3. SITE 505: SEDIMENTS AND OCEAN CRUST IN AN AREA OF LOW HEAT FLOW SOUTH OF THE COSTA RICA RIFT[1]

Shipboard Scientific Party[2]

HOLE 505

Date occupied: 29 September 1979, 1200Z

Date departed: 1 October 1979, 2400Z

Time on hole: 60 hours

Position: 01°54.8′N; 83°47.4′W

Water depth (sea level; corrected m, echo-sounding): 3537

Water depth (rig floor; corrected m, echo-sounding): 3547

Bottom felt (m, drill pipe): 3548.5

Penetration (m): 242.0

Number of cores: 26

Total length of cored section (m): 223

Total core recovered (m): 187.05

Core recovery (%): 72

Oldest sediment cored:
Depth sub-bottom (m): 232
Nature: Gray green siliceous nannofossil ooze
Age: 3.9 m.y.
Measured velocity (km/s): 1.51

Basement:
Depth sub-bottom (m): 232
Nature: Highly fractured basalts
Velocity range (km/s): 5.80-5.95

Principal results: See discussion following site data for Hole 505B.

HOLE 505A

Date occupied: 2 October 1979, 0255Z

Date departed: 2 October 1979, 2400Z

Time on hole: 21 hours

Position: 01°55.1′N; 83°47.4′W

Water depth (sea level; corrected m, echo-sounding): 3525

Water depth (rig floor; corrected m, echo-sounding): 3535

Bottom felt (m, drill pipe): 3535

Penetration (m): 208.5

Number of cores: 2

Total length of cored section (m): 12

Total core recovered (m): 0.75

Core recovery (%): 6

Basement:
Depth sub-bottom (m): 196.5
Nature: Fractured basalts

Principal results: See discussion following site data for Hole 505B.

HOLE 505B

Date occupied: 3 October 1979, 0000Z

Date departed: 7 October 1979, 1200Z

Time on hole: 108 hours

Position: 01°55.2′N; 83°47.3′W

Water depth (sea level; corrected m, echo-sounding): 3507

Water depth (rig floor; corrected m, echo-sounding): 3517

Penetration (m): 178.0

Number of cores: 6

Total length of cored section (m): 42

Total core recovered (m): 6.85

Core recovery (%): 16.3

Basement:
Depth sub-bottom (m): 136
Nature: Highly fractured basalts
Velocity range (km/s): 5.85-5.95

Principal results: Holes 505, 505A, 505B—Site 505 is in an area of the Costa Rica Rift where seafloor heat flow measurements indicate anomalously low conductive heat flow, a condition that implies low basement temperatures. Three holes were drilled at Site 505 in the floor of a broad east-west-trending trough. The water depth was 3535 meters, about 60 meters deeper than at the older Site 504. The 232-meter sedimentary section at Hole 505 was continuously cored by rotary drilling. It was made up entirely of a grayish green to olive grayish green siliceous nannofossil ooze that represented a complete section from the early Pliocene (~3.9 Ma) to the present. Diatom markers indicated a sedimentation rate of about 60 m/m.y. Only three distinct ash layers were found, at 3.9, 16.6, and 26.4 meters. The 20 meters of sediment above basement were distinctly chalky and compact, but the remainder of the section showed little evidence of compaction or diagenesis. Temperatures measured at four points between 86 and 210 meters indicated a uniform gradient of 2°C per 100 meters and basement temperatures of approximately 9°C. Interstitial water from squeezed samples and four *in situ* samples showed evidence for strongly reducing conditions at sub-bottom depths up to 100 meters. Reducing conditions were further evidenced by a very strong smell of hydrogen sulfide in all cores. The pore water chemistry profiles, low

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[1] Cann, J. R., Langseth, M. G., Honnorez, J., Von Herzen, R. P., White, S. M., et al., *Init. Repts. DSDP*, 69: Washington (U.S. Govt. Printing Office).

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temperatures, lack of density gradients, and lack of diagenetic effects in the upper 210 meters of sediment were in sharp contrast to the characteristics of Site 504.

Basement rocks were drilled for 9.5 meters in Hole 505, 12 meters in Hole 505A, and 42 meters in Hole 505B. Drilling conditions were difficult, and the percentage of recovery was low. The rocks were fractured, relatively fresh basalts. Alteration rinds frequently bordered cracks. Minerals found in cracks included phillipsite, pyrite, smectite, and calcite. The basalts at Site 505 were little fractionated, with an average value of Mg/(Mg + Fe) of 0.64. The Hole 505 basalts have large phenocrysts of plagioclase, olivine, and clinopyroxene and smaller crystals of chrome-spinel. The basalts in Holes 505A and 505B were nearly identical to these except that they were more sparsely phyric and lacked phenocrysts of clinopyroxene.

Three suites of logs were successfully run in Hole 505B in the lower part of the sedimentary section and the entire basement section. The logs showed considerable density variation at the scale of meters. The variation probably corresponded to interbedded pillow lava flows, zones of rubbly basalt, and sedimentary interlayers. The downhole magnetometer showed the drilled section of basalt to be uniformly reversely magnetized. Measurements made on core samples confirmed this result and indicated a low inclination angle relative to the present field, high intensities of magnetization, and low susceptibilities.

OPERATIONS

Site 505 (Site Survey Target CR-2) is located in the floor of a broad east-west-trending graben (see Fig. 1) centered at 1°55′N. The southern wall of the graben is made up of steplike normal faults with vertical displacements of 100 to 200 meters. The site survey observations showed that this feature is characterized by anomalously low heat flow—about 10% of the theoretically anticipated value. The floor of the graben is about 1.5 meters wide and is at depths from 3510 to 3530 meters near Site 505. A postdrilling survey made with the *Gloria's* side-scan sonar shows the trough to be continuous and linear for at least 30 km (Searle, this volume). Because the trough could be identified easily, the beacon was dropped during the first pass over it (at 1224 hr., 29 Sept. 1979).

Three single-bit holes were drilled in a north-south line at Site 505.

Hole 505

Hole 505 was located several hundred meters north of the deepest fault scarp on the south wall of the graben. We began running pipe into Hole 505 during the afternoon of 29 September. The bottom hole assembly (BHA) contained the Lynes packer subassembly and a torque jar, a device for applying sudden shocks to the BHA if it jammed in the basement. We intended to run experiments using the packer as soon as we could drill a sufficiently deep hole in a suitable basement formation. Hole 505 was spudded into seafloor sediments at 0200 hr. on 30 September at a water depth of 3537 meters.

Continuous rotary coring was begun at the mudline (Table 1). Coring was interrupted at 86, 143, 181, and 210 meters sub-bottom to make observations with the downhole temperature probe and to take *in situ* pore water samples. All four measurement runs were successful. Two intervals in the sediment, at 86 to 95.5 meters and 143 to 152.5 meters sub-bottom, were not cored because the drill bit sank through the soft mud while the downhole temperature measurements were being made. In the sedimentary section cored, recovery was about 75%.

Basement was reached at 232 meters sub-bottom. Drilling in the basement was difficult. Torque was high and variable, and the core bit jammed frequently. Torque was very high even when the bit was not on the bottom, suggesting that hole conditions were poor. The high torque may have been due in part to the unintentional inflation of the rubber packer assembly. During the drilling there was continuous difficulty with the Bowen rotary power unit as well. After penetrating the basement for 9 meters and recovering only a few fragments of basalt, we decided to move to another place to try to find better basement conditions. Operations at Hole 505 finished at about midnight, 1 October 1979.

Hole 505A

The bit was raised above the mudline, and the vessel was moved 500 meters north. This brought us over the southern flank of a small sediment-covered ridge in the floor of the trough. Hole 505A was spudded at 0255 hr. on 2 October in a water depth of 3525 meters. We washed through the sedimentary section, which was entirely unconsolidated ooze, to basement, which was at 196.5 meters sub-bottom (Table 1), about 36 meters higher than the basement at Hole 505.

Torque was very high when we tried to start the basement hole. The first core consisted of a few small pieces of basalt. The rotary power unit continued to break down for extended periods. The drill pipe stuck while we were taking the second core, but we managed to free it by using the torque jar. As a result of these difficulties, we decided to pull up the drill string and inspect the packer assembly and the bit. In total, 12 meters of basement were cored, of which 0.75 meter was recovered (Table 1). When we brought the drill string up to the surface we realized that the inflatable packer element had been completely torn off. The bit was still in good condition. Operations at Hole 505A ended at about midnight on 2 October.

Hole 505B

In hopes of finding more easily drilled basement, we moved the *Glomar Challenger* 250 meters north, to the top of a small ridge in the center of the graben. This time the packer was not included in the BHA. Pipe was run in, and Hole 505B was spudded at 1237 hr. on 3 October in 3507 meters of water. Again the bit was washed through the sedimentary layer, and basement was encountered at 136 meters sub-bottom (Table 1), 48.5 meters higher than at Hole 505A and 128 meters higher than at Hole 505.

Basement was drilled and cored to 42 meters below the base of the sediments. Drilling conditions were difficult again. The problems we encountered in drilling basement at Site 505 stemmed from the highly fractured and fresh nature of the basement rocks. Fragments of the walls of the hole readily broke free and jammed the BHA. After 42 meters of basement had been penetrated, conditions in the hole became very difficult, and we

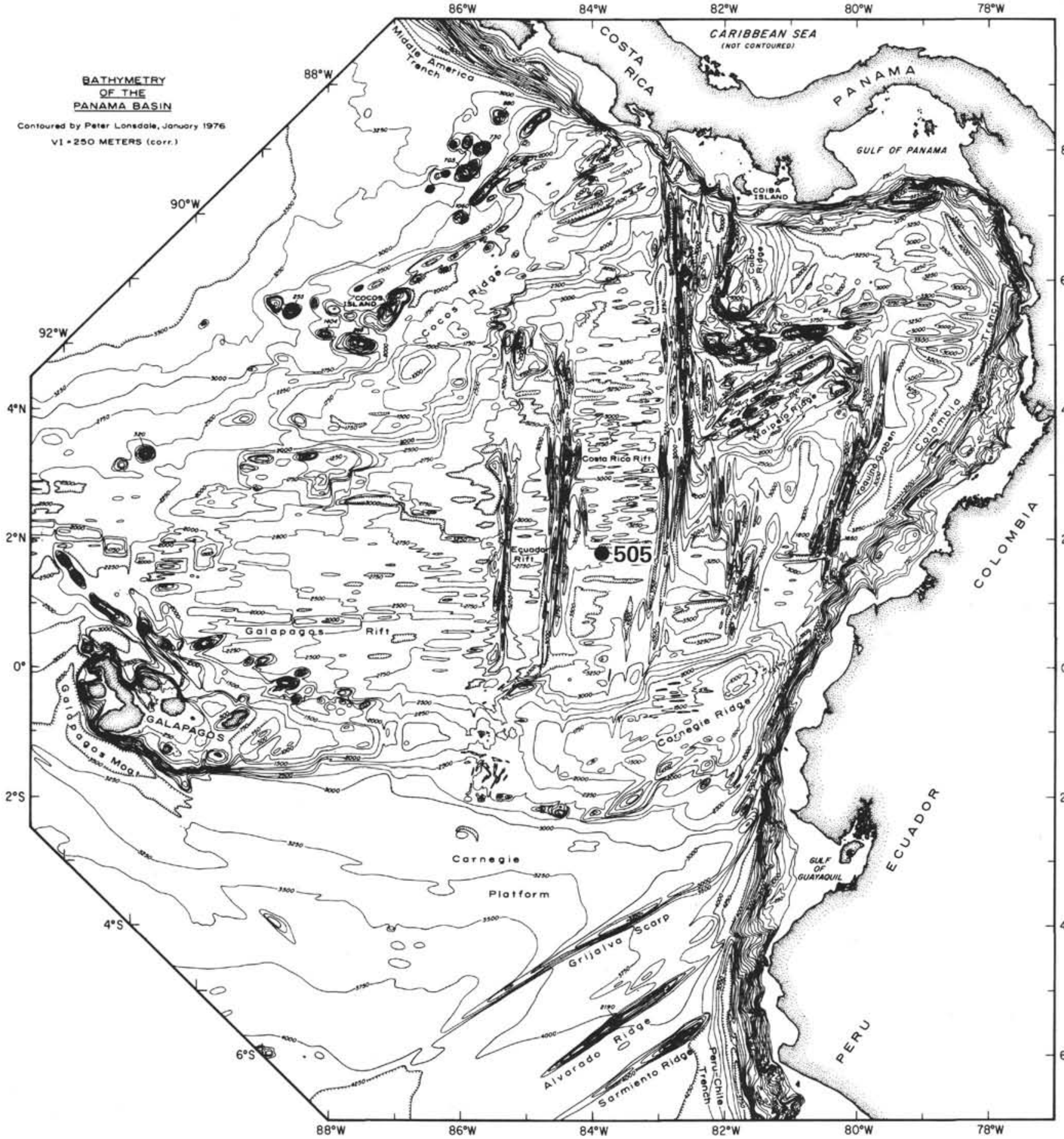


Figure 1. Location of Site 505 near the Costa Rica Rift. Bathymetry from Lonsdale and Klitgord (1978). Contour interval = 250 m.

decided to stop drilling. The hole was flushed with 50 barrels of weighted mud, and the bit was released in preparation for logging.

Three suites of logging tools were run into the hole. The first measured compensated gamma density, caliper, natural gamma rays, and temperature; the second, neutron porosity, guard resistivity, and natural gamma rays. The third took downhole water samples and measured temperature.

While the tools were being lowered through the hole, the bottom hole assembly was lowered so that its end was 1 meter below the sediment/basalt contact. For the logging run itself, which was made while the logging tools were being hoisted up the hole, the pipe was raised 28 meters (one stand).

The first two suites of tools were run very successfully. The third, however, may not have reached the bottom of the hole. The temperature record suggests that the

Table 1. Coring summary, Site 505.

Core	Date (1979)	Time	Depth from Drill Floor (m)	Depth below Seafloor (m)	Length Cored (m)	Length Recovered (m)	Recovery (%)
Hole 505							
1	30 Sept.	0300	3548.5–3549.0	0–0.5	0.5	0.17	34
2	30	0430	3549.0–3558.5	0.5–10.0	9.5	8.90	94
3	30	0555	3558.5–3568.0	10.0–19.5	9.5	7.50	79
4	30	0725	3568.0–3577.5	19.5–29.0	9.5	10.23	108
5	30	0900	3577.5–3587.0	29.0–38.5	9.5	9.52	100
6	30	1025	3581.0–3596.5	38.5–48.0	9.5	10.83	114
7	30	1200	3596.5–3606.0	48.0–57.5	9.5	9.05	95
8	30	1325	3606.0–3615.5	57.5–67.0	9.5	1.31	14
9	30	1435	3615.5–3625.0	67.0–76.5	9.5	5.03	53
10	30	1553	3625.0–3634.5	76.5–86.0	9.5	7.03	74
—	30	1740	3634.5–3644.0	86.0–95.5	Wash—heat flow, pore water		
11	30	1852	3644.0–3653.5	95.5–105.0	9.5	8.83	93
12	30	1956	3653.5–3663.0	105.0–114.5	9.5	6.47	68
13	30	2112	3663.0–3672.5	114.5–124.0	9.5	9.46	100
14	30	2225	3672.5–3682.0	124.0–133.5	9.5	8.28	87
15	30	2339	3682.0–3691.5	133.5–143.0	9.5	8.64	89
—	1 Oct.	0115	3691.5–3701.0	143.0–152.5	Wash—heat flow, pore water		
16	1	0250	3701.0–3710.5	152.5–162.0	9.5	0.02	2
17	1	0415	3710.5–3720.0	162.0–171.5	9.5	10.99	115
18	1	0542	3720.0–3729.5	171.5–181.0	9.5	8.20	86
—	1	0720	3729.5	181.0	Wash—heat flow, pore water		
19	1	0950	3729–3739.0	181.0–190.5	9.5	11.10	117
20	1	1030	3739.0–3748.5	190.5–200.0	9.5	11.00	116
21	1	1155	3748.5–3758.0	200.0–209.5	9.5	11.49	120
—	1	1340	3758.0	209.5	Wash—heat flow, pore water		
22	1	1450	3758.0–3767.5	209.5–219.0	9.5	9.58	101
23	1	1620	3767.5–3777.0	219.0–228.5	9.5	9.53	100
24	1	1735	3777.0–3782.0	228.5–233.5	5.0	3.55	71
25	1	1947	3782.0–3786.5	233.5–238.0	4.5	0.09	2
26	1	2355	3786.5–3790.5	238.0–242.0	4.0	0.34	9
				Totals	223	187.14	83.9
Hole 505A							
—	2 Oct.		Washed to basement at 196.5 m sub-bottom				
1	2	0950	3731.5–3738.5	196.5–203.5	7.0	0.30	4
2	2	1500	3738.5–3743.5	203.5–208.5	5.0	0.45	9
—	2	2350	3743.5	208.5	Bag of basalt pieces		
Hole 505B							
—	3 Oct.		Washed to basement at 136 m sub-bottom				
1	3	1520	3653.0–3658.0	136.0–141.0	5.0	0.15	3
2	3	2220	3658.0–3667.5	141.0–150.5	9.5	2.62	28
3	4	0820	3667.5–3676.5	150.5–159.5	9.0	1.65	18
4	4	1120	3676.5–3681.0	159.5–164.0	4.5	0.10	2
5	4	1515	3681.0–3686.0	164.0–169.0	5.0	0.73	14
6	4	2140	3686.0–3695.0	169.0–178.0	9.0	1.60	17
				Totals	42.0	6.85	16

tool may have lodged in the hole at a depth of about 3661 meters. If so, the 100-ml sample of water that was drawn into the water sampler was taken at that level.

Between the running of the first and second suites of logs two other downhole experiments were attempted. The Soviet downhole magnetometer was run successfully into the hole four times and produced a record of the changes in magnetic susceptibility and the three components of the magnetic field with depth. A borehole televiewer run was tried, but the instrument lost signal near the bottom of the hole. A second run was tried, but at a depth of about 2000 meters the protective sleeve around the transducer imploded, flooding the transducer end of the tool. No further attempts were made to run the televiewer into Hole 505B.

After the logging was completed the BHA was run to the bottom of the hole for the last time and an Eastman Survey was run to determine the inclination of the hole. It indicated that the hole was 2.2° from vertical. Subsequently the pipe was pulled out of the hole. Operations at Site 505 ended about noon on 7 October 1979.

SEDIMENT LITHOLOGY AND STRATIGRAPHY

Summary

The sedimentary column in Hole 505 consists of three lithologic units (Fig. 2): Unit I (0–14.5 m), a late Pleistocene calcareous marl; Unit II (14.5–133.5 m), a late Pliocene to late Pleistocene variably clay-bearing nannofossil siliceous ooze; and Unit III (133.5–232 m), an early to late Pliocene siliceous nannofossil ooze.

Calcareous and siliceous microfossils and clays with montmorillonite as the dominant clay mineral are the major constituents of the sedimentary section. Rhyolitic volcanic glass and pyrite are minor but significant components of nearly all cores. Green hues dominate the sediment colors. A strong smell of hydrogen sulfide in all cores suggests anaerobic bacterial activity. Gas bubbles occurred at depths between 100.35 and 100.50 meters, very likely as a result of the formation of hydrogen sulfide or methane. Coring disturbance, which resulted in diapiric and flow structures in the cores, has destroyed sedimentary structures to a considerable degree. However, judging from the structures that can be seen and comparison to Site 504, the sediments at Site 505 are bioturbated throughout. Only ash layers have sharp boundaries. In the remaining sediments, relict bedding is apparent only in changes in color, carbonate content, and grain-size distribution.

Description of the Lithologic Units

Unit I (Cores 1–3, 0–14.5 m below the seafloor)

Unit I consists of calcareous marl. The prevailing colors are very dark grayish brown for the top 1.7 meters and dark olive gray, grayish olive green, and dusky yellow green for the section below. The grain-size distribution shows that the sediments are composed of 7% sand-sized (>63 µm), 39% silt-sized, and 54% clay-sized material (visual estimates). The $CaCO_3$ content measured by carbonate bomb averages 26% and results mainly from calcareous nannofossils; foraminifers are rare and poorly preserved. The siliceous part of the silt-sized and sand fractions consists mainly of radiolarians and diatoms. Silicoflagellates, sponge spicules, and volcanic glass are minor constituents. There is a fairly large proportion (20–30%) of chitin fragments in the upper part of the unit, among them identifiable fragments of copepod species. At a depth of 3.9 meters the percentage of colorless volcanic glass increases to 15%. The glass probably represents an ash layer disseminated by bioturbation or drilling. The volcanic glass content of the remaining part of the unit is between 2 and 3% and is therefore higher than in the underlying units.

Unit II (Cores 3–14, 14.5–133.5 below the seafloor)

Unit II is a variably clay-bearing nannofossil siliceous ooze. The prevailing colors are dusky yellow green, grayish yellow green, grayish green, and dusky olive gray. From 14.5 to 72 meters the average $CaCO_3$ content is 34%, from 72 to 119 meters it is 25%, and from 119 to 133 meters it is 46%. The clay-sized fraction for

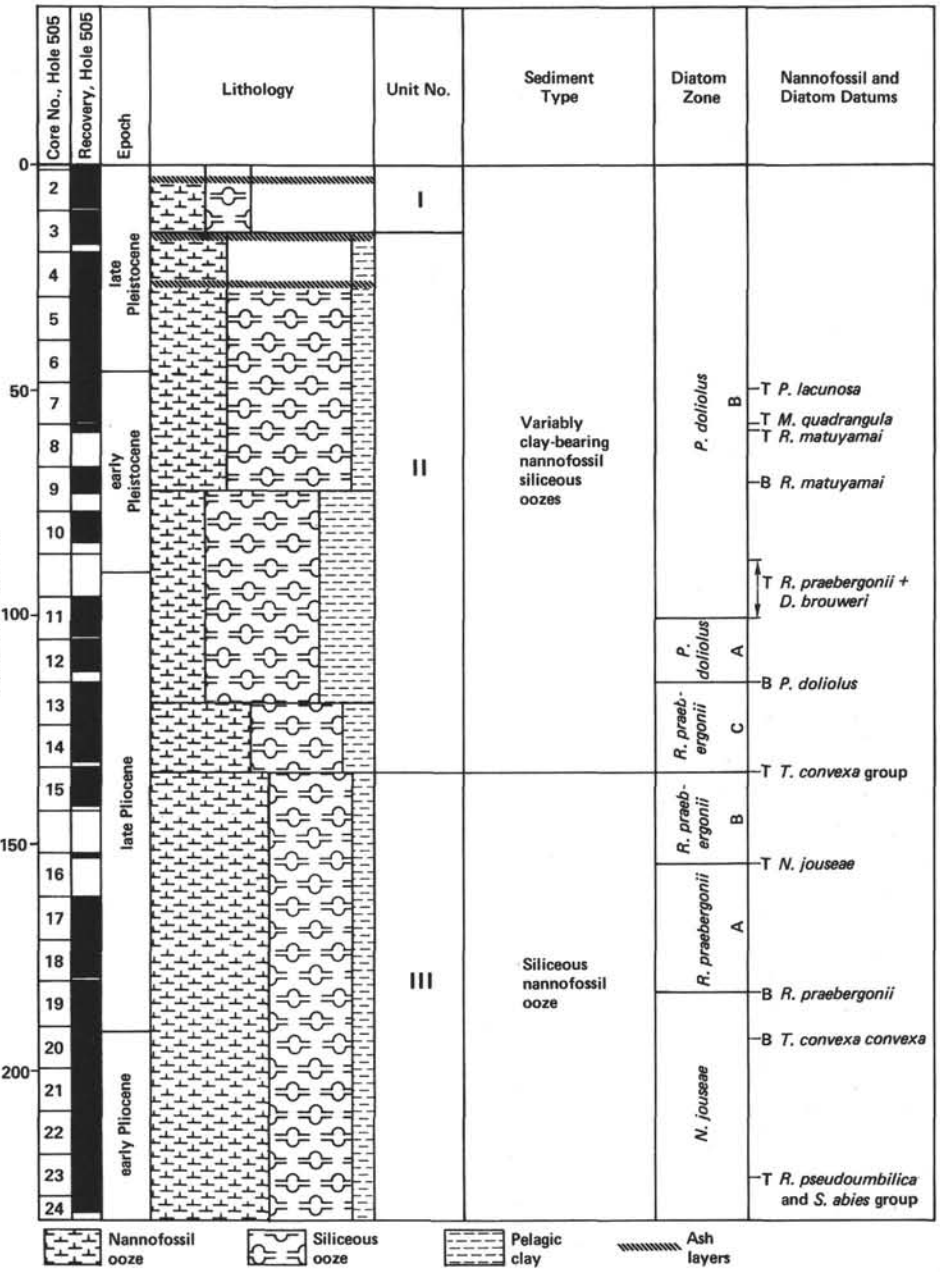


Figure 2. Lithology and diatom biostratigraphy of sediments at Site 505.

the same intervals averages 10, 20, and 13%. The size of the silt fraction follows the same trend as the clay-sized fraction. The sand-sized fraction for the three intervals varies between 1 and 5%. The components of the different grain-size fractions are essentially the same as in Unit I. There are two volcanic ash layers, one between 16.45 and 16.75 meters and one at 26.40 meters (see also Unit I). However, dispersed volcanic glass exceeds trace amounts (to values between 1 and 2%) only in the upper 15 meters of the unit. *Zoophycos* "spreiten" burrows are common in the upper part of the unit.

Unit III (Cores 15-24, 133.0-232 m below the seafloor)

Unit III consists mainly of siliceous nannofossil ooze. The prevailing colors are grayish yellow green to dusky yellow green from 133 to 209 meters and grayish yellow green to pale yellowish green and very pale green from 209 to 232 meters. In the lower part of the interval there is a considerable increase in induration.

The clay-sized fraction decreases continuously with depth, falling from 20% at the top to 5% at the base of the unit (average: 8%). The sand-sized fraction remains below 8% without significant variation. The carbonate content ranges between 42 and 73% (average: 53%) and generally increases with depth. Pyrite decreases with depth. Grayish blue green (5BG 5/2), dusky blue (5PB 3/2), grayish purple (5P 4/2), and grayish blue (5PB 5/2) tints and streaks are characteristic of Unit III. Before drilling disturbance, these streaks were burrow halos, a few of which were found in spite of the high degree of deformation due to the drilling process. At 228.50 meters, 20 to 30% of the coarse fraction consists of fragments of black to brownish glass. Such glass occurs in only trace amounts in the upper part of the sediment column.

BIOSTRATIGRAPHY

The Pliocene/Pleistocene boundary (defined by the last occurrence of *Rhizosolenia praebergonii* and of *Discoaster brouweri*) apparently falls within the washed interval between Cores 10 and 11 (86–96 m).

The lowest diatom event at Site 505 is the first occurrence of *Thalassiosira convexa convexa* in Sample 505-19,CC (190 m), which is here used for the informal division of the early and late Pliocene. The lowest nannofossil event is the extinction of *Reticulofenestra pseudoumbilica* and of the *Sphenolithus abies* group, which occurs in the upper part of Core 23 (at 221 m). The base of the sediment section must be early Pliocene (>4.3 Ma). Sedimentation rates therefore averaged about 60 m/m.y.

Figure 2 shows the diatom biostratigraphic zonation and datum levels. A few calcareous nannofossil datums are also given. In some intervals the marker species (especially discoasters and ceratoliths) are rare; the true datum levels for these species cannot be determined.

PHYSICAL PROPERTIES OF SEDIMENT

Physical property determinations at Site 505 consist of compressional wave seismic velocity measurements (made with the Hamilton frame velocimeter), needle probe measurements of thermal conductivity, and determinations (through gravimetric analysis) of wet bulk density, grain density, water content, and porosity. Measurements were carried out in the least disturbed intervals of the core sections; in cases where complete sections appeared to be disturbed, measurements were generally not carried out. Wilkens and Langseth (this volume) give a complete data presentation in their comparison of Sites 504 and 505. This comparison is of particular interest because the sites are in relatively close proximity (80 km apart) and should have similar sedimentation regimes. Comparison of the physical properties of the two holes also provides an opportunity to compare similar measurements made on sedimentary sections that have been recovered by the hydraulic piston corer (Site 504) and by the standard rotary coring method (Site 505). Of course, another factor that must be taken into consideration in a comparison of the physical properties of the sediments at the two sites is the drastic difference in the heat flow regimes.

Seismic Velocity

The compressional wave seismic velocities measured at Site 505 are essentially uniform, ranging from 1.49 to 1.53 km/s. Scatter in the data is greatest in the upper 50 meters of the section and is probably related to the greater degree of drilling disturbance in the highly unconsolidated sediments. The mean velocity of 1.51 km/s for the entire section agrees well with the mean velocity of the upper unit in the Site 504 sediments.

Gravimetric Data

As at Site 504, gravimetric parameters display several large-scale variations down the hole. The correlation between the two sites is excellent and is discussed in detail in Wilkens and Langseth (this volume). In general, wet bulk density tends to increase with depth, varying from values between 1.21 and 1.25 g/cm^3 near the top to values approaching 1.5 g/cm^3 at the bottom. Grain density also increases; porosity and water content decrease.

Thermal Conductivity

As at Site 504, thermal conductivity varies mainly with porosity and so exhibits local variations at different levels in the core. In general, conductivity increases with depth; the average value is 0.77 W/m K for the upper section of the core and 1.05 W/m K for the 20-meter-thick layer at the bottom. As at Site 504, sediments with values of conductivity greater than 1.00 W/m K generally have lower-than-usual values of resistivity for any given level of water content, suggesting that the thermal conductivity of the solid skeleton of the sediment is different from that of the more unconsolidated sediments.

PORE WATER CHEMISTRY

The pore water chemistry for the upper 100 meters of the sediment is dominated by the bacterial reduction of sulfate, which has produced an eightfold increase in alkalinity. The increase in alkalinity is accompanied by a reduction in Ca^{2+} to one-third the seawater value due to calcite precipitation. These trends are reversed below 100 meters, probably because of reactions with the basement. Both alkalinity and Ca^{2+} approach seawater values near the basement. The level of Mg^{2+} is very slightly higher in the upper 15 meters of sediment and decreases slightly and gradually from there to basement. An attempt to sample formation water from the basement with the Gearhart-Owen wireline sampler produced a mixture of surface seawater used as drilling fluid and sediment (with interstitial water) that had fallen down the hole. Further details and interstitial water analyses are to be found in chapters by Mottl and others in this volume.

BASEMENT LITHOSTRATIGRAPHY

Hole 505

The basement at Hole 505 was penetrated for about 9 meters, but of this only 0.5 meter was recovered. The rock is petrographically uniform, consisting of a highly plagioclase–olivine phyric basalt containing chrome-spinel and rare emerald green clinopyroxene phenocrysts. The phenocrysts appear rounded and resorbed and are possibly xenocrysts. The groundmass is microlitic and variolitic. Vesicles (which constitute up to 2% of the rock) are empty or partly filled around the border with smectite. In general the basalt is extremely fresh, with olivine altered to clays only along cracks. The recovered rocks would seem to suggest that the basement here is a sequence of fresh pillows and flows or brecciated flows. No cooling margins were recovered. The basalts were too similar to require lithologic subdivision.

Hole 505A

At Hole 505A basement was penetrated for 12 meters, but only about 0.75 meter of basalt was recovered. There were no chilled margins in the core. The basement appears to be a single basalt flow of sparsely plagioclase-olivine phyric basalt with rare accessory chrome-spinel. Hole 505A basalts differ from those of Hole 505 in having fewer phenocrysts and no phyric clinopyroxene.

Hole 505B

Basement was penetrated at Hole 505B for 42 meters, and 6.85 meters were recovered. The recovered rocks represent a pillow and flow sequence and are petrographically rather uniform. They are sparsely to moderately plagioclase-olivine phyric basalts with accessory chrome-spinel. The chrome-spinel is scattered in the groundmass, present in chilled glass margins, and occasionally included in phenocrysts of plagioclase and olivine. The groundmass varies from microlitic to variolitic or glassy at the chilled margins. The central parts of the unit are holocrystalline and have an ophitic groundmass of plagioclase, clinopyroxene, olivine, and titanomagnetite.

The basalts from this hole appear almost identical to those recovered from Hole 505A, both petrologically and geochemically.

BASEMENT IGNEOUS PETROGRAPHY

The basement recovered from the three holes at Site 505 can be divided into two petrographic groups on the basis of phenocryst concentration and mineral composition. The groups are designated Types C and M, the letters being mnemonic devices to indicate the basalt's important petrographic features. Type C is sparsely plagioclase-olivine phyric basalt with accessory chrome-spinel. Type M is strongly plagioclase-olivine-clinopyroxene phyric basalt with accessory chrome-spinel. Emerald green clinopyroxene occurs in Type M as isolated phenocrysts.

Basalts of Type C are confined to Holes 505A and 505B; basalts of Type M, to Hole 505. Accordingly, the Type C basalts will be dealt with under a single heading, Type M basalts under another.

Holes 505A and 505B

Basalts from Holes 505A and 505B appear as a series of fine- to medium-grained sparsely phyric rocks. Basalts defined as Type C for Site 505 can be considered identical to the basalts defined as Type C for Site 504, except that phenocrysts are more abundant at Site 505. The phenocrysts are plagioclase and olivine; clinopyroxene is present only in the groundmass.

The plagioclase phenocrysts, which constitute 4 to 5% of the rock, occur as single crystals and as glomerocrysts. In size the glomerocrysts are comparable to the single crystals (maximum diameter: 2.5–3.0 mm; average: 1.5–2.0 mm), but they are composed of an aggregate of several smaller grains. The grains can be either euhedral or subhedral, and they occasionally enclose granular olivine grains. Most of the macroscopic plagioclase is in the form of single phenocrysts.

Individual plagioclase grains show a greater range in size (0.5–3.2 mm) than the glomerocrysts (1.5–3.0 mm). They also have a more variable texture. Most of the phenocrysts are euhedral or subhedral, but there are occasional resorbed anhedral forms. In the center of a few of the larger phenocrysts there is a zone of small glass inclusions, many of which contain a gas bubble. Very rarely the phenocrysts have dendritic margins, with each dendrite acting as a nucleus for spherulite crystal growth. This nucleation is less pronounced in pillow margins because of the greater degree of undercooling, which suppresses dendrite formation.

Both the glomerocrysts and the phenocrysts are of the same composition, varying between An_{80} and An_{92} (average: An_{88}). Pronounced zoning is common, the crystals becoming more sodic toward their rims, where values are between An_{60} and An_{89}.

Olivine phenocrysts (Fo_{87-89}) form 2 to 3% of the basalt. They occur as euhedral and subhedral grains of variable size (maximum: 0.8–1.0 mm; average: 0.2–0.4 mm). The groundmass crystals occasionally form glomerocrysts of phenocryst size. There are a few cases in which anhedral olivine grains are enclosed within plagioclase phenocrysts. The olivine in these basalts is usually fresh, and alteration down cracks is minor or absent. It is rare to find olivines that are completely replaced by clays.

The groundmass textures in these basalts are similar to those in the Type M basalts, containing acicular skeletal plagioclase in a dendritic spherulitic matrix (50–75%) that is dusted with opaques. The groundmass is microlitic in a mesostasis of spherulitic crystals in glass. The proportion of microlites to mesostasis is variable but appears to be dependent on the grain size of the basalt. Microlites may make up 45% of the coarser interiors of pillows and flows and 15% of the marginal areas. They vary correspondingly in size (length: 0.05–1.5 mm), but their morphology is constant (almost always dendritic and skeletal). There is no flow orientation. Most of the microlites are plagioclase (An_{55-79}); olivine microlites occur but are rare.

The mesostasis, which forms the remainder of the rock (50–55%), is composed of spherulitic crystals in glass. In the fine-grained rocks individual crystals cannot be distinguished from the brown volcanic glass and opaques, but in the coarser-grained rocks and where the glass has been altered to light-colored clays, the crystals (0.02 mm in size) can be seen to be composed of pale brown clinopyroxene and plagioclase. Spherulite fans often show bow-tie and radial structures, and plagioclase microlites commonly act as nuclei.

The minerals pyrite, titanomagnetite, and chrome-spinel form ~2% of the rock. Pyrite occurs as euhedral or skeletal grains and as drawn-out aggregates forming minor veining, all in close proximity to vesicles (secondary?). Trace quantities of submicroscopic pyrite are disseminated in the mesostasis (primary?). Titanomagnetite is euhedral, subhedral, and skeletal; it is highly disseminated and generally submicroscopic. In pillow margins the grains are sometimes preferentially concentrated around the periphery of spherulites. Isolated euhedral chrome-spinel crystals (traces only, in Hole 505A) are skeletal, vermicular, or (more commonly) homogeneous. Chrome-spinel grains can occur within olivine and plagioclase phenocrysts but are not common.

Hole 505

Basalts from Hole 505 belong to a single petrographic group (Type M) and are strongly plagioclase-olivine phyric, with some clinopyroxene phenocrysts and accessory chrome-spinel. The phenocrysts vary widely in morphology and compose up to 30% of the basalt. In total, 20% of the crystals may be plagioclase and 5% may be olivine; the clinopyroxene crystals are occasional.

Plagioclase occurs as phenocrysts and glomerocrysts of variable size (maximum length and diameter: 2.5 mm; average: 1.5-2.0 mm). Its composition is An_{75-92}. Pronounced zoning toward more sodic rims is common. Anhedral glass inclusions occur in the cores of several crystals. Less common are ophitic plagioclase megacrysts that contain inclusions of anhedral olivines and chrome-spinel. Partially resorbed feldspar phenocrysts are sometimes evident.

Olivine (Fo_{87-89}) is present as euhedral or subhedral phenocrysts, some of which are skeletal, and as glomerocrysts. The phenocrysts are 1.0 to 2.5 mm in size. The glomerocrysts are often ophitic or subophitic, the grains containing inclusions of plagioclase. Blue and green smectites partially replace the larger olivine phenocrysts and all of the groundmass olivine.

There are a few clinopyroxene phenocrysts; they are generally anhedral and twinned (1.0-4.0 mm long). Their rounded and corroded appearance suggests a degree of resorption. In hand specimen they appear as bright emerald green crystals.

Chrome-spinel, pyrite, and titanomagnetite form ~2% of the basalt. The chrome-spinel occurs as large euhedral grains, both vermicular and skeletal. The grains often appear within phenocrysts of plagioclase and olivine. Pyrite is limited to veining and is consequently secondary. Submicroscopic euhedral grains of titanomagnetite are disseminated in the mesostasis.

BASEMENT CHEMISTRY

The difference between the petrography of the basalts in Hole 505, on the one hand, and Holes 505A and 505B, on the other, is reflected in the chemistry of these basalts. Shipboard X-ray fluorescence (XRF) measurements (Etoubleau et al., this volume) indicate that samples from Holes 505A and 505B have higher contents of TiO_2, Fe_2O_3, Na_2O, and Zr and lower contents of Al_2O_3, MgO, CaO, Ni, and Sr than basalts from Hole 505 (Table 2).

Table 2. Average chemical composition of Site 505 basalt.

	Hole 505[a]	Hole 505A[a]	Hole 505B[b]
Major elements (wt.%)			
SiO_2	48.24	49.03	49.67
TiO_2	0.74	0.95	0.96
Al_2O_3	17.45	16.05	16.08
Fe_2O_3	8.70	9.71	9.48
MnO	0.14	0.15	0.15
MgO	9.37	8.67	8.70
CaO	13.32	12.70	12.68
Na_2O	1.76	2.16	2.12
K_2O	0.07	0.04	0.05
P_2O_5	0.09	0.08	0.08
H_2O	0.73	0.68	0.75
CO_2	0.13	0.08	0.10
Total	100.24	100.30	100.82
Trace elements (ppm)			
Ni	188	151	161
Sr	85	77	77
Zr	45	54	56
Mg/Mg + Fe	0.696	0.641	0.647
Ca/Ca + Al	0.410	0.419	0.418

[a] Two analyses apiece used for averages.
[b] Eight analyses used for average.

Basalts from Holes 505A and 505B are mafic, but not enough so to have originated as direct melts from the mantle. Their Mg/(Mg + Fe) ratios (0.641 and 0.647) and Ni contents (151 and 161 ppm) are low compared with the Mg/(Mg + Fe) ratio of 0.70 and Ni content of 250 ppm for basalt presumed to derive directly from mantle. The TiO_2 and Zr contents (0.95% and 55 ppm) are lower than in typical mid-ocean-ridge basalts. The mafic character of the basalt derives from the phenocryst phases.

The basalts from Site 505 are less evolved than is common in fast-spreading ridges. (The degree of evolution is usually greater in fast- than in slow-spreading ridges.) Other samples of relatively unevolved lavas from fast-spreading ridges are known, however.

BASEMENT ALTERATION

Oxidized zones along cracks are the only visible sign of alteration. Four color zones typically occur as one proceeds from cracks to the interior of the basalt: dark gray, yellow, red, and light gray. The oxidation boundaries are sharp—vesicles are filled with a blue green clay in the light gray basalt and with orange or red clay in the red and yellow zones.

In thin section, plagioclase and clinopyroxene are fresh; olivine is partially altered to yellow smectite around rims and along cracks that cut across fresh cores. Vesicles are filled with yellow brown clay minerals in the light gray zone, yellow and red clay minerals in the red zone, and green smectites in the dark gray zone.

Carbonates and phillipsite are present in small amounts in the basalts of all three holes.

The chemical composition of the light gray basalt and basalt that is more altered is given in Table 3. The altered zone has a higher content of total iron and K_2O and a lower content of MgO than the light gray basalt (see Noack, this volume). The Sr content of the altered basalt is also higher, probably as a result of the replace-

Table 3. Chemical composition of adjacent less- and more-altered basalt in Hole 505B (shipboard XRF data; Etoubleau et al., this volume).

	Light Gray Basalt, Sample 505B-2-3 (51–52 cm)	Altered Basalt, Sample 505B-2-3 (78–87 cm)
Major elements (wt.%)		
SiO_2	49.62	49.70
TiO_2	0.96	0.96
Al_2O_3	16.05	16.24
Fe_2O_3	9.36	9.64
MnO	0.14	0.18
MgO	8.89	7.72
CaO	12.63	12.89
Na_2O	2.17	2.46
K_2O	0.03	0.16
P_2O_5	0.08	0.09
H_2O	0.97	1.03
CO_2	0.14	0.18
Trace elements (ppm)		
Ni	160	154
Sr	74	109
Zr	53	56

ment of olivine or saponitic clays by Fe- and K-rich clay minerals.

The low temperature measured at the site (Langseth et al., this volume) and the short time since the eruption of the lavas on the seafloor (3.9 Ma) have not permitted great development of alteration. Potassic layer/lattice silicates are absent entirely.

BASEMENT STRUCTURE

The low recovery of the basement basalts at Site 505 precludes a detailed analysis of basement structure. However, certain inferences can usually be drawn about basement structure from the glass rinds, fractures, and alteration rinds in the basalt.

Glassy and spherulitic pieces are present in every core. The lack of recovery of consecutive oriented pieces longer than 20 cm indicates that flows or pillows more than 1 meter thick were not cored.

The number of fractures in oriented rock pieces is too small to infer much about the direction and abundance of fractures *in situ*.

Overall, the basement section is probably a composite of small pillows or flat pillowlike lobes and sheet flows. The occurrence of vertical fractures and vertical alteration rinds implies a predominantly horizontal array of cooling units with vertical and nearly vertical joints. The material is very similar in these respects to basalts recovered from the Eastern Pacific during Legs 34 and 54, where the drilling was as difficult as at Site 505.

BASEMENT PHYSICAL PROPERTIES

Measurements of the physical properties of the basalt at Site 505 were few because of poor recovery. Velocity minicores with a mean porosity of 6.4% and a wet bulk density of 2.86 g/cm³ yielded a mean seismic velocity of 5.89 km/s. Measurements of thermal conductivity had a mean of 1.74 W/m K. Complete data for Site 505 are presented in Wilkens and Karato (this volume), along with data for Site 504. The high density values indicate an extremely fresh mineralogy for these basalts, which explains the relatively high seismic velocities.

BASEMENT PALEOMAGNETISM

The results of magnetic measurements and alternating field (AF) demagnetization with respect to sampling position in Hole 505B are listed in Table 4 and shown in Figure 3. The intensity, susceptibility, and median demagnetizing field (MDF) of the basalts in this hole are reasonably representative of the values obtained by DSDP for other oceanic basalts. The results of the magnetic measurements are as follows:

1) The average intensity of natural remanent magnetization (NRM) is approximately 1×10^{-2} emu/cc.

2) The mean inclination of the NRM of the basalts is low compared with the average inclination of the present dipole field.

3) The inclinations of the basalts before and after AF demagnetization differ by less than 4°.

The results of microscopic observation are listed in Table 5. Throughout the hole the magnetic minerals are relatively small. Both subhedral and euhedral skeletal shapes occur. Very small amounts of sulfide minerals were found in 11 samples.

EXPERIMENTS AND LOGGING

Despite the poor penetration at Site 505, experiments were attempted in the hole for comparison with the measurements at Sites 501 and 504. *In situ* temperature and water samples were obtained, the downhole magnetometer was deployed, and a set of logs was run.

Measurements of *in situ* temperature were made in the sediment in Hole 505 at depths of 86, 143, 181, and 210 meters. All four of these measurements were successful, although while the shallowest measurement was being made the drill bit and probe sank in the sediment for nearly 10 meters, and the probe may have been heated somewhat by friction. Short, apparently frictional disturbances affected the other measurements but did not prevent an accurate reading of *in situ* water temperature. The temperatures were all low; the thermal gradient was only 2°C per 100 meters, which extrapolates

Table 4. Paleomagnetic data, Hole 505B.

Sample (core-section, interval)	Sub-bottom Depth (m)	MDF[a] (Oe)	K[b] (cgs units)	Inclination before, after Demagnetization (°)	Intensity ($\times 10^{-6}$ emu/cc)	Qn[c]
2-1, 115–117	142.1	170	403	−10.5, −12.3	6,691	47
2-2, 81–83	143.3	500	176	14.9, 14.7	10,993	215
3-1, 114–116	151.6	280	228	−10.5, −12.2	14,161	177
3-2, 86–88	152.8	180	301	−10.7, −13.0	8,765	83
4-1, 10–12	159.6	220	557	1.7, 1.5	15,805	81
5-1, 31–33	164.3	150	723	−7.1, −10.0	12,001	47
6-1, 109–111	170.1	130	740	0.2, −3.5	8,400	32
6-2, 6–8	170.6	360	380	−9.0, −10.0	10,680	80

[a] Median demagnetizing field.
[b] Magnetic susceptibility.
[c] Königsberger ratio.

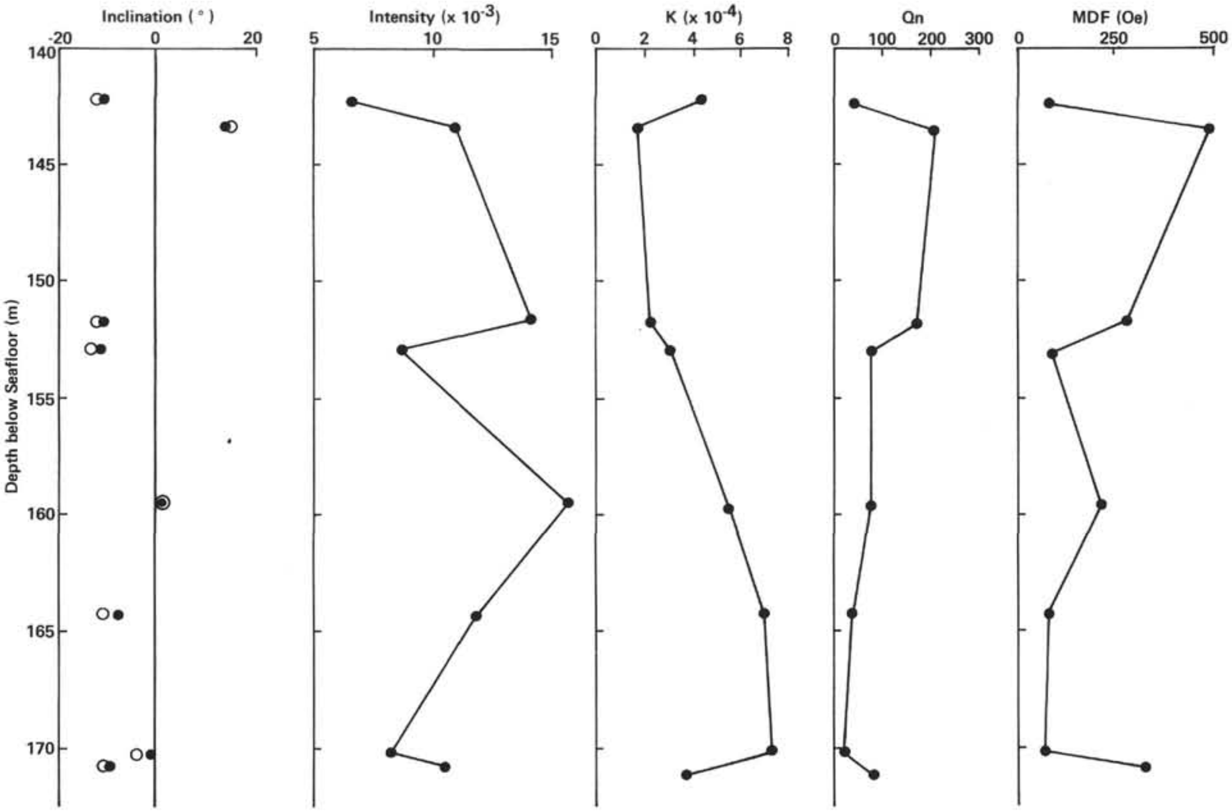


Figure 3. Paleomagnetic properties of Hole 505B basalts. Open circles, initial measurement; filled circles, measurement after demagnetization.

Table 5. Petrographic summary of opaque mineralogy of basalts, Hole 505B.

Sample (core-section, interval)	Titanomagnetite		Remarks
	Shape	Grain Size	
2-1, 108–111	Subhedral	<5 µm	—
2-1, 98–101	Subhedral Skeletal	Max. 30 µm 10~15 µm	—
3-1, 76–79	Subhedral	<5 µm	—
3-2, 99–101	Subhedral Skeletal	Max. 20 µm <10 µm	—
5-1, 43–45	Subhedral	Max. 50 µm 10–20 µm	—
6-1, 112–114	Skeletal	20–30 µm	Ilmenite

Note: Rock in all samples was olivine-plagioclase basalt. Sulfide was rare.

to only 8.95°C at basement. Calculated heat flow was low (18–45 mW m^{-2}).

In situ water samples were obtained with each temperature measurement. Sixteen additional pore water samples were obtained by squeezing sediments recovered by coring from Hole 505, and one rather muddy sample was brought up in the Gearhart-Owen water sampling tool as part of one of the logging runs in Hole 505B. Chemical analyses of these samples are presented and discussed by Mottl et al. (this volume).

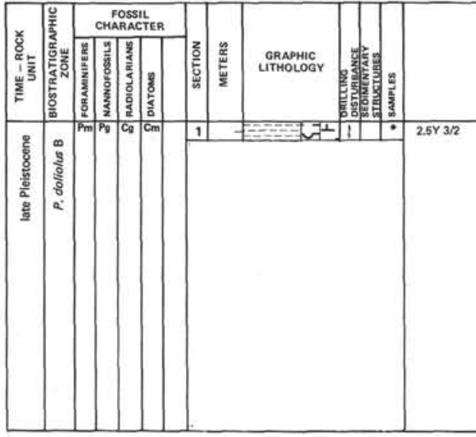
The downhole magnetometer was deployed during the logging of Hole 505B. Magnetic susceptibility and the three components of the magnetic field were measured in the lower 25 meters of sediment and the 42 meters of basement successfully penetrated. The horizontal components of the magnetic field were not measured well over most of the section, because, except for the upper 10 meters of basement, the hole was too close to vertical for the gimballed orientation device to settle in a constant direction. Based on the vertical component alone, however, the basalts are reversely magnetized. Magnetic susceptibility measurements in the sediments gave low and variable results, whereas in the basalts values ranged between 400 and 800×10^{-6} cgs unit. Below the sediment/basalt contact the vertical component of the field increased abruptly to a value approximately 3000 gammas greater than the value for the sediments. Ponomarev and Nekhoroshkov (this volume) discuss these results in greater detail.

Three sets of logs were run in Hole 505B: (1) compensated gamma density, caliper, natural gamma, and temperature logs; (2) neutron porosity, resistivity, and natural gamma logs; and (3) the temperature log, which was run at the same time as the water sampler. In addition, an inclinometer survey was run; it showed the hole to deviate from the vertical by 2.2° at the bottom of the hole. The interval logged ranged from 15 meters above the top of the basalt to 35.5 meters into basement. Below that depth the hole was not accessible to logs. The caliper log showed the hole to be rather irregular, and the porosity and related logs showed great variability in porosity on a scale of meters, with some intervals showing porosities as low as 10% and others porosities of about 50%. This we interpret to be the result of alternations of pillows, thin flows, breccias, and void spaces in the hole. The natural gamma log was generally smooth, but a large peak was observed immediately above the basalt contact, reaching 50 API units. The logs are discussed further in the chapter by Cann and Von Herzen (this volume).

REFERENCE

Lonsdale, P., and Klitgord, K. (1978). Structure and tectonic history of the eastern Panama Basin. *Geol. Soc. Amer. Bull.*, 89:981–999.

SITE 505 HOLE CORE 1 CORED INTERVAL 0.0–0.5 m



LITHOLOGIC DESCRIPTION

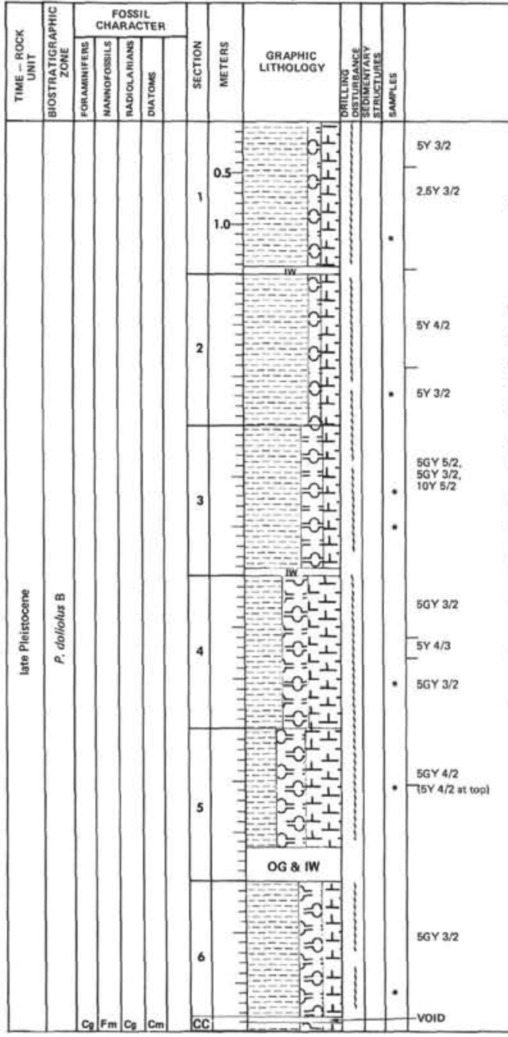
MARLY CALCAREOUS SILICEOUS OOZE

- Basic color: very dark grayish brown (2.5Y 3/2).

SMEAR SLIDE SUMMARY

	1-9
Pyrite	1
Other heavy minerals	TR
Clay minerals	60
Volcanic glass (lt)	3
Volcanic glass (dk)	TR
Carbonate unspec.	3
Foraminifers	2
Calc. nannofossils	10
Diatoms	10
Radiolarians	10
Sponge spicules	TR
Silicoflagellates	1
Mica	TR

SITE 505 HOLE CORE 2 CORED INTERVAL 0.5–10.0 m



LITHOLOGIC DESCRIPTION

MARLY SILICEOUS CALCAREOUS OOZE (0.0–3.0 m),
MARLY CALCAREOUS SILICEOUS OOZE (3.0–4.45 m),
MARLY SILICEOUS NANNOFOSSIL OOZE (4.50–8.95 m)

- Color:
  Marl – dark olive gray (5Y 3/2) to grayish olive green (5GY 3/2), inclusions of very dark grayish brown (2.5Y 3/2); olive gray (5Y 4/2), olive (10Y 5/3) and dusky yellow green (5GY 5/2) patches and "schlieren".
  Ooze – grayish olive green (5GY 3/2–4/2), minor inclusions of olive (5Y 4/3) and olive green (5Y 4/2) patches.
- Burrows only relict due to intense drilling disturbance ("schlieren").
- Grayish black (N2) streaks of pyrite frequent (pyritization of burrows).
- Cores develop strong H_2S odor when split.
- Ash(?) layer at 3.66 m.

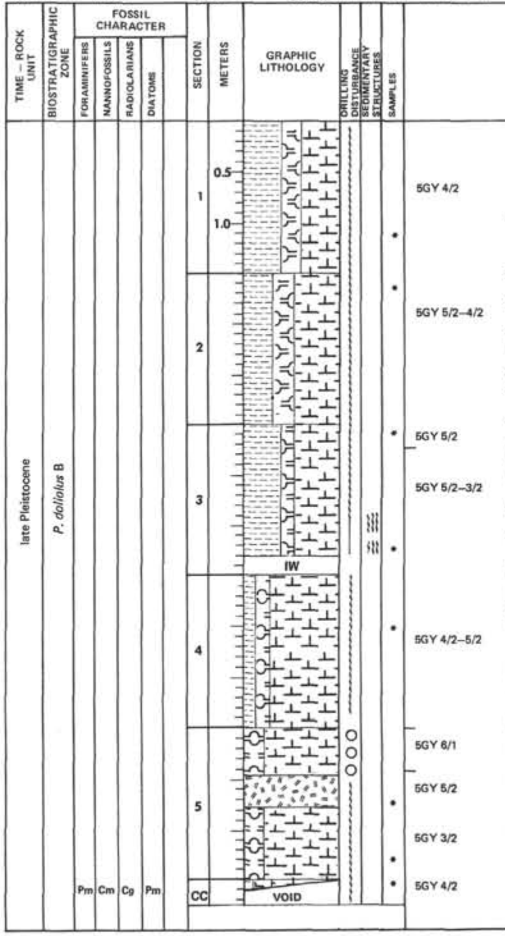
SMEAR SLIDE SUMMARY

	1-115	2-120	3-66	3-105	4-104	5-60	6-110
Feldspar	–	–	TR	–	–	–	–
Pyrite	TR	TR	TR	3	TR	TR	TR
Other heavy minerals	–	–	TR	–	TR	–	TR
Clay minerals	55	50	45	60	35	30	50
Volcanic glass (lt)	6	2	15	2	2	2	2
Carbonate unspec.	2	1	2	1	–	2	–
Foraminifers	10	8	5	2	15	5	4
Calc. nannofossils	10	20	10	10	20	30	20
Diatoms	8	10	10	8	15	15	10
Radiolarians	7	7	10	10	10	10	8
Sponge spicules	TR	2	1	2	2	3	4
Silicoflagellates	2	–	2	2	1	3	2
Mica	–	–	TR	–	TR	–	–

CARBONATE BOMB

2, 73–75 cm = 38%
3, 73–75 cm = 16%
4, 86–88 cm = 27%

SITE 505 HOLE CORE 3 CORED INTERVAL 10.0–19.5 m



LITHOLOGIC DESCRIPTION

MARLY SILICEOUS NANNOFOSSIL OOZE (0.0–4.30 m), CLAY-BEARING SILICEOUS NANNOFOSSIL OOZE (4.50–7.60 m) WITH AN INTERCALATED VOLCANIC ASH LAYER BETWEEN (6.45–6.75 m)

- Color:
  Ooze – dusky yellow green to grayish olive green (5GY 5/2–3/2); greenish gray (5GY 6/1).
  Ash layer – dusky yellow green (5GY 5/2).
- Burrows visible between 0.0–0.50 and 3.90–4.30 m, including Zoophycus.
- Grayish black (N2) streaks of pyrite frequent (pyritization of burrows, particularly between 3.40–3.70 m).
- Foraminfer-rich portion between 3.00–3.40 m.
- Ash layer consists of ~ 80% volcanic glass (colorless, rhyolitic).
- Cores developed strong H_2S odor when split.
- "Schlieren" refer to burrows disturbed by drilling.

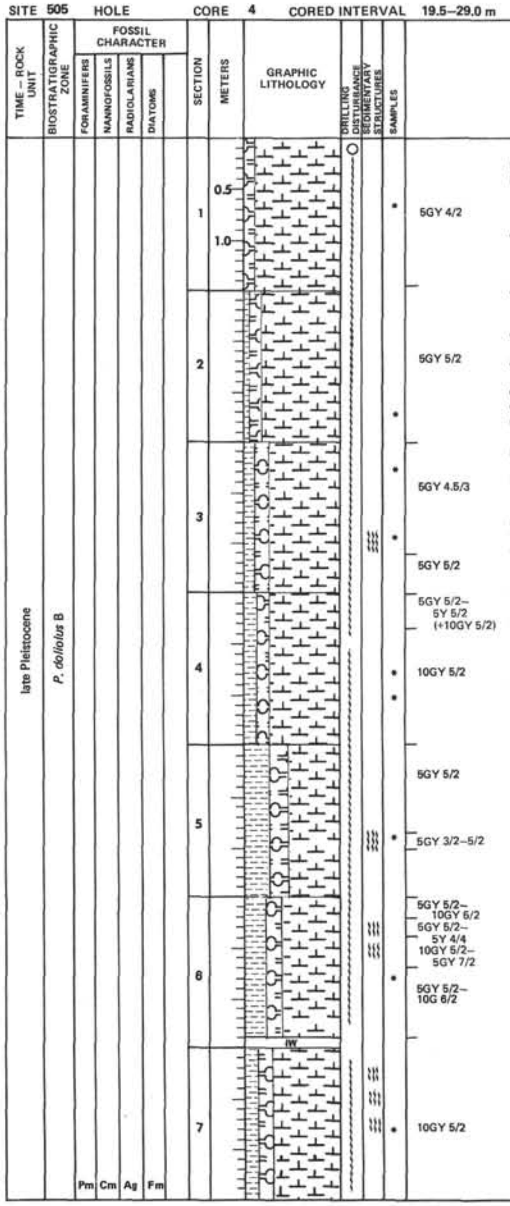
SMEAR SLIDE SUMMARY

	1-110	2-13	3-10	3-125
Feldspar	TR	–	TR	–
Pyrite	5	1	1	TR
Other heavy minerals	TR	TR	–	TR
Clay minerals	30	25	25	20
Volcanic glass (lt)	2	–	5	–
Carbonate unspec.	–	1	–	–
Foraminifers	10	5	30	5
Calc. nannofossils	30	40	25	33
Diatoms	7	10	6	8
Radiolarians	10	10	4	7
Sponge spicules	4	4	3	2
Silicoflagellates	2	2	1	1

	4-50	5-70	5-130	CC-2
Feldspar	TR	10	–	–
Pyrite	TR	TR	TR	TR
Other heavy minerals	–	2	–	–
Clay minerals	7	2	3	10
Volcanic glass (lt)	2	81	TR	TR
Carbonate unspec.	10	3	5	10
Foraminifers	1	–	TR	1
Calc. nannofossils	64	1	72	65
Diatoms	7	–	8	5
Radiolarians	5	–	6	5
Sponge spicules	3	–	4	3
Silicoflagellates	1	–	2	1
Mica	–	1	–	–

CARBONATE BOMB
2, 14–16 cm = 19%
3, 73–75 cm = 17%
5, 130–132 cm = 21%

SITE 505 HOLE CORE 4 CORED INTERVAL 19.5–29.0 m



LITHOLOGIC DESCRIPTION

NOTE: 10.23 m were recovered in this core, 0.0–0.8 m here represents the portion above the 9.5 m liner.

CLAY-BEARING SILICEOUS NANNOFOSSL OOZE

- Color: dusky yellow green (5GY 5/2–4/2) to grayish green (10GY 5/2) with shades toward moderate olive brown (5Y 4/4), pale green (10G 6/2) and grayish yellow green (5GY 7/2).
- Burrows visible between 3.90–4.10 m, 6.80–7.00 m, 7.70–8.00 m, and 9.20–9.80 m, including Zoophycus (mainly grayish yellow green (5GY 7/2).
- Grayish black (N2) to dark gray (N4) spots and streaks ("schlieren") of pyrite frequent.
- Disseminated volcanic ash at 6.90 m (15% colorless volcanic glass).
- Foraminifer-rich layer with some volcanic glass at 3.30 m.
- Cores developed strong H_2S odor when split.
- "Schlieren" also refers to burrows disturbed by drilling.

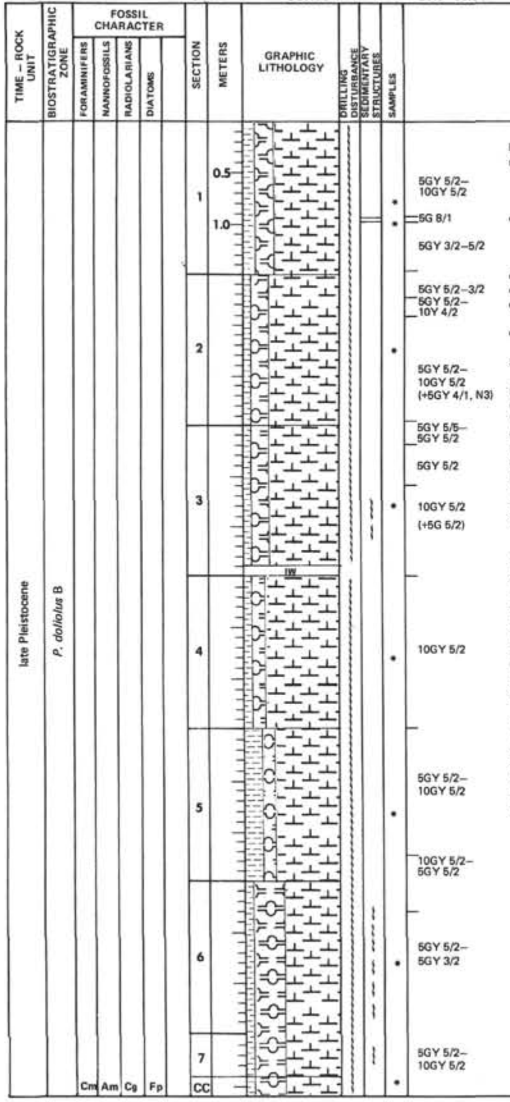
SMEAR SLIDE SUMMARY

	1-70	2-123	3-30	3-95	4-80
Pyrite	TR	TR	TR	TR	TR
Other heavy minerals	–	–	TR	–	–
Clay minerals	5	5	5	15	15
Volcanic glass (lt)	TR	TR	1	TR	TR
Carbonate unspec.	10	5	10	10	10
Foraminifers	5	TR	30	2	5
Calc. nannofossils	70	75	44	56	54
Diatoms	5	5	4	7	7
Radiolarians	5	5	3	6	5
Sponge spicules	3	3	2	3	3
Silicoflagellates	2	2	1	1	1

	4-102	5-90	6-80	7-80
Feldspar	–	3	–	–
Pyrite	TR	2	TR	TR
Clay minerals	15	10	25	15
Volcanic glass (lt)	TR	15	TR	TR
Carbonate unspec.	8	10	10	10
Foraminifers	3	2	5	10
Calc. nannofossils	64	44	45	50
Diatoms	5	5	5	5
Radiolarians	5	5	5	5
Sponge spicules	3	3	3	3
Silicoflagellates	2	1	2	2
Mica	–	TR	–	–

CARBONATE BOMB
2, 101–103 cm = 47%
3, 95–97 cm = 50%
4, 71–73 cm = 37%
5, 84–86 cm = 16%
7, 73–75 cm = 53%

SITE 505 HOLE CORE 5 CORED INTERVAL 29.0–38.5 m



LITHOLOGIC DESCRIPTION

NOTE: 9.52 m were recovered in this core, 0.0–0.02 m here represents the portion above the 9.5 m liner.

SILICEOUS NANNOFOSSIL OOZE

- Color: dusky yellow green (5GY 5/2) to grayish green (10GY 5/2) with shades towards grayish olive green (5GY 3/2), grayish olive (10Y 4/2), dark greenish gray (5GY 4/1), grayish green (5G 5/2).
- Burrows sometimes slightly preserved, including zoophycos.
- Light greenish gray nannofossil layer at 1.00 m.
- Dark gray (N4) and dusky blue green (5BG 3/2) "schlieren" common (pyrite).
- Cores developed strong H_2S odor when split.

SMEAR SLIDE SUMMARY

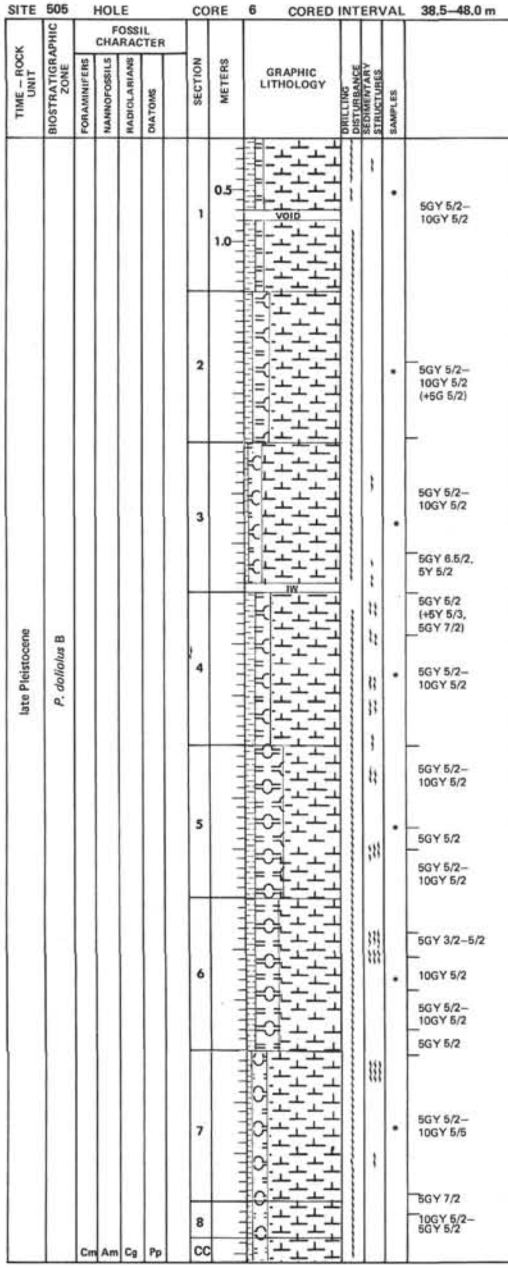
	1-80	1-100	2-75	3-80
Pyrite	TR	TR	TR	1
Clay minerals	10	5	5	5
Volcanic glass (lt)	TR	TR	TR	TR
Carbonate unspec.	15	15	15	10
Foraminifers	5	5	3	5
Calc. nannofossils	50	60	56	47
Diatoms	8	6	10	10
Radiolarians	7	5	7	10
Sponge spicules	3	3	3	5
Silicoflagellates	2	1	1	2

	4-80	5-80	6-80	CC
Pyrite	TR	TR	TR	TR
Clay minerals	5	15	10	10
Volcanic glass (lt)	TR	TR	TR	TR
Carbonate unspec.	15	10	10	7
Foraminifers	5	5	5	5
Calc. nannofossils	61	59	46	64
Diatoms	5	4	10	5
Radiolarians	5	4	10	5
Sponge spicules	3	2	6	3
Silicoflagellates	1	1	3	1

CARBONATE BOMB

1, 73–75 cm = 39%
2, 73–75 cm = 24%
3, 73–75 cm = 37%
4, 73–75 cm = 41%
5, 73–75 cm = 25%
6, 73–75 cm = 19%

SITE 505 HOLE CORE 6 CORED INTERVAL 38.5–48.0 m



LITHOLOGIC DESCRIPTION

NOTE: 10.83 m were recovered in this core, 0.0–1.33 m here represents the portion above the 9.5 m liner.

SILICEOUS NANNOFOSSIL OOZE

- Color: dusky yellow green (5GY 5/2) to grayish green (10GY 5/2) with shades towards grayish green (5G 5/2), olive (5Y 5/2–5/3), grayish yellow green (5GY 7/2).
- Burrows at few parts of the core slightly preserved, mainly Zoophycus.
- Dark gray (N4) "schlieren" and spots common (pyritization).
- Cores developed strong H_2S odor when split.

SMEAR SLIDE SUMMARY

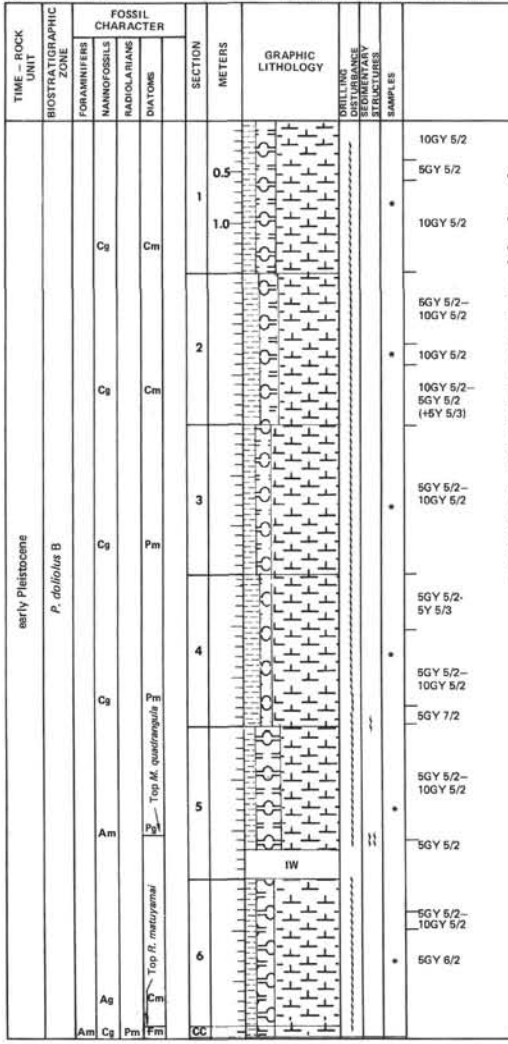
	1-52	2-80	3-80	4-80
Pyrite	TR	TR	TR	TR
Clay minerals	10	5	5	10
Volcanic glass (lt)	TR	TR	TR	TR
Carbonate unspec.	15	10	10	15
Foraminifers	3	2	3	10
Calc. nannofossils	61	64	68	49
Diatoms	3	7	7	5
Radiolarians	3	7	7	5
Sponge spicules	3	3	3	4
Silicoflagellates	2	2	1	2

	5-80	6-80	7-80
Pyrite	TR	TR	TR
Clay minerals	10	8	5
Volcanic glass (lt)	TR	TR	TR
Carbonate unspec.	8	10	5
Foraminifers	5	5	5
Calc. nannofossils	48	53	70
Diatoms	10	8	5
Radiolarians	10	8	5
Sponge spicules	6	5	3
Silicoflagellates	3	3	2

CARBONATE BOMB

1, 53–55 cm = 25%
2, 73–75 cm = 34%
3, 73–75 cm = 24%
4, 73–75 cm = 38%
5, 73–75 cm = 50%
6, 73–75 cm = 32%
7, 73–75 cm = 22%

SITE 505 HOLE CORE 7 CORED INTERVAL 48.0–57.5 m



LITHOLOGIC DESCRIPTION

SILICEOUS NANNOFOSSIL OOZE

- Color: dusky yellow green (5GY 5/2) to grayish green (10GY 5/2) with shades towards olive (5Y 5/3) and grayish yellow green (5GY 6/2).
- Burrows mainly veiled by drilling disturbance (diapiric "schlieren"). Zoophycus present.
- Dark gray (N4) "schlieren" and spots common (pyrite).
- Cores developed strong H_2S odor when split.

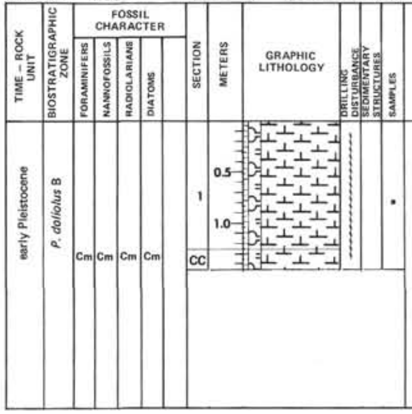
SMEAR SLIDE SUMMARY

	1-80	2-80	3-80	4-80	5-80	6-80
Pyrite	TR	TR	TR	TR	TR	TR
Clay minerals	10	10	5	10	10	10
Volcanic glass (lt)	TR	TR	TR	TR	–	TR
Palagonite	–	–	–	–	TR	–
Carbonate unspec.	15	10	15	10	7	15
Foraminifers	5	3	5	5	3	3
Calc. nannofossils	50	53	52	57	55	52
Diatoms	7	10	10	7	10	7
Radiolarians	7	8	7	6	10	7
Sponge spicules	4	4	4	3	4	4
Silicoflagellates	2	2	2	2	1	2

CARBONATE BOMB

1, 73–75 cm = 31%
2, 73–75 cm = 33%
3, 73–75 cm = 43%
4, 73–75 cm = 41%
5, 73–75 cm = 50%
6, 73–75 cm = 45%

SITE 505 HOLE CORE 8 CORED INTERVAL 57.5–67.0 m



LITHOLOGIC DESCRIPTION

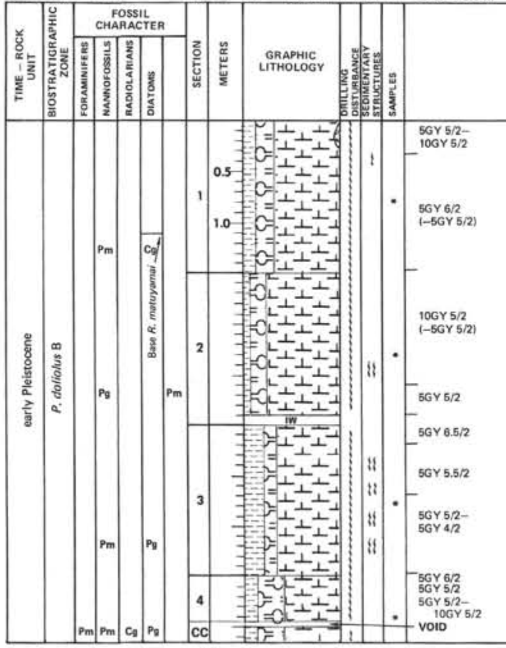
SILICEOUS NANNOFOSSIL OOZE

- Color: dusky yellow green (5GY 5/2) to grayish yellow green (10GY 5/2).
- Core developed strong H_2S odor when split.

SMEAR SLIDE SUMMARY

	1-80
Pyrite	TR
Clay minerals	5
Volcanic glass (lt)	TR
Carbonate unspec.	10
Foraminifers	3
Calc. nannofossils	68
Diatoms	5
Radiolarians	5
Sponge spicules	3
Silicoflagellates	1

SITE 505 HOLE CORE 9 CORED INTERVAL 67.0–76.5 m



LITHOLOGIC DESCRIPTION

CLAY-BEARING SILICEOUS NANNOFOSSIL OOZE

- Color: dusky yellow green (5GY 5/2, 5GY 5.5/2) to grayish yellow green (10GY 5/2) with shades towards grayish yellow green (5GY 6.5/2), grayish olive green (5GY 4/2) and light grayish green (5GY 6/2).
- Burrows common below 2.40 m, mainly Zoophycus.
- Dark gray (N4) spots and "schlieren" common (pyrite).
- Cores developed strong H_2S odor when split.

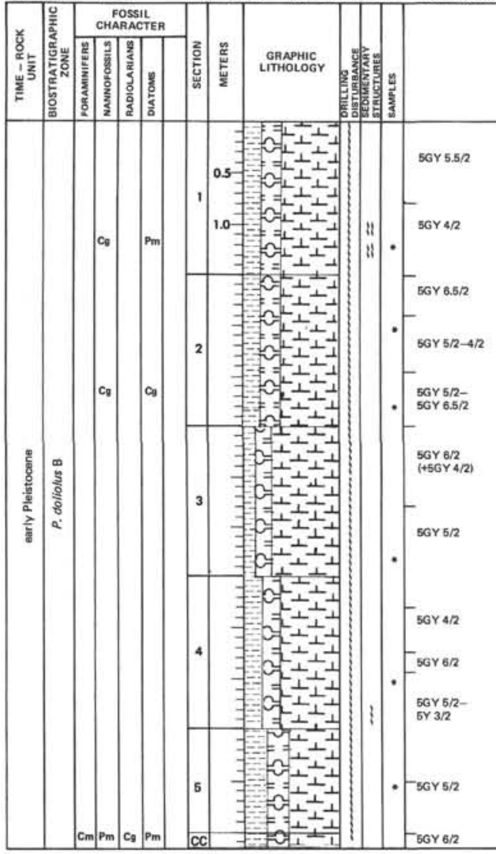
SMEAR SLIDE SUMMARY

	1-80	2-80	3-80	4-40
Pyrite	TR	TR	TR	TR
Other heavy minerals	–	TR	–	–
Clay minerals	10	5	15	15
Volcanic glass (lt)	TR	TR	TR	TR
Carbonate unspec.	10	10	10	2
Foraminifers	3	3	2	4
Calc. nannofossils	61	68	56	55
Diatoms	6	5	9	10
Radiolarians	6	5	6	8
Sponge spicules	3	3	3	3
Silicoflagellates	1	1	1	3

CARBONATE BOMB

1, 100–102 cm = 44%
2, 73–75 cm = 49%
3, 73–75 cm = 27%

SITE 505 HOLE CORE 10 CORED INTERVAL 76.5–86.0 m



LITHOLOGIC DESCRIPTION

CLAY-BEARING SILICEOUS NANNOFOSSIL OOZE

- Color: dusky yellow green (5GY 5/2–4/2) to grayish yellow green (5GY 6/2–7/2), shades towards grayish olive green (5GY 4/2), moderate olive green (5Y 3/2).
- Burrows rare. Zoophycus present.
- Dark gray (N4) and grayish black (N2) spots and "schlieren" (pyrite).
- H_2S odor when cores were split.
- "Schlieren" refer to mixed up burrows and pyrite streaks and spots (drilling disturbance).

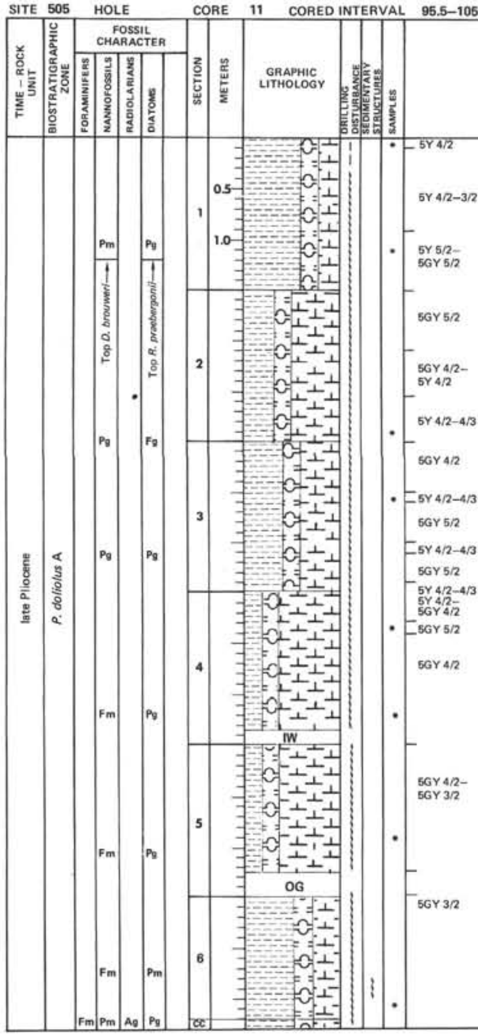
SMEAR SLIDE SUMMARY

	1-120	2-50	2-130	3-130	4-100	5-60
Pyrite	TR	1	TR	TR	TR	TR
Other heavy minerals	–	TR	–	TR	–	–
Clay minerals	20	25	5	10	15	20
Volcanic glass (lt)	TR	TR	2	TR	TR	TR
Carbonate unspec.	3	2	–	4	2	3
Foraminifers	2	5	8	6	6	5
Calc. nannofossils	52	43	59	60	60	50
Diatoms	8	6	10	8	7	8
Radiolarians	7	10	7	7	6	7
Sponge spicules	4	3	4	2	2	3
Silicoflagellates	4	4	5	3	2	4
Mica	–	TR	–	–	–	–

CARBONATE BOMB

1, 73–75 cm = 38%
2, 73–75 cm = 25%
3, 73–75 cm = 55%
4, 73–75 cm = 52%
5, 73–75 cm = 34%

SITE 505 HOLE CORE 11 CORED INTERVAL 95.5–105.0 m



LITHOLOGIC DESCRIPTION

CLAY-BEARING SILICEOUS NANNOFOSSIL OOZE/MARL

- Color: dusky olive gray (5GY 4/2–5Y 4/2) to dusky olive green (5GY 4/2) to grayish olive green (5GY 3/2), transitions to dark olive gray (5Y 3/2) and olive gray (5Y 4/3).
- Burrows rare (mainly disturbed by drilling).
- Gas bubbles between 5.35–5.50 m.
- H_2S odor when cores were split.
- "Schlieren" frequent, refer to mixed up burrows and pyrite streaks and spots.

SMEAR SLIDE SUMMARY

	1-7	1-110	2-140	3-60
Pyrite	TR	TR	TR	1
Other heavy minerals	55	25	30	20
Volcanic glass (lt)	TR	TR	2	1
Carbonate unspec.	2	8	5	10
Foraminifers	2	4	5	2
Calc. nannofossils	20	40	30	49
Diatoms	8	10	6	6
Radiolarians	7	8	5	5
Sponge spicules	5	4	5	4
Silicoflagellates	1	2	2	2

	4-35	4-120	5-90	6-105
Feldspar	–	–	–	TR
Pyrite	TR	2	TR	1
Other heavy minerals	TR	–	TR	–
Clay minerals	15	15	10	50
Volcanic glass (lt)	TR	1	TR	TR
Carbonate unspec.	5	5	8	10
Foraminifers	3	2	3	2
Calc. nannofossils	54	50	58	20
Diatoms	8	10	8	6
Radiolarians	7	8	7	6
Sponge spicules	6	5	5	3
Silicoflagellates	2	2	1	2

CARBONATE BOMB

1, 100–102 cm = 31%
2, 73–75 cm = 25%
3, 73–75 cm = 12%
4, 73–75 cm = 13%
5, 73–75 cm = 10%
6, 73–75 cm = 19%

SITE 505 HOLE CORE 12 CORED INTERVAL 105.0–114.5 m

TIME – ROCK UNIT: late Pliocene

BIOSTRATIGRAPHIC ZONE: *P. doliolus* A

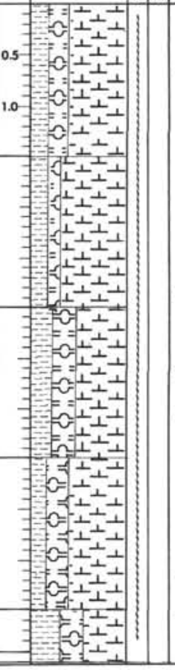
FOSSIL CHARACTER

FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS
Fm	Pm	Cg	Cg

Base *P. doliolus*

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

METERS: 0.5, 1.0



SAMPLES

5GY 3/2–5/2
5GY 4/2
5Y 4/2
5GY 5/2–
5Y 5/2
5Y 3/2
5GY 5/2–
5Y 5/2
5Y 4/2
5Y 5/2
5Y 4/2
5GY 6/2
5GY 5/2
5Y 4/3

LITHOLOGIC DESCRIPTION

CLAY-BEARING SILICEOUS NANNOFOSSIL OOZE

- Color: dusky yellow green to grayish olive green (5GY 5/2–3/2) to dusky olive green to olive gray (5GY 4/2–5Y 4/2; 5Y 5/2), olive (5Y 4/3). Inclusions of grayish yellow green (5GY 6/2).
- H_2S odor when cores were split.
- *"Schlieren" refer to mixed up burrows.*

SMEAR SLIDE SUMMARY

	1-70	2-135	3-66	3-110	4-116	5-10
Pyrite	TR	1	2	1	1	TR
Other heavy minerals	TR	–	TR	–	–	–
Clay minerals	15	15	30	25	15	30
Volcanic glass (lt)	1	TR	TR	TR	–	TR
Carbonate unspec.	6	10	10	10	5	7
Foraminifers	3	5	2	3	2	3
Calc. nannofossils	52	57	34	35	55	38
Diatoms	10	2	7	10	8	6
Radiolarians	8	5	10	8	6	5
Sponge spicules	3	4	4	5	6	10
Silicoflagellates	2	1	1	3	2	1

CARBONATE BOMB
2, 37–39 cm = 13%
3, 73–75 cm = 23%
4, 73–75 cm = 19%

SITE 505 HOLE CORE 13 CORED INTERVAL 114.5–124.0 m

TIME – ROCK UNIT: late Pliocene

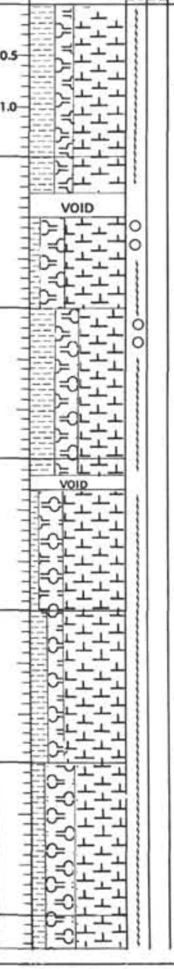
BIOSTRATIGRAPHIC ZONE: *R. praebergonii* C

FOSSIL CHARACTER

FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS
	Fm		Cg
	Fm		Pg
	Pm		Pg
	Cm		Cm
	Pm		Fm
	Pm		Pm
Rm	Pm	Ag	Cg

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

METERS: 0.5, 1.0



SAMPLES

5Y 3/2
5GY 4/2–
5Y 4/2
5Y 5/2–
5GY 5/2
5Y 4/2
5Y 5/2–
5GY 5/2
5GY 3/2
5GY 5/2
5GY 4/2
5GY 3/2
5GY 5/2–
10GY 5/2
5GY 3/2
5Y 4/3–
5GY 5/2
5GY 5/2
5GY 4/2
5Y 4/3

LITHOLOGIC DESCRIPTION

CLAY-BEARING SILICEOUS NANNOFOSSIL OOZE

- Color: dark olive gray (5Y 3/2) to dusky olive gray (5GY 4/2–5Y 4/2) to dusky olive green (5Y 5/2–5GY 5/2) with dusky yellow green (5GY 3/2–4/2), grayish green (10GY 5/2) and olive (5Y 4/3) shades.
- Mostly homogenized by drilling.
- Strong H_2S odor when cores were split.

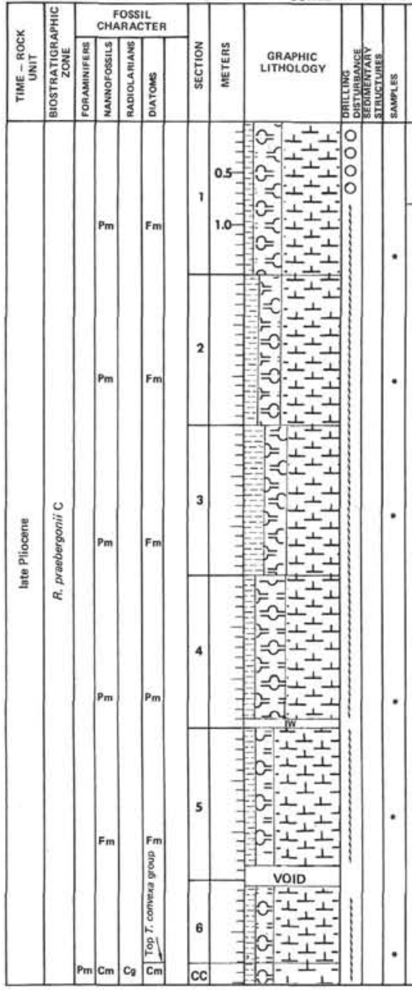
SMEAR SLIDE SUMMARY

	1-80	2-140	3-90	4-90
Pyrite	1	TR	TR	TR
Other heavy minerals	–	TR	TR	TR
Clay minerals	25	10	25	15
Volcanic glass (lt)	TR	1	1	TR
Carbonate unspec.	7	6	15	10
Foraminifers	3	3	1	1
Calc. nannofossils	44	60	39	55
Diatoms	8	8	8	8
Radiolarians	7	8	7	7
Sponge spicules	2	1	2	3
Silicoflagellates	3	3	2	1
Mica	–	TR	TR	–

	4-130	5-80	5-140	6-130
Pyrite	TR	TR	TR	TR
Clay minerals	10	15	10	15
Volcanic glass (lt)	TR	TR	TR	1
Carbonate unspec.	7	15	10	5
Foraminifers	3	–	1	1
Calc. nannofossils	60	50	60	52
Diatoms	10	10	8	15
Radiolarians	6	8	5	6
Sponge spciules	3	2	3	5
Silicoflagellates	1	–	2	1

CARBONATE BOMB
1, 73–75 cm = 14%
3, 73–75 cm = 15%
4, 73–75 cm = 13%
5, 73–75 cm = 53%
6, 73–75 cm = 46%

SITE 505 HOLE CORE 14 CORED INTERVAL 124.0–133.5 m



LITHOLOGIC DESCRIPTION

5Y 5/2–
5GY 5/2

5GY 5/2

(+5Y 5/2–
5GY 5/2)

5GY 5/2

(+5Y 5/2–
5GY 5/2)

5GY 5/2–
10GY 5/2

5GY 5/2

10GY 5/2

5GY 5/2–
10GY 5/2

CLAY-BEARING SILICEOUS NANNOFOSSIL OOZE

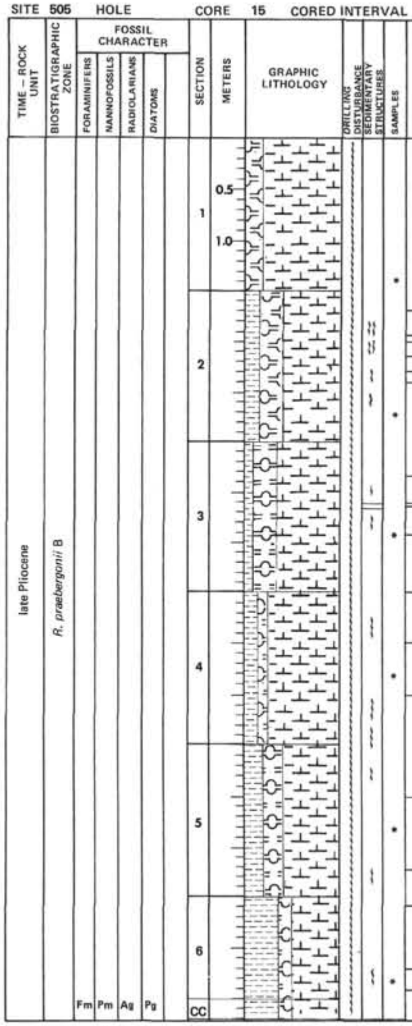
- Color: dusky olive green (5Y 5/2–5GY 5/2) to dusky yellow green (5GY 5/2) to grayish green (10GY 5/2).
- "Schlieren" and spots of olive tints as well as grayish black (N2) and gray (N4) frequent. The latter refers to pyrite in or around burrows.
- H_2S odor when cores were split.
- "Schlieren" from diapiric drilling disturbances resemble mixed up burrows and pyrite streaks and spots.

SMEAR SLIDE SUMMARY

	1-130	2-100	3-90	4-120	5-80	6-70
Pyrite	1	TR	TR	TR	TR	TR
Other heavy minerals	TR	TR	TR	–	–	–
Clay minerals	10	10	15	10	10	15
Volcanic glass (lt)	TR	TR	TR	TR	–	–
Carbonate unspec.	5	5	5	10	10	15
Foraminifers	3	1	1	–	1	4
Calc. nannofossils	55	60	56	54	60	51
Diatoms	15	10	10	15	10	7
Radiolarians	8	7	8	8	5	5
Sponge spicules	2	3	3	1	2	2
Silicoflagellates	1	4	2	2	2	1

CARBONATE BOMB
2, 73–75 cm = 44%
3, 73–75 cm = 37%
4, 73–75 cm = 39%
5, 73–75 cm = 48%

SITE 505 HOLE CORE 15 CORED INTERVAL 133.5–143.0 m



LITHOLOGIC DESCRIPTION

5GY 7/2

5GY 6/2
10GY 5/2
(–5GY 5/2)
5GY 6/2
10GY 5/2
(–5GY 5/2)
5GY 6/2

5GY 5/2

5GY 6/2

5GY 5.5/2

5GY 5/2–
5Y 4/4

5GY 5/2

5GY 5/2–
10GY 5/2

5GY 5/2

5GY 6.5/2

5GY 4.5/2

5GY 6/2

5GY 5.5/2

5GY 3/2–5/2
(+5Y 4/4)

10GY 5/2–
5GY 5/2

5GY 7/2

5GY 3/2–5/2

CLAY-BEARING SILICEOUS NANNOFOSSIL OOZE

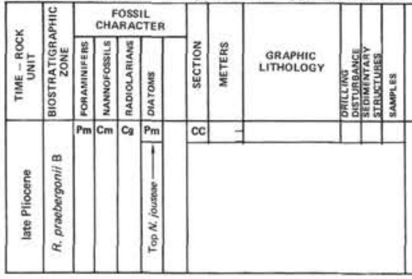
- Color: grayish yellow green (5GY 7/2–6/2) to dusky yellow green (5GY 5/2) with inclusions of grayish green (10GY 5/2), grayish olive green (5GY 3/2–4.5/2) and moderate olive brown (5Y 4/4).
- Burrows recognizable quite frequently, among them Zoophycus.
- "Schlieren" of intermixed sediment common (diapiric appearance).
- Grayish black to gray "schlieren" and spots very common, *referring to pyrite in or around burrows.*
- Grayish purple (5P 4/2) burrow rind at 2.90 m.
- H_2S odor when cores were split.

SMEAR SLIDE SUMMARY

	1-140	2-120	3-90	4-80	5-80	6-80
Pyrite	TR	TR	1	TR	TR	2
Other heavy minerals	–	–	–	TR	TR	–
Clay minerals	5	15	10	10	20	25
Volcanic glass (lt)	TR	–	TR	TR	TR	TR
Carbonate unspec.	15	10	10	7	15	15
Foraminifers	2	4	4	8	5	7
Calc. nannofossils	61	50	54	65	45	37
Diatoms	6	10	8	5	8	6
Radiolarians	5	6	6	2	5	4
Sponge spicules	4	3	3	2	2	7
Silicoflagellates	2	2	4	1	2	2
Mica	–	–	–	–	TR	–

CARBONATE BOMB
2, 123–125 cm = 54%
3, 73–75 cm = 44%
4, 73–75 cm = 60%
5, 73–75 cm = 48%
6, 26–28 cm = 32%

SITE 505 HOLE CORE 16 CORED INTERVAL 152.5–162.0 m



LITHOLOGIC DESCRIPTION

Only 2 cm were recovered, none in liner.

SITE 505 HOLE CORE 17 CORED INTERVAL 162.0–171.5 m

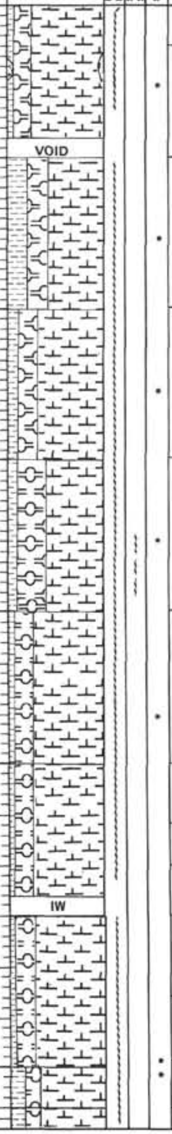
TIME – ROCK UNIT: late Pliocene

BIOSTRATIGRAPHIC ZONE: *R. praebergonii* A

FOSSIL CHARACTER: FORAMINIFERS Rm, NANNOFOSSILS Pm, RADIOLARIANS Ag, DIATOMS Pm

SECTION: 1, 2, 3, 4, 5, 6, 7, 8, CC

METERS: 0.5, 1.0



5GY 6/2
5GY 6/2–7/2
5GY 5/2–10GY 5/2
(+5GY 3.5/2)
5GY 6.5/2–7/2
5GY 6.5/2
5GY 6/2
5Y 6/2
5GY 6/2
5Y 6/2
5GY 6/2
10Y 4.5/3
5–10Y 4/3
5GY 5/2
10GY 5/2–6/2

LITHOLOGIC DESCRIPTION

NOTE: 10.99 m were recovered in this core, 0.0–1.50 m here represent the portion above the 9.5 m liner.

SILICEOUS NANNOFOSSIL OOZE

- Color: grayish yellow green (5GY 6/2–7/2) with inclusions of dusky yellow green to grayish green (5GY 5/2 to 10GY 5/2), light grayish olive (10Y 4.5/3), moderate olive gray (5–10Y 4/3), light olive gray (5Y 6/2).
- Burrows rare.
- Grayish black–medium gray (N2–N4) "schlieren and spots (pyrite).
- H_2S odor when cores were split.
- Diapiric "schlieren" from mixed up burrows.

SMEAR SLIDE SUMMARY

	1-80	2-80	3-80	4-80	5-100	7-147	8-10
Pyrite	2	1	1	TR	TR	1	TR
Other heavy minerals	–	TR	–	TR	–	–	–
Clay minerals	5	20	10	10	5	5	7
Volcanic glass (lt)	–	TR	TR	TR	–	–	–
Carbonate unspec.	15	20	10	10	10	6	5
Foraminifers	2	1	2	4	–	–	–
Calc. nannofossils	57	37	58	50	66	69	62
Diatoms	10	10	8	15	10	7	7
Radiolarians	6	7	7	6	4	5	5
Sponge spicules	2	3	1	1	3	5	3
Silicoflagellates	1	2	3	4	2	2	1

CARBONATE BOMB
2, 73–75 cm = 40%
3, 73–75 cm = 52%
4, 73–75 cm = 42%
5, 73–75 cm = 46%
7, 73–75 cm = 53%

SITE 505 HOLE CORE 18 CORED INTERVAL 171.5–181.0 m

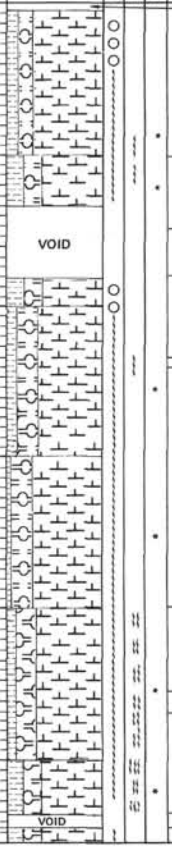
TIME – ROCK UNIT: late Pliocene

BIOSTRATIGRAPHIC ZONE: *R. praebergonii* A

FOSSIL CHARACTER: FORAMINIFERS Pm, NANNOFOSSILS Cm, Cm, Cm, Pm, Fm, Pm, RADIOLARIANS Ag, Base *R. praebergonii*, DIATOMS Pg, Pm, Pm, Pm, Pm, Pm

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

METERS: 0.5, 1.0



VOID
5GY 5/2–10GY 5/2
5GY 6/2
5GY 6/2
10GY 5/2
5GY 6/2
5GY 5.5/2
5GY 6/2
5GY 5.5/2
10GY 5/2–5GY 7/2

LITHOLOGIC DESCRIPTION

SILICEOUS NANNOFOSSIL OOZE

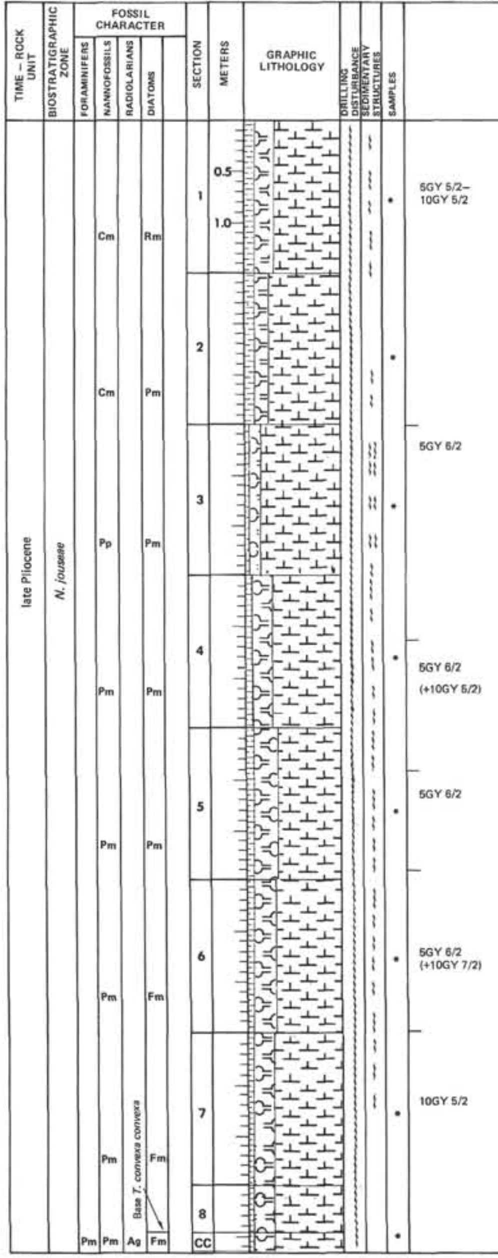
- Color: grayish yellow green (5GY 6/2–7/2) with shades towards dusky yellow green–grayish green (5GY 5/2–10GY 5/2).
- Burrows rare in upper 6.50 m, burrowing moderate to intense below 6.50 m (mainly dusky yellow green–light olive green [5GY 5/2–5Y 5/6]).
- Diapiric "schlieren" throughout the core from mixed up burrows.
- Grayish black (N2) spots and "schlieren" (pyrite), from pyrite in and around burrows frequent.

SMEAR SLIDE SUMMARY

	1-130	2-35	3-80	4-80	5-80	6-30
Pyrite	7	TR	1	1	1	15
Clay minerals	10	7	10	10	7	10
Volcanic glass (lt)	–	TR	TR	1	–	TR
Palagonite	TR	–	TR	–	TR	TR
Carbonate unspec.	10	7	3	10	5	7
Foraminifers	2	2	–	3	3	2
Calc. nannofossils	57	65	65	57	62	55
Diatoms	7	7	6	5	7	8
Radiolarians	7	6	8	8	8	9
Sponge spicules	4	4	5	5	5	5
Silicoflagellates	2	2	2	6	2	2

CARBONATE BOMB
1, 133–135 cm = 43%
3, 73–75 cm = 42%
4, 73–75 cm = 46%
5, 73–75 cm = 42%
6, 73–75 cm = 47%

SITE 505 HOLE CORE 19 CORED INTERVAL 181.0–190.5 m



LITHOLOGIC DESCRIPTION

NOTE: 11.10 m were recovered in this core, 0.0–1.60 m here represent the portion above the 9.5 m liner.

SILICEOUS NANNOFOSSIL OOZE

- Color: grayish yellow green (5GY 6/2) with shades towards dusky yellow green (5GY 5/2) to grayish green (10GY 5/2), pale yellowish green (10GY 7/2).
- Burrows common (pale olive [10Y 6/2], light olive brown [5Y 5/2]).
- Diapiric "schlieren" throughout the core from mixed up burrows.
- Grayish black (N2) to dark gray (N4) "schlieren" from pyrite in and around burrows.
- Pale green (5G 7/2) rind of "halo" around burrow at 8.55 m.
- H_2S odor when cores were split.

SMEAR SLIDE SUMMARY

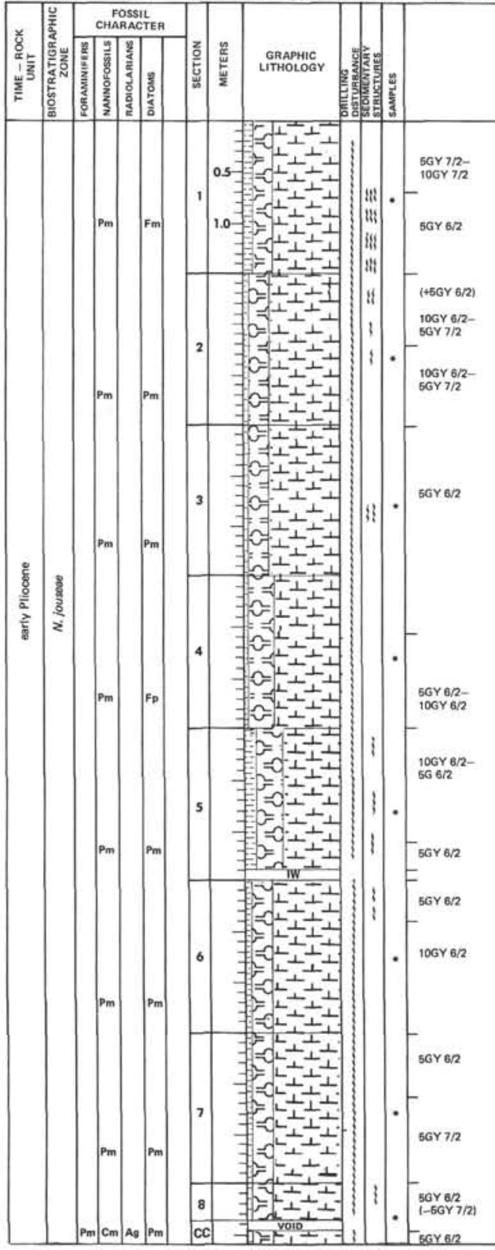
	1-80	2-80	3-80	4-80
Pyrite	1	TR	TR	–
Other heavy minerals	–	–	–	TR
Clay minerals	10	10	7	7
Palagonite	–	TR	–	TR
Carbonate unspec.	5	5	5	5
Foraminifers	2	3	3	3
Calc. nannofossils	65	67	73	69
Diatoms	5	5	4	5
Radiolarians	6	6	4	4
Sponge spicules	4	3	3	5
Silicoflagellates	2	1	1	2

	5-80	6-80	7-80	CC-10
Pyrite	TR	TR	–	TR
Other heavy minerals	–	TR	TR	–
Clay minerals	5	8	8	10
Volcanic glass (lt)	–	TR	TR	–
Palagonite	TR	–	–	TR
Carbonate unspec.	8	5	7	10
Foraminifers	2	2	2	2
Calc. nannofossils	58	62	67	61
Diatoms	8	8	5	6
Radiolarians	9	9	5	7
Sponge spicules	5	5	5	3
Silicoflagellates	2	1	1	1

CARBONATE BOMB

1, 73–75 cm = 44%
2, 73–75 cm = 41%
3, 73–75 cm = 52%
4, 73–75 cm = 46%
5, 73–75 cm = 52%
6, 73–75 cm = 57%
7, 73–75 cm = 50%

SITE 505 HOLE CORE 20 CORED INTERVAL 190.5–200 m



LITHOLOGIC DESCRIPTION

NOTE: 11.00 m were recovered in this core, 0.0–1.50 m here represent the portion above the 9.5 m liner.

SILICEOUS NANNOFOSSIL OOZE

- Color: grayish yellow green (5GY 6/2) to grayish yellow green to pale yellow green (5GY 7/2 to 10GY 6/2 to 7/2).
- Burrow common (dusky yellow green [5GY 5.5/2], pale olive [10Y 6/2]).
- Diapiric "schlieren" (pale olive [10Y 6/2], dusky yellow green [5GY 5/2]) common, refer to mixed up burrows.
- Dark gray (N4), dusky blue (5PB 3/2) and grayish green (10G 4/2) "schlieren" refer to pyrite in and around burrows.
- H_2S odor when cores were split.

SMEAR SLIDE SUMMARY

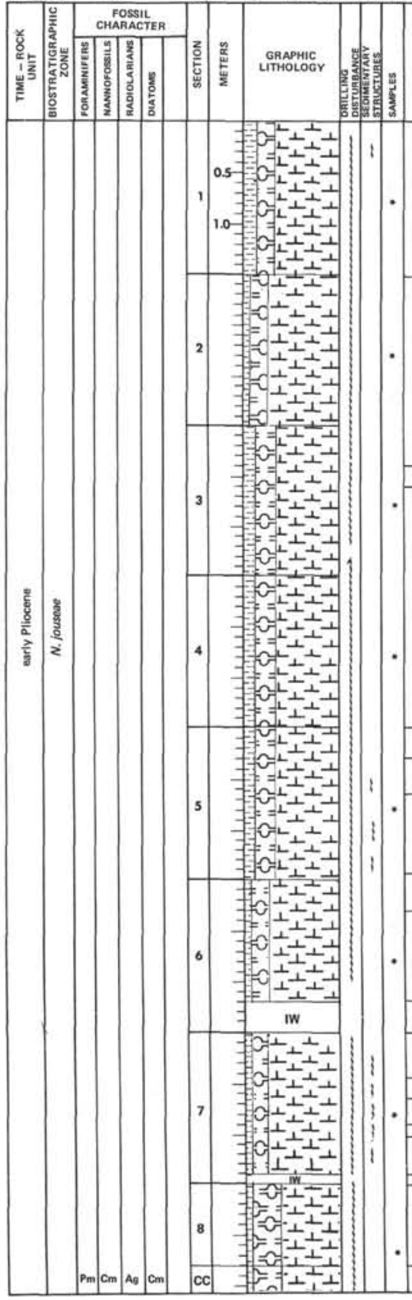
	1-80	2-80	3-80	4-80
Pyrite	TR	TR	TR	TR
Clay minerals	10	10	5	10
Volcanic glass (lt)	TR	TR	TR	TR
Palagonite	TR	TR	TR	–
Carbonate unspec.	10	10	10	7
Foraminifers	2	3	3	8
Calc. nannofossils	55	56	58	52
Diatoms	10	7	10	8
Radiolarians	8	8	7	8
Sponge spicules	4	4	5	5
Silicoflagellates	1	2	2	2
Mica	–	–	–	TR

	5-80	6-80	7-80	8-30
Pyrite	TR	TR	TR	TR
Clay minerals	8	5	5	5
Volcanic glass (lt)	TR	TR	–	–
Palagonite	–	–	TR	TR
Carbonate unspec.	10	8	5	5
Foraminifers	2	10	10	3
Calc. nannofossils	55	57	53	59
Diatoms	10	10	10	12
Radiolarians	8	8	10	8
Sponge spicules	5	5	5	4
Silicoflagellates	2	2	2	2

CARBONATE BOMB

1, 73–75 cm = 54%
2, 73–75 cm = 45%
3, 73–75 cm = 54%
4, 73–75 cm = 43%
5, 73–75 cm = 40%
6, 73–75 cm = 50%
7, 73–75 cm = 52%

SITE 505 HOLE CORE 21 CORED INTERVAL 200.0–209.5 m



LITHOLOGIC DESCRIPTION

10GY 6/2–6.5/2
(+10Y 6/2)

5GY 7/2
(–10GY 7/2)

10GY 5.5/2–6/2
(+10Y 6/2)

5GY 6.5/2

5GY 5.5/2

5GY 6/2

5GY 6.5/2
(+10Y 6/2)

5GY 6/2

5GY 6.5/2

5GY 6/2

5GY 6.5/2–
10GY 7/2

5GY 6/2

5GY 6.5/2

5GY 6/2

5GY 6.5/2

5GY 6/2

5GY 7/2–
10GY 7/2

NOTE: 11.49 m were recovered in this core, 0.0–1.99 m here represent the portion above the 9.50 m liner.

SILICEOUS NANNOFOSSIL OOZE

- Color: grayish yellow green (5GY 6/2–7/2) to pale yellowish green (10GY 6/2–7/2), shades towards grayish green (10GY 5.5/2).
- Burrows mainly disturbed by drilling leading to "schlieren" (pale olive [10Y 6/2], light olive [5Y 5/2]).
- Grayish blue green (5BG 5/2) "schlieren" seem to derive from burrow halos.
- Medium gray "schlieren" and spots refer to pyrite in and around burrows.

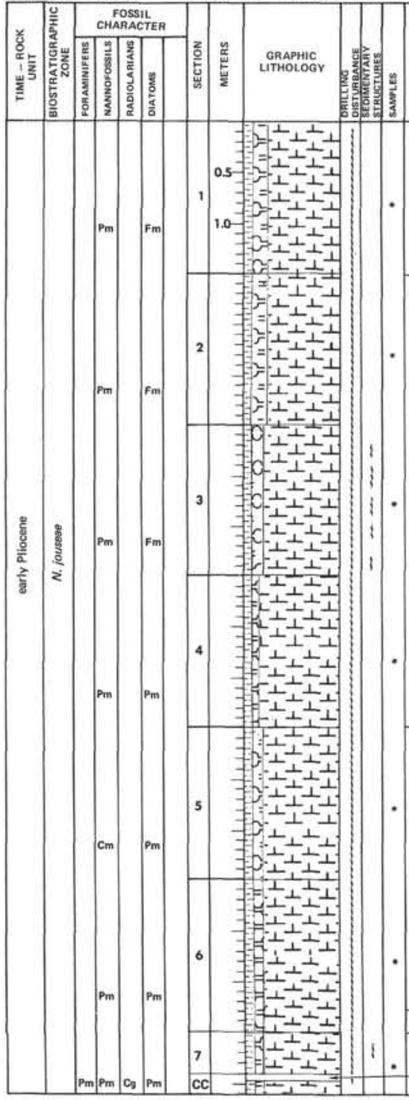
SMEAR SLIDE SUMMARY

	1-80	2-80	3-80	4-80
Pyrite	TR	TR	TR	TR
Clay minerals	10	5	10	10
Volcanic glass (lt)	TR	–	TR	–
Palagonite	TR	–	TR	–
Carbonate unspec.	8	10	10	10
Foraminifers	4	3	2	3
Calc. nannofossils	59	63	54	49
Diatoms	6	6	10	10
Radiolarians	7	6	8	10
Sponge spicules	4	5	4	5
Silicoflagellates	2	2	2	3

	5-80	6-80	7-80	8-70
Clay minerals	10	5	5	7
Carbonate unspec.	10	7	6	10
Foraminifers	3	3	2	5
Calc. nannofossils	57	64	67	51
Diatoms	8	8	8	10
Radiolarians	6	6	6	10
Sponge spicules	4	5	4	5
Silicoflagellates	2	2	2	2

CARBONATE BOMB
1, 73–75 cm = 56%
2, 73–75 cm = 57%
3, 73–75 cm = 55%
4, 73–75 cm = 52%
5, 73–75 cm = 54%
6, 73–75 cm = 59%
7, 73–75 cm = 59%
8, 63–65 cm = 64%

SITE 505 HOLE CORE 22 CORED INTERVAL 209.5–219.0 m



LITHOLOGIC DESCRIPTION

5GY 7/2–
10GY 7/2
(+5BG 7/2,
+5Y 7/2)

5GY 7/2–
10G 8/2

5GY 7/2–
10GY 7/2

(+5G 6/1,
5BG 7/2,
5PB 5/2)

(+5PB 5/2)

5GY 7/2

5GY 7/2–
5G 8/1

VOID

NOTE: 9.58 m were recovered in this core, 0.0–0.08 m represent the portion above the 9.5 m liner.

SILICEOUS NANNOFOSSIL OOZE
FIRM (LEADING INTO CHALK)

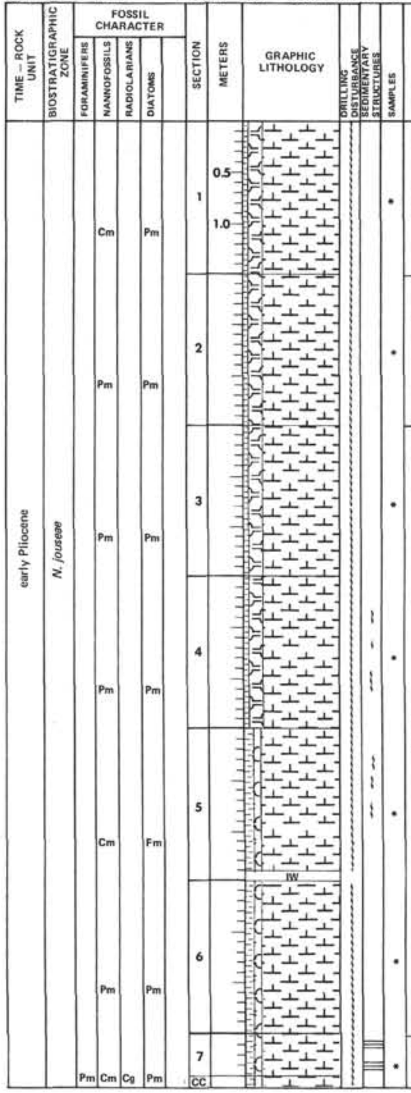
- Color: grayish yellow green to pale yellowish green (5GY 7/2 to 10GY 7/2) to very pale green (10G 8/2), shades and "schlieren" towards light greenish gray (5G 8/1), greenish gray (5G 6/1), yellowish gray (5Y 7/2), pale blue green (5BG 7/2) and pale blue (5PB 5/2).
- Blue tints seem to represent destroyed burrow "halos".
- Burrows suffered from immense diapiric drilling disturbances.

SMEAR SLIDE SUMMARY

	1-80	2-80	3-80	4-80	5-80	6-80	7-35
Pyrite	–	–	–	–	TR	–	–
Clay minerals	5	5	5	5	7	5	5
Volcanic glass (lt)	–	–	TR	TR	–	TR	–
Palagonite	–	–	–	TR	–	TR	–
Carbonate unspec.	5	8	8	5	10	15	15
Foraminifers	2	4	10	3	5	10	10
Calc. nannofossils	70	65	61	75	62	52	57
Diatoms	6	6	6	4	6	7	5
Radiolarians	6	6	5	4	5	7	4
Sponge spicules	5	4	4	3	4	3	3
Silicoflagellates	1	2	1	1	1	1	1
Mica	–	–	TR	–	–	TR	–

CARBONATE BOMB
1, 73–75 cm = 72%
2, 73–75 cm = 72%
3, 73–75 cm = 74%
4, 73–75 cm = 68%
5, 73–75 cm = 68%
6, 73–75 cm = 58%

SITE 505 HOLE CORE 23 CORED INTERVAL 219.0–228.5 m



LITHOLOGIC DESCRIPTION

5GY 7/2
(–10G 8/2)
(+5PB 5/2)

5GY 7/2–
10G 8/2

(+5Y 6/2)

5GY 7/2–10G 8/2
+ 5BG 7/2, 5PB 5/2
and 5GY 7/2

5GY 7/2–
10GY 7/2

NOTE: 9.53 m were recovered in this core, 0.0–0.03 m here represent the portion above the 9.5 m liner.

SILICEOUS NANNOFOSSIL OOZE
FIRM (LEADING INTO CHALK)

- Color: grayish yellow green to very pale green (5GY 7/2 to 10G 8/2); shades to pale yellowish green (10GY 7/2).
- Light olive gray (5Y 6/2) blotches (seem to represent burrow relicts).
- Medium dark gray (N4) and pale blue (5PB 5/2) shades and "schlieren" seem to represent pyrite rinds, streaks, spots, and burrow "halos" respectively, destroyed by drilling.

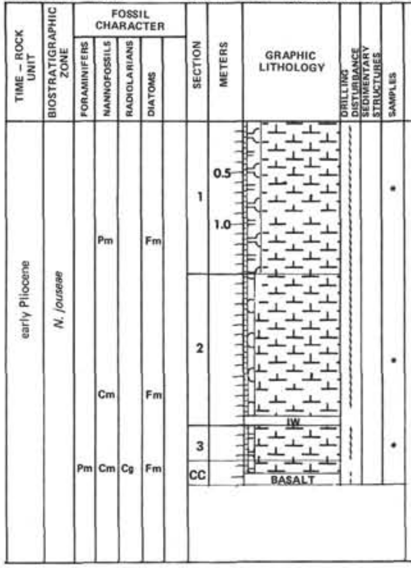
SMEAR SLIDE SUMMARY

	1-80	2-80	3-80	4-80	5-80	6-80	7-33
Pyrite	–	–	–	–	TR	TR	TR
Other heavy minerals	–	–	TR	TR	TR	–	–
Clay minerals	5	5	5	5	8	6	7
Volcanic glass (lt)	–	TR	TR	TR	TR	TR	TR
Carbonate unspec.	15	25	10	20	15	15	20
Foraminifers	10	5	4	4	2	2	2
Calc. nannofossils	50	46	64	55	65	65	60
Diatoms	10	10	8	6	3	5	4
Radiolarians	5	5	5	5	3	4	3
Sponge spicules	4	3	4	4	3	2	3
Silicoflagellates	1	1	–	1	1	1	1

CARBONATE BOMB

1, 73–75 cm = 62%
2, 73–75 cm = 63%
3, 73–75 cm = 65%
4, 73–75 cm = 61%
5, 73–75 cm = 61%
6, 73–75 cm = 65%

SITE 505 HOLE CORE 24 CORED INTERVAL 228.5–233.5 m



LITHOLOGIC DESCRIPTION

5G 7/2–
10GY 7/2

SILICEOUS NANNOFOSSIL OOZE FIRM

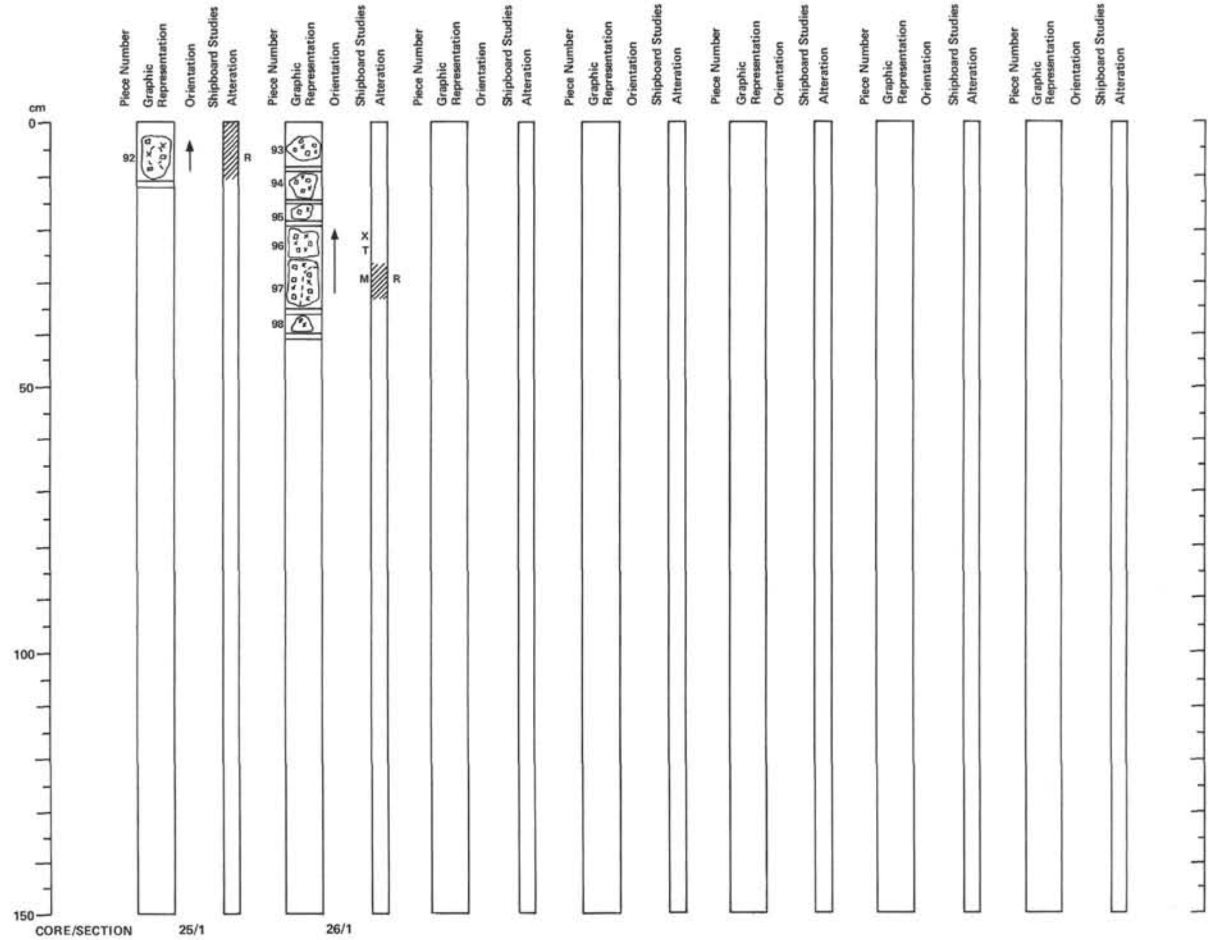
- Color: grayish yellow green to pale yellowish green (5G 7/2–10GY 7/2).
- Grayish green (5G 5/2) patches and light olive gray (5Y 6/2) blotches (seem to represent burrow relicts).
- Medium dark gray (N4) streaks seem to represent pyrite rinds, streaks, spots, and burrow "halos" destroyed by drilling.
- Basalt at 3.45 m.

SMEAR SLIDE SUMMARY

	1-70	2-90	3-20
Pyrite	TR	TR	–
Other heavy minerals	–	TR	TR
Clay minerals	5	6	5
Volcanic glass (lt)	TR	TR	TR
Carbonate unspec.	25	30	40
Foraminifers	1	2	2
Calc. nannofossils	57	55	45
Diatoms	4	1	3
Radiolarians	4	3	2
Sponge spicules	3	2	2
Silicoflagellates	1	1	1

CARBONATE BOMB

1, 73–75 cm = 65%
2, 73–75 cm = 68%



HOLE 505, CORE 25 **3772–3776.5 m (233.5–238.0 mbsf)**

PLAGIOCLASE-OLIVINE-CLINOPYROXENE PHYRIC BASALT

The basalt has about 25% phenocrysts up to 5 mm in length, mostly plagioclase, but with about 1% olivine and lesser clinopyroxene. The piece has a faint reddish oxidative alteration rind. Olivine is largely altered to clays. Plagioclase phenocrysts include some that are skeletal. Secondary minerals include waxy pale blue green clays in sparse vesicles and possibly partly replacing plagioclase. Some vesicles also are filled with calcite. There are also reddish Fe-oxyhydroxides(?) and/or clays after olivine. Plagioclase phenocrysts in the alteration rind are stained red.

Thin Section Description

Sample 25-1, 28–30 cm, Piece 92: Pillow or flow interior. The section has abundant plagioclase phenocrysts of diverse morphologies – some skeletal, some rounded (resorbed), others with ophitically intergrown olivine and Cr-spinel. These are about 20% of the rock. In addition, acicular plagioclase microlites (10%) are in the groundmass. Other phenocrysts are granular to skeletal olivine, and rounded (resorbed) twinned clinopyroxene. The groundmass, besides plagioclase, is mainly spherulitic, with dendritic clinopyroxene, skeletal olivine, and dust-like titanomagnetite. Smectites partially replace olivine and line vesicles.

HOLE 505, CORE 26 **3776.6–3780.5 m (238.0–242.0 mbsf)**

PLAGIOCLASE-OLIVINE-CLINOPYROXENE PHYRIC BASALT

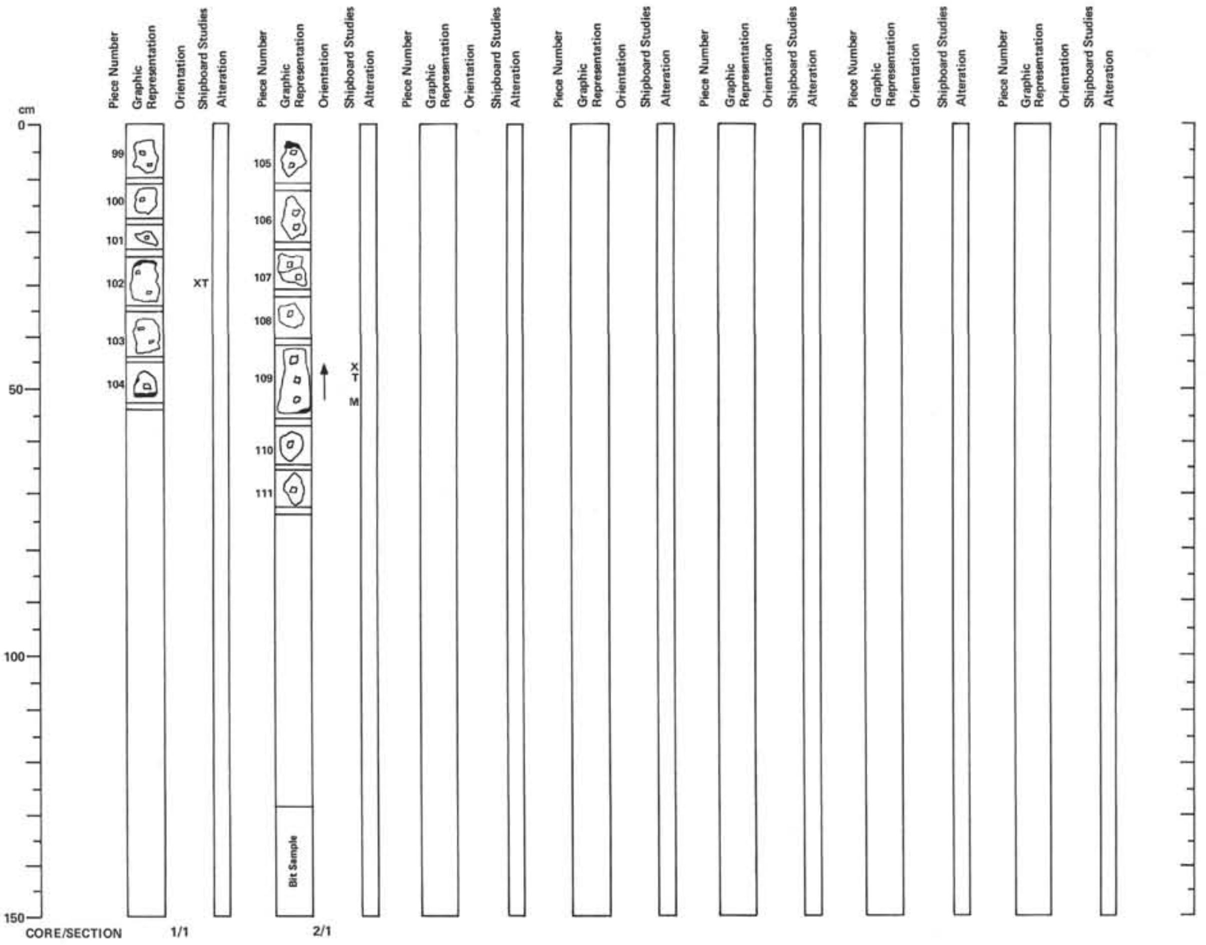
The basalts have about 25% phenocrysts averaging 2–3 mm in length (plagioclase 20%, clinopyroxene 4%, olivine 1%). Many of the plagioclases have glass inclusions. None of the pieces have glass. Piece 93 has accessory pyrite. Piece 97 has a reddish oxidation rind. Secondary minerals in all pieces include pale blue/green smectites replacing olivine, and smectites and calcite filling cracks, vesicles, and cavities.

Thin Section Description

Sample 26-1, 33–36 cm, Piece 96: Pillow interior. The section has about 20% plagioclase phenocrysts, 2% olivine phenocrysts, and scattered clinopyroxene phenocrysts. There are no ophitic glomerocrysts as in sample 25-1, piece 92. Olivines are granular, skeletal, and rounded. Clinopyroxenes are rounded. Plagioclases are skeletal, tabular, and rounded. The groundmass has about 10% acicular and skeletal plagioclase microlites, 1% granular olivines, and a dark brown spherulitic matrix, dotted with titanomagnetite. Cr-spinel is accessory. Smectites partially replace olivine, line vesicles, and fill cracks. They are yellow-red in color in the cracks, and clear in the olivines.

BULK ANALYSIS:

Core-Section	25-1	26-1
Interval (cm)	26–28	33–36
SiO_2	48.45	48.03
TiO_2	0.71	0.76
Al_2O_3	17.44	17.46
Fe_2O_3	8.15	8.25
MnO	0.13	0.14
MgO	9.67	9.07
CaO	13.22	13.43
Na_2O	1.64	1.88
K_2O	0.07	0.07
P_2O_5	0.08	0.10
Total	99.57	99.21
LOI	0.78	0.94
Mg/Mg+Fe	0.701	0.685
Ca/Ca+Al	0.408	0.412
Ni	202	173
Sr	81	89
Zr	42	47



HOLE 505A, CORE 1 **3721.5–3728.5 m (196.5–203.5 mbsf)**

PLAGIOCLASE-OLIVINE SPARSELY PHYRIC BASALT

The basalts have about 5% plagioclase phenocrysts (1–5 mm) and less than 1% olivine phenocrysts (1–2 mm). Pieces 102 and 104 have glass. Vesicles are less than 1% and 1 mm, and are filled with light green smectite in all but glass. In glass, vesicles are filled with white clays, some with Fe-oxyhydroxide(?) staining. Piece 99 has surfaces partially coated with green and gray-brown clays. One surface has pyrite with a slightly oxidized burnished cast.

Thin Section Description

Sample 1-1, 30–32 cm, Piece 102: Pillow interior. The sample has scattered euhedral to skeletal plagioclase phenocrysts, rare altered olivine phenocrysts, and a groundmass consisting of acicular skeletal plagioclase crystals enclosed in a dendritic to plumose-spherulitic matrix of clinopyroxene and interstitial titanomagnetite. There is accessory Cr-spinel. Smectites partially replace olivine, line rare, small vesicles, and fill some interstitial spaces.

HOLE 505A, CORE 2 **3728.5–3733.5 m (203.5–208.5 mbsf)**

SPARSELY PLAGIOCLASE-OLIVINE PHYRIC BASALT

The basalts have about 5% plagioclase phenocrysts up to 5 mm, and 1–2% olivine phenocrysts. Vesicles are small (up to 1 mm) and rare (less than 1%). The groundmass of most pieces is microlitic. Piece 105 has a glass rind, and 107 a reddish alteration rind. Cracks are rare. Groundmass olivine is replaced by smectite, and vesicles are lined with light green smectite and calcite.

Thin Section Description

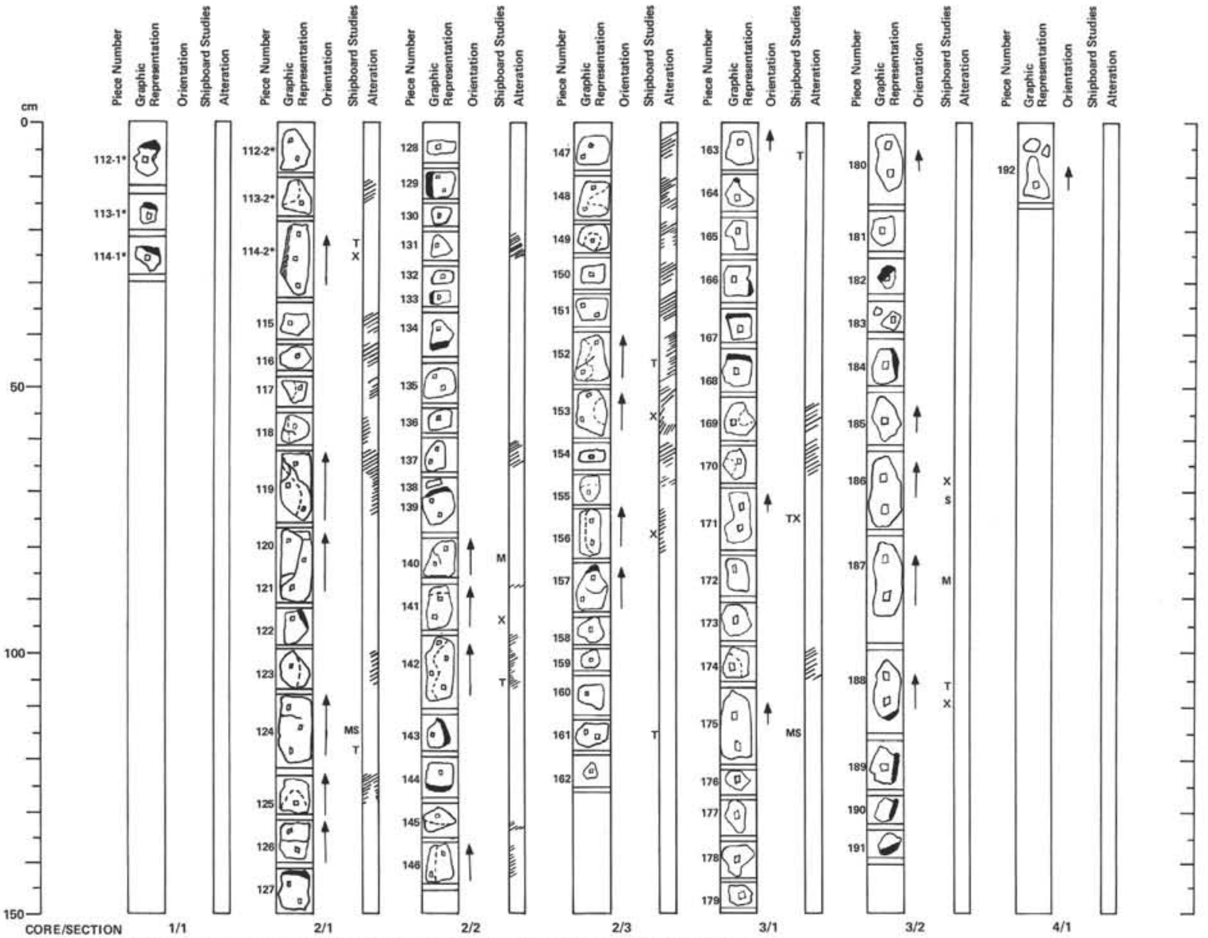
Sample 2-1, 51–55 cm, Piece 109: Pillow or flow interior. The texture is intersertal to subophitic. There are scattered euhedral and skeletal plagioclase phenocrysts, isolated olivine phenocrysts, now largely replaced by smectite, and a groundmass of acicular skeletal plagioclase in a largely dendritic-clinopyroxene, titanomagnetite matrix. Vesicles are filled with yellow-brown smectite. The section has a reddish oxidative alteration zone at one end in which patches of yellow-red material (smectite? Fe-hydroxides?) replace glass(?) and/or crystalline material between clinopyroxene dendrites.

Bit sample

About 25–30 pieces of basalt up to 1 cm diameter mostly smaller, some with glass, are in a bag at the bottom of Core 2, Section 1. These were picked out of the bit when it was brought on deck, and most likely represent pieces from the bottom of the hole.

BULK ANALYSIS:

Core-Section	1-1	2-1
Interval (cm)	28–30	51–55
SiO_2	49.13	48.93
TiO_2	0.95	0.96
Al_2O_3	16.16	15.94
Fe_2O_3	9.74	9.69
MnO	0.16	0.15
MgO	8.53	8.82
CaO	12.79	12.60
Na_2O	2.00	2.32
K_2O	0.05	0.02
P_2O_5	0.09	0.08
Total	99.62	99.52
LOI	0.23	0.95
Mg/Mg+Fe	0.634	0.643
Ca/Ca+Al	0.418	0.418
Ni	154	148
Sr	80	74
Zr	51	57



NOTE: 112-1, 113-1, and 114-1 refer to Piece 112, Section 1, etc.; and 112-2, 113-2, and 114-2 refer to Piece 112, Section 2, etc.

HOLE 505B, CORE 1 3643–3648 m (136.0–141.0 mbsf)

SPARSELY PLAGIOCLASE-OLIVINE PHYRIC PILLOW BASALT

The core consists of three pieces of basalt, each with a glass rind. Plagioclase phenocrysts (5%) are up to 5 mm in length; some have groundmass inclusions. Olivine phenocrysts (2%) are up to 3 mm. Vesicles (less than 1%) are up to 1.5 mm. They are either not filled, or partly filled with yellow smectite. Rare cracks are filled in part with yellow smectites and with small (0.1–0.3 mm) black spots of Mn-oxides.

HOLE 505B, CORE 2 3648–3657.5 m (141.0–150.5 mbsf)

SPARSELY PLAGIOCLASE-OLIVINE PHYRIC BASALT

The basalts contain 5–8% plagioclase phenocrysts (4–5 mm), more abundant in Section 2, and about 1% olivine phenocrysts (1 mm), less abundant in Section 2. Several pieces have glass along the sides, tops or bottoms, and other pieces have a variolitic surface appearance, indicating that the sequence is one of pillows or thin flows. Several pieces have dusky yellow-orange oxidative alteration rinds in which olivine is almost completely replaced by smectites. Clays also line cracks and fill vesicles. Mn-oxides are fracture surface coatings (very minor) on some pieces (e.g. pieces 137 and 153, which also has phillipsite).

Thin Section Descriptions

Sample 2-1, 29–33 cm, Piece 114: Flow interior. The section contains nearly 40% each plagioclase and clinopyroxene, the former including phenocrysts and acicular groundmass crystals, the latter exclusively as a dendritic groundmass phase. Olivine phenocrysts are less than 1%, as is titanomagnetite which forms tiny crystals in the groundmass. Cr-spinel is accessory. Smectites replace glass(?) and olivine, and fill vesicles (1%, less than 1 mm). Calcite occurs in some cracks. The section has a yellow oxidative alteration zone where the clays are abundant.

Sample 2-1, 108–111 cm, Piece 124: Pillow interior. The section contains scattered euhedral and skeletal plagioclase phenocrysts, sometimes clumped together, in a spherulitic groundmass, with acicular and equant skeletal plagioclase, skeletal olivine, and plumose spherulites between which are tiny titanomagnetite crystals. Each edge of the section has a yellow stain, in which yellow brown smectites fill vesicles and replace olivine. Pale golden clays occur in the gray interior zone, and are associated with pyrite.

Sample 2-2, 98–101 cm, Piece 142: Flow interior. Texture is microphyric to subophitic, with tabular to skeletal plagioclase enclosed by anhedral to dendritic clinopyroxene, with interstitial clays, pyrite, and titanomagnetite. There are some euhedral plagioclase and olivine phenocrysts.

Sample 2-3, 40–42 cm, Piece 152: Pillow interior. The sample is similar to 2-1, piece 124 in having about 20% primarily acicular plagioclase crystals set in a matrix of plumose spherulites. There are a few percent plagiolcase and rarer olivine phenocrysts, the former having euhedral, tabular, and skeletal morphologies. Titanomagnetite and Cr-spinel are accessory. Calcite and smectites replace olivine, and smectites fill vesicles.

Sample 2-3, 103–106 cm, Piece 161: The section is mostly plumose spherulites with 10–12% acicular plagioclase and scattered euhedral plagioclase and olivine phenocrysts. Titanomagnetite dusts spaces between spherulite fibers. Round primary pyrite can also be seen. Skeletal olivine is intergrown with acicular plagioclase. The sample is quite fresh, with only a small amount of clays in the rare, small (less than 0.5 mm) vesicles present.

HOLE 505B, CORE 3 3657.5–3666.5 m (150.5–159.5 mbsf)

SPARSELY PLAGIOCLASE-OLIVINE PHYRIC BASALT

The basalts contain about 5% plagioclase olivine phenocrysts up to 5 mm in length, some skeletal, and 1% olivine phenocrysts up to 1 mm. The rocks are microlitic in flow interiors, and variolitic to glassy at selvages. Vesicles (1%) are up to 1 mm in diameter and lined or filled with light blue green smectite. Some pieces have yellow gray oxidation zones up to 1.5 cm wide. Pieces 164–166, and 177 have thin Mn-oxide crusts, and piece 170 has a yellow crust with Mn-oxides and phillipsite.

Thin Section Descriptions

Sample 3-1, 5–8 cm, Piece 163: Pillow interior. The sample has several percent plagioclase phenocrysts and lesser olivine phenocrysts in a matrix with acicular plagioclases, skeletal olivine, and plumose spherulites. Spherulite forms suggest the sample was about 5 cm into a pillow. In the groundmass, titanomagnetite is concentrated at the ends of plumose spherulites. There are accessory euhedral and skeletal chrome spinels. Yellow-orange alteration streaks run along the cores of the spherulites, and replace olivine.

Sample 3-1, 76–79 cm, Piece 171: Pillow interior. Similar to 3-1, 5–8 cm, piece 163 except slightly coarser grained. The groundmass has about 70% plumose spherulites. The remainder is intergrown acicular to skeletal plagioclase and olivine. This sample, too, has yellow oxidized zones. Pyrite occurs in clay patches in the darker gray zones, not in the yellow zones. Chromite is accessory.

Sample 3-2, 99–100 cm, Piece 188: Pillow interior. The section consists of scattered plagioclase euhedral to skeletal phenocrysts and glomerocrysts, lesser granular olivine phenocrysts, and a groundmass with acicular skeletal plagioclase in crossing and radial arrangement, enclosing a dendritic-spherulitic matrix dusted with titanomagnetite. Calcite and smectites fill vesicles. Smectites also replace olivine and glass(?). They are associated with pyrite where pale gold in color, but not in oxidized portions of the section where they are yellow-red in color.

Sample 3-2, 135–137 cm, Piece 191: Pillow rim. The section cross a pillow rim from its glassy edge to about 5 cm into the interior. Successive zones of groundmass spherulite development can be seen. They are dark brown and spherical in the glass, and successively lighter brown and more plumose going into the pillow. Plagioclase crystallized in the groundmass as acicular needles and small euhedra with striking dendritic projections from twin lamellae and crystal corners. Plagioclase megacrysts are euhedral, and many are skeletal. The interior of the pillow is more oxidized than its rim, hence smectites filling rare (less than 1%) small (less than 1 mm) vesicles are deep orange. Near the rim, vesicles are filled with pale greenish gold smectites and calcite. The glass has quench acicular plagioclase and euhedral olivine, some with fluid inclusions. Cr-spinel and pyrite are accessory magmatic minerals.

HOLE 505B, CORE 4 3666.5–3671 m (159.5–164.0 mbsf)

SPARSELY PLAGIOCLASE-OLIVINE PHYRIC BASALT

The basalt has about 3% plagioclase phenocrysts (1–3 mm) and less than 1% olivine phenocrysts (up to 1 mm). The groundmass is microlitic. Vesicles up to 1 mm diameter are filled with light green or brown clay minerals. Crack surfaces are covered with light green and brown smectites.

BULK ANALYSIS:

Core-Section	2-1	2-2	2-3	2-3	3-1	3-2
Interval (cm)	19–23	87–90	51–52	78–83	76–79	102–105
SiO_2	49.58	49.63	49.70	49.62	49.52	49.67
TiO_2	0.98	0.96	0.96	0.96	0.95	0.95
Al_2O_3	15.94	16.23	16.24	16.05	16.21	15.94
Fe_2O_3	9.59	9.34	9.64	9.36	9.54	9.51
MnO	0.15	0.14	0.18	0.14	0.15	0.14
MgO	8.92	8.40	7.72	8.89	8.71	8.70
CaO	12.69	12.89	12.89	12.63	12.56	12.57
Na_2O	2.08	1.98	2.46	2.17	2.19	2.11
K_2O	0.05	0.06	0.16	0.03	0.11	0.04
P_2O_5	0.08	0.08	0.09	0.08	0.08	0.08
Total	100.07	99.73	100.05	99.95	100.04	99.73
LOI	1.04	1.20	1.71	1.17	0.33	0.96
Mg/Mg+Fe	0.648	0.640	0.613	0.653	0.644	0.644
Ca/Ca+Al	0.420	0.419	0.419	0.417	0.413	0.418
Ni	153	167	154	160	157	168
Sr	75	81	109	74	78	77
Zr	56	56	56	53	57	56

MAGNETIC DATA:

Core-Section, Interval (cm)	MDF	Susceptibility	INCL.	Intensity
2-1, 115–117	170	403	−12.3*	6.691
2-2, 81–83	500	176	15.7*	10.993
3-1, 114–116	280	228	−12.2*	14.161
3-2, 86–88	180	301	−13.0*	8.765
4-1, 10–12	220	557	1.5*	15.305

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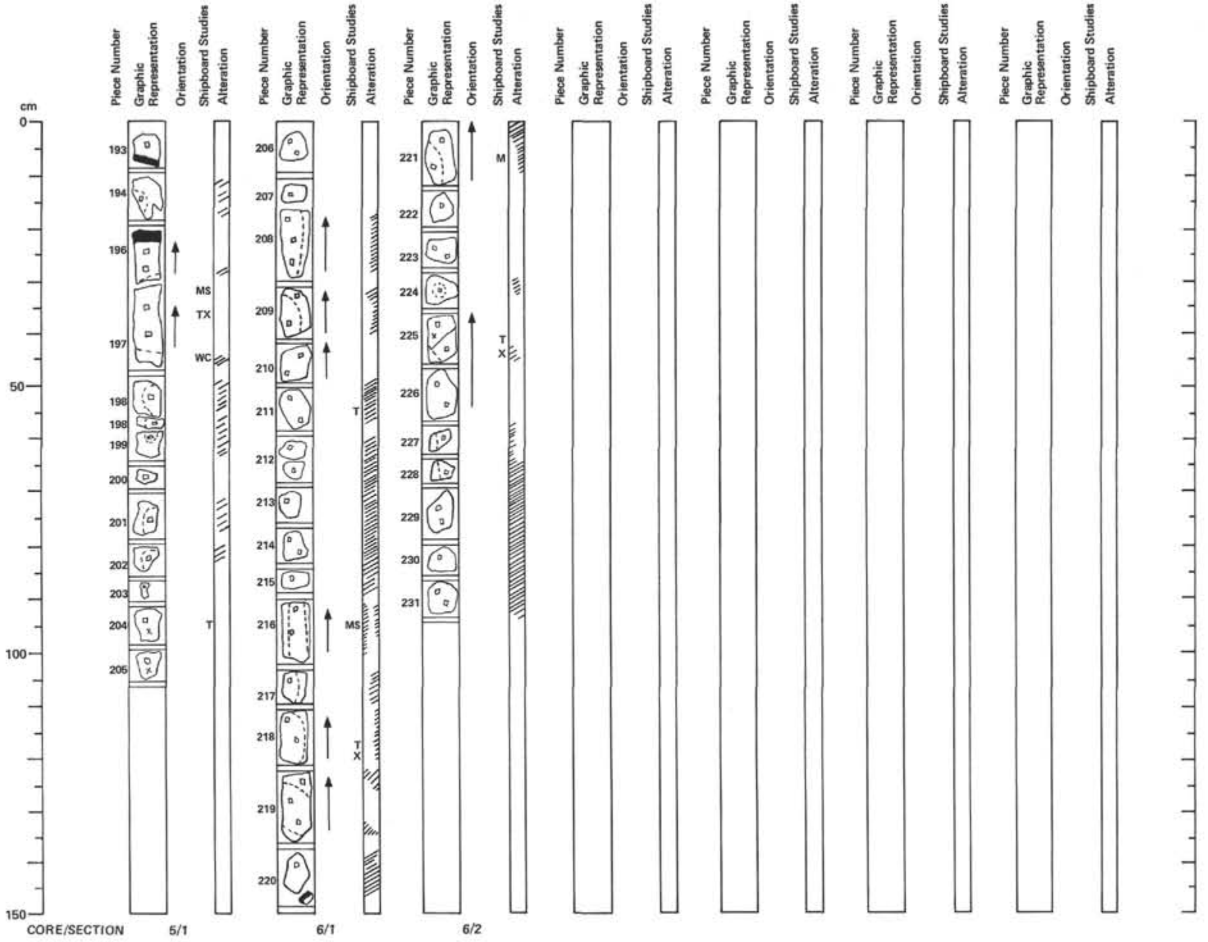
* After demagnetization

PHYSICAL PROPERTIES:

Core-Section, Interval (cm)	Water Content	Porosity	Wet-Bulk	V (⊥)
2-1, 120–122	2.42	6.67	2.83	5.845
3-1, 108–109	2.45	6.83	2.86	5.870
3-2, 76–77	1.59	4.48	2.89	5.937
4-1, 10–12	—	—	—	6.289

THERMAL CONDUCTIVITY:

Core-Section, cm	κ
2-1, 126	1.70
2-2, 140	1.81
3-1, 74	1.77



BULK ANALYSIS:

Core-Section	5-1	6-1	6-2
Interval (cm)	40–43	114–116	20–23
SiO_2	49.63	50.04	49.64
TiO_2	0.97	0.97	0.97
Al_2O_3	16.60	15.90	15.79
Fe_2O_3	9.37	9.44	9.72
MnO	0.14	0.15	0.15
MgO	8.53	8.34	9.16
CaO	12.64	12.85	12.61
Na_2O	2.12	2.17	2.11
K_2O	0.05	0.03	0.04
P_2O_5	0.08	0.09	0.08
Total	100.15	100.00	100.28
LOI	0.96	1.01	0.57
Mg/Mg+Fe	0.643	0.636	0.651
Ca/Ca+Al	0.409	0.424	0.421
Ni	167	152	166
Sr	76	79	75
Zr	59	52	58

MAGNETIC DATA:

Core-Section, Interval (cm)	MDF	Susceptibility	INCL.	Intensity
5-1, 31–33	150	723	−10.0*	12.001
6-1, 109–111	130	740	− 3.5*	8.400
6-2, 6–8	360	380	−10.0*	10.880

* After demagnetization

PHYSICAL PROPERTIES:

Core-Section, Interval (cm)	Water Content	Porosity	Wet-Bulk	V (⊥)
5-1, 45–47	2.72	7.55	2.84	5,914
6-1, 106–107	1.96	5.57	2.90	5.684

THERMAL CONDUCTIVITY:

Core-Section, cm	κ
5-1, 24	1.69

HOLE 505B, CORE 5 3671–3676 m (164.0–169.0 mbsf)

SPARSELY PLAGIOCLASE-OLIVINE PHYRIC BASALT

The pieces contain 2–5% plagioclase phenocrysts up to 2 mm, and 1–3% olivine (up to 1 mm). Two pieces have fresh glassy rims. Oxidized zones are well developed on several pieces adjacent to cracks. Vesicles (less than 1% and 1 mm diameter) are filled with blue green clays in the gray basalts, and with red clays in the oxidized zones. Olivine is fresh in the gray basalts, and altered to red clays in oxidized zones.

Thin Section Descriptions

Sample 5-1, 14–17 cm, Piece 194: Pillow interior. The sample consists predominantly of radial acicular plagioclases and intergrown skeletal olivine enclosing a dendritic-spherulitic matrix of intergrown clinopyroxene, titanomagnetite and glass. There are scattered euhedral plagioclase phenocrysts, oftimes skeletal. The section has a yellow oxidized zone on one side in which smectites replace glass and olivine, and fill vesicles. The non-oxidized zone also has pale golden smectites with associated pyrite. Cr-spinel is an accessory magmatic mineral.

Sample 5-1, 43–45 cm, Piece 197: Pillow interior. The sample is a fairly coarsely crystalline basalt with nearly 40% each of acicular plagioclase and anhedral to dendritic clinopyroxene. The usual scattered plagioclase and olivine phenocrysts also occur. There is less than 20% interstitial matrix material. Titanomagnetite occurs in this and some crystals are skeletal. Cr-spinel is accessory. The edges of the section are oxidized, and have yellow-brown smectites replacing olivines and filling vesicles. The center of the section has fresh olivine and patches of pale golden smectite with associated pyrite.

Sample 5-1, 93–95 cm, Piece 204: Pillow interior. The section has 1–2% plagioclase glomerocrysts and phenocrysts (some skeletal) in a groundmass mostly of acicular skeletal radiating plagioclase centered on granular olivine, or intergrown with skeletal olivine, in a spherulitic dendritic matrix. The dendrites are clinopyroxene. Titanomagnetite grows between the dendrites. Some clinopyroxene is anhedral and fairly coarse (0.3–1 mm). Minor smectites fill vesicles. Cr-spinel is accessory. There are some segregation vesicles.

HOLE 505B, CORE 6 3676–3685 m (169.0–178.0 mbsf)

SPARSELY PLAGIOCLASE-OLIVINE PHYRIC BASALTS

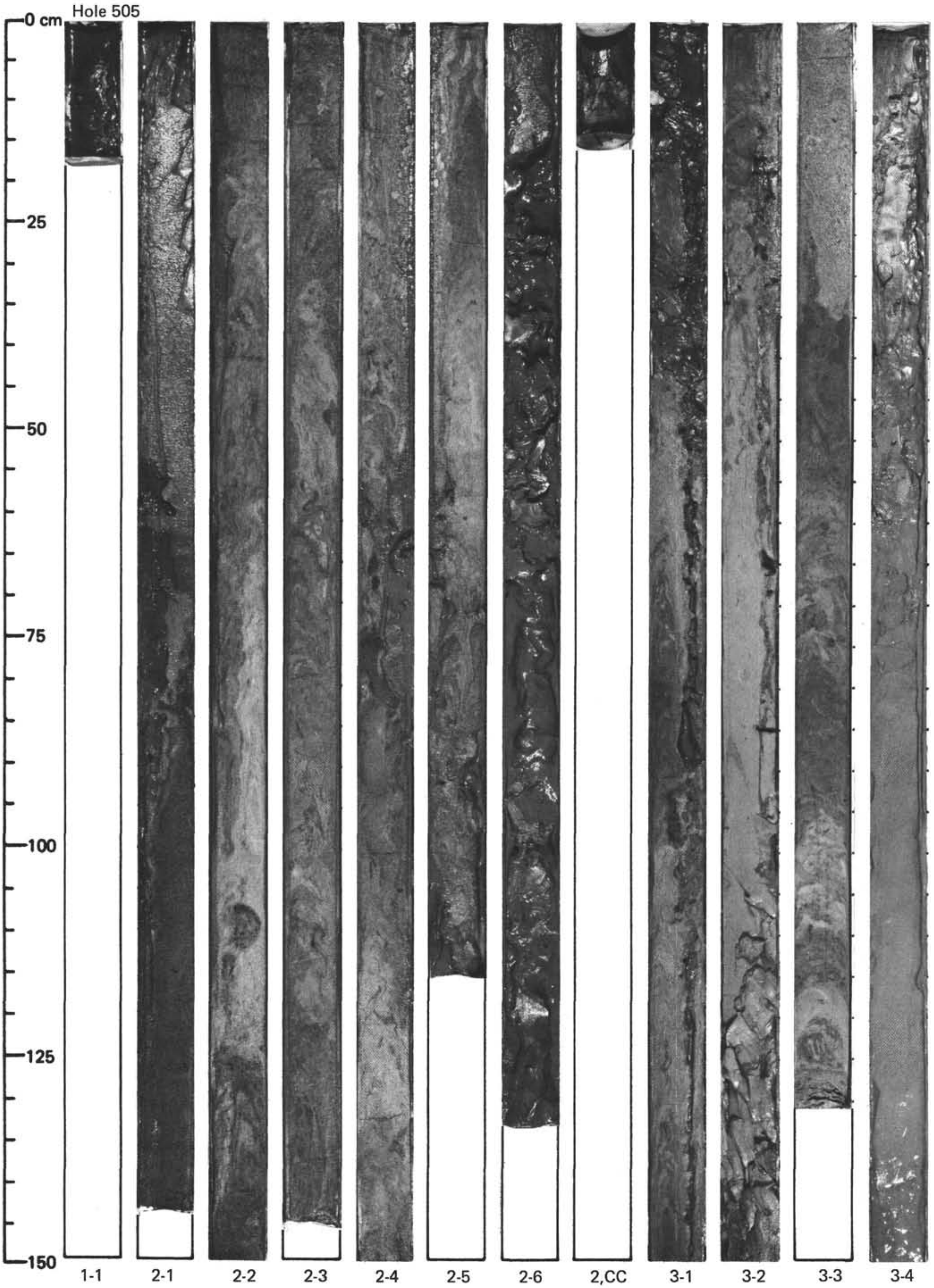
The core consists of pieces of apparently massive flow basalt without *glass rims or obvious changes in grain size. The pieces have up to 5%* plagioclase phenocrysts, some skeletal, and 1% olivine phenocrysts, often replaced by clays. Many pieces have zones of oxidative reddish alteration paralleling cracks or fracture surfaces. The groundmass is generally microlitic. Rare cracks have green smectite and/or calcite fillings. Pieces 211, and 222–224 are highly porous, possibly leached. Piece 214 has phillipsite in cavities together with yellow clays and Mn-oxides(?). Mn-oxide spots occur on fracture surfaces on pieces 222 and 229.

Thin Section Descriptions

Sample 6-1, 51–56 cm, Piece 211: Flow interior. The section consists of scattered euhedral plagioclase phenocrysts and granular olivine phenocrysts, set in an intersertal to spherulitic groundmass. Acicular plagioclase (about 30%) is arrayed in spoke-like or criss-crossed patterns, sometimes centered on olivine crystals, in between which are plumose spherulites consisting mainly of clinopyroxene, glass(?) and, between spherulites, dust-like titanomagnetite. Cr-spinel is accessory. Smectites fill cracks and vesicles.

Sample 6-1, 112–114 cm, Piece 218: Flow interior. The sample has ophitic texture, with about 50% plagioclase, 20–40% clinopyroxene, 5–10% mesostasis, and 1–5% each of olivine, titanomagnetite and vesicles. Plagioclase crystals can be greater than 3 mm. Cr-spinel is accessory. Smectites replace olivine and fill vesicles. The sample has a yellow oxidized zone, where the clays are orange. It also has a gray zone where clays are pale gold and associated with pyrite.

Sample 6-2, 38–40 cm, Piece 225: Flow interior. Finer grained than the samples just described, with 20–40% each of acicular plagioclase, *dendritic clinopyroxene, and spherulitic mesostasis. Olivine (1%) occurs* as phenocrysts and as skeletal intergrowths with acicular groundmass plagioclase. There are scattered euhedral plagioclase phenocrysts up to 3 mm in length. Skeletal titanomagnetite is fairly abundant. Cr-spinel is accessory. The sample has a dark gray zone and a yellow oxidized zone, both containing smectites. Pale gold smectites occur in the gray zone associated with pyrite. Orange clays occur in the oxidized zone, replacing olivine and filling vesicles.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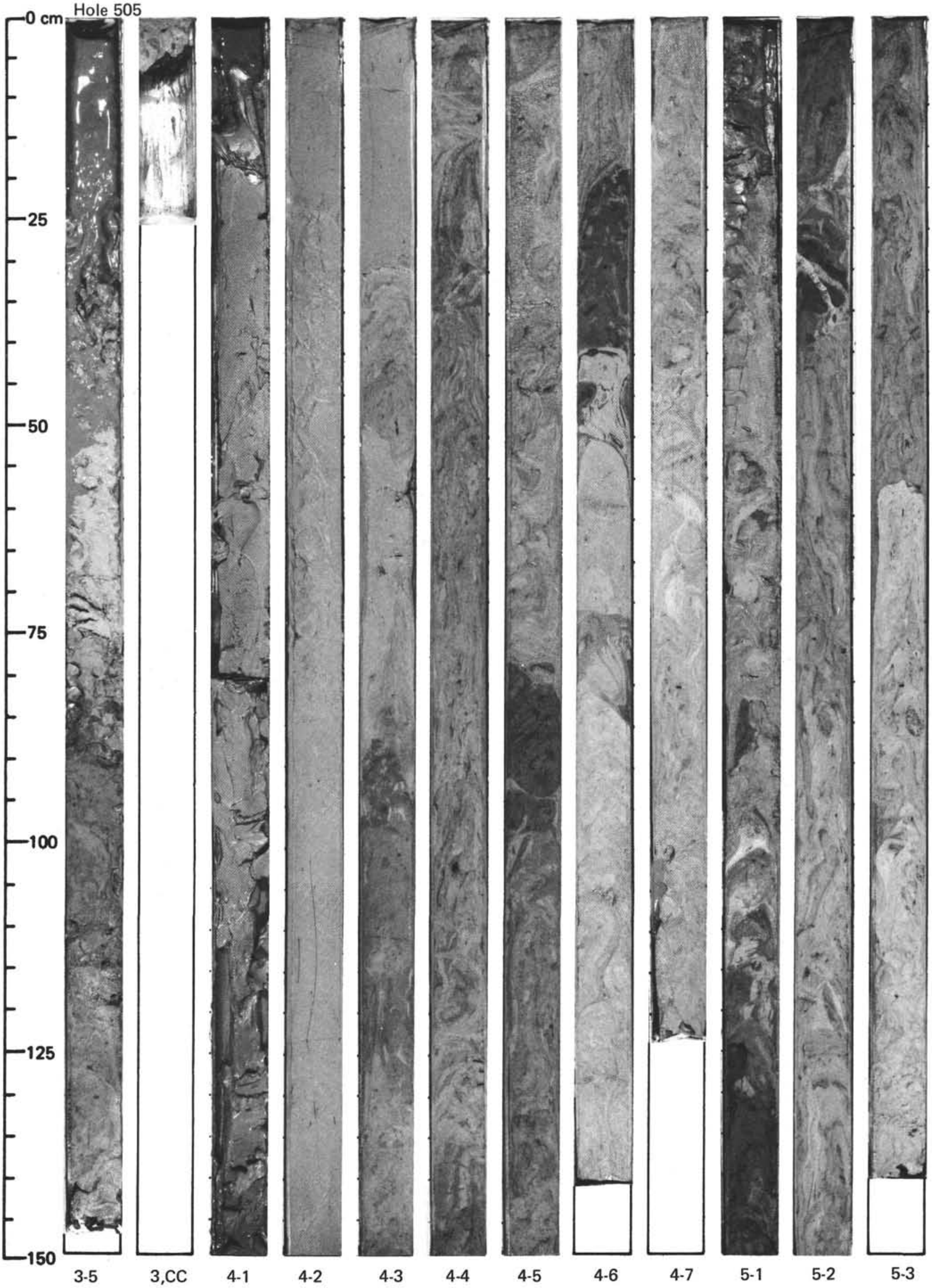
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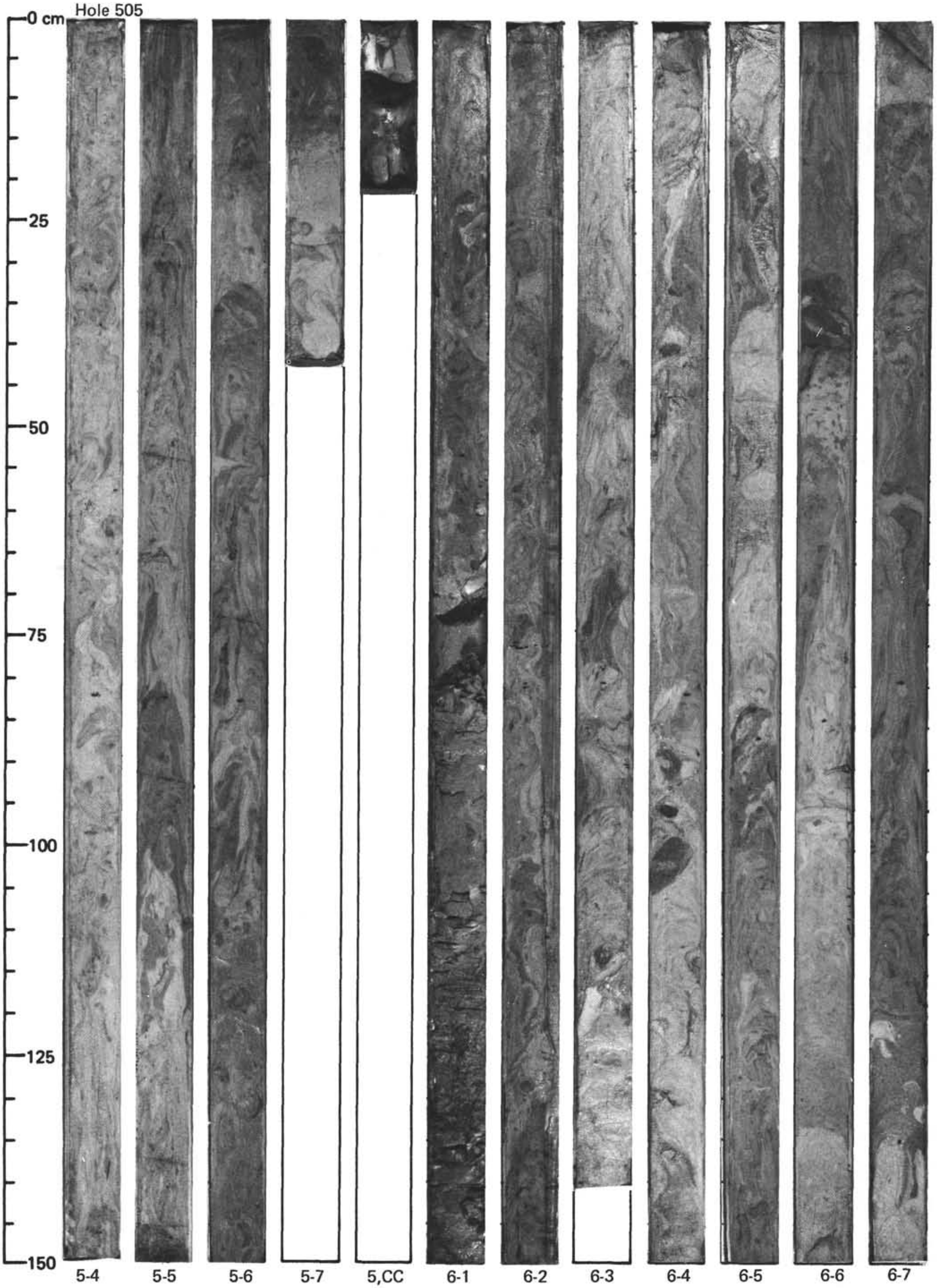
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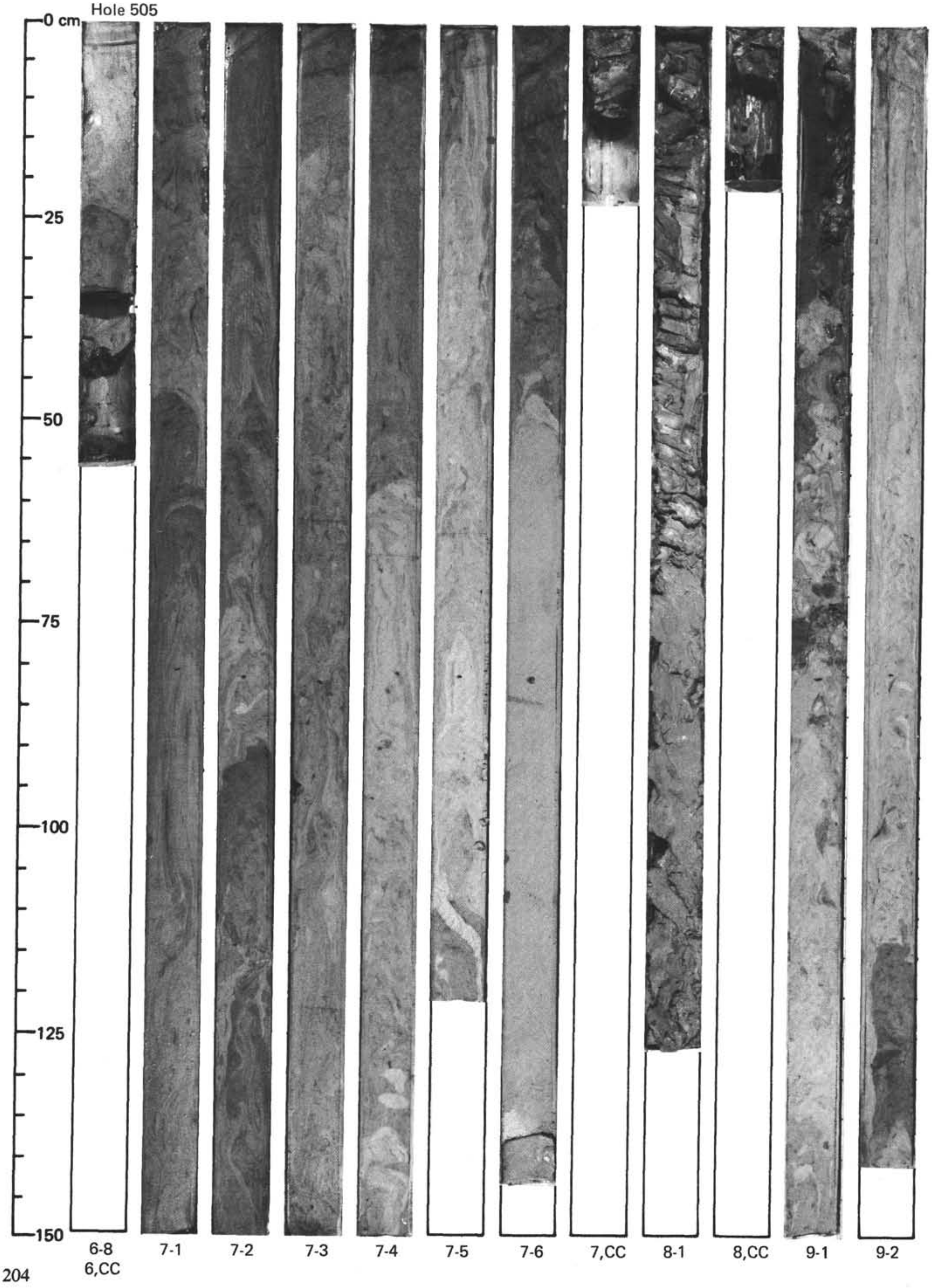
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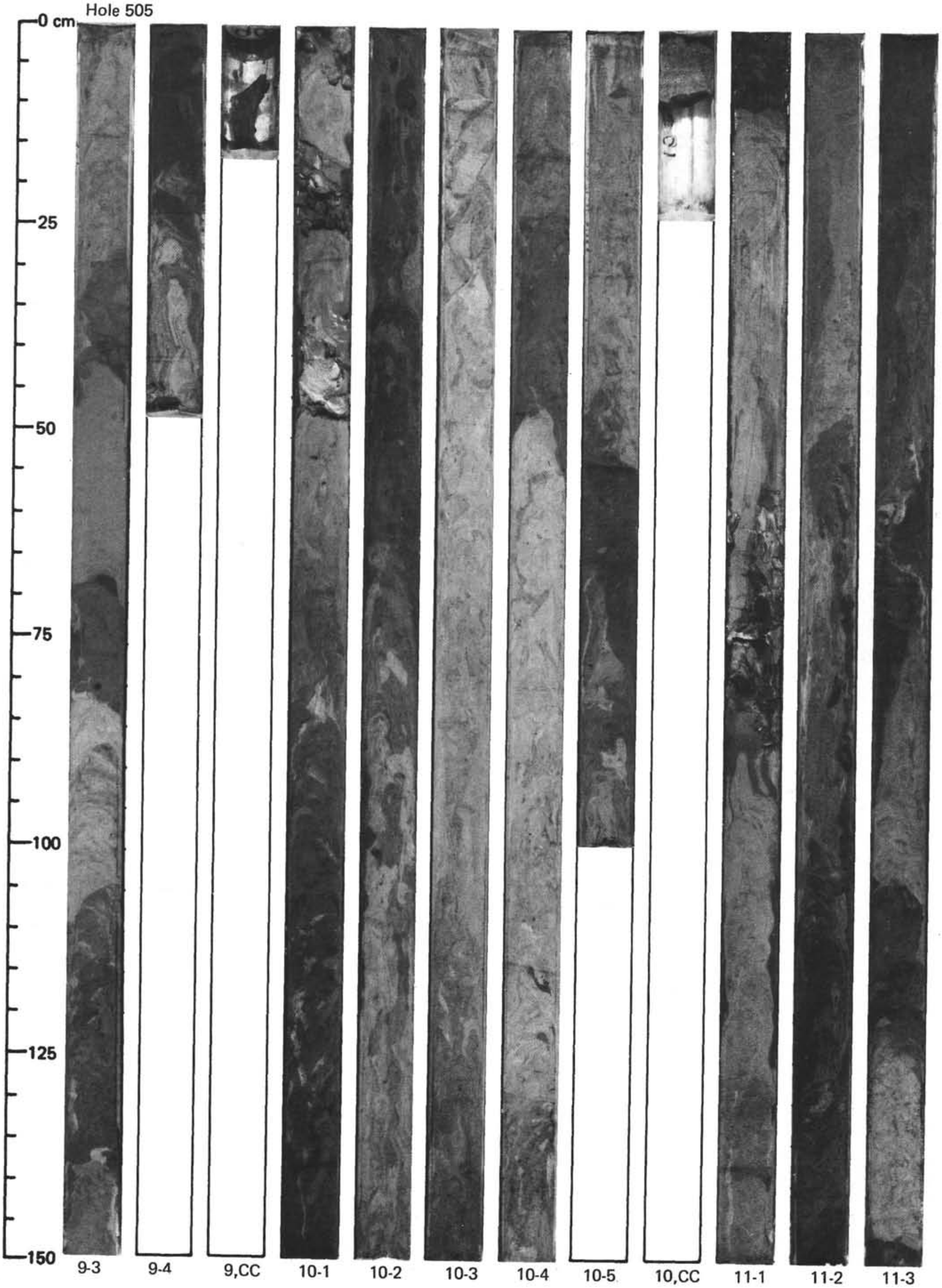
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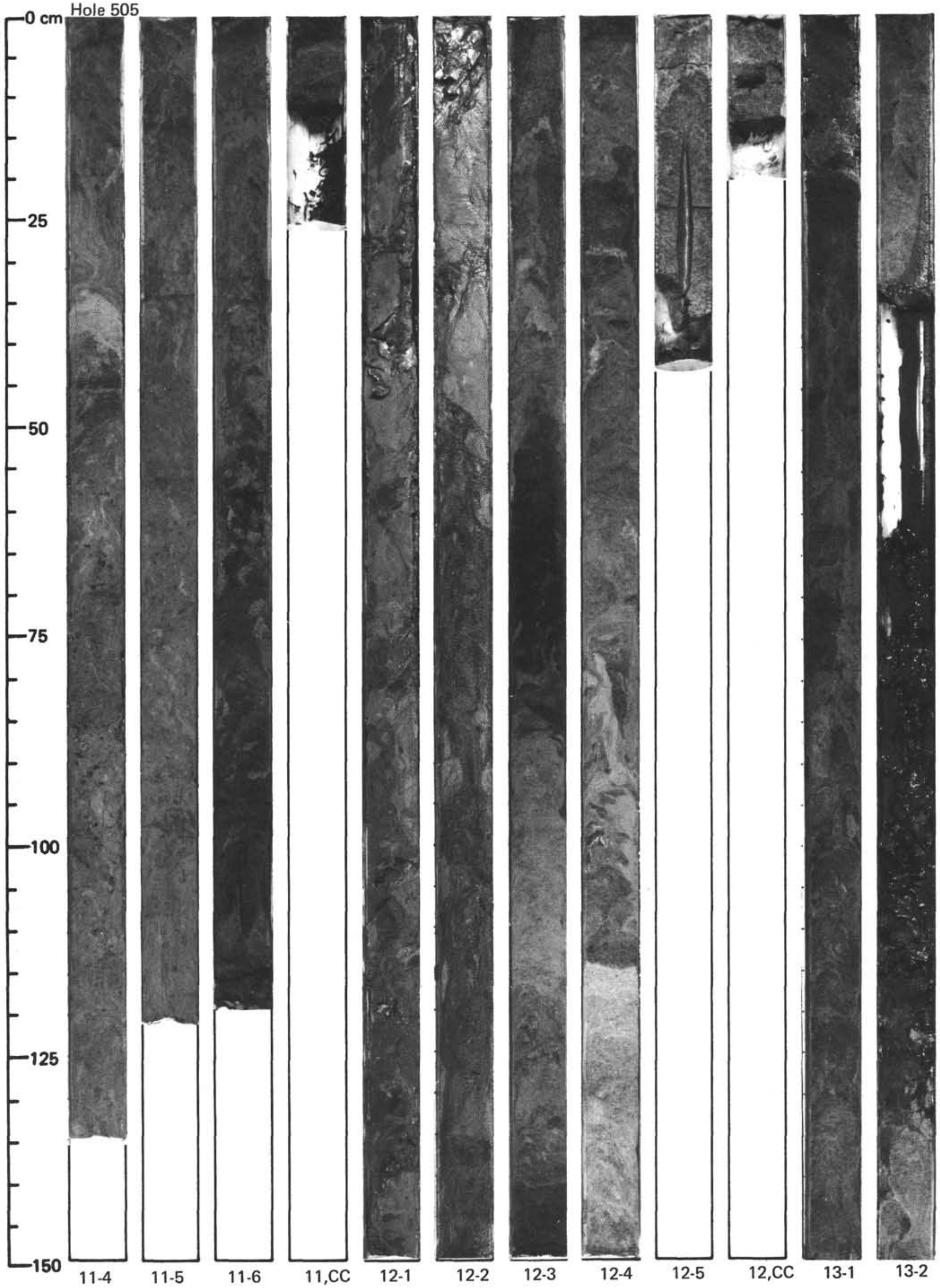
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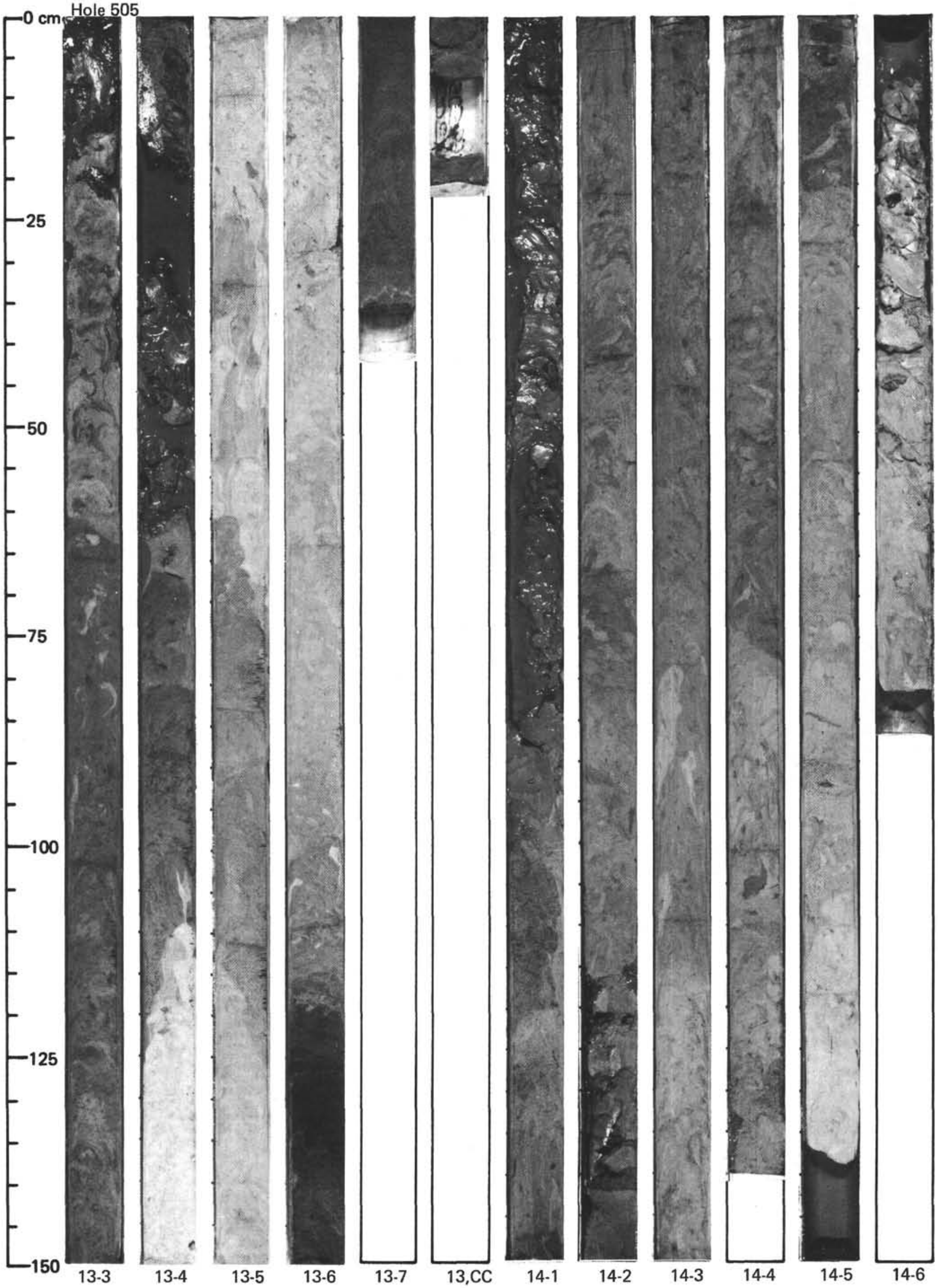
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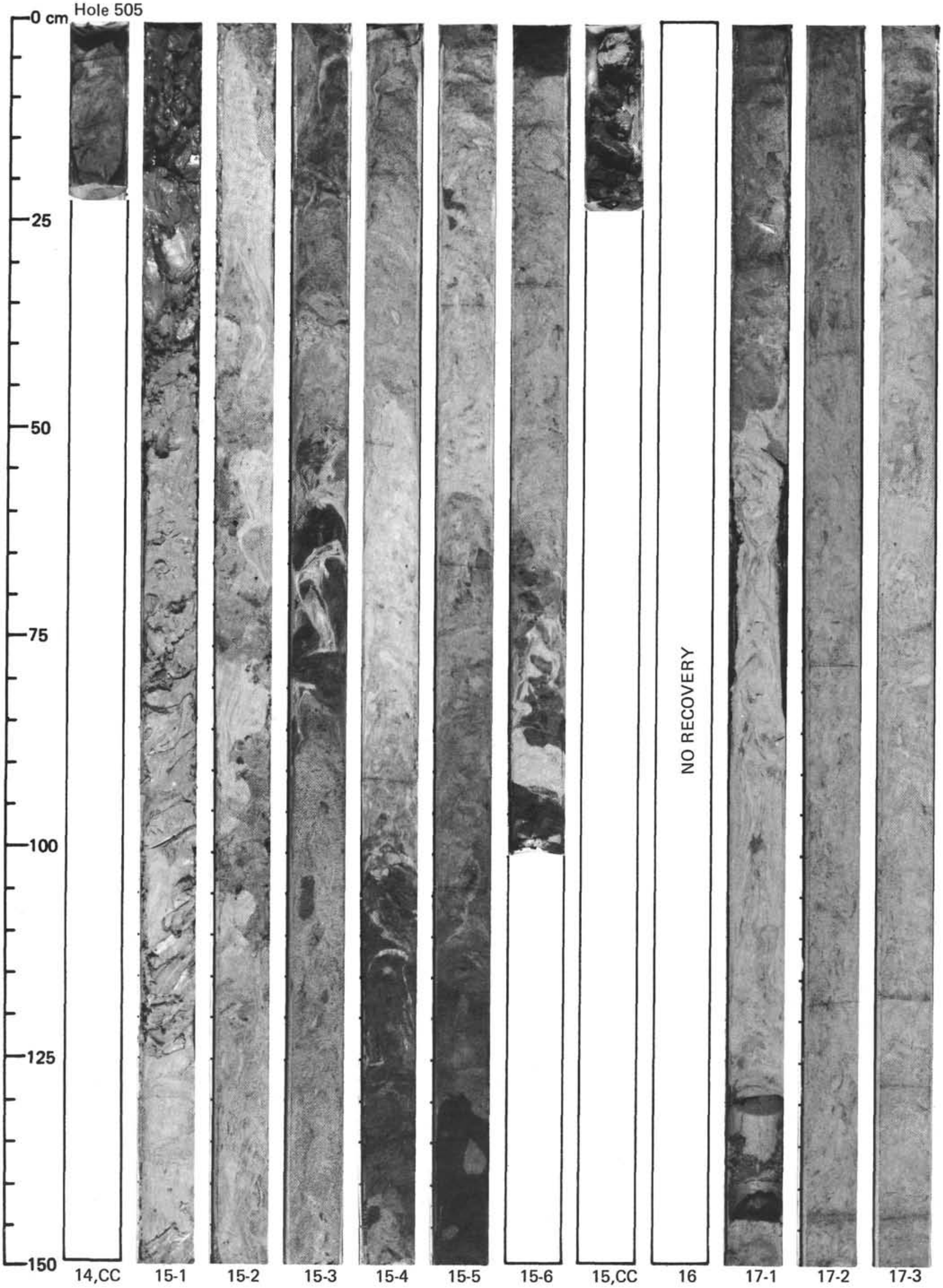
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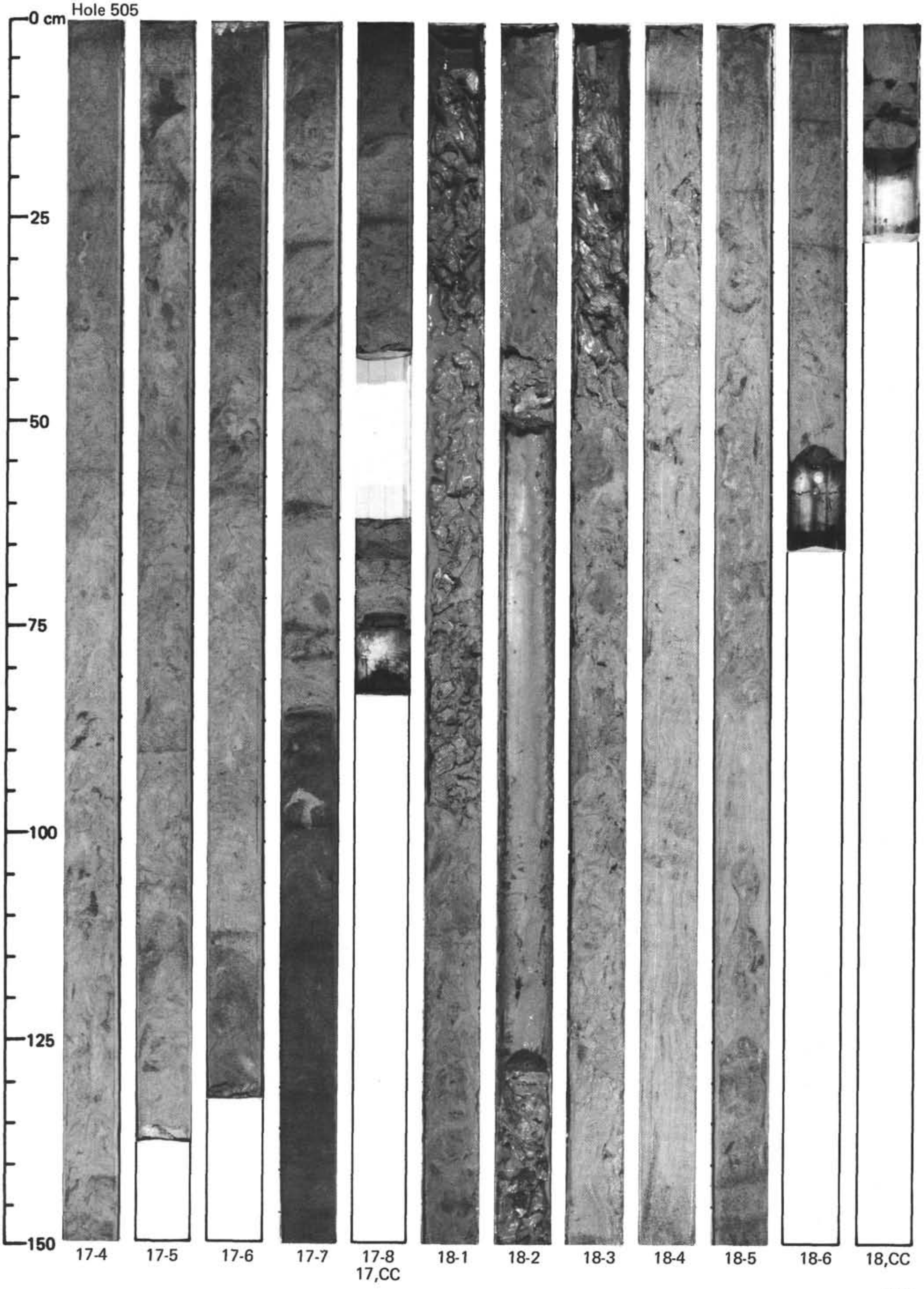
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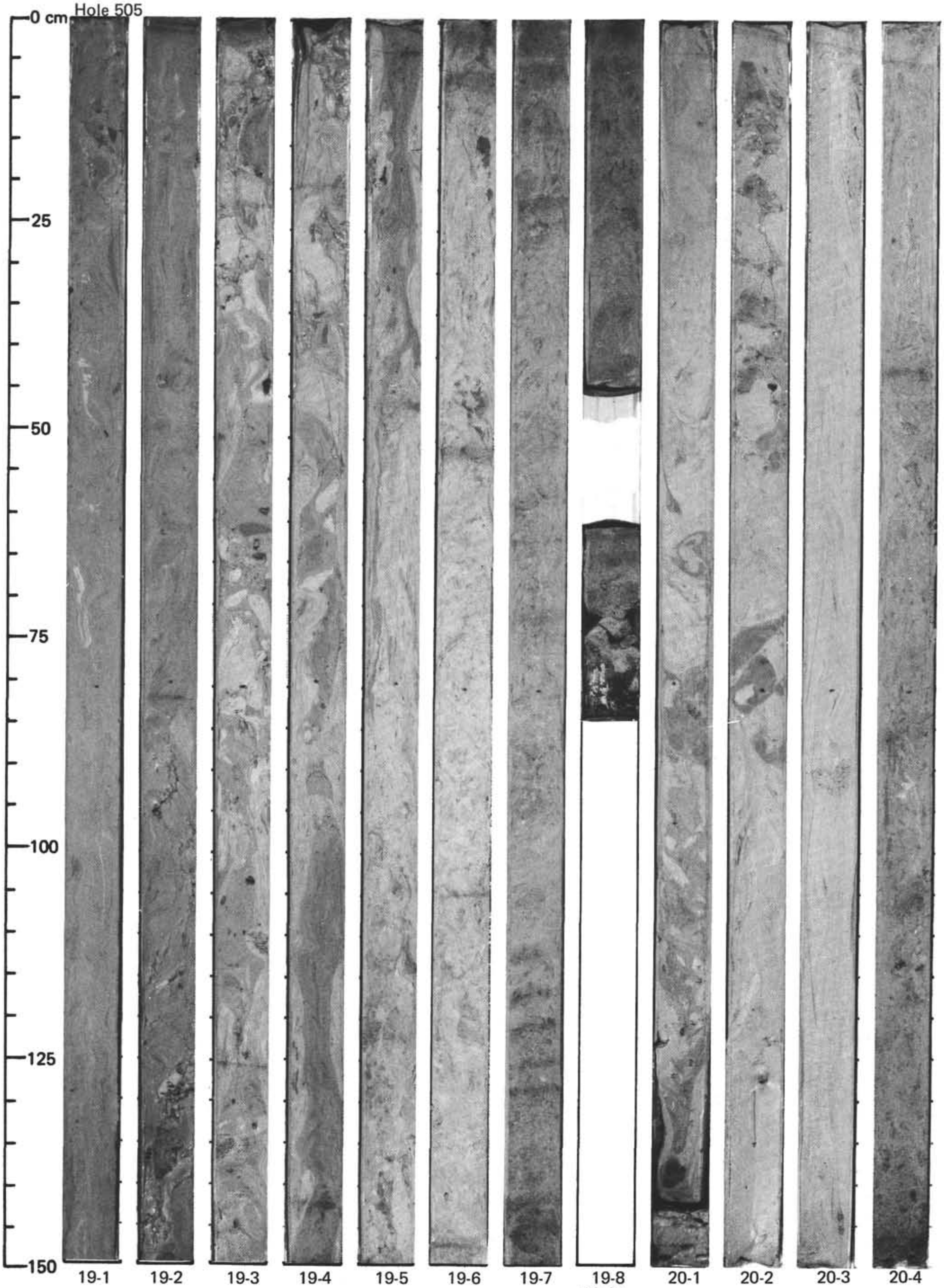
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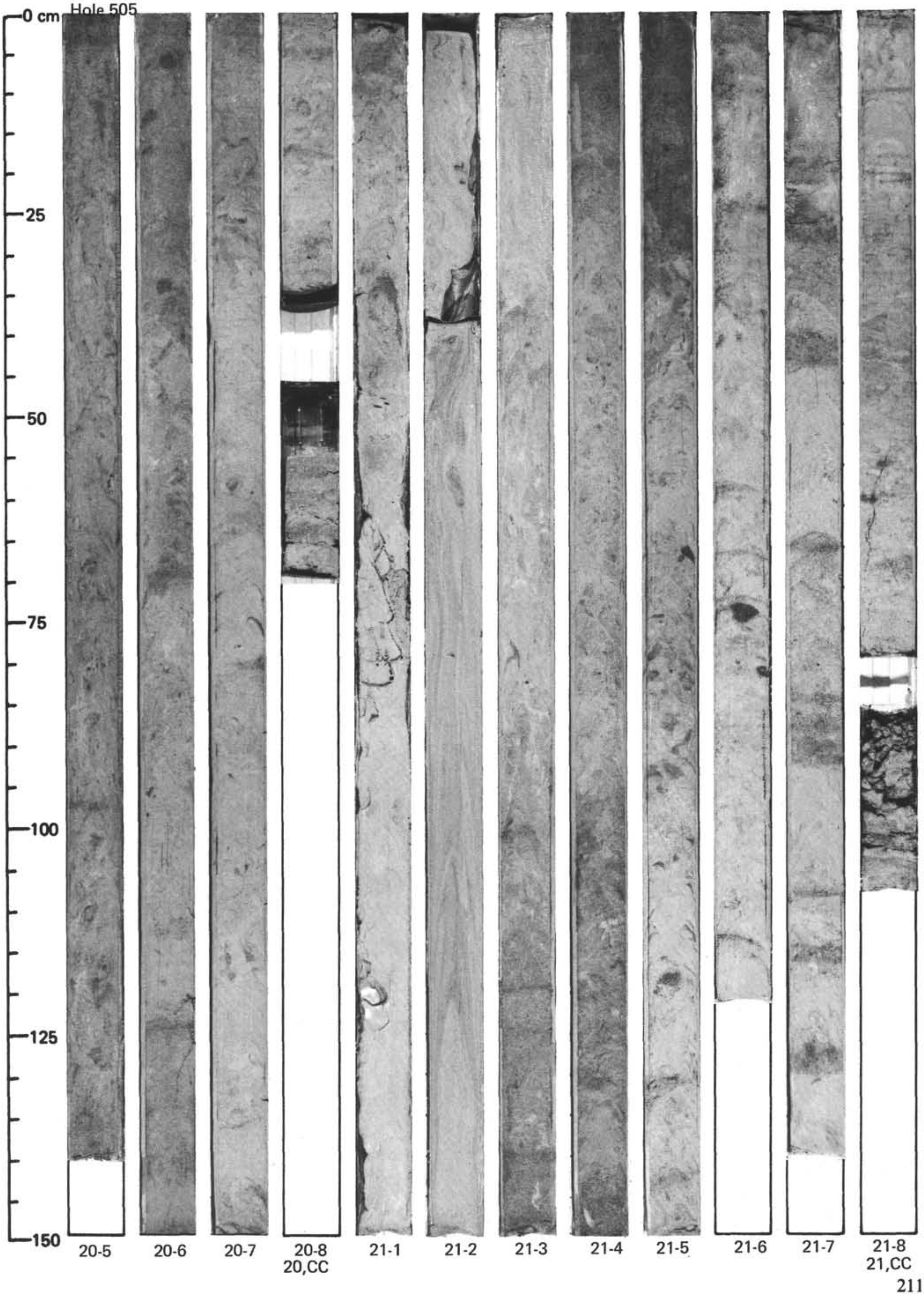
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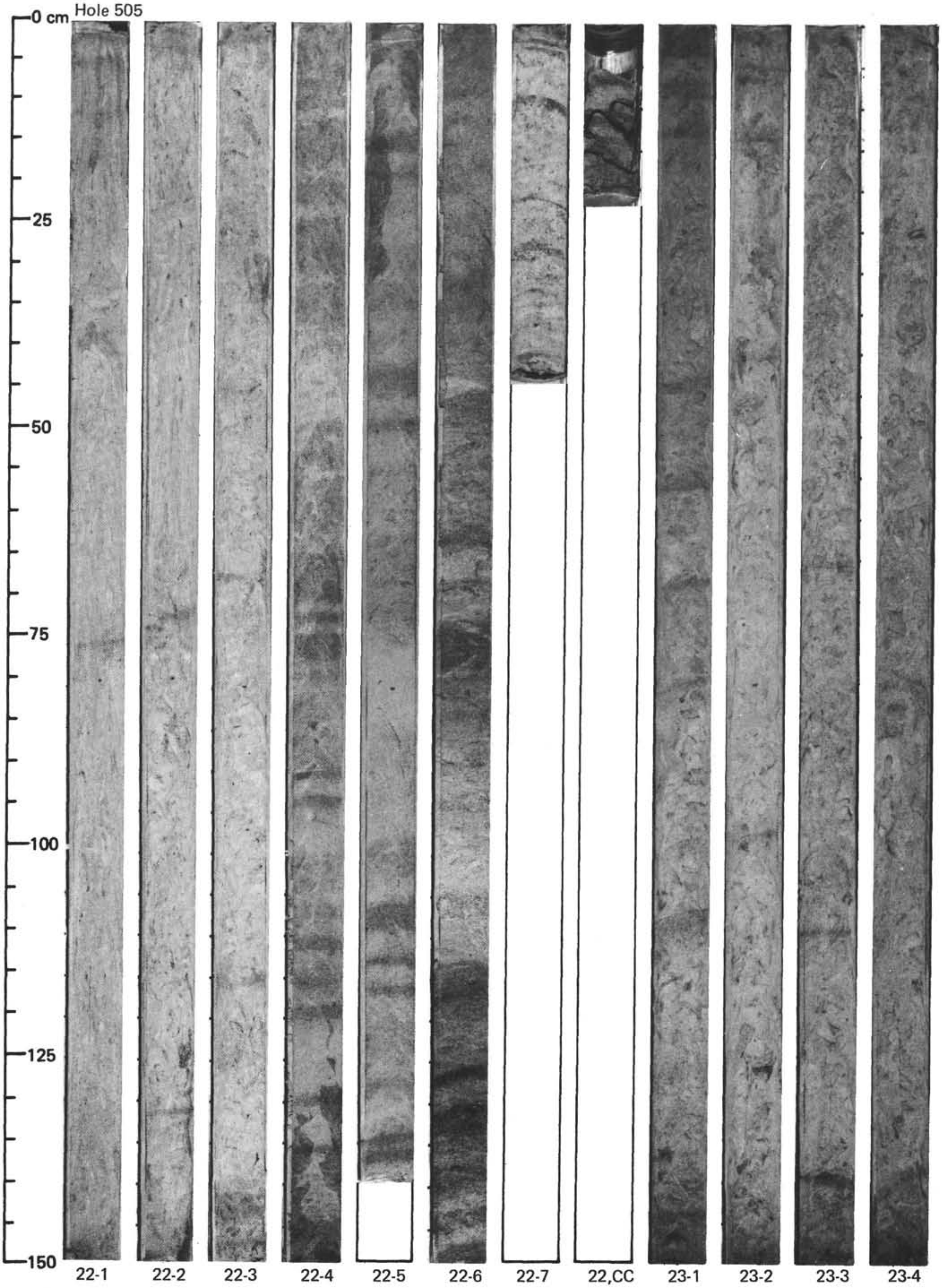
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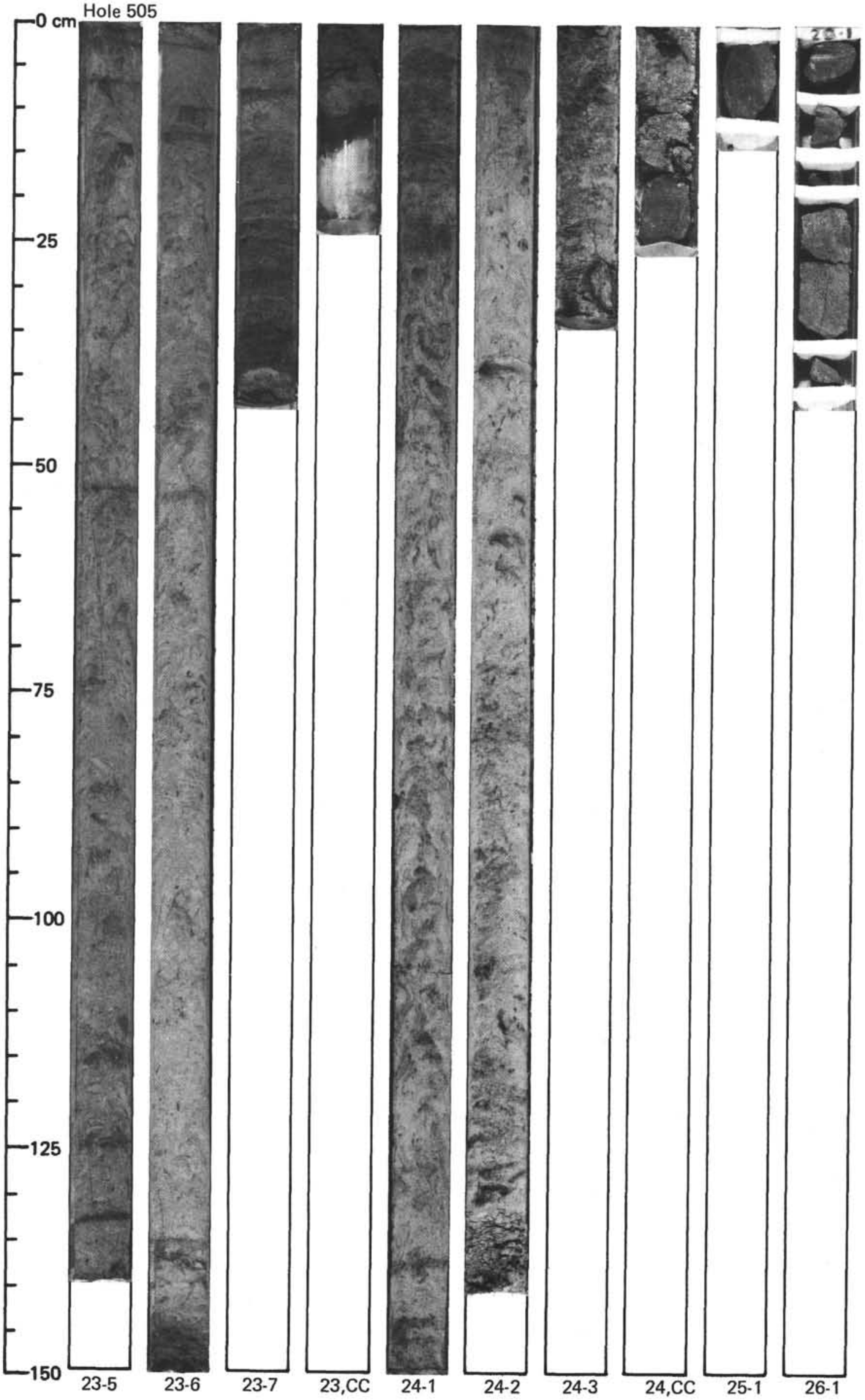
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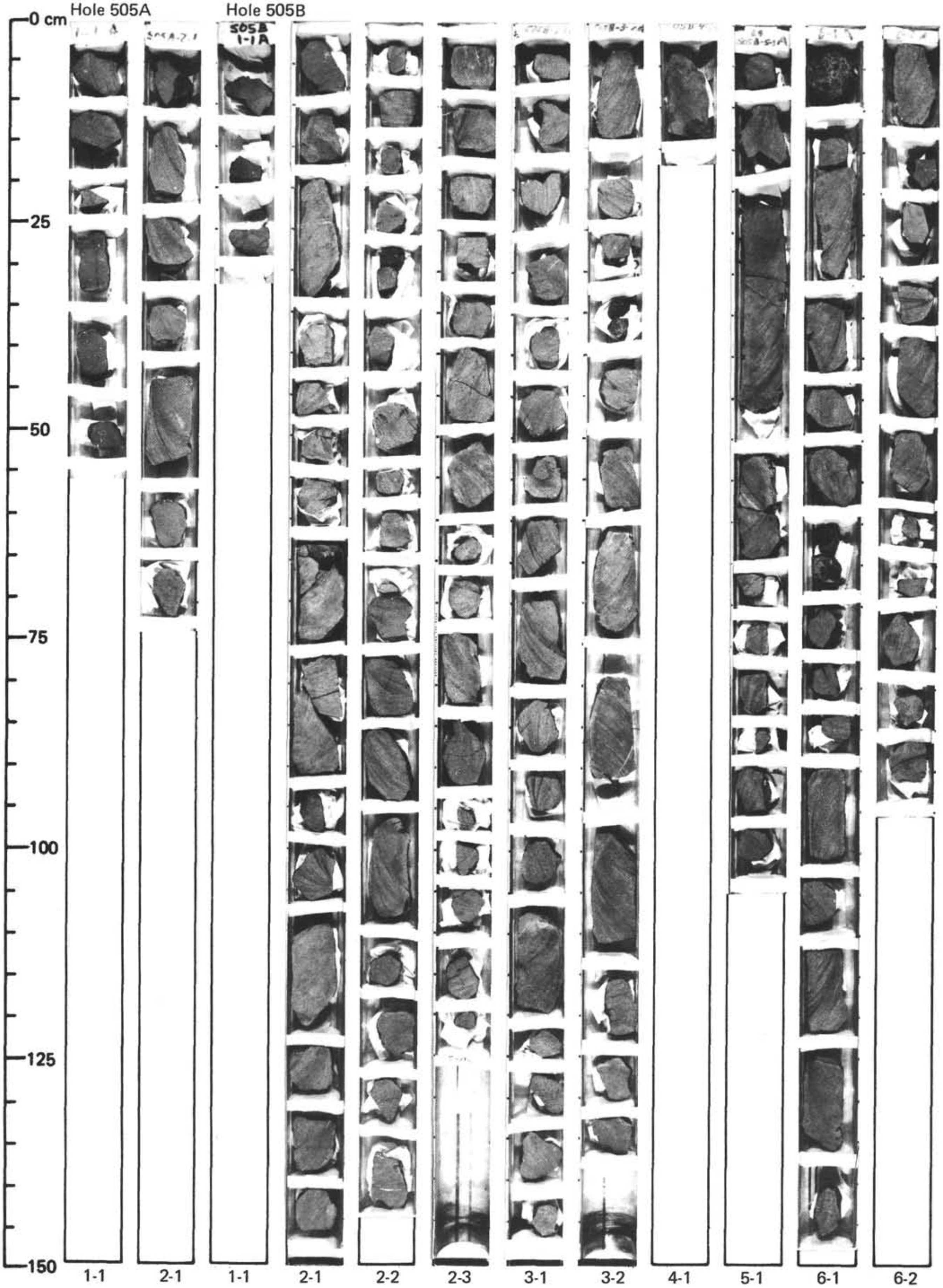
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