6. SITE 253

The Shipboard Scientific Party[1]

SITE DATA

Locality: Ninetyeast Ridge

Position:
lat 24°52.65′S
long 87°21.97′E

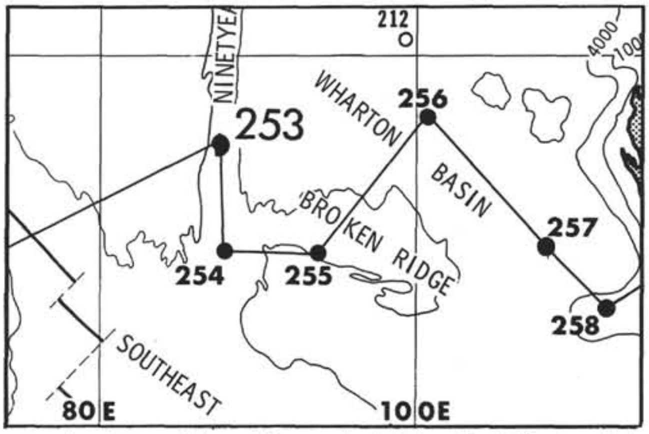
Dates Occupied: 1-5 October 1972

Water Depth: 1962 meters

Penetration: 559 meters

Number of Cores: 58

Oldest Datable Sediment Cored:
Depth (subbottom): 545-554.5 meters (Core 57)
Nature: Vitric volcanic ash
Age: Mid Eocene



Principal Results: Drilling at this site terminated with 1 meter penetration into olivine-rich porphyritic basalt. This basalt is probably not basement, although close to it. Above the basalt are 405 meters of vitric volcanic ash and lapilli of mid Eocene age. The ashes contain macrofossils and a thin basalt flow at 219 meters subbottom. Overlying the ashes are 153 meters of late mid Eocene to Recent pinkish-white nannofossil ooze and chalk.

BACKGROUND AND OBJECTIVES

Site 253 is located in 1962 meters of water on the top of the Ninetyeast Ridge, Indian Ocean. The ninetyeast Ridge is a long, linear crustal elevation rising about 2000 meters above the adjacent sea floor and striking more or less parallel to the 90°E meridian from south of Broken Ridge (~31°S) north to the Bay of Bengal (Figure 1). It is up to 100 km wide in places, has isolated peaks along its length, and has eastern and western sides marked by steep declevities. A deep trough runs along its eastern side (Sclater and Fisher, in press).

The Ninetyeast Ridge has been variously suggested to be a microcontinent, mantle hot-spot trace (nematath), and a fossil transform fault between the now-joined Indian and Wharton and/or Australian plates. Results of DSDP Leg 22 indicate that the Ninetyeast Ridge is volcanic in origin, ruling out the microcontinent hypothesis. Magnetic anomalies striking approximately east-west are found in the Wharton Basin and Central Indian Basin east and west of the Ninetyeast Ridge (Sclater and Fisher, in press). On the east side of the ridge these anomalies become older to the south; west of the Ridge anomalies become older to the north, suggesting that the Ninetyeast Ridge is a transform fault, or bounds one, but not ruling out the possibility that it is also a nematath. DSDP Leg 22 cores also indicate that the Ninetyeast Ridge becomes older to the north suggesting that it belongs to the western or old Indian plate.

A hypothesis for the evolution of the Wharton Basin put forth by Falvey (1972) suggests that besides acting as a transform fault, the Ninetyeast Ridge was subducting Wharton Basin crust to the north between about 75 m.y.B.P. and 55 m.y.B.P. and was "leaking" at its southern end between 55 m.y.B.P. and 35 m.y.B.P. Site 253 (and Site 254) was located to establish additional controls of these sets of hypotheses. In particular, any occurrence of andesitic rock types and age relations to the crust west and east of the ridge was sought.

Seismic reflection data at this site show an upper transparent section about 0.165 sec DT above a very strong intermediate reflector which lies above another very weak reflector at about 0.3 sec to over 0.6 sec DT (Figure 2). *Circe*-5 seismic profiles from the Scripps Institution allow a better definition of this weak lower reflector, evidently because of a receiving system with better low-frequency response. The *Circe* data and our data both show this weak deeper reflector to have a highly variable depth, while the strong intermediate reflector is conformable to the sediment surface.

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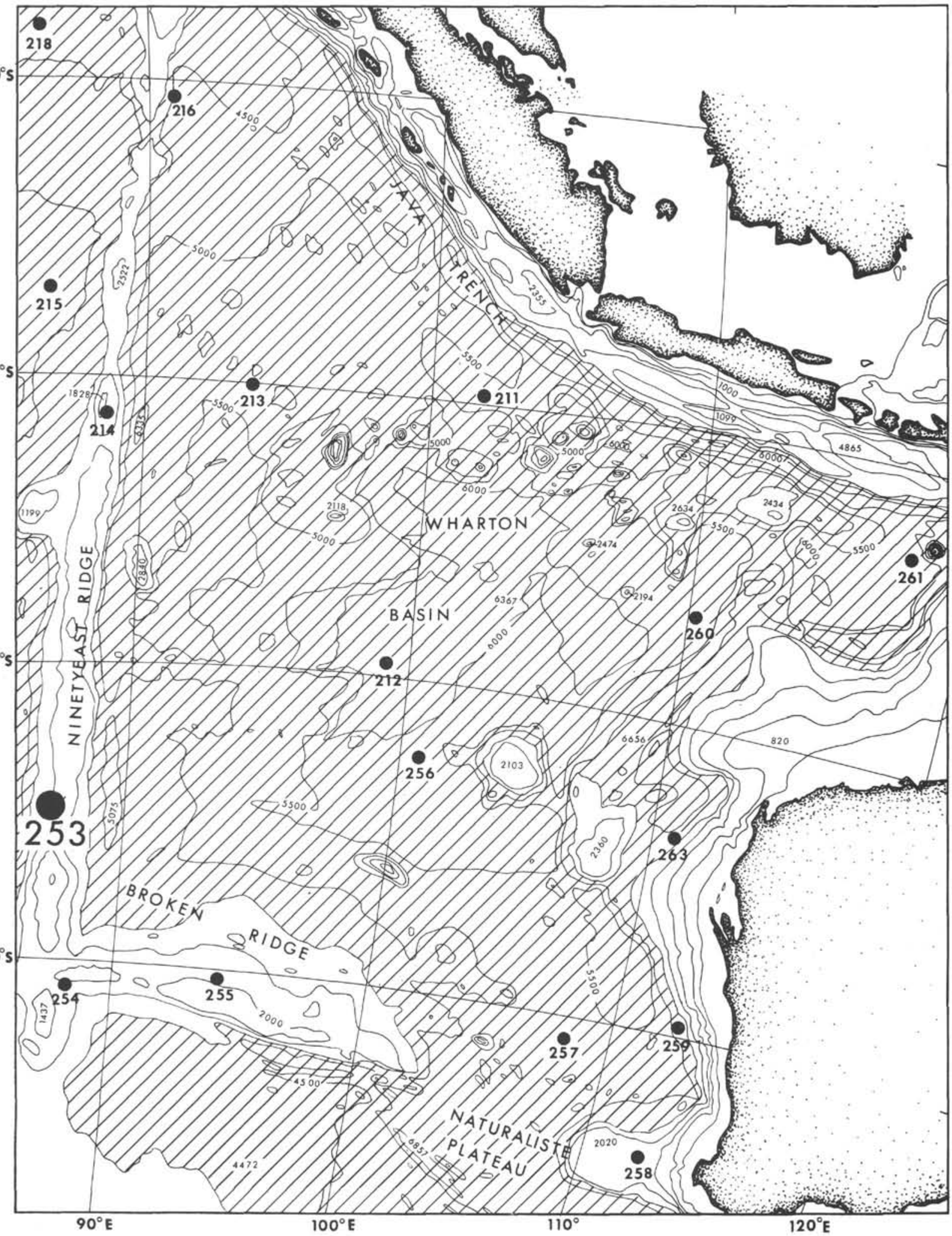

Figure 1. *Base chart and locality for Site 253. Sites from DSDP Legs 22 and 27 are also shown. (Adapted from the Russian bathymetric chart of the Indian Ocean.)*

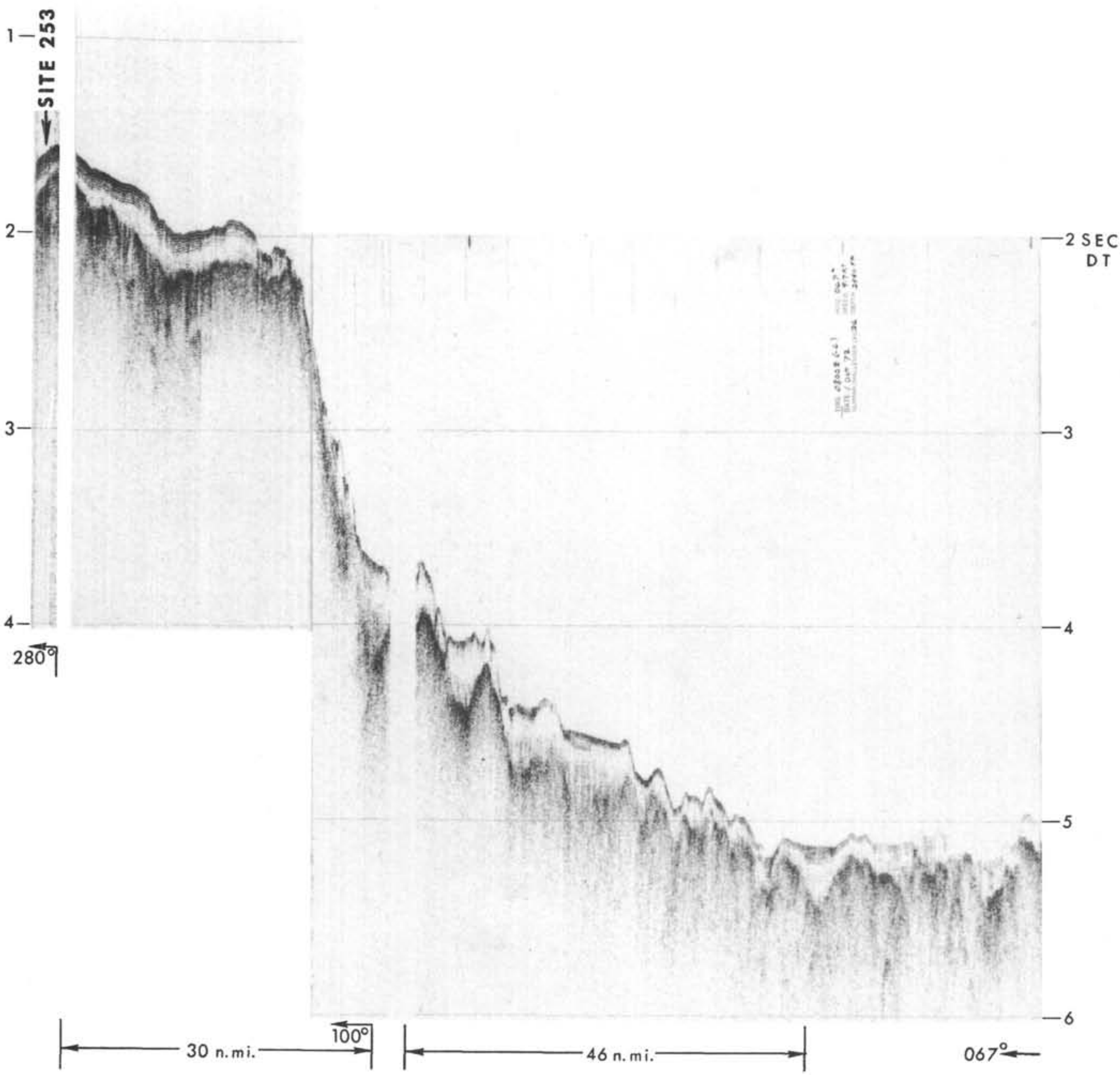

Figure 2. *Seismic reflection profile onto Site 253 taken from D/V* Glomar Challenger.

A brief survey was run after departure from Site 253 (Figures 3 and 4) to assess the variation in local structure and the horizontal extent of the strong intermediate reflector seen at about 0.15 sec DT. The pattern was run northeast from the site, northwest, then south heading for the beacon and passing it about 2 miles (3.2 km) to the west.

The track to the northeast (Figures 3 and 4) shows the intermediate reflector weakening and deepening to about 0.35 sec DT. "Basement" is seen as a weak, diffuse, and rugged return near 0.55 sec DT, and only as a multiple near the site. The northwest track shows the intermediate reflector with a much more rugged aspect and down at 0.35 sec DT. Basement on this track can be seen, again as a diffuse return, at between 0.5 and 0.7 sec DT. The southerly track shows the sea floor and the intermediate reflector shoaling on approaching the site. Just west of the site the intermediate reflector is strong and rugged at about 0.2 sec DT, and the basement return shows in the first multiple at about 0.4+ sec DT.

OPERATIONS

Glomar Challenger approached Site 253, on the top of Ninetyeast Ridge, from the west along a track parallel to, but slightly north of, a previous *Circe*-5 track. Since there had not been an opportunity to soak a beacon prior to reaching the site, we could not follow the

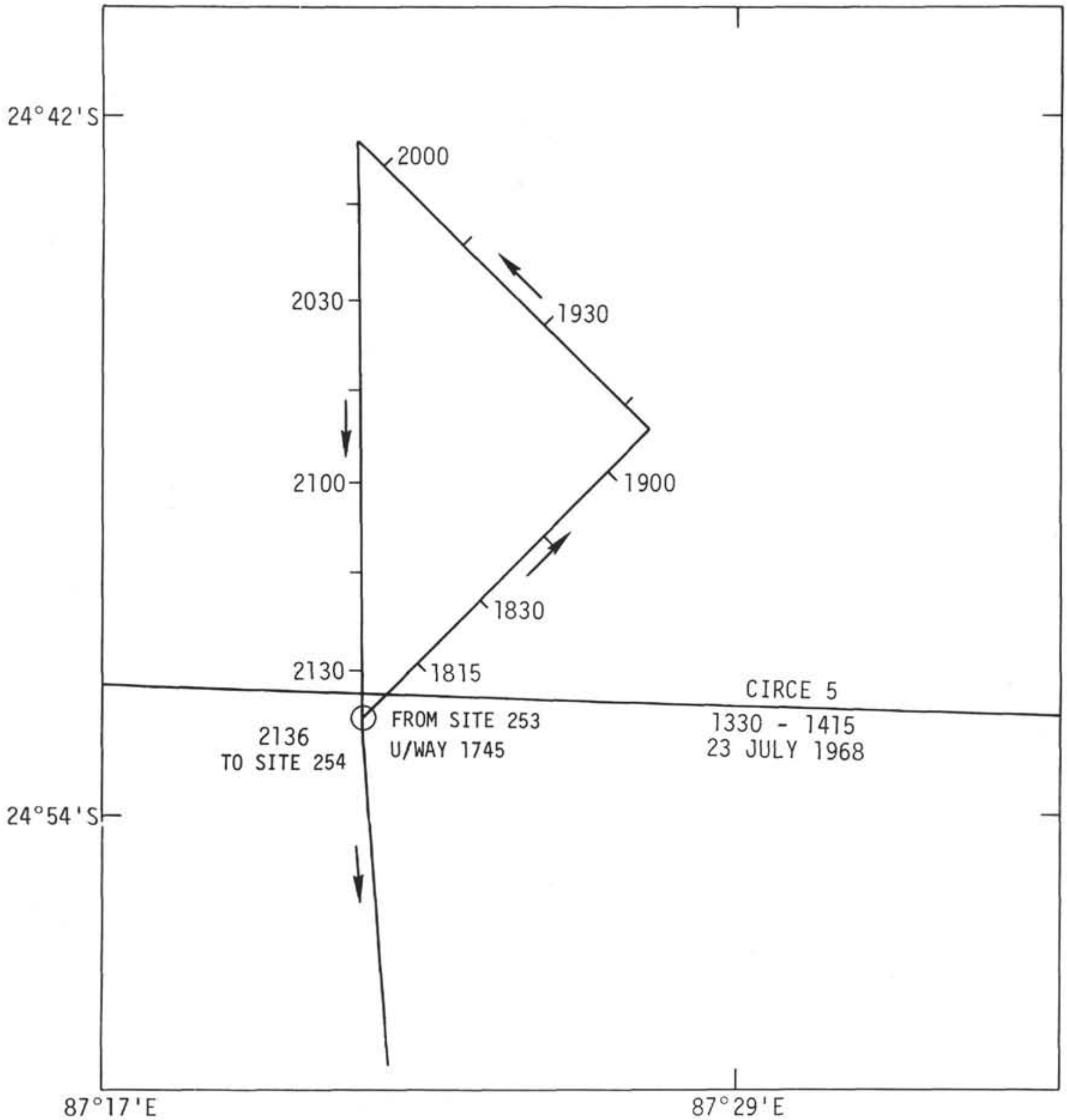

Figure 3. *Track chart of postsite survey run by D/V* Glomar Challenger *on leaving Site 253.*

procedure used on earlier sites. Instead, after the site had been selected, we made a turn to come up on a reciprocal course and dropped a spar buoy, with lights and a radar reflector, as we passed over the selected site. The buoy was dropped in 1042 fathoms (uncorrected) of water at 2301, 1 October 1972, while underway at 5 knots. We proceeded on course while recovering the underway survey gear, then turned to head back to the buoy. Unfortunately, at this point a rain squall descended upon us cutting down visibility and effectively cancelling out the radar as a tool for relocating the buoy. However, by careful dead reckoning we were able to return directly to the buoy without delay. After coming up to the buoy, we dropped the beacon and proceeded to lower the drill pipe. The beacon was dropped at 2336, October 1 in 1962 meters (1047 fm uncorrected) of water. (The buoy had drifted slightly downwind and downslope.)

Bottom was reached by the drill pipe at approximately 0530, 2 October, and a surface core was taken immediately. This core was recovered at 0607. Unfortunately, on recovery it was found that the core liner had collapsed and only about 2.0 meters of mixed material could be recovered from within the liner. It was decided to lift above the mudline and recore the top 9 meters of section. The 2.0-meter sample obtained on the first attempt is recorded as Core 0 (Hole 253) for record-keeping purposes but is not otherwise accounted for in the following report.

Vital statistics for cores taken at Site 253 are given in Table 1. Continuous coring down through a nannoplankton ooze section continued, with good recoveries to a subbottom depth of about 150 meters (bottom of Core 16). Three good heat-flow measurements were made in this ooze section by operating the downhole instrument in the locked-in

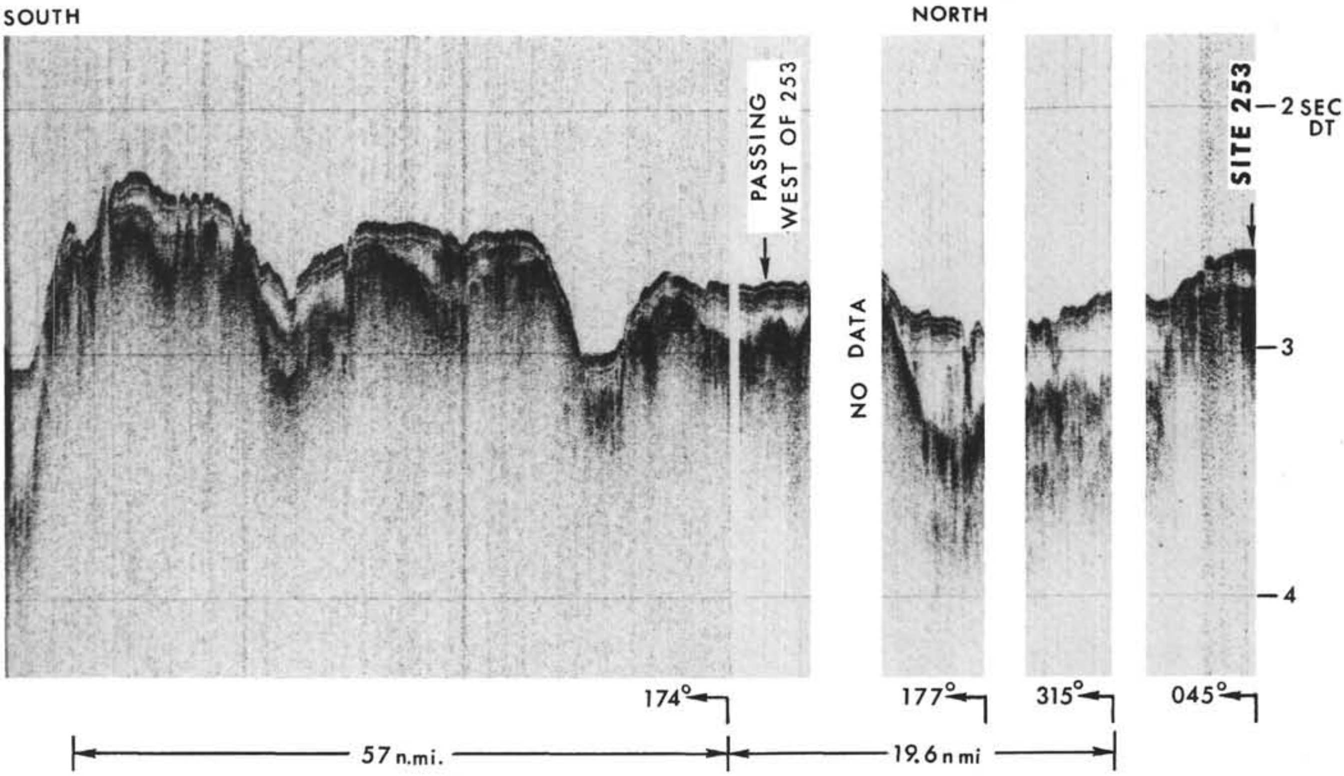

Figure 4. *Seismic reflection records made during the postsite survey (see Figure 3).*

mode. At 150 meters drilling apparently became harder, and at 153 meters (top of Core 17) lithified volcanic ashes were encountered and drilling became significantly harder. The top of the ashes corresponds to the uppermost, very strong reflector seen in the airgun profiles at 0.165 sec DT. Continuous coring proceeded through the volcanic ashes, although recoveries dropped off significantly, until it was quite apparent that we had passed, with no significant change in lithology, the depth represented by the deepest reflector seen on the underway airgun profiles. While operations continued an attempt was made to obtain a better seismic profile at the site by floating the hydrophone streamer away from the ship. The results of this experiment suggested the presence of deeper reflectors, possibly even basement, at depths in excess of 600 meters. By now we had cored through more than 400 meters of volcanic ash and were running short of time. It was decided therefore to stop continuous coring and to only core intermittently in an attempt to drill down and sample the deeper reflectors before abandoning the site.

While drilling with the center bit at a subbottom depth of 558 meters, extremely hard formation was encountered and we decided to cut a core to sample it. However, attempts to recover the center bit failed, and it was quite apparent that we would have to abandon the hole and pull the drill string. We commenced pulling out of the hole at about 0745, 5 October.

The core barrel and drill bit were on deck by 1630, (extra time had been taken to magnaflux the drill collars). It was then found that the center bit, a new one, was 1/16 in. oversize and had jammed fast in the lower support housing. It had consequently never seated properly inside the core barrel. Remarkably, as a result of this, a 35-cm core of basalt had been cut and lodged in the throat of the bit! This was recovered and designated as Core 58.

Position keeping at this site was excellent, although the 16-kHz beacon which was dropped initially began to fade very soon after we took up position. A second beacon, 13.5 kHz, was dropped at 1243, 4 October to ensure that we would not lose acoustic control over our position. This was of particular concern because of shallow-water depth at this site. Positioning was made easier because throughout operations at Site 253 weather and sea conditions were excellent, although we were troubled a little by a large swell from the southwest on 4 and 5 October.

Tools were laid down and all secured by 1745, 5 October and we got underway for Site 254 at 1750. A brief site survey was run for 3-3/4 hr after departure from Site 253.

LITHOLOGY

Hole 253 penetrated 559 meters of the sea floor; continuous coring (except between 526 and 545 m) yielded 58 cores and 270 meters of sediments representing 50% recovery. A short section of basalt was recovered in the last core which may or may not be basement.

Four main lithologic units and several subunits were distinguished on the basis of composition, color, and origin (Table 2).

TABLE 1
Cores Cut at Site 253

Core	Date (Oct. 1972)	Time	Depth from Drill Floor (m)	Depth Below Sea Floor (m)	Length Cored (m)	Length Recovered (m)	Recovery (%)
1	2	0654	1972.0–1981.0	0–9.0	9.0	8.7	97
2	2	0739	1981.0–1990.5	9.0-18.5	9.5	9.0	95
3	2	0820	1990.5–2000.0	18.5–28.0	9.5	8.7	92
4	2	0904	2000.0–2009.5	28.0–37.5	9.5	9.25	97
5	2	0950	2009.5–2019.0	37.5–47.0	9.5	8.7	92
6	2	1026	2019.0–2028.5	47.0–56.5	9.5	8.1	85
7	2	1109	2028.5–2038.0	56.5–66.0	9.5	9.5	100
8	2	1151	2038.0–2047.5	66.0–75.5	9.5	9.0	95
9	2	1237	2047.5–2057.0	75.5–85.0	9.5	9.0	95
10	2	1330	2057.0–2066.5	85.0–94.5	9.5	9.3	99
11	2	1418	2066.5–2076.0	94.5–104.0	9.5	9.1	96
12	2	1547	2076.0–2085.5	104.0–113.5	9.5	9.0	95
13	2	1638	2085.5–2095.0	113.5–123.0	9.5	9.2	97
14	2	1805	2095.0–2104.5	123.0–132.5	9.5	9.1	96
15	2	1907	2104.5–2114.0	132.5–142.0	9.5	0.0	0
16	2	2040	2114.0–2123.5	142.0–151.5	9.5	8.3	88
17	2	2143	2123.5–2133.0	151.5–161.0	9.5	3.8	40
18	2	2235	2133.0–2142.5	161.0–170.5	9.5	5.9	62
19	2	2321	2142.5–2152.0	170.5–180.0	9.5	1.8	19
20	3	0028	2152.0–2161.5	180.0–189.5	9.5	5.4	57
21	3	0159	2161.5–2171.0	189.5–199.0	9.5	4.7	49
22	3	0328	2171.0–2180.5	199.0–208.5	9.5	6.6	69
23	3	0513	2180.5–2190.0	208.5–218.0	9.5	3.0	32
24	3	0802	2190.0–2199.5	218.0–227.5	9.5	3.8	40
25	3	0911	2199.5–2209.0	227.5–237.0	9.5	2.5	26
26	3	1034	2209.0–2218.5	237.0–246.5	9.5	3.0	32
27	3	1255	2218.5–2222.5	246.5–250.5	4.0	2.2	55
28	3	1555	2222.5–2232.0	250.5–260.0	9.5	3.0	32
29	3	1910	2232.0–2241.5	260.0–269.5	9.5	2.8	31
30	3	2010	2241.5–2251.0	269.5–279.0	9.5	1.5	16
31	3	2110	2251.0–2260.5	279.0–288.5	9.5	3.4	36
32	3	2227	2260.5–2270.0	288.5–298.0	9.5	0.0	0
33	3	2327	2270.0–2279.5	298.0–307.5	9.5	CC	–
34	4	0025	2279.5–2289.0	307.5–317.0	9.5	CC	–
35	4	0120	2289.0–2298.5	317.0–326.5	9.5	0.75	8
36	4	0210	2298.5–2308.0	326.5–336.0	9.5	3.8	40
37	4	0300	2308.0–2317.5	336.0–345.5	9.5	CC	–
38	4	0356	2317.5–2327.0	345.5–355.0	9.5	0.8	8
39	4	0510	2327.0–2336.5	355.0–364.5	9.5	CC	–
40	4	0614	2336.5–2346.0	364.5–374.0	9.5	3.3	35
41	4	0710	2346.0–2355.5	374.0–383.5	9.5	0.85	9
42	4	0820	2355.5–2365.0	383.5–393.0	9.5	4.1	43
43	4	0944	2365.0–2374.5	393.0–402.5	9.5	2.4	25
44	4	1056	2374.5–2384.0	402.5–412.0	9.5	2.2	23
45	4	1200	2385.0–2393.5	412.0–421.5	9.5	8.7	92
46	4	1300	2393.5–2403.0	421.5–431.0	9.5	7.7	82
47	4	1350	2403.0–2412.5	431.0–440.5	9.5	5.5	58
48	4	1457	2412.5–2422.0	440.5–450.0	9.5	3.0	32
49	4	1617	2422.0–2431.5	450.0–459.5	9.5	3.1	33
50	4	1743	2431.5–2441.0	459.5–469.0	9.5	0.3	4
51	4	1857	2441.0–2450.5	469.0–478.5	9.5	4.6	48
52	4	2000	2450.5–2460.0	478.5–488.0	9.5	5.4	57
53	4	2103	2460.0–2469.5	488.0–497.5	9.5	6.9	73
54	4	2213	2469.5–2479.0	497.5–507.0	9.5	6.1	64
55	4	2320	2479.0–2488.5	507.0–516.5	9.5	4.6	48
56	5	0030	2488.5–2498.0	516.5–526.0	9.5	4.3	45
Drilled			2498.0–2517.0	526.0–545.0			
57	5	0256	2517.0–2526.5	545.0–554.5	9.5	3.6	38
Drilled			2526.5–2530.0	554.5–558.0			
58	5	1645	2530.0–2531.0	558.0–559.0	1	0.35	35
Total					536.5	269.70	50.3

TABLE 2
Lithologic Summary, Site 253

Unit/ Subunit	Core	Depth Below Sea Floor (m)	Thickness (m)	Description
1	1	0–9.0	9.0	Pale orange Nannoplankton Foraminiferal ooze
2	2–17	9.0–153.3	144.3	Pale orange-pale brown nannoplankton ooze and chalk
2a	2	9.0–12.8	3.8	Clayey nannoplankton ooze (nanno=mostly discoasters)
2b	2–10	12.8–88.0	75.2	Foraminiferal nannoplankton ooze (equal amounts of discoasters and coccoliths)
2c	10–16	88.0–145.0	57.2	Coccolith ooze
2d	16	145.0–151.3	6.3	Coccolith ooze
2e	16–17	151.3–153.3	2.0	Ferruginous micarb chalk
3	17–57	153.3–549.5	388.4	Olive-green and black vitric volcanic ash and lapilli
3a	17–21	153.3–192.3	39.0	Green altered vitric volcanic ash and minor lapilli
3b	21–29	192.3–262.6	70.3	Black altered vitric volcanic ash & lapilli; glassy scorlaceous olivine basalt
3c	29–35	262.6–318.0	55.4	Green altered vitric volcanic ash with minor lapilli
3d	35–48	318.0–443.5	125.5	Black altered vitric volcanic ash & minor green vitric volcanic ash.
3e	48–57	451.3–549.5	98.2	Green altered vitric volcanic ash & minor black vitric volcanic ash
4	58	558.0–558.4	0.35	Fine-grained, olivine-rich porphyritic basalt

Unit 1

This uppermost unit is 9 meters of very pale orange, nannoplankton foraminiferal ooze. This sediment is very soft and texturally consists of 43%-48% clay-sized nannos and 52%-56% sand- and silt-sized foraminifera. Slight mottling of orange-white color with light gray halos occurs throughout. Microscopic ferruginous amorphous aggregates and authigenic calcite make up the minor components, with trace amounts of all the clay and detrital minerals, clinoptilolite, gypsum, and barite.

Unit 2

This 144-meter-thick portion of the sedimentary column has colors ranging from pale orange-white to pale light brown and yellowish-gray. Its textural composition is made up of 95%-100% clay-sized nannoplankton, 1%-5% silt-sized foraminiferal fragments, and a trace of sand-sized foraminifera. Consolidation ranges from soft ooze to semilithified chalk. Nannoplankton (varying ratios of discoasters and coccoliths) is the major component, along with lesser detrital clay (at the top) and micarb (at the bottom). The unit is slightly to moderately mottled; intensity of mottling increases towards the bottom of the unit. Trace amounts of ferruginous microscopic aggregates (concentrated in the halos surrounding mottles) and detrital clay occur through. Traces of clinoptilolite, gypsum, and barite were recorded in the fine ($<2\mu$) fractions.

Subunit 2a is a soft, clayey to clay-rich nannoplankton ooze and is a 3.8-meter-thick transitional stage between Unit 1 and Subunit 2b. Sand- and silt-sized foraminifera and foraminiferal fragments decrease to 42%, clay content increases to 58%, and discoasters are present in amounts increasing up to 50% with traces of coccoliths.

Subunit 2b, a foraminiferal nannoplankton ooze, is the thickest subunit (75 m) and consists of about equal amounts of discoasters and coccoliths. Sand-sized foraminifera constitute about 7% of the upper portion of the subunit and are present throughout in concentrations of 1%-3% (slightly more abundant in mottles). Detrital clays occur in very minor trace amounts. Below 47 meters the pale orange-white color changes to very light brown. At around 60 meters coccoliths become slightly more abundant than discoasters. Mottling is moderate and has a darker shade of brown in the lower part of the subunit.

Subunit 2c is distinguished from the one above by the complete absence, or presence only in trace quantities, of discoasters, and thus it is a foraminiferal coccolith ooze (57 m thick). A variety of colors occurs in this ooze: pale brown and orange, brownish-gray, yellowish-gray. The dark gray, brown, pinkish-white mottling becomes moderate to intense in places, while it may be entirely absent in other parts. Below 100 meters consolidation in undisturbed cores changes from soft to stiff. Texture is much the same as in the previous subunits, though an overall decrease in sand-sized particles may be observed towards the bottom. Along with the trace constituents typical of Unit 2, Subunit 2c contains sponge spicules and collophanous fish debris at the top and traces of volcanic glass below 125 meters.

Subunit 2d is the 6.3-meter-thick semilithified equivalent of Subunit 2c. It is a pale orange coccolith chalk containing trace amounts of discoasters and foraminifera. Other characteristics are the same as those of previous subunits.

Subunit 2e is a dark brown, reddish-yellow ferruginous micarb chalk 2 meters thick. Its consolidation is difficult to define since it has been disaggregated by drilling into poorly sorted clayey, coarse to fine sand. It is composed of 90% micarb, 8% limonite and other iron oxides, and 2% volcanic glass.

Unit 3

Unit 3 is a 388-meter-thick section of altered vitric volcanic ash and lapilli. It comprises three distinct lithic types which justify (in conjunction with spatial distribution) the division of Unit 3 into five subunits. Types IIIa and IIIb alternate and overlap throughout the subunits (Figure 5). It should be noted that all textural descriptions for this unit are visually determined. The shore-laboratory textural analyses employ disaggregation techniques which destroy the true texture of the sediment, and hence will be ignored.

Lithic Type IIIa: Dark olive-green, greenish-gray, micarb-bearing (and/or rich) altered vitric volcanic ash. Semilithified; medium-fine sand, silty texture. Alteration of glass to glauconite and clay.

Lithic Type IIIb: Black altered vitric volcanic ash with minor lapilli (up to 1.5 cm clast size). Semilithified; it contains about 5%-25%, 1-5 mm diameter white blebs of unaltered glass. Also, 1%-2% (occasionally more) mollusc shell fragments are present.

Lithic Type IIIc: Black vesicular basalt and basalt scoria with carbonate filling voids and vesicles.

Subunit 3a is a 39-meter section consisting exclusively of Type IIIa lithology. Close to the top of this subunit is a fossiliferous, tuffaceous detrital clay portion and a small band of coccolith radiolarian diatomite. Micarb and coccolith chalk occurs as minor white patches, and micarb also serves as cement between clasts. Close to the bottom scattered black subangular and subrounded clasts of Type IIIb vitric tuff are present.

Subunit 3b is a 70-meter-thickness of Type IIIb sediments. Glass is altered, as pointed out earlier, to clay and lesser glauconite. Subangular and subrounded clasts 0.5-1.0 cm in size make up about 15%-40%. These are composed of unaltered or partially altered green, brown, or colorless glass shards, or light gray pumice. Molluscan shell fragments occur throughout the subunit in varying concentrations (1%-2% on top, higher at the bottom), and usually in thin, elongated cross-sections. Fine carbonate specks may be observed disseminated among the clasts. At places, high concentration of these specks results in overall lighter color of the sediment. One load cast was observed at a depth of 200 meters. In Core 22 traces of plagioclase and zeolite were present.

At 218 meters and 228 meters Type IIIc lithology is present (its only occurrence). The vesicular basalt flow is

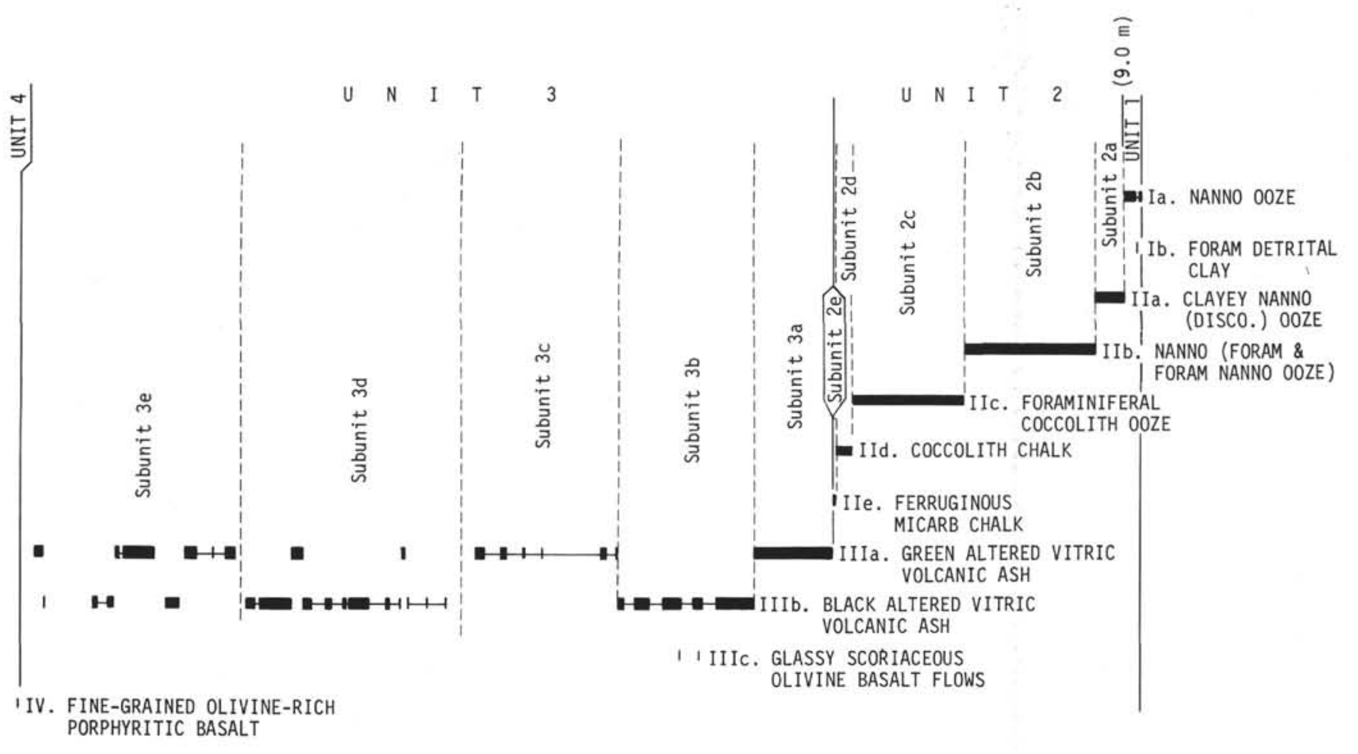

Figure 5. *Lithologic units, Site 253.*

30 cm thick, and the basalt scoria further below is 16 cm thick. The contact between the basalt and the ash exhibits fine laminations and absence of carbonate, grading down into carbonate-rich lapilli.

Towards the bottom of Subunit 3b the concentration of clasts decreases, and in fact, some portions are entirely fine grained. Shell fragment concentration seems to decrease also. Preconsolidation load deformation was observed close to the bottom.

Subunit 3c is 55 meters thick. Again, Type IIIa sediment is dominant, though it may be distinguished from Subunit 3a by the poor recovery of the present subunit, thus suggesting a lesser degree of consolidation. Subunit 3c also contains minor amounts of lapilli. The top contains locally higher concentrations of fine micarb. The ash is generally coarse grained and contains 1%-2% unaltered glass blebs (2 mm in size). Coarse shell fragments constitute up to 15% of the sediment.

At about 282 meters burrows filled with (coarse to medium sand sized) partially altered green glass are present. A typical composition of the ash in this subunit is 96% clay alteration of glass; 2% green glass altering to glauconite; 2% feldspar, mica, and clinopyroxenes. The more indurated pieces exhibit conchoidal fracture.

Subunit 3d forms a sharp boundary with Subunit 3c. It is the thickest (126 m) subunit of Unit 3. Lithic Type IIIb is dominant, with Type IIIa occurring close to the top and around 415 meters. Clasts (~35%) embedded in a fine sand-silt matrix are common. Locally, shell fragments may be present in concentrations up to 25%. Near the top of the subunit crinoid discs were found. At 367 meters a 60-cm layer of vitric and basaltic lapilli is present, consisting of 50% reddish-green, poorly sorted 4-30 mm clasts. A similar zone occurs also at 433 meters. Burrows are abundant below 413 meters, and again, conchoidal fracture was noted.

Subunit 3e (98 m) is dominantly a Type IIIa sediment, but minor thicknesses of Type IIIb lithology are present at 480 meters, 508 meters, and 517 meter depths. The top of the subunit is characterized by the absence of shell fragments and layers of lapilli. Otherwise the texture is the usual medium-fine sand. Some shell fragments and burrows occur below 470 meters, and scoria and pumice clasts are seen around 500 meters. At these depths white and orange carbonate specks begin to appear and continue to be present further below. At 519 meters there are preconsolidation deformation structures. In the lower portion of the subunit unaltered brownish-white patches of glass occur. Finally, at the base of Unit 3 burrows and subangular basalt clasts are present.

Summary of Petrographic Observations (from smear slides) on Vitric Volcanic Ash and Lapilli

Two major components are present.

I) Altered vitric tuffs.

1) Composed essentially of green or colorless volcanic glass which may be altered to glauconite or isotropic clay.

2) They are nearly 100% vitric; feldspar of pyrogenic origin is present only in trace amounts.

3) Although some tuffs are juvenile (no modification of original texture, as for example in Sample 31-4, 95 cm), most have undergone some degree of aqueous modification—as seen in rounding or obliteration of angular shards.

4) Throughout the sequence the green glass is in various states of alteration to glauconite or cryptocrystalline isotropic clay.

5) Even sediments which appear to be detrital clay are presumably altered fine-grained vitric tuffs.

II) Micarb chalk.

1) Lesser component than the vitric tuffs.

2) Origin of micarb may be due to (a) diagenesis of nannoplankton; (b) primary precipitation; (c) alteration of glass.

3) Micarb chalk contains minor tuffaceous components of green or brown volcanic glass.

X-ray mineralogy of the volcanic ashes

The mineralogy of the ashes, as revealed by X-ray diffraction studies, shows someinteresting features. Calcite and montmorillonite constitute up to 90% of the pyroclastic sequence, in inverse proportion from the top, where the ratio is typically some 55:35, to the bottom, where it is about 15:65. The decrease in plagioclase and calcite with depth is probably entirely due to diagenetic reactions in which minerals such as zeolites and montmorillonite are formed at the expense of plagioclase and augite. The zeolites are phillipsite above, then clinoptilolite, and the Na-rich mineral analcite, with some clinoptilolite, below. Of the sites drilled on Leg 26, Sites 253 and 254 have the greatest abundance of phillipsite and analcite. Well-shaped crystals of analcite, associated with orange efflorescent masses and fine white silk-like fibrous threads of mordenite, occur in vugs in the ash in Core 54, Sections 4 and 5 (Figure 6). Mordenite is known as an authigenic zeolite in sediments, as well as in igneous rocks. A similar occurrence to the present—fine silk threads associated with opaline silica in montmorillonite- and cristobalite-rich bentonitic clays in tuffaceous sediments—was reported from Japan by Hayashi and Sudo (1957). Other clays (including glauconite) and detrital minerals occur in trace amounts, and authigenic cristobalite, (?) adularia, anatase, and magnetite are present in small amounts in the lowest depth ranges. Pyrite, goethite, and gypsum are found, and there are three or four unidentified minerals, some present in significant quantities.

Petrographic Details on the Basalt and Scoria Found in Unit 3

As well as forming irregular, reddish fragments within the thick ash sequence of Unit 3, thin flows of highly vesicular or scoriaceous olivine basalt and basalt glass are interbedded at depths of 218.8-219.1 meters and 228.0-228.2 meters, within the ash flows.

At the contact with the ash below, the upper lava flow is a grayish scoriaceous basalt glass. It contains a few, usually fresh, sometimes euhedral, olivine crystals, up to 1.5 or 2 mm long. Also embedded in the glass are clear laths of plagioclase together with prismatic and rhomboid crystals of the feldspar. The laths reach 1 mm in length and are clearly twinned, although not usually on the albite law; they are frequently zoned. Much of the

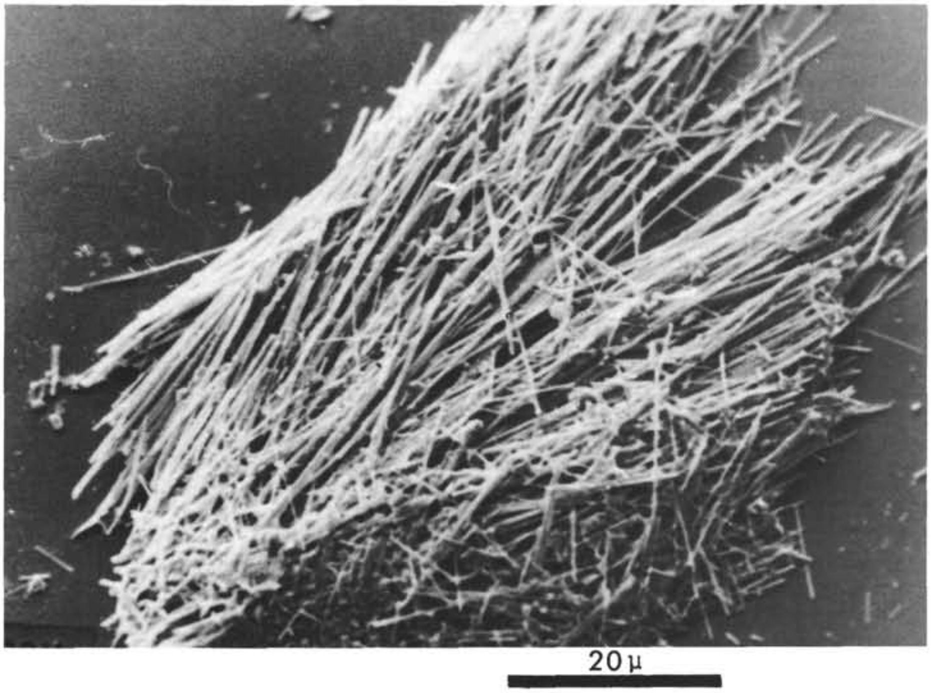

Figure 6. *Mordenite from Site 253, Core 54 (X100).*

glass is fresh and almost colorless, with refractive index well above balsam, but the remainder is altered to a dark, reddish-brown palagonite, with a low refractive index. The palagonite contains round and irregular-shaped cavities filled with a spherulitic, fibrous zeolite (length slow in orientation) and, occasionally, with calcite. Within the palagonite, the feldspars are also highly altered or resorbed.

The remainder of the flow is a scoriaceous glassy olivine basalt, brownish-gray in color and very highly vesicular. Palagonite rims the inside of the vesicles. Crystals of olivine, many of them well shaped, now totally altered to iddingsite aggregate, reach 0.6 mm in length. Plagioclase laths, poorly twinned and up to 0.8 mm long, are also scattered through the dark brown palagonite which forms the bulk of the rock.

Unit 4

Fine-grained, olivine-rich porphyritic basalt was reached at a depth of 558 meters. Thirty-five centimeters of rock were recovered, but the contact was not established (see Operations Report). However, the basalt may well be the true basement forming the sea floor, erupted before the overlying ash sequence.

The rock is fresh, gray in color, and notably rich in altered olivine crystals (ca 15%). These form black phenocrysts or groups of phenocrysts, with individuals reaching 3 mm in length, and vary in density between 1 or 2 and some 30/cm^2 of the cut surface.

In thin section, the olivines are often euhedral, averaging 0.5-1.0 mm in length, and totally altered to talc and colorless fibrous chrysotile serpentine. There are patches of green alteration material, which may be bowlingite, and skeletal ilmenite rods, up to 0.3 mm long, occur within the olivines. The latter are sometimes accompanied by tiny, very euhedral brown crystals of, probably, dipyramidal anatase. Some of the olivines show alteration beyond the euhedral outlines of the crystals, into the surrounding matrix.

Plagioclase (20%) occurs as laths, up to 1.8 mm long but normally 0.1-0.2 mm. Iron oxide (6%) is widely dispersed in small grains, as well as the rods in the olivines. Occasional discrete crystals of a reddish-brown, iron-rich mineral are also present.

The matrix, which is subvariolitic and constitutes the remaining 59% of the rock, contains pyroxene, feldspar, iron ore, and probably some glass; it thus differs from the basalts from Sites 250 and 251, which contain glassy interstitial patches within otherwise holocrystalline rocks.

Without chemical analysis, it is not considered wise to attempt to classify the basalt.

TABLE 3
Modes of the Basalts, Site 253

	Basalt Glass (24-1, 109 cm)	Scoriaceous Glassy Olivine Basalt (24-1, 93 cm)	Fine-Grained Olivine-Rich Basalt (See Unit 4, 58-1, 8 cm)
Plagioclase	23	10	20
Olivine	1	8	15
Iron Oxide	–	–	6
Pyroxene	–	–	
Fresh glass	30	–	59
Palagonite	40	82	
Zeolite and calcite	6	–	–

SHIPBOARD GEOCHEMICAL MEASUREMENTS

Routine analyses for salinity, *p*H, and alkalinity were conducted on interstitial water samples squeezed from 11 sediment samples taken at depths in the hole from 16.5 to 519.5 meters below the sea floor. In addition, *p*H was measured on the uppermost three samples of unsqueezed sediment by the punch-in method before the core recoveries became too stiff for the electrodes. The sampling and analytical techniques are described in the report on Site 250, and the results for Site 253 are summarized in Table 4 and are presented in graphical form in Figure 7.

Results

Salinity

Salinity values increased consistently with depth in the hole. At a depth of 16.5 meters below the sea floor the salinity was 35.5°/oo, or approximately 1°/oo greater than near-bottom salinities prevailing at the site (Wyrtki, 1971). From this depth down through the entire nannoplankton ooze and chalk sequence and into the uppermost 100 meters of altered volcanic ash to 234.5 meters below the sea floor, the salinities increase linearly to 37.1°/oo, at a rate of 0.76°/oo/100 meters. The increase of salinity with depth for the remainder of the hole is even more rapid: 1.8°/oo/100 meters, to a value of 42.1°/oo at 519.5 meters, the greatest depth sampled. These trends appear related to changes in lithology and may prove significant in any detailed chemical examination of the altered volcanic ash as well as the depositional and diagenetic history of the Site 253 sediments.

pH

The coupled punch-in and flow-through *p*H measurements all agreed within 0.06-0.08 *p*H unit, the agreement possibly reflecting the ease with which the interstitial waters were extracted from the soft surficial oozes. Flow-through *p*H in the uppermost sample was 7.32, which is below the normal range of 7.8-8.2 for seawater. Values decreased to a minimum of 6.97 at a depth in the hole of 154.5 meters, near the base of the ooze-chalk sequence. With the exception of one aberrant value (7.56 at 173.5 m), the values obtained from the altered volcanic ash in the lower part of the hole fall within the narrow range of 7.07-7.27.

Alkalinity

Trends in alkalinity, perhaps even more strikingly than those of salinity, seem to reflect Site 253 lithology. The maximum alkalinity of 2.38 meq/kg was measured in the shallowest sediments. Values decreased linearly with depth, to 0.391 meq/kg at 173.5 meters, about 20 meters deeper than the chalk-altered ash contact. From this point down to 519.5 meters, the greatest depth sampled, alkalinity values decreased slightly to a minimum for the hole of 0.186 meq/kg. These data, together with those for salinity, are not understood at present and deserve more attention on shore.

PHYSICAL PROPERTIES

The physical properties measured at Site 253 were bulk density, porosity, sonic velocity, and thermal conductivity. The methods are described in the Explanatory Notes (Chapter 2). The results are shown in the hole summary diagrams.

Density, Porosity, and Water Content

The densities are quite uniform and throughout this hole, 1.7-2.0 g/cc despite the diverse sediment types. The densities are poorly determined by all three methods: GRAPE, syringe, and section weight. The GRAPE densities are consistently 5%-10% higher than those from the section weight or syringe. The porosity and water content decrease steadily with depth in the ooze. They were not measured in the underlying ash layer.

Acoustic Velocity and Acoustic Impedance

The acoustic velocities were low and uniform in the upper ooze section, 1.55-1.60 km/sec, increasing slightly with depth. There is a marked increase in velocity to about 1.8 km/sec in the green altered volcanic ash starting at about 153 meters and a large increase to an average of 2.3 km/sec for the black volcanic ash starting at about 192 meters. There is a large scatter in the

TABLE 4
Summary of Shipboard Geochemical Measurements, Site 253

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)		19.8	8.36/8.34	2.38	35.8
2-5, 144-150	16.44-16.50	22.2	7.24/7.32	2.38	35.5
7-5, 144-150	63.94-64.00	22.7	7.22/7.16	1.96	36.0
12-5, 144-150	111.44-111.50	22.7	7.19/7.05	1.22	36.3
17-2, 144-150	154.44-154.50	22.5	/6.97[a]	0.792	36.6
19-2, 144-150	173.44-173.50	22.5	/7.56[a]	0.391	36.8
25-2, 144-150	230.44-234.50	22.9	/7.07[a]	0.362	37.1
36-2, 140-150	329.40-329.50	23.0	/7.27[a]	0.293	39.3
42-2, 140-150	386.40-386.50	23.0	/7.11[a]	0.225	39.9
47-3, 140-150	435.40-435.50	23.2	/7.16[a]	0.225	40.7
51-3, 140-150	473.40-473.50	22.0	/7.14[a]	0.215	40.7
56-2, 140-150	519.40-519.50	23.0	/7.23[a]	0.186	42.1

[a]Too stiff to measure punch-in.

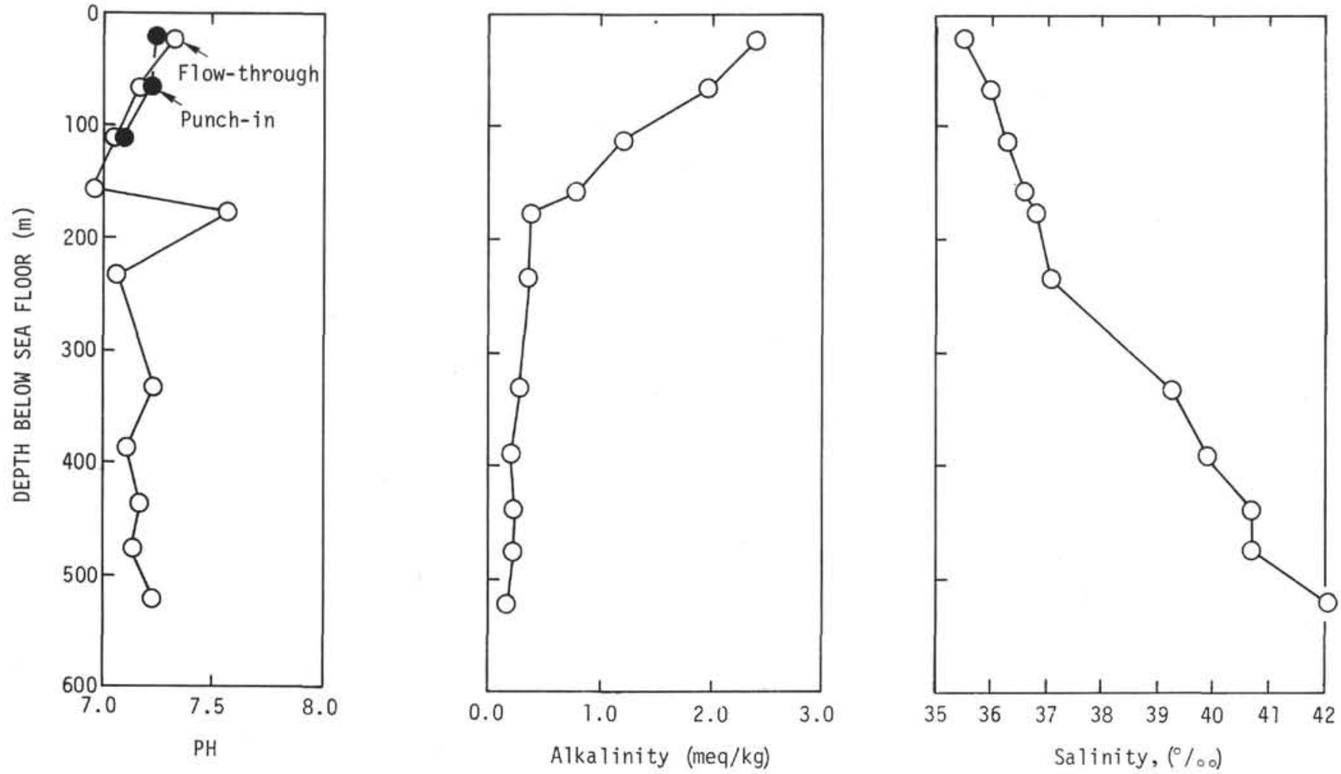

Figure 7. *Graphic summary of geochemical measurements taken at Site 253.*

velocities for the ash section. Most of the variation can be correlated with real changes in composition in this inhomogeneous layer.

The acoustic impedances are poorly determined because of the poor densities. There is probably a significant increase at 153 meters and an increase of more than 50% at 192 meters. Significant acoustic energy should be reflected from each of the many different layers in the variable velocity ash section, so that little remains to be reflected from the basalt basement. Very poor returns from the basement are observed on the seismic reflection records.

CORRELATION OF SEISMIC REFLECTION PROFILE WITH DRILLING RESULTS

Where we dropped the spar buoy at Site 253, the seismic profile showed basement clearly near 0.325 sec DT. However, after drilling below this level without encountering basement we decided to run an on-station profile using an SSQ41 sonobuoy to check our initial estimate. We had suspected that we may have dropped the beacon west of our initially chosen site. The on-site profile (Figure 8) showed returns (weak) deeper than 0.325 sec DT which is consistent with the observation of the postsite survey that the deepest observed reflector, or basement, is found deeper west of the buoy drop. The seismic record shows an upper transparent section above a strong intermediate reflector at 0.160-0.165 sec DT. Several reflectors are seen beneath this reflector becoming weaker at depth. They are found at about 0.25, 0.34, 0.48, 0.575, and about 0.625 sec DT.

The measured acoustic velocity profile shows significant acoustic impedance contrast at 153 meters, 192 meters, possibly near 263 and 320 meters, 385 meters, and 555-560 meters subbottom. The contrast at 153 meters marks the contact between the calcareous ooze and chalks and the underlying pyroclastic section while the contrast at 555-560 meters is due to the contact of the pyroclastics with the underlying basalt. The contrasts intermediate between 153 and 558 meters are due to contacts between pyroclastics of differing degrees of consolidation.

Table 5 is an attempt at correlating reflection times, depths of lithologic contrast, and depths of impedance contrast. Depths of lithologic and impedance contrasts are not always correlated, and not all impedance contrasts yield detectable reflections. We believe that the first four reflectors were drilled and sampled and that they correspond with the ooze-ash contact (0.16 sec), changes in ash lithologies, and consolidation (0.25, 0.34

TABLE 5
Reflection Times and Depths of Lithologic and Impedance Contrasts, Site 253

Reflection Time (msec DT)	Lithologic Contrast	Impedance Contrast	Average Velocity (km/sec)
160	(153)	(153)	(1.90)
–	153	153	–
250	192	192	1.54
–	263	263	–
340	318	318	1.87
–	–	385	–
–	447.5	–	–
480	558	558	2.32
575			
625			

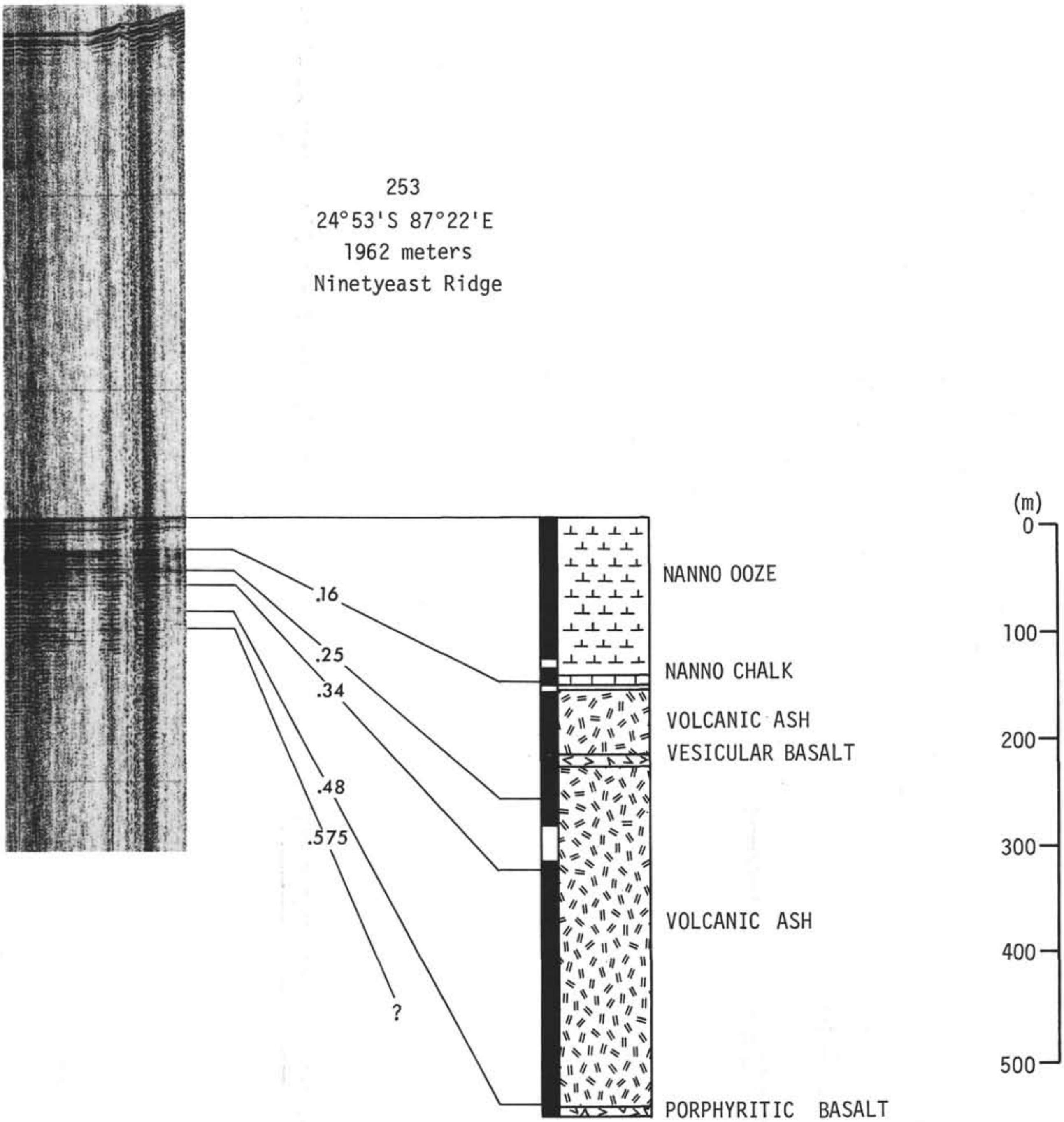

Figure 8. *Correlation of seismic reflection data and drilling results.*

sec DT; see stratigraphic column, Figure 8) and ash-basalt contact (0.48 sec). The deeper reflections at 0.575 and 0.625 sec imply that the basalt encountered at 558 meters subbottom is not true "basement," but is probably underlain by more ashfalls and lava flows.

It was at first surprising that the reflection from the basalt contact was so weak in comparison to the ooze-ash contact, for example. This observation is readily explained by calculating the decrease in amplitude of the seismic signal as it is transmitted through the section and reflects from the basalt contact (transmission plus reflection loss). This calculation shows that the sound wave returning to the sediment surface after reflection is 0.1% of the amplitude of the wave transmitted down through the sediment-water interface. This contrasts with the reflection loss from the ooze-ash contact which would produce only a 60% amplitude loss.

Table 5 also shows that if the 153-meter lithologic contact is the 0.16 sec reflection, then the implied velocity for the ooze section is very high, 1.9 km/sec, compared to the measured values which do not exceed 1.6 km/sec. The implied depth of this contact, taking into account reflection time and measured velocities, is about 125 meters, 25 meters shallower than the measured depth. The explanation of this discrepancy may be that the ooze-ash contact has considerable short wavelength relief and that we have in effect sampled the contact in a "hole," or low.

PALEONTOLOGY

Biostratigraphic Summary

At Site 253, 153 meters of foraminifera-rich nanno ooze of Quaternary to upper Eocene age overlies 405 meters of volcanic ashes containing scarce nannofossils, few smaller benthonic and very rare planktonic foraminifera, rare to common radiolarians and diatoms, and some other invertebrate fossils, such as larger foraminifera, bryozoans, crinoid fragments, and molluscs. Within the calcareous ooze, 9 meters belong to the Quaternary, 9 meters to the Pliocene, 66 meters to the Miocene, 30 meters to the Oligocene, and 39 meters to the uppermost middle and upper Eocene. The sedimentation is continuous throughout this sequence, except for a small hiatus in the upper part of the upper Eocene. The lower Oligocene is much reduced in thickness. Microfossil assemblages show an open-marine pelagic environment with water depths similar to the present. Shallower conditions are indicated towards the base of the unit (Core 16, uppermost middle Eocene).

Sedimentation of volcanic ashes ceased at about 42 m.y.B.P. and the more than 400-meter-thick volcanic unit seems to have been accumulated within less than 4 m.y. The lowermost fossiliferous sample (57, CC) at 554.5 meters below the sea floor and about 5 meters above the basalt is 46 ± 3 m.y. old. Nannofossils and foraminifera indicate an outer shelf environment during deposition of the volcanic sequence. The presence of some larger foraminifera and other invertebrate fossils is noteworthy and supports this interpretation.

Foraminifera

Neogene: The foraminiferal fauna is very well preserved in Quaternary and Pliocene deposits, slightly affected by solution in the upper Miocene, and damaged in the middle and lower Miocene. The whole Neogene sequence appears to have no gaps; however, with the material available, it was not possible to subdivide the sequence into zones.

By detailed sampling at small intervals within the uppermost Quaternary section, it was possible to locate the Recent/Pleistocene boundary at a depth of 35 cm in Core 1. (Boltovskoy, this volume).

The Quaternary/Pliocene boundary was determined by the *Globorotalia truncatulinoides: G. tosaensis* relationship. In addition, in the lowermost part of the Quaternary sequence isolated Pliocene markers were recorded, namely *Pulleniatina obliquiloculata praecursor* and *Globigerinoides obliquus.*

In the Pliocene sequence *Globorotalia crotonensis* and, somewhat lower, *G. limbata* and *Globigerinoides fistulosus* were found.

The upper Pliocene fauna of Core 1 is underlain in Core 2 by the middle and lower Pliocene assemblages. The former is characterized by the last appearance of *Sphaeroidinella seminulina, Globoquadrina venezuelana,* and *G. altispira;* the lower Pliocene fauna by the presence of *Globorotalia margaritae.*

Below the lower Pliocene, upper Miocene deposits were found. The upper part of this section contained *Sphaeroidinella subdehiscens, Globigerinopsis aguasayensis, Globigerinoides amplus,* and some other species.

The middle Miocene was recorded in Core 7 where *Globigerinoides mitra, G. bulloides,* and *Globorotalia peripheroronda* were found.

In the lower Miocene sequence the occurrence of *Globigerina yeguaensis, Globorotalia kugleri* and somewhat lower of *G. opima, Globigerinita dissimilis dissimilis, G. dissimilis ciperoensis, Globigerina "praerubra"* was noted. In addition, the lower Miocene assemblages contained a great number of unidentifiable (usually extremely small sized) planktonic foraminifera.

As shown on the range chart of selected foraminiferal species, (Boltovskoy, this volume, Chapter 30) at Site 253 the foraminiferal assemblages of Miocene and Oligocene are very different. The change from Oligocene to Miocene fauna is observed over about 10 meters of section, which means that it was rather abrupt. To locate the change from the Oligocene to the Miocene the extinction of *Globigerina ampliapertura, G. juvenilis,* and *Globorotalia pseudobulloides,* and the appearance of *Globoquadrina venezuelana, G. dehiscens dehiscens,* and *Globigerina decoraperta* were used.

Paleogene: This site has revealed an almost uninterrupted sequence of top middle Eocene to top Oligocene pelagic oozes with only a minor break in the uppermost Eocene. The assemblages of planktonic foraminifera are rich and well preserved in this interval, and most of the samples can be correlated with the standard planktonic zones.

Sections 1 to 3 of Core 10 are assigned to the upper part of Zone P22, based on the presence of *Globorotalia kugleri* and rare occurrences of *Globigerina angulisuturalis.* The lower portion of this core and probably also Section 1 of Core 11 represent the lower part of this zone.

The frequent occurrence of *Globorotalia opima opima* in Sections 3 to 6 of Core 11 and Sections 1 to 3 of Core 12 leads to a correlation with Zone P21. The remaining portion of Core 12 is mainly characterized by the association of *Globigerina ampliapertura, G. sellii, G. tapuriensis,* and *Globorotalia gemma.* It is placed into Zones P19 and P20. In Core 13, Section 1 and in the upper portion of Core 13, Section 2, *Globigerina sellii* was not found and a lowermost Oligocene age (Zone P18) is therefore indicated.

Samples 13-2, 115-117 cm and 13-3, 30-32 cm contain a typical upper Eocene assemblage of the *Globorotalia cerroazulensis* Zone with *G. cerroazulensis cocoaensis.* In the lower one of these two samples few specimens of *Globigerinatheka* were found, indicating a basal position within the *G. cerroazulensis* Zone. On the other hand, no specimens showing the late evolutionary development within the *cerroazulensis* lineage (*G. cerroazulensis cunialensis*) occurred immediately below the Oligocene.

A break occurring in the highest part of the uppermost Eocene, most likely at the Eocene/Oligocene boundary, is therefore suggested.

The *Globigerinatheka semiinvoluta* Zone of the upper Eocene is well and typically developed from Sample 13-3, 115-117 cm throughout Cores 14 and 15.

The main feature of all samples taken from Core 16 is the abundance of specimens belonging to the genus *Globigerinatheka. G. semiinvoluta,* however, is missing in this core and the presence of small hispid forms with *Globorotalia bullbrooki* and *Truncorotaloides topilensis* indicates middle Eocene. The assemblages can be assigned to the *Truncorotaloides rohri* Zone, although no typical specimens of the zonal marker have been found. The same age can be attributed to the basal ferruginous micarb chalk of Sample 16, CC. The preservation of the foraminifera is rather poor here and transport cannot be excluded.

In the volcanic sequence from Core 17 downwards planktonic foraminifera are very rare and poorly preserved. An approximate identification was possible in only a few cases: *Globorotalia bullbrooki* and *G. spinulosa* in Core 20 and *"Globigerinoides" higginsi* in Core 34. These species are restricted to the middle Eocene. The low number of planktonic foraminifera as well as their small size are indications of shallow-water conditions. This is also supported by the fact that in this part of the section benthonic foraminifera far outnumber the planktonics and by the discovery of larger foraminifera of the genera *Discocyclina* and *Asterocyclina.* The latter are generally known to be restricted to a shallow-water environment. Of all the Eocene larger foraminifera the Discocyclinids are most probably the ones which were able to live at somewhat greated depths than other representatives of this group, e.g., *Nummulites, Alveolina.* It may therefore be significant that representatives of the latter groups, although their occurrence might be expected paleogeographically and timewise, were not found in our material. A maximum water depth of around 100-150 meters can be assumed for the original biotope of the Discocyclinids, although their main occurrence is at shallower depths. However, in the upper part of the volcanic sequence, the larger foraminifera occur only in the coarser volcanoclastic rocks and some downslope transport must be considered. In the lower part of the volcanic sequence, Discocyclinids occur at various levels in the finer sandstones also, and it can be assumed that here transport after deposition was little, if it occurred at all.

Other Invertebrate Fossils

The volcanic sequence has, in a great proportion of the cores, yielded an interesting assemblage if invertebrate fossils which is important for an environmental interpretation of this rock unit. The list of these fossils includes indeterminate pelecypods, bryozoans, stems of crinoids, echinoids, mostly echinoid spines, and solitary corals. One specimen of a terebratulid brachiopod occurred in Core 18. All these fossils, together with the larger foraminifera already mentioned, represent most likely an assemblage from the deeper part of the inner shelf (50-150 m).

Calcareous Nannoplankton

Stratigraphy: Due to heavy overgrowth, several marker species could not be recognized, and many could only be identified tentatively and/or small numbers. Nevertheless, members of the families *Coccolithaceae, Sphenolithaceae, Ceratolithaceae,* and some others allowed biostratigraphic interpretation of most of the samples. All nannofossil assemblages from the volcanic ash sequence (Cores 18 to 57) are considered to be of late middle Eocene age (NP 16 = *Discoaster tani nodifer* Zone of Martini [1971]), or *Discoaster saipanensis* Subzone of Bukry (1973). Using the time correlations of Perch-Nielsen (1972) and Bukry (1973), the 400-meter-thick volcanic ash sequence was deposited about 43 m.y. ago over a period of perhaps as little as 2 m.y. Late Eocene assemblages are found up to Core 13. Cores 12 to 10 contain a rather complete Oligocene sequence. Cores 9 and 8 are of lower Miocene age. Core 8 belongs to the basal middle Miocene. It was not possible to correlate the nannofossils of Cores 7 and 6 (basal part), because the short-ranging middle Miocene marker species could not be identified. Cores 6 through 1 contain a continuous sequence of upper Miocene through Quaternary assemblages. Scarce reworked upper Eocene species have been found in Core 9.

Preservation: All pre-Quaternary nannofossil assemblages show strong overgrowth, which often made their recognition difficult. In the volcanic ash sequence the overgrowth apparently was preceded by partial dissolution. *Isthmolithus recurvus, Triquetrorhabdulus inversus, T. rugosus,* and most recognized discoasters were considerably altered. Other stratigraphically important species, such as *Helicopontosphaera recta, H. reticulata, Sphenolithus belemnos, Discoaster bollii, D. calcaris, D. challengeri, D. exilis, D. formosus, D. kugleri, D. neohamatus, D. pseudovariabilis, D. trinidadensis, Catinaster calyculus, C. coalitus,* and *Triquetrorhabdulus carinatus* could not be identified at all.

Paleoecology: The relative scarcity of discoasters in the middle Eocene ash sequence, the presence of *Zygolithus dubius, Micrantholithus* sp., *Braarudosphaera bigelowi, B. discula, B. rotundum,* and *Zygrhablithus bijugatus* indicate a nearshore or shallow-water environment. An increase in abundance of *Discoaster saipanensis,* and the disappearance of the genera *Braarudosphaera, Micrantholithus,* and *Pemma* indicate a continuous deepening of the site through the upper Eocene and the Oligocene. The Paleogene assemblages suggest transitional to subtropical paleoconditions (*Discoaster saipanensis, D. barbadiensis, Isthmolithus recurvus, Zygolithus dubius*), while those of the Miocene and Pliocene are subtropical to tropical (discoasters, sphenoliths, scyphospheres).

SEDIMENTATION RATES

The mid Eocene to Recent foram nanno ooze sequence at Site 253 is characterized by generally low sedimentation rates. Calculated values, disregarding the effects of compaction are given: Quaternary, 5.0 m/m.y.; Pliocene, 5.3 m/m.y.; upper Miocene, 6.4 m/m.y.; middle Miocene, 3.8 m/m.y.; lower Miocene, 1.4 m/m.y.; Oligocene, 2.1 m/m.y.; upper Eocene, 4.9 m/m.y. High values occur in the upper Eocene and sediment accumulation rate in the Oligocene and lower Miocene.

A drastic change of the sedimentation rate accompanies the appearance of the thick volcanic sequence. A minimum value of 65 m/m.y. must be assumed; it could be considerably higher, however, probably well in excess of 100 m/m.y., since the time interval of deposition is not exactly known and may be shorter than the maximum given by the limited fossil record, on which these figures are based.

SUMMARY AND CONCLUSIONS

Summary of Results

Site 253 is located in 1962 meters of water on the western flank of the Ninetyeast Ridge. Seismic reflection data at the site show an upper transparent section about 0.165 sec DT thick above a very strong intermediate reflector which is conformable with the sediment surface. Below the intermediate reflector lies a weak and diffuse return with a rough aspect and high relief from 0.3 sec to over 0.6 sec DT. One hole was drilled at Site 253 through 558 meters of calcareous ooze and volcanic sediment and 1 meter of basalt. Here, 536.5 meters were cored and 270.1 meters recovered including 0.3 meter of basalt.

The section at Site 253 is divided into three sedimentary units and a basalt unit. The three sediment units include two calcareous units and one of volcanic ash and lapilli. Unit 1 is 9 meters upper Pliocene to Recent very pale orange foram-rich detrital clay and foraminiferal detrital clay. The bottom of the unit grades to clayey nannoplankton ooze. Unit 2 is 144 meters of upper Eocene through upper Pliocene nannoplankton ooze grading downward into chalk and becoming micarb chalk at the base. Discoasters and coccoliths form the nannoplankton component with discoasters diminishing to trace amounts below 87 meters. Mottling intensity increases downward to the bottom of the unit. The color of this unit varies from very pale brown to very pale orange. The micarb chalk at its base is about 2 meters thick and has around 8% hematite and limonite. Unit 3 is 388 meters of middle Eocene altered vitric volcanic ash and lapilli. This unit consists of three different lithic types. The first type is dark olive-green, greenish-gray micarb-bearing, altered vitric volcanic ash. The second type is black altered vitric volcanic ash and minor lapilli; some mollusc fragments are also present. The third type is black vesicular basalt and scoria with carbonate fillings. These three lithic types alternate down the section to Unit 6, thereby dividing the unit into five subunits. Shell fragments and burrows are most abundant in Subunits 3c and 3d (262.6-443.5 m), the shells reaching concentrations of 25% at the base of Subunit 3d. Crinoid fragments were found from the top of Subunit d3 (318 m) downwards. Burrows are also abundant at the base of Subunit 3e (base Unit 3).

Salinity in this hole increases markedly with depth, and more so in the volcanic sequence, from about 35.5‰ at near the sea floor to 42.1‰ at 519.5 meters, the greatest depth sampled. These trends may be related to the lithology. Alkalinity shows a similar lithologic relationship; it decreases linearly from 2.38 meq/kg near the surface to 0.391 meq/kg near the chalk-ash contact. Below this alkalinity decreases slightly to 0.186 meq/kg.

Three downhole temperature measurements were made at the site. These results are considered very reliable and gave a heat flow of between 1.23 and 1.38 heat-flow units. This measurement agrees with others in the vicinity made with conventional short probes and a downhole measurement made on Leg 22 at Site 214 just north of Site 253.

The ooze and chalk section at Site 253 is comprised mostly of nannofossils; the ash sequence contains scarce nannofossils, few benthonic and very rare planktonic foraminifera, and other invertebrate macrofossils. Sedimentation of the ashes ceased about 42 m.y.B.P. and the 400-meter-thick ash sequence appears to have been deposited in less than 4 m.y. The oldest sediment paleontologically dated is 46 ±3 m.y. old, 5 meters above the basalt. Faunal data indicate that the environment of deposition was outer shelf in the middle Eocene ash sequence and steadily increased in depth to the present day. Nannofossils and foraminifera indicate a transitional to subtropical environment with tropical foraminifera less abundant in the Eocene section. The invertebrate macrofossils and the larger foraminifera of the volcanic unit are important to the environmental interpretation of this unit. These fossils include pelecypods, bryozoans, crinoids, echinoids, solitary corals, and Discocyclinas. This assemblage might represent the deeper part of the inner shelf (50-120 m).

Preliminary Conclusions

The most striking observation to make from the results of Site 253 is that near this site the Ninetyeast Ridge has been as shallow or shallower than it is now for its entire history. The age of this site is probably not much older than 46 m.y. Granted, the true basement may be some 100 meters below the basalt sampled in this hole, but the high sedimentation rate for the ash sequence implies that this distance may only represent about an extra million years. The shallow-water fauna in the ash sequence indicate that this area of the Ninetyeast Ridge was very close to sea level during its formation. Before much subsidence occurred, over 400 meters of ash had accumulated. The variable concentrations of macrofossils and burrows in the ash unit indicate that the sedimentation rate, although high, was variable. It cannot be determined from the observations whether the ash sequence originated from a subaerial or submarine source. In any event, the source was very close to the site because the generally well-preserved fauna indicate little horizontal transport. It is also curious that such a huge thickness of ash has so few lava flows within it. Composite volcanoes of basaltic (low silica) composition usually have a much higher ratio of flows to ash. Tropical forms are relatively diminished in the Eocene fauna of the ash sequence, possibly indicating that it was deposited in cooler water than the overlying oozes.

The ash stopped accumulating in the late Eocene, and the site subsided slightly while calcareous oozes began accumulating. The lack of discoasters in the lower ooze section indicates that the nearshore depositional environment persisted until the late Oligocene to early Miocene. After this time a more normal pelagic sequence accumulated. The Quaternary shows a significant increase in detrital clays possibly related to the onset of Pleistocene glaciation. The site is probably farther north now than it was in the Eocene.

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APPENDIX A
Grain-Size Determinations for Site 253

Core, Section Top of Interval (cm)	Subbottom Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
1-1, 90	0.9	30.1	22.0	47.9	Sand-silt-clay
1-3, 105	4.0	29.4	26.1	44.5	Sand-silt-clay
1-5, 105	7.1	28.4	28.3	43.3	Sand-silt-clay
2-1, 90	9.9	11.1	30.9	58.0	Silty clay
2-3, 90	12.9	6.9	38.8	54.3	Silty clay
2-6, 70	17.2	2.7	42.0	55.3	Silty clay
3-2, 90	20.9	2.6	46.6	50.8	Silty clay
3-5, 90	25.4	3.7	46.6	49.7	Silty clay
4-2, 90	30.4	2.2	51.5	46.2	Clayey silt
4-5, 90	34.9	2.1	43.2	54.7	Silty clay
5-2, 90	39.9	3.3	56.4	40.3	Clayey silt
5-5, 90	44.4	2.9	57.9	39.2	Clayey silt
6-2, 90	49.4	2.5	63.9	33.6	Clayey silt
6-5, 90	53.9	2.7	61.8	35.5	Clayey silt
7-2, 90	58.9	1.1	63.5	35.4	Clayey silt
7-5, 90	63.4	2.1	66.8	31.1	Clayey silt
8-2, 90	68.4	1.5	59.0	39.6	Clayey silt
8-5, 90	72.9	1.7	58.9	39.4	Clayey silt
9-2, 90	77.9	1.4	67.7	30.8	Clayey silt

APPENDIX A – *Continued*

Core, Section Top of Interval (cm)	Subbottom Depth (m)	Sand (%)	Silt (%)	Clay (%)	Classification
9-4, 90	80.9	2.3	66.5	31.2	Clayey silt
10-2, 90	87.4	2.2	67.2	30.6	Clayey silt
10-5, 90	91.9	2.2	68.4	29.4	Clayey silt
11-2, 90	96.9	.8	64.3	35.0	Clayey silt
11-5, 89	101.4	1.3	56.7	42.0	Clayey silt
12-2, 90	105.4	4.2	58.8	37.0	Clayey silt
12-5, 90	110.9	2.6	58.2	39.3	Clayey silt
13-2, 90	115.9	.3	64.9	34.8	Clayey silt
13-5, 90	120.4	1.5	65.7	32.8	Clayey silt
14-2, 90	125.4	.6	62.4	36.9	Clayey silt
14-5, 90	129.9	2.8	63.9	33.2	Clayey silt
16-6, 106	150.6	4.7	69.1	26.2	Clayey silt
17-2, 110	154.1	44.2	22.5	33.2	Sand-silt-clay
18-2, 90	163.4	57.3	21.7	21.0	Sand-silt-clay
18-4, 8	165.6	50.8	30.4	18.8	Silty sand
19-2, 88	172.9	27.2	47.2	25.6	Sand-silt-clay
20-2, 88	182.4	45.1	29.2	25.7	Sand-silt-clay
20-4, 90	185.4	56.2	24.9	18.9	Silty sand
21-2, 90	191.9	14.2	37.7	48.2	Silty sand
21-4, 88	191.9	23.1	28.7	48.2	Sand-silt-clay
23-2, 92	210.9	25.0	38.5	36.5	Sand-silt-clay
25-2, 90	229.9	22.8	24.8	52.4	Sand-silt-clay
26-2, 5	233.6	12.6	30.3	57.1	Silty clay
30-1, 95	270.5	73.3	14.4	12.3	Silty sand
36-1, 95	327.5	3.8	27.2	69.0	Silty clay
36-3, 30	329.8	51.7	25.6	22.7	Sand-silt-clay
38-1, 94	346.4	14.0	36.8	49.3	Silty clay
40-2, 43	366.4	23.0	28.9	48.0	Sand-silt-clay
43-2, 10	394.6	18.9	28.4	52.7	Silty clay
44-2, 10	404.1	36.0	26.4	37.6	Sand-silt-clay
45-5, 103	419.0	35.6	22.3	42.1	Sand-silt-clay
47-2, 84	433.3	23.4	32.1	44.4	Sand-silt-clay
49-2, 56	452.1	19.0	42.9	38.1	Clayey silt
51-2, 39	470.9	2.8	36.3	60.9	Silty clay
52-2, 133	481.3	5.2	38.7	56.1	Silty clay
52-4, 46	483.5	35.2	34.6	30.1	Sand-silt-clay
53-2, 116	490.7	36.2	27.8	36.0	Sand-silt-clay
53-5, 104	495.0	30.1	26.5	43.4	Sand-silt-clay
54-2, 119	500.2	39.8	28.9	31.3	Sand-silt-clay
55-2, 132	509.8	24.0	32.7	43.3	Sand-silt-clay
57-2, 66	547.2	15.1	26.8	58.2	Silty clay

APPENDIX B
Carbon-Carbonate Determinations for Site 253

Core, Section Top of Interval (cm)	Subbottom Depth (m)	Total Carbon (%)	Organic Carbon (%)	$CaCO_3$ (%)
1-1, 88.0	.88	11.4	0.1	95
1-3, 104.0	4.04	11.7	0.1	97
1-5, 104.0	7.04	11.8	0.0	98
2-1, 88.0	9.88	11.6	0.0	96
2-3, 88.0	12.88	11.7	0.0	97
2-6, 88.0	17.38	11.7	0.0	97
3-2, 88.0	20.88	11.5	0.0	96
3-5, 88.0	25.38	11.9	0.0	99
4-2, 88.0	30.38	11.7	0.0	97

APPENDIX B – *Continued*

Core, Section Top of Interval (cm)	Subbottom Depth (m)	Total Carbon (%)	Organic Carbon (%)	$CaCO_3$ (%)
4-5, 88.0	34.88	11.7	0.0	97
5-2, 88.0	39.88	11.8	0.0	98
5-5, 88.0	44.38	11.7	0.0	97
6-2, 88.0	49.38	11.7	0.1	97
6-5, 88.0	53.88	10.8	0.0	89
7-2, 88.0	58.88	11.6	0.1	96
7-5, 88.0	63.38	11.7	0.0	97
8-2, 88.0	68.38	11.7	0.1	97
8-5, 88.0	72.88	11.5	0.1	96
9-2, 88.0	77.88	11.6	0.1	96
9-4, 88.0	80.88	11.5	0.1	95
10-2, 88.0	87.38	11.5	0.0	96
10-5, 88.0	91.88	11.5	0.1	96
11-2, 88.0	96.88	11.6	0.1	96
11-5, 88.0	101.38	11.5	0.1	95
12-2, 89.0	106.39	11.4	0.1	95
12-5, 89.8	110.89	8.1	0.1	67
13-2, 88.0	115.88	11.5	0.0	95
13-5, 88.0	120.38	11.5	0.1	96
14-2, 88.0	125.38	11.5	0.0	95
14-5, 88.0	129.88	11.5	0.0	96
16-6, 105.0	150.55	11.3	0.0	94
17-2, 109.0	154.09	0.4	0.1	3
18-2, 89.0	163.39	4.5	0.1	37
18-4, 9.0	165.59	1.1	0.1	8
19-2, 89.0	172.89	2.0	0.2	15
20-2, 87.0	182.37	6.3	0.2	51
20-4, 89.0	185.39	6.4	0.2	52
21-2, 88.0	191.88	3.6	0.5	25
21-4, 88.0	194.88	2.4	0.1	19

APPENDIX B – *Continued*

Core, Section Top of Interval (cm)	Subbottom Depth (m)	Total Carbon (%)	Organic Carbon (%)	$CaCO_3$ (%)
23-2, 90.0	210.90	1.9	0.1	15
25-2, 96.0	229.96	1.0	0.1	7
26-2, 52.0	239.02	1.9	0.2	15
30-1, 105.0	270.55	6.2	0.1	51
31-2, 121.0	281.71	1.1	0.1	8
36-1, 88.0	327.38	0.2	0.1	1
36-3, 33.0	329.83	2.1	0.2	16
38-1, 101.0	346.51	1.6	0.1	12
40-2, 22.0	366.22	2.1	0.1	17
41-1, 70.0	374.70	0.5	0.1	3
42-2, 134.0	386.34	0.3	0.1	2
43-2, 4.0	394.54	1.8	0.1	14
44-2, 11.0	404.11	1.9	0.1	15
45-2, 84.0	414.34	2.2	0.1	17
45-5, 104.0	419.04	5.1	0.2	41
46-2, 104.0	424.04	2.1	0.2	16
46-5, 1.0	427.51	1.3	0.2	9
47-2, 87.0	433.37	0.9	0.2	6
48-2, 60.0	442.60	1.8	0.2	14
49-2, 59.0	452.09	0.2	0.1	0
51-2, 43.0	470.93	1.2	0.2	9
51-2, 132.0	481.32	0.4	0.1	3
52-4, 45.0	483.45	0.8	0.1	6
53-2, 115.0	490.65	0.5	0.1	3
53-5, 106.0	495.06	0.7	0.1	4
54-2, 118.0	500.18	0.5	0.2	3
54-5, 65.0	504.15	0.7	0.1	5
55-2, 129.0	509.79	5.1	0.2	41
56-2, 114.0	519.14	0.7	0.2	4
57-2, 65.0	547.15	1.1	0.1	8

APPENDIX C
Bulk X-Ray Analyses for Hole 253

Core	Cored Interval Below Sea Floor (m)	Sample Depth Below Sea Floor (m)	Diff.	Amor.	Calc.	U-10[a]	U-11[b]	Quar.	Cris.[c]	K-Fe.	Plag.	Kaol.	Mica	Chlo.	Mont.[d]	Paly.	Clin.	Phil.	Anal.	Pyri.	Gyps.	Bari.	Hali.	Augi.	Magn.	Anat.	Goet.[e]	U-1[f]	U-3[g]
Bulk Sample																													
1	0.0-9.0	2.6	51.7	24.6	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
5	37.5-47.0	45.7	46.9	17.1	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7	56.5-66.0	58.9	45.6	15.0	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9	75.5-85.0	80.9	48.0	18.8	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
11	94.5-104.0	96.9	51.2	23.7	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13	113.5-123.0	115.9	86.0	78.2	100.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
16	142.0-151.5	150.9	56.1	31.3	99.3	–	–	–	–	–	–	–	–	–	–	–	0.7	–	–	–	–	–	–	–	–	–	–	–	–
17	151.5-161.0	154.1	90.1	84.6	–	P	–	5.4	–	–	27.1	–	–	–	56.7	–	–	–	–	–	–	–	–	–	10.9	–	–	–	–
18	161.0-170.5	163.4	80.0	68.9	73.1	P	–	0.5	–	–	4.0	–	–	–	22.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–
		165.6	89.1	83.0	37.2	P	–	–	–	–	8.6	–	–	–	33.7	–	–	–	–	1.3	–	–	–	19.2	–	–	–	–	–
20	180.0-189.5	182.5	70.2	53.5	85.8	T	–	–	–	–	2.5	–	–	–	11.7	–	–	–	–	–	–	–	–	–	–	–	–	–	–
23	208.5-218.0	210.9	68.2	50.4	59.9	T	–	0.6	–	–	5.3	–	–	–	20.4	–	0.8	13.1	–	–	–	–	–	–	–	–	–	–	–
25	227.5-237.0	229.9	75.5	61.8	41.3	P	–	0.5	–	–	–	–	–	–	48.4	–	–	9.8	–	–	–	–	–	–	–	–	–	–	–
30	269.5-279.0	270.6	68.9	51.5	80.7	P	–	0.5	–	–	4.3	–	2.3	–	3.6	–	7.5	–	–	–	–	–	–	–	1.1	–	–	–	–
31	279.0-288.5	281.6	74.3	59.9	37.8	P	–	1.4	–	–	11.5	–	–	–	30.8	–	18.5	–	–	–	–	–	–	–	–	–	–	–	–
36	326.5-336.0	327.8	78.7	66.8	–	P	T	–	–	–	4.7	–	–	–	67.7	–	23.4	–	1.0	–	–	–	–	–	3.1	–	T	T	–
38	345.5-355.0	346.5	65.6	46.3	33.3	P	–	–	–	–	–	–	–	–	50.7	–	9.2	–	–	–	–	–	–	–	5.6	1.2	–	P	–
40	364.5-374.0	366.5	66.6	47.9	22.9	P	P	–	–	–	5.7	–	–	–	61.8	–	1.1	–	6.2	–	–	–	–	–	1.7	0.6	–	–	–
42	383.5-393.0	386.4	73.3	58.2	2.7	P	P	–	–	–	3.9	–	–	–	78.7	–	12.7	–	–	–	–	–	–	–	–	2.0	–	–	–
44	402.5-412.0	404.1	74.3	59.8	27.7	P	T	–	–	–	–	–	–	–	71.7	–	–	–	–	–	–	–	–	–	–	0.6	–	–	–
46	421.5-431.0	424.0	73.8	59.1	36.2	P	P	–	–	–	–	–	–	–	49.2	–	6.6	–	5.6	–	–	–	–	–	–	2.5	–	–	–
48	440.5-450.0	442.6	68.9	51.4	13.2	P	T	–	–	–	–	–	–	–	71.6	–	–	–	14.6	–	–	–	–	–	–	0.6	–	–	–
49	450.0-459.5	452.1	73.7	59.0	–	P	T	–	–	–	–	–	–	–	84.1	–	3.4	–	12.1	–	–	–	–	–	–	0.5	–	–	–
51	469.0-478.5	470.9	72.0	56.2	22.1	P	P	–	–	–	–	–	–	–	64.0	–	7.8	–	4.1	–	–	–	–	–	–	1.9	–	–	–
52	478.5-488.0	481.3	66.3	47.4	9.5	P	P	2.0	–	–	2.7	–	–	–	65.6	–	–	–	19.2	–	–	–	–	–	–	0.9	–	–	–
54	497.5-507.0	500.2	66.8	48.1	7.6	T	T	–	–	–	–	–	–	–	70.2	–	–	–	21.8	–	–	–	–	–	–	0.4	–	–	T
56	516.5-526.0	519.2	73.7	58.9	7.2	P	P	2.0	–	–	–	8.0	–	–	74.1	–	7.1	–	–	–	–	–	–	–	–	1.5	–	–	–
57	545.0-554.5	547.2	70.7	54.3	7.1	P	T	–	18.5	–	2.1	–	–	–	69.5	–	–	–	1.8	–	–	–	–	–	–	0.9	–	–	–
2-20µ Fraction																													
1	0.0-9.0	2.6	60.4	38.1	–	–	–	28.0	–	7.4	11.6	–	18.5	2.9	–	–	–	–	–	–	24.4	7.1	–	–	–	–	–	–	–
9	75.5-85.0	80.9	78.3	66.2	–	–	–	26.5	–	39.5	15.8	–	16.8	1.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13	113.5-123.0	115.9	74.4	60.0	–	–	–	23.7	–	26.5	14.0	–	20.5	3.2	–	9.8	2.5	–	–	–	–	–	–	–	–	–	–	–	–
16	142.0-151.5	150.9	87.0	79.6	–	P	–	7.9	–	–	11.8	–	7.5	2.3	15.0	–	35.2	–	–	–	20.3	–	–	–	–	–	–	–	–
17	151.5-161.0	154.1	85.9	77.9	–	A	–	–	–	–	10.7	–	–	2.0	70.0	–	–	–	–	–	–	–	–	–	17.2	–	–	–	–
18	161.0-170.5	163.4	84.6	76.0	–	P	–	1.3	–	–	7.7	–	–	–	85.2	–	–	–	–	5.7	–	–	–	–	–	–	–	–	–
		165.6	89.0	82.8	–	P	–	–	–	–	5.7	–	–	–	68.0	–	–	–	–	5.8	–	–	–	20.5	–	–	–	–	–
20	180.0-189.5	182.5	80.7	69.9	–	P	–	–	–	–	3.4	–	–	–	84.2	–	2.0	–	–	10.5	–	–	–	–	–	–	–	–	–
23	208.5-218.0	210.9	78.4	66.2	–	A	–	0.6	–	–	–	–	–	–	60.2	–	1.4	37.7	–	–	–	–	–	–	–	–	–	–	–
25	227.5-237.0	229.9	78.0	65.6	–	A	–	2.4	–	–	–	–	–	–	70.0	–	2.8	22.4	–	2.4	–	–	–	–	–	–	–	–	–
30	269.5-279.0	270.6	74.5	60.1	–	A	–	1.0	–	–	15.4	–	4.3	6.9	13.0	–	53.9	–	–	–	–	–	–	–	5.5	–	–	–	–
31	279.0-288.5	281.6	71.8	56.0	–	P	–	1.9	–	–	18.6	–	–	–	63.2	–	15.3	–	–	0.9	–	–	–	–	–	–	–	–	–
36	326.5-336.0	327.8	72.7	57.3	–	T	T	–	–	–	5.5	–	–	–	41.8	–	47.1	–	1.0	2.4	–	–	–	–	2.3	–	T	P	–
38	345.5-355.0	346.5	65.0	45.3	–	A	T	–	–	–	6.3	–	2.9	–	61.1	–	17.7	–	–	–	–	–	–	–	9.7	2.3	–	P	–
40	364.5-374.0	366.5	57.9	34.2	–	P	P	–	–	–	–	–	–	–	74.7	–	5.6	–	19.2	–	–	–	–	–	–	0.5	–	–	–
42	383.5-393.0	386.4	68.2	50.3	–	P	A	–	–	–	–	–	–	–	81.0	–	15.9	–	–	–	–	–	–	–	–	3.1	–	–	–
44	402.5-412.0	404.1	67.4	49.1	–	P	P	–	–	–	–	–	–	–	96.5	–	2.9	–	–	–	–	–	–	–	–	0.5	–	–	–
46	421.5-431.0	424.0	66.1	47.0	–	P	P	–	–	–	–	–	–	–	51.8	–	28.0	–	13.0	–	–	–	–	–	–	7.2	–	–	–
48	440.5-450.0	442.6	62.2	41.0	–	P	P	–	–	–	–	–	–	–	56.7	–	4.6	–	36.2	–	–	–	–	–	–	2.5	–	–	–
49	450.0-459.5	452.1	68.3	50.5	–	P	P	–	–	–	13.1	–	–	–	54.9	–	6.4	–	24.6	–	–	–	–	–	–	0.9	–	–	–

APPENDIX C – *Continued*

Core	Cored Interval Below Sea Floor (m)	Sample Depth Below Sea Floor (m)	Diff.	Amor.	Calc.	U-10[a]	U-11[b]	Quar.	Cris.[c]	K-Fe.	Plag.	Kaol.	Mica	Chlo.	Mont.[d]	Paly.	Clin.	Phil.	Anal.	Pyri.	Gyps.	Bari.	Hali.	Augi.	Magn.	Anat.	Goet.[e]	U-1[f]	U-3[g]
51	469.0-478.5	470.9	67.2	48.7	–	P	P	–	–	–	–	–	–	–	60.3	–	16.9	–	20.2	–	–	–	–	–	–	2.7	–	–	–
52	478.5-488.0	481.3	58.1	34.5	–	P	P	–	–	–	–	–	–	–	44.2	–	–	–	54.1	–	–	–	–	–	–	1.7	–	–	–
54	497.5-507.0	500.2	70.3	53.6	–	P	T	1.1	–	–	–	–	–	–	85.7	–	–	–	12.5	–	–	–	–	–	–	0.8	–	–	T
56	516.5-526.0	519.2	74.6	60.3	–	P	P	11.9	–	–	–	1.2	–	–	59.8	–	15.2	–	–	4.4	–	–	–	–	–	7.5	–	T	–
57	545.0-554.5	547.2	71.2	55.0	–	P	T	–	43.9	–	1.0	–	–	–	50.3	–	–	–	3.8	–	–	–	–	–	–	1.0	–	–	–
$<2\mu$ **Fraction**																													
1	0.0-9.0	2.6	97.9	96.7	–	–	–	19.6	–	–	17.9	11.0	20.3	–	19.2	–	–	–	–	–	2.5	9.3	–	–	–	–	–	–	–
7	56.5-66.0	58.9	97.2	95.6	–	–	–	20.7	–	–	10.4	12.8	41.4	–	14.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9	75.5-85.0	80.9	88.6	82.1	–	–	–	10.5	–	16.8	–	7.3	14.7	–	19.8	30.9	–	–	–	–	–	–	–	–	–	–	–	–	–
13	113.5-123.0	115.9	92.7	88.6	–	–	–	7.1	–	4.9	–	–	6.9	2.6	35.2	41.5	1.8	–	–	–	–	–	–	–	–	–	–	–	–
16	142.0-151.5	150.9	96.0	93.8	–	–	–	3.5	–	–	–	–	–	–	96.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–
17	151.5-161.0	154.1	88.6	82.2	–	–	–	–	–	–	–	–	–	–	90.7	–	–	–	–	–	–	–	6.4	–	2.9	–	–	–	–
18	161.0-170.5	163.4	91.5	86.7	–	–	–	–	–	–	–	–	–	–	91.8	–	–	–	–	–	1.4	–	6.9	–	–	–	–	–	–
		165.6	91.3	86.3	–	–	–	–	–	–	–	–	–	–	76.7	–	–	–	–	–	1.8	–	3.6	17.8	–	–	–	–	–
20	180.0-189.5	182.5	89.2	83.1	–	–	–	–	–	–	5.3	–	–	–	82.4	–	–	–	–	4.4	–	..	7.9	–	–	–	–	–	–
23	208.5-218.0	210.9	85.9	77.9	–	–	–	–	–	–	–	–	–	–	81.3	–	–	9.1	–	–	–	–	9.6	–	–	–	–	–	–
25	227.5-237.0	229.9	84.5	75.8	–	T	–	–	–	–	–	–	–	–	90.5	–	–	–	–	–	–	–	9.5	–	–	–	–	–	–
30	269.5-279.0	270.6	87.3	80.1	–	T	–	2.0	–	–	5.7	–	10.3	–	70.0	–	1.7	–	–	–	–	–	4.9	–	5.3	–	P	–	–
31	279.0-288.5	281.6	84.6	76.0	–	T	–	–	–	–	4.1	–	–	–	84.6	–	2.0	–	–	–	–	–	9.3	–	–	–	–	–	–
36	326.5-336.0	327.8	83.3	73.8	–	–	–	–	–	–	–	–	–	–	85.7	–	3.4	–	–	–	–	–	10.9	–	–	–	–	–	–
38	345.5-355.0	346.5	75.0	61.0	–	P	–	–	–	–	1.9	–	–	–	89.0	–	1.8	–	–	–	–	–	3.6	–	2.7	1.0	–	T	–
40	364.5-374.0	366.5	73.8	59.1	–	T	T	–	–	–	–	–	4.0	–	90.9	–	0.7	–	2.0	–	–	–	2.3	–	–	–	–	–	–
42	383.5-393.0	386.4	71.4	55.3	–	T	T	–	–	–	1.6	–	–	–	92.8	–	1.6	–	–	–	–	–	2.9	–	–	1.1	–	T	P
44	402.5-412.0	404.1	78.4	66.3	–	T	T	–	–	–	–	–	–	–	93.4	–	–	–	–	–	–	–	6.1	–	–	0.6	–	–	–
46	421.5-431.0	424.0	77.6	64.9	–	T	P	–	–	–	–	–	–	–	90.4	–	2.0	–	0.7	–	–	–	5.5	–	–	1.3	–	–	–
48	440.5-450.0	442.6	75.1	61.1	–	T	–	–	–	–	1.4	–	–	–	92.7	–	0.5	–	5.4	–	–	–	–	–	–	–	–	–	T
49	450.0-459.5	452.1	78.3	66.1	–	–	–	–	–	–	–	–	–	–	88.3	–	–	–	7.3	–	–	–	3.9	–	–	0.5	–	–	T
51	469.0-478.5	470.9	75.2	61.2	–	–	T	–	–	–	–	–	–	–	84.7	–	5.7	–	1.6	–	–	–	7.0	–	–	1.0	–	–	P
52	478.5-488.0	481.3	74.6	60.4	–	T	T	–	–	–	–	–	–	–	89.2	–	–	–	7.0	–	–	–	3.0	–	–	0.8	–	–	T
54	497.5-507.0	500.2	77.2	64.4	–	–	–	–	–	–	–	–	–	–	94.2	–	–	–	1.3	–	–	–	3.8	–	–	0.7	–	–	P
56	516.5-526.0	519.2	77.1	64.2	–	–	–	–	–	–	–	4.1	–	–	91.3	–	1.7	–	–	–	–	–	1.7	–	–	1.2	–	–	–
57	545.0-554.5	547.2	77.0	64.0	–	–	–	–	13.8	–	–	–	–	–	80.8	–	–	–	1.1	–	–	–	2.1	–	–	2.1	–	–	P

[a]Peaks at 3.23A and 2.145A among others. This mineral's peaks closely match those of anorthoclase (JCPDS 9-478). P = present; T = tracc; A = abundant.

[b]Peaks at 3.30A, 3.76A, and 2.982A among others. This mineral's peaks closely match those of adularia (JCPDS 19-931). P = present; T = trace.

[c]Narrow peaks at 4.05A, 2.492A, and 2.843A among others.

[d]An unusual montmorillonite occurs with or in place of normal montmorillonite in many samples at and below 163.4M. It has narrow peaks at 13.3A, 1.540A, and 4.61A and a broad peak at 2.55-2.64A.

[e]P = present; T = trace.

[f]Peaks at 3.38A, 4.50A, and 3.46A among others; probably mordenite (JCPDS 6-239). P = present; T = trace.

[g]Peaks at 2.970A, 3.70A, and 7.28A. P = present; T = trace.

Site 253 Hole Core 1 Cored Interval: 0.0-9.0 m

AGE	FORAMS ZONE	NANNOS ZONE	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
QUATERNARY	N22-N23		AG	0			1	0.5			* HO CC GZ
			AG	0				1.0			
			AG	0							
			AG	0							
			AG	0			2				*
			AG	0							*
			AG	0	AG						* XM
											*
			AG	0			3				CC *GZ
		NN19	AG	0			4				*
					AG						*
UPPER PLIOCENE	N21		AG	0			5				* CC GZ
			AG	0			6				*
		NN17	AG	0	AGO	—	Core Catcher				* KE

Section annotations:

10YR 8/2

10YR 7/3
slight 7.5YR 8/2 mottling
-do-

10YR 8/3

stretched 7.5YR 8/2 mottle w/ 7.5YR 6/1 halo

10YR 8/3 moderate mottling, 7.5YR 8/2 w/ 7.5YR 6/1

halo mottle

mottle

3 mottles

mottle

3 mottles

mottle

mottles

10YR 8/2

LITHOLOGIC DESCRIPTION

Very pale orange NANNOPLANKTON FORAMINIFERAL OOZE.

Entire core is slightly mottled, the mottles are 1 to 3 cm in diameter, orange white with light gray haloes, these colors probably owing to fewer foraminifera within the mottles and slightly more (trace amounts) of amorphous microscopic ferruginous aggregates in the haloes.

TEXTURE: Sand 28-30% | forams and
Silt 22-28% |
Clay 43-48% - nannofossils

MINOR CONSTITUENTS:

Common trace amounts of microscopic ferruginous amorphous aggregates.
Common trace amounts of authigenic calcite (recrystallized foram fragments).
Rare traces of fish debris.

Total Carbon: 11.4-11.8%
Organic Carbon: 0.0-0.1%
Calcium Carbonate: 95-98%

CONSOLIDATION: Very soft.

Explanatory notes in chapter 2

Site 253 Hole Core 2 Cored Interval: 9.0-18.5 m

AGE	FORAMS ZONE	NANNOS ZONE	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
MIDDLE PLIOCENE	N20	NN16	AM	0	AGO		1	0.5			CC GZ *
			AM	0				1.0			
			AM	0							
			AM	0			2				*
					AMO						
		NN15	AM	0	AGO		3				* CC GZ *
LOWER PLIOCENE	N19		AM	0	AMO		4				*
		NN14	AM	0			5		VOID		*
					AMO						
			AM	0			6				KE CC GZ *
		NN13	AM	0	AMO	—	Core Catcher				

Section annotations:

THROUGHOUT: 10YR 8/2

1.5 cm mottle

[all mottles 10YR 8/1 w/ 7.5YR 6/1 haloes]

2 mottles 0.5-1 cm

2-3 cm mottles

mottles

moderate mottling

10YR 8/2

10YR 8/2

LITHOLOGIC DESCRIPTION

Core is very pale orange. Top 2.38 m grades from CLAYEY NANNOPLANKTON OOZE through CLAY-RICH NANNOPLANKTON OOZE into NANNOPLANKTON OOZE. In general, the core is very slightly to slightly mottled, but locally mottling is moderate. The mottles are orange white with light gray haloes; interiors have fewer forams and the haloes probably have slightly more amorphous ferruginous aggregates (still traces). Forams and foram fragments comprise 3-5% of the sediment. Discoasters are present throughout, increasing in abundance downward, from 25% in Section 1 to 50% in Section 2.

TEXTURE: Sand 3-11% (Forams)
Silt 31-42% (Foram fragments)
Clay 54-58% (Nannos)

MINOR CONSTITUENTS:

The top 2.8 m of the core grades down in clay content from 56 to 16%. Rest of core has very minor trace quantities of detrital clay disseminated throughout.
Rare traces of microscopic ferruginous amorphous opaque or translucent aggregates.
Rare traces of authigenic carbonate (probably recrystallized foram fragments)

Total Carbon: 11.6-11.7%
Organic Carbon: 0%
Calcium Carbonate: 96-97%

CONSOLIDATION: Soft.

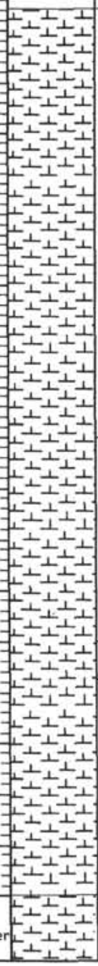
Explanatory notes in chapter 2

Site 253 Hole Core 3 Cored Interval: 18.5-28.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS
UPPER MIOCENE	N16-N18	NN12	AG	1			1	0.5, 1.0
			AG	1	AMO		2	
			AM/G	1			3	
			AM/G	1			4	
		NN11	AM/G	1	AMO		5	
			AM/G	1			6	
			AM/G	1	AMO	—	Core Catcher	

LITHOLOGY

VOID



DEFORMATION

LITHO. SAMPLE: CC GZ (Section 2); CC GZ (Section 5)

LITHOLOGIC DESCRIPTION

PREDOMINANT COLORS 10YR 8/2 & 10YR 8/3
Patch of 2.5Y 8/1

Very minor streaked mottles throughout:

2.5Y 8-5/1,
10YR 8/1,
7.5YR 8/1

10YR 8/2

Entire core is very pale orange FORAMINIFERAL NANNOPLANKTON OOZE with 1 to 3% sand-sized forams. Slightly (locally moderately) mottled white and light gray throughout, but most of the mottles are stretched by drilling deformation. Discoasters and coccoliths appear to be about equally abundant.

TEXTURE: Sand 3- 4%
Silt 47%
Clay 50-51%

MINOR CONSTITUENTS:

Very small traces of detrital clay throughout.
Common traces of amorphous ferruginous aggregates, especially in darker mottles.
One grain of detrital quartz in 1 smear slide.

Total Carbon: 11.5-11.9%
Organic Carbon: 0%
Calcium Carbonate: 96-99%

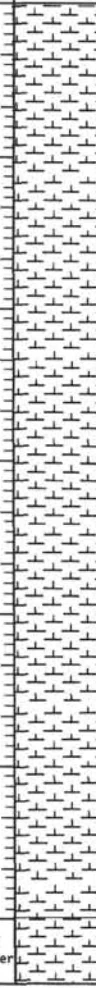
CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 253 Hole Core 4 Cored Interval: 28.0-37.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS
UPPER MIOCENE	N16-N18	NN11	AM	1			1	0.5, 1.0
			AM	1	AMO		2	
			AM	1			3	
			AM	1			4	
			AM	1	AMO		5	
			AM	1			6	
			AM	1	AMO	—	Core Catcher	

LITHOLOGY



DEFORMATION

LITHO. SAMPLE: CC GZ (Section 2); CC GZ (Section 5); *KE (Section 6)

LITHOLOGIC DESCRIPTION

10YR 8/2 THROUGHOUT

4 patches 1-3 cm, 10YR 8/1 w/ 10YR 3/1 haloes
streaked mottle
-do-

moderate mottling; streaked; same colors

streaked mottle

streaked mottle

3 cm mottle

mottle

moderate mottling

10YR 8/2

Very pale orange, slightly to moderately mottled FORAMINIFERAL NANNOPLANKTON OOZE. Mottles haloed as described in higher cores, but colors slightly different: yellowish white interiors, dark grayish brown haloes. Sand-sized forams comprise about 1-3% of the sediment. Discoasters and coccoliths appear about equally abundant.

TEXTURE: Sand 2%
Silt 43-52%
Clay 46-55%

MINOR CONSTITUENTS: Very small traces of detrital clay throughout; common traces of ferruginous microscopic aggregates, especially in darker mottles.

Total Carbon: 11.7%
Organic Carbon: 0%
Calcium Carbonate: 97%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 253 Hole Core 5 Cored Interval: 37.5-47.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
UPPER MIOCENE	N16-N18	NN11	AM	2			1	0.5, 1.0	VOID		*	10YR 8/2 DOMINANT THROUGHOUT
			AM	2	AMO		2				*, HO, CC, GZ	streaked mottles
			AM	2			3				*	stretched 7.5YR 8/1 patch
			AM	2			4				*	stretched 7.5YR 8/1 mottles
		NN9	AM	2	AMO		5				KE, XM, CC, *GZ	stretched mottles; 7.5YR 4/1 haloes, 10YR 8/1 interiors
			AM	2			6				*	
			AM	2	AMO	—	Core Catcher					10YR 8/2, w/ 10YR 4/1 & 10YR 8/1 streaks

Very pale orange, slightly mottled NANNOPLANKTON OOZE; mottles pinkish white with dark gray haloes. Coccoliths tend to predominate over discoasters. Forams are only 0.5 to 4% of the sediment.

TEXTURE: Sand 3%
Silt 56-58%
Clay 39-40%

MINOR CONSTITUENTS: Very small traces of detrital clay throughout; common traces of microscopic ferruginous aggregates, especially in darker mottles.

Total Carbon: 11.7-11.8%
Organic Carbon: 0%
Calcium Carbonate: 97-98%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 253 Hole Core 6 Cored Interval: 47.0-56.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
UPPER MIOCENE	N16-N18	NN9	AM	2			1	0.5, 1.0	VOID			2.5Y 8/2 THROUGHOUT; mottles 10YR 8/1 w/ 10YR 4/1 haloes
			AM	2	AMO		2				*, CC, GZ	1.5 cm mottle; 3 mottles, 1 to 3 cm
			AM	2			3					1 cm mottled; 2 mottles, 1 cm
			AM	2			4				*, *	deformed mottles; -do-
			AM	2	AMO		5				CC, XM, GZ, HO	0.5 cm mottle; 1 & 2 cm mottles; 1 cm band 10YR 4/1; 2 small mottles
		?	AM	2			6				*KE	1 cm mottle; 2 cm mot.; 1 cm band; 2 cm diffuse 7.5YR 4/1 zone
			AM	2	AMO	—	Core Catcher					10YR 8/3

With the exception of a very subtle color change, same NANNOPLANKTON OOZE as previous cores. Color now very light brown. Slightly and locally moderately mottled; mottle interiors white, haloes dark gray. Foraminifera only 2-5% of sediment; coccoliths appear to dominate discoasters, but still nearly equally abundant.

TEXTURE: Sand 2- 3%
Silt 62-64%
Clay 34-36%

MINOR CONSTITUENTS: Very small traces of detrital clay throughout; common traces of microscopic ferruginous translucent and opaque aggregates, especially in darker mottles.

Total Carbon: 10.8-11.7%
Organic Carbon: 0.0-0.1%
Calcium Carbonate: 89-97%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 253 Hole Core 7 Cored Interval: 56.5-66.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION
MIDDLE MIOCENE	N9-N15	?	AM	2			1
			AM	2			2
					AMO		
			AM	2			3
			AM	2			4
			AM	2			5
					AMO		
			AM	2			6
			AM	2	AMO	—	Core Catcher

METERS: 0.5, 1.0

LITHOLOGY: VOID (section 5)

LITHO. SAMPLE: *, *, * XM CC GZ, HO, *, *, *, HO, CC GZ KE, *, *

LITHOLOGIC DESCRIPTION

2.5Y 7.5/2 THROUGHOUT
- 4 cm patch of 10YR 5/1
- stretched mottle
- [all mottles 10YR 8/1 w/ 10YR 5/1 haloes]
- 1-2 cm mottle
- -do-
- -do-
- -do-
- stretched patch
- -do-
- 1 cm mottles
- 2 1-cm mottles
- 1 cm mottle
- 2 mottles, each 1 cm
- 2 x 4 cm mottle
- 1 cm mottle
- 1 x 3 cm mottles
- 1 to 3 cm mottles
- 2 mm layer
- 10YR 8/3

Very light brown NANNOPLANKTON OOZE, slightly and moderately mottled; mottles white with brownish gray haloes. Coccoliths slightly more abundant than discoasters. Foraminifera and foram fragments 2 to 5%; less abundant in white mottles.

TEXTURE: Sand 1- 2%
Silt 64-67%
Clay 31-35%

MINOR CONSTITUENTS: Very small traces of detrital clay throughout; common traces of microscopic ferruginous amorphous aggregates, especially in mottle haloes.

Total Carbon: 11.6-11.7%
Organic Carbon: 0.0-0.1%
Calcium Carbonate: 96-97%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 253 Hole Core 8 Cored Interval: 66.0-75.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION
MIDDLE MIOCENE	N9-N15	NN5					1
			AM	2			2
			AM	2	AMO		3
			AM	2			4
			AM	2	AMO		5
LOWER MIOCENE	N4-N8		AM	2			6
			AM	2	AMO	—	Core Catcher

METERS: 0.5, 1.0

LITHO. SAMPLE: *, CC GZ XM, *, HO, *, HO, *, CC GZ, KE, *, HO, *

LITHOLOGIC DESCRIPTION

PREDOMINANT COLORS: 2.5Y 7.5/2 GRADING TO 2.5Y 7/2 IN SECTION 3.
- 2.5Y 4/2 mottle
- stretched mottle
- -do-
- 2.5Y 7/2
- mottling
- 10 cm mottle, 7.5YR 8/2, -8/1, 2.5Y 4/2 halo
- 10YR 8/2 mottle
- 1 x 2 cm mot.
- stretched mot., 2.5Y 3/2
- 2 mottles: 2.5Y 4/2 & 10YR 8/2
- 3 mottles; same colors
- 2 cm patch 10YR 8/2
- 1 cm mottle
- -do-
- -do-
- 6 cm patch 10YR 8/2 & 2.5Y 5/2 + -4/2
- -do-
- -do-
- 2.5Y 7/2

Same very pale brown NANNOPLANKTON OOZE, becoming slightly darker with depth; moderately mottled; mottles very pale orange with gray haloes, or olive. Coccoliths slightly predominant over discoasters. Foraminifera comprise 1 to 3% of the sediment, but up to 10% in the dark mottles.

TEXTURE: Sand 2%
Silt 59%
Clay 39-40%

MINOR CONSTITUENTS: Very small traces of detrital clay; common traces of microscopic ferruginous aggregates, especially in mottle haloes and dark mottles.

Total Carbon: 11.5-11.7%
Organic Carbon: 0.1%
Calcium Carbonate: 96-97%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 253 Hole Core 9 Cored Interval: 75.5-85.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
LOWER MIOCENE	N4-N8	NN3	AM	2			1	0.5, 1.0			HO
			AM	2	AMO		2				CC GZ
			AM	2	AMO		3				HO
			AM	2	AMO		4				CC GZ XM
		NN2	AM	2	AMO		5				
			AM	2	AMO		6				KE, HO
		NN1	AM	2	AMO	—	Core Catcher				

2.5Y 7/2 THROUGHOUT

stretched 10YR 5/4 mottle

1 cm 10YR 8/2 mottle

moderate mottling;

2.5Y 3/2 streaks

10YR 8/2 patch

Obscure layer

3 x 3 cm 10YR 8/2 patch

2.5Y 7/2

LITHOLOGIC DESCRIPTION

Same pale brown NANNOPLANKTON OOZE, moderately mottled white with various darker shades of brown. Coccoliths slightly predominant over discoasters. Foraminiferal content 2-5% except in darker mottles, which can contain up to 8% foraminifera.

TEXTURE: Sand 1- 2%
Silt 66-68%
Clay 39-40%

MINOR CONSTITUENTS: Very small traces of detrital clay, less common traces of amorphous ferruginous aggregates, especially in darker mottles.

Total Carbon: 11.5-11.6%
Organic Carbon: 0.1%
Calcium Carbonate: 95-96%

CONSOLIDATION: Soft.

Explanatory notes in chapter 2

Site 253 Hole Core 10 Cored Interval: 85.0-94.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
UPPER OLIGOCENE	P22-N3	NP25	AM	1			1	0.5, 1.0			HO, CC GZ XM
			AM	1	AMO		2				
			AM	1							
			AM	1			3				HO
			AM	1							
			AM	1			4				
			AM	1							
			AM	1			5				CC GZ
			AM	1	AMO						
			AM	1			6				KE, HO
			AM	1							
	P21-22	NP24	AM	1	AMO	—	Core Catcher				

1 cm patch

Mod. mot., 10YR 8/2 + 5/1
2.5Y 4/1, 4/2, 5/1,
7.5YR 6/1

1 x 2 cm mottle

intense mot., 10YR 8/2

stretched 10YR 8/2 mot.

DOMINANT COLOR: 2.5Y 7/2

moderate mottling

Intense mot.

coarse 5Y 3/1 lump

Deformed moderate mottling

2 1 cm gray patches

2-cm gray patch

2.5Y 7/2

LITHOLOGIC DESCRIPTION

Same pale brown NANNOPLANKTON OOZE, moderately to intensely mottled with very pale orange, dark brown, gray, dark gray and brownish mottles. Discoasters, about as abundant as coccoliths through the first half of the core, are very few in the lower half of the core. Foraminifers comprise up to 5% of the sediment, but may be altogether missing in some parts of the lower half of the core.

TEXTURE: Sand 2%
Silt 67-68%
Clay 29-31%

MINOR CONSTITUENTS: Detrital clay in ubiquitous trace amounts; common traces of amorphous ferruginous aggregates; rare traces of sponge spicules and collophanous fish debris.

Total Carbon: 11.5%
Organic Carbon: 0.0-0.1%
Calcium Carbonate: 96%

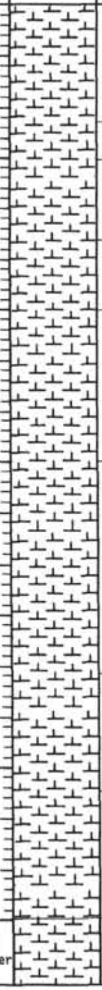
CONSOLIDATION: Soft; however, a few 1 to 2 cm thick patches of stiffer material are present.

Explanatory notes in chapter 2

Site 253 Hole Core 11 Cored Interval: 94.5-104.0 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS
MIDDLE OLIGOCENE	P21	NP23	AM	1			1	0.5
			AM	1			1	1.0
			AM	1	AMO		2	
			AM	1			2	
			AM	1			3	
			AM	1			3	
			AM	1			4	
			AM	1			4	
			AG	1	AMO		5	
			AG	1			5	
			AG	1			6	
			AG	1			6	
			AG	1	AMO		Core Catcher	

LITHOLOGY



LITHO. SAMPLE: HO, CC GZ XM, HO, CC GZ HO, KE HO

LITHOLOGIC DESCRIPTION

10YR 8/2 + 7.5YR 8/2
10YR 6/1 +
2.5Y 6/2 mot.

2.5Y 7/2
Intense mot.

2.5Y 6/2 + less
10YR 6/4

2 cm mottle
2.5Y 7/2

faint
mottling

5Y 3/2 band
3 cm 7.5Y 8/2 patch
Stretched
intense
mottling

N8 mottles

2.5Y 8/2

mottles

2.5Y 7/2

7.5YR 8/2
mottle w/
N8 core

2 cm 7.5YR 8/1

5YR 8/1
mottle

2.5Y 8/1

Same NANNOPLANKTON OOZE, top 90 cm very pale orange and orange white, becoming predominantly pale brown in the lower part of the core. Discoasters are absent or present only in trace amounts. Forams are present in trace amounts up to 2%. Mottled moderately orange white and light brownish gray. Rare patches of pinkish white.

TEXTURE: Sand 1%
Silt 57-64%
Clay 35-42%

MINOR CONSTITUENTS: Ubiquitous very minor detrital clay and less common microscopic amorphous ferruginous aggregates, especially in darker mottles.

Total Carbon: 11.5-11.6%
Organic Carbon: 0.1%
Calcium Carbonate: 95-96%

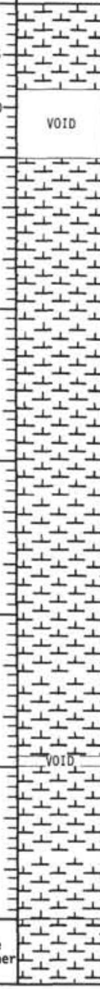
CONSOLIDATION: Soft, but the number of somewhat stiffer drilling biscuits is increasing.

Explanatory notes in chapter 2

Site 253 Hole Core 12 Cored Interval: 104.0-113.5 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS
MIDDLE OLIGOCENE	P21	NP23	AM	2			1	0.5
			AM	2			1	1.0
			AM	2			2	
					AMO		2	
			AM	2			3	
			AM	2			3	
	P19-20		AM	2			4	
			AM	2			5	
			AM	2	AMO		5	
			AM	2			6	
L. OLIG.		NP21	AM	2	AMO		Core Catcher	

LITHOLOGY



LITHO. SAMPLE: HO, CC GZ XM, HO, CC GZ KE, HO

LITHOLOGIC DESCRIPTION

2.5Y 7/2 & 5Y 6/1

Intense mot.;
7.5YR 8/2 &
10YR 8/4

VOID

10YR 5/1 & N1;
scattered
7.5YR 8/4
patches;
intensely mottled

[N1 lamina]

More than 15%
10YR 8/6

7.5YR 8/4 &
10YR 7/1

10YR 8/6 dominant;
minor N6 bands

VOID

7.5YR 8/2
5-10 cm
alternations of
intense and
slight deformation

7.5YR 8/4

10YR 8/2

NANNOPLANKTON OOZE, grading down from pale brown and gray through brownish gray and gray, into pale yellowish orange, light orange and light gray, into orange white. Upper half of core is intensely mottled orange white and very pale yellowish orange; the lower half is essentially unmottled although the lower half of Section 5 has minor light gray bands. Coccoliths make up most of the sediment; discoasters are present only in amounts up to 2%. Foraminifera, slightly more abundant in the upper part of the core, range from 7 to 3%.

TEXTURE: Sand 3- 4%
Silt 58-59%
Clay 37-39%

MINOR CONSTITUENTS: Ubiquitous very small traces of detrital clay; less common microscopic amorphous ferruginous material (even less toward bottom of core).

Total Carbon: 8.1-11.4%
Organic Carbon: 0.1%
Calcium Carbonate: 67-95%

CONSOLIDATION: Stiff where less deformed.

Explanatory notes in chapter 2

Site 253 Hole Core 13 Cored Interval: 113.5-123.0 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS.,ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
LOWER OLIGOCENE	P18		AG	1			1	0.5, 1.0			* HO
			AG	1							
			AM	2			2				CC GZ XM
UPPER EOCENE	Globorotalia semiinvoluta		AM	2	AMO						
			AG	1			3				* HO
	Globigerinatheka semiinvoluta	NP20	AG	0							
			AG	0			4				
			AG	0			5				CC GZ
			AG	0	AMO						
			AG	0			6				* KE HO
			AG	0							
			AM	0	AMO	—	Core Catcher				

LITHOLOGIC DESCRIPTION

HOMOGENEOUS 7.5YR 8/2 with very faint and indistinct zones of 7.5YR 8/4 and 7.5YR 7/4

10YR 8/2 with faint indistinct 7.5YR 8/2 & 10YR 8/1 mottles

7.5YR 8/4
7.5YR 8/2

7.5YR 8/4

7.5YR 8/2 w/ 7.5YR 8/4 disturbed mottles

7.5YR 8/2

Very pale orange *NANNOPLANKTON OOZE* with faint and indistinct (slight) orange white mottles. Discoasters comprise only up to 2% of the sediment, the rest of the clay-sized material is coccoliths. Foraminifera make up traces to 3% of the sediment.

TEXTURE: Sand 0.3- 2.0%
Silt 65 -66 %
Clay 33 -35 %

MINOR CONSTITUENTS: Ubiquitous detrital clay in trace amounts; less common opaque microscopic ferruginous material (less than in higher cores).

Total Carbon: 11.5%
Organic Carbon: 0.0-0.1%
Calcium Carbonate: 95-96%

CONSOLIDATION: Stiff where less deformed.

Explanatory notes in chapter 2

Site 253 Hole Core 14 Cored Interval: 123.0-132.5 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS.,ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
UPPER EOCENE	Globigerinatheka semiinvoluta	NP20	AM	2			1	0.5, 1.0	VOID		HO
			AG	2	AMO		2				* CC GZ XM
							3				HO
			AG	2			4				*
					AMO		5				CC GZ
			AM	2			6				HO KE *
		NP18	AG		AMO	—	Core Catcher				

LITHOLOGIC DESCRIPTION

HOMOGENEOUS

7.5YR 8/2 w/ faint patches of 7.5YR 8/4 & 7.5YR 7/4

7.5YR 8/2

Very pale orange *NANNOPLANKTON OOZE* with faint and indistinct (slight) orange-white mottles. Discoasters comprise traces to less than 2% of the sediment; coccoliths are the bulk of the clay-sized sediment. Foraminiferal content ranges between 1 and 2%.

TEXTURE: Sand 0.6- 3.0%
Silt 62 -64 %
Clay 33 -37 %

MINOR CONSTITUENTS: Ubiquitous very slight traces of detrital clay and opaque microscopic ferruginous aggregates; traces of volcanic glass; rare traces of feldspar.

Total Carbon: 11.5%
Organic Carbon: 0%
Calcium Carbonate: 95-96%

CONSOLIDATION: individual biscuits within the drilling breccia are stiff.

Explanatory notes in chapter 2

Site 253 Hole Core 15 Cored Interval: 132.5-142.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	FOSSIL CHARACTER: DISSOL. EFFECTS	FOSSIL CHARACTER: NANNOS	FOSSIL CHARACTER: SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
UPPER EOCENE	Globigerinatheka semiinvoluta	NP17	AG	0	CMO	—	Core Catcher					Scrapings NO RECOVERY.

Explanatory notes in chapter 2

Site 253 Hole Core 16 Cored Interval: 142.0-151.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	FOSSIL CHARACTER: DISSOL. EFFECTS	FOSSIL CHARACTER: NANNOS	FOSSIL CHARACTER: SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE	Truncorotaloides rohri	NP17					1	0.5, 1.0	VOID			10YR 8/2
							2		VOID		*	10YR 8/2
			AG	0	AMO		3		VOID		HO	
							4				*	10YR 8/4 w/ 7.5YR 7/6 specks
			AG	0								
			AG	0	AMO		5		VOID			
			AM	0			6				CC GZ	10YR 8/2
			AG	0							KE HO *XM	heavily specked w/ 7.5YR 5/6 7.5YR 4/4 & 3/2
			AP		AMO	—	Core Catcher				*	7.5YR 5/6

Sections 1 & 2:

Very pale orange and very pale yellowish orange COCCOLITH OOZE grading into semi-lithified equivalent COCCOLITH CHALK in Section 3. The sediment is mostly coccoliths; discoasters are present only in trace amounts, and forams are present in amounts of only up to 2%. The chalk extends into Section 6.

TEXTURE: Sand 5%
Silt 69%
Clay 26%

MINOR CONSTITUENTS: Ubiquitous very slight traces of detrital clay and microscopic opaque ferruginous oxides; rare trace of feldspar.

SECTION 6: The COCCOLITH CHALK described above grades through an 18-cm thick zone into a basal 12-cm thick, brown to dark brown LIMONITIZED FORAM BEARING MICARB CHALK, or an altered version of the overlying lithology. Approximately 2% of the sediment is hematite and limonite, responsible for the coloration. Clay-sized nannos comprise 26%; approximately 69% of the material is silt-sized and probably coccoliths overgrown with micarb. Forams comprise about 5%. Traces of feldspar were observed.

Total Carbon: 11.3%
Organic Carbon: 0%
Calcium Carbonate: 94%

Explanatory notes in chapter 2

Site 253 Hole Core 17 Cored Interval: 151.5-161.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
MIDDLE EOCENE	MIDDLE EOCENE	NP16			B		1	0.5, 1.0	VOID		
					CPO		2				HO KE, CC XM, GZ
			RP		RPO	—	3				KE HO
							Core Catcher				

LITHOLOGIC DESCRIPTION

10YR 3/2 — Very dark yellowish brown washed drill cuttings; granules to coarse sand.

N1, less N9 — Isolated 12-cm piece of black carbonate-rich semi-lithified ALTERED VITRIC VOLCANIC ASH (altered to clay).

7.5YR 4/4, 10YR 3/3, 7.5YR 6/6, 2.5Y 3/2 + 0.5-1 cm N1 clasts, 2.5Y 3/3, 5Y 5/4, 4/4 — Brown, dark brown and reddish yellow FERRUGINOUS MICARB CHALK, disaggregated by drilling into clayey, poorly sorted coarse to fine sand. 90% micarb, 8% hematite and limonite, 2% volcanic glass, trace amphibole and opaque oxides, trace to 1% glauconite, traces of zeolite.

5Y 4/6, 2.5Y 6/4, 5Y 4/6 w/ N1 clasts, 5Y 6/4 w/ N1 clasts, 5Y 5/6 w/ 5Y 3/3 clasts — Very dark grayish brown, moderate olive brown, olive brown and olive yellow ALTERED VITRIC VOLCANIC LAPILLI with subangular to subrounded black clasts up to 0.5 x 1.5 cm in size, composed of vitric ash altered to isotropic clay. ALTERED AND FRESH green glass 80%, palagonite 10%, limonite and hematite 10%, trace of zeolite, trace of coccoliths. Lighter colored intervals (as at 35 cm, Section 3) contain as much as 10% micarb in the matrix.

Total Carbon: 0.4%
Organic Carbon: 0.1%
Calcium Carbonate: 3.0%

Note: In this and the succeeding core descriptions, the textural data from the shore lab are not used to describe the tuffaceous sediments, because the laboratory disaggregation process generates a false grain-size distribution. All textures given for this lithology are determined visually.

5Y 5/6 — Crinoid stems

Explanatory notes in chapter 2

Site 253 Hole Core 18 Cored Interval: 161.0-170.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
MIDDLE EOCENE	MIDDLE EOCENE	NP16	FP				1	0.5, 1.0			KE
			CM				2				CC GZ, HO
			CM		FMO		3				CC, KE GZ, HO XM
			CM				4				
			RP		CMO	FM	5				
							6				
							Core Catcher				

LITHOLOGIC DESCRIPTION

[Loose washed bit cuttings]

5GY 4/1, 5GY 4/2

TO SECTION 3, 130: Dark greenish gray and olive green ALTERED COARSE VITRIC VOLCANIC ASH, containing very minor small patches of MICARB COCCOLITH CHALK, and 5% lapilli up to 1 cm.

COMPOSITION (erratic):
50% clay (altered from glass)
35% micarb
7% limonite and other Fe-oxides
Traces of zeolite and coccoliths

Gradational into

5Y 2/1, 5YR 2/1

SECTION 3, 130 - SECTION 4, 24 cm: Brownish black and olive black FOSSIL BEARING TUFFACEOUS DETRITAL CLAY.

COMPOSITION:

60% detrital clay (possibly glass alteration products?)
25% fresh clear brown glass
8% mixture of coccoliths, diatom and radiolarian fragments, and traces of foraminifera
5% opaque iron oxides
2% micarb

TEXTURE: Sand 10%
Silt 30%
Clay 60%
(Smear Slide)

5GY 4/2

SECTION 4, 24 - 150 cm: Olive green coarse VITRIC VOLCANIC ASH altered to ferruginous MICARB CLAY, as in upper part of core.

Total Carbon: 1.1-4.5%
Organic Carbon: 0.1%
Calcium Carbonate: 8-37%

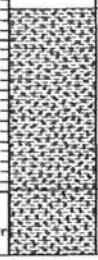
Macrofossils:
Bryozoans
Crinoid stems
Sponge spicules
1 Brachiopod fragment

5GY 4/2

Explanatory notes in chapter 2

Site 253 Hole Core 19 Cored Interval: 170.5-180.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
MIDDLE EOCENE	EOCENE	NP16					1	0.5	VOID		
			CM	O				1.0		▲	
			CM	O			2			▲	*KE HO
										▲	CC GZ XM
			RP		FPO	CG	Core Catcher				*



5GY 4/1 w/ 2 x 2 cm 5YR 4/1 lithic frag.

5GY 2/1

10Y 4/2

5Y 3/2
10Y 4/2
5Y 4/4
5Y 3/2

10Y 4/2

LITHOLOGIC DESCRIPTION

Olive green, dark greenish gray, grayish black, grayish olive and dark olive gray VITRIC VOLCANIC ASH altering to clays.

TEXTURE: Difficult to estimate, but approximately a silty clayey fine to coarse sand. The individual coarser grains are subangular to subrounded.

CONSOLIDATION: Several semilithified 3 to 10 cm pieces in a thoroughly disaggregated matrix of drilling breccia.

At 130 cm, Sec. 2 one 4 cm semilithified drilling biscuit of olive COCCOLITH RADIOLARIAN DIATOMITE.

Composition:

45% diatom fragments
45% radiolarian fragments
5% terrigenous clay
3% coccoliths
Tr micarb
Tr foraminifera
Tr sponge spicules
Tr fish remains

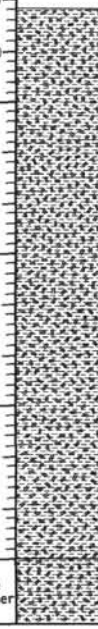
Total Carbon: 2%
Organic Carbon: 0.2%
Calcium Carbonate: 15%

Macrofossils: Bryozoans
Crinoid stems
Small Pelecypods

Explanatory notes in chapter 2

Site 253 Hole Core 20 Cored Interval: 180.0-189.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
MIDDLE EOCENE	MIDDLE EOCENE	NP16	CM	G		CM	1	0.5 / 1.0	VOID		HO
			CM	O			2				*CC GZ KE XM
						FM	3				
							4				HO
											CC GZ
											KE
			FP		CMO	FM	Core Catcher				



[washed bit cuttings]

10Y 4/2 w/ minor 5GY 4/1 patches

5GY 2/1 streak

5GY 3/2

LITHOLOGIC DESCRIPTION

As in Core 19, grayish olive ALTERED VITRIC VOLCANIC ASH, altering to clays. Minor 2-5 cm patches of dark grayish green material with a cement approximating COCCOLITH MICARB CHALK; these patches have withstood drilling better than the darker material and occur as semilithified drilling biscuits. Consolidation otherwise: disaggregated clayey fine to medium sand.

Total Carbon: 6.3-6.4%
Organic Carbon: 0.2%
Calcium Carbonate: 51-52%

Macrofossils: Bryozoans
1 Small echinoid
Pelecypods
Gastropods

Explanatory notes in chapter 2

Site 253 Hole Core 21 Cored Interval: 189.5-199.0 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS.,ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE
EOCENE	EOCENE	?	CM, FG, FG, FP		RPO		1, 2, 3, 4, Core Catcher	0.5, 1.0	VOID		HO,KE *CC GZ XM *; *CC* GZ HO KE

10Y 4/2 w/ 5GY 4/1 patches

5Y 3/4 N1 clasts, 0.5 x 1 cm

5G 2/1 clay

10Y 3/2

0.5 cm sand len

0.5 cm layers

5G 2/1 & N1

Molluscan fragments, about 2%

LITHOLOGIC DESCRIPTION

ABOVE Section 2, 130 cm:

Grayish olive, dark greenish gray, and dark olive brown ALTERED VITRIC VOLCANIC ASH, altering to clays, as in previous core. Locally, scattered black subangular to subrounded clasts of very fine altered vitric tuff, corresponding to the lower lithologic type of the core.

TEXTURE: Most of the material may have been semi-lithified, but has been disaggregated into clayey fine-to-medium sand by the drill.

Black ALTERED VITRIC VOLCANIC ASH AND LAPILLI, with subangular to subrounded clasts 0.5 to 1.0 cm making up 30-40%, the rest very fine clay-sized and slightly lighter material. Molluscan fragments 0.1 to 1.0 cm in size comprise approximately 1-2% of the material, appearing as white elongate clasts.

Toward the base of the core, small vaguely outlined round or euhedral white blebs 1-4 mm in size make their appearance, comprising well under 1% of the cut face of the core. In smear slides, these prove to be fresh green volcanic glass, identical in texture to the surrounding matrix. Both bleb and matrix material exhibit globular and cuspate shards, but in the matrix the material has been extensively altered to clay, only about 5% remaining, as brown glass containing very finely disseminated opaque or translucent iron oxides.

Total Carbon: 2.4-3.6%
Organic Carbon: 0.1-0.5%
Calcium Carbonate: 19-25%

CONSOLIDATION: Semi-lithified; the material consisting of pieces 2 to 15 cm long.

Macrofossils: Bryozoans
Pelecypods

Explanatory notes in chapter 2

Site 253 Hole Core 22 Cored Interval: 199.0-208.5 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS.,ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE
							1, 2, 3, 4, 5, Core Catcher	0.5, 1.0	VOID; VOID		(TS) *MY; (TS) *MY

N1

load cast

Lapilli; 4-6 mm

Bryozoa

LITHOLOGIC DESCRIPTION

Black ALTERED VITRIC VOLCANIC ASH; lowest 50 cm is black ALTERED VITRIC VOLCANIC LAPILLI. White 1-5 mm round and euhedral blebs comprise 15 to 20%; coarse mollusc shell fragments 1-2%. Fine carbonate also is concentrated around the coarser clasts.

TEXTURE: Layers of specific grade, generally fairly well sorted and of various sand sizes, range in thickness from 2 to 25 cm, some grading upward; 1 load cast.

The rounded and euhedral blebs are fresh brown and clear glass, with traces of plagioclase microlites. The bulk of the material is clay alteration products from glass, with traces of zeolite and micarb.

CONSOLIDATION: Entire core consists of 2 to 12 cm semi-lithified pieces.

Explanatory notes in chapter 2

Site 253 Hole Core 23 Cored Interval: 208.5-218.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
							1	0.5, 1.0			KE *
							2				KE,HO CC GZ XM
?			RP		B	RADS DIAT FP	Core Catcher				

10Y 6/2 ← patch

← [-do-] 5Y 4/2

LITHOLOGIC DESCRIPTION

Same semi-lithified ALTERED VITRIC VOLCANIC ASH; black except for olive gray lowermost 50 cm; becoming less indurated downward; Section 2 is predominantly disaggregated by the drill, with 5 to 12 cm undisturbed pieces.

The paler colors are due to higher carbonate content (fine micarb). Carbonate also occurs as elongate sections through coarse mollusc shell fragments, and as very fine 0.5 mm concentrations around coarser clasts.

TEXTURE: 60-70% clay and fine silt-sized matrix of wholly altered glass with approx. 15% 1-4 mm blebs of unaltered but otherwise identical glass. 30-40% lapilli-sized clasts up to 2 cm in size, subangular to rounded, composed of clay-sized altered glass shards.

Total Carbon: 1.9%
Organic Carbon: 0.1%
Calcium Carbonate: 15%

Explanatory notes in chapter 2

Site 253 Hole Core 24 Cored Interval: 218.0-227.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
							1	0.5, 1.0	VOID		TS *KE *TS
							2				
							3				
?			RP		B		Core Catcher				

N1
N6 ash
N1 lapilli + ash
N1 fine ash
N1 lapilli + ash
ash
lapilli + ash
ash
lapilli + ash, carb. rich
ash
Lap. + ash, carb rich
ash

LITHOLOGIC DESCRIPTION

Black VESICULAR BASALT, vesicles smaller than 3 mm; carbonate filling some vesicles and forming a 1.5 mm thick crust on one of the several 3-5 cm long pieces. Lowest piece shares contact with underlying ash.

Same ALTERED VITRIC VOLCANIC ASH and LAPILLI as in previous core. Topmost 10 cm, in contact with the basalt, is finely laminated and carbonate poor, grading down into carbonate-rich lapilli with a maximum clast size of 1.5 cm. The rest of the core consists of predominantly lapilli, with 10-70 cm layers of ash.

CONSOLIDATION: Semi-lithified.

Explanatory notes in chapter 2

Site 253 Hole Core 25 Cored Interval: 227.5-237.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
							1	0.5, 1.0	VOID		
EOCENE	EOCENE		CG	0			2				GZ,XM CC,HO KE
		?	RM	0	FPO	FP	Core Catcher				

N1
N1
5G 2/1 + 5GY 2/1

LITHOLOGIC DESCRIPTION

Top 16 cm black BASALT SCORIA with some carbonate void fillings. Small fragments and two 3 x 5 cm pieces.

Below basalt scoria is same semi-lithified black ALTERED VITRIC VOLCANIC ASH and lesser LAPILLI with maximum clast size of 1 cm. Few mollusc shell fragments in Section 1, more abundant in the upper and lower 10-20 cm of Section 2. These intervals are somewhat brecciated by the drill.

Total Carbon: 1.0%
Organic Carbon: 0.1%
Calcium Carbonate: 7%

Macrofossils: Echinoid spines
Sponge spicules
Pelecypods

Explanatory notes in chapter 2

Site 253 Hole Core 26 Cored Interval: 237.0-246.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
EOCENE			CG	0			1	0.5, 1.0			
							2				GZ XM KE HO KE
			B				Core Catcher				

5G 2/1 & 5GY 2/1
← 2 x 2 cm N6 clast
N1
ash with vacated inclusions

LITHOLOGIC DESCRIPTION

Same black ALTERED VOLCANIC ASH with lesser ALTERED VOLCANIC LAPILLI, becoming wholly fine-grained at the base of the core, this interval containing about 5% blebs of unaltered glass, the blebs as coarse as 0.5 cm in Section 2. Mollusc shell fragments are relatively abundant, especially in the lowest 100 cm of Section 1.

CONSOLIDATION: Semi-lithified. Core consists of 4 - 10 cm pieces.

Total Carbon: 1.9%
Organic Carbon: 0.2%
Calcium Carbonate: 15%

Macrofossils: Bryozoans
Sponge spicules
Pelecypods

Explanatory notes in chapter 2

Site 253 Hole Core 27 Cored Interval: 246.5-250.5 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
			B				1, 2, Core Catcher	0.5, 1.0	VOID		*	N1

Same lithology as previous core: black ALTERED VITRIC VOLCANIC ASH with lesser ALTERED VITRIC VOLCANIC LAPILLI. White rounded blebs increase below 103 cm to about 10 - 15%. Occasional gray clasts 1 to 2 cm in size. Details as follows:

- Light gray and brownish gray, very fine ash; no blebs; few dark clasts; pre-consolidation load deformation at base of interval.
- Coarser ash with minor lapilli.
- Same fine grained gray ash as above.
- [1 cm zone of fine white blebs]

CONSOLIDATION: Entire core consists of discrete pieces of semi-lithified material. Material is conchoidally fractured at the base of the core.

Explanatory notes in chapter 2

Site 253 Hole Core 28 Cored Interval: 250.5-260.0 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
							1, 2, Core Catcher	0.5, 1.0			KE	

Same ALTERED VITRIC VOLCANIC ASH and lesser LAPILLI; details as follows at appropriate intervals:

- About 25% 2-3 mm white blebs of relatively unaltered glass
- Numerous mollusc shell fragments
- Very fine ash, no blebs
- Same fine ash, 25% 2-3 mm blebs

Explanatory notes in chapter 2

Site 253 Hole Core 29 Cored Interval: 260.0-269.5 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE	MIDDLE EOCENE	NP16	F P-M		CPO		1, 2, Core Catcher	0.5, 1.0	VOID, VOID			N1; 10Y 4/2 [1 cm thick transition is 5GY 7/2]

Same ALTERED VITRIC VOLCANIC ASH, dark bluish gray and very fine grained with fine laminae showing pre-consolidation deformation; however, lowermost 35 cm is coarser (texture is that of clayey silt) and olive gray. Blebs are only 1 - 2%, with a maximum size of 2 mm.

CONSOLIDATION: 2 to 35 cm long pieces, all semi-lithified. The basal olive layer is somewhat softer, and probably marks the passage of the hole into the green lithologic type.

Explanatory notes in chapter 2

Site 253 Hole Core 30 Cored Interval: 269.5-279.0 m

AGE	FORAMS ZONE	NANNOS ZONE	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EOCENE	EOCENE	?	FM; RP	0	FMO	RADS DIAT. FP	1, Core Catcher	0.5, 1.0			*; GZ HO CC XM KE *	5GY 4/2 & 5GY 3/2; 5G 2/1

Olive green, dark olive gray and greenish black ALTERED VITRIC VOLCANIC ASH, coarse grained and badly disaggregated by the drill. Locally the material contains abundant very fine grained micarb.

Total Carbon: 6.2%
Organic Carbon: 0.1%
Calcium Carbonate: 51%

Macrofossils: Bryozoans

Explanatory notes in chapter 2

Site 253 Hole Core 31 Cored Interval: 279.0-288.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS.,ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EOCENE	EOCENE		RG	0		DIAT.	1	0.5, 1.0	VOID			Same greenish black disaggregated ALTERED VITRIC VOLCANIC ASH, very coarse grained except where otherwise indicated. Shell fragments about 15% of sediment, normal size about 3 mm. 5G 2/1
						RADS. DIAT. FP	2				* GZ XM * KE HO	Dark gray, silt-sized; containing 0.5 mm burrows filled with coarse to medium sand sized partially altered green glass.
							3		VOID			1 cm brown clay layer 5YR 2/1; less shell fragments 5 cm layer of dark gray silt-sized altered glass abundant shell fragments
		?	RM				Core Catcher					Total Carbon: 1.1% Organic Carbon: 0.1% Calcium Carbonate: 8% 5G 2/1 Crinoid stems

Explanatory notes in chapter 2

Core 32 Cored Interval: 288.5-298.0 m: NO RECOVERY

Site 253 Hole Core 33 Cored Interval: 298.0-307.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS.,ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EOCENE			RM		B		Core Catcher				*	10Y 6/2

CORE CATCHER ONLY.

Pale olive (10Y 6/2) dissaggregated sand and silt-sized ALTERED VITRIC VOLCANIC ASH, with 0.3 - 1 cm dark brown clasts, and shell fragments up to 1 cm.

COMPOSITION (Smear Slide):

96% clay alteration products from glass
2% green glass altering to glauconite
2% feldspar, mica, and clinopyroxene

Explanatory notes in chapter 2

Site 253 Hole Core 34 Cored Interval: 307.5-317.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS.,ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE			RP	0	B		Core Catcher				*	5G 2/1

CORE CATCHER ONLY.

Greenish black disaggregated ALTERED VITRIC VOLCANIC ASH with a texture of sandy-silty clay.

Explanatory notes in chapter 2

Site 253 Hole Core 35 Cored Interval: 317.0-326.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS.,ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
							1	0.5, 1.0	VOID			5G 5/2 5G 2/1 5GY 4/1
			RM	0		—	Core Catcher					5GY 4/1

ALTERED VITRIC VOLCANIC ASH. Down to 100 cm the color is medium grayish brown, and the material contains numerous 0.5 cm cavities where carbonate fillings and shell fragments have been dissolved. Some shell fragments are as large as 1 cm.

From 100 cm down, the color changes sharply to greenish black and none of the shell fragments are dissolved.

Explanatory notes in chapter 2

Site 253 Hole Core 36 Cored Interval: 326.5-336.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS.,ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EOCENE	EOCENE						1	0.5, 1.0	VOID		CC GZ KE HO XM *	Same ALTERED VITRIC VOLCANIC ASH; details as shown. 5BG 4/2 w/ minor 5G 5/2 — Grayish blue-green, texturally silty clay [note: clasts of this material have been found higher up in the hole].
							2				*	5Y 4/2 — Medium olive gray; texturally fine sand and silt; numerous 1-3 mm and up to 10 mm shell fragments throughout; also crinoid disks.
			CM	0			3				KE CC GZ HO	0.7 x 2 cm shell frag. Shell frags 15%
			RP	0								5BG 5/2 — Bluish green, coarse.
		?	RP	0	RPE	RADS DIAT FP	Core Catcher					5Y 4/2 — Medium olive gray; as above colored lithology, rich in shell fragments.

Total Carbon: 0.2-2.1%
Organic Carbon: 0.1-0.2%
Calcium Carbonate: 1-16%

CONSOLIDATION: Semi-lithified, but broken by drill into pieces 2 to 3 cm long at most; much is disaggregated.

5Y 4/2

Explanatory notes in chapter 2

Site 253 Hole Core 37 Cored Interval: 336.0-345.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	FOSSIL CHARACTER: DISSOL. EFFECTS	FOSSIL CHARACTER: NANNOS	FOSSIL CHARACTER: SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE		NP16	B		RMO		Core Catcher					5G 2/1 CORE CATCHER ONLY. Greenish black ALTERED VITRIC VOLCANIC ASH, texturally (disaggregated) silty clay with abundant shell fragments.

Explanatory notes in chapter 2

Site 253 Hole Core 38 Cored Interval: 345.5-355.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	FOSSIL CHARACTER: DISSOL. EFFECTS	FOSSIL CHARACTER: NANNOS	FOSSIL CHARACTER: SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
			CM	O			1	0.5 1.0	VOID		GZ *CC KE HO	5G 2/1 ←Bryozoans. Greenish black ALTERED VITRIC VOLCANIC ASH with 20-30% white carbonate particles 1 mm thick and 1-3 mm long. Toward base of core, fewer carbonate particles. Total Carbon: 1.6% Organic Carbon: 0.1% Calcium Carbonate: 12% Semilithified but disaggregated by drill.
							Core Catcher					

Explanatory notes in chapter 2

Site 253 Hole Core 39 Cored Interval: 355.0-364.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	FOSSIL CHARACTER: DISSOL. EFFECTS	FOSSIL CHARACTER: NANNOS	FOSSIL CHARACTER: SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
	?		R P-G				Core Catcher					5G 2/1 CORE CATCHER ONLY. Greenish black ALTERED VITRIC VOLCANIC ASH as in the lithology of Core 28. Semilithified, conchoidally fractured. Texturally, silty clay.

Explanatory notes in chapter 2

Site 253 Hole Core 40 Cored Interval: 364.5-374.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	FOSSIL CHARACTER: DISSOL. EFFECTS	FOSSIL CHARACTER: NANNOS	FOSSIL CHARACTER: SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EOCENE	EOCENE		CM	O			1	0.5 1.0	VOID		HO CC GZ XM	Predominantly black ALTERED VITRIC VOLCANIC ASH, lesser reddish to greenish ALTERED VITRIC VOLCANIC LAPILLI. Medium grained ash. Fine grained ash. Contains white clasts (carbonate); green and reddish brown subangular-subrounded clasts. Brownish clasts more abundant (5-10%).
							2				*	5GY 4/2 Gray-green; texturally fine sand to silt; abundant carbonate; well indurated. Reddish-greenish well indurated poorly sorted lapilli, 50%. 4 to 30 mm in size. Several shell fragments.
							3				*	5GY 2/1 Green-black fine ash, particles up to 3 mm in diameter, rounded. 5Y 2/1 Olive black poorly sorted coarse ash, lapilli up to 10 mm in diameter constitute 10% of material. Total Carbon: 2.1% Organic Carbon: 0.1% Calcium Carbonate: 17%
			RM		B	RADS DIAT FP	Core Catcher					Bryozoans. 5Y 2/1. CONSOLIDATION: Semi-lithified, becoming softer toward the bottom. Core consists of 2-6 cm long pieces.

Explanatory notes in chapter 2

Site 253 Hole Core 41 Cored Interval: 374.0-383.4 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	FOSSIL CHARACTER: DISSOL. EFFECTS	FOSSIL CHARACTER: NANNOS	FOSSIL CHARACTER: SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EOCENE						RADS DIAT. FP	1	0.5 1.0	VOID		CC GZ XM HO KE	5Y 3/1; silty clay texture. 5G 2/1; fine sand texture. ←[alternating 1-cm fine & coarse layers]
			RP		B	—	Core Catcher					Dark olive gray and greenish black ALTERED VITRIC VOLCANIC ASH with dispersed carbonate particles. Semilithified; core consists of 2-5 cm long pieces. Total Carbon: 0.5% Organic Carbon: 0.1% Calcium Carbonate: 3%

Explanatory notes in chapter 2

Site 253 Hole Core 42 Cored Interval: 383.4-393.0 m

AGE	FORAMS ZONE	NANNOS ZONE	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
			RM	O	B		1	0.5, 1.0	VOID			5GY 2/1; 1-5 mm 5YR 2/1 & 5G 7/4 clasts
							2		VOID		* HO CCKE GZXM	
							3					←2 mm shell fragments
			B		B	—	Core Catcher					5GY 2/1

Greenish black ALTERED VITRIC VOLCANIC ASH with local concentrations of fine lapilli. Texturally medium to fine sand; with abundant finely dispersed white carbonate imparting a "salt-and-pepper" appearance.

Partially brecciated by drilling; core consists of 2-5 cm long pieces with finer broken material.

Total Carbon: 0.3%
Organic Carbon: 0.1%
Calcium Carbonate: 2%

Explanatory notes in chapter 2

Site 253 Hole Core 43 Cored Interval: 393.0-402.5 m

AGE	FORAMS ZONE	NANNOS ZONE	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EOCENE			CG	O			1	0.5, 1.0	VOID		CC GZ XM	5G 2/1
			CG	O			2				HO KE	←Echinoid; ←Discocyclina
		?	R P-M	O	RPO		Core Catcher					5G 2/1

Greenish black ALTERED VITRIC VOLCANIC ASH; texturally predominantly fine sand, with minor coarser clasts 2-3 mm in size; containing approximately 25% mollusc shell fragments up to 1.2 cm long.

Total Carbon: 1.8%
Organic Carbon: 0.1%
Calcium Carbonate: 14%

CONSOLIDATION: Semilithified but partially disaggregated by drilling; entire core consists of 3-6 cm long pieces with finer fragments in between.

Explanatory notes in chapter 2

Site 253 Hole Core 44 Cored Interval: 402.5-412.0 m

AGE	FORAMS ZONE	NANNOS ZONE	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EOCENE	Asterocyclina						1	0.5, 1.0	VOID		XM CCGZ	5G 2/1
							2				HO KE	clasts taper off
		?	FP	O	FPO		Core Catcher					5G 2/1

Greenish black ALTERED VITRIC VOLCANIC ASH with lesser ALTERED VITRIC VOLCANIC LAPILLI, with 5% shell fragments 1-3 mm in size. Lapilli constitute 35% of the material with an average size of 5 mm. The matrix has the texture of fine sand and silt.

Total Carbon: 1.9%
Organic Carbon: 0.1%
Calcium Carbonate: 15%

CONSOLIDATION: Semilithified; core consists of 2-10 cm long pieces.

Explanatory notes in chapter 2

Site 253 Hole Core 45 Cored Interval: 412.0-421.5 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
			RP				1	0.5, 1.0	VOID			5GY 3/1; 5GY 5/2 burrows with finer material
							2				GZ CC XM KE HO	
							3					1-3 mm N1 specks; Abundant shell frags., 2-10 mm; Light green burrows, 0.2 x 1.5 - 2 cm; 5GY 4/2; More than 15% shells
							4				*	More than 15% shells; burrows
			Asterocyclina				5		VOID		KE HO GZ CC XM TS	5GY 5/2; shell frags. about 20%; Bryozoans, Pelecypods
			FM				6					very few shells; Pelecypods; silt-clay sizes
		?	RP	O	B		Core Catcher					5GY 5/2

Top to Sec. 3, 120 cm:

Greenish black ALTERED VITRIC VOLCANIC ASH containing approximately 1% mollusc shell fragments (locally more abundant), with several lighter colored burrows with finer and carbonate-rich material.

Sec. 3, 120 cm to bottom of core:

Olive green and dusky yellow green ALTERED VITRIC VOLCANIC ASH, coarser than overlying lithology and with abundant (15-20%) mollusc shell fragments.

Total Carbon: 2.2-5.1%
Organic Carbon: 0.1-0.2%
Calcium Carbonate: 17-41%

CONSOLIDATION: Semilithified; core consists of 5-30 cm long pieces.

Explanatory notes in chapter 2

Site 253 Hole Core 46 Cored Interval: 421.5-431 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE							1	0.5, 1.0	VOID			5Y 2/1; 7x12 mm lenses coarser grained
							2				KE HO XM GZ CC	fewer, smaller shell fragments; few % clasts
							3				KE *	silty matrix; 0.5-3 cm lenses & bands med. sand; 1-2 cm altern. crse-med & fine; Fine sand texture; few shell fragments
							4				CC GZ	Coarser; 10% dark clasts, 2% shell frags.; Abund. shell frags., 1-2 mm thick, 1-3 cm long
							5				XM HO KE	-do-
							6					No shells
		NP16	FM	O	CMO		Core Catcher					5Y 2/1

Predominantly olive black ALTERED VITRIC VOLCANIC ASH with the texture of medium to fine sand. Texture and molluscan shell content varies as detailed.

Total Carbon: 1.3-2.1%
Organic Carbon: 0.2%
Calcium Carbonate: 9-16%

CONSOLIDATION: Semi-lithified; core consists of 5-30 cm long pieces.

Explanatory notes in chapter 2

Site 253 Hole Core 47 Cored Interval: 431.0-440.5 m

AGE | FORAMS ZONE | NANNOS | FOSSIL CHARACTER: FORAMS, DISSOL. EFFECTS, NANNOS, SILICEOUS FOSS. ETC. | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION

MIDDLE EOCENE; NP16; RP 0 FMO (Core Catcher)

Section 1: VOID (0–0.5 m)

5GY 2/1 & 5G 2/1

Greenish black ALTERED VITRIC VOLCANIC ASH, with the texture of medium to fine sand, with few shell fragments and abundant brownish black clasts.

Total Carbon: 0.9%
Organic Carbon: 0.2%
Calcium Carbonate: 6%

CONSOLIDATION: Semilithified; core consists of pieces 2 to 15 cm long.

Section 2: *KE HO GZ XM CC — reddish & light green clasts up to 1 cm

finer; fewer clasts

Section 3: VOID

Section 4: large shell frags., 1.5-2 cm; 0.5 cm ang.-rdd cl

1 cm 5Y 4/1 fine grained band

Finer; fewer shells

Core Catcher: 5G 2/1

Explanatory notes in chapter 2

Site 253 Hole Core 48 Cored Interval: 440.5-450.0 m

AGE | FORAMS ZONE | NANNOS | FOSSIL CHARACTER: FORAMS, DISSOL. EFFECTS, NANNOS, SILICEOUS FOSS. ETC. | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION

EOCENE; Discocyclina

Section 1: 5GY 2/1 & 5G 2/1

Greenish black and olive black ALTERED VITRIC VOLCANIC ASH with the texture of medium to fine sand, with shell fragments locally abundant, especially toward base of core.

Total Carbon: 1.8%
Organic Carbon: 0.2%
Calcium Carbonate: 14%

More shells; lighter color

CONSOLIDATION: Semi-lithified; core consists of 3 - 5 cm pieces.

Section 2: GZ XM CC KE HO

5Y 2/1 silt

Core Catcher: 5G 5/1, silt-sized altered ash

Explanatory notes in chapter 2

Site 253 Hole Core 49 Cored Interval: 450-459.5 m

AGE | FORAMS ZONE | NANNOS | FOSSIL CHARACTER: FORAMS, DISSOL. EFFECTS, NANNOS, SILICEOUS FOSS. ETC. | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION

Section 1: VOID

5BG 4/2

Blue-green and dark greenish gray ALTERED VITRIC VOLCANIC ASH, of silt-sized texture with lenses of coarser sand-sized material; noticeable absence of shell fragments.

Total Carbon: 0.2%
Organic Carbon: 0.1%
Calcium Carbonate: 0%

CONSOLIDATION: Semi-lithified; 2-7 cm pieces of core with finer drilling breccia.

Section 2: GZ XM CC KE HO *

5G 4/1

rndd clasts 1 mm, 5G 3/1

1-10 mm bands brnsh gray

-do-

2 cm bands white 2 mm blebs

Section 3: RP 0

1-2 mm clasts

Med. sand

1 cm brnsh blk lapilli

Core Catcher: RP 0

5G 4/1

Explanatory notes in chapter 2

Site 253 Hole Core 50 Cored Interval: 459.5-469.0 m

AGE | FORAMS ZONE | NANNOS | FOSSIL CHARACTER: FORAMS, DISSOL. EFFECTS, NANNOS, SILICEOUS FOSS. ETC. | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION

Section 1: VOID

Drilling breccia; dark brownish gray ALTERED VITRIC VOLCANIC ASH, fine to medium grained.

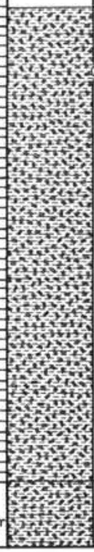
5YR 3/1

Core Catcher: B B

Explanatory notes in chapter 2

Site 253 Hole Core 51 Cored Interval: 469.0-478.5 m

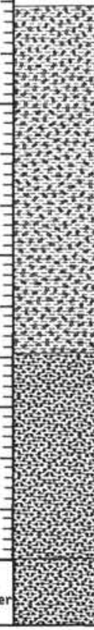
AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE		NP13-NP16			CMO		1	0.5, 1.0	VOID	KE HO	5GY 4/1	Dark greenish gray ALTERED VITRIC VOLCANIC ASH, texturally fine sand with few 1-2 mm darker and lighter green clasts. Very fine white specks throughout (carbonate), and a few 1 mm thick shell fragments. Total Carbon: 1.2% Organic Carbon: 0.2% Calcium Carbonate: 9%
							2			GZ CC XM	Burrows; 5YR 6/4	
							3					
			FP	0			4			*	more, bigger clasts	
			FM	0	FMO		Core Catcher				5GY 4/1	



Explanatory notes in chapter 2

Site 253 Hole Core 52 Cored Interval: 478.5-488.0 m

AGE	ZONE: FORAMS	ZONE: NANNOS	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
							1	0.5, 1.0	VOID		5G 2/1	Greenish black ALTERED VITRIC VOLCANIC ASH with texture of medium to fine sand, grading down into ALTERED VITRIC VOLCANIC LAPILLI. The upper ash contains 1-2% light green 2-3 mm clasts, few shell fragments 2-3 mm long, and fine white carbonate specks throughout. The lapilli include a few dark brown and light green fragments; average lapilli size is 1 cm, maximum size 1.5 x 4 cm. A fine network of carbonate outlines the clasts. Total Carbon: 0.4-0.8% Organic Carbon: 0.1% Calcium Carbonate: 3-6% CONSOLIDATION: Semilithified; the core consists of pieces 5 to 30 cm long.
										KE		
			CP	0			2			CC GZ XM	Coarser; more shells	
							3				Lath-shaped carbonate clasts (5%), 1-2 x 5 mm	Crinoid stem
											Carbonate laths as above	
							4			CC GZ XM *	0.2 - 3 cm 5G 3/2 & 1R 3/2 clasts, 30-50% near top increasing to over 50%. Few 5YR 2/2 and 5G 8/1 clasts.	
										KE HO		
			B		B		Core Catcher				5G 2/1	



Explanatory notes in chapter 2

Site 253 Hole Core 53 Cored Interval: 488.0-497.5 m

AGE | FORAMS ZONE | NANNOS | FOSSIL CHARACTER: FORAMS, DISSOL. EFFECTS, NANNOS, SILICEOUS FOSS. ETC. | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION

Section 1: 0.5, 1.0; VOID; 5GY 4/2

Section 2: CC, XMGZ, KE, HO; 3% $CaCO_3$

Section 3

Section 4: *, *; 2.5 x 4 cm angular N3 clast

Section 5: RP; GZ, CC, XM, KE

Core Catcher: B, B; 5GY 4/2

Medium olive green ALTERED VITRIC VOLCANIC ASH, texturally medium to fine sand with about 15% 5 mm subangular to subrounded clasts, and finely dispersed carbonate.

Total Carbon: 0.5-0.7%
Organic Carbon: 0.1%
Calcium Carbonate: 3-4%

CONSOLIDATION: Semi-lithified; 5-26 cm pieces comprise the core.

Explanatory notes in chapter 2

Site 253 Hole Core 54 Cored Interval: 497.5-507.0 m

AGE | FORAMS ZONE | NANNOS | FOSSIL CHARACTER: FORAMS, DISSOL. EFFECTS, NANNOS, SILICEOUS FOSS. ETC. | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION

Section 1: 0.5, 1.0; VOID; 5G 5/1; 5GY 4/2

Section 2: KE; CC, GZ, XM

Section 3: Clasts grade lighter green (5GY 7/4); Angular 3 x 3 cm N3 scoria clast; -do-

Section 4: RP, O; No 5G 7/4 clasts. Few % white carbonate and 7.5YR 6/8 1-2 mm specks

Section 5: CC, GZ, XM; KE

Core Catcher: B, B; 5GY 4/2

Medium olive green and minor light greenish gray ALTERED VITRIC VOLCANIC ASH, the matrix texturally medium to fine sand; about 15% lapilli up to 3 cm in size which are dark to light green, and dark gray (pumice?). In Sec. 4, a few 1-2 mm white and orange specks of zeolite.

Total Carbon: 0.5-0.7%
Organic Carbon: 0.1-0.2%
Calcium Carbonate: 3-5%

Explanatory notes in chapter 2

Site 253 Hole Core 55 Cored Interval: 507.0-516.5 m

AGE	FORAMS ZONE	NANNOS ZONE	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE		NP13-NP16					1	0.5, 1.0	VOID			To Section 2, 130 cm: Medium olive green and grayish green ALTERED VITRIC VOLCANIC ASH, texturally medium to fine sand; with few orange specks. Below Section 2, 130 cm: SAME, grading into greenish black fine sand with few light green 2 mm clasts which are locally larger, as indicated. 5GY 4/2 Total Carbon: 5.1% Organic Carbon: 0.2% Calcium Carbonate: 41% CONSOLIDATION: Semi-lithified; several centimeters to 20 cm long.
							2				KE,CC XM HO GZ	5YR 3/1 fine sand + 5G 7/4 silt 10G 4/2 silt; no clasts 5G 4/1 coarse sand, 1-2% 5YR 2/1 clasts 5G 2/1, fine sand, few faint 2 mm 5G 7/4 clasts
							3				*	0.5 x 2 cm 10G 5/2 clast
							4					1 x 1.5 cm 10G 5/2 clast 3 x 2 cm 10G 5/2 clast
			RM	0	CMO		Core Catcher					5G 2/1

Explanatory notes in chapter 2

Site 253 Hole Core 56 Cored Interval: 516.5-526.0 m

AGE	FORAMS ZONE	NANNOS ZONE	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE		NP13-NP16					1	0.5, 1.0	VOID			5Y 3/2 Greenish black and lesser olive gray ALTERED VITRIC VOLCANIC ASH; silt-sized, with very few light brown patches of partly unaltered glass, and gastropod fragment. Total Carbon: 0.7% Organic Carbon: 0.2% Calcium Carbonate: 4% CONSOLIDATION: Semi-lithified; core consists of 2 to 24 cm long pieces.
							2				KE HO CC GZ XM	pre-consolid. deformation structures six 0.5 x 0.7 cm brownish white glassy clasts 5G 2/1, silt, no clasts
							3					1 cm gastropod in cross sect.
			FP	0	CMO		Core Catcher					5G 2/1 silt

Explanatory notes in chapter 2

Site 253 Hole Core 57 Cored Interval: 545.0-554.5 m

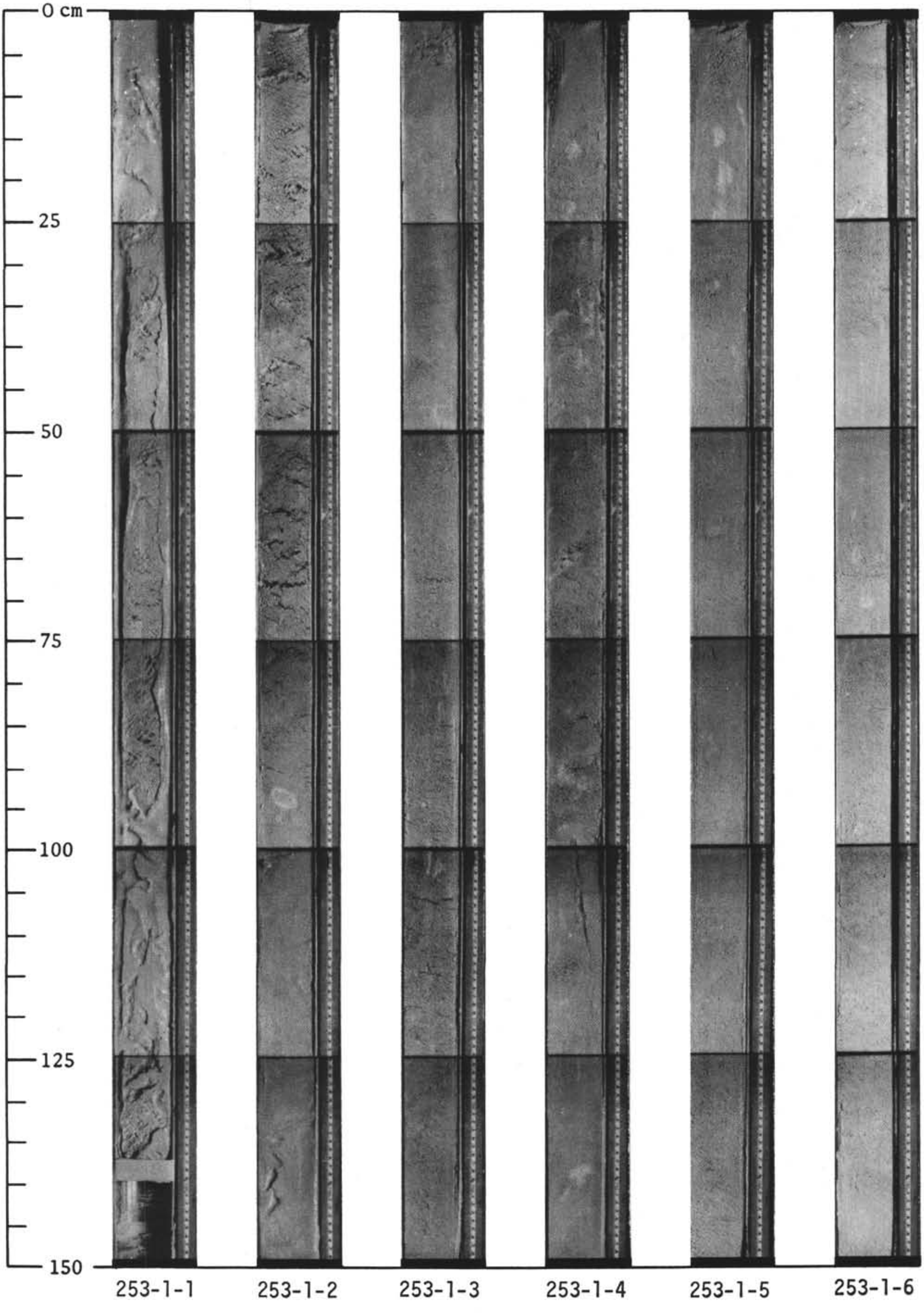
AGE	FORAMS ZONE	NANNOS ZONE	FOSSIL CHARACTER: FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS., ETC.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE		NP13-NP16					1	0.5, 1.0	VOID			5G 2/1 Lighter green with a few clasts 10G 6/2 coarse sand 5B 5/1
							2				CC XM GZ KE HO	Greenish black and medium bluish gray ALTERED VITRIC VOLCANIC ASH, the black ash being silt-sized without clasts, the gray being silt-to-fine-sand-sized. In places the color becomes lighter due to 1 mm light blebs, probably of fairly fresh glassy ash. Burrows, vertical or horizontal, 3-5 mm wide and 1 to 3 cm long, occur throughout the gray lithology. In Sec. 3, small subangular basalt clasts occur. Total Carbon: 1.1% Organic Carbon: 0.1% Calcium Carbonate: 8% CONSOLIDATION: Semi-lithified; 2-15 cm long pieces comprise the core.
							3				KE	Basalt clasts subangular, few mm to 0.7 x 1 cm
			RP	0	RMO		Core Catcher					5B 5/1 fine sand-silt

Explanatory notes in chapter 2

Site 253 Hole Core 58 Cored Interval: 558.0-559.0 m

AGE	ZONE		FOSSIL CHARACTER				SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
	FORAMS	NANNOS	FORAMS	DISSOL. EFFECTS	NANNOS	SILICEOUS FOSS. ETC.						
							1	0.5 1.0	VOID		TS *KE	[Bit sample] Grayish black fine-grained OLIVINE-RICH PICRITIC BASALT. 4 pieces: 1. 8.5 cm 2. 15.6 cm 3. 5.5 cm 4. 6.5 cm

Explanatory notes in chapter 2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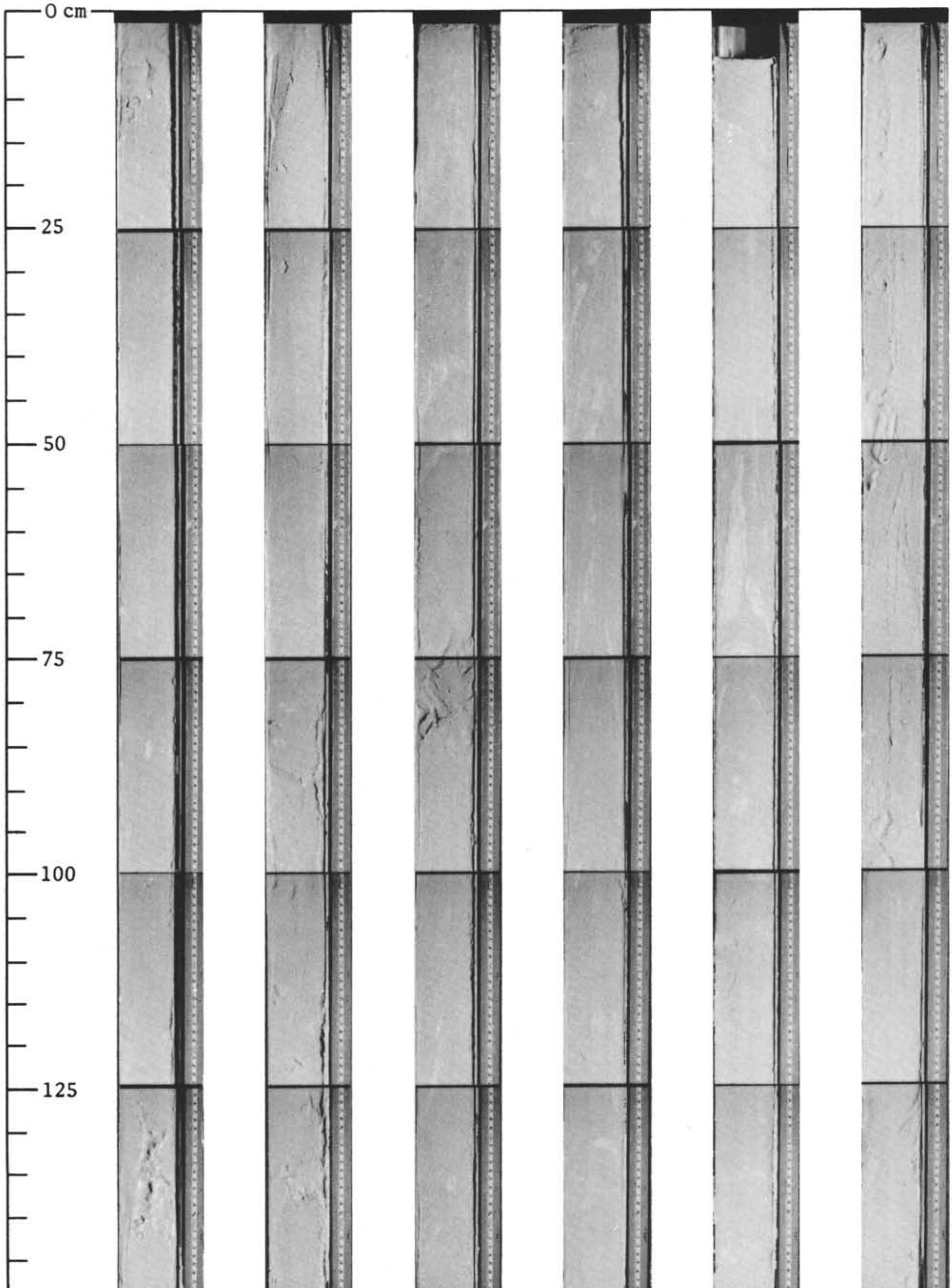
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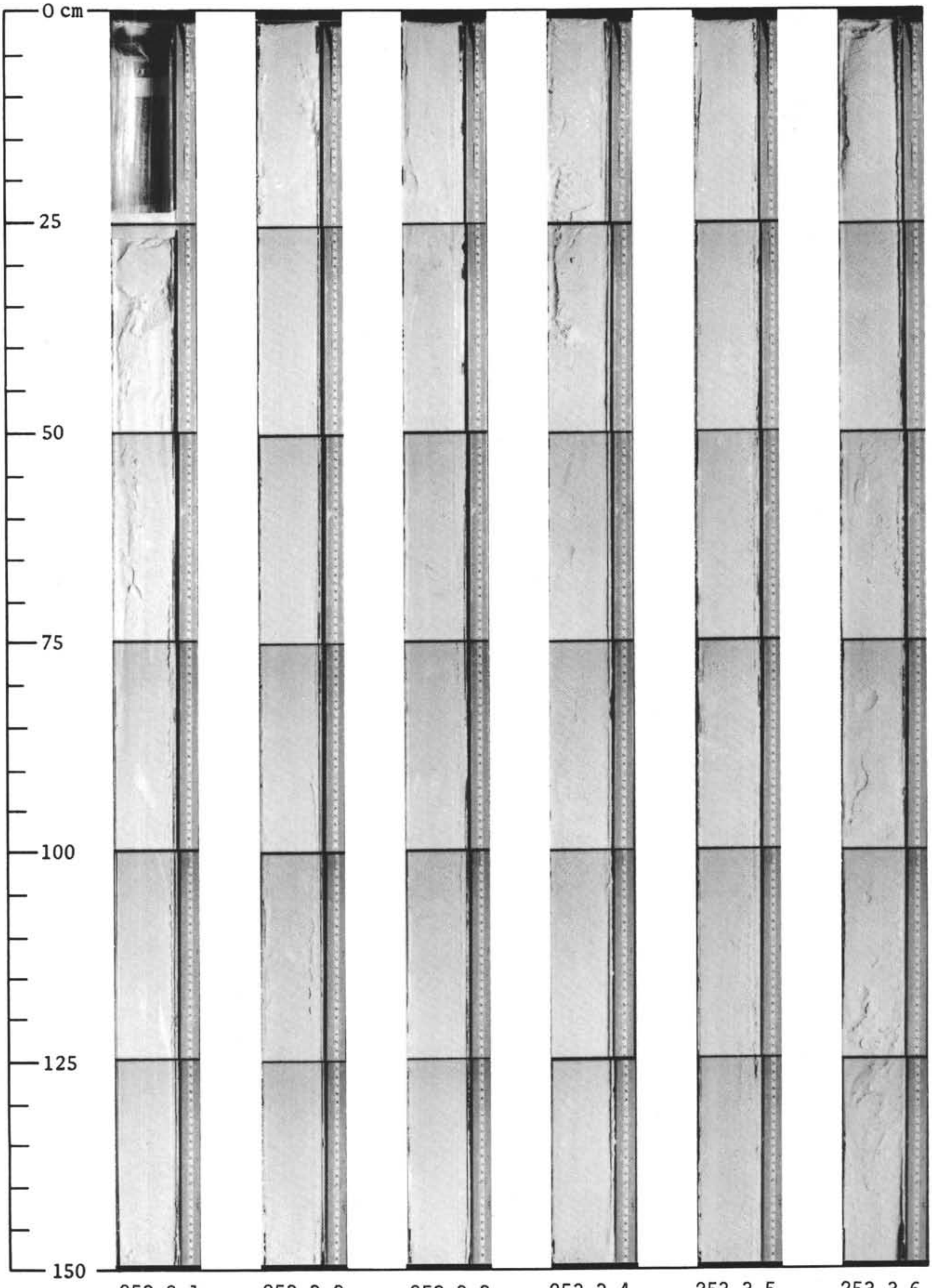

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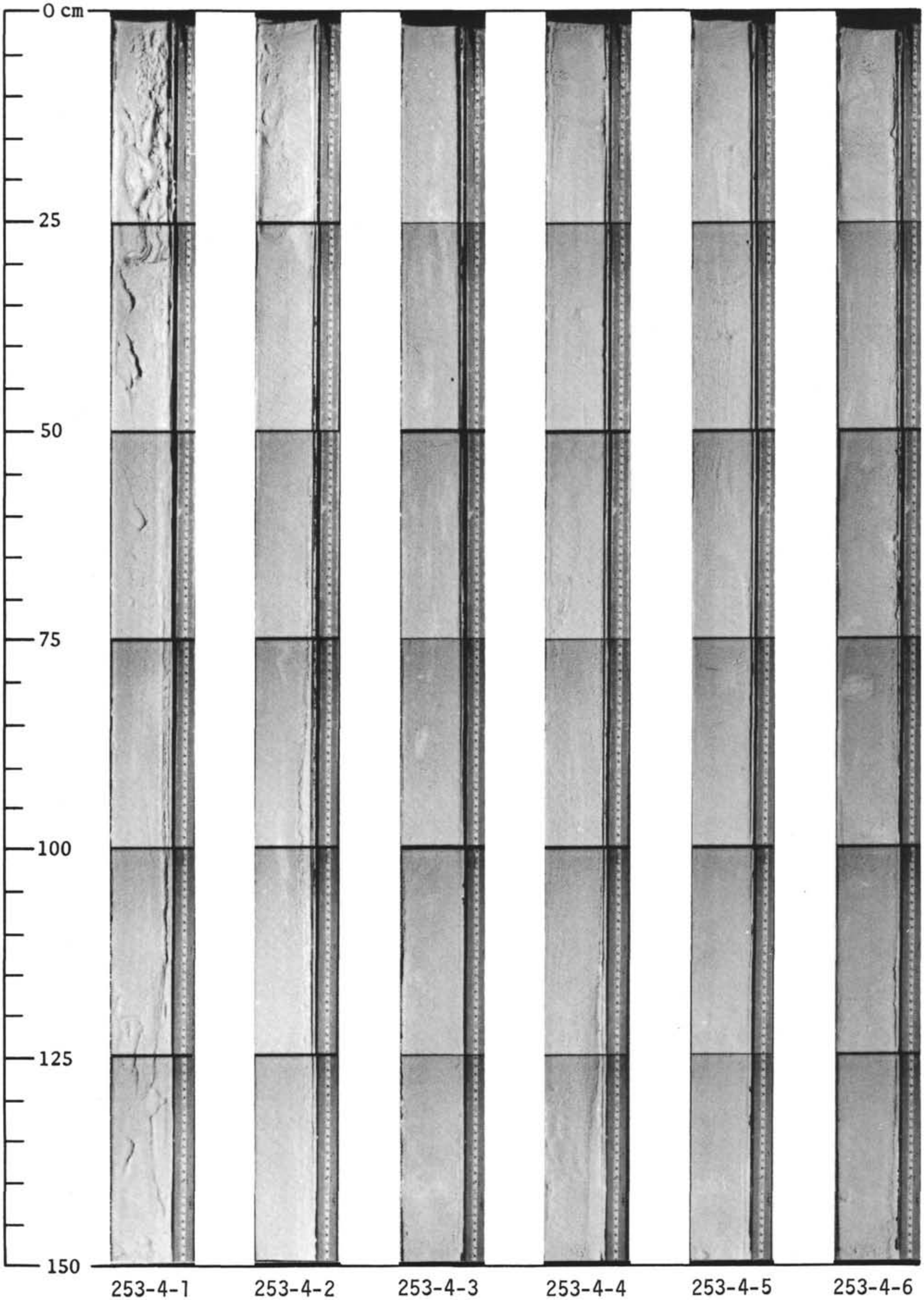
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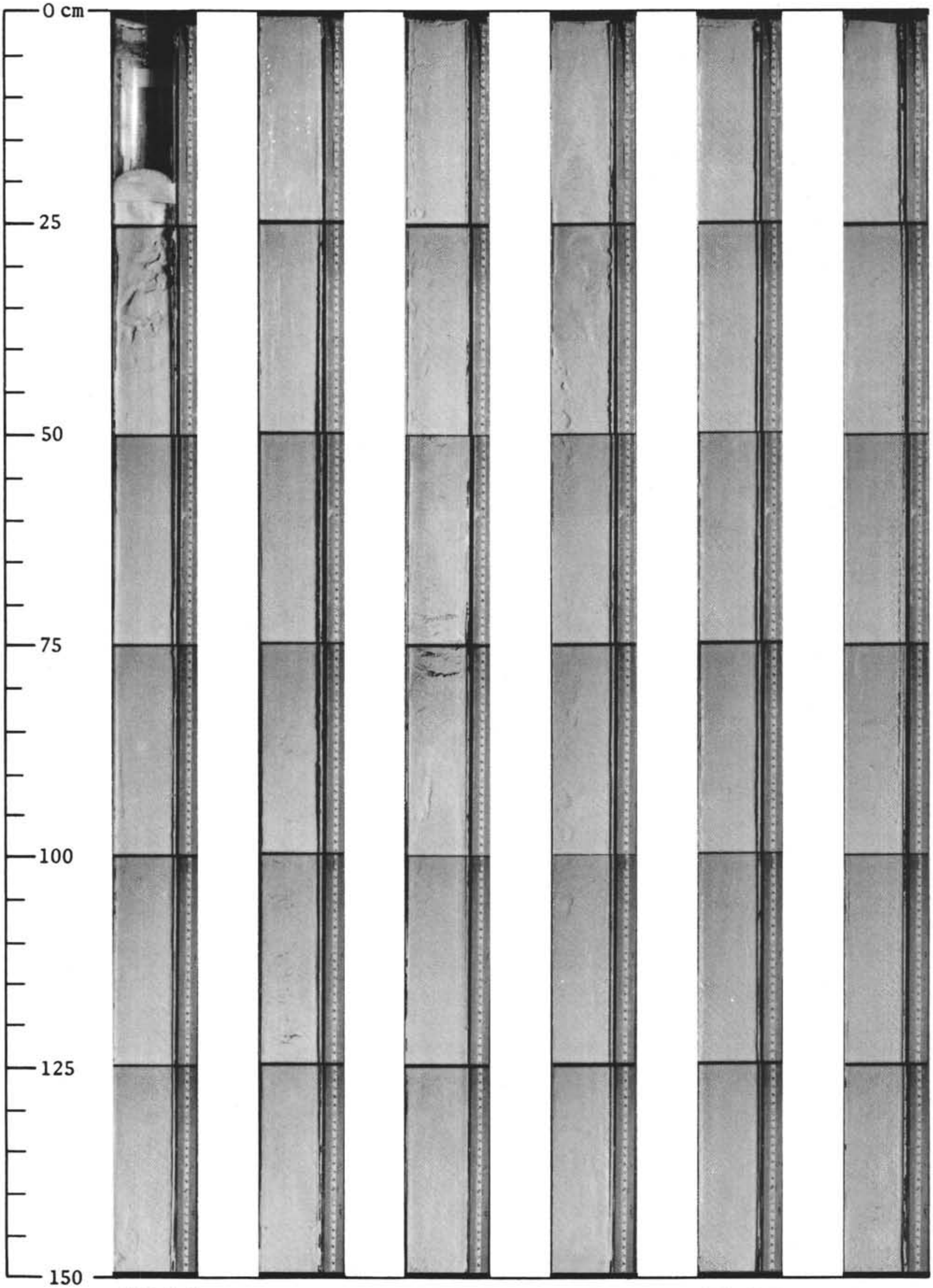
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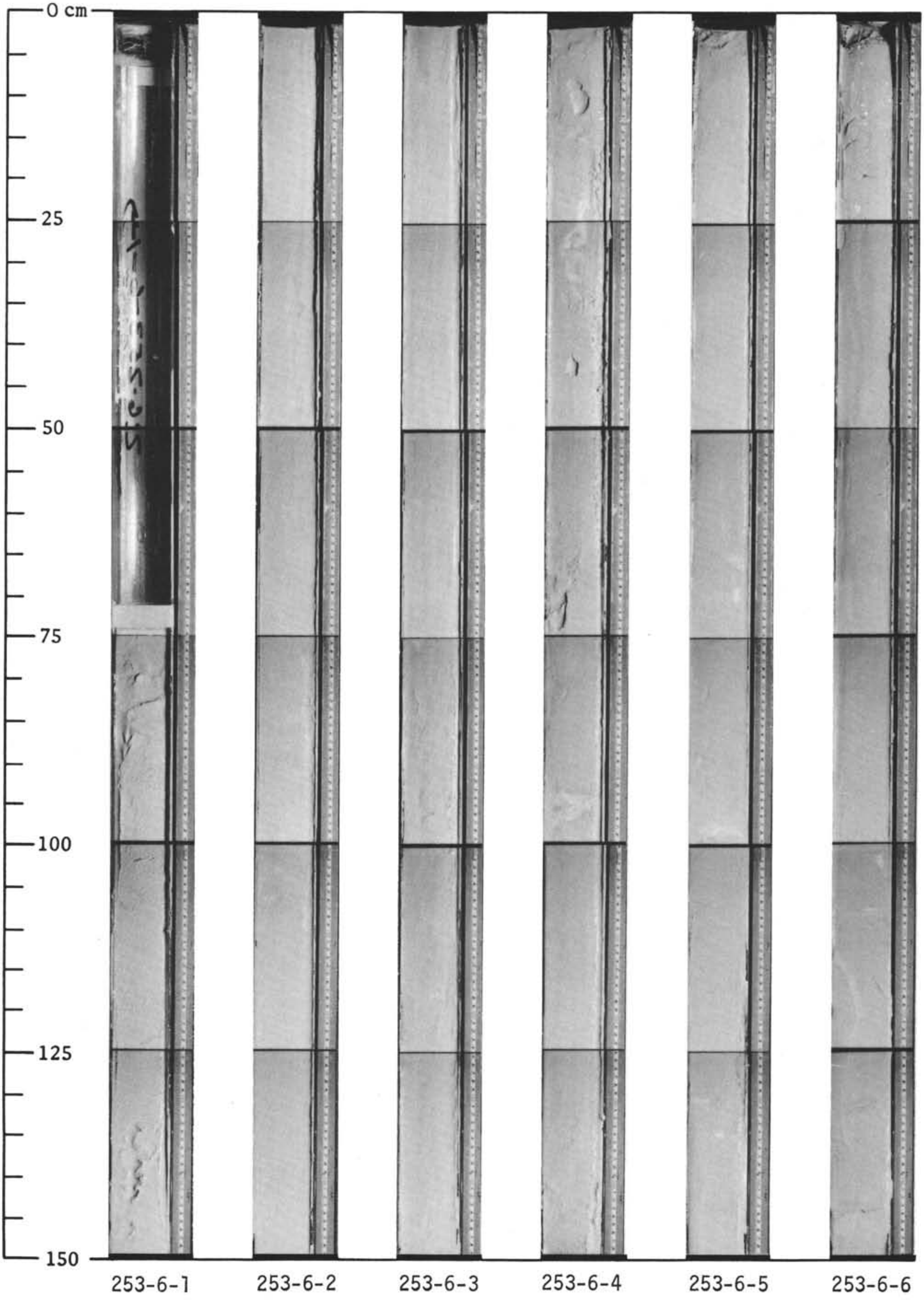
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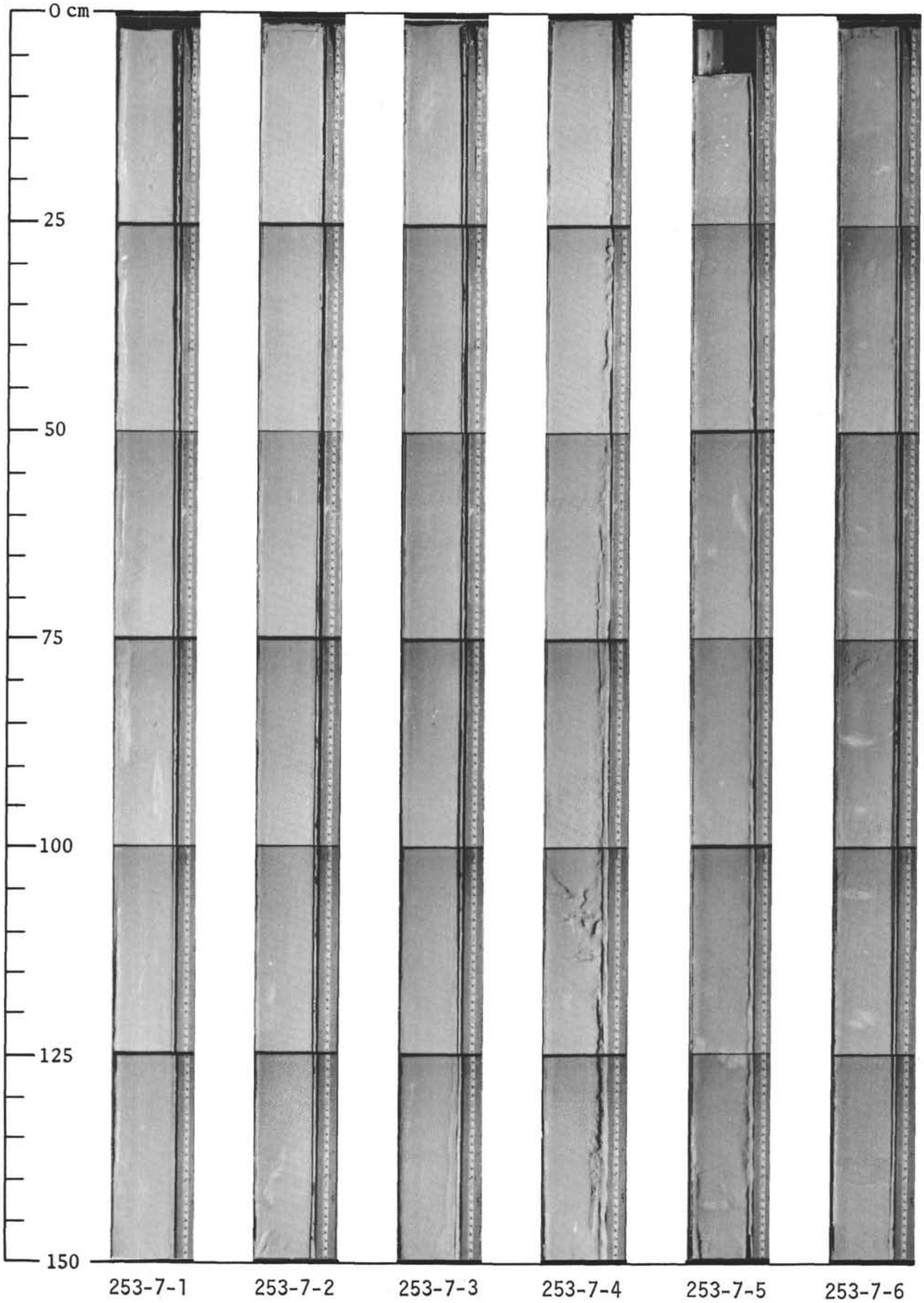
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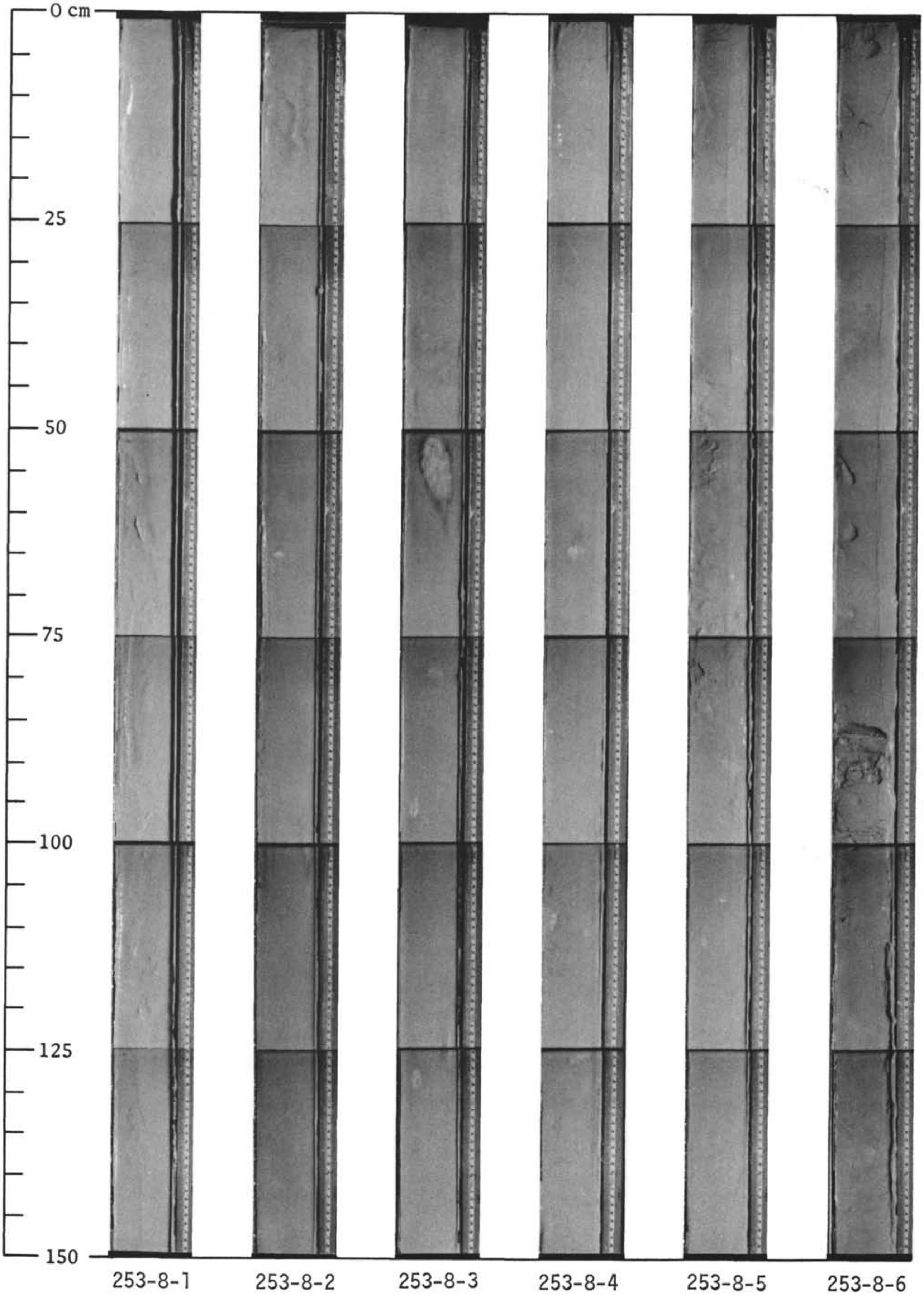
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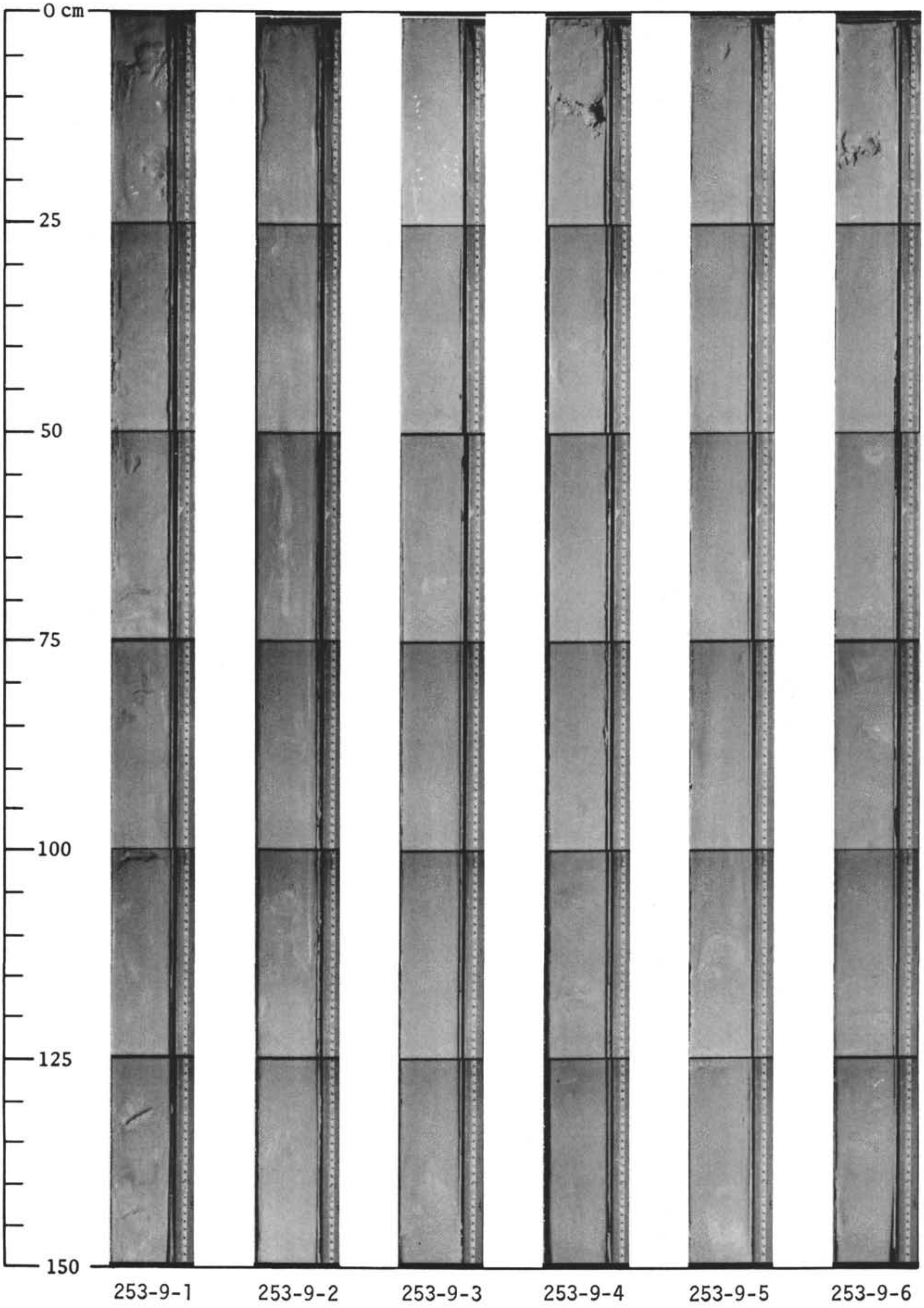
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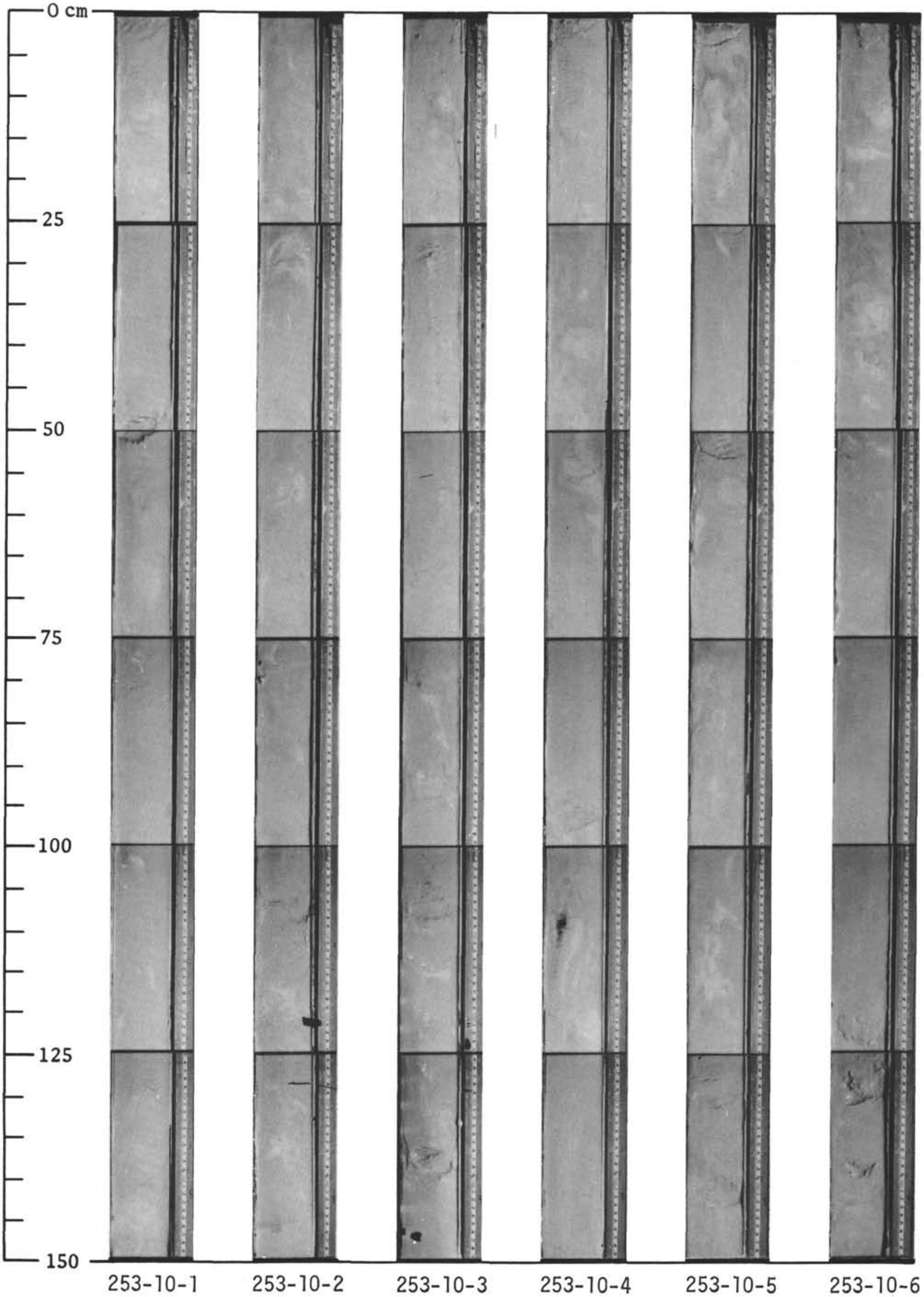
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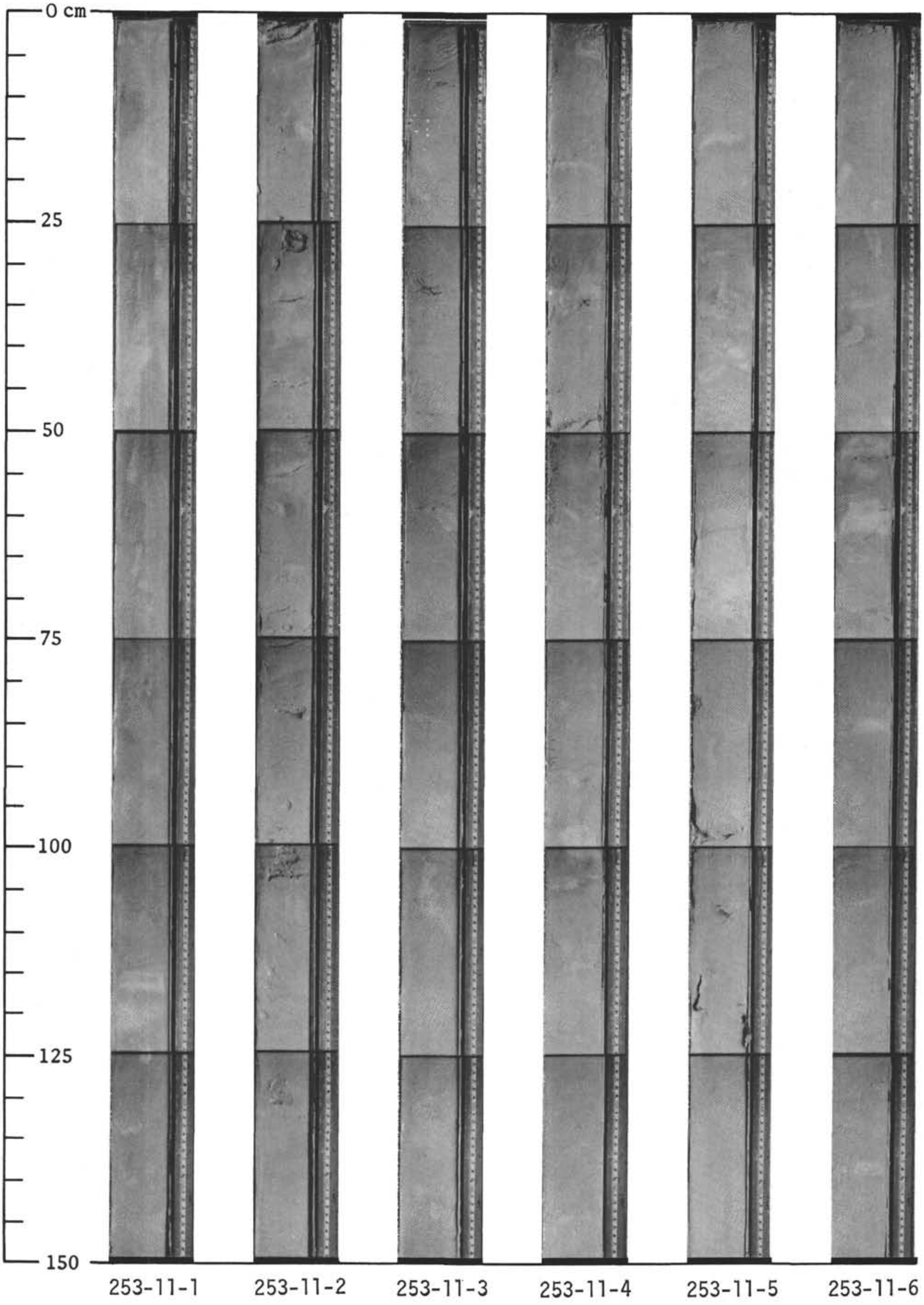
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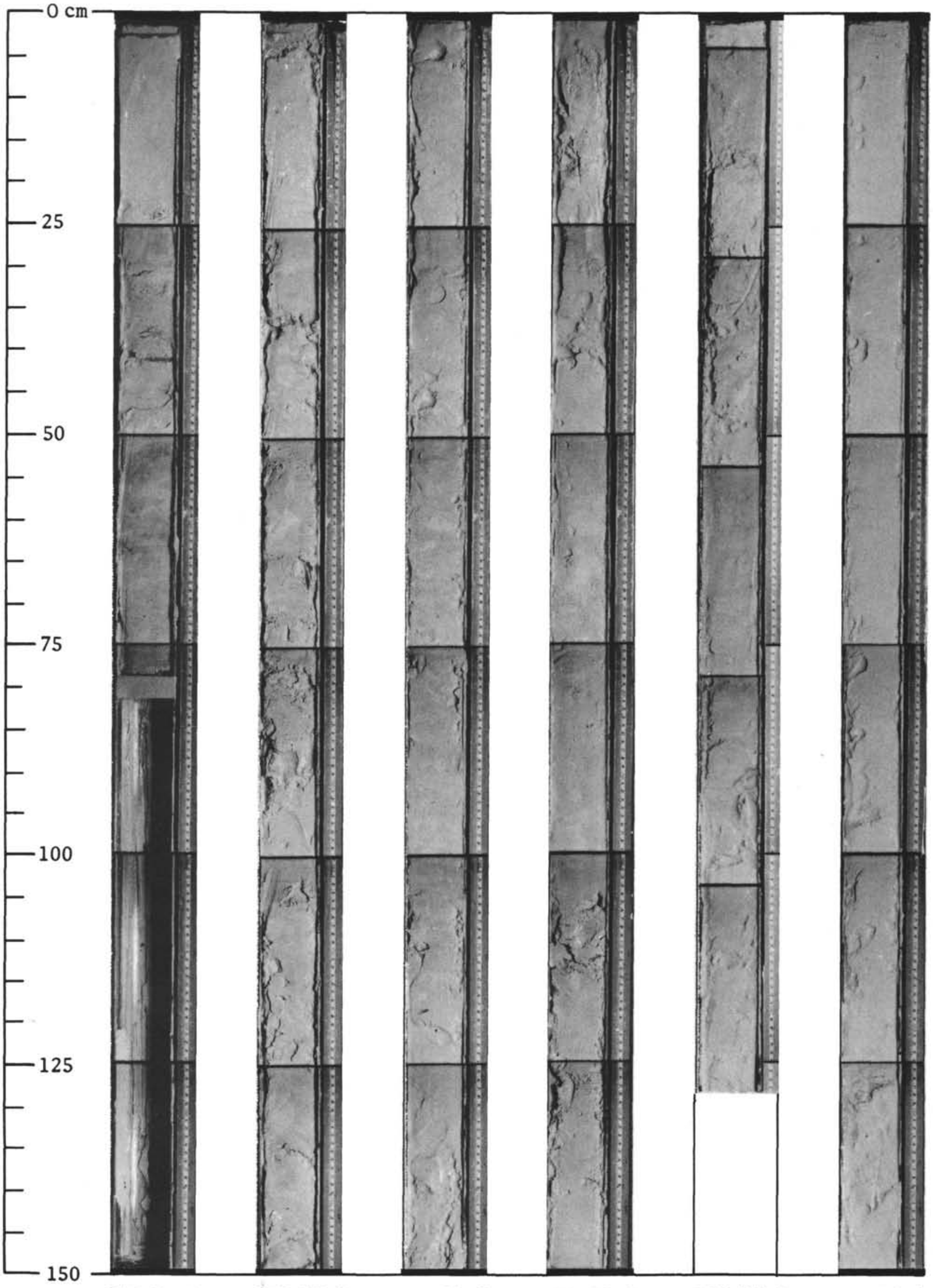
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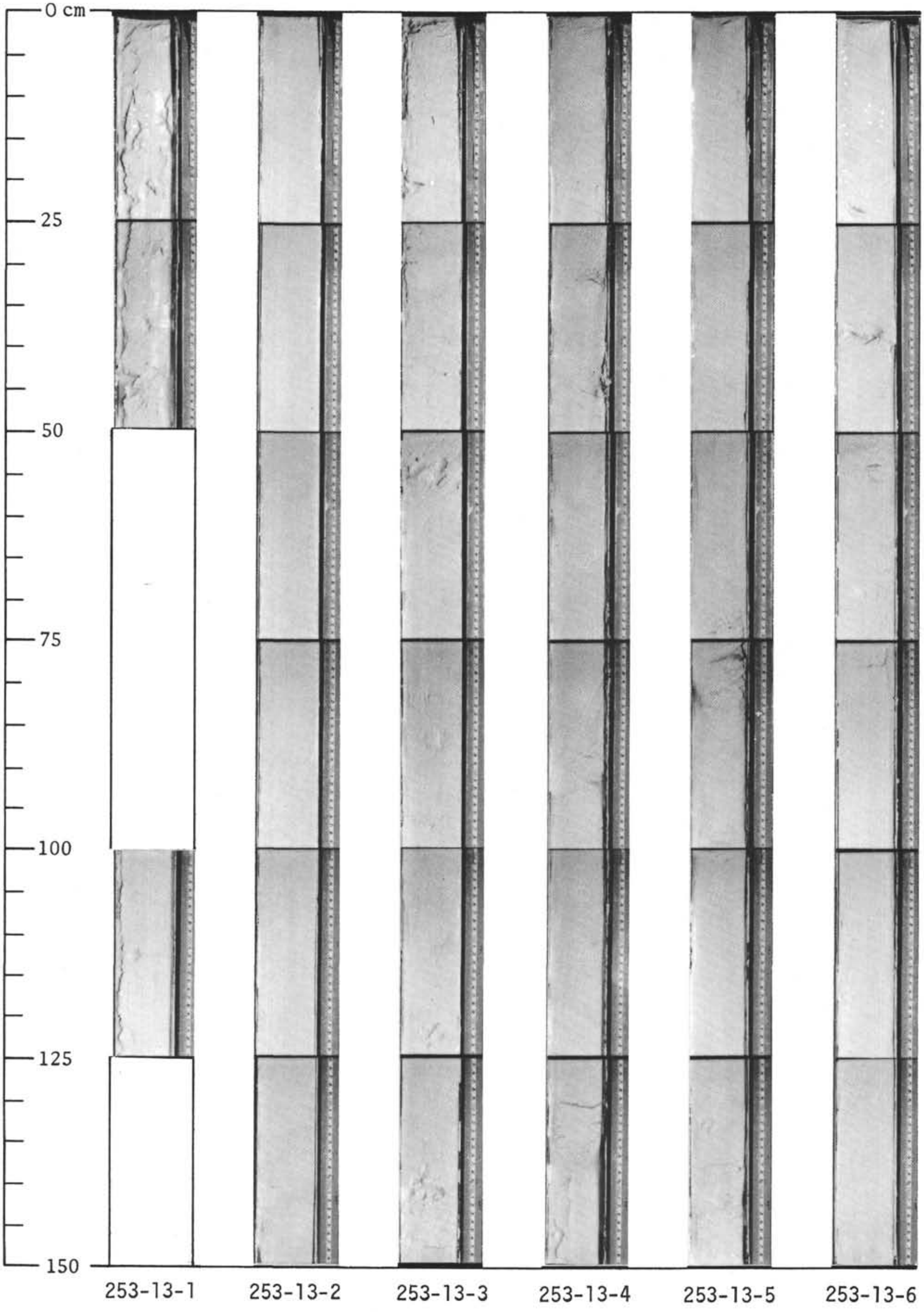
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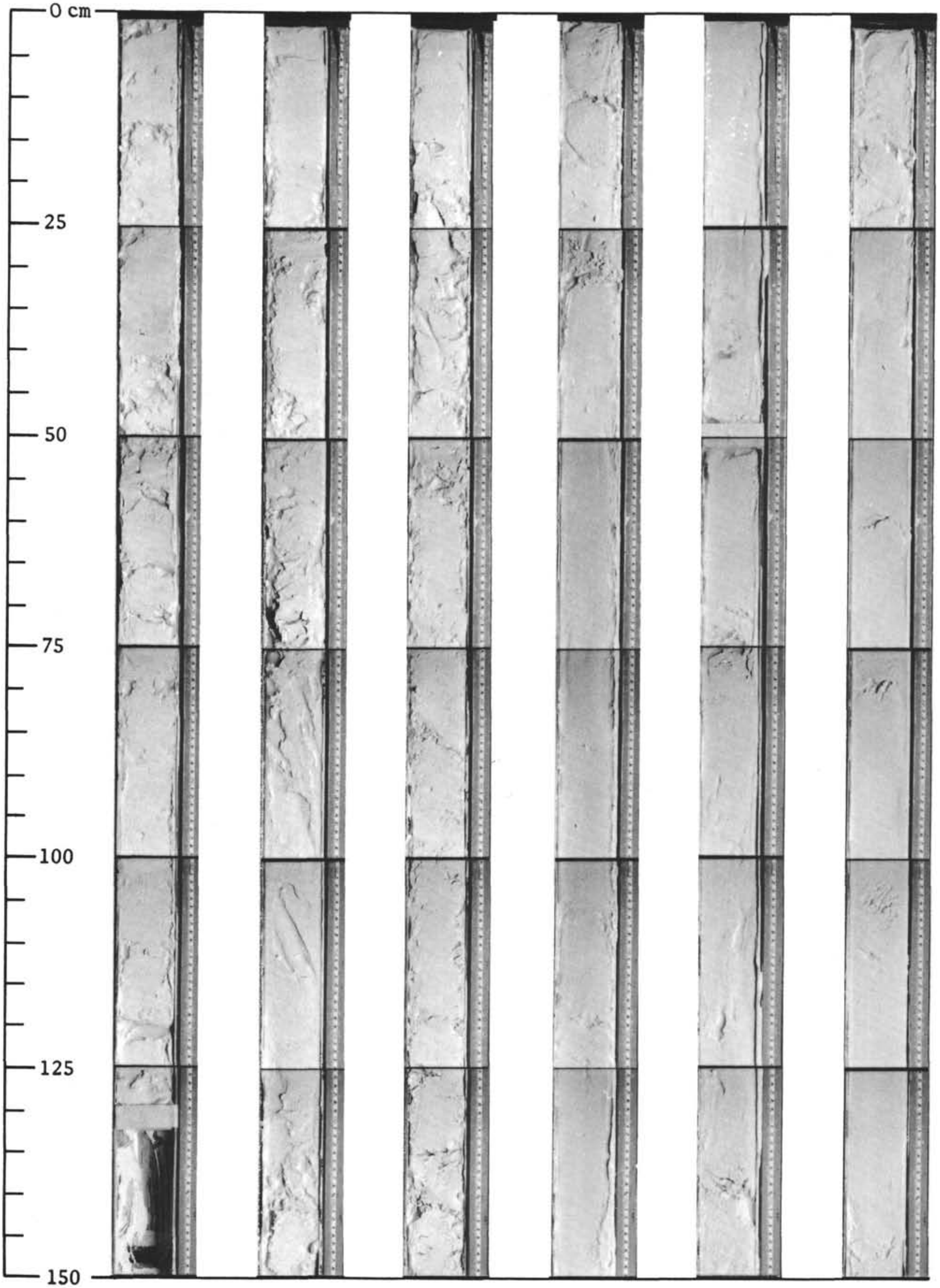
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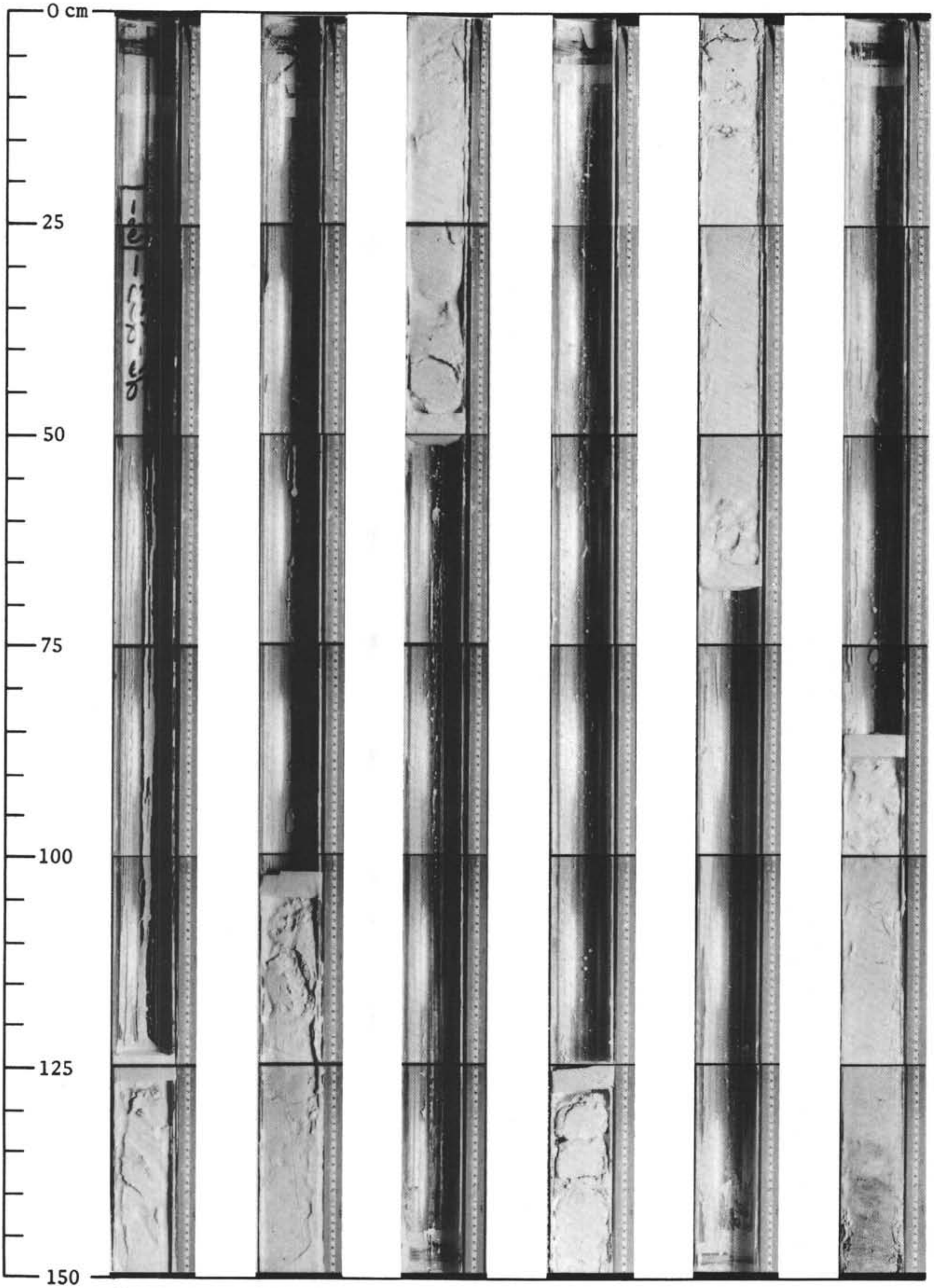

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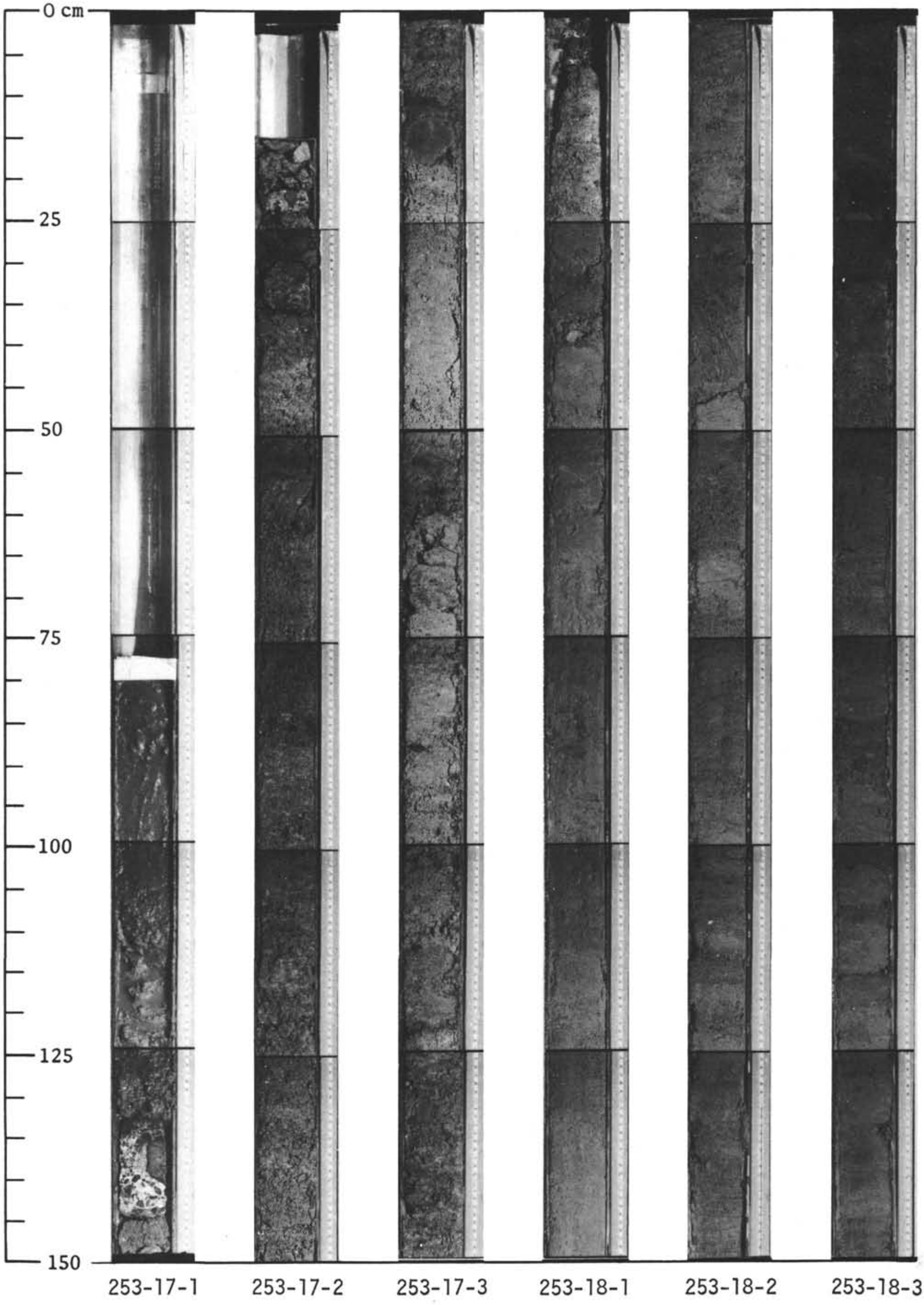
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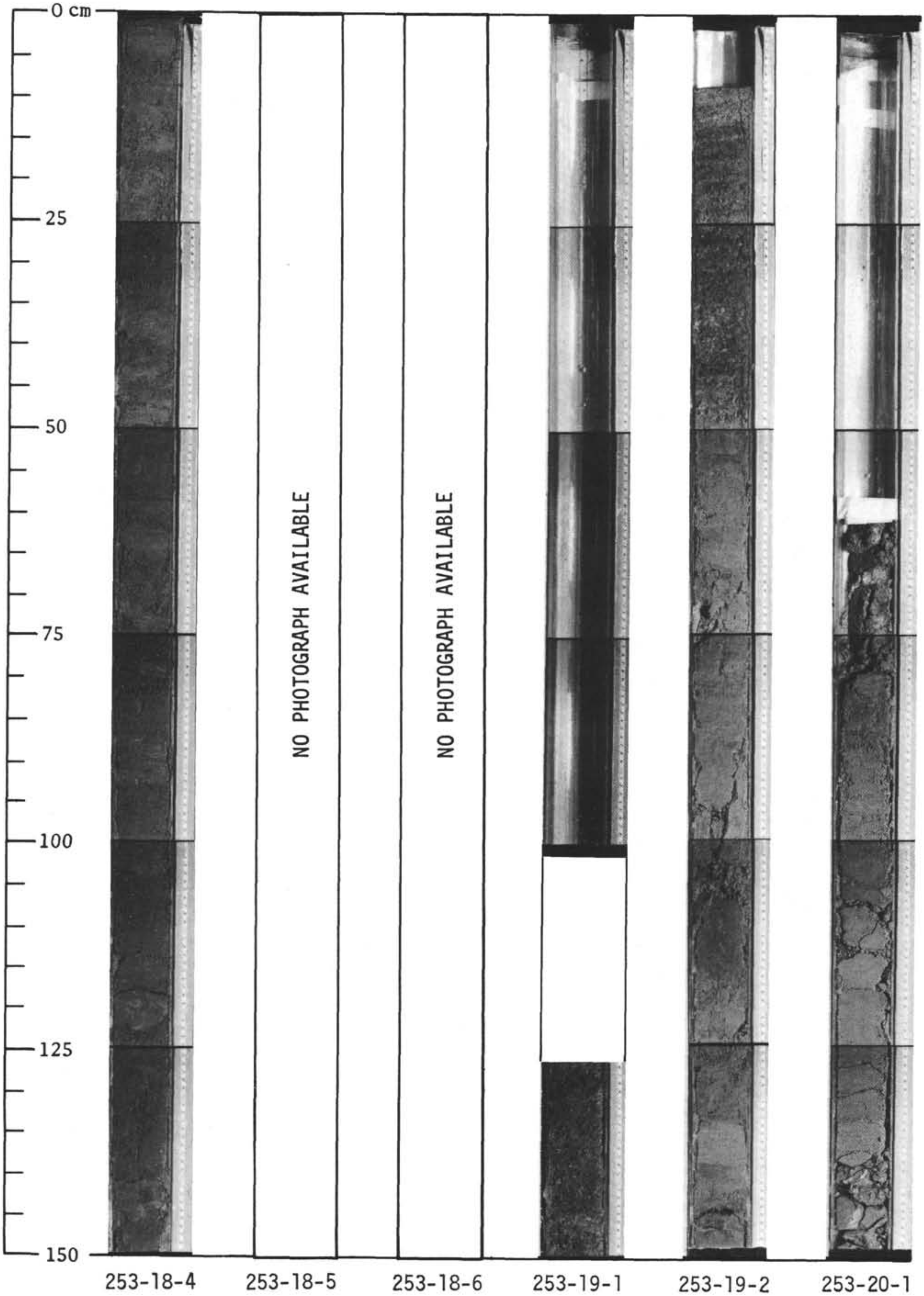
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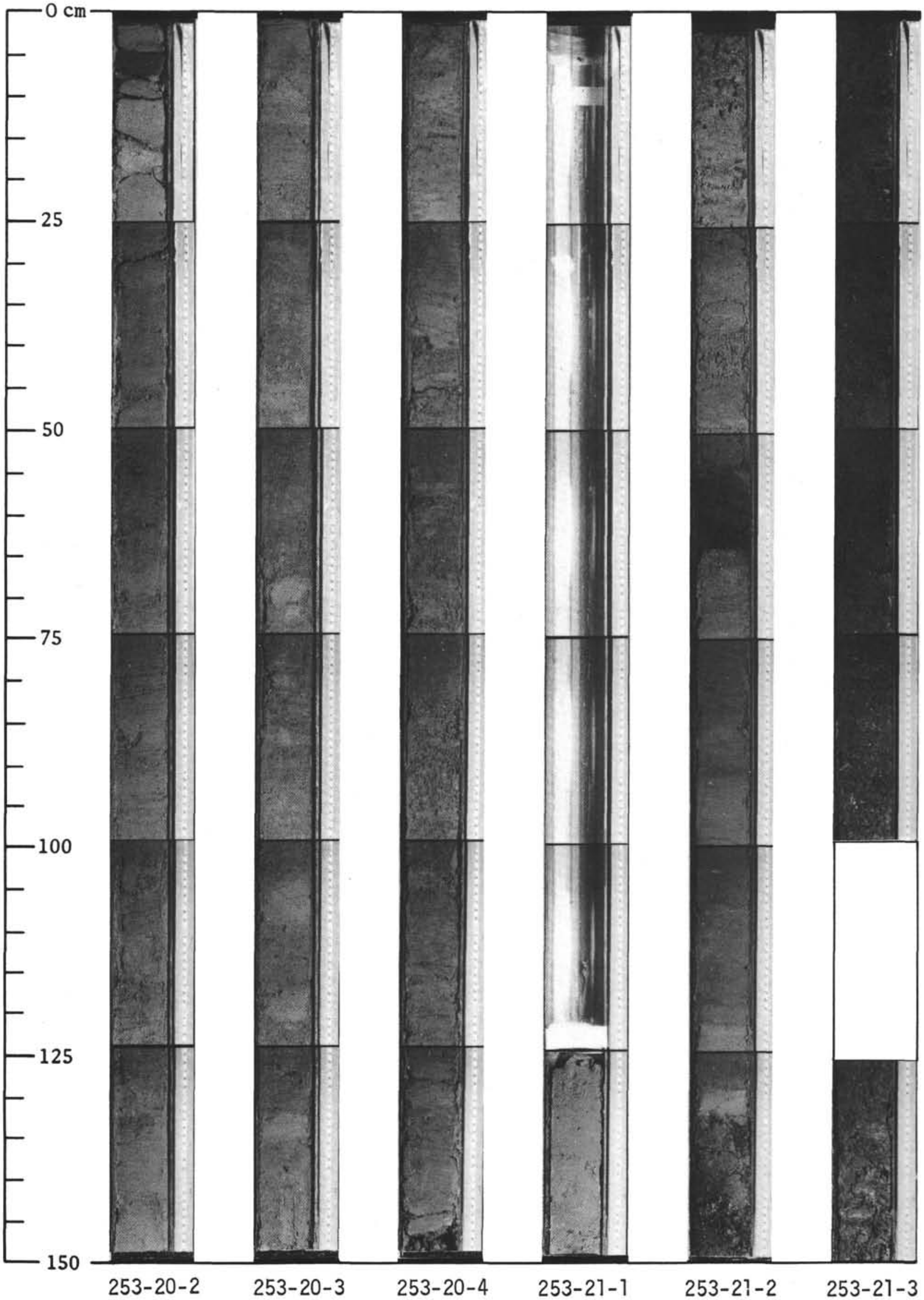
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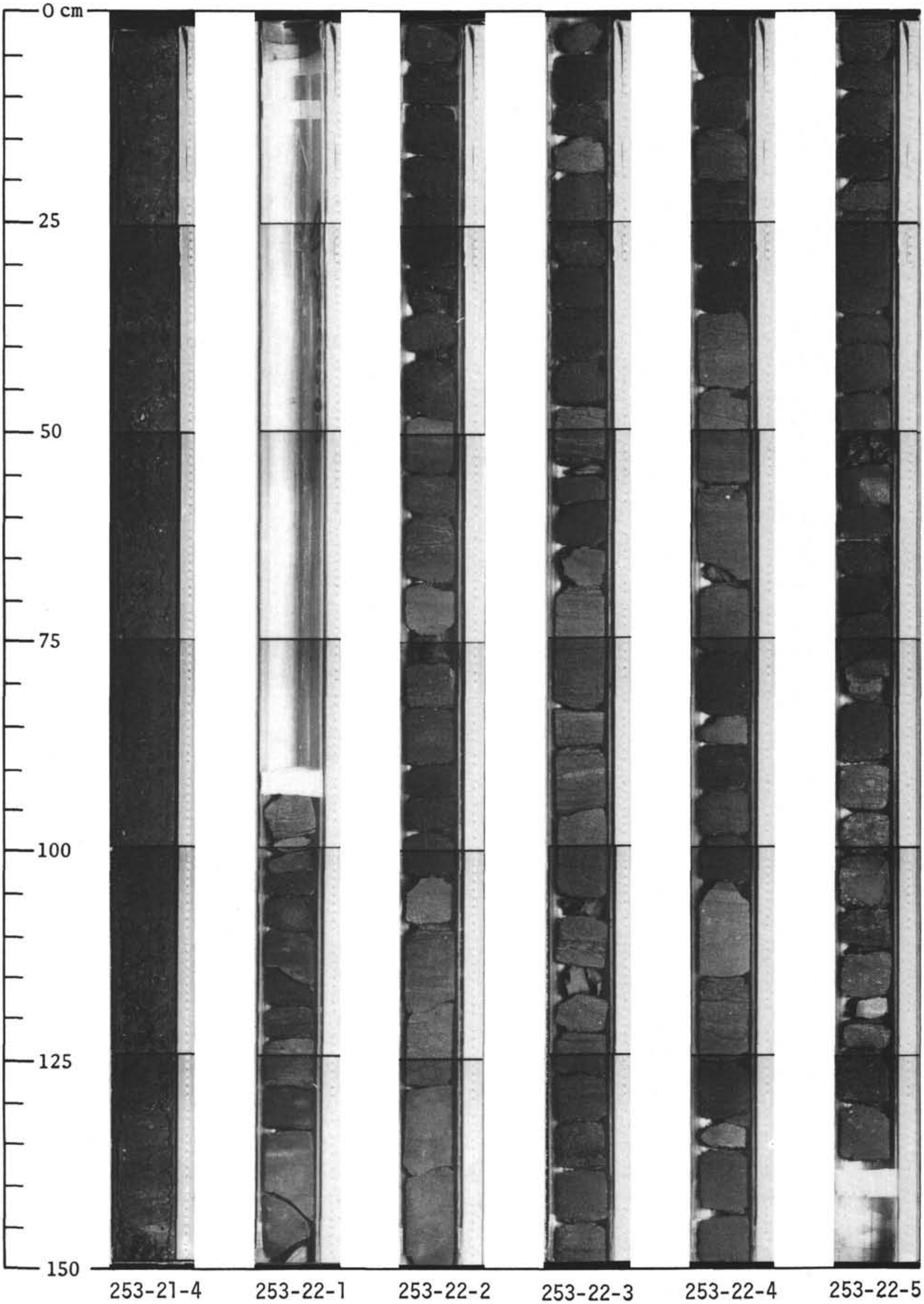
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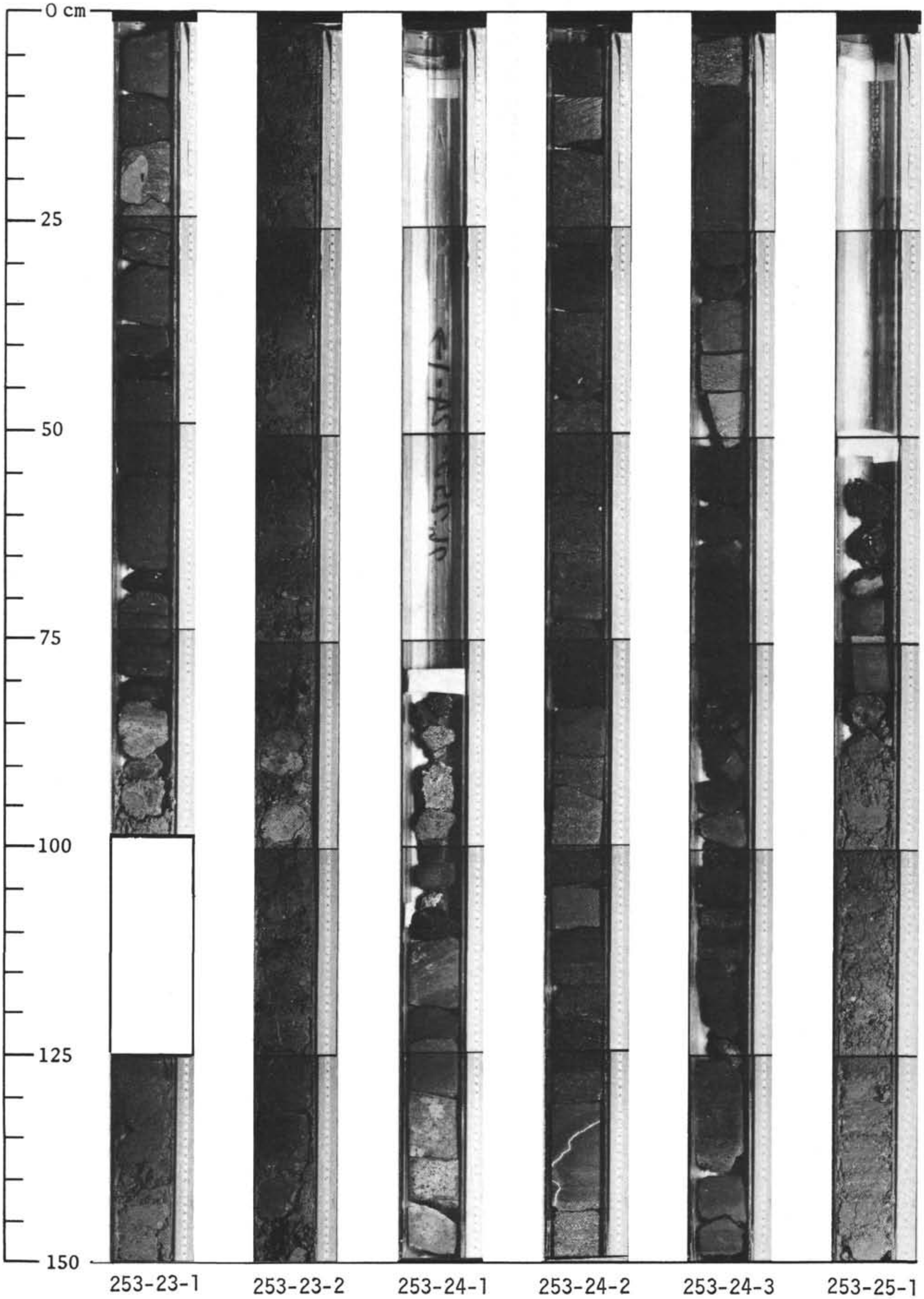
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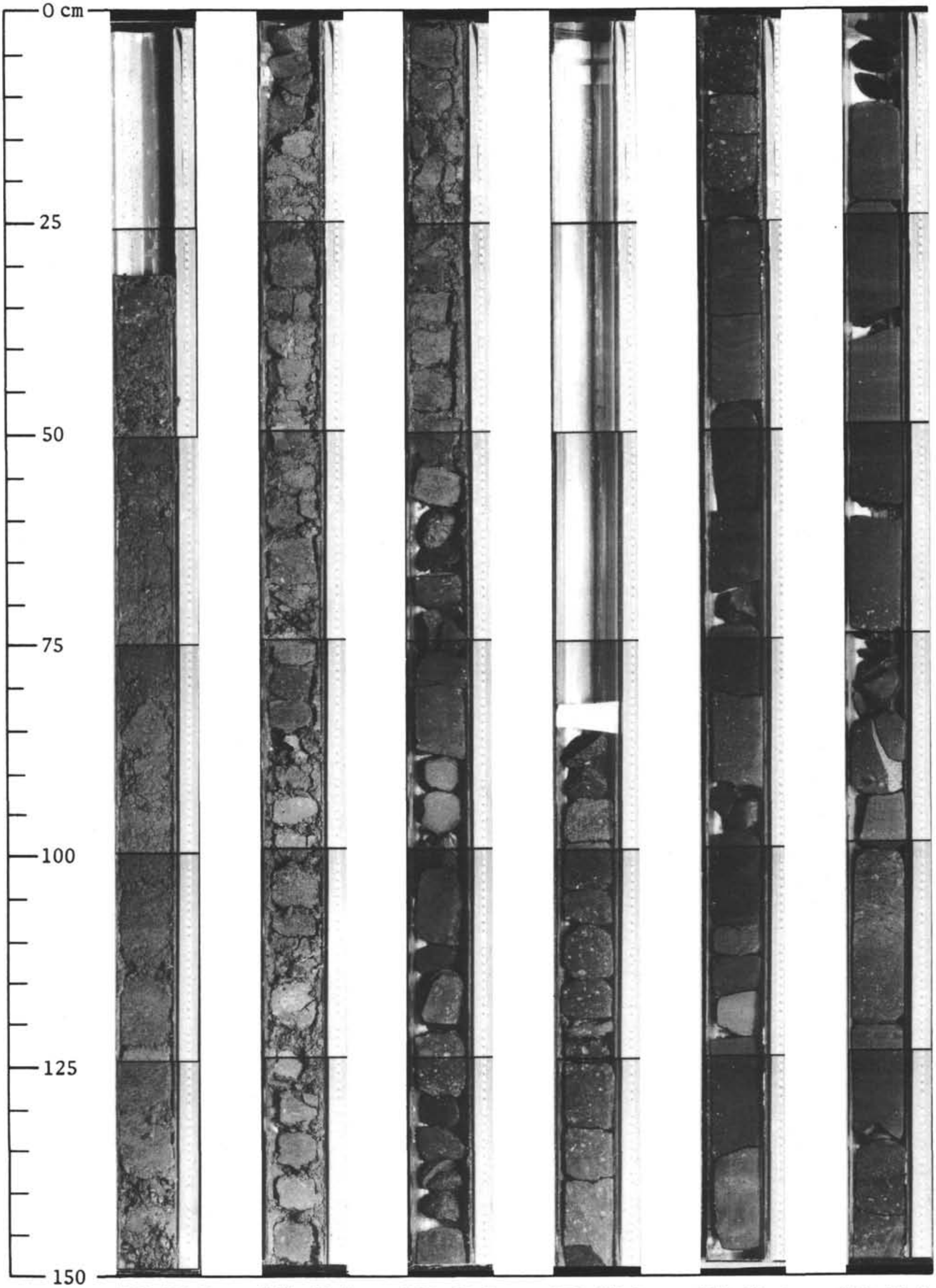
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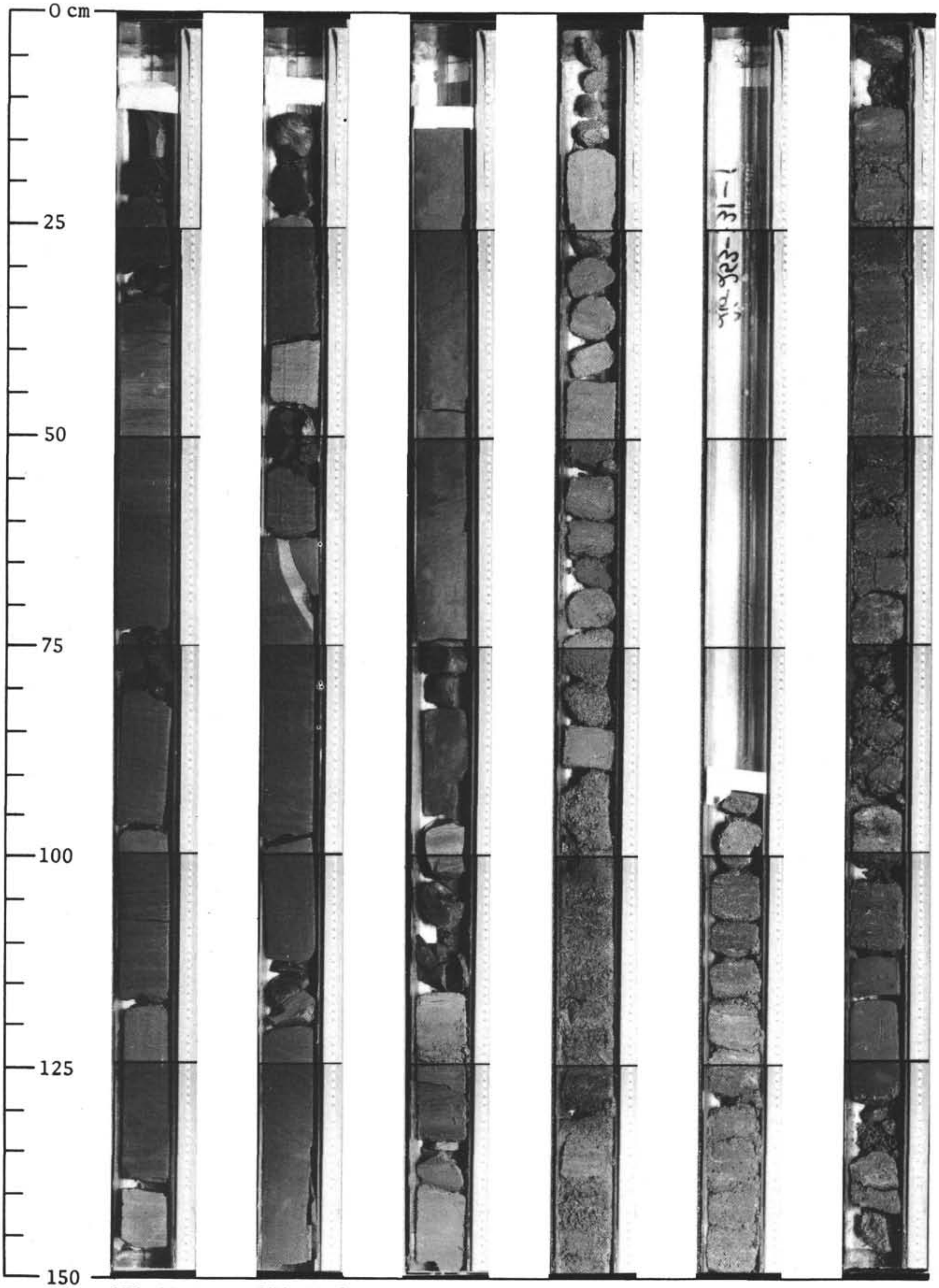

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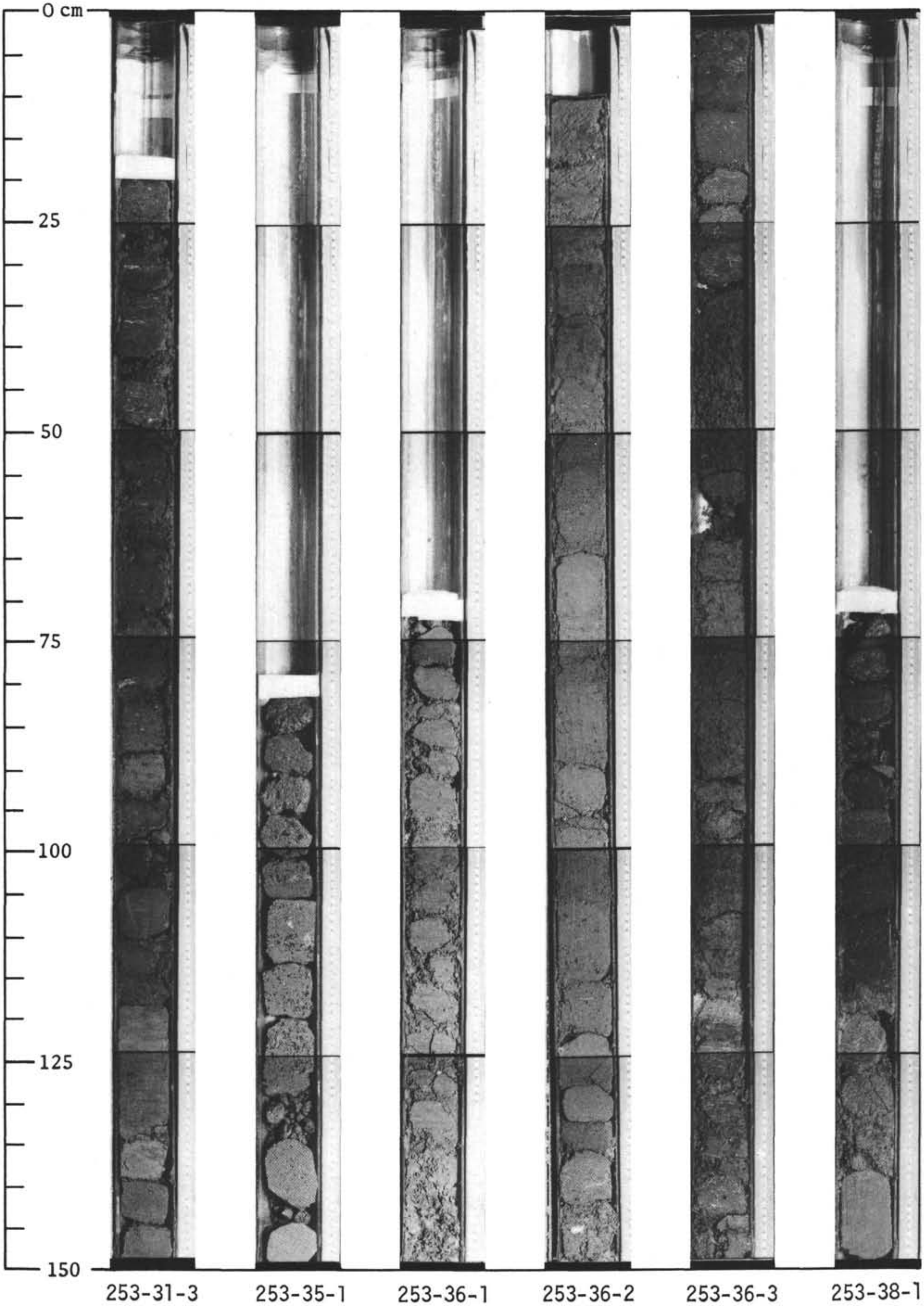
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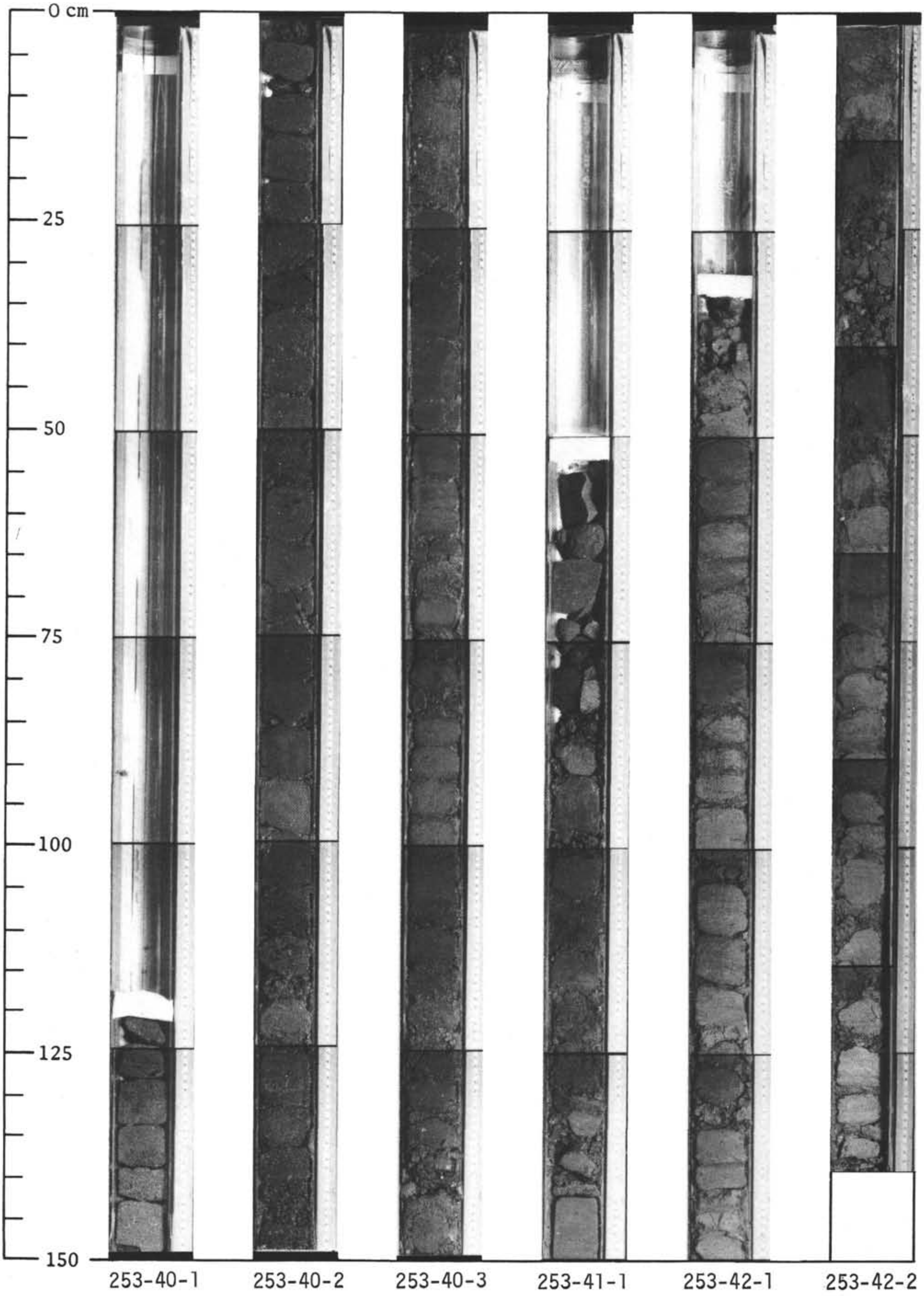
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253-41-1
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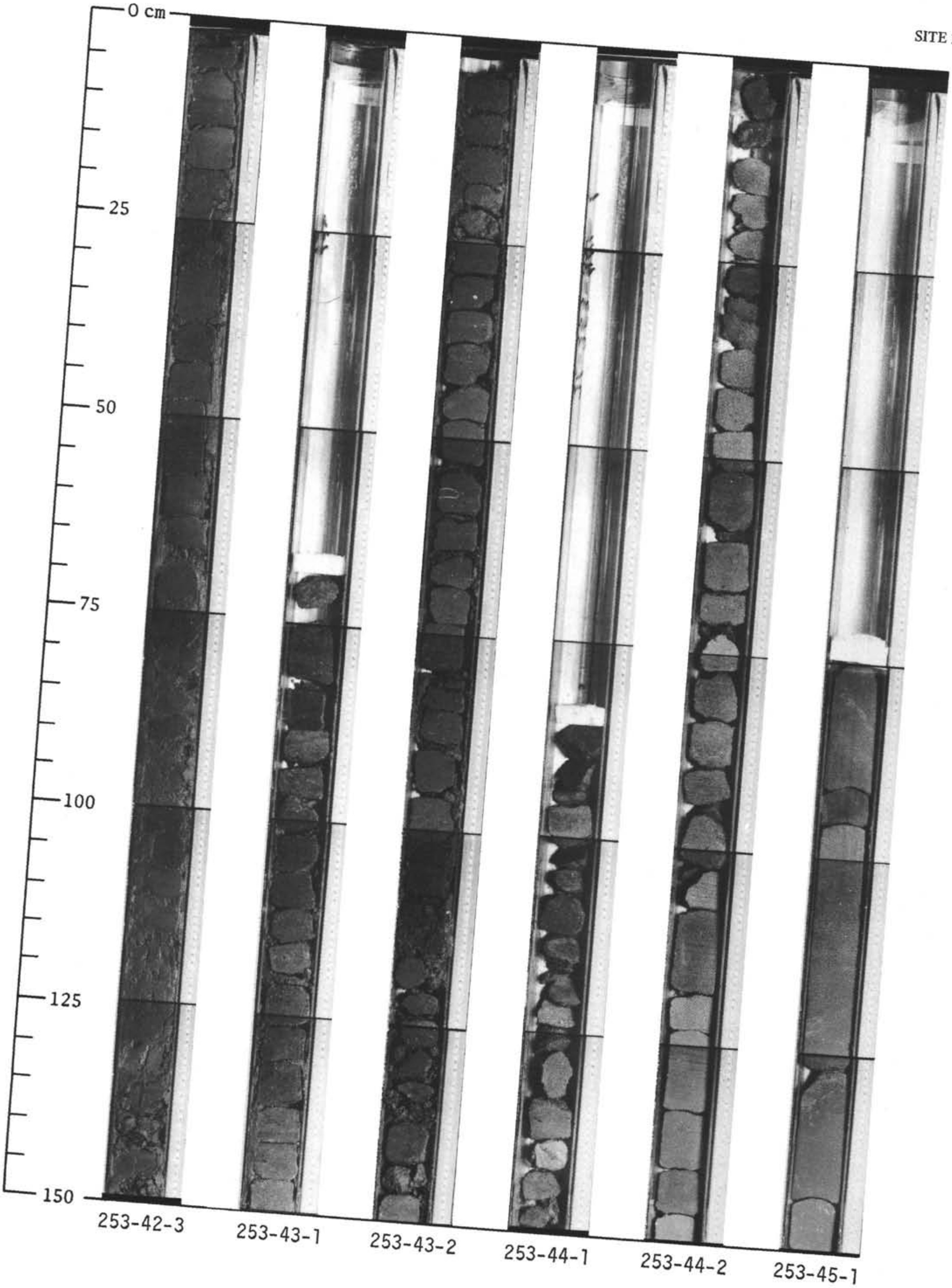
253-42-2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75
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125
150
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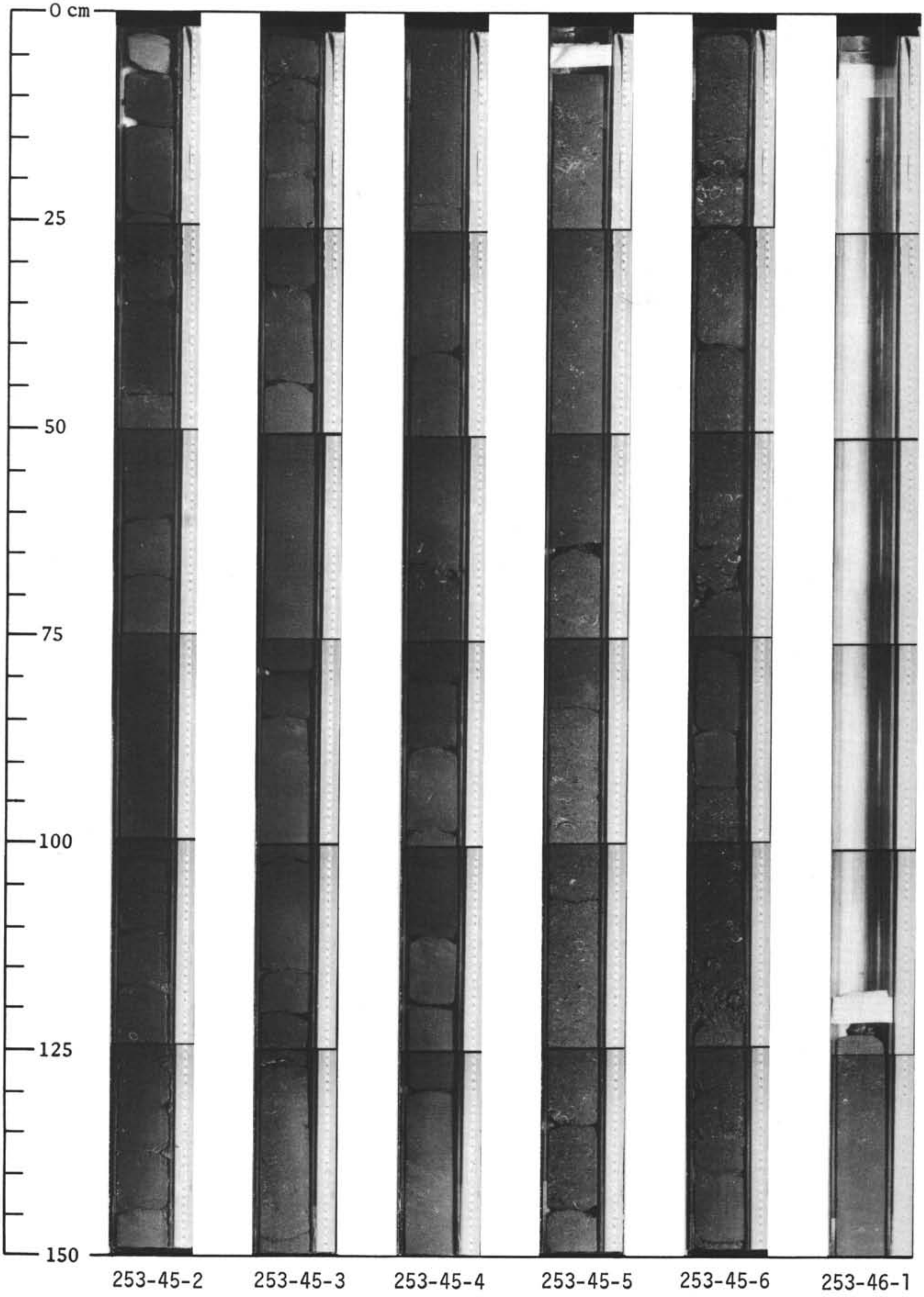
253-43-1
253-43-2
253-44-1
253-44-2
253-45-1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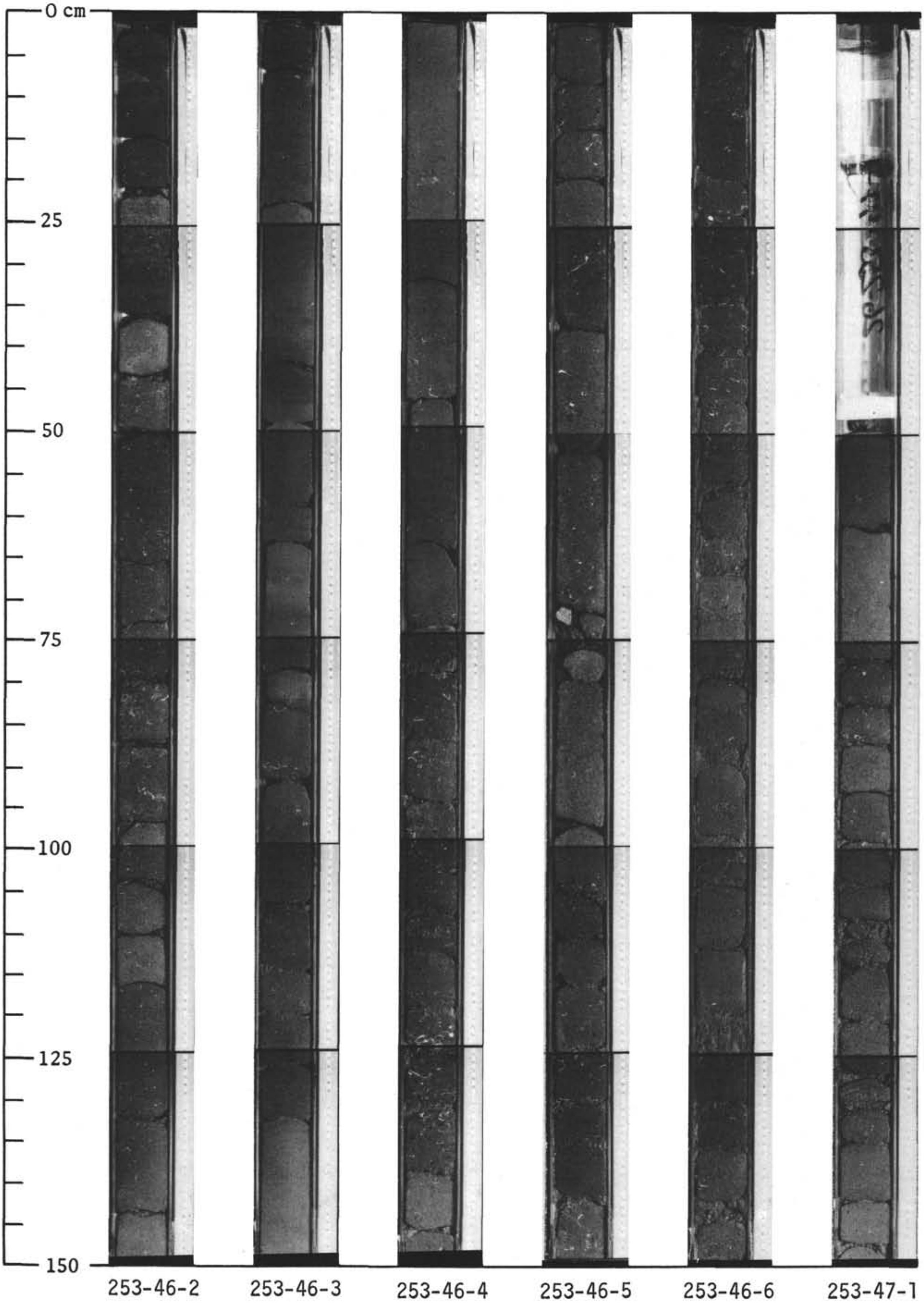
253-45-4
253-45-5
253-45-6
253-46-1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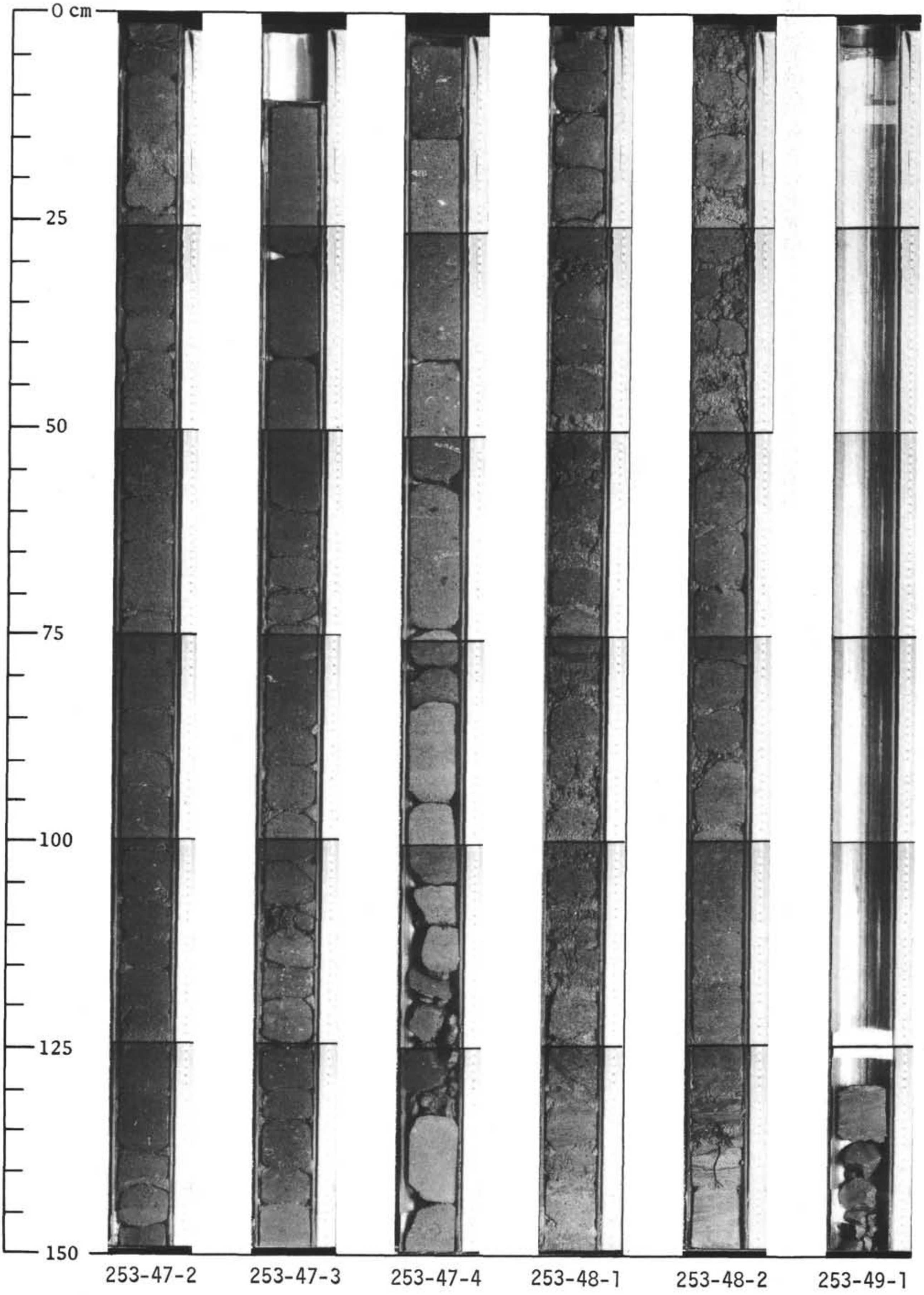
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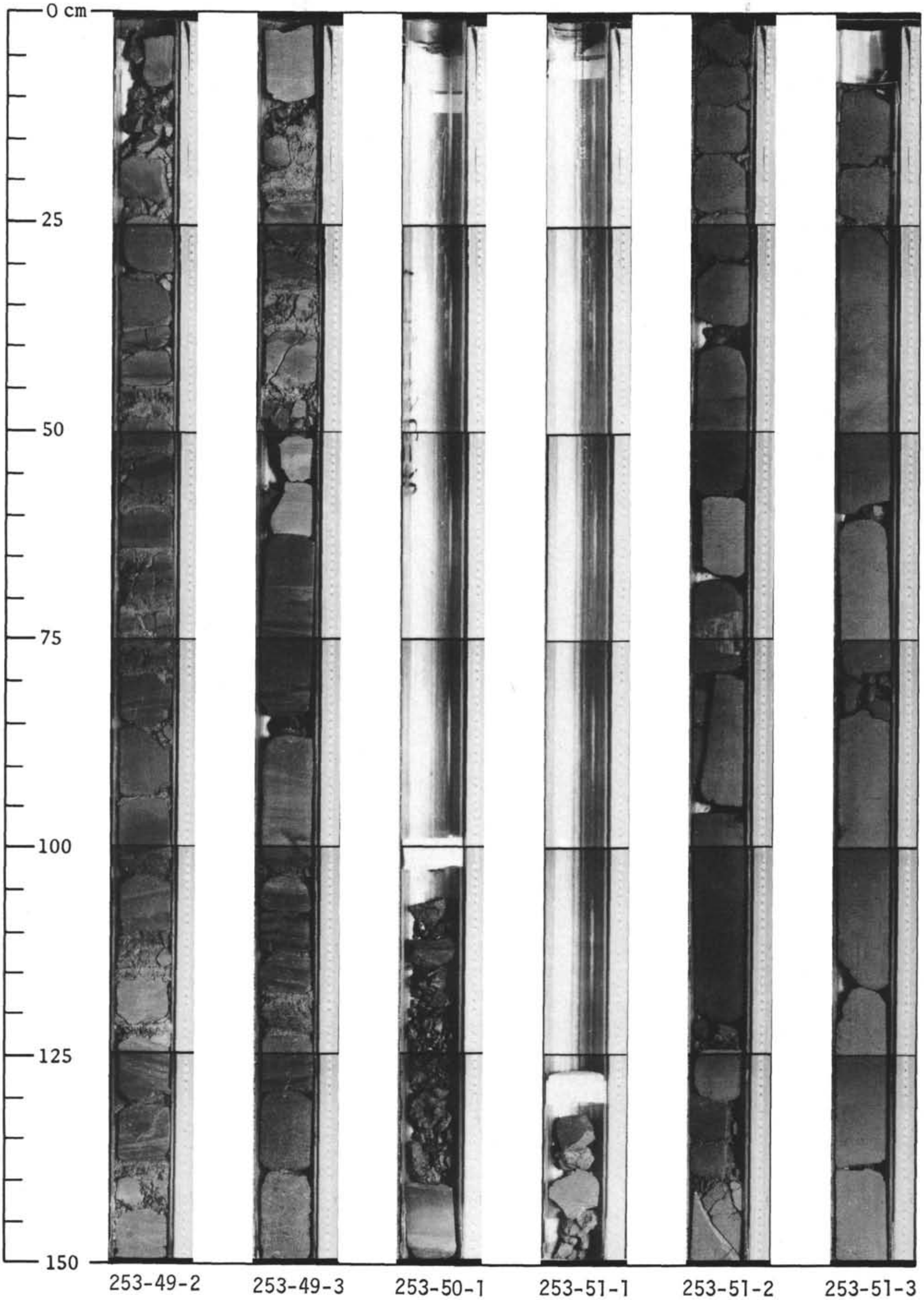
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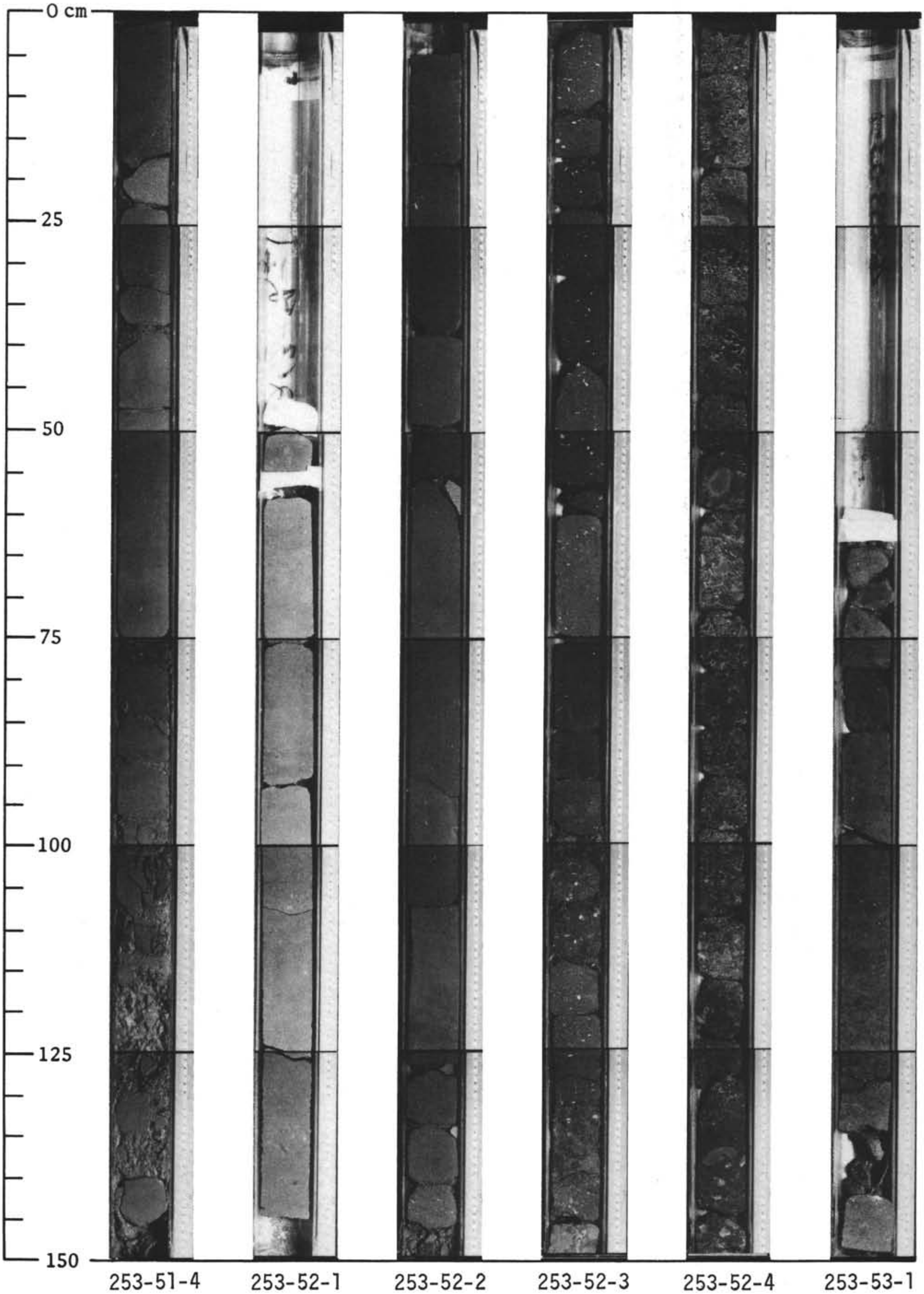
253-51-3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100
125
150
253-51-4
253-52-1
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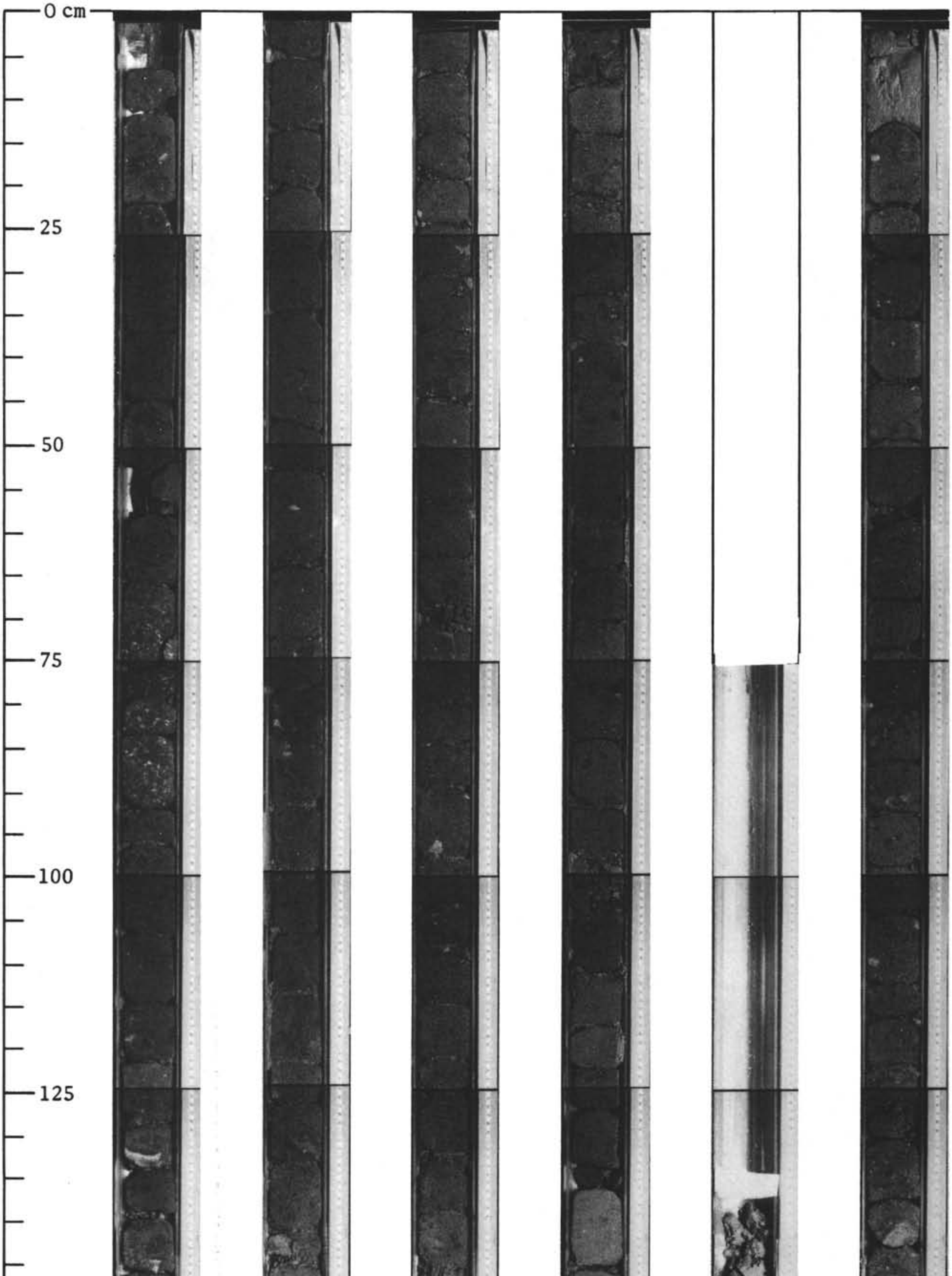
253-52-3
253-52-4
253-53-1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100
125
150
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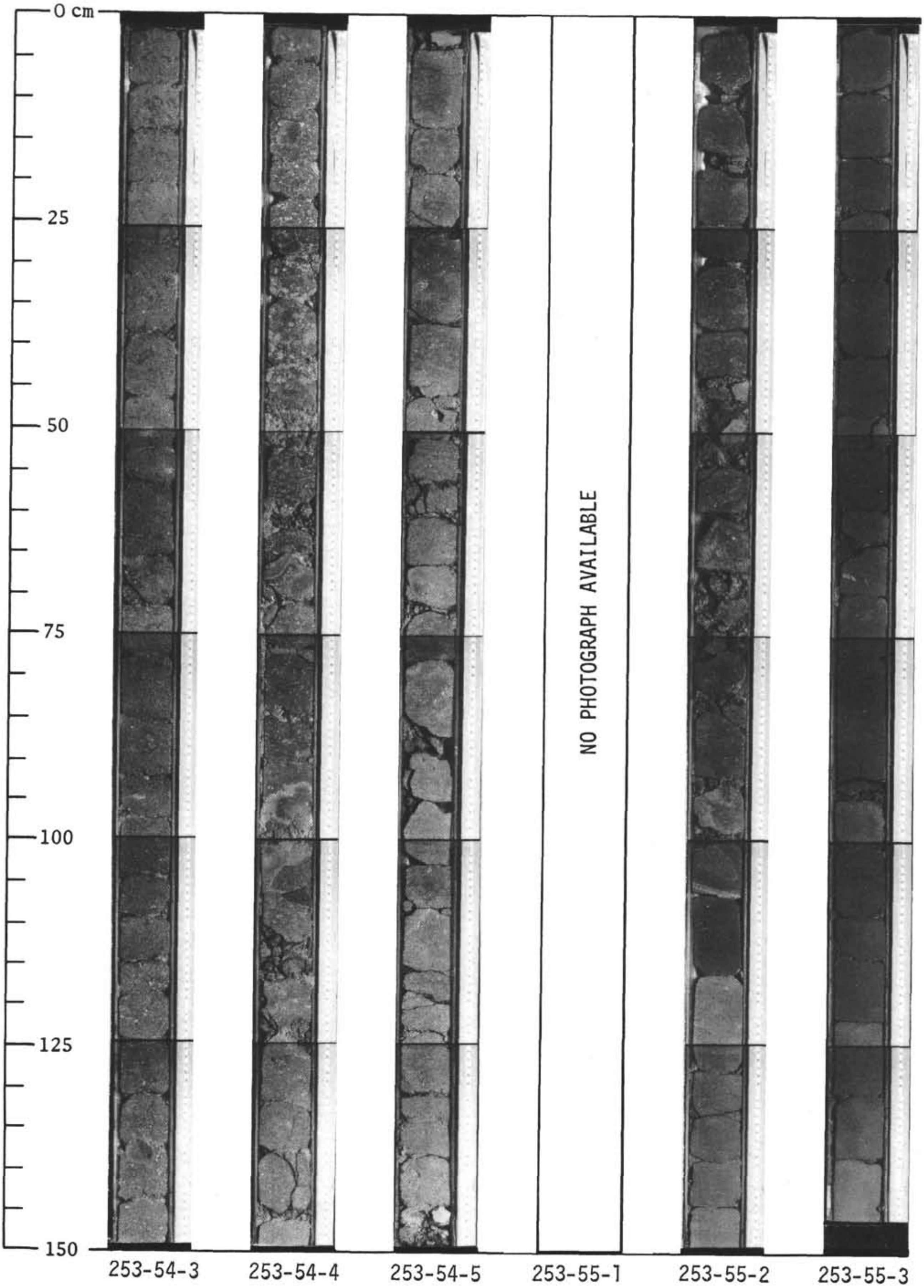
253-53-3
253-53-4
253-53-5
253-54-1
253-54-2


0 cm
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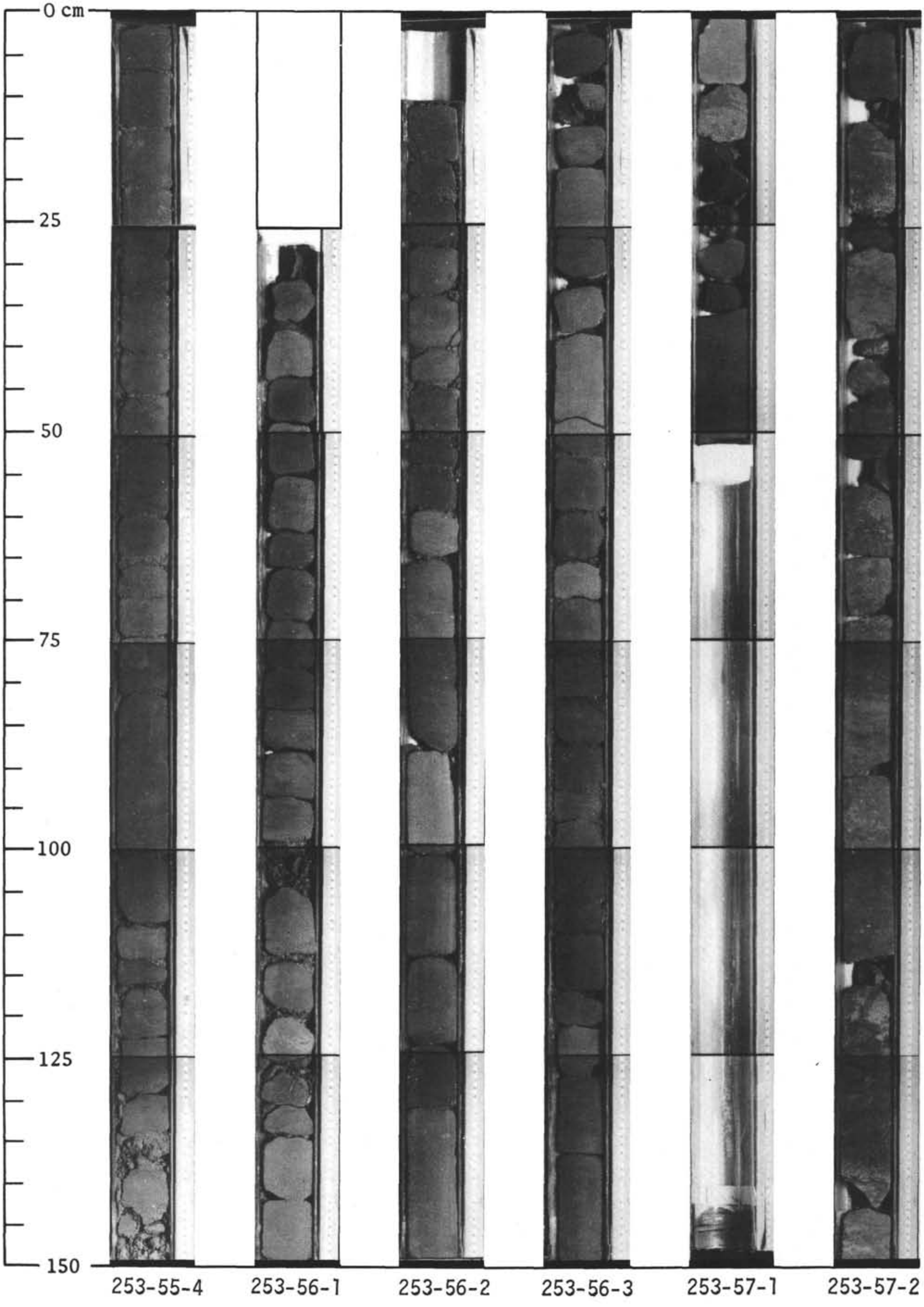
75
100
125
150
NO PHOTOGRAPH AVAILABLE
253-54-3
253-54-4
253-54-5
253-55-1
253-55-2
253-55-3


0 cm
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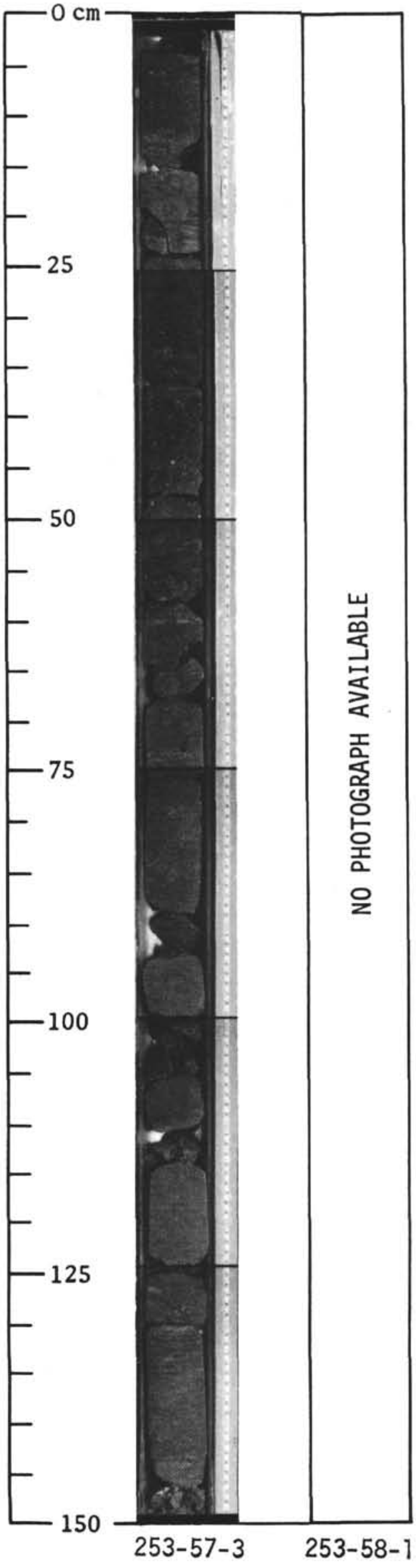
100
125
150
253-55-4
253-56-1
253-56-2
253-56-3
253-57-1
253-57-2


0 cm
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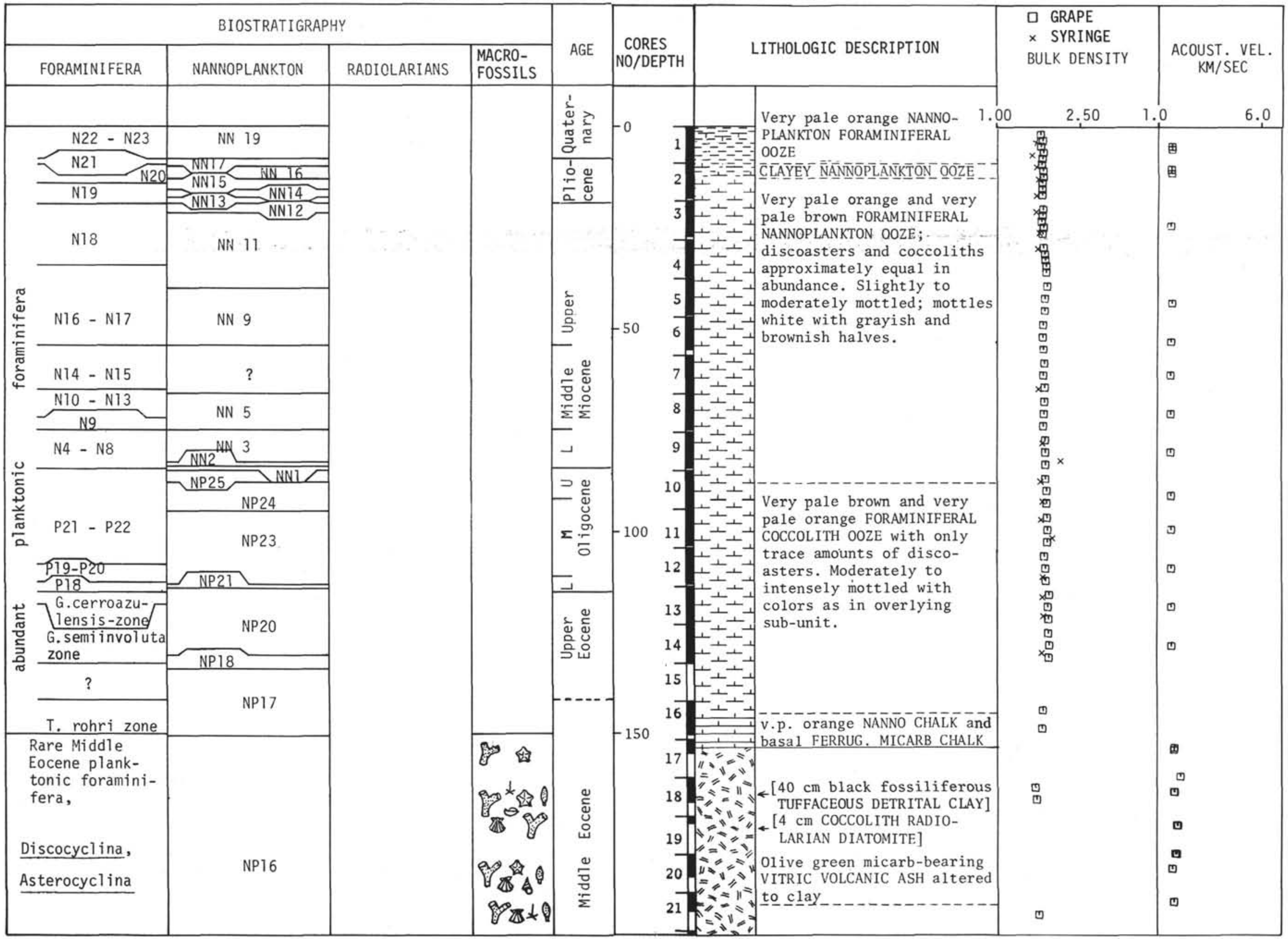
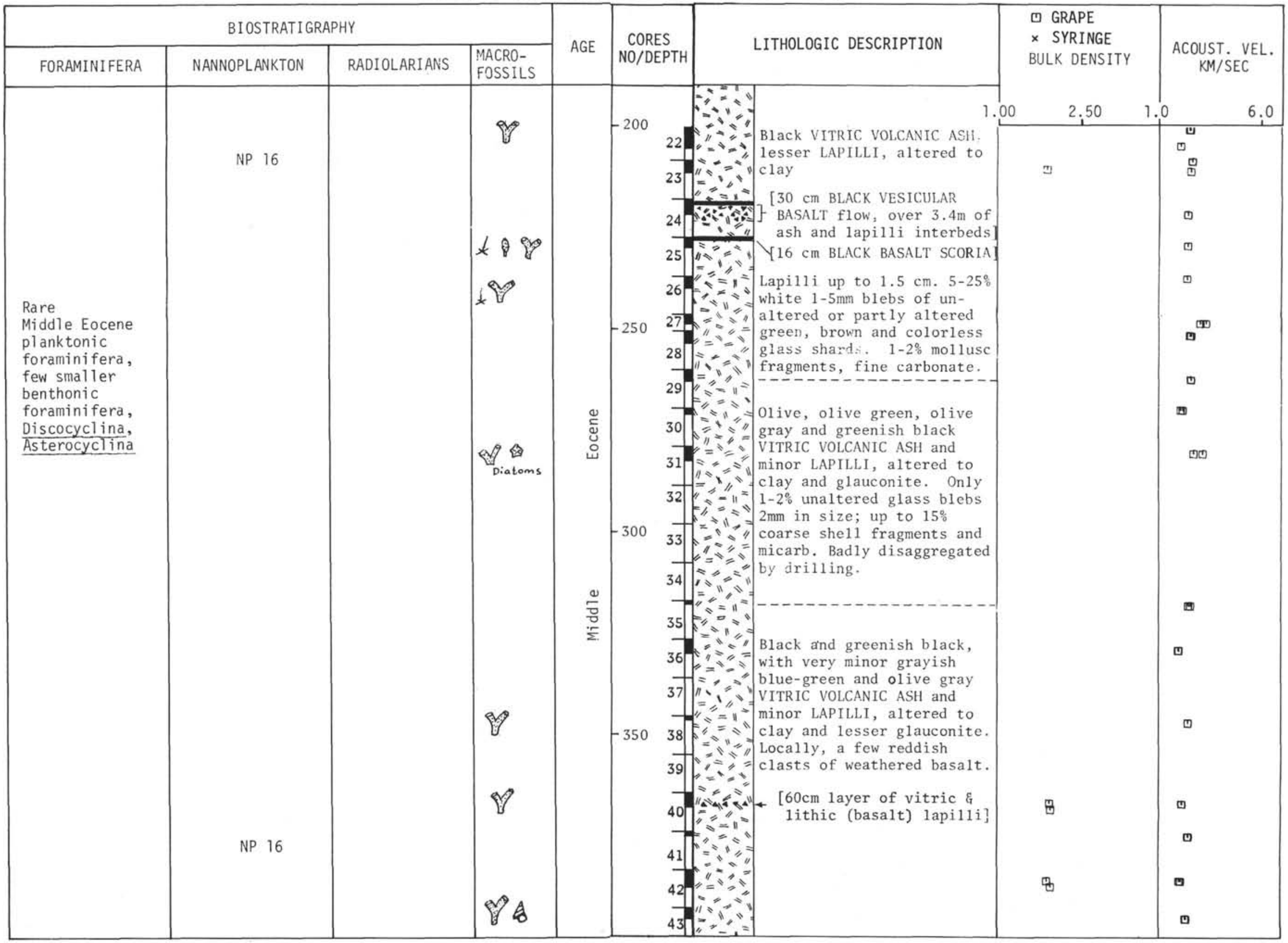
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
253-57-3
253-58-1

SUMMARY OF DRILLING RESULTS: SITE 253/0 - 200 m



SUMMARY OF DRILLING RESULTS: SITE 253/200 - 400 m



SUMMARY OF DRILLING RESULTS: SITE 253/400 - 600 m