5. SITE 150

The Shipboard Scientific Party[1]

Position:
14°30.69′N
69°21.35′W.

Water Depth: 4545 meters.

Penetration:
150: 180 meters
150A: 128 meters.

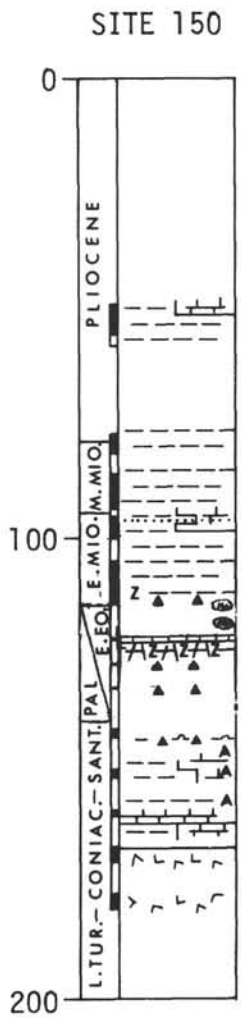
Recovery:
150: 39.3 meters (22%)
150A: 10 meters (0.5%)

ABSTRACT

The extremely thin sediment cover (0.2 sec reflection time) overlying the deepest reflector (dolerite) is attributed to a hiatus in deposition during the early Tertiary and dissolution of calcium carbonate components below the depth of compensation. Late Cretaceous sediments overlying the dolerite are calcium carbonate-rich and are similar to carbonates of the same age recovered at shallower depths (Site 146/149). Cenozoic sedimentation is characterized by deposition below the calcium carbonate compensation depth. Two phases of deposition in the Cenozoic can be recognized; an early volcanic phase and, starting in the Miocene, a clay characterized by terrigenous mineralogy. Seismic reflector, Horizon A″, indistinguishable from B″ on the seismic records, may be represented by a thin cherty carbonate of early Eocene-Paleocene age that overlies Horizon B″ dolerite by less than 60 meters.

BACKGROUND

As discussed in the Site Report for Site 146/149, Chapter 2, Horizons A″ and B″ are two reflectors that are present throughout most of the Venezuelan Basin, with the exception of an area in the southern part of the basin where only a thin sedimentary section overlies a single reflector. Extensive seismic reflection coverage of the area by ships of the Lamont-Doherty Geological Observatory and the Naval Oceanographic Laboratories and by the *Glomar Challenger* (Chapter 36) shows that the area of thin sediment is fairly extensive. Site 146/149 is located in an area where the entire sedimentary section is present according to seismic data (0.8 sec reflection time), but Site 29 of Leg 4 is located south of Site 146/149 where the sediment is thinner (0.48 sec) (Bader, Gerard et al., 1970) and Horizons A″ and B″ converge. Site 150 was selected where A″ and B″ coalesced, forming one subbottom reflector, and where the total sediment thickness is less than 0.2 sec reflection time. Figure 1 a seismic profiler record made by *Glomar Challenger* as she steamed from Site 146/149 to Site 150, passing within 3 km of Site 29, shows the location of these sites relative to the sediment thickness. Figure 2 shows the track corresponding to the reflection records shown in Figure 1.



The water depth also increases to the south: 3949 meters/3972 meters at Site 146/149; 4284 meters at Site 29; and 4545 meters at Site 150. The calcium carbonate compensation depth in the Venezuelan Basin lies within this depth range.

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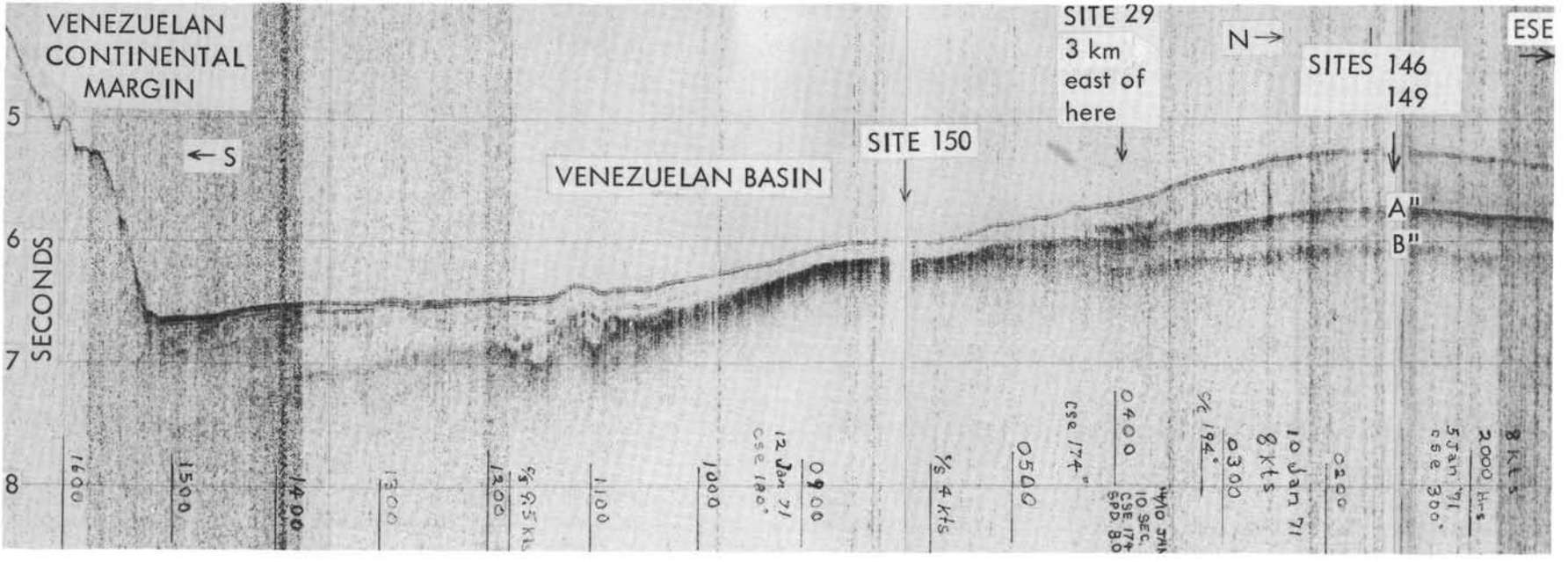
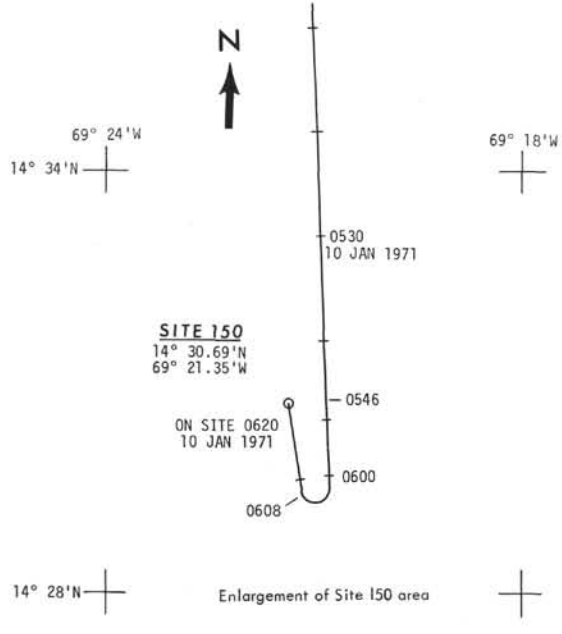




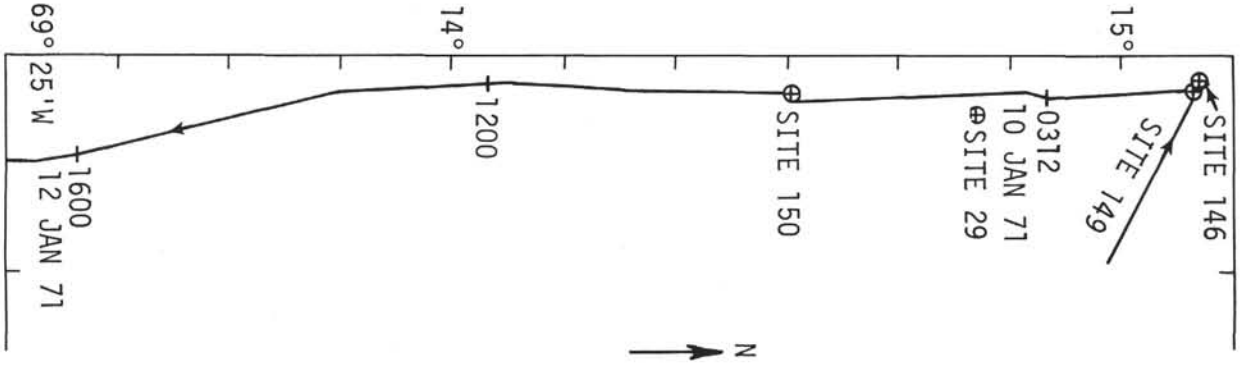


Figure 1. *Reflection record made by* Glomar Challenger *over the southern Venezuelan Basin showing the thinning of the sedimentary section southward, the coalescing of horizons A" and B", and the location of Sites 146/149, 29, and 150.*

Figure 2. *Track of the* Glomar Challenger *corresponding to reflection records shown in Figure 1 and showing the detailed track of the vessel as it came on location at Site 150.*

OBJECTIVES

The primary objectives are to determine the nature of the thinning of the sediments in the southern part of the Venezuelan Basin and establish the nature of the single subbottom reflector. It is not clear from the seismic records whether A″ and B″ are both present but very close to each other or if one of the two horizons is missing.

OPERATIONS

The *Glomar Challenger* arrived on the site at 0630 hours on 10 January 1971. A beacon was dropped without further site surveying and drilling began immediately. The first core was taken at 49 meters and continuous coring was conducted from 77 to 114 meters and again from 127 to 180 meters. An offset hole (150A) was cored from 110 to 128 meters in a largely unsuccessful effort to recover the unconformity indicated in the drilled interval between Cores 5 and 6 of Hole 150. The drill string was then withdrawn and the ship made way to Curacao at 0800 hours on 12 January.

LITHOLOGY

The sedimentary section can be divided into two basic lithologic units: a clay with interbedded marl and calcareous clay (0-120.17 m) overlying varicolored clays, marls, chalks, and cherts (120.17-168.55 m). Dolerite underlies the lower sedimentary unit.

The single spot core in the upper unit (49-58 m) recovered olive gray calcareous clay, rich in foraminifera and nannofossils, showing only moderate solution effects, and containing volcanic plagioclase. The remaining part of the unit contains a zeolitic brown clay (77-101.35 m) overlying an interbedded zeolitic clay and marl (101-132 m). The homogeneous brown clay shows characteristic terrigenous mineralogy: mica, kaolin/chlorite, and minor corroded plagioclase. Authigenic minerals include dolomite and fans of platy barite. The interbedded clay and marl sequence is layered in pale (carbonate-rich) and dark (carbonate-poor) brown (Figure 3). It contains phillipsite, clinoptilolite (the latter evidently displacing the former below, but cooccurring in two cores), sepiolite, abundant fresh plagioclase crystals, and minor amounts of quartz bipyramids, etched clinopyroxene, and magnetite octahedra. At 97 meters there is a 10-cm thick layer of silt (Figure 4), possibly a turbidite, containing dominantly angular quartz, benthonic foraminifera and a suite of metamorphic minerals of undoubted continental derivation, including abundant quartz, feldspars of plutonic aspect, glaucophane, tourmaline, metamict zircon, kyanite, and deep blue corundum. Similar sparse debris is dispersed throughout this part of the section.

Iron manganese nodules (to 5 cm in diameter) (Figure 5) are found in the clay between 100 and 115 meters depth. The larger nodules are distinctly iron-rich, but micronodules recovered from one of the cores with large nodules have a very high manganese and very low iron content (Donnelly and Nalli, this volume). Although the sediment in this interval is disturbed, the nodules appear to be both numerous and sharply restricted to one interval, suggesting that they occurred at this depth and were not displaced from the surface during drilling.

Figure 3. *Interlayered zeolitic clay and marl showing effects of burrowing and abundance of iron-manganese streaks, spots, and blotches (150-4-2, 33-64).*

At the base (120 m) of the clay unit a cristobalitic chert and pale orange limestone occur. Recovery of this interval was extremely poor.

Below the clay unit is a series of varicolored marls and chalks (132-168 m), which is very similar to sediments of this age at Site 146. As at the former site, these sediments are partially lithified, interlayered colored marls (grayish blue green to yellowish brown) and paler chalks with fish

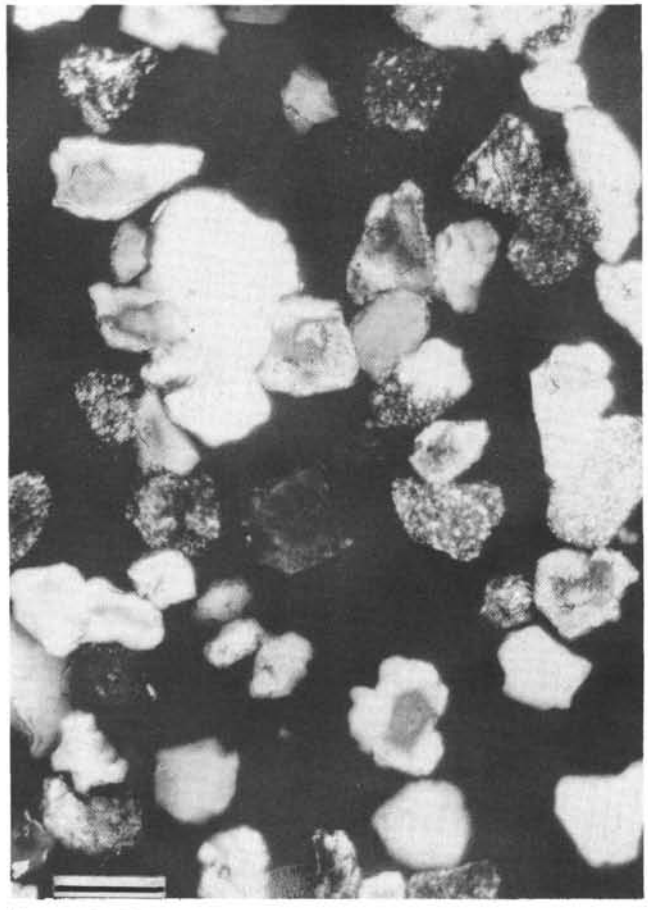


Figure 4. *Photomicrograph of a smear slide of light mineral concentrate in turbidite of continental origin showing dominant quartz, chert, and plutonic feldspars in Miocene core. Bar is 100 microns long; polarized light (150-4-1, 89-90).*

debris and ash beds a few cm thick. Burrows occur throughout but are faint. Pebbles of dolomitic limestone are found in some chalks. Intercalated near the base of this unit are highly altered ashes, probably basaltic in origin, probably more calc-alkalic.

The lowermost unit recovered at Site 150 is a fine-grained dolerite. This has a fresh appearance and is somewhat fractured, with secondary calcite. The upper contact of the dolerite and the chalk-marl sequence was not recovered.

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 the enclosed dots in the core and hole plots). Water content was determined by weight-weight relationships. In general, the precision of these data is ±5 percent. The methods, equipment, errors, assumptions, sediment disturbance, and interpretation precautions are described and discussed in the Appendix.

Figure 5. *Large spherical iron-manganese nodule, one of several found, apparently in situ, in zeolitic clay (150-5-5, 78-100).*

At Site 150, wet-bulk densities were relatively uniform and ranged from 1.4 (80% porosity) to 1.8 g/cc (56%), with 1.60 to 1.65 g/cc (60-65%) typical of Pliocene and Miocene clay and marl, and Cretaceous chalk ooze and marl. These sediments were recovered between 50 and 165 meters below the sea floor. Diabase below 168 meters had densities of 2.65 to 2.75 g/cc. The Eocene, Paleocene, and Cretaceous clay and chert sequence was not sampled.

There are several high-density spikes (low-porosity spikes) in the GRAPE data that are caused by the presence

of nodules in the sediment. These density and porosity values are not representative of the nodules, as the gamma ray path also included the sediment around the nodules. This occurs in Core 4, Section 3, and Core 5, Sections 4 through 6.

Water content samples were collected within 50 and 100 meters below the sea floor from Pliocene and Miocene clay and marl. The measurements unsystematically ranged from 36 to 42 percent.

Sound Velocity

Velocities of sound propagation through rock samples were measured by the Hamilton Frame technique, which is discussed in the Appendix. This method has a precision within ±1.1 percent.

At Site 150, the only sound velocities measured were a series on dolerite as a test. Sound velocities were measured on a dolerite sample that was (A) cut only with a rock saw, and then again (B) after polishing the surfaces of the dolerite sample. The results are listed below.

Sample 150-11-1 (88 to 96 cm)

A. Saw Cut (km/sec)		B. Polished Cut (km/sec)
5.161		5.215
5.109	Vertical to "Bedding"	5.217
5.114		5.215
5.035		5.168
5.109	Horizontal to "Bedding"	5.146
5.114		–

Natural Gamma Radiation

Natural gamma ray emissions are 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. Methods, equipment, sediment disburbance, and porosity adjustments are discussed in the Appendix.

Natural gamma ray emissions from Pliocene, Miocene, and Cretaceous clay, marl, chalk, and diabase have a range from 100 to 2600 counts per 1.25 min counting period. The Pliocene-Miocene clay and marl from 0 to 95 meters depth appears to have the highest counts, 1200 to 2600, while Miocene clay and marl from 95 to 115 meters had intermediate counts of 700 to 1700. The Paleocene and Cretaceous clay and chert sequence was not scanned with the natural gamma radiation counter. Cretaceous foraminifera nannofossil chalk and marl between 150 and 162 meters emitted counts of 300 to 900, while dolerite below these sediments emitted the lowest counts of 0 to 400.

Penetrometer

Needle penetration tests were conducted at Site 150 with a 1-mm diameter needle. The methods, equipment, and sediment disturbance are discussed in the Appendix.

At Site 150, penetrometer tests were only significant in the Pliocene-Miocene clay recovered from subbottom depths of 50 to 100 meters, where needle penetration varied irregularly from 5 mm to 1 mm, respectively. Penetration was zero or insignificant in Eocene and older sediment below 102 meters.

BIOSTRATIGRAPHY

The upper lithic unit recognized at this site, clay with interbedded marl and calcareous clay, extends to a depth of 120 meters (Cores 1 to 5; Hole 150A, Core 1). The assemblages of planktonic foraminifera are meager and are strongly affected by dissolution. The calcareous nannoplankton assemblages are more diverse but also have been affected by dissolution. Apart from a few "ghosts" of poorly preserved (probably zeolitized) skeletons in the catcher sample of Core 4, no radiolarians were found in Cores 1 through 5.

A spot core taken in brown clay (Core 1) at 49 to 58 meters yielded the best planktonic foraminiferal assemblages found in this unit, a sample from Section 1 belonging to the *Globigerinoides trilobus fistulosus* Subzone of the *Globorotalia miocenica* Zone (Middle Pliocene). Samples from Sections 3 and 4 belong to the *Globorotalia margaritae evoluta* Subzone of the *Globorotalia margaritae* Zone. Calcareous nannoplankton assemblages show variable preservation, some having almost all of the coccoliths removed by dissolution. All are referred to the *Discoaster surculus* Zone.

The only calcareous planktonic fossil found in sediments from Core 2 and most of Core 3 (77-95 m) is *Coccolithus pelagicus* which is itself very rare. The core catcher sample of Core 3 provided a few specimens of planktonic foraminifera which may represent the *Globorotalia mayeri* Zone (middle Miocene).

Cores 4 and 5 (95-114 m) contain planktonic foraminiferal assemblages suitable for dating at a few levels, but generally contain better calcareous nannoplankton assemblages. Three zones can be recognized in samples from the lower part of Section 1 of Core 4: the *Sphenolithus heteromorphus* Zone (95-106 cm); the *Helicopontosphaera ampliaperta* Zone (115-116 cm); and the *Sphendithus belemnos* Zone (124 cm and below). A planktonic foraminiferal assemblage from 116 to 118 cm belongs to the *Globigerintella insueta* Zone. The upper part of Section 2 of Core 4 belongs to the *Sphenolithus belemnos* Zone, the lower part to the *Discoaster druggi* Zone. A sample from Section 3 of Core 4 belongs to the *Triquetrorhabdulus carinatus* Zone, and a few specimens of *Globigerinita dissimilis* found at the top of Section 3 may indicate the presence of the *Globigerinita dissimilis* Zone. Sections 4, 5, and 6 of Core 5 all contain calcareous nannofossils of the *Triquetrorhabdulus carinatus* Zone. Section 5 contains a planktonic foraminiferal assemblage of the *Globigerinoides primordius* Zone. At this site all of the calcareous nannoplankton zones of the Early Miocene are present but represented by the very short sequence in Cores 4 and 5.

Cores 1 and 2 of Hole 150A span the interval between Cores 5 and 6 of Hole 150. Core 1 consisted of soupy material and was not investigated. Core 2 yielded moderately well- to well-preserved calcareous plankton assemblages belonging to the *Globorotalia edgari* and *Discoaster multiradiatus* zones.

The catcher sample from Core 2 of Hole 150A (119-120 m) contains rare, moderately preserved radiolarians (some dissolved, some infilled) which may be Paleocene in age.

The lower part of the sedimentary section at this site consists of variegated clays, marls, chalks, and cherts extending from 120 to 169 meters (Cores 6-10).

Only a catcher sample was recovered from Core 6 which yielded an assemblage of the *Globorotalia edgari* Zone (Early Eocene). Soupy material from Core 7 yielded similar planktonic foraminifera along with some Late Cretaceous benthonic foraminifera and Miocene calcareous nannofossils of the *Triquetrorhabdulus carinatus* Zone undoubtedly introduced by downhole slumping. Core 8 contains no useful calcareous fossils. The cherts of Cores 6 through 8 (from 127 to approximately 142 m) contain few to common, poorly preserved (silicified, dissolved, and altered) radiolarians (reworked?) of Cretaceous age. Soupy material from Core 7 contains few Cretaceous forms (reworked?) and abundant, moderately well preserved radiolarians of the *Buryella clinata* Zone (Early Eocene). A small piece of gray mud from the catcher of Core 8 contains a few, moderately preserved (some dissolved and some infilled) Cretaceous skeletons.

Core 9 (150-159 m) contains calcareous clay and marl with abundant diverse and well-preserved planktonic foraminifera and calcareous nannofossils. The planktonic foraminifera belong to the *Globotruncana concavata concavata* Zone (Santonian) and the calcareous nannofossils belong to the *Kamptnerius punctatus* and *Arkhangelskiella ethmopora* zones. Radiolarians are rare, moderately well preserved in Section 1 of Core 9 (at approximately 150 m). Core 10 (159-168 m) contains moderately well to well preserved planktonic foraminifera of the *Globotruncana schneegansi* Zone (Coniacian). Calcareous nannofossil assemblages are less distinctive than in the overlying core and precise zonal assignment is not possible. Radiolarians are absent in Core 10 (at 159 to approximately 160 m) and common and poorly preserved (somewhat dissolved and silicified) in Core 12 (177-180 m).

CONCLUSIONS

The Cenozoic part of Site 150 represents pelagic sedimentation generally well below the carbonate compensation depth. The sedimentation is divided into two phases: an earlier, highly volcanic zeolitic clay with abundant volcanic crystals of several species and, starting in the middle Miocene, clay with a greater terrigenous affinity.

The proximity of the steep continental rise of South America suggests that terrigenous turbiditic debris should be found at this site. The near absence of this recognizable debris (with one conspicuous and a few minor exceptions) attests to the persistence of a linear depression located just south of this site, which has acted as an effective sediment trap throughout the Cenozoic and much of the late Cretaceous.

Although the mid-Tertiary unconformity was not recovered, a conspicuous paleontological hiatus between 114 and 119 meters suggests that this gap is present. At Site 146/149 (about 60 km north and presently 600 m shallower) this interval is probably complete, but the fossil assemblages are partially dissolved. At Site 29, which is about midway between the sites, both laterally and vertically, there is apparently a hiatus separating early Miocene from late Eocene, although it cannot be definitely established. In addition, early and middle Eocene sediments were not recovered at Site 150, although they may be represented in the uncored interval. The hiatus evidently represents nondeposition as well as solution of the fossil components, and the decreasing hiatus higher on the slope, towards the center of the Venezuelan Basin, is noteworthy. It is possible that laterally moving currents channeled between the slope and the continental rise of South America and selectively scoured the lower slope sediments for a considerable fraction of the Tertiary period. The sediment above the hiatus is not a normal pelagic clay but is a zeolitic clay which formed from the alteration of volcanic ash. Very possibly the post-middle Eocene vulcanism of the Lesser Antilles supplied large quantities of pumice which was able to accumulate even in the presence of moderate currents. A post-deposition alteration in the presence of corrosive pore waters changed the glass to a clay while the crystals enclosed in the pumice were relatively unaffected. The presence of iron-manganese nodules in the zeolitic clay is consistent with this hypothesis; relatively rapid bottom currents favor the growth of nodules, and iron-rich nodules are thought to grow especially rapidly.

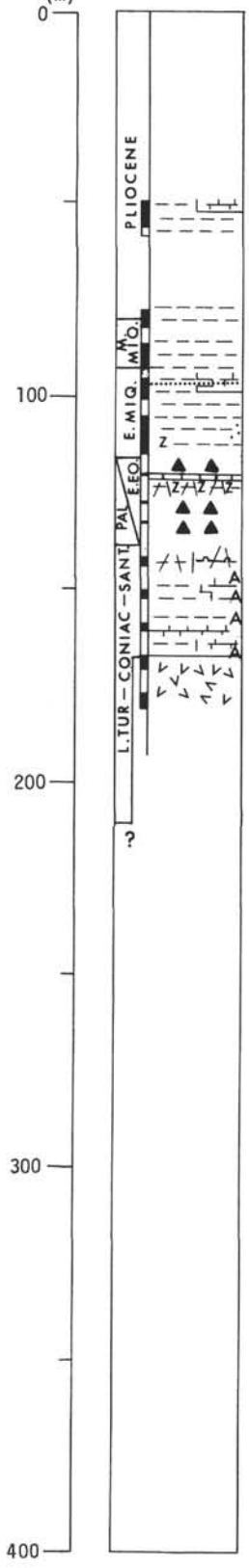
The gradual closing of the Panamanian isthmus may have shut off the deep currents in the middle Miocene changing the sedimentary regime.

REFERENCE

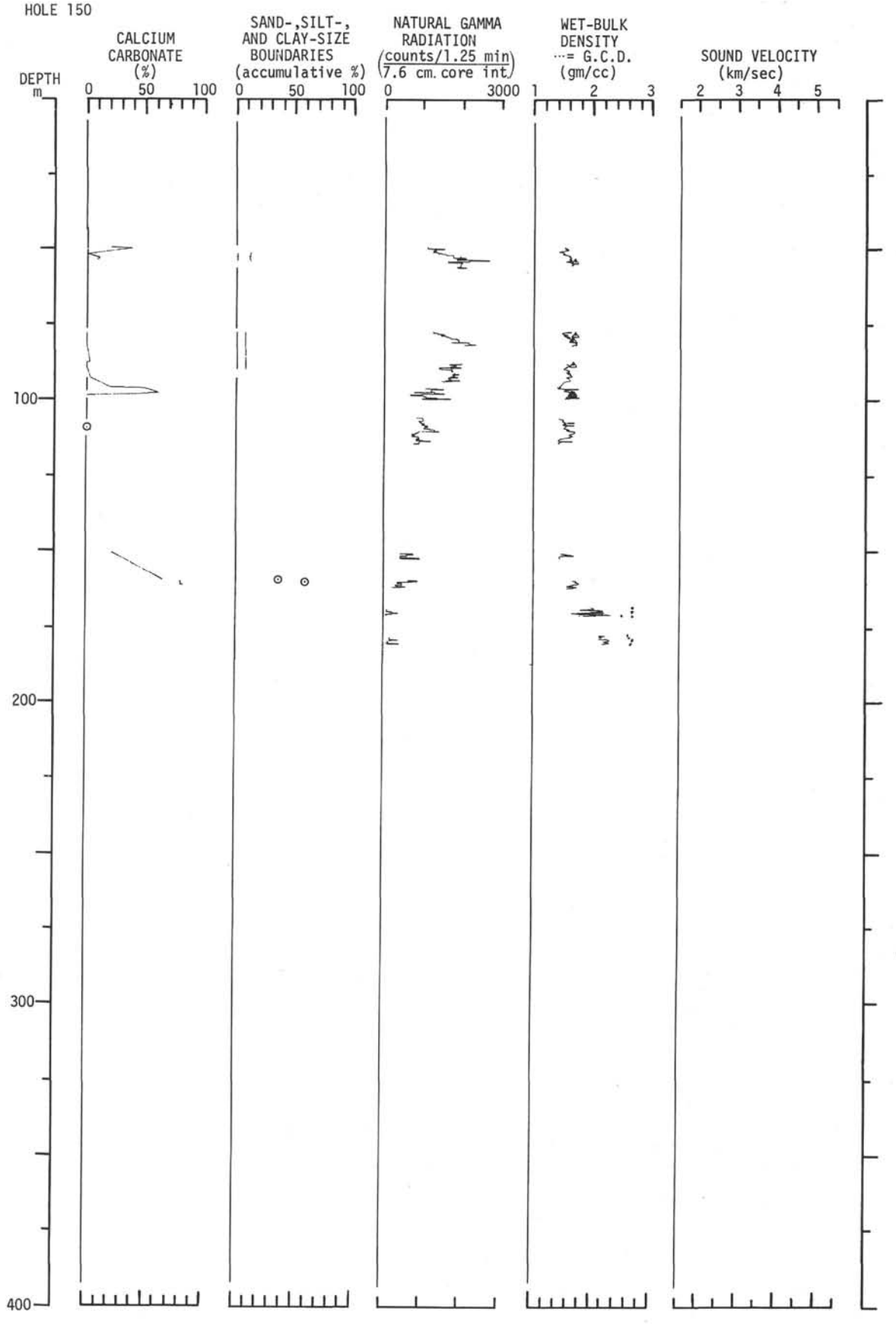
Bader, R. G., Gerard, R. D. et al., 1970. Initial Reports of the Deep Sea Drilling Project, Volume IV. Washington (U. S. Government Printing Office).

SITE 150

LITHOLOGY



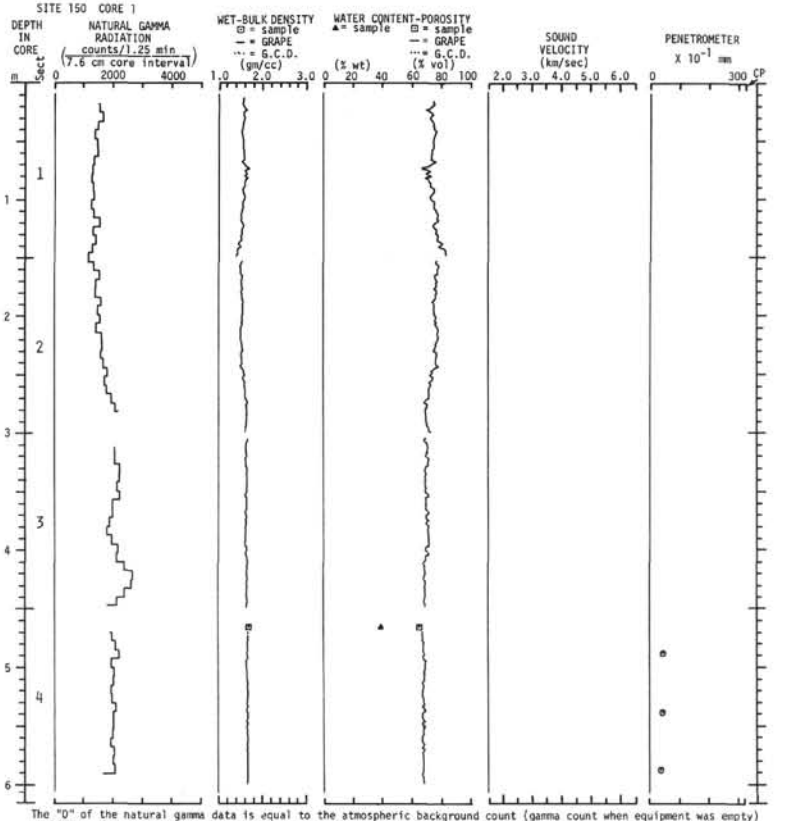
UNITS	SUBUNITS OR DESCRIPTION
UNIT I (0 to 120.17 m) CLAY with interbeds of FORAM NANNO MARL and FORAM NANNO rich CLAY	Core 1 (49 to 58 m) FORAM NANNO MARL OOZE and CLAY, olive gray.
	(77? to 101.35? m) ZEOLITIC CLAY, brown. Volcanic ash layers. Abundant iron-manganese oxide speckles and nodules. Occurrences of pyrite in upper part.
	(101.35? to 120.17 m) Interbedded brown zeolitic clays and FORAM NANNO MARL, olive gray and grayish orange. Abundant ash layers, Fe-Mn nodules, and chert.
UNIT II (120.17 to 168.55 m) Varicolored CLAYS, FORAM NANNO MARLS, and CHALK	FORAM NANNO MARL and CHALK, predominately grayish blue green to yellowish brown. Abundant volcanic ash layers. Abundant cherts in upper part. Zeolites in clay.
UNIT III (168.55 to 180 m T.D.) DIABASE	Topmost 5 cm is an ash layer. DIABASE, fine grained with extensive subvertical fractures, some filled with calcite. One lense of metamorphosed foram limestone.


HOLE 150
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

SITE 150 HOLE CORE 1 CORED INTERVAL (m) 49-58

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 %)	DEFORMATION
PLIOCENE	Globorotalia miocenica	Discoaster surculus		1	0.5			F A W N A W	FORAMINIFERAL NANNOPLANKTON MARL; light olive gray (5Y5/2), with scattered dark speckling. Sediment is very soft and highly disturbed.	0 50 100	CH-13 III
	Globorotalia margaritae			2	1.0 0.0 0.5 1.0			n N F P	CLAY; moderate olive gray (5Y4/2) and grayish olive green (5GY4/2). Dark material is disseminated throughout, some as thin oxidized laminae. Some plagioclase; X-ray also shows K-feldspar. Sediment is firm and plastic.		
				3	0.0 0.5 1.0			N F P F C W			
					0.0	GEO CHEM					
				4	0.5 1.0			N F P F C M n F C M			
				CORE CATCHER				R O f			

[1]For explanation of symbols, see Chapter 1

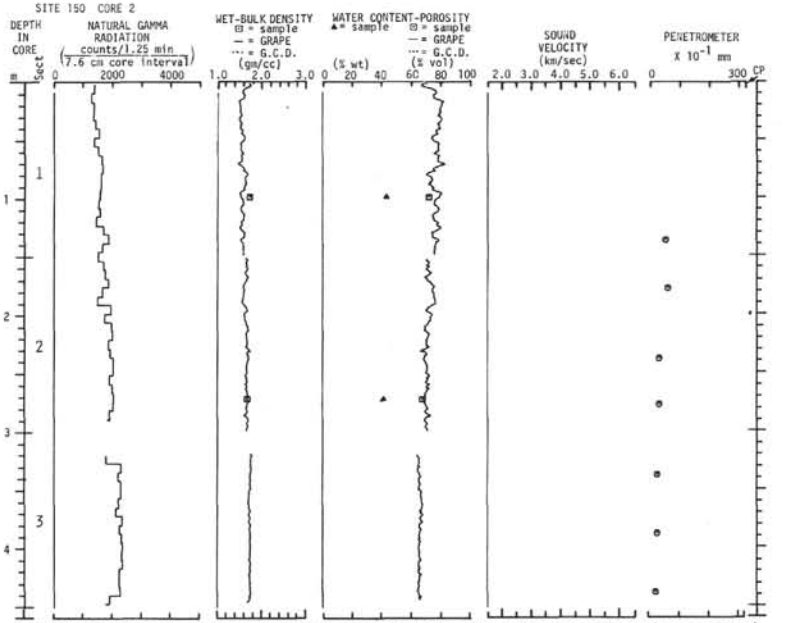


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1420. This background was subtracted from the data.

SITE 150 HOLE CORE 2 CORED INTERVAL (m) 77-86

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
				1	0.5			n	quartz CLAY; moderately to dark yellowish brown (10YR5/4) to (10YR4/4) with light greenish gray mottles associated with burrows and pyrite concretions. Sparse plagioclase; X-ray shows K-feldspar. Rare anatase. Sediment is moderately firm and plastic.		CH-13 III
					1.0						
					0.0			n			
				2	0.5			N R P			
					1.0			N R P f			
					0.0	GEO CHEM					
				3	0.5						
					1.0			n			
				CORE CATCHER				f R O	Core catcher contains barite radial plates, plagioclase crystals, and cylindrical aggregates of dolomite pellets.		

[1]For explanation of symbols, see Chapter 1

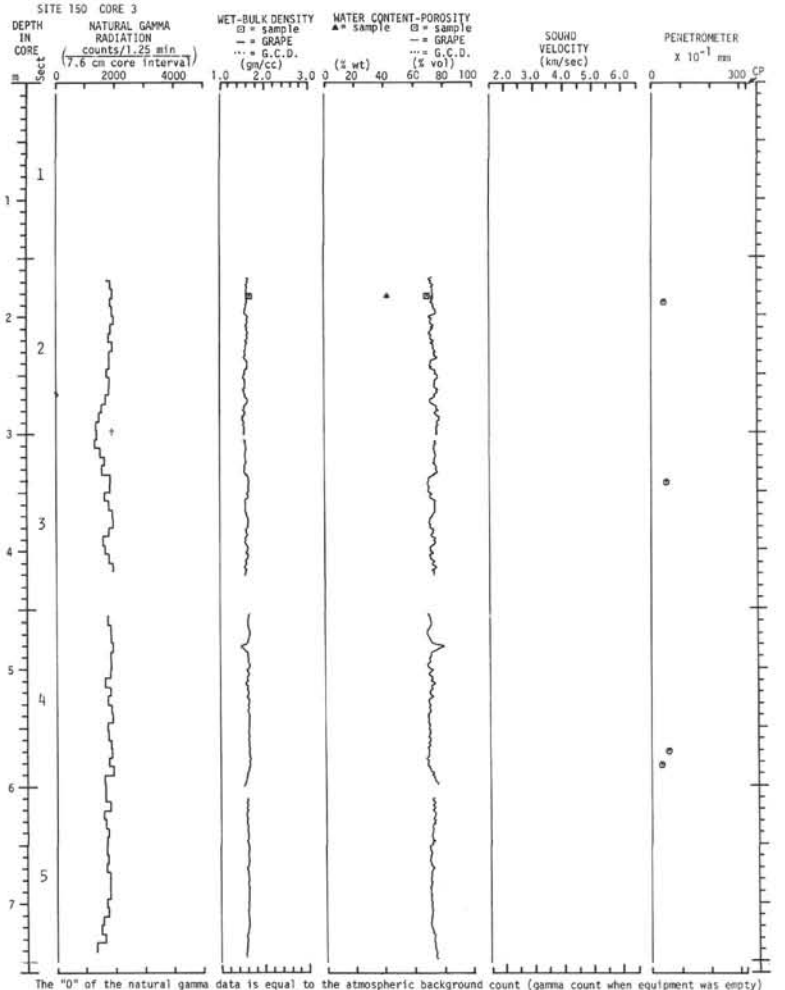


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1420. This background was subtracted from the data.

SITE 150 HOLE CORE 3 CORED INTERVAL (m) 86-95

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 %)	DEFORMATION
MIDDLE MIOCENE	?Globorotalia mayeri			1	0.5	VOID			CLAY; dark yellowish brown (10YR4/4) to (10YR5/4) with disturbed streaks of faint greenish gray (5GY8/1). X-ray shows K-feldspar.	0 50 100	
					1.0						
				2	0.0			n			
					0.5			n			CH-13 III
					1.0						
				3	0.0			f	5GY8/1 streaks		
					0.5			n			
					1.0	GEO CHEM					
				4	0.0			n			
					0.5						
					1.0			N R P			
				5	0.0			n			
					0.5						
					1.0			n			
				CORE CATCHER				F R P R O	Core catcher contains plagioclase and radial plates of barite.		

[1]For explanation of symbols, see Chapter 1

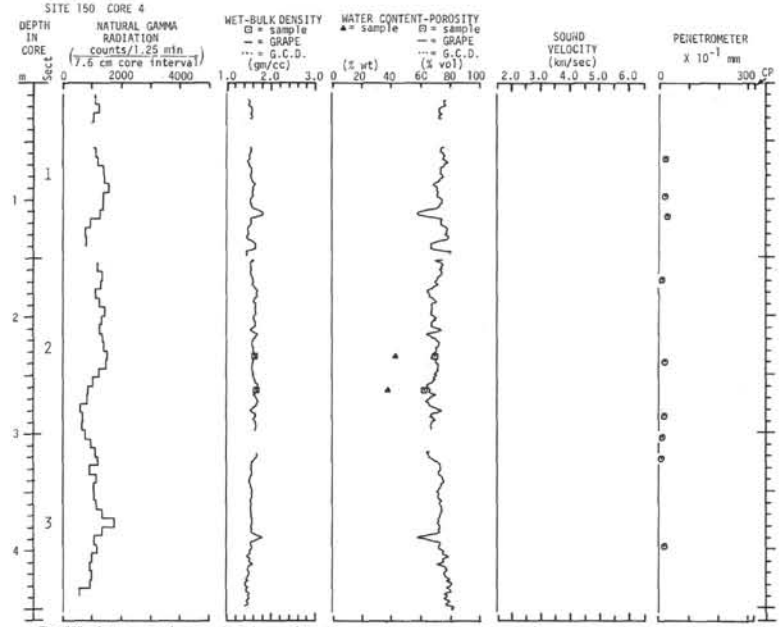


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1376. This background was subtracted from the data.

SITE 150 HOLE CORE 4 CORED INTERVAL (m) 95-105

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
EARLY MIOCENE	Globigerinatella insueta	Sphenolithus heteromorphus	2	1	0.5			n	CLAY; predominantly moderate yellowish brown (10YR5/4), darker toward bottom, with dark blotches.		
					1.0			N F M N R P F A W N F W	CLAY; olive gray (10Y5/2) with a sandy layer at 80 cm, containing dominant quartz, plagioclase, orthoclase, biotite, green hornblende, glaucophane, kyanite, garnet, rutile, zircon, epidote, olive-green tourmaline, and blue corundum.		CH-13
	Globigerinita dissimilus	Sphenolithus belemnos	3		VOID			N R P			
				2	0.0			N F M	CLAY, FORAMINIFERAL NANNOFOSSIL CALCAREOUS CLAY interbedded with NANNOFOSSIL FORAMINIFERAL MARL; mainly yellowish brown (10YR6/4). The marl is mainly pale grayish orange (10YR3/4). Extensive burrows throughout. Black speckles are disseminated throughout, increasing downward. X-ray shows clinoptilolite.		
					0.5			N R P			
					1.0			N C W			
		Triquetrorhabdulus carinatus		3	0.0			F R P N R P			
					0.5				FORAMINIFERAL NANNOPLANKTON MARL; grayish orange (10YR7/4) with black speckles and nodules, some up to 1 cm in diameter. Plagioclase, phillipsite, clinoptilolite, and sparse apatite in smear slides.		
					VOID						
					1.0			n			
				CORE CATCHER				R F P f			
									CLAY; dark yellowish brown (10YR4/2) with darker and lighter blotches associated with black spots. Fe-Mn nodules up to 6 cm in length occur in Section 3. Core catcher contains plagioclase, quartz, garnet, and clinopyroxene crystals.		

[1]For explanation of symbols, see Chapter 1

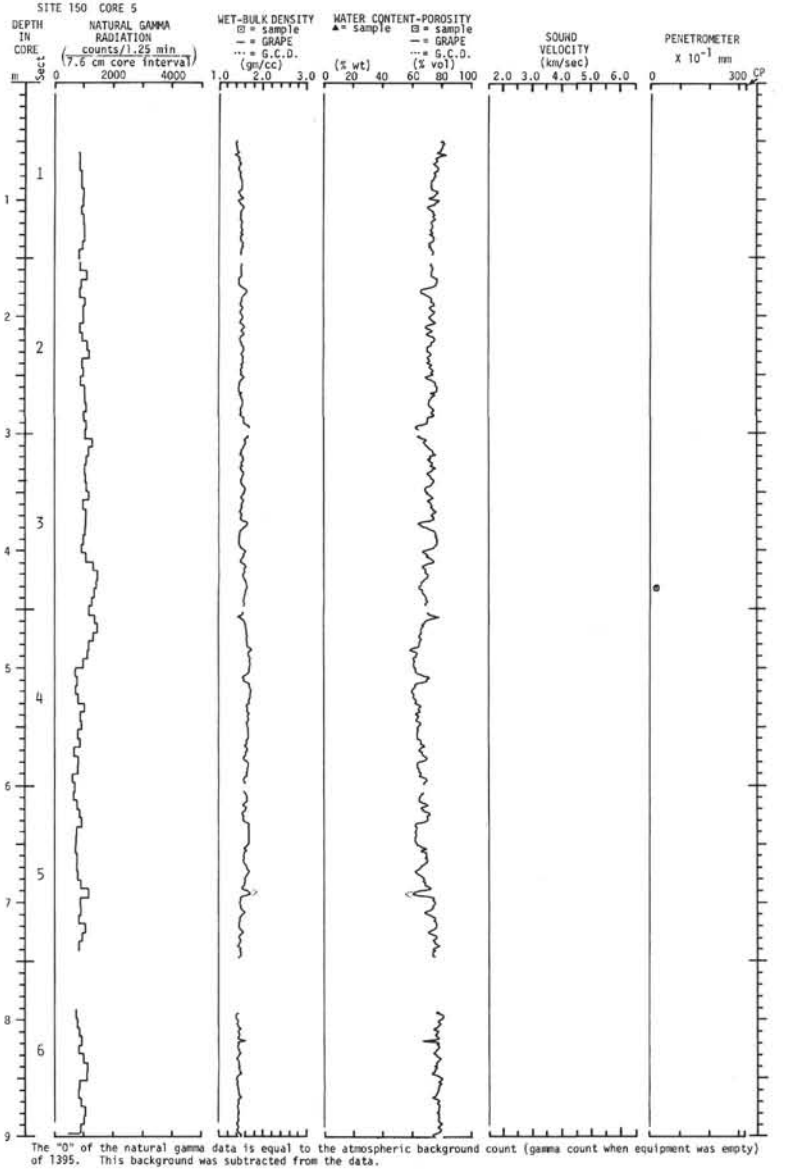


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1376. This background was subtracted from the data.

SITE 150 HOLE CORE 5 CORED INTERVAL (m) 105-114

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 %)	DEFORMATION
EARLY MIOCENE	Globigerinoides primordius	Triquetrorhabdulus carinatus		1	0.5	VOID		F R M	CLAY; mainly dark yellowish brown (10YR4/2) with irregularly intermixed, varicolored fragments of olive gray, pale olive gray, pale yellowish brown, dusky yellowish brown, and pale greenish orange. Botryoidal nodules up to 4 cm diameter; olive gray (5Y3/2) irregular, hard streaks are particularly abundant in Sections 5 and 6. Sediment is plastic, lightly stiff and friable. "S" indicates silt with hornblende, biotite, zircon, and tourmaline.	0 50 100	
					1.0						
				2	0.0						
					0.5						
					1.0						
				3	0.0				III and IV: Highly disturbed, both flow-in and drilling breccia, causing an appearance similar to an intraformational breccia. Boundaries between various clays are either sharp or gradual and very irregular.		CH-13 III IV
					0.5						
					1.0			S	Smear slides contain plagioclase, clinoptilolite, and phillipsite. X-ray diffraction shows sepiolite.		
				4	0.0						
					0.5			N F P	10YR5.5/3 pale yellowish brown		
					1.0			N F P			
				5	0.0			N F M			
					0.5			F A W	10YR2/2		
					1.0			N F M			
				6	0.0	GEO CHEM					
					0.5						
					1.0			N F M			
						VOID					
				CORE CATCHER				R O f	Core catcher contains quartz, plagioclase, and clinopyroxene.		

[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 150 HOLE CORE 7 CORED INTERVAL (m) 132-141

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
EARLY EOCENE			Buryella clinata	1	0.5	VOID		R F P	Core 6 contained several chert fragments in the core catcher. Not described.		
					1.0			R A M	DRILL CUTTINGS composed of a graded mixture of grayish orange (10YR7/4) SANDY SILT, pale yellowish brown (10YR6/4) angular and slightly CALCAREOUS SAND and light olive gray (5Y6/1), slightly CALCAREOUS GRAVEL composed mainly of less than 2 cm angular CHERT fragments. Smear slides contain plagioclase.		CH-13 IV
				CORE CATCHER				R R P			

SITE 150 HOLE CORE 8 CORED INTERVAL (m) 141-150

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
				CORE CATCHER				R F M R C P	Core catcher: SILICIFIED MARL; sparse biomicrite with irregular lenses (burrows ?) of fossiliferous micrite, partly silicified. Contains subparallel, abundant radiolaria, some benthonic foraminifers, and monoaxial and triaxial sponge spicules. The radiolaria are poorly preserved, the chambers filled by chalcedony. Rare sand-sized angular plagioclase and silt-sized quartz grains are dispersed throughout.		

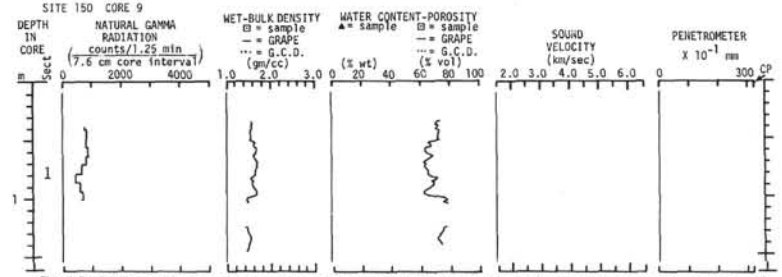
SITE 150 HOLE CORE 9 CORED INTERVAL (m) 150-159

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
CONIAC/SANT	Globotruncana c. concavata			1	0.5	VOID		N F P	5GY7/1	▲	
	*				1.0			N C M	10YR2/2 plagioclase		
								N C M	5BG5/2		
								R R M	5Y2/1		
								N R P	5BG3/2 plagioclase		
				CORE CATCHER				R O			

CALCAREOUS CLAY and NANNOFOSSIL MARL; interbedded layers, grayish blue green (5BG5/2) and light greenish gray (5GY7/1) respectively. Some nannofossils in the clay. Dusky blue green (5BG3/2) becomes predominant with olive black (5Y2/1) volcanic clay toward the bottom. Two distinct clayey ash layers with sharp boundaries are indicated. Faint burrows occur throughout. Sediment is compact and moderately crumbly. All smear slides contain clinoptilolite, some coarsely crystallized.

* ?G. schneegansi

[1]For explanation of symbols, see Chapter 1



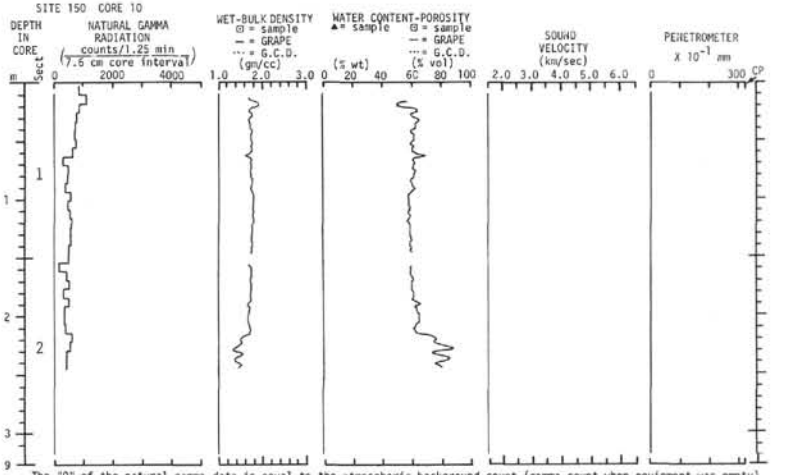
The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1426. This background was subtracted from the data.

SITE 150 HOLE CORE 10 CORED INTERVAL (m) 159-168

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
L. TURONIAN/CONIACIAN	Globotruncana schneegansi			1	0.5			N R P N R P N R P N R P N F P N C M	ASH; very dusky blue (5PB2/2) in the upper 7 cm underlain by NANNOPLANKTON MARL with volcanic clay, dark grayish blue green (5BG4/2). Highly bioturbated, compacted and broken. Contains glauconite and chlorite; X-ray shows barite.	▲▲	
					1.0				10YR4/2 5G8/1		
					0.0				5Y7/2		
				2	0.5			N F P N F M R O N R P	NANNOPLANKTON CHALK; yellowish brown (10YR5/2) with extensive burrows, compacted and broken, with sharp basal contact. The upper part (13-17 cm) consists of fragments of indurated dolomite-rich pebbles, some with graded laminae, intermixed with chalk.	▲ ▲	
					1.0	VOID			10R4/2 authigenic K-feldspar		CH-13 IV
					0.0						
				CORE CATCHER				R O	FORAMINIFERAL NANNOPLANKTON CHALK; light greenish gray (5G3/1) with an interbedded dark yellowish brown (10YR4/2) layer between 38-54 cm, changing into yellowish gray downward. Dark greenish gray intrusions in Section 2.		
									FORAMINIFERAL NANNOPLANKTON CHALK OOZE; pale red (10R4/2) with a sharp basal contact, homogeneous with slight burrowing near the bottom.		
									NANNOPLANKTON MARL; moderate yellowish brown (10YR5/4) with clasts of greenish gray (5GY6/1) altered volcanic clay. Uppermost part (66-71 cm) is a grayish red (10R4/2) nannoplankton marl with dark greenish gray (5GY4/1) intrusions and calcite rhombs.		
									X-ray diffraction also shows barite.		

For explanation of symbols, see page

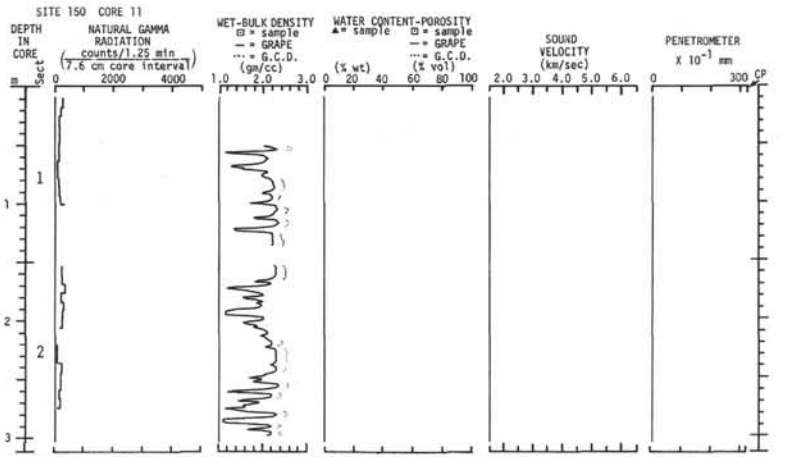
[1]For explanation of symbols, see Chapter 1



The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1357. This background was subtracted from the data.

SITE 150 HOLE CORE 11 CORED INTERVAL (m) 168-177

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
				1	0.5	VOID A			ASH pebble; dark greenish gray (5GY4/1) with light olive gray blotches (5Y6/1). Glauconite present.		
					1.0				DOLERITE; greenish black (5GY2/1) with fractures. Prominent fracture at 103 cm filled by grayish olive (10Y4/2) and pink metamorphosed (?) limestone.		
				2	0.0						
					0.5						
					1.0						
				CORE CATCHER							

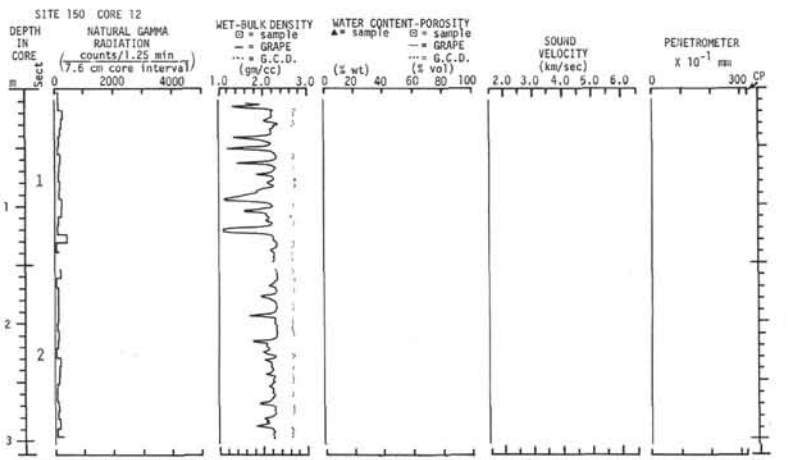


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1423. This background was subtracted from the data.

SITE 150 HOLE CORE 12 CORED INTERVAL (m) 177-180

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
				1	0.5			R C P	DOLERITE; greenish black (5GY2/1) fine grained in fragments 5-15 cm long, fractured, with some calcite veins.		
					1.0						
				2	0.0						
					0.5						
					1.0						
				CORE CATCHER							

[1]For explanation of symbols, see Chapter 1

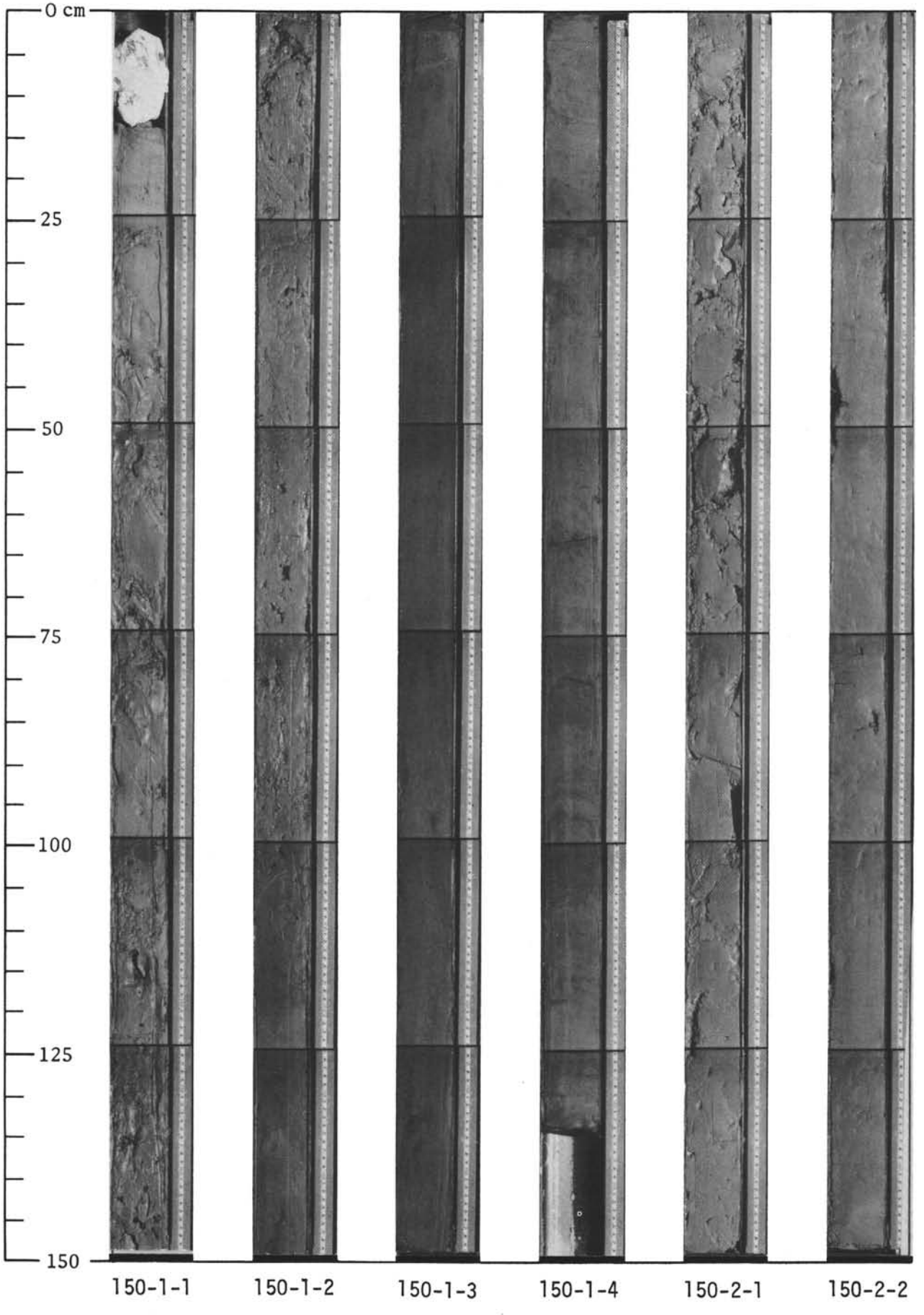


The "0" of the natural gamma data is equal to the atmospheric background count (gamma count when equipment was empty) of 1427. This background was subtracted from the data.

SITE 150 HOLE A CORE 2 CORED INTERVAL (m) 119-128

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
EARLY EOCENE / PALEOCENE	Globorotalia edgari	Discoaster multiradiatus		1	0.5	VOID			LIMESTONE and CHERT fragments; very pale orange (10YR8/2) limestone and grayish orange (10YR7/4) chert. Lower contact destroyed.		
					1.0			N C M R C M n	CLAY; between light brown (5YR5/6) and moderate yellowish brown (10YR5/4) zeolitic, bioturbated. Sediment is compacted and crumbly.		
				CORE CATCHER				R R M	Common plagioclase, clinoptilolite, and some hornblende and apatite.		

[1]For explanation of symbols, see Chapter 1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100
125
150
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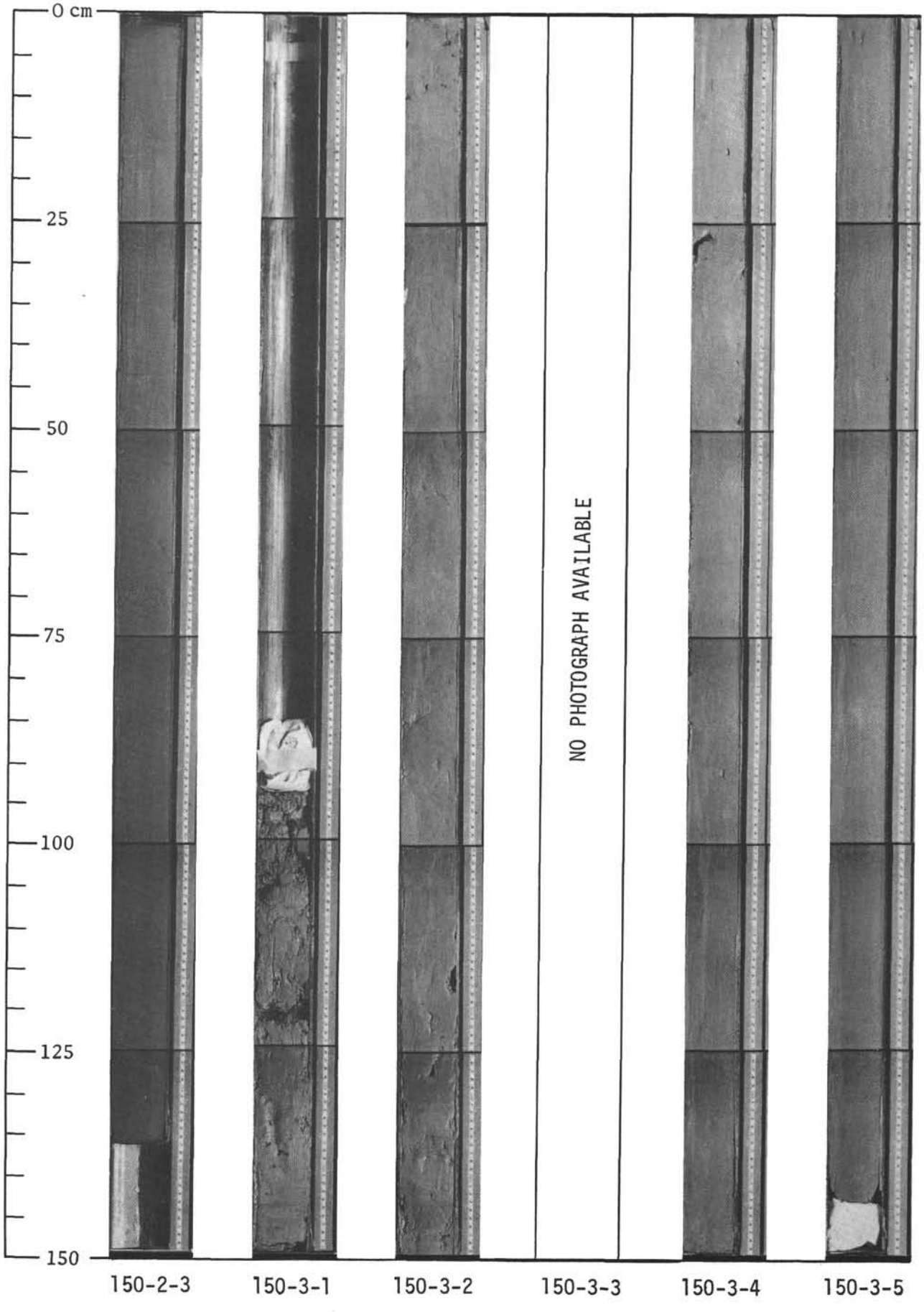
150-1-2
150-1-3
150-1-4
150-2-1
150-2-2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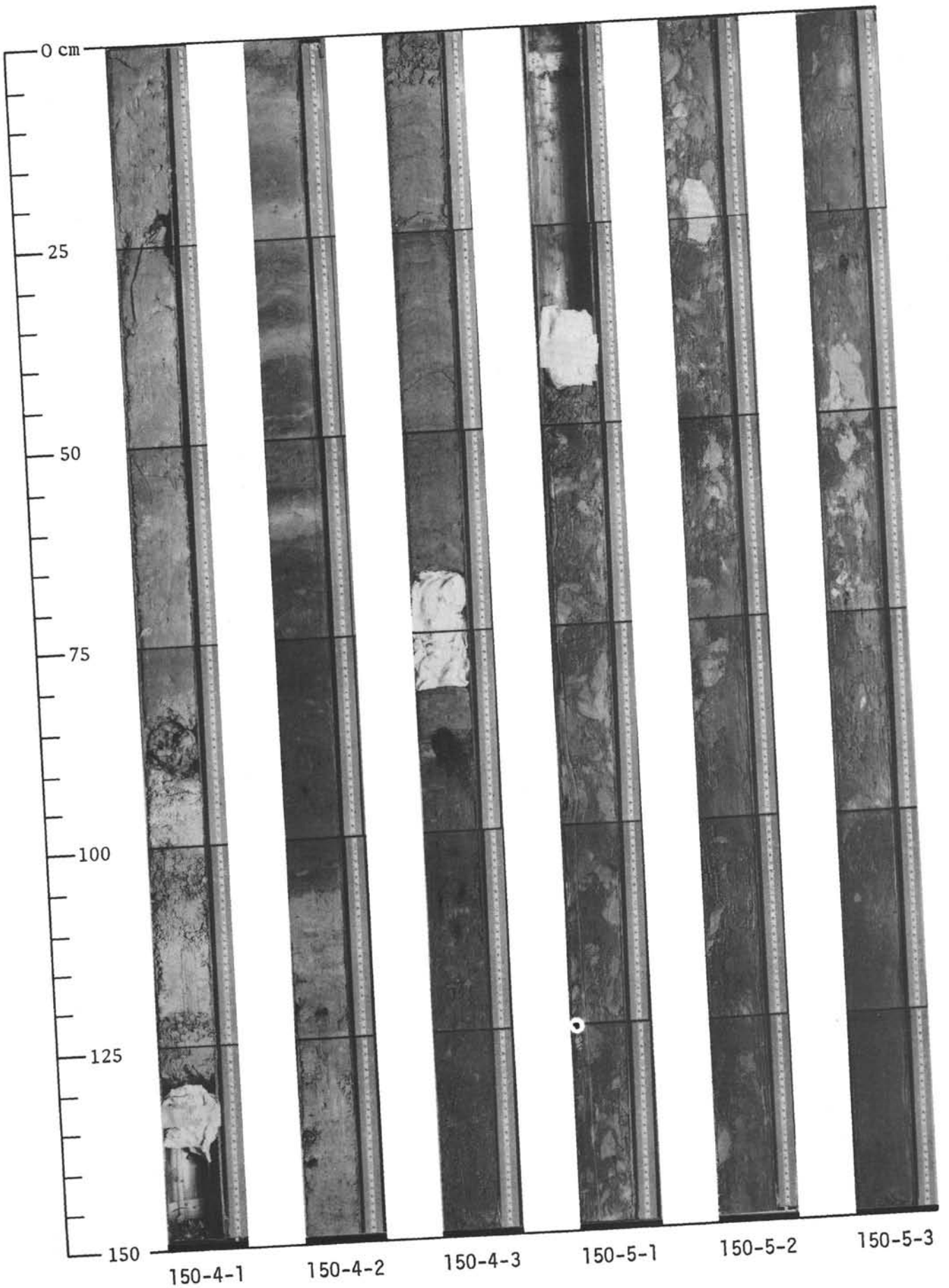
150-3-5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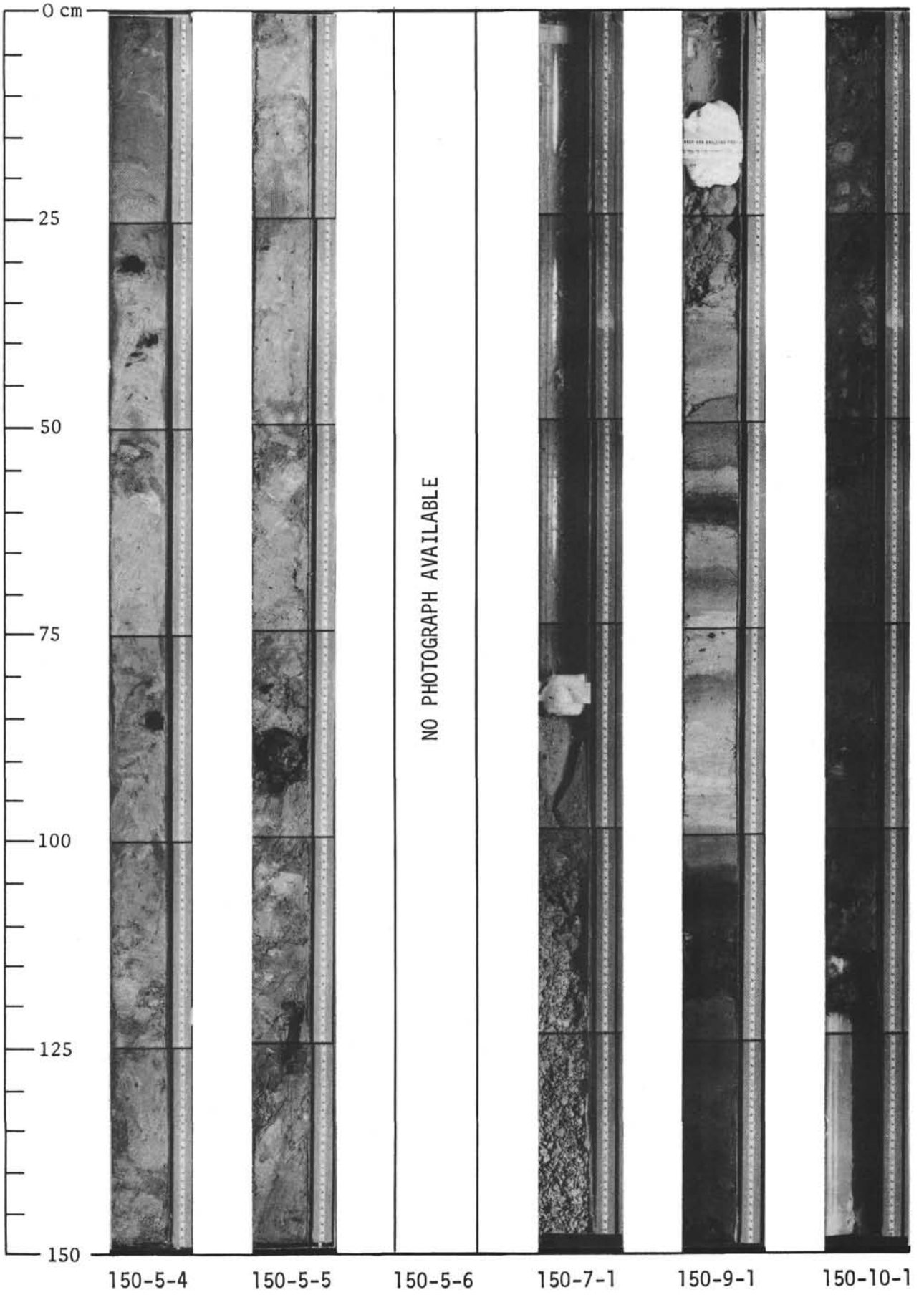
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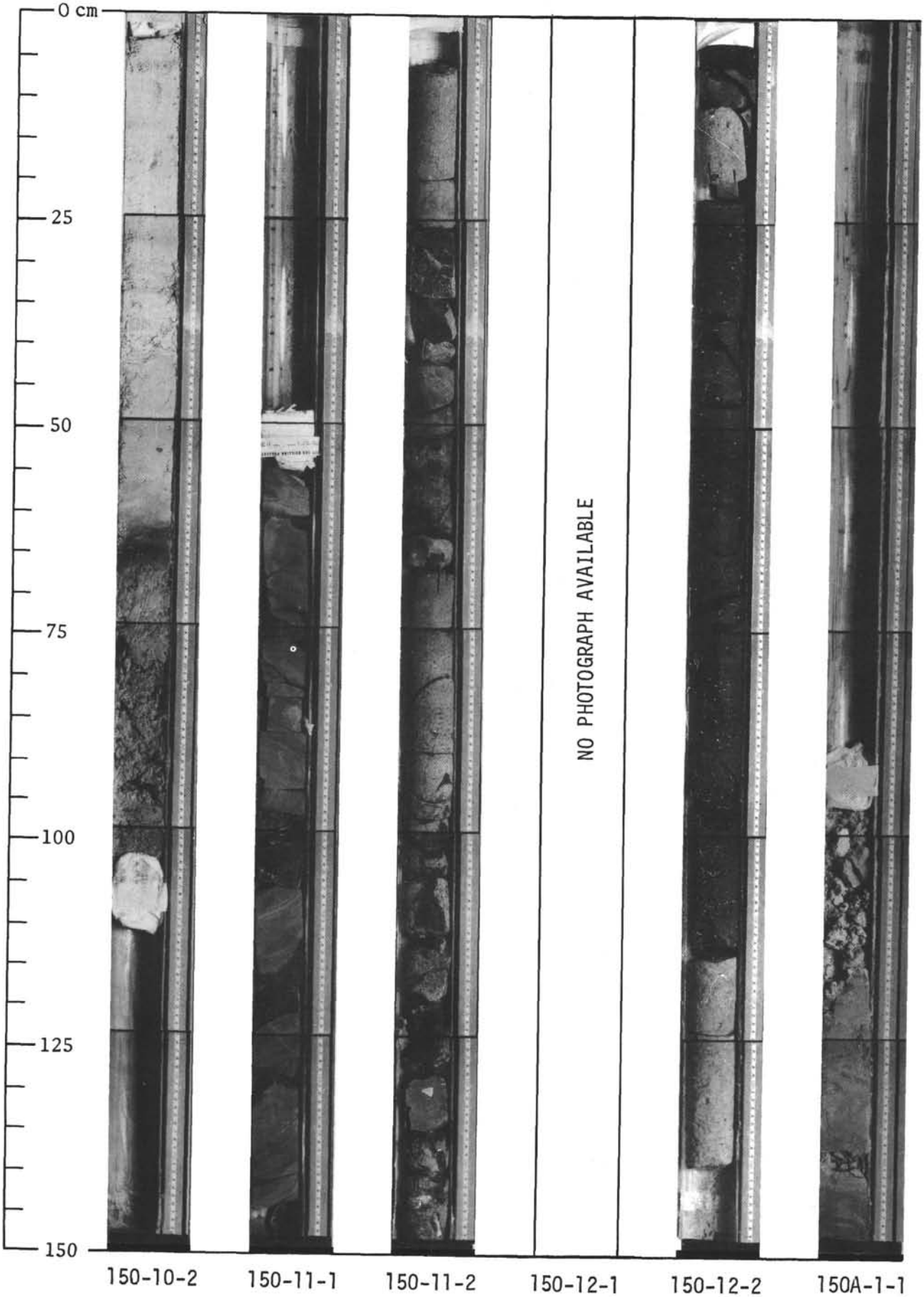
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