4. SITE 555[1]

Shipboard Scientific Party[2]

HOLE 555

Date occupied: 21 August 1981

Date departed: 10 September 1981

Time on hole: 221 hr., 45 min.

Position (latitude; longitude): 56°33.70′N; 20°46.93′W

Water depth (sea level; corrected m, echo-sounding): 1659

Water depth (rig floor; corrected m, echo-sounding): 1669

Bottom felt (m, drill pipe): 1669

Penetration (m): 964

Number of cores: 98

Total length of cored section (m): 926

Total core recovered (m): 505.25

Core recovery (%): 54

Oldest sediment cored:
Depth sub-bottom (m): 927.32
Nature: Micaceous siltstones and mudstones
Age: late Paleocene (NP9)
Measured velocity (km/s): 2.5

Basement:
Depth sub-bottom (m): 927.32
Nature: Basalt
Velocity range (km/s): 5.3–6.0

Principal results: See Chapter 1: Introduction and Explanatory Notes.

BACKGROUND AND OBJECTIVES

The five sites originally scheduled for Leg 81 were designed to provide a complete transect of the "dipping reflector" type of margin from the oceanic crust to thick continental crust. Unfortunately, losses of time resulting from frequent bad weather and the chain of operational problems detailed in the operations sections allowed us enough time (10 days) to drill only one of the two remaining sites located, respectively, on oceanic crust and thick continental crust. Of these two sites, it was felt that more fundamental problems related to the genesis of passive margins—their paleoenvironment, the development of North Atlantic climate, and ocean circulation—could be addressed at the site ostensibly located on the thick continental crust between Hatton Bank and Edoras Bank. Further, there was an open possibility that time would remain to hydraulic piston core (HPC) the important Pliocene–Pleistocene section again, either at this site or by a return to Site 552.

Geological Background

Site 555 was the most "landward" (Zone IV) site of the Leg 81 transect and was situated on the col between Hatton Bank and Edoras Bank some 160 km ENE of Site 554 (Figs. 1–3). Hatton Bank and Edoras Bank make up a prominent ridge locally shallower than 600 m in the north and deepening southward (Fig. 2). The banks are bounded to the west by a steep slope marking the inner edge of the Edoras Basin containing the dipping reflectors. This slope trends obliquely to the magnetic anomalies and to the trend of the outer high. The difference in relief of the basement between the high and the basalts of Hole 553A is about 2000 m. Gravity modelling of the margin (Scrutton, 1972) (Fig. 4) shows that crustal thickness changes from 25 km beneath the banks to about 12 km beneath the dipping reflectors over a distance of about 30 km, demonstrating rapid crustal thinning between the banks and the outer high.

Although the Hatton and Edoras banks are presently isolated highs, they can be considered as marking the transition from the thicker crust of the Rockall Plateau microcontinent to the thinner crust of the outer margin. In this sense, their western slope may be comparable with the so-called hinge line marking the change from the thin, attenuated, or transitional crust (where dipping reflectors may be present) to the thicker crust of the continental platform (see east coast of the United States, Hutchinson et al., in press). The banks may also be analogous to the structural high that underlies the Vøring Plateau escarpment (Hinz, 1981). However, there are no direct equivalents to these highs on the conjugate East Greenland margin (Featherstone et al., 1977), but a possibly equivalent transition from oceanward dipping reflectors via a steep slope to shelf and landmass of Greenland is present.

Results obtained at Hole 553A as well as at previously drilled Sites 403 and 404 demonstrate that inner-shelf conditions prevailed immediately prior to the onset of spreading in early Eocene time, indicated by Anomaly 24B (Montadert, Roberts et al., 1979). The present rela-

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[1] Roberts, D. G., Schnitker, D., et al., *Init. Repts. DSDP*, 81: Washington (U.S. Govt. Printing Office).

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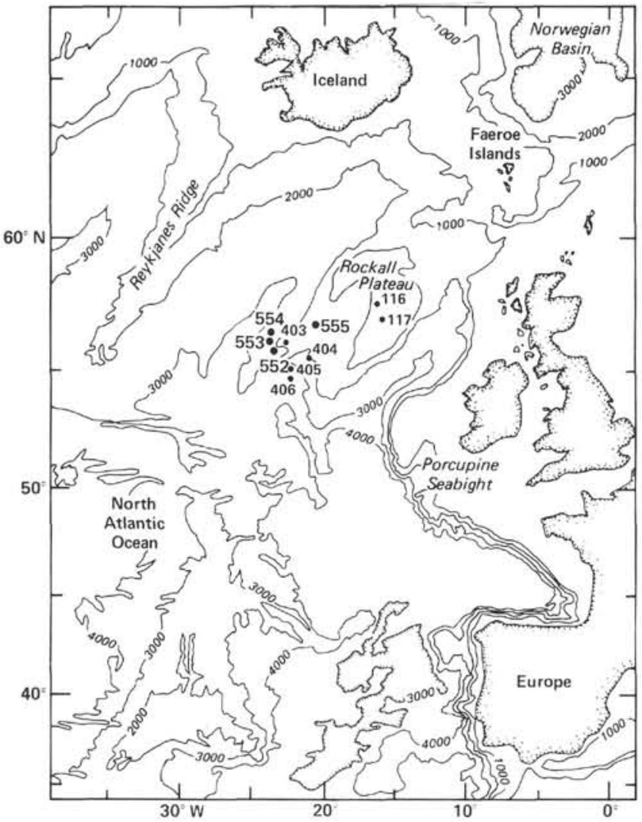


Figure 1. Northeast Atlantic bathymetry showing locations of Sites 552, 553, 554, 555, 403, 404, 405, 406, 116, and 117.

tive relief of the basement between these sites, Site 555 and Sites 116 and 117, is of the order of 2000 m, yet depths were apparently equivalent in early Eocene time at Site 117 (Laughton, Berggren et al., 1972; Roberts et al., 1979). Quite clearly the relief has been created subsequent to this time and may have formed in several ways. Conceivably it might represent the relief created rapidly during the terminal phases of rifting, or it might have formed by subsequent flexing of the entire margin, perhaps in response to postrift differential thermal subsidence reflecting differences in crustal thickness. In the former case, a substantial subaerial relief is implied in early Eocene time, and, in the latter, strong differential subsidence and/or uplift of an original relief created at or close to sea level is implied.

In terms of examining the paleoenvironmental history of the northern North Atlantic Ocean, Site 555 was important in several respects. The sedimentary section was thick (c. 700 m) in comparison to that at Sites 552 through 554, and developed on top of a regional high. Regional seismic studies show that the thicker section is part of the ubiquitous sediment drifts on the Rockall Plateau, where deposition under the pervasive influence of bottom currents was initiated in post-Eocene time (Roberts, 1975; Roberts, et al., 1979). The site was also close to the present axis of the North Atlantic Drift current.

The development of this thicker section offered the opportunity to examine a number of problems of North Atlantic paleoceanography. Intercomparison of Site 555 with Sites 553 and 552 (as well as Sites 403–404), situated at greater depths, might allow some assessment of the evolution of temperature gradients in the water column with time from the response of benthic foraminiferal assemblages, although the effects of subsidence would need to be taken into account. The possibly more complete stratigraphic and paleontologic record at this site might also provide data on timing of important events, such as the subsidence of the Iceland–Faeroes Ridge, the impact of Eocene–Oligocene cooling, and the significance of the Eocene through Miocene unconformities observed at the deeper sites. By no means least, there might be an opportunitiy to HPC a complete Pliocene–Pleistocene section to examine glacial climate and migration of the North Atlantic Drift. In this context, it was noted that the first description of North Atlantic Pliocene–Pleistocene biostratigraphy was made from Site 116 in the adjoining Hatton-Rockall Basin (Berggren, 1972).

In summary, the principal objectives of Site 555 were to examine the following:

1. Subsidence history: Determining the subsidence history of the site using quantitative paleobathymetric data would contribute to the problem of the timing, rate, and amount of relative movement across the zone of crustal attenuation. Specifically, the site would examine the question of a rift or postrift origin for the topographic relief.
2. Basement: Coring of basement was intended to determine whether basic lava flows or continental metamorphic rocks are present.
3. Paleoceanography: The drilling was intended to core a complete Neogene and Paleogene section to examine the evolution of North Atlantic climate and ocean circulation. In particular, the site was intended to document lithologic and biostratigraphic changes across key hiatuses and their relationship to global sea level variations (Vail et al., 1977).
4. Pliocene–Pleistocene climatic history: Drilling was intended to obtain by HPC a complete Pliocene–Pleistocene section in an area of increased sedimentation.

OPERATIONS

After making a return crossing of the beacon at Site 554, *Glomar Challenger* set course for Site 555 some 120 n. mi. distant (Fig. 5). The site was approached from the southwest at 1400Z, 30 August (Fig. 6). Unfortunately, a substantial discrepancy existed between the LORAN-C and OMEGA fixes, but a satellite fix was obtained at 1446Z. This allowed an approximate estimate of the fixed error between the satellite fix, OMEGA, and LORAN-C. Although the LORAN-C signals were weak, requiring frequent resetting of the receiver, these proved to be the most reliable during the site approach.

At 1500Z, course was adjusted to 205° (−3° leeway) to run down the control seismic Profile IPOD 76-9B to the site (Fig. 6). LORAN-C fixes indicated that the *Glomar Challenger* track lay approximately 1.6 n. mi. east

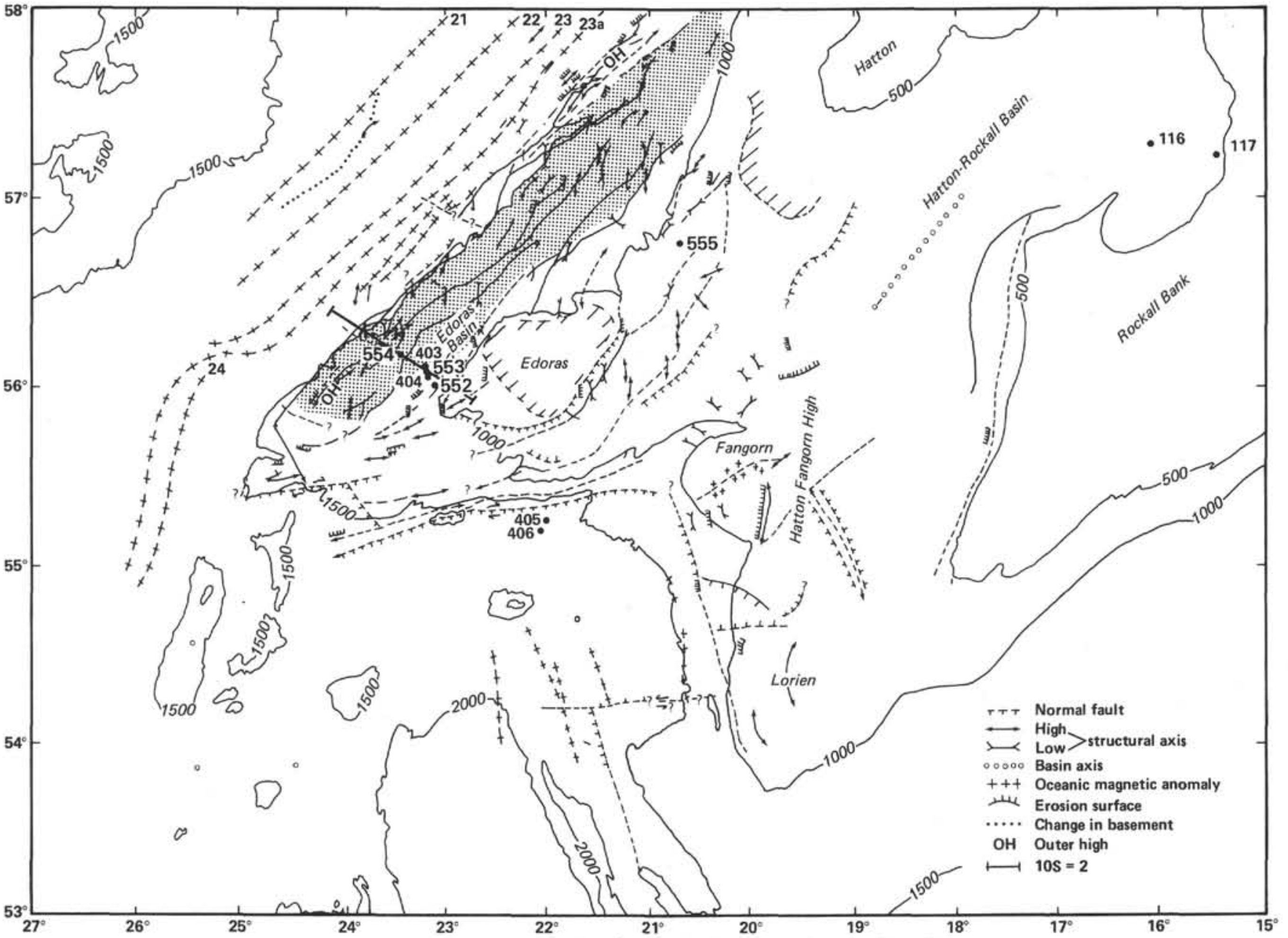


Figure 2. Principal structural elements of the southwestern Rockall Plateau based on seismic reflection profiles and magnetic data.

of the line, and at 1530Z course was altered to 270° to return directly to the control line. At 1540Z, course was adjusted back to 205° to run directly along the control seismic line. The site was identified on the *Glomar Challenger* seismic profile at 1550Z, but course was maintained until 1630Z to obtain a good crossing of the site. At 1632Z, *Glomar Challenger* executed a Williamson turn, returning to deploy a 16.5 kHz beacon at 1740Z, 30 August. After retrieving the geophysical gear, *Glomar Challenger* began positioning and maneuvering to the beacon.

At 1830Z, preparations began to pick up the bottom-hole assembly and to run-in hole. At 0030Z, 31 August, shortly before reaching bottom, abnormally low pump pressures were noted. At 0050Z, sinker bars were run in hole to feel for the core barrel. It was eventually concluded that the pipe was open-ended. Between 0130 and 0215Z, the heave compensator and Bowen sub were set back preparatory to tripping the pipe. At 0458Z, the drill stem reached the rig floor; it was then found that the hydraulic bit release had shifted and released the bit. The cause remains unknown. Between 0458 and 1000Z, the pipe was again run back. After a possible premature spud at 1652 m, the first core was finally cut at the mudline at 1325Z, 31 August. Continuous coring then began. Heat-flow measurements were taken at 62.5, 99.5, 148.0, 199.5, and 243.0 m subsea, and the intervals from 72.0 to 91.0 m and from 100 to 129.0 m were washed. Continuous coring continued to total depth. Gel mud was spotted throughout. Basalt interbedded with sediments was cut in Core 84. Drilling rates in the basalt remained fairly high throughout at 1 to 2 hr. per core. At 933.0 m, a dense fine-grained basalt was cored, and drilling rates slowed to 4 hr. per core. A further 31.0 m of penetration into the basalts to total depth at 964.0 m was achieved by 0518Z, 7 September (Table 1). In view of the fact that rapid deterioration in weather conditions was forecast, it was decided to terminate the hole to ensure that a full logging program could be done in the remaining time available.

Between 0515 and 0730Z, 7 September, the hole was flushed with 50 barrels of gel and the bit released. The hole was then filled with mud, and the pipe pulled back to the logging point of 1869.0 m. The Bowen sub and heave compensator were also set back (0730–1235Z). A rather deeper logging point was chosen to ensure complete burial of the bottom-hole assembly in the soft sediments in the upper part of the hole. Further, pipe could

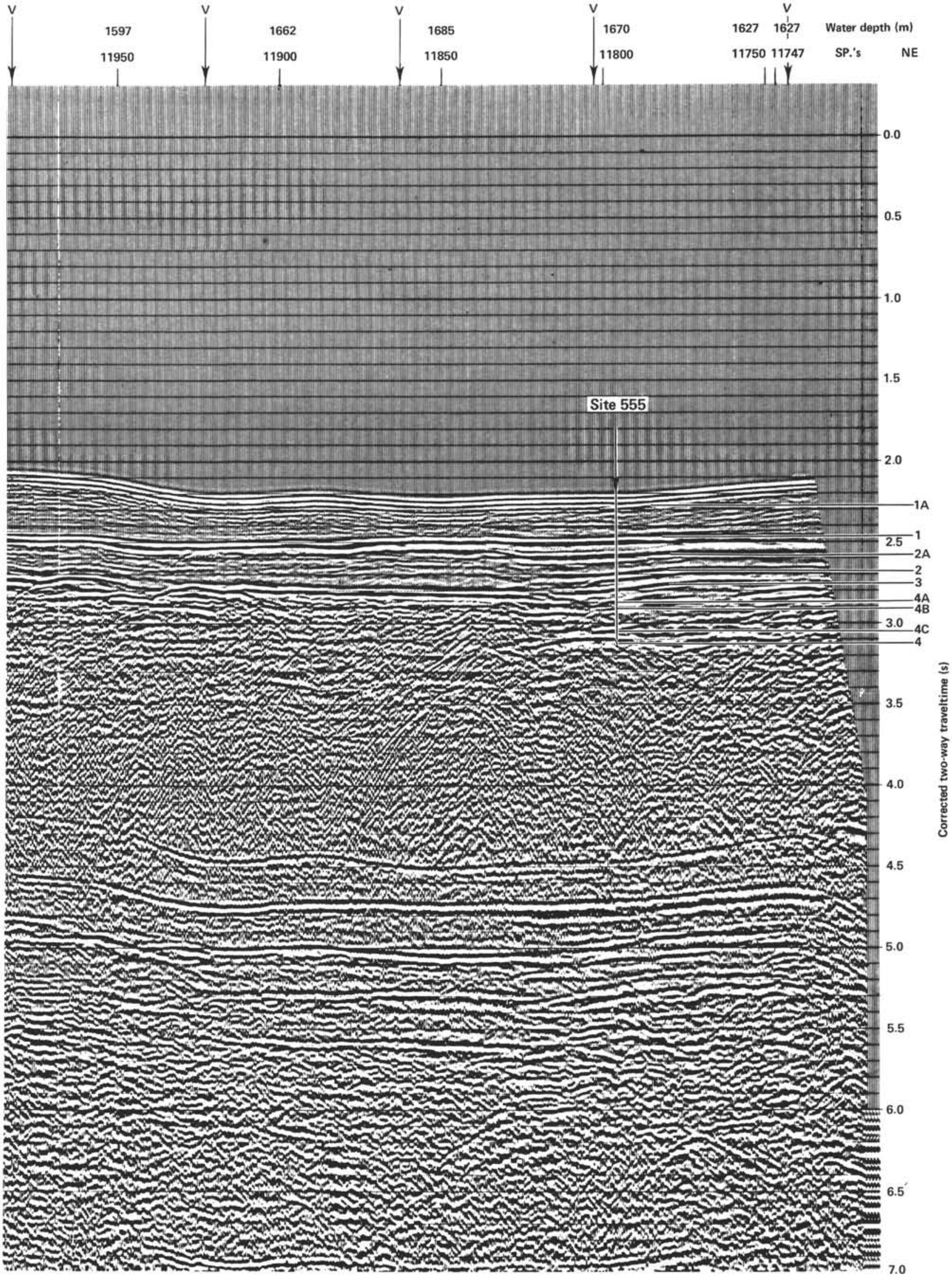


Figure 3. Multichannel seismic line IOS 76-9B through Site 555. (Right-hand figures represent provisional correlation of seismic reflectors with sonic gamma log.)

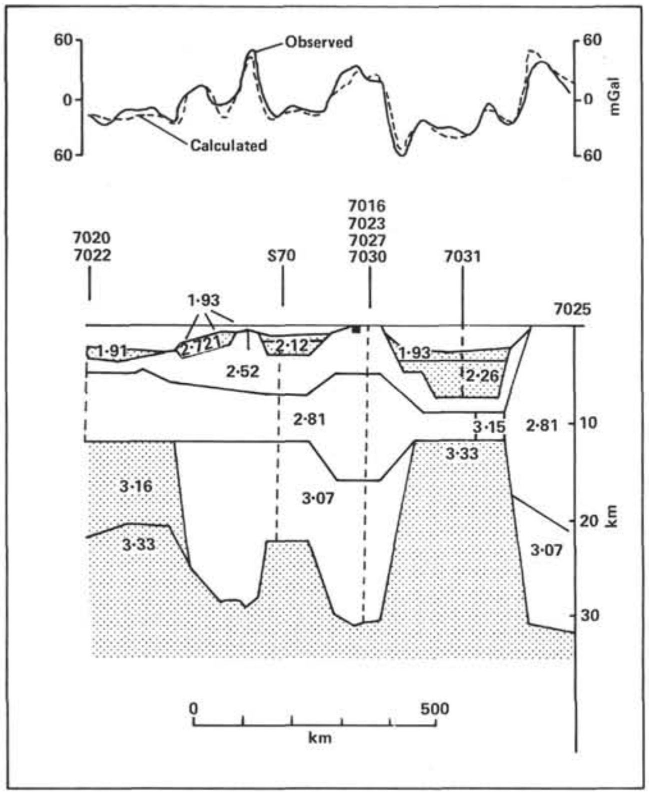


Figure 4. Studies of the Rockall Plateau modeled from gravity and available refraction data (redrawn from Scrutton, 1972).

be easily pulled out of the hole in the event of severe weather.

At 1350Z, the sonic–caliper–gamma combination was run in hole. However, a bridge was encountered at 2345.0 m and could not be penetrated despite several attempts to break through with the logging tool. Between 1415 and 1610Z, the hole was logged upward from 2345.0 m, preparatory to an attempt to remove the bridge using the core barrel. Meanwhile, the weather had been deteriorating rapidly, so that by 1610Z there was difficulty positioning in heavy swells and winds were gusting up to 40 knots. Operations were suspended at 1610Z, but every effort was made to keep *Glomar Challenger* on station and the pipe in hole throughout the night of 7 and 8 September. The poor weather conditions continued until 0930Z, 8 September. At 0930Z, an attempt was made to run pipe back in hole but no progress could be made, suggesting (1) that the pipe had side tracked during the storm or (2) that an obstruction was present or (3) that the pipe was bent. A core barrel was run in hole to check for bent pipe but found none, although a lot of debris was recovered in the barrel. In view of this, it was decided to run back carefully in the hole while rotating to remove the bridges. Between 1400 and 1920Z, the pipe was run in hole, encountering a bridge at 2345 m, but at 2363 m the pipe was still taking weight. By 2200Z, 8 September, with the aid of some rotation, the drill stem reached a point 3 m above (2630.0 m) total depth. One hundred barrels of gel were circulated, and the pipe was then pulled back to the first logging point of 2382.0 m. This point had been selected because it lay below the troublesome bridge previously encountered at 2355 m. After successfully running in the sonic combination to 2596 m, pipe was pulled back to the second logging point of 1928.0 m, and all the remaining part of the hole was logged with the sonic combination.

Between 0850 and 1515Z, the CNL-FDC gamma and IRL-Gamma combinations were successfully run to a lesser total depth of 2556 m as a result of infilling of the hole. In view of this success in logging through the bridge, a final attempt (between 1515–1800Z) was made to secure a good sonic log for the entire hole. This attempt was successful and completed the important logging program. A special vote of thanks is owed to the captain, drilling superintendent, and operations manager who kindly allowed a later departure for the Azores to complete the logging program. After setting down the logging tools, the pipe was pulled out of the hole, clearing the mudline at 1855 hr., 9 September, despite a temporary failure of the hydraulic lines and gusset on the pipe stabber. Wind and sea conditions deteriorated markedly during the evening. By 2300Z, the rig floor had been secured, and at 2300Z, 8 September, *Glomar Challenger* departed Site 555 for Ponta Delgada, Azores, in winds gusting to 60 mph. Arrival of *Glomar Challenger* in Ponta Delgada, 15 September, terminated Leg 81.

SEDIMENT LITHOLOGY

The lithologic sequence drilled at Site 555 has been divided into four units; I to III are composed of sediments and IV is a basalt unit interbedded with sediments. The lithologic divisions are summarized in Table 2 and Figure 7. The detailed composition of the sediments from smear slides is summarized in Appendix A and the gamma-sonic character of lithologic units is shown in Figure 8.

Unit I: Section 1-1 to Sample 3-4, 80 cm; 0 to 22.3 sub-bottom. Age: Quaternary.

Unit I is characterized by cyclic sedimentation. Alternating horizons of foraminiferal–nannofossil ooze, marls, and calcareous muds extend from the seafloor to a depth of 22.3 m. Although moderately to highly disturbed by drilling, the cyclical nature of these sediments is clearly distinguished on the basis of color, texture, and composition. Drilling disturbance precluded further attempts to define or correlate individual cycles or to examine burrowing, primary structures, or the nature of the contacts between cycles. The base of the unit, at the lowermost marl in Core 3, is marked by a hiatus between Pleistocene sediments and those of earliest Pliocene age.

The calcareous facies are pale in color, ranging from white to pale yellow, whereas the marls and muds are various shades of brown, olive, or dark gray. The calcareous sediments appear coarse in grain size as a result of their foraminiferal content which ranges to 60%; nannofossils and a small but persistent clay component (10%) constitute the remainder of the facies. Carbonate bomb values are consistently above 80%.

The mud facies is dominantly clay-sized with a coarse terrigenous component (30%) consisting predominantly

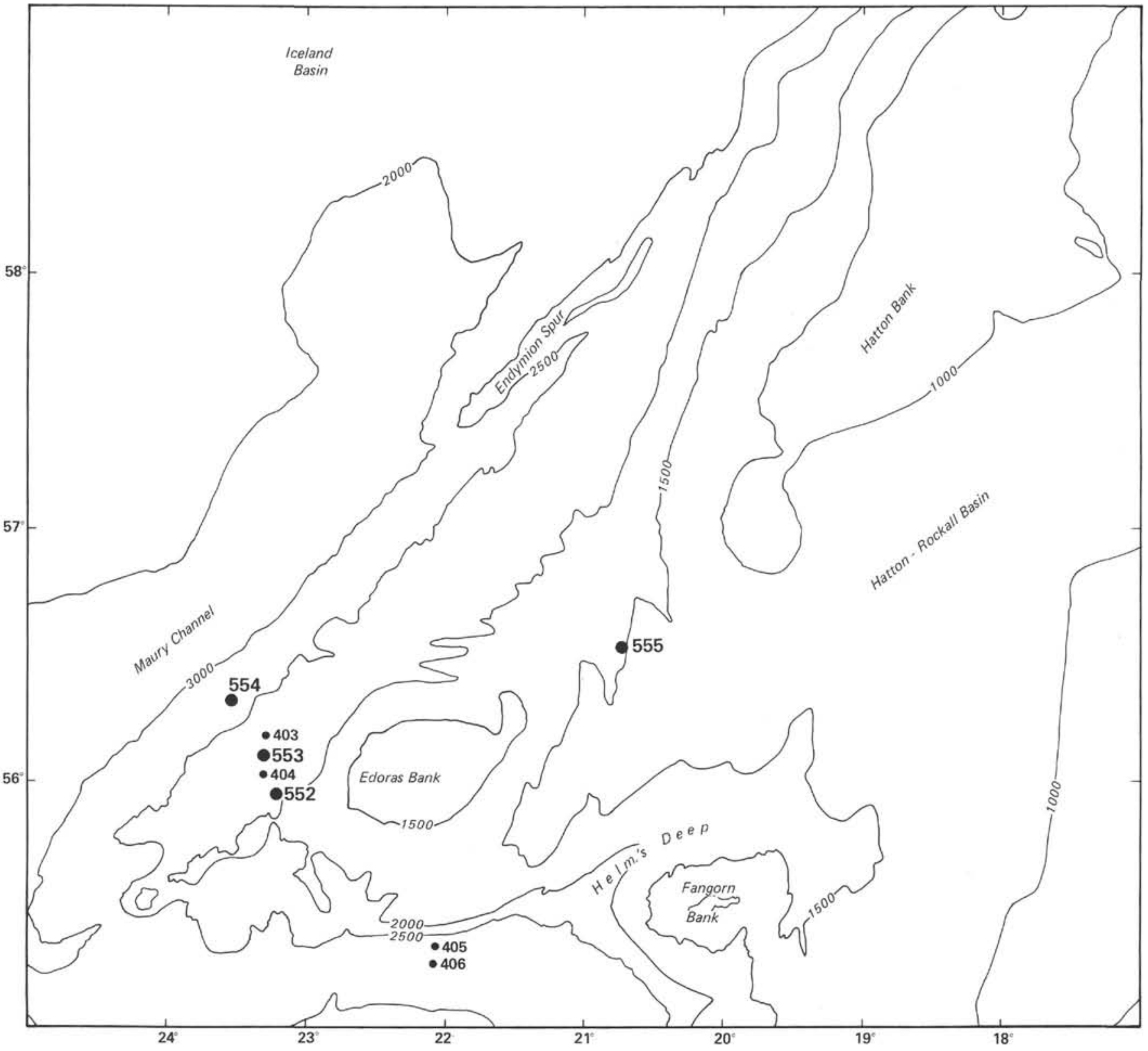


Figure 5. Bathymetry of Sites 552, 553, 554, and 555, Rockall Plateau.

of quartz grains. Feldspar and heavy mineral grains are also present in small amounts (5%), and the carbonate content is about 25%. The disturbed nature of the sediment cores makes it difficult to assign ice-rafted dropstones to any particular horizon. Minor components include sponge spicules, pyrite, glauconite, and echinoid spines. Black sand-sized slate grains are evident throughout this unit.

No lithification is evident in these sediments. The cyclical nature of the unit and the abundance of the terrigenous component distinguishes this sequence from the underlying sediment.

In agreement with several previous studies (e.g., Ericson and Wollin, 1968), the pelagic carbonate ooze of the North Atlantic represents an interglacial climatic stage, whereas the terrigenous marls and muds represent the episodic advances of large continental ice sheets. These stages are reflected in the wide fluctuation of the carbonate content. High carbonate input occurs during the warmer interglacial periods, with relatively high productivity in the overlying waters. The presence of a sea ice cover during the glacial periods effectively reduced surface productivity (Macintyre et al., 1976). Increased erosion of continental areas, the presence of icebergs, and exposure of continental shelves during glacial stages led to the increase in the terrestrial and ice-rafted component of this facies.

Unit II: Samples 3-4, 80 cm to 26,CC; 22.3 to 281.0 m sub-bottom. Age: early Pliocene to early Miocene.

These sediments are essentially pelagic in character. They lie between the cyclical Pleistocene sequence and the volcanogenic-terrigenous sediments beneath the Mi-

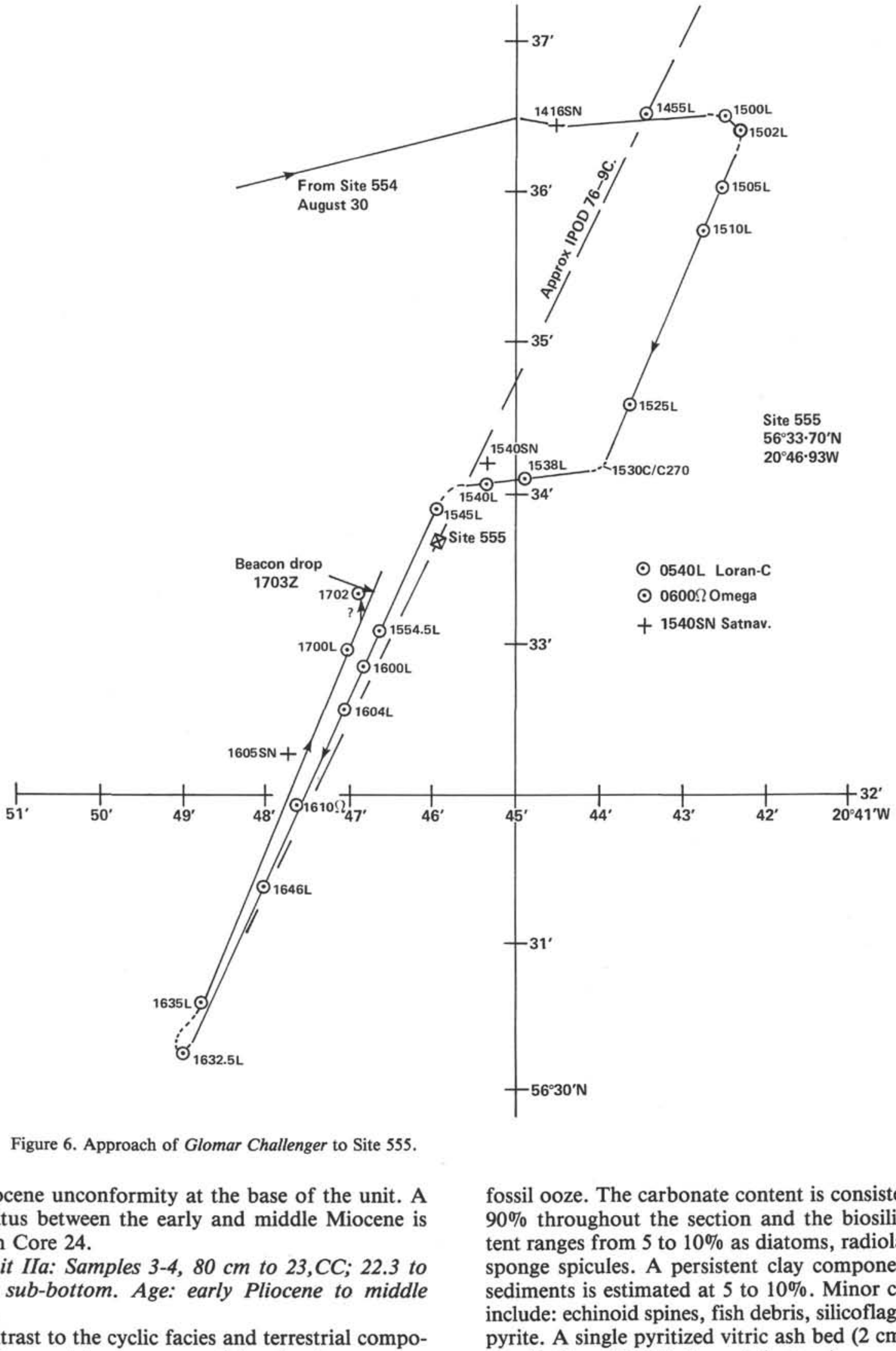


Figure 6. Approach of *Glomar Challenger* to Site 555.

ocene–Eocene unconformity at the base of the unit. A small hiatus between the early and middle Miocene is present in Core 24.

Subunit IIa: Samples 3-4, 80 cm to 23,CC; 22.3 to 252.5 m sub-bottom. Age: early Pliocene to middle Miocene.

In contrast to the cyclic facies and terrestrial component of the overlying sequence, this subunit comprises uniform pelagic biogenic sediments which are bluish white in color with little variation and consist of foraminiferal-nannofossil ooze or biosiliceous foraminifer–nannofossil ooze. The carbonate content is consistently above 90% throughout the section and the biosiliceous content ranges from 5 to 10% as diatoms, radiolarians, and sponge spicules. A persistent clay component in these sediments is estimated at 5 to 10%. Minor constituents include: echinoid spines, fish debris, silicoflagellates, and pyrite. A single pyritized vitric ash bed (2 cm thick) occurs in Core 15 (168.6 m sub-bottom).

Most of the sedimentary structures were destroyed by the drilling process. Where the structure was preserved, the sediments were faintly laminated in black, light gray,

Table 1. Coring summary, Site 555.

Core	Date (1981)	Time	Depth from drill floor (m) Top Bottom	Depth below seafloor (m) Top Bottom	Length cored (m)	Length recovered (m)	Percent recovered
1	Aug. 31	1355	1669.0–1674.5	0.0–5.5	5.5	5.5	100
2	Aug. 31	1435	1674.5–1684.0	5.5–15.0	9.5	7.18	75
3	Aug. 31	1523	1684.0–1693.5	15.0–24.5	9.5	9.70	102
4	Aug. 31	1626	1693.5–1703.0	24.5–34.0	9.5	9.30	97
5	Aug. 31	1721	1703.0–1712.5	34.0–43.5	9.5	8.71	92
6	Aug. 31	1815	1712.5–1722.0	43.4–53.0	9.5	9.31	98
7	Aug. 31	1917	1722.0–1731.5	53.0–62.5	9.5	9.35	98
8	Aug. 31	2120	1731.5–1741.0	62.5–72.0	9.5	9.52	100
9	Aug. 31	2313	1760.0–1769.5	91.0–100.5	9.5	3.24	34
10	Sept. 1	0125	1769.5–1779.0	100.5–110.0	9.5	9.66	107
11	Sept. 1	0327	1798.0–1807.5	129.0–138.5	9.5	4.41	46
12	Sept. 1	0437	1807.5–1817.0	138.5–148.0	9.5	2.78	29
13	Sept. 1	0648	1817.0–1826.5	148.0–157.5	9.5	0.47	04
14	Sept. 1	0745	1826.5–1836.0	157.5–167.0	9.5	0.84	08
15	Sept. 1	0839	1836.0–1845.5	167.0–176.5	9.5	1.79	19
16	Sept. 1	1000	1845.5–1855.0	176.5–186.0	9.5	9.65	101
17	Sept. 1	1055	1855.0–1864.5	186.0–195.5	9.5	4.93	52
18	Sept. 1	1321	1864.5–1874.0	195.5–205.0	9.5	2.67	28
19	Sept. 1	1457	1874.0–1883.5	205.0–214.5	9.5	3.86	41
20	Sept. 1	1557	1883.5–1893.0	214.5–224.0	9.5	3.86	41
21	Sept. 1	1739	1893.0–1902.5	224.0–233.5	9.5	1.91	20
22	Sept. 1	1830	1902.5–1912.0	233.5–243.0	9.5	3.20	34
23	Sept. 1	2040	1912.0–1921.5	243.0–252.5	9.5	0.15	02
24	Sept. 1	2128	1921.5–1931.0	252.5–262.0	9.5	9.55	101
25	Sept. 1	2225	1930.0–1940.5	262.0–271.5	9.5	9.44	99
26	Sept. 1	2333	1940.0–1950.0	271.5–281.0	9.5	9.53	100
27	Sept. 2	0100	1950.0–1959.5	281.0–290.5	9.5	3.10	33
28	Sept. 2	0200	1959.5–1969.0	290.5–300.0	9.5	0.98	103
29	Sept. 2	0253	1969.0–1978.5	300.0–309.5	9.5		
30	Sept. 2	0353	1979.5–1988.0	309.5–319.0	9.5	1.99	21
31	Sept. 2	0507	1988.0–1997.5	319.0–328.5	9.5	2.28	24
32	Sept. 2	0600	1997.5–2007.0	328.5–338.0	9.5	8.02	84
33	Sept. 2	0704	2007.0–2016.5	338.0–347.5	9.5	9.15	96
34	Sept. 2	0803	2016.5–2026.0	347.5–357.0	9.5	7.30	77
35	Sept. 2	0856	2026.0–2035.5	357.0–366.5	9.5	0.13	01
36	Sept. 2	1004	2035.5–2045.0	366.5–376.0	9.5	2.06	22
37	Sept. 2	1103	2045.0–2054.5	376.0–385.5	9.5	3.45	36
38	Sept. 2	1210	2054.5–2064.0	385.5–395.0	9.5	4.93	52
39	Sept. 2	1323	2064.0–2073.5	395.0–404.5	9.5	9.82	103
40	Sept. 2	1435	2073.5–2083.0	404.5–414.0	9.5	9.69	102
41	Sept. 2	1619	2083.0–2092.5	414.0–423.5	9.5	7.26	76
42	Sept. 2	1759	2092.5–2102.0	423.5–433.0	9.5	5.37	57
43	Sept. 2	1925	2102.0–2111.5	433.0–442.5	9.5	7.43	78
44	Sept. 2	2032	2111.5–2121.0	442.5–452.0	9.5	4.63	49
45	Sept. 2	2142	2121.0–2130.5	452.0–461.5	9.5	4.38	46
46	Sept. 2	2250	2130.5–2140.0	461.5–471.0	9.5	8.20	86
47	Sept. 3	0005	2140.0–2149.5	471.0–480.5	9.5	6.20	65
48	Sept. 3	0106	2149.5–2159.0	480.5–490.0	9.5	5.76	61
49	Sept. 3	0210	2159.0–2168.5	490.0–499.5	9.5	5.43	57
50	Sept. 3	0300	2168.5–2178.0	499.5–509.0	9.5	0.18	02
51	Sept. 3	0405	2178.0–2182.5	509.0–518.5	9.5	0.49	05
52	Sept. 3	0535	2187.5–2197.0	518.5–528.0	9.5	4.22	44
53	Sept. 3	0655	2197.0–2206.5	528.0–537.5	9.5	8.38	88
54	Sept. 3	0803	2206.5–2216.0	537.5–547.0	9.5	9.22	97
55	Sept. 3	0931	2216.0–2225.5	547.0–556.5	9.5	3.55	37
56	Sept. 3	1043	2225.5–2535.0	556.5–566.0	9.5	9.50	100
57	Sept. 3	1210	2235.0–2244.5	566.0–575.5	9.5	1.22	13
58	Sept. 3	1345	2244.5–2254.0	575.5–585.0	9.5	8.02	84
59	Sept. 3	1505	2254.0–2263.5	585.0–594.5	9.5	9.05	95
60	Sept. 3	1612	2263.5–2273.0	594.5–604.0	9.5	9.92	104
61	Sept. 3	1720	2273.0–2281.5	604.0–613.5	9.5	8.48	89
62	Sept. 3	1840	2281.5–2292.0	613.5–623.0	9.5	7.16	75
63	Sept. 3	1950	2292.0–2301.5	623.0–632.5	9.5	1.50	16
64	Sept. 3	2153	2301.5–2311.0	632.5–642.0	9.5	6.56	69
65	Sept. 3	2300	2311.0–2320.5	642.0–651.5	9.5	3.40	36
66	Sept. 4	0022	2320.5–2330.0	651.5–661.0	9.5	0.80	8
67	Sept. 4	0155	2330.0–2339.5	661.0–670.5	9.5	5.86	62
68	Sept. 4	0515	2339.5–2349.0	670.5–680.0	9.5	4.24	45
69	Sept. 4	0815	2349.0–2358.5	680.0–689.5	9.5	7.72	81
70	Sept. 4	1102	2358.5–2368.0	689.5–699.0	9.5	2.31	24
71	Sept. 4	1255	2368.0–2377.5	699.0–708.5	9.5	1.50	16
72	Sept. 4	1442	2377.5–2387.0	708.5–718.0	9.5	4.15	44
73	Sept. 4	1715	2387.0–2396.5	718.0–727.5	9.5	6.84	72
74	Sept. 4	2125	2396.5–2406.0	727.5–737.0	9.5	3.78	40
75	Sept. 5	0025	2406.0–2415.5	737.0–746.5	9.5	2.20	23
76	Sept. 5	0310	2415.5–2425.0	746.5–756.0	9.5	6.35	67
77	Sept. 5	0540	2425.0–2434.5	756.0–765.5	9.5	7.88	83
78	Sept. 5	0803	2434.5–2444.0	765.5–775.0	9.5	5.02	53
79	Sept. 5	1012	2444.0–2453.5	775.0–784.5	9.5	5.90	62
80	Sept. 5	1225	2453.5–2463.0	784.5–794.0	9.5	4.56	48
81	Sept. 5	1520	2463.0–2472.5	794.0–803.5	9.5	3.98	42
82	Sept. 5	1805	2472.5–2482.0	803.5–813.0	9.5	3.15	33
					92.6	505.25	54.5

yellowish gray, and pale blue green colors. Vague yellowish gray mottles were also often present. These color variations were apparently unrelated to any obvious compositional or textural change. Bioturbation occurred occasionally, but was rarely intense enough to destroy the lamination. Burrows were light gray in color and related to the presence of pyrite, as were the black laminae.

Apart from the pyrite development, the only other diagenetic effect was the transformation of ooze to chalk as the depth of burial increases. The first chalky interbed appeared in Core 9 at about 95 m sub-bottom; interbeds increase in frequency with depth in the section.

The base of the subunit was marked by the appearance of glauconite. The lower boundary of this subunit was placed at the base of the cored interval for Core 23, for which only a core-catcher sample was retrieved.

Subunit IIb: Section 24-1 to Sample 26,CC; 252.5 to 281.0 m sub-bottom. Age: early to middle Miocene.

Based on the change in recovery (Fig. 7), the upper boundary is marked by a distinct change in physical properties. Although pelagic chalks were more common in this subunit, ooze was the predominant lithology; it graded from a bluish white foraminiferal ooze at the top to a pale green glauconitic foraminifer ooze at the base. The glauconite was present as distinct fine sand to silt-sized grains within the ooze matrix.

Basically consisting of biogenic pelagic sediments, the subunit is distinguished from the overlying sediment by the sudden increase in foraminifer content (from 15 to 35%) and in the common occurrence of glauconite. Glauconite content exhibits a gradual increase from 1 to 2% at the top to about 10% at the base and is probably of the same origin as that found at Sites 552 and 553.

This subunit was lithologically identical to Subunit IIb at Sites 552 and 553 but its age is quite different (21 m.y. cf. 12 m.y.), and it was deposited in depths of about 1500 m (cf. 2500 m). Strong independence of depth in the formation of glauconite is thus shown.

The lower boundary of this subunit corresponds to a major unconformity spanning some 30 m.y. from early Miocene to the early Eocene.

Unit III: Section 27-1 to Sample 68-2, 30 cm; 281 to 672.3 m sub-bottom. Age: early Eocene.

This unit consists of a number of widely varying lithologies which lie between the pelagic oozes of Unit II and the basalts and hyaloclastites of Unit IV, and is equivalent to Subunits IVb–f of Site 553. It has been divided into five subunits on a lithological basis.

The upper boundary is placed at the early Miocene/early Eocene unconformity which is situated in the mixed zeolitic clays and chalks at the top of Core 27 (0–15 cm). The unit's upper boundary is also marked by the reappearance of a terrestrial component. The lower boundary is defined by the downhole appearance of basalts and hyaloclastites.

Subunit IIIa: Section 27-1 to Sample 30,CC; 281.0 to 320.0 m sub-bottom. Age: early Eocene.

This subunit was composed of a number of lithologies and is considered to be a transitional phase between more consistent lithologic sequences above and below. In their order of appearance in Cores 27 and 28, the major lithologies were:

1. Vitric tuff: A dusky green to grayish black to black partially indurated volcanic glass with minor pyrite and sponge spicules.

Table 2. Lithologic summary, Site 555.

Unit	Lithology	Sub-bottom depth (m)	Thickness (m)	Sedimentation rate (m/m.y.)	Age	Core
I	Cylic alternations of muds, calcareous muds, and nanno-foram ooze	0–22.30	22.30	13	Quaternary	1-1 to 3-4, 80 cm
IIa	Nanno ooze, foram-nanno ooze, biosiliceous nanno-foram ooze	22.30–252.50	230.20	16	early Pliocene to mid-Miocene	3-4, 80 cm to 23,CC
IIb	Glauconitic foram chalks and oozes	252.50–281.00	28.50	18	middle to early Miocene	24-1 to 26,CC
IIIa	Lithologically variable, including zeolitic chalk, vitric spiculite, volcanic tuff, macrofossil limestone	281.00–320.00	39.00	52	early Eocene	27-1 to 30,CC
IIIb	Tuffaceous glauconitic sandstone	320.00–352.20	32.20	52-265	early Eocene	31-1 to 34-4, 20 cm
IIIc	Tuffs and lapilli tuffs interbedded with feldspathic sandstone and carbonaceous mudstone	352.20–482.50	130.30	265	early Eocene	34-4, 20 cm to 48-1, 50 cm
IIId	Micaceous carbonaceous mudstone and feldspathic sandstone, often with carbonate cement	482.50–632.50	150.00	265	early Eocene	48-1, 50 cm to 63
IIIe	Volcanic tuff and lapilli interbedded with mudstone and sandstone	632.50–672.30	48.80	265	early Eocene	64-1 to 68-2, 30 cm
IVa	Hyaloclastite, basalt, and pillow basalt, with thin sandstone interbeds	672.30–822.50	150.20		late Paleocene(?)	68-2, 30 m to 83
IVb	Micaceous sandstone and mudstone, volcanic tuff and lapilli interbeds, and thin basalt flows	822.50–927.32	104.82	95	late Paleocene	84-1 to 95-1, 32 cm
IVc	Basalt and dolerite	927.32–964.00	37+		late Paleocene	95-1, 32 cm to 98

2. Vitric spiculite: Occurs as a loose sand of olive to yellowish green in color with black grains of volcanic glass visible. The sediment contained abundant quantities of sponge spicules and altered glass (palagonite and glauconite).

3. Glauconite zeolitic chalk: A partially indurated, dusky yellow green sediment consisting primarily of carbonate grains with common clinoptilolite, glauconite, clay, and sponge spicules. At the base of Core 27 and in Core 28 this chalk was interbedded with a light olive brown clay; small scale flaser bedding was present.

4. Macrofossil limestone: Occurring as a number of loose cobbles at the base and in the core catcher of Core 28. Yellow and dusky yellow green in color, these rocks consist of firmly cemented (possibly silicified) carbonate shell hash. Thick-shelled bivalves (oysters) were present, suggesting high-energy conditions and close proximity to shore.

The volcanic glass present in this subunit was frequently unaltered and is of basaltic composition throughout.

The top of the subunit is the Miocene–Eocene transition as discussed above: The base is marked by the downhole appearance of highly glauconitic tuffaceous sandstones.

Subunit IIIb: Section 31-1 to Sample 34-4, 20 cm; 320.0 to 352.2 m sub-bottom. Age: early Eocene.

This subunit was characterized by high proportions of glauconite, with the upper and lower boundaries essentially defined on glauconite content. The lower boundary was also the horizon below which volcanic tuffs reappeared and was marked by the downhole appearance of the epidote–amphibole heavy mineral association.

The sediments were slightly tuffaceous glauconitic sandstones and siltstones, with glauconite contents up to about 50%. Zeolitic content reached 30%, and calcareous nannofossils made up as much as 20% of the sediment. The clay minerals consisted entirely of well-crystallized smectite. There was always a small terrigenous component of quartz, feldspar, mica, and heavy minerals reaching some 25%. The heavy minerals were of the garnet–pyroxene–amphibole–apatite association, indicating derivation from the metamorphic basement of the southern Rockall Plateau.

The sediments were frequently burrowed and laminated throughout, with the laminae occasionally showing flaser bedding. Serpulid worm tubes and fragments of other carbonate shells were scattered through the subunit.

The abundance of glauconite, the disappearance of the epidote–amphibole association, and the early Eocene (NP10) age indicate that the subunit is equivalent to the lower part of Subunit IVb in Hole 553A and is considered to represent the same major transgressive event.

Subunit IIIc: Samples 34-4, 20 cm to 48-1, 50 cm; 352.2 to 482.5 m sub-bottom. Age: early Eocene.

This subunit was characterized by the presence of volcanic tuffs and lapilli tuffs interbedded with carbonaceous sandstones, siltstones, and mudstones which first appear at the top of the unit. The lower unit was marked by the disappearance of tuff. The volcanic glass was altered to smectite in most cases but some fresh glass was preserved, particularly where early calcite concentration has occurred. Volcanic glass was largely of basaltic composition (tholeiitic and alkali) but intermediate types also occurred, indicating a correlation with Unit IVc of Site 553. Although tuffs were frequent, they were less common than at 553, probably as a result of lack of preservation in the higher-energy environment.

The interbedded detrital sediments were highly carbonaceous (10–15% plant debris noted in smear slides), with variable amounts of sand, silt, and clay. The clay mineral assemblage consisted predominantly of smectite, with less than 10% of illite and kaolinite. The sandstones were highly feldspathic (quartz:feldspar being 50:50 in several cases), with both the epidote–amphibole association (South Greenland derivation) and the garnet–amphibole–apatite association (Rockall Plateau deri-

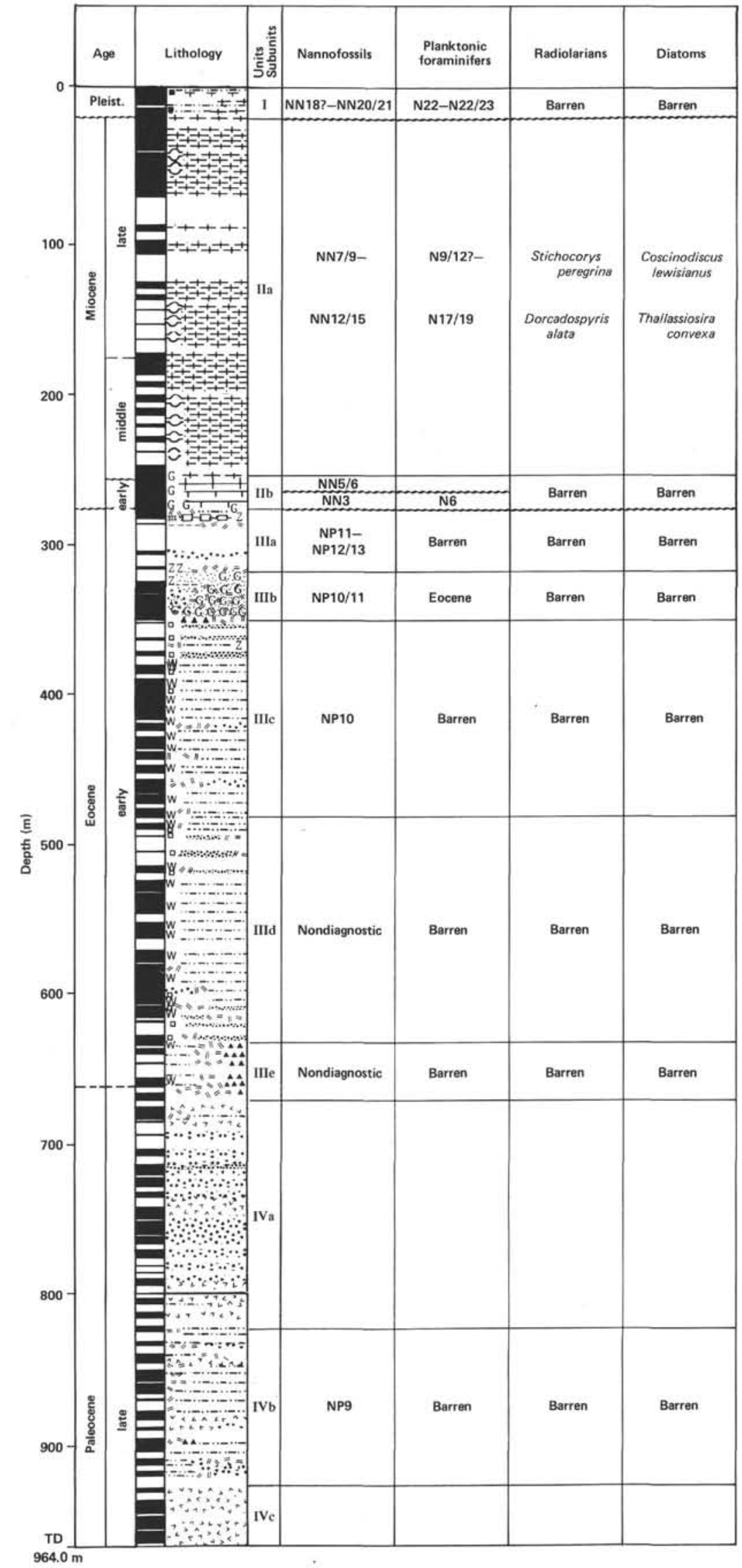


Figure 7. Lithologic and biostratigraphic summary, Site 555.

vation) being represented. Small amounts of foraminifers and nannofossils occurred throughout.

The mudstone frequently showed well-developed but indistinct laminae. They were occasionally in flaser form and less commonly convoluted. Burrows were not abundant, but when present were usually distinct and often pyritized. Various types of shell debris were scattered throughout and include serpulids, gastropod shells, thin shelled bivalves, a single crab pincer, and in one section a hermatypic coral. The depositional environment of this facies was probably a shallow basin with moderate current activity (tidal) and low oxygen content within the sediment because of the concentration of organic material.

Carbonate cementation occurred both in the sandstones and the tuffs. Other diagenetic phases particularly within the tuffs were smectite and zeolites (clinoptilolite, phillipsite).

Subunit IIId: Sample 48-1, 50 cm to Core 63; 482.5-632.5 m sub-bottom. Age: early Eocene.

Subunit IIId was lithologically similar to the adjacent subunits, except that tuffs are virtually absent. As with Subunit IIIc the dominant lithologies are highly feldspathic sandstones and carbonaceous mudstones, and contain a similar fauna (serpulids, gastropods, thin-shelled bivalves, hermatypic corals, etc.; Fig. 9). Heavy minerals were dominated by the garnet–amphibole–apatite association. Chlorite first appeared in the clay fraction. Siderite and hematite were present at the upper boundary of the subunit as well as in the interval of 530 to 550 m sub-bottom. The lower part of the subunit was also distinguished by the presence of cristobalite. A single graded lapilli tuff occurred near the base of the subunit (Fig. 10).

Carbonate cementation frequently occurred in the sandstones, generally in zones with poor recovery, suggesting that other, less-well indurated sands might have been washed out by the drilling process.

Subunit IIIe: Section 64-1 to Sample 68-2, 30 cm; 632.5 to 672.3 m sub-bottom. Age: early Eocene.

This subunit was characterized primarily by volcanic tuff and lapilli tuffs. The upper boundary was placed within Core 64, where vitric tuffs and lapilli tuffs of basaltic composition first appear.

The vitric tuffs were dark gray to olive black in color and contain variably altered basaltic glass, frequently cemented with zeolite (mainly analcite). Small amounts of plant debris, clay, and terrigenous quartz, feldspar, mica, and heavy minerals were present. Graded lapilli tuff beds were interspersed throughout, the black and gray lapilli imparting a distinctive "salt and pepper" appearance to the facies. A single case of reverse grading was noted in the lapilli tuff bed from Core 67, Section 1 (Fig. 11).

Interbedded with this unit were calcite-cemented feldspathic sandstones, light gray in color. These beds were as thick as 30 cm and especially numerous in Core 64. Occasionally, brownish black carbonaceous mudstones, characteristic of the overlying subunits, were also present.

Although burrows are common, the subunit retained a subhorizontal fine lamination throughout, especially in the finer sediments. The laminae were occasionally convoluted and infrequently imbricated. Core 67 contained a number of small slump features or faults associated with pyrite mineralization. Infrequently this subunit contained an intermeshing series of calcite vein fillings.

The presence of slumps, regular and convoluted laminations in the finer-grained sediments, and the thick sequence of volcanic tuff suggests that sedimentation took place in a rapidly subsiding basin where water depth was controlled by the relative rates of deposition and subsidence. Currents (tidal?) were moderate, and, where lamination is preserved, a low oxygen content within the sediment is indicated.

The contact with the underlying pillow basalts (Subunit IVa) is sharp and clearly defined.

Unit IV: Sample 68-2, 30 cm to Core 98; 672.3 to 964.0 m sub-bottom. Age: early Eocene to late Paleocene.

Unit IV was distinguished from the overlying unit by the presence of basalt flows and hyaloclastites in addition to volcanic tuff and lapilli tuff beds, and continues to total depth. It was subdivided into three subunits on the presence or absence of interbedded sediment and hyaloclastite content.

Subunit IVa: Samples 68-2, 30 cm to Core 83; 672.3 to 822.5 m sub-bottom. Age: early Eocene to late Paleocene.

Subunit IVa largely consisted of hyaloclastites and pillow lavas with minor basalt flow units and rare thin sediment interbeds. The top of the subunit was defined by the downhole appearance of basalt and the base by the reappearance of relatively thick detrital sediment interbeds.

Seven basalt units occur within Subunit IVa as follows:

68-2, 23 cm to 69-4, 122 cm	Single flow unit
70-1, 0 cm to 70-2, 32 cm	Composite pillow lava unit
75-1, 130 cm to 76-1, 140 cm	Single flow unit
76-1, 140 cm to 76-5, 56 cm	Composite pillow lava unit
81-2, 42 cm to 82-1, 97 cm	Composite pillow lava unit
82-1, 107 cm to 82-2, 54 cm	Single pillow lava
82-1, 92 cm to 83-3, 26 cm	Composite pillow lava unit

As shown above, several of the basalt units were single or multiple thin pillow basalt flows, rarely greater than 1 m in thickness, which displayed thin (c. 5 mm) rinds of palagonitized glass at their upper and lower surfaces. These surfaces were often curved and oriented at any angle between the horizontal and vertical in the cores; such curved glassy surfaces are characteristic of pillow lavas.

Within each pillow, major textural variations occurred: Below the glassy rind, a zone of very fine to fine-grained basalt was present showing some textural and compositional inhomogeneity resulting from the presence of resorbed fine-grained basalt reincorporated into the pillow flow. This zone was typically vesicular, with large elongate or irregular vesicles, often with their long axes perpendicular to the pillow surfaces: Vesicles in this zone were often calcite lined and smectite or chlorite

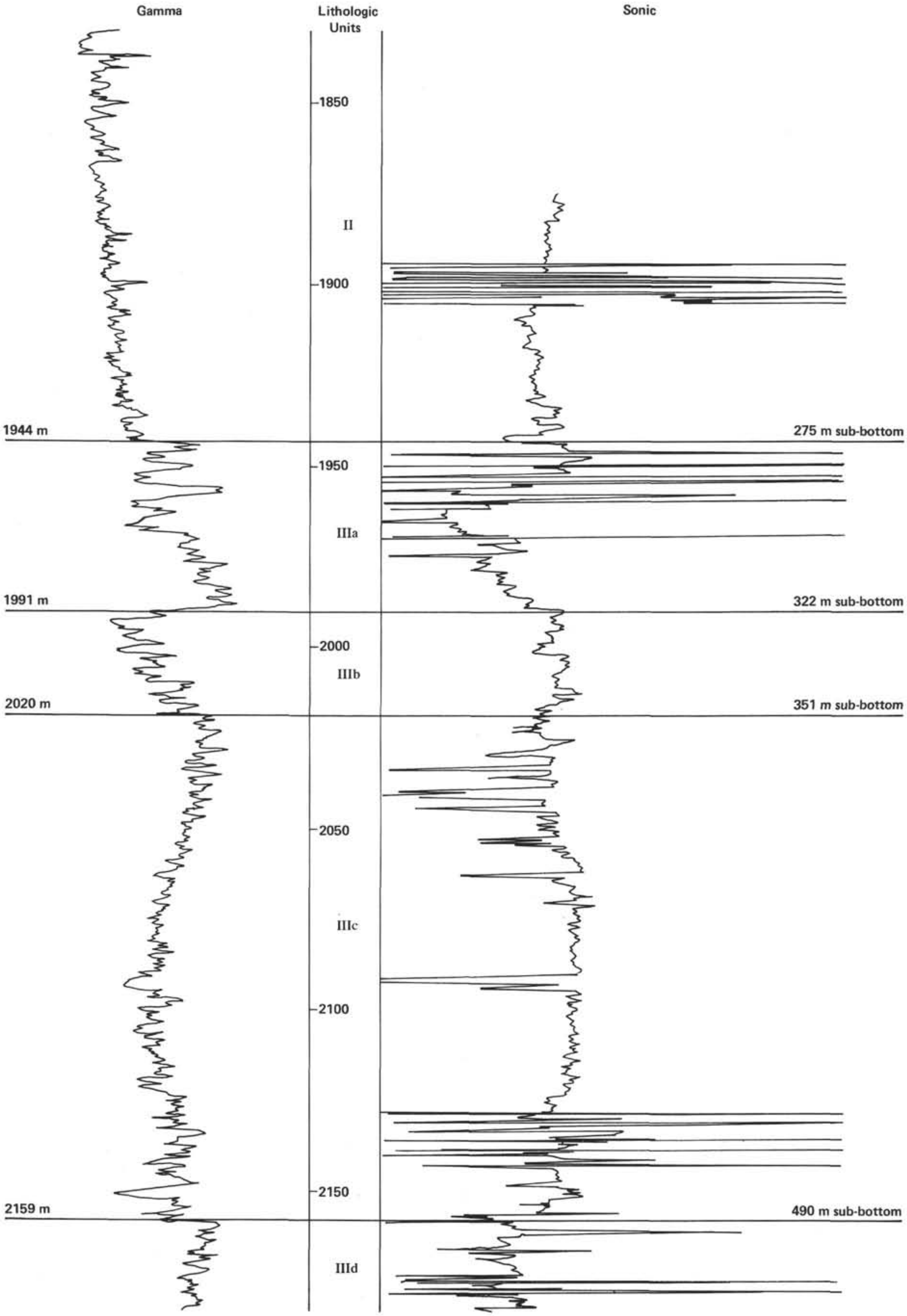


Figure 8. Gamma-sonic log response of principal lithologic units, Site 555.

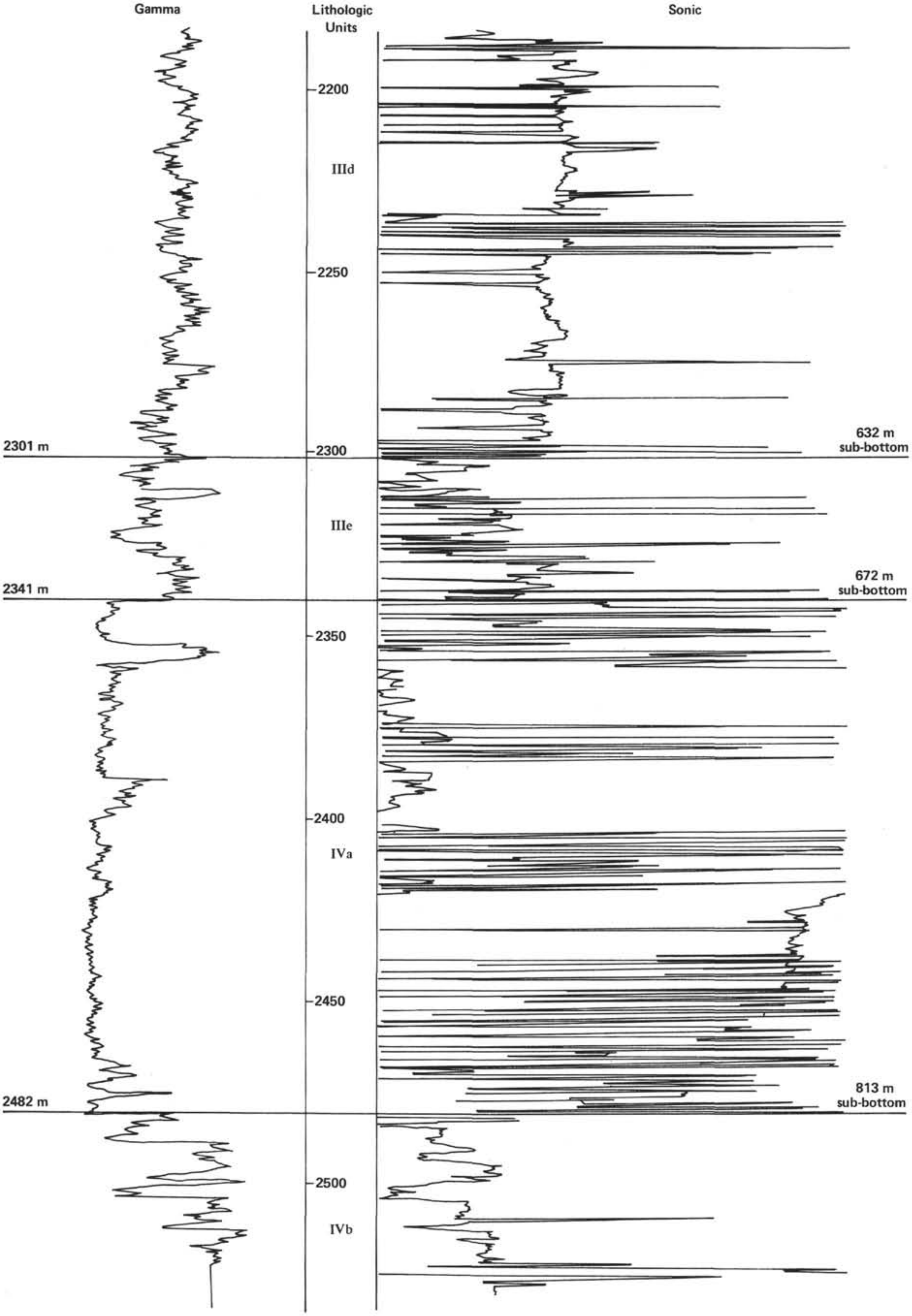


Figure 8. (Continued).

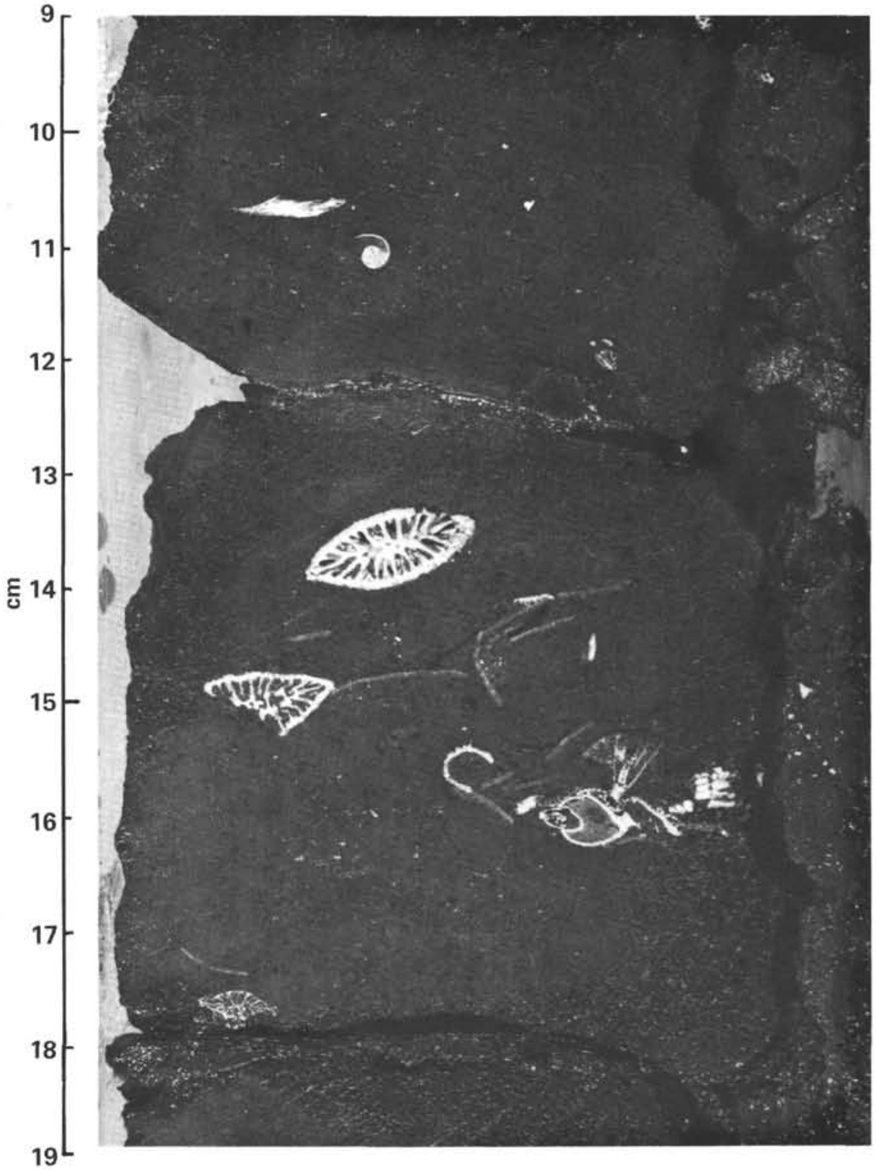


Figure 9. Caryophylliid coral and other macrofauna in carbonaceous mudstone (Sample 555-59-4, 9–19 cm).

filled. The central part of the pillow was coarser grained with minor, small, smectite and chlorite filled vesicles; below this, the basalt passed back through a fine-grained vesicular zone to glass at the base. The pillows were commonly fractured, with fractures filled with calcite and/or smectite. Incipient brecciation of the pillow flows was observed at several pillow margins, with angular fine-grained basalt fragments occurring within glassy margins.

The basalts were tholeiitic in composition, made up essentially of plagioclase, both as phenocrysts (ranging from An_{52} to An_{76}) and in the groundmass (ranging from An_{48} to An_{52}), and clinopyroxene (ranging from endiopside, $Mg_{49}Fe_{10}Ca_{41}$, to augite, $Mg_{46}Fe_{15}Ca_{39}$), with minor titaniferous magnetite and rare pseudomorphs after olivine (Harrison and Merriman, this volume). They showed variable alteration, with the development of smectite, chlorite, celadonite, and calcite.

Hyaloclastites formed an important part of the interval under discussion. They consisted of angular to subrounded clasts of vesicular or nonvesicular basalt and basaltic glass set in a white groundmass mainly composed of analcite and saponite with minor calcite. Thin sections showed that minor amounts of terrigenous sand have also been incorporated into the hyaloclastites. Generally they were very poorly sorted, with clasts of diameters ranging from less than 1 cm to greater than 20 cm occurring in close association. However, toward the tops and bases of hyaloclastite units some better sorted zones associated with planar bedding were present, indicating some reworking.

Subunit IVb: Section 84-1 to Sample 95-1, 32 cm; 822.5 to 927.32 m sub-bottom. Age: late Paleocene.

This subunit consisted primarily of tuffs and lapilli tuffs interbedded with terrigenous sediments, consisting of micaceous and feldspathic sand-, silt-, and mudstones.

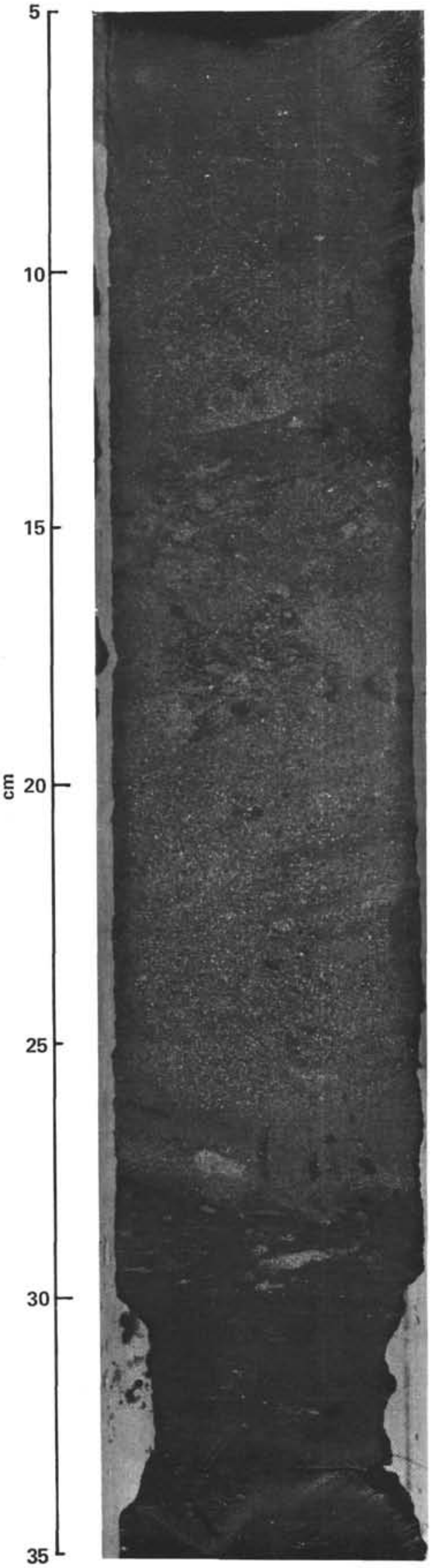


Figure 10. Graded lapilli tuff (Sample 555-62-2, 5–35 cm).

Sediments of mixed origin, such as sandy vitric tuffs, were also commonly present. Three thin basalt flows were also present.

The pyroclastics were similar to those in Subunit IIIe. Beds were often graded from lapilli tuff at the base to finer-grained vitric tuffs above. The beds were varying shades of medium gray and had a "salt and pepper" appearance where lapilli are concentrated. Varying degrees of alteration were noted in the volcanic glass, which was of basaltic type.

The terrigenous facies exhibited a wide variation in grain size and was poorly sorted. Quartz sand and silt constituted about 20 to 40% of the sediment, with feldspar and mica each at about 10%. The remainder consisted of minor amounts of pyrite, carbonate grains, and plant debris, which together constituted about 10% of the sediment and varying amounts of clay. In contrast to the sediments above, the clay mineral assemblage reflects a large continental contribution, with the presence of illite (20–40%) and lesser amounts of chlorite and kaolinite. Smectite, however, still constituted over 50% of the clay content.

The sediments of the upper portion of this subunit exhibited fine lamination (generally at 5° from the horizontal) and flaser bedding; burrows were infrequent. In Core 86 there was an excellent example of channeling (Fig. 12), with laminated siltstone being crosscut by a channel fill of vitric tuff and lapilli. Core 87 contained a lapilli sand dyke structure which crosscuts fine-grained tuffaceous silts (Fig. 13). The occurrence of scours, cross lamination, and soft sediment deformation structure suggests a high-energy depositional environment with high rates of sediment accumulation.

The sediment of the lower portion of this subunit showed finer and indistinct lamination, occasional wood fragments, scattered serpulids(?), and infrequent shell debris. Burrows were sparse. The frequency of volcanic events increased with depth in this sequence. These features suggest a somewhat deeper water setting for the depositional environment under lower energy conditions than the sections above. High rates of sediment accumulation primarily reflect the influx of volcanogenic material.

Three thin basalt units occur within the subunit:

86-1, 122 cm to 86-1, 136 cm	Single flow unit (or intrusion)
90-2, 50 cm to 90-4, 80 cm	Single flow unit
93-2, 123 cm to 93-3, 4 cm	Single pillow lava

These basalts were petrographically and texturally similar to those in the overlying subunit, except that the basalt in Core 86 lacked glassy chilled margins and might be an intrusion rather than a flow. Core 94 contained a layer of altered basalt clasts (Fig. 14).

Subunit IVc: Sample 95-1, 32 cm to Core 98; 927.32 to 964.0 m sub-bottom. Age: late Paleocene.

Subunit IVc consisted of a single massive unit, with a thin chilled top (15 cm thick) passing down through a medium-grained zone into a coarse-grained dolerite in the central portion. Total depth was reached before the base of the unit.

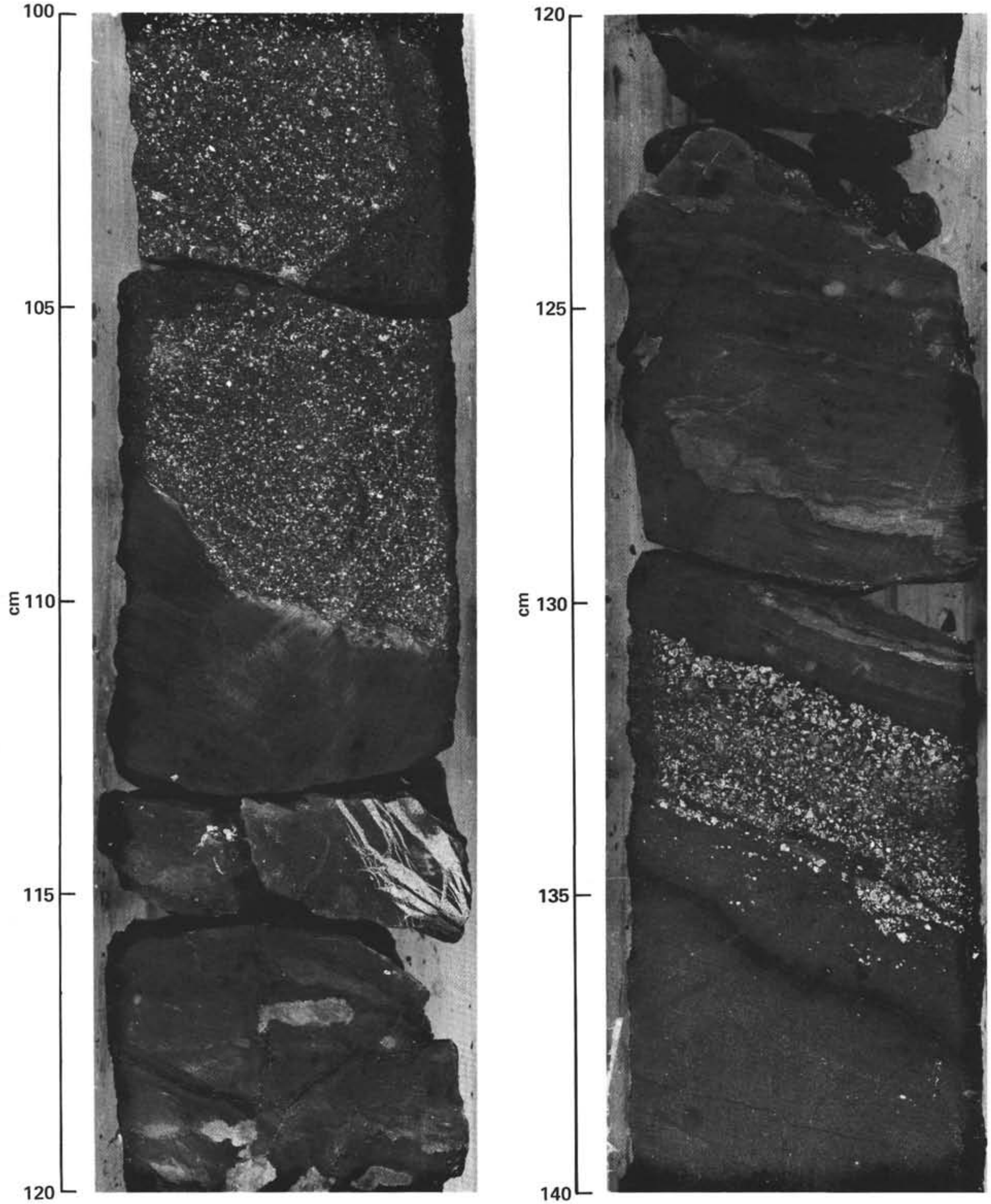


Figure 11. Typical sedimentary structures of Subunit IIIe (Sample 555-67-1, 100–120 cm). Reversely graded lapilli tuff (130–134 cm); convoluted lamina (126–128 cm); imbricated structure (124 and 125 cm); small slumps or faults, associated with pyrite mineralization (126–120 cm).

Very little textural variation occurred in the main body of the flow, although there were some minor inhomogeneities in grain size and composition resulting from the presence of small resorbed pre-existing basalt xenoliths. Vesicles throughout the flow were rare and generally less than 1 mm in diameter, and were filled with black smectite and chlorite.

This thick flow unit was extremely fractured, particularly in the coarse-grained massive central zone. Fracturing was generally near horizontal (up to 20°), but

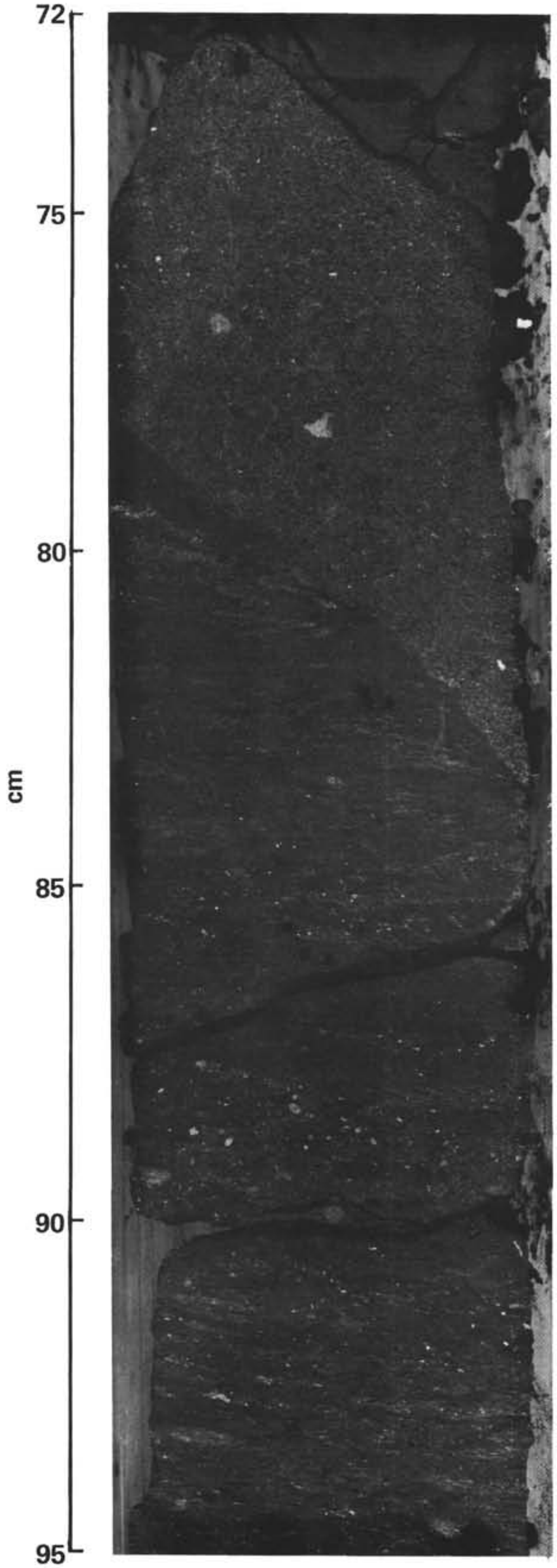


Figure 12. Channel cut in mudstone infilled by lapilli tuff (Sample 555-86-3, 72–95 cm).

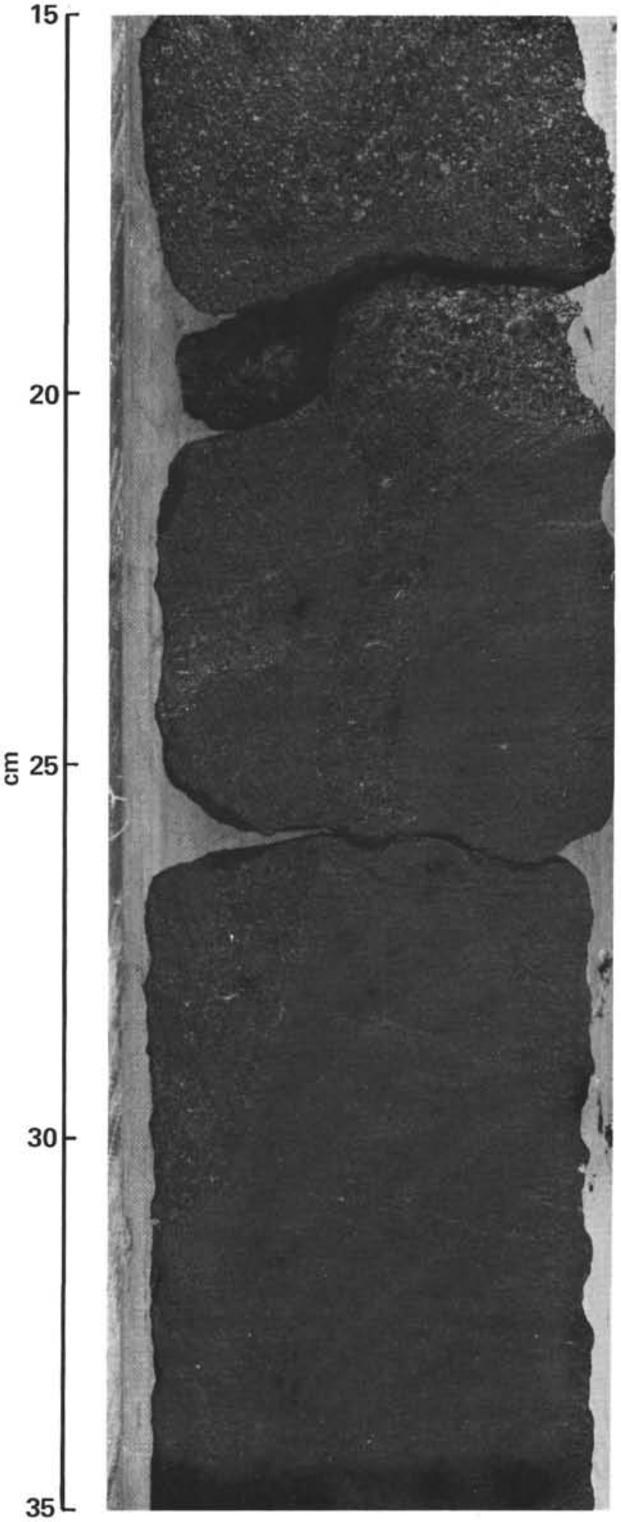


Figure 13. Lapilli dyke (Sample 555-87-5, 15–35 cm).

high-angle cross-cutting fractures were also frequent and commonly oriented at about 60° to the horizontal. Fractures were usually wholly filled with black smectite: in some cases calcite and analcite occurred as later phases.

Petrographically the dolerites differed from the overlying basalts in that they contained fresh and altered oli-

Figure 14. Altered basalt clasts base of Subunit IVb (Sample 555-94-1, 100–115 cm).

vine (Harrison and Merriman, this volume). They consisted of equigranular intergrowths of bytownite (An_{74}) and augite (ranging from $Mg_{44-46}Fe_{14-28}$) with accessory forsterite (Fo_{76-82}), titaniferous magnetite, and ilmenite. Some alteration to smectite and chlorite has occurred. Although those dolerites differed both texturally and petrographically from the overlying basalts, they have similar whole rock chemistries and were of tholeiitic type throughout.

BIOSTRATIGRAPHY

Neogene

Site 555 is the shallowest site drilled during Leg 81, and was located in a small basin which separates the highs of the Hatton and the Edoras banks. Neogene sediments are represented in Cores 1 through 26. The Neogene sedimentation rates are based on 21 biostratigraphic events and/or zonal assignments. Individual microfossil groups provided a low biostratigraphic resolution, but collectively the data from all groups gave a coherent biostratigraphic framework with a fairly high resolution (Fig. 7).

The only foraminiferal criterion used in the Pleistocene at Site 555 is the regional first occurrence of *Globorotalia truncatulinoides*. The time-correlation of this biostratigraphic indicator is derived from the results obtained from previous Leg 81 sites. An interval barren of siliceous microfossils occurs during latest Pliocene to Pleistocene times (Samples 555-1,CC to 3,CC). This interval correlates with a similar Pliocene–Pleistocene barren interval observed at Hole 552A. At that site, the upward beginning of the interval barren of siliceous fossils marks the initiation of Northern Hemisphere glaciation.

Virtually all of the Pliocene is represented by a hiatus at Site 555.

The late Miocene represents a period of low biostratigraphic resolution with regard to nannofossils and planktonic foraminifers. Diatoms and radiolarians provide more biostratigraphic information in the upper Miocene sequence. The planktonic foraminifers are characterized by low diversity and long-ranging forms during late Miocene times. In addition, the intra- and interspecific variation of late Miocene foraminifers makes specific identifications difficult and limits their usefulness as precise biostratigraphic tools (see Huddleston, this volume). Because minor differences in taxonomic interpretation between workers may cause major discrepancies in biostratigraphic assignments, Poore and Berggren's (1975) high latitude zonation could not completely be applied to the Leg 81 material.

Radiolarians and diatoms again provided the most precise stratigraphic assignments in earliest late and middle Miocene times. It was virtually impossible to apply Martini's (1971) nannofossil zonation in the interval between Zones NN5 and NN11 in the Rockall area because of the absence of zonal marker fossils. Bukry's (1973) nannofossil zonation provides some useful guide fossils in the middle and earliest late Miocene interval. The extinction of the foraminiferal species *Globorotalia mayeri*, which defines the N14/N15 boundary, appears to represent the least ambiguous foraminiferal datum event in the Rockall area during middle Miocene times.

The early Miocene nannofossil species *Sphenolithus belemnos* is present at Site 555. It is the first observation of this warm water species in the Rockall area, and its presence indicates that at least one pulse of warmer waters penetrated into this region during the early Miocene. Radiolarians and diatoms provide less detailed biostratigraphic information in the middle and late part of the early Miocene, compared to the information provided by nannofossils and planktonic foraminifers.

Paleogene

The early Miocene is separated from the early Eocene by a hiatus.

The biostratigraphy of the early Eocene (NP12/13–NP10) and the late Paleocene (NP9) was based solely on nannofossils, which were few to rare and poorly preserved as a result of dissolution. The voluminous influx of terrigenous material and the shallow-shelf depositional environments some distance from open ocean may both have contributed to the comparatively low abundance of nannofossils per unit sediment. Occasional samples contain a more diverse nannofossil assemblage.

Macrofossils

No complete macrofossils were observed in the Neogene section, but the presence of spines of irregular echinoids and sponge spicules in many of the samples indicates the existence of these two groups throughout the section. Core 30 contained (at the top) a considerable volume of drill slurry in which there were large numbers of the stem and arm ossicles of crinoids. Their age is uncertain but may be Miocene.

The lower Eocene is relatively abundant in macrofossils, especially the mudstones and particularly between Cores 28 and 67. Beneath this, fossils are sparse. Core 28 contains a bryozoan coquina composed of stick bryozoans (cheilostomes), but in the rest of the succession bryozoans are rare. (A brief description of bryozoans from two Leg 81 samples appears in Appendix B.)

The mudstone faunas commonly consist of irregular echinoids (whole tests preserved but most commonly loose spines), ophiuroids (disarticulated skeletal remains), tunicates (spicules observed in smear slides), and sponges (spicules). At certain levels, e.g., Cores 40 and 58, the infaunal bivalve *Nucula* is relatively common. Ahermatypic solitary corals are present in Cores 41 and 58 and are abundant in Core 59. Although preserved in a mudstone which does not offer a stable substrate for attachment, it is thought that during life they were cemented to firm substrates such as mollusc shells and serpulid tubes as is modern *Caryophylla.* Isolated oyster shells and layers rich in them are present in Cores 33, 46, 48, and 49. Finally, the tubes of serpulid worms occur at many levels within the sequence, and they extend down to Cores 92 and 93 where they form the only preserved evidence of marine life.

From this brief survey of the macrofauna it is not possible to make detailed environmental interpretations. However, it is clear that collectively they represent a shelf association with much evidence of shallow water, and this accords with the environmental interpretations based on the benthic foraminifers.

Calcareous Nannofossils

Nannofossil-bearing sediments are present continuously from Cores 1 to 32 and sporadically between Cores 32 and 67. Sediments interbedded with basalt are present from Cores 84 to 94. Some levels in this interbedded sequence contain nannofossils indicative of Zone NP9 of the late Paleocene. The shipboard study of nannofossils from Site 555 was primarily confined to core-catcher samples.

Cores 1, 2, and the upper half of 3 are Pleistocene in age. The last occurrence of *Pseudoemiliania lacunosa* occurs within Core 2. *Helicosphaera sellii* and *Calcidiscus macintyrei* are present in the upper half of Core 3. Thus, part of the early Pleistocene is probably missing.

Reticulofenestra pseudoumbilica is present in Sample 555-3-5, 80 cm. No other early Pliocene index fossils were observed below that level in Core 3. The lower part of Core 3 thus may range in age from Zones NN12 to NN15. *Discoaster quinqueramus* is continuously present from 4,CC through 10,CC, indicating Zone NN11. *Reticulofenestra minuta* is very abundant in 9,CC. Sample 11,CC shows *Discoaster bellus*, suggesting that this sample may belong to Zone NN10. A distinct downhole increase in abundance of *Dictyococcites perplexus* is observed in 11,CC. The high abundance of *D. perplexus* continues down to 16,CC. No five-rayed discoasters or *Coccolithus miopelagicus* were observed in 12,CC and 13,CC. These two samples may therefore belong to Zone NN9. The first downhole occurrence of *C. miopelagicus* is in 15,CC, which indicates Zone NN8 according to Bukry (1973). The next obvious change in the assemblage occurs in Sample 555-24-1, 100 cm where *Coronocyclus nitescens, Cyclicargolithus abisectus*, and *C. floridanus* are present, and *Sphenolithus heteromorphus* is missing. This suggests that the interval from 15,CC to 23,CC (where *Discoaster kugleri* is present) belongs to Zones NN7 and NN8. Zone NN6 is represented between Sample 24-1, 100 cm and 24-3, 135 cm since *S. heteromorphus* has its last occurrence at the latter level. Zone NN5 is represented between 24-3, 135 cm and 24-4, 135 cm. Samples 24-5, 100 cm through 26,CC show an assemblage indicative of Zone NN3; *Sphenolithus belemnos* and *Helicosphaera ampliaperta* are present whereas *Triquetrorhabdulus carinatus* is missing.

A major change in lithology occurs between 26,CC and the top of Core 27; this change represents a hiatus encompassing approximately 30 m.y. A disturbed drilling breccia, which partly consists of lumps of soft light-brown sediment, is present in the uppermost 20 cm in Section 555-27-1. A sample at the 5-cm level in Section 27-1 from the nucleus of such a brownish lump contained an early Eocene assemblage (NP12–NP13), e.g., *Discoaster lodoensis, D. keupperi, Tribrachiatus orthostylus, Imperiaster obscurus, Chiasmolithus eograndis, Pontosphaera fimbriata*, etc.

Coccoliths are few in Cores 27 through 32, except in Sample 555-31,CC in which they are common and show a fairly diverse early Eocene assemblage, including *Tribrachiatus orthostylus* (first occurrence), *Chiasmolithus bidens*, and *Ellipsolithus macellus* (last occurrences). Sample 31,CC thus represents the NP10/NP11 boundary. Sample 33,CC is barren. However, rare *Tribrachiatus contortus* are present in Sample 555-33-2, 80 cm, thus confirming the suggested position of the NP10/NP11 boundary in 31,CC. The interval between 34-5, 41 cm and 41,CC is barren of coccoliths. *Rhomboaster cuspis* is present from 43,CC to 45-1, 95 cm, and *Chiasmolithus eograndis, Discoaster diastypus, D. lenticularis*, and *D. mediosus* are represented in 45,CC, suggesting that 45,CC is referable to Zone NP10 and thus the lowermost part of the Eocene.

Samples 555-46-1, 70 cm through 56,CC are barren.

Rare coccoliths which are biostratigraphically nondiagnostic occur from Cores 57 to 67,CC. Because fasciculiths are absent, this interval is referred to NP10.

Basalts were recovered from the middle part of Cores 68 though 83, but 84 through 93 recovered sediments. Basalts were cored again in the top of Core 94, and no sediments were recorded below the top of Core 94. A few cores in the middle part of the interbedded sedimentary sequence yielded nannofossils representative of Zone NP9 of the late Paleocene. Section 88-4 contains the most diverse assemblage. Investigation of several samples in that section revealed the following species: *Braarudosphaera discula, Chiasmolithus bidens, Coccolithus luminis, C. pelagicus, Discoaster mediosus, D. mohleri* (one specimen), *D. multiradiatus, Ellipsolithus distichus, E. macellus, Fasciculithus bobii, F. involutus, F. lillianae, F. tympaniformis, Fasciculithus* sp., *Markalius astroporus, Neochiastozygus* sp., *Neococcolithes protenus, Pontosphaera* aff. *P. plana, Prinsius bisulcus, Toweius eminens, T. occultatus, T. pertusus, Zygrhablithus bijugatus*, and *Zygodiscus sigmoides*. Fragments of thoracosphaerids are common. One specimen of a reworked Cretaceous species, *Watznaueria barnesae*, was observed at 48 cm in Core 88-4.

Planktonic Foraminifers

Sample 1,CC is middle to late Pleistocene in age based on the presence of *Globorotalia truncatulinoides*, which makes its first local appearance in the middle part of the Pleistocene section. Sample 2,CC is probably middle to early Pleistocene in age, based on the presence of abundant *Neogloboquadrina pachyderma* s.s. and common *G. inflata* and the absence of *G. truncatulinoides*.

Samples 3,CC to 5,CC appear to be of earliest Pliocene or late Miocene age based on the occurrence of *G. margaritae* and the absence of *G. puncticulata*. Samples 6,CC through 10,CC are late Miocene in age (N17 to N16) based on the occurrence of *G. conoidea* and *Globoquadrina dehiscens*. The coiling change in the *Neogloboquadrina atlantica* plexus occurs between Sections 8-6 and 9-2. The plexus is randomly coiled in 8,CC. The interval from 11,CC to 16,CC is evidently earliest late Miocene to latest middle Miocene in age. This interval can be characterized by the presence of *Neogloboquadrina continuosa, G. cibaoensis-scitula*, generally more common *G. dehiscens*, a more consistent occurrence of *Globigerinoides quadrilobatus*, and *Sphaeroidinellopsis seminulina*, and by the scattered occurrence of *Globigerina nepenthes* and *Globoquadrina altispira*.

Sample 17,CC is middle Miocene in age based on the occurrence of *Globorotalia mayeri*. This sample is no younger than N14 since the extinction of *G. mayeri* defines the top of Zone N14. Sample 19,CC is, at the youngest, N13 in age based on the frequent occurrence of *Globigerina druryi*. The lowest occurrence of the *N. atlantica–N. acostaensis plexus*, represented by *Globorotalia challengeri* (Kennett and Srinivasan), is in Sample 20,CC. The interval 19,CC to 20,CC appears to represent a transition interval above which *G. challengeri-N. atlantica–N. acostaensis, G. mayeri*, and *Globigerina bulloides-parabulloides* are the dominant elements of the fauna, and below which the *N. atlantica–G. acostaensis* plexus does not occur. The underlying fauna is dominated by *Globorotalia panda*, and undifferentiated keeled *Globorotalia* aff. *menardii, Globigerina praebulloides, Globoquadrina altispira*, and *Globigerinoides quadrilobatus* are present in relative abundance.

There was no sample recovery in 24,CC. Sample 25,CC is late early Miocene (N6) in age based on the co-occurrence of well-developed *Globigerinoides quadrilobatus, G. subquadratus, G.* cf. *altiapertura, Catapsydrax dissimilis*, and *Sphaeroidinellopsis seminulina*. It is assumed that 26,CC is the same age as 25,CC because it contains a similar assemblage except for the absence of *G. subquadratus, G.* cf. *altipertura*, and *Sphaeroidinellopsis seminulina*.

Most of the samples between 27,CC and total depth were indurated or were barren of planktonic foraminifers. Only Samples 28,CC; 31,CC; 32,CC; 43,CC; 45,CC; 56,CC; 59,CC; 60,CC; and 67-4, 64 cm contained planktonic foraminifers. Of these samples only 31,CC contained an appreciable quantity of planktonic foraminifers, but only two species are present: *Globigerina patagonica* and *Acarinina* cf. *soldadoensis*. This suggests an early Eocene age for Sample 31,CC. Sample 59,CC contained a single specimen of *Globigerina velascoensis*, which suggests an early Eocene or late Paleocene age for that sample.

Benthic Foraminifers

The basic *Planulina wuellerstorfi* fauna (including *Cibicidoides kullenbergi, Oridorsalis umbonatus*, and *Epistomella exigua*) is present from the Pleistocene (1,CC) to the early Miocene (26,CC). The Pleistocene assemblages (1,CC and 2,CC) also include *Cassidulina teretis* and *Triloculina frigida*. The Pliocene is present in 3,CC. Species found only in the Miocene include *Globocassidulina subglobosa* (often very common), *Uvigerina auberiana, U. compressa, Siphotextularia catenata*, and *Laticarinina pauperata*. In the lowermost middle Miocene and early Miocene, *Siphonina tenuicarinata* is present.

The diversity ranges between ∝10 and 25. Pleistocene values are ∝20 to 22, early Pliocene ∝16, and late Miocene ∝14 to 23, with most values between ∝14 and 19. There are big fluctuations in the middle Miocene, ∝11 to 25, and lower values of ∝10 to 12 in the early Miocene. This suggests that conditions have been variable and especially so during the middle Miocene.

The planktonic:benthic ratio is 99:1 from 1,CC to 20,CC; then 96:4 until 23,CC; 91:9 at 24-7, 55 cm; 98:2 at 25,CC; and 80:20 at 26,CC. There may be some dissolution in the lowermost part of the Neogene succession. However, overall the values are high and indicate open oceanic waters. The *P. wuellerstorfi* fauna suggests depths greater than 1500 m.

It may be reasonable to assume that the site has not in the past been significantly deeper than it is at present, i.e., 1659 m. The sporadic rare occurrence of *Melonis pompilioides* suggests depths less than 2000 m.

There is a major hiatus between Cores 26 and 27, with the early Miocene represented in Sample 555-26,CC and early Eocene in Core 27. Fossiliferous early Eocene to late Paleocene continues down to Sample 555-67-4, 64 cm.

The two samples from immediately beneath the hiatus have been affected by dissolution (27-2, 105 cm and 28-1, 37 cm). The faunas are poorly preserved and difficult to identify. The planktonic: benthic ratios are 17:83 and 7:93 respectively, both affected by dissolution. The dominant benthic forms are *Osangularia* spp. together with *Gyroidinoides* spp. These assemblages probably represent outer shelf depths, 150–200 m. No samples were available from Cores 29 and 30.

Samples 555-31-1, 120 cm, 31,CC, and 32,CC have moderate preservation. The planktonic:benthic ratios are 44:56, 72:28, and 26:74, respectively. The assemblages are dominated by *Anomalinoides howelli*, but many other species are present and the diversity values range from ∝12 to 20. These are clearly shelf assemblages, probably mid- to outer-shelf, with depths of 75 to 150 m. In Sample 33,CC the planktonic:benthic ratio is 2:98. The dominant species are *Praeglobobulimina ovata, Bulimina trigonalis*, and *A. acutus.* The diversity is low (∝5.5), and the environment is interpreted as inner shelf, 25 to 100 m, some distance from the influence of open oceanic waters. The occurrence of oysters in this sample is in accordance with this interpretation.

There then follows a barren interval (34-3, 60 cm; 34,CC) of volcaniclastic sediments. In Sample 35,CC there are rare *Cribrostomoides* sp., *Lenticulina* sp., and *A. howelli* and, in Sample 36-2, 3 cm rare *Protelphidium* sp. together with plant debris. From Samples 38,CC to 67-4, 64 cm planktonic foraminifers are rare or absent, showing that the area was isolated from the influence of open oceanic waters. All the assemblages are indicative of inner-shelf depths of less than 75 m. The dominant forms vary from sample to sample, but commonly they are *Lenticulina* spp., *Alabamina obtusa, Anomalinoides acutus, A. nobilis, Praeglobobulimina ovata, Cribrostomoides* sp., and *Nonionella* spp. Most of the samples represent near-normal salinities, but brackish influences are evident in 38,CC and 46,CC while 52,CC having 97% *Protelphidium* sp., is considered to represent a brackish intertidal level; salinity 10–25‰. This sample contains much plant debris. Some levels have very sparse fauna (46,CC; 53,CC; 54,CC), while others are barren (64,CC; 66,CC; 69,CC; 73,CC; 74,CC; 88,CC; 89-1, 29 cm; 92,CC; and 93,CC).

To summarize, foraminiferal faunas first appear up the succession in lithological Unit IVc where they indicate inner-shelf seas of normal salinity, isolated from the open ocean. Shallow water conditions prevailed during the deposition of more than 300 m of sediment. In Zone NP11 the waters deepened to mid- and outer-shelf depths and the influence of oceanic waters became more marked. There is then a major hiatus of around 30 m.y. during which the site subsided to its present depth, for all the Neogene succession was deposited in the epibathyal zone under the influence of North Atlantic Deep Water (see Murray, this volume).

Diatoms

Hole 555

Diatoms are abundant to rare in Site 555. No siliceous late Pliocene or Pleistocene sediments are present. Within the middle Miocene, the diatom flora ranges from abundant and diverse flora to poorly preserved and rare to absent.

Cores 555-1 through 4 are either barren or contain no age diagnostic species. Species present include *Hemidiscus cuneiformis, Actinoptychus undulatus, Thalassiosira eccentrica*, and *Nitzschia reinholdii.*

Common moderately preserved diatoms are observed in Cores 5 to 6-4. This late Miocene interval is assigned to the *Thalassiosira convexa* Zone based on presence of *T. miocenica, T. nativa*, and *T. convexa* s. ampl. The interval of dissolution present at the base of this zone occurs in Cores 6 through 8.

Sample 555-8,CC contains *N. cylindrica, H. cuneiformis*, and *N. marina-reinholdii*, and is therefore assigned to *Nitzschia porteri-Nitzschia miocenica* Zone.

The interval from Cores 9-2 to 11-2 is assigned to the *Coscinodiscus yabei* Zone based on the presence of *Coscinodiscus plicatus, Denticulopsis dimorpha, D. hustedtii*, and *H. cuneiformis*. Preservation within this interval is poor to moderate.

Few to common, moderate to well-preserved diatoms occur in Cores 12 to 16. Species present include: *D. hustedtii, D. punctata, D. praedimorpha, D. hyalina, C. yabei, C. plicatus, Actinocyclus ingens*, and *H. cuneiformis.* This middle Miocene assemblage is assigned to the *Denticulopsis praedimorpha* Zone.

The *Rhizosolenia barboi* Zone occurs in the interval from Cores 16 to 18. The base of this zone is defined by the first occurrence of *R. barboi* which occurs in Sample 555-18,CC. Other species present include *D. punctata* var. *hustedtii, R. praebarboi, A. ingens*, and *A. ellipticus.*

Cores 19 to 21 are assigned to the *Denticulopsis nicobarica* Zone based on the presence of *D. nicobarica* and *D. punctata* var. *hustedtii* without *R. barboi.* Additional species include *Asterolampra marylandica, R. miocenica, Craspedodiscus coscinodiscus*, and *A. ingens.*

Rare specimens of *Coscinodiscus lewisianus* are found in Samples 555-21,CC and 22-1, and therefore are placed within the *Coscinodiscus lewisianus* Zone. The remaining portion of Core 22 is poorly preserved, and only specimens of *A. ingens* are observed.

All other samples below Core 22 with the following exceptions are barren of diatoms. Core 27 contains fragments of the Eocene diatom *Stephanopyxis.* Samples 555-32,CC; 41,CC; 48,CC; 58,CC; 59,CC; 61,CC; and 67,CC contain undiagnostic pyritized diatom frustules.

Radiolarians

Radiolarians were recovered from late Pliocene through middle Miocene sediments of Samples 555-4,CC through 23,CC. None of the samples examined from Pleistocene Cores 555-1 through 3 contained siliceous fossils, and the only radiolarians in the core catcher of Core 555-4 are large, robust, indeterminate actinommids, litheliids, and spongodiscids. In Core 555-5, there is a moderately well-preserved assemblage from the *Stichocorys peregrina* Zone.

The dominance of *S. delmontensis* over *S. peregrina* in Sample 555-6-4, 30–32 cm indicates an age below the lower boundary of the *S. peregrina* Zone, but the species necessary to distinguish between *Didymocyrtis penultima* Zone and *D. antepenultima* Zone are not present.

Core catchers from Cores 555-9 and 10 contain very few robust radiolarians and large sponge spicules; most diagnostic species have probably dissolved, but several specimens of *D. laticonus* indicate middle to late Miocene age. There is more variety, better preservation, and greater abundance of radiolarians in samples below Sample 555-10,CC. Although most of the artiscins are not sufficiently well preserved for species distinction, more *D. laticonus* are preserved than *D. antepenultima*, suggesting that Cores 555-11 through 19 belong to the *Diartus petterssoni* Zone. *D. petterssoni* is also present in this interval along with *Lithopera neotera* and other species which range through this zone. The same assemblage persists down through Sample 555-16,CC, but that in 17,CC is noticeably different. There are abundant large sponge spicules, forms that are common in the cores above are very rare or absent, and other forms, some previously undescribed, are common. *L. neotera* is found in small numbers down to Core 555-21, where its ancestor *L. renzae* is more abundant. This evolutionary transition is placed in the top of the *Dorcadospyris alata* Zone by Riedel and Sanfilippo (1978). All of the above zonal assignments correlate well with nannofossil data.

Recovery in Cores 555-22 and 23 was very poor, and most of the siliceous material is dissolved; only large robust actinommids and large sponge spicules remain in Core 22. There is apparently a great deal of downhole contamination in Core 555-23; in addition to the partly dissolved radiolarians and sponge spicules like those in Core 22, there are small forms with very well-preserved delicate spines, and species characteristic of the Pliocene and Pleistocene. Below this, radiolarians are absent except for occasional occurrences of robust, nondiagnostic actinommids.

There is a striking difference between Site 555 and the previous Leg 81 sites in both the thickness of late to middle Miocene sediments and the preservation of siliceous fossils in these sediments. Table 3 summarizes the approximate thickness in meters of radiolarians zones and the Pleistocene and Miocene siliceous barren intervals, in order to compare and contrast the four sites with respect to radiolarian recovery. The question marks in the column for Site 553 note the spot coring in Pliocene and late Miocene sediments.

Site 555 was drilled in a depression between the Hatton and Edoras banks which received current-borne sediment as well as the products of the overlying waters during Miocene time. The other sites also reflect the influence of bottom currents on rate of deposition. Middle Miocene unconformities found at each site are evidence of erosion. Although the linear sedimentation rates at the deeper sites in the late Miocene suggest that there was no erosion taking place, the fluctuation in relative amounts of nannofossils and foraminifers indicates that the availability of sediments deposited may have been controlled by the changing strength and position of currents in relation to the sites.

Table 3. Approximate thickness (m) of radiolarian zones, Site 555.

	Site			
	552	553	554	555
Pleistocene	10	15	15	0
Barren	30	15	15	35
S. langii Zone *S. peregrina* Zone	75	?	35	10
D. penultima Zone *D. antepenultima* Zone	5	?	15	40
Barren	25	20	5	0
D. alata Zone *D. petterssoni* Zone	0	10	10	140
early Miocene/Oligocene	5(?)	10	5	0
Eocene	10	20	0	0

Differences in productivity caused by local upwelling at topographical highs cannot be discounted, but it is difficult to distinguish here between the effects of productivity and transport. Silica preservation is undoubtedly affected by both these factors. Where more silica is deposited per unit time, whatever the cause, more will be available to buffer interstitial waters and burial will take place faster, preserving more siliceous skeletons. This may be why Site 555 has radiolarians preserved below the *D. antepenultima* Zone while the other sites are barren at that interval.

Dinoflagellates

Dinoflagellates from the Paleocene and Eocene sediments of Hole 555 have been examined by Brown and Downie (this volume), and their results are summarized here. The zonal scheme is that devised by Costa and Downie (1979).

Cores 85 to 94 contain *Apectodinium hypercanthum, A. quinquelatum, A. homomorphum, A. divissum, A. parvum*, and *A. augustrum*, indicating a Zone Ia assignment.

Between Cores 67 and 85 lies a sequence of basalts and volcanic breccias barren of palynomorphs.

The interval between Cores 45 to 67 is characterized by wide variations in the ratio of dinoflagellate cysts to pollen and spores, indicating that the environment fluctuated between estuarine and shallow shelf conditions. The sporadic occurrence of *Wetzeliella astra* throughout this interval is an indication of Zone Ia1. The interval is also characterized by many reworked dinoflagellate cysts of Jurassic, Cretaceous, and Danian age.

Cores 33 to 44 contain no diagnostic species, probably because of ecological factors. Over most of the interval there are very few cysts and abundant pollen and spores, and the fresh water alga *Pediastrum* sp. is present in one sample. In Cores 33 and 34 the ratio of dinoflagellate cysts to pollen and spores rises dramatically, indicating a change to more normal shallow marine conditions.

Core 32 contains *Wetzeliella meckelfeldensis*, indicative of a Zone Ib age. The base of this zone presumably lies in the underlying interval of low species diversity.

Cores 27 to 31 are barren of palynomorphs.

PHYSICAL PROPERTIES

Physical properties measured on the sediments and basalts, agglomerates, and terrigenous intercalated sediments penetrated in Hole 555 included compressional-wave velocity, 2-minute GRAPE wet-bulk density, continuous GRAPE wet-bulk density and water content, porosity, and wet-bulk density measured by gravimetric techniques.

The gravimetric measurements were carried out in the shipboard chemistry laboratory. Shear strength measurements were not carried out because the soft sediments recovered by rotary drilling were severely disturbed throughout.

All the measurements and calculations were done as described in the Introduction and Explanatory Notes. All the data measured and calculated are given in Table 4 and plotted in Figure 15 which appears in the back pocket of this volume.

Main Results

According to the physical properties, seven different units can be distinguished. The last unit can be subdivided into two major subunits.

In most cases the boundaries correlate well with the boundaries of the lithologic units or subunits of this site, and they are also established by a preliminary interpretation of the gamma ray log in scale 1:1000.

Unit A: Pleistocene–middle Miocene

Unit A (0–252.5 m) comprises lithologic Units I and IIa and is characterized by sonic velocities averaging about 1.5 km/s and porosity values between 50 and 60%. These data are very typical for nannofossil- and foraminifer–nannofossil ooze, and they are comparable to those found at the other sites of this leg.

Unit B: middle Miocene–early Miocene

This unit which has its lower boundary at about 281 m sub-bottom shows a steady increase of the sonic velocity from 1.5 to 1.6 km/s, coinciding with a decrease in porosity from 62–55%. The glauconitic foram chalks and oozes are rather homogeneous, which is the reason for the good core recovery within this interval (Unit IIb of the lithologic subdivision).

Unit C: early Eocene

Unit C goes down to about 352 m sub-bottom depth. Because of the poor recovery in the upper part of this unit, there are few physical properties data for this interval. However, the limited core recovered shows a heterogeneous sequence of sediments.

The sonic velocity is higher than 3.0 km/s for some horizons in the upper part and shows a steady increase in the lower part from 1.75–2.0 km/s. All the other data do not show reliable trends.

Unit C includes Units IIIa and IIIb of the lithologic subdivision.

Unit D: early Eocene

The sediments of the interval down to 519 m seem to have the same overall mineralogical composition but have undergone differential cementation as indicated by the sonic velocity variations. For some layers high sonic velocities of about 5 km/s are caused by calcite cementation, with a corresponding decrease in porosity down to 10% and acoustic impedance values higher than 11. These phenomena are restricted to distinct layers as shown by the sonic log. Heterogeneity is the reason for the poor recovery in some intervals of this unit, which covers lithologic Unit IIIc and the upper part of lithologic Unit IIId.

Unit E: early Eocene

The base of Unit E lies at a depth of about 618 m sub-bottom. This unit has fairly uniform physical properties. The porosities vary little, as do the sonic velocities (between 1.7 and 1.8 km/s). The homogeneity of this interval resulted in fairly good recovery of the micaceous carbonaceous mudstones and feldspathic sandstones.

Unit F: early Eocene

Unit F, which overlies the basalt sequence with a very sharp contact at 672 m, again shows great differences in the sonic velocity, which range between 1.8 and 3.6 km/s according to differences in the porosity. The heterogeneity in physical properties of the sediments caused the poor core recovery in this interval. The lower boundary of this interval coincides with the boundary between lithologic Units IIIe and IVa.

Unit G: late Paleocene

The interval from the top of the first basalt penetrated to total depth (964 m) is characterized as Unit G, which is subdivided primarily into Subunits G1 and G2.

Subunit G1 consists of several individual lava flows with intercalated agglomerates and volcaniclastic sediments. The different lava flows are characterized by sonic velocities which range up to 5.0 km/s according to their vesicularity, internal texture, and overall mineralogical composition. The variations in grain densities of the basalts between 2.97 and 3.03 g/cm^3 and in the porosities (between 6 and 10%) are also caused by the above features.

The agglomerates interbedded between the basalt flows in the upper part of Subunit G1 show very homogeneous physical properties and are characterized by sonic velocities of 2.7 to 3.5 km/s, grain densities of 2.75 g/cm^3, and porosities of 30 to 40%.

The sedimentary sequence which occurs in the lower part of the subunit has physical properties which allow a subdivision into a more coarse-grained upper part (Cores 84 and 85) and a predominantly argillaceous lower part (Cores 86 to 89; see Fig. 15). Another more argillaceous sedimentary intercalation can be seen at a depth between 890 and 910 m sub-bottom.

Subunit G2: late Paleocene

This subunit comprises the massive basalt which was drilled from 927 to 964 m total depth. Sonic velocities are very high (higher than 5 km/s throughout the interval), grain densities are exclusively higher than 3.02 g/cm^3, and the porosities are lower than 5% in all cases.

Table 4. Physical property data, Hole 555.

		Sound velocity[a]		GRAPE "special" Wet-bulk density 2-min. count (g/cm^3)		Gravimetric			
Core-Section (interval in cm)	Depth in hole (m)	∥ Beds (km/s)	⊥ Beds (km/s)	∥ Beds	⊥ Beds	Wet-bulk density (g/cm^3)	Wet-water content salt corr. (%)	Porosity (%)	Acoustic impedance $\left(\frac{g\cdot 10^5}{cm^2\cdot s}\right)$
2-4, 62–64	10.64	1.515		1.669		1.61	38.77	62.40	2.529
3-1, 83–86	15.86	1.592		1.795		1.76	30.84	54.23	2.858
3-5, 83–86	21.86	1.583		1.811		1.75	30.25	53.04	2.867
4-7, 10–12	33.62	1.567		1.843		1.76	28.68	50.60	2.888
5-6, 81–83	42.33	1.475		1.853		1.70	32.15	54.78	2.733
6-4, 93–96	48.96	1.558		1.796		1.75	29.87	52.34	2.798
6-6, 92–95	51.95	1.503		1.794		1.70	31.72	53.92	2.696
7-7, 22–25	62.25	1.539		1.749		1.73	30.86	53.45	2.692
8-2, 82–85	64.85	1.530		1.786		1.74	31.45	54.67	2.733
8-5, 78–81	69.31	1.489		1.777		1.70	33.73	57.24	2.646
9-1, 97–100	92.00	1.551		1.846		1.78	30.63	54.49	2.863
10-3, 77–80	104.30	1.554		1.819		1.80	29.92	53.87	2.827
10-7, 35–38	109.88	1.579		1.747		1.77	31.42	55.75	2.759
11-3, 80–83	132.83	1.554		1.710		1.71	34.44	58.97	2.657
12,CC (10–13)	141.28	1.561		1.808		1.74	32.85	57.19	2.822
15-1, 51–54	167.54	1.484		1.739		1.68	35.75	59.97	2.581
16-5, 83–86	183.36	1.504		1.783		1.76	32.03	56.32	2.682
16-7, 31–34	185.84	1.537		1.838		1.79	29.42	52.59	2.825
17-3, 27–30	189.30	1.564		1.786		1.75	31.74	55.60	2.793
18-2, 27–30	197.30	1.521		1.837		1.75	30.45	53.16	2.794
19-2, 35–38	206.38	1.516		1.853		1.79	31.33	53.20	2.809
20-2, 17–20	216.20	1.305		1.775		1.72	32.85	56.60	2.316
21-2, 115–118	226.68	1.528		1.760		1.73	32.75	56.66	2.689
22-2, 10–13	235.13	1.061		1.778		1.65	35.51	58.60	2.847
24-2, 111–114	255.14	1.527		1.663		1.58	38.83	61.39	2.539
24-4, 105–108	258.08	1.530		1.739		1.59	38.16	60.58	2.661
25-3, 114–117	266.17	1.522		1.661		1.62	38.39	62.29	2.528
25-5, 106–109	269.09	1.535		1.669		1.61	37.64	60.79	2.562
26-3, 123–126	275.76	1.554		1.788		1.74	32.75	57.01	2.779
26-6, 121–124	280.24	1.553		1.803		1.71	32.96	56.29	2.800
27-1, 17–20	281.20		1.876		1.550	1.54	42.71	65.76	2.908
27,CC (14–17)	284.00		3.332		2.336	2.17	9.57	20.74	7.784
28-1, 15–18	290.68		1.653		1.851	1.81	29.11	52.70	3.060
30,CC (12–14)	311.40		2.510		1.824	1.86	28.60	53.05	4.578
31,CC (12–15)	321.15		1.769			1.55	44.47	68.71	2.742
32-1, 94–96	329.46		1.806		1.588	1.59	41.98	66.95	2.868
32-4, 111–113	334.13		1.918		1.621	1.69	37.17	62.74	3.109
33-1, 142–144	339.44		1.771		1.568	1.59	42.71	68.09	2.777
33-3, 63–65	341.65		1.871		1.682	1.71	36.26	62.16	3.147
34-1, 108–110	348.60		2.095		1.677	1.83	30.77	56.21	3.513
34-4, 30–32	352.32		4.988		2.308	2.41	9.17	22.12	11.512
36-1, 17–19	366.69		4.346		2.556	2.58	4.04	10.41	11.108
37-1, 92–94	376.94		4.301		2.569	2.61	3.75	9.76	11.049
38-2, 33–35	387.35		3.336		2.340	2.35	9.83	23.05	7.806
38-3, 146–148	390.00		1.738		1.75	1.84	29.02	53.50	3.042
39-1, 87–89	395.89		3.419		2.214	2.31	11.99	27.68	7.570
39-7, 37–40	404.40		2.232		1.913	2.08	20.57	42.78	4.270
40-4, 109–111	410.11		1.670		1.694	1.73	35.14	60.68	2.829
41-1, 146–149	415.50		1.689		1.707	1.78	33.37	59.25	2.883
41-4, 69–71	419.21		1.664		1.682	1.73	35.17	60.80	2.799
42-1, 44–47	424.00		3.580		2.146	2.26	14.08	31.82	7.683
42-2, 118–119	426.20		2.589		2.072	2.06	20.79	42.83	5.364
43-3, 107–109	437.10		1.703		1.744	1.74	33.05	57.51	2.970
44-1, 42–44	443.00		1.714		1.720	1.71	33.89	58.02	2.948
45-1, 4–6	452.06		1.717		1.785	1.78	30.86	54.98	3.065
46-2, 49–51	463.50		3.842		2.412	2.35	10.65	25.03	9.267
46-6, 17–19	469.20		1.808		1.855	1.82	28.36	51.65	3.354
47-2, 113–115	473.65		1.802		1.809	1.79	30.78	55.18	3.260
48-3, 146–148	485.00		1.801		1.793	1.80	30.30	54.68	3.229
51-1, 34–36	509.36		3.992		2.506	2.47	5.58	13.79	10.004
52-2, 56–58	520.58		1.810		1.785	1.79	30.67	54.95	3.231
53-1, 123–126	529.26		1.780		1.87	1.84	28.14	51.88	3.329
53-6, 10–12	535.60		1.785		1.834	1.85	28.29	52.41	3.274
54-3, 29–31	540.80		1.685		1.786	1.84	28.25	51.96	3.006
56-1, 147–149	558.00		1.760		1.832	1.84	28.69	52.91	3.224
56-5, 81–83	563.30		1.797		1.807	1.81	29.65	53.79	3.247
58-1, 111–114	576.60		1.785		1.806	1.80	28.83	51.93	3.224
58-3, 109–111	579.60		1.781		1.929	1.93	24.19	46.73	3.436
58-6, 25–28	583.30		1.889		1.906	1.92	25.39	48.63	3.600
59-1, 119–123	586.20		1.841		1.889	1.86	26.16	48.72	3.478
59-5, 133–135	592.35		1.829		1.944	1.90	24.53	46.61	3.556
60-3, 140–142	598.90		1.737		1.876	1.82	28.99	52.84	3.259
60-6, 145–147	603.50		1.742		1.855	1.87	26.95	50.35	3.231
61-2, 39–41	605.90		1.839		1.910	1.92	25.05	48.14	3.512
61-6, 58–60	612.10		1.802		1.794	1.85	29.03	53.64	3.233

Table 4. (Continued).

				GRAPE "special"		Gravimetric			
Core-Section (interval in cm)	Depth in hole (m)	Sound velocity[a] ‖ Beds (km/s)	Sound velocity[a] ⊥ Beds (km/s)	Wet-bulk density 2-min. count (g/cm^3) ‖ Beds	Wet-bulk density 2-min. count (g/cm^3) ⊥ Beds	Wet-bulk density (g/cm^3)	Wet-water content salt corr. (%)	Porosity (%)	Acoustic impedance $\left(\frac{g \cdot 10^5}{cm^2 \cdot s}\right)$
62-2, 133–135	616.35		1.793		1.841	1.87	27.86	52.20	3.301
62-5, 71–74	620.24		2.116		1.894	1.88	26.17	49.31	4.008
63-1, 141–143	624.40		3.553		2.413	2.44	7.52	18.32	8.573
64-1, 119–121	633.70		1.842		1.882	1.88	26.69	50.20	3.467
64-4, 138–141	638.40		3.037		2.094	2.11	17.35	36.58	6.359
65-2, 78–81	644.30		2.864		2.01	2.01	19.93	40.12	5.757
66-1, 78–81	652.30		2.986		2.155	2.08	17.41	36.14	6.435
67-2, 141–143	663.90		1.992		2.042	2.04	21.18	43.27	4.068
67,CC (5–7)	666.70		2.992		2.216	2.13	15.08	32.18	6.630
68-2, 128–130	673.30		5.462		2.564	2.82	3.12	8.77	14.005
68-3, 49–51	674.00		5.712		2.597	2.83	2.85	8.06	14.834
69-2, 108–110	682.60		5.743		2.605	2.87	2.14	6.14	14.961
69-3, 44–46	683.50		5.280		2.577	2.85	2.49	7.09	13.607
69-5, 37–40	686.40		2.567		2.185	2.19	14.09	30.82	5.609
69-6, 49–52	688.00		2.275		2.156	2.11	15.43	32.59	4.905
70-1, 76–80	690.30		4.226		2.367	2.58	6.97	18.02	10.003
71-1, 69–71	699.70		3.065		2.054	2.01	18.64	37.50	6.296
72-2, 129–131	711.30		3.165		2.041	2.20	14.15	38.18	6.460
73-1, 117–119	719.20		2.879		2.026	2.03	19.48	39.56	5.833
73-3, 49–51	721.50		2.873		2.022	2.02	19.47	39.40	5.809
73-5, 21–23	724.20		2.743		2.105	2.08	17.47	36.41	5.774
74-1, 109–111	728.60		2.917		2.120	2.11	17.16	36.27	6.184
74-3, 19–21	730.70		3.030		2.096	2.12	16.89	35.78	6.351
75-1, 57–59	737.60		2.712		1.986	1.99	21.38	42.65	5.386
76-1, 119–121	747.70		5.347		2.522	2.83	3.48	9.84	13.485
76-3, 127–129	750.80		5.525		2.480	2.80	3.99	11.19	13.702
76-4, 110–112	752.10		5.179		2.641	2.55	5.12	13.06	13.678
76-5, 41–43	753.00		5.068		2.519	2.74	4.69	12.86	12.766
77-1, 104–106	757.05		3.133		2.079	2.11	17.57	37.17	6.514
77-3, 27–29	759.30		3.324		2.11	2.13	16.39	34.92	7.014
77-5, 94–97	763.00		3.335		2.070	2.18	15.19	33.06	6.903
78-1, 56–59	767.00		3.157		2.263	2.19	14.77	32.33	7.144
78-3, 103–106	769.60		3.249		2.18	2.18	15.05	32.85	7.083
79-1, 41–43	775.40		3.350		2.12	2.20	14.25	31.42	7.105
79-3, 17–19	778.70		3.494		2.75	2.37	9.34	22.09	9.609
79-4, 124–126	780.80		4.287		2.85	2.31	12.46	28.83	12.218
80-1, 44–46	785.00		3.401		2.80	2.17	16.35	35.40	9.523
80-3, 102–104	788.50		5.842		1.658	2.59	3.21	8.32	15.541
81-1, 69–71	794.70		5.358		2.198	2.51	7.27	18.28	11.777
81-2, 104–107	796.60		4.316		2.555	2.51	6.06	15.20	11.027
81-3, 70–72	797.70		5.206		2.542	2.67	4.09	10.92	13.234
82-1, 47–49	804.00		4.672		2.470	2.63	6.15	16.19	11.540
82-3, 15–17	806.70		4.061		2.319	2.55	8.39	21.35	9.417
83-1, 57–59	814.00		4.767		2.480	2.78	4.45	12.37	11.822
84-1, 5–7	822.60		2.667		2.034	1.99	21.94	43.68	5.425
85-1, 21–23	832.20		2.652		2.257	2.19	13.09	28.66	5.986
85-2, 3–5	833.55		3.169		2.158	2.22	14.30	31.79	6.839
86-1, 79–81	842.30		2.249		2.076	2.07	19.05	39.38	4.669
86-3, 132–134	845.80		2.263		2.105	2.07	17.84	36.92	4.764
87-1, 82–85	851.85		2.166		2.059	2.05	18.88	38.75	4.460
87-4, 38–40	856.00		2.222		2.029	2.05	19.41	39.81	4.508
87-6, 31–33	858.80		2.377		2.113	2.13	16.89	36.06	5.023
88-1, 78–80	861.30		1.996		1.892	1.96	24.87	48.71	3.776
88-4, 28–40	865.40		2.14		2.055	2.06	18.51	38.13	4.398
89-1, 119–121	871.20		2.424		2.138	2.16	14.91	32.20	5.183
90-1, 8–10	879.60		2.235		2.040	2.09	18.67	38.99	4.559
90-3, 95–97	883.50		5.394		2.568	2.84	3.42	9.72	13.852
91-1, 120–122	890.20		4.344		2.502	2.67	5.95	15.87	10.869
91-2, 3–5	890.55		2.633		2.191	2.13	15.79	33.67	5.769
92-1, 34–36	898.90		2.426		2.13	2.12	16.57	35.11	5.203
92-2, 140–142	901.40		2.258		2.141	2.08	17.90	37.22	4.834
93-1, 7–9	908.10		2.224		2.215	2.09	15.03	31.46	4.926
93-2, 137–139	910.90		4.325		2.451	2.55	5.83	14.87	10.601
94-1, 93–95	918.50		2.483		2.241	2.18	14.11	30.76	5.564
95-1, 128–130	928.30		5.962		2.671	2.98	0.44	1.32	15.925
95-3, 3–5	929.85		6.474		2.78	3.02	0.26	0.80	17.998
96-1, 73–75	937.25		5.766		2.707	2.99	0.66	1.96	15.609
96-3, 104–106	940.55		5.237		2.694	2.95	1.42	4.20	14.108
96-5, 103–105	343.55		6.076		2.735	2.98	0.67	2.01	16.618
97-1, 3–5	946.05		6.018		2.699	2.98	0.60	1.79	16.243
97-3, 43–45	949.50		5.846		2.708	3.01	0.43	1.29	15.831
97-7, 41–43	954.00		6.638		2.749	2.97	0.88	2.61	18.248
98-1, 94–96	956.00		6.048		2.690	2.96	0.89	2.63	16.269
98-4, 97–98	960.50		5.915		2.733	3.00	0.53	1.58	16.166
98-7, 5–7	962.50		6.535		2.721	3.00	0.55	1.65	17.782

[a] Sound velocity at 18.5°C.

The physical properties measured on samples from Hole 555 allow a good subdivision of the penetrated sediments and basalts which correlate well with the lithological observations and thus can be used to support the interpretation of the seismic profiles.

ORGANIC GEOCHEMISTRY

Gases

The results of gas analyses run at Site 555 are given in Table 5. Pore-water gas extraction was done on Sections 2-3 through 31-1 (320 m). The occurrence of volcaniclastic sediments at this depth coincided with a significant decrease in the amount of interstitial water that could be squeezed from the sediments. A thick sequence of obviously organic sediments was recovered in Cores 40–60. Since very little pore water was being removed, "vacutainer" samples were drawn from these cores for analysis. Although the hydrocarbon gases occur at low levels (C_1 4–40 ppm), these are the highest levels encountered on Leg 81.

The results suggest low-temperature (21–32°C) thermal-decomposition reactions as the source for the light hydrocarbons present in these sediments.

Sediments

The thick sediment sequence at Site 555 contains high levels of organic matter (0.02–4.1%) compared to the other Rockall sites (552–554). Results are shown in Tables 6 and 7 and Figures 16 and 17.

Present–Early Miocene

The Recent–early Miocene section at Site 555 contained organic matter similar to the previous sites, with an average C/N ratio of 10.

Early Eocene

The early Eocene sediments at Site 555 contained 0.1–4.1% organic carbon with an average C/N ratio of about 40. Figure 17 shows that these organic-rich sediments are Type III terrestrial and were probably deposited in a very shallow marsh environment. The very mature nature reflects the major contribution of the reworked or volcanically altered component of organic matter discussed at earlier sites.

The occurrence of two S_2 peaks of different maturity in the sediments indicates that the mature component was not heated *in situ*, but is reworked.

Paleocene

The Paleocene sediments still contain immature kerogen as the major component. This is consistent with the present thermal gradient, and suggests that the interlayered lavas did not significantly heat the sediments or were cool at the time of sedimentation. Finally, the very mature component (550°C T_{max}) was only a minor part of the Paleocene sediments relative to the Eocene, indicating a different source of organic matter during this time. This may have been the result of a different depositional environment, or a lack of this material available for deposition. A fuller discussion is given elsewhere in this volume by Kaltenback et al.

CORRELATION OF SEISMIC REFLECTORS WITH DRILLING RESULTS

Seismic reflection data in the vicinity of Site 555 consisted principally of several multichannel seismic profiles made by the IOS (Figs. 3, 6, 18). The control seismic line, IPOD 76-9B, was acquired using a 2160 in.^{3} air-gun array and a 48-channel hydrophone with 50 m between traces. The digitized data were resampled at 4 ms and subjected to true amplitude recovery prior to 24-fold processing using deconvolution before and after stack, and time-varied filtering. An additional line, IOS-7 shot using Maxipulse and a 60-channel streamer, also crosses the site. A few NAVOCEANO and LDGO single-channel seismic lines were available in the area in

Table 5. Gas analyses, Site 555.

Sample (interval in cm)	Air (%)	CO_2 (%)	C_1 (ppm)	C_2 (ppm)	C_3 (ppm)	iC_4 (ppm)	nC_4 (ppm)	C_5^+	$\frac{C_1}{C_2}$	Wetness (%) $\frac{C_2\text{-}C_4}{C_1\text{-}C_4}$	Remarks
2-3, 144–150	21.2	0.08	0.39			nd			—	—	Pore water 1:2 extraction w̄ He
5-5, 144–150	23.5	0.10	0.25			nd			—	—	Pore water 1:2 extraction w̄ He
8-5, 144–150	21.7	0.10	0.88			nd			—	—	Pore water 1:2 extraction w̄ He
9-2, 144–150	22.8	0.10			nd				—	—	Pore water 1:2 extraction w̄ He
11-2, 144–150	21.3	0.12	1.07	0.07	0.02	0.02	—	—	15.3	9.3	Pore water 1:2 extraction w̄ He
15-1, 144–150	22.5	0.12	2.43	0.07	0.05	—	0.02	—	34.7	5.5	Pore water 1:2 extraction w̄ He
19-2, 144–150	20.0	0.16	1.35			Sample lost			—	—	Pore water 1:2 extraction w̄ He
22-1, 144–150	33.5	0.14	1.10	0.07	0.16	0.02	—	—	15.7	18.5	Pore water 1:2 extraction w̄ He
25-5, 144–149	24.4	0.16	2.39	0.35	0.16	0.07	0.03	tr.	6.8	20.3	Pore water 1:2 extraction w̄ He
31-1, 144–150	43.2	0.06			nd				—	—	Pore water limited 1:1 extraction
34-4, 144–150	23.9	0.05	0.09	—	0.01	—	—	—	—	—	Pore water 1:2 extraction w̄ He
37-2, 144–150	27.4	0.08	0.42	—	0.01	—	—	—	—	—	Pore water 1:2 extraction w̄ He
43-4, 123	95.6	0.11	4.37	0.11	0.10	0.09	0.10	—	39.7	8.3	No pore water: Core vacutainer samples
46-5, 140–150	61.7	0.10	0.89			nd			—	—	Pore water 1:1 extraction
48-3, 57	93.6	0.08	4.35	—	0.2	0.13	0.33	—	—	13.2	Core "vacutainer" sample
49-1, 39	91.6	0.18	5.90	0.86	0.48	0.05	0.02	—	6.9	22.0	Core "vacu"-sample, no core, just cuttings
53-4, 24	93.8	0.09	35.8	0.66	0.61	C_4's 0.52		—	54.2	4.8	Core "vacu"-sample, no core, just cuttings
58-4, 101	93.1	0.07	4.6	0.29	0.15	0.04	0.03	—	15.9	10.0	Core "vacu"-sample, no core, just cuttings
60-3, 74	90.6	0.08	37.9	1.66	0.51	0.29	0.79	tr.	22.8	8.1	Core "vacu"-sample, no core, just cuttings
62-3, 76	93.6	0.06	8.1	0.35	0.22	0.04	—	—	23.1	7.0	Core "vacu"-sample, no core, just cuttings
64-4, 28	92.9	0.06	3.14		0.05	C_4's 0.02			—	2.2	Core "vacu"-sample, no core, just cuttings
67-4, 47	94.7	0.07	4.65	0.14	0.07	C_4's 0.04		C_5-tr.	33.2	5.1	Core "vacu"-sample, no core, just cuttings

Table 6. Pyrolysis data, Site 555.

Sample (interval in cm)	$\frac{S_1}{\text{g rock}}$	$\frac{S_2}{\text{g rock}}$	$\frac{T_{max}°C}{S_2A/S_2B}$		S_3 $\left(\frac{\text{mg } CO_2}{\text{g rock}}\right)$	$S_1 + S_2$ $\left(\frac{\text{mg HC}}{\text{g rock}}\right)$	$\frac{S_1}{S_1 + S_2}$	$\frac{S_2}{S_3}$	HI $\left(\frac{\text{mg HC}}{\text{g OC}}\right)$	OI $\left(\frac{\text{mg } CO_2}{\text{g OC}}\right)$	Remarks
2-3, 140	0.05	0.09	—	—	1.35	0.14	0.36	0.07	450	6750	~10 m, mudline, 30% $CaCO_3$, 1W, tan, Pleistocene
5-5, 140	0.03	0.02	—	—	0.56	0.05	0.60	0.04	14	400	l. Miocene, 41 m, top ooze, white, 1W, 96% $CaCO_3$
15-1, 140	0.04	0.02	—	—	0.75	0.06	0.67	0.03	29	1071	m. Miocene, 168 m, middle ooze, white, 1W, 94% $CaCO_3$
25-5, 130	0.04	0.01	—	—	0.81	0.05	0.80	0.01	13	1013	e. Miocene, 270 m, bottom ooze top glauc., SS, 1W, 92% $CaCO_3$
31-1, 138	0.12	0.14	411	550	0.75	0.26	0.46	0.19	56	300	e. Eocene, glau. volc. SS, grn., 1W, (top) 320 m, 3% $CaCO_3$
34-4, 137	0.22	1.02	412	525	1.25	1.24	0.18	0.82	52	64	e. Eocene, glau. SS, 1W, 346 m, 1% $CaCO_3$
36-1, 11	0.09	0.28	427	510	1.48	0.37	0.24	0.19	39	209	e. Eocene, SS $\overline{w}$ calcite cement, org. layer, 45% $CaCO_3$
36,CC	0.03	0.05	—	—	0.37	0.08	0.38	0.14	50	370	e. Eocene, SS calcite cement, near org. layer, 78% $CaCO_3$
37-2, 21–25	0.23	1.34	396	550	2.49	1.57	0.15	0.54	33	61	e. Eocene, mudstone $\overline{w}$ sand, 379 m, 1W, 2% $CaCO_3$
38-3, 13	0.25	2.35	428	532	1.45	2.60	0.10	1.62	101	62	e. Eocene, mudstone $\overline{w}$ org. layer, 1% $CaCO_3$
40-5, 138	0.20	2.79	434	550	1.15	2.99	0.07	2.43	297	122	e. Eocene, mudstone, 412 m, 1W, 0% $CaCO_3$
42-4, 70	0.29	0.48	418	550	1.28	0.77	0.38	0.38	45	120	e. Eocene, mudstone, salt marsh, 17% $CaCO_3$
43-4, 148	0.38	1.04	418	550	1.18	1.42	0.27	0.88	81	92	e. Eocene, mudstone, marsh, 437 m, 1W, 2% $CaCO_3$
45-1, 145	0.27	0.65	423	550	1.45	0.92	0.29	0.45	63	141	e. Eocene, mudstone, org.? marsh, 2% $CaCO_3$
48-4, 90–92	0.22	0.29	400	550	1.11	0.51	0.43	0.26	33	128	e. Eocene, mudstone, marsh, 486 m, 1W, 2% $CaCO_3$
52-2, 78	0.10	1.09	410	550	1.46	1.19	0.08	0.75	43	57	e. Eocene, ms, sandy, C_1–C_4's 520 m, 1W, 17% $CaCO_3$
56-5, 116	0.28	0.98	409	550	1.99	1.26	0.22	0.49	50	101	e. Eocene, ms, org., 2% $CaCO_3$
58-3, 136	0.32	0.52	423	520	1.15	0.84	0.38	0.45	55	121	e. Eocene, ms, sandy, 580 m, 1W, 4% $CaCO_3$
60-5, 118	0.18	0.39	412	550	1.23	0.57	0.32	0.32	53	169	e. Eocene, ms, light gy., org. 3% $CaCO_3$
64-1, 102	0.14	1.54	427	550	0.73	1.68	0.08	2.11	69	80	e. Eocene, SS or ms, 638 m, 1W, 0% $CaCO_3$
64-3, 117	0.06	0.18	447	550	1.12	0.24	0.25	0.16	180	1120	e. Eocene, grn. sandy tuff? 2% $CaCO_3$
67-3, 138	0.16	0.81	415	550	1.55	0.97	0.17	0.52	72	137	e. Eocene, ash sed. before volc./ sed. layer, ; L Paleocene, gy. ms, 665 m, 1W? 1% $CaCO_3$
85-1, 40–43	0.06	0.40	437	—	0.34	0.46	0.13	1.18	56	48	l. Paleocene, 2% $CaCO_3$
86,CC	0.08	0.40	420	(485)	0.69	0.48	0.17	0.58	36	62	l. Paleocene, volc. SS, 866 m 2% $CaCO_3$
87-5, 145	0.19	1.68	415	550	0.98	1.87	0.10	1.71	62	36	l. Paleocene, volc. sed. $\overline{w}$ org.? 2% $CaCO_3$
90-1, 33–36	0.02	0.27	440	523	0.35	0.29	0.07	0.77	61	80	l. Paleocene, org. in sed.? 3% $CaCO_3$
92-2, 148–150	0.05	0.20	433	—	0.52	0.25	0.20	0.39	30	78	l. Paleocene, org. in seds? 899 m, 2% $CaCO_3$

addition to the single-channel seismic profile obtained during the site approach by *Glomar Challenger.*

Site 555 was located very close to SP 11782 on Line IPOD 76-9B (Fig. 18).

Seismic Stratigraphy

The multichannel profile across the site shows several reflectors of contrasting character discussed here in order of increasing depth. These are shown in Table 8.

Seabed-Reflector 1

The interval between the seabed and underlying Reflector 1 is acoustically transparent in comparison to the interval below Reflector 1. The seismic stratigraphy of the seabed Reflector-1 interval can be best appreciated by noting that the site is located in the channel between two sediment drifts (Fig. 3). The crest of the adjacent drift to the northeast is 0.23 s shallower than the channel. Within the drift, Reflector 1A divides the drift into two seismic subunits and can be followed to a depth of 0.27 s beneath the channel. Both of these are characterized by laterally impersistent reflectors. The upper subunit, Seabed-1A thins southwestward toward the axis of the channel. Within the subunit, reflectors downlap onto Reflector 1A. The interval thus marks a period of strong differential deposition beginning at the level of Reflector 1A. Erosion may be indicated by channels in Reflector 1A. In the underlying Subunit 1A-1, reflectors are truncated by Reflector 1A and also downlap onto Reflector 1. Pinch-outs within the subunit also suggest

Table 7. Organic C/N data summary, Site 555.

Sample no.	Core-Section (interval in cm)	N (%)	C_{org} (%)	H (%)	$\frac{14}{12} \times \frac{C_{org}}{N_{org}}$	$CaCO_3$ (bomb) (%)
1	2-3, 140	0.02	0.02		1.2	30
2	5-5, 140	0.01	0.14		16.3	96
3	8-5, 137	0.01	0.08		9.3	94
4	9-2, 140-143	0.01	0.08		9.3	91
5	15-1, 140	0.01	0.07		8.2	94
6	19-2, 140	0.01	0.09		10.5	92
7	22-1, 142	0.01	0.11		12.8	90
8	25-5, 130	0.01	0.08		9.3	92
9	31-1, 138	0.01	0.25		29.2	3
10	34-4, 137	0.04	1.95		56.9	1
11	36-1, 11-12	0.01	0.71		82.8	45
12	36,CC	0.005	0.10		29.2	78
13	37-2, 21-25	0.08	4.10		59.8	2
14	38-3, 13	0.06	2.33		44.9	1
15	40-5, 138	0.03	0.94		36.6	0
16	42-4, 70	0.05	1.07		24.7	1
17	43-4, 148	0.05	1.28		29.9	2
18	45-1, 145	0.04	1.03		30.0	2
19	48-4, 90-92	0.04	0.87		25.4	2
20	52-2, 78	0.07	2.55		42.5	1
21	56-5, 116	0.08	1.98		28.9	2
22	58-3, 136	0.03	0.95		38.5	4
23	60-5, 118	0.03	0.73		28.4	3
24	64-1, 102	0.03	0.91		35.4	0
25	64-3, 117	0.01	0.10		11.7	2
26	67-3, 138	0.04	1.13		33.0	1
27	86,CC	0.04	1.12		32.7	2
28	87-5, 145	0.06	2.70		52.5	2
29	85-1, 40-43	0.02	0.71		41.4	2
30	90-1, 33-36	0.01	0.44		51.3	3
31	92-2, 148-150	0.02	0.67		39.1	2

the characteristics of a sediment drift. The strong unconformity marked by Reflector 1 at the base of the unit clearly marks the onset of drift growth.

Interval 1 to 2A

Beneath the strong unconformity defined by Reflector 1, a thin 0.08-s-thick interval is present at the site. Overlap of the basal Reflector 2A both to the northeast and southwest again suggests erosion associated with the Reflector 1 unconformity. At the site the basal reflector has a channel-like form that may be erosional in origin.

Interval 2A to 2

This interval thins to the northeast and thickens to the southwest. Truncation of the weak laterally impersistent reflectors in the overlying Reflector 2A indicate erosion at that level. The basal Reflector 2 is a particularly strong reflector that is locally faulted (e.g., at SP 11620). To the southwest, Reflector 2 passes laterally into a weaker reflector that rises westward.

Interval 2 to 3

The underlying 2-3 interval can only be confidently identified beneath the site and to the northwest. In this direction, Reflector 2 downlaps onto Reflector 3, and a thickening in the interval is present.

Interval 3 to 4

Three strong reflectors (4A, 4B, and 4C) occur in this interval at the suite. They form part of a suite of reflectors exhibiting strongly cross-cutting relationships that may be sills or lavas. To the southwest, these reflectors are not evident beneath Reflector 3 but may be masked by the strong diffractions. These reflectors are underlain at 3.08 s subsea by the strong Reflector 4 that was the objective of Site 555. Beneath Reflector 4, a number of strong but laterally impersistent events are present.

Relationship to Hatton Bank and Edoras Bank

Site 555 was located in the depressions between the two structural culminations forming these banks. To the southwest Reflector 3 rises to form the shallow (2.1 s) basement. To the northwest, Reflector 3 rises to onlap Reflector 4, which underlies the upper slope of Hatton Bank at a depth of 2.0 s.

Correlation of Seismic Reflectors

Correlation of the seismic reflectors has been mainly made using the interval transit time data provided by the sonic log and the lithologic logs.

The interval transit time data requires a small correction since sonic logging did not begin until the tool left the drill stem at 196 m subsea. This unusually great depth was necessary because of poor hole conditions. Severe cycle skipping is evident on the sonic log (Fig. 8), and the interval transit times may be in error. Correlation of the logs with lithology should thus be regarded as preliminary. Further the tool did not reach the basalt cored from 920 m to total depth at 964.5 m because of hole infilling.

Table 9 and Figure 3 summarize the correlation of the seismic reflectors:

The correlations given above should be regarded as tentative; synthetic seismograms as well as more detailed lithologic studies are required to establish them precisely. Nonetheless some general remarks can be made.

Reflector 2 is almost certainly correlative with Reflector 1 of Sites 553, 403, and 404 and is seemingly caused by a tuff close to the NP10/NP11 boundary. This reflector is thus an important time horizon that can be used regionally as a marker horizon.

Reflector 4 at 3.90 s, corresponding to the base of the basalts of Subunit Va, was identified as the basement on the seismic profile. However, the massive flows were encountered some 80 m or so below the computed depth of this reflector.

The discrepancy may have arisen for three reasons. Firstly, persistent cycle skipping on the logs may have resulted in a cumulative error (a decrease) in the interval transit time with depth. Secondly, irregularities in the basement topography and the position of the site slightly off the control profile may account for the discrepancy. Thirdly, the strong reflection from basalts of Unit Va and the long seismic wavelength may have masked the sandstone interval between Subunits Va and Vc.

SEDIMENT ACCUMULATION RATES

Ninety-eight cores were recovered from Site 555. The following major lithologic and stratigraphic units are recorded.

Cores 1-26: Neogene sediments (Pleistocene-Miocene, NN21-NN3)

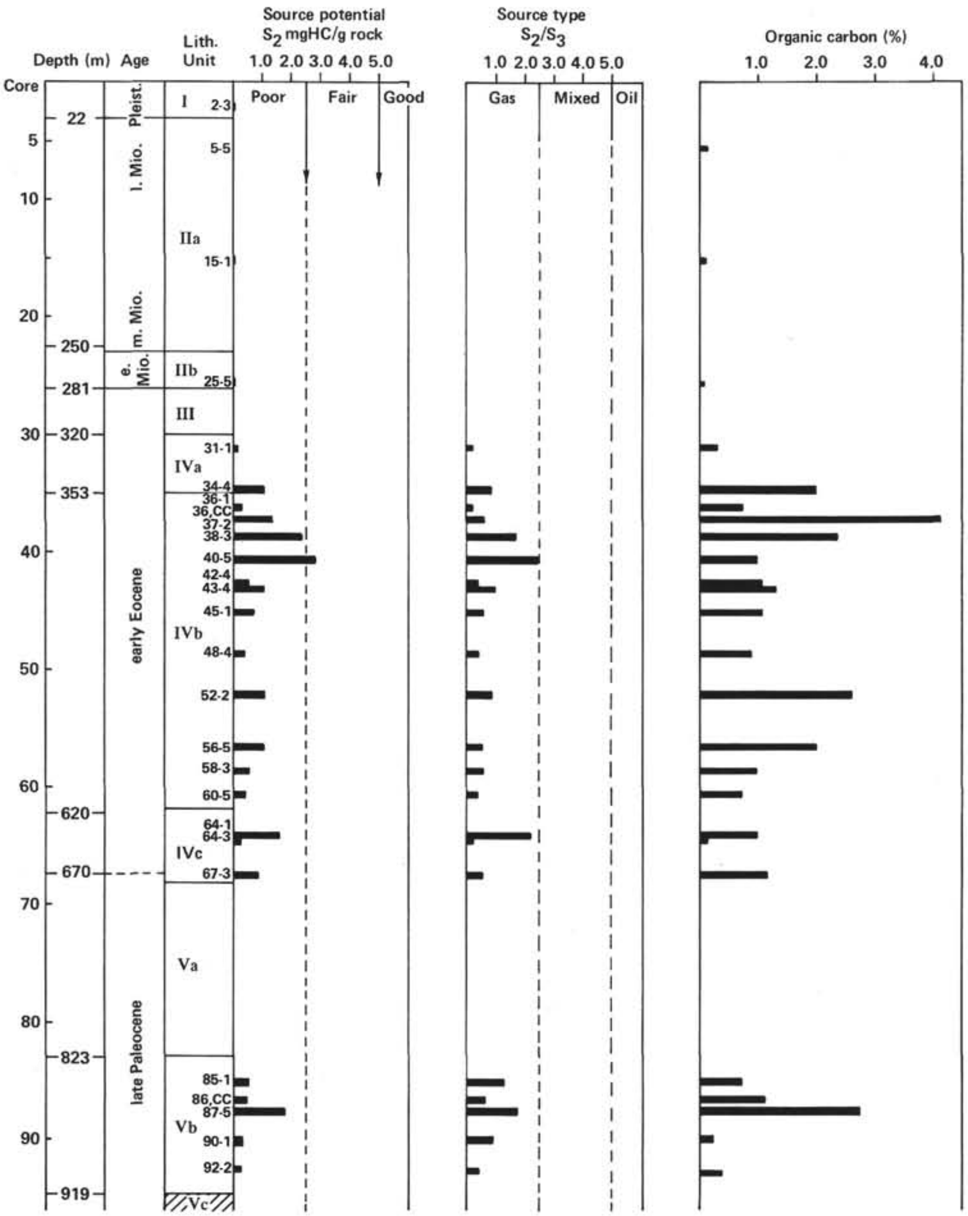


Figure 16. Sediment pyrolysis data, Site 555.

Cores 27–68: Paleogene sediments (early Eocene, NP12/13–NP10)

Cores 68–83: Basalt

Cores 84–93: Paleogene sediments (Paleocene, NP9)

Cores 94–98: Basalt

The Pleistocene sedimentation rate is 1.3 cm/1000 yr. The entire Pliocene appears to be missing (Fig. 19; Table 10). This hiatus probably begins close to the Miocene/Pliocene boundary and ends in the lowermost part of the Pleistocene. In view of the fact that sedimentation rates increased at about the Miocene/Pliocene boundary in Sites 552 and 553, it follows that the bottom current influence at Site 555 was different from that at the former sites. The reason for this difference probably lies in differences in depth of the three sites: Site 552, 2301 m; Site 553, 2329 m; Site 555, 1659 m. The changing sedimentation patterns thus indicate a major reorganization of flow regimes of intermediate and deep waters in the western part of the Rockall area at approximately the Miocene/Pliocene boundary, albeit differently expressed at different water depths.

Moreover, Site 555 differs from Sites 552 and 553 in showing a comparatively thick middle Miocene sequence. A short hiatus representing Zone NN4 and probably a part of Zone NN5 is present in Core 24. The 24-m-thick lower Miocene sequence ends in 26,CC. The drilling breccia in the uppermost 20 cm in Core 27 consists of a mixture of early Miocene and early Eocene sediments. Some sedimentary lumps in the breccia exclusively represent Zones NP12 and NP13 of the early Eocene.

Zone NP11 shows a sedimentation rate of 5.2 cm/1000 yr., which must be considered as a minimum value since the top of this zone is associated with a hiatus. The earliest part of the Eocene, Zone NP10, shows a

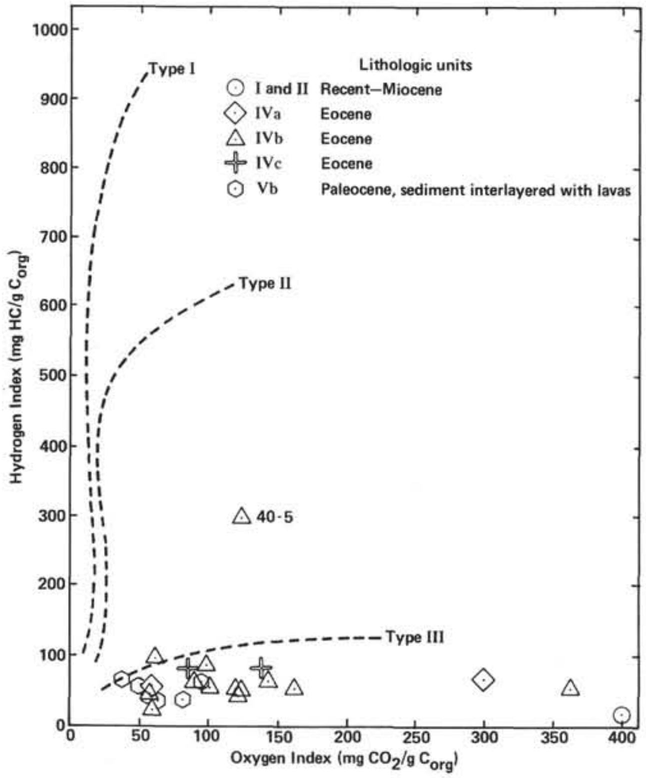


Figure 17. Kerogen-type plot of sediments, Site 555.

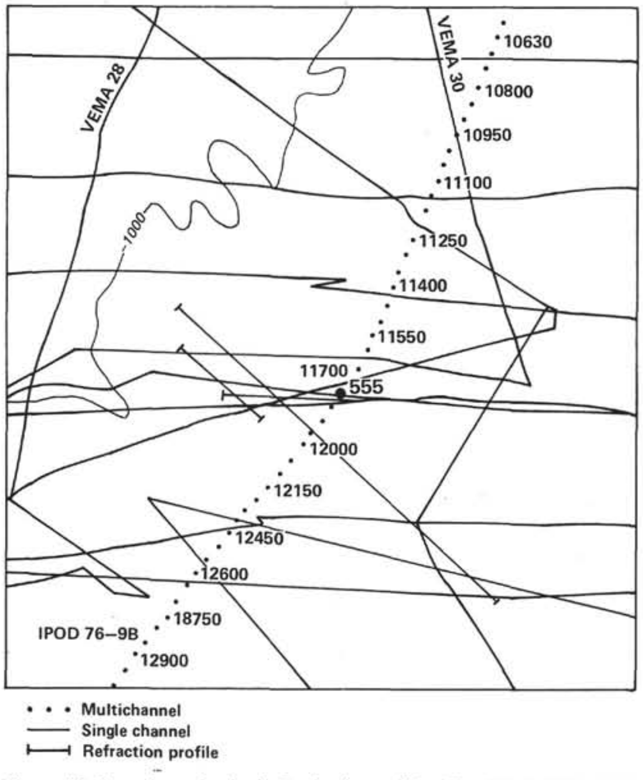


Figure 18. Location of principal seismic profiles, Site 555 (56°33.70′N; 20°46.93′W).

Table 8. Seabed reflectors, Site 555.

	Two-way time (s)	
Reflectors	Total	Subsea
Seabed	2.18	
1A	2.29	0.08
1	2.45	0.27
2A	2.53	0.35
2	2.67	0.49
3	2.72	0.34
4A	2.81	0.63
4B	2.91	0.73
4C	3.00	0.82
4	3.10	0.92

Note: This numbering system does not imply any common seismic identity with units identified at Sites 552–554.

Table 9. Correlation of seismic reflectors.

Time (two-way)		Depth		
Reflector no.	Total (s)	Subsea (s)	Subsea (m)	Lithology/age
Seabed	2.18		0	
1A[a]	2.29	0.11	82	Washed interval, poor recovery
1[a]	2.45	0.27	202	Transition calcareous-biosiliceous ooze?
2A	2.53	0.35	216	Poor recovery
2	2.67	0.49	336	Tuffaceous glauconitic sandstone below NP10/11 boundary?
3	2.72	0.54	391	Base of cemented sandstones in Unit IIIC
4A	2.81	0.63	475	Transition tuffs to interbedded mudstones and sandstones Unit IIIc
4B	2.91	0.73	561–576	Change in cementation sandstones?
4C	3.00	0.82	671–681	Top basalt Unit IVa
4	3.10	0.92	791–831	Base basalt Unit IVa

[a] Computed from physical properties data.

sedimentation rate of 26.5 cm/1000 yr. However, Cores 46 through 56 are barren of nannofossils and Cores 57 through 67 lack age-indicative fossils. Therefore, one cannot exclude the possibility that the lower part of the interval, which is interpreted to represent Zone NP10 (Cores 32 through 67), may actually belong to NP9. In consequence, the suggested sedimentation rate of 26.5 cm/1000 yr. for this interval may be somewhat high. The entire sedimentary sequence which is interlayered between the basalts (Cores 83–93) is thought to represent NP9, which gives a sedimentation rate of 9.5 cm/1000 yr. This is considered to represent a minimum value since both the upper and the lower boundary of Zone NP9 are unknown at Site 555.

Accumulation Rates

The accumulation rates span the period early Miocene to Pleistocene (Fig. 20; Table 11). The total accumulation rate ranges from moderate values in the early

Miocene through high values in the middle and late Miocene to moderate values in the Pleistocene. The total $CaCO_3$ rates follow the same pattern. However, although the nannofossils show a similar pattern, in detail they show fluctuations reciprocating those of the foraminifers. The middle late Miocene section has the appearance of a contourite, and this shows clearly on the seismic profile (Fig. 3).

SUMMARY AND CONCLUSIONS

The structure and topography of the west margin of Rockall Plateau has already been discussed in terms of three distinct units (see Site 553).

The most landward (Fig. 2) of these units comprises the Hatton and Edoras banks which form the western culmination of the Rockall Plateau and are separated from the shallower Rockall Bank by the intervening Hatton–Rockall Basin (Figs. 2, 4).

In detail, the Hatton and Edoras banks are flat-topped and are the highest parts of the culmination defining this third unit.

Drilling on the Hatton–Edoras Bank offered the opportunity to compare its subsidence history with that obtained on the thin crust of structural Unit 2 to the west for the period both during and after rifting. This would aid assessment of the relative roles of rifting and postrift differential subsidence in fashioning the observed structural relief.

Site 555 was located midway between the Hatton and Edoras banks near SP 11780 on line IPOD 76-9B.

Late Paleocene

Basaltic lava flows (lithologic Unit IV) interbedded with sediment were drilled from 672 m sub-bottom to total depth at 964.0 m.

The basalts drilled from 927.0 m to total depth at 964.0 m compose a single massive flow unit with a fine-grained chilled top that contrasts with the coarser-grained doleritic interior. No pillowed upper surface was evident. The flow exhibits reverse polarity.

In the overlying basalts, 11 flow units were identified in the recovered core. These consist of single, relatively thick flows or single and composite pillow lava units. The more massive flow units are extensively cross cut by high angle and near horizontal fractures. In thin section, these thick dolerites are mainly phyric, consisting of bytownite (An_{74}) and augite with minor olivine; subophitic textures are common. In the upper part of these units, plagioclase phenocrysts are altered to clays.

The pillow basalts are comparable in composition to the more massive flows except that olivine is absent. Individual flow units rarely exceed 1 m thickness. Textures within individual pillows reflect chilling and cooling behavior. Within the chilled glassy rind, radially disposed elongate vesicles pass into the coarse-grained and less-vesicular core of the pillow. Incipient brecciation occurs at the pillow margins. Interbedded with basalts are 47 m of autoclastic(?) breccias with thin intercalations of sediment. The breccias consist mainly of angular clasts of basalt and basaltic glass (hyaloclastites) set in a cement of analcite and saponite. Minor amounts of terrigenous sand are also present. Toward the top of the breccias, there are indications of sedimentary reworking.

Shallow marine sediments are interbedded with the basalts of Units IV. These sediments show reverse polarity and are of late Paleocene (NP9) age. They consist of tuffs and lapilli tuffs interbedded with poorly sorted micaceous and feldspathic sandstones and silty mudstones. Plant debris and serpulids are present together with scours and cross laminae and evidence of soft sediment deformation such as sand dykes. The contact between the basal lapilli tuffs and the underlying basalt is sharp and marked by large basalt clasts with deeply altered rims.

Resting with sharp contact on the underlying basalts are sediments of NP10 age. These sediments make up Subunit IIIc and are of reverse polarity. The principal li-

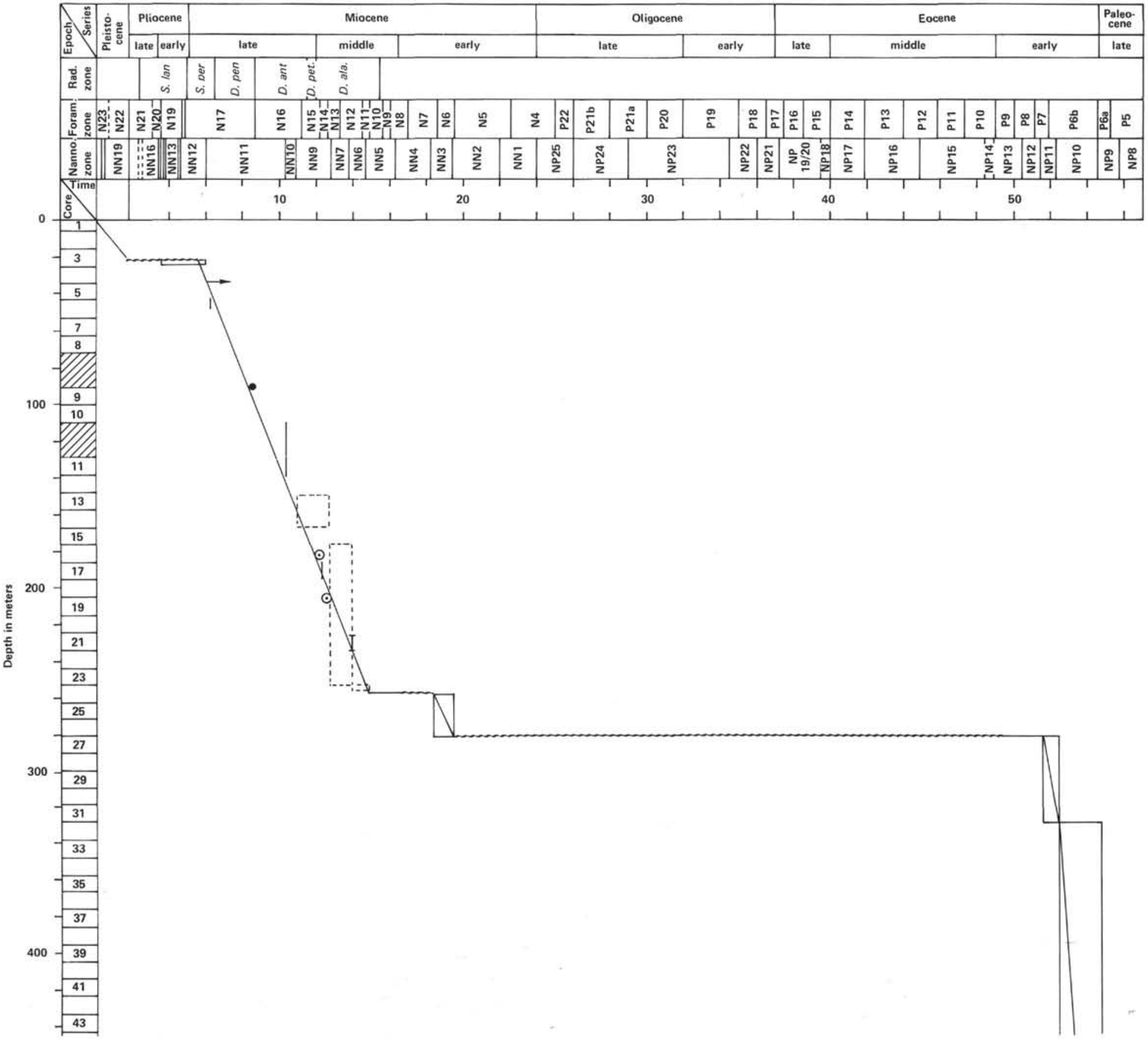
Table 10. Biostratigraphic data used to derive sedimentation rates for Site 555 (see Fig. 19).

Paleontologic event	Sub-bottom depth (m)	Ma	Sedimentation rate (cm/1000 yr.)
Younger than NN19	5.5	<0.458	1.3
NN19 L.O. *C. macintyrei*	19.5	1.45	
NN12–NN15	22–24.5	3.53–6	
Below top NN11	34	>6	
F.O. *T. convexa*, F.O. *T. miocenica*	43.5–48	6.2	
L.O. *C. plicatus*	92	8.3	
NN10/NN11	110–138.5	10.3	
NN9?	148–167	10.9–11.6	2.7
L.O. *D. punctata* var. *hustedtii*	180–186	12	
L.O. *G. mayeri*	186–195	12.2	
NN7–NN8?	176.5–252.5	12.6–13.8	
F.O. *R. barboi*	205–206	12.5	
L.O. *C. lewisianus*	226.5–233.5	13.8	
NN6	253.5–256	13.8–14.7	
NN5	256.5–257.5	14.7–16.3	1.8
NN3	259–281	18.2–19.4	
NP12/NP13	281	50.4	
NP11 F.O. *T. orthostylus*	281.5–328.5	51.4–52.2	7–11
NP10	328.5–480.5	52.2–54.6	
NP9	480.5–868	54.6–56.6	

Table 11. Data for sediment accumulation rates, Site 555.

Sample	A	B	C	D	E	F	G	H	I	J
2,CC	1.3	1.669	1.02	1.32	77	1.00	34.09	0.74	0.26	0.32
3,CC	1.3	1.811	1.26	1.64	94	1.22	20.82	0.49	0.73	0.42
4,CC	2.7	1.843	1.31	3.54	95	2.56	8.86	0.44	2.12	0.98
5,CC	2.7	1.853	1.26	3.40	96	2.59	4.79	0.24	2.35	0.81
6,CC	2.7	1.794	1.22	3.30	93	2.51	3.83	0.19	2.32	0.79
7,CC	2.7	1.749	1.21	3.27	94	2.54	6.92	0.33	2.21	0.73
8,CC	2.7	1.777	1.18	3.19	93	2.51	6.24	0.30	2.21	0.68
9,CC	2.7	1.846	1.28	3.46	94	2.54	17.95	0.89	1.65	0.92
10,CC	2.7	1.747	1.20	3.24	91	2.46	8.35	0.39	2.07	0.78
11,CC	2.7	1.710	1.12	3.02	94	2.54	8.07	0.37	2.17	0.48
12,CC	2.7	1.808	1.21	3.27	93	2.51	13.00	0.63	1.88	0.76
13,CC	2.7	1.808	1,21	3.27	93	2.51	4.05	0.20	2.31	0.76
14,CC	2.7	1.808	1.21	3.27	92	2.48	2.19	0.11	2.37	0.79
15,CC	2.7	1.739	1.12	3.02	92	2.48	5.37	0.25	2.23	0.54
16,CC	2.7	1.838	1.30	3.51	89	2.40	3.87	0.19	2.21	1.11
17,CC	2.7	1.786	1.22	3.29	93	2.51	17.54	0.85	1.66	0.78
18,CC	2.7	1.837	1.28	3.96	93	2.51	9.10	0.45	2.06	0.95
19,CC	2.7	1.853	1.27	3.43	92	2.48	6.19	0.31	2.17	0.95
20,CC	2.7	1.775	1.19	3.21	92	2.48	9.92	0.47	2.01	0.73
21,CC	2.7	1.760	1.18	3.19	93	2.51	12.28	0.58	1.93	0.68
22,CC	2.7	1.778	1.15	3.10	93	2.51	6.94	0.33	2.18	0.59
23,CC	2.7	1.778	1.15	3.10	95	2.56	36.21	1.73	0.83	0.54
24-7, 55	1.8	1.739	1.07	1.93	95	1.71	30.79	0.96	0.75	0.22
25,CC	1.8	1.669	1.04	1.87	92	1.66	25.64	0.77	0.89	0.21
26,CC	1.8	1.803	1.21	2.18	81	1.46	20.72	0.67	0.59	0.72

Note: For key to letters, see Site 552 chapter.


Epoch
Series
Pleisto-cene
Pliocene
late
early
Miocene
late
middle
early
Oligocene
late
early
Eocene
late
middle
early
Paleo-cene
late
Rad. zone
S. lan
S. per
D. pen
D. ant
D. pet.
D. ala.
Foram. zone
N23
N22
N21
N20
N19
N17
N16
N15
N14
N13
N12
N11
N10
N9
N8
N7
N6
N5
N4
P22
P21b
P21a
P20
P19
P18
P17
P16
P15
P14
P13
P12
P11
P10
P9
P8
P7
P6b
P6a
P5
Nanno. zone
NN19
NN16
NN13
NN12
NN11
NN10
NN9
NN7
NN6
NN5
NN4
NN3
NN2
NN1
NP25
NP24
NP23
NP22
NP21
NP 19/20
NP18
NP17
NP16
NP15
NP14
NP13
NP12
NP11
NP10
NP9
NP8
Time
Core
10
20
30
40
50
0
100
200
300
400
Depth in meters
1
3
5
7
8
9
10
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43

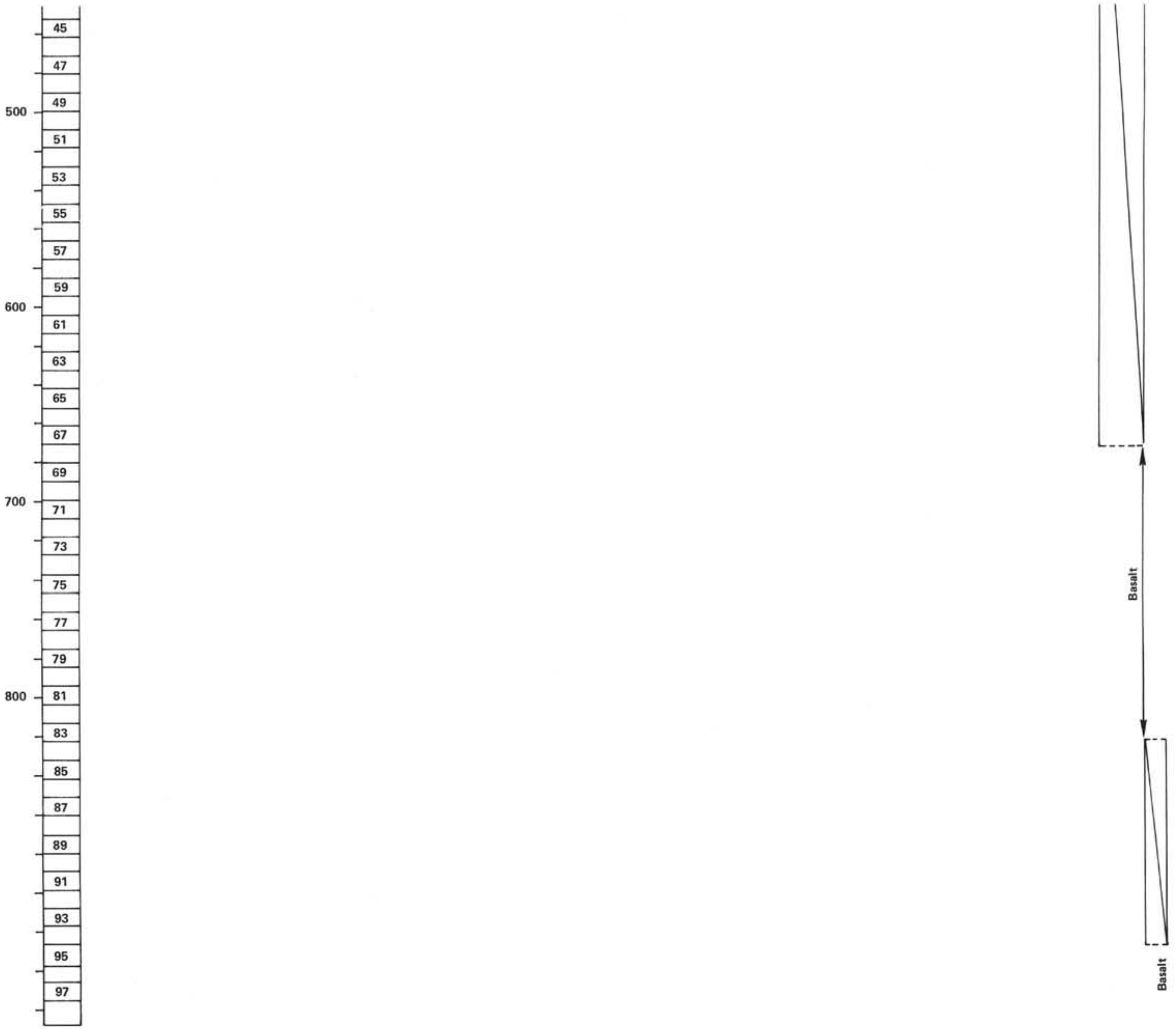


Figure 19. Sedimentation rates, Site 555.

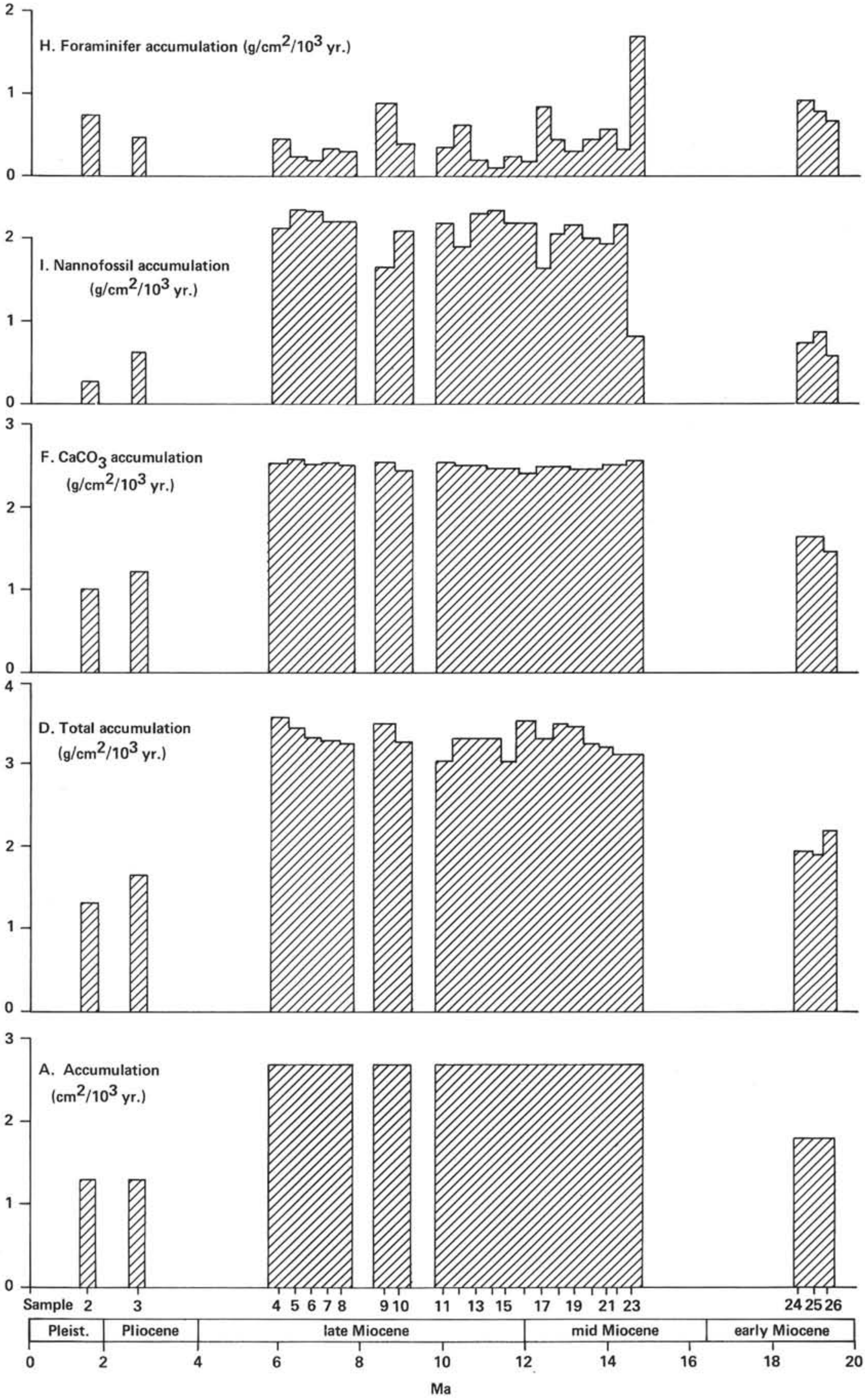


Figure 20. Neogene sediment accumulation rates, Site 555. (See Site 552 for explanation of lettering A to H.)

thologies are vitric tuffs and lapilli tuffs with minor interbeds of calcite-cemented sandstones and carbonaceous mudstones. The volcanic glass is of basaltic type, but in many cases is severely altered. Typical sedimentary structures include slumps, microfaults, and regular and convoluted laminae. Grading and, in one instance, reverse grading is present in the lapilli tuff beds. The subunit is barren of planktonic foraminifers, diatoms, and radiolarians, but the benthic foraminifers are indicative of inner-shelf depths.

These primarily volcanogenic sediments pass upward into the sediments of Subunit IIId, of late Paleocene (NP10) age (Cores 48 to 63). The predominant facies in this subunit is a brownish black carbonaceous mudstone with interbeds of highly feldspathic sandstones, many of which are calcite cemented. Various types of shell and shell debris occur throughout and include serpulids, gastropods, thin-shelled bivalves, and ahermatypic solitary corals; plant debris is present throughout in small amounts. Benthic foraminifers show an upward decrease in depths of deposition, from inner shelf (Core 61) to brackish intertidal marsh by Core 52. Seismic Reflector 4B may be caused by lithological changes within the subunit, but Reflector 4A, close to the boundary with the overlying subunit, reflects the differences in tuff content.

Subunit IIId is considered to be equivalent to lithologic Unit IVd at Site 553. Furthermore, the normal polarity interval found in Cores 58–62 correlates with that in Cores 35–37 at Site 553, demonstrating the equivalence of the section below at Site 555 to the basalts (and dipping reflectors) of Site 553.

Subunit IIIc is represented by a series of volcanic tuffs and lapilli tuffs interbedded with carbonaceous mudstones and highly feldspathic sandstones of early Eocene (NP10) age. A significant proportion of the tuff beds are intermediate to acidic in composition, indicating a correlation with Subunit IVc of Site 553, and are interbedded with a coarse sand. During the intervening periods, carbonaceous mudstones accumulated with somewhat slower sedimentation rates.

The appearance of abundant glauconite marks the upward transition from Subunits IIIc to IIIb. Subunit IIIb is of NP10 age in its lower part and NP11 age at the top, and exhibits reverse polarity in its lower part and normal polarity in the upper. Tuffaceous glauconitic sandstones, black to greenish black in color, characterize this unit, and represent the same major transgressive event as that at the base of Subunit IVb at Site 553. The base of the unit is also marked by the upward disappearance of the epidote–amphibole heavy mineral association indicating the cessation of supply from south Greenland. Heavy minerals indicate derivation from the metamorphic basement of the Rockall Plateau throughout.

The unit shows an upward-decreasing gamma response. Principal sedimentary structures include laminae and flaser bedding. Benthic foraminifers show an increase in water depth of deposition from 25–100 to 100–200 m, which accords with the interpretation of the unit as marking a major transgression.

The overlying subunit, IIIa, is marked by poor recovery, and the low fragments were disturbed intensely. The principal lithologies are vitric spiculite, glauconitic zeolitic chalk, vitric tuff, and a bioclastic limestone, of NP11 age. Volcanic glass is of basaltic type and is rarely altered. Although benthic foraminifers suggest water depths of deposition of 150 to 200 m, thick-shelled oysters also present suggest higher energy conditions and proximity to shore. The lower boundary falls within NP11. The uppermost part of the unit is of normal polarity. The comparable lithologies, biostratigraphy, and magnetostratigraphy suggest that Unit III is the lateral equivalent of the upper part of Unit IVb at Site 553.

Early Miocene

A hiatus of 30 m.y. is represented by the unconformity between the early Eocene volcanogenic beds and the overlying chalks of early Miocene age. During this hiatus from 50 to 19.5 m.y., the site evidently subsided close to its present depth, and the supply of terrigenous and volcaniclastic material was completely cut off. Perhaps surprisingly, no seismic reflection is associated with the hiatus, but truncation of beds at the level of Reflector 2 just below the unconformity is convincing evidence of erosion.

The early Miocene section consists of glauconite-rich oozes and chalks deposited in water depths in excess of 1500 m. Decreasing content of glauconite upward is also shown by a concomitant decrease in gamma response. A small hiatus representing NN4 time is present between the early Miocene and the succeeding middle Miocene. The early Miocene accumulated at a rate of 1.8 cm/1000 yr.

Middle Miocene–Early Pliocene

The middle Miocene section is characterized by the absence of glauconite. The principal lithology consists of bluish white foraminifer–nannofossil or biosiliceous foraminifer–nannofossil ooze. Clay components comprise about 10% of the sediment, and the biosiliceous components are diatoms, radiolarians and sponge spicules. A single pyritized ash bed (2 cm in thickness) is present in Core 15 but is clearly older (NN7–8) than that found at Site 552 (NN19). Sedimentary structures have been mostly destroyed by drilling. However, faint clay(?) laminae may be shown in the logs by increased gamma response, although transformation of ooze to chalk is another possible explanation. Depths of deposition were in excess of 1400 m.

A small hiatus is present in the lowermost part of the middle Miocene (Fig. 19). Sediments accumulated at an average rate of 1.8 cm/1000 yr.

Pliocene–Pleistocene

A hiatus beginning close to the Miocene/Pliocene boundary and ending at about 1.5 m.y. ago separates the late Miocene from the Pleistocene. The Pleistocene shows the expected alternations of foraminifer–nannofossil oozes, marls, and calcareous muds distinguished by color, texture, and composition that contrast markedly with the uniform lithologies below. These cyclical variations, extensively disturbed by drilling, probably represent glacial-interglacial cycles. Sediments accumulated in the Pleistocene at 1.3 cm/1000 yr. in depths comparable to those at present. In comparison to the underlying late Miocene, nannofossil accumulation rates show a sharp decline although foraminifers accumulated at a slightly higher rate.

REFERENCES

Berggren, W. A., 1972. Late Pliocene-Pleistocene glaciation. *In* Laughton, A. S., Berggren, W. A., et al., *Init. Repts. DSDP*, 12: Washington (U.S. Govt. Printing Office), 953-963.

Bukry, D., 1973. Coccolith and silicoflagellate stratigraphy, Tasman Sea and South Western Pacific Ocean. *In* Burns, R. E., Andrews, J. E., et al., *Init. Repts. DSDP*, 21: Washington (U.S. Govt. Printing Office), 885-893.

Costa, L., and Downie, C., 1979. Cenozoic dinocyst stratigraphy of Sites 403 to 406, Rockall Plateau. *In* Montadert, L., Roberts, D. G., et al., *Init. Repts. DSDP*, 48: Washington (U.S. Govt. Printing Office), 513-529.

Ericson, D. B., and Wollin, G., 1968. Pleistocene climates and chronology in deep-sea sediment. *Science*, 162:1214-1217.

Featherstone, P. S., Bott, M. H. P., and Peacock, J. H., 1977. Structure of the continental margin of southeastern Greenland. *Geophys. J.*, 48:15-40.

Harrison, R. A., Knox O'B., R. W., and Morton, A. C., 1979. Petrography and mineralogy of volcanogenic sediments, DSDP Sites 403-404, Leg 48. *In* Montadert, L., Roberts, D. G., et al., *Init. Repts. DSDP*, 48: Washington (U.S. Govt. Printing Office), 771-786.

Hinz, K., 1982. A hypothesis on terrestrial catastrophes: Wedges of very thick oceanward dipping layers beneath passive continental margins—Their origin and palaeoenvironmental significance. *Geol. Jahrb. Ser. E.*, 22:3-28.

Hutchinson, D., Grow, J., et al., in press. Tectonic and depositional patterns off Eastern North America. *Mem. Am. Assoc. Petr. Geol.*

Laughton, A. S., Berggren, W. A., et al., 1972. *Init. Repts. DSDP*, 12: Washington (U.S. Govt. Printing Office).

Macintyre, A., Kipp, N. G., et al., 1976. Glacial North Atlantic 18,000 yr. ago: A climap reconstruction. *In* Cline, R. M., and Hays, J. D. (Eds.), *Investigation of Late Quaternary Paleoceanography and Paleoclimatology. Mem. Geol. Soc. Am.*, 145, 43-76.

Martini, E., 1971. Standard Tertiary and Quaternary calcareous nannoplankton zonation. *Proc. Second Planktonic Conf.:* Rome (Technoscienza), 2:739-785.

Montadert, L., Roberts, D. G., et al., 1979. *Init. Repts. DSDP*, 48: Washington (U.S. Govt. Printing Office).

Poore, R. Z., and Berggren, W. A., 1975. Late Cenozoic planktonic foraminifera, biostratigraphy and climatology: Hatton-Rockall Basin, DSDP Site 116. *J. Foram. Res.*, 5(4):279-293.

Riedel, W. R., and Sanfilippo, A., 1978. Stratigraphy and evolution of tropical Cenozoic radiolarians. *Micropalaeontology*, 24(1):61-96.

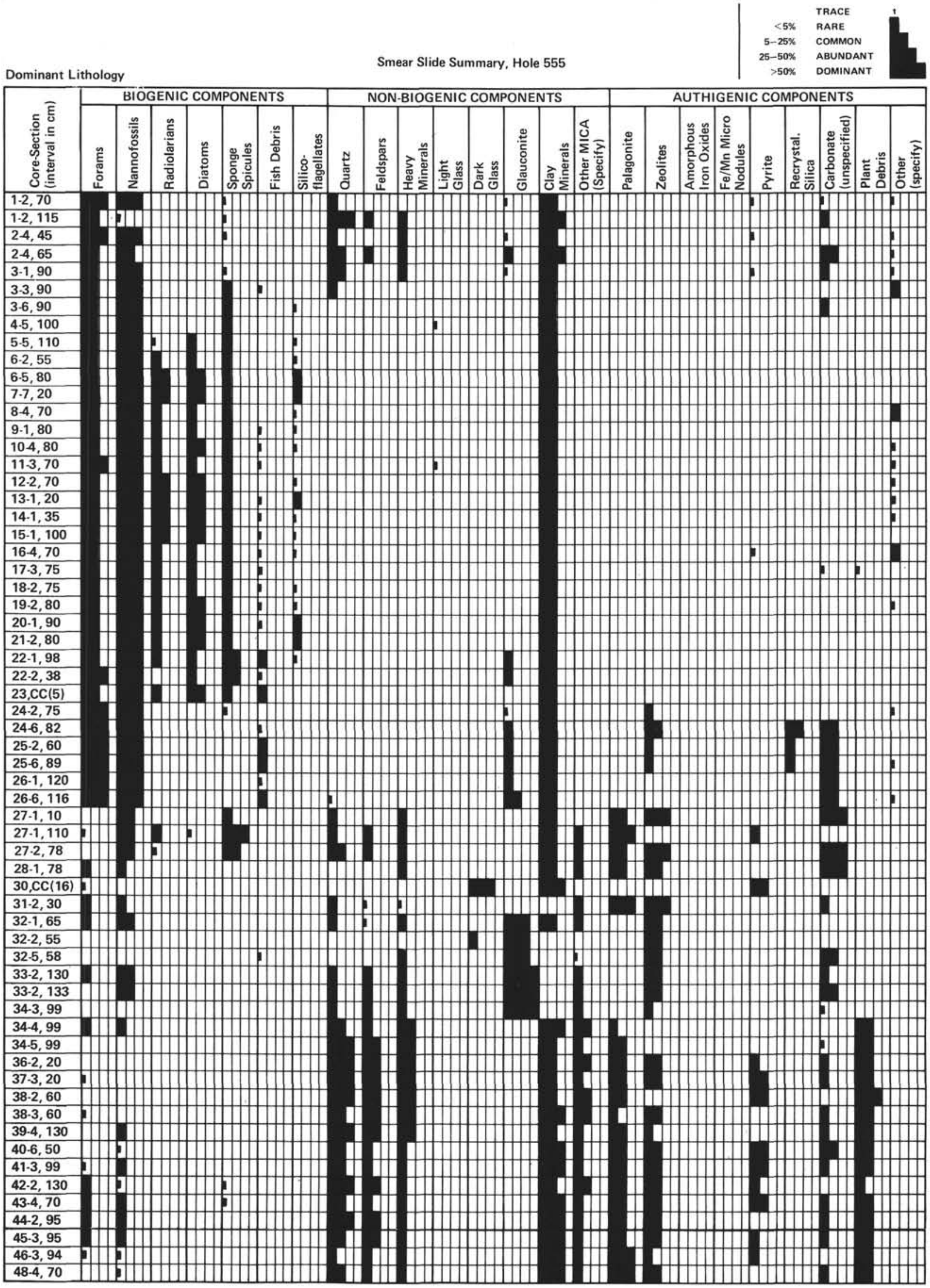
Roberts, D. G., 1975. Marine Geology of the Rockall Plateau and Trough. *Philos. Trans. R. Soc. London, Ser. A.*, 278:447-509.

Roberts, D. G., Montadert, L., and Searle, R. C., 1979. The Western Rockall Plateau: Stratigraphy and crustal evolution. *In* Montadert, L., Roberts, D. G., et al., *Init. Repts. DSDP*, 48: Washington (U.S. Govt. Printing Office), 1061-1088.

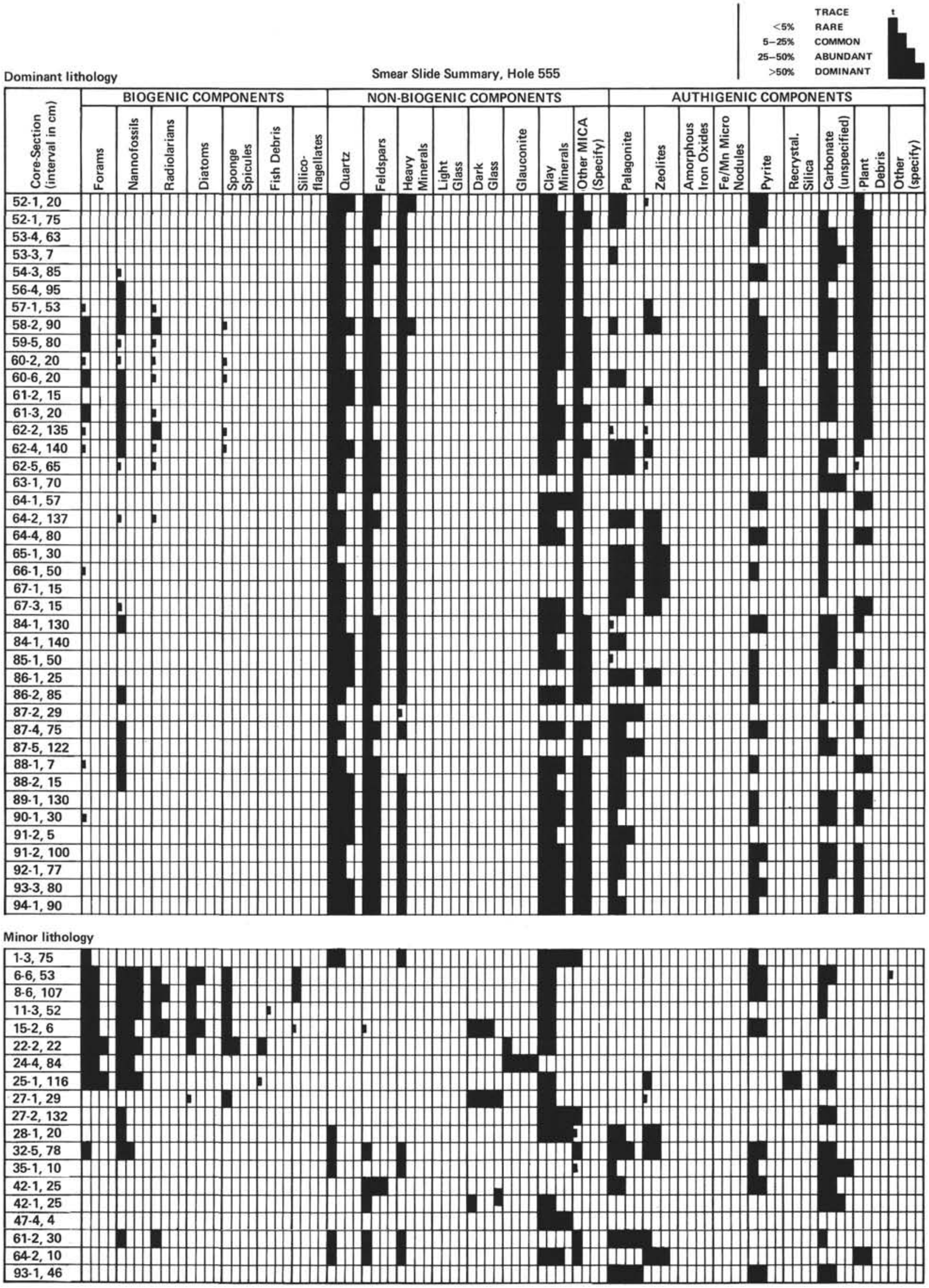
Scrutton, R. A., 1972. The crustal structure of Rockall Plateau microcontinent. *Geophys. J.*, 27(3):259-275.

Vail, P. R., Mitchum, R. M., and Thompson, S., 1977. Global cycles of relative changes in sea level. *Mem. Am. Assoc. Pet. Geol.*, 26: 83-98.

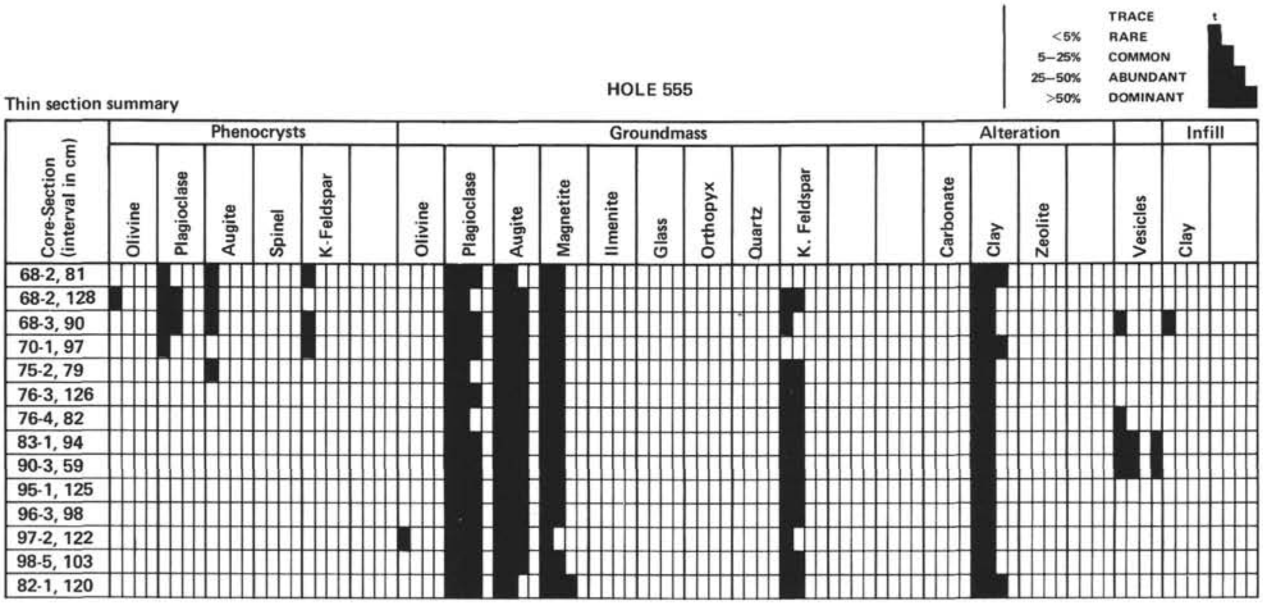
APPENDIX A
Smear Slides



Appendix A. (Continued).



Appendix A. (Continued).



APPENDIX B
Bryozoa from Leg 81

Krister Brood, Paleozoologiska sektionen, Riksmuseet, 104 05
Stockholm, Sweden

Two samples from Site 555 have been investigated for bryozoans. Sample 555-28,CC contains numerous identifiable bryozoan fragments. All are badly worn, and it is almost impossible to make even a generic identification of the bryozoans. The specimens are approximately 1 to 2 mm long and of rather uniform size, suggesting some transportation and current sorting. Unfortunately, the bryozoans are recrystallized, which makes their identification even more difficult.

The bryozoan fauna is dominated by cyclostomes but many cheilostomes are also present.

The following cyclostomes were identified from Sample 555-28,CC: *Diastopora* sp., *Nevianopora cf. bialternata* (Gregory, 1893), *Crisisina carinata* (Römer, 1840), *Idmidronea* sp., *Pustulopora* sp., *Crisina* cf. *farehamensis* (Gregory, 1893).

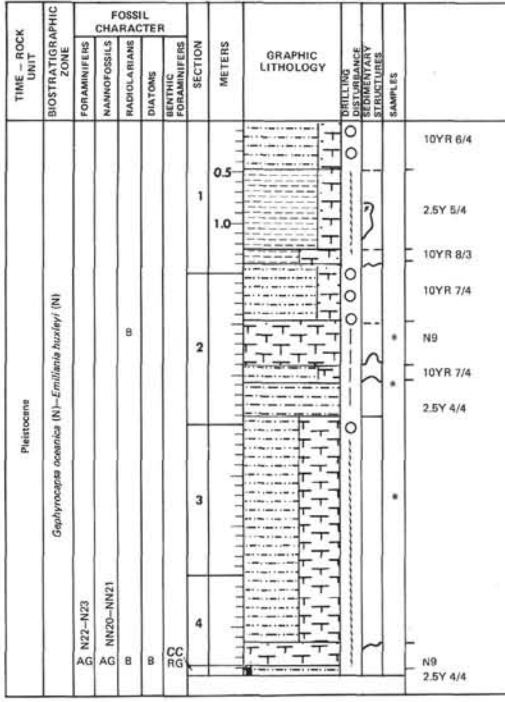
Since there is no complete identification of specimens, it is impossible to attribute a certain age to the samples. However, the fauna seems to be consistent with the upper Paleocene or lower Eocene (Gregory, 1893). It must be remembered, however, that the bryozoan fauna from this interval is badly known and a certain determination is not possible even when good bryozoan faunas are present.

The composition of the fauna (with a high content of idmidronids, crisinids, and erect diastoporids) suggests that the bryozoans have grown on a shelf in moderately deep water below the wave base.

REFERENCE

Gregory, J. W., 1893. On the British Palaeogene Bryozoa. *Trans. Zool. Soc. London*, 42(8):219–279.

SITE 555 HOLE CORE 1 CORED INTERVAL 0.0–5.5 m



LITHOLOGIC DESCRIPTION

CALCAREOUS MUD, olive brown (2.5Y 4/4) and dark olive brown (2.5Y 2/4) in color; interbedded with FORAM OOZE, white (N9) and FORAM MARL, very pale brown (10YR 7/4) and light yellowish brown (10YR 6/4).

Sediments are in cyclical arrangement, although very disturbed.

Foram content gives ooze coarse *textural* appearance. Ooze also contains grains of shale.

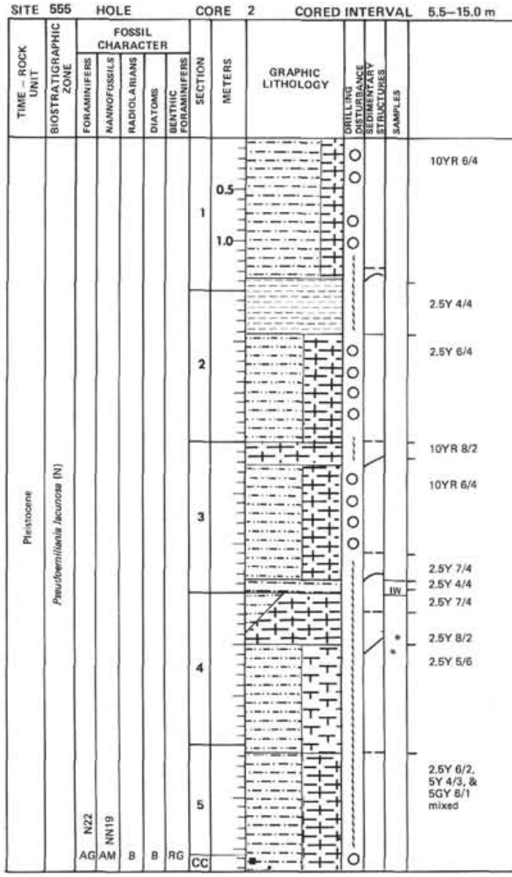
Dropstone in Core-Catcher (gray sandstone).

SMEAR SLIDE SUMMARY (%):

	2, 70 D	2, 115 D	3, 75 M
Texture:			
Sand	60	30	5
Silt	20	30	5
Clay	30	40	90
Composition:			
Quartz	2	30	10
Feldspar	–	3	–
Mica	Tr	–	2
Heavy minerals	–	2	1
Clay	8	53	82
Glauconite	Tr	–	–
Pyrite	Tr	–	3
Carbonate unspec.	Tr	2	–
Foraminifers	60	10	2
Calc. nannofossils	30	Tr	–
Sponge spicules	Tr	Tr	–
Ech. spines	Tr	–	–

CARBONATE BOMB (%):
2, 70 = 88
2, 115 = 31

SITE 555 HOLE CORE 2 CORED INTERVAL 5.5–15.0 m



LITHOLOGIC DESCRIPTION

FORAM MARL, light olive brown (10YR 6/4) and light yellowish brown (2.5Y 6/4) in color, interbedded with NANNO FORAM OOZE, white (2.5Y 8/2) and CALCAREOUS MUD, olive brown (2.5Y 4/4).

Sediments are in cyclical arrangement, although very disturbed.

Foram marls appear coarser in texture due to foram content – otherwise mud texture. Black grains of shale are found throughout.

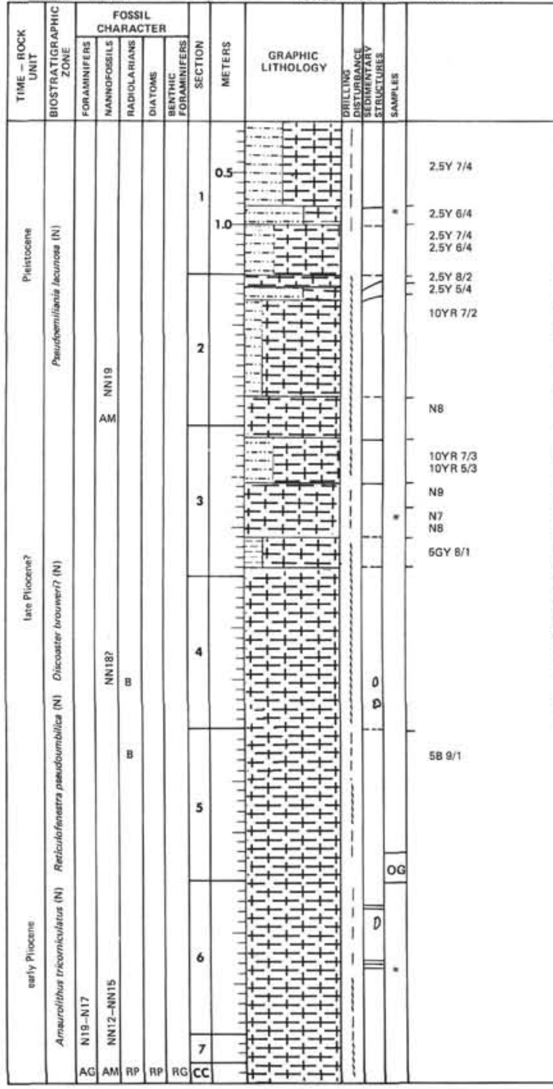
Large dropstone in Core-Catcher (basalt).

SMEAR SLIDE SUMMARY (%):

	4, 45 D	4, 65 D
Texture:		
Sand	30	30
Silt	30	20
Clay	40	50
Composition:		
Quartz	2	10
Feldspar	–	3
Heavy minerals	1	2
Clay	20	49
Glauconite	Tr	1
Pyrite	Tr	–
Carbonate unspec.	–	5
Foraminifers	35	20
Calc. nannofossils	42	10
Sponge spicules	Tr	–
Ech. Spines	Tr	Tr

$CaCO_3$ BOMB (%):
3, 140 = 30
4, 45 = 77
4, 65 = 21

SITE 555 HOLE CORE 3 CORED INTERVAL 15.0–24.5 m



LITHOLOGIC DESCRIPTION

NANNO FORAM OOZE, white (N9) to bluish white (5B 9/1) to light gray (N7) in color, interbedded in the upper sections with:

NANNO FORAM MARL, light yellowish brown (2.5Y 6/4) to very pale brown (10YR 7/2) and light olive brown (2.5Y 5/4).

Black grains of shale are found above Section 2, 124 cm. Core appears to firm at this point as well. Shale grains and firm areas (nanno foram ooze – N9) in cyclical arrangement throughout Sections 3 and 4; Sections 5–6 are firm and structureless, except for some very faint lamina in Section 6.

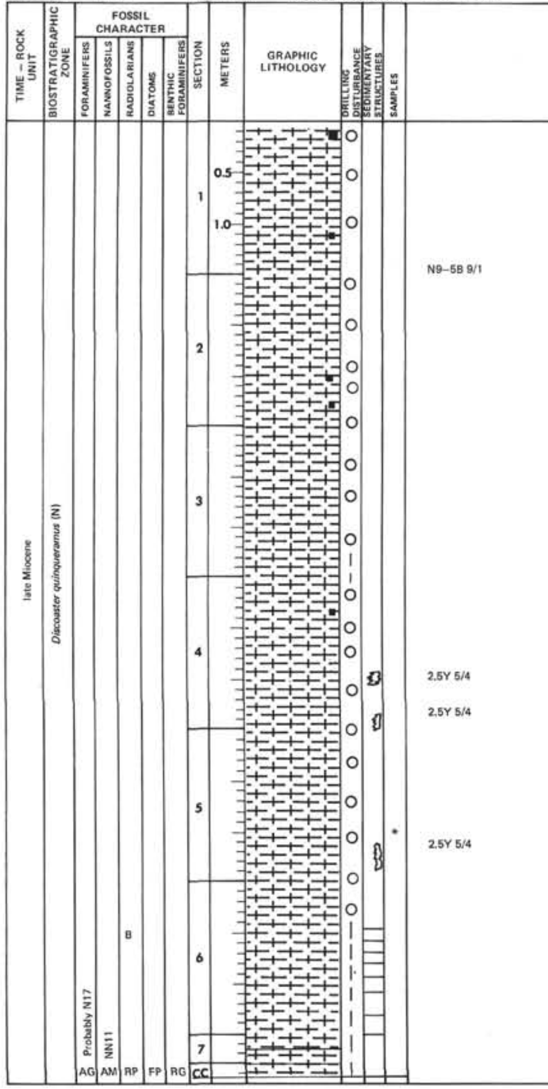
Cyclicity decreases down core.

SMEAR SLIDE SUMMARY (%):

	1, 90 D	3, 90 D	6, 90 D
Texture:			
Sand	25	20	15
Silt	15	20	15
Clay	60	60	70
Composition:			
Quartz	10	2	–
Heavy minerals	2	–	–
Clay	20	10	15
Glauconite	Tr	–	–
Pyrite	Tr	–	–
Carbonate unspec.	1	–	2
Foraminifers	15	20	15
Calc. nannofossils	43	65	67
Sponge spicules	Tr	2	1
Silicoflagellates	–	–	Tr
Fish remains	–	Tr	–
Ech. spines	Tr	1	–

CARBONATE BOMB (%):
1, 87 = 48
6, 90 = 94

SITE 555 HOLE CORE 4 CORED INTERVAL 24.5–34.0 m



LITHOLOGIC DESCRIPTION

FORAM NANNO OOZE, white (N9) to bluish white (5B 9/1) in color.

Core is highly disturbed throughout. Some faint lamina (yellowish gray [5Y 8/1] and medium light gray [N6]) are preserved in Section 6.

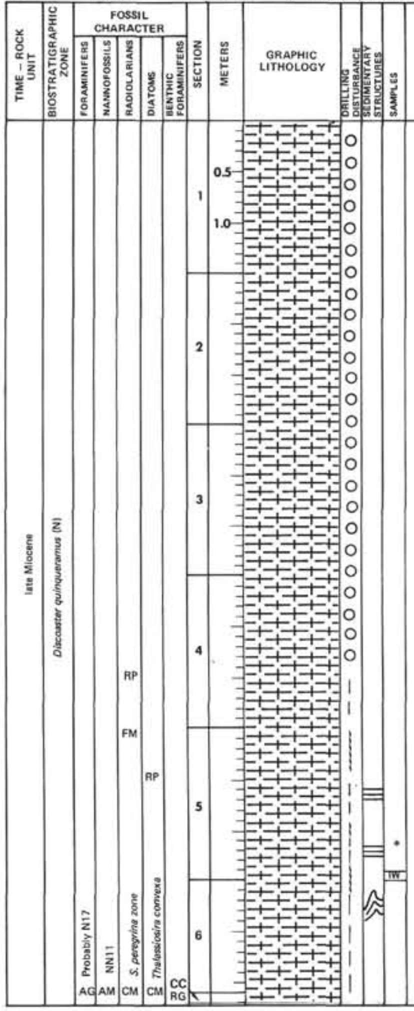
Dropstones (up hole contamination) are scattered throughout as are areas of light olive brown sediment in Sections 4 and 5.

SMEAR SLIDE SUMMARY (%):

	5, 100 D
Texture:	
Sand	15
Silt	15
Clay	70
Composition:	
Clay	10
Volcanic glass	Tr
Foraminifers	19
Calc. nannofossils	70
Sponge spicules	1

CARBONATE BOMB (%):
5, 111 = 95

SITE 555 HOLE CORE 5 CORED INTERVAL 34.0–43.5 m



LITHOLOGIC DESCRIPTION

5B 9/1

FORAM NANNO OOZE, bluish white (5B 9/1) in color.

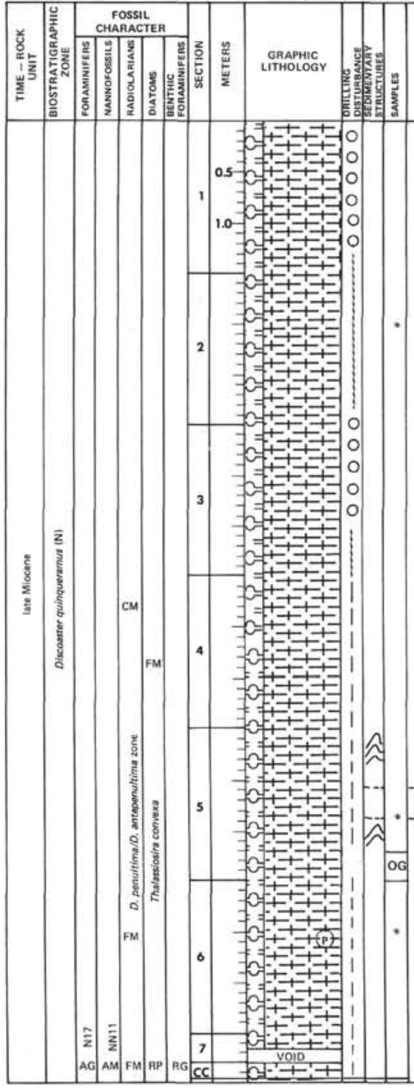
Core is highly disturbed in the upper 4 sections, firming in the lower part. Where firm, the sediment shows some very vague mottles and lamina, yellowish gray (5Y 8/1) to medium light gray (N6).

SMEAR SLIDE SUMMARY (%):

	5, 110
	D
Texture:	
Sand	10
Silt	10
Clay	80
Composition:	
Clay	10
Foraminifers	15
Calc. nannofossils	69
Diatoms	4
Radiolarians	Tr
Sponge spicules	2
Silicoflagellates	Tr

CARBONATE BOMB (%):
5, 110 = 96
5, 140 = 96

SITE 555 HOLE CORE 6 CORED INTERVAL 43.5–53.0 m



LITHOLOGIC DESCRIPTION

5B 9/1

5Y 8/1

5B 9/1

FORAM NANNO OOZE, bluish white (5B 9/1) in the upper sections – grading to BIOSILICEOUS FORAM NANNO OOZE in yellowish gray (5Y 8/1) areas in the lower sections.

Core is highly disturbed but firming in lower sections.

Deformed lamina, yellowish gray (5Y 8/1) and medium light gray (N6), throughout the lower sections.

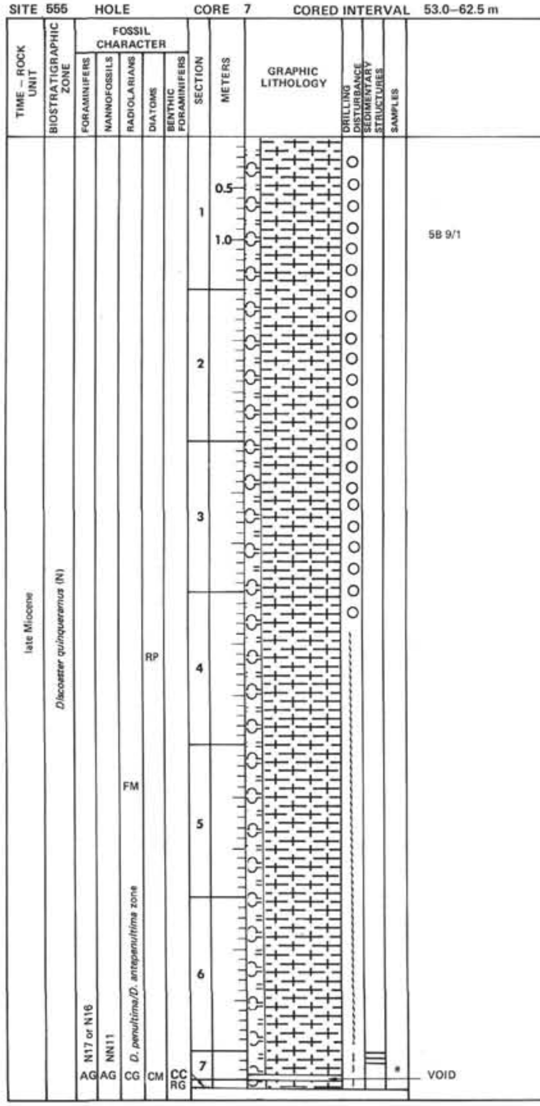
Section 6, 53 cm – pyrite nodule.

SMEAR SLIDE SUMMARY (%):

	2, 55	5, 80	6, 53
	D	D	M
Texture:			
Sand	10	10	20
Silt	10	10	10
Clay	80	80	70
Composition:			
Clay	10	10	10
Pyrite	–	–	10
Carbonate unspec.	–	–	10
Foraminifers	15	10	15
Calc. nannofossils	67	68	45
Diatoms	3	5	5
Radiolarians	3	5	2
Sponge spicules	2	1	2
Silicoflagellates	1	1	1
Ech. spines	–	–	Tr

CARBONATE BOMB (%):
2, 55 = 94
6, 55 = 92

SITE 555 HOLE CORE 7 CORED INTERVAL 53.0–62.5 m



LITHOLOGIC DESCRIPTION

BIOSILICEOUS FORAM NANNO OOZE, bluish white (5B 9/1) in color.

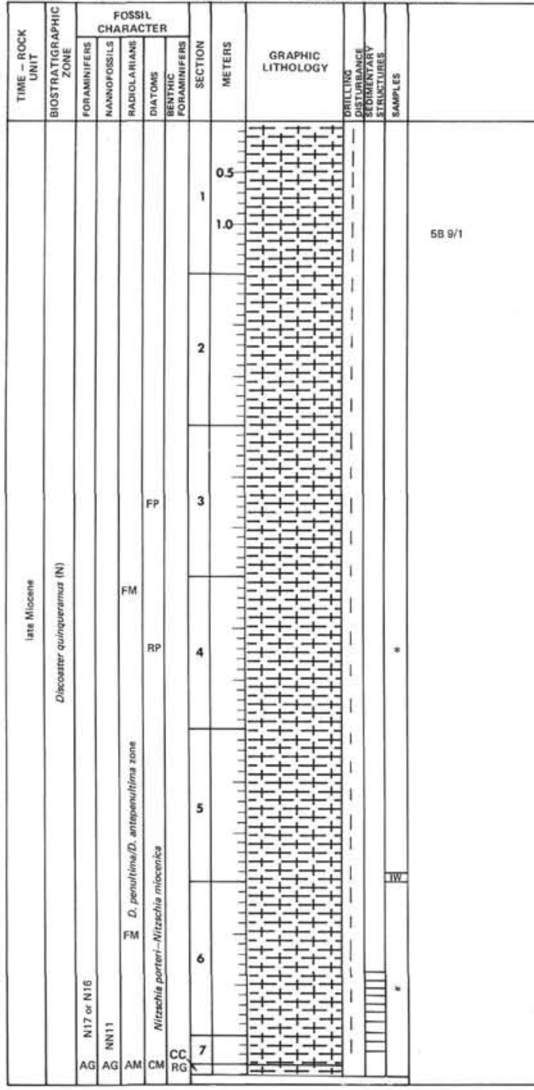
Core is highly disturbed to Section 7, where it firms and shows vague lamina of light greenish gray (5GY 8/1) and medium light gray (N6).

SMEAR SLIDE SUMMARY (%):

	7, 20
	D
Texture:	
Sand	10
Silt	10
Clay	80
Composition:	
Clay	5
Foraminifers	15
Calc. nannofossils	67
Diatoms	5
Radiolarians	5
Sponge spicules	2
Silicoflagellates	1

CARBONATE BOMB (%):
7, 20 = 94

SITE 555 HOLE CORE 8 CORED INTERVAL 62.5–72.0 m



LITHOLOGIC DESCRIPTION

FORAM NANNO OOZE, bluish white (5B 9/1) in color.

Core is moderately deformed throughout, with areas of flow-in. In general, however, the ooze has stiffened.

Vague lamina and mottles, light greenish gray (5G 8/1) and medium light gray (N6) present throughout.

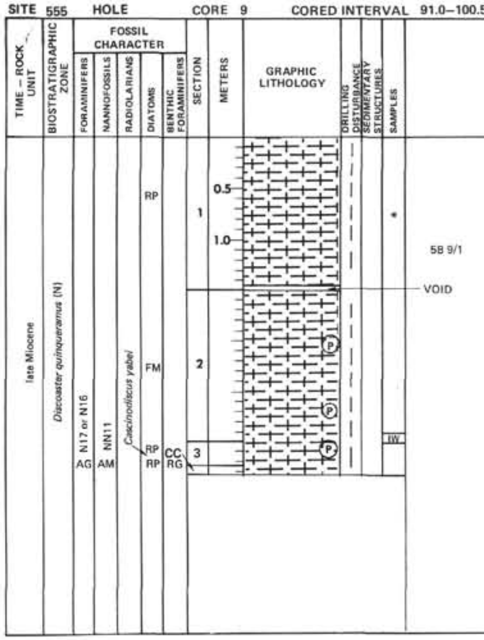
Section 6, 60–150 cm – area where lamina are more prominent. Gray lamina has concentrated pyrite (smear slide Section 6, 107 cm).

SMEAR SLIDE SUMMARY (%):

	4, 70	6, 107
	D	M
Texture:		
Sand	10	10
Silt	10	10
Clay	80	80
Composition:		
Clay	10	10
Pyrite	–	10
Carbonate unspec.	–	1
Foraminifers	15	13
Calc. nannofossils	66	65
Diatoms	3	4
Radiolarians	4	5
Sponge spicules	1	1
Silicoflagellates	Tr	1
Ech. spines	1	–

CARBONATE BOMB (%):
4, 70 = 93
5, 137 = 94

SITE 555 HOLE CORE 9 CORED INTERVAL 91.0–100.5 m



LITHOLOGIC DESCRIPTION

FORAM NANNO OOZE, bluish white (5B 9/1) in color.

Core is moderately disturbed. Vague lamina are present throughout: pale blue green (5BG 7/2), yellowish gray (5Y 8/1), and medium light gray (N6).

Pyrite blebs in the lower portion of Section 2, with great concentration between 57–63 cm.

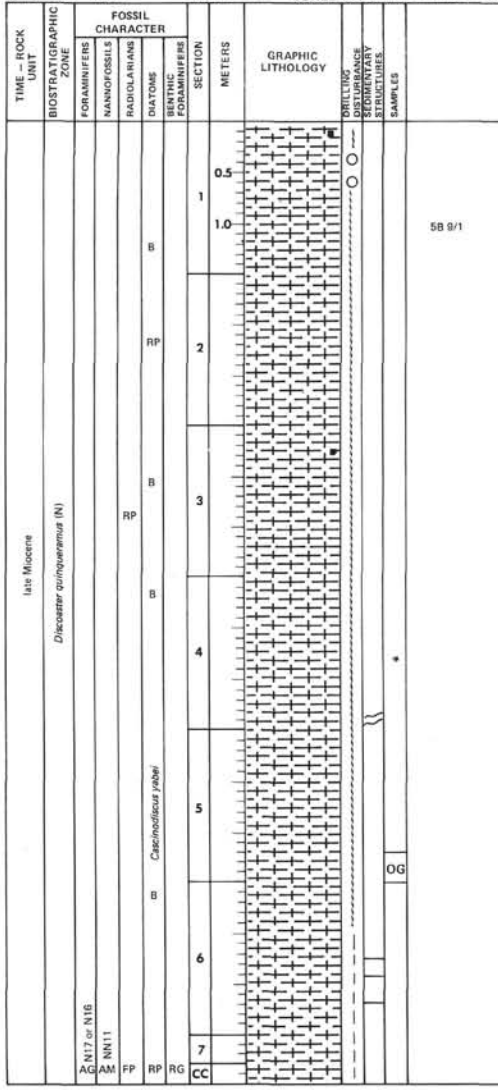
Chalky layers occur at: Section 2, 89–91 and 126–130 cm.

SMEAR SLIDE SUMMARY (%):

	1, 80
	D
Texture:	
Sand	10
Silt	10
Clay	80
Composition:	
Clay	10
Foraminifers	10
Calc. nannofossils	74
Diatoms	3
Radiolarians	2
Sponge spicules	1
Silicoflagellates	Tr
Fish remains	Tr

CARBONATE BOMB (%):
1, 10 = 94
2, 140 = 91

SITE 555 HOLE CORE 10 CORED INTERVAL 100.5–110.0 m



LITHOLOGIC DESCRIPTION

FORAM NANNO OOZE, bluish white (5B 9/1) in color.

Core is highly disturbed through Section 5. Lamina are smeared by flow-in.

Section 6, 48 cm to bottom fo core: vague lamina, slightly deformed, medium light gray (N6) and yellowish gray (5Y 8/1).

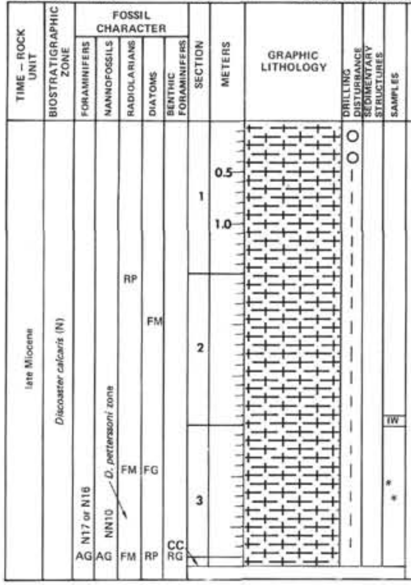
Dropstones (Section 1, 0 cm; Section 3, 30 cm) are probably downhole contaminants.

SMEAR SLIDE SUMMARY (%):

	4, 80
	D
Texture:	
Sand	15
Silt	15
Clay	70
Composition:	
Clay	10
Foraminifers	20
Calc. nannofossils	62
Diatoms	5
Radiolarians	2
Sponge spicules	1
Silicoflagellates	Tr
Fish remains	Tr

CARBONATE BOMB (%):
4, 80 = 91

SITE 555 HOLE CORE 11 CORED INTERVAL 129.0–138.5 m



5B 9/1

LITHOLOGIC DESCRIPTION

NANNO FORAM OOZE, bluish white (5B 9/1). Vague lamina throughout, medium light gray (N6), pale green (5G 7/2), and yellowish gray (5Y 8/1). Lamina especially prominent at Section 3, 23–24, 43–44, and 50–52 cm.

Core is slightly deformed.

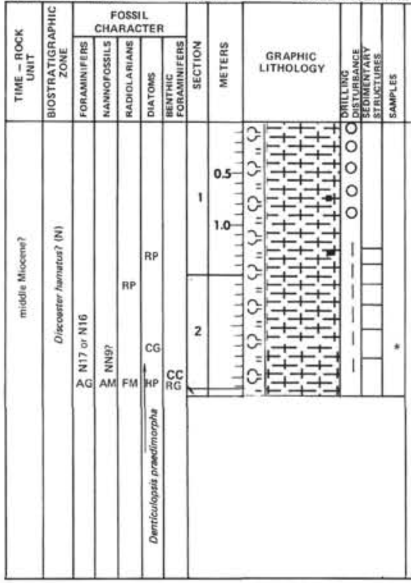
Chalk areas at Section 2, 75–79 and 85–87 cm.

SMEAR SLIDE SUMMARY (%):

	3, 52	3, 70
	M	D
Texture:		
Sand	15	20
Silt	20	20
Clay	65	60
Composition:		
Clay	10	8
Volcanic glass	–	Tr
Carbonate unspec.	2	–
Foraminifers	23	25
Calc. nannofossils	60	59
Diatoms	2	3
Radiolarians	2	2
Sponge spicules	1	2
Fish remains	Tr	Tr
Ech. spines	–	Tr

CARBONATE BOMB (%):
3, 36 = 94

SITE 555 HOLE CORE 12 CORED INTERVAL 138.5–148.0 m



5B 9/1

LITHOLOGIC DESCRIPTION

BIOSILICEOUS NANNO FORAM OOZE, bluish white (5B 9/1) in color.

Upper portion of Section 1 is highly disturbed and contains a pale yellow (2.5Y 7/4) sediment – probably downhole contaminant.

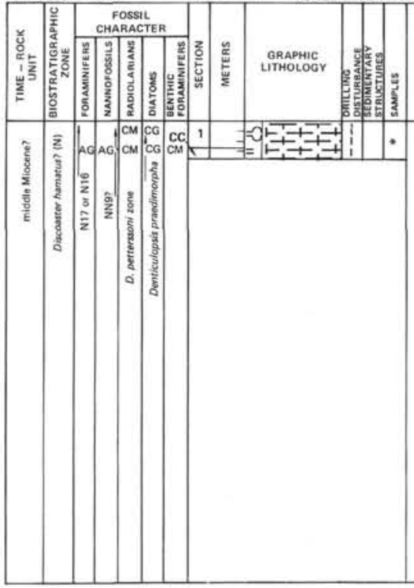
In the areas with slight disturbance, vague lamina are present: medium light gray (N6), pale green (5G 7/2), and yellowish gray (5Y 8/1).

SMEAR SLIDE SUMMARY (%):

	2, 70
	D
Texture:	
Sand	10
Silt	10
Clay	80
Composition:	
Clay	10
Foraminifers	20
Calc. nannofossils	59
Diatoms	5
Radiolarians	5
Sponge spicules	1
Silicoflagellates	Tr
Ech. spines	Tr

CARBONATE BOMB (%):
2, 80 = 93

SITE 555 HOLE CORE 13 CORED INTERVAL 148.0–157.5 m



5B 9/1

LITHOLOGIC DESCRIPTION

BIOSILICEOUS NANNO FORAM OOZE, bluish white (5B 9/1) in color.

Section 1, 0–15 cm, smeared with pale yellow (2.5Y 3/4) sediment – downhole contaminant.

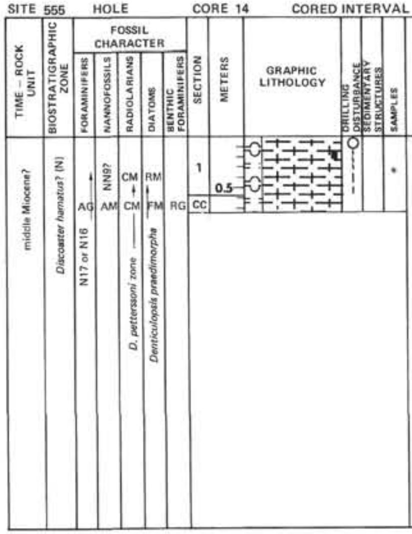
Core-Catcher shows faint lamina: medium light gray (N6), pale green (5G 7/2), and yellowish gray (5Y 8/1).

SMEAR SLIDE SUMMARY (%):

	1, 20
	D
Texture:	
Sand	10
Silt	10
Clay	80
Composition:	
Clay	10
Carbonate unspec.	1
Foraminifers	20
Calc. nannofossils	55
Diatoms	7
Radiolarians	5
Sponge spicules	1
Silicoflagellates	1
Fish remains	Tr
Ech. spines	Tr

CARBONATE BOMB (%):
CC = 93

SITE 555 HOLE CORE 14 CORED INTERVAL 157.5–167.0 m



5B 9/1

LITHOLOGIC DESCRIPTION

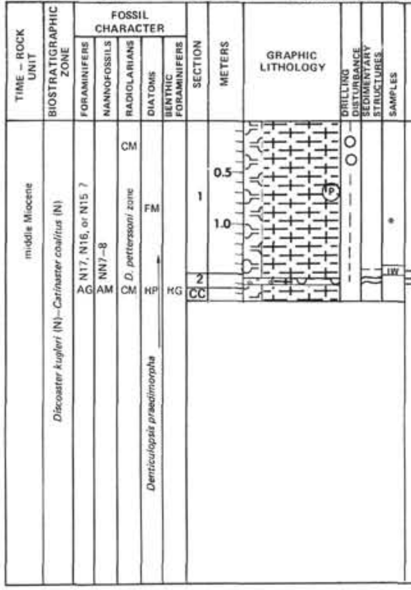
BIOSILICEOUS NANNO FORAM OOZE, bluish white (5B 9/1) in color. Vague mottles and lamina: medium light gray (N6), pale green (5G 7/2), yellowish gray (5Y 8/1).

SMEAR SLIDE SUMMARY (%):

	1, 35
	D
Texture:	
Sand	15
Silt	20
Clay	65
Composition:	
Clay	10
Foraminifers	20
Calc. nannofossils	58
Diatoms	5
Radiolarians	5
Sponge spicules	2
Silicoflagellates	Tr
Fish remains	Tr
Ech. spines	Tr

CARBONATE BOMB (%):
1, 25 = 92

SITE 555 HOLE CORE 15 CORED INTERVAL 167.0–176.5 m



LITHOLOGIC DESCRIPTION

5B 9/1

BIOSILICEOUS FORAM NANNO OOZE, bluish white (5B 9/1) in color. Vague lamina and mottles: medium light gray (N6), pale green (5G 7/2), yellowish gray (5Y 8/1).

Section 2, 5–7 cm: pyritized ash, grayish black (N2) – mixed zone above (0–5 cm): light gray (N7) in color.

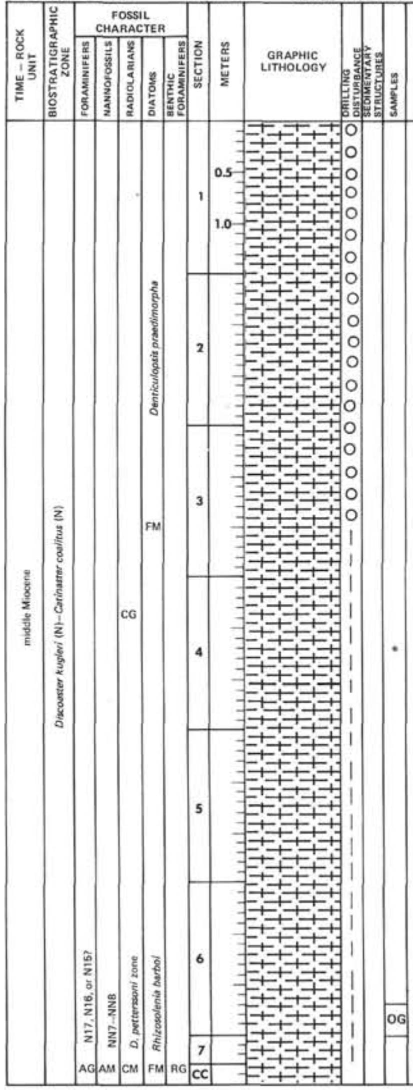
N7
N2
5B 9/1

SMEAR SLIDE SUMMARY (%):

	1, 100	2, 6
	D	M
Texture:		
Sand	10	30
Silt	10	40
Clay	80	30
Composition:		
Feldspar	–	Tr
Clay	10	5
Volcanic glass	–	25
Pyrite	–	10
Foraminifers	15	5
Calc. nannofossils	63	18
Diatoms	5	20
Radiolarians	5	15
Sponge spicules	2	2
Silicoflagellates	Tr	Tr

CARBONATE BOMB (%):
1, 95 = 92
1, 140 = 94

SITE 555 HOLE CORE 16 CORED INTERVAL 176.5–186.0 m



LITHOLOGIC DESCRIPTION

5B 9/1

FORAM NANNO OOZE, bluish white (5B 9/1) in color.

Core is highly disturbed in upper sections, but firm to slight disturbance below.

Vague mottles throughout: pale green (5G 7/2), yellowish gray (5Y 8/1), and medium light gray (N6).

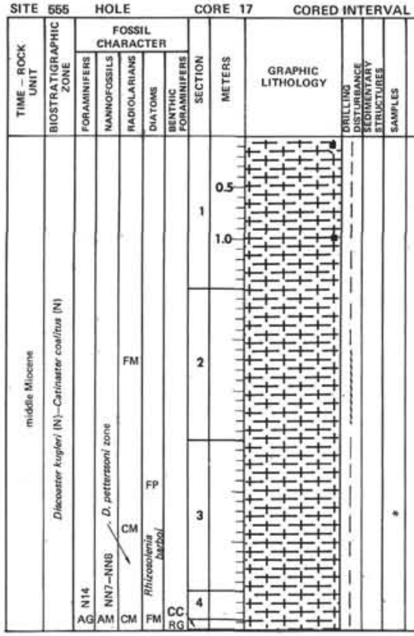
Appears faintly burrowed in Section 7.

SMEAR SLIDE SUMMARY (%):

	4, 70
	D
Texture:	
Sand	10
Silt	10
Clay	80
Composition:	
Clay	10
Pyrite	Tr
Carbonate unspec.	1
Foraminifers	15
Calc. nannofossils	67
Diatoms	4
Radiolarians	2
Sponge spicules	1
Silicoflagellates	Tr
Fish remains	Tr

CARBONATE BOMB (%):
5, 55 = 89

SITE 555 HOLE CORE 17 CORED INTERVAL 186.0–195.5 m



LITHOLOGIC DESCRIPTION

5B 9/1

FORAM NANNO OOZE, bluish white (5B 9/1) in color.

Vague and indistinct mottles: light greenish gray (5GY 8/1), yellowish gray (5Y 8/1), and medium light gray (N6).

Alternating soft and firm areas.

Section 2, 42–50 cm prominent burrow with dark halo.

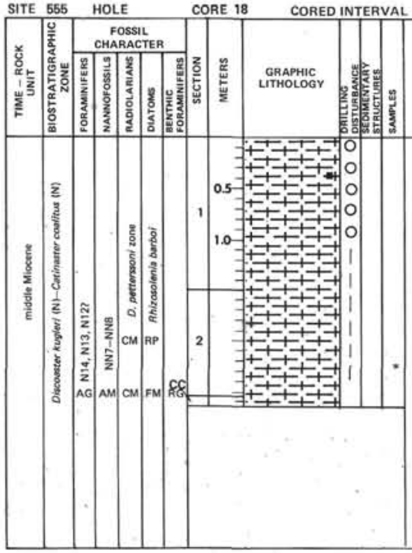
Section 4, 10–13 cm: chalky.

SMEAR SLIDE SUMMARY (%):

	3, 75
	D
Composition:	
Clay	10
Foraminifers	15
Calc. nannofossils	70
Diatoms	2
Radiolarians	2
Sponge spicules	1
Fish remains	Tr
Dolomite rhombs	Tr

CARBONATE BOMB (%):
3, 73 = 93

SITE 555 HOLE CORE 18 CORED INTERVAL 195.5–205.0 m



LITHOLOGIC DESCRIPTION

5B 9/1

FORAM NANNO OOZE, bluish white (5B 9/1) in color.

Vague mottles throughout, predominantly yellowish gray (5Y 8/1). Occasional pyrite blebs (N6) are also present.

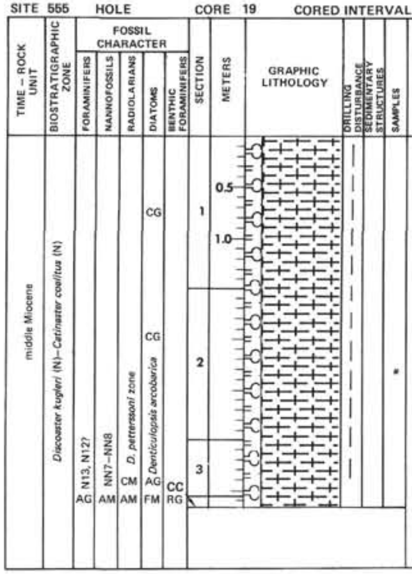
Chalky areas: Section 2, 31–33, 48–49, and 60–69 cm.

SMEAR SLIDE SUMMARY (%):

	2, 75
	D
Texture:	
Sand	10
Silt	10
Clay	80
Composition:	
Clay	10
Foraminifers	19
Calc. nannofossils	65
Diatoms	2
Radiolarians	3
Sponge spicules	1
Silicoflagellates	Tr
Fish remains	Tr

CARBONATE BOMB (%):
2, 70 = 93

SITE 555 HOLE CORE 19 CORED INTERVAL 205.0–214.5 m



LITHOLOGIC DESCRIPTION

5B 9/1

BIOSILICEOUS NANNO FORAM OOZE, bluish white (5B 9/1) in color, mottled with yellowish gray (5Y 8/1) and minor medium light gray (N6).

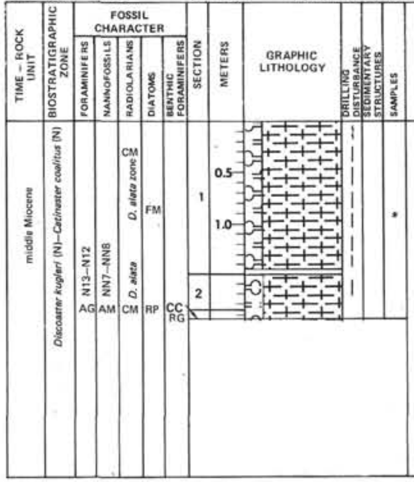
Alternating chalk and ooze.

SMEAR SLIDE SUMMARY (%):

	2, 80
	D
Texture:	
Sand	15
Silt	15
Clay	70
Composition:	
Clay	10
Foraminifers	20
Calc. nannofossils	59
Diatoms	5
Radiolarians	4
Sponge spicules	2
Silicoflagellates	Tr
Fish remains	Tr
Ech. spines	Tr

CARBONATE BOMB (%):
2, 87 = 92
2, 140 = 92

SITE 555 HOLE CORE 20 CORED INTERVAL 214.5–224.0 m



LITHOLOGIC DESCRIPTION

5Y 8/1

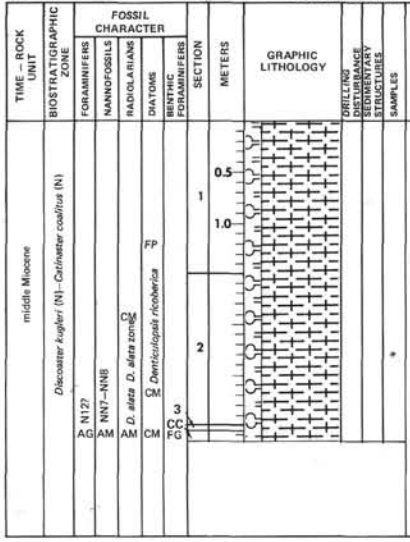
BIOSILICEOUS FORAM NANNO OOZE, yellowish gray (5Y 8/1) in color. Very faintly mottled with grayish orange (10YR 7/4).

SMEAR SLIDE SUMMARY (%):

	1, 90
	D
Texture:	
Sand	10
Silt	10
Clay	80
Composition:	
Clay	10
Foraminifers	15
Calc. nannofossils	65
Diatoms	5
Radiolarians	2
Sponge spicules	2
Silicoflagellates	1
Fish remains	Tr

CARBONATE BOMB (%):
1, 75 = 92

SITE 555 HOLE CORE 21 CORED INTERVAL 224.0–233.5 m



LITHOLOGIC DESCRIPTION

5B 9/1

BIOSILICEOUS NANNO FORAM OOZE, bluish white (5B 9/1) in color. Very faintly and sparsely mottled with yellowish gray (5Y 8/1).

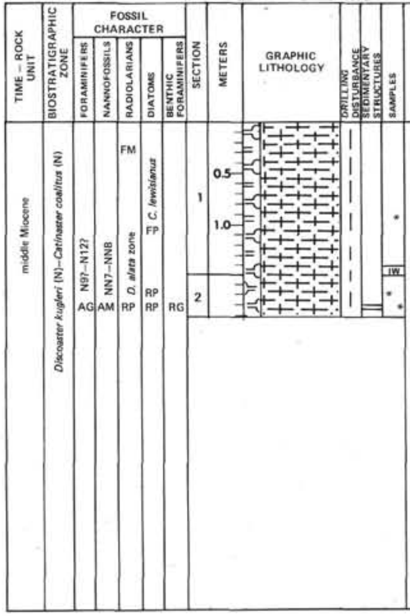
Alternating ooze and chalk.

SMEAR SLIDE SUMMARY (%):

	2, 80
	D
Texture:	
Sand	15
Silt	15
Clay	70
Composition:	
Clay	10
Foraminifers	20
Calc. nannofossils	59
Diatoms	5
Radiolarians	4
Sponge spicules	3
Silicoflagellates	1

CARBONATE BOMB (%):
2, 74 = 93

SITE 555 HOLE CORE 22 CORED INTERVAL 233.5–243.0 m



LITHOLOGIC DESCRIPTION

5B 9/1

BIOSILICEOUS NANNO FORAM OOZE, bluish white (5B 9/1) in color. Very faintly laminated in: medium light gray (N6), yellowish gray (5Y 8/1), and pale green (10G 6/2).

Becoming chalky throughout.

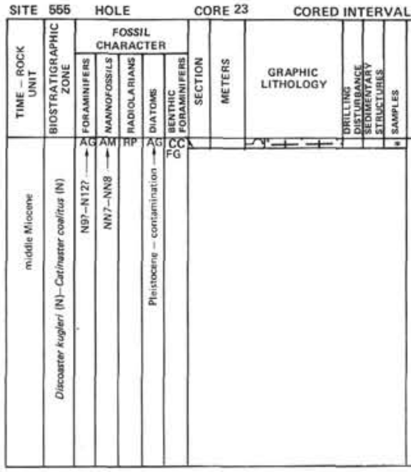
Section 2, 34–35 cm: bed of scattered pale green (10G 6/2) grains – glauconite.

SMEAR SLIDE SUMMARY (%):

	1, 98	2, 22	2, 38
	D	M	D
Texture:			
Sand	15	20	25
Silt	15	20	25
Clay	70	60	50
Composition:			
Clay	10	10	10
Glauconite	1	1	2
Foraminifers	20	30	30
Calc. nannofossils	58	51	38
Diatoms	3	2	3
Radiolarians	2	0	–
Sponge spicules	5	5	7
Silicoflagellates	Tr	–	–
Fish remains	1	1	Tr

CARBONATE BOMB (%):
1, 125 = 93
1, 142 = 90

SITE 555 HOLE CORE 23 CORED INTERVAL 243.0–252.5 m



LITHOLOGIC DESCRIPTION

5B 9/1

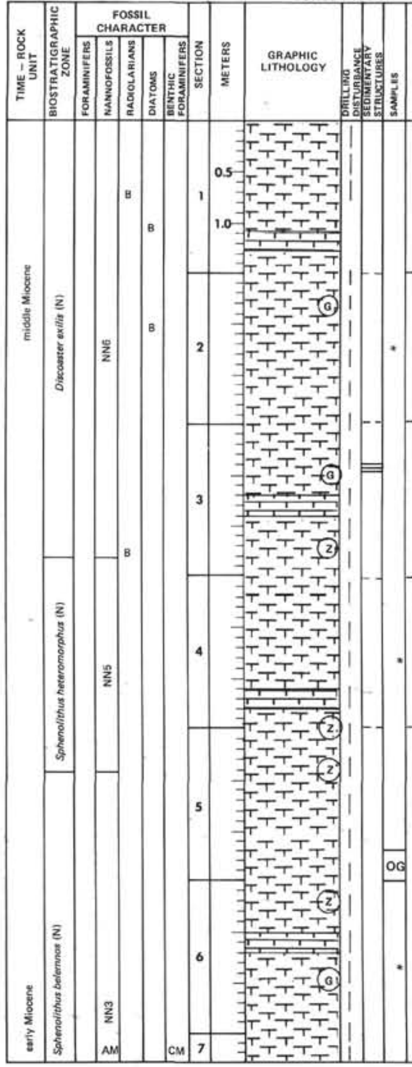
BIOSILICEOUS FORAM NANNO OOZE, bluish white (5B 9/1) in color.

Core-Catcher only.

SMEAR SLIDE SUMMARY (%):

	CC
	D
Texture:	
Sand	10
Silt	10
Clay	80
Composition:	
Clay	10
Foraminifers	15
Calc. nannofossils	69
Diatoms	5
Radiolarians	4
Sponge spicules	1
Fish remains	1

SITE 555 HOLE CORE 24 CORED INTERVAL 252.5–262.0 m



LITHOLOGIC DESCRIPTION

N9

N9–10YR 8/2

N9–5G 8/1

N9

N9–5G 8/1

NANNO FORAM OOZE AND CHALK, white (N9) in color. Glauconite grains dispersed throughout.

Ooze and chalk alternate throughout, otherwise generally structureless.

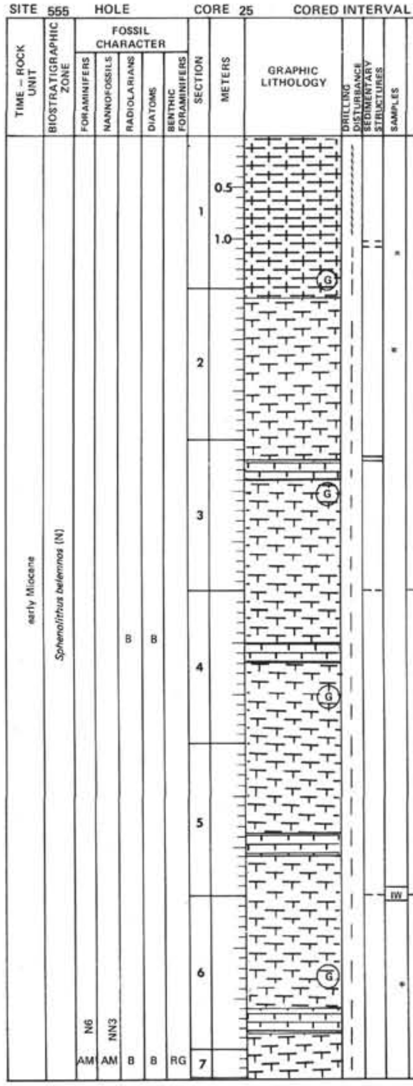
Color becomes white (N9) to light greenish gray (5G 8/1) in the lower sections.

SMEAR SLIDE SUMMARY (%):

	2, 75 D	4, 84 M	6, 82 D
Texture:			
Sand	40	–	40
Silt	30	–	30
Clay	30	–	30
Composition:			
Clay	10	–	10
Glauconite	Tr	90	2
Zeolite	2	–	5
Carbonate unspec.	10	–	5
Foraminifers	38	5	35
Calc. nannofossils	40	5	38
Sponge spicules	Tr	–	–
Fish remains	–	–	Tr
Unspecified silica	–	–	5
Ech. spines	Tr	–	–

CARBONATE BOMB (%):
2, 75 = 95
5, 75 = 93

SITE 555 HOLE CORE 25 CORED INTERVAL 262.0–271.5 m



LITHOLOGIC DESCRIPTION

N9–5GY 8/1

N9

N9–5GY 8/1

FORAM OOZE, white (N9) to light greenish gray (5GY 8/1). Firm ooze to chalk throughout. Glauconite grains scattered throughout.

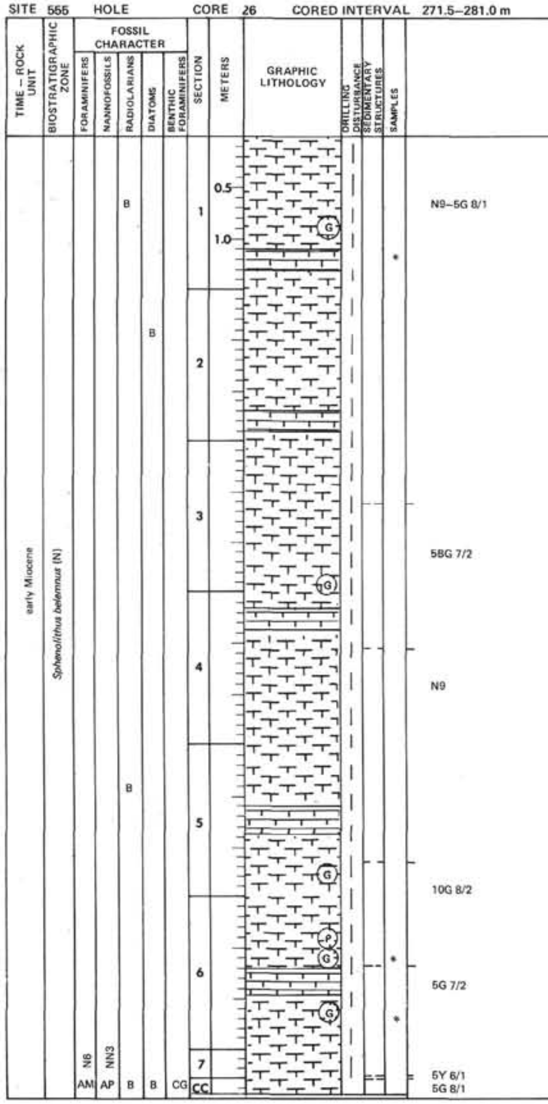
Section 1, 112–119 cm: indistinct band of nanno foram ooze, light yellowish brown (2.5Y 6/4) in color.

SMEAR SLIDE SUMMARY (%):

	1, 116 M	2, 60 D	6, 89 D
Texture:			
Sand	30	40	40
Silt	40	30	30
Clay	30	30	30
Composition:			
Clay	10	10	10
Glauconite	–	1	1
Zeolite	2	1	1
Carbonate unspec.	5	10	10
Foraminifers	30	45	40
Calc. nannofossils	48	30	35
Fish remains	Tr	1	1
Unspecified silica	5	2	2

CARBONATE BOMB (%):
3, 90 = 92
5, 130 = 92

SITE 555 HOLE CORE 26 CORED INTERVAL 271.5–281.0 m



LITHOLOGIC DESCRIPTION

FORAM OOZE AND CHALK, white (N9) to light greenish gray (5G 8/1) grading irregularly downward to GLAUCONITIC FORAM OOZE, pale blue green (5BG 7/2) to pale green (5G 7/2).

Chalk and ooze alternating throughout.

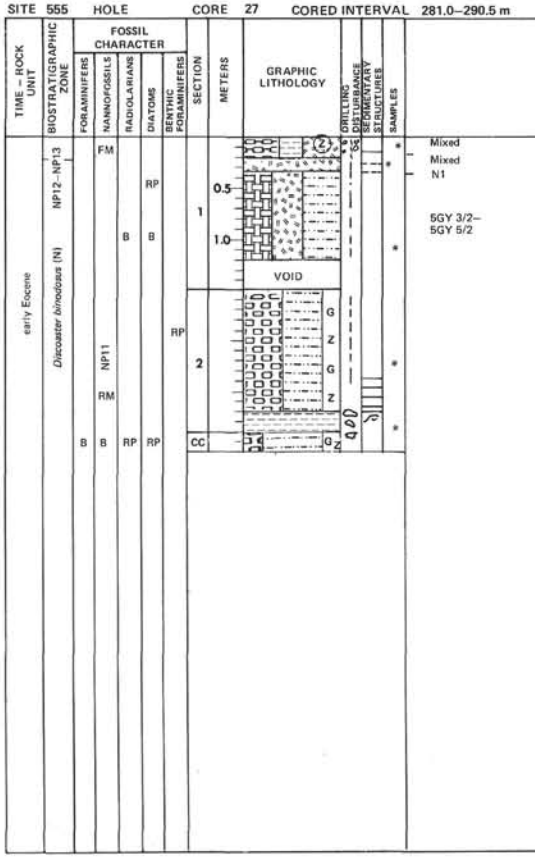
Prominent grains of glauconite, dusky green (5G 3/2) at: Section 3, 148 cm, and Section 6, 60, 141, and 142 cm.

SMEAR SLIDE SUMMARY (%):

	1, 120	6, 60	6, 116
	D	M	D
Texture:			
Sand	40	50	50
Silt	30	25	25
Clay	30	25	25
Composition:			
Quartz	–	–	Tr
Clay	10	5	10
Glauconite	3	50	10
Pyrite	–	20	–
Carbonate unspec.	10	10	10
Foraminifers	47	5	31
Calc. nannofossils	30	10	30
Sponge spicules	–	Tr	–
Fish remains	Tr	–	1

CARBONATE BOMB (%):
5, 26 = 91
6, 43 = 81

SITE 555 HOLE CORE 27 CORED INTERVAL 281.0–290.5 m



LITHOLOGIC DESCRIPTION

Section 1, 0–15 cm: a mixed assemblage of clasts of various size (to 2 cm): white (N9), dusky green (5G 3/2) in matrix of light olive brown (2.5Y 5/6) – white clasts are ZEOLITIC CHALK.

Section 1, 15–33 cm: VITRIC TUFF, black (N1) to grayish green (10GY 5/2) upper portion (26–15 cm) shows vague flaser bedding(?).

Section 1, 33–120 cm: VITRIC SPICULITE, sand, grayish olive green (5GY 3/2) to dusky yellow green (5GY 5/2) with dispersed black (N1) glass grains.

Section 2, 0–130 cm: GLAUCONITIC ZEOLITIC CHALK, mixed with above sand; texture becoming more indurated and bedded with depth. Color is dusky yellow green (5GY 5/2) to pale olive (5Y 6/4) in the chalk.

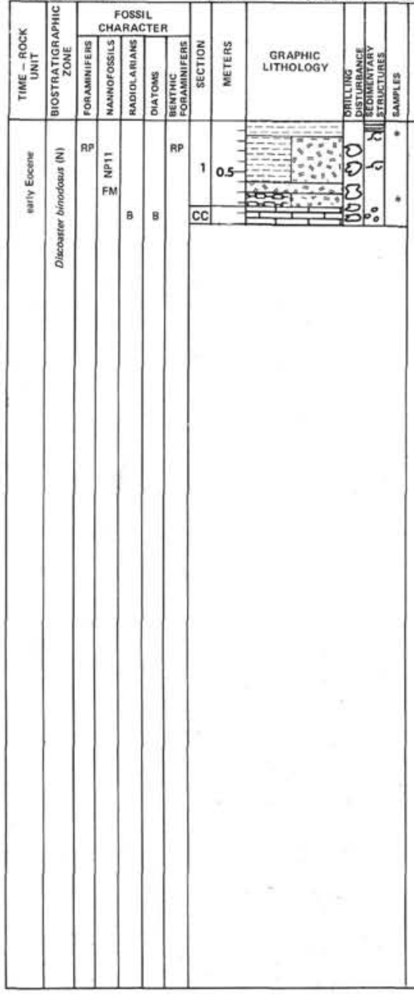
Section 2, 130–140 cm: CLAY, light olive brown (2.5Y 5/6) with flaser bedding.

SMEAR SLIDE SUMMARY (%):

	1, 10	1, 29	1, 110	2, 78	2,132
	D	M	D	D	M
Texture:					
Sand	20	50	50	25	0
Silt	20	30	25	25	0
Clay	60	20	25	50	100
Composition:					
Quartz	1	–	4	1	–
Feldspar	–	–	1	1	–
Mica	–	–	1	2	2
Heavy minerals	1	–	2	2	–
Clay	15	5	15	15	90
Volcanic glass	–	90	–	–	–
Palagonite	–	–	27	–	–
Glauconite	5	–	10	10	–
Pyrite	–	2	3	–	–
Zeolite	40	Tr	–	25	–
Carbonate unspec.	30	–	Tr	28	5
Foraminifers	–	–	Tr	–	–
Calc. nannofossils	5	–	5	5	3
Diatoms	–	Tr	Tr	–	–
Radiolarians	–	–	2	Tr	–
Sponge spicules	3	3	30	5	–

CARBONATE BOMB (%):
2, 55 = 3

SITE 555 HOLE CORE 28 CORED INTERVAL 290.5–300.0 m



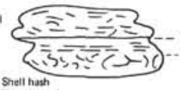
LITHOLOGIC DESCRIPTION

10GY 5/2

CLAY, grayish green (10GY 5/2) with interbedded VITRIC TUFF, dusky yellowish green (10GY 3/2) showing distinct black (N1) glass grains. Indurated, with distinct flaser bedding (Section 1, 0–75 cm).

CALCITE-CEMENTED SAND/TUFF, dusky yellow green (5GY 5/2).

Core-Catcher consists of a number of cobbles of indurated shell hash: MACROFOSSIL LIMESTONE, dusky yellow green (10GY 3/2) and yellow (2.5Y 7/6).



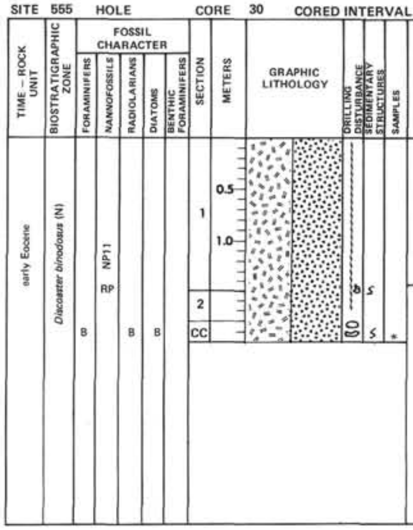
SMEAR SLIDE SUMMARY (%):

	1, 10	1, 78
	M	D
Texture:		
Sand	0	15
Silt	10	15
Clay	90	70
Composition:		
Quartz	1	–
Mica	Tr	1
Heavy minerals	–	1
Clay	80	30
Glauconite	5	5
Zeolite	6	5
Carbonate unspec.	5	62
Foraminieers	–	3
Calc. nannofossils	3	3

CARBONATE BOMB (%):
1, 36 = 10

NOTE: Core 29, 300.0–309.5 m: No recovery.

SITE 555 HOLE CORE 30 CORED INTERVAL 309.5–319.0 m



LITHOLOGIC DESCRIPTION

10GY 3/2

N1

VITRIC TUFF AND LAPILLI, Section 1 consists of loose pea gravel grading down into sand in Section 2. Dusky yellowish green (10GY 3/2) in color, with grains of light red (10R 6/8), and black (N1). White (N9) shell debris also present.

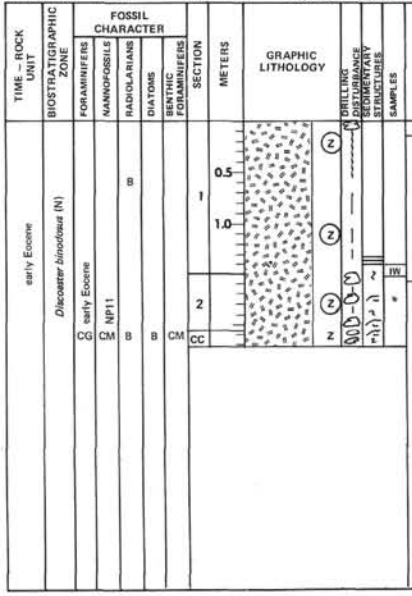
Section 2, 0–6 cm and Core-Catcher: indurated cobbles of black (N1) ash.

SMEAR SLIDE SUMMARY (%):

	CC, 16
	D
Texture:	
Sand	40
Silt	30
Clay	30
Composition:	
Clay	25
Volcanic glass	55
Pyrite	20
Foraminifers	Tr

CARBONATE BOMB (%):
CC, 19 = 1

SITE 555 HOLE CORE 31 CORED INTERVAL 319.0–328.5 m



LITHOLOGIC DESCRIPTION

N1

5G 3/2
to
5G 2/1 &
5Y 2/1

5Y 2/1 &
5Y 4/1

ZEOLITIC VITRIC TUFF, dusky green (5G 3/2), greenish black (5G 2/1), and olive black (5Y 2/1) to olive gray (5Y 4/1). Flaser bedding and burrowed throughout. Texture is loose sand becoming indurated towards bottom.

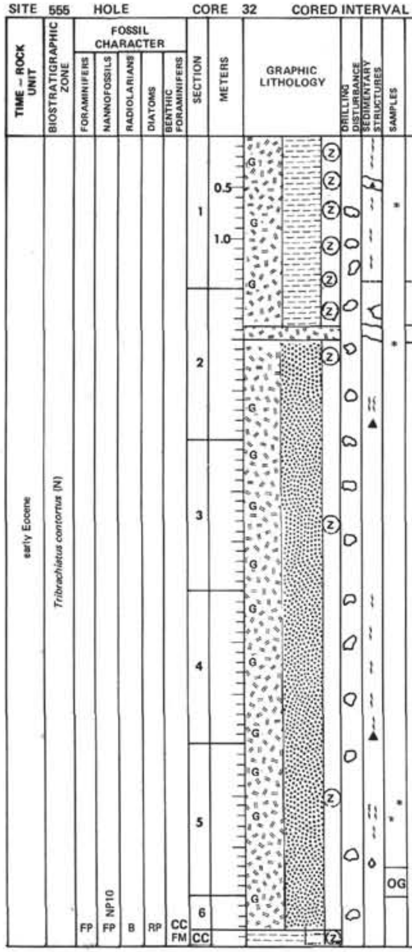
0–5 cm: black (N1) ash cobble.

SMEAR SLIDE SUMMARY (%):

	2, 30
	D
Texture:	
Sand	20
Silr	20
Clay	60
Composition:	
Quartz	3
Feldspar	Tr
Mica	1
Heavy minerals	Tr
Palagonite	40
Zeolite	30
Carbonate unspec.	3
Foraminifers	1
Calc. nannofossils	2
Opaque	20

CARBONATE BOMB (%):
1, 103 = 7
1, 138 = 3

SITE 555 HOLE CORE 32 CORED INTERVAL 328.5–338.0 m



LITHOLOGIC DESCRIPTION

5G 2/1 &
5Y 2/1

5GY 3/2,
5Y 3/2, &
5Y 2/1

N1

5GY 3/2,
5Y 3/2,
5Y 2/1, &
5BG 3/2

TUFFACEOUS GLAUCONITIC SANDSTONE, greenish black (5G 2/1) to olive black (5Y 2/1) to grayish olive green (5GY 3/2) in color. Occasional coarse (3–4 mm) clasts of black (N1) glass. Burrowed throughout in dusky green (5G 3/2).

Sections 4–5: coarse, black (N1) glass clasts increase in size (to 3 cm) and frequency.

White specks throughout are shell fragments.

Section 2, 54–59 cm: black (N1) band of PALAGONIZED VITRIC TUFF.

Section 5, 75–80 cm: prominent burrow with light olive gray (5Y 6/1) halo.

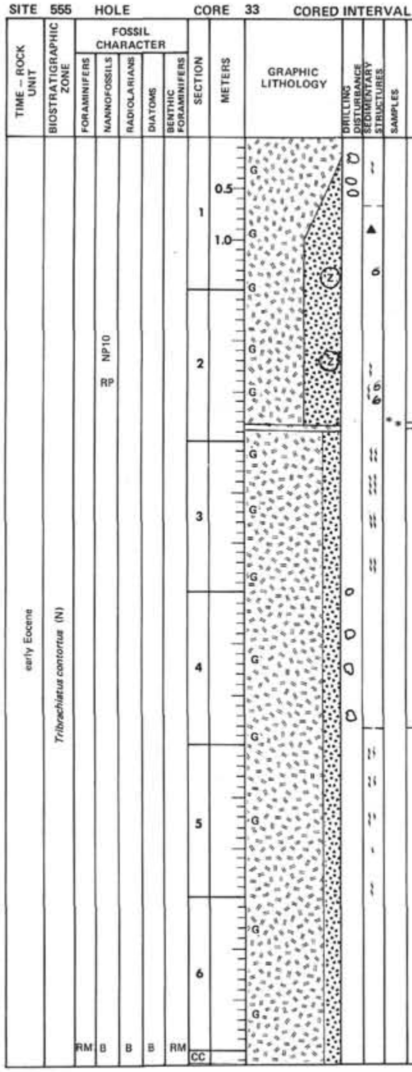
Section 5, 111–116 cm, rip up clasts of clay.

SMEAR SLIDE SUMMARY (%):

	1, 65	2, 55	5, 58	5, 78
	D	D	D	M
Texture:				
Sand	20	50	30	20
Silt	30	25	30	40
Clay	50	25	40	40
Composition:				
Quartz	3	–	–	4
Feldspar	Tr	–	–	1
Mica	1	–	Tr	1
Heavy minerals	1	–	1	1
Clay	30	–	–	–
Volcanic glass	–	2	–	–
Palagonite	–	–	–	32
Glauconite	50	63	70	–
Zeolite	20	5	15	13
Carobnate unspec.	–	–	6	10
Foraminifers	2	–	–	2
Calc. nannofossils	13	–	8	20
Fish remains	–	–	Tr	–
Opaque	–	30	–	20

CARBONATE BOMB (%):
1, 60 = 7
6, 68 = 3

SITE 555 HOLE CORE 33 CORED INTERVAL 338.0–347.5 m



LITHOLOGIC DESCRIPTION

5GY 4/1

5BG 3/2

5GY 4/1

5GY 2/1

TUFFACEOUS GLAUCONITIC SANDSTONE. Content of lapilli increases through Section 1 to base at Section 2, 131 cm. Color of sandstone is dark greenish gray (5GY 4/1), lapilli are mostly black (N1), some light red (10R 6/8), light bluish gray (5B 7/1) and medium light gray (N6). Sediment has a vague horizontal orientation and shell fragments are scattered throughout.

Section 2, 131–136 cm: zeolitic glauconitized vitric tuff with black glass concentration.

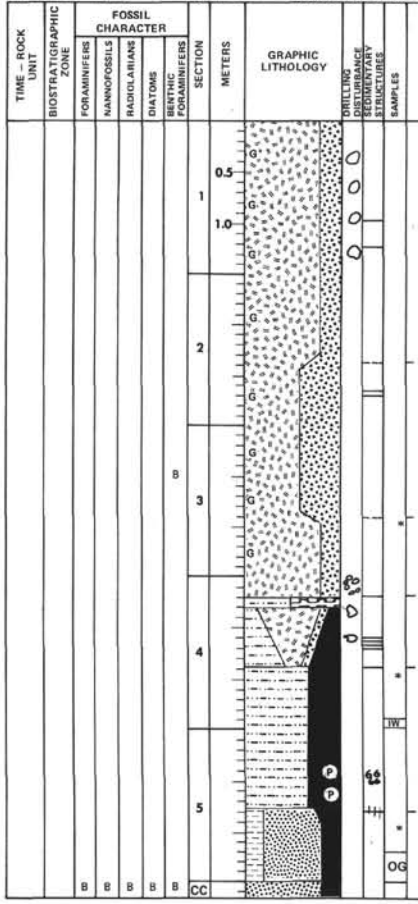
Section 2, 136 cm–Core-Catcher: ZEOLITIC TUFFACEOUS GLAUCONITIC SANDSTONE, dark greenish gray (5GY 4/1) becoming greenish black (5GY 2/1) in lower sections. Vaguely burrowed. Black glass lapilli scattered throughout.

SMEAR SLIDE SUMMARY (%):

	2, 130	2, 133
	D	D
Texture:		
Sand	30	50
Silt	30	25
Clay	40	25
Composition:		
Quartz	3	2
Feldspar	1	1
Mica	1	1
Heavy minerals	1	1
Glauconite	80	75
Zeolite	10	10
Carbonate unspec.	4	5
Foraminifers	2	–
Calc. nannofossils	8	5

CARBONATE BOMB (%):
6, 25 = 2

SITE 555 HOLE CORE 34 CORED INTERVAL 347.5–357.0 m



LITHOLOGIC DESCRIPTION

5GY 2/1
5GY 2/1–N2
5GY 2/1
N1
10YR 2/2
N2
N2

TUFFACEOUS GLAUCONITIC SANDSTONE, greenish black (5GY 2/1) in color, with scattered black (N1) glass lapilli. Shell debris and serpulid scattered throughout. Vague horizontal bedding where black (N1) glass lapilli are concentrated.

Section 4, 21–89 cm: altered lapilli tuff.

Section 4, 28–36 cm: carbonate-rich burrows.

Section 5, 89 cm–Section 5, 74 cm: CARBONACEOUS SILTY MUDSTONE, dusky yellowish brown (10YR 2/2), scattered fine shell debris and pyrite nodules (burrows).

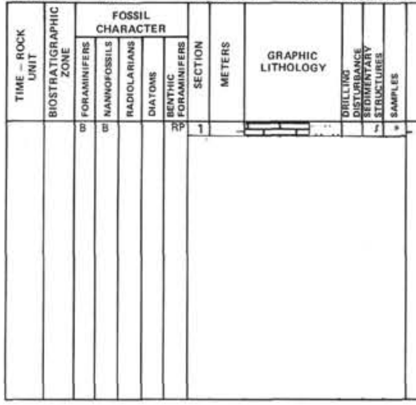
Section 5, 74 cm–Core-Catcher: FELDSPATHIC SANDSTONE, carbonaceous and glauconitic, black (N2) in color.

SMEAR SLIDE SUMMARY (%):

	3, 99 D	4, 99 D	5, 99 D
Texture:			
Sand	40	10	50
Silt	30	40	30
Clay	30	50	20
Composition:			
Quartz	3	20	45
Feldspar	1	4	13
Mica	1	10	1
Heavy minerals	2	5	6
Clay	–	35	27
Palagonite	30	–	–
Glauconite	90	4	5
Zeolite	3	–	–
Carbonate unspec.	Tr	–	Tr
Foraminifers	–	1	–
Calc. nannofossils	–	1	–
Plant debris	–	20	8

CARBONATE BOMB (%):
3, 46 = 1
5, 43 = 0
4, 137 = 1

SITE 555 HOLE CORE 35 CORED INTERVAL 357.0–366.5 m



LITHOLOGIC DESCRIPTION

5B 7/1

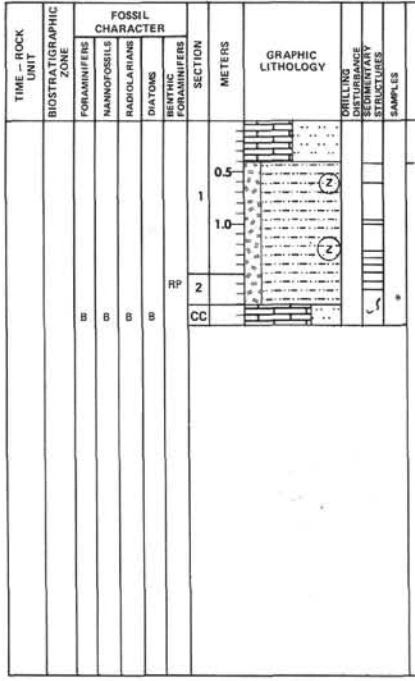
Calcite-cemented sandstone, light bluish gray (5B 7/1) in color. Completely indurated.

SMEAR SLIDE SUMMARY (%):

	1, 10 M
Composition:	
Quartz	4
Mica	Tr
Heavy minerals	2
Glauconite	2
Pyrite	1
Carbonate unspec.	91

CARBONATE BOMB (%):
1, 7 = 68

SITE 555 HOLE CORE 36 CORED INTERVAL 366.5–376.0 m



LITHOLOGIC DESCRIPTION

5B 7/1
5Y 2/1
N4

CALCITE-CEMENTED SANDSTONE, light bluish gray (5B 7/1) in color, indurated with indistinct burrows and irregular lamina of plant material, Section 1, 0–42 cm.

Section 1, 42 cm–Section 2, 27 cm: FELDSPATHIC SANDSTONE, olive black (5Y 2/1) in color. Plant material in lamina 1 mm to 1 cm thick.

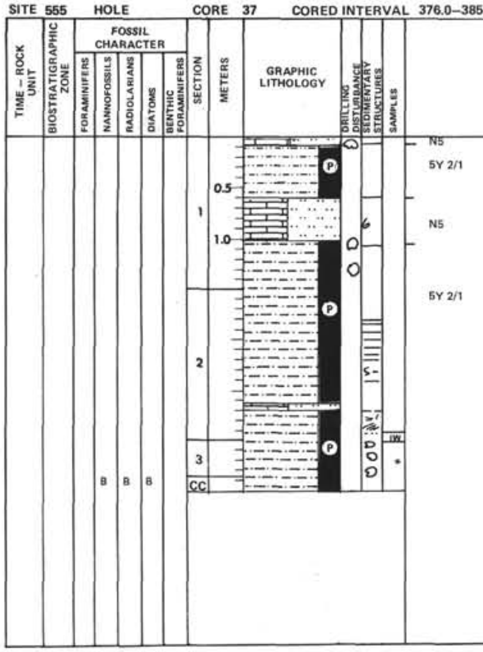
Core-Catcher: CALCITE-CEMENTED SANDSTONE, light bluish gray (5B 7/1), with indistinct inclined lamina and shell debris.

SMEAR SLIDE SUMMARY (%):

	2, 20 D
Texture:	
Sand	50
Silt	30
Clay	20
Composition:	
Quartz	50
Feldspar	13
Mica	5
Heavy minerals	5
Clay	5
Palagonite	5
Glauconite	2
Pyrite	3
Zeolite	5
Carbonate unspec.	5
Plant debris	2

CARBONATE BOMB (%):
1, 30 = 47
1, 11 = 45
CC = 78

SITE 555 HOLE CORE 37 CORED INTERVAL 376.0–385.5 m



LITHOLOGIC DESCRIPTION

CARBONACEOUS FELDSPATHIC MUDSTONE, olive black (5Y 2/1) with irregular black lamina and scattered pyrite burrows.

Interbedded with CALCITE-CEMENTED SANDSTONE: medium gray (N5) in color.

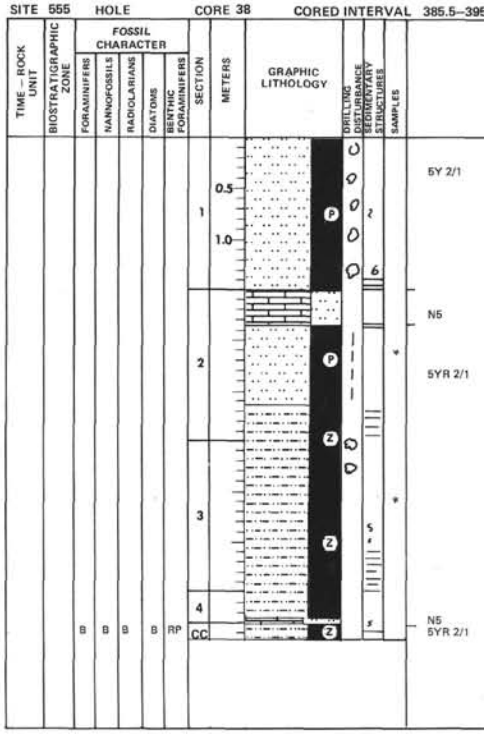
Shell debris scattered throughout core.

SMEAR SLIDE SUMMARY (%):

	3, 20
	D
Texture:	
Sand	40
Silt	30
Clay	30
Composition:	
Quartz	40
Feldspar	15
Mica	4
Heavy minerals	5
Clay	9
Palagonite	5
Pyrite	5
Zeolite	5
Carbonate unspec.	2
Foraminifers	Tr
Plant debris	10

CARBONATE BOMB (%):
2, 19 = 1
2, 21 = 2

SITE 555 HOLE CORE 38 CORED INTERVAL 385.5–395.0 m



LITHOLOGIC DESCRIPTION

CARBONACEOUS FELDSPATHIC SANDSTONE, olive black (5Y 2/1) in color. Indistinct burrows and shell debris scattered throughout. Color becoming brownish black (5YR 2/1) in the lower sections where the sediment has become a ZEOLITIC CARBONACEOUS MUDSTONE. Vaguely laminated throughout, the lamina rich in plant material.

Section 1, 130: Crab pincer.

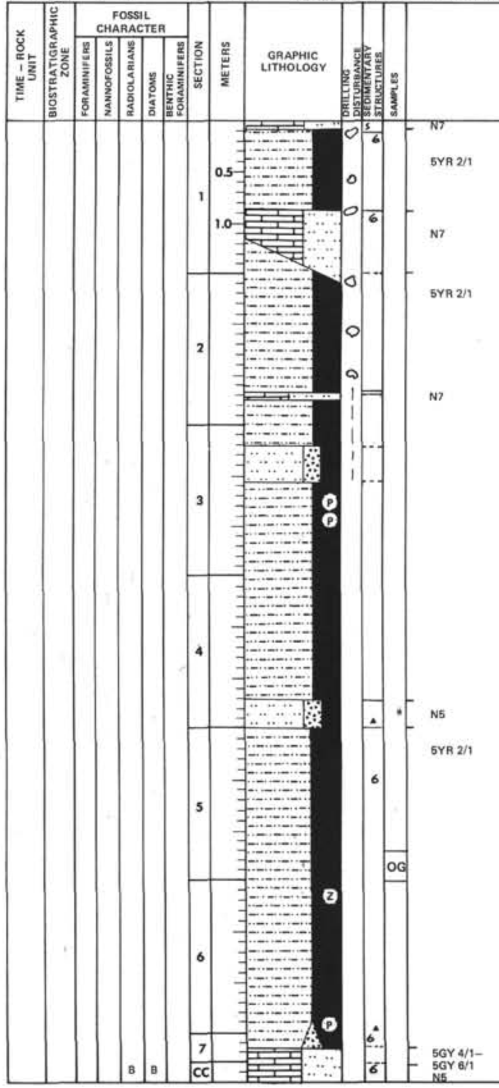
Section 2, 0–37 cm: calcite-cemented sandstone, medium gray (N5) in color.

SMEAR SLIDE SUMMARY (%):

	2, 60	3, 60
	D	D
Texture:		
Sand	30	20
Silt	40	40
Clay	30	40
Composition:		
Quartz	45	20
Feldspar	15	5
Mica	5	5
Heavy minerals	5	5
Clay	10	30
Palagonite	5	3
Glauconite	Tr	Tr
Pyrite	10	–
Zeolite	–	10
Carbonate unspec.	–	2
Foraminifers	–	Tr
Plant debris	25	20

CARBONATE BOMB (%):
2, 15 = 51
3, 12 = 0
3, 13 = 1

SITE 555 HOLE CORE 39 CORED INTERVAL 395.0–404.5 m



LITHOLOGIC DESCRIPTION

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1), vaguely burrowed, with flaser bedding. Shell material scattered throughout.

Interbedded with coarse CALCITE-CEMENTED SANDSTONE, light gray (N7) in color and interbedded with CARBONACEOUS VITRIC FELDSPATHIC SILTSTONE, medium gray (N5) in color.

Section 1, 0–5 cm: reaction halo.

Section 1, 21 and 93 cm: prominent gastropod.

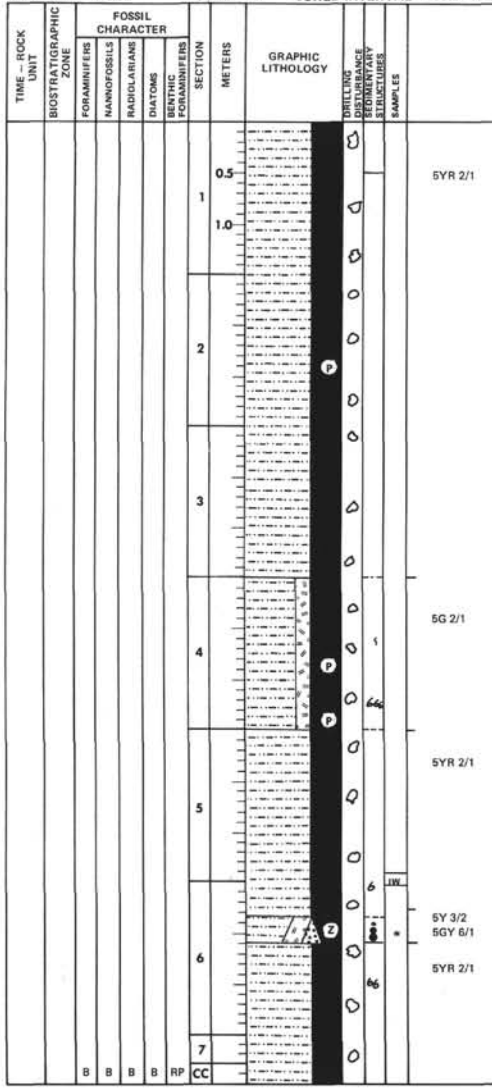
Carbonaceous mudstone becomes more homogeneous in lower sections of core.

SMEAR SLIDE SUMMARY (%):

	4, 130
	D
Texture:	
Sand	30
Silt	40
Clay	30
Composition:	
Quartz	36
Feldspar	10
Mica	2
Heavy minerals	5
Clay	20
Palagonite	10
Zeolite	2
Carbonate unspec.	2
Calc. nannofossils	3
Plant debris	10

CARBONATE BOMB (%):
2, 76 = 2
4, 135 = 1

SITE 555 HOLE CORE 40 CORED INTERVAL 405.5–414.0 m



LITHOLOGIC DESCRIPTION

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1) in color. Shell material scattered throughout, otherwise homogeneous. Section 6: VITRIC CARBONACEOUS MUDSTONE, greenish black (5G 2/1) in color.

Section 6, 58–35 cm: graded VITRIC SILTY MUDSTONE, greenish gray (5GY 6/1) to olive gray (5Y 3/2) in color.

Section 4, 55–60 cm: discolored area surrounding burrow, yellowish gray (5Y 8/1).

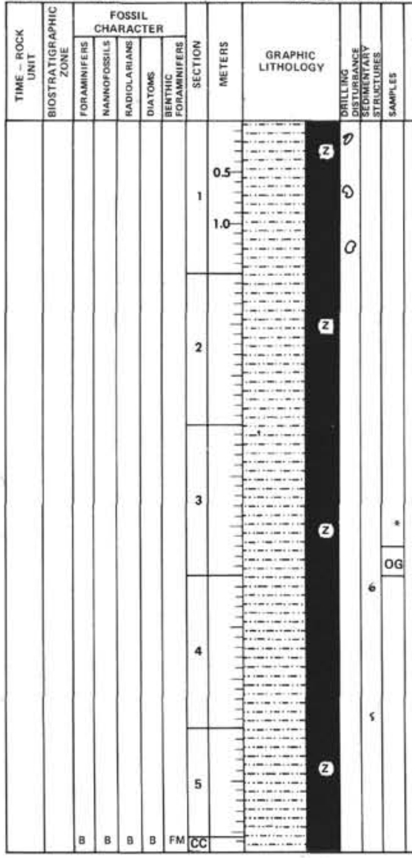
Section 4, 120–130 cm: concentrated shell debris.

SMEAR SLIDE SUMMARY (%):

	6, 50
	D
Texture:	
Sand	20
Silt	20
Clay	60
Composition:	
Quartz	10
Feldspar	3
Mica	1
Heavy minerals	3
Clay	55
Palagonite	10
Pyrite	3
Micronodules	5
Carbonate unspec.	5
Calc. nannofossils	Tr
Plant debris	5

CARBONATE BOMB (%):
3, 123 = 2
5, 138 = 0

SITE 555 HOLE CORE 41 CORED INTERVAL 414.0–423.5 m



LITHOLOGIC DESCRIPTION

5YR 2/1

CARBONACEOUS VITRIC MUDSTONE, brownish black (5YR 2/1). Shell debris and black (N1) glass lapilli scattered throughout. Vague mottles of olive gray (5Y 4/1) throughout.

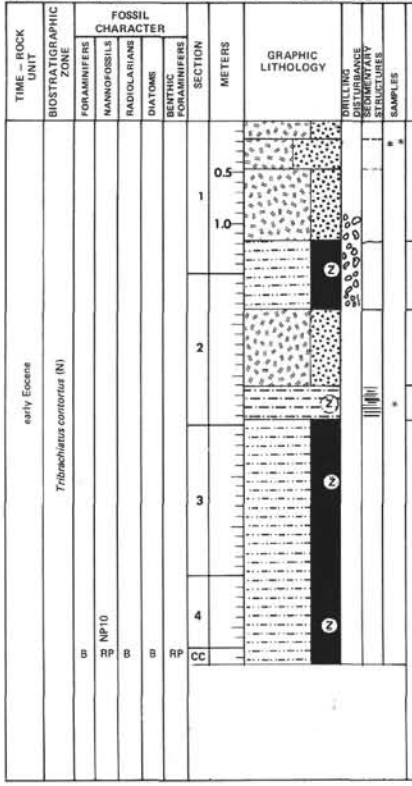
Section 4, 12 cm: ahermatypic coral.

SMEAR SLIDE SUMMARY (%):

	3, 99 D
Texture:	
Sand	20
Silt	20
Clay	60
Composition:	
Quartz	10
Feldspar	3
Mica	1
Heavy minerals	1
Clay	50
Palagonite	10
Pyrite	5
Zeolite	10
Carbonate unspec.	4
Foraminifers	Tr
Calc. nannofossils	1
Plant debris	5

CARBONATE BOMB (%):
4, 50 = 1

SITE 555 HOLE CORE 42 CORED INTERVAL 423.5–433.0 m



LITHOLOGIC DESCRIPTION

N3 to N4

5YR 2/1

N3 to N4

N2 to 5G 2/1

5YR 2/1

5YR 2/1

LAPILLI TUFF, dark gray (N3) to medium dark gray (N4), interbedded with CARBONACEOUS MUDSTONE, brownish black (5YR 2/1) shell debris and black (N1) lapilli scattered throughout.

Section 2, 112–142 cm: VITRIC FELDSPATHIC SANDSTONE, black (N2) to greenish black (5G 2/1). Distinct lamina and beds (up to 3 mm thick), inclined bedding 8° dip.

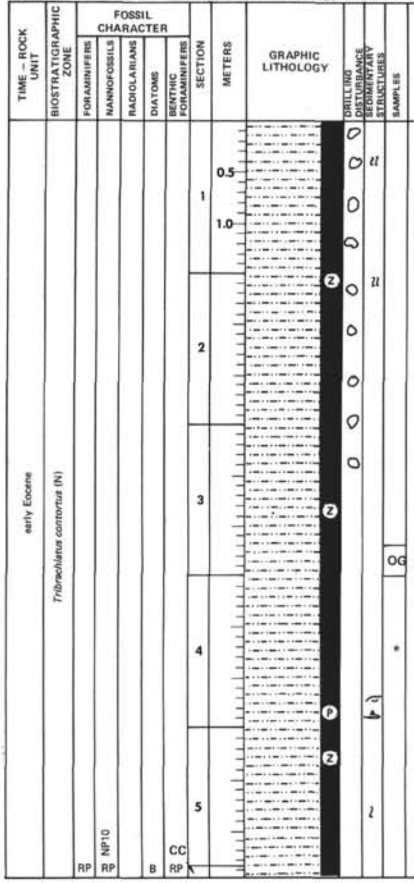
Lapilli tuff: lapilli up to 5 cm diameter include basalt fragments and fragments of vitric tuff. Clasts are mostly subangular and some show chilled margins. Colors are shades of gray and brown. Section 1, 16–44 cm: distinctly coarser lapilli.

SMEAR SLIDE SUMMARY (%):

	1, 25 M	1, 25 M	2, 130 D
Texture:			
Sand	–	–	50
Silt	–	–	20
Clay	–	–	30
Composition:			
Quartz	–	–	35
Feldspar	65	4	15
Mica	–	–	5
Heavy minerals	–	–	3
Clay	–	16	16
Volcanic glass	–	20	–
Palagonite	15	10	15
Pyrite	–	–	2
Zeolite	–	–	5
Carbonate unspec.	5	50	–
Foraminifers	–	–	2
Calc. nannofossils	–	–	Tr
Sponge spicules	–	–	Tr
Plant debris	–	–	2
Opaque	15	–	–

CARBONATE BOMB (%):
4, 69 = 2

SITE 555 HOLE CORE 43 CORED INTERVAL 433.0–442.5 m



LITHOLOGIC DESCRIPTION

5YR 2/1

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1). Scattered serpulid and shell throughout – but generally very small amount.

Pyrite burrows at Section 1, 32 and 40 cm. Section 2, 13–16 cm: prominent burrow group.

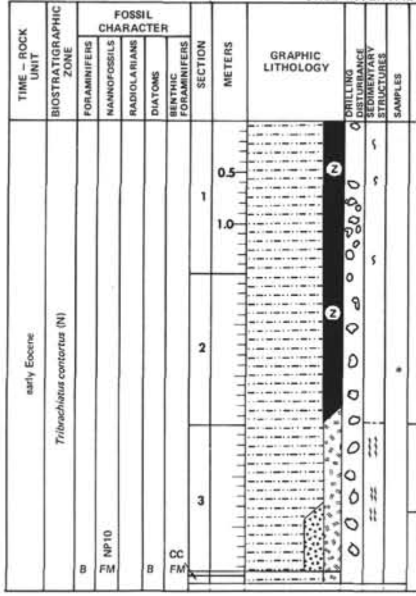
Section 4, 125–130 cm: small layer graded lapilli.

SMEAR SLIDE SUMMARY (%):

	4, 70
	D
Texture:	
Sand	10
Silt	20
Clay	70
Composition:	
Quartz	18
Feldspar	2
Mica	1
Heavy minerals	1
Clay	50
Palagonite	5
Pyrite	5
Zeolite	5
Carbonate unspec.	1
Foraminifers	1
Calc. nannofossils	1
Sponge spicules	Tr
Plant debris	10

CARBONATE BOMB (%):
2, 92 = 2
4, 148 = 2

SITE 555 HOLE CORE 44 CORED INTERVAL 442.5–452.0 m



LITHOLOGIC DESCRIPTION

5YR 2/1

CARBONACEOUS SILTY MUDSTONE, brownish black (5YR 2/1), with very sparse serpulid.

Color grades to dark gray (N3) in Section 3 as vitric content increases. Section 3 with scattered lapilli – greenish gray (5GY 6/1), with alteration rims.

Section 3, 67–90 cm: concentration of burrows and mottles generally greenish gray (5GY 6/1), probably coalesed alteration halos.

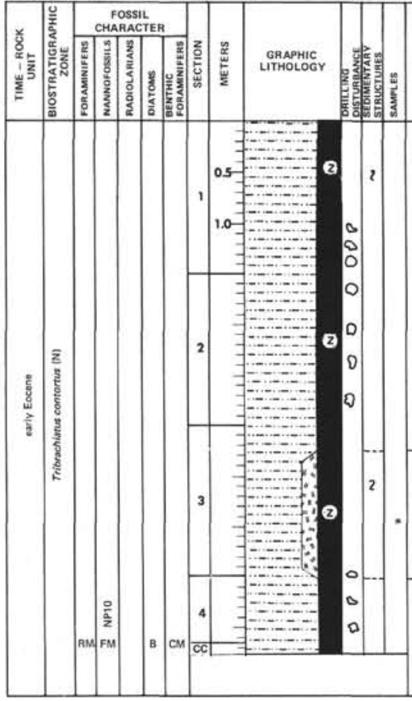
N3

5BG 3/2

SMEAR SLIDE SUMMARY (%):

	2, 95
	D
Texture:	
Sand	20
Silt	40
Clay	40
Composition:	
Quartz	25
Feldspar	5
Mica	2
Heavy minerals	2
Clay	40
Palagonite	5
Zeolite	5
Carbonate unspec.	2
Foraminifers	1
Calc. nannofossils	2
Plant debris	10

SITE 555 HOLE CORE 45 CORED INTERVAL 452.0–461.5 m



LITHOLOGIC DESCRIPTION

5YR 2/1

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1) with CARBONACEOUS VITRIC SILTY MUDSTONE, at Section 3, 24 cm–Section 4, 5 cm greenish black (5GY 2/1).

Generally structureless.

Section 1, 52 cm: prominent burrow/halo, olive yellow (2.5Y 6/6).

Occasional serpulids.

5GY 2/1

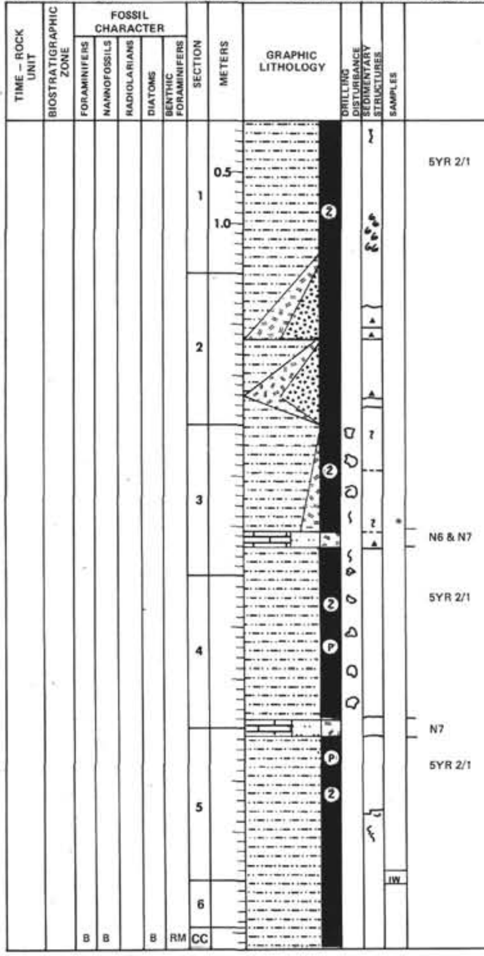
5YR 2/1

SMEAR SLIDE SUMMARY (%):

	3, 95
	D
Texture:	
Sand	20
Silt	30
Clay	50
Composition:	
Quartz	15
Feldspar	5
Mica	4
Heavy minerals	3
Clay	40
Glauconite	10
Pyrite	2
Zeolite	5
Carbonate unspec	2
Foraminifers	1
Calc. nannofossils	10
Plant debris	10

CARBONATE BOMB (%):
2, 73 = 3
1, 145 = 2

SITE 555 HOLE CORE 46 CORED INTERVAL 461.5–471.0 m



LITHOLOGIC DESCRIPTION

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1) interbedded with LAPILLI TUFF beds – graded.

Also interbedded are: CALCITE-CEMENTED TUFFACEOUS SILTSTONES, light gray (N7) in color, including coarse shell debris.

Lapilli appear graded, but not sorted, 1–5 mm size range.

Further scattered →
With vitric ash matrix →
All lapilli in contact →

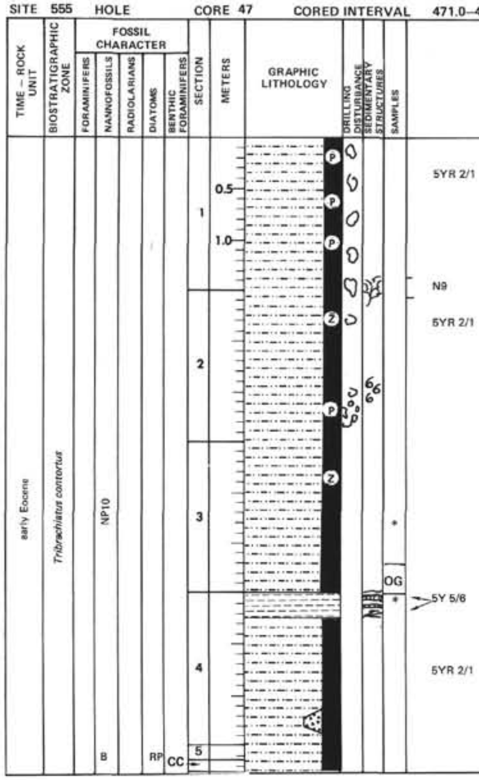
Section 1, 90–130 cm: concentration of shell debris; serpulid and thin-walled bivalve, otherwise, shell debris scattered throughout.

SMEAR SLIDE SUMMARY (%):

	3, 94
	D
Texture:	
Sand	20
Silt	40
Clay	40
Composition:	
Quartz	7
Feldspar	3
Mica	2
Heavy minerals	2
Clay	35
Palagonite	30
Pyrite	3
Zeolite	3
Foraminifers	Tr
Calc. nannofossils	Tr
Plant debris	5
Lithic fragments	5

CARBONATE BOMB (%):
4, 57 = 0
2, 116 = 1

SITE 555 HOLE CORE 47 CORED INTERVAL 471.0–480.5 m



LITHOLOGIC DESCRIPTION

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1), structureless.

Section 2, 25 cm–Section 1, 140 cm: calcite veins white (N9), in diffuse intermeshing system.

Interbeds of clay, light olive brown (5Y 5/6) at Section 4, 0–20 cm.

Section 4, 118–126 cm: scattered lapilli.

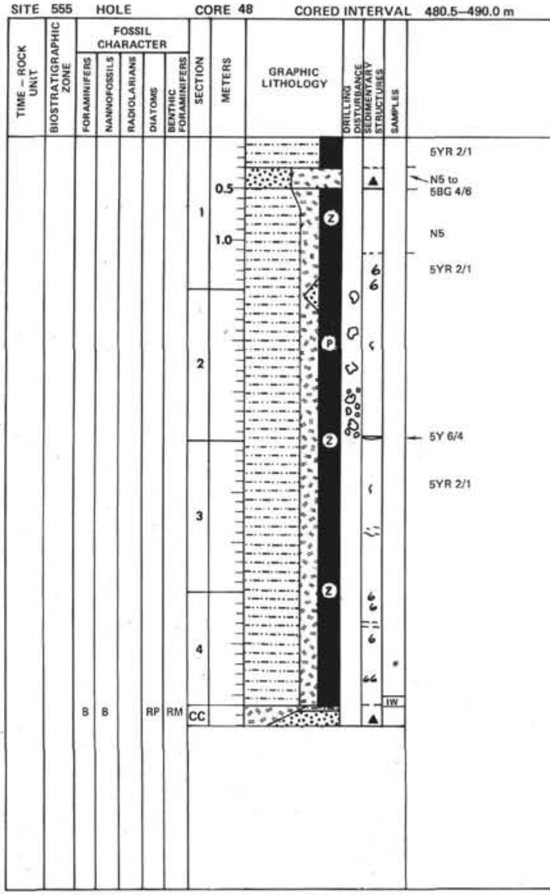
Fine shell debris scattered throughout.

SMEAR SLIDE SUMMARY (%):

	3, 80	4, 4
	D	M
Texture:		
Sand	20	0
Silt	30	0
Clay	50	100
Composition:		
Quartz	15	–
Feldspar	4	–
Mica	2	–
Heavy minerals	2	–
Clay	50	100
Palagonite	4	–
Pyrite	3	–
Zeolite	10	–
Carbonate unspec.	Tr	–
Calc. nannofossils	Tr	–
Plant debris	10	–

CARBONATE BOMB (%):
2, 34 = 2

SITE 555 HOLE CORE 48 CORED INTERVAL 480.5–490.0 m



LITHOLOGIC DESCRIPTION

CARBONACEOUS VITRIC MUDSTONE, brownish black (5YR 2/1).

Interbeds of lapilli tuff at Section 1, 48–30 cm and Core-Catcher – graded and sorted.

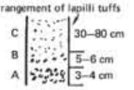
Section 1, 113–50 cm: concentration of black (N1) glass lapilli and ash, general color of medium gray (N5).

Section 2, 15–0 cm: lapilli scattered in roughly horizontal bands.

Section 2, 144–145 cm: clay layer; dusky yellow (5Y 6/4).

Section 3, 86–87 cm and Section 4: shell concentrated in layer – lag concentrate.

General arrangement of lapilli tuffs



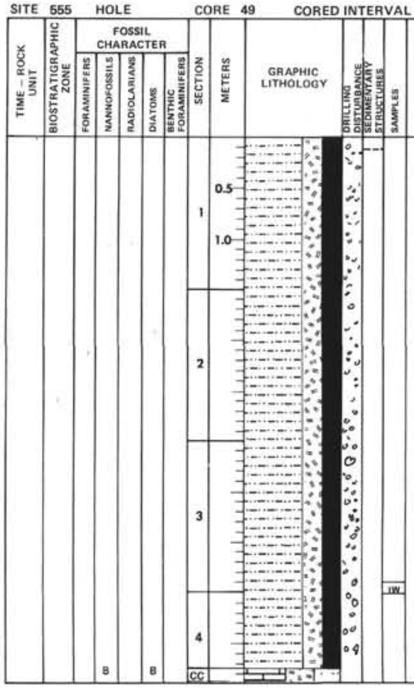
B = Scattered and burrowed in rough horizontal bands.
C = Scattered black glass in sediment matrix.
A = Coarse lapilli (1–5 mm) on deformed contact.

SMEAR SLIDE SUMMARY (%):

	4, 70
	D
Texture:	
Sand	20
Silt	20
Clay	60
Composition:	
Quartz	5
Feldspar	1
Mica	2
Heavy minerals	2
Clay	43
Palagonite	30
Zeolite	5
Carbonate unspec.	2
Calc. nannofossils	Tr
Plant debris	10

CARBONATE BOMB (%):
3, 10 = 1
4, 90 = 2

SITE 555 HOLE CORE 49 CORED INTERVAL 490.0–499.5 m



LITHOLOGIC DESCRIPTION

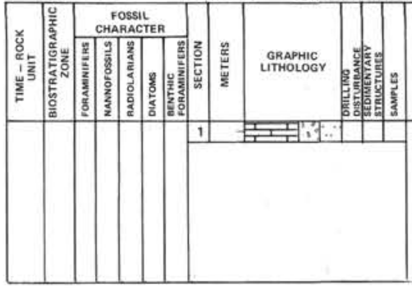
5YR 2/1

GRAVEL – drill cuttings original material appears to have been CARBONACEOUS MUDSTONE, brownish black (5YR 2/1) in color.

Core-Catcher: INDURATED SHELL SANDSTONE, medium light gray (N6).

N6

SITE 555 HOLE CORE 50 CORED INTERVAL 499.5–509.0 m



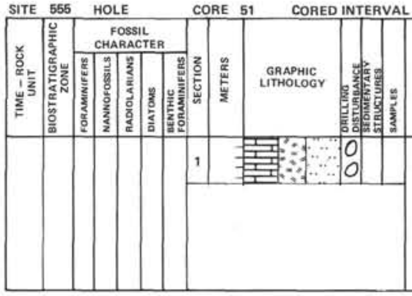
LITHOLOGIC DESCRIPTION

N6

CALCITE-CEMENTED VITRIC TUFF, medium light gray (N6). Matrix consists of calcite, glass grains, and brownish black (5YR 2/1) and clasts and shell debris form the clasts. Included are many large and thick shells – fragments and complete.

CARBONATE BOMB (%):
1, 3 = 32

SITE 555 HOLE CORE 51 CORED INTERVAL 509.0–518.5 m



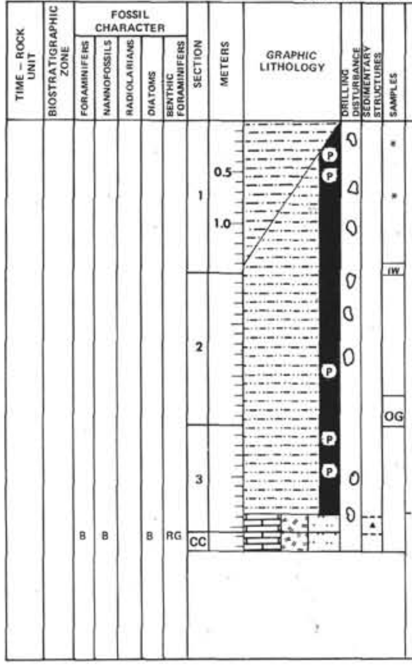
LITHOLOGIC DESCRIPTION

N5

CALCITE-CEMENTED VITRIC SANDSTONE, medium gray (N5) in color. Grains consist of glass: moderate blue green (5BG 4/6) palagonite – altered and black (N1) glass. No structure discernable.

CARBONATE BOMB (%):
1, 41 = 37

SITE 555 HOLE CORE 52 CORED INTERVAL 518.5–528.0 m



LITHOLOGIC DESCRIPTION

5YR 2/1

CARBONACEOUS SILTY MUDSTONE, brownish black (5YR 2/1). Fine and coarsely (up to 3 cm thick) bedded, with interbedded plant material.

Section 1, 0–30 cm: FELDSPATHIC SANDSTONE.

Section 3, 90 cm–Core-Catcher: CALCITE-CEMENTED SANDSTONE, medium light gray (N6). Plant material interbedded.

N6
N6

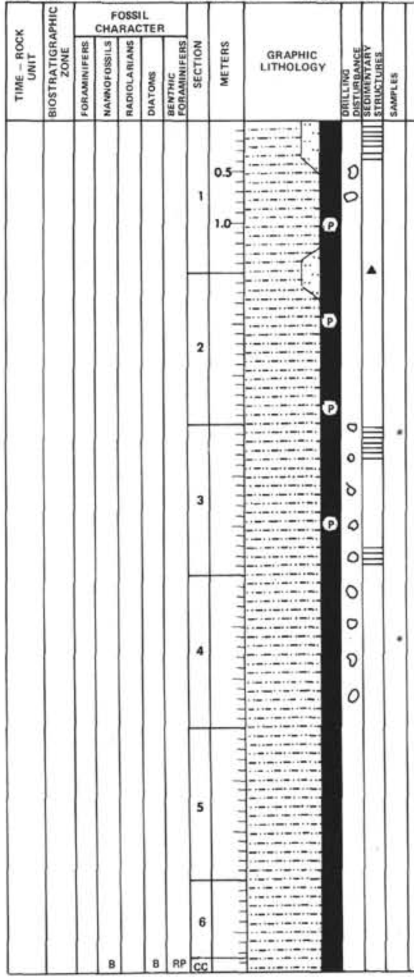
Shell debris – infrequent.

SMEAR SLIDE SUMMARY (%):

	1, 20	1,75
	D	D
Texture:		
Sand	50	20
Silt	30	20
Clay	20	60
Composition:		
Quartz	40	10
Feldspar	15	5
Mica	3	5
Heavy minerals	10	3
Clay	20	50
Palagonite	5	5
Pyrite	5	8
Zeolite	Tr	–
Carbonate unspec.	–	2
Plant debris	2	12

CARBONATE BOMB (%):
2, 60 = 1
2, 78 = 1

SITE 555 HOLE CORE 53 CORED INTERVAL 528.0–537.5 m



LITHOLOGIC DESCRIPTION

5YR 2/1

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1). Section 1, 0–45 cm: intercalated coarse and fine layers – contacts indistinct – burrowed. No structure below this point, except for vague lamina in Sections 3 and 4.

Calcareous nodules: Section 5, 52 cm.

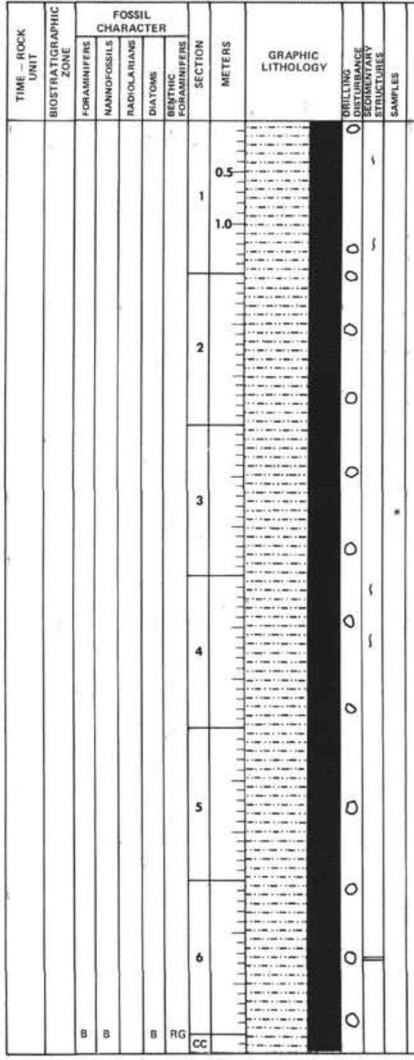
Shell debris scattered throughout.

SMEAR SLIDE SUMMARY (%):

	3, 7	4, 63
	D	D
Texture:		
Sand	30	10
Silt	30	20
Clay	40	70
Composition:		
Quartz	20	13
Feldspar	8	3
Mica	2	3
Heavy minerals	2	2
Clay	25	50
Glauconite	3	–
Pyrite	–	4
Carbonate unspec.	30	10
Plant debris	10	15

CARBONATE BOMB (%):
5, 103 = 1

SITE 555 HOLE CORE 54 CORED INTERVAL 537.5–547.0 m



5YR 2/1

LITHOLOGIC DESCRIPTION

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1).

Calcareous concretions and shell debris common throughout otherwise structureless.

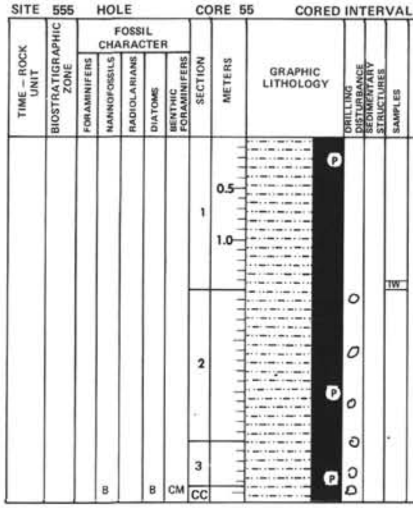
Burrowing infrequent, shell debris throughout, otherwise structureless.

SMEAR SLIDE SUMMARY (%):

	3, 85 D
Texture:	
Sand	10
Silt	20
Clay	70
Composition:	
Quartz	10
Feldspar	3
Mica	4
Heavy minerals	3
Clay	40
Pyrite	5
Carbonate unspec.	20
Calc. nannofossils	Tr
Plant debris	15

CARBONATE BOMB (%):
5, 95 = 1

SITE 555 HOLE CORE 55 CORED INTERVAL 547.0–556.5 m



5YR 2/1

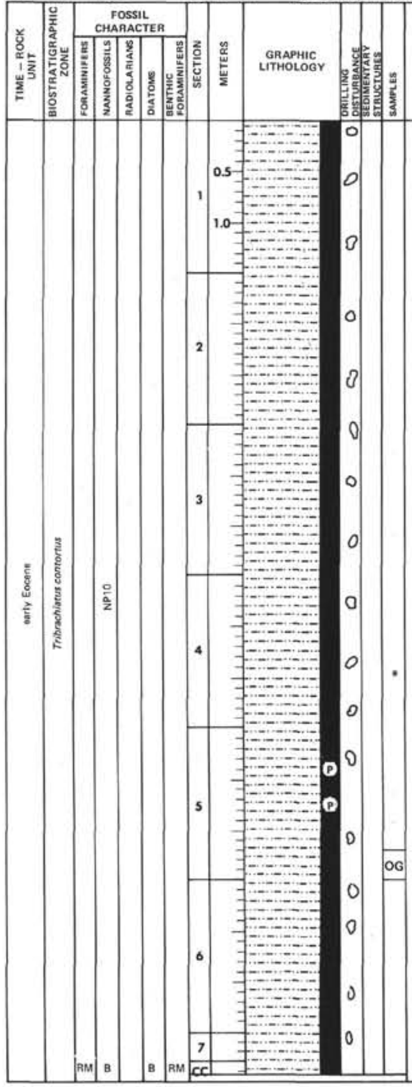
LITHOLOGIC DESCRIPTION

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1).

Shells infrequent, generally homogeneous.

CARBONATE BOMB (%):
1, 71 = 1

SITE 555 HOLE CORE 56 CORED INTERVAL 556.5–566.0 m



LITHOLOGIC DESCRIPTION

5YR 2/1

Carbonaceous mudstone, brownish black (5YR 2/1) in color.

Occasional lapilli and infrequent shell material.

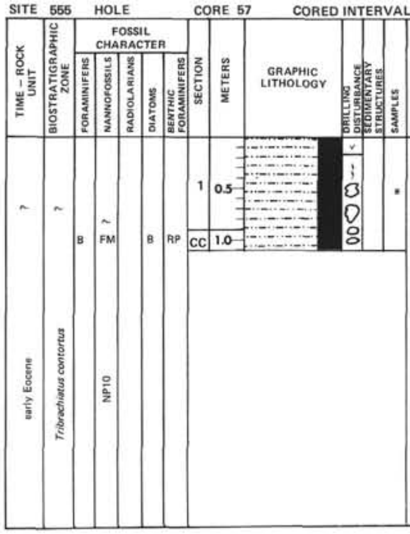
Section 3, 31 cm: prominent calcareous concretion.

SMEAR SLIDE SUMMARY (%):

	4, 95
	D
Texture:	
Sand	10
Silt	20
Clay	70
Composition:	
Quartz	10
Feldspar	4
Mica	1
Heavy minerals	1
Clay	65
Pyrite	4
Carbonate unspec.	4
Calc. nannofossils	1
Plant debris	10

CARBONATE BOMB (%):
4, 70 = 2
5, 116 = 2

SITE 555 HOLE CORE 57 CORED INTERVAL 566.0–575.5 m



LITHOLOGIC DESCRIPTION

5YR 2/1

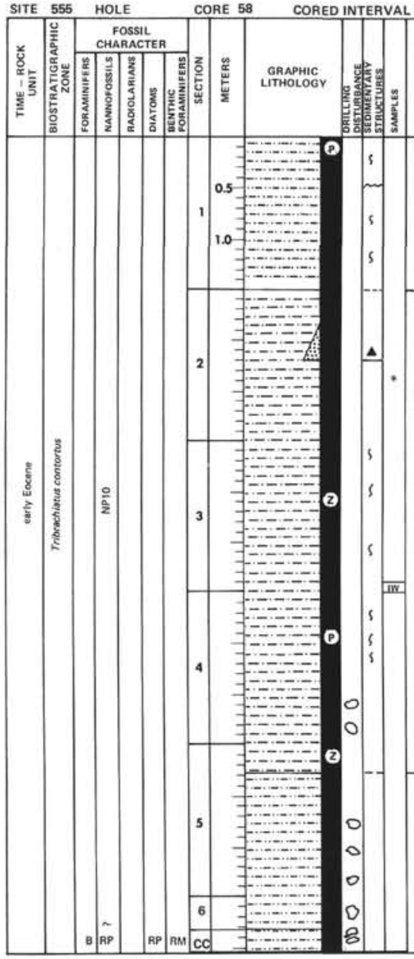
Carbonaceous mudstone, brownish black (5YR 2/1).

Core-Catcher: prominent carbonate nodule (5 cm diameter).

SMEAR SLIDE SUMMARY (%):

	1, 55
	D
Texture:	
Sand	15
Silt	20
Clay	65
Composition:	
Quartz	12
Feldspar	3
Mica	2
Heavy minerals	1
Clay	60
Pyrite	4
Zeolite	2
Carbonate unspec.	5
Foraminifers	Tr
Calc. nannofossils	1
Radiolarians	Tr
Plant debris	10

SITE 555 HOLE CORE 58 CORED INTERVAL 575.5–585.0 m



LITHOLOGIC DESCRIPTION

5YR 2/1

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1); Section 1 and below Section 5, 25 cm.

Central portion of core (Sections 2, 3, 4, and upper part of 5) is FELDSPATHIC MUDSTONE-SILTSTONE, dark gray (N3) to greenish black (5G 2/1).

Faintly burrowed and shell debris throughout.

Section 1, 55 cm: possible scour channel.

N3 to
5G 2/1

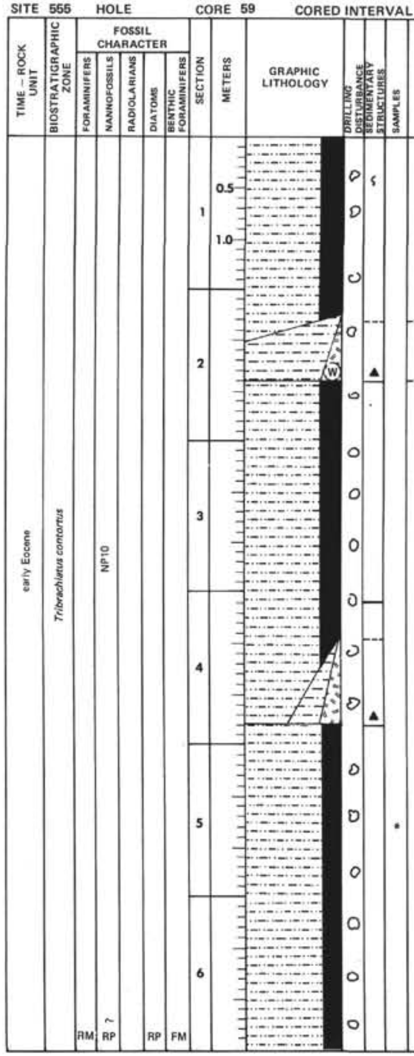
SMEAR SLIDE SUMMARY (%):

	2, 90
	D
Texture:	
Sand	40
Silt	30
Clay	30
Composition:	
Quartz	28
Feldspar	7
Mica	5
Heavy minerals	5
Clay	30
Glauconite	2
Pyrite	5
Zeolite	5
Carbonate unspec.	5
Foraminifers	1
Calc. nannofossils	1
Radiolarians	1
Sponge spicules	Tr
Plant debris	5

CARBONATE BOMB (%):
2, 90 = 2
3, 136 = 4

5YR 2/1

SITE 555 HOLE CORE 59 CORED INTERVAL 585.0–594.5 m



LITHOLOGIC DESCRIPTION

5YR 2/1

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1), shell debris frequent, structureless.

Interbedded with VITRIC SILTSTONE in Section 2, olive black (5Y 2/1).

Section 4, 128 cm grading upwards to 40 cm: VITRIC SILTSTONE.

Section 3, 10 cm: lag shell concentrate.

Section 4: throughout many small ahermatypic coral.

5Y 2/1

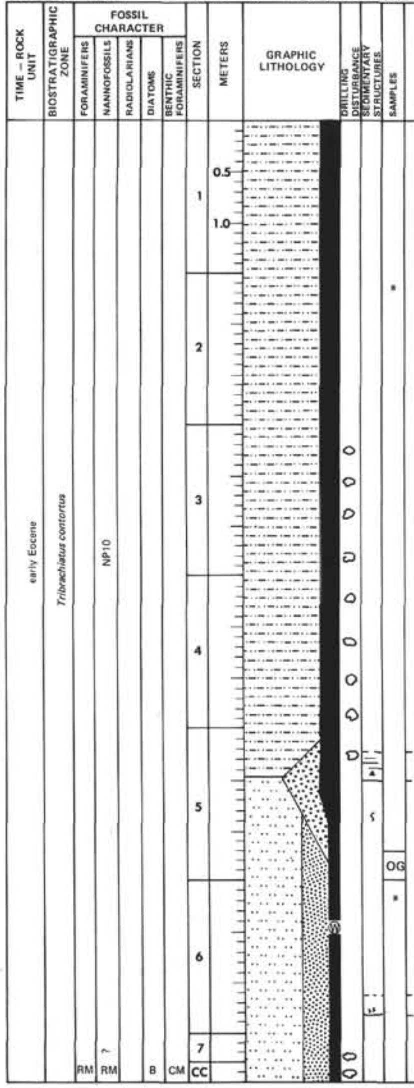
5YR 2/1

SMEAR SLIDE SUMMARY (%):

	5, 80
	D
Texture:	
Sand	30
Silt	30
Clay	40
Composition:	
Quartz	22
Feldspar	8
Mica	5
Heavy minerals	2
Clay	40
Pyrite	7
Carbonate unspec.	5
Foraminifers	1
Calc. nannofossils	Tr
Radiolarians	Tr
Plant debris	10

CARBONATE BOMB (%):
2, 64 = 2

SITE 555 HOLE CORE 60 CORED INTERVAL 594.5–604.0 m



LITHOLOGIC DESCRIPTION

5YR 2/1

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1). Shell debris infrequent. Very vague and infrequent burrows.

Section 5: graded LAPILLI bed grading down to MICACEOUS FELDSPATHIC SANDSTONE, medium dark gray (N4) to dark gray (N3) with scattered lapilli throughout.

Section 5, 26–51 cm, lapilli in horizontal bands.

Section 5, 85 cm: prominent shell-burrow combination.

SMEAR SLIDE SUMMARY (%):

	2, 20	6, 20
	D	D
Texture:		
Sand	15	40
Silt	20	30
Clay	65	30
Composition:		
Quartz	20	35
Feldspar	5	10
Mica	5	10
Heavy minerals	2	1
Clay	50	30
Pyrite	6	2
Carbonate unspec.	2	5
Foraminifers	Tr	1
Calc. nannofossils	Tr	1
Radiolarians	Tr	Tr
Sponge spicules	Tr	Tr
Plant debris	10	5

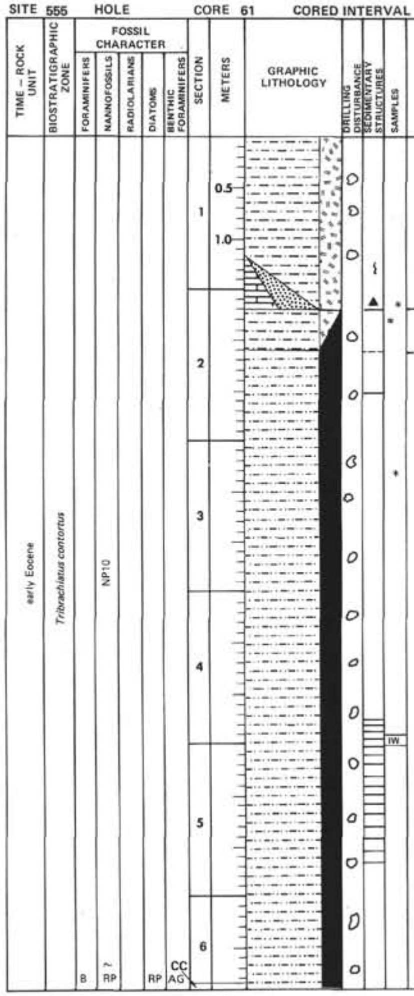
CARBONATE BOMB (%):
7, 55 = 3
5, 118 = 3

N4

N4

N6
N3–N4

SITE 555 HOLE CORE 61 CORED INTERVAL 604.0–613.5 m



LITHOLOGIC DESCRIPTION

N3–N4

VITRIC FELDSPATHIC SILTSTONE, medium-dark gray (N3–N4), grades downward to CALCITE CEMENTED VITRIC SANDSTONE, medium light gray (N6) which grades downward to CARBONACEOUS MUDSTONE, brownish black (5YR 2/1). Generally structureless, occasional lapilli bands (1 cm thick) or scattered lapilli.

Sections 4–5: indistinct lamina and very fine shell debris scattered throughout.

N6
N4

Section 2, 70–20 cm: palagonized black (N1) glass grains increase in quantity upwards.

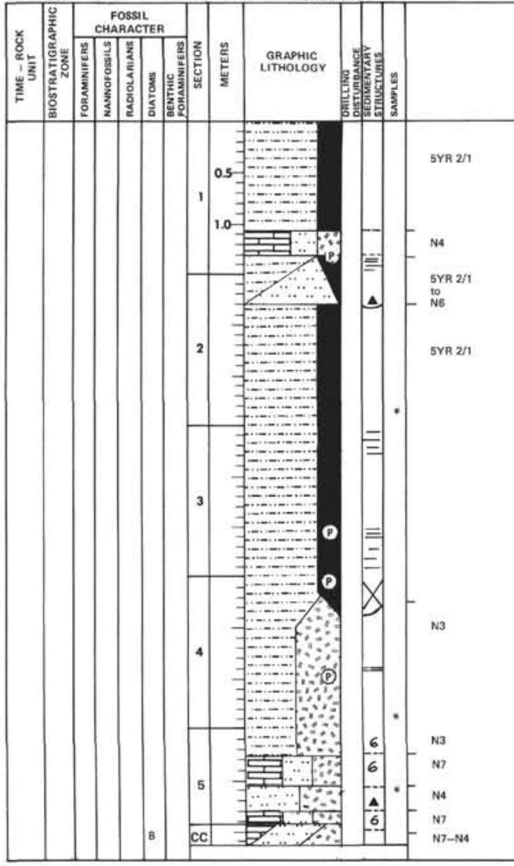
5YR 2/1

SMEAR SLIDE SUMMARY (%):

	2, 15	2, 30	3, 20
	D	M	D
Texture:			
Sand	60	–	15
Silt	25	–	15
Clay	25	–	70
Composition:			
Quartz	40	1	11
Feldspar	10	1	4
Mica	2	1	5
Heavy minerals	3	1	1
Clay	15	–	55
Glauconite	–	90	–
Pyrite	5	–	6
Zeolite	2	2	–
Carbonate unspec.	15	–	5
Foraminifers	–	–	1
Calc. nannofossils	1	1	2
Radiolrians	–	1	Tr
Plant debris	7	2	10

CARBONATE BOMB (%):
4, 58 = 2

SITE 555 HOLE CORE 62 CORED INTERVAL 613.5–623.0 m



LITHOLOGIC DESCRIPTION

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1) with interbedded CALCITE CEMENTED SANDSTONE, dark gray (N4) to FELDSPATHIC SANDSTONE, medium light gray (N6).

Infrequent burrows and shell debris in upper sections increasing in lower part.

Contact at Section 2, 30 cm: scoured.

Section 3, 103–107 cm: distinct lamina, some convolute.

Section 4: carbonaceous mudstone grades downward into VITRIC FELDSPATHIC SANDSTONE, very dark gray (N3) and CALCITE-CEMENTED VITRIC SILTSTONES, very light gray (N7).

Section 4, 10–20 cm: pyrite-filled fractures.

Section 4, 17 cm: scoured contact.

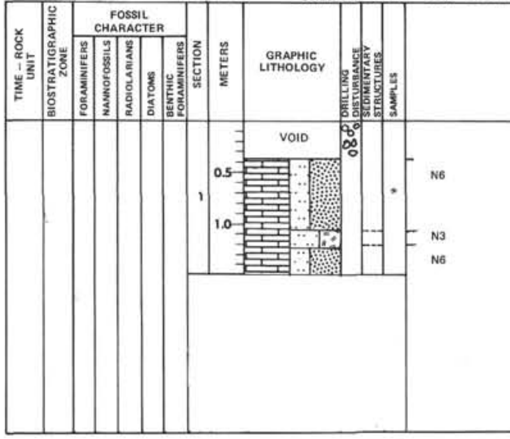
Section 4, 85–87 cm: band of lapilli.

SMEAR SLIDE SUMMARY (%):

	2, 135	4, 140	5, 65
	D	D	D
Texture:			
Sand	20	30	50
Silt	20	40	30
Clay	60	30	20
Composition:			
Quartz	10	2	22
Feldspar	4	8	8
Mica	4	5	4
Heavy minerals	1	2	1
Clay	60	20	13
Palagonite	Tr	25	50
Pyrite	8	5	–
Zeolite	Tr	2	Tr
Carbonate unspec.	–	5	2
Foraminifers	Tr	Tr	–
Calc. nannofossils	2	2	Tr
Radiolarians	1	Tr	Tr
Sponge spicules	Tr	Tr	–
Plant debris	10	1	Tr

CARBONATE BOMB (%):
4, 147 = 3

SITE 555 HOLE CORE 63 CORED INTERVAL 623.0–672.5 m



LITHOLOGIC DESCRIPTION

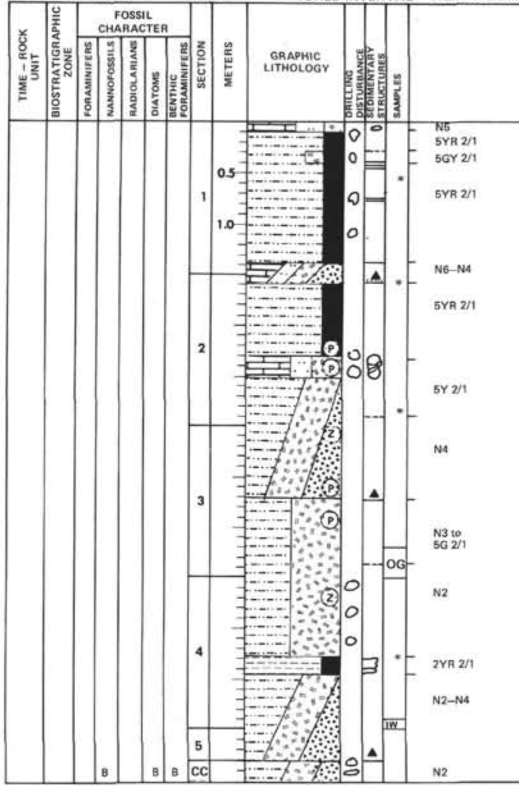
CALCITE-CEMENTED FELDSPATHIC SANDSTONE, light gray (N6).

Section 1, 105–122 cm: fine VITRIC SANDSTONE, very dark gray (N3).

SMEAR SLIDE SUMMARY (%):

	1, 70
	D
Texture:	
Sand	50
Silt	25
Clay	25
Composition:	
Quartz	20
Feldspar	5
Mica	3
Heavy minerals	2
Carbonate unspec.	70

SITE 555 HOLE CORE 64 CORED INTERVAL 632.5–642.0 m



LITHOLOGIC DESCRIPTION

CARBONACEOUS MUDSTONE, brownish black (5YR 2/1), interbedded with CALCITE-CEMENTED VITRIC SANDSTONE (N4–6) grading downward to SANDY VITRIC TUFF, olive black (5Y 2/1) with interbedded graded LAPILLI TUFFS of "salt and pepper" appearance but overall medium dark gray (N4) to grayish black (N2); coarse lapilli often with chilled margins.

Section 1, 64 cm: possible microfault.

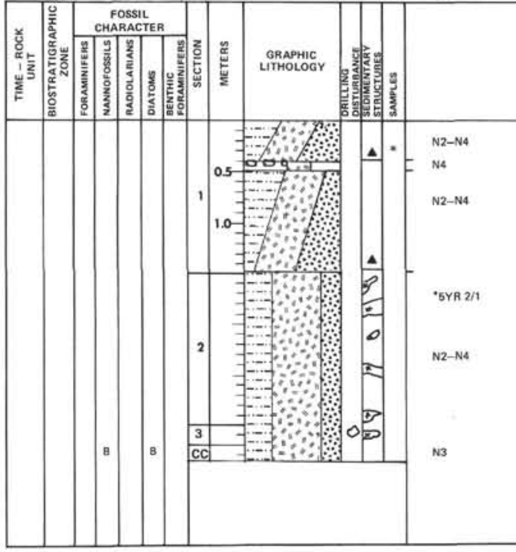
Fine lamination and possible scour frequent.

SMEAR SLIDE SUMMARY (%):

	1, 57	2, 10	2, 137	4, 80
	D	M	D	D
Texture:				
Sand	5	10	60	10
Silt	5	10	20	20
Clay	90	80	20	70
Composition:				
Quartz	2	2	10	7
Feldspar	1	1	5	1
Mica	1	1	4	1
Heavy minerals	1	1	3	1
Clay	80	60	10	70
Palagonite	50	–	–	–
Pyrite	5	–	–	5
Zeolite	15	–	30	2
Carbonate unspec.	–	–	3	3
Calc. nannofossils	–	–	Tr	–
Radiolarians	–	–	Tr	–
Plant debris	10	5	–	10

CARBONATE BOMB (%):
1, 102 = 0
3, 117 = 2
4, 57 = 1

SITE 555 HOLE CORE 65 CORED INTERVAL 642.0–651.5 m



LITHOLOGIC DESCRIPTION

VITRIC TUFF and graded beds of LAPILLI TUFF, grayish black (N2) to dark gray (N4), lapilli tuff inpart "salt and pepper" appearance. Lapilli range to 1.5 cm in diameter.

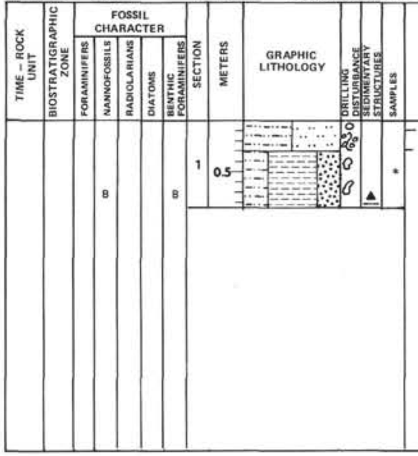
Section 2*: irregular interbeds or clasts of carbonaceous mudstone.

SMEAR SLIDE SUMMARY (%):

	1, 30
	D
Texture:	
Sand	50
Silt	25
Clay	25
Composition:	
Quartz	4
Feldspar	1
Mica	2
Heavy minerals	1
Palagonite	40
Zeolite	49
Carbonate unspec.	3

CARBONATE BOMB (%):
1, 20 = 3

SITE 555 HOLE CORE 66 CORED INTERVAL 651.5–661.0 m



LITHOLOGIC DESCRIPTION

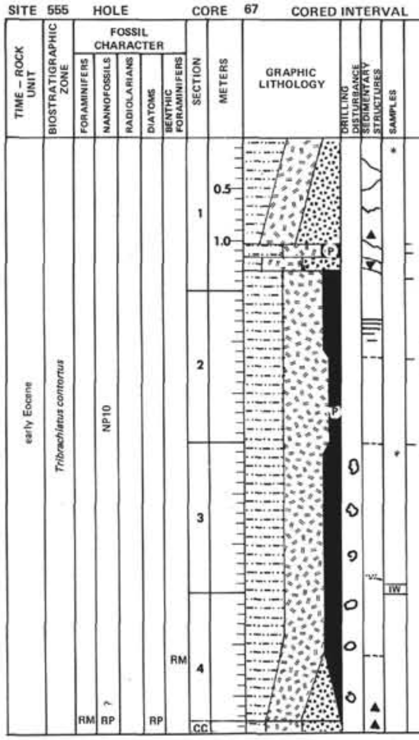
5Y 6/1
N4–N2
N3

LAPILLI VITRIC TUFF, very dark gray (N3). Lapilli to 0.5 cm in diameter.
Section 1, 0–28 cm: calcite cemented siltstone and mudstone with drill cuttings.

SMEAR SLIDE SUMMARY (%):

	1, 50 D
Texture:	
Sand	50
Silt	25
Clay	25
Composition:	
Quartz	10
Feldspar	4
Mica	3
Heavy minerals	3
Palagonite	40
Pyrite	3
Zeolite	35
Carbonate unspec.	2
Foraminifers	Tr

SITE 555 HOLE CORE 67 CORED INTERVAL 661.0–670.5 m



LITHOLOGIC DESCRIPTION

N3–N2
N6
N3
5YR 2/1
N4
5YR 2/1
N4–N2

LAPILLI VITRIC TUFF, grayish black (N2) to very dark gray (N3) in upper section.

Lower portion of core is VITRIC CARBONACEOUS MUDSTONE, brownish black (5YR 2/1); grading downward in Section 4 to LAPILLI TUFF.

Section 1, 0–100 cm, coarse–fine contacts with the lapilli tuff are complex, may be slumped, or cut and fill. Other structures in Section 1 are loadcast deformed contact, convoluted and imbricated bedding, and faulting. Also, reverse grading on one lapilli tuff unit. Contacts dip at about 20° in Section 1, 100–130 cm.

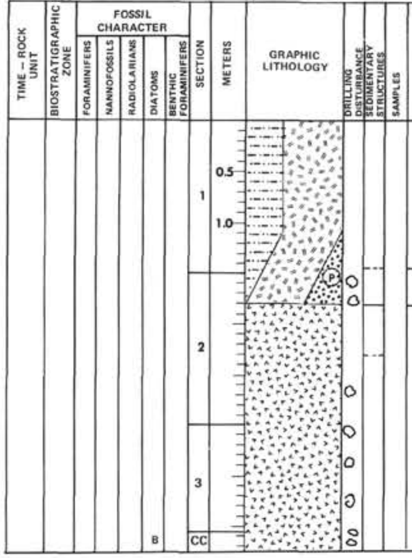
Section 3: irregular layers of lapilli at 76 and 85–83 cm.

SMEAR SLIDE SUMMARY (%):

	1, 15 D	3, 15 D
Texture:		
Sand	–	30
Silt	–	30
Clay	–	40
Composition:		
Quartz	6	8
Feldspar	2	2
Mica	2	3
Heavy minerals	2	2
Clay	–	40
Palagonite	50	25
Zeolite	35	10
Carbonate unspec.	3	–
Calc. nannofossils	–	Tr
Plant debris	–	10

CARBONATE BOMB (%):
1, 70 = 2
3, 138 = 1

SITE 555 HOLE CORE 68 CORED INTERVAL 670.5–680.0 m



LITHOLOGIC DESCRIPTION

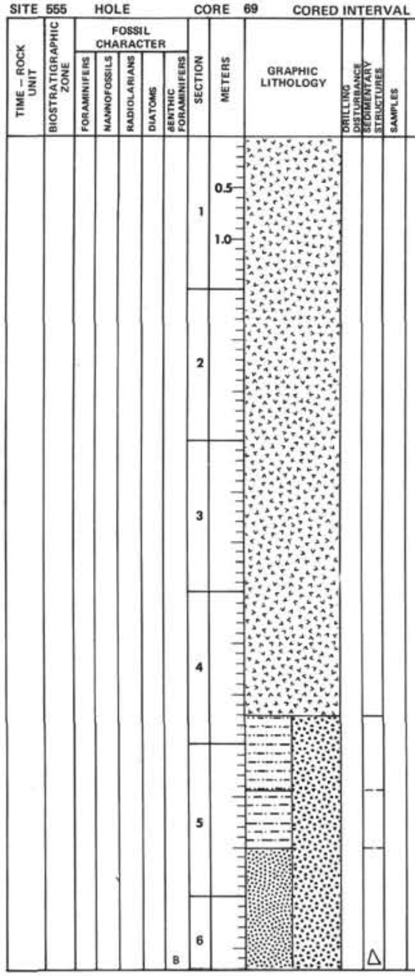
5Y 2/1
N3–N4
N4
N5

VITRIC MUDSTONE, olive black (5Y 2/1) grading downward to LAPILLI TUFF, dark gray (N4) to very dark gray (N3).

Section 2, 35 cm: contact with basalt, medium dark gray (N4) to gray (N5).

Described more fully in visual core descriptions for igneous rocks.

SITE 555 HOLE CORE 69 CORED INTERVAL 680.0–689.5 m



LITHOLOGIC DESCRIPTION

Basalt (see visual core description for igneous rock).

Overlying volcanic lapilli tuff unit (intermixed with terrigenous sand and clay). Terrigenous component shows fining upward trend from sandstone through silty sandstone to mudstone. Color grades from dark greenish gray (5G 4/1) through olive gray (5Y 4/1) to olive black (5Y 2/1).

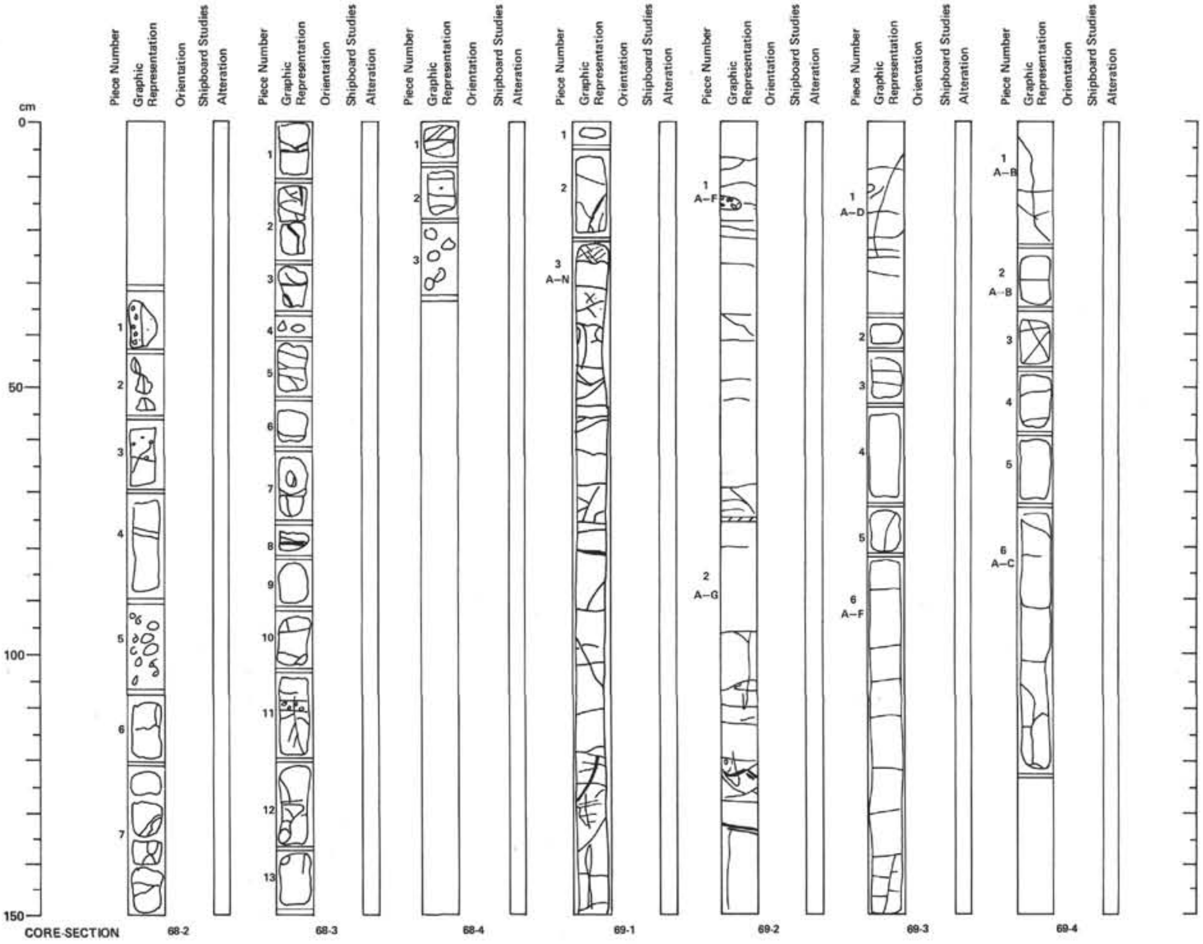
Mudstone immediately below basalt is indurated and probably baked.

NOTE: Due to practice of spacing basalt pieces total recovery may not correspond with recovery marked on basalt sheets.

5Y 2/1

5Y 4/1

5GY 4/1



CORE 68, SECTION 2 Depth 672.3–673.5 m

Piece 1: Medium gray (N5) phyric basalt with vertical fracture filled with basalt breccia and calcite cement. Minor calcite-filled vesicles. Fine-grained.

Piece 2: Fractured basalt as above, calcite vein fill.

Piece 3: Fine-grained basalt as above, minor fractures.

Piece 4: As above with vein near horizontal lined with fractured basalts in calcite cement. Slightly coarser grained than above, vesicles very rare.

Piece 5: Basalt rubble as above.

Pieces 6 and 7: Medium-grained basalt as above. Very small vesicles calcite and smectite filled. Fractures – some horizontal but others irregular.

CORE 68, SECTION 3 Depth 673.5–675.0 m

Medium light gray (N6) phyric basalt, 1 mm vesicles rare throughout, filled with smectite, rarely calcite. Two large vesicles filled with smectite and calcite with smectite alteration rims. Much fracturing, all smectite filled; larger fractures have calcite second-stage fill. One large fracture 1 cm wide in Piece 11 has basalt breccia fill with smectite/calcite cement.

CORE 68, SECTION 4 Depth 675.0–675.3 m

Similar to Section 3, minor smectite-filled vesicles. Fractures mainly near-horizontal.

CORE 69, SECTION 1 Depth 680.0–681.5 m

Medium light gray (N6) phyric basalt. Scattered minor 1 mm smectite filled vesicles, rarely calcite. Some glomerophyric textures. Fractures abundant, numerous horizontal but largely irregular, filled with smectite and lath calcite. Below 60 cm becoming coarser grained, otherwise similar.

CORE 69, SECTION 2 Depth 681.5–683.0 m

Uniform glomerophyric basalt similar to Section 1. Vesicles and fractures as before. Two resorbed clasts (at 15 and 120 cm) of vesicular basalt slightly darker (medium dark gray – N4). Vesicles up to 0.5 cm filled with smectite. Calcite: minor pyrite in upper clasts. Clasts 5 cm, elongate.

CORE 69, SECTION 3 Depth 683.0–684.5 m

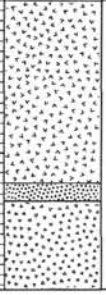
As above, less fractured. One small resorbed clast at 13–14 cm.

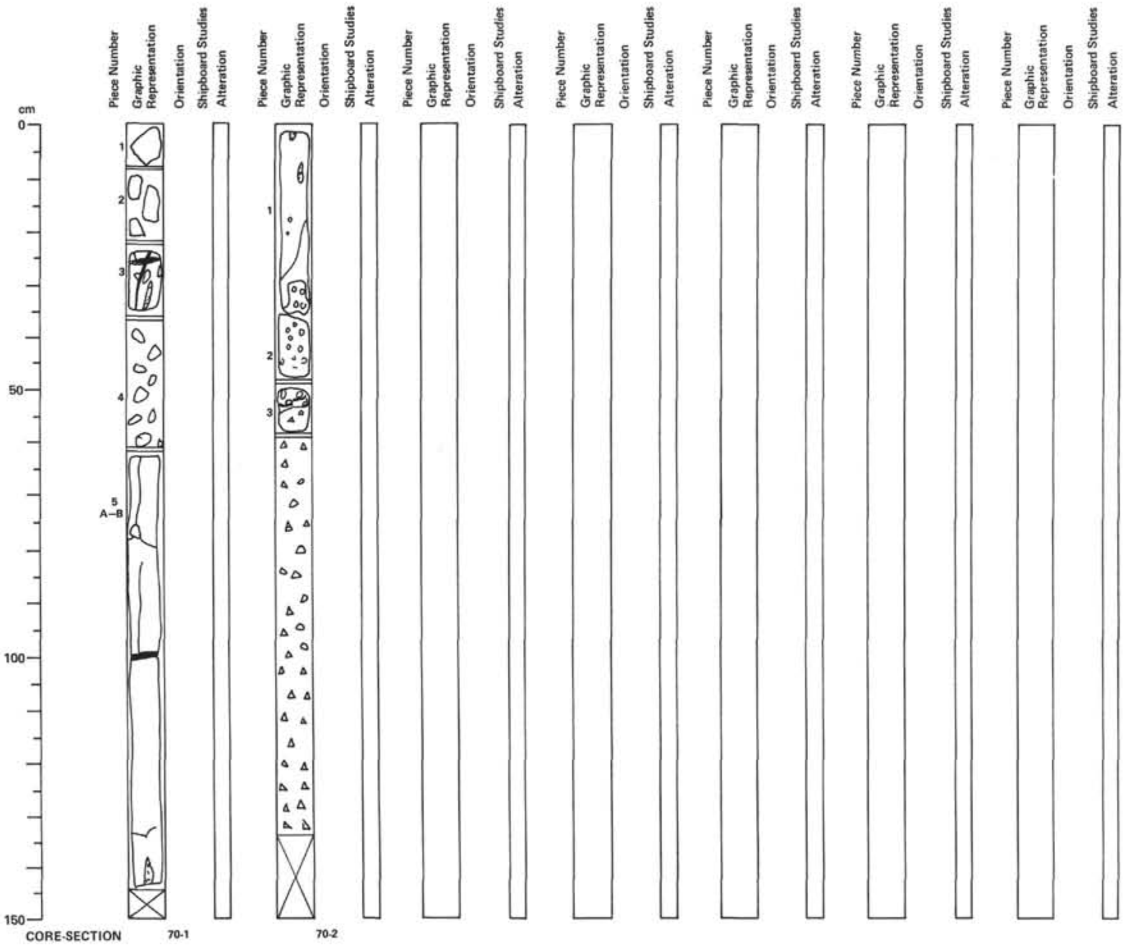
CORE 69, SECTION 4 Depth 684.5–686.0 m

0–70 cm: Similar to Section 3.

70–120 cm: Gradational unit Piece 6A similar to basalt above, Piece 6B becoming darker and finer grained glomerophyric basalt. Vesicles change to calcite-fill, slightly more abundant, still less than 1 mm in size.
120–150 cm: Baked sediment – claystone, indurated, olive black (5Y 2/1), fine grained with volcanic lapilli clasts.

SITE 555 **HOLE** **CORE** 70 **CORED INTERVAL** 689.5–699.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER					SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES		LITHOLOGIC DESCRIPTION
		FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	BENTHIC FORAMINIFERS								
							1 2	0.5 1.0					5GY 6/1	Basalt and volcanic breccia (hyaloclastite) separated by sandstone bed. Sandstone is greenish gray (5GY 6/1), coarse grained, feldspathic. At base contains 2 cm size basalt clasts and bivalve fragments. Hyaloclastite is olive black (5Y 2/1). Clast size variable, angular, vitric basaltic material. Size 0.5–1 cm (lapilli). Cemented with analcite and calcite. NOTE: Due to practice of spacing basalt pieces total recovery may not correspond with recovery marked on barrel sheets.



CORE 70, SECTION 1 Depth 689.5–699.0 m

Pieces 1 and 2: Fine grained glomerophyric basalt, medium gray (N5). Vesicles, 1 up to 0.5 cm smectite filled, rare pyrite.

23 cm: Probably zone of core loss – base of flow.

Piece 3: Sediment coarser sandstone at top over chilled glassy margin 1 mm thick. Fine grained medium dark gray (N4) basalt. Elongate vertically oriented vesicles lined/filled with smectite.

Pieces 4 and 5A to 80 cm: Fine grained basalt, abundant small calcite/smectite filled vesicles, largest around 70–80 with more smectite here. Resorbed clast of vesicular altered basalt/agglomerate.

Pieces 5A (80 cm) and 5B: Coarse grained, less vesicular, glomerophyric basalt, medium gray (N5). Horizontal and vertical fractures, smectite and calcite filled. Vesicles are rare. Base – vertical vesicle train, calcite filled and smectite lined.

CORE 70, SECTION 2 Depth 691.0–692.3 m

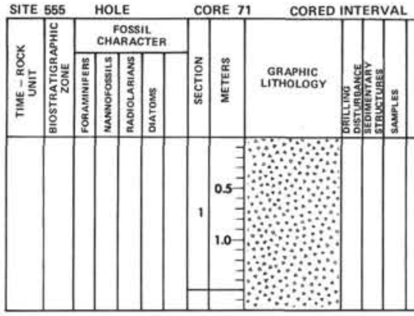
0–22 cm: Similar to Section 1, vesicle trains, smectite and calcite.

22–32 cm: Finer grained chilled contact with underlying sandstone, partly incorporated into base of the flow (medium gray – N5).

32–54 cm: Sandstone, coarse grained, feldspathic probably volcaniclastic well bedded, planar: calcite cement, greenish gray (5GY 6/1). Coarse base – large basalt clasts 2 cm in diameter and bivalves and other broken-up macrofauna.

54–133 cm: Hyaloclastite, olive black (5Y 2/1). Clast size variable, angular, probably vitric basaltic material, between 0.5–1 cm (lapilli size). Cemented with silica phase(?) and calcite.

SITE 555 HOLE CORE 71 CORED INTERVAL 699.0–708.5 m

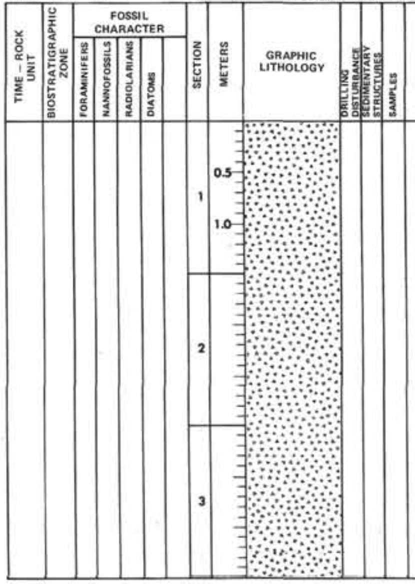


LITHOLOGIC DESCRIPTION

Volcanic breccia (hyaloclastite), brownish black (5YR 2/1). Clast size generally 1–2 cm but some up to 6 cm. Clasts are basaltic glass and basalt, some larger clasts contain vesicles. Well packed and cemented with white (N9) calcite, analcite and quartz.

Possible base of one unit at 130 cm. Below is slightly finer grain size.

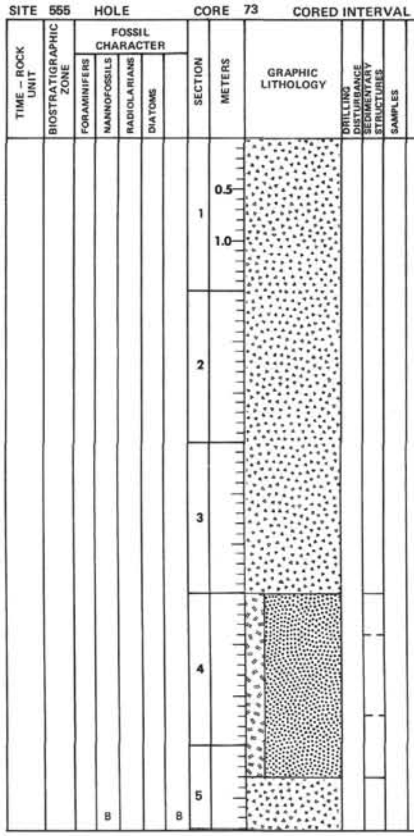
SITE 555 HOLE CORE 72 CORED INTERVAL 708.5–718.0 m



LITHOLOGIC DESCRIPTION

Volcanic breccia (hyaloclastite). Basaltic glass clasts with some vesicular basalt clasts 8 to 14 cm in size. White (N9) cement of analcite and calcite.

SITE 555 HOLE CORE 73 CORED INTERVAL 718.0–727.5 m



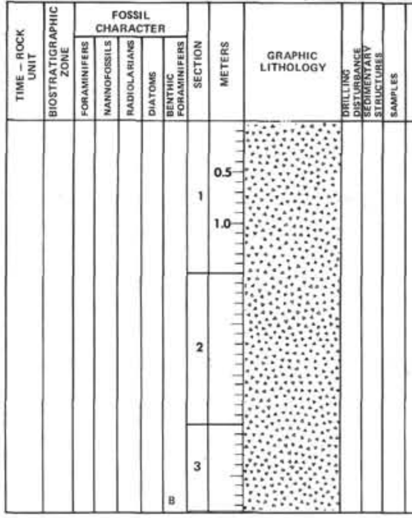
LITHOLOGIC DESCRIPTION

Volcanic breccia (hyaloclastite) interbedded with tuffaceous sandstone unit, olive black (5G 2/1). Sandstone is coarse grained at the top, becoming finer and then coarser again at the base. Poorly sorted.

Hyaloclastite consists of angular clasts up to 10 cm in size. Minor evidence of grading and bedding. Very poorly sorted elsewhere. Cemented by white analcite and calcite.

5G 2/1

SITE 555 HOLE CORE 74 CORED INTERVAL 727.5–737.0 m

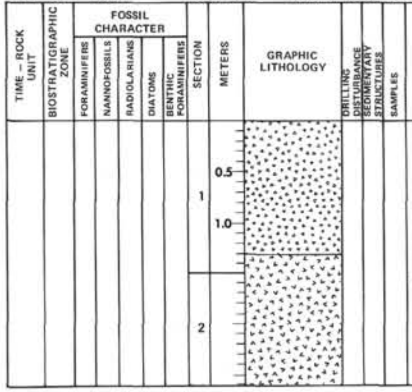


LITHOLOGIC DESCRIPTION

Volcanic breccia (hyaloclastite).

Angular clasts of 1–5 mm basaltic glass, some basalt clasts. Horizontal and vertical fractures minor. Cemented by white analcite and calcite. Very uniform (chaotic), no grading or bedding. One very large basalt clast in Section 3, 41–55 cm.

SITE 555 HOLE CORE 75 CORED INTERVAL 737.0–746.5 m



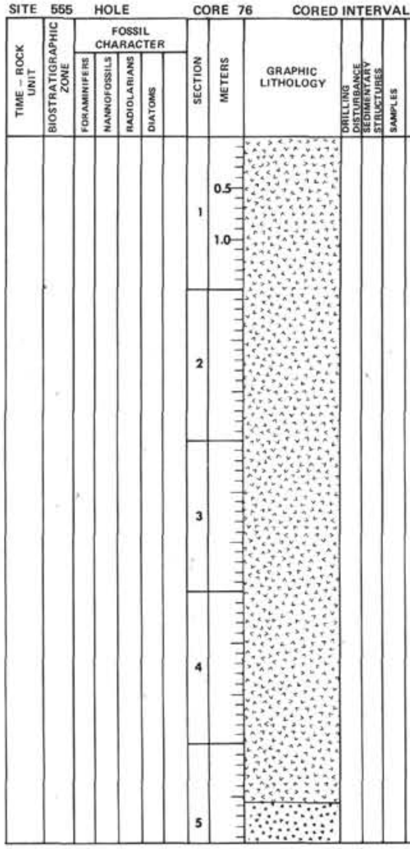
LITHOLOGIC DESCRIPTION

N2

Volcanic breccia (hyaloclastite) overlying pillow basalts. Hyaloclastite consists of angular clasts of basaltic glass and basalt cemented by white analcite and calcite. Clast size generally less than 1 cm. Some hint of laminations throughout.

Note: Due to practice of spacing basalt pieces in curation, recovery as indicated here may not correspond with that indicated by coring summary.

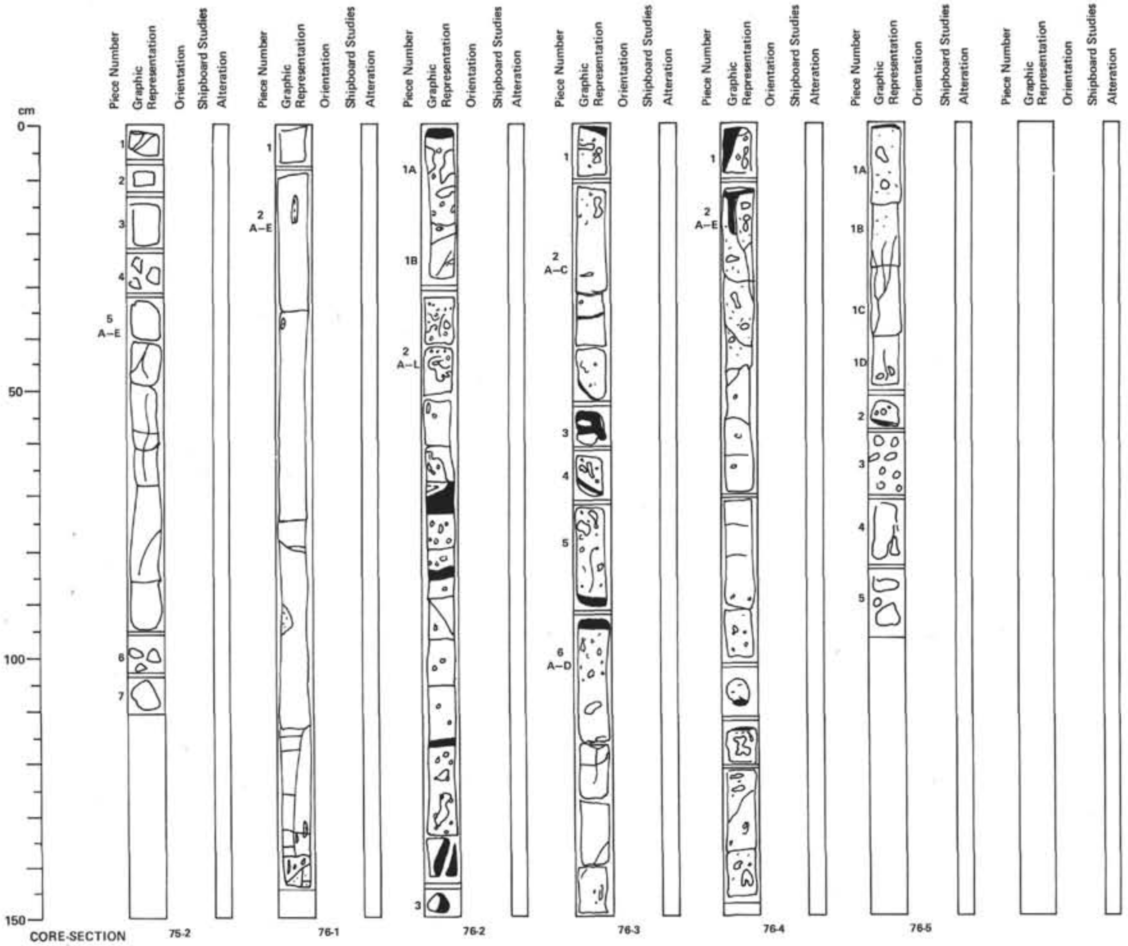
SITE 555 HOLE CORE 76 CORED INTERVAL 746.5–756.0 m



LITHOLOGIC DESCRIPTION

Pillow basalt overlying volcanic breccia (hyaloclastite). (Lithologies described on visual core descriptions.)

Note: Due to practice of spacing basalt pieces in curation, total recovery may not correspond to that indicated here.



CORE 75, SECTION 2 Depth 738.5–739.6 m

Pieces 1–5A: Fine grained medium light gray (N6) vesicular basalt. Vesicles up to 5 mm, calcite filled and smectite lined/filled. Large irregular vesicles in Pieces 1–4 and small circular in Piece 5A, abundant.

Pieces 5B–E: Coarse grained glomerophyric medium light gray (N6) basalt. Rare vesicles (calcite and smectite). Minor fracturing. Calcite followed by smectite fills: horizontal and vertical.

Pieces 6 and 7: Finer grained vesicular basalt, vesicles 1–6 mm calcite filled irregular. Base of flow?

CORE 76, SECTION 1 Depth 746.5–748.0 m

0–50 cm: Coarse to medium grained glomerophyric basalt with abundant 1–2 mm spherical vesicles. Calcite and/or smectite filled; scattered irregular 2 cm (vertical orientation).

50–119 cm: As above but vesicles become smaller and rarer, all smectite filled.

90–93 cm: Almost completely resorbed clast of vesicular basalt (calcite fills).

119–140 cm: Finer grained unit with abundant vesicles – vertical, irregular up to 2 cm vesicles filled with calcite and smectite.

140–150 cm: Sharp angular contact to glassy black (N1) basalt possibly pillow margin, calcite veined and small calcite filled vesicles.

CORE 76, SECTION 2 Depth 748.0–749.5 m

0–19 cm: Glassy margin at top. Fine grained highly vesicular basalt. Vesicles up to 2 cm, elongate and irregular, calcite filled; some have calcite rims and clay fills (not different to below). Diffuse: irregular darker patches – resorbed glassy basalt?

19–36 cm: Uniform coarser black and minor vesicles smectite filled.

36–48 cm: Abundant vesicles 1–2 mm, some up to 1 cm, resorbed darker glassier fragments as above. Calcite and smectite fills.

48–61 cm: Coarser, uniform basalt. Rare large vertical filled vesicles.

61 cm: Irregular contact.

61–70 cm: Vesicular and incorporated glass with chilled very fine 1 cm glass margin, curved.

70–73 cm: Glass, brecciated, cemented with calcite between lower glassy margin (pillow?).

73–85 cm: Vesicular basalt with resorbed glassy clasts. Vesicles are calcite lined and clay filled, margins from 1 mm–1 cm.

85–108 cm: Coarser grained, scattered large irregular 5 mm–1 cm vesicles. Calcite lined/filled, some have clay fills.

108–116 cm: Finer grained more abundant vesicles and resorbed glass as above.

116–117 cm: Glass rind of both above and below basalt units.

117–135 cm: Vesicular fine grained basalt large vesicles, calcite and later clay fills, up to 1 cm; glassy resorbed clasts.

135–150 cm: Sloping contact with 2 cm black glass margin with calcite fractures. Vesicles in glass calcite filled.

CORE 76, SECTION 3 Depth 749.5–751.0 m

0–20 cm: Glassy rind: fine grained medium gray (N5) basalt with reworked irregular glass patches and abundant calcite fill/calcite and later clay fill vesicles.

20–42 cm: Coarse grained basalt less vesicular. Vesicles rare but large.

42–53 cm: Fine grained as above – glassy rind at base.

Piece 3: Glassy rind of underlying basalt pillow with calcite cement filling large fractures.

Piece 4: Fine grained vesicular basalt as above with glassy rind at base.

Piece 5: As above – glassy rind at base.

93–108 cm: Glassy rind at top then basalt as above.

108–145 cm: Coarse grained as in above part with rare large vesicles – quartz fill.

145–150 cm: Becoming fine grained vesicles and resorbed glass clasts.

CORE 76, SECTION 4 Depth 751.0–752.5 m

Piece 1: Glassy rind, calcite fracture fill basalt. Fine grained with vesicles and resorbed clasts.

10–42 cm: Glassy rind at top with fractured glass cemented with clay and calcite below. Fine basalt with large vesicles up to 1 cm and resorbed glassy clasts.

42–90 cm: Coarser grained glomerophyric basalt with horizontal fractures and minor large vesicles filled with calcite and clay.

90–107 cm: Fine grained zone as above.

107–110 cm: Glassy rind as above.

110–150 cm: Fine zone as above.

CORE 76, SECTION 5 Depth 752.5–753.5 m

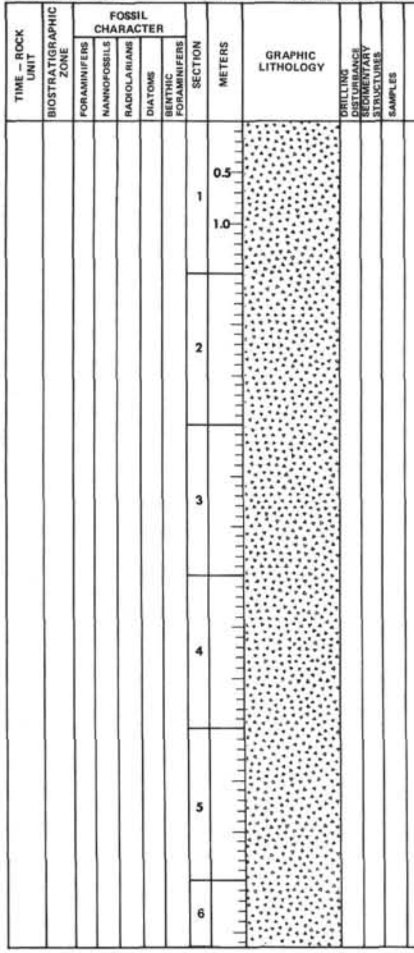
0–24 cm: Glassy rind. Fine grained unit as above.

24–48 cm: Coarse unit as above.

48–58 cm: Fine unit with glassy rind at base.

58–95 cm: Volcanic tuff/lapilli, lithified (baked?), greenish black (5B 2/1) clasts up to 5 mm.

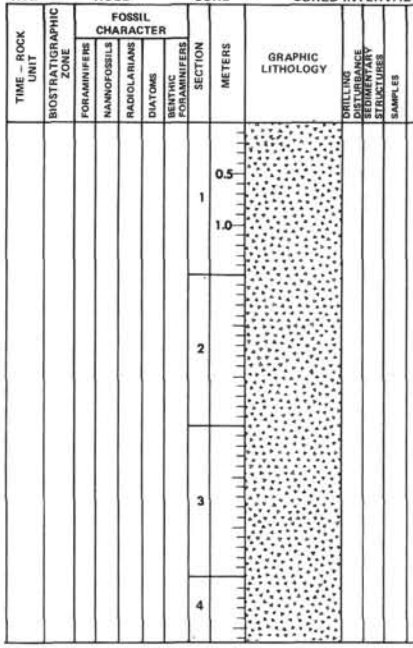
SITE 555 HOLE CORE 77 CORED INTERVAL 756.0–765.5 m



LITHOLOGIC DESCRIPTION

Volcanic breccia (hyaloclastite). Smaller clasts (up to 2 cm) are basaltic glass. Clasts of basalt are up to 10 cm in size, some with glassy rinds and some contain vesicles. White cement is analcite and calcite. Massive, no evidence of bedding.

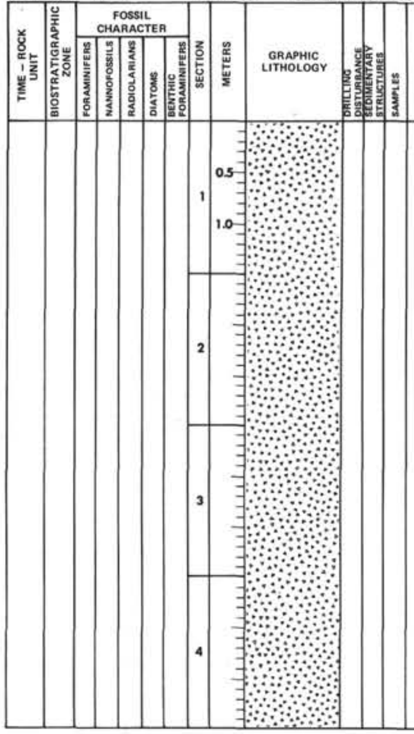
SITE 555 HOLE CORE 78 CORED INTERVAL 765.5–775.0 m



LITHOLOGIC DESCRIPTION

Volcanic breccia (hyaloclastite). Consists of angular clasts of basaltic glass generally less than 1 cm in size. Angular clasts of basalt 2–10 cm in size are scattered throughout. Cemented by white analcite and calcite.

SITE 555 HOLE CORE 79 CORED INTERVAL 775.0–784.5 m

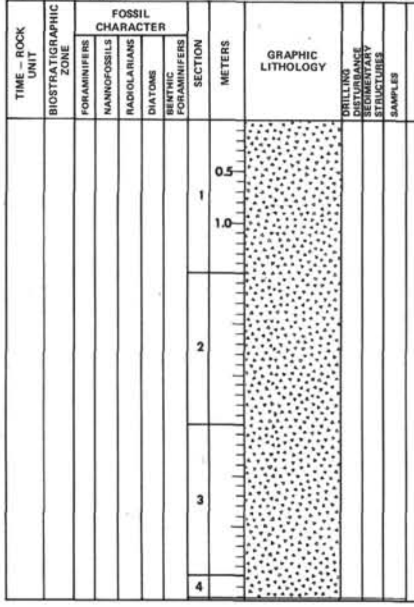


LITHOLOGIC DESCRIPTION

Volcanic breccia (hyaloclastite). Angular clasts of basaltic glass generally less than 1 cm in size comprise the groundmass. Larger angular clasts of basalt up to 20 cm in size are scattered throughout and become more common in Section 3. Cemented by white analcite and calcite.

Section 3, 53–70 and 79–92 cm basalt clasts, Sandstone clast at 123–131 cm.

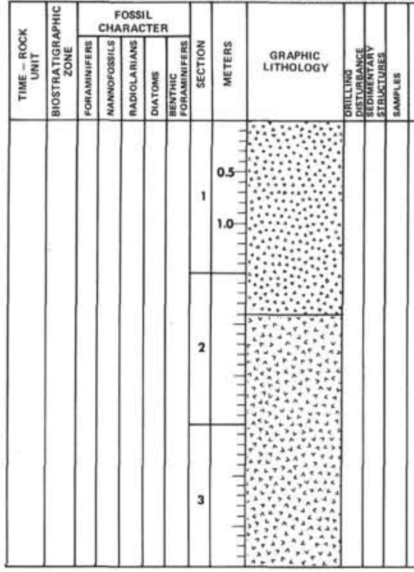
SITE 555 HOLE CORE 80 CORED INTERVAL 784.5–794.0 m



LITHOLOGIC DESCRIPTION

Volcanic breccia (hyaloclastite). Angular clasts of basaltic glass up to 1 cm in size make up the matrix. Larger clasts of basalt up to 30 cm in size are common, particularly in Section 3. Cemented by analcite and calcite.

SITE 555 HOLE CORE 81 CORED INTERVAL 744.0–803.5 m



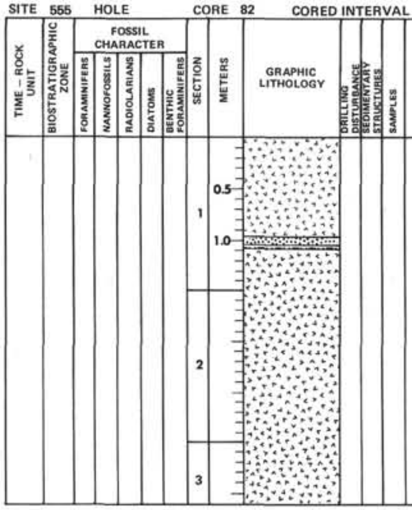
LITHOLOGIC DESCRIPTION

Volcanic breccia (hyaloclastite) and basalt.

Breccia consists of angular clasts of basaltic glass up to 1 cm in size. Larger angular clasts of basalt are set in the matrix of glass. All cemented by analcite and calcite.

Note: Due to practice of spacing basalt pieces during curation, total recovery may not correspond to that shown here.

SITE 555 HOLE CORE 82 CORED INTERVAL 803.5–813.0 m



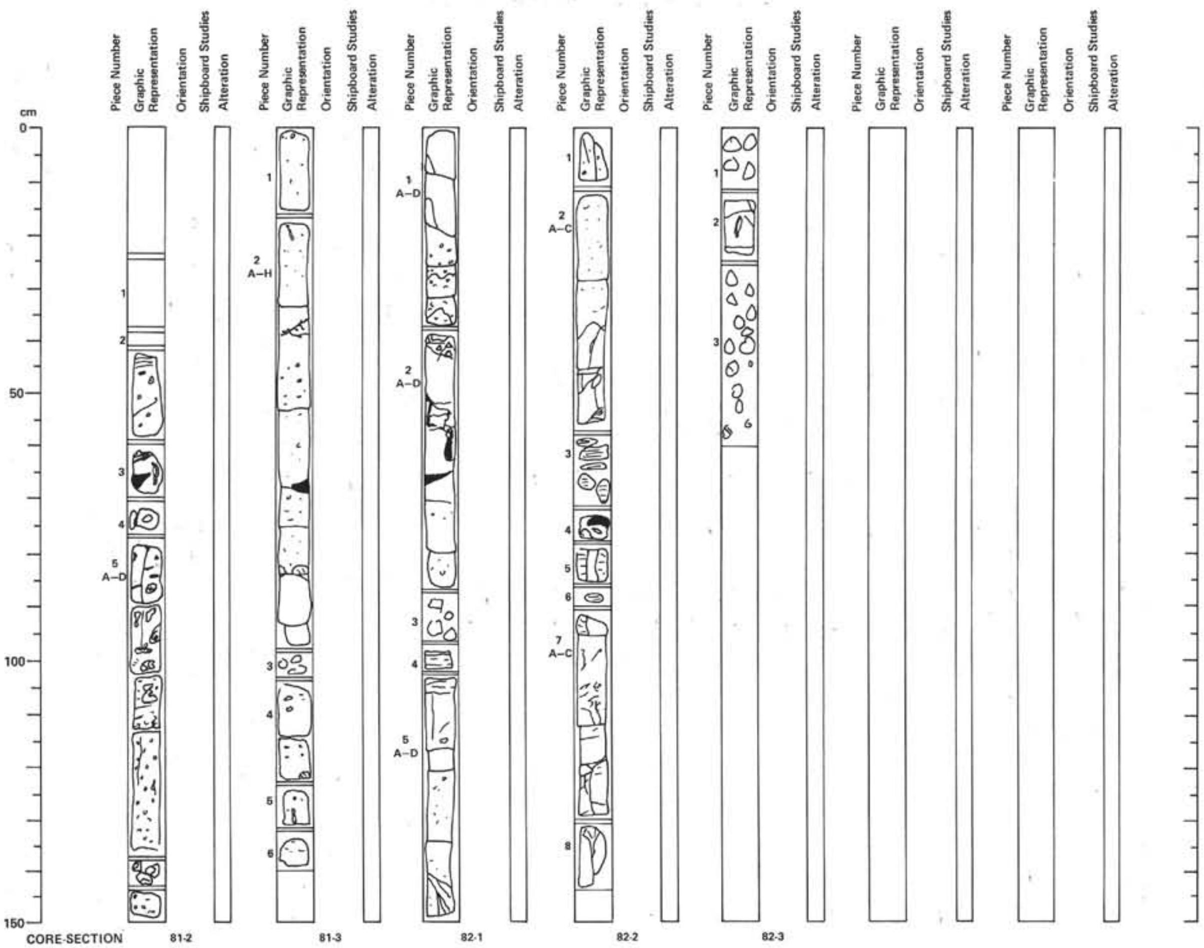
LITHOLOGIC DESCRIPTION

5GY 4/1

Basalt, more fully described on visual core descriptions for igneous rocks, interbedded with sandstone and mudstone, both dark greenish gray (5GY 4/1).

Sandstone is medium grained, planar bedding evident, and overlies mudstone also planar bedded.

NOTE: Due to spacing of basalt pieces total recovery may not correspond to that shown here.



CORE 81, SECTION 2 Depth: 795.5–797.0 m

Agglomerate as Core 77, Section 1.

42–85 cm: Very fine grained basalt. Top: glassy top and incroporated glass. Resorbed: some glassy infills fractures. Some vesicles, rare – white analcite/calcite fills.

85–150 cm: Medium grained highly vesicular basalt. Infills all smectite, analcite and calcite. Some horizontal vesicle trains.

CORE 81, SECTION 3 Depth: 797.0–798.5 m

Coarse grained glomerophyric basalt, vesicles common throughout. Mostly analcite filled at top, then calcite lower down (about 50 cm) and below 90 cm all smectite. Some smectite filled fractures, vertical and horizontal, very minor.

CORE 82, SECTION 1 Depth 803.5–805.0 m

0–38 cm: Fine grained fractured basalt, irregular vesicle patches. Some brecciation, minor. Smectite and analcite filled.

38–67 cm: Highly brecciated fine grained basalt. Fractures filled with lapilli size basalt clasts set in glass smectite.

67–85 cm: Fine grained vesicular basalt.

Piece 3: One basalt fragment as above and sandstone as below.

Piece 4: Sandstone, medium grained, probably volcaniclastic, dark greenish gray (5GY 4/1) planar bedded.

Piece 5A: Baked mudstone, 5GY 4/1.

106–121 cm: Fine grained basalt, rare vesicles smectite filled, fracturing.

121–150 cm: Coarse grained basalt, numerous irregular calcite filled vesicles, glomerophyric, minor fractures, and smectite filled.

CORE 82, SECTION 2 Depth 805.0–806.5 m

0–40 cm: Coarse grained vesicular basalt. Irregular vesicles smectite filled mainly, some calcite. Minor fracturing.

40–54 cm: Glassy rind at sharp upper contact to fine grained basalt and fractured glassy base also. Larger irregular smectite/calcite vesicles.

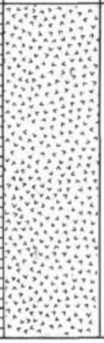
54–92 cm: Baked sandstone with basalt fragments brecciated during flow into sandstone. Sandstone is fine to medium grained dark greenish gray (5GY 4/1).

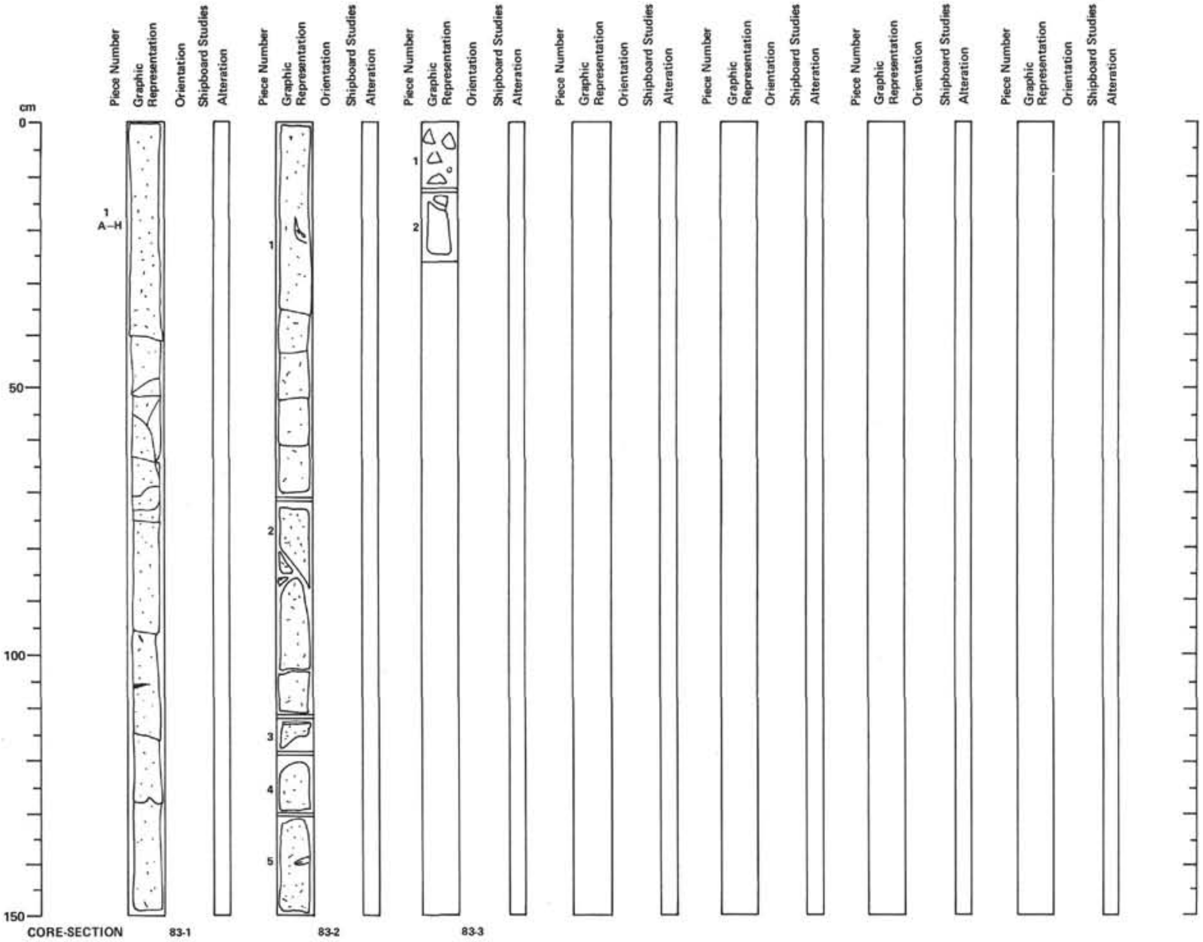
92–142 cm: Fine grained basalt with abundant fractures, calcite and smectite filled. Very irregular fractures. Some resorbed clasts.

CORE 82, SECTION 3 Depth 806.5–807.1 m

Pieces 1–3: Fractured fine grained basalt. Smectite filled fractures and minor large vesicles. Rubble.

SITE 555 HOLE CORE 83 CORED INTERVAL 813.0–822.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER				SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
		FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS							
						1	0.5 1.0					Basalt, more fully described on visual core descriptions for igneous rocks. Note: Due to spacing of basalt pieces during curation, total recovery may not correspond to that shown here.
						2						
						3						



CORE 83, SECTION 1 Depth 813.0–814.5 m

Very coarse grained phyric basalt with abundant irregular smectite filled vesicles up to 2–4 mm throughout; some calcite filled. Rare fractures. Smectite, pyrite, and calcite fills.

CORE 83, SECTION 2 Depth 814.5–816.0 m

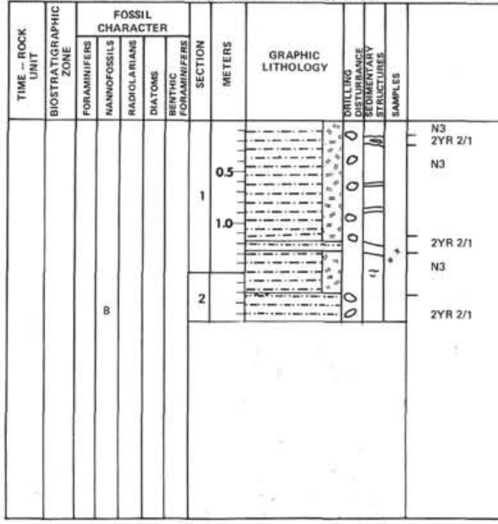
As Core 83, Section 1. Vesicles much smaller – 1 mm, still abundant toward base. Calcite filled veins at 110 cm.

CORE 83, SECTION 3 Depth 816.0–816.3

Piece 1: Rubble.

Piece 2: Finer grained basalt than in Core 83, Section 2. Abundant fine vesicles, smectite filled. Some pyrite filled fractures.

SITE 555 HOLE CORE 84 CORED INTERVAL 822.5–832.0 m



LITHOLOGIC DESCRIPTION

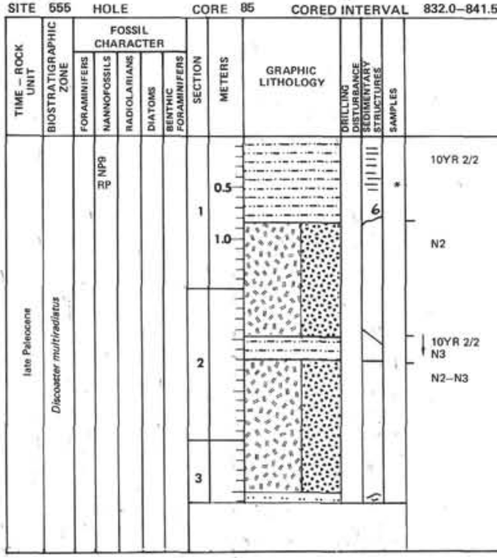
MICACEOUS VITRIC SANDSTONE, very dark gray (N3) interbedded with MICACEOUS SILTY MUDSTONE, brownish black (5YR 2/1).

SMEAR SLIDE SUMMARY (%):

	1, 130	1, 140
	D	D
Texture:		
Sand	20	60
Silt	30	20
Clay	50	20
Composition:		
Quartz	22	35
Feldspar	8	15
Mica	10	10
Heavy minerals	1	1
Clay	40	20
Palagonite	7	10
Pyrite	5	–
Carbonate unspec.	7	9
Calc. nannofossils	4	–
Plant debris	3	–

CARBONATE BOMB (%):
2, 15 = 5

SITE 555 HOLE CORE 85 CORED INTERVAL 832.0–841.5 m



LITHOLOGIC DESCRIPTION

MICACEOUS SILTSTONE, dusky yellowish brown (10YR 2/2) interbedded with LAPILLI TUFF, grayish black (N2). Many basalt fragments to 5 cm diameter. Analcite cement.

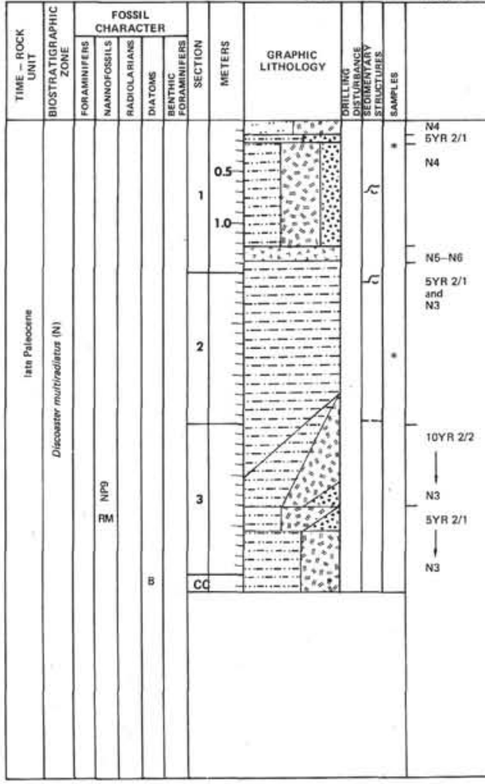
Contact at Section 1, 80 cm irregular.

SMEAR SLIDE SUMMARY (%):

	1, 50
	D
Texture:	
Sand	20
Silt	50
Clay	30
Composition:	
Quartz	40
Feldspar	10
Mica	10
Heavy minerals	1
Clay	29
Palagonite	Tr
Pyrite	3
Carbonate unspec.	5
Plant debris	2

CARBONATE BOMB (%):
1, 40 = 2
1, 78 = 7

SITE 555 HOLE CORE 86 CORED INTERVAL 841.5–851.0 m



LITHOLOGIC DESCRIPTION

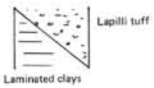
SANDY VITRIC TUFF, dark gray (N4) with interbed of MICACEOUS SILTY MUDSTONE, brownish black (5YR 2/1) to very dark gray (N3).

Section 1, 124–137 cm: basalt, light gray (N6) to gray (N5).

Section 3: interbedded lapilli tuffs.

Sections 2 and 3: faint lamina at 5° dip.

Section 3, 80 cm: distinct channel with cutoff lamina.

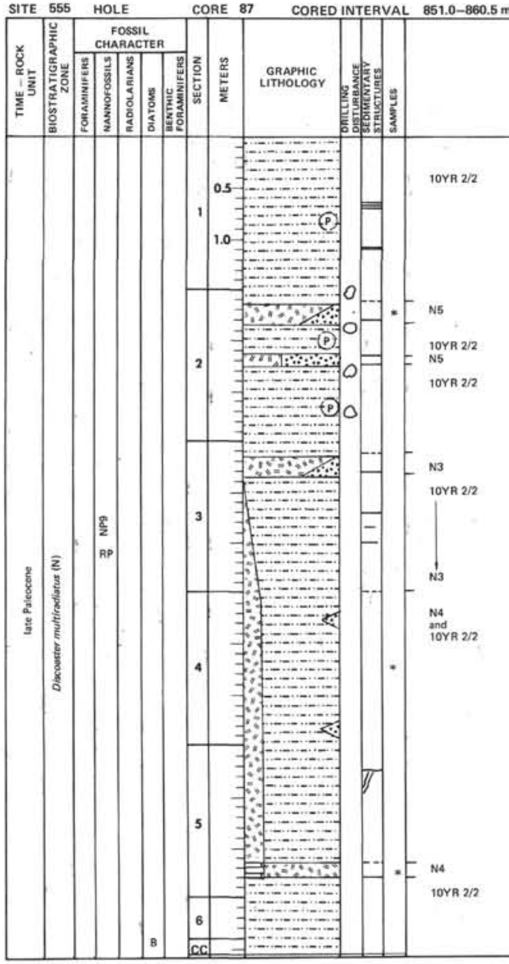


SMEAR SLIDE SUMMARY (%):

	1, 25	2, 85
	D	D
Texture:		
Sand	50	10
Silt	30	30
Clay	20	60
Composition:		
Quartz	30	15
Feldspar	10	5
Mica	5	10
Heavy minerals	1	1
Clay	–	60
Palagonite	35	–
Pyrite	2	2
Zeolite	15	–
Carbonate unspec.	2	3
Calc. nannofossils	–	2
Plant debris	–	2

CARBONATE BOMB (%):
3, 55 = 2
CC = 2

SITE 555 HOLE CORE 87 CORED INTERVAL 851.0–860.5 m



LITHOLOGIC DESCRIPTION

MICACEOUS SILTY MUDSTONE, dusky yellowish brown (10YR 2/2); minor lapilli bands throughout, **LAPILLI VITRIC TUFF**, gray (N5).

Color grading downward to dark gray (N4).

Lamina throughout are subhorizontal.

Section 3, 6–7, 53–54, 70–68, and 86–87 cm: local tuff beds.

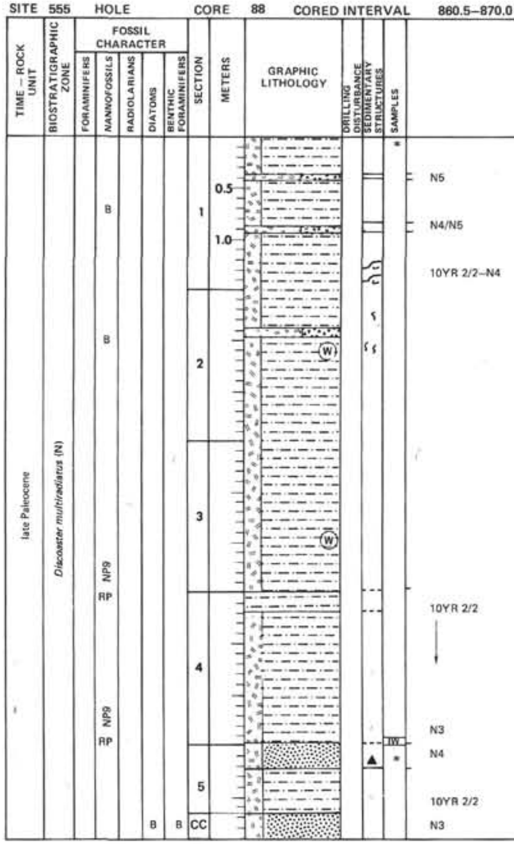
Section 5, 30–18 cm: lapilli dyke.

SMEAR SLIDE SUMMARY (%):

	2, 29 D	4, 75 D	5, 122 D
Texture:			
Sand	20	20	–
Silt	50	30	–
Clay	30	50	–
Composition:			
Quartz	1	22	4
Feldspar	1	8	1
Mica	–	10	4
Heavy minerals	Tr	2	–
Clay	–	40	–
Volcanic glass	Tr	–	–
Palagonite	85	5	15
Pyrite	–	10	–
Carbonate unspec.	–	1	15
Calc. nannofossils	–	1	1
Plant debris	–	1	–

CARBONATE BOMB (%):
5, 145 = 2
6, 24 = 3

SITE 555 HOLE CORE 88 CORED INTERVAL 860.5–870.0 m



LITHOLOGIC DESCRIPTION

VITRIC MICACEOUS MUDSTONE, dusky yellowish brown (10YR 2/2) and interbeds of **LAPILLI TUFF**, medium gray (N5) and medium dark gray (N4), "salt and pepper" appearance.

Clay and silt laminations throughout in flaser form.

Serpulid scattered throughout, especially Section 2.

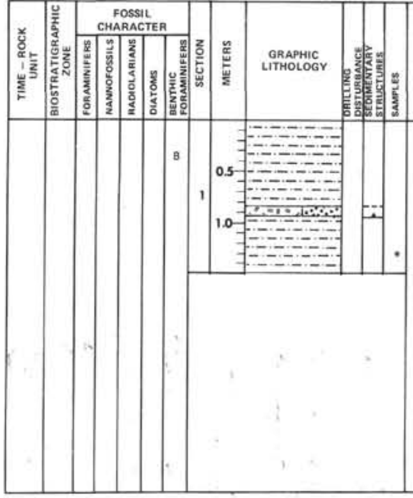
Section 4, 20 cm: scoured contact with **VITRIC MICACEOUS FELDSPATHIC SANDSTONE**, medium dark gray (N4), graded.

SMEAR SLIDE SUMMARY (%):

	1, 7 D	5, 15 D
Texture:		
Sand	20	60
Silt	30	20
Clay	50	20
Composition:		
Quartz	15	45
Feldspar	5	15
Mica	10	10
Heavy minerals	–	2
Clay	50	12
Volcanic glass	–	Tr
Palagonite	10	15
Pyrite	4	–
Foraminifers	Tr	–
Calc. nannofossils	1	1
Plant debris	5	–

CARBONATE BOMB (%):
4, 122 = 2

SITE 555 HOLE CORE 89 CORED INTERVAL 870.0–879.5 m



LITHOLOGIC DESCRIPTION

10YR 2/2

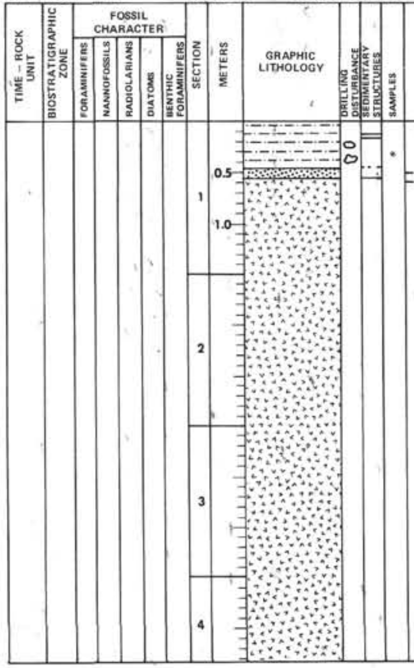
SILTY MUDSTONE, dusky yellowish brown (10YR 2/2); faintly laminated.

Section 1, 95–91 cm: graded LAPILLI TUFF; "salt and pepper" appearance, medium light gray (N6) lapilli in dark gray (N3) matrix.

SMEAR SLIDE SUMMARY (%):

	1, 130
	D
Texture:	
Sand	20
Silt	40
Clay	40
Composition:	
Quartz	28
Feldspar	7
Mica	5
Heavy minerals	1
Clay	40
Palagonite	5
Pyrite	2
Carbonate unspec.	7
Plant debris	5

SITE 555 HOLE CORE 90 CORED INTERVAL 879.5–889.0 m



LITHOLOGIC DESCRIPTION

10YR 2/2

N5

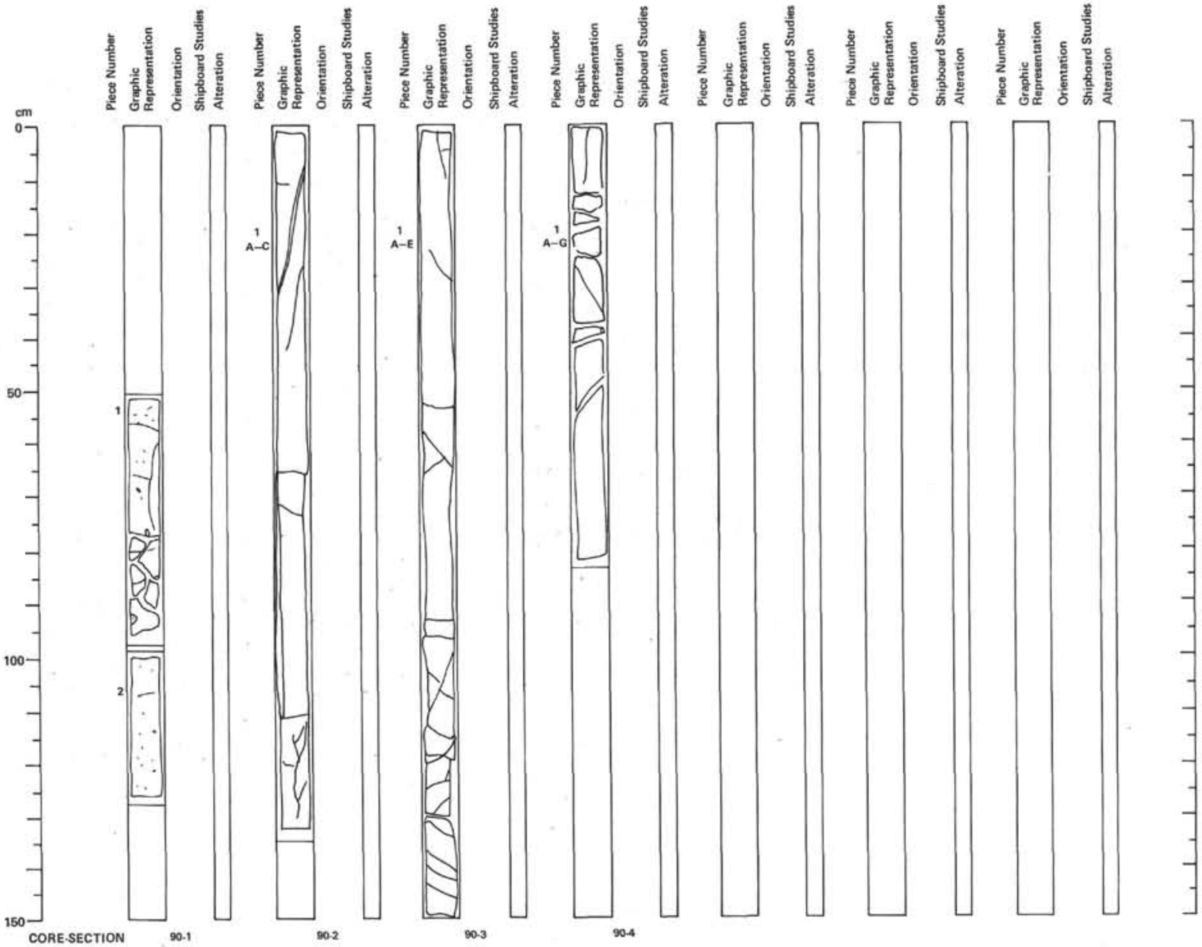
MICACEOUS SILTY MUDSTONE, dusky yellowish brown (10YR 2/2). Indistinctly laminated.

Section 1, 55 cm: contact with basalt – contact exhibits chilled margin with pillow structure – also sediment-filled cooling crack. Immediately above contact is a sandstone, medium gray (N5).

SMEAR SLIDE SUMMARY (%):

	1, 30
	D
Texture:	
Sand	20
Silt	40
Clay	40
Composition:	
Quartz	25
Feldspar	8
Mica	10
Heavy minerals	1
Clay	40
Palagonite	2
Pyrite	4
Carbonate unspec.	8
Foraminifers	Tr
Plant debris	2

CARBONATE BOMB (%):
1, 33 = 3



CORE 90, SECTION 1 Depth 880.0–881.0 m

0 -55 cm: Sandstone as above.

55–75 cm: Dark gray (N3) very fine grained aphanitic basalt. Minor vesicles – calcite filled.

75–95 cm: Lighter gray (medium dark gray – N4), very fine grained phyric basalt. Horizontal fractures. Calcite filled. Vesicles small, smectite filled with rare larger ones calcite filled.

95–125 cm: Fine grained phyric basalt becoming coarser grained. Abundant small (1 mm) vesilces all smectite filled.

CORE 90, SECTION 2 Dpeth 881.0–882.5 m

Very uniform, medium grained, glomerophyric basalt, medium light gray (N5). Minor fractures mostly smectite filled, rare calcite fills. Abundant fine vesicles throughout, becoming larger below 60 cm (up to 3 mm), all smectite filled, and irregular shape.

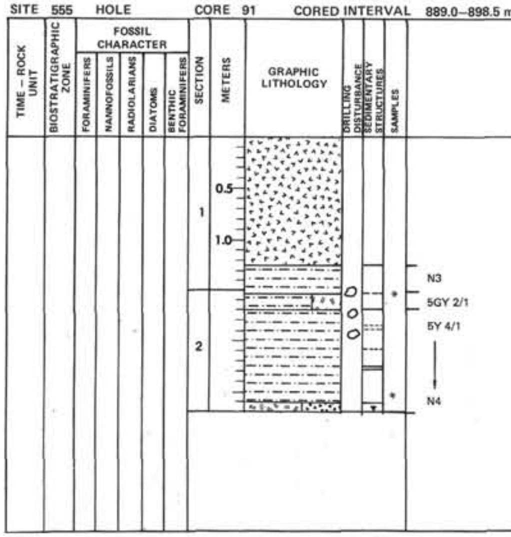
CORE 90, SECTION 3 Depth 882.5–884.0 m

Medium grained glomerophyric basalts with abundant irregular vesicles – smectite filled. No variation through core. Fractures irregular, increasing in frequency toward base.

CORE 90, SECTION 4 Depth 884.0–884.8 m

As above, possibly becoming finer grained and vesicles reduced in size below 60 cm.

SITE 555 HOLE CORE 91 CORED INTERVAL 889.0–898.5 m



LITHOLOGIC DESCRIPTION

BASALT

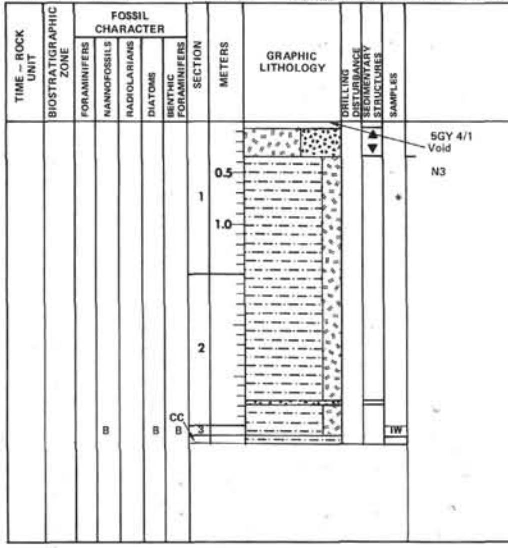
Section 1, 131 cm: lower contact with MICACEOUS SILTY MUDSTONE, dark gray (N3), olive gray (5Y 4/1), with interbeds of VITRIC FELDSPATHIC SANDSTONE, greenish black (5GY 2/1).

Section 2, 51–48, 65, 73–75 cm: graded lapilli bands.

SMEAR SLIDE SUMMARY (%):

	2, 5 D	2, 100 D
Texture:		
Sand	60	20
Silt	20	30
Clay	20	50
Composition:		
Quartz	35	15
Feldspar	14	5
Mica	5	10
Heavy minerals	1	1
Clay	20	40
Palagonite	25	5
Pyrite	–	5
Carbonate unspec.	–	6
Plant debris	–	3

SITE 555 HOLE CORE 92 CORED INTERVAL 898.5–908.0 m



LITHOLOGIC DESCRIPTION

VITRIC MICACEOUS SILTY MUDSTONE, very dark gray (N3), lapilli scattered throughout in roughly horizontal concentrations.

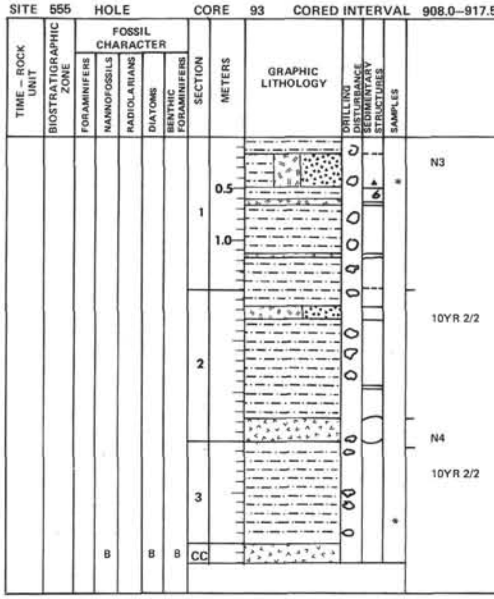
Section 1, 8–35 cm: LAPILLI TUFF, olive gray (5Y 4/1), burrowed. Lapilli: greenish gray (5GY 6/1) and grayish black (N2), in matrix: dark greenish gray (5GY 4/1).

SMEAR SLIDE SUMMARY (%):

	1, 77 D
Texture:	
Sand	20
Silt	20
Clay	60
Composition:	
Quartz	18
Feldspar	6
Mica	10
Heavy minerals	1
Clay	40
Palagonite	12
Pyrite	3
Carbonate unspec.	8
Plant debris	2

CARBONATE BOMB (%):
2, 148 = 2

SITE 555 HOLE CORE 93 CORED INTERVAL 908.0–917.5 m



LITHOLOGIC DESCRIPTION

MICACEOUS SILTY MUDSTONE, dark gray (N3) to dusky yellowish brown (10YR 2/2) with interbeds of LAPILLI TUFF. Greenish gray (5GY 6/1) lapilli in matrix of dark greenish gray (5GY 4/1).

Vaguely laminated throughout.

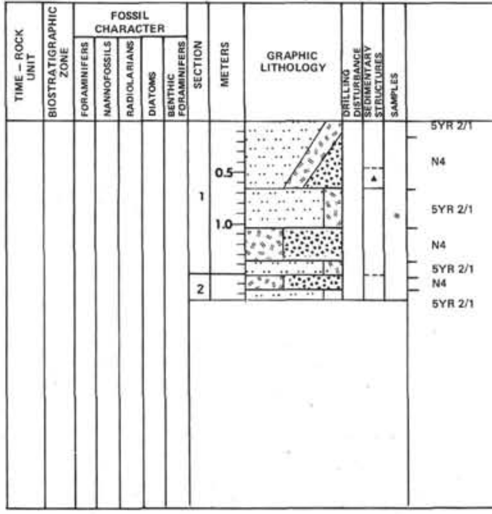
Section 2, 123 cm–Section 3, 3 cm: basalt pillow, medium dark gray (N4).

Core-Catcher: basalt clasts.

SMEAR SLIDE SUMMARY (%):

	1, 46 M	3, 80 D
Texture:		
Sand	–	20
Silt	–	30
Clay	–	50
Composition:		
Quartz	–	30
Feldspar	–	5
Mica	–	10
Heavy minerals	–	1
Clay	–	40
Palagonite	80	4
Pyrite	5	5
Carbonate unspec.	15	2
Plant debris	–	3

SITE 555 HOLE CORE 94 CORED INTERVAL 917.5–927.0 m



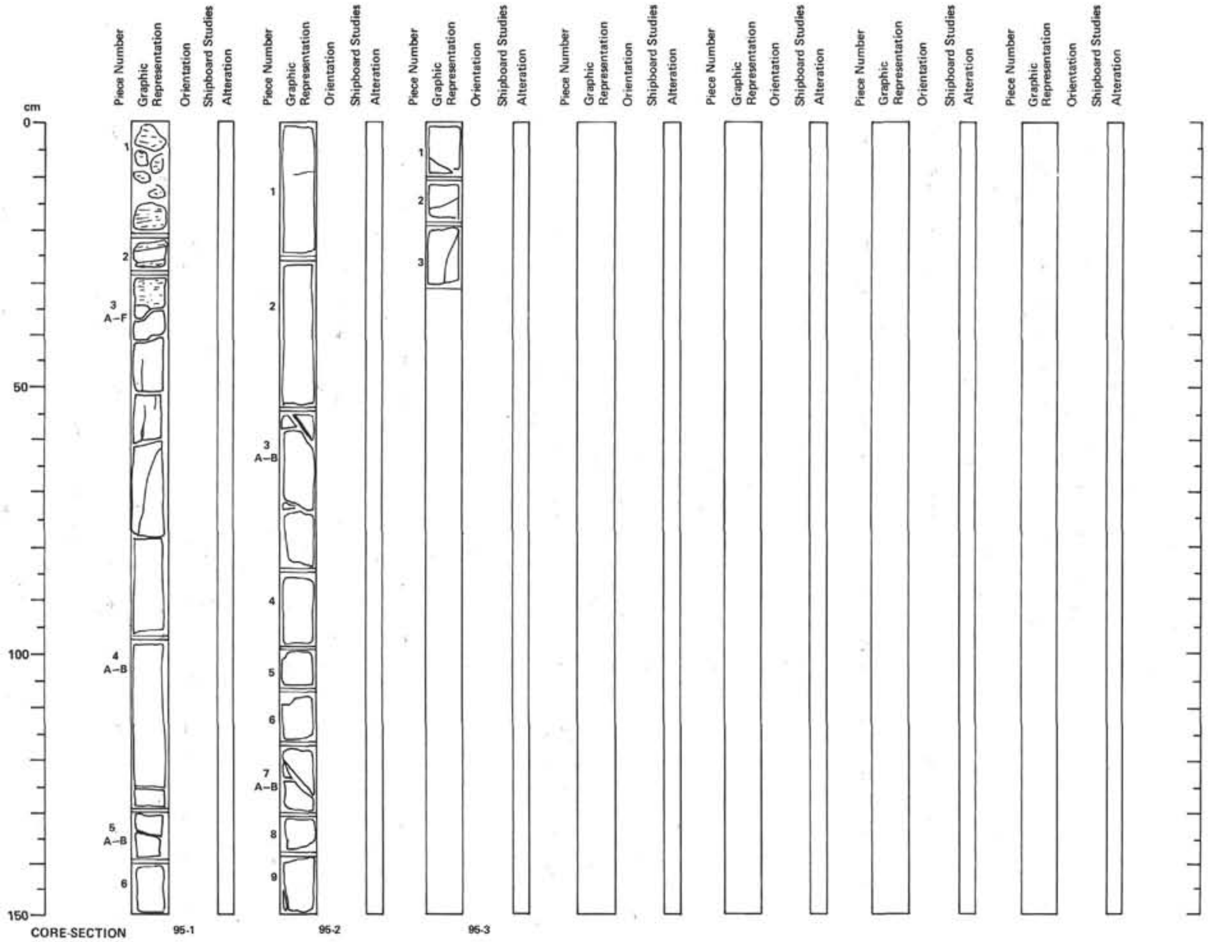
LITHOLOGIC DESCRIPTION

VITRIC MICACEOUS SANDSTONE, brownish black (5YR 2/1) with distinct lamina and flaser bedding. Scattered serpulids interbedded with LAPILLI TUFF, generally dark gray (N4).

Section 1, 100–135 cm: lapilli and basalt clasts with reaction rims in dark gray (N4) matrix. Lapilli: greenish gray (5G 6/1).

SMEAR SLIDE SUMMARY (%):

	1, 94 D
Texture:	
Sand	40
Silt	30
Clay	30
Composition:	
Quartz	32
Feldspar	8
Mica	10
Heavy minerals	1
Clay	30
Palagonite	10
Pyrite	4
Carbonate unspec.	3
Plant debris	2



CORE 95, SECTION 1 Depth: 927.0–928.5 m

0–15 cm: Mudstone, medium gray (N5), fine grained, indurated.

15–20 cm: Sandstone, coarse grained, dark greenish gray (5GY 4/1), indurated. Also in Pieces 2 and 3A.

Piece 2: Thin, very fine grained basalt flow. Basalt dark gray (N3). Contact with sandstone above and below.

Piece 3: Fine grained glomerophyric basalt, medium dark gray (N5), rare fractures, near vertical. Very rare vesicles filled with green smectite.

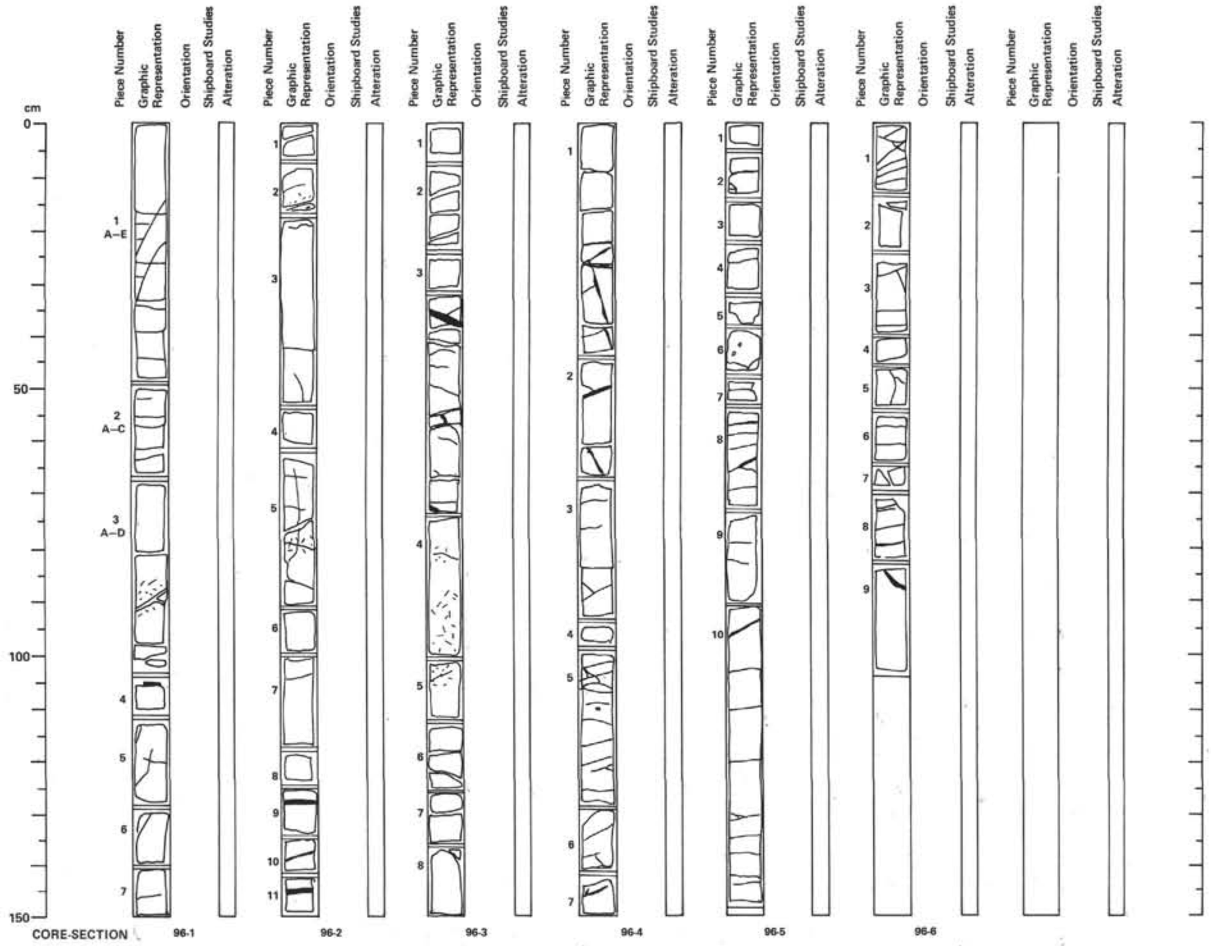
Pieces 3B and C: Very fine grained basalt, aphyric at top becoming phyric, vesicles rare, smectite filled, grading from N3 to N4.

CORE 95, SECTION 2 Depth 928.5–930.0 m

Medium grained glomerophyric basalt becoming coarser below 50 cm. Non-vesicular; fractures minor mainly oriented at 60° to horizontal, some at 90° to this direction. Fractures filled with smectite.

CORE 95, SECTION 3 Depth 930.0–930.3 m

Coarse grained glomerophyric basalt as before, no vesicles, rare smectite filled fractures; sharp fractures noted which have no common direction.



CORE 96, SECTION 1 Depth 936.5–938.0 m

Coarse grained glomerophyric, medium dark gray (N4) basalt. No vesicles, fractures fairly common. Dominant fracturing horizontal and at 60° to horizontal. Fractures generally less than 1 mm across, smectite filled. Larger fractures are smectite lined and zeolite-filled (analcite?). Minor very coarse grained zone around 90 cm.

CORE 96, SECTION 2 Depth 938.0–939.5 m

Coarser grained glomerophyric, non-vesicular basalt as before. No variations in grain size. Discernible apart from two minor coarser zones (15 and 79 cm). Fracturing common, no apparent preferred orientation although these wide smectite-filled fractures near base are parallel and near-horizontal.

CORE 96, SECTION 3 Depth 939.5–941.0 m

Coarse grained glomerophyric basalt as before – one courser band between 85–105 cm. Fractured badly, fractures infilled with black smectite. Fractures near horizontal (up to 20° from horizontal). No vesicles.

CORE 96, SECTION 4 Depth 941.0–942.5 m

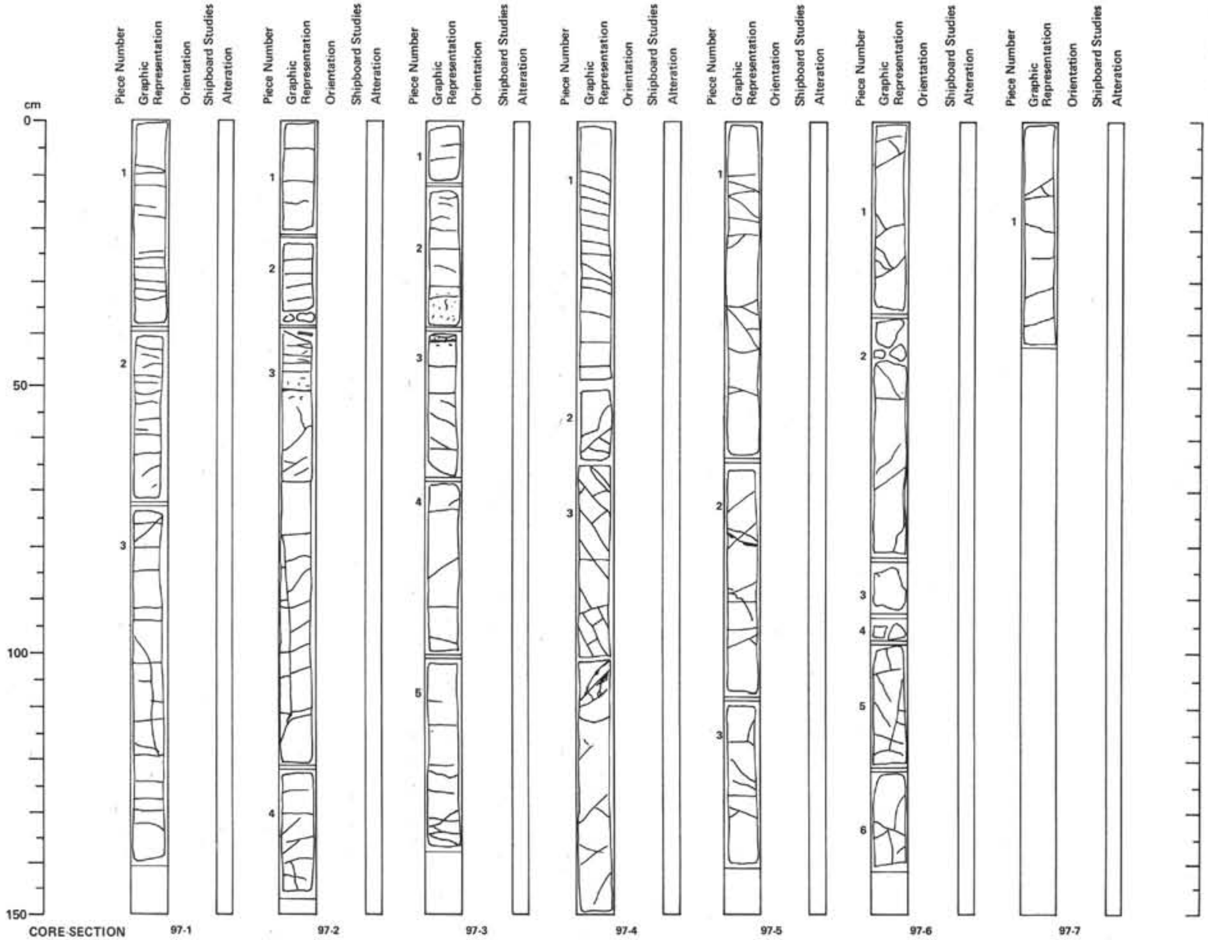
As before, uniform glomerophyric basalt. Fracturing becoming very intense locally. Dominant direction still near horizontal but cross-cutting fractures occur at many angles. Smectite fills near fractures. One vesicle at 110 cm filled with black smectite.

CORE 96, SECTION 5 Depth 942.5–944.0 m

As before, uniform throughout. Fractures again very common, mainly near horizontal. Smectite filled, larger ones have analcite as later phase. Minor large round vesicles are smectite filled, up to 0,5 cm in Piece 6.

CORE 96, SECTION 6 Depth 944.0–945.0 m

As before, highly fractured coarse grained glomerophyric basalt with uniform grain size and smectite and analcite fracture fills.



CORE 97, SECTION 1 Depth 946.0–947.5 m

Coarse grained glomerophyric medium dark gray (N5) basalt. No vesicles, but very frequent fracturing. Fractures mainly aligned within 20° of horizontal but mainly cross-cutting fractures at no particular alignment.

CORE 97, SECTION 2 Depth: 947.5–949.0 m

As before. One coarser band at 50 cm but otherwise uniform. Fracturing becoming more intense in similar fashion to that previously described, with some pieces completely shattered.

CORE 97, SECTION 3 Depth 949.0–950.5 m

Uniform coarse grained glomerophyric basalt as before, one coarser band at 35–40 cm. Fracturing intense, as previously described (near horizontal dominating, with cross-cutting fractures oriented in no particular direction although some suggestion of about 60°).

CORE 97, SECTION 4 Depth 950.5–952.0 m

As before, orientation of fractures becomes dominantly 60° below 50 cm. Some fractures have late calcite/analcite fills (after smectite).

CORE 97, SECTION 5 Depth 952.0–953.5 m

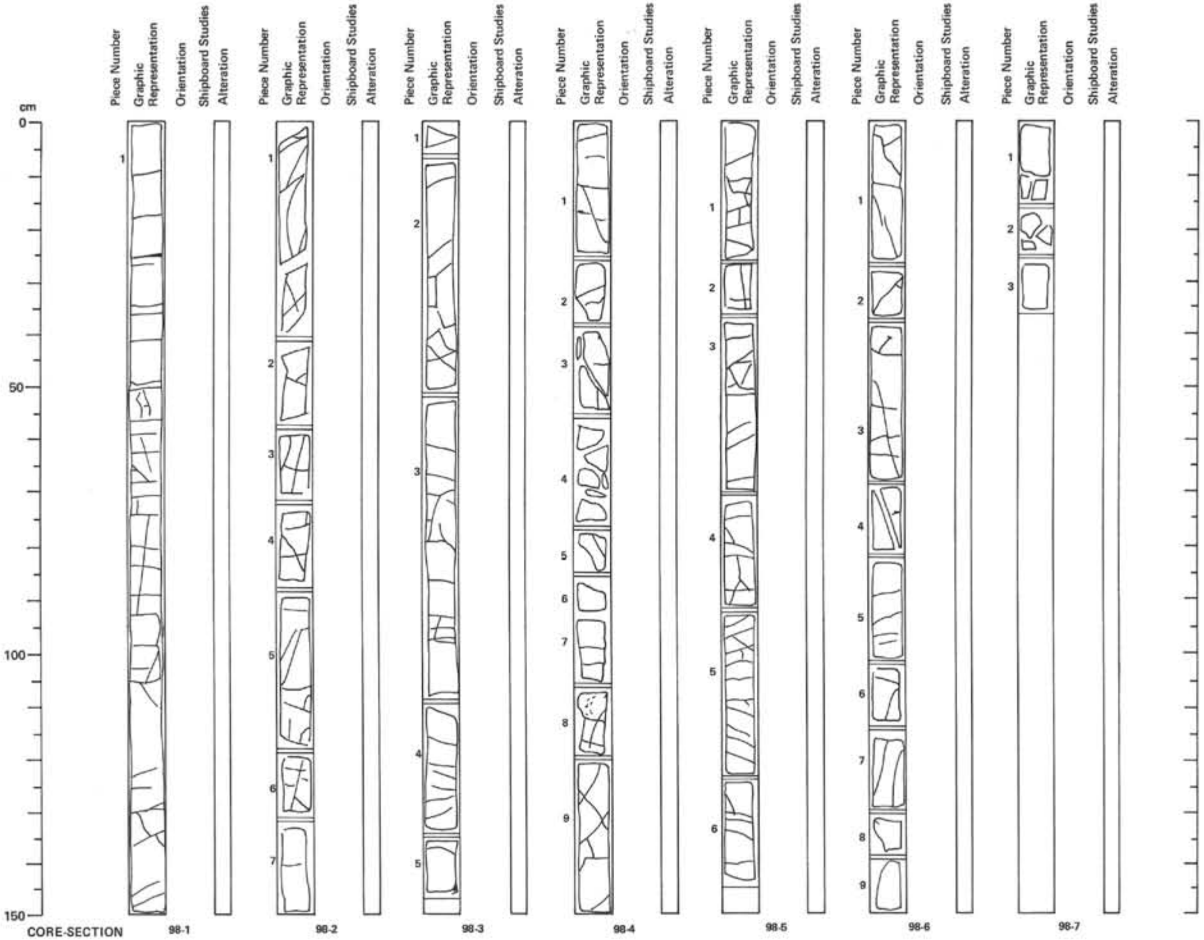
Fractured coarser glomerophyric basalt as before. Fractures filled with smectite, with one showing analcite fill also. Fractures dominantly marked about 60° to horizontal.

CORE 97, SECTION 6 Depth 953.5–955.0 m

Highly fractured basalt as before. Fractures dominantly about 60° from horizontal but others are apparently random. Basalt texture unchanged from previous sections.

CORE 97, SECTION 7 Depth 955.0–955.4 m

As before, fractures revert to about 20° from horizontal. Additional amount of core here possibly resulting from spacing out of basalt during curation.



CORE 98, SECTION 1 Depth: 955.0–956.5 m

Highly fractured coarse grained glomerophyric basalt, medium dark gray (N5). No grain size variations over core. No vesicles. Fractures generally within 20° of horizontal with some high angle cross-cutting. Mostly smectite filled, rarely with later analcite.

CORE 98, SECTION 2 Depth 956.5–958.0 m

As before, no textural variation whatsoever. Many fractures, dominantly less than 20° and about 60° but other higher angles. Smectite filled throughout.

CORE 98, SECTION 3 Depth 958.0–959.5 m

As before, no change in texture or color. Fracturing intense, dominated by the 20° direction with many high angle cross cutting. All smectite filled.

CORE 98, SECTION 4 Depth 959.5–961.0 m

Fractured coarse glomerophyric basalt as before. Fractures dominated by 60° orientation:<20° position common also. No textural variations observed except coarse pieces in Piece 8, elongate zone (resorbed clast of coarse grained basalt?).

CORE 98, SECTION 5 Depth 961.0–962.5 m

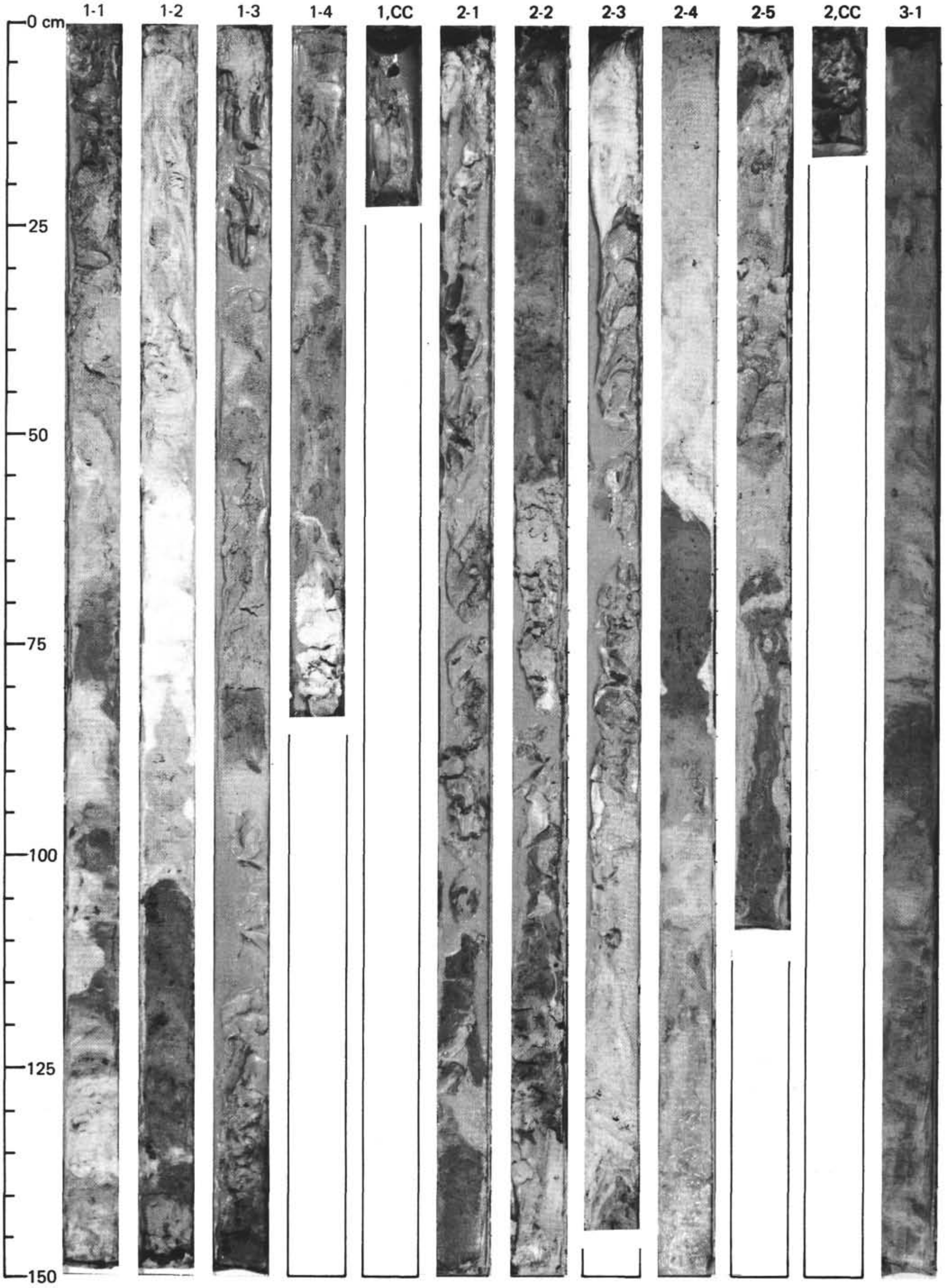
As before, very uniform glomerophyric basalt. Fracturing intense, near horizontal most common with high angle cross cuts frequent.

CORE 98, SECTION 6 Depth 962.5–964.0 m

As before, fracturing less intense and dominated by high angle fractures. Again smectite fills.

CORE 98, SECTION 7 Depth 964.0–964.4 n

Coarse grained basalt as before.



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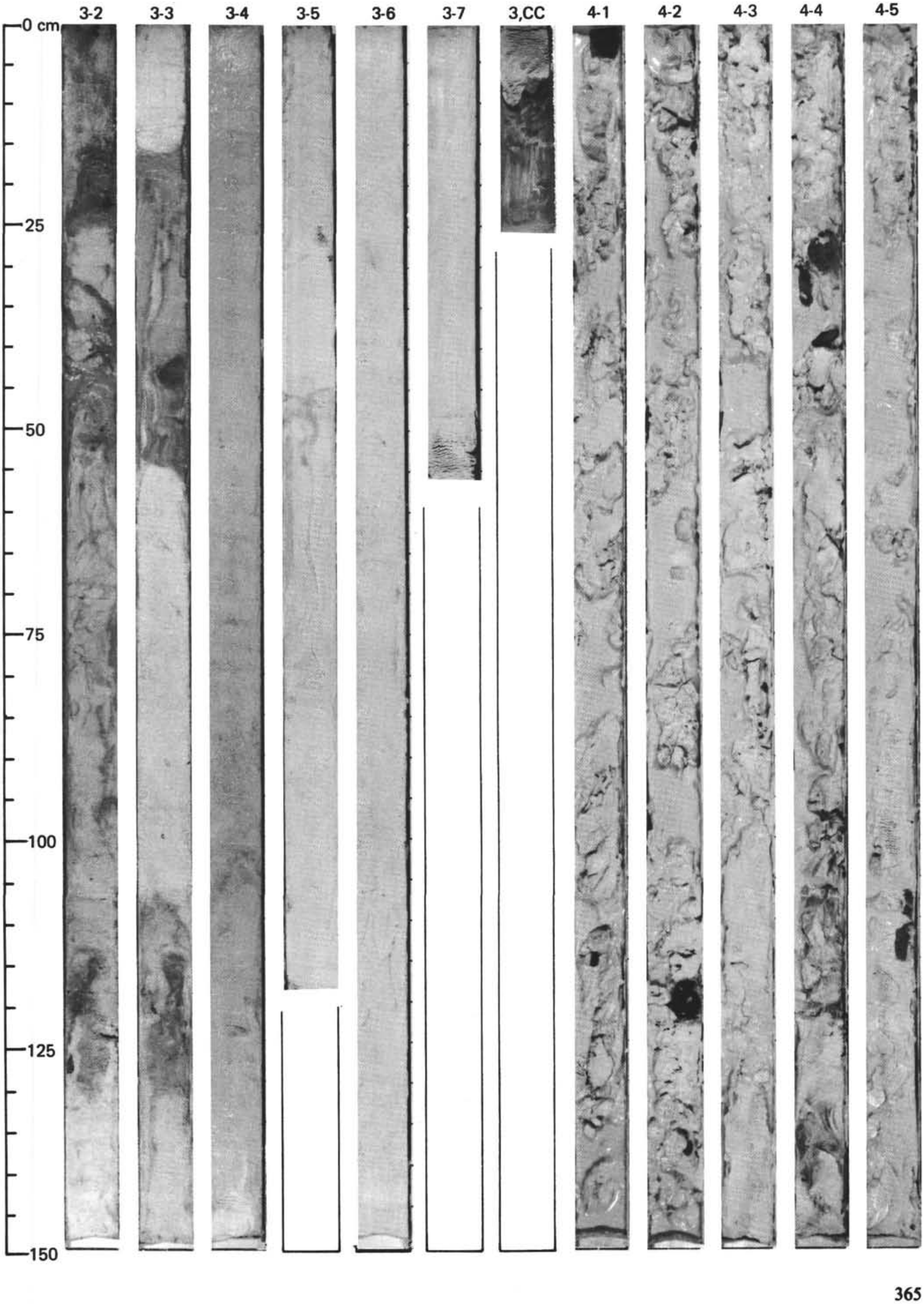
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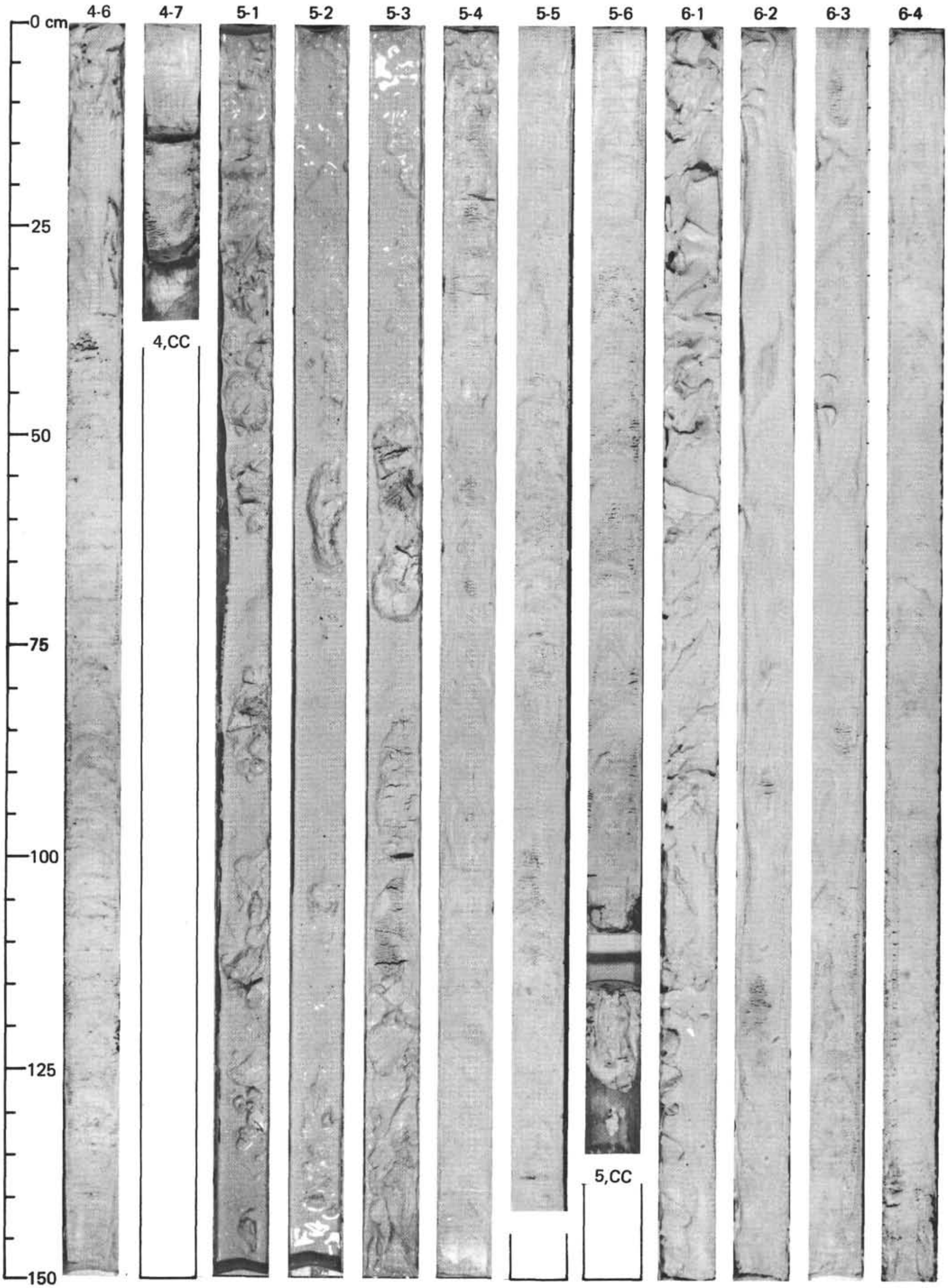
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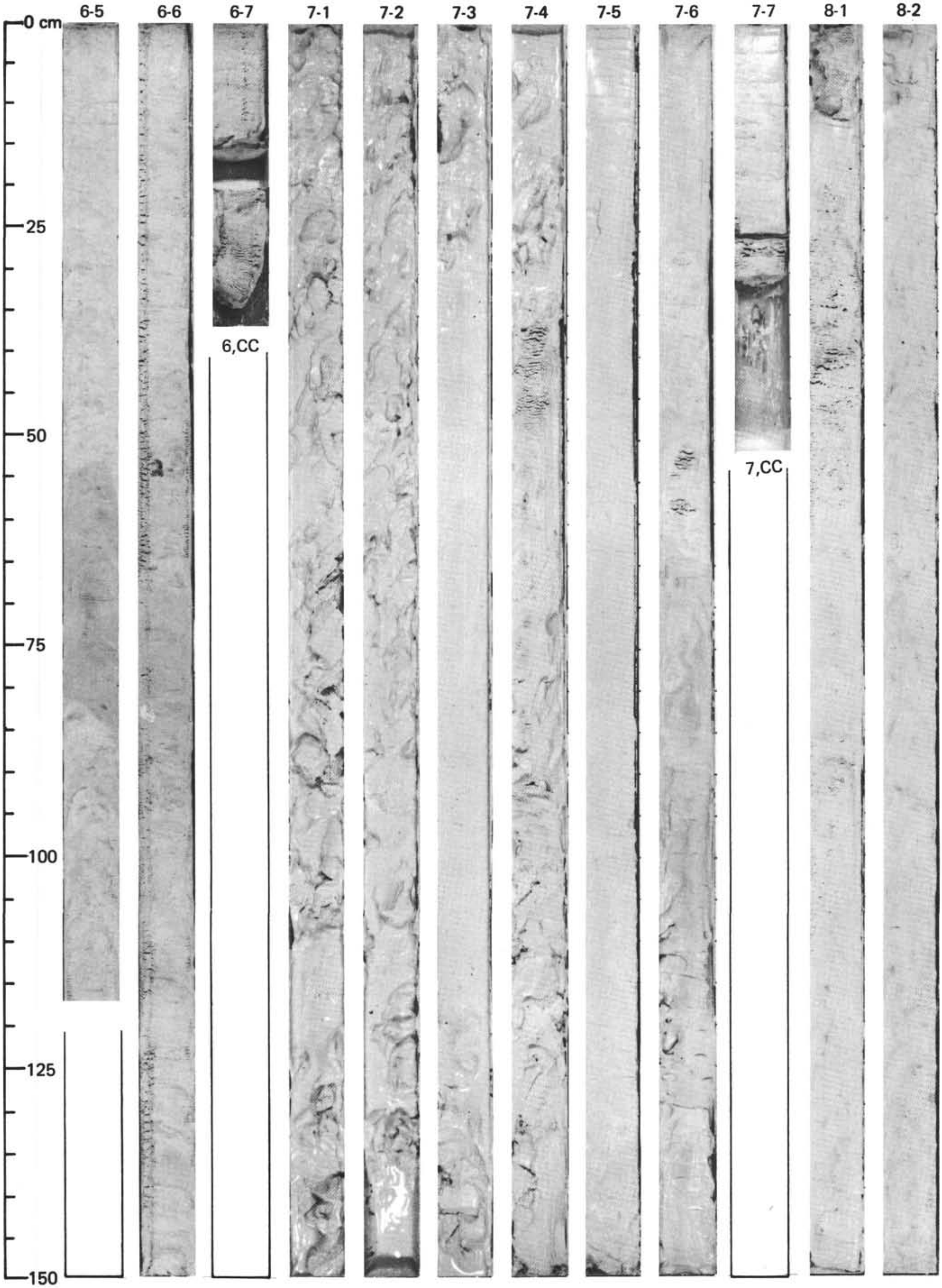
5,CC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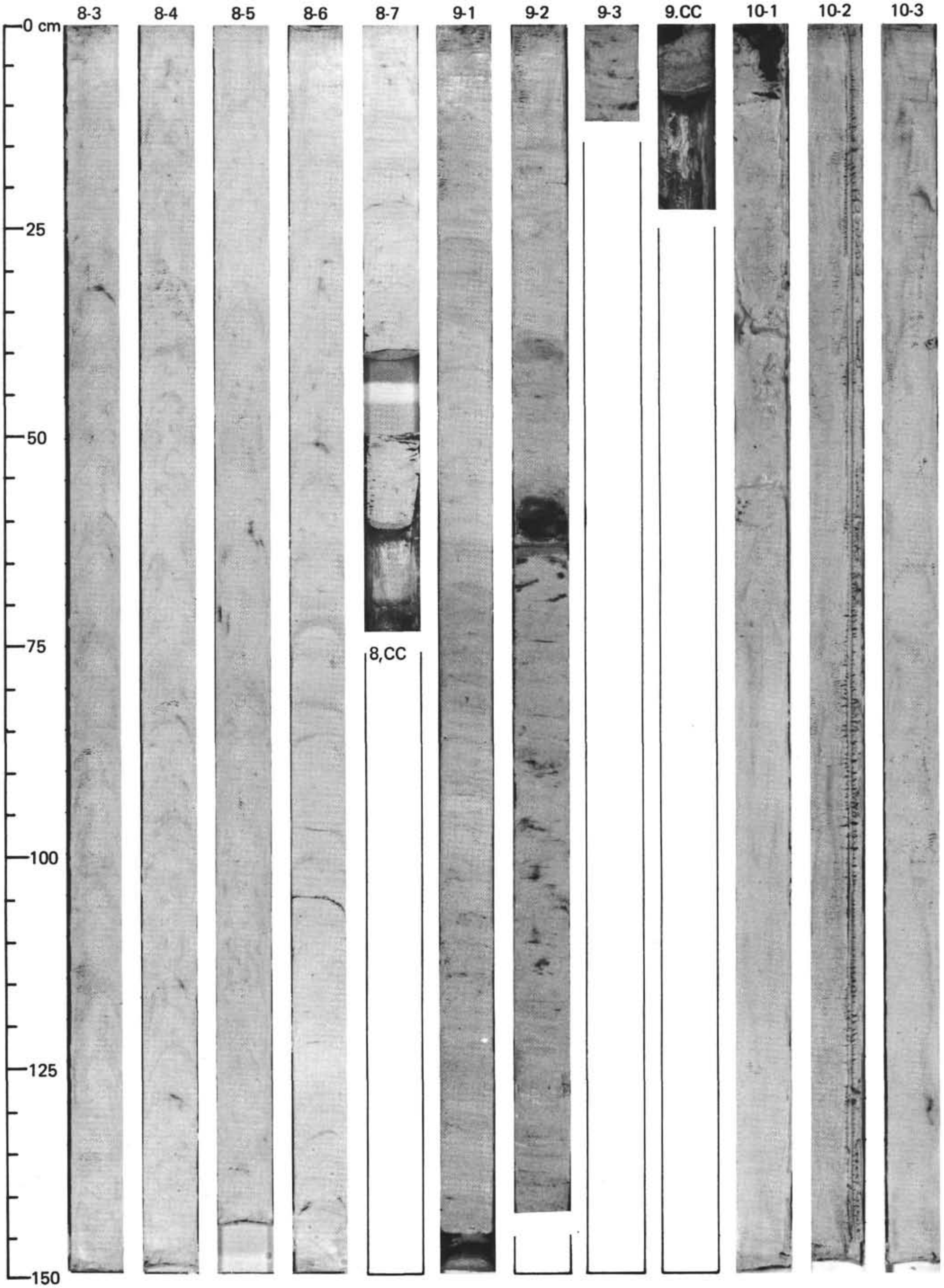
7,CC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9.CC
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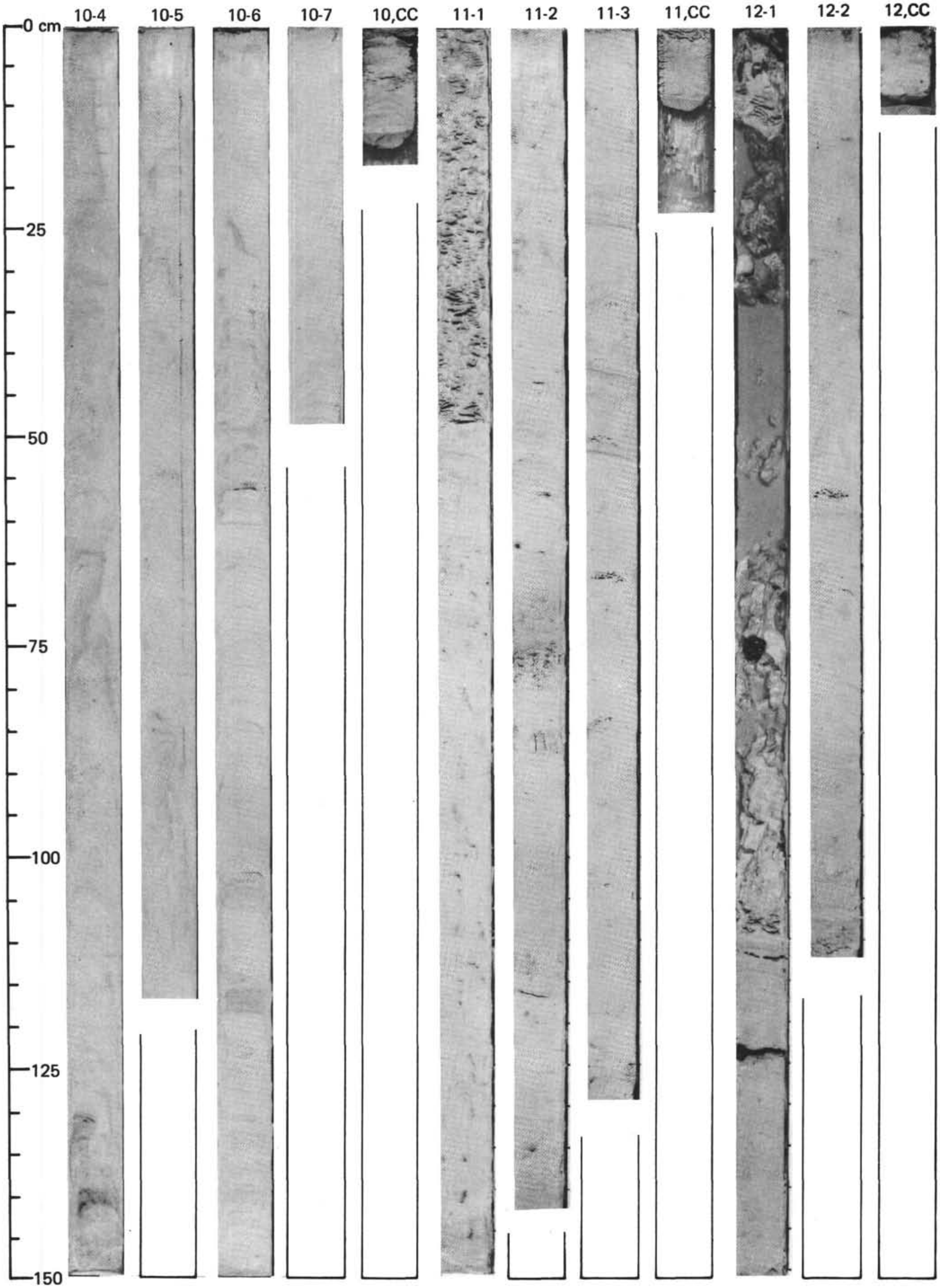
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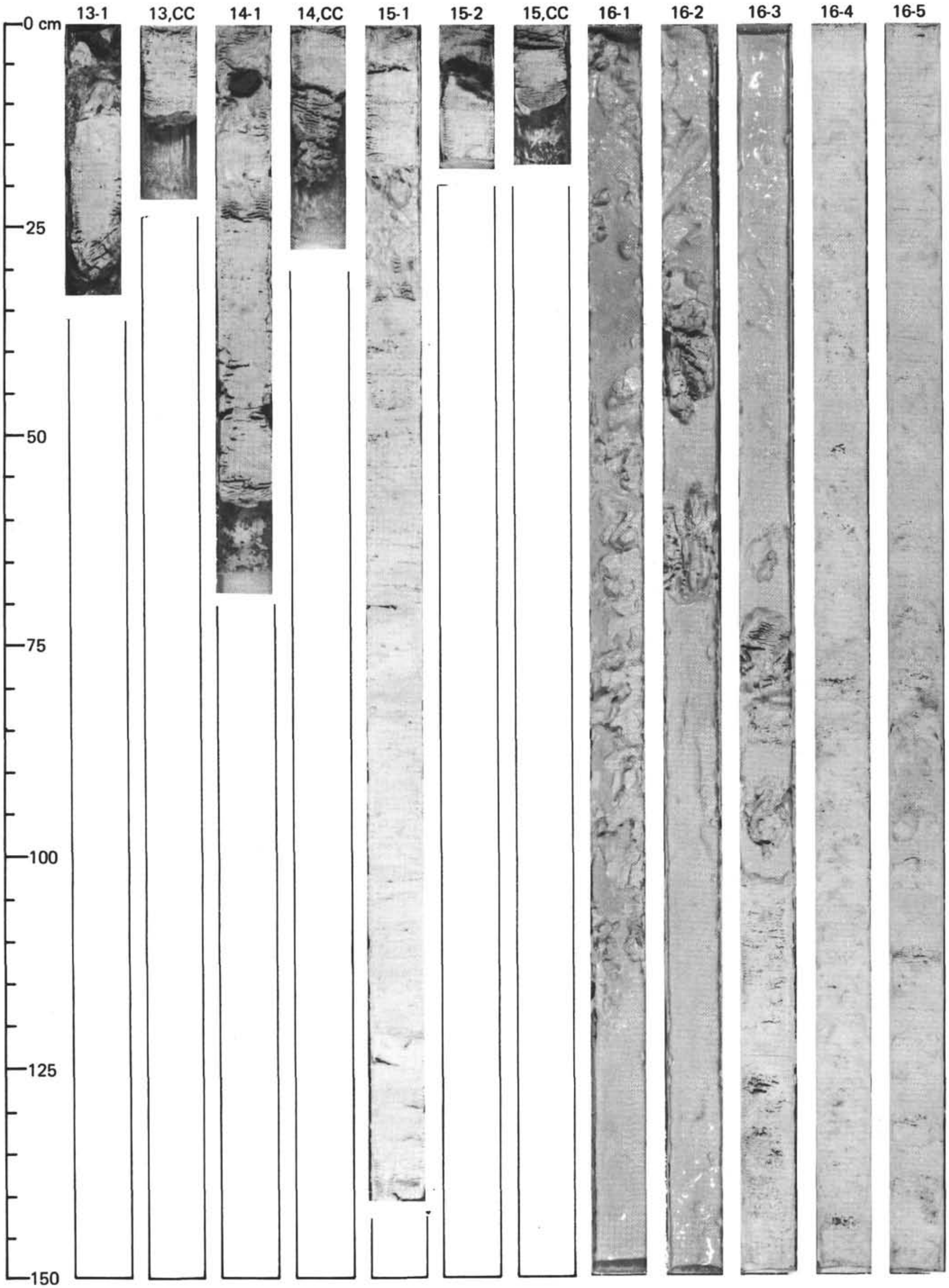
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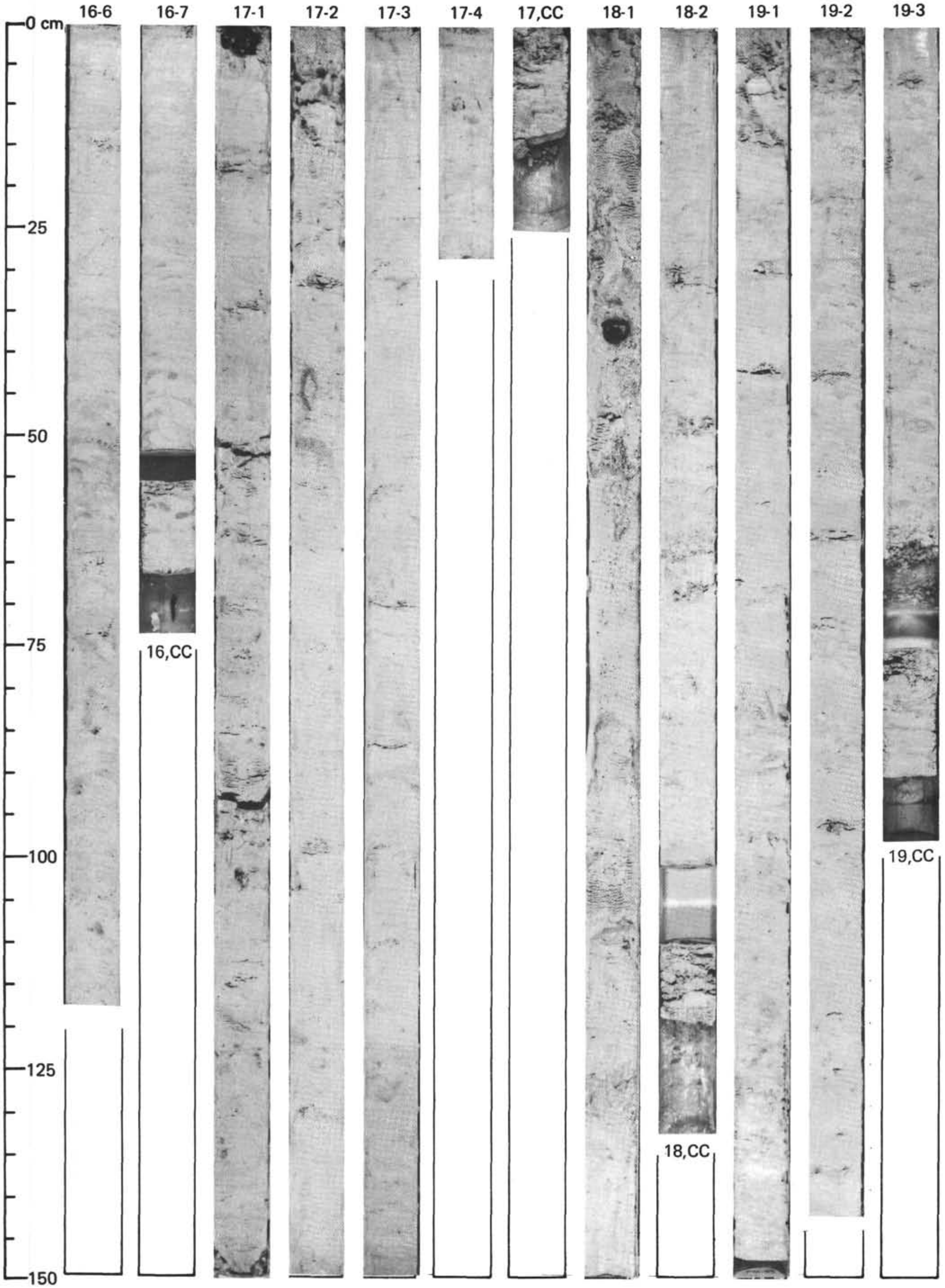
16-5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19-3
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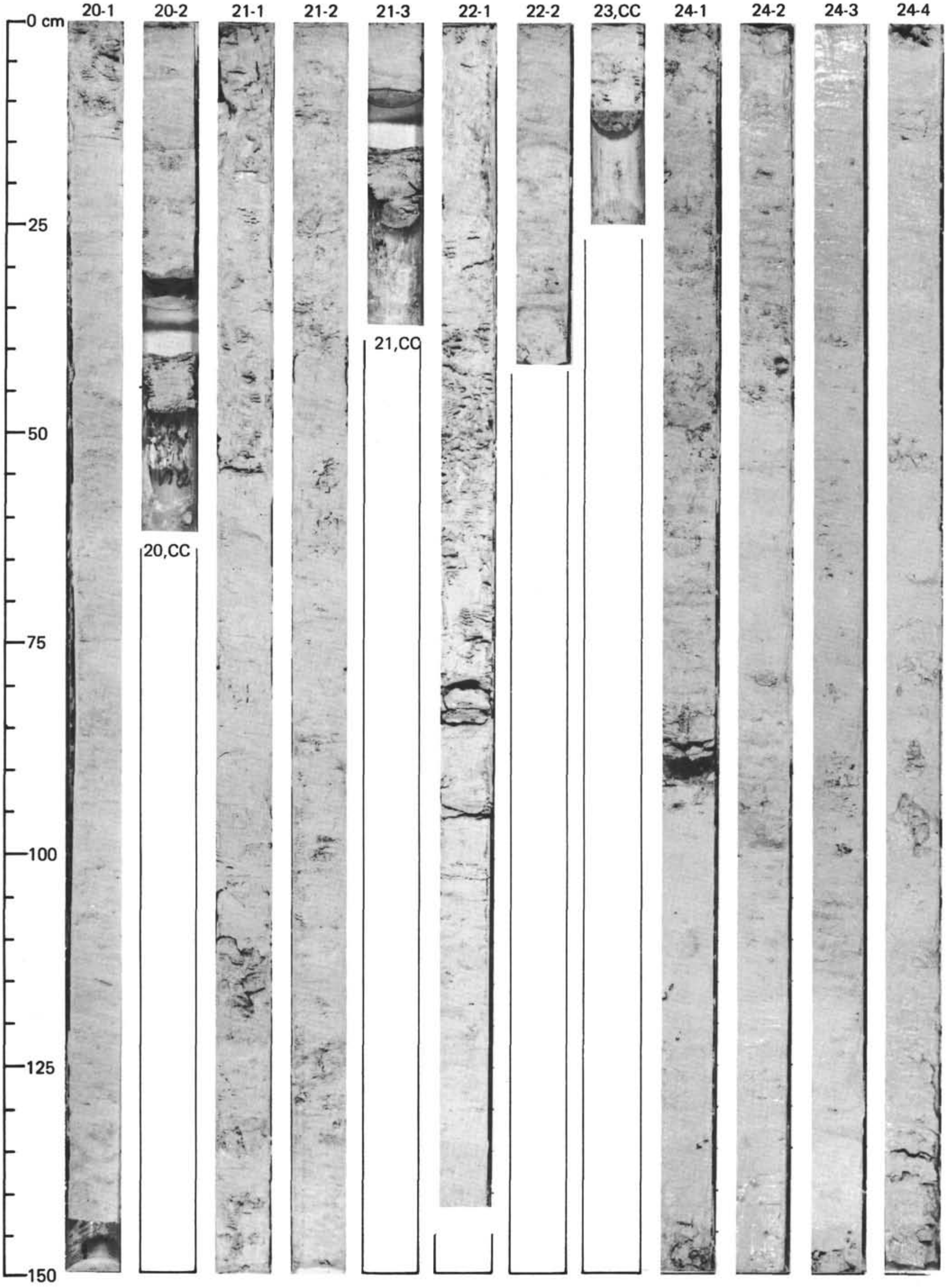
19,CC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22-1
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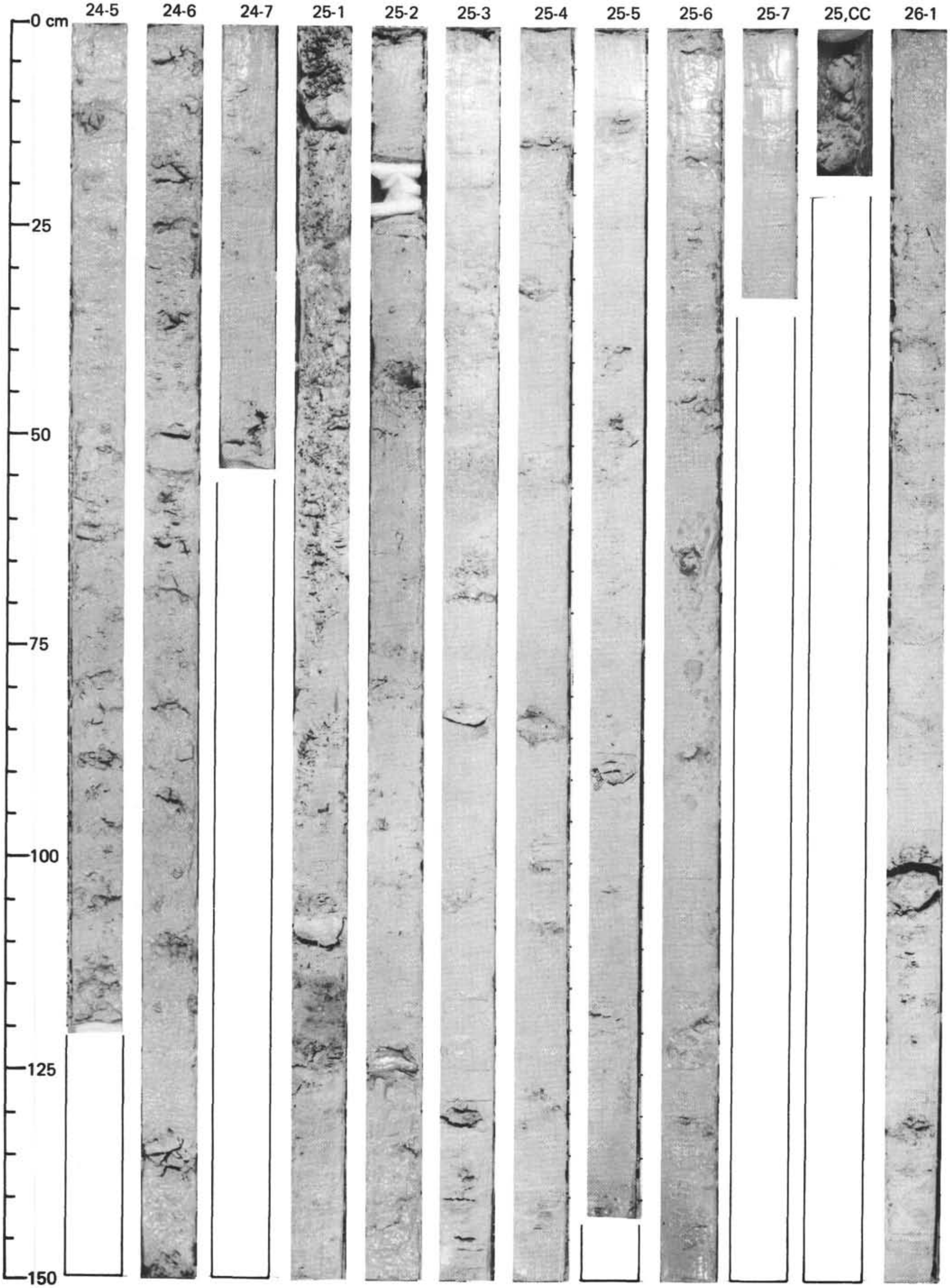
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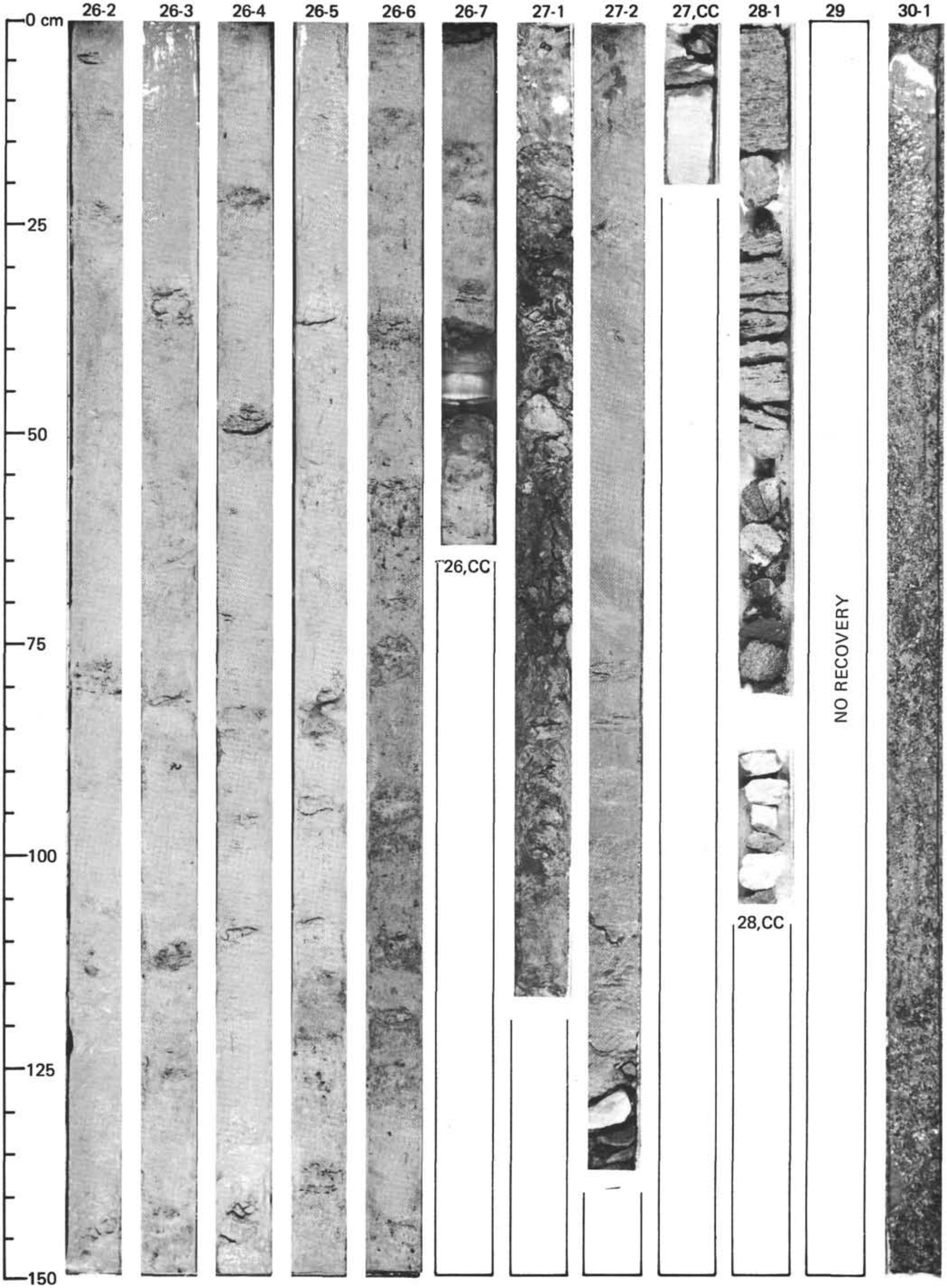
25-7
25,CC
26-1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27-1
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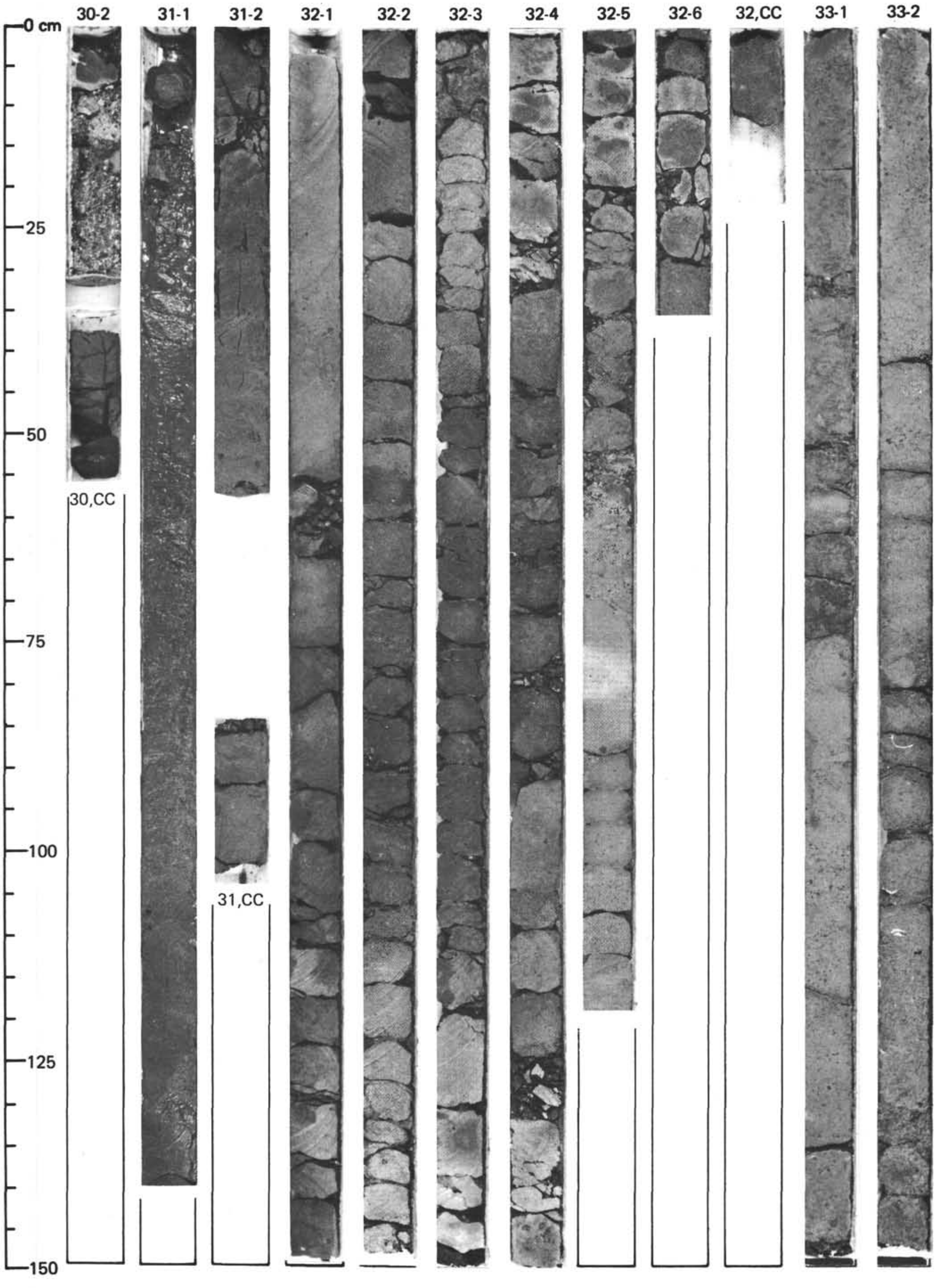
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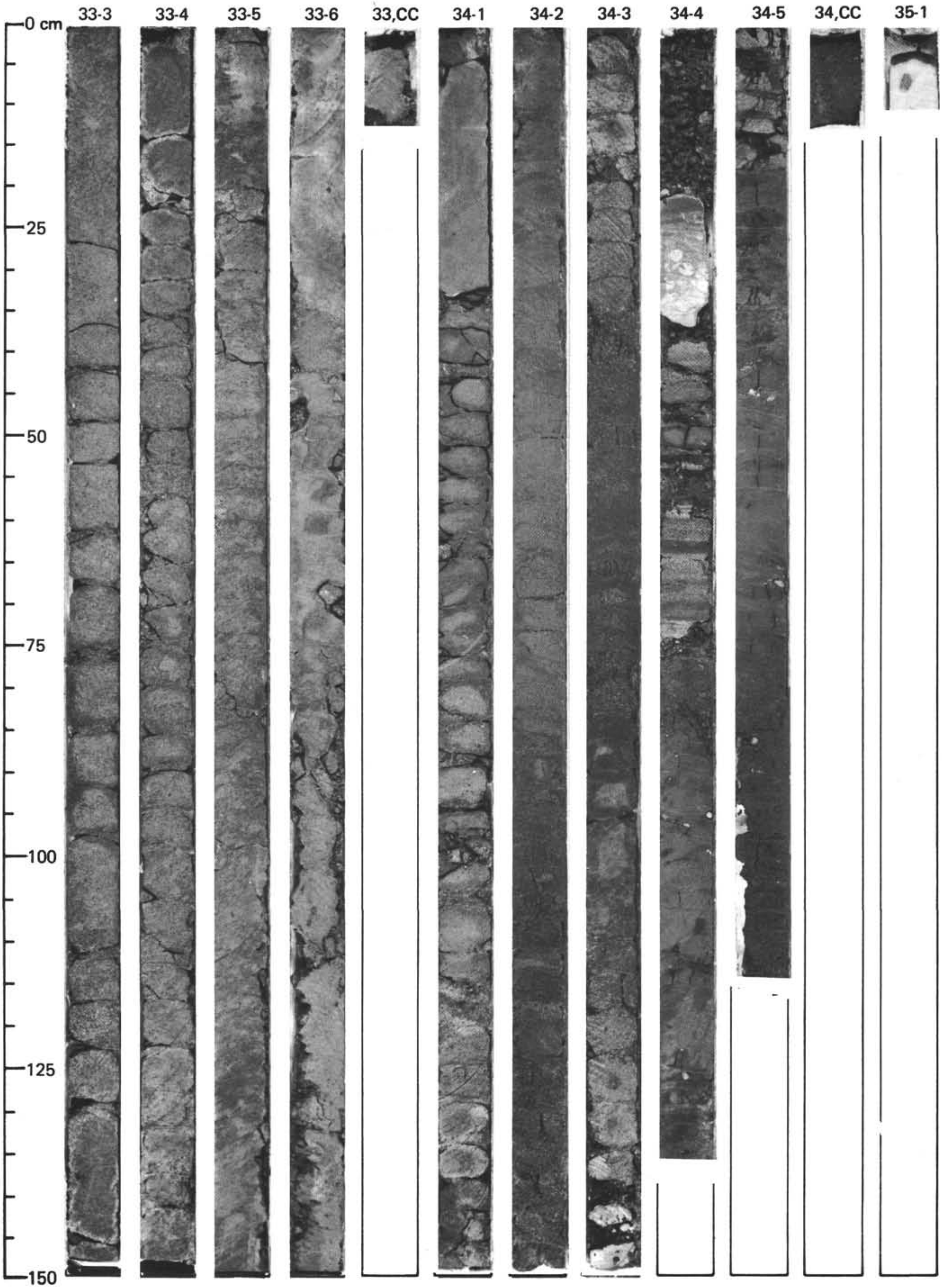
33-2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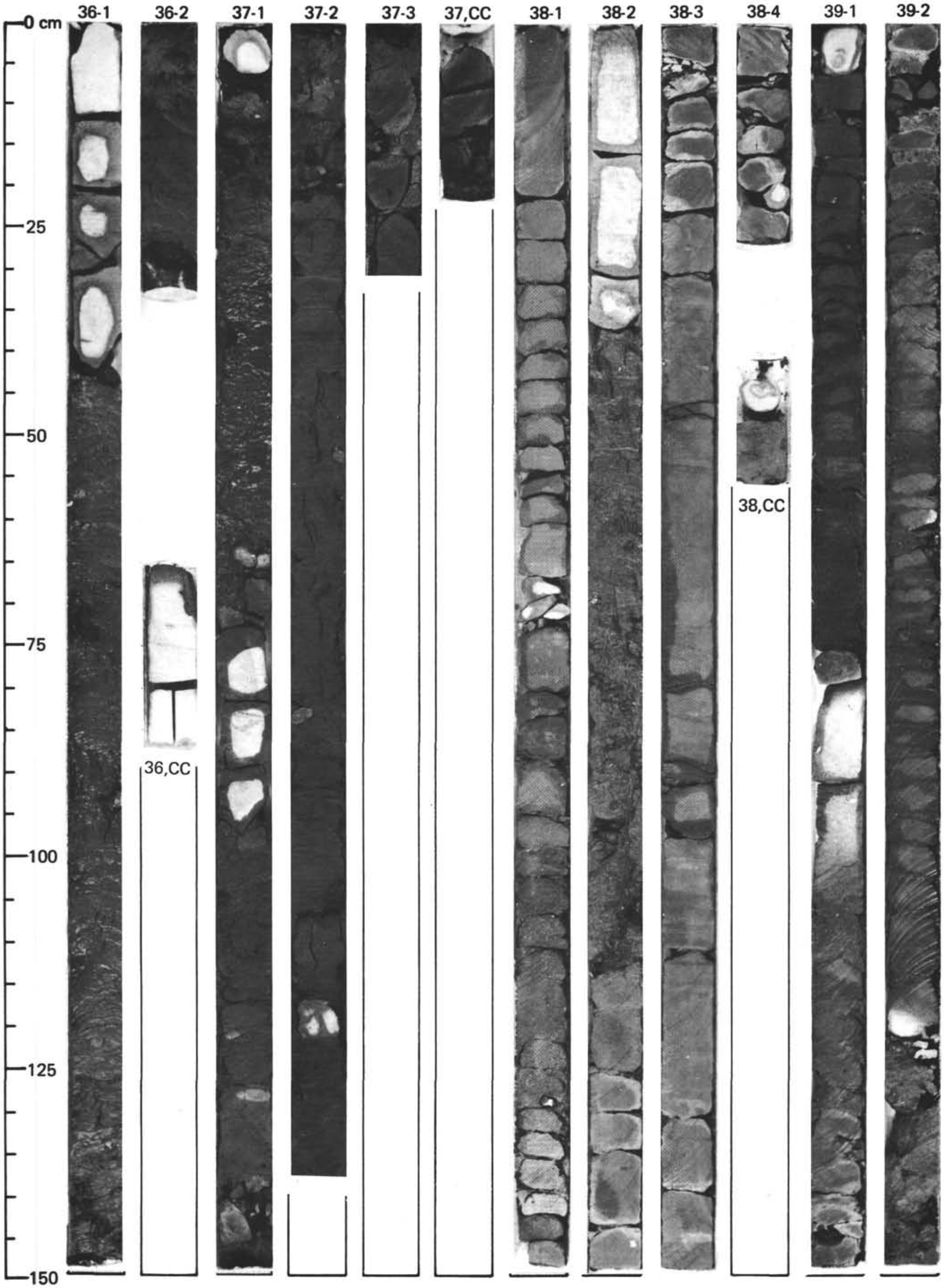
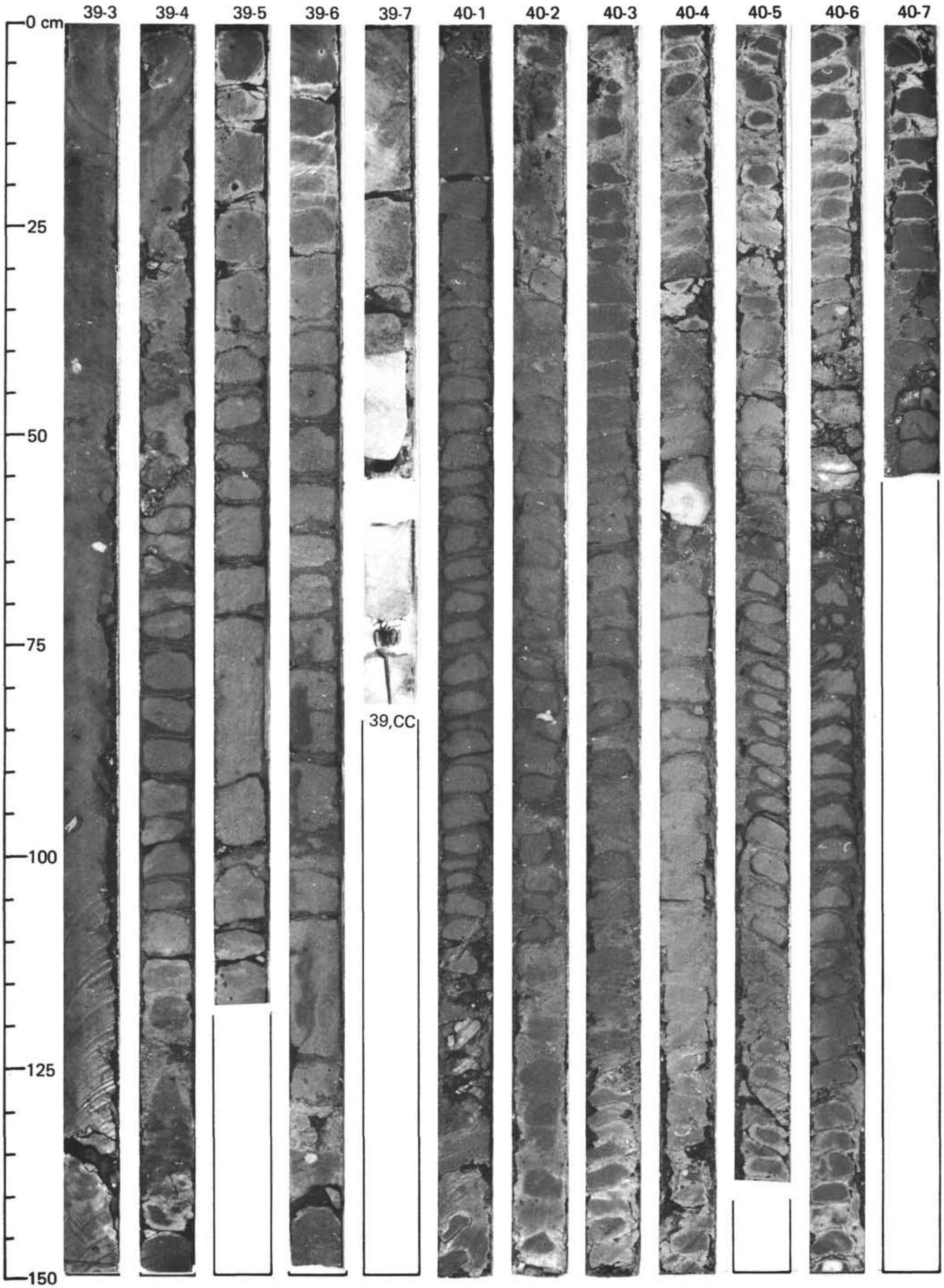
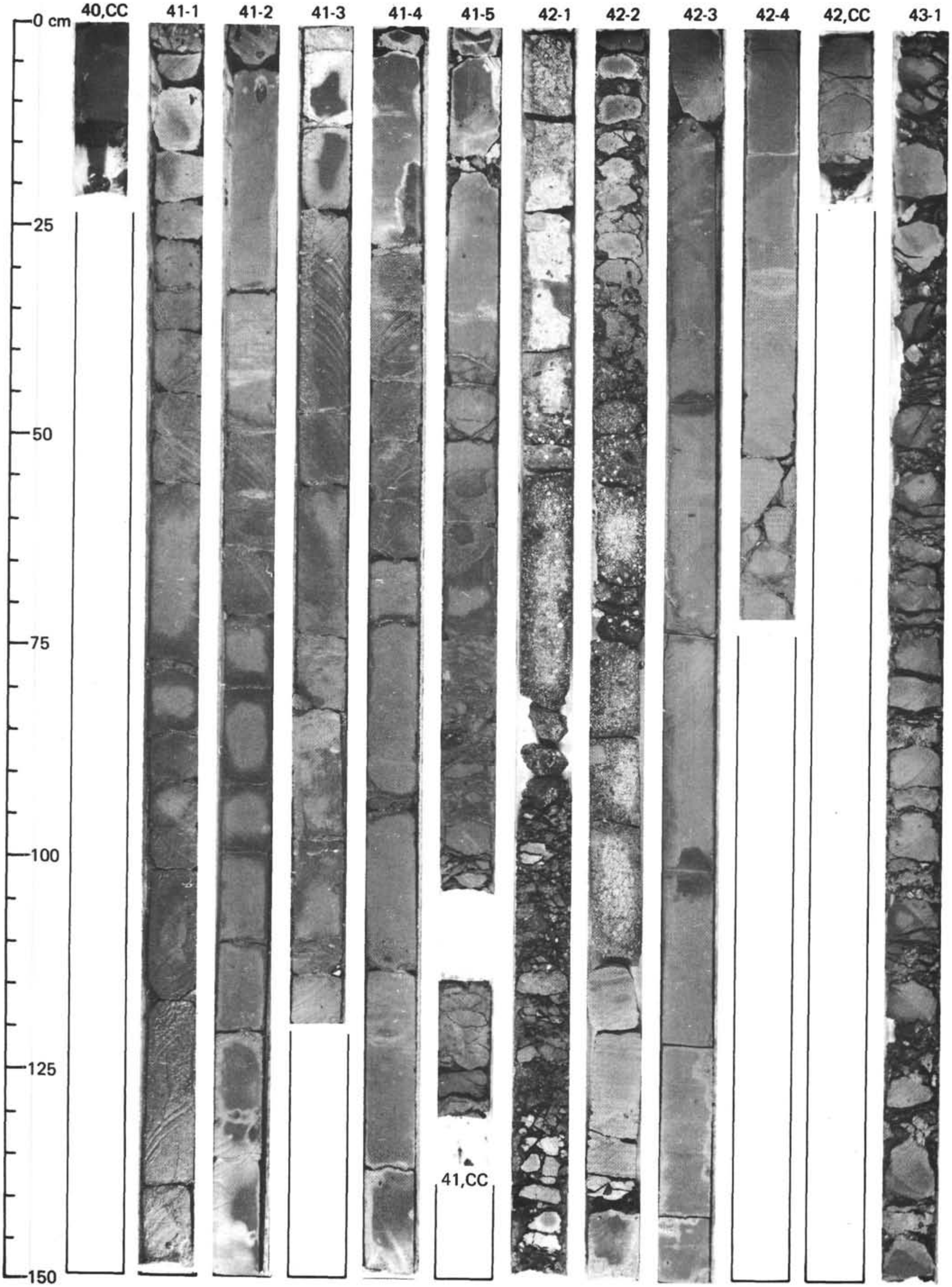
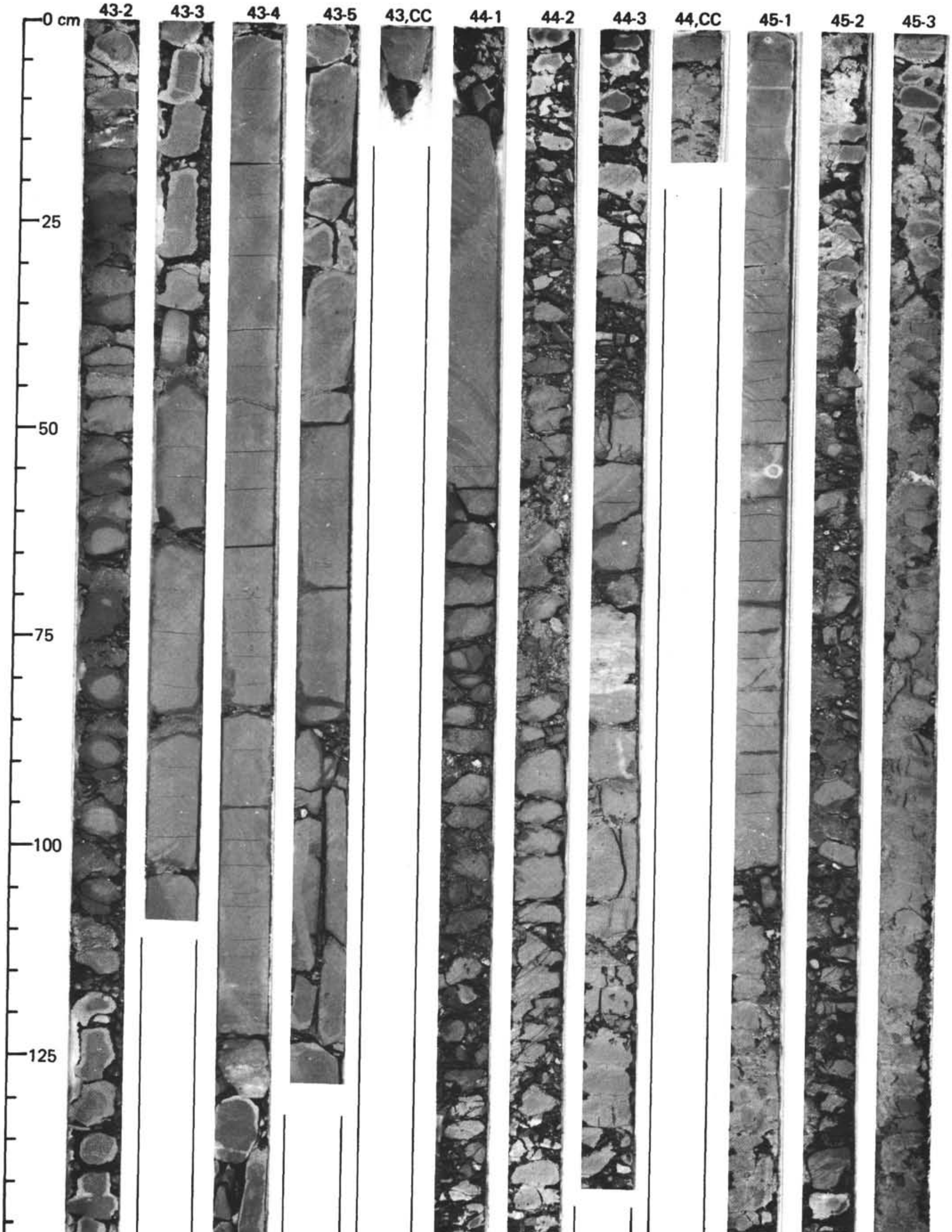
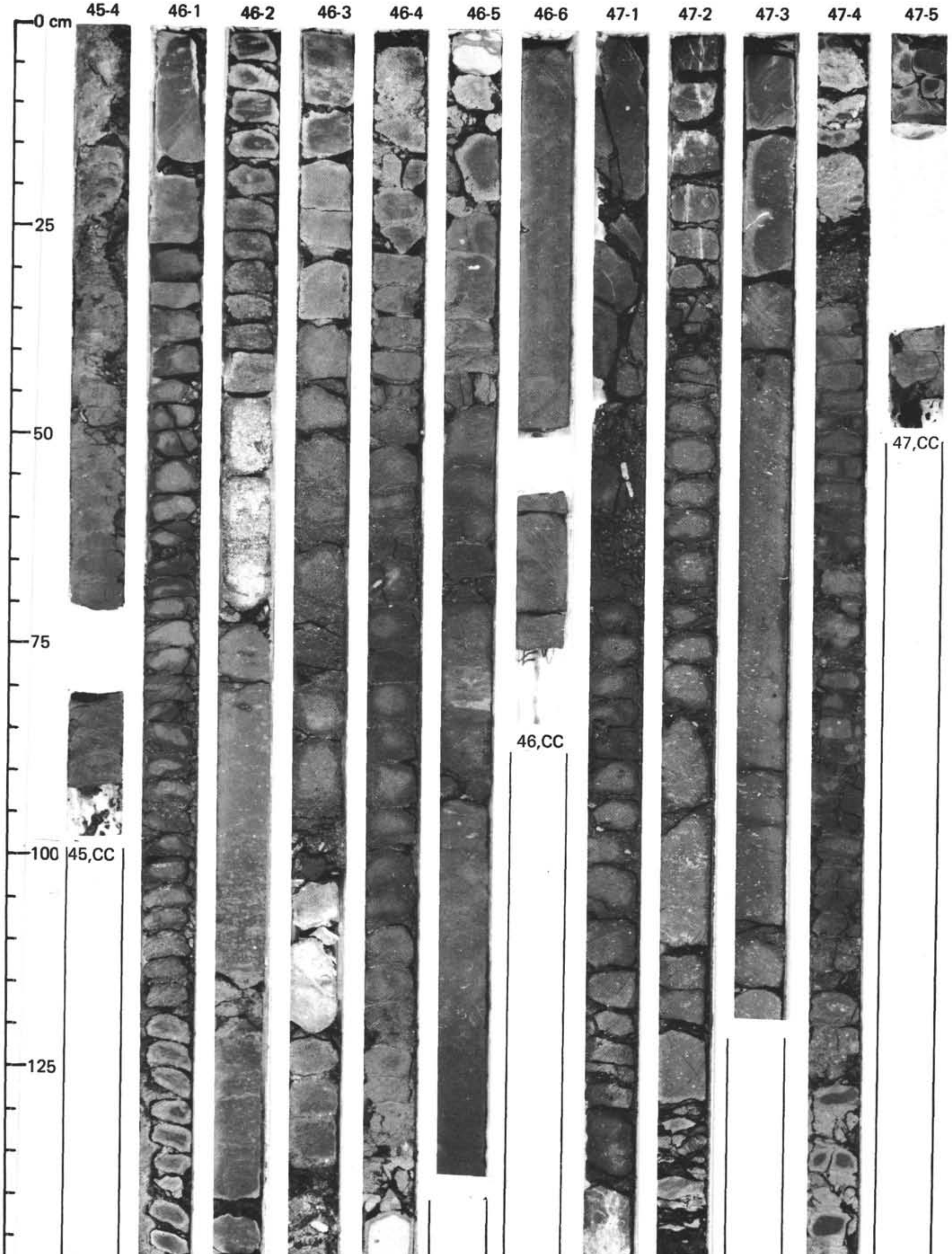
125
150

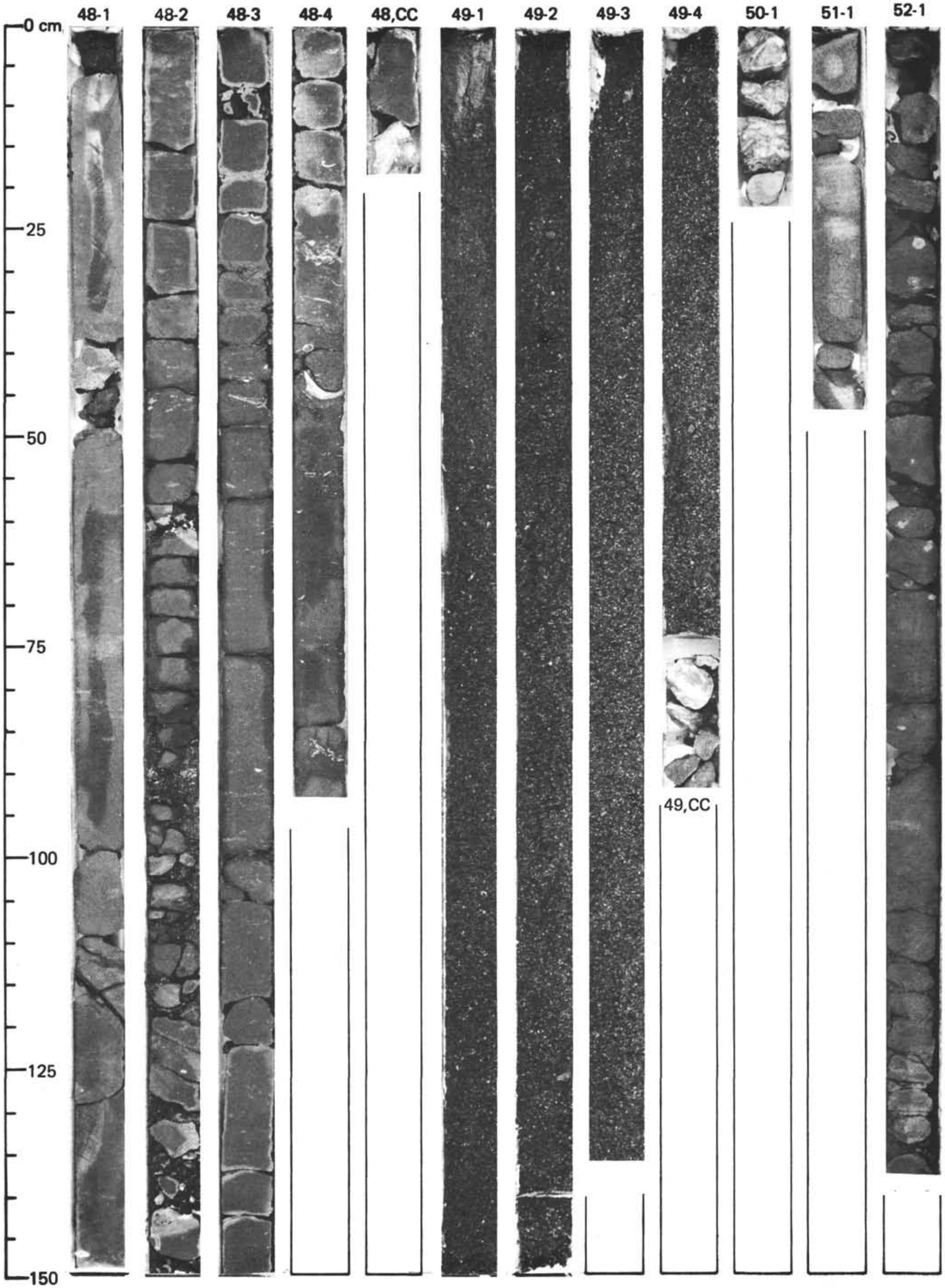

36-1
36-2
37-1
37-2
37-3
37,CC
38-1
38-2
38-3
38-4
39-1
39-2
0 cm
25
50
75
100
125
150
36,CC
38,CC

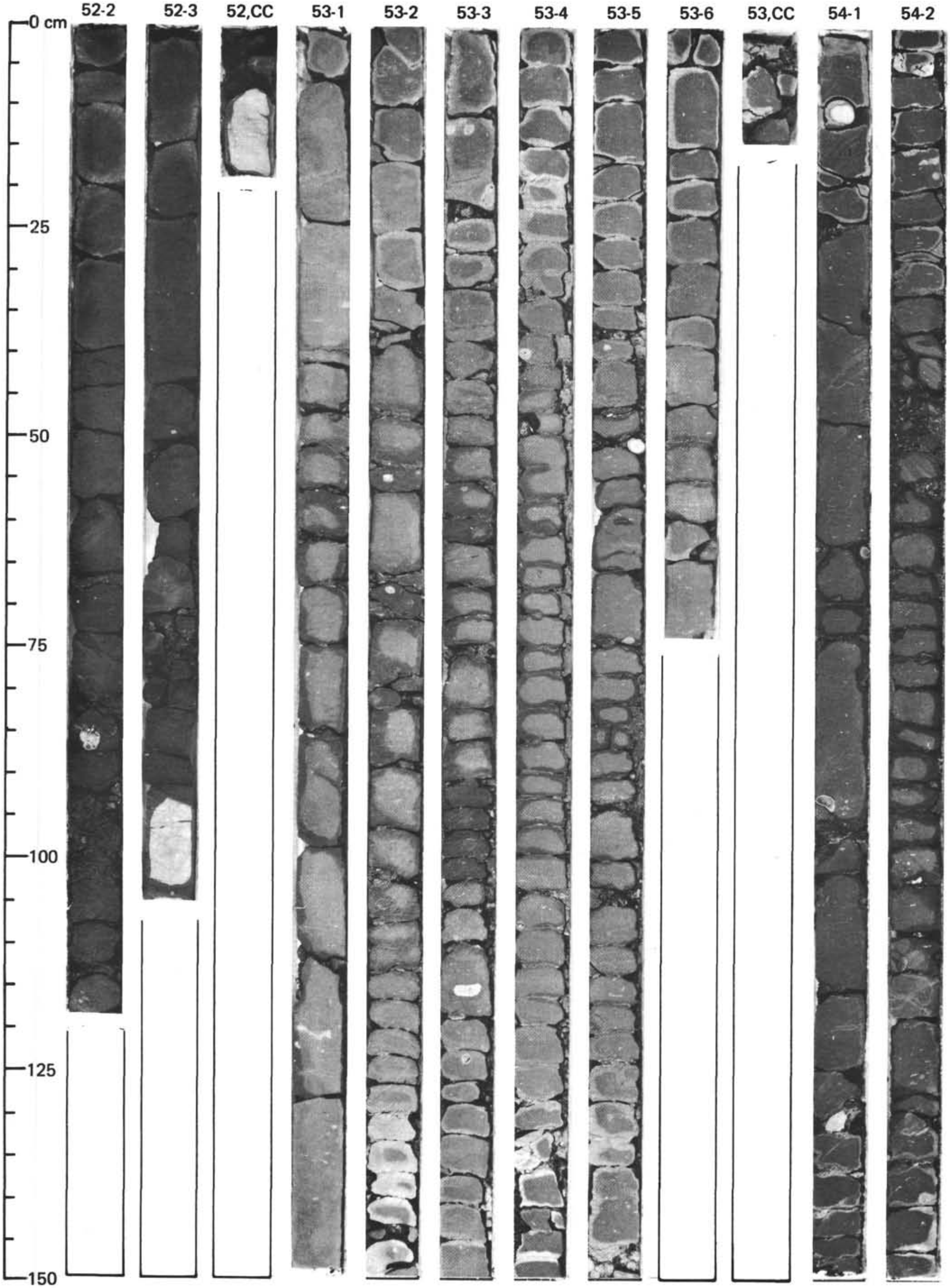

0 cm
25
50
75
100
125
150
39-3
39-4
39-5
39-6
39-7
39,CC
40-1
40-2
40-3
40-4
40-5
40-6
40-7

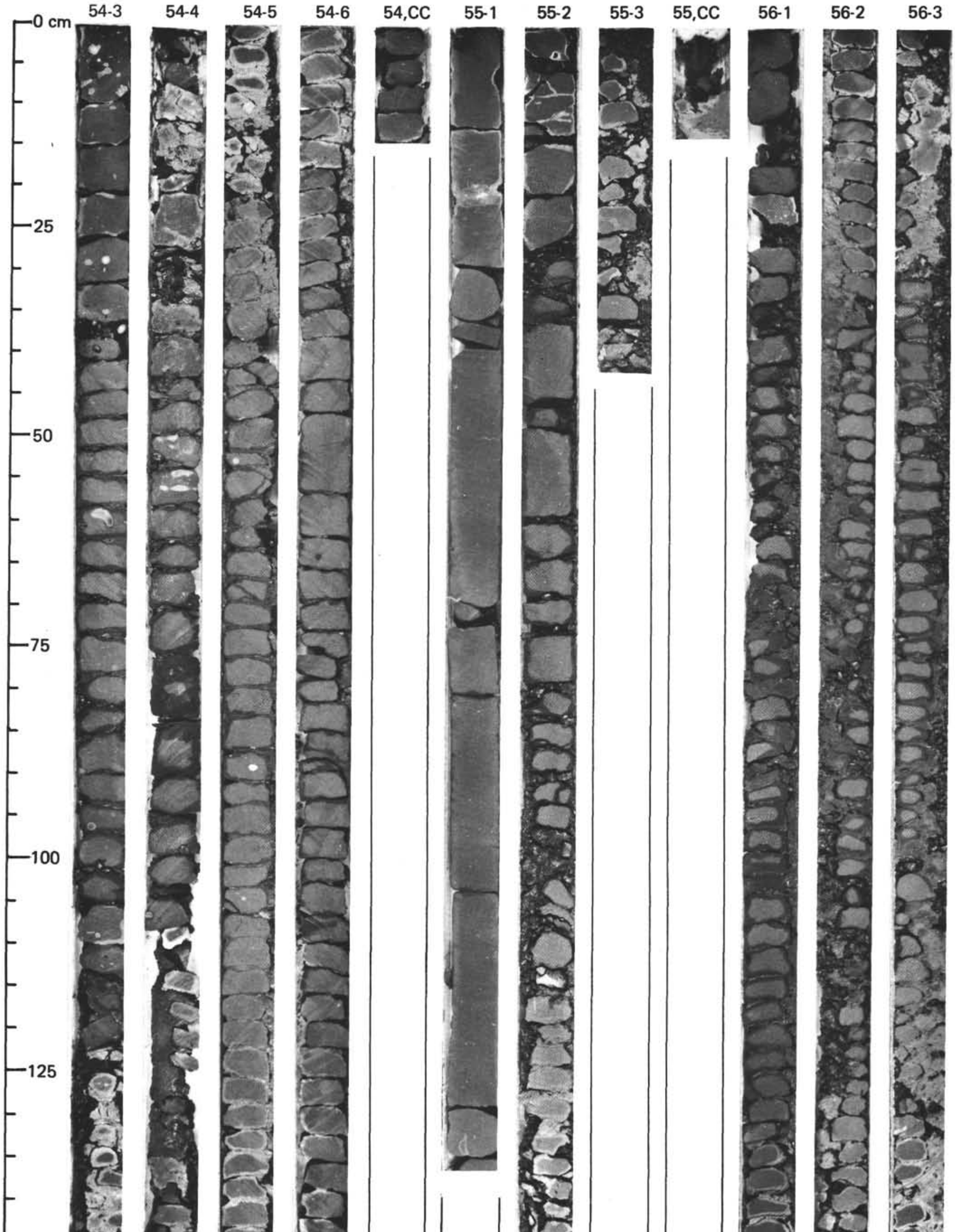

0 cm
25
50
75
100
125
150
40,CC
41-1
41-2
41-3
41-4
41-5
41,CC
42-1
42-2
42-3
42-4
42,CC
43-1

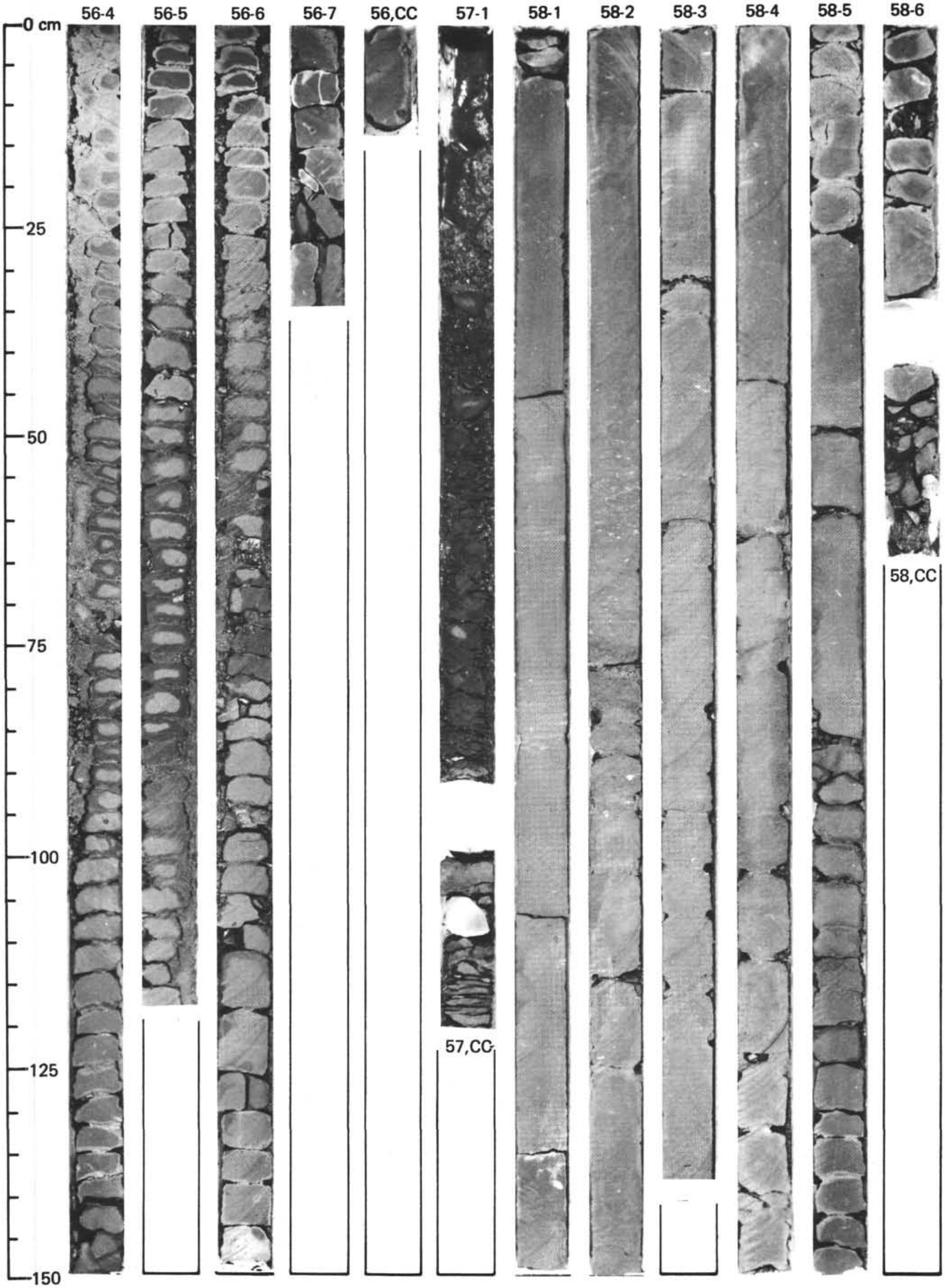

0 cm
25
50
75
100
125
150
43-2
43-3
43-4
43-5
43,CC
44-1
44-2
44-3
44,CC
45-1
45-2
45-3

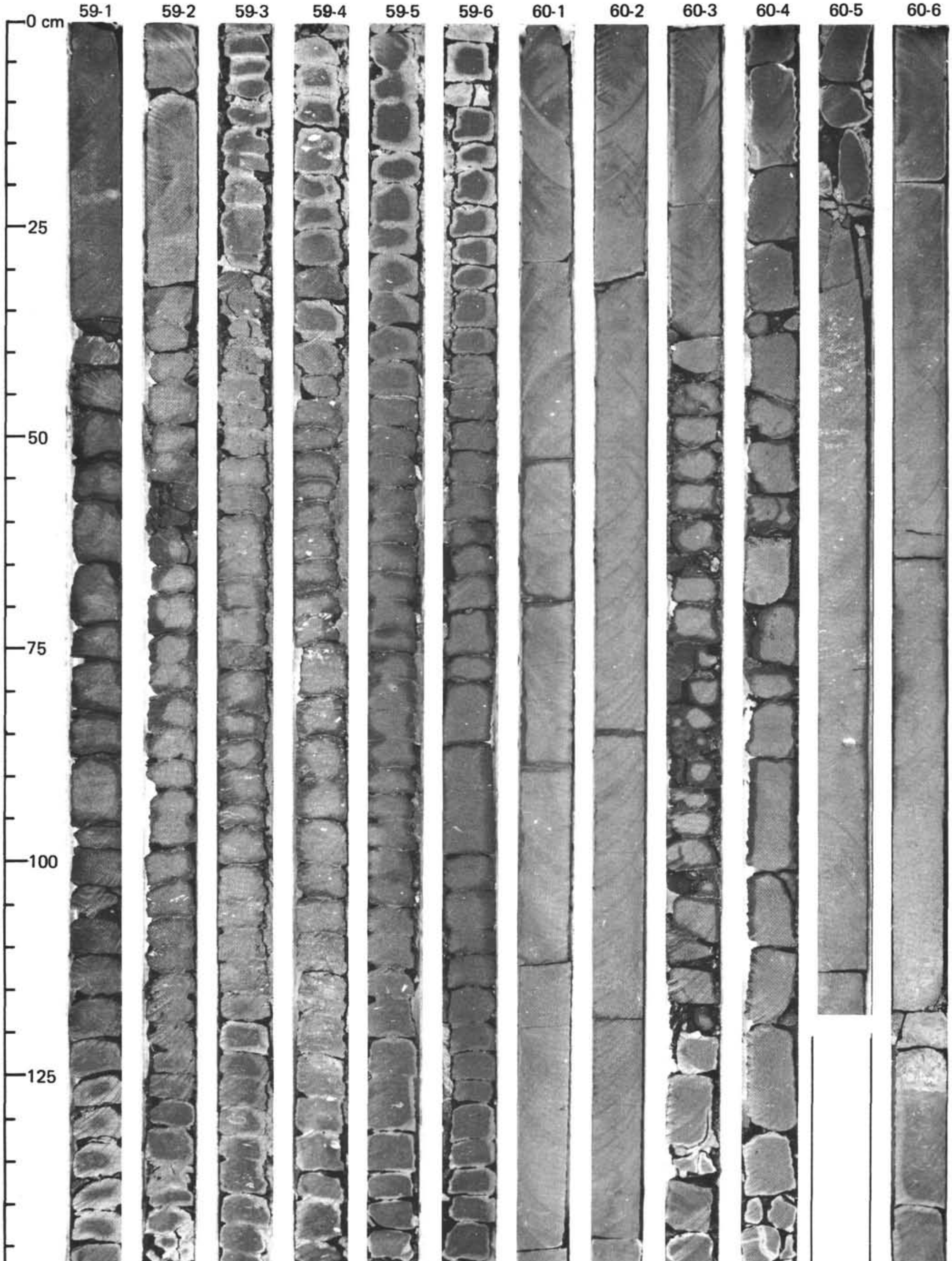

45-4
46-1
46-2
46-3
46-4
46-5
46-6
47-1
47-2
47-3
47-4
47-5
0 cm
25
50
75
100
125
150
45,CC
46,CC
47,CC

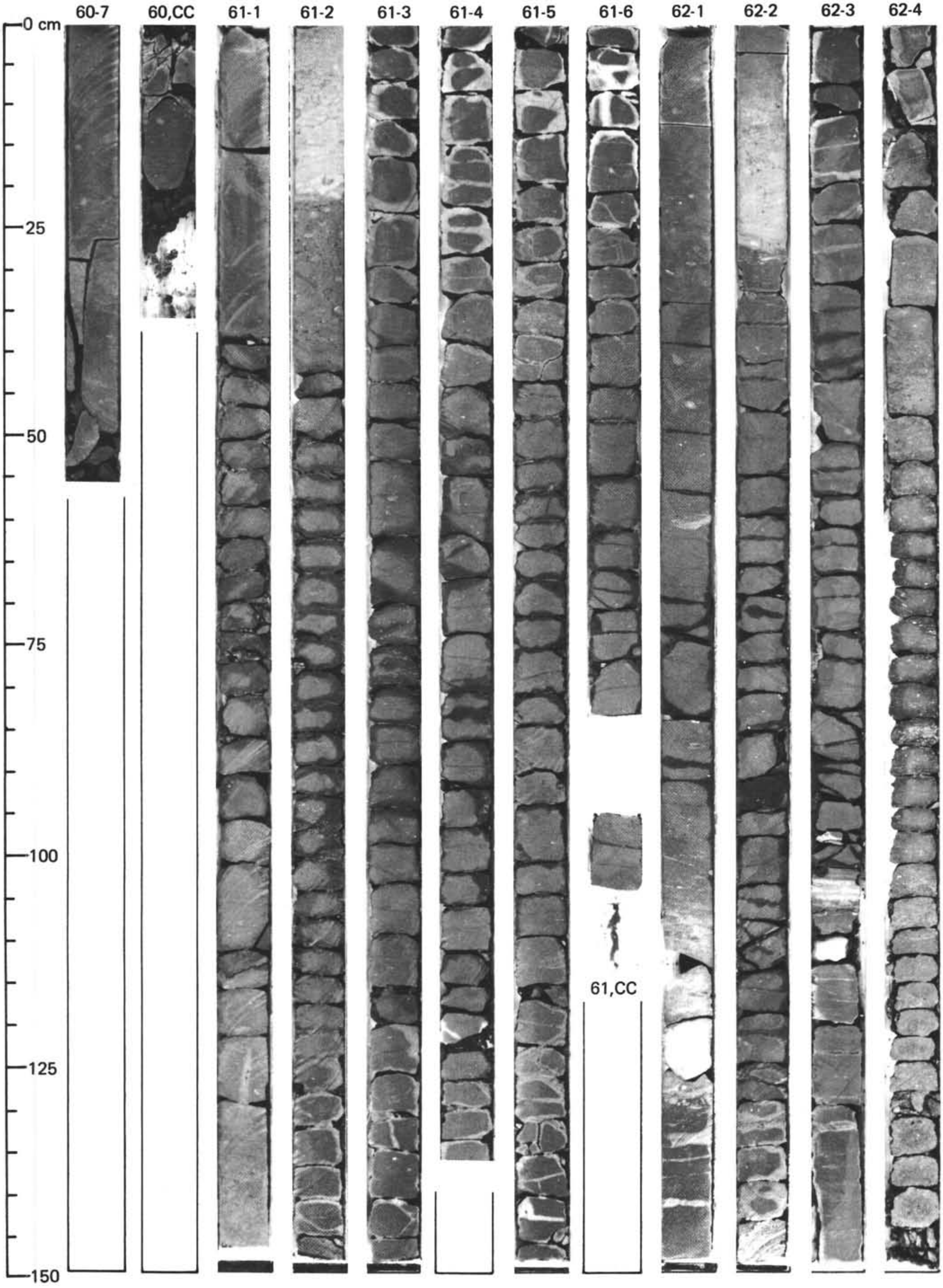

48-1
48-2
48-3
48-4
48,CC
49-1
49-2
49-3
49-4
50-1
51-1
52-1
49,CC
0 cm
25
50
75
100
125
150

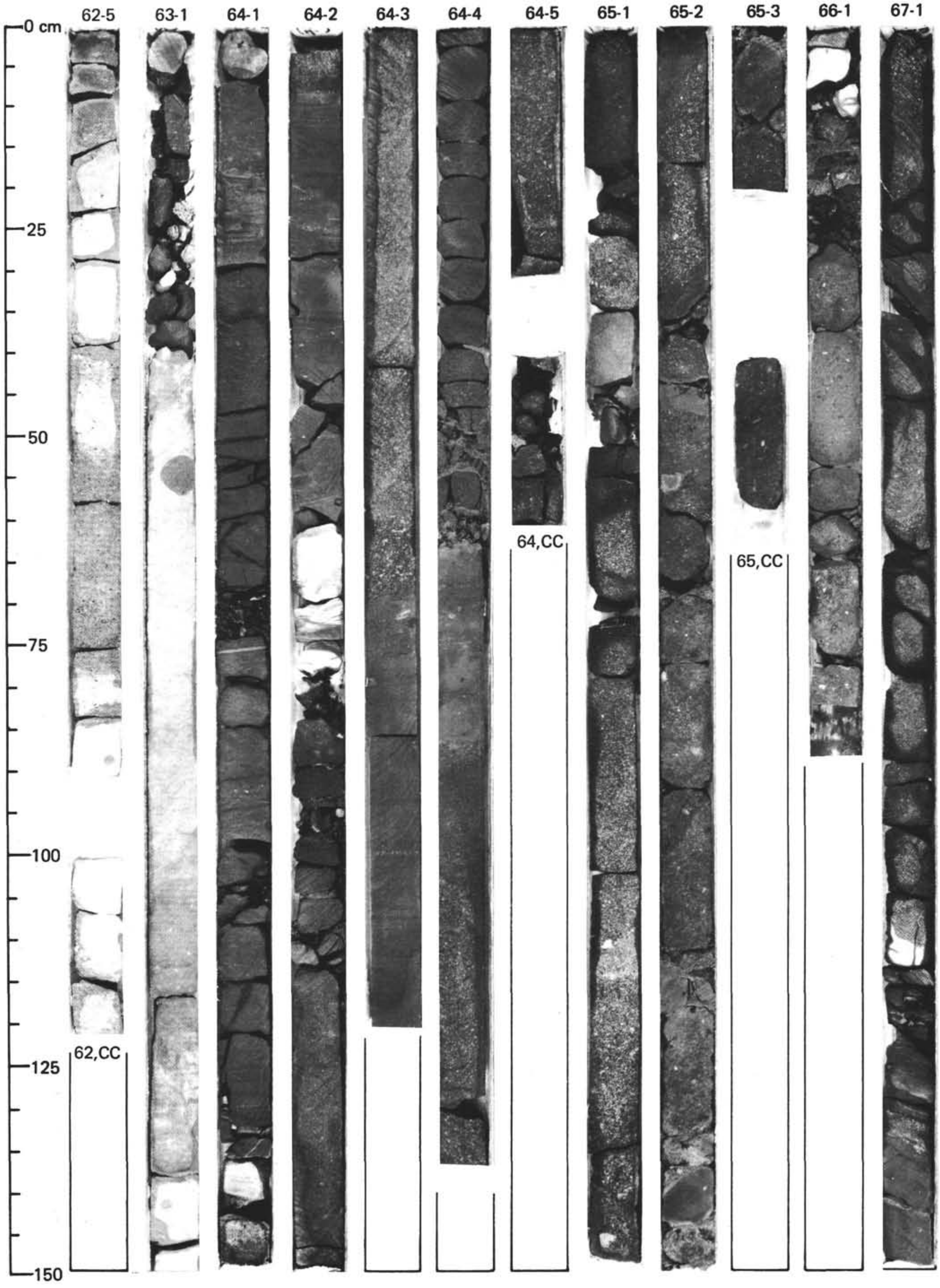

52-2
52-3
52,CC
53-1
53-2
53-3
53-4
53-5
53-6
53,CC
54-1
54-2
0 cm
25
50
75
100
125
150


54-3
54-4
54-5
54-6
54,CC
55-1
55-2
55-3
55,CC
56-1
56-2
56-3
0 cm
25
50
75
100
125
150

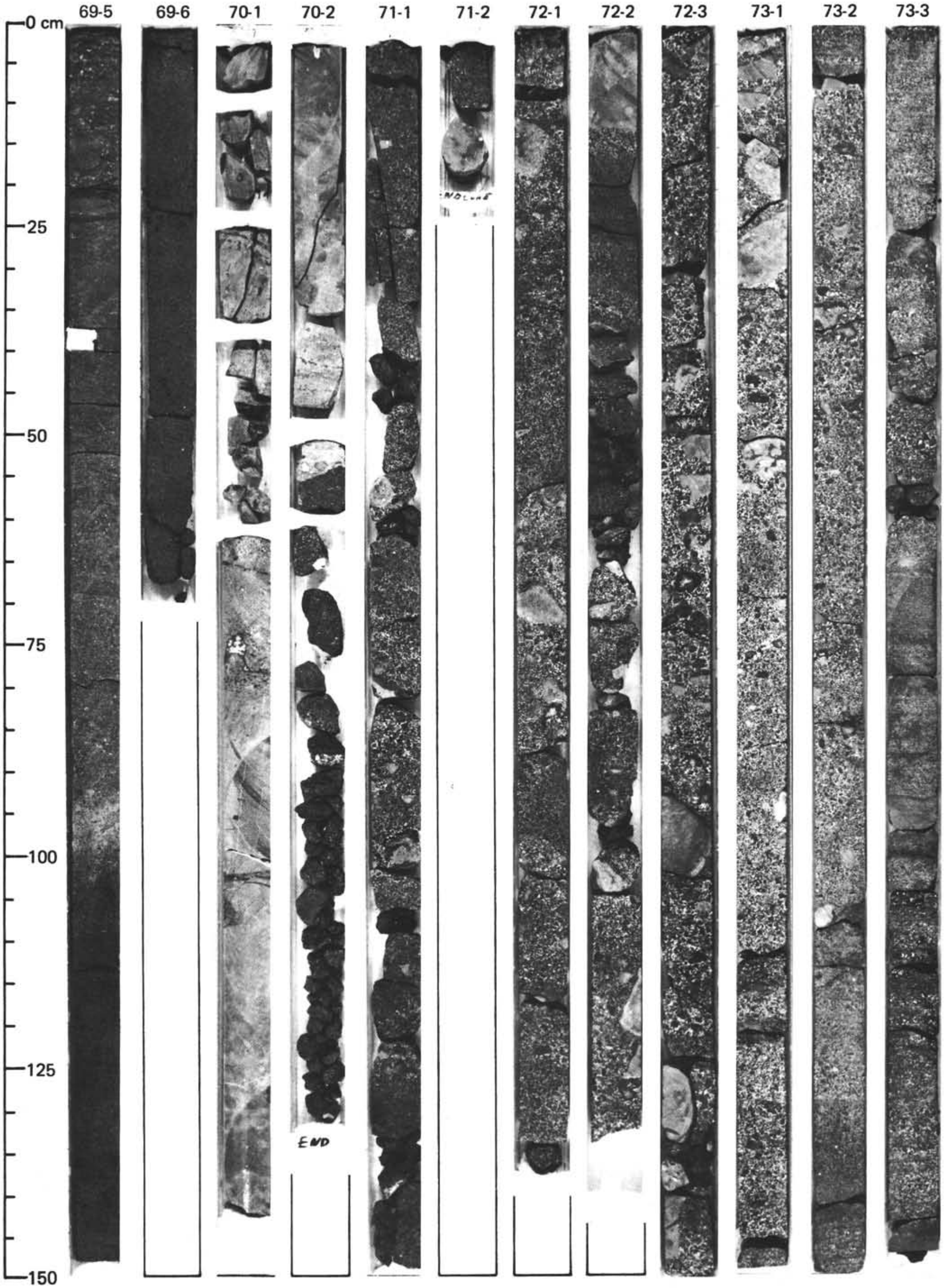

0 cm
25
50
75
100
125
150
56-4
56-5
56-6
56-7
56,CC
57-1
57,CC
58-1
58-2
58-3
58-4
58-5
58-6
58,CC

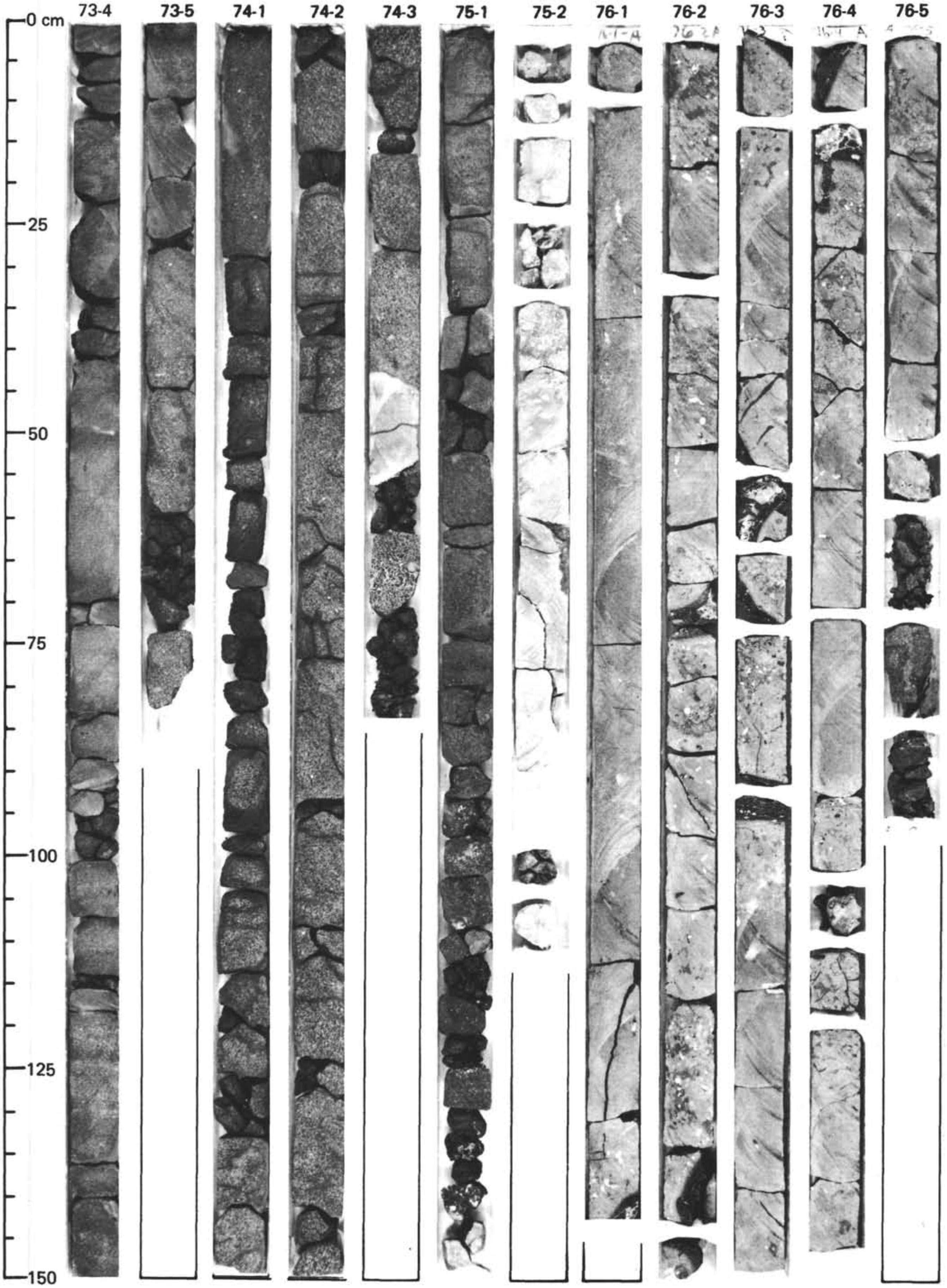

59-1
59-2
59-3
59-4
59-5
59-6
60-1
60-2
60-3
60-4
60-5
60-6
0 cm
25
50
75
100
125
150

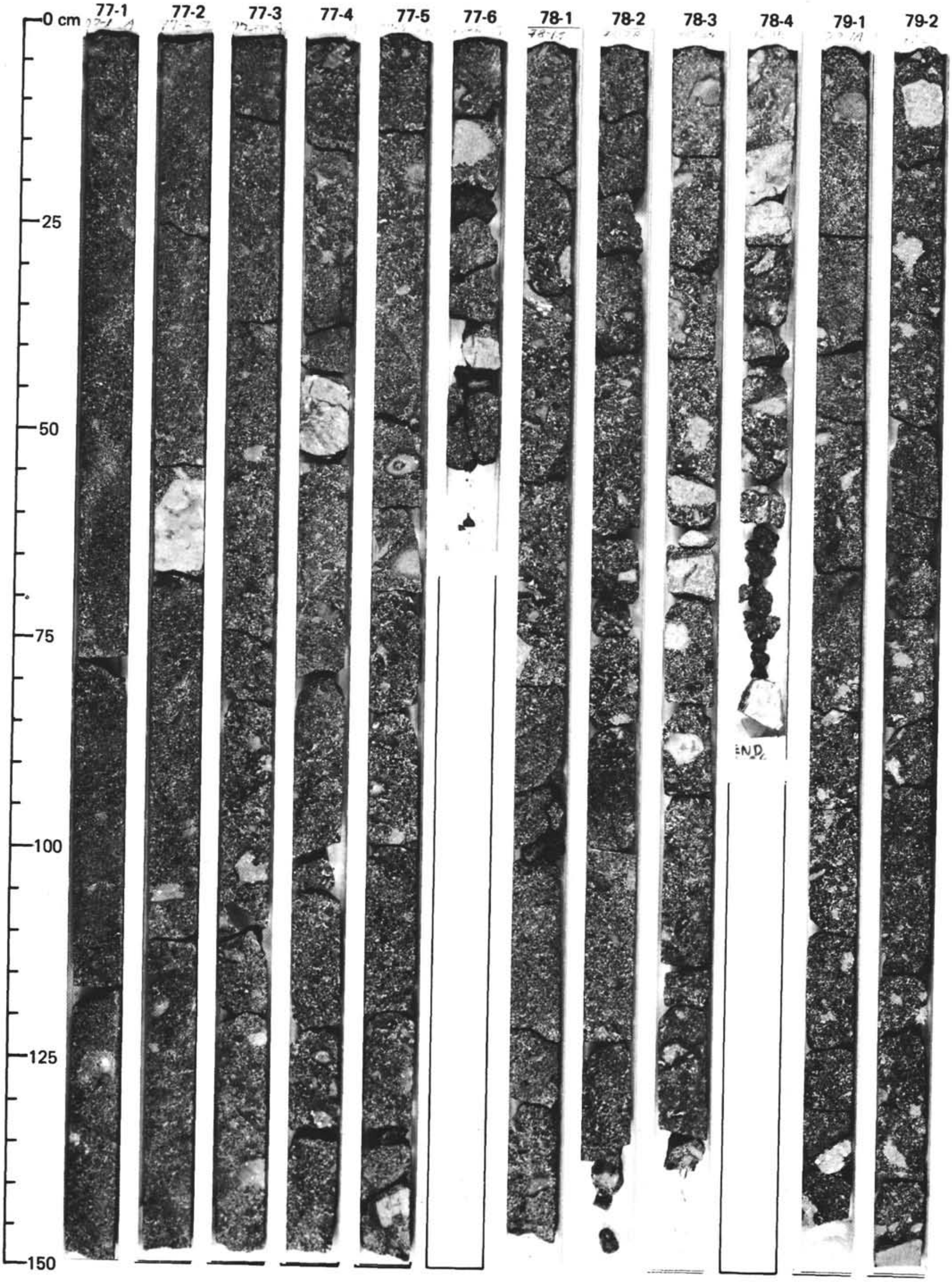

60-7
60,CC
61-1
61-2
61-3
61-4
61-5
61-6
62-1
62-2
62-3
62-4
0 cm
25
50
75
100
125
150
61,CC

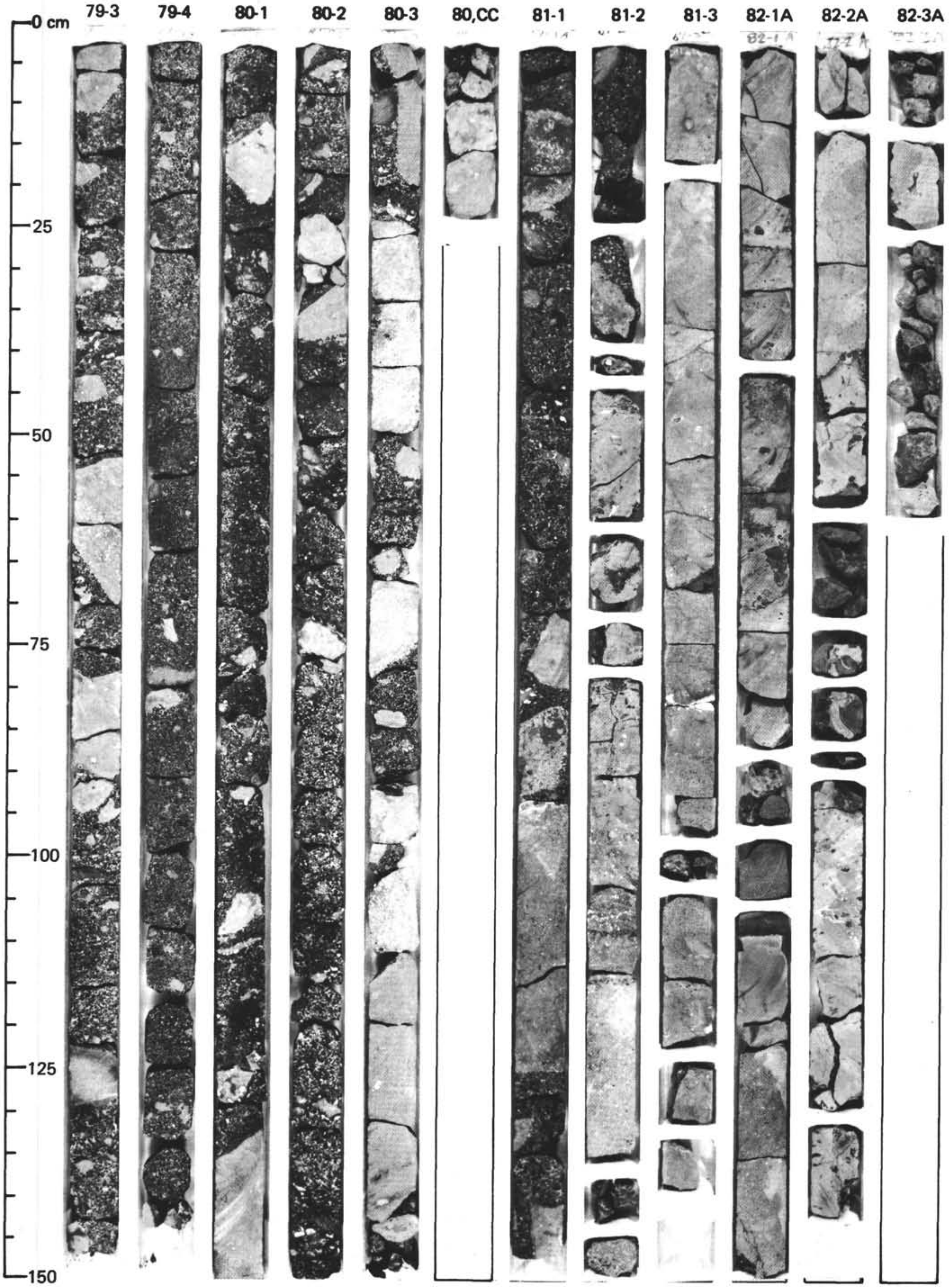

0 cm
25
50
75
100
125
150
62-5
63-1
64-1
64-2
64-3
64-4
64-5
65-1
65-2
65-3
66-1
67-1
62,CC
64,CC
65,CC

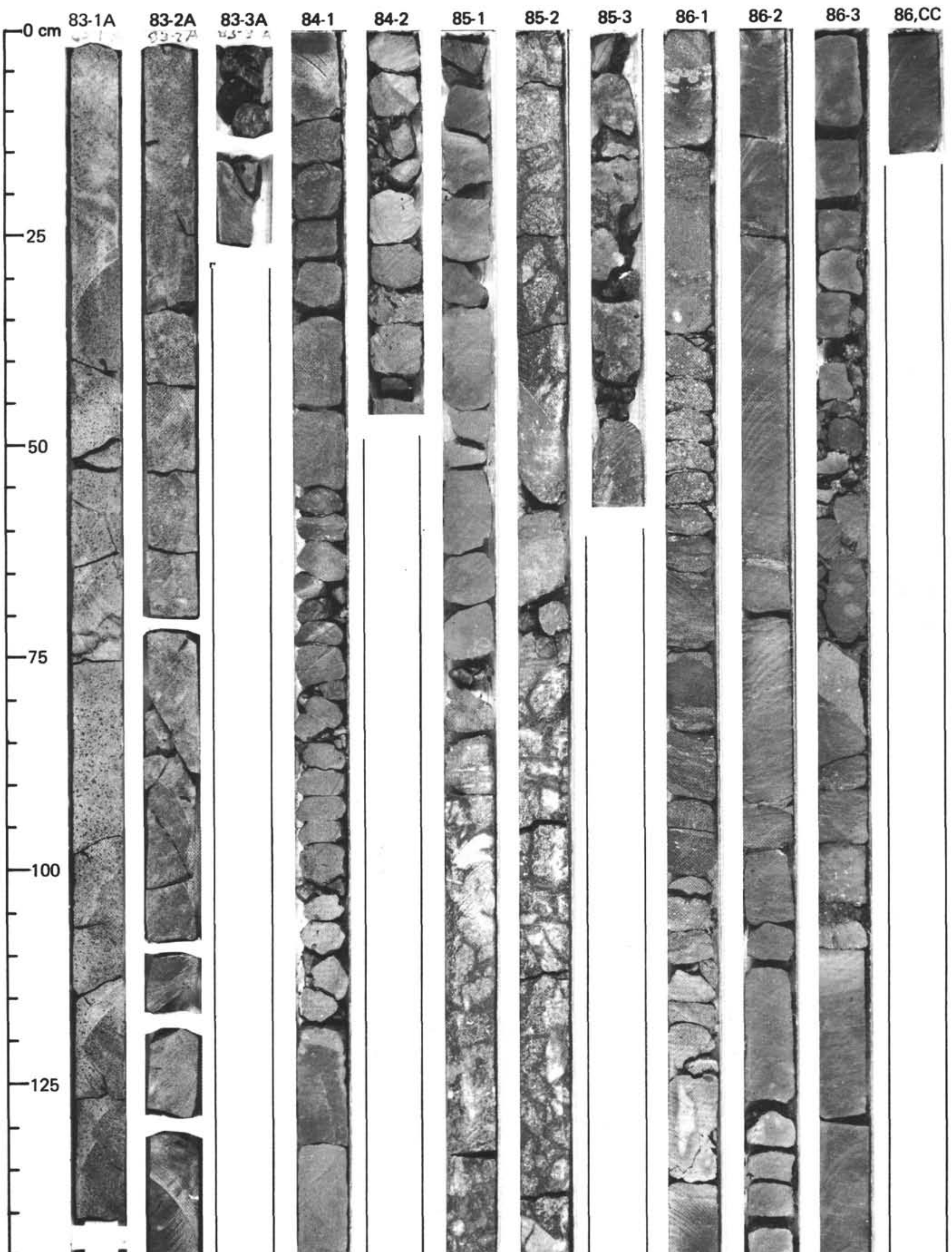

0 cm
25
50
75
100
125
150
67-2
67-3
67-4
67,CC
68-1
68-2
68-3
68-4
69-1
69-2
69-3
69-4

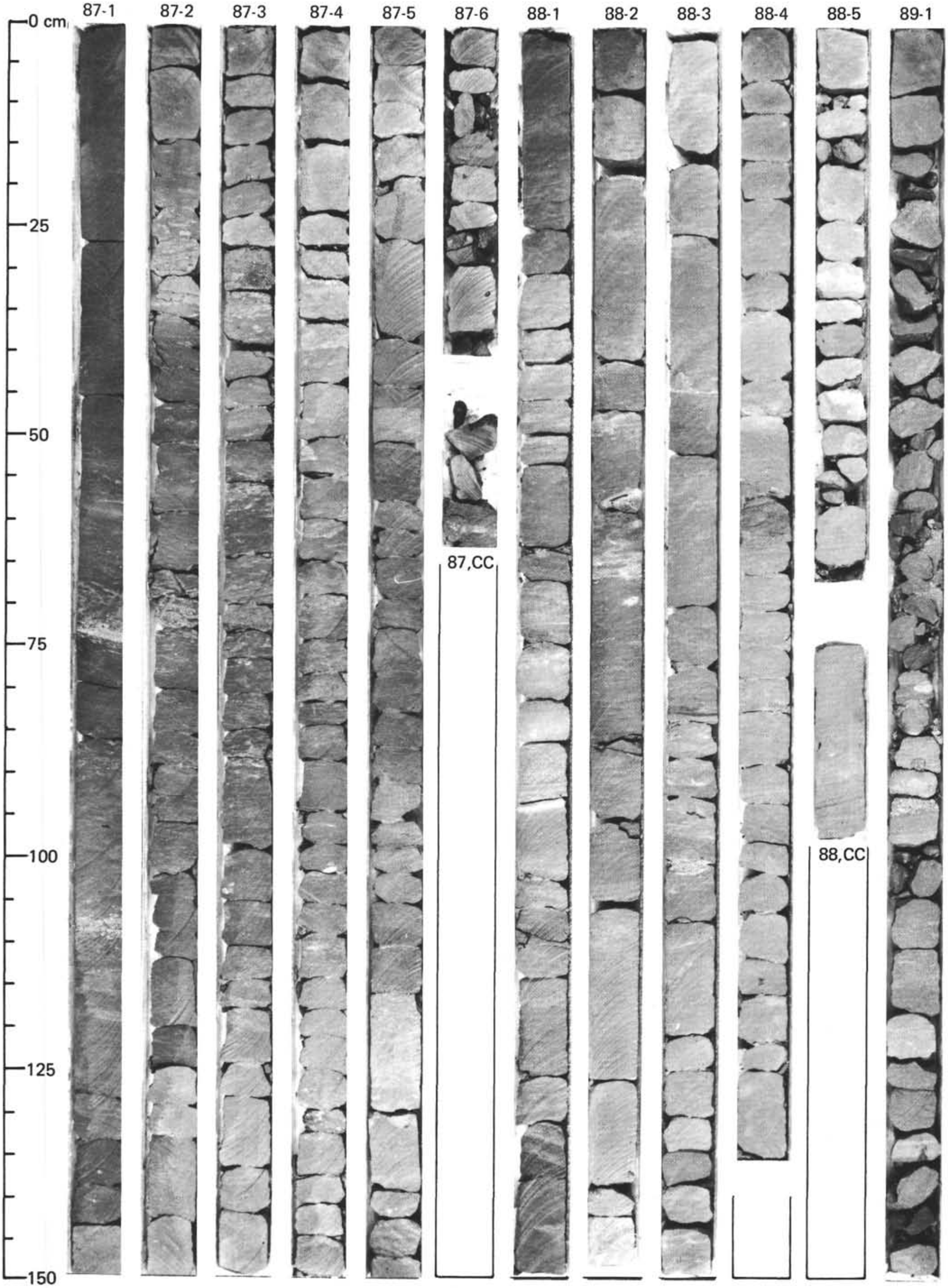

69-5
69-6
70-1
70-2
71-1
71-2
72-1
72-2
72-3
73-1
73-2
73-3
0 cm
25
50
75
100
125
150
END

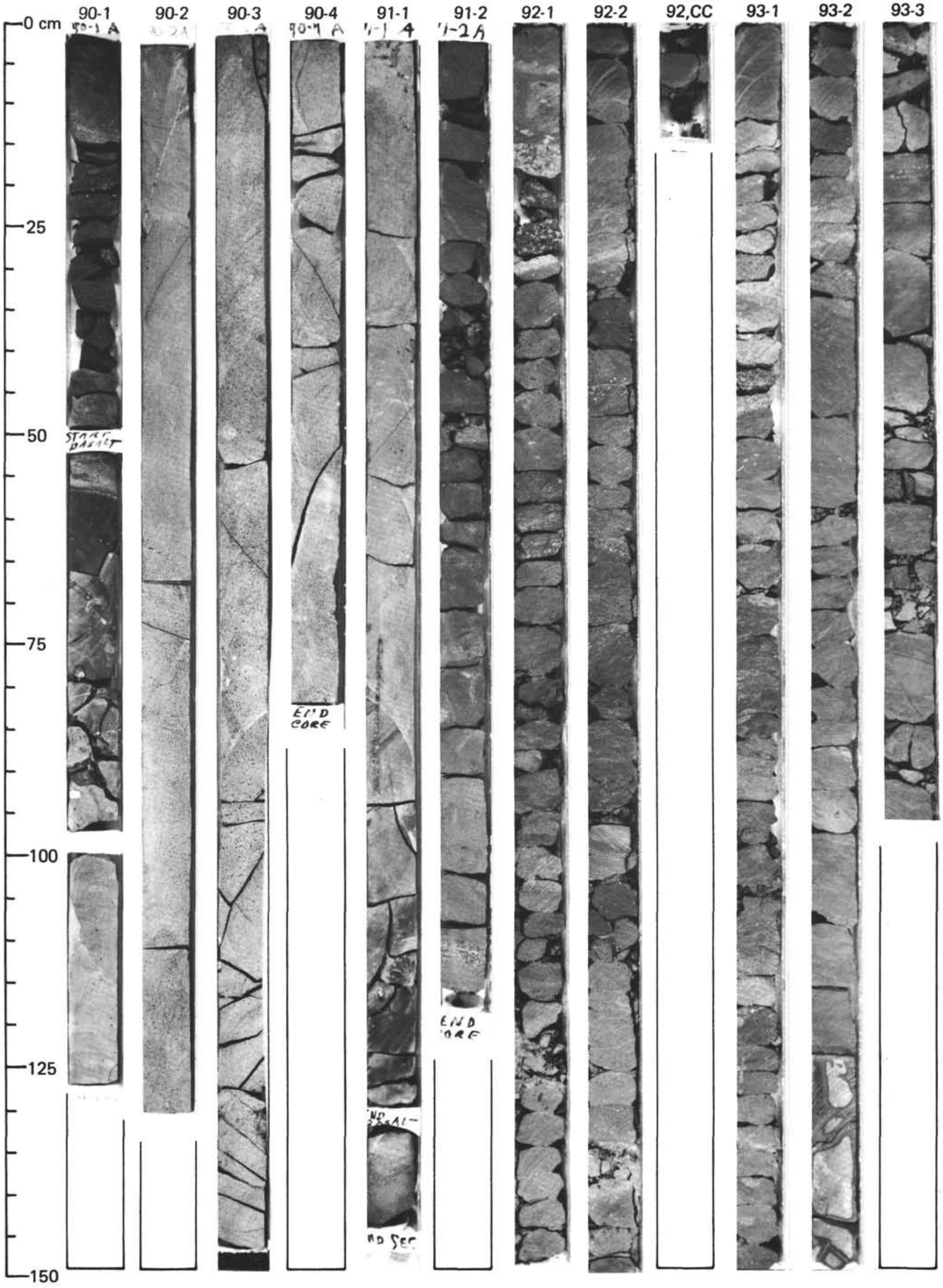

0 cm
25
50
75
100
125
150
73-4
73-5
74-1
74-2
74-3
75-1
75-2
76-1
76-2
76-3
76-4
76-5

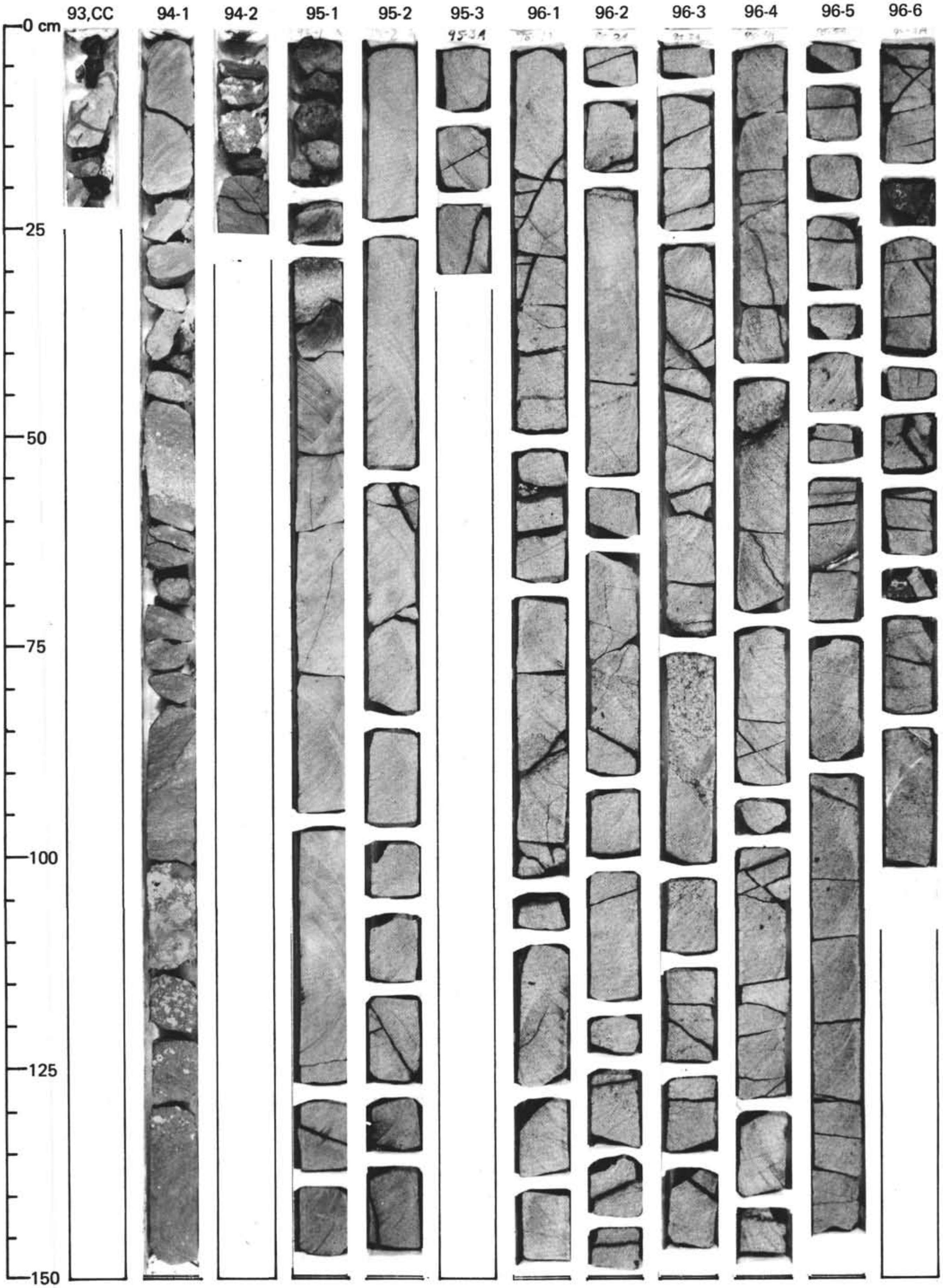

0 cm
25
50
75
100
125
150
77-1
77-2
77-3
77-4
77-5
77-6
78-1
78-2
78-3
78-4
79-1
79-2
END

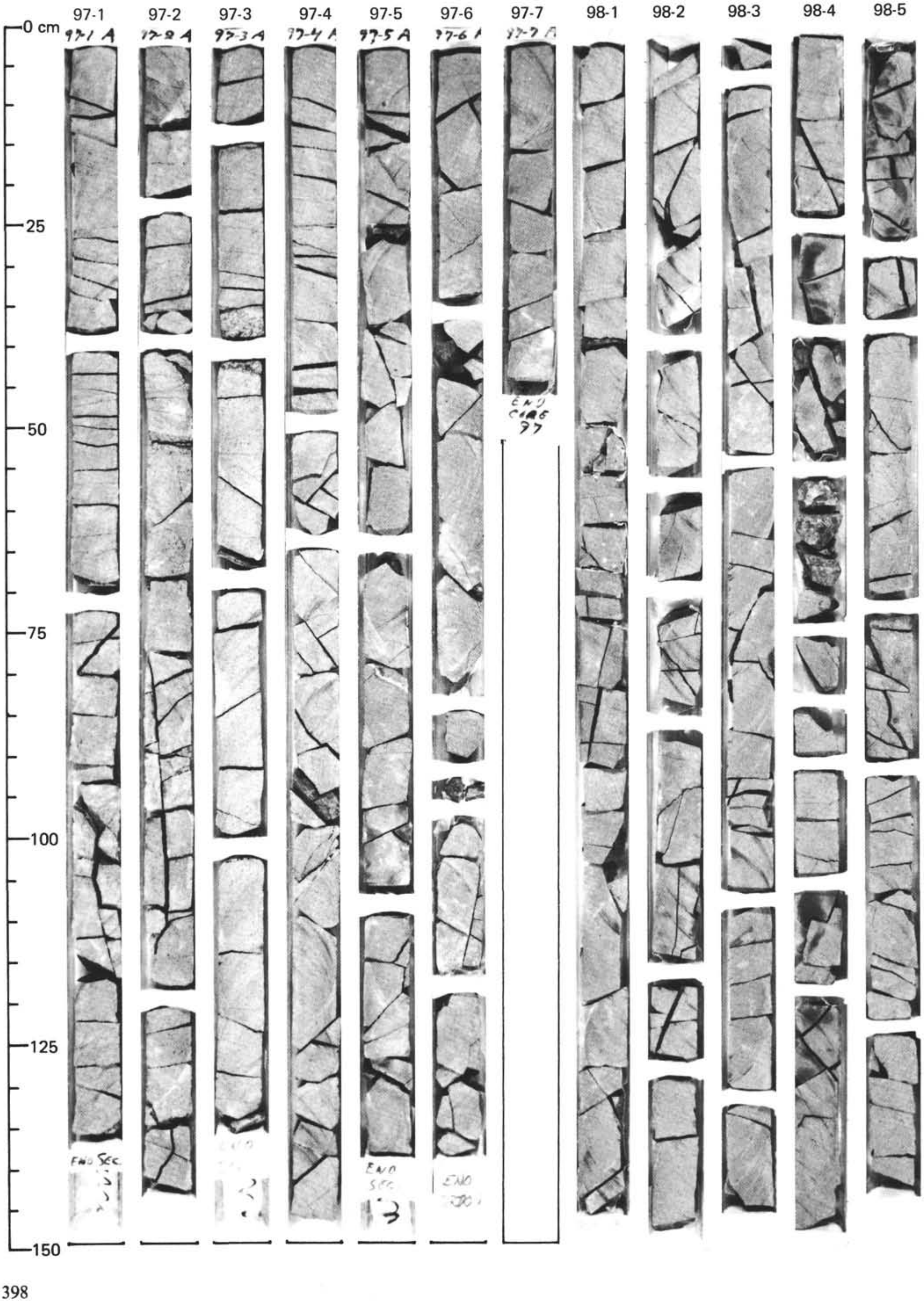

79-3
79-4
80-1
80-2
80-3
80,CC
81-1
81-2
81-3
82-1A
82-2A
82-3A
0 cm
25
50
75
100
125
150

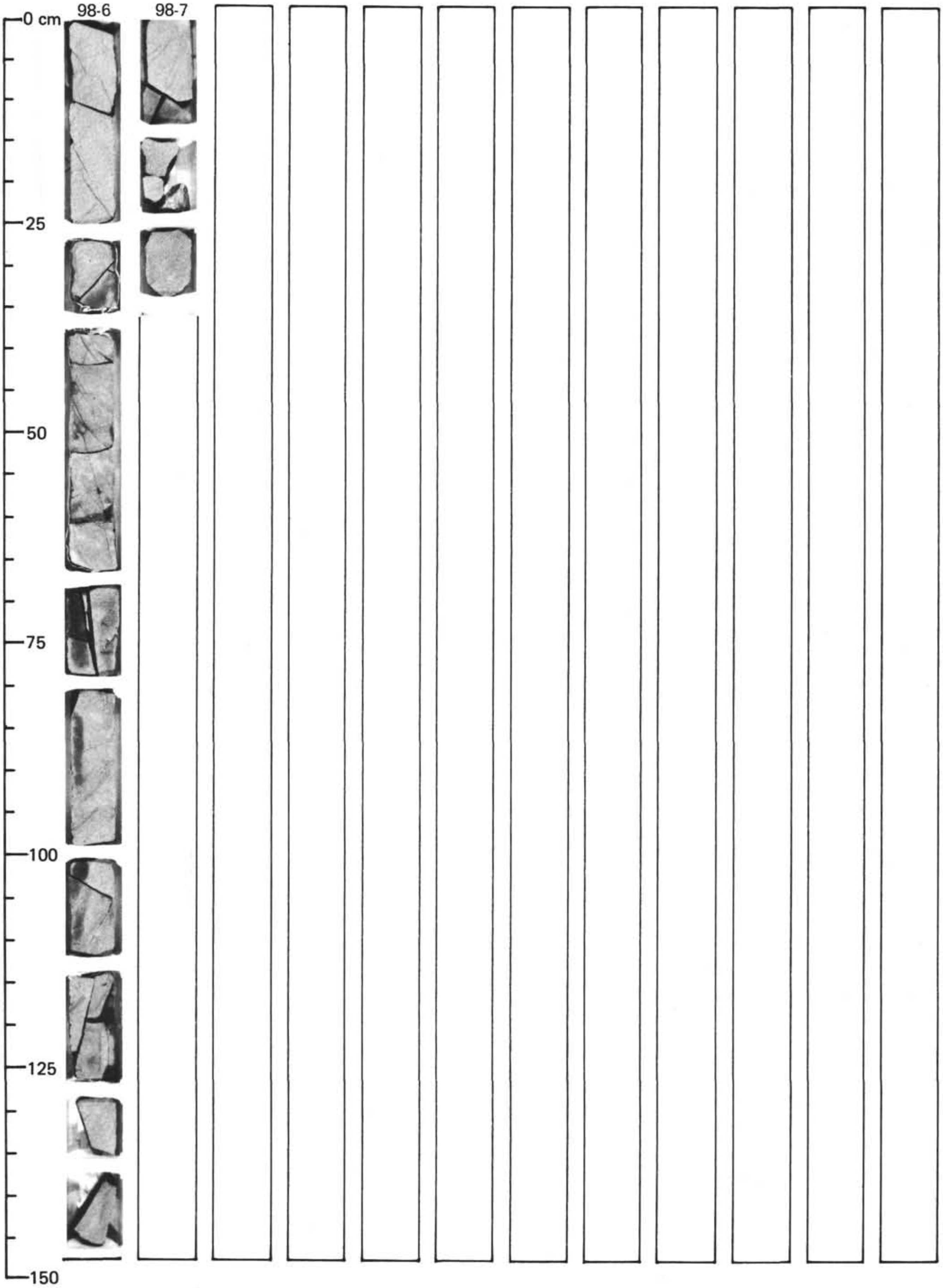

83-1A
83-2A
83-3A
84-1
84-2
85-1
85-2
85-3
86-1
86-2
86-3
86,CC
0 cm
25
50
75
100
125
150


0 cm
25
50
75
100
125
150
87-1
87-2
87-3
87-4
87-5
87-6
88-1
88-2
88-3
88-4
88-5
89-1
87,CC
88,CC


0 cm
25
50
75
100
125
150
90-1
90-2
90-3
90-4
91-1
91-2
92-1
92-2
92,CC
93-1
93-2
93-3
START BASALT
END CORE
END BASALT
END SEC
END CORE


93,CC
94-1
94-2
95-1
95-2
95-3
96-1
96-2
96-3
96-4
96-5
96-6
0 cm
25
50
75
100
125
150


97-1
97-2
97-3
97-4
97-5
97-6
97-7
98-1
98-2
98-3
98-4
98-5
97-1 A
97-2 A
97-3 A
97-4 A
97-5 A
97-6 A
97-7 A
0 cm
25
50
75
100
125
150
END CORE 97
END SEC
END SEC 3
END


0 cm
25
50
75
100
125
150
98-6
98-7