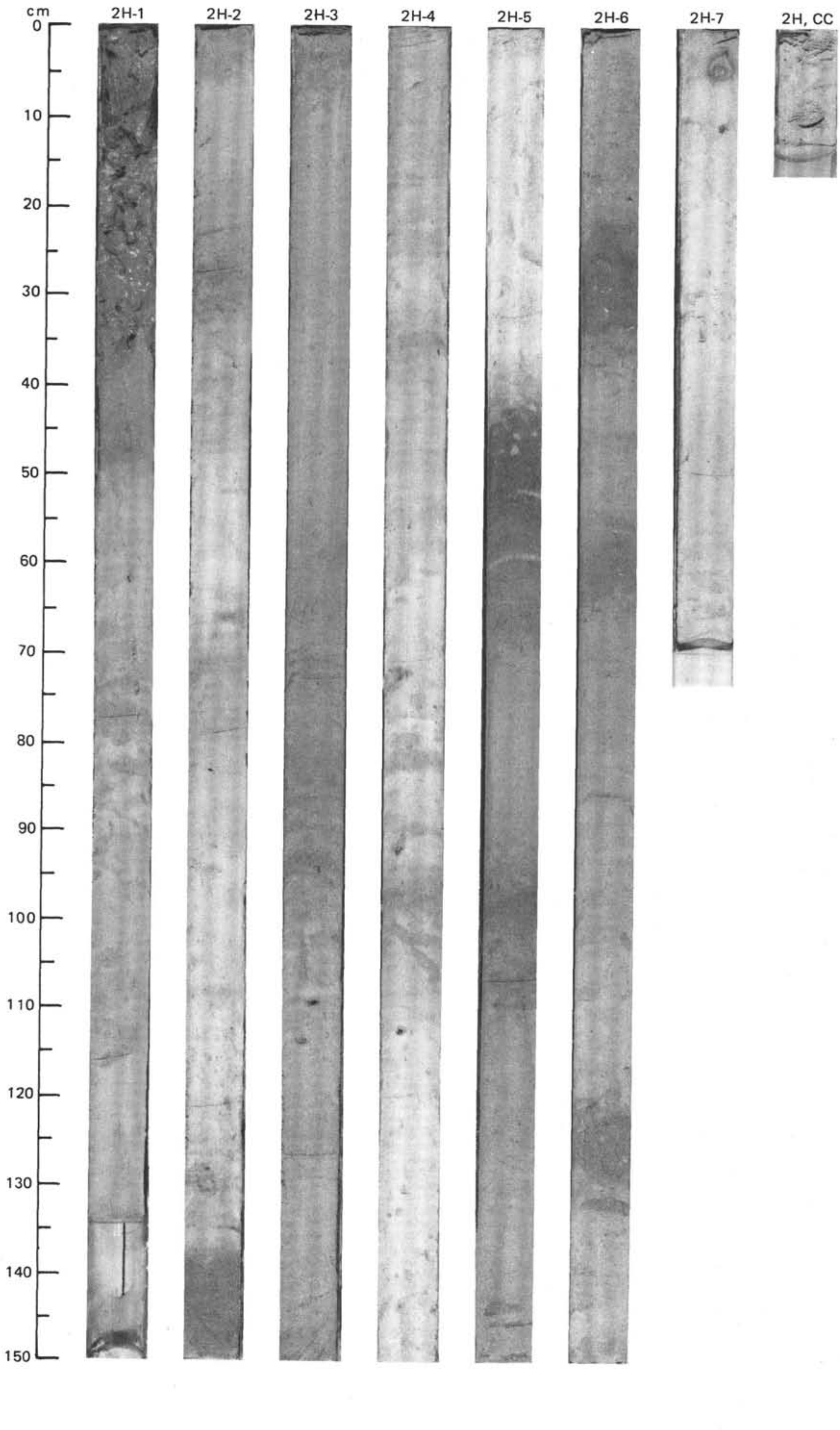
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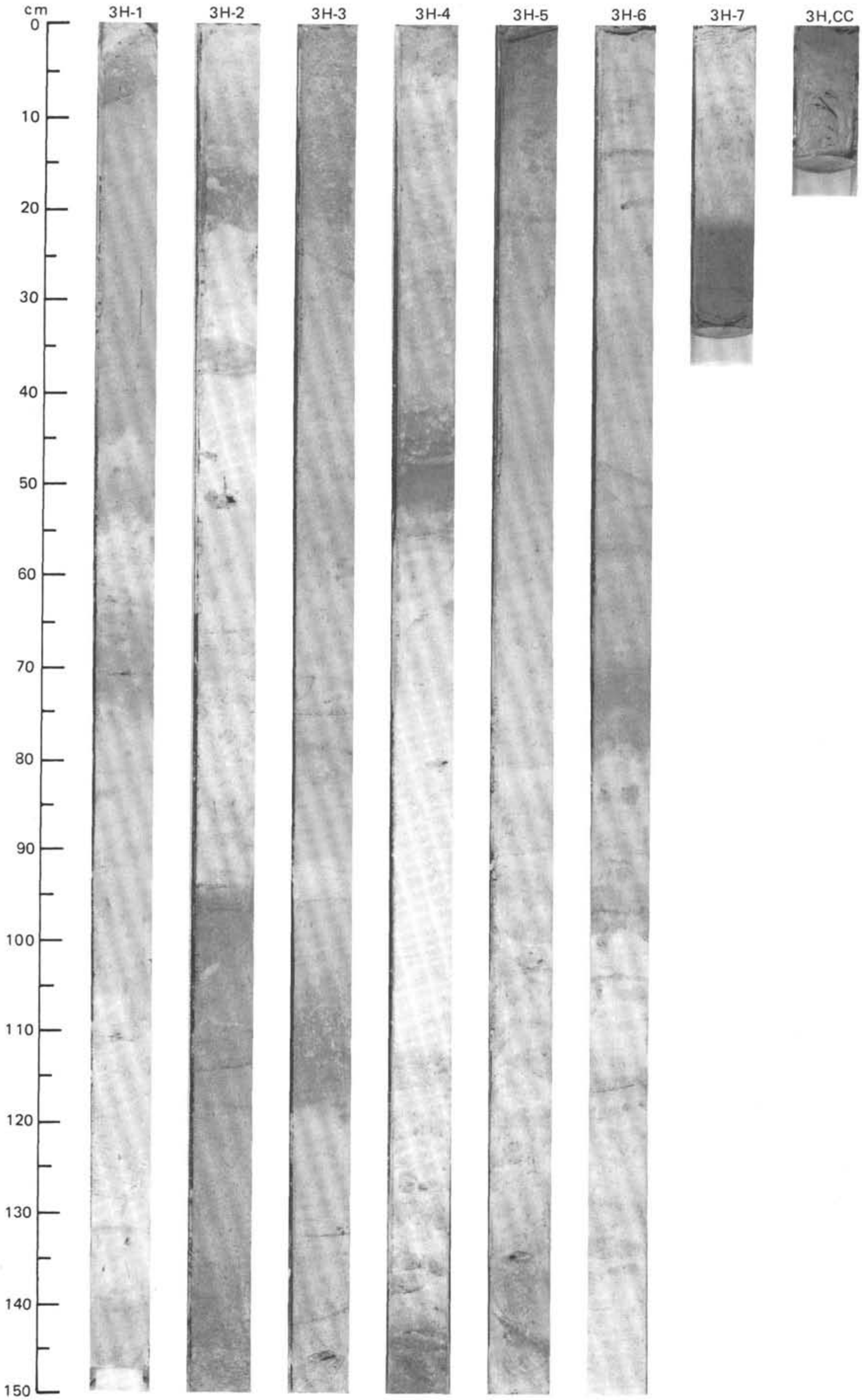
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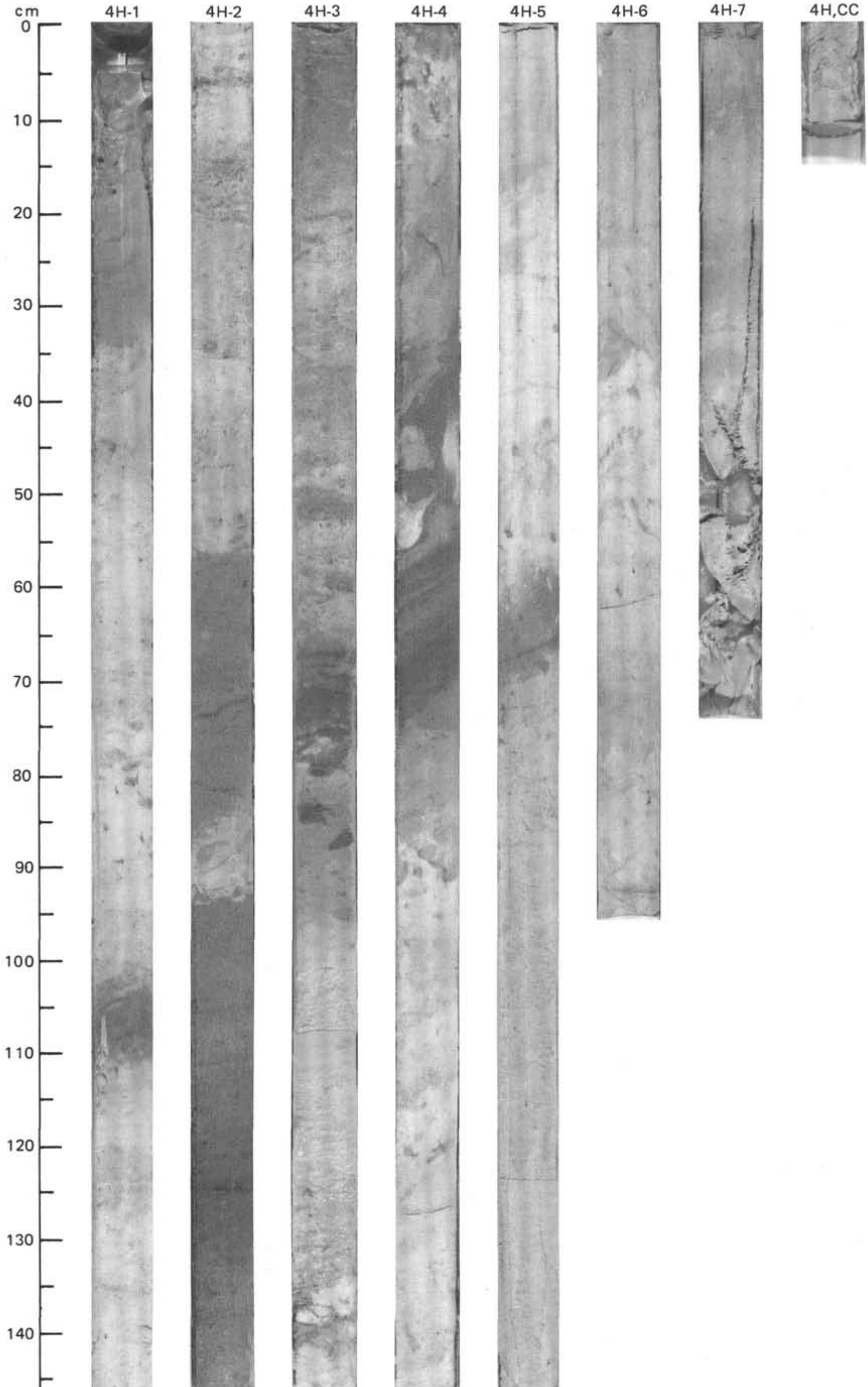
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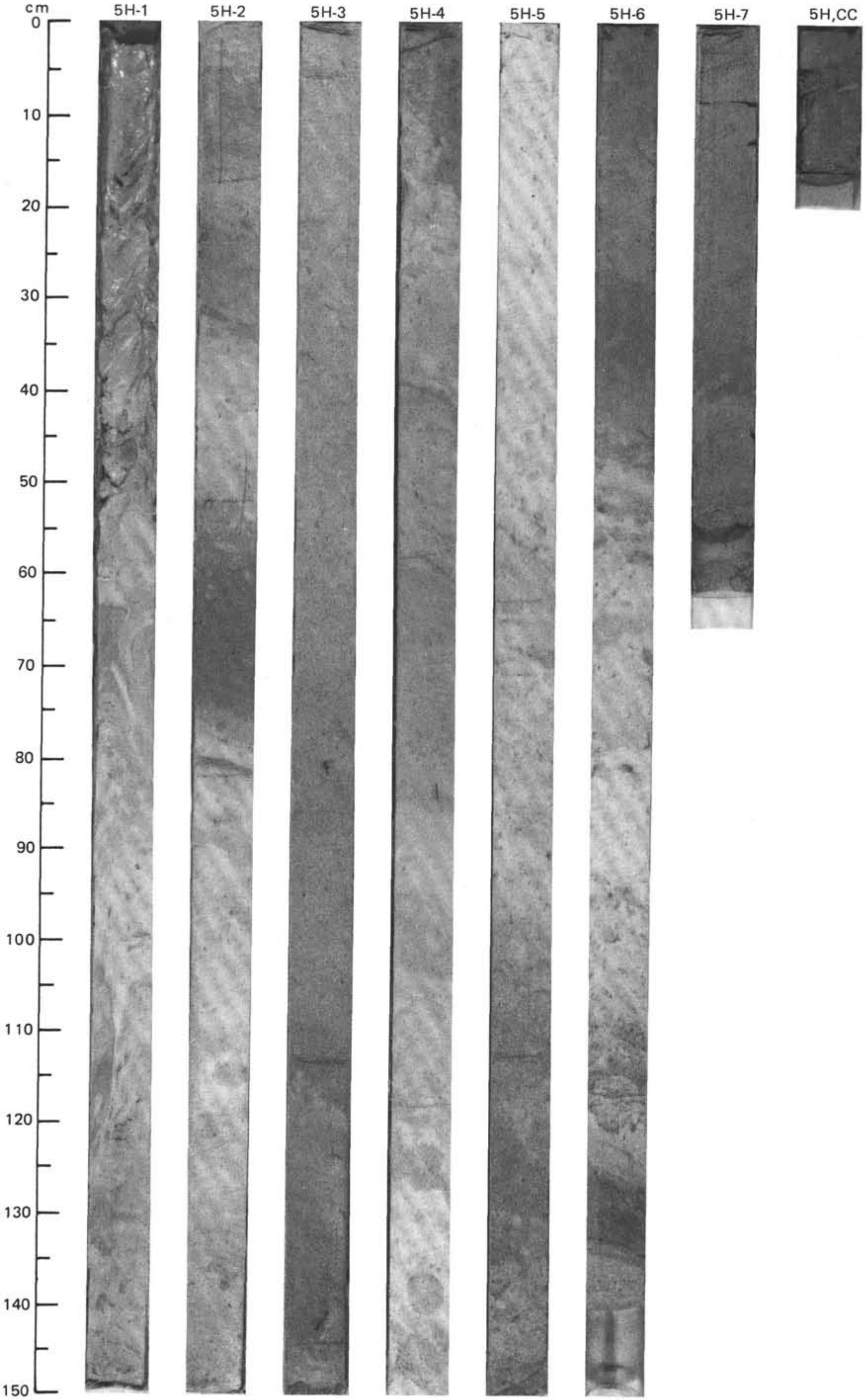
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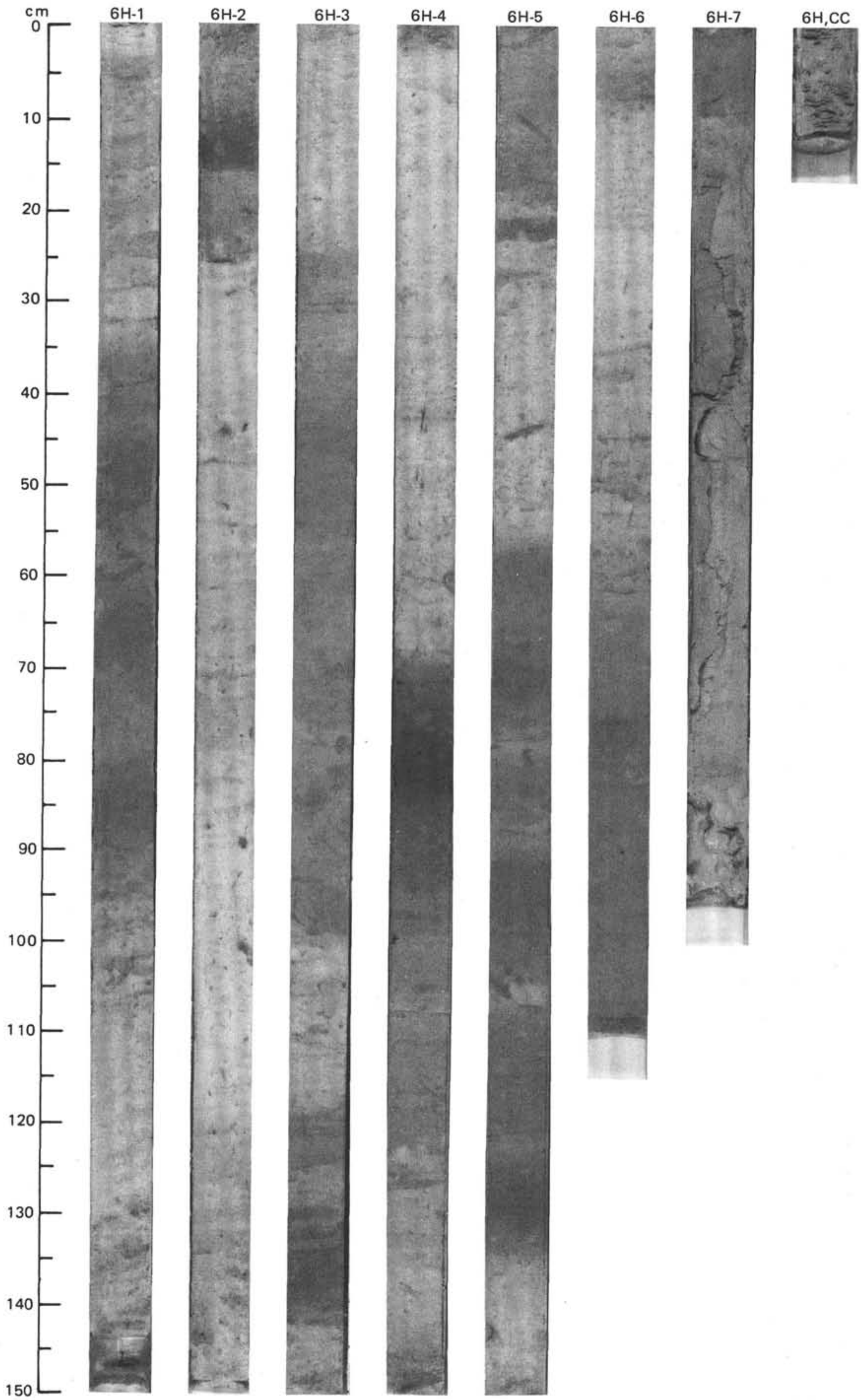
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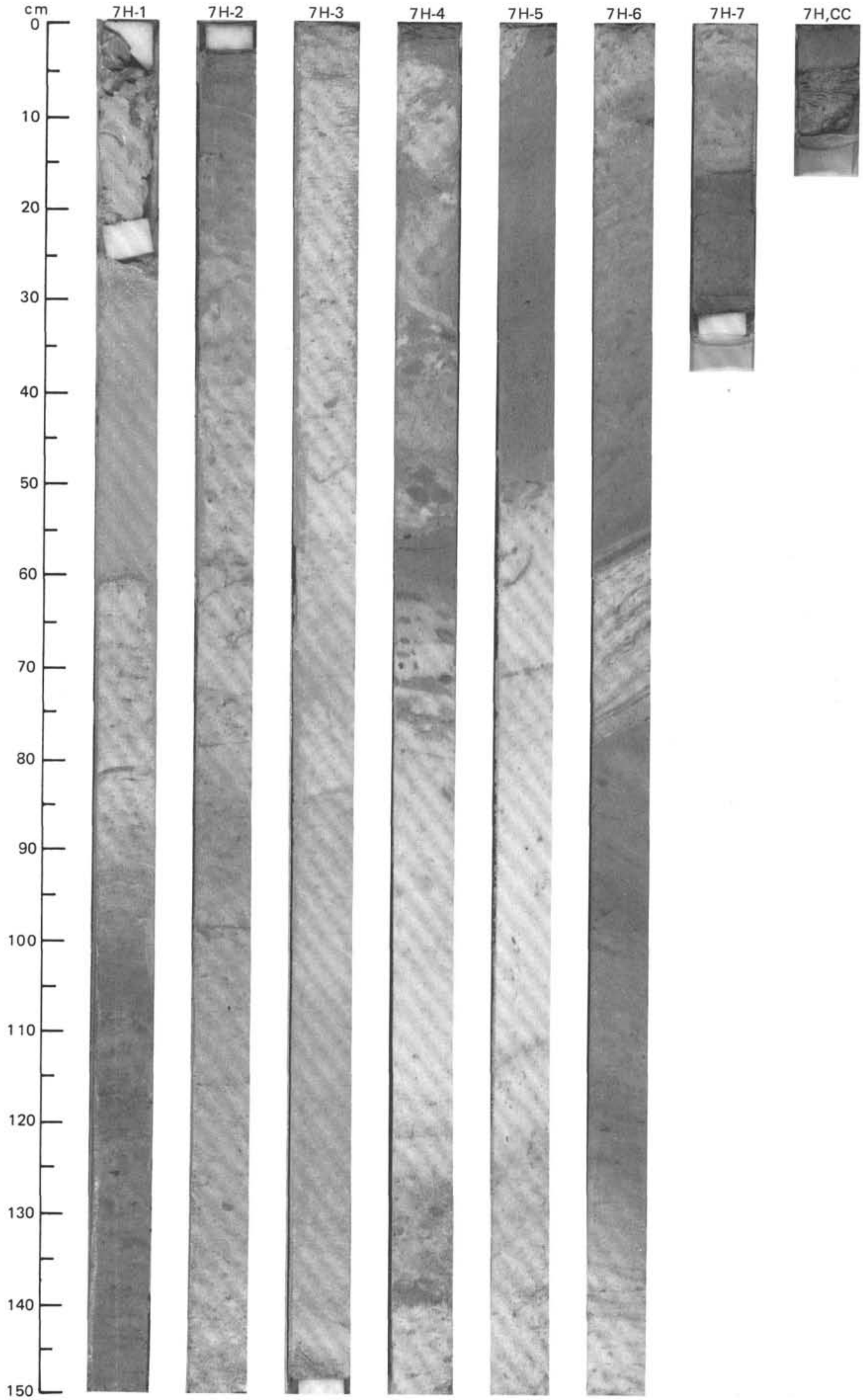
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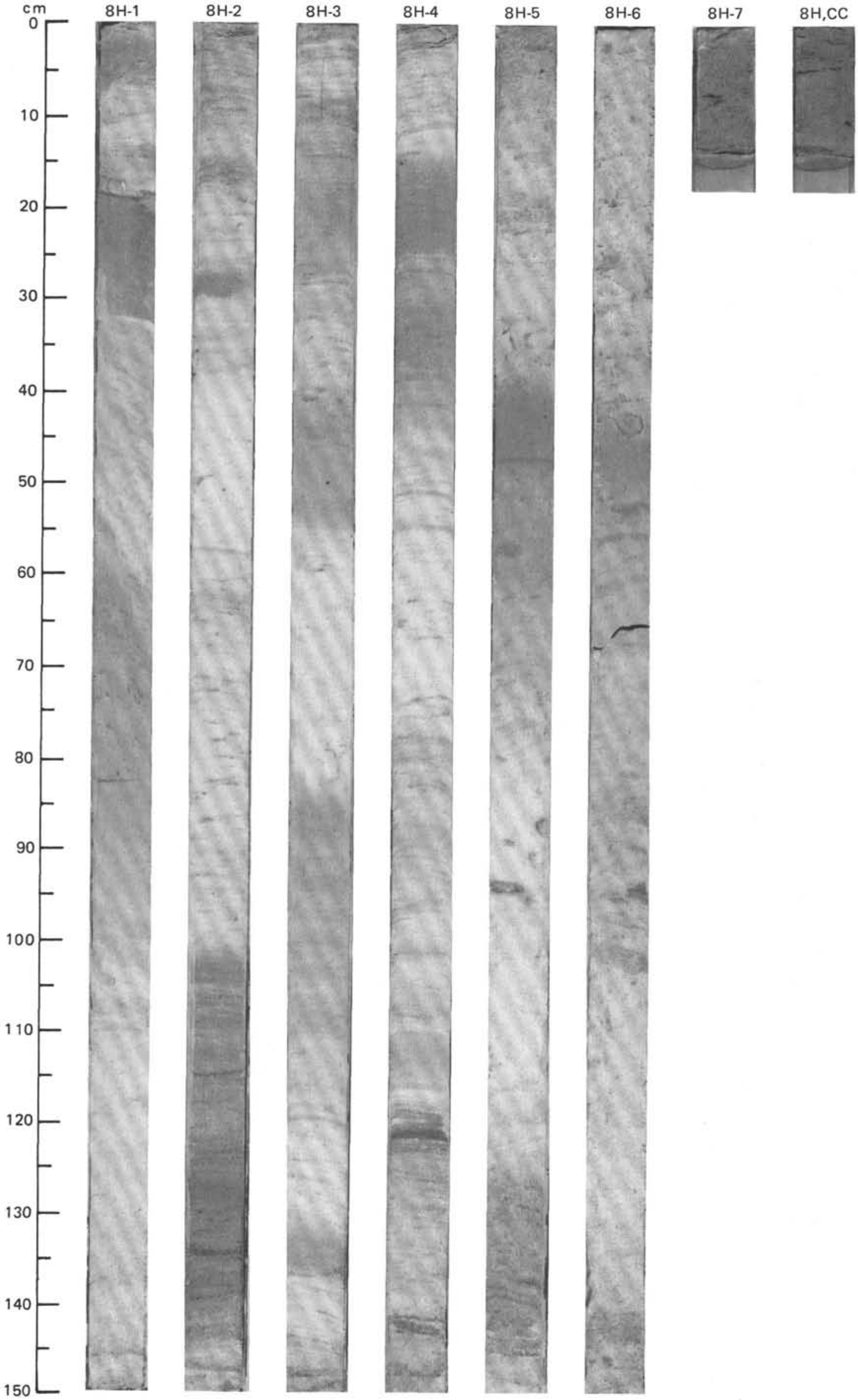
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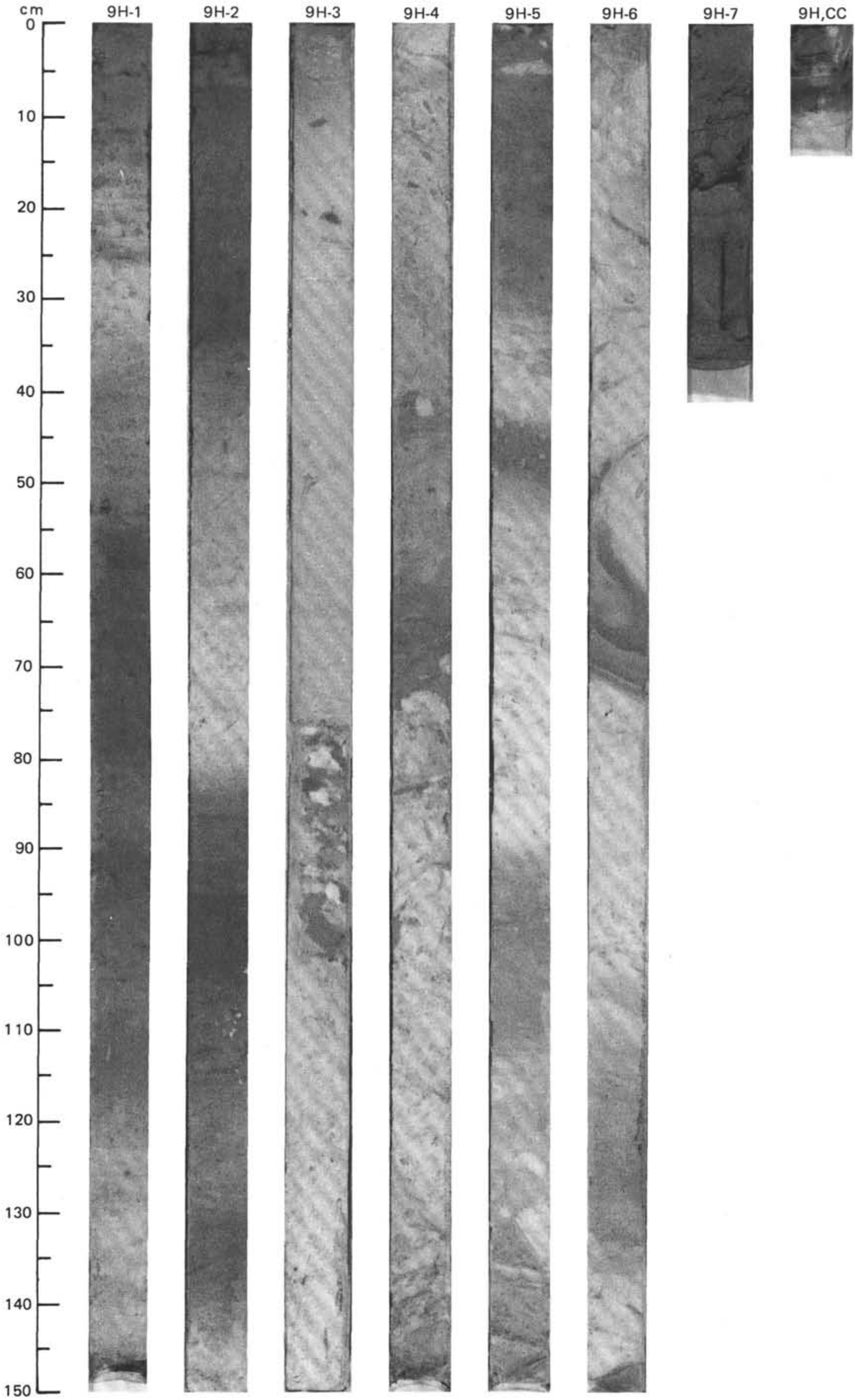
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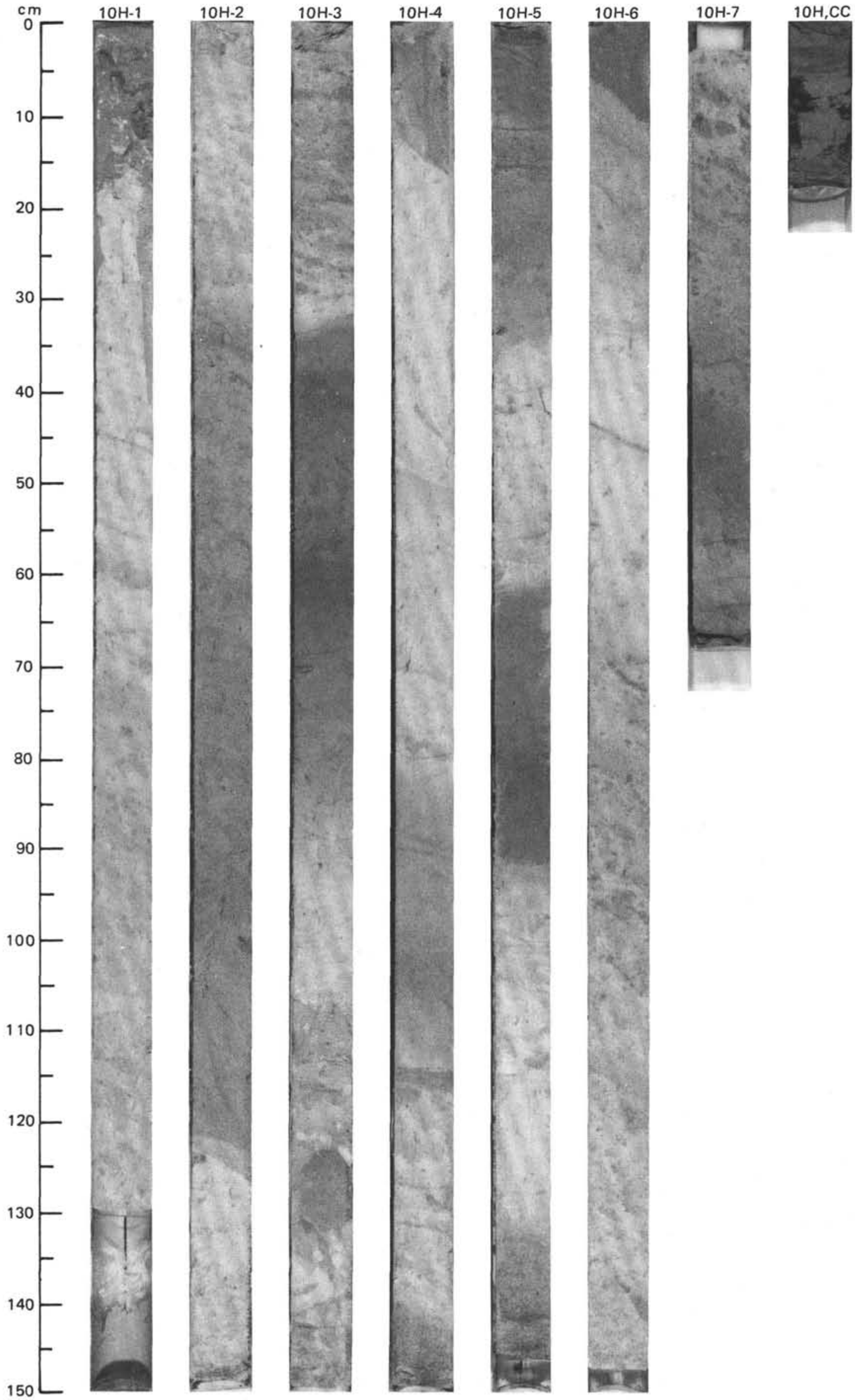
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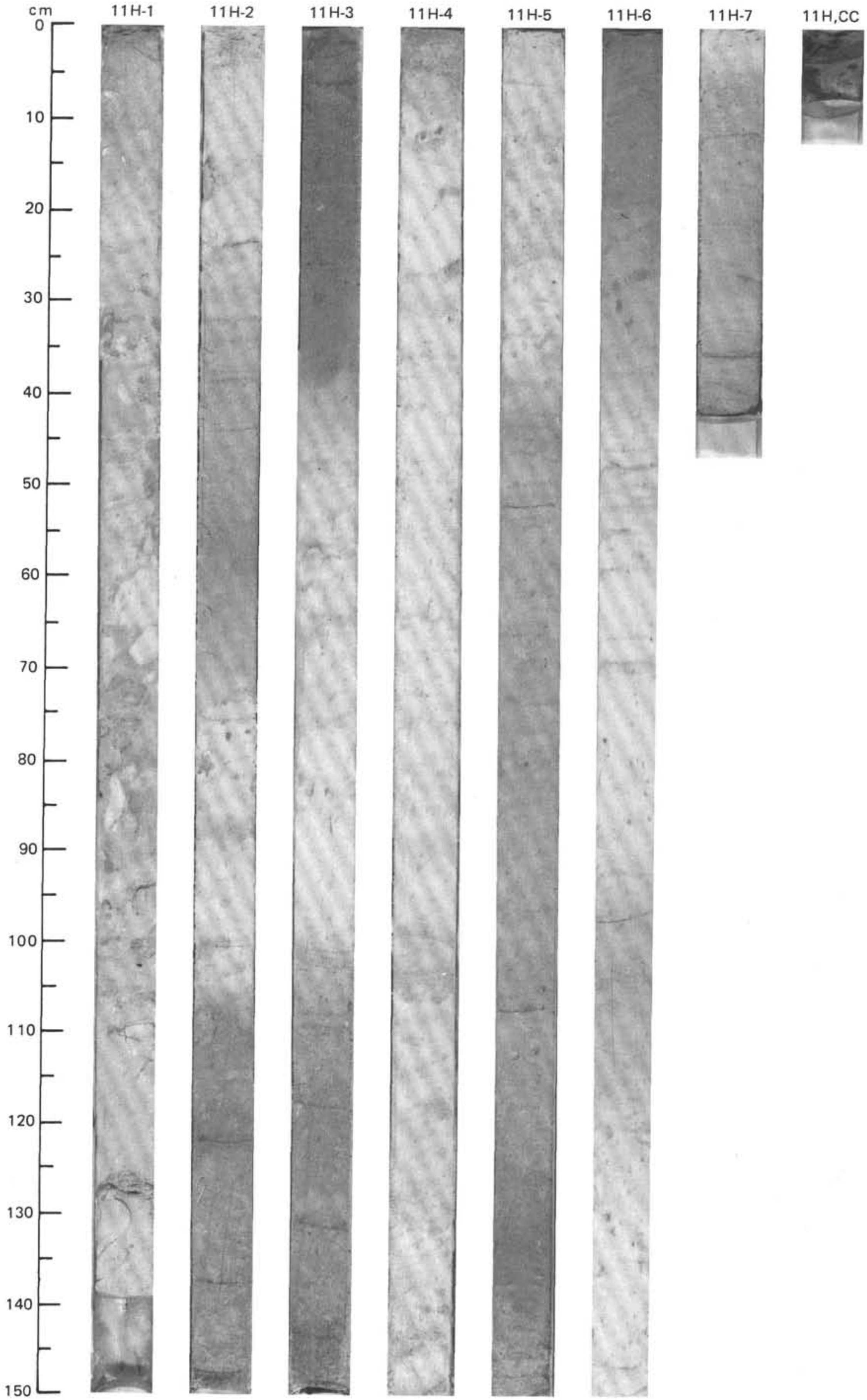
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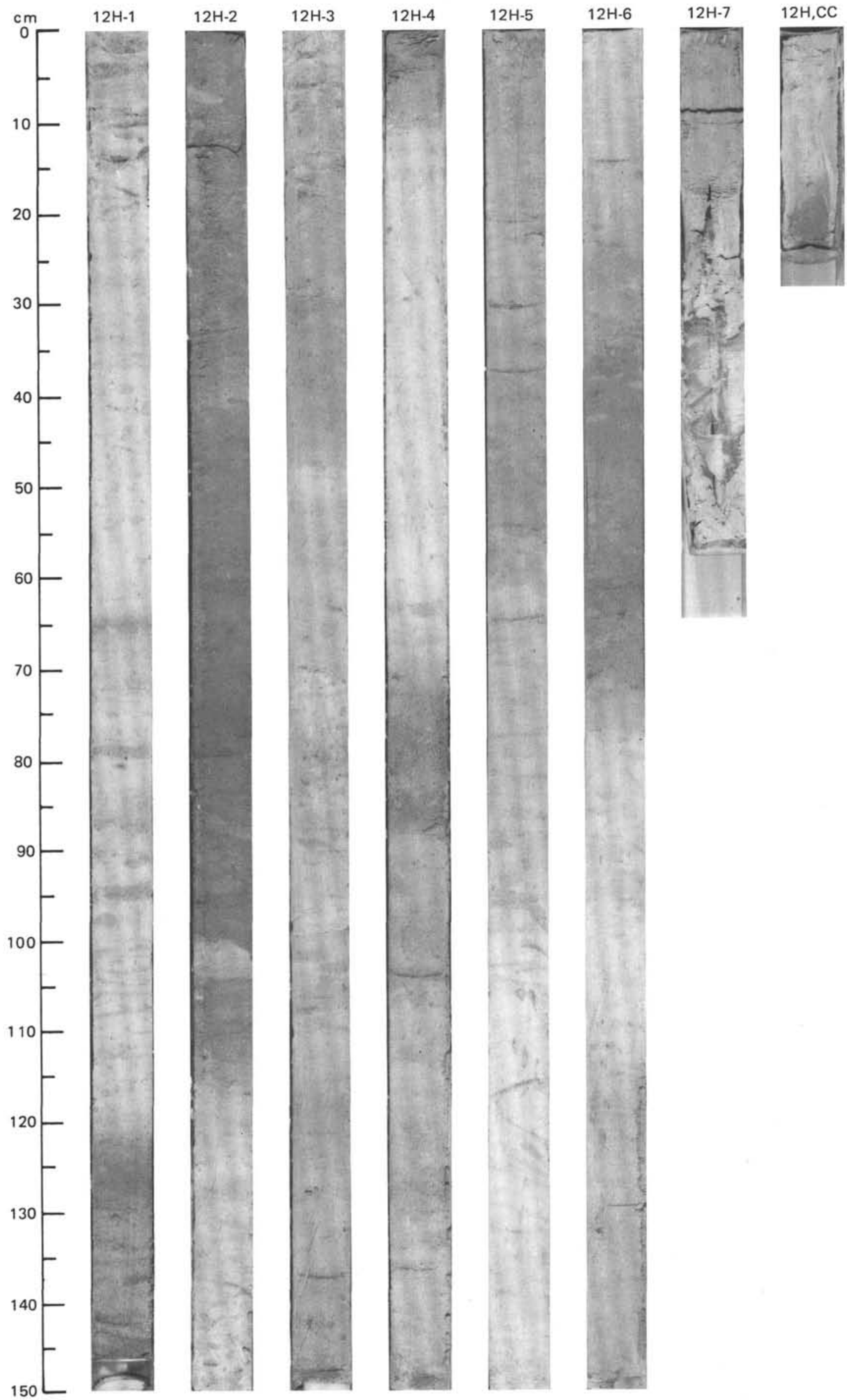
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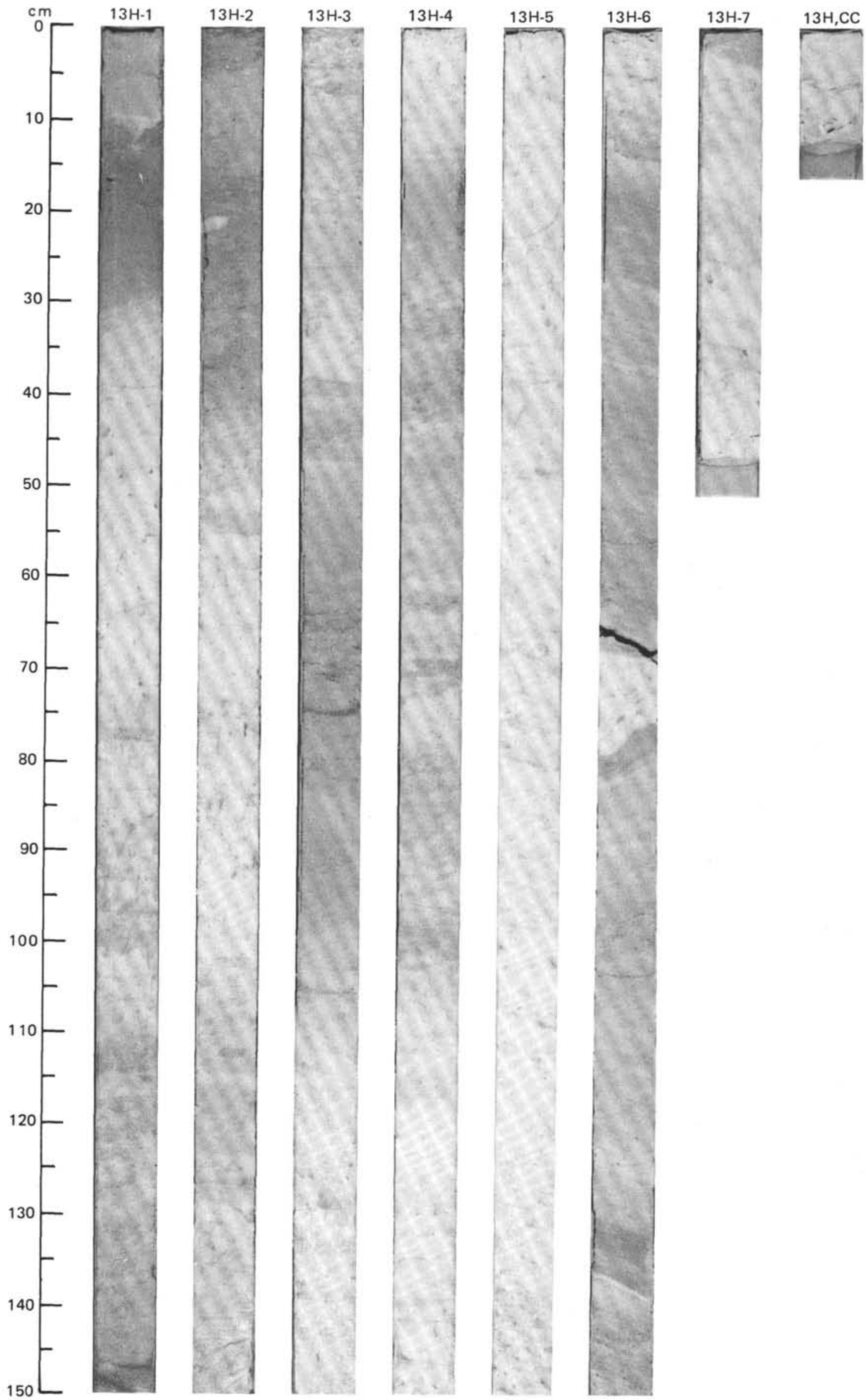
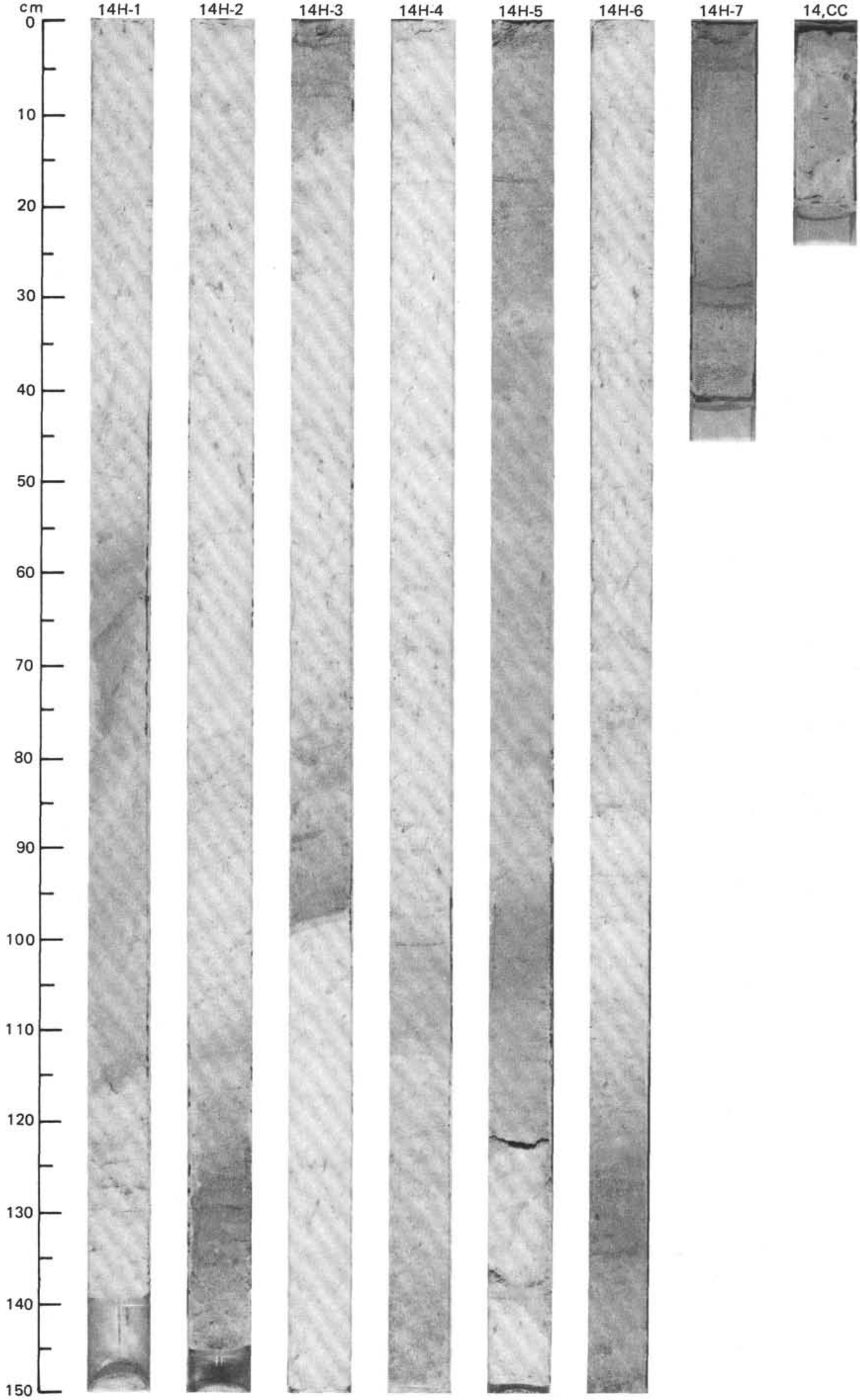
SITE 663 (HOLE B)

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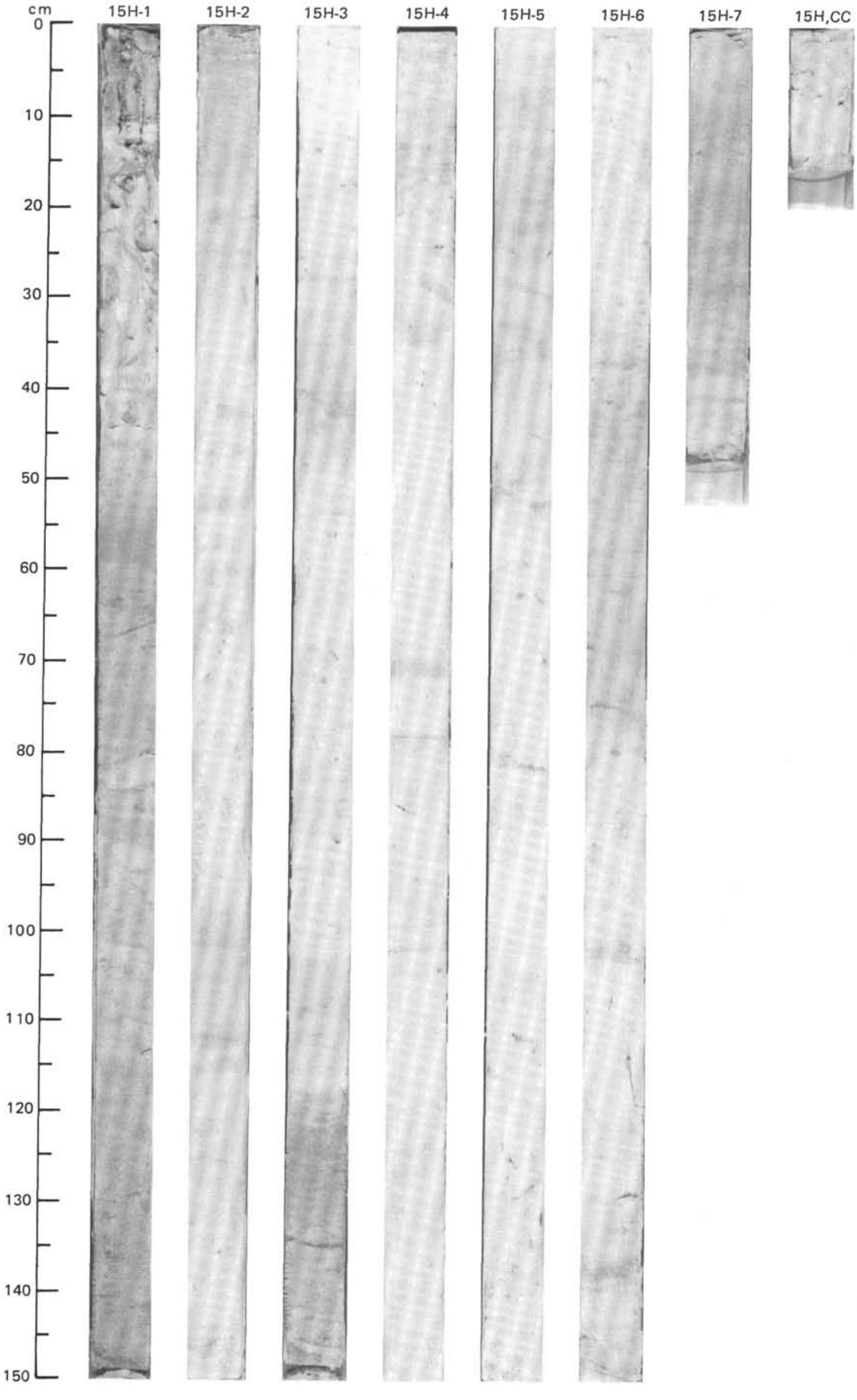
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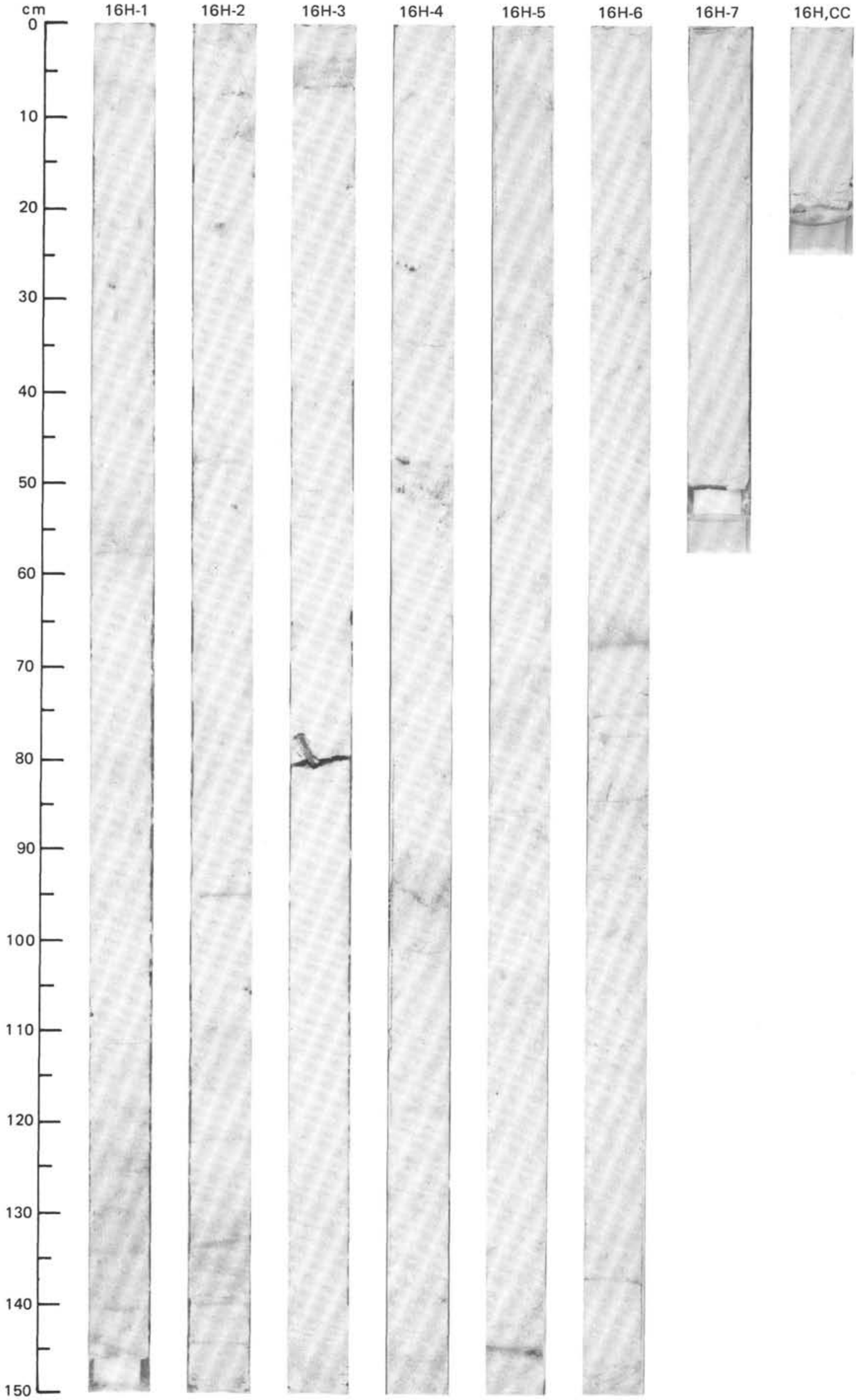
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