10. SITE 257

The Shipboard Scientific Party[1]

SITE DATA

Locality: Southeastern Wharton Basin, northeast of Naturaliste Plateau

Position:
lat 30°59.16′S
long 108°20.99′E

Dates Occupied: 20-23 October 1972

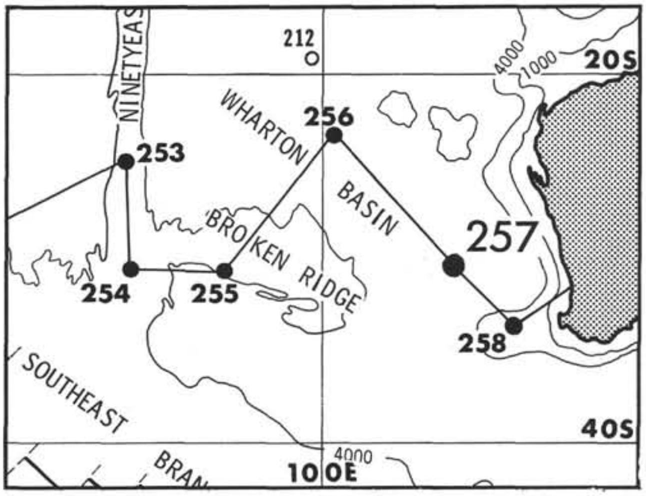
Water Depth: 5278 meters

Penetration: 326.5 meters

Number of Cores: 17

Oldest Datable Sediment Cored:
Depth (subbottom): 247.0-256.5 meters (Core 9)
Nature: Brown detrital clay
Age: Mid Albian

Basement:
Depth encountered (subbottom): 262 meters
Nature: Olivine basalt
Penetration: 64.5 meters



Principal Results: The basalt is overlain by 262 meters of mid Albian to Recent brown detrital clay. There is a section of gray coccolith clay from 199 to 247 meters subbottom. Contact with the basalt appears depositional. There is a probable disconformity between Cretaceous and Tertiary or Recent sediments, but this cannot be proven due to the unfossiliferous nature of the sediments.

BACKGROUND AND OBJECTIVES

Site 257 is located in the southeastern Wharton Basin, northeast of the Naturaliste Plateau in 5278 meters of water (Figure 1). The Wharton Basin was formed by either north-south or east-west spreading soon after the breakup of Gondwanaland. In the case of either spreading direction, the oldest sea floor in the basin, and possibly in the Indian Ocean, would be adjacent to the western edge of Australia, and basement age determination at Site 257 should give the date of the initiation of the breakup. Site 257, in conjunction with other Wharton Basin sites, was planned to help determine the age gradient in the basin. It was expected that if the gradient were north-south, then Site 257 would be older than Sites 212 and 256 in some reasonable proportion. If the gradient were east-west, then Site 257 would be much older; for instance, four or five times the age difference between Sites 212 and 256.

The seismic record approaching the site (Figure 2) shows abyssal hill topography covered by between 0.3 and 0.6 sec DT of transparent sediments. The acoustic basement has a relief of about 0.3 sec. At the site about 0.335 sec DT of sediment is present. A very weak internal reflector can be seen near 0.15 sec DT which is not conformable to the sediment surface or the acoustic basement. There are no significant topographic features seen in the vicinity of Site 257.

OPERATIONS

Glomar Challenger approached Site 257 from the northwest. After turning north onto the same track as the *Conrad*-11 profile upon which the site had originally been selected, we followed our now well-established procedure of passing over the site, identifying it, then making a Williamson turn to come up on a reciprocal course, dropping the beacon while underway on the

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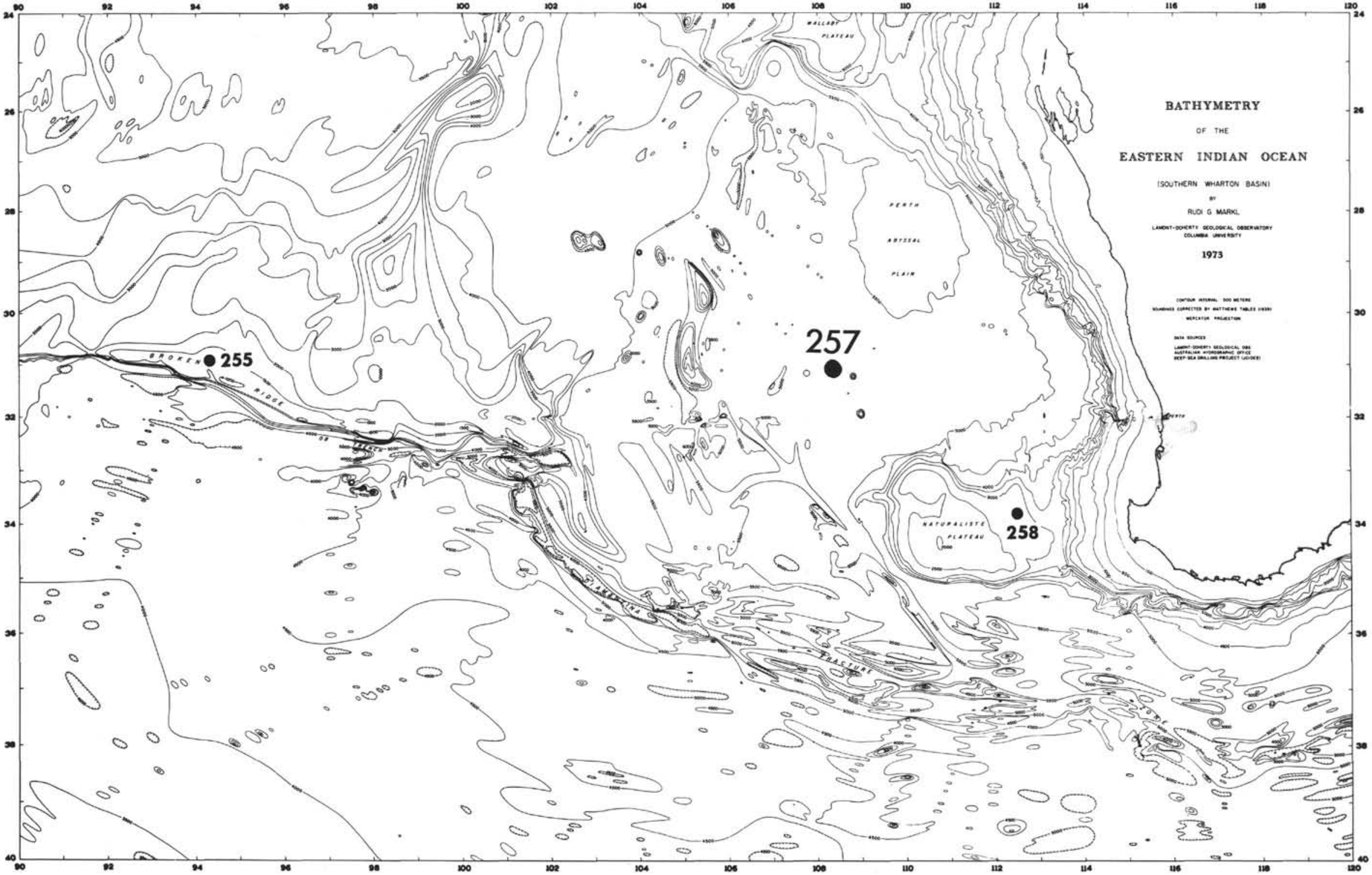

Figure 1. *Base chart and locality for Site 257. (Compiled and contoured by R. Markl, Lamont-Doherty Geological Observatory.)*

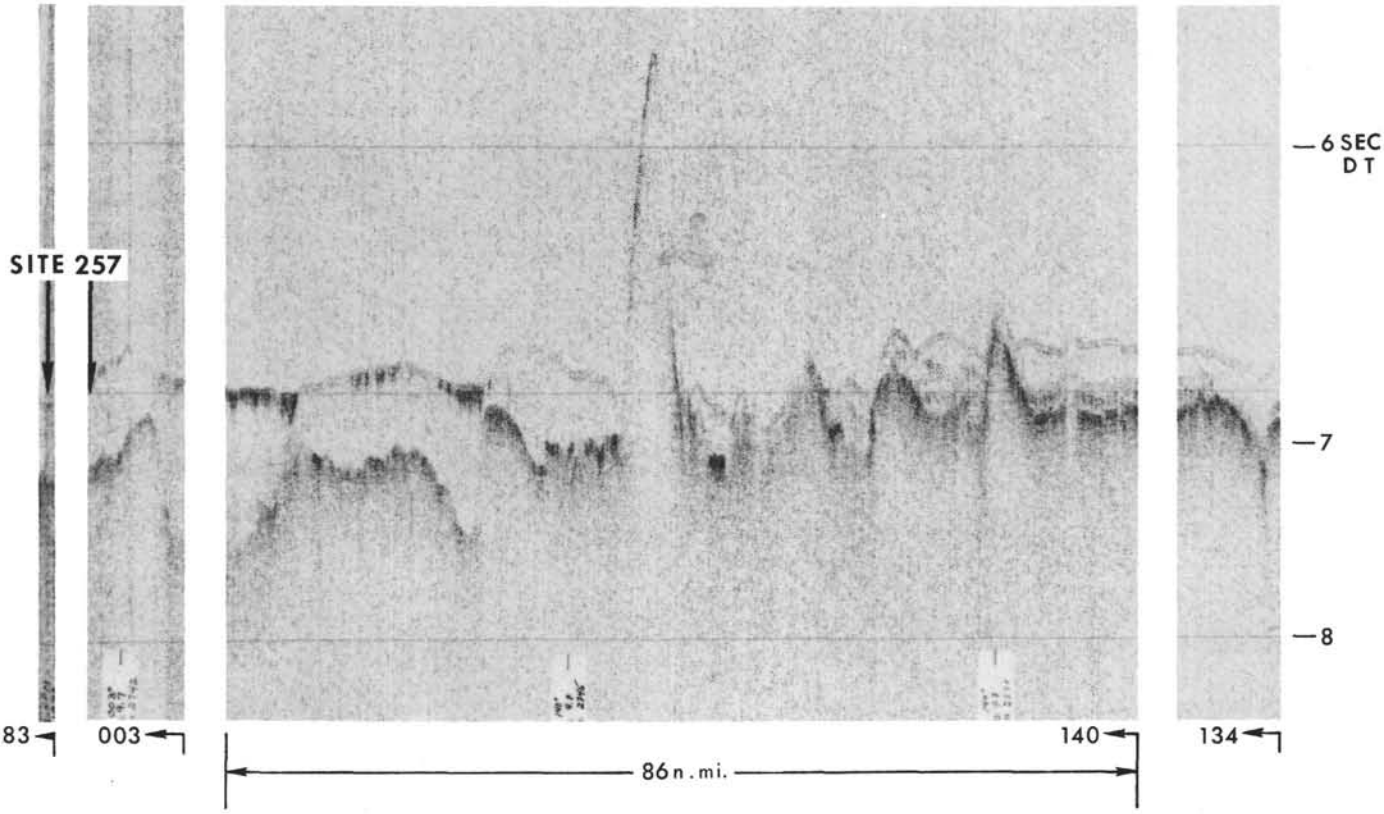

Figure 2. *Seismic reflection profile approaching Site 257, taken from D/V* Glomar Challenger.

second crossing of the site. The beacon was dropped, while underway at 5 knots, at 1533, 20 October, in 5278 meters of water. We then retrieved the underway survey gear and taking up position over the beacon, commenced lowering pipe.

The bottom was reached soon after midnight, and a core was taken at the mudline. This core was on deck at 0236, 21 October. Drilling and intermittent coring then proceeded uneventfully until we reached a subbottom depth of 237.5 meters where we commenced continuous coring. Basement was reached at 262 meters (Core 10) and we cut seven further cores into the basement before abandoning the site. Table 1 gives the vital statistics for cores cut at Site 257.

Three lowerings of the downhole temperature instrument were made immediately after cutting Cores 5, 6, and 7. The instrument was operated in the locked-in mode, and no attempt was made to cut core at the same time as a temperature measurement was made. This was done to try to avoid the problems encountered at Site 256. The first lowering was successful. On the second lowering the tip of the stinger was bent through a right angle, and on the third lowering the stinger was bent and broken off completely. It is suspected that the tool was hanging up in the bottom hole assembly somewhere since the sediment we were sampling was quite soft.

After the decision was made to abandon the site, the sidewall sampling tool was dropped in order to test the shear-pin assembly. No attempt was made to retrieve the tool; it was simply left in the core barrel until the bottom hole assembly was recovered. The bit was brought onboard soon after 2300, 23 October when it was seen that although the shear-pin assembly on the sidewall sampler had operated correctly, the pull necessary to shear the pin had seriously damaged the tool and clearly a stronger design was required. The sampler was cut free with a torch and the tools laid down and secured. We got underway for Site 258 at 2356, 23 October. A postsite survey was not considered necessary.

LITHOLOGY

Total penetration into the sea floor at Site 257 was 326 meters: 262 meters through sediment and 65 meters through basalt. Slightly less than half of the hole was cored, although coring was continuous below 237 meters and 44 meters of sediment and 32 meters of basalt was recovered.

Two major lithologic units were distinguished in the material obtained: (1) detrital clay and (2) olivine basalt.

Unit 1

Subunit 1a is the major, 185-meter-thick portion of this unit. It is a dark brown, soft (stiff in Cores 5 and 6) zeolite-bearing and zeolite-rich detrital clay. The predominant clay mineral is montmorillonite, with lesser amounts of mica/illite and kaolinite. Core 3 (between 48 and 57 m) is the only section containing no more than rare traces of clinoptilolite which occurs in

TABLE 1
Cores Cut at Site 257

Core	Date (Oct. 1972)	Time	Depth Drill Floor (m)	Depth Below Sea Floor (m)	Length		Recovery (%)
					Cored (m)	Recovered (m)	
1	21	0236	5288.0-5297.5	0-9.5	9.5	9.5	100
2	21	0411	5297.5-5307.0	9.5-19.0	9.5	6.0	63
Drilled			5307.0-5335.5				
3	21	0536	5335.5-5345.0	47.5-57.0	9.5	4.0	42
Drilled			5345.0-5373.5				
4	21	0714	5373.5-5383.0	85.5-95.0	9.5	4.8	51
Drilled			5383.0-5411.5				
5	21	0906	5411.5-5421.0	123.5-133.0	9.5	3.1	33
Drilled[a]			5421.0-5449.5				
6	21	1228	5449.5-5459.0	161.5-171.0	9.5	1.3	14
Drilled[a]			5459.0-5487.5				
7	21	1612	5487.5-5497.0	199.5-209.0	9.5	8.3	87
Drilled[a]			5497.0-5525.5				
8	21	2135	5525.5-5535.0	237.5-247.0	9.5	2.4	25
9	22	0020	5535.0-5544.5	247.0-256.5	9.5	3.6	38
10	22	0255	5544.5-5551.0	256.5-263.0	6.5	1.5	23
11	22	0655	5551.0-5560.5	263.0-272.5	9.5	3.3	35
12	22	1016	5560.5-5570.0	272.5-282.0	9.5	4.0	42
13	22	1516	5570.0-5578.0	282.0-290.0	8.0	5.0	63
14	22	2155	5578.0-5586.0	290.0-298.0	8.0	6.0	75
15	23	0343	5586.0-5595.5	298.0-307.5	9.5	3.5	37
16	23	0715	5595.5-5605.0	307.5-317.0	9.5	4.0	42
17	23	1138	5605.0-5614.5	317.0-326.5	9.5	6.4	67
Total					155.5	76.7	49

[a] Heat flow measurement in this interval.

TABLE 2
Lithologic Summary, Site 257

Unit/ Subunit	Core	Depth Below Sea Floor (m)	Thickness (m)	Description
1	1-10	0-262.0	262	Dark brown detrital clay; reddish-brown-gray coccolith detrital clay and clayey coccolith ooze.
1a	1-6	0-185.0	185	Dark reddish-brown detrital clay.
1b	7-9	185.0-249.0	64	Reddish-brown-gray coccolith detrital clay, minor clayey coccolith ooze and clayey coccolith chalk
1c	9-10	249.0-262.0	13	Stiff and semilithified laminated reddish-brown detrital clay.
2	10-17	262.0-326.5	64.5	Vesicular porphyritic olivine basalt.

maximal quantities in Cores 4, 5, and 6. The dark brown color of the sediment is due to the presence of clay-sized translucent and opaque ferruginous aggregates which comprise an average of 2% of the material. Fish debris is present throughout the subunit in trace amounts, although a maximum concentration of 5% was observed in Core 1. Coccoliths are virtually absent. Siliceous fossils comprise 2%-10% of Core 1, but are absent in the rest of the subunit.

An interesting feature of Subunit 1a is the occurrence of black manganese micronodules in Core 3, at around 50 meters. It has already been noted that the concentration of zeolites is minimal in this same portion of the subunit. Similar manganese micronodules appeared at about the same depth in sediments of identical lithology at Site 256.

In Cores 4 and 5 partially silicified mudstone, possibly incipient chert, occurs. These cores are rich in clinoptilolite and cristobalite but with montmorillonite still the predominant clay mineral; a trace of tridymite is present.

The boundary between Subunits 1a and 1b was not cored and is arbitrarily placed 185 meters below the sea floor, at the middle of the uncored interval. These subunits are probably lithologically gradational.

Subunit 1b consists of red- and gray-colored coccolith detrital clay, with minor amounts of clayey coccolith ooze, and an 84-cm-thick clayey coccolith chalk at about 240 meters. The consolidation of Subunit 1b ranges from stiff to semilithified. This is the only lithologic unit at Site 257 where calcite is a significant component of the sediment. The predominant clay mineral is still montmorillonite. Ferruginous aggregates continue to be present in trace to 2% concentrations, but zeolites are entirely absent.

Subunit 1c is a thin (13 m) red and reddish-brown semilithified detrital clay. Most of the sediment is montmorillonite (57%) and finely divided quartz (28%). Only the upper few centimeters are coccolith bearing, and the rest of the subunit is barren. Core 10 is finely laminated and contains a 5-cm-thick greenish-bluish gray layer. Ferruginous material (mostly hematite) occurs in concentrations of up to 4%. Barite is present but the other minor components characteristic of Unit 1 are absent or present only in trace amounts (Table 3).

The base of the red detrital clay is in sharp normal contact with the underlying basalt. The contact at 262 meters is based on drilling log information.

Unit 2

Basalt was reached at a depth of 262 meters and was drilled for a total of 64.5 meters, with a recovery of 32 meters. The contact with the overlying red clay was recovered and is normal; there is considerable alteration of the uppermost half meter of basalt, but no indication of deuteric or metasomatic alteration, or of baking, of the sediment. The sequence comprises medium- and fine-grained olivine basalt, alternating approximately so that a number of separate flows, on the order of seven or eight, can be distinguished. Several very shallow flows may be present, rendering an exact count impossible. The whole sequence is highly fractured, especially the coarser intervals, there being many high-angle or even vertical fractures. The majority are recemented with calcite, which also occurs as spherulitic blebs, but there are several horizontal veins, some 2 cm thick, of serpentine chlorite; this material also forms films on some of the open fracture surfaces. The upper (fine-grained) portions of several flows appear to have been brecciated, perhaps due to violent temperature changes resulting from contact with cold seawater, many of the fragments being recemented with red-stained calcite; this in turn may also be due to solution of carbonate in seawater heated by the extruded basalt and reprecipitation on cooling. Core 15 contains a short sedimentary sequence of graded sand and clay having a similar mineralogy to Subunit 1b. This is detailed in Core Summary 15, and may possibly be interpreted as an interbasaltic sedimentation episode. There are also a certain number of short intervals (ca 10 cm) of red carbonate. In each case, the micarb limestone, heavily stained with iron oxide (presumably derived from the basalt), occurs at blank places in the basalt, at the top of a core. This limestone may represent cavings, inasmuch as the drilling procedure in the basalt involves clearing the bit face above the basalt. At least one vug containing well-developed dog's tooth crystals of calcite, coated with hydrated oxide of manganese, was noted, as were occasional patches of botryoidal spherulitic calcite.

The basalt is vesicular, porphyritic, and subvariolitic; apart from Site 253, its porphyritic nature is unique to this hole on Leg 26. Ten thin sections of the basalt were cut and are described below under two headings.

1) Medium-grained porphyritic and subvariolitic olivine basalt forms the coarser, lower, sections of each flow. It exceeds the fine-grained rock in volume and is

TABLE 3
Summary of Minor Components, Site 257

Core	Zeolite (%)	Ferromanganese (%)	Iron Oxides (%)	Quartz (%)	Fish Debris (%)	Coccoliths (%)	Siliceous Fossils (%)
Unit 1a							
1	1-10	–	Tr-4	Tr-2	Tr-5	Tr	2-10
2	2-10	–	1	Tr-2	Tr	Tr (rare)	Rare
3	Tr (rare)	X	1	Tr (rare)	Tr-1	0	0
4	12-20	–	1-2	0	Tr-1	Tr (rare)	0
5	4-15	–	1-2	0	Tr	0	0
6	8-50	–	Tr-5	Tr (rare)	Tr	0	0
Unit 1b							
7	0	–	Tr-2	0	Tr	10-35	0
8	0	–	1-2	0	Tr (rare)	12-55	0
Unit 1c							
9	0	–	Tr-2	0	Tr	Tr-1	0
10	0	–	Tr-4	0	Tr	0	Tr (rare)
Unit 2							
10-17	Basalt						

on the whole slightly less fractured; it is considerably fresher, probably partly due to the smaller amount of glass it contains and to its having received less exposure to seawater.

The rocks are fresh and gray in color, subvariolitic to subophitic, or hyaloophitic in texture. Two of the five rocks sectioned are porphyritic. Olivine reaches 6% in one rock but is only present in traces in others; it is sometimes euhedral, reaching 0.8 mm in size, but always totally altered to dark bowlingite or smectite. In one porphyritic rock, smectite patches reaching 2.5 mm may represent olivine pseudomorphs.

Plagioclase forms laths reaching 0.8 mm or, in the case of the more acicular crystals, 1 mm. There are occasional larger, chunky crystals, always zoned, and in the porphyritic rocks zoned phenocrysts reaching 4 mm occur, often in groups and sometimes accompanied by smaller (0.8 mm) phenocrysts of pyroxene. Clinopyroxene otherwise reached 0.5 mm and occurs as grains, ophitic plates, or in spherulitic, fan-like bunches. It may exceed plagioclase in abundance. Iron oxide, probably ilmenite, usually forms skeletal bars or rods, up to 0.4 mm, and grains. Dark or very dark palagonitic, mesostatic glass, between the groups of feldspar and pyroxene crystals, completes the rocks. Vesicles are scarce compared with the fine-grained rocks, but occasional palagonite-filled vesicles are present throughout and Sample 11-2, 27 cm contains very abundant black, green, and colorless vesicles, filled with dark or pale palagonite, some of it vivid green in color and vermicular in texture, with an inner filling of calcite.

2) Fine-grained or glassy vesicular porphyritic basalt varies in texture from subophitic or subvariolitic to glassy. Olivine is present in very small quantities, the subhedral crystals completely altered to bowlingite or palagonite. One very euhedral crystal (0.5 mm) occurs in 13-2, 80 cm, framed and cracked with iron oxide and replaced, exceptionally, by chrysotile serpentine. Plagioclase laths reach 0.8 mm or occur as zoned microphenocrysts up to 1.2 mm. Pyroxene may also form small, zoned microphenocrysts up to 0.7 mm in length, but usually occurs as grains or spherulitic rosettes up to 0.5 mm, from which the feldspar laths fan out. Iron oxide is present as grains up to 0.2 mm, but in the very fine-grained rocks it may not be exsolved from the glassy matrix. The glass itself is very dark to light brown in color, varying from an interstitial mesostasis to a dense matrix full of feathery devitrifying microlites, interspersed with the crystal groups. The vesicles are filled with dark glass or bowlingite or palagonite; the latter may be dark or bright vivid green. Some are filled with calcite. In Sample 13-2, 80 cm the vesicles are black or green, filled with very dark opaque glass or vivid, fibrous celadonite, with a composite spherulitic texture.

SHIPBOARD GEOCHEMICAL MEASUREMENTS

Routine analysis for salinity, *p*H, and alkalinity were conducted on interstitial water samples squeezed from seven samples taken at depths in the hole from 8.0 to

TABLE 4
Modes of the Basalts, Site 257

	Medium-Grained Vesicular Basalt (11-2, 27 cm)	Medium-Grained Basalt (11-2, 80 cm)	Medium-Grained Porphyritic Olivine Basalt (14-4, 125 cm)	Medium-Grained Porphyritic Olivine Basalt (16-2, 100 cm)	Medium-Grained Spherulitic Olivine Basalt (17-5, 66 cm)	Fine-Grained Vesicular Basalt (11-3, 29 cm)	Glassy Vesicular Basalt (13-2, 80 cm)	Fine-Grained Vesicular Basalt (13-3, 10 cm)	Glassy Porphyritic Basalt (14-4, 22 cm)
Olivine	tr	0.5	4	6	3	tr	tr	–	1
Plagioclase	40	36.5	38	37	32	40	18	25	37
Pyroxene	15	32	37	36	42	20	5	24	22
Iron oxide	10	6	8	6	5	7	5	8	40
Glass	15	25	13	15	18	25	67	35	
Vesicles	20	–	–	–	–	8	5	8	–

256.5 meters below the sea floor. In addition, *p*H was also measured on all but the deepest of the unsqueezed samples by the punch-in method. The sampling and analytical techniques are described in the report on Site 250, and the results for Site 257 are summarized in Table 5 and presented in graphical form in Figure 3.

Results

Salinity in the uppermost four samples was measured as 35.4°/oo, or 0.7°/oo higher than the region's near-bottom water salinity of 34.7°/oo quoted by Wyrtki (1971). At a depth of 239 meters salinity was only 34.4°/oo. Salinity again was measured as 35.2°/oo at 239 meters; however, this value is suspect inasmuch as the sediment sample appeared badly disturbed and could easily have been contaminated. The deepest measurement, taken from a sample 256.5 meters below the mudline, was also 34.4°/oo. The data are too scarce for the apparent correlation between the decreased salinity with depth to be interpreted or even evaluated.

Alkalinity

Alkalinity decreases fluctuatingly and slightly with depth in the hole, from a near-seabottom value of 2.00 meq/kg to 1.66 in the lowermost sample. Again, the only exception to this trend was measured in the suspect sample from 239 meters.

pH

Punch-in and flow-through values differed by 0.07-0.27 *p*H unit, four of the flow-through and two of the punch-in values being the lower. All taken together, the *p*H values appear to increase irregularly and slightly down the hole, from 7.0 to 7.25 in the uppermost sample to between 7.22 and 7.52 in the sample taken from the greatest depth.

PHYSICAL PROPERTIES

The physical properties measured at Site 257 were porosity, acoustic velocity, bulk density, and thermal conductivity. The methods are described in the Explanatory Notes (Chapter 2). The results are shown in the hole summary diagram.

Density, Porosity, and Water Content

Density increases linearly with depth in the sediments from 1.35 g/cc near the surface to 1.65 g/cc just above the basalt basement. The GRAPE densities are slightly higher than those from the syringe and section weight. Porosity and water content decrease very rapidly with depth. Porosity ranges from 85% near the surface to 65% near basement. The rapid increase in consolidation with depth, similar to Site 256, is to be expected with a slow sedimentation rate.

Acoustic Velocity and Acoustic Impedance

The acoustic velocity is very uniform with an average of 1.50 km/sec for the upper part of the sedimentary section, increasing to 1.60 km/sec near basement. There is no significant anisotropy in velocity. Vertical and horizontal velocities were measured on 16 basalt samples using the Hamilton Frame. There is no systematic anisotropy but measurements in the two directions differed by up to 4% which probably represents the extent of inhomogeneities in the samples. Obvious fractures, calcite-filled veins, and areas of pronounced weathering were avoided.

Surprisingly, the velocities increase almost linearly with depth from an average of 4.5 km/sec at the top of the basalt to an average of 6.2 km/sec 60 meters into the basalt. These results are discussed in detail in this volume (Chapter 16).

CORRELATION OF SEISMIC REFLECTION PROFILE WITH DRILLING RESULTS

An on-site profile was conducted with a 30-in.^{3} airgun and an SSQ41 sonobuoy (Figure 4). This profile shows about 0.325 sec DT of sediments above acoustic basement with a time-intermittent (horizontally intermittent considering the sonobuoy drift) intermediate reflector at 0.135 sec DT. No continuous, discrete reflectors are seen below the acoustic basement. This basement is the basalt reached by the drill at 262 meters subbottom. The average sediment velocity is then 1.61 km/sec. The intermediate reflector should then be near 108 meters subbottom. Cores 4 and 5 bracket this depth

TABLE 5
Summary of Shipboard Geochemical Measurements, Site 257

Sample (Interval in cm)	Depth Below Sea Floor (m)	Lab Temp (°C)	*p*H Punch-in/Flow-through	Alkalinity (meq/kg)	Salinity (°/oo)
(Reference seawater)	–	–	–	–	–
1-5, 144-150	8.0	22.3	7.26/7.03	2.00	35.2
3-2, 144-150	55.5	22.5	7.03/6.85	1.81	35.2
4-4, 144-150	95.0	22.8	6.99/7.06	1.86	35.2
5-2, 144-150	131.5	22.6	7.19/6.92	2.00	35.2
7-5, 144-150	207.5	22.6	7.42/7.53	1.79	34.4
8-1, 145-150	235.5	22.2	7.52/7.35	0.88	35.2
9-3, 140-150	256.5	22.8	/7.22[a]	1.66	34.4

[a] Too stiff to measure punch-in.

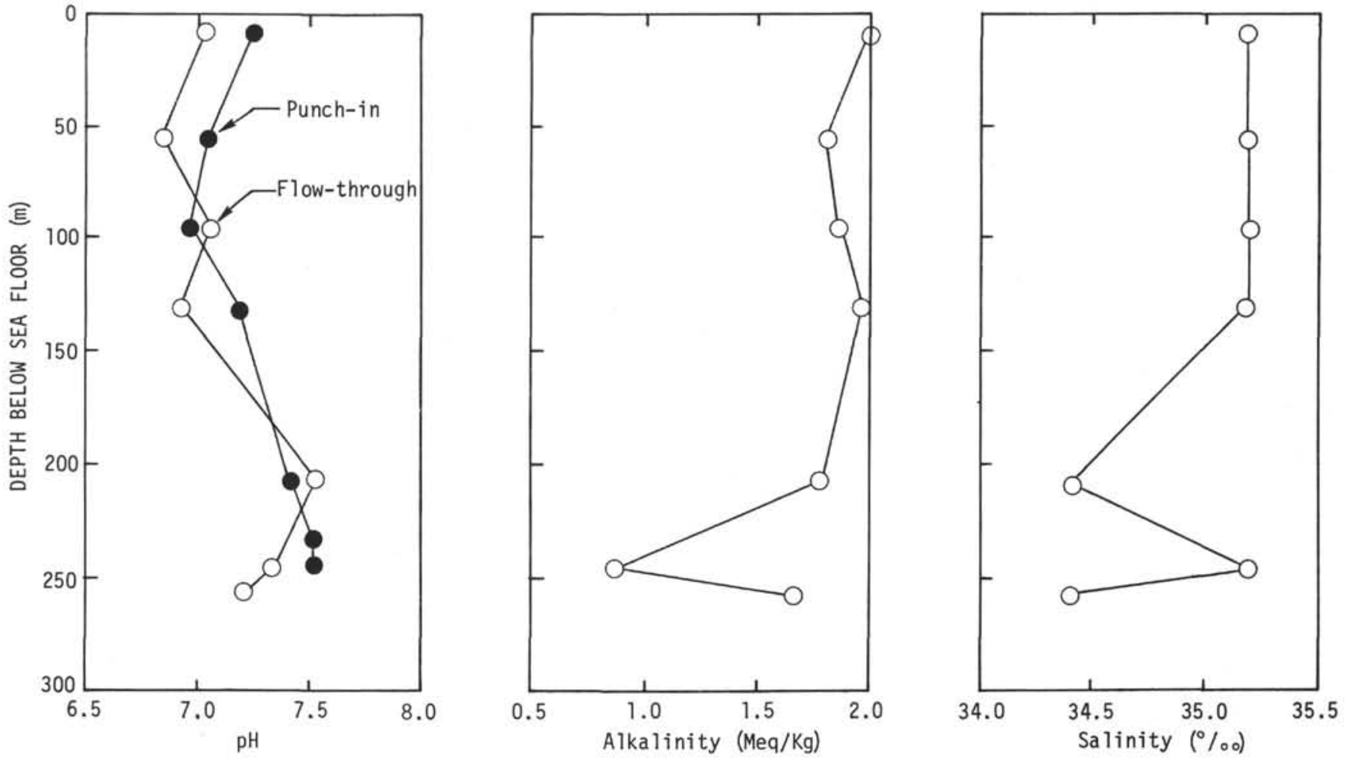

Figure 3. *Graphic summary of geochemical measurements taken at Site 257.*

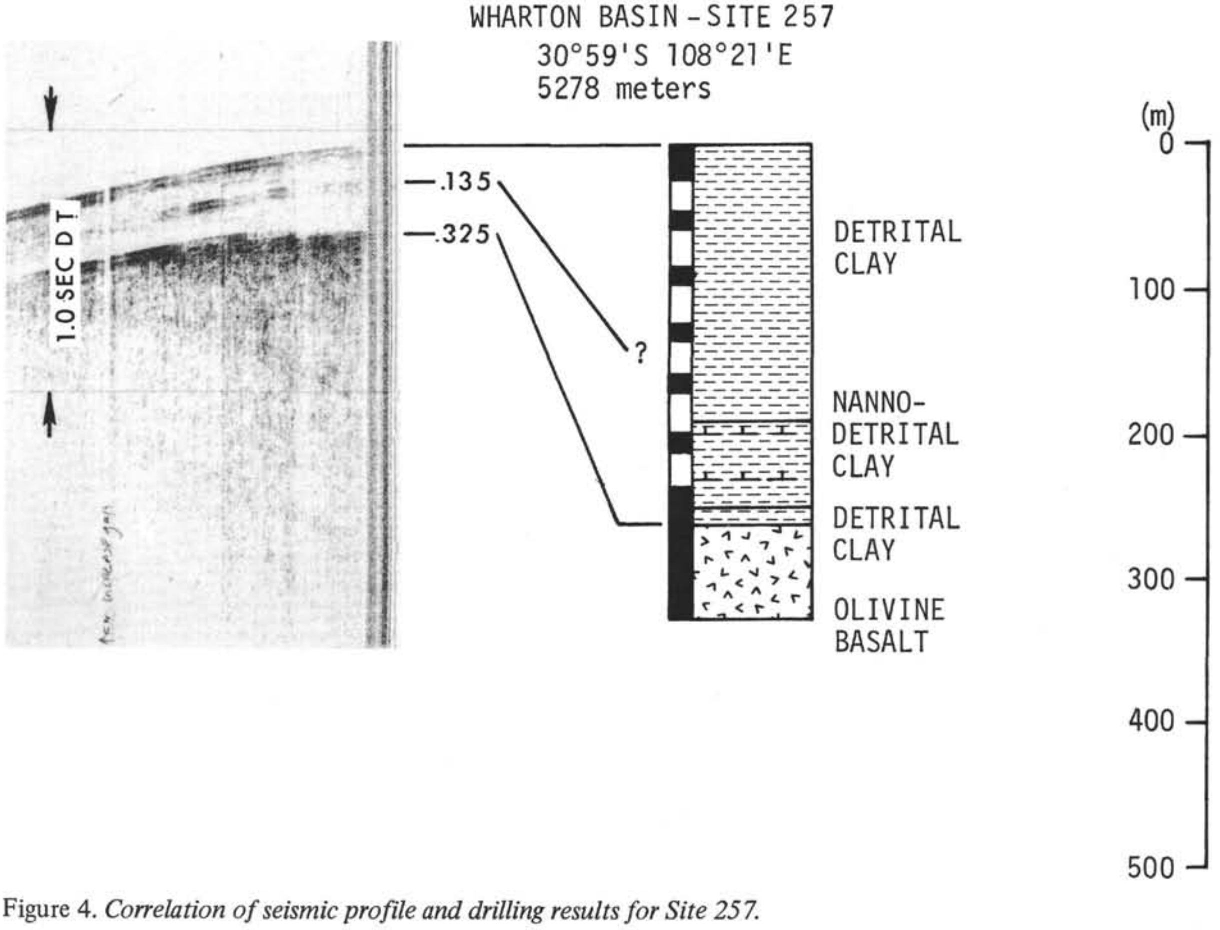

Figure 4. *Correlation of seismic profile and drilling results for Site 257.*

and did not sample a change in lithology. However, Core 5 was more consolidated. A change in drilling rate was not seen between Cores 4 and 5 that would indicate a change in lithology or induration.

PALEONTOLOGY

Biostratigraphic Summary

The upper part of the sequence is devoid of calcareous microfossils and was therefore deposited below the carbonate compensation depth. Cretaceous radiolarians are present from 85 meters downwards. In a thin section of a siliceous clay in Core 5 (125 m) a *Globotruncana* of possible Campanian age has been found. Arenaceous foraminifera and calcispheres occur in Cores 6 and 7. Calcareous nannoplankton of middle Albian age are present in Cores 7, 8, and 9. In the latter two cores, arenaceous and calcareous benthonic foraminifera, as well as planktonic foraminifera, are common.

A gradual increase in water depth, or shoaling of the lysocline, with time through Cores 8 to 6 can be inferred based upon the preservation distribution of calcareous micro- and nannofossils. The lowermost part of the section, however, shows the reverse trend, and in a short distance within Core 9 calcareous fossils are gradually eliminated.

Strongly recrystallized calcified radiolarians occur in a baked recrystallized limestone layer within the basalt sequence of Core 12, Section 1.

The restricted diversity of planktonic foraminifera indicates a rather cold-water environment during the Cretaceous.

Foraminifera

In Cores 1 to 4 (0-91 m) only rare and poorly preserved arenaceous foraminifera were found, which did not allow any age determination. Cores 5 and 6 are equally devoid of calcareous microfossils except for a single specimen of *Globotruncana* cf. *elevata* ssp., which was found in a thin section of a siliceous clay in Sample 5-1, 140-142 cm, and which indicates a possible Campanian age for this level. A Cretaceous age for Cores 5 and 6 is also supported by the scattered occurrence of *Haplophragmium* cf. *aequale* (Roemer).

Calcareous benthonic foraminifera, including *Osangularia utaturensis* (Sastri and Sastri), *Gyroidinoides* cf. *primitiva* Hofker, and *Gavelinella* ex gr. *intermedia* (Berthelin) occur in Cores 7 to 9. They are moderately preserved and etched in Core 7, but become well preserved, although nowhere abundant, in Core 8. At the same time, beginning with Core 7, Section 5, we find an increasing number of planktonic foraminifera: *Hedbergella planispira, H.* aff. *infracretacea*, and rare *Ticinella.* In Core 9 a rapid increase in the solution effects can be noted from Section 1 downwards. Planktonic foraminifera still occur in Section 1 and a few specimens were found in Section 2; they are missing, however, below this level. Few poorly preserved calcareous benthonic foraminifera occur throughout the lower part of Core 9, but none have been found in Core 10. The sediments immediately overlying the basalt contain only few primitive arenaceous foraminifera which are not suitable for dating this sediment. The planktonic foraminifera found in Cores 7 to 9 support the Albian age determined by the nannoplankton investigation. The restricted diversity prohibits a precise age assignment and, as for Site 256, indicates a cold-water environment at this site during the uppermost Lower Cretaceous.

Calcisphaerulidae

Calcispheres of the genus *Pithonella* occur between Sample 7-1, 78-82 cm and 9-2, 18-22 cm. They have been described by Bolli, 1974.

Calcareous Nannoplankton

Stratigraphy: Calcareous nannofossils were found only in Cores 7, 8, and 9 and are all of middle Albian age (*Prediscosphaera cretacea* Zone).

Preservation: A continuous decrease of solution effects is observed from Sections 1 through 6 of Core 7. Samples 257-7, CC and 257-8-1, 139 cm contain only slightly etched assemblages. An increase of etching is observed in Samples 257-8-2, 9 cm through 257-9-2, 37 cm. The samples from the lower part of Core 9 and those from Core 10 are barren. A shipboard study of 20 smear slides from red, brown, gray, and pale green pebbles and the grayish-brown matrix of the drilling breccias in Core 8, Sections 2 and 6 showed no difference in age between pebbles and matrix, but a decreasing abundance of coccoliths, due to etching, from pale green to gray to brown to red-brown-colored pebbles.

Paleoecology: The middle Albian assemblages are similar to those from the Gault Section at Copt Point, Folkstone, England. They represent a non-Tethyan, temperate to cool-water paleoenvironment.

SEDIMENTATION RATES

From 0 to 199.5 meters subbottom depth only a net sedimentation rate of 2 m/m.y. can be calculated, due to the absence of paleontological data. It is likely that the rate for the Cenozoic is much below this.

The sedimentary sequence between 199.5 and 250.0 meters belongs to the middle Albian and accumulated at a rate of at least 25 m/m.y., if we assume that the middle Albian extended over a period of 2 m.y.

SUMMARY AND CONCLUSIONS

Summary of Results

Site 257 is located in 5278 meters of water in the southeastern Wharton Basin. Near the site seismic profiles show about 0.3 sec DT of sediments with a ghostly internal reflector near 0.10-0.15 sec DT. One hole was drilled at this site through 262 meters of sediments and 64.5 meters of basalt. The oldest sediment dated is middle Albian, 13 meters above the contact.

One sedimentary unit and three subunits were recognized. From the surface down to between 170 and 200 meters is a dark reddish-brown detrital clay, zeolite rich, or zeolite bearing. Below this and down to 249 meters is a reddish-brown to gray coccolith detrital clay to clayey coccolith ooze and chalk. Between this unit and the basement is 13 meters of barren reddish-brown detrital clay. The contact with the basalt is sharp and appears conformable. The basalt is gray, vesicular and porphyritic, highly fractured with veins of calcite and serpentine. Seven or eight flows were drilled. It is fresher deeper into the hole which caused a decrease in drilling rate with depth. The acoustic velocity in the basalt increases from about 4.5 km/sec at the contact to over 6 km/sec 64 meters below, also indicating increasing freshness. At the top of Core 15 (298-307.5 m) a clay layer plus consolidated graded sand with subrounded pebbles of basalt was recovered. We have not established whether this material was in situ or not.

The site is largely barren of microfossils. Cretaceous radiolarians were found at 85.5-95 meters and middle Albian nannofossils and foraminifera were found below 199.5 meters. Only one species of planktonic foraminifera was seen suggesting a cold-water environment for the middle Albian. The middle Albian section is at least 50 meters thick which implies a minimum sedimentation rate of about 25 m/m.y. for this sequence. Because Cretaceous radiolarians are found near 85 meters and Quaternary radiolarians at 10 meters, the entire Tertiary and Upper Cretaceous is restricted to 75 meters, or a sedimentation rate near 1 m/m.y.

Preliminary Conclusions

As with Site 256, much of the section at Site 257 was deposited below the carbonate compensation depth (CCD). However, the barren layer below the Albian coccolith clay at Site 257 indicates that, unlike Site 256, sedimentation began here below the CCD, rose above it for a short period, then again took place below it. A Cretaceous cold-water environment, and therefore a more southerly location, is indicated by the fauna here as at Site 256. Also, both sites show a rather thick Lower Cretaceous (Albian) sequence and a thin Upper Cretaceous through Tertiary section. It is tempting to correlate this decrease in sedimentation rate and/or hiatus to changes in oceanic circulation associated with the breakup of Australia-Antarctica in the Eocene, but lacking more precise dating, this is only speculation.

It was disappointing that the sediment-basalt contact proved barren. The crust might be significantly older than middle Albian, but the high sedimentation rate for the lower section would argue against this. From tectonic arguments the crust here should be close to 120 m.y. The apparently young age could be explained by a disconformity at the base of the section or the basalt sequence being younger than the true basement. We saw no obvious changes in the lithology of the basalt sequence to indicate a disconformity, but a clay layer at 298-307.5 meters may indicate an unconformity. A final explanation for the apparent young age is the possibility of a north-south-trending right-lateral fracture zone between Sites 256 and 257. This would tend to move younger material south to where the older material would be expected.

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APPENDIX A

Grain-Size Determinations for Site 257

Core, Section Top of Interval (cm)	Subbottom Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
1-2, 90	2.4	0.0	18.3	81.6	Clay
1-5, 90	6.9	0.2	21.1	78.7	Clay
2-2, 121	12.2	0.0	15.9	84.1	Clay
3-2, 90	49.9	0.1	12.0	87.8	Clay
4-2, 91	87.9	0.0	19.3	80.6	Clay
5-2, 90	125.9	0.0	15.6	84.3	Clay
6-1, 131	162.8	0.0	11.5	88.5	Clay
7-2, 90	201.9	0.0	5.8	94.2	Clay
7-5, 91	205.4	0.0	6.5	93.5	Clay
8-2, 89	239.9	0.4	16.6	82.9	Clay
9-2, 90	249.4	0.0	3.8	96.1	Clay
10-1, 89	257.4	0.9	3.1	96.0	Clay

APPENDIX B

Carbon-Carbonate Determinations for Site 257

Core, Section Top of Interval (cm)	Subbottom Depth (m)	Total Carbon (%)	Organic Carbon (%)	$CaCO_3$ (%)
1-2, 88.0	2.38	0.1	0.1	0
1-5, 88.0	6.88	0.1	0.1	0
2-2, 120	12.20	0.1	0.1	0
3-2, 88	49.88	0.1	0.1	0
4-2, 89	87.89	0.1	0.1	0
5-2, 88	125.88	0.0	0.1	0
6-1, 130	162.80	0.2	0.2	0
7-2, 88	201.88	1.7	0.2	12
7-5, 88	206.38	1.2	0.3	7
8-2, 88	239.88	2.1	0.1	17
9-2, 88	249.38	0.1	0.1	0
10-1, 88	257.38	0.4	0.1	2

APPENDIX C
X-Ray Analyses for Site 257

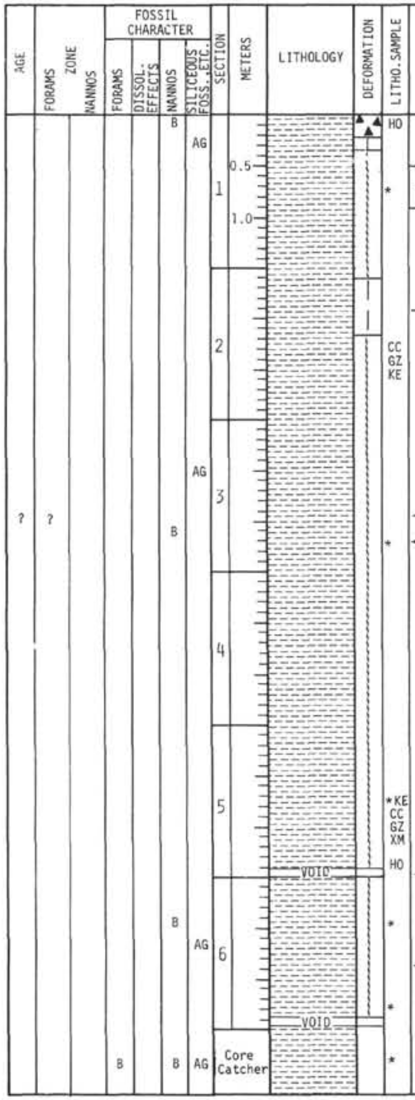
Core	Cored Interval Below Sea Floor (m)	Sample Depth Below Sea Floor (m)	Diff.	Amor.	Calc.	Quar.	Cris.	K-Fe.	Plag.	Kaol.	Mica	Mont.	Trid.	Clin.	Hema.	Bari.	Hali.	U–4[a]	U–5[b]	U–7[c]
Bulk Sample																				
1	0.0-9.5	6.9	88.4	81.9	–	21.2	–	5.4	10.2	5.8	21.3	36.1	–	–	–	–	–	–	–	–
2	9.5-19.0	12.3	84.3	75.4	–	9.6	–	4.1	1.8	11.2	21.5	43.6	–	8.2	–	–	–	–	–	–
3	47.5-57.0	51.7	83.2	73.8	–	8.1	–	2.9	–	12.0	9.4	67.7	–	–	–	–	–	T	–	–
4	85.5-95.0	90.2	84.1	75.1	–	4.1	5.9	3.0	1.2	–	18.3	40.2	1.3	26.0	–	–	–	–	–	–
5	123.5-133.0	125.9	87.1	79.9	–	4.8	13.5	5.8	2.0	4.6	18.4	24.2	2.3	24.3	–	–	–	–	–	–
6	161.5-171.0	162.8	84.5	75.7	–	9.3	–	11.1	2.1	–	19.1	39.2	–	19.2	–	–	–	–	–	–
7	199.5-209.0	201.9	81.3	70.7	18.8	8.4	–	10.0	–	4.8	8.2	49.8	–	–	–	–	–	–	–	–
8	237.5-247.0	239.9	81.4	70.9	5.3	8.2	–	9.1	–	7.0	5.8	64.6	–	–	–	–	–	–	–	–
9	247.0-256.5	249.5	78.2	66.0	–	22.5	–	4.8	1.5	–	3.0	64.8	–	–	3.4	–	–	–	–	–
10	256.5-263.0	257.4	76.9	63.9	–	34.5	–	2.7	–	–	8.2	49.8	–	–	4.7	–	–	–	–	–
2-20μ Fraction																				
1	0.0-9.5	6.9	81.1	70.4	–	42.3	–	8.5	15.3	3.2	12.7	9.9	–	8.2	–	–	–	–	–	–
2	9.5-19.0	12.3	71.5	55.5	–	30.1	–	5.4	3.7	8.9	20.9	13.3	–	17.7	–	–	–	–	–	–
3	47.5-57.0	51.7	70.8	54.5	–	31.2	–	7.9	2.9	14.8	28.7	14.4	–	–	–	–	–	P	–	–
4	85.5-95.0	90.2	59.9	37.4	–	10.2	–	3.7	2.9	–	11.5	7.2	–	64.5	–	–	–	–	–	–
5	123.5-133.0	125.9	65.6	46.2	–	9.9	–	9.1	1.6	4.0	8.3	11.2	–	56.0	–	–	–	–	–	–
6	161.5-171.0	162.8	66.3	47.3	–	12.9	–	19.0	2.3	3.9	13.6	8.0	–	40.4	–	–	–	–	–	–
7	199.5-209.0	201.9	77.0	64.1	–	17.2	–	37.7	2.3	7.6	23.1	12.1	–	–	–	–	–	–	–	–
8	237.5-247.0	239.9	76.2	62.8	–	19.2	–	40.0	–	10.6	11.5	18.7	–	–	–	–	–	–	–	–
9	247.0-256.5	249.5	74.0	59.4	–	26.9	–	16.3	1.9	–	20.6	29.8	–	–	3.2	1.4	–	–	–	–
10	256.5-263.0	257.4	68.3	50.5	–	56.6	–	10.8	–	–	13.9	15.1	–	–	3.6	–	–	–	–	–
<2μ Fraction																				
1	0.0-9.5	6.9	87.0	79.8	–	23.1	–	4.3	9.9	–	11.4	42.4	–	–	–	–	8.8	–	–	–
2	9.5-19.0	12.3	86.1	78.3	–	6.9	–	1.7	2.6	15.6	8.6	44.1	–	1.0	–	–	19.5	–	–	–
3	47.5-57.0	51.7	82.0	71.9	–	15.7	–	8.2	3.4	12.3	10.2	32.2	–	–	–	–	18.0	T	–	–
4	85.5-95.0	90.2	80.2	69.1	–	5.2	18.7	5.6	–	–	7.6	36.9	–	11.2	–	–	14.6	–	–	–
5	123.5-133.0	125.9	81.1	70.5	–	7.1	14.5	7.0	1.3	4.1	10.0	20.7	2.0	17.4	–	–	15.9	–	–	–
6	161.5-171.0	162.8	82.0	71.8	–	9.5	–	12.1	2.6	5.5	4.3	41.4	–	13.5	–	–	10.8	–	–	–
8	237.5-247.0	239.9	84.7	76.1	–	11.6	–	10.3	–	7.0	6.4	53.7	–	–	–	–	10.9	–	P	–
9	247.0-256.5	249.5	75.1	61.1	–	20.6	–	2.6	–	–	25.4	35.1	–	–	3.0	–	13.3	–	–	A
10	256.5-263.0	257.4	75.3	61.3	–	52.2	–	2.9	–	–	2.6	31.7	–	–	3.7	–	6.9	–	–	–

[a] Narrow Peaks at 4.63Å and 9.33Å. P = present; T = trace.

[b] Broad peaks at 3.00Å, 4.94Å, and 4.13Å among others. The peaks are similar in position, ratio, and shape to goethite and hematite. However, the unidentified mineral has several peaks not represented by goethite's or hematite's peaks. P = present.

[c] Very narrow peaks at 9.86Å, 2.492Å, and 1.700Å among others. A = abundant.

Site 257 Hole Core 1 Cored Interval: 0.0-9.5 m



10YR 3/3 w/
10YR 7/6 specks

10YR 5/4
stretched
layer

10YR 3/2

10YR 3/3 w/
minor 10YR 3/2
[10YR 3/2 lump]

10YR 3/2 w/
minor 10YR 7/6
patches few
mm in size

10YR 2.5/2

10YR 3/3

LITHOLOGIC DESCRIPTION

Dark brown DETRITAL CLAY, colored by trace quantities to 4% microscopic opaque or amorphous translucent particles and aggregates.

TEXTURE: Sand 0.0-0.2%
Silt 18-21%
Clay 79-82%

COMPOSITION:

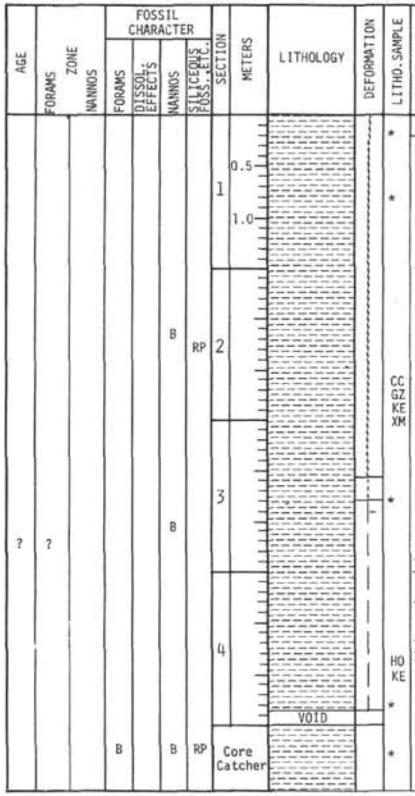
85-94% detrital clay
1- 5% amorphous ferruginous material
1-10% zeolite
2-10% fragments of diatoms, radiolaria and sponge spicules
Tr- 5% collophanous fish debris
Tr- 2% quartz
Tr- 2% feldspar
Rare traces of mica, glauconite, authigenic carbonate, and coccoliths.

Total Carbon: .1%
Organic Carbon: .1%
Calcium Carbonate: 0%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 257 Hole Core 2 Cored Interval: 9.5-19.0 m



[10YR 7/6
stretched
mottles]
10YR 3/3

10YR 3/2.5

10YR 4/6

[5 cm 10YR 3/2
mottle]

[3 cm 10YR 3/2
mottles]

10YR 5/4

LITHOLOGIC DESCRIPTION

DETRITAL CLAY, dark brown in upper portions, grading down to moderate yellowish brown in Sec. 4, which is moderately mottled with dark yellowish brown mottles approximately 3 cm in diameter. Siliceous fossil remains are largely missing, and the detrital clay particles exhibit authigenic growth or replacement rims which become extinct under crossed nichols at angles which differ from the particle cores.

TEXTURE: Sand 0%
Silt 16%
Clay 84%

COMPOSITION:

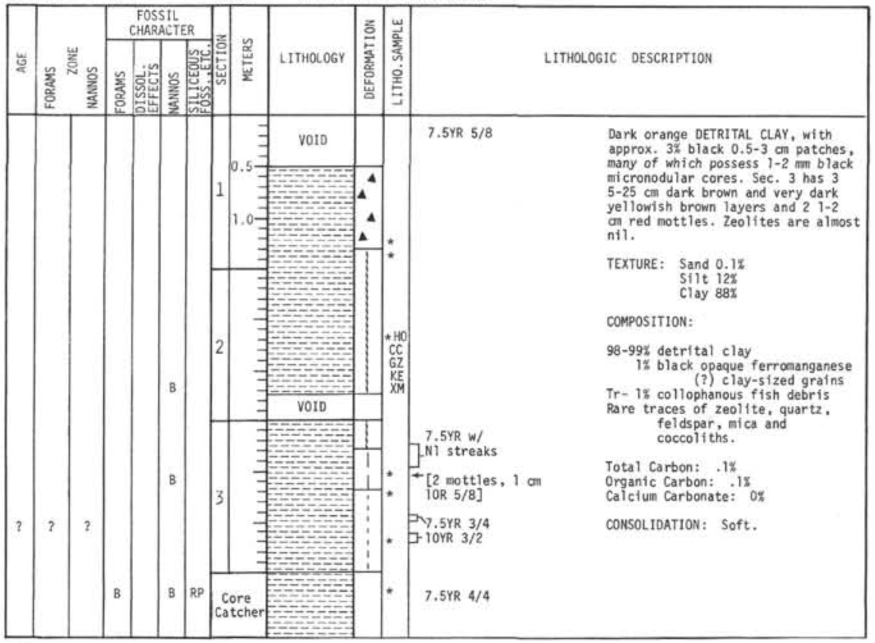
87-98% detrital clay
2-10% zeolite
Tr- 2% quartz
Tr- 2% feldspar
1% ferruginous material as before
Tr collophanous fish debris
Rare traces of glauconite, coccoliths and diatom fragments.

Total Carbon: .1%
Organic Carbon: .1%
Calcium Carbonate: 0%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 257 Hole Core 3 Cored Interval:47.5-57.0 m



Dark orange DETRITAL CLAY, with approx. 3% black 0.5-3 cm patches, many of which possess 1-2 mm black micronodular cores. Sec. 3 has 3 5-25 cm dark brown and very dark yellowish brown layers and 2 1-2 cm red mottles. Zeolites are almost nil.

TEXTURE: Sand 0.1%
Silt 12%
Clay 88%

COMPOSITION:

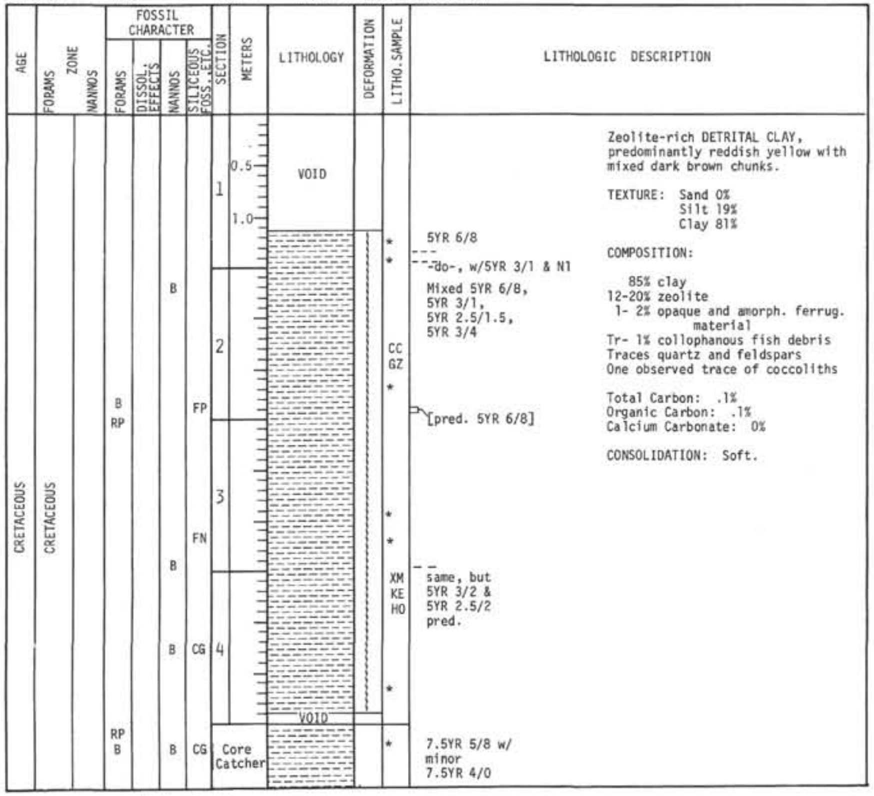
98-99% detrital clay
1% black opaque ferromanganese (?) clay-sized grains
Tr- 1% collophanous fish debris
Rare traces of zeolite, quartz, feldspar, mica and coccoliths.

Total Carbon: .1%
Organic Carbon: .1%
Calcium Carbonate: 0%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 257 Hole Core 4 Cored Interval: 85.5-95.0 m



Zeolite-rich DETRITAL CLAY, predominantly reddish yellow with mixed dark brown chunks.

TEXTURE: Sand 0%
Silt 19%
Clay 81%

COMPOSITION:

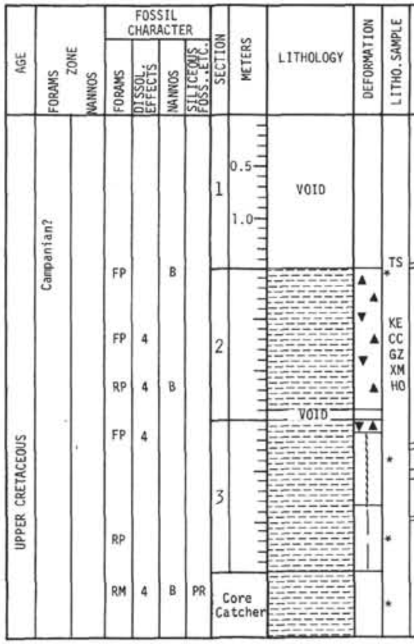
85% clay
12-20% zeolite
1- 2% opaque and amorph. ferrug. material
Tr- 1% collophanous fish debris
Traces quartz and feldspars
One observed trace of coccoliths

Total Carbon: .1%
Organic Carbon: .1%
Calcium Carbonate: 0%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 257 Hole Core 5 Cored Interval: 123.5-133.0 m



LITHOLOGIC DESCRIPTION

[3 x 4 cm 7.5YR 4/0 partially silic. mudstone w/ 7.5YR 6/8 lenses]

[7.5YR 3/2 only]

[7.5YR 6/8 mottles]

[-do-]

10YR 3/2

Dark brown DETRITAL CLAY, zeolite-bearing or zeolite-rich. In Sec. 1, at top, one 3 x 4 cm lithified (partially silicified) piece of dark gray mudstone with small pinkish lenses. Sec. 1 also contains minor chunks of material which are 100% zeolite.

TEXTURE: Sand: 0%
Silt: 16%
Clay: 84%

COMPOSITION:

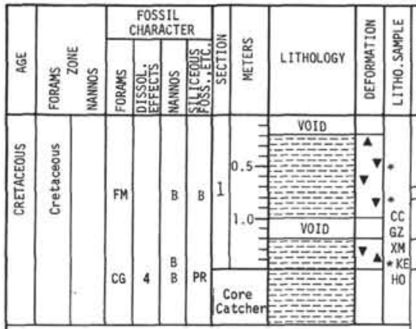
84-94% detrital clay
4-15% zeolite
1- 2% amorphous and opaque ferrug. material
Tr collophanous fish debris
Tr quartz and feldspars

Total Carbon: 0%
Organic Carbon: .1%
Calcium Carbonate: 0%

CONSOLIDATION: Stiff where undeformed.

Explanatory notes in chapter 2

Site 257 Hole Core 6 Cored Interval: 161.5-171.0 m



LITHOLOGIC DESCRIPTION

2.5YR 5/8 & 10R 5/8

[1-2 cm chunks 7.5YR 3/2]

[chunks of 5Y 5/1]

Red zeolite rich and zeolite bearing DETRITAL CLAY with scattered drilling biscuits of gray ZEOLITE DETRITAL CLAY.

TEXTURE: Sand 0%
Silt 12%
Clay 88%

COMPOSITION:

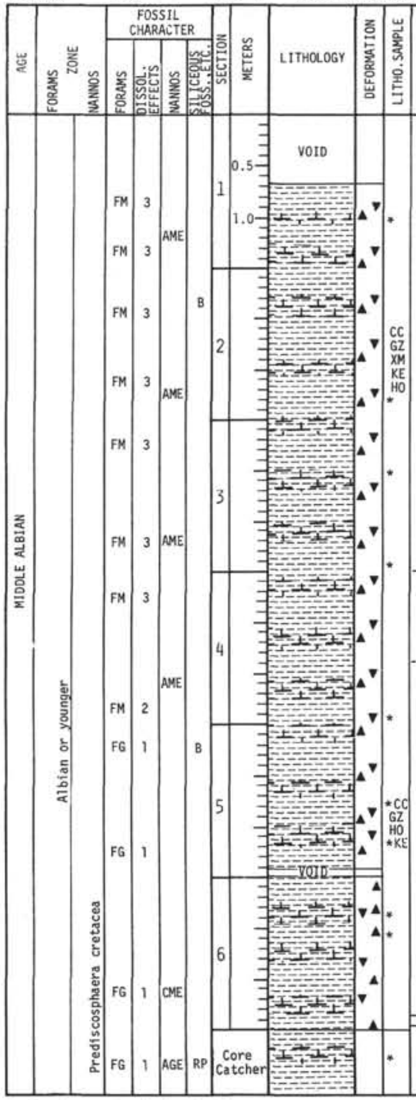
	Red detrital clay	Zeolite detrital clay
Clay	83-90%	50-70%
Zeolite	8-12%	30-50%
Amorph. Fe oxides	1- 5%	0-Tr
Quartz, feldspars	Tr	Tr
Colloph. fish deb.	Tr	Tr

Total Carbon: .2%
Organic Carbon: .2%
Calcium Carbonate: 0%

7.5YR 5/4 w/ minor 2.5Y 6/0 and 2.5YR 5/8

Explanatory notes in chapter 2

Site 257 Hole Core 7 Cored Interval: 198.5-209.0 m



All drilling breccia; pred. 10R 5/8 w/ stretched chunks and biscuits of 5Y 5/1, 2.5Y 5/1, 2.5YR 5/0, 2.5Y 4/0, 5YR 4/0, and 7.5YR 4/0.

[cocco. ooze chunk]

[folded collapsed core liner]

5YR 4/2

LITHOLOGIC DESCRIPTION

Drilling breccia of red COCCOLITH DETRITAL CLAY with drilling biscuits and chunks of gray COCCOLITH DETRITAL CLAY and minor CLAYEY COCCOLITH OOZE in Secs 5 and core catcher.

TEXTURE: Sand 0%
Silt 6%
Clay 94%

COMPOSITION:

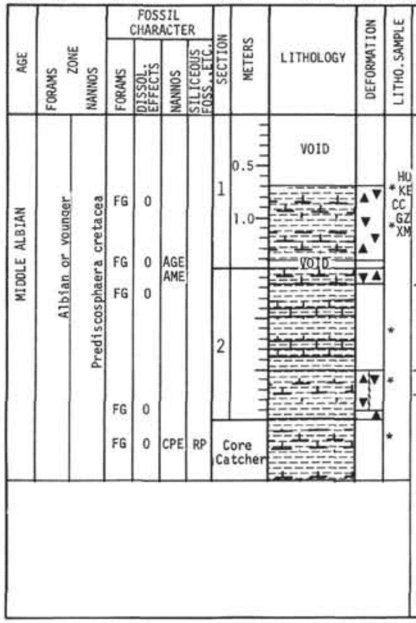
61-87% detrital clay (rarely 46-49%)
10-35% coccoliths (rarely 50-53%)
Tr- 2% ferruginous material
Tr- 2% authigenic carbonate (?siderite)
Traces of quartz and feldspars
Traces of collophanous fish debris

Total Carbon: 1.2-1.7%
Organic Carbon: .2-.3%
Calcium Carbonate: 7-12%

CONSOLIDATION: Stiff where less disturbed by drilling.

Explanatory notes in chapter 2

Site 257 Hole Core 8 Cored Interval: 237.5-247.0 m



Pred. 10R 4/6, 5/8 & 4/8, w/ 3% 5Y 6/1 chunks

5YR 4/3 grading to

5YR 3/1

10R 4/6

2.5YR 6/6

2.5YR 5/6

LITHOLOGIC DESCRIPTION

Section 1 is drilling breccia of red and gray COCCOLITH-RICH DETRITAL CLAY. Rest of core is 2 intervals of reddish brown and light red COCCOLITH DETRITAL CLAY with an intervening interval (16-100 cm, Sec. 2) of reddish brown CLAYEY COCCOLITH CHALK.

TEXTURE: Sand 0.4%
Silt 17%
Clay 83%

COMPOSITION:

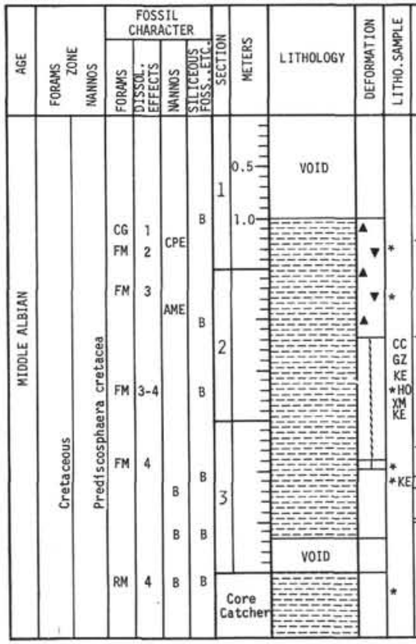
	Cocco. detrital clay	Clayey coccolith chalk
Clay	54-85%	43%
Ferrug. matter	1- 2%	1%
Quartz and feldspars	Tr	
Coccoliths	12-45%	55%
Authig. carb.	Tr- 1%	Tr- 1%
Fish debris	Tr	---
Forams	---	Tr

Total Carbon: 2.1%
Organic Carbon: .1%
Calcium Carbonate: 17%

CONSOLIDATION: Semi-lithified where less disturbed.

Explanatory notes in chapter 2

Site 257 Hole Core 9 Cored Interval: 247.0-256.5 m



2.5YR 5/6

5YR 3/2

10YR 5/6, 10YR 5/8

10R 4/4, 4/6

[10 cm 5G 6/1 & 5B 7/1]

[-do-, 4 cm]
5YR 3/3

2.5YR 4/4, 4/6

LITHOLOGIC DESCRIPTION

Red and dark reddish brown DETRITAL CLAY, coccolith bearing only in Sec. 1; with a 10-cm layer and a 4-cm layer in Sec. 3.

TEXTURE: Sand 0%
Silt 4%
Clay 96%

COMPOSITION:

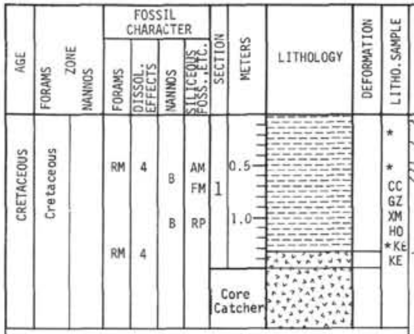
94-100% detrital clay
Traces quartz and feldspars
Tr- 2% amorphous and translucent microscopic ferrug. material
Tr collophanous fish debris
Tr- 1% coccoliths, except for 5% in Sec. 1.
Rare traces of authigenic calcite

Total Carbon: 0.1%
Organic Carbon: 0.1%
Calcium Carbonate: 0.0%

CONSOLIDATION: Semi-lithified.

Explanatory notes in chapter 2

Site 257 Hole Core 10 Cored Interval: 256.5-263.0 m



LITHOLOGIC DESCRIPTION

2.5YR 3/2
2.5YR 4/6 w/ 1 x 2 cm patch of 5G 6/1
2.5YR 3/2 w/ 1-2 mm N1 laminae 0.5 to 2 cm apart
5G 6/1 & 5B 7/1
2.5YR 4/6
10R 3/4 & 2.5YR 2.5/4 w/
light pink & N1 laminae
0.5-3 cm apart

Weath.
basalt

TOP OF CORE:

Dusky red, red and dark red DETRITAL CLAY, finely laminated in part, with a 2 cm patch and a 5 cm layer which are greenish gray to light bluish gray. The basal clays contain 5% radiolarians and 4% finely disseminated ferruginous oxides and radiolarian fillings.

TEXTURE: Sand 0.9%
Silt 3.0%
Clay 96%

COMPOSITION:

91-100% clay
Traces quartz and feldspars
Tr- 4% ferruginous material
Traces of collophanous fish debris
Rare traces of authigenic carbonate
Above the basal clays, only one rare trace occurrence of radiolarians.

Total Carbon: 0.4%
Organic Carbon: 0.1%
Calcium Carbonate: 2%

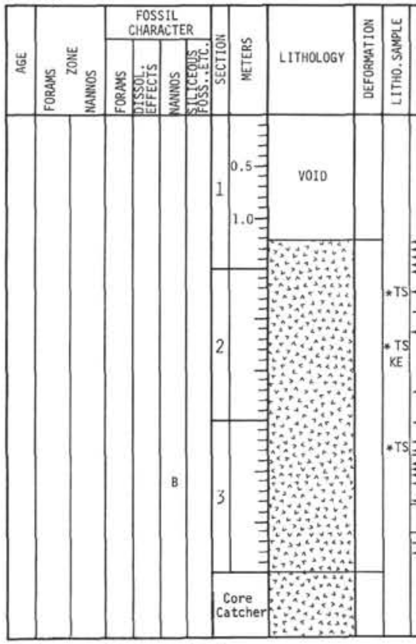
CONSOLIDATION: Semi-lithified.

BASE OF CORE:

Weathered (limonitized) and fractured fine-grained porphyritic BASALT, with calcite and chlorite or serpentine fracture fillings.

Explanatory notes in chapter 2

Site 257 Hole Core 11 Cored Interval: 263.0-272.5 m



LITHOLOGIC DESCRIPTION

Fine-grained,
vesicular
Arrows
indicate filled
fractures

Few vesicles
[dark gn veins]
Medium grained

No vesicles

[Abundant veins, mostly white, 1-2 mm wide]

Vesicular
[2-3 cm thick
filled fracture]

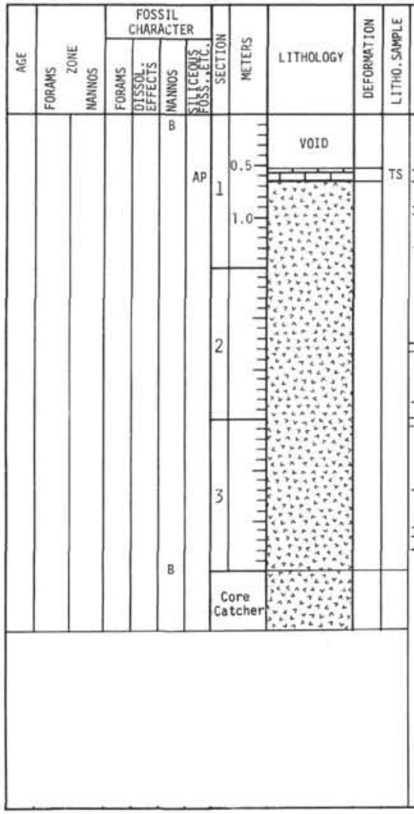
Weathered, fine-grained vesicular BASALT with a 0.5 cm carbonate-filled fracture.

BASALT, fine-grained and vesicular or medium-grained as indicated. Weathered and randomly fractured (less so in Sec. 2); 1-3 mm wide fractures filled with calcite, lesser ?chlorite and/or serpentine, and even lesser reddish iron oxides. The vesicles are filled with the same material. The core consists of pieces 2 to 40 cm long, average length being 5 to 10 cm.

NOTE: DRILLING LOG PLACES THE SEDIMENT-BASALT CONTACT AT 262 m.

Explanatory notes in chapter 2

Site 257 Hole Core 12 Cored Interval: 272.5-282.0 m



LITHOLOGIC DESCRIPTION

Separate piece, 2.5YR 6/2 & 4/2 pale to weak red lithified MICARB LIMESTONE.

Fine-grained, vesicular

1 cm fractures filled with calcite and red iron oxides

No vesicles

5 cm indurated mass of iron-stained carbonate

Vesicular

[basalt in vertical contact with carbonate-iron oxide cemented breccia]

Few vesicles

[2 cm light red breccia cap on basalt piece]

Vesicles

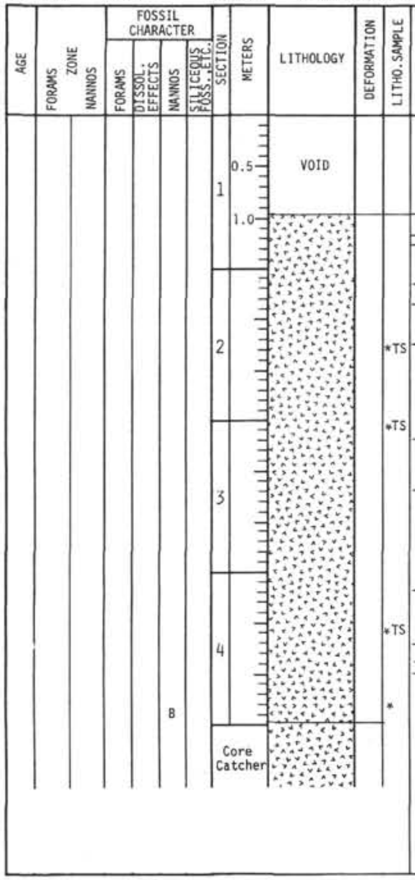
[4 cm piece of basalt with breccia as at top of Sec.]

Basalt, fine-grained and vesicular, or medium grained. Weathered, with abundant randomly oriented fractures (not plotted individually as in Core 11); the fractures are 3 to 20 mm wide and are filled with calcite and green ?chlorite and/or serpentine. As indicated, several pieces are brecciated and recemented with carbonate and red iron oxides. The vesicles are filled with calcite and the green replacement minerals.

Entire core consists of pieces 2-43 cm long, averaging 5-10 cm long.

Explanatory notes in chapter 2

Site 257 Hole Core 13 Cored Interval: 282.0-290.0 m



LITHOLOGIC DESCRIPTION

[Extremely abund. 1-2 cm calcite fracture fillings]

[Fractures filled with iron oxide rich carbonate]

[5 cm wide calcite fracture filling]

Medium grained, few vesicles, fresher than above or previous cores.

[6 mm light green vein]

No fracture fillings, but core is highly fractured.

Few fracture fillings, several mm wide.

[dark green vein]

Color pred. reddish-green

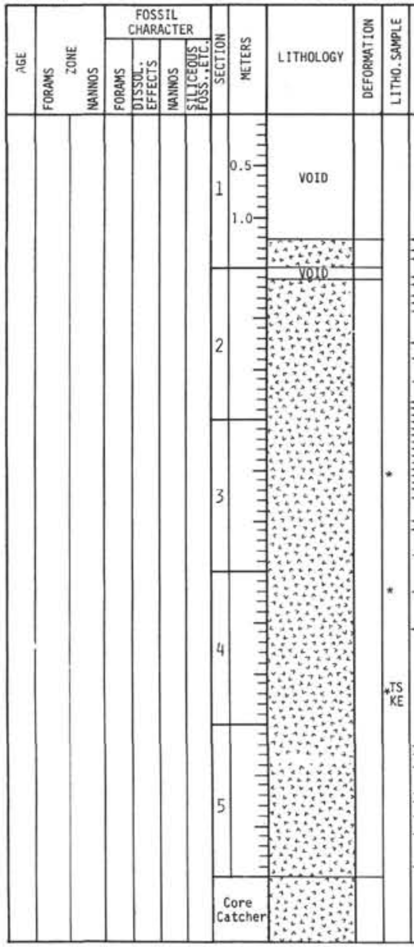
[2 dark green veins 5 mm wide]

Light brownish gray matrix; white and reddish brecciated and recemented fracture fillings very abundant; whole rock is virtually a breccia. Vesicular from 125 cm down.

BASALT, predominantly medium grained and vesicular; relatively fresh from 37 cm in Sec. 2 to 75 cm in Sec. 4. Variably fractured and fracture-filled with calcite, ?chlorite and/or serpentine, and reddish iron oxides. In part, the fracture fillings are exceedingly abundant and the rock has the aspect of a breccia.

Explanatory notes in chapter 2

Site 257 Hole Core 14 Cored Interval: 290.0-298.0 m



LITHOLOGIC DESCRIPTION

Fine-grained, no vesicles abund. calcite-filled fr.

[2 cm patch 1-3 mm calcite crystals]

ARROWS INDICATE PRED. LIGHT GREEN FRACT. FILLLINGS UNLESS OTHERWISE INDICATED

[8 mm lt gn & white fracture filling]

Vesicular (filled), w/ 1-5 mm gn veins, fewer white calcite veins

Larger vesicles; green fract. fillings as indicated by arrows

Coarser; larger vesicles; plag. phenocr. up to 5 mm

[1 mm white fracture filling]

Finer grained; only slightly vesicular; only isolated phenocr.

[2 cm dark red patch]

[red patch]

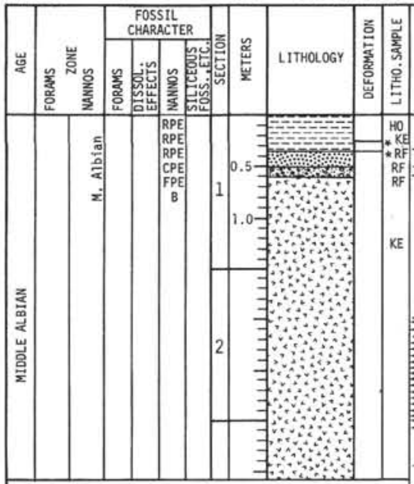
[1.5 cm patch w/ massive coarse calcite]

Weathered BASALT, variably fine to medium grained, in part porphyritic with phenocrysts up to 5 mm long; variably vesicular, the vesicles up to 2 mm in diameter invariably filled with calcite, palagonite, and ?serpentine and/or chlorite. Fractured, with 1-10 mm wide ?chlorite and serpentine fracture fillings and lesser calcite fracture fillings.

The entire core consists of pieces 2 to 28 cm long, the average length being 5-10 cm.

Explanatory notes in chapter 2

Site 257 Hole Core 15 Cored Interval: 298.0-307.5 m



LITHOLOGIC DESCRIPTION

2.5YR 3/4 dark reddish brown DETRITAL CLAY; soupy drilling breccia to 25 cm, stiff from 25-33 cm, in sharp contact with Silty fine ss grading down to crse ss, all fresh & basalt-derived.

Pebbly gravel, max size 2.5 cm, ang-sub-rdd basalt and rarer red micarb lst.

BASALT, medium-grained, porphyritic, slightly vesicular, the vesicles up to 2 mm in diameter filled with calcite and green palagonite and/or ?serpentine and/or ?chlorite; fractured with very few thin calcite fracture fillings.

8 mm wide calcite-filled fracture

Vesicular; as indicated, abund. calcite and iron-oxide rich calcite-filled fractures up to 1 cm wide

Fine-grained, badly fractured, weathered, yellowish-greenish gray BASALT with few dark red micarb patches and 2 calcite-filled fracts.

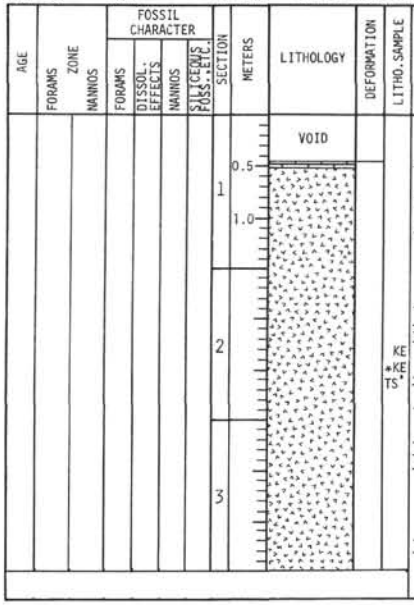
NOTES: The uppermost DETRITAL CLAY is obviously drill cuttings. The lowermost DETRITAL CLAY is very stiff, the lowermost single chunk being 6 cm in length. This is in sharp v-shaped contact with a very well sorted fine-grained sand composed of remarkably fresh lithic fragments of basalt, including prominent pieces of fresh plagioclase. 2 to 3 cm below the contact with the overlying clay, the fine sand has gradationally coarsened downward into a medium to coarse sand of the same composition, with a 1 cm interval containing discrete 0.2 to 0.8 mm pieces of the same very stiff red clay. However, the medium-coarse sand interval is free of these clay chunks for 8 cm below the 1 cm interval. Beneath the medium-coarse sand is a coarse sand, also basalt-derived and fresh, containing abundant 0.2-0.8 cm chunks of red clay. Below the sand is a loose accumulation of angular to subrounded granule-pebble gravel, the coarsest pebbles tending to occur at the base of the interval. Most of this gravel is basalt, with several pieces of reddish micarb limestone.

The extremely well-sorted nature and compaction of the fine sands in particular is very noteworthy. In overall appearance, the entire sand-to-gravel interval looks like a single graded sequence, possibly with some fines washed out of the gravels.

The basalt portion of the core consists of 2-28 cm pieces, the average length being about 5 to 10 cm.

Explanatory notes in chapter 2

Site 257 Hole Core 16 Cored Interval: 307.5-317.0 m



LITHOLOGIC DESCRIPTION

At top, 4 cm piece of 5YR 6/3 & -6/4 reddish brown MICARB LIMESTONE.

Light grayish green fine-grained weathered BASALT.

Same; light gray, coarser than above, porph. & vesicular.
BASALT, coarser, vesicular, with few dark green & white fracture fillings.
[2-10 mm white calcite fracture filling]

BASALT, light gray, vesicular, porphyritic, with 1-3 mm phenocrysts, with predominantly greenish gracture fillings 3 mm to 1 cm wide, indicated by arrows.

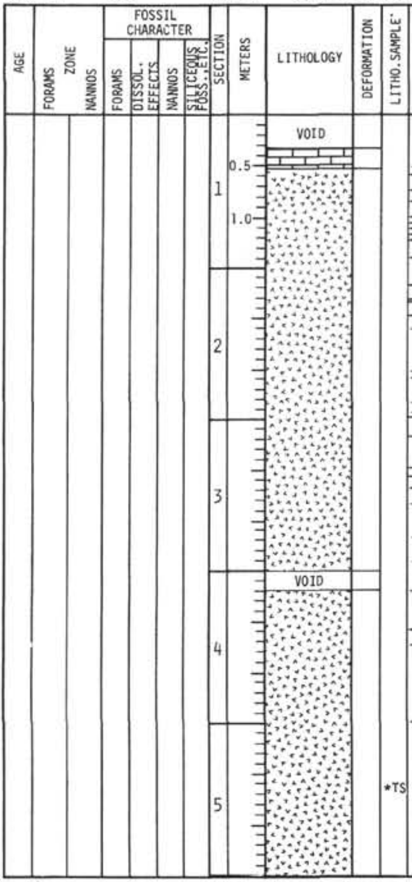
BASALT, fine-grained, no phenocrysts or vesicles
[2 mm black filled fracture]

BASALT, very vesicular, the vesicles about 1 mm in diameter, filled with calcite and green alteration minerals; with very few carbonate-filled fractures as indicated.

Entire core consists of 25-2 cm long pieces, the average length being about 10 cm.

Explanatory notes in chapter 2

Site 257 Hole Core 17 Cored Interval: 317.0-326.5 m



LITHOLOGIC DESCRIPTION

10YR 4/3 & 2.5YR 4/4 yellowish brown and red MICARB LIMESTONE with masses of greenish carbonate crystals.

BASALT, greenish gray, vesicular, the vesicles being 1 mm in diameter and filled with calcite and green alteration minerals as in previous cores; fractured and the fractures filled predominantly with ?chlorite and/or ?serpentine, and lesser calcite and iron oxide rich calcite 1-3 mm wide, indicated by short arrows.

Vertical filled fracture.

-do-

BASALT, light to dark gray, fine-grained, vesicular, filled fractures as above indicated by arrows.

[Intensely fractured into 1-2 cm pieces]

[Light green massive vein]

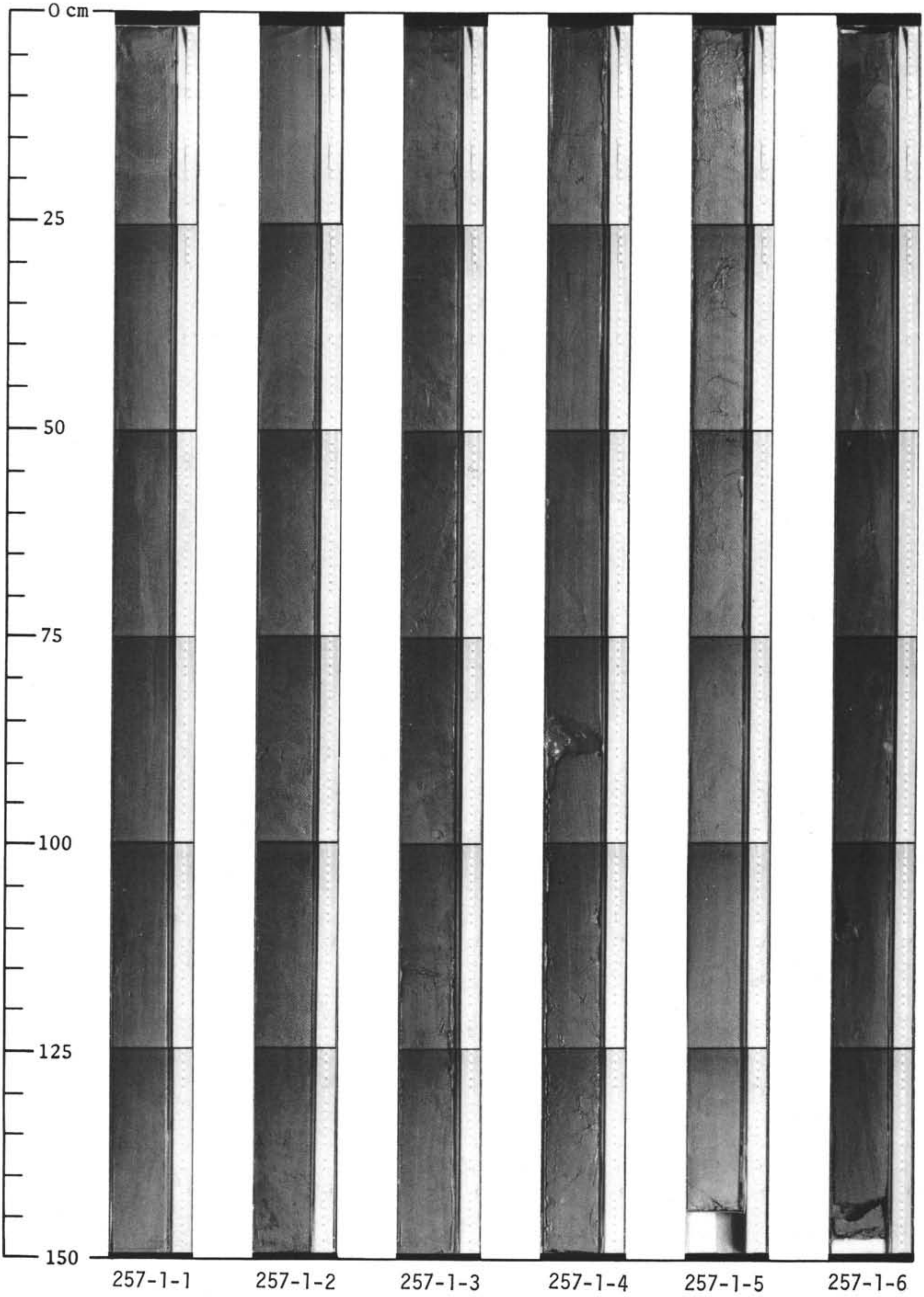
[2 white calcite-filled fractures 2-3 mm wide]

Dark gray, irregularly vesicular BASALT, medium-fine grained, fractured, but fractures not filled except for 2 indicated.

Light gray fine-grained basalt, no fracture fillings.

Entire core consists of pieces 1-36 cm long, with an average length of 5-10 cm.

Explanatory notes in chapter 2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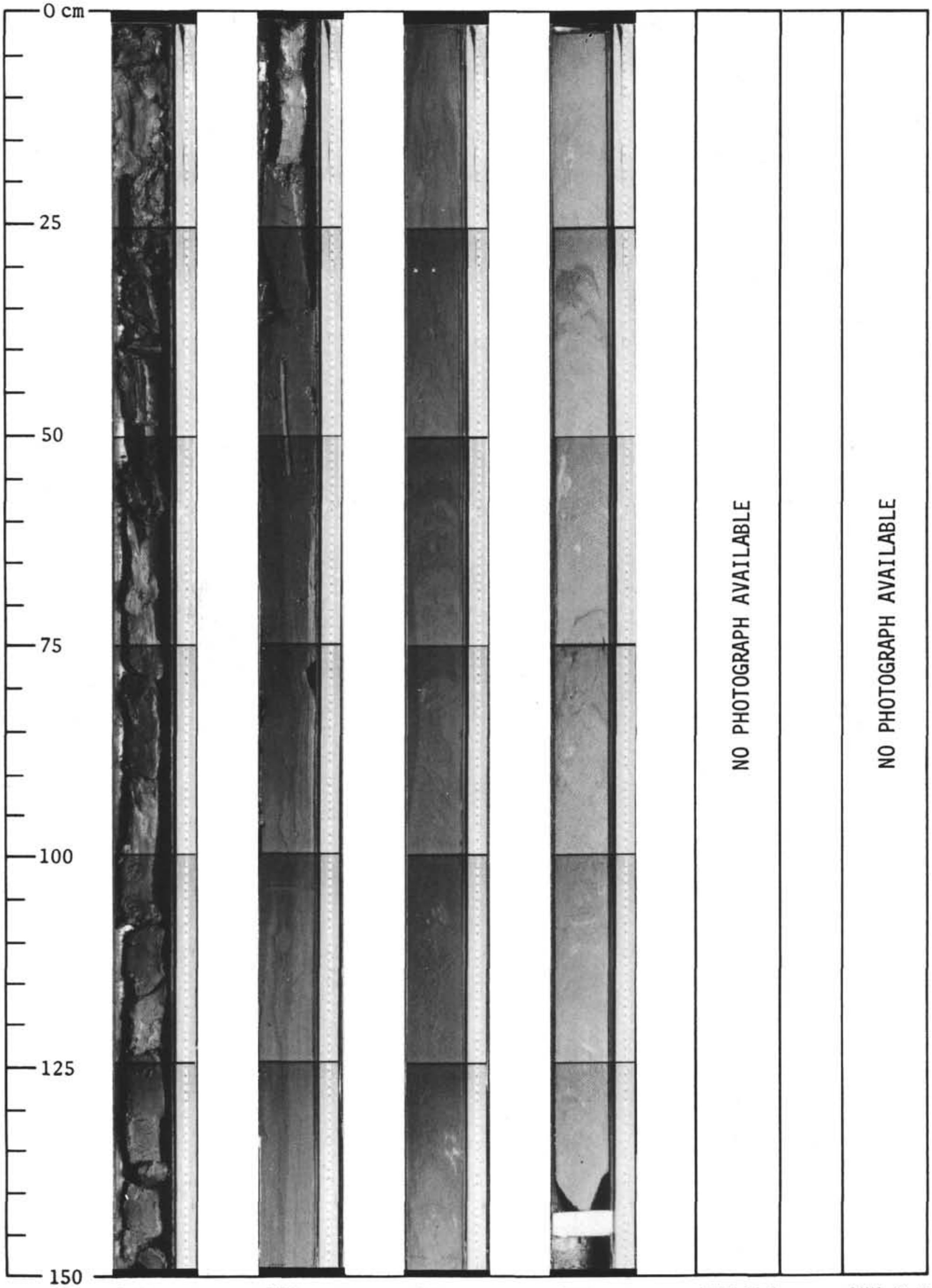
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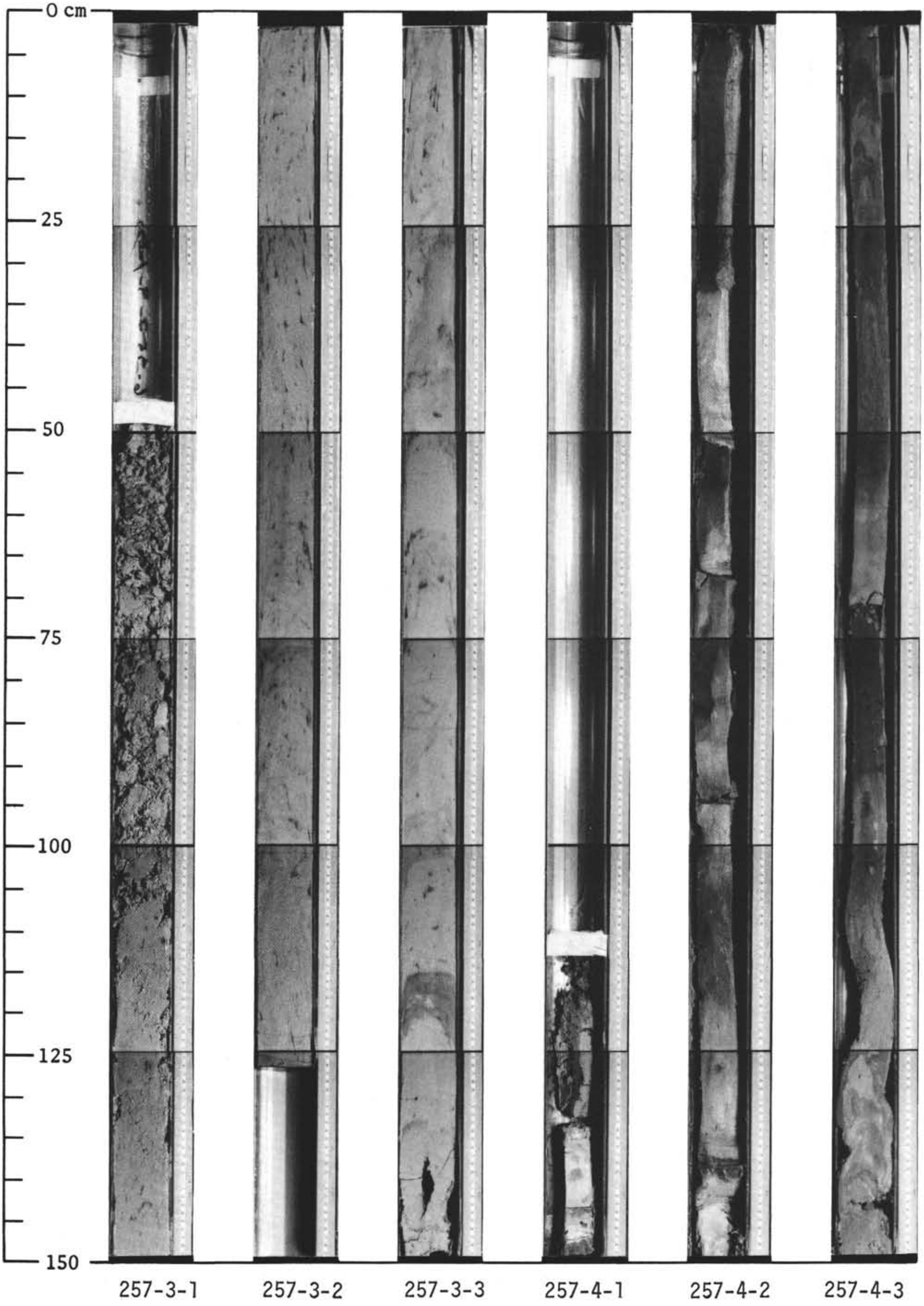
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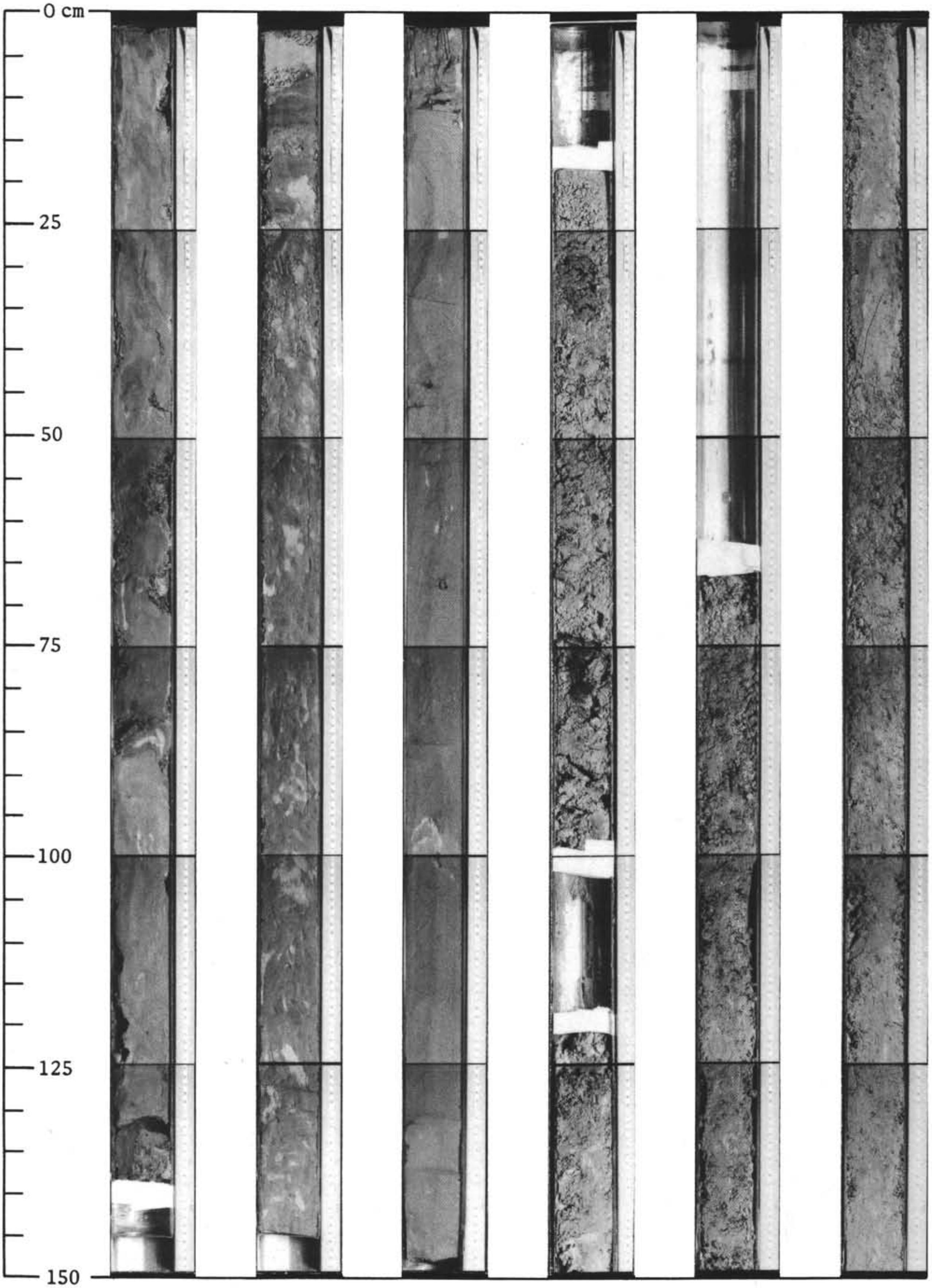
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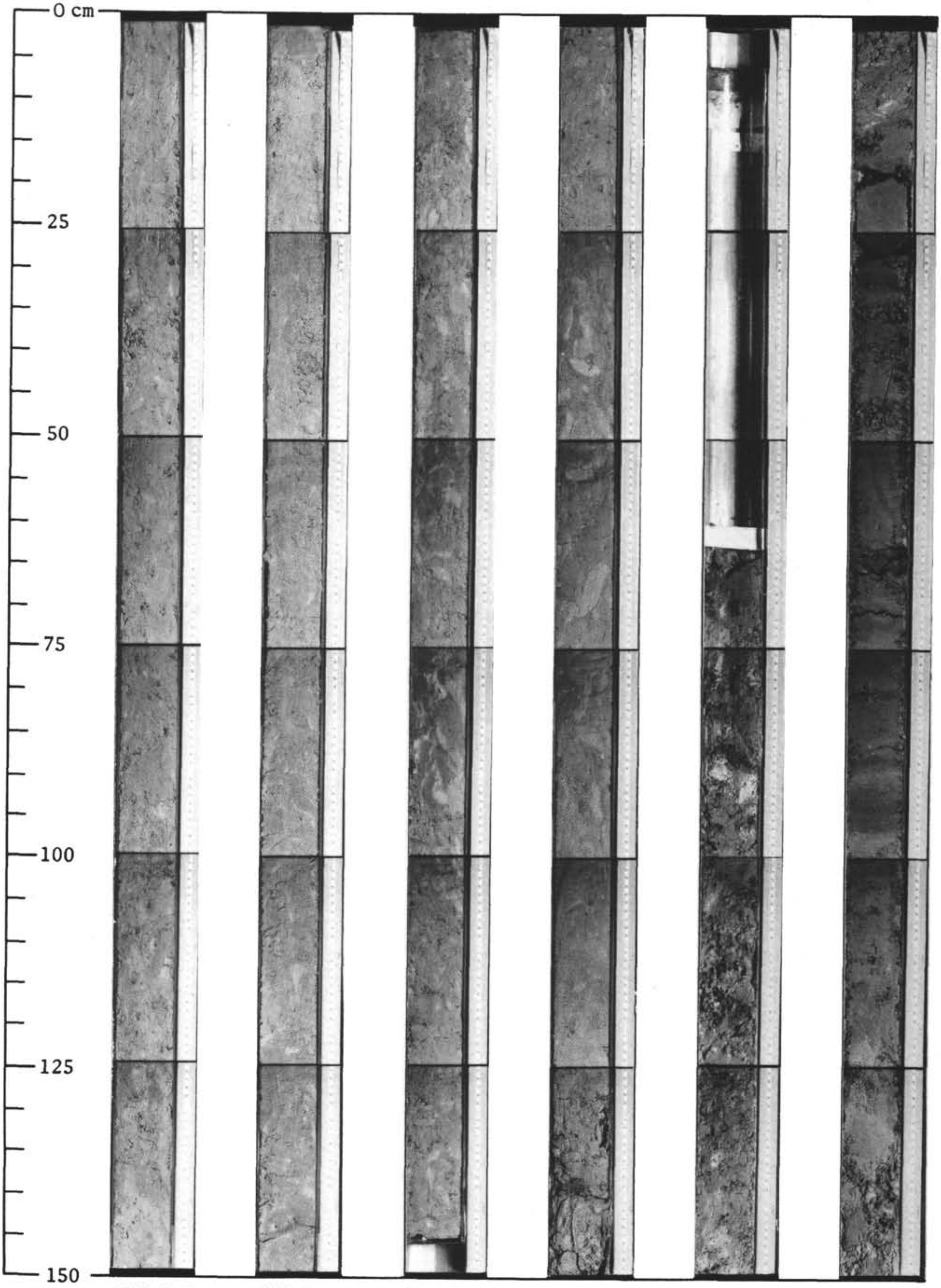
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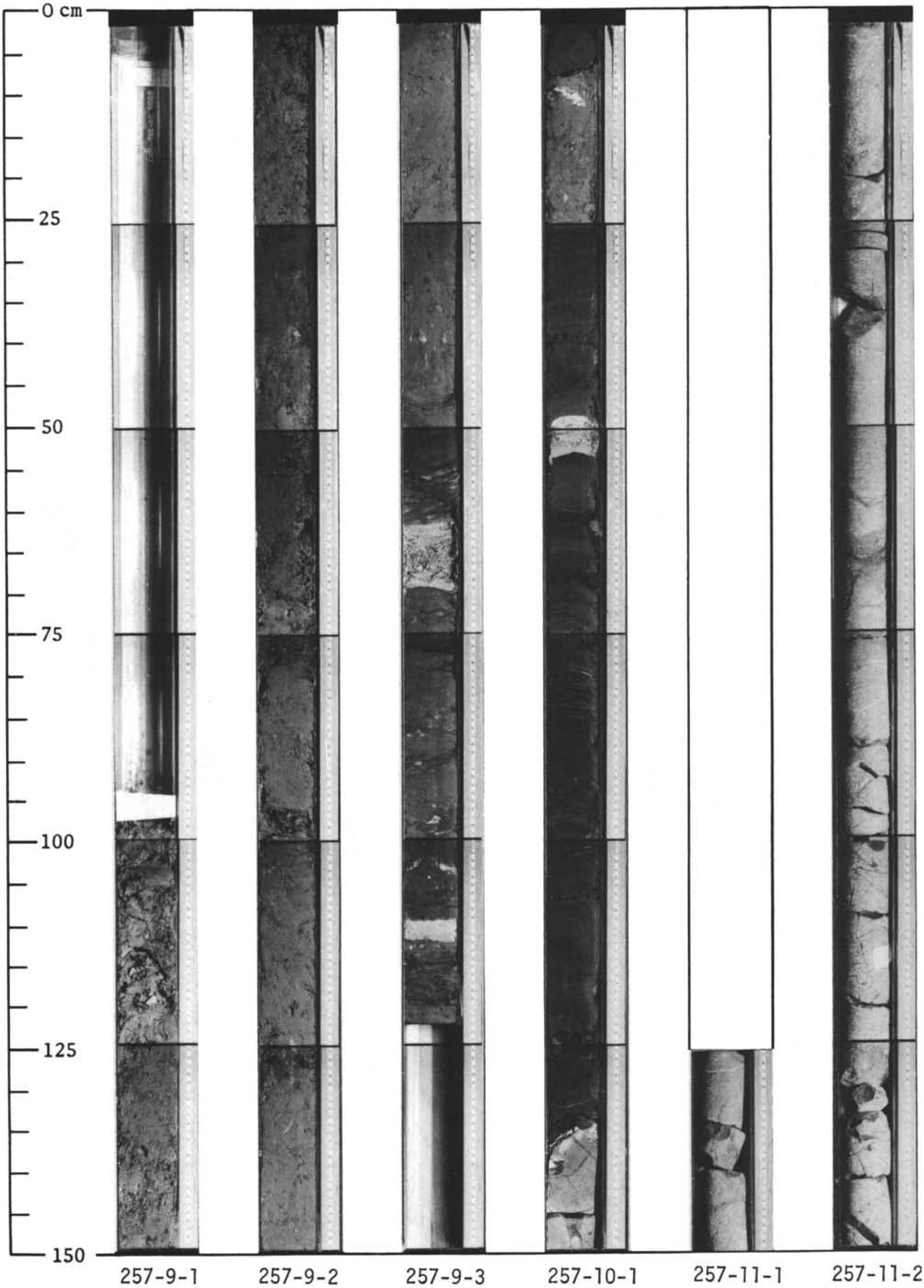
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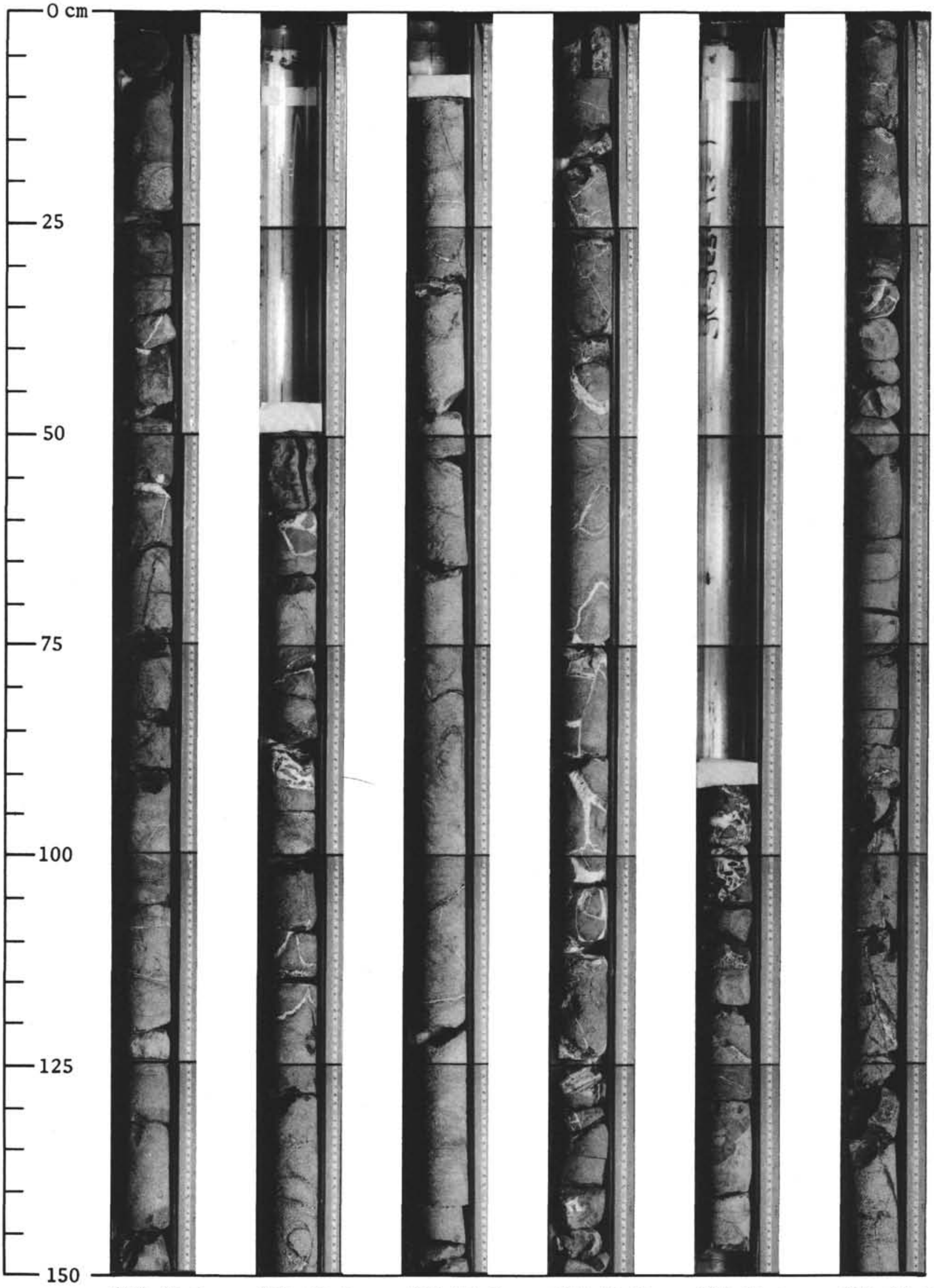
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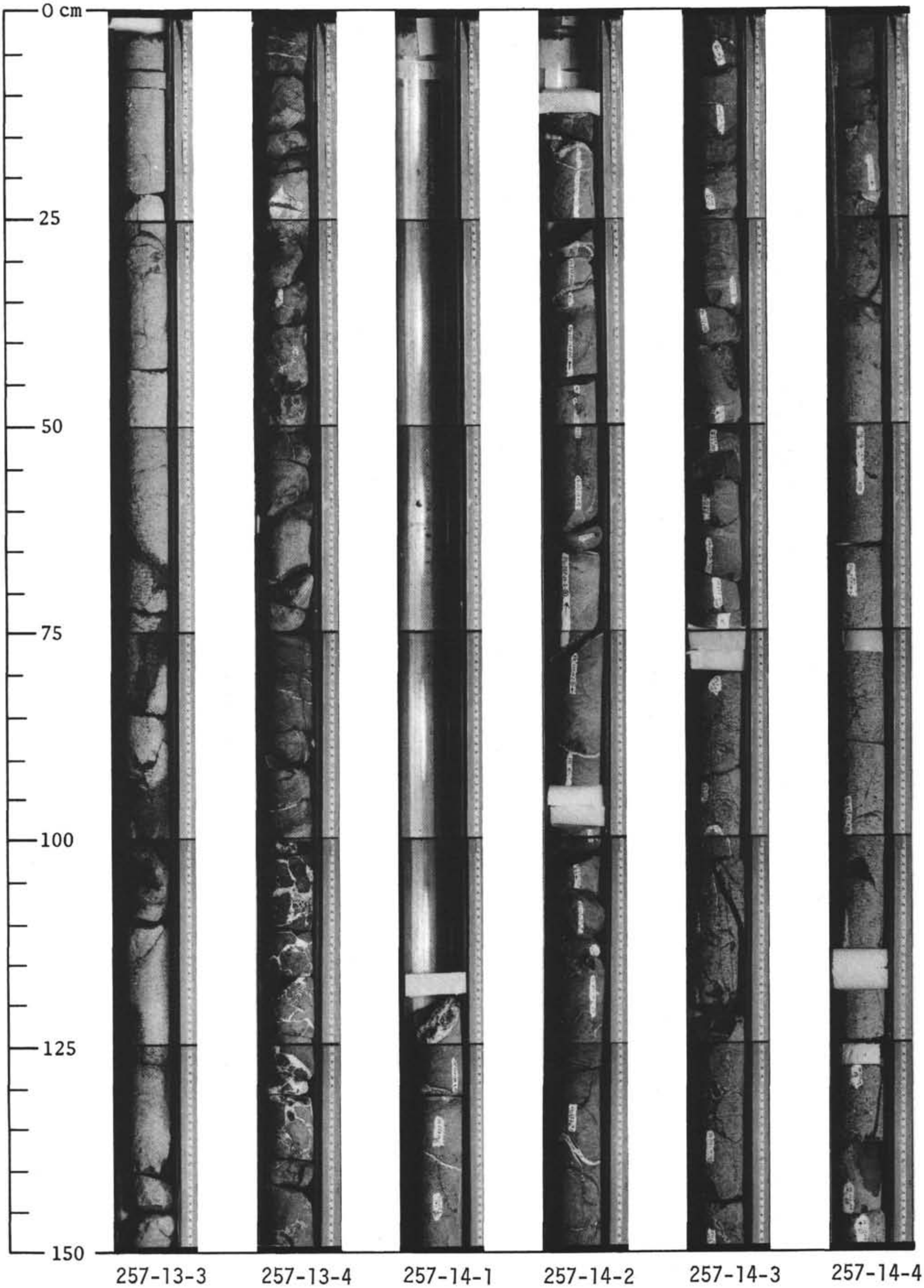
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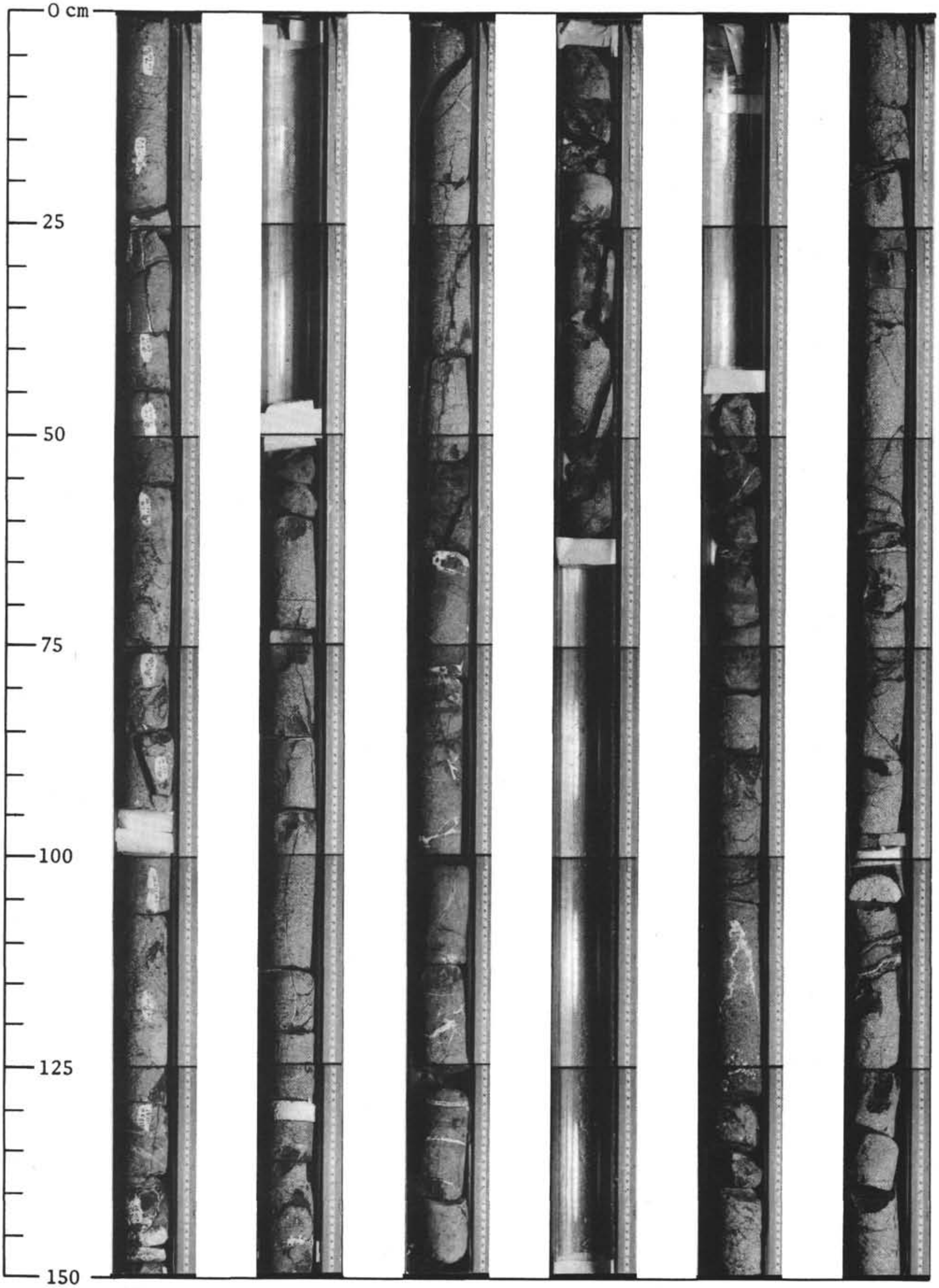
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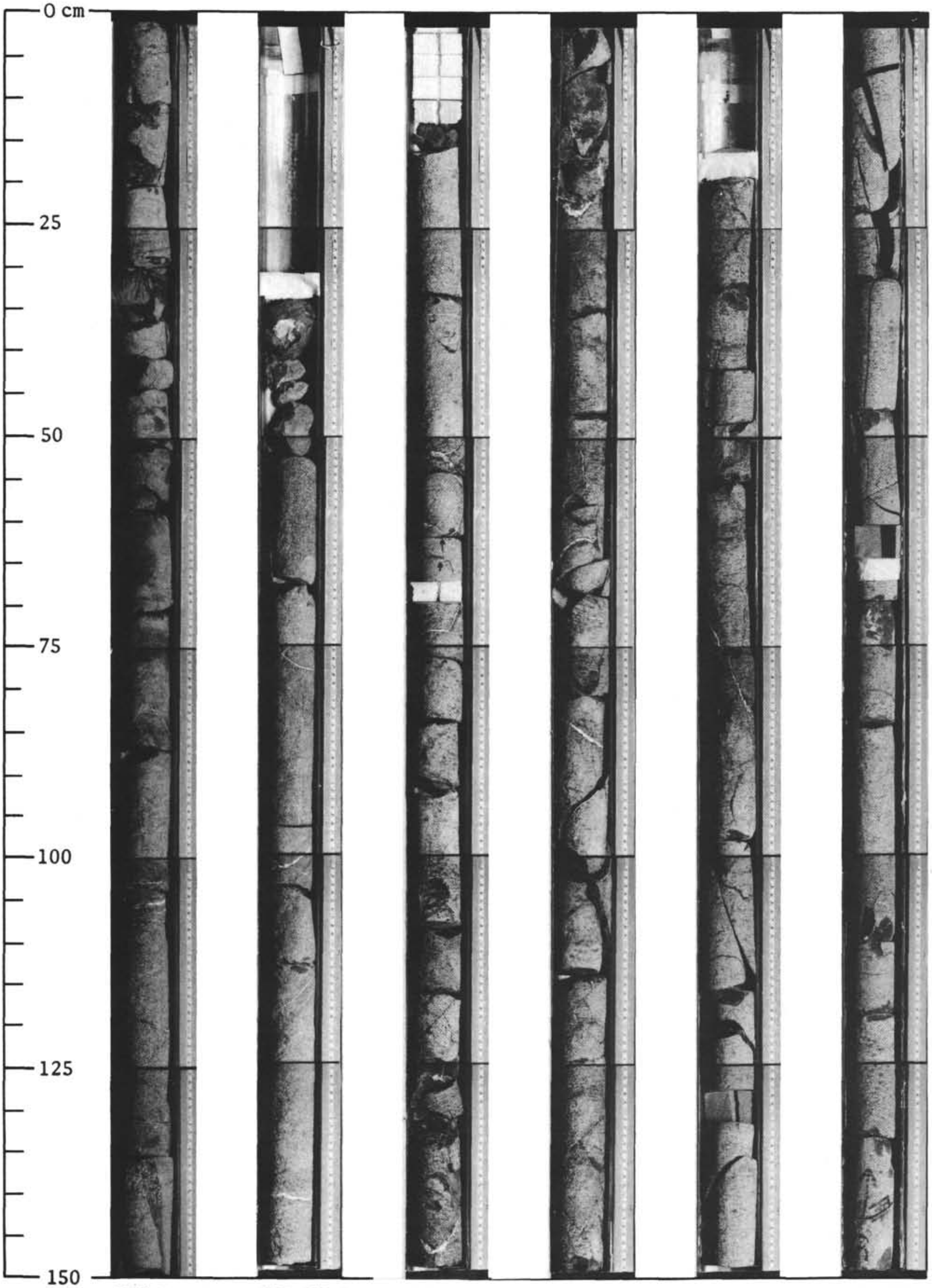
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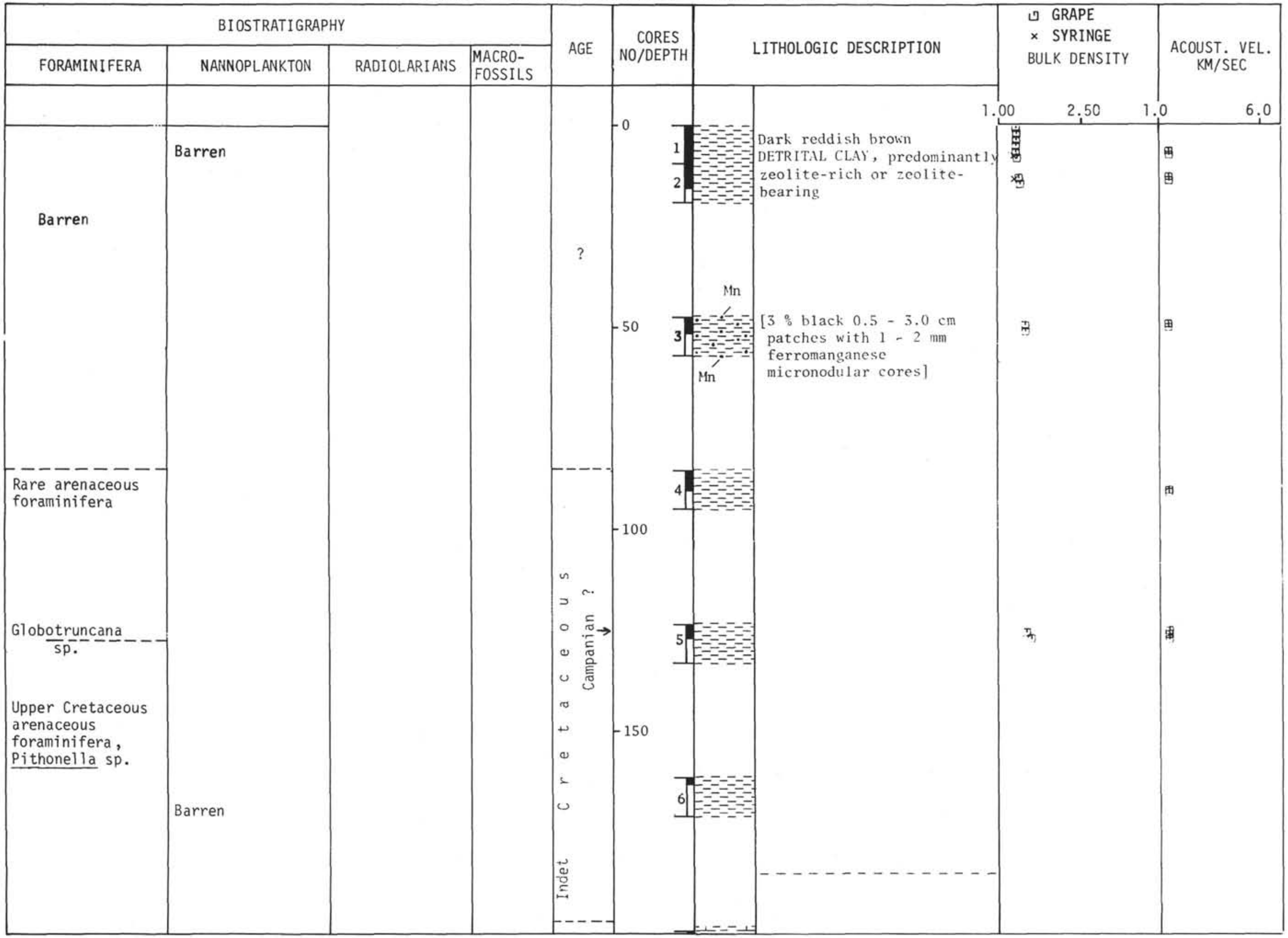
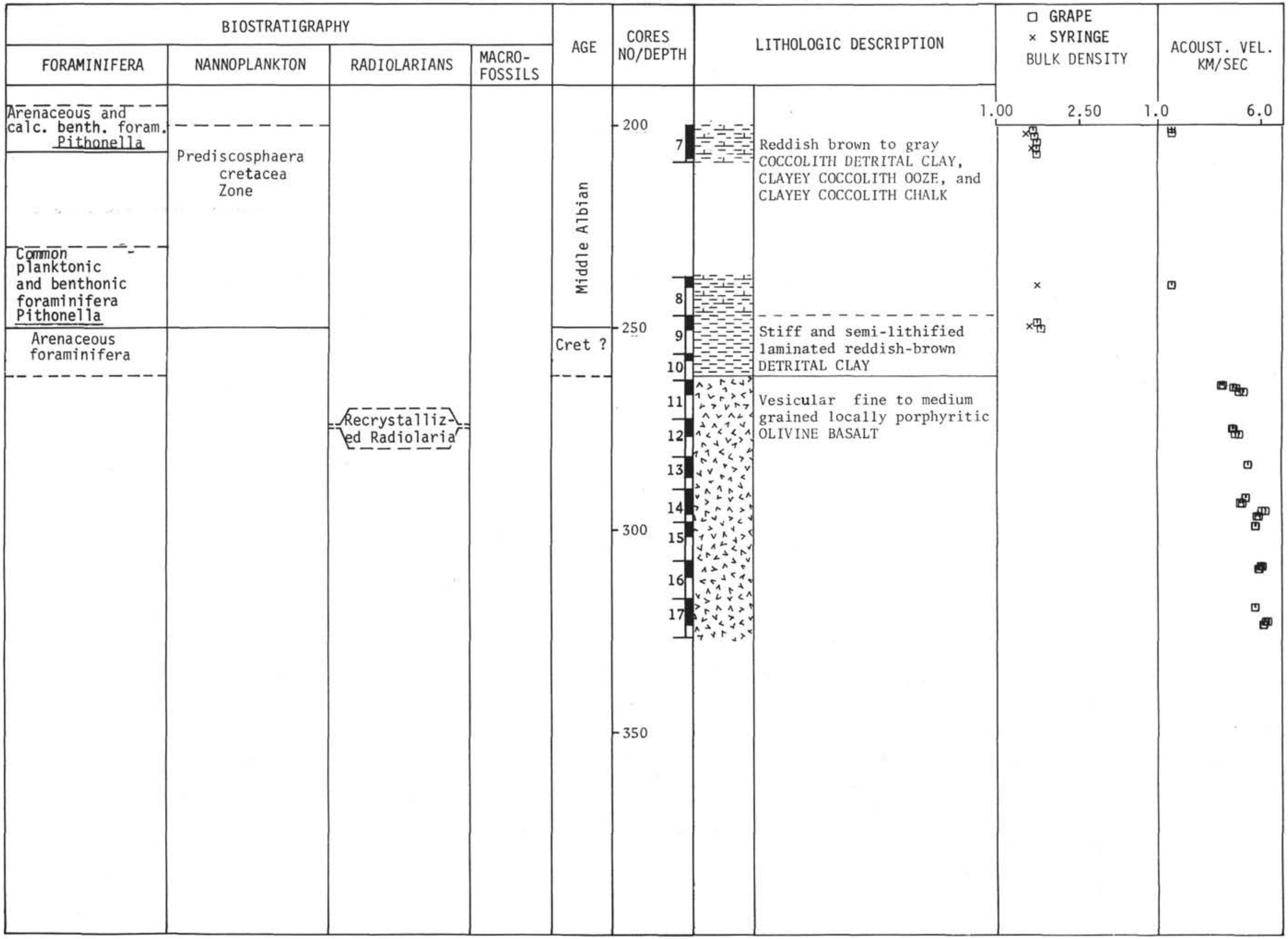
SUMMARY OF DRILLING RESULTS: SITE 257/0 - 200 m



Dark reddish brown DETRITAL CLAY, predominantly zeolite-rich or zeolite-bearing

[3 % black 0.5 - 3.0 cm patches with 1 - 2 mm ferromanganese micronodular cores]

SUMMARY OF DRILLING RESULTS: SITE 257/200 - 400 m



Reddish brown to gray COCCOLITH DETRITAL CLAY, CLAYEY COCCOLITH OOZE, and CLAYEY COCCOLITH CHALK

Stiff and semi-lithified laminated reddish-brown DETRITAL CLAY

Vesicular fine to medium grained locally porphyritic OLIVINE BASALT