# 8. SITE 73

Shipboard Scientific Party[1]

## SITE DATA

**Occupied**: November 17-19.

**Position**: Latitude 01° 54.58'S.
Longitude 137° 28.12'N.

**Water Depth**: 4387 meters.

**Hole Depth**: 302 meters ending in middle Eocene siliceous chalk, limestone and chert.

**Holes Drilled**: One hole.

**Cores Taken**: Twenty-one cores; continuous 0 to 94 meters, 243 to 302 meters; spot cores at 140, 206 meters.

## RESULTS

The cored sediments may be grouped into three principle sequences:

1) An upper layered sequence, 74 meters thick, of Quaternary to Middle Miocene age comprising repetitive beds of variable carbonate content (radiolarian-nannofossil and nannofossil-radiolarian ooze) (0 to 65 meters) of Quaternary, Pliocene and Upper Miocene age, overlying a bedded siliceous ooze, dominantly radiolarian (67 to 74 meters) of upper and middle Miocene age, but containing a dominant assemblage of reworked lower Miocene species.

2) A high-carbonate sequence (radiolarian-nannofossil to nannofossil ooze, 65 to 288 meters) of middle Miocene to lower Oligocene age.

3) Bedded carbonate ooze, siliceous chalk and chert (288 to 302 meters) of upper and middle Eocene age.

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## BACKGROUND

Site 73 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. It lies about 170 miles south of Site 72 and 270 miles north of Site 74. Site 73, along with Site 72 to the north, was added to the N-S line of sites proposed by the JOIDES Pacific Advisory Panel in order to obtain better stratigraphic correlation across the Equator.

There was no SCAN survey for this site and all site information is derived from observations made on the *Challenger*. The principal topographic feature in the vicinity of the site is a northeast trending ridge or alignment of seamounts with a maximum relief of about 300 meters in the southwestern part of the survey area (about 6 miles from the site). The shortest distance between the ridge and the drilling site is about 3 miles. The ridge runs transverse to the general dip of the sea floor of about 10 meters per mile to the southeast. A depression, or moat, is apparent in the upper sediments on either side of the ridge. Generally the rather gentle sea floor topography and intermediate reflectors follow variations in acoustic basement with some attenuation. However, there are a number of exceptions in the area. Near the site are a number of small-scale flexures and offsets that may be controlled by underlying faults. Also, there appears to be a discordant zone within the upper portion of the sediments near the site. Depth to acoustic basement in the vicinity is about 0.36 second. Near the site this rises to 0.25 second (Figure 1 and Figure 10, Chapter 2).

At Site 73 the prominent reflectors are at 0.100 and 0.355 seconds. The upper reflector correlates with the Clipperton-Marquesas boundary at 73 meters depth, which, at this location, appears to be an unconformable contact. The lower reflector, acoustic basement, is correlated with the Marquesas-Line Islands boundary at 288 meters or indurated sediment within the Line Islands occurring near 300 meters (Figures 6, 7 and 8, Chapter 2).

A topographic map of the vicinity of Site 73, airgun records, and further site information are given in Chapter 25.

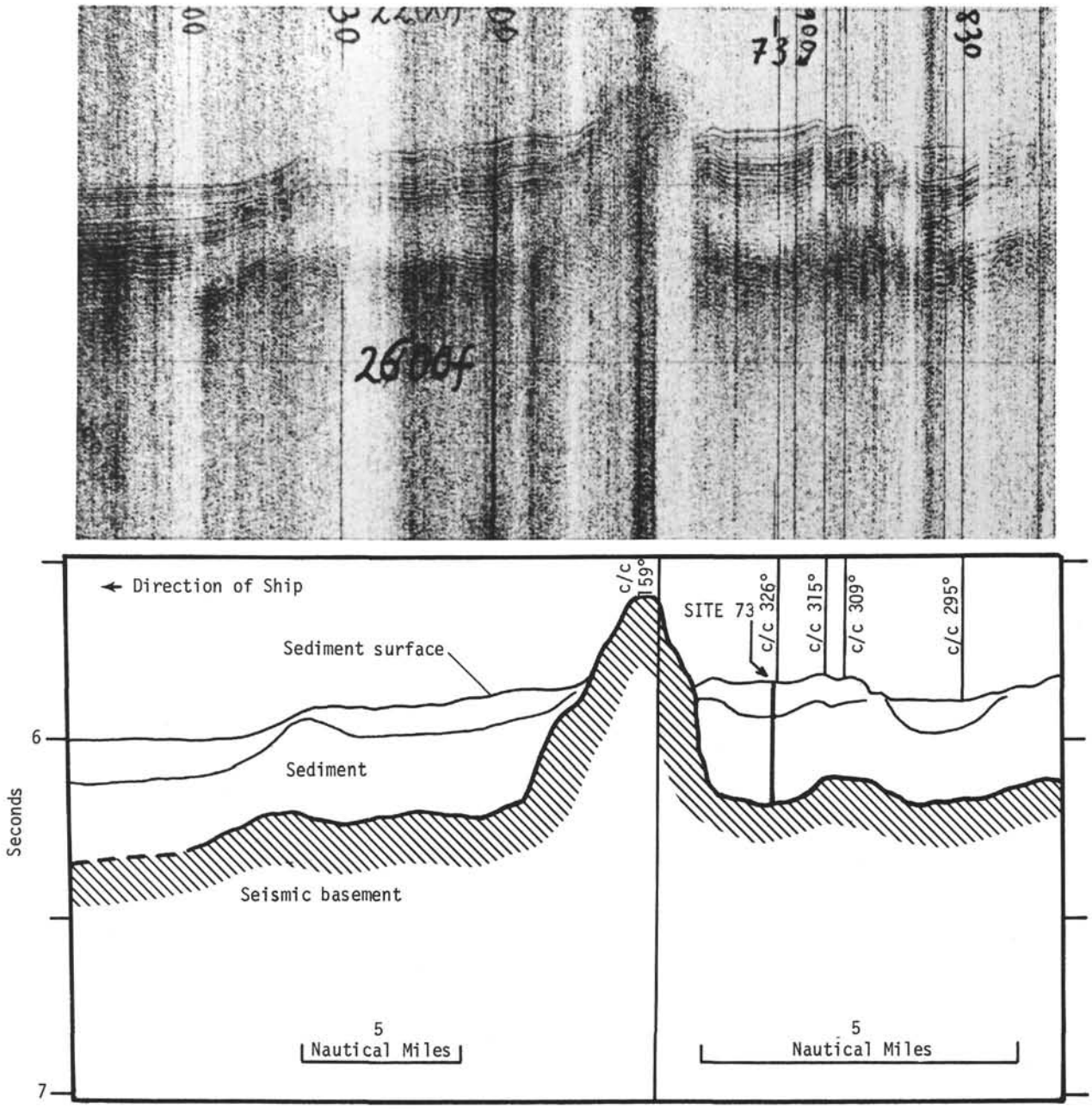



Figure 1. *Airgun record across Site 73 and interpretation.*

## OPERATIONS

The drilling plan was to core continuously from the sea floor into upper Miocene; then to "ship core" (coring every 50 meters or so) into Oligocene sediments; then to core continuously to basement.

In the drilling of Hole 73, 11 core runs (0 to 94 meters) were taken into middle Miocene sediment before any "ship coring" was attempted, for upper Miocene cores contained lower Miocene fossils, indicating a probable significant hiatus or discontinuity.

Two cores were taken at 190 meters and 206 meters, and coring was continuous from 243 to 302 meters.

A Welex drill pipe electric log was run while coming out of the hole.

**TABLE 1**
**Summary of Coring at Site 73**

| | Core No. | Interval Below Seafloor (meters) | Cored (m) | Recovered (m) | Comments |
|---|---|---|---|---|---|
| **Hole 73** | 1 | 0-3 | 3.1 | 3.1 | Poor core |
| | 2 | 3-12 | 9.1 | 7.6 | |
| | 3 | 12-21 | 9.1 | 8.5 | |
| | 4 | 21-30 | 9.1 | 9.1 | |
| | 5 | 31-40 | 9.1 | 8.2 | |
| | 6 | 40-49 | 9.1 | 9.1 | |
| | 7 | 49-58 | 9.1 | 9.1 | |
| | 8 | 58-67 | 9.1 | 9.1 | |
| | 9 | 67-76 | 9.1 | 8.7 | |
| | 10 | 76-85 | 9.1 | 9.1 | |
| | 11 | 85-94 | 9.1 | 9.1 | |
| | – | 94-140 | – | – | Drilled 149 feet |
| | 12 | 140-149 | 9.1 | 9.1 | |
| | – | 149-206 | – | – | Drilled 187 feet |
| | 13 | 206-215 | 9.1 | 9.1 | |
| | – | 215-243 | – | – | Drilled 90 feet |
| | 14 | 243-252 | 9.1 | 9.1 | |
| | 15 | 252-262 | 9.1 | 9.1 | |
| | 16 | 262-270 | 9.1 | 9.1 | |
| | 17 | 270-279 | 9.1 | 9.1 | |
| | 18 | 279-288 | 9.1 | 9.1 | |
| | 19 | 288-297 | 9.1 | 9.1 | |
| | 20 | 297-300 | 3.1 | 3.1 | Hard layer at 300 m |
| | 21 | 300-302 | 2.4 | 2.4 | |
| Total | | 302 | 173.1 | 169.8 | 97.5% recovery |

## LITHOLOGY AND STRATIGRAPHY

Three sedimentary formations are present at Site 73: the Clipperton Oceanic Formation (0 to 73.4 meters) consisting of an upper cyclic unit (0 to 6.5 meters) of alternating calcareous and siliceous oozes, a middle varicolored unit (6.5 to 62.9 meters) of calcareous oozes, and a lower unit (62.9 to 73.4 meters) of radiolarian ooze; the Marquesas Oceanic Formation (73.4 to 288 meters) consisting of radiolarian-nannofossil ooze, nannofossil ooze and siliceous nannofossil ooze; and the Line Islands Oceanic Formation (288 to 302 meters) consisting of semi-indurated radiolarian-nannofossil ooze, nannofossil-radiolarian ooze, and radiolarian ooze overlying silicified limestone and chert.

Calcareous nannoplankton are by far the most common constituent of the sediments at Site 73 with Radiolaria, foraminifera and diatoms forming significant portions of some intervals.

### Clipperton Oceanic Formation

The Clipperton Oceanic Formation is composed of three units at Site 73. The upper cyclic unit (0 to 6.5 meters) consists of alternating calcareous and siliceous oozes. The contacts between the two lithologies are usually sharp and marked by color changes. Most of the individual beds are from 5 to 50 centimeters thick and are soft and plastic. The calcareous portions are siliceous foraminiferal-nannofossil oozes and make up about 80 per cent of the unit. They are white to very

light gray or brown and are composed predominantly of calcareous nannoplankton (50 to 65 per cent) with Radiolaria (10 to 25 per cent), foraminifera (10 to 20 per cent), and diatoms (5 to 10 per cent) The siliceous portions are calcareous radiolarian oozes and form about 20 per cent of the unit. They are various shades of brown and have an average composition of Radiolaria (50 per cent), calcareous nannoplankton (25 per cent), foraminifera (15 per cent), and diatoms (10 per cent). In general, the darker brown the color, the lower the calcium carbonate ($CaCO_3$) content. This cyclic unit is Quaternary in age. The contact of the cyclic unit with the underlying varicolored unit is sharp and is placed at the top of the uppermost pastel-hued bed.

The middle varicolored unit (6.5 to 62.9 meters) of the Clipperton Oceanic Formation is distinguished from the overlying cyclic unit by its pastel colors and from the underlying radiolarian ooze unit by its colors and composition. The varicolored unit is bedded with most beds in the upper portion between 5 and 30 centimeters thick and most beds in the lower portion between 5 and 50 centimeters thick. Beds are distinguished mainly by sharp color differences with little compositional change evident. Most beds are either bluish white, light bluish gray, light greenish gray, yellowish gray, or pale purple. Mottling is not present at the top of the unit but increases in intensity to moderate mottling at the base. All beds are soft and plastic. The upper portion of the unit is siliceous foraminiferal-nannofossil ooze similar compositionally to that in the overlying cyclic unit. From about 43 meters to the base of the varicolored unit the composition changes to radiolarian-nannofossil ooze mainly due to an increasing Radiolaria content and a decreasing foraminifera content. The radiolarian-nannofossil oozes are mainly composed of calcareous nannoplankton (45 to 60 per cent) with Radiolaria (30 to 50 per cent), foraminifera (0 to 10 per cent), and diatoms (0 to 10 per cent). The lower portion of the varicolored unit is more variable in composition than at Sites 71 and 72.

From about 56 to 64.4 meters is a zone having characteristics of both the varicolored unit and the underlying radiolarian ooze unit. The pastel purple, green, and blue sediments are interbedded with brownish, more siliceous oozes. The basal contact of the varicolored unit has been placed at the top of the uppermost radiolarian ooze bed at 62.9 meters. The varicolored unit is Quaternary, Pliocene, and late Miocene in age.

The lower unit (62.9 to 73.4 meters) of the Clipperton Formation at Site 73 consists of radiolarian ooze. Thin individual beds can be distinguished in the upper and lower portions of the unit with a single 5.3-meter thick bed from 67.6 to 72.9 meters. The radiolarian ooze unit is mostly dark grayish brown in the upper and lower portions and various shades of brown and dark brown in between. The darkest portions contain no carbonate, whereas the lighter brown portions average about 20 per cent carbonate. The entire interval is moderately mottled with very pale brown. Radiolaria make up 80 to 95 per cent of the unit with calcareous nannoplankton usually ranging from 0 to 20 per cent. The radiolarian ooze unit is upper and middle Miocene in age based mainly on foraminifera and calcareous nannoplankton in the enclosing calcareous layers. Much of the unit contains an almost pure lower Miocene radiolarian fauna however, which suggests that much of the radiolarian ooze unit may represent a slump or slide deposit, or solution and deposition at a disconformity. Paleontological evidence suggests mixing and reworking. In addition, the site survey seismic profiles show an apparent unconformity at the depth of this unit. The contact between the radiolarian ooze unit and the underlying Marquesas Oceanic Formation is sharp and occurs at the hiatus at the base of the lowermost radiolarian ooze bed.

**Marquesas Oceanic Formation**

The entire Marquesas Oceanic Formation at Site 73 is highly calcareous (65 to 95 per cent), composed mainly of calcareous nannoplankton (coccolithophoride and discoasters). The upper and lower portions contain more siliceous debris than the middle portion. The upper portion consists of radiolarian-nannofossil ooze and extends from 73.4 to 149 meters below the sea floor. Colors grade from light gray to pale brown to white, sharp contacts being rare. The beds are slightly to moderately mottled with very pale brown and white. Calcareous nannoplankton comprise 65 to 95 per cent of the sediment, Radiolaria 5 to 35 per cent.

The middle portion of the Marquesas Oceanic Formation consists of one bed of nannofossil ooze, extending from 206 to approximately 261 meters below the sea floor. The unit is white and not mottled. Calcareous nannoplankton comprise 90 to 95 per cent of the unit, Radiolaria 3 to 8 per cent. The contact with the underlying beds is gradational.

The lower portion of the Marquesas Oceanic Formation is siliceous nannofossil ooze and is part of the same bed that forms the middle portion. A compositional difference is all that distinguishes one from the other. The lower beds are slightly more siliceous than the middle ones, 5 to 20 per cent silica compared to 5 to 10 per cent. The lower portion extends from about 261 to 288 meters below the sea floor. The unit is white and not mottled. Calcareous nannoplankton form 80 to 95 per cent of the unit. Radiolaria form 3 to 15 per cent of the unit near the top and less than 5 per cent near the base. Diatoms form less than 5 per cent of the unit near the top and 5 to 15 per cent near the base. The contact with the underlying Line Islands

Oceanic Formation at 288 meters is sharp and represents a disconformity that corresponds to the Oligocene-Eocene boundary. The Marquesas Formation is middle Miocene and Oligocene in age.

### Line Islands Oceanic Formation

The upper portion of the Line Islands Oceanic Formation at Site 73 consists of interbedded radiolarian-nannofossil ooze, nannofossil radiolarian ooze, and radiolarian ooze extending from 288 to about 300 meters below the sea floor. Most beds are between 60 and 160 centimeters thick and are distinguished by both color and compositional differences. Some of the contacts are sharp, others gradational. The beds are various shades of brown, ranging from pale brown to dark brown with yellowish-brown beds being especially common. In general, the darker brown the color, the lower the carbonate content of the beds. All the beds are moderately mottled with very pale brown. The beds are stiff near the top and grade to semi-indurated at the bottom. The radiolarian-nannofossil oozes are composed mainly of calcareous nannoplankton (50 to 85 per cent) and Radiolaria (15 to 50 per cent). The nannofossil-radiolarian oozes and radiolarian oozes are composed mainly of Radiolaria (50 to 98 per cent) and calcareous nannoplankton (1 to 50 per cent). Calcareous beds are more abundant than siliceous beds. This upper portion of the Line Islands Oceanic Formation is late Eocene in age. The contact with the underlying beds is gradational.

The lower portion consists of one 12-centimeter bed of very dark gray chert with yellowish-brown silicified limestone both above and below. The unit extends from about 300 meters below the sea floor to the bottom of the hole at 302.7 meters. The contact between radiolarian-nannofossil ooze of the upper portion and silicified limestone of the lower portion is gradational and is rather arbitrarily placed at 300 meters, where a color change and an age boundary occur. The silicified limestone is intensely mottled with very pale brown and is composed of about 70 per cent carbonate and about 30 per cent silica. The limestone contains calcareous nannoplankton, Radiolaria, and diatoms that are partially to almost completely dissolved. The chert is more indurated than the limestone and contains vugs partially filled with carbonate. The lower portion of the Line Islands Oceanic Formation is middle 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).

## PHYSICAL PROPERTIES

Porosities range between about 40 and 80 per cent and velocities range between 1.49 and 1.58 km/sec. Most of 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$^3$ appropriate for such material. The few data points for low calcium carbonate ($CaCO_3$) (0 to 35 per cent) fall near the curve for density 2.20 g/cm$^3$ appropriate for siliceous ooze. Some points fall below the curves; possible reasons for this are mentioned in Chapter 2.

There appears to be a rather sharp decrease in porosity and increase in sonic impedance with depth near the Clipperton-Marquesas boundary at 73 meters depth. A prominent subbottom reflection is correlated with this boundary (Figure 6, Chapter 2). There also appears to be a decrease in natural gamma radiation across this boundary. Radiation abruptly increases again across the Marquesas-Line Islands boundary at 288 meters. Near the top of the hole, radiation exceeds 1800 counts and rapidly decreases to less than 1000 counts.

For depths less than 100 meters, sonic velocities are less than that for sea water.

Velocity and density were determined for two pieces of indurated core; a muddy limestone and a chert (Chapter 2). A velocity of 4.70 km/sec and a density of 2.53 g/cm$^3$ were obtained for the chert.

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

## PALEONTOLOGY

### Foraminifera

A single hole was drilled at this site, which reached a depth of 302 meters in the Middle Eocene. Continuous cores are available from the Quaternary into the Middle Miocene (Cores 73-1 to 11) and again from within the Oligocene to total depth (Cores 73-14 to 21). The stratigraphic section is similar to that of Site 72, but the Pliocene and Upper Miocene are richer in radiolarians. The microfaunas of Cores 73-8 and 9 in the Upper Miocene are often predominantly siliceous, as are those of Cores 73-19 and 20 at the top of the Eocene. It appears that in both these cases the siliceous faunas are closely associated with unconformities.

As at Site 72, the Quaternary is fairly thick (at least 15 meters). Planktonic foraminifera are common and are dominated by *Globorotalia tumida* and *Pulleniatina* spp. The change in coiling of *Pulleniatina* from random to dextral occurs just above Section 73-2-4 (depth 7 meters). The Pliocene/Quaternary boundary is within Core 73-3, somewhere between Section 2 (earliest *Globorotalia truncatulinoides*) and Section 5 (highest *G. tosaensis*), at a depth of 15 to 18 meters. The highest zone of the Pliocene, N. 21 with *Globorotalia*

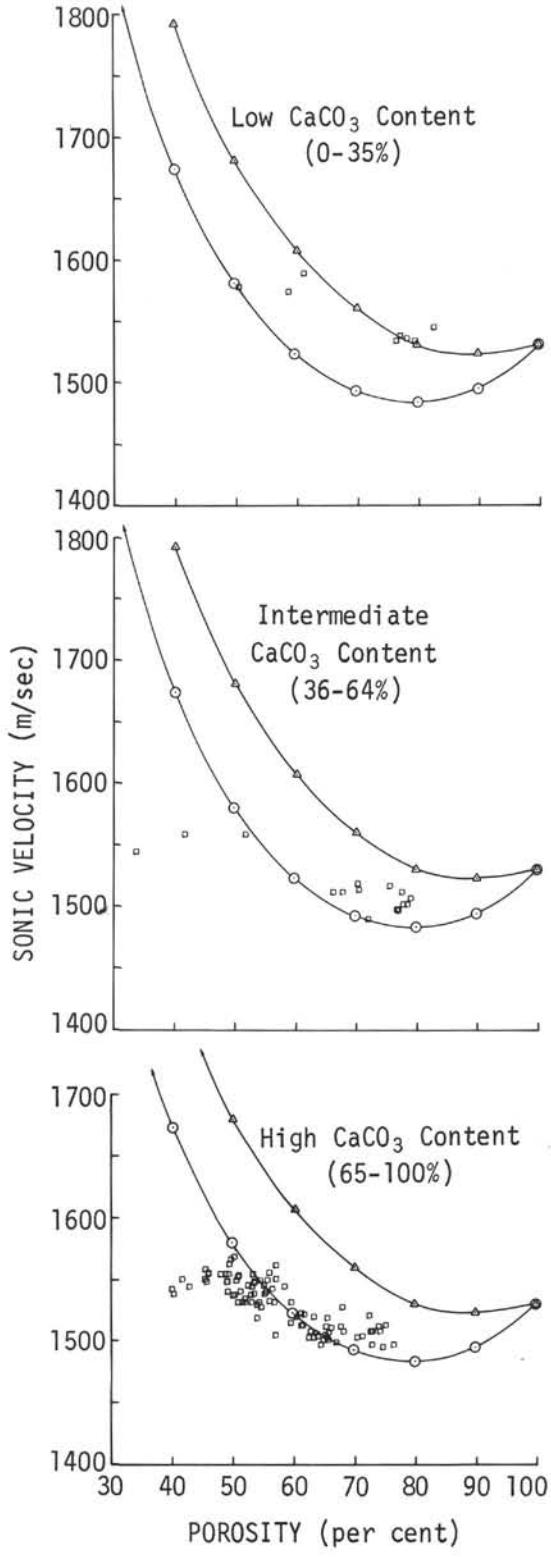



Figure 2. *Sonic velocity versus porosity of unlithified sediments from Site 73 for three ranges of calcium carbonate content. Theoretical curves are based on the equation of Wood (1941). Upper curve, grain-matrix density 2.2 g/cm$^3$, appropriate for siliceous ooze. Lower curve, grain-matrix density 2.65 g/cm$^3$, appropriate for calcareous ooze.*

*tosaensis*, extends down to Section 73-5-3 (36 meters). Practically at the same depth, the earliest *G. pseudopima*, indicating the base of N. 20, was found. The base of the Pliocene (base of N. 19) is at 73-7-4 (55 meters). The thickness of the Pliocene is thus almost the same as at Site 72 (at least 37 meters, a maximum for the Leg 8 sites).

Upper Miocene foraminiferal faunas are found from 73-7-5 to 73-9-5, 77 centimeters (55 to 74 meters). They are practically homogeneous and all indicate the highest Miocene zone, N. 18. However, some downmixing may have occurred in the lower part of this interval, which is predominantly siliceous, in which case the base of N. 18 would be slightly higher than Section 73-9-5. The samples from here downwards are already Middle Miocene (probably N. 12) in age. Most probably there is an unconformity at 74 meters (or slightly higher), which would account for the absence of several zones (N. 13 to N. 16-17).

In the Middle Miocene, we have a good record of the *Globorotalia fohsi* lineage, which can be paralleled with that of Site 71. The stratigraphically important first occurrences are located as follows:

Earliest *Globorotalia fohsi robusta* at 73-9-6 (76 meters).

Earliest *G. f. lobata* (approximate base of N. 12) at 73-10-1 (77 meters).

Earliest *G. f. praefohsi* (base of N. 11) at 73-10-4 (82 meters).

Earliest *G. f. peripheroacuta* (base of N. 10) at 73-11-6 (94 meters).

Continuous coring was stopped after Core 73-11, and two spot cores were taken, which represent the *Globorotalia kugleri* Zone (N. 4) and the *G. opima opima* Zone (P. 21), respectively. Continuous coring was resumed at 243 meters with Core 73-14. From here down to 73-17-2 (273 meters), *Globorotalia opima* s.l. (medium-sized), *Globigerina prasaepis* and rare *G. ampliapertura* are found, indicating most probably the *Globorotalia ampliapertura* Zone (P. 20). The highest *Pseudohastigerina* occurs at 73-17-3, and the *Pseudohastigerina/Cassigerinella chipolensis* Zone (P. 18-19) reaches down to the Eocene/Oligocene boundary at the bottom of Core 73-18 (288 meters).

The Eocene faunas are again quite distinct from those of the Oligocene. In Cores 73-19 and 20, they are rather siliceous and contain only a few benthonic species such as *Nuttalides truempyi* and *Alabamina dissonata*. From the core catcher sample of Core 20 (approximately 299 meters) to total drilling depth (302 meters), planktonic foraminifera are again more common and include *Catapsydrax dissimilis, Globigerina senni* and *Truncorotaloides rohri*. The age of these samples is upper Middle Eocene, *Orbulinoides beckmanni* Zone (P. 13) or *Truncorotaloides rohri* Zone (P. 14). The samples from Cores 18 to 21 are often contaminated with younger sediments.

### Calcareous Nannoplankton and Silicoflagellates

Calcareous nannoplankton occur abundantly in all material retrieved from Site 73. In one portion of the middle Miocene the majority of the species present are reworked from lower Miocene deposits. Silicoflagellates are present throughout the Neogene and upper Eocene, but are absent from the Oligocene. Forty-eight species of calcareous nannoplankton and two of silicoflagellates were identified at Site 73. Fifteen nannoplankton zones were recognized. Two intervals include two zones together because they could not be separated.

Hole 73

| | |
|---|---|
| Core 1-1 to 3-3: | *Gephyrocapsa oceanica* and *Pseudoemiliania lacunosa* Zones |
| Core 3-4 to 4-2: | *Discoaster brouweri* Zone |
| Core 4-3 to 5-CC: | *Discoaster asymmetricus* Zone |
| Core 6-1 to 7-4: | *Ceratolithus rugosus* Zone |
| Core 7-5 to 8: | *Ceratolithus tricorniculatus* Zone |
| Core 9-1 to 9-3: | *Discoaster quinqueramus* Zone |
| Core 9-4 to 9-CC: | *Discoaster kugleri* Zone |
| Core 10-1 to 10-4: | *Discoaster exilis* Zone |
| Core 10-5 to 11-CC: | *Sphenolithus heteromorphus* and *Helicopontosphaera ampliaperta* Zones |
| Core 12-1 to 12-CC: | *Triquetrorhabdulus carinatus* Zone |
| Core 13-1 to 13-CC: | *Sphenolithus distentus* Zone |
| Core 14-1 to 17-3: | *Sphenolithus predistentus* Zone |
| Core 17-4 to 18-CC: | *Discoaster tani ornatus* Zone |
| Core 19-1 to 21-CC: | Middle Eocene, probably *Discoaster sublodoensis* Zone |

### Radiolaria

At this site cores were taken continuously from the sea floor to the Middle Miocene part of the section. All of the Pliocene and most of the Middle and Upper Miocene biostratigraphic zones described by Riedel and Sanfilippo (1970) were identified. The Radiolaria are numerous and well preserved; however, reworking of Lower Miocene Radiolaria (from the *Calocycletta virginis* and *C. costata* Zones) is common through the lower part of this continuously cored section (73-6-5

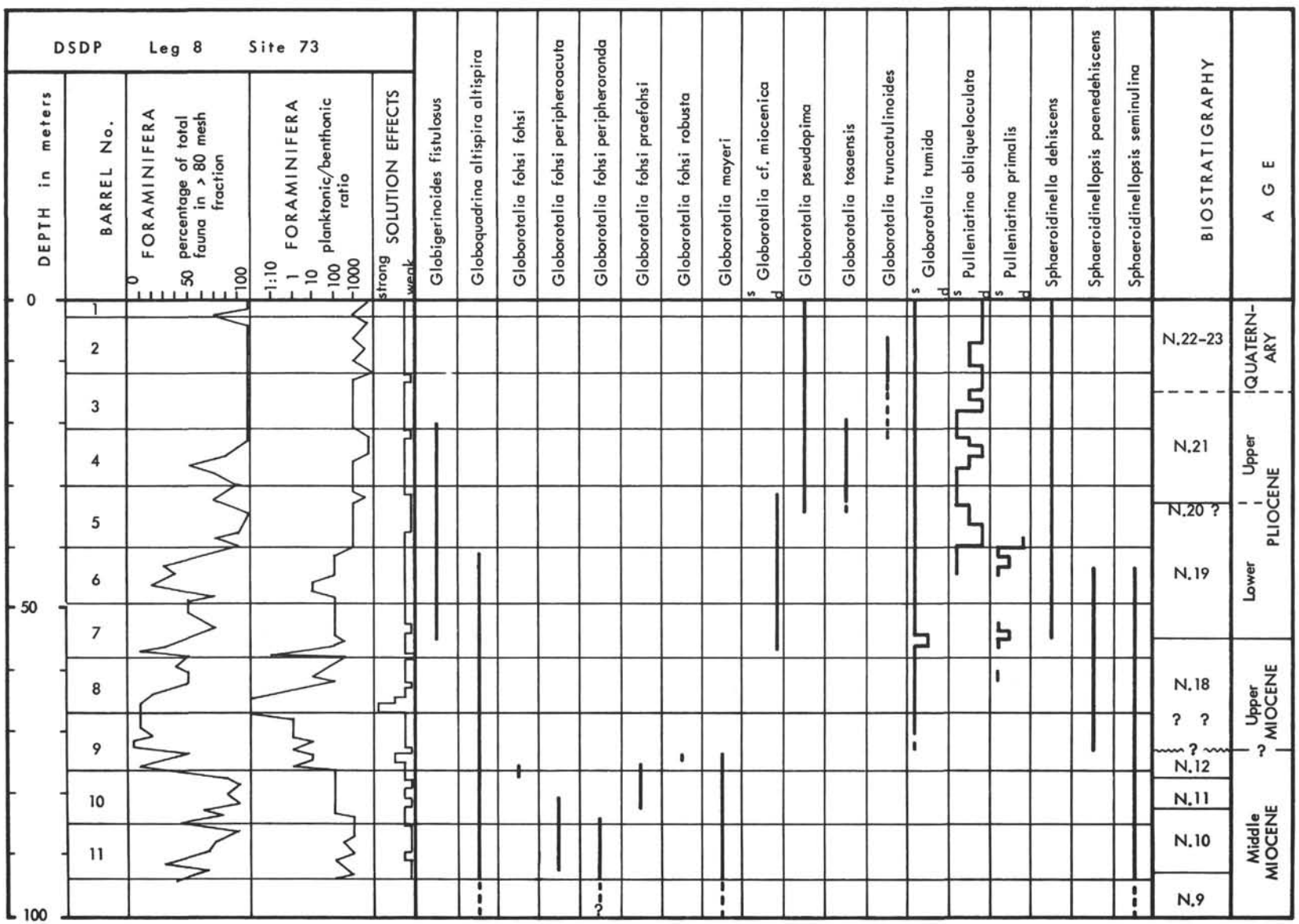
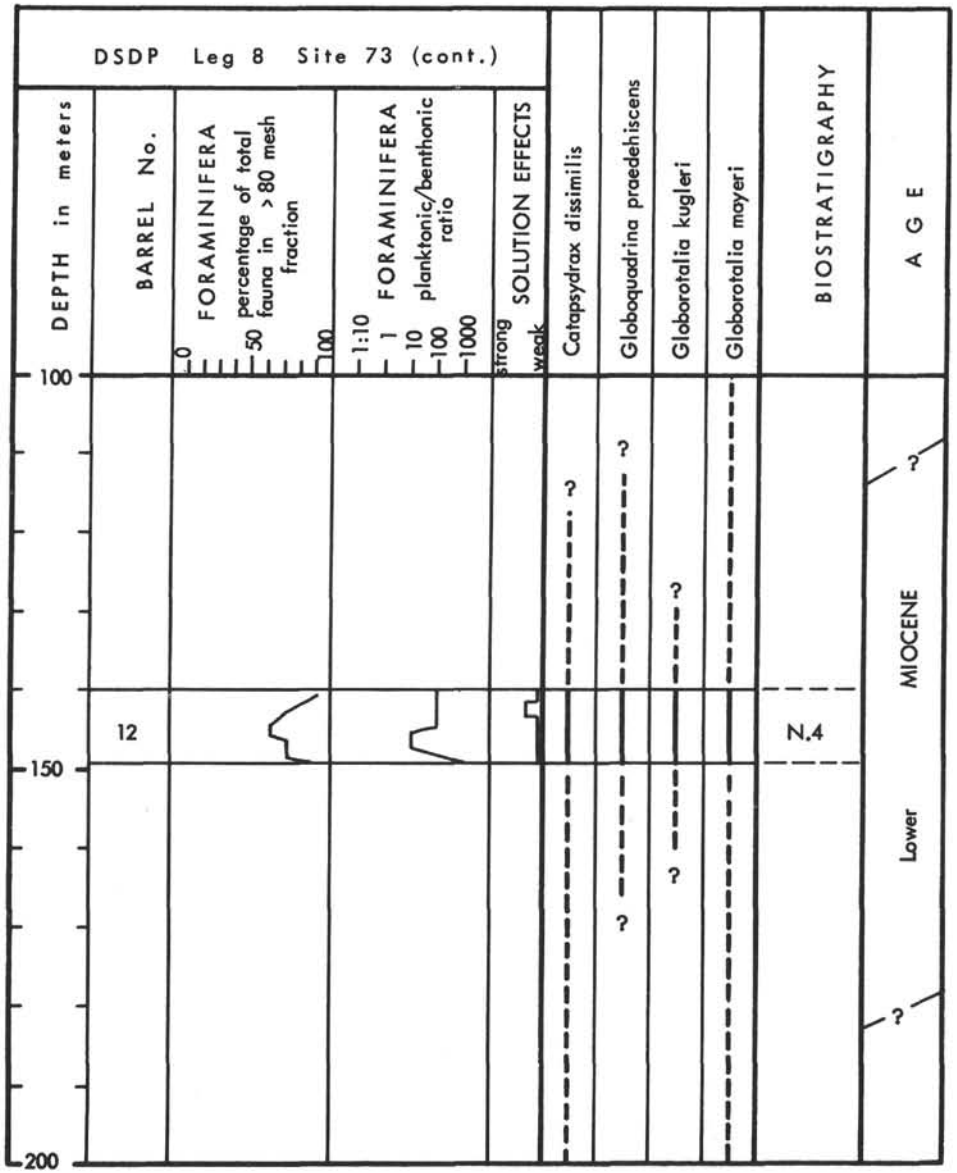



Figure 3. *Foraminifera of Site 73. Frequency distribution, ranges of important species and biostratigraphy.*

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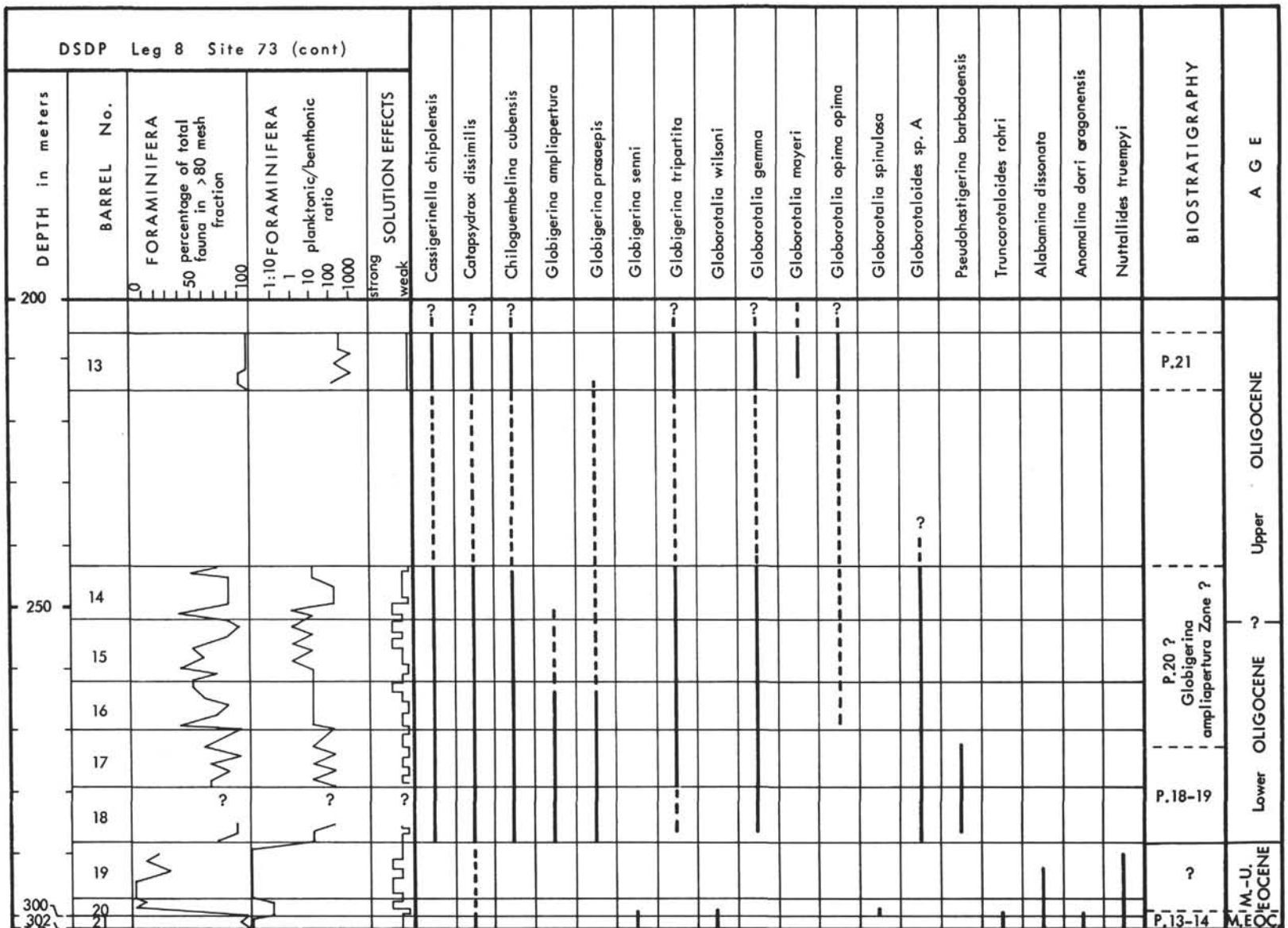



Figure 3. *Continued.*

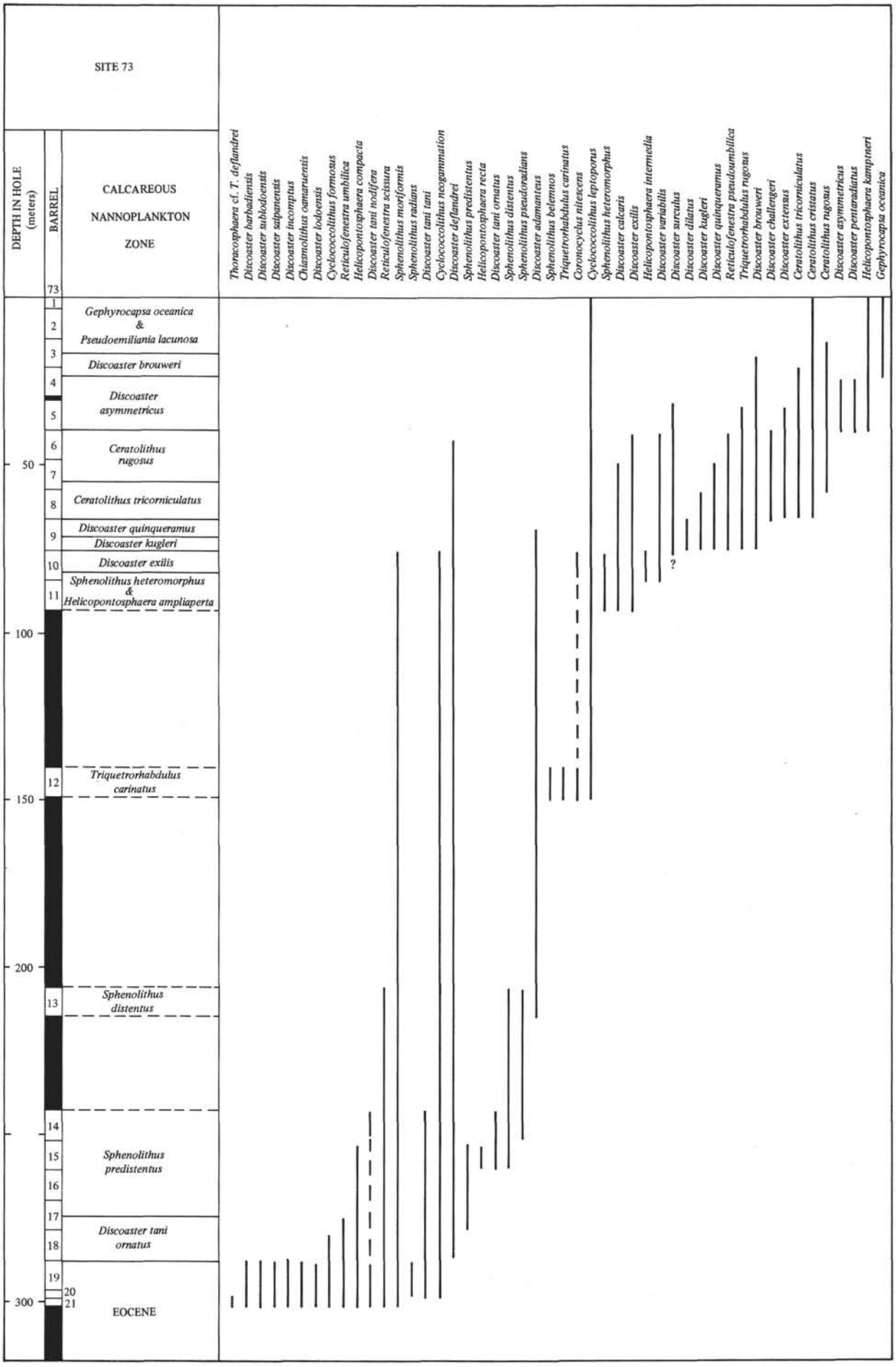



Figure 4. *Calcareous nannoplankton of Site 73. Distribution and biostratigraphy.*

through 73-11-CC). The reworking is especially pronounced in the lower part of Core 73-8 and top of Core 73-9 where a layer of brown siliceous ooze contains a fauna composed predominantly of Lower Miocene Radiolaria. Abundant fragments of lower Miocene Orosphaerid Radiolaria are also present; the tests are not well preserved. The almost pure Lower Miocene fauna of this highly siliceous layer is sandwiched in a calcareous Middle to Upper Miocene sequence and suggests that this siliceous ooze may represent either a slump deposit or a layer of very slow accumulation from which the carbonate and less resistant Middle-Upper Miocene Radiolaria have been removed by solution.

In the lower part of Core 73-9 (Sections 5 and 6) some Upper Miocene material (*Stichocorys peregrina* Zone) is present. In light of the two intervening biostratigraphic zones and in spite of the intensive reworking and apparent slumping present in these cores, rather than relying on more complicated explanations, it is suggested that this Upper Miocene material results from downworking during drilling.

Spot samples were taken in the Lower Miocene (Core 73-12, lower part of the *Calocycletta virginis* Zone) and Middle Oligocene (Core 73-13, *Theocyrtis annosa* Zone). Radiolaria in these two cores were sparse and not well preserved. Little or no reworked older material was found.

The lower part of the Oligocene to the bottom of the hole in Upper to Middle Eocene chert, was cored continuously. Cores 73-14 and 73-15 are from the uppermost part of the Lower Oligocene, an interval entirely missing at Site 72. The lower part of the Lower Oligocene is found in Cores 73-17 and 73-18. Most samples from these two cores also contain common to abundant diatoms. Radiolaria from the uppermost Eocene are found in Cores 73-19 and 73-20

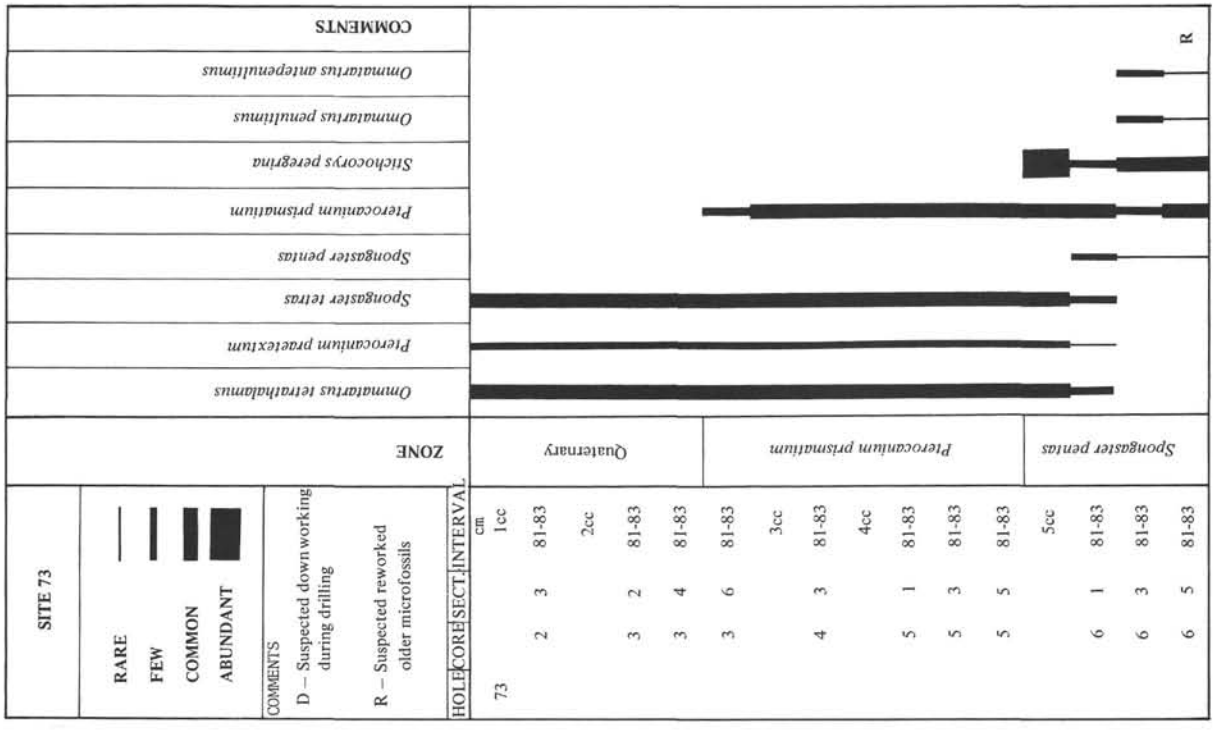



Figure 5. *Radiolaria at Site 73. Frequency, distribution and biostratigraphy.*

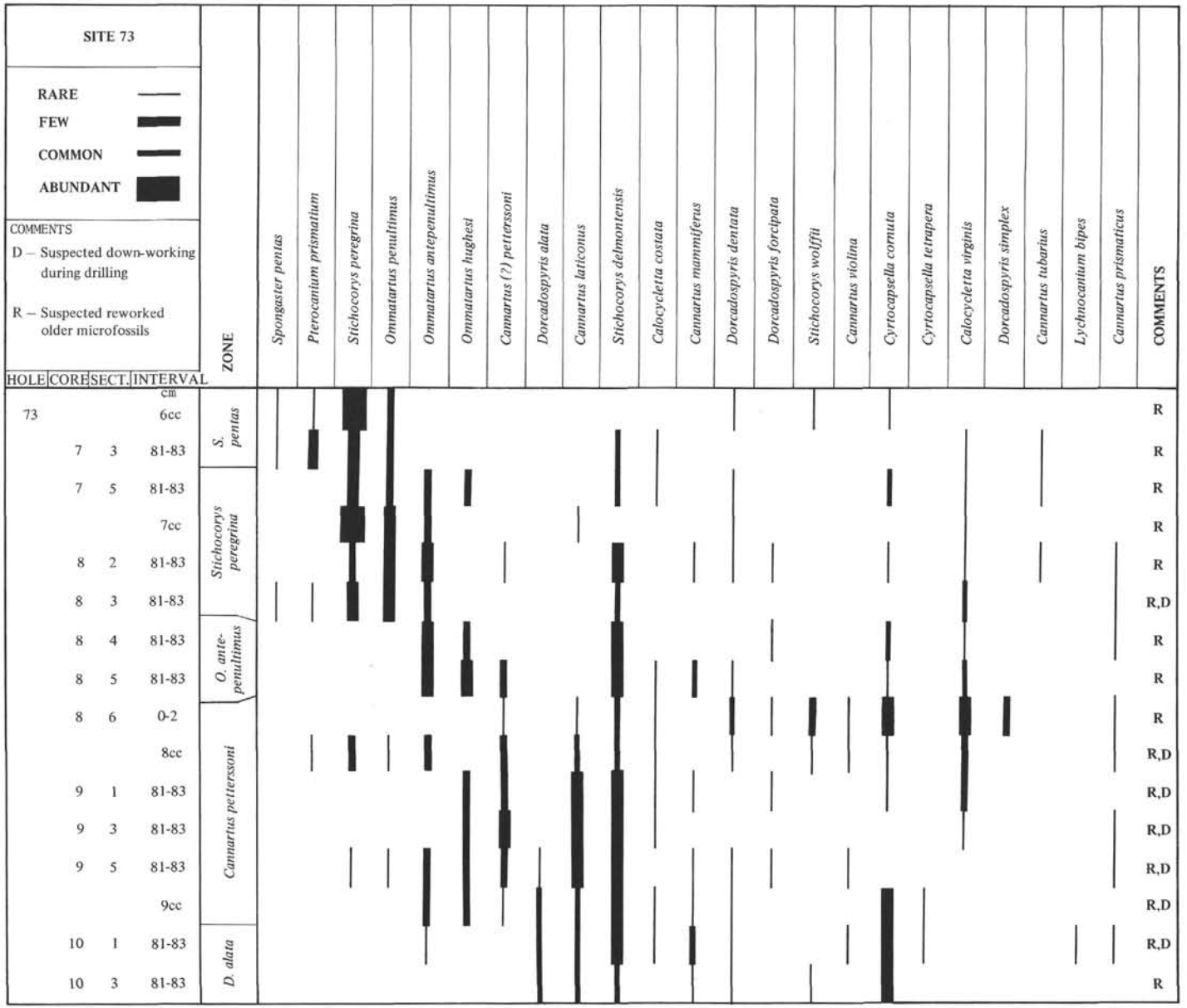



Figure 5. *Continued.*

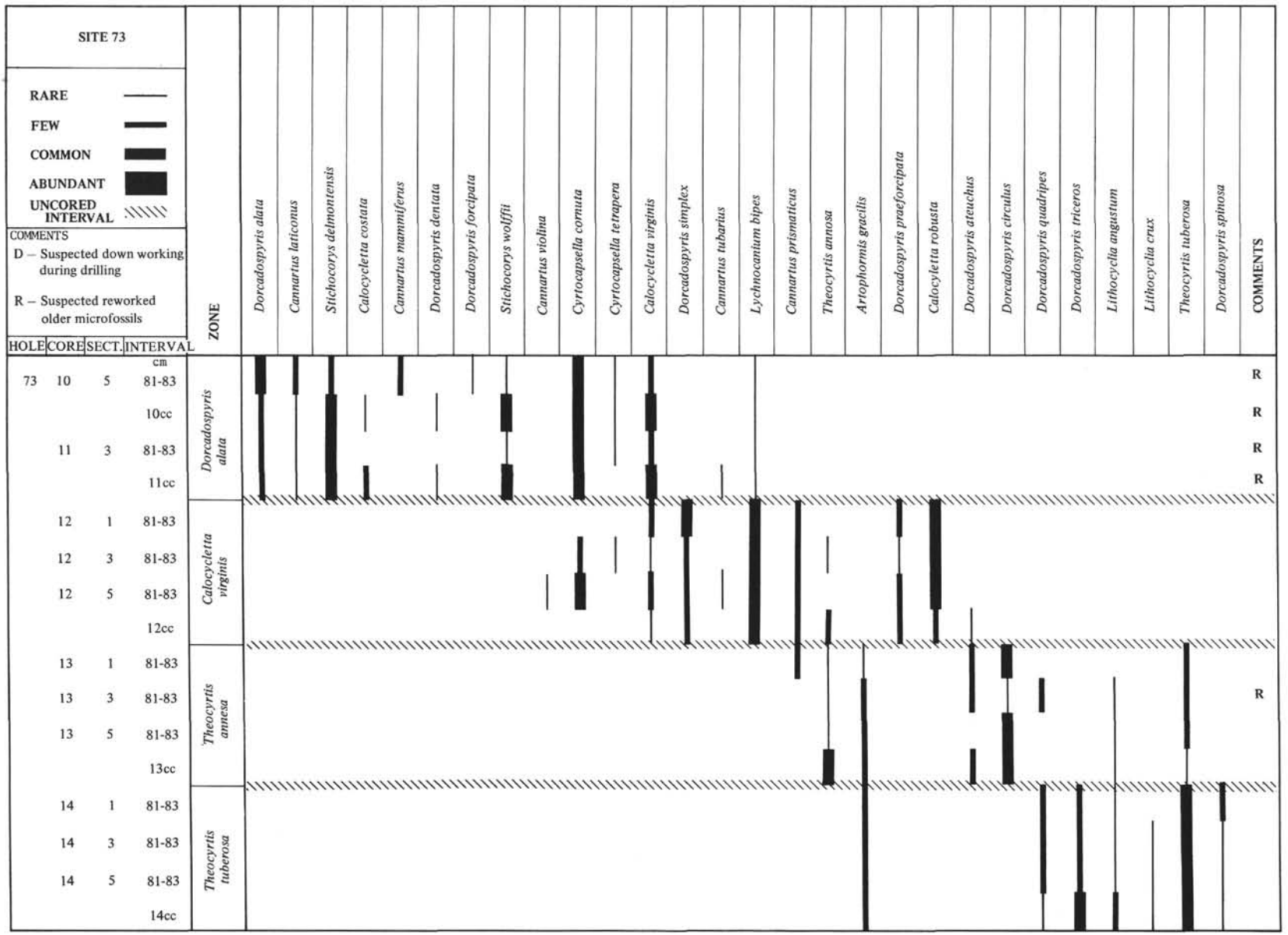



Figure 5. *Continued.*

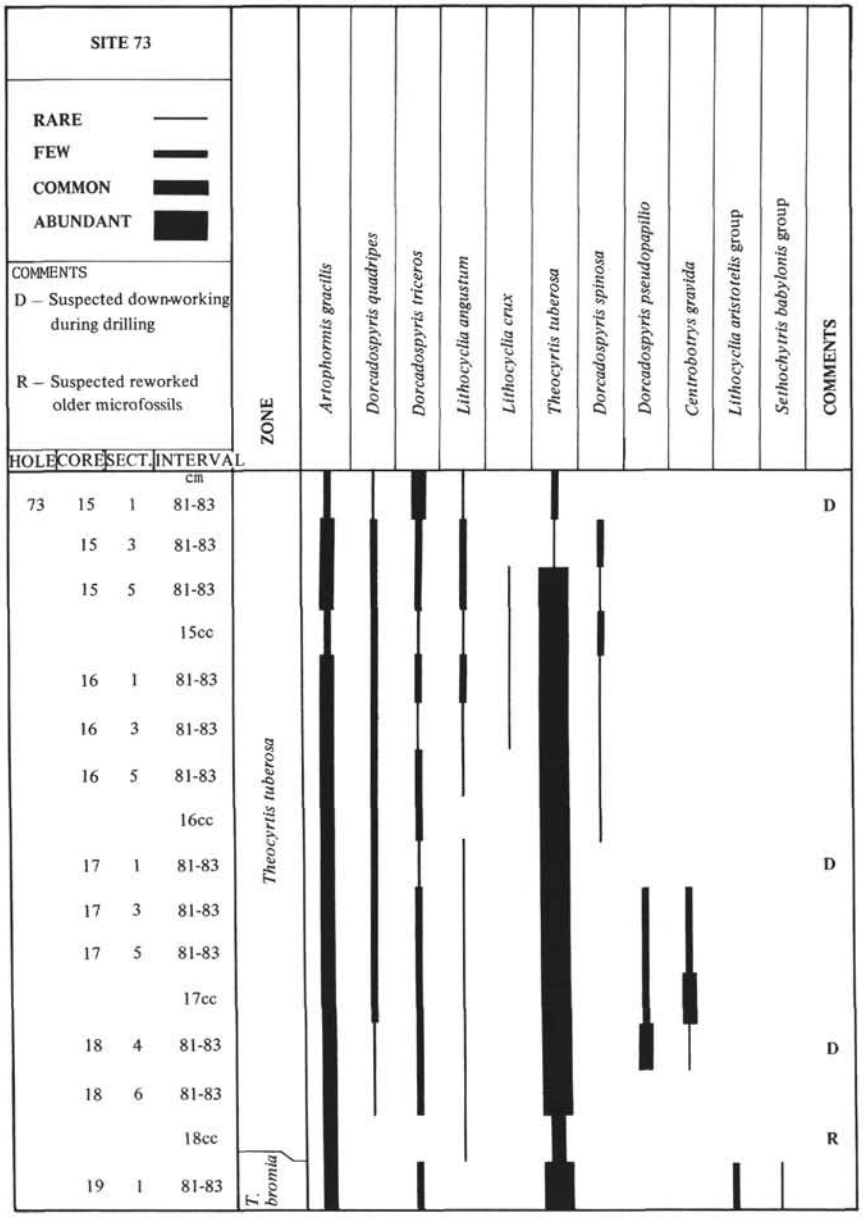



Figure 5. *Continued.*

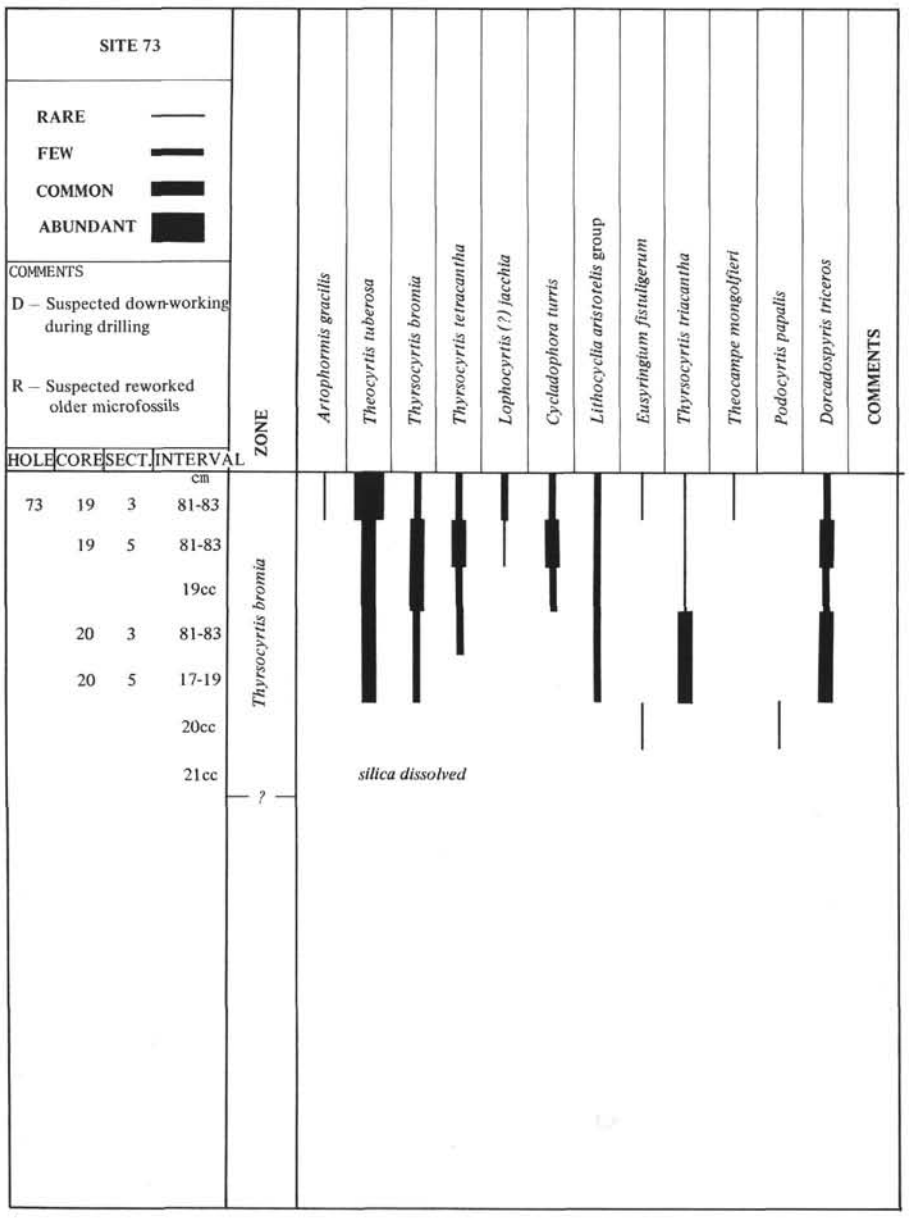



Figure 5. *Continued.*

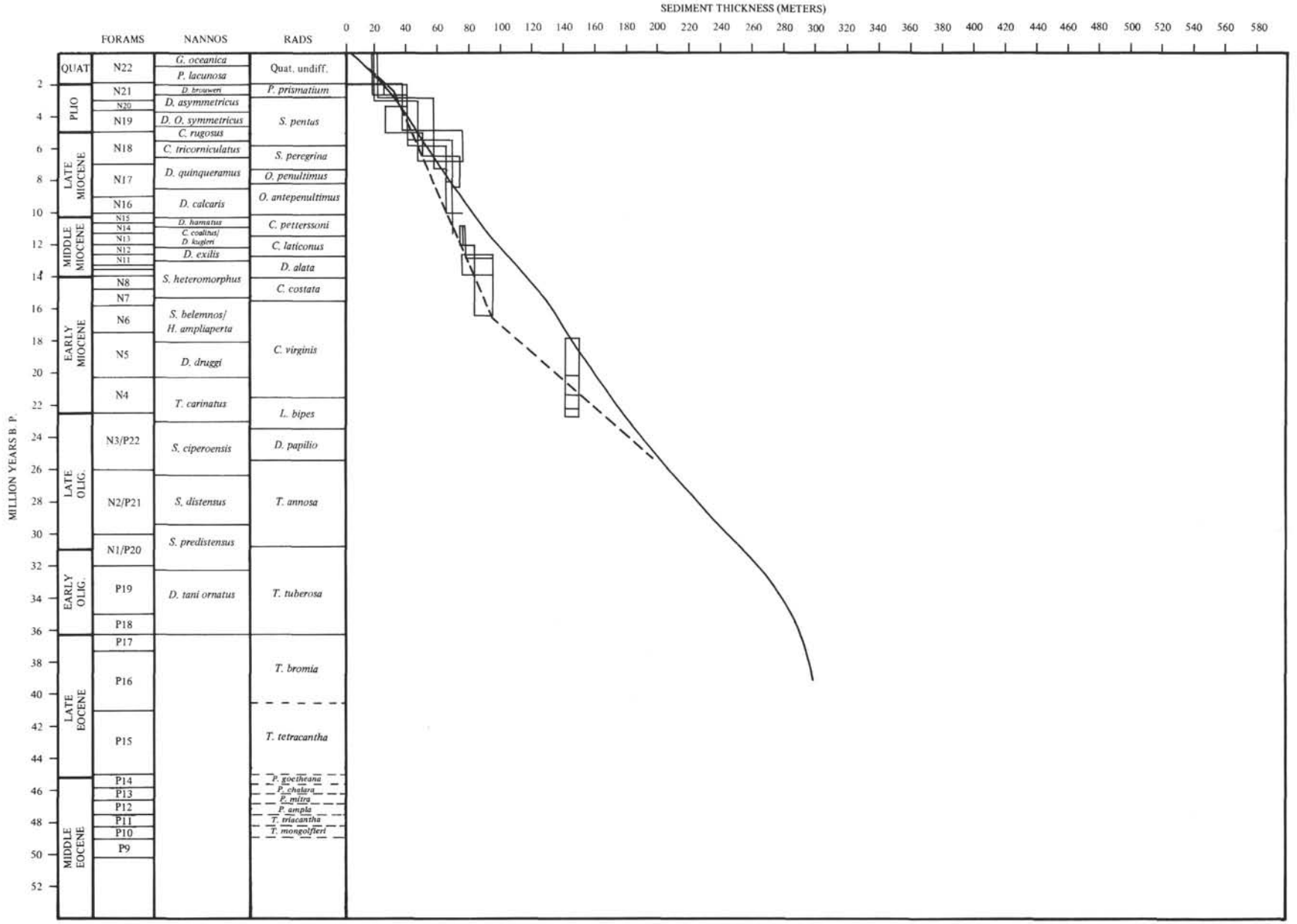



Figure 6. *Age versus depth at Site 73, based on the biostratigraphic zonations of the foraminifera, calcareous nannoplankton and Radiolaria. Ages based on the time scale of Berggren (1969).*

**TABLE 2**
**Calcareous Nannoplankton and Silicoflagellate Occurrences at Site 73**

| Species | Occurrences (Hole/Core Nos.) |
|---|---|
| Calcareous Nannoplankton | |
| *Ceratolithus cristatus* Kamptner | 73/1-8 |
| *C. rugosus* Bukry and Bramlette | 73/3-7 |
| *C. tricorniculatus* Gartner | 73/5-8 |
| *Chiasmolithus oamaruensis* (Deflandre) Hay, Mohler and Wade | 73/19-21 |
| *Coccolithus bisectus* (Hay, Mohler and Wade) as figured by Bramlette and Wilcoxon | 73/13, 15-21 |
| *Coronocyclus nitescens* (Kamptner) Bramlette and Wilcoxon | 73/10, 12 |
| *Cyclococcolithus formosus* Kamptner | 73/18-21 |
| *C. leptoporus* (Murray and Blackman) Kamptner | 73/1-12 |
| *C. neogammation* Bramlette and Wilcoxon | 73/10-19 |
| *Discoaster adamanteus* Bramlette and Wilcoxon | 73/9, 11, 13 |
| *D. asymmetricus* Gartner | 73/4, 5 |
| *D. barbadiensis* Tan Sin Hok | 73/19-21 |
| *D. brouweri* Tan Sin Hok | 73/3-9 |
| *D. calcaris* Gartner | 73/8-11 |
| *D. challengeri* Bramlette and Riedel | 73/6-8 |
| *D. deflandrei* Bramlette and Riedel | 73/6-8, 10-14, 17, 18 |
| *D. dilatus* Hay | 73/9 |
| *D. exilis* Martini and Bramlette | 73/6-11 |
| *D. extensus* Hay | 73/5-8 |
| *D. incomptus* Hay | 73/19-21 |
| *D. kugleri* Martini and Bramlette | 73/8, 9 |
| *D. lodoensis* Bramlette and Riedel | 73/19, 21 |
| *D. pentaradiatus* Tan Sin Hok | 73/4, 5 |
| *D. quinqueramus* Gartner | 73/7-9 |
| *D. saipanensis* Bramlette and Riedel | 73/19-21 |
| *D. sublodoensis* Bramlette and Sullivan | 73/19-21 |
| *D. surculus* Martini and Bramlette | 73/5-9, 10? |
| *D. tani nodifer* Bramlette and Riedel | 73/14, 19-21 |
| *D. tani ornatus* Bramlette and Wilcoxon | 73/14, 15 |
| *D. tani tani* Bramlette and Riedel | 73/14, 17-19 |
| *D. variabilis* Martini and Bramlette | 73/6-10 |
| *Gephyrocapsa oceanica* Kamptner | 73/1-4 |
| *Helicopontosphaera compacta* (Bramlette and Wilcoxon) | 73/15-17, 21 |
| *H. intermedia* (Martini) Hay and Mohler | 73/10 |
| *H. kamptneri* Hay and Mohler | 73/1, 3-5 |
| *H. recta* (Haq) Martini | 73/15 |

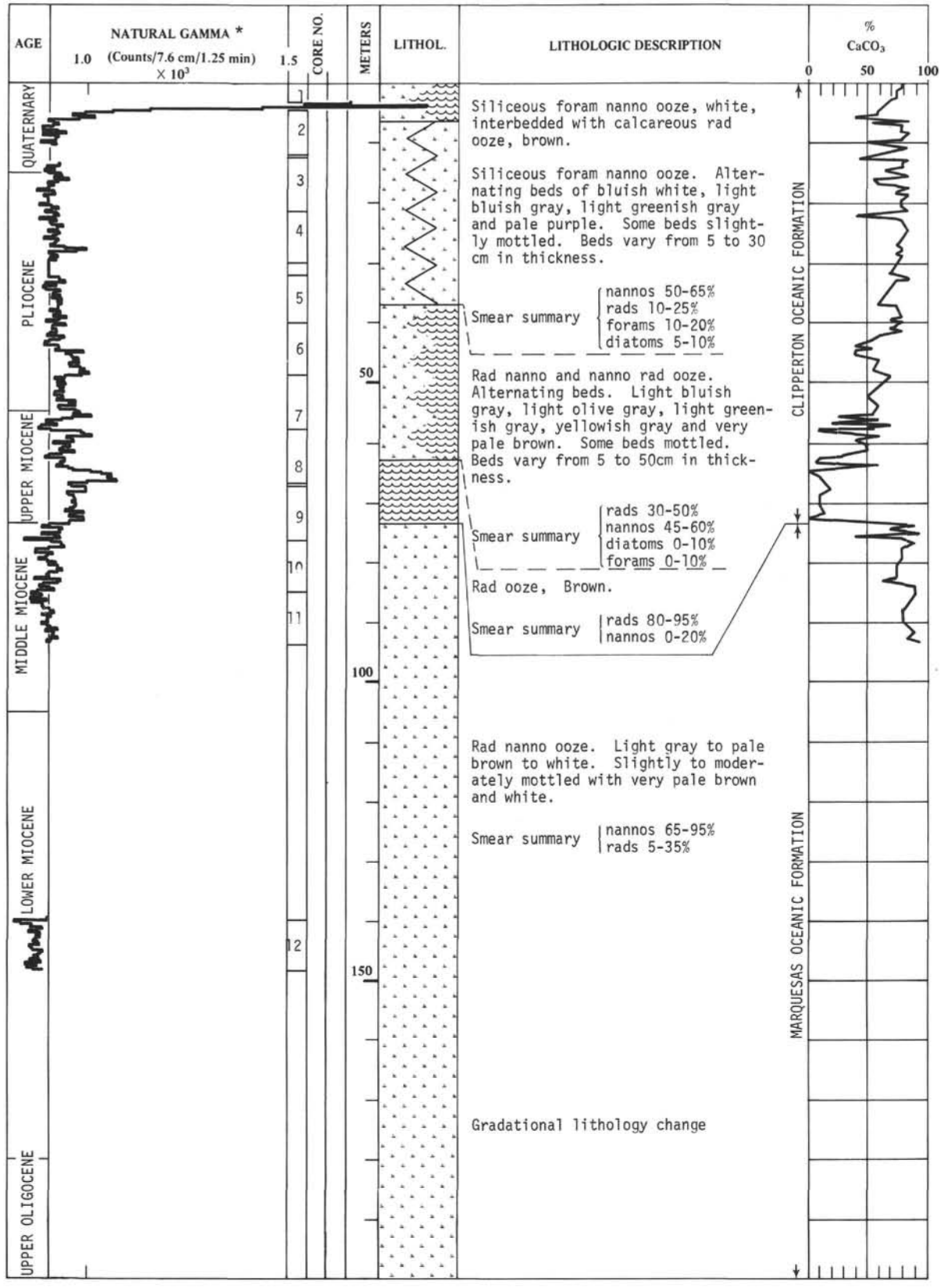
TABLE 2 – *Continued*

| Species | Occurrences (Hole/Core Nos.) |
|---|---|
| *Reticulofenestra pseudoumbilica* | 73/6, 7, 9 |
| *R. umbilica* (Levin) Martini and Ritzkowski | 73/17-21 |
| *Sphenolithus belemnos* Bramlette and Wilcoxon | 73/12 |
| *S. distentus* Bramlette and Wilcoxon | 73/13-15 |
| *S. heteromorphus* Deflandre | 73/10, 11 |
| *S. moriformis* (Bronnimann and Stradner) Bramlette and Wilcoxon | 73/10-21 |
| *S. predistentus* Bramlette and Wilcoxon | 73/15-17 |
| *S. pseudoradians* Bramlette and Wilcoxon | 73/13, 14 |
| *S. radians* Deflandre | 73/19, 20 |
| *Thoracosphaera* cf. *T. deflandrei* Kamptner | 73/21 |
| *Triquetrorhabdulus carinatus* Martini | 73/12 |
| *T. rugosus* Bramlette and Wilcoxon | 73/5, 7-9 |
| Silicoflagellates | |
| *Corbisema tricantha* (Ehrenberg) Haeckel | 73/18 |
| *Dictyocha fibula* Ehrenberg | 73/2-4, 18 |

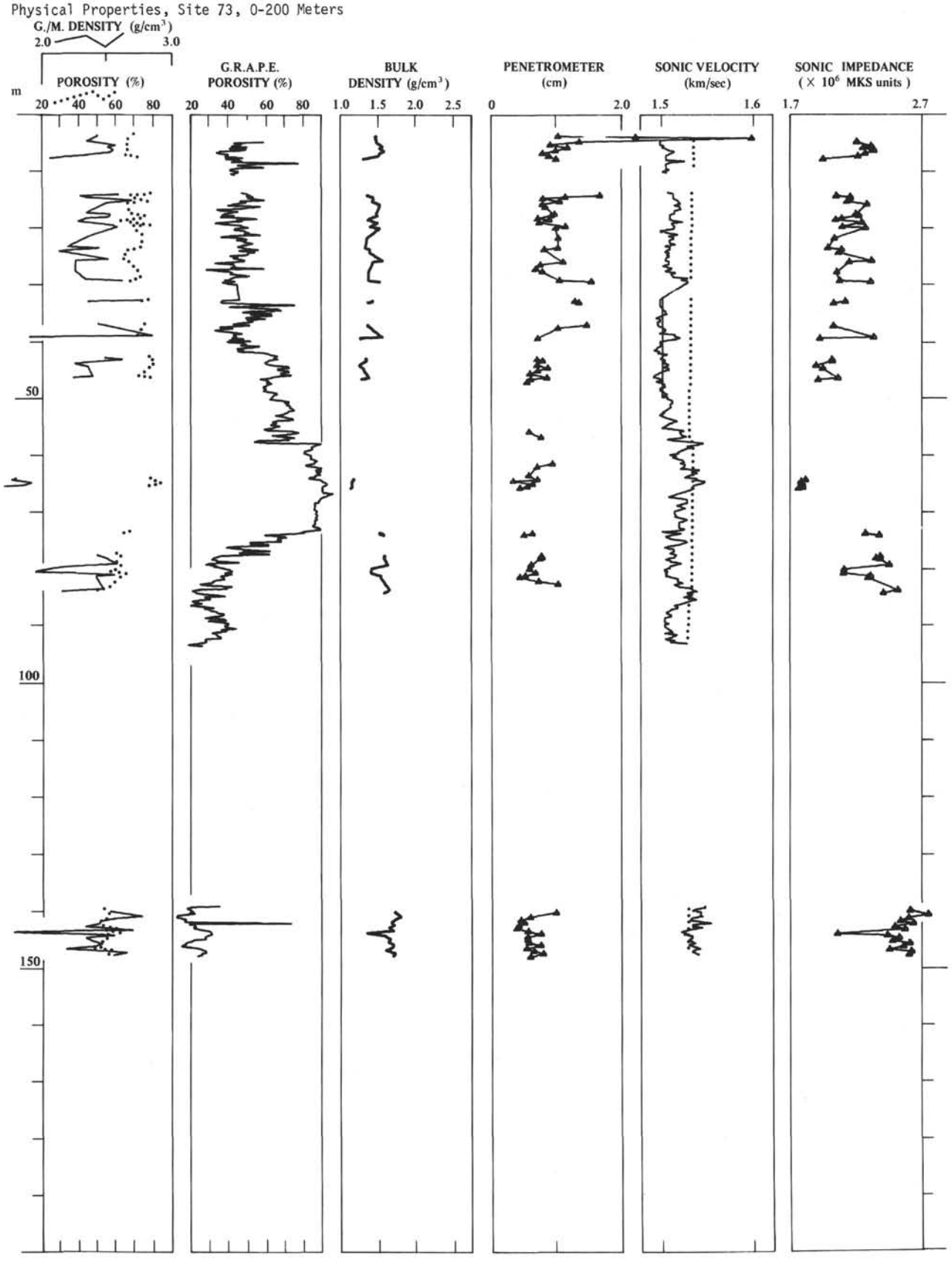
(to 73-20-5). Sediments from Section 73-20-5 (lower part) and 73-21 contain few Radiolaria; no age is given for this interval. Except in the lowermost Oligocene and Upper Eocene, Radiolaria are poorly preserved in the bottom part of the section.

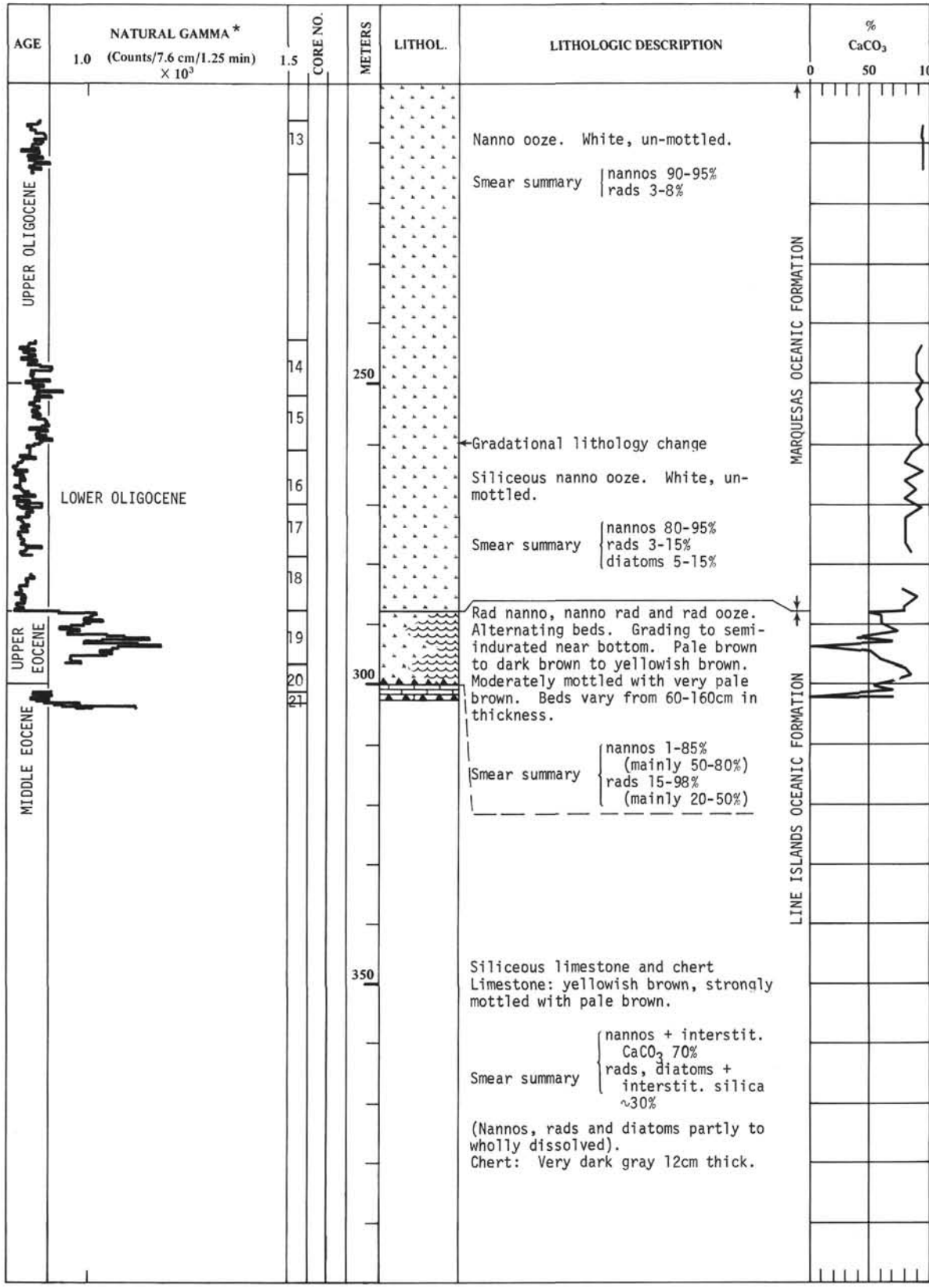
## REFERENCE

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

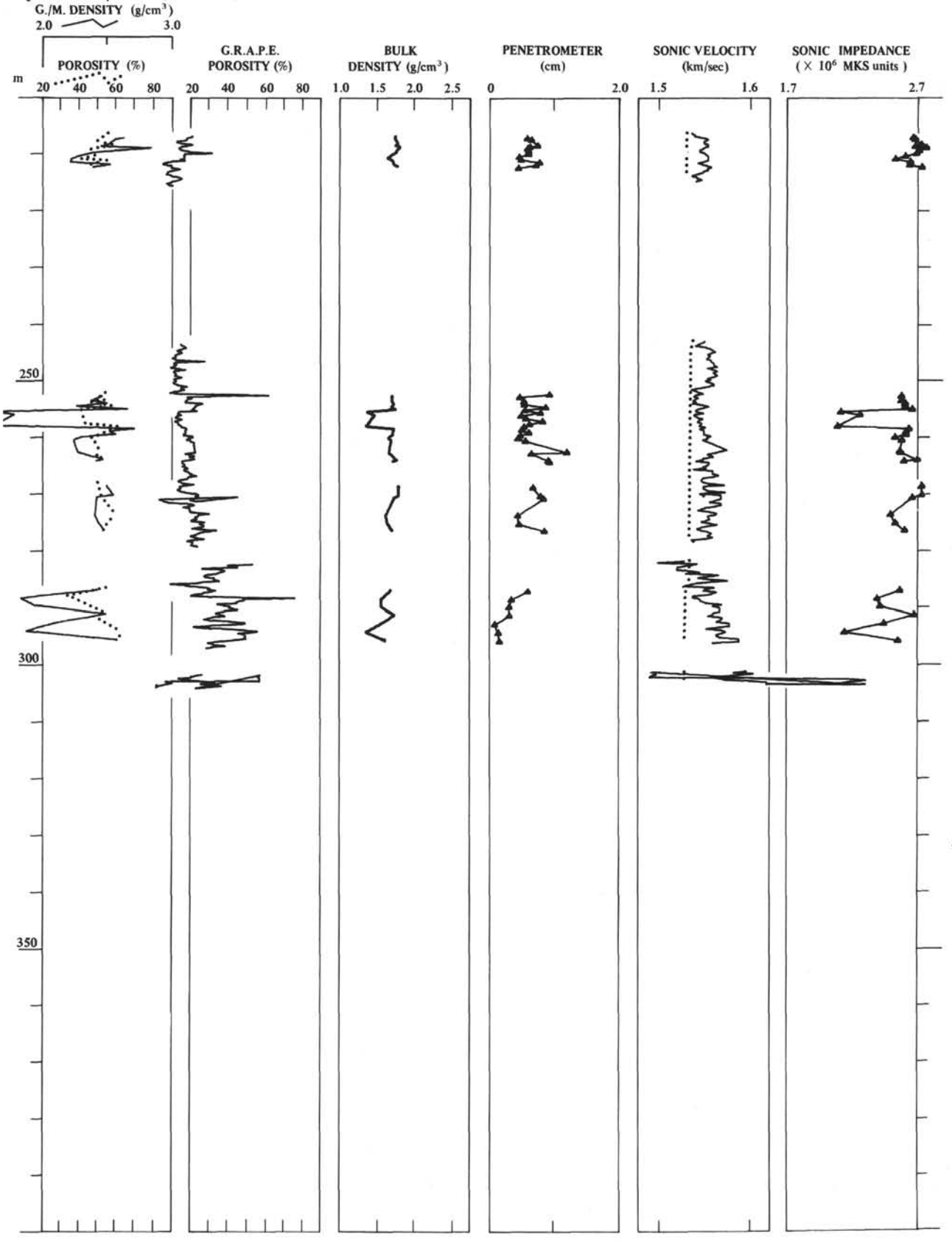

AGE
NATURAL GAMMA *
1.0 (Counts/7.6 cm/1.25 min) 1.5
× 10³
CORE NO.
METERS
LITHOL.
LITHOLOGIC DESCRIPTION
% CaCO₃
0 50 100
QUATERNARY
PLIOCENE
UPPER MIOCENE
MIDDLE MIOCENE
LOWER MIOCENE
UPPER OLIGOCENE
1
2
3
4
5
6
7
8
9
10
11
12
50
100
150
Siliceous foram nanno ooze, white, interbedded with calcareous rad ooze, brown.
Siliceous foram nanno ooze. Alternating beds of bluish white, light bluish gray, light greenish gray and pale purple. Some beds slightly mottled. Beds vary from 5 to 30 cm in thickness.
Smear summary
nannos 50-65%
rads 10-25%
forams 10-20%
diatoms 5-10%
Rad nanno and nanno rad ooze. Alternating beds. Light bluish gray, light olive gray, light greenish gray, yellowish gray and very pale brown. Some beds mottled. Beds vary from 5 to 50cm in thickness.
Smear summary
rads 30-50%
nannos 45-60%
diatoms 0-10%
forams 0-10%
Rad ooze, Brown.
Smear summary
rads 80-95%
nannos 0-20%
Rad nanno ooze. Light gray to pale brown to white. Slightly to moderately mottled with very pale brown and white.
Smear summary
nannos 65-95%
rads 5-35%
Gradational lithology change
CLIPPERTON OCEANIC FORMATION
MARQUESAS OCEANIC FORMATION

Physical Properties, Site 73, 0-200 Meters

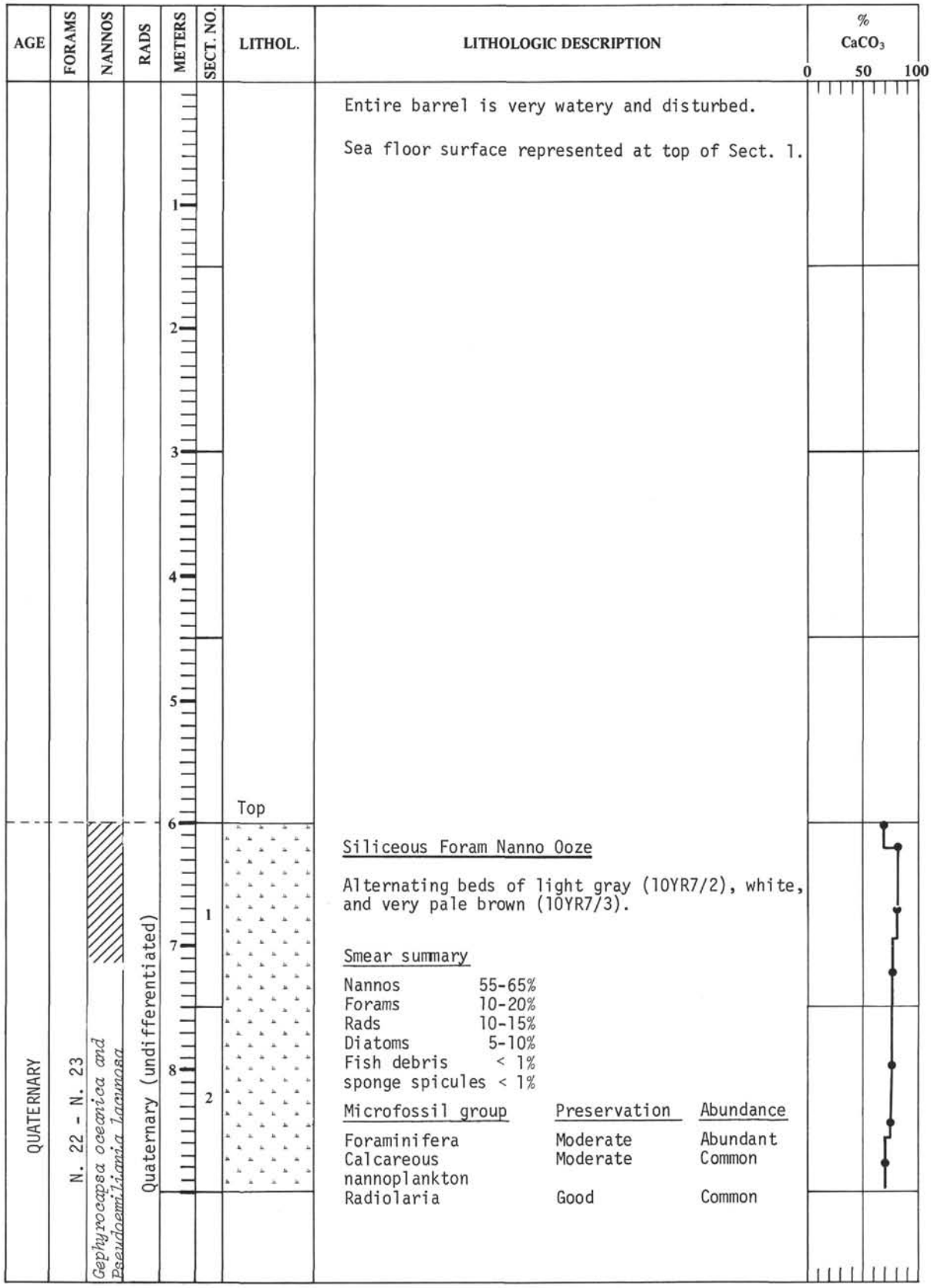



AGE
NATURAL GAMMA *
1.0 (Counts/7.6 cm/1.25 min) 1.5
X 10³
CORE NO.
METERS
LITHOL.
LITHOLOGIC DESCRIPTION
% CaCO₃
0 50 100
UPPER OLIGOCENE
LOWER OLIGOCENE
UPPER EOCENE
MIDDLE EOCENE
13
14
15
16
17
18
19
20
21
250
300
350
Nanno ooze. White, un-mottled.
Smear summary
nannos 90-95%
rads 3-8%
Gradational lithology change
Siliceous nanno ooze. White, un-mottled.
Smear summary
nannos 80-95%
rads 3-15%
diatoms 5-15%
Rad nanno, nanno rad and rad ooze. Alternating beds. Grading to semi-indurated near bottom. Pale brown to dark brown to yellowish brown. Moderately mottled with very pale brown. Beds vary from 60-160cm in thickness.
Smear summary
nannos 1-85% (mainly 50-80%)
rads 15-98% (mainly 20-50%)
Siliceous limestone and chert
Limestone: yellowish brown, strongly mottled with pale brown.
Smear summary
nannos + interstit. CaCO3 70%
rads, diatoms + interstit. silica ~30%
(Nannos, rads and diatoms partly to wholly dissolved).
Chert: Very dark gray 12cm thick.
MARQUESAS OCEANIC FORMATION
LINE ISLANDS OCEANIC FORMATION

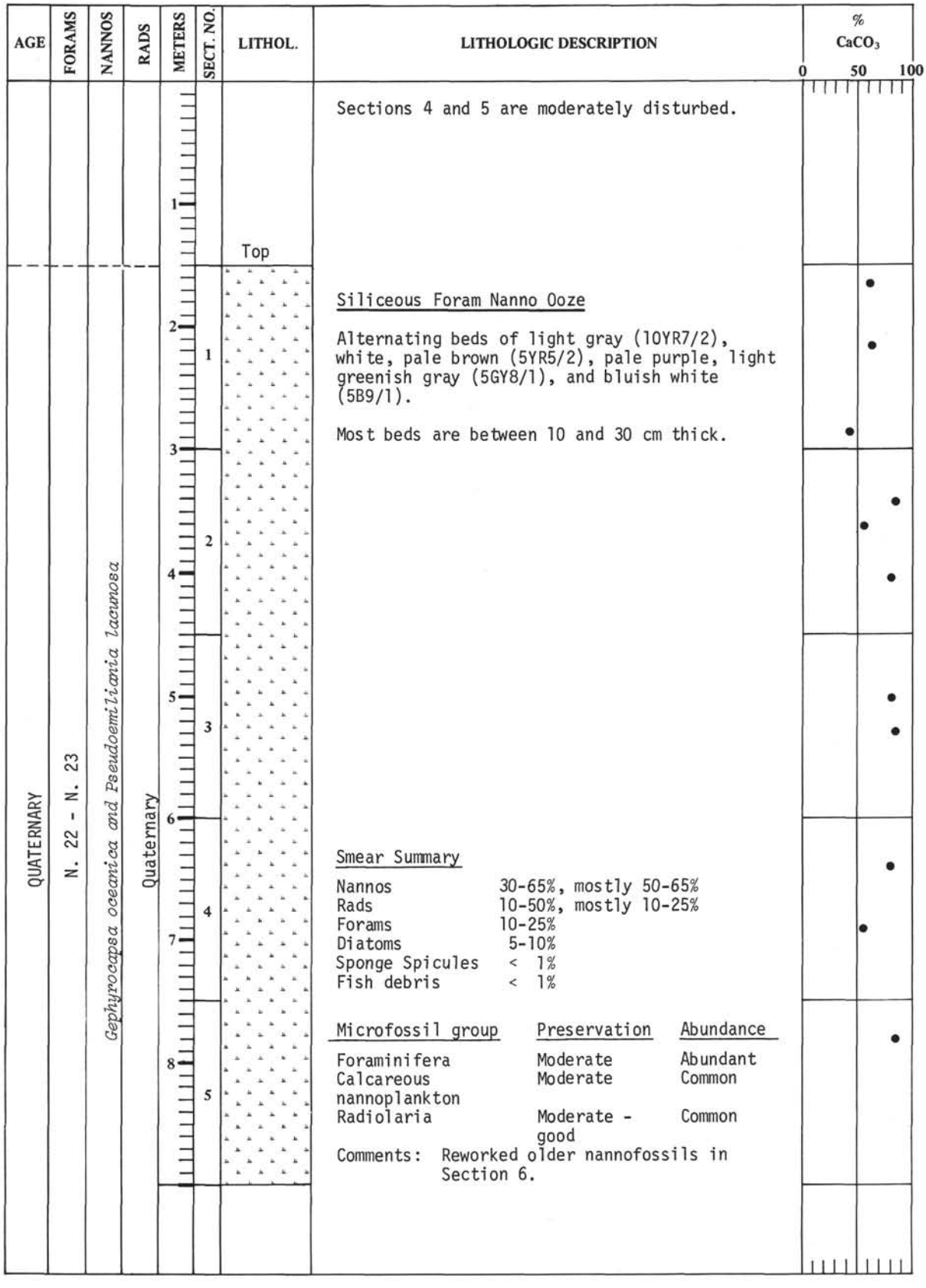
Physical Properties, Site 73, 200-400 Meters



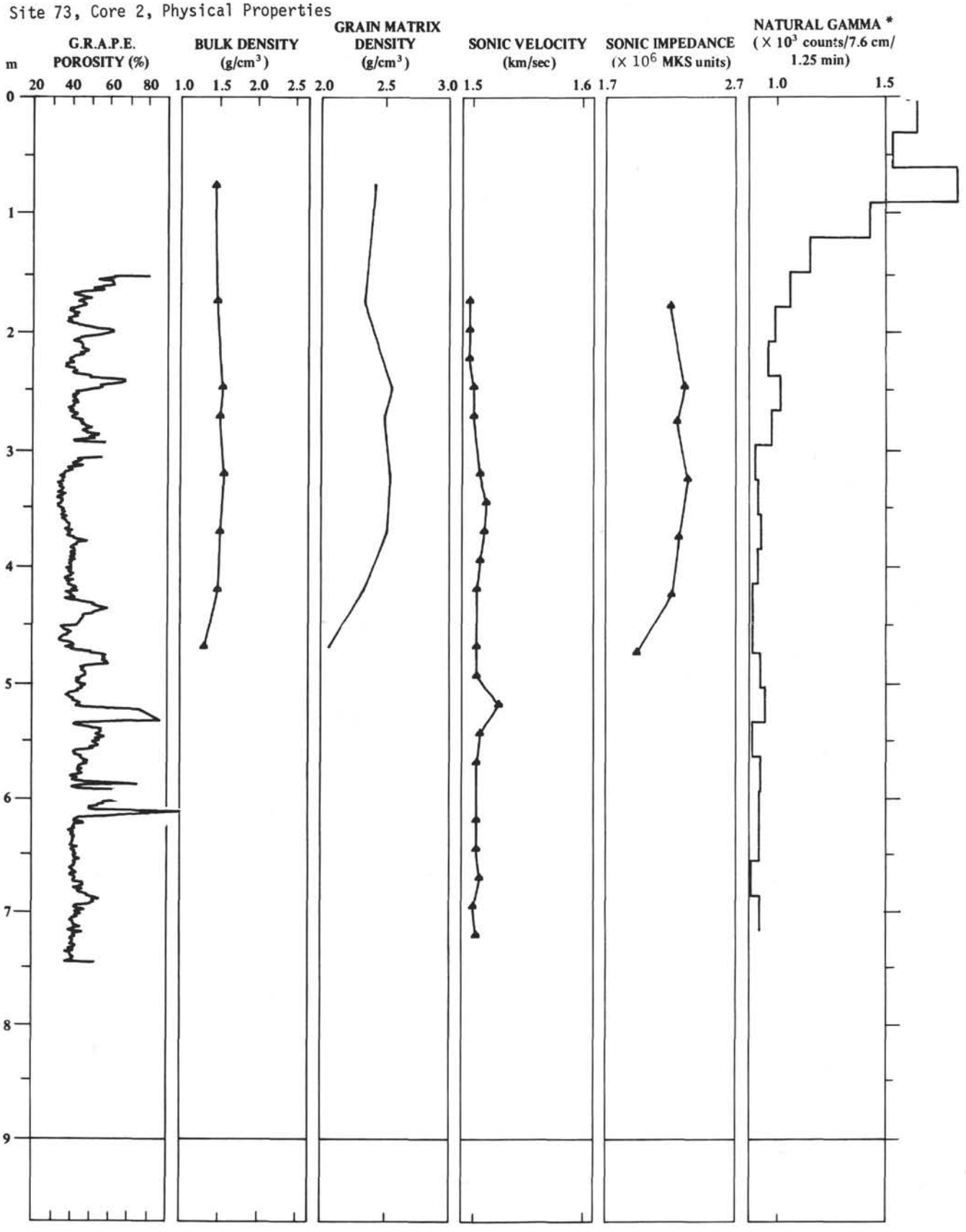
SITE 73 Core 1 Cored interval: 0-3 m



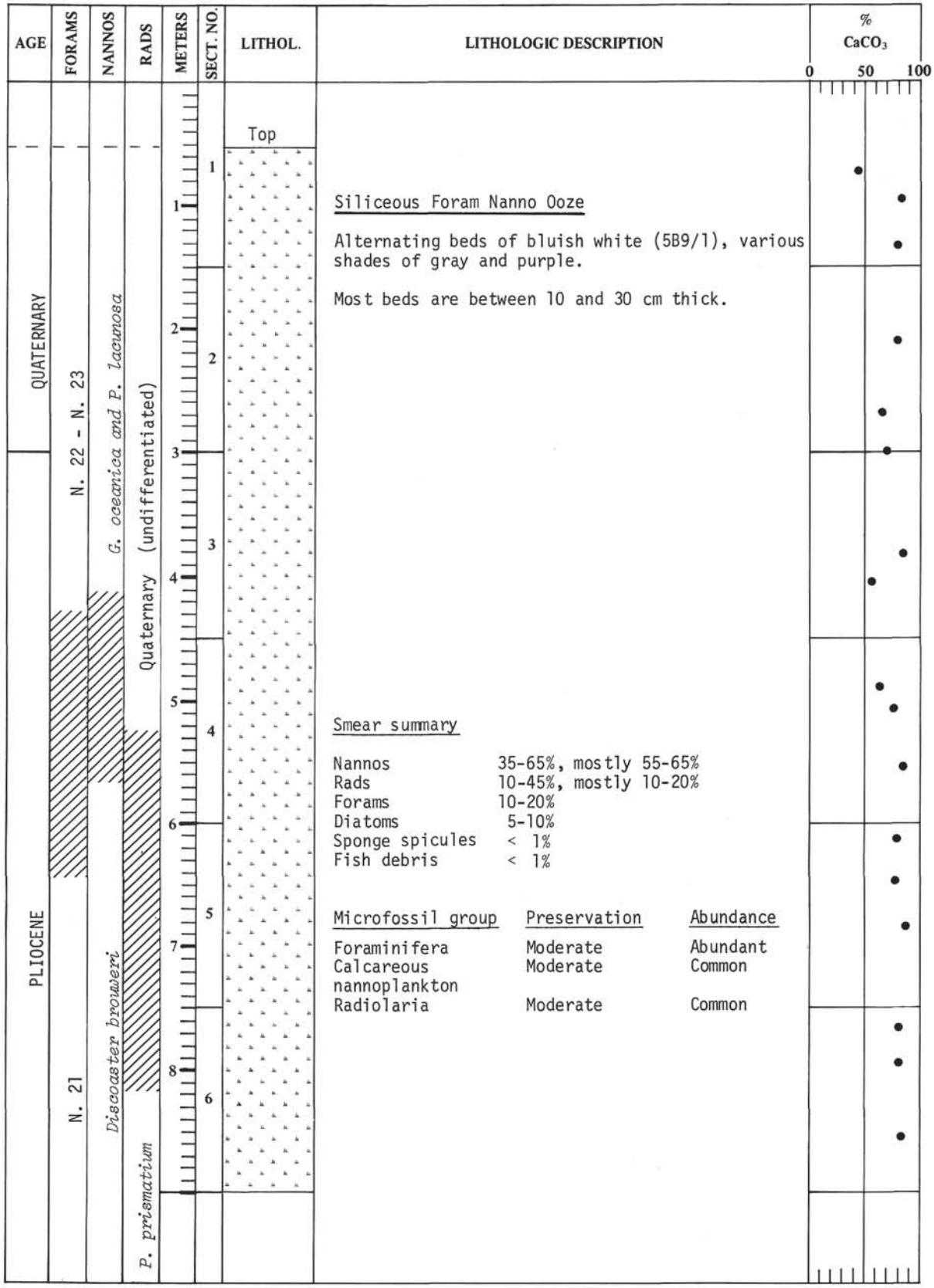
SITE 73 Core 2 Cored interval: 3-12 m



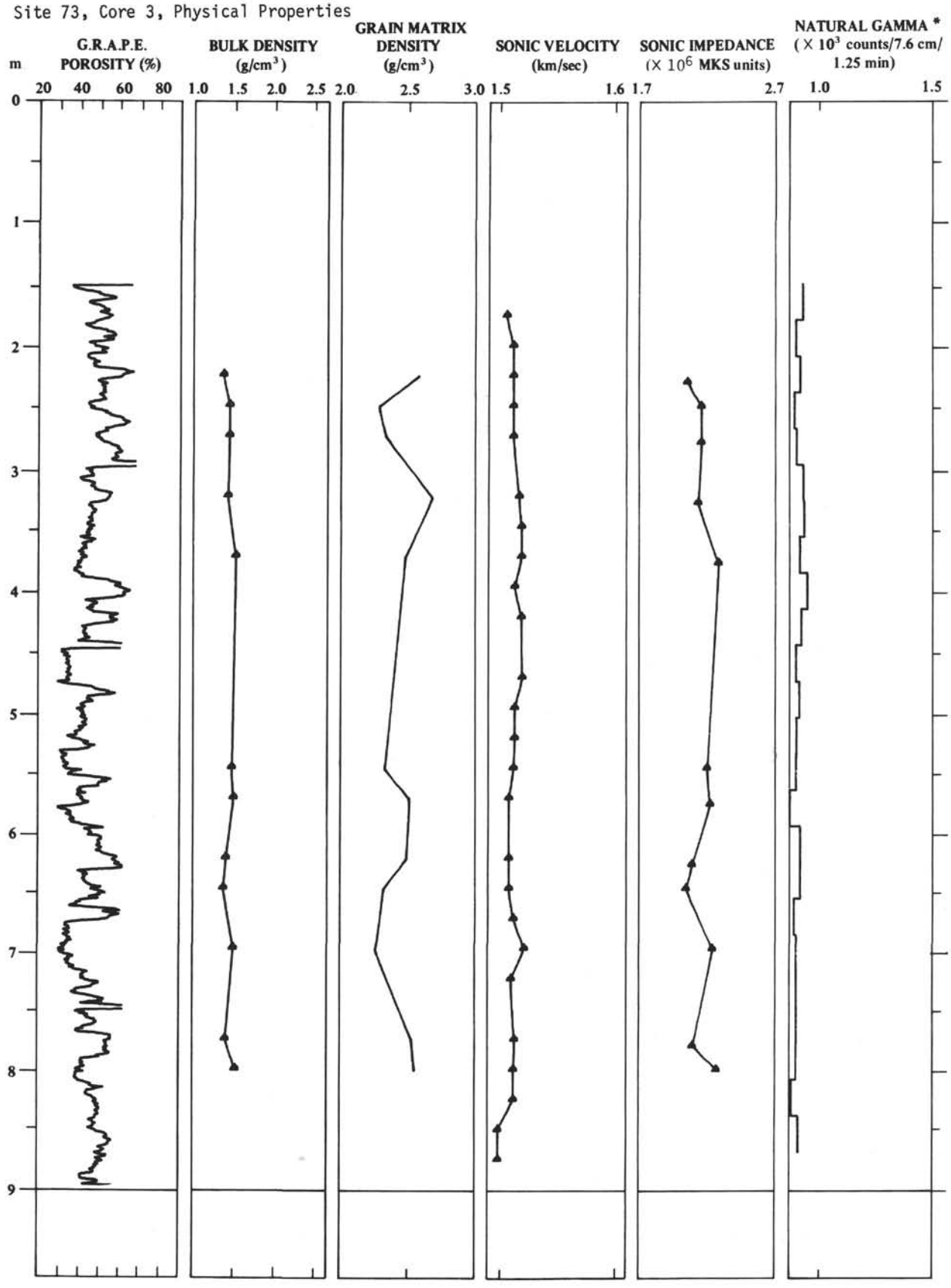
Site 73, Core 2, Physical Properties



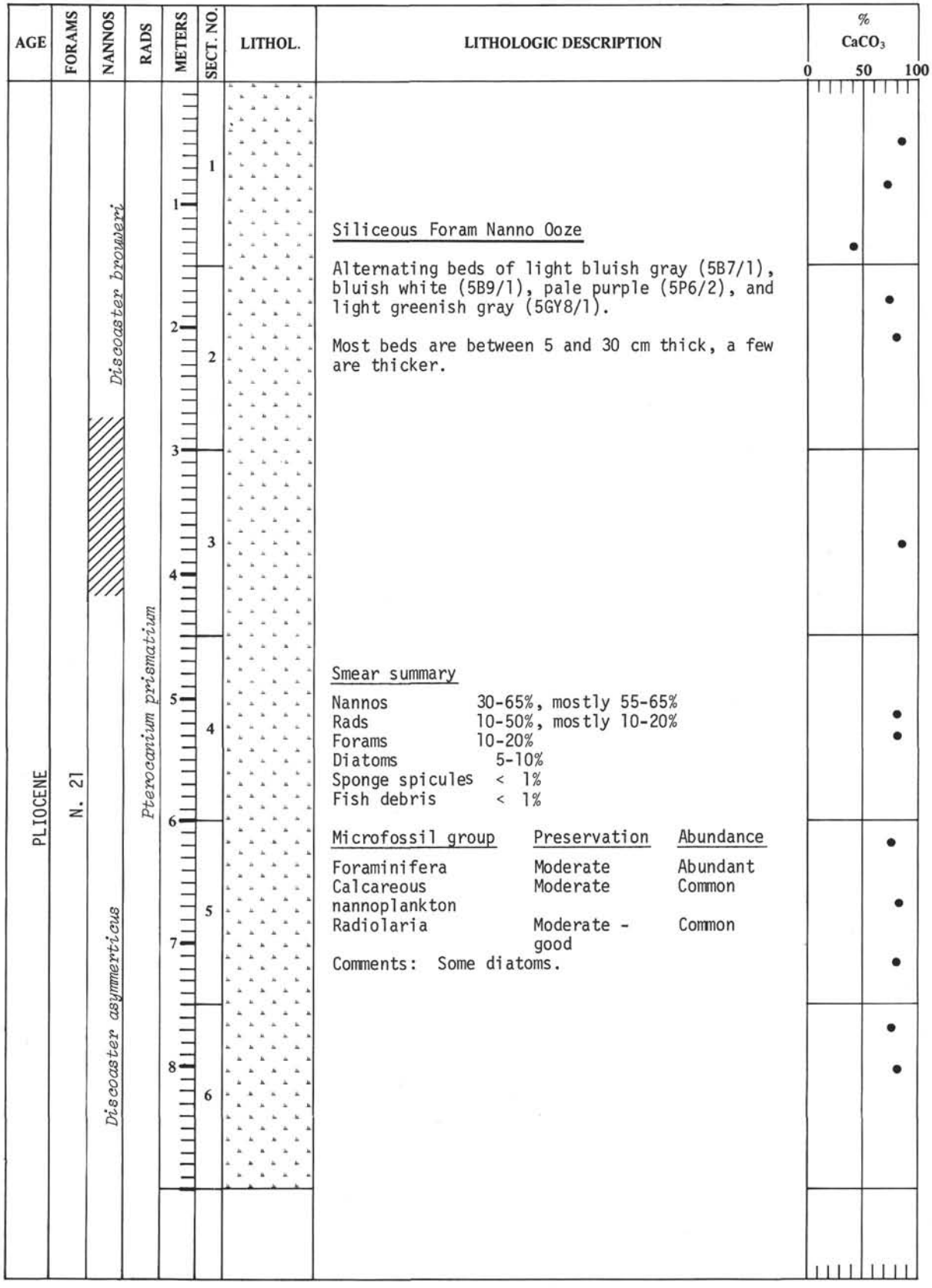
SITE 73 Core 3 Cored interval: 12-21 m



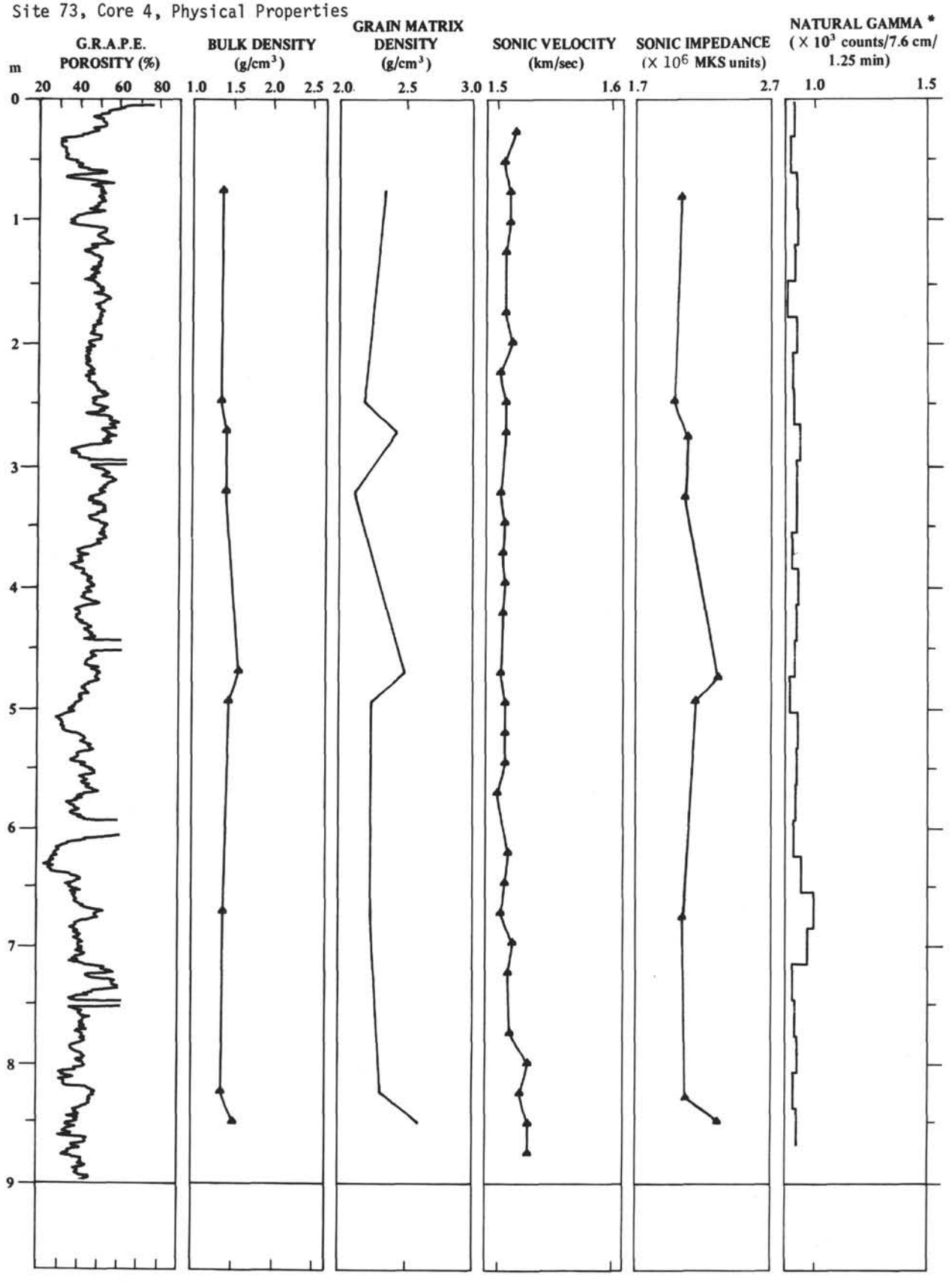
Site 73, Core 3, Physical Properties



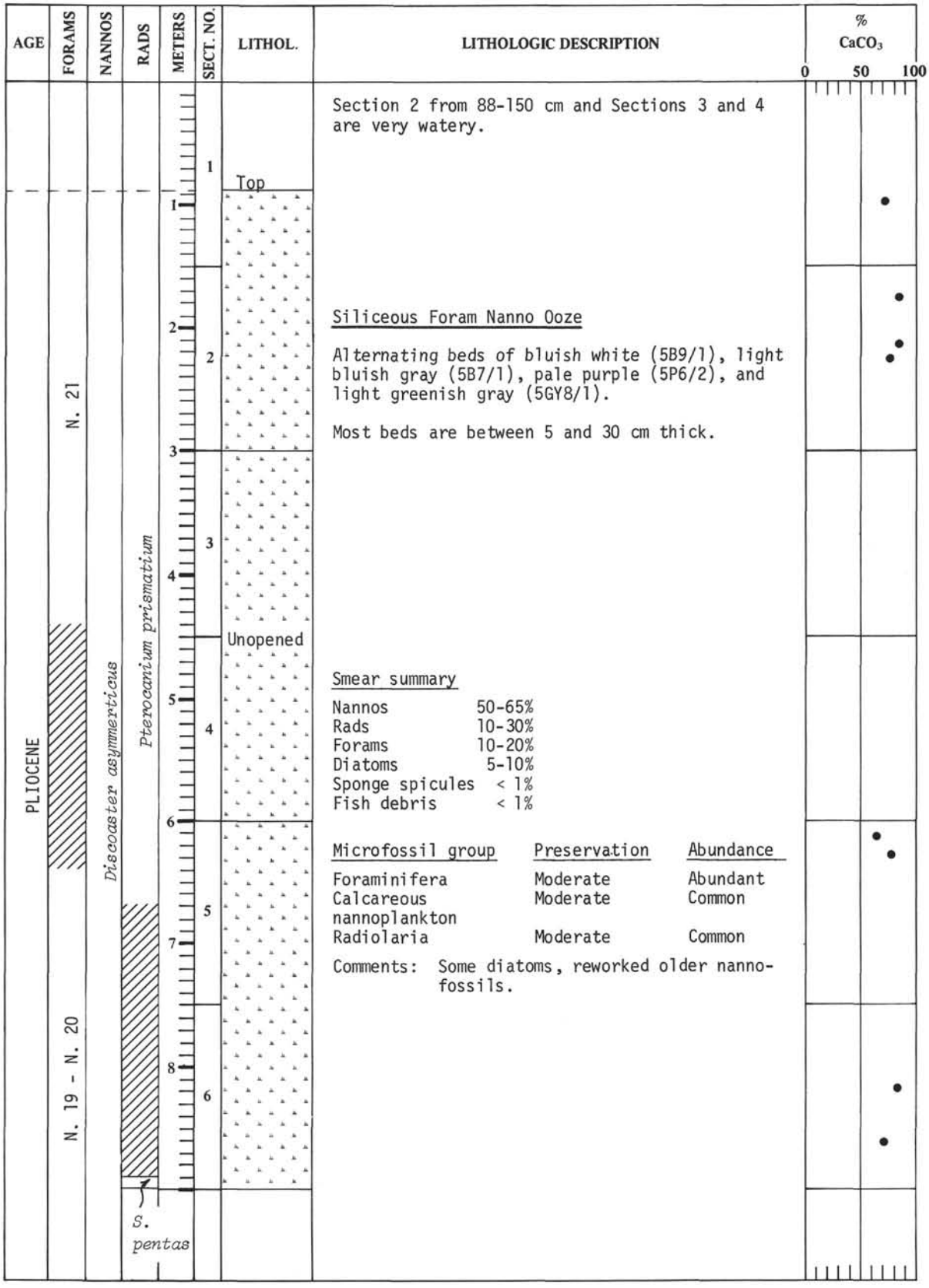
SITE 73 Core 4 Cored interval: 21-30 m



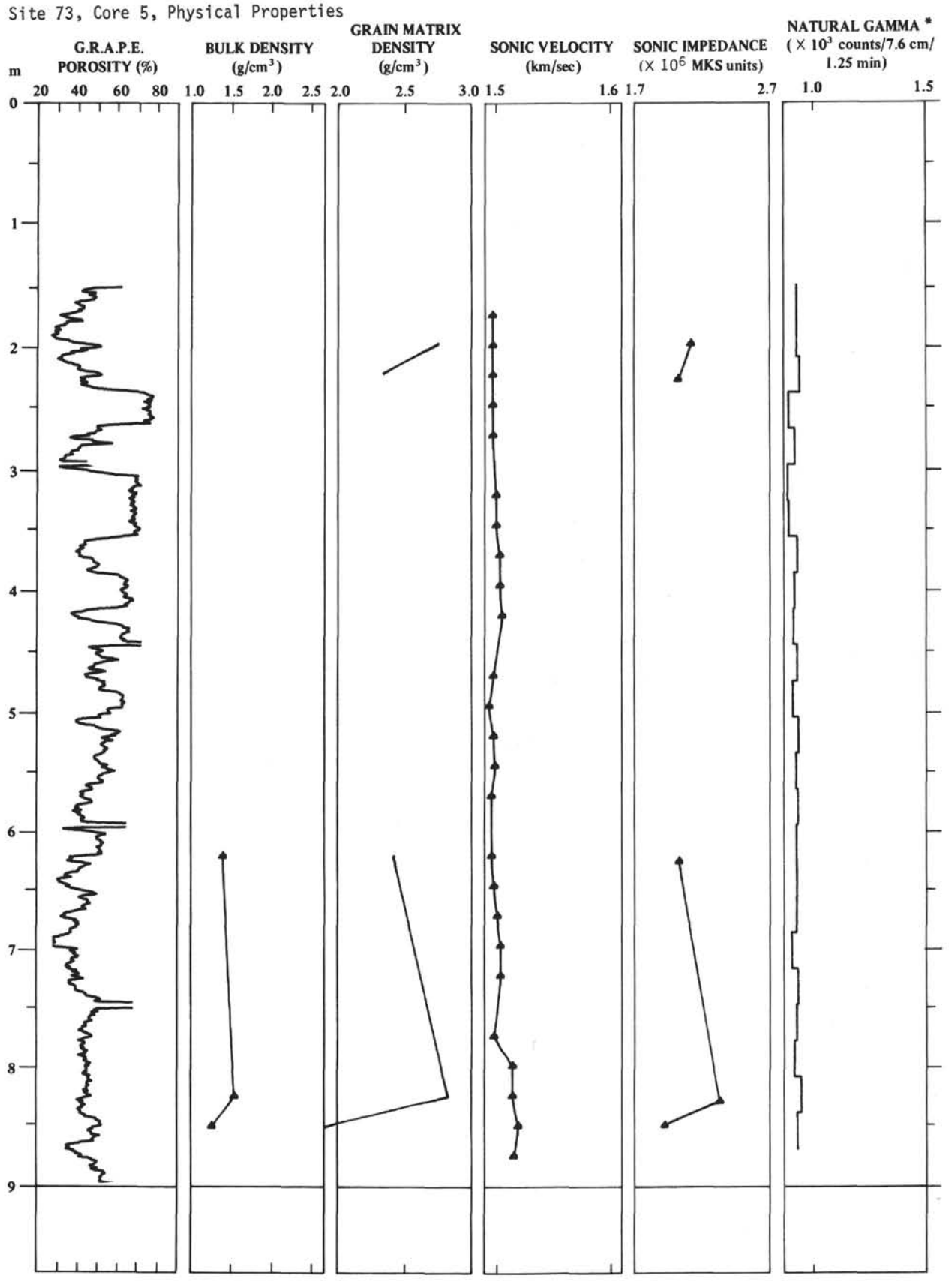
Site 73, Core 4, Physical Properties



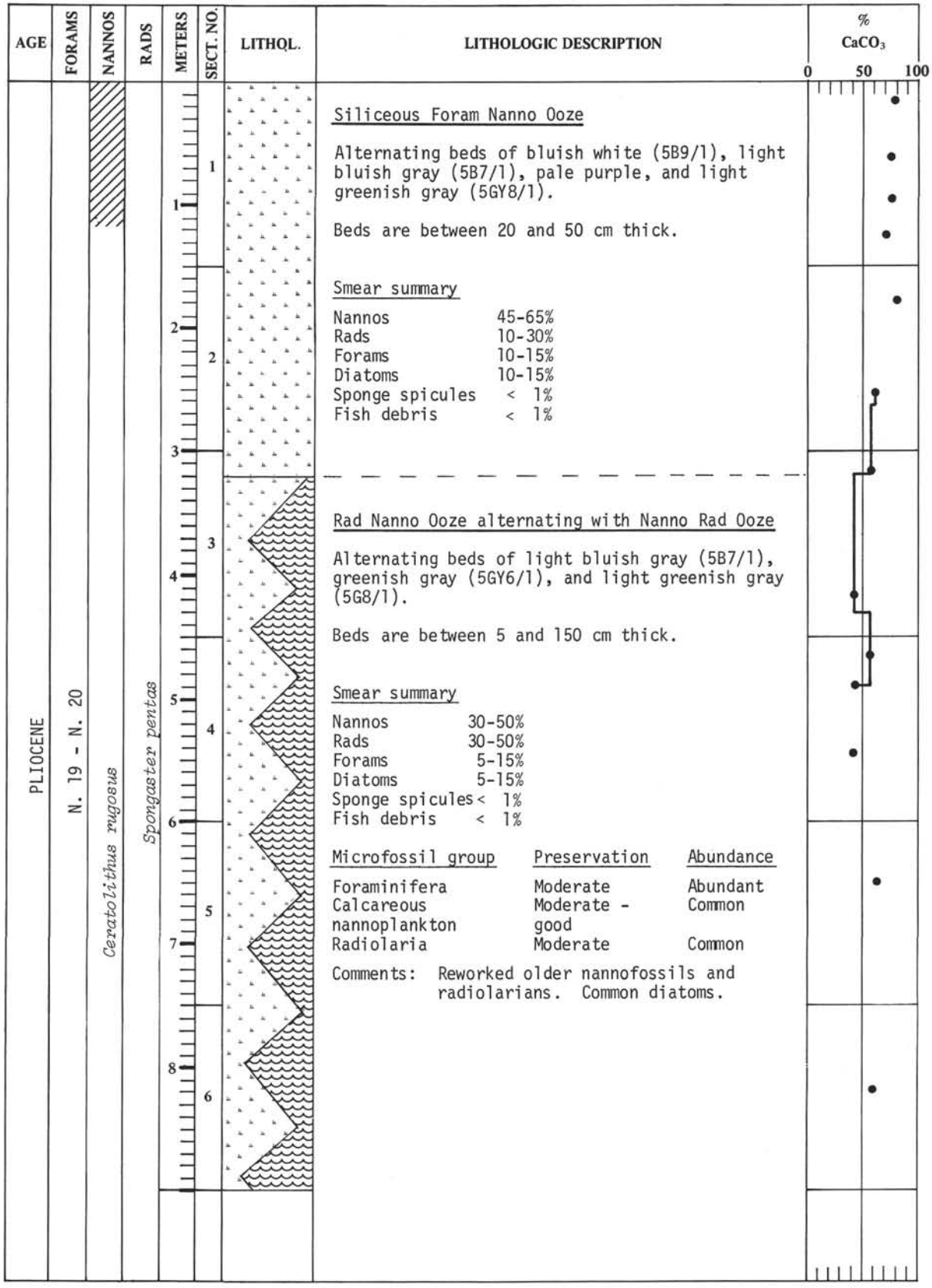
SITE 73 Core 5 Cored interval: 31-40 m



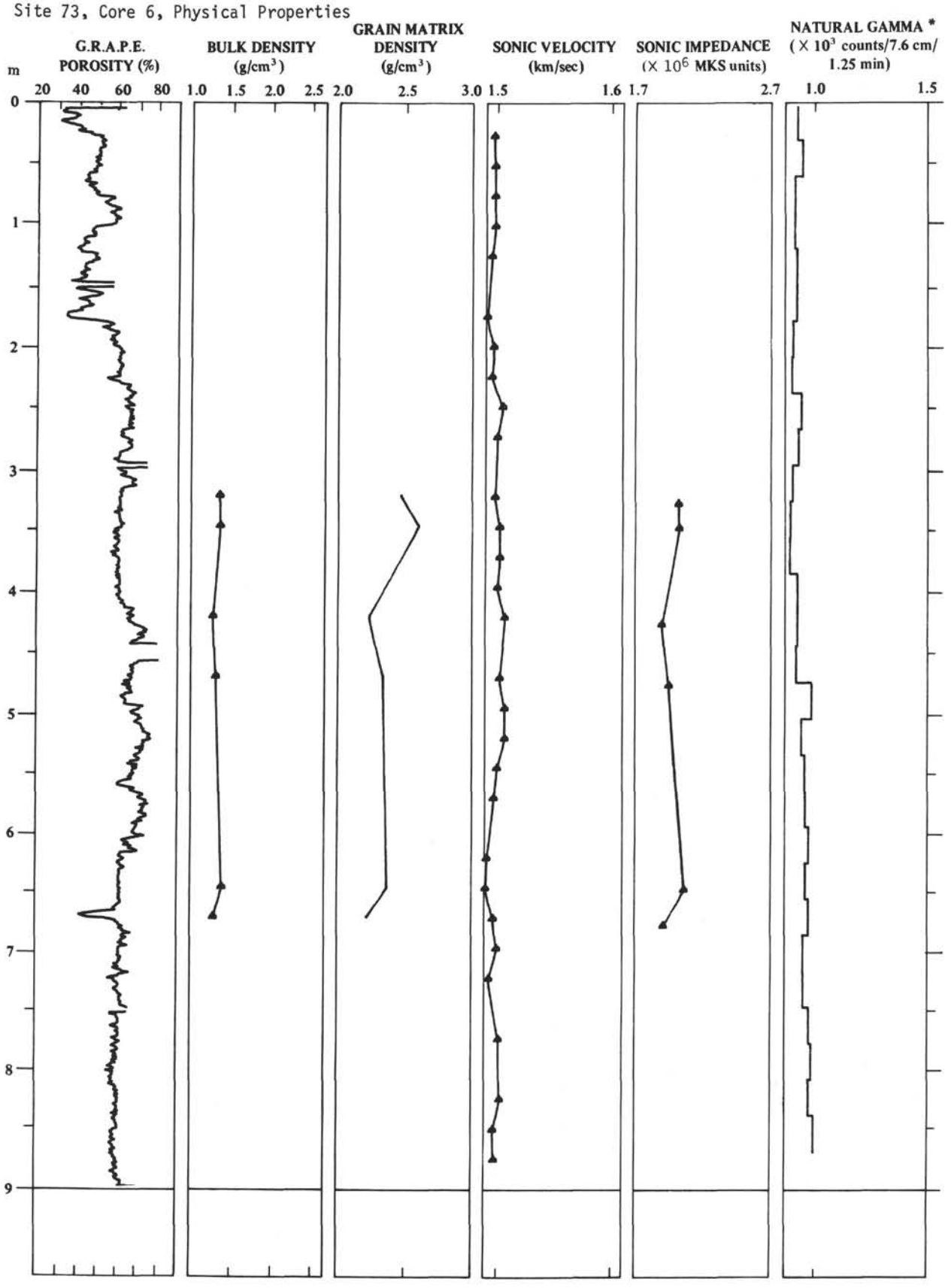
Site 73, Core 5, Physical Properties



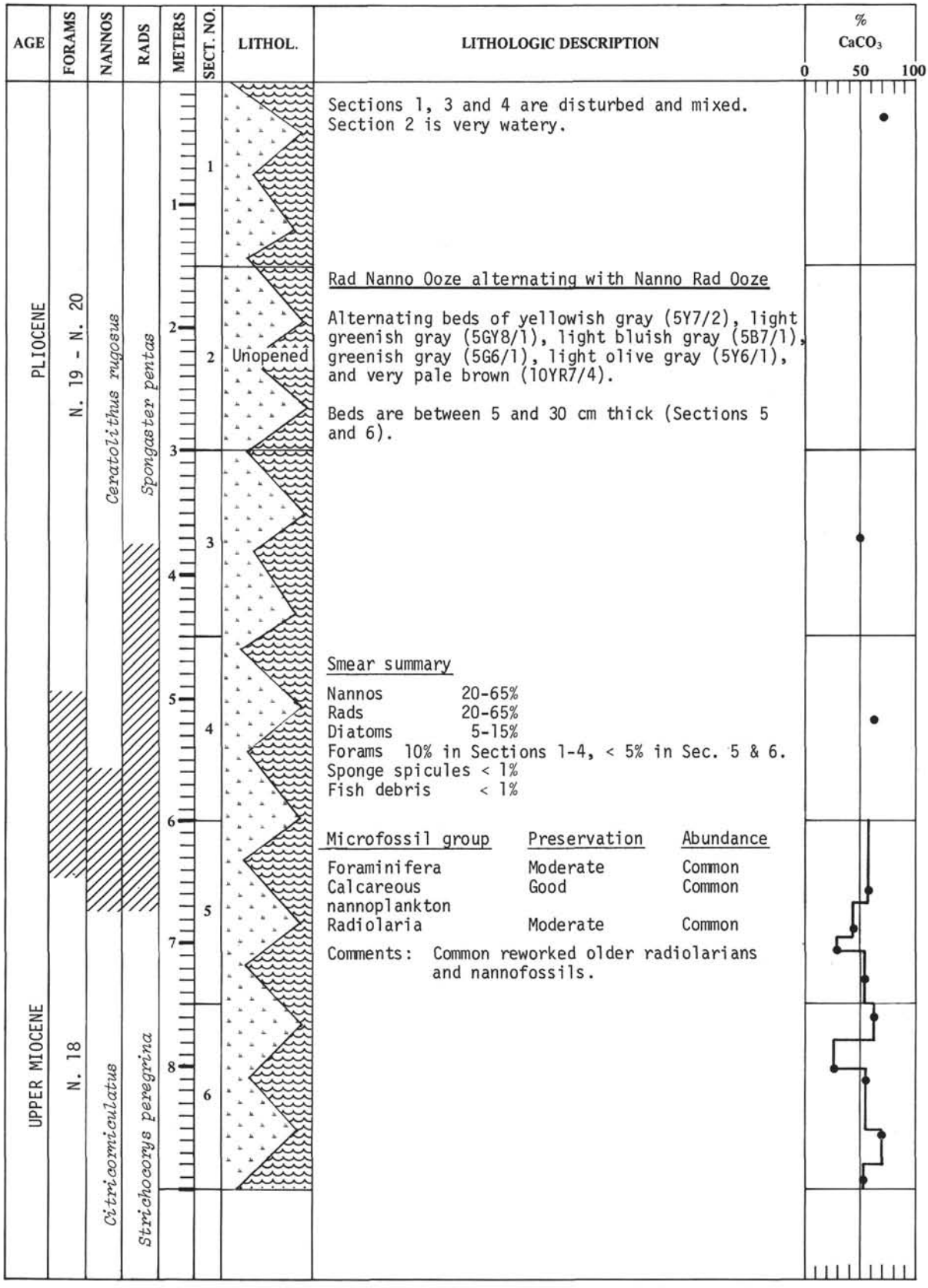
SITE 73 Core 6 Cored interval: 40-49



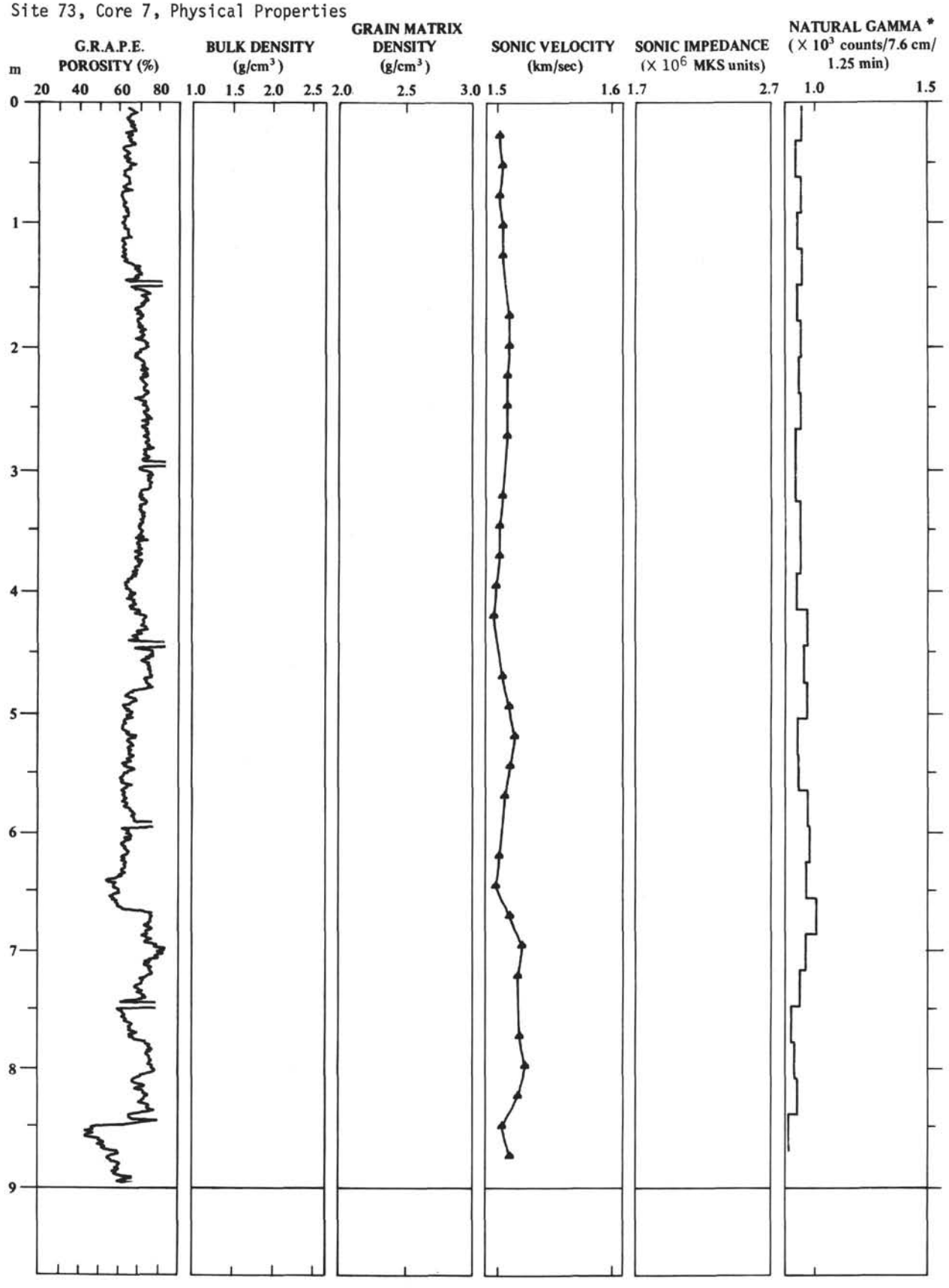
Site 73, Core 6, Physical Properties



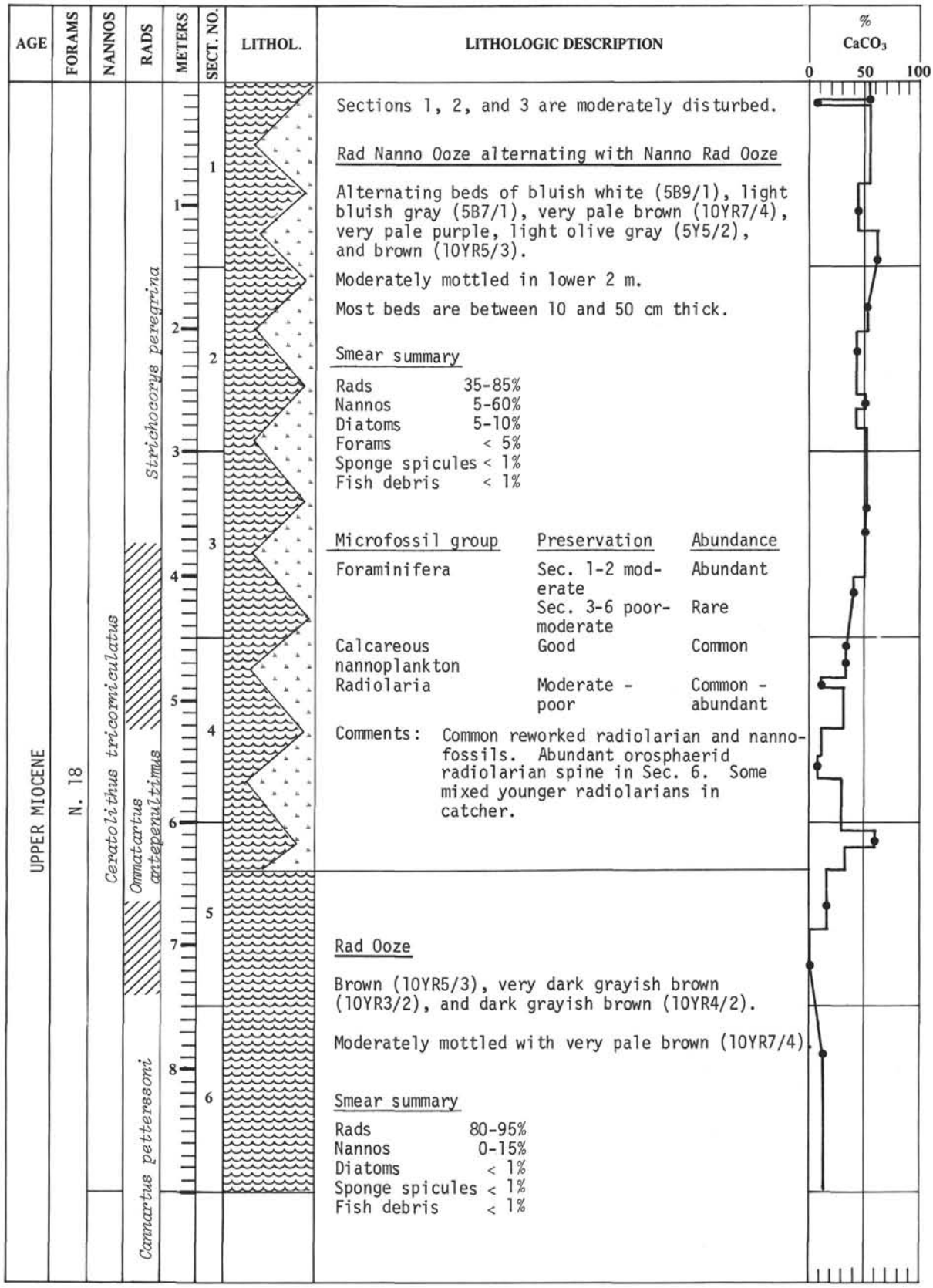
SITE 73 Core 7 Cored interval: 49-58 m



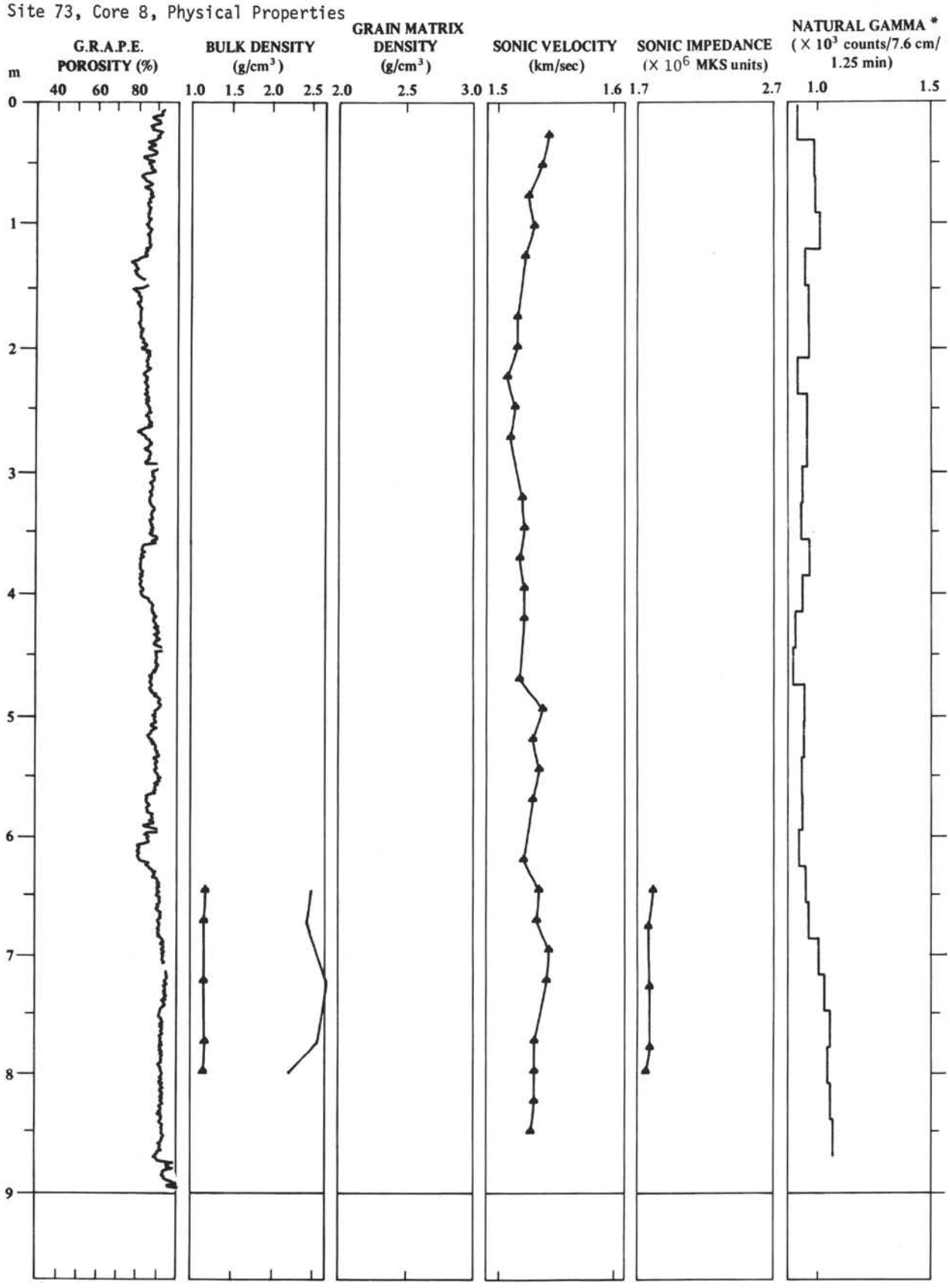
Site 73, Core 7, Physical Properties



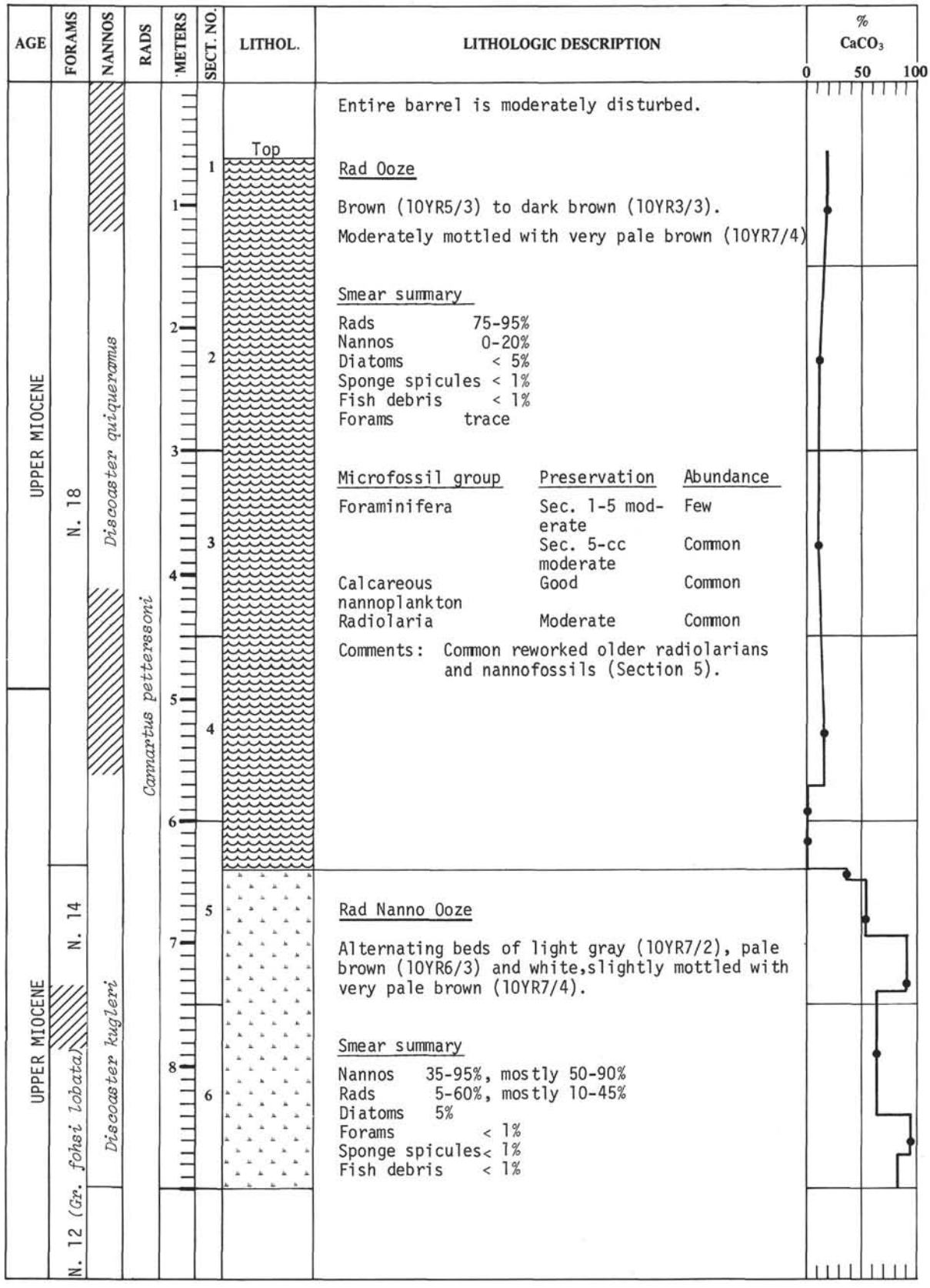
SITE 73 Core 8 Cored interval: 58-67 m



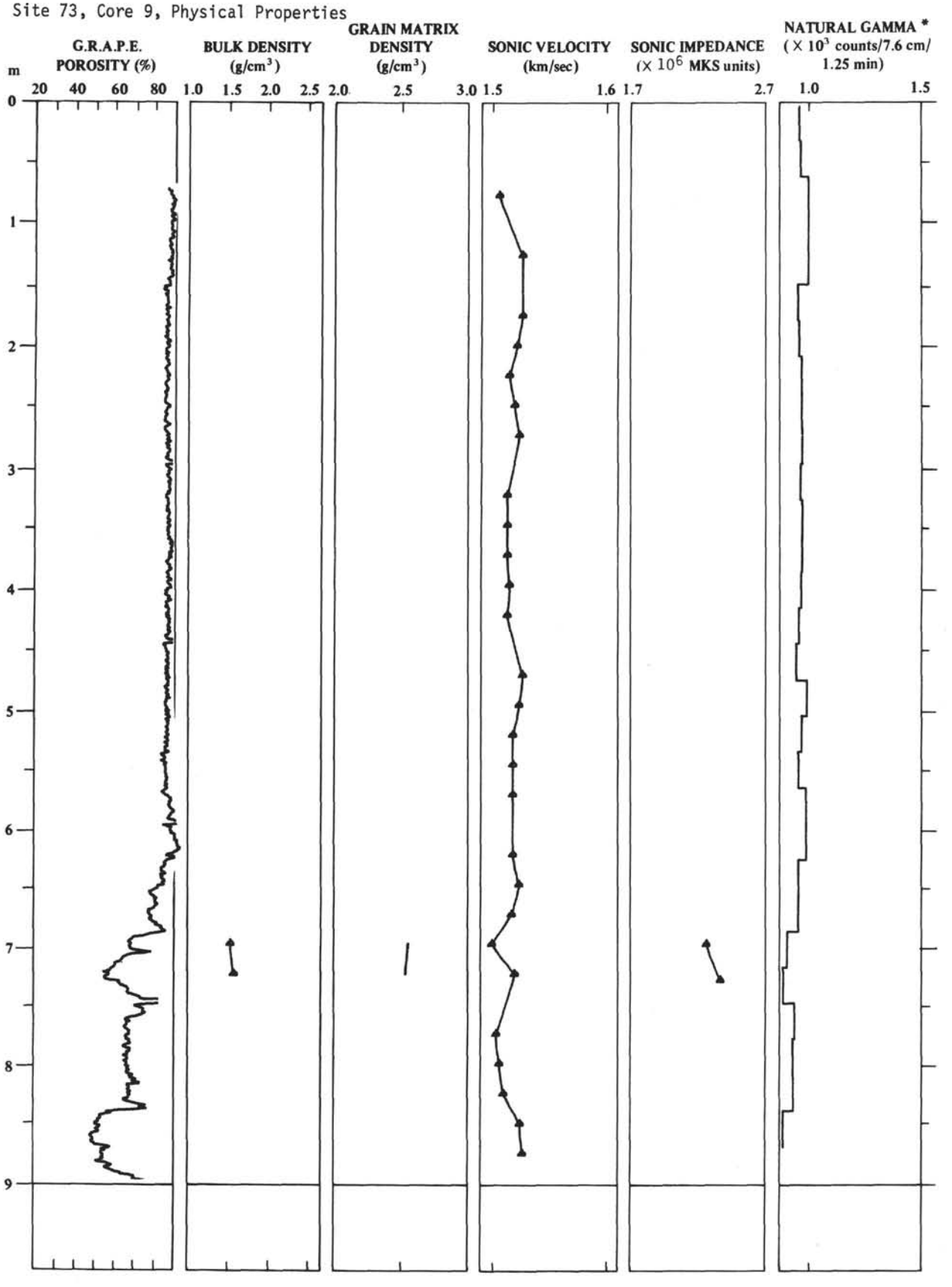
Site 73, Core 8, Physical Properties



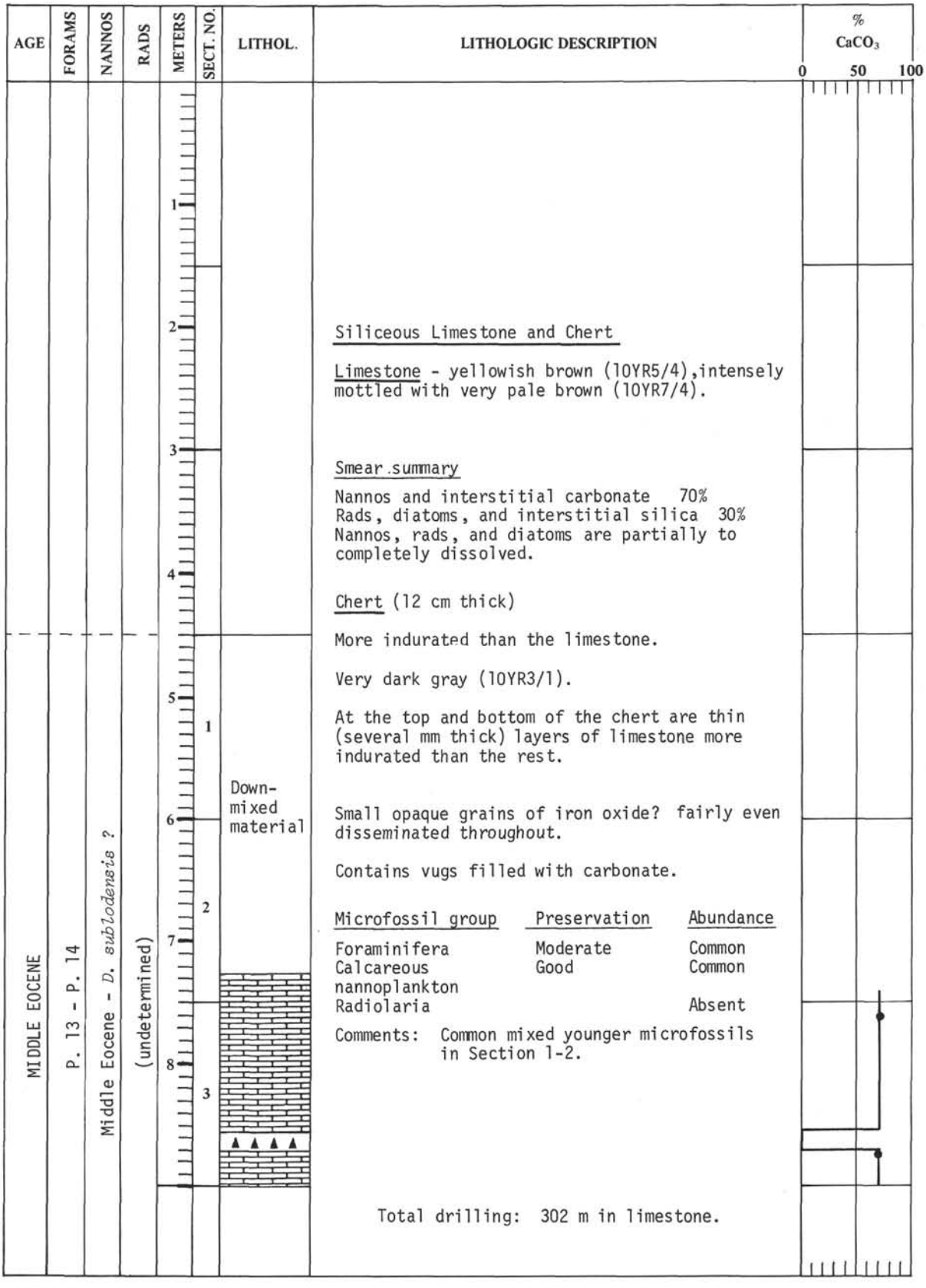
SITE 73 Core 9 Cored interval: 67-76 m



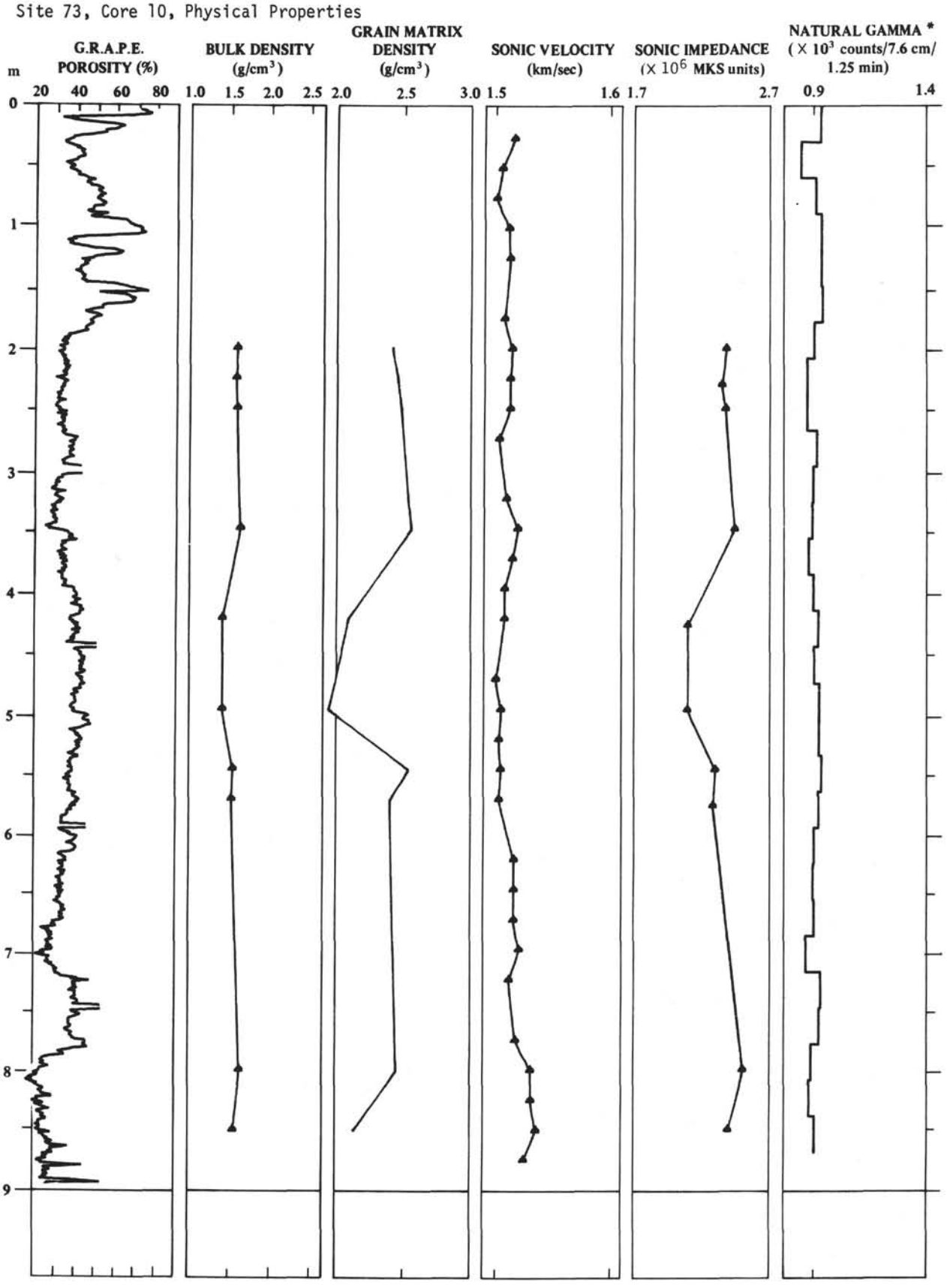
Site 73, Core 9, Physical Properties



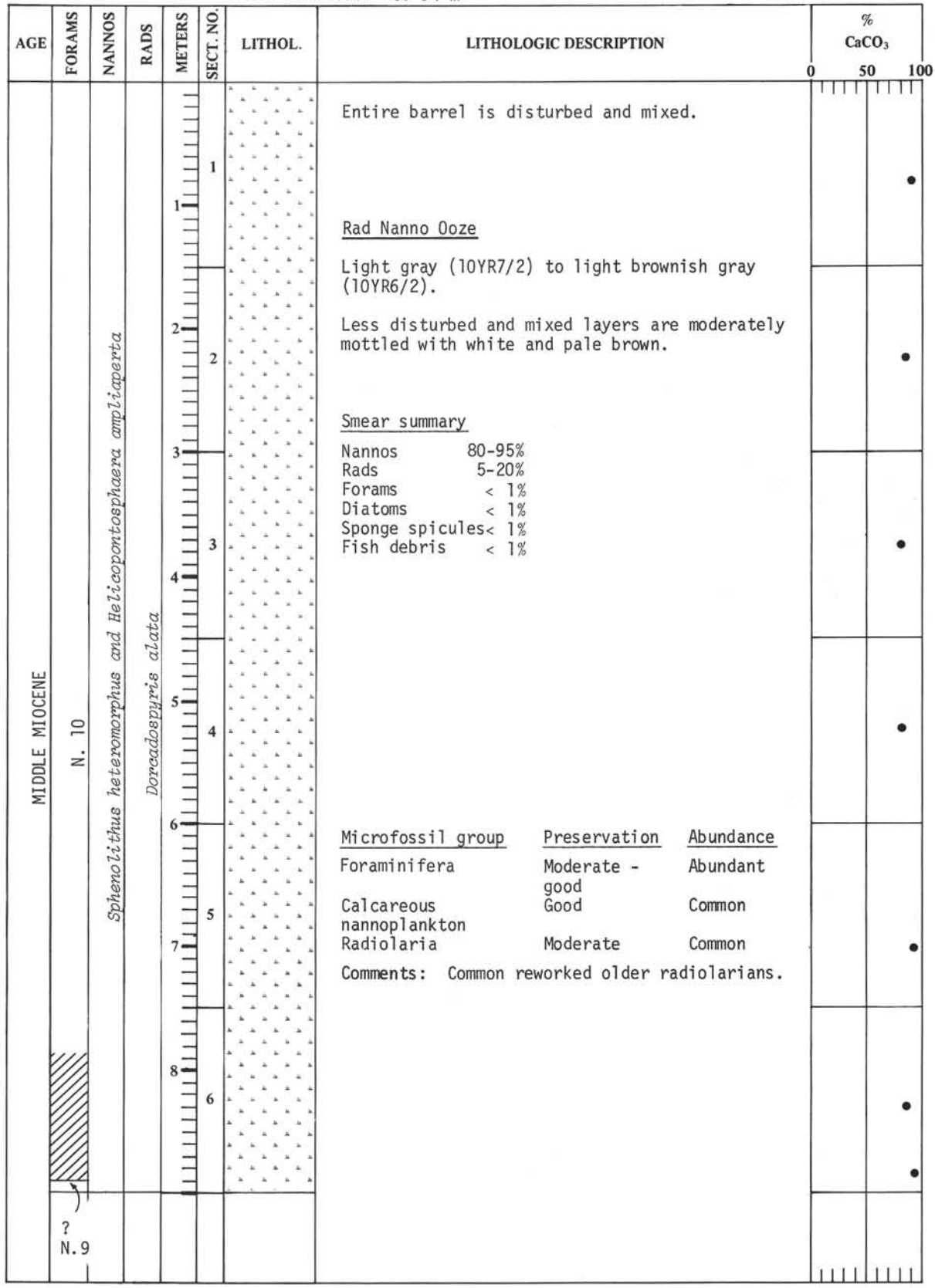
SITE 73 Core 21 Cored interval: 300-302 m



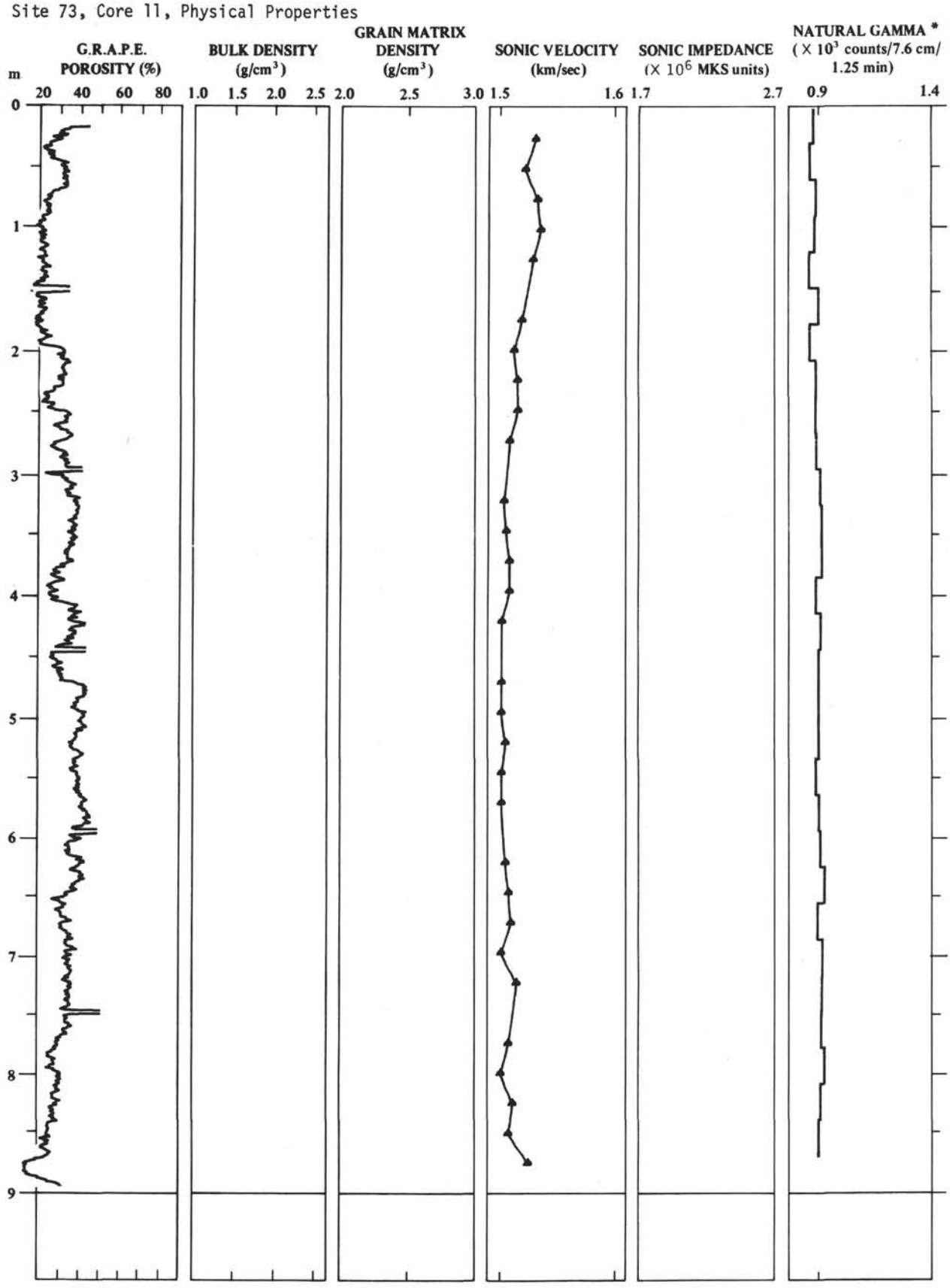
Site 73, Core 10, Physical Properties



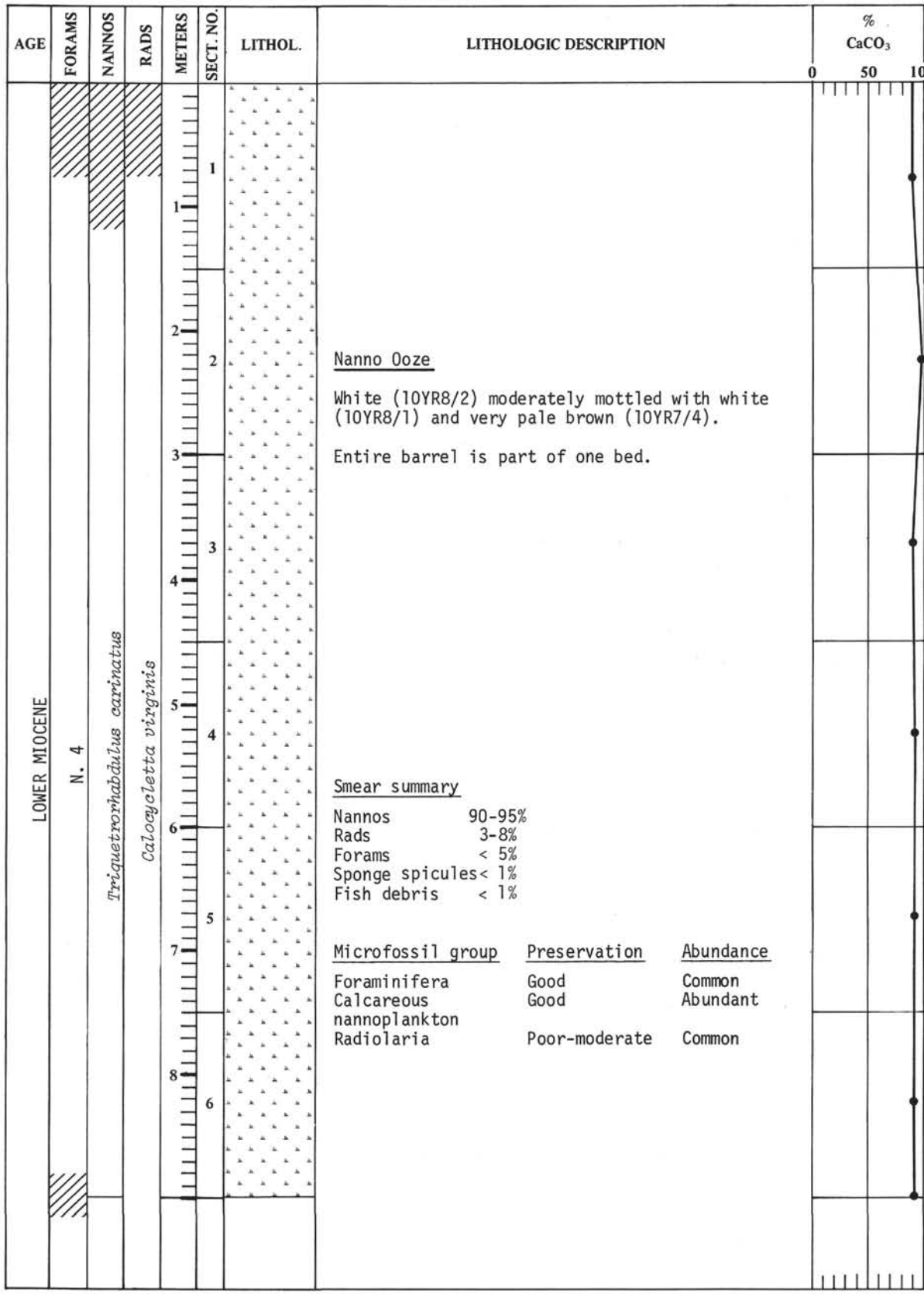
SITE 73 Core 11 Cored interval: 85-94 m



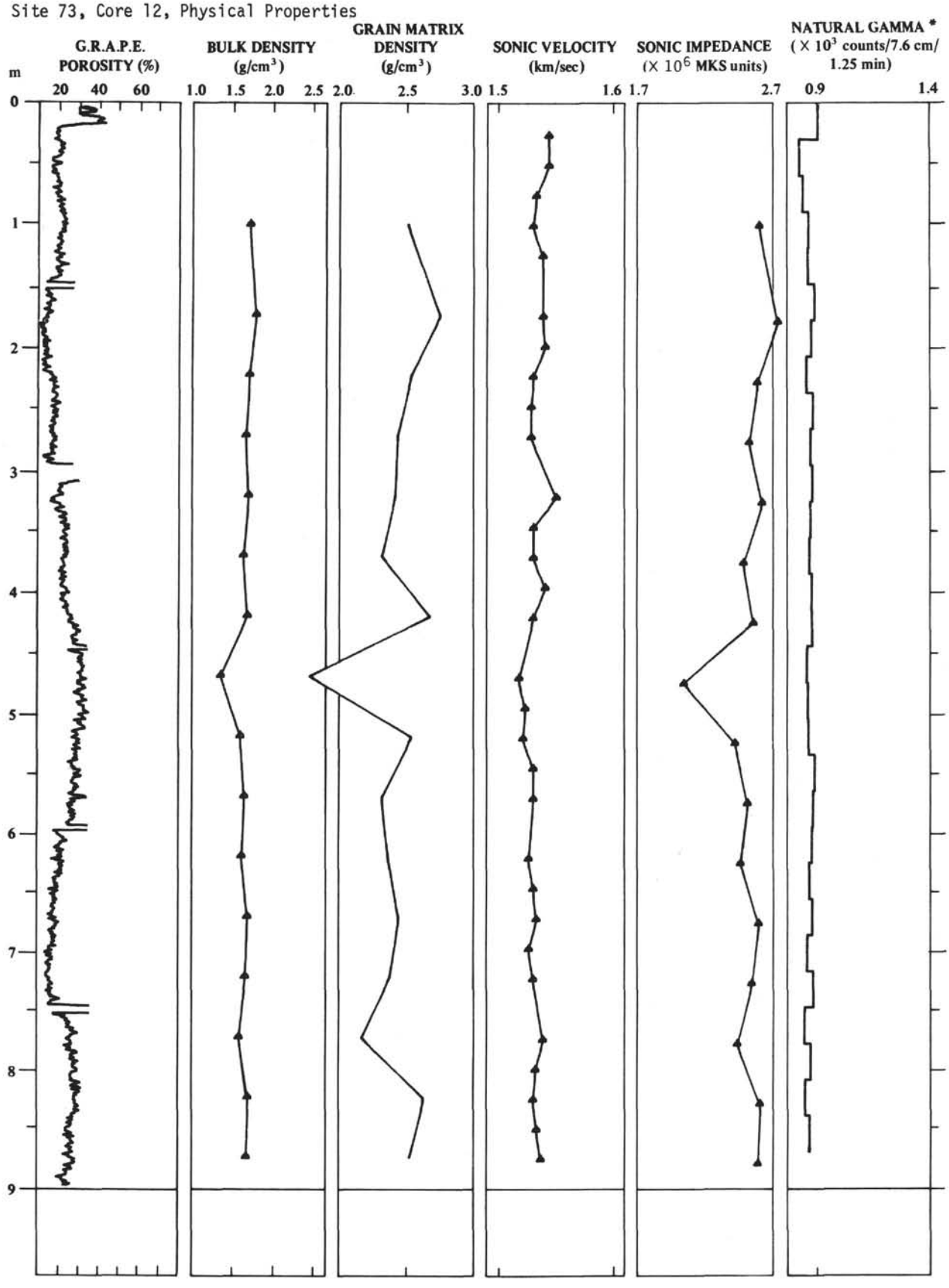
Site 73, Core 11, Physical Properties



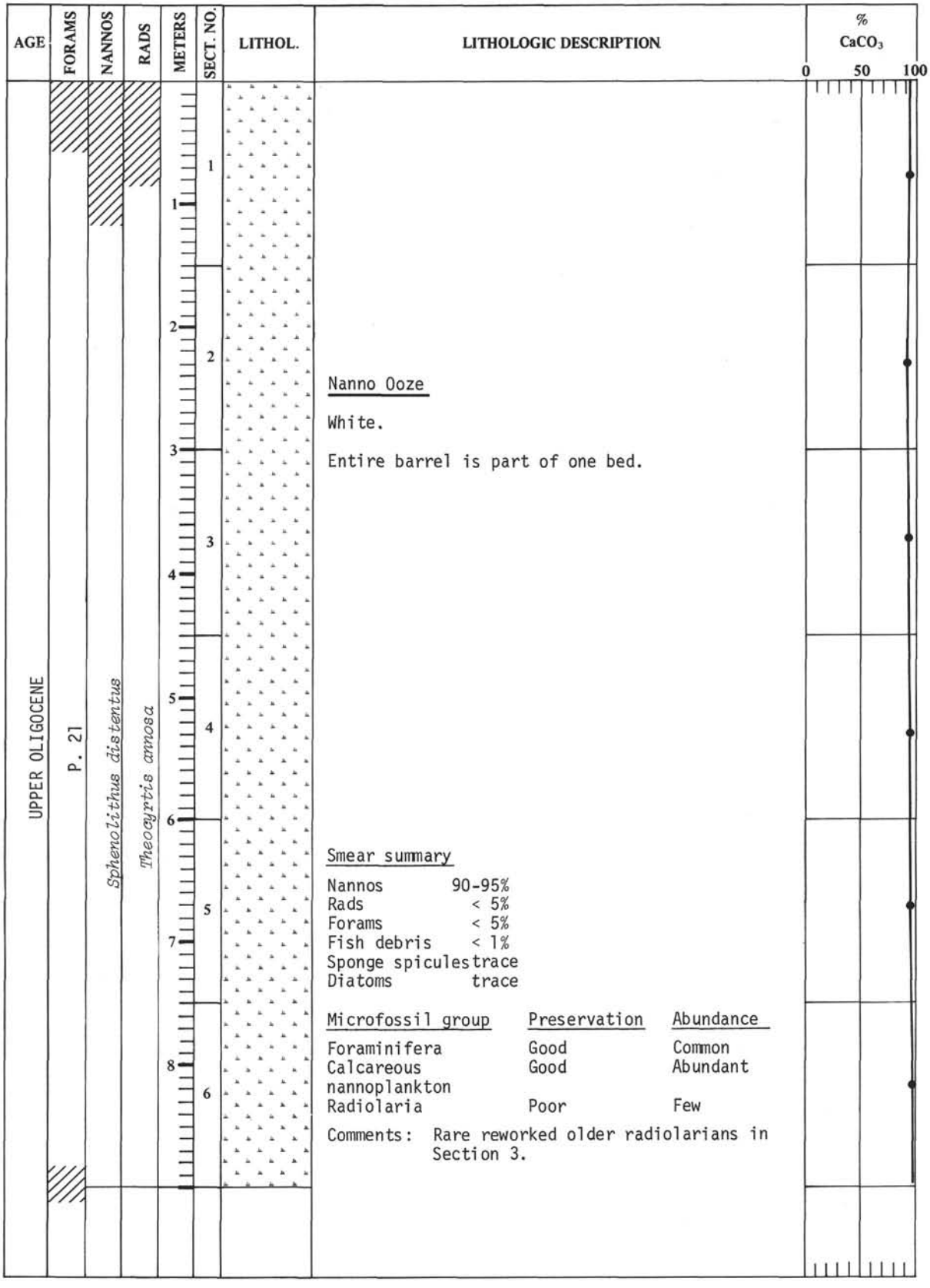
SITE 73 Core 12 Cored interval: 140-149 m



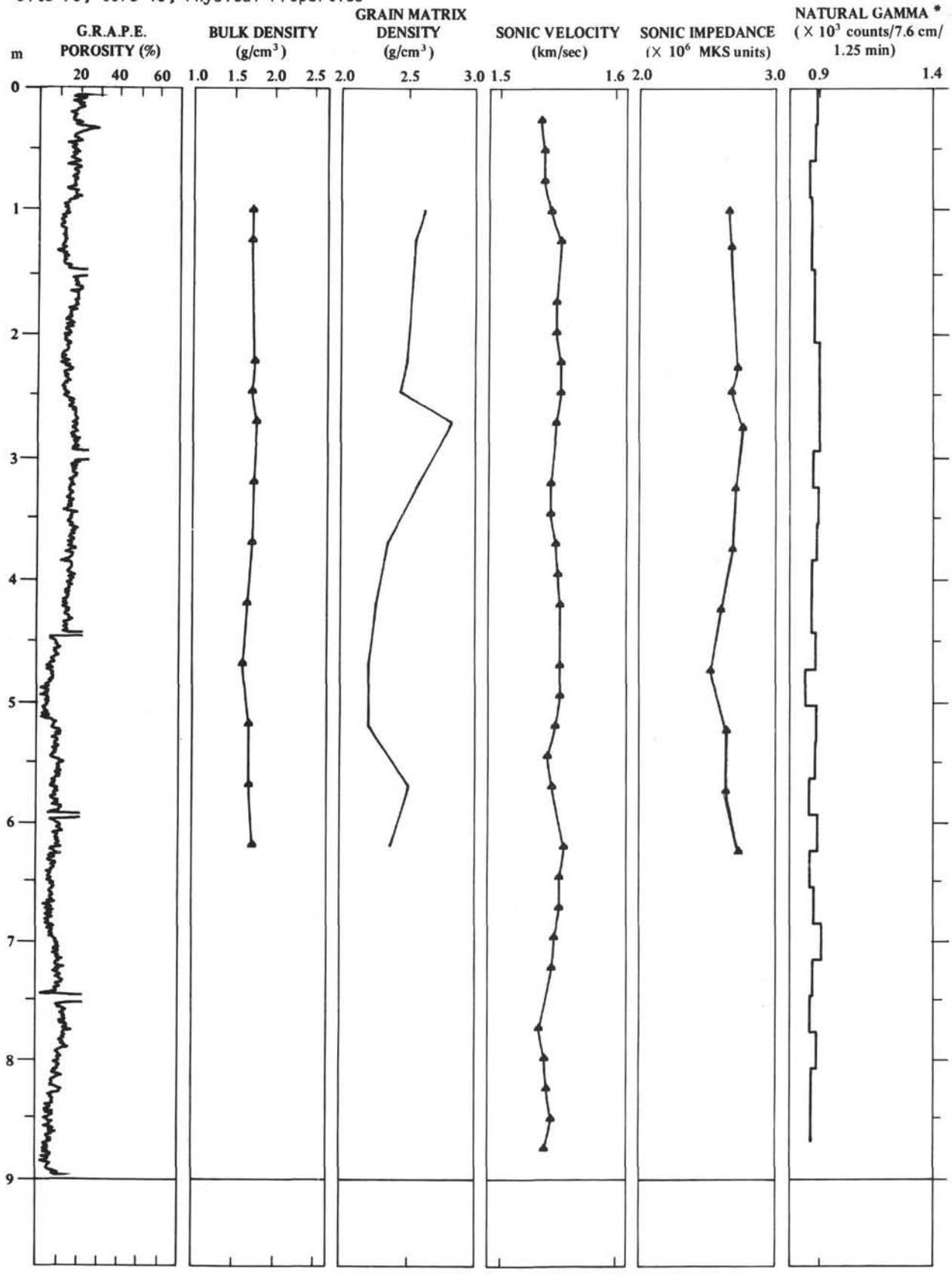
Site 73, Core 12, Physical Properties



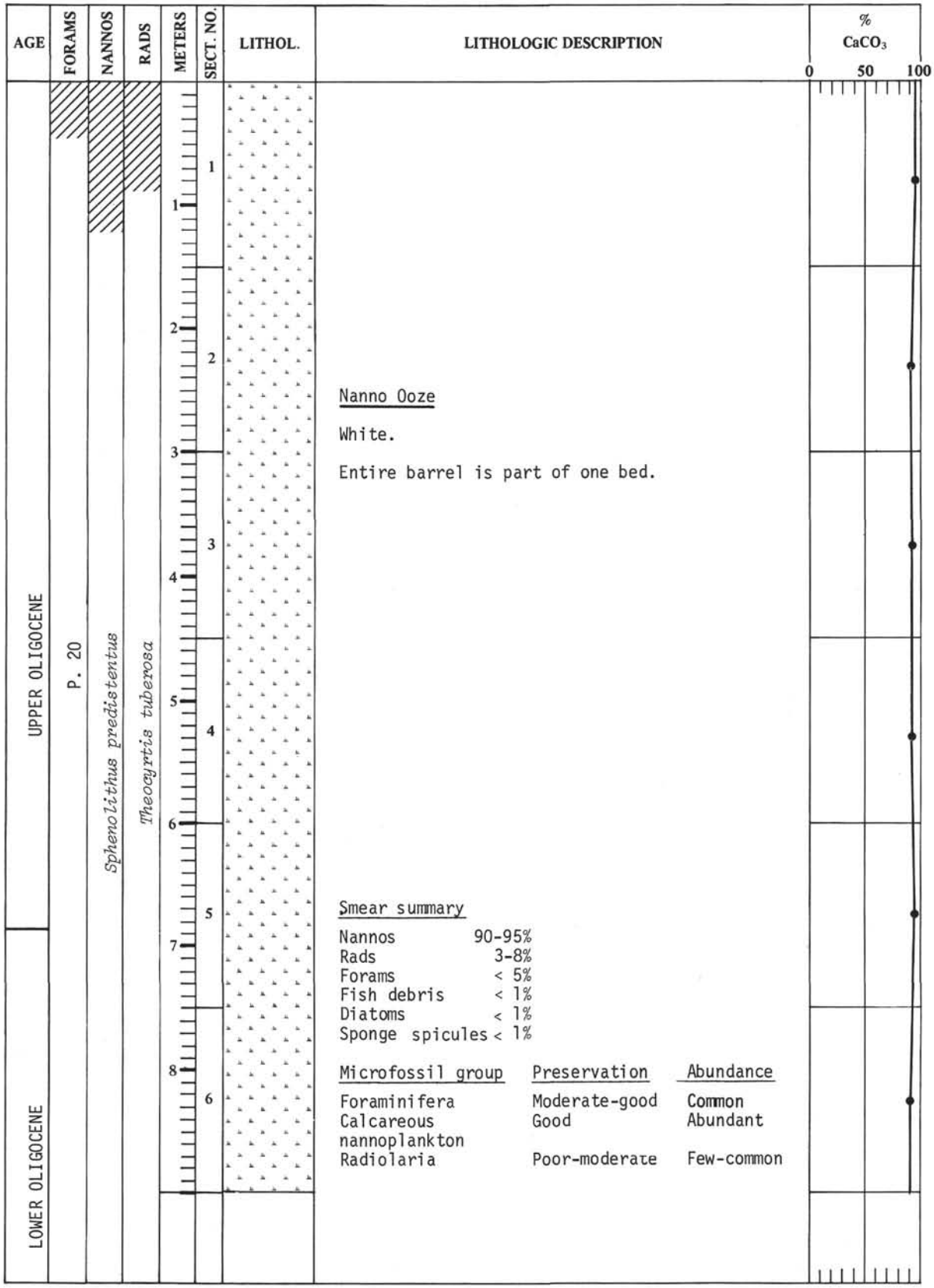
SITE 73 Core 13 Cored interval: 206-215 m



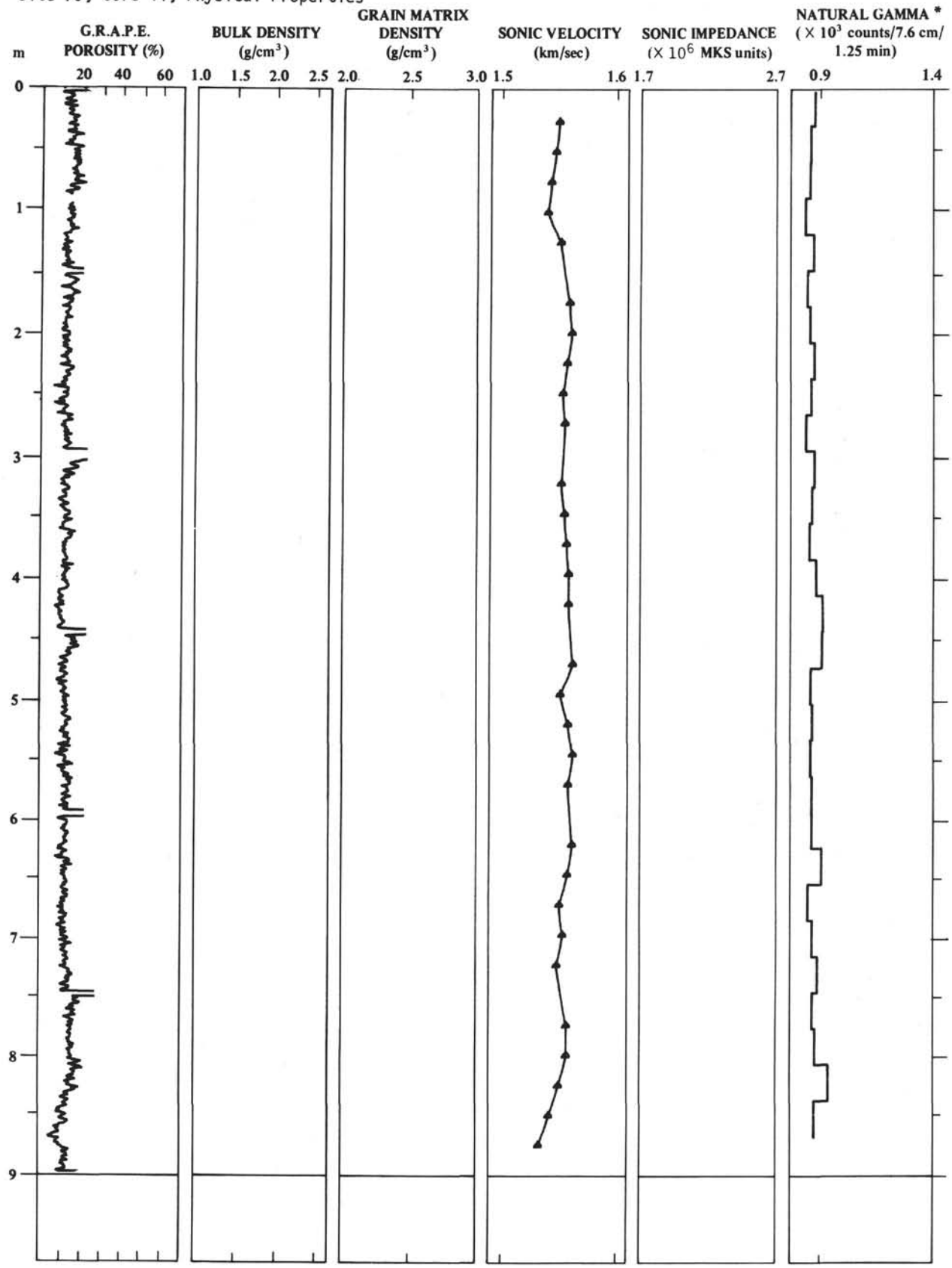
Site 73, Core 13, Physical Properties



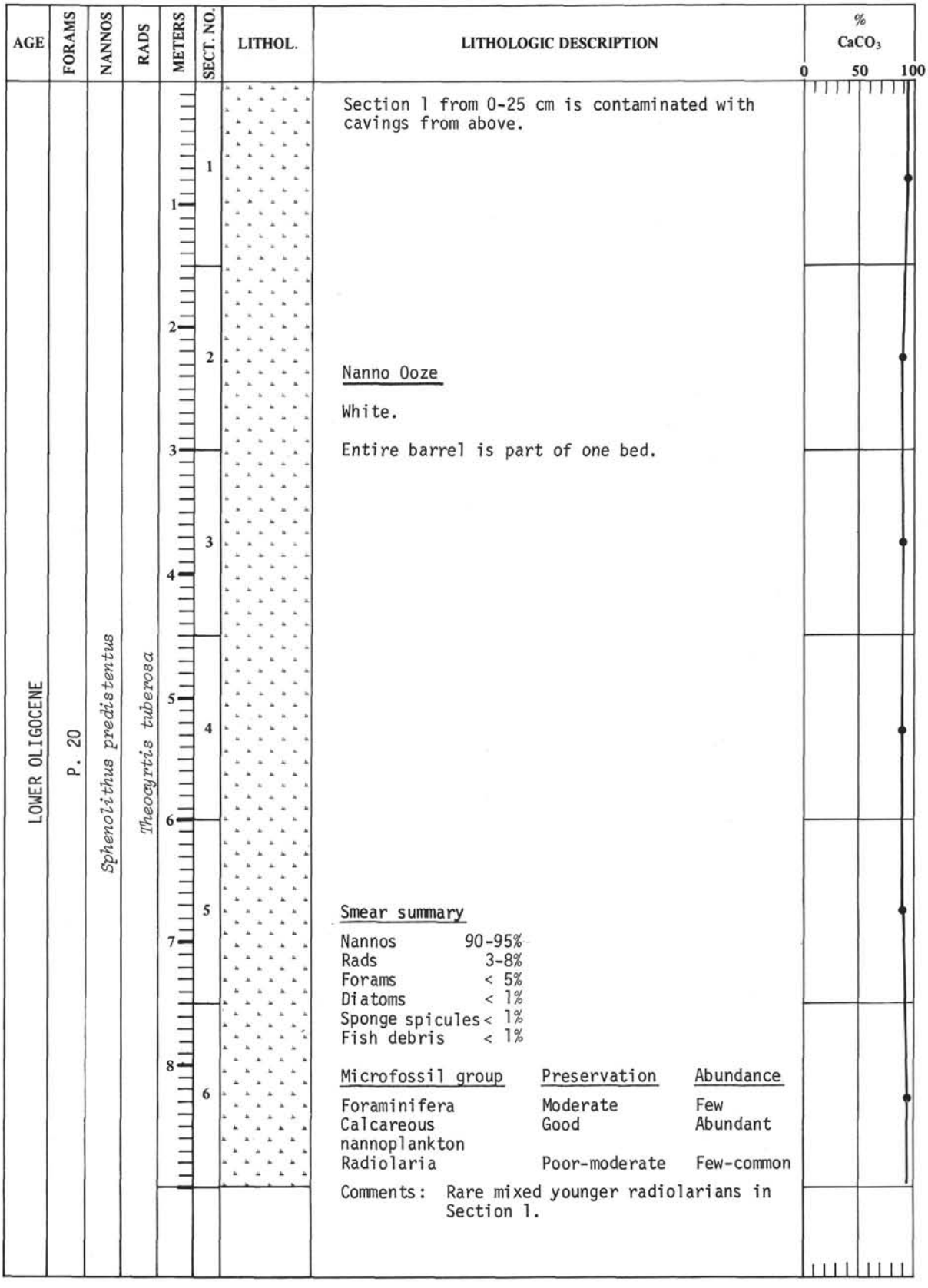
SITE 73 Core 14 Cored interval: 293-252 m



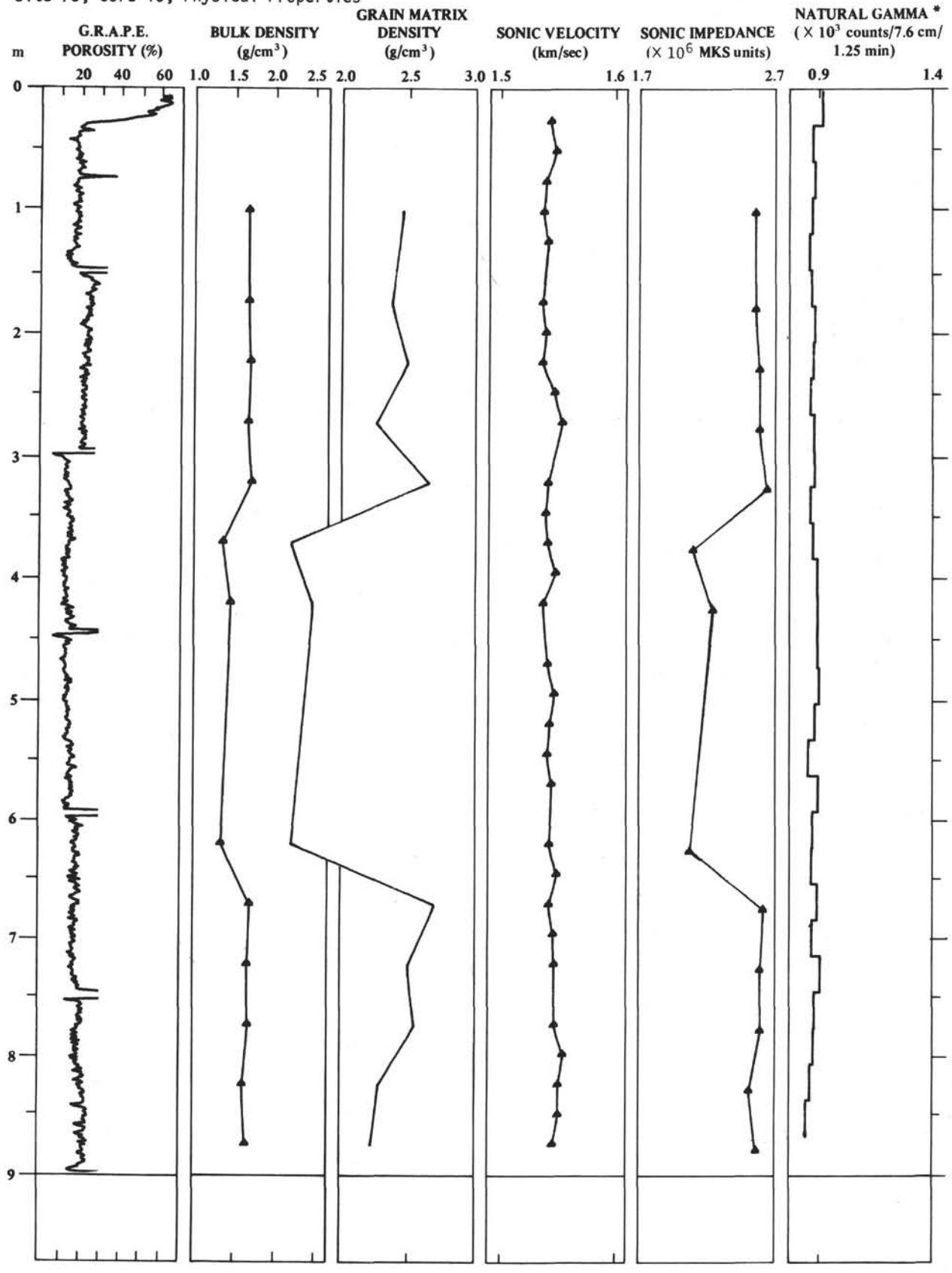
Site 73, Core 14, Physical Properties



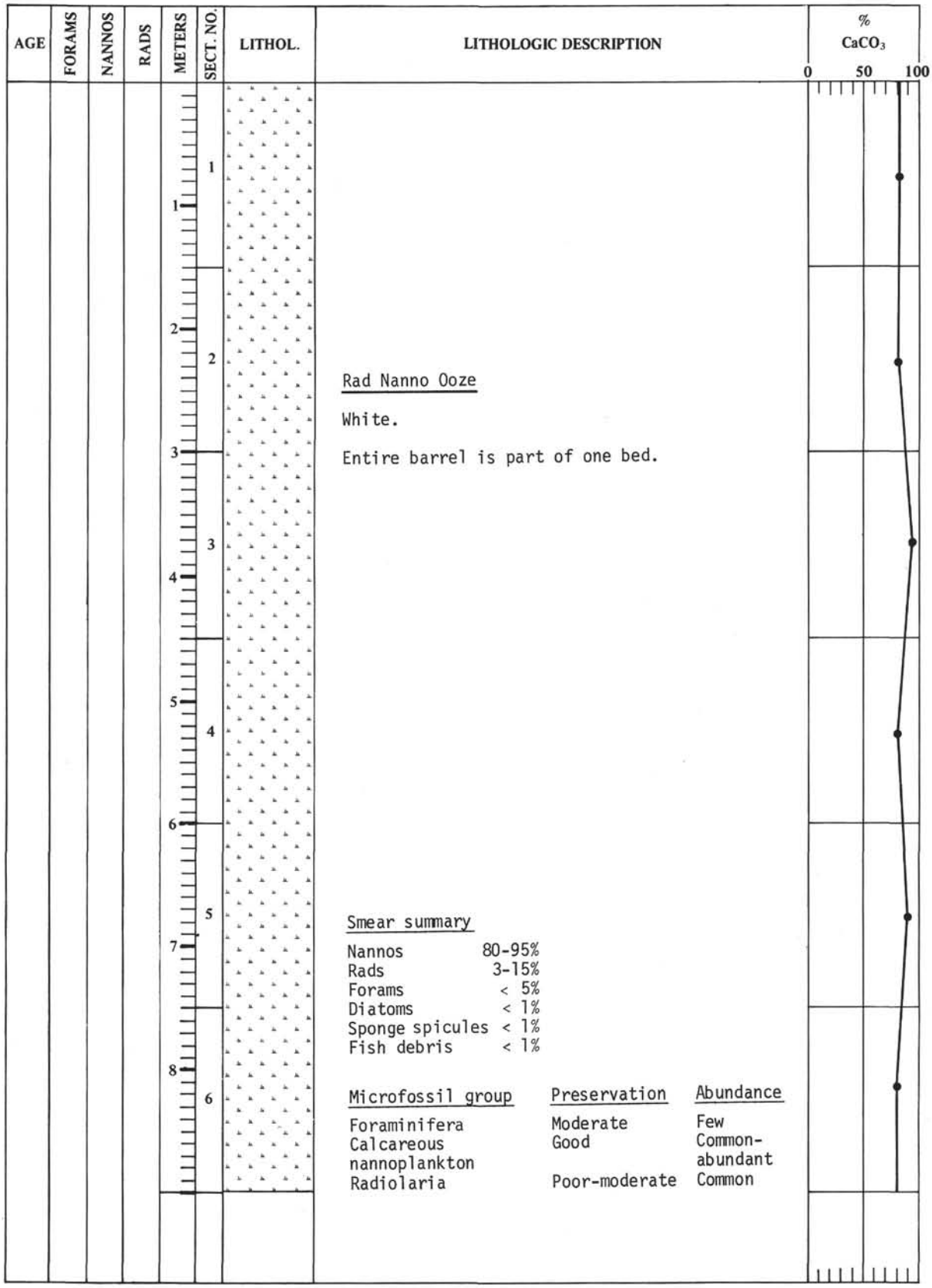
SITE 73 Core 15 Cored interval: 252-261 m



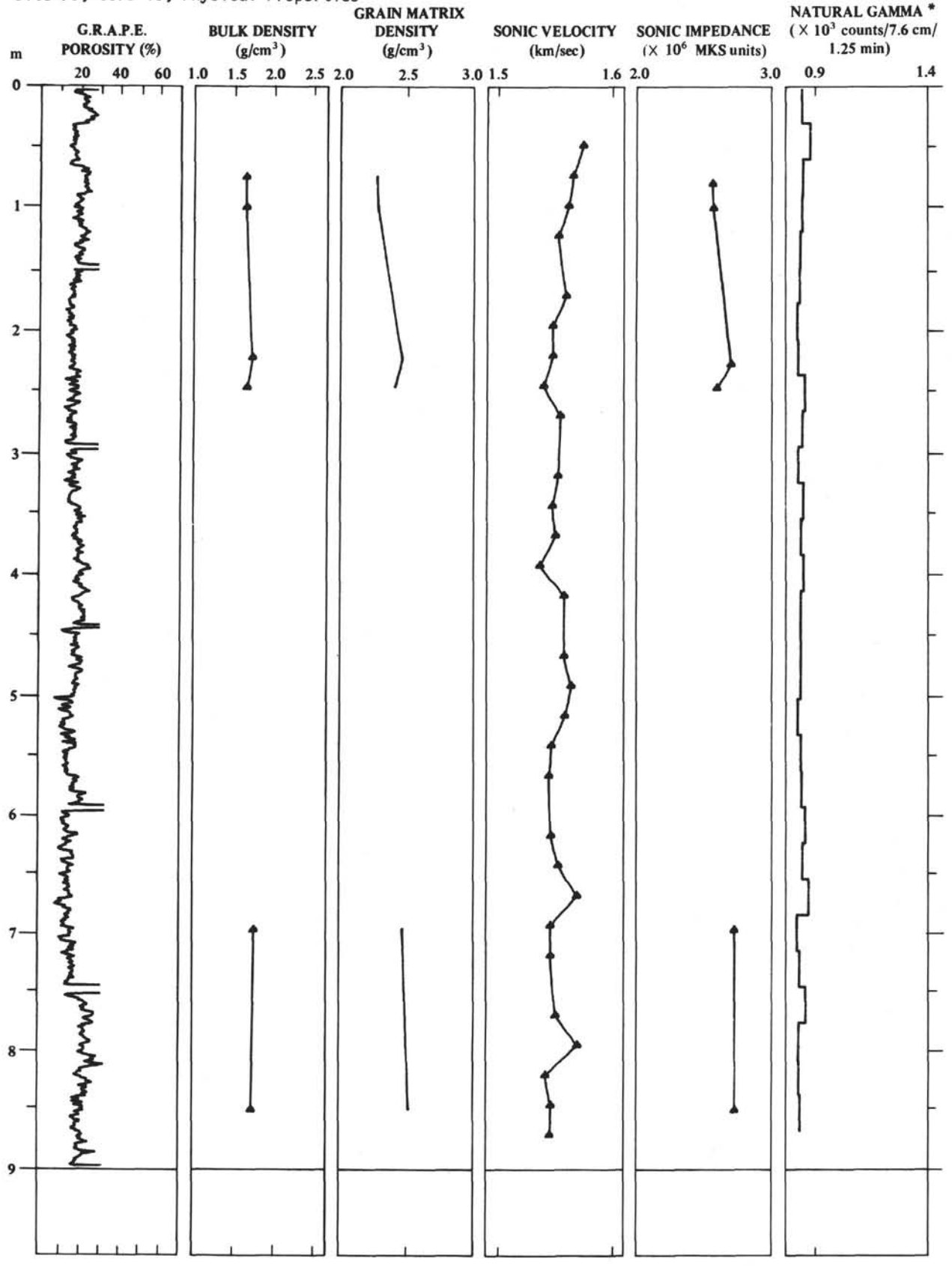
Site 73, Core 15, Physical Properties



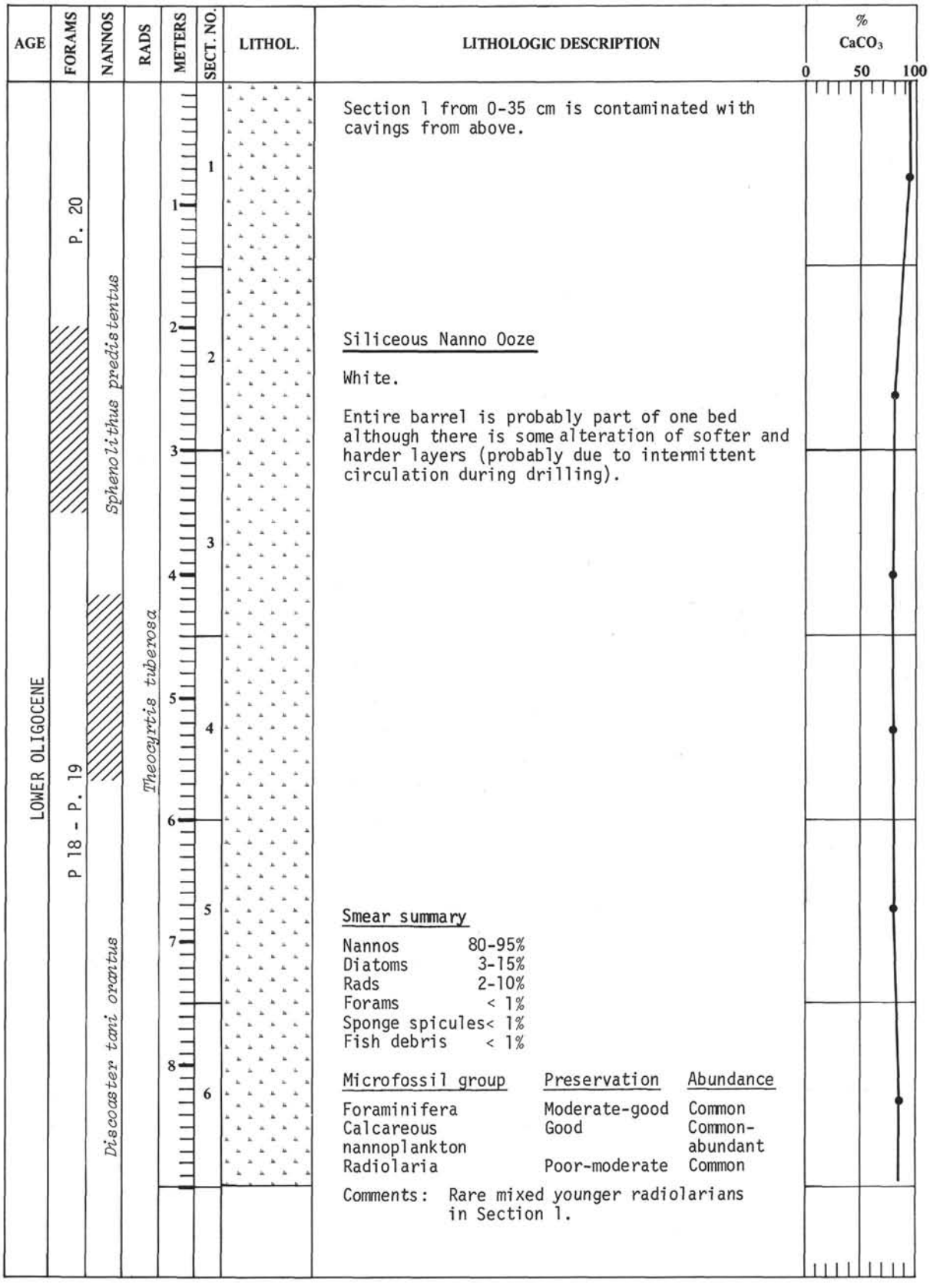
SITE 73 Core 16 Cored interval: 261-270 m



Site 73, Core 16, Physical Properties



SITE 73 Core 17 Cored interval: 270-279 m




Section 1 from 0-35 cm is contaminated with cavings from above.

Siliceous Nanno Ooze

White.

Entire barrel is probably part of one bed although there is some alteration of softer and harder layers (probably due to intermittent circulation during drilling).

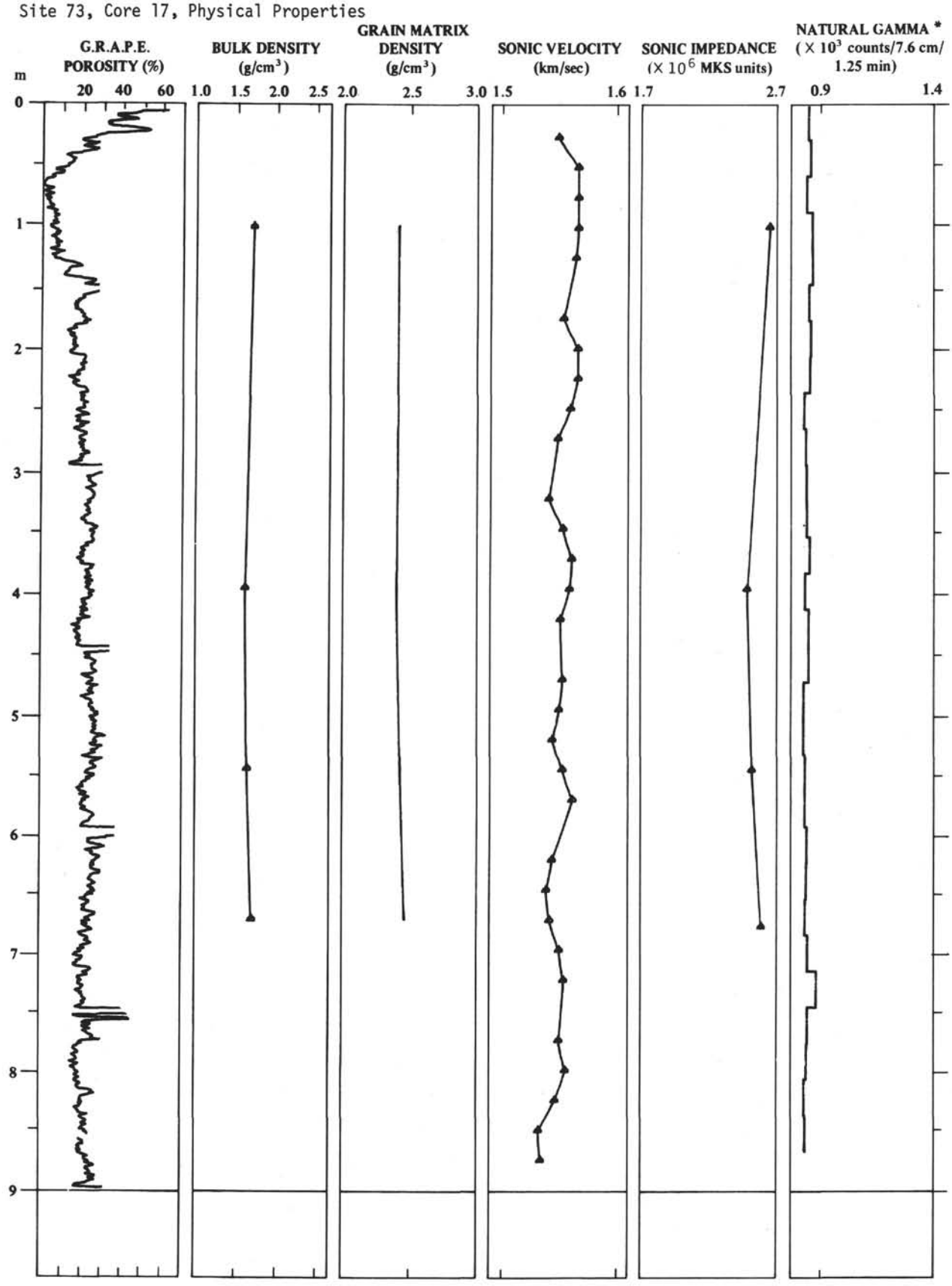
Smear summary

| | |
|---|---|
| Nannos | 80-95% |
| Diatoms | 3-15% |
| Rads | 2-10% |
| Forams | < 1% |
| Sponge spicules | < 1% |
| Fish debris | < 1% |

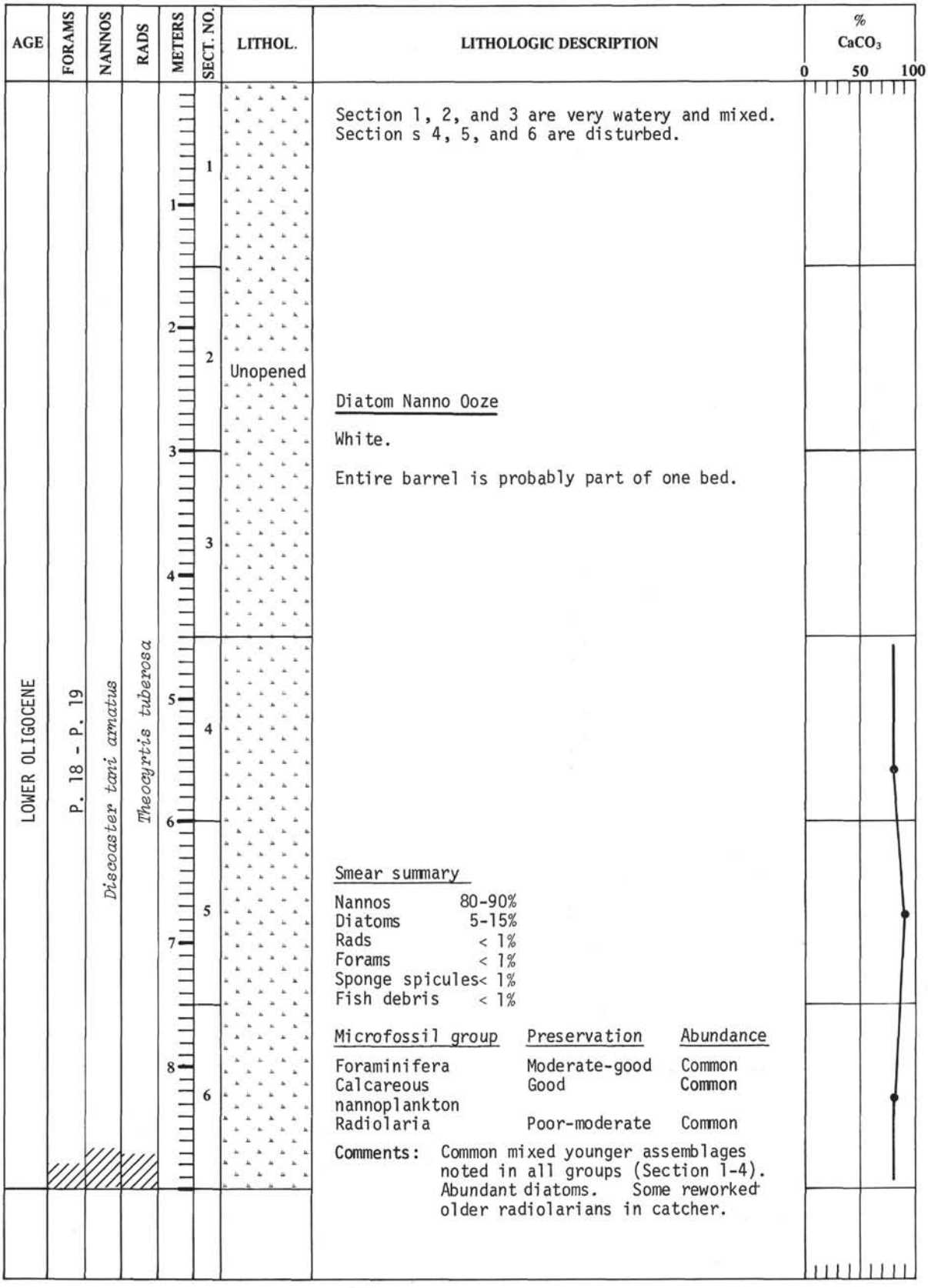
| Microfossil group | Preservation | Abundance |
|---|---|---|
| Foraminifera | Moderate-good | Common |
| Calcareous nannoplankton | Good | Common-abundant |
| Radiolaria | Poor-moderate | Common |

Comments: Rare mixed younger radiolarians in Section 1.

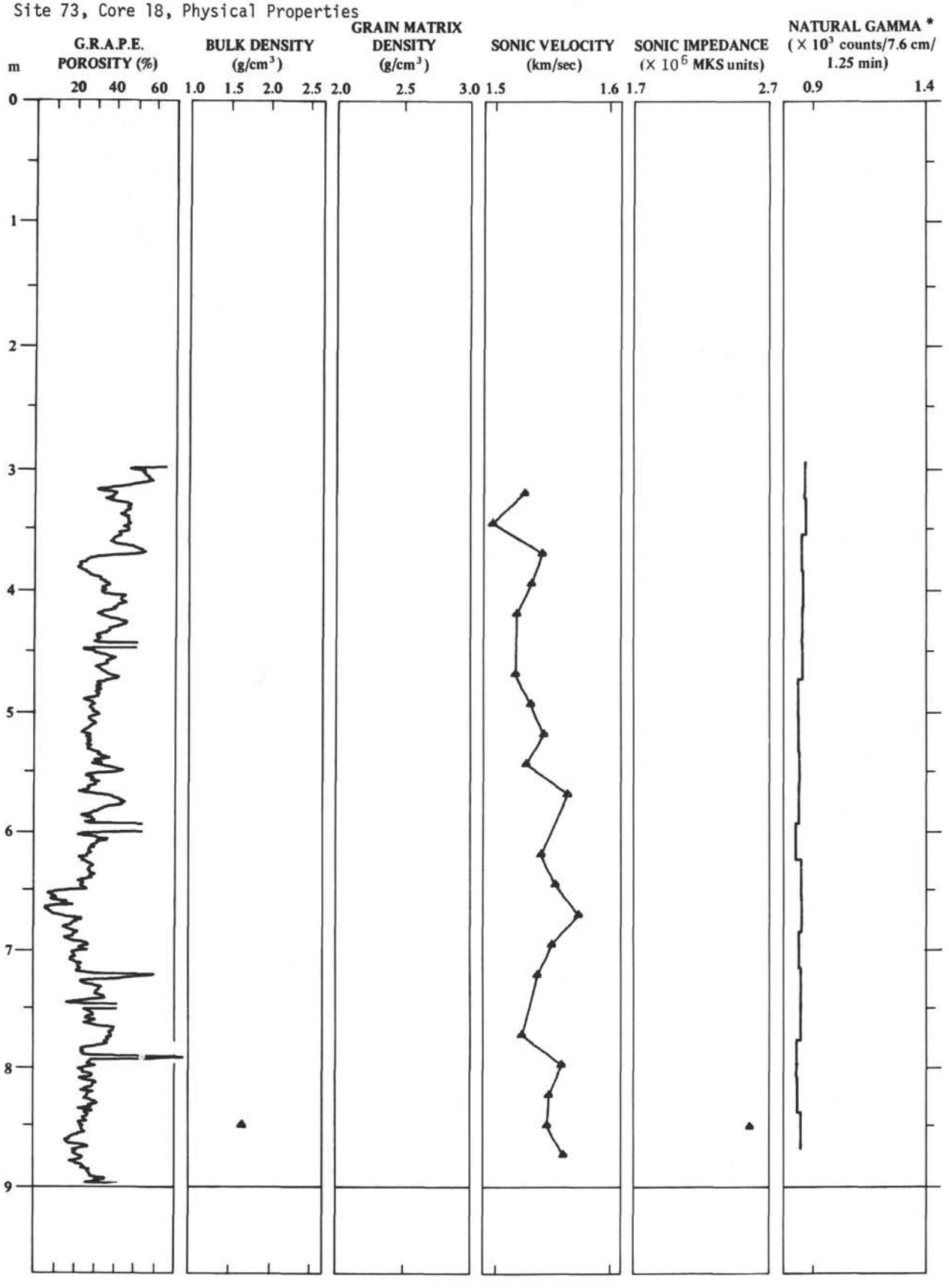
Site 73, Core 17, Physical Properties



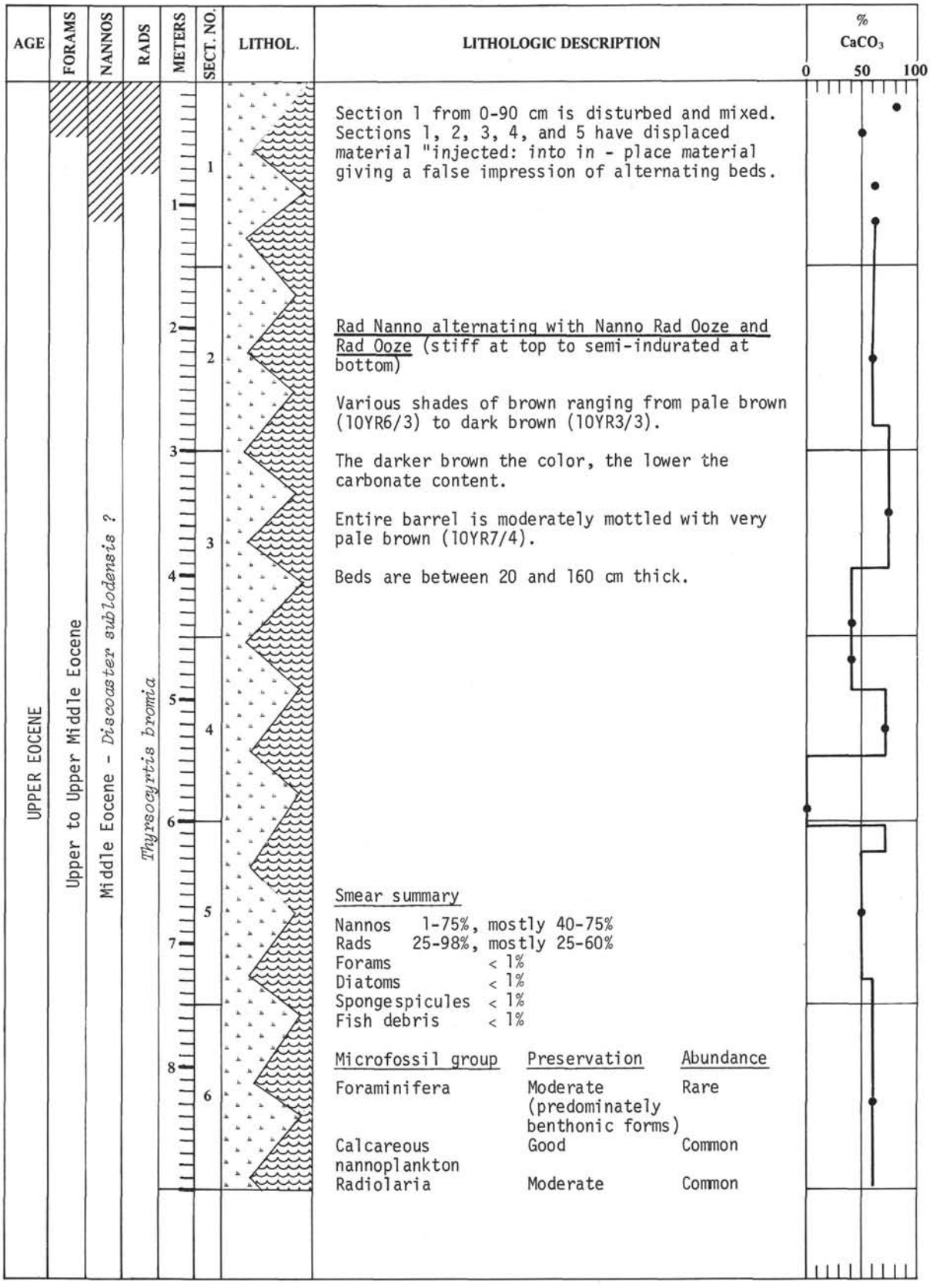
SITE 73 Core 18 Cored interval: 279-288 m



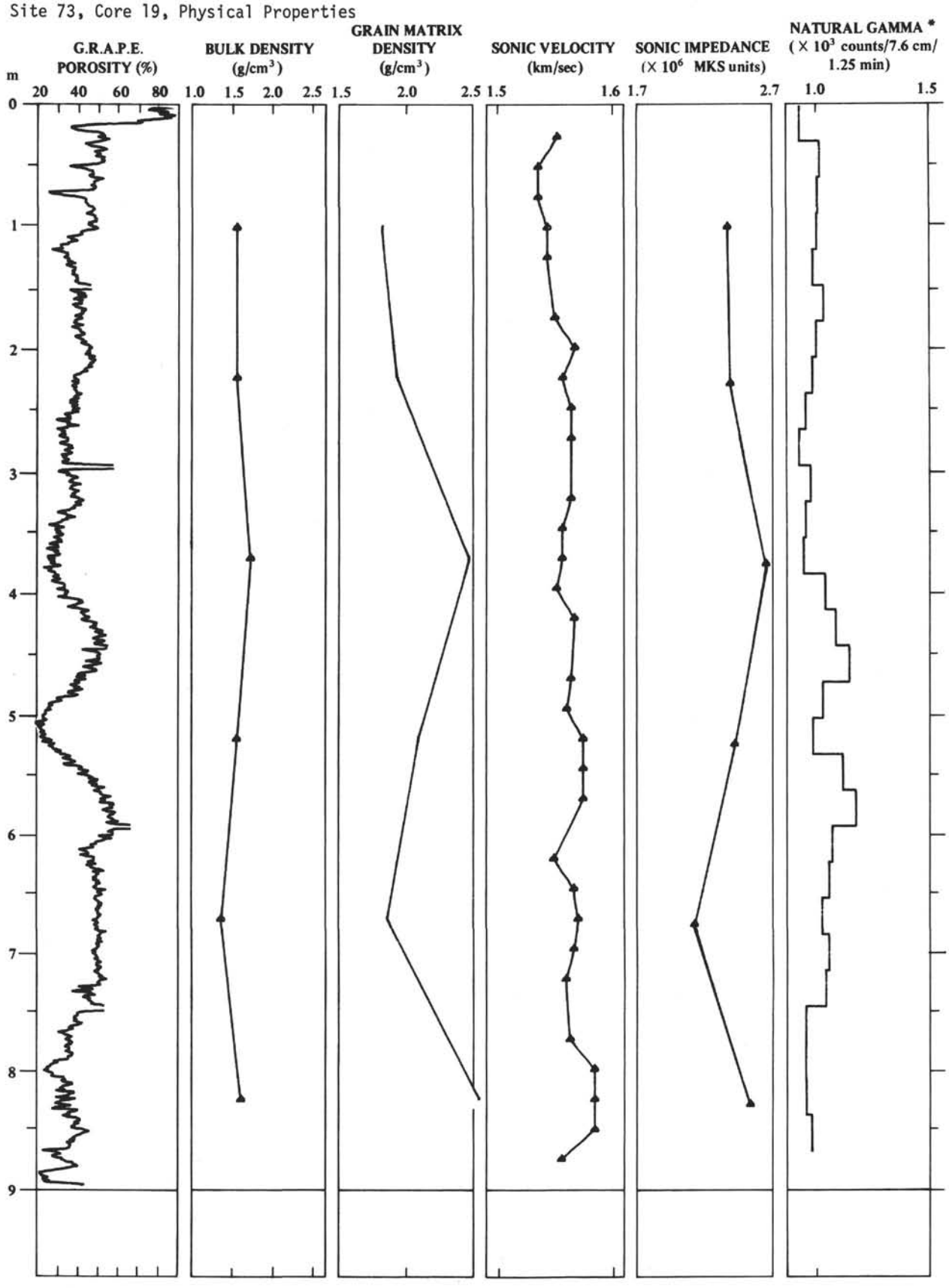
Site 73, Core 18, Physical Properties



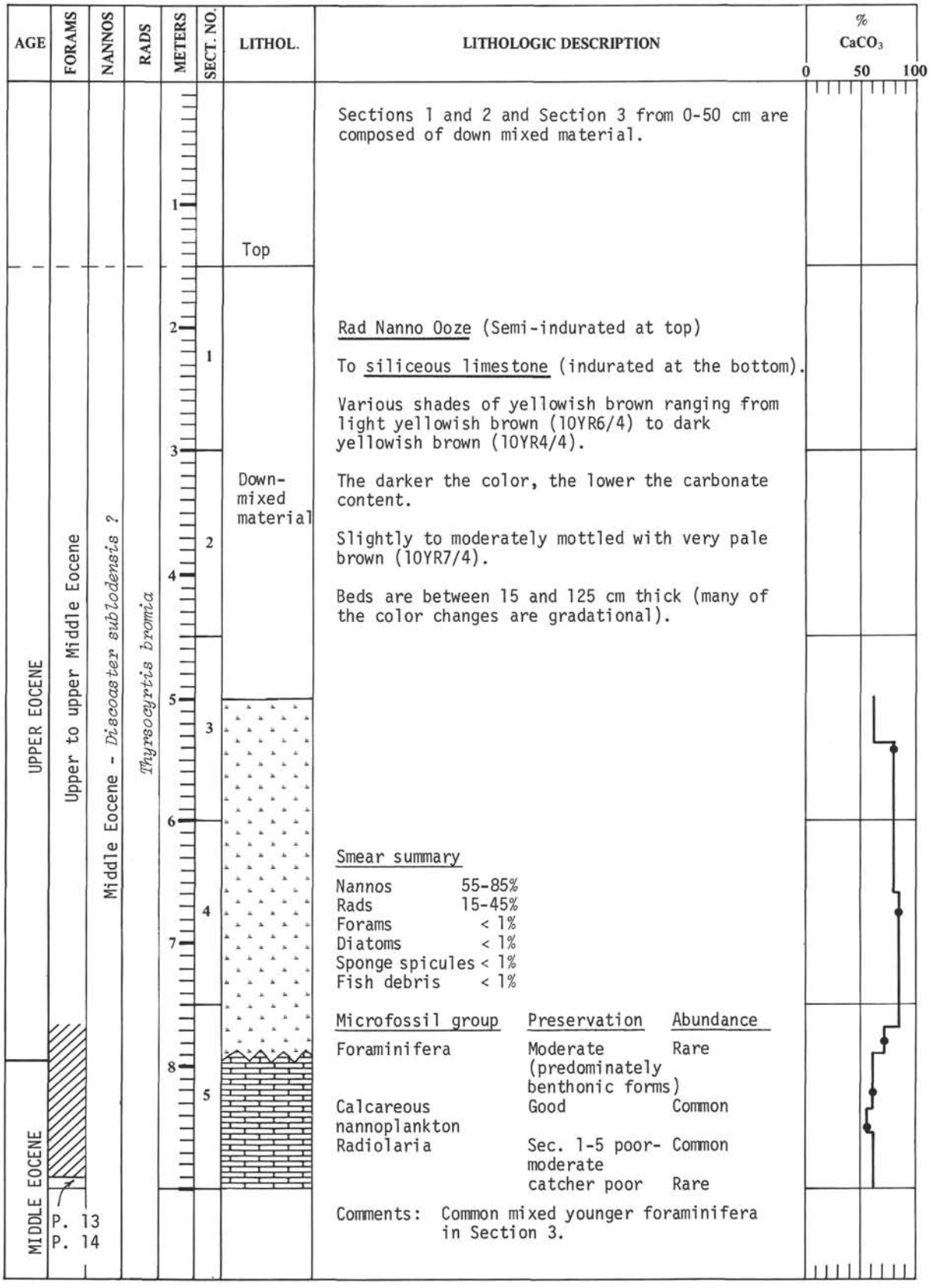
SITE 73 Core 19 Cored interval: 288-297 m



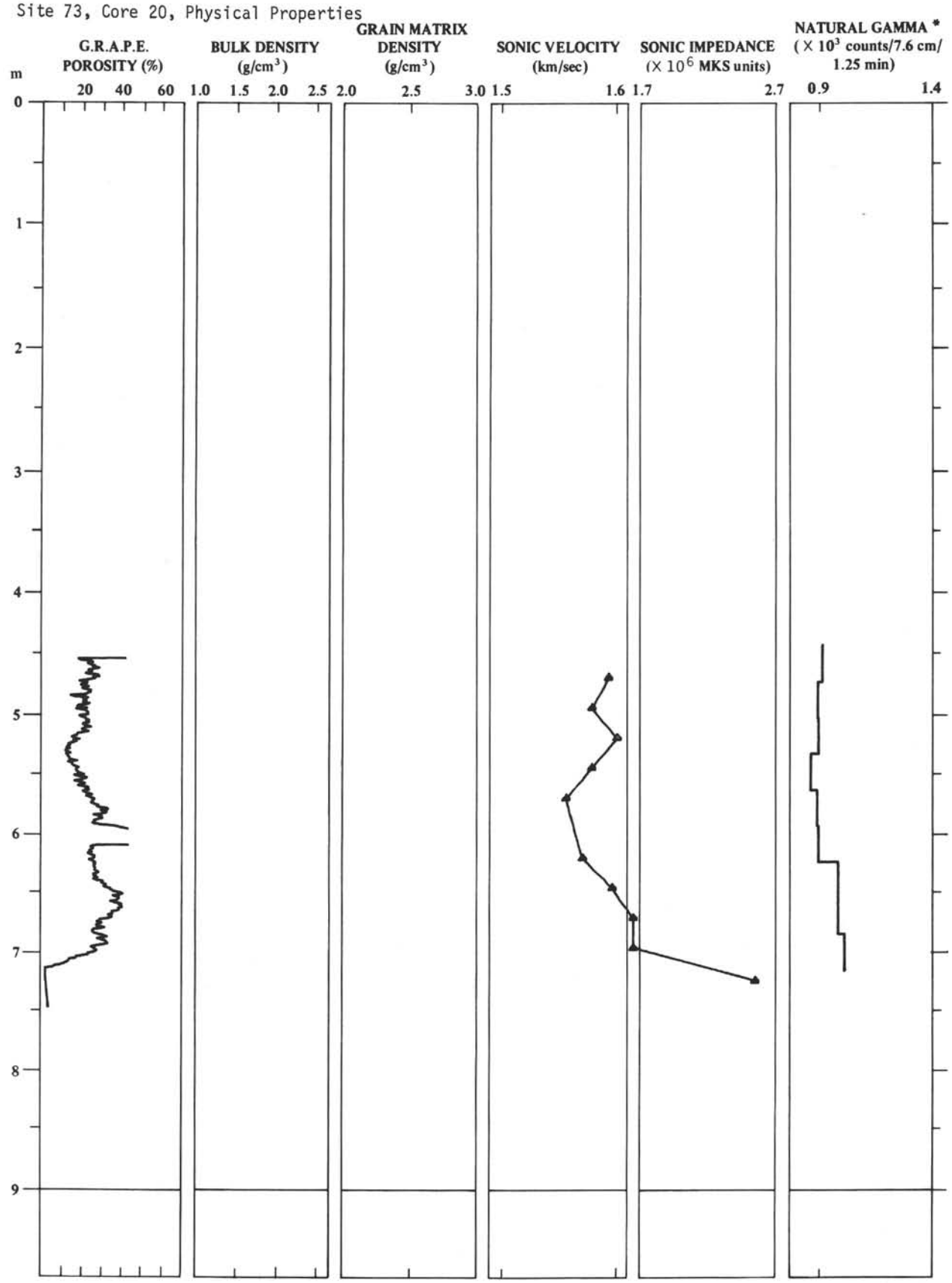
Site 73, Core 19, Physical Properties



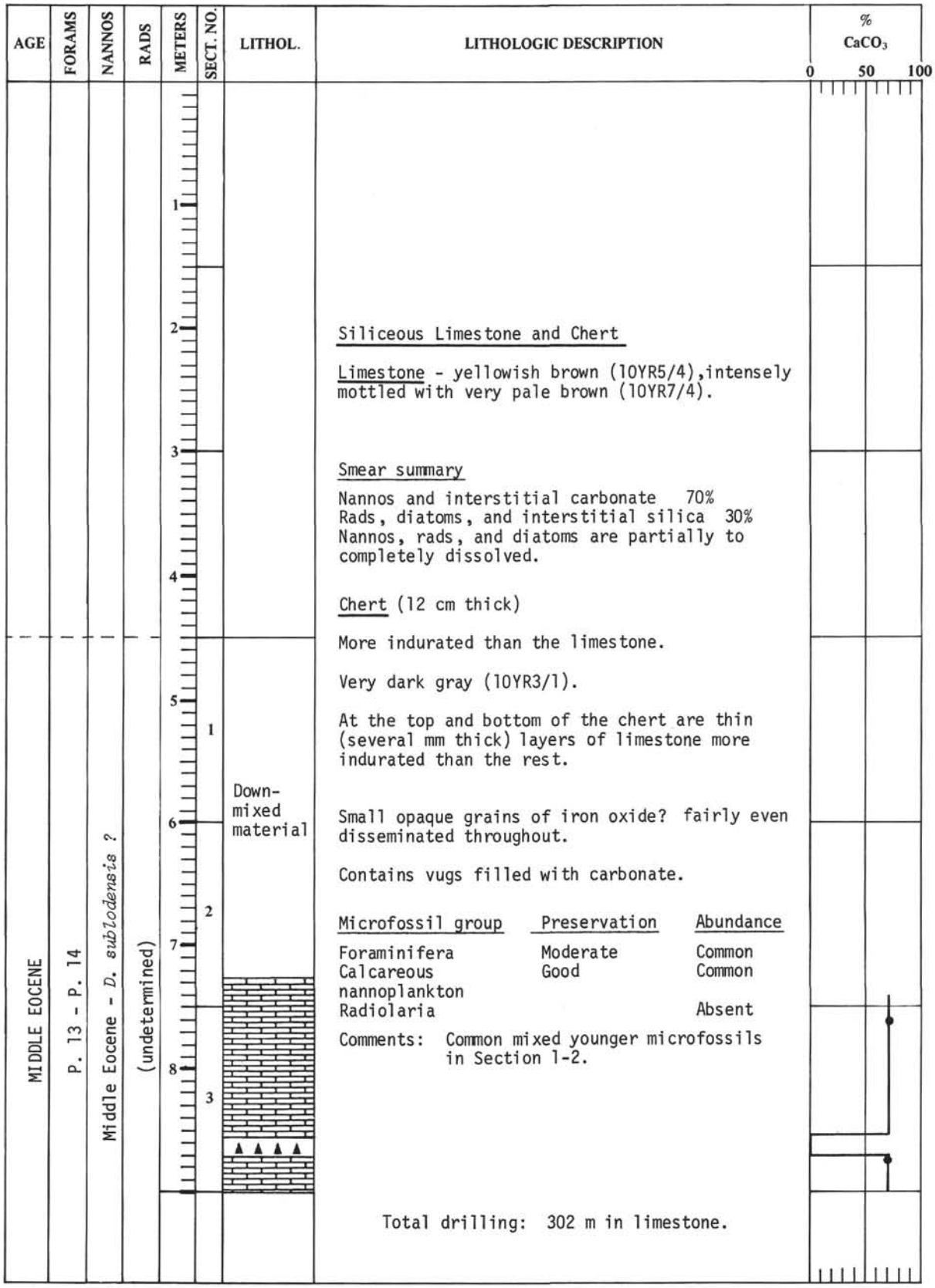
SITE 73 Core 20 Cored interval: 297-300 m



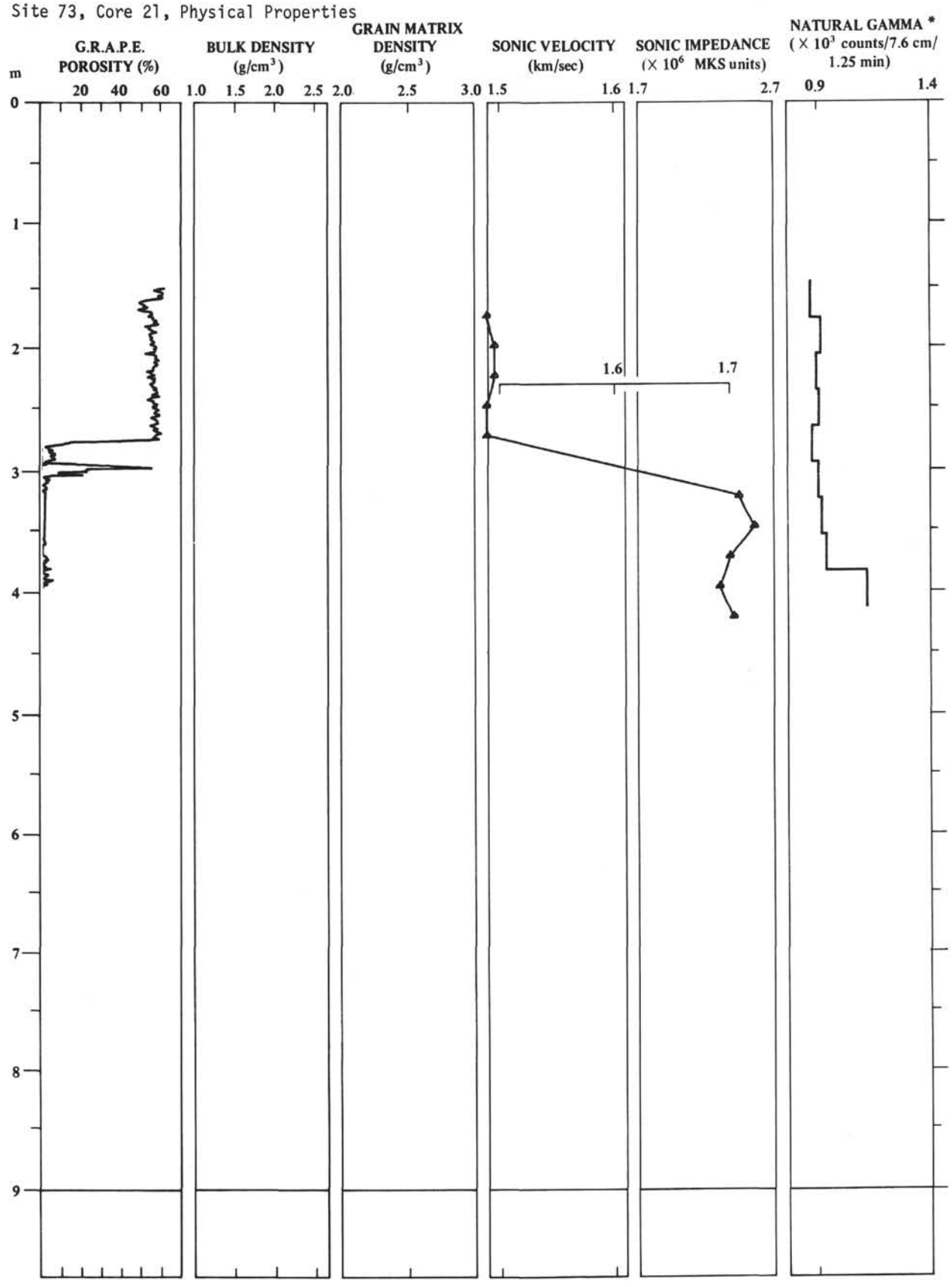
Site 73, Core 20, Physical Properties

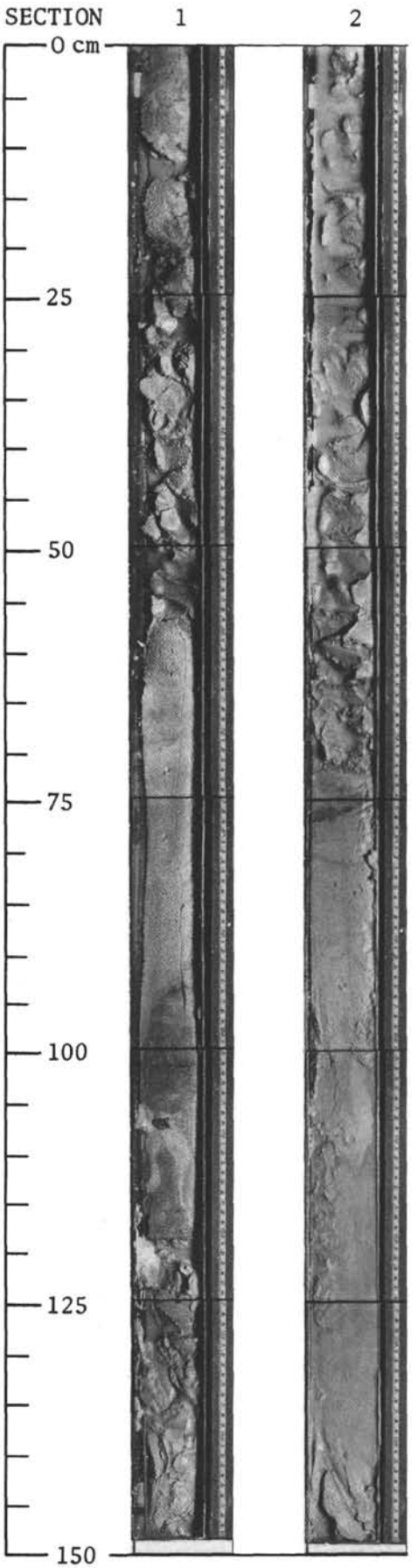


SITE 73 Core 21 Cored interval: 300-302 m

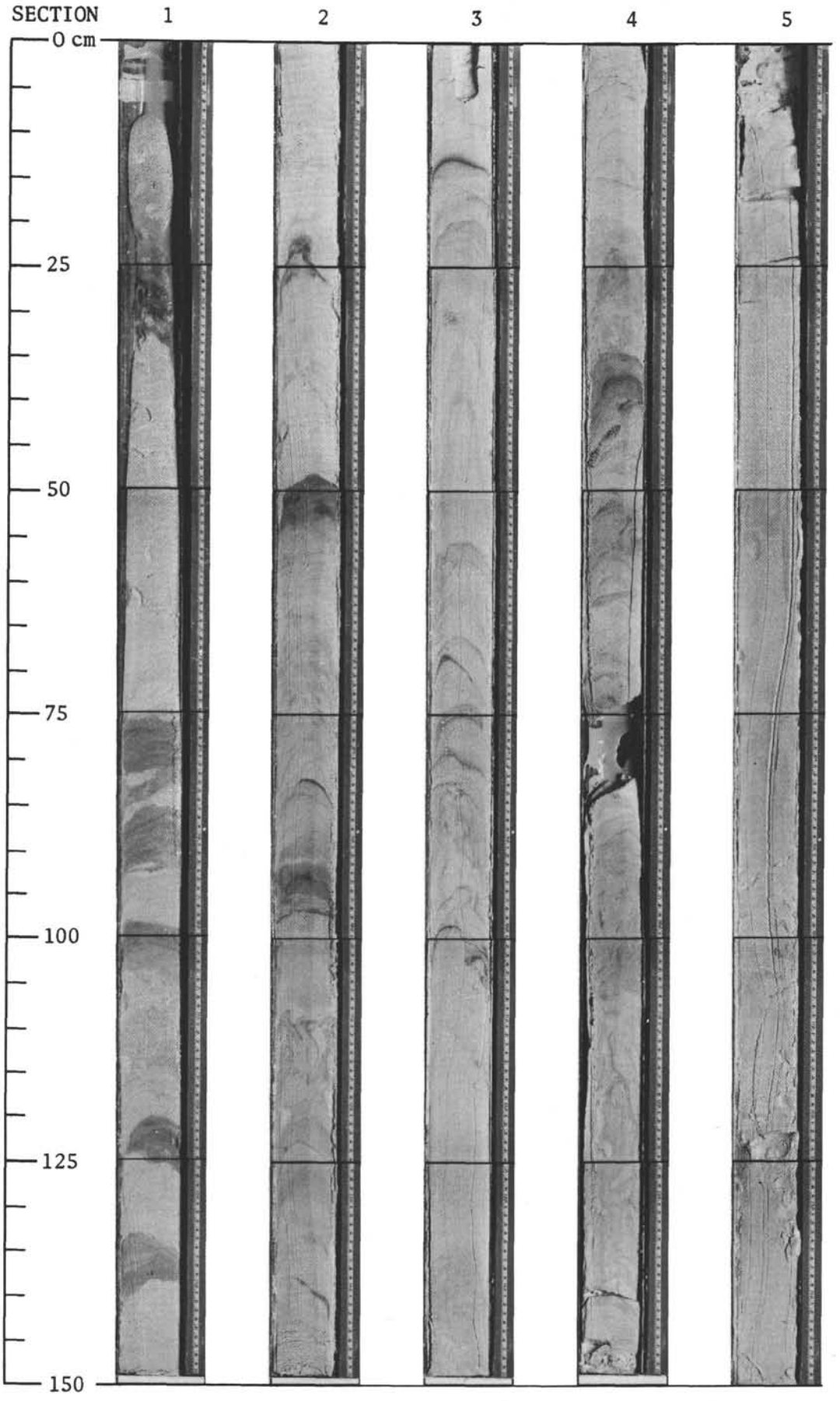


Site 73, Core 21, Physical Properties

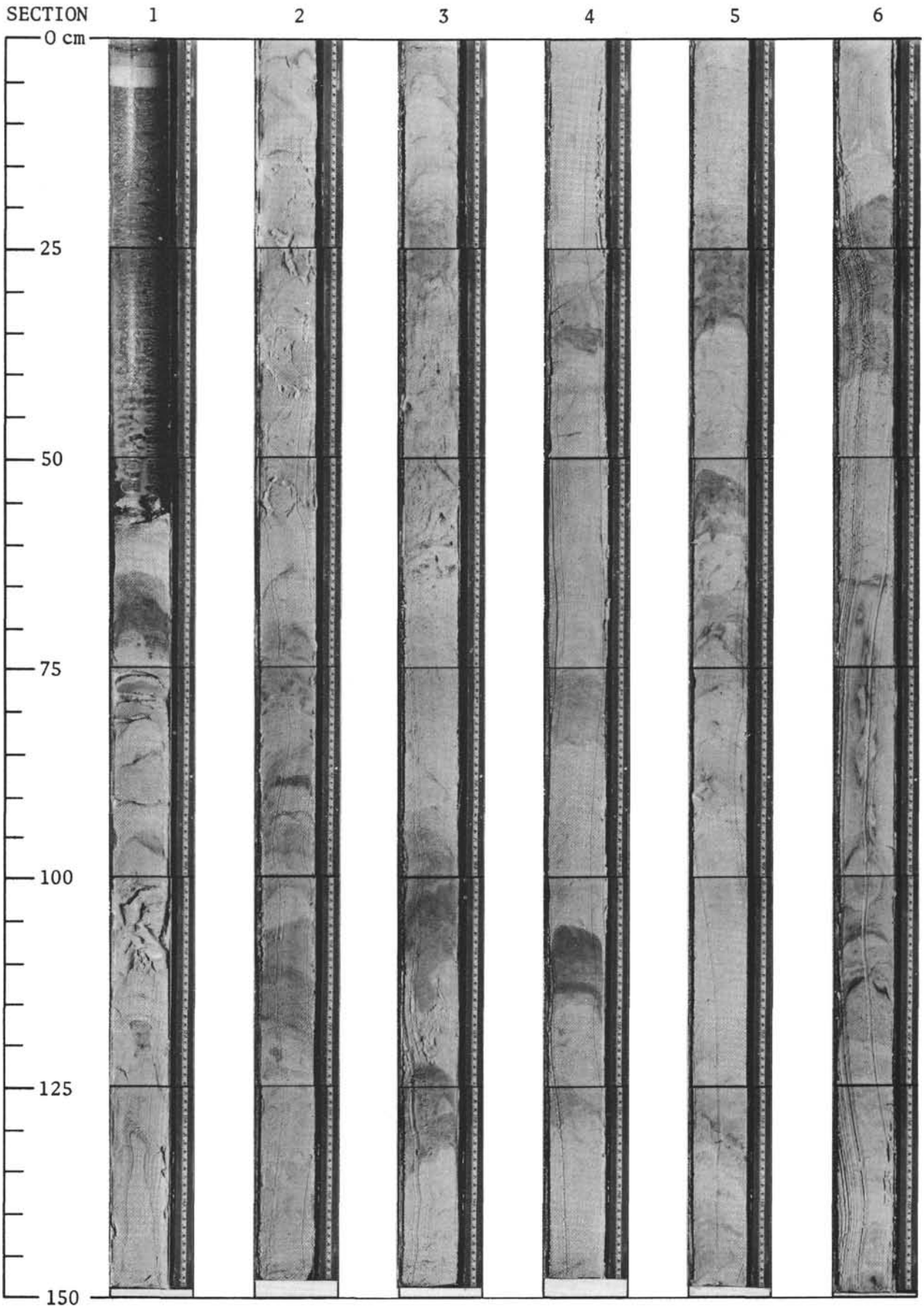




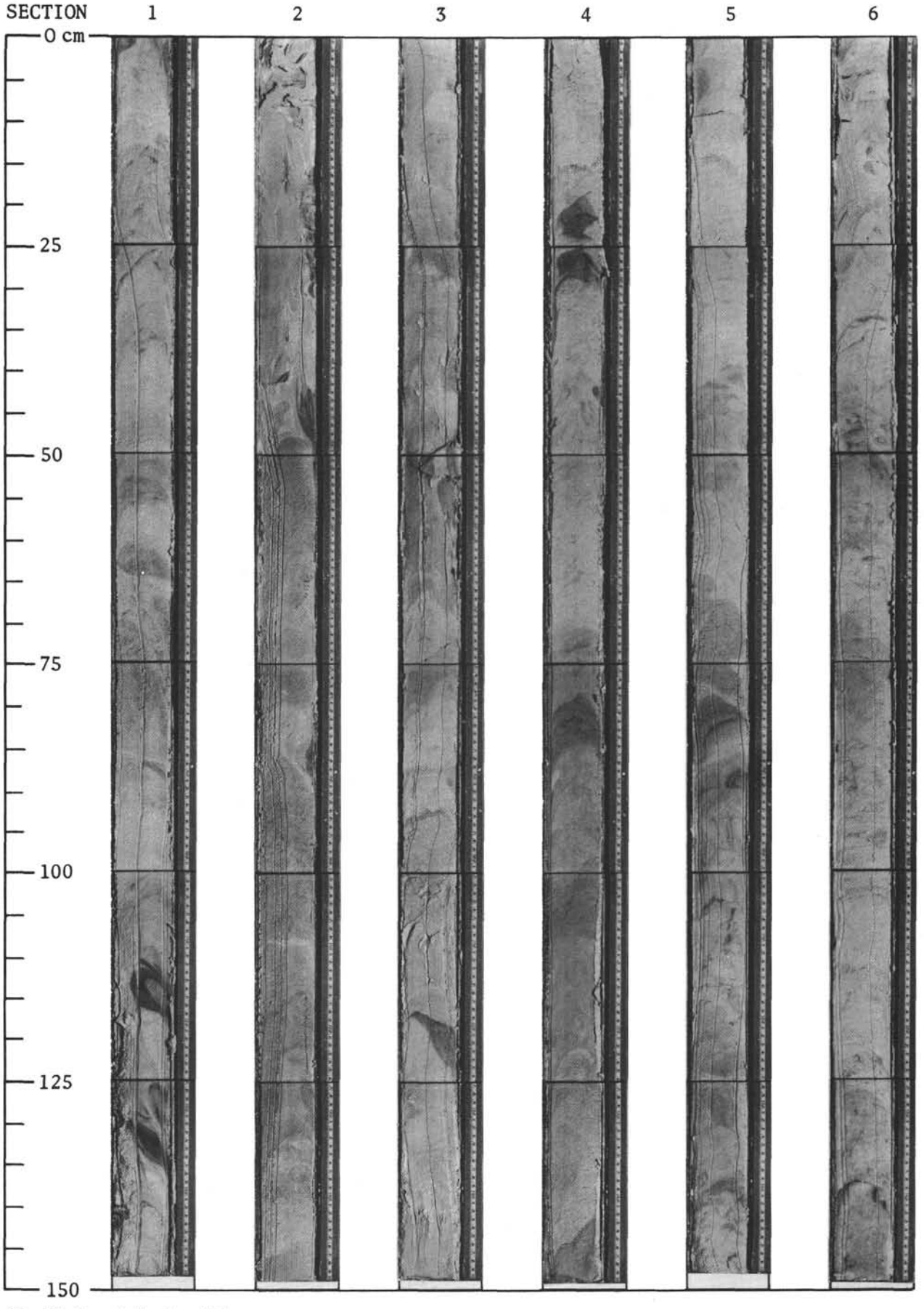

*Site 73, Core 1, Sections 1, 2.*



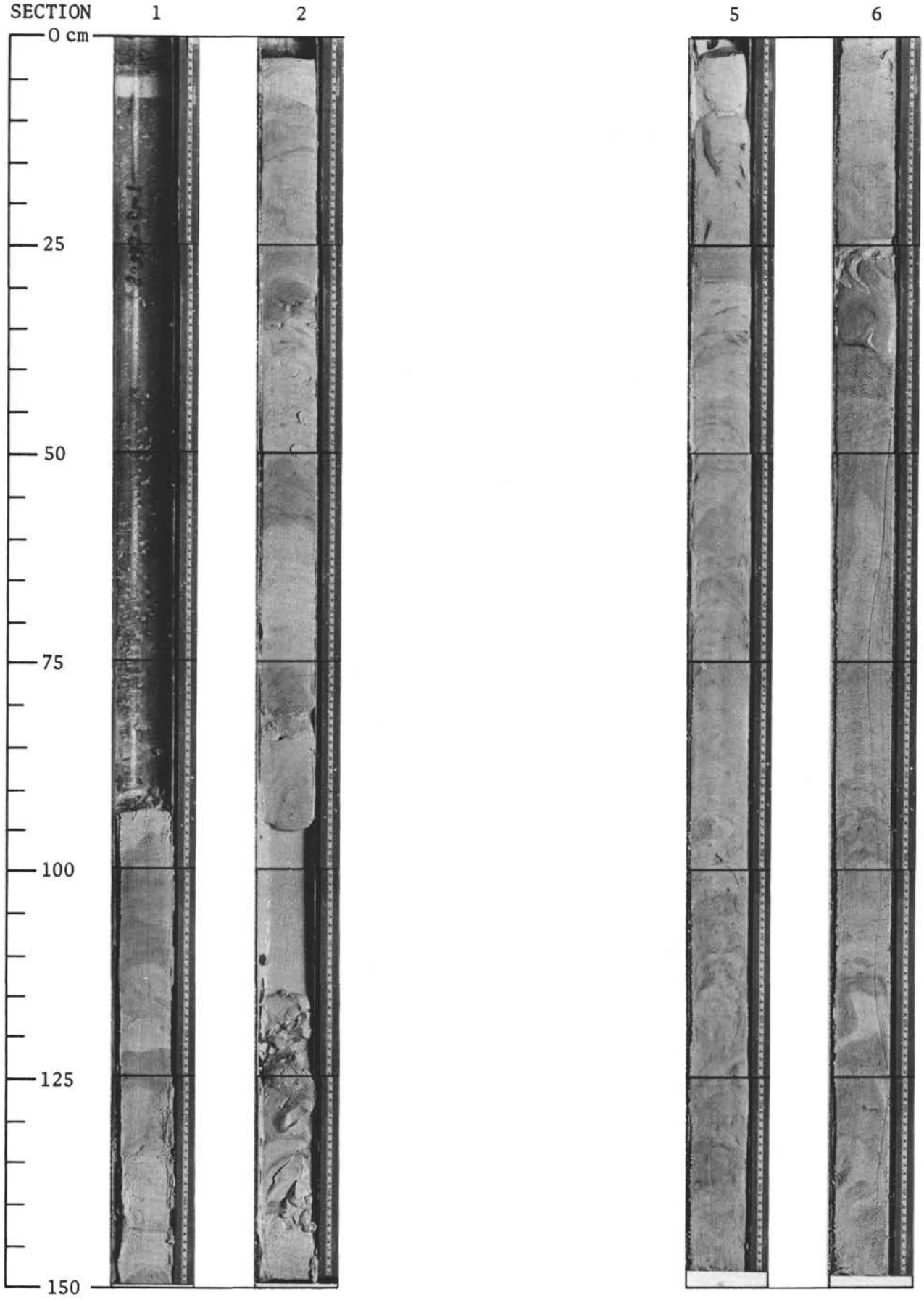

*Site 73, Core 2, Sections 1-5.*



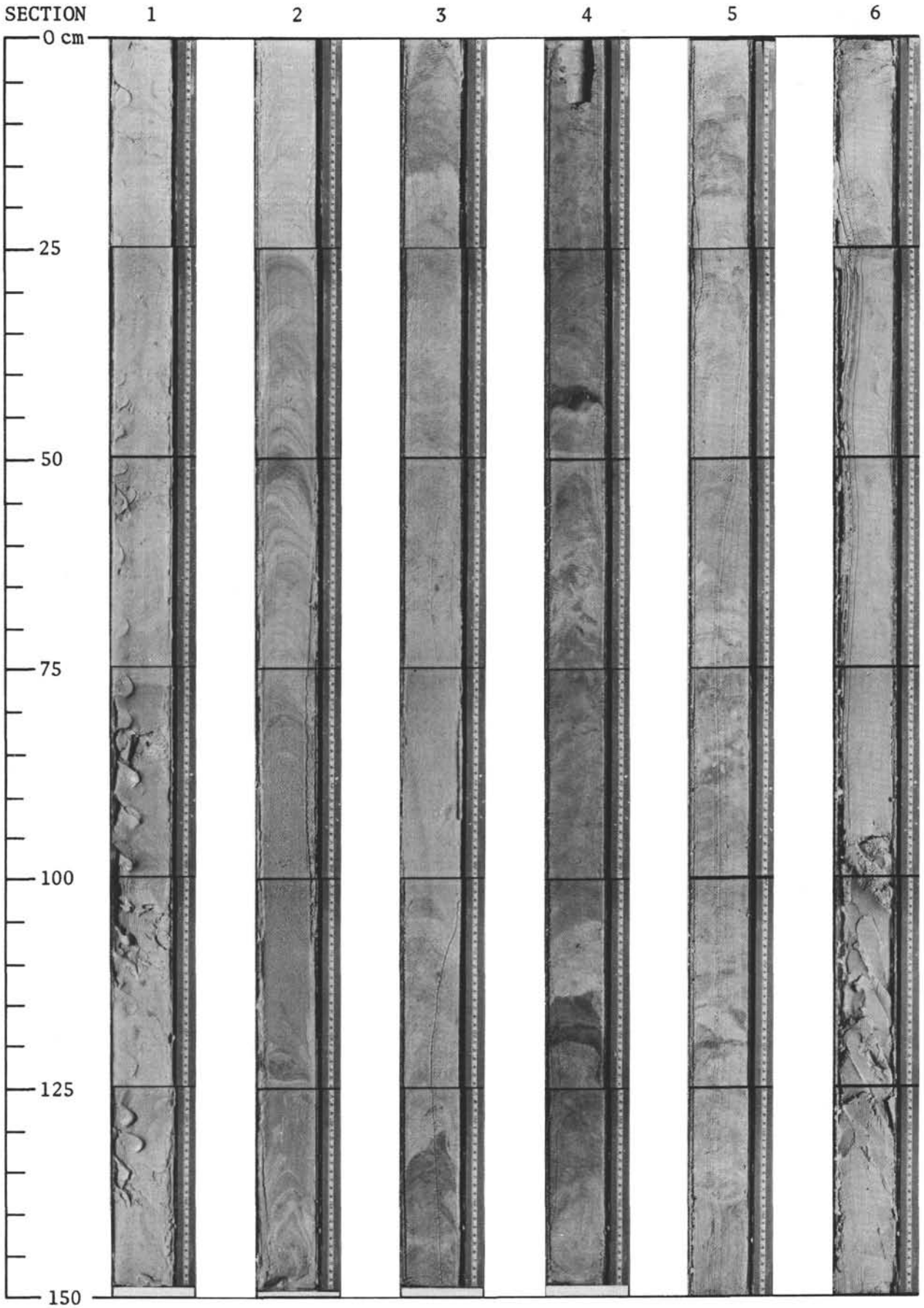

*Site 73, Core 3, Sections 1-6.*



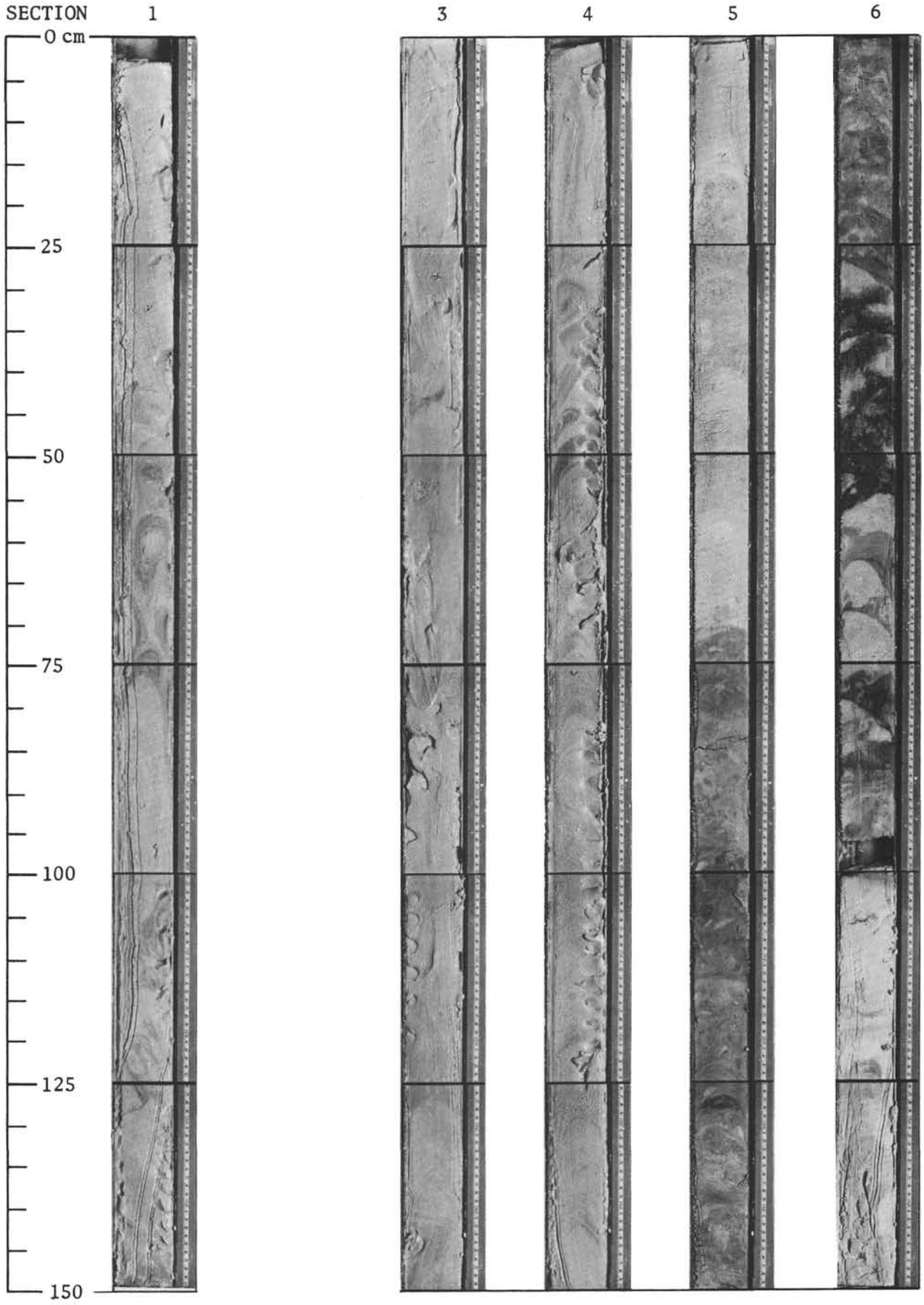

*Site 73, Core 4. Sections 1-6.*



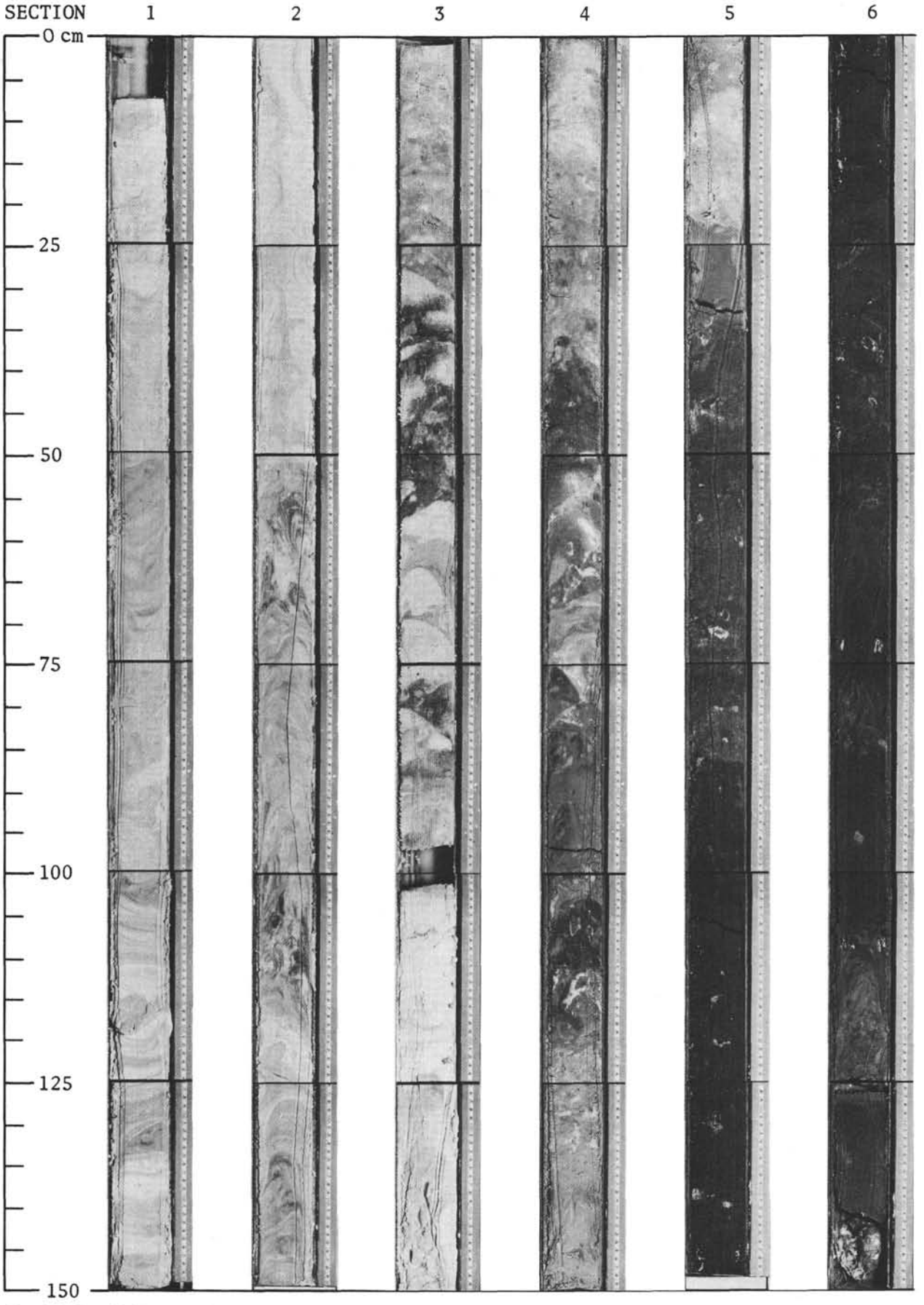

*Site 73, Core 5, Sections 1, 2, 5, 6.*



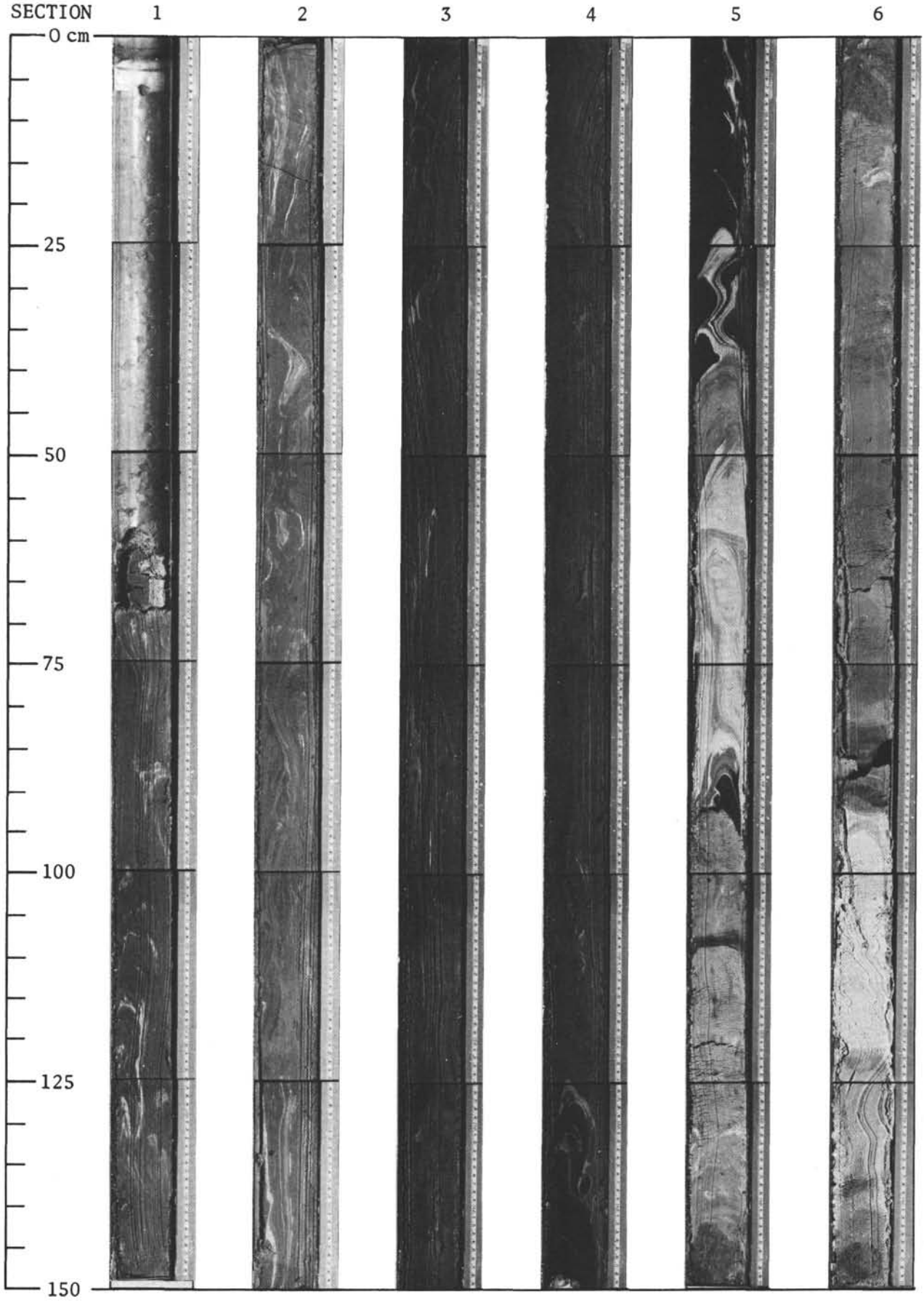

*Site 73, Core 6, Sections 1-6.*



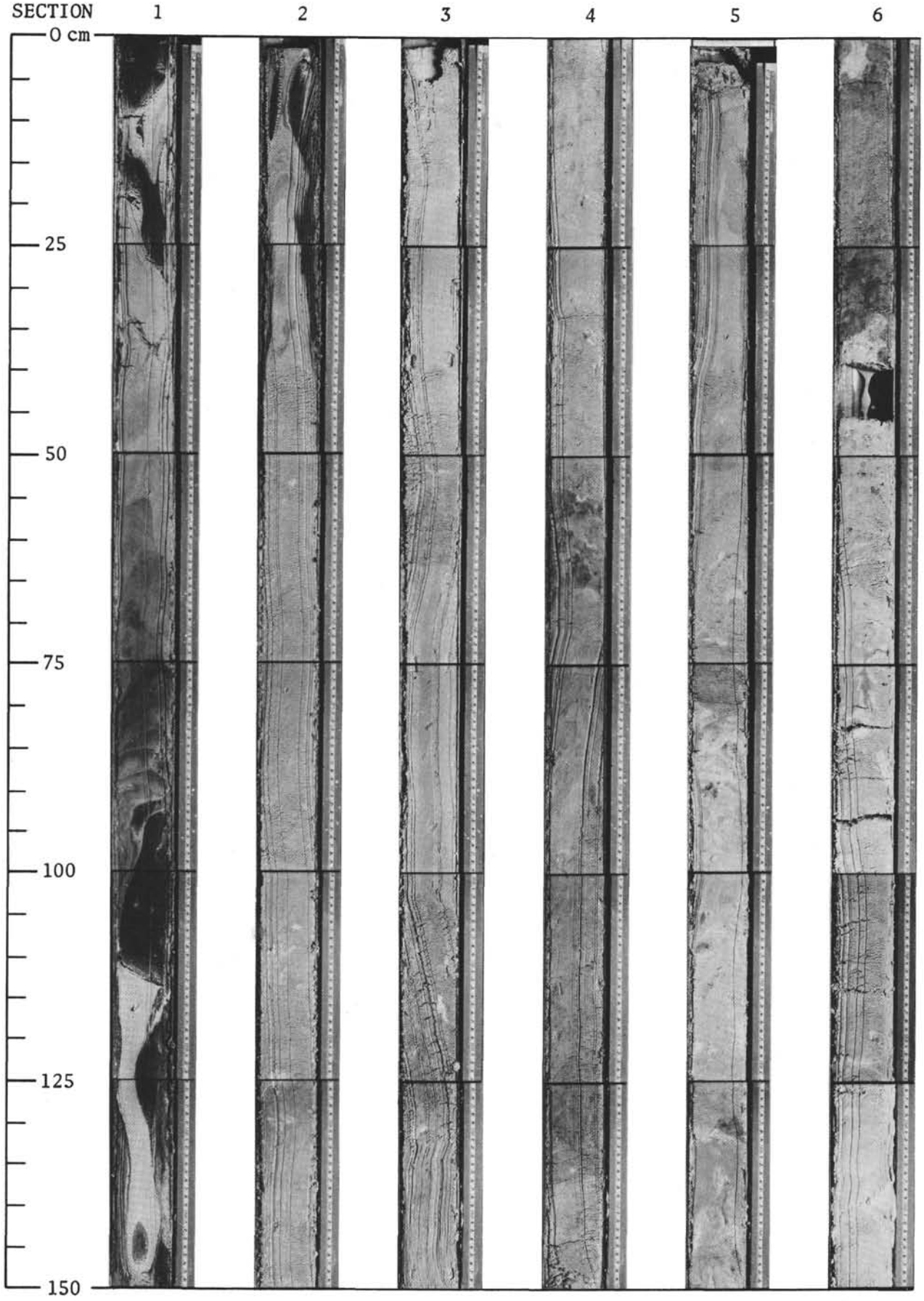

*Site 73, Core 7, Sections 1, 3-6.*



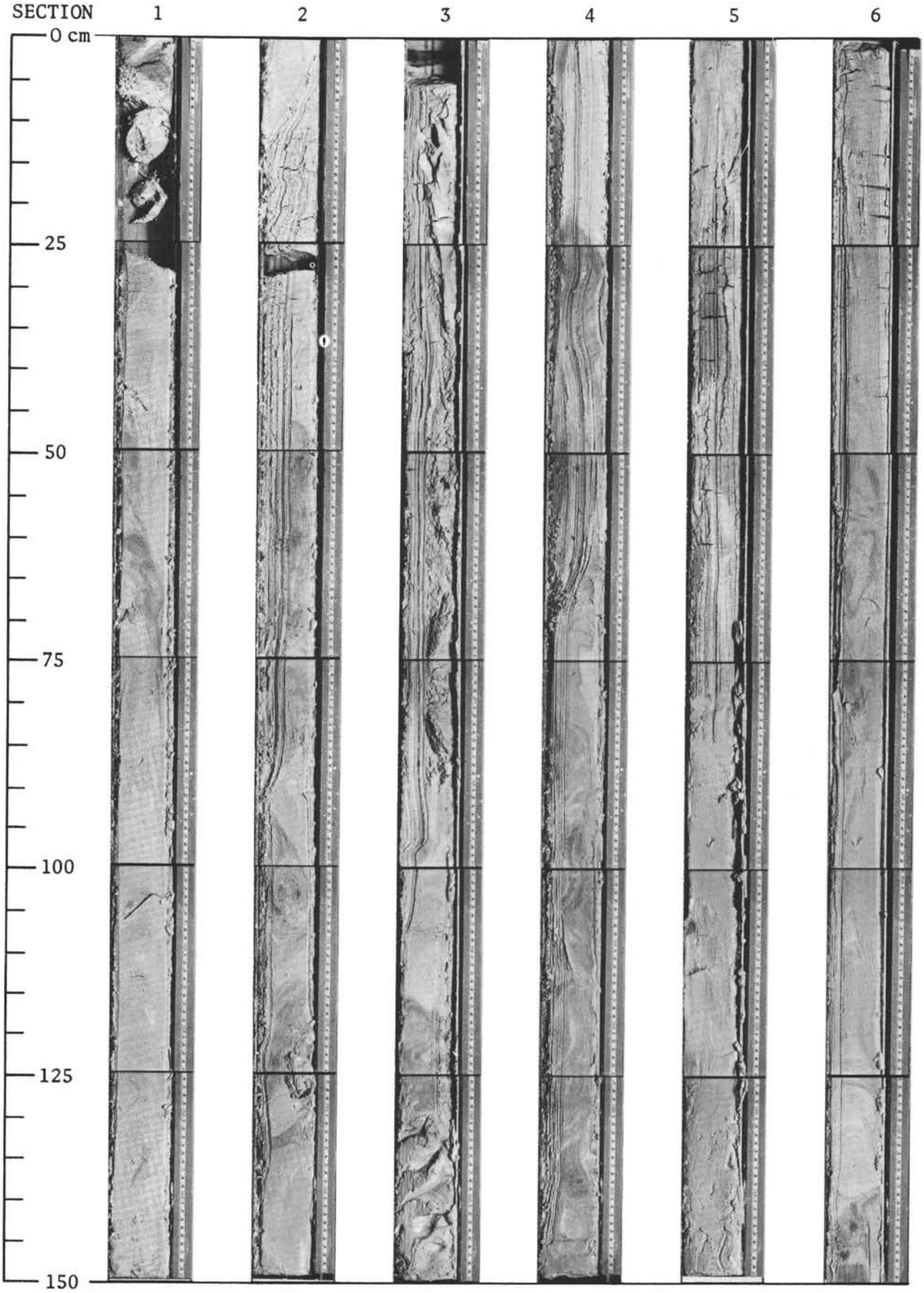

*Site 73, Core 8, Sections 1-6.*



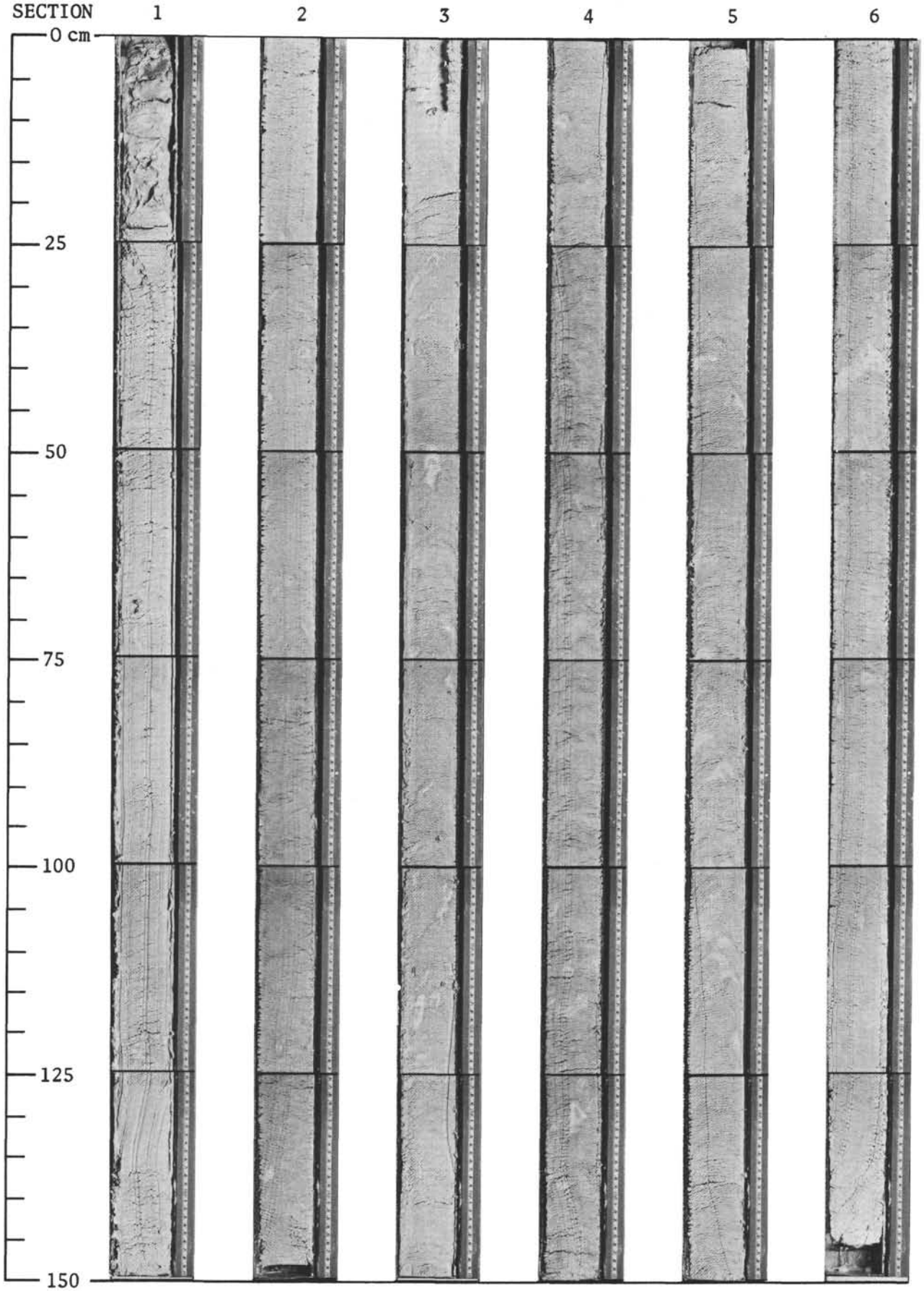

*Site 73, Core 9, Sections 1-6.*



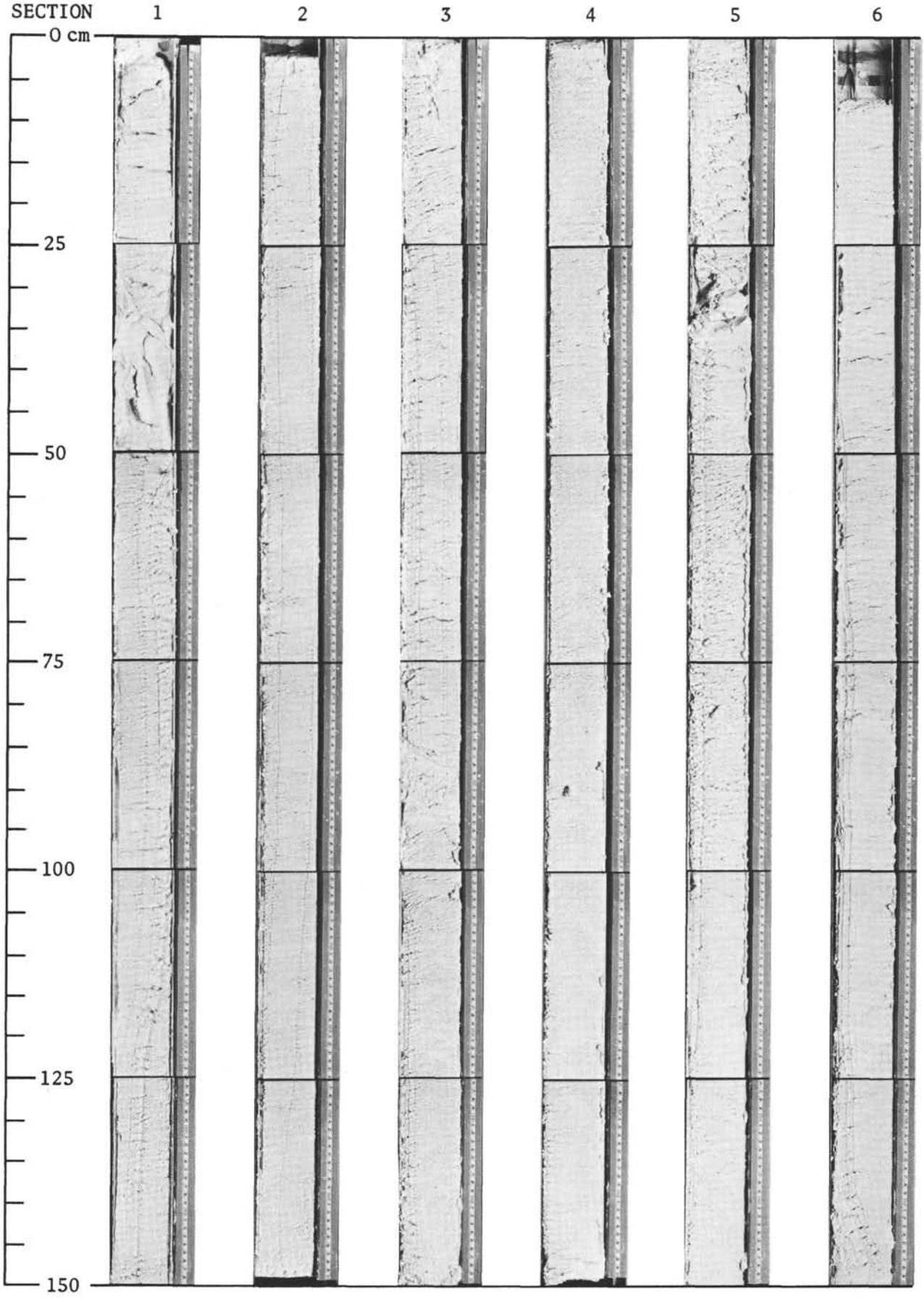

*Site 73, Core 10, Sections 1-6.*



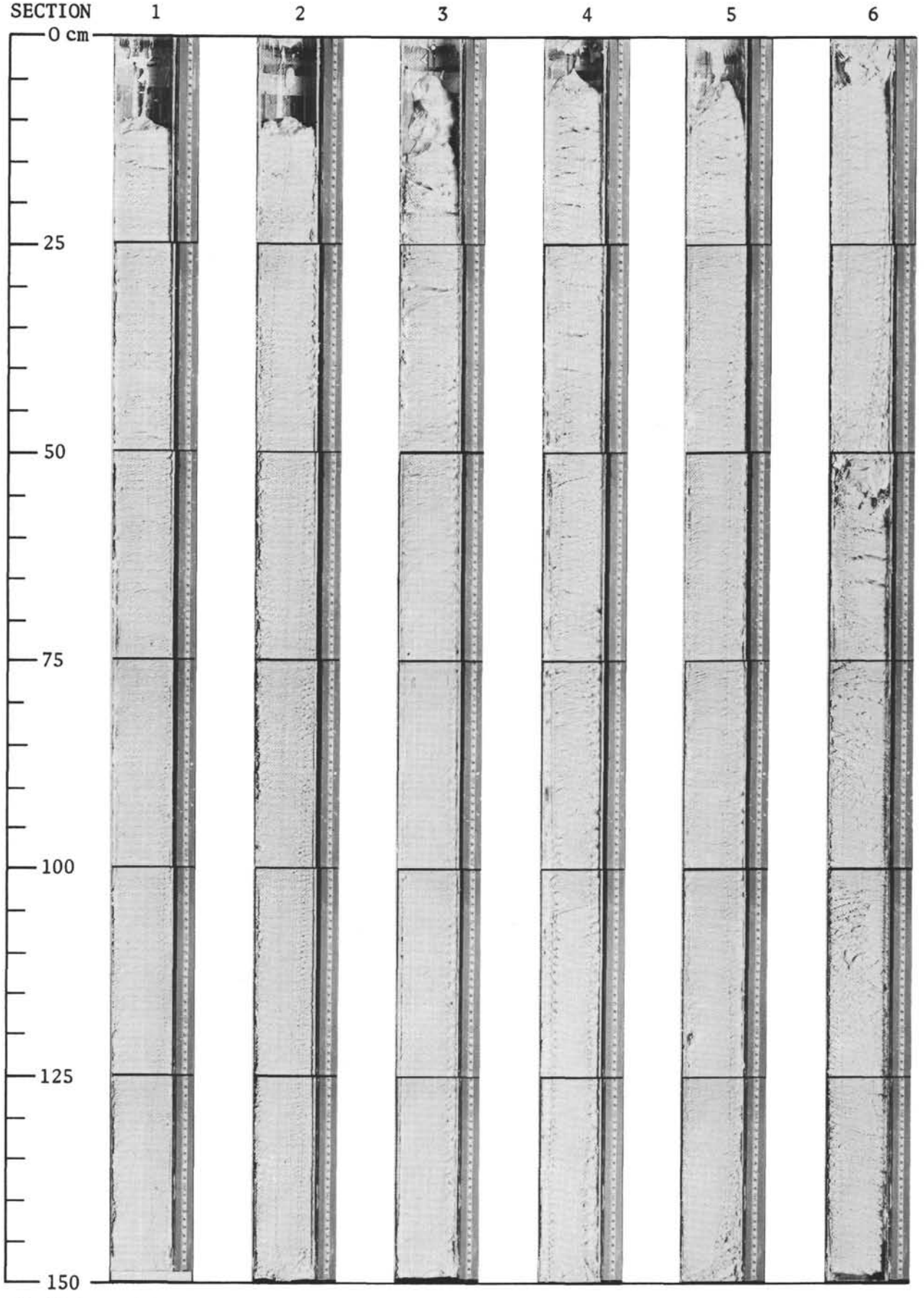

*Site 73, Core 11, Sections 1-6.*



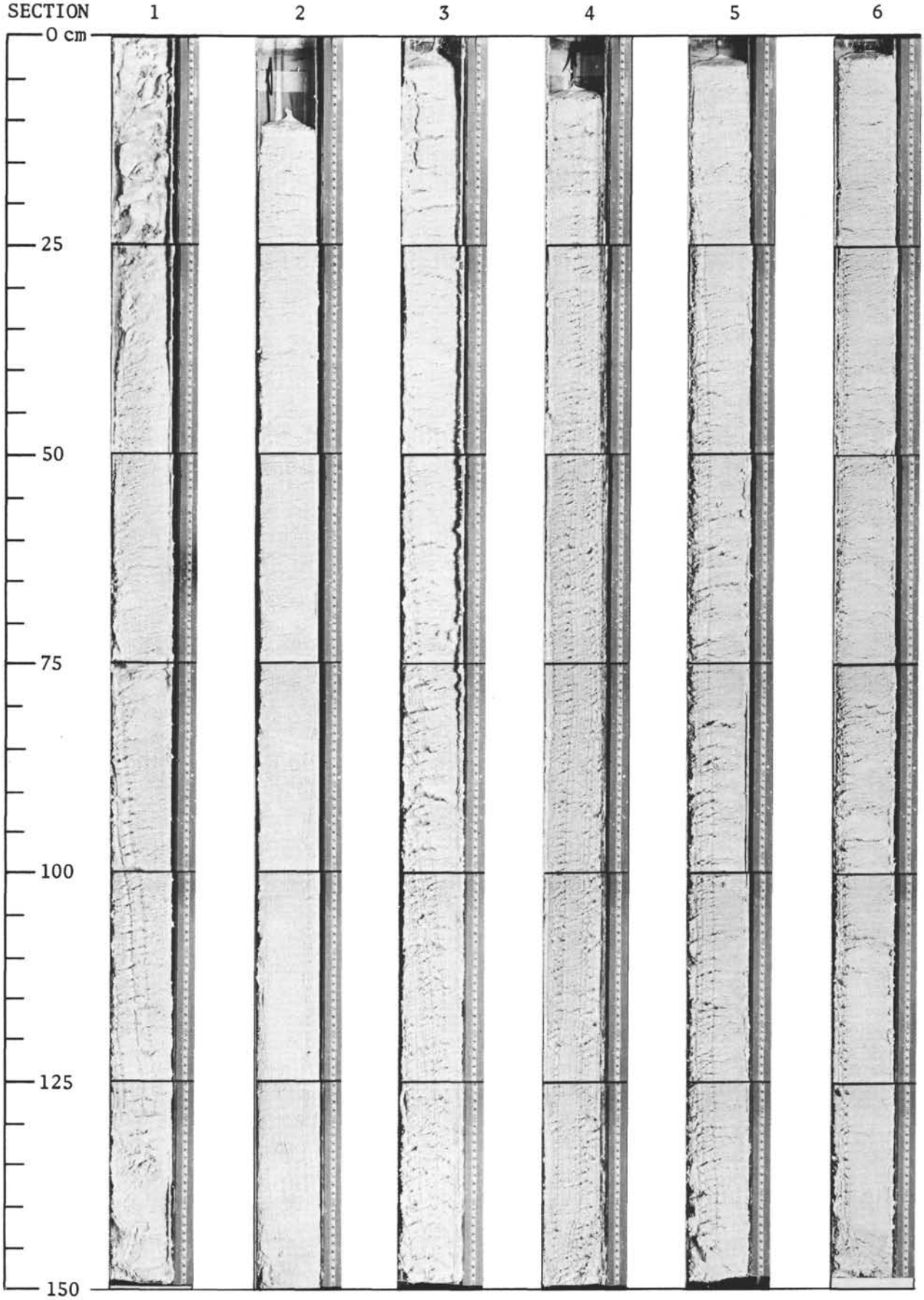

*Site 73, Core 12, Sections 1-6.*



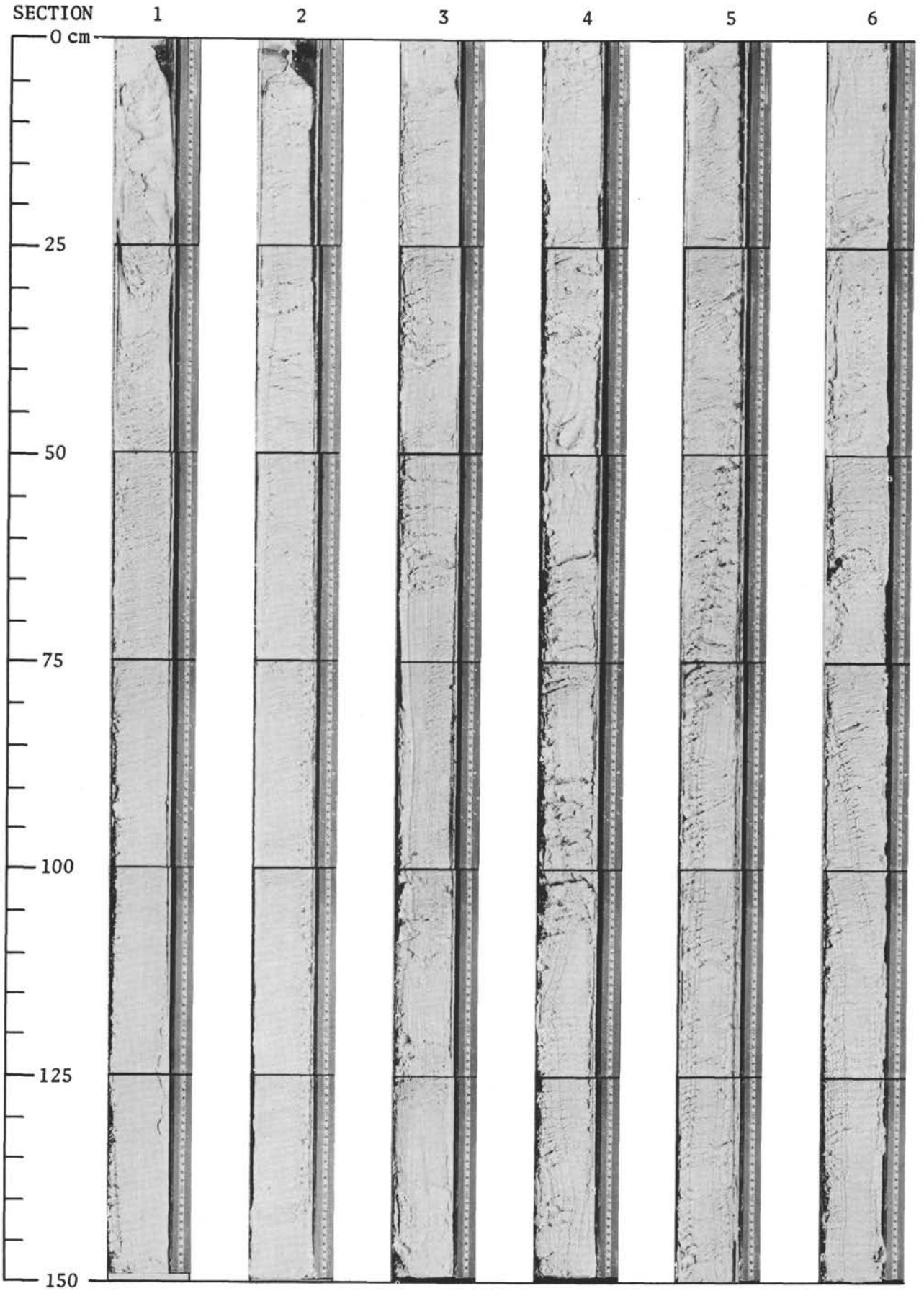

*Site 73, Core 13, Sections 1-6.*



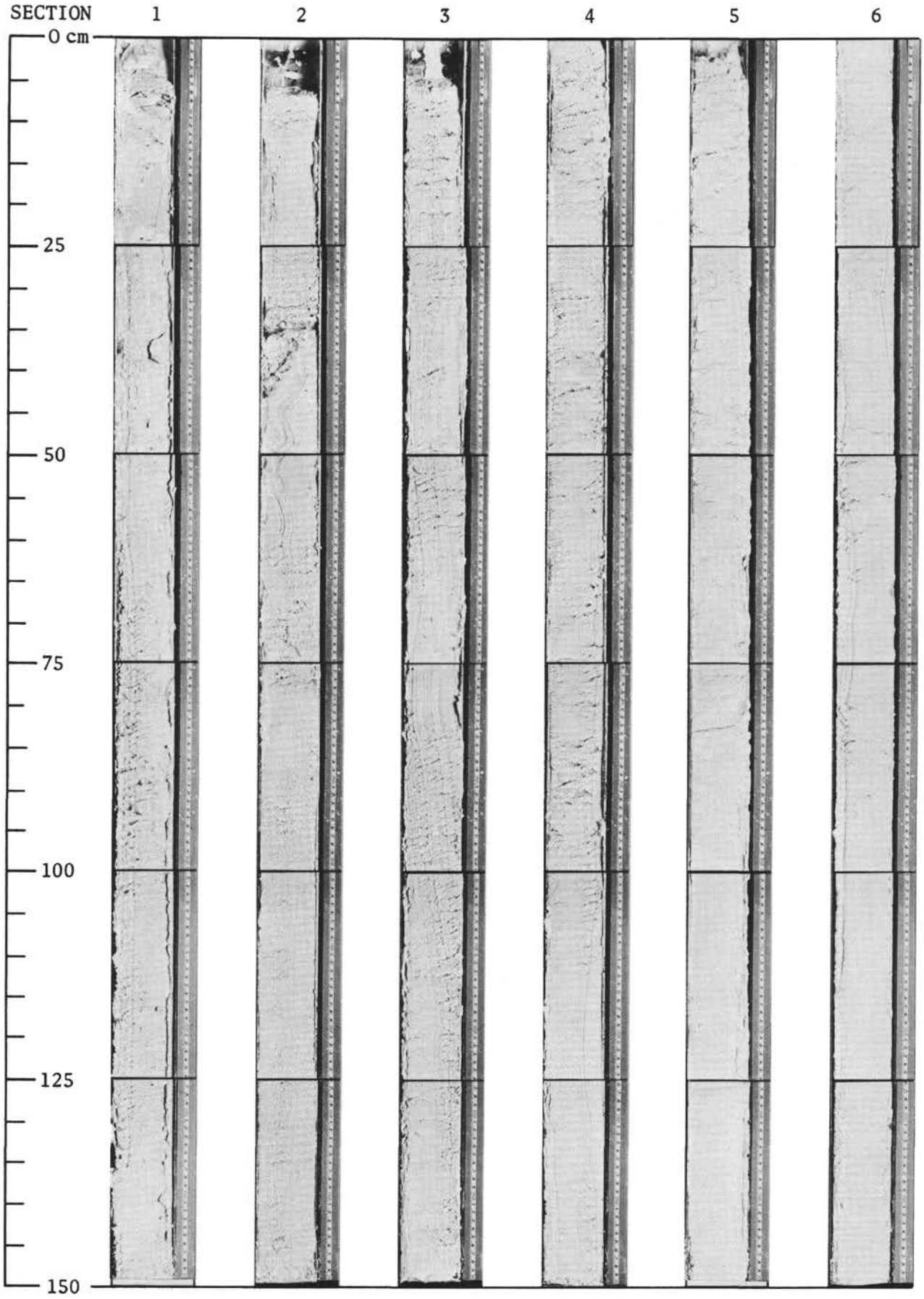

*Site 73, Core 14, Sections 1-6.*



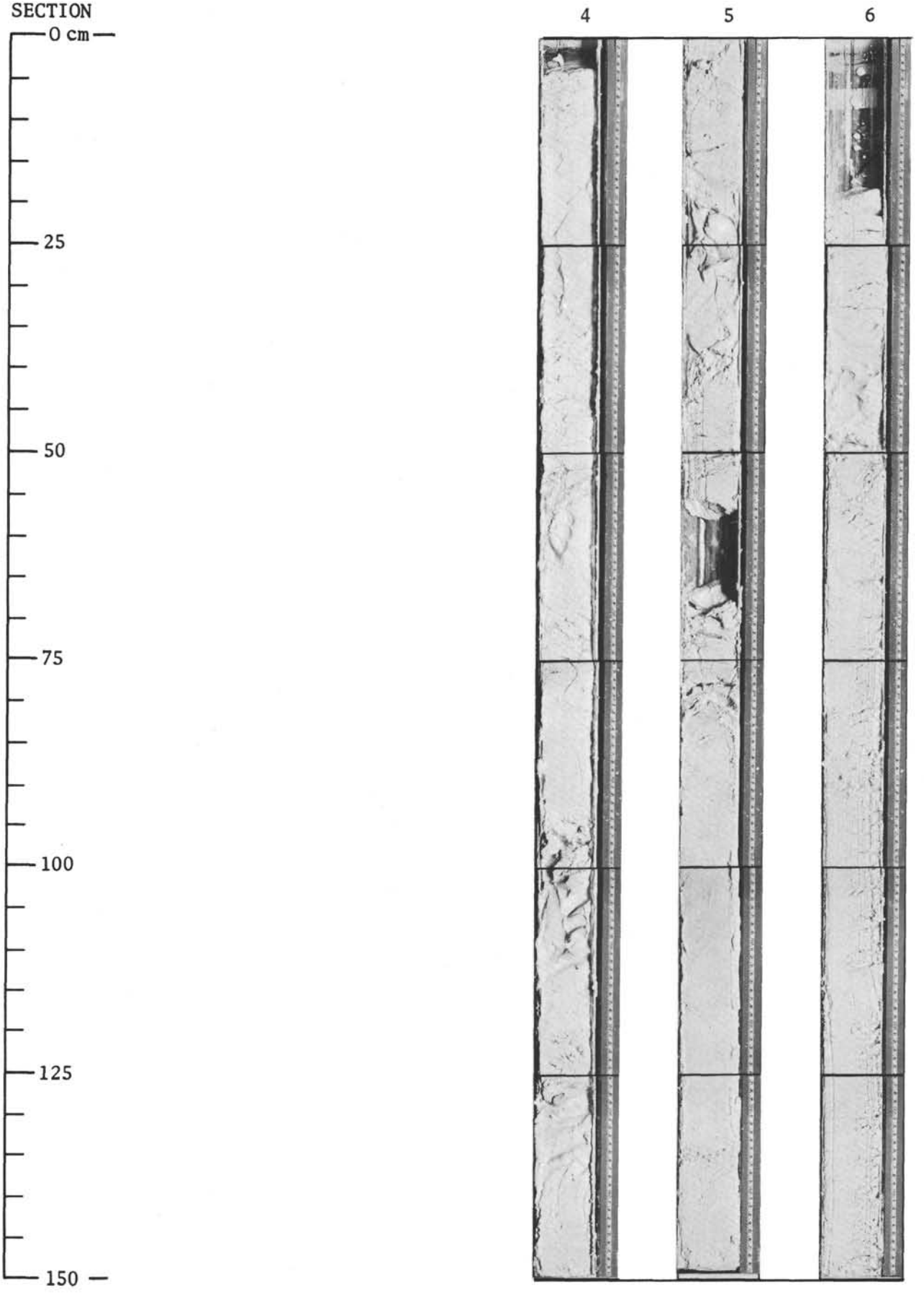

*Site 73, Core 15, Sections 1-6.*



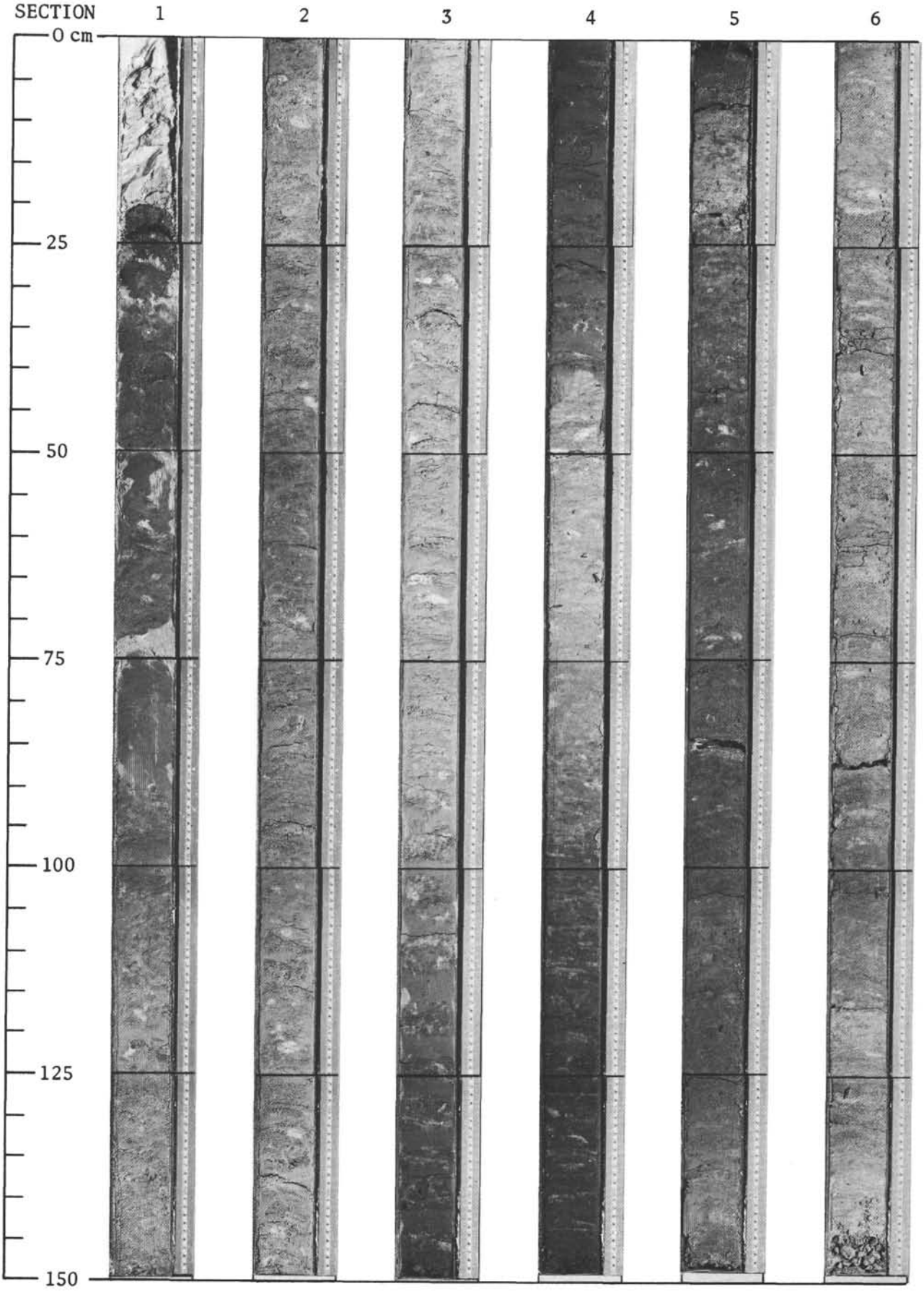

*Site 73, Core 16, Sections 1-6.*



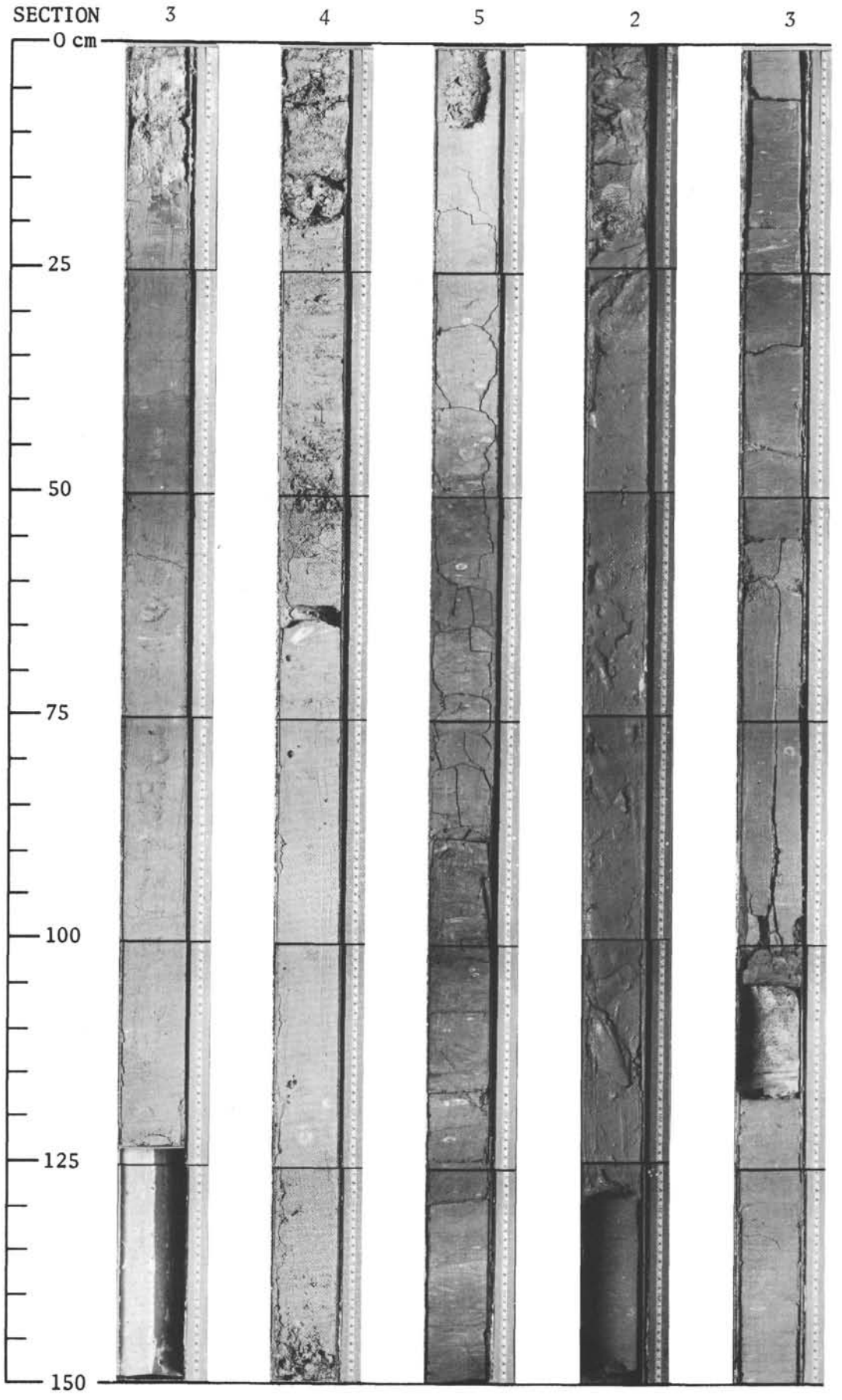

*Site 73, Core 17, Sections 1-6.*




*Site 73, Core 18, Sections 4, 5, 6.*




*Site 73, Core 19, Sections 1-6.*




*Site 73, Core 20, Sections 3, 4, 5.*

*Site 73, Core 21, Sections 2, 3.*