6. SITE 569[1]

Shipboard Scientific Party[2]

HOLE 569

Date occupied: 12 February 1982, 2045 hr.

Date departed: 15 February 1982, 0135 hr.

Time on Hole: 52 hr., 50 min.

Position: 12°56.31′N; 90°50.35′W

Water depth (sea level; corrected m, echo-sounding): 2744

Water depth (rig floor; corrected m, echo-sounding): 2754

Bottom felt (m, drill pipe): 2799.7

Penetration (m): 250.7

Number of cores: 27

Total length of cored section (m): 250.7

Total core recovered (m): 134.83

Core recovery (%): 53.7

Oldest sediment cored:
Depth sub-bottom (m): 250.7
Nature: mudstone
Age: late Oligocene
Measured velocity (km/s): 1.8

Basement: not reached

HOLE 569A

Date occupied: 15 February 1982, 0320 hr.

Date departed: 17 February 1982, 0050 hr.

Time on Hole: 46 hr., 30 min.

Position (latitude; longitude): 12°56.22′N; 90°50.81′W

Water depth (sea level; corrected m, echo-sounding): 2795

Water depth (rig floor; corrected m, echo-sounding): 2805

Bottom felt (m, drill pipe): 2814

Penetration (m): 364.9

Number of cores: 11

Total length of cored section (m): 100.0

Total core recovered (m): 16.32

Core recovery (%): 16.3

Oldest sediment cored:
Depth sub-bottom (m): 351.4
Nature: mudstone
Age: early Eocene
Measured velocity (km/s): 2.4

Basement:
Depth sub-bottom (m): 351.4
Nature: amphibolites (altered gabbros and diabases)
Velocity range (km/s): 4.982–5.232

Principal results: (Holes 569 and 569A): At Site 569, situated in the midslope area, drilling penetrated a 351-m Recent–late Pleistocene through Eocene sedimentary sequence overlying a basement of gabbros and diabases, of which 14 m were cored. The sequence recovered in Hole 569 is:

Unit I. 0–57 m, Pleistocene and late Pliocene green mud.

Unit II. 57–250 m, Miocene green mudstone including 57–77.9 m late Miocene, 77.9–87.4 m middle Miocene, 87.4–231.4 m early Miocene, and 231.4–250 m, late Oligocene light green calcareous mudstone.

In Hole 569A the sequence recovered is:

Unit II (continued). 246.0–332 m late Oligocene light green calcareous mudstone.

Unit III. 332–351 m, early to late Eocene green and black siliceous mudstone.

Hard-rock basement. 351-365 m, gabbro and diabase metamorphosed to amphibolite and greenschist facies.

Unconformities are suspected between the upper Pliocene and Miocene, the upper Oligocene and Eocene, and between the Eocene and the igneous basement rock.

Together with the results from Sites 566 on the lower slope, and 567 at the base of the slope, the results from this site show that the landward slope of the Middle America Trench is constructed of a basement of ophiolitic rocks beneath a cover of sediments. The oldest material overlying ophiolitic rocks is late Miocene at Site 566, early Miocene at Site 567, and early Eocene at Site 569; the minimum age of the tectonics that emplaced the original ophiolitic rock is, at least, pre-early Eocene.

These results strongly suggest an analogy with on-land geology and confirm the fact that off Guatemala the whole margin is constructed of an igneous basement belonging to the continental framework of Central America.

BACKGROUND AND OBJECTIVES

Site 569, situated in about 2800 m of water, 3200 m above and 32 km from the Middle America Trench axis, is in the middle of the slope where the generally thick sediment becomes thin enough to be penetrated by the *Glomar Challenger*. The seismic records show an irregular mantel of slope deposits burying a rough basement topography. The maximum length of drill string available on board the *Glomar Challenger* (3300 m), and the area where the base of the sediment is above the BSR (bottom simulating reflector) were important considerations in order to avoid the gas hydrate problem in getting to the basement. Site 569 is situated above a bump in the basement perhaps related to faulting. Two strong

[1] von Huene, R., Aubouin, J., et al., *Init. Repts. DSDP*, 84: Washington (U.S. Govt. Printing Office).

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reflectors, at a sub-bottom depth of about 400 m (assuming an average sound velocity of 1.8 km/s in the sediments), are the indication of basement upon which rests first a conformable sediment cover and then prograding slope deposits.

The main objectives at this site were (1) to sample the basement so that it would be possible to compare it with the basement at Sites 566 and 567, which are igneous rocks of an ophiolitic suite; (2) to recovering a complete section of the sediments above the basement, in order to compare this sequence with the results at Sites 494 (Leg 67), 566, and 567 (Leg 84), and the sites abandoned before basement was reached for safety reasons related to the gas hydrates problem (Leg 67: Sites 496, 497, 498: Leg 84: Site 568).

OPERATIONS

Glomar Challenger departed Site 568 at 1615L (local time) 12 February, under way to Site 569 where a 16-kHz beacon was dropped at 1950L. The ship was in position at 2045L. Running in began at 2330L after making up BHA (bottom hole assembly) and sorting 27 joints of premium pipe.

The hole was spudded at 0852L, 13 February, and the first core recovered at 1052L.

After having recovered Core 27 at 2107L, 14 February, it appeared that there was annular packing around collars in overpressured formation (250 psi static pressure on pipe), which caused us to abandon the hole.

At 0136L, 15 February, with four joints retrieved above the mud line, *Glomar Challenger* moved about 900 m west, 200 m south from the beacon to Hole 569A, the ship was positioned at 0320L.

After spudding at 0445L, drilling first washed down to 246 m, below which continuous coring was begun. The wash core, 569A-H1, was retrieved at 1010L, and the first core recovered at 1226L. The coring was somewhat difficult on February 16, with repeated mud flushes in the hole. In order to try to keep on drilling the hole and to reach basement, it was decided to drill two joints before retrieving the core barrel: recovery had been very low, so further recovery was not jeopardized, which reduced the tendency to stick during the wireline trips. This was done for Cores 8 and 9; at 1352L, 16 February, Core 10 was recovered with gabbros and dolerites below the Eocene mudstone. Only 4 m were cut of Core 11, because the main target of the hole had been reached, and further drilling was abandoned.

After filling the hole with heavy mud, running out began at 1615L, 16 February, and ended at 0045L, 17 February.

At 0050L, 17 February, *Glomar Challenger* departed for Site 570.

Table 1 shows the coring summary for Site 569.

LITHOSTRATIGRAPHY

Site 569 is located between Sites 568 and 567 on the landward side of the Middle America Trench at a water depth of about 2800 m. The site is 32, km from the Trench axis and 125 km south of the coast of Guatemala (Fig. 1).

Twenty-seven cores were drilled in Hole 569 with good recovery to a sub-bottom depth of 251 m, when caving in the hole became a problem. The hole was abandoned and our location offset about 1 km to drill Hole 569A. After washing down to 246 m at Hole 569A, continuous coring was resumed for eight cores, at which point the consistently poor recovery and the imminent danger of caving promoted the decision to drill two cores' length between core retrievals. This procedure was continued for two cores (8 and 9) when the drilling encountered hard rock, and continuous coring was resumed (Cores 10 and 11).

We divide the sedimentary lithology into three units on the basis of color, texture, constituents, and seismic data; below Unit III, hard rock was drilled (Fig. 2).

Hole 569

Unit I

Unit I, composed of (Cores 1 to 7, 0 to 57 m sub-bottom depth (Recent–late Pleistocene to late Pliocene), is a generally massive, dark olive gray (5Y 3/2) to grayish olive (10Y 4/2) mud that easily deforms into swirled layers during drilling. Average sand-silt-clay composition of the unit is 6, 17, and 77%, respectively. Siliceous biogenic remains (radiolarians, sponge spicules, silicoflagellates, and, in particular, diatoms) are common and locally constitute 15% of the total sediment composition, and sandy horizons occur in Cores 1 to 3 and in Core 7. The sand in Core 7 is coarse, dark, and angular, and contain a high percentage of ash. Sedimentary layering is weakly preserved in Cores 2 to 4, and is generally less than 10 cm thick.

Twelve ash or muddy-sandy ash layers occur in Cores 1 to 5, and numerous ash mottles (which may be drilling-disturbed layers) and pumice clasts occur throughout the unit. Colors range from light gray olive (10Y 4/2) to olive black (5Y 2/1) (containing quartz, plagioclase, pyroxene, and orthopyroxene), and very light gray to white (N8–N9, usually glass-shard-rich).

Unit II

Unit II comprises Cores 7 to 27, 57–250 m, sub-bottom depth (Miocene-late Oligocene). The contact between Unit I and Unit II is placed at an abrupt color change below a 15-cm-thick dark sand layer in Core 7, Section 2. Mud below the contact is firmer. The horizon roughly corresponds to an acoustically defined contact between downslope-dipping reflections of sedimentary lobes and sediments draping over these (see the Geophysics section) and for this reason was favored as the contact over another color change observed in Core 8. This unit comprises ash-bearing mud-mudstone that is olive gray (10Y 4/2) to grayish blue green (5BG 5/2) in color, mottled and bioturbated particularly from Core 12 to the bottom of the hole. Small silty-sandy horizons are common, and burrows are commonly filled with coarser sediment. The average sand-silt-clay composition of the mud is 4, 21, and 75%, respectively.

Thin limestone layers occur in Cores 13 and 18 that are yellowish gray (5Y 7/2) and greenish gray (5GY 6/1),

Table 1. Coring summary, Site 569.

Core	Date Feb. 1982	Time	Depth from drill floor (m) Top Bottom	Depth below seafloor (m) Top Bottom	Length cored (m)	Length recovered (m)	Recovery (%)
Hole 569							
1	13	0952	2799.7–2800.9	0.0–1.2	1.2	1.18	98
2	13	1055	2800.9–2810.8	1.2–11.1	9.9	7.63	77
3	13	1200	2810.8–2820.3	11.1–20.6	9.5	5.73	60
4	13	1259	2820.3–2830.0	20.6–30.3	9.7	9.62	99
5	13	1356	2830.0–2839.7	30.3–40.0	9.7	5.41	56
6	13	1457	2839.7–2849.4	40.0–49.7	9.7	8.90	92
7	13	1555	2849.4–2858.6	49.7–58.9	9.2	9.55	100
8	13	1705	2858.6–2868.2	58.9–68.5	9.6	4.22	44
9	13	1828	2868.2–2877.6	68.5–77.9	9.4	3.13	33
10	13	1937	2877.6–2887.1	77,9–87.4	9.5	3.20	34
11	13	2050	2887.1–2896.8	87.4–97.1	9.7	3.13	32
12	13	2204	2896.8–2906.4	97.1–106.7	9.6	8.97	93
13	13	2324	2906.4–2915.7	106.7–116.0	9.3	5.12	55
14	14	0037	2915.7–2925.3	116.0–125.6	9.6	3.81	40
15	14	0200	2925.3–2934.8	125.6–135.1	9.5	4.46	47
16	14	0308	2934.8–2944.5	135.1–144.8	9.7	1.27	13
17	14	0415	2944.5–2954.1	144.8–154.4	9.6	7.27	76
18	14	0520	2954.1–2963.8	154.4–164.1	9.7	4.29	44
19	14	0645	2963.8–2973.5	164.1–173.8	9.7	0.37	4
20	14	0820	2973.5–2983.1	173.8–183.4	9.6	2.15	22
21	14	0940	2983.1–2992.6	183.4–192.9	9.5	3.54	37
22	14	1115	2992.6–3002.3	192.9–202.6	9.7	3.14	32
23	14	1331	3002.3–3011.8	202.6–212.1	9.5	5.23	55
24	14	1515	3011.8–3021.5	212.1–221.8	9.7	8.24	85
25	14	1643	3021.5–3031.1	221.8–231.4	9.6	3.82	40
26	14	1815	3031.1–3040.7	231.4–241.0	9.6	6.85	71
27	14	2107	3040.7–3050.4	241.0–250.7	9.7	4.60	47
Total					250.7	134.83	54
Hole 569A							
H1	15	Washed	2814.0–3060.0	0.0–246.0	—	—	—
1	15	1226	3060.0–3069.5	246.0–255.5	9.5	6.47	68
2	15	1436	3069.5–3079.9	255.5–265.1	9.6	2.47	26
3	15	1616	3079.1–3088.5	265.1–274.5	9.4	0.00	0
4	15	1805	3088.5–3098.2	274.5–284.2	9.7	0.97	10
5	15	2012	3098.2–3107.9	284.2–293.9	9.7	0.06	1
6	15	2325	3107.9–3117.5	293.9–303.5	9.6	1.00	10
7	15	0230	3117.5–3127.1	303.5–313.1	9.6	1.14	12
8	16	0430	3127.1–3136.8	313.1–322.8	9.7	0.68	1
	16	Drilled	3136.8–3146.3	322.8–332.3	—	—	—
9	16	0947	3146.3–3156.0	332.3–342.0	9.7	1.96	20
	16	Drilled	3156.0–3165.4	342.0–351.4	—	—	—
10	16	1352	3165.4–3174.9	351.4–360.9	9.5	1.35	14
11	17	0008	3174.9–3178.9	360.9–364.9	4.0	0.22	6
Total					100.0	16.32	16

Note: H1 designates wash core. "Drilled" in Time column indicates that recovery was combined with recovery of the preceding core, that is, two core lengths were drilled for every instance of recovery.

respectively, and bioturbated. Sandy layers occur in Cores 13, 18, and 21.

Bedding inclinations of 30 to 60° are observed in Cores 14 through 16 and 27. Veining and small-scale fractures are first observed in Core 12, where the mudstone is also stiff enough to break into biscuitlike chunks. These features are similar to the veining and fracturing observed at Site 568, except that they range in size to include greater dimensions (lengths observed up to 10 cm, thickness of parallel-type veins up to 3 mm); see Figure 3. Offset along fractures indicates extension.

Hole 569A

Unit II

Unit II comprises Cores 1 to 8, 246 to 332.3 m sub-bottom depth, (late Oligocene). After washing down to 246 m, coring was resumed in the Unit II sedimentary facies encountered in Hole 569. The major lithology is composed of heavily burrowed and mottled olive gray (5Y 3/2) to grayish olive (10Y 4/2) mudstone. Veining and fracturing as described at Site 568 and Hole 569 are common in this hole. Two ash layers occur in Cores 2 and 7; these are pale reddish purple (5NP 6/2) and medium dark gray (N4), respectively.

Cores 6 to 8 make up the minor lithology of this unit and consist of interbedding calcareous mudstone and claystone (pale blue green 5BG 6/6), which exhibit the same striking mottled, bioturbated, fractured, and veined appearance. In the core catcher of Section 8, a coarse blue gray (5G 6/1), sandy limestone identifies the base of Unit II.

Unit III

Unit III is Core 9, 322 to 351 m sub-bottom depth, (late–early Eocene). The contact between Units II and

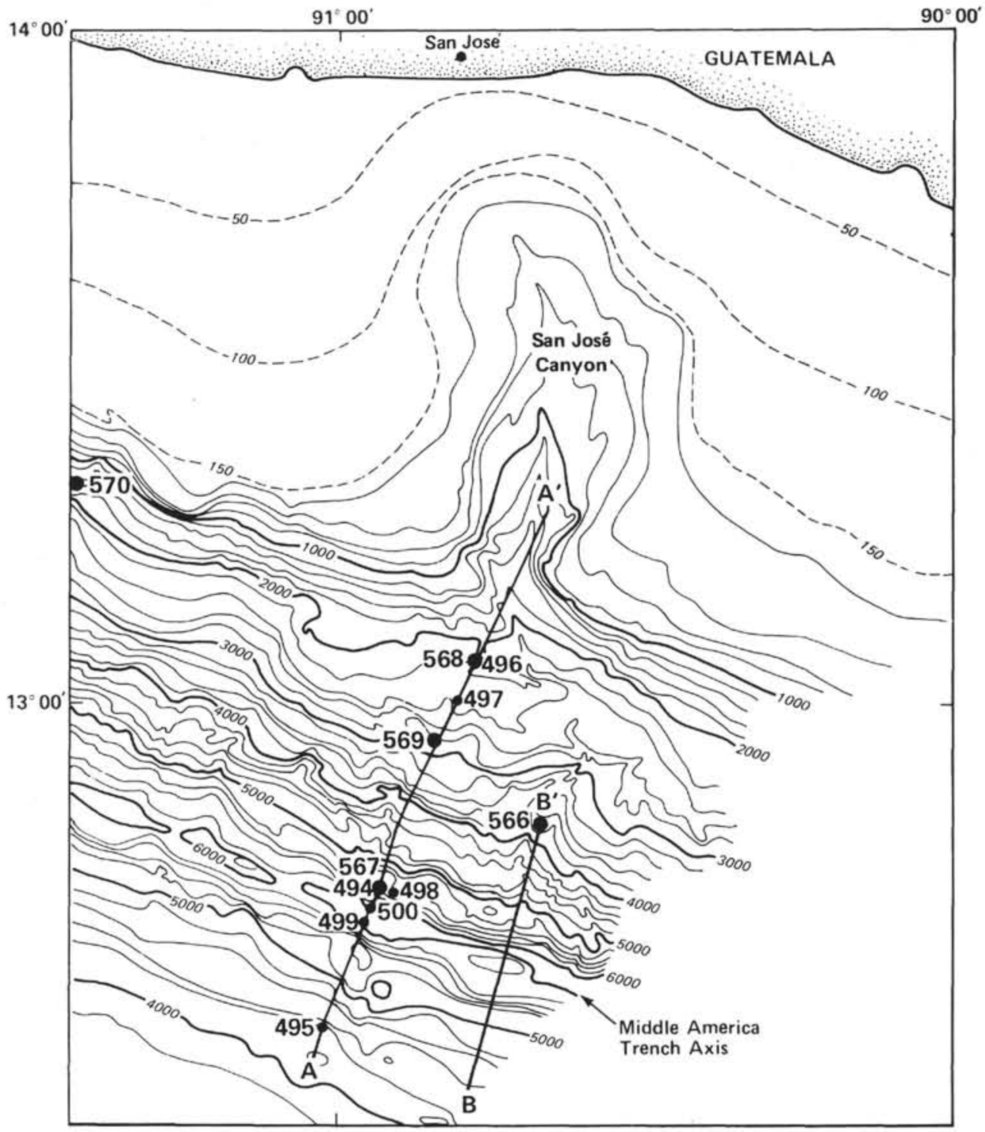

Figure 1. Bathymetry of the Guatemala margin and San José Canyon, showing the UTMSI survey tracks and the location of Legs 67 and 84 sites off Guatemala.

III is placed at the base of Core 8 on the base of a textural and color change.

Unit III comprises heavily mottled and bioturbated radiolarian-rich mudstone. The top of Core 9, Section 1, is a blue gray mudstone that occurs in swirled, drilling-disturbed contact with darker (light olive gray 5Y 5/2 to grayish olive 10Y 4/2) mudstone. The lowermost 30 cm of the unit consists of a faintly mottled, brownish black mudstone.

Hard Rock Petrology

Gabbroic and diabasic rocks were recovered from the base of Hole 569A; amphibolite (hornblende) and greenschist facies minerals replace the primary minerals. Crosscutting veins filled with zeolite minerals and prehnite are common features in the rock.

If these rocks are of an igneous provenance similar to that of the hard rocks recovered at Hole 567A, they have been subjected to nearly complete alteration during greenschist metamorphism. Later mineralization under zeolite metamorphic conditions is identified by the abundant zeolite-filled veins that crosscut the rock.

Discussion

The dipping beds in Unit II lend themselves to the same suite of interpretations proposed in the discussion of the Site 568 lithology.

The presence of late Oligocene ash layers in Holes 569 and 569A has interesting implications for the regional tectonic history. One of the reasons for assuming that the initiation of subduction along the Middle America Trench took place in the Miocene is the first appearance of ash horizons during this time. The recovery of still older ash layer may permit extension of the age of the present subduction setting back into the late Oligocene.

The altered metamorphosed igneous rocks are similar to the hard crystalline rocks of the ophiolitic suite recovered from Site 567.

BIOSTRATIGRAPHY

Introduction

Two holes drilled at Site 569 recovered 361 m of Pleistocene through early Eocene sediments overlying metabasite basement. Calcareous nannofossils are age-diagnostic and moderately preserved within most of the Pleistocene through late Eocene mudstones, but less frequent and nondiverse within much of the early Miocene and probable early Eocene sediments. Below the Pleistocene, diatoms are commonly low in abundance and moderately to poorly preserved. A barren interval exists until the early middle Miocene, when diatoms again become useful for biostratigraphy. Benthic foraminifers are moderately well preserved and abundant in the Pleistocene, however, they decrease in number and quality of preservation through the Miocene and Eocene.

In Hole 569 Sections 569-1-2 through 569-6,CC are Pleistocene and 569-7,CC is late Pliocene, although some reworked Miocene specimens were noted. Sample 569-8-1, 18–22 cm is late Miocene, on the basis of benthic foraminifers and diatoms; 569-10,CC is middle Miocene, based on nannofossils and benthic foraminifers; 569-11-2, 71 cm through 569-12,CC are early Miocene based on diatoms and nannofossils, whereas 569-13-4 through 569-26-4, 44 cm are early Miocene undifferentiated, based on nannofossils, diatoms, and benthic foraminifers. Nannofossil Samples 569-27-1, 19 cm through 569-27,CC are late Oligocene (Fig. 4).

In Hole 569A, Samples 569A-1-1, 99 cm through 569A-7,CC are late Oligocene, based on nannofossils, whereas 569A-8,CC is late Eocene. And 569A-9-1, 18 cm through 569A-9,CC are late middle Eocene, based on nannofossils and, in part, benthic foraminifers and diatoms. A muddy limestone recovered just above basement in 569A-10-1 is probably late early Eocene (possibly early middle Eocene), in the basis of nannofossils (Fig. 4).

Paleoecologic analysis of Holes 569 and 569A suggests deposition occurred at abyssal depths during the Miocene through middle Eocene. Additionally, the early Miocene through middle Eocene deposition was probably below of near the foraminiferal CCD (calcite compensation depth). Calcareous benthic foraminiferal tests were occasionally preserved (569A-8 and -9,CC) at these great abyssal depths, and planktonic foraminiferal tests only rarely (569A-10-1). Transported material in the abyssal biofacies was primarily from the lower and upper middle bathyal biofacies. In assemblages deposited below the CCD, transported outer shelf and upper bathyal species are often the only components of the fauna.

Sediment accumulation rates uncorrected for compaction (Fig. 5) vary from 7 m/m.y. to 33 m/m.y. for both holes and illustrate at least three (probably more) unconformities.

The accumulation rate for the Pleistocene (Hole 569, 1–55 m, Cores 1 through 7) is approximately 33 m/m.y. Below this interval is a sequence (56–85, Cores 7 through 10) of siliceous mudstones that contain late Pliocene nannofossils and diatoms at the top, and early middle Miocene diatoms at the bottom. This interval represents one, and possibly several early Pliocene–Miocene unconformities.

Rates of sediment accumulation are approximately 7 m/m.y. for the early middle and late early Miocene (Hole 569, 86–107 m, Cores 10 through 12) and increase to approximately 25 m/m.y. for the remainder of the recovered early Miocene section (108–231 m, Cores 13 through 25). The sedimentation rate for the late Oligocene is approximately 7 m/m.y. (Hole 569, 232–251 m, Cores 26 through 27, and Hole 569A, Cores H1 through 1); this rate was averaged through two zones that bracket a barren interval.

The late Oligocene sedimentation rate for Hole 569A (250–324 ± 10 m, Cores through 10) was also averaged across a barren interval bracketed by two zones, and is approximately 23 m/m.y.

Late Eocene sediments are present from 332 to 352 m, with accumulation rates of 7 m/m.y. An unconformity near the base of the late Oligocene is therefore suggested somewhere between 315 and 330 m, which is an interval of poor sample recovery.

A few centimeters of probably early Eocene limestones are present in Section 569A-10-1, which is indicative of another unconformity at 355 m (± 5 m) near the base of the late Eocene.

Nannofossils

Recovery at Hole 569 include 250.7 m of Pleistocene to late Oligocene (Fig 4) mudstones. Hole 569A was washed to 246 m and cored through late Oligocene probably early Eocene sediments upon basement.

Calcareous nannofossils are frequent to common and moderately preserved within most of the Pleistocene through late Eocene intervals, except for the early Miocene interval from 125 to 231 m in Hole 569 where assemblages diversity and numbers drop. Early Eocene nannofossils are also rare and heavily recrystallized within Sample 569-10-1, 1–2 cm.

Reworking is minimal, and it is largely restricted to the Pleistocene, where several rare Cretaceous species were observed.

Hole 569

Sections 569-1-2 through 569-4,CC are assigned to the Recent–late Pleistocene *Emiliania huxleyi* to *Gephyrocapsa oceanica* Zones and contain common *G. oceanica, Helicosphaera kamptneri*, small *Gephyrocapsa* spp., and minute placoliths with affinities to *Emiliania huxleyi*. Samples 569-5,CC and 569-6,CC (40.0–49.7 m) are also Pleistocene, but species diversity and abundances are unfavorably low for detailed zonation. *Pseudoemiliana lacunosa* is present, which is indicative of an age older than the *G. oceanica* Zone. Very rare specimens of the Cretaceous species *Watznaueria barnesae* are present in 569-6,CC. Samples 569-7-2, 10 cm through 569-7-6, 10 cm are barren of nannofossils.

Sample 569-7,CC (58.9 m) is assigned to the late Pliocene *Discoaster pentaradiatus* Subzone. It contains frequent *Discoaster pentaradiatus,* and rare *D. brouwe-*

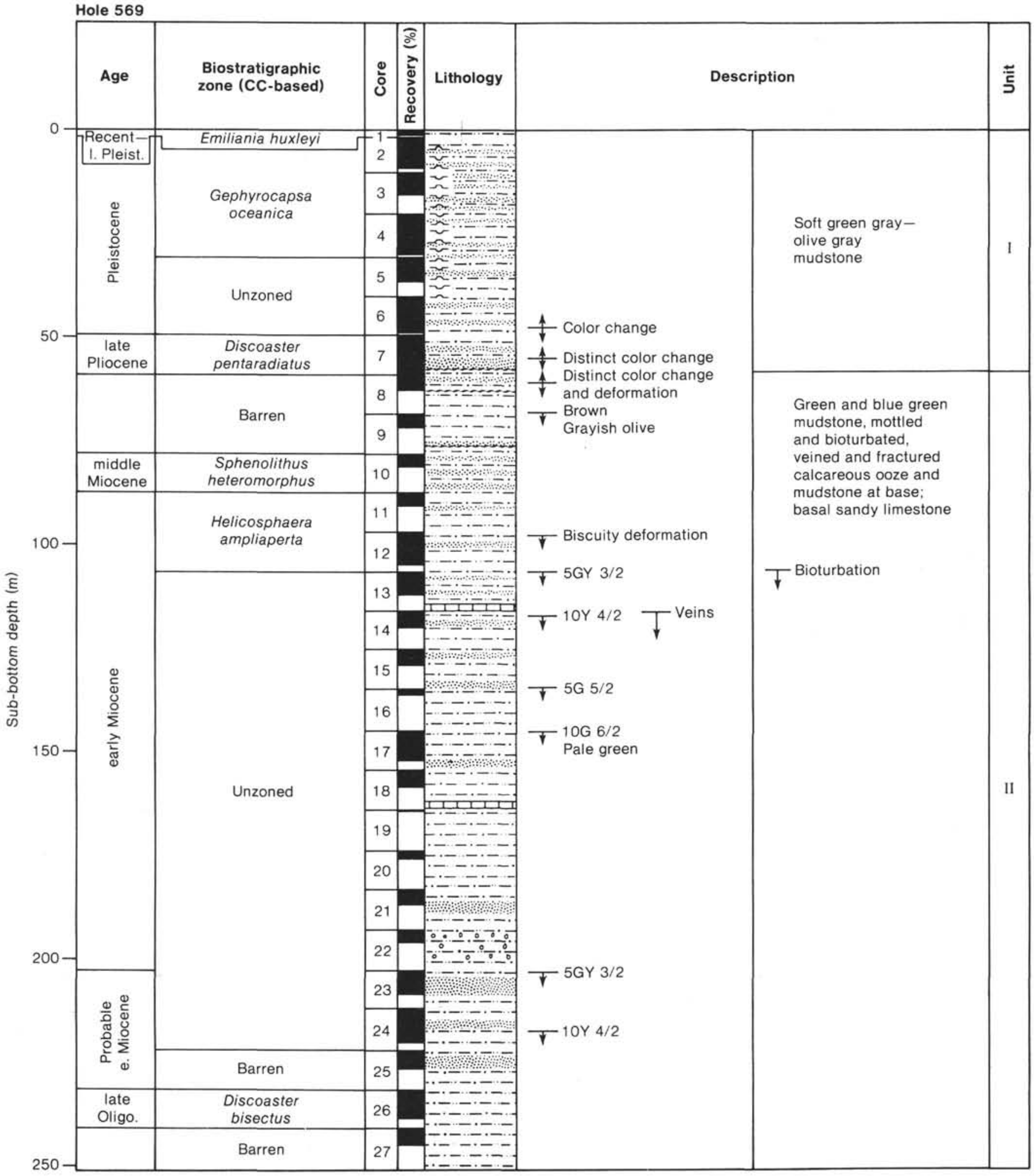

Figure 2. Lithostratigraphic summary of Site 569.

ri and *D. decorus.* A change in sediment color, which may be the Pleistocene/Pliocene boundary, is present near 569-7-6, 49 cm, but samples that bracket the contact are barren of nannofossils. Samples 569-8,CC and 569-9,CC are also barren of nannofossils.

Sample 569-10-2, 20 cm through 569-10,CC are middle Miocene and assigned to the *Sphenolithus heteromorphus* Zone. Diagnostic species include *S. heteromorphus, Discoaster exilis* s.l., *Coccolithus miopelagicus*, and *Discoaster signus.*

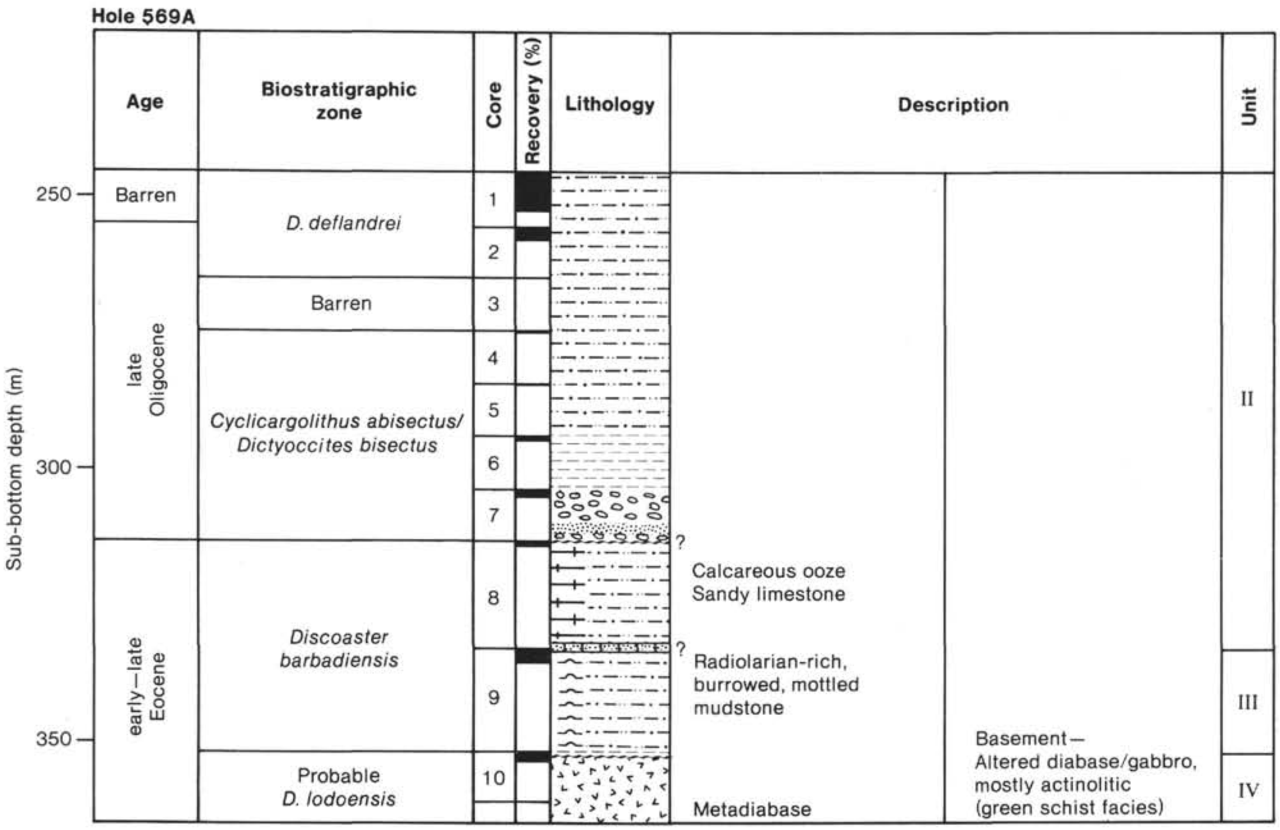

Figure 2. (Continued).

Sample 569-11-2, 71 cm through 569-12,CC are assigned to the early Miocene *Helicosphaera ampliaperta* Zone and contain *H. ampliaperta, S. heteromorphus* and *Discoaster deflandrei*.

Sample 569-13-4, 3 cm through 569-22,CC (116–202.6 m) are early Miocene, based on rare to frequent abundances of moderately to poorly preserved specimens of *D. deflandrei, Cyclicargolithus floridanus, Sphenolithus moriformis, S. conicus, S.* cf. *belemnos,* and *Discoaster saundersi*. Sample 569-17,CC also contains rare *Triquetrorhabdulus milowii*, which is restricted to early Miocene or younger. The absence of *Discoaster druggii* indicates that this entire interval may be within the *Sphenolithus belemnos* Zones, but low assemblage abundance and diversity prohibit definite zonal assignment. Samples 569-23,CC and 569-24,CC are dominated by siliceous microfossils and are barren of nannofossils.

Samples 569-26-3, 62 cm and 569-26-4, 44 cm were selected from the light gray calcareous mudstones that fills the burrows of a highly bioturbated sediment. They contain *Discoaster deflandrei, Dictyococcites scrippsae, Helicosphaera recta,* and *H. bramlettei* and lack *Cyclicargolithus abisectus* and *Dictyococcites bisectus*, which is most indicative of the early Miocene *Discoaster deflandrei*, Subzone.

Sample 569-27-1, 19 cm through 569-27,CC (250.7 m) are late Oligocene and assigned to the *Dictyococcites bisectus* Subzone. Age-diagnostic species include *Cyclicargolithus floridanus, Discoaster deflandrei, Triquetrorhabdulus carinatus, Dictyococcites bisectus, Helicosphaera recta, Cyclicargolithus abisectus, Sphenolithus ciperoensis*, and *Helicosphaera bramlettei*.

Hole 569A

Sample 569A-1-1, 99 cm is probably early Miocene (*Discoaster deflandrei* Subzone) and contains *Discoaster deflandrei, Helicosphaera bramlettei*, and *Dictyococcites scrippsae*.

Samples 569A-2-1, 147 cm through 569A-7-1, 43 cm are late Oligocene and are assigned to the *Dictyococcites bisectus* Zone. They contain the species *Cyclicargolithus floridanus, Discoaster deflandrei, Helicosphaera intermedia, C. abisectus*, and *Helicosphaera recta*. Sample 569A-7,CC contains well developed *Dictyococcites bisectus* and *Sphenolithus predistentus,* along with the above assemblages, and is assigned to the late Oligocene *Sphenolithus perdistentus* Zone.

Sample 569A-8,CC (322.7 m) is late Eocene and is assigned to the *Discoaster barbadiensis* Zone. *Discoaster barbadiensis, Reticulofenestra umbilica*, and *Dictyococcites scrippsae* are present along with rare *Calcidiscus formosus* and common *C. reticulatus*. Sample 569A-9-1, 18–19 cm contains the contact of a heavily burrowed and possibly disturbed base of a light gray calcareous mudstone that overlies the dark gray mudstone sampled from 569A-9, CC. Rare specimens of *Chiasmolithus grandis* are present, which, if not reworked, would suggest a slightly older age (late middle Eocene *Discoaster saipanensis* Zone) for all of Core 569A-9.

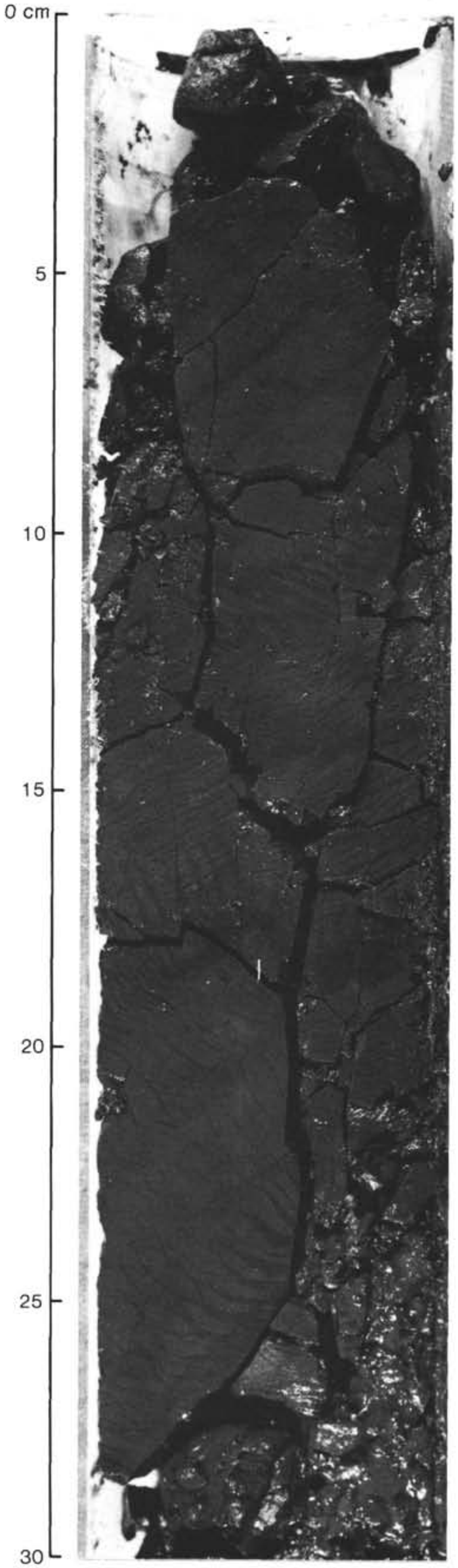

Figure 3. Photograph of parallel veins in sediment at Site 569, Sample 569-15-1, 0–30 cm.

Core 569A-10 (360.9 m) penetrate dolerite basement and contains only several centimeters of disturbed, muddy, light gray limestone fragments at the top of Section 1. This limestone contains highly recrystallized specimens of *Discoaster lodoensis, Coccolithus crassus, C. gammation, Chiasmolithus solithus, D. barbadiensis,* and *Sphenolithus radians*. This assemblage is most indicative of the late early Eocene *Discoaster lodoensis* Zone, but extremely poor preservation may have destroyed key species that would place it within the early middle Eocene *Discoaster sublodoensis* Zone. Core 569A-11 recovered metabasite mixed with a piece of late middle Eocene limestone displaced from upsection

Diatoms

Diatomaceous material occurs throughout practically the entire length of Hole 569; only Core 19 is entirely barren of diatoms. There is a hiatus, however, from Cores 14 to 23, where no stratigraphically useful taxa were observed.

The Pleistocene is represented by a diverse flora in core catchers 569-1 through -6. *Pseudoeunotia doliolus* is present throughout this entire interval as well as in Section 569-7-2 and 569-7-4 which should put the Pliocene/Pleistocene boundary somewhere within this core.

Rhizosolenia praebergonii, a lower Pleistocene indicator, is present only in 569-5,CC.

The Pliocene is represented by all, or at least part of, Core 7. *Rossiella tatsunokuchiensis*, extant only during the Miocene, appears at the end of Cores 569-7 and -8. *Thalassiosira convexa*, a marker fossil for the late Miocene to early Pliocene, is common in 569-7,CC. Section 569-8,CC contains the last appearence of *Thalassiosira oestrupii*, a marker fossil for the interval from latest Miocene to mid-Pliocene. Core 10 contains definite late early to early middle Miocene material. First appearing in Core 10 is *Actinocyclus radionovae*, restricted to early Miocene (Barron, in press); *Coscinodiscus lewisianus* (middle Miocene); *Craspedodiscus coscinodiscus* (middle Miocene); *Denticulopsis nicobarica* (late middle Miocene); and *Synedra jouseána* (middle Miocene). Although the Miocene continues through Core 27, Cores 13 and 23 contain the late Oligocene taxon *Coscinodiscus oblongus*. Section 569-25,CC contains *Melosira clavigera* fragments (late Eocene) and *Cestodiscus pulchellus* (early to mid-Oligocene), which suggests that there was some Eocene and Oligocene reworking during the early Miocene.

The first cores of Hole 569A contain an assemblage again representing reworked Eocene and Oligocene at an early Miocene depositional site. This is confirmed by the presence of the early Miocene taxa *Actinocyclus radionovae, Coscinodiseus rhombicus*, and *Craspedodiscus elegans*. This interval also includes *Xanthiopyxis acrolopha* (late Eocene-early Oligocene). The section from 569A-2 through 569A-8,CC is barren of stratigraphically useful diatoms. In 569A-9,CC the following species appear: *Hemiaulus polymorphus* (late Eocene), *Monobrachia simplex* (late Eocene), *Melosira architecturalis* (late Eocene–early Oligocene), and *Archaeomonas dubia* (late Eocene). This suggests an Eocene age for 569A-

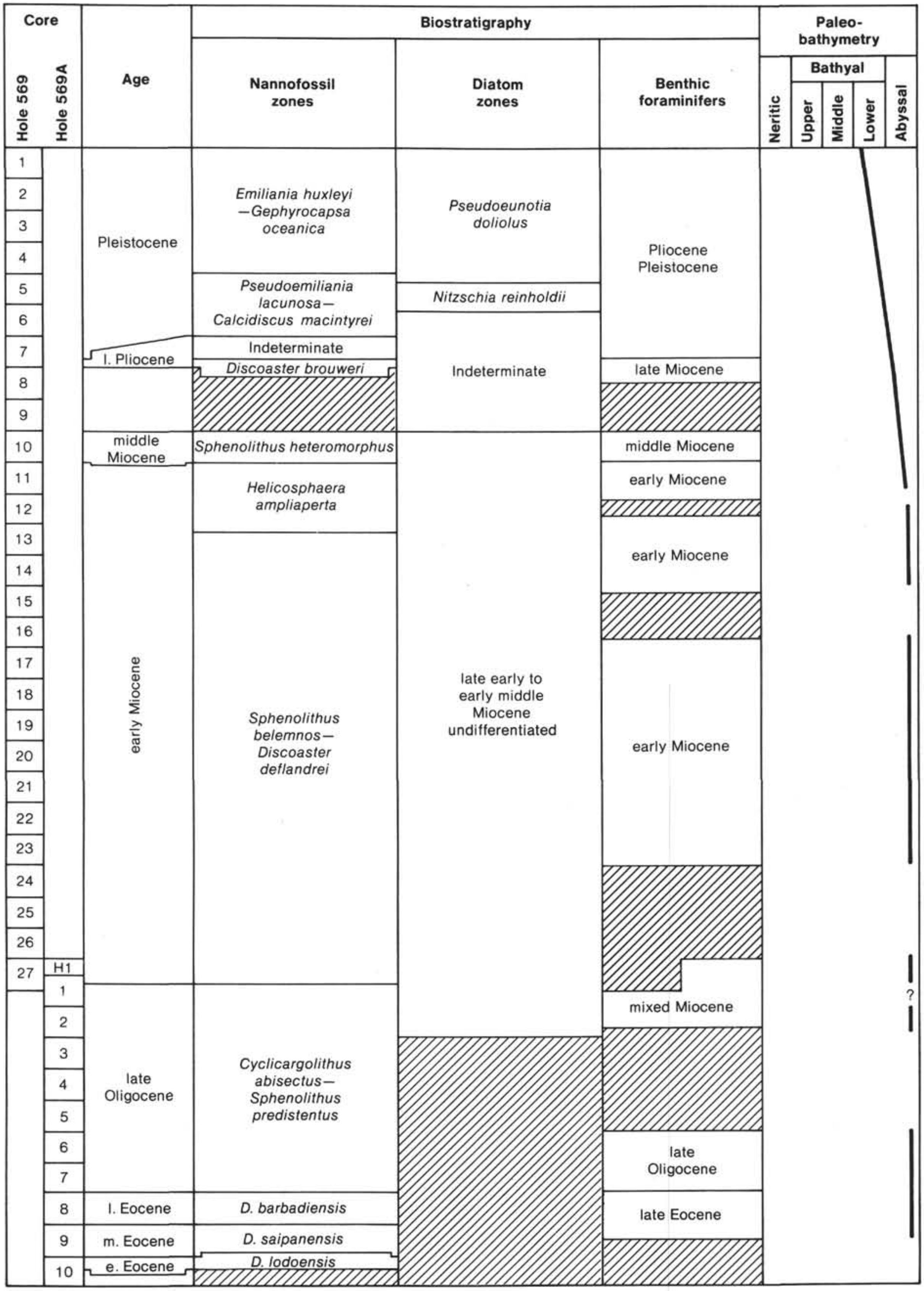

Figure 4. Biostratigraphic and paleoecologic summary, Site 569. Hachures indicate barren intervals.

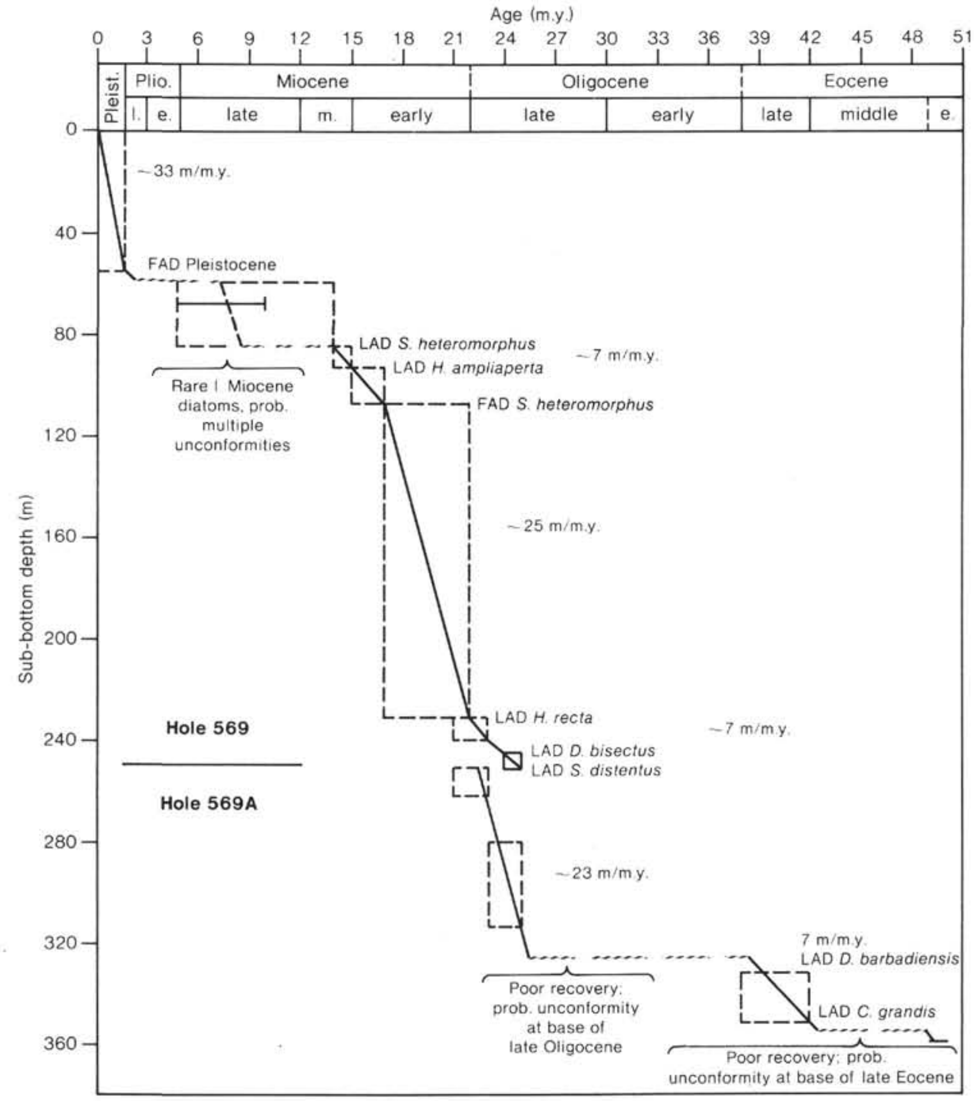

Figure 5. Sediment accumulation rates for Holes 569 and 569A, uncorrected for compaction.

9 through 569A-11,CC, after which dolerite is encountered to the base of the hole.

Benthic Foraminifers

Benthic foraminiferal assemblages in Holes 569 and 569A are highly variable in number and preservation. Well-preserved assemblages are encountered in the Pleistocene through late early Miocene, whereas the early Miocene and older sediments are poorly preserved and of low diversity. Paleoecologic analysis of the benthic foraminiferal assemblages indicates deposition occurred within the abyssal biofacies ($\geq$4000 m) from the Pleistocene through the middle Eocene. The scarcity of calcareous tests in the early Miocene to middle Eocene interval suggests that deposition occurred near the foraminiferal CCD. Shallowing to present lower bathyal depths occurred in the latest Pleistocene.

Samples 569-1-1, 91–95 cm to 569-6,CC, contain Pleistocene assemblages similar to the Holocene of this area (Smith, 1964). Ecologic analysis of these samples indicates deposition occurred at abyssal depths, that is, below 4000 m. This interpretation indicates a decrease in water depths from the Pleistocene to the present depth of 2700 m. Uvigerinids (*Uvigerina senticosa, U. rustica*, and *U. peregrina*) are the most abundant component. Transported material was primarily from the lower middle bathyal biofacies.

Benthic foraminiferal assemblages in Core 569-7, may be Pliocene. This assemblage, through less diverse, contains many of the same species as the Pleistocene assemblage and some Miocene species. These Miocene species are rare and may have been reworked into younger sediments. Water depths of greater than 4000 m are again suggested by the benthic foraminifers. Transported material is principally from the lower middle bathyal biofacies.

Cores 569-8 to -25 are Miocene: Samples 569-8-1, 18–22 cm through 569-10,CC are middle Miocene, and Cores 11 through 25 are early Miocene. In this hole the Pliocene/Miocene and middle/early Miocene boundaries are marked by extensive faunal changes. Miocene benthic foraminifers are also present in Cores 569A-H1 and -1, but probably indicate downhole contamination rather than a Miocene age. Cores 569A-2 through -5 are barren or poorly preserved and contain no age-diagnostic benthic foraminifers. Paleoecologic analysis indicates that deposition continued in the abyssal biofacies ($\geq$4000 m) during the Miocene. Upper middle bathyal benthic foraminiferal species are most common in the transported material. This change suggests a change in source area from the Pliocene–Pleistocene and Miocene. The poorly preserved early early Miocene Samples 569-20,CC, 569-22,CC, 569-25,CC as well as the barren samples below these appear to have been deposited either below the foraminiferal CCD or were subjected to corrosive bottom waters because only the most solution-resistant forms remain.

Reworked middle Eocene benthic foraminifers are present in Cores 569-12 and -13. Species of *Lenticulina, Nodosaria*, and *Vaginulinopsis* are rare, poorly preserved, diagnostic of the middle Eocene, and indicate warm, shallow marine conditions. Thus their association with well-preserved abyssal Miocene assemblages makes them easily identifiable as reworked.

Benthic foraminiferal assemblages in Cores 569A-6 through -9, are poorly preserved and of low deversity. These cores are characterized by rapid faunal changes and intervening barren samples. Late Oligocene species are present in Cores 569A-6 and -7, and late Eocene species occur in Cores 569A-8 and -9. Samples from Core 569A-10 are barren or too poorly preserved for age interpretation. Paleoecologic analyses suggest deposition occurred in the abyssal biofacies ($\geq$4000 m) and below the foraminiferal CCD, because most of the calcareous tests are siliceous.

PHYSICAL PROPERTIES

Methods

Measurements of bulk density, porosity, water content, compressive wave velocity, shear and unconfined compressive strength, and thermal conductivity were conducted as described for earlier sites and in Boyce (1976). All tests were run routinely except for thermal conductivity, which was run on a limited number of samples.

Results

Index properties for the sedimentary column at this site resemble those obtained at Sites 568 and 496. Bulk densities show a gradual increase from about 1.4 Mg/m^3 near subsurface to 1.8 Mg/m^3 in the overall trend, with some higher densities reflecting cementation in calcareous mudstones. Corrected wet-water contents, porosities, and bulk densities are presented in Figure 6, where the former two inversely mimic the distribution of bulk densities described. Three features in index property trends stand out from the main tendencies at sub-bottom depths of approximately 60, 115, and 352 m. The 352-m depth represents the sediment/crystalline rock (amphibolite) contact, whereas the 60-m depth can be correlated to the Pliocene/Miocene boundary. As at Sites 568 and 496, the 60- and 115-m depth show a more abrupt change in index properties, which is best appreciated in the wet-water content profile.

Shear and unconfined compressive strengths were measured routinely on Cores 1 through 12 beyond which lithified mudstone biscuits were recovered. Figure 7 shows the vertical distribution of strengths measured and the close correlation. The section shows a slow increase of strength in the upper 35 m, below which the section is more variable. Strength data showing deviation from a downhole trend are found at about 35, 58, and 70 m sub-bottom. The Pliocene/Miocene boundary can also be appreciated from this curve as well as from index properties.

Compressional wave velocity and acoustic impedance are displayed in Figure 8. The overall trend is gradual. Velocities increase from 1.5 km/s at subsurface to 1.9 km/s at 310 m. Deviations occur at the Pliocene/Miocene boundary or unconformity (60 m) and at about 115 m sub-bottom. Bulk densities, velocities, and impedances for igneous rock samples are detailed in Table 2.

Limited thermal conductivity measurements were made and are displayed in Table 3. These values are not corrected to *in situ* conditions and the variability is attributed, in part, to degassed structure in unlithified sediments and questionable contact between probe and slabbed samples (569-24-4 and 569-27,CC are mudstones and 569A-10-1 is amphibolite).

Discussion

The sedimentary column drilled resembles other slope sites in this area, showing a slow and gradual diagenetic modification except for some limited horizons. Two zones are outstanding, however, showing rapidly changing characteristics typical of an increased state of consolidation relative to the remaining section. The upper of these events is correlated to the Pliocene/Miocene boundary and may represent one or more nondepositional or erosional unconformities. At about 115 m sub-bottom a similar horizon occurs. Through no clear paleostratigraphic boundary is distinguished at this deeper horizon, some evidence of one or more hiatuses is suggested from microfossil assemblages, which leads us to believe this zone may also represent some type of unconformity.

GEOPHYSICS

Site 569 is near the juncture of the middle and lower slope of the Trench. The middle slope area is distinguished by thick sediment and a rough acoustic basement surface. The lower slope is steeper has a thin cover of slope deposits conforming to the topography, and a relatively smooth acoustic basement surface except along seismic line GUA-13 (Fig. 9) where the lower slope has three steps. Site 569 is located on GUA-13, about 8 km upslope from the highest step. The site is also 1.5 km southeast of a canyon that traverses the lower slope of the Trench.

Although the topography of the slope appears relatively simple on GUA-13, variation in on-board bathymetric records was seen during the attempts to find the site and drop a beacon. The ship made five passes up and down the slope within about 1 km of each other,

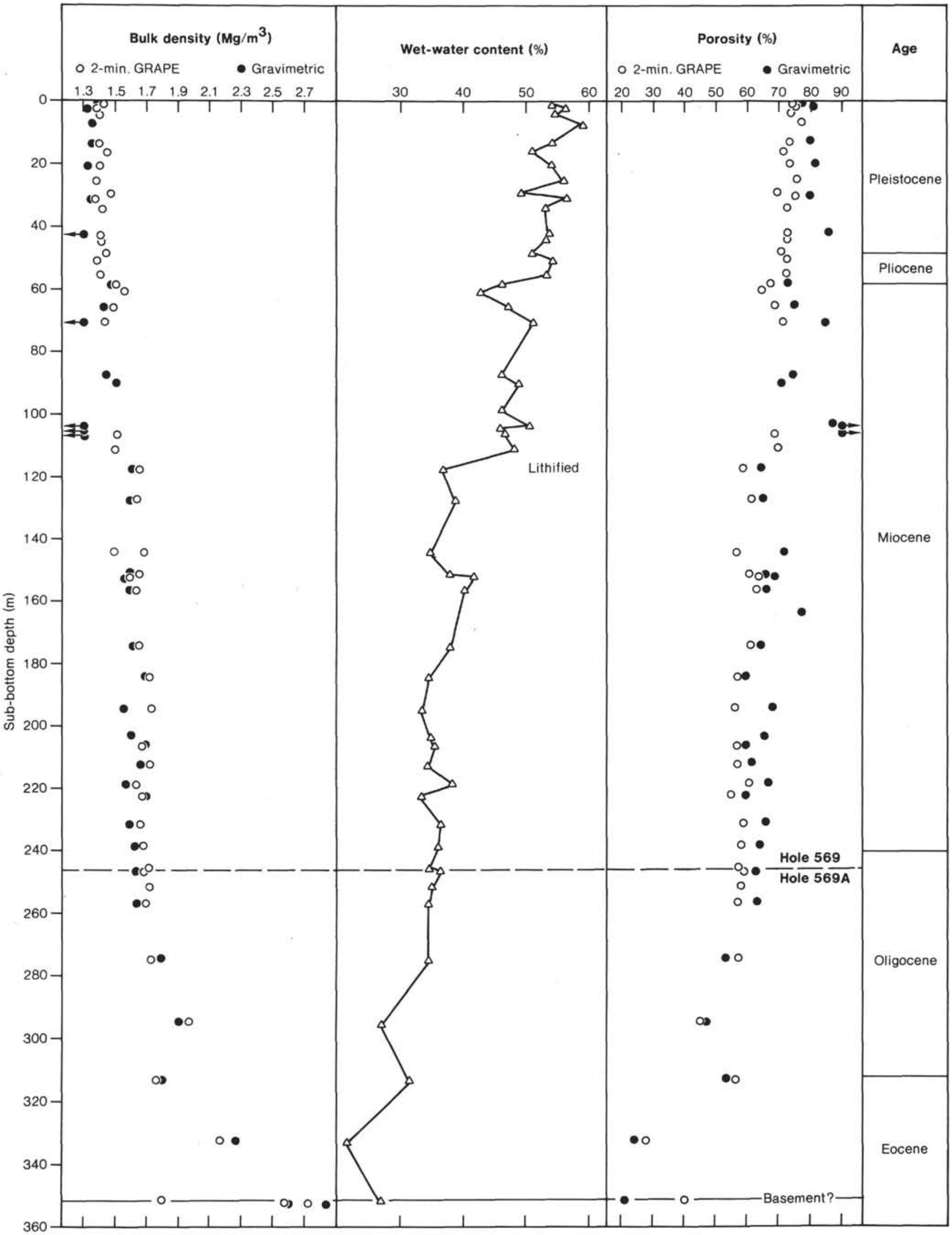

Figure 6. Index properties of material recovered at Site 569. Data points with arrows indicate data are off scale.

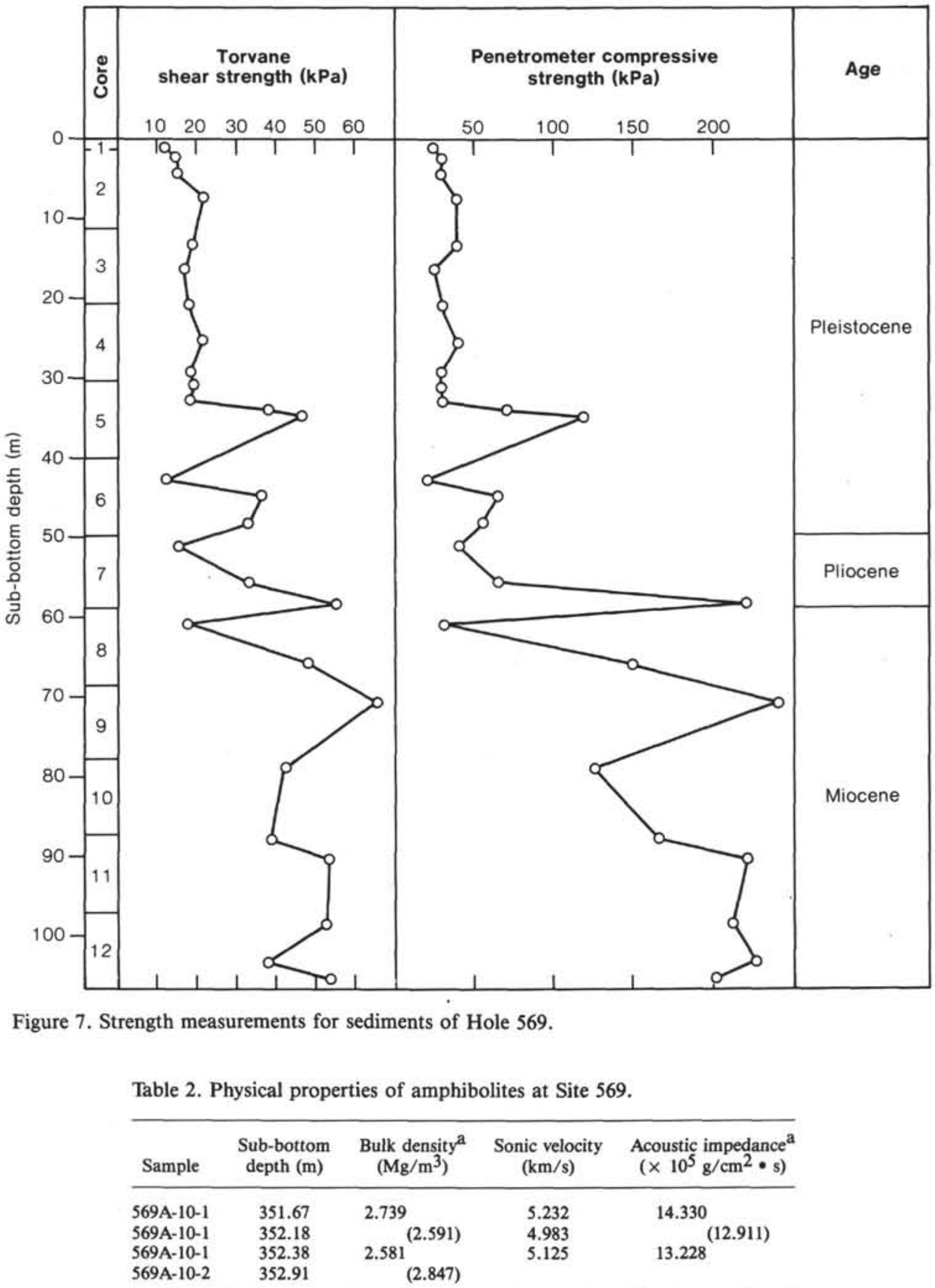

Figure 7. Strength measurements for sediments of Hole 569.

Table 2. Physical properties of amphibolites at Site 569.

Sample	Sub-bottom depth (m)	Bulk density[a] (Mg/m^3)	Sonic velocity (km/s)	Acoustic impedance[a] ($\times 10^5$ $g/cm^2 \bullet s$)
569A-10-1	351.67	2.739	5.232	14.330
569A-10-1	352.18	(2.591)	4.983	(12.911)
569A-10-1	352.38	2.581	5.125	13.228
569A-10-2	352.91	(2.847)		

[a] Bulk density and acoustic impedance values obtained from gravimetric data. Values in parenthesis are based on 2-min. GRAPE counts.

Table 3. Thermal conductivity measurements at Site 569.

Sample	Sub-bottom depth (m)	Thermal conductivity (mcal/cm°C s)
569-4,CC	30.30	1.713
569-6,CC	49.70	1.160
569-9,CC	77.90	1.826
569-13,CC	116.00	1.856
569-24-4	216.89	4.192
569-27,CC	250.70	3.068
569A-10-1 (amphibolite)	351.50	9.301

and all had some different features at the scale of 1 to 2 km. The style of the topography fits that along the side of a canyon system or in a highly channeled area.

Magnetic anomaly contours wander aimlessly around the site and have no distinct trend, nor do they show much variation of the magnetic field. This is consistant with the magnetic susceptibility measured on the recovered rocks (see Paleomagnetism section).

Across the site, seismic record GUA-13 shows first a seaward-dipping reflective sequence, then a sequence similar to the prograding sequence at Sites 496 and 568, which is underlain by a zone of very faint reflections

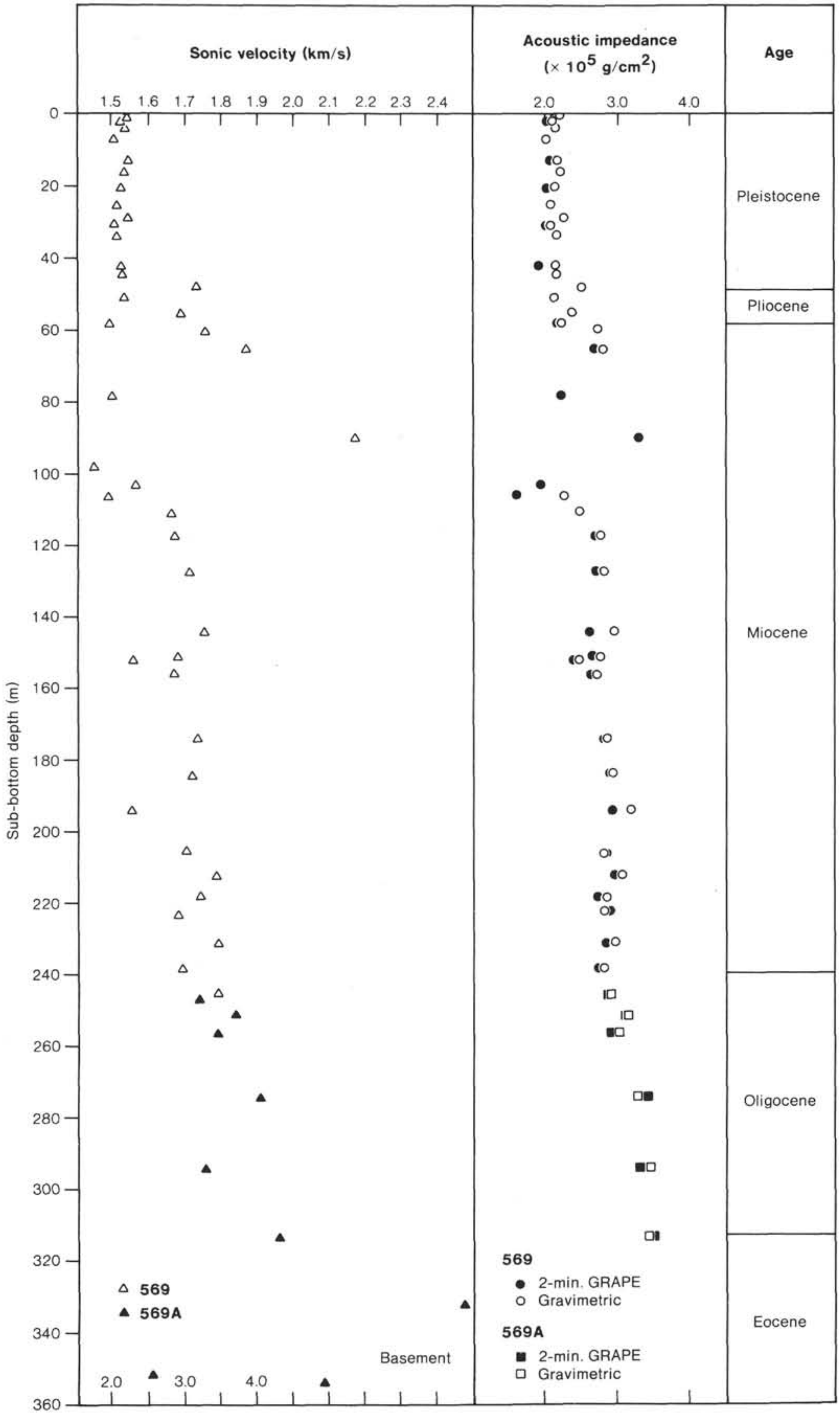

Figure 8. Acoustic characteristics of recovered materials at Site 569.

conforming to the basement topography, and finally a diffracted reflection of relatively high amplitude marking the top of acoustic basement (Fig. 10). Applying laboratory measurements of velocity (see Physical Properties section) to intercepts on the seismic record indicates that the top and bottom of the prograding sequence are 50 and 245 m, and the basement 340 m sub-bottom. This corresponds with lithology as follows:

Core depth (m) and age		Seismic record	Seismic sub-bottom depth (m)
0–50	Pleistocene	Hemipelagic cover	0–50
50–250	Pliocene–late Oligocene	Seaward dipping reflections, prograding sequence	50–245
250–351	Eocene–Oligocene	Faint reflections conforming with basement	245–340
351	Igneous rock	Top of basement reflection	340

At Hole 569, sudden failure was attributed to elevated pore pressure from the response of pump volume and circulation pressures at the rig floor. When the drill stem became stuck, the pressure was vented, and twice after going to 0 it built up again to 250 lb. without pumping. After freeing the drill stem, pressures returned to normal, indicating no unusual back-flow condition. This is similar to the conditions at Sites 566 and 567 where overpressures also appeared to be present.

PALEOMAGNETISM

Oriented samples of sediment were taken from each section of all cores that were sufficiently consolidated for paleomagnetic measurement. Alternating field demagnetization results for selected samples are plotted on Figure 11. All of samples except one show fairly stable behavior with little change in the inclinations. Figure 12 is stratigraphic plot of inclinations and intensities after alternating field demagnetization at 150 to 175 Oe. The inclinations are very scatter and do not define any pattern of normal and reversed intervals. However, the scattered does appear to decrease in the lower half of the hole where the sediment was more cohesive, suggesting that drilling disturbance was responsible for at least some of the scatter.

It is interesting to note the large variations in intensity of magnetization that occur in Figure 12. The highest intensity occurs in the sample from Core 5, which was taken close to an ash layer. It is possible that variations in volcanic activity occurring close to this site may have been responsible for the variations in intensity of magnetization of these sediments.

Results of A. F. demagnetization of two samples of crystalline basement obtained from Hole 569A are plotted in Figure 13. Both samples are fairly stable, although one (569A-10-1, 98 cm) contained a large vis-

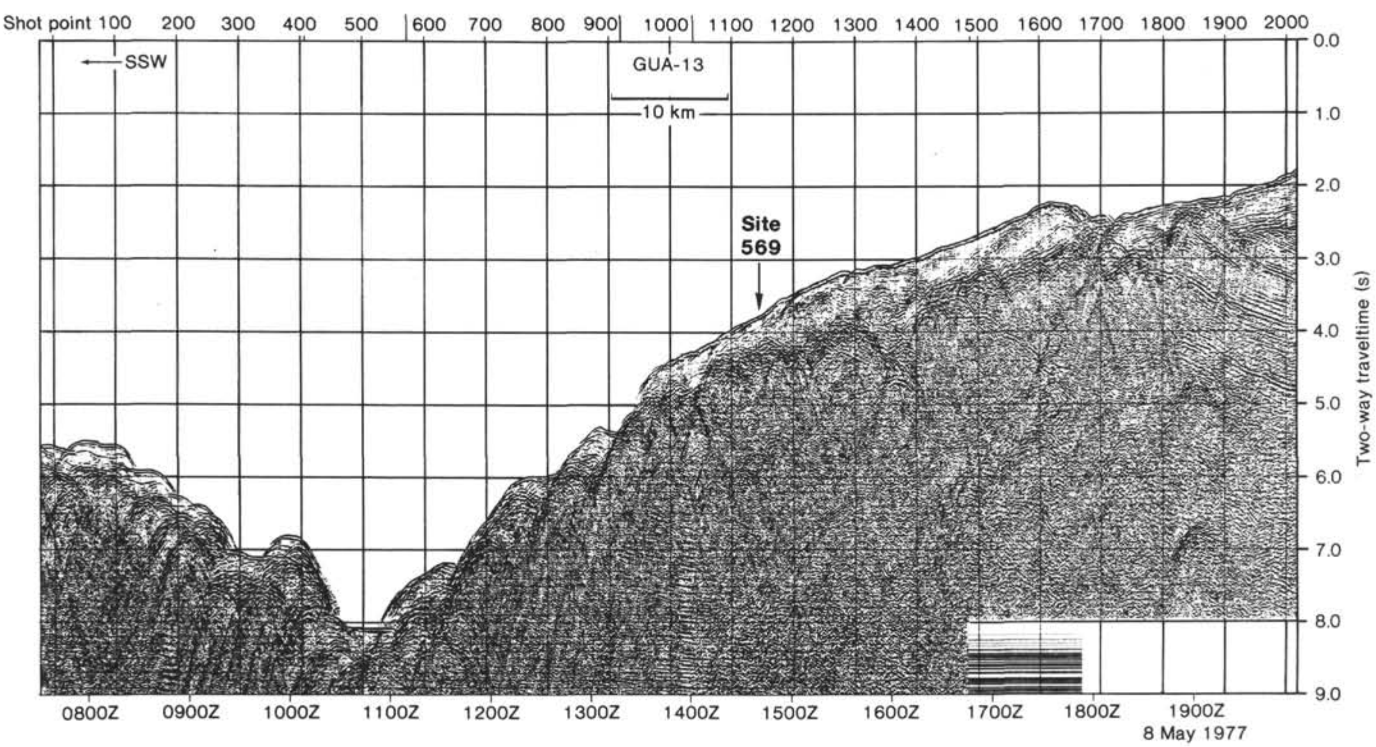

Figure 9. Seismic record GUA-13 showing position of Site 569 (from Ladd et al., 1982). This display, at a vertical exaggeration of about 10 times, is processed as a 24-fold stacked section with a vertical axis in units of time.

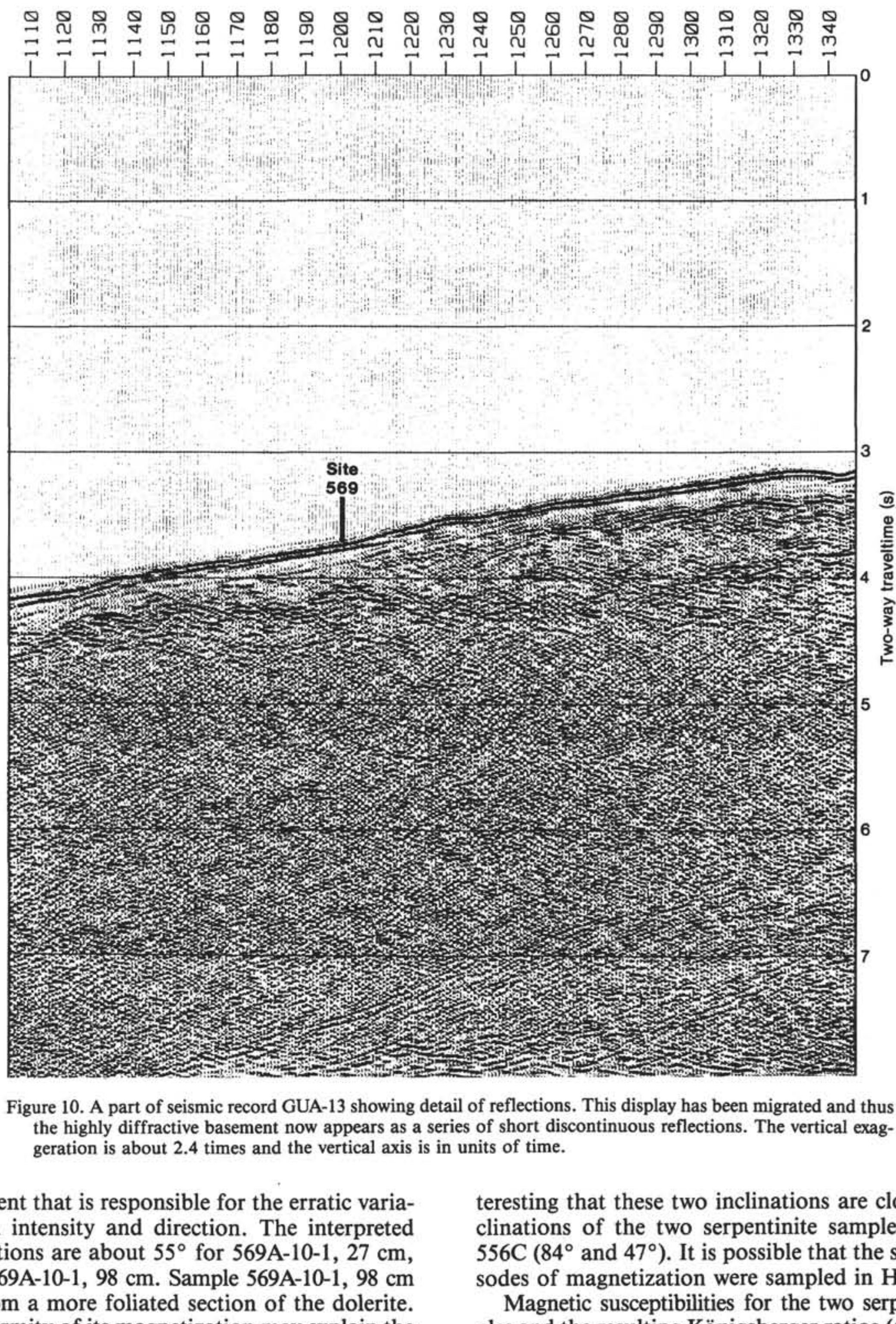

Figure 10. A part of seismic record GUA-13 showing detail of reflections. This display has been migrated and thus the highly diffractive basement now appears as a series of short discontinuous reflections. The vertical exaggeration is about 2.4 times and the vertical axis is in units of time.

cous component that is responsible for the erratic variations in both intensity and direction. The interpreted stable inclinations are about 55° for 569A-10-1, 27 cm, and 75° for 569A-10-1, 98 cm. Sample 569A-10-1, 98 cm was taken from a more foliated section of the dolerite. The nonuniformity of its magnetization may explain the 20° difference between the inclinations of the two samples. The difference could also have been caused by overprinting during the tectonic events that produced the foliation. Even an inclination of 55° is considerably higher than the axial dipole inclination for this site, which is about 20°. The result therefore suggests either a tilting of at least 25° about an east-west axis, or that the dolerite was emplaced at a latitude of 35°N. It is interesting that these two inclinations are close to the inclinations of the two serpentinite samples from Hole 556C (84° and 47°). It is possible that the same two episodes of magnetization were sampled in Hole 569.

Magnetic susceptibilities for the two serpentinite samples and the resulting Königsberger ratios (Q_n) appear in the table below.

Sample	NRM ($\times 10^{-4}$ emu/cm^3)	Susceptibility ($\times 10^{-4}$ cm·g·s)	Q_n
569-10-1, 27 cm	0.21	2.3	0.23
569-10-1, 98 cm	0.041	1.8	0.057

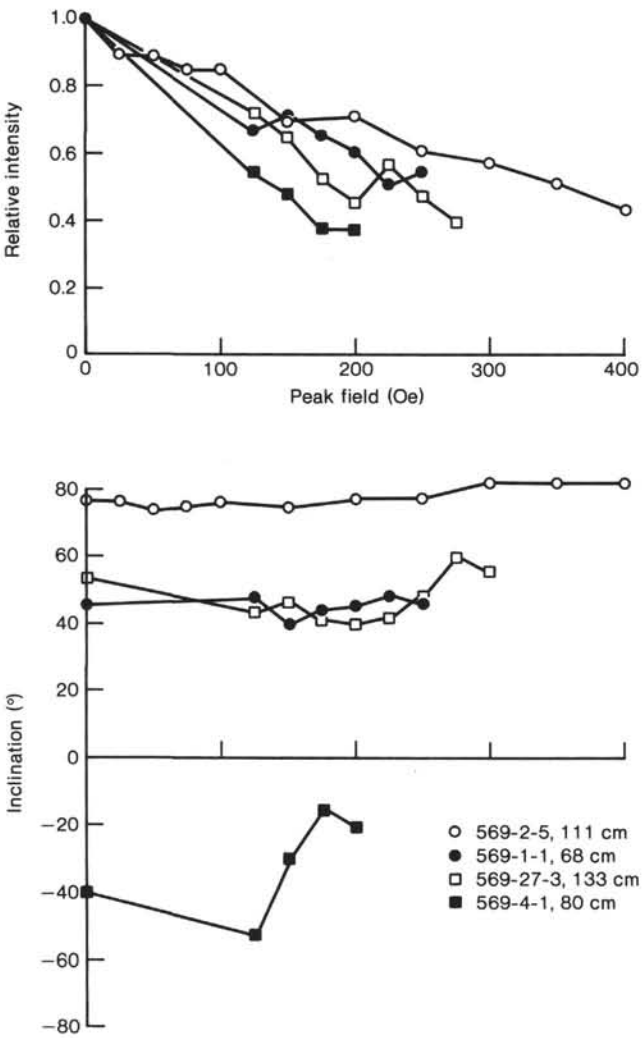

Figure 11. Alternating field demagnetization of selected sedimentary samples from Hole 569.

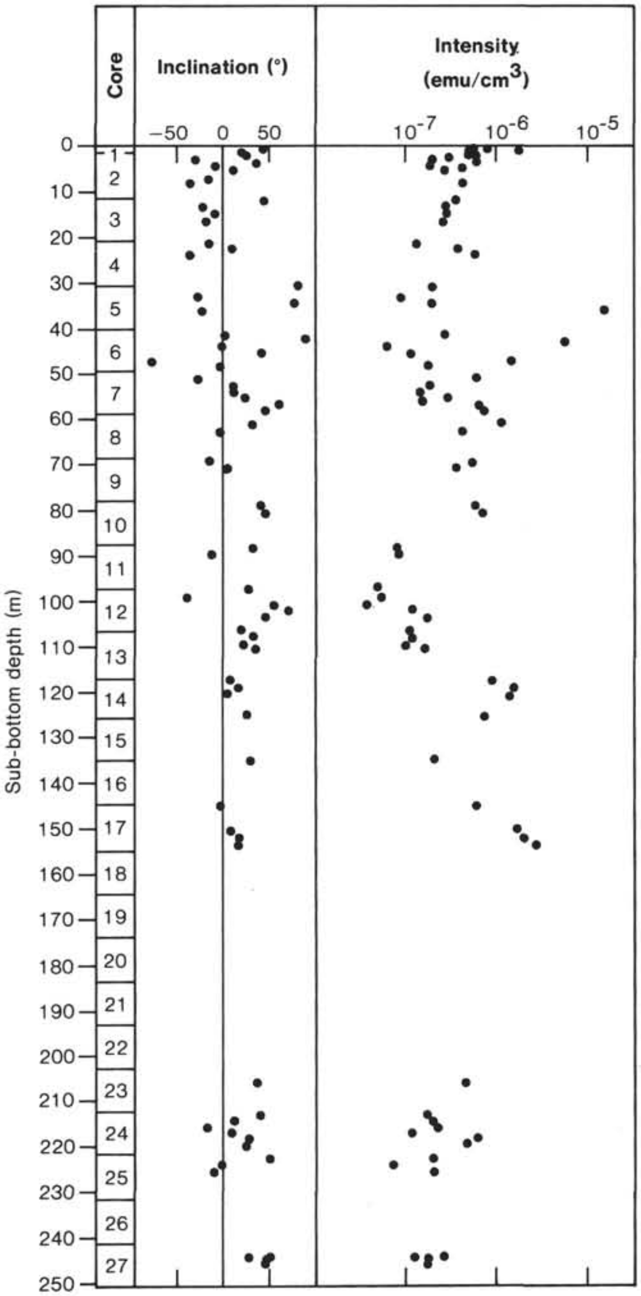

Figure 12. Stratigraphic plot of data from Hole 569, demagnetized at either 150 or 175 Oe.

GEOCHEMISTRY

Gas Analyses

Hydrocarbon gases methane (C_1), ethane (C_2), propane (C_3), isobutane (i-C_4), normal butane (n-C_4), neopentane (neo-C_5), isopentane (i-C_5), and normal pentane (n-C_5) were measured in cores from Holes 569 and 569A. Hole 569 penetrated from the seafloor to a total sub-bottom depth of 251 m before it was necessary to abandon it. Hole 569A was washed to 246 m and then continually cored to a total sub-bottom depth of 365 m. Results of gas analyses are shown in Table 4.

The use of vacutainers for collection of gases requires that sufficient gas be present to be collected within the core liners, preferably in pockets formed as the sediment expands. Samples of gas were not collected from the first 30 m of core from Hole 569. Sediments in this interval did not show any expansion cracks because of gas but smelled strongly of H_2S. These cores came from the zone of sulfate reduction, and amount of hydrocarbon gas in these sediments undoubtedly was low. From 30 to 67.5 m sub-bottom the cores did not develop, at least while on deck, cracks or pockets resulting from gas expansion; therefore, in order to monitor the hydrocarbon gas composition, samples were taken through the end caps at the lower end of the cores (Cores 5 through 8). Below 67.5 m most cores developed gas pockets that could be sampled. Gas samples taken through the end caps usually had low concentration of hydrocarbons, because of the ample opportunity for air to dilute the gas mixture.

Although the concentrations of hydrocarbon gases varied and depended in part on where the samples were taken (end cap, gas pocket, annular space), the methane-ethane ratios (C_1/C_2) were remarkably consistent throughout both Holes 569 and 569A (Fig. 14). The ratios

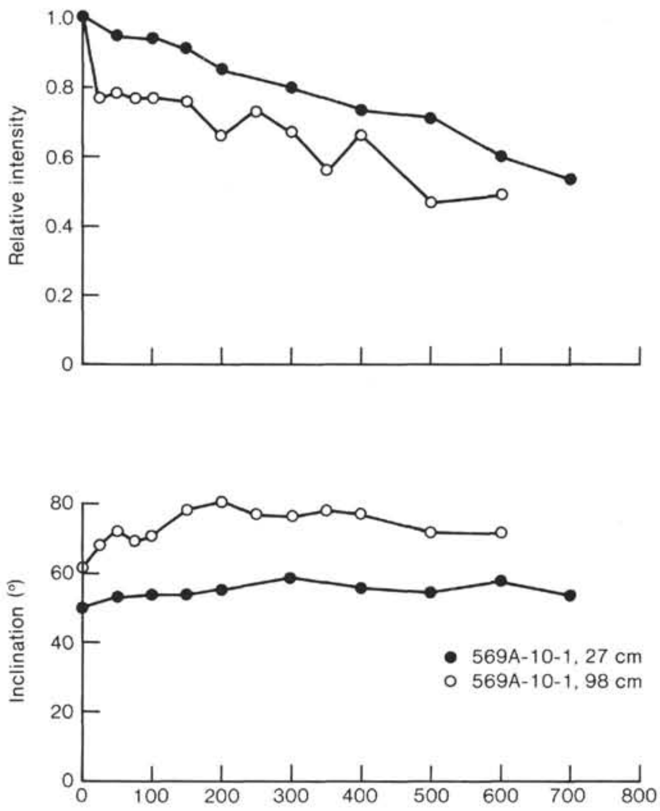

Figure 13. Alternating field demagnetization of two samples of basement from Hole 569A.

ranged between 5900 and 13,600 and averaged 8300 ± 1600; the ratios did not decrease exponentially with depth as they did at Sites 569 and 568.

The mixture of hydrocarbon gases throughout the sediments at this site is very simple, being composed mainly of C_1 and C_2 and much lower amounts of C_3 and i-C_4. Other hydrocarbons are present but usually in amounts less than 0.1 ppm. This simple mixture of hydrocarbons could reflect that the gas is present as a gas hydrate because of the very low amounts of hydrocarbons larger than C_2; however, there was no visual evidence of gas hydrates at this site.

Interstitial Water Chemistry

The following inorganic parameters were measured: calcium, magnesium, chlorinity, salinity, alkalinity, and pH. The results are displayed in Figure 15. The slight decrease with depth of chlorinity and salinity may reflect the presence of gas hydrates, as discussed in the Sites 565 and 568 reports.

Summary

At Site 569 the C_1/C_2 ratios are remarkably consistent in all cores sampled and average 8300; the ratios do not decrease with depth as is the general rule. The gas mixture is simple and dominated by C_1 and C_2, with lower amounts of C_3 and i-C_4. This distribution of hydrocarbons could reflect that the gas is present as gas hydrate. The decreasing values with depth of chlorinity and salinity support the conclusion that gas hydrates are present. However, no visual evidence of gas hydrates was noted.

SUMMARY AND CONCLUSIONS

Site 569 is in the mid-slope area off Guatemala, in about 2800 m of water, 32 km upslope and 3200 m above the Middle America Trench axis. The objectives at this site were to sample the basement and the cover of sediment immediately overlying it to study the tectonic history of the mid-slope area.

Seismic record GUA-13 across the site shows first a seaward-dipping reflective sequence similar to the prograding sequence at Sites 496 and 568. The sequence is underlain by a zone of very faint reflections conforming to the basement topography, and beneath which a diffracted reflection of relatively high amplitude marks the top of acoustic basement. Application of the velocities measured on cores to the time intercepts in the seismic record indicates that the top and bottom of the prograding sequence are at 50 and 245 m, respectively, and the basement at 340 m. This corresponds well with the depth of lithologic changes found in the cores and shows that an Oligocene–Miocene prograding sequence overlies an Eocene and Oligocene sediment cover, which overlies in turn the igneous basement.

Two holes were drilled at the site: 569 penetrated the late Oligocene before a suspected overpressure zone caused the hole to fail, and 569A penetrated into basement composed of metamorphosed gabbro and diabase beneath Eocene mudstones. The sequence recovered in Hole 569 is:

- 0–58.9 m, Pleistocene and late Pliocene green mud;
- 58.9–250.7 m, Miocene to late Oligocene green mudstone (including 58.9–77.9 m upper Miocene, 77.9–87.4 m middle Miocene, 87.4–240 m early Miocene, and 240–250.7 m, late Oligocene light green calcareous mudstone).

In Hole 569A the sequence is:

- 246.0–313.1 m, late Oligocene light green calcareous mudstone;
- 313.1–351.4 m, late Eocene green and black siliceous mudstone, and a few pieces of blue gray mudstone overlying early Eocene mudstone;
- 351.4–360.9 m, gabbro and diabases metamorphosed to amphibolite and greenschist facies.

Sediment accumulation rates for Hole 569 are approximately 33 m/m.y. for Pleistocene mudstones, 7 m/m.y. for the middle and late early Miocene mudstones, 25 m/m.y. for early Miocene undifferentiated sediments, and approximately 7 m/m.y. for late Oligocene mudstones.

Unrecovered unconformities are suspected between the late Pliocene and Miocene, the late Oligocene and Eocene, and between the Eocene and the igneous basement rock.

The presence of late Oligocene ash layers in Holes 569 and 569A has interesting implications for the regional tectonic history. One reason for dating the initiation of subduction along the Middle America Trench at the beginning of the Miocene is the first appearance of ash horizons during this time. The recovery of still older

Table 4. Distribution of hydrocarbon gases at Site 569.

Section (core-section)	Sub-bottom depth (m)	C_1 (%)	C_2 (ppm)	C_3 (ppm)	i-C_4 (ppm)	n-C_4 (ppm)	neo-C_5 (ppm)	i-C_5 (ppm)	n-C_5 (ppm)
Hole 569									
5-4	38	0.6	0.96	0.39	0.07	0.02	—	0.07	0.09
6-6	49	1.2	1.60	0.34	0.07	—	—	0.45	0.19
7-7	59	4.0	4.80	0.16	0.18	0.05	0.77	—	0.33
8-3	63	26.0	30.00	0.38	0.41	0.04	0.01	0.01	0.22
9-1	69	9.2	11.00	0.29	0.18	0.09	0.04	0.05	0.12
10-1	78	15.0	17.00	0.16	0.23	0.02	0.08	0.01	0.03
11-2	90	55.0	67.00	0.38	0.75	0.07	0.09	0.06	0.02
12-6	105	87.0	130.00	0.22	1.30	0.04	0.06	0.06	—
13-3	110	88.0	120.00	0.28	1.30	0.04	0.06	0.03	—
14-1	117	65.0	94.00	0.27	1.00	0.06	0.09	0.05	0.22
15-3	129	84.0	140.00	0.21	1.20	0.07	0.10	0.09	—
16-1	136	0.7	0.48	0.07	0.05	—	0.01	—	—
17-6	153	0.5	0.61	0.09	0.10	—	0.04	0.05	—
18-2	156	54.0	60.00	0.17	0.68	0.06	0.07	0.04	0.08
20-1	175	17.0	17.00	0.08	0.30	—	0.04	—	0.18
21-2	186	42.0	38.00	0.12	0.52	0.02	0.05	0.05	0.05
22-2	195	11.0	12.00	0.22	0.17	0.04	0.06	0.02	—
23-3	207	94.0	160.00	0.23	1.30	0.04	—	—	—
24-5	219	90.0	130.00	0.22	1.10	0.03	0.08	0.02	—
25-2	224	92.0	120.00	0.21	1.10	0.01	0.08	0.02	—
26-5	238	89.0	130.00	0.22	0.90	0.03	0.08	—	—
27-3	244	91.0	120.00	0.20	0.83	0.03	0.07	—	—
Hole 569A									
1-2	248	89.0	110.00	0.21	1.50	0.07	0.07	0.12	0.11
2-2	258	1.9	2.00	0.19	0.09	0.01	0.04	0.13	—
4-1	275	20.0	21.00	0.10	0.38	0.03	0.04	—	—
6-1	294	84.0	110.00	0.19	1.00	0.18	0.06	0.06	0.11
7-1	304	85.0	110.00	0.37	0.80	0.07	0.14	0.17	—
9-1	333	66.0	70.00	0.19	0.32	0.04	0.15	0.05	0.05

Note: — indicates not detected.

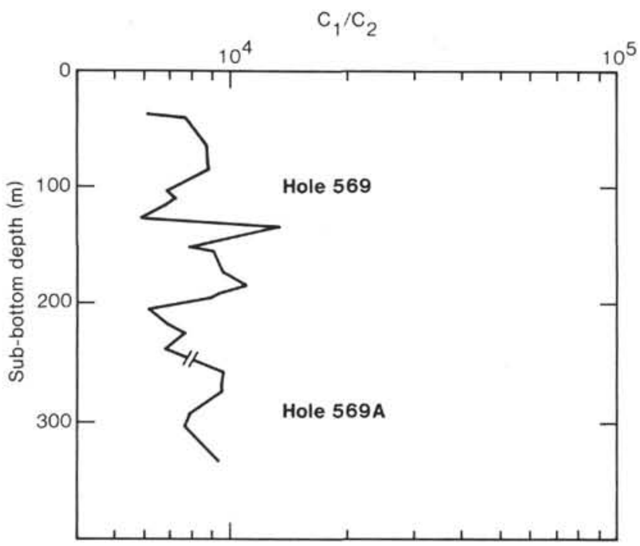

Figure 14. Ratios of methane/ethane (C_1/C_2) with depth at Site 569.

ash layers may permit the age of the present subduction setting to be moved back into the late Oligocene.

Paleoecologic analysis of Holes 569 and 569A suggests deposition occurred at abyssal depths during the Miocene through middle Eocene. Additionally, the early Miocene through middle Eocene deposition was probably below or near the CCD. Calcareous benthic foraminiferal tests are replaced with silica in Eocene intervals occasionally preserved at these great abyssal depths and planktonic foraminiferal tests only rarely. Transported material in the abyssal biofacies was primarily from lower and upper middle bathyal biofacies. In assemblages deposited below the CCD, transported outer shelf and upper bathyal species are often the only components of the fauna.

Physical properties for the sedimentary column at this site resemble those obtained at Sites 568 and 496. Bulk densities show a gradual increase from about 1.4 Mg/m^3 near subsurface to 1.8 Mg/m^3 in the overall trend, with some higher densities reflecting cementation in calcareous mudstone. Three deviations in the physical property trends stand out from the main tendencies at sub-bottom depths of approximately 60, 115, and 352 m. The latter represents the sediment/crystalline rock (gabbro) contact, whereas the uppermost can be correlated to the Pliocene/Miocene boundary. As at Sites 568 and 496, the first two deviations show a more abrupt change in index properties, which is best appreciated in the wet-water content profile.

At Hole 569, sudden failure was attributed to elevated pore pressure as indicated by the response of pump volume and circulation pressures at the rig floor. During sticking of the drill stem the pressure was vented, and twice after going to zero it built up again to 250 lbs. without pumping. After freeing the drill stem pressures

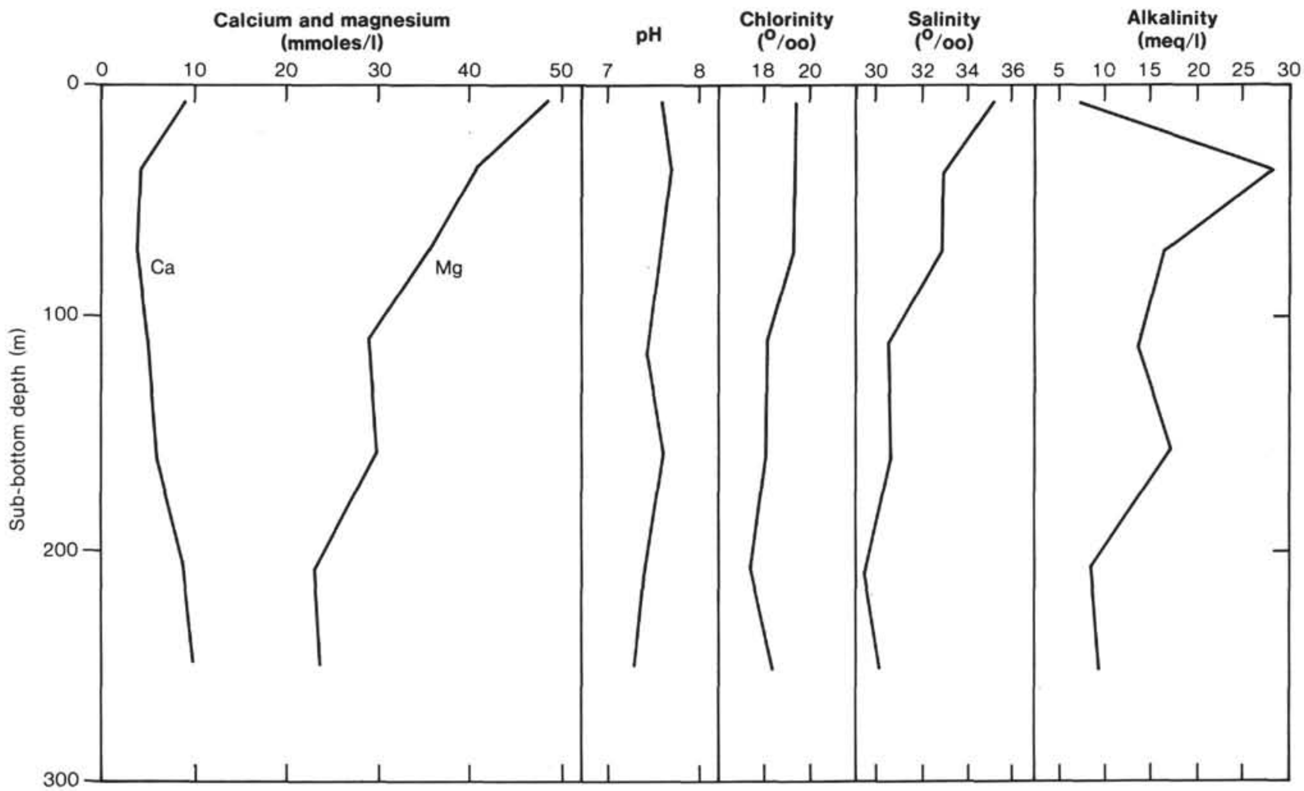

Figure 15. Chemistry of interstitial water at Site 569.

returned to normal, indicating that the pressure cannot be attributed to an unusual backflow condition. This is similar to the conditions at Sites 566 and 567 where overpressures also appeared to be present.

At Sites 569 the C_1/C_2 ratios are remarkably consistent in all cores sampled and average 8300; the ratios do not decrease with depth as is the general rule. The gas mixture is simple and dominated by C_1 and C_2 with lower amounts of C_3 and i-C_4. This distribution of hydrocarbons could reflect that the gas is present as gas hydrate. The decreasing values with depth of chlorinity and salinity support the conclusion that gas hydrates are present. However, no visual evidence of gas hydrates was noted.

Together with the results from Sites 566 on the lower slope, and 567 at the base of the slope, the results from this site show that the landward slope of the Middle America Trench is constructed of a basement of ophiolitic rocks beneath a cover of slope sediment. The results from Site 569 show that the tectonic emplacement of ophiolitic rocks is at least pre-early Eocene.

This pre-Eocene age of ophiolitic rocks suggests an analogy with on-land geology and confirms the fact that off Guatemala the margin is constructed of an igneous basement belonging to the continental framework of Central America.

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SITE 569 HOLE CORE 1 CORED INTERVAL 0.0–1.2 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
Recent–upper Pleistocene	*Emiliana huxleyi*		AM			1	0.5				*	
						CC	1.0				*	Pumice clasts

Dominant lithology: mud containing an ashy sand layer and ashy mottles.

Color: grayish olive (10Y 4/2).

SMEAR SLIDE SUMMARY (%):

	1, 77	CC D
Texture:		
Sand	–	5
Silt	–	20
Clay	–	75
Composition:		
Quartz	25	–
Feldspar	20	2
Mica	10	1
Heavy minerals	–	Tr
Clay	–	82
Volcanic glass	3	2
Glauconite	10	1
Pyrite	–	1
Carbonate unspec.	4	5
Foraminifers	5	2
Calc. nannofossils	–	1
Diatoms	1	–
Radiolarians	–	2
Sponge spicules	–	1
Rock fragments	20	Tr
Wood fragment	–	Tr

CARBONATE BOMB (% $CaCO_3$):
1, 100 cm = 5 (shipboard analysis)

SITE 569 HOLE CORE 2 CORED INTERVAL 1.2–11.1 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
Pleistocene	*Gephyrocapsa oceanica*					1	0.5 1.0				*	
						2						
						3						
						4					*	Olive gray (5Y 3/2) mottles
						5						
		FM				CC					*	

Dominant lithology: mud with high siliceous biogenic component. Several sandy ash layers, clasts of ash and pumice. Scattered foraminifera in base of Section 5.

Color: grayish olive (10Y 4/2).

SMEAR SLIDE SUMMARY (%):

	1, 66 M	4, 120 M	5, 140
Texture:			
Sand	80	10	5
Silt	20	70	20
Clay	–	20	75
Composition:			
Quartz	20	–	1
Feldspar	20	2	Tr
Mica	3	2	–
Heavy minerals	8	Tr	Tr
Clay	1	60	81
Volcanic glass	6	15	–
Glauconite	10	2	–
Pyrite	5	8	2
Carbonate unspec.	10	2	3
Foraminifers	2	–	1
Calc. nannofossils	–	Tr	1
Diatoms	1	6	5
Radiolarians	–	1	1
Sponge spicules	–	4	5
Rock fragments	15	–	–

SITE 569 HOLE CORE 3 CORED INTERVAL 11.1–20.6 m sub-bottom

TIME – ROCK UNIT: Pleistocene

BIOSTRATIGRAPHIC ZONE: *Gephyrocapsa oceanica*

FOSSIL CHARACTER: FORAMINIFERS | NANNOFOSSILS | RADIOLARIANS | DIATOMS — Nannofossils: FP

SECTION: 1, 2, 3, 4, CC

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY | DRILLING DISTURBANCE | SEDIMENTARY STRUCTURES | SAMPLES

LITHOLOGIC DESCRIPTION

Ash – light olive gray (5Y 6/1)

Brownish black (5YR 2/1) ashy sand

White (N9) ash mottle

White (N9) ash

Light gray (N8) ash

Dominant lithology: *mud with high siliceous biogenic content. Foraminifera* scattered throughout. Ash layers and sandier horizons especially in Sections 3 and 4.

SMEAR SLIDE SUMMARY (%):

	1, 116	2, 95	3, 52	3, 60
	D	M	M	M
Texture:				
Sand	10	30	–	85
Silt	20	40	–	15
Clay	70	30	–	–
Composition:				
Quartz	2	25	–	10
Feldspar	–	15	10	25
Mica	–	2	–	2
Heavy minerals	1	3	2	7
Clay	62	30	–	–
Volcanic glass	–	5	88	12
Palagonite	1	–	–	–
Glauconite	1	2	–	–
Pyrite	2	3	–	2
Carbonate unspec.	Tr	5	–	3
Foraminifers	Tr	Tr	–	4
Calc. nannofossils	5	2	–	–
Diatoms	20	2	–	Tr
Radiolarians	3	1	–	–
Sponge spicules	1	1	–	Tr
Rock fragments	–	5	–	35

SITE 569 HOLE CORE 4 CORED INTERVAL 20.6–30.3 m sub-bottom

TIME – ROCK UNIT: Pleistocene

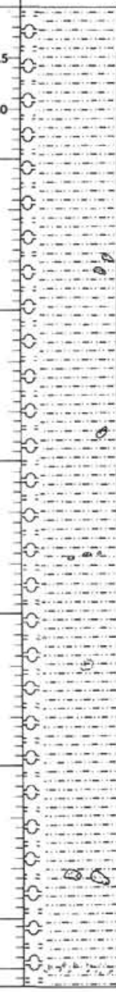
BIOSTRATIGRAPHIC ZONE: *Gephyrocapsa oceanica*

FOSSIL CHARACTER: FORAMINIFERS | NANNOFOSSILS | RADIOLARIANS | DIATOMS — Foraminifers: A; Nannofossils: CM; Radiolarians: F

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

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY | DRILLING DISTURBANCE | SEDIMENTARY STRUCTURES | SAMPLES



LITHOLOGIC DESCRIPTION

Pumice clasts white (N9)

Pumice clast, N9

Glassy ash

Pale olive yellow mottling

Very light gray (N8) ash mottles

White (N9) ash mottle

Olive black (5Y 2/1) ashy sand

Dominant lithology: mud (diatomaceous). Faintly bedded *in upper sections* (≲10 *cm* thick). *Foraminifera* tests scattered throughout Section 5.

Color: olive gray (5Y 3/2).

Color change at base of Section 7 to light olive (10Y 5/4).

SMEAR SLIDE SUMMARY (%):

	1, 90	3, 117	6, 114	6, 125
	D	M	M	D
Texture:				
Sand	10	80	80	4
Silt	20	18	20	20
Clay	70	2	–	76
Composition:				
Quartz	4	–	–	–
Feldspar	1	15	15	1
Mica	1	–	5	–
Heavy minerals	–	10	–	Tr
Clay	64	1	75	67
Volcanic glass	–	81	–	10
Glauconite	2	–	–	–
Pyrite	2	2	5	Tr
Carbonate unspec.	3	–	–	1
Calc. nannofossils	3	–	–	5
Diatoms	15	–	–	10
Radiolarians	3	–	–	1
Sponge spicules	2	–	–	5
Silicoflagellates	–	–	–	1

CARBONATE BOMB (% $CaCO_3$):
2, 40 cm (clasts) = 8 (shipboard analysis)
2, 60 cm (dominant lithology) = 12 (shipboard anaylsis)

SITE 569 HOLE CORE 5 CORED INTERVAL 30.3–40.0 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES	SAMPLES
Pleistocene	unzoned	Foraminifers: RP	1, 2, 3, 4, CC	0.5, 1.0			* (Sections 1, 4)

LITHOLOGIC DESCRIPTION

Void

Moderate olive brown (5Y 4/4) mottling

Disturbed ash layer of light bluish gray (5B 7/1), very light gray (N8), and yellow gray (5Y 8/1)

Dominant lithology: diatomaceous mud, weakly layered. Mottled in Section 3.

Color: olive gray (5Y 3/2) and grayish olive (10Y 4/2).

SMEAR SLIDE SUMMARY (%):

	1, 137 D	4, 60 M
Texture:		
Sand	17	65
Silt	10	35
Clay	73	–
Composition:		
Feldspar	–	8
Mica	Tr	–
Heavy minerals	1	2
Clay	73	–
Volcanic glass	–	89
Glauconite	1	–
Pyrite	2	1
Carbonate unspec.	2	–
Foraminifers	Tr	–
Diatoms	15	–
Radiolarians	1	–
Sponge spicules	3	–
Silicoflagellates	1	–

SITE 569 HOLE CORE 6 CORED INTERVAL 40.0–49.7 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES	SAMPLES
Pleistocene		Nannofossils: FM	1, 2, 3, 4, 5, 6, 7, CC	0.5, 1.0			* (Sections 1, 3, 5, CC)

LITHOLOGIC DESCRIPTION

Scattered glassy ash, light gray (N7)

Dark greenish gray (5GY 5/1) ash

Glassy ash – light gray (N7)

Light ash layers distorted by drilling disturbance

Void

Color is 5Y 3/2

Dominant lithology: mud, weakly layered as indicated by color alternations.

Color: grayish olive (10Y 4/2) and light olive (10Y 5/4).

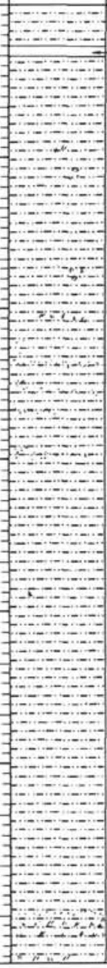
SMEAR SLIDE SUMMARY (%):

	1, 121 D	3, 76 D	5, 125 M	CC D
Texture:				
Sand	1	5	–	–
Silt	15	60	–	–
Clay	84	35	–	–
Composition:				
Quartz	–	–	10	–
Feldspar	2	20	40	1
Mica	2	–	2	Tr
Heavy minerals	Tr	5	20	–
Clay	85	59	–	89
Volcanic glass	1	10	–	–
Palagonite	–	–	–	1
Glauconite	–	Tr	–	–
Pyrite	2	2	–	1
Carbonate unspec.	1	–	–	3
Foraminifers	–	Tr	–	–
Calc. nannofossils	Tr	–	–	1
Diatoms	3	1	–	1
Radiolarians	1	1	–	1
Sponge spicules	2	–	–	1
Silicoflagellates	1	2	–	1
Rock fragments	–	–	30	–

SITE 569 HOLE CORE 7 CORED INTERVAL 49.7–58.9 m sub-bottom

TIME – ROCK UNIT: upper Pliocene–Pleistocene | BIOSTRATIGRAPHIC ZONE | FOSSIL CHARACTER: FORAMINIFERS, NANNOFOSSILS (CM), RADIOLARIANS, DIATOMS | SECTION | METERS | GRAPHIC LITHOLOGY | DRILLING DISTURBANCE | SEDIMENTARY STRUCTURES | SAMPLES

Sections: 1, 2, 3, 4, 5, 6, 7. Meters: 0.5, 1.0



Void

Ashy mottles

Ash

Minor lithology sand beds

Sand as above

Reworked, graded ashy beds

LITHOLOGIC DESCRIPTION

Dominant lithology: mud – weakly layered by color in alternations about 30 cm thick.

Minor lithology: coarse sand containing shell fragments, volcanic material; rounded to sub-angular material.

Color: dominant – alternating olive gray (5Y 3/2) and grayish olive (10Y 4/2).

Minor lithology: dark gray (N3).

SMEAR SLIDE SUMMARY (%):

	1, 117	4, 140	7, 49
	D	D	M
Texture:			
Sand	–	–	70
Silt	15	15	20
Clay	85	85	10
Composition:			
Quartz	5	3	–
Feldspar	3	2	30
Heavy minerals	–	–	5
Clay	85	89	10
Volcanic glass	5	–	–
Glauconite	2	–	–
Pyrite	–	–	15
Diatoms	–	1	–
Radiolarians	–	2	–
Sponge spicules	–	1	–
Silicoflagellates	–	2	–

SITE 569 HOLE CORE 8 CORED INTERVAL 58.9–68.5 m sub-bottom

TIME – ROCK UNIT | BIOSTRATIGRAPHIC ZONE | FOSSIL CHARACTER: FORAMINIFERS, NANNOFOSSILS (B), RADIOLARIANS, DIATOMS | SECTION | METERS | GRAPHIC LITHOLOGY | DRILLING DISTURBANCE | SEDIMENTARY STRUCTURES | SAMPLES

Sections: 1, 2, 3, CC. Meters: 0.5, 1.0

Olive gray (5Y 3/2) ashy band

Laminated ash bed

Clast of ash

Grayish olive (10Y 4/2)

Moderate olive brown (5Y 4/4)

Dusky blue green (5BG 3/2) spot

LITHOLOGIC DESCRIPTION

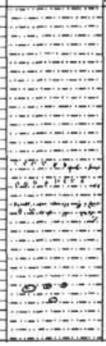
Dominant lithology: mud with ashy layers and clasts. Major difference in color and firmness in Section 2, 90 cm. Firmer underlying mud.

Color: grayish olive (10Y 4/2) to Section 2, 90 cm; moderate olive brown to grayish olive (5Y 4/4–10Y 4/5) below.

SMEAR SLIDE SUMMARY (%):

	1, 135
	D
Texture:	
Sand	3
Silt	12
Clay	85
Composition:	
Quartz	3
Feldspar	2
Mica	Tr
Volcanic glass	5
Glauconite	Tr
Carbonate unspec.	1
Calc. nannofossils	2
Diatoms	Tr
Radiolarians	2
Silicoflagellates	1

SITE 569 HOLE CORE 9 CORED INTERVAL 68.5–77.9 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
			B			1, 2, CC	0.5, 1.0				

LITHOLOGIC DESCRIPTION

Ash sand, light gray (N6)

Sandy ash layer greenish black (5GY 2/1)

Dusky yellow (5Y 6/4) mottling

Rounded pumice clasts

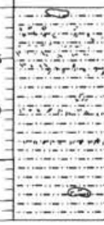
Dominant lithology: mud, structureless.

Color: grayish olive (10Y 4/2) to Section 2, 50 cm, olive gray to moderate olive brown (5Y 3/2 to 5Y 4/4) below.

SMEAR SLIDE SUMMARY (%):

	2, 60
	D
Texture:	
Sand	10
Silt	25
Clay	65
Composition:	
Quartz	5
Feldspar	2
Mica	–
Heavy minerals	Tr
Clay	71
Volcanic glass	20
Glauconite	1
Pyrite	Tr
Micronodules	Tr
Zeolite	Tr
Carbonate unspec.	Tr
Foraminifers	Tr
Calc. nannofossils	Tr
Diatoms	Tr
Radiolarians	1
Sponge spicules	Tr
Silicoflagellates	Tr

SITE 569 HOLE CORE 10 CORED INTERVAL 77.9–87.4 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
middle Miocene	*Sphenolithus heteromorphus*	R	CM			1, 2, CC	0.5, 1.0				* *

LITHOLOGIC DESCRIPTION

Pyrite nodules

Ash bands

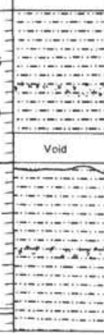
Dominant lithology: mud with several ashy layers.

Color: grayish olive (10Y 4/2).

SMEAR SLIDE SUMMARY (%):

	1, 73	2, 22
Texture:		
Sand	50	3
Silt	30	12
Clay	20	85
Composition:		
Quartz	5	1
Feldspar	3	–
Clay	12	84
Volcanic glass	80	2
Glauconite	Tr	–
Carbonate unspec.	–	1
Calc. nannofossils	–	5
Radiolarians	–	3
Silicoflagellates	1	1

SITE 569 HOLE CORE 11 CORED INTERVAL 87.4–97.1 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
lower Miocene	*Helicosphaera ampliaperta*		CM			1, 2, CC	0.5, 1.0				* *

LITHOLOGIC DESCRIPTION

Ash, light greenish gray (5G 8/1); slightly calcareous

Greenish black (5GY 2/1) horizon

Grayish blue green

Grayish olive

Dominant lithology: structureless mud.

Color: grayish olive (10Y 4/2).

SMEAR SLIDE SUMMARY (%):

	CC	CC
	D	
Texture:		
Sand	3	–
Silt	10	5
Clay	87	95
Composition:		
Quartz	2	2
Feldspar	1	–
Mica	–	Tr
Heavy minerals	–	Tr
Clay	79	85
Volcanic glass	3	–
Glauconite	Tr	Tr
Carbonate unspec.	5	3
Calc. nannofossils	10	10
Diatoms	Tr	–
Radiolarians	Tr	Tr
Sponge spicules	Tr	–

SITE 569 HOLE CORE 12 CORED INTERVAL 97.1–106.7 m sub-bottom

TIME-ROCK UNIT: lower Miocene

BIOSTRATIGRAPHIC ZONE: *Helicosphaera ampliaperta*

FOSSIL CHARACTER: FORAMINIFERS | NANNOFOSSILS | RADIOLARIANS | DIATOMS — CM

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

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY

DRILLING DISTURBANCE | SEDIMENTARY STRUCTURES | SAMPLES

LITHOLOGIC DESCRIPTION

Light gray (N7) muddy ash

Medium dark gray (N4) graded bed with sharp base

Gray ash band

Dominant lithology: structureless mud.

SMEAR SLIDE SUMMARY (%):

	6, 14
	D
Texture:	
Sand	–
Silt	15
Clay	85
Composition:	
Quartz	3
Feldspar	2
Mica	Tr
Clay	85
Volcanic glass	5
Glauconite	2
Carbonate unspec.	–
Foraminifers	–
Calc. nannofossils	2
Diatoms	Tr
Radiolarians	2
Sponge spicules	1
Silicoflagellates	Tr

SITE 569 HOLE CORE 13 CORED INTERVAL 106.7–116.0 m sub-bottom

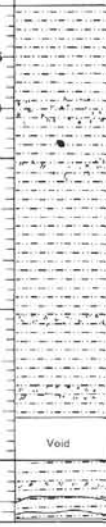
TIME-ROCK UNIT: lower Miocene

FOSSIL CHARACTER: FORAMINIFERS | NANNOFOSSILS | RADIOLARIANS | DIATOMS — FM

SECTION: 1, 2, 3, 4, CC

METERS: 0.5, 1.0

GRAPHIC LITHOLOGY



DRILLING DISTURBANCE | SEDIMENTARY STRUCTURES | SAMPLES

LITHOLOGIC DESCRIPTION

Coaley clast, light greenish gray (5GY 8/1) ash

Very dark gray (N3)

Black (N1) ash

Yellowish gray (5Y 7/2) limestone

Dominant lithology: bioturbated mudstone.

Color: grayish olive green (5GY 3/2) in top 2 sections; greenish black (5GY 2/1) in Section 3; grayish olive green (5GY 3/2) in Section 4.

SMEAR SLIDE SUMMARY (%):

	2, 67	3, 72
	D	M
Texture:		
Sand	–	5
Silt	15	80
Clay	85	15
Composition:		
Quartz	3	10
Feldspar	2	5
Mica	Tr	–
Clay	84	5
Volcanic glass	–	80
Glauconite	1	–
Carbonate unspec.	1	–
Calc. nannofossils	5	–
Diatoms	Tr	–
Radiolarians	2	–
Sponge spicules	1	–
Silicoflagellates	1	–

SITE 569 HOLE CORE 14 CORED INTERVAL 116.0–125.6 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
lower Miocene			RM			1, 2, 3, CC	0.5, 1.0	Void			*

LITHOLOGIC DESCRIPTION

Dark gray (N3) ash

30°

30°

Ashy layer

30° ashy layer

Dominant lithology: bioturbated, mottled mudstone. Bedding is at an angle. Fracturing. Color: grayish olive (10Y 4/2).

SMEAR SLIDE SUMMARY (%):

	2, 37
Texture:	
Sand	–
Silt	25
Clay	75
Composition:	
Quartz	7
Feldspar	2
Clay	84
Volcanic glass	7
Glauconite	Tr
Radiolarians	Tr

Biscuit from Section 3, 90 cm – typical structures

2 Normal faulting

3 Normal faulting

1 Also cuts 2 and 3 type extension

SITE 569 HOLE CORE 15 CORED INTERVAL 125.6–135.1 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
lower Miocene			RP			1, 2, 3, CC	0.5, 1.0				*

LITHOLOGIC DESCRIPTION

40°

N1 ashy layer

Pale blue green (5BG 7/2) mottling

Black (N1) ash, coaley clast

Dominant lithology: mudstone. Mottled and bioturbation, bedding an angle to horizontal, fractured and veined.

Color: grayish olive (10Y 4/2) to dusky yellow green (5Y 5/2).

SMEAR SLIDE SUMMARY (%).

	3, 94
Texture:	
Sand	–
Silt	15
Clay	85
Composition:	
Quartz	5
Feldspar	3
Mica	Tr
Clay	79
Volcanic glass	5
Glauconite	Tr
Carbonate unspec.	2
Calc. nannofossils	5
Radiolarians	1
Sponge spicules	1
Silicoflagellates	Tr

Extension fractures

SITE 569 HOLE CORE 16 CORED INTERVAL 135.1–144.8 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
lower Miocene			RP			1, CC	0.5, 1.0				*

LITHOLOGIC DESCRIPTION

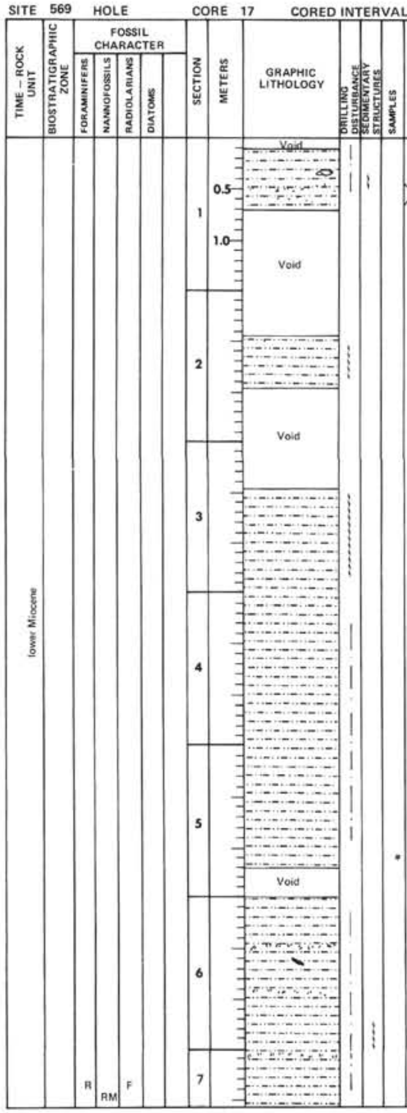
20°

Dominant lithology: mudstone.

SMEAR SLIDE SUMMARY (%):

	1, 94 D
Texture:	
Sand	–
Silt	5
Clay	95
Composition:	
Quartz	2
Feldspar	Tr
Clay	92
Volcanic glass	3
Glauconite	1
Calc. nannofossils	Tr
Radiolarians	1
Sponge spicules	1
Silicoflagellates	Tr

SITE 569 HOLE CORE 17 CORED INTERVAL 144.8–154.4 m sub-bottom



LITHOLOGIC DESCRIPTION

Ash-filled burrow

Yellowish gray (5Y 8/1) ash

Ashy
Ash
Coaley clast
Ash

Ash

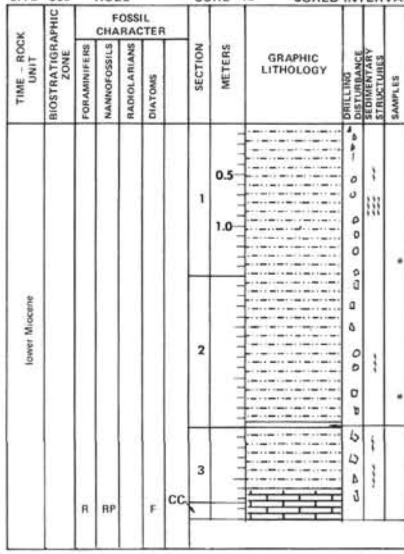
Dominant lithology: mudstone, burrowed, mottled, fractured and veined.

Color: bluish green (5BG 5/2) to pale green (10G 6/2).

SMEAR SLIDE SUMMARY (%):

	5, 110
Texture:	
Sand	5
Silt	25
Clay	70
Composition:	
Quartz	10
Feldspar	5
Mica	Tr
Clay	71
Volcanic glass	5
Glauconite	1
Carbonate unspec.	1
Calc. nannofossils	2
Diatoms	1
Radiolarians	3
Sponge spicules	1
Silicoflagellates	Tr

SITE 569 HOLE CORE 18 CORED INTERVAL 154.4–164.1 m sub-bottom



LITHOLOGIC DESCRIPTION

Void

Limestone

Dominant lithology: burrowed, mottled, fractured and veined. Bedding at angle. Nice backfilling traces in zoophycus-type burrows.

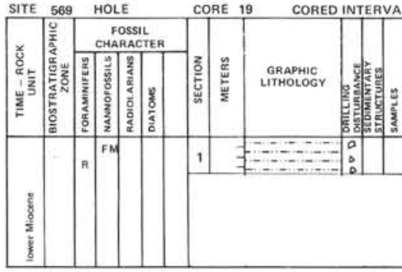
Color: pale green (10G 6/2) to pale blue green (5BG 7/2).

SMEAR SLIDE SUMMARY (%):

	1, 148	2, 127
Texture:		
Sand	12	20
Silt	35	55
Clay	53	25
Composition:		
Quartz	12	2
Feldspar	10	10
Mica	–	Tr
Heavy minerals	Tr	Tr
Clay	25	59
Volcanic glass	30	18
Pyrite	–	2
Carbonate unspec.	22	5
Radiolarians	1	2
Sponge spicules	–	2

CARBONATE BOMB (% $CaCO_3$):
1, 147 cm = 22 (shipboard analysis)

SITE 569 HOLE CORE 19 CORED INTERVAL 164.1–173.8 m sub-bottom



LITHOLOGIC DESCRIPTION

Dominant lithology: mudstone, fractured, burrowed, mottled.

Color: pale green (10G 6/2) to pale blue green (5BG 7/2).

SITE 569 HOLE CORE 20 CORED INTERVAL 173.8–185.4 m sub-bottom

TIME-ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
lower Miocene		F	RM			1, 2, CC	0.5, 1.0

GRAPHIC LITHOLOGY · DRILLING DISTURBANCE · SEDIMENTARY STRUCTURES · SAMPLES

LITHOLOGIC DESCRIPTION

Dominant lithology: mudstone, burrowed, mottled, fractured and veined.

Color: pale green (5BG 7/2) to grayish blue green (5BG 5/2).

SMEAR SLIDE SUMMARY (%):

	1, 123
Texture:	
Sand	6
Silt	14
Clay	80
Composition:	
Quartz	1
Feldspar	1
Clay	75
Volcanic glass	10
Glauconite	5
Diatoms	1

SITE 569 HOLE CORE 21 CORED INTERVAL 183.4–192.9 m sub-bottom

TIME-ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
lower Miocene			FM			1, 2, 3, CC	0.5, 1.0

GRAPHIC LITHOLOGY · DRILLING DISTURBANCE · SEDIMENTARY STRUCTURES · SAMPLES

LITHOLOGIC DESCRIPTION

Limestone clast

50°

Sandstone layers with shells and volcanic fragments

Dominant lithology: mudstone, burrowed, mottles, extensively fractured and veined.

Color: grayish blue green (5BG 6/2).

SMEAR SLIDE SUMMARY (%):

	2, 75
Texture:	
Sand	70
Silt	15
Clay	15
Composition:	
Quartz	60
Clay	10
Volcanic glass	10
Glauconite	10
Carbonate unspec.	10

SITE 569 HOLE CORE 22 CORED INTERVAL 192.9–202.6 m sub-bottom

TIME-ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
lower Miocene			RP			1, 2, CC	0.5, 1.0

GRAPHIC LITHOLOGY · DRILLING DISTURBANCE · SEDIMENTARY STRUCTURES · SAMPLES

Void

Void

LITHOLOGIC DESCRIPTION

Dominant lithology: pebbly mudstone. Clasts are rounded to subrounded, composed of limestone, shell fragments, greenish mudstone.

Color: pale green (10G 6/2).

SMEAR SLIDE SUMMARY (%):

	2, 140
Texture:	
Sand	5
Silt	40
Clay	55
Composition:	
Feldspar	2
Mica	1
Heavy minerals	Tr
Clay	88
Volcanic glass	3
Carbonate unspec.	5
Radiolarians	Tr
Sponge spicules	1

SITE 569 HOLE CORE 23 CORED INTERVAL 202.6–212.1 m sub-bottom

TIME-ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
probable lower Miocene			B			1, 2, 3, 4, CC	0.5, 1.0

GRAPHIC LITHOLOGY · DRILLING DISTURBANCE · SEDIMENTARY STRUCTURES · SAMPLES

Void

LITHOLOGIC DESCRIPTION

Very light (N8) ash

Light brownish gray (5YR 6/1) ash spot

Light gray (N7) ash

Ash, 5YR 6/1

Pumice clast white (N9)

Dominant lithology: mudstone, mottled and burrowed with abundant fractures and veins. Burrows are calcareous.

Color: grayish olive green (5GY 3/2) with mottles of light olive gray (5Y 5/2).

SMEAR SLIDE SUMMARY (%):

	1, 20
Texture:	
Sand	5
Silt	25
Clay	70
Composition:	
Quartz	1
Feldspar	2
Mica	Tr
Heavy minerals	Tr
Clay	89
Volcanic glass	2
Pyrite	1
Diatoms	Tr
Radiolarians	Tr
Sponge spicules	2
Silicoflagellates	Tr

SITE 569 HOLE CORE 24 CORED INTERVAL 212.1–221.8 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
probable lower Miocene			RP			1, 2, 3, 4, 5, 6, CC	0.5, 1.0				* (Sec. 5), * (CC)	Olive gray (5Y 4/1) ash; Olive black (5Y 2/1) glassy ash

Dominant lithology: mudstone, with slightly calcareous burrows, burrows and veination and fractures.

Color: grayish olive green (5GY 3/2) to grayish olive (10Y 4/2).

Scaley structure.

SMEAR SLIDE SUMMARY (%):

	5, 98	CC
	M	D
Texture:		
Sand	–	5
Silt	–	40
Clay	–	55
Composition:		
Quartz	2	–
Feldspar	8	3
Mica	5	1
Heavy minerals	1	Tr
Clay	–	89
Volcanic glass	82	3
Glauconite	–	1
Pyrite	2	1
Diatoms	–	Tr
Radiolarians	–	Tr
Sponge spicules	–	2

SITE 569 HOLE CORE 25 CORED INTERVAL 221.8–231.4 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
Probable early Miocene						1, 2, 3, CC	0.5, 1.0				* (Sec. 1)	Light gray (N7) glassy ash; Olive gray (5Y 4/1) ash

Dominant lithology: burrowed and fractured mudstone.

Color: grayish olive green (5GY 3/2).

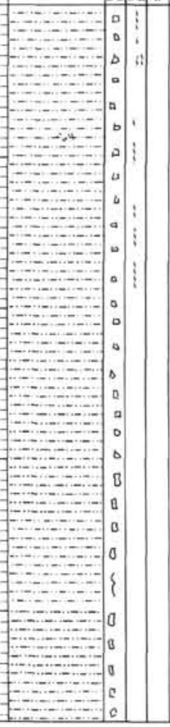
SMEAR SLIDE SUMMARY (%):

	1, 142
Texture:	
Sand	2
Silt	10
Clay	88
Composition:	
Feldspar	3
Mica	Tr
Heavy minerals	Tr
Clay	89
Volcanic glass	1
Glauconite	1
Pyrite	Tr
Diatoms	1
Radiolarians	1
Sponge spicules	4

SITE 569 HOLE CORE 26 CORED INTERVAL 231.4–241.0 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
Probable early Miocene			CM			1, 2, 3, 4, 5	0.5, 1.0

GRAPHIC LITHOLOGY / DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES



LITHOLOGIC DESCRIPTION

Very light gray (N8) ash

Dusky blue green (5BG 3/2)

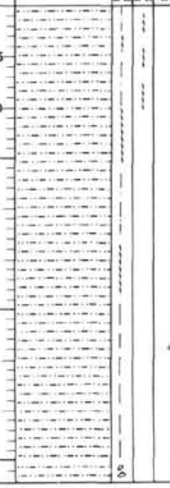
Dominant lithology: mudstone, burrowed, fractured and veined.

Color: grayish olive (10Y 4/2) with light olive brown (5Y 5/6) burrows.

SITE 569 HOLE CORE 27 CORED INTERVAL 241.0–250.7 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS
upper Oligocene	*Dictyococcites bisectus*					1, 2, 3, CC	0.5, 1.0

GRAPHIC LITHOLOGY / DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES



LITHOLOGIC DESCRIPTION

60° bedding

30° some veins

Dominant lithology: mudstone, burrowed, fractured and veined with slightly calcareous burrows. Zoophyous type.

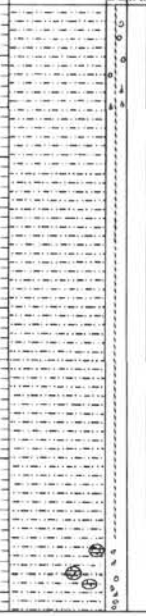
Color: grayish olive (10Y 4/2). Burrows filled with moderate olive brown (5Y 4/4), light olive brown (5Y 5/6), and dusky blue (5PR 3/2).

SMEAR SLIDE SUMMARY (%):

	3, 35
	D
Texture:	
Sand	–
Silt	15
Clay	85
Composition:	
Quartz	2
Feldspar	1
Mica	Tr
Clay	85
Volcanic glass	1
Glauconite	Tr
Calc. nannofossils	10
Diatoms	–
Radiolarians	Tr
Sponge spicules	1
Silicoflagellates	Tr

SITE 569 HOLE A CORE H1 CORED INTERVAL 0.0–246.0 m sub-bottom (wash)

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
probable lower Miocene	unzoned					1, 2, 3, 4, CC	0.5, 1.0					



Wash core.

Dominant lithology: mudstone with mixture of veined and burrowed biscuits and clasts and soupy to brecciated mud matrix.

Color: olive gray (5Y 3/2) to grayish olive green (5GY 3/2).

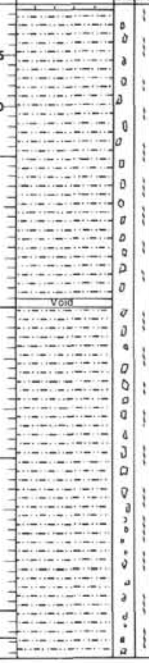
Olive gray (5Y 3/2)

Color change

Grayish olive green (5GY 3/2)

SITE 569 HOLE A CORE 1 CORED INTERVAL 246.0–255.5 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
	barren					1, 2, 3, 4, 5, CC	0.5, 1.0	Void				



$CaCO_3$ = 43%

Dominant lithology: mottled, burrowed, fractured and veined mudstone. Burrows are calcareous.

Color: olive gray (5Y 3/2) with moderate olive brown (5Y 4/4) mottles.

SMEAR SLIDE SUMMARY (%):

	CC
Texture:	
Sand	3
Silt	15
Clay	82
Composition:	
Quartz	1
Feldspar	3
Mica	1
Heavy minerals	1
Clay	89
Volcanic glass	3
Pyrite	1
Radiolarians	1
Silicoflagellates	Tr

SITE 569 HOLE A CORE 2 CORED INTERVAL 255.5–264.9 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
upper Oligocene	*Cyclicargolithus abisectus*		CM			1, 2, CC	0.5, 1.0				*

Ash – pale red purple (5RP 6/2)

LITHOLOGIC DESCRIPTION

Dominant lithology: burrowed, veined, and fractured mudstone. Burrows are slightly calcareous. Faintly laminated in places.

Color: grayish olive (10Y 4/2).

SMEAR SLIDE SUMMARY (%):

	2, 65
	D
Texture:	
Sand	1
Silt	15
Clay	84
Composition:	
Quartz	1
Feldspar	2
Mica	Tr
Heavy minerals	Tr
Clay	92
Volcanic glass	1
Pyrite	1
Diatoms	Tr
Radiolarians	1
Sponge spicules	2

Core 3, 264.9–274.6 m sub-bottom: no recovery.

SITE 569 HOLE A CORE 4 CORED INTERVAL 274.6–284.3 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
upper Oligocene	*Cyclicargolithus abisectus/Dictyococites bisectus*		RM			1, CC	0.5, 1.0				*

LITHOLOGIC DESCRIPTION

Dominant lithology: burrowed, fractured mudstone.

Color: grayish olive green (5GY 3/2).

SMEAR SLIDE SUMMARY (%):

	1, 45
	D
Texture:	
Sand	5
Silt	15
Clay	80
Composition:	
Quartz	2
Feldspar	1
Clay	86
Glauconite	Tr
Carbonate unspec.	5
Calc. nannofossils	3
Radiolarians	Tr

SITE 569 HOLE A CORE 5 CORED INTERVAL 284.3–294.0 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
upper Oligocene	*Cyclicargolithus abisectus/Dictyococites bisectur*	FM				CC					

Void

LITHOLOGIC DESCRIPTION

Core Catcher only.

Dominant lithology: structureless mud.

Color: grayish olive green (5GY 3/2).

SMEAR SLIDE SUMMARY (%):

	CC
Texture:	
Sand	3
Silt	5
Clay	92
Composition:	
Quartz	2
Feldspar	1
Heavy minerals	Tr
Clay	87
Volcanic glass	1
Glauconite	1
Pyrite	2
Carbonate unspec.	1
Calc. nannofossils	5

SITE 569 HOLE A CORE 6 CORED INTERVAL 294.0–303.6 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
upper Oligocene	barren					1	0.5, 1.0				*

LITHOLOGIC DESCRIPTION

Dominant lithology: fine claystone; slightly calcareous.

Minor lithology: massive mudstone.

Color: mudstone is olive gray (5Y 4/1). Claystone is pale blue green (5BG 6/6).

SMEAR SLIDE SUMMARY (%):

	1, 82
Texture:	
Sand	–
Silt	3
Clay	97
Composition:	
Clay	70
Volcanic glass	Tr
Carbonate unspec.	20
Calc. nannofossils	10

SITE 569 HOLE A CORE 7 CORED INTERVAL 303.6–313.2 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
upper Oligocene	*Dictyococcites bisectus*		FM			1	0.5, 1.0				* * •

LITHOLOGIC DESCRIPTION

Light olive gray (5Y 5/2) mudstone
Medium dark gray (N4) ash
pyrite

Dominant lithology: calcareous claystone.

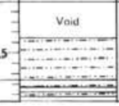
Color: pale blue green (5BG 6/6).

SMEAR SLIDE SUMMARY (%):

	1, 18	1, 84
Texture:		
Sand	–	25
Silt	5	30
Clay	95	45
Composition:		
Quartz	1	5
Feldspar	Tr	2
Clay	84	68
Volcanic glass	–	20
Zeolite	–	Tr
Carbonate unspec.	10	5
Calc. nannofossils	6	–

CARBONATE BOMB (% $CaCO_3$):
1, 105 cm = 15 (shipboard)

SITE 569 HOLE A CORE 8 CORED INTERVAL 313.1–332.3 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
upper Eocene	*Discoaster barbadiensis*		FP			1, CC	0.5	 Void			*

LITHOLOGIC DESCRIPTION

5B 5/1–5G 6/1

Dominant lithology: mottled, bioturbated, veined, fractured.

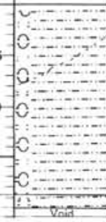
Color: pale blue green (5BG 7/2) with mottles of pale blue (5BG 6/6) and light olive gray (5Y 5/2).

Minor lithology: medium bluish gray (5B 5/1) to greenish gray (5G 6/1).

SMEAR SLIDE SUMMARY (%):

	1, 54
Texture:	
Sand	8
Silt	22
Clay	70
Composition:	
Quartz	3
Feldspar	1
Mica	Tr
Clay	90
Volcanic glass	5
Zeolite	Tr
Calc. nannofossils	Tr
Radiolarians	1
Sponge spicules	Tr
Silicoflagellates	Tr

SITE 569 HOLE A CORE 9 CORED INTERVAL 332.3–351.4 m sub-bottom

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES
upper middle Eocene	*Discoaster saipanensis*		FP			1, 2, CC	0.5, 1.0	 Void			* • * * *

LITHOLOGIC DESCRIPTION

Pale blue gray (5BG 7/2)
Light olive gray (5Y 5/2)
①
Olive gray (5Y 3/2)
Grayish olive (10Y 4/2), calcareous
Brownish black (5YR 2/1) scaley fabric ②
Brownish black (5YR 2/1)
Pale olive (10Y 6/2)

Dominant lithology: burrowed, mottled, veined and fractured mudstone. Burrowed over 60–90%, 0– ~80 cm, slanted contact.

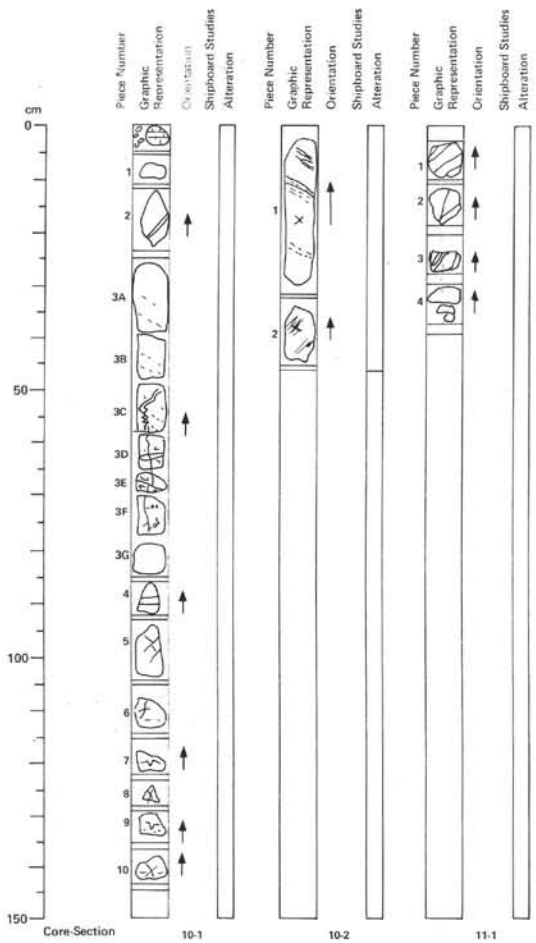
Radiolarian rich.

Minor lithology: ① as above, except with different color as indicated on lithology column and burrowed over 30–60%. ② Darker mudstone with fewer burrows (0–30%). ③ Lighter, more heavily burrowed calcareous mudstone. ④ Dark, scaley fabric mudstone. ①, ②, ③, ④ are all mud mudstone/diatom-rad or siliceous ooze; contacts between litho facies are sharp.

SMEAR SLIDE SUMMARY (%):

	1, 14	1, 54	CC, top	CC, 17
Texture:				
Sand	30	8	20	10
Silt	30	22	55	30
Clay	40	70	25	60
Composition:				
Quartz	–	3	1	
Feldspar	3	1	2	3
Mica	–	Tr	–	1
Heavy minerals	1	–	Tr	–
Clay	45	90	76	58
Volcanic glass	–	5	3	3
Glauconite	Tr	–	–	–
Pyrite	1	–	1	–
Zeolite	–	Tr	–	–
Carbonate unspec.	20	–	5	20
Calc. nannofossils	–	Tr	2	–
Radiolarians	20	1	4	6
Sponge spicules	5	Tr	6	5
Silicoflagellates	–	Tr	–	–

CARBONATE BOMB (% $CaCO_3$):
1, 15 cm = 20 (shipboard analysis)



84-569A-10-1 Depth 351.4–364.9 m

0–5 cm: pale blue green calcareous serpentinite mudstone.

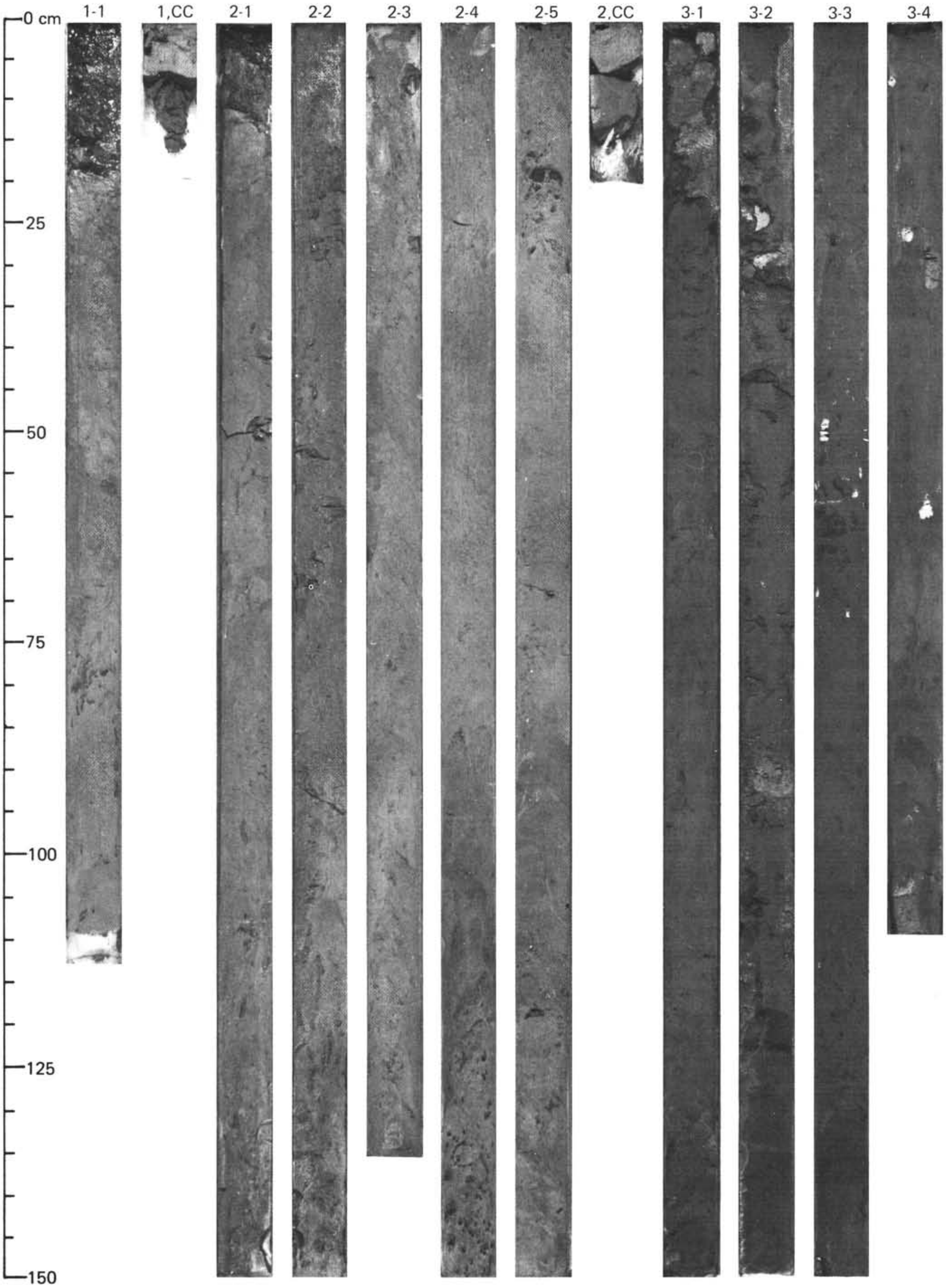
Pieces 1–10: dark greenish gray (5G 4/1) amphibolite, metamorphically altered to amphibolite facies then retrograded to zeolite facies. Foliated and fractured containing plagioclase veins that are also offset by the fractures that pervade the rock. Prehnite is present in Piece 3C and prehnite and pompellyite are present in Pieces 6–10. Plagioclase veining is present in some samples and may be replaced by natrolite.

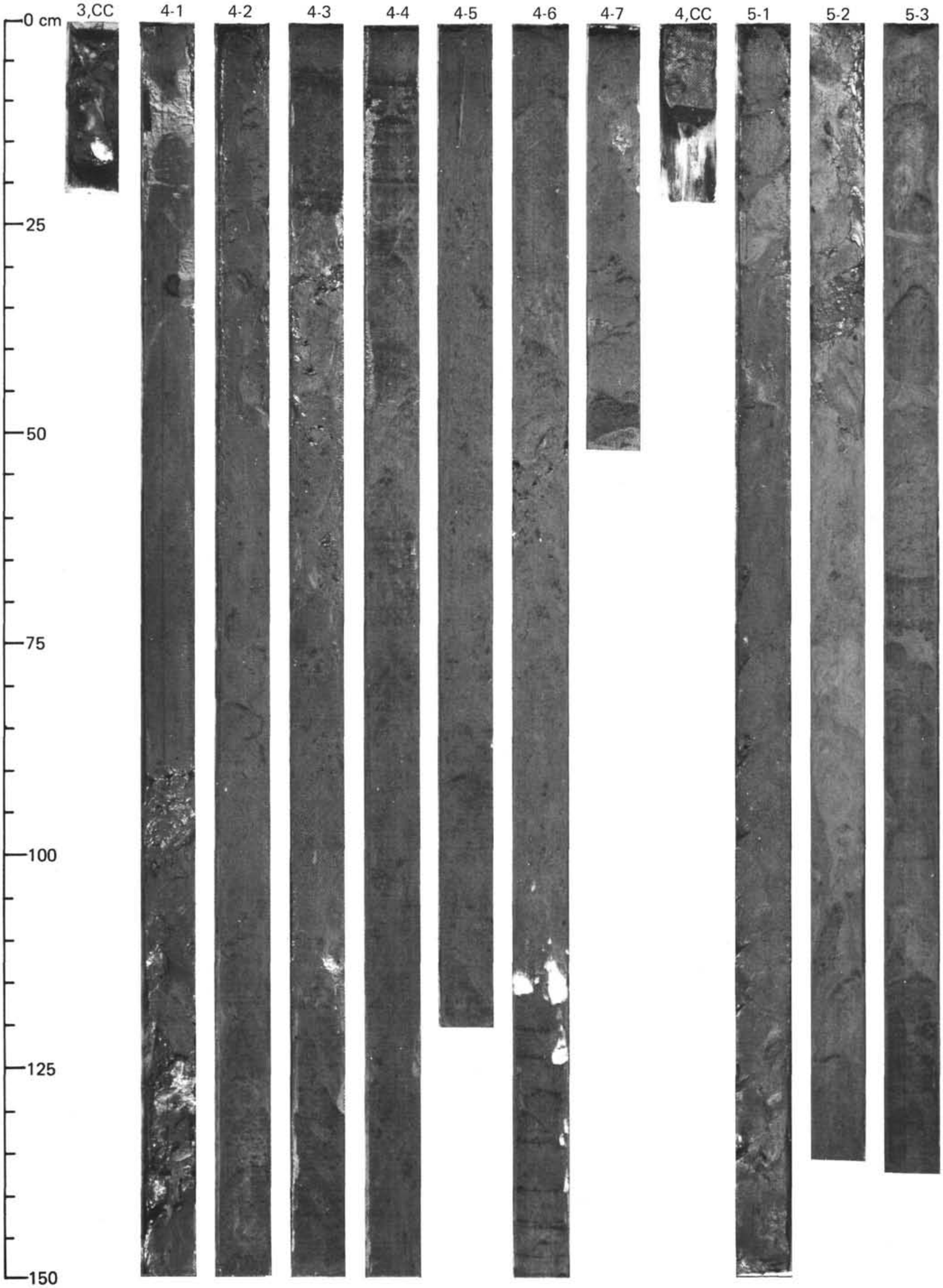
84-569A-10-2 Depth 351.4–364.9 m

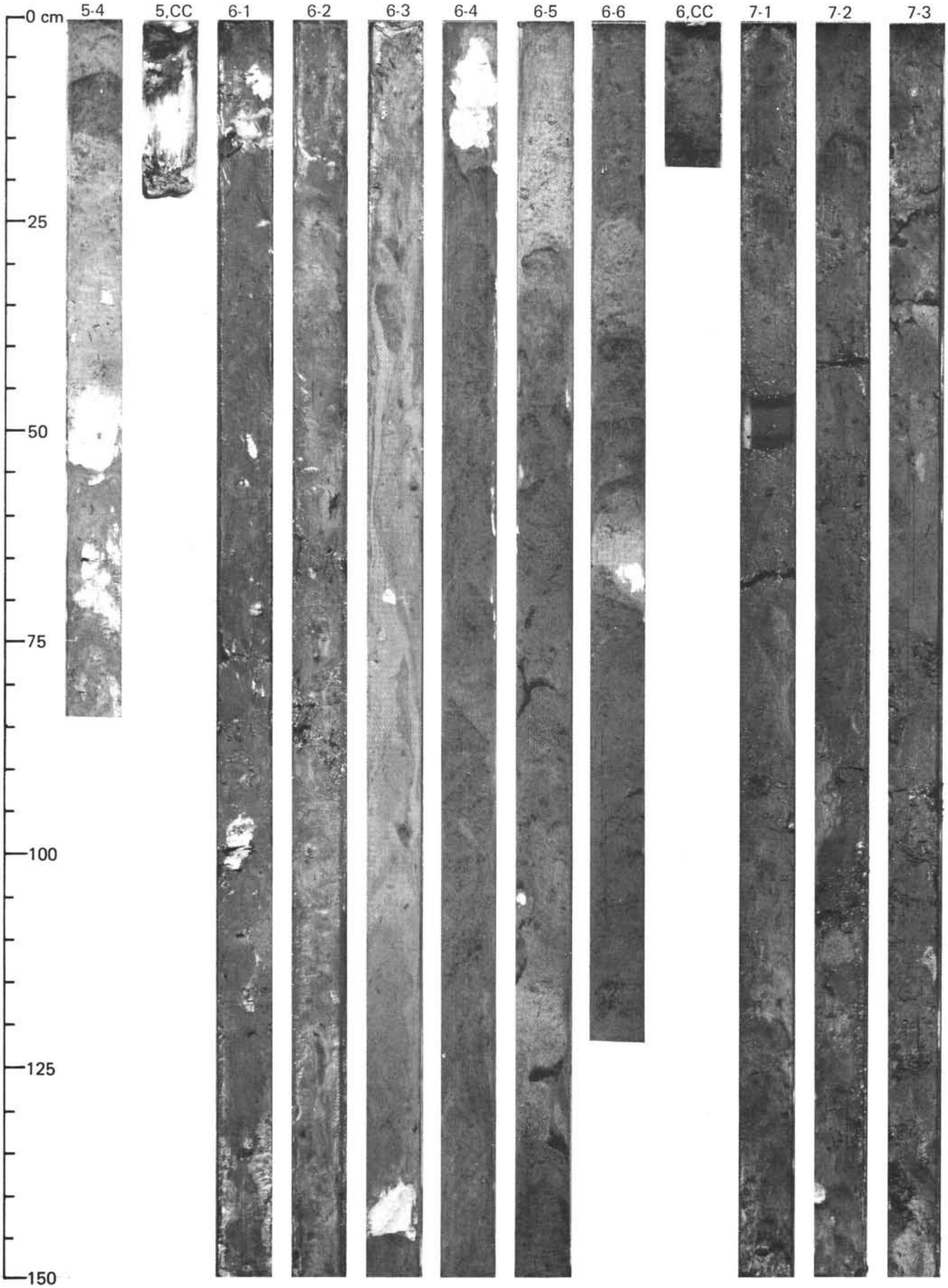
Greenish gray (5G 4/1). Foliated amphibolite with plagioclase veins.

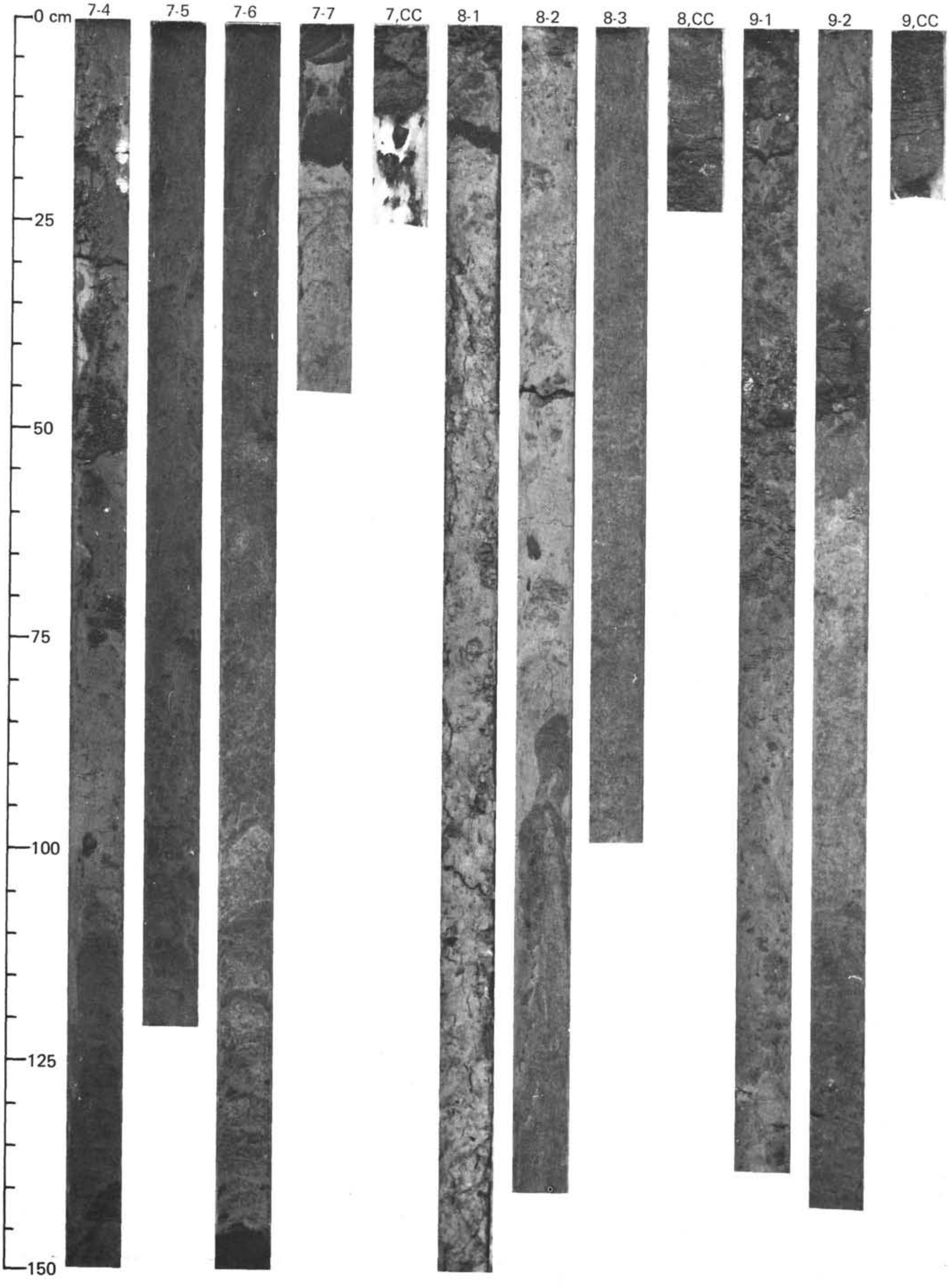
84-569A-11-1 Depth 360.9–364.0 m

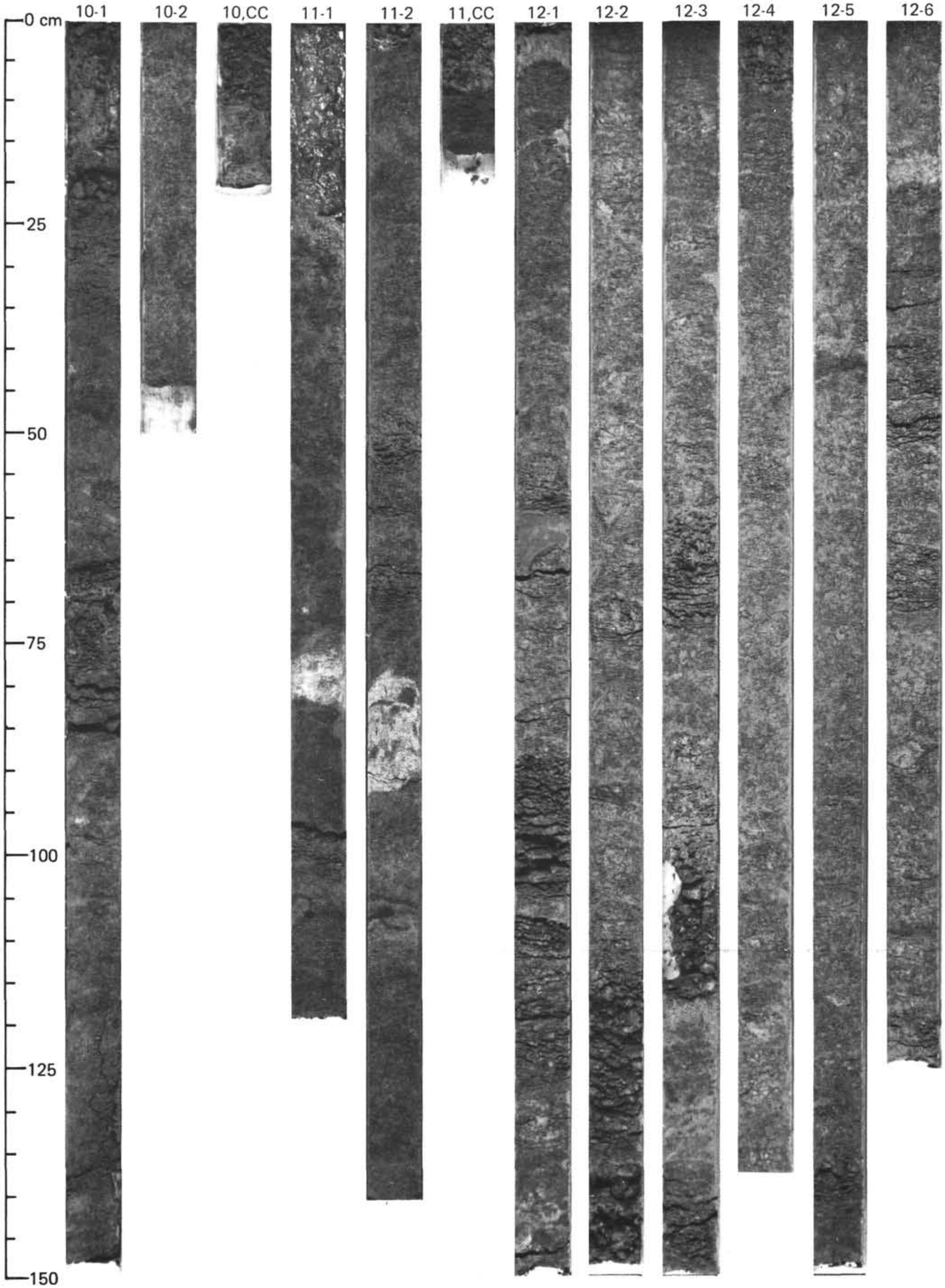
Foliated diabase with plagioclase(?) veins, dark greenish gray (5G 4/1).

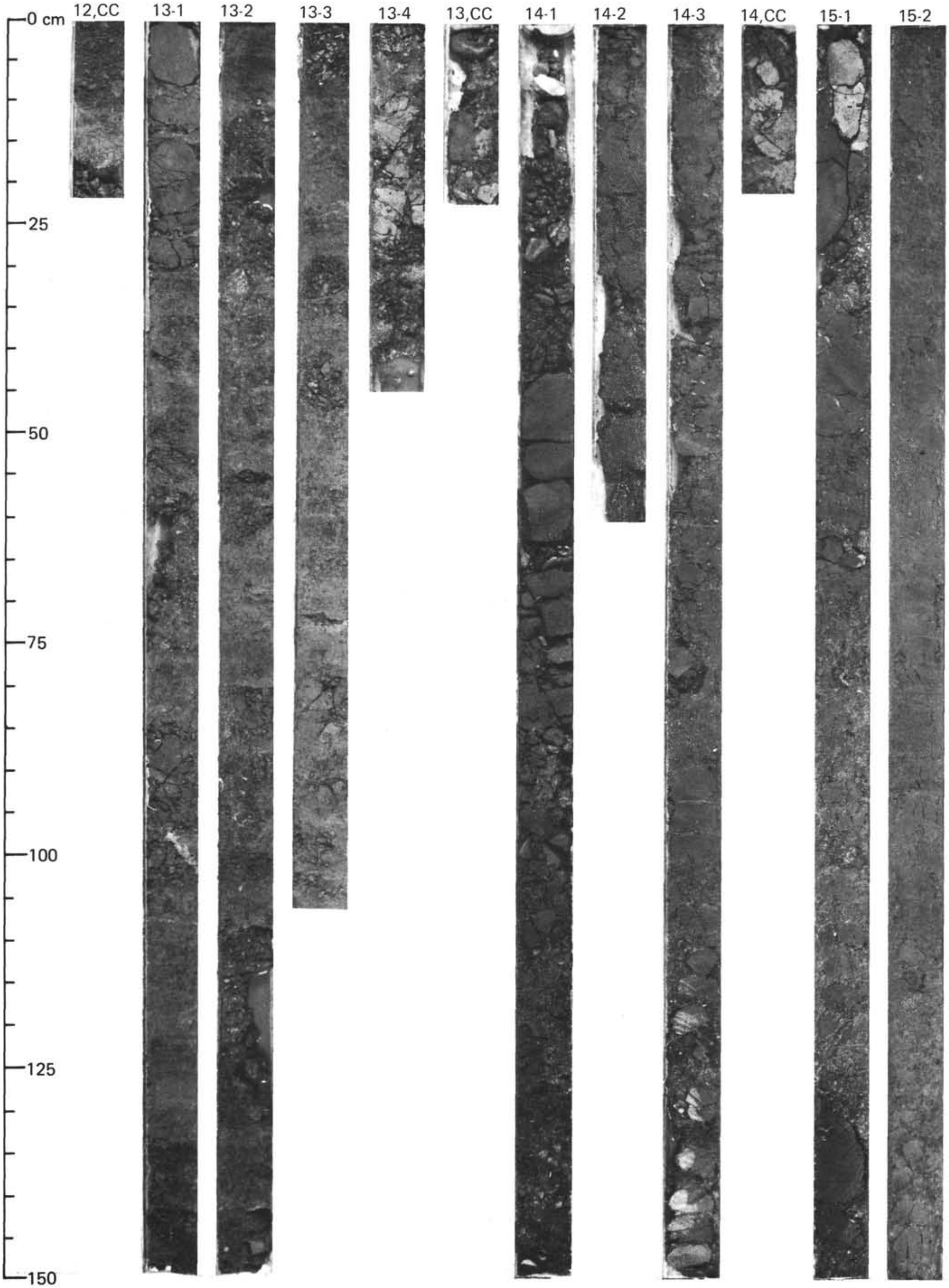

0 cm
25
50
75
100
125
150
1-1
1,CC
2-1
2-2
2-3
2-4
2-5
2,CC
3-1
3-2
3-3
3-4

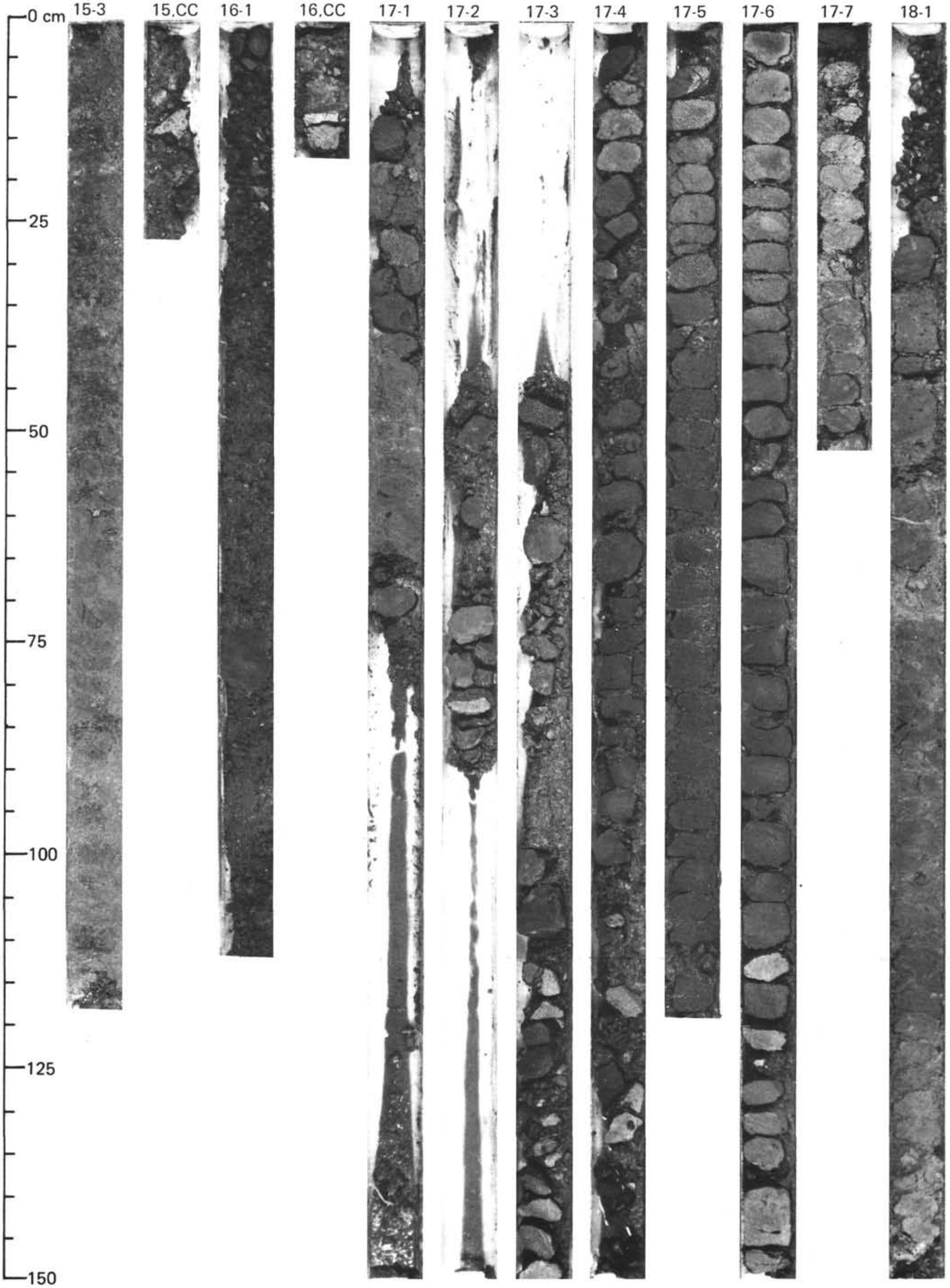

0 cm
25
50
75
100
125
150
3,CC
4-1
4-2
4-3
4-4
4-5
4-6
4-7
4,CC
5-1
5-2
5-3

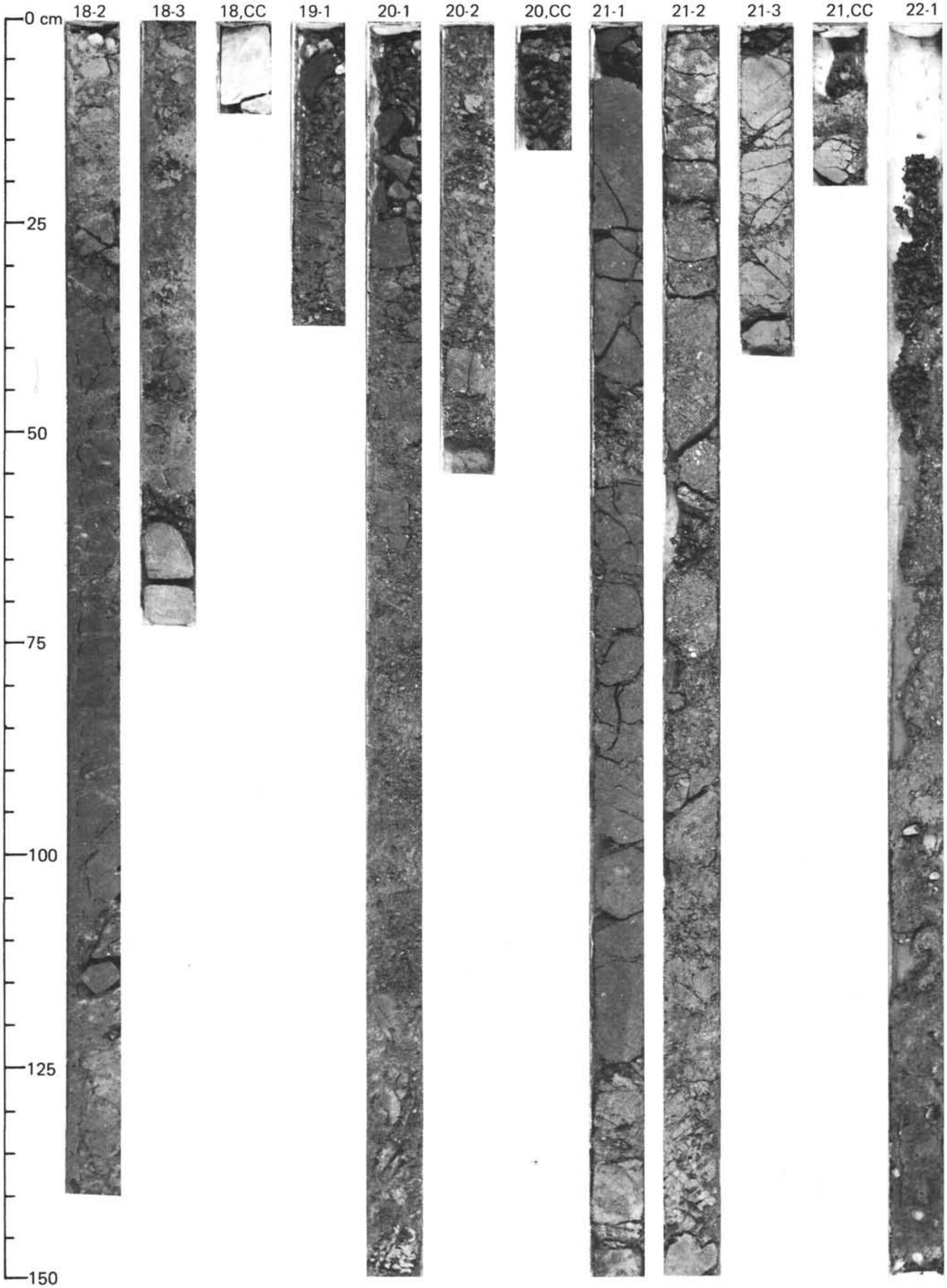

0 cm
25
50
75
100
125
150
5-4
5,CC
6-1
6-2
6-3
6-4
6-5
6-6
6,CC
7-1
7-2
7-3

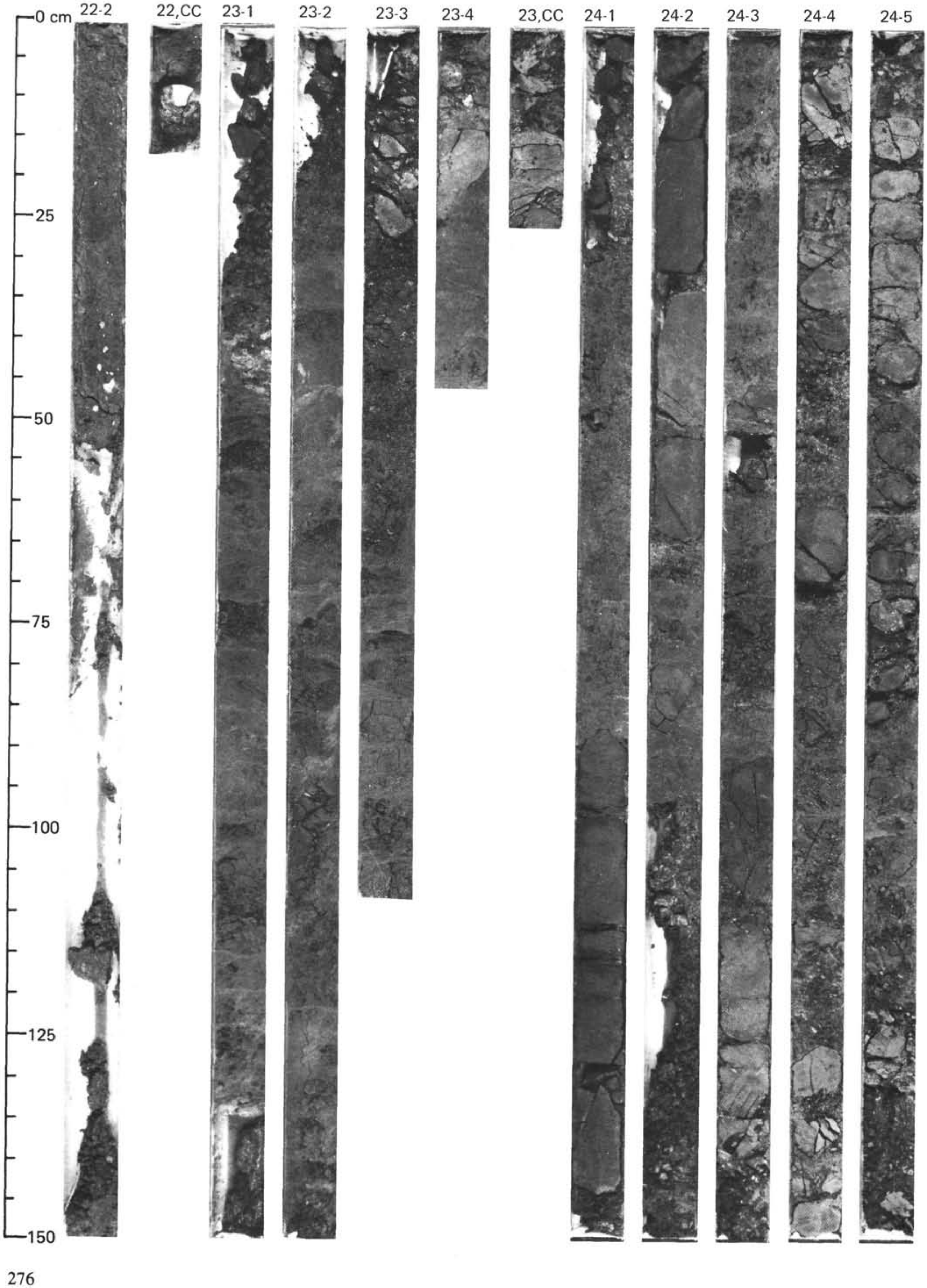

0 cm
25
50
75
100
125
150
7-4
7-5
7-6
7-7
7,CC
8-1
8-2
8-3
8,CC
9-1
9-2
9,CC

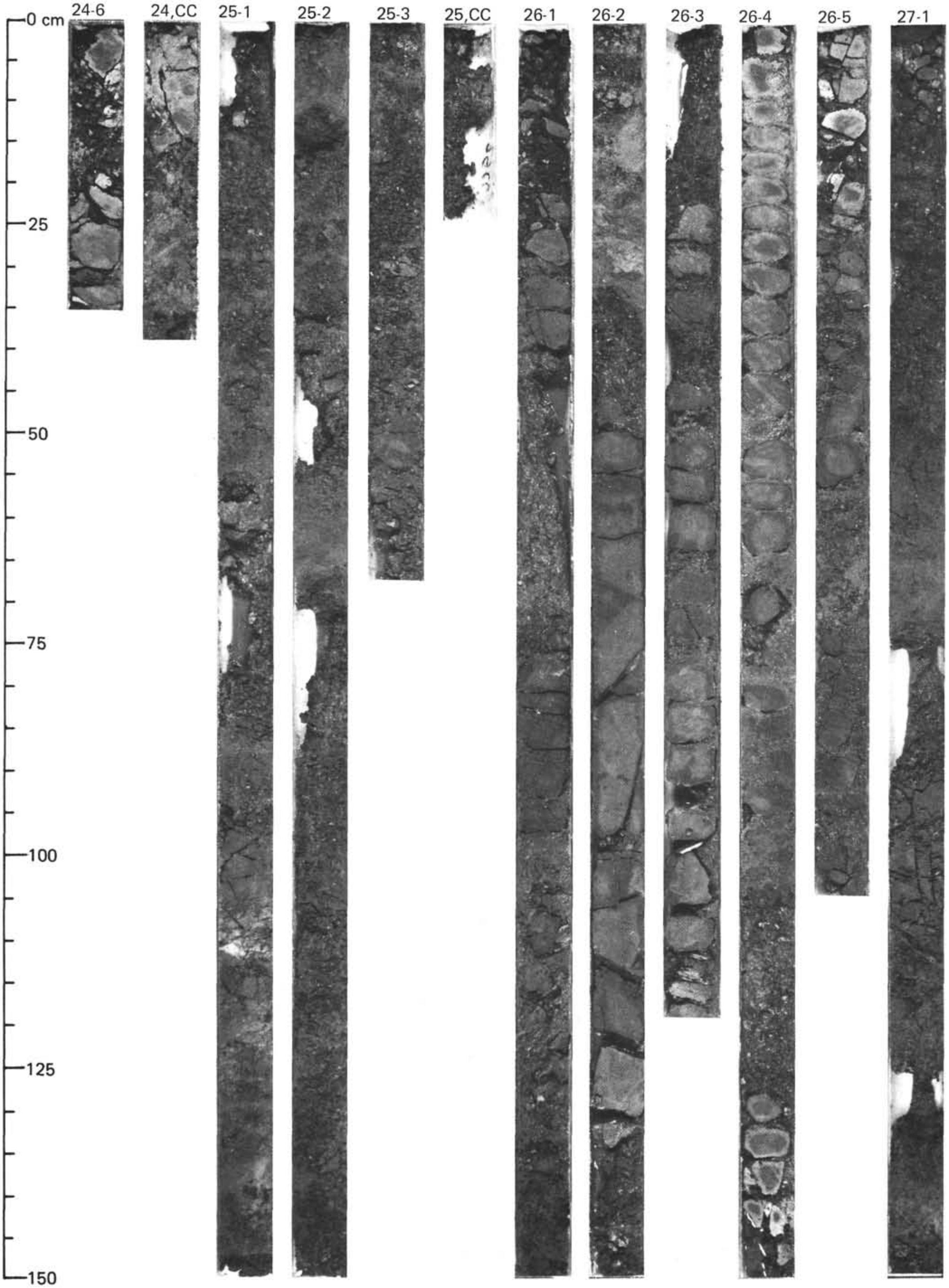

10-1
10-2
10,CC
11-1
11-2
11,CC
12-1
12-2
12-3
12-4
12-5
12-6
0 cm
25
50
75
100
125
150

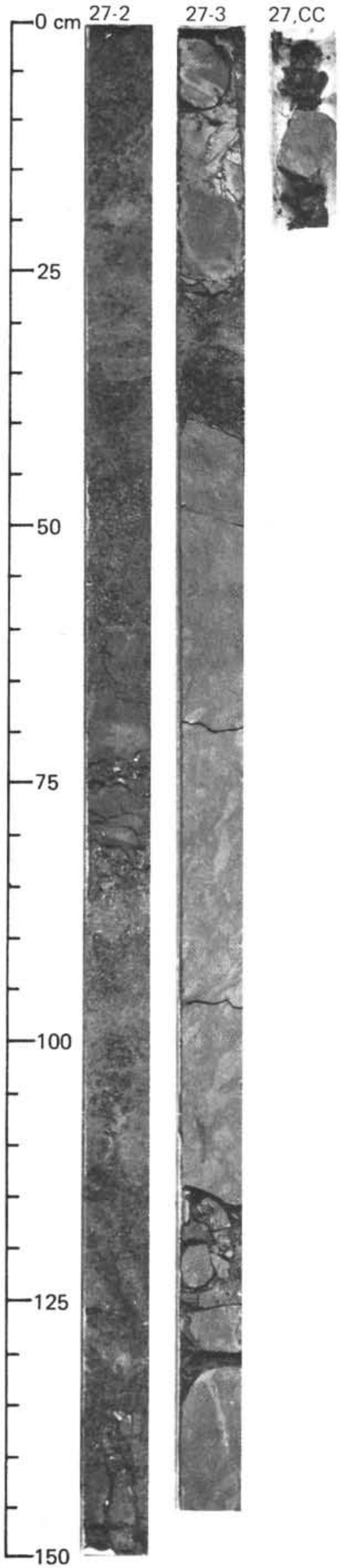

0 cm
25
50
75
100
125
150
12,CC
13-1
13-2
13-3
13-4
13,CC
14-1
14-2
14-3
14,CC
15-1
15-2

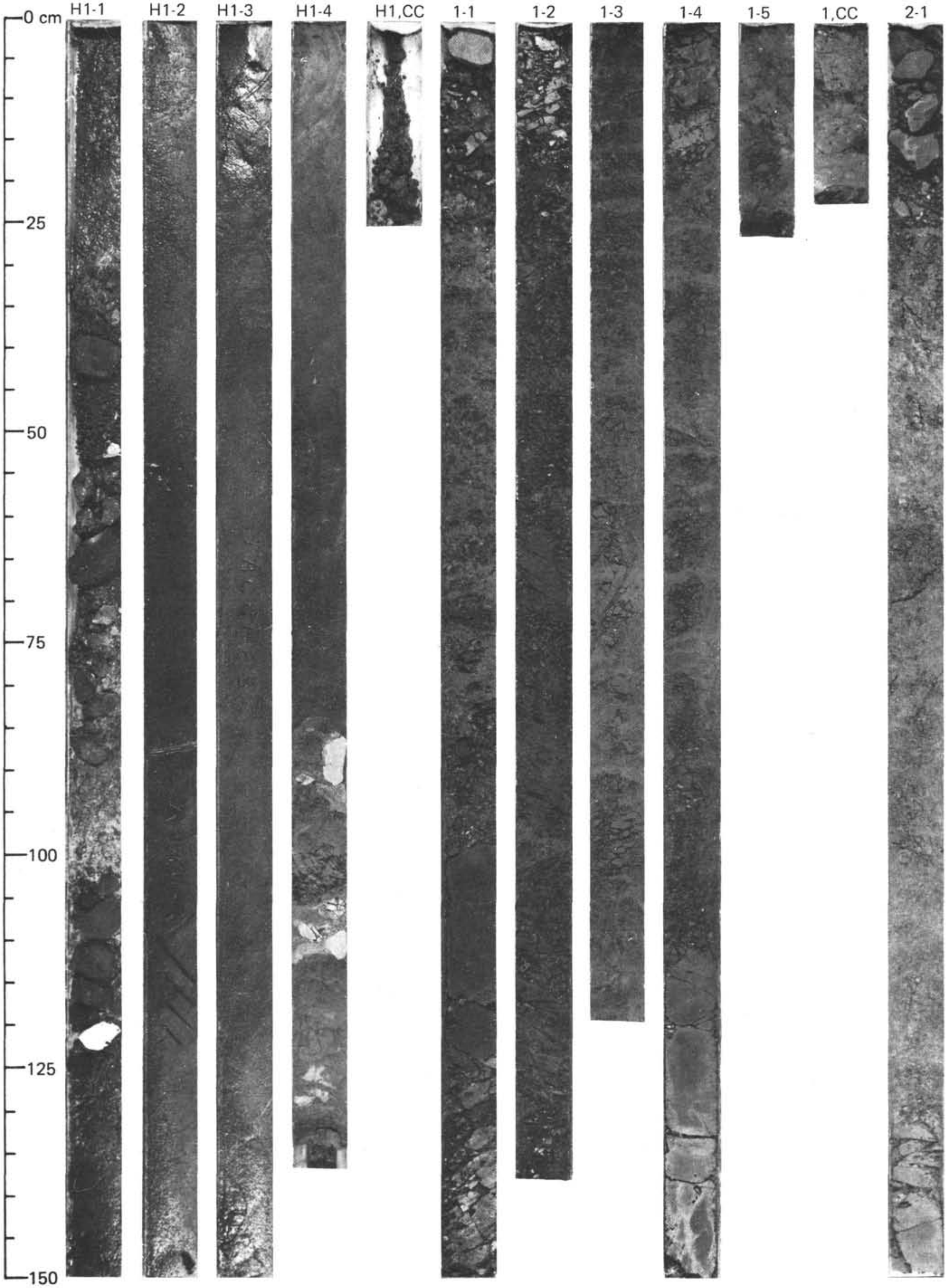

0 cm
25
50
75
100
125
150
15-3
15,CC
16-1
16,CC
17-1
17-2
17-3
17-4
17-5
17-6
17-7
18-1

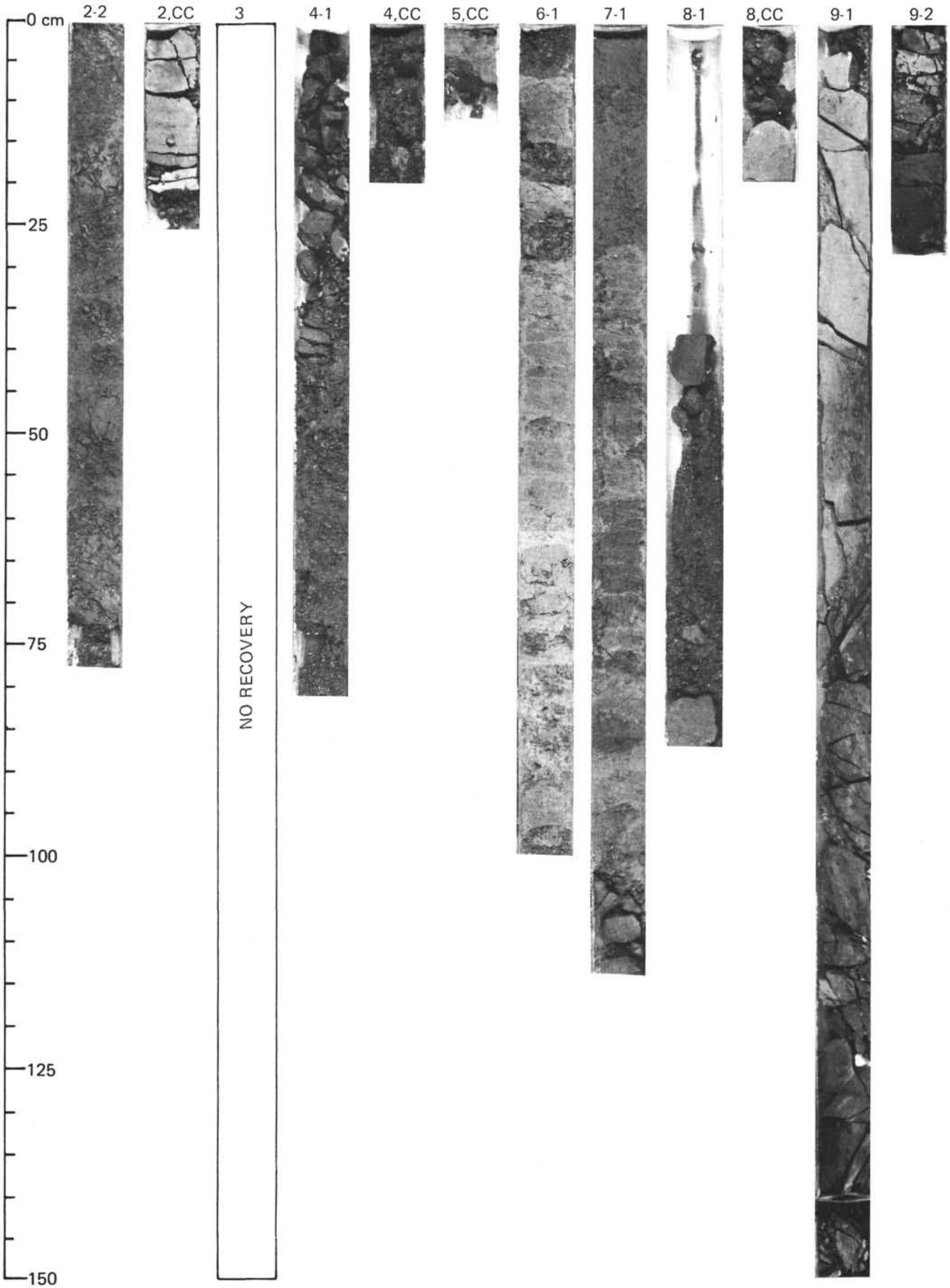

0 cm
25
50
75
100
125
150
18-2
18-3
18,CC
19-1
20-1
20-2
20,CC
21-1
21-2
21-3
21,CC
22-1

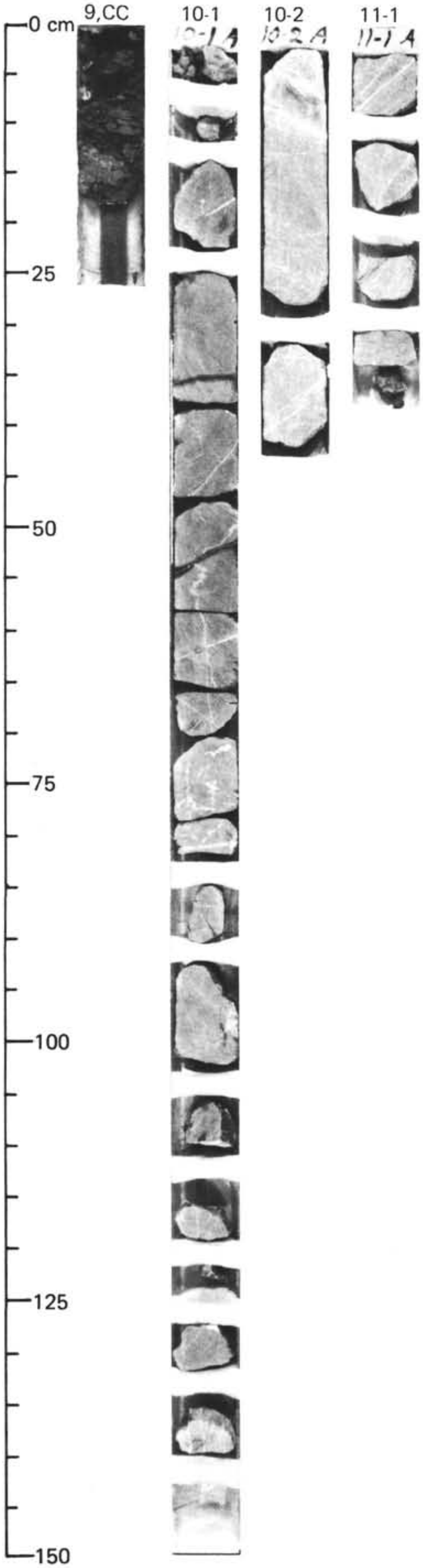

0 cm
25
50
75
100
125
150
22-2
22,CC
23-1
23-2
23-3
23-4
23,CC
24-1
24-2
24-3
24-4
24-5


0 cm
25
50
75
100
125
150
24-6
24,CC
25-1
25-2
25-3
25,CC
26-1
26-2
26-3
26-4
26-5
27-1


0 cm
25
50
75
100
125
150
27-2
27-3
27,CC


0 cm
25
50
75
100
125
150
H1-1
H1-2
H1-3
H1-4
H1,CC
1-1
1-2
1-3
1-4
1-5
1,CC
2-1


0 cm
25
50
75
100
125
150
2-2
2,CC
3
NO RECOVERY
4-1
4,CC
5,CC
6-1
7-1
8-1
8,CC
9-1
9-2


0 cm
25
50
75
100
125
150
9,CC
10-1
10-2
11-1
10-1 A
10-2 A
11-1 A