2. SITE 44

The Shipboard Scientific Party[1]

SITE DATA

Occupied: June 14-15, 1969.

Position: On Horizon Ridge (Guyot):
Latitude 19° 18.5′N.
Longitude 169° 00.9′W.

Water Depth: 1478 meters.

Cores: Five cores.

Total Depth Subbottom: 76 meters in Mid-Eocene chert (bit worn out; bottom hole assembly parted on the way out of hole).

MAIN RESULTS

Penetrated two thirds of sedimentary cover-carbonate ooze with chert beds or lenses; recovered cores through Lower Oligocene, Upper Eocene, and most of Middle Eocene; established age and character of acoustic reflector as a Mid-Eocene chert.

BACKGROUND

Site 44 was chosen to contribute to the knowledge of the Mid-Pacific Mountains and thereby to the general history of the mid-Pacific area. These mountains are of volcanic material ranging in age from at least as old as Middle Cretaceous to Recent (Hamilton, 1956; Menard, 1964). Some mountains are peaked seamounts, others are flat-topped guyots. The Horizon feature, commonly called a guyot, is really neither, being a narrow ridge trending NE-SW for a distance of 170 miles with a flattish top that is 10 to 20 miles wide in the area drilled; it has sharply defined shoulders at depths of 1850 to 2050 meters (Figures 1, 2). Gentle hills along the ridge axis rise to depths of about 1400 meters in the region of Site 44. Bottom soundings in area of Site 44 are given in Figure 4. Dredging near the southwestern end yielded Eocene limestones, partly silicified and phosphatized, and recovered olivine basalt from depths of about 1800 meters (Hamilton, 1956). A dredge haul by Newman (personal communication) recovered Eocene limestone and chert from the northern shoulder.

A site survey by the *Argo* is discussed in Chapter 19. It showed the presence of a sedimentary cap, thickest under the hills along the axis of the ridge (up to 100 meters thick). A prominent reflector lies at a maximum depth of about 60 meters and outcrops locally along the northern edge where it forms a small terrace. Evidence from dredging tentatively suggested that this is an Eocene chert bed. The sedimentary cap is underlain by an acoustically distinct, opaque mass largely devoid of coherent reflections with seismic velocities of 3 to 3.5 km/sec; this was interpreted by Shor as either volcanics or limestone. This material seems to crop out in places along the northern edge of the ridge, and forms in such places a terrace below that of the sedimentary reflector.

The magnetic survey (Figures 2, 3) revealed a prominent pattern of anomalies, roughly parallel to the topography, with major lows corresponding to the flanks of the ridge.

Bottom photographs showed rippled sand on the crest, and a rocky bottom with patches of sand along the northern edge.

Objectives

The specific objectives, in order of importance, were (1) to sample the oldest sediments and the underlying material (presumably basalt), in order to determine the age of the mountain and the date of its initial submergence; and (2) to sample the sedimentary sequence, in order to shed some light on the history of submergence, and to provide biostratigraphic and sedimentologic data.

Only a limited amount of time was judged allowable for this second priority site.

Strategy

Two drill sites were considered: the crest of the feature or its extreme northern shoulder.

A hole in the crest would provide suitable soft sediment for spudding in, and would allow sampling of the upper part of the sedimentary section. The risk in such a hole was posed by the reflector, interpreted as Eocene chert, which might prove to be impenetrable.

[1]B. C. Heezen, Lamont-Doherty Geological Observatory; A. G. Fischer, Princeton University; R. E. Boyce, Scripps Institution of Oceanography; D. Bukry, U.S.G.S. La Jolla; R. G. Douglas, Case Western Reserve University; R. E. Garrison, University of California, Santa Cruz; S. A. Kling, Cities Service Oil Company; V. Krasheninnikov, Academy of Sciences of the U.S.S.R.; A. P. Lisitzin, Academy of Sciences of the U.S.S.R.; A. C. Pimm, Scripps Institution of Oceanography.

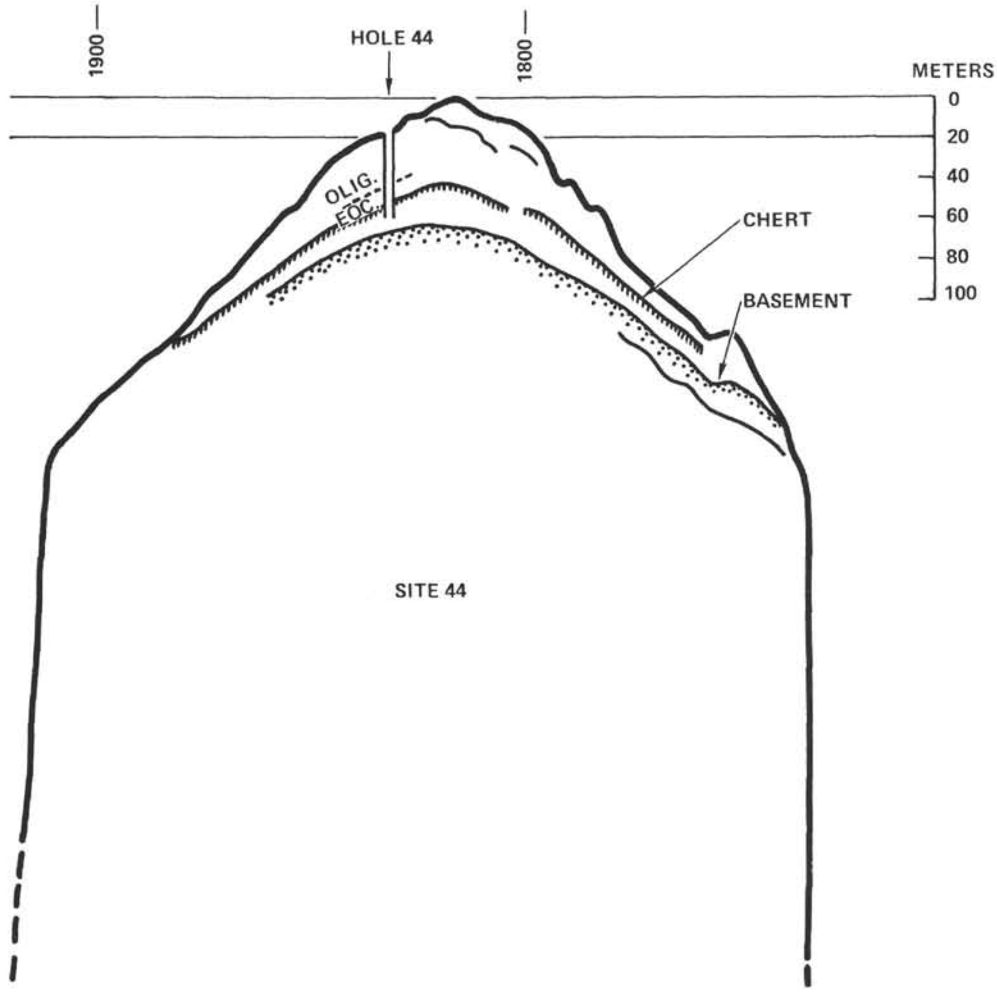

Figure 1. Argo *profile at Site 44.*

The northern shoulder appeared to offer areas not underlain by this chert, but seemingly underlain by the massive opaque material below the sedimentary cap—material which might be either Cretaceous reef limestone (by comparison with some of the guyots) or basalt (more likely, to judge from the dredging). The risk here lay in not being able to spud in. The hard rocky appearance of the bottom photographs was not encouraging.

Therefore, the first alternative—a crest location—was chosen. With only two massively set diamond bits on board, a lightly set diamond bit was run. And it was decided to make this a one-hole site barring unusual geological discoveries, even if the reflector might prove impenetrable.

OPERATIONS

Site 44 was occupied at 2245 hours June 13. The hole was drilled to 40 meters, and mainly cored beyond this to a total depth of 76 meters (Table 1). Chert encountered at 62 meters damaged the bit, and that encountered at 76 meters proved impenetrable. On starting out of the hole, the bottom assembly parted at the top of the sixth drill collar, bending the pin. Failure may have resulted either from insufficient torque in making up the string, or from stresses induced by encountering chert at such shallow depth below the sea floor. The sediment recovered was so water-saturated that the core sections were largely left unsplit.

The site was abandoned at 0100 hours on June 15.

NATURE OF THE SEDIMENTS

The 24 meters of sediment recovered at this site consist of yellowish-white nannoplankton-foraminiferal chalk ooze and small amounts of chert. At the time of recovery the sediment varied from a water-rich slurry to pasty, incoherent material; consequently, none of the

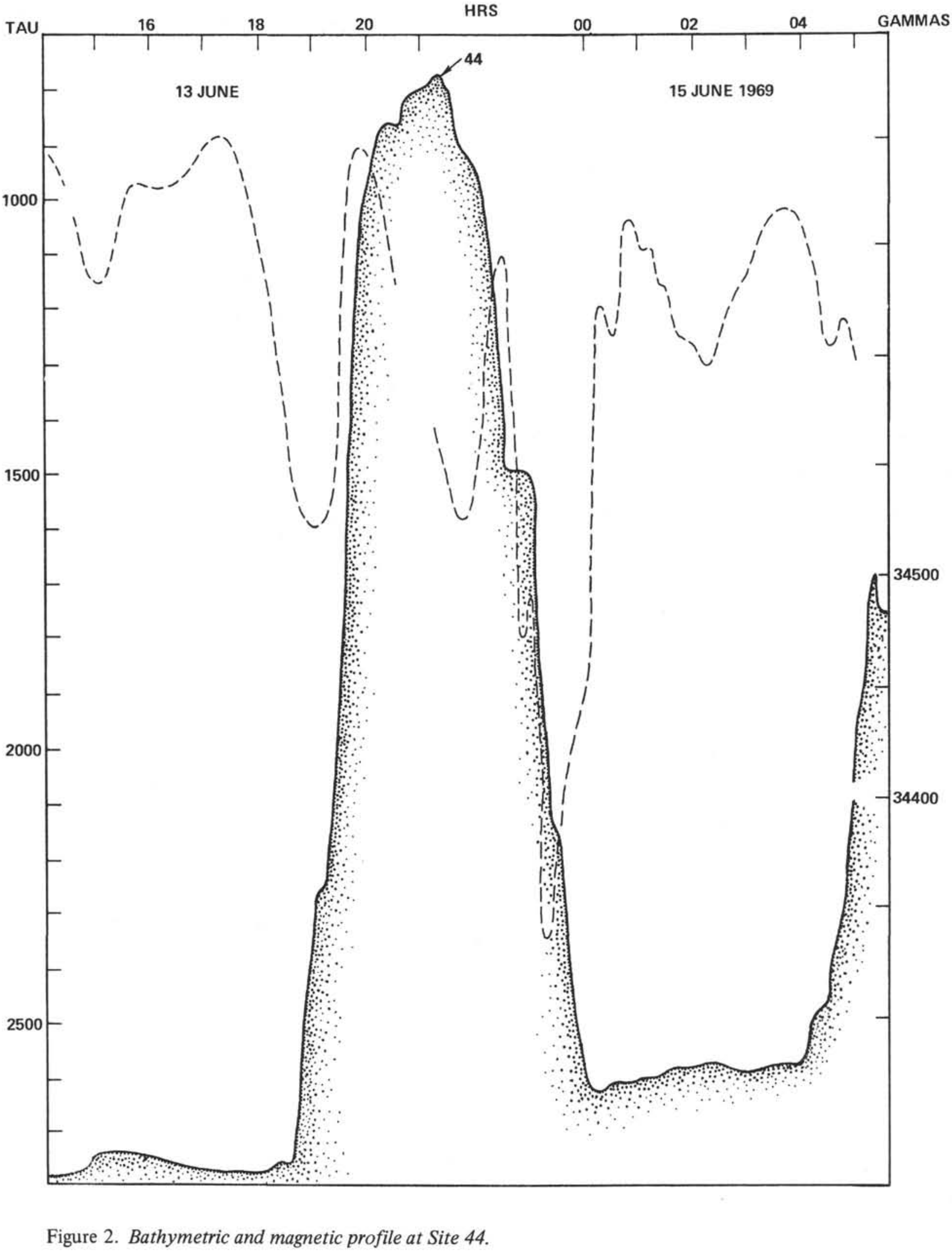

Figure 2. *Bathymetric and magnetic profile at Site 44.*

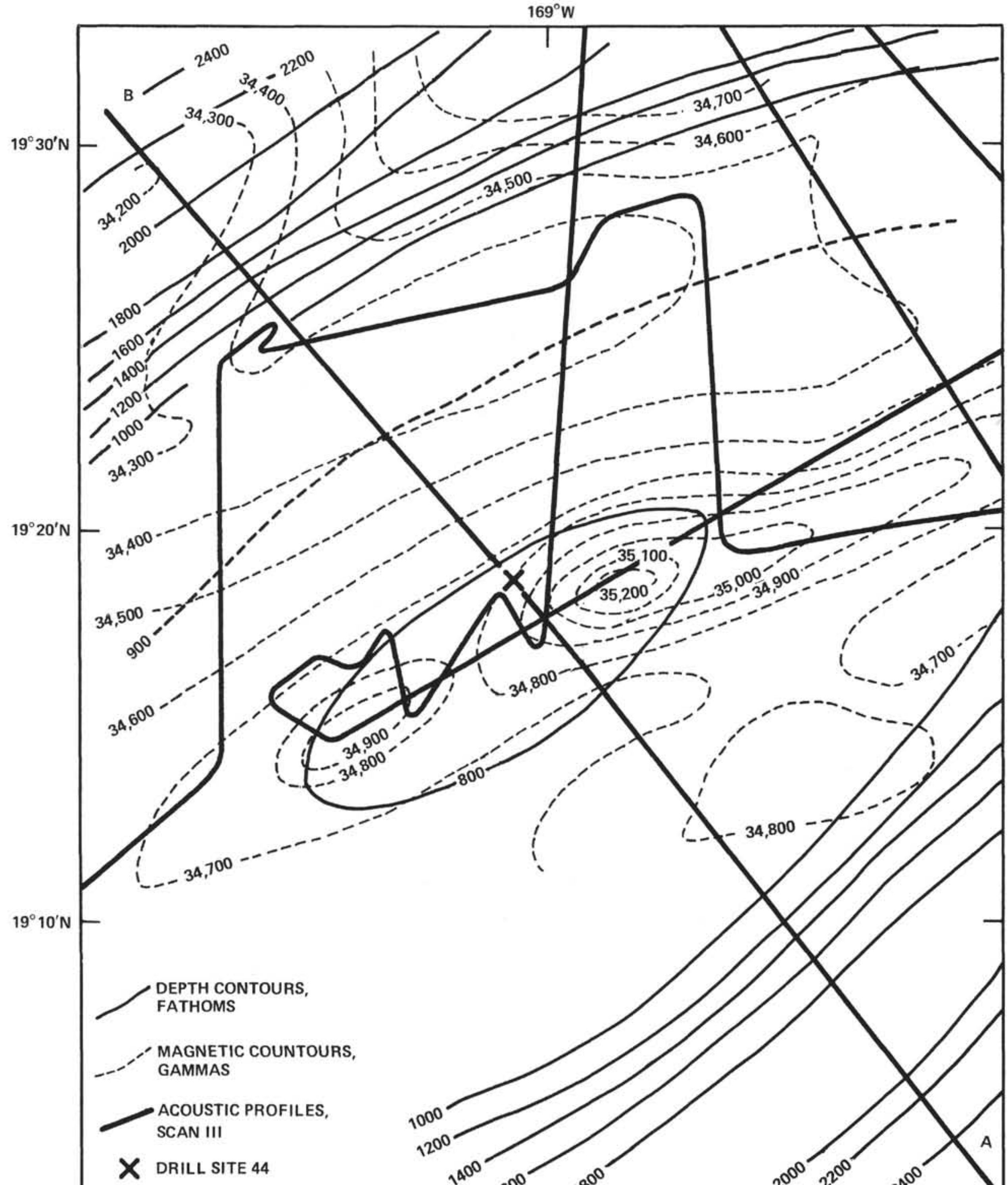

Figure 3. Challenger *bathymetric and magnetic contour map at Site 44.*

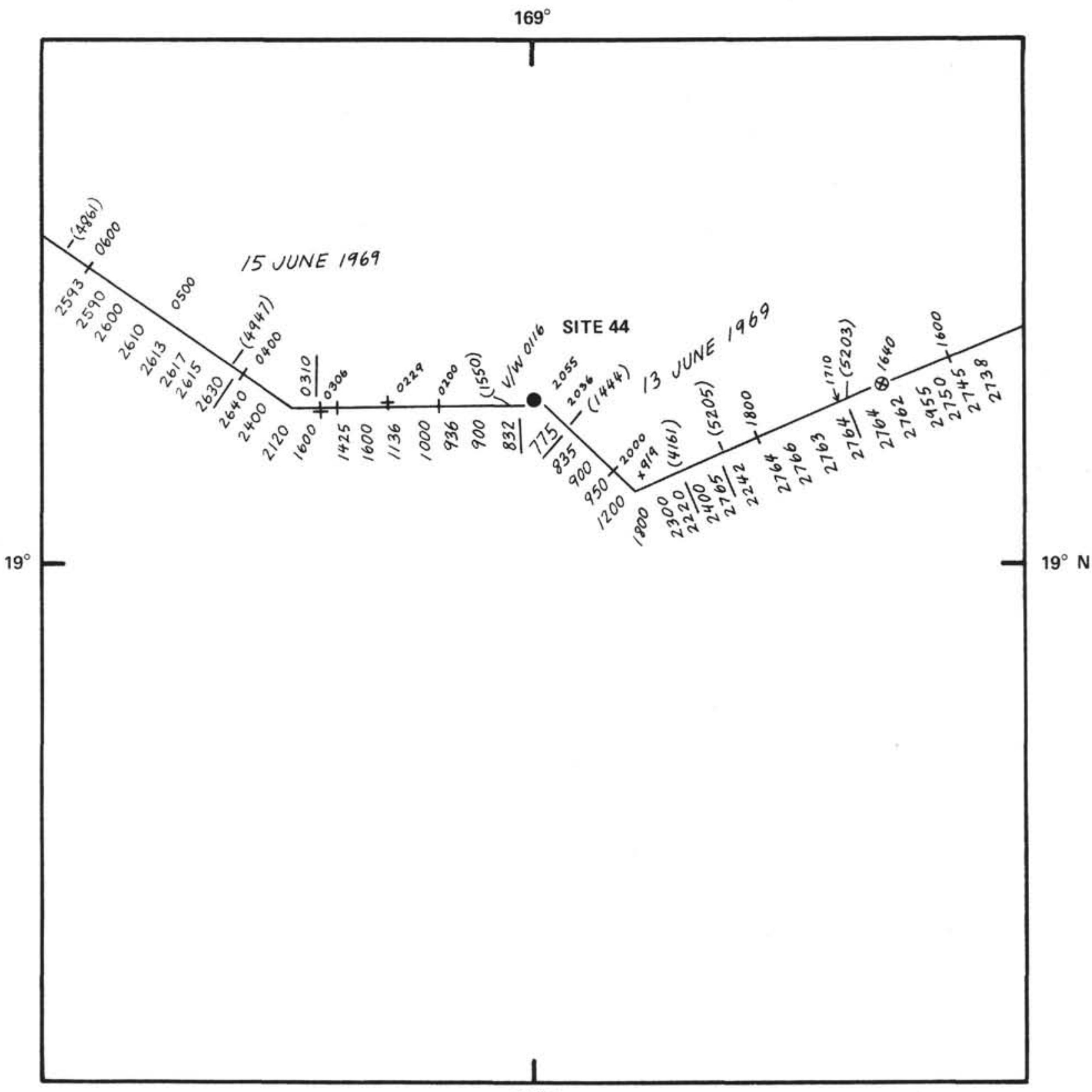

Figure 4. *Bottom soundings in area of Site 44.*

TABLE 1
Summary of Coring at Site 44

	Interval Cored (Below Mudline)		Recovery	
Core No.	(ft)	(m)	(ft)	(m)
44.0-1	131-161	39.9-49.1	17	5.2
44.0-2	161-191	49.1-58.2	30	9.1
44.0-3	191-206	58.2-62.8	15	4.6
44.0-4	217-245	66.1-74.7	28	8.5
44.0-5	245-248	74.7-75.6	3	0.9
Water depth: 1478.3 meters (4850 feet)				

core sections were split open, and the sections were sampled only at the ends.

The chalk ooze at this site is very uniform (Chapter 38). Nannofossils (coccoliths, discoasters and *Thoracosphaera*) compose 80 per cent to 90 per cent of this sediment, and foraminifera, chiefly planktonics, constitute most of the remainder. Small amounts of anhedral carbonate crystals, in the 5 to 20 micron size range, occur throughout the sediment recovered, but it is uncertain whether this material is of authigenic origin or represents broken fragments of molluscan or foraminiferal shells.

The only other lithology noted is chert which is usually brown, fine-grained and vitreous. Chert first appears as small angular fragments in Core 1 at a depth of 41 meters below mudline; this may represent penetration of a thin chert stringer or a small nodule. Below this point most samples contain small amounts of chert which could likewise represent thin stringers, or alternatively, might be cavings from uphole.

The main chert body encountered occurs at 63 meters below mudline, at the base of Core 3, where several angular fragments of brown chert were recovered in the core catcher. These fragments have thin white crusts of hard, partially silicified limestone on one side. They resemble pieces of the nodular cherts seen in the British and other chalks. Within the outer crusts are tests of foraminifera that have been replaced by microcrystalline or chalcedonic quartz, but the test outlines remain distinct and sharply bounded against the surrounding fine-grained matrix of microcrystalline quartz and calcite (Chapter 38). This crust grades into the main body of the chert which is very fine-grained, uniform microcrystalline quartz containing only scattered and very faint outlines of silicified foraminifera.

Similar chert fragments were recovered from the core catcher of Core 5, at a subbottom depth of 76 meters. These may be from another chert body, or they may represent cavings from the body at 63 meters.

The chert recovered at this site appears to be of secondary origin, formed through local replacement of chalk ooze. Noteworthy is the fact that no siliceous microfossils were noted either in the cherts themselves or in the associated chalk oozes. Possibly their total obliteration by diagenetic solution supplied the silica for the chert bodies.

PHYSICAL PROPERTIES

Methods used in the physical property determinations, the effects of coring disturbance, and a general discussion are given in the Appendix.

During drilling operations at Site 44 the sediments were disturbed and thus all physical property measurements may not represent *in situ* values.

Natural Gamma Radiation

Twenty-eight meters of Eocene-Oligocene white foraminiferal-nannoplankton chalk ooze were cored within 40 to 76 meters beneath the sediment surface from Hole 44.0. Emissions of natural gamma radiation varied from 0 to 250 counts per 7.6-centimeters (3 inches) core segment during a 1.25 minute scanning period, with an average of 100. Such a low gamma count is typical for nannoplankton chalk ooze which contains very little clay, zeolite, or other radionuclide-bearing substances. There is no significant variation in radiation with depth in this hole (see hole and core plots).

Porosity, Wet-Bulk and Water Content

Porosities of the Eocene-Oligocene white foraminiferal nannoplankton chalk ooze recovered within 40 to 76 meters in Hole 44.0 spanned from 48 to 90 per cent with a typical value of about 58 per cent. Wet-bulk densities ranged from 1.23 to 1.87 g/cc with a mode of about 1.76 g/cc. These values do not exhibit a systematic variation with depth (see hole and core plots). The maximum porosity and minimum wet-bulk density values probably represent artifically disturbed sediment. Individual samples were not taken, thus water content was not measured.

Sound Velocity

Sediment sound velocities through 23 meters of Eocene white nannoplankton ooze recovered at a depth of 49 to 75 meters from Hole 44.0 ranged from 1.46 to 1.61 km/sec with a norm of 1.57 km/sec. No systematic variation with depth is apparent and the statistical population is too small to make correlations with other physical properties with a high degree of confidence.

However, core averages of sound velocity and wet-bulk density have an apparent indirect variation (see hole and core plots). See porosity section for a discussion of this relationship.

Penetrometer

As the cores were too soft to split, no penetrometer measurements were made.

Thermal Conductivity

Heat conductivity values in the Eocene white foraminiferal-nannoplankton ooze from 50 to 75 meters at Hole 44.0 were 3.62 and 3.61×10^{-3} cal-$^{\circ}C^{-1}$ cm^{-1} sec^{-1}.

CONCLUSIONS

The sediments on this mountain are, as expected, mainly foraminiferal-nannoplankton oozes. While the Neogene was penetrated without recovery of samples, a good sequence of cores was obtained through the Lower Oligocene, the Upper Eocene, and most of the Middle Eocene. The sediment is so soft and watery that it was badly disturbed inside the core barrel.

Traces of brown chert were encountered in the Oligocene and Upper Eocene, and more massive vitreous brown layers in the Middle Eocene; the latter may be confidently identified with the prominent acoustic reflecting horizon shown on the profiles, and terminated the drilling here.

No new light was shed on the sediments below this reflector, nor on the composition of the underlying, "opaque" material. It seems likely that Eocene sediments here rest on basalt.

REFERENCES

Hamilton, E. L., 1956. Sunken islands of the mid-Pacific mountains. *Geol. Soc. Amer. Mem.* **64**, 97 p.

Menard, H. W., 1964. *Marine geology of the Pacific.* New York (McGraw-Hill).

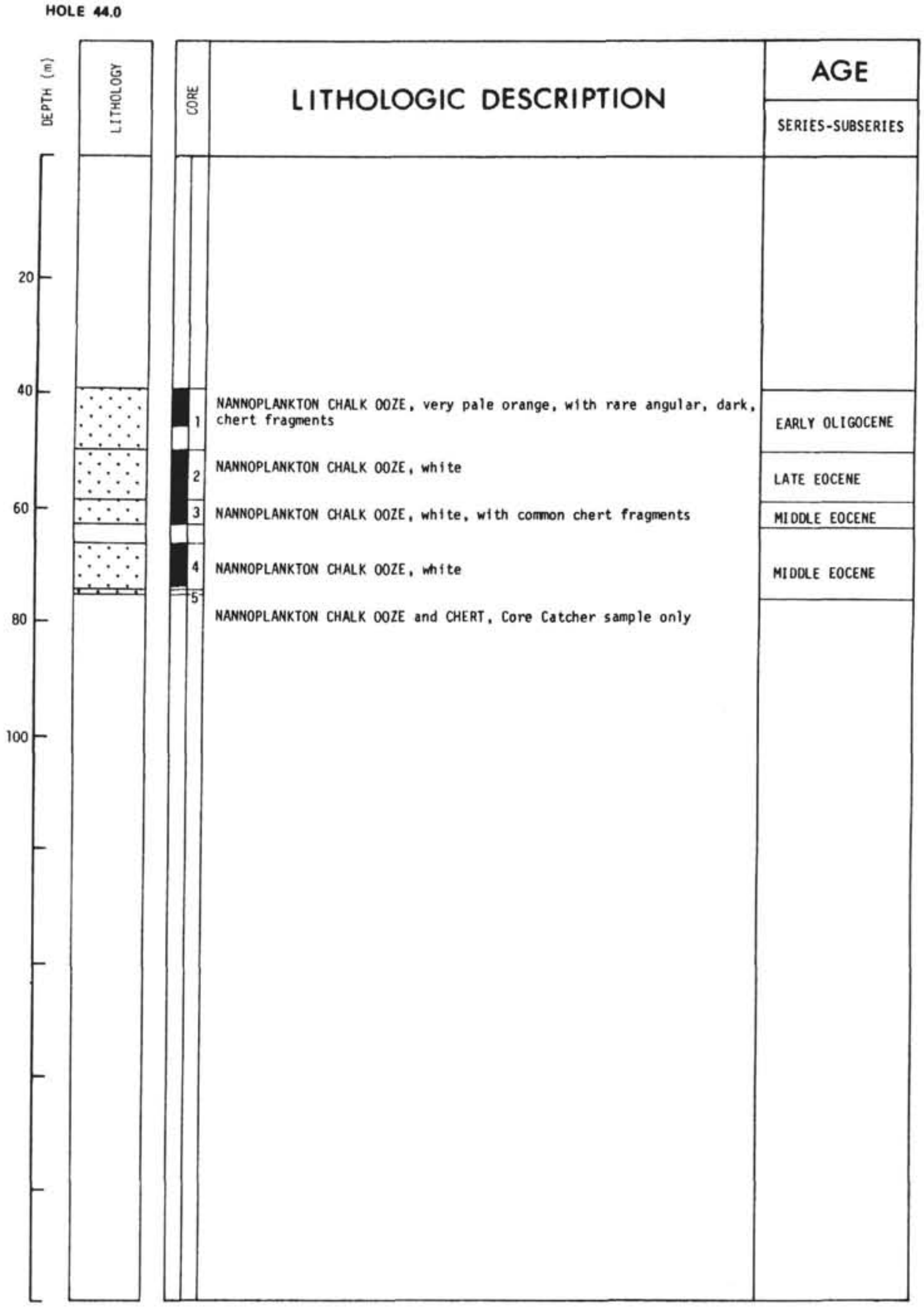

Figure 5. *Summary of lithology in Hole 44.0.*

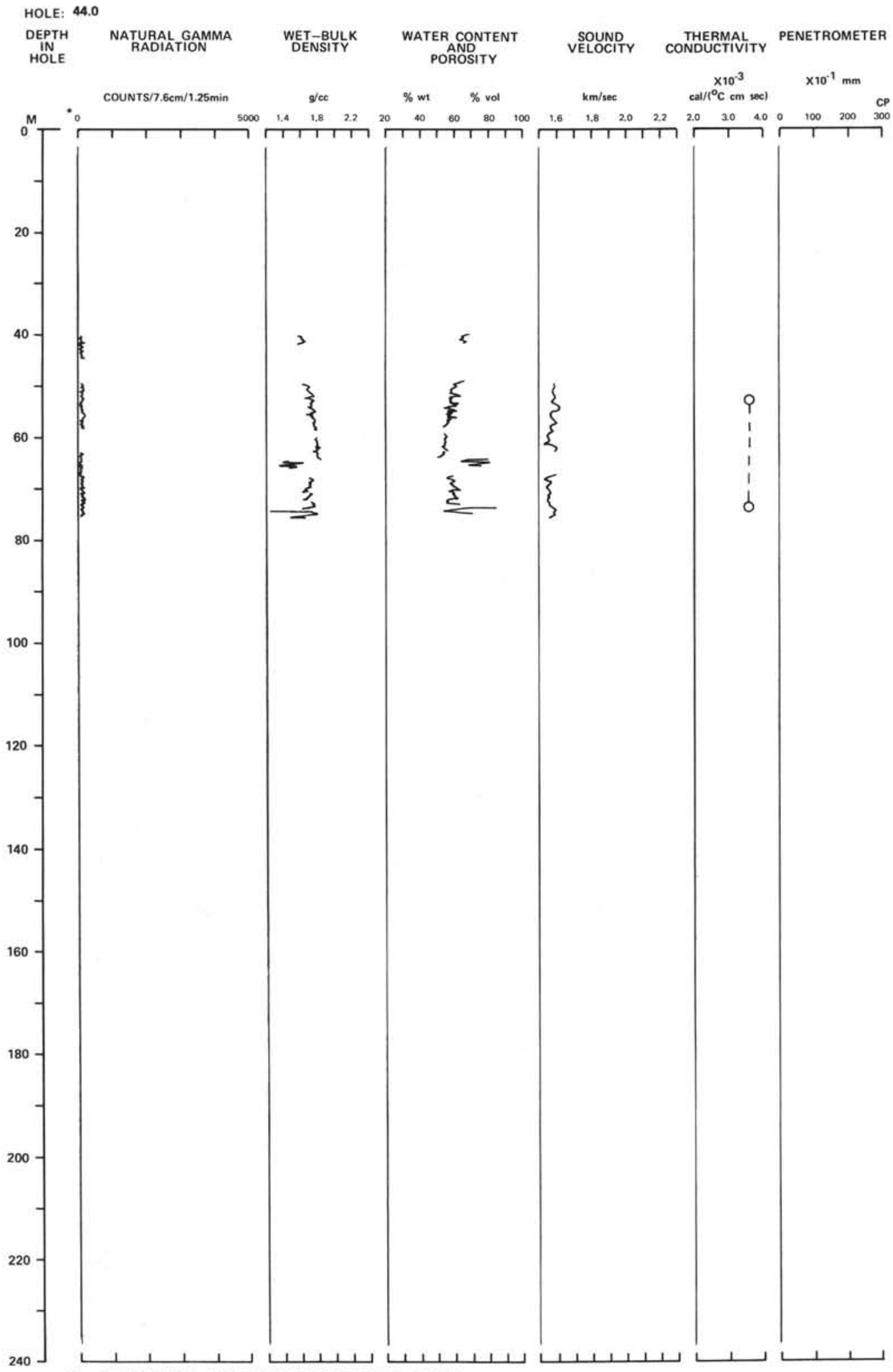

Figure 6. *Summary of physical properties in Hole 44.0.*

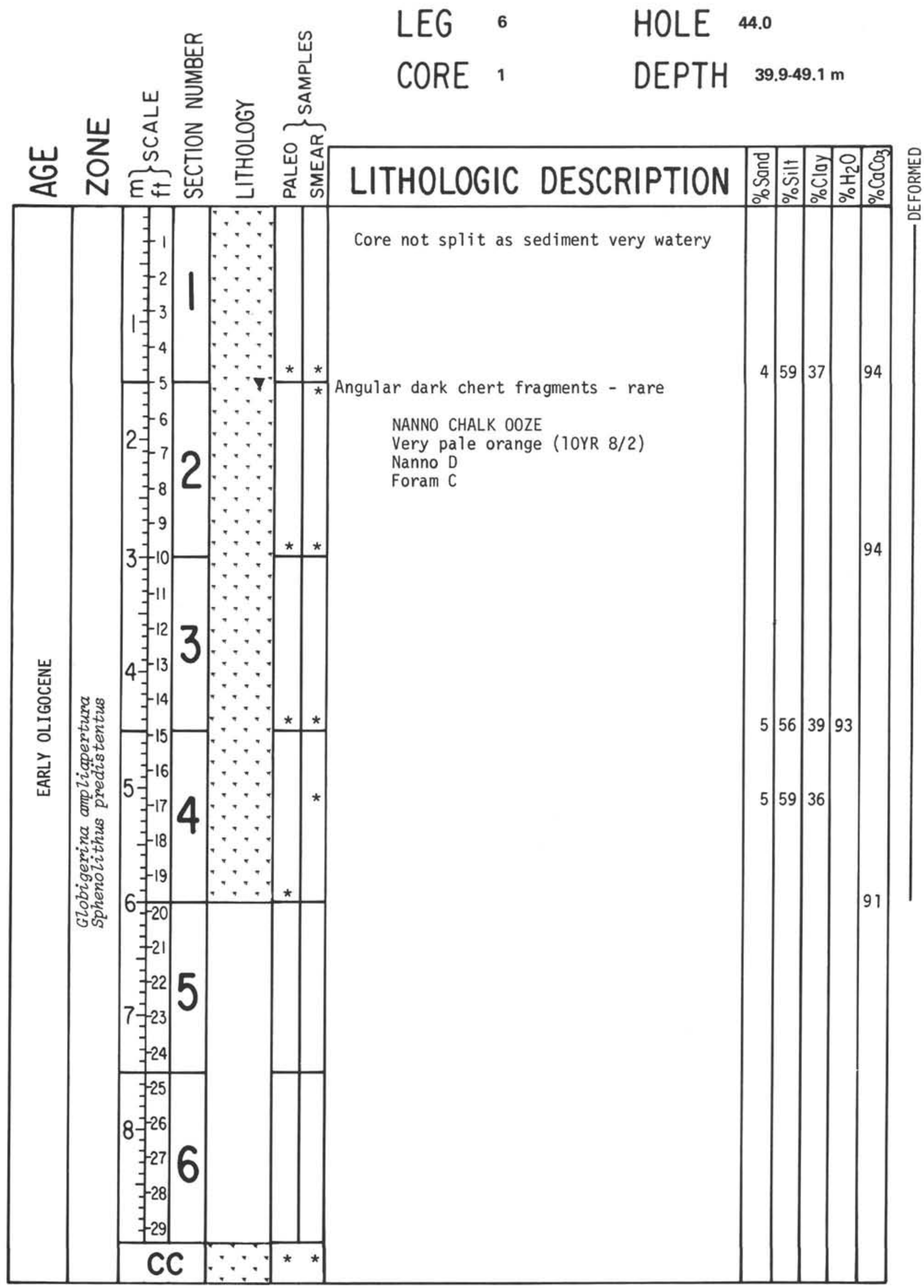

Figure 7. *Summary of lithology in Hole 44.0 Core 1.*

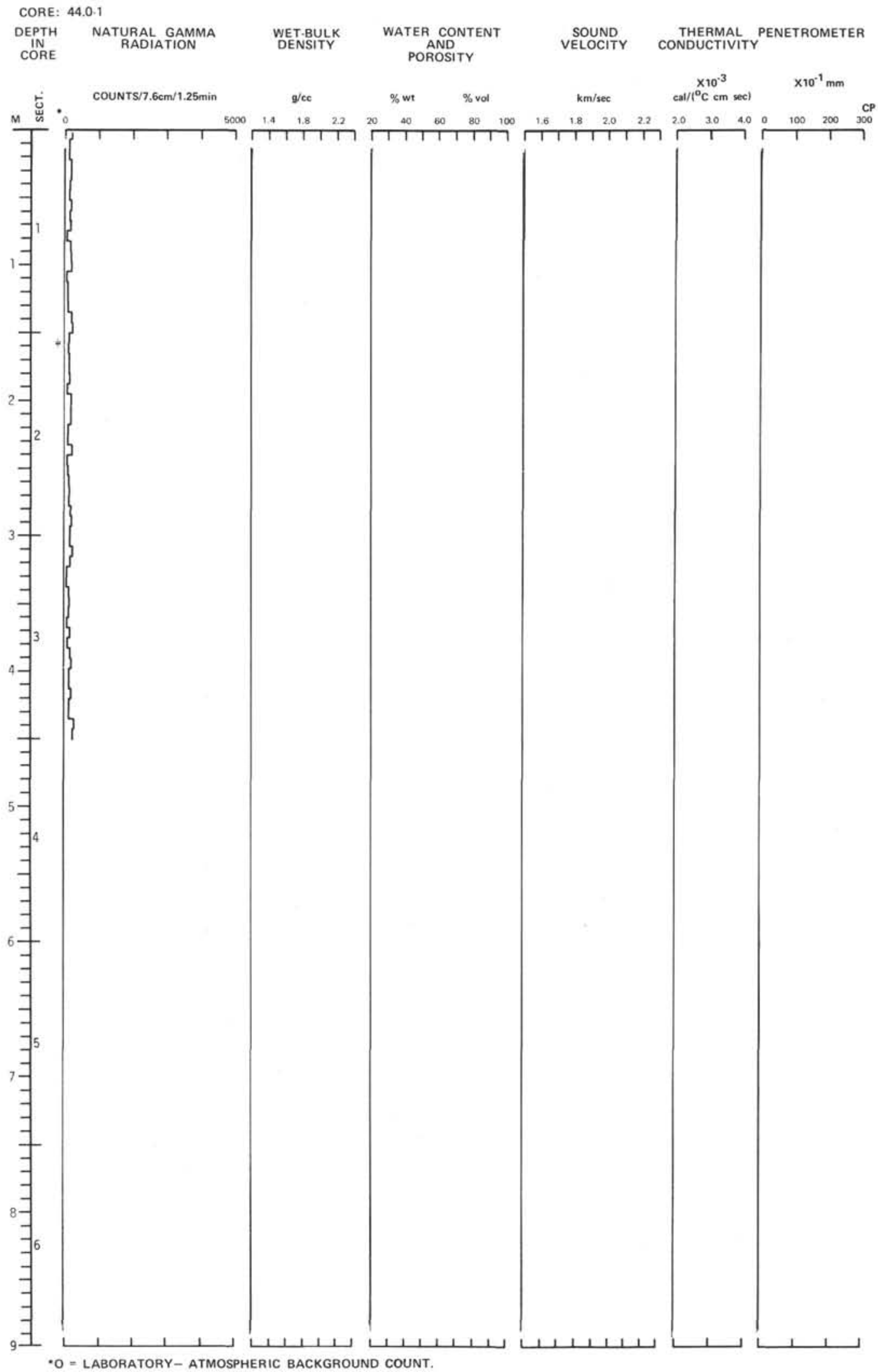

Figure 8. *Summary of physical properties in Hole 44.0 Core 1.*

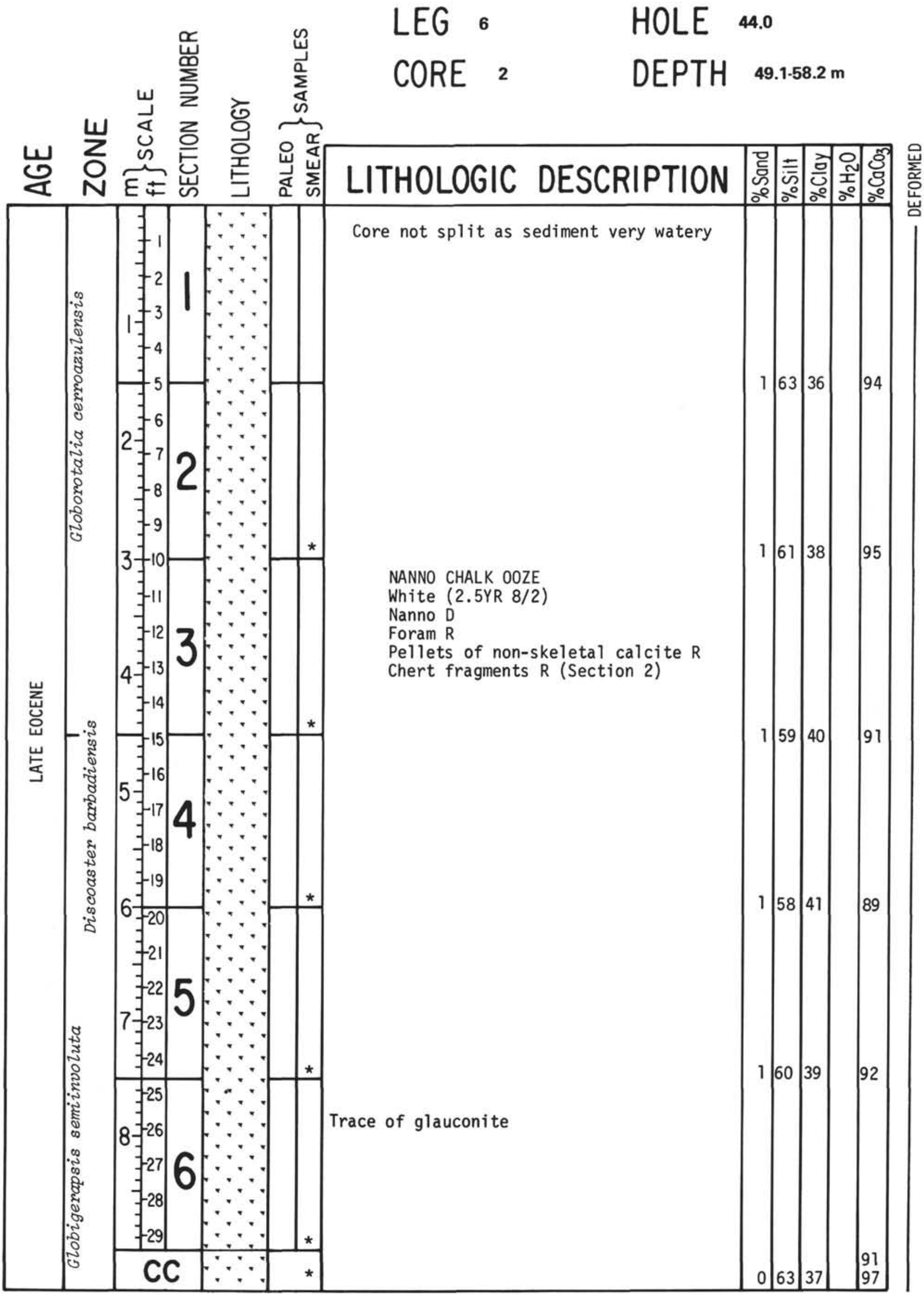

Figure 9. *Summary of lithology in Hole 44.0 Core 2.*

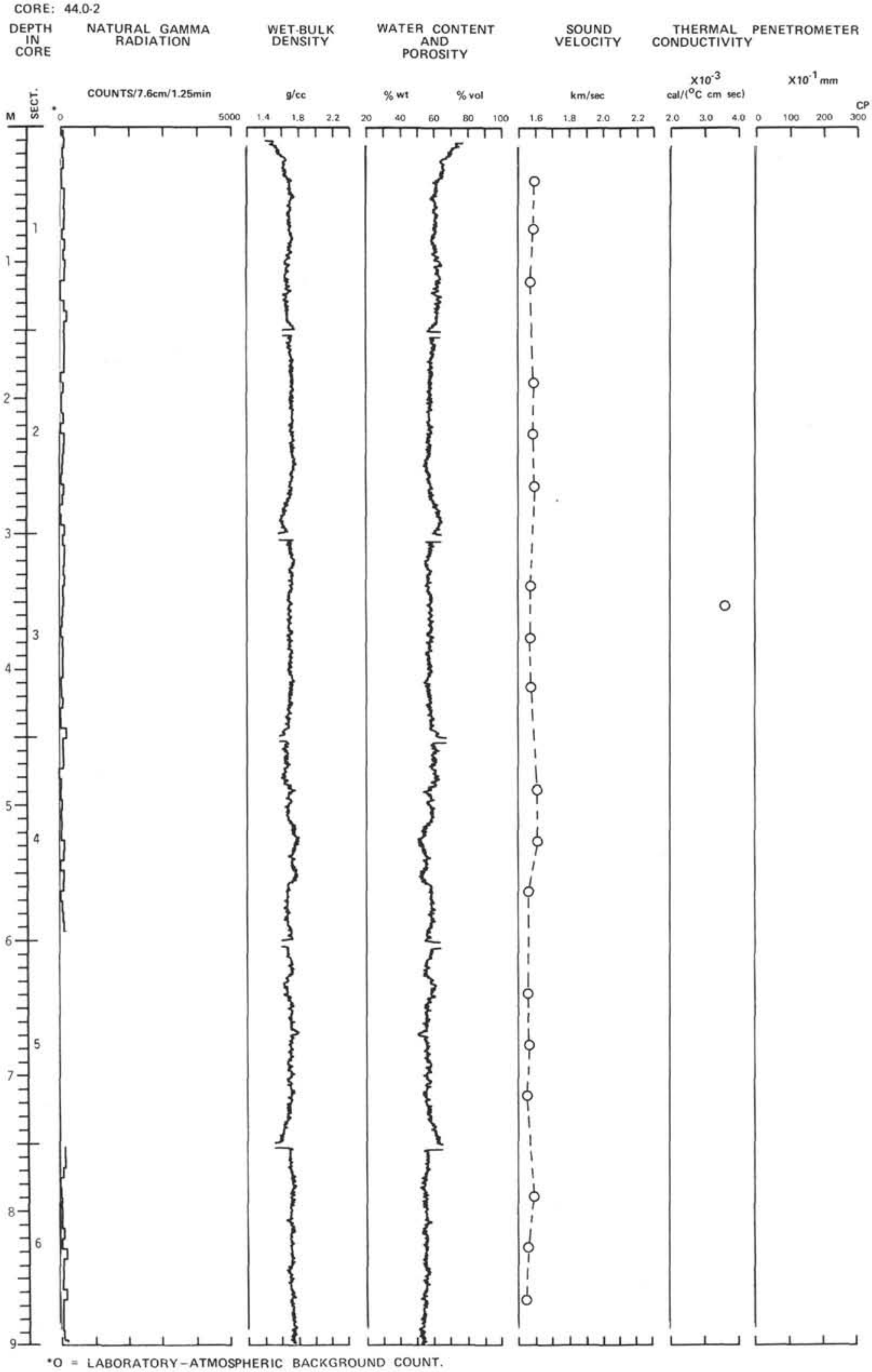

Figure 10. *Summary of physical properties in Hole 44.0 Core 2.*

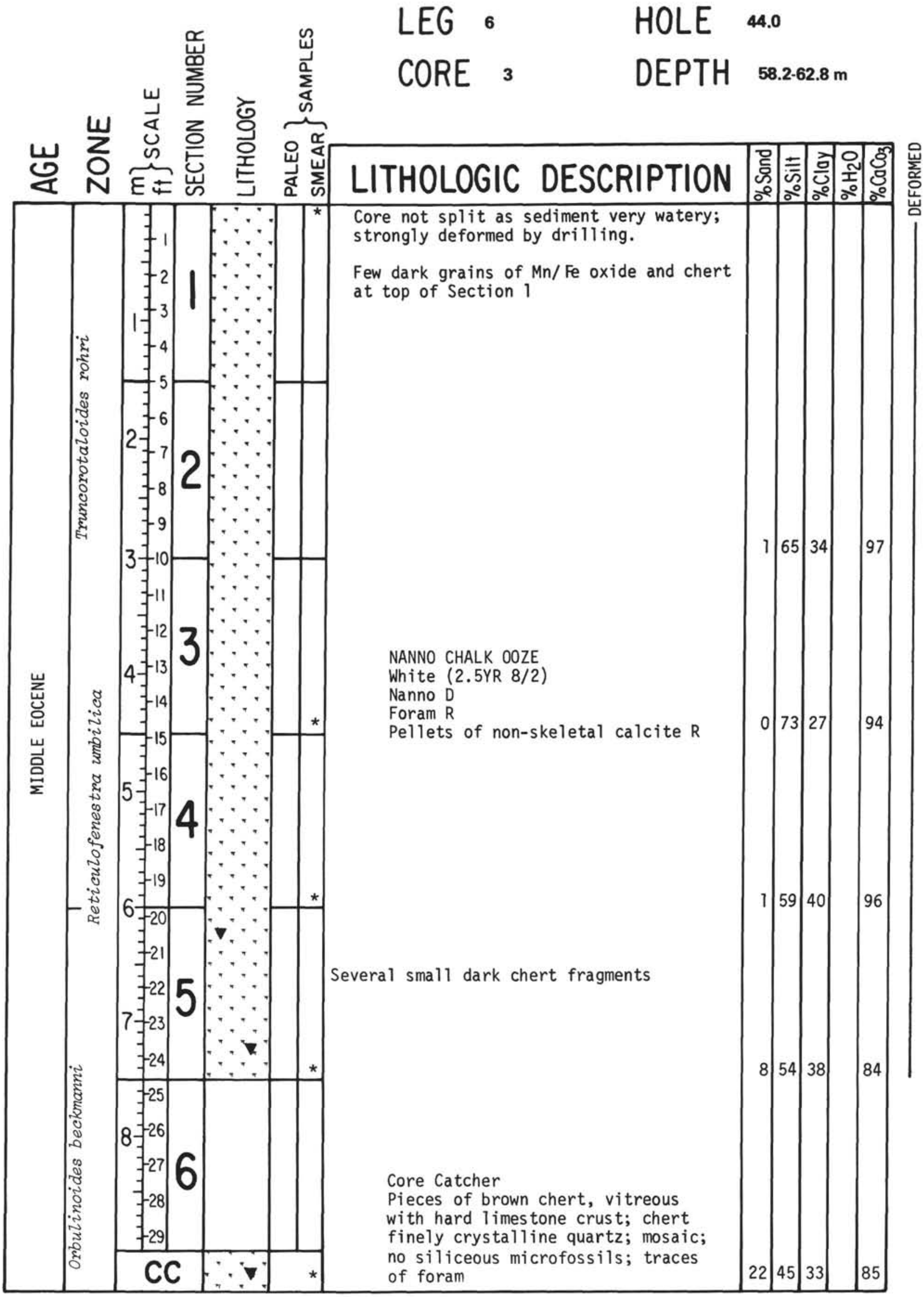

Figure 11. *Summary of lithology Hole 44.0 Core 3.*

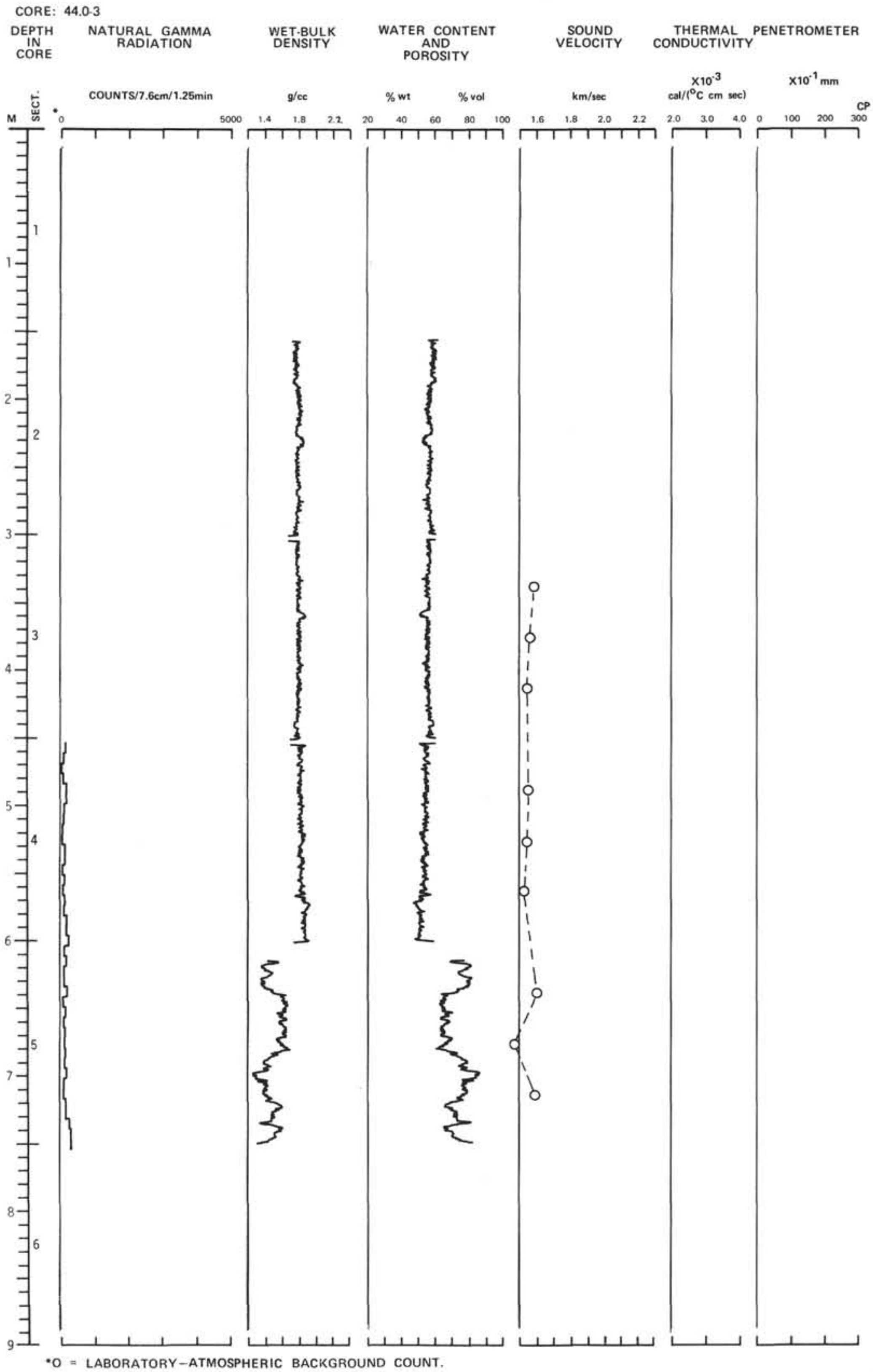

Figure 12. *Summary of physical properties in Hole 44.0 Core 3.*

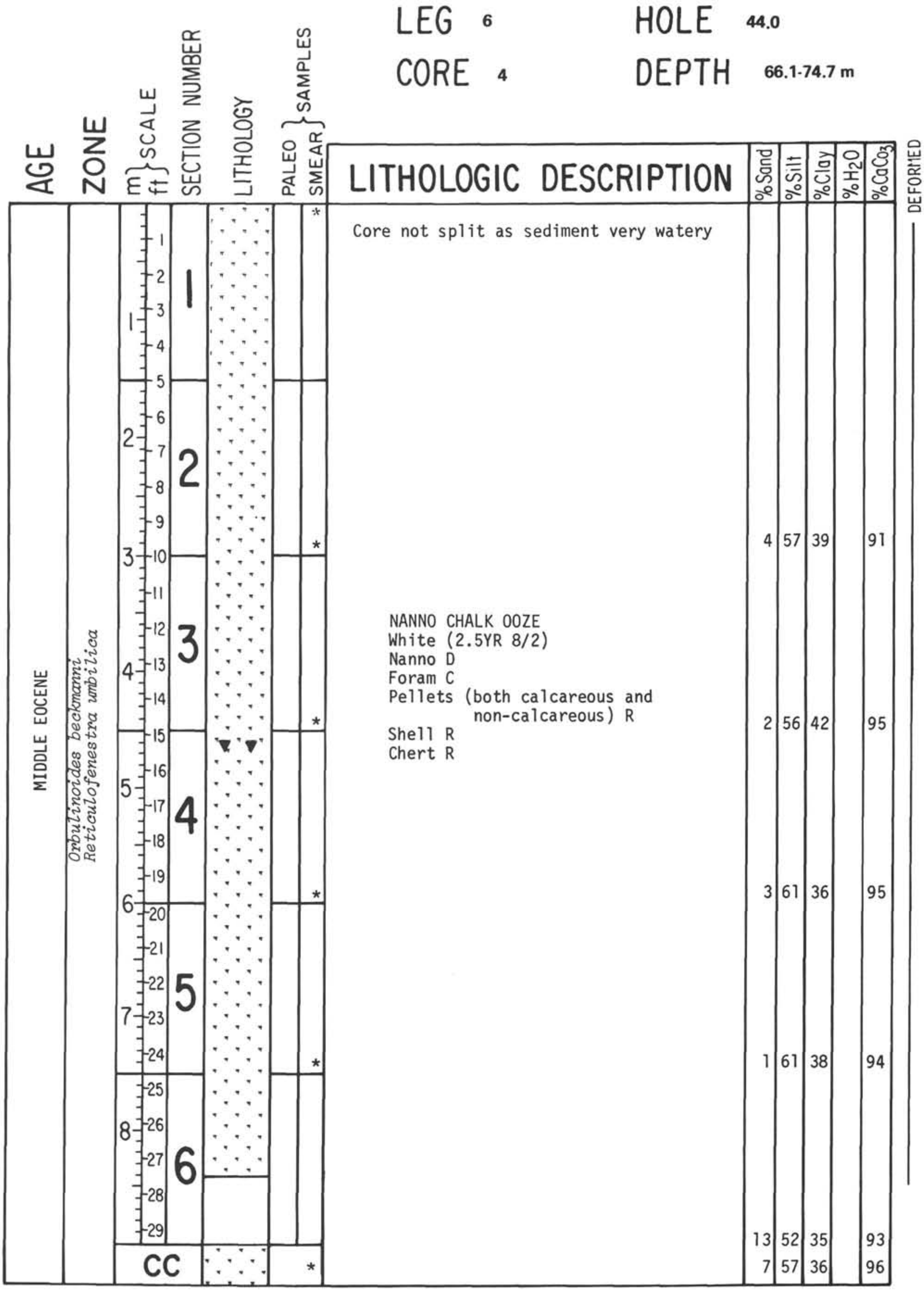

Figure 13. *Summary of lithology in Hole 44.0 Core 4.*

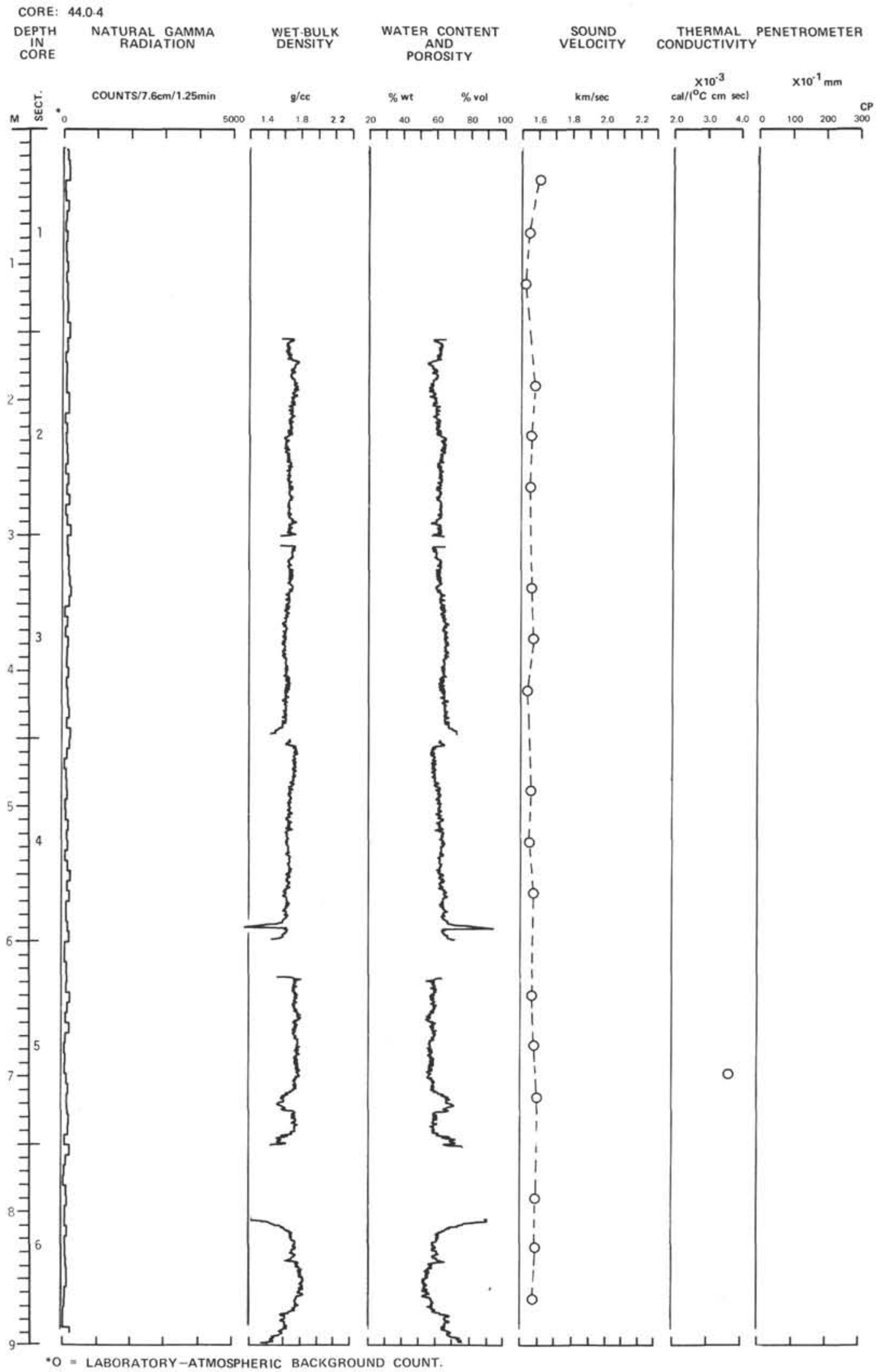

Figure 14. *Summary of physical properties in Hole 44.0 Core 4.*

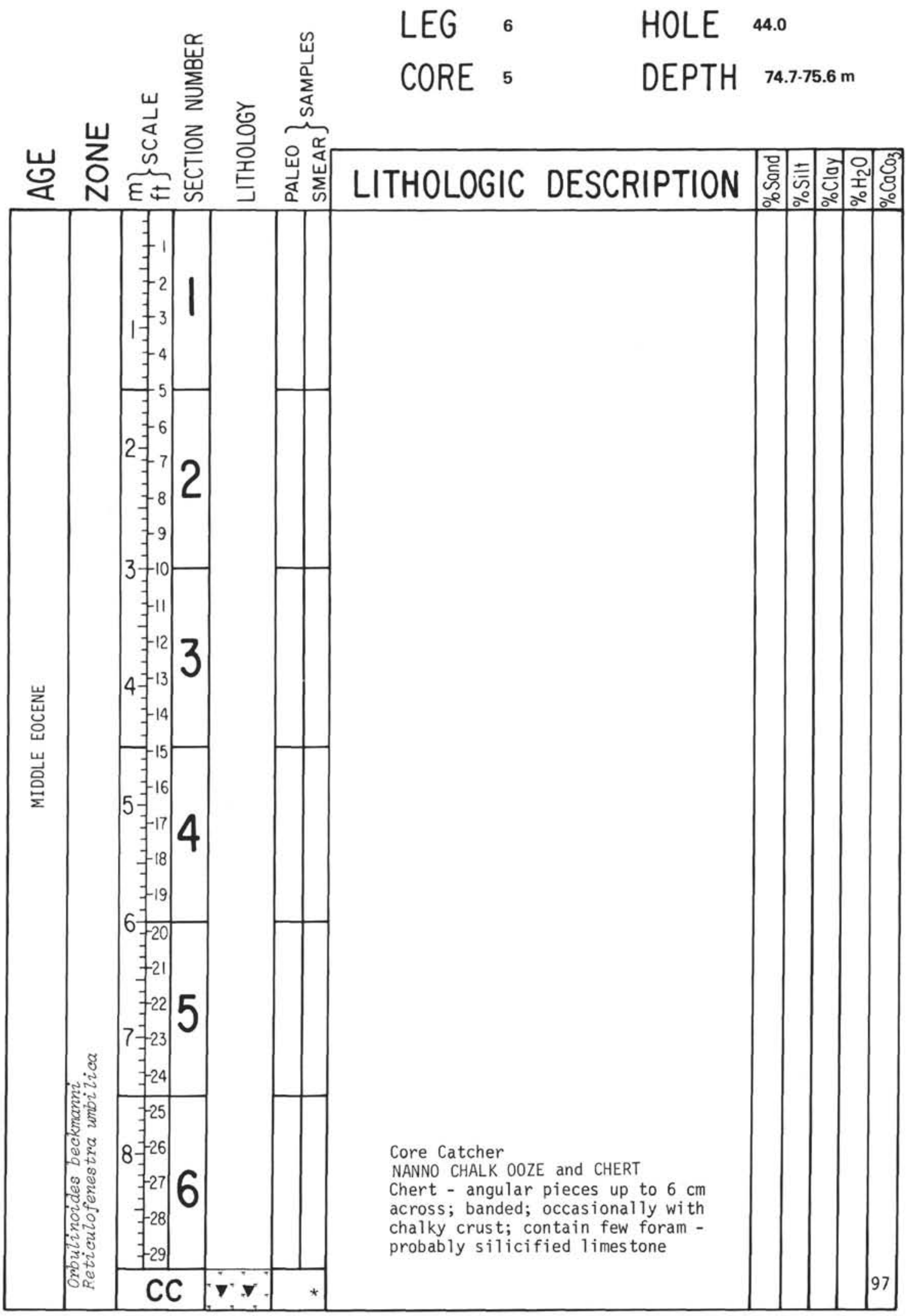

Figure 15. *Summary of lithology in Hole 44.0 Core 5.*

LEG 6 HOLE 44.0

CORE 1 DEPTH 39.9-49.1 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Assemblages of foraminifers throughout the core are rather similar and belong to the *Globigerina ampliapertura* Zone (the lower part of Oligocene). They include numerous *Globigerina ampliapertura, G. sellii, G. pseudovenezuelana, G. praebulloides, G. officinalis, G. angustiumbilicata, G. tripartita, G. tapuriensis, G. ouachitaensis, Globorotalia postcretacea, Cassigerinella chipolensis, Pseudohastigerina barbadoensis, Chiloguembelina cubensis* together with rare *Globigerina ciperoensis* and *G. gortanii*.	Nannofossil assemblages throughout the core are similar and represent the lower Oligocene lower *Sphenolithus predistentus* Zone. The spines of *S. predistentus* are very long and abundant in this core and appear as long rods when broken from their base.	None.

Figure 16. *Summary of biostratigraphy in Hole 44.0 Core 1.*

LEG 6 HOLE 44.0

CORE 2 DEPTH 49.1-58.2 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Planktonic Foraminifera indicate the Upper Eocene age of sediments (the *Globigerina corpulenta* Zone). Throughout the core are developed *Globigerina corpulenta, G. pseudo-venezuelana, Globigerapsis tropicalis, Hantkenina suprasuturalis, Cribro-hantkenina inflata, Pseudohastigerina micra.* The lower part of the core (sections 6 - 4) with *Globigerapsis semi-involuta* and *G. index* belongs to the *G. semi-involuta* Subzone; the upper part (sections 3-1) with *Globorotalia cerro-azulensis, Globigerina gortanii* and rare *G. ampliapertura* and *G. officinalis* - to the *Globorotalia cerro-azulensis* Subzone.	Assemblages of the upper Eocene *Discoaster barbadiensis* Zone are present throughout the core. The surficial character of the discoasters is obscured by excess calcification. Rare specimens of middle Eocene species such as *Chiasmolithus grandis* and *Thoracosphaera prolata* occur in the lower part of the core.	None.

Figure 17. *Summary of biostratigraphy in Hole 44.0 Core 2.*

LEG 6 **HOLE** 44.0

CORE 3 **DEPTH** 58.2-62.8 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Planktonic foraminifers determine the age of sediments as the upper part of the Middle Eocene. Sections 1 - 4 belong to the *Truncorotaloides* Zone and are characterized by *T. rohri*, *Acarinina rugosoaculeata*, *Hantkenina longispina*, *Pseudohastigerina micra*, *Globigerina praebulloides*, *G. incretacea*, *G. turcmenica*, *G. azerbaidjanica*, *G. pseudovenezuelana*, *Globigerinita howei*, *Globorotalia centralis* and rare *G. spinulosa* and *G. renzi*. Sections 5 - 6 with *Globorotalia armenica*, *G. centralis*, *G. spinulosa*, *G. renzi*, *Hantkenina alabamensis*, *Truncorotaloides topilensis*, *T. rohri*, *Globigerapsis kugleri* correspond to the *Orbulinoides beckmanni* Zone.	Only upper middle Eocene assemblages of the *Reticulofenestra umbilica* Zone are present. Heavily calcified *Discoaster barbadiensis* and *D. tani nodifera* dominate the discoasters; *D. tani tani* is rare and small.	None.

Figure 18. *Summary of biostratigraphy in Hole 44.0 Core 3.*

LEG 6 HOLE 44.0

CORE 4 DEPTH 66.1-74.5 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Throughout the core chalk oozes contain abundant foraminifers of the *Orbulinoides beckmanni* Zone (upper Middle Eocene), *O. beckmanni, Hantkenina alabamensis, Glogorotalia centralis, G. armenica, G. renzi, G. spinulosa, G. golivariana, Globigerinatheca barri, Globigerapsis index, G. kugleri, Truncorotaloides topilensis, T. rohri, Globigerina pseudoecaena compacta, G. frontosa, Globigerinita echinata,* and infrequent *Globorotalia lehneri* and *Acarinina rotundimarginata* near the base of the core.	Upper middle Eocene assemblages of the *Reticulofenestra umbilica* Zone are present throughout the core. Species present include *Chiasmolithus grandis* and *Thoracosphaera prolata.*	None.

Figure 19. *Summary of biostratigraphy in Hole 44.0 Core 4.*

LEG 6 HOLE 44.0

CORE 5 DEPTH 74.7-75.6 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Core 5 comtains mixture of abundant Pliocene - Lower Pleistocene Foraminifera with rare specimens of *Orbulinoides beckmanni*, *Hantkenina alabamensis*, *Globorotalia centralis*, *Globigerapsis kugleri*, *Truncorotaloides topilensis* (the *Orbulinoides beckmanni* Zone of Middle Eocene), as a result of contamination of microfossils in the process of drilling.	Upper middle Eocene assemblages of the *Reticulofenestra umbilica* Zone are present in both top and core-catcher samples. Species present include *Bramletteius serraculoides*, *Thoracosphaera prolata*, and *Triquetrorhabdulus inversus*.	None.

Figure 20. *Summary of biostratigraphy in Hole 44.0 Core 5.*