6. SITE 151

The Shipboard Scientific Party[1]

Position:
15°01.02′N
73°24.58′W.

Water Depth: 2029 meters.

Penetration: 381 meters.

Recovery: 56.7 meters (15%).

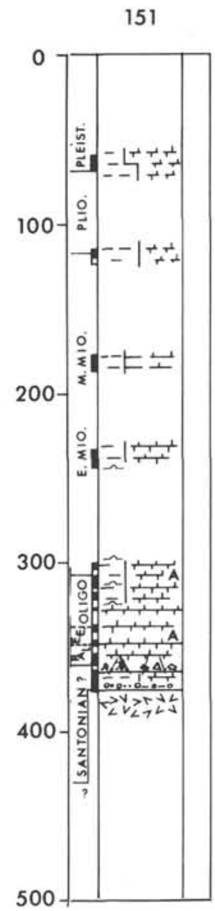
ABSTRACT

Cores at this site depict two contrasting periods of sedimentation on the southern part of the Beata Ridge. The early sediments are characterized by foraminiferal sands, volcanics, and carbonaceous clays of Santonian age and are capped by a siliceous hard ground. The hard ground marks an unconformity with Paleocene sediments overlying the Santonian (80 m.y.). The second period is represented by the overlying Tertiary pelagic sediments rich in carbonate faunal assemblages. Only fragments of the Paleocene and Eocene sequence are present. Three meters of basalt were recovered, but the contact with the overlying sediments was not recovered.

BACKGROUND

The Beata Ridge is a north-south trending structure that almost completely separates the Venezuelan and Colombian basins. It joins the island of Hispaniola at Cape Beata but stops short of the South American continent on the southern end (Aruba Gap). The ridge is totally submarine south of Cape Beata. The topography of the ridge may be described as rugged, with variable relief; the west side is characterized by a relatively steep escarpment, while the east side has a moderate gradient to the Venezuelan Basin.

Seismic refraction investigations over the Beata Ridge demonstrate that the acoustic crustal section is unlike that of the Venezuelan Basin, Colombian Basin, or Aves Ridge (Ewing et al., 1960; Edgar et al., 1971). The Beata ridge, like the Nicaragua Rise, has a crustal velocity structure of 3.9, 5.4, 6.7, and 8.1 km/sec, similar in velocity to an oceanic section but much thicker. The topography of the ridge was attributed to a rise in all the crustal layers (Ewing et al., 1960) but Edgar et al. (1971) using other refraction data interpreted it as a thickening of the 3.9 km/sec layer.



Only one strong subbottom reflector was noted, at a depth of 0.20 seconds of reflection time. It was believed to correlate with Horizon B″ of the Venezuelan Basin. Horizon A″ is not present in any of reflection records crossing the crest of the ridge.

Fox et al. (1970) published the only data derived from direct sampling of the ridge as a result of an intensive dredging and coring program. From the west escarpment they dredged basalts and diabase and recovered three piston cores containing Middle Eocene carbonate pebbles in Recent sediment. Based on the faunal assemblages in these pebbles they concluded that the Middle Eocene sediment had been deposited in a neritic environment. From other cores, Late Oligocene to Recent sediments are believed to have been deposited under deep marine conditions.

Bader, Gerard et al., (1970) drilled Site 21 of Beata Ridge, where Horizon A″ was hoped to be avoided on a fault escarpment, in the anticipation of sampling Horizon B″. Pleistocene through Oligocene foraminifer nannofossil chalk ooze and marl ooze were recovered to a depth of 279

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meters (Figure 1). The site was terminated before reaching Horizon B'' because of equipment failure and lack of time.

Based on seismic reflection records collected by the Lamont-Doherty Geological Observatory, a site was selected on the crest of the Beata Ridge near the southern end. Figure 2 shows the profiler record made by the *Glomar Challenger* over the site and Figure 3 shows the corresponding track.

OBJECTIVES

This site was selected on the Beata Ridge in order to obtain a biostratigraphic section of the early Tertiary in relatively shallow water, to obtain information on the history of vertical movements (origin of the ridge), and to identify horizon B'', which has proven to be Santonian-Coniacian dolerite at Sites 146 and 150.

OPERATIONS

The area of this site had been extensively surveyed by the R/V *Vema* of Lamont-Doherty Geological Observatory. The *Glomar Challenger* approached this site from the southeast at 0300 hours on January 1971. Spot cores were taken at 61, 117, 181, and 237 meters and continuous coring was begun at 302 meters. Coring continued until the basalt was reached at 378 meters and penetrated for 4 meters. The ship departed the site at 1750 hours on 15 January.

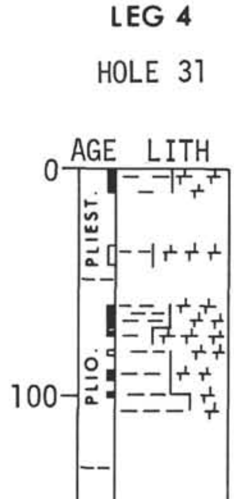

Figure 1. *Columnar section of Site 31, Leg 4, on eastern flank of the Beata Ridge (3369 m).*

LITHOLOGY

Site 151 can be divided conveniently into two sedimentary units overlying basalt; upper varicolored foraminiferal nanno chalks and marls and a lower hard ground and olive black (sapropelite) clay.

The uppermost spot core (60-70 m) is a homogeneous, relatively uncompacted nannofossil foraminiferal marl and chalk ooze. This is an obscurely layered sediment with color grading from moderate yellow green above to light olive gray below. Calcareous fossils are well preserved. The carbonate content is about 60 percent. The lower part of the unit is represented by Cores 2 (117-126 m), 3 (191-190 m), 4 (237-246 m), and 5 through 11 (302-367 m). Except for a low carbonate portion at 180 meters (carbonate is as low as 20%), the carbonate content increases downward from about 50 to more than 80 percent. Most of this unit is distinctly layered, with minor dark greenish gray, intensely burrowed oozes intercalated with light olive gray, less distinctly burrowed chalks. Compaction increases with depth, but calcareous fossils are well preserved throughout. Radiolaria are abundant and well preserved below 240 meters. Volcanic debris also appears at this level, increases downward, and is persistent to the base of the unit. The most common volcanic constituent is plagioclase, but glass, pumice, clinopyroxene, orthopyroxene, hornblende, and apatite occur. Pyrite is scarce in this unit. A minor amount of dispersed quartz in Core 2 (117-126 m) may be of terrigenous origin. Black spots (iron-manganese oxides or hydrotroilite) appear directly above the base.

This unit rests on a siliceous, ferruginous, 17-cm fractured layer (breccia) (Figure 4) that is interpreted as "hard ground" at an unconformity. Although the layer itself contains no recognizable fossil remains, a chip of this (or a nearby layer) recovered from drilling fragments shows silicified planktonic foraminifera (Figure 5), suggesting that the hard ground itself is a silicified foraminiferal ooze.

Beneath the hard ground, intense drilling disturbance reduced the underlying beds to rubble. The most prominent lithologies in this debris are greenish calcareous and glauconitic clay, volcanic ash and sandstone, and foraminiferal sandstone, as well as displaced chips of the hard ground. Carbonaceous clays contain pollen and fish debris; the latter is sometimes replaced by glauconite. Two samples from Core 12 contain 4.2 and 2.7 percent organic carbon, classifying it as a sapropelitic (Olausson, 1960).

The underlying basalt is moderately fresh and fractured, but apparently not pillowed. Of the 4 meters cored, about 1 meter was recovered. The basalt is somewhat vesicular with chalcedony and greenish mica filling the vesicles. Reddish calcite patches probably represent limestone inclusions.

PHYSICAL PROPERTIES

Wet-bulk Density, Water Content and Porosity

Wet-bulk density and porosity were measured by two methods aboard the *Glomar Challenger*: Gamma Ray Attenuation Porosity Evaluator (GRAPE) and individual sample volume-weight measurements (sample data are enclosed dots in the core and hole plots). Water content

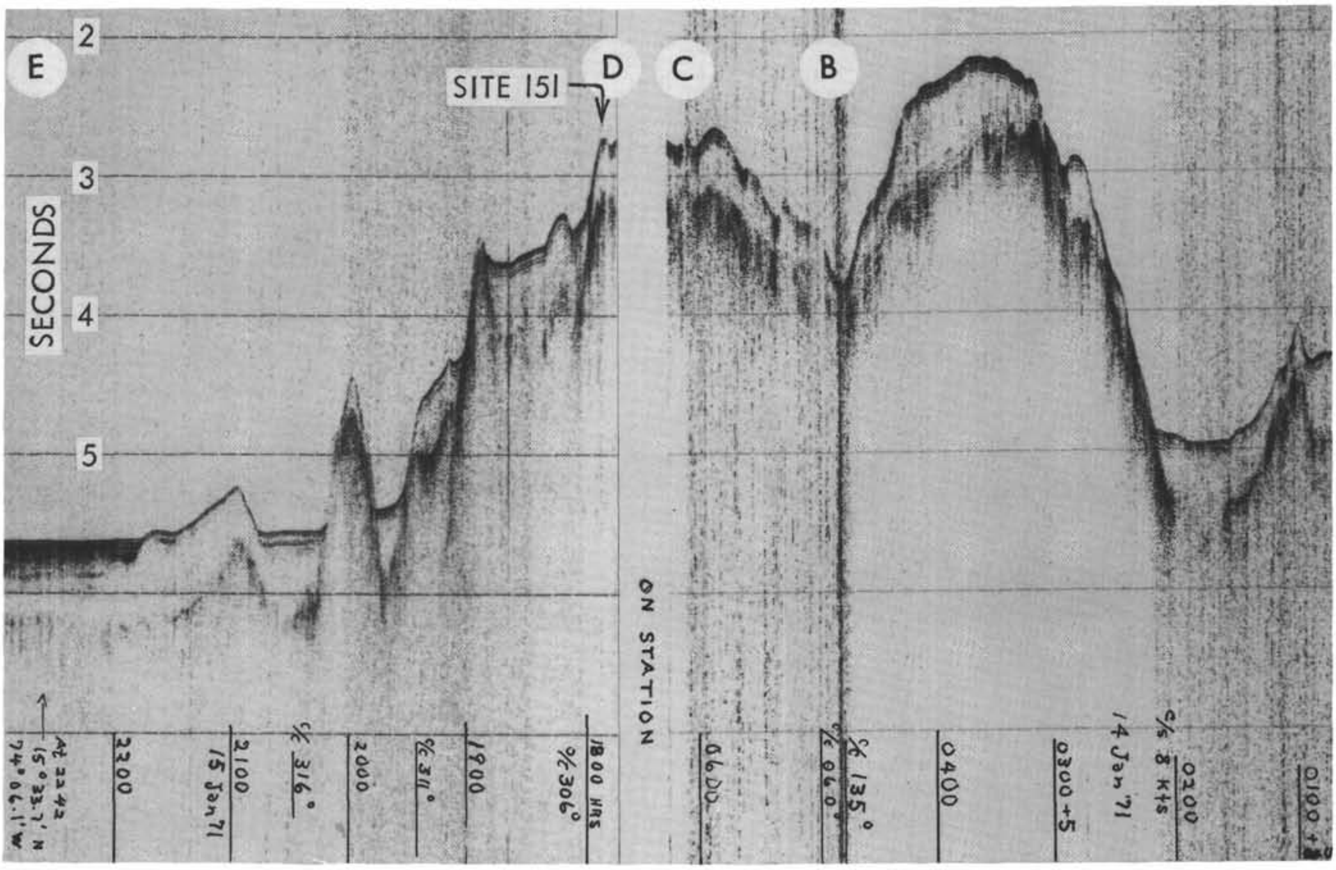

Figure 2. *Reflection record made by* Glomar Challenger *on approach and departure from Site 151, Beata Ridge.*

was determined by weight-weight relationships. Equipment, methods, hard rock diameter corrections, errors, assumptions, sediment disturbance, and interpretation precautions are discussed in Appendix.

Some stiff sediments or rocks are cored without plastic flowage of the sample and since the drill bit has a smaller diameter than the core liner (2.60-in internal diameter), the hard sediment sample also has that small diameter with the remaining space in the core being filled with a drilling slurry or highly disturbed sediment (in some cases water or air). A problem arises here because the 2.60-inch diameter is assumed in the density calculation. Correction for anomalous diameters have been done where necessary.

Diameters of the hard rocks in the cores were generally smaller than 2.60 inches by 6% in Core 10; 12% in Cores 7 and 8; 13% in Core 5; 13.5% in Cores 4, 6, 9, and 11; and 19.5% in Core 13. Adjustments were made using a slurry density of 1.1 g/cc. Equations, errors, and assumptions of this correction are discussed in Chapter 13. The adjusted data (dotted lines) are shown with the raw data (solid lines) in the hole and core plots and should be considered as only an approximation.

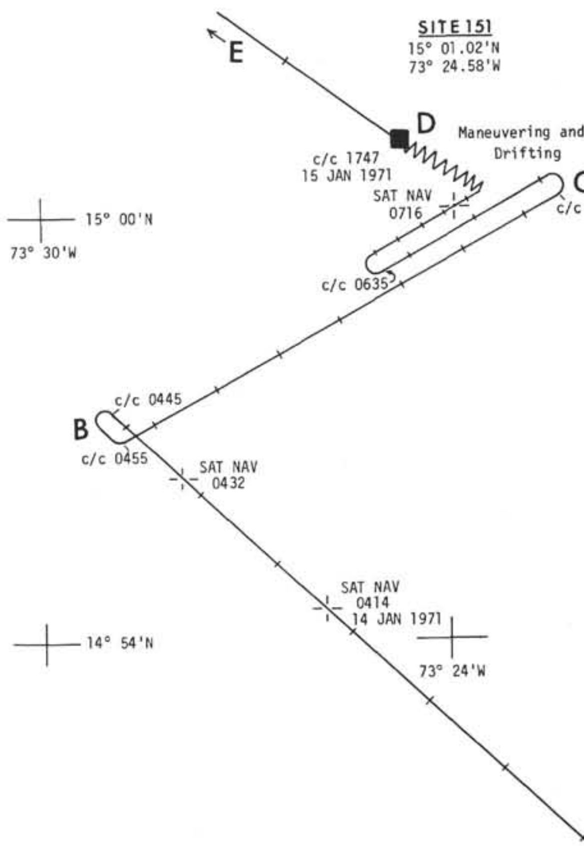

Figure 3. *Track of* Glomar Challenger *corresponding to reflection records shown in Figure 2 and showing final site location.*

Results

In general, sediment wet bulk densities at Site 151 increased slightly with increasing depth. Wet bulk densities in Pleistocene foraminifer chalk ooze and marl ooze from 61 to 70 meters depth ranged from 1.6 to 1.7 g/cc (58 to 66% porosity), while Pliocene-Paleocene foraminifer nannofossil chalk ooze and marl ooze from 117 to 366 meters depth and Santonian (?) clay and marl ooze from 366 to 377 meters depth, had wet bulk densities ranging from 1.25 g/cc (86% porosity) (disturbed ?) to 2.0 g/cc (44% porosity), typically being 1.6 to 1.8 g/cc (52 to 67%). The basalt had a maximum density of 2.65 to 2.75 g/cc.

Interesting density contrasts were observed in several cores. Core 3 has nannofossil chalk in chalk ooze, and this can be observed as a high-density of 1.90 g/cc (48% porosity) in a matrix of 1.70 g/cc (61% porosity). Core 11 is "soupy" and mixed as is apparent from the very low GRAPE densities, but the high density interval at the bottom of the core (2.22 g/cc, 33% porosity) is that of the rusty colored "hard ground" breccia. In Core 12, some of the high-density spikes appear to be caused by pyritic concretions.

Water content samples were collected at a 62 meter depth from Pleistocene nannofossil foraminiferal chalk ooze and at 120 meter and 180 meter depths from Pliocene and Miocene foraminiferal nannofossil marl ooze and chalk. Measured water content values decreased from 41% to 33% and 27% respectively, with corresponding porosities of 62%, 58%, and 50%.

In general, the lower part of the cores are disturbed less than the upper parts as can be seen by higher and more homogeneous GRAPE densities in the lower parts of these cores.

Sound Velocity

Sound velocity through sediment and rock samples was measured by the Hamilton Frame technique, which is discussed in Chapter 13. This method has a precision within ±1.1 percent.

Only sediments and rocks which appeared to be physically undisturbed had velocities measured. These velocities were measured parallel to the bedding plane, unless otherwise noted in Table 1, and were measured and reported at laboratory pressures and temperatures (24.2 to 25.3°C).

Results

Pleistocene to Paleocene chalk ooze and marl ooze, marl, and chalk recovered from 66 to 350 meters below the sea floor at Site 151 had sound velocities which ranged from 1.66 to 2.38 km/sec. Sound velocities through Pleistocene nannofossil foraminiferal marl ooze from 66 meters depth and Pliocene foraminiferal nannofossil marl ooze and chalk from 120 and 185 meter depths, respectively, ranged from 1.60 to 1.66 km/second, while Oligocene light gray foraminiferal nannofossil chalk from 300 to 341 meters depth had faster velocities, between 1.77 and 2.05 km/sec. The Paleocene pink foraminiferal nannofossil chalk (348-362 m) had slightly higher velocities, from 1.98 to 2.37 km/second.

Figure 4. *Unconformity between Eocene and Paleocene nannoplankton foraminiferal chalk and rusty, siliceous breccia interpreted as "hard ground." The unconformity represents a hiatus of about 20 m.y. (151-11-6, 112-140).*

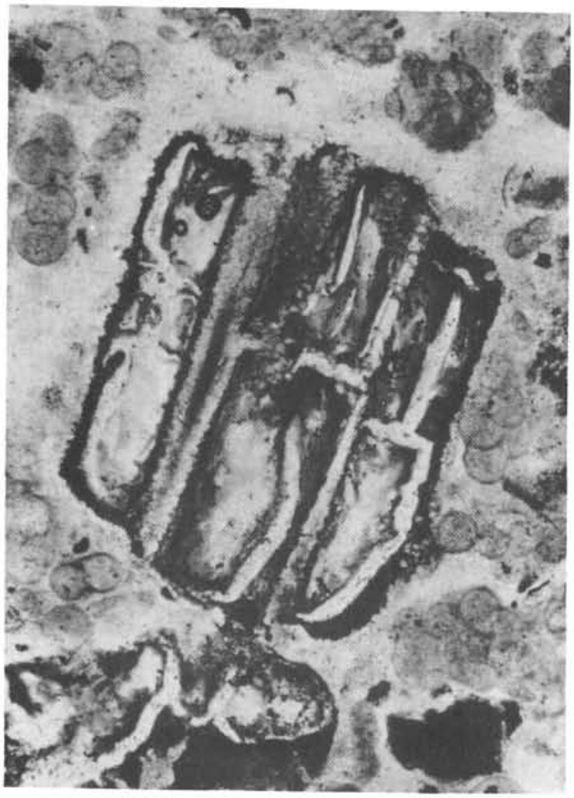

Figure 5. *Chert showing silicified foraminifera and ferruginous fragment of fish (?) bone. Sample is a fragment probably from "hard ground" between Tertiary and Cretaceous sediments. Bar is 1 mm (151-13-1 fragment).*

Hard rock samples, collected between 365 meters and 377 meters depth, were a yellow brown "hard ground" breccia, pyrite, and a vesicular basalt which had the following respective velocities: 4.71 to 4.82 km/sec; 5.03 km/sec; and 4.52 to 4.66 km/sec.

Sound velocities were measured both perpendicular and parallel to the bedding planes of 13 samples (noted in Table 1) which were recovered between 300 and 350 meters below the sea floor from Oligocene-Paleocene foraminifer nannofossil chalk. In general, the velocities ranged from -1 percent to 7.3 percent faster parallel to the bedding planes, with 2 to 3 percent being characteristic.

Natural Gamma Radiation

Natural gamma ray emissions were counted during a period of 1.25 min at 7.62 cm (3 in) intervals along the core, with a counting precision of about ±100 counts. Methods, equipment, and sediment disturbance are discussed in the Appendix.

Natural gamma radiation at Site 151 ranged from 0 to 1800 counts, varying with the age and type of sediment. Pleistocene nannofossil foraminiferal chalk ooze plus marl ooze (61-70 m) and Pliocene-Miocene grayish yellow green foraminiferal nannofossil marl ooze chalk (117-190 m) had moderate counts of 100 to 1400, with typical values about 500 to 900, while very low counts of 0 to 300 were emitted from Miocene-Oligocene light gray and Paleocene pink foraminiferal nannofossil chalk from 237 to 365 meters depth. The highest gamma counts were emitted by the Santonian (?) olive black clay with a range of 500 to 1800, and with typical values within 600 to 1100 counts. The diabase had low counts of 500 to 800.

The high gamma radiation variations in Core 2 are apparently related to the greater amount of clay in layers relative to the adjacent sediments. In many cores it is possible to correlate high gamma peaks with corresponding high-density peaks. Porosity and density corrections can be applied by interested readers. See Appendix I for discussions of porosity corrections.

Penetrometer

Needle penetration tests were conducted at Site 151 with a 1-mm diameter needle. The methods, equipment, and sediment disturbance are discussed in the Appendix.

At Site 151, penetrometer tests were only significant in the Pleistocene-Miocene chalk ooze and marl ooze from 61 to 190 meters below the sea floor, where penetration decreased with increasing depth. Pleistocene nannofossil foraminiferal chalk ooze and marl ooze at 61 to 70 meters had penetrations from 3 to 8 mm with 4 or 5 mm being typical, while Pliocene foraminiferal nannofossil chalk ooze from 120 meters had penetrations of 2 to 6 mm with 2 to 4 mm being typical. The lowest significant penetration readings were taken in Miocene foraminiferal nannofossil chalk at 187 to 190 meters, where penetrations ranged from 0 to 2 mm. Penetrations were nil or insignificant below this depth (190 m) and age (Miocene) in similar sedimentary rocks as well as Santonian(?) claystone.

BIOSTRATIGRAPHY

The first four cores taken at this site were spotted through a sequence of foraminiferal nannofossil ooze and chalk. Core 1 sampled early Pleistocene sediments with well-preserved, diverse assemblages of planktonic foraminifera and calcareous nannofossils. Sections 1 to 3 belong to the *Globorotalia hessi* Subzone, and Sections 4 to 6 belong to the *Globorotalia crassaformis viola* Subzone of the *Globorotalia truncatulinoides truncatulinoides* Zone. The base of the *Gephyrocapsa oceanica* Zone lies between Sections 2 and 3, approximating the boundary between the two planktonic foraminiferal subzones as at Site 148. *Discoaster brouweri* occurs in the lower part of Section 6; Sections 3, 4, 5, and most of 6 belong to the "*Gephyrocapsa caribbeanica*" Zone, and the base of the core is in the *Discoaster brouweri* Zone. Thus, the ranges of *Discoaster brouweri* and *Globorotalia truncatulinoides truncatulinoides* overlap slightly at this site, which may indicate a minor hiatus with bioturbation at the base of this core. In any case, the base of the core approximates the Pliocene-Pleistocene boundary.

The second core contains rich and diverse planktonic foraminiferal assemblages of the *Globorotalia margaritae margaritae* Subzone of the *Globorotalia margaritae* Zone (Early Pliocene). Sediments above the middle of Section 2 belong to the *Discoaster asymmetricus* Zone, those below to the *Ceratolithus rugosus* Zone.

Core 3 (181-190 m) contains a sequence with a sample from Section 1 belonging to the *Globorotalia fohsi lobata*

TABLE 1
Hamilton Frame Sonic Velocities, Site 151

Core	Section	Interval[a] (cm)	Depth in Hole (m)	Velocity[b] (m/sec)	Temperature (°C)	Remarks
1	4	56.0	66.06	1657[c]	25.3	Nanno foram marl ooze.
2	3	32.0	120.32	1596	25.3	Foram nanno marl ooze.
3	3	105.0	185.05	1643	25.3	Nanno chalk ooze, clay-rich.
5	1	60.0	302.60	1971	25.3	Foram nanno chalk, clay-rich, ⊥ to bedding.
5	1	60.0	302.60	1946	25.3	Foram nanno chalk, clay-rich, ‖ to bedding.
5	1	60.0	302.60	1971		
5	2	34.0	303.84	1786	24.2	Foram nanno chalk, clay-rich, ‖ to bedding.
5	2	34.0	303.84	1771	24.2	Foram nanno chalk, clay-rich, ⊥ to bedding.
6	2	12.0	312.62	1855	23.8	Foram nanno chalk, clay-rich, ‖ to bedding.
6	2	38.0	312.88	1796	23.1	Foram nanno chalk, clay-rich, ⊥ to bedding.
6	2	38.0	312.88	1836	23.1	Foram nanno chalk, clay-rich, ‖ to bedding.
6	2	85.0	313.35	1842	23.1	Foram nanno chalk, clay-rich, ‖ to bedding.
6	2	85.0	313.35	1834	23.1	Foram nanno chalk, clay-rich, ⊥ to bedding.
6	2	140.0	313.90	1855	23.8	Foram nanno chalk, clay-rich.
6	3	143.0	319.93	1865	24.4	Foram nanno chalk, clay-rich, ‖ to bedding.
6	3	143.0	319.93	1830	24.4	Foram nanno chalk, clay-rich, ⊥ to bedding.
7	1	12.0	320.12	1917	23.8	Foram nanno chalk, clay-rich, ‖ to bedding.
7	1	12.0	320.12	1864	23.8	Foram nanno chalk, clay-rich, ⊥ to bedding.
7	2	25.0	321.75	1868	23.8	Foram nanno chalk, clay-rich, ⊥ to bedding.
7	2	25.0	321.75	1916	23.8	Foram nanno chalk, clay-rich, ‖ to bedding.
8	1	81.0	329.81	2059	24.5	Foram nanno chalk, ‖ to bedding.
8	1	81.0	329.81	1972	24.5	Foram nanno chalk, ⊥ to bedding.
9	1	104.0	340.04	1973	24.5	Foram nanno chalk, ‖ to bedding.
9	1	104.0	340.04	1905	24.5	Foram nanno chalk, ⊥ to bedding.
9	2	64.0	341.14	1983	24.5	Foram nanno chalk, ‖ to bedding.
9	2	64.0	341.14	1947	24.5	Foram nanno chalk, ⊥ to bedding.
10	1	124.0	349.24	2133	23.0	Foram nanno chalk, ‖ to bedding.
10	1	124.0	349.24	2150	23.0	Foram nanno chalk, ⊥ to bedding.
10	2	61.0	350.11	2017	22.8	Foram nanno chalk, ‖ to bedding.
10	2	61.0	350.11	1984	22.8	Foram nanno chalk, ⊥ to bedding.
10	2	118.0	350.68	2306	22.8	Foram nanno chalk, ⊥ to bedding.
10	2	118.0	350.68	2375	22.5	Foram nanno chalk, ‖ to bedding.
11	6	145.0	365.95	4711	23.0	Breccia, silicified limestone, yellow brown "hard ground."
11	6	145.0	365.95	4824	23.0	Foram sandstone, ferruginous.
11	7	0.0	366.00	1883	23.0	Foram sandstone, ferruginous
12	4	0.0	371.50	5026	23.0	Pyrite, irregular piece.
13	2	0.0	377.50	4607	22.9	Basalt, vesicular
13	2	0.0	377.50	4665		
13	2	0.0	377.50	4519		

[a]Upper limit of a 3-cm sample interval.

[b]Velocities were measured parallel to bedding unless noted otherwise.

[c]Indicates the only velocity measurement which used a D-shaped block to obtain liner thickness and travel time.

Zone and *Discoaster kugleri* Zone and samples from Sections 3 and 6 belonging to the *Globorotalia fohsi fohsi* and *Discoaster exilis* Zones.

Cores 1 to 3 are devoid of Radiolaria.

Core 4 (237-246 m) contains a remarkably condensed Middle-Early Miocene sequence similar to that in Core 4 at Site 150. The *Globorotalia fohsi peripheroronda, Praeorbulina glomerosa, Globigerinita stainforthi,* and *Globigerinita dissimilis* Zones all appear to be present in a stratigraphic interval of only 2 meters. The *Sphenolithus heteromorphus, Sphenolithus belemnos*, and *Discoaster kugleri* Zones are all present. The *Helicopontosphaera ampliapertura* Zone, which intervenes between the two above mentioned *Sphenolithus* zones was not noted but may be present in an unsampled interval between 29 and 73 cm in Section 1.

Core 4 contains abundant, moderately well-preserved (somewhat dissolved) radiolarians, those in the top of the core belonging to the *Dorcadospyris alata* Zone and those lower in the core belonging to the *Calocycletta virginis* Zone—the *Calocycletta costata* Zone being either missing or included in the unsampled 40 cm below (151-4-1 (28-30 cm).

Continuous coring began with Core 5 at 302 meters. Cores 5 to 9 (302-348 m) are a light gray foraminiferal nannoplankton chalk and represent the early Miocene-late Oligocene. Core 5 belongs to the *Globigerinita dissimilis* Zone and *Triquetrorhabdulus carinatus* Zone. Radiolarians are also abundant and moderately well preserved in Core 5 (at 302 to approximately 305 m), most of the core belonging in the *C. virginis* Zone and its base in the *Lychnocanoma elongata* Zone.

Core 6 and possibly the top of Core 7 belong to the *Globorotalia kugleri* Zone of the late Oligocene. Both cores belong to the *Triquetrorhabdulus carinatus* Zone. The lower part of Core 7 and Core 8 belong to the *Globigerina ciperoensis ciperoensis* Zone (late Oligocene). Cores 6 through 8 (at 311 to approximately 330 m) contain abundant, well-preserved assemblages of the *Dorcadospyris ateuchus* Zone. The samples examined from Cores 7 and 8 contain a few reworked, Middle Eocene forms.

Cores 8 and 9 belong to the *Sphenolithus ciperoensis* Zone. Core 9 contains planktonic foraminifera of the *Globorotalia opima opima* Zone (middle Oligocene). Core 9 (at 339 to approximately 341 m) contains rare, poorly preserved (somewhat dissolved) radiolarians including *Pterocodon ampla* as well as some apparently younger forms. No radiolarians were found in Cores 10 through 12 (at 348-376 m).

The catcher sample of Core 9 (339-348 m) contains an assemblage of the early Eocene *Globorotalia formosa formosa* Zone.

A smear of material from the top of Core 10 (348-357 m) contains an unusual assemblage of calcareous nannofossils, including *Marthasterites tribrachiatus* and *Discoaster lodoensis*. This is the only sample in which these two important species have been positively identified in Caribbean deep sea sediments.

Section 1 of Core 10, to a depth of 35 cm belongs to the *Globorotalia edgari* Zone of the Early Eocene and to the *Discoaster multiradiatus* Zone usually assigned to the Paleocene.

The lower part of Section 1 and the top of Section 2 belong to the middle Paleocene *Globorotalia angulata* Zone.

The lower part of Section 2 of Core 10 belongs to the early Paleocene *Globorotalia uncinata* Zone and *Chiasmolithus danicus* Zone.

Most of Core 11 (357-367 m) belongs to the *Globorotalia trinidadensis* Zone of the early Paleocene. Samples from the top of Section 6 belong to the *Cruciplacolithus tenuis* Zone, lower samples from Section 6 belong to the *Markalius astroporus* Zone. A hard ground marks the Cretaceous-Tertiary boundary at 135-148 cm. Samples from the base of the core contain planktonic foraminifera of the Santonian *Globotruncana concavata carinata* Zone.

The boundary between the *Globotruncana concavata carinata* and *Globotruncana concavata concavata* Zones is placed between samples from Sections 4 and 5 of Core 12 (367-376 m).

The lower part of Core 12 and Core 13 belong to the early Santonian *Globotruncana concavata concavata* zone.

Cores 12 and 13 contain sparse assemblages of calcareous nannofossils lacking age diagnostic species.

CONCLUSIONS

The sedimentary sequence recovered at Site 151 represents two contrasting regimes of sedimentation separated by siliceous hard ground at a sedimentary hiatus. The underlying sequence, whose precise relationship to the basalt is uncertain because of failure to recover the contact, contains a variety of lithologies including highly reduced, carbonaceous clay and foraminiferal sands. The implied environment is similar to that inferred for Site 146: a topographically diverse sea floor with restricted circulation and accumulation of undecomposed organic material in low areas with intercalations of foraminiferal sands (possibly turbidites derived from intervening high areas). The total relief, however, may have been relatively low—a hundred meters or so.

The hard ground itself and the considerable sedimentary hiatus implies a long exposure to moderate to strong current in an oxidizing environment, possibly on a topographic high. The pelagic sequence on the hard ground represents an apparently abrupt cessation of these currents.

The presence of carbonaceous clay (sapropelite) and possibly turbidite-deposited foraminiferal sands implies lower topography at the site of deposition than the surrounding area—a situation totally different from the present topographic situation. From these data it may be inferred that the Beata Ridge, or at least part of it, has undergone some vertical motion between the time the carbonaceous clays and foraminiferal sands were deposited (Santonian) and the time when the pelagic sequence was first laid down (Paleocene). Alternatively, a major part of the Caribbean waters must have been anoxic in order to deposit sapropelite on the crest of the Beata Ridge.

From the cores there is no indication of neritic sedimentation in the Eocene as reported by Fox et al. (1970) from piston cores (described in this chapter under Background), despite the implication of vertical motion occurring at about that time. However, the irregular topography of the Beata Ridge suggests that isolated highs or peaks could have been shallow enough to have received faunal assemblages typical of a neritic environment.

The upper pelagic sequence is not remarkable. Accumulation well above the calcium carbonate compensation level resulted in the preservation of a rich planktonic foraminiferal assemblage. The occurrence of early Miocene through Oligocene radiolarian tests reflects the apparently high productivity of these organisms during this interval. The superior preservation of these Radiolaria, compared with coeval Radiolaria at Site 149, indicates shallower accumulation in chemically less corrosive water.

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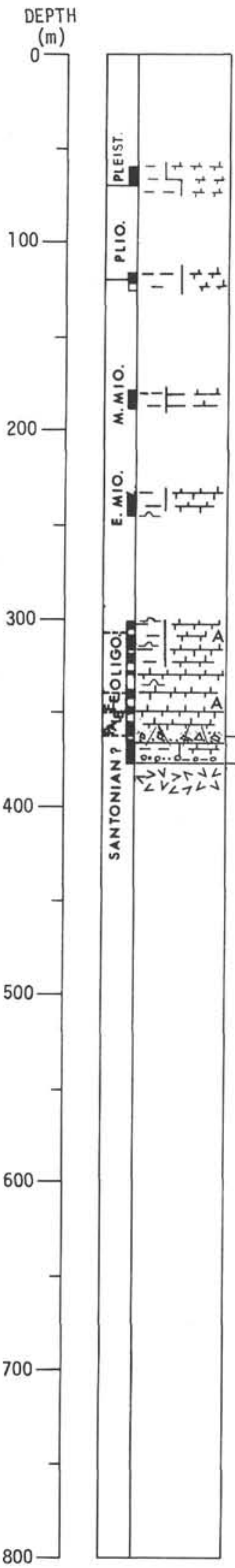
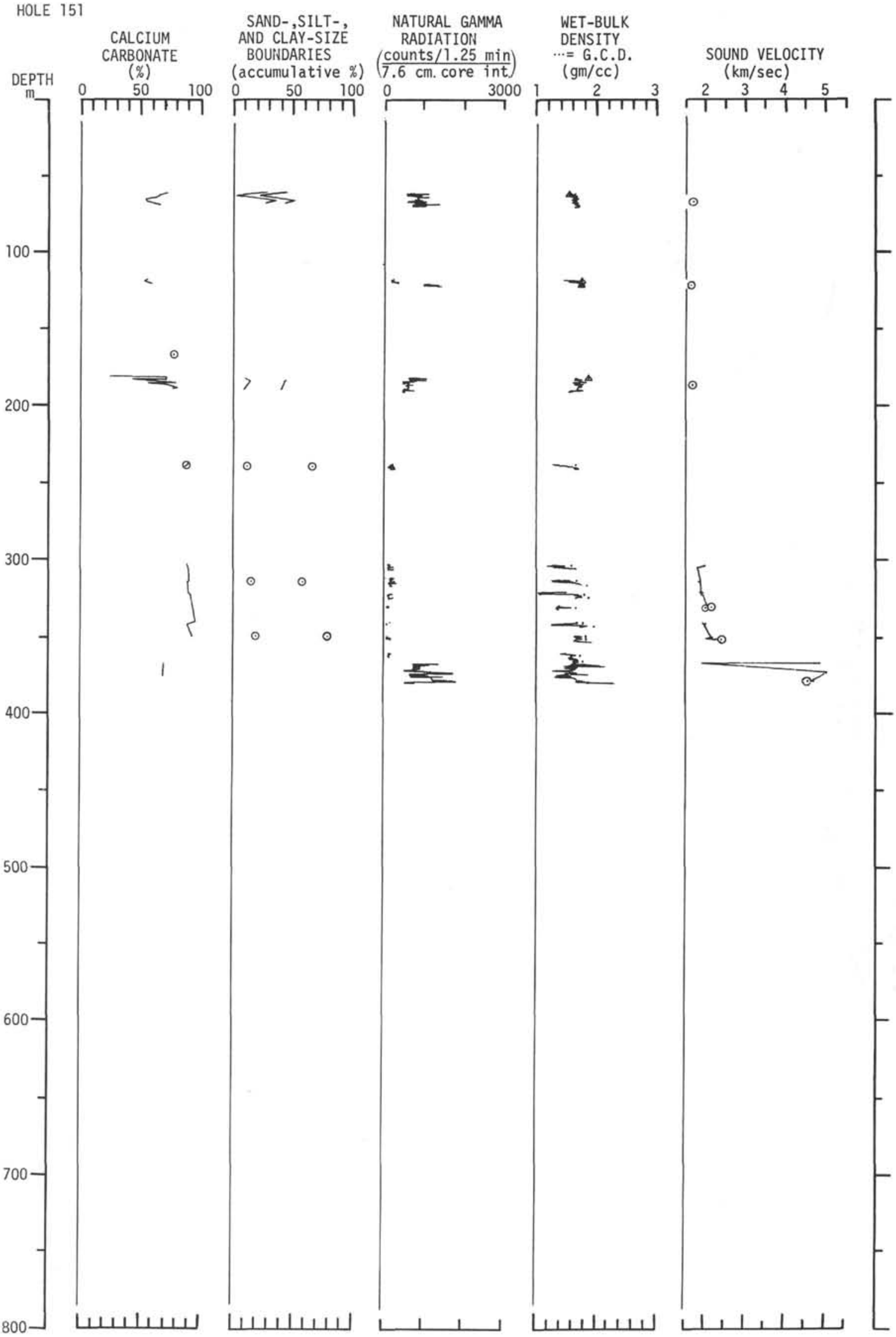
SITE 151 LITHOLOGY



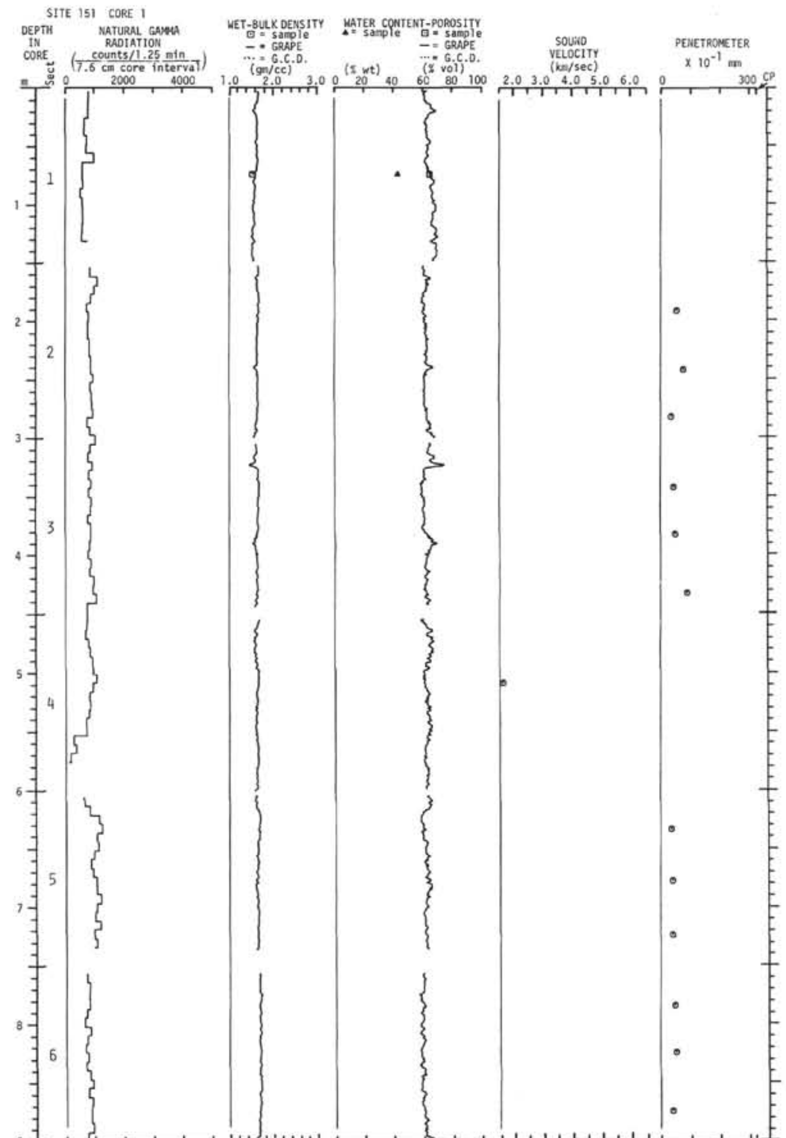
UNITS	SUBUNITS OR DESCRIPTION
UNIT I (0 to 365.78 m) FORAM NANNO CHALK OOZE and MARL OOZE	NANNO FORAM CHALK OOZE and MARL OOZE, grayish yellow green. Some pyrite and disseminated dark oxide.
	FORAM NANNO MARL OOZE, grayish yellow green. Faint burrowing.
	CLAY rich NANNO CHALK and MARLSTONE. Bluish gray, olive gray, and green gray. Thin dark gray clay layer which is burrowed, and pyrite.
	CLAY rich FORAM NANNO CHALK, light gray and greenish gray. Pumice fragments and thin ash layers and pyrite specks.
	FORAM NANNO CHALK, light gray.
	Pinkish gray FORAM NANNO CHALK. Ash layers.
UNIT II (365.78 to 378.71 m) BRECCIA, CLAY, and MARL	Subunit a. (365.78 to 365.89 m) BRECCIA, yellow brown, quartz cemented, ferruginous, of siliceous clasts.
	Subunit b. (365.89 to 378.71 m) CALCAREOUS (forams and nannos) rich CLAY, MARL, and CHALK lumps, variegated, very dark green. "Pebbles" of volcanic ash sandstone; foraminiferal-radiolarian sandstone.
UNIT III (378.71 to 380.50 m) DIABASE	DIABASE, very fine grained. Extensive subvertical fractures filled with calcite.


HOLE 151
DEPTH m
CALCIUM CARBONATE (%)
0 50 100
SAND-, SILT-, AND CLAY-SIZE BOUNDARIES (accumulative %)
0 50 100
NATURAL GAMMA RADIATION (counts/1.25 min / 7.6 cm. core int.)
0 3000
WET-BULK DENSITY ···= G.C.D. (gm/cc)
1 2 3
SOUND VELOCITY (km/sec)
2 3 4 5
100
200
300
400
500
600
700
800

SITE 151 HOLE CORE 1 CORED INTERVAL (m) 61-70

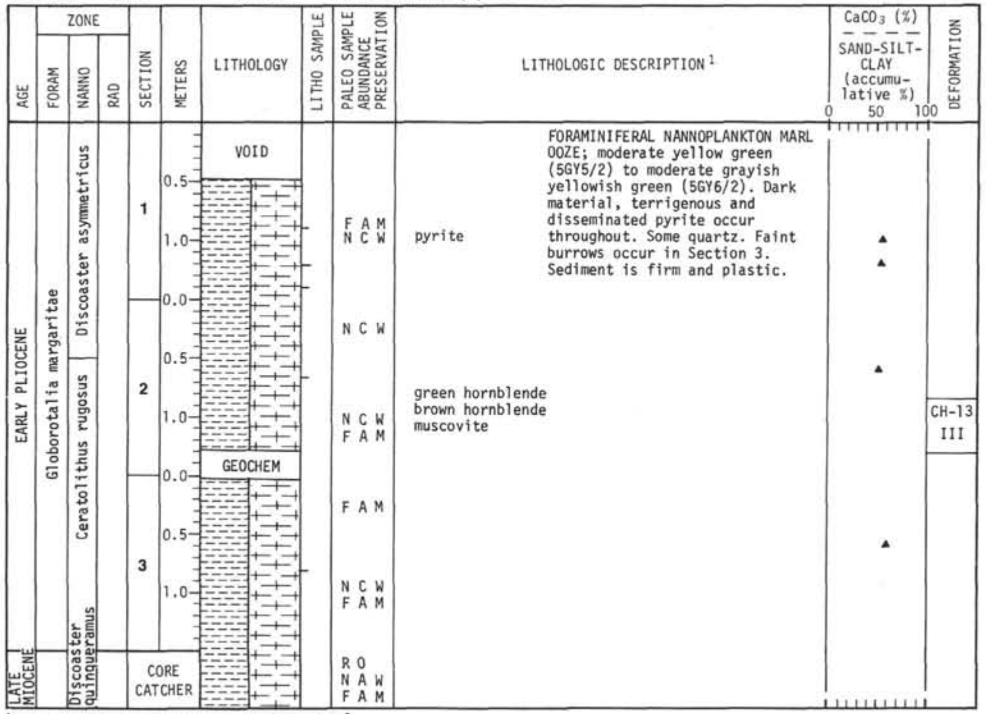
AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO3 (%) / SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
PLEISTOCENE	(Globorotalia hessi sz) Globorotalia truncatulinoides truncatulinoides (Globorotalia crassaformis viola sz)	Gephyrocapsa oceanica; Gephyrocapsa caribbeanica		1	0.5, 1.0			F A W	NANNOPLANKTON FORAMINIFERAL CLAY RICH CHALK OOZE and MARL OOZE; moderate yellow green (5GY6/2) in Section 1 grading through entire core to light olive gray (5Y6/2) in Section 6. Benthonic foraminifers, mainly miliolids, are scattered throughout. Fish debris and rare pyrite. Dark material is disseminated in all sections and concentrated between 32 and 40 cm in Section 3. Sediment is soft and crumbly. X-ray diffraction shows K-feldspar > plagioclase.		
				2	0.0, 0.5, 1.0			N A W; F A W; N A W			
				3	0.0, 0.5, 1.0			N C W; N C W			
				4	0.0, 0.5, 1.0			F A W; N C W			
				5	0.0, 0.5, 1.0	GEOCHEM		N C W			
PLIOCENE	(Globorotalia crassaformis viola sz)	Discoaster brouweri		6	0.0, 0.5, 1.0			N C W; N C M; F A W			
				CORE CATCHER				R O; D A W; N A W			

[1]For explanation of symbols, see Chapter 1

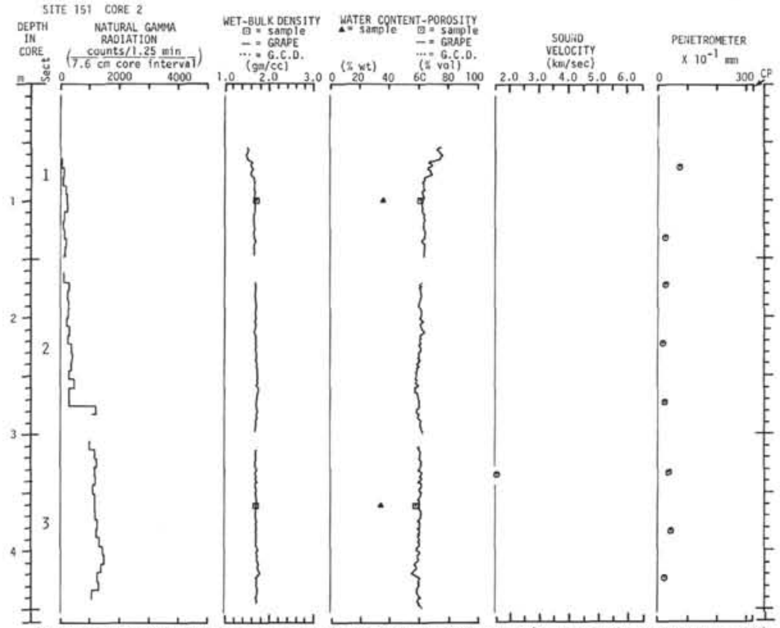


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1387. This background was subtracted from the data.

SITE 151 HOLE CORE 2 CORED INTERVAL (m) 117-126

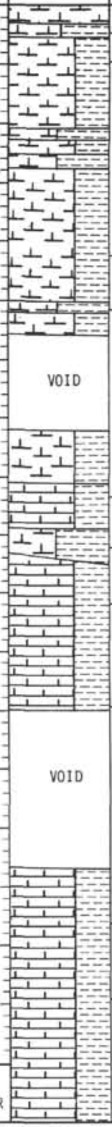


[1]For explanation of symbols, see Chapter 1

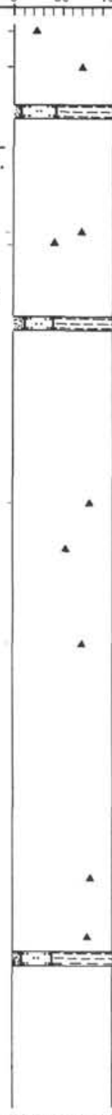


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1442. This background was subtracted from the data.

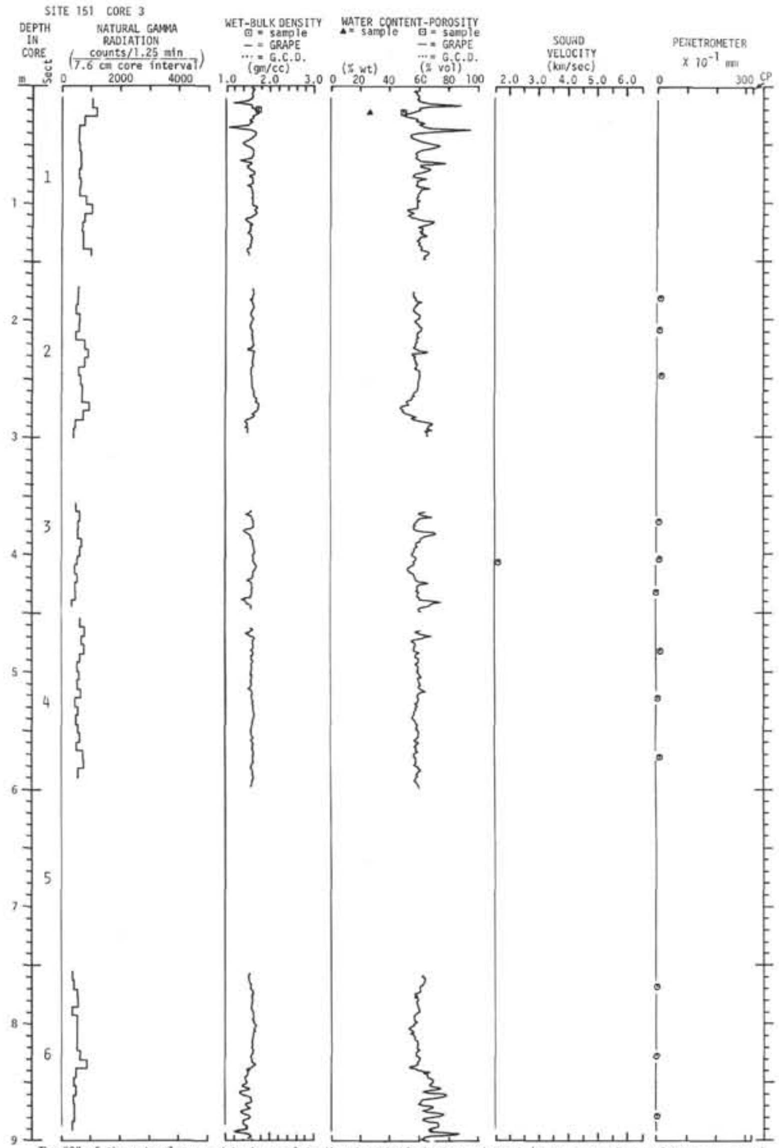
SITE 151 HOLE CORE 3 CORED INTERVAL (m) 181-190

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	$CaCO_3$ (%) / SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
MIDDLE MIOCENE	Globorotalia fohsi lobata (Sections 1–3); Globorotalia fohsi fohsi (Sections 3–6)	Discoaster exilis		1	0.5, 1.0			F A M; F A M; N C W	5Y6/1; 5GY4/1; 5Y6/1; 5GY4/1		
				2	0.0, 0.5, 1.0				5Y6/1; 5GY4/1; 5Y6/1		
				3	0.0, 0.5, 1.0	VOID		N C W; F A M	5GY6/1; 5Y6/1		
				4	0.0, 0.5, 1.0				5GY6/1; 5B7/1 to 5Y6/1		
				5	0.0, 0.5, 1.0	VOID					
				6	0.0, 0.5, 1.0			N C W; F A M	5B7/1; *		
				CORE CATCHER				R O; F A M; N A W			

NANNOPLANKTON CHALK interbedded with NANNOPLANKTON MARL OOZE often grading into CALCAREOUS CLAY. The chalk is mainly light olive gray (5Y6/1) grading in lower part into light bluish gray (5B7/1). Slight burrowing throughout. Pyrite is disseminated throughout, mainly as streaks. Some pyritic laminations appear in Section 6. X-ray diffraction shows K-feldspar > plagioclase. Sediment is hard, slightly indurated in Section 6. The marl ooze is dark greenish gray (5GY6/1) to greenish gray (5GY6/1), with intense burrowing of light gray (N7) to medium gray (N5) color. Contacts between the various layers are always sharp. A dark greenish gray (5G4/1) CLAY layer intensely burrowed, is indicated by an asterisk. The nannofossil assemblage indicates the upper part of Section 1 may have originated higher up in the hole.



[1]For explanation of symbols, see Chapter 1



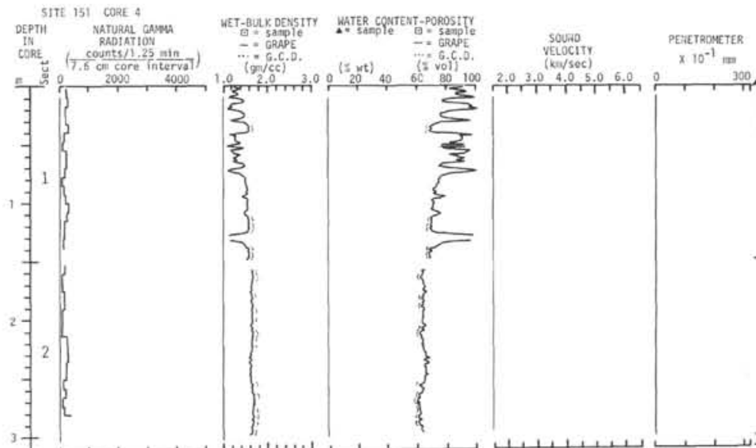
The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1370. This background was subtracted from the data.

SITE 151 HOLE CORE 4 CORED INTERVAL (m) 237-246

AGE	FORAM	NANNO	RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO3 (%) SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
1 / EARLY MIOCENE	2 / 3 / 4 / Globigerinita stainforthi or Globigerinita dissimilus	5 / 6 / Discoaster druggi	7 / Calocycletta virginis	1 / 2 / CORE CATCHER	0.5 / 1.0 / 0.0 / 0.5 / 1.0			N F M / R C M / F A M / N C W / R C M / N C W / F A M / F A M / F A M / F A M / R C M / N C W / R C M / N F P / F A M / R C M	5F2/2 * plagioclase, clinopyroxene apatite, plagioclase, glass 5Y7/2	▲ ▲	CH-13 IV

FORAMINIFERAL NANNOPLANKTON CHALK; clay rich, very light gray (N8), becoming slightly greenish gray (5G6/1) in Section 1 and tending toward yellowish gray (5Y8/1) in Section 2. Dusky purple (5F2/2) is dominant between 114 and 132 cm in Section 1, and yellowish gray (5Y8/1) between 83-95 cm in Section 2. Burrows are abundant in Section 1. Sediment is homogenous and broken in Section 1. The asterisk indicates the location of an ashy layer with abundant pumice.

1. MIDDLE MIOCENE
2. Globrotalia fohsi peripheroronda
3. ? Praeorbulina glomerosa
4. Globigerinita stainforthi
5. Sphenolithus heteromorphus
6. Sphenolithus belemnos
7. D. alata



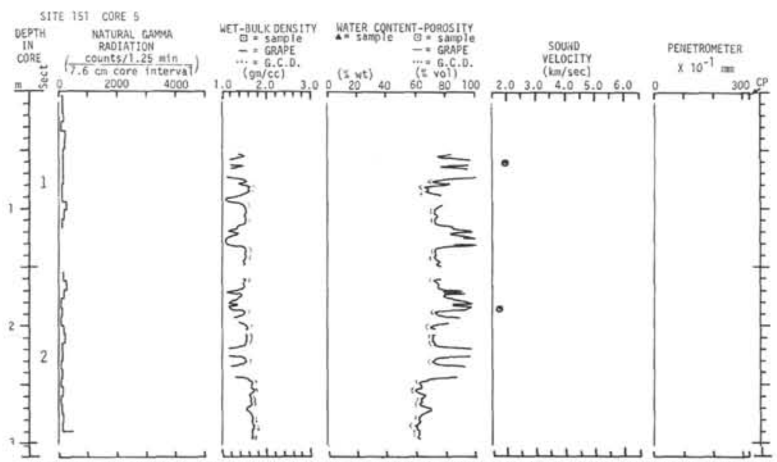
The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1394. This background was subtracted from the data.

SITE 151 HOLE CORE 5 CORED INTERVAL (m) 302-311

AGE	FORAM	NANNO	RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO3 (%) SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
EARLY MIOCENE	Globigerinita dissimilus	Triquetrorhabdulus carinatus	Calocycletta virginis / 1	1 / 2 / CORE CATCHER	0.5 / 1.0 / 0.0 / 0.5 / 1.0	VOID		R F P / F A M / N C M / R C M / R C M / N C M / F A M	pumice brown glass	▲ ▲	

FORAMINIFERAL NANNOPLANKTON CHALK; clay rich, very light gray (N8), with a yellowish gray (5Y7/2) zone at 31-35 cm in Section 2. Olive black (5Y2/1) pyritic speckles and yellowish gray burrows are scattered throughout. Sediment is homogeneous, indurated, crumbly and broken into fragments. Some plagioclase. In addition, X-ray diffraction shows clinoptilolite.

1. Lychnocanoma elongata

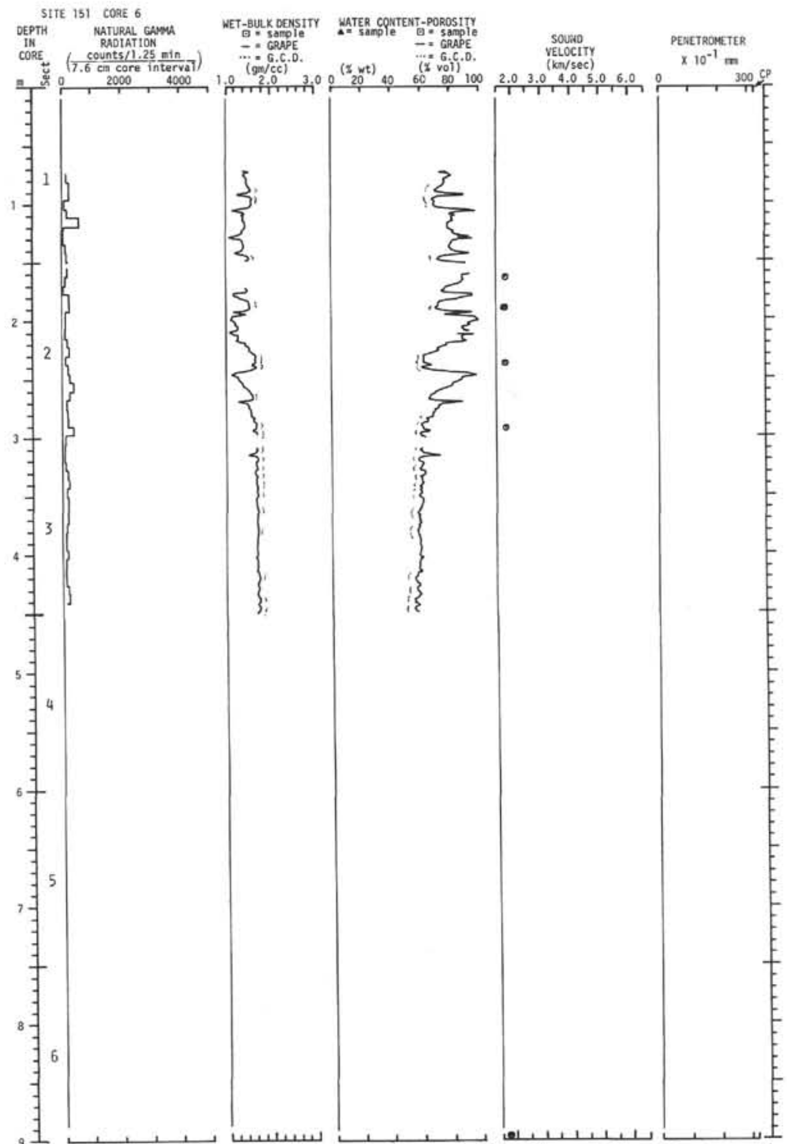


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1394. This background was subtracted from the data.

[1]For explanation of symbols, see Chapter 1

SITE 151 HOLE CORE 6 CORED INTERVAL (m) 311-320

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO3 (%) / SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
LATE OLIGOCENE	? Globorotalia kugleri	Triquetrorhabdulus carinatus	Dorcadospyris ateuchus	1	0.5, 1.0	VOID		R C M N C W	FORAMINIFERAL NANNOPLANKTON CHALK; clay rich, very light gray (N8), slightly brownish gray (5YR4/1) associated in Section 2 with dispersed ash (indicated by "*") and in both Sections 2 and 3 with burrows. "•" indicates a lens of medium gray (N5) volcanic ASH. A pebble of similar composition is found at 130 cm. Extensive bioturbation. Sediment indurated, crumbly, and broken by drilling. Some plagioclase and clinoptilolite; sparse glass, orthopyroxene, and apatite.		
				2	0.0, 0.5, 1.0			N C M R A M F A M	• plagioclase clinopyroxene, apatite *plagioclase, orthopyroxene, glass * *plagioclase, glass		
				3	0.0, 0.5, 1.0			R A M N F M	*		
				CORE CATCHER				R C M F A M			

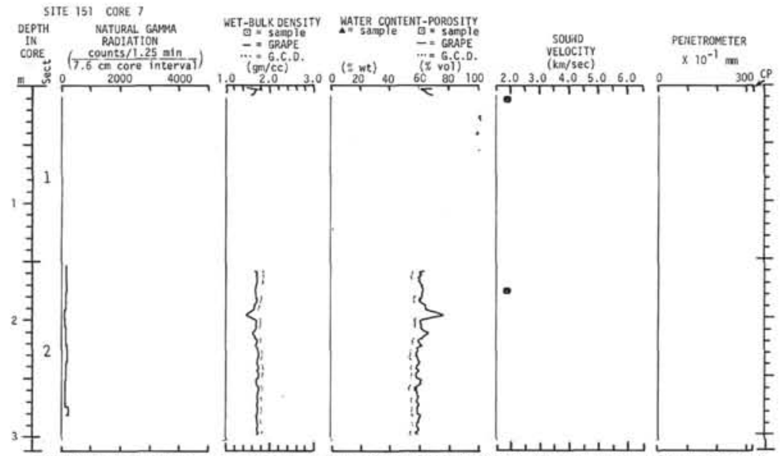


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1362. This background was subtracted from the data.

SITE 151 HOLE CORE 7 CORED INTERVAL (m) 320-329

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO₃ (%) SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
LATE OLIGOCENE	1; Globigerina ciperoensis ciperoensis	Triquetrorhabdulus carinatus	Dorcadospyris ateuchus	1	0.5, 1.0		glass	R A M N C W R C M F A M	FORAMINIFERAL NANNOPLANKTON CHALK; clay rich, very light gray (N8), with very few conspicuous burrows. Sediment is indurated and crumbly. Sparse plagioclase and clinopyroxene. Drilling disturbances resulted in fragmentation and abrasion of the resulting pieces. Water and pulverized sediment flowed along sides of liner. Only the solid lumps appear to be *in situ*.	▲	CH-13 IV
				2	0.0, 0.5, 1.0			N F P F A M	1. Globorotalia kugleri Globigerina ciperocensis ciperoensis	▲	
				CORE CATCHER				R C M F A M			

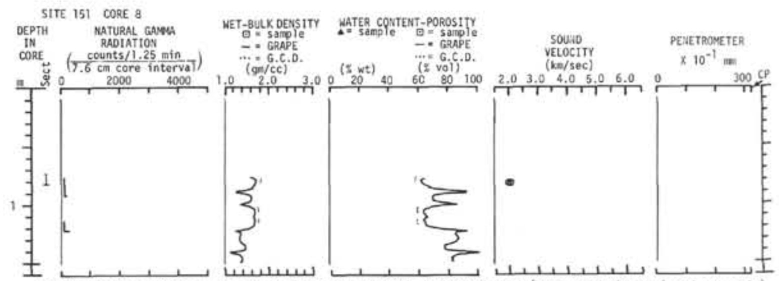
[1]For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1362. This background was subtracted from the data.

SITE 151 HOLE CORE 8 CORED INTERVAL (m) 329-339

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION [1]	$CaCO_3$ (%) — SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
LATE OLIGOCENE	Globigerina ciperoensis ciperoensis	Sphenolithus ciperoensis	Dorcadospyris ateuchus	1	0.5 – 1.0	VOID		R C M F A M N C W	FORAMINIFERAL NANNOPLANKTON CHALK; very light gray (N8), with few brownish gray (5YR4/1) burrows. Sediment is homogeneous, indurated, and crumbly. Some plagioclase.	▲	
				CORE CATCHER				R C M F A M			

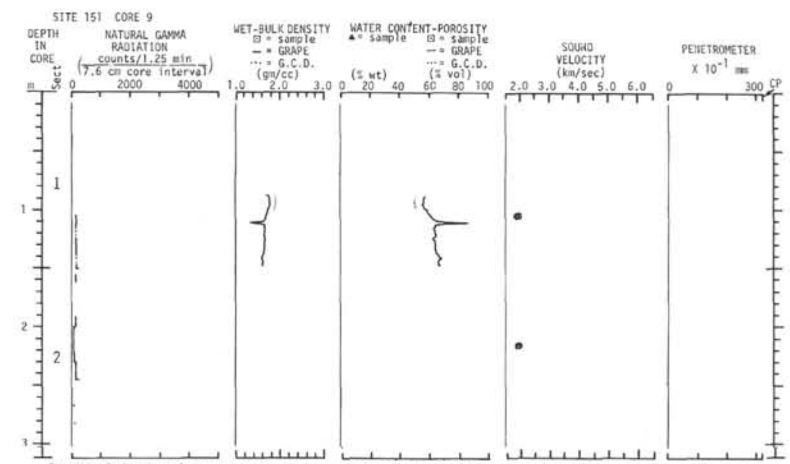


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1362. This background was subtracted from the data.

SITE 151 HOLE CORE 9 CORED INTERVAL (m) 339-348

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION [1]	$CaCO_3$ (%) — SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
MIDDLE OLIGOCENE	Globorotalia opima opima	Sphenolithus ciperoensis		1	0.5 – 1.0	VOID		N C M	FORAMINIFERAL NANNOPLANKTON CHALK; very light gray (N8), with scattered very faint burrows. Some plagioclase; X-ray diffraction also shows clinoptilolite. Sediment is homogeneous, indurated and crumbly. Drilling results in intensive fragmentation.	▲	
				2	0.0 – 0.5 – 1.0			F A M N C W		▲	
1	2			CORE CATCHER				F A W R R M	1. EARLY EOCENE 2. *Globorotalia formosa formosa*		

[1] For explanation of symbols, see Chapter 1



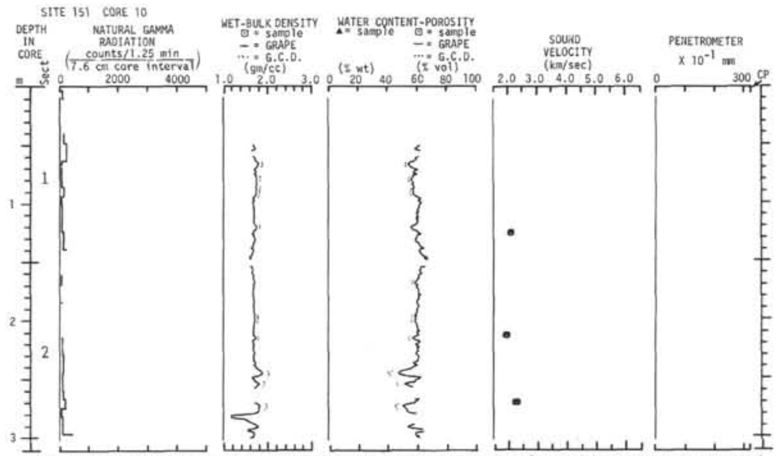
The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1362. This background was subtracted from the data.

SITE 151 HOLE CORE 10 CORED INTERVAL (m) 348-357

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION		LITHOLOGIC DESCRIPTION[1]	CaCO3 (%) / SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
1	2	3				VOID		F C M	*	NANNOPLANKTON FORAMINIFERAL CHALK; pinkish gray (5YR8/1), with with fine pale red (10R6/2) and light brownish gray (5YR6/1) mottling associated with bio-turbation. Generally, some plagioclase and sparse horn-blende. In addition, X-ray shows clinoptilolite. The upper 47 cm consist of a medium light gray (N6) ASH layer low in carbonate overlain and underlain by a very light gray (N6) foraminiferal chalk, with burrows. This complex may be misplaced from higher up in the hole. The sediment is indurated, crumbly, and broken.		
		4						N R M				CH-13 VI
MIDDLE PALEOCENE	Globorotalia angulata	Cruciplacolithus tenuis		1	0.5			F A M	5YR6/1			
								N F M				
								N C M				
					1.0			F A W				
								F A W				
				2	0.0							CH-13 IV
	Globorotalia uncinata				0.5							
					1.0			F A W				
								N F P				
								N F P		VI. Mixed assemblages: sediment is not in situ as based on the nannofossil assemblage.		
								F A M				
				CORE CATCHER				R O				
								F A M		Thin section from Section 1, 135 cm: Packed planktonic foraminiferal biomicrite, mainly well-preserved, unsorted foraminifers with empty or matrix filled chambers. Contains rare plagioclase and quartz, silt and sand sized, angular. Some sponge spicules are partly replaced by calcite. Smear slide indicated by asterisk contains plagioclase, green hornblende, apatite, devitrified glass, alkali feldspar, and zircon.		CH-13 VI

1. EARLY EOCENE
2. Globorotalia edgari
3. MIXED Discoaster binodosus/ Marthasterites tribrachiatus
4. Discoaster multiradiatus

[1]For explanation of symbols, see Chapter 1

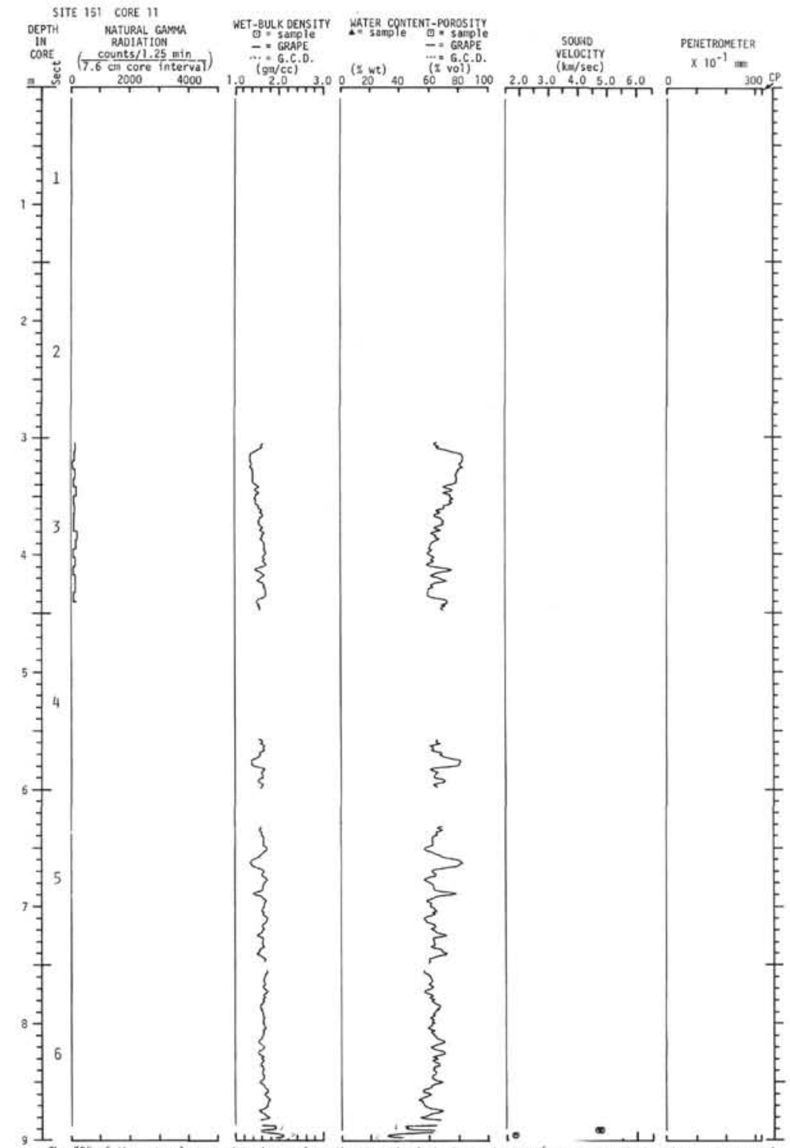


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1362. This background was subtracted from the data.

SITE 151 HOLE CORE 11 CORED INTERVAL (m) 357-366

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO₃ (%) / SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
EARLY PALEOCENE	Globorotalia trinidadensis	Cruciplacolithus tenuis		1	0.5, 1.0	NOT OPENED			NANNOPLANKTON FORAMINIFERAL CHALK; mainly pinkish gray (5YR8/1) with irregularly scattered fragments of dark olive gray (5Y3/1) and yellowish gray (5Y7/1) chalk and marl with yellowish gray (5Y7/1) and greenish gray (5GY5/1) volcanic clay. The undisturbed 112-132 cm in Section 6 display dark olive gray (5Y3/1) streaks, lenses, and microlaminations. Common plagioclase and sparse clinoptilolite. I. Watery: not split (Sections 1 and 2). Stored in freezer boxes, including upper part of Section 3.		CH-13 I
				2	0.0, 0.5, 1.0						
				3	0.0, 0.5, 1.0			F A W	clinoptilolite		CH-13 I
				4	0.0, 0.5, 1.0	VOID					
				5	0.0, 0.5, 1.0	VOID		F A W	plagioclase clinoptilolite		CH-13 III
				6	0.0, 0.5, 1.0			F A W; F A W; N F M; R O; F A W; N F M; R O; N F M; N F M; F F P; F A W	In the lower part of Section 6, BRECCIA ["hard ground" (?)]; yellowish brown, quartz-cemented, composed of fine-grained, siliceous fragments, with iron hydrates concentrated mainly in cavities. Possible silicified fish bones. Core catcher: FORAMINIFERAL SANDSTONE; reddish gray, graded bedding, with foraminifers, rare radiolaria, glauconite grains, and chlorite oriented parallel. Cementation by iron oxide and goethite.		
LATE SANTONIAN	Globotruncana concavata carinata			CORE CATCHER							

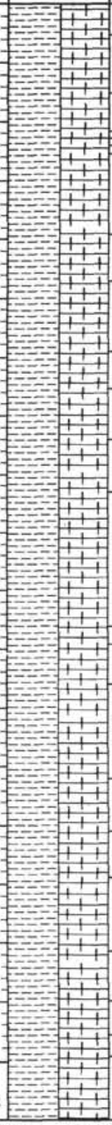
[1]For explanation of symbols, see Chapter 1



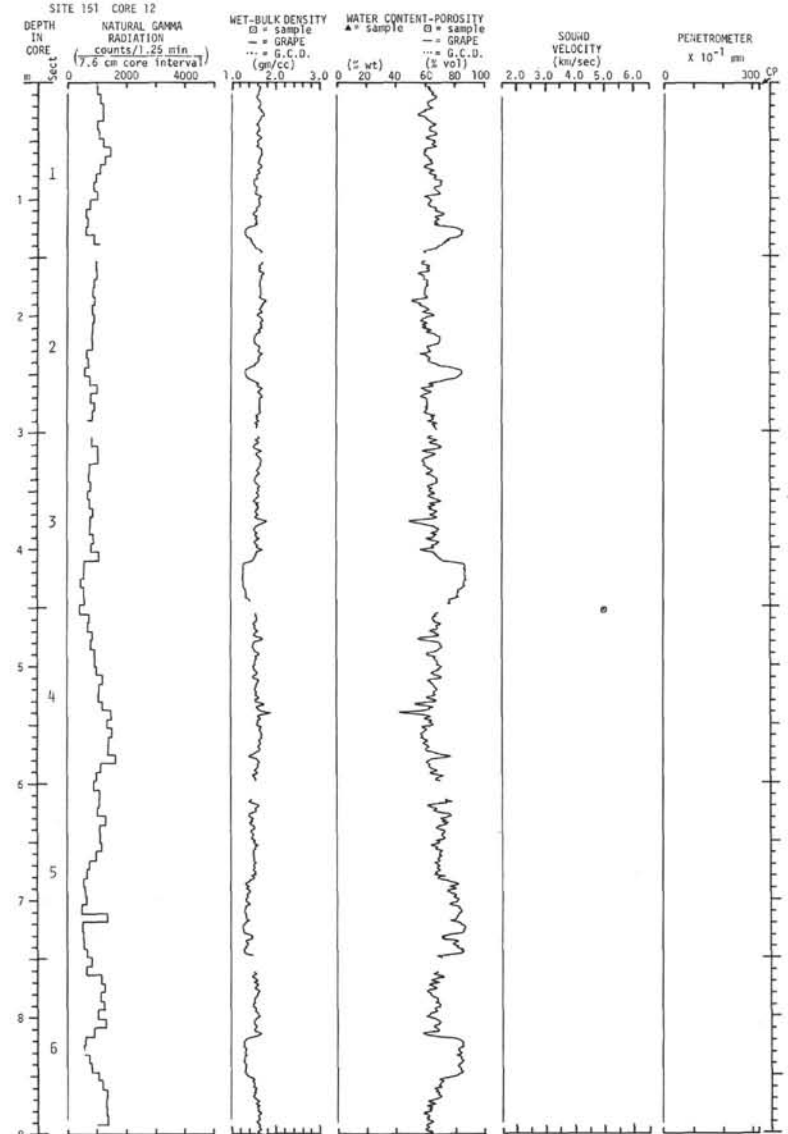
The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1362. This background was subtracted from the data.

SITE 151 HOLE CORE 12 CORED INTERVAL (m) 367-376

AGE	FORAM	NANNO	RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	$CaCO_3$ (%) SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
LATE SANTONIAN	Globotruncana concavata carinata	?		1	0.5 1.0			F C M F C M R O N F M	FORAMINIFERAL NANNOPLANKTON MARL AND CHALK; predominatly dark olive gray (5Y3/1) intermixed with fragments of light gray (N7) SILICEOUS CLAY, dark yellowish orange (10YR6/6) MARL, reddish brown CLAY, and light green and dark green CALCAREOUS CLAY. Large pyrite concretions occur mainly in lenses. Fragments of the breccia described in Core 11 Section 6 are scattered throughout. Lumps of grayish olive glauconitic sediment are abundant in Section 6. Some plagioclase, sparse apatite, quartz. In addition, X-ray shows phillipsite and barite. The greenish material is mica (glauconite) rich, but lacks quartz. Contains abundant juvenile foraminifers, plagioclase, and glauconite. Some of the glauconite may be replacing fish debris. Scattered clinoptilolite, plagioclase, biotite (?), apatite, quartz (?), and chlorite (?).	▲	
				2	0.0 0.5 1.0			F C M F R P R O N F M N R M F C M N R P N C W			
				3	0.0 0.5 1.0			R O F F P N F M			CH-13 V
				4	0.0 0.5 1.0			F C M F C W R O N C W			
EARLY SANTONIAN	Globotruncana concavata concavata			5	0.0 0.5 1.0			F C P			
				6	0.0 0.5 1.0			F C M F C P			
				CORE CATCHER				F A W R O			



[1]For explanation of symbols, see Chapter 1

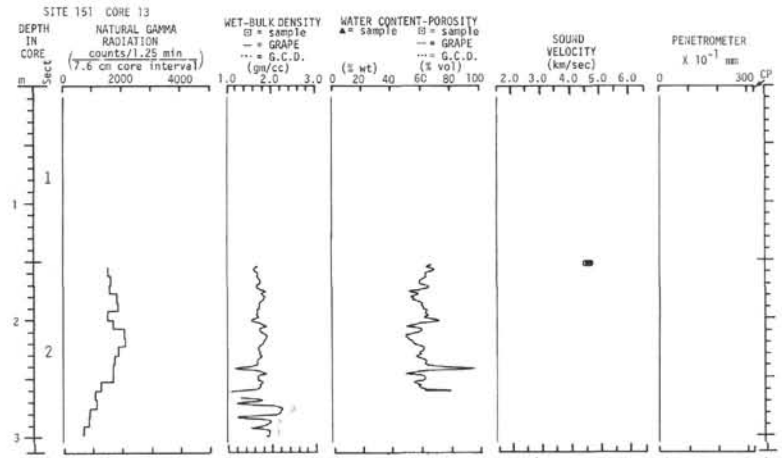


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1416. This background was subtracted from the data.

SITE 151 HOLE CORE 13 CORED INTERVAL (m) 376-378

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO3 (%) / SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
EARLY SANTONIAN	Globotruncana concavata concavata	?		1	0.5 1.0	VOID			CLAY; gray (N4) intermixed with fragments of dusky blue green (5BG3/2) and light gray (N7) clay with scarce spots of dark yellowish orange (10YR6/6) MARL. Green gray pebbles of SANDSTONE, appear in Section 1. The clay appears to be carbonaceous-volcanic.		
				2	0.0 0.5 1.0			n f F R P N F M *	Thin section of one of the fragments indicates, that it is a packed radiolarian LIMESTONE, completely recrystallized; some small plagioclase phenocrysts. Asterisk indicates location of fragments of SANDSTONE, medium dark gray (N4) on wet surface with well-sorted, angular volcanic and fossil fragments. Glauconite matrix along one edge.		CH-13 V
				CORE CATCHER							
									BASALT; see description on Core 14.		

[1]For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1420. This background was subtracted from the data.

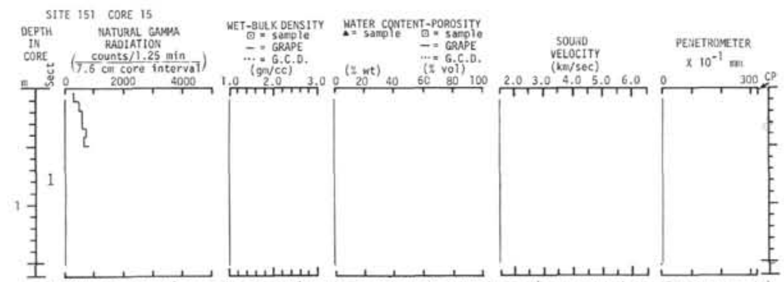
SITE 151 HOLE CORE 14 CORED INTERVAL (m) 378-379

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO3 (%) / SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
				1	0.5 / 1.0	VOID			BASALT; holocrystalline, amygdules with greenish micaceous filling, somewhat glomeroporphyritic, and has vertical fractures with calcite and green micaceous filling. Appears fresh. Larger amygdules show two-stage filling, the latter deep green. Plagioclase crystals, up to An_{90}, have squarish ends. The glomeroporphyritic aggregates are entirely plagioclase with oscillatory zoning, a slight tendency toward interlocking of grains, and yielding a granular texture. Fine micaceous alteration shows around the margins of the aggregates. The groundmass consists of plagioclase laths, pyroxene and oxide grains, and scattered specks of a micaceous substance. K_2O-1.76, TiO_2-2.52, and P_2O_5-0.26.		
				CORE CATCHER							

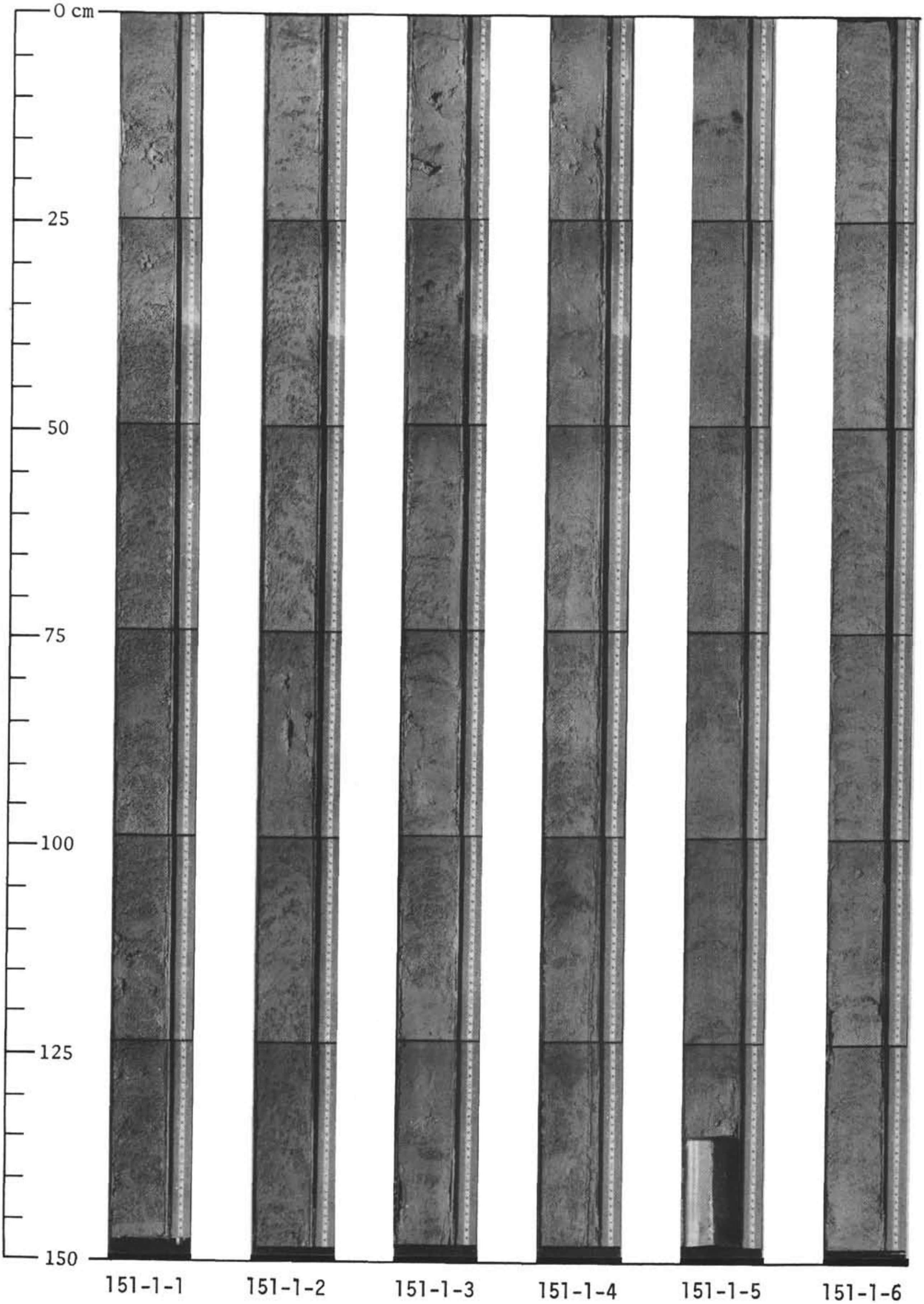
SITE 151 HOLE CORE 15 CORED INTERVAL (m) 379-381

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO3 (%) / SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
				1	0.5 / 1.0	VOID			BASALT; see description on Core 14.		
				CORE CATCHER							

[1]For explanation of symbols, Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1420. This background was subtracted from the data.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125
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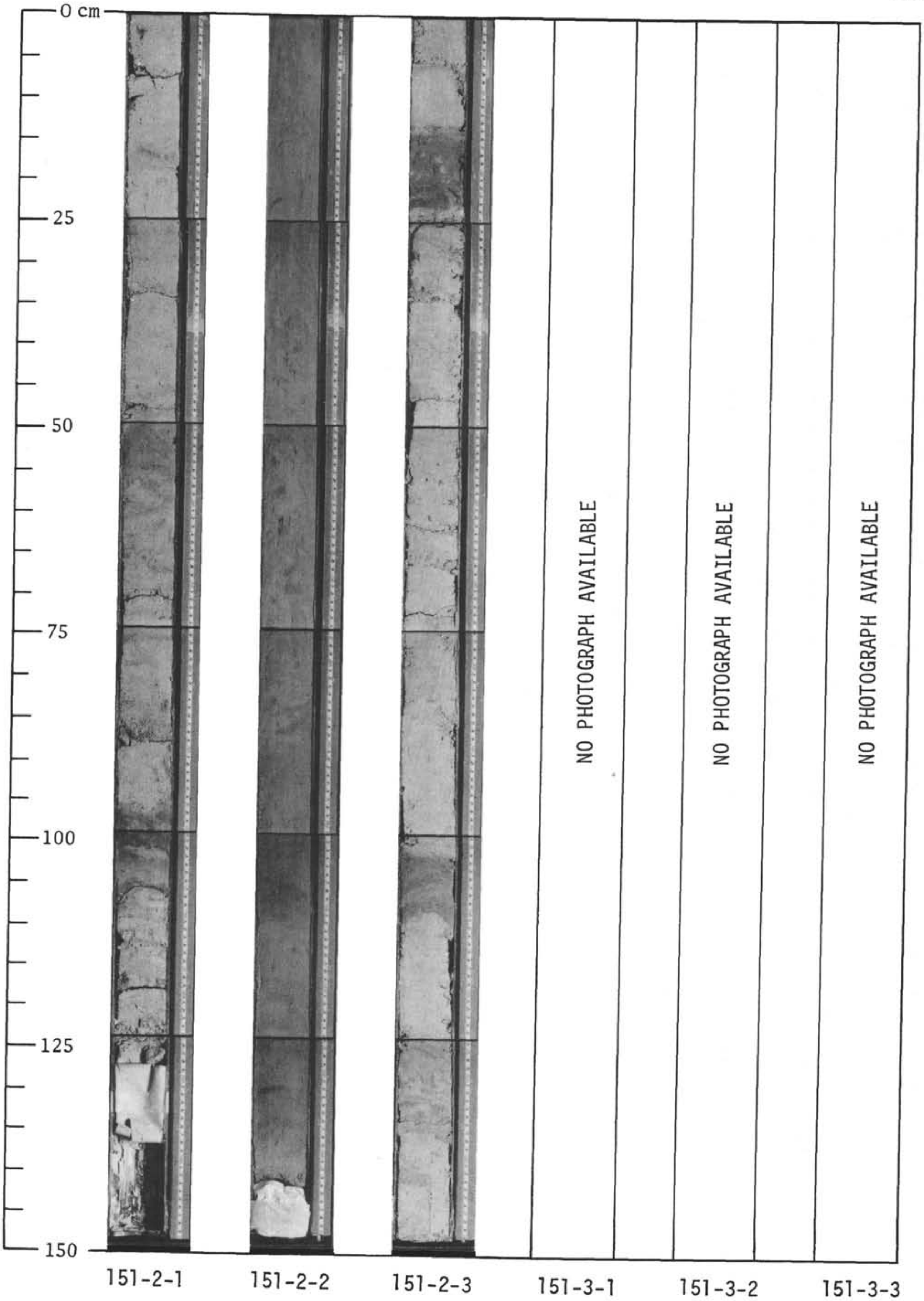
151-1-6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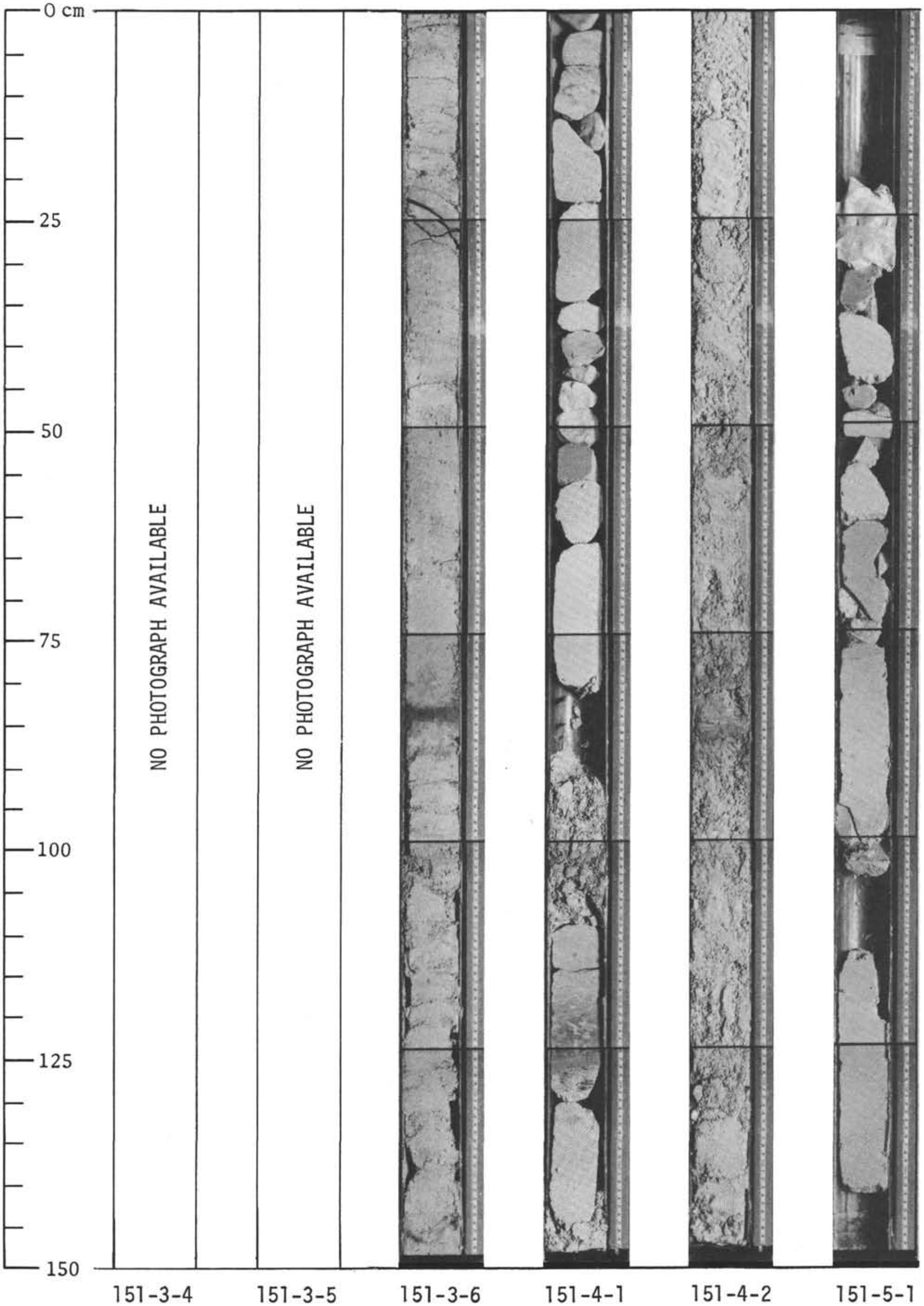
151-3-3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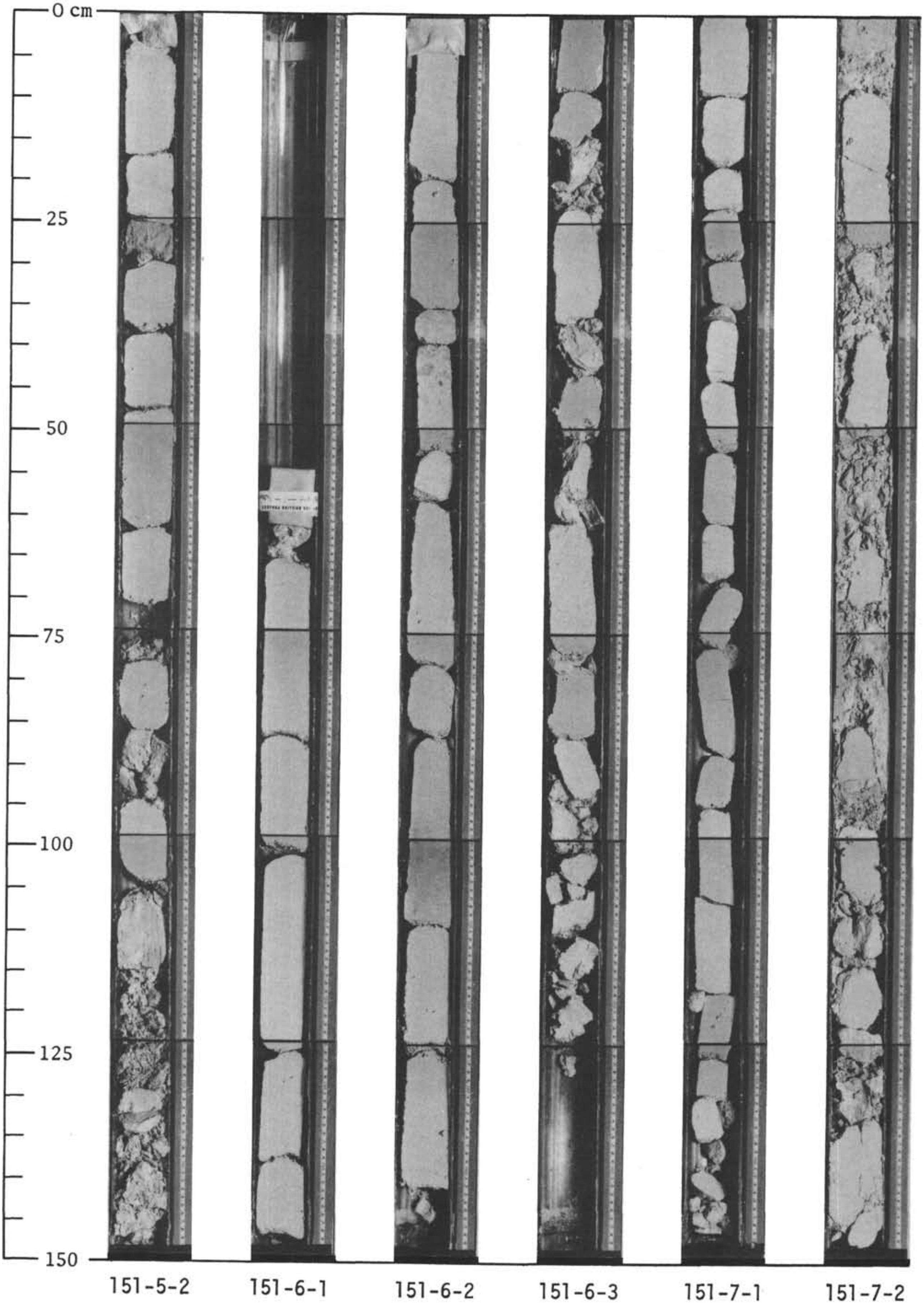
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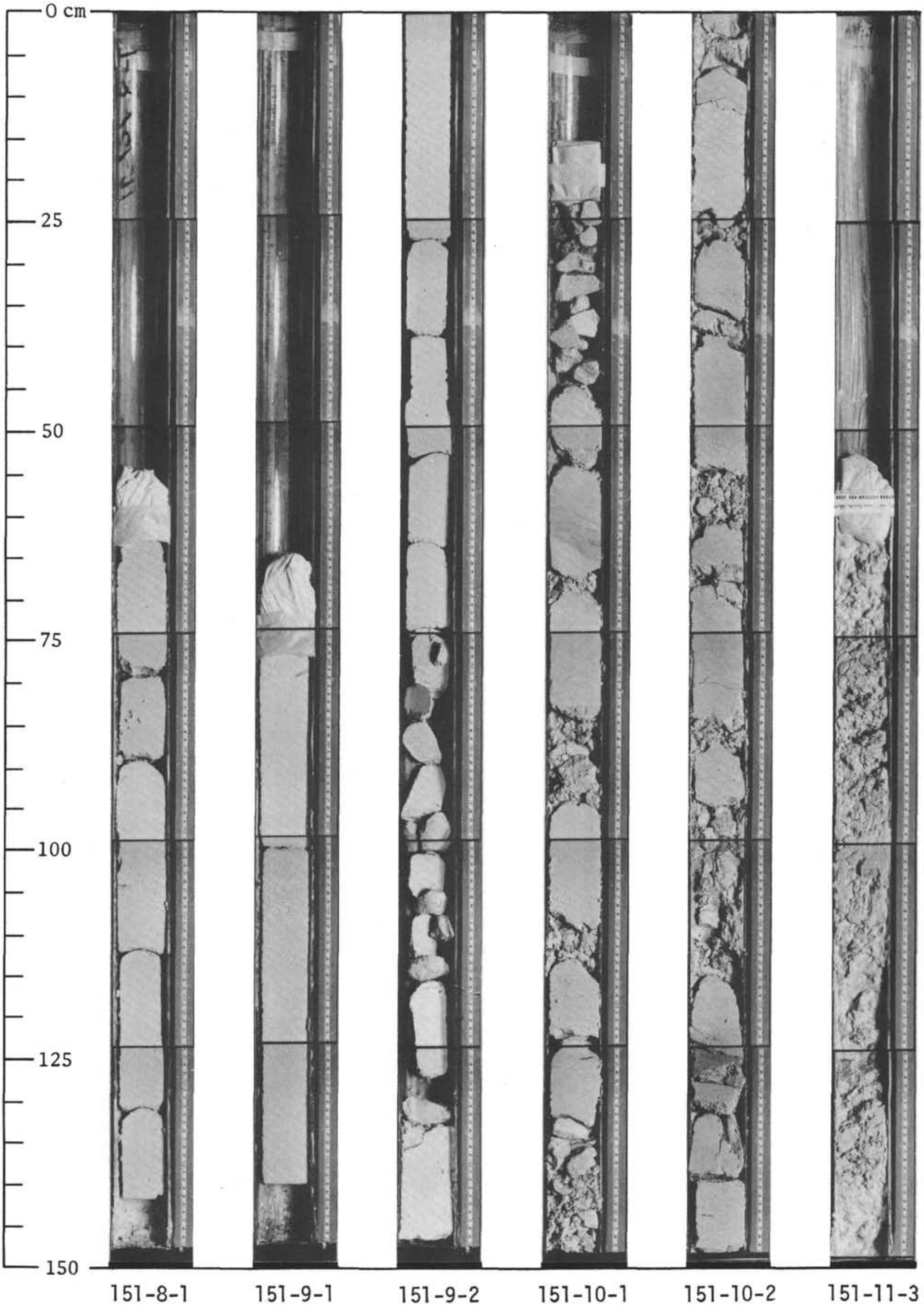
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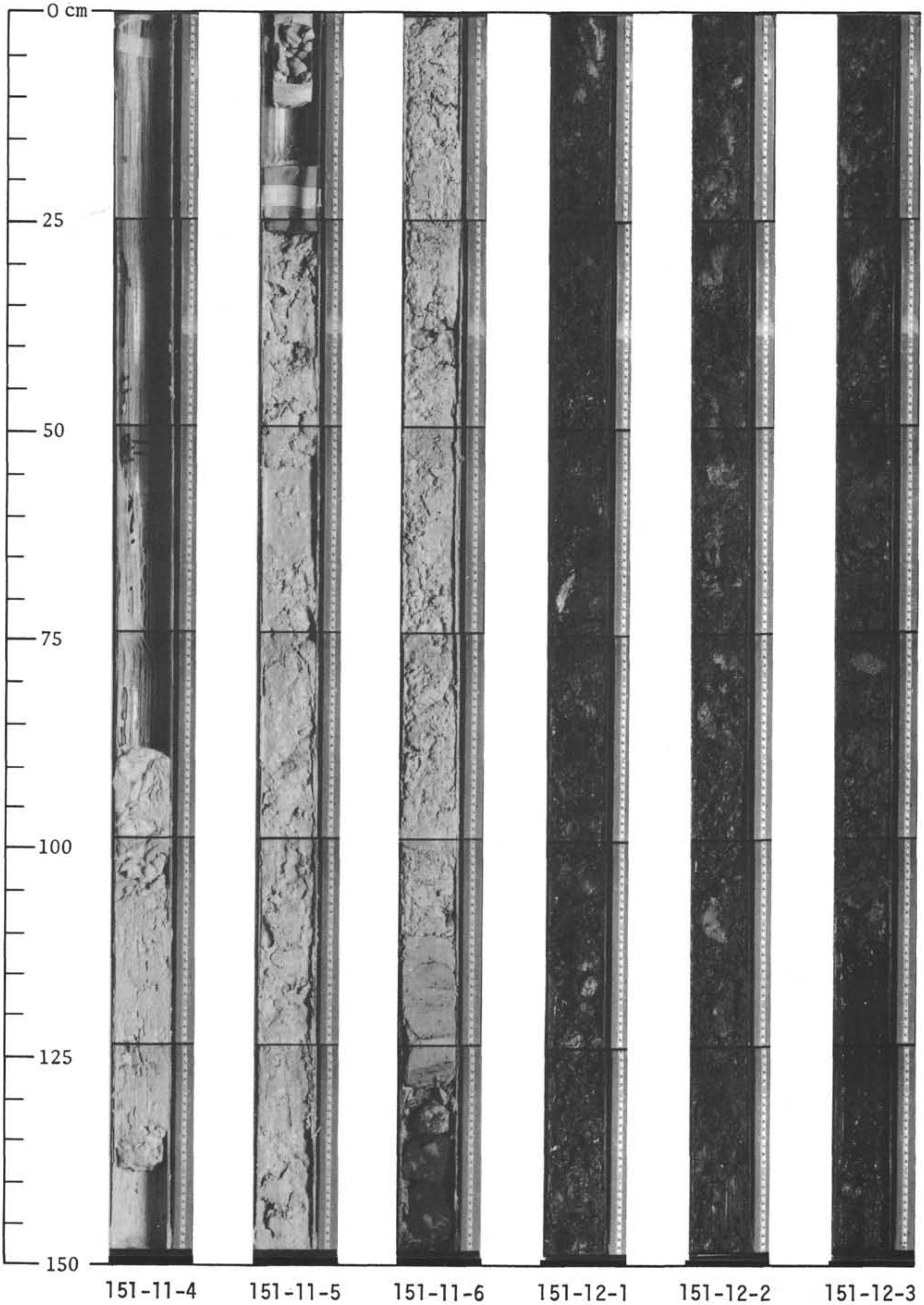
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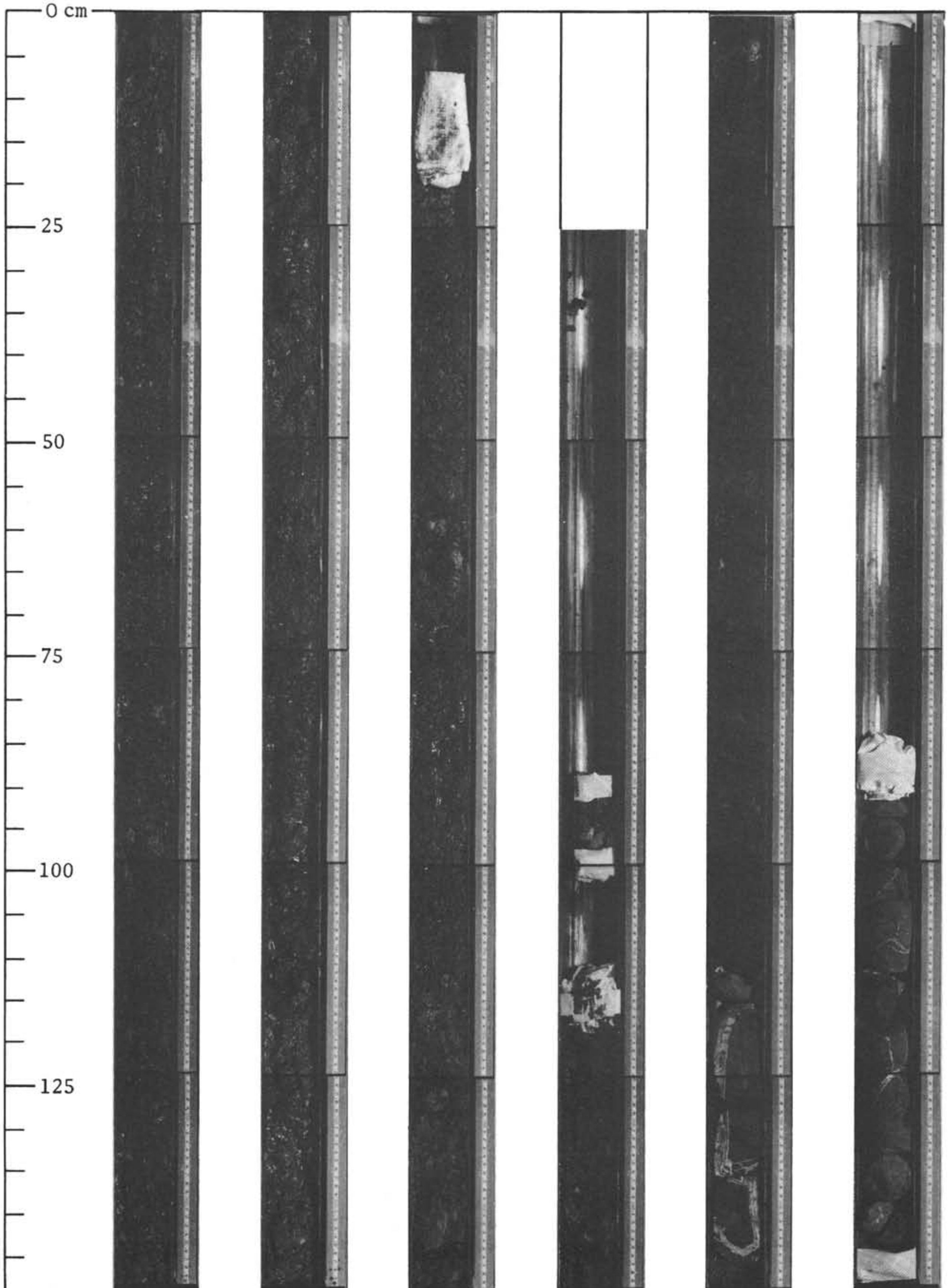
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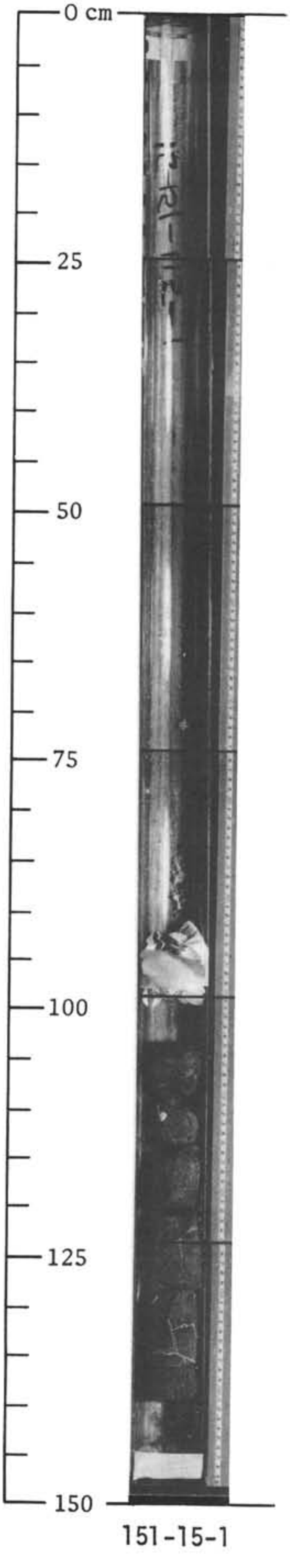
151-14-1



151-15-1