9. SITE 83

The Shipboard Scientific Party[1]

MAIN RESULTS

Site 83, drilled to the east of the East Pacific Rise, was cored almost continuously by discontinuous coring in two holes. The sediments are 242 meters thick and are underlain by intrusive basalt, as evidenced by the recovery of a baked sediment-basalt contact. Rates of accumulation are nearly constant at this site, showing little change with increasing age and averaging 21.1 m/m.y. The sediments are highly fossiliferous, and contain well-preserved foraminifera, Radiolaria, coccoliths and diatoms. The percentage of carbonate in the sediment increases with depth. The inferred age of the basal sediments is 10.5 million years, which is similar to the age of the basal sediments at Site 82. Both sites are nearly equidistant from the East Pacific ridge crest, suggesting that the basal sediment ages reflect underlying basement ages resulting from symmetrical spreading.

INTRODUCTION

Background and Objectives

This site is located in an area previously described as actively spreading at right angles to the East Pacific Rise with a source in the Galapagos area (Figure 1). The basement is unusually smooth. The objectives at this site as stated by the JOIDES Pacific Panel were to establish the biostratigraphy of the region and to sample and date the smooth basement surface. This site is nearly the same distance from the East Pacific Ridge crest as Site 82, so if the basal sediments provide a good indication of basement age, and the ridge is spreading symmetrically, then basal sediments at Site 83 should be about the same age as the basal sediments at Site 82.

[1] J. D. Hays, Lamont-Doherty Geological Observatory, Palisades, New York; H. E. Cook, University of California, Riverside; D. G. Jenkins, University of Canterbury, Christchurch, New Zealand; F. M. Cook, independent; J. Fuller, Kennecott Exploration, Inc., San Diego, California; R. Goll, Lamont-Doherty Geological Observatory, Palisades, New York; E. D. Milow, Scripps Institution of Oceanography, La Jolla, California; W. Orr, University of Oregon, Eugene, Oregon.

Operations

Site Survey

The site was approached on course 078°. Both the basement and the sea floor showed considerable relief amounting to a maximum of about 80 fathoms. When the *Challenger* reached a relatively level area the site survey was begun (see Figure 2). During the survey the relief of basement and the sea floor was very small. The sediment thickness was quite uniform, averaging about 0.33 second penetration or about 280 meters using a sound velocity in the sediment of 1.7 km/sec. The sediments along the survey track are stratified, with the most intense stratification in the upper 0.1 second interval.

Coring

The *Challenger* arrived at the drilling site at 1841 hours January 17, 1970 and after dropping one Burnett beacon we lowered the drill string to the sea floor. The driller took the first core at 3630 meters below the rig floor which was 2 meters above the P.D.R. depth. When the core was recovered it contained 4.9 meters of sediment. This suggests that the top of the sediment column was cored and recovered. Three continuous cores were taken down to a depth of 76 feet. Coring then proceeded at roughly 45-meter intervals until basement was reached at 240 meters (Tables 1 and 2). In order to recheck the acoustical thickness of the section we passed over the beacon after completing our station work. We came within 120 feet of being directly over the beacon and the sediment thickness shown was 0.30 seconds. Again, using a sound velocity of 1.7 km/sec this gives a sediment thickness of 255 meters; this is probably within the margin of error of reading the profiler record.

LITHOLOGY

Three sedimentary formations are present at Site 83: the Clipperton Oceanic Formation (0 to 12.6 meters) which consists of the cyclic unit of interbedded brown siliceous and orange calcareous oozes; the San Blas Oceanic Formation (12.6 to 222 meters) of green montmorillonite-rich calcareous ooze and chalk; and the Line Islands Oceanic Formation (222 to 233 meters). Basement at this site is a black, very fine-grained basalt.

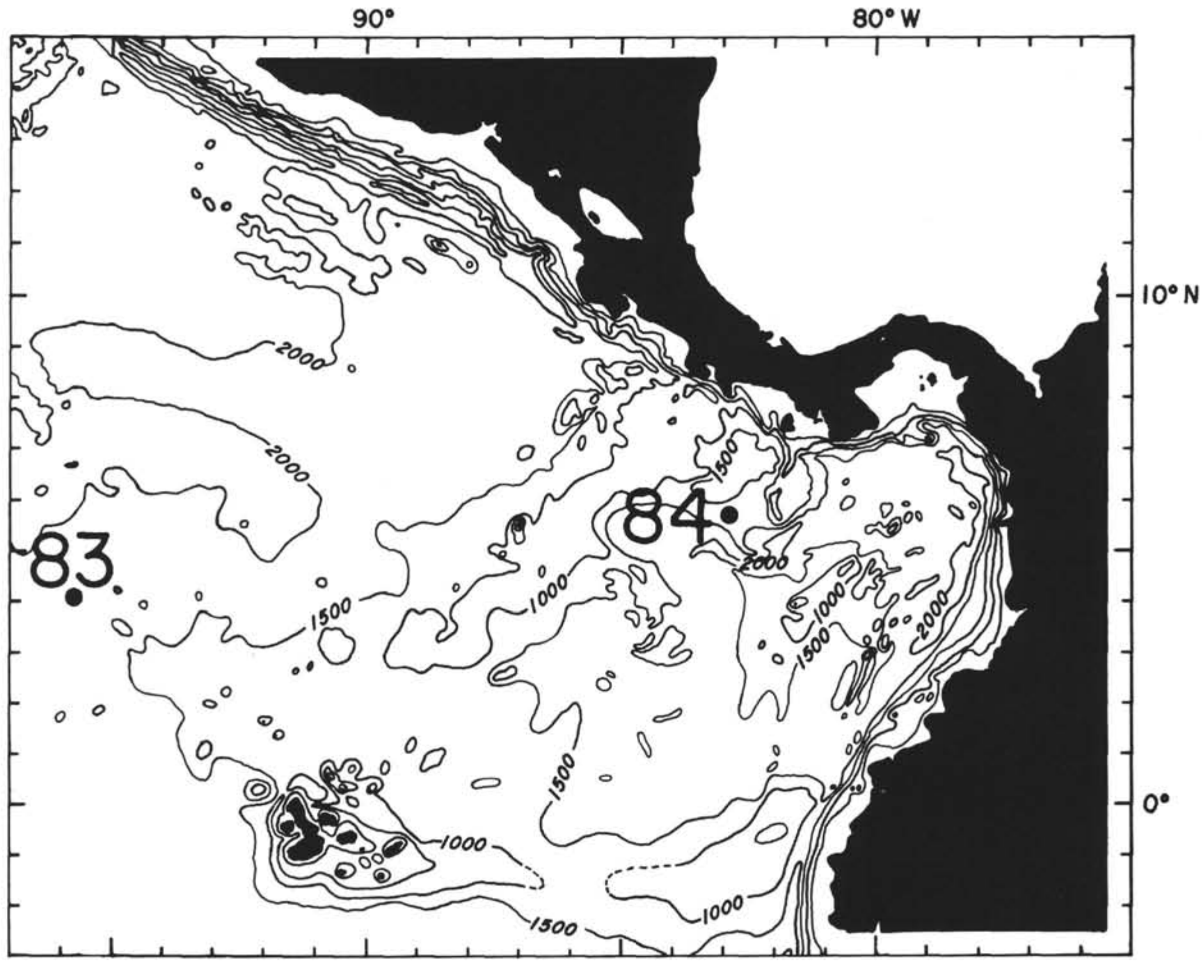


Figure 1. *Location of Sites 83 and 84.*

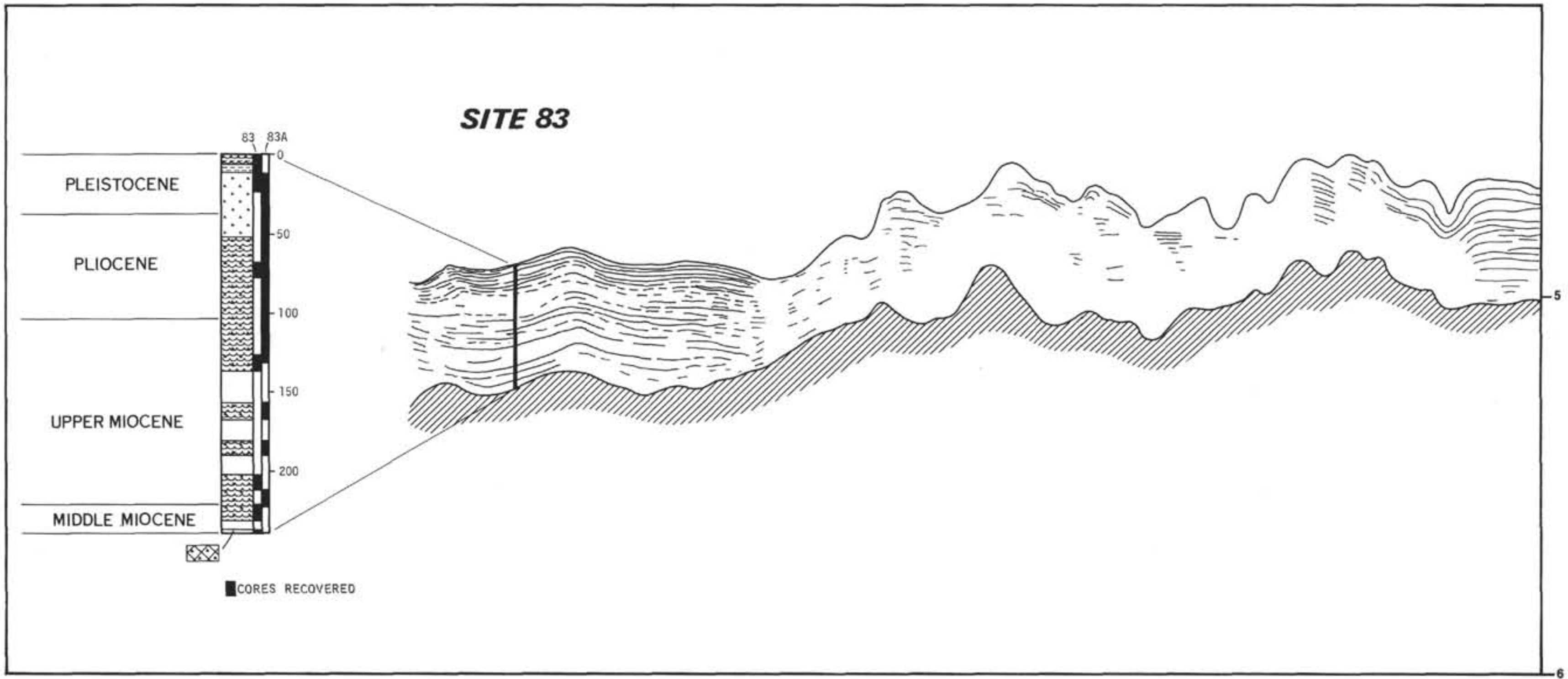


Figure 2. *Sketch of seismic reflection record in vicinity of Site 83 showing interval cored in each hole.*

TABLE 1
Site Operational Summary

Site 83

Latitude: 04° 02.8'N; Longitude: 95° 44.25'W.

Time of arrival: 1841 hours, 1/17/70; Time of departure: 0654 hours, 1/20/70.

Total time of site: 2 days, 22 hours, 13 minutes.

Water depth: 3632 meters.

Sediment thickness determined by drilling: 241 meters.

Acoustical thickness: 0.3 second.

Average sound velocity of sediments: 1.6 km/sec.

Hole	Penetration (m)	Cores Attempted	Cores Recovered	Per Cent Cored	Recovery (m)	Per Cent Recovered
83	241.5	9	9	25.5	46.8	76.0
83A	219.5	16	16	66.7	142.1	97.1
Total 2	241.5	25	25	85.7	188.9	90.9

Clipperton Oceanic Formation

Cyclic Unit (0 to 12.6 meters)

At this site the cyclic unit is characterized by its dark brown and orange colored sediments that occur in 5 to 75 centimeter thick beds with sharp contacts. A complete cycle (Figure 71) consists from top to base of:

1. Grayish-orange (10YR7/4) clay (2 to 5 per cent)–radiolarian (10 to 20 per cent)–foraminiferal (30 to 40 per cent)–calcareous nannofossil (30 to 40 per cent) ooze.

2. Dark yellowish-brown (10YR4/2) radiolarian (10 to 20 per cent)–clay (20 to 30 per cent)–foraminiferal (30 to 40 per cent)–calcareous nannofossil (30 to 40 per cent) ooze.

3. Dusky brown (5YR2/2) foraminiferal (15 to 20 per cent)–radiolarian (15 to 20 per cent)–clay (30 to 40 per cent)–calcareous nannofossil (30 to 40 per cent) ooze.

The cyclic unit grades into the San Blas Formation over a 40-centimeter interval, within which brown and green beds are interbedded.

San Blas Oceanic Formation

The San Blas is characterized by its various shades of green oozes and chalks that derive their color from ubiquitous fine-grained green montmorillonite (Cook and Zemmels, 1971).

For the purpose of possible future correlations the San Blas is subdivided in three informal units at this site.

Unit 1 (12.6 to 49.6 meters)

Unit 1 is dominated by very dark shades of green and, in general, appears to have a higher calcium carbonate ($CaCO_3$) content than the underlying two units. Unit 1 consists of:

1. Dark greenish-gray (5G4/1) montmorillonite (2 to 5 per cent)–radiolarian (10 to 20 per cent)–foraminiferal (20 to 30 per cent)–calcareous nannofossil (50 to 60 per cent) ooze chalk.

2. Greenish black (5GY2/1) montmorillonite (5 to 15 per cent)–foraminiferal (10 to 15 per cent)–radiolarian (20 to 30 per cent)–calcareous nannofossil (40 to 50 per cent) ooze and ooze chalk.

3. Greenish-gray (5G6/1) montmorillonite (1 to 3 per cent)–radiolarian (10 to 20 per cent)–foraminiferal (20 to 30 per cent)–calcareous nannofossil (50 to 60 per cent) ooze chalk.

4. Very dusky purple (5RP2/2) foraminiferal (10 to 15 per cent)–calcareous nannofossil (40 to 50 per cent)–radiolarian (40 to 50 per cent) ooze with about 5 per cent manganese (?) coatings on the radiolarians.

Bedding in this unit is often highly disturbed, but original bedding thicknesses appear to have been about 1 to 10 centimeters with laminations probably less than 2 millimeters thick.

TABLE 2
Hole Drilling Summary, Site 83
(Latitude 04° 02.8′N, Longitude 95° 44.25′W; 3632 meters depth)

Hole 83

Interval Below Sea Floor (m)	(ft)	Drilled	Core	Core Cut (m)	(ft)	Core Recovered (m)	(ft)	Drill Stem Rotated	Pump Circ	Drilling Rate (ft/min)
0.00-4.90	0.0-16.0		1	4.90	16.0	4.90	16.0	–	–	
4.90-14.00	16.0-46.0		2	9.10	30.0	9.10	30.0	–	–	
14.00-23.20	46.0-76.0		3	9.10	30.0	4.30	14.0	–	–	
23.20-68.60	76.0-225.0								Cont	
68.60-77.70	225.0-255.0		4	9.10	30.0	2.70	9.0	–	–	
77.70-136.00	255.0-446.0								Cont	
136.00-145.10	446.0-476.0		5	9.10	30.0	9.10	30.0		–	
145.10-202.10	476.0-663.0								Cont	
202.10-211.30	663.0-693.0		6	9.10	30.0	7.90	26.0		Int	
211.30-221.60	693.0-727.0								Cont	
211.30-230.80	727.0-757.0		7	9.10	30.0	8.50	28.0		Int	
230.80-240.00	757.0-787.0								Cont	
239.93-239.96	787.0-787.1		8	0.03	0.1	0.03	0.1	–	–	
239.96-241.50	787.1-792.1			1.60	5.0	0.15	0.5	–	–	
Total 241.5	792.1			61.60	201.9	48.68	153.6			

Hole 83A

Interval Below Sea Floor (m)	(ft)	Drilled	Core	Core Cut (m)	(ft)	Core Recovered (m)	(ft)	Drill Stem Rotated	Pump Circ	Drilling Rate (ft/min)
0.0-13.1	0-43		1							
13.1-22.3	43-73			9.1	30	4.9	16			
22.3-31.4	73-103		2	9.1	30	9.1	30			
31.4-40.5	103-133		3	9.1	30	9.1	30	–	–	
40.5-49.7	133-163		4	9.1	30	9.1	30	–	–	
49.7-58.8	163-193		5	9.1	30	9.1	30		–	
58.8-68.0	193-223		6	9.1	30	9.1	30		–	
68.0-77.1	223-253		7	9.1	30	9.1	30		–	
77.1-86.3	253-283		8	9.1	30	9.1	30		–	
86.3-95.0	283-313		9	9.1	30	9.1	30		–	
95.0-104.6	313-343		10	9.1	30	9.1	30		–	
104.6-113.7	343-373		11	9.1	30	9.1	30		–	
113.7-122.9	373-403		12	9.1	30	9.1	30		–	
122.9-132.0	403-433		13	9.1	30	9.1	30		–	
132.0-158.5	433-520		14						Cont	

TABLE 2 – *Continued*

Hole 83A – *Continued*

Interval Below Sea Floor (m)	(ft)	Drilled	Core	Core Cut (m)	(ft)	Core Recovered (m)	(ft)	Drill Stem Rotated	Pump Circ	Drilling Rate (ft/min)
158.5-167.6	520-550			9.1	30	9.1	30		–	
167.6-179.8	550-590		15						Cont	
179.8-189.0	590-620			9.1	30	9.1	30		Int	
189.0-210.3	620-690		16						Cont	
210.3-219.5	690-720			9.1	30	9.1	30		Int	
Total 219.5	720		16	146.3	480	142.1	466			

Unit 2 (49.6 to 150 meters)

Unit 2 consists of sediments of lighter shades of green than unit 1, has a relatively high percentage of radiolarians, and the bedding is also disturbed by the coring process. The dominant sediment types are:

1. Light bluish-gray (5B7/1) foraminiferal (10 to 15 per cent)–radiolarian (15 to 25 per cent)–calcareous nannofossil (60 to 80 per cent) ooze with less than 1 per cent montmorillonite.
2. Greenish-gray (5G6/1) calcareous nannofossil (40 to 50 per cent)–radiolarian (50 to 60 per cent) chalk ooze with less than 1 per cent montmorillonite.
3. Pale greenish-yellow (10Y8/2) foraminiferal (15 to 25 per cent)–radiolarian (30 to 60 per cent) chalk ooze with less than 1 per cent montmorillonite.
4. Very dusky purple (5P2/2) foraminiferal (10 to 15 per cent)–calcareous nannofossil (40 to 50 per cent)–radiolarian (50 to 60 per cent) chalk ooze with less than 1 per cent montmorillonite.

Unit 3 (150 to 222 meters)

Unit 3 is characterized by its moderately to intensely burrowed, green sediments.

The intensely burrowed beds consist of purple, white, pale orange and dusky green chalk oozes that are intertwined together into one multicolored bed (see Hole 87, Core 7, Section 3, photo):

1. Foraminiferal (10 to 15 per cent)–radiolarian (30 to 50 per cent)–calcareous nannofossil (40 to 60 per cent) chalk ooze with a few per cent of montmorillonite in the green sediments.

The moderately burrowed beds consist of:

1. Light bluish-gray (5B7/1) foraminiferal (10 to 15 per cent)–radiolarian (30 to 50 per cent)–calcareous nannofossil (40 to 60 per cent) ooze.

These two types of sediments occur in about equal amounts in the upper half of unit 3; here they occur in 5 to 20 centimeter-thick beds. In the lower half of this unit the sediments are almost entirely of the multicolored, intensely burrowed type.

The contact between the San Blas and Line Islands Oceanic Formations was not cored.

Line Islands Oceanic Formation

At this site the Line Islands Oceanic Formation consists of various shades of brecciated chalk. The brecciation probably occurred during the intrusion of the underlying basalt. The main sediment types are:

1. Very pale orange (10YR8/2), grayish-orange (10YR7/4), and moderate brown (5YR3/4) foraminiferal (10 to 15 per cent)–calcareous nannofossil (80 to 90 per cent) chalk. In addition it contains up to 10 per cent yellow hydrothermal (?) clay, hematite, tridymite, rhodochrosite (?), dolomite and amorphous iron and (?) manganese oxides.

Basalt

Basement at Site 83 is a black (N-1), very fine-grained basalt.

PHYSICAL PROPERTIES

Natural Gamma

Natural gamma readings at Site 83 ranged from 850 to 2428 counts/75 sec.

The cyclic unit of the Clipperton Oceanic Formation yields readings from 883 to 2428 counts. The dark sediments give higher readings than the interbedded lighter sediments. This is probably due to a higher concentration of clay in the dark sediments. In Core 1, counts from 1064 to 2428 were recorded in sediments containing up to 40 per cent clay. The San Blas Oceanic Formation yields readings from 850 to 1130 counts.

The cyclic unit of the Clipperton Oceanic Formation can be distinguished from the San Blas Oceanic Formaon the basis of natural gamma emission readings. The overall readings of the cyclic unit are much higher than those of the San Blas Oceanic Formation, although in an individual core it might be difficult to distinguish the two formations on the basis of natural gamma alone.

Porosity

Porosity at Site 83 ranges from 94 per cent in greenish black foraminiferal-radiolarian-calcareous nannofossil oozes to 67 per cent in blue green montmorillonitic-foraminiferal-radiolarian-calcareous nannofossil oozes. There is an overall porosity decrease of 27 per cent which is probably due to compaction or incipient cementation. There is no correlation between lithology and porosity at this site.

Sonic Velocity

Sound velocities range from 1225 to 1550 m/sec. However 1225 m/sec as the low end of the range is misleading because it is almost certainly due to a large amount of injected water during drilling. Probably a more reliable low figure is 1492 m/sec. A compaction trend is reflected in slightly higher sound velocities downhole.

Bulk Density

The bulk density readings vary from 1.081 g/cc to 1.389 g/cc. These are the lowest and highest readings obtained for a site on Leg 9. Average density readings at the top of the hole are lower than average readings in the lower part of the hole. However, on a detailed scale there is no consistent correlation between bulk density readings and depth or changes in lithology.

Penetrometer

Penetrometer readings range from 0.2 centimeter to 3 centimeters and generally decrease downhole. Readings of 3 centimeters were recorded at depths of 31 to 36 meters, 62 meters, 98 meters, 115 meters, and 137 meters and reflect intervals disturbed during coring. The highest reliable reading is 2.7 centimeters. From 1 to 175 meters the readings fluctuate between 2.7 centimeters and 0.3 centimeter. At approximately 175 meters and below, the sediment readings average about 1 centimeter and show less fluctuation, possibly due to compaction and/or incipient cementation.

BIOSTRATIGRAPHY

Foraminifera

Following the initial eight cores from Hole 83, the site was cored a second time and Hole 83A yielded 16 cores from intervals missed in the first hole, particularly at zonal interfaces. By this technique, good control for most of the zonal boundaries was gained for the site. With the exception of isolated samples in Cores 1A, 3, 7 and 15A, where there was evidence of solution, foraminiferal specimens were well preserved and the faunas diverse. The cored interval included an apparently continuous sequence from the Pleistocene *Pulleniatina obliquiloculata* Zone to the upper Miocene *Globoquadrina altispira* Zone. All of the zones recorded consist of well-developed tropical faunas with some specific exceptions in the Pleistocene interval where cool water foraminiferal indices such as *Globorotalia inflata* (d'Orbigny) and *G.* cf. *pachyderma* (Ehrenberg) were recorded.

The hole was terminated in basalt at 792 feet (241 meters) below the sea floor and sediments from the baked interval overlying the basalt a foraminiferal fauna from the *G. altispira* Zone.

Radiolaria

Samples for radiolarian preparations were not taken from Core 8 where no Radiolaria were observed on the smear slides. All the remaining cores from both Holes 83 and 83A were sampled and found to contain abundant Radiolaria as well as other siliceous pelagic microfossils. Clay and humic components are moderately abundant throughout this section, although they are not as abundant as at Site 84. It was difficult therefore to obtain absolutely clean radiolarian preparations, although the state of preservation is excellent.

The oldest definitive samples belong to the *Cannartus* (?) *petterssoni* Zone, and the middle Miocene-upper Miocene boundary is located between Cores 16A and 7. The stratigraphic ranges of the radiolarian species examined here occupy their normal sequence, but four exceptions are evident. At Site 83, *Tholospyris procera* occurs below the stratigraphic range of *Giraffospyris laterispina.* The opposite situation exists at Site 77. At Site 83, *Liriospyris ovalis* disappears in the *Spongaster pentas* Zone, although this species ranges into modern sediment at Site 77. At Sites 77 and 82, *Pterocanium prismatium* appears below the stratigraphic range of *Archicircus rhombus.* The opposite situation exists at Site 83. Although *Pterocanium prismatium* overlaps *Tholospyris devexa,* it disappears below the Pliocene-Pleistocene boundary based on foraminifera. The stratigraphic range of *Pterocanium prismatium* appears, then, to be anomalously short at both terminations. Despite the aberrant stratigraphic range for this species, the base of the *Spongaster pentas* Zone and the top of the *Pterocanium prismatium* Zone are placed at the top and bottom of the occurrence of *Pterocanium prismatium* in agreement with their definition.

DISCUSSION AND INTERPRETATION

Rates of Sedimentation

The rates of sedimentation at this site are uniform throughout (Table 3). This constancy may be interpreted in two ways: either the belt of high productivity in this easternmost part of the equatorial Pacific is quite broad, therefore having a low meridional gradient, or the motion at this site since Middle Miocene has been predominantly east-west, parallel to the productivity gradient.

The sediment at the top of the section (approximately the upper 10 meters) is a dark reddish-brown clay that grades downward to a dark green radiolarian ooze which in turn becomes increasingly calcareous with depth. We can probably safely conclude that the amount of north-south movement has been small since the rate of deposition at the base never reaches the 27.0 m/m.y. recorded in the Upper Miocene part of Site 82.

Age of Basement

The basal sediments at this site occur in the *G. altispira* foraminiferal zone. This would give them an age of between 10.5 and 12 million years, probably closer to 11 million years. If we assume an age of 11 million years for the base of Site 83 and a distance to the ridge crest of 797 kilometers then the spreading rate is about 71 km/m.y., which is approximately the same as the 61 km/m.y. calculated between Sites 82 and the ridge crest on the western flank of the ridge. As at the previous sites on Leg 9 the sediments above basement show evidence of baking and at Site 83, as at 82, they show evidence of brecciation.

REFERENCE

Cook, H. E. and Zemmels, I., 1971. X-ray mineralogy studies–Leg 9. In Hays, J. D. *et al., Initial Reports of the Deep Sea Drilling Project, Volume IX.* Washington (U. S. Government Printing Office), in press.

TABLE 3
Rates of Sedimentation, Site 83

Geologic Interval	Duration Geologic Interval (m.y.)	Sediment Thickness (meters)	Accumulation Rate ($m/10^6$ yrs.)
Pleistocene	1.8	37	20.5
Upper Pliocene	1.2	25	20.8
Lower Pliocene	2.0	42	21.0
Upper Miocene	5.0	118	23.6

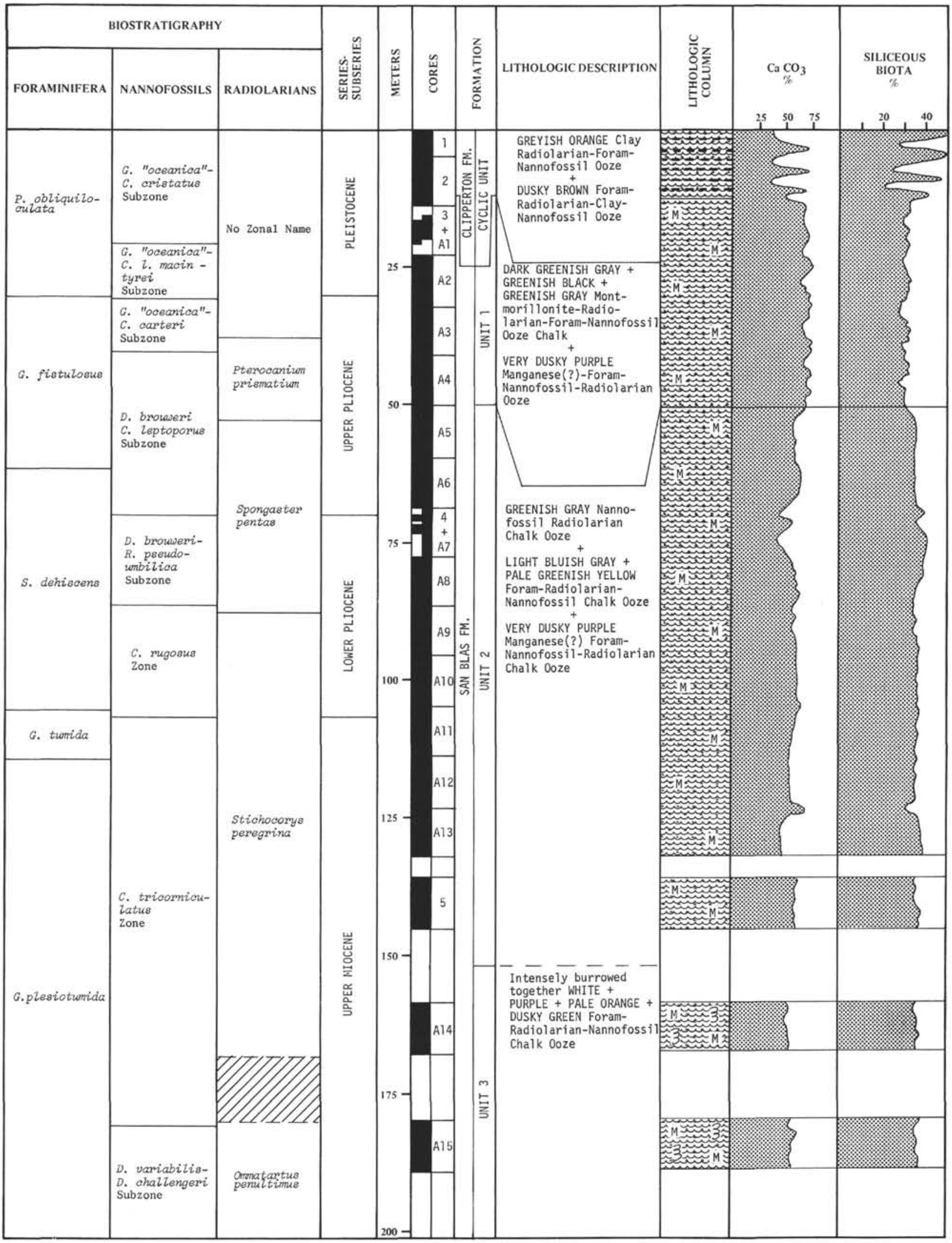


Figure 3. *Site 83 summary.*

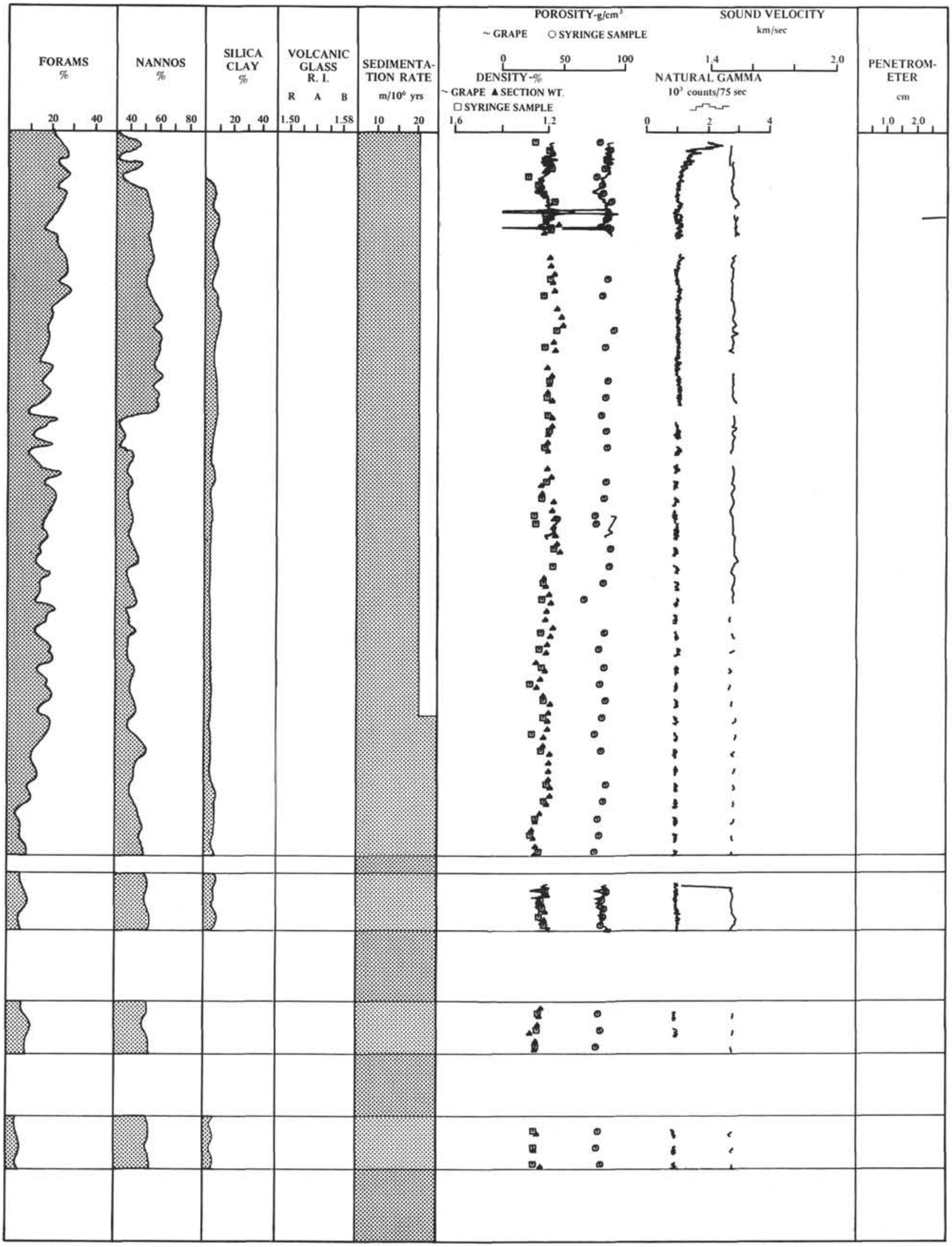


Figure 4. *Site 83 summary.*

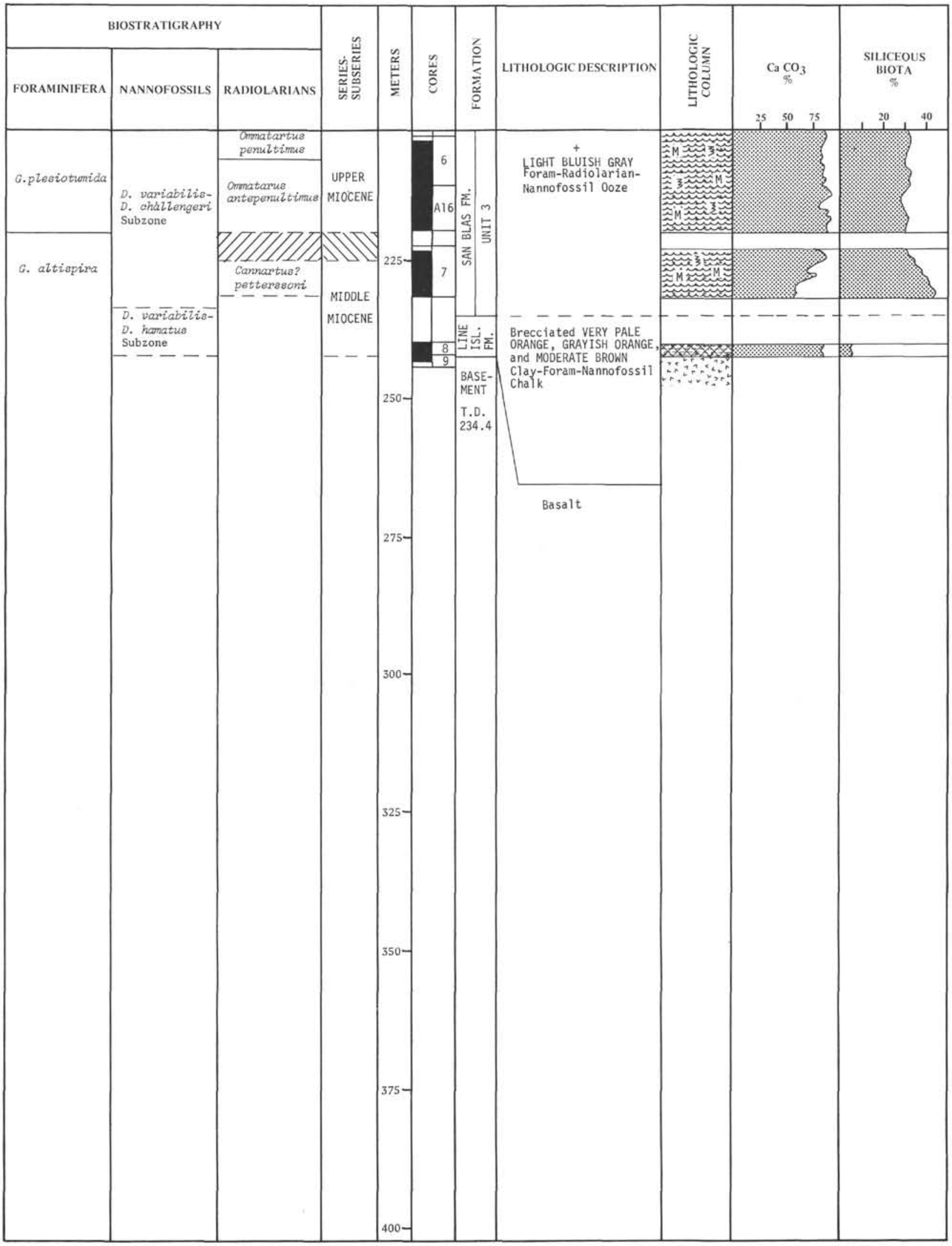


Figure 5. *Site 83 summary (continued).*

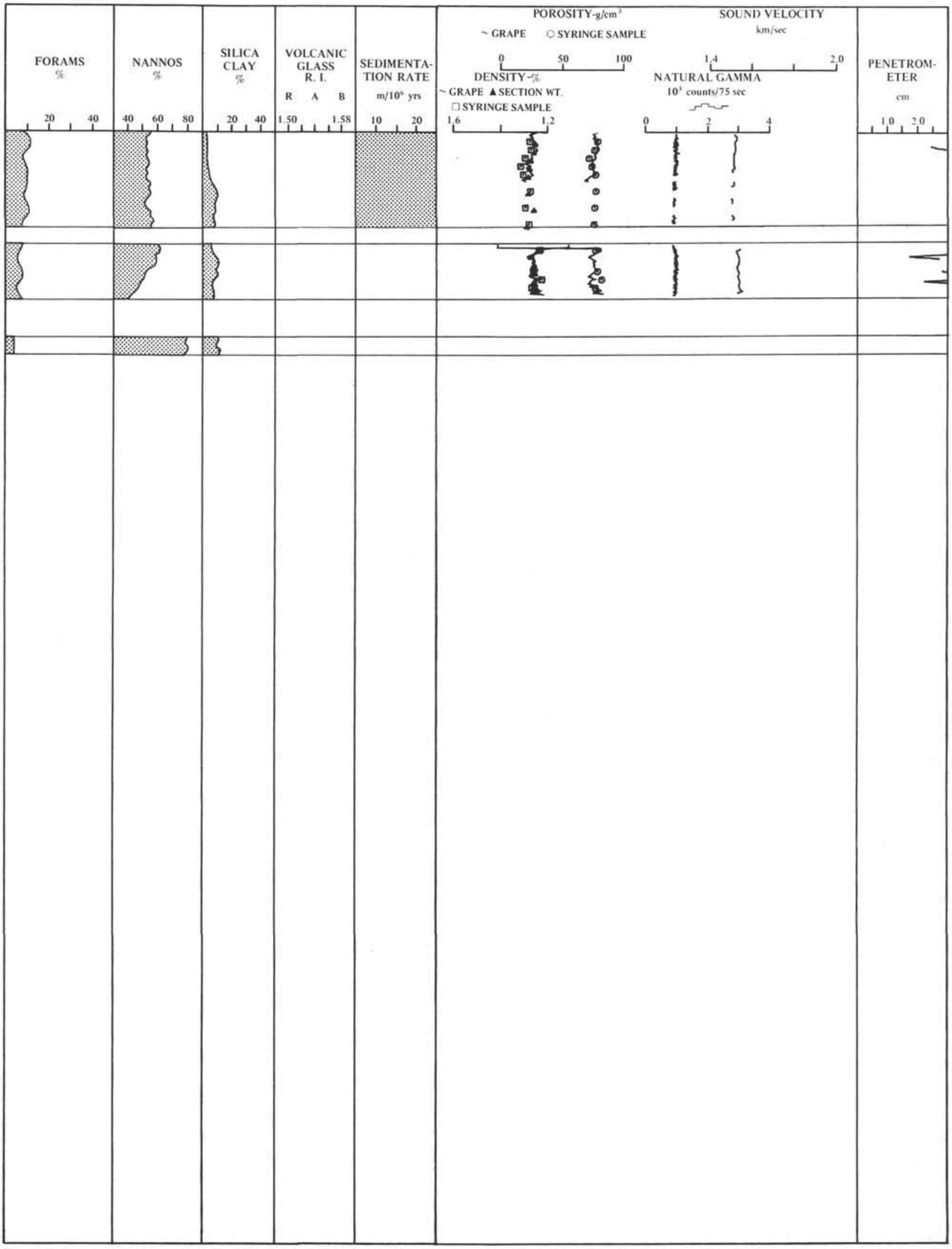


Figure 6. *Site 83 summary (continued).*

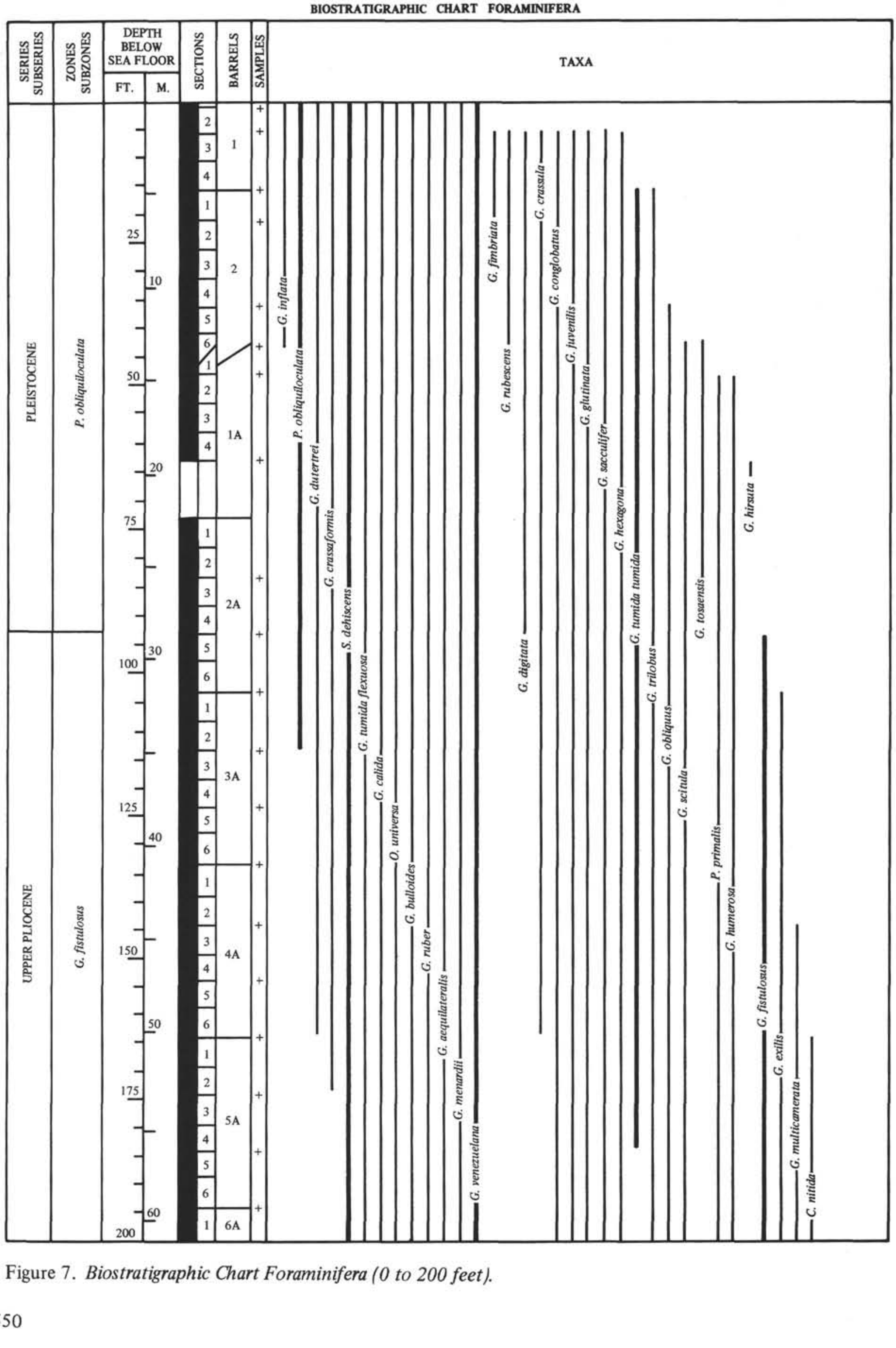


Figure 7. *Biostratigraphic Chart Foraminifera (0 to 200 feet).*

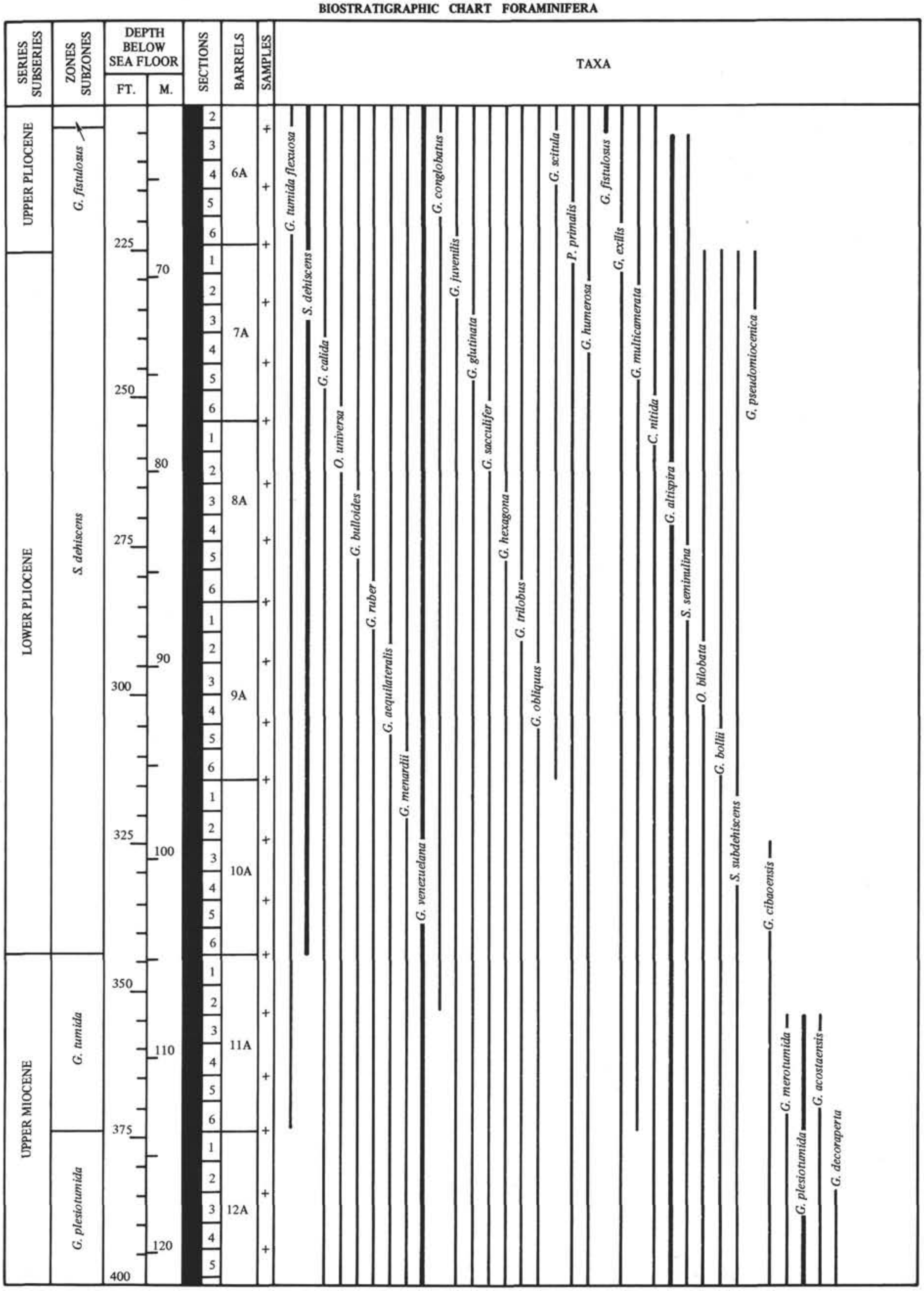


Figure 8. *Biostratigraphic Chart Foraminifera (200 to 400 feet).*

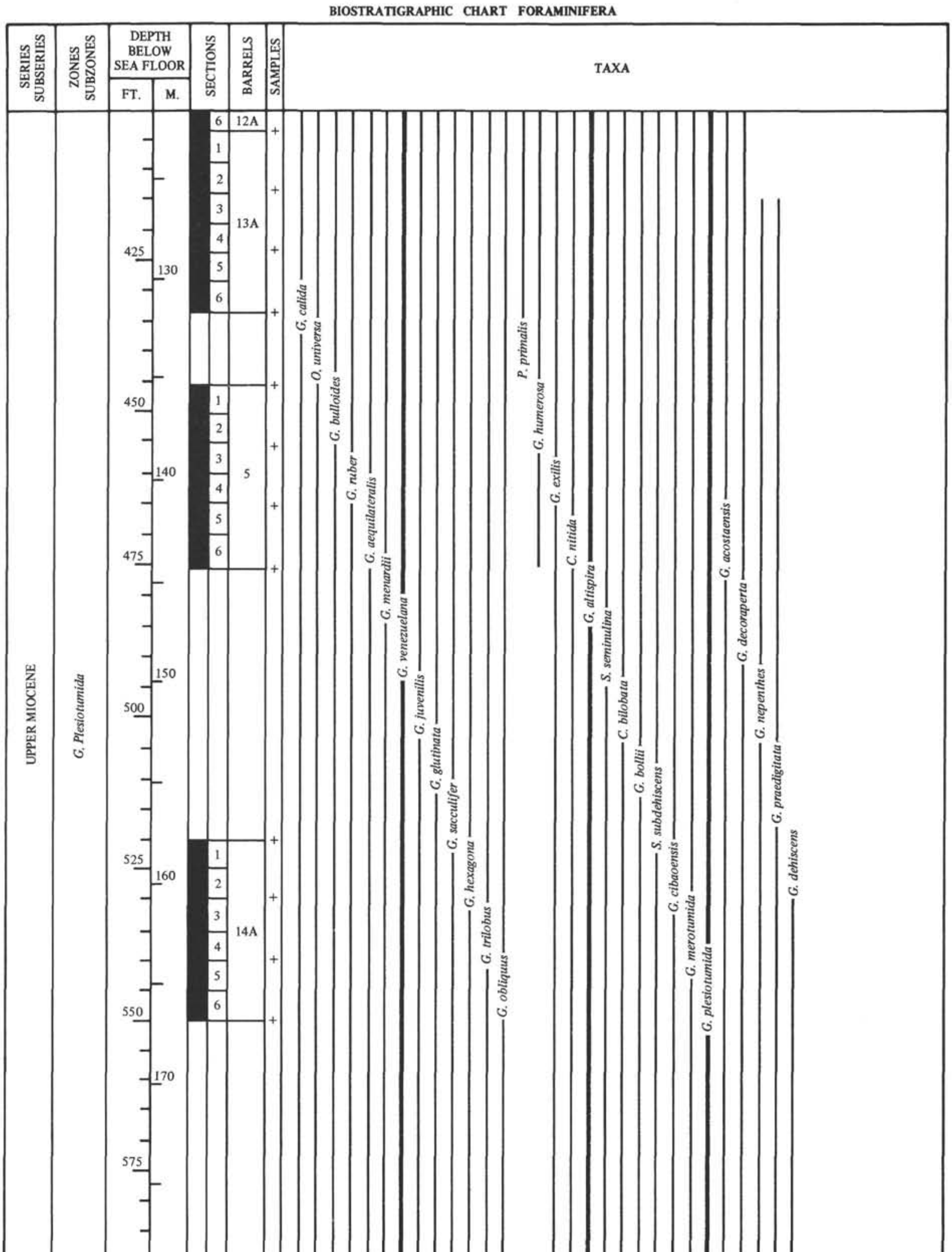


Figure 9. *Biostratigraphic Chart Foraminifera (400 to 600 feet).*

BIOSTRATIGRAPHIC CHART FORAMINIFERA

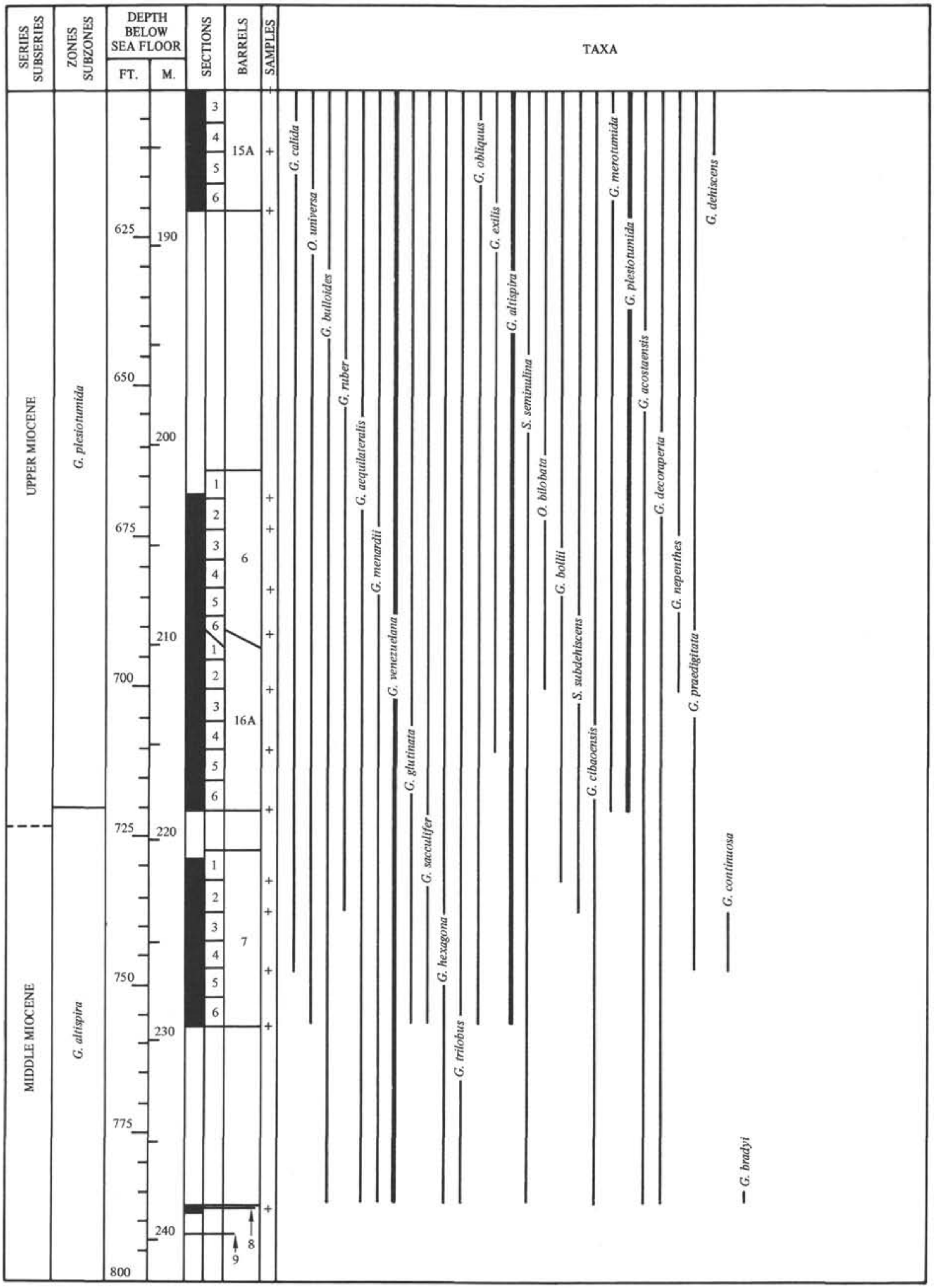


Figure 10. *Biostratigraphic Chart Foraminifera (600 to 800 feet).*

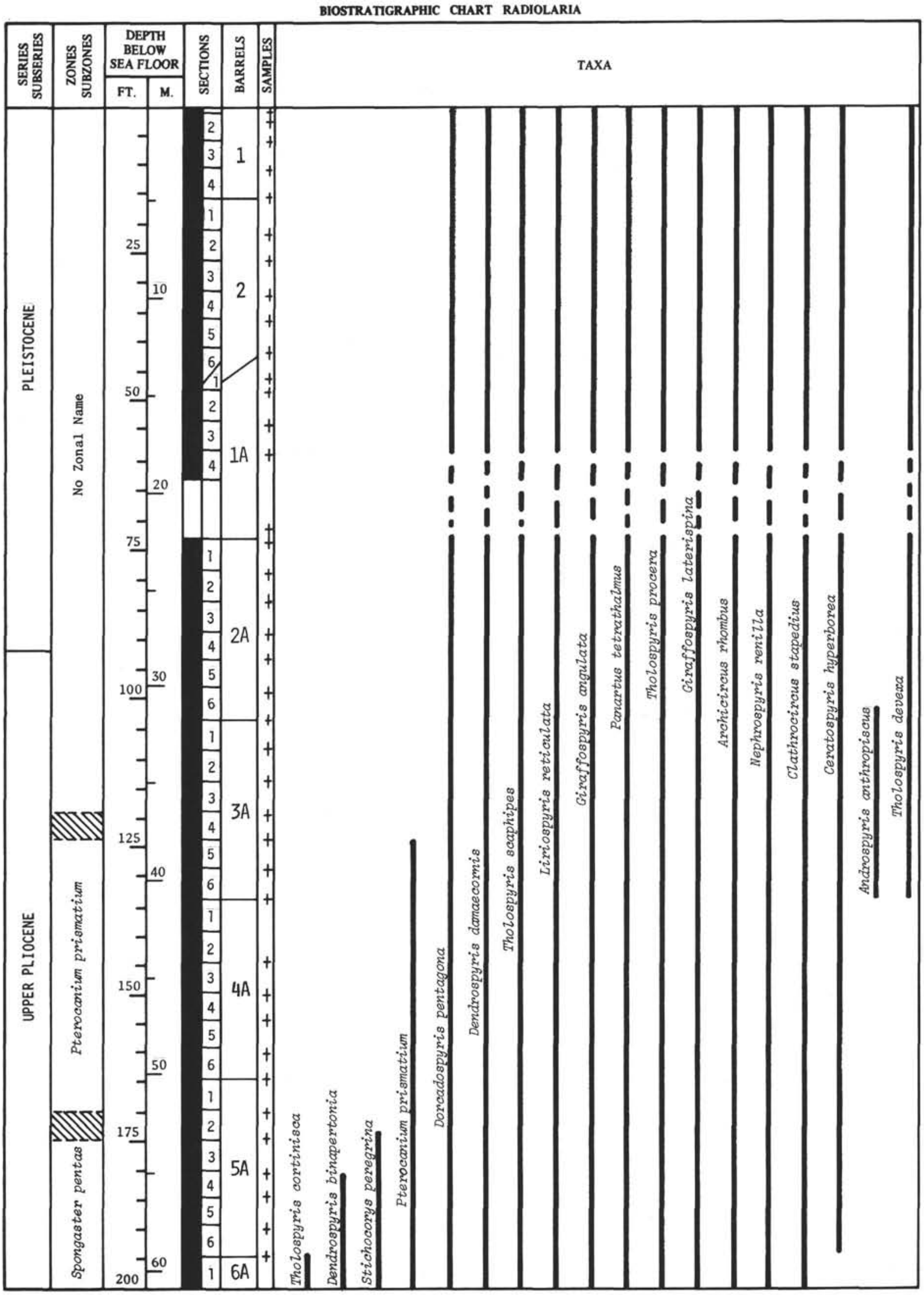


Figure 11. *Biostratigraphic Chart Radiolaria (0 to 200 feet).*

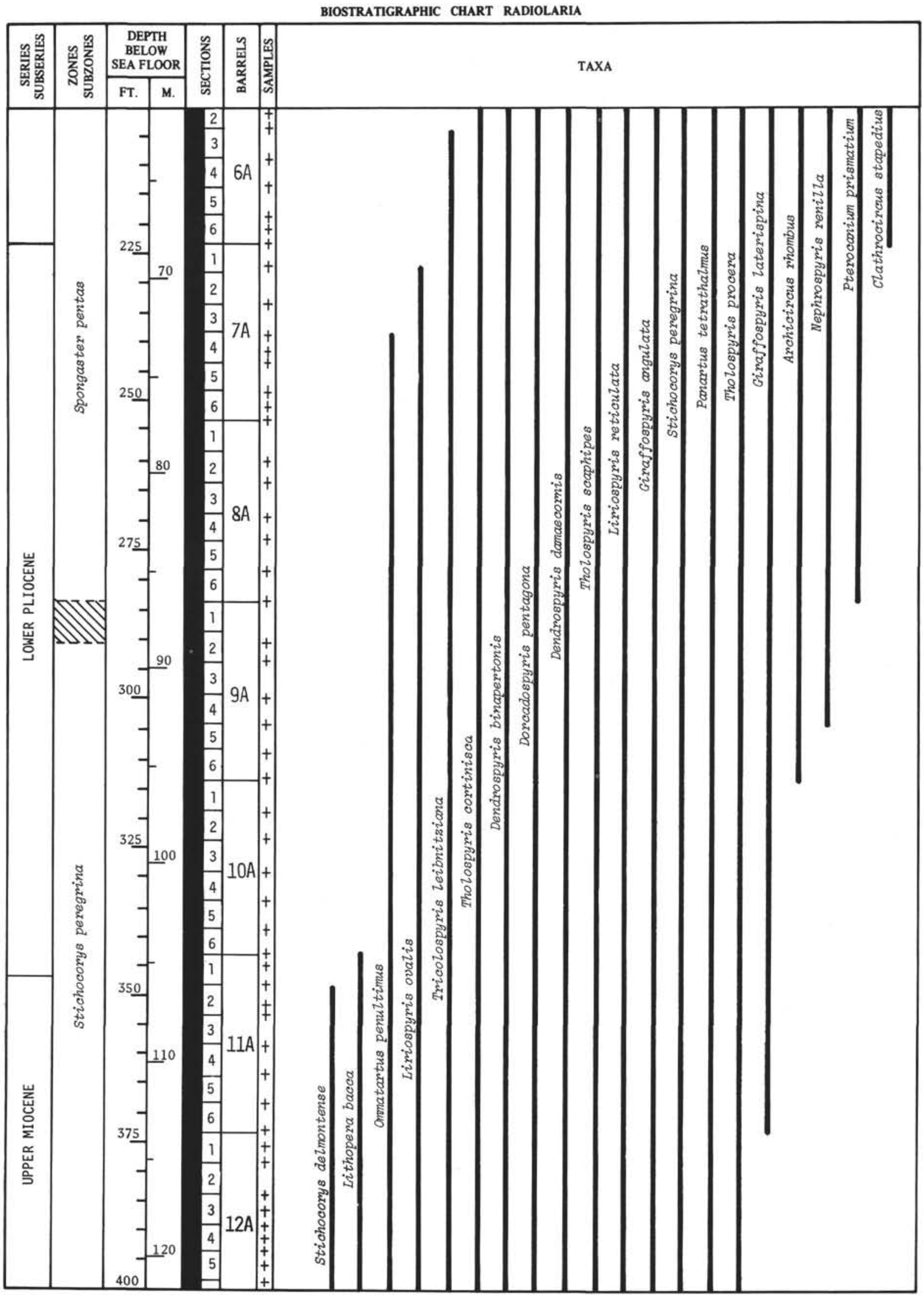


Figure 12. *Biostratigraphic Chart Radiolaria (200 to 400 feet).*

BIOSTRATIGRAPHIC CHART RADIOLARIA

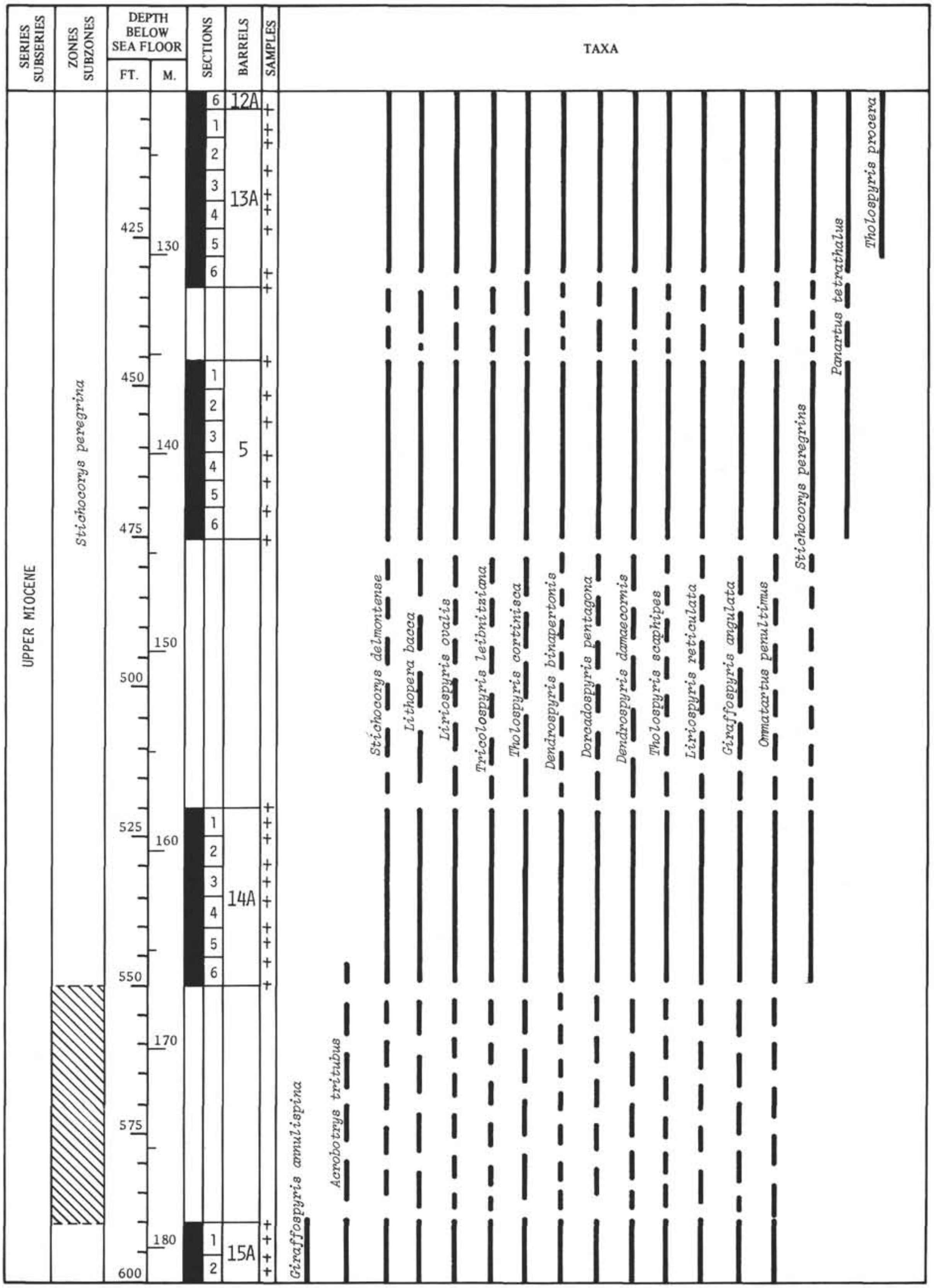


Figure 13. *Biostratigraphic Chart Radiolaria (400 to 600 feet).*

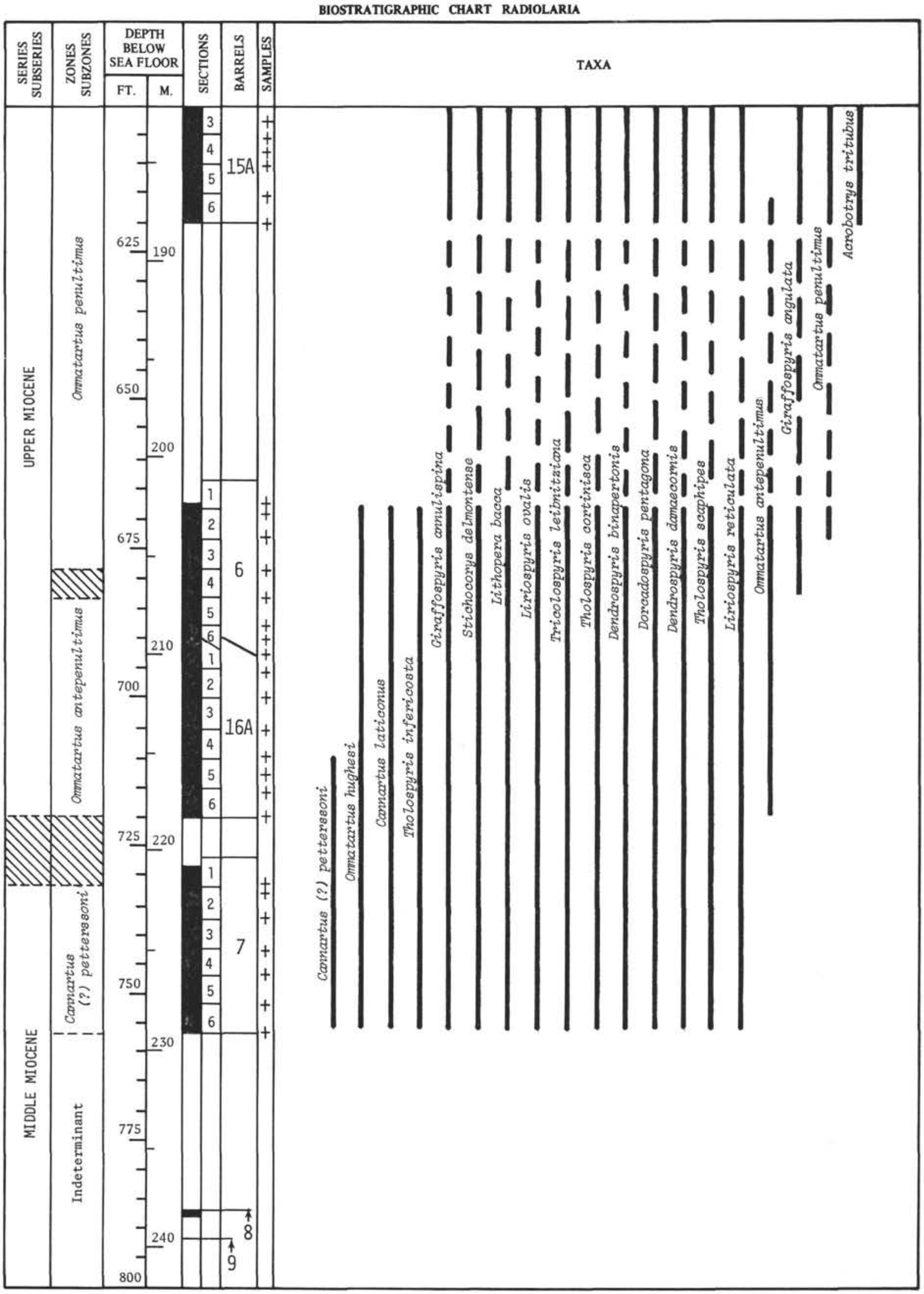
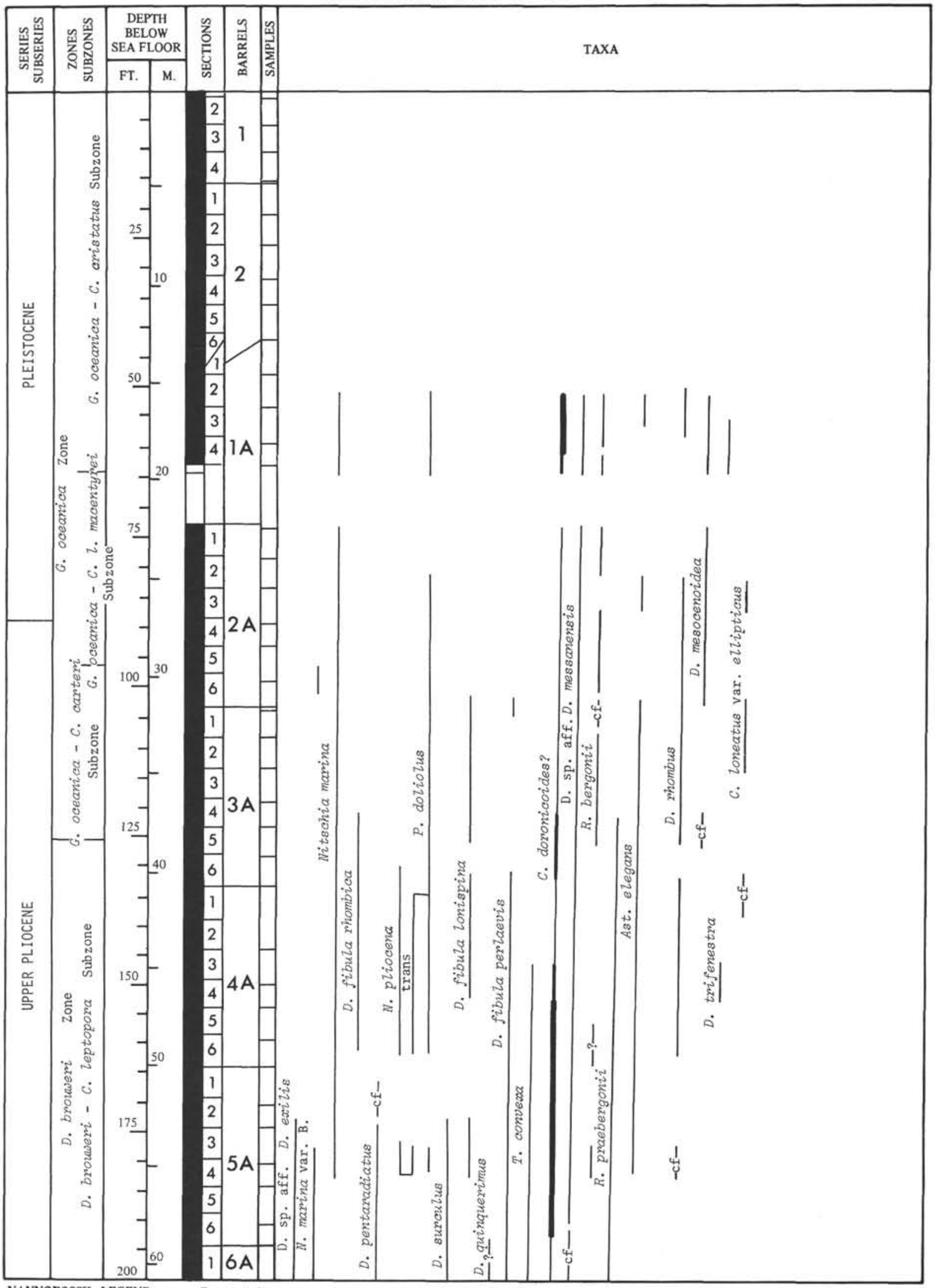


Figure 14. *Biostratigraphic Chart Radiolaria (600 to 800 feet).*

BIOSTRATIGRAPHIC CHART NANNOFOSSILS



NANNOFOSSIL LEGEND: —— Rare to infrequent occurrence. ▬▬ Frequent occurrence. ████ Greater than frequent occurrence.

Figure 15. *Biostratigraphic Chart Nannofossils (0 to 200 feet).*

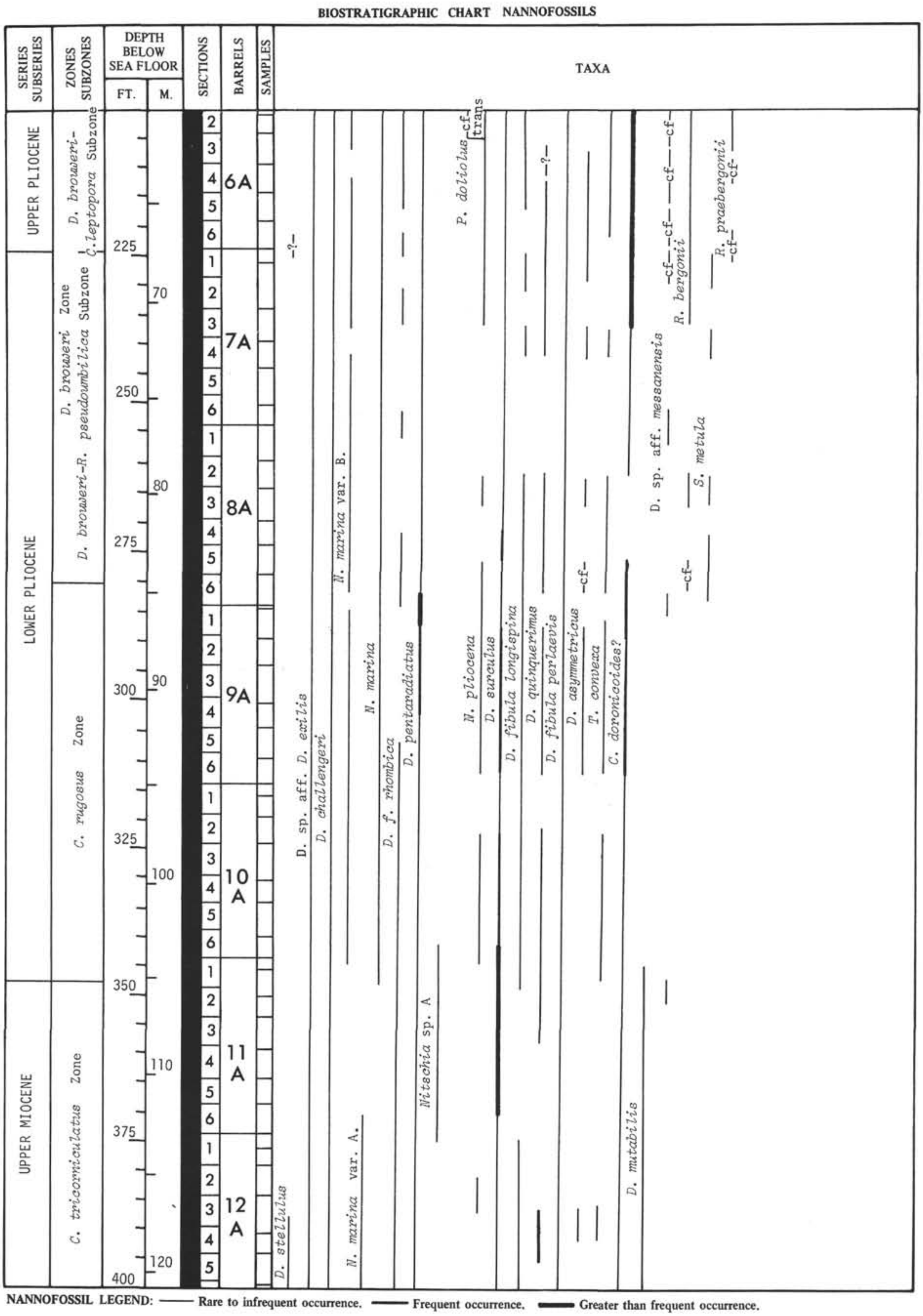


Figure 16. *Biostratigraphic Chart Nannofossils (200 to 400 feet).*

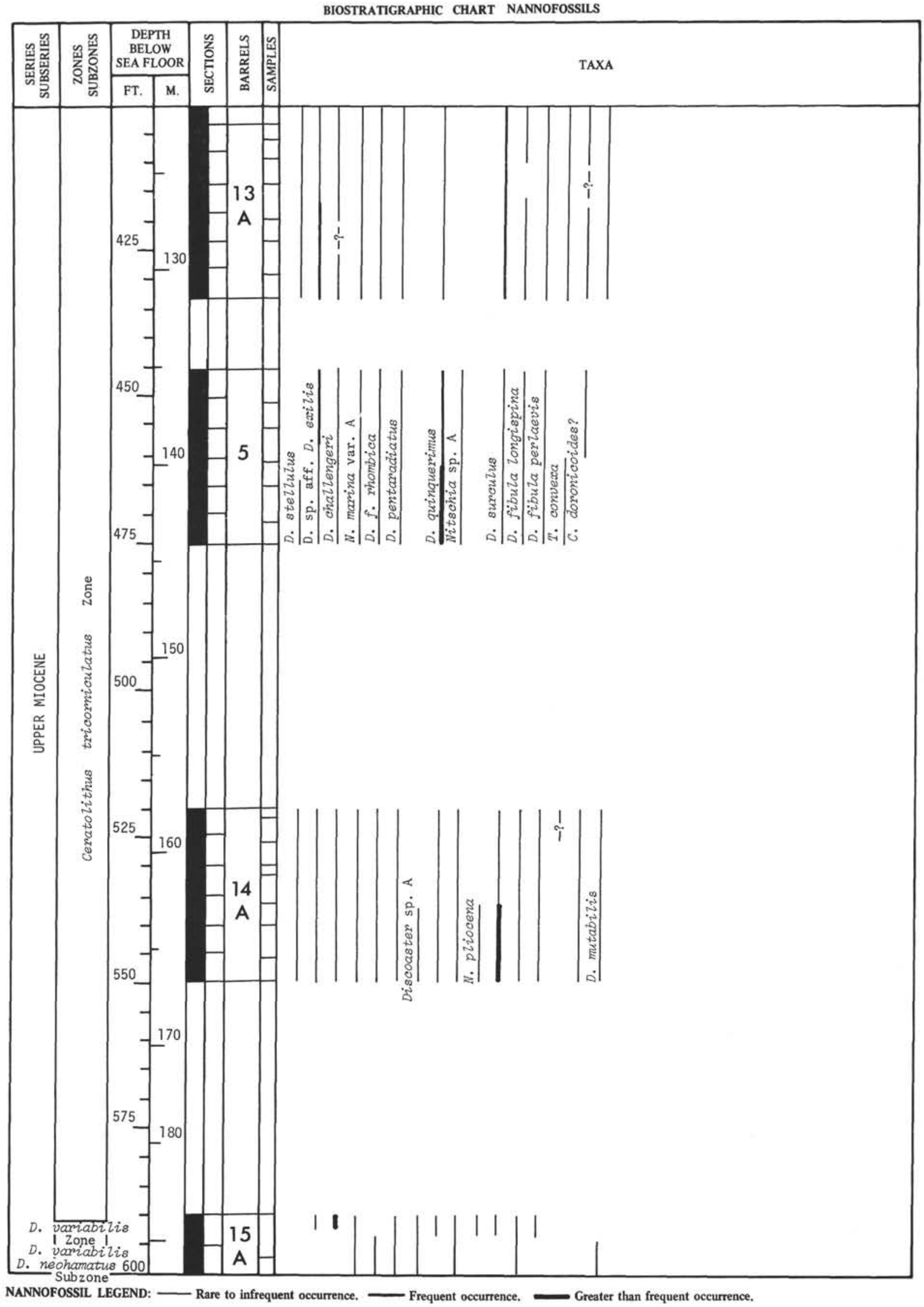


Figure 17. *Biostratigraphic Chart Nannofossils (400 to 600 feet).*

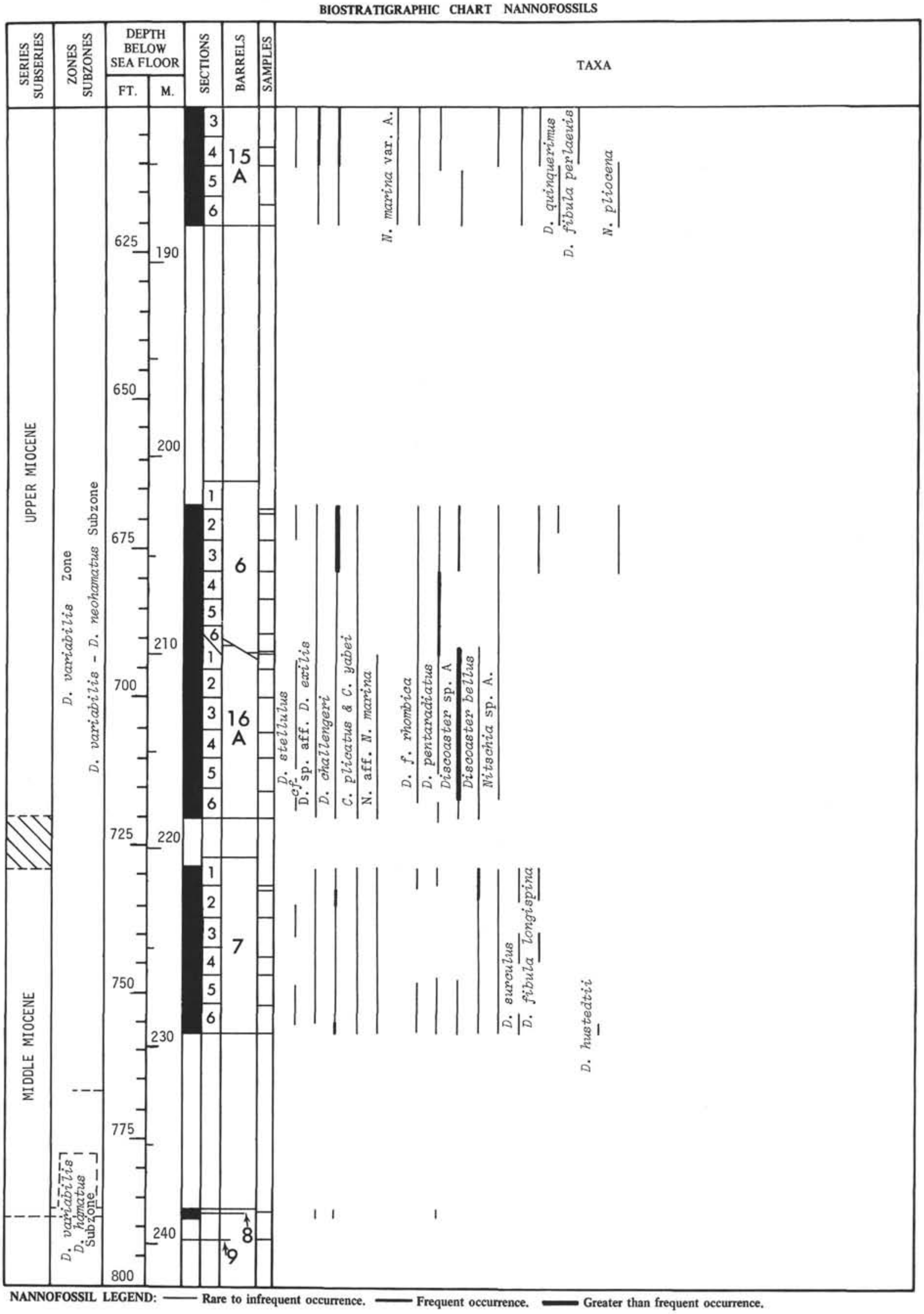


Figure 18. *Biostratigraphic Chart Nannofossils (600 to 800 feet).*

BIOSTRATIGRAPHIC COMPARISON CHART

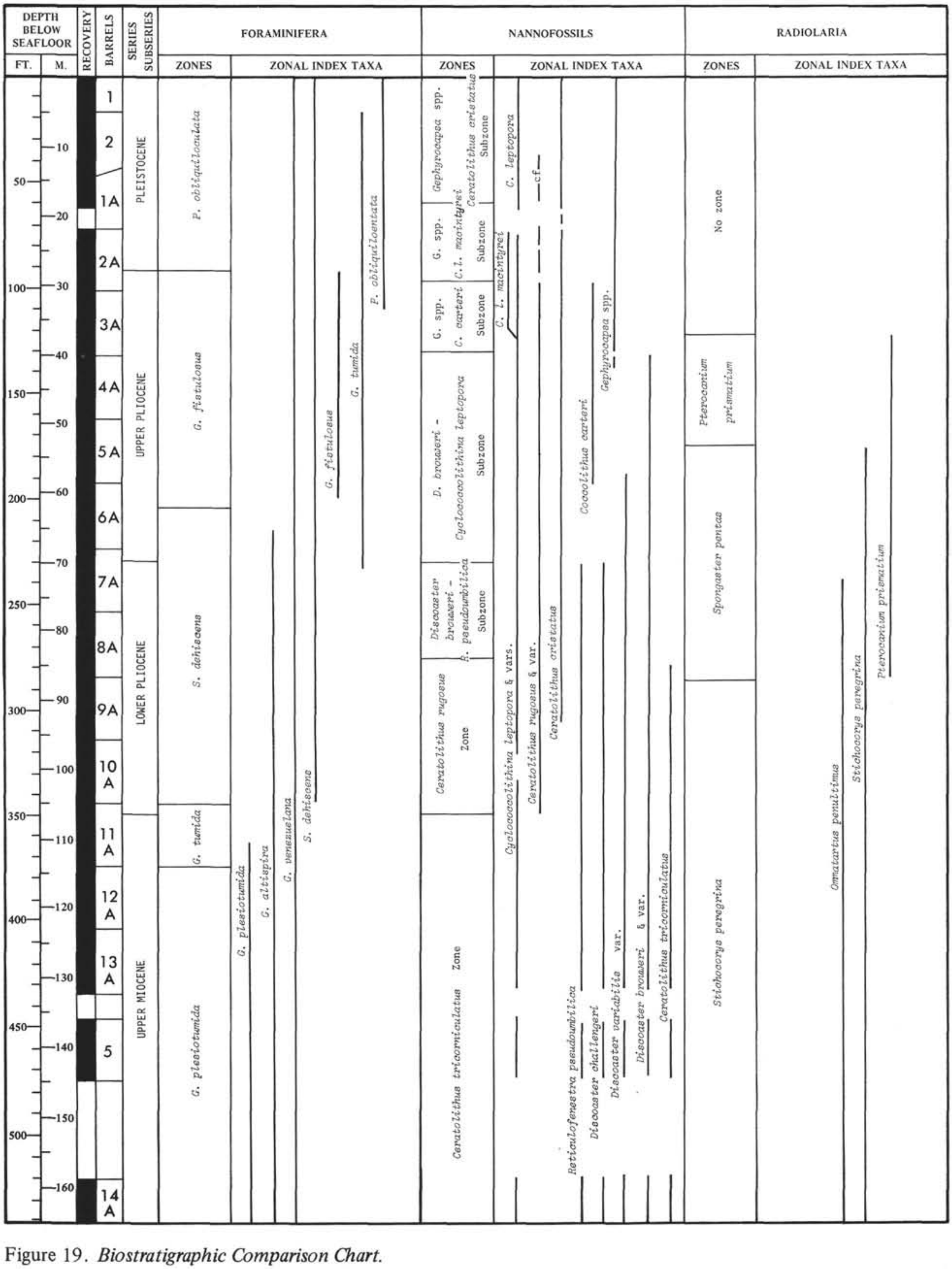


Figure 19. *Biostratigraphic Comparison Chart.*

BIOSTRATIGRAPHIC COMPARISON CHART

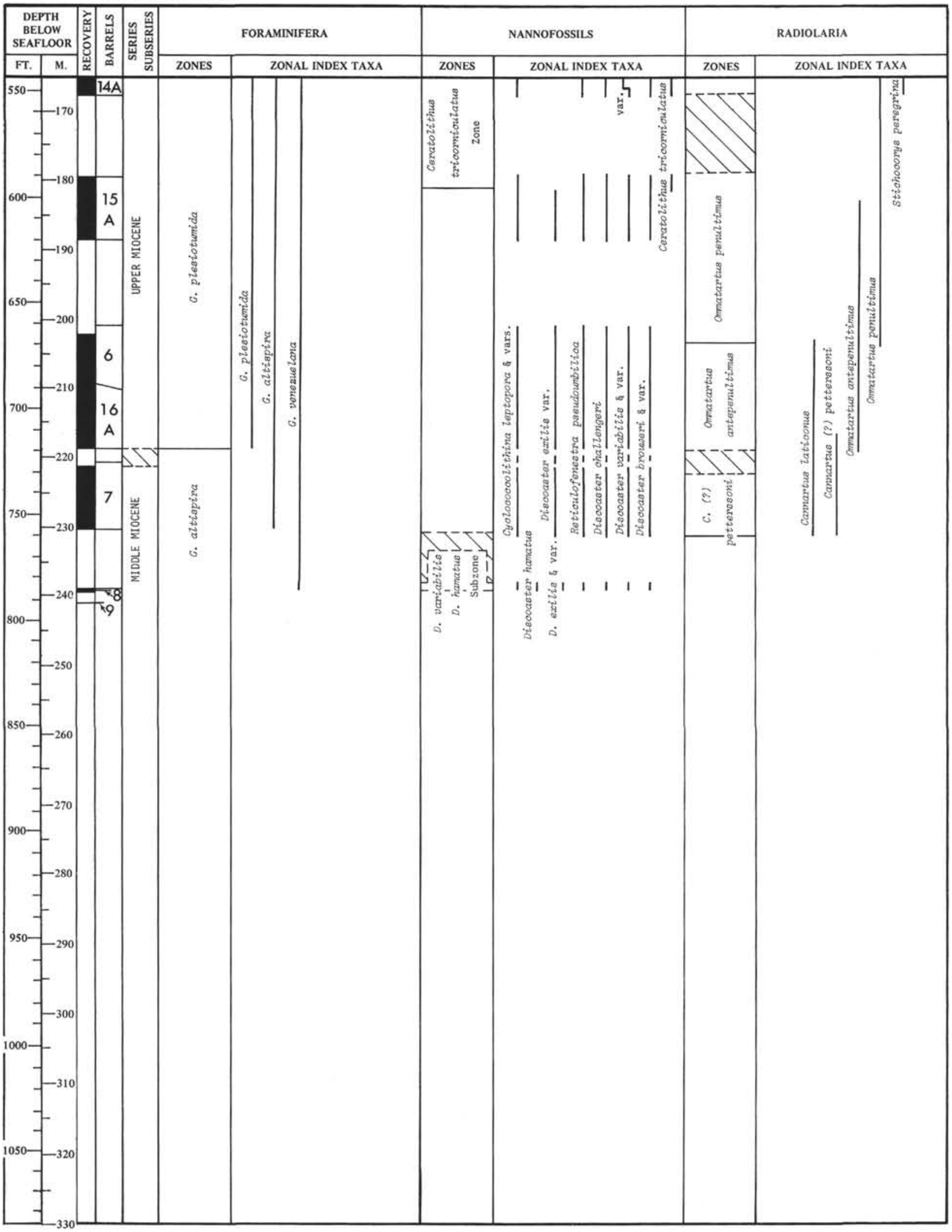


Figure 20. *Biostratigraphic Comparison Chart (continued).*

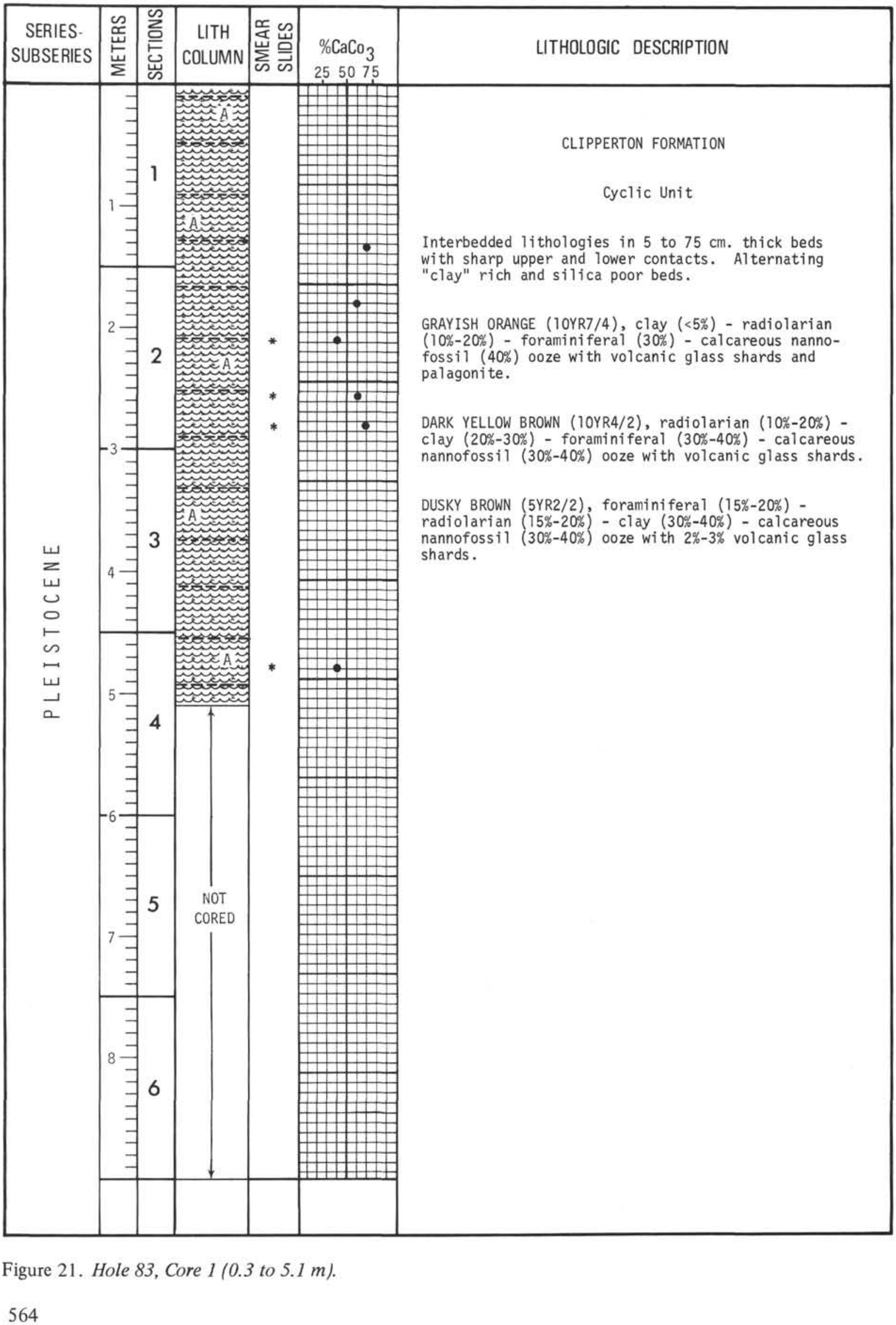


Figure 21. *Hole 83, Core 1 (0.3 to 5.1 m).*

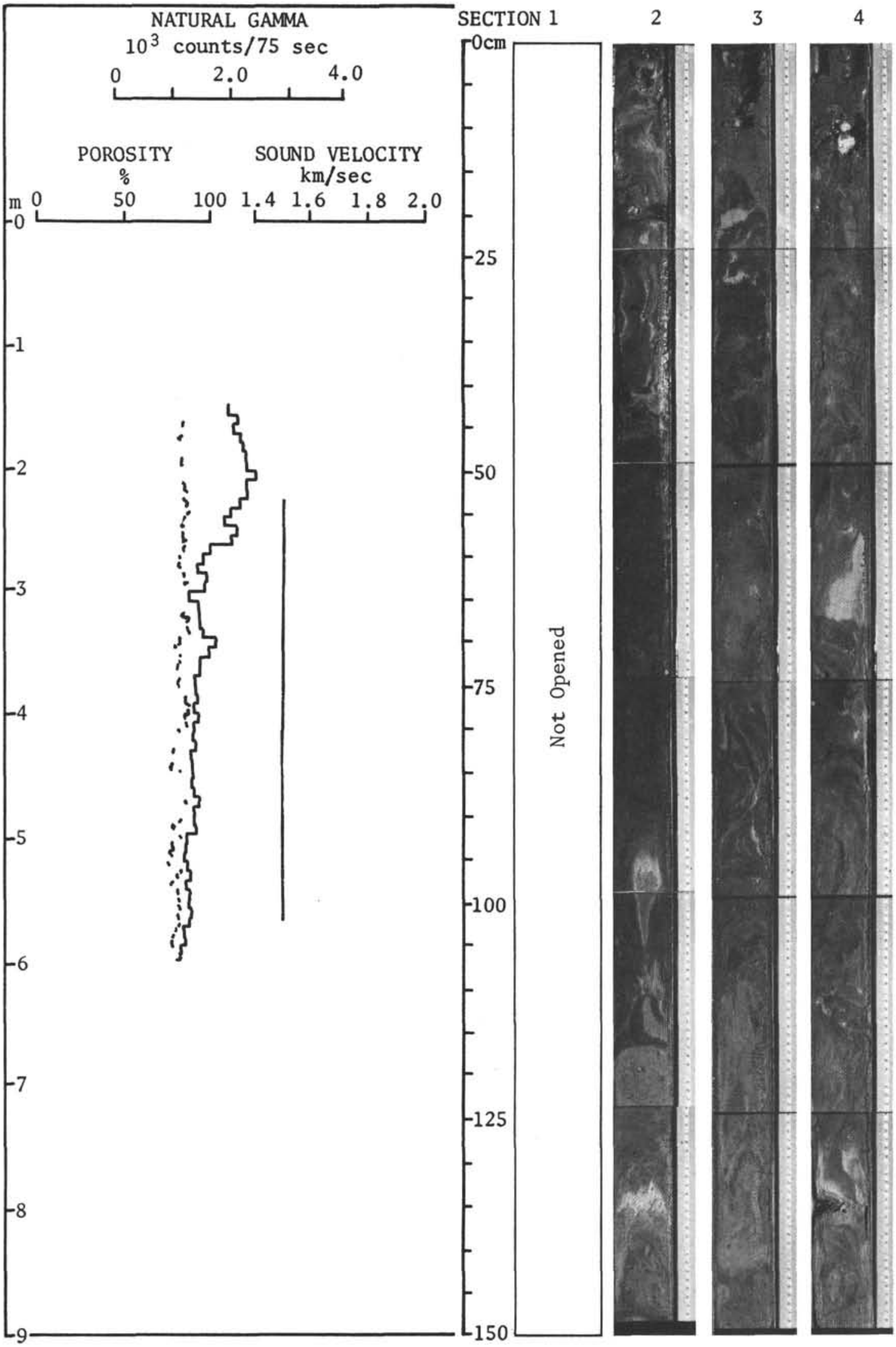
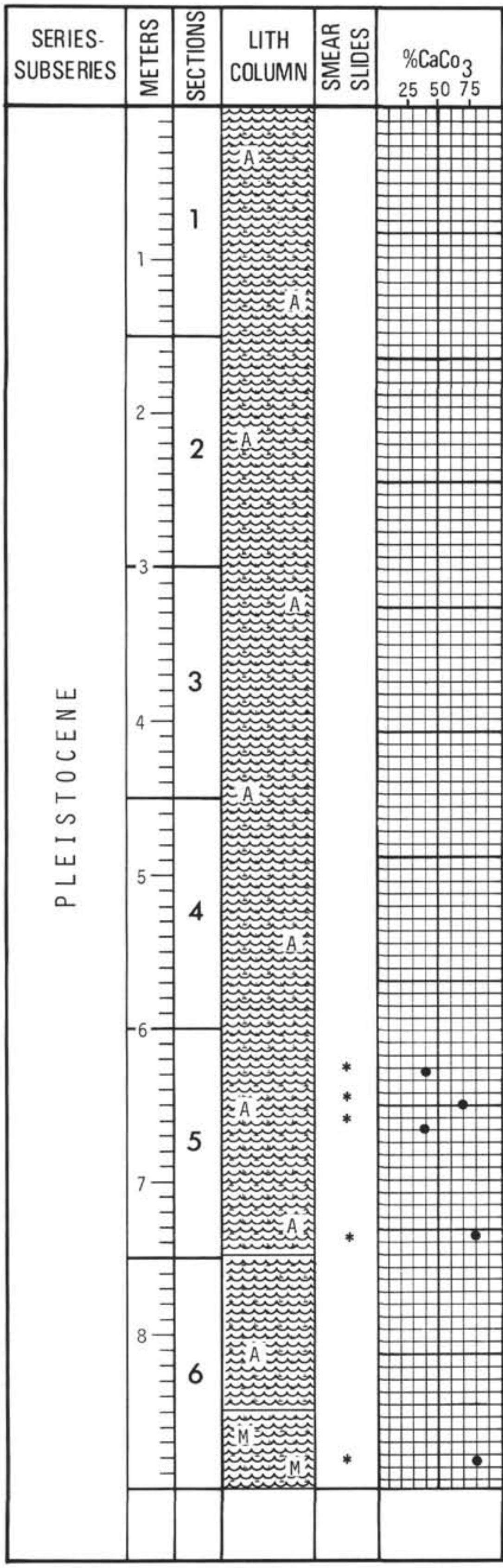


Figure 22. *Hole 83, Core 1, Sections 1-4, Physical Properties.*



LITHOLOGIC DESCRIPTION

CLIPPERTON FORMATION

Cyclic Unit

Interbedded cyclic sequences of "clay" rich and "clay" poor beds.

GRAYISH ORANGE (10YR7/4), "clay" (<5%) - radiolarian (10%-20%) - foraminiferal (30%) - calcareous nannofossil (40%) ooze with volcanic glass shards and palagonite.

DARK YELLOW BROWN (10YR4/2), radiolarian (10%-20%) - clay (20%-30%) - foraminiferal (30%-40%) - calcareous nannofossil (30%-40%) ooze with volcanic glass shards.

DUSKY BROWN (5YR2/2), foraminiferal (15%-20%) - radiolarian (15%-20%) - clay (30%-40%) - calcareous nannofossil (30%-40%) ooze with 2%-3% volcanic glass shards.

BASE CLIPPERTON FORMATION

Cyclic Unit

TOP SAN BLAS FORMATION

Unit 1

MEDIUM BLUISH GRAY (5B5/1), foraminiferal (15%-20%) - radiolarian (15%-20%) - calcareous nannofossil (60%-70%) ooze with palagonite and shards.

GRAYISH RED PURPLE (5RP4/2) to VERY DUSKY RED PURPLE (5RP2/2) foraminiferal (15%-25%) - radiolarian (20%-30%) - calcareous nannofossil (80%) ooze.

Figure 23. *Hole 83, Core 2 (5.1 to 14.3 m).*

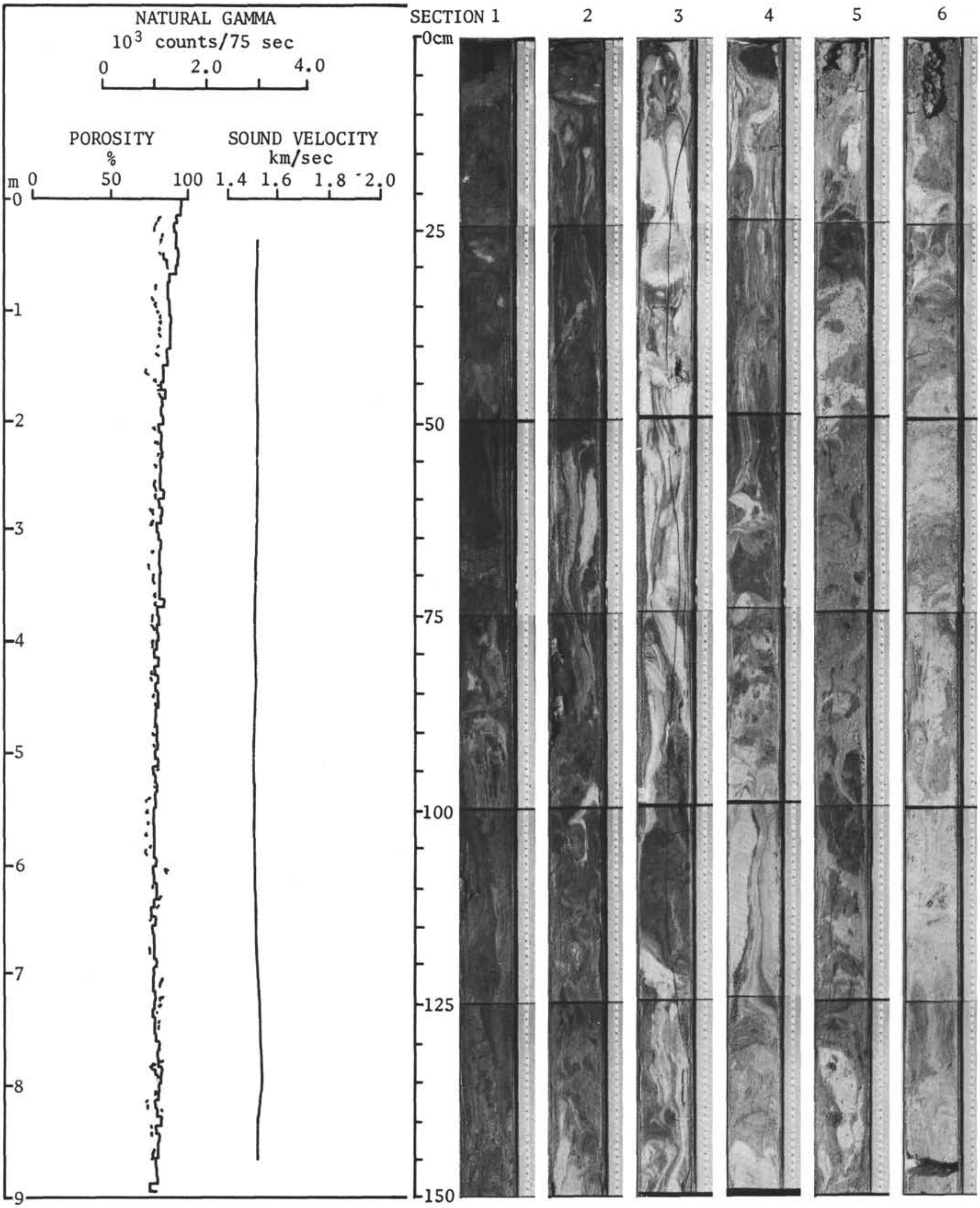


Figure 24. *Hole 83, Core 2, Sections 1-6, Physical Properties.*

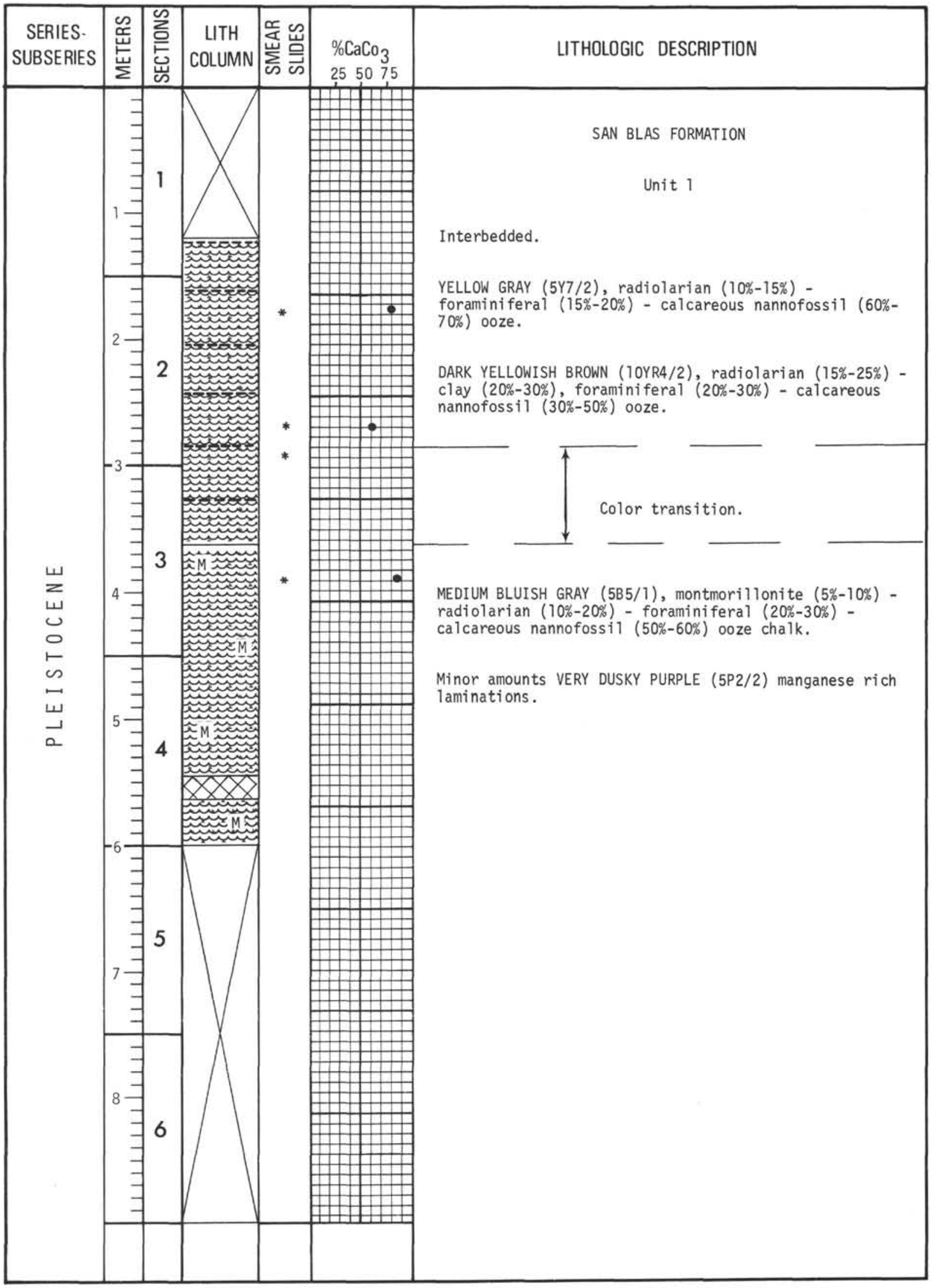


Figure 25. *Hole 83A, Core 1 (13.1 to 22.1 m).*

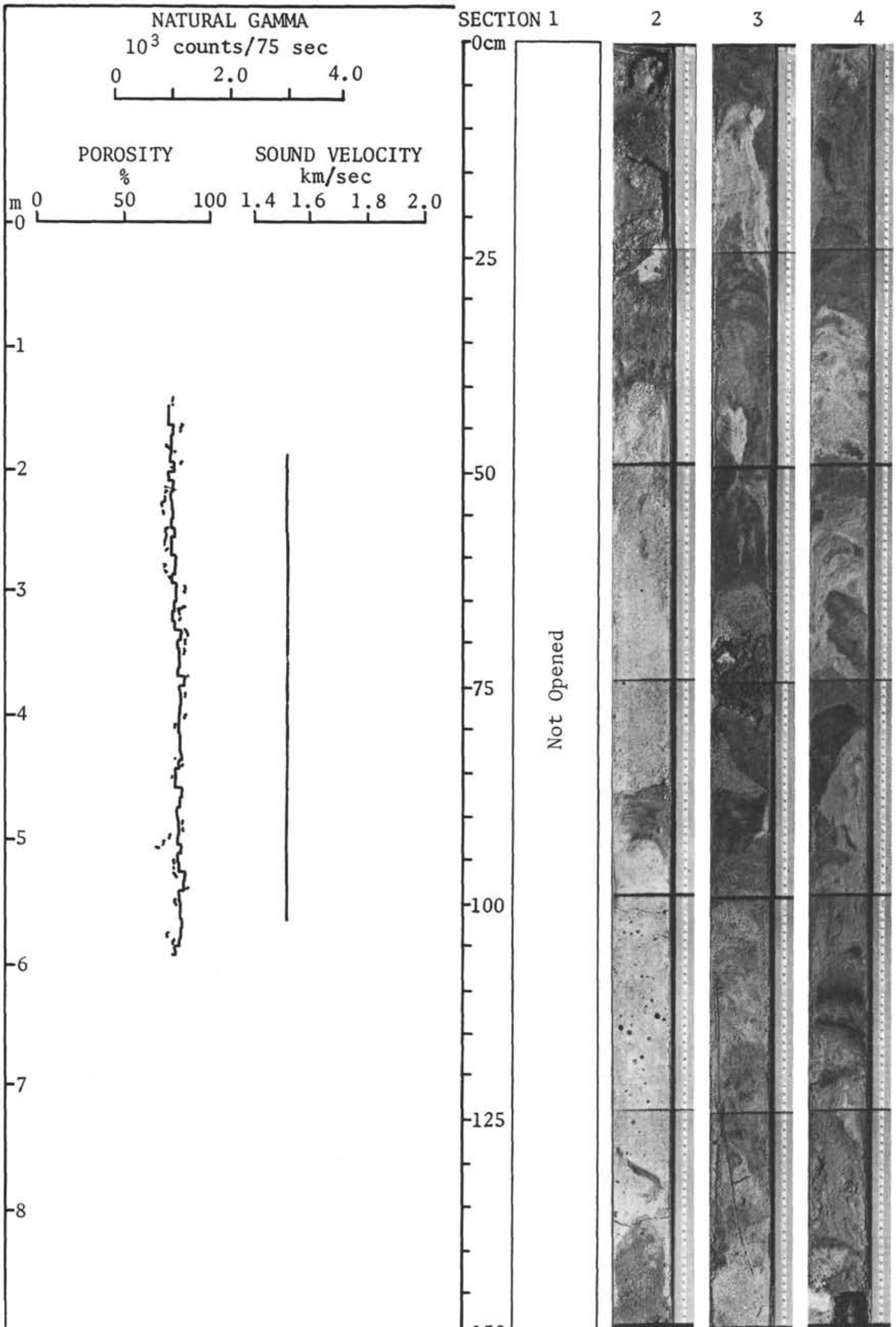


Figure 26. *Hole 83A, Core 1, Sections 1-4, Physical Properties.*

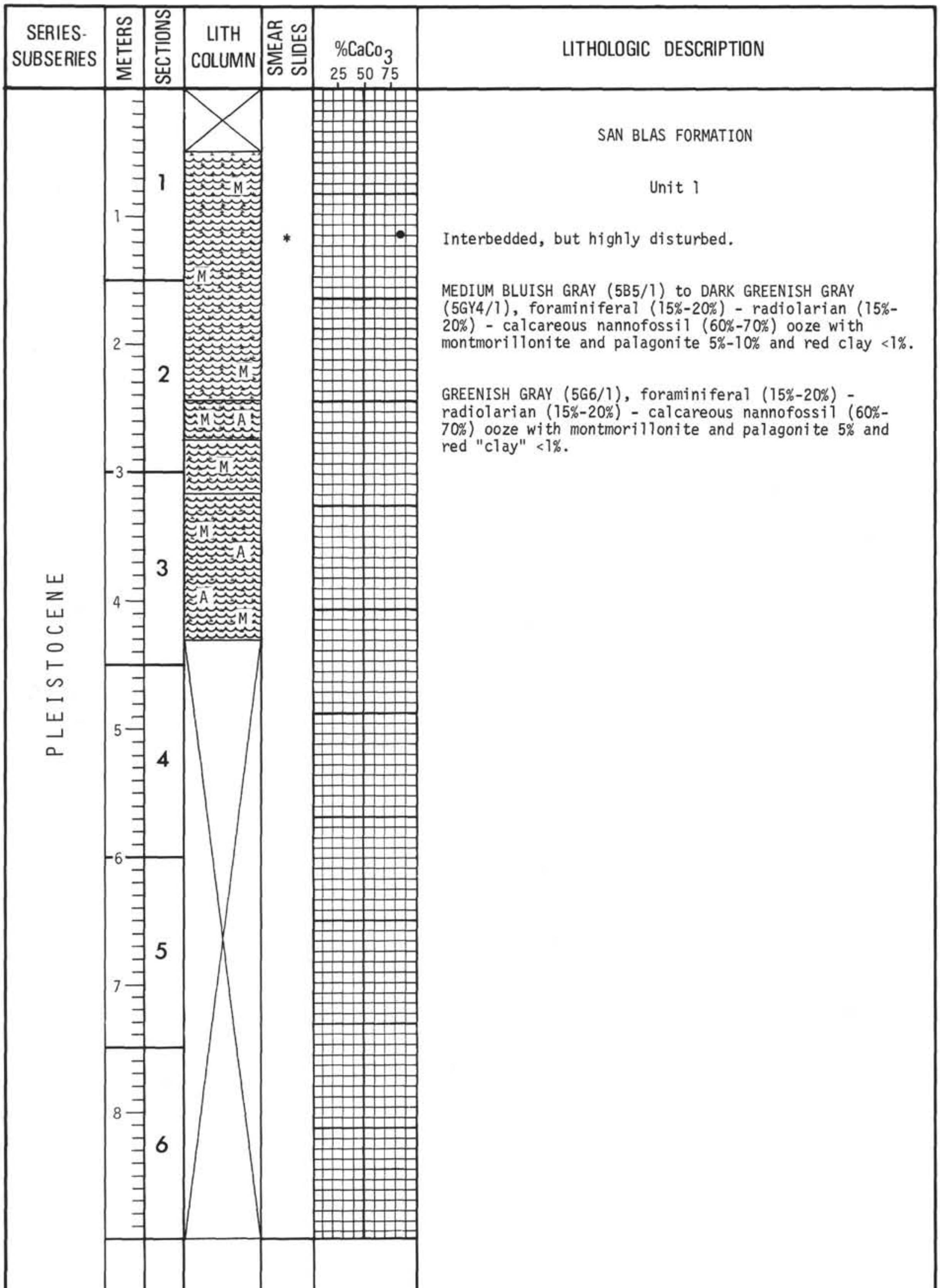


Figure 27. *Hole 83, Core 3 (14.3 to 23.4 m).*

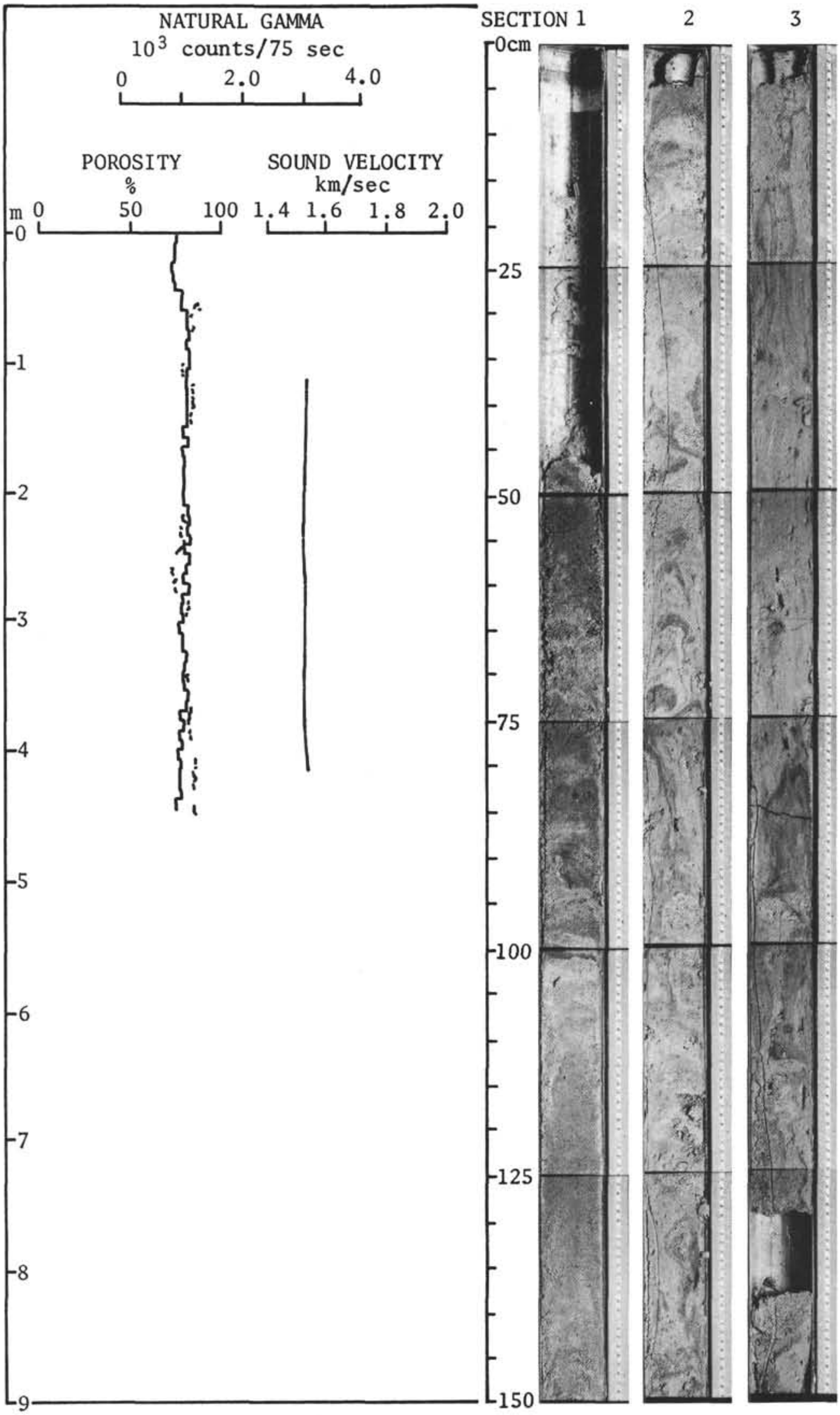


Figure 28. *Hole 83, Core 3, Sections 1, 2, 3, Physical Properties.*

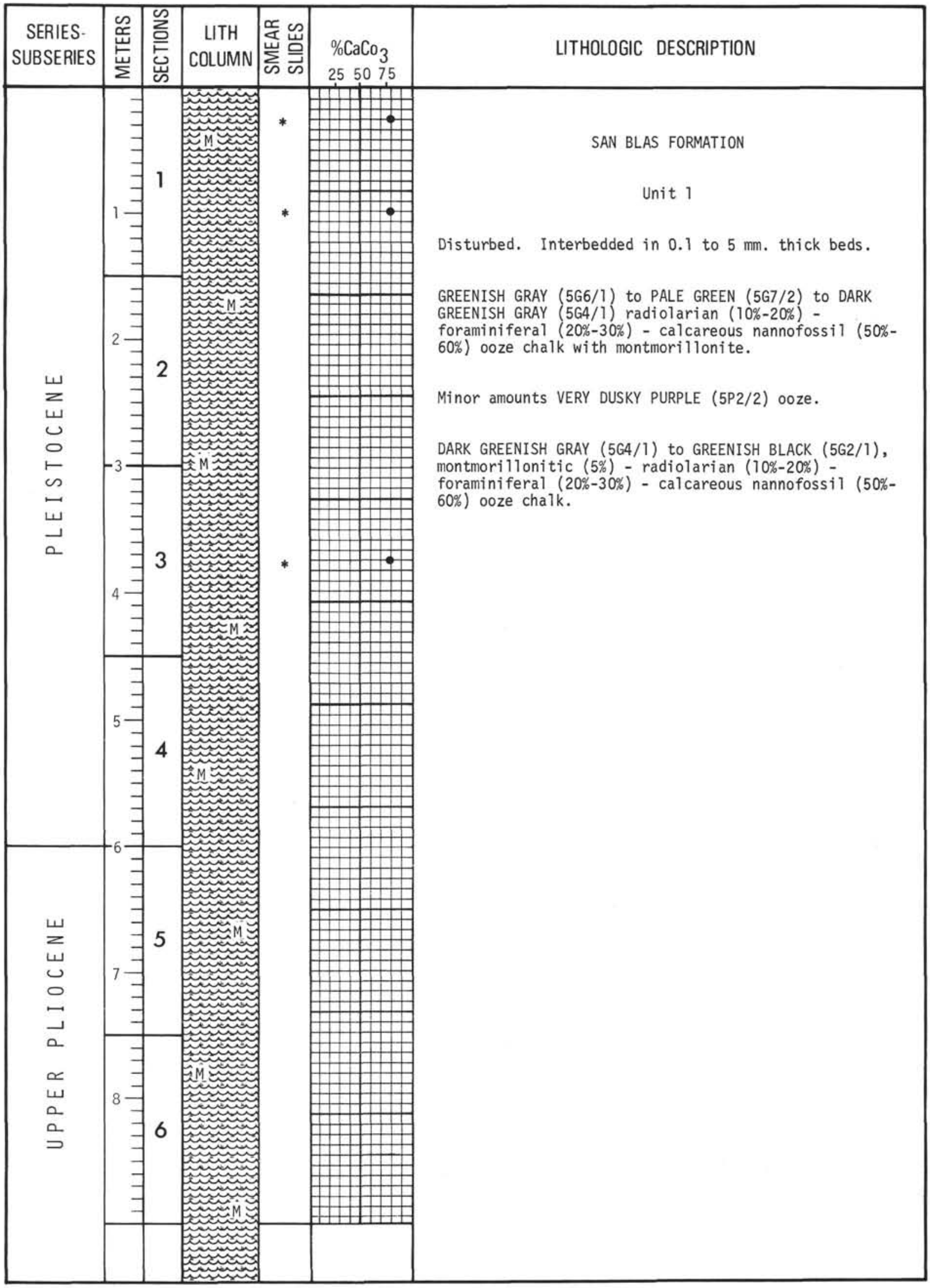


Figure 29. *Hole 83A, Core 2 (22.1 to 31.4 m).*

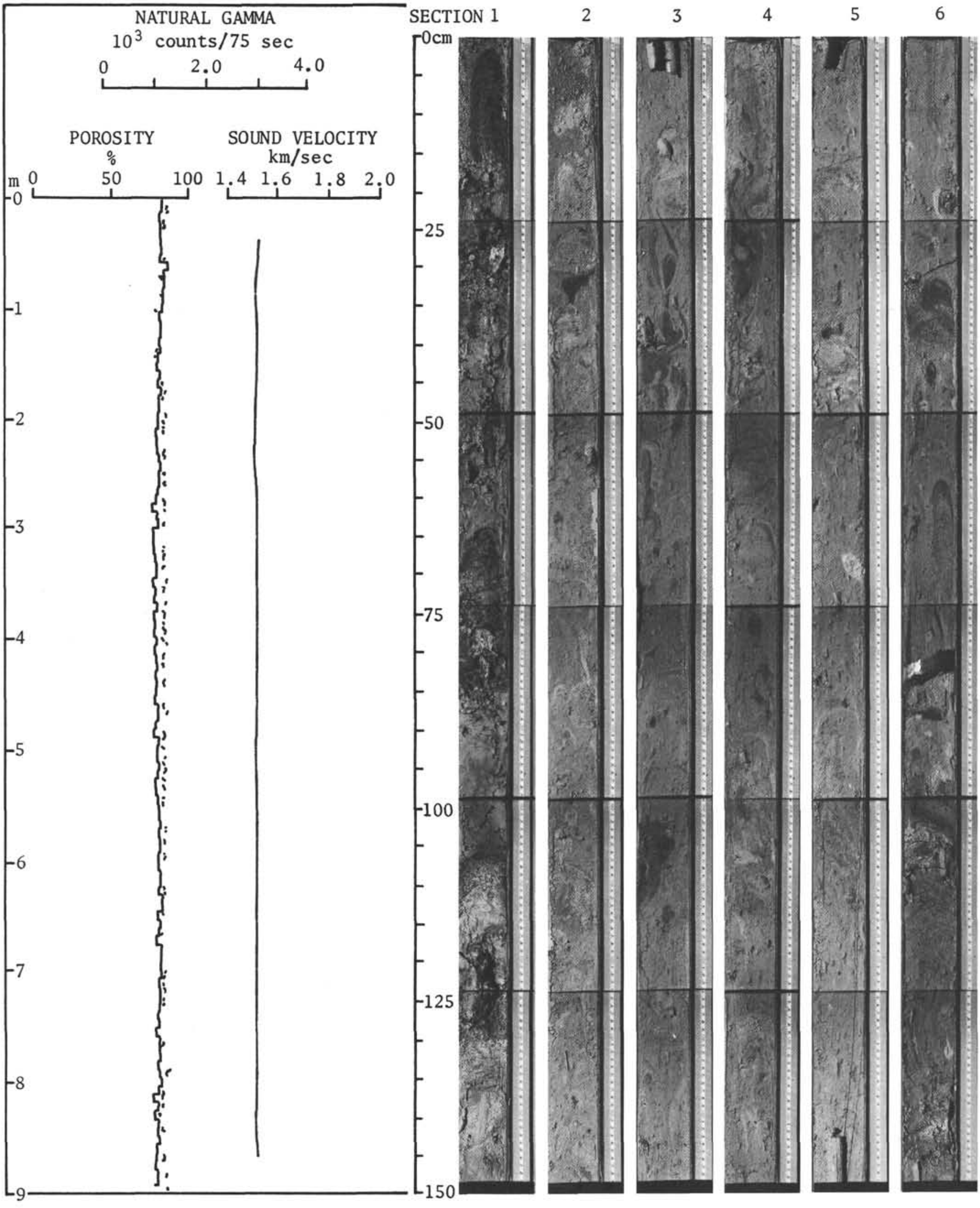


Figure 30. *Hole 83A, Core 2, Sections 1-6, Physical Properties.*

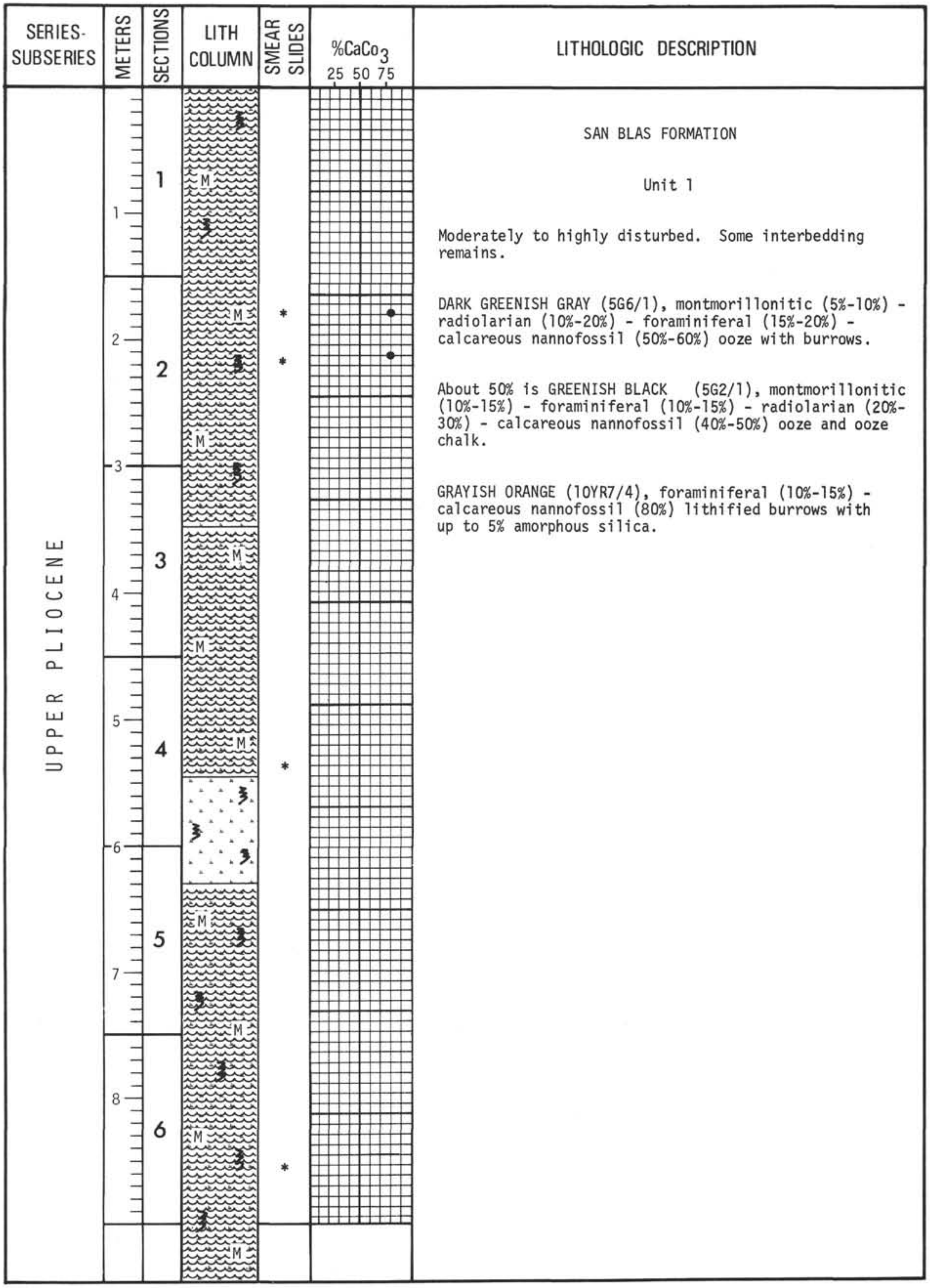


Figure 31. *Hole 83A, Core 3 (31.4 to 40.5 m).*

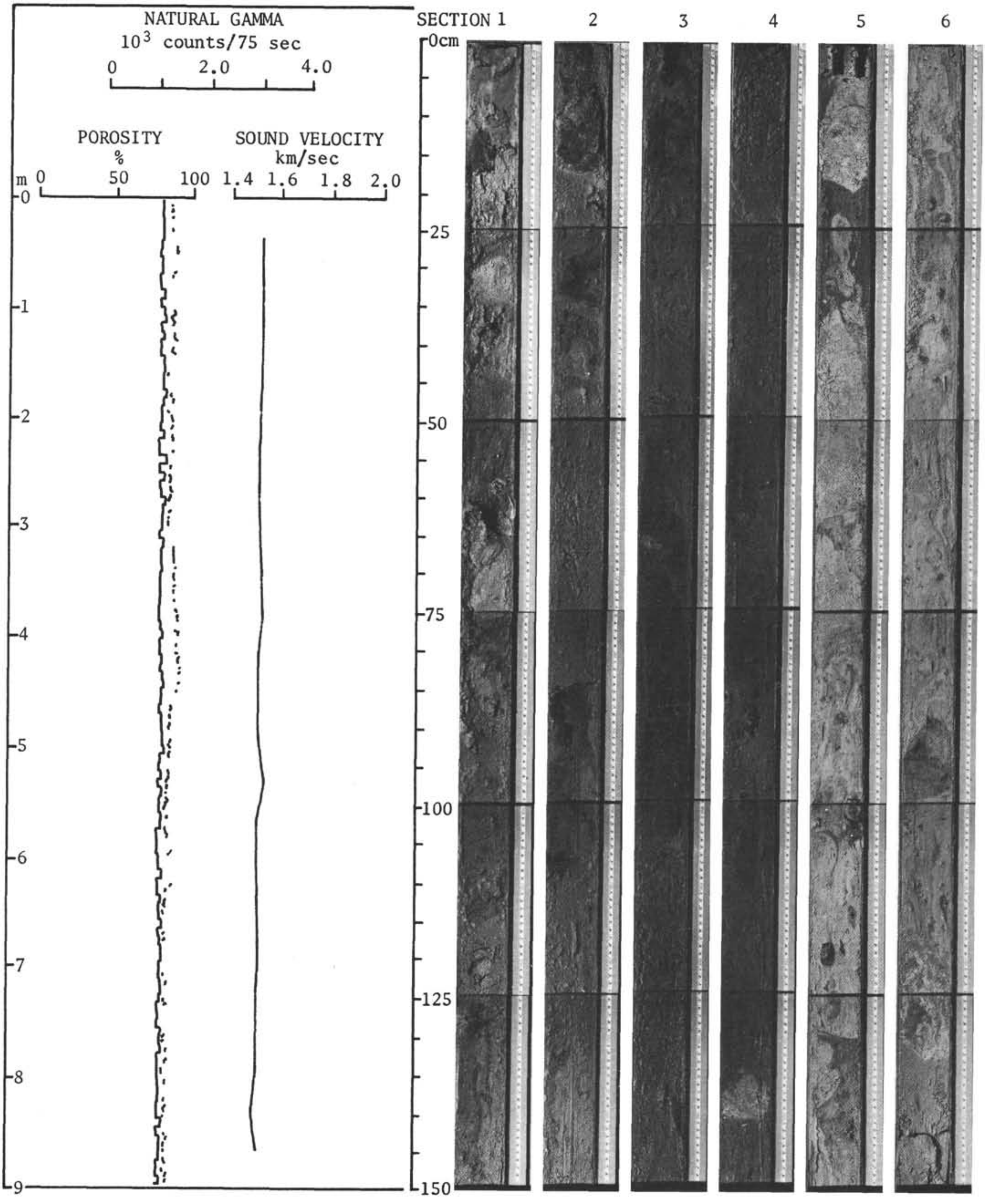
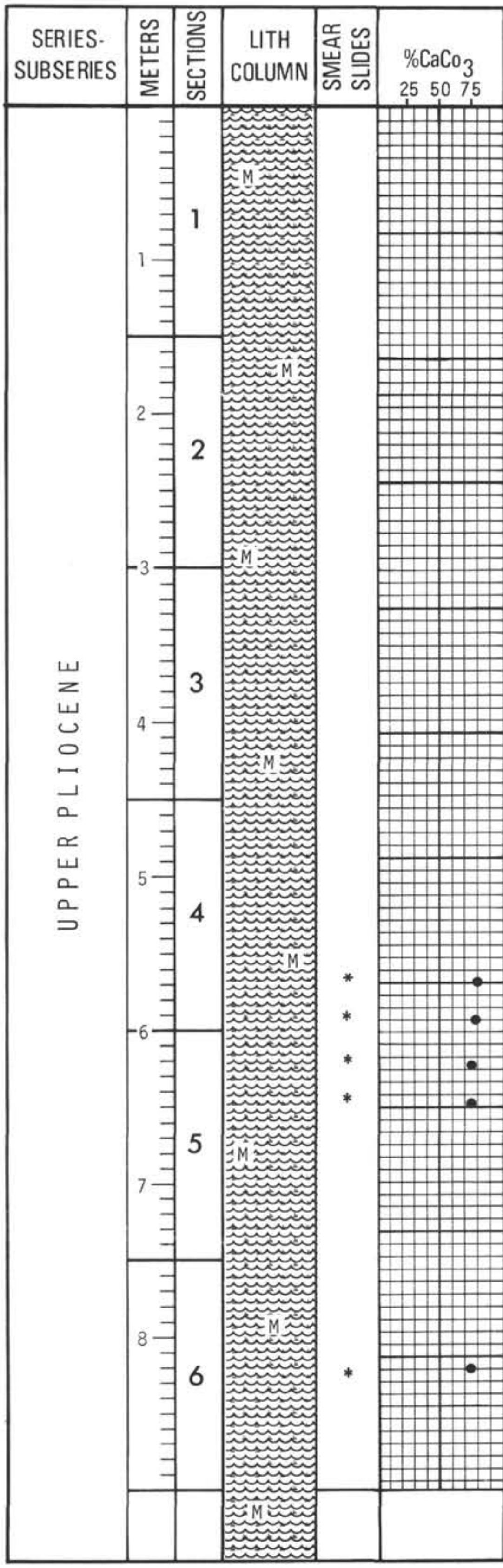


Figure 32. *Hole 83A, Core 3, Sections 1-6, Physical Properties.*



LITHOLOGIC DESCRIPTION

SAN BLAS FORMATION

Unit 1

Highly disturbed.

DARK GREENISH GRAY (5G4/1), montmorillonitic (5%) - radiolarian (10%-20%) - foraminiferal (15%-20%) - calcareous nannofossil (50%-60%) ooze.

SAN BLAS FORMATION

Base Unit 1

Figure 33. *Hole 83A, Core 4 (40.5 to 49.6 m).*

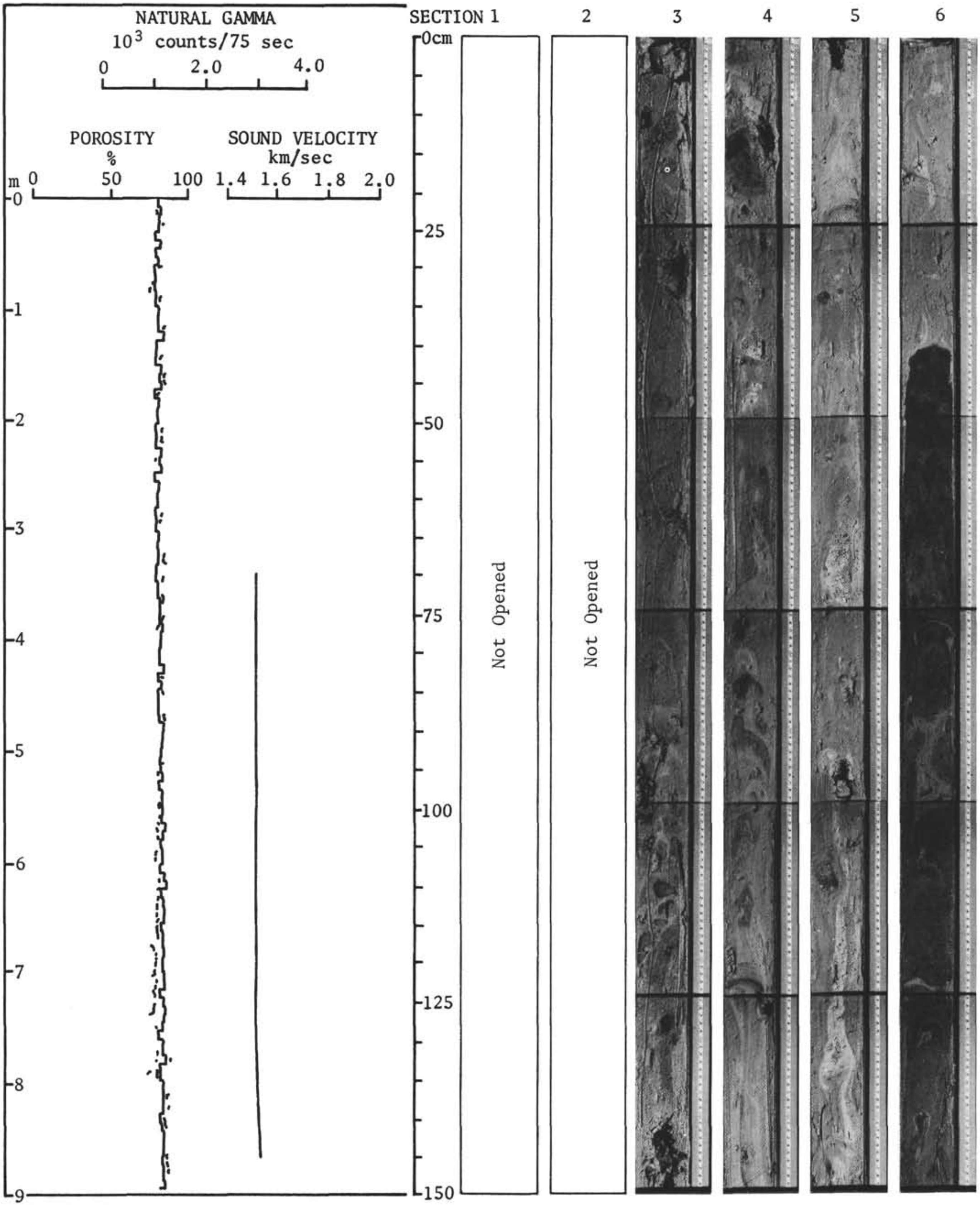
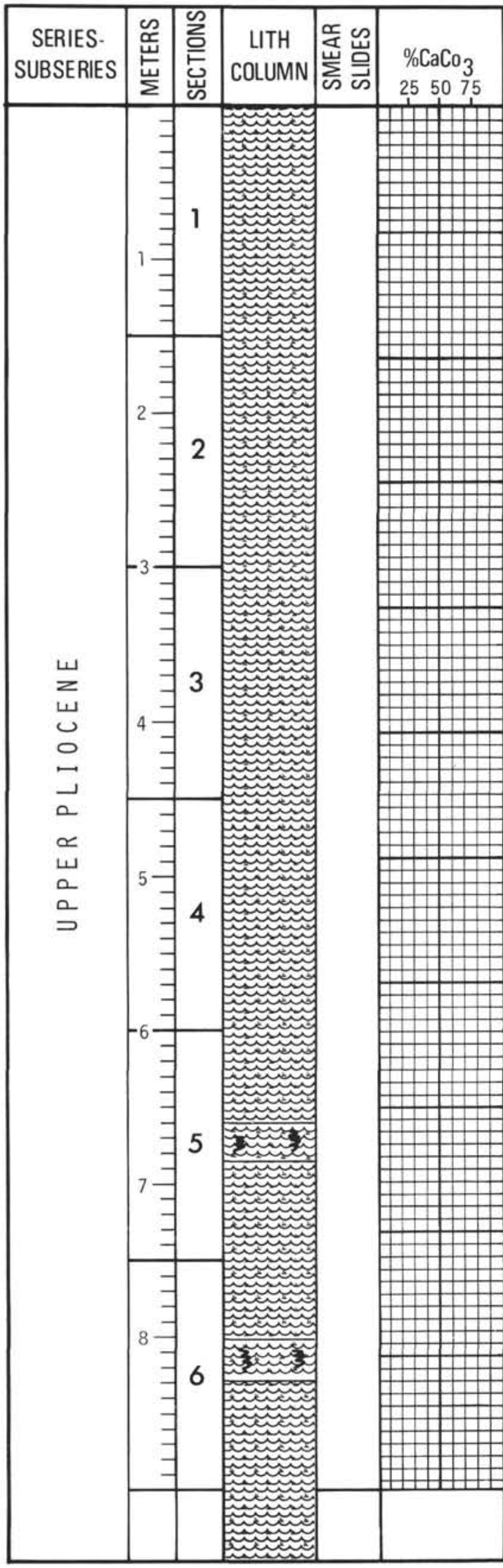


Figure 34. *Hole 83A, Core 4, Sections 1-6, Physical Properties.*



LITHOLOGIC DESCRIPTION

SAN BLAS FORMATION

Top Unit 2

Moderately disturbed. Interbedded in 10 to 15 cm. thick beds.

About 80% MEDIUM BLUISH GRAY (5B5/1), foraminiferal (15%-25%) - radiolarian (30%-40%) - calcareous nannofossil (40%-50%) ooze.

About 10% GREENISH BLACK (5G2/1), montmorillonitic (5%-10%) - radiolarian (15%-25%) - with foraminifers <5%.

About 10% GREENISH GRAY (5GY6/1), foraminiferal (15%-25%) - radiolarian (30%-40%) - calcareous nannofossil (40%-50%).

Rare YELLOWISH GRAY (5Y7/2) lithified burrows.

Figure 35. *Hole 83A, Core 5 (49.6 to 58.8 m).*

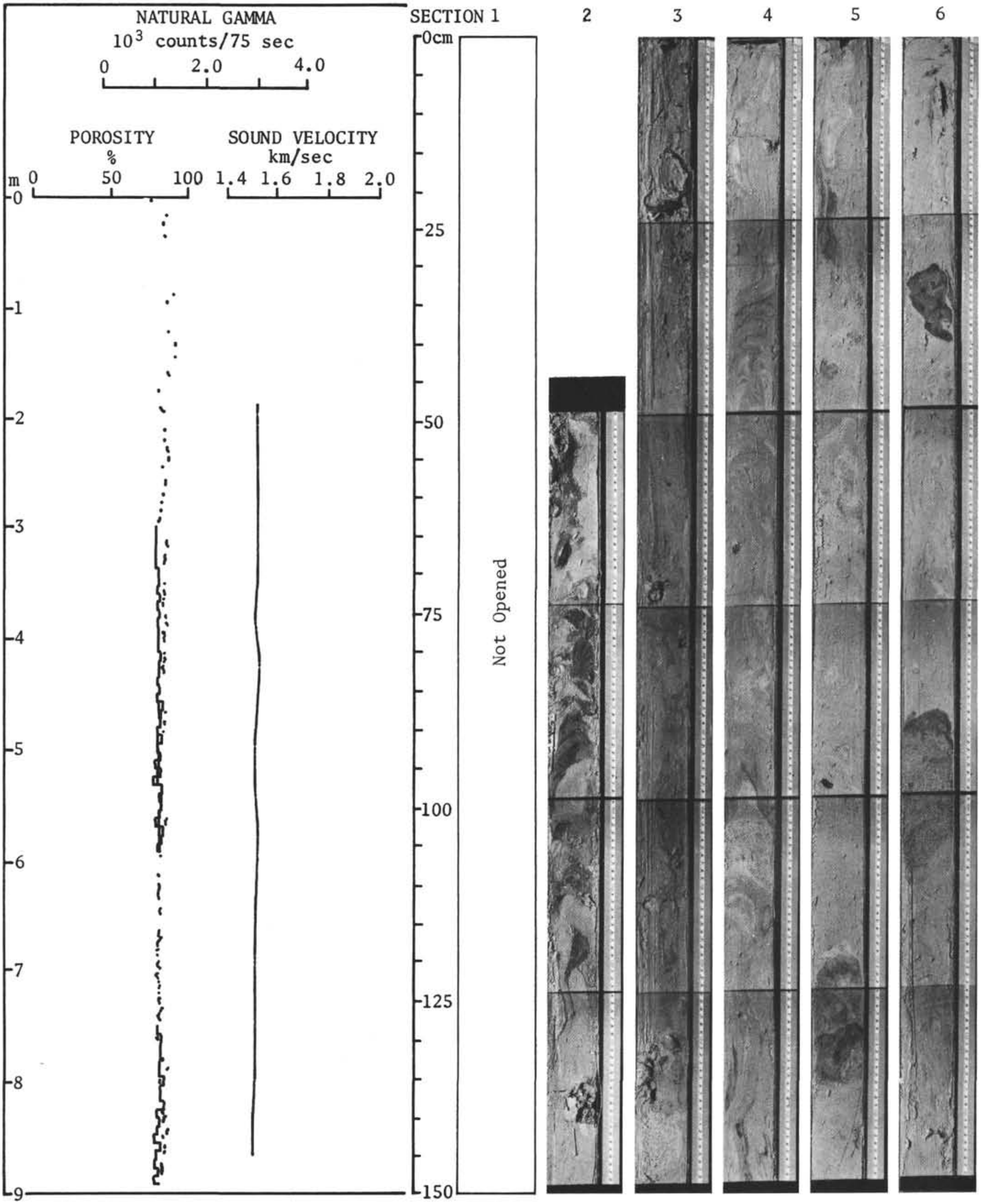
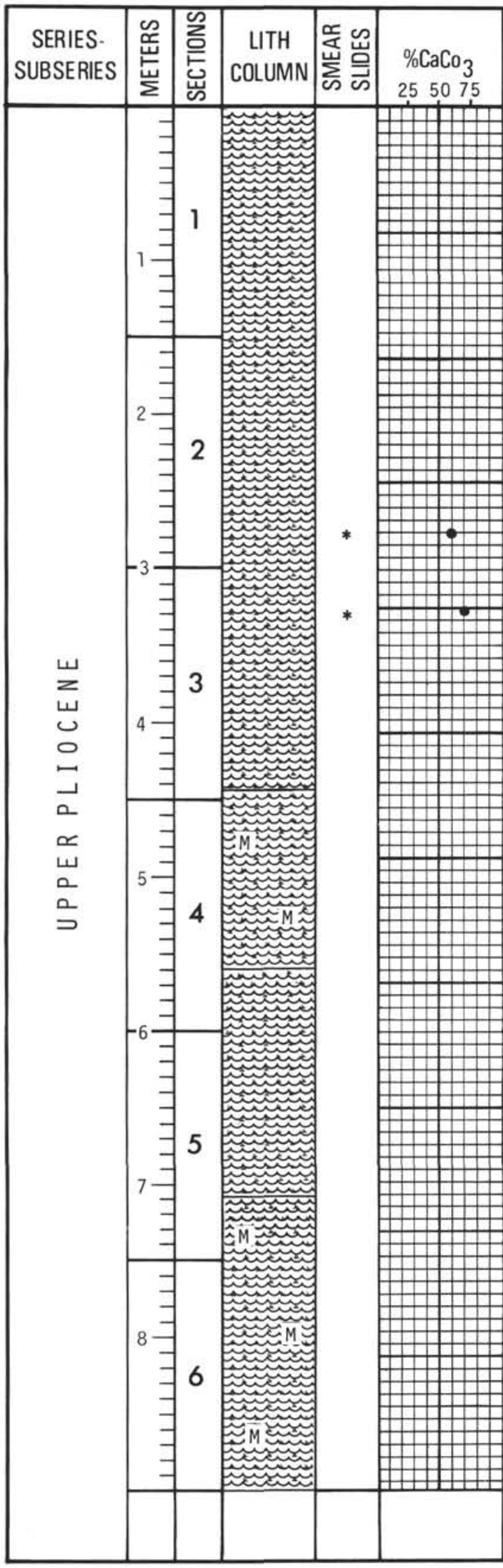


Figure 36. *Hole 83A, Core 5, Sections 1-6, Physical Properties.*



LITHOLOGIC DESCRIPTION

SAN BLAS FORMATION

Unit 2

Disturbed. Interbedded in 5 to 50 cm. thick beds.

About 80% PALE GREENISH YELLOW (10Y8/2), foraminiferal (15%-25%) - radiolarian (30%-40%) - calcareous nannofossil (40%-60%) chalk ooze.

MEDIUM BLUISH GRAY (5B5/1) to DARK GREENISH GRAY (5G4/1), montmorillonitic (5%) - foraminiferal (15%-25%) - radiolarian (30%-40%) - calcareous nannofossil (40%-50%) chalk ooze.

Figure 37. *Hole 83A, Core 6 (58.8 to 67.9 m).*

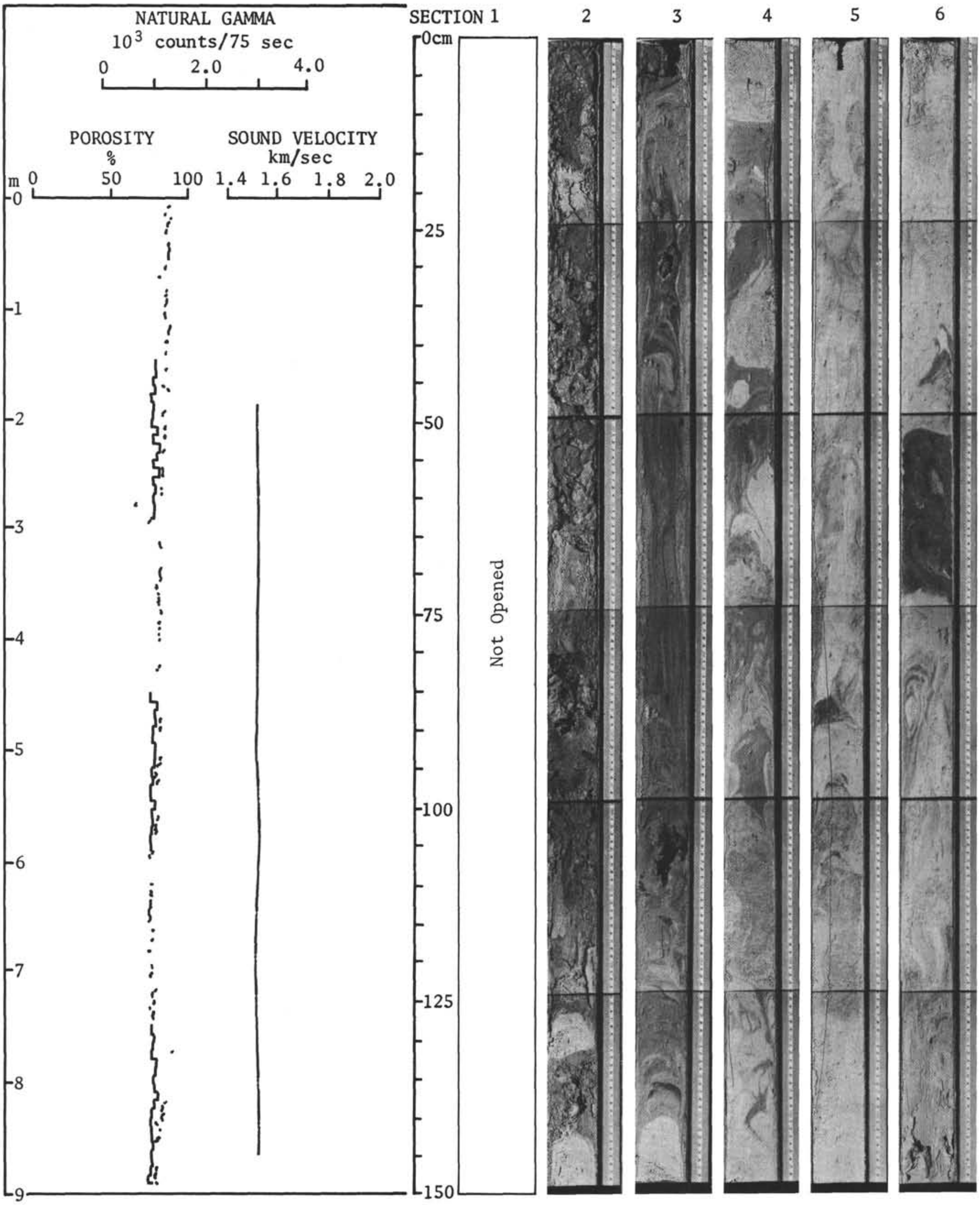


Figure 38. *Hole 83A, Core 6, Sections 1-6, Physical Properties.*

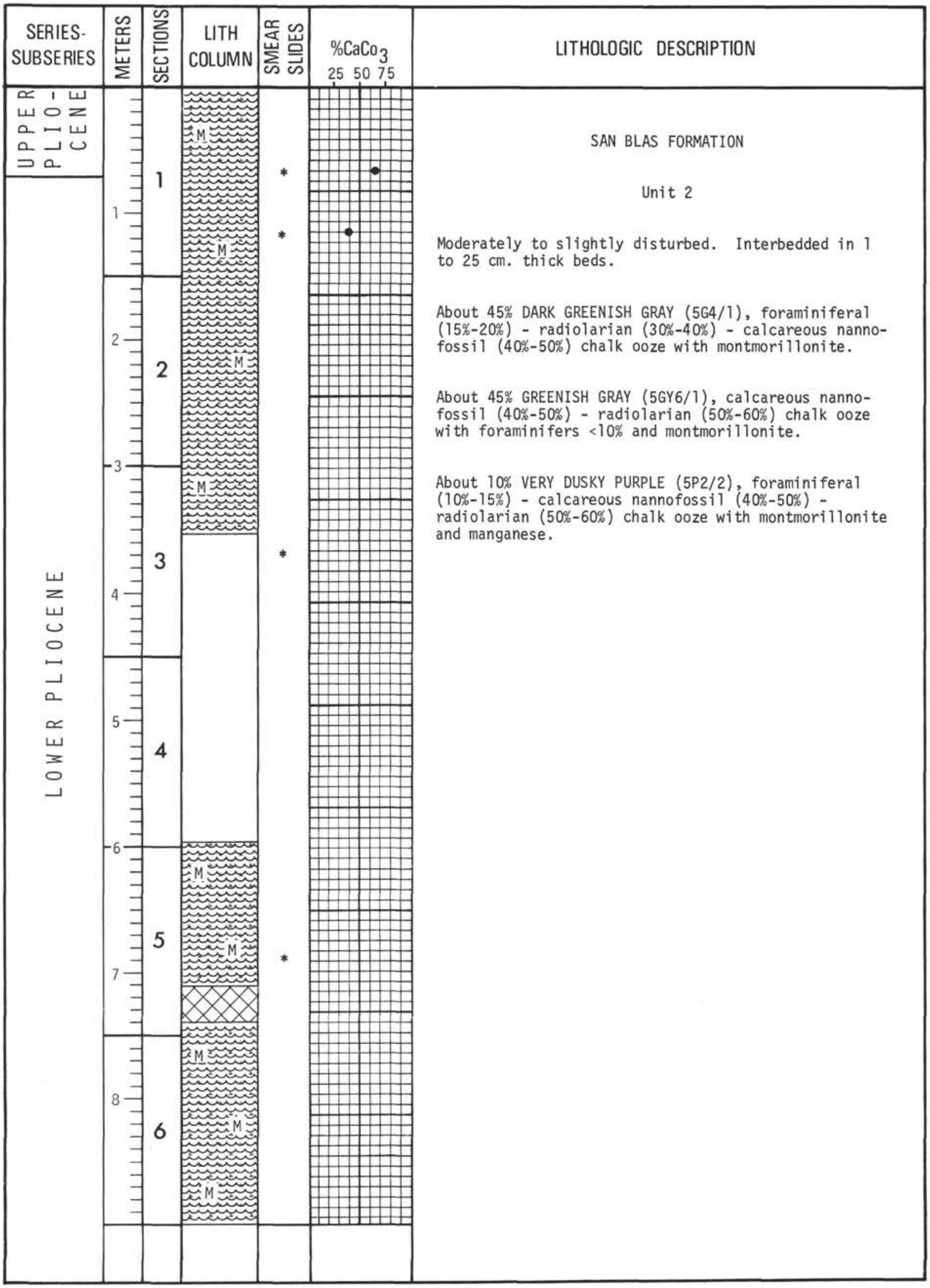


Figure 39. *Hole 83A, Core 7 (67.9 to 77.1 m).*

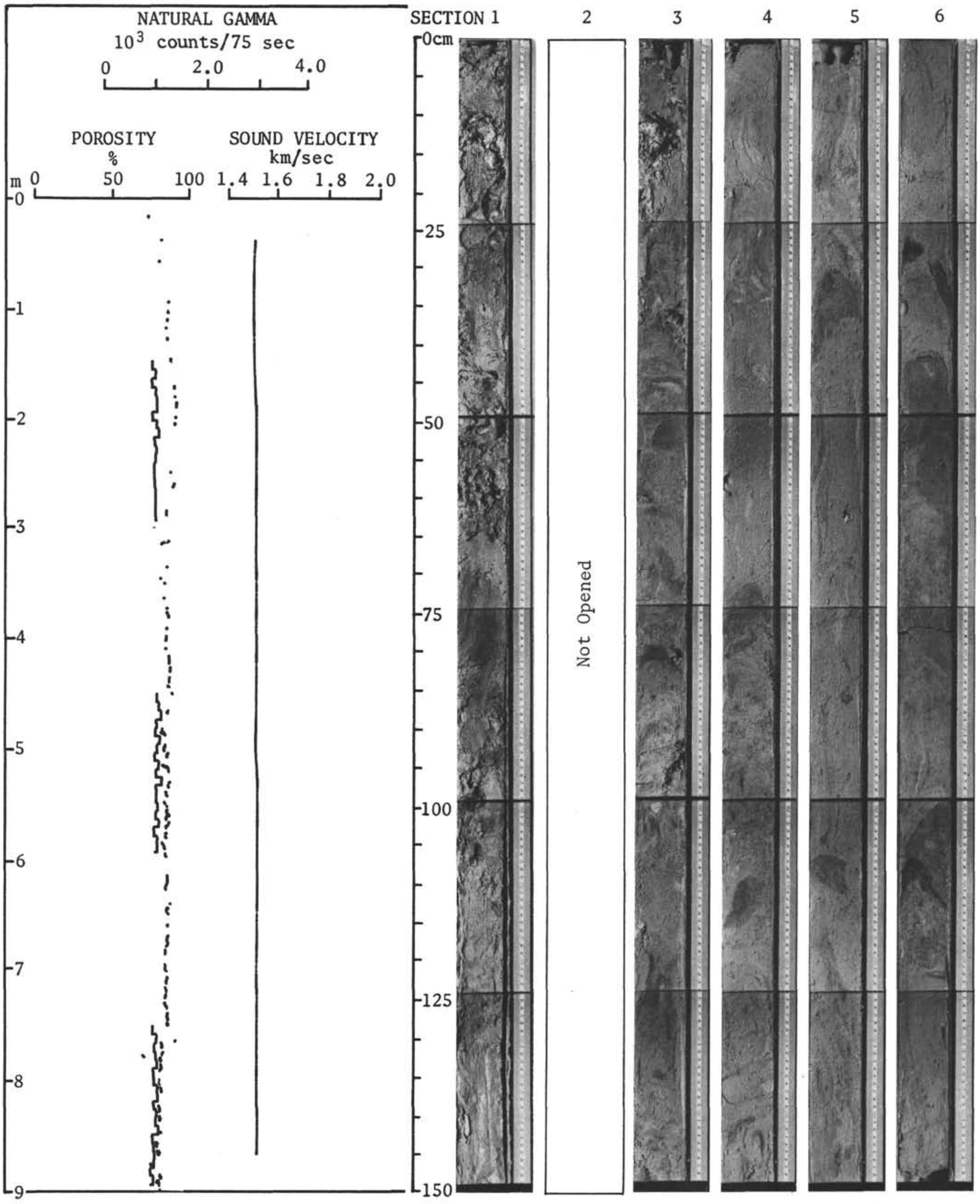


Figure 40. *Hole 83A, Core 7, Sections 1-6, Physical Properties.*

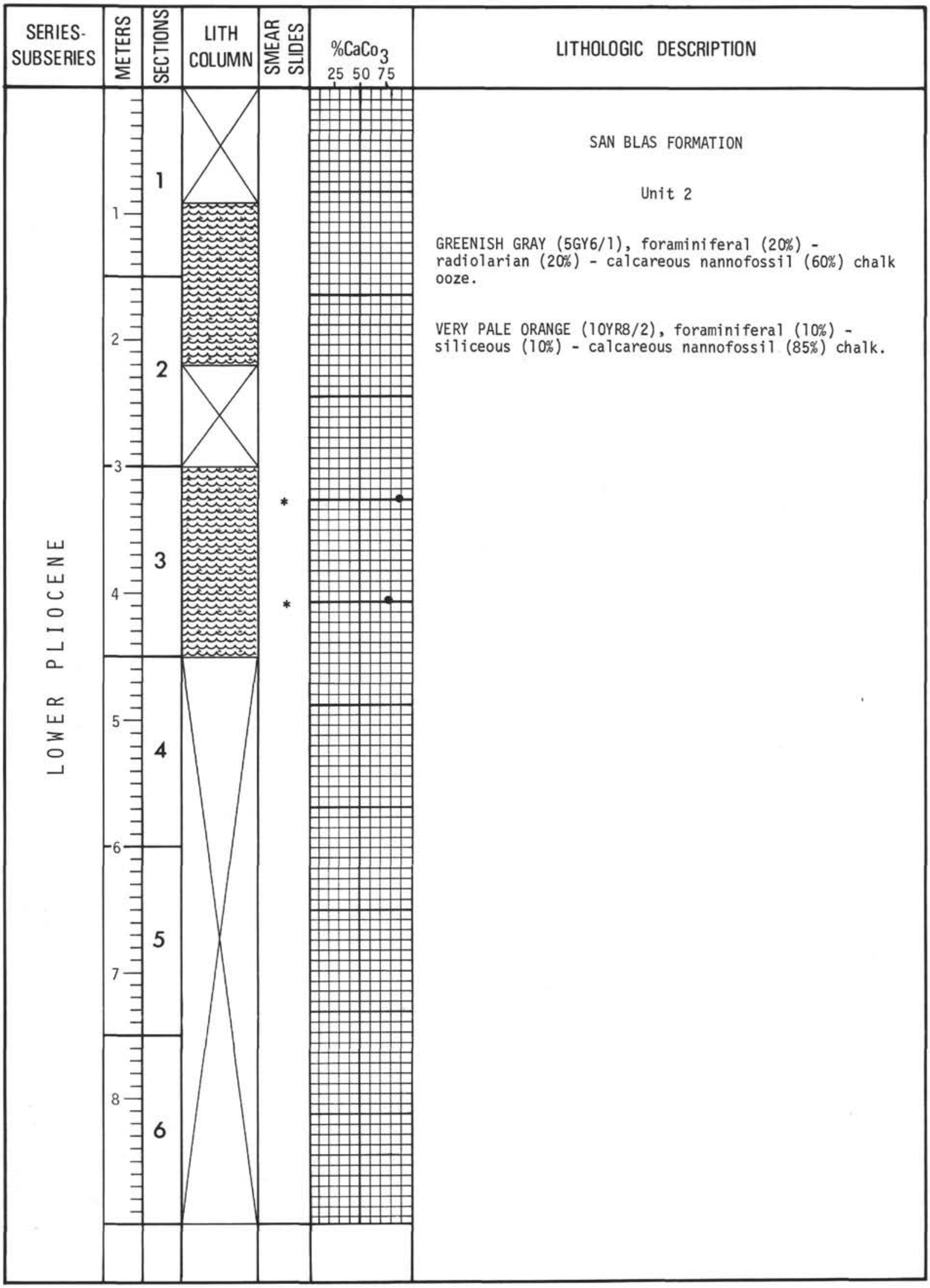


Figure 41. *Hole 83, Core 4 (68.8 to 78.0 m).*

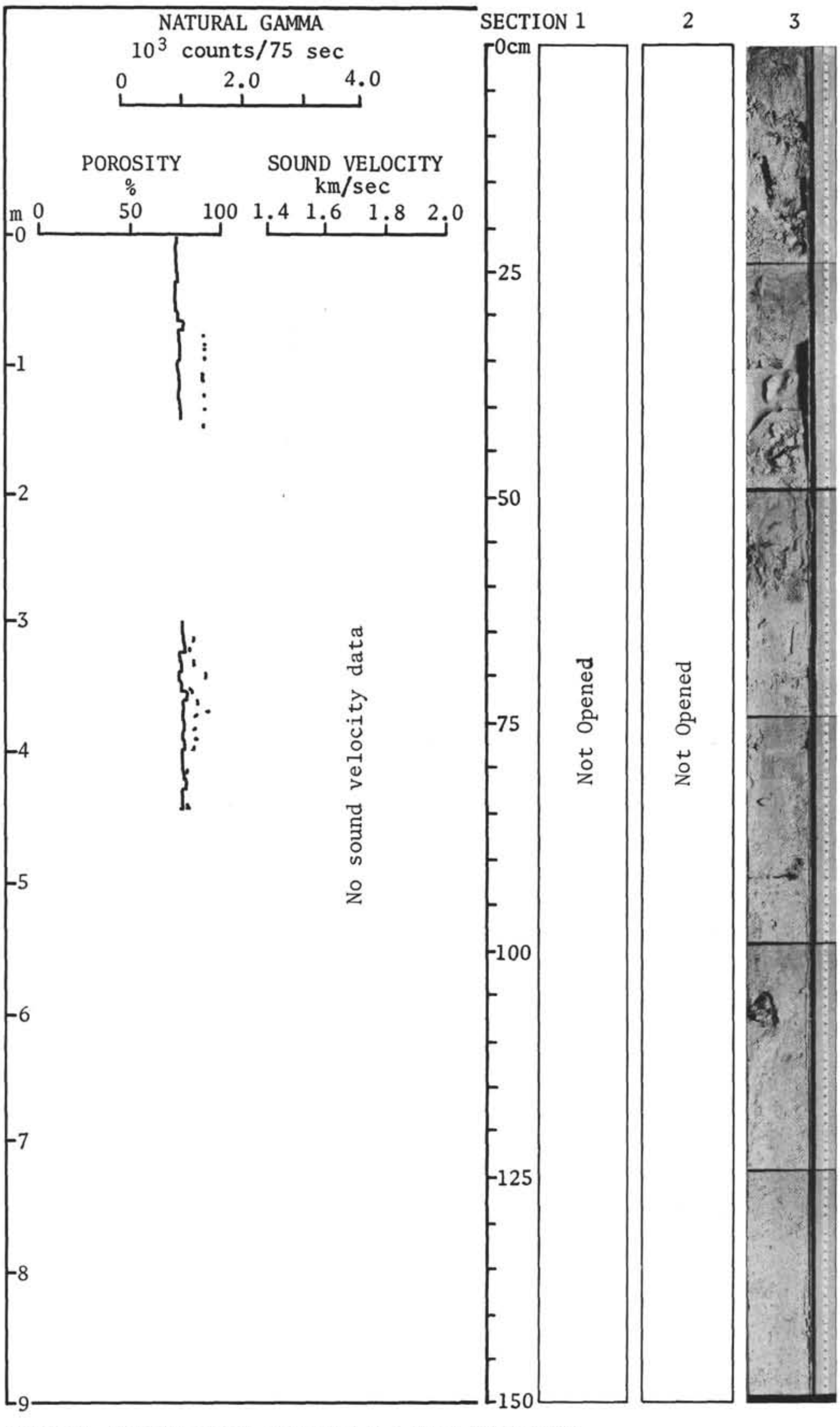


Figure 42. *Hole 83, Core 4, Sections 1, 2, 3, Physical Properties.*

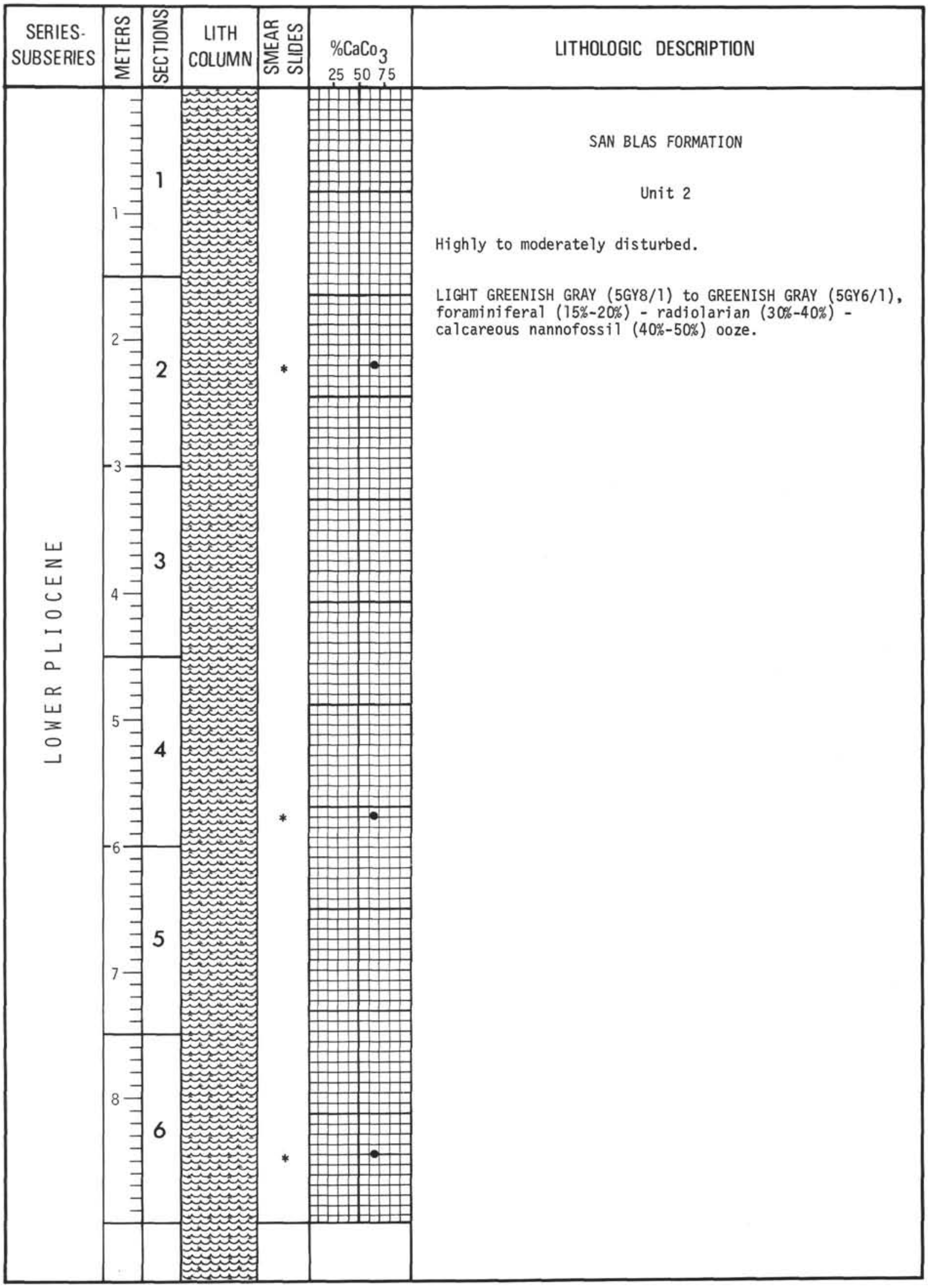


Figure 43. *Hole 83A, Core 8 (77.1 to 86.1 m).*

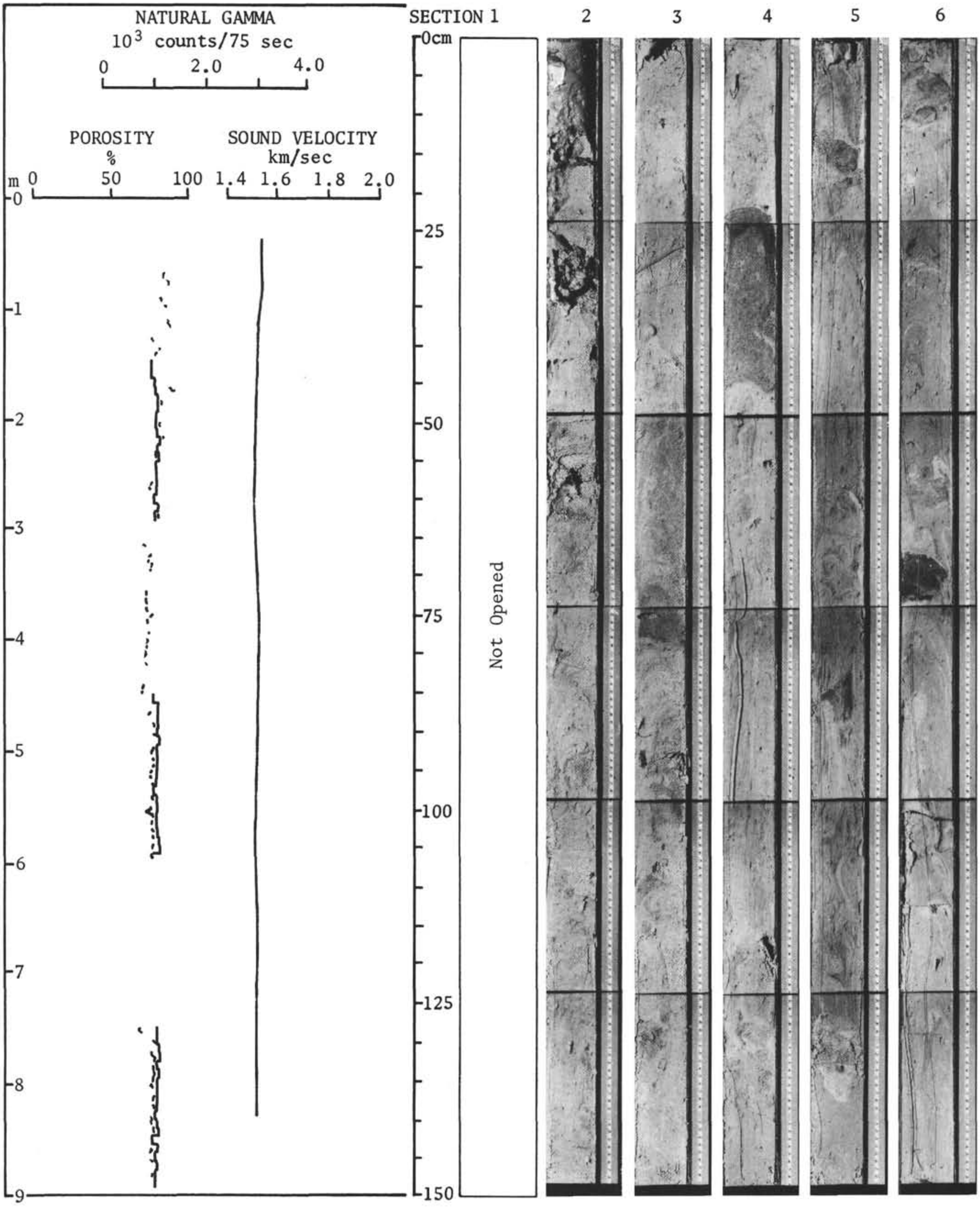


Figure 44. *Hole 83A, Core 8, Sections 1-6, Physical Properties.*

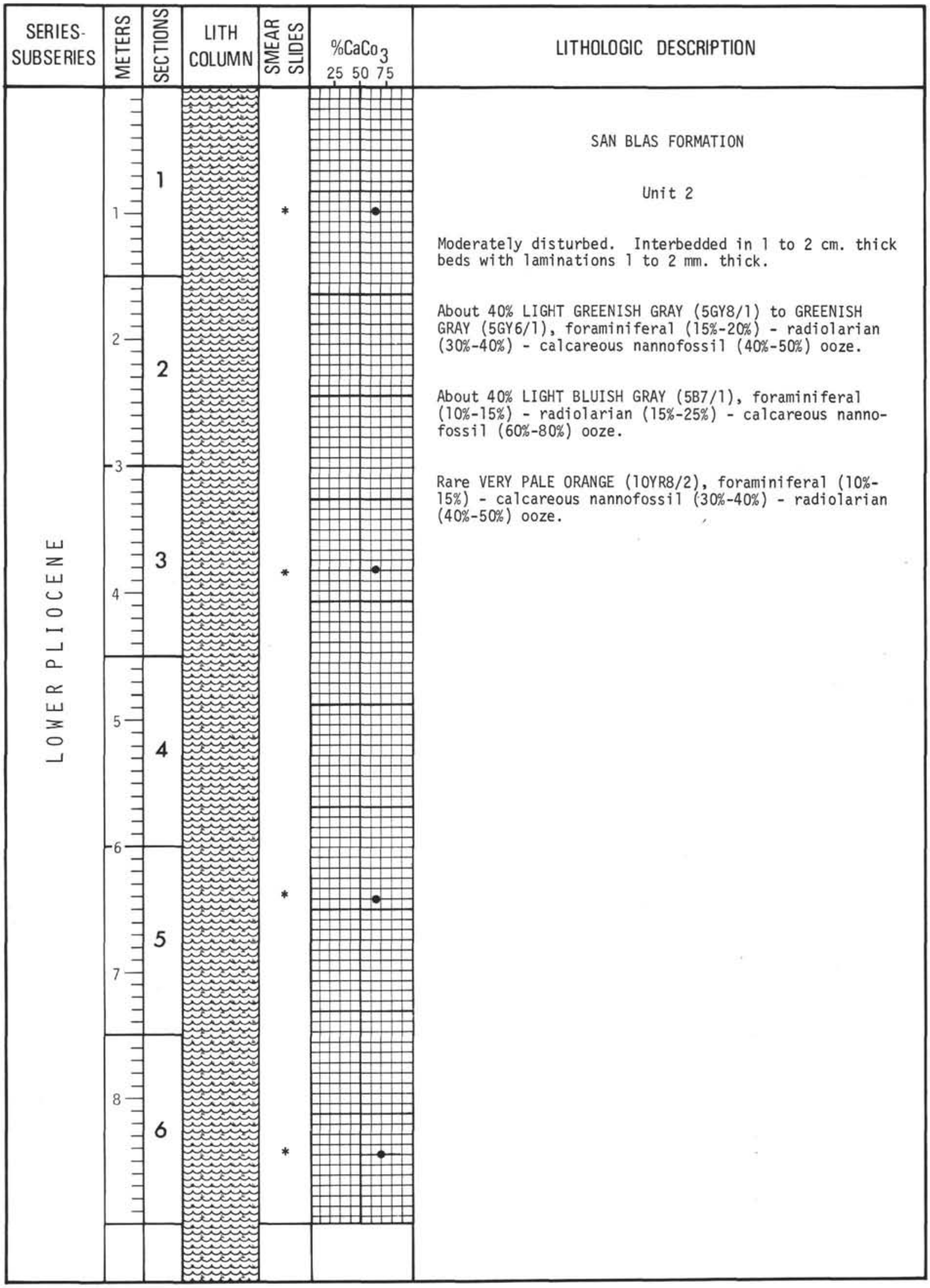


Figure 45. *Hole 83A, Core 9 (86.1 to 95.4 m).*

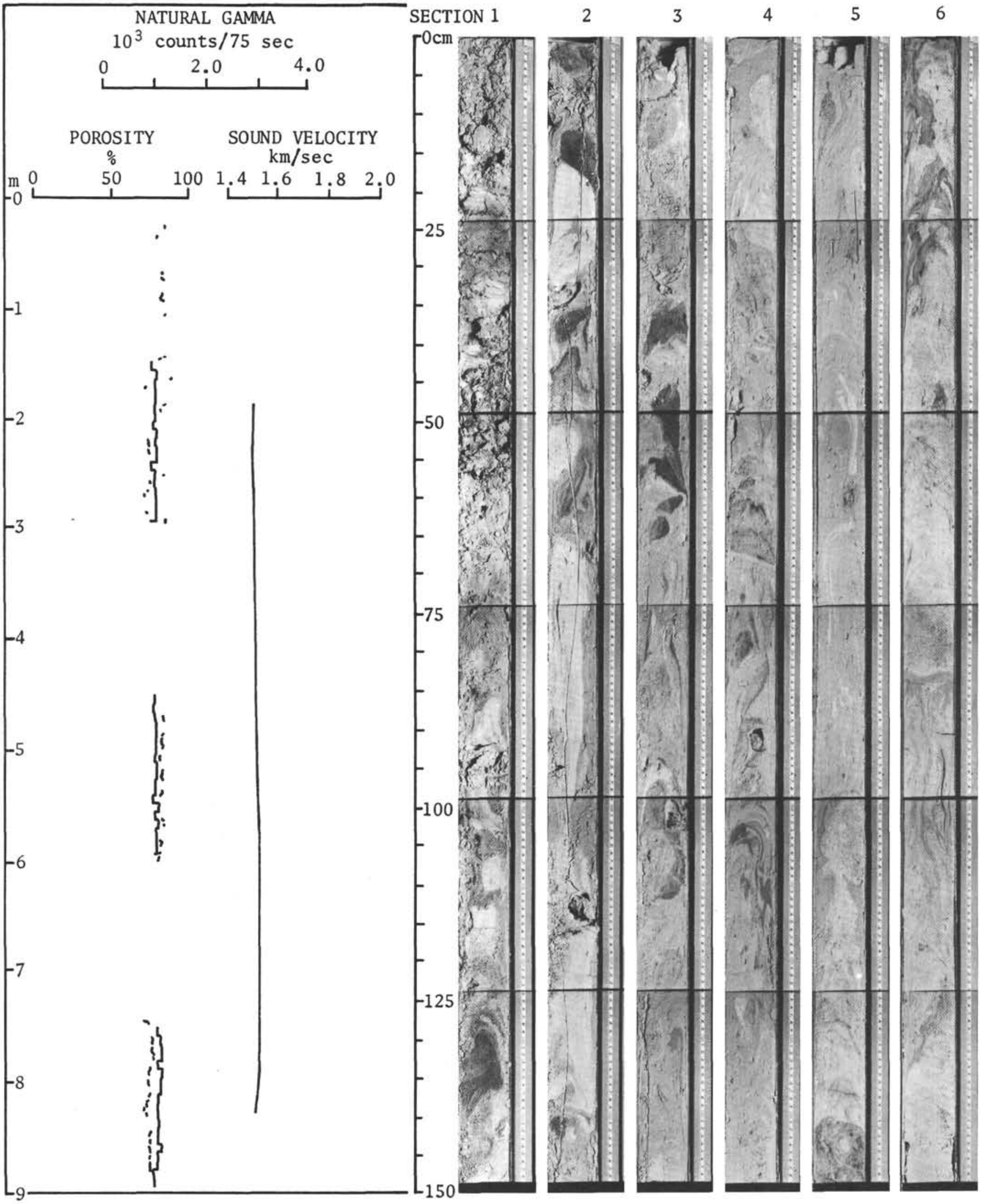
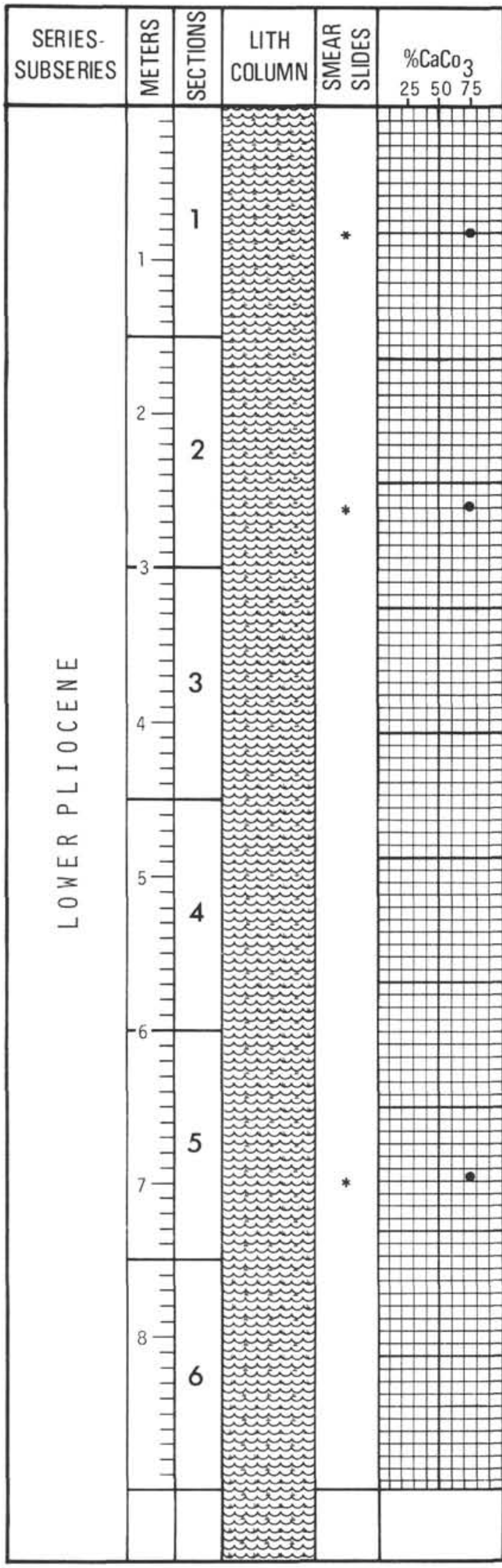


Figure 46. *Hole 83A, Core 9, Sections 1-6, Physical Properties.*



LITHOLOGIC DESCRIPTION

SAN BLAS FORMATION

Unit 2

Moderately disturbed. Interbedded in 1 to 5 cm. thick beds.

About 90% LIGHT BLUISH GRAY (5B7/1), foraminiferal (10%-15%) - radiolarian (15%-25%) - calcareous nannofossil (60%-80%) ooze.

About 5% GREENISH GRAY (5G6/1), foraminiferal (10%-15%) - radiolarian (15%-25%) - calcareous nannofossil (60%-80%) ooze.

Less than 5% BLUISH WHITE (5B9/1), foraminiferal (10%-15%) - radiolarian (15%-25%) - calcareous nannofossil (60%-80%) ooze.

Figure 47. *Hole 83A, Core 10 (95.4 to 104.5 m).*

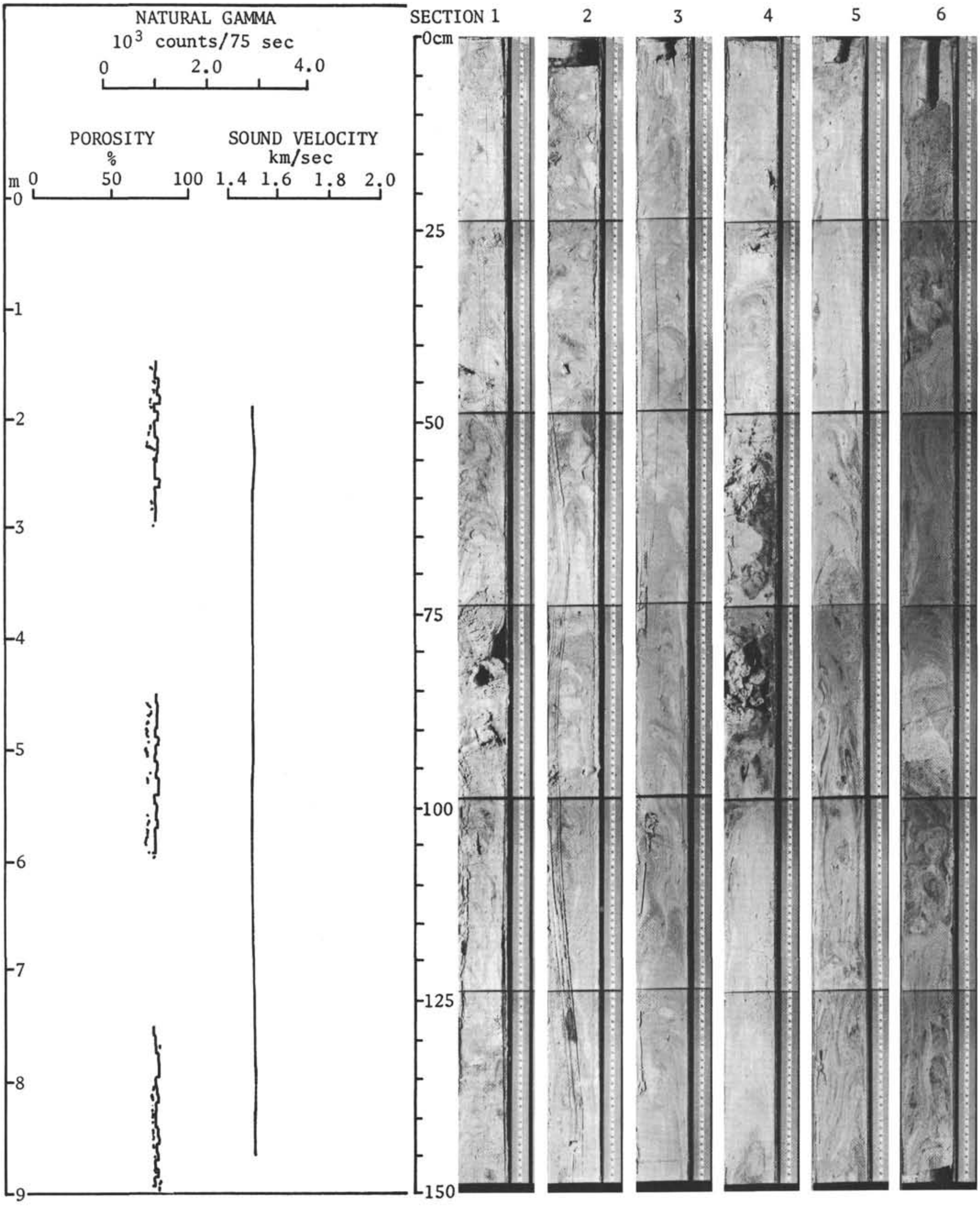


Figure 48. *Hole 83A, Core 10, Sections 1-6, Physical Properties.*

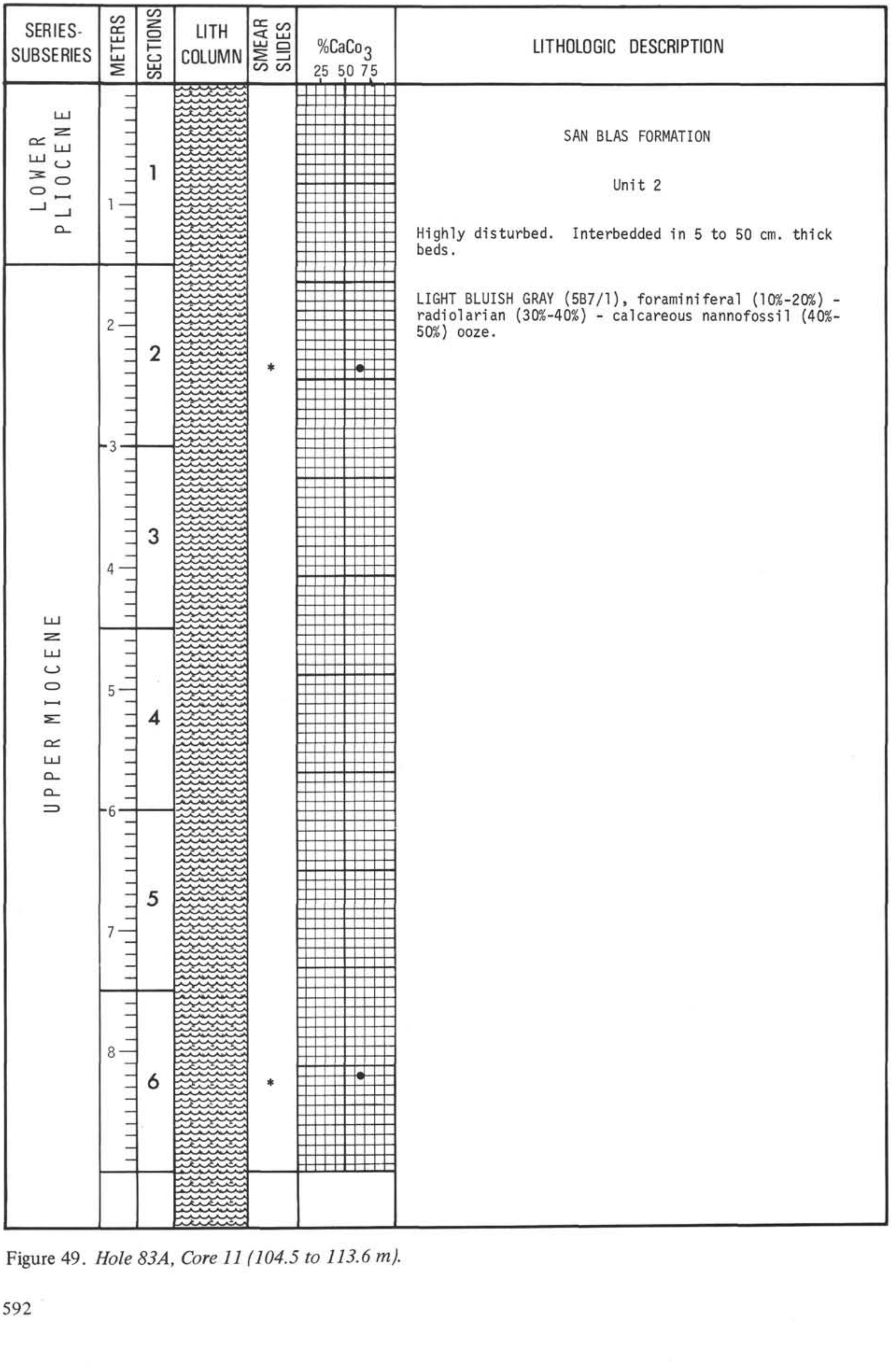


Figure 49. *Hole 83A, Core 11 (104.5 to 113.6 m).*

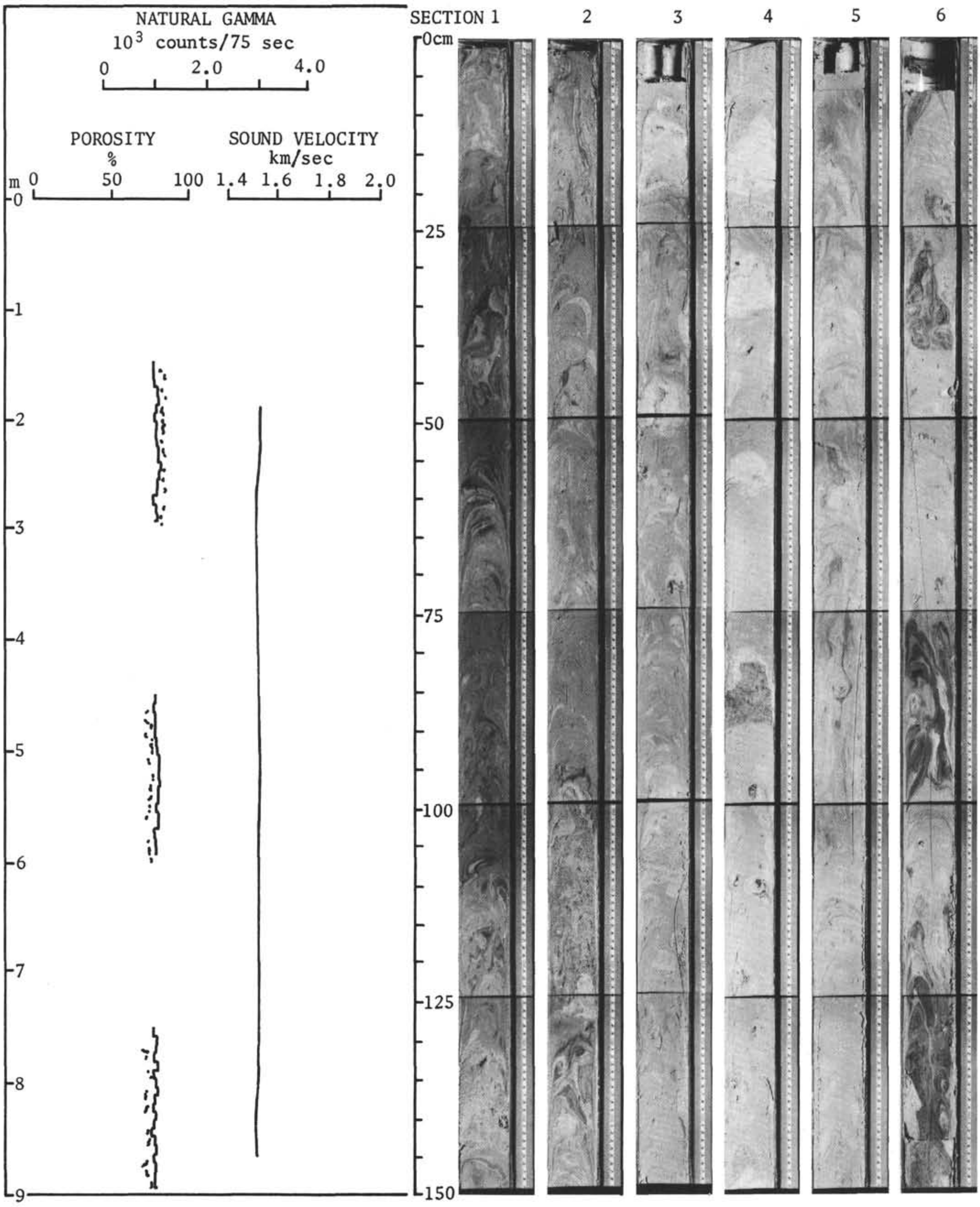
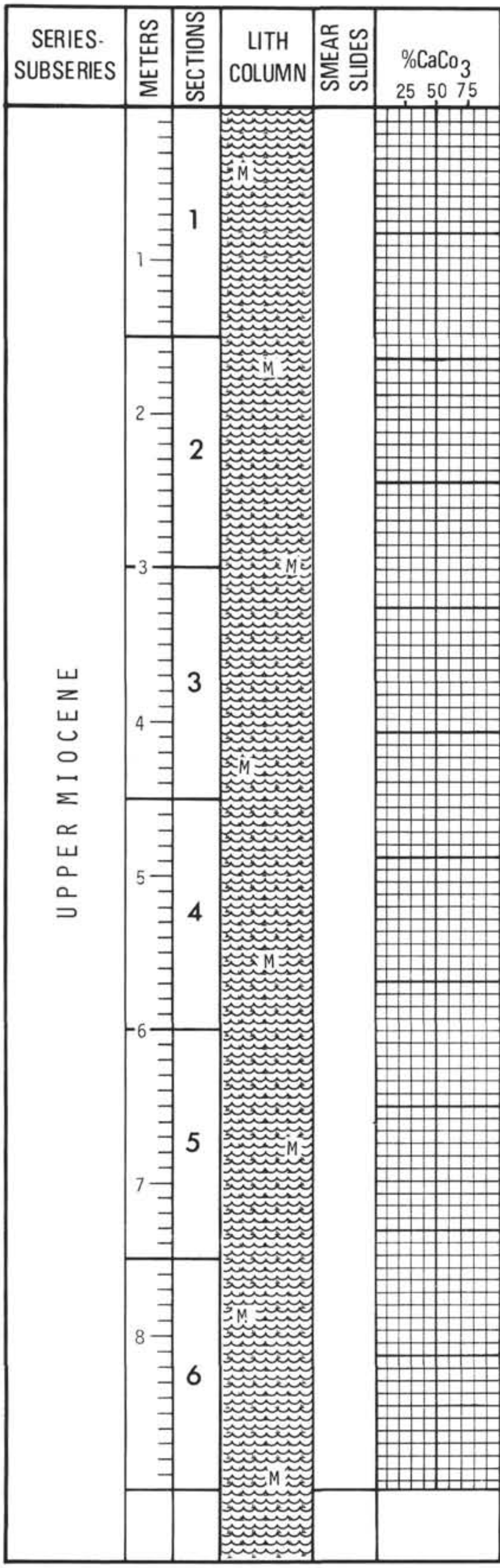


Figure 50. *Hole 83A, Core 11, Sections 1-6, Physical Properties.*



LITHOLOGIC DESCRIPTION

SAN BLAS FORMATION

Unit 2

Moderately to slightly disturbed. Interbedded in 5 to 25 cm. thick beds.

About 90% DARK GREENISH GRAY (5GY4/1), montmorillonitic (5%-10%) - foraminiferal (10%) - radiolarian (40%-50%)- calcareous nannofossil (40%-50%) chalk ooze.

About 10% GREENISH BLACK (5G2/1), foraminiferal (10%) - montmorillonitic (10%-15%) - radiolarian (40%-45%) - calcareous nannofossil (40%-45%) chalk ooze.

LIGHT BLUISH GRAY (5B7/1) to MEDIUM BLUISH GRAY (5B5/1), foraminiferal (10%) - radiolarian (30%-40%) - calcareous nannofossil (50%-60%) ooze.

Figure 51. *Hole 83A, Core 12 (113.6 to 122.8 m).*

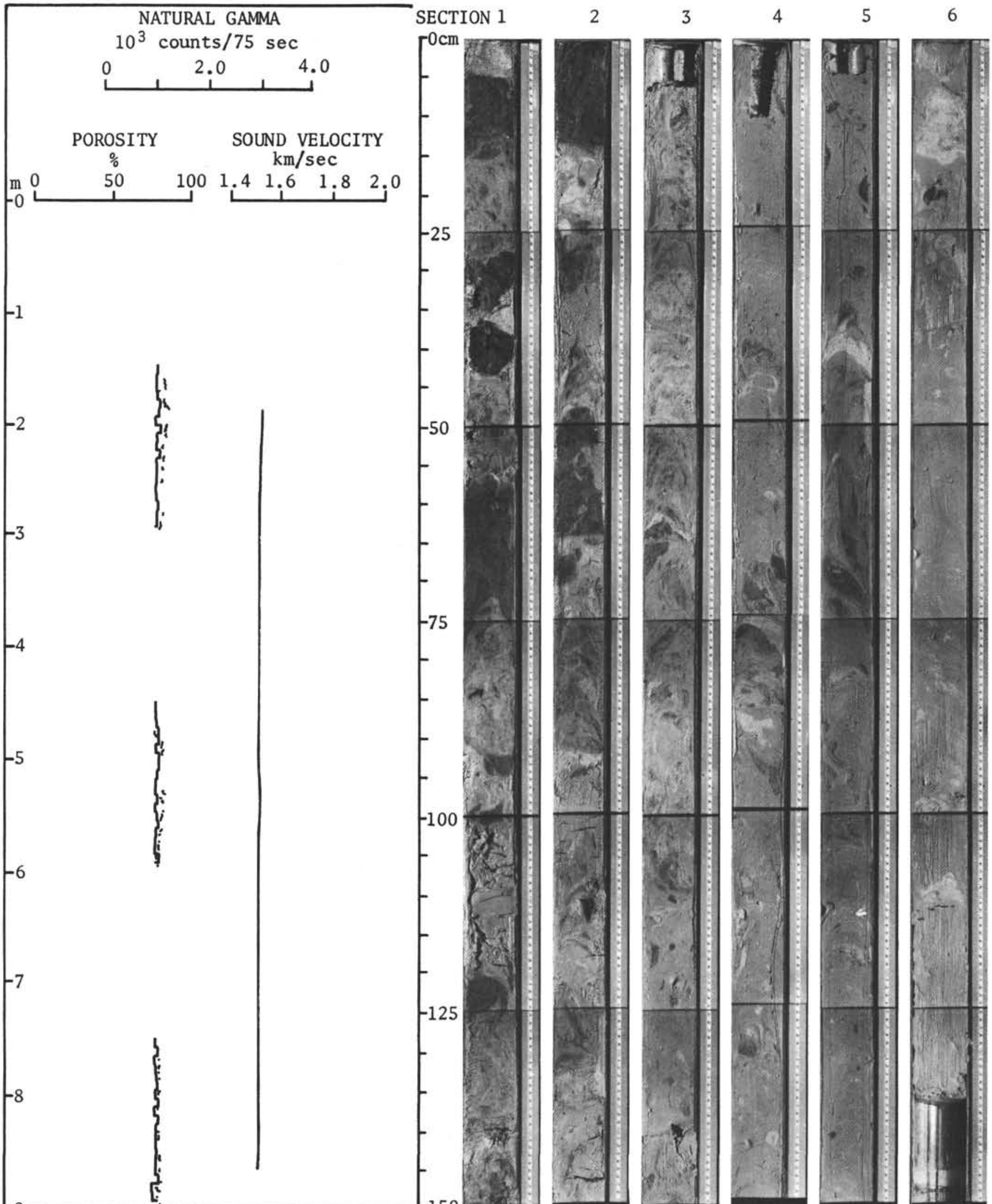
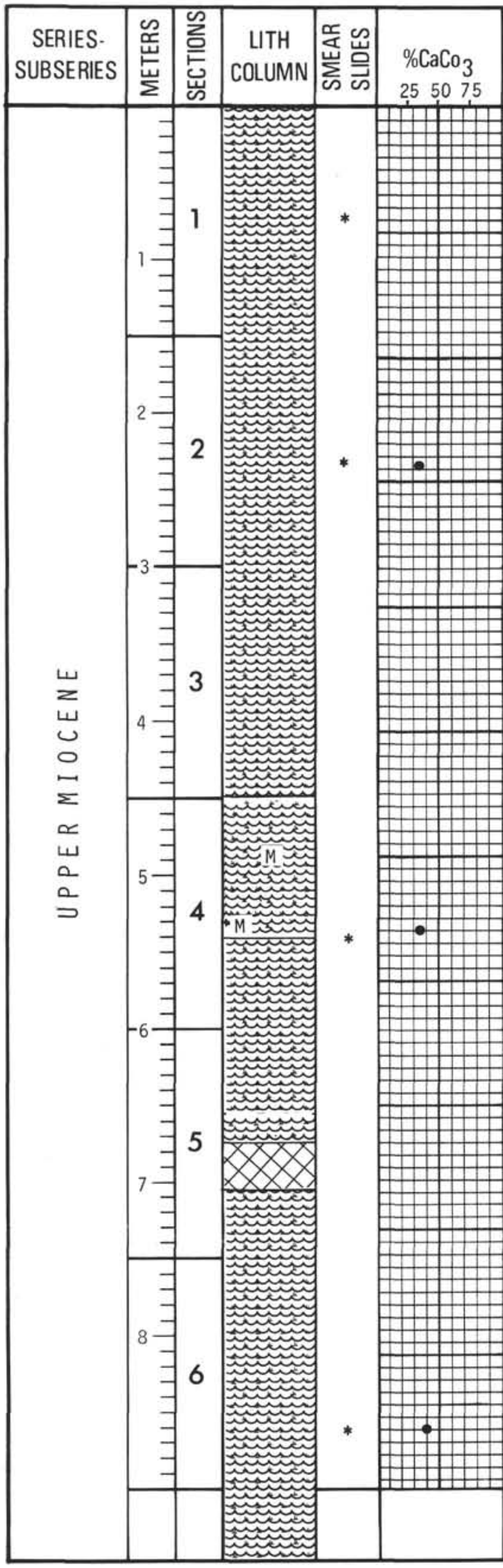


Figure 52. *Hole 83A, Core 12, Sections 1-6, Physical Properties.*



LITHOLOGIC DESCRIPTION

SAN BLAS FORMATION

Unit 2

LIGHT BLUISH GRAY (5B7/1) to MEDIUM BLUISH GRAY (5B7/1), foraminiferal (10%) - radiolarian (30%-40%) - calcareous nannofossil (50%-60%) ooze.

About 90% LIGHT BLUISH GRAY (5B7/1), radiolarian (40%-50%) ooze with less than 5% foraminifers, calcareous nannofossil (40%-50%).

About 5% GREENISH GRAY (5G6/1), radiolarian (40%-50%) - calcareous nannofossil (40%-50%) ooze with <5% montmorillonite and foraminifers.

About 5% WHITE (N9), radiolarian (40%-50%) - calcareous nannofossil (40%-50%) ooze.

About 1% VERY DUSKY PURPLE (5P2/2), manganese laminations.

Figure 53. *Hole 83A, Core 13 (122.8 to 131.9 m).*

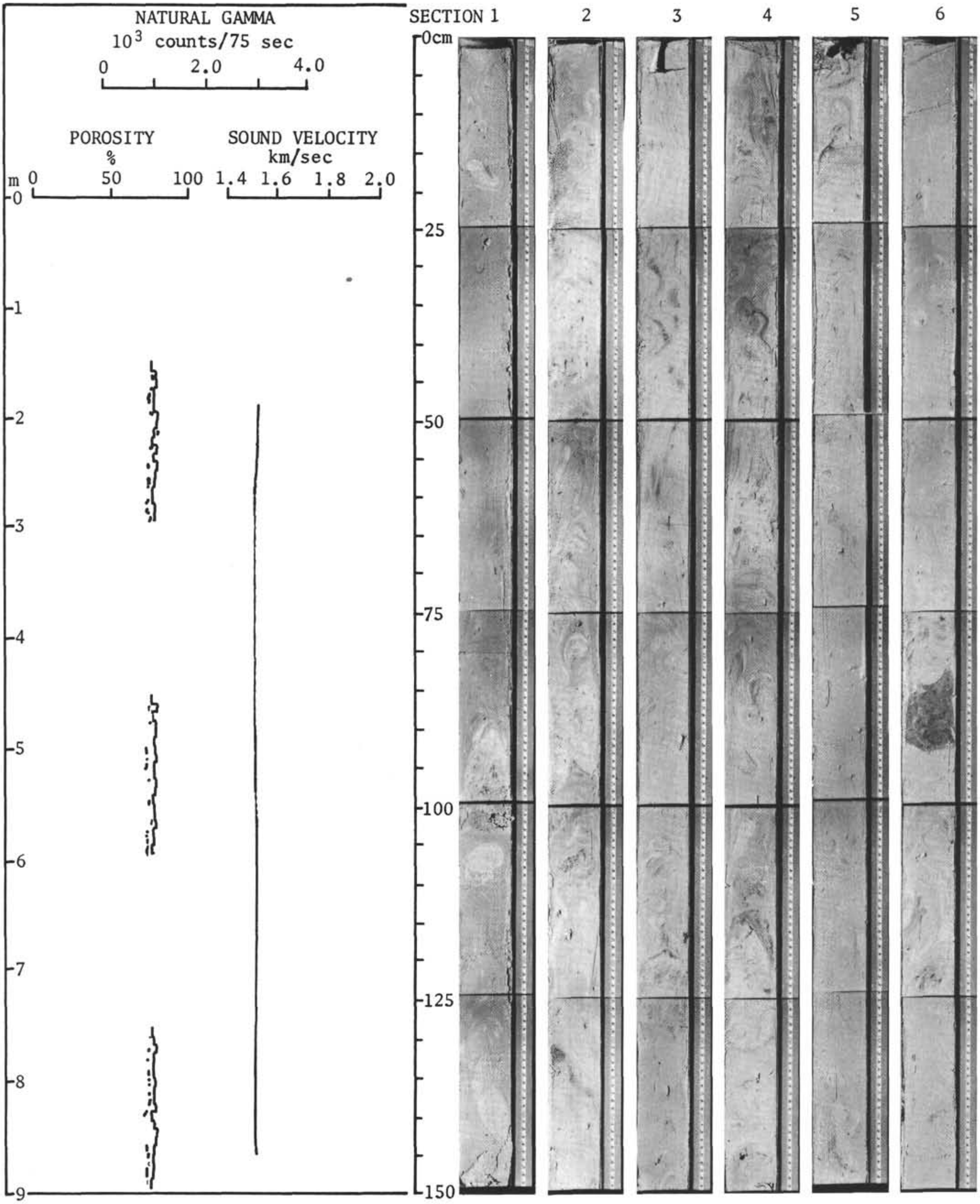


Figure 54. *Hole 83A, Core 13, Sections 1-6, Physical Properties.*

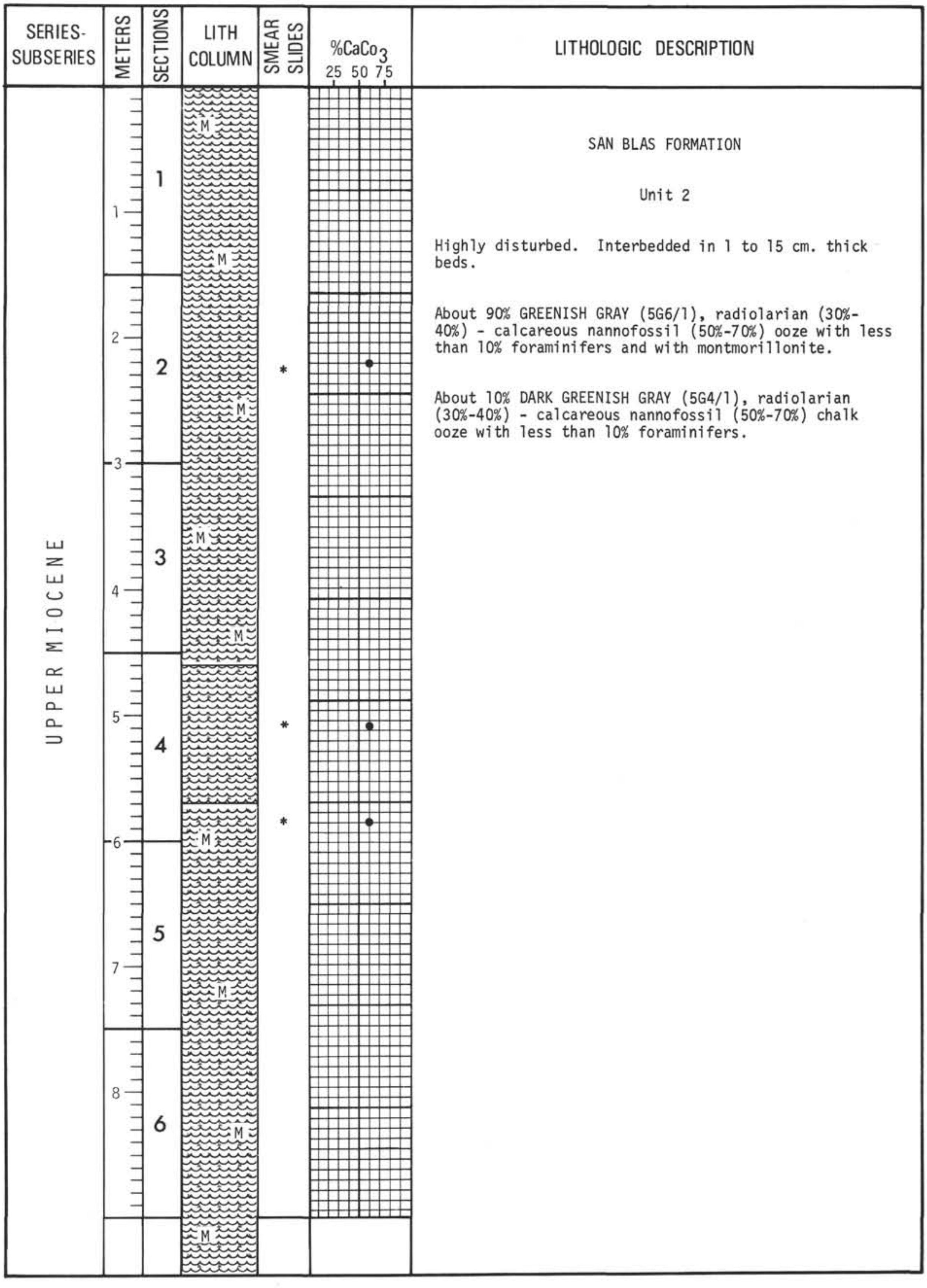


Figure 55. *Hole 83, Core 5 (136.2 to 145.3 m).*

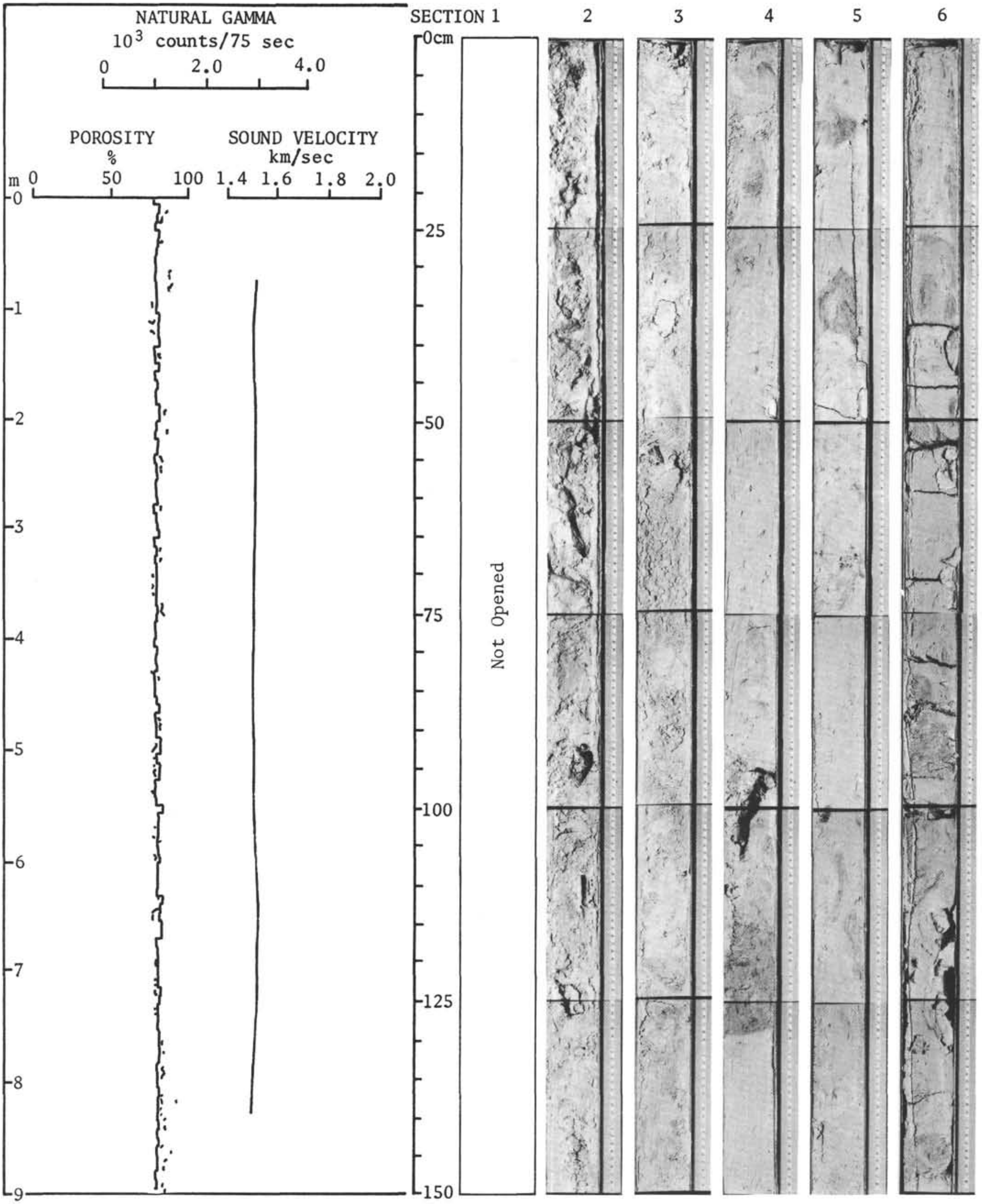


Figure 56. *Hole 83, Core 5, Sections 1-6, Physical Properties.*

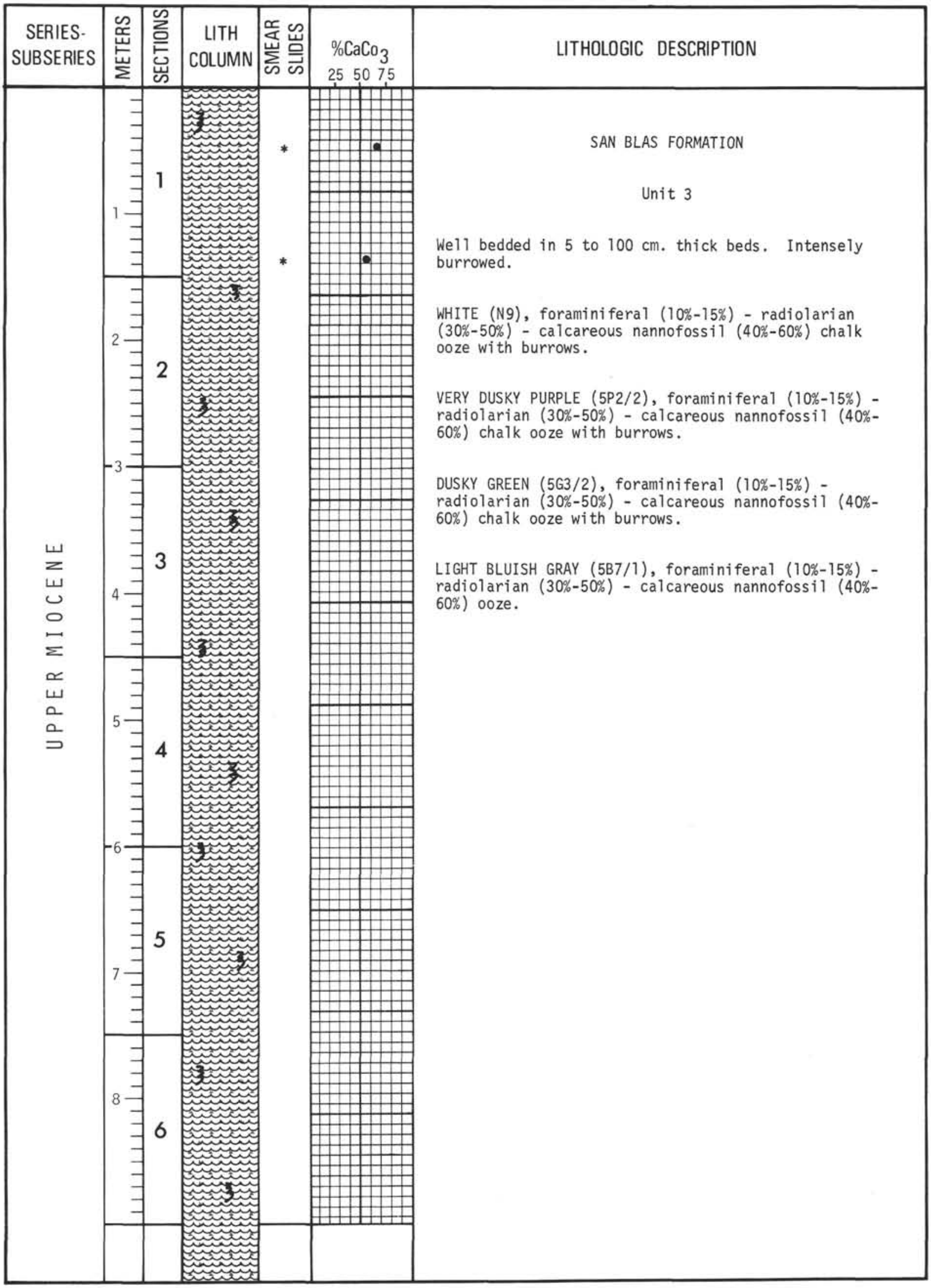


Figure 57. *Hole 83A, Core 14 (158.1 to 167.3 m).*

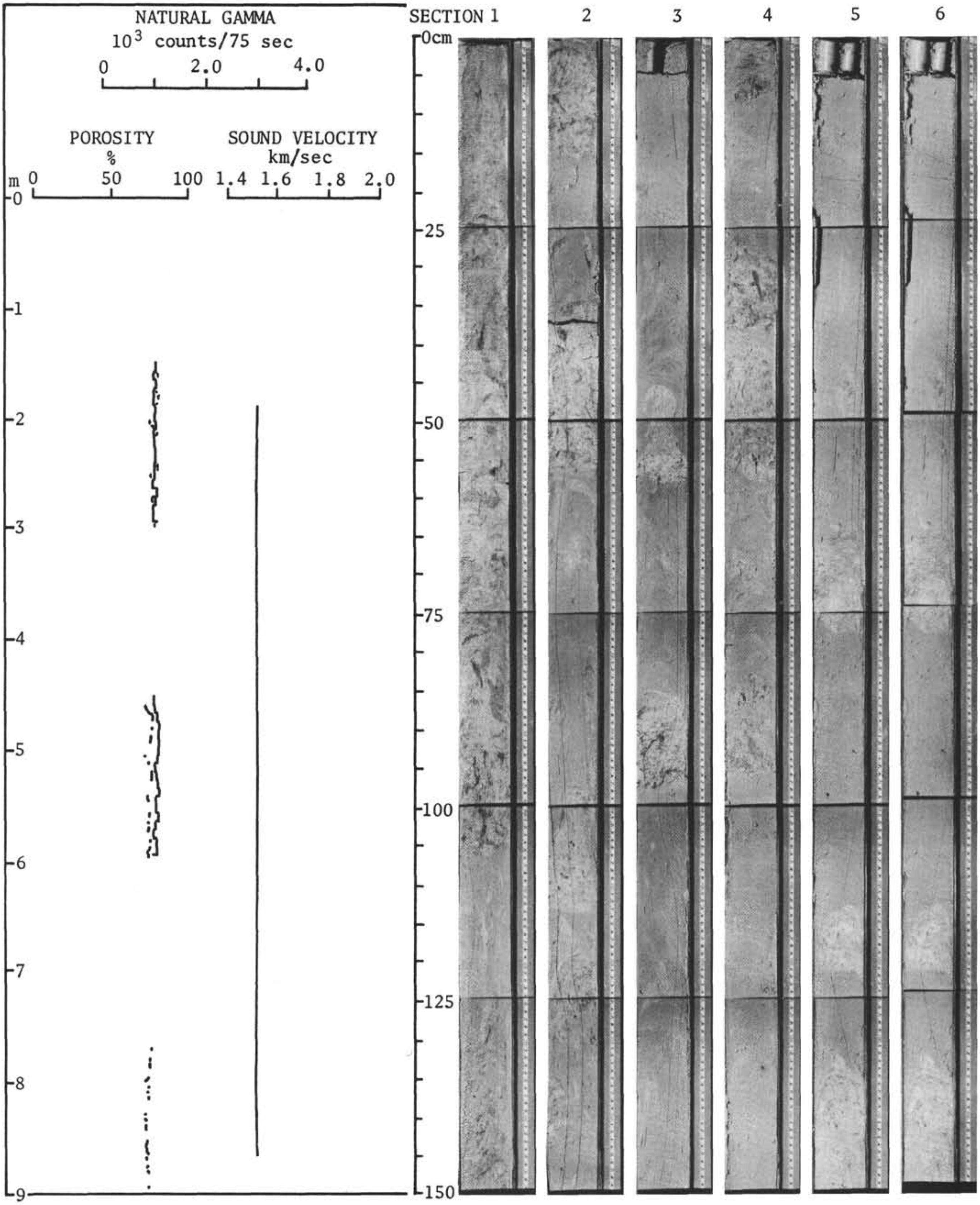


Figure 58. *Hole 83A, Core 14, Sections 1-6, Physical Properties.*

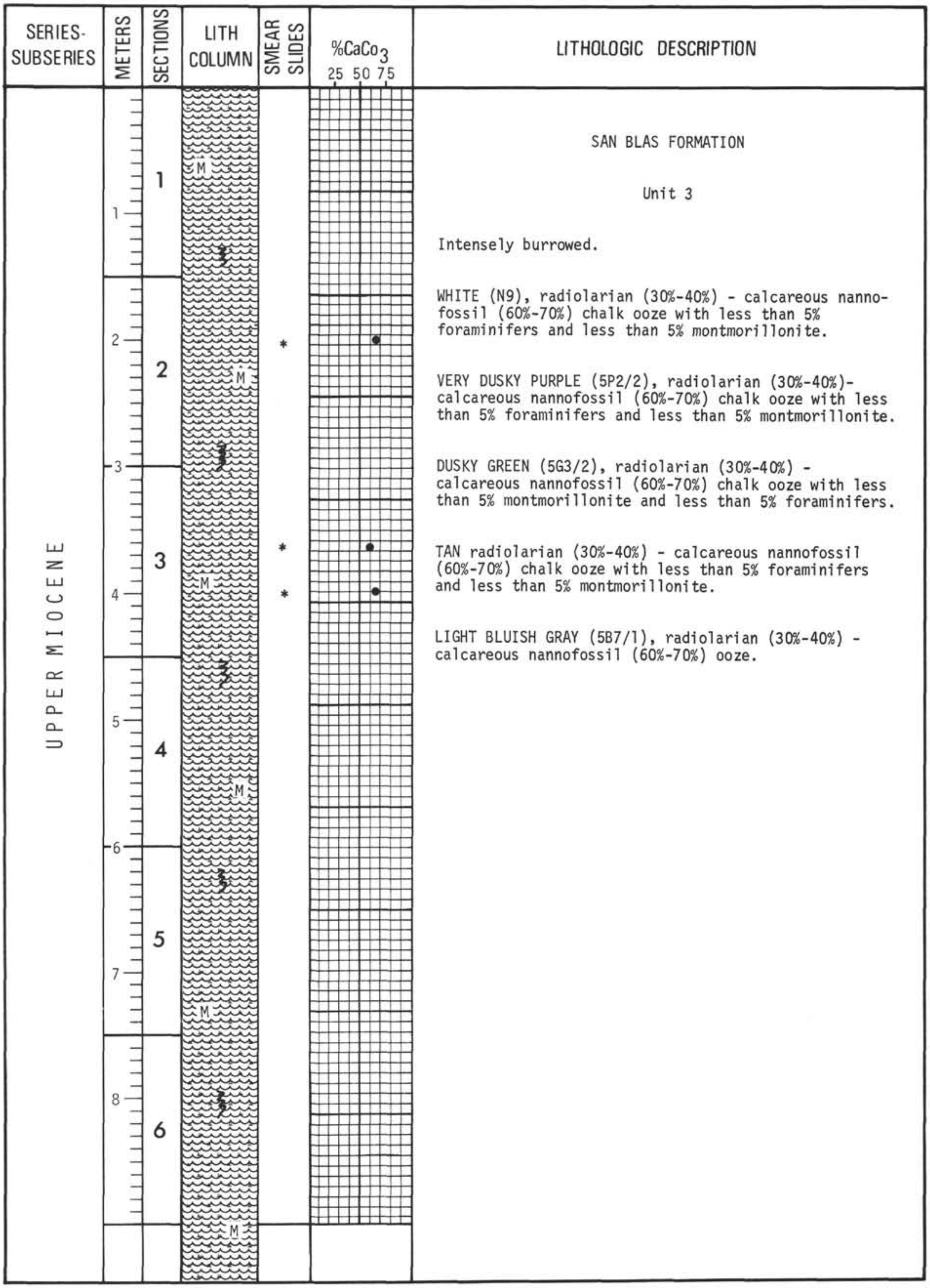


Figure 59. *Hole 83A, Core 15 (179.5 to 188.6 m).*

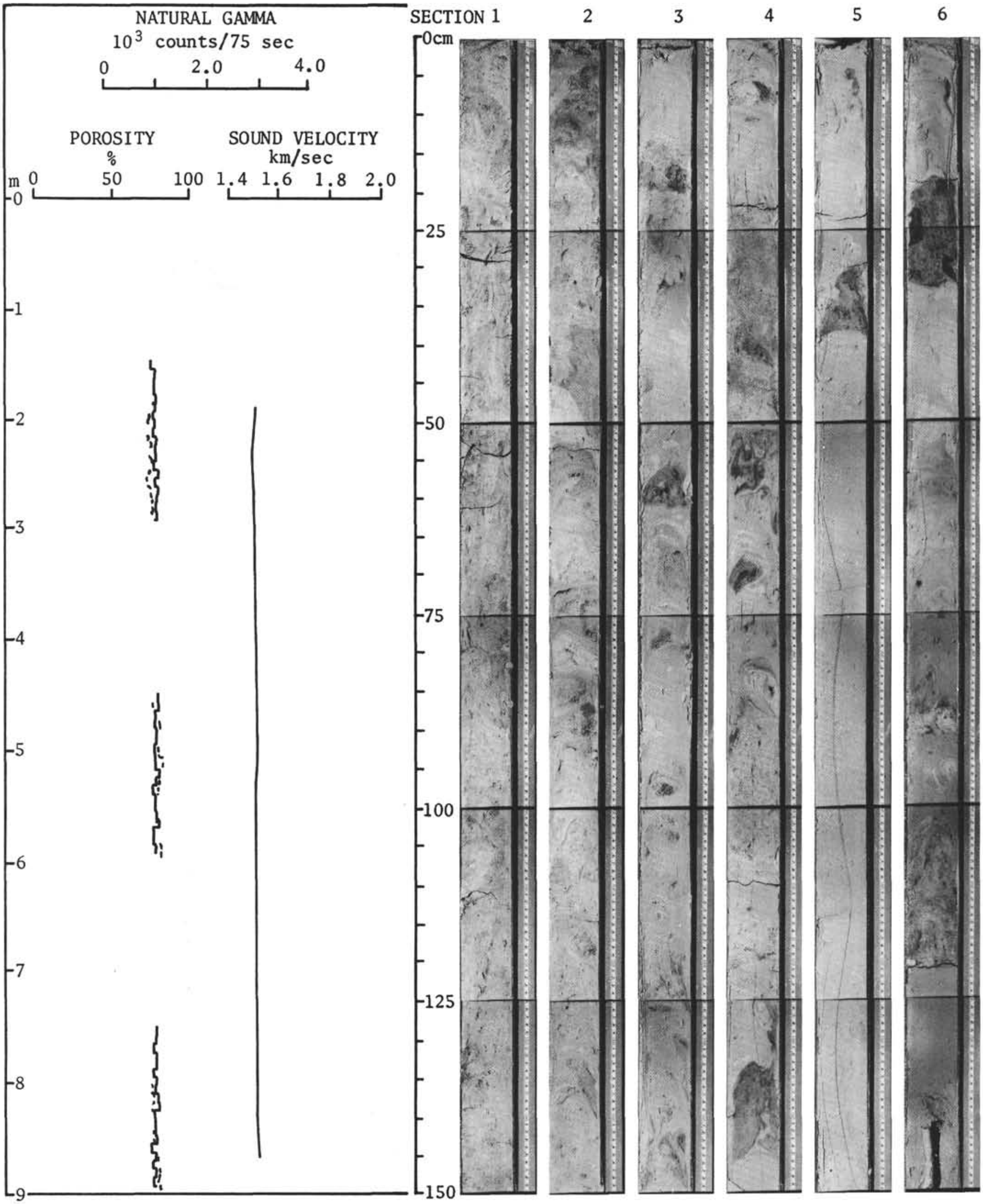


Figure 60. *Hole 83A, Core 15, Sections 1-6, Physical Properties.*

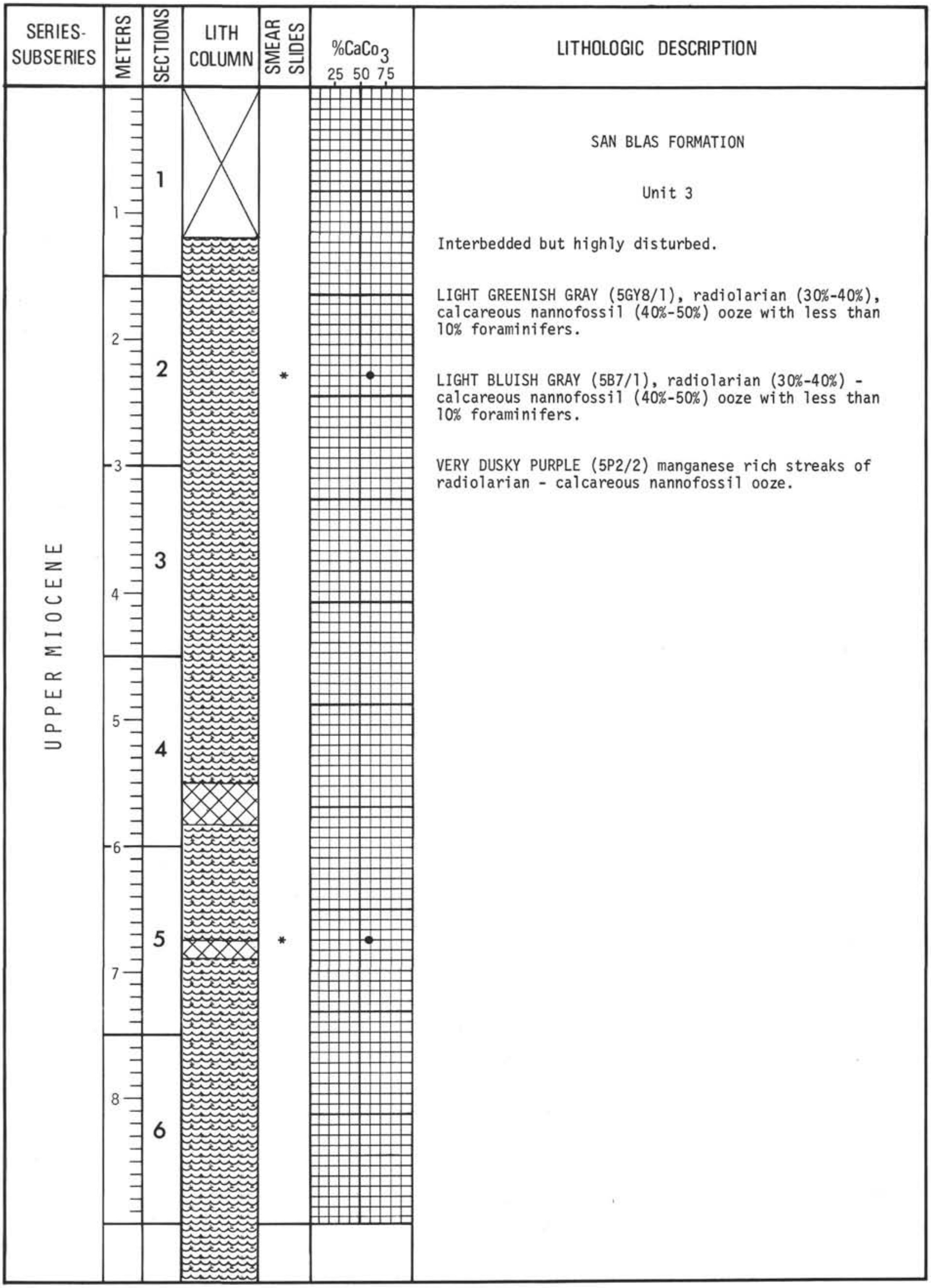


Figure 61. *Hole 83, Core 6 (202.3 to 211.5 m).*

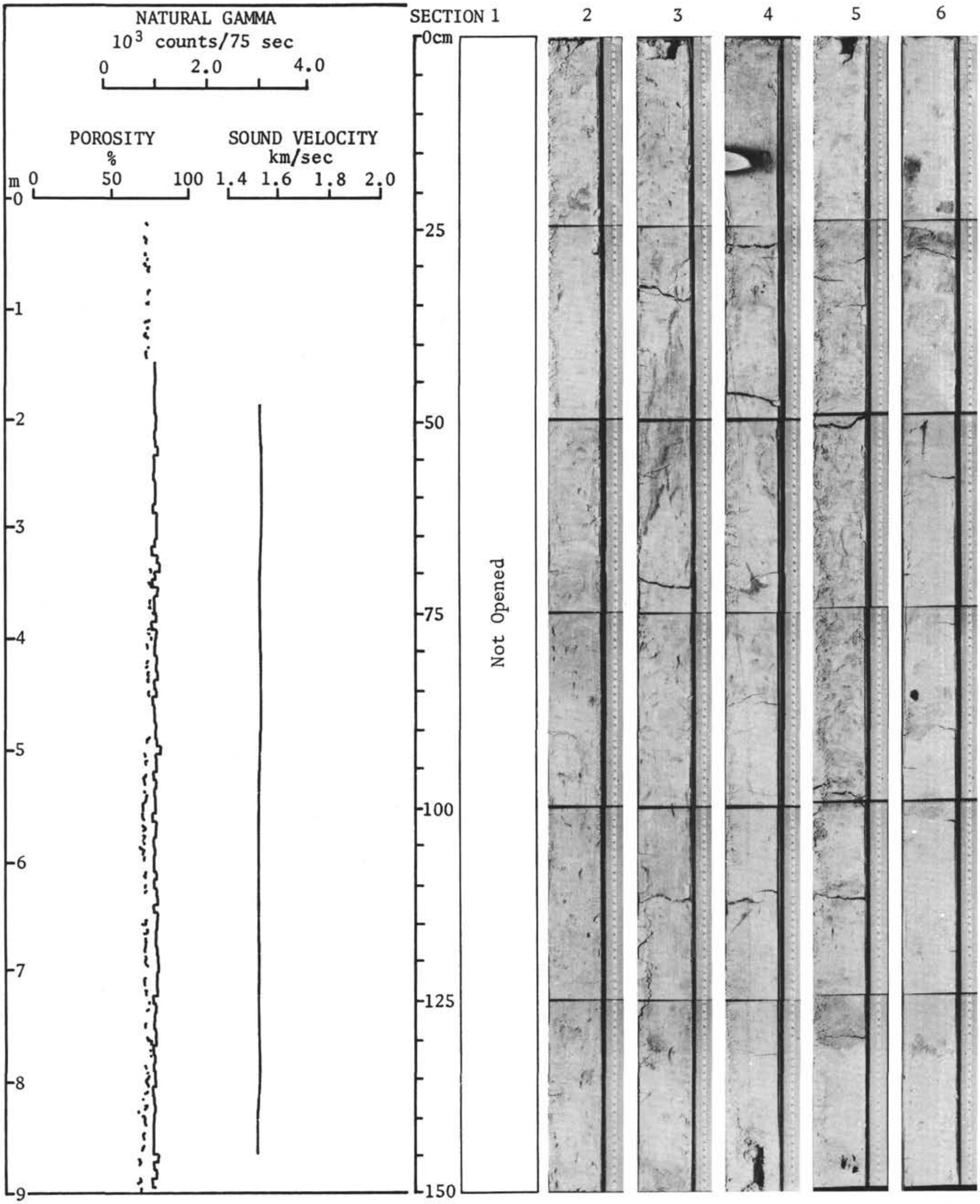


Figure 62. *Hole 83, Core 6, Sections 1-6, Physical Properties.*

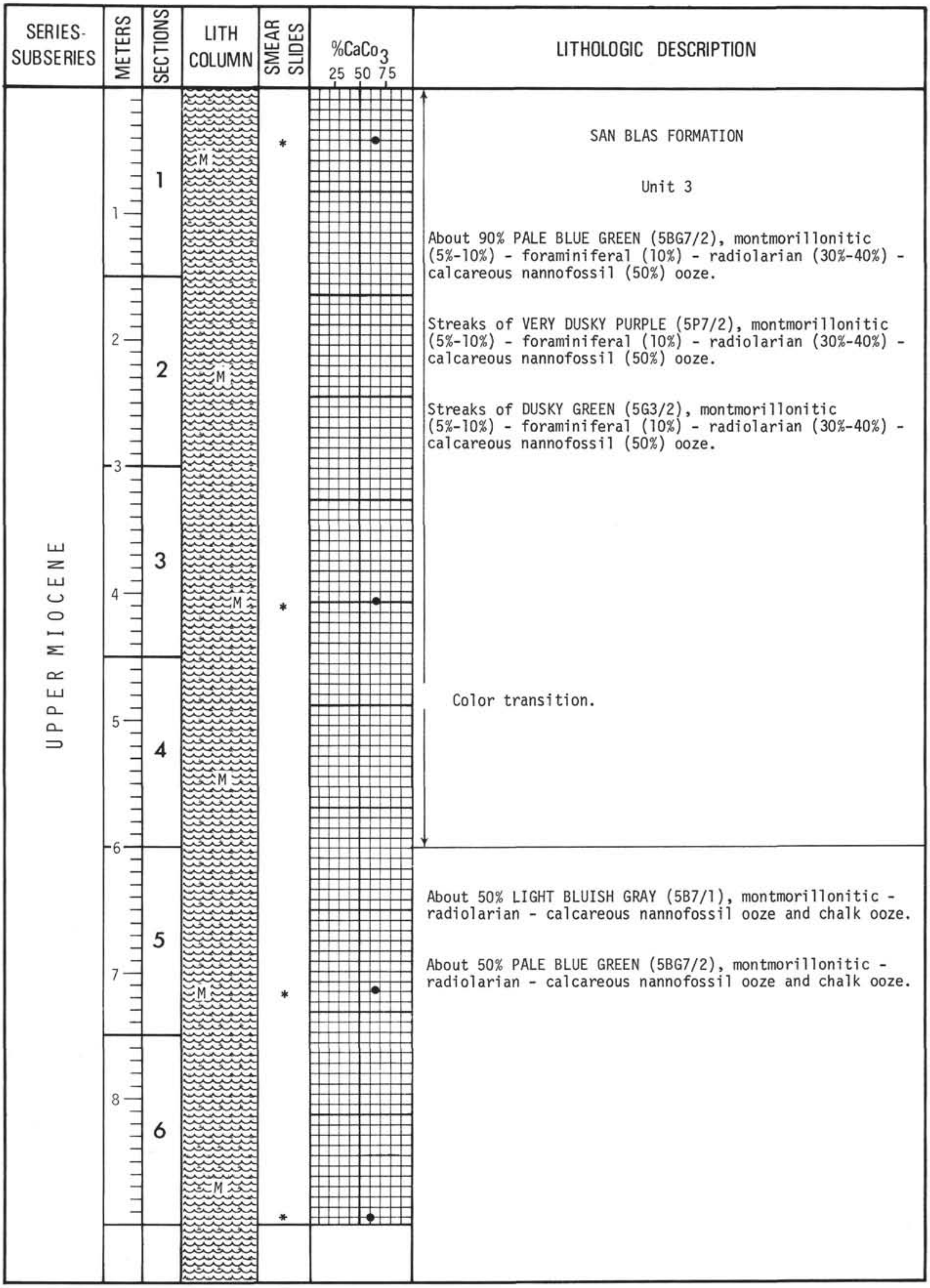


Figure 63. *Hole 83A, Core 16 (211.1 to 220.3 m).*

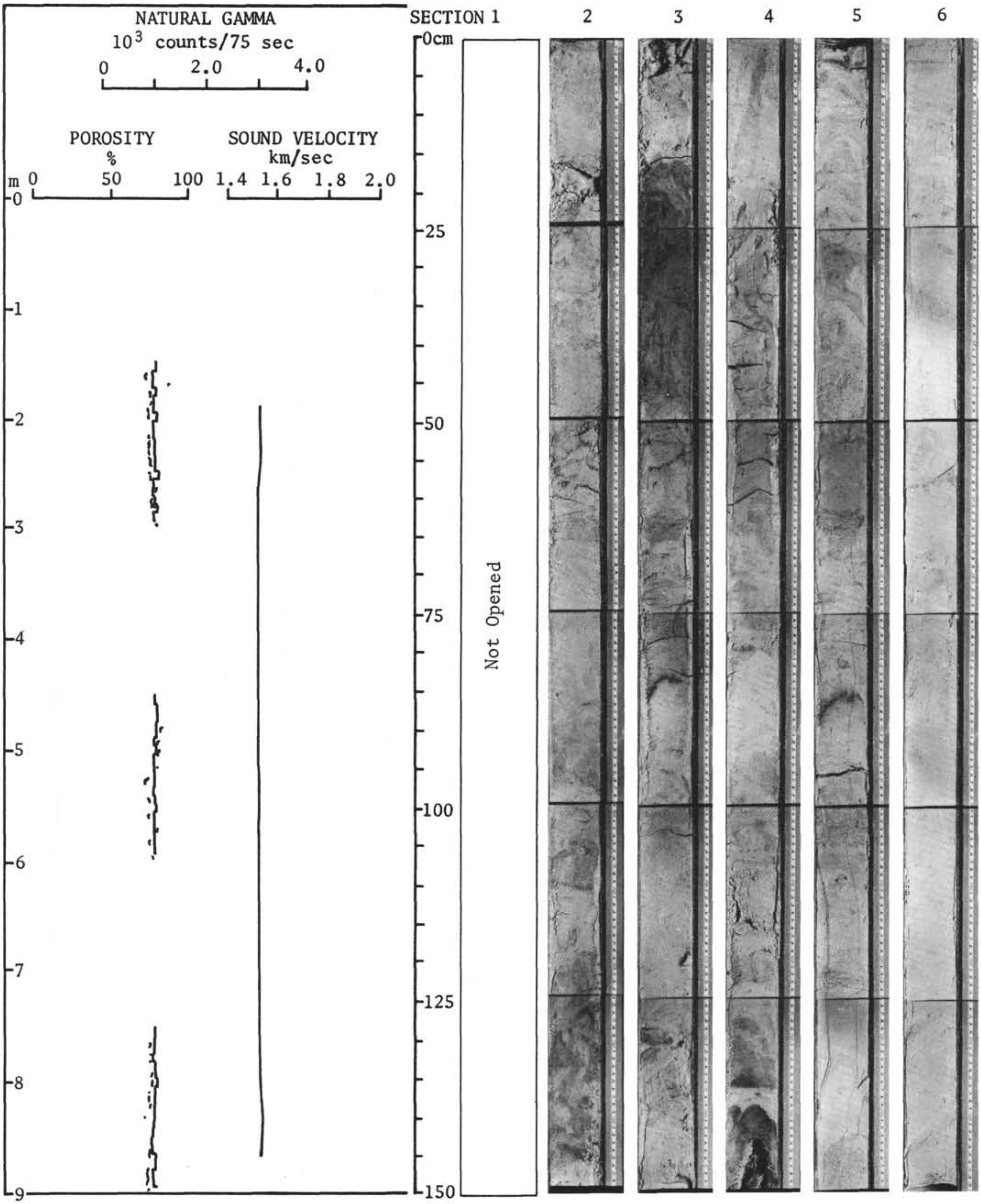
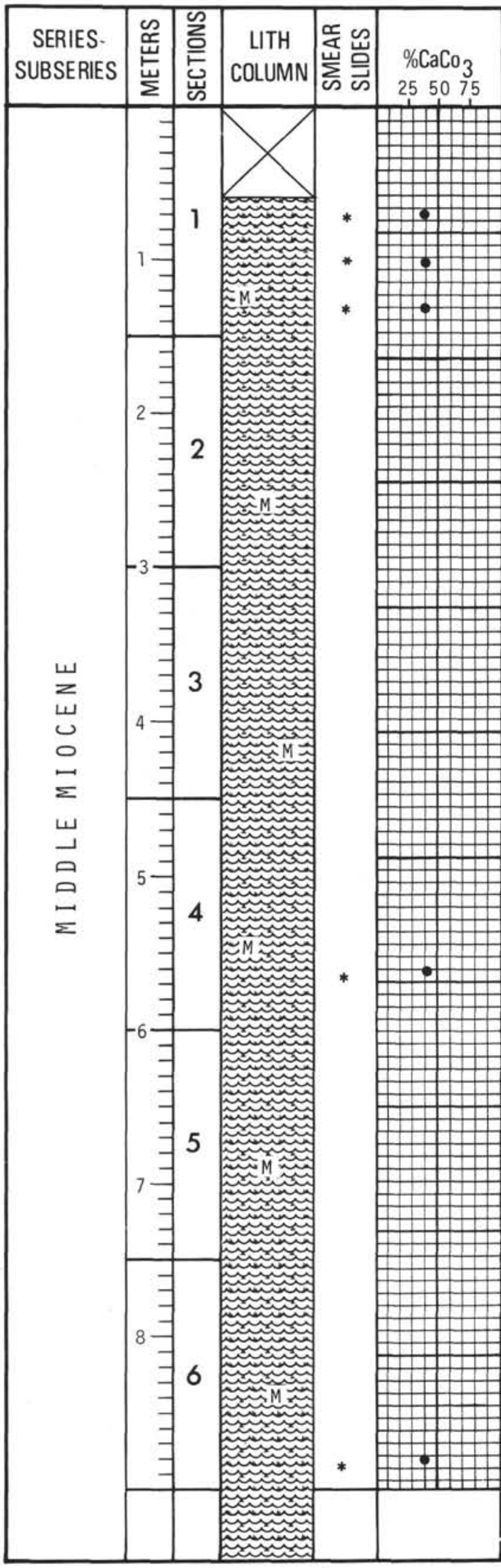


Figure 64. *Hole 83A, Core 16, Sections 1-6, Physical Properties.*



LITHOLOGIC DESCRIPTION

SAN BLAS FORMATION

Unit 3

Intensely mottled. Interbedded in 5 mm. to 5 cm. thick beds of strikingly different colors. Apparently the beds were partially coherent before burrowing (?) so that homogenization did not occur, and color boundaries are interlingering in and around one another.

PALE BLUE GREEN (5BG7/2) to PALE GREEN (5G7/2), calcareous nannofossil - radiolarian - ooze chalk with foraminifers less than 10% and montmorillonite.

PALE BLUE GREEN (5BG7/2) to PALE GREEN (5G7/2), calcareous nannofossil - radiolarian - ooze chalk with foraminifers less than 10% and montmorillonite.

PALE BLUE GREEN (5BG7/2) to PALE GREEN (5G7/2), radiolarian - calcareous nannofossil ooze chalk with montmorillonite and less than 10% foraminifers.

PALE YELLOWISH BROWN (10YR6/2), calcareous nannofossil (40%-50%) - radiolarian (40%-50%) - ooze chalk with less than 10% foraminifers and a trace of palagonite.

PALE YELLOWISH BROWN (10YR6/2), radiolarian (40%-50%) - calcareous nannofossil (40%-50%) ooze chalk with less than 10% foraminifers and a trace of palagonite.

Minor amounts of MEDIUM LIGHT GRAY (N6), radiolarian (40%-50%) - calcareous nannofossil (40%-50%) ooze.

Minor amounts of MEDIUM LIGHT GRAY (N6), radiolarian (40%-50%) - calcareous nannofossil (40%-50%) ooze.

Minor amounts of DUSKY BLUISH GREEN (5BG3/2), montmorillonitic (10%-20%) - calcareous nannofossil (40%-50%) - radiolarian (40%-50%) ooze chalk.

Figure 65. *Hole 83, Core 7 (221.8 to 231.0 m).*

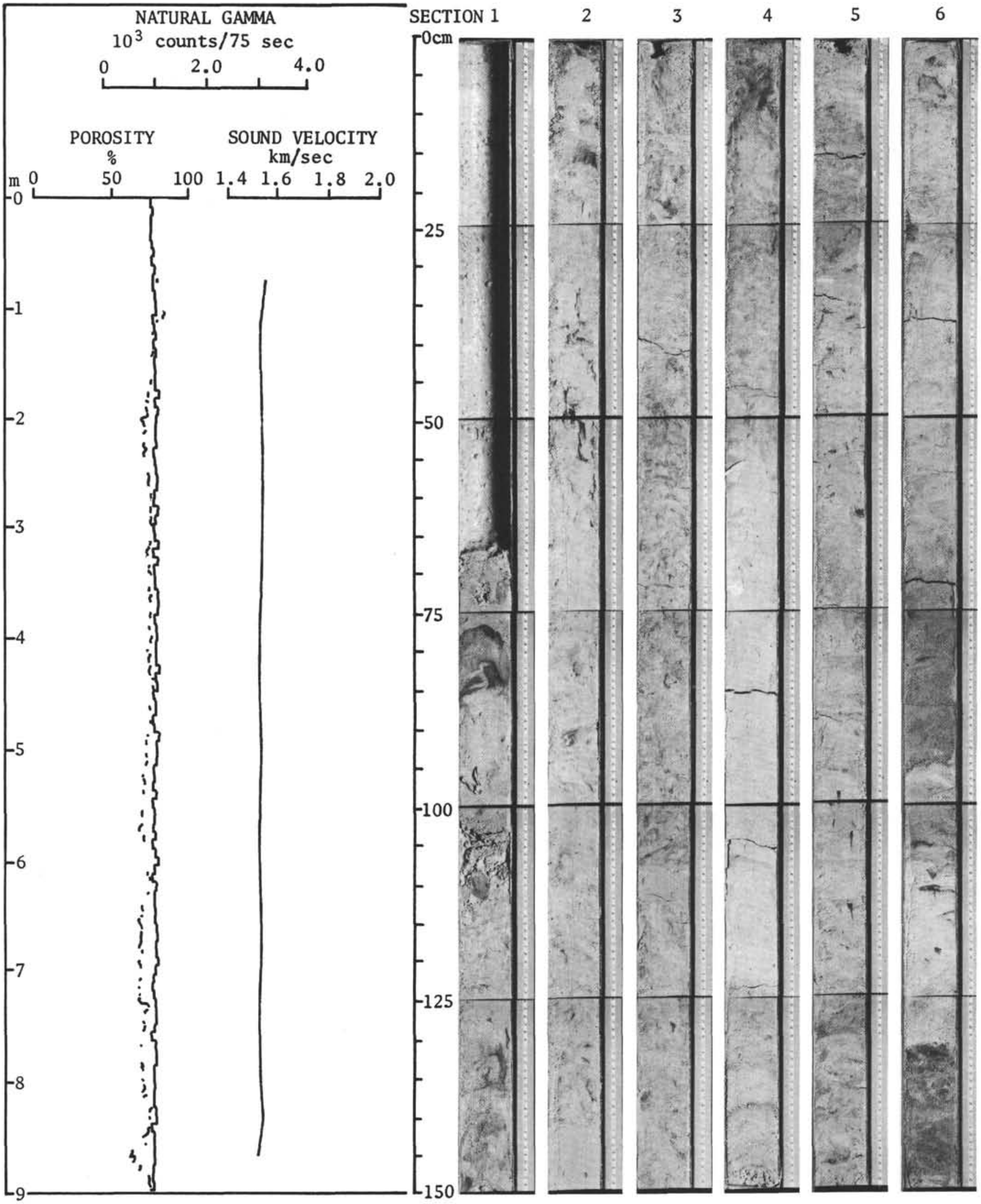
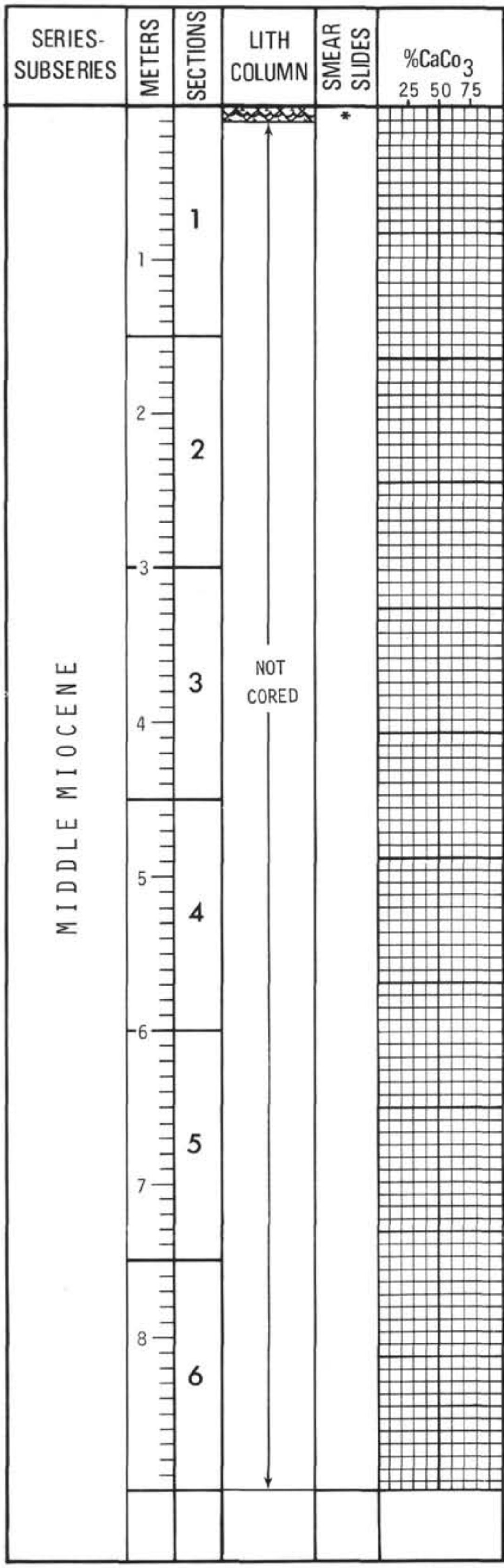


Figure 66. *Hole 83, Core 7, Sections 1-6, Physical Properties.*



LITHOLOGIC DESCRIPTION

LINE ISLANDS FORMATION

VERY PALE ORANGE (10YR8/2) to GRAYISH ORANGE (10YR7/4) to MODERATE BROWN (5YR3/4) foraminiferal (10%-15%) - calcareous nannofossil (80%) brecciated chalk with less than 1% radiolarians and trace amounts of hematite, tridymite, rhodochrosite or siderite, dolomite rhombohedrons and yellow green clay.

The tectonic breccia is probably related to basaltic intrusion.

VERY PALE ORANGE (10YR8/2) to MODERATE BROWN (5YR3/4), calcareous nannofossil (90%) chalk with less than 5% foraminifers, iron oxides 5%-10%, and a trace of tridymite and radiolarians.

Figure 67. *Hole 83, Core 8 (232.9 to 233.0 m).*

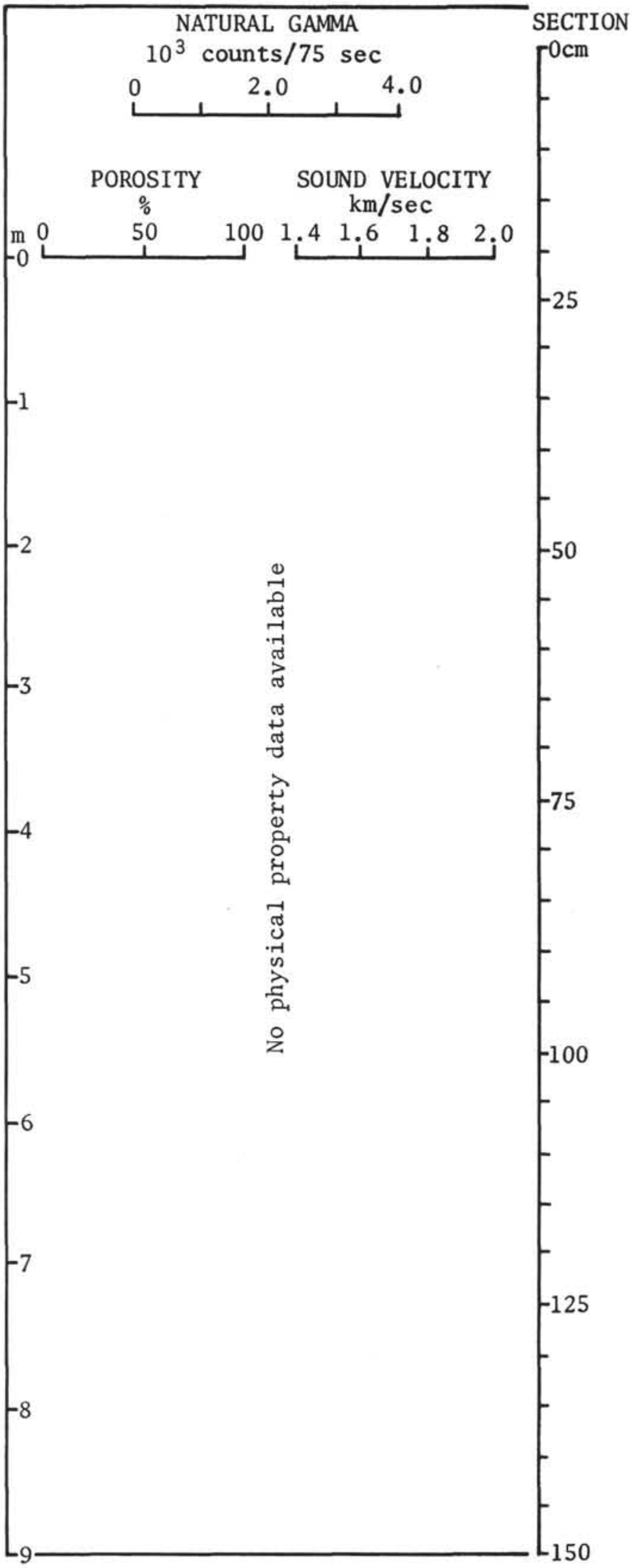


Figure 68. *Hole 83, Core 8.*

SERIES-SUBSERIES	METERS	SECTIONS	LITH COLUMN	SMEAR SLIDES	%CaCo3 25 50 75	LITHOLOGIC DESCRIPTION
MIDDLE MIOCENE	1	1		* *		LINE ISLANDS FORMATION VERY PALE ORANGE (10YR8/2) to MODERATE BROWN (5YR3/4), iron oxides (5%-10%) - calcareous nannofossil (95%) tectonically brecciated chalk with less than 5% foraminifers and with traces of radiolarians and tridymite.
	2	2				
	3					BLACK (N1) very fine grained basalt.
	4	3				
	5	4				
	6					
	7	5				
	8	6				

Figure 69. *Hole 83, Core 9 (233.0 to 234.4 m).*

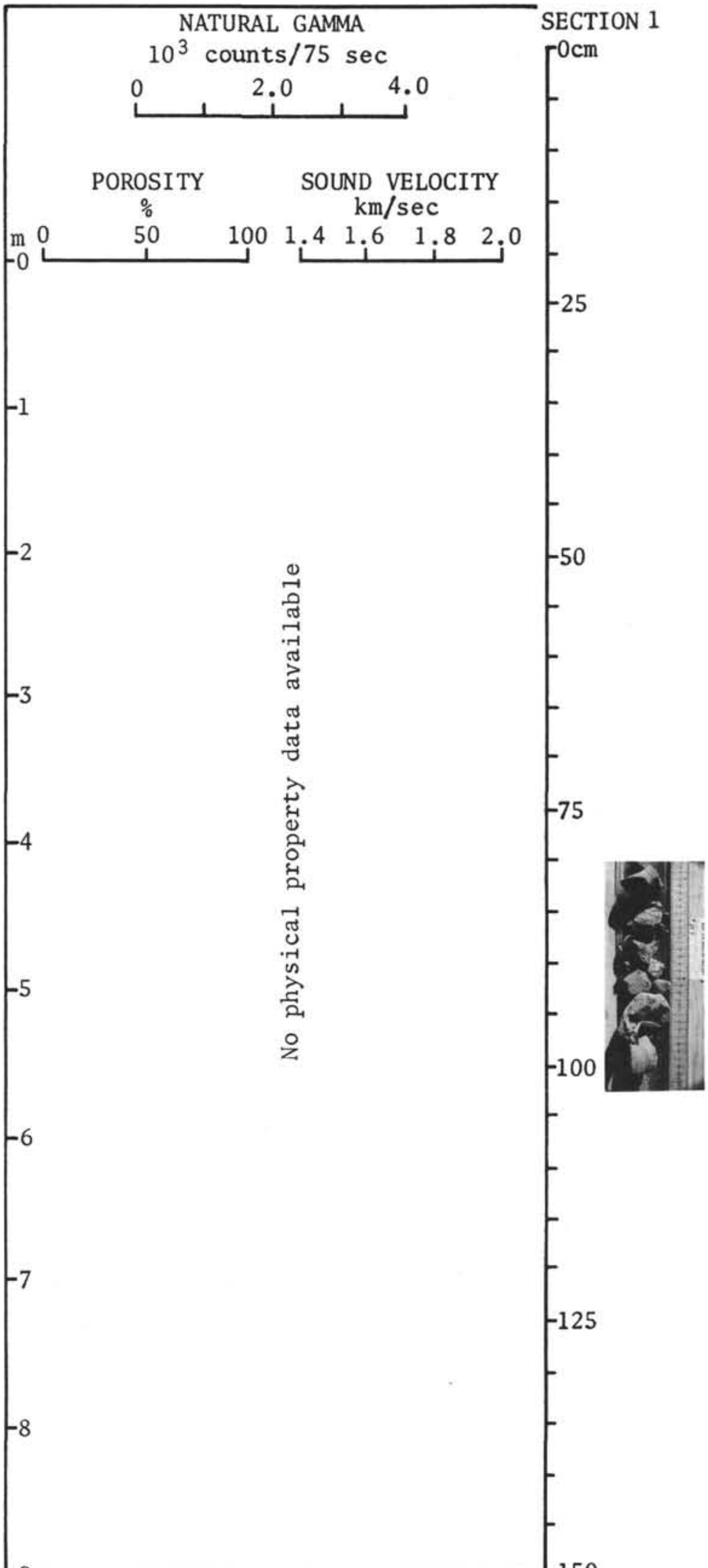


Figure 70. *Hole 83, Core 9, Section 1, Physical Properties.*

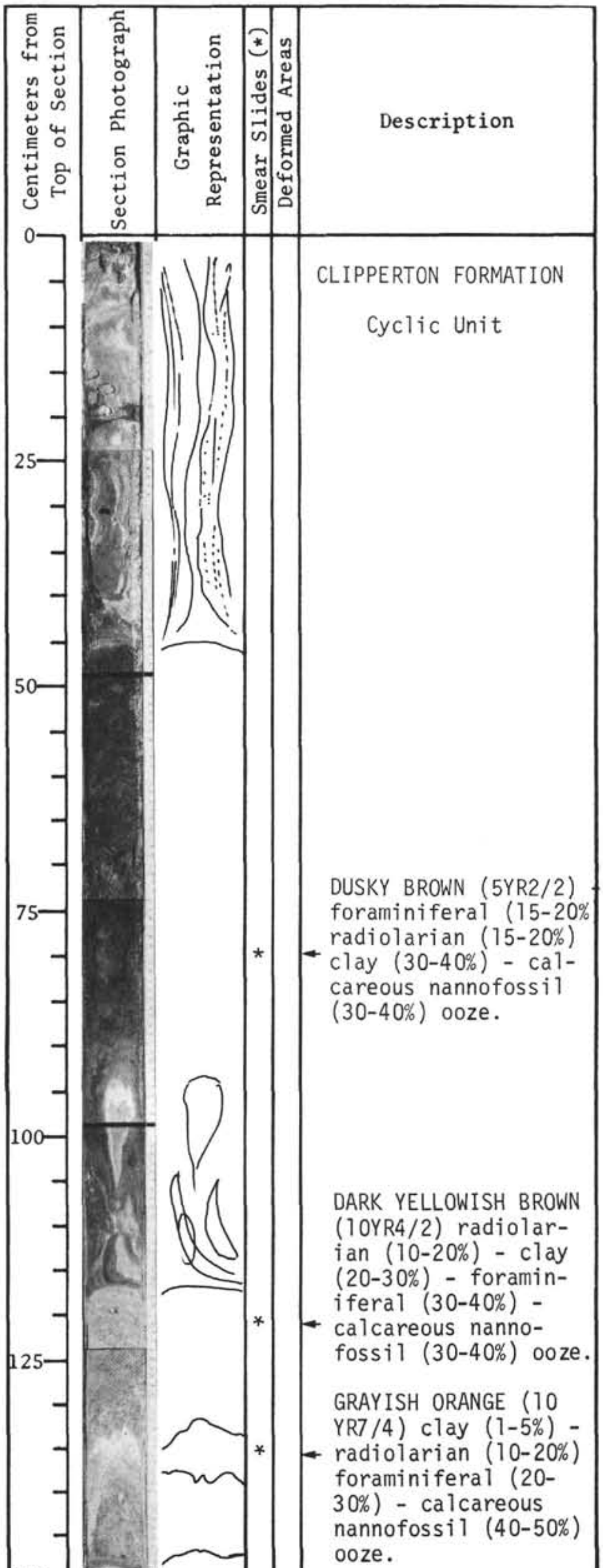


Figure 71. *Hole 83, Core 1, Section 2.*