4. SITE 577[1]

Shipboard Scientific Party[2]

HOLES 577, 577A, 577B

Date occupied: 23 May 1982 (577), 24 May (577A), 25 May (577B)

Date departed: 25 May 1982

Time on site: 2 days, 19 hr., 27 min.

Position (latitude; longitude): 32°26.51′N; 157°43.40′E (577)
32°26.53′N; 157°43.39′E (577A)
32°26.48′N; 157°43.39′E (577B)

Water depth (sea level; corrected m, echo-sounding): 2675

Water depth (rig floor; corrected m, echo-sounding): 2685

Bottom felt (m, drill pipe): 2678.2 (577), 2677.6 (577A), 2782.0 (577B)

Penetration (m): 118.8 (577), 123.4 (577A), 113.9 (577B)

Number of cores: 13 (577), 13 (577A), 1 (577B)

Total length of cored section (m): 118.8 (577), 123.4 (577A), 9.5 (577B)

Total core recovered (m): 111.07 (577), 110.64 (577A), 9.63 (577B)

Core recovery (%): 93 (577), 90 (577A), 101 (577B)

Oldest sediment cored:
Depth sub-bottom (m): 123.4
Nature: calcareous nannofossil ooze
Age: Cretaceous (Maestrichtian)
Measured Velocity (km/s): 1.52

Basement: Not reached

Principal results: An unusually good late Cenozoic sequence, a Paleogene sequence, and an undisturbed record of the Cretaceous/Tertiary boundary were recovered at Site 577. The former two sections were recovered in two holes, while the latter was recovered in three holes. A paleomagnetic reversal record was determined for the Neogene but, since the magnetization of the Cretaceous and Paleogene sediments was within the noise level of the shipboard magnetometer, detailed magnetostratigraphy had to await shore-based analysis. Although the sediments recovered are all nannofossil oozes, they can be divided into three lithologic units.

Unit I (0–53.5 m) is a white to light gray nannofossil ooze. It is divided into two subunits based on a downcore decrease in the percentage of foraminifers, radiolarians, and diatoms. The lower subunit carries only a few percent foraminifers and traces of radiolarians and diatoms.

Unit II is a white to pale brown nannofossil ooze. This unit is characterized by high percentages (60–90%) of coccoliths. It is further divided into two subunits, with the upper one being pale brown in color and the lower one characterized by alternating white and pale brown colors.

The deepest lithologic unit (Unit III) is a calcareous nannofossil ooze, white in color, and Latest Cretaceous in age. It is found in the lower 20 m of the hole. Penetration was stopped by a hard layer, presumably chert.

Sediment accumulation rates were highest in the late Cenozoic (11.6 m/m.y.) and markedly less below the late Miocene/middle Eocene unconformity (3 m/m.y.). Late Cretaceous rates were on the order of 10 m/m.y.

Both the measurements of physical properties and heat flow seemed to "sense" the late Miocene/middle Eocene unconformity at approximately 60 m. There is a sudden increase in bulk density just below this boundary as well as a rapid increase in compressional wave velocity at this level (1.48 to 1.53 km/s). The heat-flow data show a linear increase with depth until the level of the unconformity at which point there is an apparent temperature reversal.

All in all, this was a highly successful site, highlighted by three separate holes in which we recovered undisturbed and complete Cretaceous/Tertiary boundary sequences.

BACKGROUND AND OBJECTIVES

Site 577 (target Site NW-8B) is the middle member of the suite of three sites taken along an east–west track between 32°N, 164°E and the west side of the Shatsky Rise. It is located as near as possible to Site 47 on the flank of the Shatsky Rise. Its proximity to the western edge of the subtropical gyre and the water depth (<3000 m) permit the preservation of calcareous microfossils. In addition to standard biostratigraphic treatment of this site, we expected to establish good stratigraphic control using stable isotopes (oxygen and carbon). At the same time, at least marginal preservation of siliceous microfossils allows us to correlate the Neogene sequences in this site with the more siliceous sequences to the north (Sites 578–581). Such a strategy will result in high resolution stratigraphic control for Neogene sediments from the equatorial Pacific to the northwest Pacific and is a natural prelude to any broad, regional paleoceanographic or paleoenvironmental study.

The location of this site is an excellent complement to Site 576 and LL44-GPC3 in that it reflects input of eolian sediments from the Asian mainland.

Our specific scientific objectives were

1. To obtain a detailed paleoceanographic record for the western edge of the subtropical gyre during the late Neogene, principally using foraminifers and calcareous nannofossils.

2. To recover a late Neogene carbon and oxygen isotope record for comparison with the noncalcareous (siliceous) sites to the north.

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[1] Heath, G. R., Burckle, L. H., et al., *Init. Repts. DSDP*, 86: Washington (U.S. Govt. Printing Office).

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3. To establish a high-resolution stratigraphy for the late Neogene and Quaternary, using paleomagnetics, stable isotopes, tephrachronology, and biostratigraphy (chiefly foraminifers and calcareous nannofossils, but also siliceous microfossils).

4. To determine the late Neogene history of eolian sedimentation for comparison with other sites along the east-west track.

5. To recover the Cretaceous/Tertiary boundary for midlatitude calcareous biostratigraphy and for paleomagnetic and geochemical studies.

OPERATIONS

We arrived at Site 577 after approximately 1 1/2 days steaming from Site 576. Air-gun, 3.5, and 12-kHz records were taken en route. We passed over the proposed site at 1534 hr., after which the gear was retrieved and the ship was positioned over the beacon. After a 1-hr. delay (slips did not hold) we began running pipe at 2400 hr. and, by 0400 hr., 24 May, were ready to take the first hydraulic piston core (HPC) at Site 577. This went off without a hitch, with the first core coming up at 0500 hr. and then at 1 hr., 15 min. to 1 hr., 30 min. intervals after that (Table 1). At 2335 hr. (24 May), Hole 577A was spudded in and the first core came up at 2400 hr. This operation also went off without a hitch (Table 1). However, when Site 577 cores were opened, we discovered considerable coring disturbance in some parts of the section, particularly the Paleogene. An effort was made to rectify this by modifying the shear pin assembly to allow the equivalent of one additional shear pin. It was believed that the shallow water depth at this site coupled with premature yielding of shear pins resulted in slow penetration rates on some cores, resulting in increased disturbance. The character of the sediments (a clay-poor nannofossil ooze) may have contributed to this problem. At Hole 577B (0035 hr., 25 May), we washed down to just above the approximate level of the Cretaceous/Tertiary boundary and recovered one core of the boundary (Table 1).

Table 1. Site 577 coring summary.

Core	Date (May 1982)	Local time	Depth from drill floor (m)	Depth below seafloor (m)	Length cored (m)	Length recovered (m)	Percent recovered
Hole 577							
1	23	0505	2678.2–2685.0	0.0–6.8	6.8	6.81	100
2	23	0615	2685.0–2694.5	6.8–16.3	9.5	8.84	93
3	23	0730	2694.5–2704.0	16.3–25.8	9.5	8.15	86
4	23	0845	2704.0–2713.5	25.8–35.3	9.5	8.62	91
5	23	0958	2713.5–2723.0	35.3–44.8	9.5	7.99	84
6	23	1110	2723.0–2732.5	44.8–54.3	9.5	9.69	102
7	23	1225	2732.5–2742.0	54.3–63.8	9.5	8.24	87
8	23	1350	2742.0–2751.5	63.8–73.3	9.5	9.33	98
9	23	1505	2751.5–2761.0	73.3–82.8	9.5	8.80	93
10	23	1610	2761.0–2770.5	82.8–92.3	9.5	9.61	101
11	23	1800	2770.5–2780.0	92.3–101.8	9.5	9.21	97
12	23	1910	2780.0–2789.5	101.8–111.3	9.5	9.39	99
13	23	2020	2789.5–2797.0	111.3–118.8	7.5	6.39	85
					118.8 (total)	111.07 (total)	93 (avg.)
Hole 577A							
1	24	0001	2677.6–2687.0	0.0–9.4	9.4	9.39	100
2	24	0119	2687.0–2696.5	9.4–18.9	9.5	8.70	92
3	24	0245	2696.5–2706.0	18.9–28.4	9.5	7.08	75
4	24	0356	2706.0–2715.5	28.4–37.9	9.5	9.72	102
5	24	0705	2715.5–2725.0	37.9–47.4	9.5	8.78	92
6	24	0815	2725.0–2734.5	47.4–56.9	9.5	9.85	104
7	24	1120	2734.5–2744.0	56.9–66.4	9.5	8.90	94
8	24	1230	2744.0–2753.5	66.4–75.9	9.5	8.13	86
9	24	1520	2753.5–2763.0	75.9–85.4	9.5	3.80	40
10	24	1650	2763.0–2772.5	85.4–94.9	9.5	8.15	86
11	24	1802	2772.5–2782.0	94.9–104.4	9.5	9.26	97
12	24	1938	2782.0–2791.5	104.4–113.9	9.5	9.62	101
13	24	2058	2791.5–2801.0	113.9–123.4	9.5	9.26	97
					123.4 (total)	110.64 (total)	90 (avg.)
Hole 577B							
1	25	0035	2782.0–2791.5	104.4–113.9	9.5	9.63	101
					9.5 (total)	9.63 (total)	101 (avg.)

While coring Holes 577A and 577B, it was noticed that several connections were breaking with a torque of 8000/ft. lbs. or less. This problem has occurred on previous legs and, since no rotation is imparted to drill pipe during HPC coring, it was decided to retorque all connections on new pipe while coming out of Hole 577B.

The heat flow shoe was deployed nine times, six of which were successful. However, the three unsuccessful runs were not due to any inadequacies of the unit. Two failures were due to an undiscovered broken wire; the third occurred when the unit was plugged into the computer before the recording cycle was completed and the data were dumped.

LITHOSTRATIGRAPHY

The sediments in Holes 577, 577A, and 577B at Site 577 are nannofossil oozes that can be divided into three units based on color variations: (I) a white to light gray unit, (II) a white to pale brown unit, (III) a white unit. The upper two units can be further subdivided on the basis of color variation (Fig. 1, Table 2). Carbonate contents of these sediments, determined by the shipboard Carbonate Bomb, are included in Figure 1.

Unit I: White to Light Gray Nannofossil Ooze

This unit is characterized by high percentages (60–97%) of nannofossils and is further divided into two subunits as follows.

Subunit IA

Subunit IA is an alternating white to light gray (2.5Y and 5Y), lightly mottled nannofossil ooze that extends from the top of Cores 1 through 5 in both Holes 577 and 577A. This subunit contains 60–95% nannofossils with subordinate amounts of foraminifers (0–20%), radiolarians (0–7%), and diatoms (0–3%). Sponge spicules are present in trace amounts. With the exception of Cores 577-1 and 577A-1, terrigenous material generally accounts for less than 15% of the sediment; in Cores 577-1 and 577A-1, terrigenous concentrations of up to 35% occur. The dominant terrigenous components are quartz (0–10%), feldspar (0–5%) and clay (0–15%). Volcanic ash is generally present in concentrations of 2% or less.

Hole 577 contains three ash layers in Subunit IA (ash greater than 50%), one in Sample 577-2-5, 60 cm; one in Sample 577-2-6, 103 cm; and one in Sample 577-3-1, 39 cm. Hole 577A contains two ash layers, one in Sample 577A-2-3, 105 cm and another in Sample 577A-2-4, 136 cm. An ash-rich horizon (ash concentrations 20–30%) is also found in Sample 577A-4-4, 76–80 cm. The ash layer in Sample 577-2-5, 60 cm is likely correlated with the one in Sample 577A-2-3, 105 cm. The ash layer in

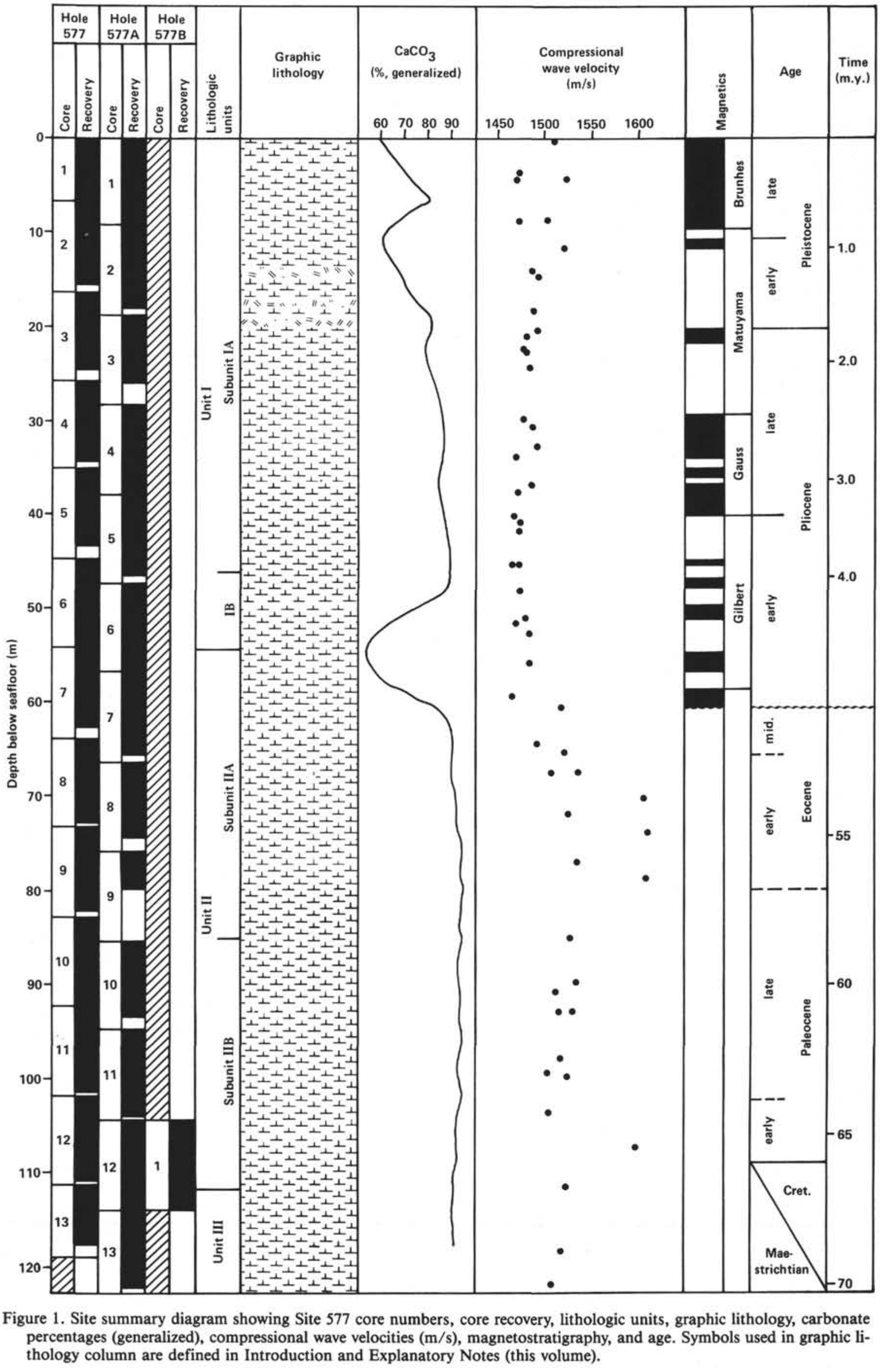

Figure 1. Site summary diagram showing Site 577 core numbers, core recovery, lithologic units, graphic lithology, carbonate percentages (generalized), compressional wave velocities (m/s), magnetostratigraphy, and age. Symbols used in graphic lithology column are defined in Introduction and Explanatory Notes (this volume).

Table 2. Site 577 lithostratigraphic units.

		Core interval			Sub-bottom depth (m)		
	Lithologic unit	Hole 577	Hole 577A	Hole 577B	Hole 577	Hole 577A	Hole 577B
I	White to light gray nannofossil ooze						
	Subunit IA (2.5Y to 5Y color)	1-1, 0 cm to 5,CC	1-1, 0 cm to 5,CC		0–44.8	0–47.4	
	Subunit IB (10YR color)	6-1, 0 cm to 6,CC	6-1, 0 cm to 6-5, 150 cm		44.8–54.3	47.4–53.5	
II	White to pale brown nannofossil ooze						
	Subunit IIA (pale brown)	7-1, 0 cm to 9,CC	6-6, 0 cm to 10-2, 150 cm		54.3–82.8	53.5–88.4	
	Subunit IIB (white to pale brown)	10-1, 0 cm to 12-7, 50 cm	10-3, 0 cm to 12-6, 150 cm	1-1, 0 cm to 1-5, 150 cm	82.8–111.1	88.4–111.9	104.4–111.9
III	White nannofossil ooze	12,CC to 13,CC	12-7, 0 cm to 13,CC	1-6, 150 cm to 1,CC	111.1–118.8	111.9–123.4	111.9–113.9

Sample 577A-2-4, 136 cm may be correlative with either the layer in Sample 577-2-6, 103 cm or Sample 577-3-1, 39 cm. Hole 577 does not contain an ash-rich horizon correlative to that found in Sample 577A-4-4, 76–80 cm.

Subunit IB

Subunit IB is an alternating white to light gray (10YR) nannofossil ooze that extends from the top of Core 577-6 to the top of Core 577-7 and from the top of Core 577A-6 through Section 577A-6-5. This subunit contains 90–97% nannofossils with only a few percent foraminifers. Siliceous microfossils are present in trace amounts. Combined quartz, feldspar, and clay concentrations are less than 5%. Volcanic ash generally constitutes less than 2% of the sediment. An ash layer in Sample 577A-6-4, 60 cm does not appear to have a correlative layer in Hole 577.

Unit II: White to Pale Brown Nannofossil Ooze

This nannofossil ooze unit is characterized by high percentages (60–90%) of nannofossils and is divided into two subunits as follows.

Subunit IIA

Subunit IIA is a pale brown (10YR) nannofossil ooze that extends from the top of Cores 577-7 through 577-9 and from the top of Sections 577-6-6 through 577A-10-2. This subunit contains 80–90% nannofossils with only trace amounts of foraminifers and siliceous microfossils. Quartz (0–5%), feldspar (0–2%), clay (0–10%), and volcanic ash (0–2%) constitute the remaining sediment.

Subunit IIB

Subunit IIB is characterized by alternating white and pale brown (10YR) nannofossil oozes found in Sections 577-10-1 through 577-12-7, 577A-10-3 through 577A-12-6, and 577B-1-1 through 577B-1-5. Nannofossils comprise 65–95% of the sediment; foraminifer concentrations range up to 35%. Combined quartz, feldspar, clay, and ash concentrations are generally less than 10%.

Unit III: White Nannofossil Ooze Unit

This white (10YR) nannofossil unit extends from Sections 577-12,CC through 577-13,CC, 577A-12-7 through 577A-13,CC, and 577B-1-6 through 577B-1,CC. Core 577-13 struck a hard layer, presumably chert, and coring in that hole was discontinued. Holes 577A and 577B did not reach this layer. Unit III is comprised of 80–90% nannofossils with foraminifers and siliceous microfossils present in trace amounts. Quartz and clay concentrations each comprise 0–5% of the sediment; feldspar and ash are present in abundances of less than 2%.

SEISMIC CORRELATIONS

High-resolution seismic reflection profiles (3.5 and 12 kHz) and about 100-Hz reflection profiles were recorded at Site 577. Both hull-mounted and near-bottom sound sources were utilized. The near-bottom transducer (3.5 and 5.25 kHz) was mounted on the drill string 253 m above the face of the drill bit.

The 3.5-kHz echograms over Site 577 reveal a four-part seismic section (Fig. 2, Table 3). Seismic Unit 1 extends to 0.032 s (23.8 m below seafloor, assuming a velocity of 1485 m/s) and consists of strong, multiple, parallel sub-bottom reflectors at 0.008 s (5.9 m, Reflector 1a), 0.011 s (7.9 m, Reflector 1b), 0.015 s (11.4 m, Reflector 1c), 0.019 s (14.4 m, Reflector 1d), and 0.023 s (16.8 m, Reflector 1e) below the seafloor. The strongest reflectors are 1b, 1c, and especially 1e; Reflectors 1a and 1d are somewhat intermittent. A relatively thin transparent layer separates Reflector 1e from the underlying seismic Unit 2. The source of these reflectors is unclear, but the interval thickness between Reflectors 1d and 1e (2.4 m) and the depth below seafloor of these reflectors (1d = 14.4 m, 1e = 16.8 m) are similar to those of the ash layers encountered in Core 2 of Holes 577 and 577A (577: 2.0 cm thickness, 13.5 and 15.5 m depth; 577A: 1.5 cm thickness, 13.5 and 15 m depth). The shallower depths recorded between the cored ashes and seafloor suggests that the HPC did not retrieve the uppermost 1 to 1.5 m of sediment.

Seismic Unit 2 is composed of two parallel reflectors of medium strength overlying a transparent section. The uppermost reflector (2a) occurs at 0.032 s (23.8 m) below seafloor; the lowest reflector (2b) occurs at 0.039 s (29.2 m) below seafloor. The source of these reflectors is unknown.

Seismic Unit 3 consists of a transparent section with its top defined by a weak, generally continuous reflector (Reflector 3a at 0.059 s, 43.5 m below seafloor assuming

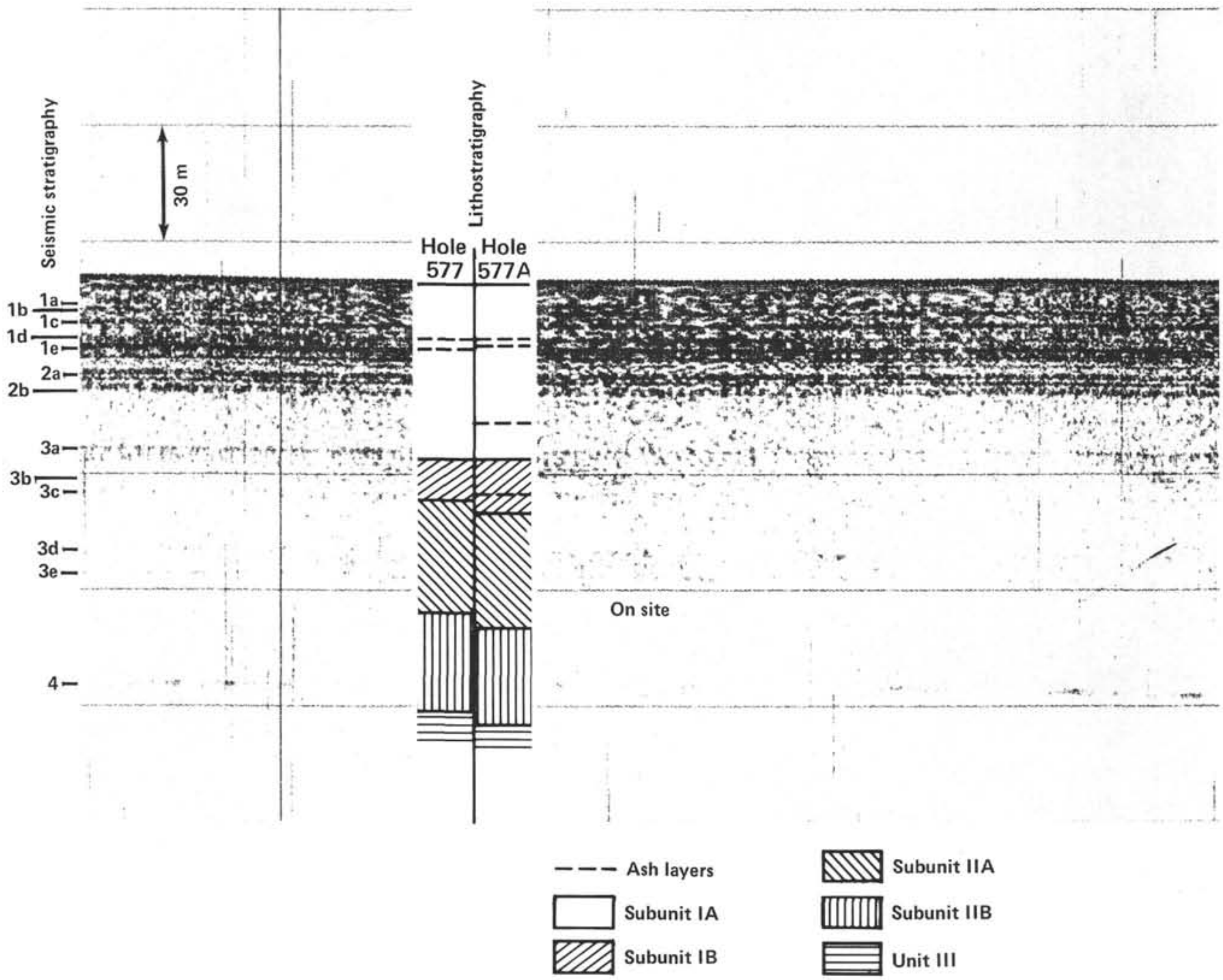

Figure 2. 3.5-kHz echogram over Site 577 showing the four-part seismic section described in the text. Sub-bottom depths to seismic reflectors are given in Table 3.

Table 3. 3.5-kHz seismic correlations, Site 577.

Reflector	Relative strength[a]	Sub-bottom depth (s)	Sub-bottom depth (m)[b]
1a	I	0.00795	5.9
1b	S	0.0106	7.9
1c	S	0.0153	11.4
1d	I	0.0194	14.4
1e	S	0.0226	16.8
2a	M	0.0320	23.8
2b	M	0.0393	29.2
3a	W	0.0587	43.5
3b	W, I	0.0694	51.4
3c	W, I	0.0733	54.3
3d	W, I	0.0932	69.3
3e	W, I	0.102	76.3
4	W-M, I	0.140	104.8

[a] I = intermittent, M = medium, S = strong, W = weak.

[b] Assuming 0–30 m = 1485 m/s, 30–60 m = 1475 m/s, 60+ m = 1520 m.

1475 m/s below 30 m depth). The transparent section is punctuated by weak, intermittent reflectors at 0.069 s (51.4 m, Reflector 3b), 0.073 s (54.3 m, Reflector 3c), 0.093 s (69.3 m, Reflector 3d), and 0.102 s (76.4 m, assuming a velocity of 1520 cm/s below 60 m, Reflector 3e). The generally transparent section between Reflectors 3a and 3e reflects the homogenous nature of the nannofossil oozes. The transparent intervals below Reflector 3e correlate with the uncored clay(?) section.

The sources for the sparse reflectors are unclear. An angular unconformity is observed on both the 3.5-kHz echograms and 100-Hz seismic reflection profiles on the ship's departure track between 0300Z and 0330Z (Figs. 3 and 4). This unconformity is observed around a seamount on top of the Shatsky Rise and on the margins of the top of the Rise. The unconformity separates parallel reflectors with relatively little local relief above the unconformity from parallel reflectors with relatively high local relief below the unconformity (e.g., Reflectors 3e and 4). The weak, intermittent reflector that marks the unconformity is about 8 m below Reflector 3a and probably is Reflector 3b/3c at Site 577. This unconformity is

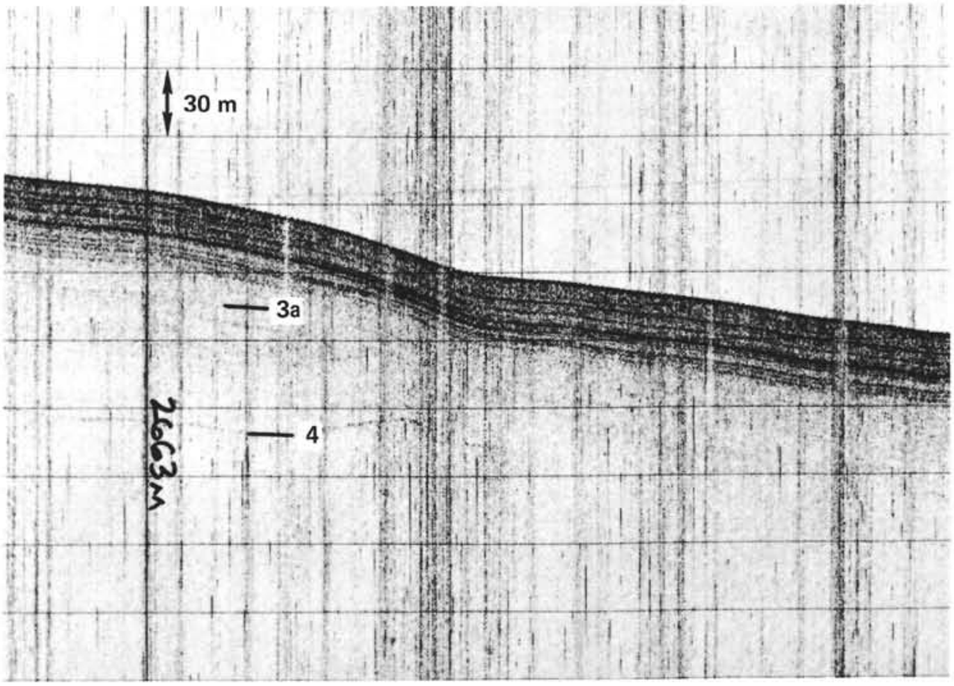

Figure 3. 3.5-kHz echogram collected on ship's departure track from Site 577 (0300Z to 0330Z on 25 May 1982) showing angular unconformity discussed in the text.

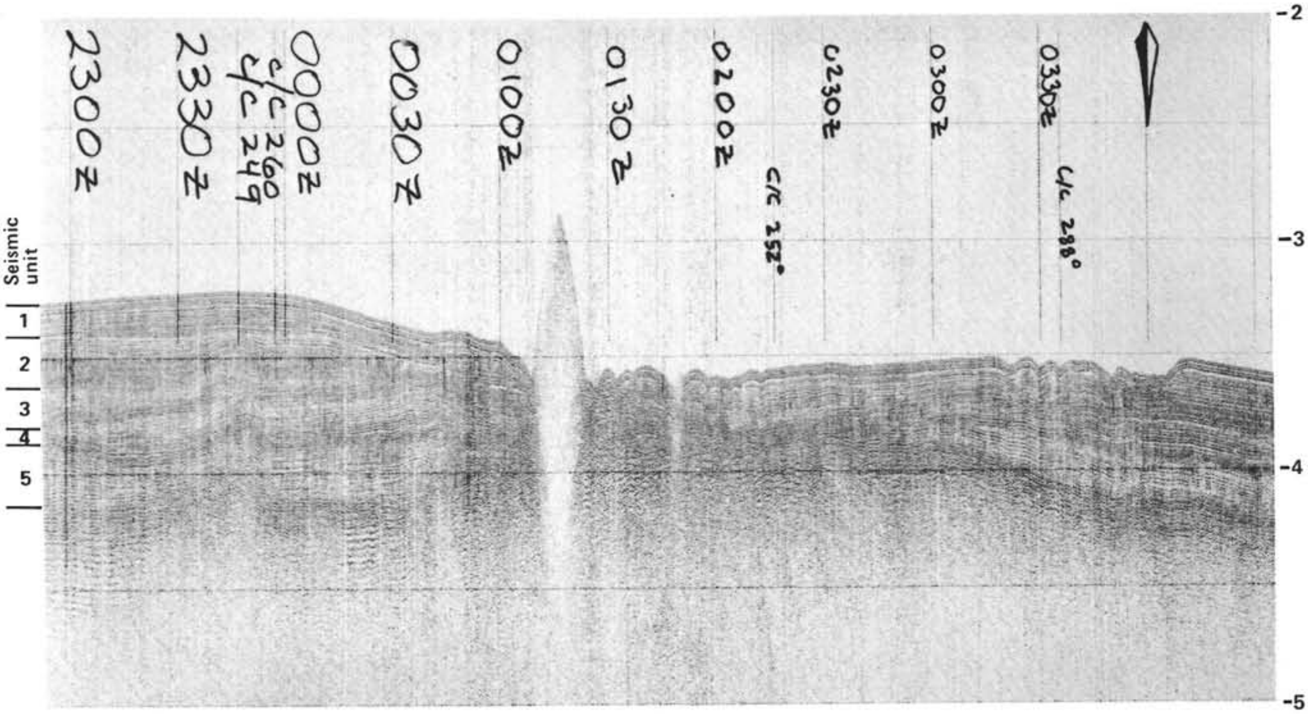

Figure 4. 100-Hz reflection profile near Site 577 showing the five-part seismic section described in the text.

the upper Miocene/middle Eocene unconformity observed in the upper part of Core 7 of Hole 577A. However, Reflectors 3b and 3c are 51.4 and 54.3 m below the seafloor, respectively, at Site 577, while the cored unconformity occurs at about 57.5 and 61 m below seafloor. This discrepancy suggests that (1) the assumed velocities deduced from shipboard velocity measurements are too low, or (2) the cores were actually retrieved from shallower depths. If Reflector 3c marks the unconformity, then Reflector 3a is probably the ash layer cored at about 53 m below seafloor in Hole 577A.

Reflector 4 of seismic Unit 4 is a weak, generally continuous reflector at 0.140 s (104.8 m) below the seafloor. Before coring, this reflector was thought to be a chert horizon, but its depth below seafloor is more consistent with the top of sedimentary Unit III at 111-114 m or the Cretaceous/Tertiary boundary at about 110 m. In either proposed correlation, velocities deduced from shipboard measurements appear to low. The doubt concerning the velocity structure and core depths does not allow a more precise correlation.

The 100-Hz seismic reflection profiles reveal a five-part seismic section (Fig. 4). The uppermost unit (Unit 1) in the seismic section is a packet of strong, parallel reflectors. On the relatively flat areas at the top of the Shatsky Rise, Unit 1 consists of conformable reflectors down to a relatively transparent zone at approximately 0.16 to 0.17 s (about 120 m) below seafloor. The interval thickness suggests that Unit 1 includes all the sediment above the Cretaceous chert layer. However, along the margins of the top of Shatsky Rise and near seamounts at the top, Unit 1 consists of two sections: an upper section of strong reflectors parallel to the seafloor and a lower section that has strong reflectors with dips divergent from those of the upper section. On both the site approach and departure tracks, it is clear that the upper section cuts downsection, thinning the lower section to a "0" isopach. This angular unconformity at about 0.085 s below seafloor is the upper Miocene/middle Eocene unconformity cored in Holes 577 and 577A. Because of the interference of the "bubble pulse," it is not possible to identify precisely the reflector that marks this unconformity.

Each of the succeeding three lower seismic units (Units 2, 3, and 4) consists of weak reflectors forming a relatively semitransparent zone that grades downward into strong parallel reflectors. At the maximum sediment thickness near Site 577, Unit 2 occurs from 0.17 to 0.38 s below seafloor, Unit 3 extends to about 0.52 s below seafloor, and Unit 4 extends to about 0.68 s below seafloor. Unit 5 consists of only a semitransparent section and extends to about 0.88 s below seafloor. The deepest reflector (the base of Unit 5) is probably basement. A minor unconformity is observed near seamounts on the Shatsky Rise where Unit 2 crosscuts Unit 3 and possibly Unit 4.

BIOSTRATIGRAPHY

A total thickness of 251.7 m of nannofossil ooze was recovered from three holes at Site 577. The sediment is rich in calcareous microfossils throughout and provides a high-resolution biostratigraphy (Fig. 5).

A late Miocene through Quaternary sequence was recovered down to Section 577A-7-3. There is a major hiatus at approximately 61 m representing the late Eocene, the Oligocene, and the early and middle Miocene. Below this, a Late Cretaceous through middle Eocene sequence was recovered. Foraminifers and nannofossils indicate two minor hiatuses in the Paleogene. The Cretaceous/Tertiary boundary was recovered intact in Sections 577-12-5, 577A-12-4, and 577B-1-4.

Preservation and Abundance

Radiolarians are abundant and moderately to well preserved through Core 577A-6, below which the samples are barren. Diatoms are rare to few and their preservation is poor to moderate through Cores 577-5 and 577A-5, below which the samples are barren. In general, calcareous nannofossils are common to abundant and moderately to well-preserved throughout. Near the Cretaceous/Tertiary boundary, nannofossils are abundant but preservation is poor to moderate. Nannofossils in Cores 577-5 through 577-8 also show poor to moderate preservation. Foraminifers are abundant throughout. In the upper Tertiary intervals, effects of dissolution are light to moderate and moderate test breakage is common. In the middle Eocene interval (Cores 577-7 and 577A-7), test breakage is heavy, the samples are flooded with fragments, but dissolution effects on the survivors are light. The assemblage is limited to the subspherical forms *Globigerinatheca index index* and *G. barri*, which make their outlines more spherical and abrasion resistant by adding bullae over their sutural apertures. The Paleocene and Upper Cretaceous samples contain moderately to well-preserved foraminiferal faunas.

Stratigraphic Record and Hiatuses

The biostratigraphic record is summarized in Figure 5. An upper Miocene to lower Pleistocene sequence was defined by all four fossil groups. Calcareous nannofossils and foraminifers define an Upper Cretaceous through middle Eocene sequence. There is a lengthy middle Tertiary hiatus between Cores 577-6, -7 and 577A-6 and -7. Cores 577-7 and 577A-7 contain middle Eocene sediments which were not reported at nearby Site 47. Calcareous nannofossils suggest additional hiatuses in the middle Eocene and the middle Paleocene. The foraminifers also suggest the possibility of an earliest Eocene-latest Paleocene hiatus and a hiatus in the middle Paleocene.

Three core sections (577-12-5, 577A-12-4, and 577B-1-4) contain an undisturbed Cretaceous/Tertiary boundary. There is no significant lithologic change at the boundary. The most distinctive feature is a color change from white below the boundary to pale brown above. Mottling attributed to bioturbation is visible in the pale brown earliest Paleocene ooze.

Calcareous Nannofossils

The stratigraphic sequence of this site ranges from Quaternary to Late Cretaceous (Maestrichtian). The calcareous nannofossil assemblages are abundant and diversified. Their preservation ranges from poor to moderate. Calcareous nannofossils are significantly overgrown near the Cretaceous/Tertiary boundary and in the lower-middle Eocene. A significant hiatus is noted from the late Eocene to the late Miocene.

Diverse and well-preserved Pleistocene nannofossil assemblages were found in Core 577-1 through Section 577-3-4, and in Core 577A-1 through Section 577A-3-2. They represent the *Emiliania huxleyi* (CN15), *Gephyrocapsa oceanica* (CN14), and *Crenalithus doronicoides* (CN13) Zones (Bukry, 1973, 1975; Okada and Bukry, 1980). Abundant and generally well preserved Pliocene nannofossil assemblages occur between Samples 577-3-5, 44 cm and 577-5-4, 60 cm and between Samples 577A-3-3, 60 cm and 577A-5-5, 15 cm. All the subzones of the *Dis-*

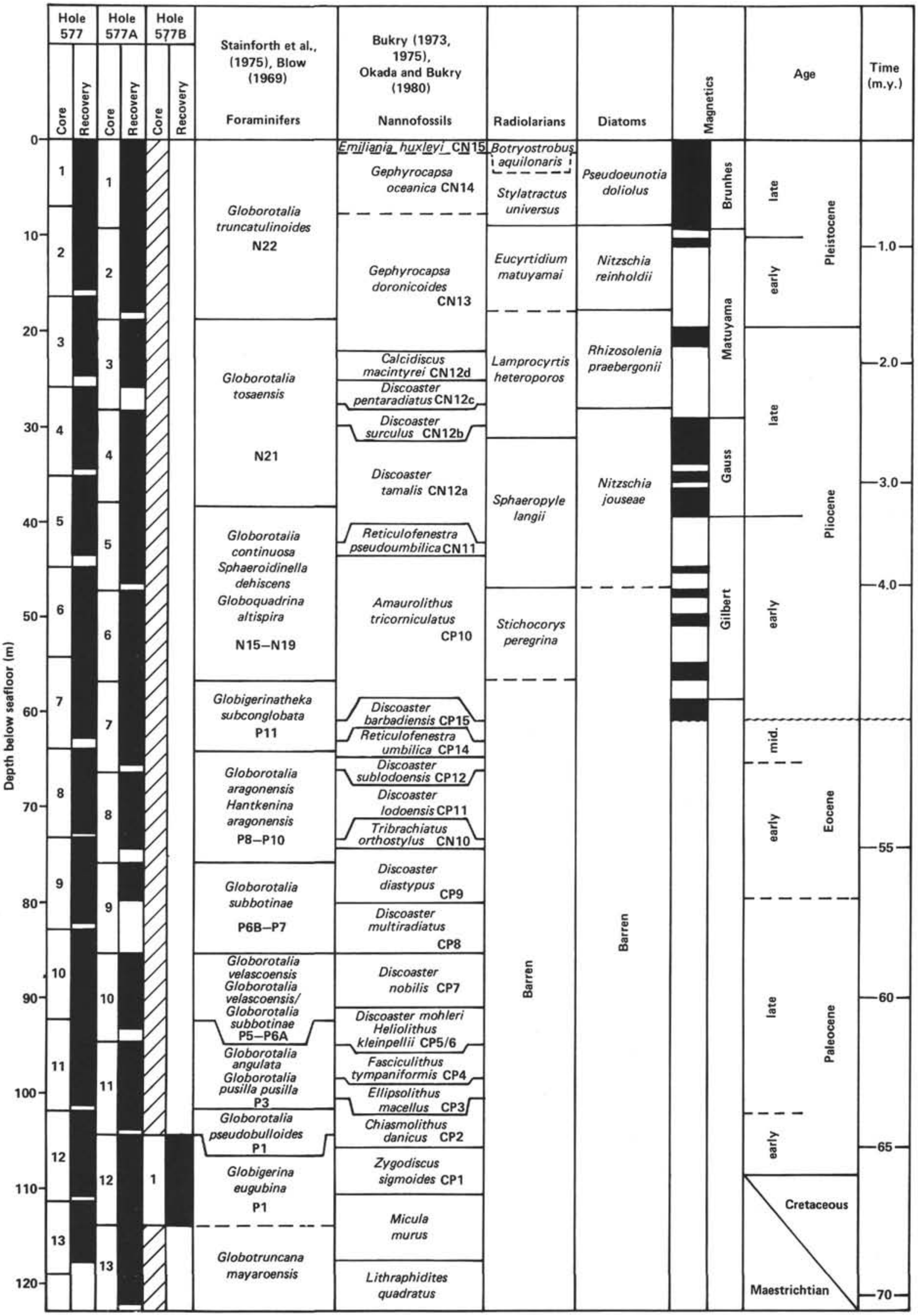

Figure 5. Site 577 biostratigraphic and magnetostratigraphic summary.

coaster brouweri Zone (CN12) are recognized. In Cores 577-5, -6 and 577A-5, -6 a moderately well preserved assemblage belongs to the *Amaurolithus tricorniculatus* (CN10) Zone. The absence of *Triquetrorhabdulus rugosus* indicates that the lower part of the *A. tricorniculatus* Zone is missing. An important hiatus is found in Cores 577-7 and 577A-7 separating assemblages of the *A. primus* (CN9b) Subzone from the *D. barbadiensis* (CP15) Zone. Most of the lower Eocene and Paleocene zonal markers were found with these exceptions: *Tribrachiatus contortus* was not found and *D. mohleri* and *Heliolithus kleinpellii* have the lowest occurrence in the same samples.

The Cretaceous/Tertiary boundary is located in Samples 577-12-5, 130 cm, 577A-12-4, 72 cm, and 577B-1-4, 72 cm. The boundary is recognized by the appearance of common *Thorascosphaera* and *Biscutum* sp. The oldest assemblage recovered from Hole 577 is moderately well preserved and belongs to the *Micula murus* Zone of latest Maestrichtian age. Holes 577A and 577B extend just below the appearance level of *M. murus*.

Planktonic Foraminifers

Abundant foraminifers were recovered from all cores taken at Site 577. Preliminary examination of core-catcher samples has revealed an upper Miocene–Pliocene–lower Pleistocene sequence, a long hiatus in the middle Tertiary and an Upper Cretaceous through middle Eocene sequence. Preliminary zonations are shown in Figure 5.

Samples 577-1,CC and -2,CC and 577A-1,CC and -2,CC contain an abundant early Pleistocene fauna typical of the *Globorotalia truncatulinoides* Zone (Stainforth et al., 1975) or N22 (Blow, 1969). Representative taxa include: *Globorotalia acostaensis, G. hirsuta, G. humerosa, G. inflata, G. menardii* (ex. gr., sinistral), *G. ronda, G. tosaensis, G. triangula, Globigerina dutertrei*, and *Globigerinoides conglobatus*. Core catchers from 577-3, -4 and 577A-3, -4 contain an upper Pliocene fauna of the *G. tosaensis* Zone (N21). This diverse fauna includes: *Globorotalia praehirsuta, G. menardii* (ex. gr., dextral), *G. crassaformis, Globigerina venezuelana, Globigerinoides conglobatus*, and many of the long-ranging taxa found in Zone N22. Samples 577-5,CC, -6,CC, 577A-5,CC, and -6,CC contain a mixed assemblage that spans the upper Miocene and lower Pliocene *Globorotalia continuosa* Zone to *G. margaritae* Zone or N15–N19. The assemblage includes: *G. acostaensis, G. humerosa, G. obesa, G. multicamerata, G. tosaensis, G. margaritae, G. scitula, Globigerinoides obliquus, G. quadrilobatus trilobus*, and *G. sacculifer*. Sample 577-7,CC contains a middle Eocene fauna of the *Globigerinatheka subconglobata* Zone (P11). The fauna is composed entirely of *G. barri* and *G. index index*. A fauna found in Samples 577-8,CC -9,CC and 577A-7,CC and -8,CC characterizes the *Globorotalia aragonensis* Zone to the *Hantkenina aragonensis* Zone (P8–P10). Taxa comprising this fauna include: *Globigerina primitiva, G. soldadoensis soldadoensis, G. soldadoensis angulosa, Globorotalia pseudotopilensis, G. wilcoxensis, G. subbotinae, G. formosa formosa, G. formosa gracilis*, and *G. aragonensis*. Sample 577A-9,CC contains taxa characteristic of the earliest Eocene, *G. subbotinae* Zone or P6B. This fauna is similar to the younger P7 fauna, but excludes *G. soldadoensis angulosa* and includes *G. velascoensis*.

The upper Paleocene is identified in Sample 577-10,CC by the combined *Globorotalia velascoensis* Zone and *G. velascoensis/G. subbotinae* Zone or P5 to P6A. The characteristic taxa are *Globorotalia subbotinae, G. aequa, G. pusilla pusilla, G. velascoensis, G. angulata*, and *Globigerina mckannai*. Samples 577A-10,CC and 577-11,CC represent the middle Paleocene. They contain species found in the *Globorotalia angulata* Zone through *G. pusilla pusilla* Zone or P3. These are *G. aequa, G. pusilla pusilla, G. angulata, G. occlusa, G. pseudobulloides, G. compressa, Globigerina mckannai, G. nitida, G. trilocculinoides*, and *G. velascoensis*. The *Globorotalia pseudobulloides* Zone or the middle portion of P1 was recognized in Sample 577A-11,CC. The earliest Paleocene, *Globigerina eugubina* Zone (P1) was identified in Samples 577-12,CC and 577A-12,CC. This fauna is typified by *Globorotalia pseudobulloides, Globigerina eugubina, G. sabina, G. trinidadensis*, and *Chiloguembelina taurica*. The next sample downhole is problematic and will require further detailed study because of proximity to the Cretaceous/Tertiary boundary. Sample 577A-12,CC contains *G. eugubina* and *G. sabina* and other primitive globigerinids in roughly equal abundance with many Cretaceous taxa. The samples are below the boundary (Samples 577-12-5, 130 cm and 577A-12-4, 72 cm) as identified by nannofossils, the extinction of Cretaceous forms, and a change in maximum diameter of *G. eugubina*. We hope that close-spaced sampling in Core 12 will explain this occurrence. Samples 577-13,CC and 577A-13,CC contain a distinctive Upper Cretaceous fauna of the *Globotruncana mayaroensis* Zone including: *Globotruncana mayaroensis, G. stuarti, G. contusa, Globotruncanella petaloides, Rugoglobigerina rotundata, R. rugosa, Pseudotextularia varians*, and *P. carseyae*.

Radiolarians

Holes 577 and 577A contain abundant radiolarians from the top of Sections 1-1 through 6,CC. Radiolaria are not found in Sections 7-4 through 13,CC. The results of the preliminary biostratigraphic survey of the sediments recovered at Site 577 are summarized in Figure 5.

The species in the uppermost samples from Holes 577 and 577A are representative of the *Botryostrobus aquilonaris* Zone (Hays, 1970), indicating that sediment younger than 400,000 yrs. was recovered at this site. The sediment sequence from the lower half of Cores 577-1 and 577A-1 is assigned to the *Stylatractus universus* Zone (Hays, 1970) based on the presence of *S. universus* and *Druppatractus acquilonius* and the absence of *Eucyrtidium matuyamai*. Based on the presence of the radiolarian species *E. matuyamai*, the *E. matuyamai* Zone (Hays, 1970; Foreman, 1973) extends from Core 2 through the upper half of Core 3. This zone was somewhat difficult to define since the southern limit of *E. matuyamai's* habitat nearly coincides with this site's position. The absence of *E. matuyamai* and *Stichocorys peregrina* from the lower half of Core 577-3 through the upper half of

Core 577-4 indicates that this sequence belongs to the *Lamprocyrtis heteroporos* Zone (Hays, 1970; Foreman, 1975). The top of the *Sphaeropyle langii* Zone (Foreman, 1975), based on the presence of *Stichocorys peregrina*, is located in a core-catcher sample of Core 577-4 and in Section 577A-4-5. The fauna in Core 577-5 and 577A-5 is representative of the *Sphaeropyle langii* Zone. The oldest radiolarian-bearing sediment at this site belongs to the *Stichocorys peregrina* Zone (Riedel and Sanfilippo, 1970; Foreman, 1975) and is confined to Cores 577-6 and 577-A-6.

Diatoms

Cores 577-1 through 577-6 contain few to rare diatoms with moderate preservation, but diatoms are absent below Core 7. Core 1 belongs to the *Pseudoeunotia doliolus* Zone. Core 2 is placed in the *Nitzschia reinholdii* Zone by the presence of *N. reinholdii*. Core 3 is correlated with the *Rhizosolenia praebergonii* Zone by the presence of *R. praebergonii* and the absence of *P. doliolus*. Cores 4 and 5 correlate with the middle Pliocene *N. jouseae* Zone, which ranges from the lower part of the Gauss Epoch to the Sidufjall Event of the Gilbert Epoch, by the presence of *N. jouseae* and *Thalassiosira convexa*, and the absence of *R. praebergonii* (Burckle and Opdyke, 1977; Burckle, 1978).

Diatoms are few to rare and preservation is moderate above Core 577A-6. Core 1 belongs to the *P. doliolus* Zone, Core 2 to the *N. reinholdii* Zone, and Core 3 to the *R. praebergonii* Zone. Cores 4 and 5 belong to the *N. jouseae* Zone. In Core 6, no age-diagnostic species were found.

Diatoms are completely absent from Core 577B-1.

PALEOMAGNETICS

Paleomagnetic analyses were performed on 475 samples from the sedimentary sequences recovered in Holes 577 and 577A at this site. The details of this study are given in a separate chapter (see Bleil, this volume).

The intensity of the natural remanent magnetization (NRM) in both holes decreases systematically from about 1.5×10^{-5} Gauss near the top to about 1×10^{-6} Gauss in the lower parts. The variability of the NRM intensities, both between and within cores, is less at this site than at the more northern sites drilled during Leg 86. The magnetic stability displays just the opposite characteristic. In the upper 60 m of both holes median destructive field (MDF) determinations yielded extremely variable results, with an average high level of about 400 Oe. At greater depths, consistently lower MDF values, mostly in the range of about 200 Oe, were observed. Over several zones, MDF values of less than 100 Oe indicate poor magnetic stability.

Alternating field (AF) demagnetization resulted in large changes in magnetization directions not only for the majority of samples from lower parts of both holes, but also for many samples from the upper 60 m. The relatively large scatter in directional data likely indicates that the stable directions defined are not always true primary single component magnetizations, but also include some secondary components that could not be erased completely by AF demagnetization.

The downhole pattern of stable magnetization directions at a number of levels is further complicated by large amounts of physical disturbances introduced during the coring operation. All samples from below about 60 m sub-bottom in both holes show clear evidence of a strong artificial magnetic overprinting. A discussion of the complex results from these sections is given elsewhere (see Bleil, this volume).

In the upper part of the cored sections, the downhole sequence of stable magnetization directions yields an unequivocal reversal stratigraphy for the last 5.5 m.y. that includes all major reversals of the Earth's magnetic field since the beginning of the Gilbert Epoch (Fig. 5). However, because of the limited recovery or badly disturbed sediment in some cores of both holes, exact sub-bottom depths are difficult to define for a number of the reversals. For the same reason, some short polarity events (such as the Jaramillo in Hole 577A and the Cochiti in Hole 577A) are missing in one hole but could be recognized in the other. A comparison of the depth data for several well-defined reversals in both holes reveals variable degrees of mutual offsets amounting to at least ± 1 m downhole.

Down to about 60 m sub-bottom, the inclination data scatter around the axial dipole value for the present latitude of the site (51.8°). A hiatus of about 35 m.y. is revealed by the biostratigraphy at this level. Below the hiatus, the range of stable inclinations abruptly changes to about 20–30°, a reflection of the northward motion of the Pacific Plate. Using the most recent polarity time scale of Berggren et al. (in press) the sedimentary column above the hiatus accumulated at a remarkably average rate of about 11 m/m.y.

SEDIMENT ACCUMULATION RATES

The average sediment accumulation rate through the Neogene portion of Holes 577 and 577A was 11.6 m/m.y. The rate in the Paleogene portion averaged 3.0 m/m.y. This is in stark contrast to the rate of accumulation in the Late Cretaceous, which was 10.0 m/m.y. An age versus depth plot is given in Figure 6. Age determinations are based on nannofossil correlations calibrated according to Berggren et al. (in press) below the hiatus at a sub-bottom depth of 60 m. Age determinations for the first 5 m.y. are based on magnetostratigraphy according to Berggren et al. (in press).

PHYSICAL PROPERTIES

Physical properties measurements at Site 577 were performed using mainly standard Deep Sea Drilling Project (DSDP) methods (Boyce, 1976a, b; see Introduction and Explanatory Notes, this volume). Table 4 summarizes the properties that were measured in sediments from Holes 577 and 577A. Measurements were taken at approximately 3-m intervals throughout Hole 577. Measurements were taken at approximately 4.5-m intervals in Hole 577A. Figures 7, 8, and 9 show profiles for Holes 577 and 577A of shear strength, compressional and shear wave veloci-

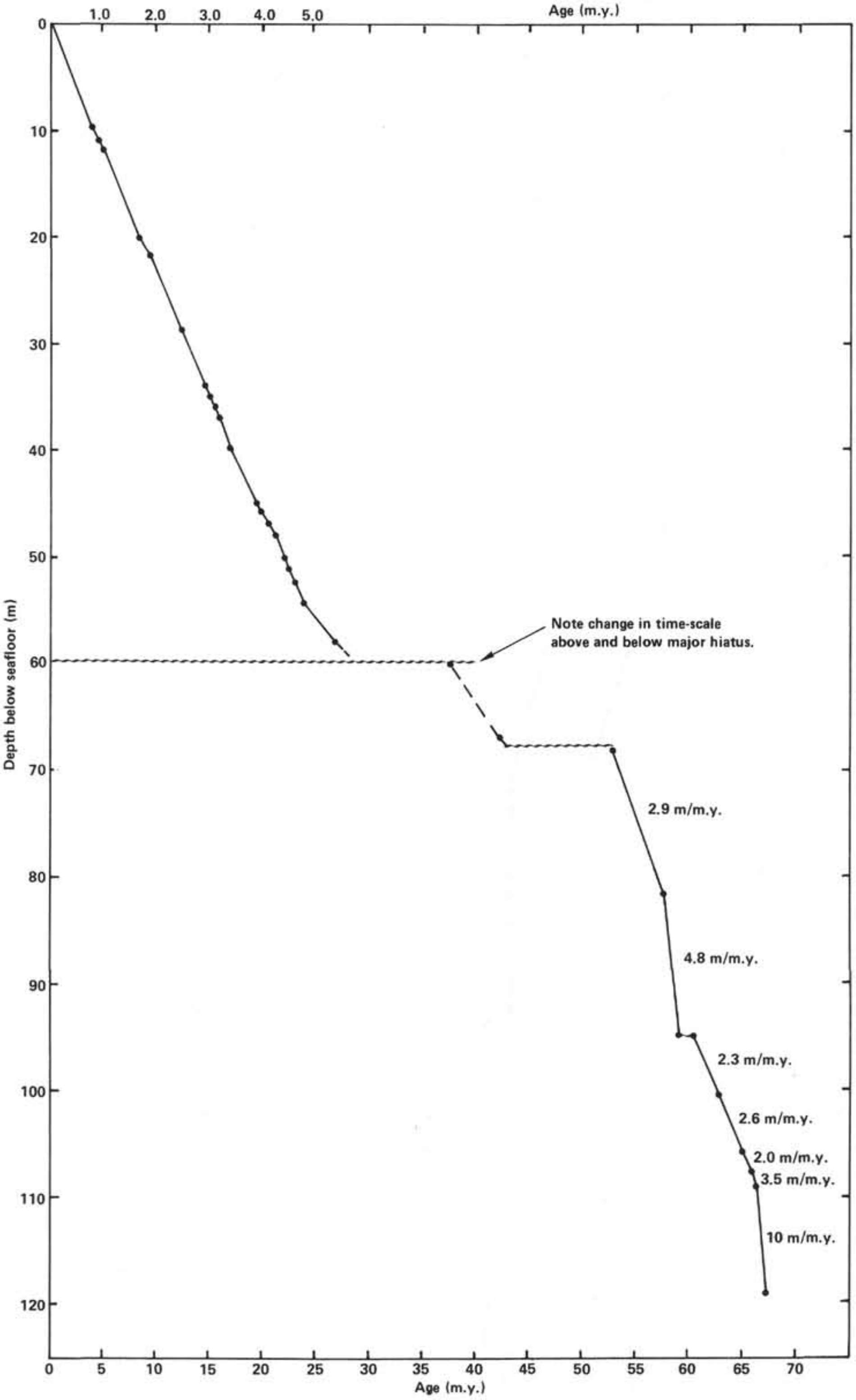

Figure 6. Site 577 sediment accumulation rates.

ty, and saturated bulk density and water content, respectively. A full discussion of the physical properties of the recovered sediment, including tables of the data, is given by Schultheiss (this volume). However, some of the more interesting features of the data are highlighted here.

1. There are wide variations in the shear strength measurements down to 50 m, below which there is a rapid decrease in strength which remains consistently low (Fig. 7). The reduction in shear strength correlates with the boundary of lithologic Units I and II, and is thought to occur

Table 4. Physical properties measurements made at Site 577.

	Hole 577	Hole 577A
Shear strength:		
Hand-operated vane	x	x
Motorized vane	x	x
Wave velocity:		
Shear wave	x	x
Compressional wave	x	x
Water content/bulk density:		
Shipboard analysis	x	—
Shore-based analysis	x	x
Bulk density by 2-min. GRAPE	x	—

as a result of the changing carbonate content (Fig. 1). It is postulated that, at carbonate contents in excess of 90 to 95%, the sediment strength is drastically reduced by the coring process (the interparticulate bonding may be more brittle).

2. The shear wave velocity data show no distinct trends throughout the two holes, the velocity varies between 20 and 70 m/s (Fig. 8). Poor signal quality in most of these cores limits the accuracy of these measurements to ±10 m/s.

3. A sudden increase in bulk density (and decrease in water content) at about 60 m is the major feature that occurs just below the lithologic boundary between Units 1 and II (Fig. 9). This corresponds to a possible 30-m.y. missing section in the mid-Tertiary (see Biostratigraphic summary), which at sedimentation rates of 3.0 m/m.y. would represent 90 m of missing sediment. The rapid change in water content suggests that this may have been an erosional event because the material may be overconsolidated. Laboratory consolidation data from Hole 577A may be able to indicate whether this was a nondepositional or an erosional hiatus.

4. The compressional wave velocity profile (Fig. 8) also shows a major discontinuity at 60 m. The velocity increases rapidly from around 1480 to 1530 m/s. The corresponding impedance changes using bulk density values of 1590 and 1720 kg/m^3, respectively, are 2.35×10^6 and 2.63×10^6 kg m^{-2}S^{-1} (a change of more than 10%). However, this depth does not correspond to any distinct reflector on the 3.5-kHz seismic record.

INORGANIC GEOCHEMISTRY

Six squeezed core samples, three from Hole 577 and three from 577A, were analyzed for the standard suite of components: pH, alkalinity, salinity, calcium, magnesium, and chlorinity (Table 5). The two data sets agree well (Fig. 10) and show a slight downcore increase in alkalinity and an overall drop in Mg, but otherwise little variation with depth.

No *in situ* samples were taken.

HEAT FLOW

Downhole temperature measurements were made with the new WHOI heat flow instrument. Of 15 runs (6 in Hole 577 and 9 in Hole 577A), 10 (4 in Hole 577 and 6 in Hole 577A) were successful. Of the unsuccessful runs, the cause of failure could be more specifically diagnosed than for the previous runs at Site 576. For example, the first run at this site appeared to fail because of a loose interface connection in the shipboard Apple computer that was used for loading the program into, and recovering data from, the heat flow instrument's temperature recorder. The recorder was designed to be capable of delaying the starting time of data collection by an amount specified by the program. It appeared, however, that the delay time circuit of all the recorders was not functioning properly. Recorder WHOI-4A connected to battery pack NTLT-3, which had functioned correctly on nine previous deployments, failed on its fifth run at this site when the delay time was set to 30 min., as well as on the eleventh run at Site 576, when the delay time also had been set to a nonzero value (60 min.). A check of the log book revealed that all successful runs at Sites 576 and 577 were made with zero delay times. Use of a nonzero delay time always resulted in failure or an unsatisfactory record. All measurements in subsequent sites of this cruise were made by setting the delay time equal to zero. It was also found that measurement results from recorder WHOI-2A were not satisfactory.

For the first time during this cruise, the new WHOI heat flow instrument was compared with the conventional ERI-type heat flow instrument. In Hole 577A, a combined run was made by attaching the shoe containing the WHOI instrument to the ERI-type heat flow rig. Unfortunately, only one out of three such runs was successful. The result of that successful run showed, however, that the ERI-type instrument recorded a temperature 3.5°C higher than the WHOI instrument. The difference appears to be too large to be accounted for by the measurement error at a single downhole depth. A detailed comparison of the two measurements is in progress at the time of this writing.

Thermal conductivity data were taken on 240 samples selected from the cores of Holes 577 and 577A (see Horai and Von Herzen, this volume).

SUMMARY AND CONCLUSIONS

Site 577 is located at 32°26.51′N and 157°43.40′E in 2678 m of water on the flank of the Shatsky Rise. Over this part of the Rise sediments reach a thickness of 0.88 s.

The objective at this site—to obtain an expanded late Miocene to Quaternary record for detailed paleoceanographic and isotopic analyses, to determine the late Cenozoic history of eolian sedimentation, and to recover the Cretaceous/Tertiary boundary for mid-latitude calcareous biostratigraphy and for paleomagnetic and geochemical analysis—was achieved in two holes. In an additional hole (577B), we washed down to basal Paleocene sediments and took one core to recover a third Cretaceous/Tertiary boundary sequence. Hole 577 (HPC) penetrated to a maximum depth of 118.8 m sub-bottom depth and terminated in a hard layer.

The sediments recovered in Holes 577, 577A, and 577B are nannofossil oozes that can be divided into three units based upon color changes. Lithologic Unit I is a white to light gray nannofossil ooze characterized by high percentages of nannofossils. It is further divided into two subunits: an alternating white to light gray lightly mot-

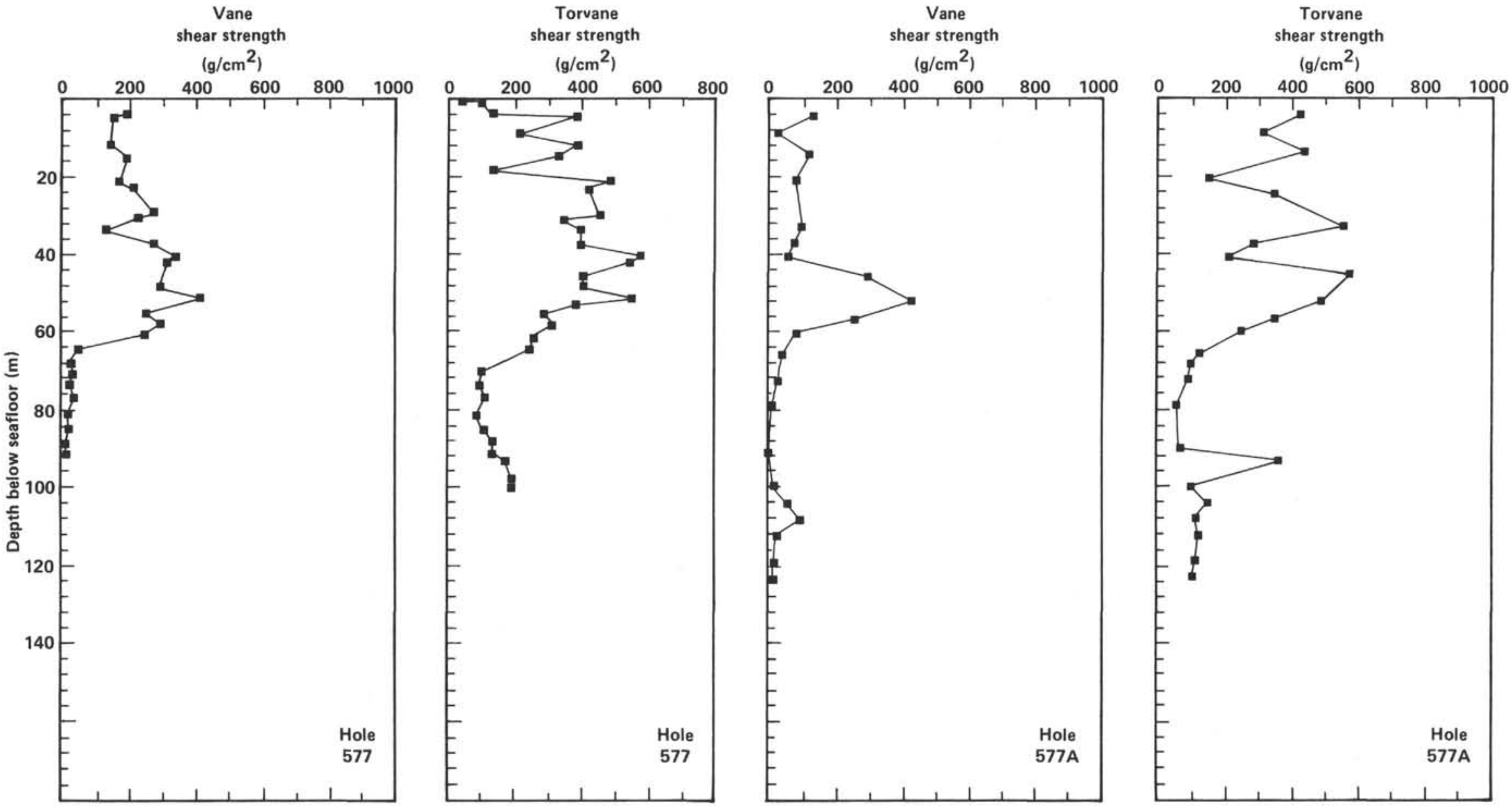

Figure 7. Plot of shear strength versus sub-bottom depth for Site 577.

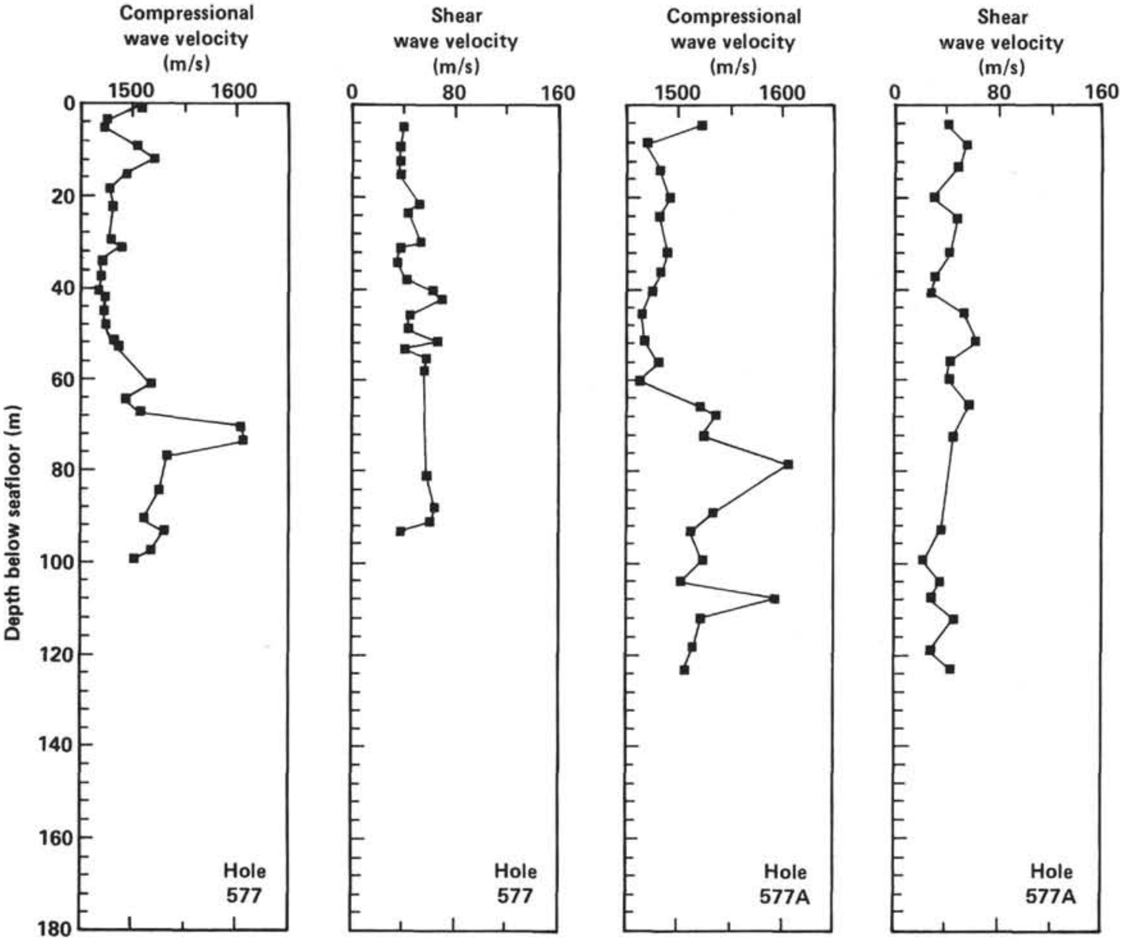

Figure 8. Plot of compressional and shear wave velocities versus sub-bottom depth for Site 577.

tled nannofossil ooze (Subunit IA) and a white nannofossil ooze (Subunit IB) that contains up to 97% calcareous nannofossils.

Lithologic Unit II is a white to pale brown nannofossil ooze that is divided into two subunits: Subunits IIA is a pale brown nannofossil ooze; Subunit IIB is characterized by alternating white and pale brown nannofossil ooze layers and contains the Cretaceous/Tertiary boundary. Lithologic Unit III is a white nannofossil ooze unit.

An apparently complete Miocene to Quaternary section was recovered in Holes 577 and 577A. Late Cenozoic sediments are primarily nannofossil ooze, but foraminifers are also present. Well-preserved and diverse radiolarian assemblages occur in the late Cenozoic sediments but tend to drop off, both in abundance and in degree of preservation, in the latest Miocene. Diatoms are present in Pliocene–Pleistocene sediments but are never abundant or well preserved. They are essentially absent below the Pliocene

A major unconformity at approximately 60 m sub-bottom depth separates late Miocene from middle Eocene sediments. This unconformity was previously reported in Site 47 and was expected. Paleogene sediments are also nannofossil oozes with minor (but diverse and moderately well preserved) foraminifers. No diatoms or radiolarians were found from this part of the section. Part of this Paleogene section was disturbed, mostly by flow-in and/or disturbed bedding. This disturbance was likely due to a number of factors: (1) the absence or near absence of clay in this part of the section resulting in a less cohesive lithology, and (2) premature yielding of the HPC shear pins causing reduced penetration rates and, thus, increased disturbance. The increased disturbance in the Paleogene section means that one of our objectives—to recover an expanded Paleogene section for paleoenvironment analysis—was not entirely met. This, however, can be more properly assessed by shore-based studies.

The Cretaceous/Tertiary boundary was recovered in Sections 577-12-5; 577A-12-4, and 577B-1-4 and at a sub-bottom depth of approximately 109.6 m. Lithologically, the basal Paleocene-Upper Cretaceous sequence is an undisturbed white to light brown nannofossil ooze. Moderate to well-preserved foraminifers are present, but diatoms and radiolarians are absent. Except for a minor color change just below it, the Cretaceous/Tertiary boundary is essentially featureless with no obvious signs of sediment disruption or nondeposition. The biostratigraphic data yield sedimentation rates of 11.6 m/m.y. (for the Neogene), 3 m/m.y. (for the Paleogene), and 10 m/m.y. (for the Cretaceous).

Physical properties were measured on the entire section (Quaternary to Cretaceous). However, some sections were skipped because obvious coring disturbance and/

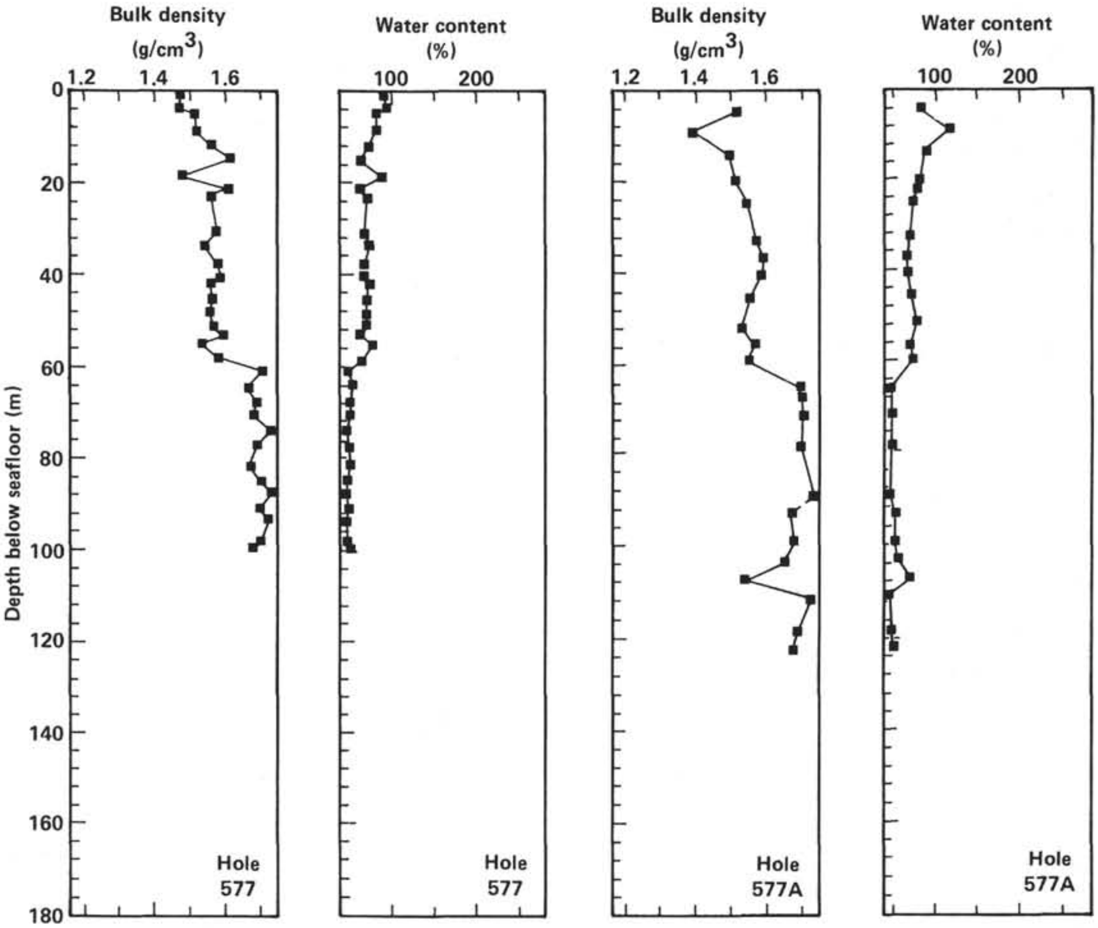

Figure 9. Profiles of saturated bulk density and water content versus sub-bottom depth for Site 577.

Table 5. Inorganic geochemical measurements from Site 577.

Sample	pH	Alkalinity (mEq/l)	Salinity (‰)	Calcium (m*M*)	Magnesium (m*M*)	Chlorinity (‰)
IAPSO	8.00	2.45	35.2	10.55	53.99	19.38
SSW	8.08	2.37	35.2	10.34	52.98	19.14
577-2-5, 140–150 cm	7.39	2.64	35.2	10.32	51.16	19.51
577-6-4, 140–150 cm	7.31	2.89	35.5	10.51	51.95	19.58
577-10-5, 140–150 cm	7.42	3.17	35.5	11.14	51.99	19.44
577A-4-5, 140–150 cm	7.35	2.60	35.2	9.88	52.09	19.54
577A-8-5, 140–150 cm	7.16	3.27	35.5	10.78	52.35	19.48
577A-13-5, 140–150 cm	7.29	3.15	35.5	10.57	52.32	19.38

or excess water at these levels made measurements unreliable. Shear strength, water content, bulk density, and compressional wave velocity data all show a major discontinuity at about 60 m sub-bottom depth. This is the approximate boundary between lithologic Units I and II and represents a major unconformity in which late Eocene to early Miocene sediments are missing. Bulk density data suggest that, given the measured 3.9 m/m.y. sedimentation rate for this hole, this unconformity may represent as much as 156 m of missing sediments. Further studies on shore (laboratory consolidations tests) may be useful in indicating whether this is an erosional or a nondepositional hiatus.

The 3.5-kHz echograms reveal a four-part seismic section. The uppermost unit consists of strong, multiple, parallel reflections that are tentatively correlated with volcanic ash layers. The second unit is composed of three parallel reflectors of medium strength which overlie a transparent section. The source of these reflectors is not immediately obvious from the lithology. The third seismic unit is a transparent section with its top defined by a weak, although generally continuous, reflector. Within this unit are several weak, discontinuous reflectors. The source of these weaker reflectors is unclear, but the transparent section reflects the homogeneous nature of the nannofossil ooze. The lowermost unit and its source lithology is uncertain. Because of uncertainty concerning velocity structure and core depth, this reflector may be a chert layer or may be within the sediment sequence.

Downhole temperature measurements were made with the new WHOI heat flow instrument. Of 15 runs, 10 were successful. The data show a linear increase with depth to the level of the Eocene/Miocene unconformity. Below the unconformity, the data indicate a temperature reversal.

Samples for paleomagnetic studies were taken throughout Holes 577 and 577A, with particularly dense sampling across the Cretaceous/Tertiary boundary. Because magnetic intensities were usually close to or within the noise level of the shipboard instrument, no attempt was made to identify specific magnetic reversals below the

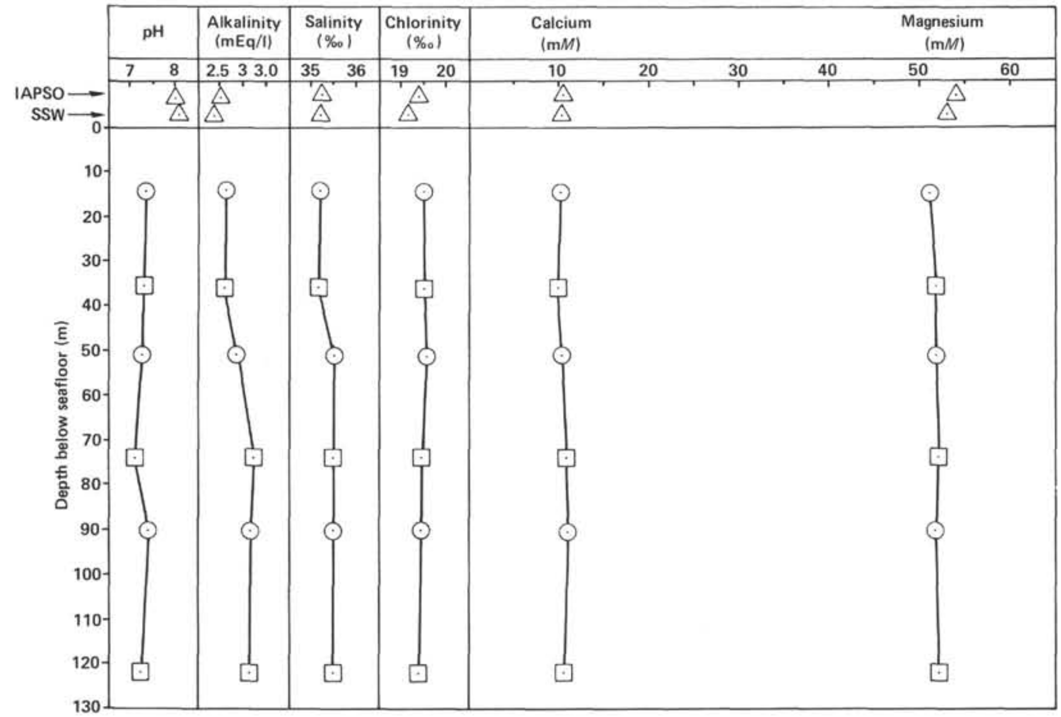

Figure 10. Profiles of pH, alkalinity, salinity (‰), chlorinity (‰), calcium (m*M*), and magnesium (m*M*), versus sub-bottom depth from interstitial water samples analyzed at Site 577. Symbols are as follows: △ = IAPSO and SSW standards; ⊙ = samples from Hole 577; ⊡ = samples from Hole 577A.

Eocene/Miocene unconformity. Study of this part of the section requires shore-based AF demagnetization experiments.

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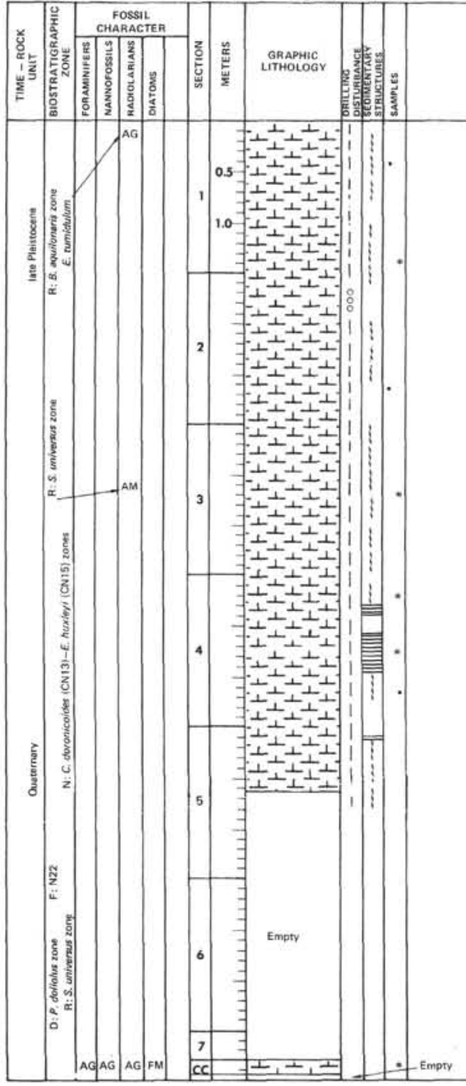
SITE 577 HOLE CORE 1 CORED INTERVAL 2678.2–2685.0 mbsl; 0.0–6.8 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

- Dominant colors: grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) in Section 1; olive gray (5Y 5/2) in Section 2; gray (5Y 5/1), gray (5Y 6/1), and light gray (5Y 7/1) in the rest of the core with olive gray (5Y 5/2) and white (2.5Y 8/0) intervals. Minor colors: gray (5GY 5/1), gray (5GY 7/1), and gray (5B 6/1) laminations in Section 4.

  This core is slightly deformed, except for one soupy interval in Section 2, 20–40 cm.

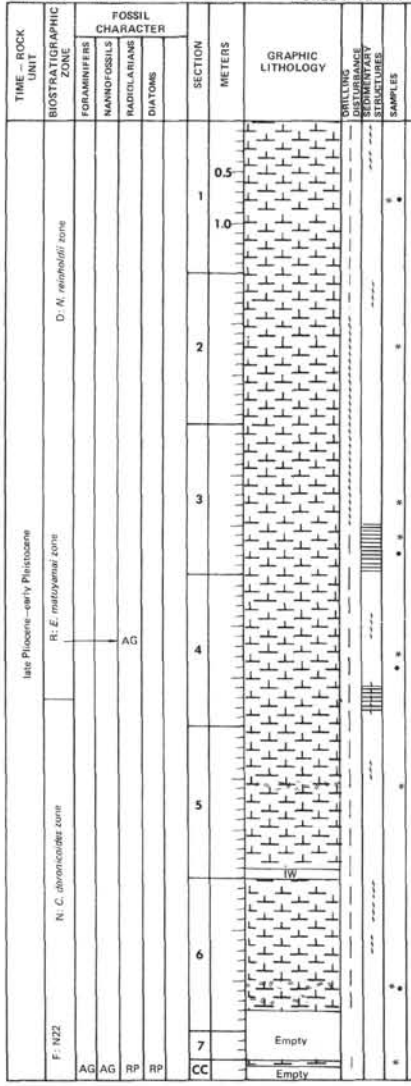
- This core contains mottled and homogeneous nannofossil ooze layers, with thin laminations locally present in Section 4. It contains a 0.5 cm diameter pumice(?) pebble in Section 4, 86 cm.

SMEAR SLIDE SUMMARY (%):

	1, 140	3, 70	4, 20	4, 72	CC
	D	D	D	D	D
Texture:					
Sand	5	3	2	2	0
Silt	30	32	28	28	30
Clay	65	65	70	70	70
Composition:					
Quartz	7	7	7	5	7
Feldspar	5	3	5	2	3
Heavy minerals	3	5	Tr	1	–
Clay	15	10	5	5	5
Volcanic glass	5	3	2	2	–
Carbonate unspec.	–	–	2	2	–
Foraminifers	2	1	–	–	Tr
Calc. nannofossils	60	69	79	83	85
Diatoms	2	2	Tr	–	–
Sponge spicules	1	Tr	Tr	–	–

$CaCO_3$ data:
1, 45 cm = 57%
2, 115 cm = 61%
4, 119 cm = 77%

SITE 577 HOLE CORE 2 CORED INTERVAL 2685.0–2694.5 mbsl; 6.8–16.3 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE WITH ASH LAYERS

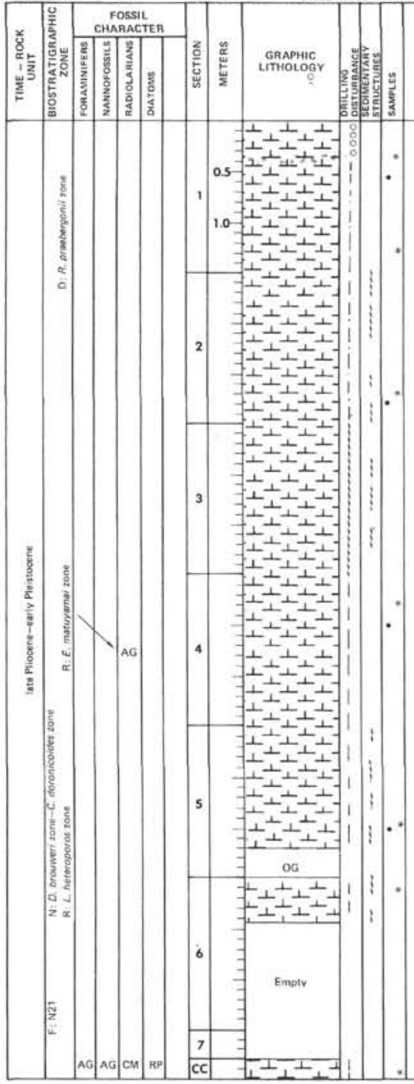
- Dominant colors: white (2.5Y 8/0), white (5Y 8/1), light gray (2.5Y 7/0–2.5Y 7/1), light gray (5Y 7/1), gray (10YR 6/1), and medium gray (5Y 6/1). Minor colors: medium to dark (5Y 5/1–5Y 4/1), light gray (5Y 7/1), and gray (2.5Y N5) ash layers.
- Very deformed portions of Sections 2 and 3 result from flow-in. The rest of the core is slightly deformed.
- This core consists of homogeneous to slightly mottled nannofossil ooze. There is a large pumice cobble in Section 3, 153–157 cm. Sections 3 and 4 contain intervals of 3–4 cm laminations with gradational contacts. Ash layers occur in Section 5, 57–60 cm; Section 6, 102.5–103.5 cm; and, Section 6, 114.5 cm.

SMEAR SLIDE SUMMARY (%):

	1, 80	2, 75	3, 80	3, 114	4, 80	5, 60	6, 103	CC
	D	D	D	D	D	M	M	D
Texture:								
Sand	0	0	0	0	10	40	45	5
Silt	17	15	10	25	40	50	5	25
Clay	83	85	90	75	50	10	50	70
Composition:								
Quartz	5	5	5	5	2	5	Tr	1
Feldspar	2	1	1	1	1	2	–	2
Mica	–	–	–	1	–	–	–	–
Heavy minerals	–	1	–	–	–	–	–	–
Clay	5	3	5	3	5	5	5	20
Volcanic glass	5	6	7	7	7	85	45	3
Palagonite	–	–	–	–	–	1	–	–
Micronodules	–	–	–	–	–	–	Tr	–
Zeolite	–	1	–	–	–	–	–	–
Carbonate unspec.	–	–	–	–	5	–	2	–
Foraminifers	5	3	–	Tr	20	–	Tr	2
Calc. nannofossils	71	73	82	83	60	–	48	72
Diatoms	Tr	1	Tr	–	–	–	Tr	–
Radiolarians	7	5	–	–	–	–	Tr	–
Sponge spicules	–	1	Tr	Tr	–	–	–	–
Opaques	–	–	–	–	–	2	–	–

$CaCO_3$ data:
1, 80 cm = 67%
3, 130 cm = 56%
4, 93 cm = 73%
6, 110 cm = 84%

SITE 577 HOLE CORE 3 CORED INTERVAL 2694.5–2704.0 mbsl; 16.3–25.8 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

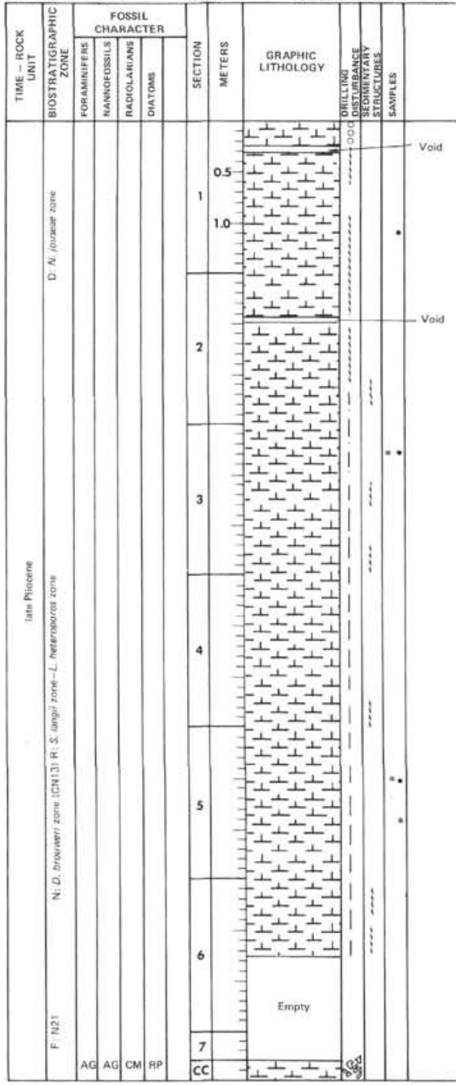
- Dominant colors: medium gray (5Y 6/1), light gray (5Y 7/1), light gray (2.5Y N7), and white (2.5Y N8). Minor colors: thin layers of medium gray (5Y 6/1), light olive gray (5Y 6/2), and light green (5G 7/1). Gray (2.5Y N6) ash.
- Moderately to very deformed portions of Sections 2 and 3 result from flow-in, Rest of the core is slightly deformed.
- This core consists of nannofossil ooze. Thin (0.1–0.2 cm), distinct light green layers of nannofossil ooze occur in Section 5 and the Core Catcher. There is a discontinuous ash layer in Section 1, 39–40 cm.

SMEAR SLIDE SUMMARY (%):

	1, 39	1, 130	2, 120	4, 30	5, 94	6, 15	CC
	M	D	D	D	D	D	D
Texture:							
Sand	93	10	10	5	Tr	5	2
Silt	5	2	3	3	5	5	30
Clay	2	88	87	92	95	90	68
Composition:							
Quartz	7	–	–	–	–	–	5
Clay	2	5	10	3	30	10	10
Volcanic glass	91	–	–	Tr	Tr	Tr	2
Glauconite	–	–	–	Tr	–	–	–
Micronodules	Tr	1	–	3	–	–	–
Carbonate unspec.	–	Tr	–	1	1	Tr	3
Foraminifers	–	10	15	5	7	5	–
Calc. nannofossils	–	82	74	87	60	80	80
Diatoms	–	Tr	Tr	Tr	1	3	–
Radiolarians	–	2	1	Tr	1	1	–
Silicoflagellates	–	Tr	Tr	–	Tr	1	–
Opaques	–	–	–	1	–	–	–

$CaCO_3$ data:
1, 60 cm = 84%
2, 130 cm = 84%
4, 56 cm = 84%
5, 100 cm = 81%

SITE 577 HOLE CORE 4 CORED INTERVAL 2704.0–2713.5 mbsl; 25.8–35.3 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

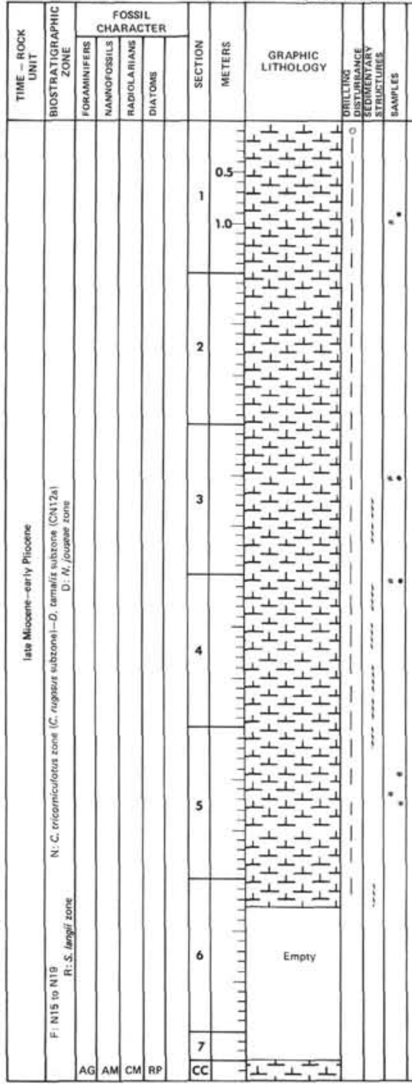
- Dominant colors: light gray (2.5Y N7), white (2.5Y N8), medium gray (5Y 6/1), and light gray (5Y 5/1) gradually changing to light gray (7.5YR N7) and white (7.5YR N8) below Section 5. Minor colors: thin layers of light green (5G 7/1) and light green (5GY 7/1)
- Core is very deformed in Section 1 and Section 2, 0–112 cm. Rest of the core is slightly deformed.
- This core consists of homogeneous nannofossil ooze. Section 1 and Section 2, 0–112 cm are very deformed, resulting from flow-in. Sections 5 and 6 contain thin (0.2 cm), distinct layers of light green nannofossil ooze. All downcore color changes are gradational.

SMEAR SLIDE SUMMARY (%):

	3, 30	5, 52	5, 92
	D	D	D
Texture:			
Sand	7	5	3
Silt	3	2	2
Clay	90	93	95
Composition:			
Quartz	Tr	Tr	–
Clay	15	25	10
Volcanic glass	Tr	Tr	–
Carbonate unspec.	Tr	1	Tr
Foraminifers	10	5	5
Calc. nannofossils	75	68	83
Diatoms	Tr	1	1
Radiolarians	Tr	Tr	1
Sponge spicules	Tr	–	Tr
Silicoflagellates	–	–	Tr

$CaCO_3$ data:
1, 116 cm = 83%
3, 30 cm = 87%
5, 55 cm = 87%

SITE 577 HOLE CORE 5 CORED INTERVAL 2713.5–2723.0 mbsl; 35.3–44.8 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

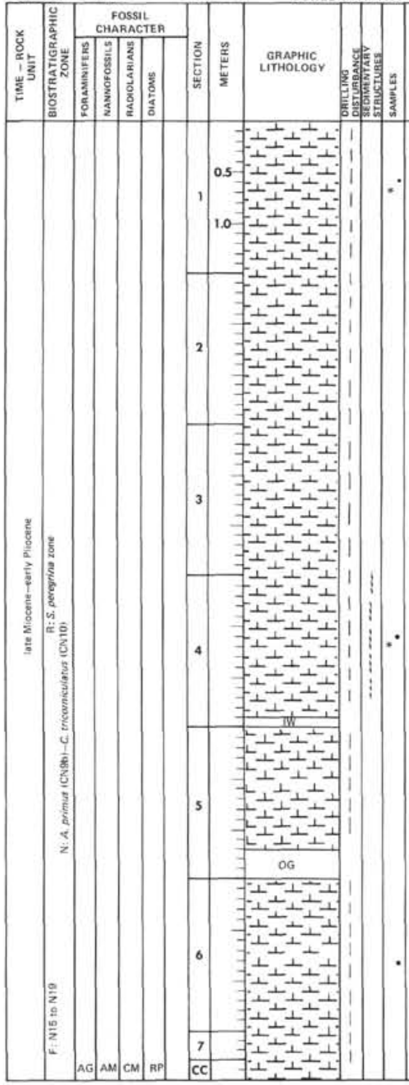
- Dominant colors: alternating intervals of white (2.5Y N8), white (7.5YR N8), and light gray (5Y 7/1). Minor colors: grayish brown (2.5Y 5/2) pebble.
- Core is slightly deformed throughout.
- This core consists of fairly homogeneous nannofossil ooze. Sections 3 and 4 are lightly burrowed and mottled. Section 5 contains a pebble at 125 cm.

SMEAR SLIDE SUMMARY (%):

	1, 100	3, 53	4, 7	5, 47	5, 66	5, 78
	D	D	D	D	D	D
Texture:						
Sand	2	1	10	15	4	0
Silt	3	2	6	7	1	1
Clay	95	97	84	78	95	99
Composition:						
Quartz	–	–	–	12	Tr	Tr
Feldspar	Tr	–	–	Tr	–	–
Mica	–	–	–	Tr	–	1
Clay	5	2	7	2	1	3
Volcanic glass	Tr	1	–	2	Tr	–
Glauconite	–	–	–	Tr	–	–
Micronodules	Tr	Tr	–	2	–	–
Carbonate unspec.	–	–	Tr	–	–	–
Foraminifers	–	4	3	–	5	–
Calc. nannofossils	95	93	77	80	94	96
Diatoms	Tr	–	2	–	–	Tr
Radiolarians	Tr	–	1	2	–	–
Sponge spicules	–	–	Tr	–	–	–
Silicoflagellates	–	–	Tr	–	–	–
Opaques	–	–	10	–	–	–

$CaCO_3$ data:
1, 96 cm = 87%
3, 53 cm = 93%
4, 8 cm = 90%

SITE 577 HOLE CORE 6 CORED INTERVAL 2723.0–2732.5 mbsl; 44.8–54.3 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

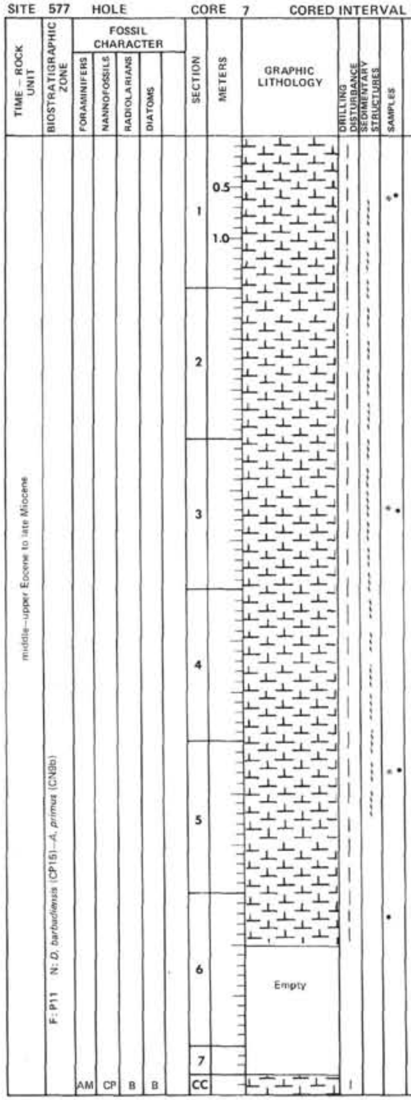
- Dominant colors: alternating layers of light gray (10YR 7/1) and white (10YR 8/1). Section 7 and the Core Catcher contain intervals of white (10YR 8/2).
- Core is slightly deformed throughout.
- This core consists of very homogeneous nannofossil ooze. Section 4 is lightly mottled. All downcore color changes are gradational.

SMEAR SLIDE SUMMARY (%):

	1, 70	4, 70
	D	D
Texture:		
Sand	3	1
Silt	6	3
Clay	91	96
Composition:		
Quartz	1	1
Mica	–	1
Foraminifers	2	1
Calc. nannofossils	95	97
Diatoms	2	Tr
Radiolarians	Tr	Tr
Hematite	–	Tr

$CaCO_3$ data:
1, 64 cm = 91%
4, 67 cm = 76%
6, 82 cm = 94%

SITE 577 HOLE CORE 7 CORED INTERVAL 2732.5–2742.0 mbsl; 54.3–63.8 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

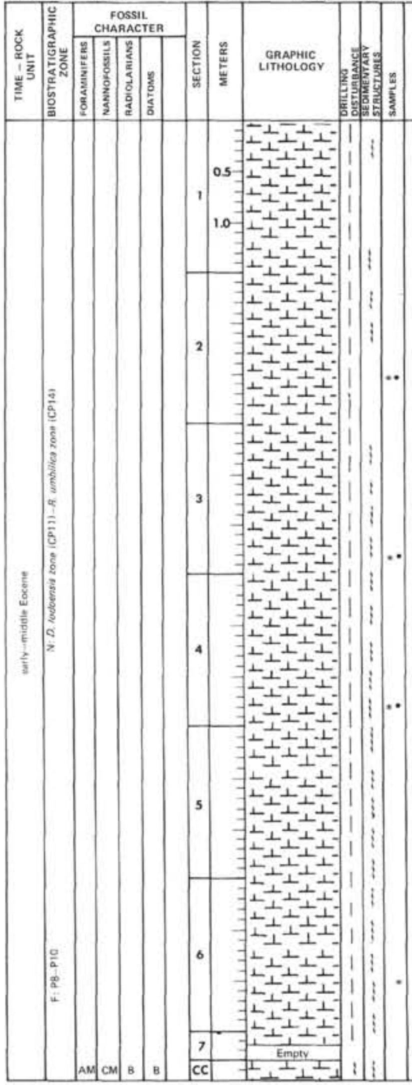
- Dominant colors: white (10YR 8/2), very pale brown (10YR 7/3–10YR 8/3), and pale brown (10YR 6/3) mottled with the same colors and brown (10YR 4/3). Minor colors: Section 5 contains a light gray (10YR 7/2) interval.
- Section 2, 72 cm to Section 3, 40 cm is moderately deformed, perhaps resulting from flow-in. The rest of the core is slightly deformed.
- This core consists of slightly mottled nannofossil ooze. *All downcore color changes are gradational.*

SMEAR SLIDE SUMMARY (%):

	1, 60	3, 70	5, 30	6, 30
	D	D	D	D
Texture:				
Sand	10	7	2	2
Silt	30	33	38	38
Clay	60	60	60	60
Composition:				
Quartz	5	7	5	7
Feldspar	–	2	2	3
Heavy minerals	–	2	3	2
Clay	5	5	10	5
Volcanic glass	2	2	2	3
Foraminifers	5	–	–	–
Calc. nannofossils	78	77	68	65
Diatoms	2	Tr	–	–
Radiolarians	Tr	–	–	–
Discoasters	3	5	10	15

$CaCO_3$ data:
1, 60 cm = 83%
3, 69 cm = 83%
5, 28 cm = 59%
6, 22 cm = 96%

SITE 577 HOLE CORE 8 CORED INTERVAL 2742.0–2751.5 mbsl; 63.8–73.3 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

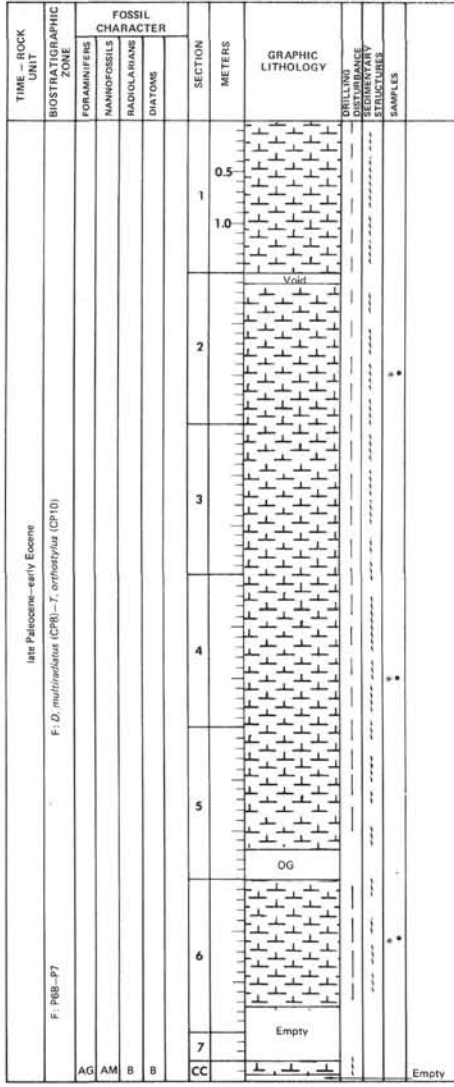
- Dominant colors: pale brown (10YR 6/3) and very pale brown (10YR 7/3–10YR 8/3) with white (10YR 8/2) *intervals in Section 2.*
- This core is slightly deformed throughout.
- This core consists of mottled nannofossil ooze. All *downcore color changes are gradational.*

SMEAR SLIDE SUMMARY (%):

	2, 100	3, 132	4, 130	6, 100
	D	D	D	D
Texture:				
Sand	2	2	1	1
Silt	48	48	44	44
Clay	50	50	55	55
Composition:				
Quartz	5	7	7	7
Feldspar	2	–	2	2
Heavy minerals	2	5	Tr	1
Clay	5	5	5	5
Volcanic glass	3	2	1	2
Carbonate unspec.	5	–	–	–
Calc. nannofossils	63	66	70	68
Radiolarians	Tr	–	–	–
Discoasters	15	15	15	15

$CaCO_3$ data:
2, 105 cm = 99%
3, 132 cm = 99%
4, 130 cm = 97%

SITE 577 HOLE CORE 9 CORED INTERVAL 2751.5–2761.0 mbsl; 73.3–82.8 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

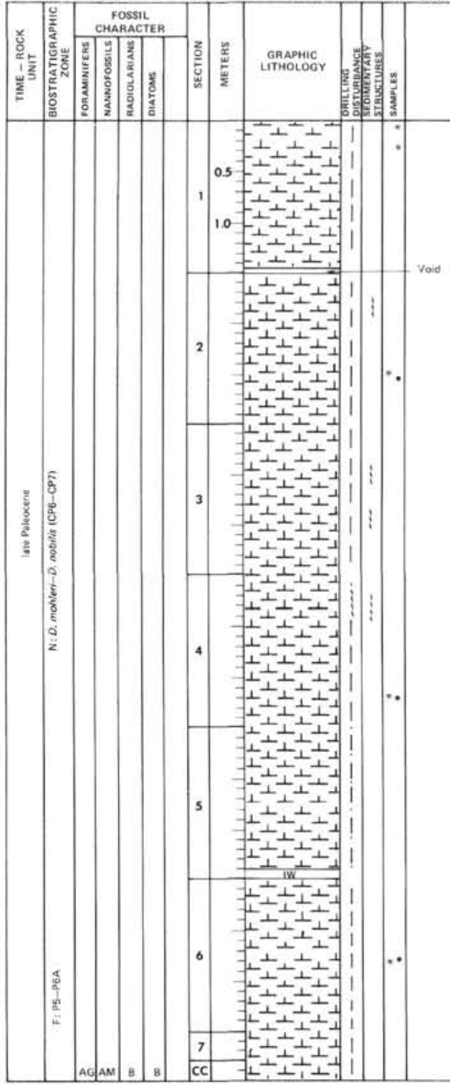
- *Dominant colors: very pale brown (10YR 8/3). Minor colors: pale brown (10YR 6/3), very pale brown (10YR 7/3), white (10YR 8/2), and black mottles.
- *Core is slightly deformed throughout.
- *This core consists of homogeneous white nannofossil ooze with infrequent small mottles in all sections.

SMEAR SLIDE SUMMARY (%):

	2, 100	4, 100	6, 60
	D	D	D
Texture:			
Sand	1	2	1
Silt	34	38	34
Clay	65	60	65
Composition:			
Quartz	7	5	8
Feldspar	2	2	2
Heavy minerals	2	1	1
Clay	5	–	4
Volcanic glass	2	2	2
Carbonate unspec.	–	2	–
Foraminifers	–	1	–
Calc. nannofossils	77	82	76
Discoasters	5	5	7

$CaCO_3$ data:
2, 100 cm = 100%
4, 100 cm = 100%
6, 60 cm = 97%

SITE 577 HOLE CORE 10 CORED INTERVAL 2761.0–2770.5 mbsl; 82.8–92.3 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

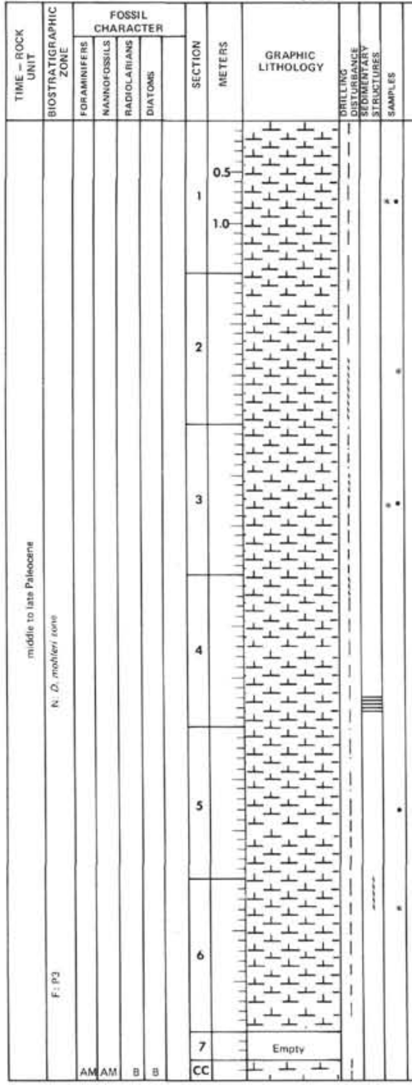
- *Dominant colors: white (10YR 8/2) with minor very pale brown (10YR 7/3–10YR 8/3), light gray (7.5YR 7/0), and pale brown (10YR 6/3) zones and mottles.
- *Except for the very disturbed zone in Section 2, 0–40 cm, this core is slightly to moderately deformed. The very deformed zone in Section 2 is due to the fact that an O-ring was dragged through the section when the core was split.
- *This core consists of homogeneous white nannofossil ooze with minor mottles.

SMEAR SLIDE SUMMARY (%):

	1, 2	1, 30	2, 100	4, 120	6, 80
	D	D	D	D	D
Texture:					
Sand	7	1	0	1	0
Silt	28	39	25	39	20
Clay	65	60	75	60	80
Composition:					
Quartz	5	5	5	5	3
Feldspar	1	1	2	2	–
Heavy minerals	1	2	1	1	–
Clay	5	5	5	5	1
Volcanic glass	2	2	2	Tr	Tr
Carbonate unspec.	3	3	–	–	5
Foraminifers	5	2	–	–	1
Calc. nannofossils	78	75	82	84	90
Diatoms	–	Tr	Tr	–	–
Radiolarians	Tr	Tr	–	–	–
Discoasters	–	5	3	3	–

$CaCO_3$ data:
2, 102 cm = 100%
4, 120 cm = 97%
6, 80 cm = 98%

SITE 577 HOLE CORE 11 CORED INTERVAL 2770.5–2780.0 mbsl; 92.3–101.8 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

*Dominant colors: white (10YR 8/2), very pale brown (10YR 7/3–10YR 8/3), and very pale brown (10YR 7/4) with minor white (10YR 8/1) patches and mottles.

*Section 2, 80 cm to Section 3, 62 cm and Section 4 0–22 cm are moderately to very deformed, probably due to splitting the core sections. The rest of the core is slightly deformed.

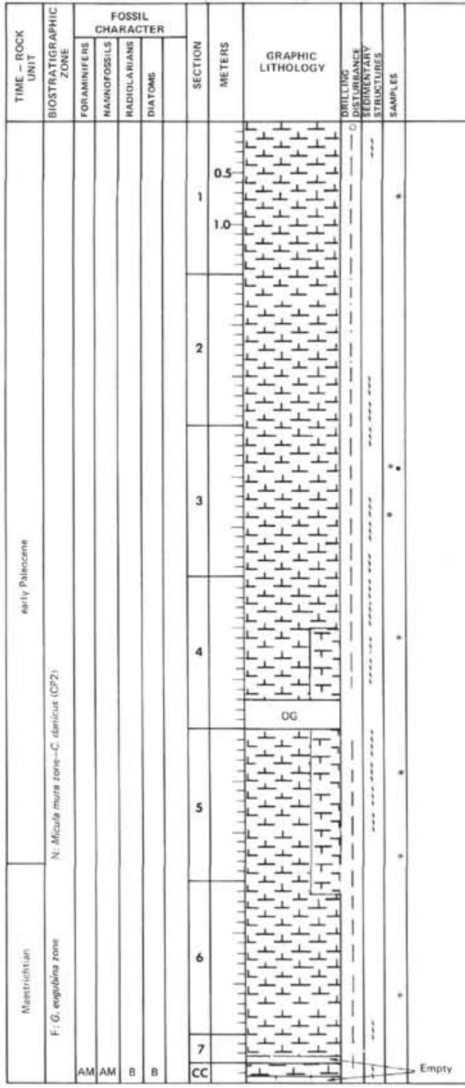
*This core consists of homogeneous to slightly mottled nannofossil ooze. Several thin laminations are present near the base of Section 4.

SMEAR SLIDE SUMMARY (%):

	1, 80 D	2, 92 D	3, 80 D	6, 30 D
Texture:				
Sand	0	0	1	4
Silt	20	20	39	36
Clay	80	80	60	60
Composition:				
Quartz	2	3	7	5
Feldspar	–	–	1	1
Heavy minerals	–	–	Tr	1
Clay	1	2	7	5
Volcanic glass	1	–	Tr	2
Zeolite	1	1	–	–
Carbonate unspec.	5	3	–	–
Foraminifers	5	2	–	3
Calc. nannofossils	85	89	85	83

$CaCO_3$ data: 1, 80 cm = 96%
3, 80 cm = 94%
5, 80 cm = 95%

SITE 577 HOLE CORE 12 CORED INTERVAL 2780.0–2789.5 mbsl; 101.8–111.3 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

*Dominant colors: very pale brown (10YR 7/3–10YR 7/4), very pale brown (10YR 8/3–10YR 8/4), white (10YR 8/1–10YR 8/2), yellow (10YR 7/6), and light yellowish brown (10YR 6/4) in Sections 1 through 4. Sections 5, 6, 7, and the Core Catcher are white (10YR 8/1–10YR 8/2) with minor zones of very pale brown (10YR 7/3–10YR 8/3).

*This core is slightly deformed, except for a moderately deformed zone in Section 2. Deformation in Section 2 is due to the process of splitting the core.

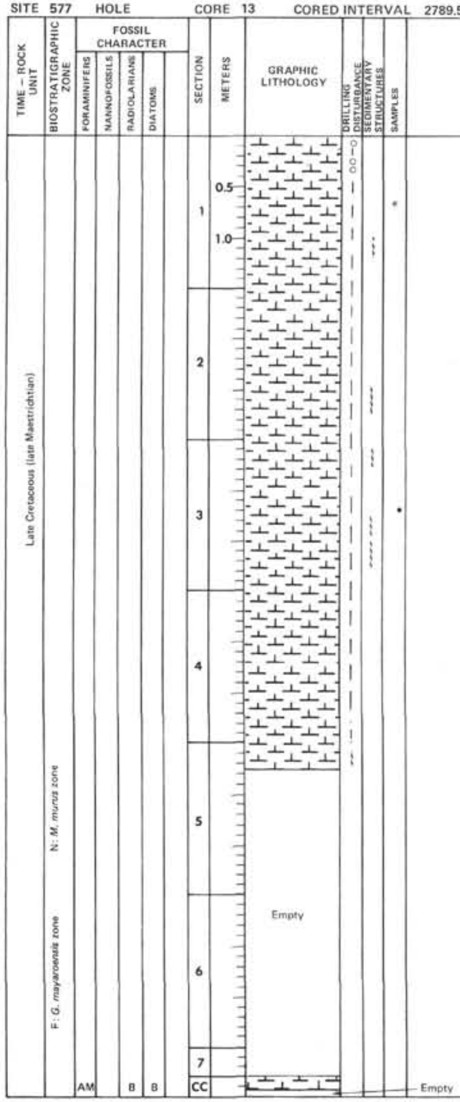
*This core consists of homogeneous to slightly mottled nannofossil ooze. The Cretaceous-Tertiary boundary is located in Section 5, 114–116 cm.

SMEAR SLIDE SUMMARY (%):

	1, 75 D	3, 43 D	3, 90 D	4, 60 D	5, 40 D	5, 125 D	6, 115 D
Texture:							
Sand	7	2	1	25	10	25	0
Silt	33	2	3	2	25	2	20
Clay	60	96	96	73	65	73	80
Composition:							
Quartz	5	–	–	–	–	–	5
Feldspar	1	–	Tr	–	–	–	1
Mica	–	Tr	–	–	–	–	–
Heavy minerals	Tr	–	–	–	–	–	–
Clay	10	Tr	–	–	–	–	2
Volcanic glass	2	1	1	–	Tr	–	–
Zeolite	–	–	–	–	–	–	2
Carbonate unspec.	–	–	–	–	–	–	5
Foraminifers	5	1	2	25	35	25	Tr
Calc. nannofossils	77	97	96	75	65	74	85
Radiolarians	–	Tr	–	–	–	–	–
Sponge spicules	–	–	–	–	–	–	Tr
Hematite	–	–	1	–	–	1	–

$CaCO_3$ data: 3, 44 cm = 93%

SITE 577 HOLE CORE 13 CORED INTERVAL 2789.5–2797.0 mbsl; 111.3–118.8 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

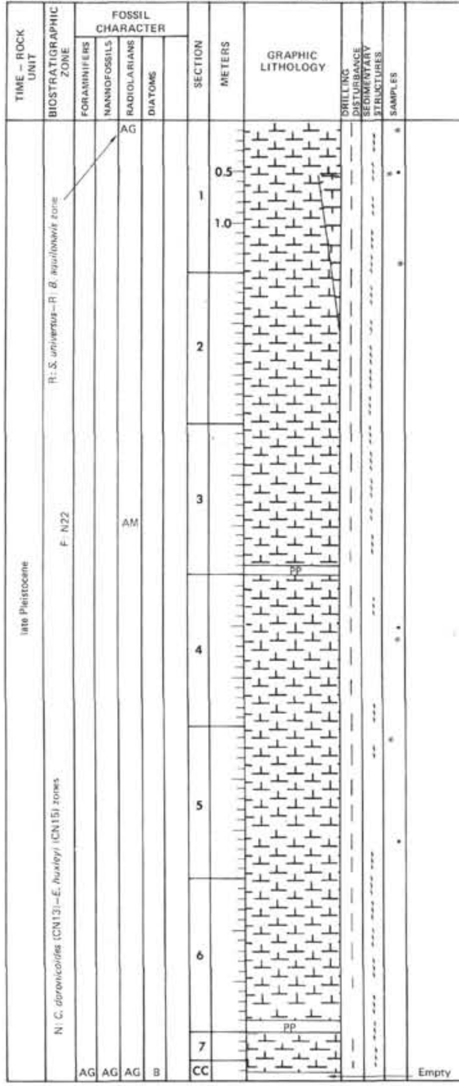
- Dominant colors: white (10YR 8/2). Minor colors: white (10YR 8/1) and very pale brown (10YR 8/3) mottles.
- Core is slightly deformed throughout.
- This core consists of uniform, white nannofossil ooze. Sections 1 through 3 are slightly mottled.

SMEAR SLIDE SUMMARY (%):

	1, 70
Texture:	
Sand	0
Silt	5
Clay	95
Composition:	
Quartz	5
Feldspar	2
Heavy minerals	Tr
Clay	2
Volcanic glass	1
Carbonate unspec.	3
Calc. nannofossils	87

$CaCO_3$ data: 3, 70 cm = 94%

SITE 577 HOLE A CORE 1 CORED INTERVAL 2677.6–2687.0 mbsl; 0.0–9.4 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

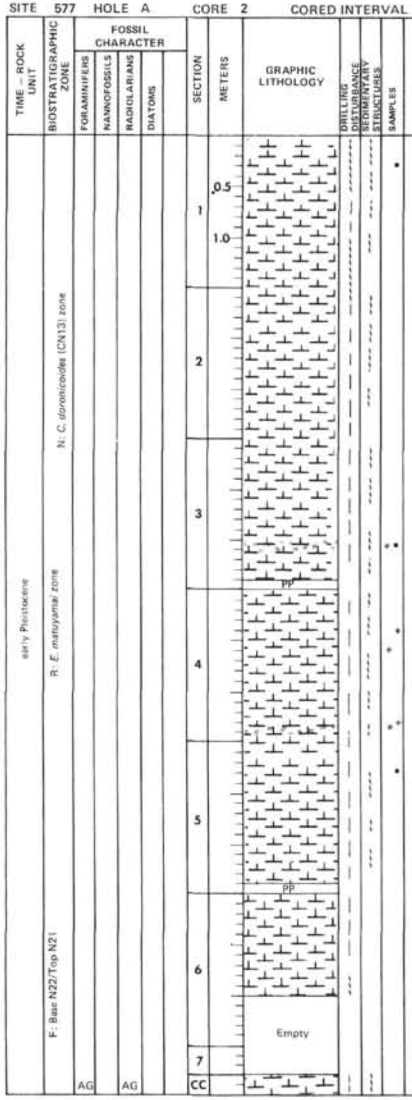
- Dominant colors: grayish brown (2.5Y 5/2), pale brown (10YR 6/3) grading to light gray (5Y 7/1), medium gray (5Y 6/1), and light gray (10YR 7/1) at the base of Section 1. Core contains white (2.5Y N8) intervals in Sections 3, 4, and 5. Minor colors: Thin (less than or equal to 0.1–0.2 cm) distinct layers of olive gray (5Y 4/2) in Section 2, and light green (5G 7/1) to green (5GY 5/1–5GY 6/1) in Sections 3 and 4.
- This core is slightly deformed throughout.
- This core contains mottled and burrowed nannofossil ooze, with thin layers of greenish ooze in Sections 3 and 4.

SMEAR SLIDE SUMMARY (%):

	1, 10	1, 50	1, 140	4, 66	5, 12
	D	D	D	D	D
Texture:					
Sand	7	20	15	7	7
Silt	3	5	3	3	3
Clay	90	75	82	90	90
Composition:					
Quartz	–	1	3	1	1
Feldspar	–	Tr	1	Tr	Tr
Clay	5	7	3	15	3
Volcanic glass	–	1	1	1	1
Micronodules	Tr	Tr	–	Tr	–
Carbonate unspec.	1	Tr	1	–	1
Foraminifers	7	20	14	7	5
Calc. nannofossils	83	69	74	73	87
Diatoms	1	1	2	2	1
Radiolarians	3	1	Tr	1	1
Sponge spicules	Tr	Tr	–	Tr	Tr
Silicoflagellates	Tr	Tr	–	Tr	–

$CaCO_3$ data: 1, 50 cm = 59%
4, 55 cm = 78%
5, 111 cm = 87%

SITE 577 HOLE A CORE 2 CORED INTERVAL 2687.0–2696.5 mbsl; 9.4–18.9 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

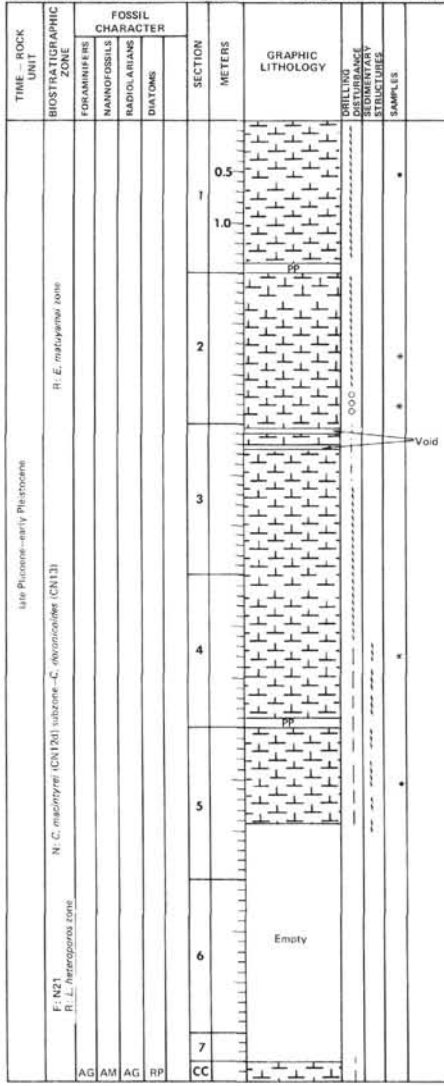
- Dominant colors: medium gray (5Y 6/1), light gray (5Y 7/1), white (2.5Y N8), and white (7.5YR N7) in all sections. Minor colors: thin distinct layers of light green (5G 7/1) ooze; dark gray (5Y 4/1) ash; gray (2.5Y N5) pyritiferous nanno ooze crust.
- This core is slightly deformed in Sections 2 to 6, and very deformed in Section 1.
- This core contains mottled and burrowed nannofossil ooze with thin (0.1–0.2 cm) layers of light green ooze in Sections 3 to 6. An ash layer was recovered in Section 3, 103–105.5 cm. Pumice fragments and pebbles up to 3 cm in diameter occur at Section 3, 22.5–23 cm, Section 3, 88--91 cm, and Section 4 54–55 cm. The base of Section 4 contains a gray, hard crust of pyritiferous nannofossil ooze.

SMEAR SLIDE SUMMARY (%):

	3, 105 M	4, 40 D	4, 61 D	4, 130 D	4, 136 M
Texture:					
Sand	80	7	7	7	75
Silt	15	2	3	10	20
Clay	5	91	90	83	5
Composition:					
Quartz	15	–	–	–	10
Feldspar	1	–	–	–	Tr
Clay	–	10	10	3	–
Volcanic glass	75	3	1	2	86
Pyrite	3	–	–	7	–
Micronodules	1	Tr	–	–	1
Carbonate unspec.	Tr	1	Tr	–	–
Foraminifers	–	5	10	7	1
Calc. nannofossils	5	81	77	80	1
Diatoms	–	Tr	1	1	–
Radiolarians	–	Tr	1	Tr	–
Opaques	–	–	–	–	1

$CaCO_3$ data:
1, 30 cm = 65%
3, 108 cm = 37%
5, 30 cm = 86%

SITE 577 HOLE A CORE 3 CORED INTERVAL 2696.5–2706.0 mbsl; 18.9–28.4 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

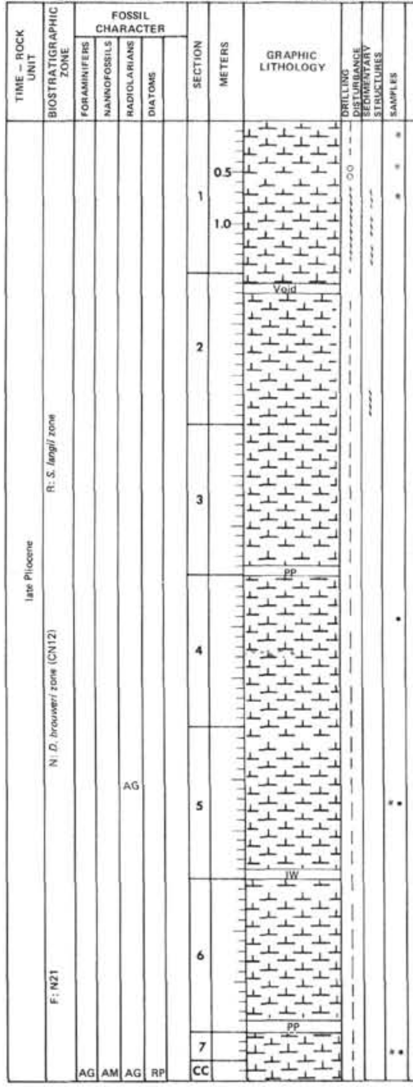
- Dominant colors: white (2.5Y N8), white (7.5YR N8), light gray (2.5Y N7), light gray (5Y 7/1), medium gray (5Y 6/1), gray (5Y 8/1), gray (2.5Y N5), and gray (2.5Y N6).
- This core is very disturbed in Sections 1 to 4 65 cm. Section 2, 95–150 cm is soupy. Section 4, 65 cm to the end of the core is slightly deformed.
- This core contains nannofossil ooze. The upper portions of Sections 1 and 2, Section 3, 49–150 cm, and Section 4, 0–65 cm are very disturbed to soupy, resulting from flow-in.

SMEAR SLIDE SUMMARY (%):

	2, 85 D	2, 132 D	4, 82 D
Texture:			
Sand	5	5	7
Silt	6	10	4
Clay	89	85	89
Composition:			
Quartz	–	–	Tr
Clay	15	10	25
Volcanic glass	Tr	Tr	Tr
Pyrite	–	7	–
Micronodules	–	Tr	–
Carbonate unspec.	–	–	1
Foraminifers	7	5	10
Calc. nannofossils	74	76	64
Diatoms	1	Tr	Tr
Radiolarians	1	Tr	Tr
Sponge spicules	2	–	Tr
Silicoflagellates	Tr	1	–
Opaques	–	1	–

$CaCO_3$ data:
1, 53 cm = 73%
5, 53 cm = 86%

SITE 577 HOLE A CORE 4 CORED INTERVAL 2706.0–2715.5 mbsl; 28.4–37.9 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

* Dominant colors: white (7.5YR N8), white (10YR 8/1), light gray (7.5YR N7), light gray (5Y 7/1), and medium gray (5Y 6/1). Minor colors: gray (7.5YR N6) pyritiferous crust and gray (10YR 6/1) ashy layer.

* This core is slightly deformed throughout, except for the very deformed to soupy portion of Section 1. The very deformed material at Section 1, 104–150 cm is flow-in.

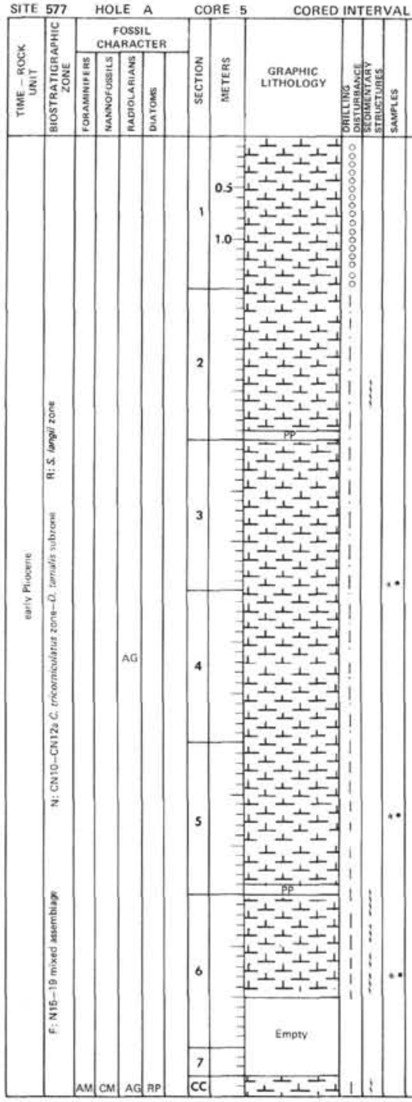
* This core contains homogeneous to slightly burrowed nannofossil ooze. The number of burrows decreases downcore. Section 2 contains a burrow filled with gray pyritiferous crust at 130 cm. Pumice pebbles are found at Section 3, 24 and 78 cm, and Section 5, 58 cm. Section 4, 78–80 cm consists of a gray ashy layer (see smear slide summary below).

SMEAR SLIDE SUMMARY (%):

	1, 15	4, 45	4, 78	5, 76	7, 20
	D	D	M	D	D
Texture:					
Sand	1	9	20	6	3
Silt	5	4	15	4	2
Clay	94	87	65	90	95
Composition:					
Quartz	Tr	–	Tr	Tr	Tr
Mica	–	Tr	–	1	Tr
Clay	7	Tr	–	–	2
Volcanic glass	Tr	1	20	–	–
Carbonate unspec.	Tr	–	–	–	–
Foraminifers	2	9	15	8	4
Calc. nannofossils	87	90	64	91	94
Diatoms	2	–	–	Tr	–
Radiolarians	2	Tr	1	–	–
Sponge spicules	Tr	–	–	–	–
Silicoflagellates	Tr	–	–	–	–

$CaCO_3$ data: 4, 46 cm = 86%
5, 78 cm = 86%
7, 20 cm = 85%

SITE 577 HOLE A CORE 5 CORED INTERVAL 2715.5–2725.0 mbsl; 37.9–47.4 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

* Dominant colors: white (7.5YR N8) and light gray (2.5Y N7) with intervals of white (2.5Y N8), white (10YR 8/1), light gray (5Y 7/1), and gray (5Y 6/1). Core Catcher is white (5Y 8/1–5Y 8/2). Minor colors: burrow in Section 1 is gray (2.5Y N5).

* Section 1 of this core is soupy; Section 2 is moderately deformed and appears to be flow-in; Sections 3 and 4 are moderately deformed. Sections 5, 6, and Core Catcher are slightly deformed.

* This core contains homogeneous nannofossil ooze. There is a single gray burrow in Section 1, 95–96 cm.

SMEAR SLIDE SUMMARY (%):

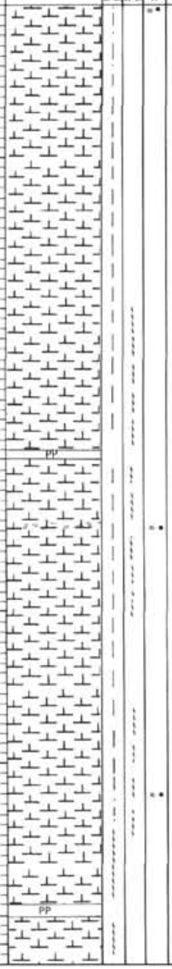
	3, 146	5, 71	6, 80
	D	D	D
Texture:			
Sand	2	3	4
Silt	2	10	7
Clay	96	87	89
Composition:			
Quartz	1	Tr	1
Mica	1	1	–
Clay	–	1	Tr
Volcanic glass	–	–	Tr
Pyrite	–	–	4
Foraminifers	2	3	5
Calc. nannofossils	96	95	90
Diatoms	–	Tr	–

$CaCO_3$ data: 3, 145 cm = 91%
5, 70 cm = 75%
6, 80 cm = 51%

SITE 577 HOLE A CORE 6 CORED INTERVAL 2725.0–2734.5 mbsl; 47.4–56.9 mbsf

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
late Miocene–early Pliocene	N: D. quinqueramus (CN9)–A. tricorniculatus (CN10) zones R: S. peregrina zone F: N15–N19 mixed assemblage	CP	CM	AG AG	RP	1 2 3 4 5 6 7 CC	0.5 1.0

GRAPHIC LITHOLOGY / DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

- Dominant colors: white (10YR 8/1–10YR 8/2), white (5Y 8/2), white (2.5Y N8), white (7.5YR N8), and white (7.5YR 8/1) with intervals of light gray (5Y 7/1) and light gray (10YR 7/2); color changes below Section 5 to pale brown (10YR 6/3), very pale brown (10YR 7/3–10YR 7/4), very pale brown (10YR 8/3), and light yellowish brown (10YR 6/4). Minor colors: light brownish gray (10YR 6/2) ash.
- Sections 1 to 6, 60 cm are slightly deformed. Core below Section 6, 60 cm is very deformed, resulting from flow-in.
- This core contains nannofossil ooze lightly mottled below Section 2. All downcore color changes are gradational. Section 4, 66–68 cm is an ash layer (see smear slide summary below).

SMEAR SLIDE SUMMARY (%):

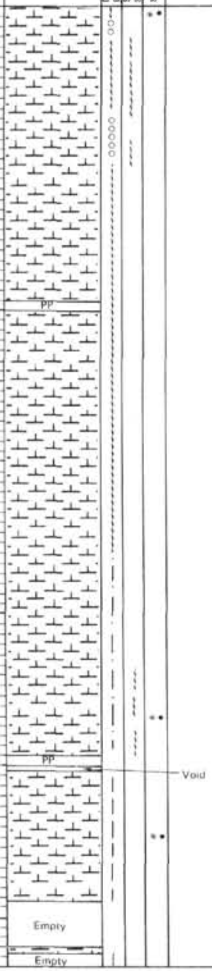
	1, 6 D	4, 68 M	6, 30 D
Texture:			
Sand	5	40	0
Silt	10	40	35
Clay	85	20	65
Composition:			
Quartz	1	2	5
Mica	Tr	–	–
Clay	1	3	10
Volcanic glass	–	50	10
Palagonite	–	5	–
Pyrite	5	–	–
Carbonate unspec.	–	5	3
Foraminifers	7	–	10
Calc. nannofossils	85	35	50
Diatoms	1	–	–
Sponge spicules	–	–	2
Discoasters	–	–	10

$CaCO_3$ data:
1, 5 cm = 72%
4, 68 cm = 56%
6, 28 cm = 65%

SITE 577 HOLE A CORE 7 CORED INTERVAL 2734.5–2744.0 mbsl; 56.9–66.4 mbsf

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
early Eocene–late Miocene	N: sublodoensis (CP12) zone–A. primus (CN9b) subzone F: P8–P10	AG	AM	B	B	1 2 3 4 5 6 7 CC	0.5 1.0

GRAPHIC LITHOLOGY / DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

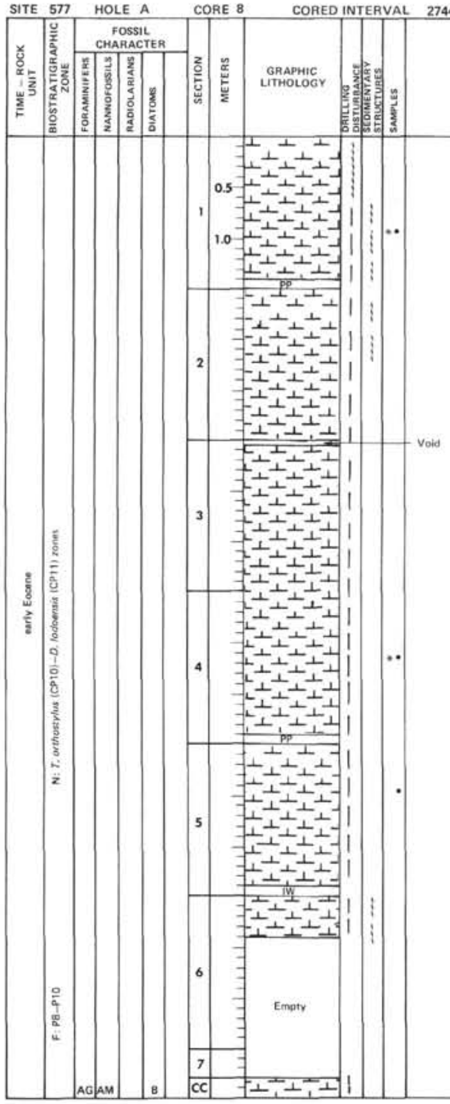
- Dominant colors: Sections 1 to 4, 90 cm are white (10YR 8/2), very pale brown (10YR 7/3–10YR 8/3) pale brown (10YR 6/3), and yellowish brown (10YR 5/4). Section 4, 90 cm through Section 5 is light gray (2.5Y 7/2). Section 6 and the Core Catcher are white (10YR 8/2) and very pale brown (10Y 7/3).
- Sections 1 to 4, 90 cm are very deformed or soupy, resulting from flow-in. The rest of the core is moderately or slightly deformed, some or all of which may have resulted from flow-in.
- This core contains nannofossil ooze with mottled zones in Sections 1 and 5.

SMEAR SLIDE SUMMARY (%):

	1, 10 D	5, 100 D	6, 70 D
Texture:			
Sand	0	0	1
Silt	30	10	15
Clay	70	90	84
Composition:			
Quartz	4	3	5
Feldspar	Tr	–	–
Heavy minerals	1	–	–
Clay	Tr	7	5
Volcanic glass	Tr	10	2
Glauconite	–	–	Tr
Zeolite	–	–	1
Carbonate unspec.	–	–	10
Foraminifers	5	–	–
Calc. nannofossils	70	75	65
Sponge spicules	–	–	2
Discoasters	20	5	10

$CaCO_3$ data:
1, 10 cm = 81%
5, 100 cm = 96%
6, 68 cm = 94%

SITE 577 HOLE A CORE 8 CORED INTERVAL 2744.0–2753.5 mbsl; 66.4–75.9 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

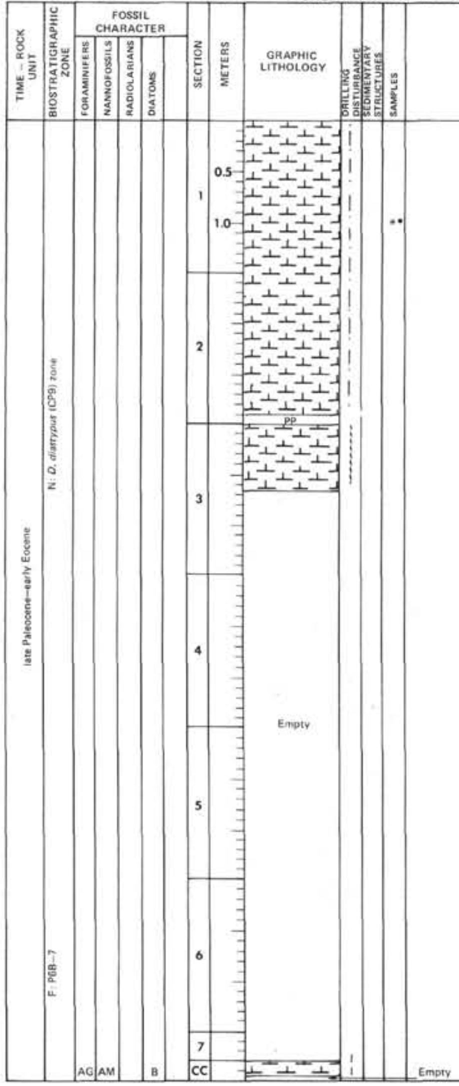
- Dominant colors: very pale brown (10YR 7/3–10YR 8/3). Minor colors: Section 1, 0–60 cm is light gray (2.5Y 7/2) with very pale brown (10YR 7/3–10YR 8/3) and white (10YR 8/1) distorted laminations. Section 1, 60–150 cm has small black mottles; Section 2 contains large white (10YR 8/2) mottles. Sections 2 through 5 contain faint thin (0.5 cm) black layers and zones.
- This core has been slightly deformed, except for Section 1, 0–60 cm which is very deformed and consists of flow-in.
- This core contains nannofossil ooze with common thin black layers and zones.

SMEAR SLIDE SUMMARY (%):

	1, 95 D	4, 70 D
Texture:		
Sand	0	0
Silt	50	50
Clay	50	50
Composition:		
Quartz	1	2
Clay	3	5
Volcanic glass	1	–
Carbonate unspec.	5	5
Foraminifers	–	Tr
Calc. nannofossils	85	85
Discoasters	5	3

$CaCO_3$ data: 1, 95 cm = 94%
4, 68 cm = 96%
5, 46 cm = 94%

SITE 577 HOLE A CORE 9 CORED INTERVAL 2753.5–2763.0 mbsl; 75.9–85.4 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

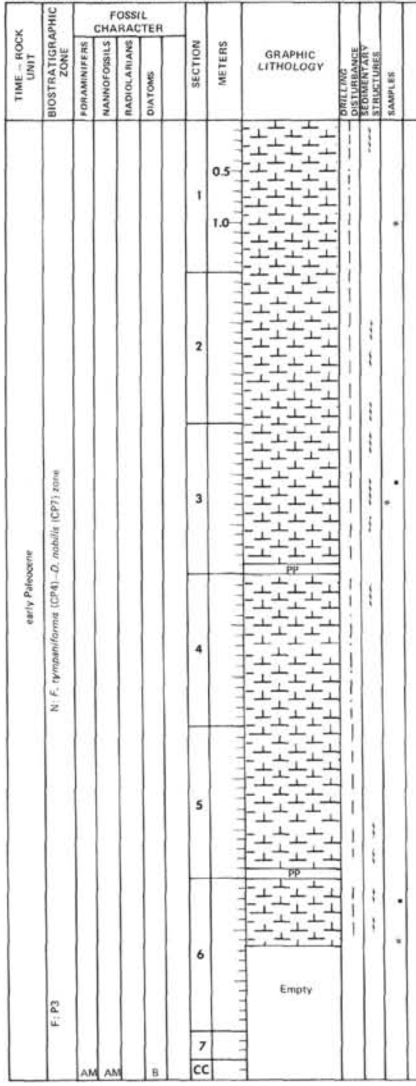
- Dominant colors: very pale brown (10YR 8/3), very pale brown (10YR 7/4), and white (10YR 8/2). Minor colors: white (2.5Y 8/0) pumice cobble.
- Sections 1 and 2 of this core are moderately deformed; Section 3 is very deformed.
- This core consists of homogeneous nannofossil ooze, with small, infrequent mottles in Section 2. Section 1, 0–4 cm contains a single white pumice cobble 3 cm in diameter.

SMEAR SLIDE SUMMARY (%):

	1, 100 D
Texture:	
Sand	0
Silt	40
Clay	60
Composition:	
Quartz	2
Clay	3
Volcanic glass	3
Glauconite	5
Carbonate unspec.	3
Calc. nannofossils	81
Discoasters	3

$CaCO_3$ data: 1, 100 cm = 97%

SITE 577 HOLE A CORE 10 CORED INTERVAL 2763.0–2772.5 mbsl; 85.4–94.9 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

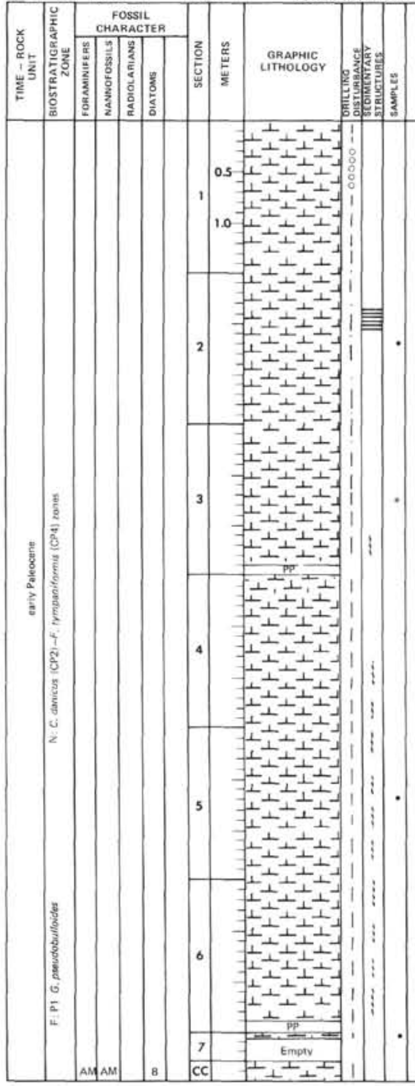
- Dominant colors: white (10YR 8/2) with white (10YR 8/1) and very pale brown (10YR 7/3) mottles. Very pale brown (10YR 7/3–10YR 8/3) with white (10YR 8/2) and light yellowish brown (10YR 6/4) mottles. Sections 5 and 6 contain intervals of light yellowish brown (10YR 6/4) nannofossil ooze.
- This core is slightly deformed, except for Section 4 which is moderately deformed.
- This core consists of homogeneous nannofossil ooze with infrequent mottles. All downcore color changes have gradational contacts.

SMEAR SLIDE SUMMARY (%):

	1, 100 D	3, 80 D	6, 60 D
Texture:			
Sand	3	0	1
Silt	37	30	39
Clay	60	70	60
Composition:			
Quartz	5	3	5
Feldspar	2	–	2
Heavy minerals	1	–	1
Clay	5	3	5
Volcanic glass	2	2	2
Glauconite	–	1	–
Zeolite	–	1	–
Carbonate unspec.	–	4	–
Foraminifers	Tr	–	–
Calc. nannofossils	80	86	85
Discoasters	5	–	–

$CaCO_3$ data: 3, 60 cm = 90%
6, 24 cm = 96%

SITE 577 HOLE A CORE 11 CORED INTERVAL 2772.5–2782.0 mbsl; 94.9–104.4 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

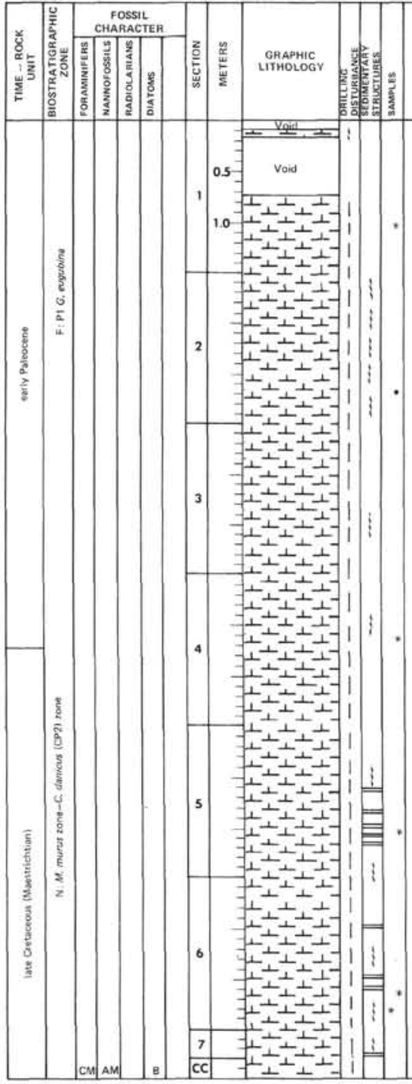
- Dominant colors: white (10YR 8/2), and very pale brown (10YR 7/3–10YR 8/3) with interval of very pale brown (10YR 7/4) in Section 6. Sections 3 through 6 contain white (10YR 8/1) mottles.
- This core is slightly deformed, except for Section 2 which is moderately deformed. Section 1 contains a soupy interval from 30–70 cm.
- This core consists of homogeneous to slightly mottled nannofossil ooze.

SMEAR SLIDE SUMMARY (%):

	3, 75 D
Texture:	
Sand	0
Silt	50
Clay	50
Composition:	
Quartz	3
Clay	3
Volcanic glass	2
Glauconite	1
Carbonate unspec.	3
Calc. nannofossils	88

$CaCO_3$ data: 2, 70 cm = 97%
5, 70 cm = 98%
7, 3 cm = 92%

SITE 577 HOLE A CORE 12 CORED INTERVAL 2782.0–2791.5 mbsl; 104.4–113.9 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

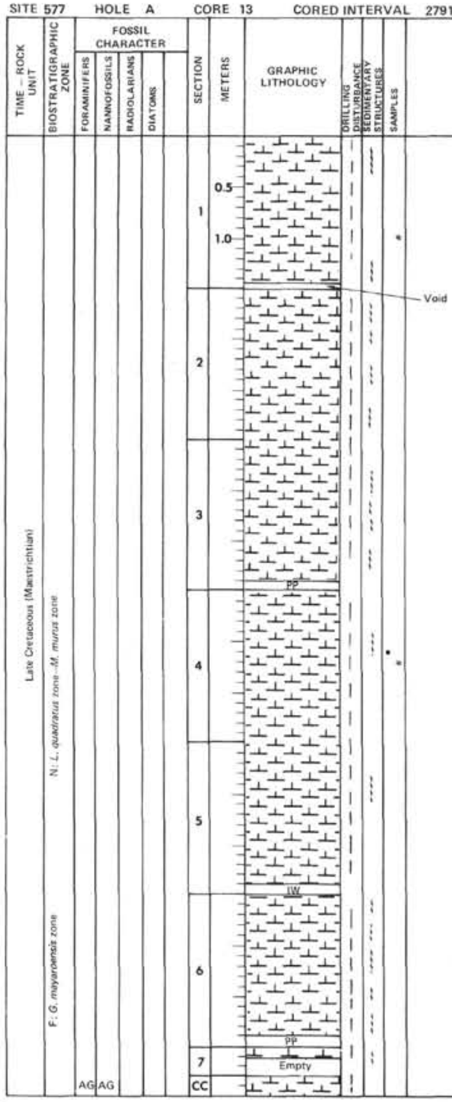
- Dominant colors: very pale brown (10YR 7/3–10YR 7/4), very pale brown (10YR 8/3), white (10YR 8/1–10YR 8/2), and light yellowish brown (10YR 6/4). Sections 4 through the Core Catcher are dominantly white (10YR 8/1–10YR 8/2).
- Core is slightly deformed throughout.
- This core consists of homogeneous to slightly mottled nannofossil ooze. Sections 5 and 6 contain thin (1 cm) laminations of light yellowish brown nannofossil ooze. All downcore color changes are gradational contacts.

SMEAR SLIDE SUMMARY (%):

	1, 107	4, 70	5, 106	6, 117	6, 132
	D	D	D	D	D
Texture:					
Sand	0	0	0	0	0
Silt	20	20	20	30	30
Clay	80	80	80	70	70
Composition:					
Quartz	2	2	2	2	2
Clay	3	5	3	3	5
Volcanic glass	2	3	2	2	2
Palagonite	1	–	–	–	–
Glauconite	1	–	2	–	1
Carbonate unspec.	5	5	7	7	3
Foraminfiers	1	–	Tr	–	Tr
Calc. nannofossils	85	85	84	86	87
Sponge spicules	–	–	–	–	Tr

$CaCO_3$ data: 2, 120 cm = 96%

SITE 577 HOLE A CORE 13 CORED INTERVAL 2791.5–2801.0 mbsl; 113.9–123.4 mbsf



LITHOLOGIC DESCRIPTION

NANNOFOSSIL OOZE

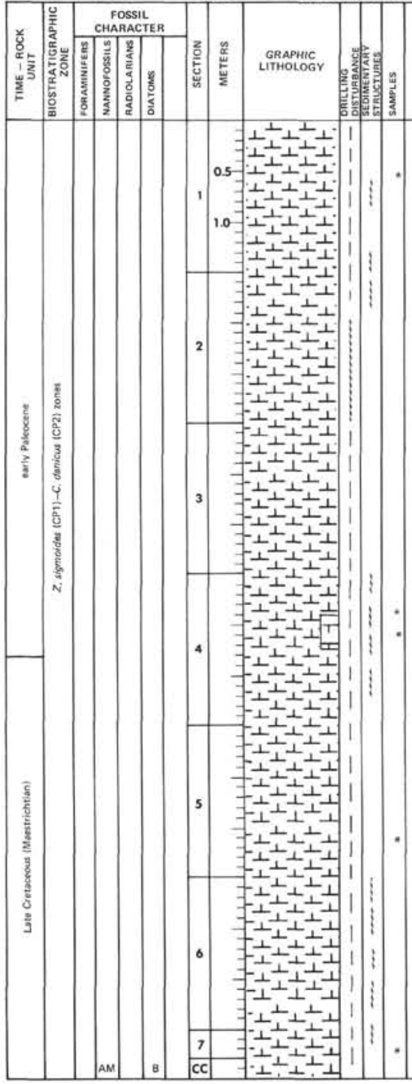
- Dominant colors: white (10YR 8/2). Minor colors: white (10YR 8/1) and very pale brown (10YR 7/3–10YR 8/3) mottles.
- Core is slightly deformed throughout.
- This core consists of uniform, white nannofossil ooze with minor mottles.

SMEAR SLIDE SUMMARY (%):

	1, 100	4, 75
	D	D
Texture:		
Sand	2	0
Silt	38	40
Clay	60	60
Composition:		
Quartz	5	2
Feldspar	2	–
Heavy minerals	1	–
Clay	5	3
Volcanic glass	2	2
Glauconite	–	1
Carbonate unspec.	5	5
Calc. nannofossils	80	87

$CaCO_3$ data: 4, 60 cm = 97%

SITE 577 HOLE B CORE 1 CORED INTERVAL 2782.0–2791.5 mbsl; 104.4–113.9 mbsf



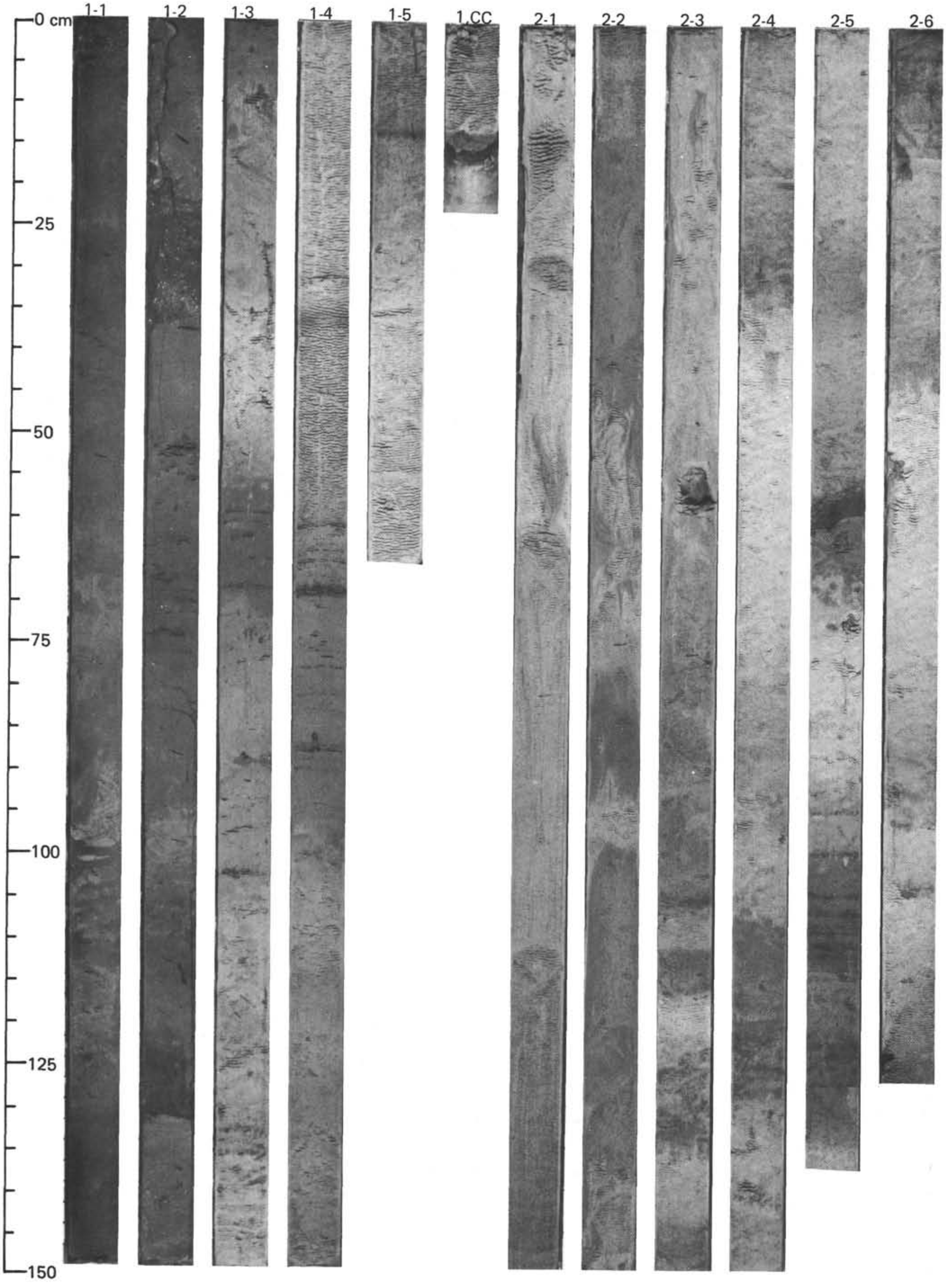
LITHOLOGIC DESCRIPTION

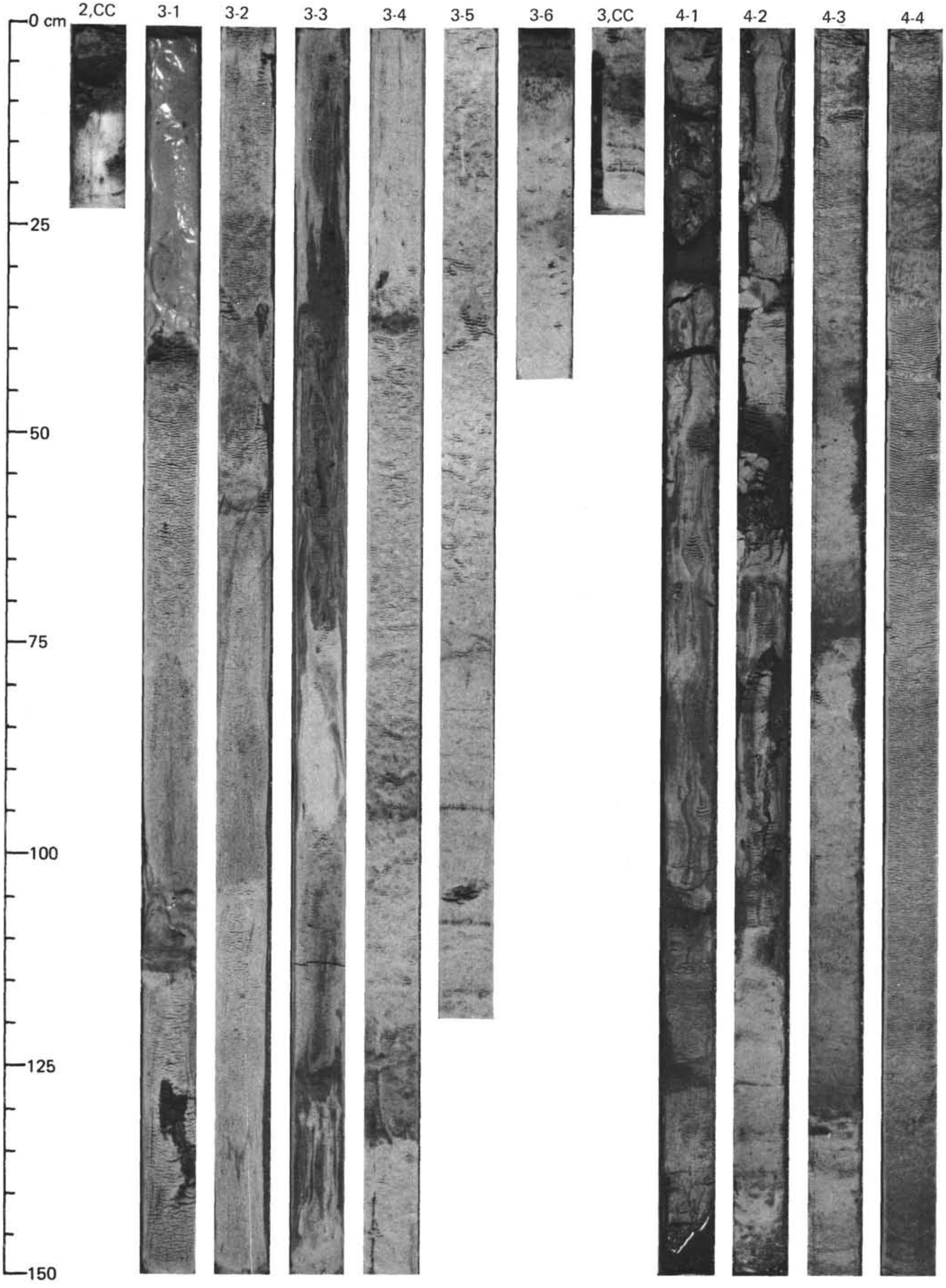
NANNOFOSSIL OOZE

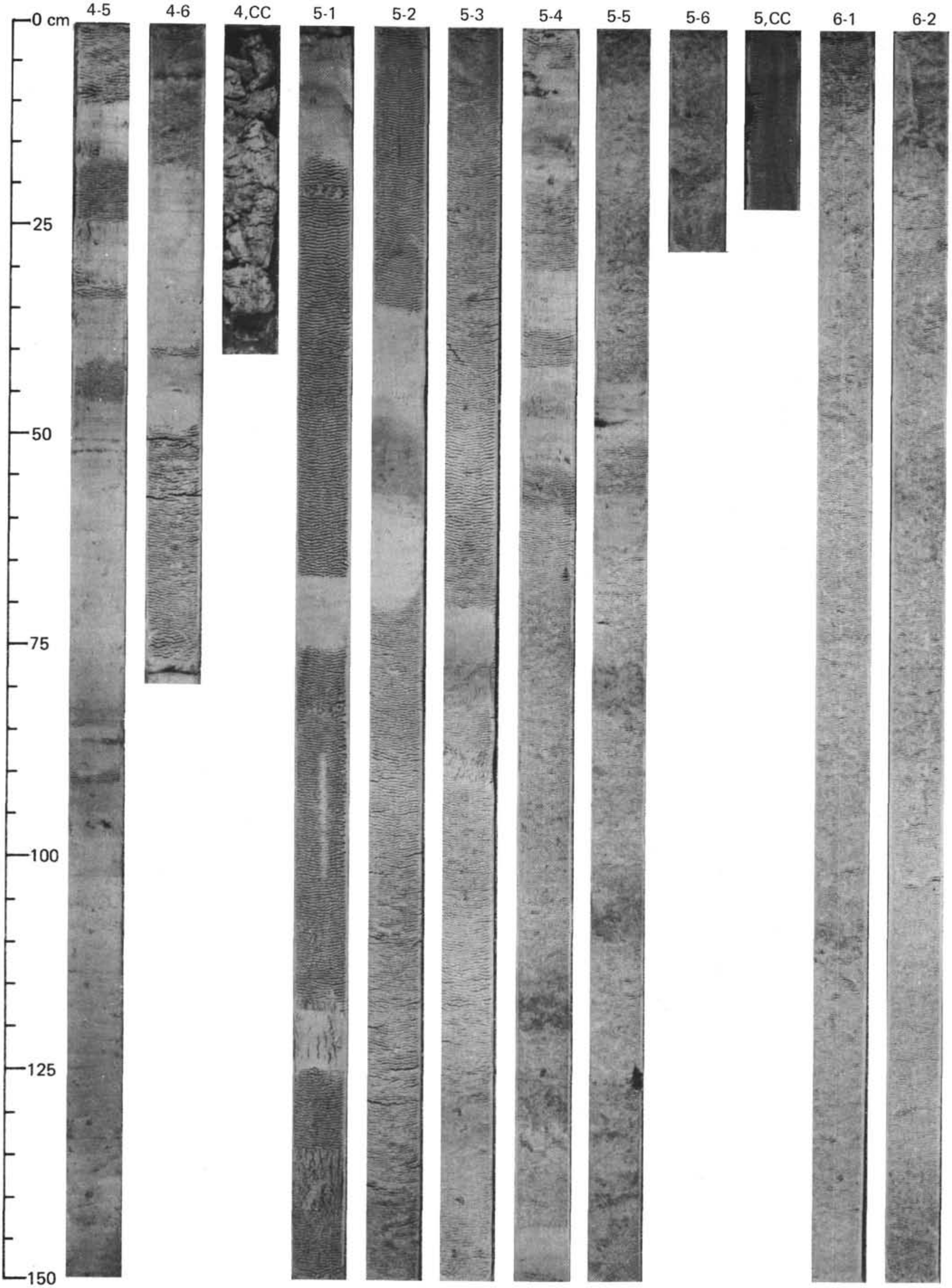
- Dominant colors: very pale brown (10YR 7/4–10YR 8/4), very pale brown (10YR 7/3–10YR 8/3), and light yellowish brown (10YR 6/4) changing to white (10YR 8/1–10YR 8/2) at base of Section 3. Sections 4 through 6 contain thin intervals of very pale brown (10YR 7/4), yellowish brown (10YR 5/4), and light gray (2.5Y N7).
- Section 2, 32–150 cm is very deformed flow-in. The rest of the core is slightly deformed.
- This core consists of homogeneous to slightly mottled nannofossil ooze. Downcore color changes are gradational.

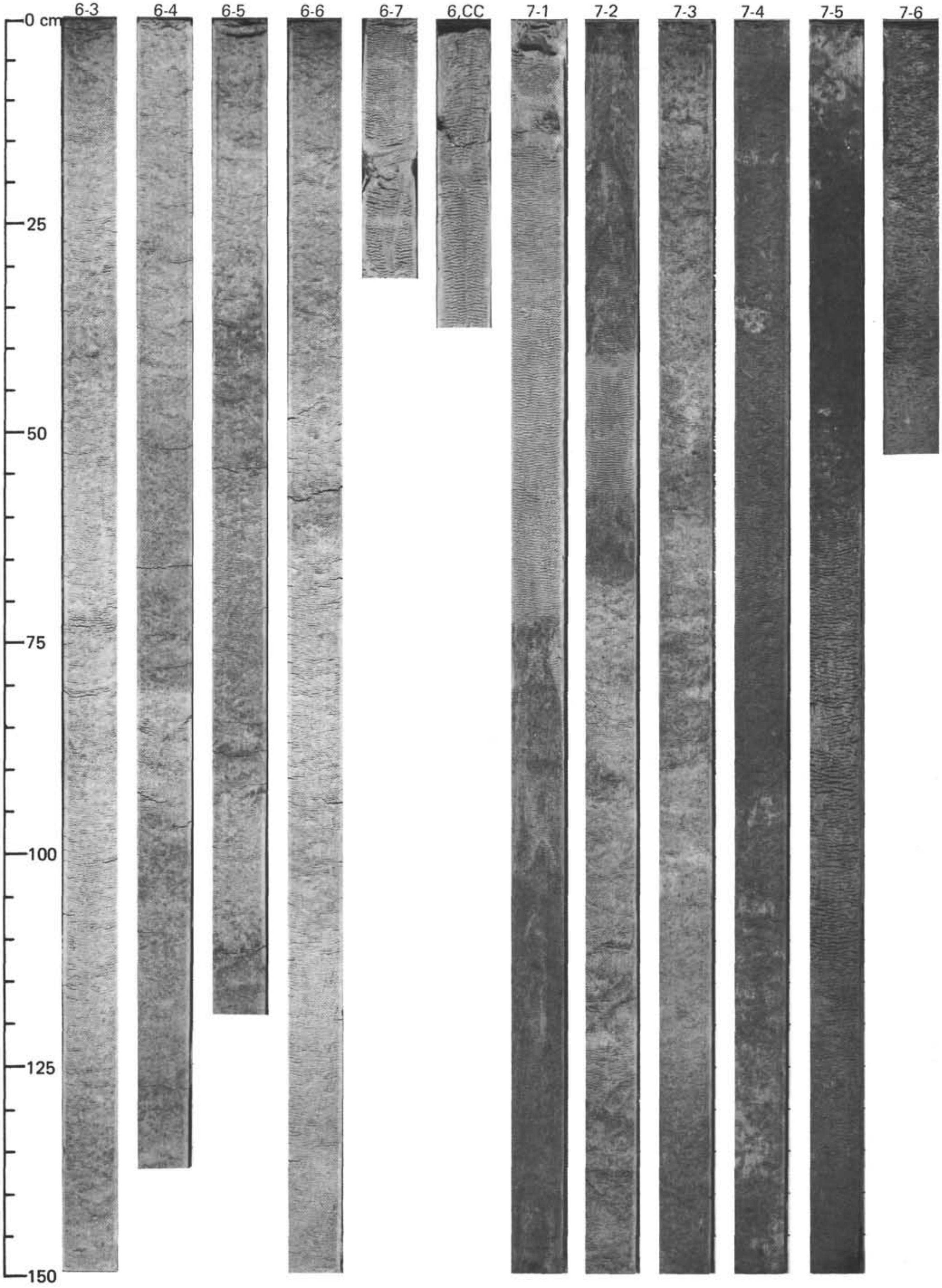
SMEAR SLIDE SUMMARY (%):

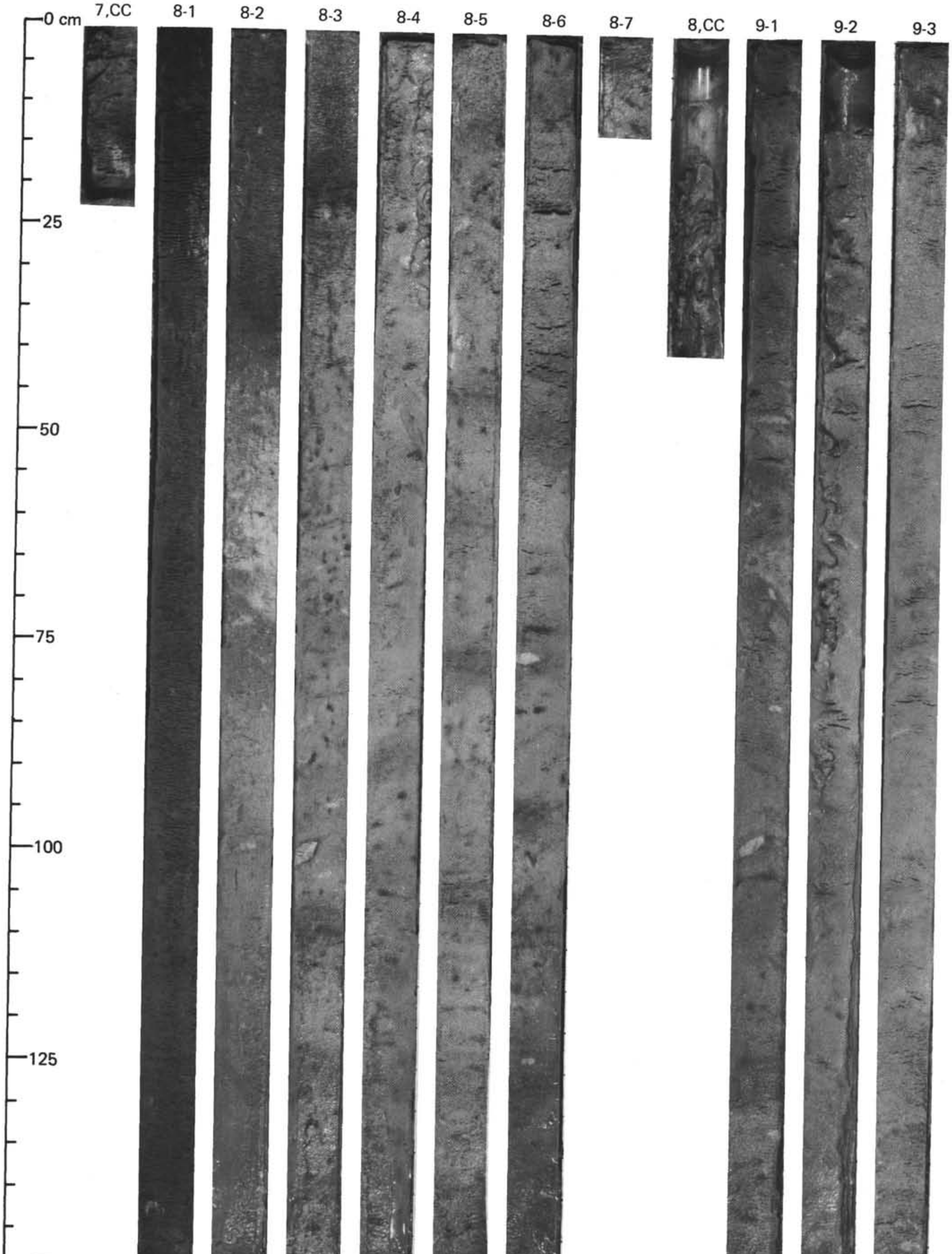
	1, 60	4, 40	4, 65	5, 116	7, 25
	D	D	D	D	D
Texture:					
Sand	5	15	20	1	1
Silt	2	5	5	0	0
Clay	93	80	75	99	99
Composition:					
Quartz	Tr	Tr	Tr	Tr	Tr
Feldspar	–	–	–	–	Tr
Clay	25	3	15	25	10
Volcanic glass	1	3	–	Tr	–
Carbonate unspec.	1	2	–	1	–
Foraminifers	7	15	25	Tr	1
Calc. nannofossils	66	77	60	74	89
Sponge spicules	–	–	–	–	Tr

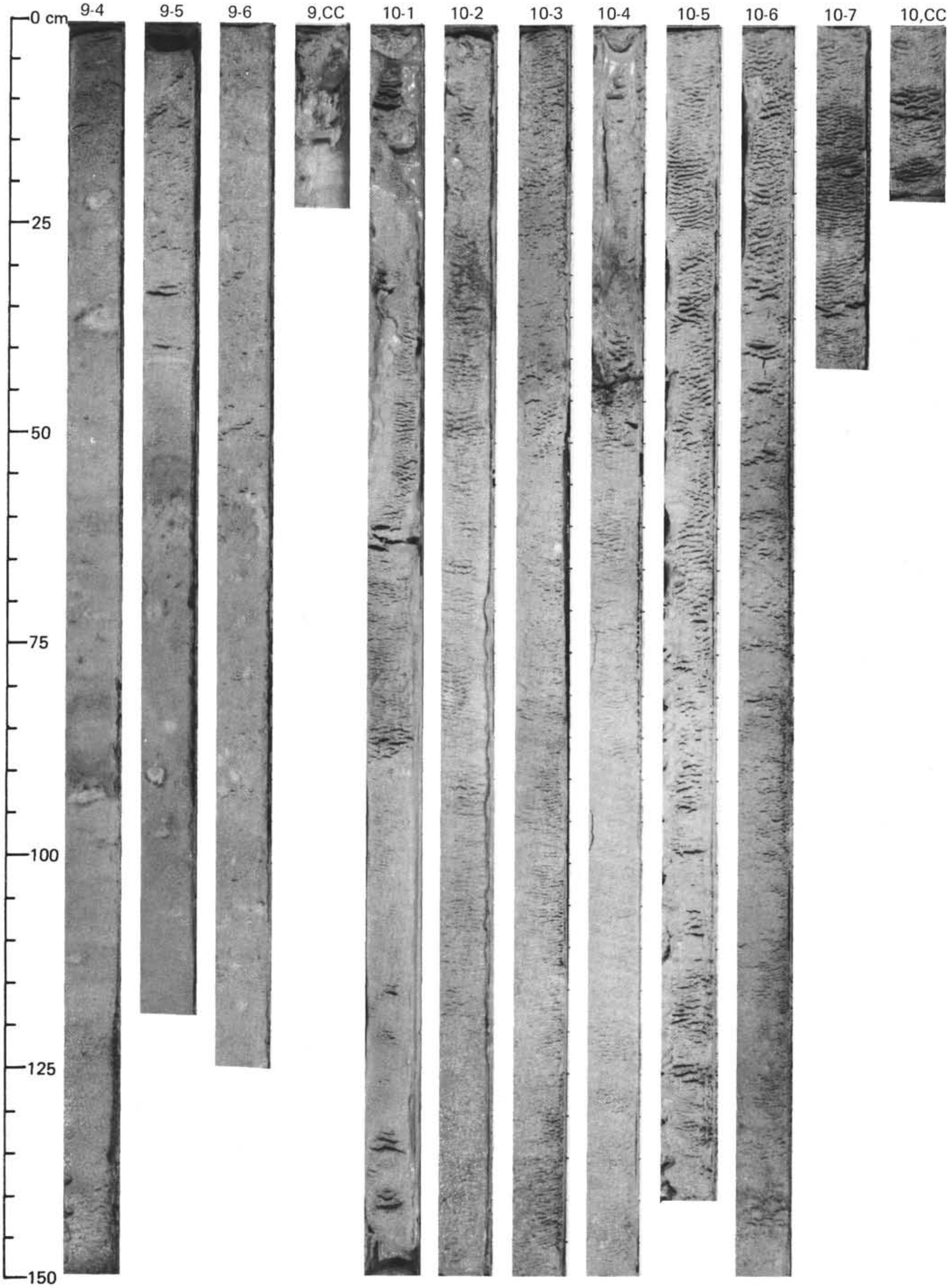

0 cm
25
50
75
100
125
150
1-1
1-2
1-3
1-4
1-5
1,CC
2-1
2-2
2-3
2-4
2-5
2-6

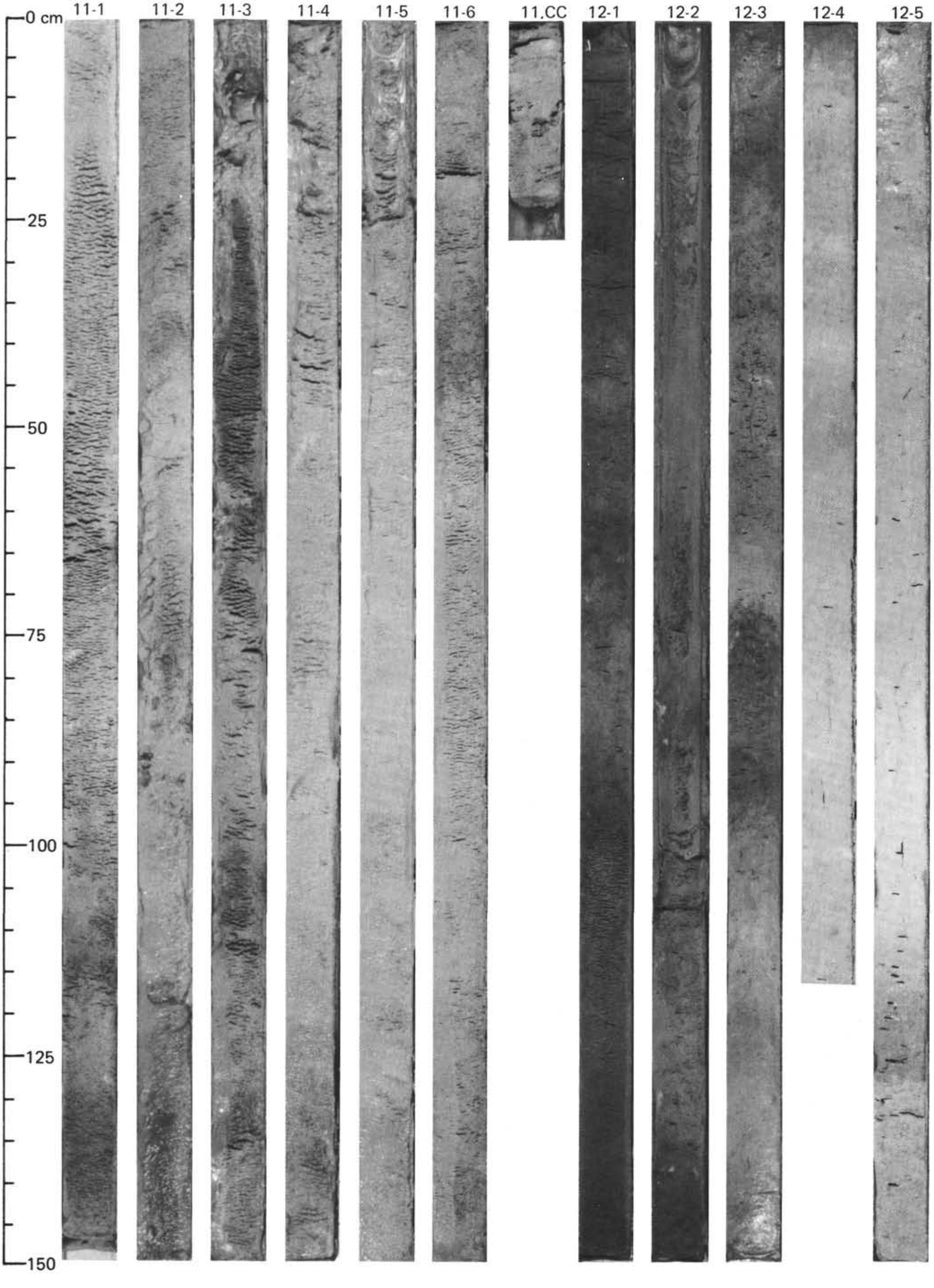

0 cm
25
50
75
100
125
150
2,CC
3-1
3-2
3-3
3-4
3-5
3-6
3,CC
4-1
4-2
4-3
4-4


0 cm
25
50
75
100
125
150
4-5
4-6
4,CC
5-1
5-2
5-3
5-4
5-5
5-6
5,CC
6-1
6-2


0 cm
25
50
75
100
125
150
6-3
6-4
6-5
6-6
6-7
6,CC
7-1
7-2
7-3
7-4
7-5
7-6


0 cm
25
50
75
100
125
150
7,CC
8-1
8-2
8-3
8-4
8-5
8-6
8-7
8,CC
9-1
9-2
9-3


0 cm
25
50
75
100
125
150
9-4
9-5
9-6
9,CC
10-1
10-2
10-3
10-4
10-5
10-6
10-7
10,CC


0 cm
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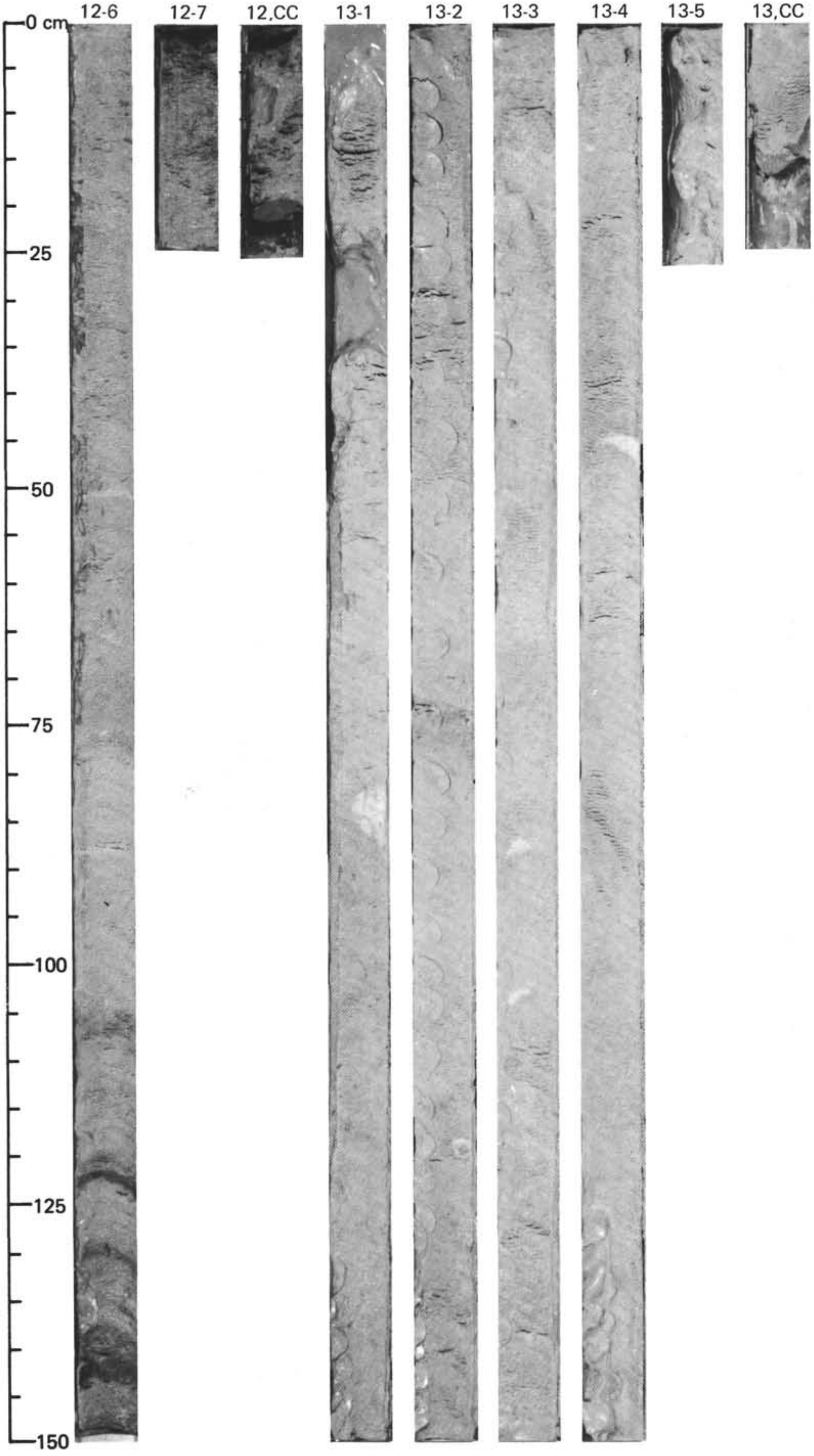
125
150
11-1
11-2
11-3
11-4
11-5
11-6
11,CC
12-1
12-2
12-3
12-4
12-5


12-6
12-7
12,CC
13-1
13-2
13-3
13-4
13-5
13,CC
0 cm
25
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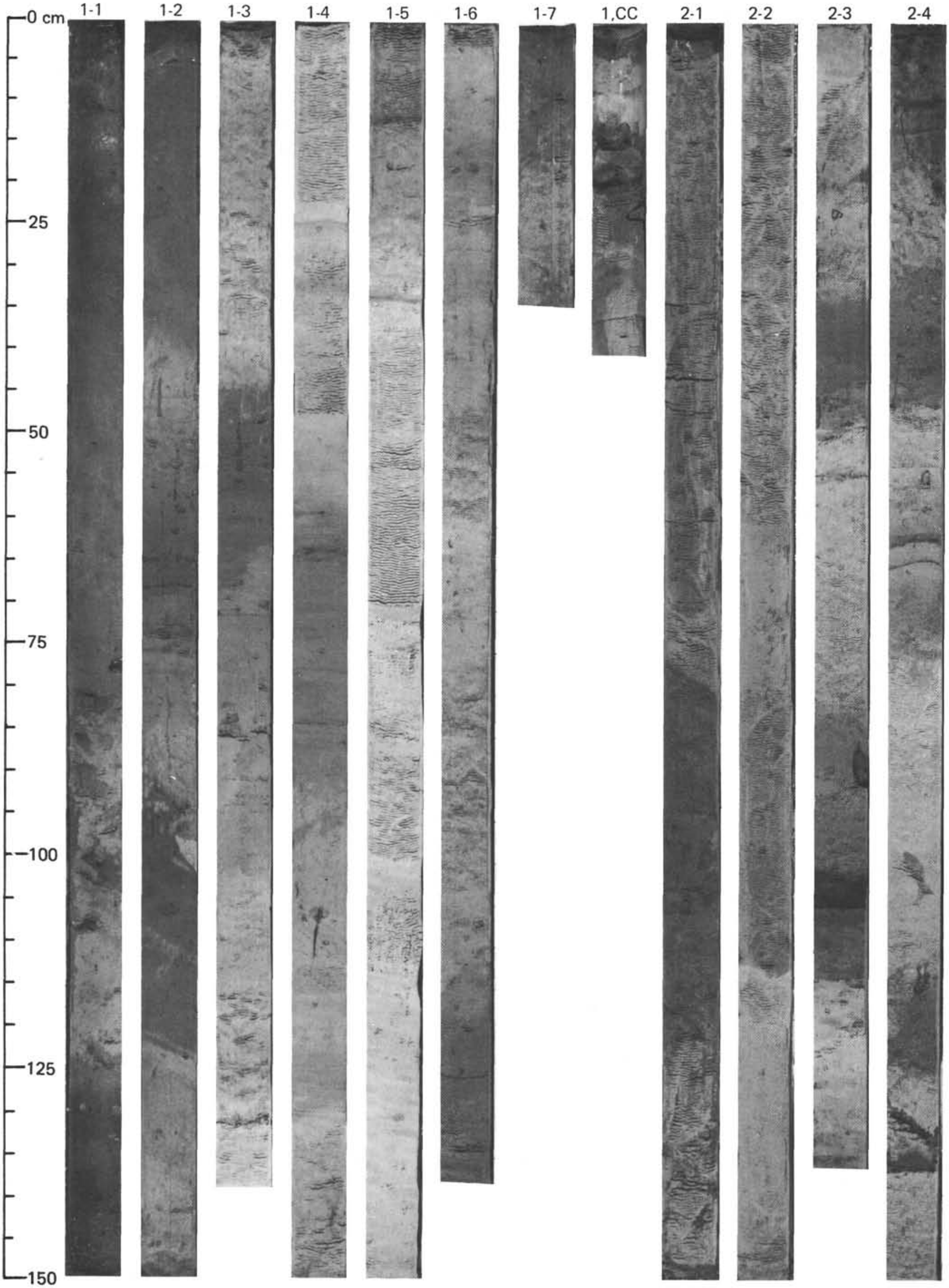
75
100
125
150


0 cm
25
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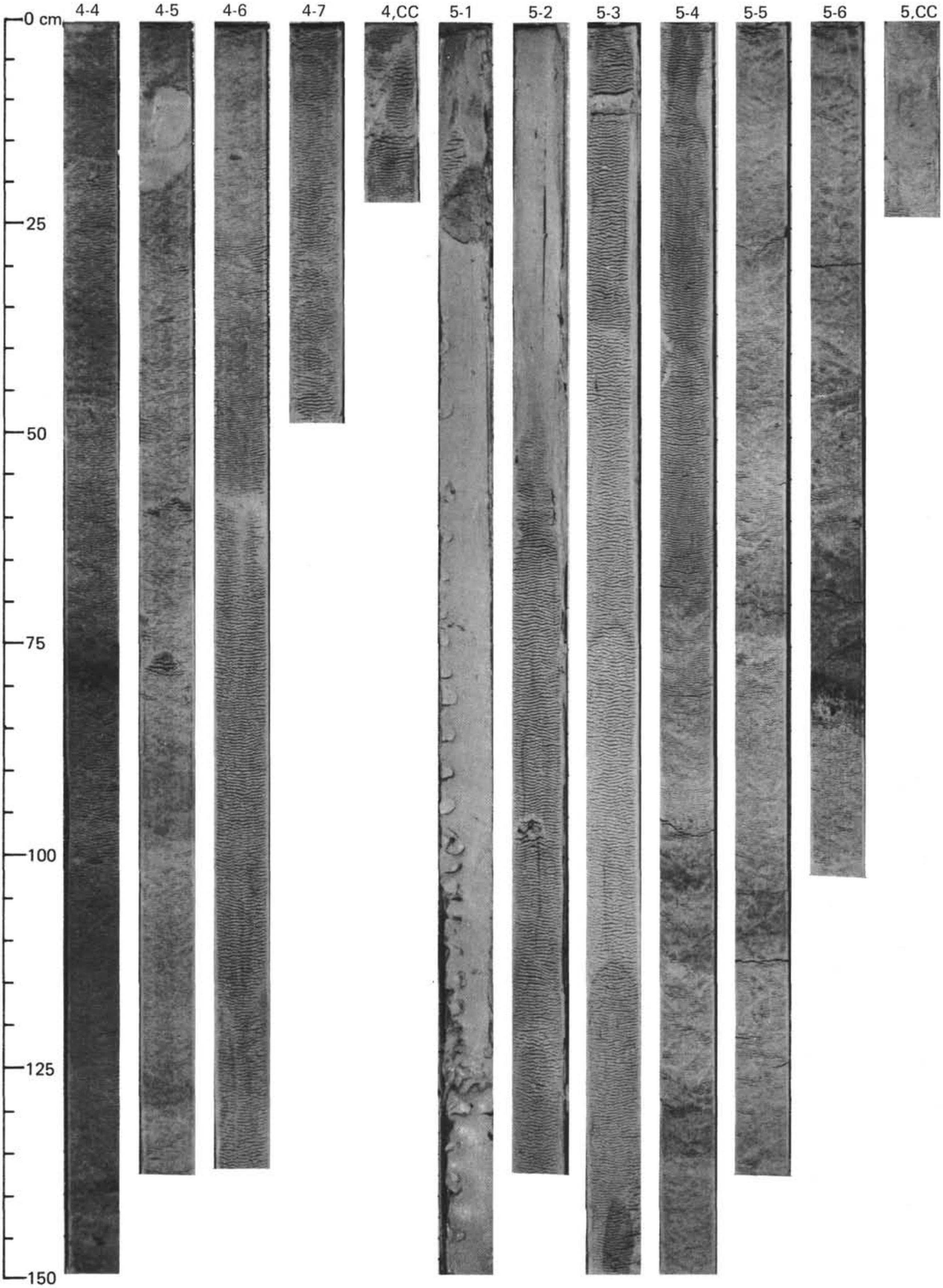
75
100
125
150
1-1
1-2
1-3
1-4
1-5
1-6
1-7
1,CC
2-1
2-2
2-3
2-4


0 cm
25
50
75
100
125
150
2-5
2-6
2,CC
3-1
3-2
3-3
3-4
3-5
3,CC
4-1
4-2
4-3


0 cm
25
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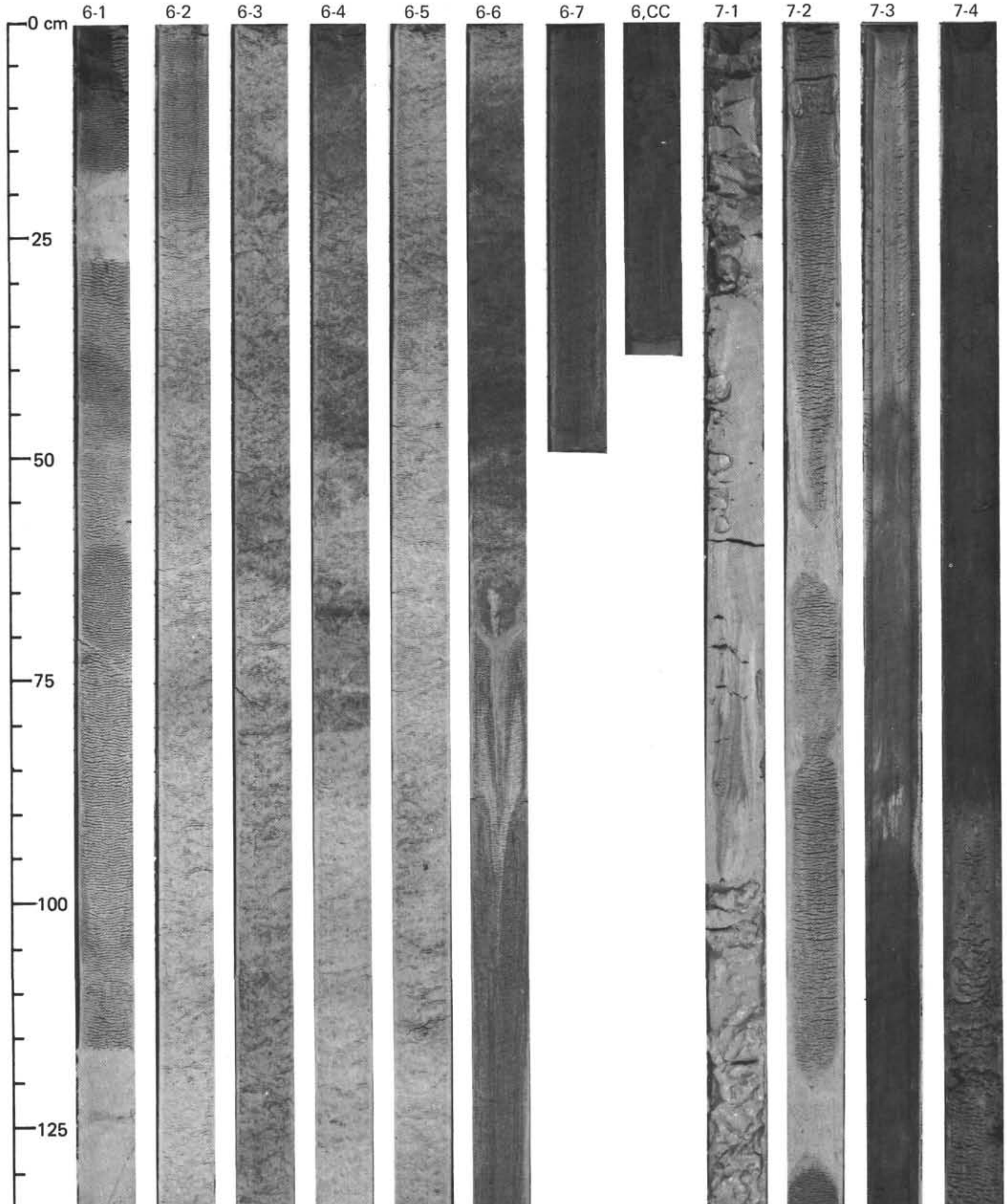
75
100
125
150
4-4
4-5
4-6
4-7
4,CC
5-1
5-2
5-3
5-4
5-5
5-6
5,CC


6-1
6-2
6-3
6-4
6-5
6-6
6-7
6,CC
7-1
7-2
7-3
7-4
0 cm
25
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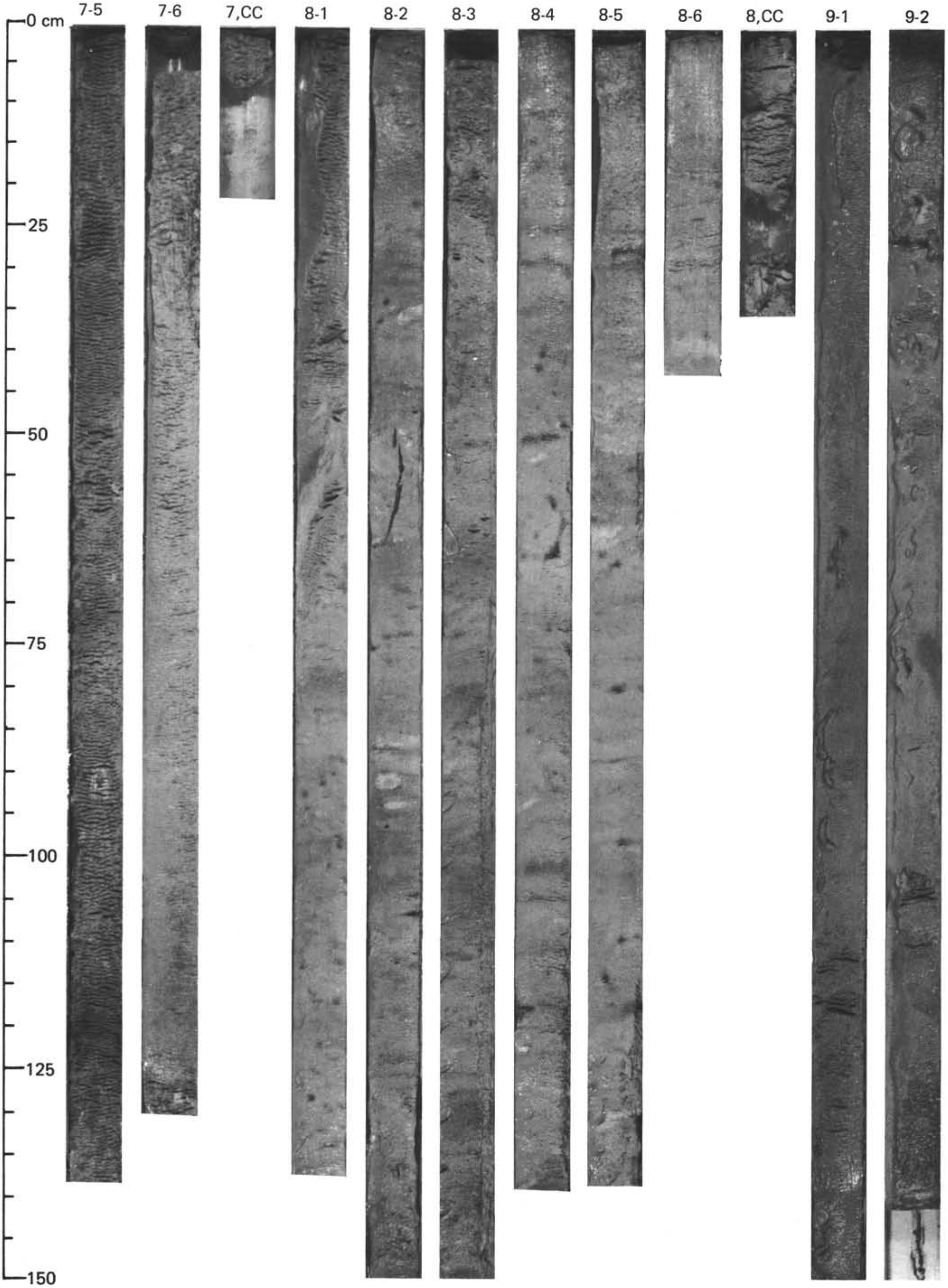
0 cm
25
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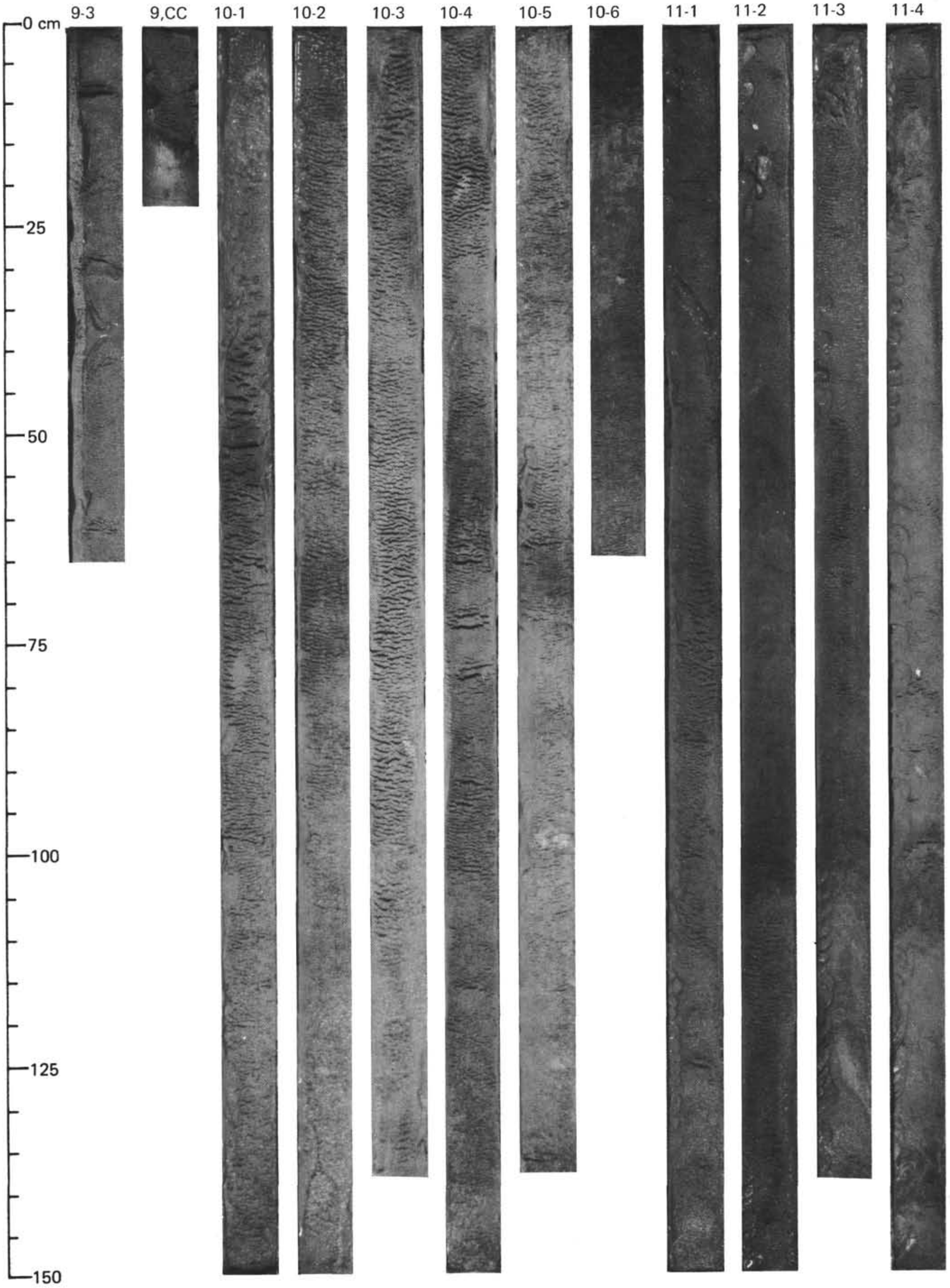
75
100
125
150
7-5
7-6
7,CC
8-1
8-2
8-3
8-4
8-5
8-6
8,CC
9-1
9-2


0 cm
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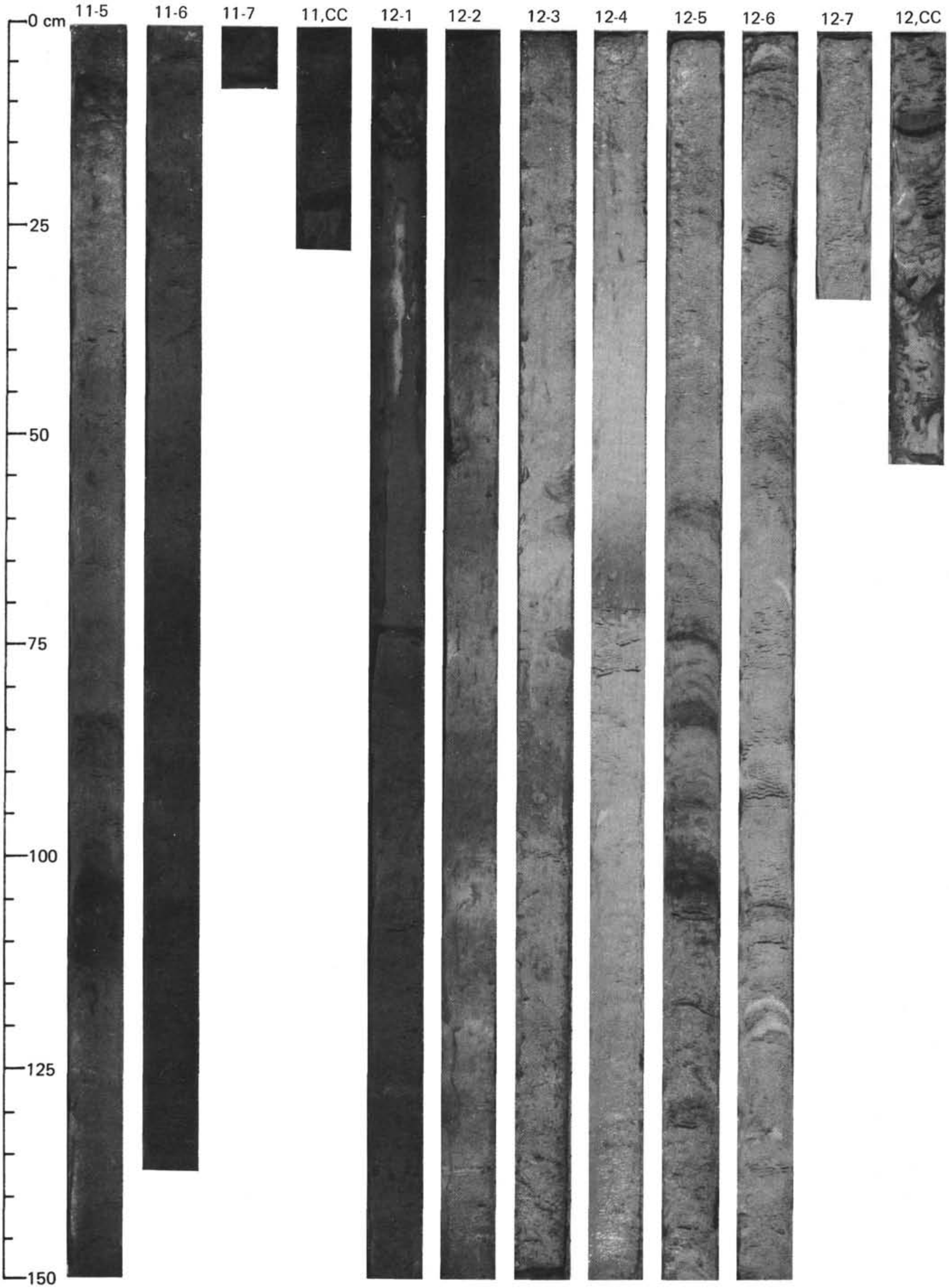
150
9-3
9,CC
10-1
10-2
10-3
10-4
10-5
10-6
11-1
11-2
11-3
11-4


0 cm
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11-5
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11-7
11,CC
12-1
12-2
12-3
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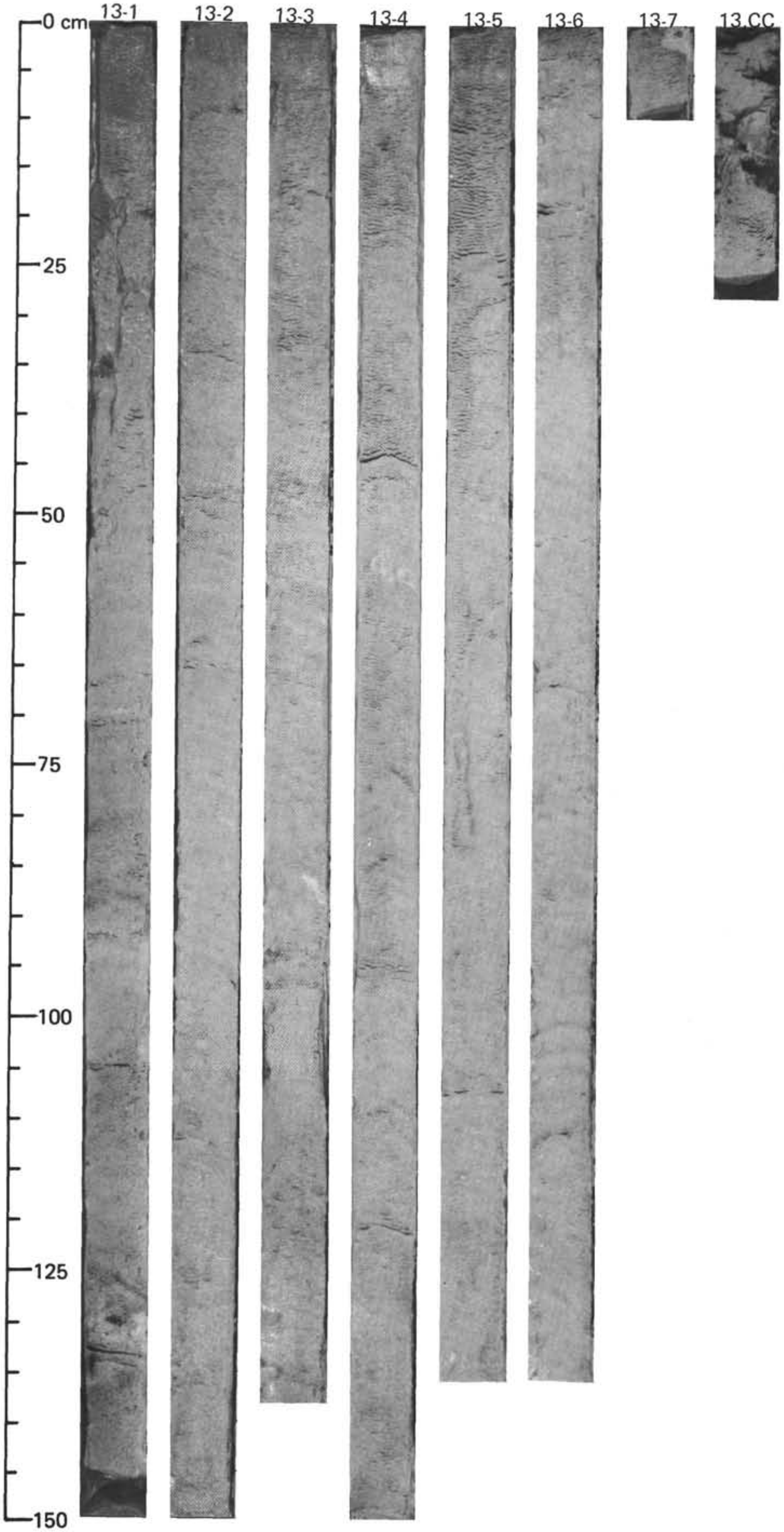
12-5
12-6
12-7
12,CC


0 cm
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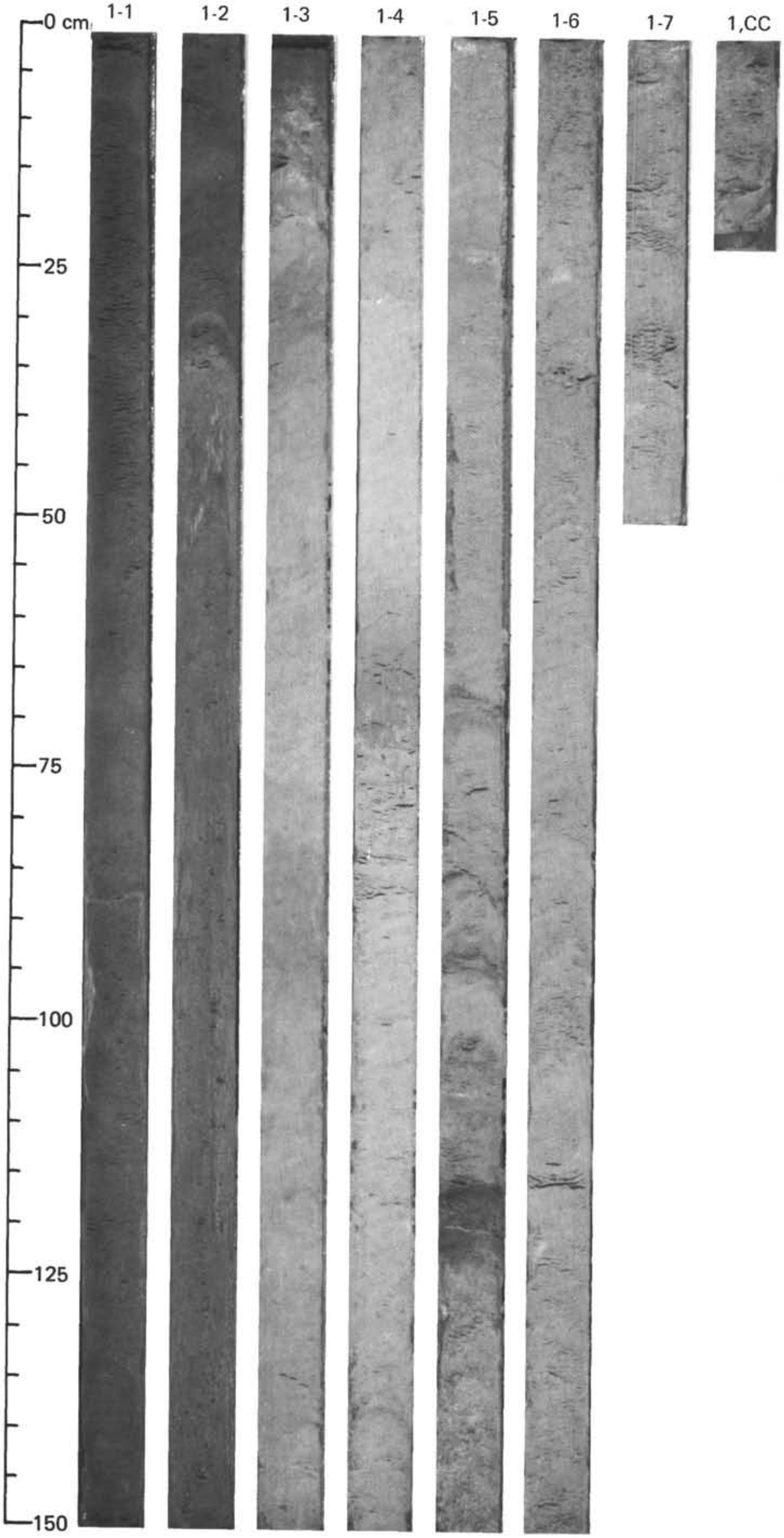
13-1
13-2
13-3
13-4
13-5
13-6
13-7
13,CC


0 cm
25
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75
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150
1-1
1-2
1-3
1-4
1-5
1-6
1-7
1,CC