7. SITE 152

The Shipboard Scientific Party[1]

Position:
15°52.72′N
74°36.47′W.

Water Depth: 3899 meters.

Penetration: 477 meters.

Recovery: 59 meters (28%).

ABSTRACT

This site is located on the lower flanks of the Nicaragua Rise adjacent to the northern part of the Colombia Basin.

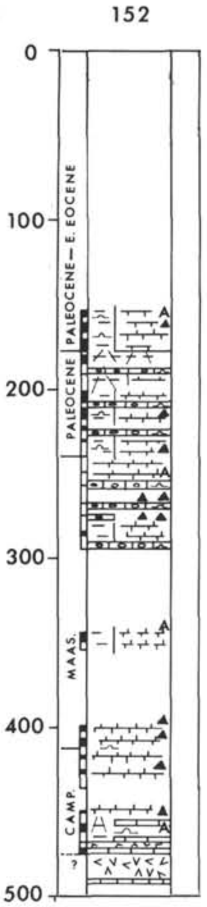
The entire sediment cover overlying basalt to the youngest core taken (Eocene) is all chalk and limestone of varying degrees of compaction and silicification. The prominent reflector, Horizon A″, could be associated with either stiff Eocene chalks with minor cherts or with the underlying hard, partly silicified cherty Paleocene limestones. The sediment-basalt contact (Horizon B″) was not recovered but large pieces of metamorphosed foraminiferal limestone were recovered below the top of the basalt.

BACKGROUND

Site 152 is located on the lower reaches of the southeast flank of the Nicaragua Rise. The rise extends from Honduras and Nicaragua in Central America to the Island of Hispaniola in the Greater Antilles. Jamaica, the only major subaerial expression on the rise, has Cretaceous rocks exposed that have been described as part of the Greater Antilles geosynclinal belt (Chubb, 1960). The rise is bounded on the southeast by the Colombian Basin and the northwest by the Cayman Trough.

Seismic refraction profiles over the rise show a velocity structure of 3.9, 5.4, 6.6, and 8.1 km/sec, like that of the Beata Ridge, but quite different from the Venezuelan and Colombian basisn and the Aves Ridge (Ewing et al., 1957, 1960; Edgar et al., 1971).

Seismic reflection records (Ewing et al., 1967; Edgar et al., 1971) indicate a marked difference in the acoustic properties of sediments deposited on the rise crest (stratified) to those of the southeast flank (transparent). There are two seismic reflectors in the deeper acoustically transparent sediments (Figures 1 and 2) that are distinct in some areas and appear to coalesce to form one strong reflection in others. The two reflectors which are very similar to Horizons A″ and B″ of the Venezuelan Basin, can be traced beneath the highly stratified sediments of the northern tongue of the Colombian Basin.



Lamont's R/V *Vema* located a fault on the Nicaragua Rise just above the sediments of the Colombian Basin that exposed (piston cored) Maestrichtian carbonate ooze. The piston core was taken on the face of a fault escarpment on the lowermost flank of the Nicaragua Rise (Figure 1). The reflection record of Figure 1 shows the fault structure as the *Glomar Challenger* passed over the site en route to Jamaica for an unscheduled port stop. On her return a survey of the area was made before the final site (Figures 1 and 2) was located. The possibility of spudding in below the first subbottom reflector on the escarpment was very low, consequently the final site was established on the top of the fault block.

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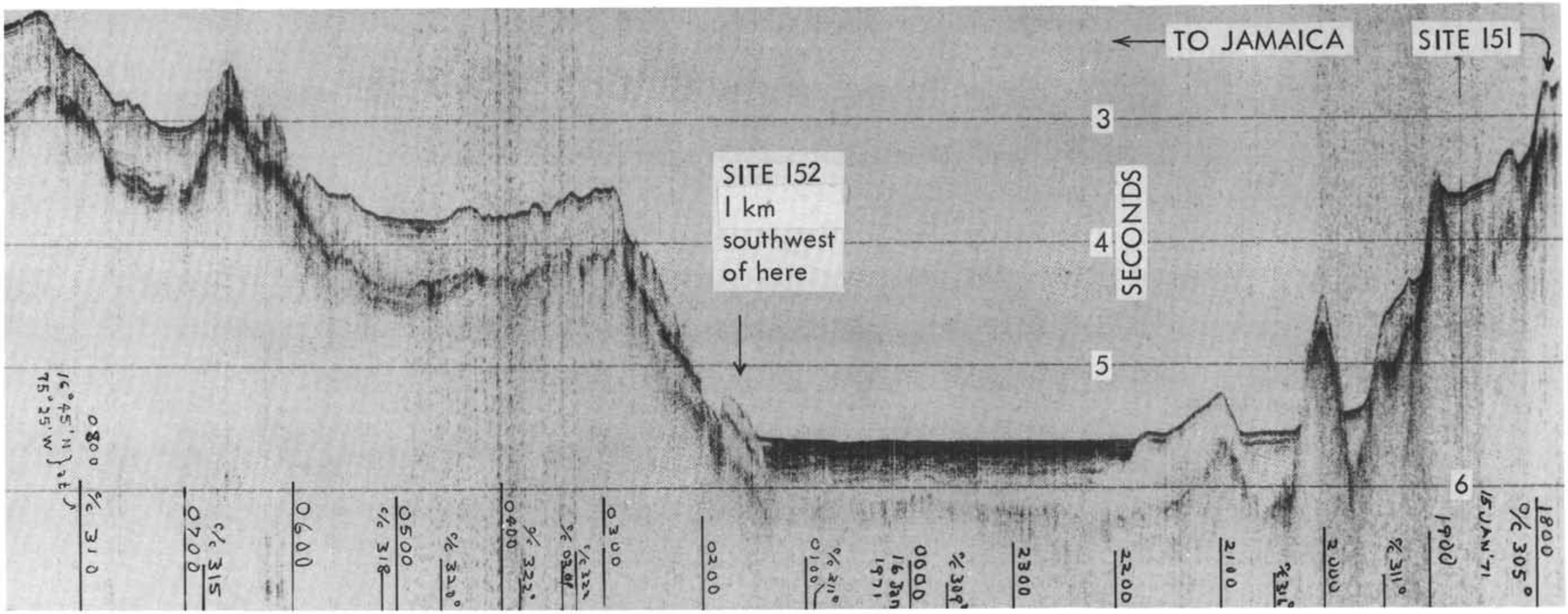

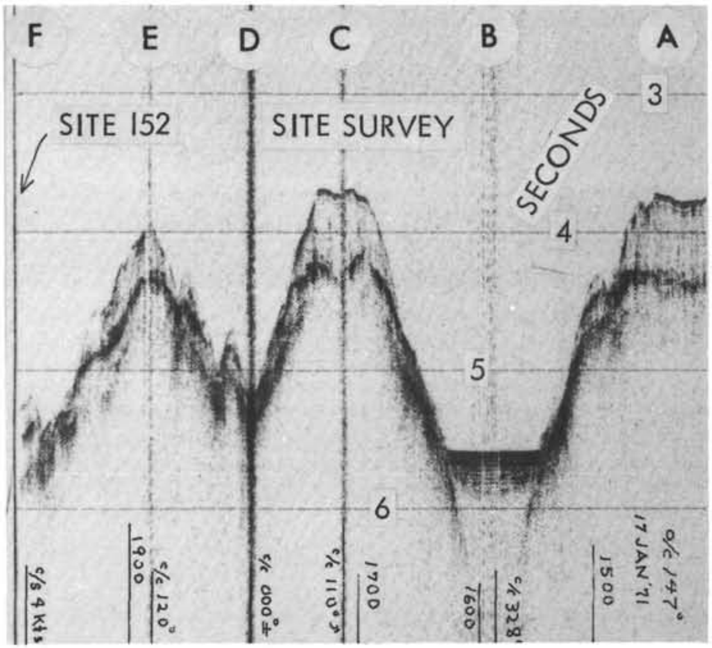

Figure 1. *Seismic reflection record made by* Glomar Challenger *over the area of Site 152 while en route to Jamaica for an unscheduled port stop and the survey on returning to the site. The fault escarpment parallels the trend of the Nicaragua Rise.*

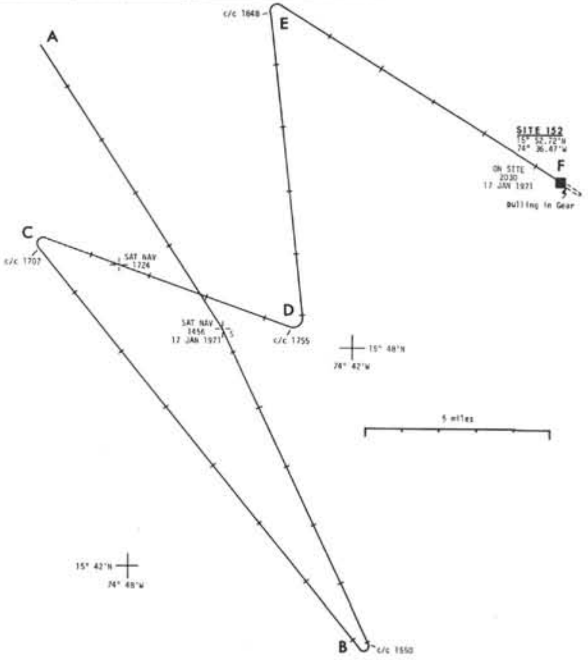

Figure 2. *Chart showing* Glomar Challenger *track for reflection records shown in Figure 1.*

OBJECTIVES

This site offered the westernmost location where two seismic reflections that resembled Horizons A″ and B″ of the Venezuelan Basin could be identified and the biostratigraphy and lithostratigraphy of the Venezuelan Basin could be compared with that of the Colombian Basin. The age of Horizon B″ in the Venezuelan Basin and the Beata Ridge sites was found to be remarkably similar–Late Cretaceous Coniacian and Santonian. Drilling in the westernmost area where B″ could be tentatively identified on the seismic records would give an indication of the areal extent and variations in the age of the igenous surface.

OPERATIONS

The ship arrived on Site 152 at 1445 hours on 17 January 1971 and after dropping the beacon was diverted to Kingston, Jamaica, to let off a crew member. The ship returned to the site at 0730 hours 19 January and the upper 153 meters of soft sediment was drilled. At this depth the drilling rate indicated that more indurated sediment had been encountered and coring was started. Coring was continuous between 153 and 289 meters, but poor recovery and slow headway in siliceous sediment required rapid drilling in the hope of reaching sediments that could be cored more easily. Four meters of basalt and limestone (marble) were recovered at the bottom of the hole. An attempt was made to drill an offset hole to take additional cores, however, at deterioration in the signal from the positioning beacon forced abandonment of the site and the ship departed at 0800 hours on 22 January.

LITHOLOGY

The sediment above the basalt at this site is chalk and limestone, varying in degree of compaction and induration but generally becoming more lithified with increasing depth. The uppermost chalks (Eocene and late Paleocene) are very pale orange, changing gradually to white with depth but becoming light bluish gray in the lowermost cores near the basalt. Burrowing is evident in adjacent beds of slightly different color (Figure 3), but the general color and textural homogeneity makes the recognition of burrowing difficult. Silicification is evident in all degrees from complete absence to the occurrence of chert and commonly occurring as discrete lithified layers of limestone (Figure 4).

Three different types of chert were recognized, based mainly on color. The upper cherts of Cores 1 through 5 (Eocene and late Paleocene) are a yellowish brown, but those in the underlying sediments of Cores 6 through 21 are a greenish gray. The third type, found in the bluish gray limestones overlying the basalt, are olive black and are among the hardest cherts collected on this leg. The chert fragments found in the uppermost few cores may have been displaced from the first encounter with chert just above Core 1. Chert micronodules occur below 210 meters and become more conspicuous downward. These micronodules overlap with moderately well-preserved radiolaria over a vertical interval of 30 meters and may represent a horizontally transported, silicified radiolarian element.

Figure 3. *Intensely burrowed varicolored limestone (152-22-3, 51-72).*

Volcanic constituents are persistent throughout this hole. Ash layers with fresh glass occur down to 200 meters, but lower ash beds are altered to montmorillonite with clinoptilolite. A basaltic ash layer (Figure 5) was found a short distance above the basalt. Plagioclase crystals are nearly ubiquitous and hornblende and clinopyroxene almost equally widespread. A subalkalic component (quartz, alkali feldspar, biotite, apatite, and zircon) is locally conspicuous in the Paleocene sediments and more abundantly in the Cretaceous. Authigenic K-feldspar was found in Core 18 (415 m).

The basalt beneath the section is not pillowed and appears to be somewhat weathered. It is vesicular and fractured with vesicles and fractures filled with chalcedony and green mica. Although the contact with the limestone was not recovered, recrystallized limestone fragments crowded with planktonic foraminifera were found as inclusions in the basalt.

Figure 4. *Limestone showing dark band of cherty limestone; silicification through replacement (152-16-1, 100-118).*

Figure 5. *Dark basaltic ash layer in limestone sequence. Note deformation of ash bed probably resulting from differential compaction.*

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 (the sample data are the enclosed dots on the hole and core plots). Water content was determined by weight-weight relationships. In general, precision of these data is about ±5 percent. Methods, errors, assumptions, hard rock diameter corrections, sediment disturbance, and interpretation precautions are discussed in the Appendix.

Some stiff sediments or rocks are cored without resulting plastic flowage, and, since the drill bit has a smaller diameter than the core liner, the hard sediment sample also has that small diameter, and the remaining space is filled with a drilling slurry or highly disturbed sediment (in some cases air). A problem arises here because a 2.60-inch diameter is assumed in the density calculation. Where necessary the GRAPE data of Site 152 are adjusted for incorrect diameter of the core (GRAPE Corrected Diameter [GCD] are on the core and hole plots as single dots or a dotted line density and porosity). Diameters were generally smaller than 2.60 inches by 10 percent in Cores 1 and 2; 12 percent in Cores 16, 17, and 19; 13.5 percent in Cores 6 to 10, 18, and 21 through 24; and 27 percent in Core 4. The typical density of the disturbed sediment or drilling slurries was about 1.1 g/cc (ranged from 1.0 to 1.25 g/cc); however, this is largely an assumption and the data may be manipulated with the equations in Appendix I.

Only the maximum density trends and minimum porosity trends are recalculated as lesser densities and greater porosities are suspected of being drill-disturbed sediments, smaller diameters, or fractured rock. These adjusted data are only approximations.

Results

Wet-bulk density of the Early Tertiary and Cretaceous chalk ooze and limestone at Site 152 ranged from 1.2 g/cc (disturbed ?, 86% porosity) to 2.35 g/cc (20% porosity). From 150 to 230 meters, Eocene and Paleocene foraminiferal nannofossil chalk and slightly micritic limestone, both with radiolarians or chert layers, had a typical density of 1.65 g/cc (60%), with low values of 1.35 g/cc (74%), and a few high-density spikes of 2.18 to 2.35 g/cc. The low values in Core 1 are probably related to the high radiolarian content while low densities in Cores 6 and 7 (200 to 220 m) appear to be related to drill disturbance. The high-density spikes at 177 meters and 209 meters were in cherty limestone (2.18 g/cc) and a silicified limestone layer (2.35 g/cc), respectively. Cretaceous foraminiferal nannofossil chalk (with chert layers) from 270 to 450 meters and limestone from 450 to 470 meters had a typical density of 2.10 g/cc (36% porosity), with lows of 1.75 g/cc (45% porosity) and highs of 2.18 to 2.35 g/cc. These high densities characterize siliceous limestone and foraminiferal nannofossil micritic chalk and limestone. In general, sediments below 200 meters become more micritic, recrystallized, and denser with increasing depth. Basalt densities ranged from 2.58 to 2.70 g/cc.

Water content samples collected from Eocene foraminiferal nannofossil chalk ooze, with radiolarian layers, ranged from 29 to 43 percent.

Sound Velocity

Sound velocity through sediment and rock samples was measured by the Hamilton Frame technique, which is discussed in the Appendix. 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 planes unless otherwise noted in Table 1 and were measured at laboratory pressures and temperatures (22.9 to 27.6°C).

Results

Sound velocities in the sediments and rocks recovered at Site 152 ranged from 1.55 to 5.43 km/sec and irregularly increased with increasing depth. Eocene-Paleocene clay-rich chalk from 150 to 250 meters propagated typically lower sound velocities than the Cretaceous micritic biogenic chalk from 250 to 455 meters.

More specifically, velocities ranged from 1.64 to 4.21 km/sec, with typical values about 1.7 to 2.2 km/sec through Eocene-Paleocene clay-rich foraminiferal nannofossil chalk but with lower velocities typical of foraminiferal radiolarian chalk ooze layers. These minimal velocities tend to increase with depth. High velocities, from 2.3 to 4.2 km/sec, are characteristic of silicified or cherty zones in the chalk. Siliceous limestones had velocities ranging from 3.0 to 3.8 km/sec, while chert and cherty limestone had slightly higher velocities of 4.17 to 4.44 km/sec.

Cretaceous foraminiferal nannofossil chalk (increasingly micritic with increasing depth) from 258 to 455 meters had typical velocities of 2.0 to 3.0 km/sec, and a single high velocity of 5.48 km/sec which was measured through chert from 410 meters. The limestone from 460 to 472 meters had velocities between 2.39 and 3.55 km/sec, with the low velocity of 2.39 km/sec from an ash- and zeolite-rich limestone. Metamorphosed pink limestone in the basalt, however, has a velocity of 5.39 km/sec, while the basalt has velocities of only 4.39 to 4.47 km/sec.

Velocities were measured parallel and perpendicular to the bedding in five samples from Site 152. Three Tertiary samples showed anisotrophy of 2 to 5 percent, with greater velocities perpendicular to the bedding, while two samples from the Cretaceous have velocities 3 to 11 percent faster parallel to the bedding.

Natural Gamma Radiation

Natural gamma ray emissions were counted for a period of 1.25 min at 7.62 cm(3 in) intervals along the core, with a counting precision of about ±100 counts. The following data are not corrected for varying porosity, which along with sediment disturbance, methods, and equipment is discussed in Appendix I.

Natural gamma radiation from sediments recovered at Site 152 ranged from 0 to 1700 counts. Eocene, Paleocene, and Cretaceous foraminiferal nannofossil chalk and limestone, from 150 to 475 meters below the sea floor, emitted typical counts from 0 to 800 with 200 to 300 being characteristic. The higher counts were related to dark layers of apparently higher clay content. The high spike of 1700 counts in Core 2 (recovered from 165 m) was emitted from a volcanic clay layer.

Penetrometer

Needle penetration tests were conducted at Site 152 with a 1-mm diameter needle. The methods, equipment, and sediment disturbance are discussed in Appendix I.

Penetrometer measurements in Eocene and Paleocene foraminiferal nannofossil chalk ooze between 165 and 185 meters below the sea floor ranged from 0 to 12 mm, while below 185 to 250 meters, penetration in undisturbed sediments was 1 mm or less. The low penetration below 185 meters is related to the sediments becoming more micritic and indurated with increasing depth. Cretaceous micritic foraminiferal nannofossil chalk below 250 meters had zero penetration.

BIOSTRATIGRAPHY

Cores 1 to 4 (153-192 m below the sediment surface) are siliceous foraminiferal nannofossil chalks. The calcareous plankton assemblages are diverse and generally well preserved, being only slightly affected by solution. The planktonic foraminifera of Core 1 are assigned to the *Globorotalia subbotina* Zone, *Globorotalia edgari* being absent from this core. Calcareous nannofossil assemblages from the top of Section 1 of Core 1 lack *Discoaster multiradiatus* and are referred to the *Discoaster diastypus* Zone. *Discoaster multiradiatus* is present in the lower part of Section 1 and through Cores 2, 3, and 4 so that all of these are referred to the *Discoaster multiradiatus* Zone. The highest occurrence of *Globorotalia velasconensis* is in the middle of Section 5 of Core 3; higher strata in this unit, up

TABLE 1
Hamilton Frame Sonic Velocities, Site 152

Core	Section	Upper Interval[a] (cm)	Depth in Hole (m)	Velocity[b] (m/sec)	Temperature (°C)	Remarks
1	1	89.0	153.89	1642	23.5	Foram chalk, radiolarian- and clay-rich; ∥ to bedding.
1	1	89.0	153.89	1728	23.5	Foram chalk, radiolarian- and clay-rich; ⊥ to bedding.
1	1	126.0	154.26	1670	23.5	Foram chalk, radiolarian- and clay-rich; ∥ to bedding.
1	1	126.0	154.26	1706	23.5	Foram chalk, radiolarian- and clay-rich; ⊥ to bedding.
1	2	130.0	155.80	1730	23.5	Foram chalk, radiolarian- and clay-rich; ∥ to bedding.
1	2	130.0	155.80	1818	23.5	Foram chalk, radiolarian- and clay-rich; ⊥ to bedding.
2	4	40.0	166.90	1911	23.6	Ash lump and foram chalk.
2	4	40.0	166.90	1924	23.6	Ash lump and foram chalk.
3	3	30.0	175.30	1636[c]	23.6	Foram chalk, radiolarian- and clay-rich.
3	3	45.0	175.45	1620[c]	23.2	Foram chalk, radiolarian- and clay-rich.
3	5	17.0	178.17	1638[c]	22.9	Foram chalk, radiolarian- and clay-rich.
3	5	35.0	178.35	4170	22.9	Cherty limestone.
3	5	45.0	178.45	2302	22.9	Foram chalk, radiolarian- and clay-rich.
3	5	90.0	178.90	1687[c]	22.9	Foram chalk, radiolarian- and clay-rich.
3	5	123.0	179.23	2448	22.9	Foram chalk, radiolarian- and clay-rich.
4	3	94.0	185.94	2319	22.9	Foram nanno chalk, clay-rich, abundant sparite.
4	3	106.0	186.06	2513	24.0	Foram nanno chalk (harder, near chert), clay-rich, abundant sparite.
4	3	108.0	186.08	3601	24.0	Chert, yellow brown.
5	CC	0.0	201.00	3444	24.2	Limestone, siliceous, conchoidal fracture.
6	5	86.0	207.86	3798	24.2	Limestone, silicified.
6	5	86.0	207.86	3739	24.2	Limestone, silicified.
6	5	136.0	208.36	1713	25.7	Nanno micritic chalk, clay-rich; ∥ to bedding.
6	5	136.0	208.36	1675	25.7	Nanno micritic chalk, clay-rich; ⊥ to bedding.
7	1	0.0	211.00	2569	25.7	Foram nanno chalk, clay-rich; ⊥ to bedding.
7	3	130.0	215.30	3392	26.4	Foram nanno limestone, silicified.
7	4	42.0	215.92	3131	25.8	Nanno micritic limestone, silicified.
7	4	75.0	216.25	3436	25.8	Nanno micritic limestone, silicified.
7	4	122.0	216.72	1760	25.2	Nanno micritic chalk, partly lithified.
8	1	10.0	220.10	3770	24.8	Limestone, silicified, some radiolarians.
9	1	69.0	229.69	3024	24.7	Limestone, silicified.
9	1	118.0	230.18	1788	24.7	Foram nanno micritic chalk.
9	1	120.0	230.20	1822	24.7	Foram nanno micritic chalk.
10	1	145.0	240.45	2329	25.6	Foram nanno micritic chalk.
10	1	145.0	240.45	1907	25.6	Foram nanno micritic chalk.
10	CC	0.0	248.0	1924	25.6	Foram nanno micritic chalk.
13	CC	0.0	276.00	3166	25.6	Limestone
14	1	146.0	277.46	3217	25.6	Limestone, silicified; ⊥ to bedding.
15	2	145.0	288.95	3037	24.4	Limestone, silicified.
16	1	55.0	342.55	1954	24.2	Nanno micritic chalk.
16	2	22.0	343.72	2934	24.1	Micritic limestone, silicified.
16	2	90.0	344.40	2332	24.1	Nanno micritic chalk, clay-rich.
16	3	45.0	345.45	2100	24.2	Nanno micritic chalk, clay-rich.
16	3	66.0	345.66	2333	24.4	Nanno micritic chalk, clay-rich.
17	1	26.0	398.26	2740	25.4	Foram nanno micritic chalk.
17	2	10.0	399.60	2103	25.4	Foram nanno micritic chalk.
17	2	80.0	400.30	2462	25.4	Foram nanno micritic chalk.
18	1	46.0	407.46	2425	27.6	Foram nanno micritic chalk.
18	1	87.0	407.87	5418	27.6	Chert, dark gray.
18	2	110.0	409.60	2528	24.3	Foram nanno micritic chalk.
19	1	80.0	416.80	2714	27.3	Foram nanno micritic chalk.
21	1	75.0	453.75	2855	26.2	Foram nanno micritic chalk.
22	1	100.0	463.00	3448	26.0	Foram limestone, argillaceous.
22	2	30.0	463.80	2385	25.5	Limestone, argillaceous.
22	2	30.0	463.80	3475	25.5	Foram limestone, argillaceous.
22	3	0.0	465.00	2144	25.2	Foram limestone, argillaceous, and some ash.
22	3	51.0	465.51	3113	25.2	Foram limestone, argillaceous; ∥ to bedding.
22	3	51.0	465.51	2805	25.2	Foram limestone, argillaceous; ⊥ to bedding.
22	3	132.0	466.32	3292	25.2	Foram limestone, artillaceous, some ash.
22	CC	0.0	471.00	3295	25.2	Limestone, argillaceous, slightly silicified.
23	1	27.0	471.27 1	3213	25.9	Foram limestone, argillaceous; ∥ to bedding.
23	1	27.0	471.27	2957	25.9	Foram limestone, argillaceous; ⊥ to bedding.

TABLE 1 – *Continued*

Core	Section	Interval^a (cm)	Depth in Hole (m)	Velocity^b (m/sec)	Temperature (°C)	Remarks
23	1	68.0	471.68	4388	25.9	Basalt (numerous fractures).
23	1	135.0	472.35	4468	25.9	Basalt (numerous fractures).
23	1	141.0	472.41	5386	25.9	Limestone, pink, slightly metamorphosed.

[a] This column is the upper limit of a 3-cm sample interval.

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

[c] The few velocity measurements which used a "D"-shaped block to obtain liner thickness and travel time.

to the *Globorotalia subbotinae* Zone, are assigned to the *Globorotalia edgari* Zone, but the lower part of Core 3 and all of Core 4 are assigned to the *Globorotalia velasconensis* Zone. Radiolarians are abundant and well preserved in Core 1. They are rare to common, poorly to well preserved in Cores 2 through 9. Core 1 and the upper part of Core 2 (to approximately 165 m) evidently belong in the *Bekoma bidarfensis* Zone (though the zonal marker is absent); the remainder of Core 2, Core 3, and the upper part of Core 4 (to approximately 185 m) belong either in the *B. bidarfensis* Zone or in the underlying "unzoned interval" of the Leg 10 Initial Report; diverse but corroded Late Cretaceous planktonic foraminiferal assemblages occur which may belong to either the *Abathomphalus mayaroensis* or *Globotruncana contusa* zones.

Only a catcher sample was recovered from Core 5 and no calcareous plankton or Radiolaria useful for zonation were recovered from it. This would be the position of the *Globorotalia pseudomenardii* Zone and *Heliolithus riedeli* and *Discoaster gemmeus* zones if they are present.

Cores 6 to 10 are foraminiferal nannofossil chalks, calcareous plankton assemblages are again diverse and generally well preserved, although they tend to be somewhat more affected by dissolution than in the overlying unit. Cores 6 to 8 belong to the Middle Paleocene *Globorotalia pusilla pusilla* Zone. Core 6 contains *Heliolithus kleinpelli*, index fossil of the *Heliolithus kleinpelli* Zone, and Cores 7 and 8 belong to the *Fasciculithus tympaniformis* Zone. Core 9 belongs to the *Globorotalia angulata* Zone (Middle Paleocene) and the *Chiasmolithus danicus* Zone. The radiolarian samples of Cores 6 to 9 are apparently in the "unzoned interval" mentioned in the Leg 10 Initial Report. Core 10 presents a special situation. Only a few, poorly preserved Late Cretaceous calcareous nannoplankton are present near the base of Section 1, but planktonic foraminifera of the *Globigerina eugubina* Zone (earliest Paleocene) are present at 127 to 130 cm in Section 1, 10 cm below. No radiolarians are present in Core 10.

Cores 11 to 21 consist of gray foraminiferal nannoplankton chalk. In Cores 11 to 22 radiolarians are generally absent or present as rare to few, poorly preserved (silicified) specimens. A good zonation is available using the planktonic foraminifera which are either unaffected or only slightly affected by dissolution throughout this sequence. The boundary between the *Globotruncana contusa* Zone and the *Globotruncana gansseri* Zone lies in the drilled interval between 295 and 347 meters. The base of the *Globotruncana gansseri* Zone lies near the base of Core 17, the catcher sample belonging to the underlying *Globotruncana "tricarinata"* Zone. The base of the *Globotruncana "tricarinata"* Zone is fixed relatively precisely between samples from Cores 18 and 19 at a depth of approximately 320 meters. Cores 19, 20, and 21 all belong to the *Globotruncana calcarata* Zone. The calcareous nannofossils of this interval are moderately diverse but show signs of being attacked by solution. Cores 13 to 16 belong to the *Chiastozygus initialis* Zone, although the index species is missing. Deeper cores belong to the *Tetralithus aculeus* Zone.

The sediment in Cores 22 to 24 (462-477 m) is limestone. Planktonic foraminifera have been badly damaged and calcareous nannofossils at some levels wholly obliterated by recrystallization. Nevertheless, the planktonic foraminifera unequivocally indicate the *Globotruncana elevata* Zone, and the calcareous nannoplankton, with considerably less certainty, the *Tetralithus aculeus* Zone.

CONCLUSIONS

The extent of drilling disturbance in the uppermost four cores makes the significance of the chert fragments uncertain. There is no indication that they were found in situ, and they were most probably displaced during coring.

The pelagic sequence can be compared to that recovered at Site 146, but the depth to the early Tertiary section is shallower at Site 152. The superior preservation of both calcareous and siliceous fossils certainly suggests that the sediments at Site 152 accumulated well above the calcium carbonate compensation depth, whereas the sediments at Site 146 certainly accumulated well below this depth. The faulted aspect of this part of the Nicaragua Rise and Colombian Basin suggests that sediment could have accumulated at a much shallower depth.

The occurrence of fresh glass below the Eocene cherts contrasts sharply with the complete disappearance of fresh glass at this level at Site 146. Glass has altered to clinoptilolite and montmorillonite at greater depth, but the persistence of glass 40 meters below the chert is remarkable. The abundance of hornblende in the early Tertiary is unique to this site; a source on or near Jamaica is suggested.

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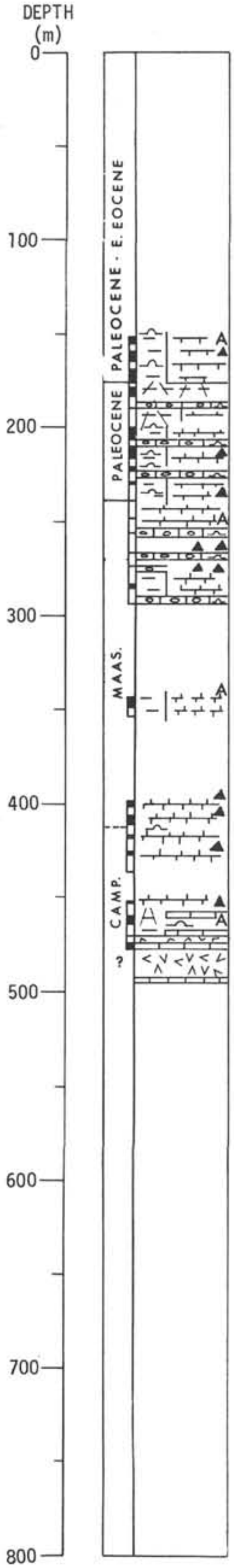
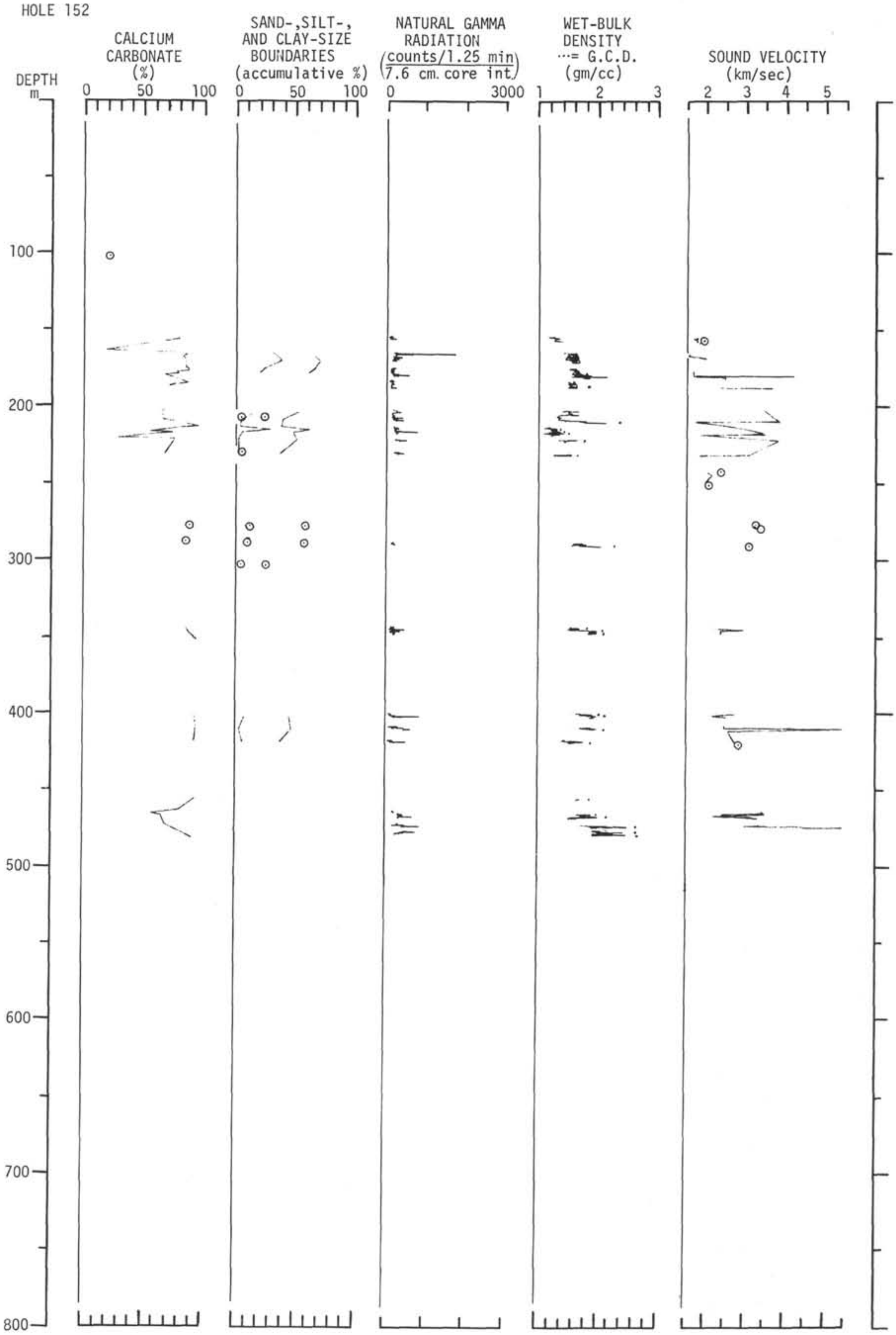
SITE 152

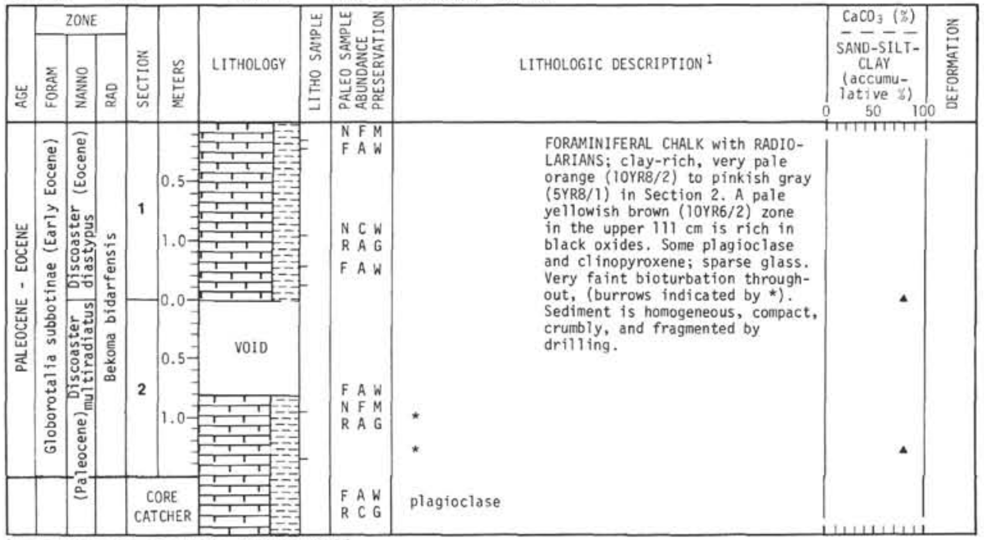
LITHOLOGY



UNITS	SUBUNITS OR DESCRIPTION
UNIT I (0 to 471.43 m) NANNO FORAM CHALK and LIMESTONE	FORAM CHALK and NANNO FORAM CHALK, very pale orange, pinkish gray, and very light gray, which are predominantly clay rich. Intermittent occurrences of radiolarians between 150 and 180 m, which are in varying abundances. Frequent occurrences of grayish orange cherts, silicified chalk layers, indurated chalk layers, and silicified limestone layers. Few brown volcanic ash layers. Induration increasing with increasing depth with occurrences of microfractures in semi-lithified areas in the lower part of the hole. CHERT, olive black and VOLCANIC ASHES, olive brown. LIMESTONE, light bluish gray with frequent clay rich laminae. Micrite and sparite are the main constituents, rare forams and nannos.
UNIT II (471.43 to 477.50 m T.D.) BASALT and MARBLE	Metamorphosed FORAM LIMESTONE with amygdaloid BASALTS. Interbedded. Limestones are characteristically grayish to reddish brown with varigated streaks. Basalt shows subvertical fractures, some filled with calcite and reddish calcareous materials.


HOLE 152
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 152 HOLE CORE 1 CORED INTERVAL (m) 153-162



FORAMINIFERAL CHALK with RADIOLARIANS; clay-rich, very pale orange (10YR8/2) to pinkish gray (5YR8/1) in Section 2. A pale yellowish brown (10YR6/2) zone in the upper 111 cm is rich in black oxides. Some plagioclase and clinopyroxene; sparse glass. Very faint bioturbation throughout, (burrows indicated by *). Sediment is homogeneous, compact, crumbly, and fragmented by drilling.

plagioclase

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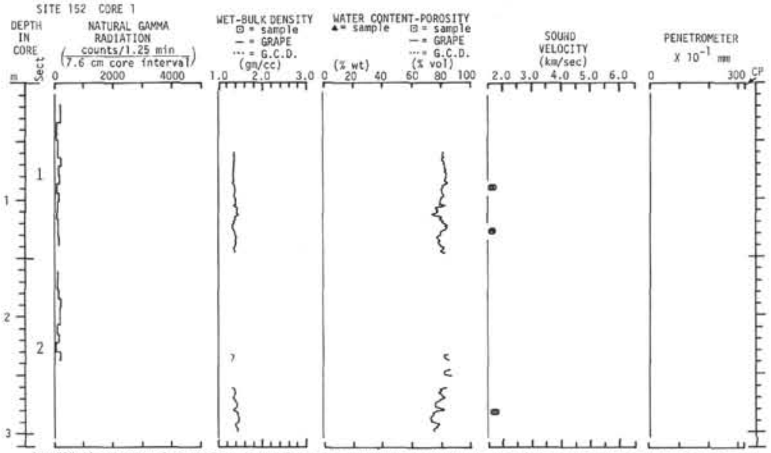
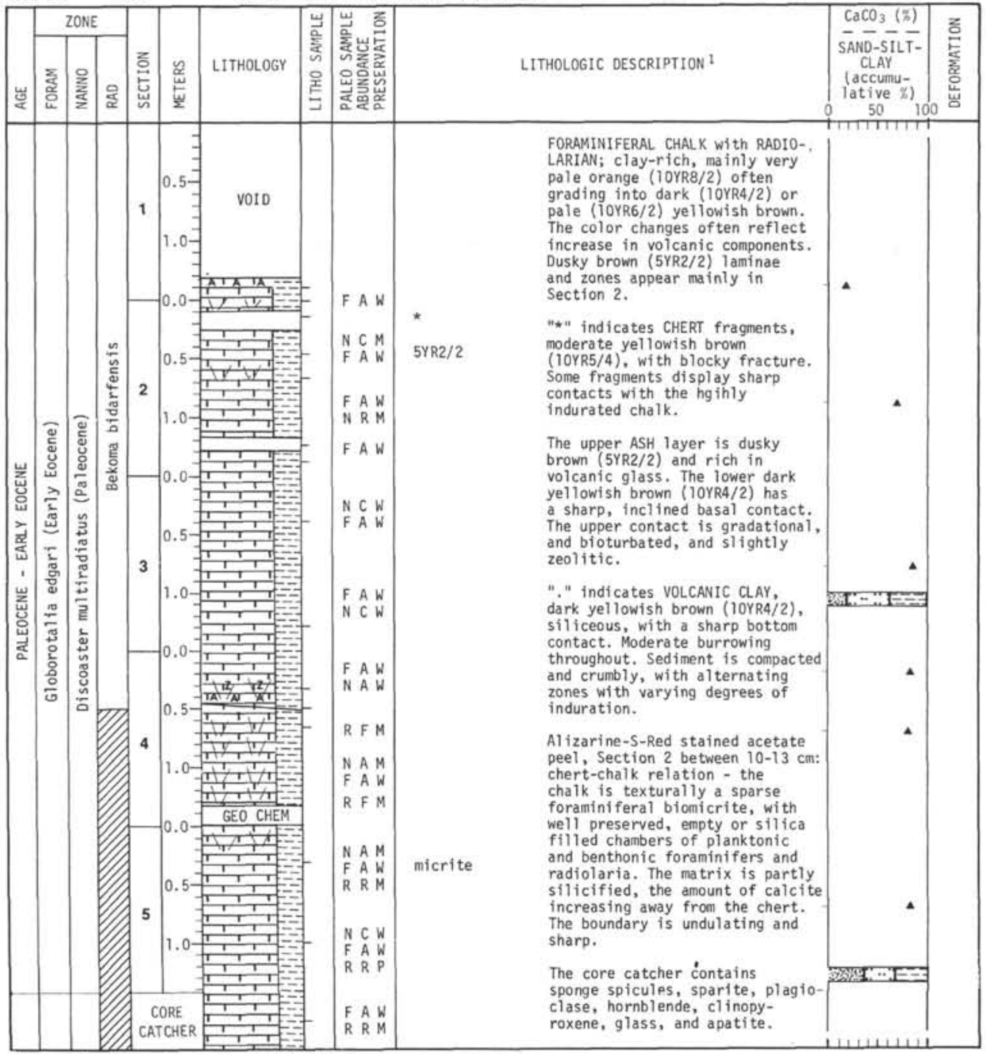
[1] For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1395. This background was subtracted from the data.

SITE 152 HOLE CORE 2 CORED INTERVAL (m) 162-172



FORAMINIFERAL CHALK with RADIOLARIAN; clay-rich, mainly very pale orange (10YR8/2) often grading into dark (10YR4/2) or pale (10YR6/2) yellowish brown. The color changes often reflect increase in volcanic components. Dusky brown (5YR2/2) laminae and zones appear mainly in Section 2.

"*" indicates CHERT fragments, moderate yellowish brown (10YR5/4), with blocky fracture. Some fragments display sharp contacts with the hgihly indurated chalk.

The upper ASH layer is dusky brown (5YR2/2) and rich in volcanic glass. The lower dark yellowish brown (10YR4/2) has a sharp, inclined basal contact. The upper contact is gradational, and bioturbated, and slightly zeolitic.

"." indicates VOLCANIC CLAY, dark yellowish brown (10YR4/2), siliceous, with a sharp bottom contact. Moderate burrowing throughout. Sediment is compacted and crumbly, with alternating zones with varying degrees of induration.

Alizarine-S-Red stained acetate peel, Section 2 between 10-13 cm: chert-chalk relation - the chalk is texturally a sparse foraminiferal biomicrite, with well preserved, empty or silica filled chambers of planktonic and benthonic foraminifers and radiolaria. The matrix is partly silicified, the amount of calcite increasing away from the chert. The boundary is undulating and sharp.

The core catcher contains sponge spicules, sparite, plagioclase, hornblende, clinopyroxene, glass, and apatite.

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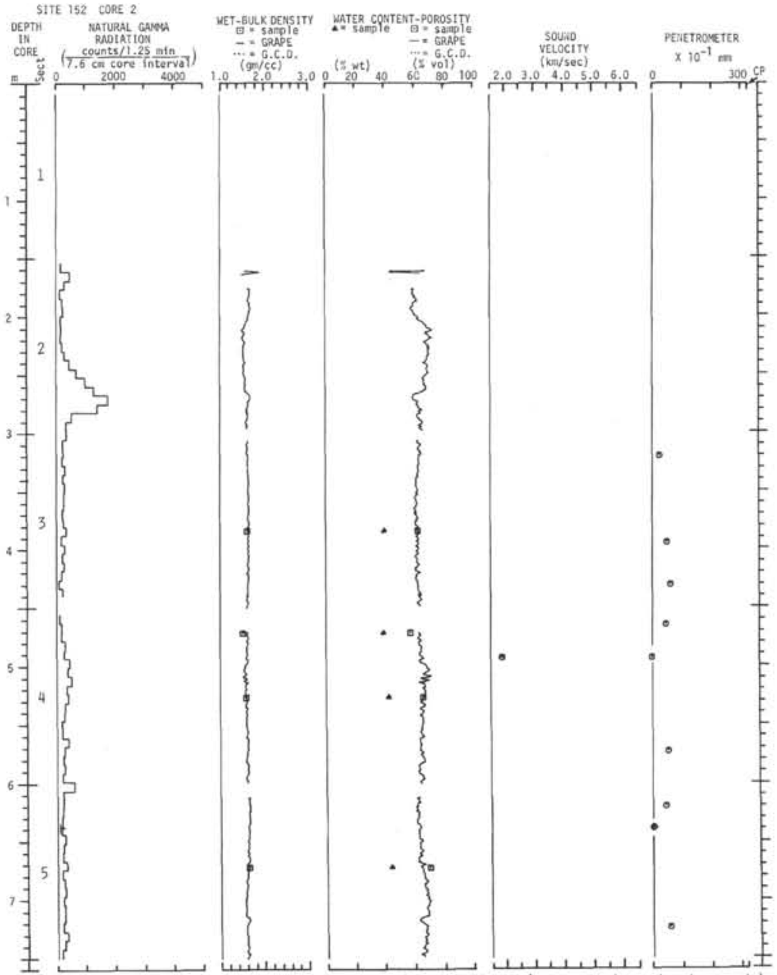
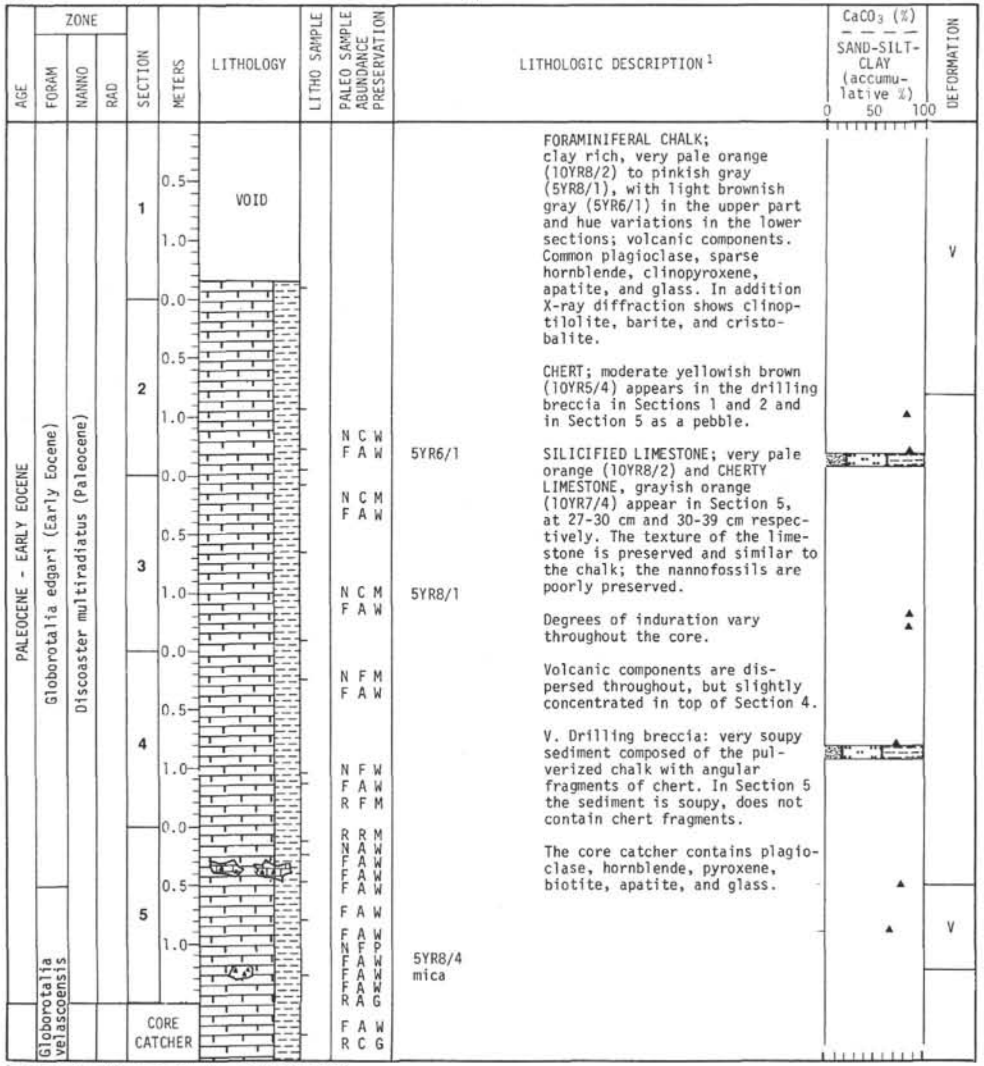
[1] For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1391. This background was subtracted from the data.

SITE 152 HOLE CORE 3 CORED INTERVAL (m) 172-182



FORAMINIFERAL CHALK; clay rich, very pale orange (10YR8/2) to pinkish gray (5YR8/1), with light brownish gray (5YR6/1) in the upper part and hue variations in the lower sections; volcanic components. Common plagioclase, sparse hornblende, clinopyroxene, apatite, and glass. In addition X-ray diffraction shows clinoptilolite, barite, and cristobalite.

CHERT; moderate yellowish brown (10YR5/4) appears in the drilling breccia in Sections 1 and 2 and in Section 5 as a pebble.

SILICIFIED LIMESTONE; very pale orange (10YR8/2) and CHERTY LIMESTONE, grayish orange (10YR7/4) appear in Section 5, at 27-30 cm and 30-39 cm respectively. The texture of the limestone is preserved and similar to the chalk; the nannofossils are poorly preserved.

Degrees of induration vary throughout the core.

Volcanic components are dispersed throughout, but slightly concentrated in top of Section 4.

V. Drilling breccia: very soupy sediment composed of the pulverized chalk with angular fragments of chert. In Section 5 the sediment is soupy, does not contain chert fragments.

The core catcher contains plagioclase, hornblende, pyroxene, biotite, apatite, and glass.

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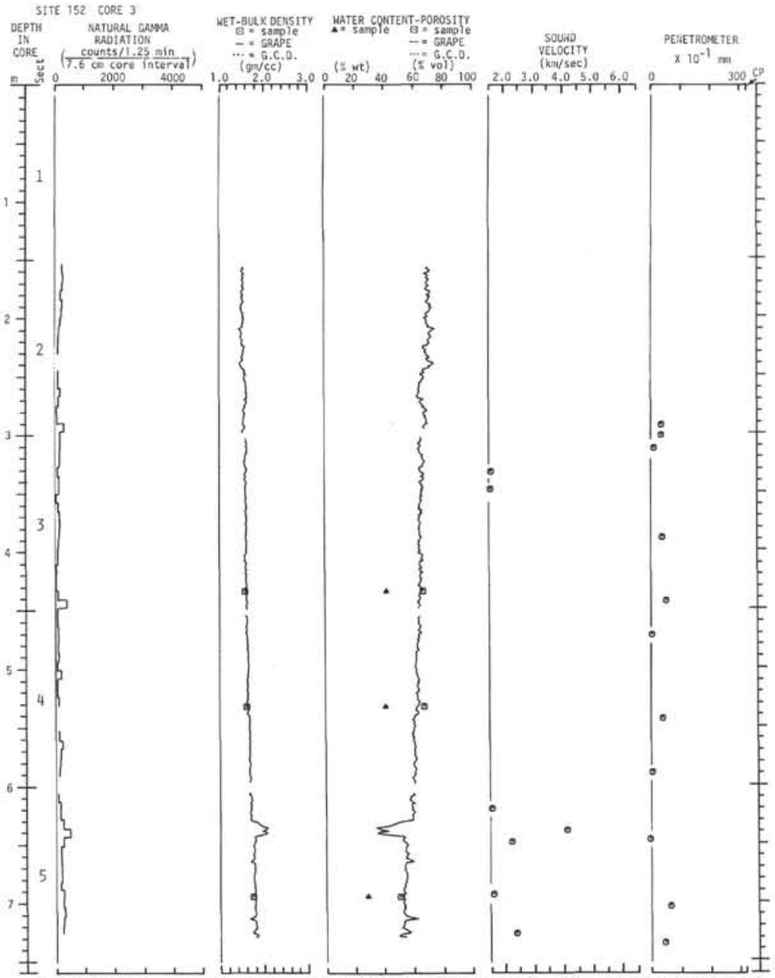
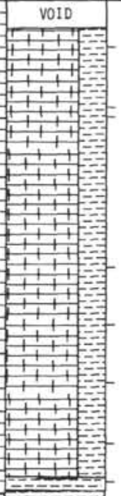
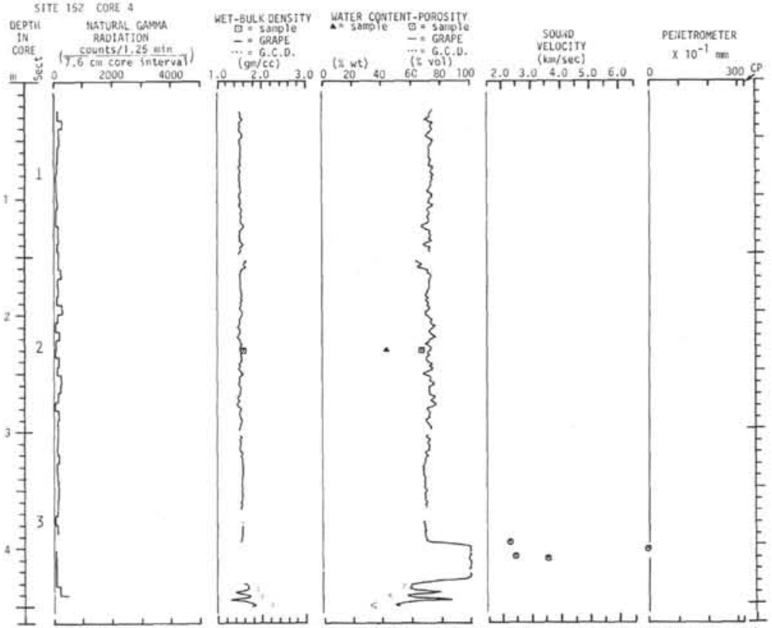
¹For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1431. This background was subtracted from the data.

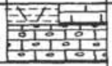
SITE 152 HOLE CORE 4 CORED INTERVAL (m) 182-192

AGE	ZONE FORAM	ZONE NANNO	ZONE RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION¹	CaCO₃ (%) — SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
LATE PALEOCENE	Globorotalia velascoensis	Discoaster multiradiatus		1	0.5 1.0	VOID 			FORAMINIFERAL NANNOPLANKTON CHALK; clay rich, very pale orange (10YR8/2) in Section 1 and pinkish gray (5YR8/1) in the remainder. Light gray (N7) zones are rich in volcanic glass and sponge spicules. Common plagioclase, hornblende; sparse clinopyroxene, apatite, and glass. X-ray shows clinoptilolite, cristobolite, and barite. "." indicates a highly indurated, slightly silicified pinkish gray CHALK with a sharp basal contact with CHERT, moderate yellowish brown (10YR5/4). In thin section the indurated chalk is classified as sparse to packed planktonic foraminiferal biomicrite, with rare radiolaria, benthonic foraminifers, and sponge spicules. The microfossils range from well preserved to fragments, with chambers empty or filled by the matrix. Nannofossil fragments and micrite comprise the matrix. Very rare plagioclase and silt-sized angular quartz. VI. Mixed assemblage: probably not in situ, excluding the indurated chalk. I. Watery: preserved in freezer box. Core catcher contains fragments of CHALK and mottled CHERT, light brownish gray (10YR6/2) with light gray (10YR7/1). In the light gray, the matrix is argillaceous-calcareous, while the foraminifers are filled by microquartz and parallel oriented chalcedony. In the light brownish gray part, both the grains and the matrix are totally silicified.		I VI
				2	0.0 0.5 1.0			N A W F A W R C G		▲	
		unzoned		3	0.0 0.5 1.0			F A W N R P R R M		▲	
				CORE CATCHER				R F M F A W	chert		

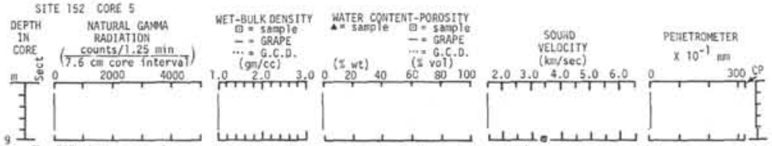


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1431. This background was subtracted from the data.

SITE 152 HOLE CORE 5 CORED INTERVAL (m) 192-201

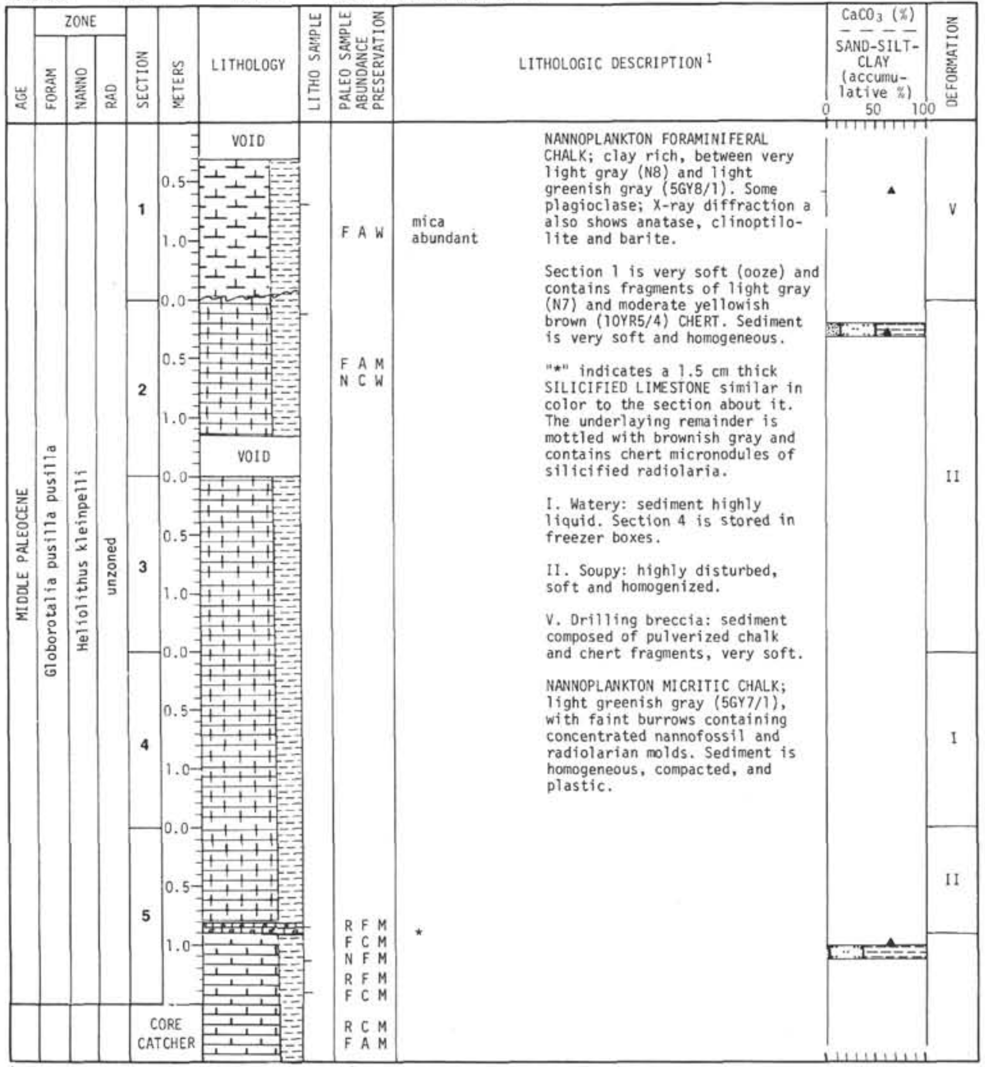
AGE	ZONE FORAM	ZONE NANNO	ZONE RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION¹	CaCO₃ (%) — SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
				CORE CATCHER					Core catcher: SILICEOUS LIMESTONE, pinkish gray (5YR8/1), bioturbated, and with conchoidal fracture, and silicified NANNOPLANKTON MARL, greenish gray (5GY6/1), bioturbated, with microspar, spar, and mica, conchoidal and blocky fracture.		

¹For 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 1431. This background was subtracted from the data.

SITE 152 HOLE CORE 6 CORED INTERVAL (m) 201-211



NANNOPLANKTON FORAMINIFERAL CHALK; clay rich, between very light gray (N8) and light greenish gray (5GY8/1). Some plagioclase; X-ray diffraction a also shows anatase, clinoptilolite and barite.

Section 1 is very soft (ooze) and contains fragments of light gray (N7) and moderate yellowish brown (10YR5/4) CHERT. Sediment is very soft and homogeneous.

"*" indicates a 1.5 cm thick SILICIFIED LIMESTONE similar in color to the section about it. The underlaying remainder is mottled with brownish gray and contains chert micronodules of silicified radiolaria.

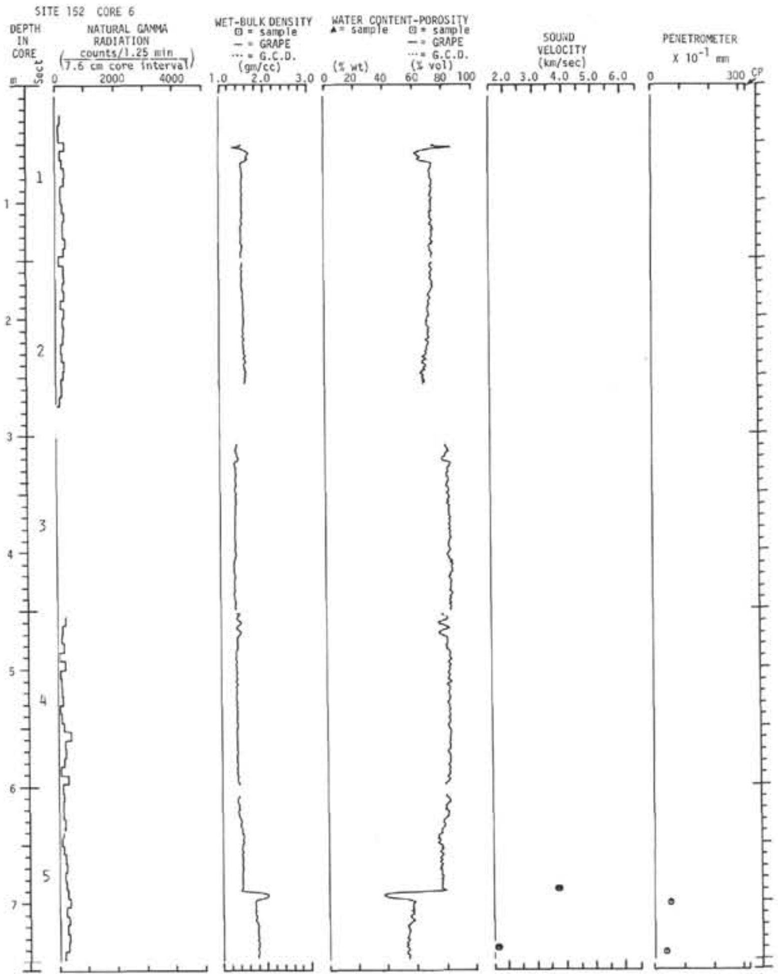
I. Watery: sediment highly liquid. Section 4 is stored in freezer boxes.

II. Soupy: highly disturbed, soft and homogenized.

V. Drilling breccia: sediment composed of pulverized chalk and chert fragments, very soft.

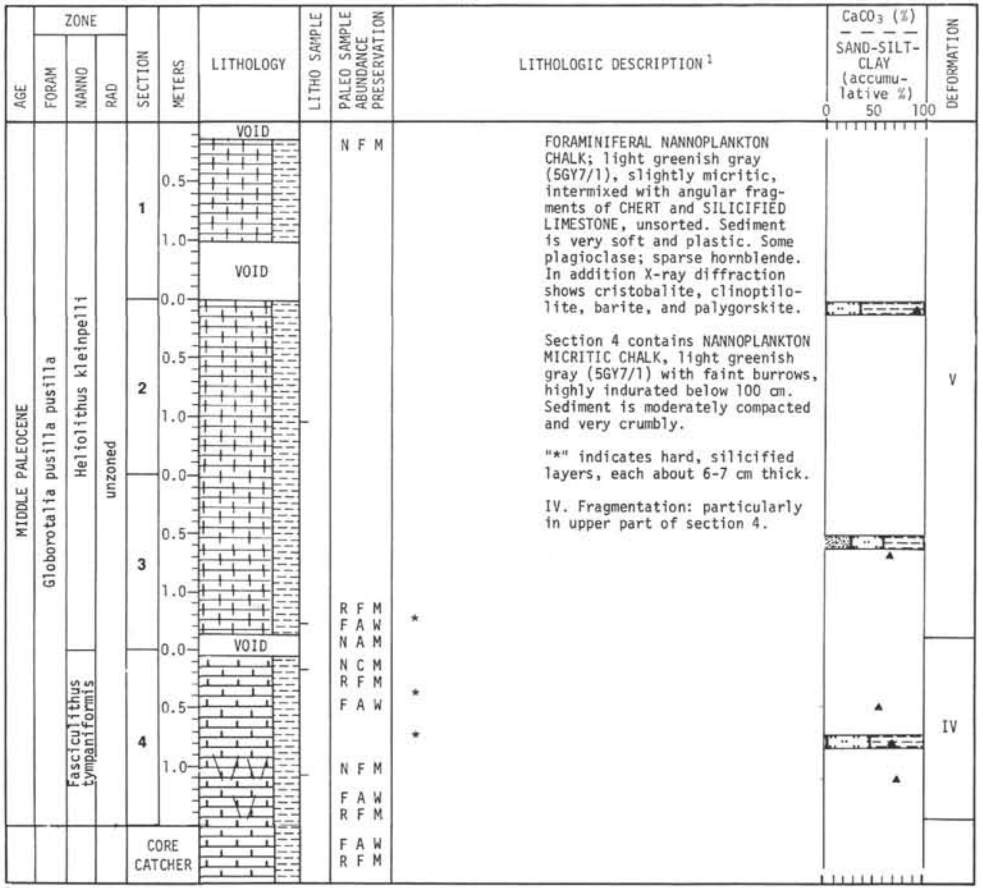
NANNOPLANKTON MICRITIC CHALK; light greenish gray (5GY7/1), with faint burrows containing concentrated nannofossil and radiolarian molds. Sediment is homogeneous, compacted, and plastic.

¹For 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 1372. This background was subtracted from the data.

SITE 152 HOLE CORE 7 CORED INTERVAL (m) 211-220



FORAMINIFERAL NANNOPLANKTON CHALK; light greenish gray (5GY7/1), slightly micritic, intermixed with angular fragments of CHERT and SILICIFIED LIMESTONE, unsorted. Sediment is very soft and plastic. Some plagioclase; sparse hornblende. In addition X-ray diffraction shows cristobalite, clinoptilolite, barite, and palygorskite.

Section 4 contains NANNOPLANKTON MICRITIC CHALK, light greenish gray (5GY7/1) with faint burrows, highly indurated below 100 cm. Sediment is moderately compacted and very crumbly.

"*" indicates hard, silicified layers, each about 6-7 cm thick.

IV. Fragmentation: particularly in upper part of section 4.

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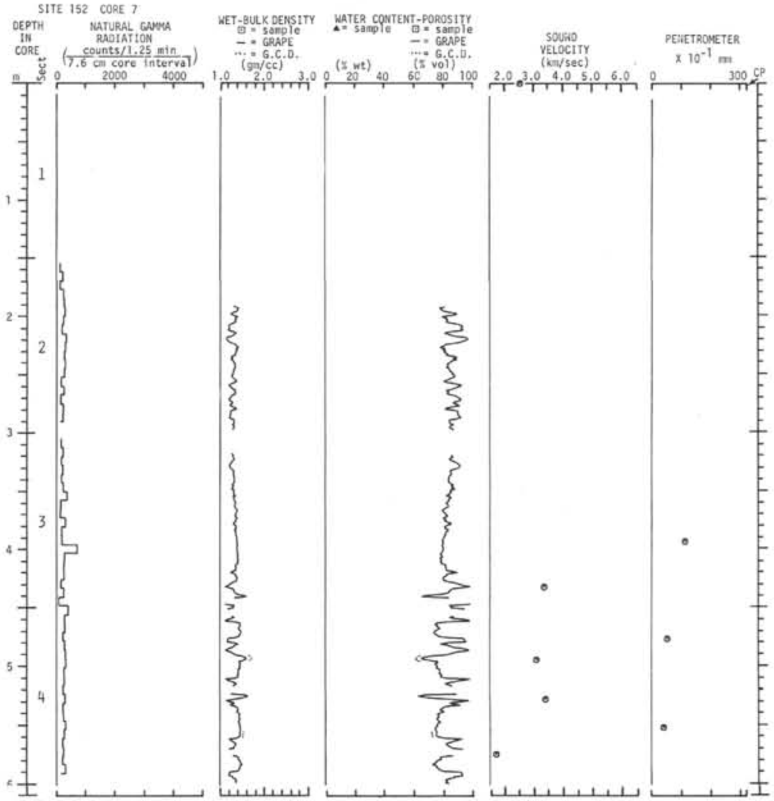
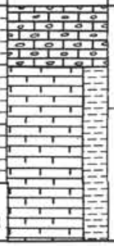
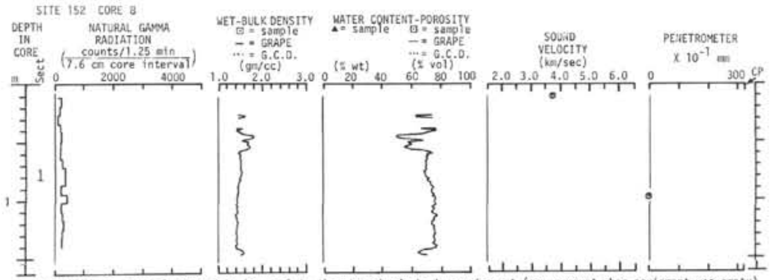
¹For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1372. This background was subtracted from the data.

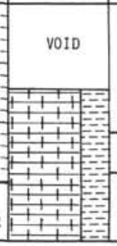
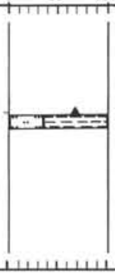
SITE 152 HOLE CORE 8 CORED INTERVAL (m) 220-229

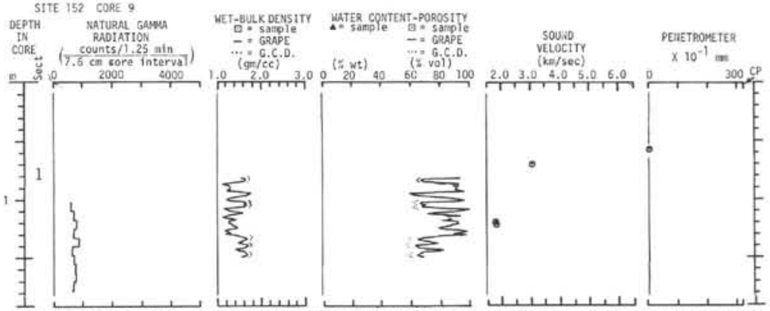
AGE	ZONE FORAM	ZONE NANNO	ZONE RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]	CaCO3 (%) SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
MIDDLE PALEOCENE	Globorotalia pusilla pusilla	Chiasmolithus danicus	unzoned	1	0.5 1.0			F C M N C M R F M N F M F C M	SILICIFIED LIMESTONE; light olive gray (5Y7/1) with a faint brownish shade; common radiolaria and burrow mottling. plagioclase FORAMINIFERAL MICRITIC CHALK; clay rich, light greenish gray (5GY7/1); bioturbated. Sediment moderately firm but contains disturbed soft intervals. Fragments of silicified limestone at the bottom. X-ray diffraction also shows palygorskite, clinoptilolite, and barite.		IV
				CORE CATCHER				F A W R C G			



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1372. This background was subtracted from the data.

SITE 152 HOLE CORE 9 CORED INTERVAL (m) 229-239

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 - MIDDLE PALEOCENE	Globorotalia angulata	Chiasmolithus danicus	unzoned	1	0.5 1.0			F F M N R P F F M R F M N F P	* FORAMINIFERAL NANNOPLANKTON MICRITIC CHALK; clay rich, yellowish gray (5Y7/1), with silicified fragments at the top. Highly bioturbated. Common plagioclase; some hornblende and clinopyroxene. In addition, X-ray diffraction shows palygorskite and clinoptilolite. "*" indicates a darker zone rich in volcanic components and containing large subhorizontal burrows. Sediment is very compacted and crumbly.		
				CORE CATCHER				F A W R R P			



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1425. This background was subtracted from the data.

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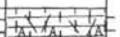
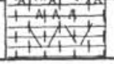
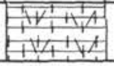
[1] For explanation of symbols, see Chapter 1

SITE 152 HOLE CORE 10 CORED INTERVAL (m) 239-248

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	Globigerina eugubina	? Cruciplacolithus tenuis		1	0.5 1.0	VOID 		F A W N R P C F M/P n	FORAMINIFERAL NANNOPLANKTON MICRITIC CHALK; light olive gray (5Y7/1), highly bioturbated, with a brownish gray ash layer at the bottom. ASH has subspherical quartz, plagioclase, green and red hornblende, biotite, apatite, and zircon. In addition, X-ray diffraction shows dolomite, clinoptilolite, and cristobalite. Core catcher contains a similar assemblage. Sediment is very compacted and crumbly.		
MAASTRICHTIAN	Abathomphalus mayaroensis or Globotruncana contusa			CORE CATCHER				F A W R O			

CORE CATCHER: presumed contaminant
AGE: EARLY PALEOCENE
FORAM: Globigerina eugubina

SITE 152 HOLE CORE 11 CORED INTERVAL (m) 248-257

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.			CORE CATCHER				F	FORAMINIFERAL NANNOPLANKTON MICRITIC CHALK; light gray (5Y7/2), with abundant planktonic foraminifers having empty or matrix-filled chambers. Highly compacted and indurated.		

1. MAASTRICHTIAN 2. Globotruncana contusa

SITE 152 HOLE CORE 12 CORED INTERVAL (m) 257-267

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.			CORE CATCHER				F A W R R M	SILICIFIED LIMESTONE; Alizarine-S-Red stained acetate peel description: packed planktonic foraminiferal biomicrite with well-preserved planktonic foraminifers, some benthonic foraminifers, and rare radiolaria. The matrix and foraminifers are silicified.		

1. MAASTRICHTIAN
2. Globotruncana contusa

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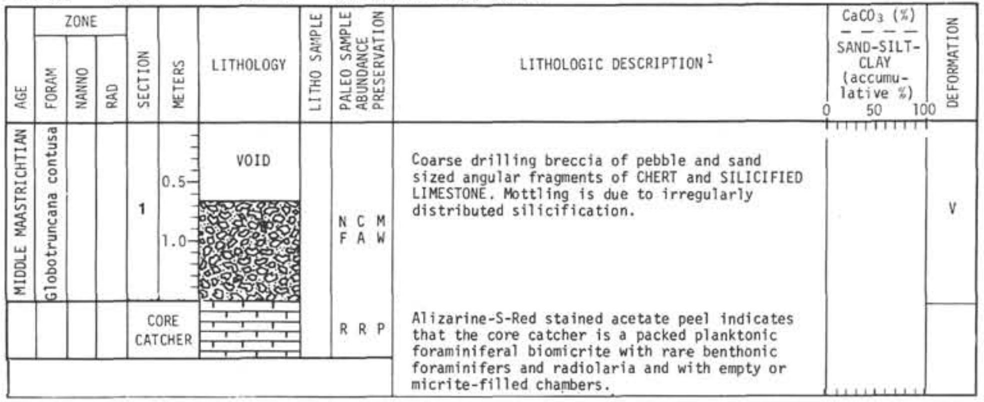
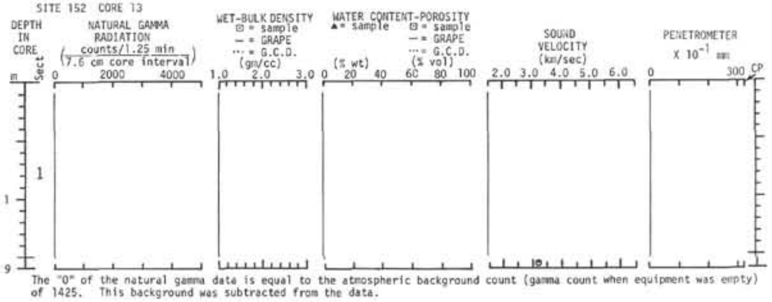
[1] For explanation of symbols, see Chapter 1

SITE 152 HOLE CORE 13 CORED INTERVAL (m) 267-276

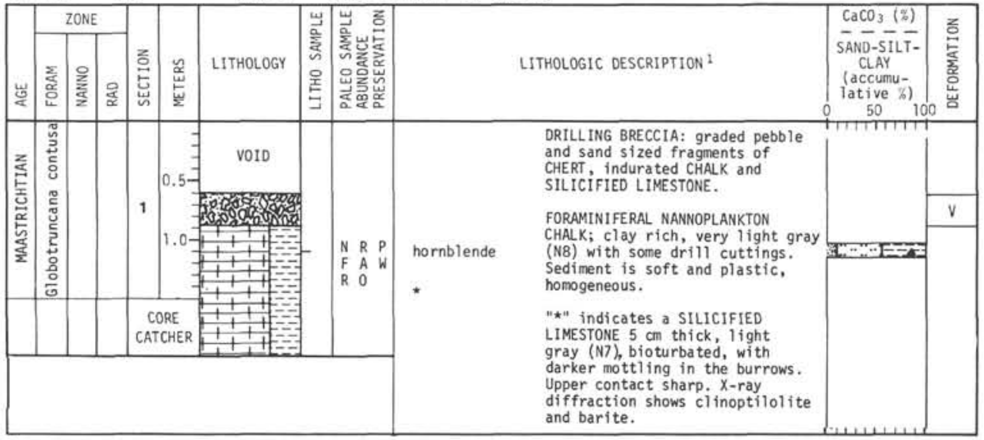


AGE	ZONE FORAM	ZONE NANNO	ZONE RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION¹	CaCO3 (%) ---- SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
MIDDLE MAASTRICHTIAN	Globotruncana contusa			1	0.5 1.0	VOID		N C M F A W	Coarse drilling breccia of pebble and sand sized angular fragments of CHERT and SILICIFIED LIMESTONE. Mottling is due to irregularly distributed silicification.		V
				CORE CATCHER				R R P	Alizarine-S-Red stained acetate peel indicates that the core catcher is a packed planktonic foraminiferal biomicrite with rare benthonic foraminifers and radiolaria and with empty or micrite-filled chambers.		

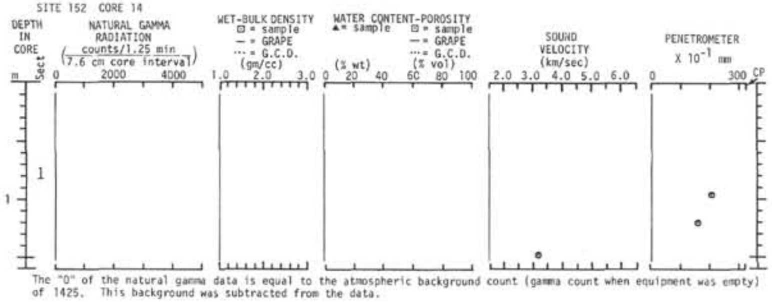


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1425. This background was subtracted from the data.

SITE 152 HOLE CORE 14 CORED INTERVAL (m) 276-286



AGE	ZONE FORAM	ZONE NANNO	ZONE RAD	SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION¹	CaCO3 (%) ---- SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
MAASTRICHTIAN	Globotruncana contusa			1	0.5 1.0	VOID		N R P F A W R O	DRILLING BRECCIA: graded pebble and sand sized fragments of CHERT, indurated CHALK and SILICIFIED LIMESTONE. hornblende * FORAMINIFERAL NANNOPLANKTON CHALK; clay rich, very light gray (N8) with some drill cuttings. Sediment is soft and plastic, homogeneous. "*" indicates a SILICIFIED LIMESTONE 5 cm thick, light gray (N7), bioturbated, with darker mottling in the burrows. Upper contact sharp. X-ray diffraction shows clinoptilolite and barite.		V
				CORE CATCHER							



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1425. This background was subtracted from the data.

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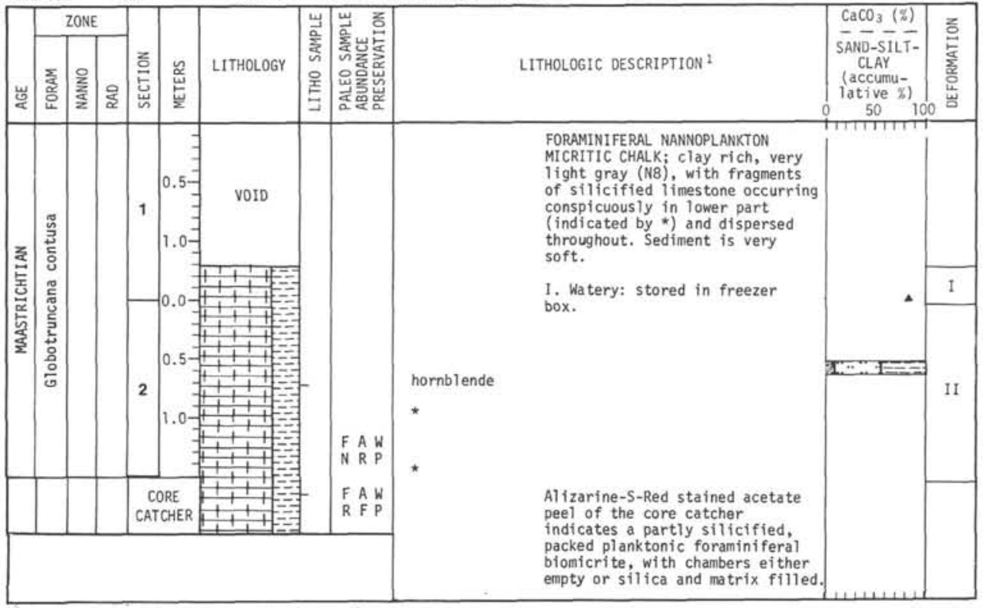
¹For explanation of symbols, see Chapter 1

SITE 152 HOLE CORE 15 CORED INTERVAL (m) 286-295



hornblende

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*

FORAMINIFERAL NANNOPLANKTON MICRITIC CHALK; clay rich, very light gray (N8), with fragments of silicified limestone occurring conspicuously in lower part (indicated by *) and dispersed throughout. Sediment is very soft.

I. Watery: stored in freezer box.

Alizarine-S-Red stained acetate peel of the core catcher indicates a partly silicified, packed planktonic foraminiferal biomicrite, with chambers either empty or silica and matrix filled.

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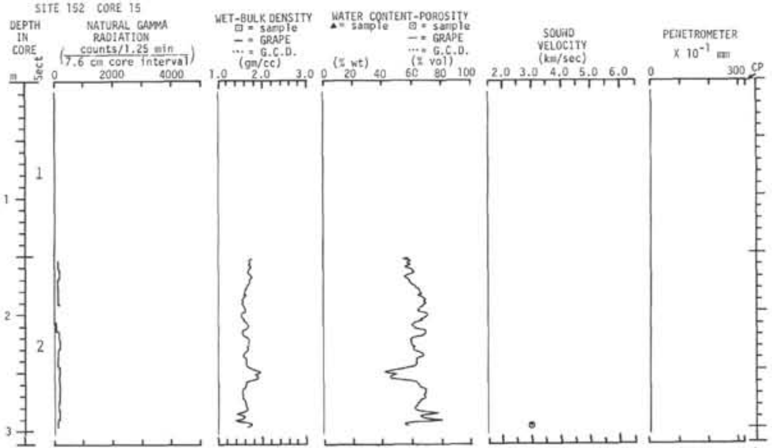
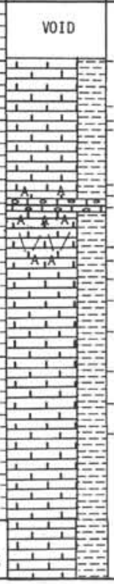
¹For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1402. This background was subtracted from the data.

SITE 152 HOLE CORE 16 CORED INTERVAL (m) 342-351



AGE	ZONE FORAM	SECTION	METERS	PALEO SAMPLE ABUNDANCE PRESERVATION	
MIDDLE MAASTRICHTIAN	Globotruncana gansseri	1	0.5	F A W	*N6
				N R P	
			1.0	N F M	*
				F A W	
				F A W	
		2	0.0		*
			0.5	N F P	
				A F W	
				A F W	*
			1.0	R O	micro-cross-laminations
		3	0.0	N R P	
				F A W	5G6/1
			0.5		5G6/1
				F A W	fractured
			1.0	N F M	5G6/1
					5G6/1
		CORE CATCHER		F A W	
				R O	

LITHOLOGIC DESCRIPTION[1]

NANNOPLANKTON MICRITIC CHALK; clay rich, light gray (N7) to very light gray (N8) with greenish gray (5G6/1) intervals in Section 3; moderately bioturbated. Burrows more common in the greenish zones. Light gray (N7) laminations in lower part of Section 2 contain glass. In general, sparse plagioclase, chlorite, and chert micronodules. In addition, X-ray diffraction shows cristobalite, K-feldspar >plagioclase, clinoptilolite, and barite. Volcanic components are concentrated in ashy zones.

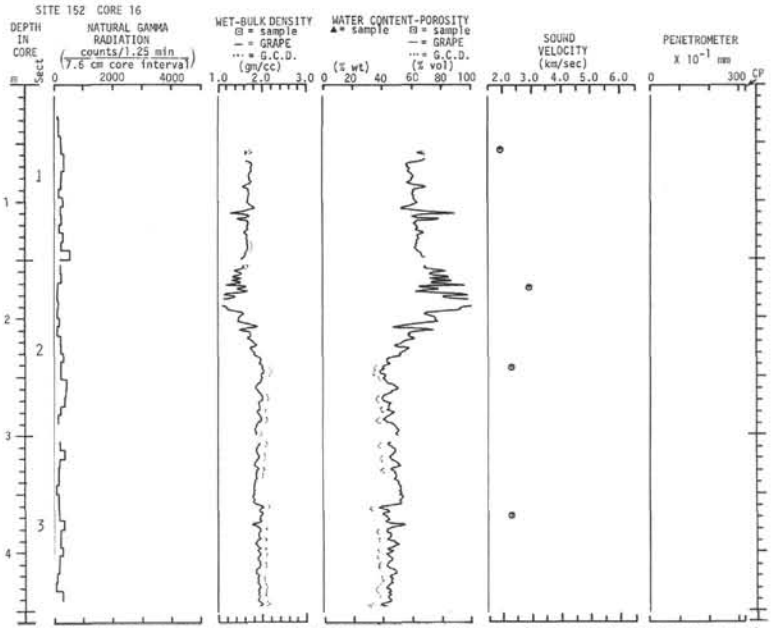
"*" indicates lenticular, concretion-like silicified limestone, medium light gray (N6) to light gray (N7), sometimes containing glass. Alizarine-S-Red stained acetate peel from Section 1, 109-114 cm, indicates, that the concretion-like appearance is a result of differential silicification. The darker center is more silicified than the lighter part. The boundary with the chalk is irregular and anastomosing often involving partly silicified foraminifers.

The highly indurated zone in Section 2 contains abundant foraminifers and sand-sized metallic particles.

CaCO₃ (%) — SAND-SILT-CLAY (accumulative %) 0 50 100

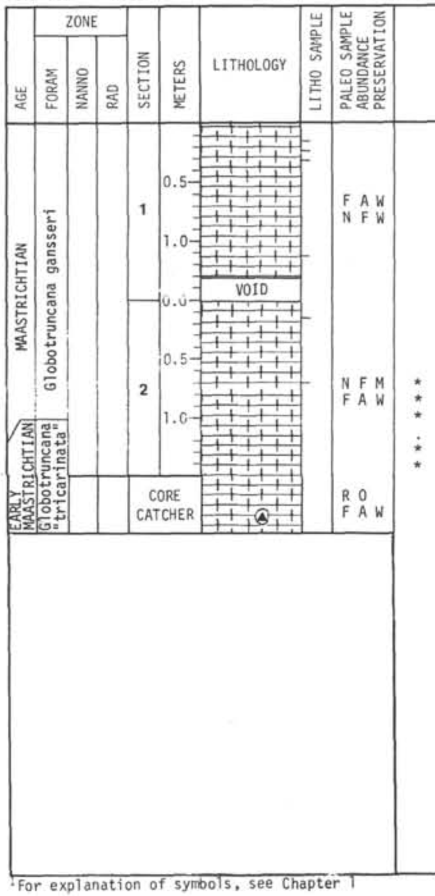
DEFORMATION

[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 1436. This background was subtracted from the data.

SITE 152 HOLE CORE 17 CORED INTERVAL (m) 398-407



LITHOLOGIC DESCRIPTION[1]

FORAMINIFERAL MICRITE NANNOPLANKTON CHALK; very light gray (N8) to white (N9), extensively bioturbated and mottled (abundant irregular and lenticular zones). Some plagioclase, apatite, and clinoptilolite. X-ray diffraction shows palygorskite. Sediment is highly compacted and indurated, but crumbly.

"*" indicates thin (2-6 cm), medium (N5) to light gray bands with gradational boundaries.

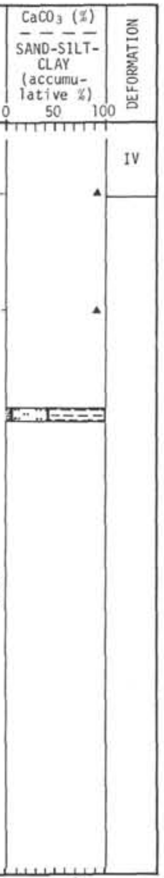
"." indicates microfractures inclined about 60°.

Thin section from Section 1, 112 cm: sparse to packed planktonic foraminiferal biomicrite with empty or matrix filled chambers. The foraminifers have a binodal distribution, containing both well-preserved and totally broken tests. The matrix contains nannofossil, micrite and foraminiferal fragments.

X-ray diffraction results,

<u>Section 2</u>, 82-83 cm:	
Amorphous scattering	44%
Calcite	82%
Quartz	2%
Plagioclase	7%
Montmorillonite	8%

Core catcher contains CHERT, grayish black (N2), almost transparent, waxy, and with conchoidal fracture. Contains white remains of chalk.



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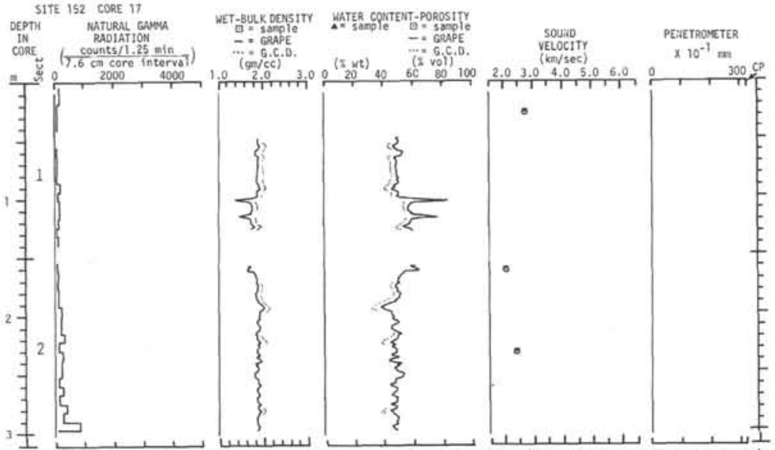
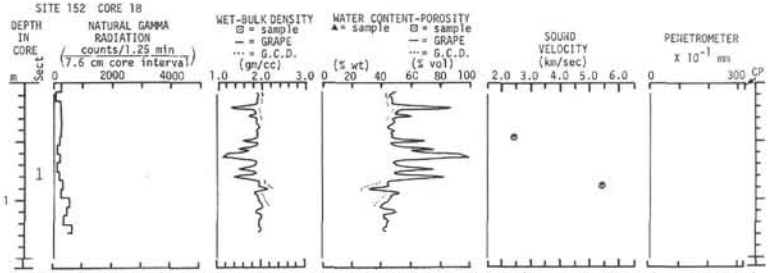
[1] For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1464. This background was subtracted from the data.

SITE 152 HOLE CORE 18 CORED INTERVAL (m) 407-416

AGE	ZONE			SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]		$CaCO_3$ (%) ---- SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
	FORAM	NANNO	RAD									
EARLY MAASTRICHTIAN	Globotruncana "tricarinata"			1	0.5 1.0	VOID		F A W F A W N C M	*	FORAMINIFERAL NANNOPLANKTON MICRITIC CHALK, white (N9) to very light gray (N8), with medium light gray (N4) and light olive gray (5Y6/1) bands and beds (5 cm and thinner). Extensively bioturbated; burrows conspicuous in darker zones. Micro-cross-laminations occur, particularly in Section 1; sharp to graded contacts. Some plagioclase, sparse quartz, alkali feldspar, hornblende, apatite, authigenic K-feldspar, and chert micronodules. X-ray diffraction also shows palygorskite and gypsum. Sediment is hard, crumbly with zones of varying induration.	▲	IV
				2	0.0 0.5 1.0			R O N R P F A W	micro-fractures 5Y6/1 5Y6/1		▲	
				CORE CATCHER				R R P F A W	5Y6/1	"*" indicates CHERT, medium dark gray (N4) with a waxy luster and conchoidal fracture.		

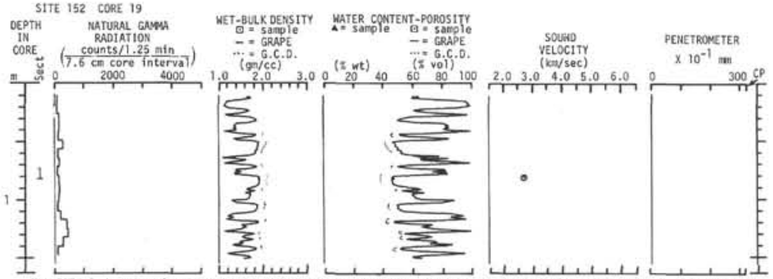


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1395. This background was subtracted from the data.

SITE 152 HOLE CORE 19 CORED INTERVAL (m) 416-425

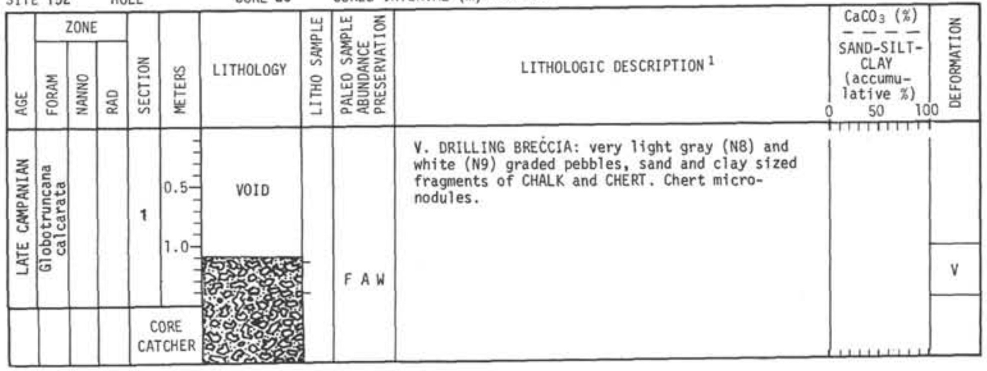
AGE	ZONE			SECTION	METERS	LITHOLOGY	LITHO SAMPLE	PALEO SAMPLE ABUNDANCE PRESERVATION	LITHOLOGIC DESCRIPTION[1]		$CaCO_3$ (%) ---- SAND-SILT-CLAY (accumulative %) 0 50 100	DEFORMATION
	FORAM	NANNO	RAD									
LATE CAMPANIAN	Globotruncana calcarata			1	0.5 1.0			F A W N C M R O F A W	dark thin laminae	FORAMINIFERAL NANNOPLANKTON MICRITIC CHALK; white (N9) with dark to medium gray (N3-N5) micro-cross-laminated bands and layers, with sharp to gradational contacts. Bioturbated, with a large burrow at 79-83 cm. Some clinopyroxene. X-ray diffraction shows K-feldspar >plagioclase. Sediment is indurated and very hard.	▲	IV
				CORE CATCHER				F A M				

[1] For explanation of symbols, see Chapter 1



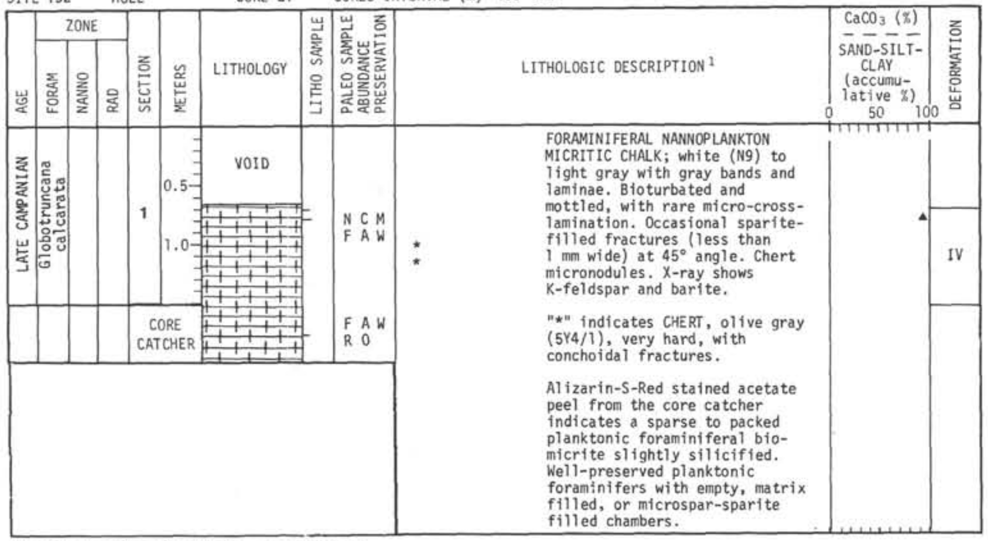
The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1475. This background was subtracted from the data.

SITE 152 HOLE CORE 20 CORED INTERVAL (m) 425-434



V. DRILLING BRECCIA: very light gray (N8) and white (N9) graded pebbles, sand and clay sized fragments of CHALK and CHERT. Chert micronodules.

SITE 152 HOLE CORE 21 CORED INTERVAL (m) 453-462



FORAMINIFERAL NANNOPLANKTON MICRITIC CHALK; white (N9) to light gray with gray bands and laminae. Bioturbated and mottled, with rare micro-cross-lamination. Occasional sparite-filled fractures (less than 1 mm wide) at 45° angle. Chert micronodules. X-ray shows K-feldspar and barite.

"*" indicates CHERT, olive gray (5Y4/1), very hard, with conchoidal fractures.

Alizarin-S-Red stained acetate peel from the core catcher indicates a sparse to packed planktonic foraminiferal biomicrite slightly silicified. Well-preserved planktonic foraminifers with empty, matrix filled, or microspar-sparite filled chambers.

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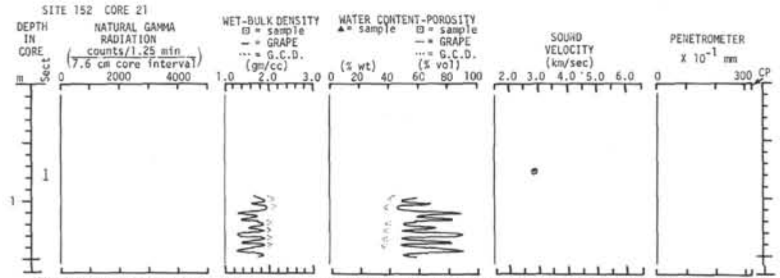
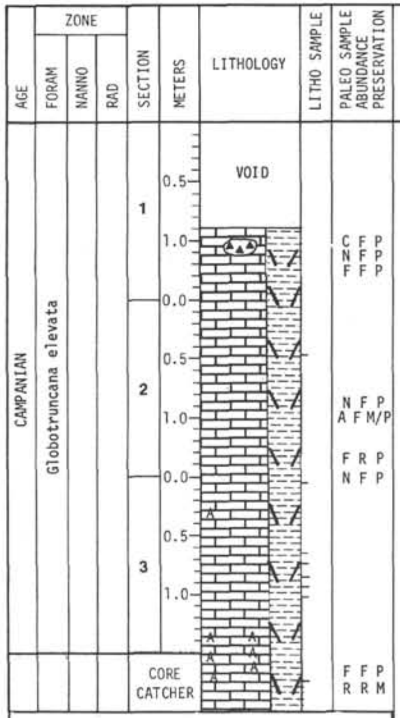
[1] For explanation of symbols, see Chapter 1



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

SITE 152 HOLE CORE 22 CORED INTERVAL (m) 462-471



burrow
*

←

←
burrow
burrow

microfracture
←
←
sandy texture
5B5/1
←
←

5B5/1

5B5/1
5B5/1

LITHOLOGIC DESCRIPTION[1]

FORAMINIFERAL LIMESTONE; slightly argillaceous, light bluish gray (5B7/1) to medium bluish gray (5B5/1), micro-cross-laminated, with lenses and irregular laminae. Contacts are sharp to gradational. Bioturbated, with distinct burrows. Ash (glass and plagioclase) is concentrated in medium bluish gray zones in Section 3. Sediment is very hard and broken. Sparse clinopyroxene. X-ray shows K-feldspar, barite, and clinoptilolite.

"*" indicates CHERT lense, olive black (5YR2/1) with a silicified limestone on the margins.

"←" indicates olive black (5Y2/1) to grayish black (N2) clayey and silicified lenses and laminae.

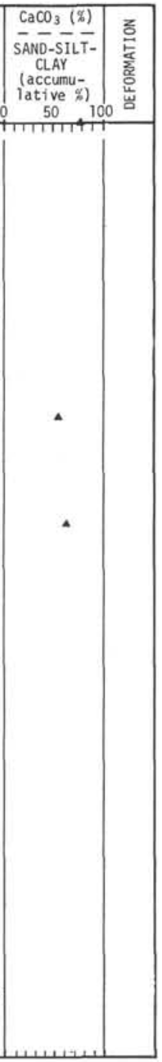
Thin sections (Section 2, 45 cm and Section 3, 95 cm) indicate an almost packed planktonic foraminiferal biomicrite, with microspar and sparite filled chambers, some incomplete. The matrix is composed of micritic grains, nannofossils, and foraminiferal fragments. In Section 3, sand sized angular to subrounded fragments of feldspar and silt sized very angular grains of quartz occur. Contains some flattened and *in situ* broken foraminifers.

X-ray diffraction results,

Section 3, 11-14 cm:

Amorphous scattering	42%
Calcite	88%
Montmorillonite	10%
Quartz	1%

Core catcher contains FORAMINIFERAL LIMESTONE, slightly silicified and argillaceous, with microchert and silicified radiolaria. Drusy sparite in some chambers.



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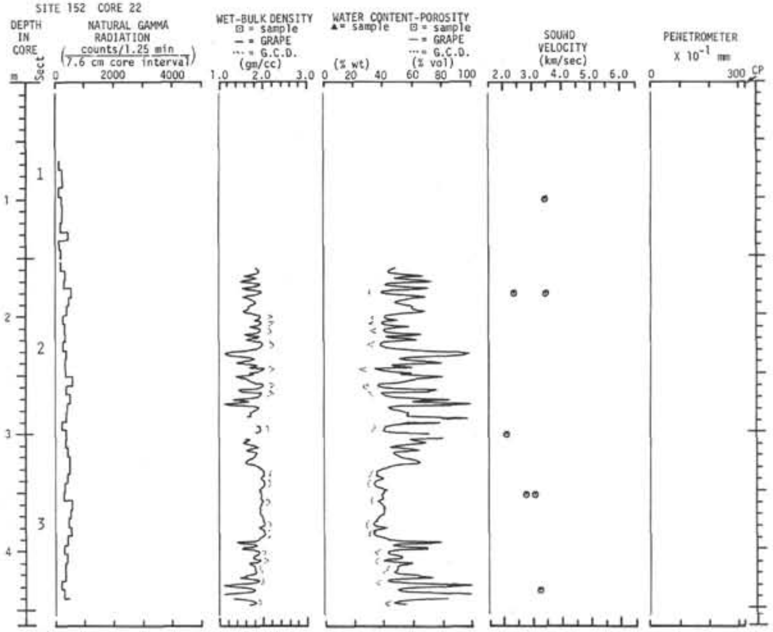
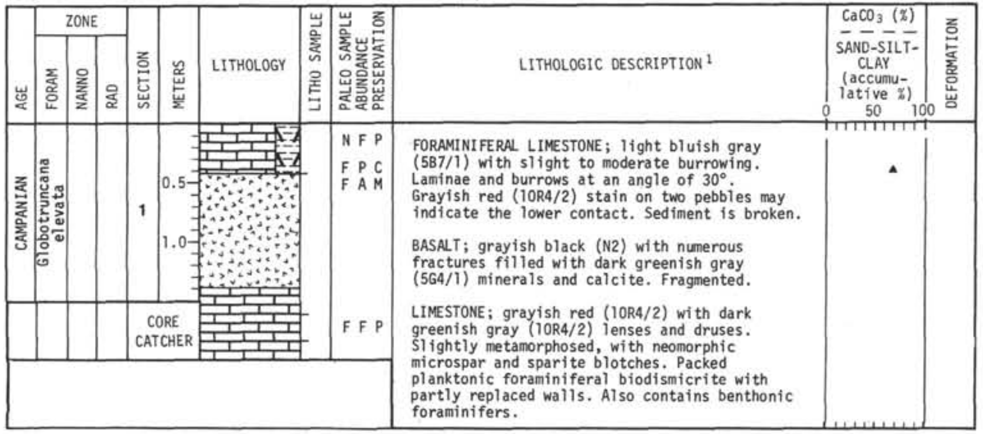
[1] For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1404. This background was subtracted from the data.

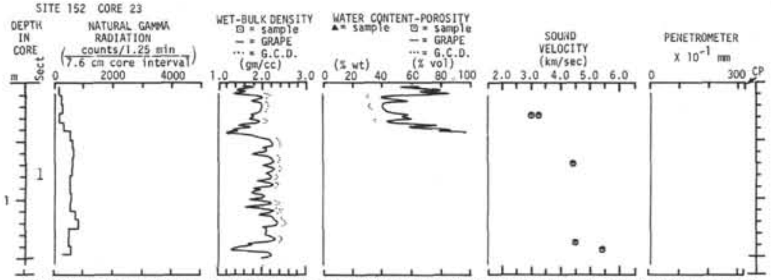
SITE 152 HOLE CORE 23 CORED INTERVAL (m) 471-474



FORAMINIFERAL LIMESTONE; light bluish gray (5B7/1) with slight to moderate burrowing. Laminae and burrows at an angle of 30°. Grayish red (10R4/2) stain on two pebbles may indicate the lower contact. Sediment is broken.

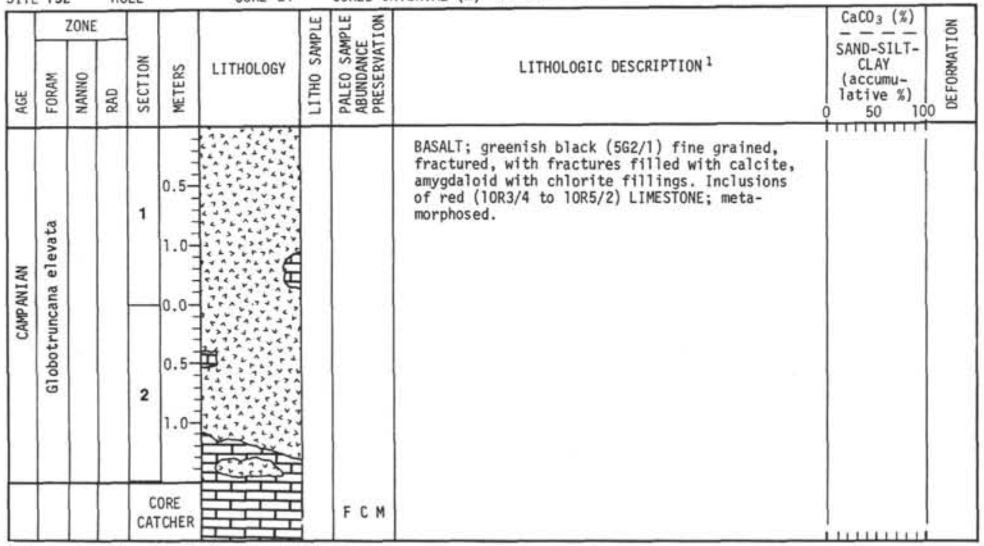
BASALT; grayish black (N2) with numerous fractures filled with dark greenish gray (5G4/1) minerals and calcite. Fragmented.

LIMESTONE; grayish red (10R4/2) with dark greenish gray (10R4/2) lenses and druses. Slightly metamorphosed, with neomorphic microspar and sparite blotches. Packed planktonic foraminiferal biodismicrite with partly replaced walls. Also contains benthonic foraminifers.

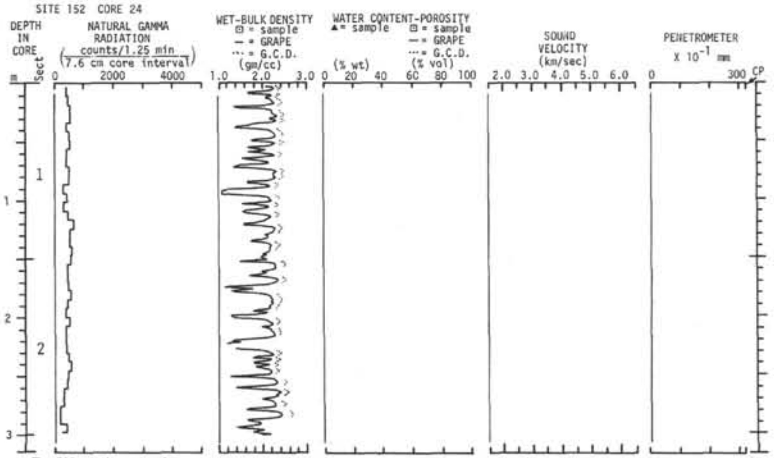


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1393. This background was subtracted from the data.

SITE 152 HOLE CORE 24 CORED INTERVAL (m) 474-477



BASALT; greenish black (5G2/1) fine grained, fractured, with fractures filled with calcite, amygdaloid with chlorite fillings. Inclusions of red (10R3/4 to 10R5/2) LIMESTONE; metamorphosed.



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1403. This background was subtracted from the data.

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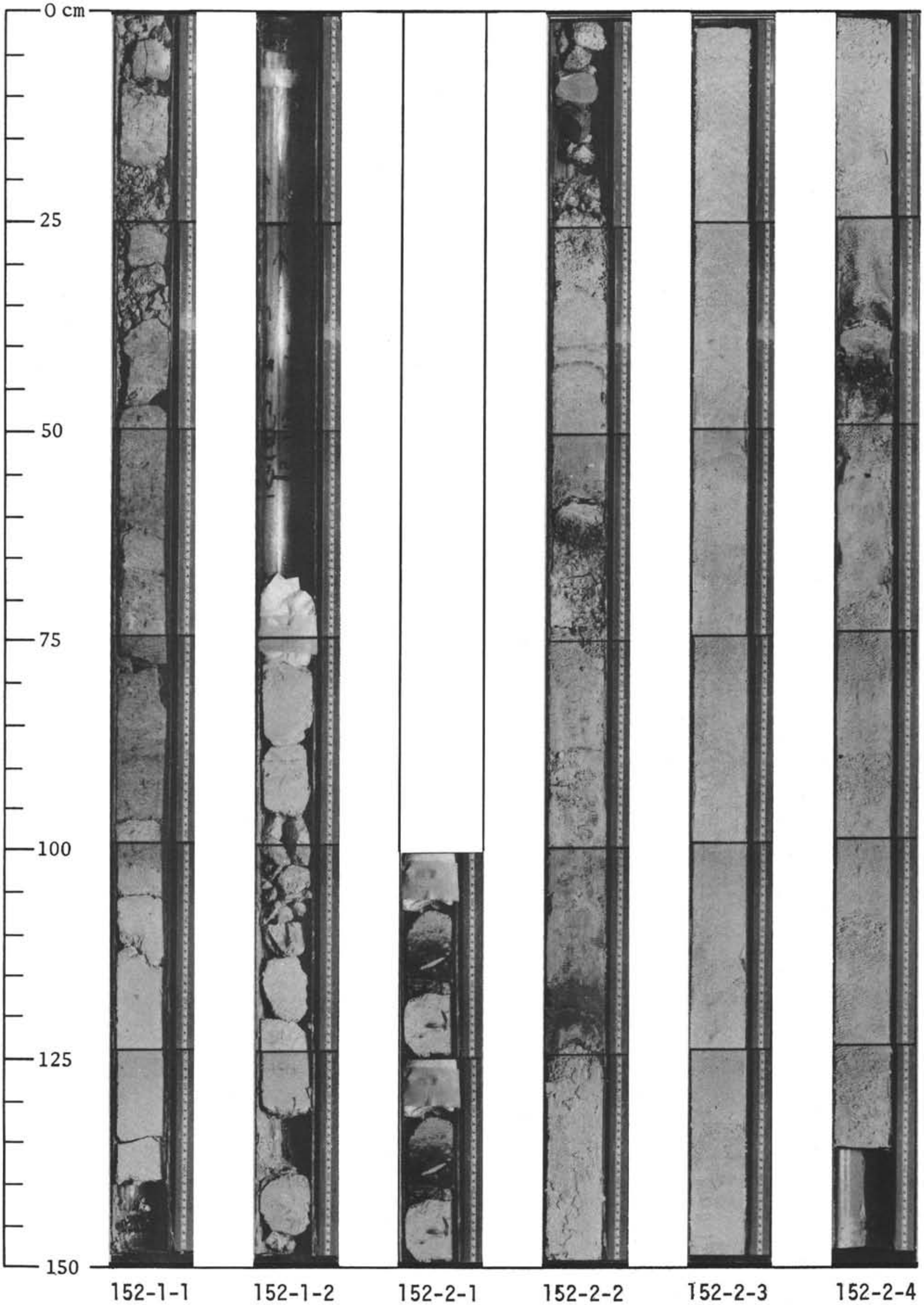
[1] For explanation of symbols, see Chapter 1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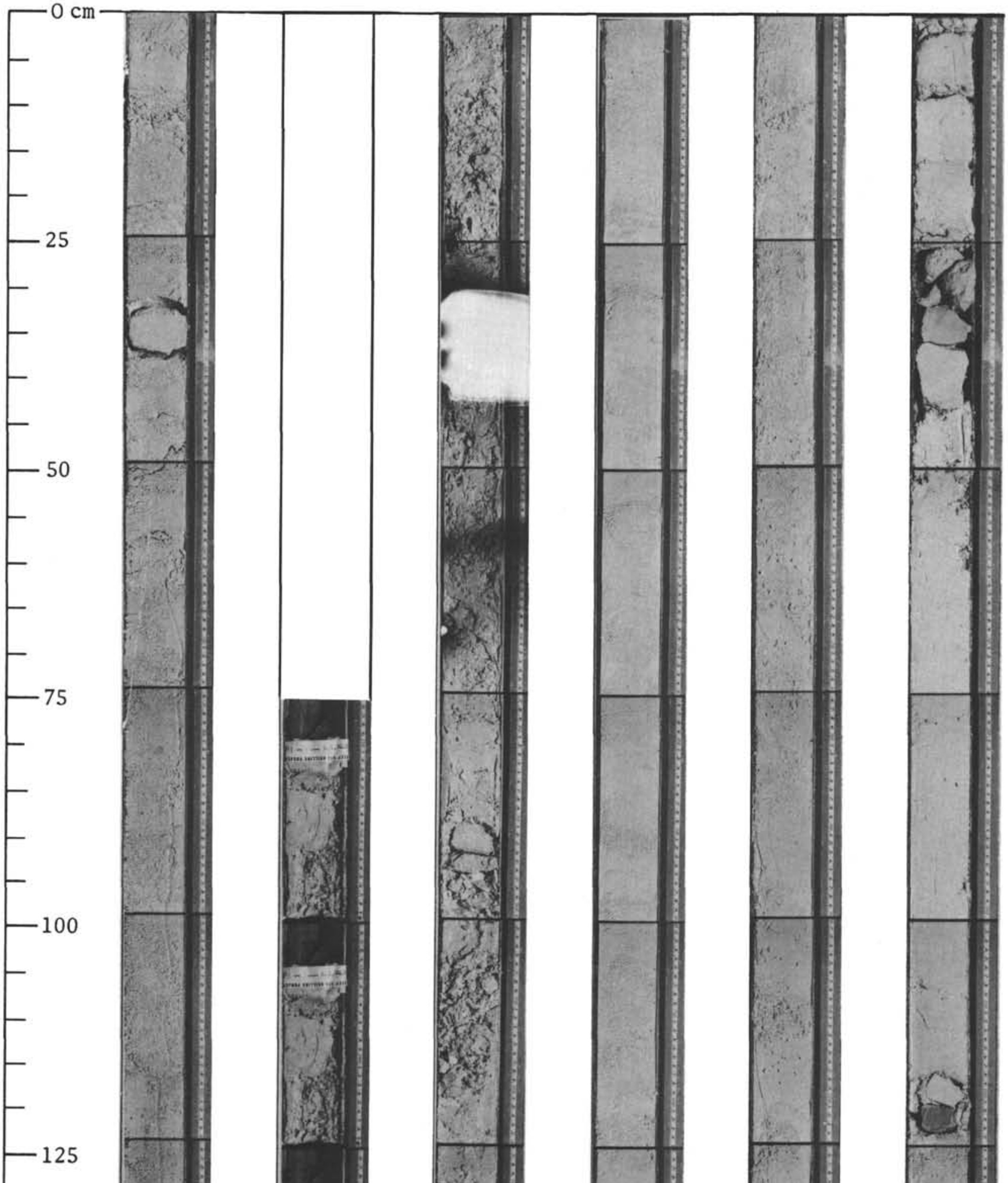
152-2-4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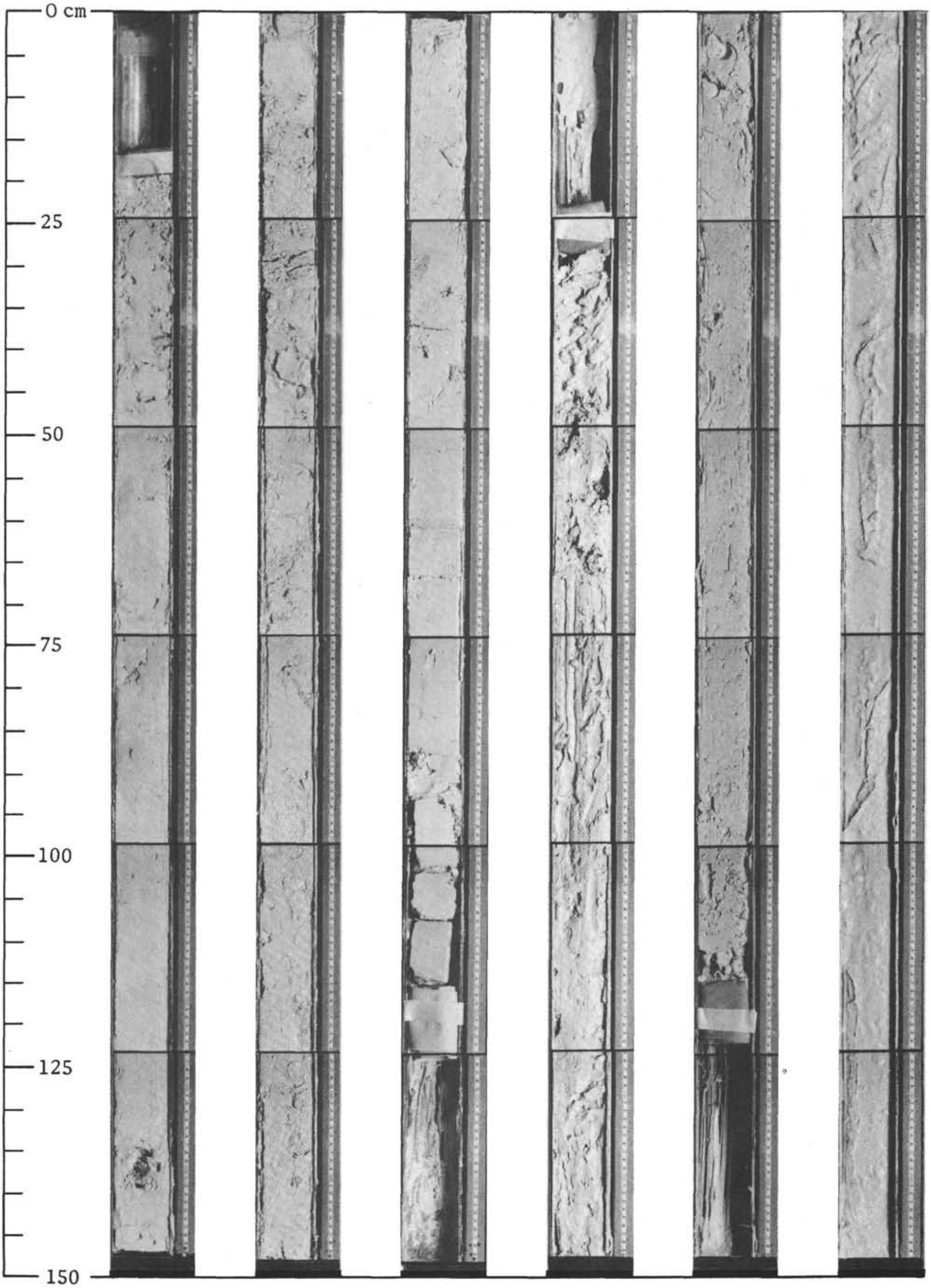
152-3-5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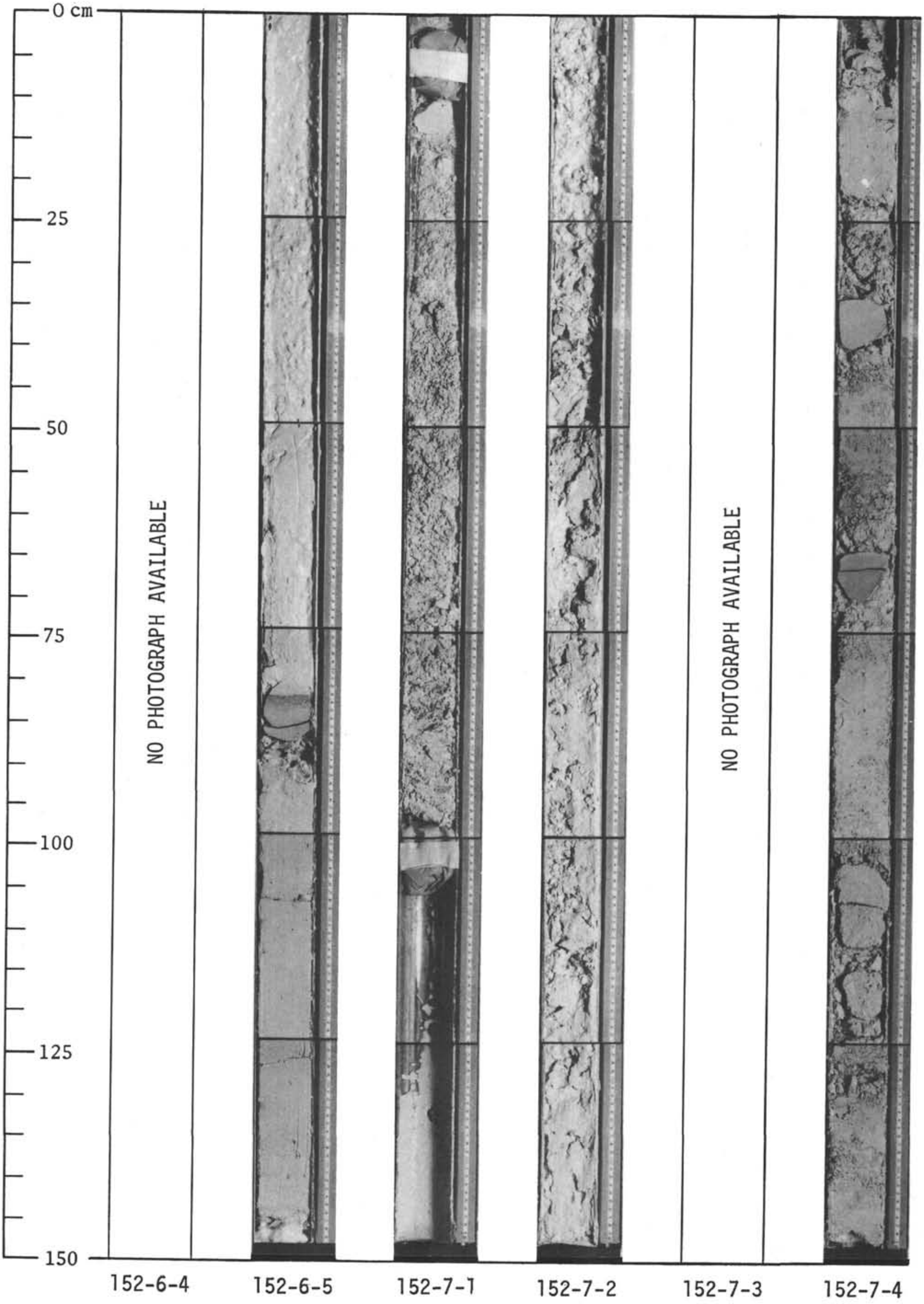
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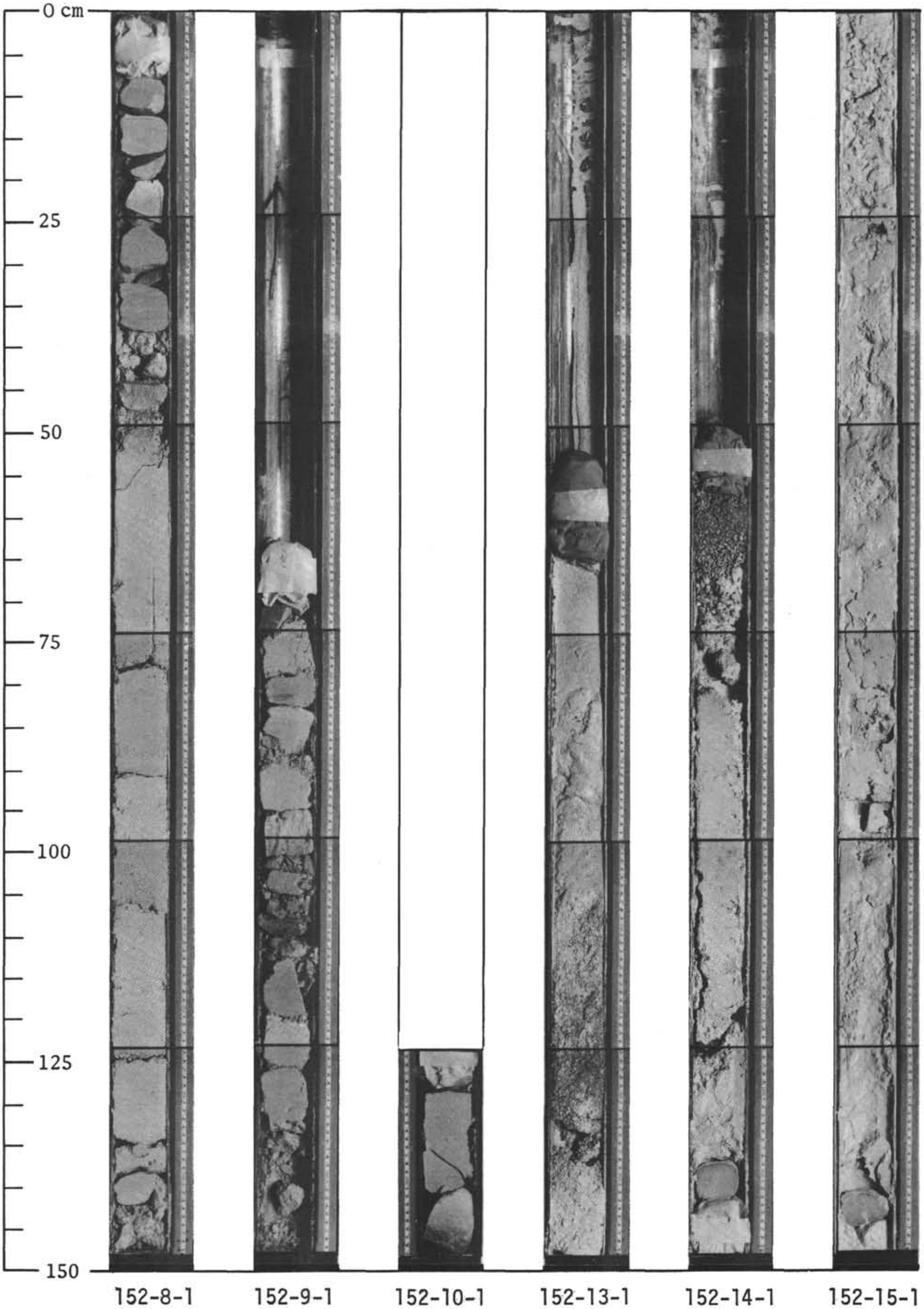
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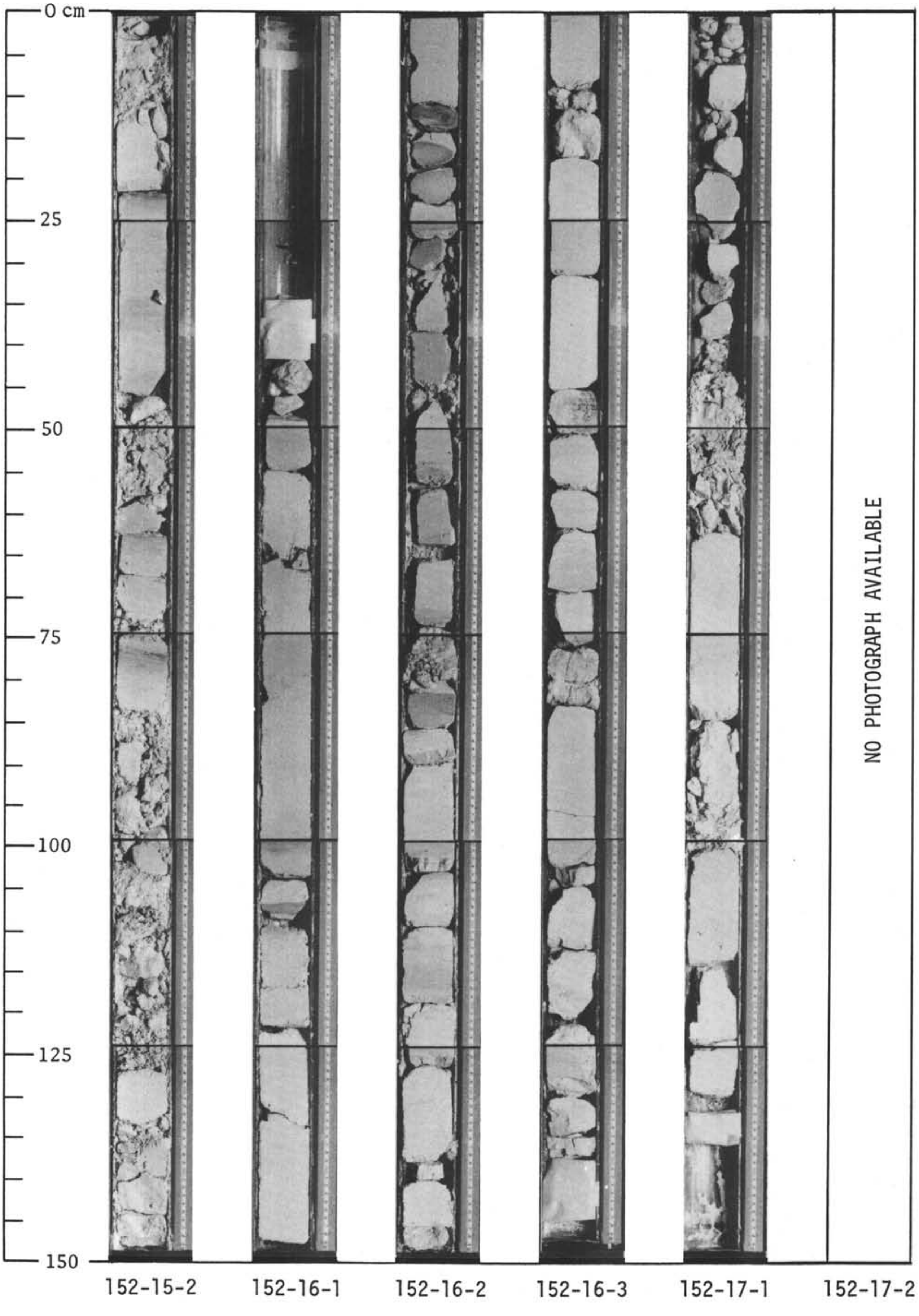
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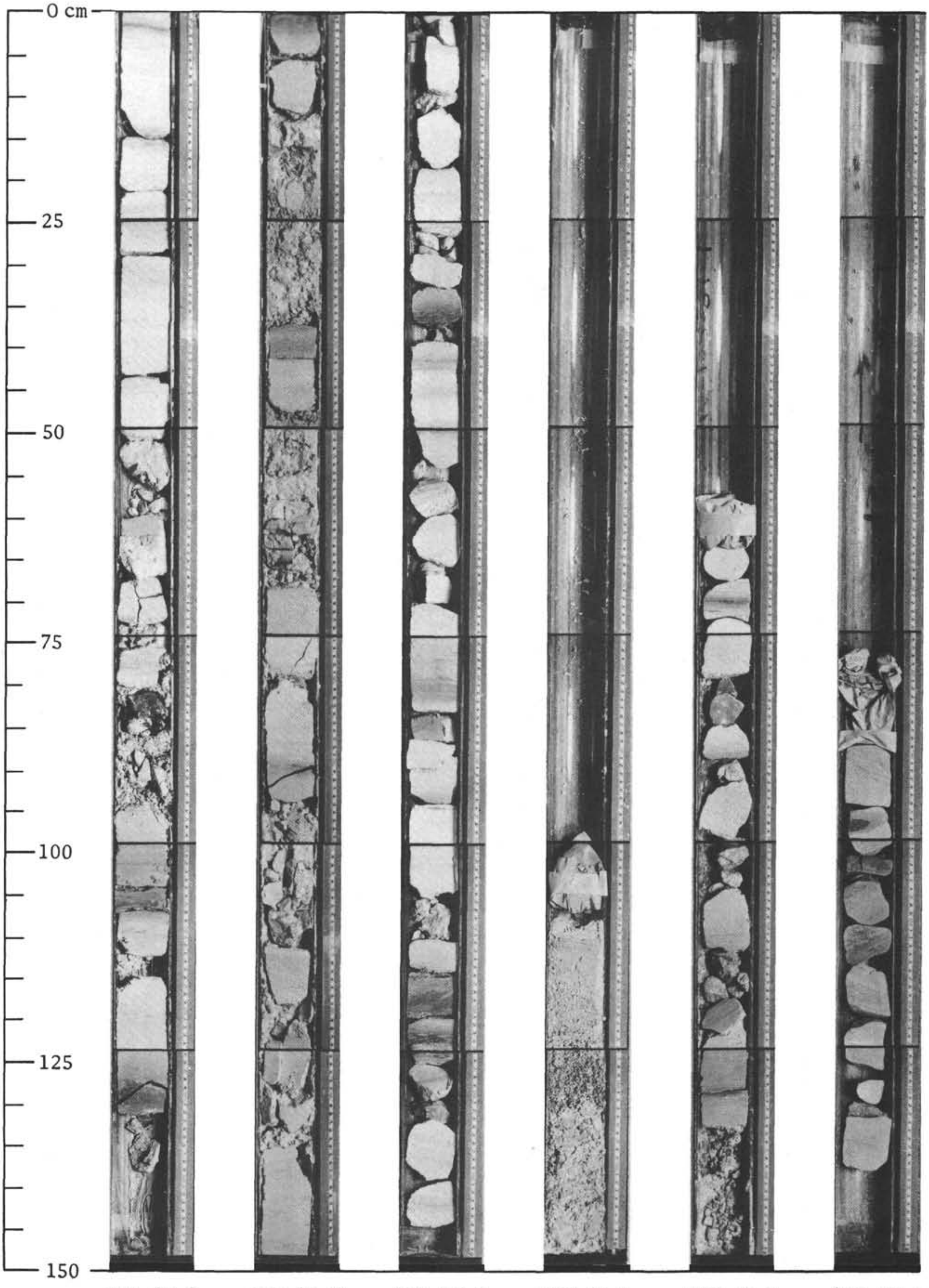
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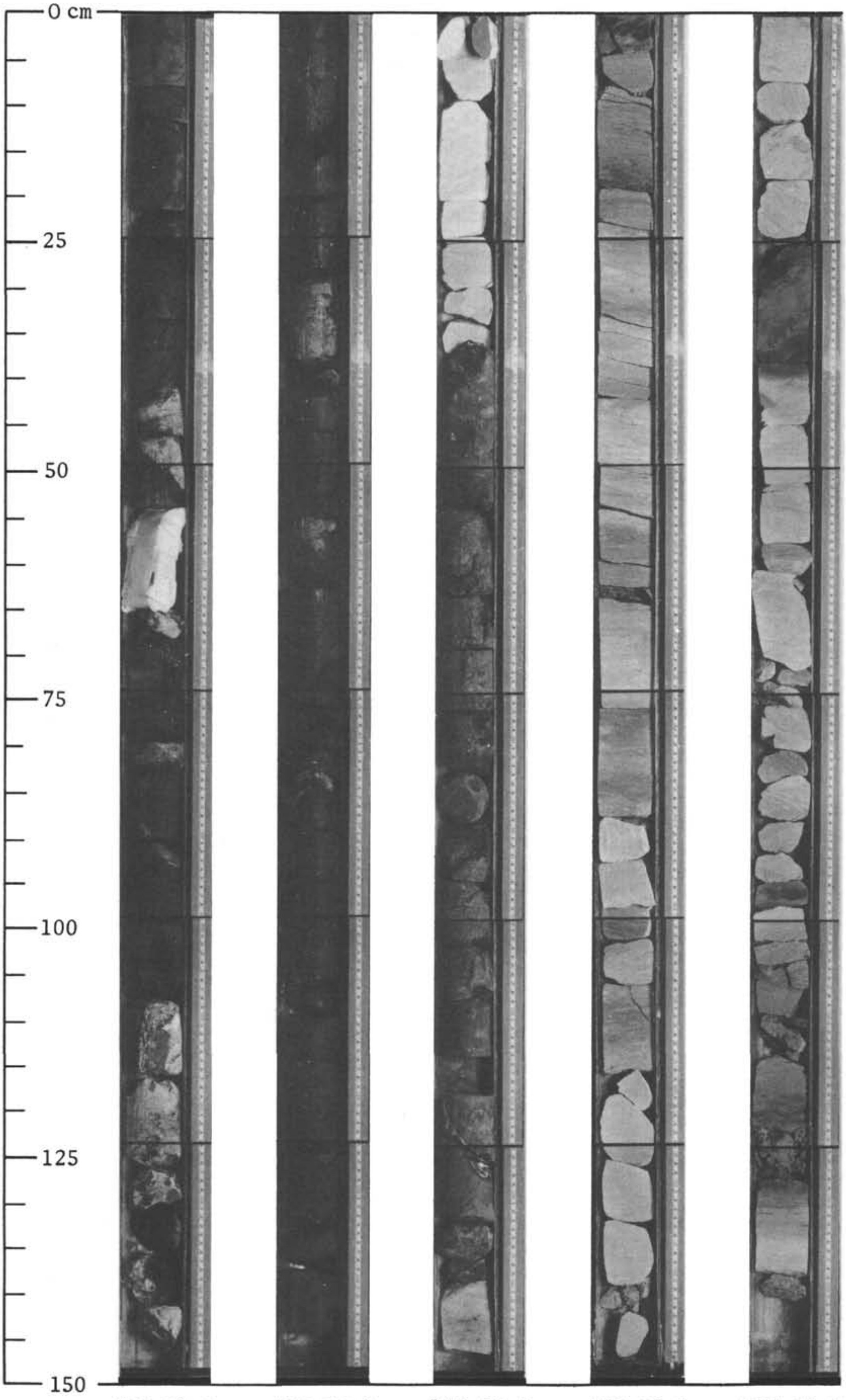
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