7. SITE 37

The Shipboard Scientific Party[1]

SITE BACKGROUND

The JOIDES Pacific Advisory Panel proposed Site 37 to meet two principal objectives: to determine the significance of the magnetic anomaly pattern, and the longitudinal profile of the sediment sequence in the eastern Pacific. Site 37 was to be located on the same magnetic anomaly as was Site 33 (#10, 32 million years age), for comparison across the intervening Mendocino Fracture Zone. As basement had not been reached at Site 33, this objective could not be met specifically. However, sediment comparison across the fracture zone was possible.

No seismic reflection profiles in the region of Site 37 were available at the time the Pacific Advisory Panel proposed the site. Studies of the pelagic sediment in the northeastern Pacific, however, indicated that the sediment thickness and topography at Site 37 would be similar to that at Site 36. Instead, a very thin section of poorly fossiliferous sediment was actually recorded by *Argo* during the site survey (Appendix III). Where detectable in this abyssal hills region, the sediment was less than 0.05-second thick. The piston core taken by *Argo* during the site survey contained Upper Pliocene coccoliths in a "red" clay at a depth of 3 meters; surficial manganese nodules were caught in the corer.

The approach to the site by *Glomar Challenger* was made from the east. When the magnetometer indicated that the ship was on the axis of the positive Magnetic Anomaly 10 (Figure 1), a southerly course was set in an attempt to stay on the magnetic axis while the seismic profiler was monitored for sediment thickness suitable for drilling. The very thin sediment section led to a search for an adequate sediment thickness and the final site selection was on the eastern half of Magnetic Anomaly 10, on the flank of an abyssal hill having at least 40-meter relief.

The on-site seismic reflection profile (Figure 2) indicated about 0.04 second of acoustically transparent sediment.

Location

Site 37 is located at latitude 40° 58.74′N, longitude 140° 43.11′W in a region of abyssal hills having a major relief of about 200 meters and minor relief of 40 to 80 meters.

OPERATIONS

The section was continuously cored during May 11 (Table 1). The relief of the local abyssal hills led to some initial difficulty in reconciling sonic water depth with driller's depth. The discrepancy, about 100 feet (32.8 meters), resulted in the first coring attempt being made before the bit was set in the bottom. Core 4 (23 to 30 meters) contained a cut fragment of basalt in the core catcher. Although a hard rock catcher was placed in the core barrel and almost three hours of coring was attempted in the basalt, Core 5 (30 to 31 meters) contained no recovery. Apparently, the very thin sediment did not supply sufficient stabilization for the coring operation in basalt.

LITHOLOGY

At Site 37, continuous coring between the sea floor and a total depth of 31 meters resulted in about 30 meters of sediment recovery.

The sedimentary section consists mostly of yellowish-brown "muds" locally rich in amorphous iron oxides. On the basis of color, which reflects variations in zeolite content, four facies could be distinguished in the cores.

A light brown facies, characterized by less than 5 per cent zeolites, is present in most of Core 1 and into the upper part of Core 2 (0 to 5 meters). Several prominent streaks of nannofossil ooze with common foraminifera occur in this upper core.

An interbedded dark brown facies and a yellow facies extend from near the top of Core 2 (about 5 meters) to the middle of Core 3 (20 meters). The dark brown facies, which is dominant, contains from 10 to 20 per cent zeolites and some large well-indurated nodules, which consist entirely of zeolite minerals.

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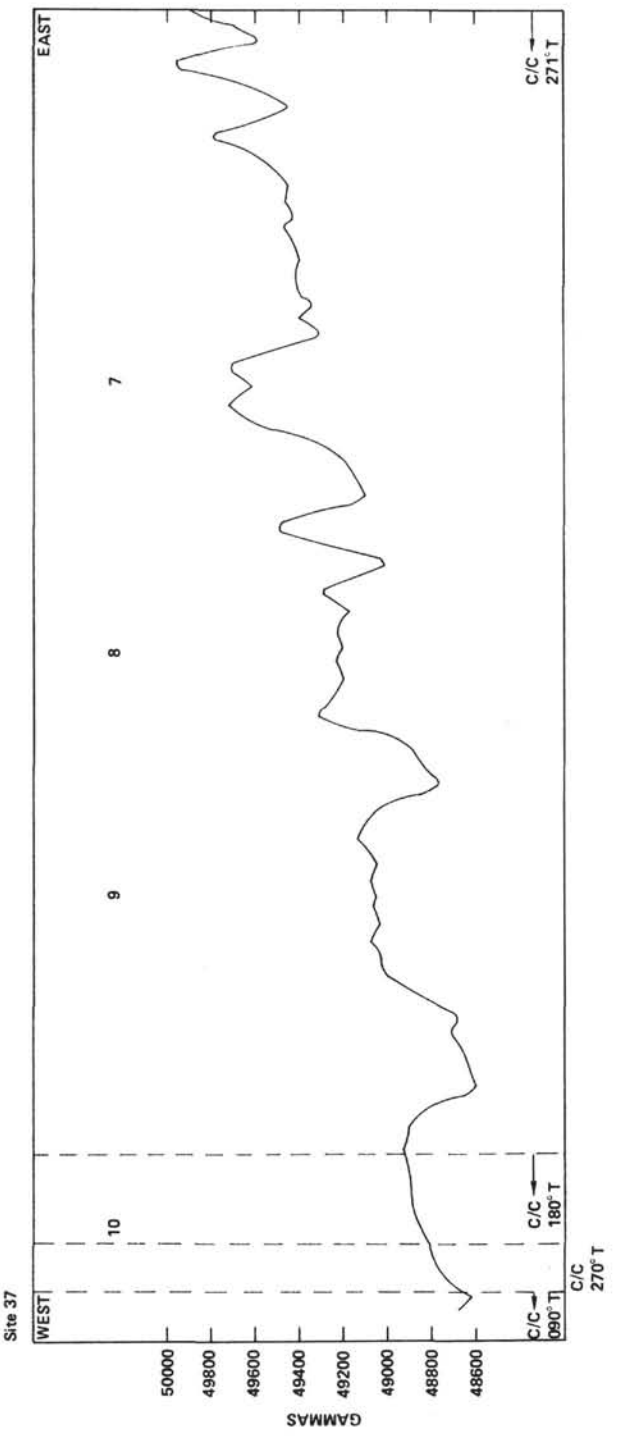

Figure 1. *Generalized plot of magnetometer record during last part of track between Sites 36 and 37. Site 37 is located at left end of plot. Magnetic anomalies numbered 7-10 are identified.*

Figure 2. *On-site seismic reflection profile, Site 37.*

TABLE 1
Drilling Summary of Leg 5, Site 37

Date	Core	Depth Below Sea Floor (m)	Depth Below Rig Floor (ft)	Core Cut (ft)	Core Cut (m)	Core Recovered (ft)	Core Recovered (m)	Per Cent Recovered
11 May	1	0-5	15,429-15,446	17	5.2	17	5.2	100
	2	5-14	15,446-15,476	30	9.1	30	9.1	100
	3	14-23	15,476-15,506	30	9.1	30	9.1	100
	4	23-30	15,506-15,529	23	7.0	23	7.0	100
	5	30-31	15,529-15,531	2	0.6	0	0.0	0
			Totals	102	31.0	100	30.4	98

Note: Sonic water depth (corrected): 4682 meters; 15,356 feet, 2560 fathoms. Driller's depth: 15,429 feet.

The yellow facies is characterized by 30 to 60 per cent zeolites. It is less prevalent than the dark brown facies, except between 15 to 17 meters (in Core 3) where it is locally dominant.

The very dark brown facies, from about 20 meters (in Core 3) to 30 meters (in Core 4), is characterized by an almost complete absence of zeolites. The zeolites that are present in this facies occur mostly as white streaks and nodules of pure zeolite minerals. Two highly altered ash beds are also present in this facies.

Four large and many small (pea-sized) manganese nodules were noted within the upper two cores (0 to 14 meters), and smaller micronodules were found throughout all of the cores. Sections cut through the large nodules reveal yellow nuclei of altered volcanic materials covered by concentric layers of manganese. The unbroken botryoidal surfaces of the nodules are locally encrusted by patches of the same ooze. On the basis of paleontology and lithology, it is difficult to say whether the manganese nodules are in place or a contaminant from higher in the hole. At present, meager fossil data favor the former viewpoint.

Near the bottom of the hole, a 3-inch section of basaltic basement rock was recovered. No baking of the sediments overlying the basalt was noted.

The sediment is firm to locally well-indurated throughout; most were intensely deformed by coring. Local areas of slight to moderate deformation exhibit burrow mottling in places, but for the most part no mottling is visible.

PALEONTOLOGY

Nannoplankton

Calcareous nannofosisls occur in, essentially, four parts of this hole. Three bands of calcareous ooze are found in the bottom part of Core 1 and the top of Core 2 with the calcareous forms found within and adjacent to these beds. Lower in Core 2, several manganese nodules are found and these have coccoliths and discoasters within calcareous material encrusting or infilling depressions on these nodules.

The assemblage of calcareous forms indicates a Late Pliocene age by the presence of *Ceratolithus rugosus* Bukry and Bramlette var., *Coccolithus doronicoides* Black and Barnes?, *Cyclococcolithus leptoporus* (Murray and Blackman) Kamptner, *Discoaster brouweri* Tan and vars., with reworked Late Miocene or younger forms included. These older species are: *D. brouweri rutellus* Gartner, *D. calcaris* Gartner, *D. challengeri, D.* sp. aff. *D. exilis* Martini and Bramlette, *D. surculus* Martini and Bramlette, *D.* aff. *D. variabilis* Martini and Bramlette. Another form occurs which most likely represents broken and etched specimens of an asterolith like *D. exilis* or a similar form, and is labeled *D.* sp. aff. *D. stellulus* Gartner.

A few scattered siliceous nannofossils occur in Core 1. Of these diatoms, the occurrence of *Denticula seminae* Simonsen and Kanaya in the top and bottom of Core 1 is significant. This species has been found to be an excellent guide for the Quaternary by the Russians and Japanese in the northern Pacific (Simonsen and Kanaya, 1961; Kanaya and Koizumi, 1966).

An examination of the finer material composing the calcareous oozes shows that it is essentially made up of small fragments of coccoliths instead of an abundance

of *Coccolithus doronicoides?*, as is characteristic of the background of the Pliocene parts of the sections recovered in earlier holes on this leg. Many of the asteroliths also show the results of breakage. The presence of fair-sized manganese nodules well below the sediment surface is also anomalous.

It is concluded that at least the upper part of the section of sediments from this hole are of Pleistocene age and represent reworked material from an area above the calcium carbonate compensation depth.

Foraminifera

Foraminifera are present in thin beds of chalk ooze in Cores 1 and 2. Selective solution of the smaller thin-walled forms is evident in Core 2.

The foraminifera present at this site are Pliocene in age. The occurrence of the species *Globorotalia miozea conoidea* Walters, *Globorotalia puncticulata* (Deshayes), and *Globorotalia obesa* Akers indicates either a late early or an early late Pliocene age. The absence of the genus *Sphaeroidinellopsis* probably means the chalk beds come from a level above the *Sphaeroidinellopsis* extinction datum, thus favoring a late Pliocene age. The nannofossil data also support an upper Pliocene interval.

The presence in Core 1 (Section 1 and core catcher samples) of a siliceous nannofossil species (see discussion under Nannoplankton) of possible Quaternary age suggests Pleistocene beds are present. The foraminiferal faunas in Core 1 (lower part of Section 3 and Section 4) do not contain any species of restricted Pleistocene age, but consist of species associations encountered in Pliocene sections at other sites of Leg 5. This does not preclude, however, that the upper parts of Core 1 may be of Pleistocene age or that the chalk beds are slip masses of Pliocene strata introduced into the Site 37 area during Pleistocene time.

The species recovered from Hole 37 include:

Sample 37-1-2, 28-30 cm:
Planktonic foraminifera absent.

Sample 37-1-2, 107-109 cm:
Sample as above.

Sample 37-1-3, 60-62 cm:
Globigerina bulloides d'Orbigny, *Globigerina dutertrei* d'Orbigny–4 to 5 chambered variants.

Sample 37-1-3, 110-112 cm:
Globigerina bulloides, Globigerina decoraperta Takayanagi and Saito, *Globigerina dutertrei*–4 to 5 chambered variants, *Globigerina parabulloides* Blow, *Globigerina quinqueloba* Natland, *Globorotalia crassaformis ronda* Blow, *Globorotalia crassaformis crassaformis* (Galloway and Wissler), *Globorotalia miozea sphericomiozea* Walters, *Globorotalia puncticulata* (Deshayes), *Globorotalia tumida* (Brady), *Globigerinita glutinata* (Egger), *Globigerinoides ruber* d'Orbigny, *Sphaeroidinella dehiscens* (Parker and Jones)–immatura form, *Orbulina universa* d'Orbigny.

Sample 37-1-4, 24-26 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina parabulloides, Globorotalia crassaformis crassaformis, Globorotalia crassaformis ronda, Globorotalia miozea conoidea Walters, *Globorotalia miozea sphericomiozea, Globoquadrina obesa* Akers, *Orbulina universa.*

Sample 37-1-4, 90-92 cm:
Globigerina bulloides, Globigerina dutertrei–4 chambered variant, *Globigerina parabulloides, Globorotalia crassaformis ronda, Globorotalia miozea conoidea, Globorotalia* cf. *G. sphericomiozea, Globorotalia puncticulata, Orbulina universa.*

Sample 37-2-1, 6-8 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina dutertrei–4 to 5 chambered variants, *Globigerina parabulloides, Globorotalia acostaensis acostaensis* Blow, *Globorotalia crassaformis crassaformis, Globorotalia crassaformis ronda, Globorotalia miozea conoidea, Globorotalia miozea sphericomiozea, Globorotalia puncticulata, Globorotalia tumida, Globoquadrina* cf. *G. obesa, Sphaeroidinella dehiscens*–immatura form, *Orbulina universa.*

Sample 37-2-2, 10-12 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina dutertrei–4 chambered variant, *Globorotalia crassaformis crassaformis, Globorotalia crassaformis ronda, Globorotalia miozea conoidea, Globorotalia miozea sphericomiozea, Globoquadrina* cf. *G. obesa, Orbulina universa.*

Radiolaria

Radiolaria were not found in any of the cores from Hole 37.

SUMMARY

The thin (30 meter) sediment section at Site 37 can be divided into three stratigraphic units (Table 2). The identification of the sedimentary units is based on variations in color and zeolite abundance. The units are described in more detail in the lithology section of this report.

Unit 4 (Core 5, 30 to 31 meters) is the basalt of the abyssal hill. No evidence of contact metamorphism was observed in the overlying sediments of unit 3

TABLE 2
Stratigraphic Units at Site 37

Unit	Depth (m)	Cores	Age	Description
1	0-5	1 and 2 (part)	Pleistocene	Light brown pelagic clay containing 0 to 5 per cent zeolites. Several streaks of nannofossil ooze. Manganese nodules.
2	5-20	2 (part) and 3 (part)	?	Interbedded dark brown and yellow "clays" and zeolitic "clays". Dark brown "clay": 10 to 20 per cent zeolites, some manganese nodules. Yellow zeolitic "clay": 30 to 60 per cent zeolites.
3	20-30	3 (part), 4	?	Very dark brown amorphous iron oxide sediment with traces of zeolites; also, with white layers and nodules of pure zeolites and two altered ash beds.
4	30	5	?	Basalt.

(Core 4 and bottom of Core 3, 20 to 30 meters). Unit 3 is a very dark brown amorphous iron oxide sediment containing few zeolites. In addition, this unit, which is nonfossiliferous, contains white layers and nodules of almost pure zeolites.

Unit 2 (top of Core 2 to top of Core 3, 5 to 20 meters) is dominantly a dark brown iron oxide-rich sediment interbedded with yellow zeolitic sediment. The yellow zeolitic material is more prominent in the lower part of the unit and contains the most abundant zeolites in the entire sediment section (30 to 60 per cent). The dark brown "red" clay contains 10 to 20 per cent zeolites.

Unit 1 (the surface to top of Core 2, 0 to 5 meters) is a light brown pelagic clay containing fewer zeolites (0 to 5 per cent) than the underlying unit. This unit is Pleistocene, but contains reworked Pliocene calcareous fossils. Cores 1 and 2 also contain manganese nodules coated in places with Pliocene calcareous nannofossil ooze.

Although there is no trace of volcanic pumice fragments or fresh ash beds, there are beds of almost pure zeolites which may represent replaced ash beds. There are also nodules of pure zeolites, which may represent zeolitized pumice fragments.

Due to the lack of fossils in most of the section, little can be inferred at this time about the geologic history at this site. The magnetic anomaly here is Number 10, which presumably represents an age of 32 million years for the basement. If the basal sediment is actually this old, then the 30 meters of sediment would have been deposited at an average rate of about 0.1 cm/1000 years.

Occasionally in the Pleistocene, conditions were such that calcareous oozes were transported to the site.

From the seismic reflection profiles throughout the survey area, the sediments at the drilling site are not considered anomalously thin, but rather to be representative of this abyssal hill region. Lack of contact metamorphism in the basal sediment probably indicates that the basalt basement is not a sill that truncated the lower part of the section.

The amorphous iron oxide sediments occurring at this site are discussed in detail in Chapter 26 of this volume.

REFERENCES

Kanaya, Taro and Koizumi, Itaru, 1966. Interpretation of diatom thanatocoenoses from the North Pacific applied to a study of core V20-130. *Sci. Rept. Tohoku Univ., Second Sr.* **37** (2), 89.

Simonsen, R. and Kanaya, T., 1961. Notes on the marine species of the diatom genus *Denticula* Kütz. *Intern. Rev. gesamten Hydrobiol.* **46**, 4, 498.

THE CORES RECOVERED FROM SITE 37

The following pages present a graphic summary of the results of drilling and coring at Site 37. Fig. 3, a summary of Site 37 is at the back of the book. Figures 4 to 7 are summaries of the individual cores recovered. A key to the lithologic symbols is given in the Introduction (Chapter 1).

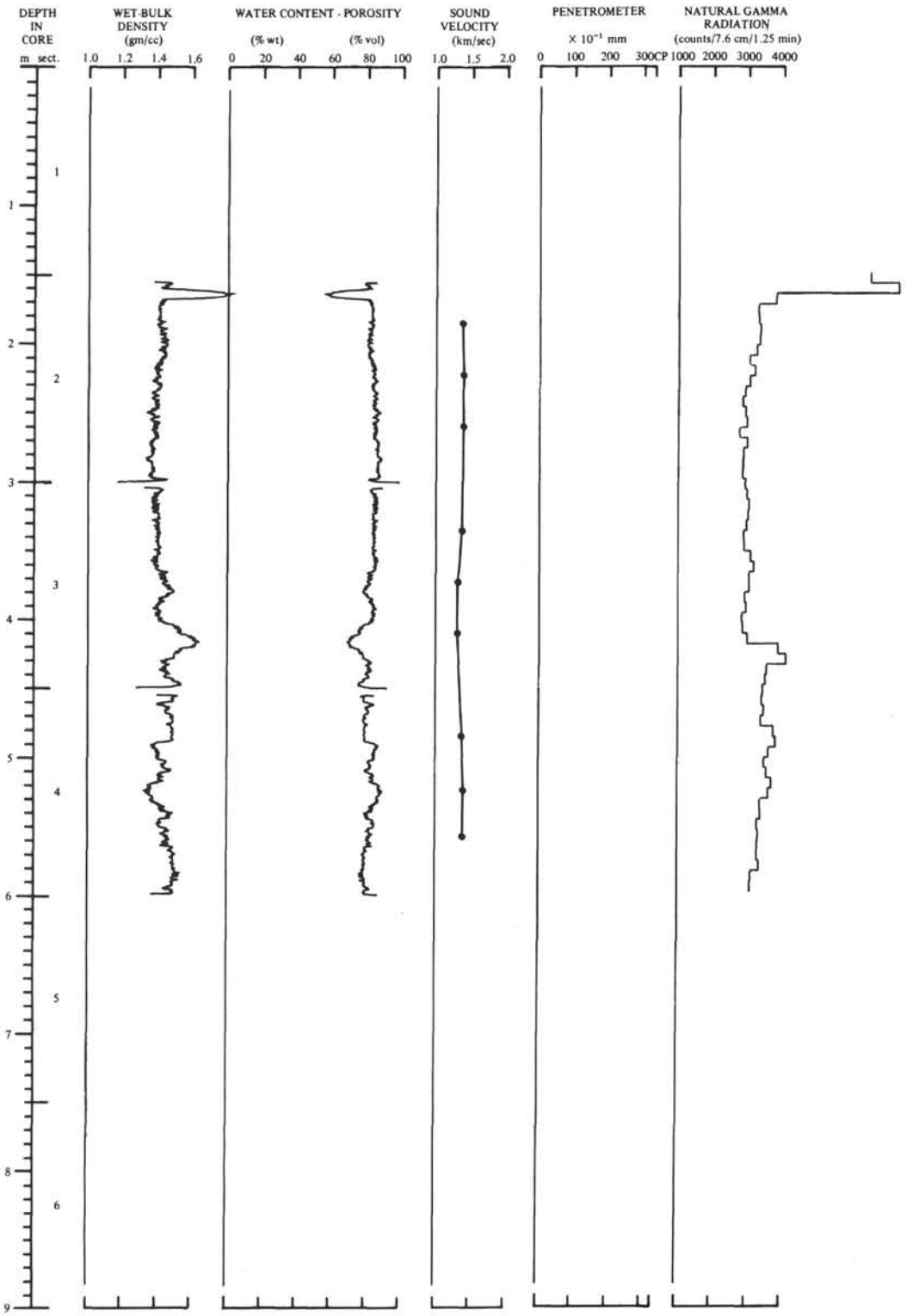

Figure 4A. *Physical Properties of Core 1, Hole 37*

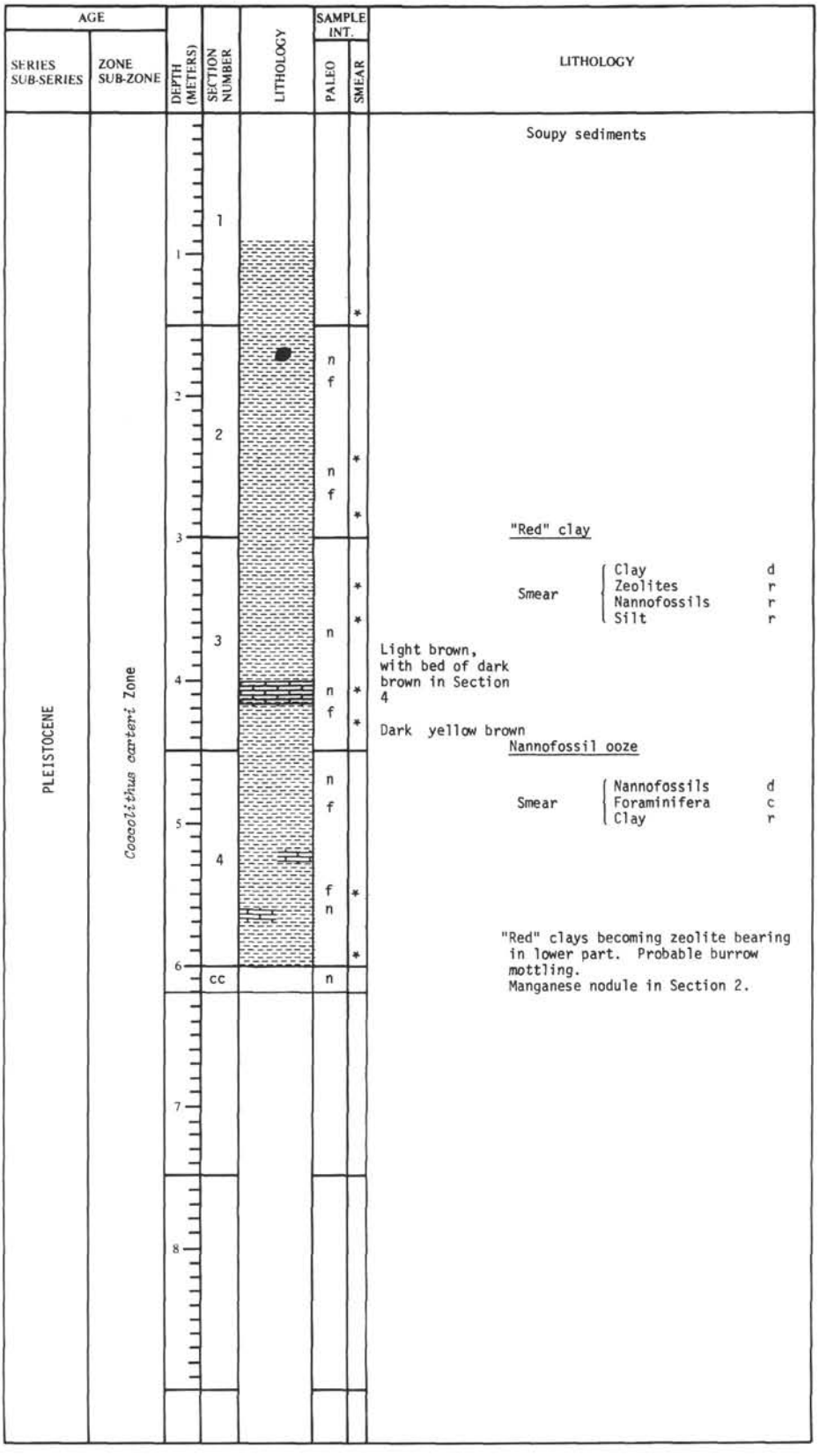

Figure 4B. *Core 1, Hole 37 (0-5 m Below Seabed)*

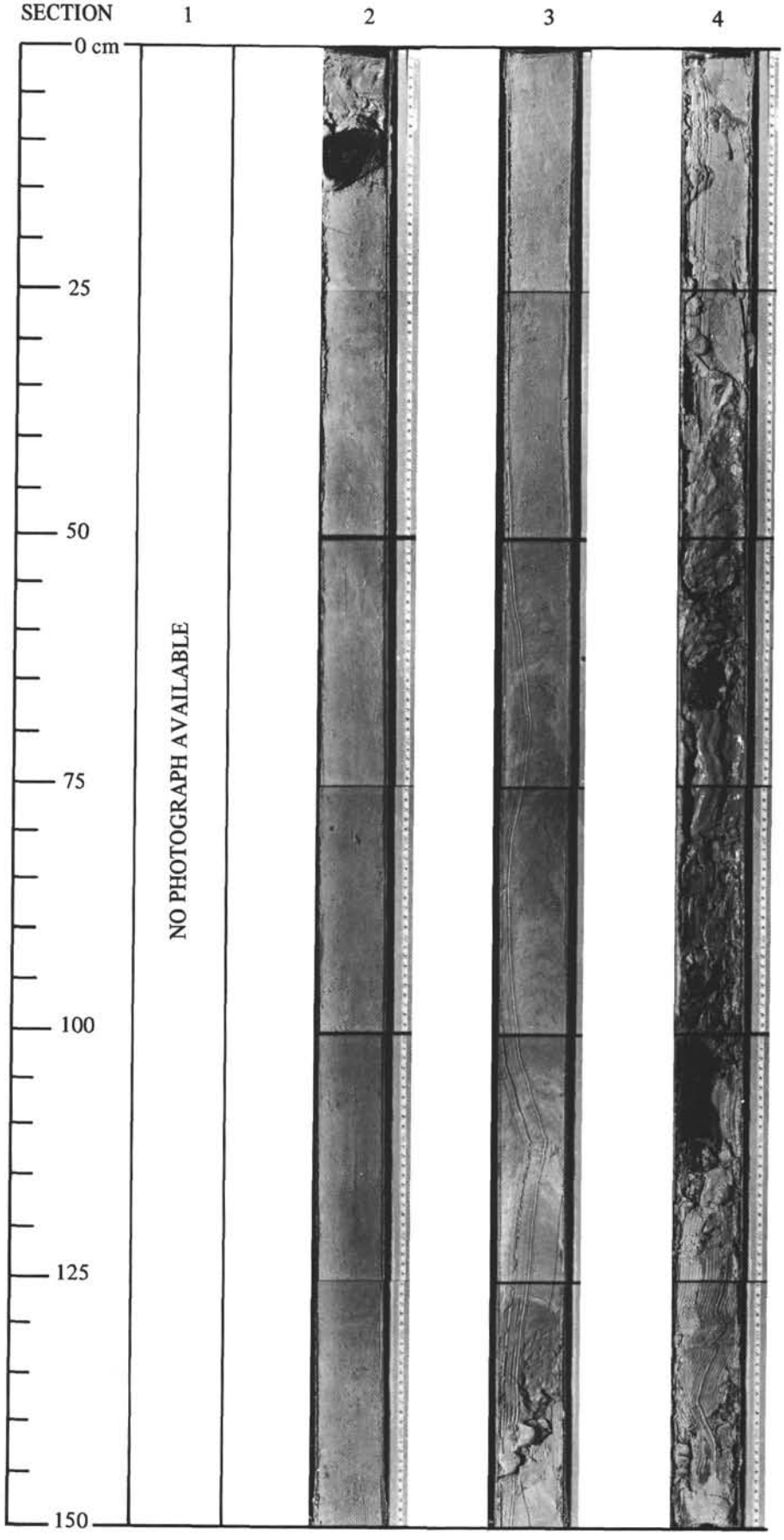

Plate 1. *Core 1, Hole 37*

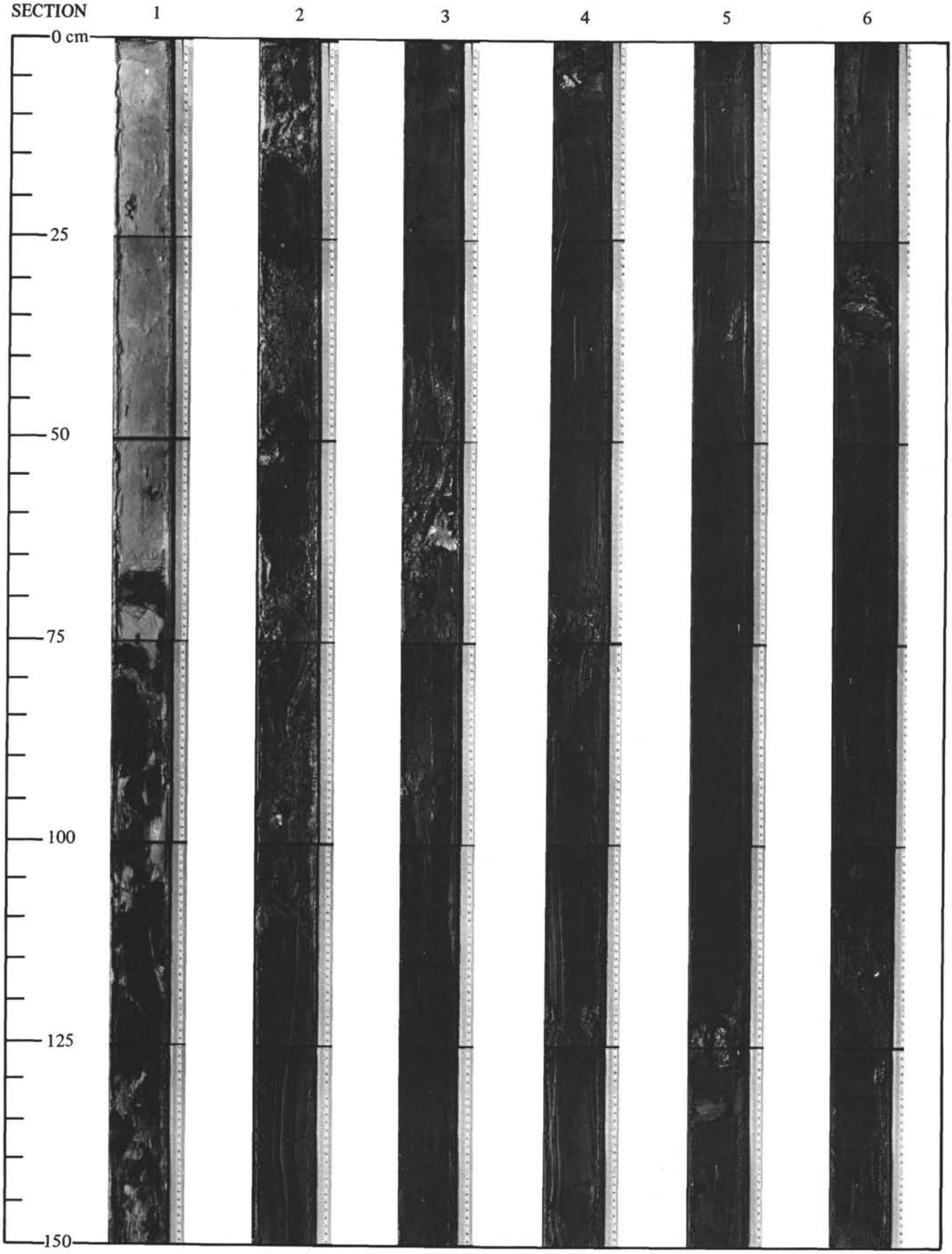

Plate 2. *Core 2, Hole 37*

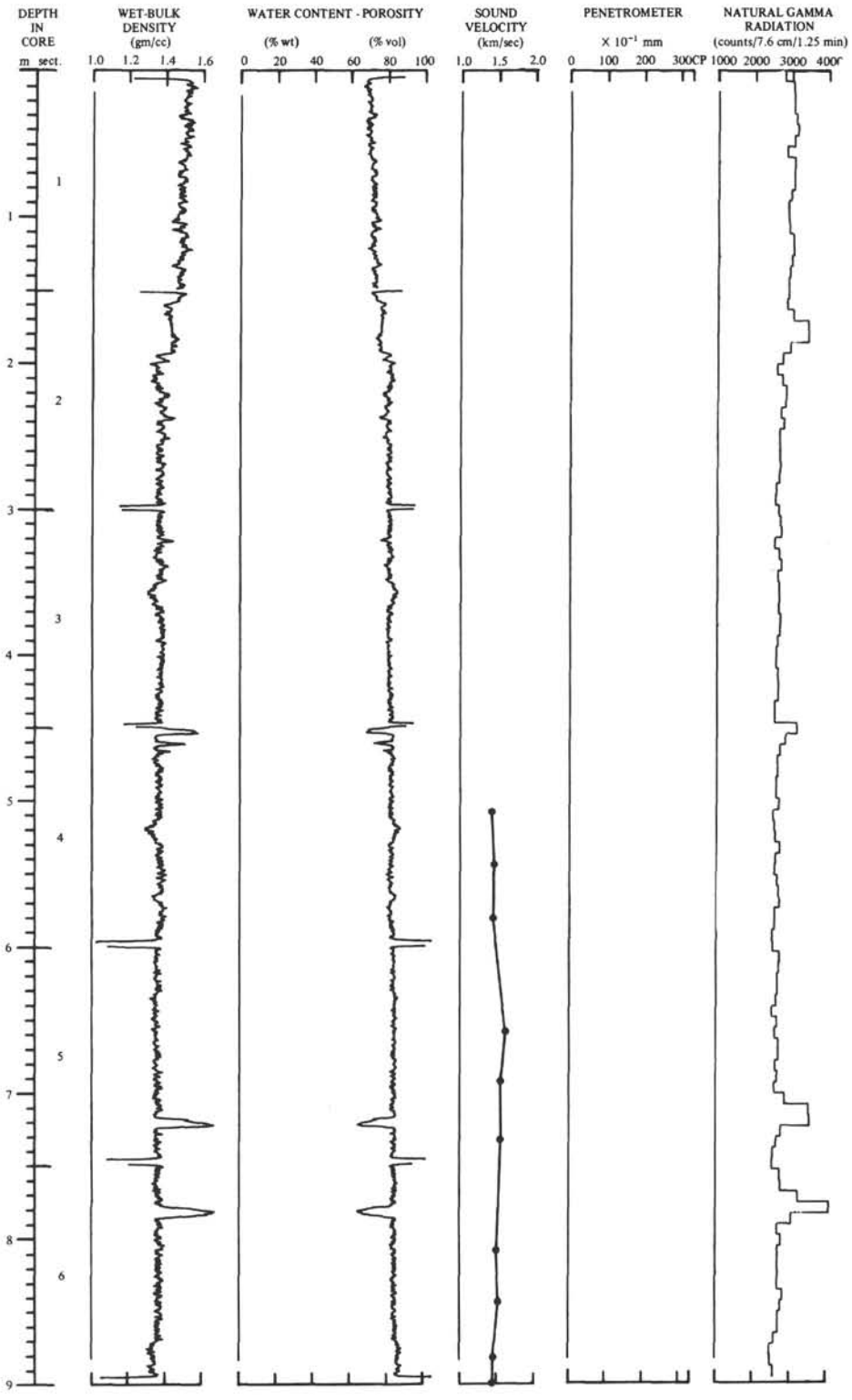

Figure 5A. *Physical Properties of Core 2, Hole 37*

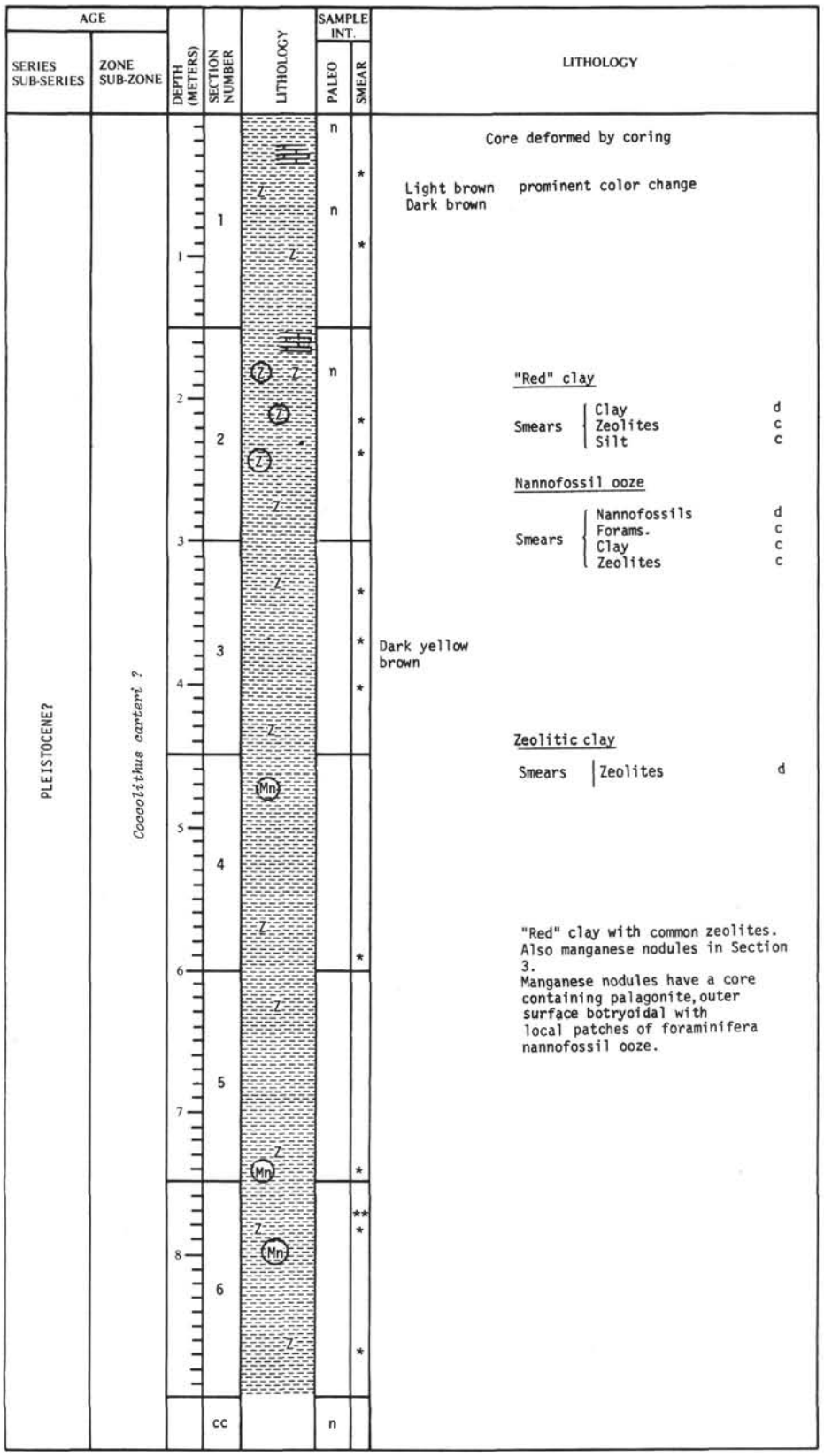

Figure 5B. *Core 2, Hole 37 (5-14 m Below Seabed)*

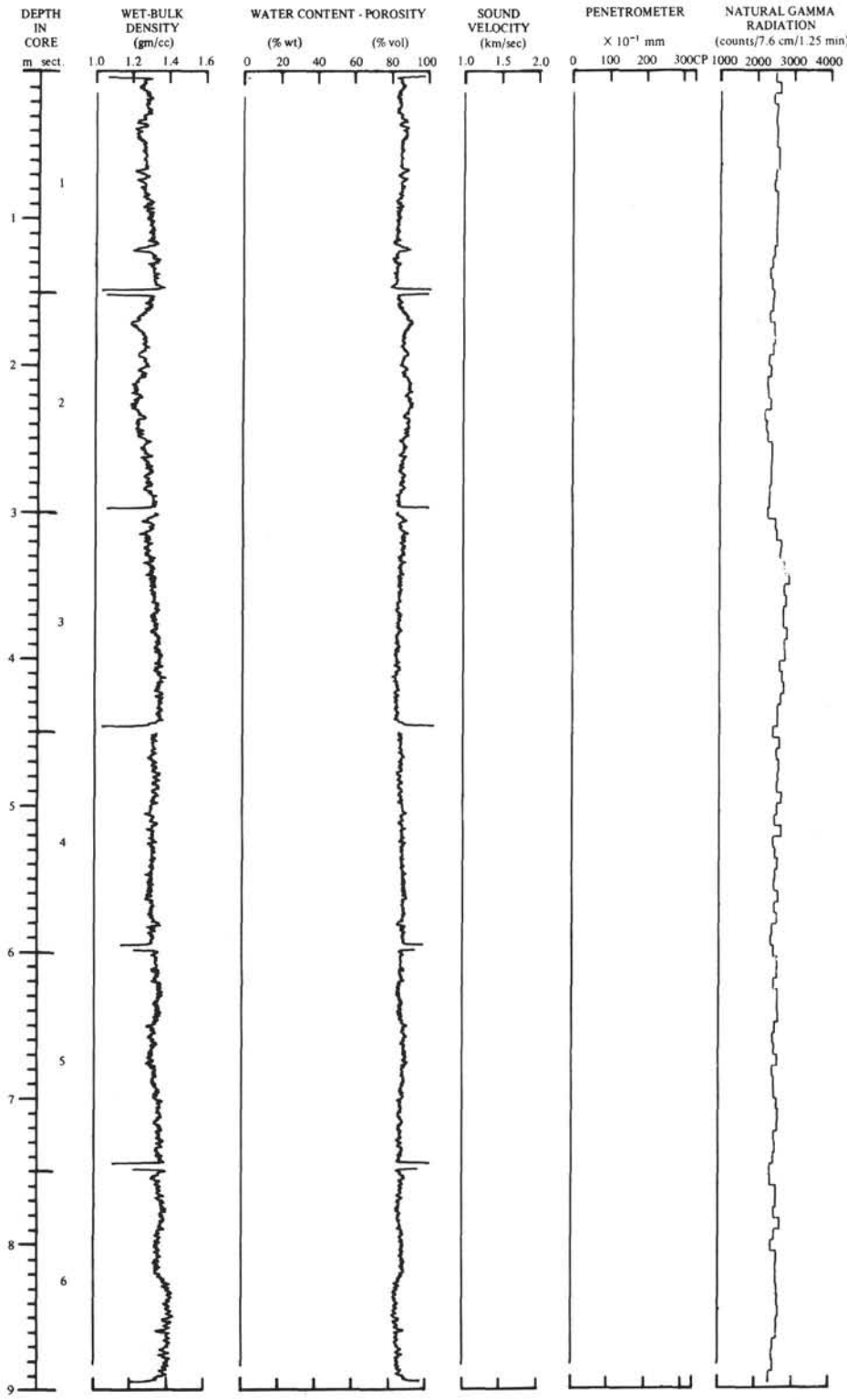

Figure 6A. *Physical Properties of Core 3, Hole 37*

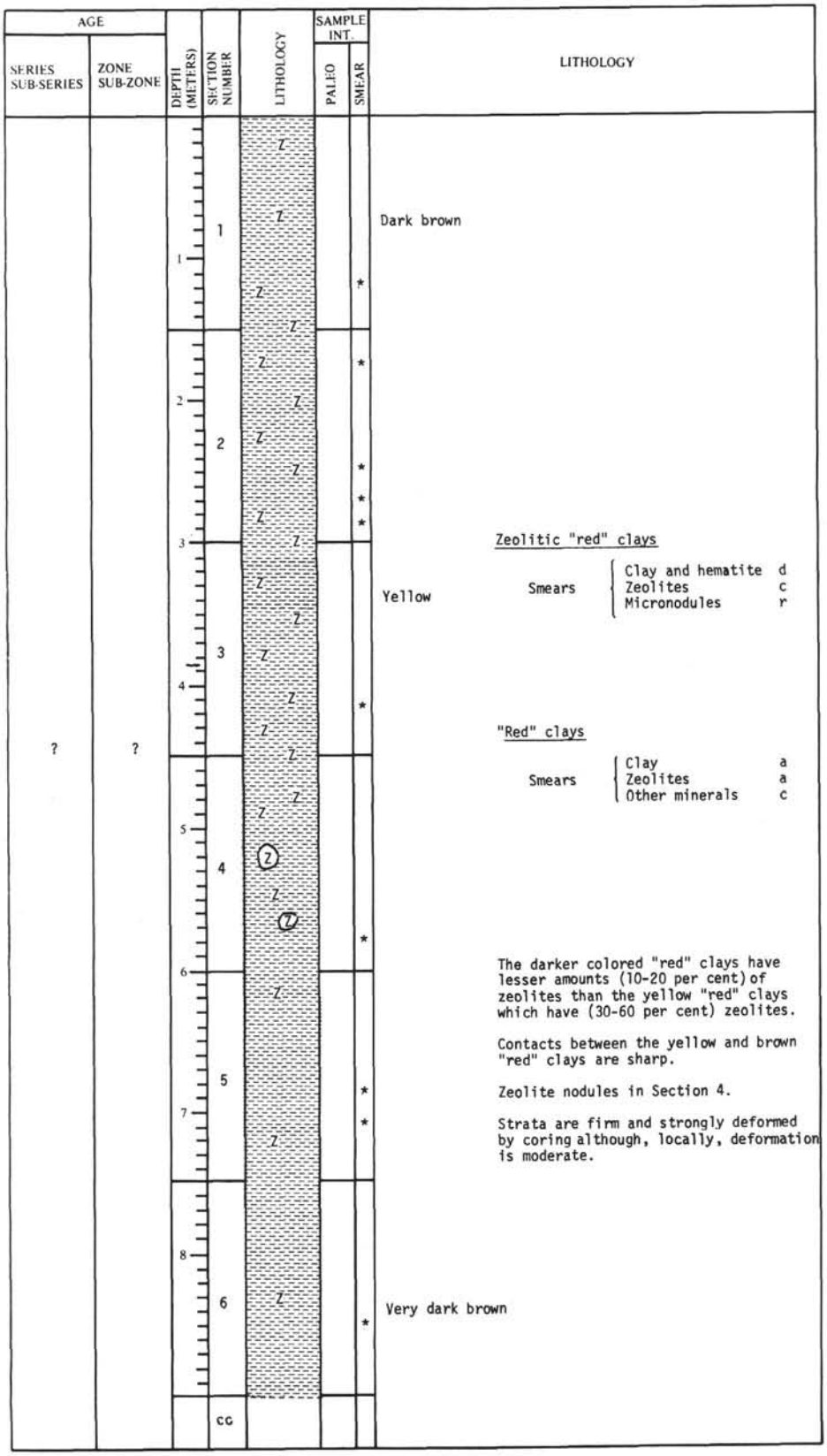

Figure 6B. *Core 3, Hole 37 (14-23 m Below Seabed)*

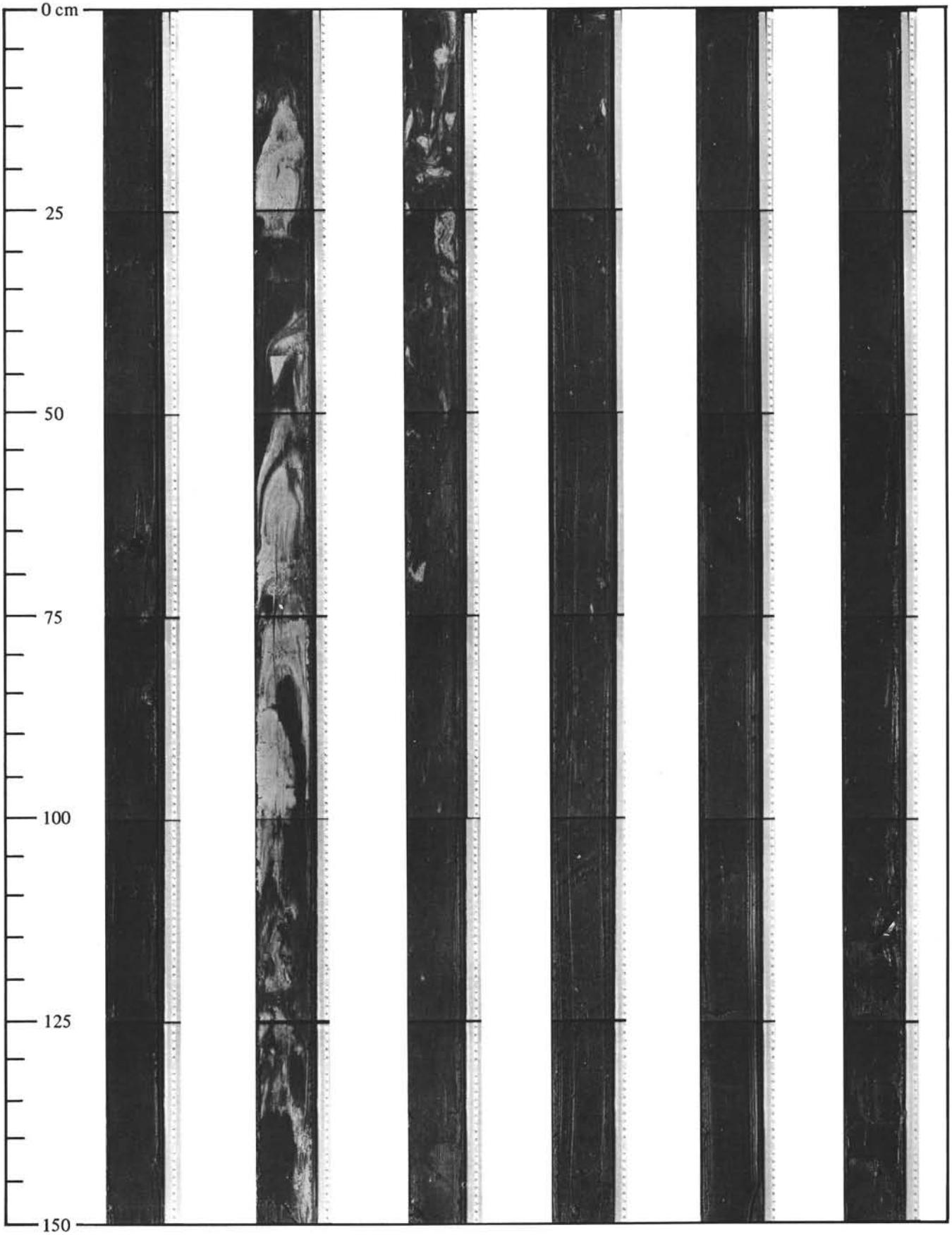

Plate 3. *Core 3, Hole 37*

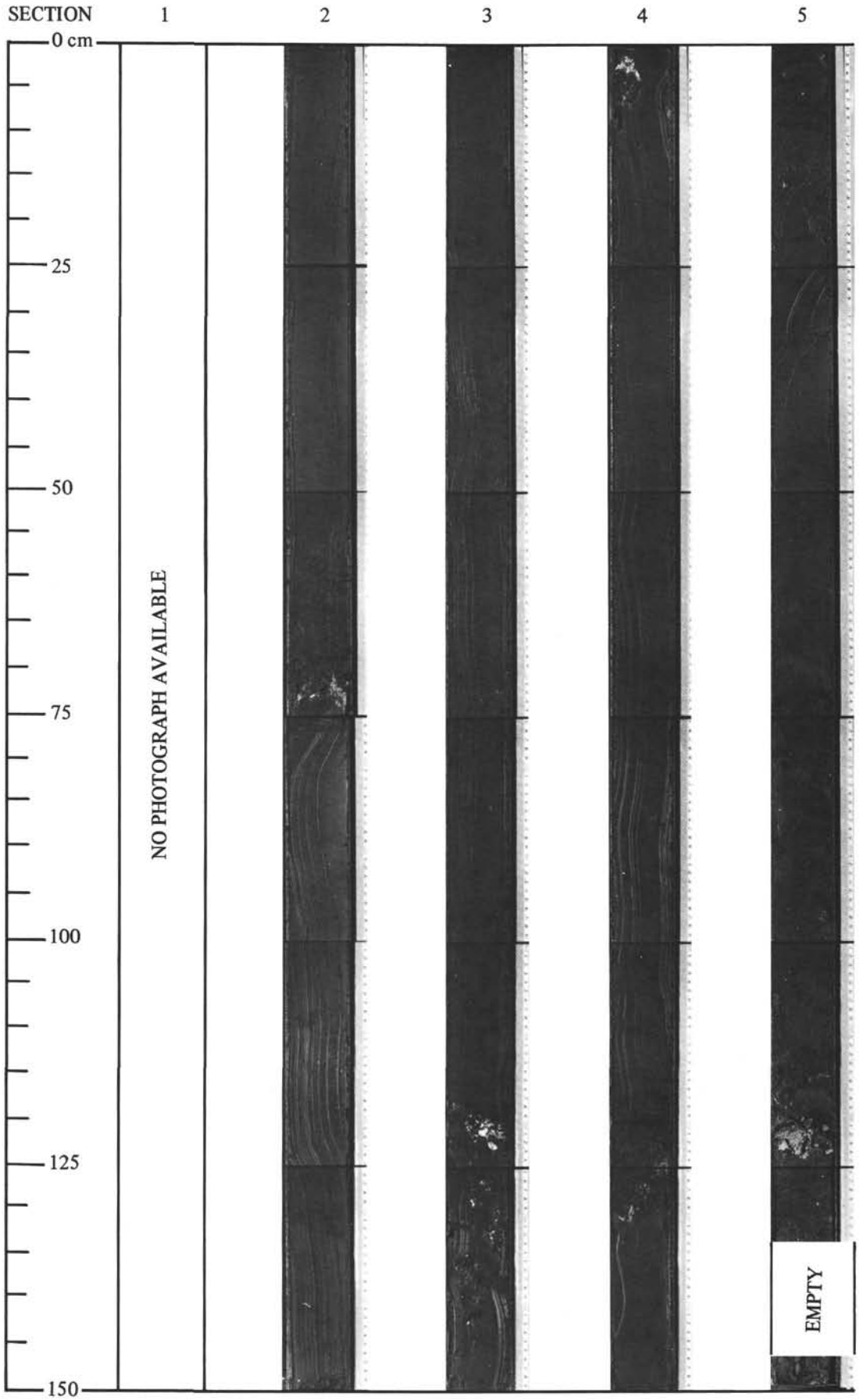

Plate 4. *Core 4, Hole 37*

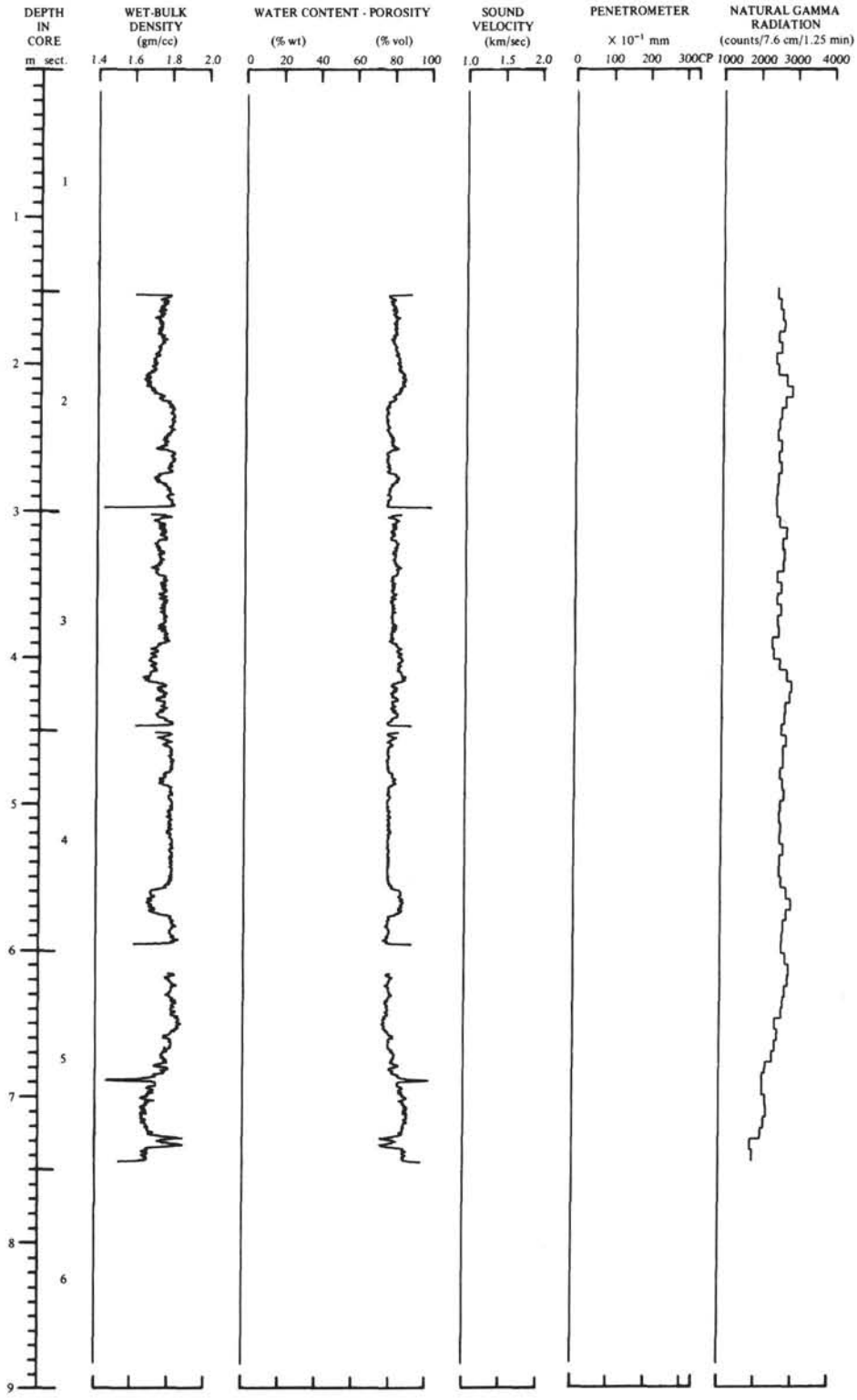

Figure 7A. *Physical Properties of Core 4, Hole 37*

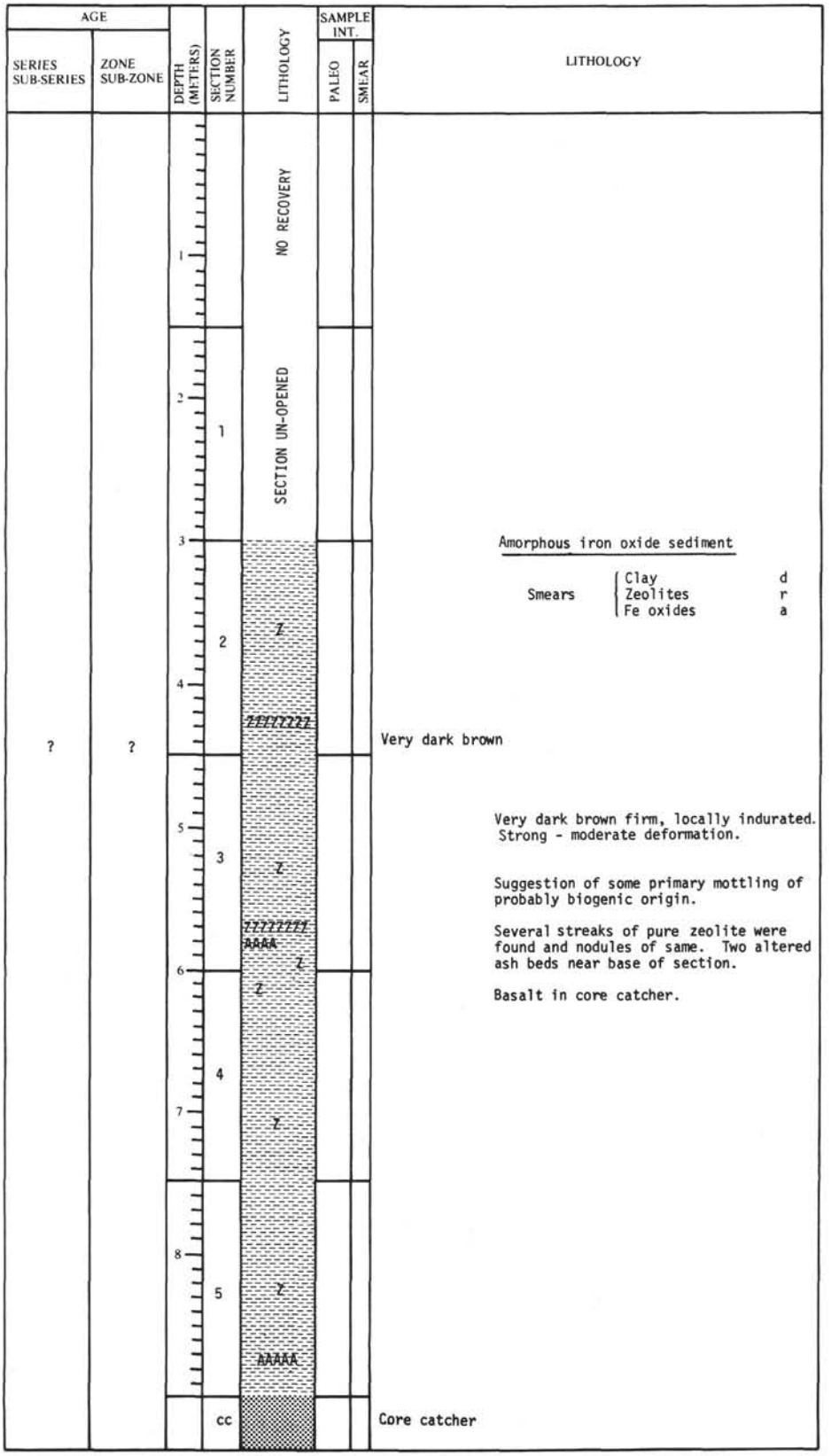

Figure 7B. *Core 4, Hole 37 (23-30 m Below Seabed)*