15. SITE 57

Shipboard Scientific Party[1]

SITE DATA

Occupied: July 25-28, 1969.

Position: Caroline Ridge: Latitude: 8°40.9′N.
Longitude: 143°32.0′E.

Water Depth: 3300 meters.

Hole 57.0: Three cores, logged.

Hole 57.1: Four cores.

Hole 57.2: One core.

Total Depth: 335 meters in doleritic basalt.

MAIN RESULTS

Unaltered Upper Oligocene sediments rest on the surface of a fresh coarsely porphyritic doleritic basalt. The smooth opaque reflector is thus shown to be igneous.

BACKGROUND

The geological setting of the Caroline Ridge has been discussed in connection with Site 55. The objectives of Site 57 were the same as those of Site 55 from which the ship was driven by typhoon Viola, and of Site 56 which reached the base of the sediments but failed to retrieve a core of the underlying material. The site (Chapter 13, Figure 2) was chosen on the next-lower terrace to the north, not very different in elevation from Site 55. Bottom soundings in the area of Site 57 are given as Figure 1.

OPERATIONS

Site 57 was occupied at 1300 hours on July 25. A first core was cut in Upper Oligocene coccolith-diatom-radiolarian ooze, 26 meters below which hard rock was encountered. Two cores recovered fresh diabasic basalt to a total depth of 335 meters. Electrical, gamma-neutron, acoustic, caliper and density logs were run. With the object of recovering the sediment/basalt contact, a second hole, 57.1, was spudded at 0400 hours, July 27. Three cores were taken in the Tertiary sediments, and a fourth recovered the desired contact.

A third hole, 57.2, was spudded at 1830 hours on July 27, in order to cut a Pliocene core. The site was abandoned at 0130 hours, July 28.

NATURE OF THE SEDIMENTS

Cores taken from three holes at this site recovered sediment between 37.7 and 335.3 meters below mudline.

Hole 57.0

Hole 57.0 was drilled to a total depth of 335.3 meters subbottom where olivine dolerite, considered to be basement in this area, was encountered. Three cores were recovered. Core 1, drilled between 297.5 and 302.1 meters subbottom, recovered only six meters of nannoplankton marl ooze and chalk ooze with colors varying from grayish-yellow green, grayish-green to (less commonly) gray and white. The sediment is compact and consists largely of nannofossils with significant (5 to 10 per cent) amounts of Radiolaria, sponge spicules and volcanic glass shards. Planktonic foraminifera vary from absent to common, and small amounts of clay minerals, mica and opaque minerals are usually present. This calcareous sediment has what appear to be several cyclic sedimentation units. Each cycle consists of a thinner (2 to 5 centimeters thick) unit comprising thinly laminated gray, green and white beds that are slightly to moderately burrowed, and a thick (10 to 15 centimeters) unit comprising light gray-green sediment that is greatly burrow mottled.

Interlayered in the calcareous sediment are scattered, thin, (1 to 2 millimeters) black ash beds composed largely of acidic volcanic glass (n = 1.495).

Cores 2 and 3 recovered a total of about 2.80 meters of olivine dolerite (see description by Melson elsewhere in this report). This rock is fresh, dark gray, holocrystalline, and contains numerous large euhedral plagioclase phenocrysts and smaller anhedral crystals of pyroxene and olivine. The plagioclase phenocrysts are lath-shaped, average about 5 millimeters in length and range up to 10 millimeters. On the basis of its refractive index the plagioclase is labradorite (n = 1.565).

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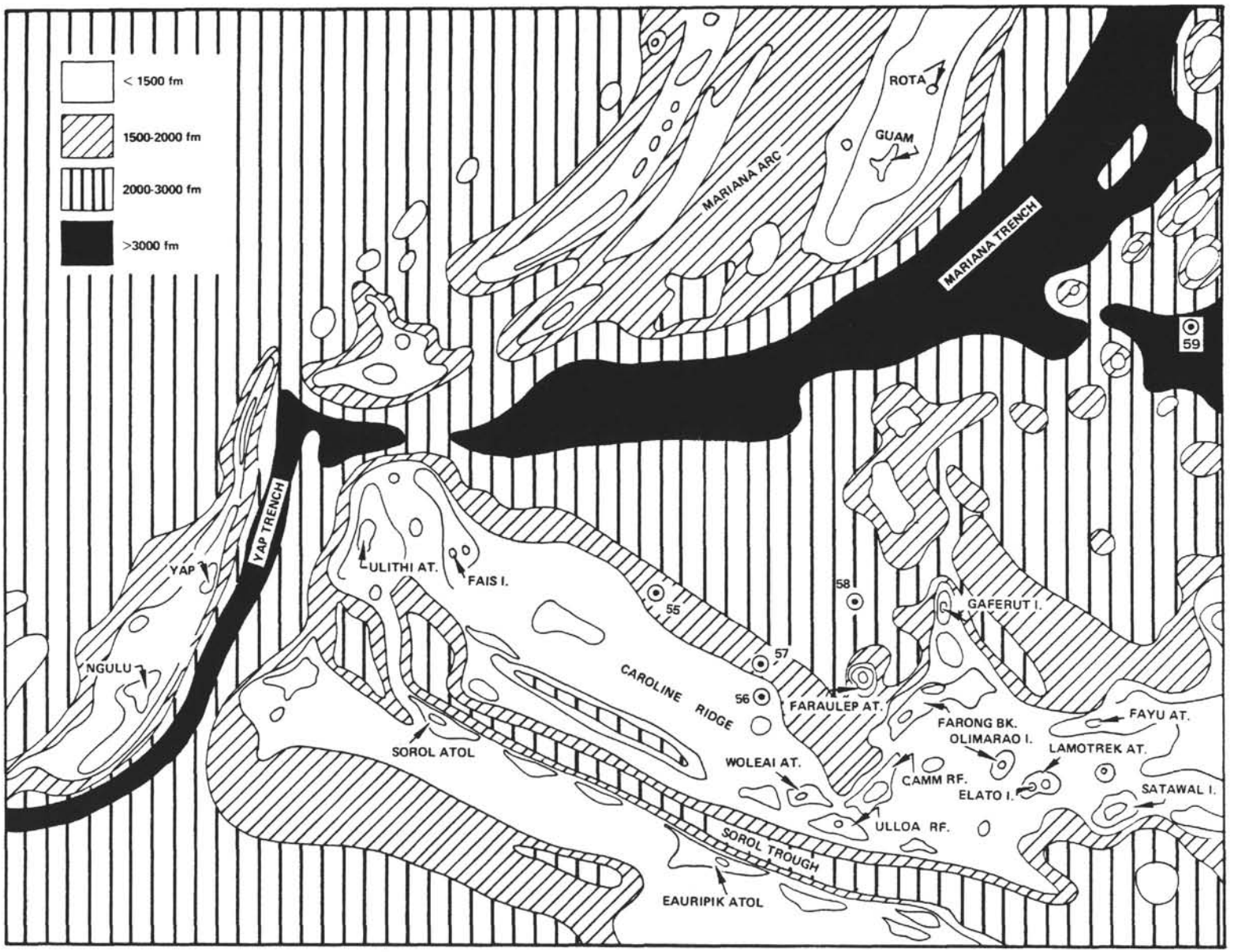


Figure 1. *Bottom soundings in area of Site 57.*

Hole 57.1

The first of four cores from this hole was recovered between 43.9 and 53.0 meters subbottom depth and comprises a uniform white nannoplankton ooze composed dominantly of nannoplankton (largely discoasters) and small amounts, generally less than 5 per cent, of planktonic foraminifera, Radiolaria, sponge spicules, fish debris, and small anhedral calcite grains that are partly finely abraded skeletal material but may be in part of authigenic origin.

Cores 2 through 4 were recovered between 306.9 and 329.2 meters below mudline, this being the interval immediately above the basement dolerite. The sediment within this interval is moderately to greatly burrow mottled, gray-green to white nannoplankton chalk ooze interlayered with black volcanic ash beds. As in Core 1 from Hole 57.0, the succession shows cyclic sedimentation, but volcanic ash layers are more numerous. In Hole 57.1 the black ash beds form the base of each cycle and are 5 to 10 centimeters thick; they are often graded, and greatly burrow mottled. The upper part of each cycle is marl or chalk ooze in layers 10 to 30 centimeters thick and greatly burrow mottled. This ooze is less pure than in Core 1 of Hole 57.1 and has, in addition to abundant nannoplankton, abundant planktonic foraminifera and significant amounts (5 to 10 per cent) of clay minerals, sponge spicules, Radiolaria, and volcanic glass shards.

The volcanic ash in Core 2 contains a preponderance of transparent andesitic (n = 1.53) glass (about 70 per cent) and olive green basaltic (n = 1.59) glass (about 30 per cent). In Core 3 the glass is nearly all basaltic (about 90 per cent). All of the ash layers in Cores 2 through 4 are calcareous, containing, in addition to the abundant angular glass shards, abundant nannoplankton and common to rare amounts of opaque minerals, feldspar, Radiolaria, sponge spicules, and planktonic foraminifera.

In the base of Core 4 from Hole 57.1 the contact between chalk ooze and dolerite basement was recovered (see Chapter 38). The basal ooze, which is firm and somewhat compacted, is unmetamorphosed, laminated and contains angular fragments of dolerite up to 3 centimeters across. Layers in this ooze also appear slightly contorted and brecciated, perhaps due to drilling. At the top of the dolerite is a very thin (0 to 3 millimeters), irregular and discontinuous glassy zone. All evidence indicates this contact is depositional.

Hole 57.2

One core from this hole was recovered between 34.7 and 43.9 meters below mudline and comprises uniform white nannoplankton chalk ooze with rare pumice fragments. The sediment is similar in composition to that in Core 1 of Hole 57.1.

TABLE 1
Summary of Coring at Site 57

Core No.	Interval Cored (below mudline)		Recovery	
	(ft)	(m)	(ft)	(m)
57.0-1	976-991	297.5-302.1	12	3.7
57.0-2	1075-1085	327.7-330.7	7	2.1
57.0-3	1085-1100	330.7-335.3	3	0.9
57.1-1	144-174	43.9-53.0	30	9.1
57.1-2	1007-1037	306.9-316.1	10	3.0
57.1-3	1037-1052	316.1-320.6	10	3.0
57.1-4	1052-1080	320.6-329.2	25	7.6
57.2-1	114-144	34.7-43.9	30	9.1
Water Depth: 3300.1 meters (10,827 feet)				

PHYSICAL PROPERTIES

These values are not necessarily related to *in situ* conditions as these cores were disturbed.

Natural Gamma Radiation

Holes 57.0 and 57.1

Lower Pliocene, late Miocene and Upper Oligocene nannoplankton chalk ooze (with ash layers) and basalt were recovered from 34 to 335 meters below the mudline. Natural gamma radiation emissions ranged from zero to 650 with an average of 200 counts/7.6-cm core segment/1.25 minutes. In general, core averages increased only slightly (50 to 200 counts) with increasing depth. The basalt emitted the highest core average of 350 counts. The highest single count, however, was emitted from the Oligocene nannoplankton and chalk ooze containing green glass (basaltic-andesitic) and with interlayered volcanic ash. These sediments were cored at a depth of 330 to 335 meters (Cores 57.1, 2 and 3). Some ash layers emitted low counts of about 100 to 200.

Porosity, Wet-Bulk Density and Water Content

Holes 57.0 and 57.1

At Site 57 (34 to 335 meters), Lower Pliocene and Upper Miocene nannoplankton chalk oozes, and Upper Oligocene marl chalk oozes with interbedded ash layers had porosities from 40 to 85 per cent (?), wet-bulk densities of 1.25 (?) to 1.88 g/cc, and water contents from 31 to 51 per cent. These averaged about 62 per cent, 1.63 g/cc, and 41 per cent, respectively. Systematic variations of porosity with depth and lithology were not evident.

Sound Velocity

Holes 57.0 and 57.1

Sound velocities through the Lower Pliocene, Upper Miocene, and Upper Oligocene sediments, recovered at Site 57, ranged from 1.48 to 1.96 km/sec. The basalt at the bottom of the hole (330 to 335 meters) transmitted sound at 5.31 to 6.02 km/sec with an average of 5.60 km/sec. The lower sediment velocities occurred in the very uniform and soft Pliocene and Miocene nannoplankton chalk ooze recovered from 30 to 53 meters below the mudline (1.48 to 1.58 km/sec). The higher sediment velocities of 1.62 to 1.91 km/sec occurred through the firm compact Oligocene nannoplankton-foraminiferal ooze and tuffaceous marl ooze (with radiolarians and sponge spicules) which were cored at 297 to 321 meters. These sediments also contained dark layers of sulphide material and ash. The radiolarians and ash may have contributed to the sediment being firm and having higher velocities.

Penetrometer

Holes 57.0 and 57.1

Penetration measurements into Pliocene, Miocene and Oligocene chalk oozes, retrieved at Site 57, ranged from 0 to 280×10^{-1} millimeters with an average of about 65. In general, penetration decreased irregularly with increasing depth. The higher core averages (80 to 170×10^{-1} millimeters) occurred in the Pliocene-Miocene soft uniform nannoplankton chalk oozes (34 to 53 meters). The upper Oligocene (297 to 325 meters) nannoplankton and foraminiferal-nannoplankton chalk ooze, tuffaceous marl ooze, and volcanic ash had lower penetration values of 0 to 80×10^{-1} millimeters. Penetration correlated inversely to sound velocity. The presence of volcanic ash combined with coarse grain size and compaction may account for the low penetration in the Oligocene section.

Thermal Conductivity

Holes 57.0 and 57.1

Heat conductivity through sediments from Site 57 ranged from 2.57 to 3.23×10^{-3} cal-°C^{-1} cm^{-1} sec^{-1}, and averaged 2.92×10^{-3}. Conductivity was about 3.0 in the Pliocene and Miocene nannoplankton ooze (34 to 53 meters). In Oligocene nannoplankton oozes (114 to 330 meters), conductivity decreased with increasing depth from 3.0 to about 2.56×10^{-3} cal-°C^{-1} cm^{-1} sec^{-1}. Thermal conductivity was inversely similar to the water content and directly similar to the penetrability of the Oligocene sediments.

CONCLUSIONS

The massive opaque reflector at the base of the sediments is a doleritic basalt flow, emplaced before the end of the Oligocene.

The similarity of the section in Holes 56 and 56, and of the reflection profiles over the area, leads the authors to believe that Site 57 is representative of the area, and that basaltic rocks here form a smooth floor beneath Oligocene sediments.

The basalt and its contact with the sediments offer problems. The coarse (doleritic) texture of the basalt shows it to be either a sill or a very thick flow ("lava lake"). The unaltered nature of the overlying sediments, however, eliminates the likelihood of its having been a sill. The lack of a chill zone at the top of the basalt is surprising, especially inasmuch as there is no sign of weathering and erosion. This might be explained as a result of the spalling-off of a glassy chill crust, an explanation which receives support from the fact that several loose pieces of basalt (also fresh) were recovered from the sediment above the contact.

If this floor were very much older than Oligocene, it would be expected to have older sediments on it, or to be deeply altered. Since it is fresh, and directly overlain by pelagic Late Oligocene sediments, the age of the basalt is interpreted as Oligocene.

The north flank of the Caroline Ridge thus appears to have a young basaltic floor, like the Philippine Sea (Sites 53, 54), and contrasts sharply with the much older Pacific Ocean floor farther north. It is suggested that this younger basaltic floor may be true oceanic basement, but this cannot be proven.

Basaltic surfaces at sea are not necessarily topographically rough but can be smooth and flat. The relief associated with juvenile crust near the Mid-Oceanic Ridge results from tectonic displacements characteristic of setting, rather than from extrusion of lava on the sea floor.

It follows that the flat surfaces which underlie the sediments over large parts of the western Atlantic and Pacific Oceans (Ewing's Horizons B and B′) may be basalt surfaces, and may be the top of the oceanic basement.

Further implications of these observations will be brought out elsewhere in this report.

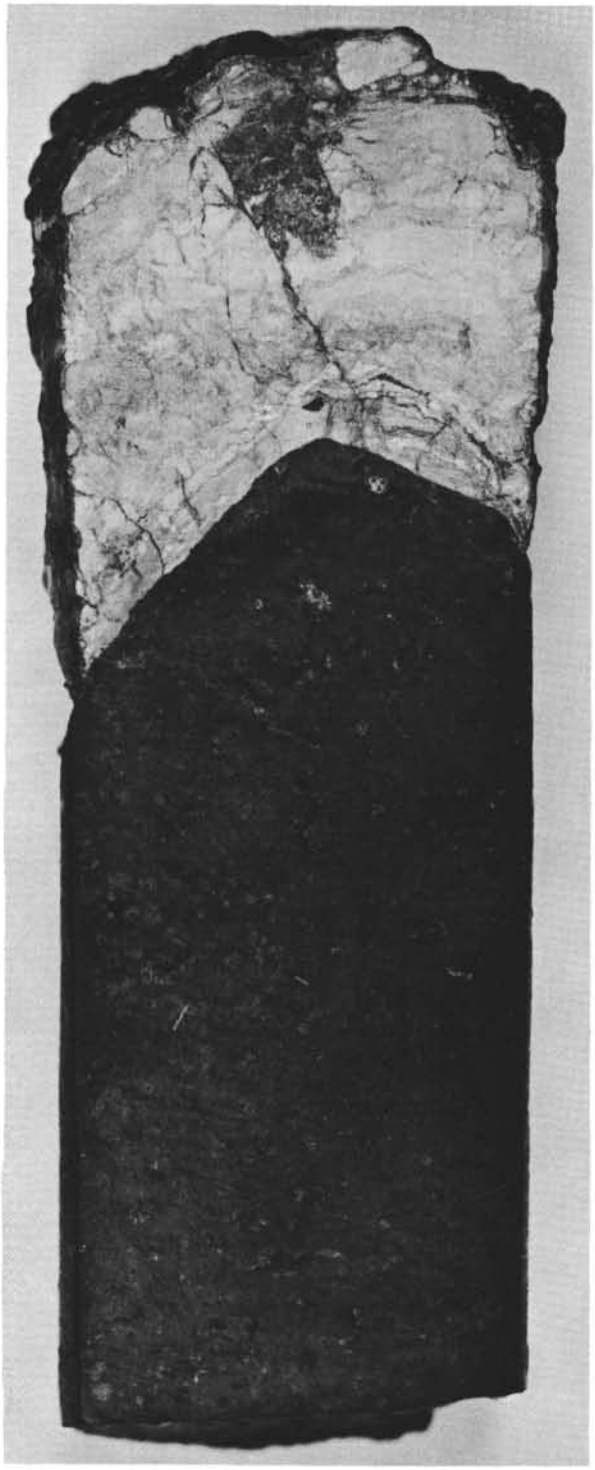


Plate 1. *Contact between chalk ooze and dolerite basement Hole 57.1 Core 4.*

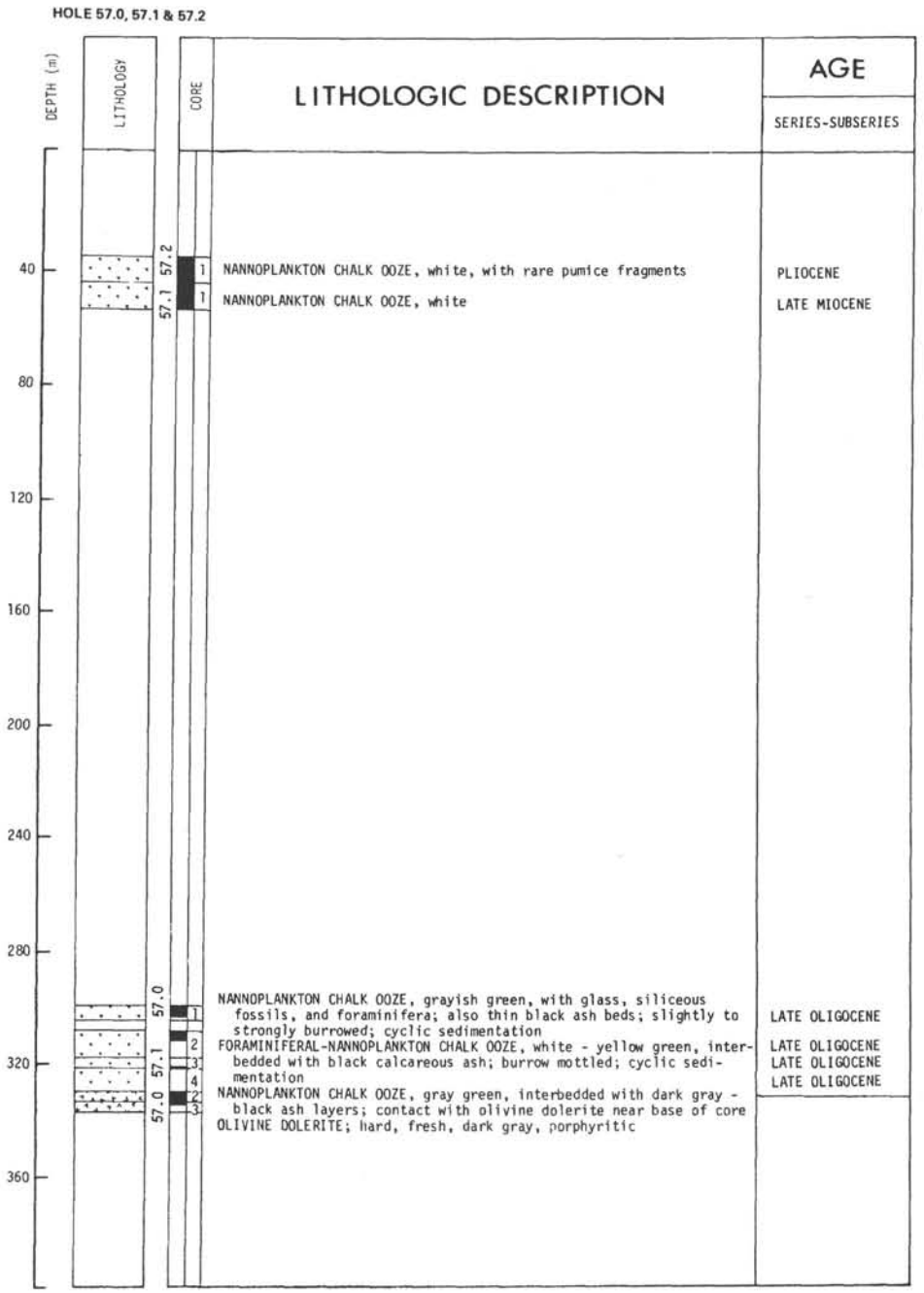


Figure 2. *Summary of lithology in Holes 57.0, 57.1, 57.2.*

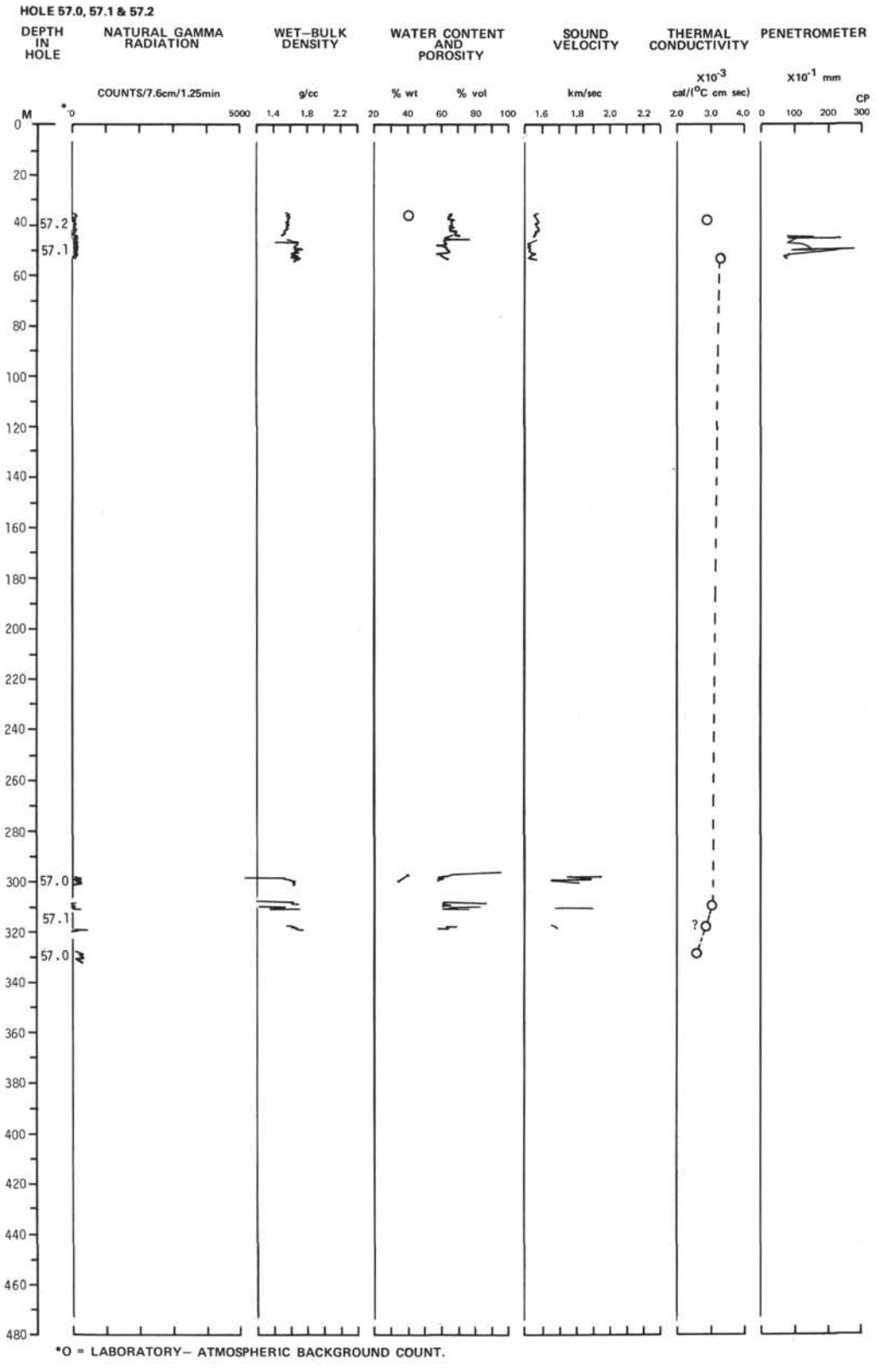


Figure 3. *Summary of physical properties in Holes 57.0, 57.1, 57.2.*

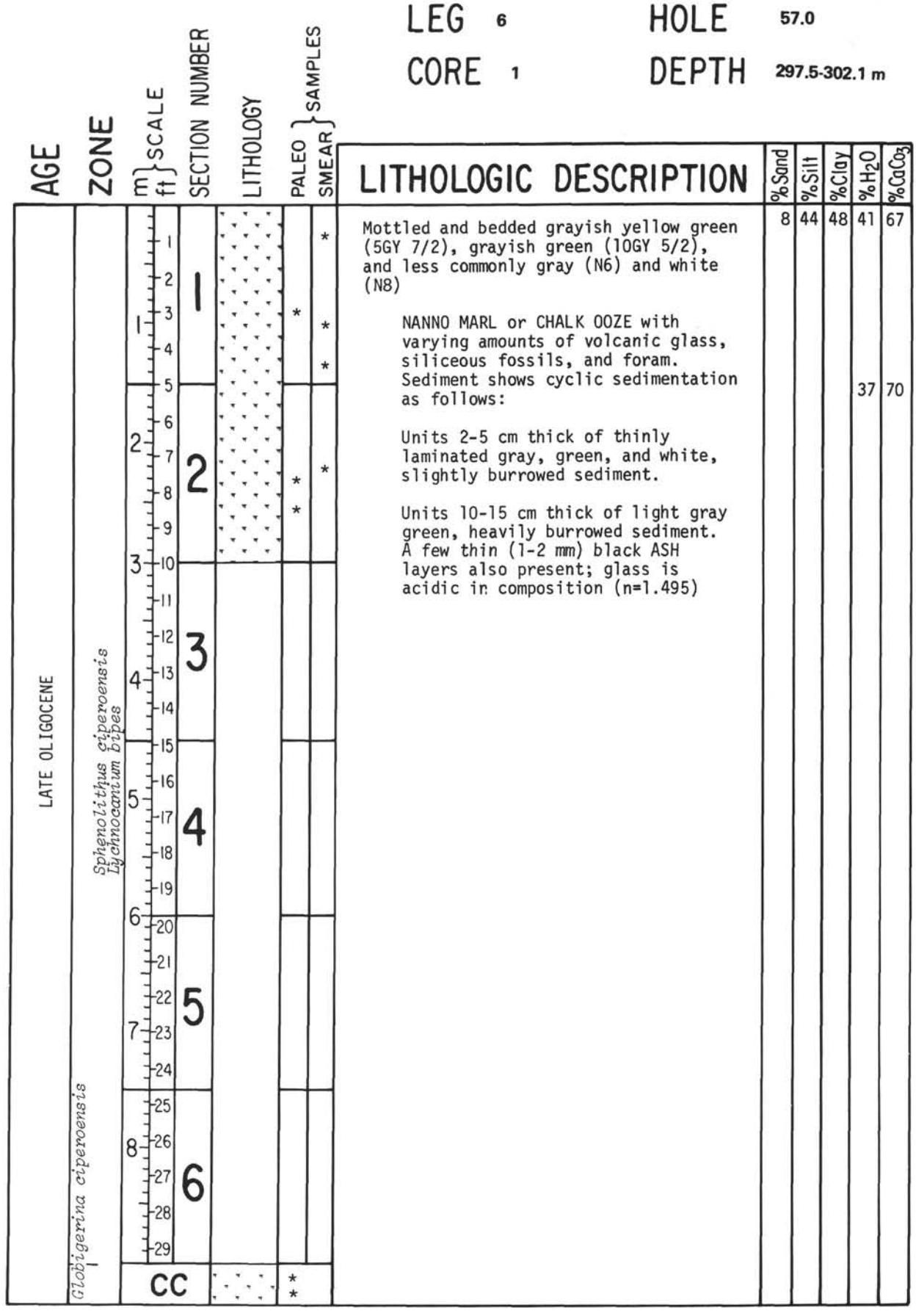


Figure 4. *Summary of lithology in Hole 57.0 Core 1.*

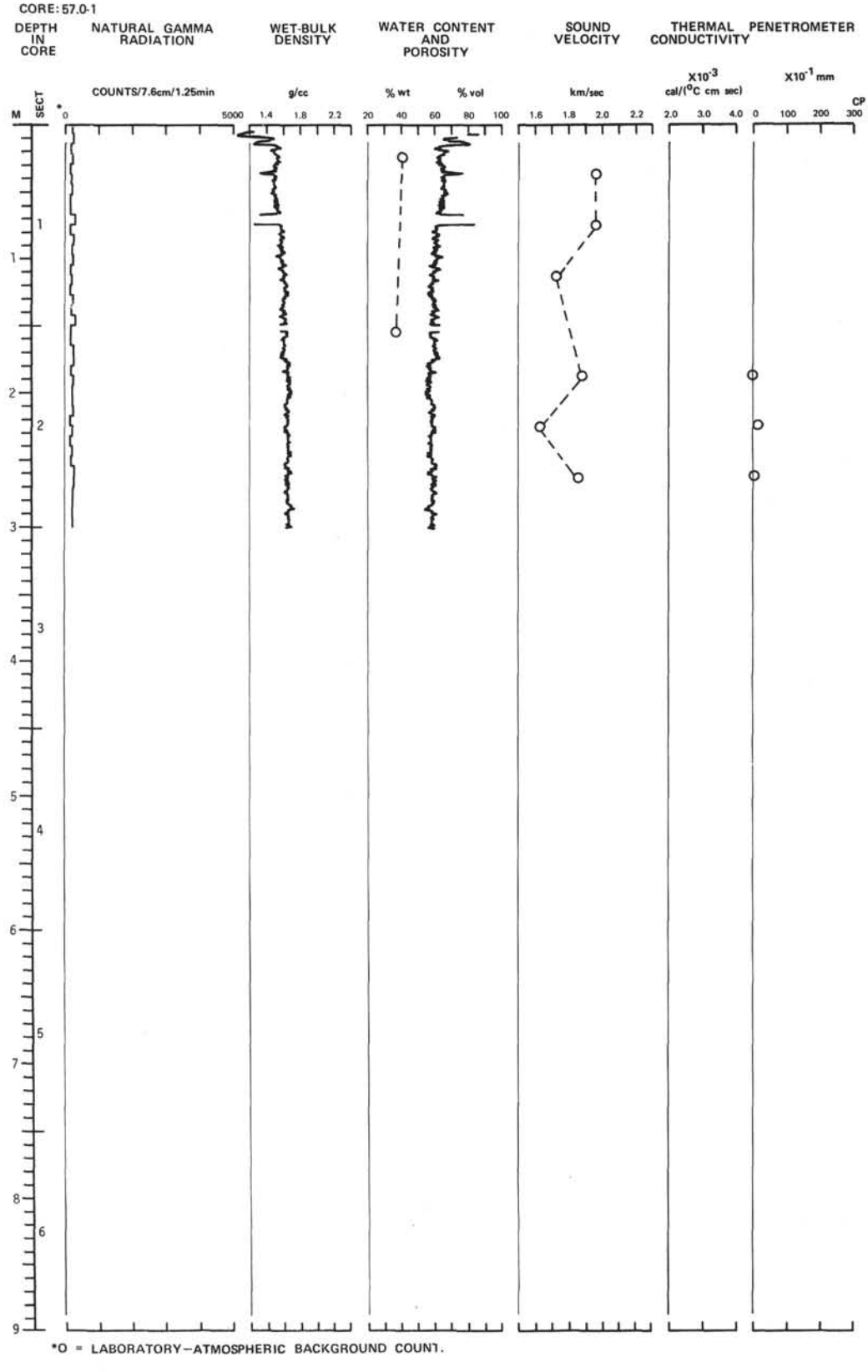


Figure 5. *Summary of physical properties in Hole 57.0 Core 1.*

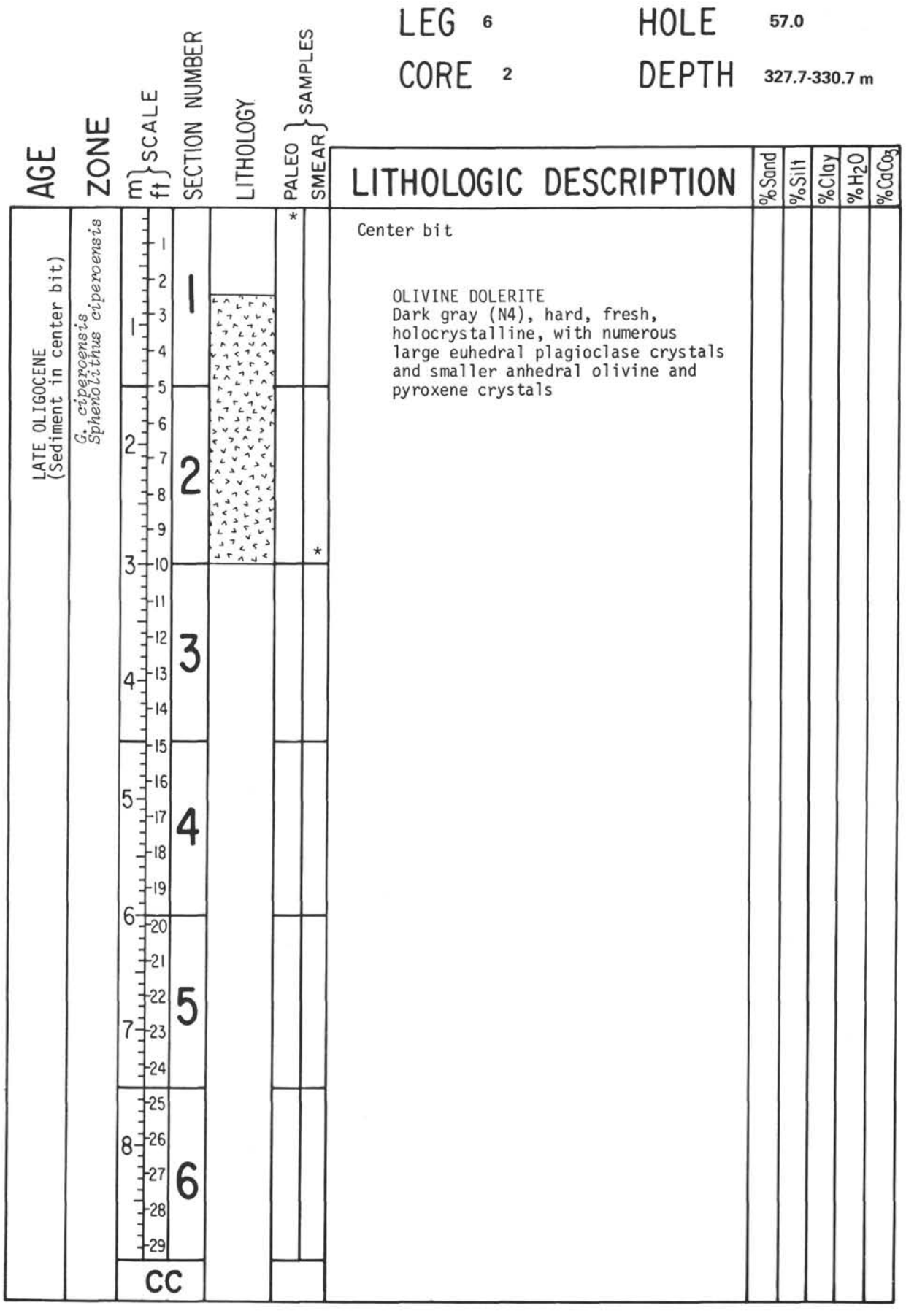


Figure 6. *Summary of lithology in Hole 57.0 Core 2.*

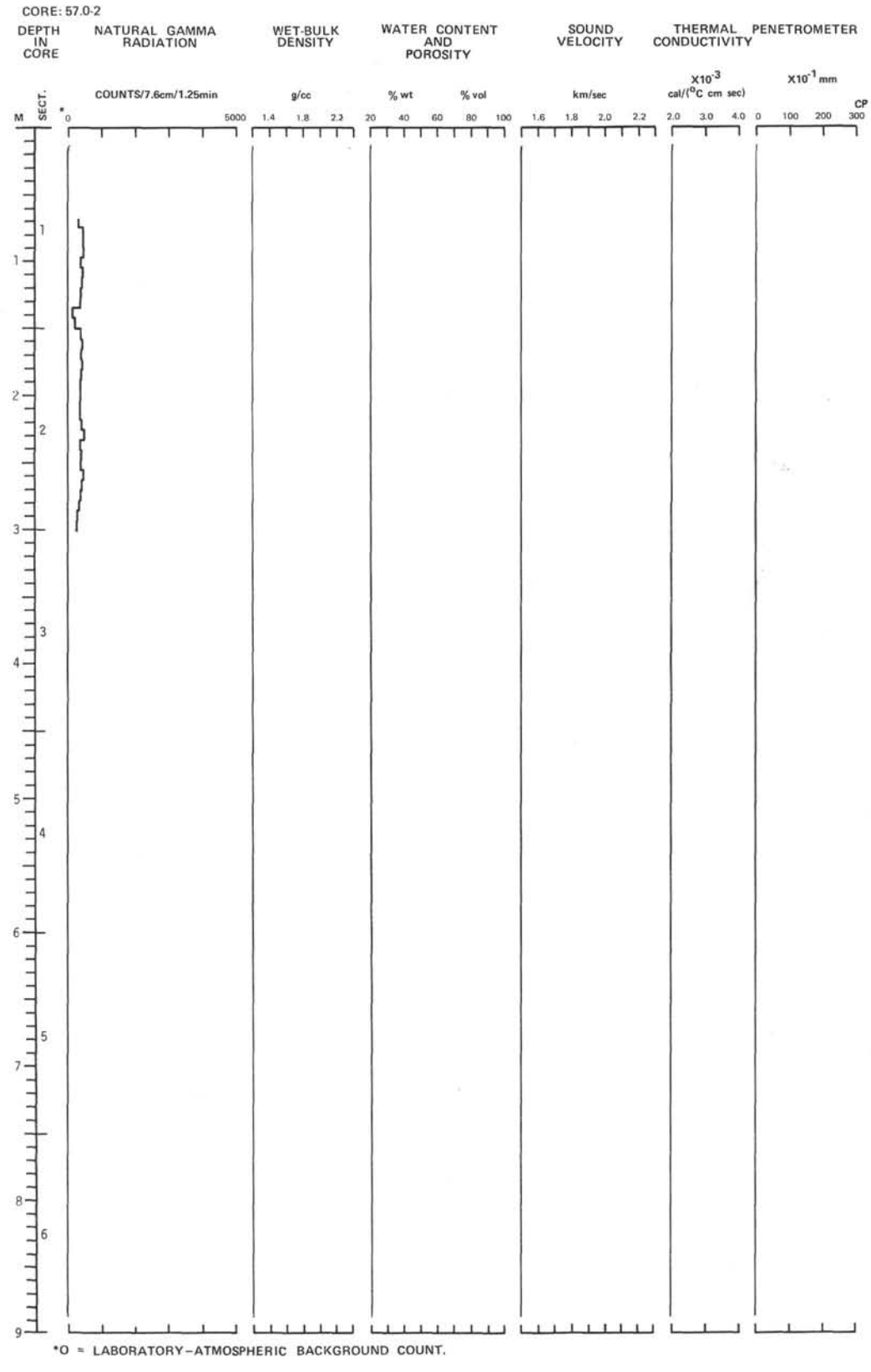


Figure 7. *Summary of physical properties in Hole 57.0 Core 2.*

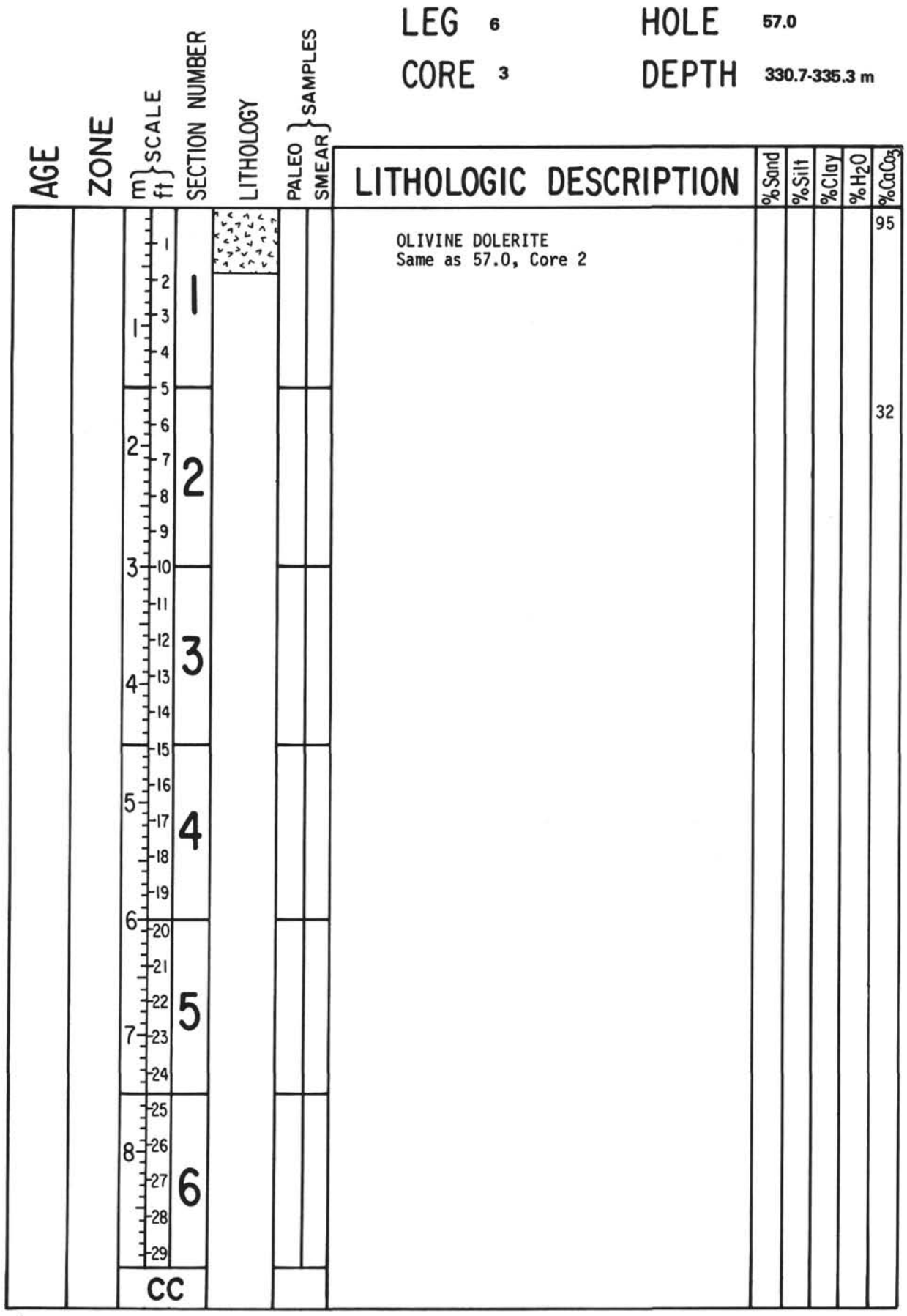


Figure 8. *Summary of lithology in Hole 57.0 Core 3.*

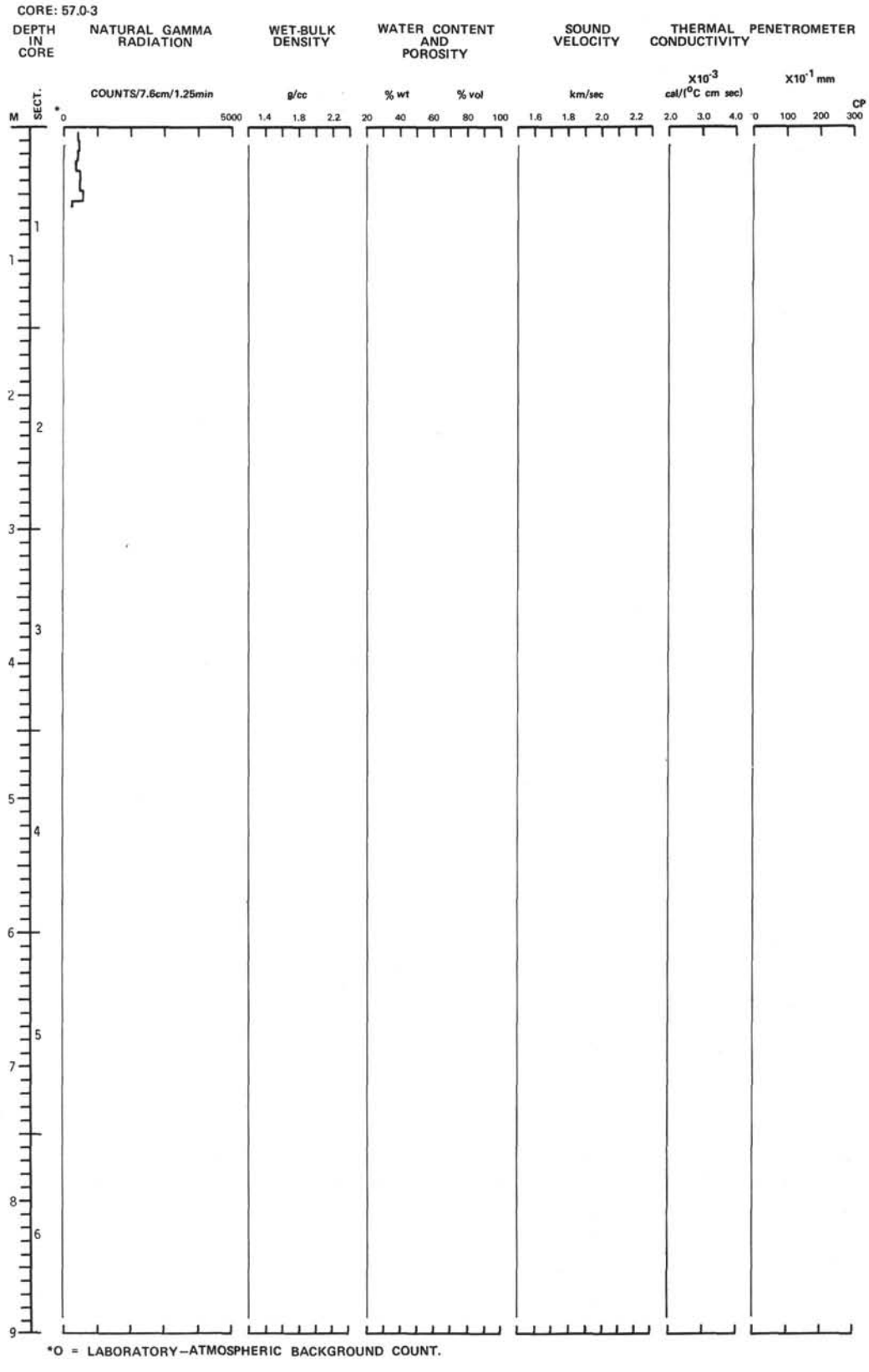


Figure 9. *Summary of physical properties in Hole 57.0 Core 3.*

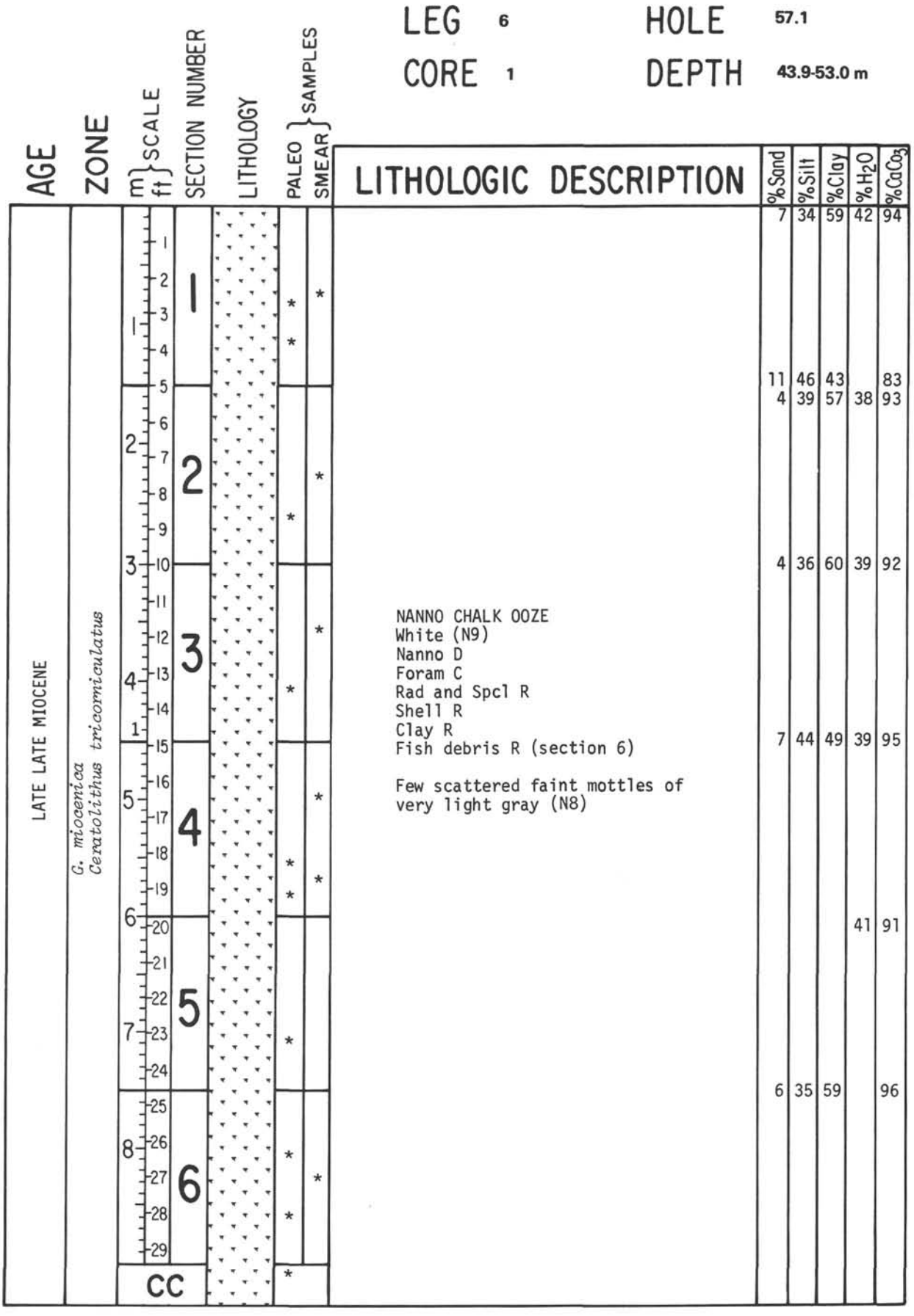


Figure 10. *Summary of lithology in Hole 57.1 Core 1.*

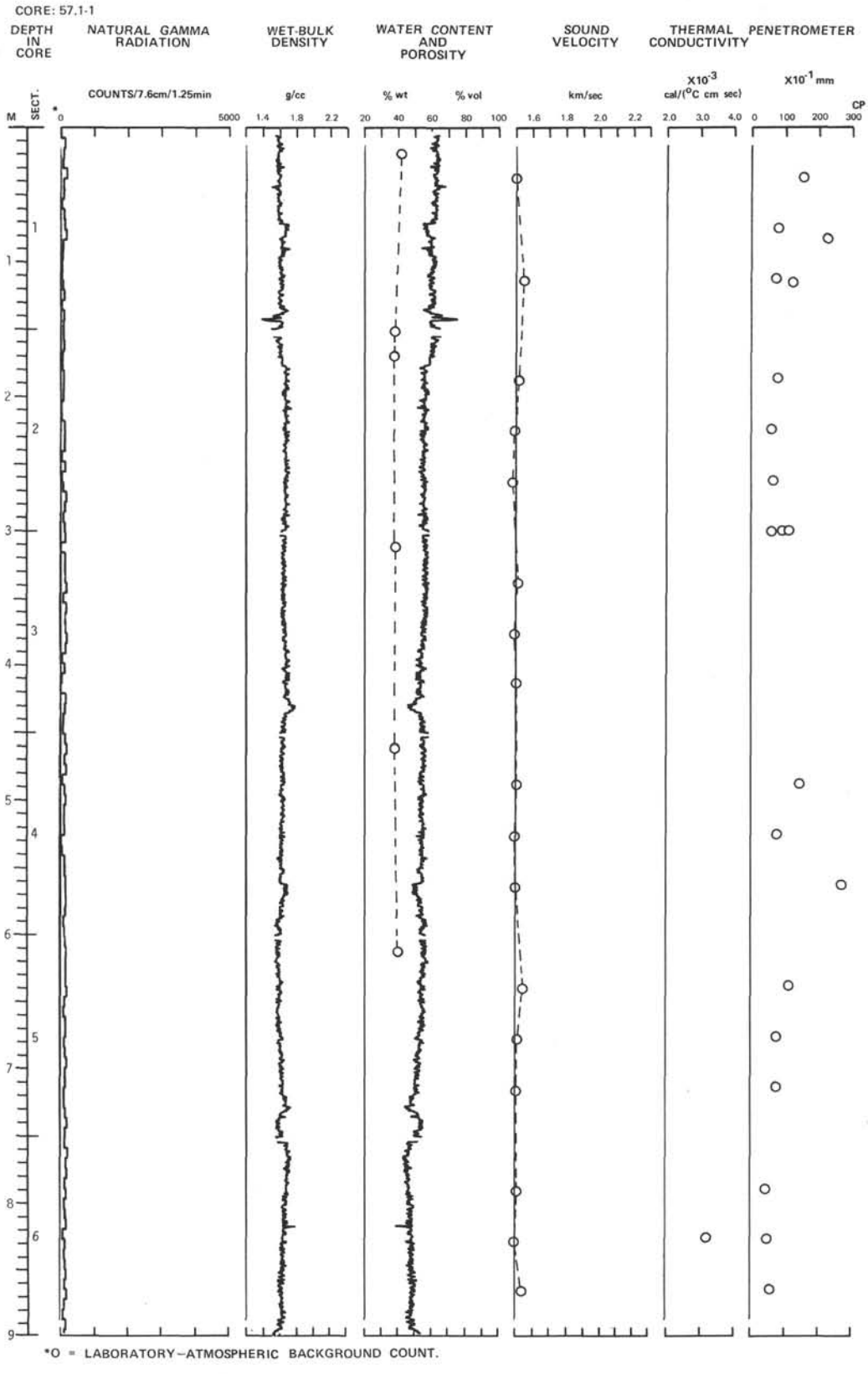


Figure 11. *Summary of physical properties in Hole 57.1 Core 1.*

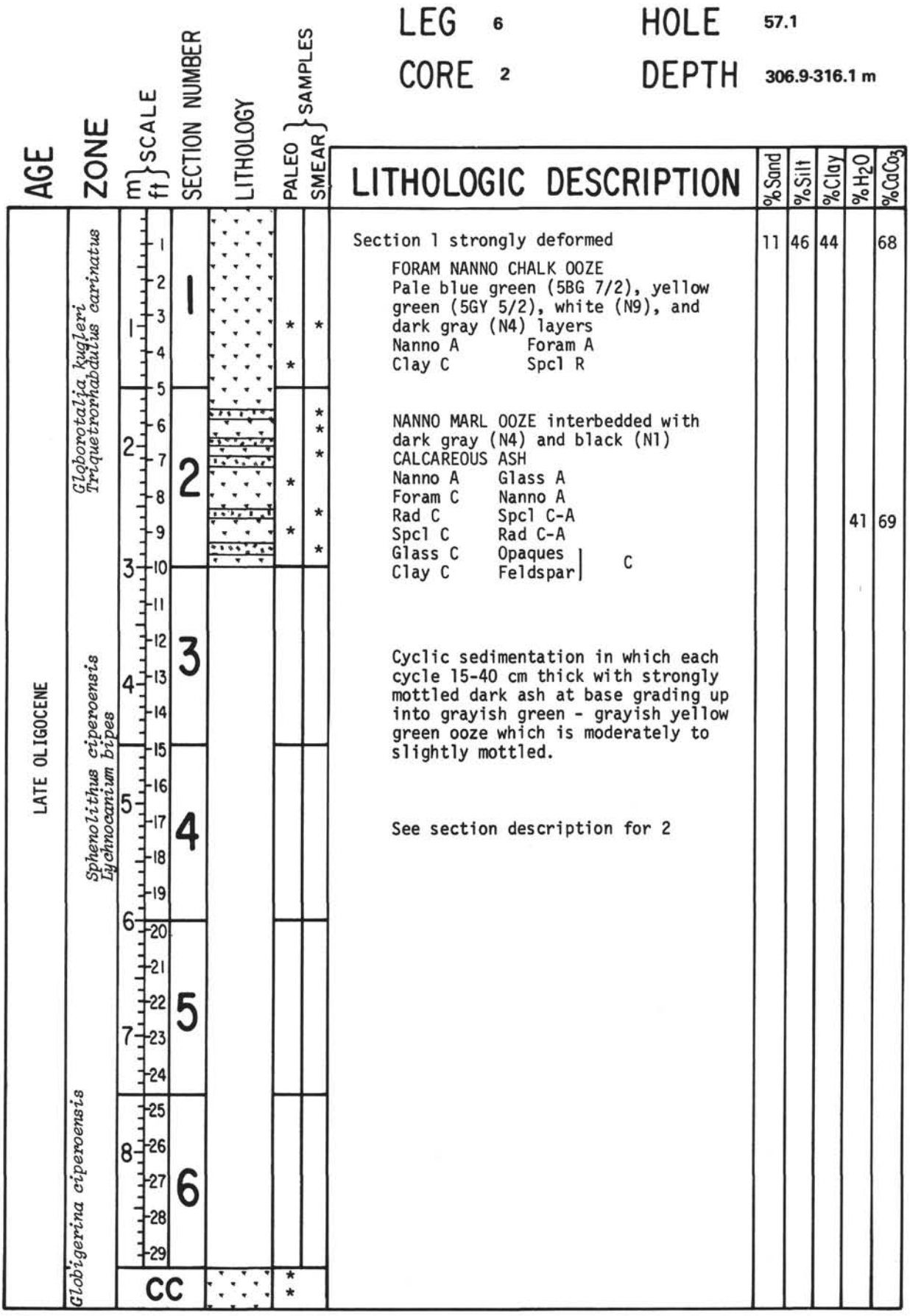
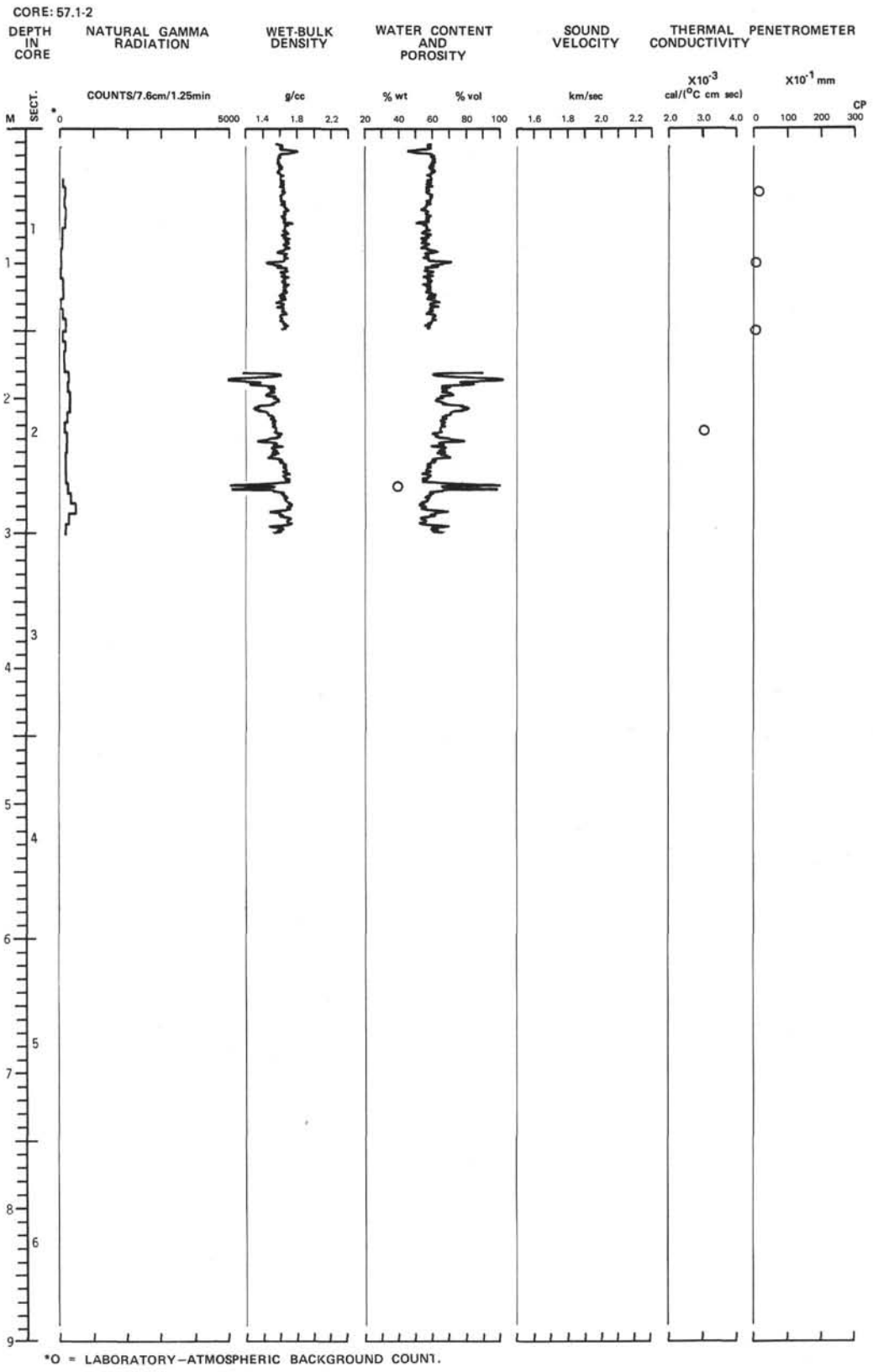


Figure 12. *Summary of lithology in Hole 57.1 Core 2.*



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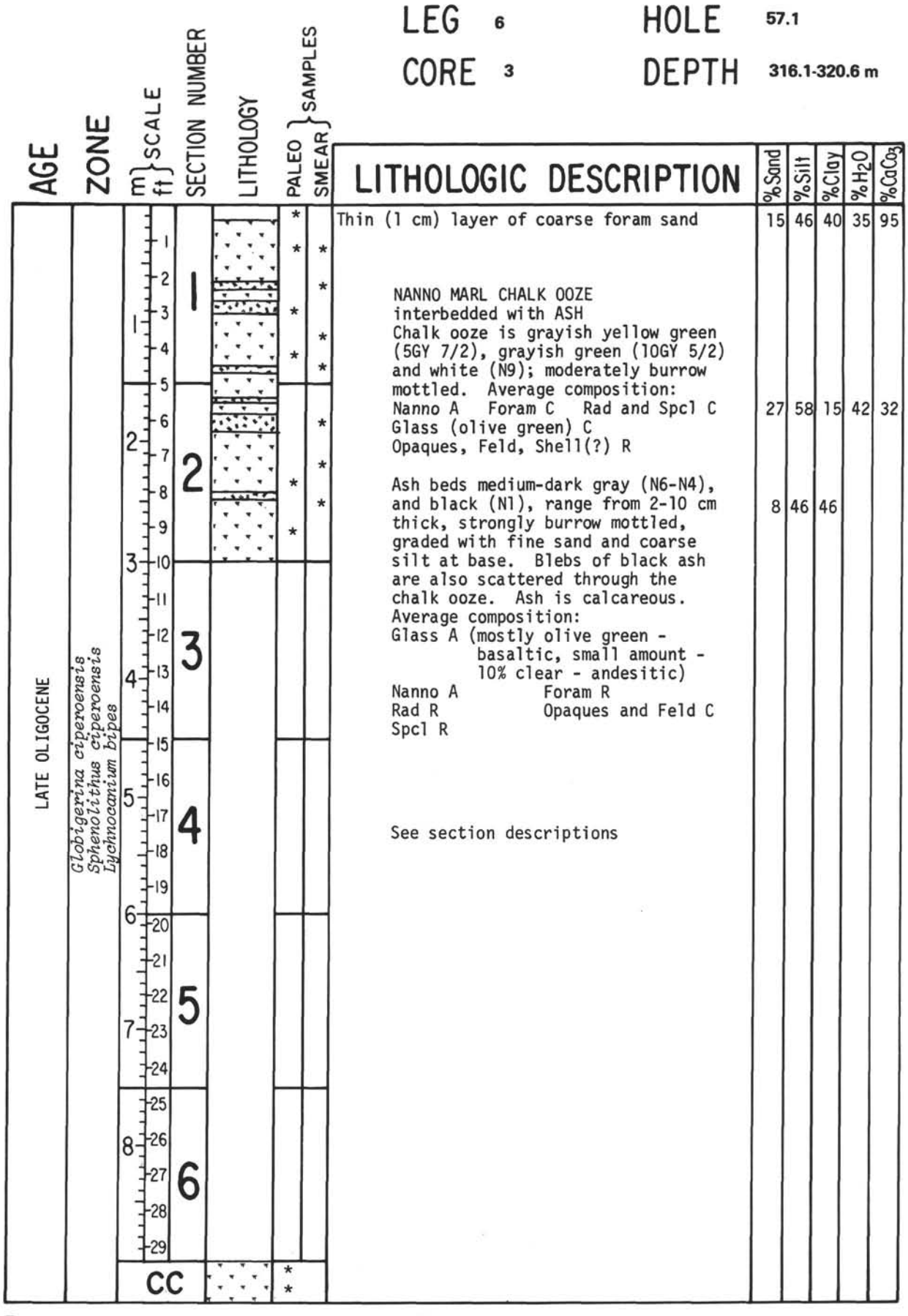

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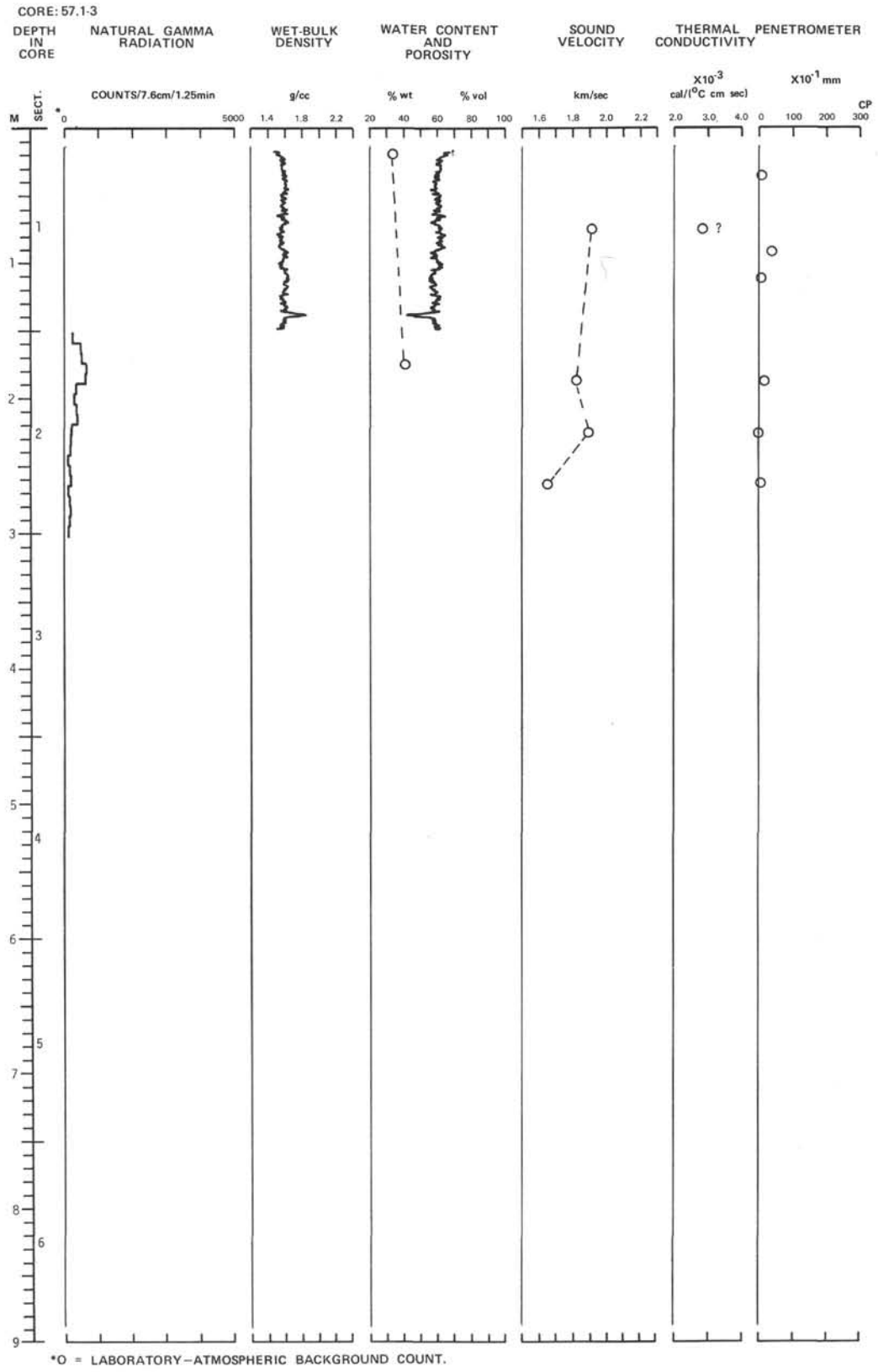

Figure 15. *Summary of physical properties in Hole 57.1 Core 3.*

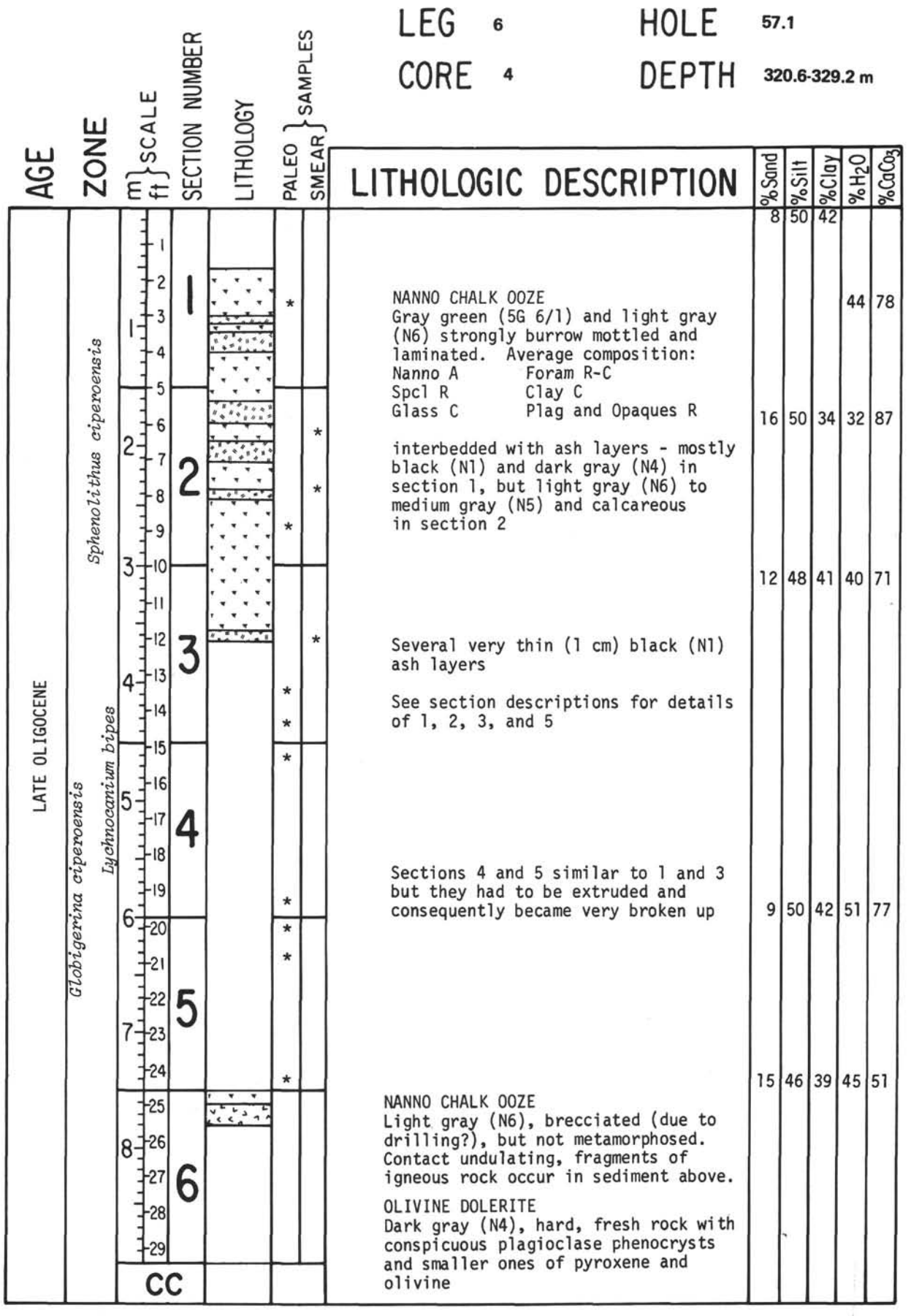

Figure 16. *Summary of lithology in Hole 57.1 Core 4.*

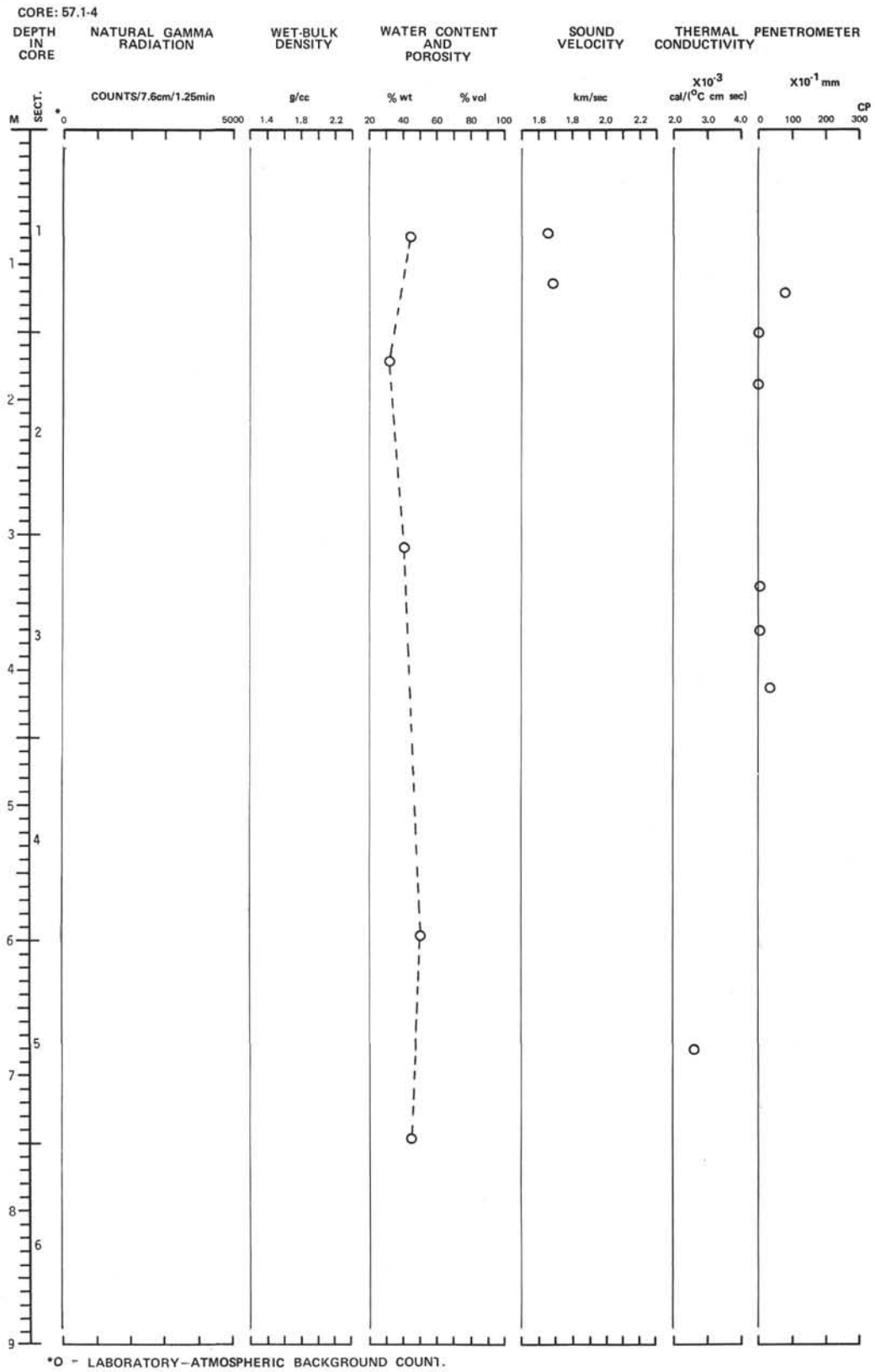

Figure 17. *Summary of physical properties in Hole 57.1 Core 4.*

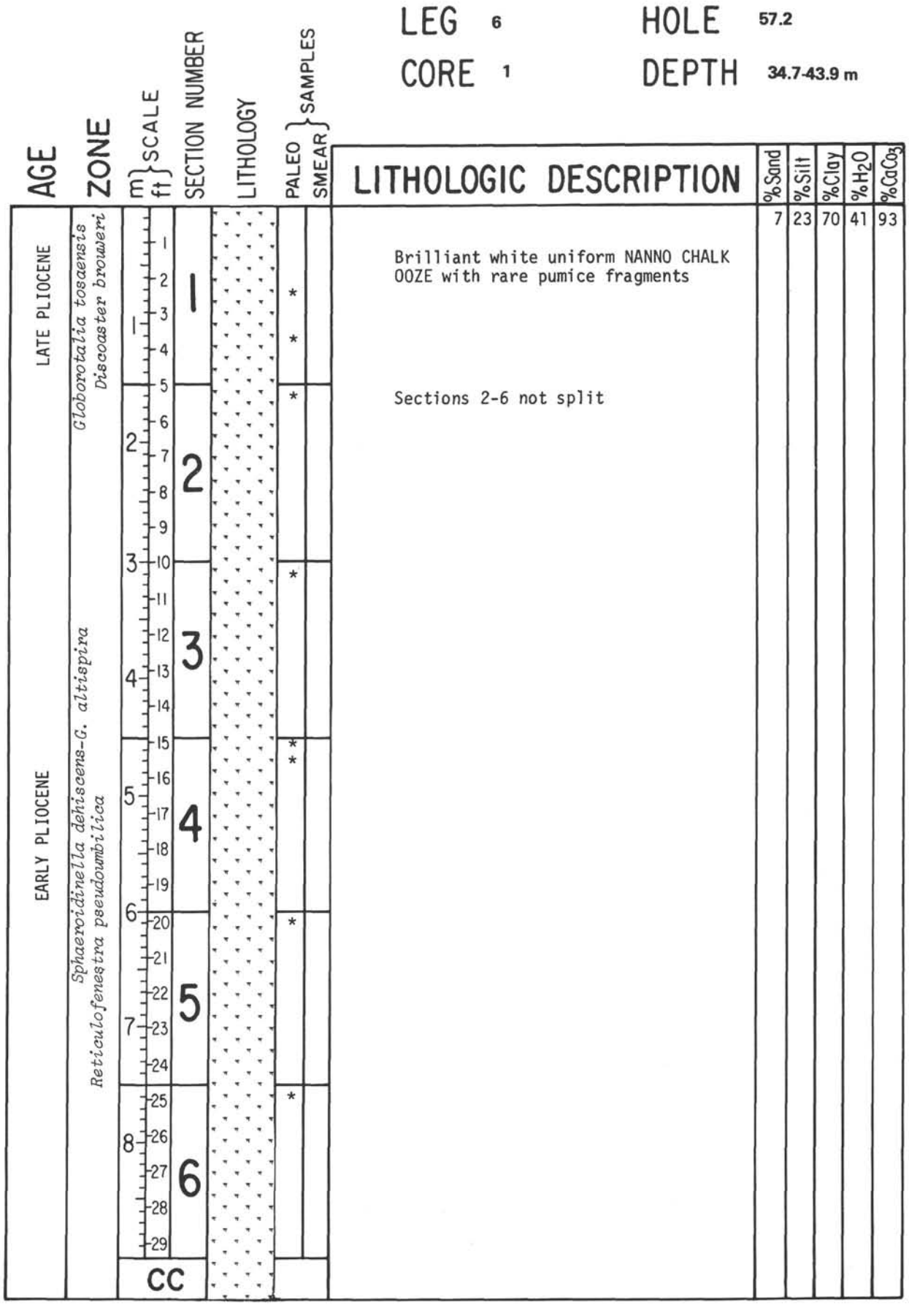

Figure 18. *Summary of lithology in Hole 57.2 Core 1.*

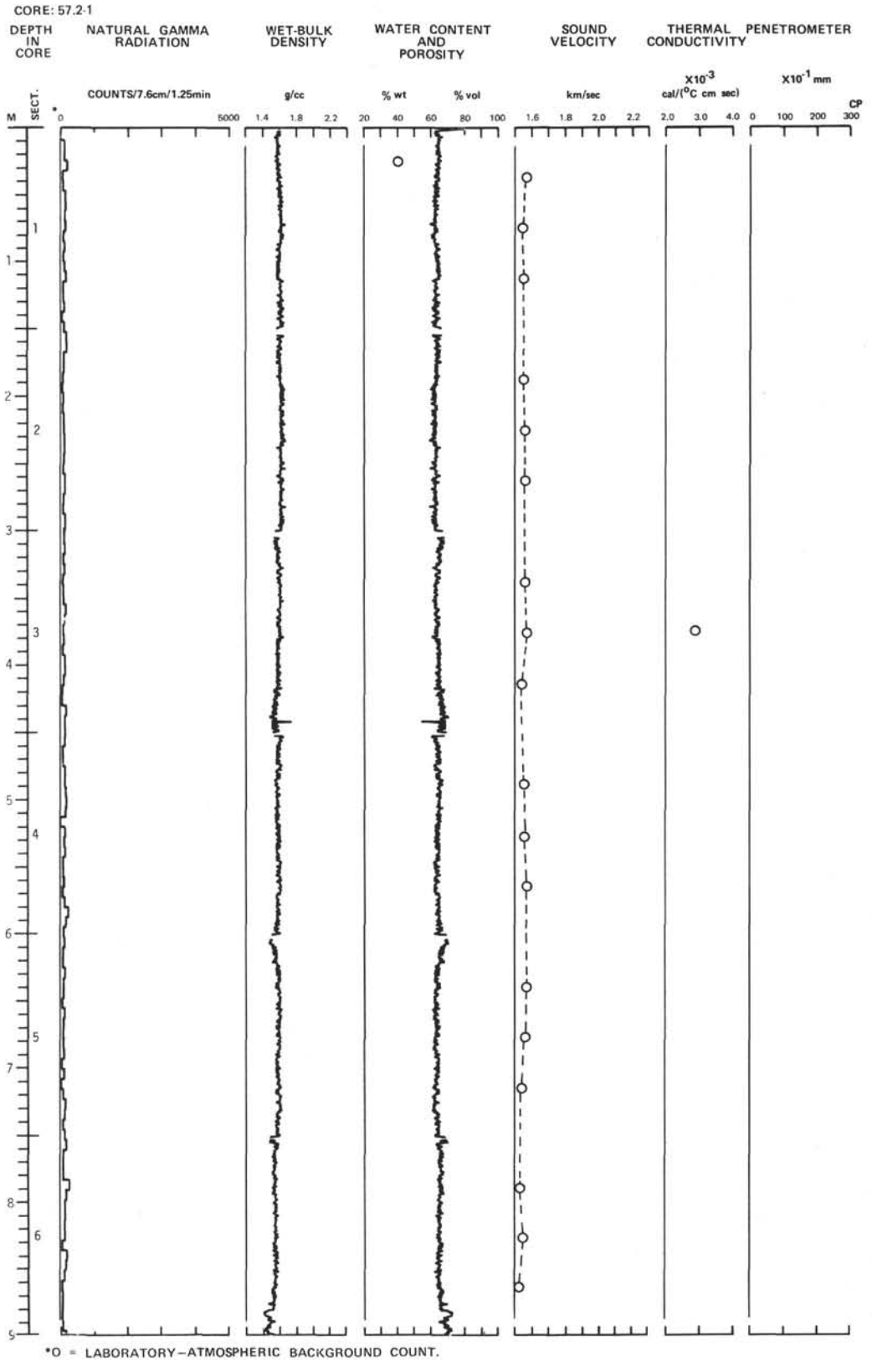

Figure 19. *Summary of physical properties in Hole 57.2 Core 1.*

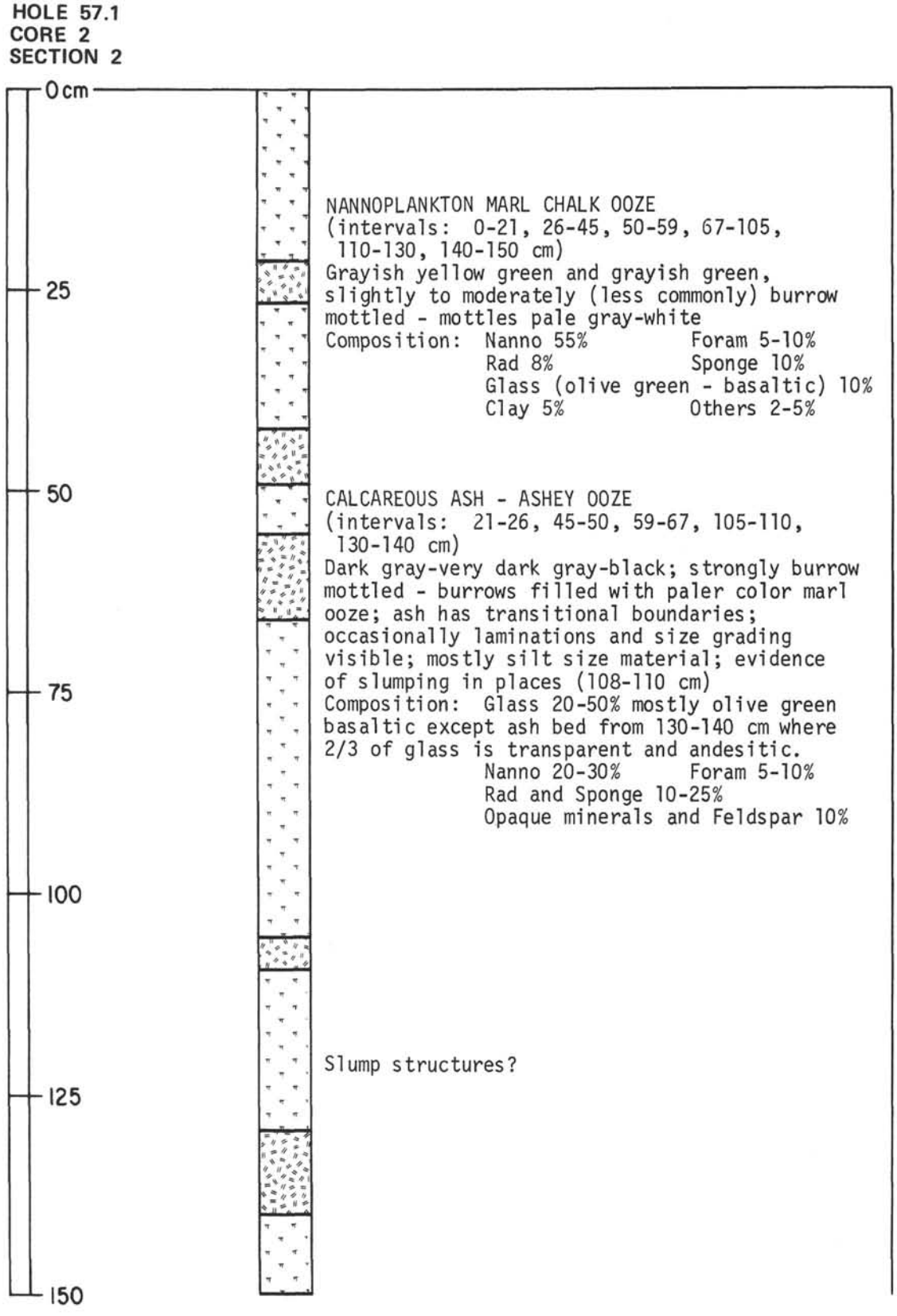

Figure 20. *Summary of lithology in Hole 57.1 Core 2 Section 2.*

HOLE 57.1
CORE 3
SECTION 1

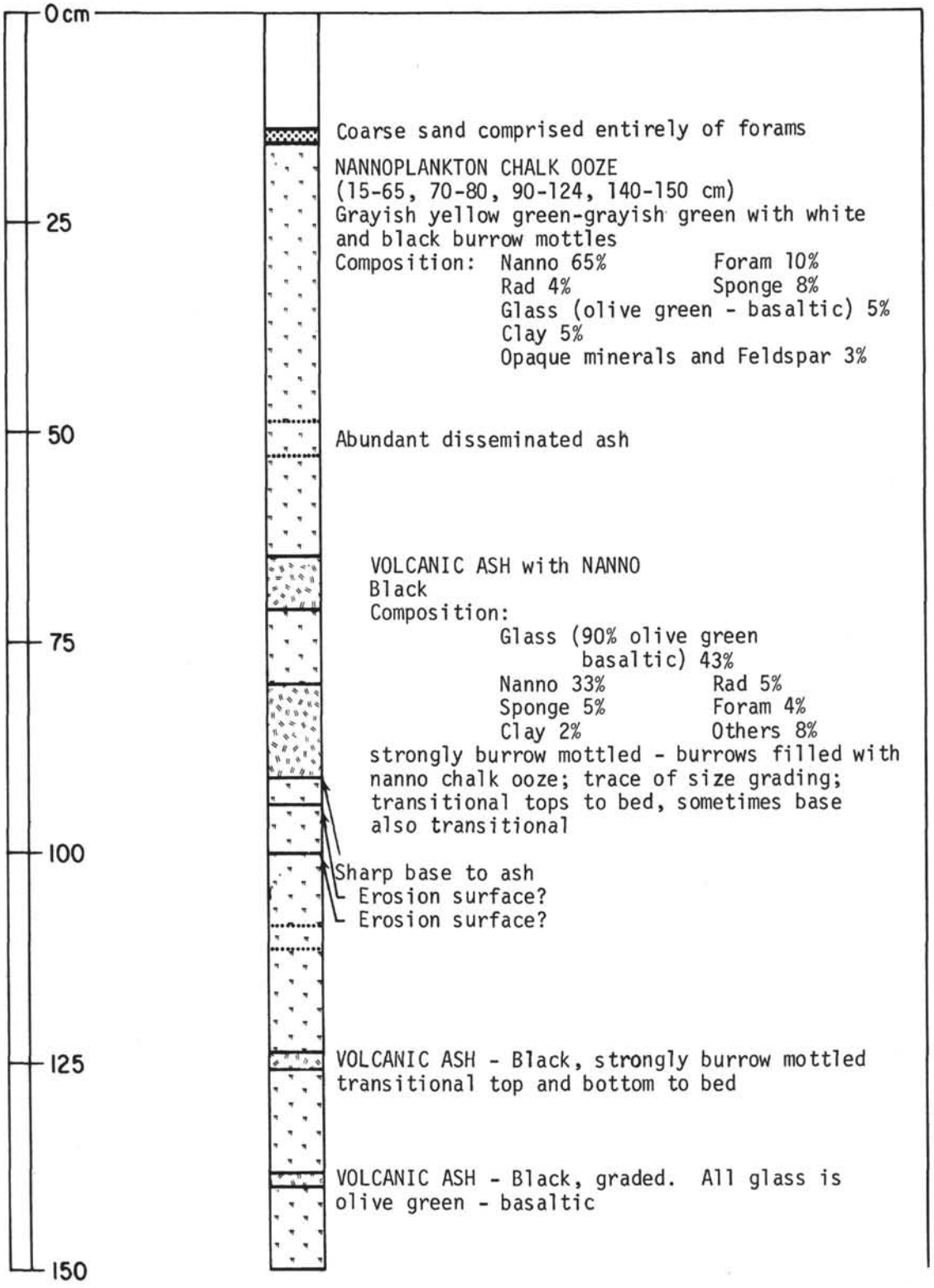

Figure 21. *Summary of lithology in Hole 57.1 Core 3 Section 1.*

HOLE 57.1
CORE 3
SECTION 2

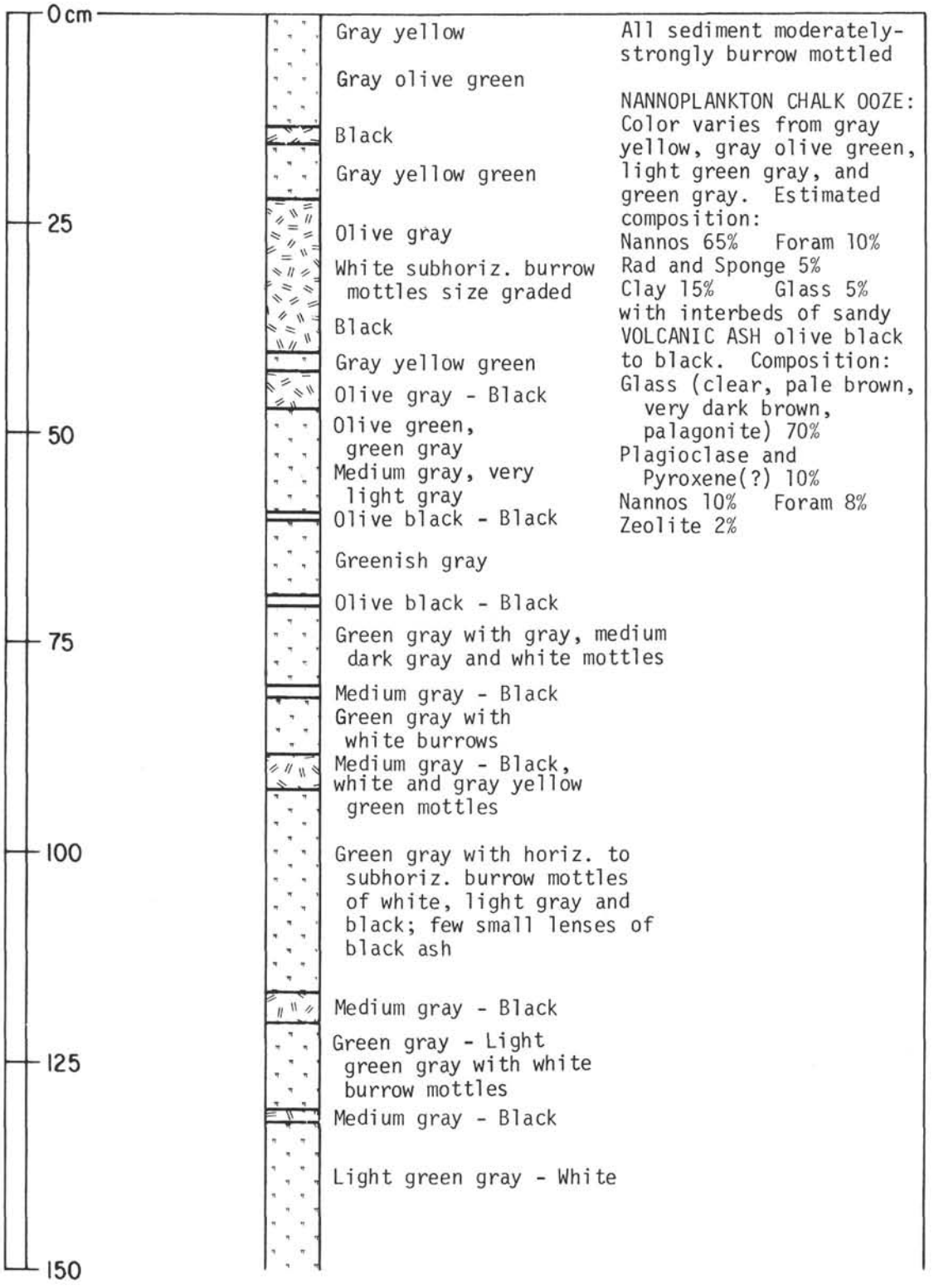

Figure 22. *Summary of lithology in Hole 57.1 Core 3 Section 2.*

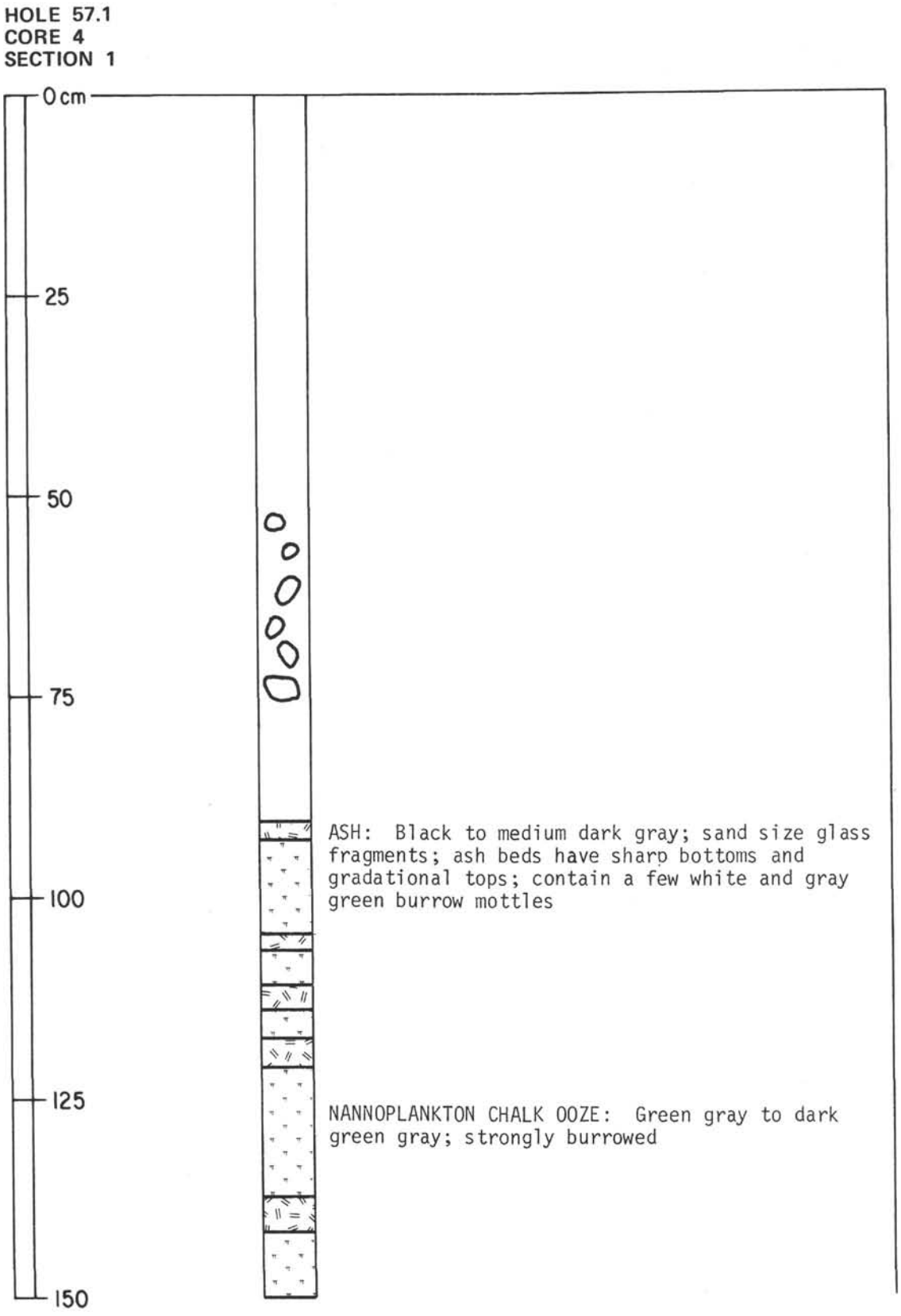

Figure 23. *Summary of lithology in Hole 57.1 Core 4 Section 1.*

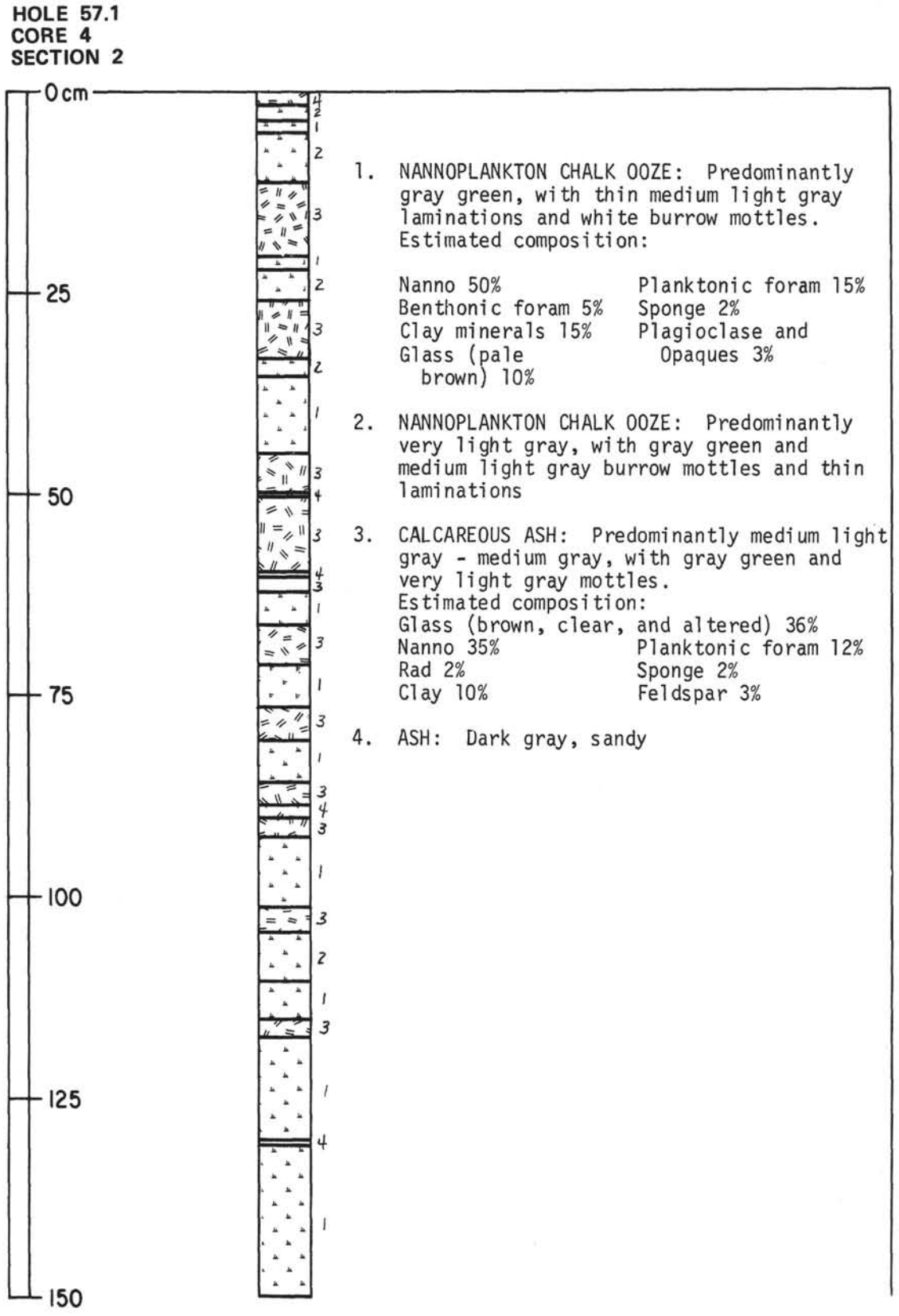

Figure 24. *Summary of lithology in Hole 57.1 Core 4 Section 2.*

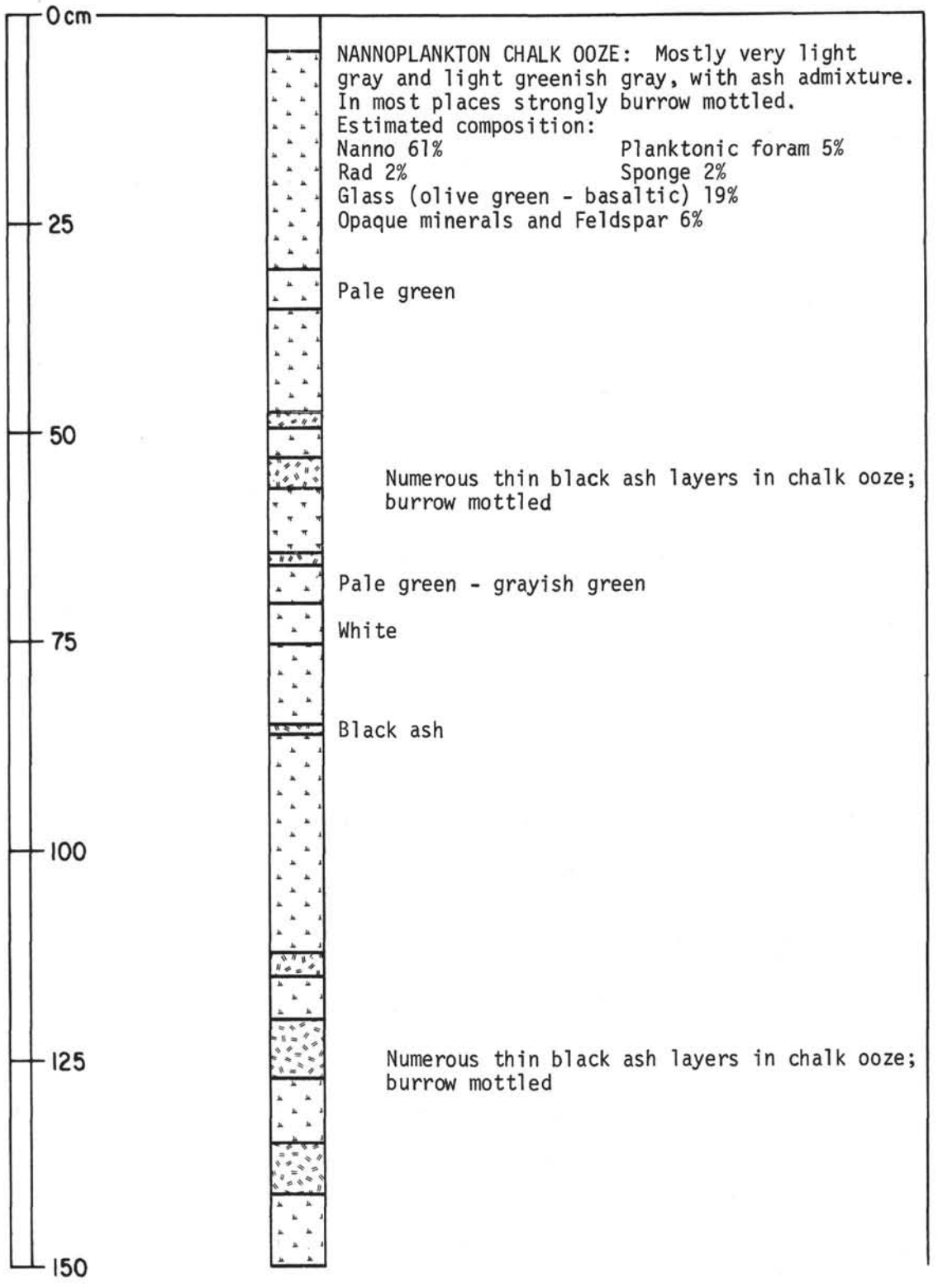

Figure 25. *Summary of lithology in Hole 57.1 Core 4 Section 3.*

LEG 6 HOLE 57.0

CORE CENTER BIT BEFORE CORE 1 DEPTH 295.7 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
The age of the center bit sample can be considered as the lower part of the *Globorotalia kugleri* Zone, lower Lower Miocene (or upper Upper Oligocene of Bolli's zonal scale, 1957). Species present include *Globorotalia kugleri, G. pseudokugleri, G. brevispira, G. opima nana, Globigerina bradyi, G. juvenilis, G. angustiumbilicata, G. woodi, G. pseudoedita, Cassigerinella chipolensis* and very rare *Globigerina angulisaturalis.*	None.	None.

Figure 26. *Summary of biostratigraphy in Hole 57.0 center bit.*

LEG 6 HOLE 57.0

CORE 1 DEPTH 297.5-302.1 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Assemblages of the *Globigerina ciperoensis* Zone, Upper Oligocene, were met in this core. Planktonic Foraminifera are represented by *Globigerina ciperoensis, G. angulisuturalis, G. angustiumbilicata, G. ouangustiumbilicata, G. ouachitaensis, G. pseudoedita, G. woodi, Globorotalia pseudokugleri, G. brevispira, G. opima nana, Cassigerinella chipolensis* and very rare *Globigerinoides trilobus primordius.* Coexistence of *G. pseudokugleri*, subordinate *G. ciperoensis* and rare *G. trilobus primordius* indicates the upper part of the *G. ciperoensis* Zone.	Samples from this core contain upper upper Oligocene assemblages of the upper *Sphenolithus ciperoensis* Zone. Species present include *Coccolithus* sp. aff. *C. bisectus, C. eopelagicus, Cyclococcolithina neogammation, Discoaster deflandrei, Helicopontosphaera intermedia, H. obliqua, Sphenolithus* sp. aff. *S. belemnos, S. ciperoensis*, and *Triquetrorhabdulus* sp. cf. *T. carinatus.*	This core contains Radiolaria of the approximately upper Oligocene *Lychnocanium bipes* Zone. TOP: *Lychnocanium bipes, Dorcadospyris ateuchus, Theocyrtis annosa, Cyrtocapsella cornuta, Cannartus prismaticus, Cyrtocapsella tetrapera*, and *Artophormis gracilis.* BOTTOM: *Theocyrtis annosa, Dorcadospyris ateuchus, Cannartus prismaticus, Artophormis gracilis*, and *Lychnocanium bipes.*

Figure 27. *Summary of biostratigraphy in Hole 57.0 Core 1.*

LEG 6 HOLE 57.0

CORE Center Bit 1-2 DEPTH 302.1-327.7m.

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
The center bit sample contains an assemblage of planktonic Foraminifera typical for the *Globigerina ciperoensis* Zone, Upper Oligocene. Among them were determined *Globigerina ciperoensis, G. angulisuturalis, G. angustiumbilicata, G. ouachitaensis, G. praebulloides, Cassigerinella chipolensis, Globorotalia brevispira, G. opima nana.*	The sediment recovered from the center bit, the oldest sediment in this hole since core 2 recovered igneous rock, contains an assemblage similar to the *Triquetrorhabdulus carinatus* Zone. But, the presence of small specimens of *Sphenolithus ciperoensis* indicates a correlation to the upper *Sphenolithus ciperoensis* Zone.	The center bit sample retreived before taking this core contained Radiolaria of approximately upper Oligocene *Lychnocanium bipes* Zone. CENTER BIT 1/2: *Dorcadospyris ateuchus, Theocyrtis annosa, Cannartus prismaticus,* and *Lychnocanium bipes.*

Figure 28. *Summary of biostratigraphy in Hole 57.0 center bit between Core 1 and Core 2.*

LEG 6 HOLE 57.0

CORE 2 DEPTH 327.7-330.7 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
The center bit sample contains an assemblage of planktonic Foraminifera typical for the *Globigerina ciperoensis* Zone, Upper Oligocene. Among them were determined *Globigerina ciperoensis, G. angulisuturalis, G. angustiumbilicata, G. ouachitaensis, G. praebulloides, Cassigerinella chipolensis, Globorotalia brevispira, G. opima nana.*	The sediment recovered from the center bit, the oldest sediment in this hole since core 2 recovered igneous rock, contains an assemblage similar to the *Triquetrorhabdulus carinatus* Zone. But, the presence of small specimens of *Sphenolithus ciperoensis* indicates a correlation to the upper *Sphenolithus ciperoensis* Zone.	The center bit sample retreived before taking this core contained Radiolaria of approximately upper Oligocene *Lychnocanium bipes* Zone. CENTER BIT 1/2: *Dorcadospyris ateuchus, Theocyrtis annosa, Cannartus prismaticus,* and *Lychnocanium bipes.*

Figure 29. *Summary of biostratigraphy in Hole 57.0 Core 2.*

LEG 6 HOLE 57.0

CORE 3 DEPTH 330.7-335.3 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
None.	None.	None.

Figure 30. *Summary of biostratigraphy in Hole 57.0 Core 3.*

LEG 6 HOLE 57.1

CORE 1 DEPTH 43.9-53.0 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Very rich assemblages of the *Globigerina miocaenica* Zone (upper Miocene, Messinian stage) were found in all samples. Evidently the zone is presented by its upper part (the *Globorotalia tumida - Sphaeroidinellopsis subdehiscens paenedehiscens* Subzone). Planktonic Foraminifera include *Globorotalia tumida tumida, G. multicamerata, G. tumida plesiotumida, G. acostaensis humerosa, Sphaeroidinellopsis seminulina, S. subdehiscens paenedehiscens, Globigerinoides sacculifera, G. obliquus extremus, Pulleniatina primalis, Globigerina nepenthes, G. apertura, G. bulloides, Orbulina universa, Globoquadrina altispira.*	A nannoplankton ooze of the upper upper Miocene *Ceratolithus tricorniculatus* Zone is present throughout the core. Species present include *Ceratolithus tricorniculatus, Cyclococcolithina leptoporus, C. macintyrei, Discoaster browseri, D. challengeri, D. pentaradiatus, D. perplexus, D. quintatus, D. surculus, Reticulofenestra pseudoumbilica, Scyphosphaera* sp. aff. *S. apsteinii,* and *Triquetrorhabdulus rugosus.*	Radiolaria are rare in this core. The species identified are from the lower Miocene. Judging from the upper Miocene ages based on calcareous microfossils and the lack of Radiolaria of intermediate age, it appears that the Radiolaria in this core were contributed from nearby outcrops. TOP: not examined. BOTTOM: *Stichocorys wolffii, Calocycletta costata, Dorcadospyris dentata,* and *D. ateuchus.*

Figure 31. *Summary of biostratigraphy in Hole 57.1 Core 1.*

LEG 6 HOLE 57.1

CORE 2 DEPTH 306.9-316.1 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Abundant planktonic Foraminifera of the Upper Oligocene *Globigerina ciperoensis* Zone were met in the core catcher - *Globigerina ciperoensis, G. angulisuturalis, G. angustiumbilicata, G. ouachitaensis, Globorotalia brevispira, G. opima nana.* Near the top (sections 1 and 2) assemblages consist of numerous *Globorotalia pseudokugleri, G. brevispira, Globigerina angustiumbilicata, G. pseudoedita, Cassigerinella chipolensis* and rare *Globigerina ciperoensis, G. woodi.* It is the transition to the overlying *Globorotalia kugleri* Zone or even the basal part of this zone, lower Lower Miocene.	Assemblages of the upper Oligocene *Sphenolithus ciperoensis* Zone are present throughout this core. Species present include *Coccolithus bisectus, C.* sp. aff. *C. bisectus, Cyclococcolithina neogammation, Discoaster deflandrei, Helicopontosphaera parallela, H. truncata, Sphenolithus ciperoensis,* and *Triquetrorhabdulus carinatus.*	Radiolaria are abundant in this core. The species are of the approximately upper Oligocene *Lychnocanium bipes* Zone. TOP: *Theocyrtis annosa, Dorcadospyris ateuchus, Lychnocanium bipes, Cannartus prismaticus,* and *Dorcadospyris papilio.* BOTTOM: *Dorcadospyris ateuchus, D. papilio.*

Figure 32. *Summary of biostratigraphy in Hole 57.1 Core 2.*

LEG 6 HOLE 57.1

CORE 3 DEPTH 316.1-320.6 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Assemblages of planktonic Foraminifera belong to the *Globigerina ciperoensis* Zone, Upper Oligocene, and consist of *Globigerina ciperoensis, G. angulisuturalis, G. angustiumbilicata, G. ouachitaensis, G. tripartita, Cassigerinella chipolensis, Globorotalia opima nana, G. brevispira, G. inaequiconica.*	Samples from this core contain nannoplankton assemblages of the upper Oligocene *Sphenolithus ciperoensis* Zone. Species present include *Coccolithus bisectus, C.* sp. aff. *C. bisectus, Cyclococcolithina neogammation, Discoaster deflandrei, Helicopontosphaera parallela, H.* sp. aff. *H. seminulum, Sphenolithus ciperoensis,* and *Triquetrorhabdulus carinatus.* Some erratic white clay from the top of the core contains an upper Pliocene assemblage from the lower *Discoaster browseri* Zone. Species present include *Ceratolithus rugosus, Cyclococcolithina macintyrei, Discoaster browseri, D. pentaradiatus, D. surculus,* and *Helicopontosphaera sellii.*	This core contains Radiolaria of the approximately upper Oligocene *Lychnocanium bipes* Zone. TOP: *Cannartus prismaticus, Dorcadospyris ateuchus, Lychnocanium bipes, Cyrtocapsella cornuta,* and *Dorcadospyris papilio.* BOTTOM: *Cannartus prismaticus, Dorcadospyris ateuchus, Theocyrtis annosa,* and *Lychnocanium bipes.*

Figure 33. *Summary of biostratigraphy in Hole 57.1 Core 3.*

LEG 6 HOLE 57.1

CORE 4 DEPTH 320.6-329.2 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Assemblages of the *Globigerina ciperoensis* Zone, Upper Oligocene, are present throughout the core. The following species were singled out - *Globigerina ciperoensis, G. angulisuturalis, G. angustiumbilicata, G. ouachitaensis, G. praebulloides, G. senilis, Cassigerinella chiponensis, Globorotalia opima nana.* Here the bottom rare specimens of *Globorotalia opima opima* were found and in "the top sample" - very rare *Glogerinoides trilobus primordius.*	Upper Oligocene *Sphenolithus ciperoensis* Zone assemblages are present in this core. Characteristic species include *Coccolithus bisectus, C.* sp. aff. *C. bisectus, Cyclococcolithina neogammation, D. deflandrei, Helicopontosphaera parallela, Sphenolithus ciperoensis,* and *Triquetrorhabdulus carinatus.*	Radiolaria are rare and poorly preserved in this core. Identifiable species represent the approximately upper Oligocene *Lychnocanium bipes* Zone. TOP: not examined. BOTTOM: *Dorcadospyris ateuchus, D. papilio, Theocyrtis annosa,* and *Lychnocanium bipes.*

Figure 34. *Summary of biostratigraphy in Hole 57.1 Core 4.*

LEG 6 HOLE 57.1

CORE CENTER BIT 1-2 DEPTH 53.0-306.9m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
The center bit sample contains abundant Foraminifera of the *Globorotalia kugleri* Zone, lower Lower Miocene (or upper Upper Oligocene of Bolli's zonal scale, 1957). They are represented by *Globorotalia kugleri, G. brevispira, G. opima nana, Globigerina bradyi, G. juvenilis, G. angustiumbilicata, G. pseudoedita, G. woodi, Cassigerinella chipolensis* and very rare *Globigerinoides trilobus primordius.*		

Figure 35. *Summary of biostratigraphy in Hole 57.1 center bit between Core 1 and Core 2.*

LEG 6 HOLE 57.2

CORE 1 DEPTH 34.7-43.9 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
All assemblages of planktonic Foraminifera (except one from the top sample) are typical for the lower part of Pliocene - *Globorotalia tumida tumida, G. acostaensis humerosa, G. acostaensis pseudopima, G. cultrata, G. multicamerata, Sphaeroidinella dehiscens, Globigerinoides conglobatus, G. sacculifera, G. ruber Pulleniatina obliquiloculata, Globoquadrina altispira, G. conglomerata.* The top sample contains numerous *Globigerinoides fistulosus* together with *Globorotalia crassaformis, G. hirsuta* and rare *G. tosaensis; Globoquadrina altispira* lacks. Evidently it is the upper part of Pliocene.	The transition from upper to lower Pliocene assemblages occurs in this core. In the upper half of the core assemblages of the lower *Discoaster brouweri* Zone are present, whereas the assemblages of the lower half of the core are assigned to the lower Pliocene *Reticulofenestra pseudoumbilica* Zone. Aside from the extinction of *Reticulofenestra pseudoumbilica* the assemblages of the core are similar--*Ceratolithus rugosus, Cyclococcolithina leptoporus, C. macintyrei, Discoaster brouweri, D. challengeri, D. pentaradiatus, D. surculus, Helicopontosphaera kamptneri,* and *Scyphosphaera* sp. aff. *S. apsteinii.*	None.

Figure 36. *Summary of biostratigraphy in Hole 57.2 Core 1.*

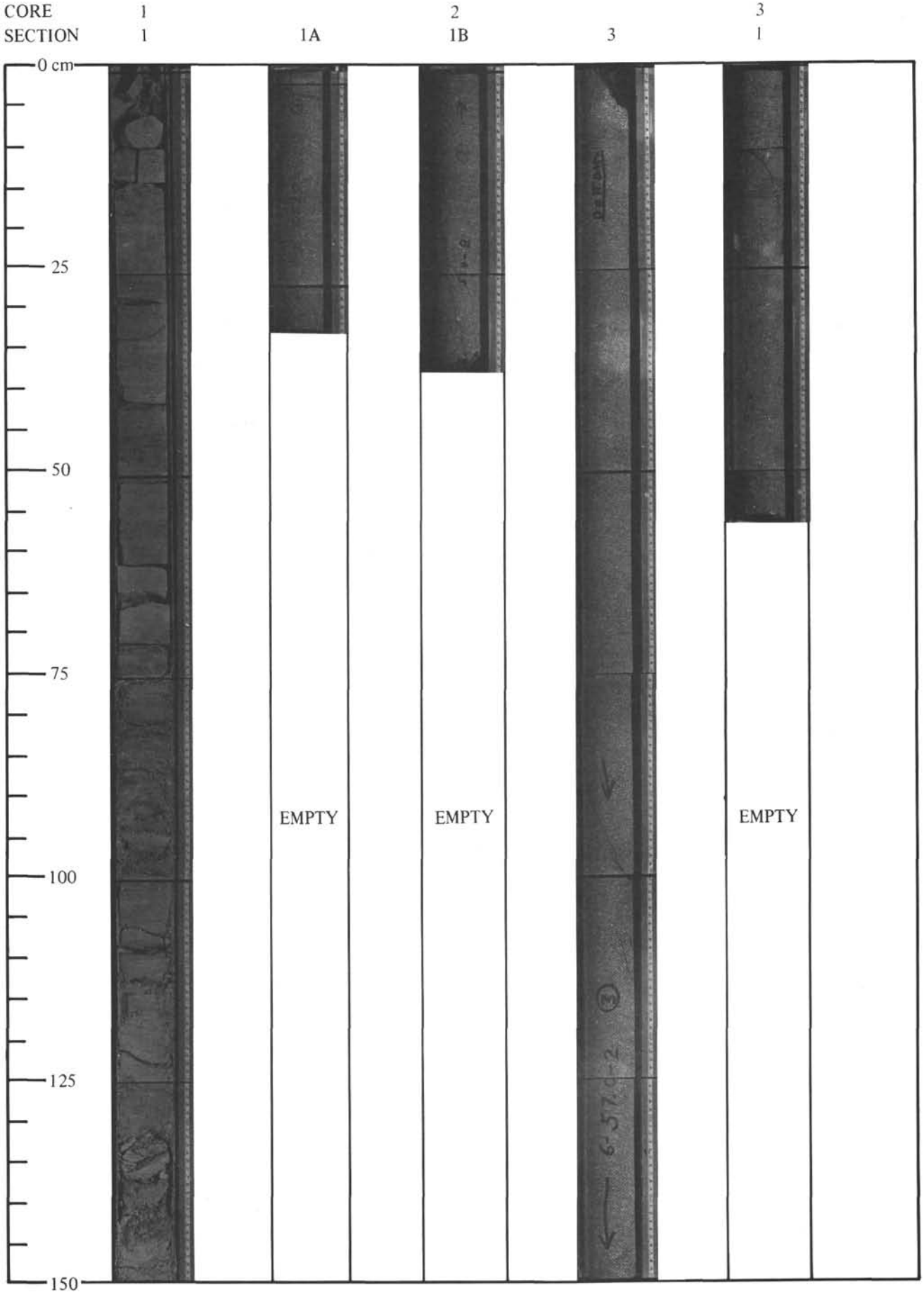

Plate 2. *Photographs of Hole 57.0 Cores 1, 2 and 3.*

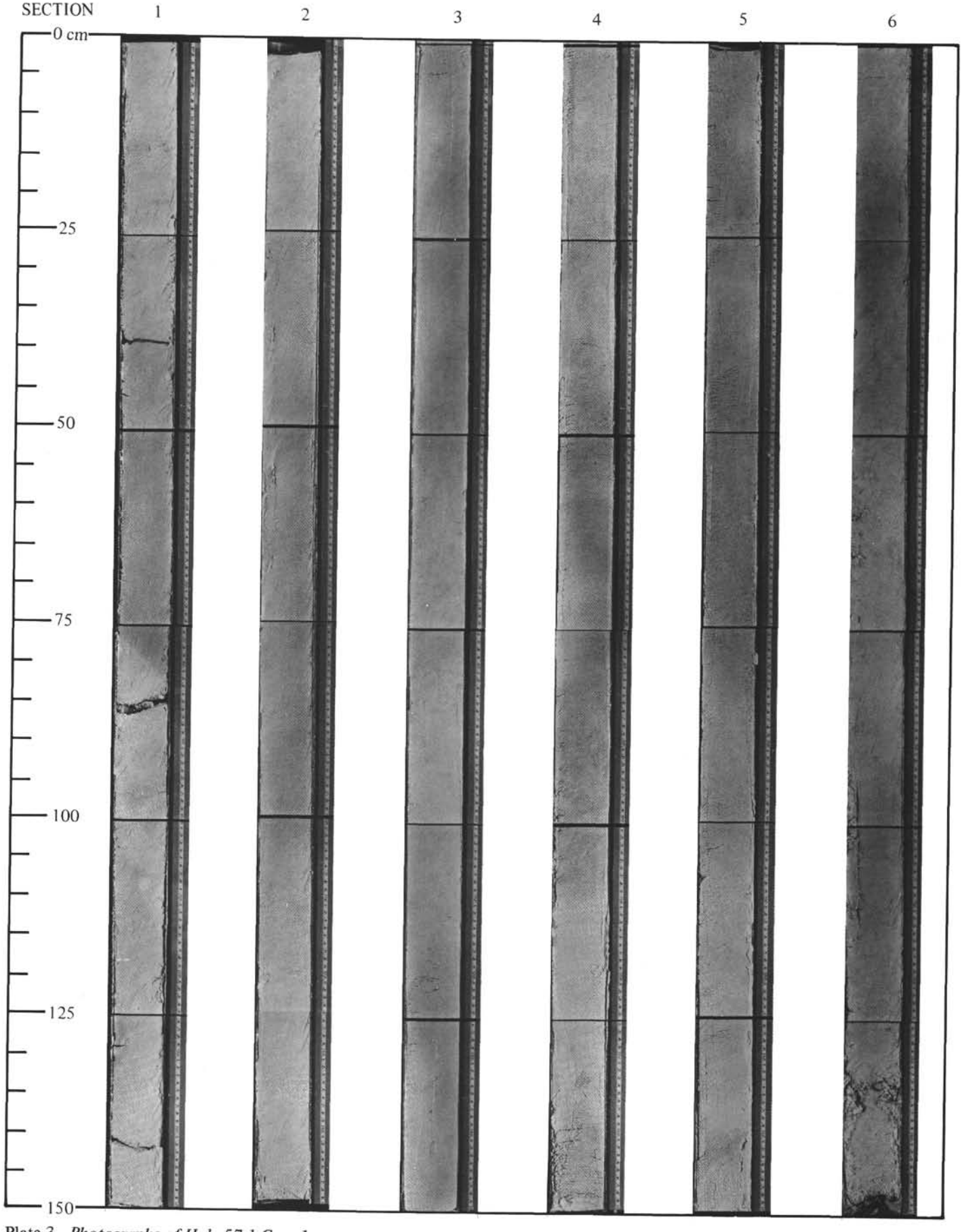

Plate 3. *Photographs of Hole 57.1 Core 1.*

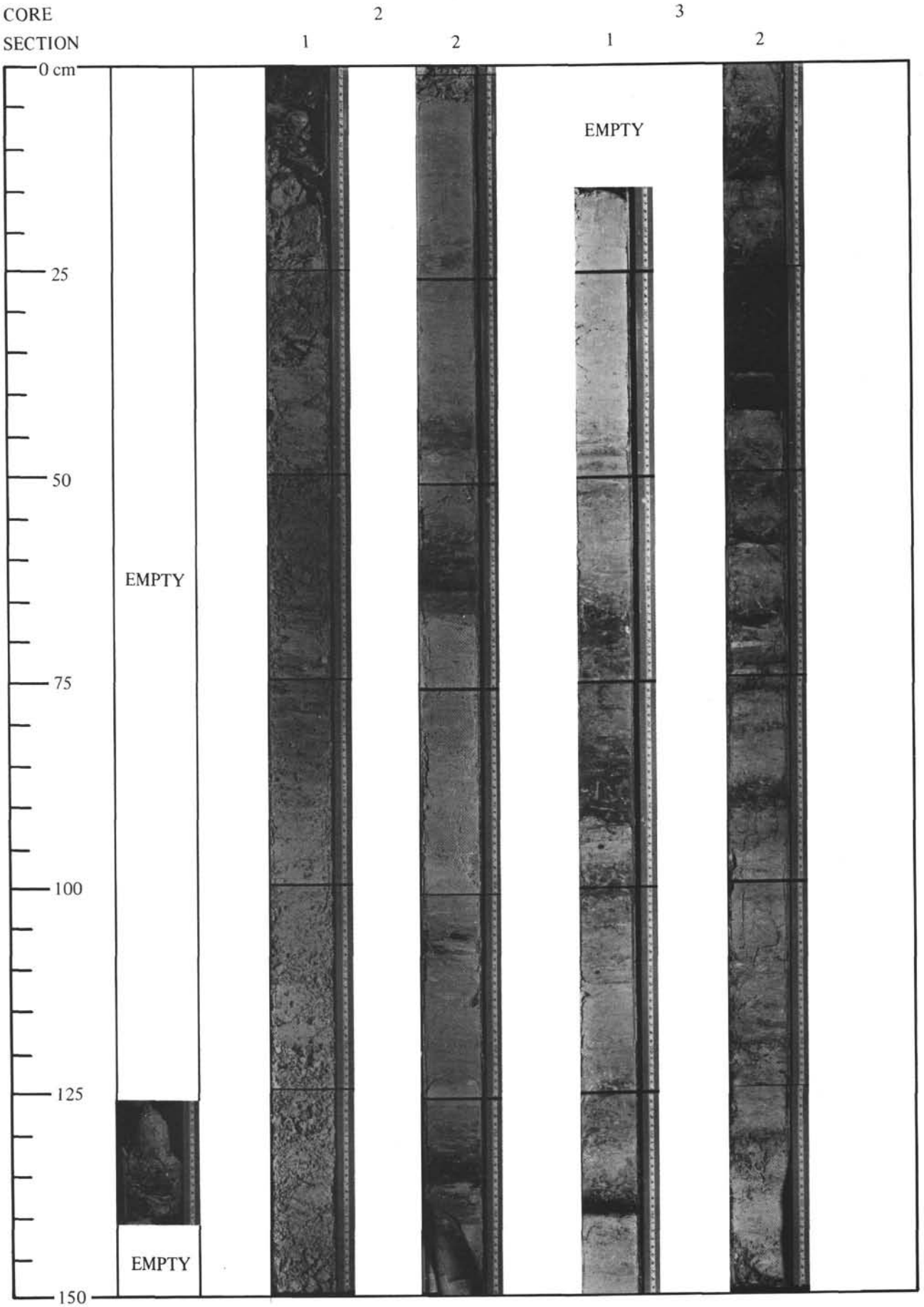

Plate 4. *Photographs of Hole 57.1 Cores 2 and 3.*

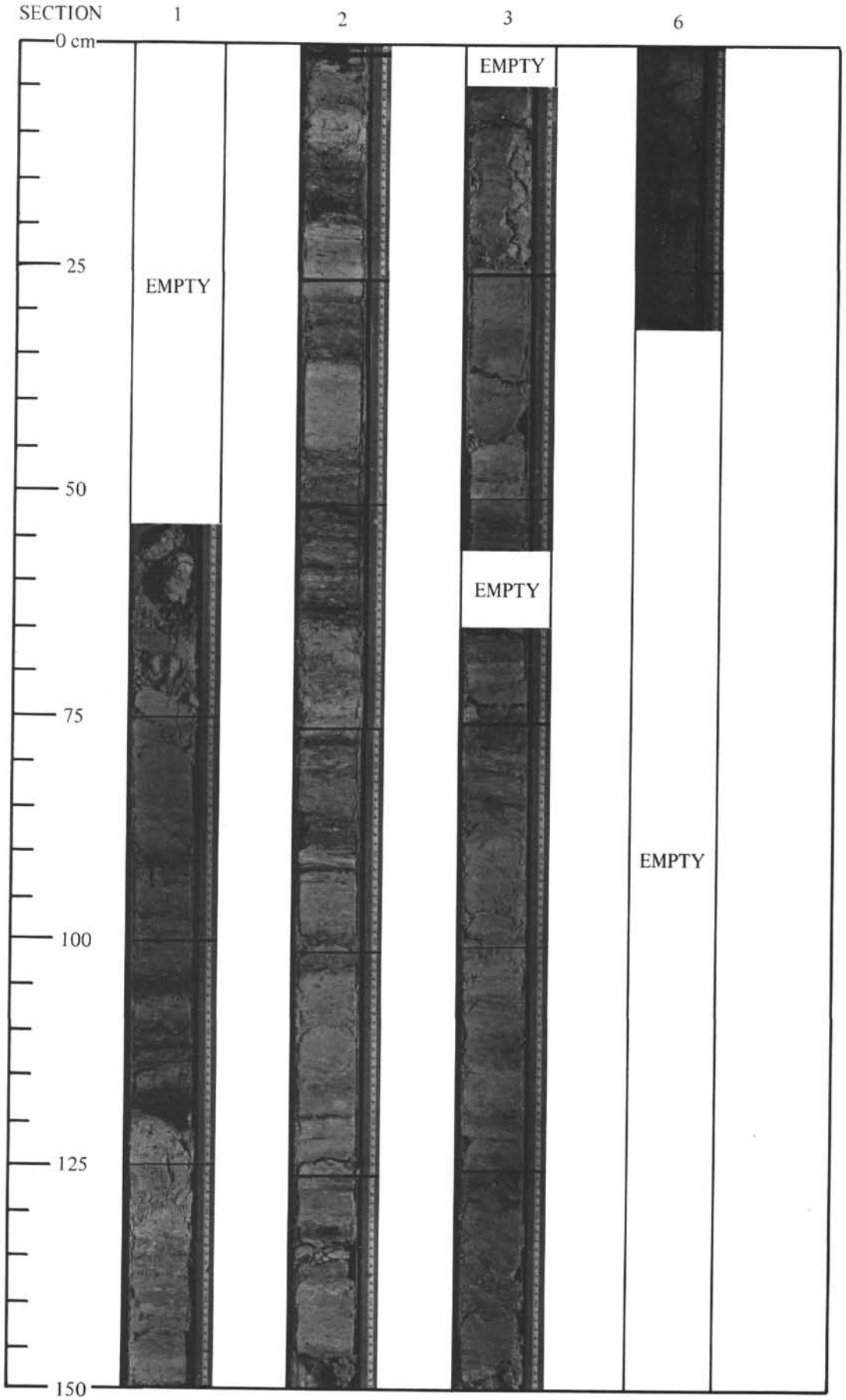

Plate 5. *Photographs of Hole 57.1 Core 4*

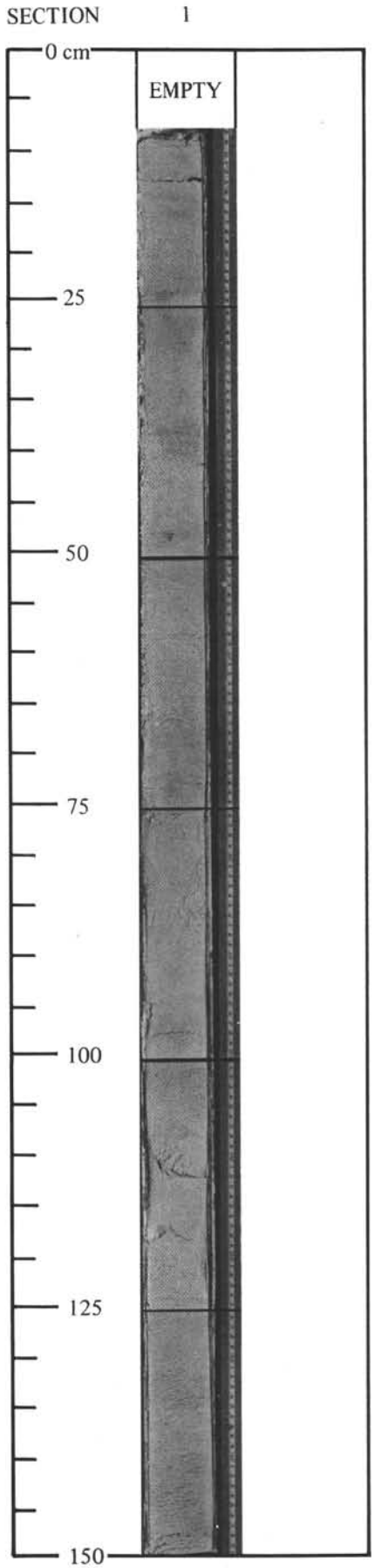

Plate 6. *Photographs of Hole 57.2 Core 1.*