6. SITE 36

The Shipboard Scientific Party[1]

SITE BACKGROUND

Site 36 was originally selected by the JOIDES Pacific Advisory Panel on a strong negative magnetic anomaly about 200 kilometers west of the ridge crest at Site 35. Coring of the sediment and basement was proposed at this site in order to provide a test of the hypothesis that there is a correlation between age and distance of the magnetic anomalies away from the ridge crest. In addition, the pairing of a positive and negative magnetic anomaly over the several hundred kilometer distance would permit measurements of the degree of variation in the geomagnetism represented by a series of lateral changes in the anomalies. These results could then be compared with the variations between a single lateral change in anomalies as represented by the results from Sites 33 and 34. However, the inability to reach basement during the actual drilling at the earlier sites (Sites 33 and 35), placed a restriction on the possibility of attaining these objectives.

The pelagic sediment forming the section at Sites 36 and 37 would provide the only opportunity for obtaining a cool-water microfossil sequence from the northeastern Pacific. The continuous coring and almost complete recovery at Site 36 has led to the complete realization of this objective.

During the site survey by *Argo* (Appendix III) the proposed drilling site was found to be over a prominent seamount. Consequently, the site was shifted and lies in the abyssal hills region just west of the large north-south ridge which forms the last barrier to the westward dispersal of terrigenous sands and silts through the gap between Gorda Ridge and the Mendocino Fracture Zone. The topography is formed by several seamounts and numerous abyssal hills of 50-meter relief.

An 8.9-meter piston core was taken by *Argo* and consisted mostly of light greenish-gray to light bluish-gray brittle clay. Bottom photographs show that the sea floor is covered to a reasonable degree by manganese nodules. A heat flow measurement of 1.3×10^{-6} cal cm^{-2} sec^{-1} was recorded.

The proposed site was approached by the *Glomar Challenger* along a westerly course, monitoring the magnetometer for the negative anomaly. During the approach to the site, the seismic profiler compressor failed and a course was taken southward along the magnetic low until the compressor could be repaired. After the repair, the drilling location was found quickly. The site is located over the negative magnetic anomaly just west of Anomaly 4 (Pitman-Heirtzler) and, therefore, according to Heirtzler *et al.* (1968), represents an age of slightly less than 8 million years.

The on-site seismic reflection profile (Figure 1) shows questionable reflectors at depths of 0.055 and 0.11 second below the sea floor. Basement is at a depth of 0.15 second below acoustically transparent sediment.

Location

Site 36 is located at latitude 40° 59.08′N, longitude 130° 06.58′W.

OPERATIONS

Continuous coring began on 6 May with an intended surface core (Table 1). Detection of the sea floor with the drill string was difficult, and great uncertainty existed as to whether the core barrel was in contact with the bottom at the time the core was taken. Later paleontological study of the first core failed to disclose the presence of the forms reported in *Argo* piston core. Consequently, it is assumed that the first core, although indicated as representing the interval from 0 to 9 meters, actually was at a distance of several meters below the sea floor.

Upon returning the core barrel to the bottom for Core 6, the bottom of the hole was indicated as being about two meters lower than the depth indicated at the time of retrieval of Core 5. The cause of the discrepancy is believed to be the greater excursion of the ship from position at the time of taking Core 5. A depth correction was made in the log (Table 1), but this does not necessarily indicate a gap in the section, nor does it represent a washed or drilled interval. A similar, but reversed, discrepancy exists between Cores 9 and 10,

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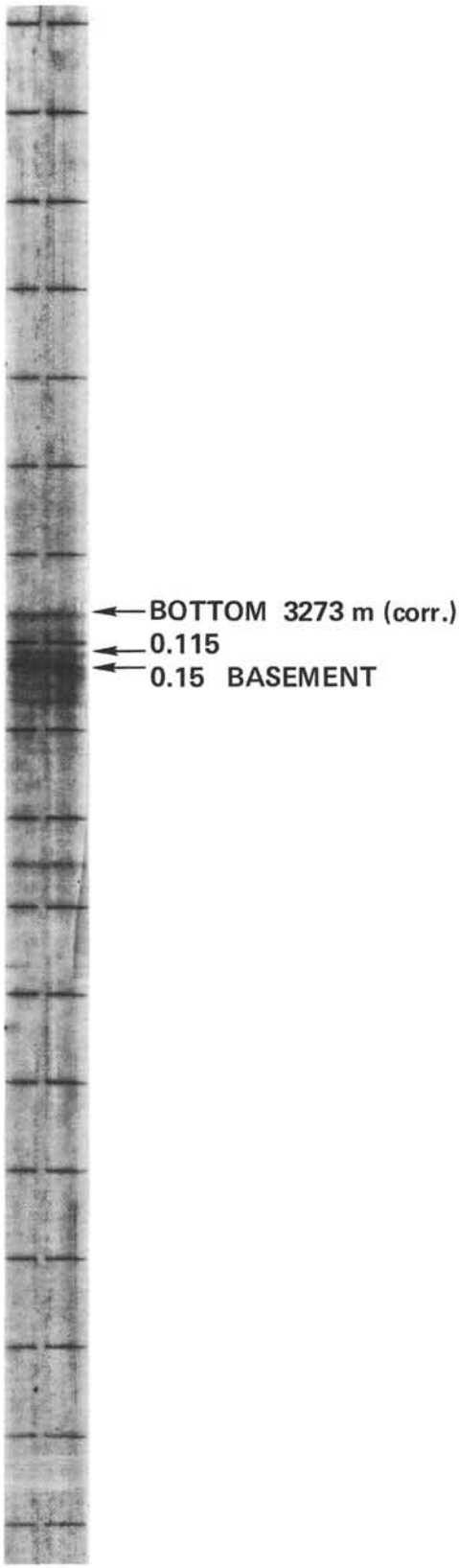

Figure 1. *On-site seismic profile, Site 36.*

where the hole was about two meters shallower upon entering for Core 10 than for retrieval of Core 9.

Although the sediment section is 115 meters thick, this thickness was not sufficient to stabilize the bit during the attempt to core the basalt basement in Core 14. A core length of a few feet in the basalt apparently requires a greater sediment thickness, at least in a pelagic section, or casing in order to provide the requisite stability for the drill string.

LITHOLOGY

At Site 36.0, about 112 meters of sediment were recovered from the 115-meter interval between the sea floor and basement. Of the seventy-three sections from thirteen cores, sixty-two were cut and described. Ninety-six smear slides were studied. Because all of the cores were disturbed by the drilling process, most bedding relationships and other sedimentary structures were destroyed.

Foraminiferal-nannofossil oozes are the dominant sediments, but the terrigenous influence is apparent. Colors range from dark greenish-gray and greenish-gray to gray and yellow. In general, the lighter greenish-grays and grays are oozes and the dark greenish-grays are muds or are oozes with higher clay contents. However, exceptions to these generalizations do occur. Near the top of the section, colors are predominantly greenish-grays. At a depth of 40 meters the color changes to light gray for about 10 meters (in Cores 5 and 6). Between 50 meters and 110 meters (Cores 6 through 12) the colors are greenish-gray and dark greenish-gray with thin gray interbeds. Below 110 meters (Cores 12 and 13), the colors change to yellow-gray and dusky yellow.

Oozes occur as thick beds and also as thin interbeds within intervals of mud. Major ooze intervals are 0 to 21 meters (Cores 1, 2 and part of 3), 25 to 75 meters (bottom of Core 3 through Core 8), 81 to 92 meters (bottom of Core 9 through Core 10), and 99 to 111 meters (Cores 11 and 12). The bottom 1.5 meters of the last interval is a yellow-gray ooze. In oozes of the first 5 cores, coccoliths and planktonic foraminifera are major contributors. Amounts of coccoliths range from 70 to 80 per cent and foraminifera contribute the remaining 20 to 30 per cent. Below Core 5, discoasters become important components. Amounts of foraminifera seem to decrease below 83 meters (Core 9). Also, the clay content of the oozes increases below 83 meters and contributes as much as 20 per cent to some beds.

Four major mud and "red" clay intervals were cored. The first, at depths of 21 to 25 meters (Core 3) below the sea floor, is a greenish-gray calcareous mud. Thin interbeds of ooze reflect changing conditions of sedimentation. A second interval of greenish-gray mud

TABLE 1
Drilling Summary of Leg 5, Site 36

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
6 May	1[a]	0-9	10,783-10,813	30	9.1	30	9.1	100
7 May	2	9-18	10,813-10,843	30	9.1	30	9.1	100
	3	18-27	10,843-10,873	30	9.1	30	9.1	100
	4	27-36	10,873-10,903	30	9.1	30	9.1	100
	5	36-46	10,903-10,933	30	9.1	30	9.1	100
	6[b]	48-57	10,940-10,970	30	9.1	30	9.1	100
	7	57-66	10,970-11,000	30	9.1	30	9.1	100
	8	66-75	11,000-11,030	30	9.1	30	9.1	100
	9	75-83	11,030-11,056	26	7.9	23	7.0	88
	10[c]	83-92	11,056-11,086	30	9.1	30	9.1	100
	11	92-102	11,086-11,116	30	9.1	30	9.1	100
	12	102-111	11,116-11,146	30	9.1	30	9.1	100
8 May	13	111-115	11,146-11,161	15	4.6	15	4.6	100
	14[d]	115.0-115.5	11,161-11,162	1	0.3	1	0.3	100
			Totals	372	112.9	369	112.0	99

[a]Identification of bottom difficult. Core 1 is probably more than 10 meters below sea floor.
[b]Gap between Cores 5 and 6 only apparent. It is actually a depth correction on entering the hole for Core 6.
[c]Bottom of hole was 6 feet (1.8 meters) shallower on entering for Core 10 than on retrieving Core 9.
[d]Sediment was not thick enough to prevent bit from wandering during the coring of basalt.

Note: Sonic water depth (corrected): 3273 meters; 10,735 feet; 1787 fathoms.
Driller's depth: 10,783 feet.

occurs at depths of about 75 to 81 meters (Core 9). Siliceous fossils, glass shards and a few zeolites (?) are minor constituents. No ooze interbeds were noted. A third greenish-gray mud interval, at 92 to 99 meters (Core 11), has thin interbeds of nannofossil ooze. No zeolites or siliceous fossils were observed in the eight smear slides taken from this interval. The deepest mud interval, which is properly termed "red" clay, is dusky yellow in color and lies between 111 meters and the basement (Core 13). Fragments of basalt and siliceous fossils are common constituents. No zeolites were observed.

Four ash beds, ranging in thickness between 3 and 12 centimeters, were described. Depths of the ash beds are 7, 35, 85 and 110 meters (Cores 1, 4, 10 and 12, respectively). The thickest ash bed occurs at 110 meters. Most glass in the ash beds has undergone only slight devitrification.

Basement rock is basalt. About 45 centimeters of black glassy basalt were recovered.

PALEONTOLOGY

Nannofossils

Most of the sediment penetrated at this site contains common calcareous nannoplankton. Less frequent occurrences coincide with scattered clayey intervals in Cores 1 to 5, through most of Core 9, and in parts of Cores 11 and 13. One sample from Section 3, Core 10, is devoid of nannofossils. A few siliceous nannofossils occur in the lower part of Core 13, just above the basalt.

Fragmented debris of calcareous nannofossils is quite abundant at intervals in these sediments and forms the bulk of material in some samples. Associated with these intervals of dominantly fragmental coccolith matrix is

an assortment of reworked older forms from sources of Miocene to Eocene age. Reasonably good preservation of the contemporaneous calcareous nannofossils is present through most of the column of sediment. Some etching and/or disaggregation of specimens is evident, most notably in the less calcareous material–particularly in Core 13.

An hiatus is evident in Core 12, Section 6, at 40 centimeters coincident with a lithologic change where part of the Upper Miocene is missing. A possible hiatus is suggested between Cores 5 and 6 where the uppermost part of the Pliocene is probably missing.

Part of the Pleistocene (Core 1 to the upper part of Core 4) is represented by alternating or mixtures of two assemblages of calcareous nannoplankton. One is dominated by *Cyclococcolithus leptoporus* (Murray and Blackman)–mostly var. B of McIntyre, Bé and Preikstas, *Gephyrocapsa* spp., and occasionally the small coccolith *Coccolithus doronicoides* Black and Barnes?. The *Gephyrocapsa* spp. through this part of the sequence include the three forms which can be differentiated optically: *G. caribbeanica* Boudreaux and Hay–more elongate form with an acute angle between the bridge and the long axis of the coccolith; *G. oceanica* Kamptner–with a high angle between the bridge and coccolith axis; and, *G. aperta* Kamptner–a shorter and smaller form with the bridge approximating an intermediate position (±45°). The other assemblage is dominated by *Coccolithus pelagicus* (Wallich) and *C. carteri* (Wallich), with lesser amounts of the above species or even the complete absence of *Cyclococcolithus leptoporus.* Other species that have a less consistent occurrence through this interval include: *Ceratolithus cristatus* Kamptner, *C. rugosus* Bukry and Bramlette var., *Discolithina japonica* Takayama, *Helicopontosphaera kamptneri* Hay and Mohler, and *Pseudoemiliania lacunosa* (Kamptner). This latter species becomes difficult to identify with any assurance when examining etched smaller coccoliths. These two assemblages probably reflect different surface water conditions in this area at different times in the past when compared with the distributional and environmental data provided by McIntyre and Bé (1967) and McIntyre *et al.* (1967).

The remainder of the Pleistocene, from the upper part of Core 4 through Core 5, is characterized by a slight change in the nannofossil assemblage and is modified in part by the occurrence of reworked forms. *Cyclococcolithus leptoporus macintyrei* Bukry and Bramlette occurs in these two cores; and, there is a drop in the frequency of *Gephyrocapsa* spp. (mostly *G. caribbeanica* and some *G. aperta*), and a concommitant persistent rise in the frequency of *Coccolithus doronicoides?* below the top of Core 4 (see range chart, Hole Summary). A small, 4- to 5-micron, oblong and weakly birefringent coccolith with a central cross occurs in the lowest part of Core 5. Though slightly larger than reported, this species may be *C. neohelis* McIntyre and Bé or a closely related form.

The occurrence of reworked older forms is most evident near the middle of Core 5, especially Section 3. Frequent fragments and parts of asteroliths, including heavy forms, are present. Some can be identified as *Discoaster brouweri* Tan, *D. brouweri* var., *D. brouweri rutellus* Gartner, *D. surculus* Martini and Bramlette, and *D. pentaradiatus* Tan. Other associated reworked forms include *Coccolithus eopelagicus* (Bramlette and Riedel), *Cyclococcolithus neogammation* Bramlette and Wilcoxon, *Discolithina* cf. *D. anisotrema* (Kamptner) of Bramlette and Wilcoxon, and *Helicopontosphaera sellii* Bukry and Bramlette. A preponderance of fragmented coccolith debris forms the matrix where these reworked forms occur. Lower in Core 5, rare fragments and parts of asteroliths are present, but they are completely absent from the lowest part of the core.

The range of *Cyclococcolithus leptoporus macintyrei* appears to be natural and well above the occurrence of any obvious reworked material. A comparable range for this form within the Pleistocene occurs in other areas. In the equatorial Pacific (Leg 9 study in progress) the highest occurrence of this subspecies is a short distance above Datum II of Hays *et al.* (1969). A drop in the frequency of *Coccolithus doronicoides?* occurs at the top of the recovery of this hole (Core 1, Sections 0 and 1), and a number of specimens of these small coccoliths tend toward the expression of less typical optical properties. This may be near the top of the range of this form (McIntyre, 1970).

The highly calcareous ooze of the Upper Pliocene *Discoaster brouweri* Zone (Cores 6 and 7) is characterized by a small coccolith groundmass with common to abundant *Coccolithus doronicoides?* and in some intervals associated with fairly common coccolith detritus. Other characteristic species include: *Cyclococcolithus leptoporus* and vars.–including *C. l. macintyrei; Discoaster brouweri* and vars.; *D. surculus*–many with rather tenuous trifurcations; *D. variabilis* Martini and Bramlette var.; *D. pentaradiatus; D.* sp. aff. *D. exilis* Martini and Bramlette; *Coccolithus pelagicus; Ceratolithus cristatus;* and, *C. rugosus* var. Species with a more infrequent occurrence in these two cores include: *Coccolithus carteri, Discolithina japonica, Helicopontosphaera kamptneri, H. sellii, Pseudoemiliania lacunosa,* and *Thoracosphaera saxea* Stradner (see Diagnostic Fossils, Hole Summary). In addition, rare occurrences of *Discoaster asymmetricus* Gartner–top and middle of Core 6, and *D. quinquerimus* Gartner–lower part of Core 6–are recorded. *D. brouweri rutellus* and *D.* cf. *D. challengeri* Bramlette and Riedel–with weakly bifurcating ray terminations–are found in the lower part of this zone.

A few reworked specimens of older forms exhibiting poorer preservation are present in this Upper Pliocene sequence. Most notable are the various fragmented asteroliths in the top of Core 6, including *Discoaster exilis* and var., and the presence of *D. deflandrei* Bramlette and Riedel in the lower part of Core 7. A peculiar assemblage is present in the sample from the upper part of Section 2, Core 6. This assemblage has numerous large forms of *Coccolithus pelagicus*–many of which are pitted or partly coated, and an increase in the frequency of *Cyclococcolithus leptoporus macintyrei* and *Helicopontosphaera sellii.* No asteroliths are evident, but poorly preserved *H. intermedia* (Martini) is present; and, the matrix is composed of abundant coccolith debris. These features suggest a modification or dilution of the contemporaneous calcareous nannoplankton accumulation by the influx of sediment from an older source, or a distinctly different set of environmental factors.

The occurrence of *Discoaster surculus, D. variabilis* var., *D.* sp. aff. *D. exilis,* and *D. pentaradiatus* at the top of the Pliocene at this site is suspect. The highest part of the Pliocene in other areas is characterized by the singular presence of *D. brouweri* and vars. without these heavier or distinctly ray-terminated forms (Gartner, 1969; Hay *et al.*, 1967; Riedel *et al.*, 1963). The occurrence of these asteroliths, coupled with the reworking evident in the Pleistocene above, suggests an hiatus between the Pliocene and Pleistocene at this site with the uppermost part of the Pliocene missing. However, the irregularities in the nannofossil suites in the upper part of Core 6 could mean that the range of some of these asteroliths has been extended upward by reworking into the upper part of Core 6. It seems unreasonable, however, to account for this time span (equivalent to at least the upper half of the foraminiferal Zone N21) within one or two meters of section with the higher rates of sedimentation indicated at this site (see Chapter 31).

The Lower Pliocene (most of Core 8 through Core 11) generally contains the same calcareous nannofossil assemblage as the Upper Pliocene in conjunction with additional forms. These include *Ceratolithus tricorniculatus* Gartner and unquestionable *Discoaster challengeri.* With the presence of *Reticulofenestra pseudoumbilica* (Gartner) in the lower subzone, *Coccolithus doronicoides?* becomes a minor constituent of the assemblage. The highest occurrence of *Discoaster variabilis* s.s. is in this lower subzone within Core 10, and rare specimens of *D. quinquerimus* occur in the upper part of Section 3, Core 8, and in Core 9, Section 2.

Corroded or otherwise poorly preserved reworked older specimens are scattered at intervals in Core 8. *D. exilis* and var. and *D. variabilis* are present in Sections 1, 5 and 6. A single corroded specimen of the distinctive Eocene nannofossil, *Chiphragmalithus quadratus* Bramlette and Sullivan occurs in the upper part of Section 2, Core 9.

Parts of the Lower Pliocene section, Core 9, and certain intervals of Core 11, are not exceptionally coccolith-rich, and contain scattered siliceous spicules and radiolarian parts. Most of the highly calcareous parts of Core 11, as well as the calcareous-rich sediments of the upper and lower parts of Core 10, essentially, are composed of very small fragments of coccoliths, and occasionally calcareous grains. Associated with this fragmental material is a higher incidence of reworked older calcareous nannofossils. These include fragmented, etched, or coated Miocene forms, such as, *Discoaster exilis* and var. and larger, heavy forms of *D. variabilis.* Broken, ragged edged or distorted coccoliths exhibiting heavier preservation characteristics represented by *Coccolithus* aff. *C. bisectus* (Hay, Mohler and Wade) of Bramlette and Wilcoxon and *Cyclococcolithus neogammation* Bramlette and Wilcoxon occur in these areas of Core 10. In the parts of Core 11 containing the fragmental background, the most frequent and diverse suite of reworked specimens occurs. Besides the above species, the following are found: *C. lucitanicus* (Black), *Coccolithus bisectus* (Hay, Mohler and Wade), *Reticulofenestra umbilica* (Levin), *Discoaster deflandrei, D. barbadiensis* Tan and *D. lodoensis* Bramlette and Riedel. The Middle Miocene forms are the most frequent with slightly fewer Oligocene specimens and only rare Eocene derived individuals. It is most likely that the bulk of the fragmental coccolith-matrix also represents deposited material.

The Upper Miocene is represented in Core 12 by material similar to that of Core 11 with scattered reworked calcareous nannofossils and fragmental coccolith matrix. The most obvious older forms are *D. exilis, Coccolithus eopelagicus, Cyclococcolithus neogammation* and *Reticulofenestra umbilica.* Most of the Upper Miocene is represented by the *Ceratolithus tricorniculatus* Zone. A seven-centimeter thick lighter-colored calcareous ooze, just above a sharp lithologic change at 40 centimeters in Section 6, Core 12, is all that can be found representing the *Discoaster variabilis* Zone. This thin bed is characterized by the *D. variabilis-D. challengeri* Subzone, while the assemblage in the nannofossil oozes below represents the *D. exilis-Reticulofenestra pseudoumbilica* Subzone of the Middle Miocene. Therefore, a significant hiatus is present at this lithologic change with all of the *Discoaster variabilis-D. exilis* Subzone missing, and probably a large portion of the *D. variabilis-D. challengeri* Subzone. This represents a gap in the record at this site with a magnitude of about 2 million years. Additional species encountered in the Upper Miocene above the hiatus include *D. calcaris* Gartner, *D. subsurculus* Gartner, *D.* aff. *D. bollii* Martini and Bramlette, and *D. exilis* var.

The nannofossil assemblage below the lithologic change in Core 12 is dominated by the *D. exilis* group including the *sensu stricto* form in association with *Reticulofenestra pseudoumbilica, Cyclococcolithus leptoporus* and vars., *Discoaster challengeri*–many somewhat atypical with shorter bifurcations and slightly larger discs, *D.* cf. *D. divaricatus* Hay–with weak blocky or U-shaped bifurcations, *D. variabilis, D.* cf. *D. brouweri*–quite small atypical forms with larger central nob, *D. b. rutellus, D. kugleri* Martini and Bramlette var., and *D.* cf. *D. calcaris*–with incompletely expressed or indistinctly asymmetrical spurs on ray ends. Other species are evident in the less calcareous sediments of Core 13, which also contain infrequent siliceous microfossils. The most diverse and well-preserved assemblage of siliceous nannofossils occurs in the bottom of Core 13, and it includes *Denticula lauta* Bailey–also present in Section 2, *D. hustedtii* Simonsen and Kanaya, *Actinocyclus ingens* Rattray, *Coscinodiscus marginatus* Ehrenberg, *Dictyocha triommata* Ehrenberg, and *Distephanus crux longispina* Schulz. Additional calcareous nannofossils in Core 13 are *Discoaster aulakos* Gartner–five- and six-rayed, *D. divaricatus*–highest in the lower part of Section 3, *D.* cf. *D. variabilis*–heavy or gross form, and *D.* cf. *D. deflandrei*–the immediate form to *D.* cf. *D. variabilis.* The preservation of the coccoliths is quite poor to only fair in Core 13 with many specimens exhibiting etched or missing parts. There are rare specimens of circular or near circular coccoliths in Sections 3 and 4 that approach *Cyclococcolithus neogammation,* but their central parts are distorted or missing due to the poor preservation, thus preventing positive identification. However, the joint occurrence of the siliceous and calcareous nannofossils in the lower part of Core 13 is certainly comparable to the association in the upper part of the *Discoaster exilis-Cyclococcolithus neogammation* Subzone of Sites 33 and 34 where the boundary approximates the highest occurrence of *Discoaster divaricatus s.s.* The approximate subzone boundary is placed above the occurrences of these characteristic forms.

Foraminifera

Foraminifera occur throughout Cores 1 to 12. They are generally abundant to common throughout, but become less frequent in the lower few cores, apparently due to solution effects.

Identification of Species:

Sample 36-1-1, top:
Globigerina bulloides d'Orbigny, *Globigerina calida praecalida* Blow, *Globigerina pachyderma* (Ehrenberg), *Globigerina quinqueloba* Natland, *Globorotalia scitula* (Brady), *Globigerinita glutinata* (Egger), *Orbulina universa* d'Orbigny.

Sample 36-1-1, 34-36 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia crassaformis s.l. (Galloway and Wissler), *Orbulina universa.*

Sample 36-1-1, 125-127 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia hirsuta (d'Orbigny), *Globorotalia inflata* (d'Orbigny).

Sample 36-1-2, 25-27 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia crassaformis s.l., *Globorotalia hirsuta, Globorotalia inflata, Globorotalia scitula* (Brady), *Globigerinita humilis* (Brady), *Globigerinoides ruber* d'Orbigny, *Sphaeroidinella dehiscens* (Parker and Jones), *Orbulina universa.*

Sample 36-1-2, 104-106 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia crassaformis s.l., *Globorotalia hirsuta, Globorotalia inflata, Globorotalia tosaensis* Takayanagi and Saito–worn fragment–*Sphaeroidinella dehiscens, Orbulina universa.*

Sample 36-1-3, 30-32 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia hirsuta, Globorotalia inflata, Globigerinoides ruber, Orbulina universa.

Sample 36-1-3, 112-114 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia hirsuta, Globorotalia inflata, Globigerinita uvula (Ehrenberg), *Orbulina universa.*

Sample 36-1-4, 60-62 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia crassaformis s.l., *Globorotalia hirsuta, Globorotalia inflata, Globigerinoides ruber, Orbulina universa.*

Sample 36-1-4, 103-104 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia crassaformis s.l., *Globorotalia hirsuta, Globorotalia inflata, Globigerinoides ruber, Sphaeroidinella dehiscens, Orbulina universa.*

Sample 36-1-5, 91-93 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia crassaformis s.l., *Globorotalia hirsuta, Globorotalia inflata, Globorotalia scitula, Globigerinita glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-1-5, 115-117 cm:
Same as above.

Sample 36-1-6, 25-27 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia hirsuta, Globorotalia inflata, Globigerinita glutinata.

Sample 36-1-6, 95-97 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia inflata, Globorotalia scitula, Globigerinita glutinata, Orbulina universa.

Sample 36-2-1, 11-13 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia crassaformis, Globorotalia hirsuta, Globorotalia inflata, Globigerinita glutinata, Orbulina universa.

Sample 36-2-1, 100-102 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia inflata, Globorotalia scitula, Globigerinita glutinata, Globigerinita uvula, Globigerinoides ruber, Orbulina universa.

Sample 36-2-2, 8-10 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia crassaformis s.l., *Globorotalia inflata, Globorotalia scitula, Globigerinita glutinata, Orbulina universa.*

Sample 36-2-2, 100-102 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia crassaformis, Globorotalia inflata, Globorotalia scitula, Globigerinita glutinata, Globigerinita uvula, Orbulina universa.

Sample 36-2-3, 10-12 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia crassaformis, Globorotalia inflata, Globorotalia scitula, Globigerinita iota Parker, *Orbulina universa.*

Sample 36-2-3, 102-104 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia crassaformis s.l., *Globorotalia inflata, Globigerina glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-2-4, 13-15 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia crassaformis, Globorotalia inflata, Orbulina universa.

Sample 36-2-4, 103-105 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima Blow, *Globorotalia crassaformis, Globorotalia hirsuta, Globorotalia inflata, Globigerinita glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-2-5, 13-15 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia crassaformis, Globorotalia inflata, Globorotalia scitula, Globigerinita glutinata, Orbulina universa.

Sample 36-2-5, 102-104 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia cf. *G. acostaensis acostaensis* Blow, *Globorotalia acostaensis pseudopima, Globorotalia inflata, Globorotalia scitula, Globigerinita glutinata, Globigerinita uvula.*

Sample 36-2-6, 18-20 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia cf. *G. acostaensis acostaensis, Globorotalia crassaformis* s.l., *Globorotalia hirsuta praehirsuta* Blow, *Globigerinita glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-2-6, 98-100 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia cf. *G. acostaensis acostaensis, Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globigerinita glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-3-1, 18-20 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina glutinata, Globorotalia hirsuta praehirsuta.

Sample 36-3-1, 102-104 cm:
Globigerina bulloides, Globigerina cf. *G. dutertrei* d'Orbigny, *Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia crassaformis, Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globorotalia* cf. *G. scitula, Globigerinita glutinata, Globigerinita uvula, Globigerinoides ruber, Sphaeroidinella dehiscens, Orbulina universa.*

Sample 36-3-2, 18-20 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globigerinita glutinata, Globigerinoides ruber, Orbulina universa.*

Sample 36-3-2, 100-102 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia inflata, Globigerinita glutinata, Globigerinita uvula.

Sample 36-3-3, 13-15 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia crassaformis s.l., *Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globigerinita glutinata, Globigerinoides ruber, Orbulina universa.*

Sample 36-3-3, 100-102 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia inflata, Globigerinita glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-3-4, 15-17 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia crassaformis s.l., *Globorotalia inflata.*

Sample 36-3-4, 110-112 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia inflata, Globorotalia* cf. *G. scitula, Globigerinita glutinata, Globigerinita uvula, Globigerinoides ruber, Orbulina universa.*

Sample 36-3-5, 15-17 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia acostaensis pseudopima, Globorotalia inflata, Globorotalia scitula.

Sample 36-3-5, 100-102 cm:
Globigerina bulloides, Globigerina calida praecalida, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globigerinita glutinata, Globigerinita uvula, Globigerinoides ruber, Orbulina universa.*

Sample 36-3-6, 11-13 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia cf. *G. acostaensis acostaensis, Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globorotalia tosaensis, Globorotalia truncatulinoides pachytheca* Blow, *Globigerina glutinata, Globigerinoides conglobatus* (Brady), *Globigerinoides ruber, Orbulina universa.*

Sample 36-3-6, 100-102 cm:
Globigerina bulloides, Globigerina cf. *G. conglomerata* Schwager, *Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia inflata, Globorotalia truncatulinoides pachytheca, Globigerinita glutinata, Globigerinita uvula, Globigerinoides conglobatus, Globigerinoides ruber, Orbulina universa.*

Sample 36-4-1, 35-37 cm:
Globigerina bulloides, Globigerina pachyderma, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia inflata, Globorotalia tosaensis, Globigerinita glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-4-1, 100-102 cm:
Globigerina bulloides, Globigerina cf. *G. conglomerata, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia inflata, Globorotalia truncatulinoides pachytheca, Globigerinita glutinata, Globigerinita uvula, Globigerinoides conglobatus, Globigerinoides ruber, Hastigerina siphonifera* (d'Orbigny), *Orbulina universa.*

Sample 36-4-2, 28-30 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia cf. *G. acostaensis acostaensis, Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia inflata, Globorotalia scitula, Globorotalia tosaensis, Globigerinita glutinata, Globigerinoides conglobatus, Hastigerina siphonifera, Orbulina universa.*

Sample 36-4-2, 102-104 cm:
Globigerina bulloides, Globigerina calida praecalida, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis Blow, *Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globorotalia scitula, Globorotalia truncatulinoides pachytheca, Globigerinita glutinata, Globigerinita uvula, Globigerinoides conglobatus, Hastigerina siphonifera, Orbulina universa.*

Sample 36-4-3, 35-36 cm:
Globigerina bulloides, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia inflata, Globorotalia scitula, Globorotalia tosaensis, Globigerinita glutinata, Orbulina universa.*

Sample 36-4-3, 113-115 cm:
Globigerina bulloides, Globigerina cf. *G. dutertrei* d'Orbigny, *Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia inflata, Globorotalia* cf. *G. scitula, Globigerinita glutinata, Globigerinita uvula, Globigerinoides ruber, Hastigerina siphonifera, Orbulina universa.*

Sample 36-4-4, 17-19 cm:
Globigerina bulloides, Globigerina calida praecalida, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globorotalia tosaensis, Orbulina universa.*

Sample 36-4-4, 100-102 cm:
Globigerina bulloides, Globigerina calida praecalida, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia inflata, Globorotalia truncatulinoides pachytheca, Globigerinita glutinata, Globigerinita uvula, Globigerinoides ruber, Orbulina universa.*

Sample 36-4-5, 30-32 cm:
Globigerina bulloides, Globigerina calida praecalida, Globigerina dutertrei d'Orbigny, *Globigerina pachyderma, Globigerina quinqueloba, Globorotalia*

acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia inflata, Globorotalia* cf. *G. scitula, Globorotalia tosaensis, Globigerinita glutinata, Globigerinoides conglobatus, Globigerinoides ruber, Orbulina universa.*

Sample 36-4-5, 100-102 cm:
Globigerina bulloides, Globigerina dutertrei, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia cf. *G. acostaensis humerosa* Takayanagi and Saito, *Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia crassula* Cushman and Stewart, *Globorotalia inflata, Globorotalia truncatulinoides pachytheca, Globigerinita glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-4-6, 20-22 cm:
Globigerina bulloides, Globigerina dutertrei, Globigerina pachyderma, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globigerinita glutinata, Orbulina universa.*

Sample 36-4-6, 109-111 cm:
Globigerina bulloides, Globigerina dutertrei, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia inflata, Globigerinita glutinata, Globigerinita uvula, Globigerinoides ruber, Orbulina universa.*

Sample 36-5-1, 100-102 cm:
Globigerina bulloides, Globigerina dutertrei, Globigerina pachyderma, Globorotalia cf. *G. subscitula* Conato, *Orbulina universa.*

Sample 36-5-3, 10-12 cm:
Globigerina bulloides, Globigerina dutertrei, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia acostaensis humerosa Takayanagi and Saito, *Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia hirsuta praehirsuta, Globorotalia inflata, Globorotalia tumida* (Brady), *Globigerinita glutinata, Globigerinoides ruber, Orbulina universa.*

Sample 36-5-3, 108-110 cm:
Globigerina bulloides, Globigerina dutertrei, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globigerinita glutinata, Globigerinita uvula, Globigerinoides conglobatus, Globigerinoides ruber, Orbulina universa.*

Sample 36-5-4, 31-33 cm:
Globigerina bulloides, Globigerina dutertrei, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia crassaformis s.l., *Globigerinita glutinata, Orbulina universa.*

Sample 36-5-4, 100-102 cm:
Globigerina bulloides, Globigerina cf. *G. digitata praedigitata* Parker, *Globigerina dutertrei, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia acostaensis humerosa, Globorotalia acostaensis pseudopima, Globorotalia crassaformis, Globorotalia inflata, Globigerinita glutinata, Globigerinita uvula, Globigerinoides ruber, Orbulina universa.*

Sample 36-5-6, 20-22 cm:
Globigerina bulloides, Globigerina dutertrei, Globigerina pachyderma, Globorotalia acostaensis acostaensis, Globorotalia acostaensis humerosa, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globigerinita glutinata, Orbulina universa.*

Sample 36-5-6, 110-112 cm:
Globigerina bulloides, Globigerina dutertrei, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia acostaensis humerosa, Globorotalia acostaensis pseudopima, Globorotalia crassaformis s.l., *Globorotalia inflata, Globigerinita glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-6-1, 84-86 cm:
Globigerina bulloides, Globigerina dutertrei–5 chambered variants–*Globigerina pachyderma, Globigerina quinqueloba, Globorotalia crassaformis* s.l., *Globigerinita glutinata, Globigerinita uvula, Orbulina universa.*

Sample 36-6-1, 120-122 cm:
Globigerina bulloides, Globigerina calida praecalida, Globigerina dutertrei, Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia acostaensis pseudopima, Globorotalia crassaformis, Globorotalia inflata, Globigerinita glutinata, Orbulina universa.

Sample 36-6-2, 50-52 cm:
Globigerina bulloides, Globigerina dutertrei–5 chambered variant–*Globigerina quinqueloba, Globorotalia crassaformis* s.l., *Globorotalia inflata, Globorotalia scitula, Globigerinita glutinata.*

Sample 36-6-2, 100-102 cm:
Globigerina bulloides, Globigerina dutertrei–5 chambered variant–*Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia acostaensis pseudopima, Globorotalia crassaformis* s.l., *Globorotalia inflata* s.l., *Globigerinita glutinata.*

Sample 36-6-3, 3-5 cm:
Globigerina bulloides, Globigerina dutertrei–4-5 chambered variants–*Globigerina quinqueloba, Globorotalia crassaformis, Globorotalia scitula, Orbulina universa.*

Sample 36-6-3, 104-106 cm:
Globigerina bulloides, Globigerina dutertrei–4-5 chambered variants–*Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia crassaformis, Globorotalia inflata, Globorotalia puncticulata* (Deshayes), *Globigerinita glutinata, Sphaeroidinella dehiscens*–primitive form–*Orbulina universa.*

Sample 36-6-4, 17-19 cm:
Globigerina bulloides, Globigerina dutertrei–4-5 chambered variants–*Globigerina pachyderma, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia crassaformis* s.l., *Globorotalia puncticulata, Globigerinita glutinata, Globigerinoides ruber, Orbulina universa.*

Sample 36-6-6, 13-15 cm:
Globigerina bulloides, Globigerina dutertrei–4-5 chambered variants–*Globorotalia crassaformis* s.l., *Globorotalia inflata* s.l., *Globorotalia* cf. *G. subscitula.*

Sample 36-6-6, 102-104 cm:
Globigerina bulloides, Globigerina parabulloides Blow, *Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia* cf. *G. anfracta* Parker, *Globorotalia crassaformis oceanica* Cushman and Bermudez, *Globorotalia crassaformis ronda, Globorotalia puncticulata, Globorotalia subscitula* Conato, *Globorotalia tosaensis*–transitional forms–*Globigerinita glutinata, Orbulina universa.*

Sample 36-7-1, 40-43 cm:
Globigerina bulloides, Globigerina dutertrei–4-5 chambered variants–*Globorotalia crassaformis ronda, Globorotalia subscitula, Globorotalia tumida, Orbulina universa.*

Sample 36-7-1, 100-102 cm:
Globigerina bulloides, Globigerina quinqueloba, Globorotalia crassaformis crassaformis (Galloway and Wissler), *Globorotalia crassaformis ronda, Globorotalia puncticulata, Globorotalia subscitula, Globorotalia tosaensis, Globorotalia tosaensis* trans-*crassaformis, Globorotalia tumida, Globigerinoides ruber, Orbulina universa.*

Sample 36-8-1, 12-14 cm:
Globigerina bulloides, Globigerina dutertrei–4-5 chambered variants–*Globorotalia crassaformis crassaformis, Orbulina universa.*

Sample 36-8-1, 117-119 cm:
Globigerina bulloides, Globigerina decoraperta Takayanagi and Saito, *Globigerina dutertrei*–4 chambered variant–*Globigerina parabulloides, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia crassaformis crassaformis, Globorotalia miozea conoidea* Walters, *Globorotalia puncticulata, Globorotalia* cf. *G. subscitula, Globigerinita glutinata, Globigerinoides ruber, Orbulina universa.*

Sample 36-8-2, 20-22 cm:
Globigerina bulloides, Globigerina bulloides apertura Cushman, *Globigerina quinqueloba, Globorotalia crassaformis crassaformis, Globorotalia puncticulata, Globigerinita glutinata, Sphaeroidinellopsis seminulina* (Schwager), *Sphaeroidinellopsis subdehiscens* (Blow), *Orbulina universa.*

Sample 36-8-2, 98-100 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina cf. *G. dutertrei, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia* cf. *G. aemiliana* Colalongo and Sartoni, *Globorotalia crassaformis crassaformis, Globorotalia crassula, Globorotalia miozea conoidea, Globorotalia puncticulata, Globigerinita glutinata, Globigerinoides obliquus* Bolli, *Globigerinoides ruber, Globigerinoides trilobus* (Reuss), *Sphaeroidinellopsis seminulina, Orbulina universa.*

Sample 36-8-3, 20-22 cm:
Globigerina bulloides, Globigerina conglomerata Schwager, *Globigerina decoraperta, Globigerina dutertrei*–4-5 chambered variants–*Globigerina juvenilis* Bolli, *Globigerina parabulloides, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia* cf. *G. aemiliana, Globorotalia hirsuta praehirsuta, Globorotalia miozea conoidea, Globorotalia puncticulata, Globorotalia subscitula, Globigerinita glutinata, Globigerinoides ruber, Orbulina universa.*

Sample 36-8-4, 24-26 cm:
Globigerina bulloides, Globigerina quinqueloba, Globorotalia crassaformis crassaformis, Globorotalia puncticulata, Globorotalia subscitula, Globigerinoides obliquus extremus.

Sample 36-8-4, 113-115 cm:
Globigerina bulloides, Globigerina conglomerata, Globigerina decoraperta, Globigerina dutertrei–4-5 chambered variants–*Globigerina parabulloides, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia* cf. *G. aemiliana, Globorotalia crassaformis crassaformis, Globorotalia miozea conoidea, Globorotalia puncticulata, Globorotalia subscitula, Globigerinita glutinata, Globigerinoides obliquus, Globigerinoides trilobus, Sphaeroidinellopsis seminulina, Orbulina universa.*

Sample 36-8-5, 20-22 cm:
Globigerina bulloides, Globorotalia crassaformis crassaformis, Globorotalia puncticulata, Orbulina universa.

Sample 36-8-5, 115-117 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina dutertrei–4-5 chambered variants–*Globigerina*

parabulloides, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia cf. *G. aemiliana, Globorotalia miozea conoidea, Globorotalia miozea sphericomiozea* Walters, *Globorotalia puncticulata, Globorotalia* cf. *G. scitula, Globigerinita glutinata, Globigerinoides obliquus, Globigerinoides trilobus, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-8-6, 18-20 cm:
Globigerina bulloides, Globigerina bulloides apertura, Globigerina quinqueloba, Globorotalia crassaformis crassaformis, Globorotalia miozea conoidea, Globorotalia puncticulata, Globigerinoides trilobus, Sphaeroidinellopsis subdehiscens, Orbulina universa.

Sample 36-8-6, 100-102 cm:
Globigerina bulloides, Globigerina calida praecalida, Globigerina decoraperta, Globigerina parabulloides, Globorotalia acostaensis acostaensis, Globorotalia crassaformis crassaformis, Globorotalia miozea conoidea, Globorotalia miozea sphericomiozea, Globorotalia puncticulata, Orbulina universa.

Sample 36-9-2, 20-22 cm:
Globigerina bulloides, Globorotalia miozea conoidea.

Sample 36-9-2, 110-112 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina parabulloides, Globorotalia miozea conoidea, Globorotalia cf. *G. subscitula, Globigerinita glutinata, Orbulina universa.*

Sample 36-9-3, 20-22 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina foliata Bolli, *Globigerina* cf. *G. woodi* Jenkins, *Globorotalia miozea conoidea, Globorotalia subscitula.*

Sample 36-9-3, 103-105 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina parabulloides, Globigerina quinqueloba, Globorotalia cf. *G. miozea cibaoensis* Bermudez, *Globorotalia miozea conoidea, Globorotalia* cf. *G. ungulata* Bermudez, *Globigerinita glutinata, Orbulina universa.*

Sample 36-10-1, 19-21 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina foliata, Globigerina parabulloides, Globorotalia hirsuta praehirsuta, Sphaeroidinellopsis seminulina, Orbulina universa.

Sample 36-10-1, 132-134 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes Todd, *Globigerina parabulloides, Globigerinita glutinata.*

Sample 36-10-2, 62-64 cm:
Globigerina bulloides, Orbulina universa.

Sample 36-10-2, 124-126 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerinita glutinata, Orbulina universa.

Sample 36-10-3, 20-22 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina foliata, Globigerina hexagona Natland, *Globigerina parabulloides, Globigerina* cf. *G. woodi, Globorotalia scitula, Orbulina universa.*

Sample 36-10-3, 88-90 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina quinqueloba, Globorotalia miozea s.l. Finlay, *Globorotalia miozea conoidea, Globorotalia* cf. *G. subscitula, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-10-4, 27-29 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina cf. *G. woodi, Sphaeroidinellopsis dehiscens*–immatura form–*Orbulina universa.*

Sample 36-10-4, 99-101 cm:
Globigerina bulloides, Globigerina bulloides apertura, Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globigerina quinqueloba, Globigerina cf. *G. woodi, Globorotalia* cf. *G. subscitula, Globigerinita? glutinata, Orbulina universa.*

Sample 36-10-5, 2-4 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina cf. *G. woodi.*

Sample 36-10-5, 119-121 cm:
Globigerina bulloides, Globigerina cf. *G. conglomerata, Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globigerina quinqueloba, Globorotalia* cf. *G. miozea, Globigerinita glutinata, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-10-6, 20-22 cm:
Globigerina bulloides, Globigerina decoraperta.

Sample 36-10-6, 98-100 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia cf. *G. scitula, Orbulina universa.*

Sample 36-11-2, 19-21 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina parabulloides, Globigerina cf. *G. woodi, Globorotalia miozea miozea* s.l., *Sphaeroidinellopsis seminulina.*

Sample 36-11-2, 115-117 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globigerina quinqueloba, Globorotalia miozea miozea s.l., *Globigerinita glutinata, Orbulina universa.*

Sample 36-11-3, 39-41 cm:
Globigerina bulloides, Orbulina universa.

Sample 36-11-3, 133-135 cm:
Globigerina decoraperta, Globigerina cf. *G. nepenthes, Globigerina parabulloides, Globorotalia miozea miozea* s.l., *Globigerinita glutinata, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-11-4, 19-21 cm:
Globigerina bulloides, Globigerina parabulloides, Globorotalia cf. *G. hirsuta praehirsuta.*

Sample 36-11-4, 99-101 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia scitula, Globigerinita glutinata, Sphaeroidinellopsis seminulina, Orbulina universa.

Sample 36-11-5, 5-7 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina parabulloides, Globigerina woodi Jenkins, *Sphaeroidinellopsis seminulina, Orbulina universa.*

Sample 36-11-5, 100-102 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina parabulloides, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globorotalia miozea miozea s.l., *Globorotalia* cf. *G. scitula, Globigerinita glutinata, Orbulina universa.*

Sample 36-11-6, 35-37 cm:
Globigerina decoraperta, Globigerina cf. *G. eamesi* Blow, *Globigerina woodi, Sphaeroidinellopsis seminulina, Sphaeroidinellopsis subdehiscens.*

Sample 36-11-6, 99-101 cm:
Globigerina bulloides, Globigerina nepenthes, Globigerina quinqueloba, Globorotalia acostaensis acostaensis, Globigerinita glutinata, Sphaeroidinellopsis subdehiscens, Orbulina universa.

Sample 36-12-1, 20-22 cm:
Globigerina decoraperta, Globigerina woodi, Orbulina universa.

Sample 36-12-1, 101-103 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globigerina woodi, Globorotalia miozea miozea s.l., *Globigerinita glutinata, Sphaeroidinellopsis seminulina, Orbulina universa.*

Sample 36-12-2, 19-21 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globigerina woodi, Globorotalia miozea miozea s.l., *Sphaeroidinellopsis seminulina, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-12-2, 99-101 cm:
Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globigerina woodi, Globorotalia miozea conoidea, Globorotalia miozea miozea s.l., *Globigerinita glutinata, Sphaeroidinellopsis seminulina, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-12-3, 27-29 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina parabulloides, Globigerina woodi, Globorotalia merotumida Blow and Banner, *Globorotalia miozea miozea* s.l., *Sphaeroidinellopsis seminulina, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-12-3, 98-100 cm:
Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globorotalia acostaensis acostaensis, Globorotalia miozea conoidea, Globorotalia miozea miozea s.l., *Globigerinita glutinata, Sphaeroidinellopsis seminulina, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-12-4, 11-13 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globigerina woodi, Globorotalia merotumida, Globorotalia miozea miozea s.l., *Sphaeroidinellopsis seminulina, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-12-4, 93-95 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina parabulloides, Globorotalia acostaensis acostaensis, Globorotalia menardii (d'Orbigny), *Globorotalia miozea miozea, Globigerinita glutinata, Sphaeroidinellopsis seminulina, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-12-5, 25-27 cm:
Globigerina decoraperta, Globigerina parabulloides, Globigerina woodi, Globorotalia miozea miozea s.l., *Sphaeroidinellopsis seminulina.*

Sample 36-12-5, 93-95 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina nepenthes, Globigerina quinqueloba, Globigerina woodi, Globorotalia miozea miozea s.l., *Globorotalia* cf. *G. scitula, Globigerinita glutinata, Sphaeroidinellopsis seminulina, Sphaeroidinellopsis subdehiscens, Orbulina universa.*

Sample 36-12-6, 6-8 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina parabulloides, Globigerina quinqueloba, Globigerina woodi, Globorotalia miozea miozea s.l., *Sphaeroidinellopsis seminulina, Orbulina universa.*

Sample 36-12-6, 97-99 cm:
Globigerina bulloides, Globigerina decoraperta, Globigerina woodi, Orbulina universa.

Sample 36-13-2, 23-25 cm:
Planktonic foraminifera absent.

Sample 36-13-2, 99-101 cm:
Same as above.

Sample 36-13-3, 19-21 cm:
Same as above.

Sample 36-13-3, 99-101 cm:
Same as above.

Sample 36-13-4, 18-20 cm:
Same as above.

Sample 36-13-4, 94-96 cm:
Same as above.

Radiolaria

Radiolaria have been found only as minor constituents of Cores 9 and 13. Their occurrence is sparse, the percentage of broken specimens is high, and age-diagnostic Radiolaria were not observed. Orosphaerid fragments are common elements of the radiolarian assemblage in Core 13.

SUMMARY

At Site 36 the 115-meter sedimentary section has been divided into nine stratigraphic units which overlie glassy basalt (Table 2).

Unit 9 (Core 13, 111 to 115 meters) is dusky yellow "red" clay and nannofossil red clay. Interbedded fossiliferous material provides the basis for a Middle Miocene age. The nannofossil red clay of unit 9 passes upward into a nannofossil ooze of unit 8 (part of Core 12, 110 to 111 meters). Overlying this yellowish-gray Middle Miocene ooze is Upper Miocene to Lower Pliocene grayish-green mud nannofossil ooze of unit 7 (parts of Cores 11 and 12, 99 to 110 meters). The color and lithologic change mark a disconformity of the missing part of the Upper Miocene. The rest of the column above this disconformity contains frequent reworked Tertiary nannoplankton.

Units 4 to 6 (part of Core 9 through Core 11, 75 to 99 meters) are greenish-gray and are an alternation of mud and mud nannofossil ooze. Units 4 and 6 are muds. Unit 5 is a mud nannofossil ooze. Volcanic ash layers are present in units 5 and 8, and traces occur in units 4 and 9.

Unit 3 (part of Core 3 through Core 8, 25 to 75 meters) is gray foraminiferal-nannofossil ooze, locally with some clay. This Lower Pliocene to Pleistocene sequence contains an ash layer in the ooze.

Unit 2 (part of Core 3, 21 to 25 meters) is a calcareous mud with foraminiferal-nannofossil ooze interbeds.

Unit 1 (Core 1 through part of Core 3, 0 to 21 meters) is a gray foraminiferal-nannofossil ooze of Pleistocene age.

In relation to the magnetic anomalies, Site 36 is tentatively located over the negative anomaly (8 million years) to the older side of Anomaly 4 (7 million years). The oldest sediments are about 13 million years.

Sedimentation began in the Middle Miocene with the deposition of material which now forms the "red" clay. A few siliceous plankton remains and a very few nannoplankton remains are preserved. The siliceous fossils soon ceased to accumulate or be preserved, but conditions were such that the calcareous nannoplankton increased in abundance until accumulation of their remains became the dominant form of sedimentation, as the clay accumulation ceased. In the late part of the Middle Miocene (about 11 or 10.5 million years) the calcareous ooze deposition apparently ceased.

Sediments representing the early part of the Late Miocene are not present, nor is there any indication that they formerly existed and were removed. For a period of as much as 2 million years, no record is preserved. When sedimentation recommenced in the Late Miocene, the change from pelagic "red" clays to terrigenous sediment in the nannofossil ooze and the presence of reworked Middle Miocene, Oligocene and Eocene nannoplankton in younger units suggest a change in sedimentary environment from that present prior to the hiatus. The hiatus may be caused by bottom current erosion related to the formation of new sea floor topography. For the preserved part of the Late Miocene sedimentation, the rate of accumulation was 2 m/m.y.

During the Early Pliocene, mud and calcareous ooze deposition continued, with the mud decreasing near the end of the epoch. The average rate of sedimentation for the Pliocene is 1.5 cm/1000 years. The same calcareous ooze sedimentary environment continued into the Late Pliocene with occasional influxes of mud. Most of the sediments of Pleistocene age are foraminiferal-nannofossil oozes. One mud-rich bed occurs in Core 3. Volcanism played a small role in sedimentation at this site; only four distinct ash beds are present and none is devitrified.

TABLE 2
Stratigraphic Units at Site 36

Unit	Core	Age	Depth (m)	Name	Comments
1	1, 2, 3	Pleistocene	0-21	Foraminiferal-nannofossil ooze (olive-gray and green-gray)	Volcanic ash at 7 meters.
2	3	Pleistocene	21-25	Calcareous mud with ooze interbeds (green-gray)	Sixty to eighty per cent mud, 20 to 40 per cent foraminiferal-nannofossil ooze.
3	3-8	Pleistocene Upper Pliocene Lower Pliocene	25-75	Foraminiferal-nannofossil ooze (green-gray, light gray 40 to 50 meters)	Volcanic ash at 35 meters; pyritized worm tubes at 73 meters.
4	9	Lower Pliocene	75-81	Mud (green-gray)	Traces of glass nannoplankton. Some siliceous fossils.
5	9-10	Lower Pliocene	81-92	Mud nannofossil ooze (green-gray)	Volcanic ash at approximately 85 meters. Clay = approximately 10 per cent.
6	11	Lower Pliocene	92-99	Mud (dark green-gray)	Ten to fifteen per cent nannoplankton in some samples. Probably represents ooze interbeds.
7	11-12	Lower Pliocene Upper Miocene	99-110	Mud nannofossil ooze (green-gray 99 to 110 meters)	Volcanic ash at approximately 109.5 meters. Unconformity at 110 meters between Upper Miocene and Middle Miocene.
8	12	Middle Miocene	110-111	Nannofossil ooze (yellow-gray)	
9	13	Middle Miocene	111-115	"Red" clay (dusky yellow)	Five to twenty-five per cent nannoplankton interbeds. Some siliceous fossils at 113 meters, trace palagonite at 114 meters. Basalt fragments at 113 meters.
	14	?	115	Glassy black basalt	Palagonite rinds and small vesicles.

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THE CORES RECOVERED FROM SITE 36

The following pages present a graphic summary of the results of drilling and coring at Site 36. Fig. 2, a summary of Site 36 is at the back of the book. Figures 3 to 16 are summaries of the individual cores recovered. A key to the lithologic symbols is given in the Introduction (Chapter 1).

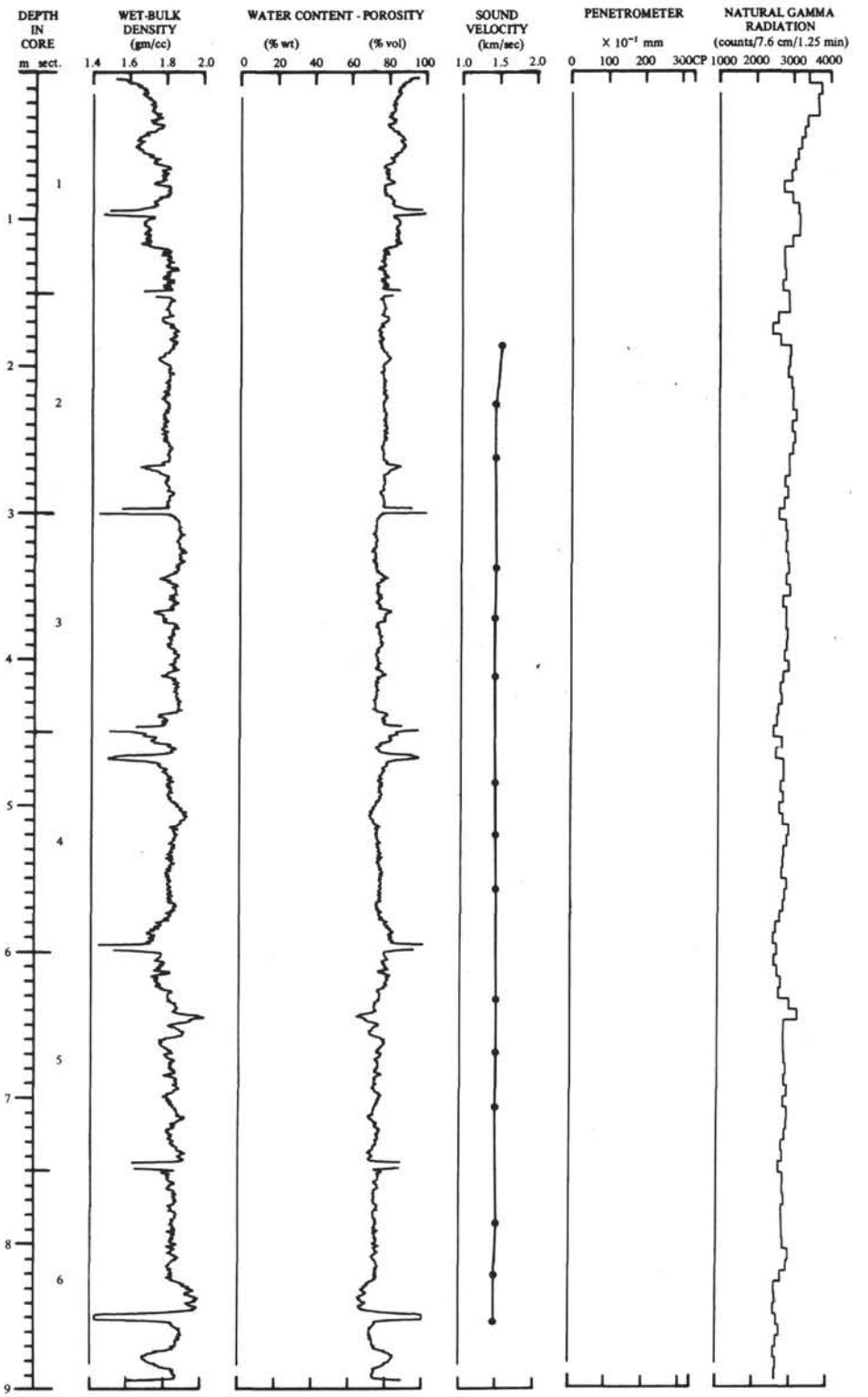

Figure 3A. *Physical Properties of Core 1, Hole 36*

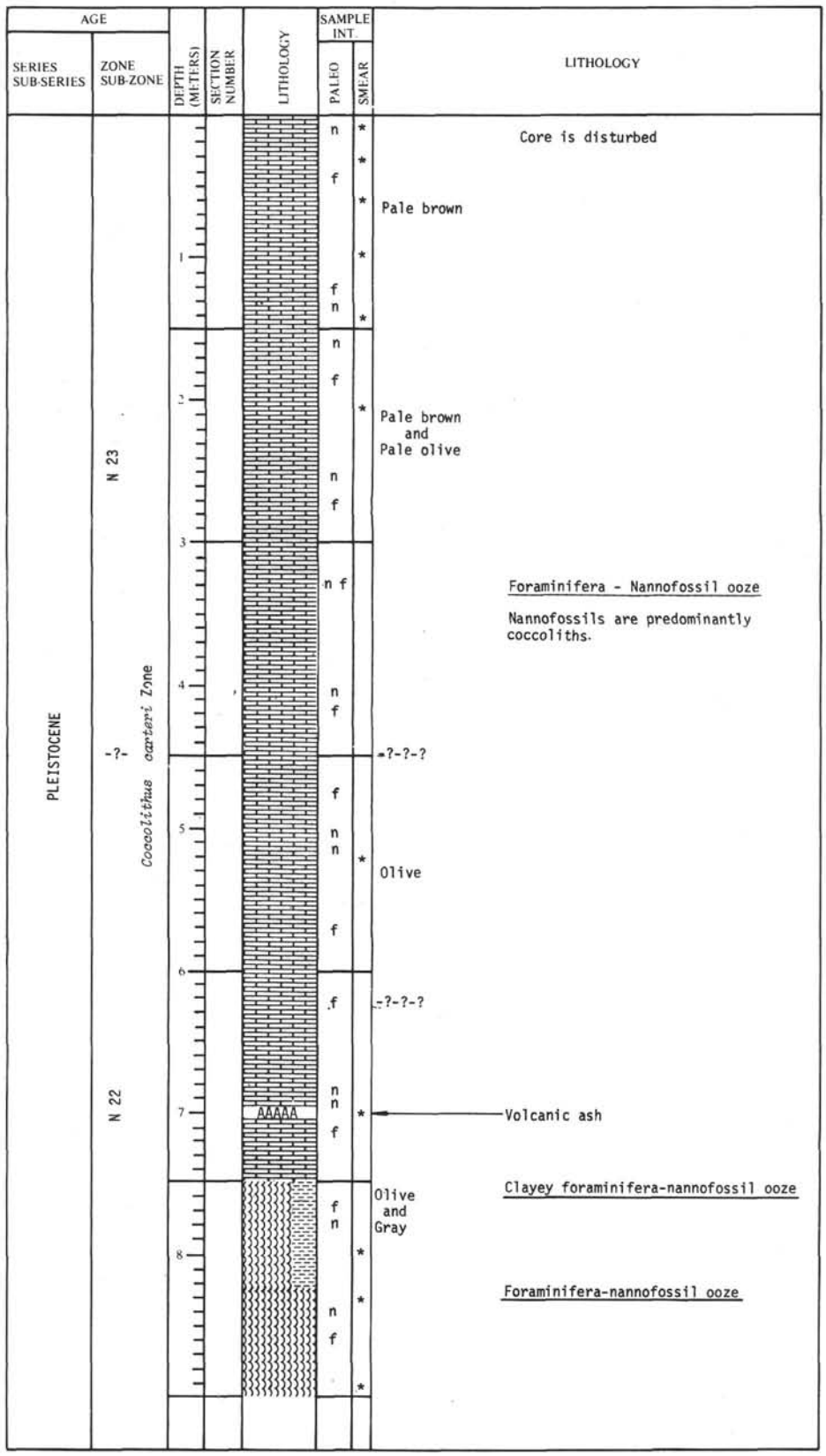

Figure 3B. *Core 1, Hole 36 (0-9 m Below Seabed)*

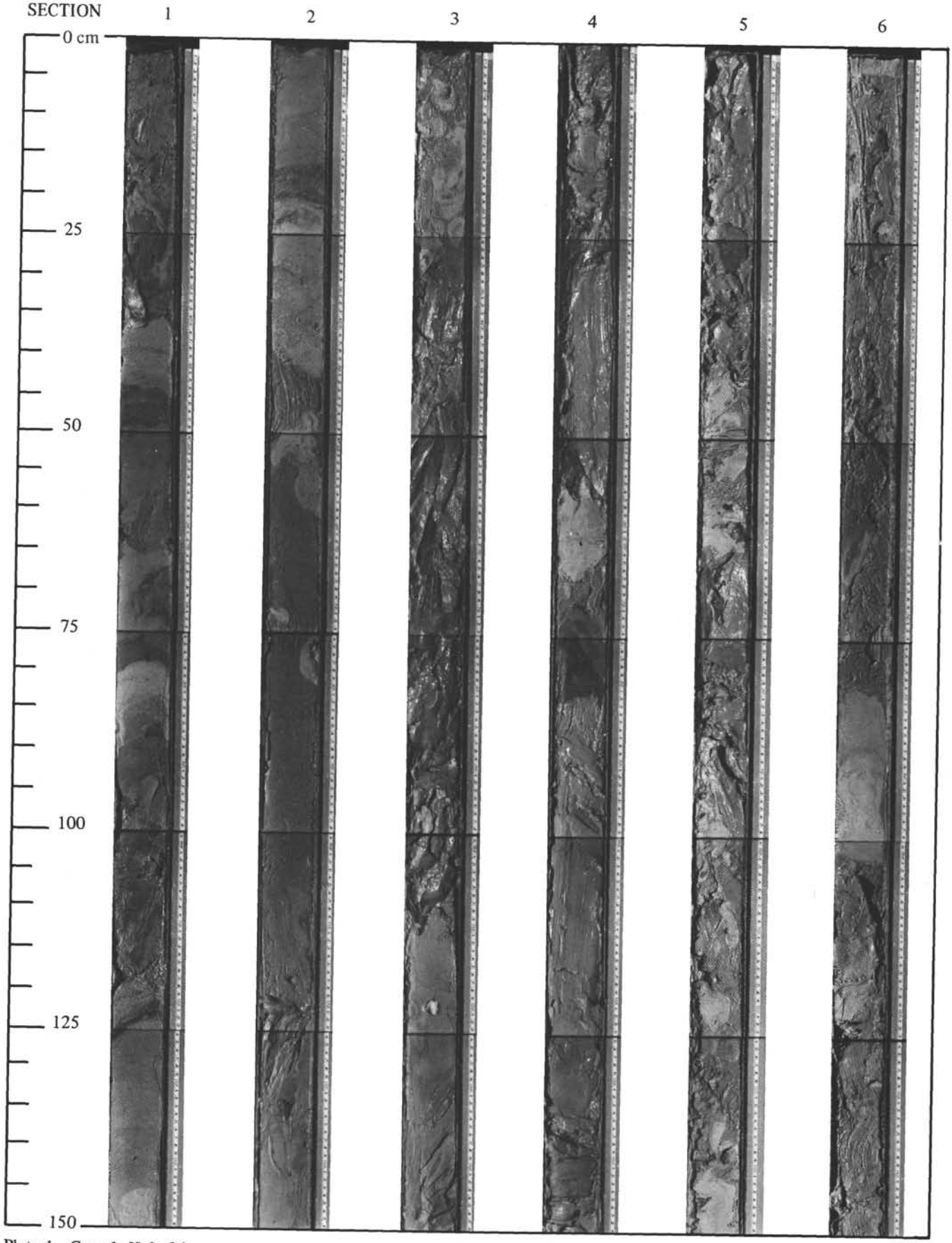

Plate 1. *Core 1, Hole 36*

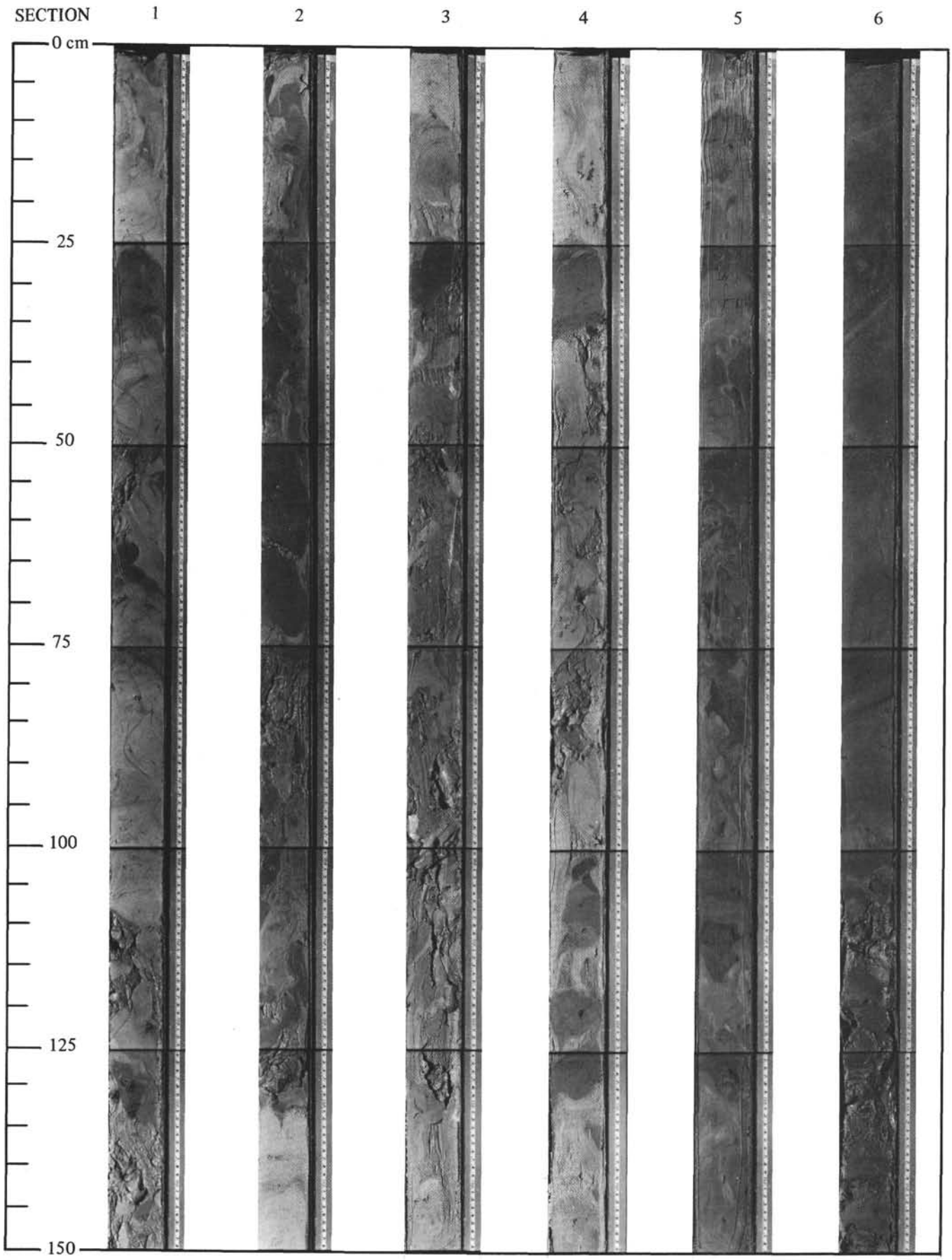

Plate 2. *Core 2, Hole 36*

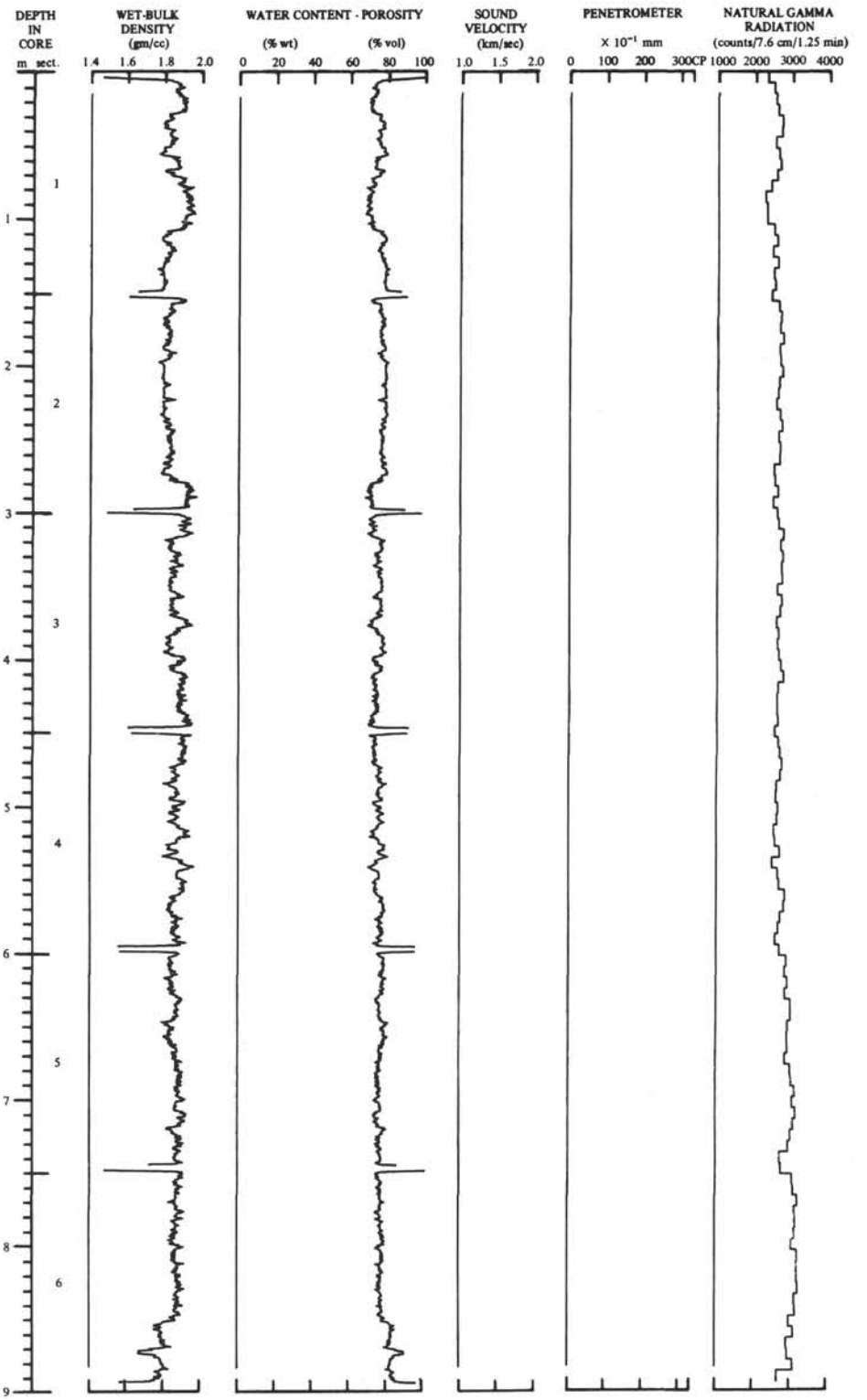

Figure 4A. *Physical Properties of Core 2, Hole 36*

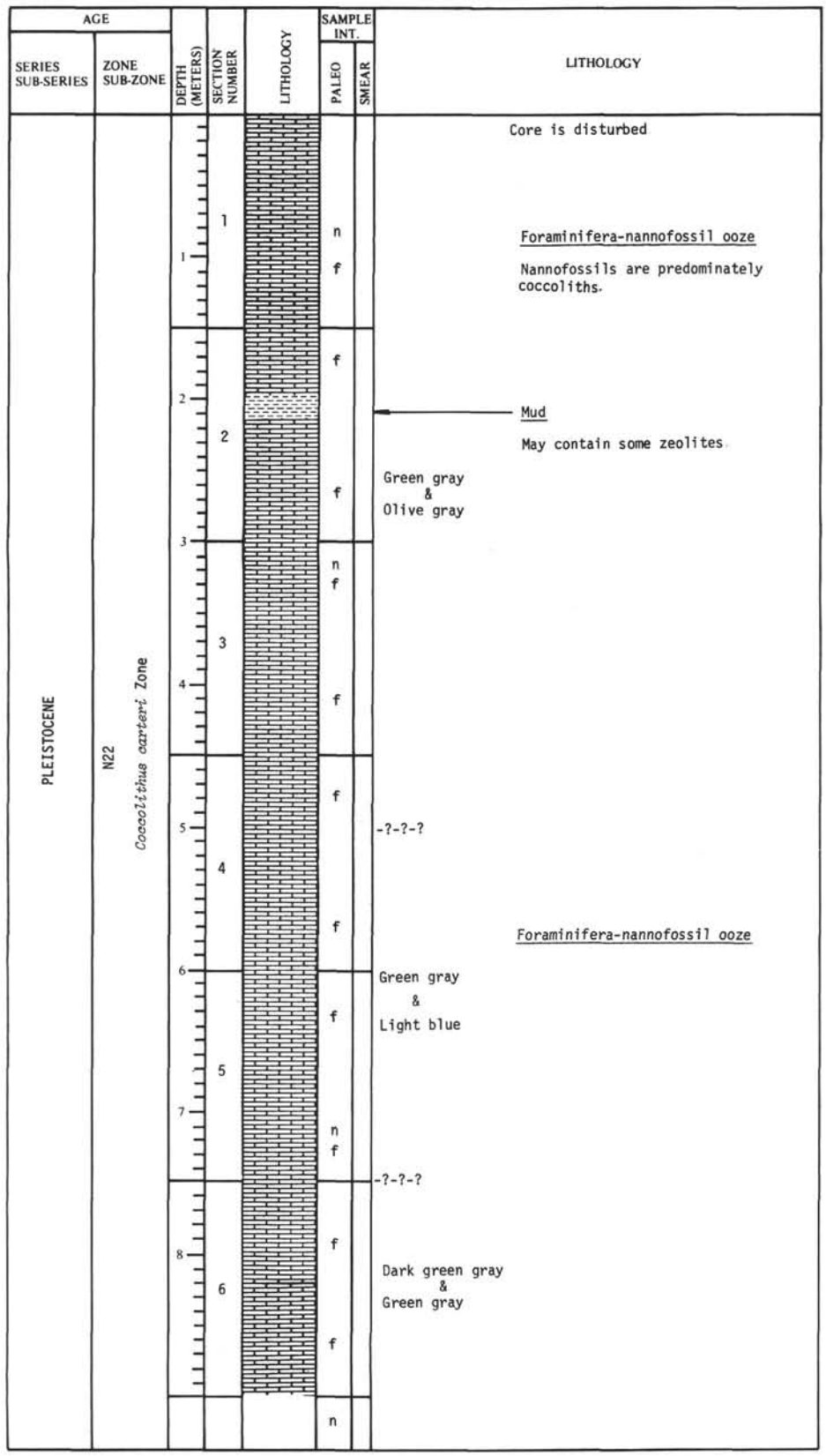

Figure 4B. *Core 2, Hole 36 (9-18 m Below Seabed)*

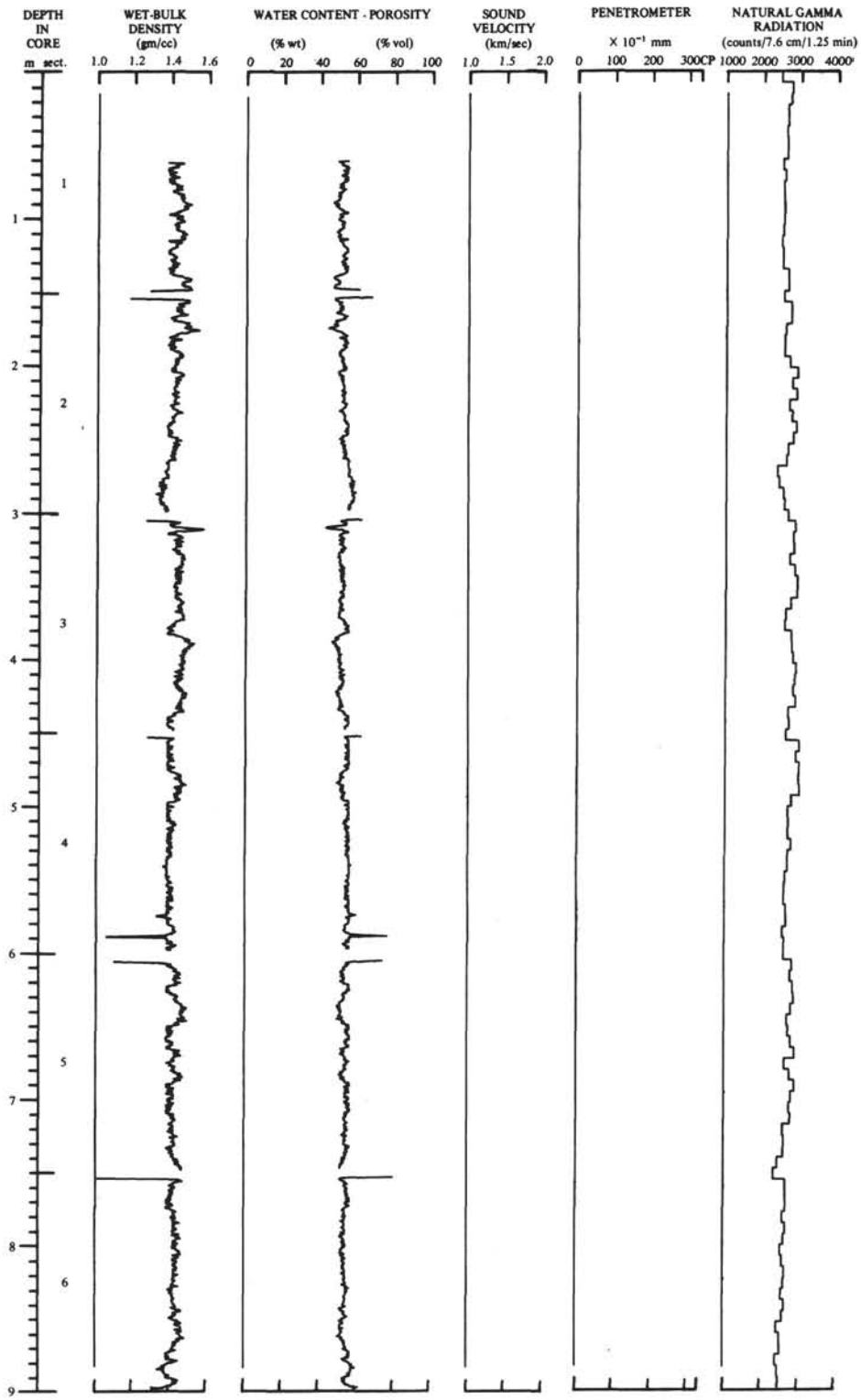

Figure 5A. *Physical Properties of Core 3, Hole 36*

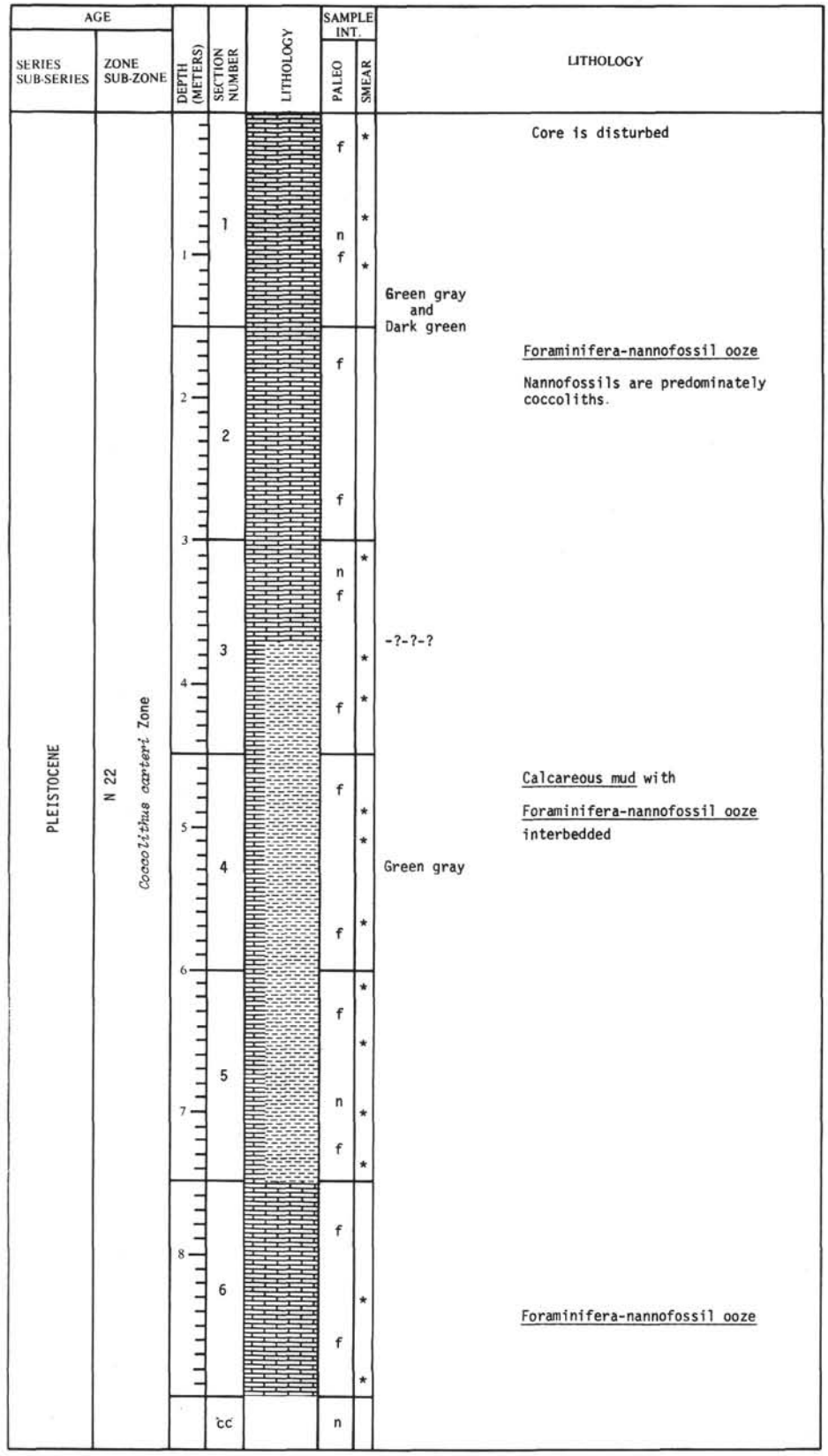

Figure 5B. *Core 3, Hole 36 (18-27 m Below Seabed)*

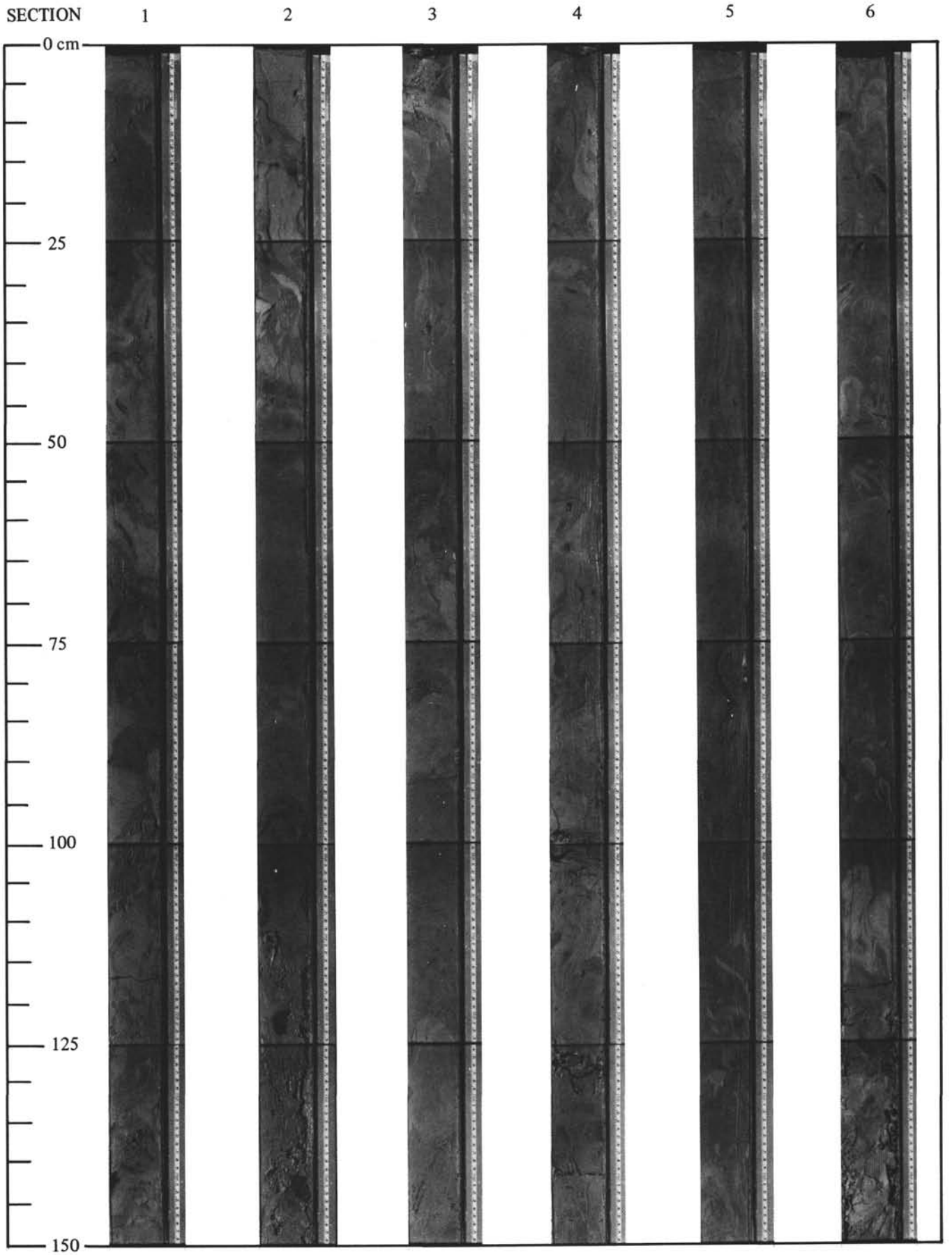

Plate 3. *Core 3, Hole 36*

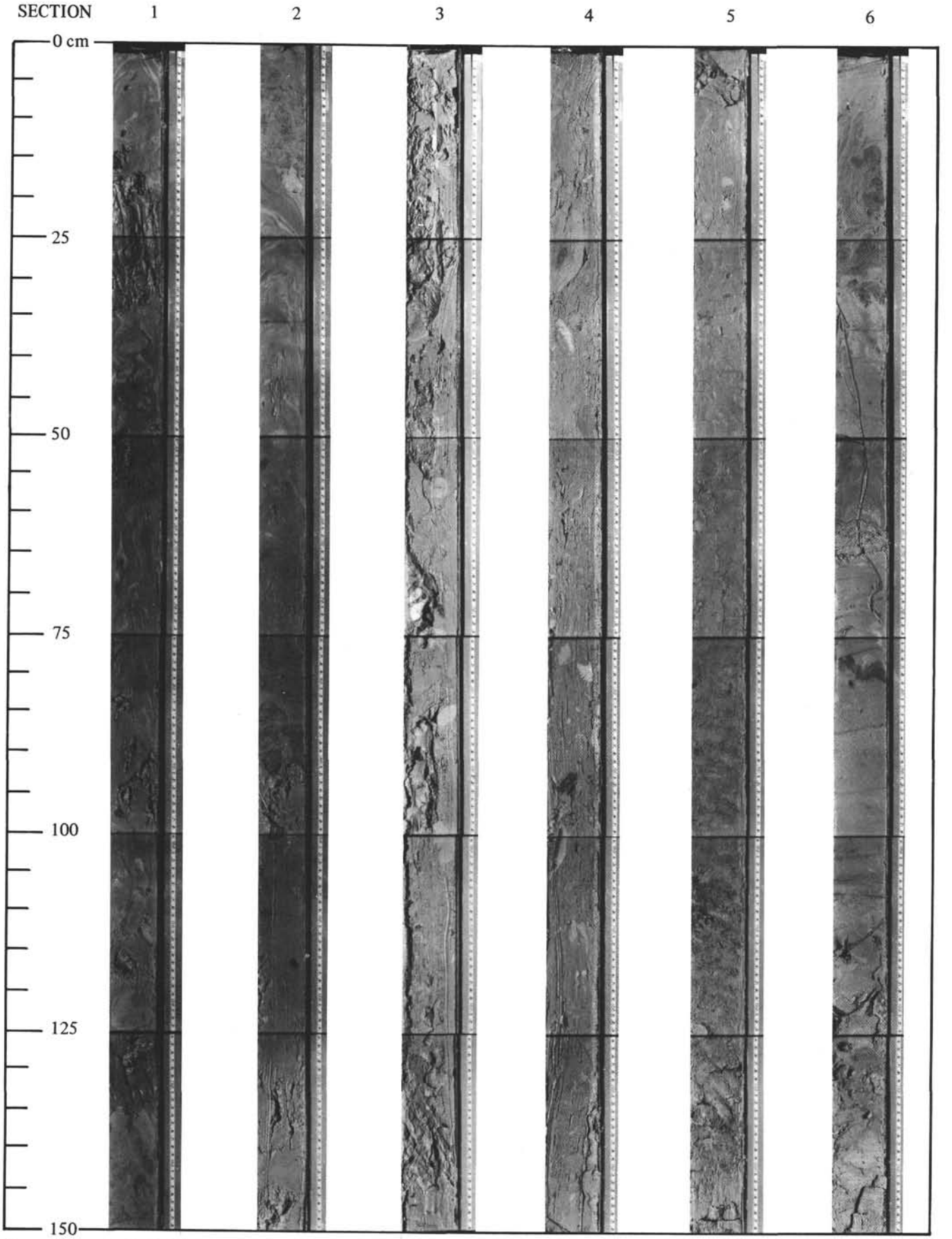

Plate 4. *Core 4, Hole 36*

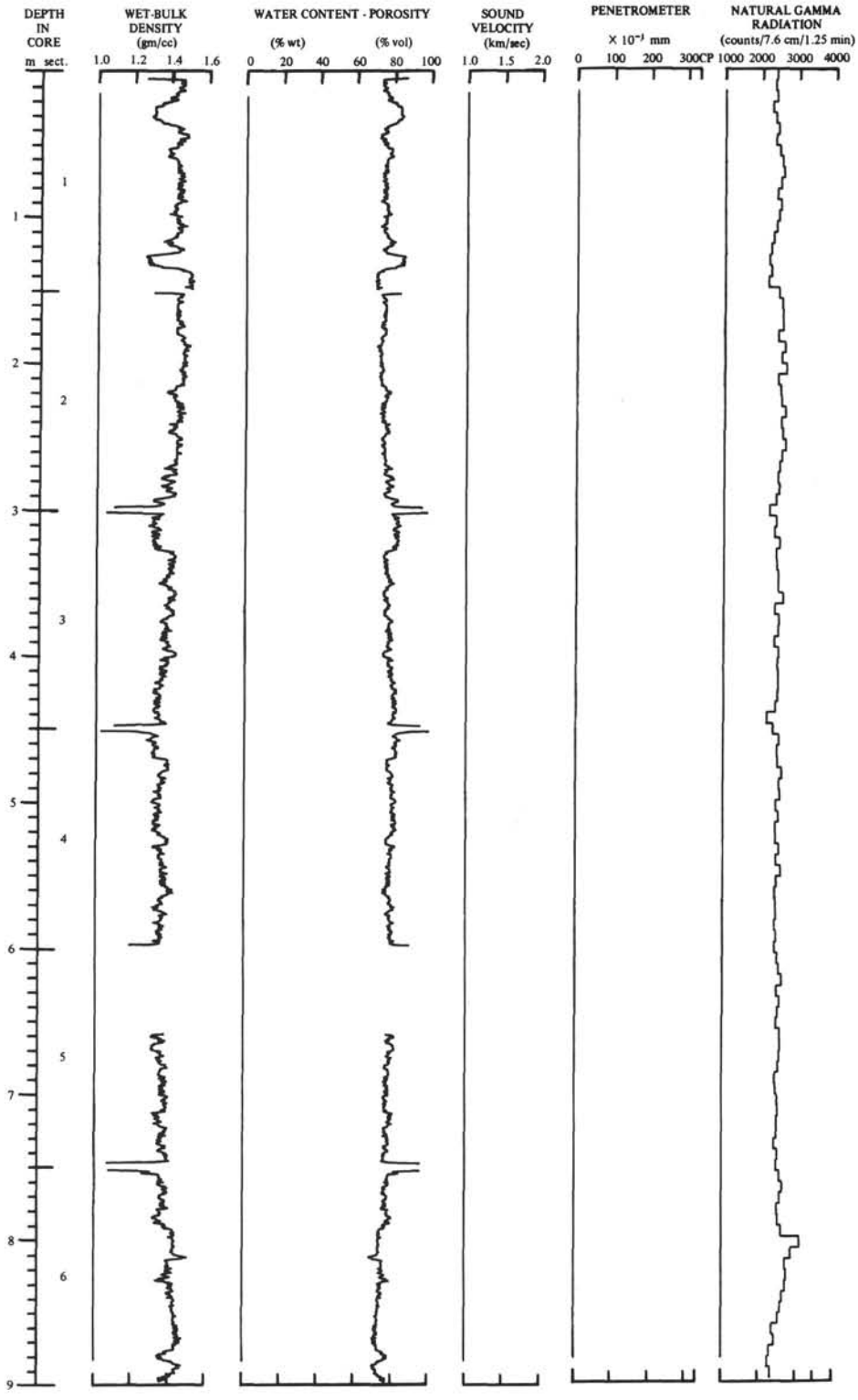

Figure 6A. *Physical Properties of Core 4, Hole 36*

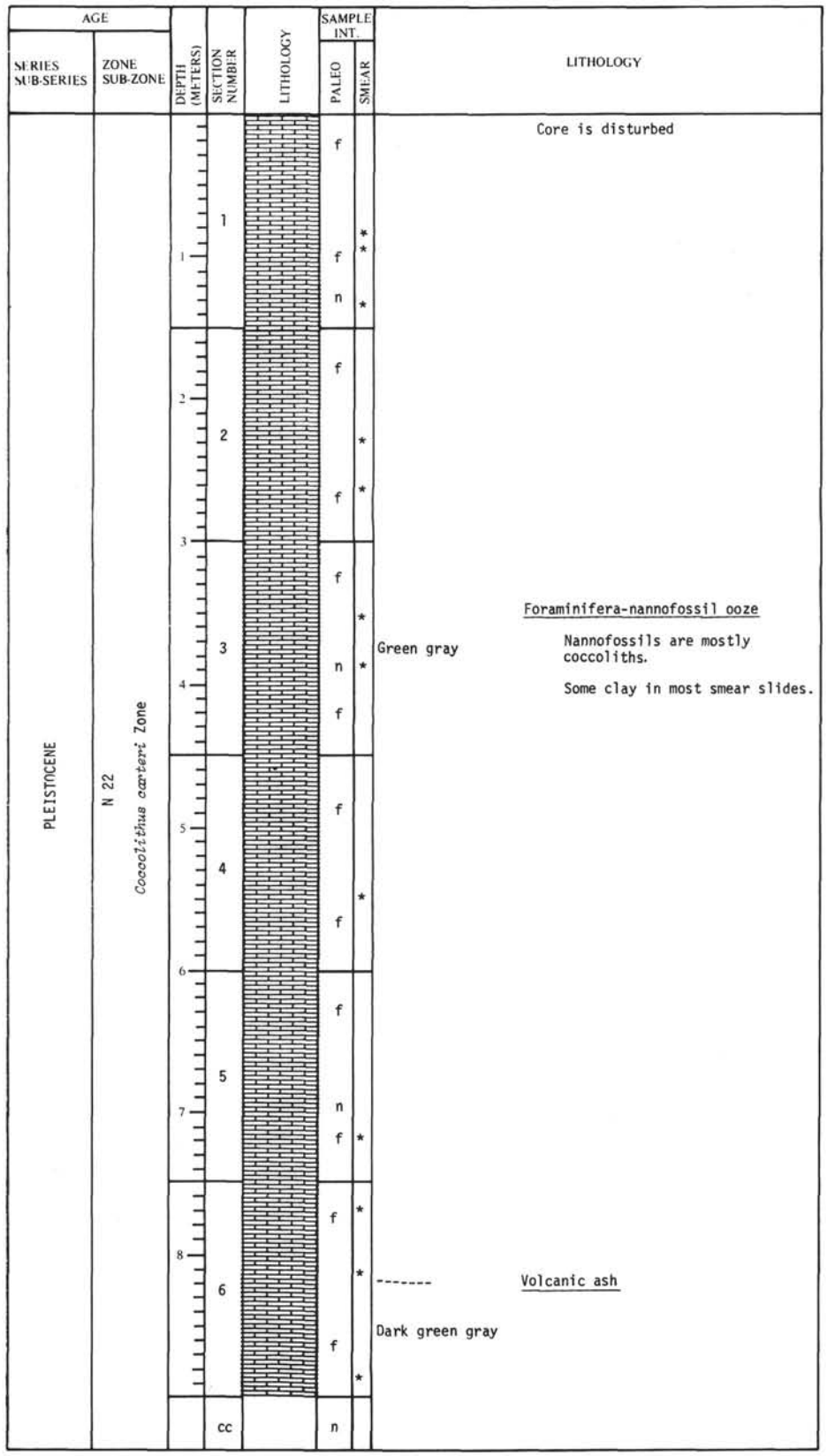

Figure 6B. *Core 4, Hole 36 (27-36 m Below Seabed)*

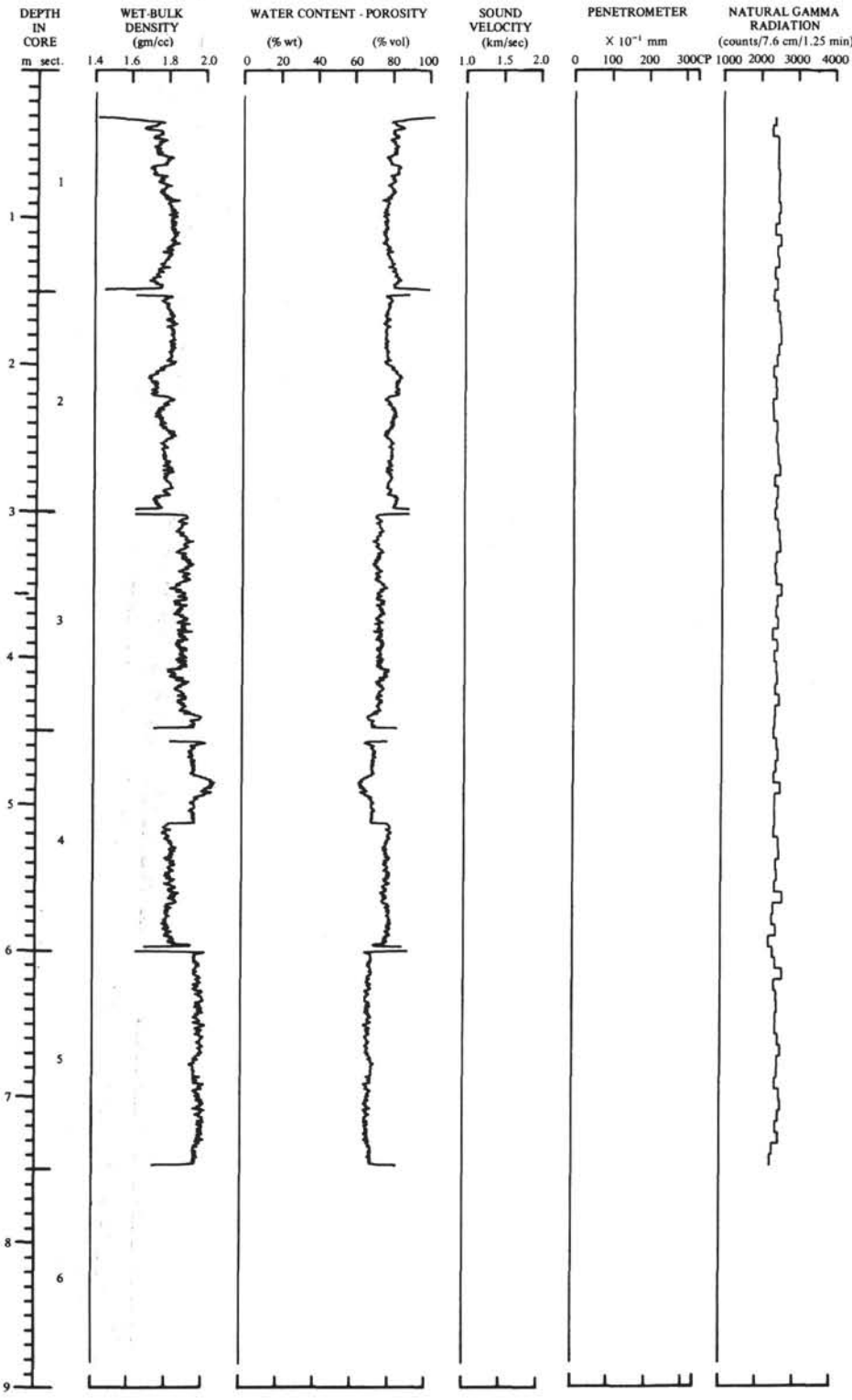

Figure 7A. *Physical Properties of Core 5, Hole 36*

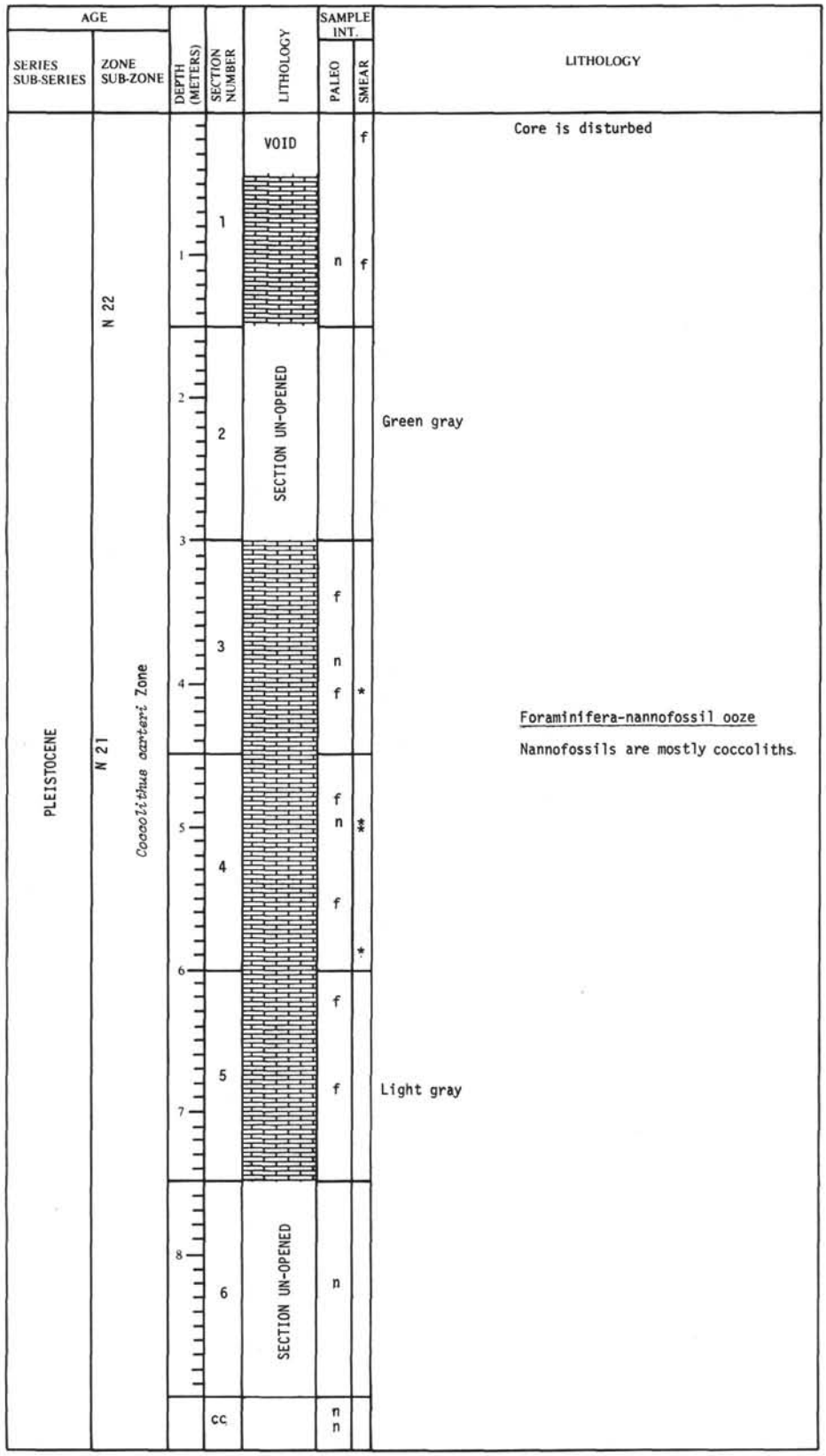

Figure 7B. *Core 5, Hole 36 (36-46 m Below Seabed)*

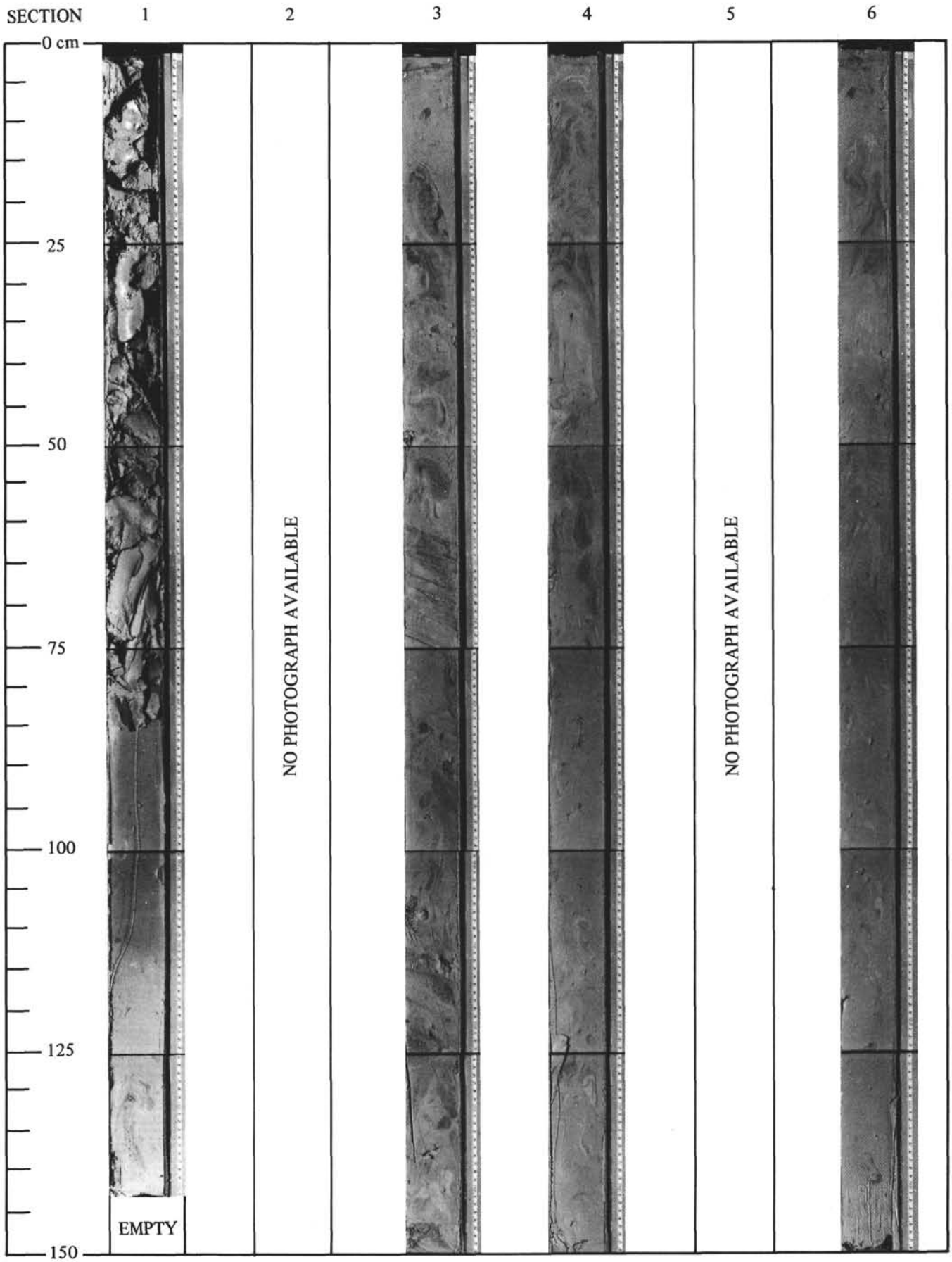

Plate 5. *Core 5, Hole 36*

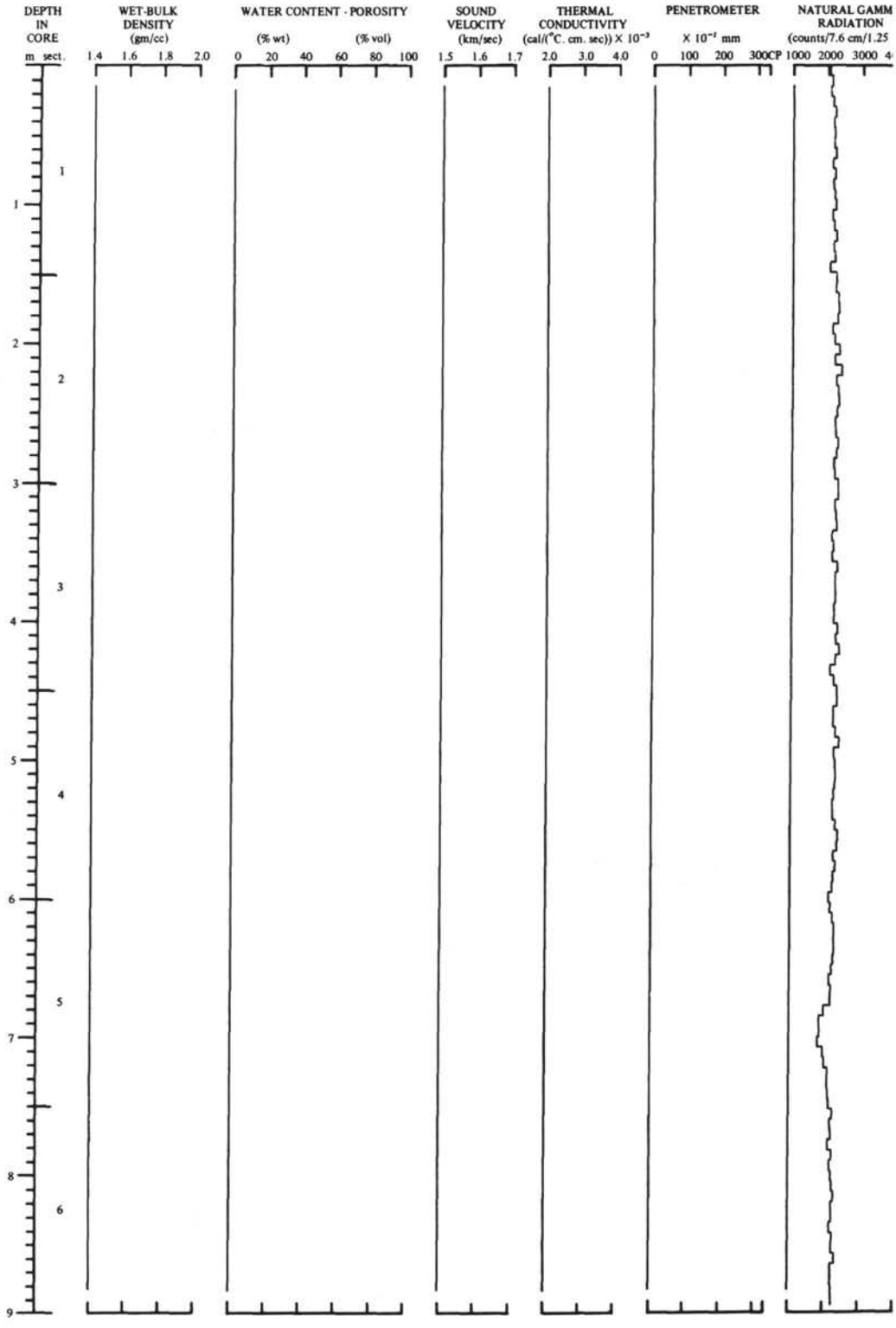

Figure 8A *Physical Properties of Core 6, Hole 36.*

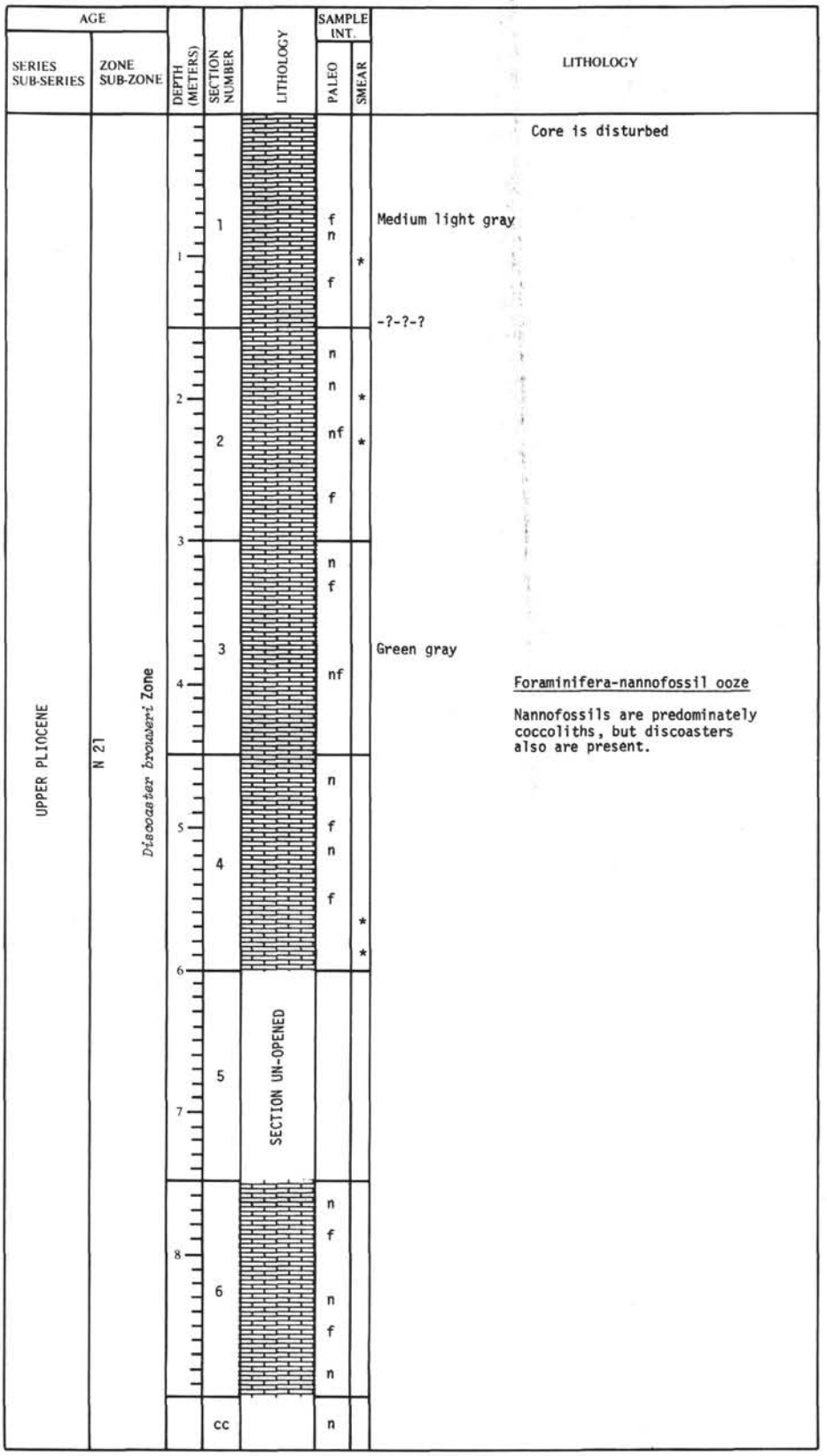

Figure 8B *Core 6, Hole 36. (48 - 57 m below seabed)*

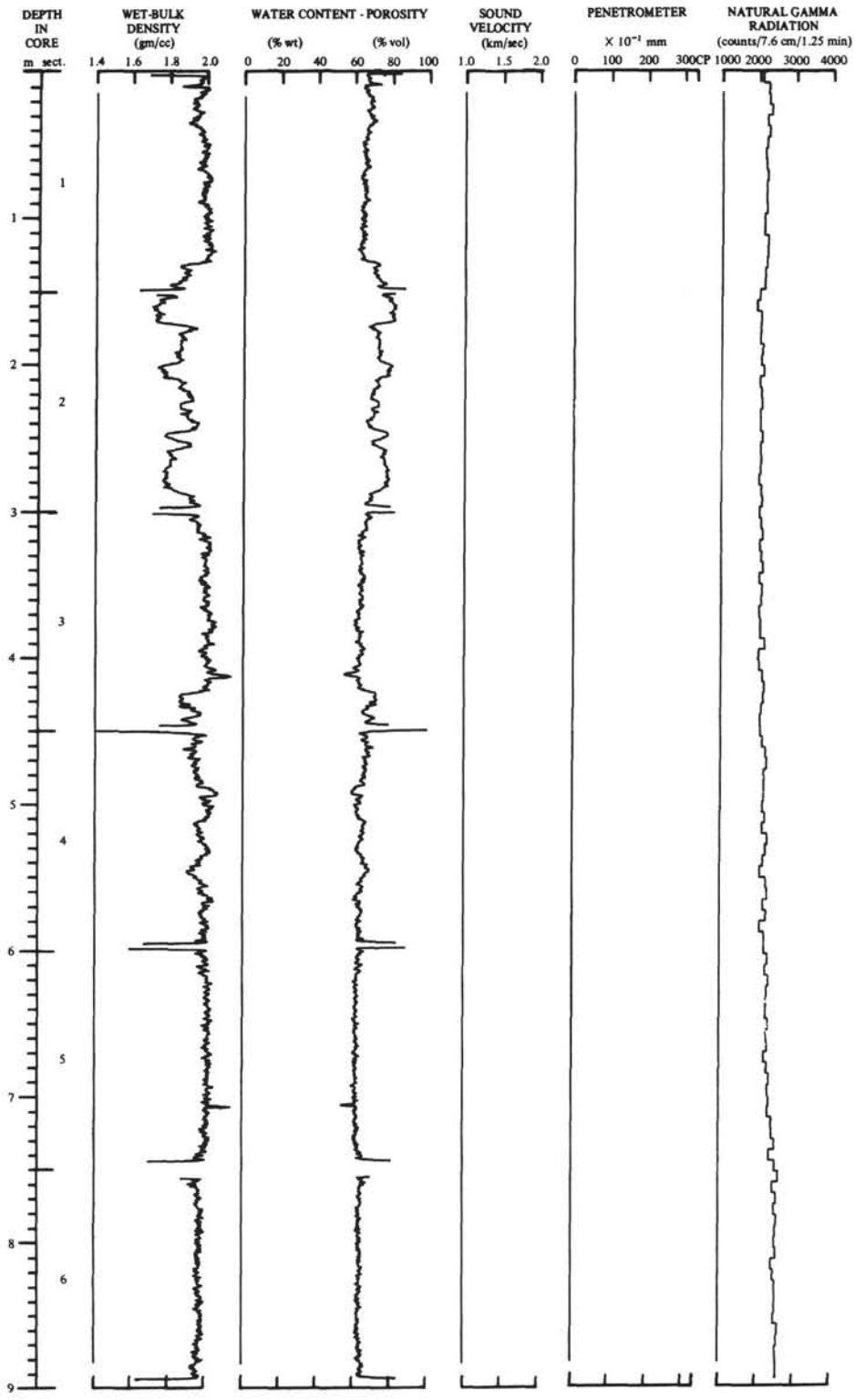

Figure 9A *Physical Properties of Core 7, Hole 36.*

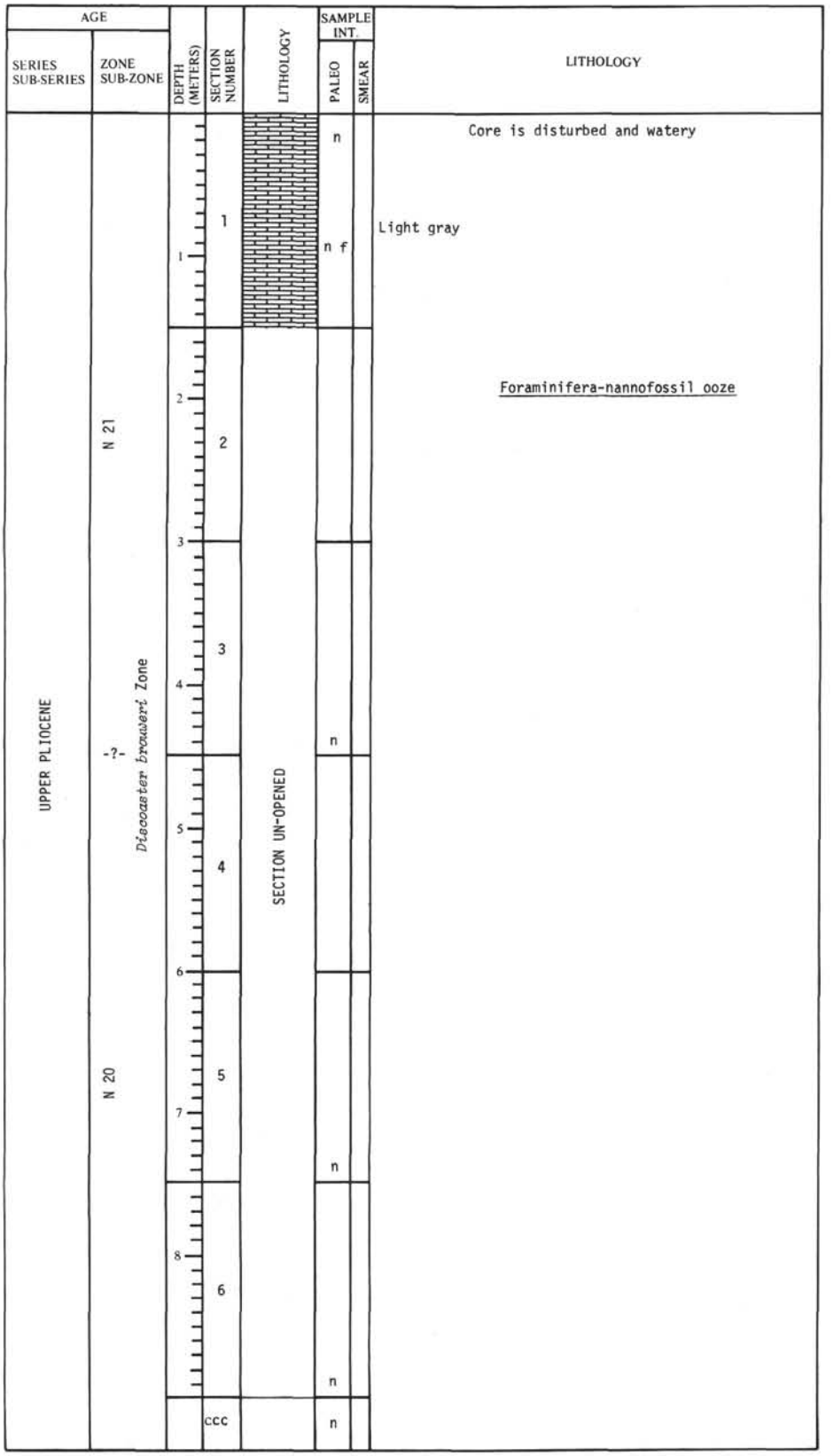

Figure 9B *Core 7, Hole 36. (57 - 66 m below seabed)*

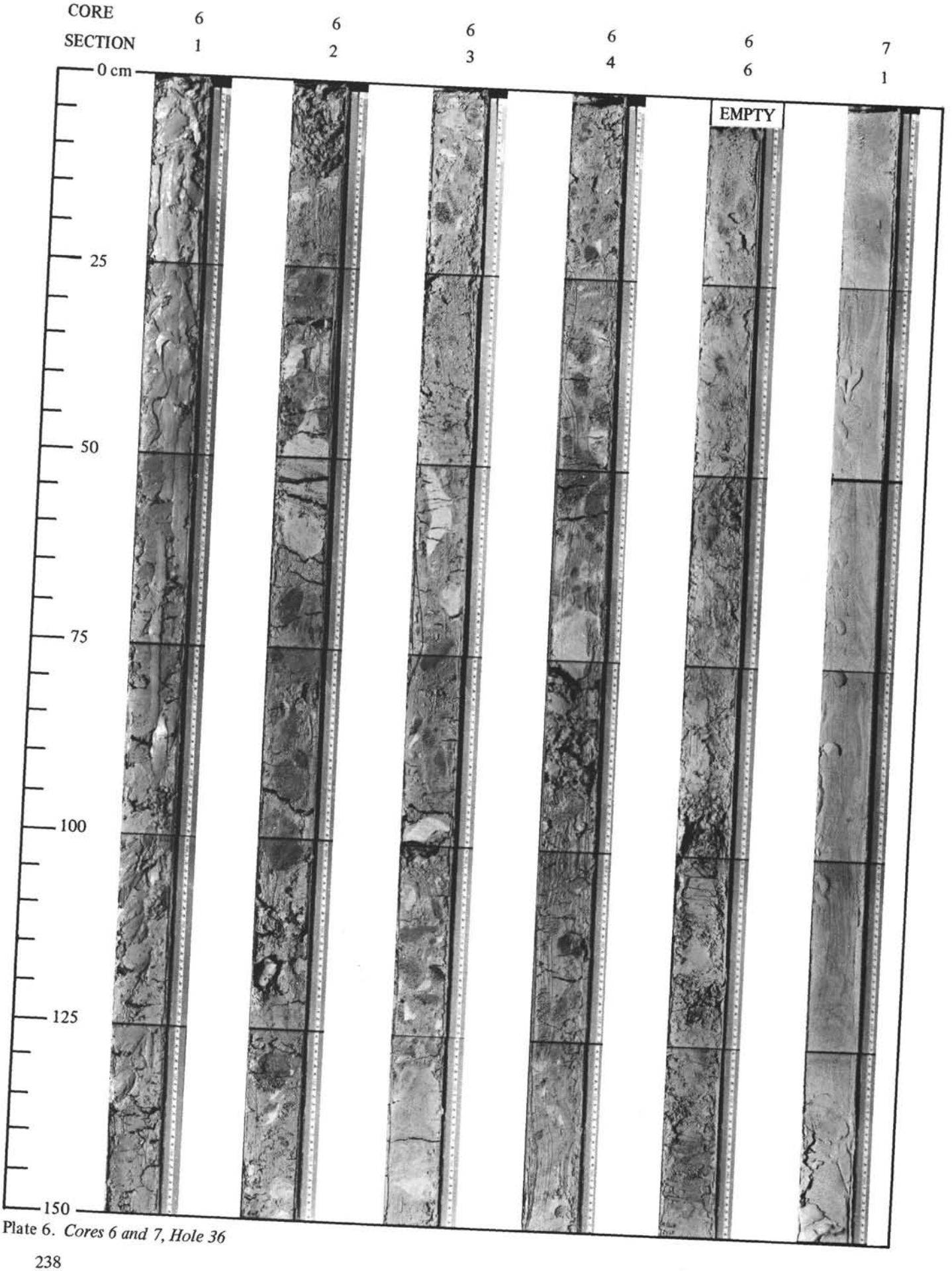

Plate 6. *Cores 6 and 7, Hole 36*

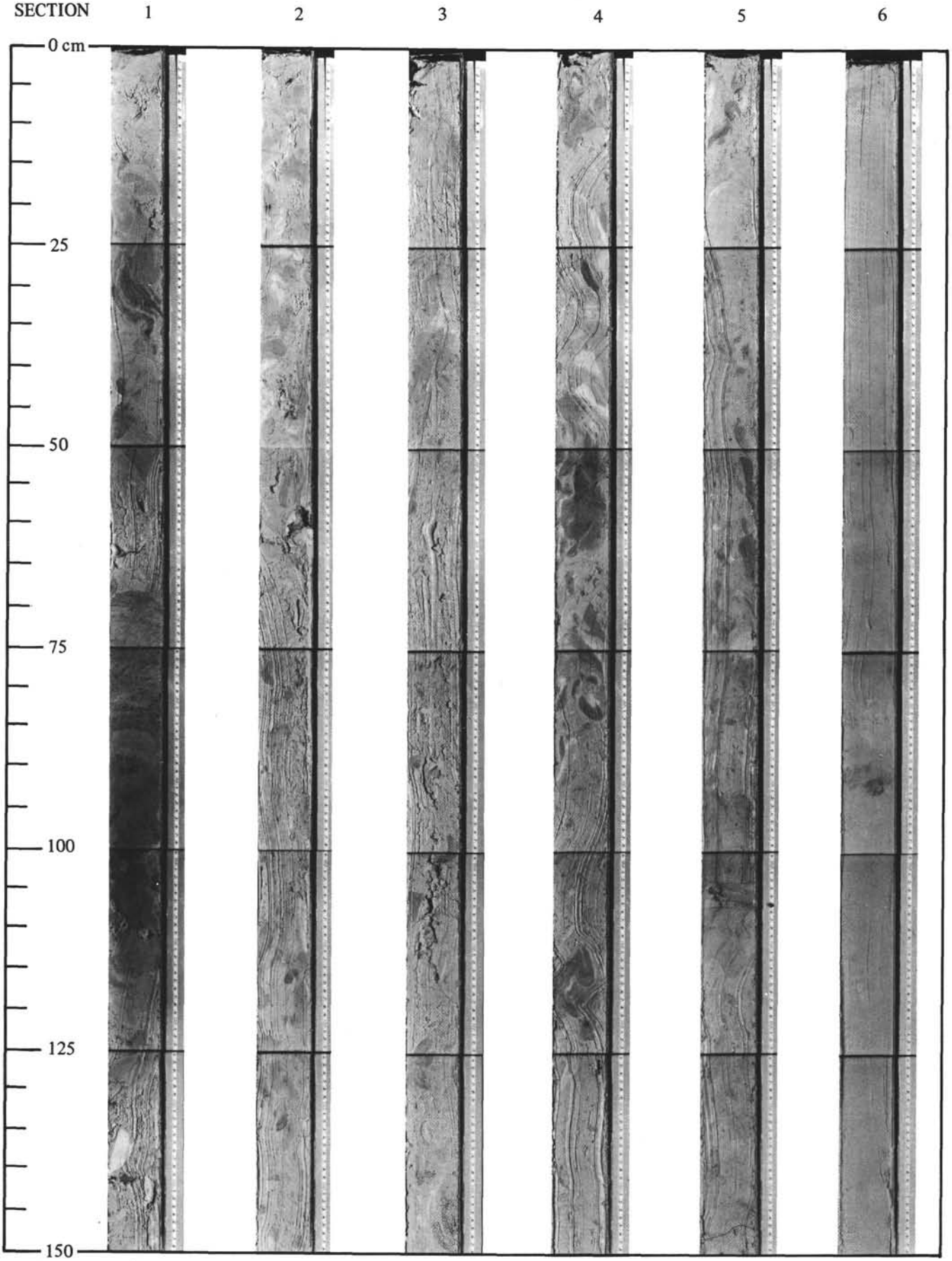

Plate 7. *Core 8, Hole 36*

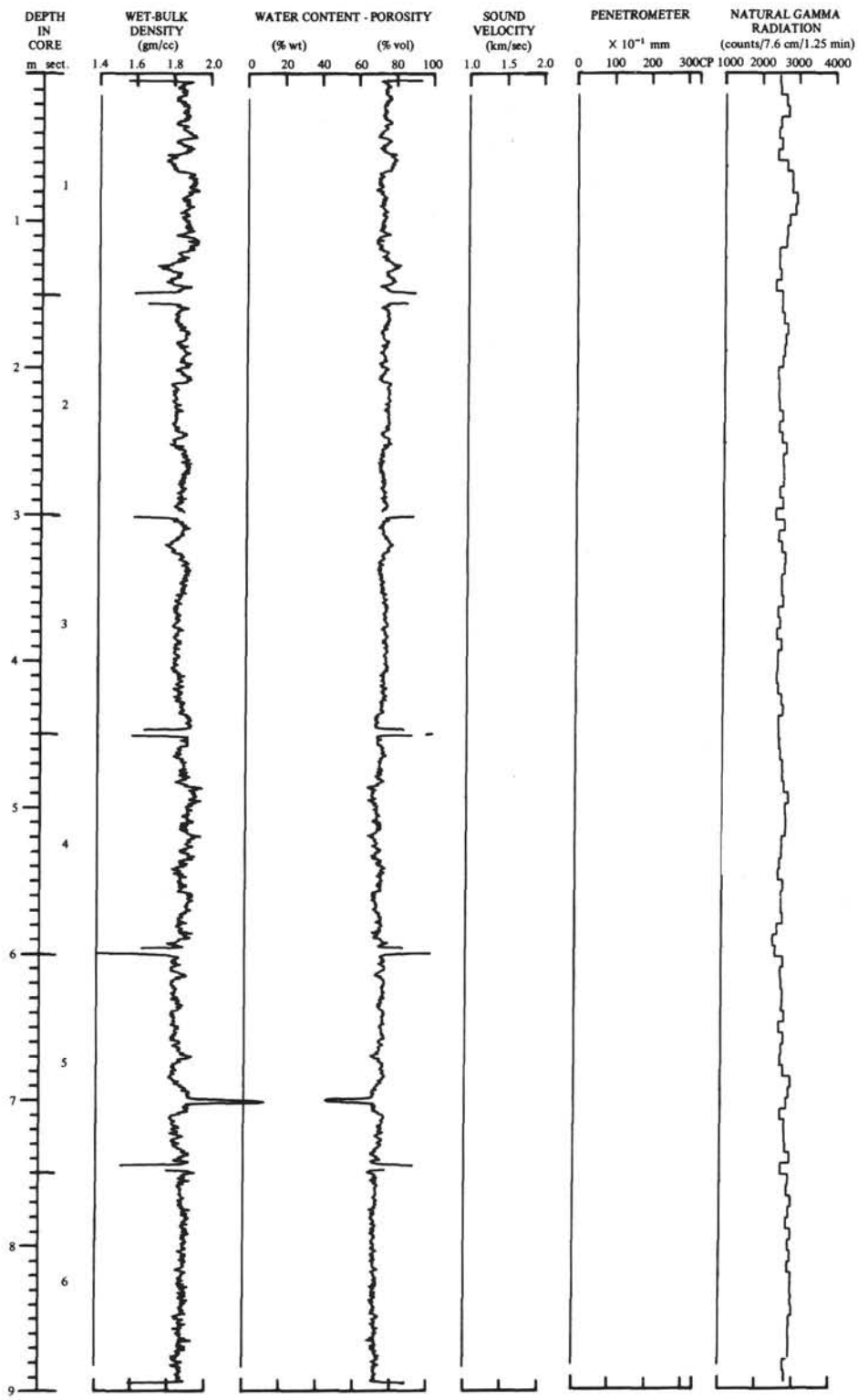

Figure 10A *Physical Properties of Core 8, Hole 36.*

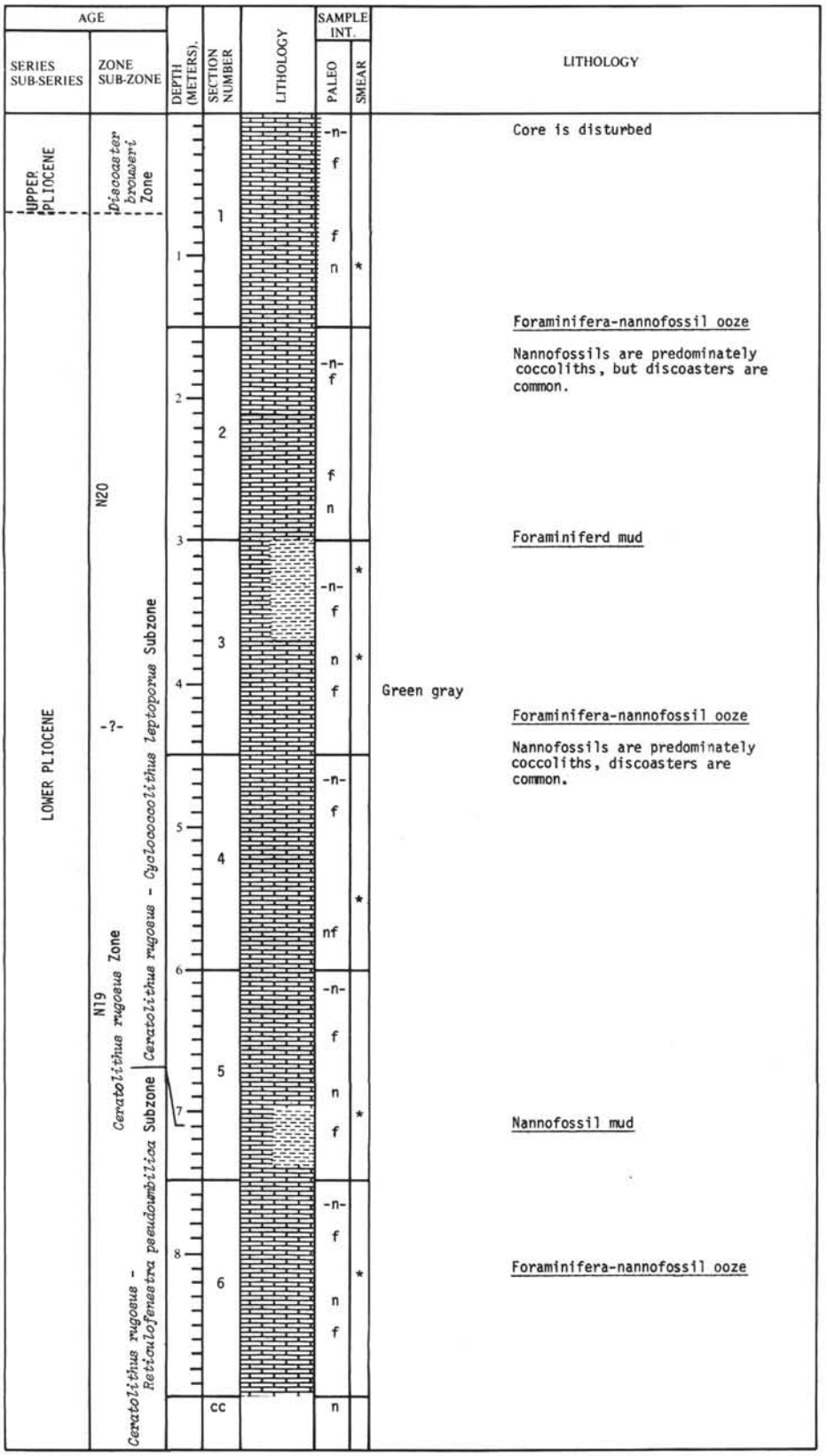

Figure 10B *Core 8, Hole 36. (66 - 75 m below seabed)*

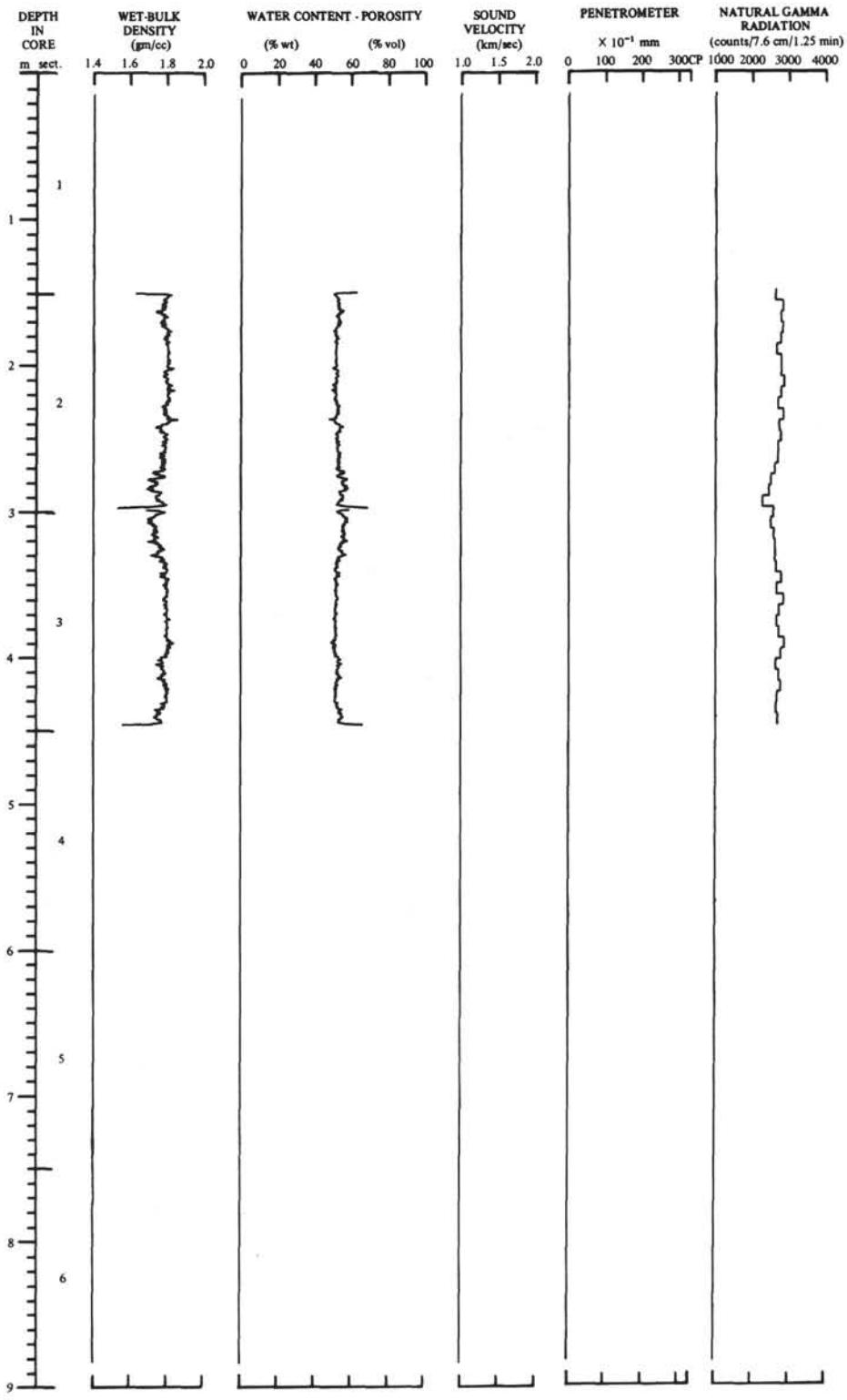

Figure 11A *Physical Properties of Core 9, Hole 36.*

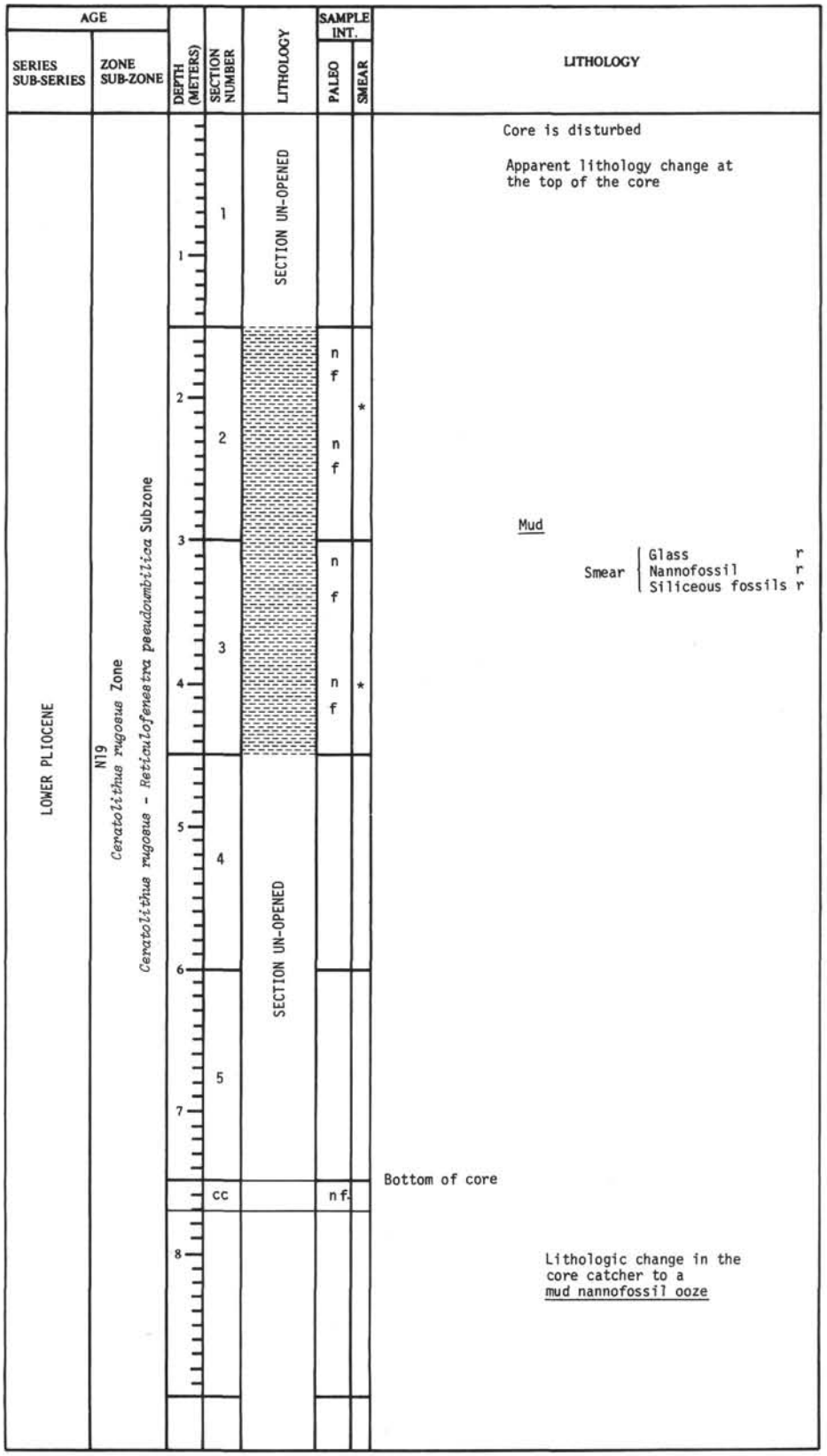

Figure 11B *Core 9, Hole 36 (75 - 83 m below seabed)*

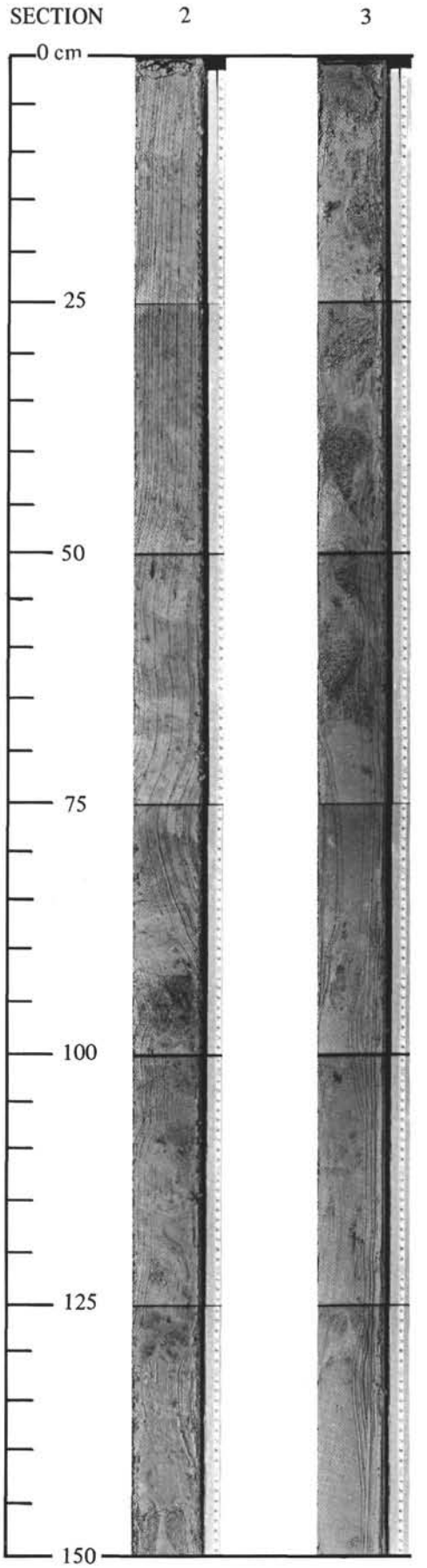

Plate 8. *Core 9, Hole 36.*

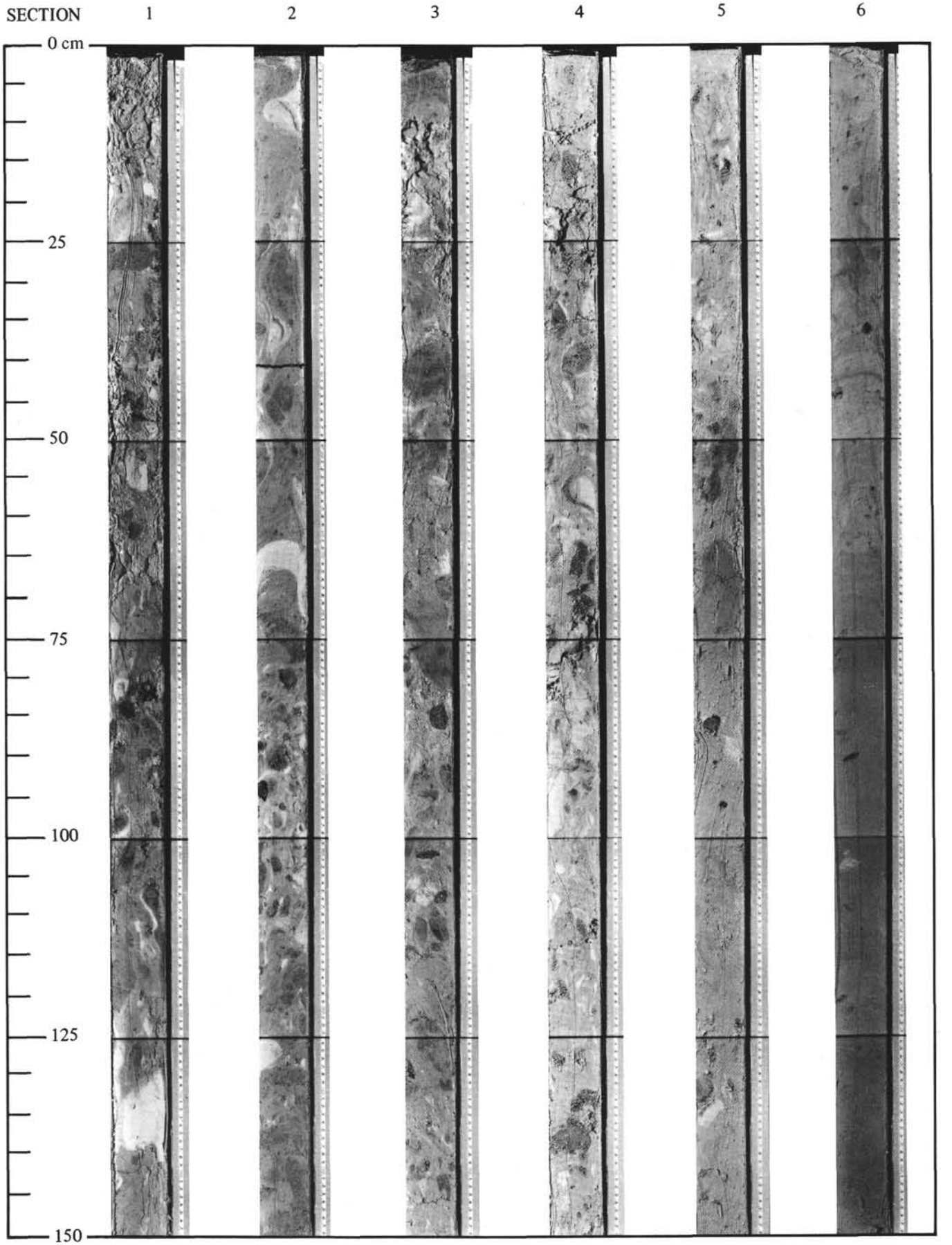

Plate 9. *Core 10, Hole 36*

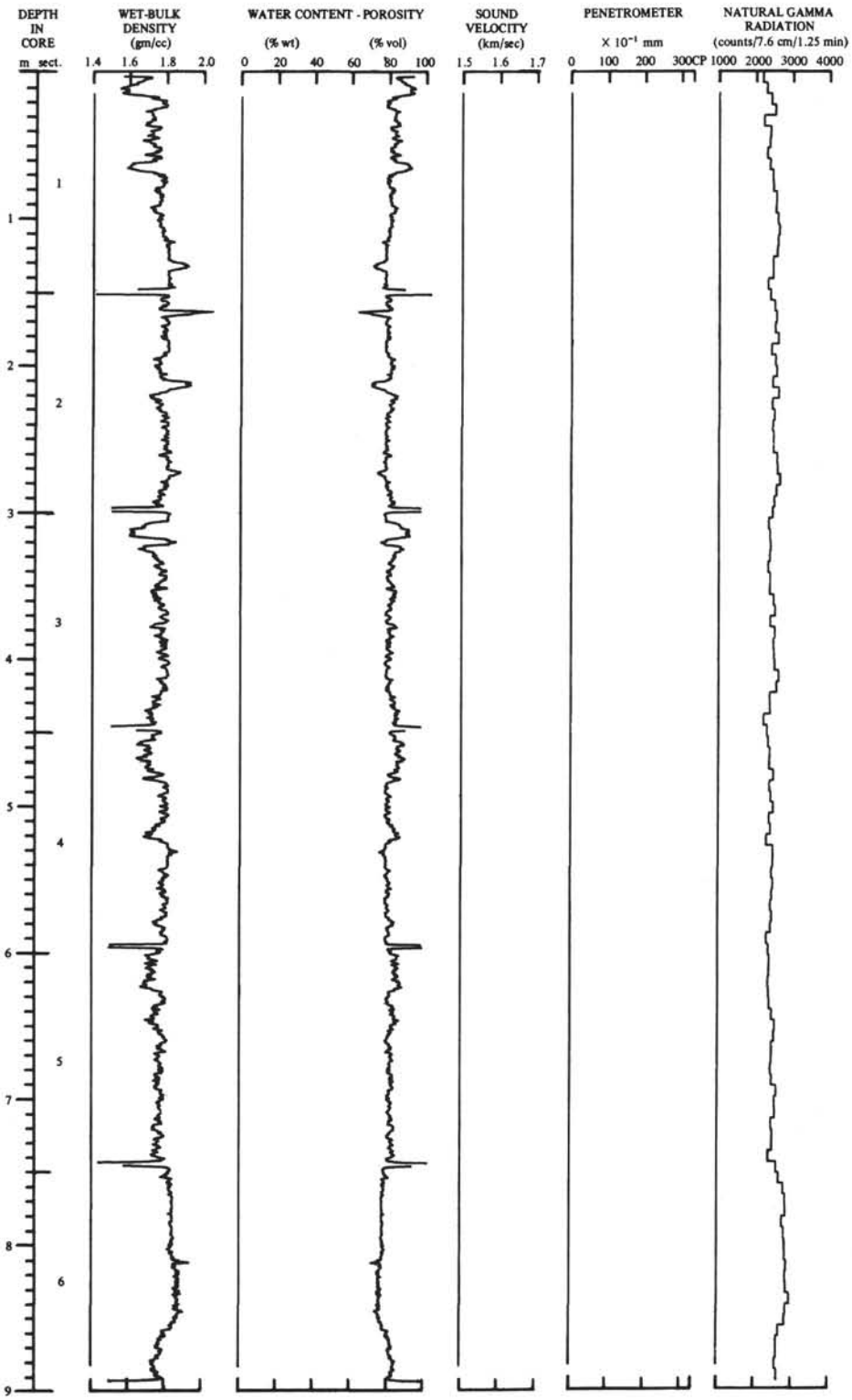

Figure 12A *Physical Properties of Core 10, Hole 36.*

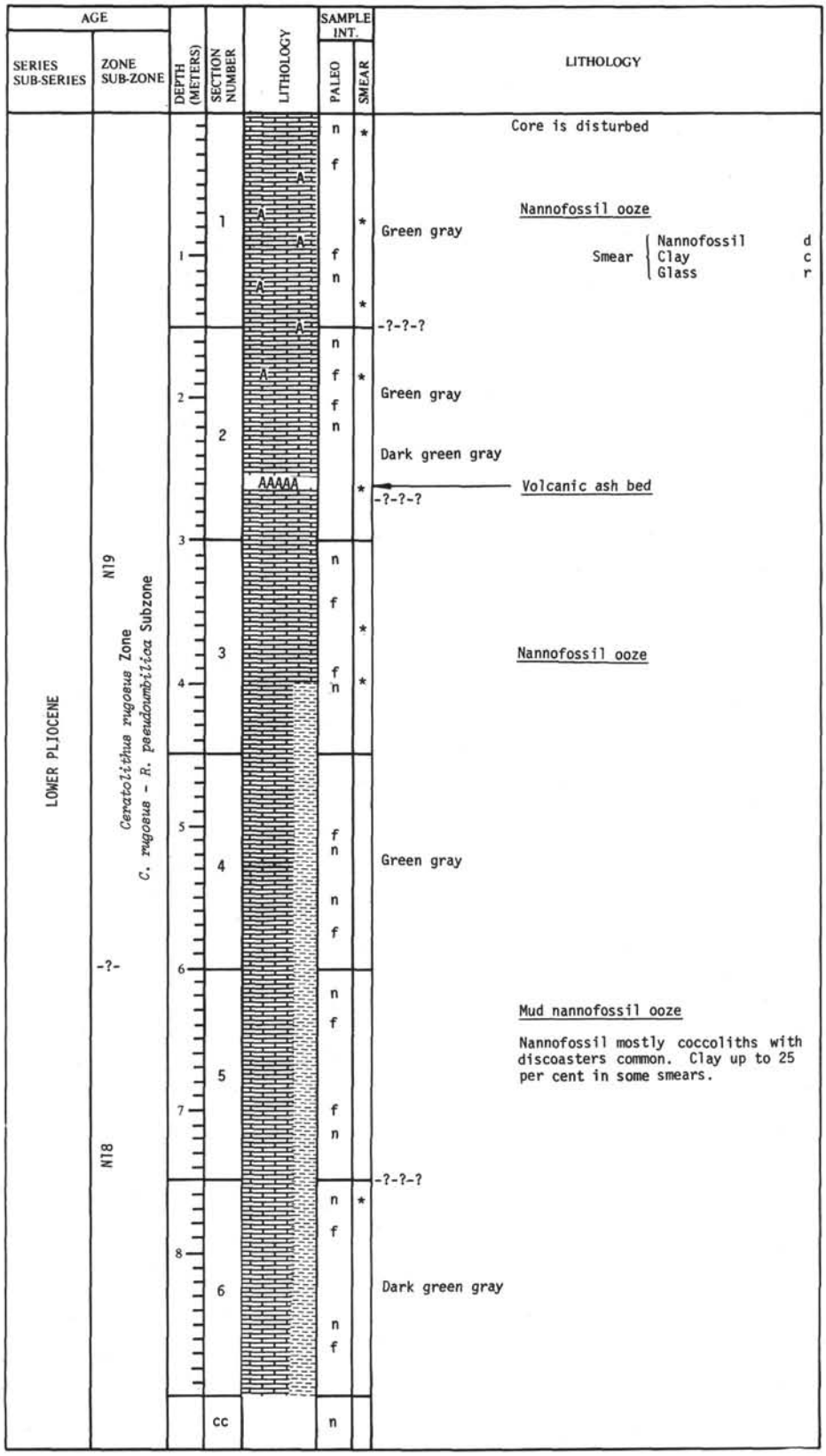

Figure 12B *Core 10, Hole 36 (83 - 92 m below seabed)*

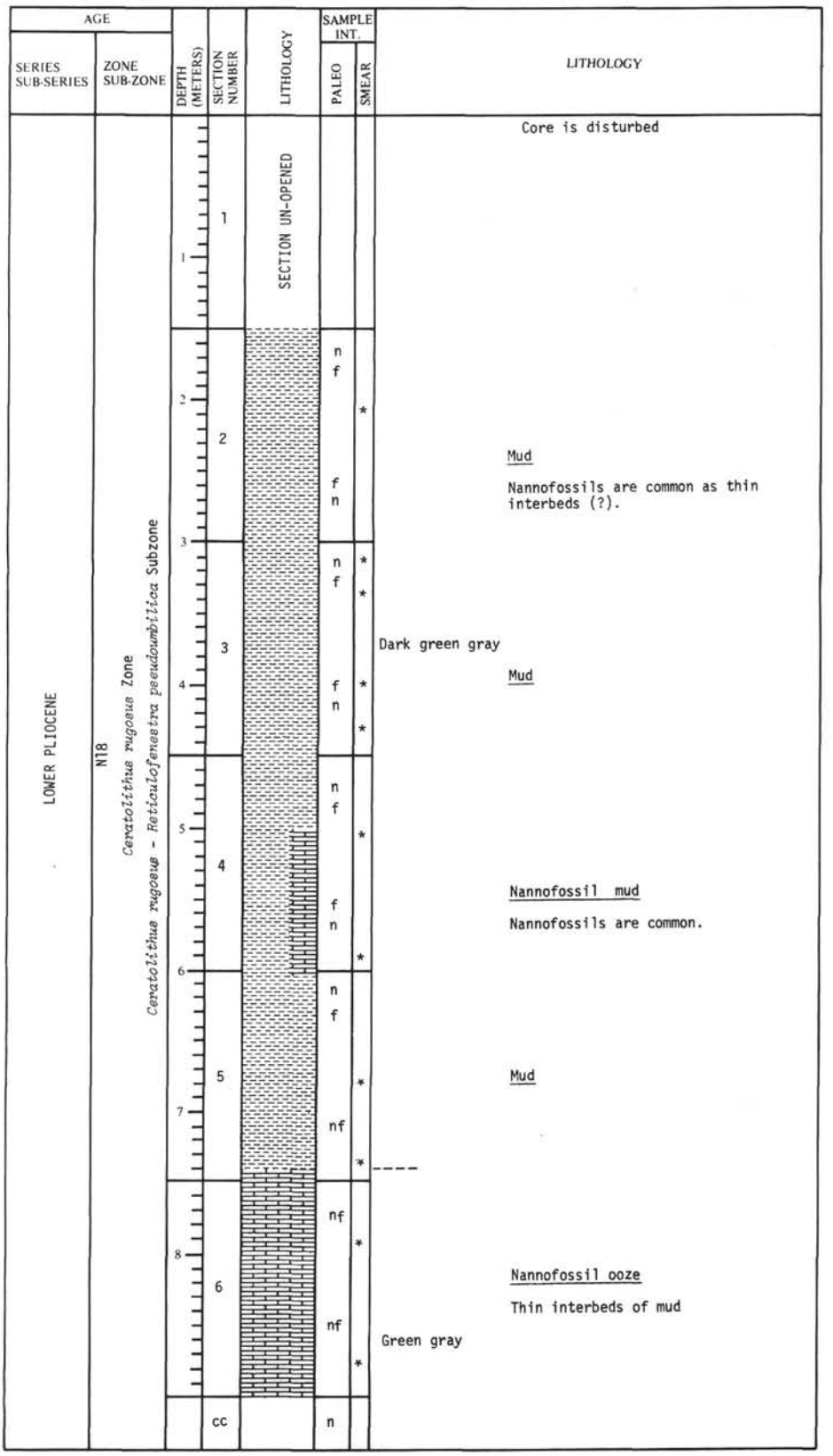

Figure 13 *Core 11, Hole 36 (92 - 102 m below seabed)*

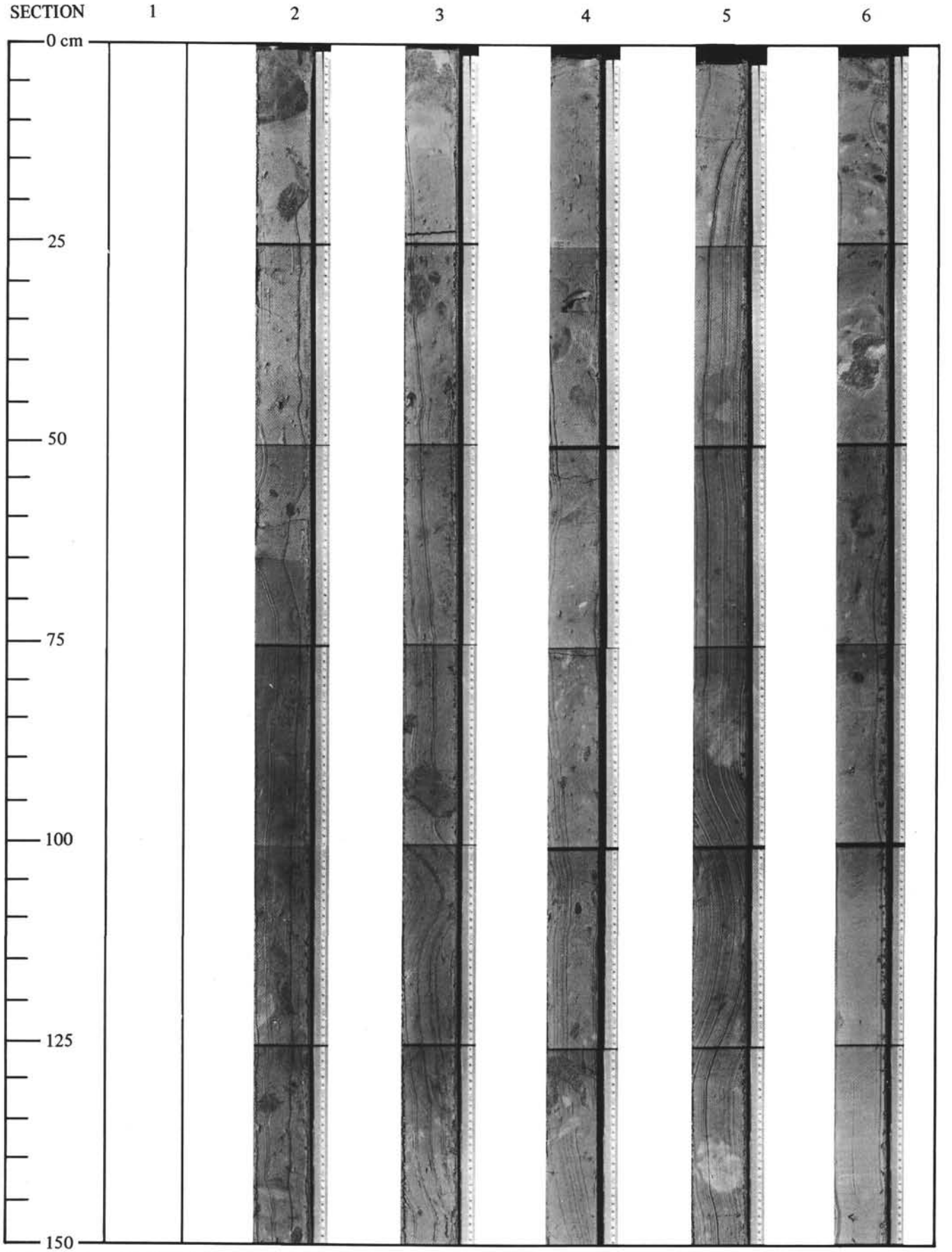

Plate 10. *Core 11, Hole 36*

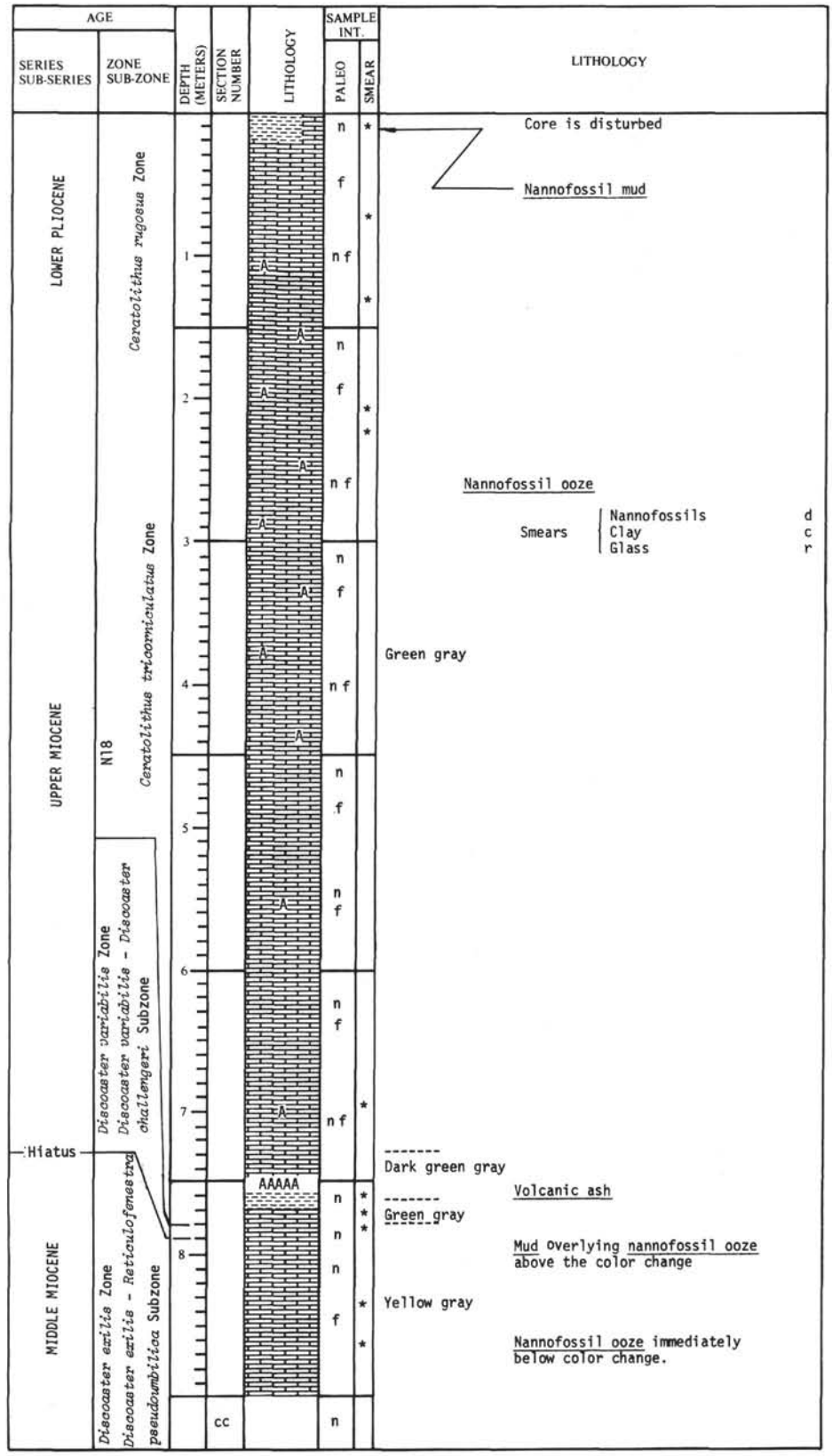

Figure 14 *Core 12, Hole 36 (102 - 111 m below seabed)*

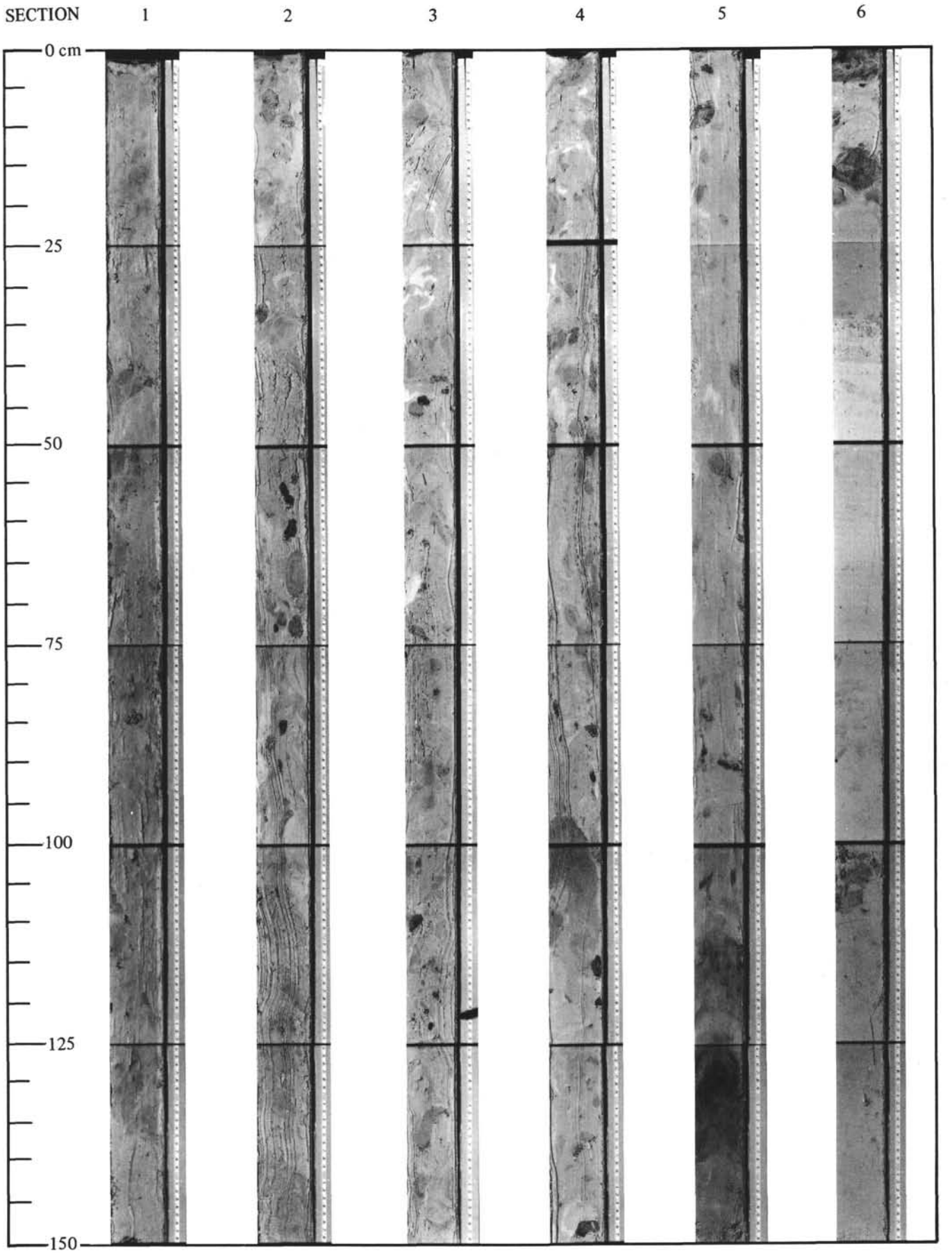

Plate 11. *Core 12, Hole 36*

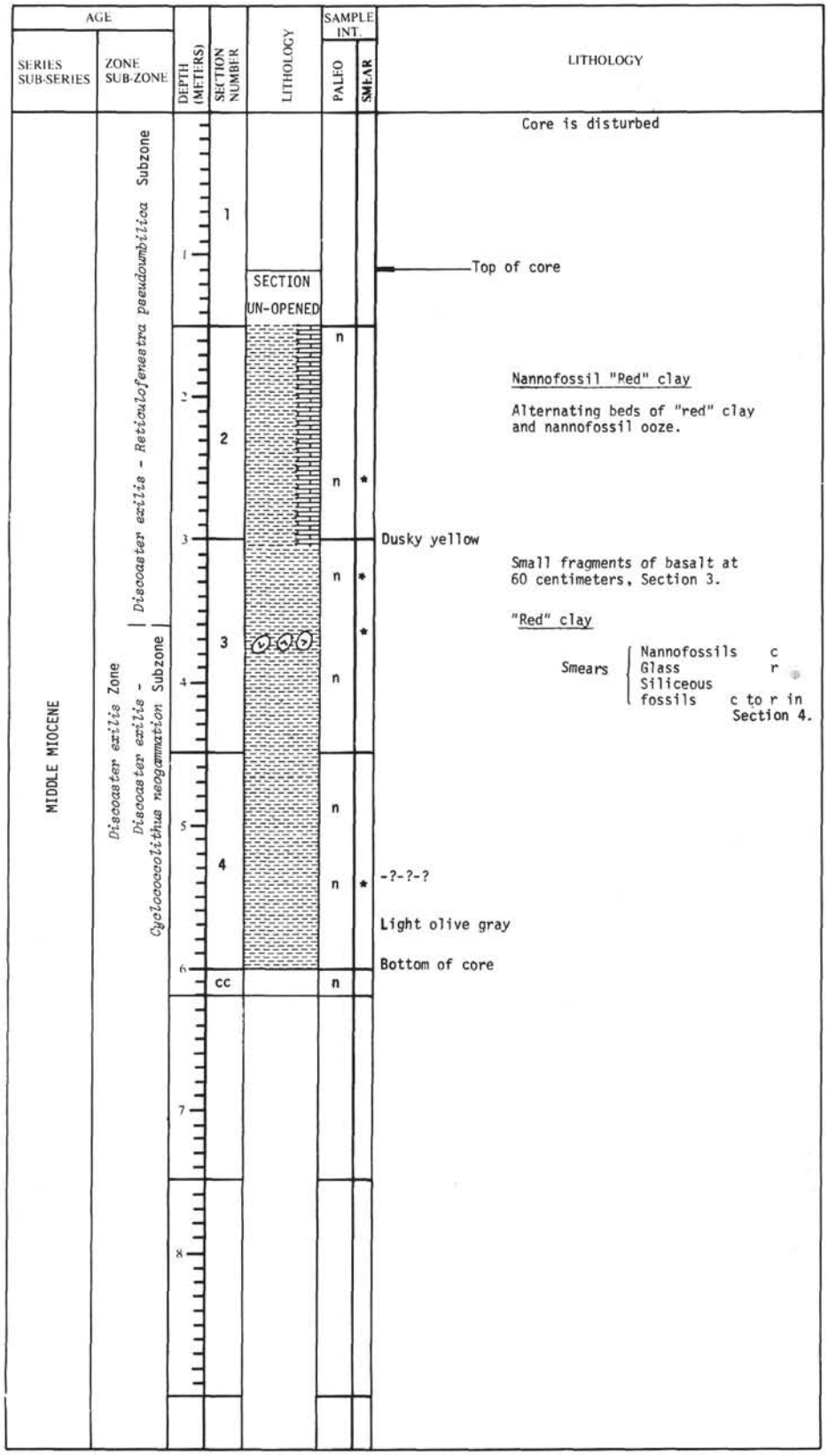

Figure 15 *Core 13, Hole 36 (111 - 115 m below seabed)*

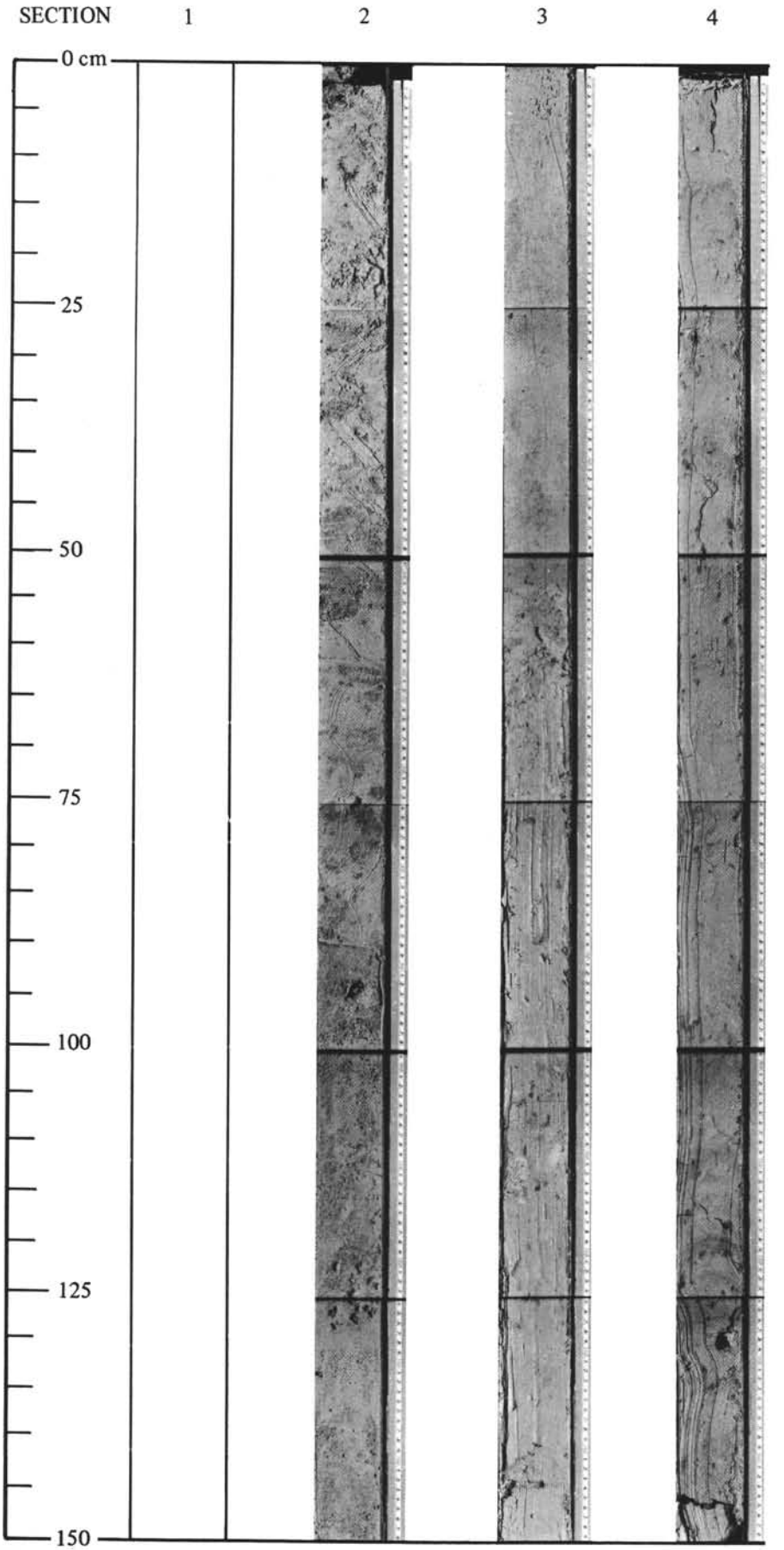

Plate 12. *Core 13, Hole 36*

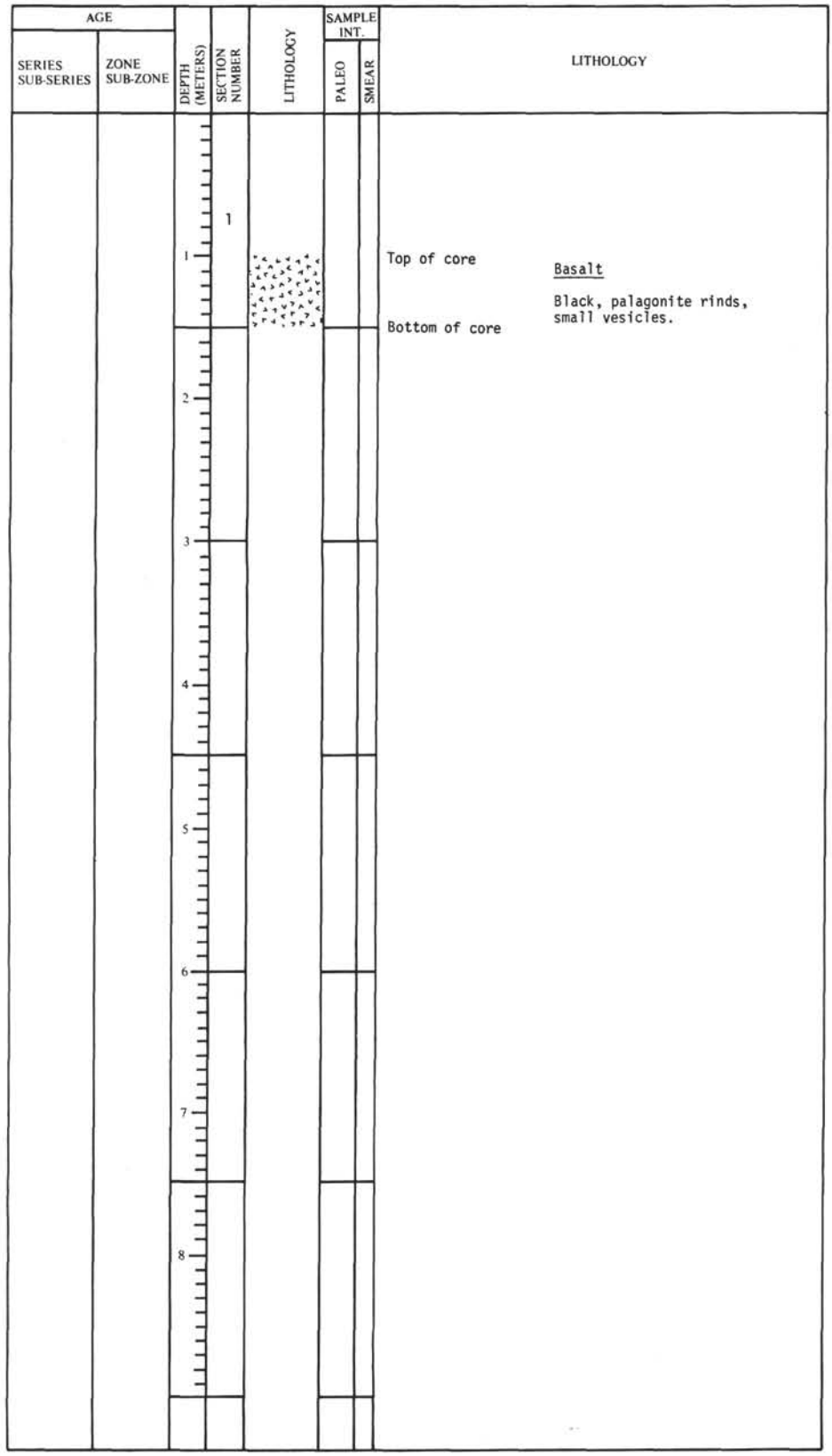

Figure 16 *Core 14, Hole 36 (115 - 115.5 m below seabed)*