9. SITE 74

Shipboard Scientific Party[1]

SITE DATA

Occupied: November 21, 22.

Position: Latitude 06° 14.20′S.
Longitude 136° 05.80′W.

Water Depth: 4431 meters.

Hole Depth: 102 meters ending in basalt overlain by middle Eocene carbonate ooze.

Holes Drilled: One hole.

Cores Taken: Twelve cores (continuous).

RESULTS

A continuous section was cored that included:

1) A bedded sequence primarily of high silica radiolarian ooze (0 to 24 meters) of Quaternary to early Miocene age.
2) A uniform sequence of high carbonate ooze, chiefly composed of calcareous nannofossils (30 to 100 meters) of early Miocene and Oligocene age.
3) A calcareous (nannofossil) ooze containing phillipsitic clay and at the base, volcanic shards and mineral grains, 100 to 102 meters, of late and middle Eocene age.
4) Crystalline igneous rock, probably basalt, somewhat weathered, and a fragment of indurated carbonate tuff.

BACKGROUND

Site 74 is located 250 miles northeast of the Marquesas Islands and lies 270 miles south of Site 73 and 400 miles north of Site 75. It is one of the sites along the N-S line drilled during Leg 8 to investigate the east-west trending accumulation of sediments centered about 2°N near 140°W. This site is a replacement for the site at 25°S originally chosen by the JOIDES Pacific Advisory Panel (PAP Site 26). The original site was not drilled since a preliminary SCAN survey indicated insufficient sediment thickness.

The SCAN (PAP 26) and *Challenger* surveys show small-scale, rough topography with local faulting and flexures. Maximum relief is about 150 meters; commonly, it is about 80 meters. The strike of the topographic grain appears to be roughly north to northwest. Sediment thickness to acoustic basement is generally nearly constant between 0.12 and 0.14 seconds with some local ponding, unconformities, and denuding over higher elevations (Figure 1 and Figure 10, Chapter 2). A piston core taken during the SCAN survey at 06° 31.47′S, 136° 05.75′W, recovered about 10 centimeters of foraminiferal ooze over about 80 centimeters of stiff siliceous ooze, of Lower Miocene age at the bottom.

Site 74 is located near the center of a relatively flat area about 3 miles across. There is some indication of minor deformation at the site. Prominent reflectors at the site are at 0.020, 0.060 and 0.130 seconds. The upper reflector correlates with a change from siliceous to calcareous ooze at 18 meters, near the base of the Clipperton. Acoustic basement (0.130 second) correlates with indurated Eocene sediment below the Marquesas-Line Islands boundary and with basalt near 100 meters (Figures 6, 7 and 8, Chapter 2).

A topographic map of the vicinity of Site 74, airgun records, and further site information are given in Chapter 25.

OPERATIONS

Site 74 was continuously cored to a depth of 102 meters. Core recovery was 74 meters for a recovery percentage of 74 per cent.

Due to lack of sediment cover and the poor lateral support provided for the bottom hole assembly, coring on hard rock was limited to 40 minutes, but a basalt sample was obtained.

A Welex drill pipe log was run.

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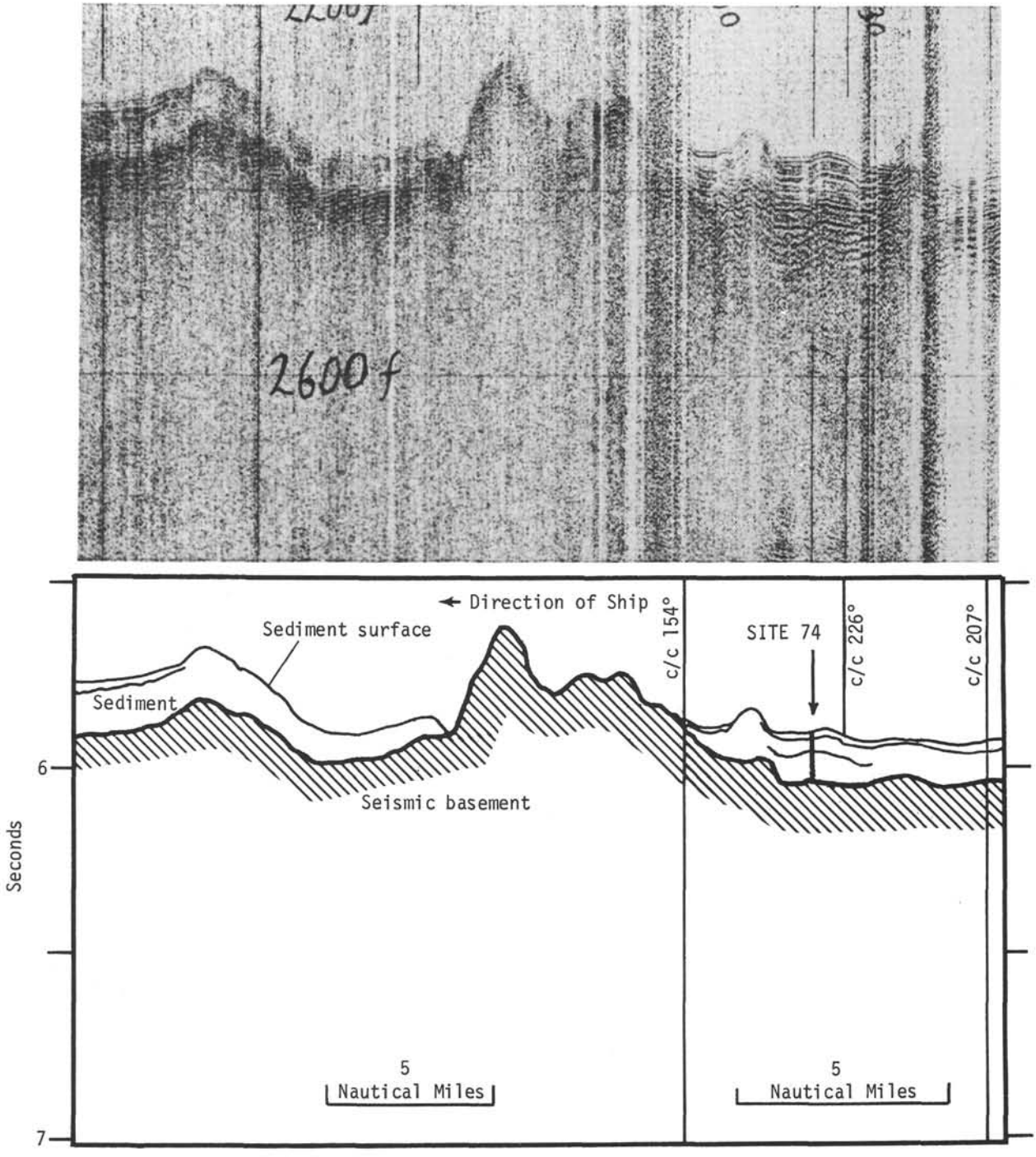


Figure 1. *Airgun record across Site 74 and interpretation.*

LITHOLOGY AND STRATIGRAPHY

Three sedimentary formations are present at Site 74: the Clipperton Oceanic Formation (0 to 23.5 meters) consisting of a radiolarian ooze unit; the Marquesas Oceanic Formation (23.5 to 100 meters) composed of nannofossil ooze; and the Line Islands Oceanic Formation (100 to 102 meters) primarily composed of nannofossil oozes interbedded with iron oxide-rich nannofossil oozes.

TABLE 1
Summary of Coring at Site 74

	Core No.	Interval Below Seafloor (meters)	Cored (m)	Recovered (m)	Comments
Hole 74	1	0-9	9.1	8.7	
	2	9-18	9.1	4.0	
	3	18-27	9.1	7.0	
	4	27-36	9.1	7.5	
	5	36-45	9.1	8.8	
	6	46-55	9.1	9.1	
	7	55-64	9.1	8.8	
	8	64-73	9.1	5.2	
	9	73-82	9.1	8.5	
	10	82-91	9.1	1.8	
	11	91-100	9.1	2.4	
	12	100-102	1.8	1.8	
Total		102	102.4	73.8	74% recovery

Clipperton Oceanic Formation

The Clipperton Oceanic Formation (0 to 23.5 meters) at Site 74 consists almost entirely of a radiolarian ooze unit. The radiolarian ooze is a structureless dusky yellowish-brown bed of zero calcium carbonate ($CaCO_3$) content. The composition is almost wholly Radiolaria with the dark color due to the presence of microscopic sub-spherical translucent red-brown limonitic fragments. A bed of foraminiferal-nannofossil ooze occurs in the uppermost few centimeters of the cored sediment and one 40-centimeter bed of foraminiferal-radiolarian-nannofossil ooze occurs at about 18 meters. Otherwise the entire unit is radiolarian ooze of Pliocene to early Miocene age. The contact with the underlying Marquesas Oceanic Formation is sharp and occurs at the base of the lowermost radiolarian ooze.

Marquesas Oceanic Formation

The Marquesas Oceanic Formation (23.5 to 100 meters) at Site 74 consists almost entirely of yellowish-brown to grayish-orange nannofossil ooze. The ooze is composed predominantly of calcareous nannoplankton (95 to 99 per cent) with Radiolaria (1 to 5 per cent). At 29 meters a dark grayish-brown layer about 1 meter thick occurs which is rich in hydrous iron/manganese oxides associated with phillipsite and rare siliceous organisms. The Marquesas Oceanic Formation is early Miocene and Oligocene in age. The contact with the underlying Line Islands Oceanic Formation is sharp and corresponds to a disconformity at the Oligocene-Eocene boundary.

Line Islands Oceanic Formation

At a sediment depth of 100 meters, at the Eocene-Oligocene boundary, a hiatus occurs. Tentatively correlated with this hiatus is an abrupt lithological change from essentially iron-oxide-free nannoplankton ooze above to underlying iron-oxide-rich nannoplankton ooze. From this level to the basaltic "basement" at 102 meters, iron-oxide-rich zones–estimated at 50 per cent calcium carbonate ($CaCO_3$) content–alternate with sharp boundaries and with essentially iron-free light-colored nannoplankton layers (see Chapter 17). Iron and possibly manganese oxides are present in the form of translucent yellowish-brown microscopic aggregates and colloids admixed with the calcareous ooze. Towards the bottom of the hole thin lenses of ginger-brown devitrified volcanic glass and some feldspar appear. In the last core sample, two fragments of hard rock were recovered. One piece is an igneous rock of possible basaltic or slightly more acid composition which shows evidence of coating by iron-manganese oxide. The other fragment is a dull dark brown rock composed dominantly of what appears to be recrystallized carbonate, associated with some ash and possible rare foraminifera fragments. The basalt is considered to correlate with seismic basement. The Line Islands Oceanic Formation at Site 74 is late and probably middle to late Eocene in age.

Figure 6 is a plot of age versus depth, based on the biostratigraphic zonations of the foraminifera, nannoplankton, and Radiolaria, with the time scale, in millions of years, based on that of Berggren (1969).

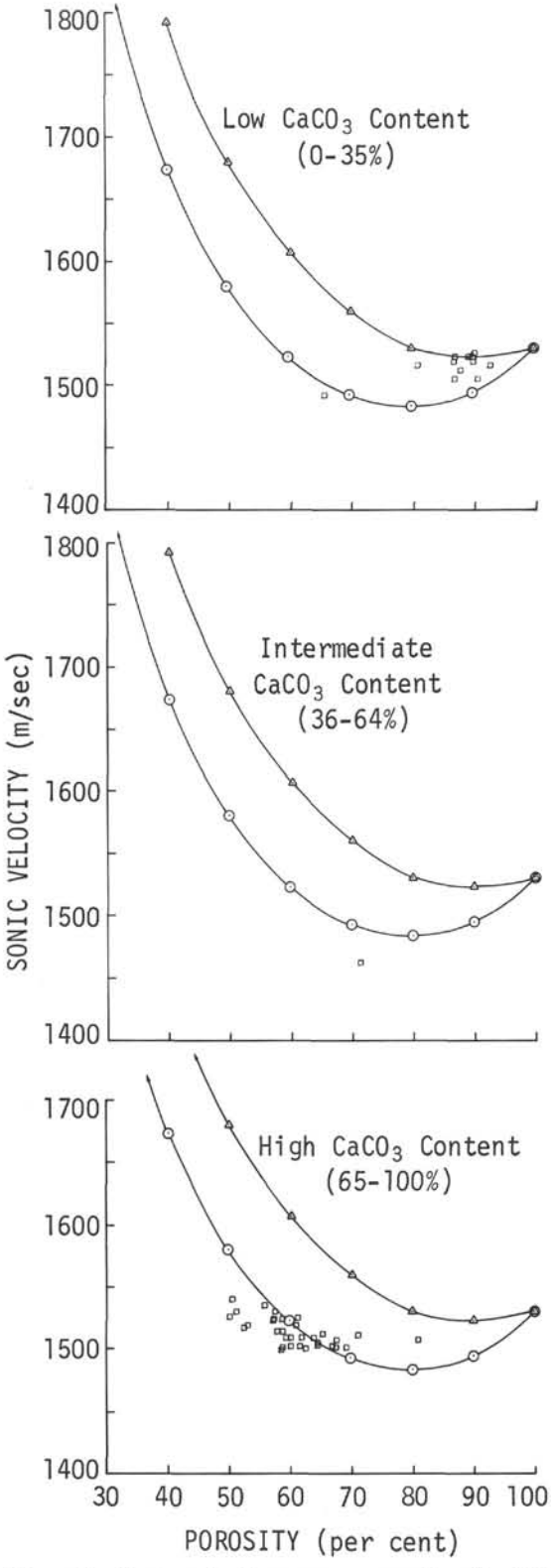


Figure 2. *Sonic velocity versus porosity of unlithified sediments from Site 74 for three ranges of calcium carbonate content. Theoretical curves are based on the equation of Wood (1941). Upper curve, grain-matrix density 2.2 g/cm^3, appropriate for siliceous ooze. Lower curve, grain-matrix density 2.65 g/cm^3, appropriate for calcareous ooze.*

PHYSICAL PROPERTIES

Porosities range from about 50 to greater than 90 per cent and velocities range between about 1.50 and 1.54 km/sec. Most of the sampled sediments are high in calcium carbonate ($CaCO_3$) and the velocity-porosity data for 65 to 100 per cent calcium carbonate ($CaCO_3$) in Figure 2 fall near the theoretical curve for a grain-matrix density of 2.65 g/cm^3 as appropriate for such material. With one exception, the data for 0 to 35 per cent calcium carbonate ($CaCO_3$) fall on or slightly below the curve for density 2.20 g/cm^3. Near the Clipperton-Marquesas boundary, at 24 meters, there is an abrupt change in most of the physical parameters measured: sonic impedance and bulk density increase; porosity, penetrability, and natural gamma decrease. No prominent subbottom reflection correlates with this depth; the nearest reflector is at about 16 meters (Figure 6, Chapter 2).

Sonic velocity is less than that for sea water for depths less than about 75 meters. Penetrability generally decreases monotonically throughout the section. Natural gamma radiation exceeds 1300 counts at the top of the section and decreases rapidly to about 1000 counts. Activity increases again in the Line Islands Oceanic Formation at 100 meters depth.

Velocity and density were determined for an indurated carbonate and ash and for a piece of basalt (Chapter 2). For the basalt the average of the two more reliable velocity measurements is 6.35 km/sec and the density is 2.89 g/cm^3.

Results of grain-size and carbon-carbonate analyses are tabulated in Appendices II and III, respectively.

PALEONTOLOGY

Foraminifera

Site 74 reached a depth of 102 meters and was continuously cored. The younger Neogene section of Site 74 is very thin and incomplete, a fact which clearly reflects its position south of the equatorial high productivity belt. Drilling was stopped below the Middle Eocene in hard igneous (basaltic?) rock.

Predominantly siliceous microfaunas were recovered from Cores 1 to 3, but Cores 4 to 12 are mostly calcareous. The number of radiolarians decreases downward and is practically zero below Core 7. The main noncalcareous constituents in the lower part of the hole are fish remains; they are locally common, particularly at the top of the Eocene. There are no more visible solution effects on the foraminifera from Core 8 to total depth, and we find here many small-sized and thin-walled specimens. Nevertheless, the total number of foraminifera per sample remains

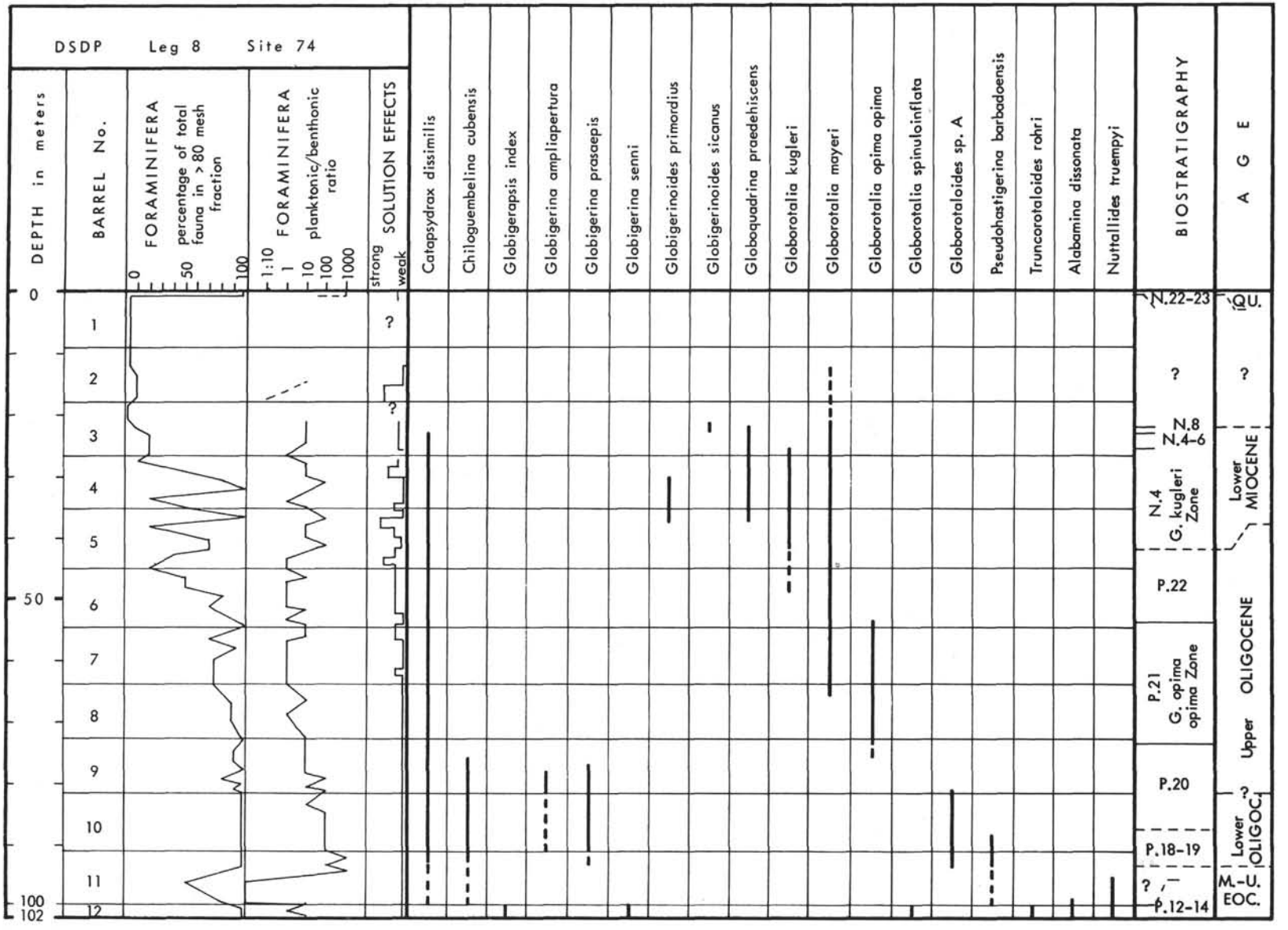


Figure 3. *Foraminifera of Site 74. Frequency distribution, ranges of important species, and biostratigraphy.*

TABLE 2
Calcareous Nannoplankton and Silicoflagellate Occurrences at Site 74

Species	Occurrences (Hole/Core Nos.)
Calcareous Nannoplankton	
Ceratolithus cristatus Kamptner	74/1
Chiasmolithus grandis (Bramlette and Riedel) Bukry	74/12
Coccolithus bisectus (Hay, Mohler and Wade) as figured by Bramlette and Wilcoxon	74/6-11
Coronocyclus nitescens (Kamptner) Bramlette and Wilcoxon	74/4-6, 9
Cyclococcolithus formosus Kamptner	74/11, 12
C. leptoporus (Murray and Blackman) Kamptner	74/1
C. neogammation Bramlette and Wilcoxon	74/3-11
Discoaster adamanteus Bramlette and Wilcoxon	74/3-6, 9-11
D. barbadiensis Tan Sin Hok	74/11, 12
D. brouweri Tan Sin Hok	74/2
D. calcaris Gartner	74/2
D. deflandrei Bramlette and Riedel	74/2-11
D. dilatus Hay	74/2-4
D. druggii Bramlette and Wilcoxon	74/3, 4
D. exilis Martini and Bramlette	74/2
D. incomptus Hay	74/12
D. kugleri Martini and Bramlette	74/2
D. lodoensis Bramlette and Riedel	74/11, 12
D. pacificus Haq	74/11, 12
D. saipanensis Bramlette and Riedel	74/11, 12
D. sublodoensis Bramlette and Sullivan	74/11, 12
D. tani nodifer Bramlette and Wilcoxon	74/8, 9, 11
D. tani ornatus Bramlette and Wilcoxon	74/9-11
D. tani tani Bramlette and Riedel	74/8-11, 12?
D. variabilis Martini and Bramlette	74/2
Gephyrocapsa oceanica Kamptner	74/1
Helicopontosphaera compacta (Bramlette and Wilcoxon)	74/9-11
H. euphratis (Haq) Martini	74/4
H. recta (Haq) Martini	74/10
Reticulofenestra umbilica (Levin) Martini and Ritzkowski	74/11, 12
Sphenolithus ciperoensis Bramlette and Wilcoxon	74/6, 7
S. distentus (Martini) Bramlette and Wilcoxon	74/6, 8-11
S. moriformis (Bronnimann and Stradner) Bramlette and Wilcoxon	74/3-12
S. predistentus Bramlette and Wilcoxon	74/6-11

TABLE 2 – *Continued*

Species	Occurrences (Hole/Core Nos.)
S. pseudoradians Bramlette and Wilcoxon	74/8,9
Triquetrorhabdulus carinatus Martini	74/3-6
Silicoflagellate	
Dictyocha fibula Ehrenberg	74/1

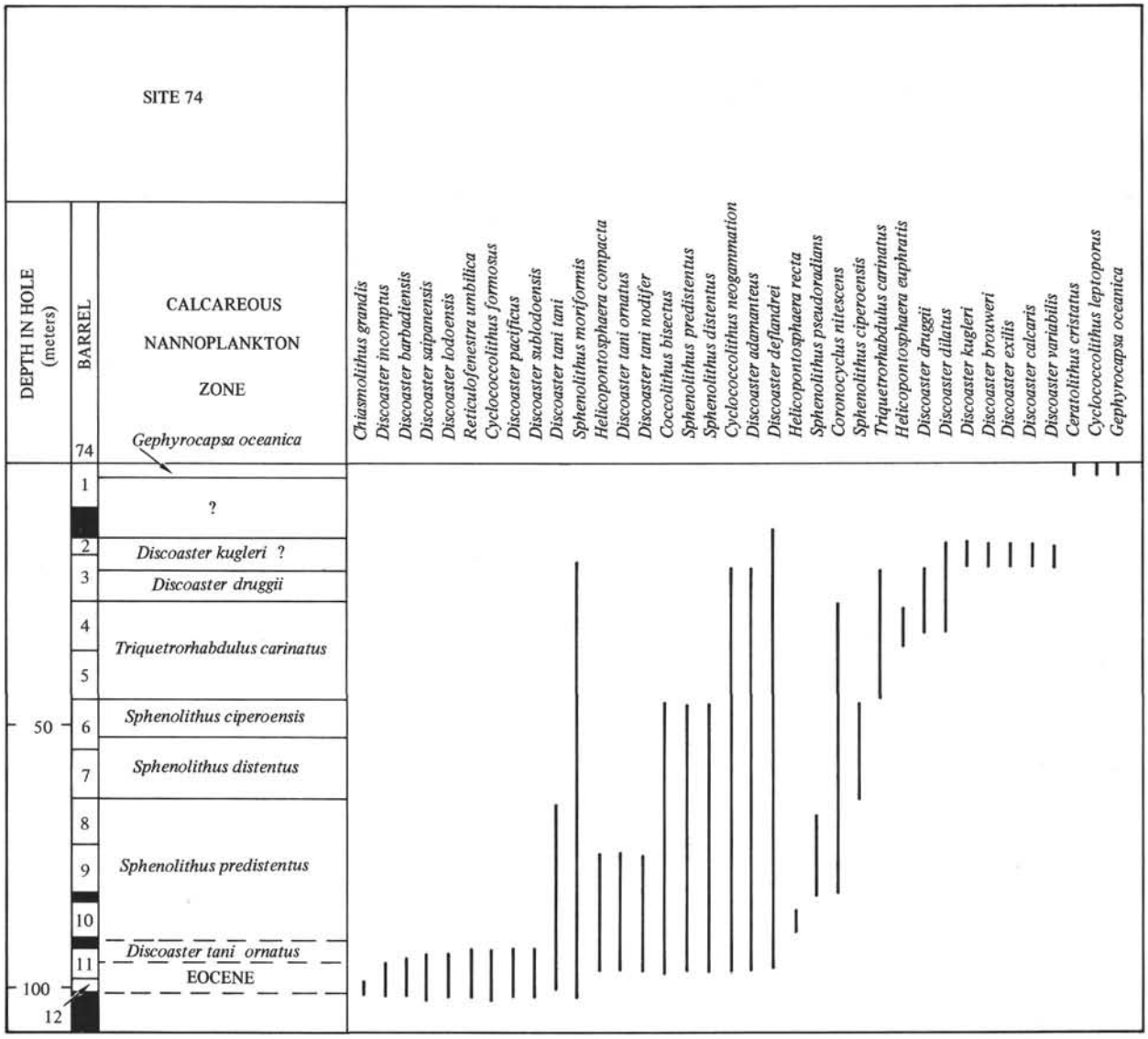


Figure 4. *Calcareous nannoplankton of Site 74. Distribution and biostratigraphy.*

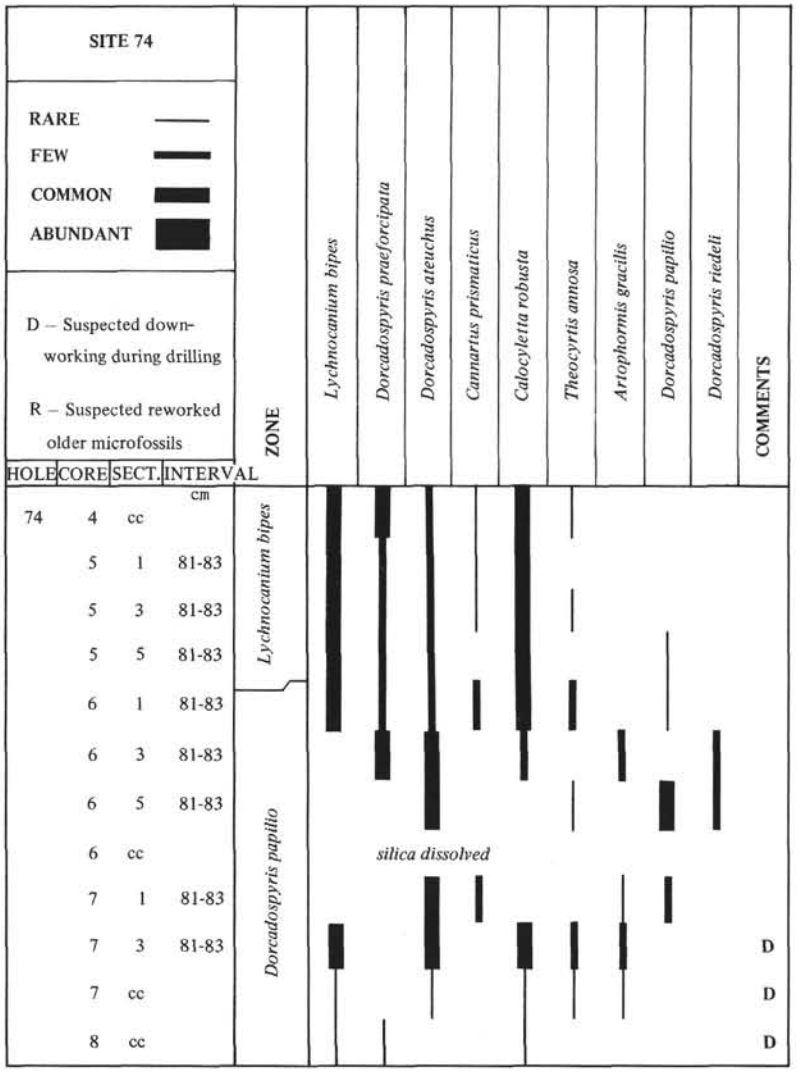


Figure 5. *Radiolaria at Site 74. Frequency, distribution and biostratigraphy.*

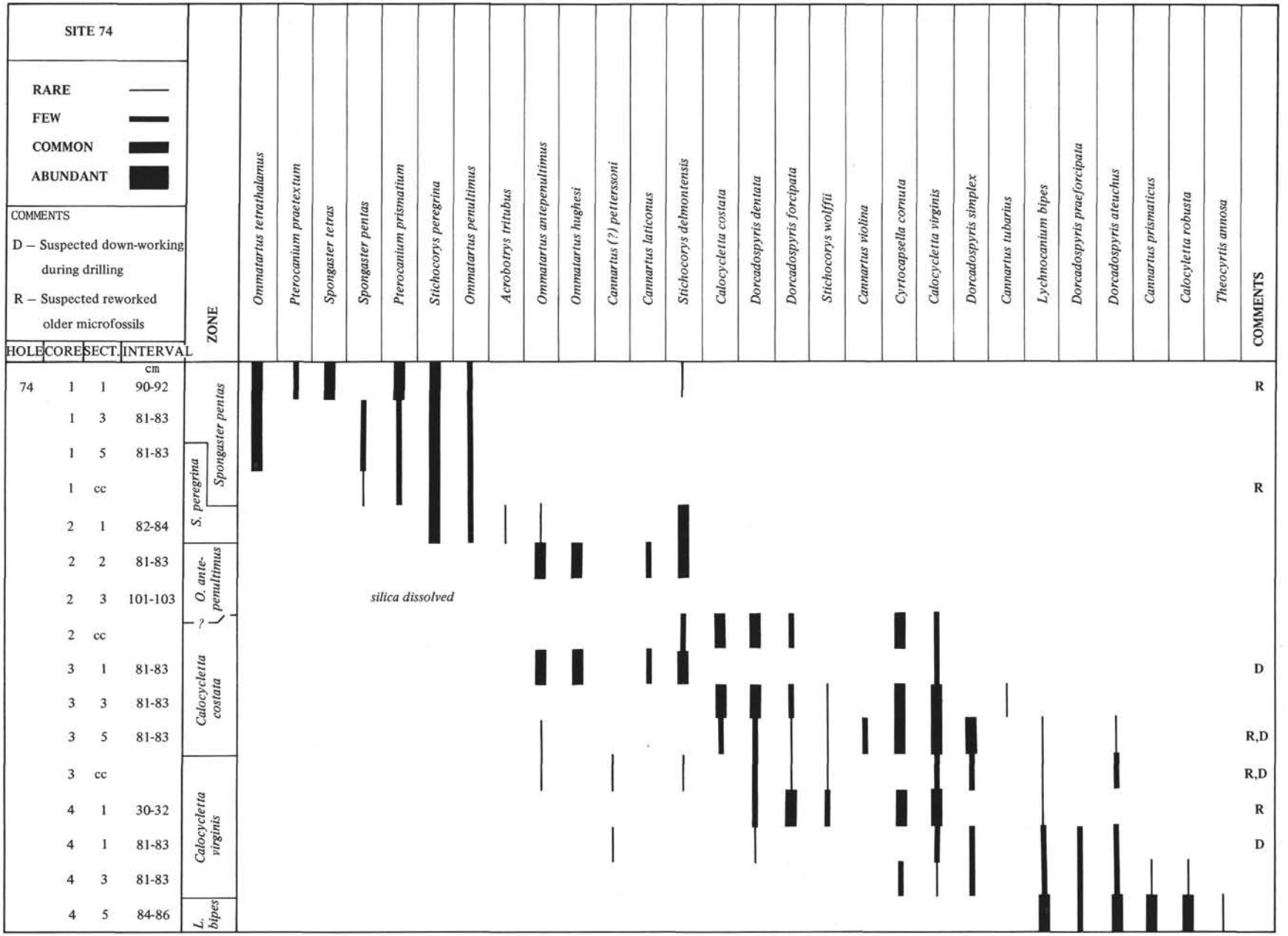


Figure 5. *Continued.*

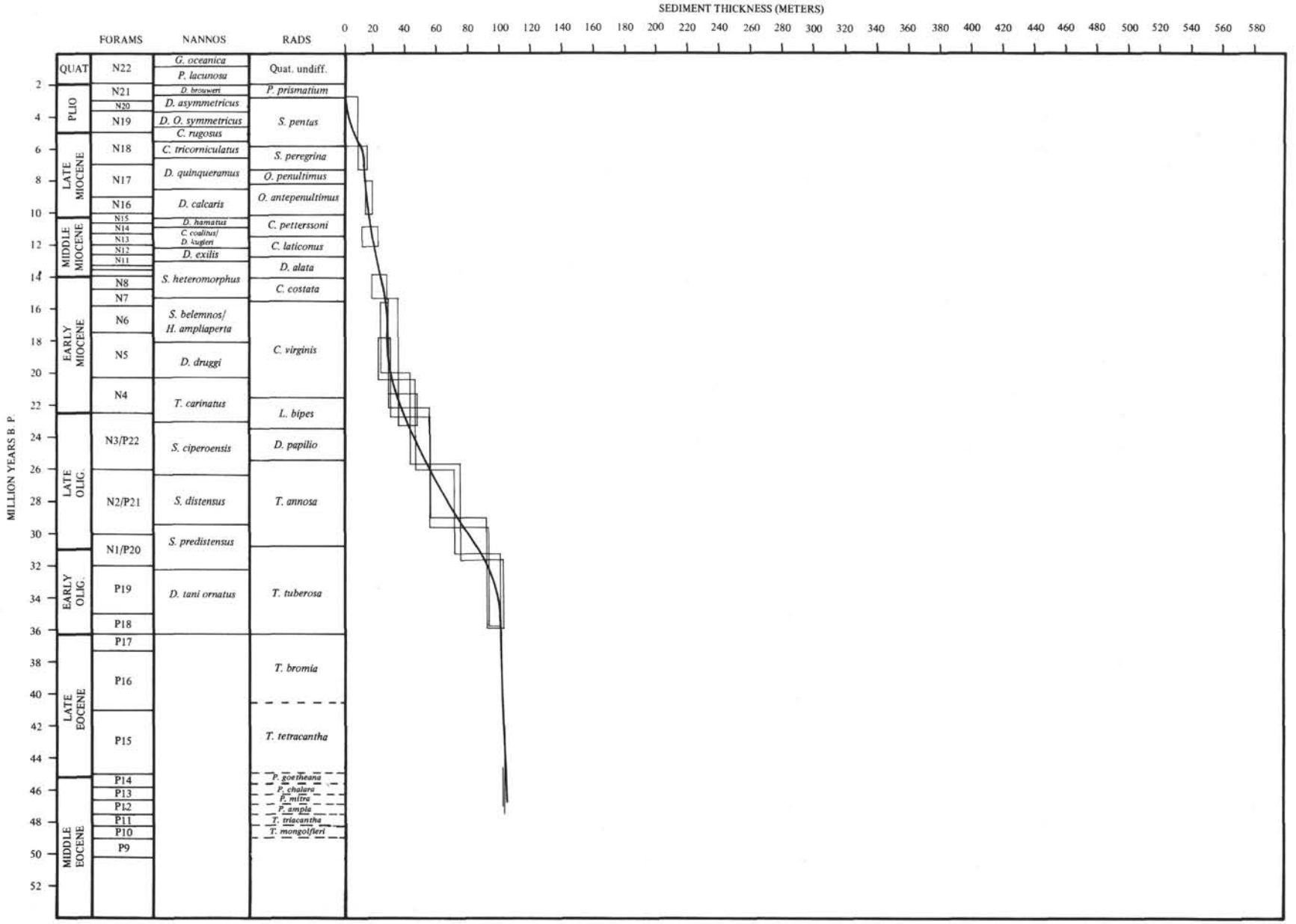


Figure 6. *Age versus depth at Site 74, based on the biostratigraphic zonations of the foraminifera, calcareous nannoplankton and Radiolaria. Ages based on the time scale of Berggren (1969).*

rather small, because of the abundance of clay-sized material (apparently mostly calcareous nannoplankton).

A smear sample taken from the very thin top layer of Core 74-1 shows a fairly rich fauna with *Globorotalia tumida*, dextrally coiled *Pulleniatinas* (including *P. finalis*) and very rare *Globigerina calida* (s. str.). Its age seems to be Upper Quaternary. Below this, the sediments are essentially noncalcareous down to Section 74-3-2 (22 meters), except for occasional benthonic foraminifera and echinoid spines. In the remainder of Core 74-3, the foraminifera indicate the presence of a highly condensed sequence comprising the interval from N. 8 to upper N. 4: in 74-3-3 *Globigerinoides sicanus* is found, but the following Section (74-3-4) already contains the highest *Catapsydrax dissimilis*. In the core catcher sample of Core 74-3 (27 meters), *Globorotalia kugleri* marks the top of the *G. kugleri* Zone (N. 4). The base of this zone is located at 74-5-4 (41 meters). Only a little higher, in 74-5-1, the earliest *Globigerinoides primordius* was seen. The Oligocene comprises the interval from 74-5-5 (41 meters) to 74-11-2, 102 centimeters 96±3 meters). The zone boundaries are placed as follows:

Base of *Globigerina ciperoensis ciperoensis* Zone (P. 22) just above the core catcher sample of Core 74-6 (55 meters).

Base of *Globorotalia opima opima* Zone (P. 21) at 74-9-1 (74 meters). Earliest *Globorotalia mayeri* at 74-8-2.

Base of *Globigerina ampliapertura* Zone (P. 20) at 74-10-2 (approximately 90 meters). From here to the base of the Oligocene we have the *Pseudohastigerina/Cassigerinella chipolensis* Zone (P. 18-19). Because of very poor recovery in Cores 10 and 11, depths in meters can be given only very approximately.

As usual, the Eocene/Oligocene boundary coincides with a lithologic and faunal change. It lies in Section 74-10-2, between 102 and 116 centimeters. As in Sites 72 and 73, the fauna of the upper part of the Eocene is poor and predominantly benthonic (with *Nuttallides truempyi* and *Alabamina dissonata*). In most samples of Core 74-12 (excluding the very top), at a depth of 100 to 102 meters, we find a richer planktonic assemblage of Middle Eocene age (unfortunately very badly contaminated with Oligocene material). It contains *Globigerina senni, Globigerapsis index, Globorotalia wilsoni* and *Truncorotaloides rohri*, which indicate an age of *Globigerapsis kugleri* Zone or younger.

Calcareous Nannoplankton and Silicoflagellates

The latest Quaternary, Middle and Early Miocene, Oligocene and Eocene sediments at Site 74 contained well-preserved calcareous nannoplankton. The Oligocene and Lower Miocene nannoplankton zones are continuous, but there is a break in the record at the top of the *Discoaster druggii* Zone.

Nine (one questionable) nannoplankton zones were distinguished on the basis of 36 species found in Hole 74 (Table 2). These zones are:

Hole 74

Core 1-1 to 1-2:	*Gephyrocapsa oceanica* Zone
Core 1-2 to 2-1:	Barren
Core 2-2 to 3-2:	Probably *Discoaster kugleri* Zone
Core 3-3 to 3-CC:	*Discoaster druggii* Zone
Core 4-1 to 5-CC:	*Triquetrorhabdulus carinatus* Zone
Core 6-1 to 6-4:	*Sphenolithus ciperoensis* Zone
Core 6-5 to 7-CC:	*Sphenolithus distentus* Zone
Core 8-2 to 10-CC:	*Sphenolithus predistentus* Zone
Core 11-2 (to 123 cm):	*Discoaster tani ornatus* Zone
Core 11-2 (143 cm) to 12-CC:	Middle Eocene–probably *Discoaster sublodoensis* Zone

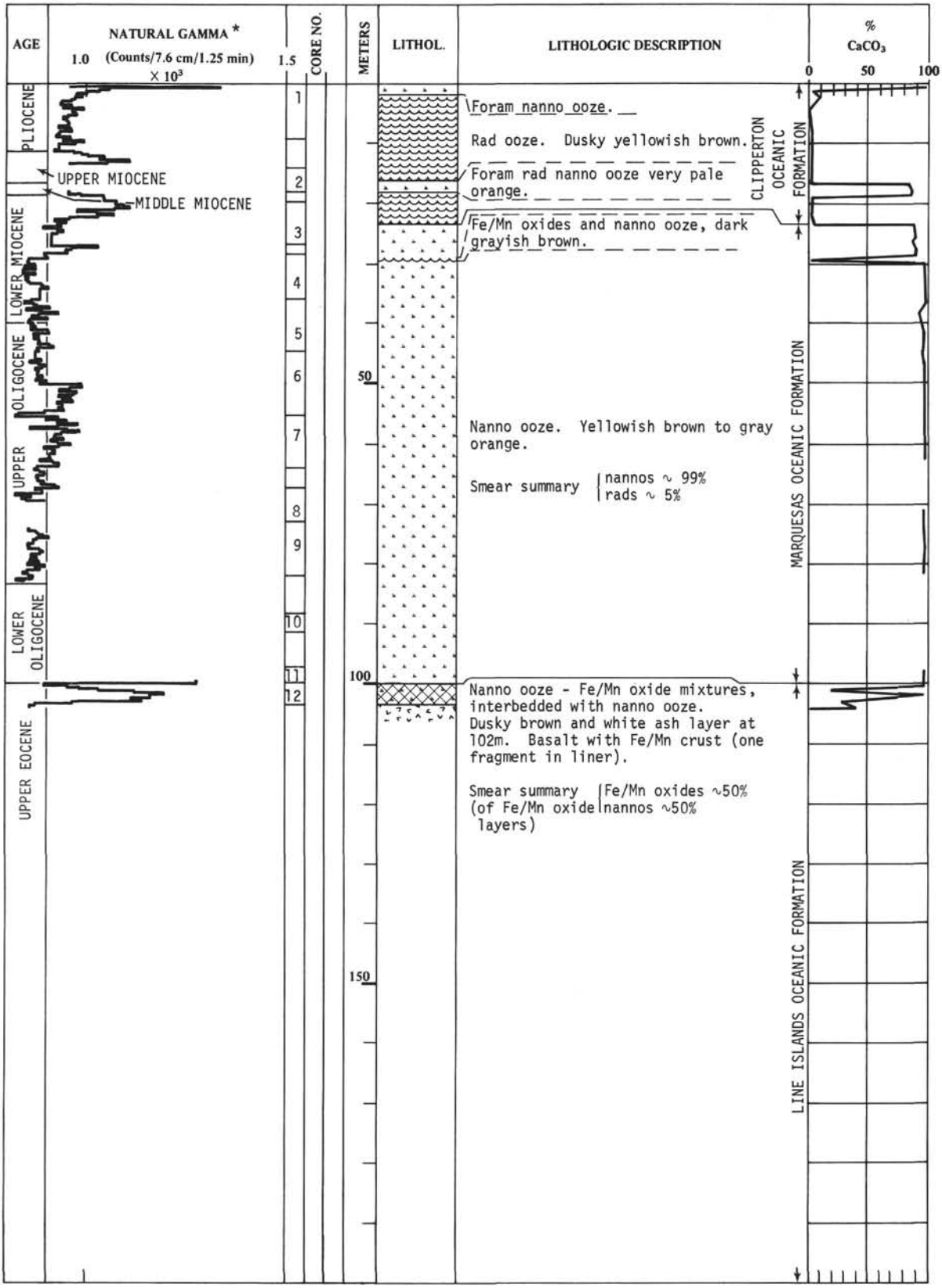
Radiolaria

Radiolaria at this site are generally numerous and moderately well preserved down to the Middle Miocene. Below this part of the section, tests are badly corroded. Oligocene and Eocene sediments contain few radiolarian tests and, therefore, were not zoned.

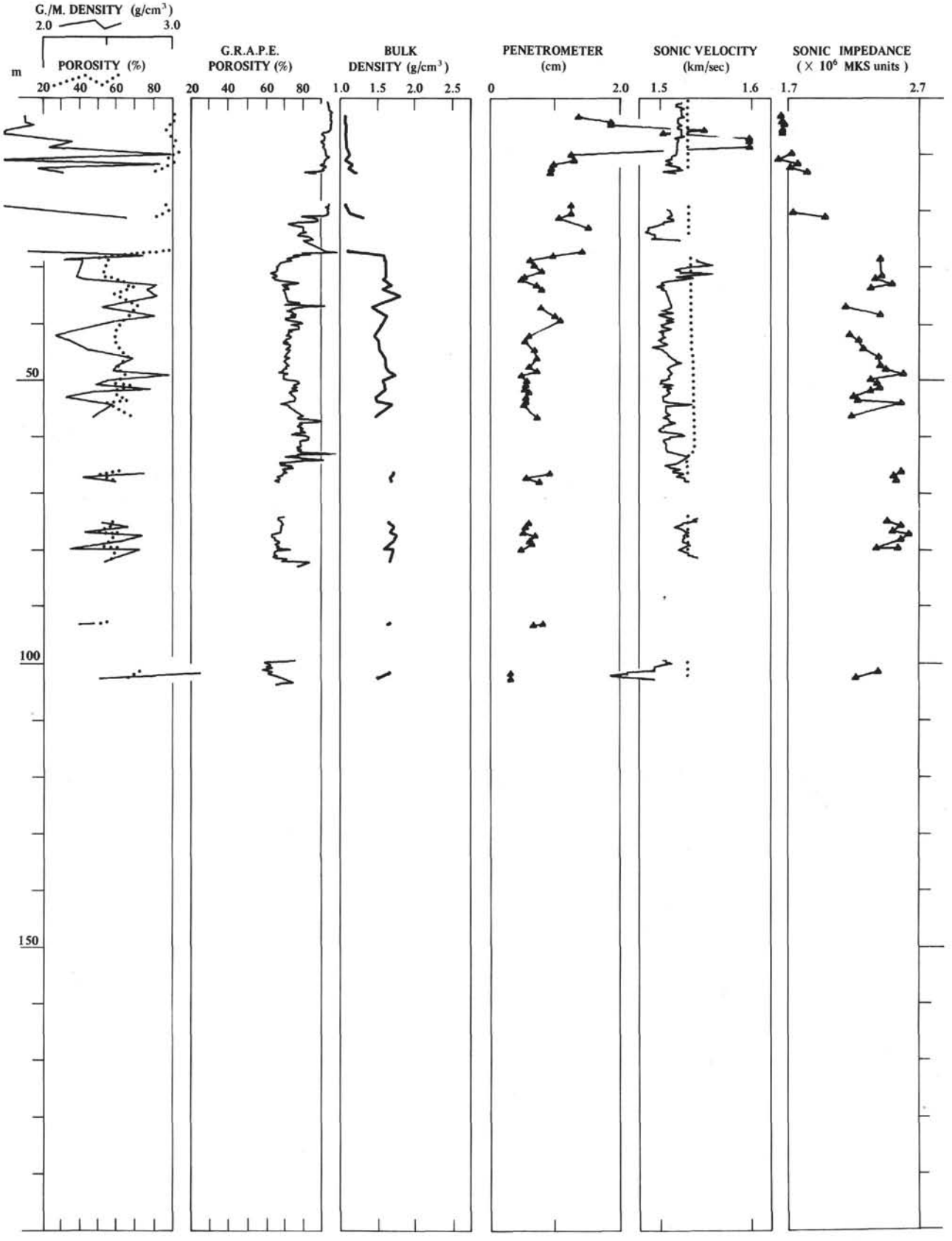
The upper, noncalcareous part of the section is very condensed. Core 74-1 apparently begins in the Lower Pliocene (*Spongaster pentas* Zone); however, a mixture of the fauna from this zone with that from the younger *Pterocanium prismatium* and "Quaternary" zones seems likely. Such mixing would be difficult to detect because these younger zones are defined on the basis of the last appearance of two Pliocene species (Riedel and Sanfilippo, 1970). Core 73-2, consisting of only three sections, gives a very abbreviated history of the Late and Middle Miocene. It contains two zones of the Upper Miocene, an interval in which radiolarian tests have been dissolved (probably representing a hiatus), and finally, in the catcher sample, a Middle to Lower Miocene fauna (*Calocycletta costata* Zone). In the more carbonate rich sediments of Cores 73-3, 73-4 and 73-5, all of the Lower Miocene radiolarian zones are identified. In the remaining cores, the sparseness of the fauna and the presence of some downmixing makes reliable zonation impossible.

REFERENCE

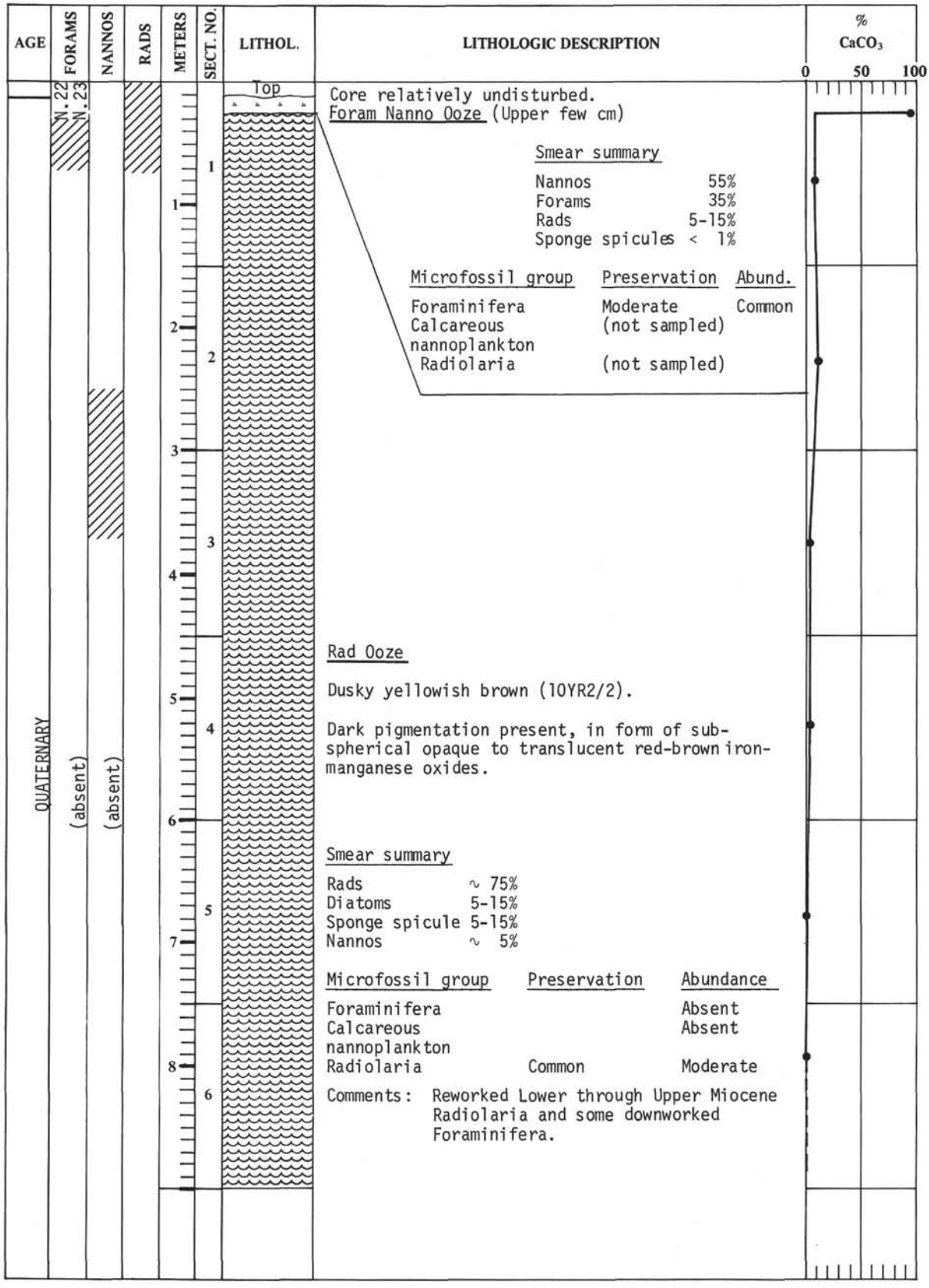
Berggren, W. A., 1969. Cenozoic chronostratigraphy, planktonic foraminiferal zonation and the radiometric time scale. *Nature*. **224**, 1072.


AGE
NATURAL GAMMA *
1.0 (Counts/7.6 cm/1.25 min) 1.5
× 10³
CORE NO.
METERS
LITHOL.
LITHOLOGIC DESCRIPTION
% CaCO₃
0 50 100
PLIOCENE
UPPER MIOCENE
MIDDLE MIOCENE
LOWER MIOCENE
OLIGOCENE
UPPER
LOWER OLIGOCENE
UPPER EOCENE
1
2
3
4
5
6
7
8
9
10
11
12
50
100
150
Foram nanno ooze.
Rad ooze. Dusky yellowish brown.
Foram rad nanno ooze very pale orange.
Fe/Mn oxides and nanno ooze, dark grayish brown.
Nanno ooze. Yellowish brown to gray orange.
Smear summary | nannos ~ 99%
rads ~ 5%
Nanno ooze - Fe/Mn oxide mixtures, interbedded with nanno ooze. Dusky brown and white ash layer at 102m. Basalt with Fe/Mn crust (one fragment in liner).
Smear summary (of Fe/Mn oxide layers) | Fe/Mn oxides ~50%
nannos ~50%
CLIPPERTON OCEANIC FORMATION
MARQUESAS OCEANIC FORMATION
LINE ISLANDS OCEANIC FORMATION

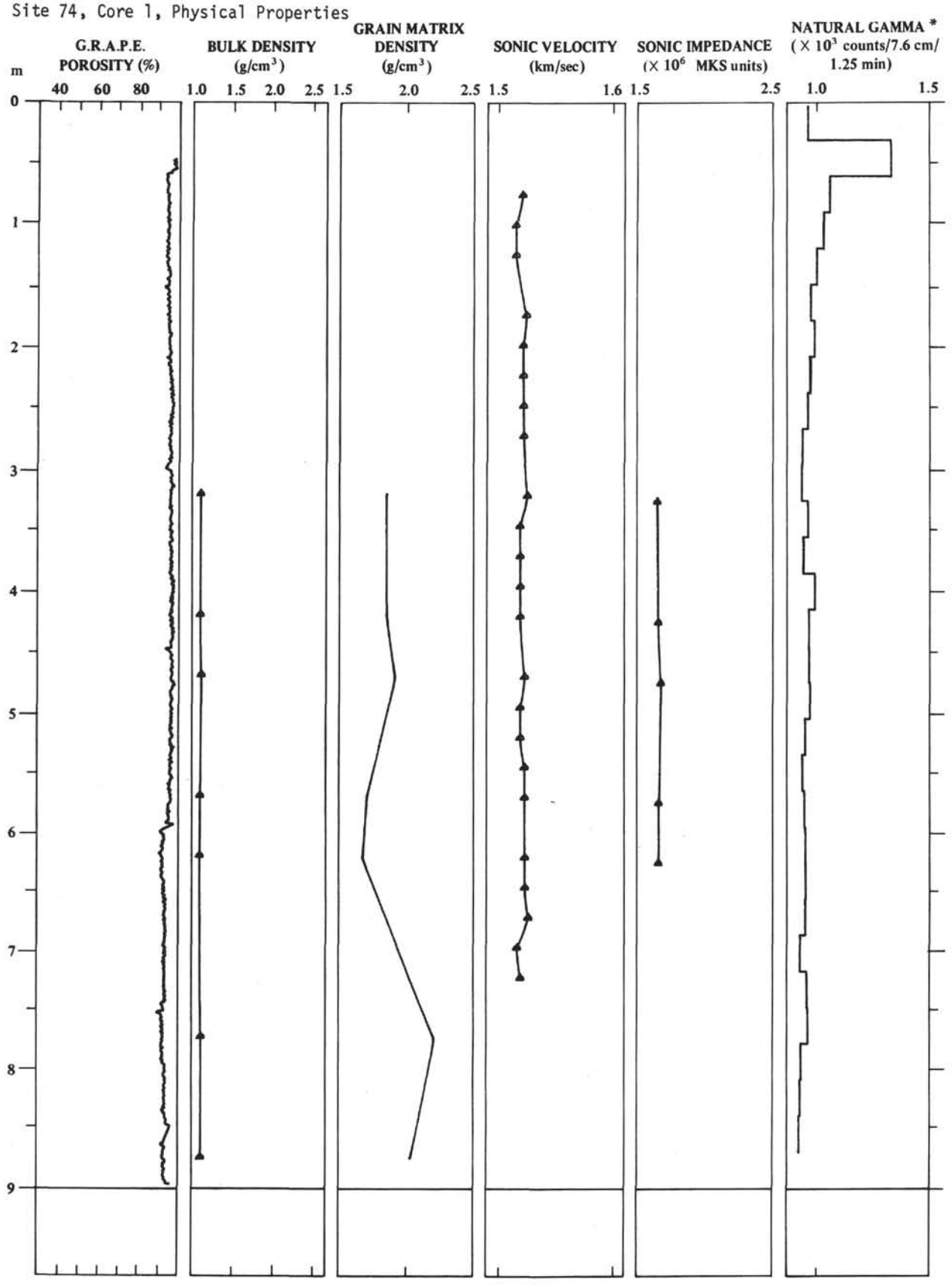
Physical Properties, Site 74, 0-200 Meters



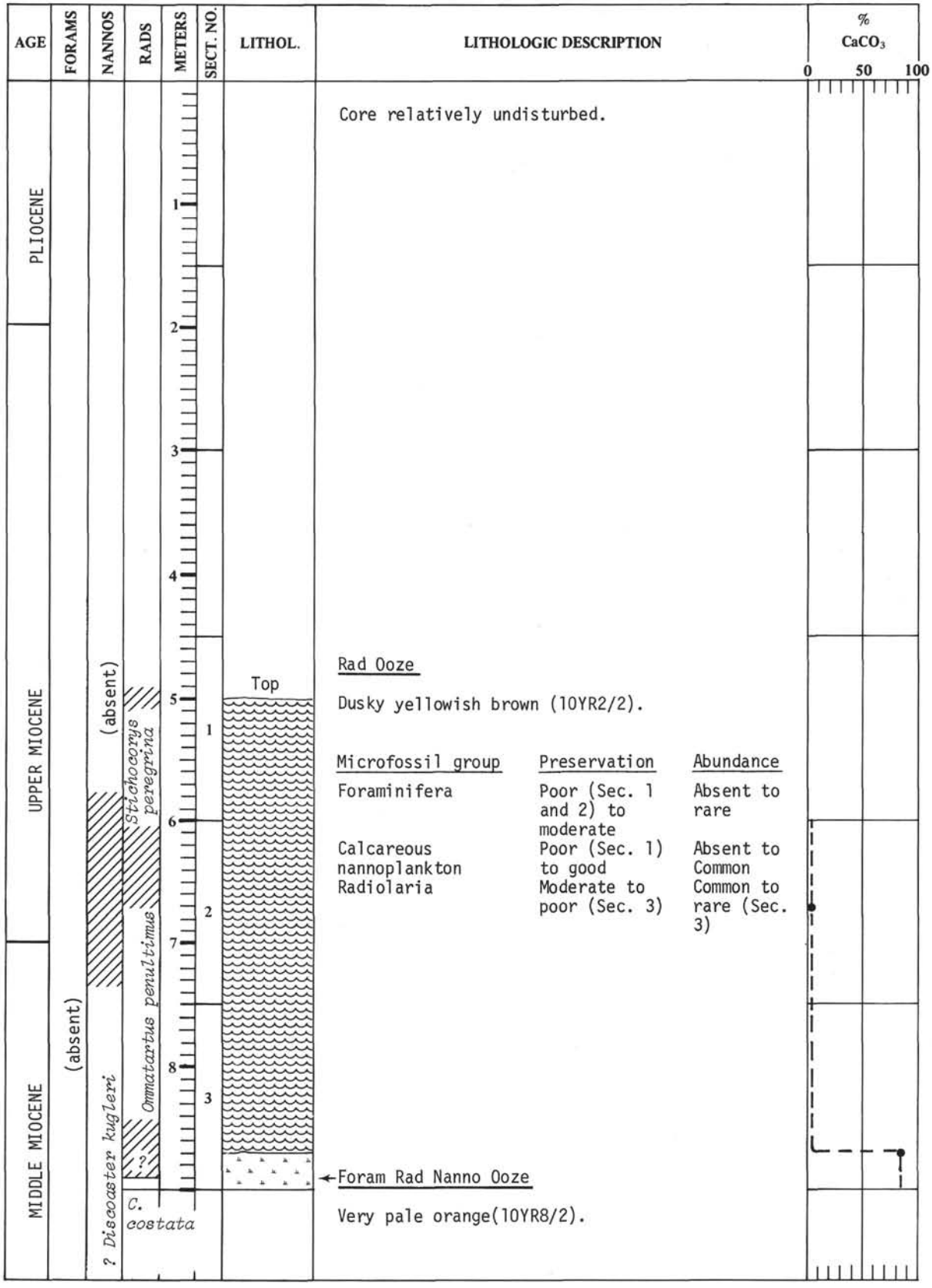
SITE 74 Core 1 Cored interval: 0-9 m



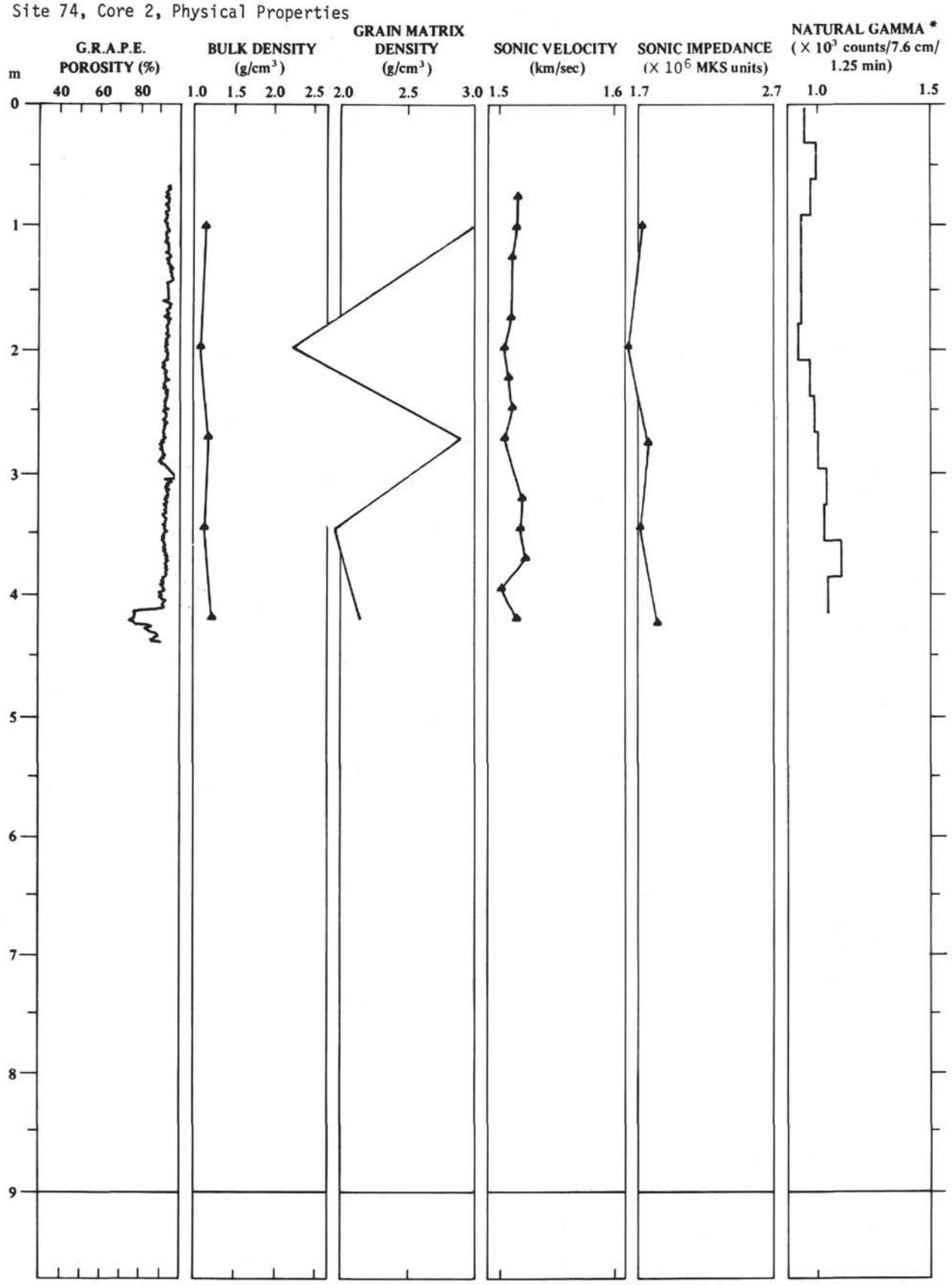
Site 74, Core 1, Physical Properties



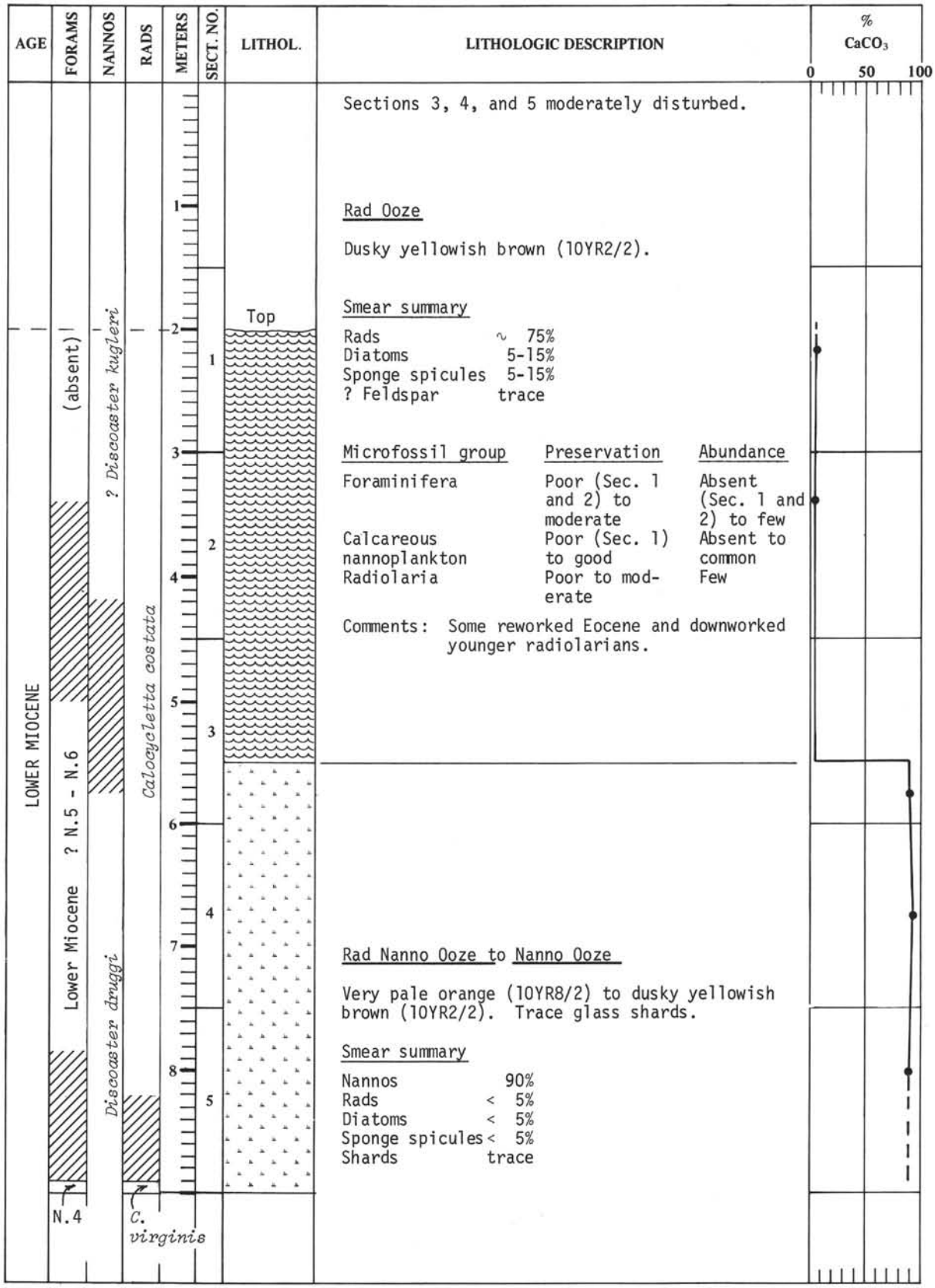
SITE 74 Core 2 Cored interval: 9-18 m



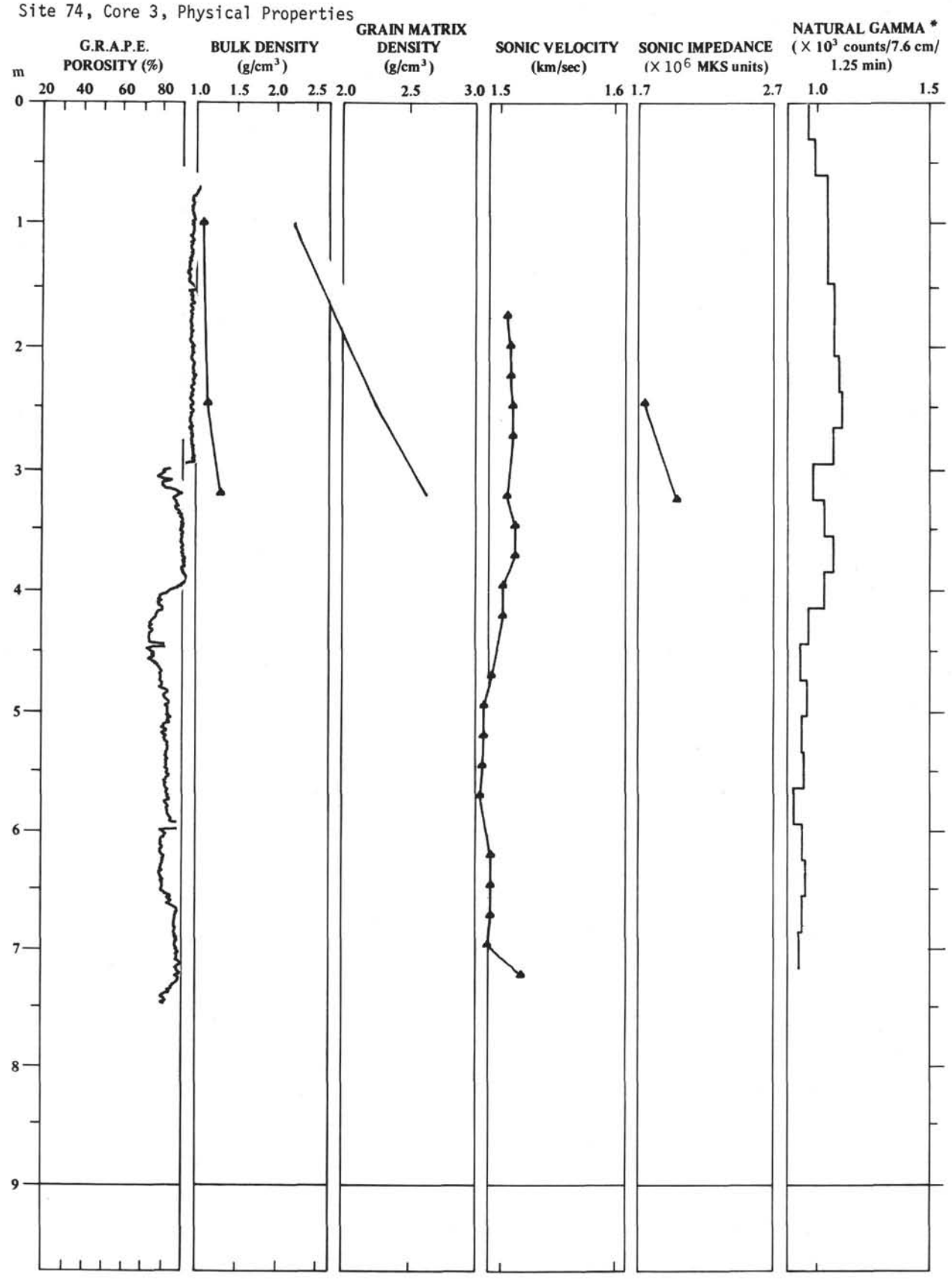
Site 74, Core 2, Physical Properties



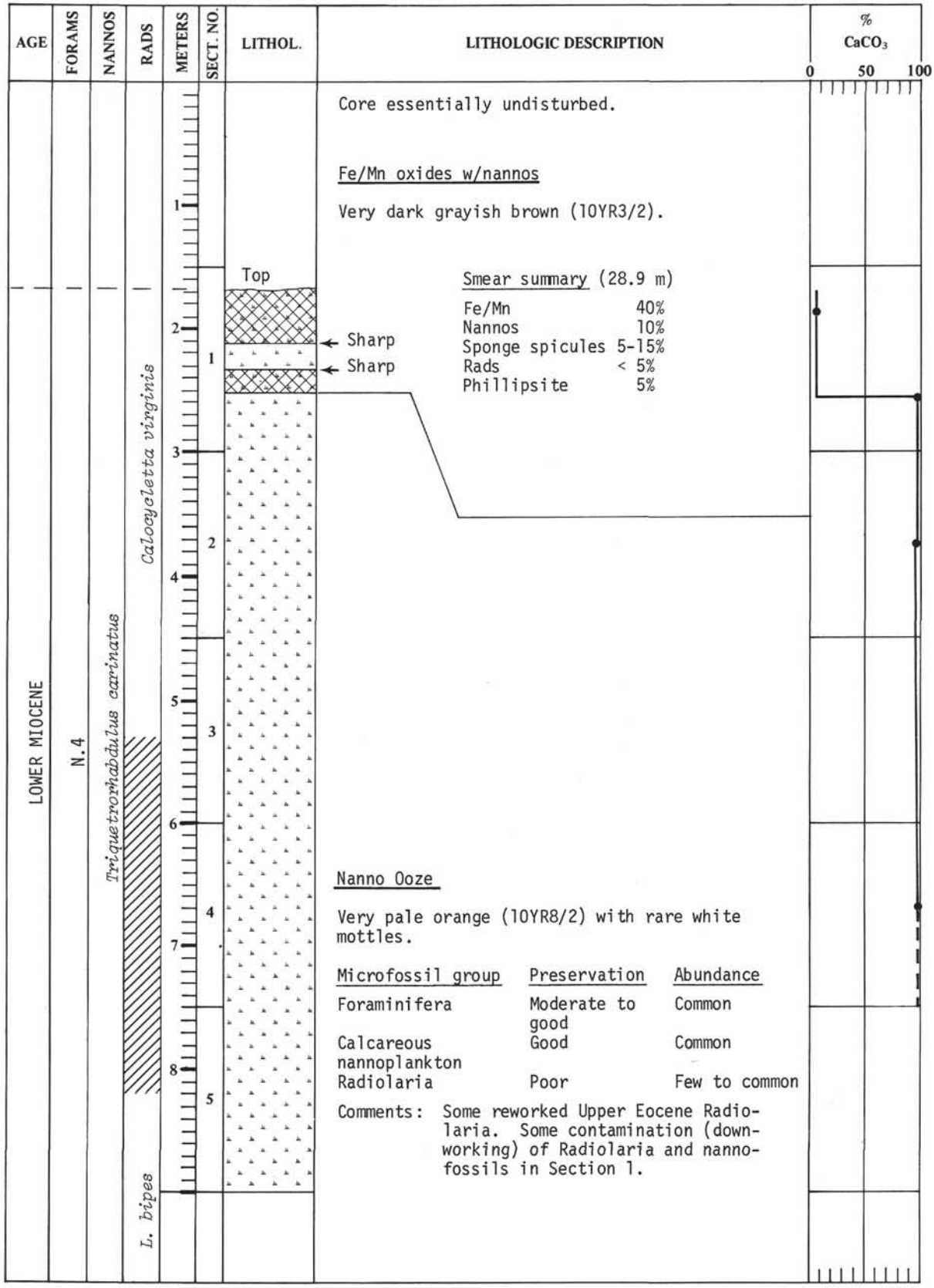
SITE 74 Core 3 Cored interval: 18-27 m



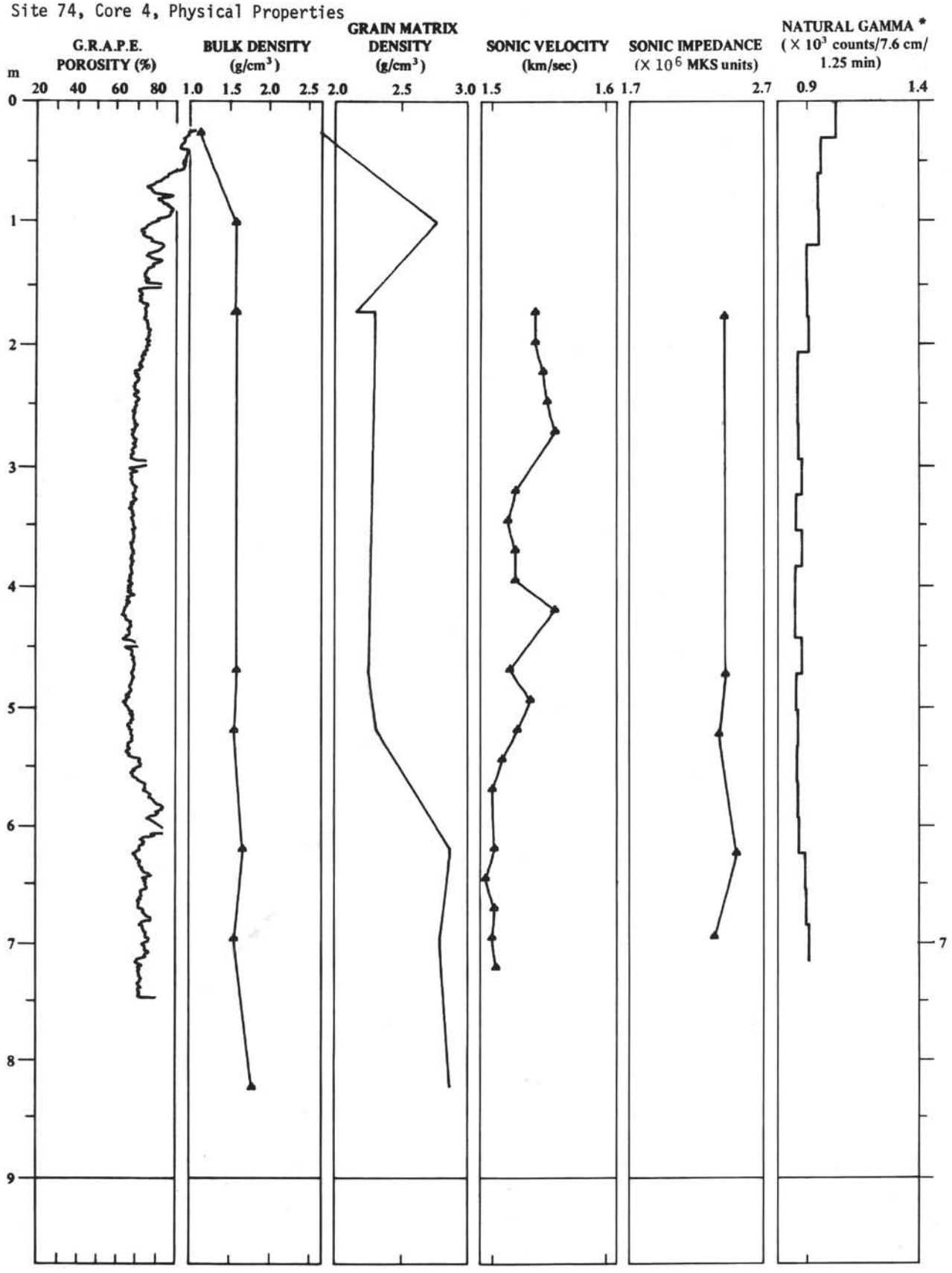
Site 74, Core 3, Physical Properties



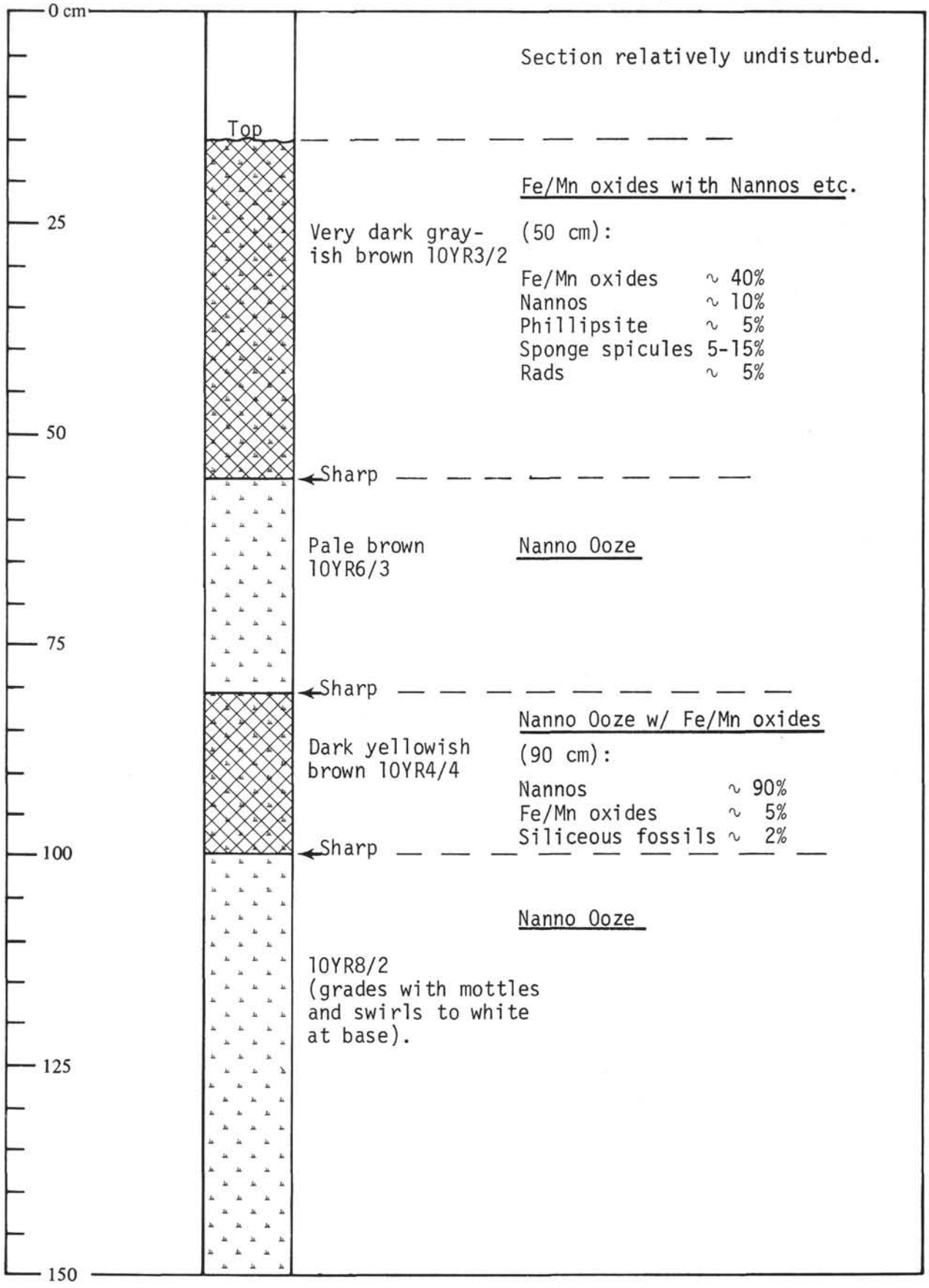
SITE 74 Core 4 Cored interval: 27-36 m



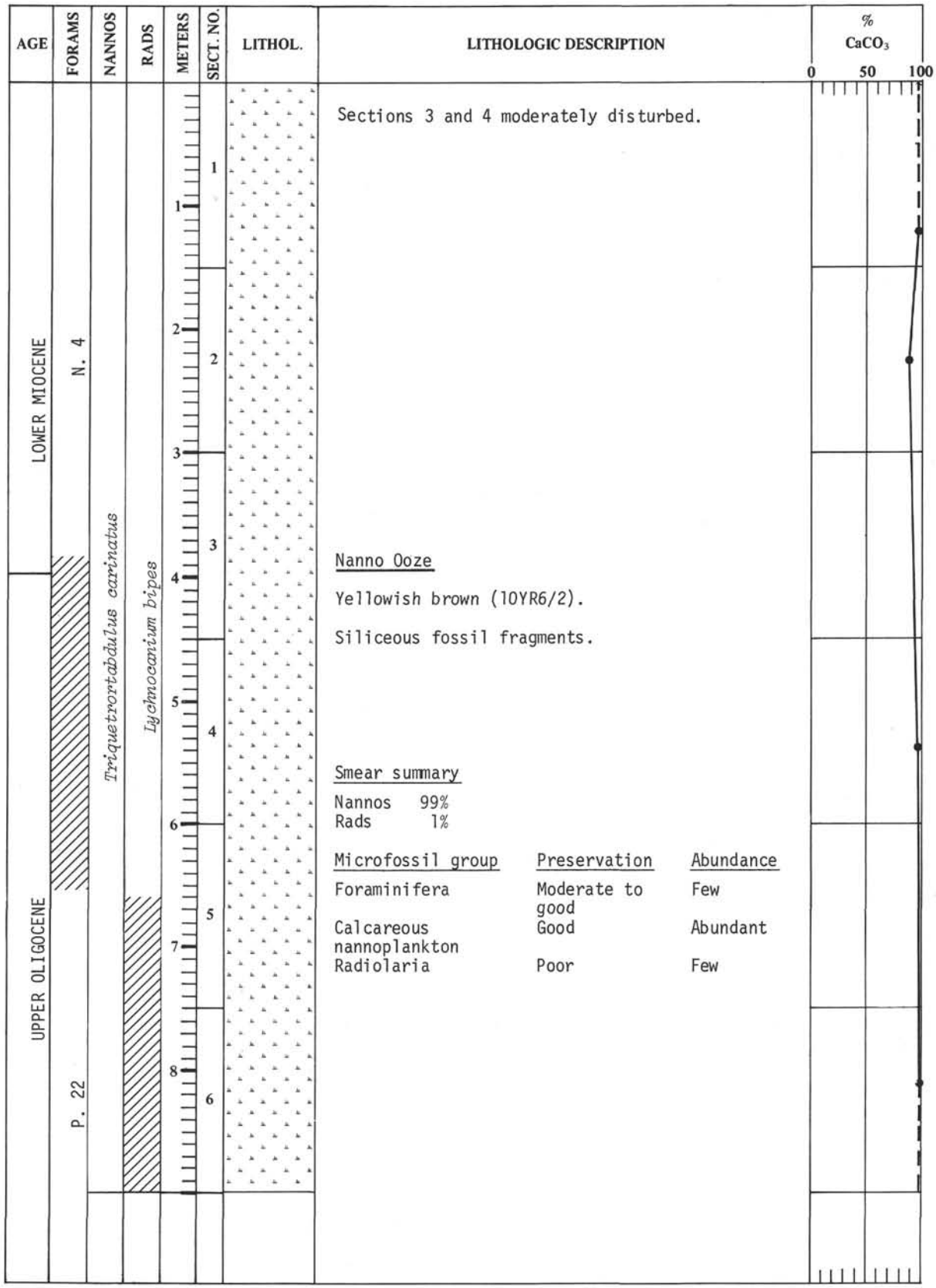
Site 74, Core 4, Physical Properties



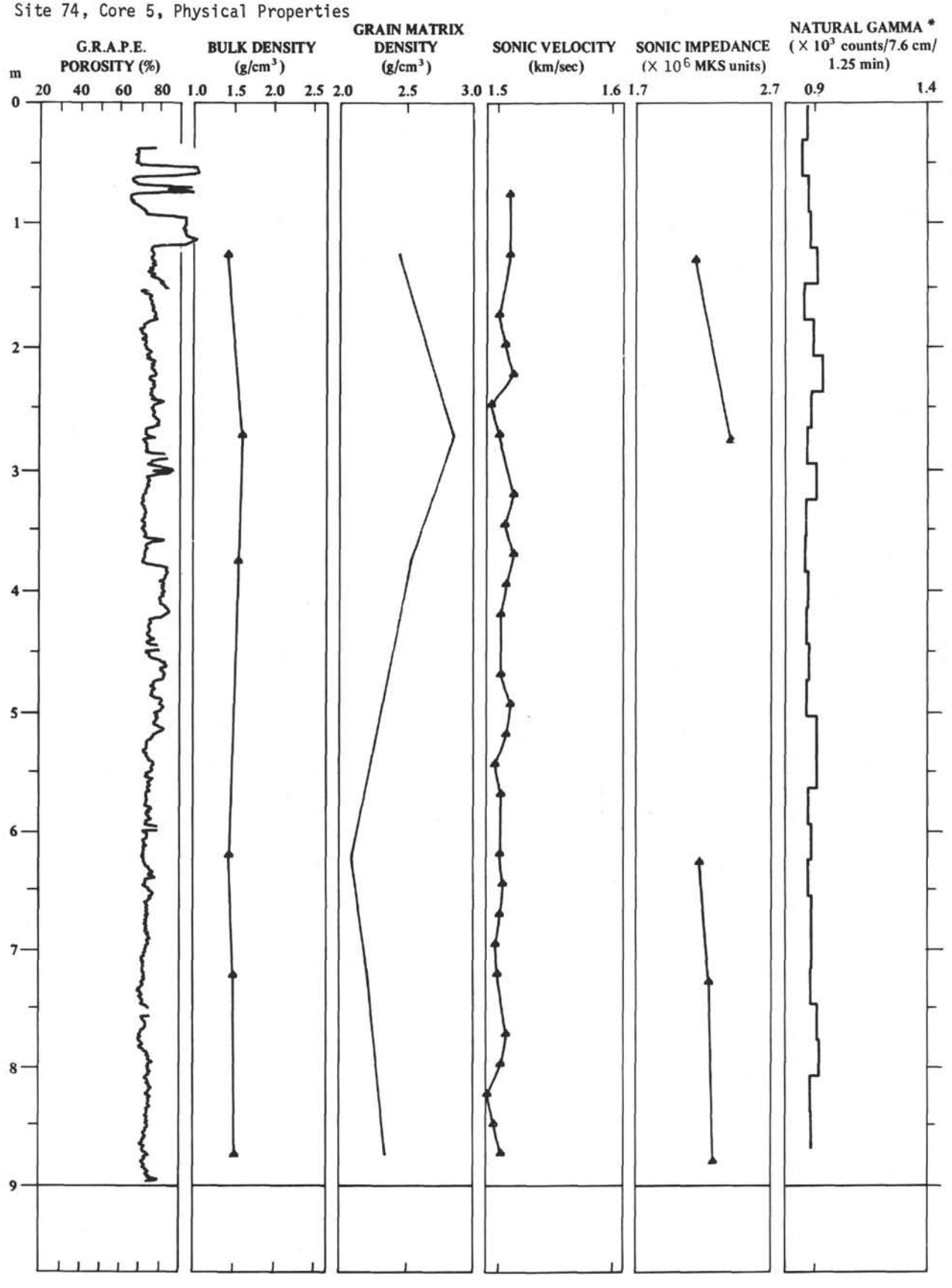
SITE 74 Core 4 Detailed description Section 1 (28.7-30 m)



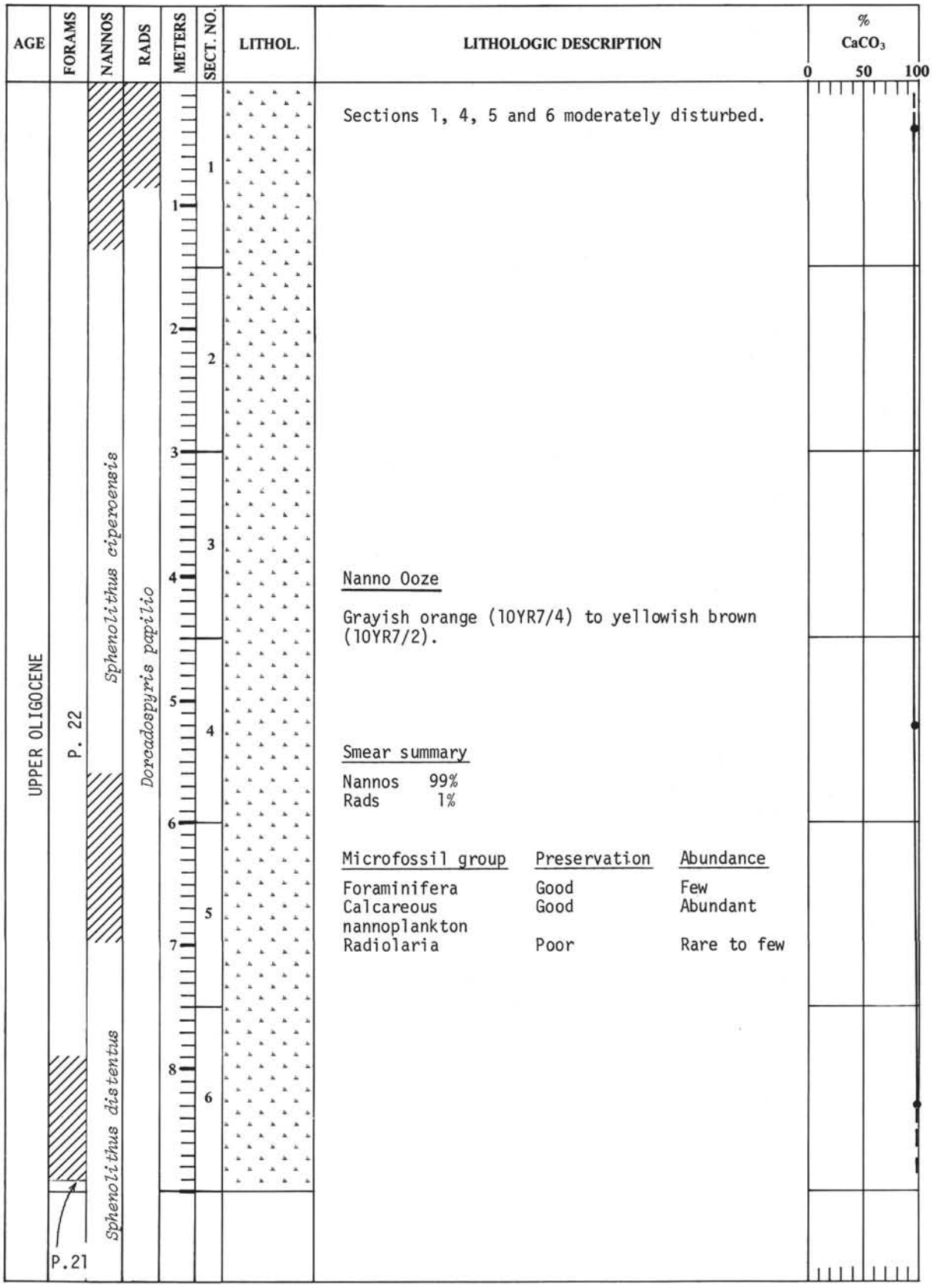
SITE 74 Core 5 Cored interval 36-45 m



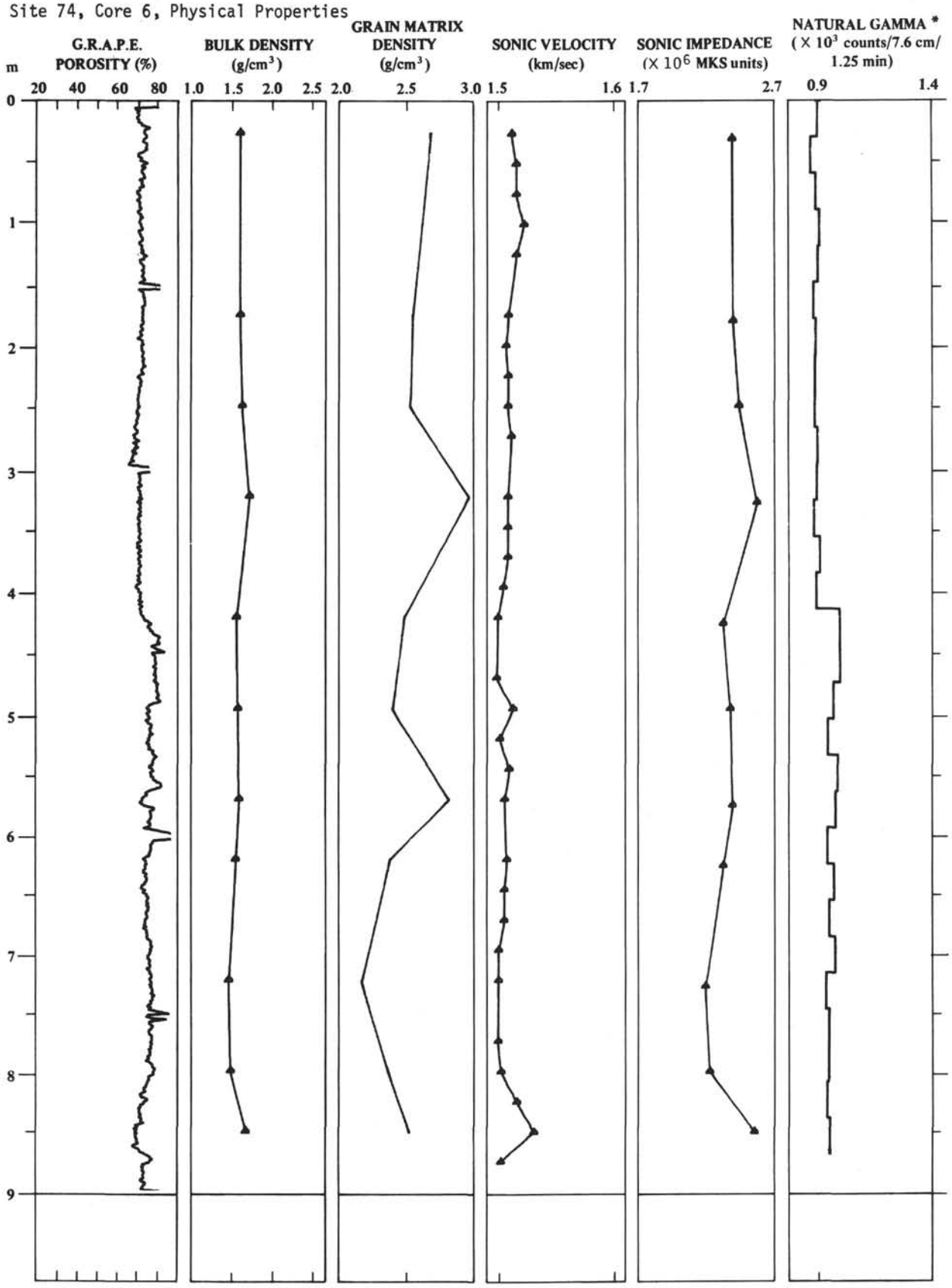
Site 74, Core 5, Physical Properties



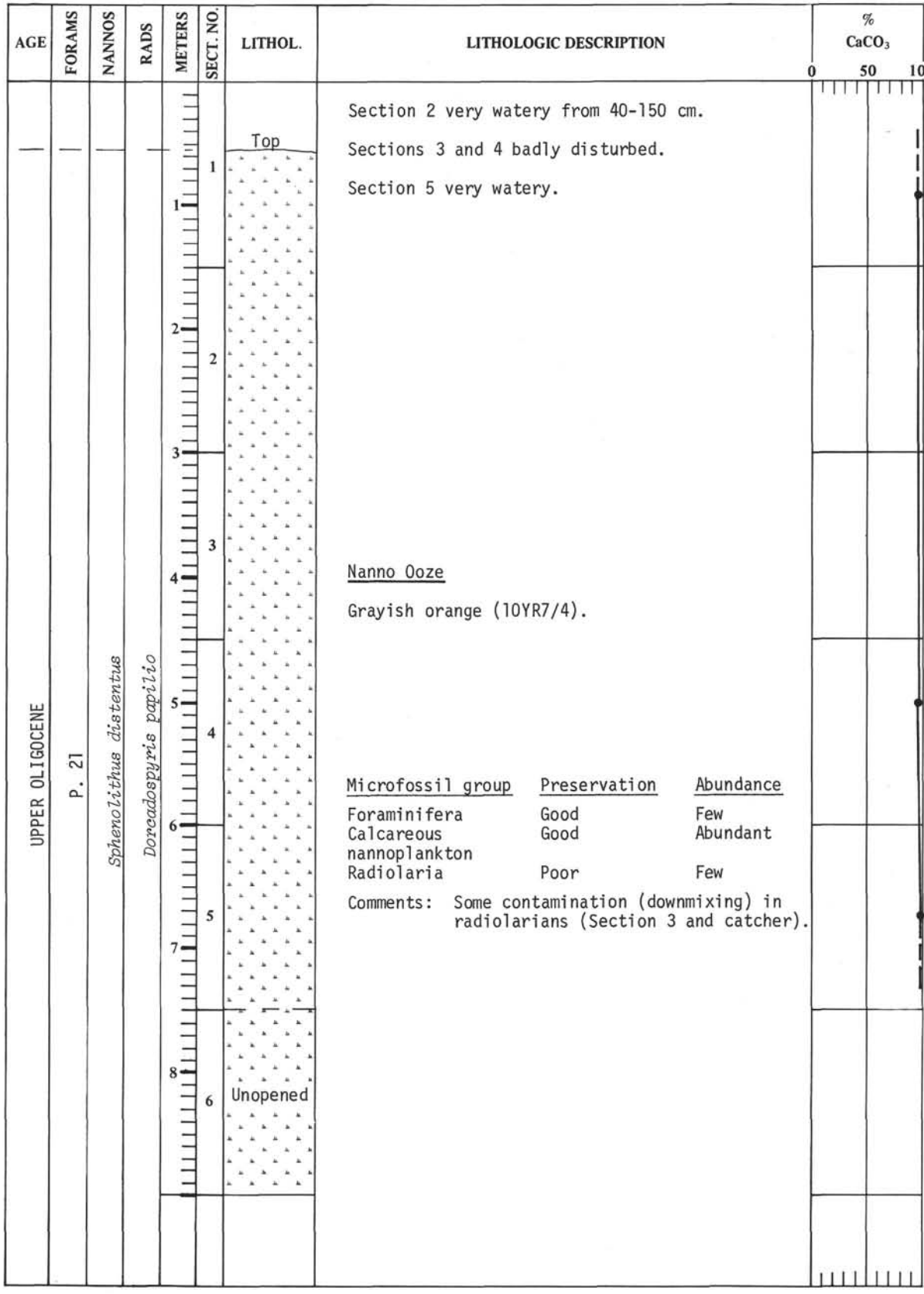
SITE 74 Core 6 Cored interval: 46-55 m



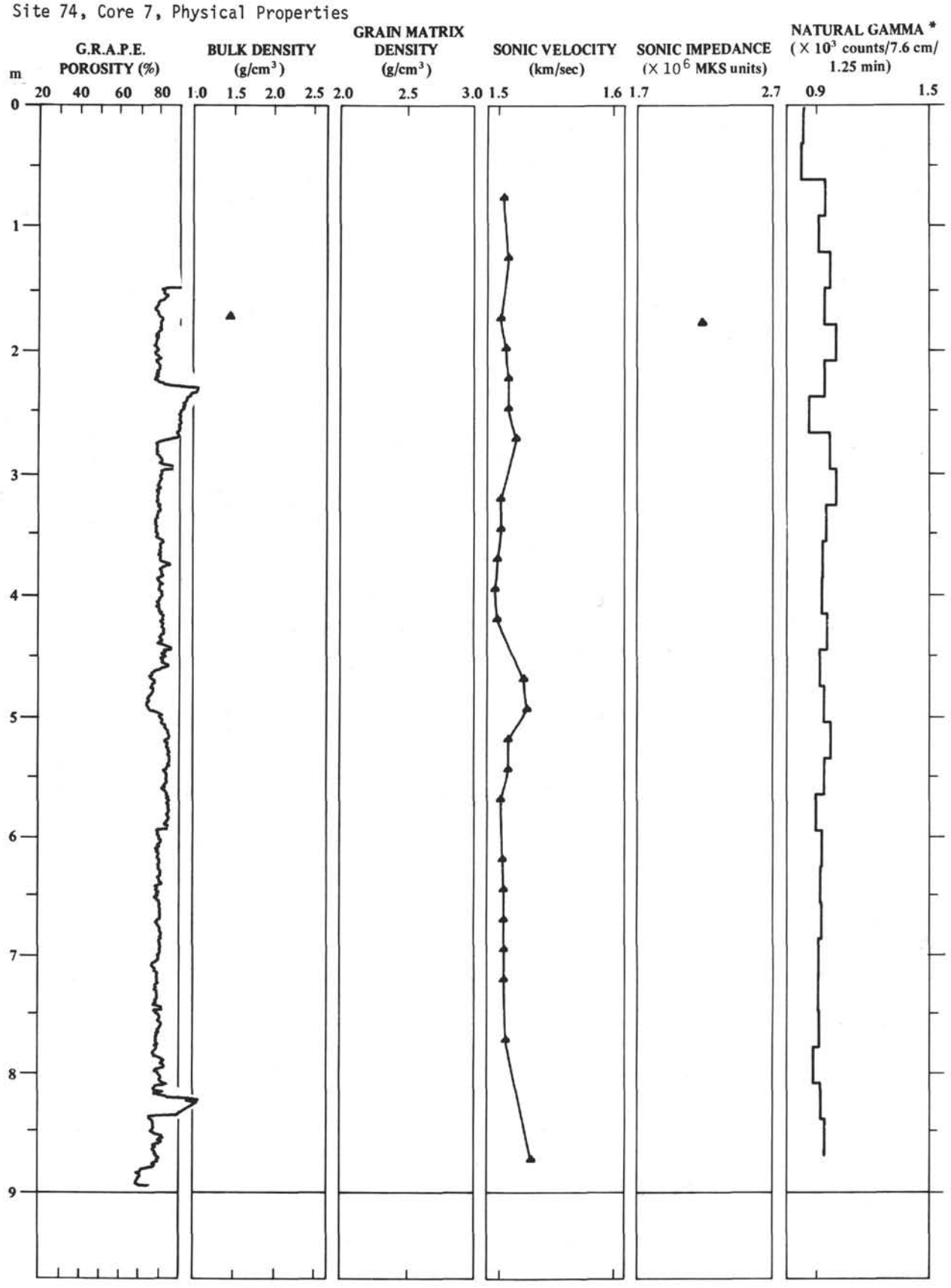
Site 74, Core 6, Physical Properties



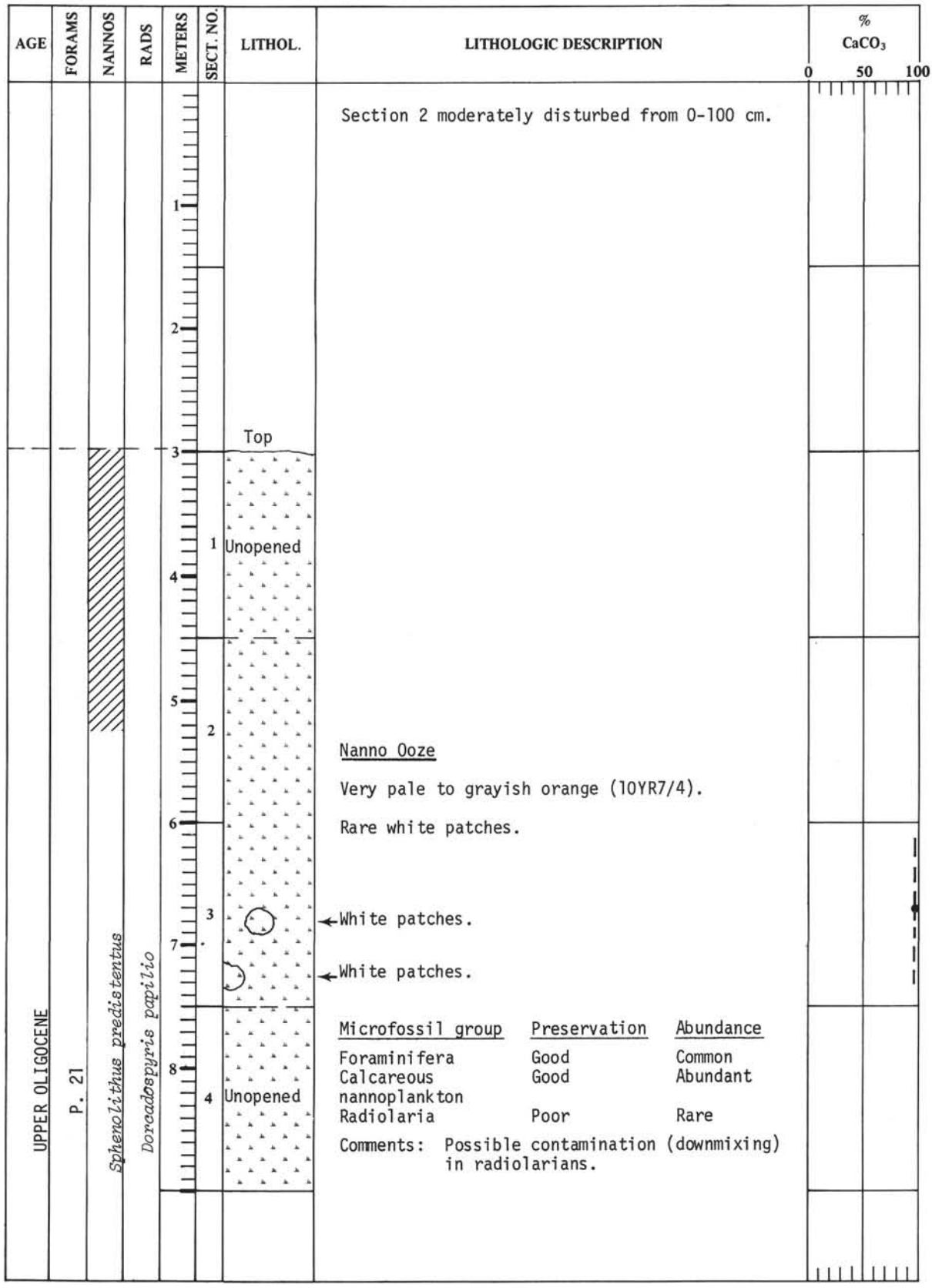
SITE 74 Core 7 Core interval: 5-64 m



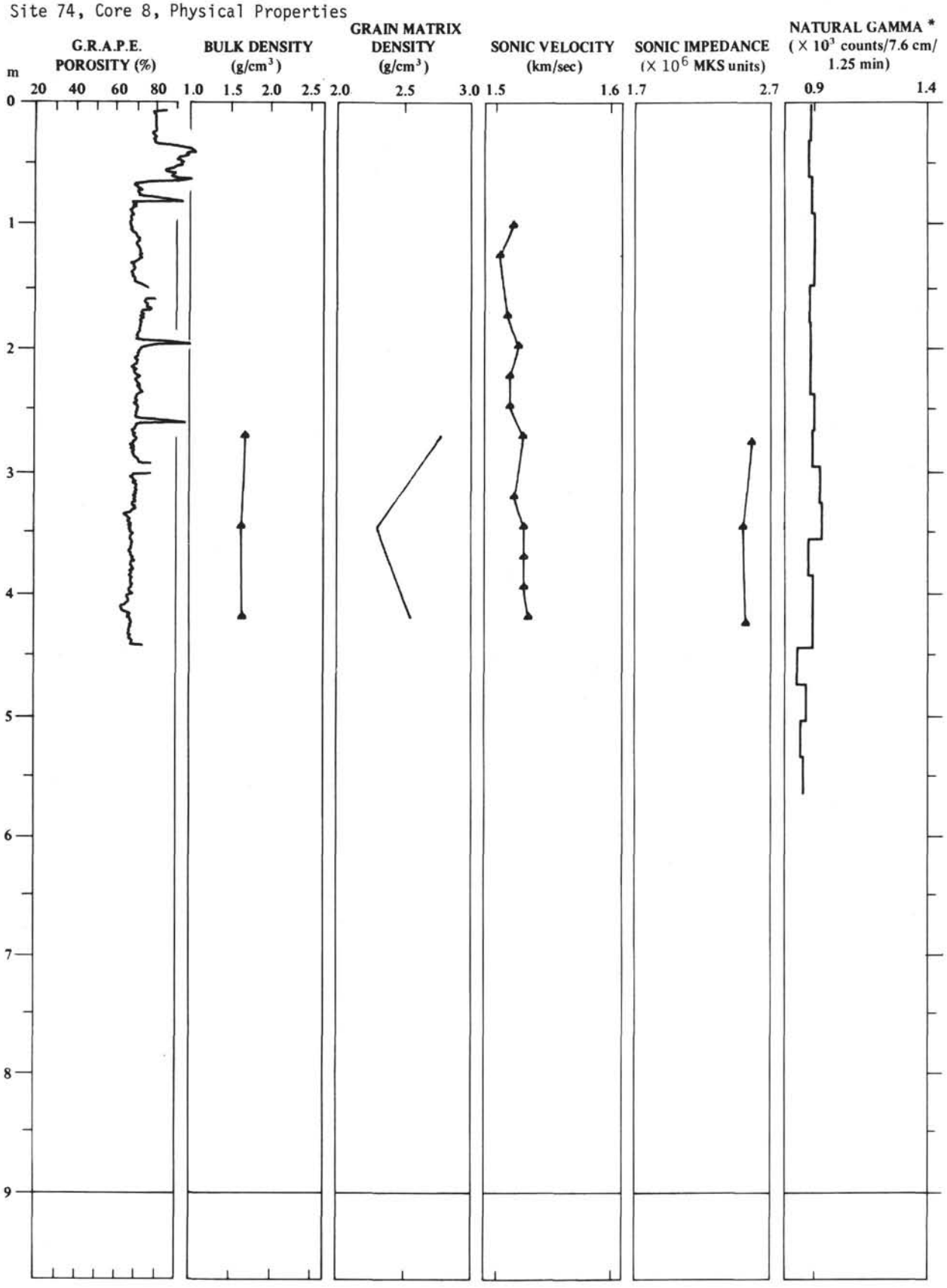
Site 74, Core 7, Physical Properties



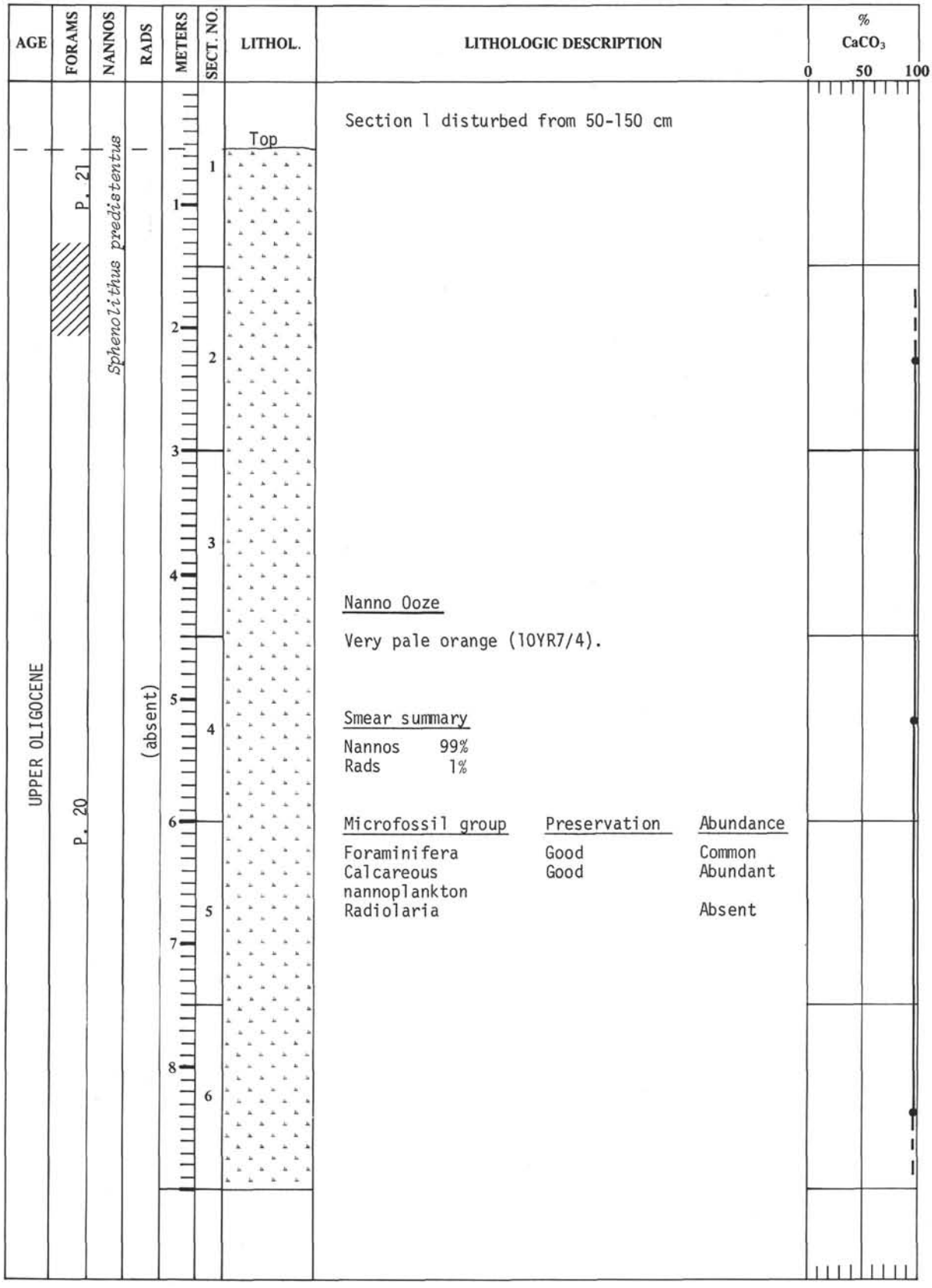
SITE 74 Core 8 Cored interval: 64-73 m



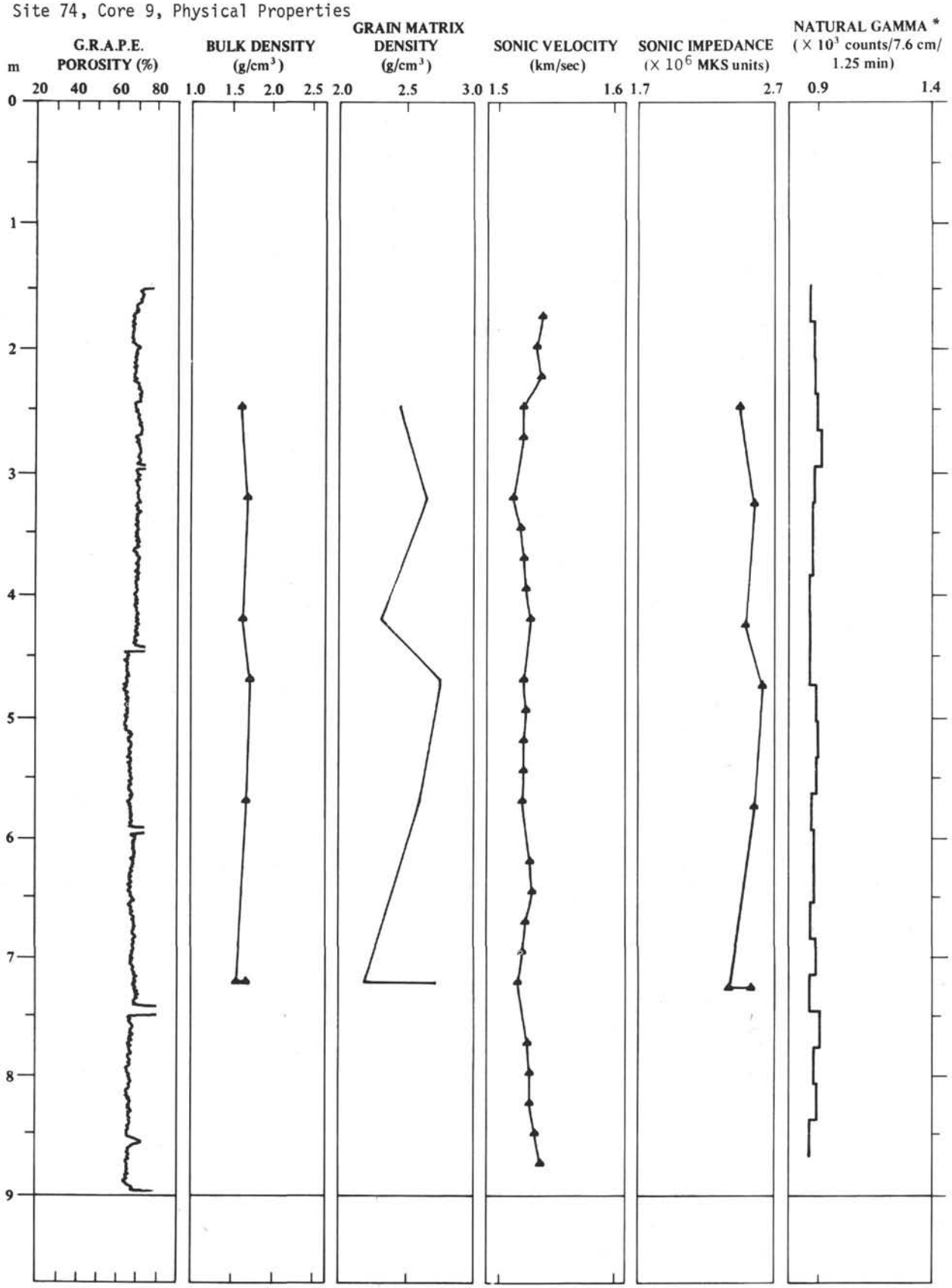
Site 74, Core 8, Physical Properties



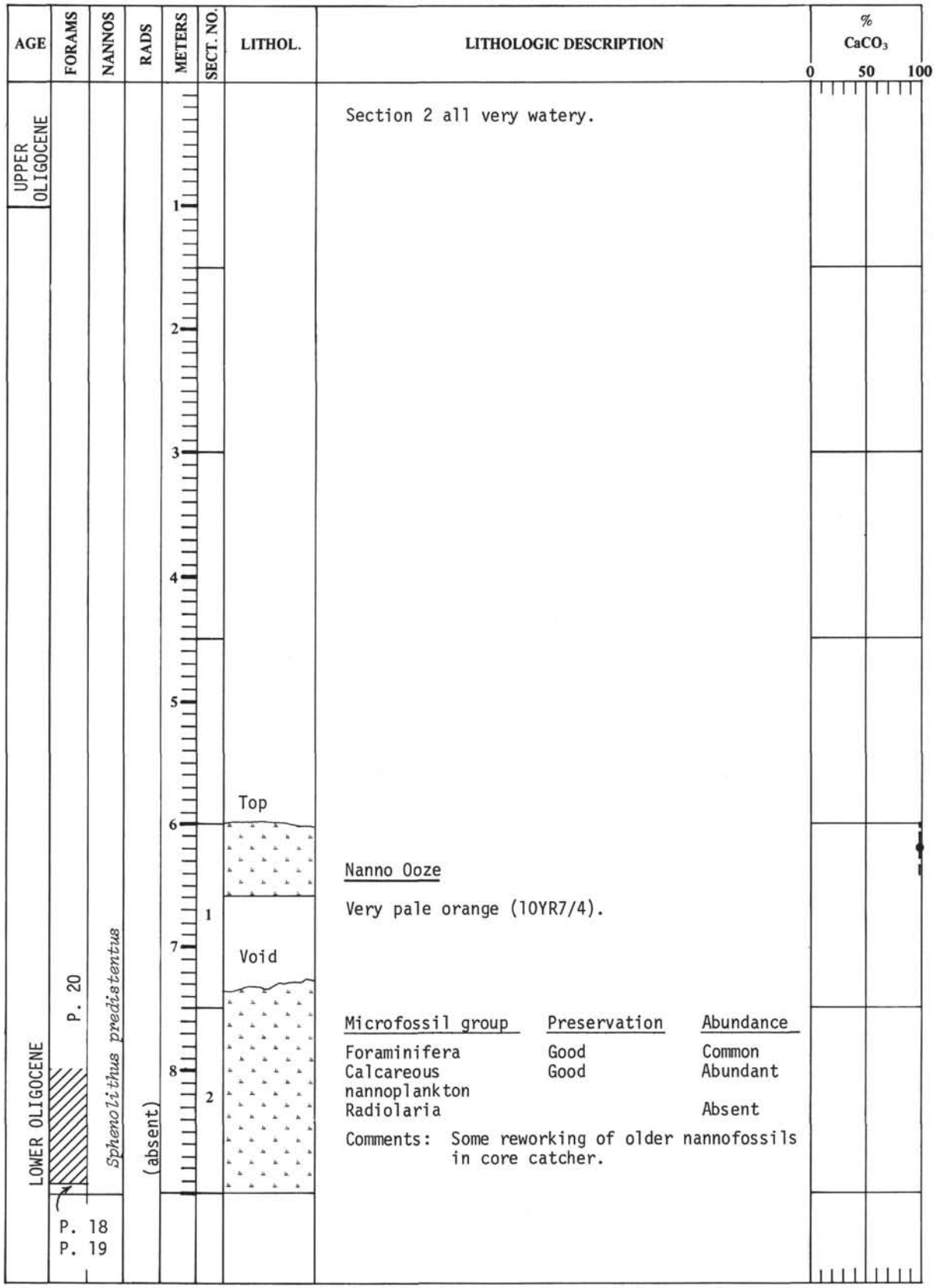
SITE 74 Core 9 Cored interval: 73-82 m



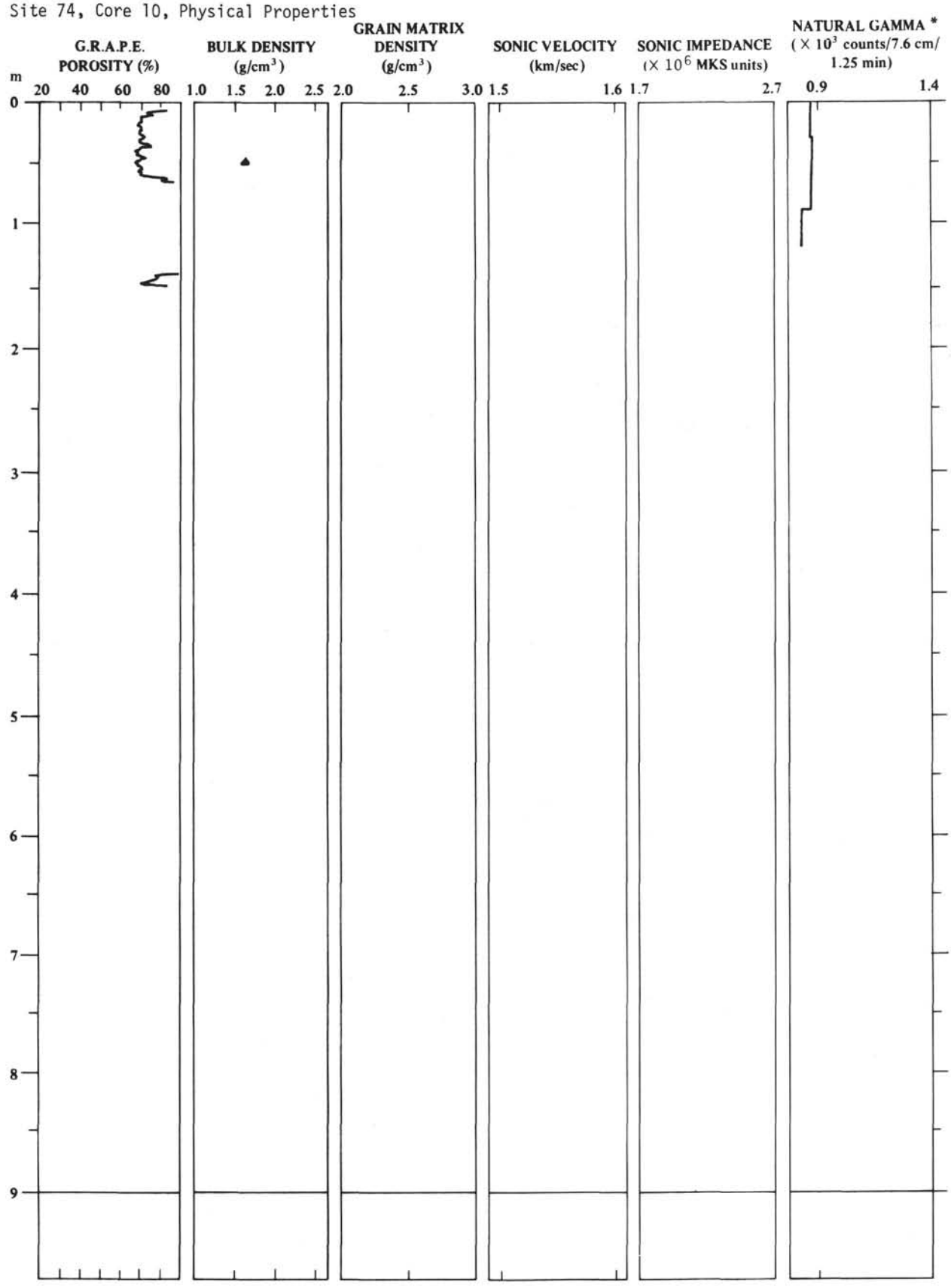
Site 74, Core 9, Physical Properties



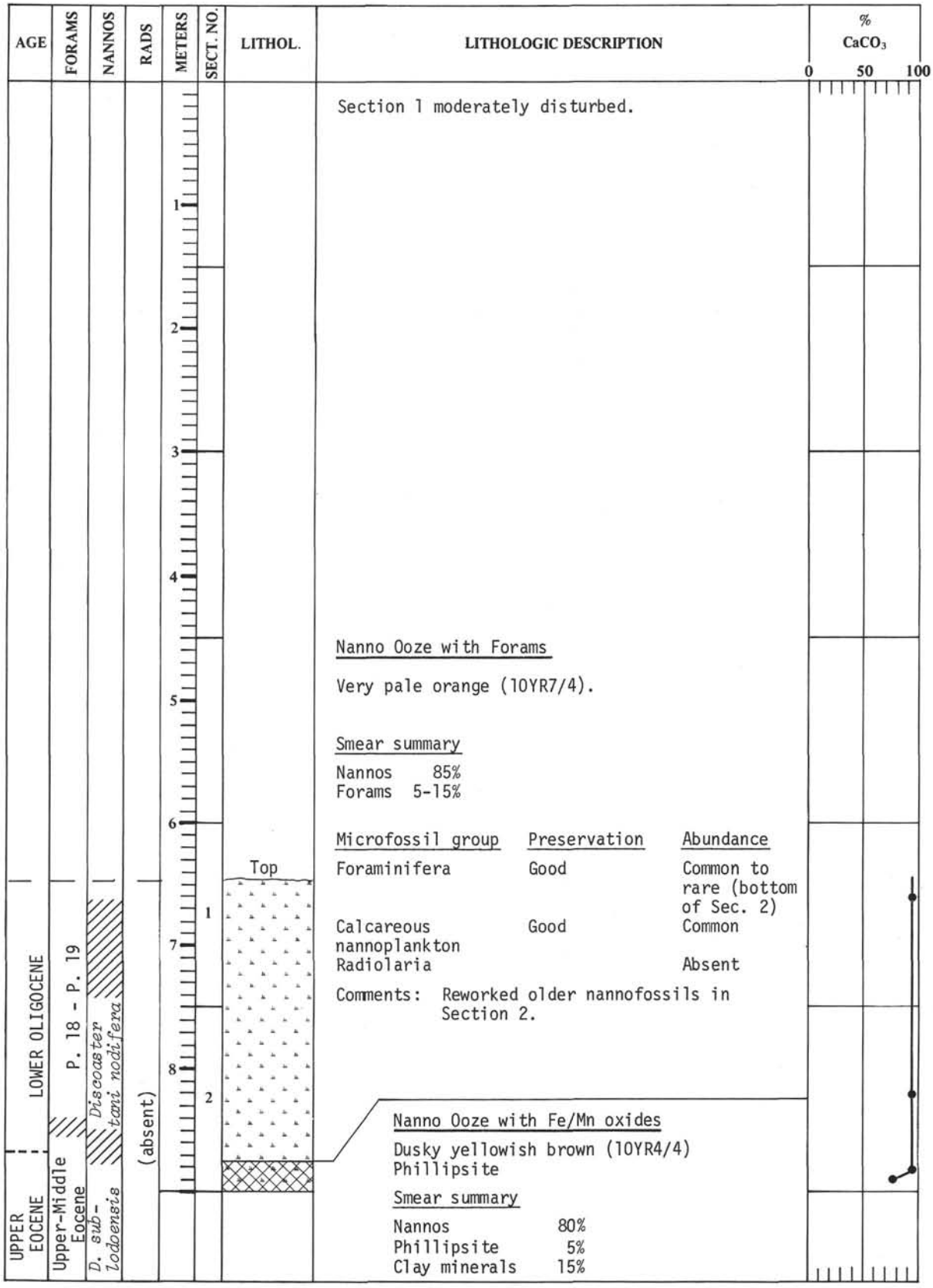
SITE 74 Core 10 Cored interval: 82-91 m



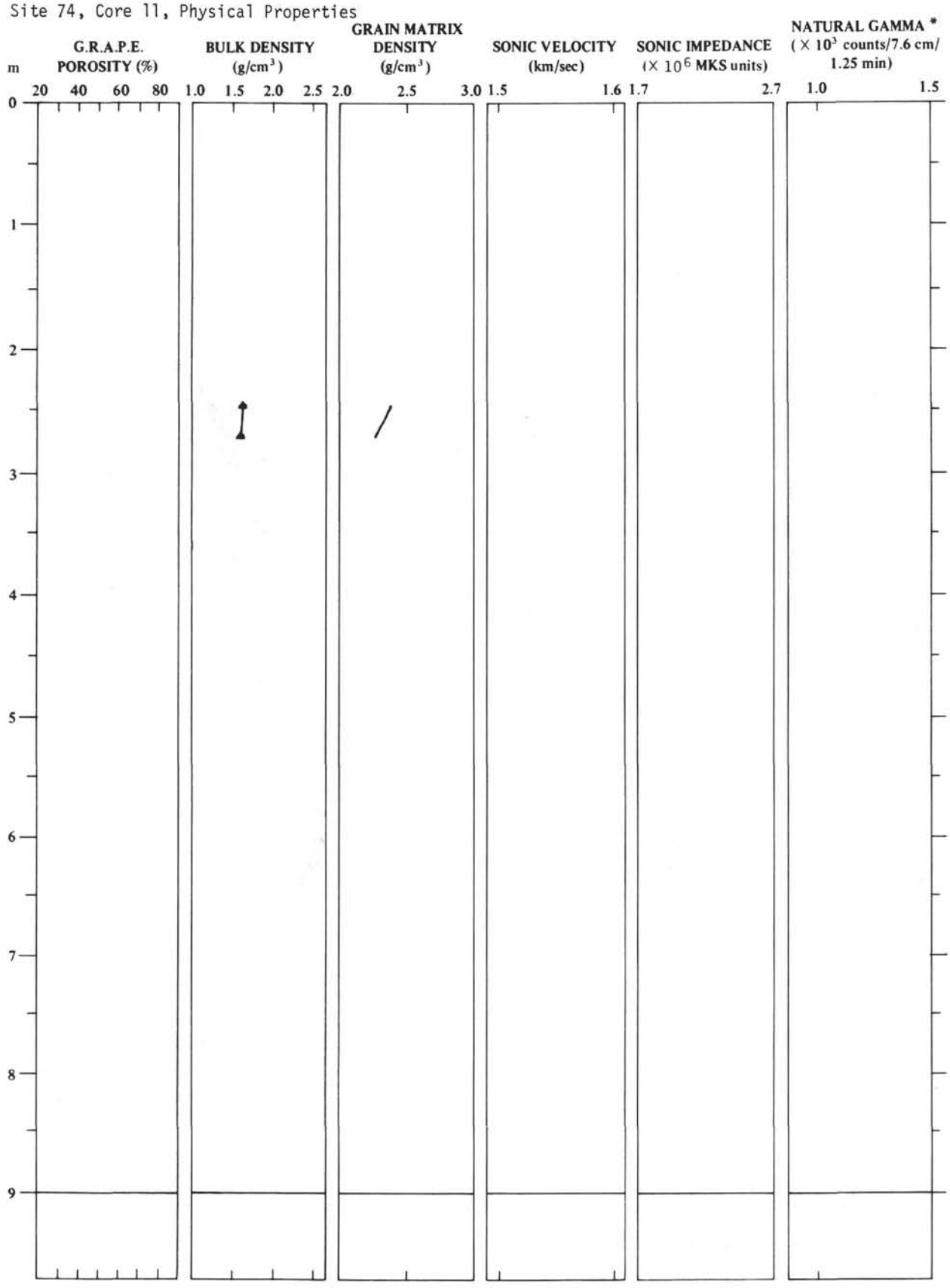
Site 74, Core 10, Physical Properties



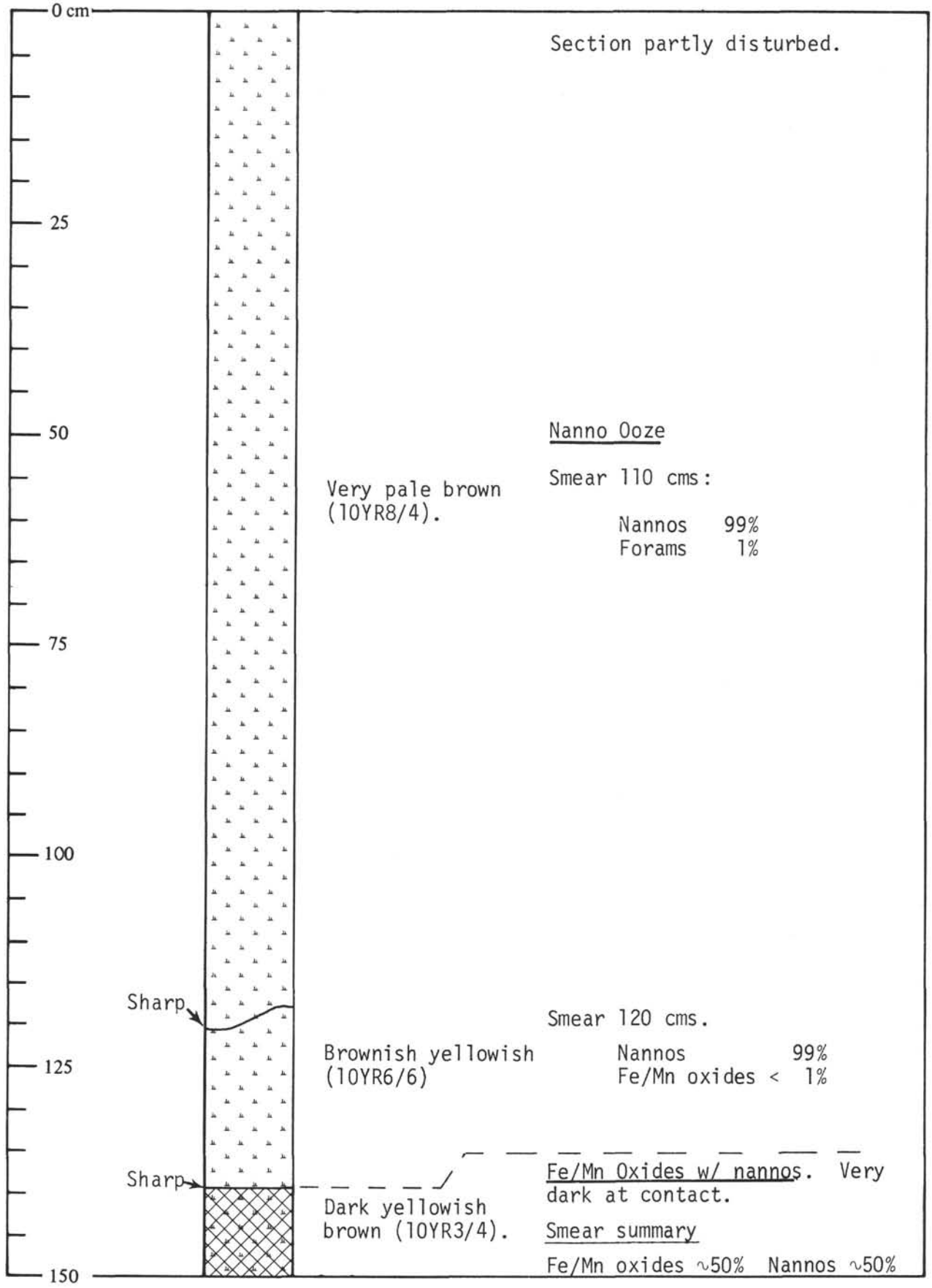
SITE 74 Core 11 Cored interval: 91-100 m



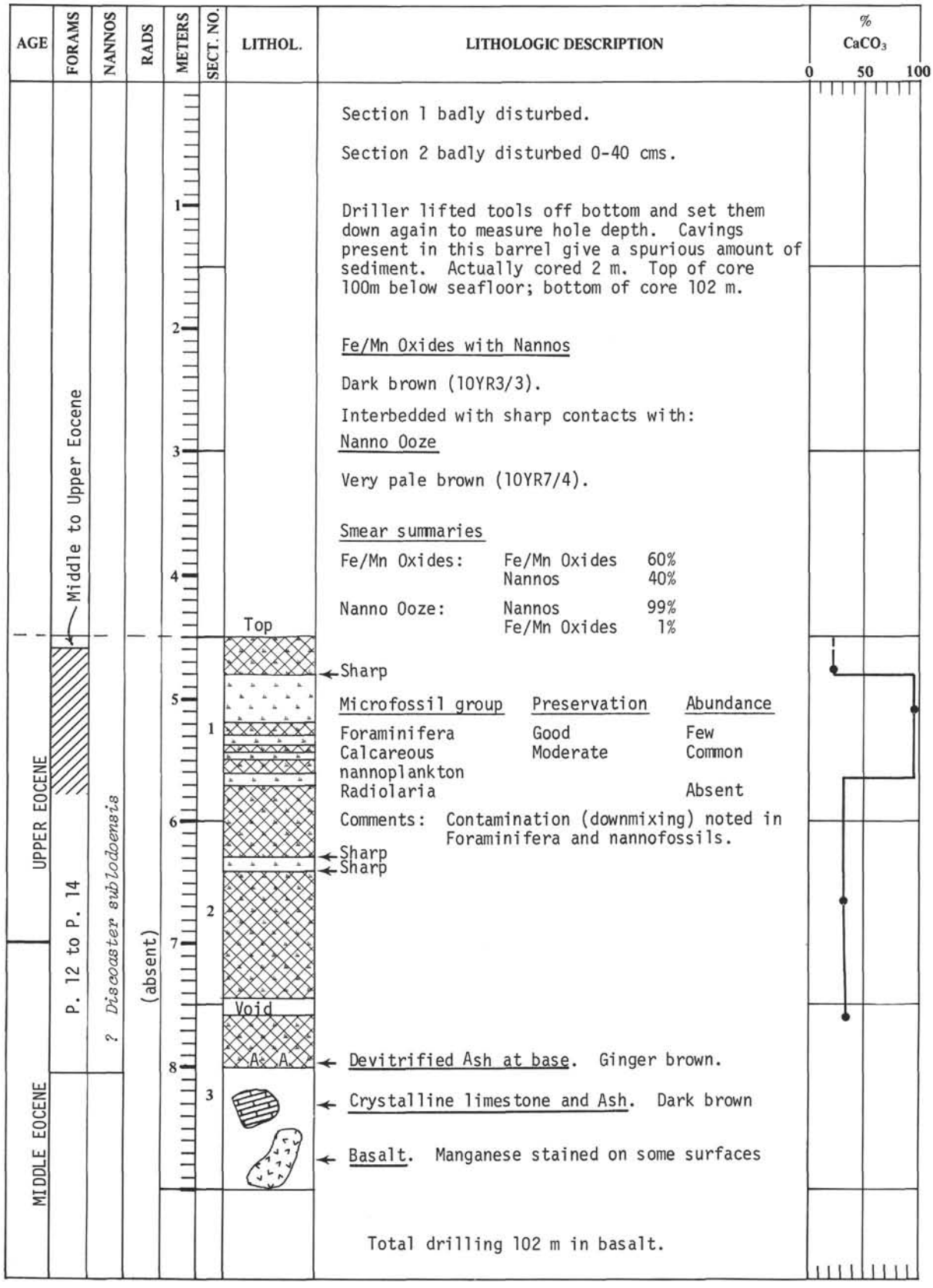
Site 74, Core 11, Physical Properties



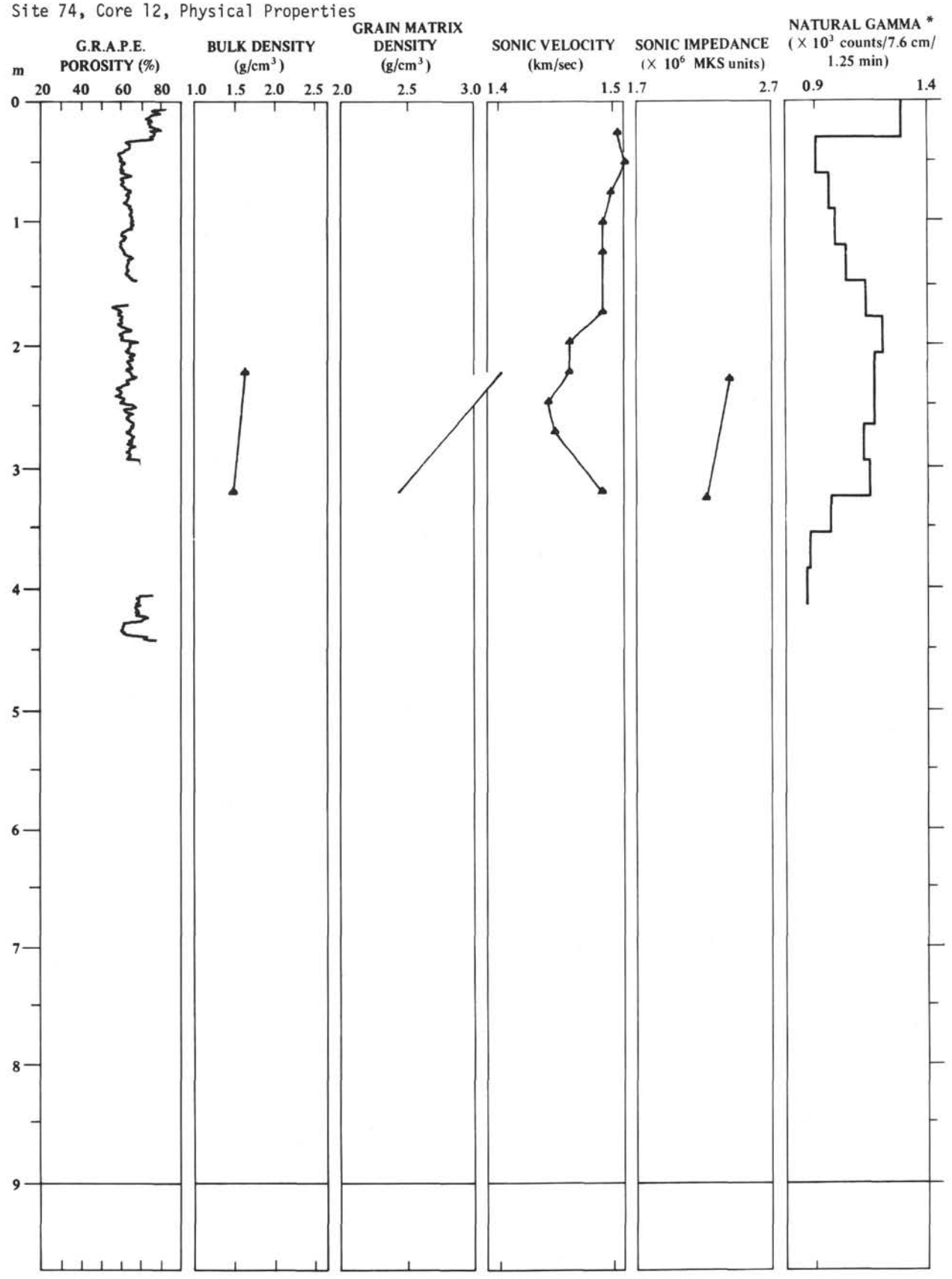
SITE 74 Core 11 Detailed description Section 2 (98.5-100 m)



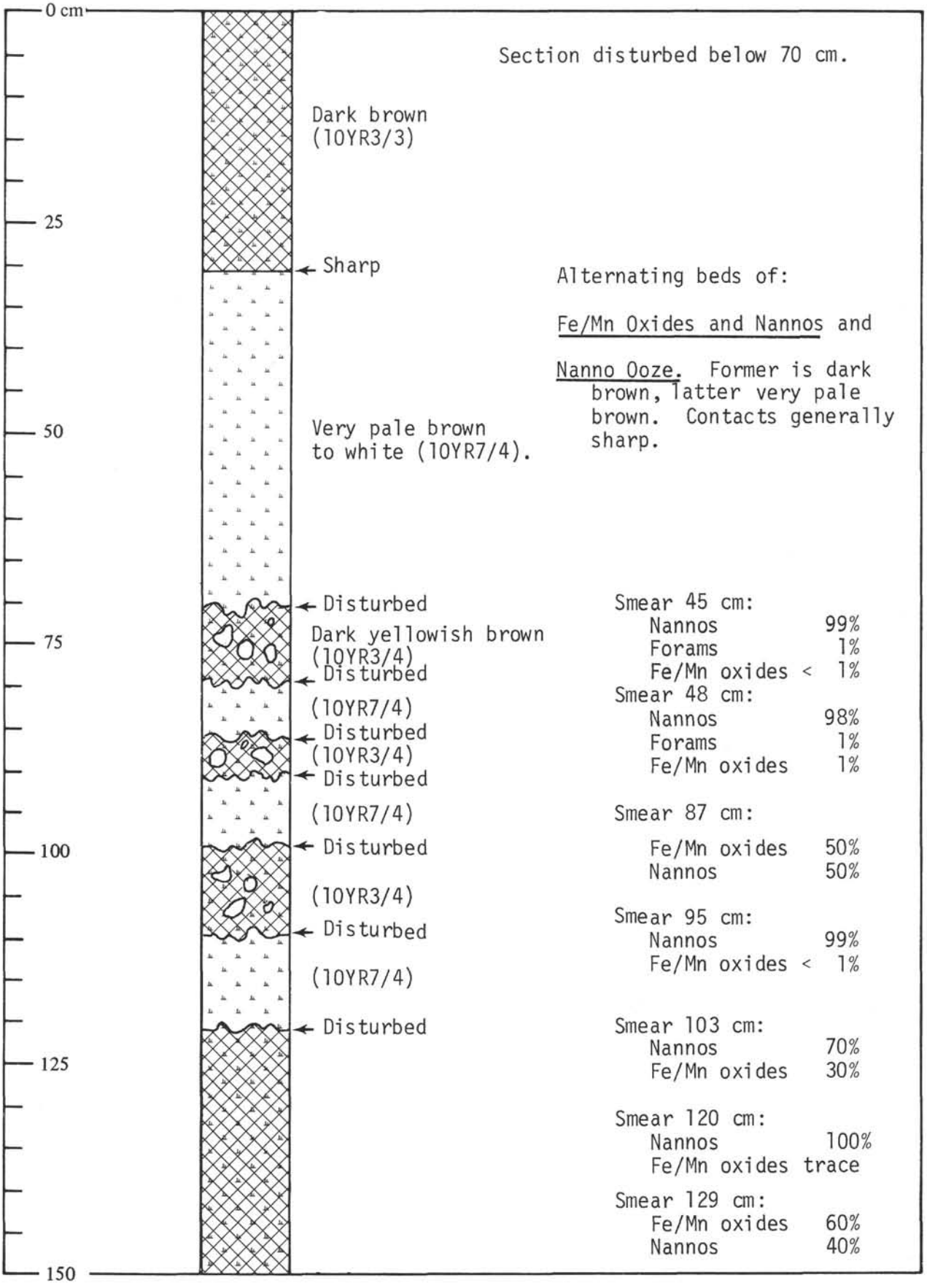
SITE 74 Core 12 Cored interval: 100-102 m



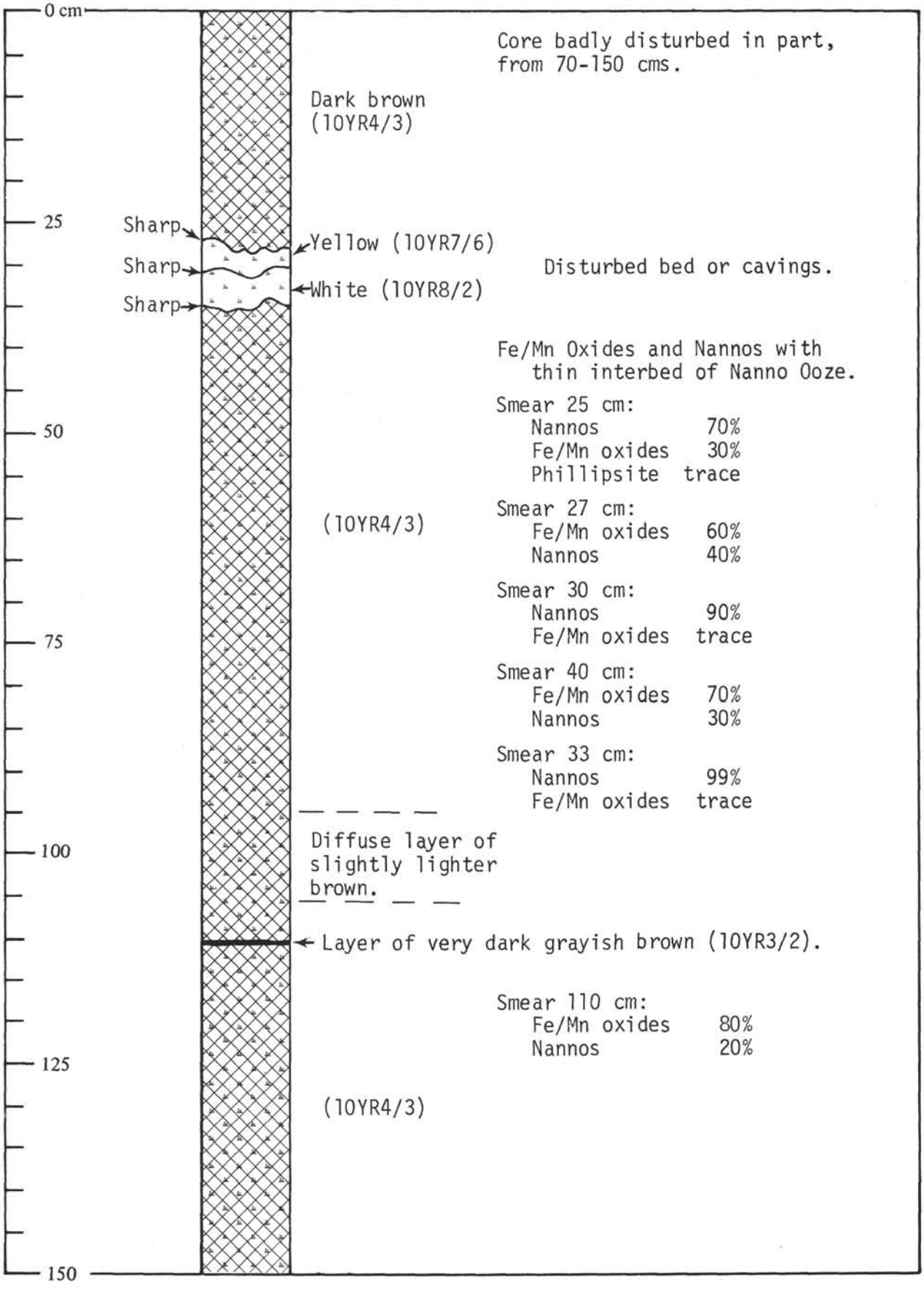
Site 74, Core 12, Physical Properties



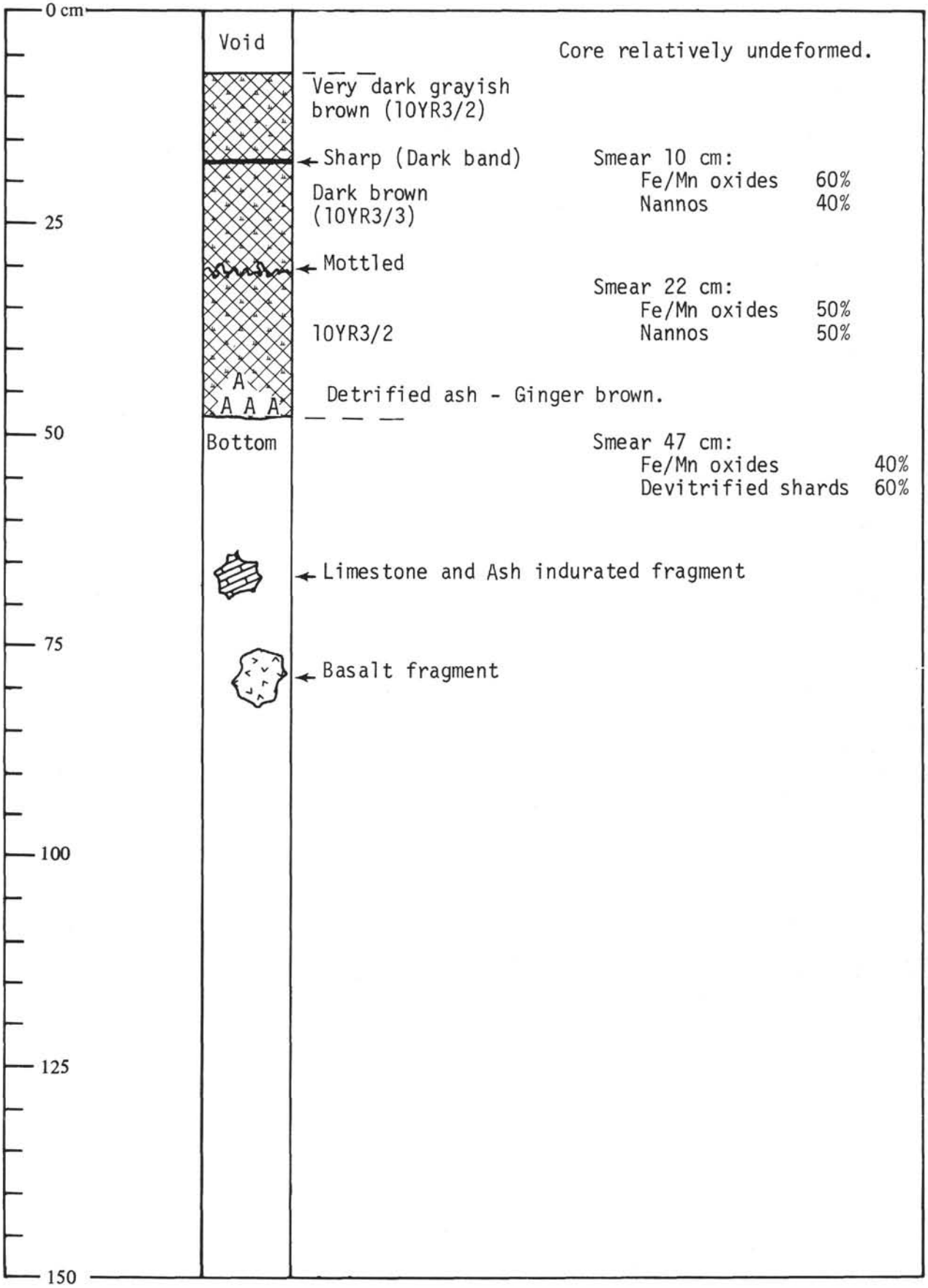
SITE 74 Core 12 Detailed description Section 1



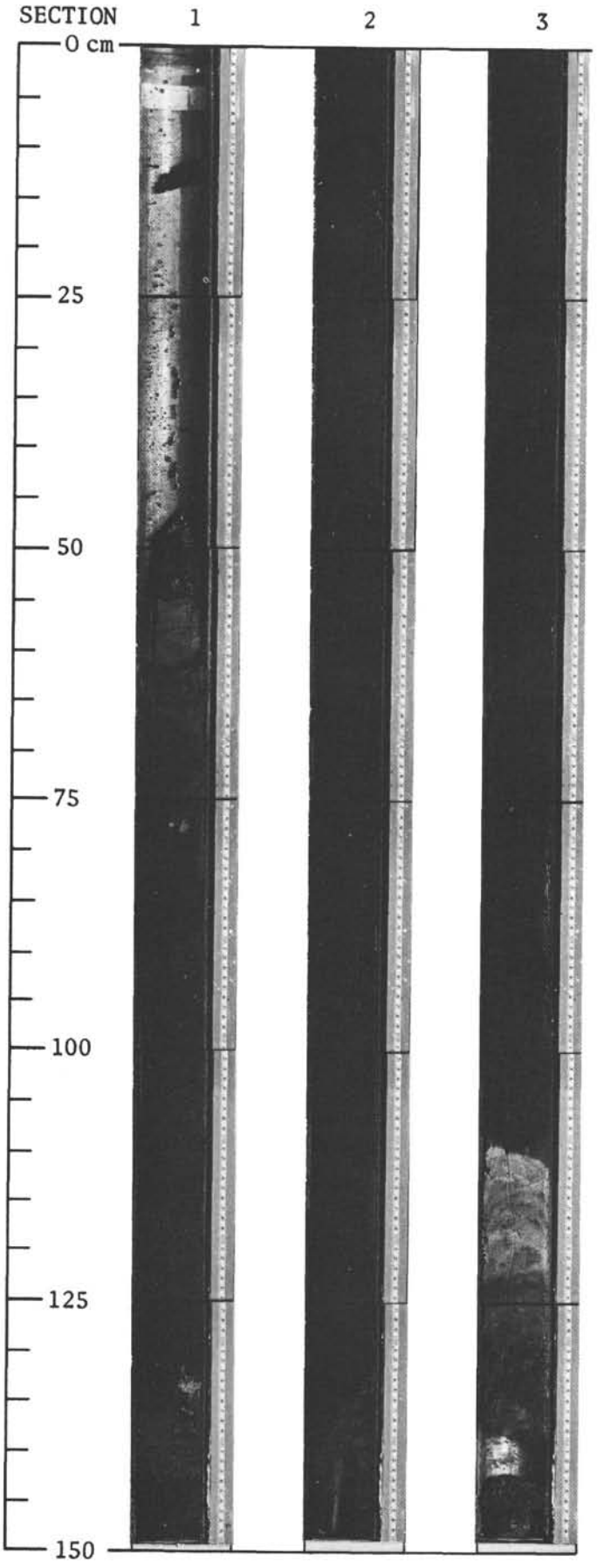
SITE 74 Core 12 Detailed description Section 2



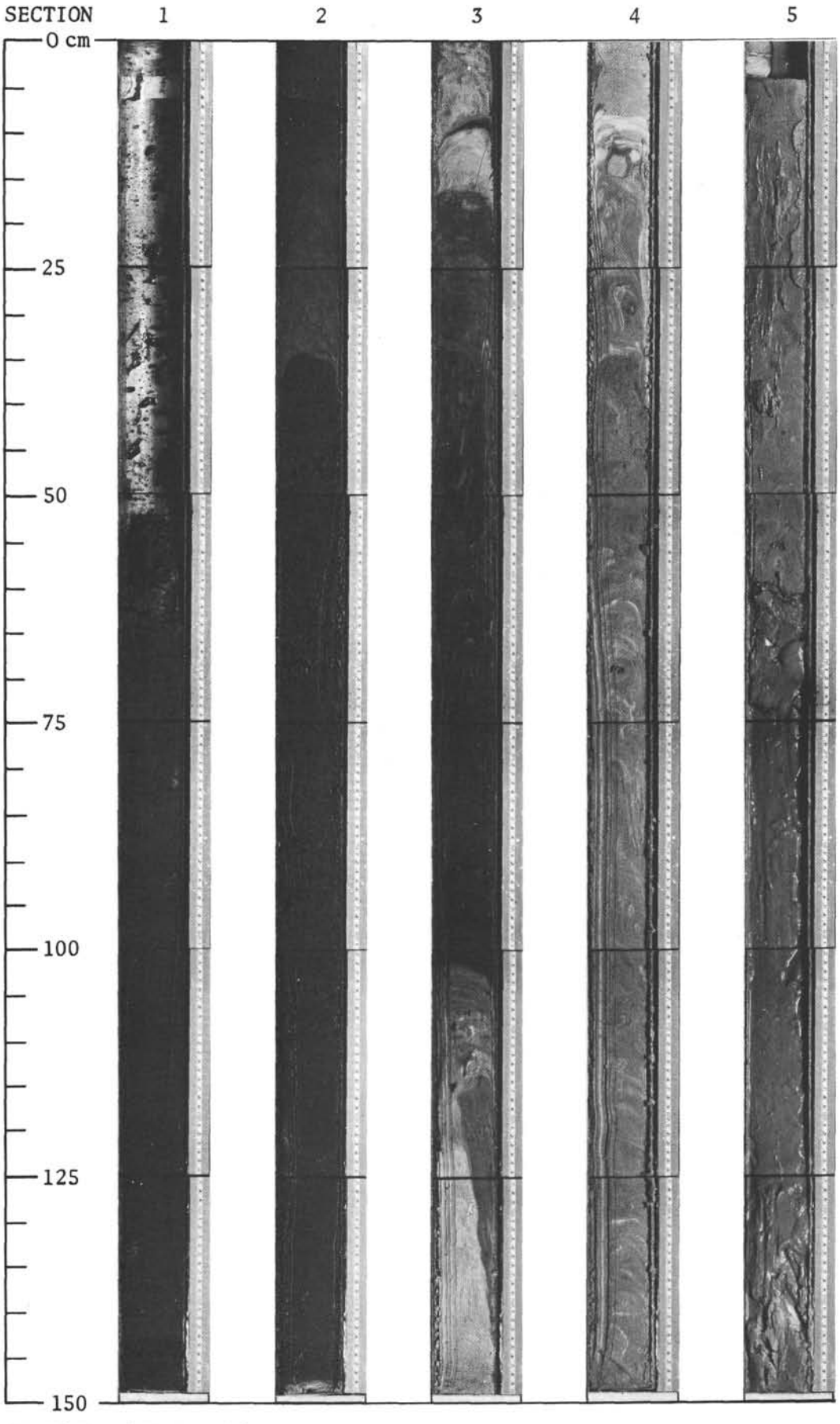
SITE 74 Core 12 Detailed description Section 3



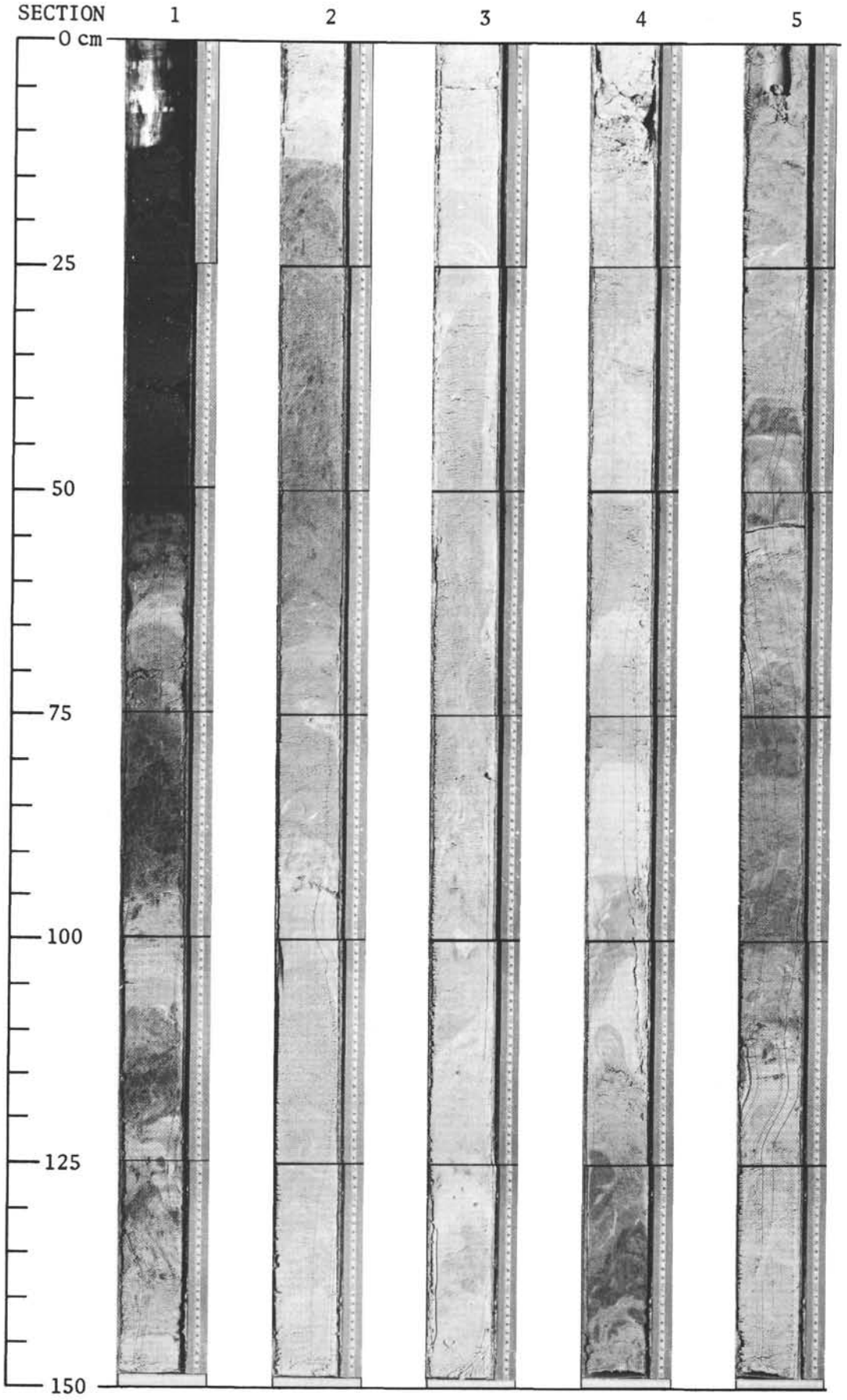
Site 74, Core 1, Sections 1-6.



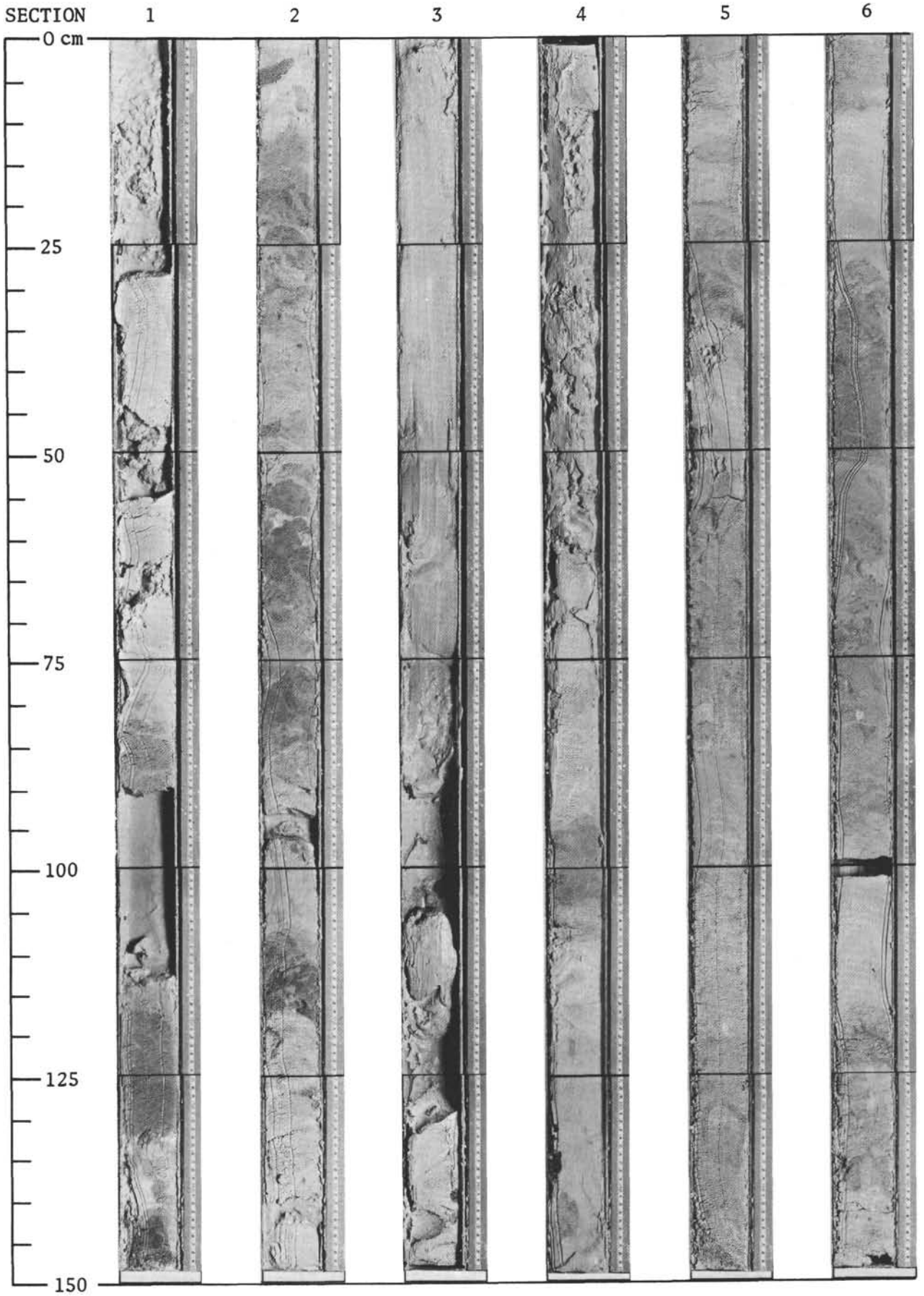
Site 74, Core 2, Sections 1, 2, 3.



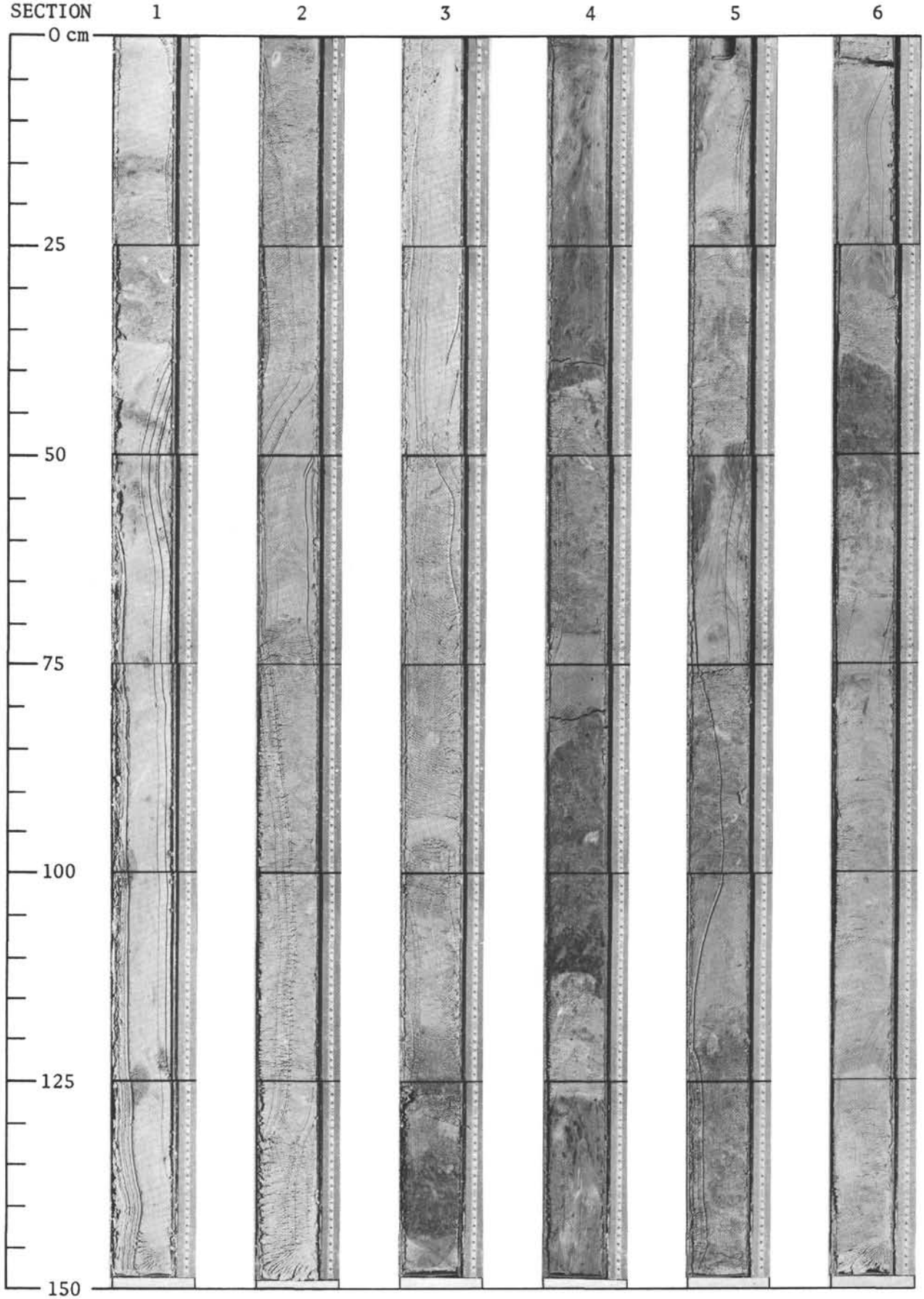
Site 74, Core 3, Sections 1-5.



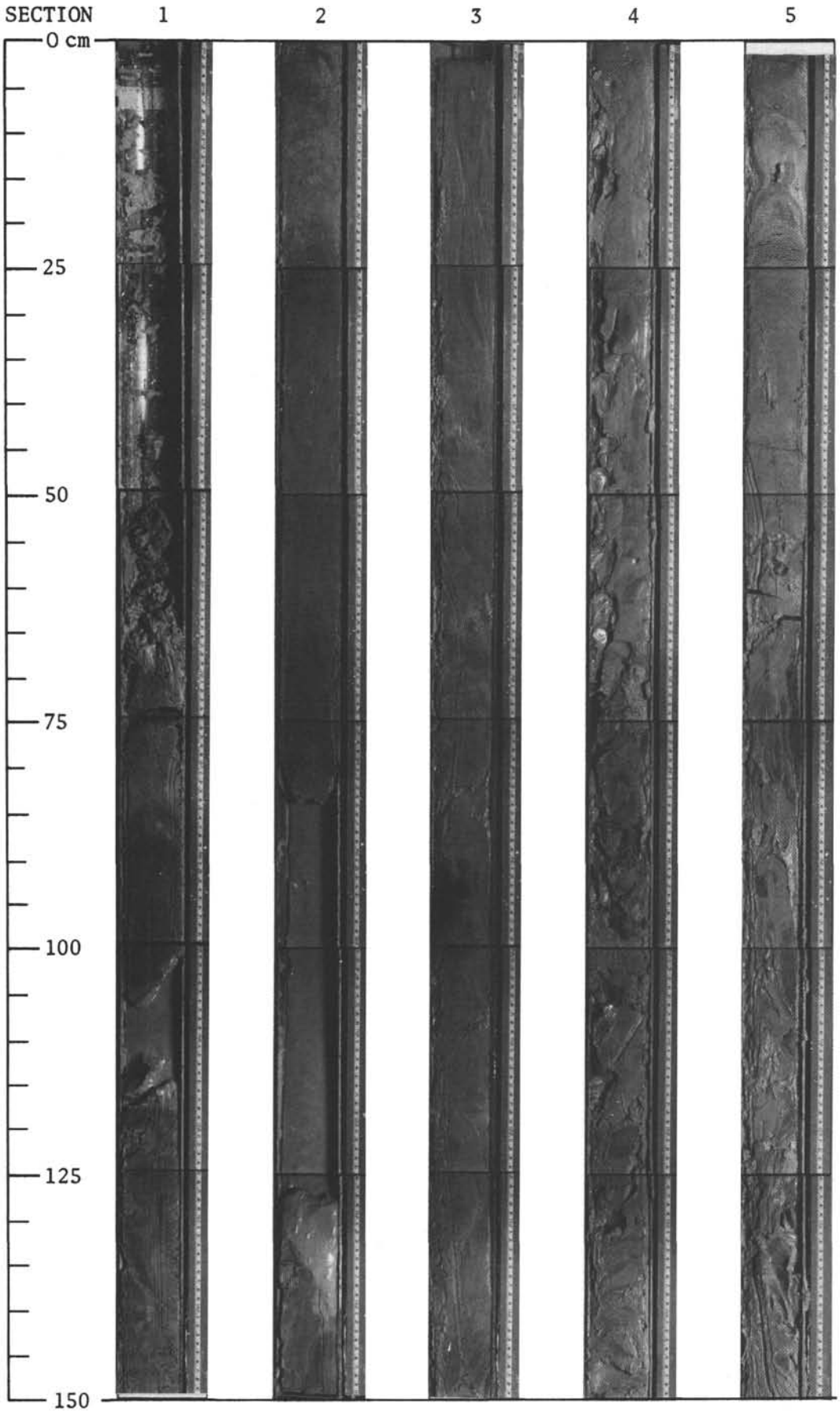
Site 74, Core 4, Secions 1-5.



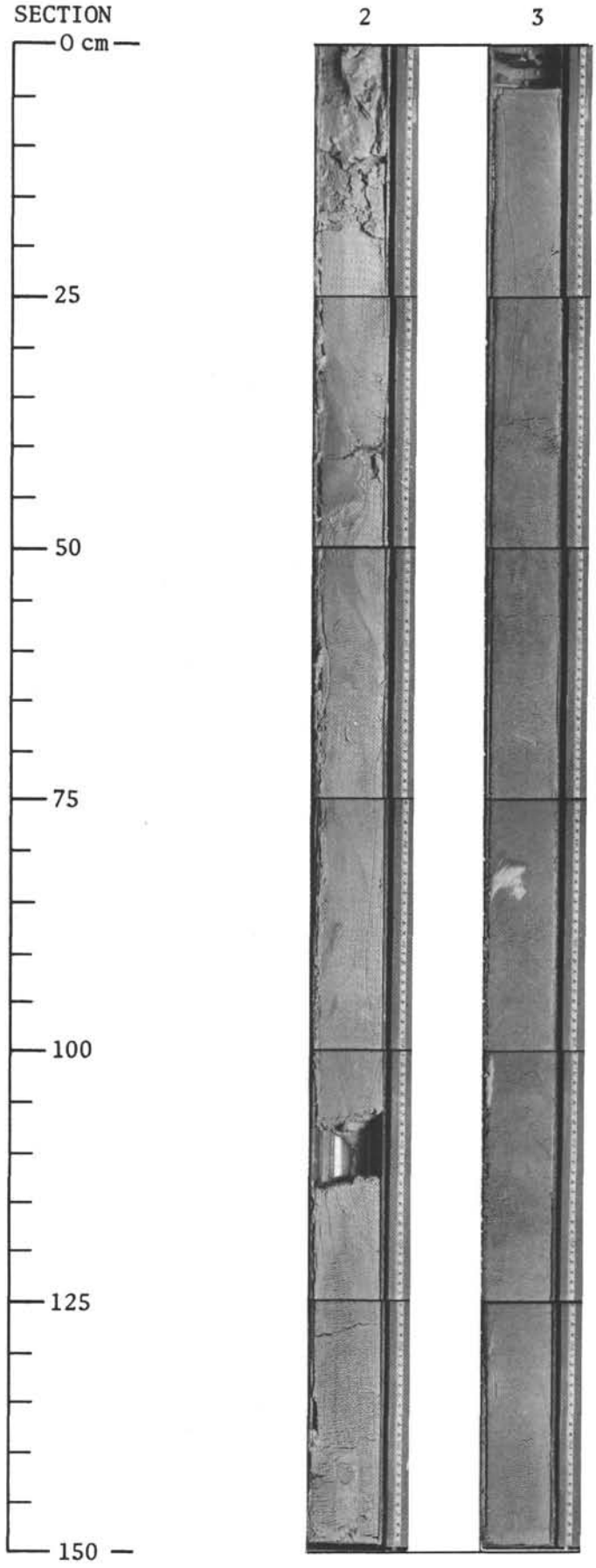
Site 74, Core 5, Sections 1-6.



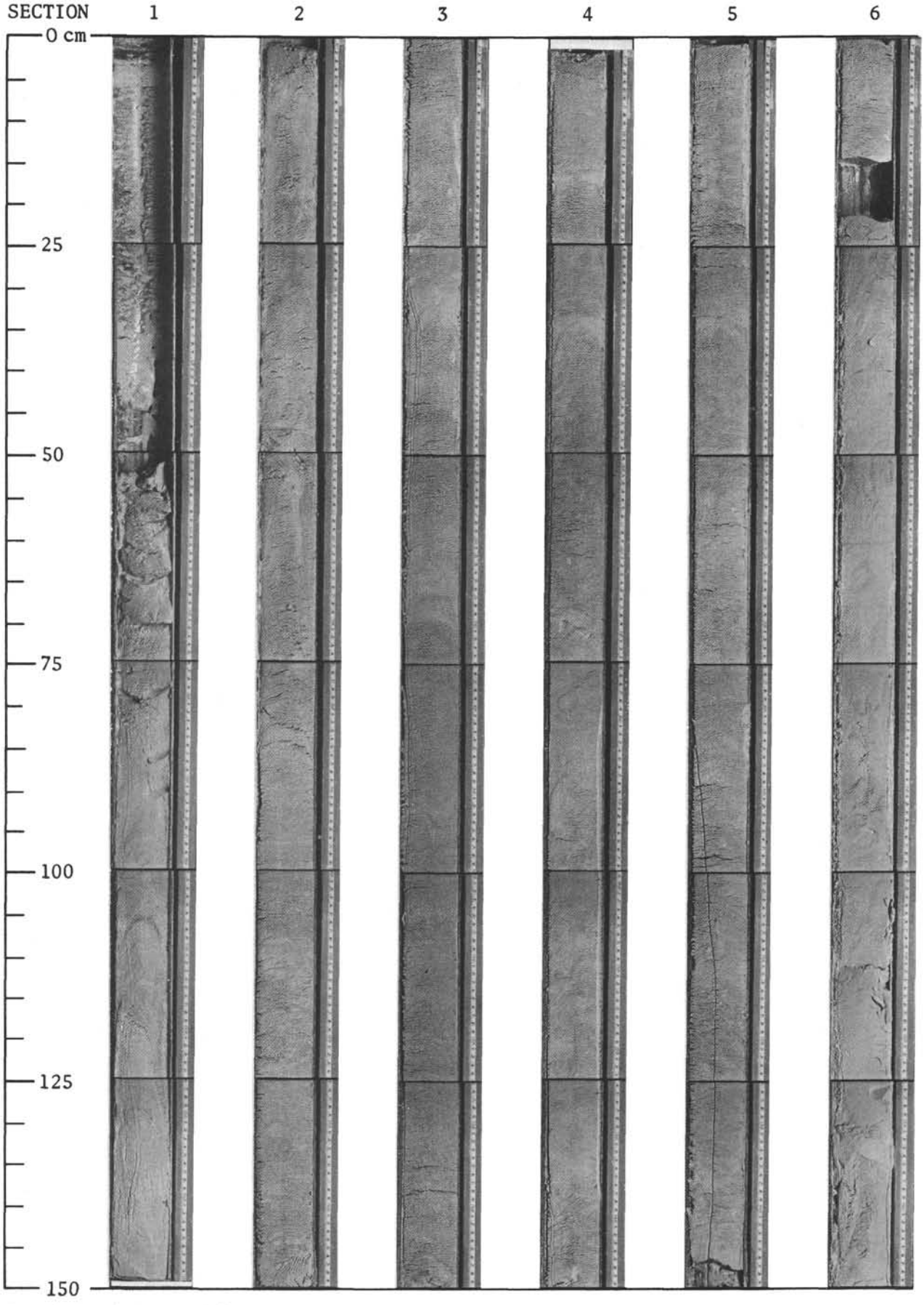
Site 74, Core 6, Sections 1-6.



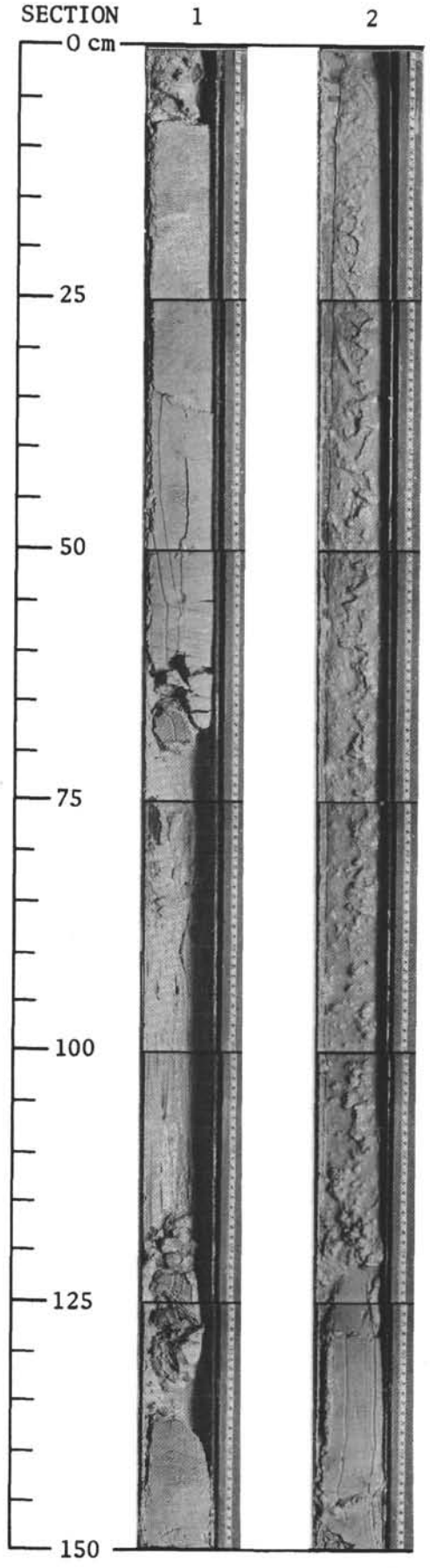
Site 74, Core 7, Sections 1-5.



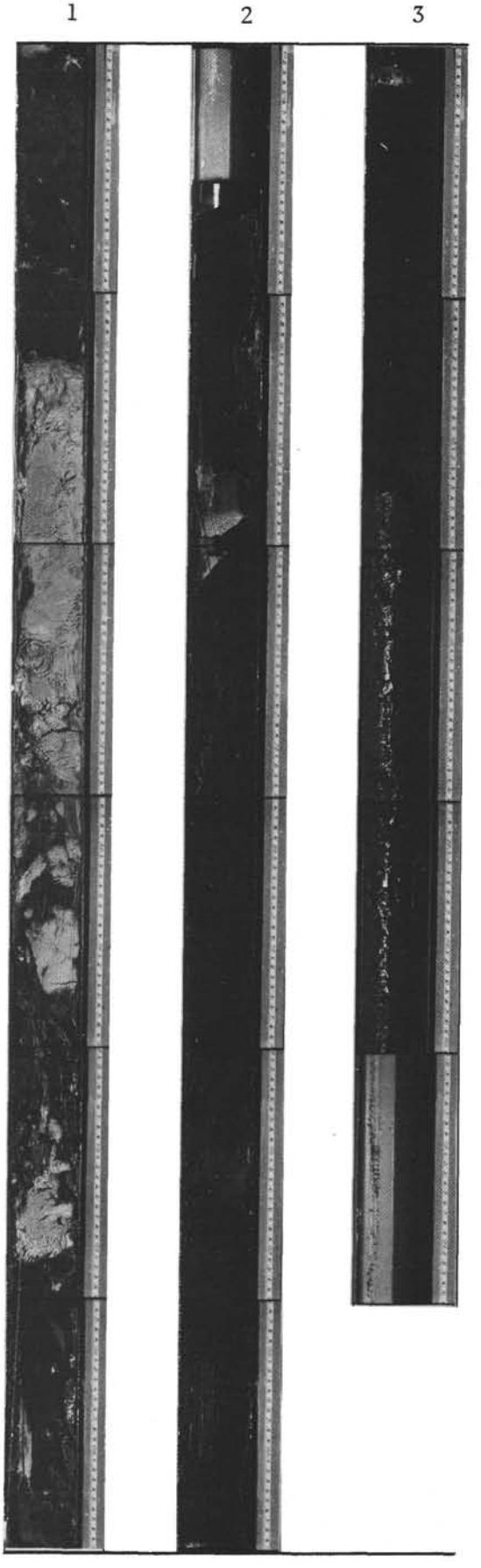
Site 74, Core 8, Sections 2, 3.



Site 74, Core 9, Sections 1-6.



Site 74, Core 10, Sections 1, 2.



Site 74, Core 12, Sections 1, 2, 3.