4. SITE 137

The Shipboard Scientific Party[1]

ABSTRACT

Site 137 lies about 1000 km west of Cap Blanc, Africa, in an area of abyssal hills close to the foot of the continental rise. Approximately 245 meters of brown clay, barren in the upper part, but early Tertiary to Campanian lower down, passes down through a 32-meter transitional zone of Turonian to Cenomanian black clay, calcareous clay and chert into about 120 meters of nannoplankton marl/chalk ooze of early Turonian to Cenomanian age.

Basalt (believed to be layer 2) was reached at 397 meters subbottom and is correlated with the basement reflector at 0.40 second. Late Albian marl ooze was recovered in a sidewall sample three meters above the top of the basalt. The basalt is a strongly altered porphyritic flow rock cut by numerous veins; it has alkalic affinities.

Neither the drilling record nor the recovered core materials give an indication as to the true depth and nature of the thin intermediate reflector seen on the seismic records at about 0.15 second.

SITE DATA

Time: 2250 October 20, 1970
0745 October 24, 1970

Position: 25° 55.53′N
27° 03.64′N

Water Depth: 17,584 feet
2,828 nominal fathoms
5,361 meters

Total Penetration: 401 meters

Cores Taken: Seventeen cores and one sidewall sample.

BACKGROUND, SURVEY, OPERATIONS

Site 137 lies in the deep eastern Atlantic basin in an area of abyssal hills close to the edge of the lower continental rise (Figures 1 and 2). The site is about 1000 km west of Cap Blanc.

Seismic records taken from *Vema* 27 and *Challenger* Leg 14 are shown in Figure 2. The portions of the records between the two sites were run along near identical traverses as shown in Figure 1. There is a major topographic barrier separating the two sites. This barrier has been surveyed by Lattimore *et al.* (1971), and their interpretation of the structural fabric in this region is shown as an inset in Figure 1. There is a pronounced change in the general character of the sediment blanket recorded seismically on opposite sides of this feature, and this contrast in sediment exists near the foot of the West African continental rise-abyssal hill boundary. Sediments on the landward side, for example, in the area of Site 138, are well layered, slightly disturbed, and have a number of reflectors that can be traced over large distances. In general, the total sediment thickness is in excess of 0.5 sec. In contrast in the area of Site 137 the sediment cover is less than 0.5 sec, more conformable with fewer internal reflectors, suggesting a predominance of pelagic sediments. This contrast in sediment character is well illustrated in the two circled areas shown on the *Challenger* 14 record (Figure 2). An enlargement of the seismic profile in the vicinity of Site 137 is shown in the composite diagram of Figure 3.

Layer 2 is well recorded in the vicinity of Site 138 especially on the *Vema* record, and the major relief of the sea floor in the vicinity of Site 137 is presumed related to an increased roughness in the oceanic basement layer 2 in that region. The presence of the pronounced topographic feature between Sites 137 and 138 complicates the interpretation for the results at these two sites. A contrast in sediment disposition similar to that observed at Sites 137 and 138 is observed elsewhere near the foot of the West African Continental rise. This contrast may be caused by a subtle change in the level and roughness of layer 2 that may create effective barriers to downslope sediment transport.

The primary objective of drilling at this site, and at Site 138, was to investigate the striking contrast in sedimentary disposition which occurs over a very small lateral distance between the two sites.

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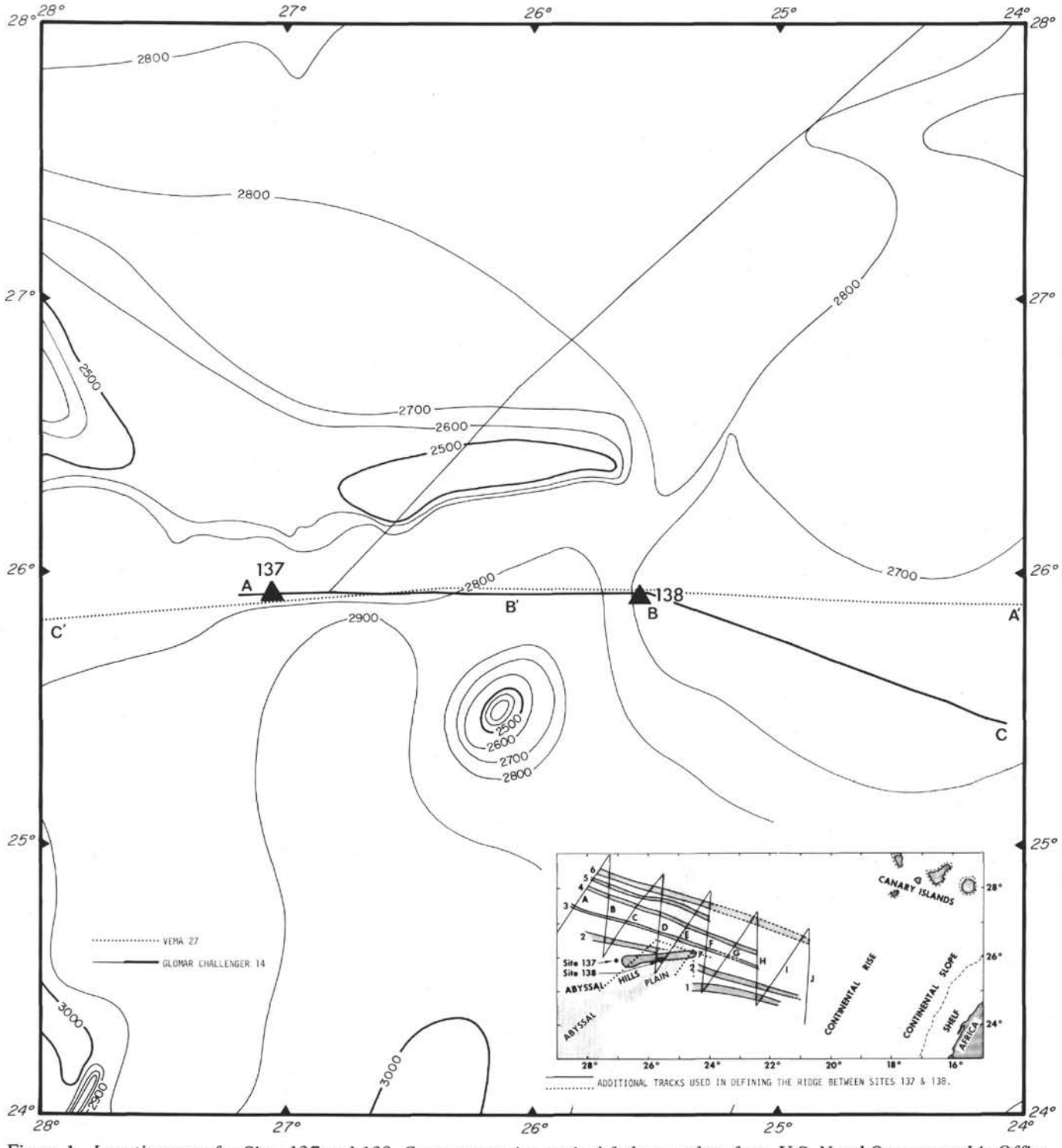


Figure 1. *Location map for Sites 137 and 138. Contours are in nominal fathoms taken from U.S. Naval Oceanographic Office B.C. Chart 0305N; contours are considered subject to major revision. Recent work of Lattimore* et. al., *(1971) is schematically summarized in the inset. Letters serve to key profiles in Figure 2.*

At Site 12 of Leg 2 (DSDP), about 300 km to the south, a thick sequence of magnesium-rich clay (palygorskite-sepiolite) was recovered. This mineral is sometimes associated with evaporite deposits. A secondary objective was to investigate the areal extent of the palygorskite and to study its mode of formation in the deep ocean environment.

Seismic Reflection Data:	*Vema* 27	*Challenger*
Intermediate Reflector	0.15 sec	0.15 sec
Basement Reflector	0.29 sec	0.30-0.40 sec

The drilling and coring records are given in Table 1 and Figure 4.

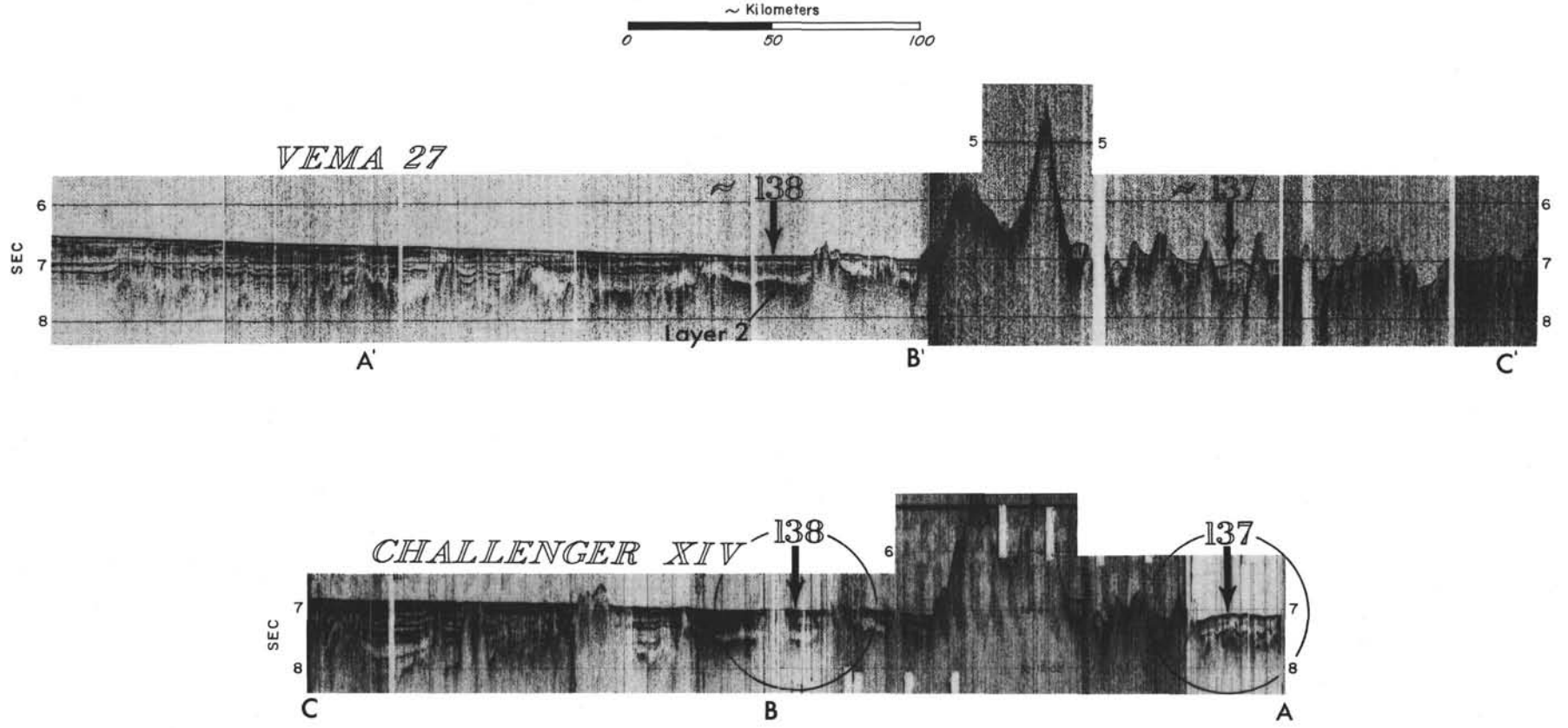


Figure 2. *Seismic reflection profiles in the vicinity of Sites 137 and 138. Location of profiles shown in Figure 1. The* Vema *record is from unpublished Lamont Doherty Geological Observatory data (J. Ewing, pers. comm.).*

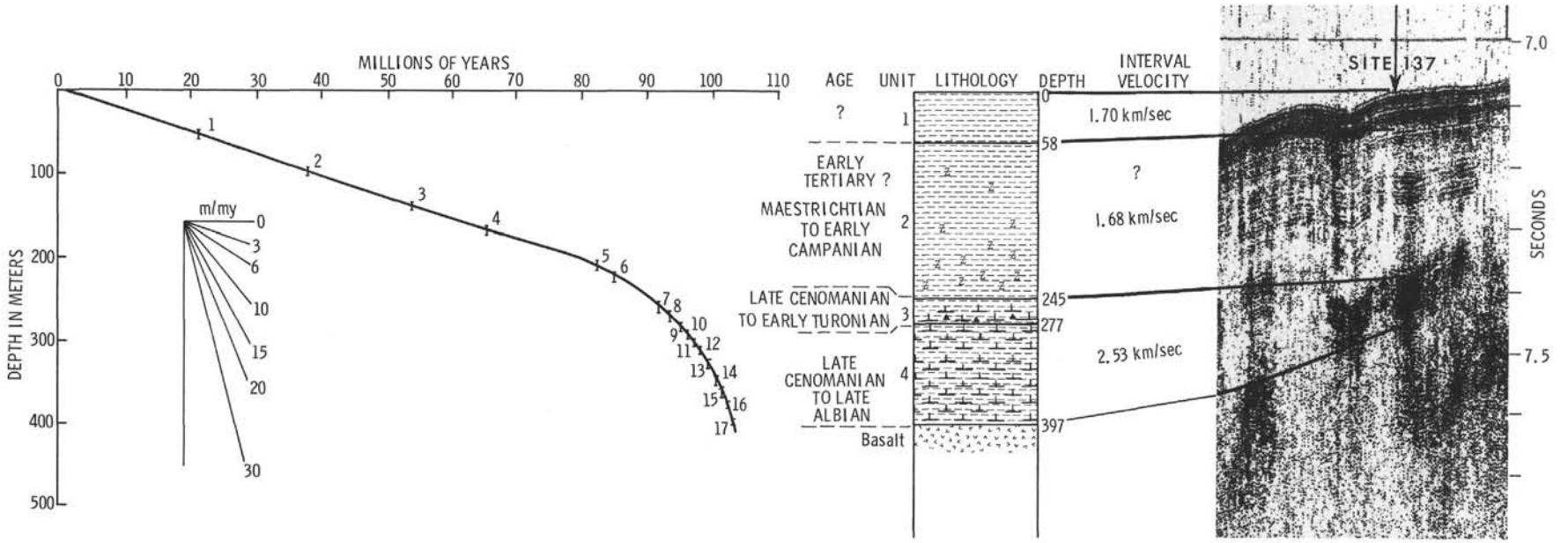


Figure 3. *Geological synthesis at Site 137.*

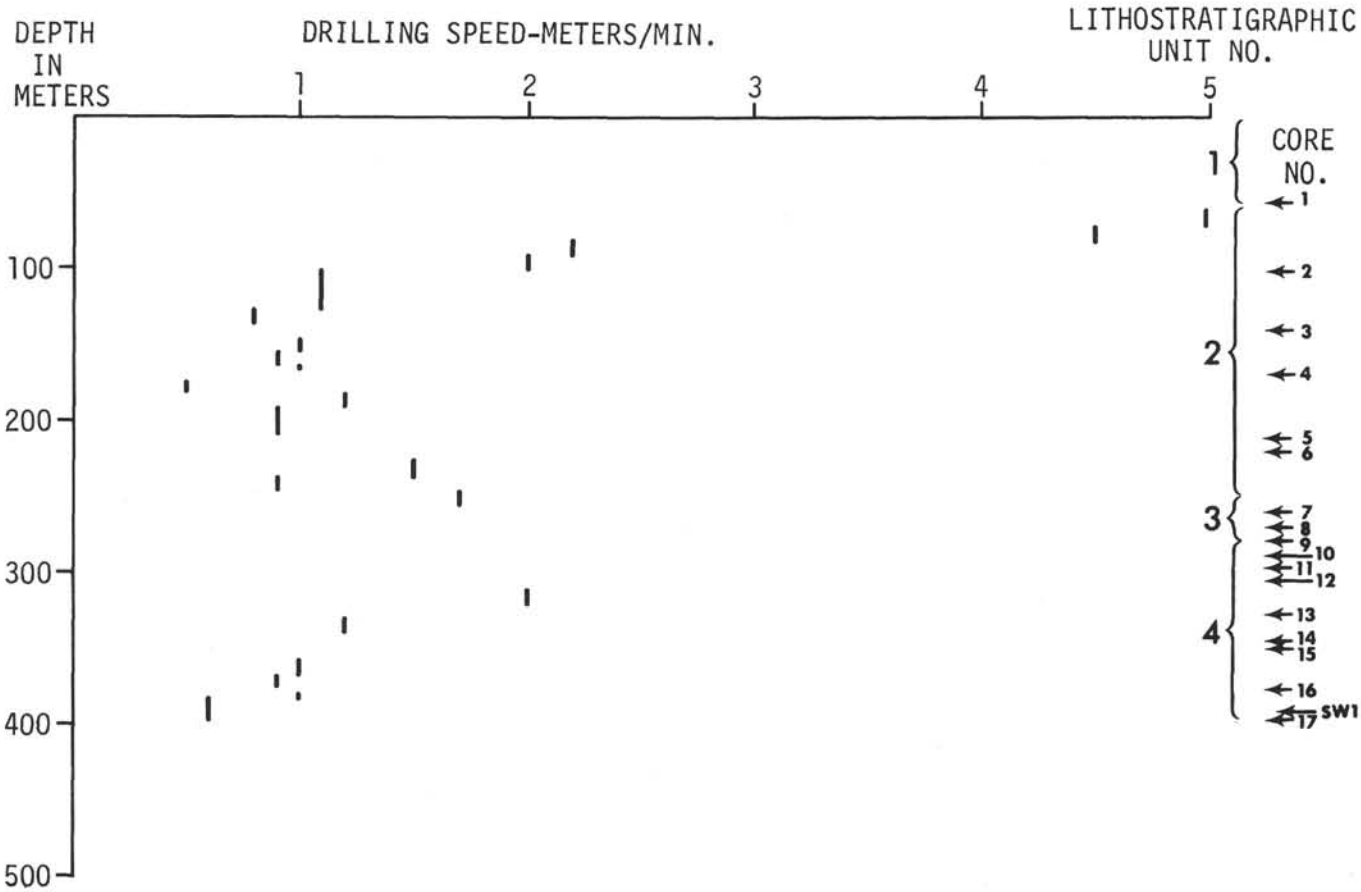


Figure 4. *Drilling and coring summary at Site 137.*

BIOSTRATIGRAPHY

General

In the upper three cores, no fossils were found except for a few deep-water arenaceous foraminifera. Radiolaria occur in Cores 4, 5 and 6 indicating an uncertain Maestrichtian age for Core 4 and an Early Campanian age for Cores 5 and 6. Core 6 and the upper part of Core 7 contain a few planktonic foraminifera of Turonian to Campanian age. A rich assemblage of well-preserved planktonic foraminifera and nannoplankton were recovered from core catcher 7 through core 16 and from the sidewall core taken below Core 16. Cores 7 and 8 also contain Cenomanian Radiolaria and Cores 10 and 11 Albian (?) Radiolaria. A list of the age diagnostic calcareous fossils is given in Table 2.

Foraminifera

The most diagnostic foraminifera in this hole are found in Core 6 (Core Catcher) and are of late Cretaceous age. Here, and in the upper part of Core 7, there are a few specimens of *Globotruncana* indicating a Turonian (or slightly younger) age. From the Core Catcher sample of Core 7, and particularly from Core 8, down to the deepest sample (Sidewall Core 1), there is an excellent succession of predominantly planktonic faunas with *Rotalipora* spp., indicating a Cenomanian and late Albian age (*Rotalipora cushmani* Zone to *R. ticinensis* Zone). The preservation of the *Rotalipora* faunas is usually excellent, but in most of the cores the non-calcareous intercalations contain mainly Radiolaria or agglutinated benthonic foraminifera.

Nannoplankton

Core 1 through 6 are barren of nannoplankton. A rich and well-preserved nannoplankton flora of Cenomanian to late Albian age occurs in Cores 7 through 16 and in the sidewall core from 393 meters. Except for changes in the relative frequency of species (see range chart Chapter 14), the assemblages are very similar throughout this whole interval. A zonal subdivision cannot be made with the light microscope.

LITHOSTRATIGRAPHY

A single hole was drilled at Site 137; it was terminated at 401 meters below the sea floor after drilling 4 to 5 meters of basalt. Four cores were taken within the upper 200 meters, whereas much of the lower 200 meters was cored continuously.

The following lithostratigraphic units are recognized:

Unit	Cores	Lithology	Depth Below Sea Floor (m)	Age
1	1	Brown Clay	0-58	? (no fossils)
2	1-6	Zeolitic brown clay	58-245	Early Tertiary? (Core 3) Maestrichtian to early Campanian 4, 5, 6
3	7	Calc. clay & ooze black clay, silty clay, and chert	245-277	Late Cenomanian Early Turonian
4	8-16	Varicolored nanno marl and chalk ooze	277-397	Late Cenomanian to Late Albian
	17	Basalt	397-?	

Unit 1 – Brown Clay (Core 1)

Unit 1 is 58 meters thick and is probably of Quaternary and Tertiary age. It consists of terrigenous minerals, mainly quartz, with minor amounts of feldspar, biotite, chlorite and pyroxene. The unit probably extends to, or nearly to, the surface.

Drill rates vary from 2 to 5 m/min. The sedimentation rate is unknown.

Unit 2 – Zeolitic Brown Clay (Cores 1-6)

Unit 2 is 187 meters thick. Its age is estimated to be Senonian to early Tertiary, based on sedimentation rates. Unit 2 differs from Unit 1 in that much of the silt fraction consists of zeolite (clinoptilolite) rather than of terrigenous minerals. This unit, also, is barren of fossils except in the lowermost part (200 m+) where a (?) Late Cretaceous age was determined on rather poor radiolarian and foraminiferal remains. The combined sedimentation rate of Unit 1 and Unit 2 is greater than 2m/my suggesting that if hiatuses are present, they are of relatively short duration.

Unit 3 – Marl Ooze, Carbonaceous Clay, and Chert (Core 7)

Unit 3 is 32 meters thick and of late Cenomanian to early Turonian age. It contains both nanno marl ooze and silty clay. Its composition is transitional between the overlying barren clays and the underlying marl-chalk ooze. It is characterized by partly laminated intercalations of carbonaceous clay with pyrite, and by silicified mudstone ("chert"). Sedimentation rates in this unit are quite low, less than 5 m/my.

Unit 4 – Nannoplankton Marl and Chalk Ooze (Cores 8-16)

Unit 4 is 120 meters thick; the age is late Albian to late Cenomanian. It consists of banded and partly laminated greenish and brownish gray nanno marl to chalk ooze, with occasional carbonate-poor silty layers. Foraminifera are common ($\gtrsim 10\%$) throughout the ooze but also are concentrated in places in thin foram sand layers. Silt-sized minerals are rare, except hematite, which is found in brown bands. Most of the sediment is quite firm, and some beds are semi-indurated. The sedimentation rate in this unit is about 15 m/my.

TABLE 1
Drilling and Coring Record for Site 137

Description	Interval Below Sea Floor (m)	Core Recovery (m)	Drilling Rate (m/min)
Drill	0-52		
Core 1	52-61	7.0	
Drill	61-71		5
	71-80		4.5
	80-89		2.2
	89-99		2
Core 2	99-101	0.4	
Drill	101-117		1.1
	117-126		1.1
	126-135		0.8
Core 3	135-144	8.8	
Drill	144-154		1
	154-163		0.9
	163-165		1
Core 4	165-173	2.2	
Drill	173-181		0.5
	181-191		1.2
	191-200		0.9
	200-209		0.9
Core 5	209-218	0	
Core 6	218-225	1.4	
Drill	225-237		1.5
	237-246		0.9
	246-256		1.7
Core 7	256-265	0.7	
Core 8	265-274	2.1	
Core 9	274-283	3.9	
Core 10	283-292	3.5	
Core 11	292-301	8.3	
Core 12	301-310	8.0	
Drill	310-320		2.0
Core 13	320-329	4.7	
Drill	329-339		1.2
Core 14	339-348	8.1	
Core 15	348-357	2.0	
Drill	357-367		1.0
	367-375		0.9
Core 16	375-382	4.7	
			1.0
Drill	382-384		0.6
	384-393		0.6
	393-396		
Core 17	397-401	1.4	

Basalt (Core 17)

The basalt is a dark gray brecciated rock cemented by green serpentine-like material and veined by calcite. The feldspars are altered to albite, natrolite, stilbite and smectite. The pyroxenes (augite?) are replaced by chlorite and serpentine. The original rock was probably a porphyritic flow with a glassy groundmass. (See also Chapter 23.)

TABLE 2

CORE	DIAGNOSTIC FOSSILS HOLE 137		
	FORAMINIFERA	NANNOPLANKTON	AGE
1	Fish debris and rare *Cyclammina* cf. *deformis*. Age: Tertiary (undifferentated)	None	Tertiary
2	None.	None	
3	An undiagnostic deep-sea assemblage of agglutinated foraminifera including *Glomospira charoides, Trochamminoides coronatus, Ammoglobigerina* sp.,*Haplophragmoides* sp.	None	
4	Rare agglutinated foraminifera *(Bathysiphon, Lituotuba, Pelosina)*.	None	
5	None.	None	
6	Core Catcher sample: Dwarfed agglutinated foraminifera *(Trochammina, Glomospira,* Textulariidae) as well as single specimens of *Globotruncana* cf. *difformis* and *Heterohelix* cf. *pulchra* Age: Late Cretaceous (Turonian to Campanian).	None	Turonian Campanian
7	Section 1: A dwarfed planktonic assemblage with *Globotruncana* cf. *sigali, Gt* cf. *imbricata, Gt.* cf. *difformis, Hedbergella amabilis, H. planispira, Globigerinelloides caseyi, Heterohelix moremani*. Core Catcher sample: A predominantly benthonic assemblage with *Marssonella oxycona, Pseudotextulariella?* sp., *Osangularia* sp. The age is most probably Early Turonian, *Marginotruncana sigali* subzone.	Rich and diversified assemblages including *Cretarhabdus coronadventis, Prediscosphaera cretacea, Eiffellithus turriseiffeli, Chiastozygus cuneatus, Zygodiscus exiguus, Podorhabdus orbiculofenestrus, Prediscosphaera spinosa, Staurolithites matalosus*. Age: Cenomanian.	Early Turonian Cenomanian
8	Rich, predominantly planktonic assemblages indicating a Late Cenomanian age *(Rotalipora cushmani - R. greenhornensis* Subzone). With *Rotalipora greenhornensis, R. cushmani, R. appenninica, Praeglobotruncana delrioensis, P. stephani, Hedbergella gautierensis, H. brittonensis, H. planispira, Heterohelix moremani*.	Abundant nannoplankton with *Cretarhabdus coronadventis, Prediscosphaera cretacea, Eiffellithus turriseiffeli, Eiffellithus cuneatus, Zygodiscus exiguus, Podorhabdus orbiculofenestrus, Prediscosphaera spinosa, Staurolithites matalosus*. Age: Cenomanian.	Late Cenomanian

TABLE 2 – *Continued*

CORE	DIAGNOSTIC FOSSILS HOLE 137		
	FORAMINIFERA	NANNOPLANKTON	AGE
9	Sections 1 - 3: Mainly agglutinated foraminifera and fish teeth. Section 5 and 6: Fairly rich faunas with *Rotalipora appenninica, R. balernaensis, R. cushmani, Praeglobotruncana delrioensis, Hedbergella amabilis, H. planispira, Globigerinelloides caseyi, Spiroplectammina anceps, Pseudotextulariella?* sp., *Clavulina gaultina.* Core Catcher sample: Similar, but also with *Schackoina cenomana, Rotalipora brotzeni,* and *Planomalina buxtorfi.* Age: Late Cenomanian, *Rotalipora cushmani - R. greenhornensis* Subzone.	Well preserved nannoflora consisting of *Cretarhabdus coronadventis, Prediscosphaera cretacea, Eiffellithus turriseiffeli, Chiastozygus cuneatus, Zygodiscus exiguus, Podorhabdus orbiculofenestrus, Prediscosphaera spinosa, Broinsonia lata + Broinsonia bevieri, Staurolithites matalosus, Cribrosphaerella ehrenbergi, Corollithion signum.* Age: Cenomanian.	Late Cenomanian
10	Rich faunas with *Rotalipora cushmani* (rare), *R. appenninica, R. brotzeni, Praeglobotruncana delrioensis, Hedbergella amabilis, H. planispira, Globigerinelloides caseyi, Planomalina buxtorfi.* In Section 1 common benthonic foraminifera (*Osangularia, Clavulina* etc.). Age: Late Cenomanian, *Rotalipora cushmani-R. greenhornensis* Subzone	Diversified assemblages including *Cretarhabdus coronadventis, Prediscosphaera cretacea, Eiffellithus turriseiffeli, Chiastozygus cuneatus, Zygodiscus exiguus, Podorhabdus orbiculofenestrus, Prediscosphaera spinosa, Broinsonia lata + Broinsonia bevieri, Cribrosphaerella ehrenbergi, Staurolithites matalosus, Eiffellithus trabeculatus.* Age: Cenomanian.	Late Cenomanian
11	Rich, predominantly planktonic faunas with *Rotalipora appenninica, R. cushmani, R. brotzeni, R. balernaensis, Praeglobotruncana delrioensis, Hedbergella gautierensis, H. planispira, Globigerinelloides caseyi, Schackoina cenomana, Planomalina buxtorfi, Heterohelix moremani, Clavulina gaultina, Osangularia* sp. Age: Late Cenomanian, *Rotalipora cushmani - R. greenhornensis* Subzone.		Late Cenomanian
12	Fairly rich, predominantly planktonic faunas with *Rotalipora cushmani* (only Sec. 1, cm 95-97), *Rotalipora evoluta, R. appenninica, R. brotzeni, Globigerinelloides caseyi, Praeglobotruncana delrioensis, Planomalina buxtorfi, Heterohelix moremani, Schackoina cenomana, Hedbergella planispira, H. amabilis, H. gautierensis, Spiroplectammina anceps, Clavulina gaultina.* Age: Late Cenomanian (*Rotalipora cushmani-R. greenhornensis* Subzone) for Sec. 1 above 97 cm. For the remainder of the Core: Early Cenomanian, Rotalipora evoluta Subzone.		Early Cenomanian
13	Fairly rich, mainly planktonic faunas with *Rotalipora appenninica, R. evoluta, R. brotzeni, Schackoina cenomana, Hedbergella planispira, H. amabilis. Clavulina gaultina, Gavelinella* cf. *schloenbachi.* Age: Early Cenomanian, *Rotalipora evoluta* Subzone.		Early Cenomanian

TABLE 2 – *Continued*

CORE	DIAGNOSTIC FOSSILS HOLE 137		
	FORAMINIFERA	NANNOPLANKTON	AGE
14	Faunas rich in radiolarians, but with some *Rotalipora appenninica, R. evoluta, Globigerinelloides caseyi, Praeglobotruncana delrioensis, Hedbergella amabilis, H. planispira.* Age: Early Cenomanian, *Rotalipora evoluta* Subzone.	Diversified assemblages including *Cretarhabdus coronadventis, Prediscosphaera cretacea, Eiffellithus turriseiffeli, Chiastozygus cuneatus, Zygodiscus exiguus, Podorhabdus orbiculofenestrus, Prediscosphaera spinosa, Broinsonia lata + Broinsonia bevieri, Cribrosphaerella ehrenbergi, Staurolithites matalosus, Eiffellithus trabeculatus.*	Early Cenomanian
15	Fairly rich, predominantly planktonic faunas with *Rotalipora appenninica* (rare), *R. evoluta, Globigerinelloides caseyi, Planomalina buxtorfi, Schackoina cenomana, Hedbergella amabilis, H. planispira, Clavulina gaultina, Gavelinella* cf. *schloenbachi, Pseudotextulariella?* sp. Age: Early Cenomanian, *Rotalipora evoluta* Subzone.	Age: Cenomanian.	Early Cenomanian
16	Fairly rich, predominantly planktonic faunas with *Rotalipora ticinensis, Globigerinelloides caseyi, Hedbergella amabilis, H. planispira, H. trocoidea, Planomalina buxtorfi, Pleurostomella subnodosa, Tritaxia tricarinata, Clavulina gaultina, Pseudotextulariella?* sp. Age: Late Albian, *Rotalipora ticinensis* Zone.	Rich nannoflora with *Cretarhabdus coronadventis, Prediscosphaera cretacea, Eiffellithus turriseiffeli, Zygodiscus exiguus, Podorhabdus orbiculofenestrus, Prediscosphaera spinosa, Broinsonia lata + Broinsonia bevieri, Staurolithites matalosus, Cribrosphaerella ehrenbergi, Eiffellithus trabeculatus.* Age: Late Albian - Cenomanian.	Late Albian
SW1	Fairly rich, predominantly planktonic fauna with *Rotalipora ticinensis, Globigerinelloides breggiensis, Ticinella raynaudi digitalis, Hedgergella amabilis, H. planispira, H. trocoidea, Pleurostomella subnodosa, Gavelinella* cf. *schloenbachi, Clavulina gaultina.* Age: Late Albian, *Rotalipora ticinensis* Zone.	Rich nannoflora with *Cretarhabdus coronadventis, Prediscosphaera cretacea, Eiffellithus turriseiffeli, Zygodiscus exiguus, Podorhabdus orbiculofenestrus, Prediscosphaera spinosa, Broinsonia lata + Broinsonia bevieri, Staurolithites matalosus, Cribosphaerella ehrenbergi, Eiffellithus trabeculatus.* Age: Late Albian - Cenomanian.	Late Albian

PHYSICAL AND CHEMICAL PROPERTIES

Penetrometer measurements (mm × 10^{-1}) show a reasonably good correlation with depth of burial and lithology. Except for a few anomalously high readings in disturbed areas, the readings show a gradual decrease downward through the clays (Lithologic Units 1, 2) from about 55 at 50 meters to about 20 at 225 meters.

Bulk densities (gm/cc), measured on the GRAPE, increase with depth through the clays and upper part of the oozes from about 1.30 at 50 meters to about 1.85 at 300 meters, below which they are nearly constant. Porosity (from GRAPE) decreases from about 70 per cent at 50 meters to 53 per cent at 300 meters, below which, it is nearly constant. As with penetrometer measurements, the differences in degree of induration of individual ooze beds is reflected in a range of values for bulk density and porosity in the lower 150 meters of the section (Table 3). From 245 meters down, the penetrometer readings have a wider scatter (~5 to 55) in Units 3 and 4, but the mean stays at about 20 except for a slight decrease near the bottom of the cored section. The scatter of values reflects varying degrees of induration of the beds.

Water content measurements show the same trend as porosity, decreasing from about 50 per cent at 50 meters to 25 per cent at 280 meters, below which, they are relatively constant.

Natural gamma radiation correlates well with the lithologic types. The counts range from about 700 to over 2500, averaging about 1500, in the clays that comprise the upper part of the section. The highest values correspond fairly well to the zeolite concentrations. The Cretaceous oozes and marls of the lower part of the section show a range of counts from 200 to 1850, but more than three-quarters of the values fall within 400 to 900. The variations correlate closely with the clay/carbonate ratios—lower values correspond to beds of nearly pure ooze; the higher ones to beds of clay with less than 30 per cent $CaCO_3$. The highest readings of 1200 to 1700 at 343 meters are from a clay bed rich in zeolites. The basalt had counts of 800 to 1100. However, as the diameter of the basalt core is less than standard, the counts are low with respect to the other samples.

Salinity values in all sediments from this site are within the normal range for seawater, ranging from 34.1 to 36.3

TABLE 3
Summary of Density, Porosity and Water Content Data for Site 137

			GRAPE			Sediment Sample			
Hole	Core	Section	Depth Below Sea Floor (m)	Density (gm/cc)	Porosity (%)	Depth Below Sea Floor (m)	Water Content	Density (gm/cc)	Porosit (%)
137	1	1	52.75	1.27	80	52.15	53	1.31	69
137	1	2	54.25	1.42	68	–	–	–	–
137	1	3	55.75	1.43	67	55.14	50	1.39	69
137	1	4	57.25	1.49	62	56.64	48	1.40	67
137	1	5	58.75	1.50	61	58.14	39	1.57	61
137	2	1	99.75	1.26	71	100.09	57	1.29	73
137	3	1	135.75	1.47	69	135.24	38	1.59	61
137	3	2	137.25	1.59	60	136.64	35	1.62	58
137	3	3	138.75	1.55	64	138.14	37	1.60	60
137	3	4	140.25	1.56	63	139.64	37	1.57	58
137	3	5	141.75	1.59	61	141.14	38	1.56	59
137	3	6	143.25	1.58	61	142.64	36	1.65	59
137	4	1	165.75	1.42	73	165.80	43	1.55	66
137	4	2	165.25	1.54	64	166.64	38	1.55	58
137	6	1	218.75	1.59	57	218.19	36	1.59	57
137	7	1	256.75	1.67	54	256.95	33	1.66	54
137	8	1	265.75	1.59	56	256.06	32	1.63	51
137	8	2	267.25	1.70	60	266.95	29	1.80	53
137	9	1	274.75	1.60	60	274.10	39	1.58	61
137	9	3	277.75	1.64	66	277.89	32	1.79	58
137	9	5	280.75	1.75	47	280.23	26	1.72	47
137	9	6	282.25	1.68	52	281.68	26	1.79	46
137	10	1	283.75	1.58	56	284.02	29	1.75	50
137	10	2	285.25	1.62	53	284.64	25	1.59	39
137	10	3	286.75	1.74	44	286.14	27	1.76	47
137	11	1	292.75	1.72	49	292.70	30	1.64	49
137	11	2	294.25	1.81	43	293.64	24	1.82	43
137	11	3	295.75	1.81	43	295.15	25	1.80	45
137	11	4	297.25	1.85	40	296.88	24	1.77	42
137	11	5	298.75	1.81	43	–	–	–	–
137	11	6	300.25	1.83	42	299.64	25	1.83	45
137	12	1	301.75	1.70	49	–	–	–	–
137	12	2	303.25	1.83	39	302.70	27	1.78	49
137	12	3	304.75	1.83	40	304.14	25	1.81	46
137	12	4	306.25	1.84	38	305.64	11	1.74	19
137	12	5	307.75	1.85	37	307.14	23	1.83	43
137	12	6	309.25	1.82	39	–	–	–	–
137	13	1	320.75	1.61	61	–	–	–	–
137	13	2	322.25	1.81	48	321.64	24	1.77	42
137	13	3	323.75	1.81	48	323.15	23	1.77	41
137	13	4	325.25	1.83	47	324.64	25	1.72	42
137	14	1	320.75	1.76	51	–	–	–	–
137	14	2	322.25	1.78	49	321.60	26	1.80	47
137	14	3	323.75	1.79	49	323.14	25	1.81	45
137	14	4	325.25	1.79	49	224.64	34	1.68	57
137	14	5	326.75	1.84	46	–	–	–	–
137	14	6	328.25	1.85	45	327.65	26	1.82	47
137	15	1	348.75	1.58	55	–	–	–	–
137	15	2	350.25	1.72	42	349.64	25	1.71	42
137	16	1	375.75	1.64	56	–	–	–	–
137	16	2	377.25	1.80	45	376.64	34	1.68	57
137	16	3	378.75	1.88	39	378.14	24	1.77	42
137	16	4	380.25	1.86	41	379.64	24	1.80	43

ppt; the sea water calibration sample was 36.3. The pH values are, however, anomalous and range from 6.7 to 7.06, averaging close to 7, in the clays, but in the Cretaceous oozes they fall well below the neutral 7.0, reaching a low of 5.72 in a sample from 380 meters depth below the sea floo The seawater calibration sample showed a normal 8.31.

All chemical properties measured on board from this sit are given in Table 4.

TABLE 4
Chemical Property Measurements on Samples from Site 137

Hole	Core	Section	Sample Interval (cm) Top	Bottom	pH	Eh	Salinity (‰)
137	1	5	0.0	10.0	6.92	+206	34.7
	2	CC			7.04	+174	34.1
	2	1	103.0	105.0	7.06	+176	35.2
	3	6	0.0	5.0	6.70	+191	34.1
	4	2	0.0	5.0	7.03	+185	34.1
	6	CC			6.69	+120	34.7
	7	CC			6.34	+114	34.7
	8	CC			6.98	+ 64	35.2
	9	5	145.0	150.0	6.04	+162	34.2
	11	5	0.0	3.0	6.39	+108	35.2
	16	5	0.0	2.0	5.72	+199	36.3

DISCUSSION AND CONCLUSIONS

Site 137 is situated in the narrow zone of abyssal hills about 120 kms west of the lower continental rise off West Africa. A pronounced topographic high lies between Site 137 and 138 (situated on the rise) which appears to partially protect the area of Site 137 from the downslope transport of terrigenous materials (see detailed discussion in Chapters 26, 27).

Typical sediments at this site are pelagic. At the present depth of Site 137 (5361 m) brown clay is being deposited. This facies is 245 m thick and overlies 120 m of nanno marl to chalk ooze, which rests on basement. A 32 m-thick transition zone with black mud and chert separates the non-calcareous from the calcareous section.

The history of sedimentation appears as follows: from late Albian until the beginning of late Cenomanian, nanno marl to chalk oozes were deposited on a site virtually free of terrigenous influx, starting at a rate of approximately 15 m/my and decreasing upward due to dissolution of carbonate. Site 137 was on the flank of a spreading Cretaceous Mid-Atlantic Ridge, accumulating nanno ooze before reaching the compensation depth by lateral migration and subsidence.

During Late Cenomanian and Early Turonian the site of deposition was near the calcite compensation depth. Slight fluctuations in this level or redeposition of nanno ooze from a short distance lying above (or both) could have produced the observed alternations of nanno marl ooze and clay sediments. The presence of carbonaceous clay, pyrite, and silicified mudstone indicate the presence of a poorly oxygenated environment near the level of compensation.

From Early Turonian until the present, the sediments deposited on the site are poor in carbonate and are more oxidized. Possibly the site was then near the foot of the ridge flank. Abundant zeolite formation during late Cretaceous indicates a slow sedimentation rate and possible volcanic influences. The Upper Tertiary is characterized by a minor terrigenous component. Approximately 245 meters of brown clay were deposited since Early Turonian at a sedimentation rate of between 2 and 3 m/my. This rate is typical for deep sea brown clays and therefore appears to indicate continuous sedimentation as shown in Figure 3).

About 400 meters of sediment were drilled and cored before basalt was reached. Both the *Vema* 27 and *Challenger* seismic profiles show a pronounced reflecting zone extending from about 0.30 second to about 0.40 second. If the basalt is assumed to be the lower part of the reflecting zone at 0.40 second on the *Challenger* record, then the 400 meters of sediments above would have an average velocity of 2.0 km/sec. The drilling record showed a considerable increase in hardness of sediment at about 240 meters, and a core taken there recovered hard cherty material, crystalline pyrite and firm mudstone. If this interval is correlated with the reflector at 0.28 second (*Vema* 27) or 0.30 second (*Challenger*), the sediments above, which are pelagic brown clays, have an average velocity of 1.6-1.7 km/sec.

Both the *Vema* 27 and *Challenger* records also show a thin intermediate reflecting horizon at 0.15 second. Using the figure of average velocity arrived at above for the upper part of the succession at Site 137, this would coincide with a subbottom depth of 130 meters. Cores 2, 3, and 4 were taken at about 100, 140 and 170 meters depth and showed no significant lithologic variation of the pelagic brown clay. However, the drilling record did show a slight decrease in the rate of penetration (Figure 4) at 126 meters, that is, in the region where the intermediate reflector was expected. The nature of this reflector remains unknown.

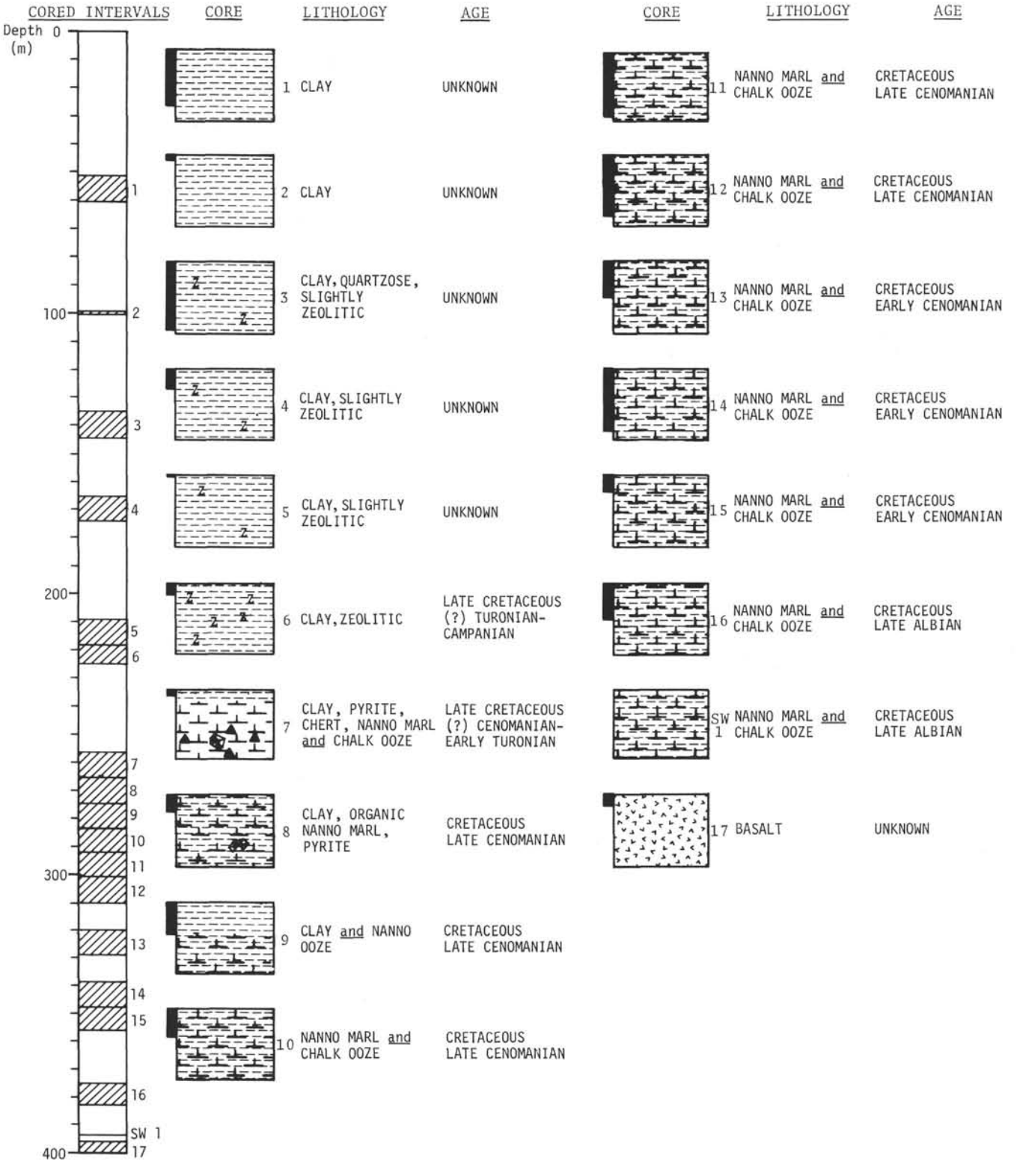
The detailed petrology, texture, nature of veins, and lack of any sign of thermal metamorphic effects in the sediment recovered from 3 meters above the basalt all suggest the basalt sampled was extrusive rather than intrusive (see Chapter 27). Chemically, the basalt has alkalic affinities (see Chapter 23). Sediment three meters above the basalt was dated as Late Albian on the basis of an excellent calcareous nannoplankton flora and planktonic foraminiferal fauna.

Samples of clay taken from the cores for X-ray analysis showed the presence of abundant palygorskite in the interval 100 to 225 meters (see Chapters 19, 20, 26 and 27).

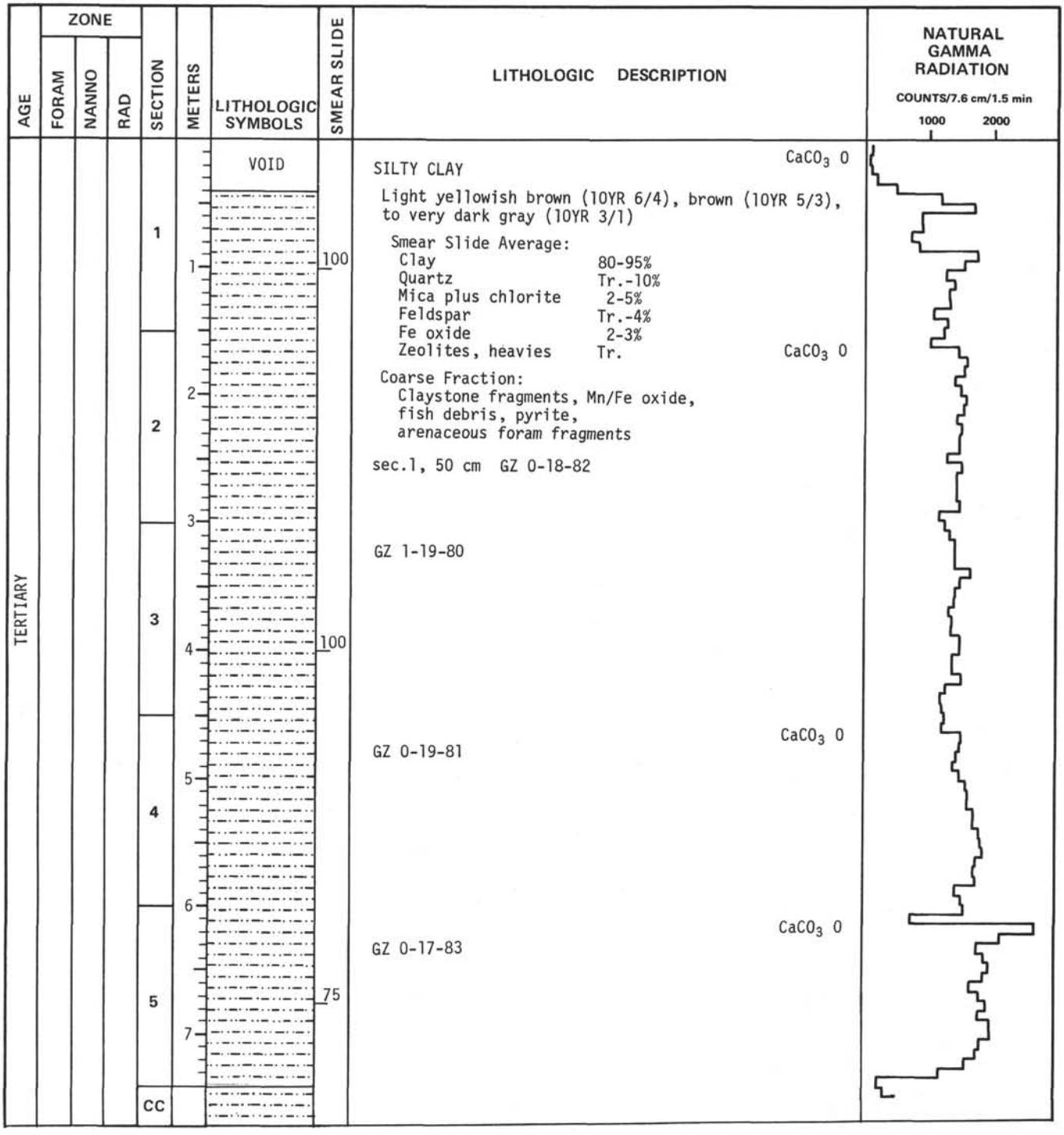
REFERENCE

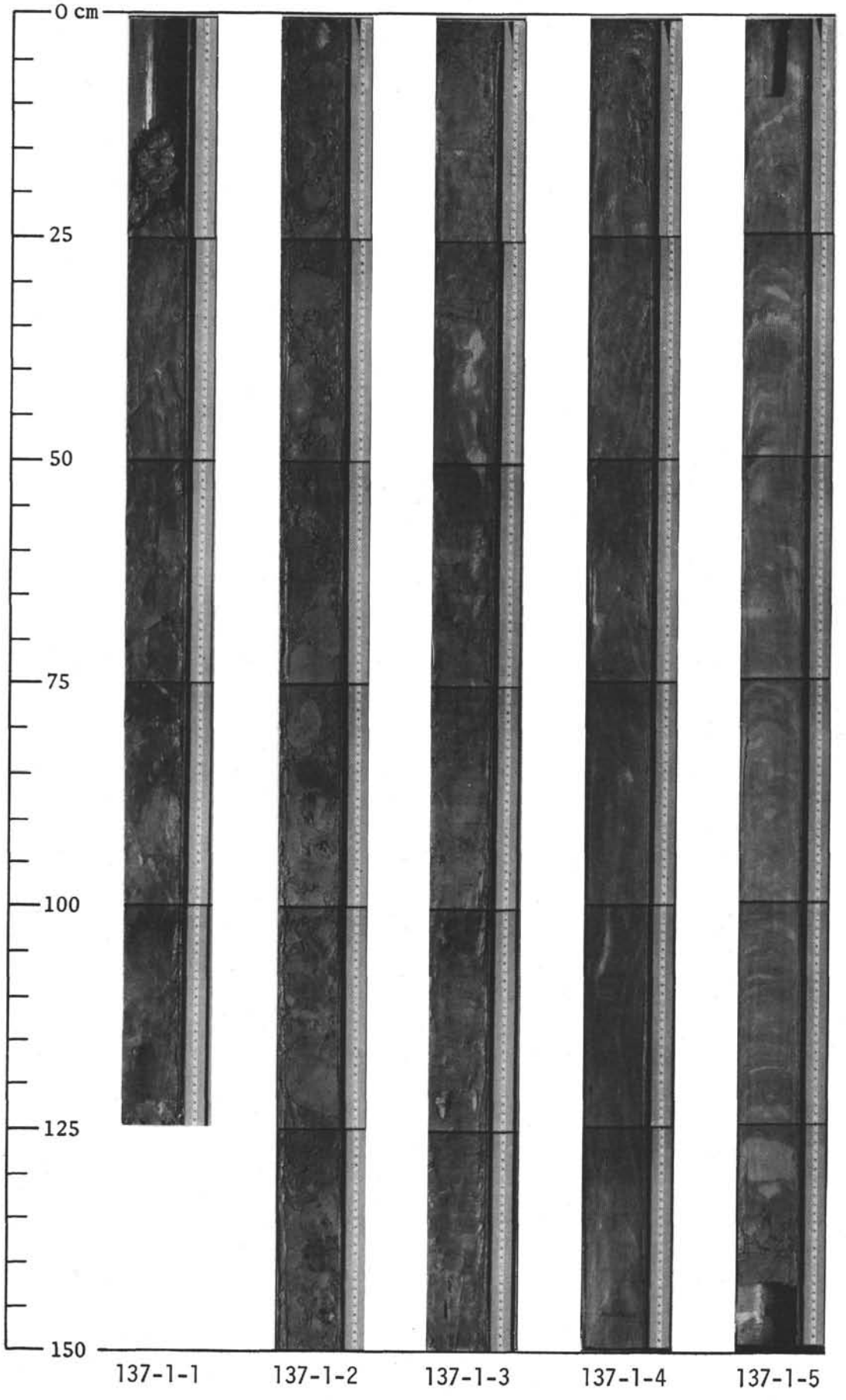
Lattimore, R. K., Harbison, R. N. and Rona, P. A., 1971. Structural Lineations, Northern Canary Basin, Central NE Atlantic (abstract). *Amer. Geophys. Union Trans.*, 52, No. 4, 250.

SITE 137–SUMMARY



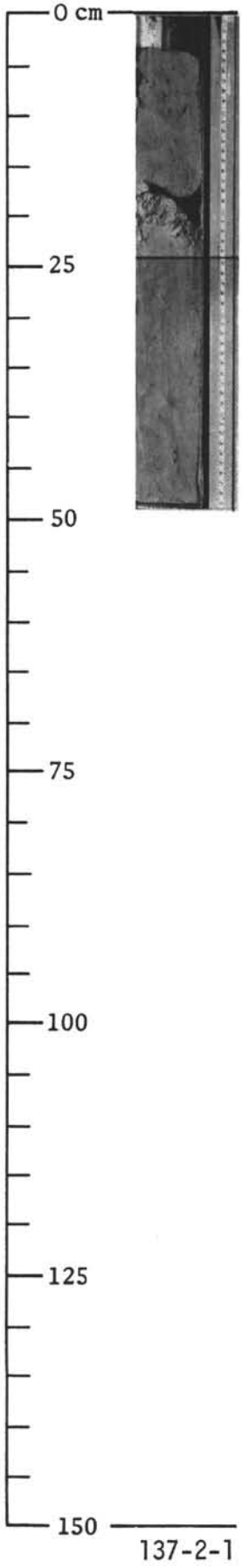
SITE 137 CORE 1 DEPTH (m) 52-61



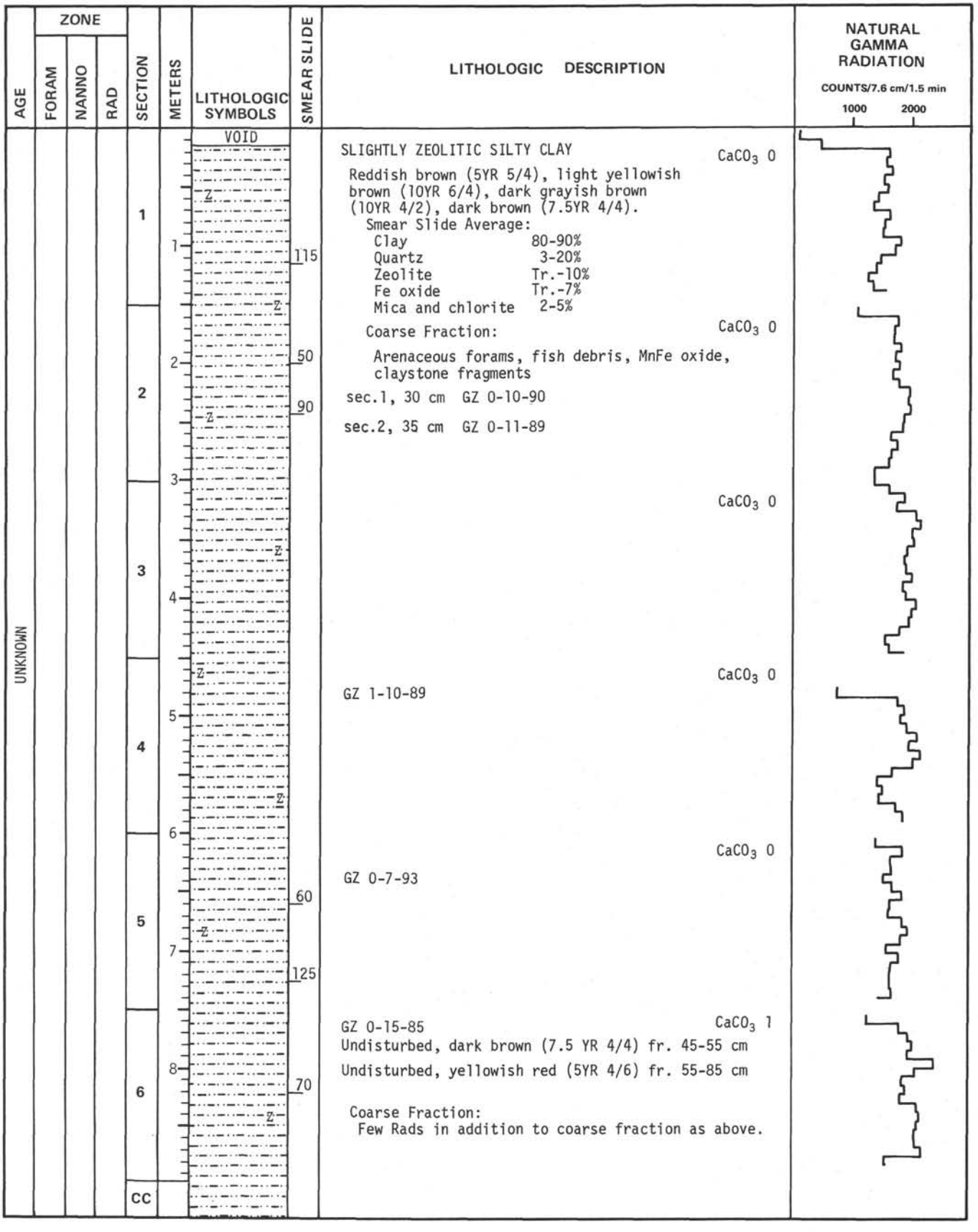

0 cm
25
50
75
100
125
150
137-1-1
137-1-2
137-1-3
137-1-4
137-1-5

SITE 137 CORE 2 DEPTH (m) 99-101

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE	LITHOLOGIC DESCRIPTION	NATURAL GAMMA RADIATION (COUNTS/7.6 cm/1.5 min: 1000, 2000)
UNKNOWN				1	1	VOID		SILTY CLAY Reddish brown (5YR 5/2); mottled, probably due to coring disturbance Smear Slide Average: Clay 55% Fe oxide 5-15% Nannos 20% Pyrite 0-5% Feldspar 0-2% Mica plus chlorite 0-2% Quartz 0-1% Carbonate fragments Tr. $CaCO_3$ 0 Coarse Fraction: Pink clay fragments 130 cm GZ 2-12-86	
				CC					


0 cm
25
50
75
100
125
150
137-2-1

SITE 137 CORE 3 DEPTH (m) 135-144




0 cm
25
50
75
100
125
150
137-3-1
137-3-2
137-3-3
137-3-4
137-3-5
137-3-6

SITE 137 CORE 4 DEPTH (m) 165-173

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE
?MAESTRICHTIAN				1	1	VOID	85
							120
				2	2		40
							100
				CC			

LITHOLOGIC DESCRIPTION

SLIGHTLY ZEOLITIC SILTY CLAY

Reddish brown (5YR 5/4) with patches of dark grayish brown (10YR 4/2), and greenish gray (5G 6/1)

Smear Slide Average: $CaCO_3$ 1

Clay	85-90%	
Zeolite (heulandite?)	10-12%	
Biotite plus chlorite quartz	Tr.-3%	
Fe oxide, feldspar, nannos, heavies	Tr.	$CaCO_3$ 1

X-Ray (130 cm):

Montmorillonite	A
Quartz, mica, palygorskite	C
Feldspar, kaolinite	Tr.

Coarse Fraction:
Zeolite crystals

sec.1, 100 cm GZ 2-13-85

NATURAL GAMMA RADIATION
COUNTS/7.6 cm/1.5 min
1000 2000

SITE 137 CORE 5 DEPTH (m) 209-218

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE
E. CAMPANIAN				CC			

LITHOLOGIC DESCRIPTION

SLIGHTLY ZEOLITIC SILTY CLAY

Brown (7.5YR 5/4)

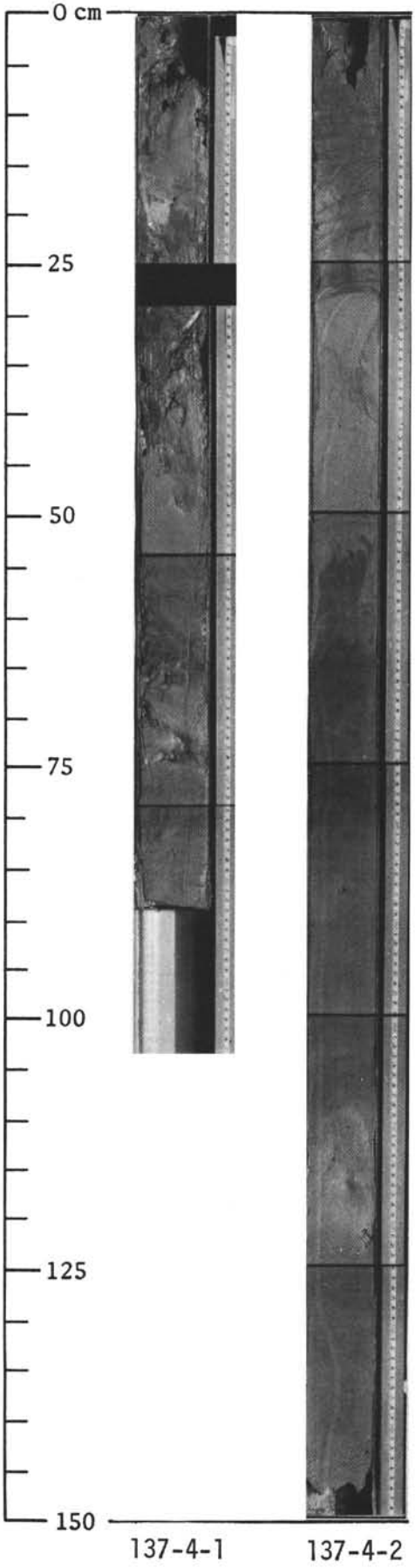
Smear Slide:

Clay	90%
Zeolite (heulandite?)	10%
Quartz	Tr.

* Not to scale. Only core catcher recovery

Coarse Fraction:
Zeolite crystals

NATURAL GAMMA RADIATION
COUNTS/7.6 cm/1.5 min
1000 2000


0 cm
25
50
75
100
125
150
137-4-1
137-4-2

SITE 137 CORE 6 DEPTH (m) 218-225

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE
?TURONIAN-E.CAMPANIAN				1	1	VOID	30
							110
				CC			

LITHOLOGIC DESCRIPTION

Greenish gray (5G 6/1)

GZ 1-10-89

Greenish gray (5G 6/1) at 70-72 cm.

Dark gray (5Y 4/1) Lenses 5 mm thick at 132 and 140 cm.

ZEOLITE SILTY CLAY $CaCO_3$ o

Reddish brown (5YR 4/3)

Smear Slide Average:

Clay	70-85%
Zeolites	10-30%
Fe oxide	Tr.-5%
Quartz, mica pyrite, naoos	Tr.

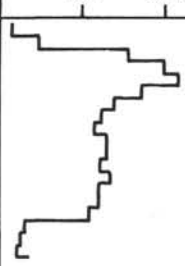
X-Ray (35-37 cm):

Montmorillonite, heulandite	A
Palygorskite, mica quartz, (?) tridymite	C

NATURAL GAMMA RADIATION

COUNTS/7.6 cm/1.5 min

1000 2000



SITE 137 CORE 7 DEPTH (m) 256-265

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE
CENOMANIAN-EARLY TURONIAN		*Chiastozygus cuneatus*		1	1	VOID	*
				CC			

LITHOLOGIC DESCRIPTION

Alternations of

CARBONACEOUS CLAY, with PYRITE, NANNO MARL OOZE, NANNO CHALK OOZE, CHERT $CaCO_3$ 68

Dark gray and brown colors

* See Section Summary

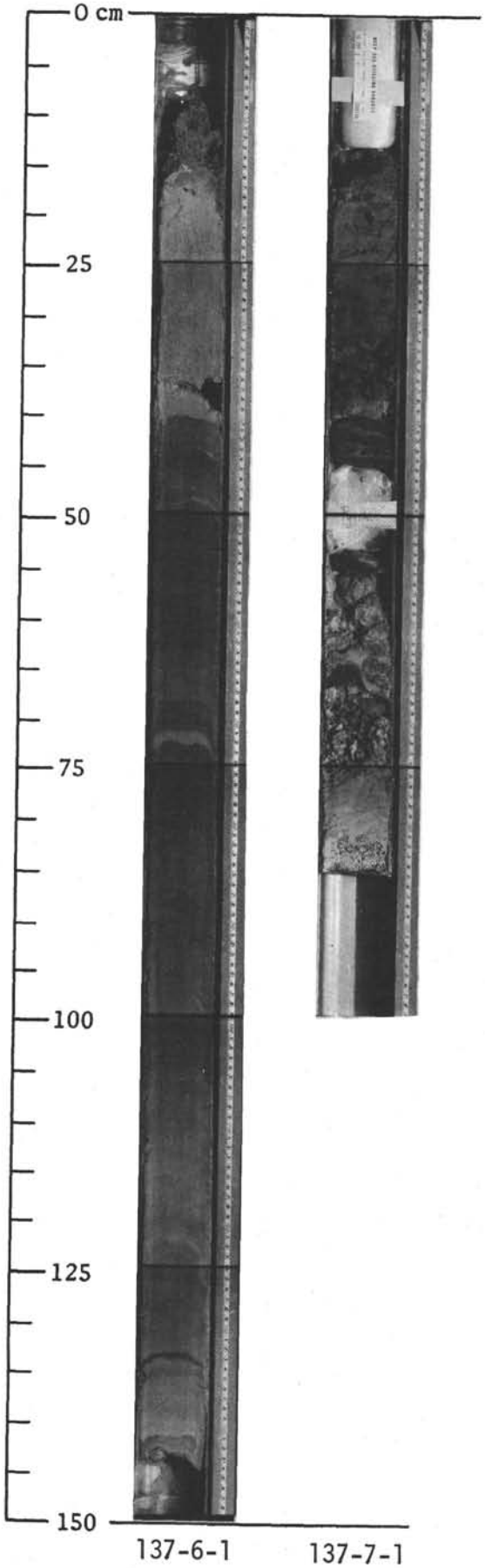
Pyrite
GZ 2-11-87

Coarse Fraction:
Claystone fragments

NATURAL GAMMA RADIATION

COUNTS/7.6 cm/1.5 min

1000 2000


0 cm
25
50
75
100
125
150
137-6-1
137-7-1

SITE 137 CORE 8 DEPTH (m) 265-274

AGE	ZONE FORAM	ZONE NANNO	ZONE RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE
LATE CENOMANIAN	*Rotalipora cushmani- R. greenhornensis*	*Chiastozygus cuneatus*		1	1	VOID	15
				2	2		60
							100
				CC			

LITHOLOGIC DESCRIPTION

NANNO MARL OOZE and SILTY CLAY with PYRITE and SILICIFIED MUDSTONE $CaCO_3$ 6

* See Section Summary sec.2, 45 cm. $CaCO_3$ 29

sec.2, 30 cm GZ 0-7-93

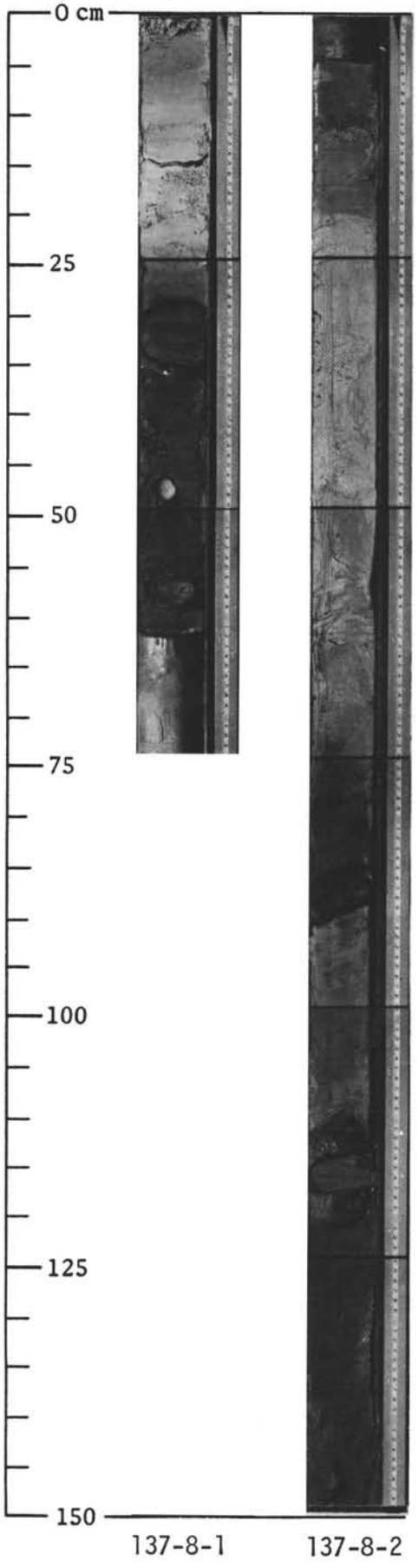
NANNO CHALK OOZE
Dark Gray (10YR 4/1)
Light bluish gray (5B 7/1), No forams
Black (5Y 2/1)
Very dark gray (5Y 3/1)
Dark gray (10YR 4/1)

Smear Slide Average:

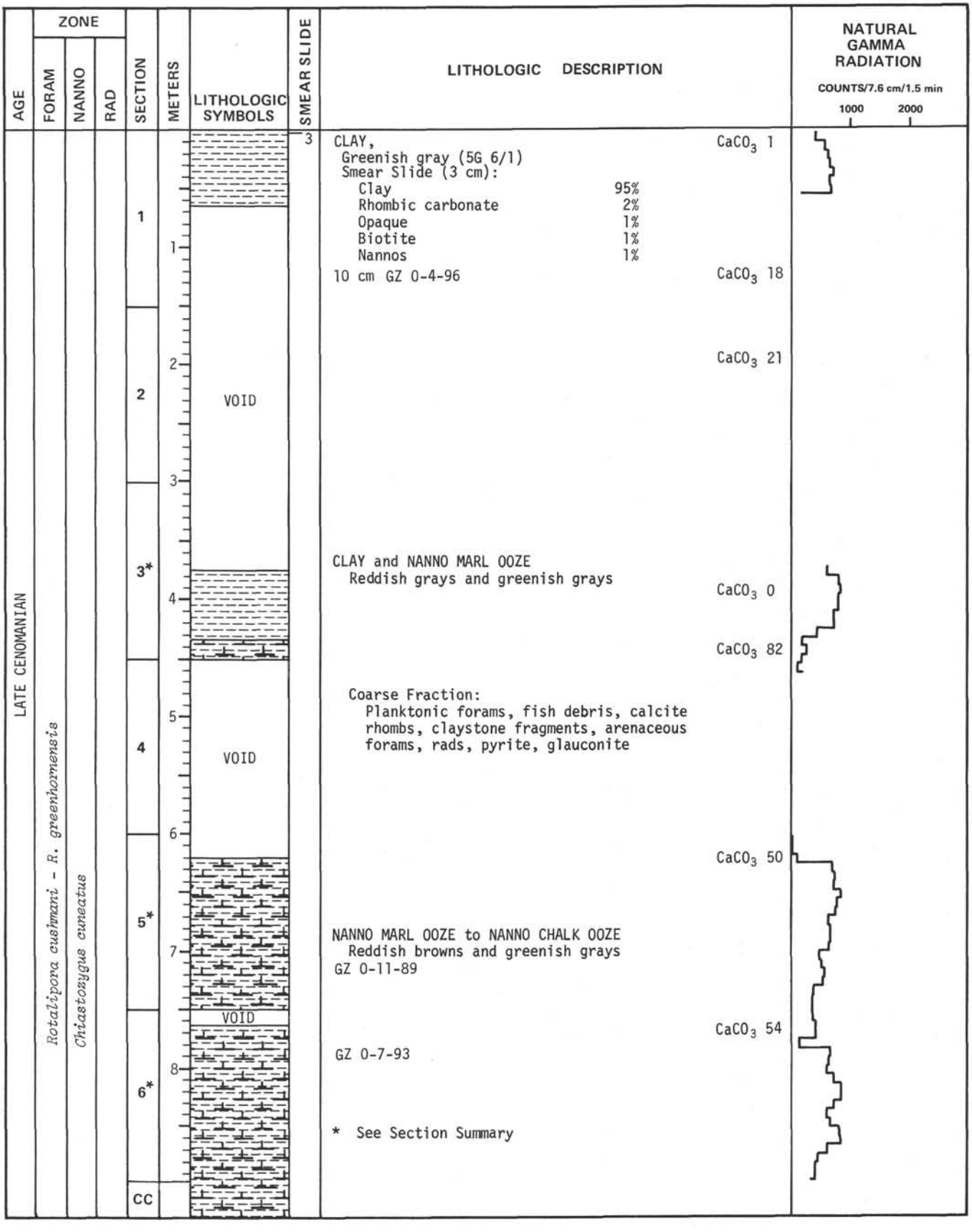
Nannos	70-85%
Clay	10-20%
Opaque	2%
Forams	0--5%
Rhombic carbonate	2%
Quartz, Feldspar	Tr.

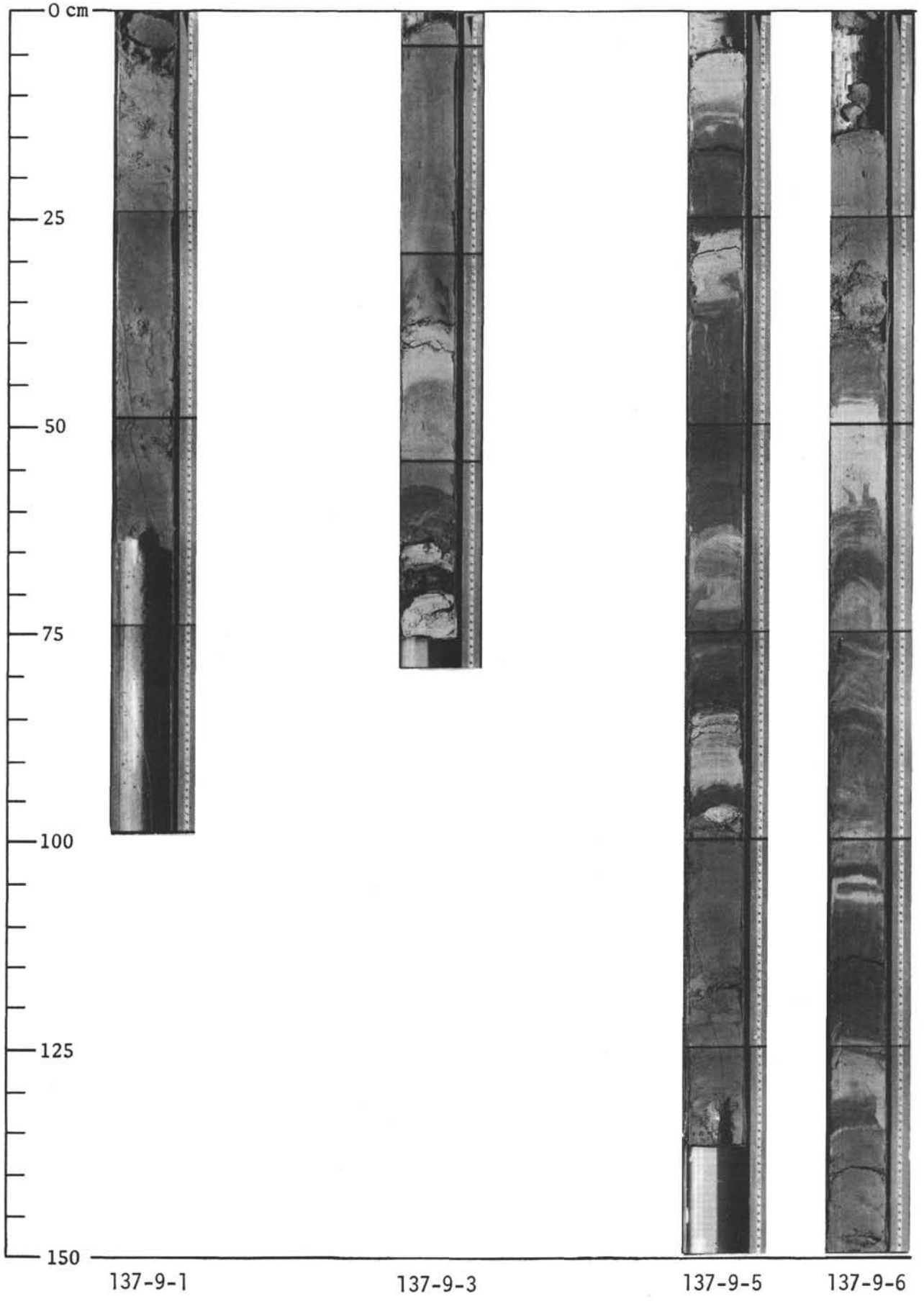
GZ 1-22-77
Coarse Fraction:
Planktonic formas, claystone fragments, Calcite platelets, fish debris

NATURAL GAMMA RADIATION
COUNTS/7.6 cm/1.5 min
1000 2000

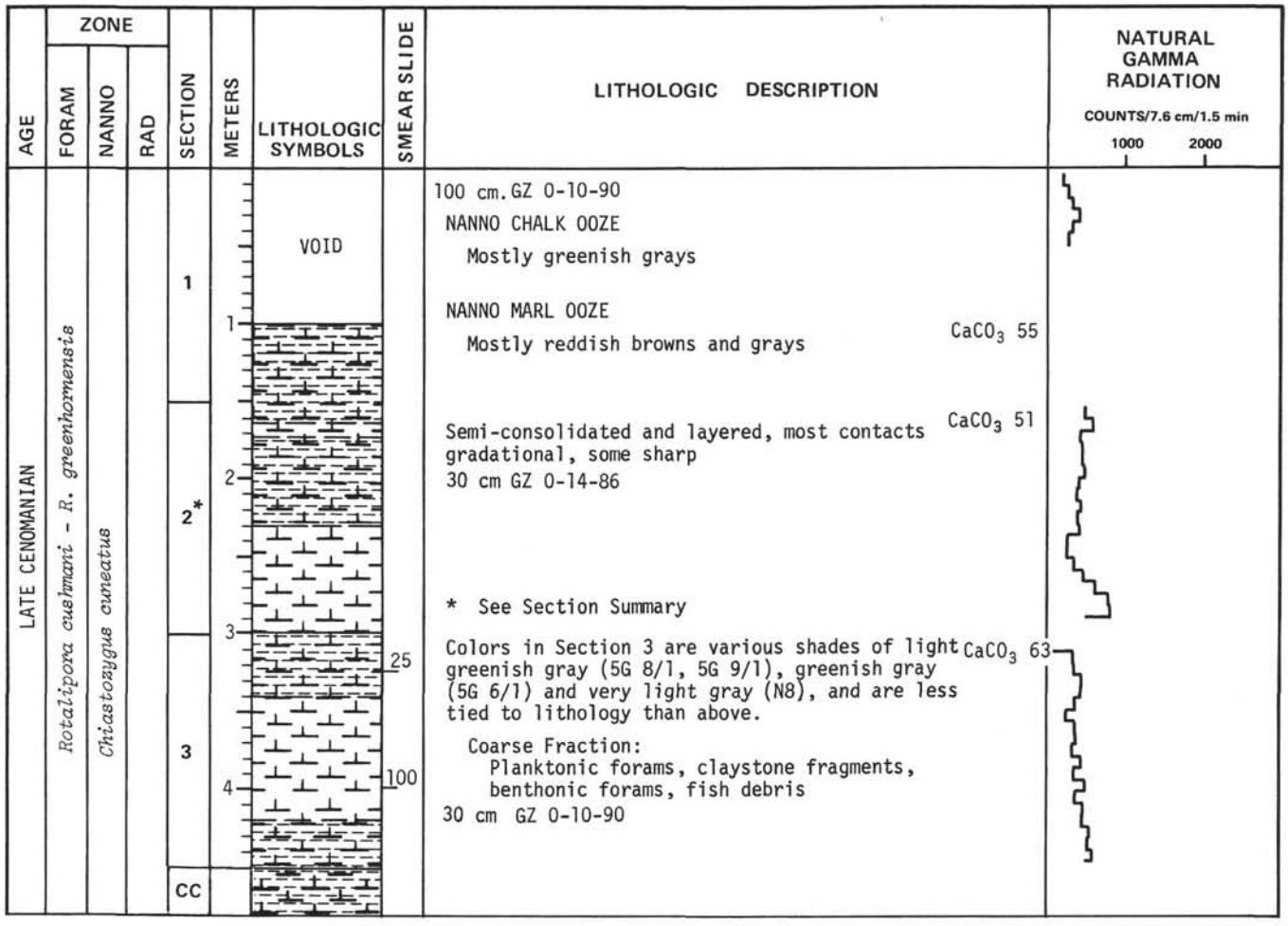

0 cm
25
50
75
100
125
150
137-8-1
137-8-2

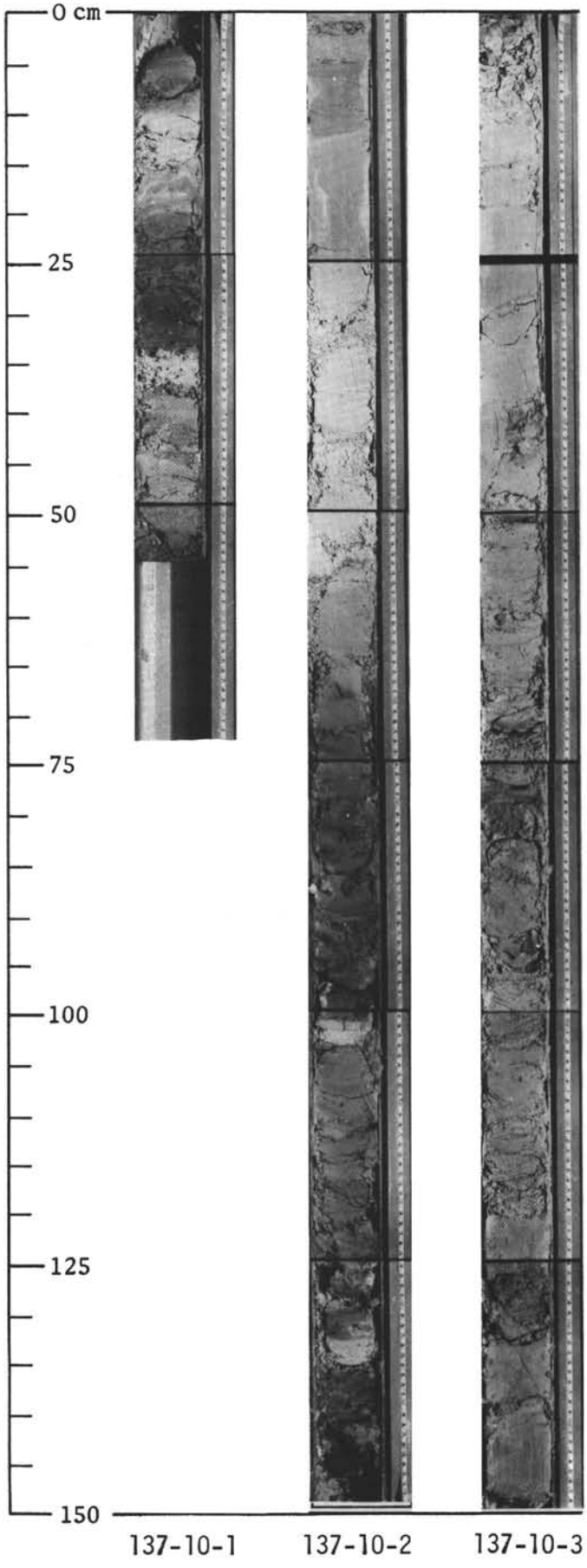
SITE 137 CORE 9 DEPTH (m) 274-283




0 cm
25
50
75
100
125
150
137-9-1
137-9-3
137-9-5
137-9-6

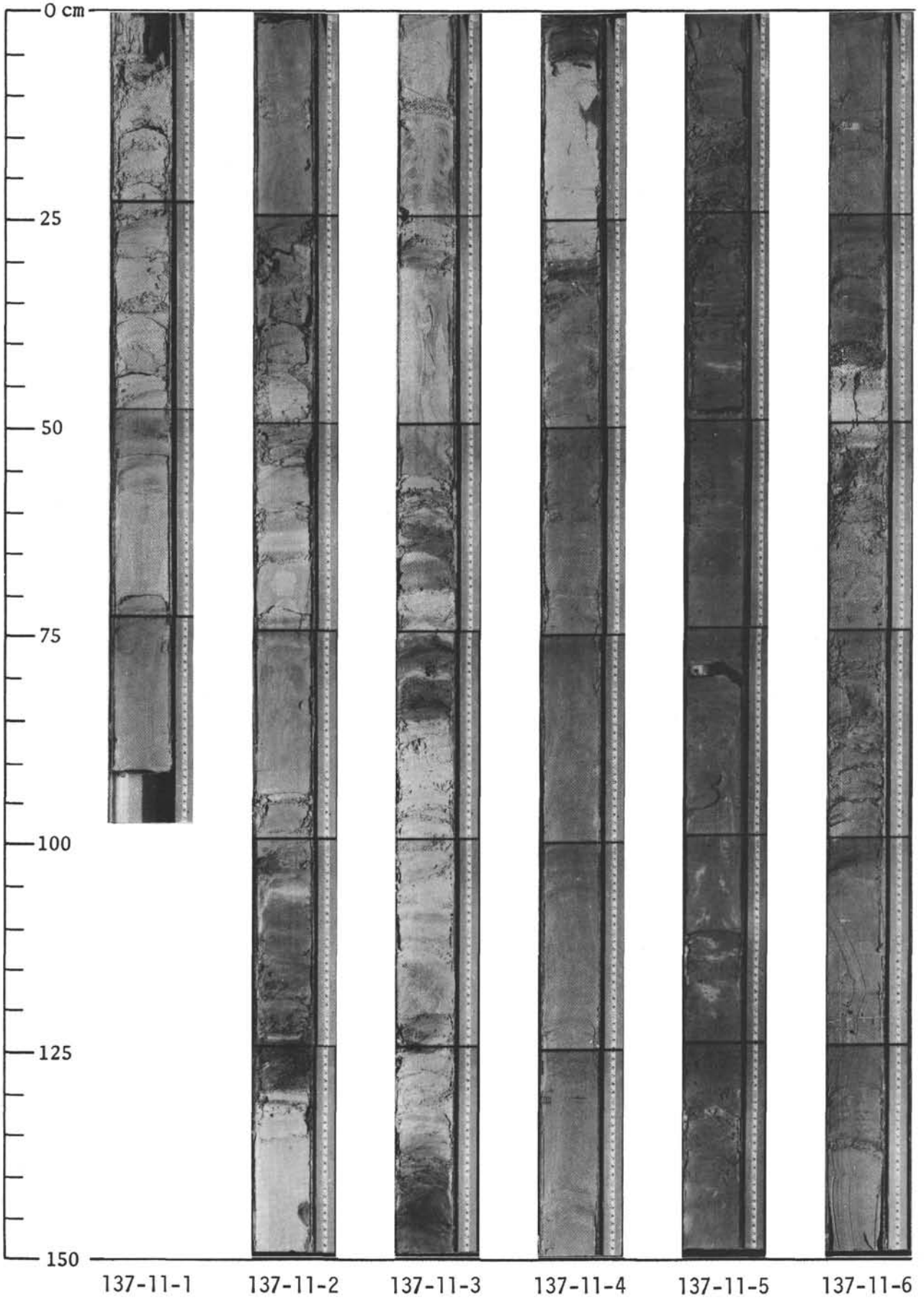
SITE 137 CORE 10 DEPTH (m) 283-292



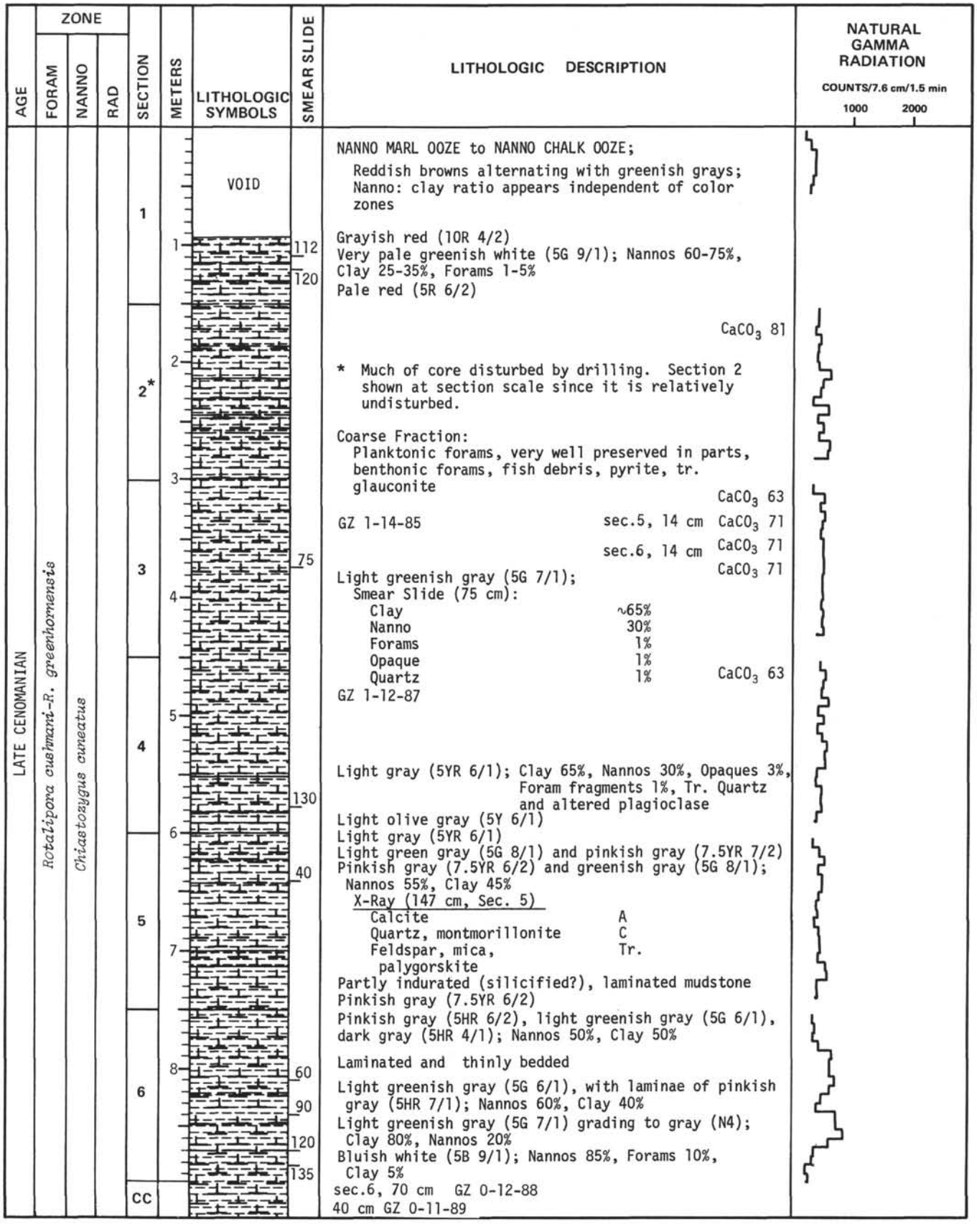

0 cm
25
50
75
100
125
150
137-10-1
137-10-2
137-10-3

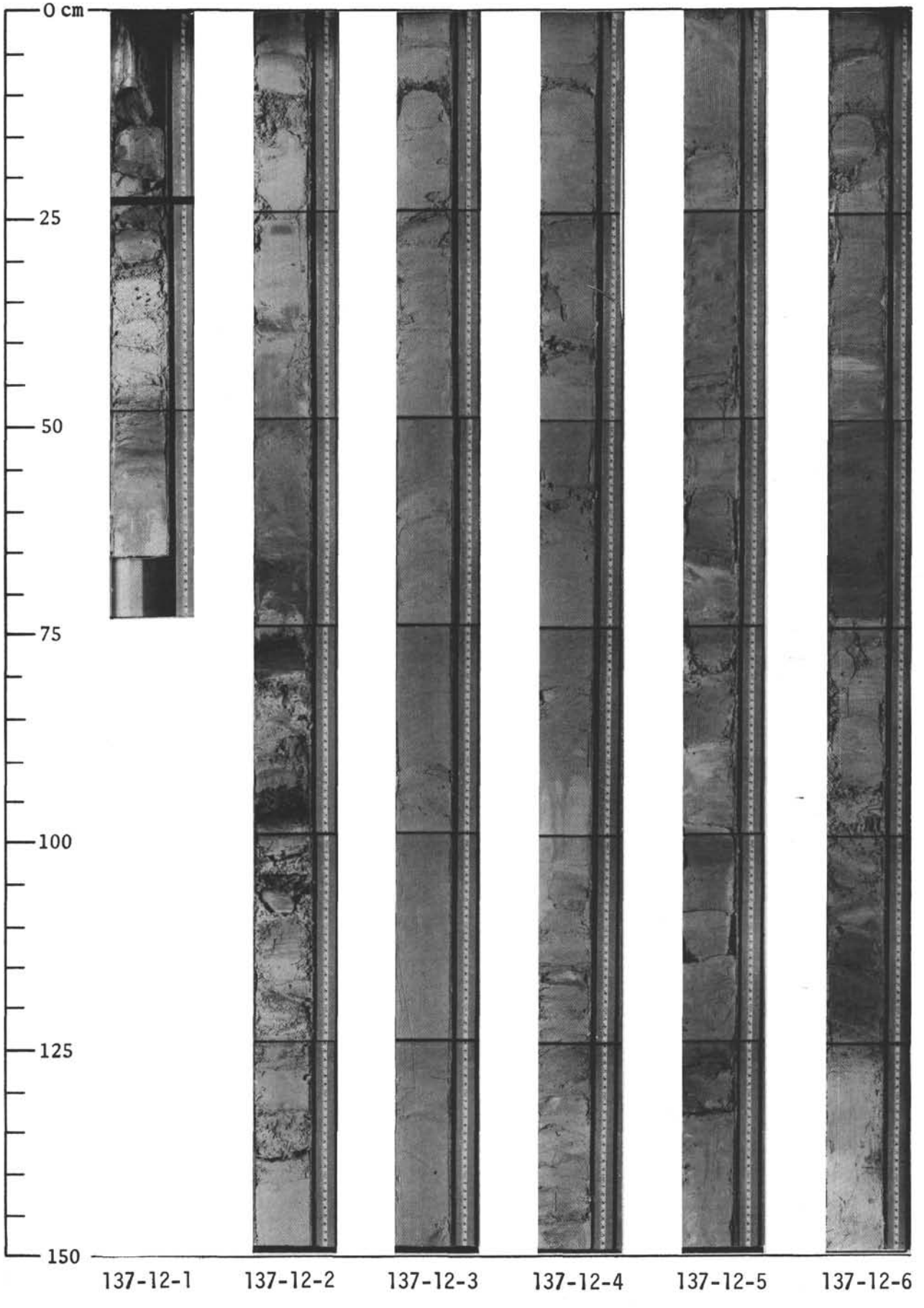
SITE 137 CORE 11 DEPTH (m) 292-301

AGE	ZONE FORAM	ZONE NANNO	ZONE RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE	LITHOLOGIC DESCRIPTION	NATURAL GAMMA RADIATION COUNTS/7.6 cm/1.5 min 1000 2000
LATE CENOMANIAN	*Rotalipora cushmani - R. greenhormensis*	*Chiastozygus cimeatus*		1	1	VOID	95	NANNO MARL OOZE to NANNO CHALK OOZE Pale red and green colors alternate; slight tendency for the light colors to be richer in nannos $CaCO_3$ 67 Light bluish gray (5B 7/1); Nannos ~75%, Clay 20% Forams 5% Pinkish gray (5YR 6/2); Nannos ~60%, Clay 30%, Forams 10%, Tr. Carbonate rhombs, Biotite	
							130		
				2	2		40	sec.1, 140 cm GZ 1-14-85 $CaCO_3$ 69 Light reddish brown (5YR 6/3) Pale greenish gray (5G 7/1) 25 cm GZ 2-14-84 Mixed, red and green Reddish brown (2.5YR 4/4)	
							130		
				3	3		76	Greenish white (5G 9/1); Nannos ~65%, Clay 35% $CaCO_3$ 71 GZ 1-14-85 Pale red (5R 6/2); Nannos ~70%, Clay 25%, Forams 5%	
							90		
				4	4		20	Greenish white (5G 9/1); Nannos ~70%, Clay ~30%, Pale red Forams 2% Greenish white Pale red Greenish white; Nannos 75%, Clay ~25%, Forams 5%, Tr. Zeolite $CaCO_3$ 67	
					5		71	GZ 1-12-87 Pale red (10R 6/2), with only local streaks of greenish gray	
				5	6			Smear Slide Average (71, 47, 135 cm): Clay ~45-60% Nannos 35-50% Forams 5% Zeolite Tr.	
				6	7			Coarse Fraction: Very well preserved planktonic forams, fish debris, quartz, pyrite, Tr. Glauconite $CaCO_3$ 68 60 cm GZ 0-10-90	
					8		47		
							135		
				CC					

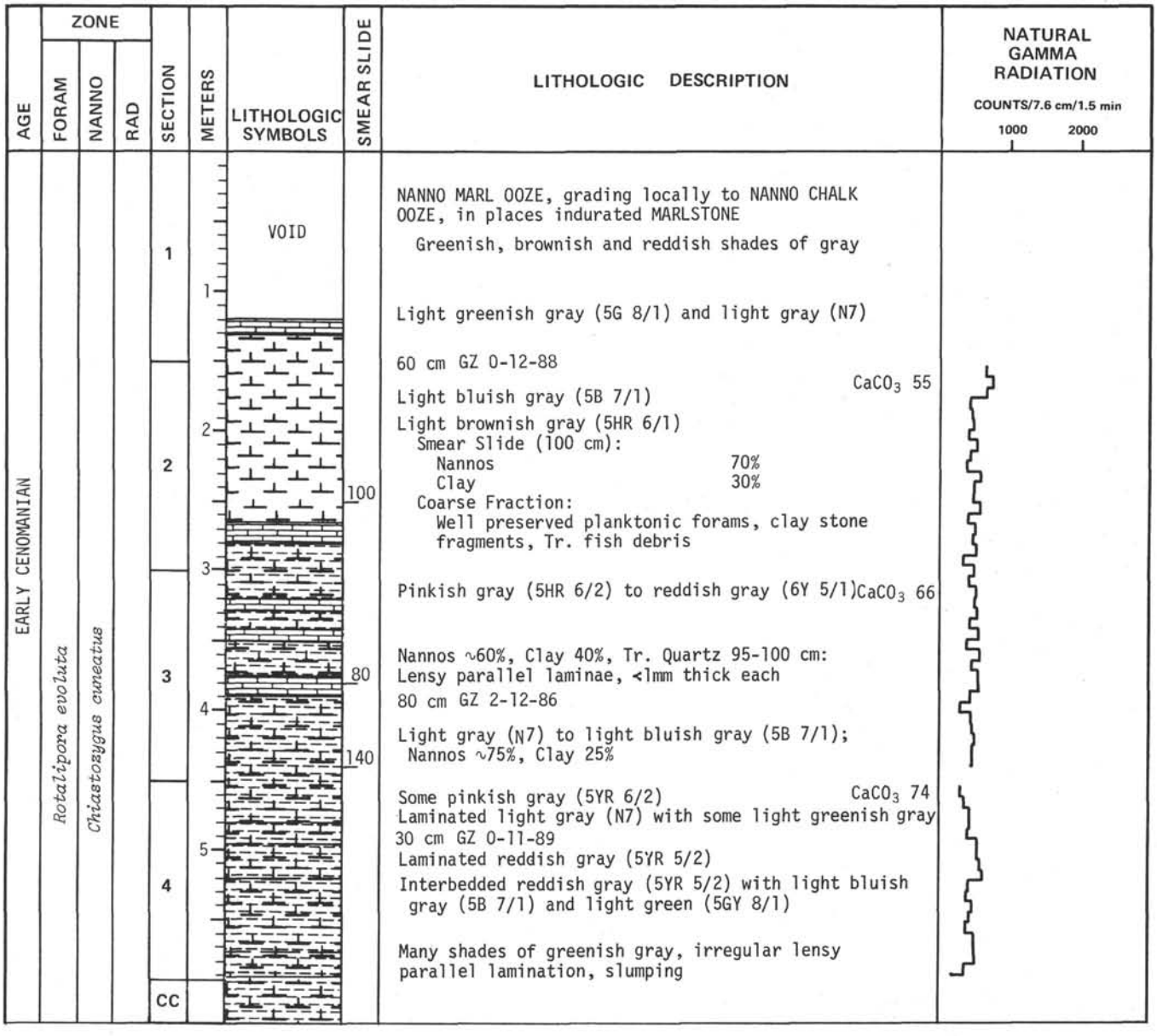

0 cm
25
50
75
100
125
150
137-11-1
137-11-2
137-11-3
137-11-4
137-11-5
137-11-6

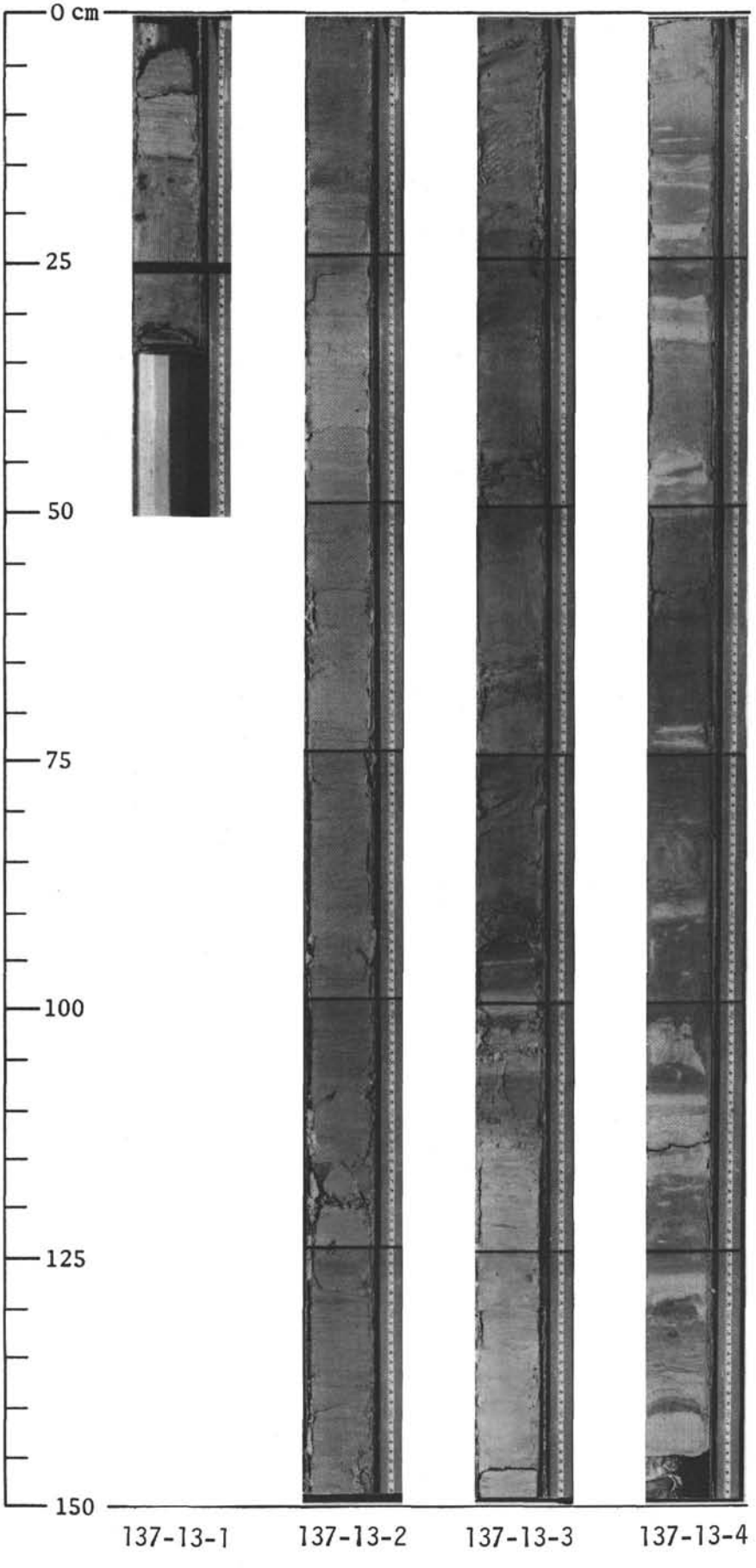
SITE 137 CORE 12 DEPTH (m) 301-310



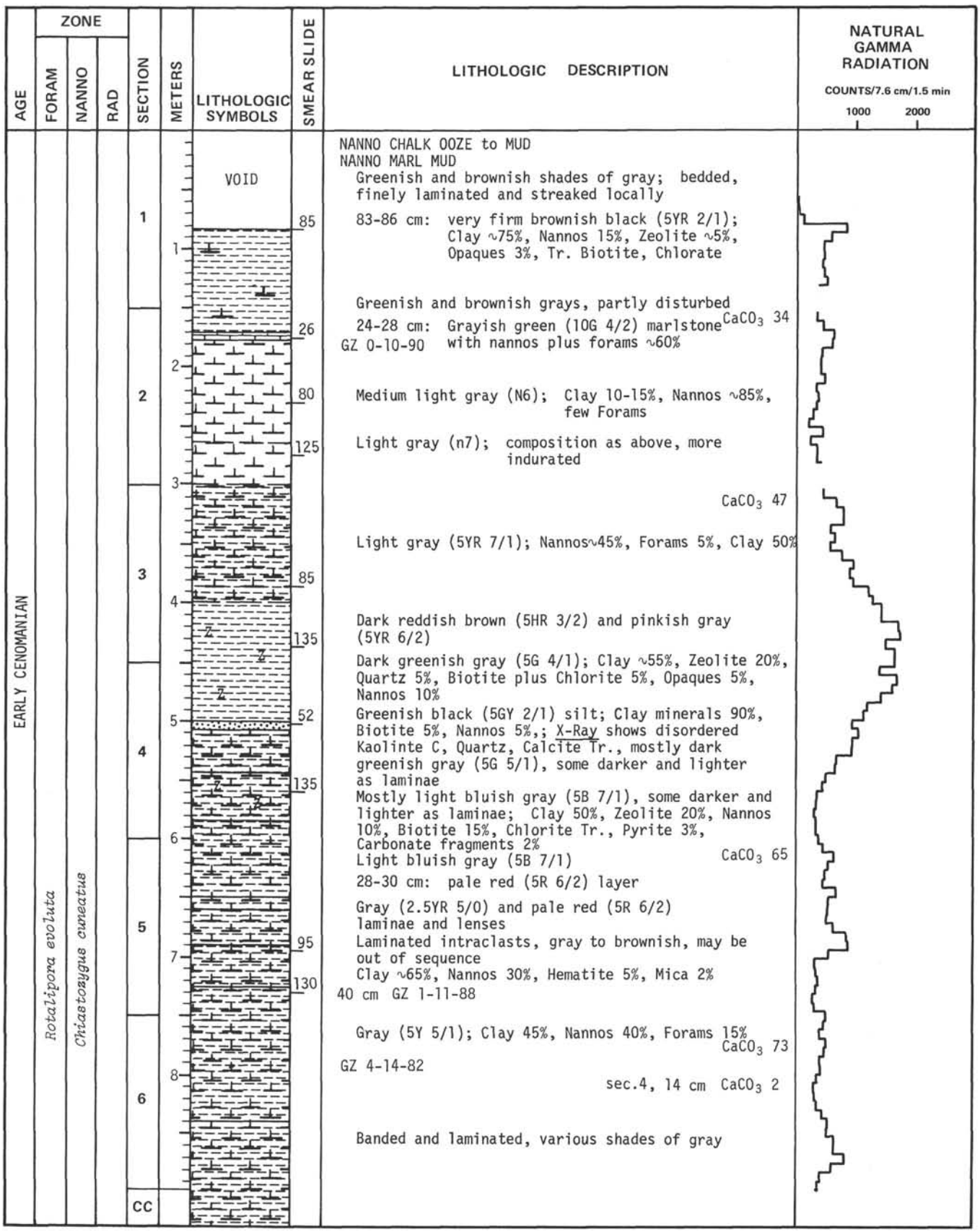

0 cm
25
50
75
100
125
150
137-12-1
137-12-2
137-12-3
137-12-4
137-12-5
137-12-6

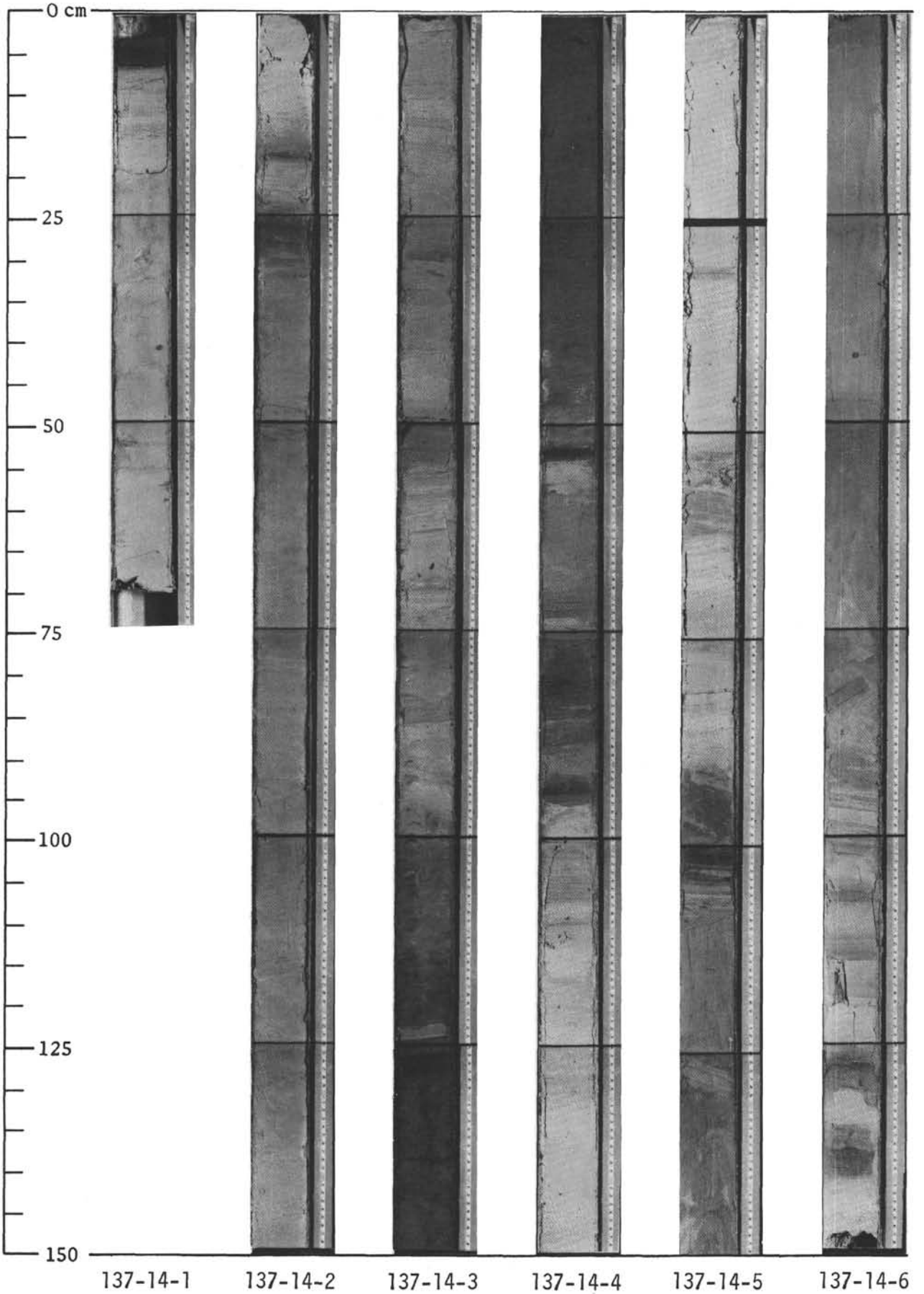
SITE 137 CORE 13 DEPTH (m) 320-329




0 cm
25
50
75
100
125
150
137-13-1
137-13-2
137-13-3
137-13-4

SITE 137 CORE 14 DEPTH (m) 339-348




0 cm
25
50
75
100
125
150
137-14-1
137-14-2
137-14-3
137-14-4
137-14-5
137-14-6

SITE 137 CORE 15 DEPTH (m) 348-357

AGE	ZONE: FORAM	ZONE: NANNO	ZONE: RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE
EARLY CENOMANIAN	*Rotalipora evoluta*	*Chiastozygus cuneatus*		1	1	VOID	110
							135
							142
				2	2		135
				CC			

LITHOLOGIC DESCRIPTION

NANNO CHALK OOZE, NANNO MARL OOZE, some MUD

Alternating brownish and greenish gray

sec.2, 30 cm GZ 0-10-90

110-133 cm: light brownish gray (5YR 6/1) and green gray (5G 8/1 to 3/1)

Smear Slide (110 cm):

Nannos	60%
Clay	40%
Forams	Tr.

$CaCO_3$ 36

133-138 cm: dark green gray (5G 8/1)

Smear Slide (135 cm):

Clay	70%
Nannos	20%
Biotite	5%
Zeolite	3%
Fe oxide	2%

138-117 cm: dark green gray (5G 8/1)

Smear Slide (142 cm):

Clay	65%
Nannos	30%
Zeolite	5%

117-118 cm: dark brown layer

118-150 cm: pinkish white

Smear Slide (135 cm):

Nannos	70%
Clay	20%
Zeolite	Tr.

X-Ray (cc):

Quartz, calcite	A
Mica, montmorillonite, palygorskite, feldspar	Tr.

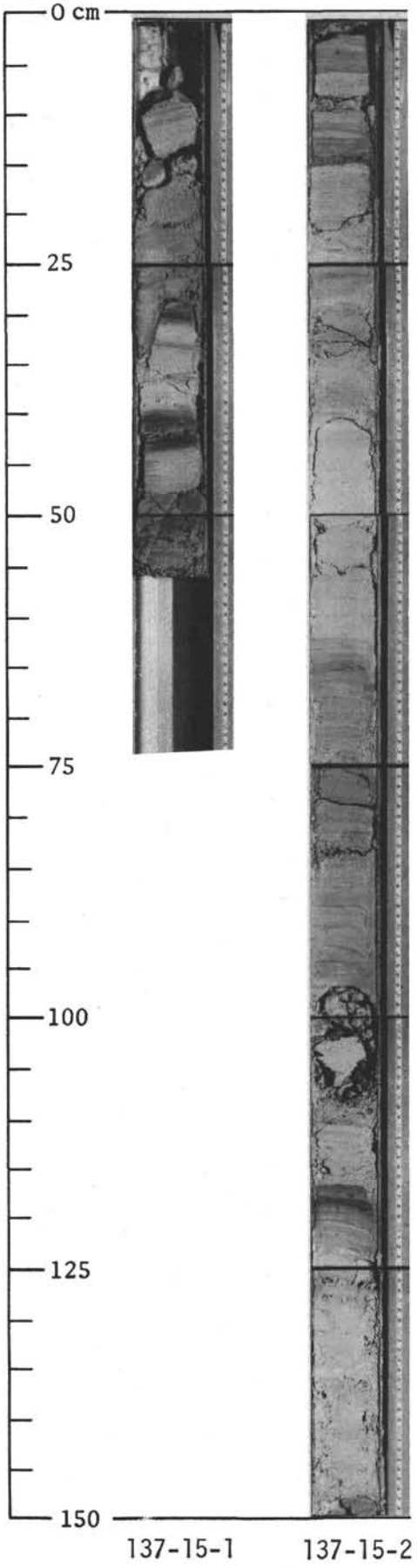
Coarse Fraction:

Planktonic forams, benthonic forams, claystone fragments, pyrite

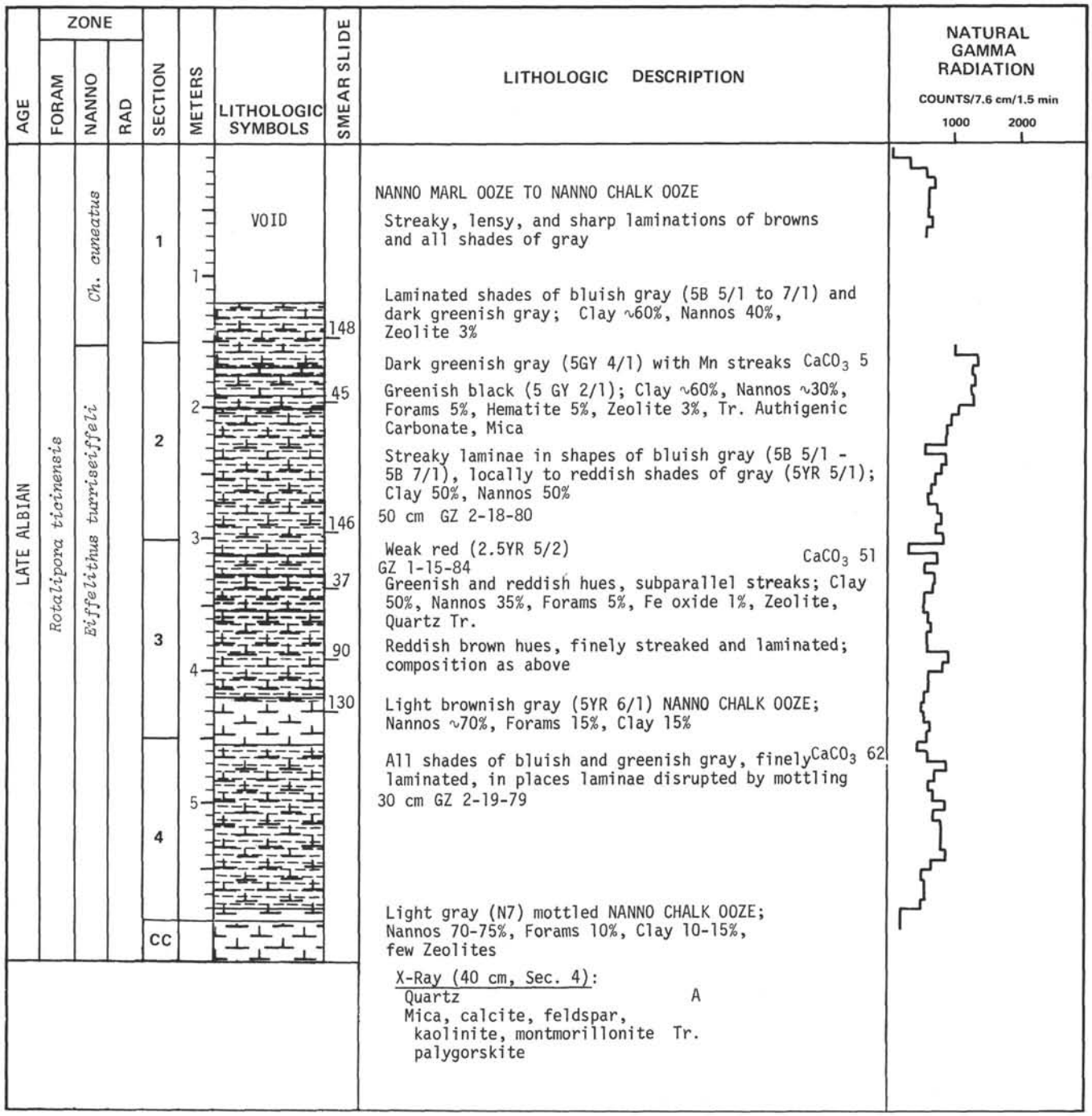
NATURAL GAMMA RADIATION

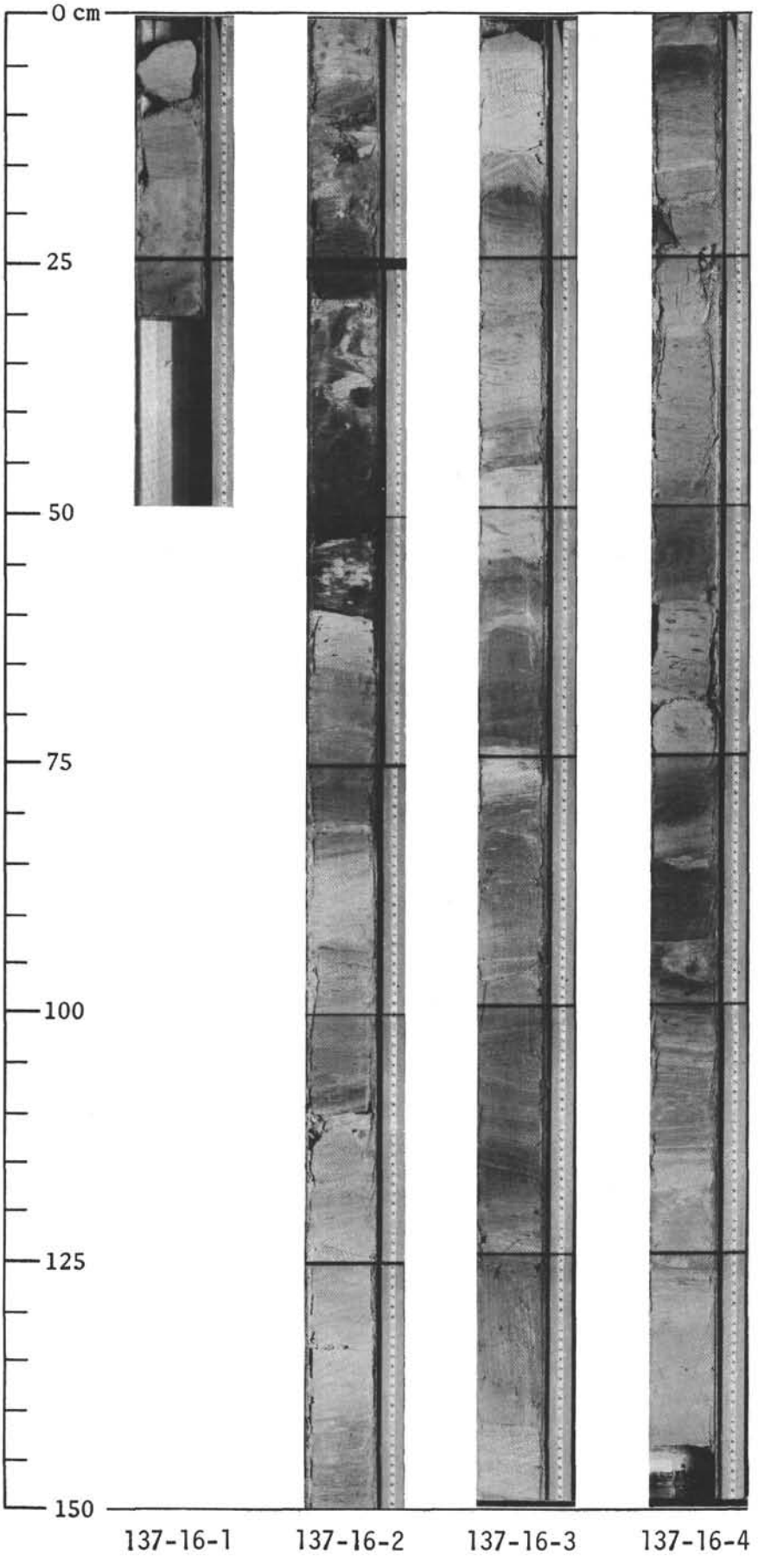
COUNTS/7.6 cm/1.5 min

1000 2000


0 cm
25
50
75
100
125
150
137-15-1
137-15-2

SITE 137 CORE 16 DEPTH (m) 375-382



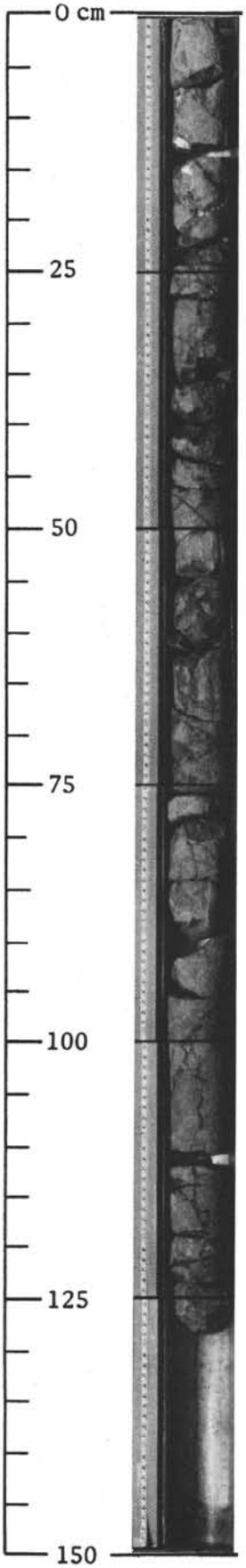

0 cm
25
50
75
100
125
150
137-16-1
137-16-2
137-16-3
137-16-4

SITE 137 CORE SW 1 DEPTH (m) 393

AGE	ZONE FORAM	ZONE NANNO	ZONE RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE	LITHOLOGIC DESCRIPTION	NATURAL GAMMA RADIATION COUNTS/7.6 cm/1.5 min 1000 2000
LATE ALBIAN	*Rotalipora ticinensis*	*E. turriseiffeli*		1	1	NOT TO SCALE		NANNO MARL OOZE Greenish gray to dark greenish gray	
				CC					

SITE 137 CORE 17 DEPTH (m) 397-401

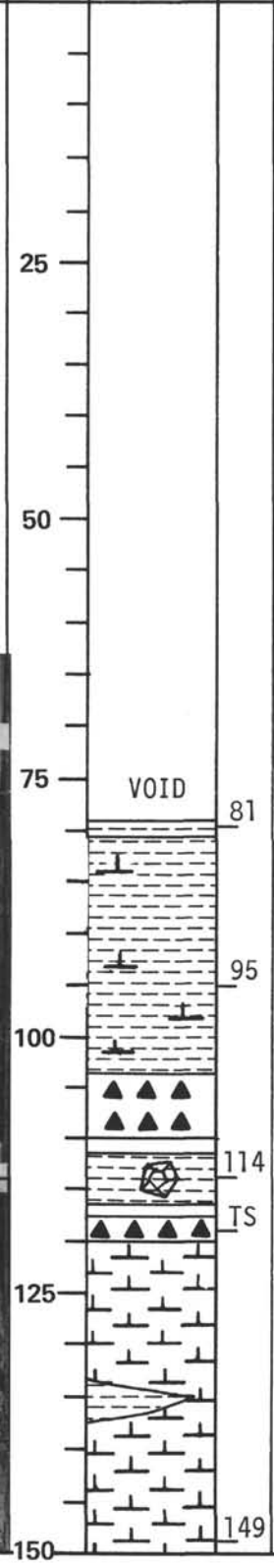
AGE	ZONE FORAM	ZONE NANNO	ZONE RAD	SECTION	METERS	LITHOLOGIC SYMBOLS	SMEAR SLIDE	LITHOLOGIC DESCRIPTION	NATURAL GAMMA RADIATION COUNTS/7.6 cm/1.5 min 1000 2000
UNKNOWN				1	1			BASALT Hyalopilitic (hypocrystalline) with microlites of feldspar (long laths), pyroxene, and possibly olivine set in a glass matrix. All but the very largest feldspar crystals completely altered to clay, chlorite (?) and some albite. Pyroxenes altered to chlorite and serpentine. Rock very fractured and healed by veins of calcite, chlorite, serpentine and perhaps saponite.	
				CC					



137-17-1

SITE 137 CORE 7 SECTION 1

AGE: CONIACIAN - EARLY TURONIAN



79-81 cm:
CARBONACEOUS CLAY
Very dark brown (10YR 2/2)
Smear Slide (81 cm):

Clay	~90%
Organic debris	5%
Nannos	3%
Mica	2%
Zeolite	1%

81-103 cm:
NANNO MARL OOZE
Olive gray (5Y 4/1)
Smear Slide (91 cm):

Clay	40%
Nannos	30%
Carbonaceous debris	20%
Carbonate flour	10%
Fe oxide	2%
Biotite, chlorite	Tr.

X-Ray (85-86 cm)

Calcite	A
Quartz, montmorillonite, pyrite	C
Mica, gypsum, palygorskite, chlorite	Tr.

103-110 cm:
SILICIFIED SILTY MUDSTONE (CHERT) SLIGHTLY CALCAREOUS; parallel laminae 0.1 to 0.2 mm thick, dark laminae due to organic matter
Thin Section:

Silica (opal?)	60%
Carbonaceous matter	15%
Carbonate	20%
Fe oxides and pyrite	5%

112-117 cm:
GREEN CLAY, containing a large PYRITOHEDRON, 6 cm in diameter by 4 cm thick consisting of small cubes 5-8 mm on a side, showing penetration twins.

117-120 cm:
CHERT, as above

120-150:
NANNO CHALK OOZE
Greenish gray (5Y 6/1)

Smear Slide (149 cm):

Nannos	52%
Carbonate flour	30%
Clay	10%
Carbonaceous matrix	5%
Fe oxide	3%
Zeolite, dolomite, biotite, quartz	Tr.

Lenses of CARBONACEOUS CLAY at 135 cm

SITE 137 CORE 8 SECTION 1

AGE: LATE CENOMANIAN

cm: 25, 50, 75, 100, 125, 150

LITHO: VOID

SMEAR SLIDE: 19, 26, 29, 50

CLAY
Greenish gray and dark gray, finely laminated
(Laminae somewhat irregular, grading into streaks)

Transitional to

NANNO MARL OOZE
Greenish gray (5GY 6/1-5G 6/1)

X-Ray (18-20 cm):

Quartz, calcite	A
Montmorillonite, mica, palygorskite	C
Chlorite, kaolinite	Tr.
gypsum	

X-Ray (28-29 cm):

Quartz, montmorillonite	A
Mica, palygorskite	C
Calcite, Dolomite	Tr.

Smear Slide (20 cm):

Clay	50%
Nannos	40%
Zeolite	5%
Carbonate (rhombic plus fragments)	5%
Pyrite	1%
Quartz, biotite, Fe oxide	Tr.

29-30 cm:
NANNO MARL OOZE
Very dark gray (7.5YR 3/3)

Smear Slide (29 cm):

Carbonaceous matter	40%
Clay	30%
Nannos	25%
Opaques	5%
Pyrite	5%
Fe oxides	2%
Zeolite, quartz, dolomite, chlorite, biotite	Tr.

30-62 cm:
FORAM NANNO MARL OOZE
Very dark gray (5Y 3/1)
Including:
44 cm: large (2 cm diameter) pyrite nodule
45-50 cm: several pieces of bedded cherty mudstone
56-58 cm: 2 cm layer of indurated mudstone, laminated with mica on bedding planes, some carbonate-filled molds of organisms (Radiolaria?)

Smear Slide (50 cm):

Clay	~35%
Nannos	40%
Forams (pyrite filled)	25%
Pyrite	5%
Angular calcite, quartz	Tr.

SITE 137 CORE 9 SECTION 3

DESCRIPTION

75-114 cm:
CLAY, greenish gray (5G 4/1); similar to core section

114-120 cm:
NANNO MARL OOZE
Light bluish gray (5B 7/1)

Smear Slide (116 cm):

Nannos	60%
Clay	35%
Rhombic carbonate	3%
Opaques	2%
Chlorite, micas	Tr.

120-133 cm:
CLAY
Greenish gray (5G 4/1); as at 75-114 cm

133-138 cm:
NANNO MARL OOZE
Grayish red (5R 4/2)

138-141 cm:
NANNO CHALK OOZE
Bluish white (5B 9/1)

141-145 cm:
NANNO MARL OOZE
Dark reddish gray (5YR 4/2)

Smear Slide (144 cm):

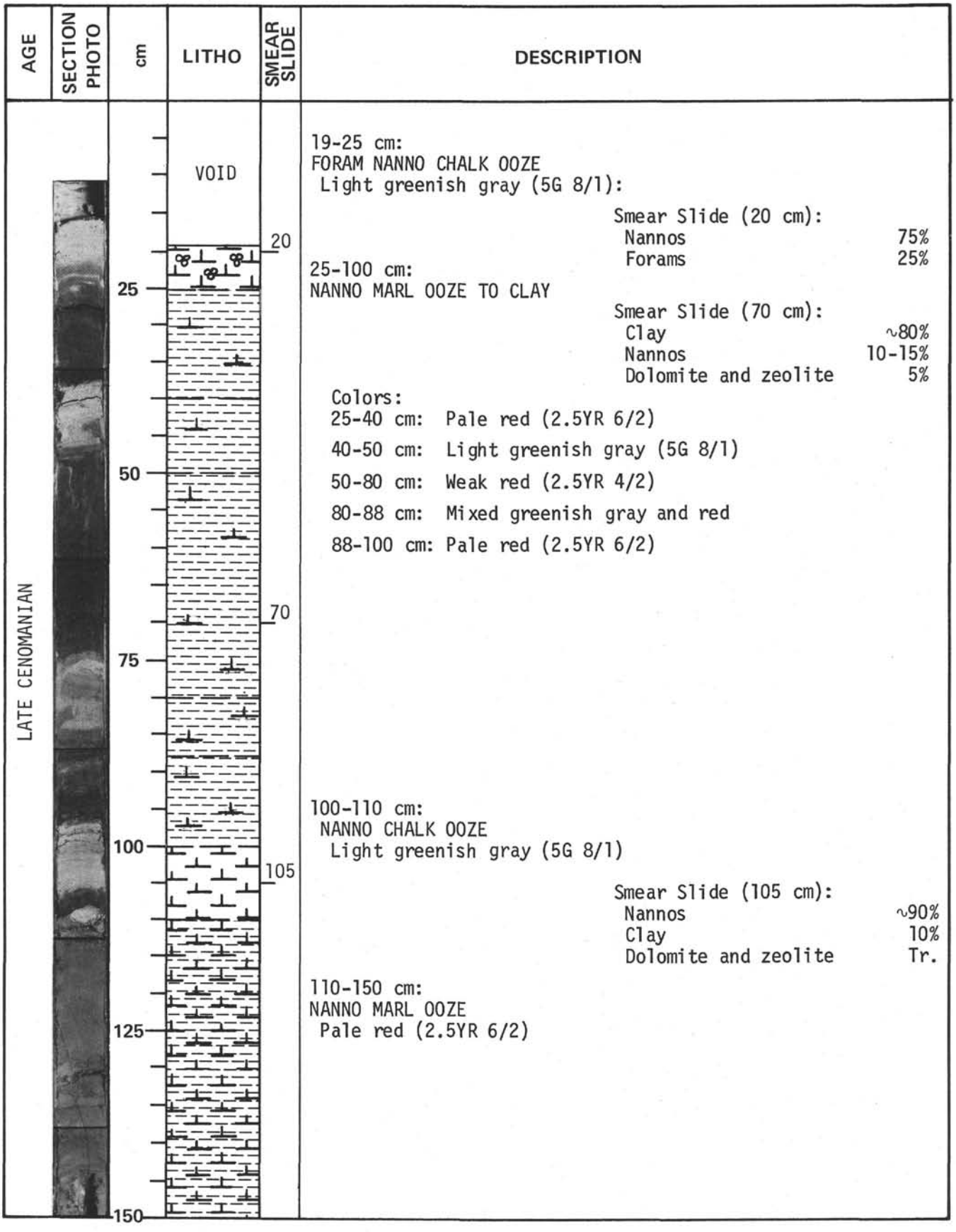
Clay	55%
Nannos	40%
Fe oxide	5%
Pyrite	1%
Biotite, rhombic carbonate	Tr.

145-150 cm:
NANNO CHALK OOZE
Bluish white (5B 4/2)

Smear Slide (149 cm):

Nannos	~85%
Clay	~10%
Forams	2%

SITE 137 CORE 9 SECTION 5



19-25 cm:
FORAM NANNO CHALK OOZE
Light greenish gray (5G 8/1):

Smear Slide (20 cm):

Nannos	75%
Forams	25%

25-100 cm:
NANNO MARL OOZE TO CLAY

Smear Slide (70 cm):

Clay	~80%
Nannos	10-15%
Dolomite and zeolite	5%

Colors:
25-40 cm: Pale red (2.5YR 6/2)
40-50 cm: Light greenish gray (5G 8/1)
50-80 cm: Weak red (2.5YR 4/2)
80-88 cm: Mixed greenish gray and red
88-100 cm: Pale red (2.5YR 6/2)

100-110 cm:
NANNO CHALK OOZE
Light greenish gray (5G 8/1)

Smear Slide (105 cm):

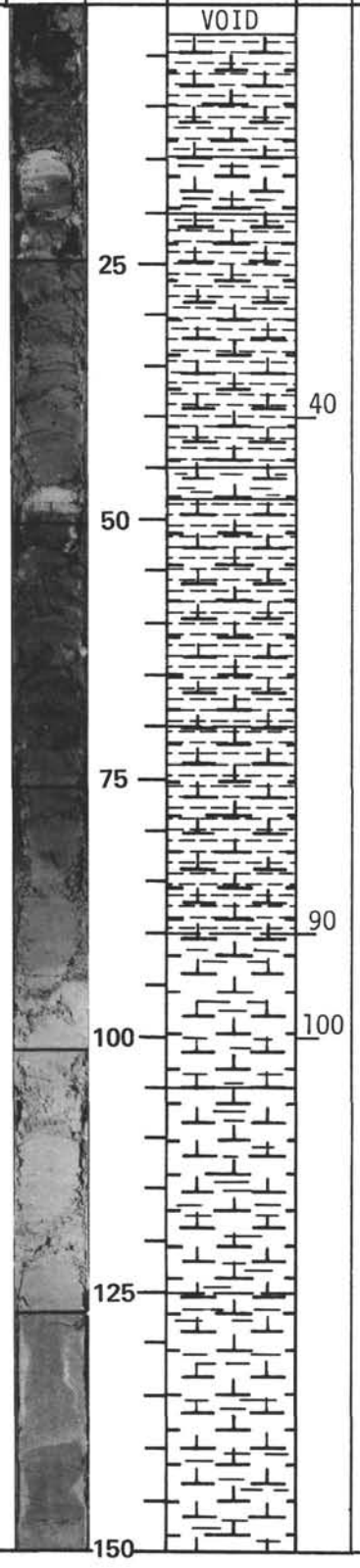
Nannos	~90%
Clay	10%
Dolomite and zeolite	Tr.

110-150 cm:
NANNO MARL OOZE
Pale red (2.5YR 6/2)

SITE 137 CORE 9 SECTION 6

AGE	cm	LITHO	SMEAR SLIDE	DESCRIPTION
LATE CENOMANIAN		VOID		
	25		30	NANO CHALK OOZE Pale red (2.5YR 6/2) (15-40 cm) and reddish gray (5YR 5/2) (40-50 cm) Smear Slide (30 cm): Nannos 60% Forams 10% Clay 30%
	50		55	NANNO CHALK OOZE Light greenish gray (5G 8/1) Smear Slide (55 cm): Nannos plus forams 90% Clay 8% Zeolite Tr.
	75			NANNO MARL OOZE Pale red (2.5YR 6/2) Streaks of greenish gray (5G 6/1) at 70-73 79-81, 83-84 cm.
	100			NANNO CHALK OOZE; as at 55 cm. Layer of pale red 102-104 cm.
			120	NANNO MARL OOZE Weak red (2.5YR 4/2); Clay 60%, Nannos 35%, Fe oxide 3%, Pyrite 2%, Biotite 1%, Quartz Tr., Zeolite Tr.
	125			NANNO CHALK OOZE, as at 55 cm.
			140	NANNO MARL OOZE Pale red (2.5YR 6/2); Clay ~55%, Nannos 45%, Zeolite Tr., Rhombic carbonate, mica Tr.
	150			

SITE 137 CORE 10 SECTION 2



AGE	cm	LITHO	SMEAR SLIDE	DESCRIPTION
LATE CENOMANIAN		VOID		NANNO MARL OOZE, greenish intervals approaching NANNO CHALK OOZE composition
				Pale red (5R 5/2)
				Very pale green (10G 8/2)
	25			Pale red (10R 6/2)
				Smear Slide (40 cm): Clay ~80%, Nannos 20%, Forams 1%
			40	
				Very pale gray (10G 8/2)
	50			
				Pale red brown (10R 5/3)
	75			Transitional, Red brown to greenish white
				Smear Slide (90 cm): Clay ~50%, Nannos ~50%
			90	
			100	Greenish white
	100			Smear Slide (100 cm): Nannos 60%, Clay 40%, Zeolite Tr.
				Transition to pale green
	125			
				Pale green (10G 6/2)
	150			

SITE 137 CORE 12 SECTION 2

DESCRIPTION

NANNO MARL OOZE

Smear slides show variable clay: Nanno Ratio:

Clay	30-60%
Nannos	40-70%
Forams	1-7%
Terrigenous	to 2%
Carbonate rhombs, zeolites	Tr.

Greenish white (5G 9/1)
Irregular lensy fine bedding

Light brownish gray (5YR 6/1)
Disturbed by coring

Laminated at contact

Reddish brown (5YR 5/3 - 4/3) and pinkish gray (5YR 7/2)

Laminated at contact
Greenish white (10G 9/1) at top, grades to pale green (10G 6/2) at bottom

Dark reddish brown (2.5Y 3/4), sharp upper contact grading to greenish gray

Yellowish red (5YR 4/6), partly consolidated

105-107 cm:
Very hard mudstone, finely lamianted and cross bedded.
Color of surrounding clays at boundaries, grayish orange (10YR 7/4) and pale green (10G 7/2) in center

Thin section 116 cm: highly altered "dusty' CHERT

Silica (5% ghost like outlines)	60%
Clay	30%
Fe oxide	5%

Pale green (10G 7/2)