7. SITE 49

Shipboard Scientific Party[1]

SITE DATA

Occupied: July 2-3, 1969.

Position: West flank of Shatsky Rise: latitude: 32° 24.1′N; longitude: 156° 36.0′E.

Water Depth: 4282 meters.

Hole 49.0: Two cores, total depth 20 meters in Tithonian or Neocomian cherty chalk.

Hole 49.1: Two cores, total depth 18 meters in Tithonian or Neocomian cherty chalk.

MAIN RESULTS

Beds near the base of sedimentary sequence revealed by the seismic profiles are of early Cretaceous (Neocomian) or latest Jurassic (Tithonian) age, and of pelagic facies. The crust under the Shatsky Rise is latest Jurassic or older.

BACKGROUND

At Sites 47 and 48, we had found the Upper Cretaceous chalks cherty and impenetrable. The upper part of what infer to be lower Cretaceous is even more reflective, and likely to be very cherty (and was found to be cherty in the *Vema* core). It became clear that basement could only be reached where the Upper Cretaceous and the upper part of the lower Cretaceous are absent.

Outcrops of the deeper reflectors occur in the east, south and west flanks of the Rise, but mostly lack the necessary sediment cover for drilling operations. However, west of Site 48, the *Argo* record shows an area in which the Upper Cretaceous has wedged out down dip, and the Lower Cretaceous is thinning out by loss of the strongly reflective beds at the top, and where there is some soft surficial sediment (Figure 1, see also Chapter 5, Figure 1 and Chapter 8, Figure 1). This area appeared to offer the best chance for sampling the lowermost transparent layer and the material below Horizon B′. A bathymetric and magnetic profile across Site 49 is given in Chapter 8, Figure 2. Soundings in the area of Site 49 are given in Figure 2 of this chapter.

OPERATIONS

Site 49 was established by dropping a Burnett beacon at 0330 hours, July 2, 1969. The beacon, aimed at an uncorrect profiler depth of 2310 fathoms, drifted southeastward and lodged higher on the slope at an uncorrected depth of 2275 fathoms.

Hole 49.0 was spudded at 1100 hours. The first core recovered Pleistocene brown clay, a second core recovered cherty Mesozoic chalk, to a total depth of 18 meters.

A second attempt, Hole 49.1, was spudded at 1445 hours, and two more cores were cut with similar results to a total depth of 20 meters.

The hard cherts in both holes made further penetration extremely hazardous in view of the lack of overburden and consequent lack of support for the drill collars. The site was therefore abandoned at 0100 hours, July 3.

TABLE 1

Summary of Coring at Site 49

	Interval Cored (Below Mudline)		Recovery	
Core No.	(ft)	(m)	(ft)	(m)
49.0-1	0-30	0.0-9.1	30	9.1
49.0-2	57-59	17.4-18.0	2	0.6
49.1-1	17-38	5.2-11.6	21	6.4
49.1-2	38-65	11.6-19.8	12	3.6

Water depth: 4282.4 meters (14,050 feet).

[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.

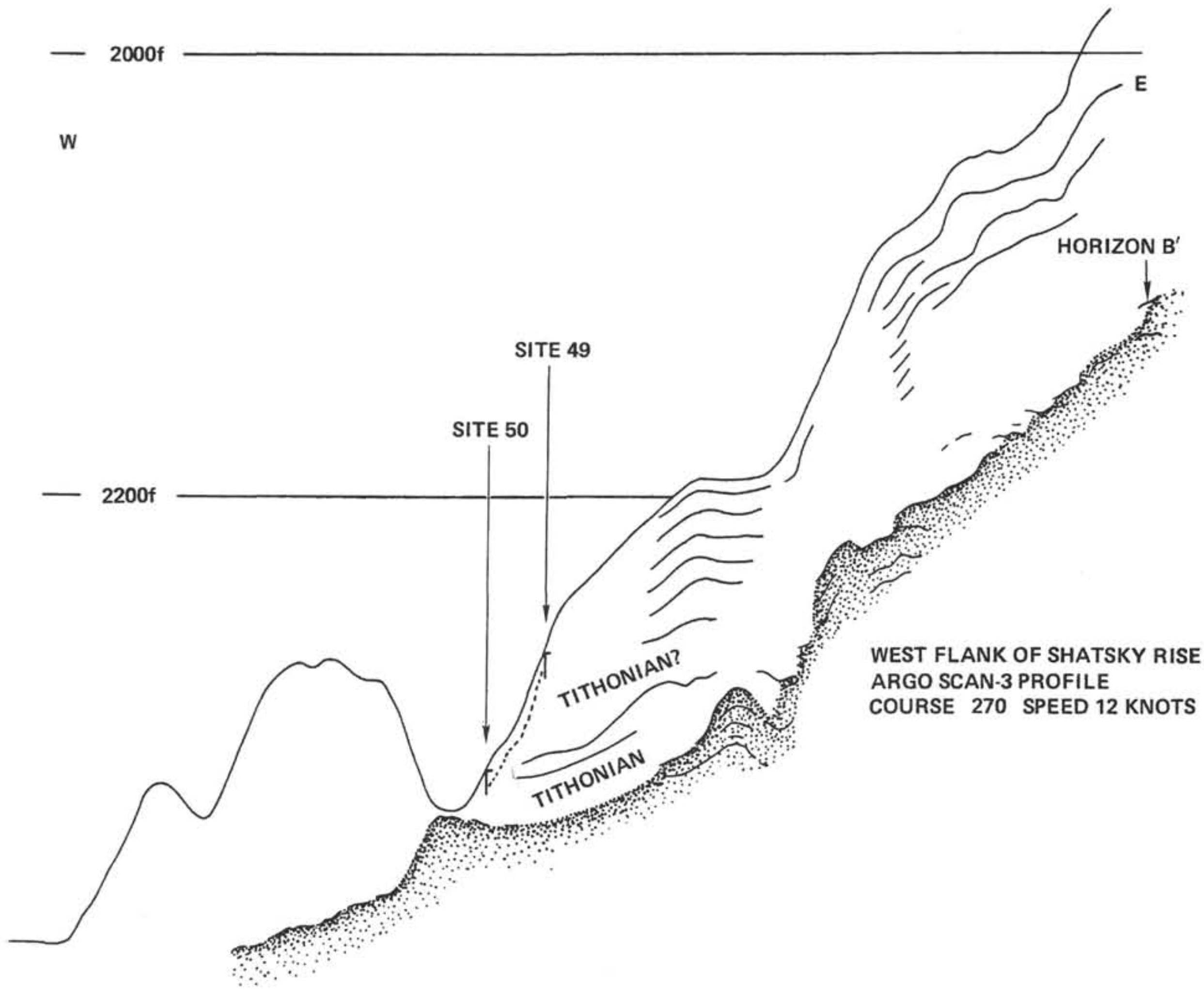

Figure 1. *Drawing of Argo profile at Sites 49 and 50*

NATURE OF THE SEDIMENTS

Hole 49.0

The first of the two cores attempted in this hole was drilled from the mudline to 10 meters and recovered 9 meters of sediment, consisting mainly of alternating yellow brown to dark brown zeolitic clay and brown clay with appreciable amounts of volcanic glass, along with minor amounts of other types of sediments described below. In detail, Core 1 consists of the following lithologies (depths listed are from the top of the core):

0 to 90 centimeters (Section 1): Interlayered brown zeolitic clay, yellow-brown diatomaceous clay with volcanic ash, pale brown nannoplankton marl ooze, and sandy brown clay with abundant volcanic glass. A small manganese-iron oxide nodule occurs near the top of this interval.

90 to 460 centimeters (Section 1 to the top of Section 4): Sandy to silty, brown to dark brown clay with abundant fragments of clear volcanic glass, common to rare unidentified shell fragments (mollusks?). Scattered through this interval are artificial, drilling-induced mottles and thin contorted layers.

460 to 510 centimeters (Section 4): Sandy, yellow-brown, poorly sorted nannoplankton-marl ooze with abundant nanofossils and fragments of volcanic glass (Chapter 38, Plate 1, Figure 4).

510 to 900 centimeters (Section 4 to 6): Mostly yellow-brown to dark brown zeolitic clay with abundant zeolites, rare to common volcanic glass, and scattered rare rhomboherdral crystals of calcite or dolomite. Between 580 and 590 centimeters there is a contorted mass of yellowish-brown nanoplankton marl ooze that has abundant nannofossils, common planktonic foraminifer, and rare

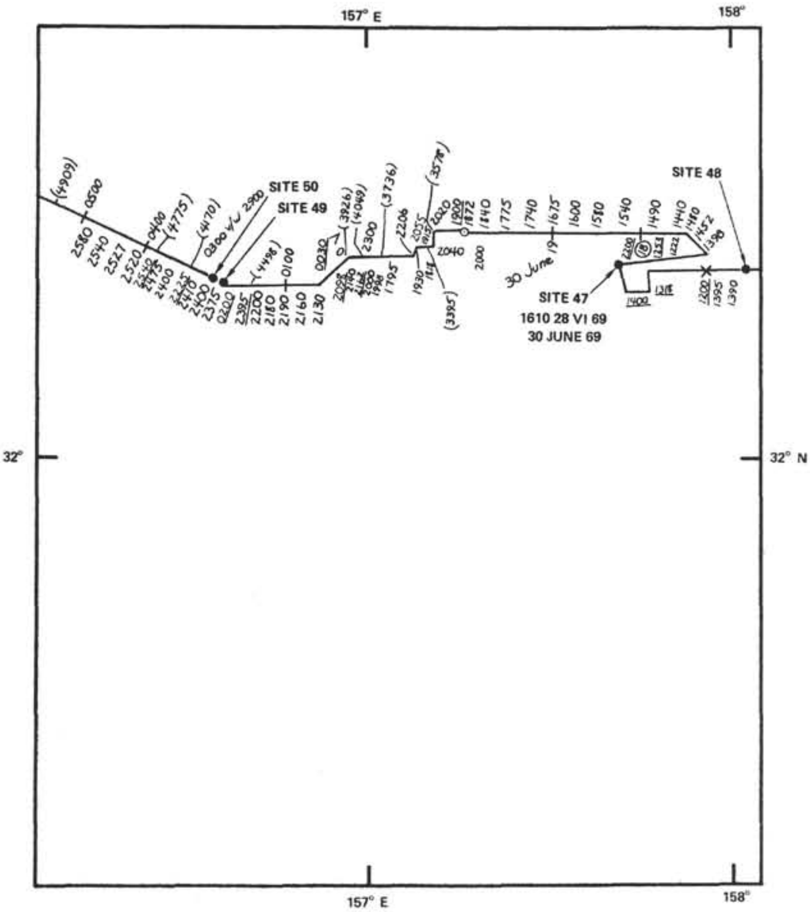

Figure 2. *Bottom soundings in area of Site 49*

Radiolaria. At 550 centimeters (Section 4) is a large manganese-iron oxide nodule, 7 centimeters in diameter. Between 730 and 740 centimeters are several small pieces of altered volcanic ash and brown chert with thin manganese coatings.

The core catcher for Core 1 contained a few small (1-3 centimeters across), angular and platy chips of friable, lithified white chalk; these may have been crusts around chert nodules.

Core 2, drilled between 18 and 19 meters below mudline, recovered the following (depths from top of core):

0 to 130 centimeters: White, very uniform nannoplankton chalk ooze in several intervals separated by areas of no recovery.

130 to 140 centimeters: Dark brown zeolitic clay with a few mottles (artifically induced?) of white nannoplankton chalk ooze. The contract between this clay and the overlying chalk ooze is wavy and deformed.

Hole 49.1

The two cores taken from this hole between 6 and 20 meters subbottom depth recovered about 11.4 meters of mainly brown zeolitic clay underlain by nannoplankton chalk ooze.

Most of Core 1 is silty zeolitic clay that is brown, yellowish-brown, and dark gray-brown. These are very poorly sorted deposits containing abundant clay minerals, common to abundant zeolites, and common limonitic grains. These clays also contain variable amounts of the following: (1) yellow and orange-yellow angular grains of isotropic palagonite, (2) silt-size grains of feldspar, quartz, mica and amphibole, and (3) scattered nannofossils. Phillipsite occurs as silt-to sand-size, euhedral to ragged crystals and intergrowth twins. Thin interlayers of zeolitic marl, with about 30 per cent nannofossils, are in Sections 2 and 3, and two interlayers (40 and 15 centimeters thick) of white to gray nannoplankton chalk ooze are present in Section 4 and 5. Although not seen in the smear slides, Rex's X-ray studies indicate the presence of cristobalite in Sections 1, 2 and 3. Manganese-iron oxide nodules occur within zeolitic brown clays in Section 3, 4 and 5. The top part of Section 4 contains small fragments of altered white volcanic ash and angular chips of brown chert; the lower part of Section 5 has angular pebbles of white, friable, lithified chalk. The majority of sediment in Core 1 was apparently highly disturbed during coring, since contorted layers and laminae and drilling-induced mottling are common.

Core 2 consists of 4.5 meters of highly disturbed white nannoplankton chalk ooze that is very even-grained and appears to consist largely of coccoliths of nearly uniform size.

The core catcher for Core 2 contained soft white nannoplankton chalk ooze and two angular pieces of vitreous chert that are mottled yellow-brown and light gray. These pieces have irregular crusts of lithified white chalk on several sides and appear to be parts of chert nodules that lay within unlithified chalk ooze. Thin sections of the chert show scattered internal molds of radiolarian tests dispersed in a very fine-grained matrix of microcrystalline quartz and scattered iron oxide (?) grains. The radiolarian molds are either hollow or are filled by fibrous chalcedonic quartz (Chapter 38) that sometimes has a pale brown color, apparently due to staining or tiny inclusions of iron oxides. There are no traces of the original radiolarian tests, and the margins of the molds against the matrix vary from very sharp and distinct to very diffuse. The chert also contains scattered small fragments of pelecypod shells, and a few thin veinlets filled by fibrous chalcedonic quartz.

PHYSICAL PROPERTIES

These physical properties do not necessarily represent *in situ* conditions as the sediments were disturbed by drilling.

Natural Gamma Radiation

Hole 49.0

Natural gamma radiation was measured on one core of Pleistocene brown clay containing beds rich in volcanic glass (up to 50 per cent) or zeolites (up to 20 per cent). This sediment was recovered from 0 to 9 meters below the sediment surface in Hole 49.0. Emission counts ranged from 700 to 2050 counts/7.6-cm core segment/1.25 minutes with an average of 1100 counts. The presence of volcanic glass appears to significantly contribute natural gamma radiation, and the phillipsite-rich intervals appear to emit even greater radiation. The highest single counts or peaks were emitted from the manganese nodules in the zeolitic clay and ash (see lithology and X-ray mineralogy for clay types and percentages).

Jurassic nannoplankton chalk ooze was recovered in Core 2 from 17 to 19 meters below the sediment surface. The natural gamma radiation emitted ranged from 100 to 500 counts/7.6-cm core segment/1.25 minutes.

Hole 49.1

Natural gamma radiation of Tithonian zeolitic brown clay from 5 to 12 meters below the sediment surface in Hole 49.1 ranged from 200 to 3100 and averaged about 1200 counts/7.6-cm core segment/1.25 minutes. The low values were emitted from the interbedded nannoplankton chalk ooze. The zeolitic clay in the 5 to 10 meter interval appears to account for the higher gamma counts. The highest single count or spike of 3100 was emitted from manganese nodules present in the relatively pure nannoplankton ooze in Sections 4 and 5.

Porosity, Wet-Bulk Density, and Water Content

Hole 49.0

The porosity of the Pleistocene zeolitic ashey clay from 0 to 9 meters in Hole 49.0 ranged from 68 to 87 per cent(?) (1.45 to 1.20 g/cc corresponding wet-bulk densities) with a mode of 77 per cent (1.37 g/cc). The water content ranged from 47 to 67 per cent and averaged 56 per cent. Manganese nodules and chert fragments caused wet-bulk density and porosity spikes on the analog records as high as 1.84 g/cc and as low as 40 per cent, respectively. Since these fragments were enclosed in sediment, their densities and porosities were averaged with the surrounding sediment by the GRAPE. Thus, the GRAPE measured density is lower and the porosity is higher than the true density and porosity, of the fragments. The ash-rich layers appeared to be slightly denser than the purer clay.

Core 2 from 17 to 19 meters in Hole 49.0, comprising Tithonian white nannoplankton chalk ooze was sampled in one place for porosity, wet-bulk density and water content, the values being 59 per cent, 1.62 g/cc, and 37 per cent, respectively. These older sediments appeared slightly more compacted than the Pleistocene sediments in Core 1.

Hole 49.1

The porosity of the Tithonian brown zeolitic clay and nannoplankton chalk ooze recovered from 5.2 to 11.6 meters in Hole 49.1 ranged from 70 to 93 per cent (1.14 to 1.44 g/cc corresponding wet-bulk densities) with a mode of 76 per cent (1.39 g/cc). The water content ranged from 58 to 63 per cent with an average of 60 per cent. The Tithonian average porosity was equivalent to that of the Pleistocene zeolitic clays. Manganese nodules and chert fragments, surrounded by sediment, cause high density (1.40 g/cc) and low porosity spikes (35 per cent in Sections 5 and 4.

Sound Velocity

Hole 49.0

Sediment sound velocities through disturbed Pleistocene zeolite clays with ash, from 0 to 9 meters in Hole 49.0, ranged from 1.48 to 1.55 km/sec. Two sound velocity measurements taken on the Tithonian white nannoplankton chalk ooze (57 to 59 meters) were 1.53 and 1.52 km/sec.

Hole 49.1

In Hole 49.1 Tithonian zeolitic clay and nannoplankton chalk ooze were recovered from 5.2 to 11.6 meters below the mudline. Sound velocities through the zeolitic clay ranged from 1.49 to 1.52 km/sec with an average of 1.51 km/sec. One velocity measurement through the white nannoplankton chalk ooze revealed a velocity of 1.58 km/sec. In general, the Pleistocene and Tithonian brown zeolitic clay had similar sound velocities

Penetrometer

Hole 49.0

Penetration into the Pleistocene zeolitic clays and volcanic glass (0.3 to 6.1 meters) ranged from 37 to 160×10^{-1} millimeters with an average of 88×10^{-1} millimeters. The topmost 0.3 meter of sediment was a very soupy zeolitic clay which the penetrometer needle completely penetrated. Below 6.1 meters to 9.1 meters, the brown clay is also zeolitic with penetrometer values ranging from 135 to 160×10^{-1} millimeters, with an average of 140×10^{-1} millimeters.

Penetrometer readings on Tithonian nannoplankton chalk ooze and zeolitic clay with a slight amount of ash ranged from 180×10^{-1} millimeters to complete penetration.

Thermal Conductivity

Hole 49.0

Thermal conductivity measurements in Pleistocene brown zeolite clays and nannoplankton chalk ooze recovered from depths of 5 meters and 17.5 meters below the mudline, respectively, gave values of 2.05 and 2.95×10^{-3} cal-$^{\circ}C^{-1}$ cm^{-1} sec^{-1}, respectively.

Hole 49.1

One thermal conductivity measurement of 2.72×10^{-3} cal-$^{\circ}C^{-1}$ cm^{-1} sec^{-1} was made in Tithonian brown zeolitic silty clay recovered at a depth of 10 meters below the mudline in Hole 49.1. On the basis of only two measurements the Pleistocene and Tithonian heat conductivities were quite similar, but this may be the result of sediment disturbance during coring.

CONCLUSIONS

Site 49 tested the sedimentary sequence about 100 meters above the basement and found cherty chalk ooze, of Late Jurassic or Early Cretaceous age, below Pleistocene brown clays and shard-rich and zeolitic muds with manganese and detrital chert derived from the Cretaceous.

The absence of planktonic foraminifera and the nature of the coccoliths show the carbonates to be pre-Aptian. The coccoliths show little variety, and belong to species which are known to range from the Late Jurassic (Kimmeridgian) through the Neocomian. Species and larger taxa (*Nannoconus)*, which are normally present in and distinctive of the various Neocomian stages, are absent, and this leads to the suspicion that the core beds may be of Jurassic age; however, positive evidence of Jurassic age is lacking.

Forced to abandon this site because of cherty rock encountered without sufficient overburden, the drilling vessel moved a short distance down-dip to Site 50.

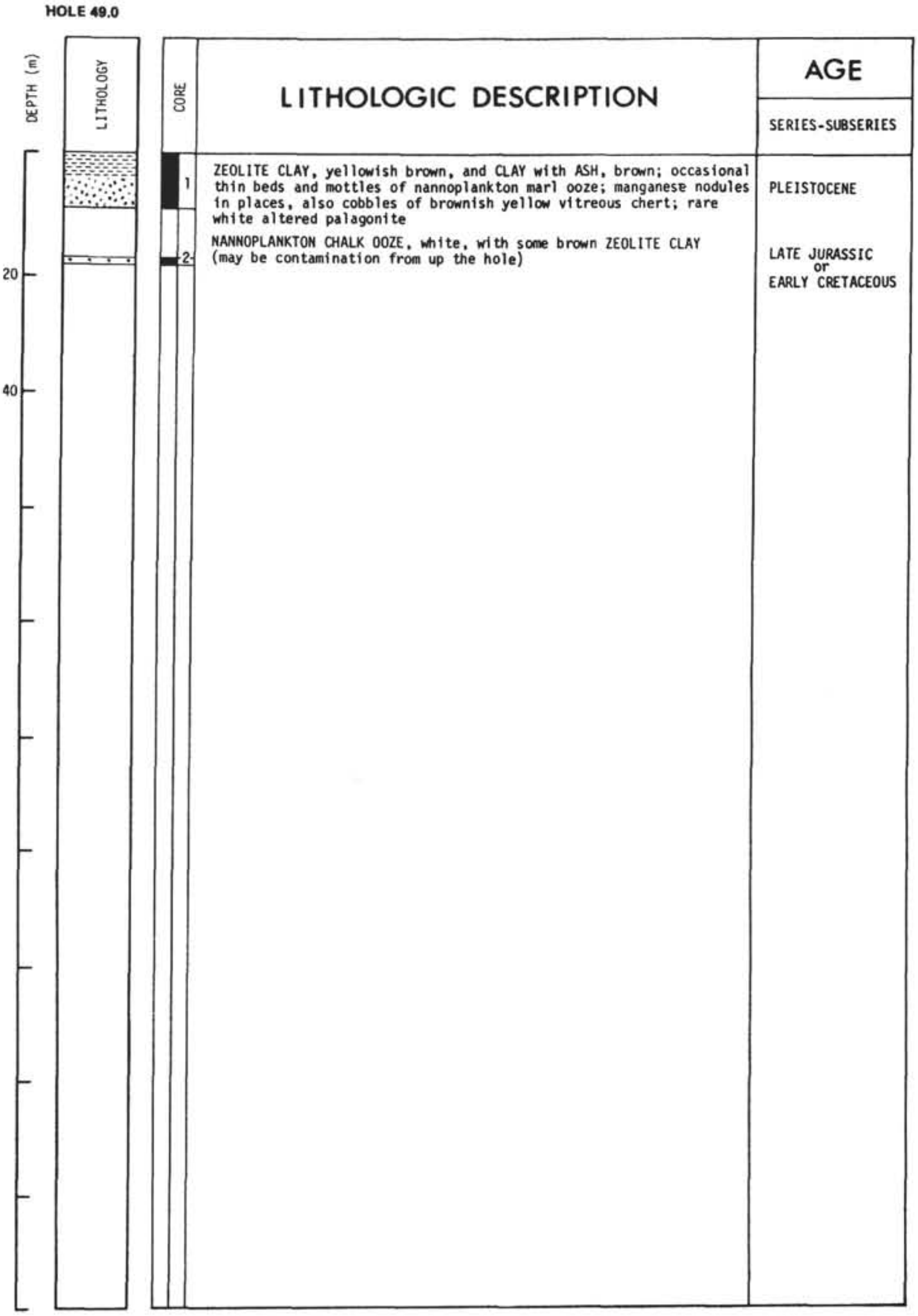

Figure 3. *Summary of lithology in Hole 49.0.*

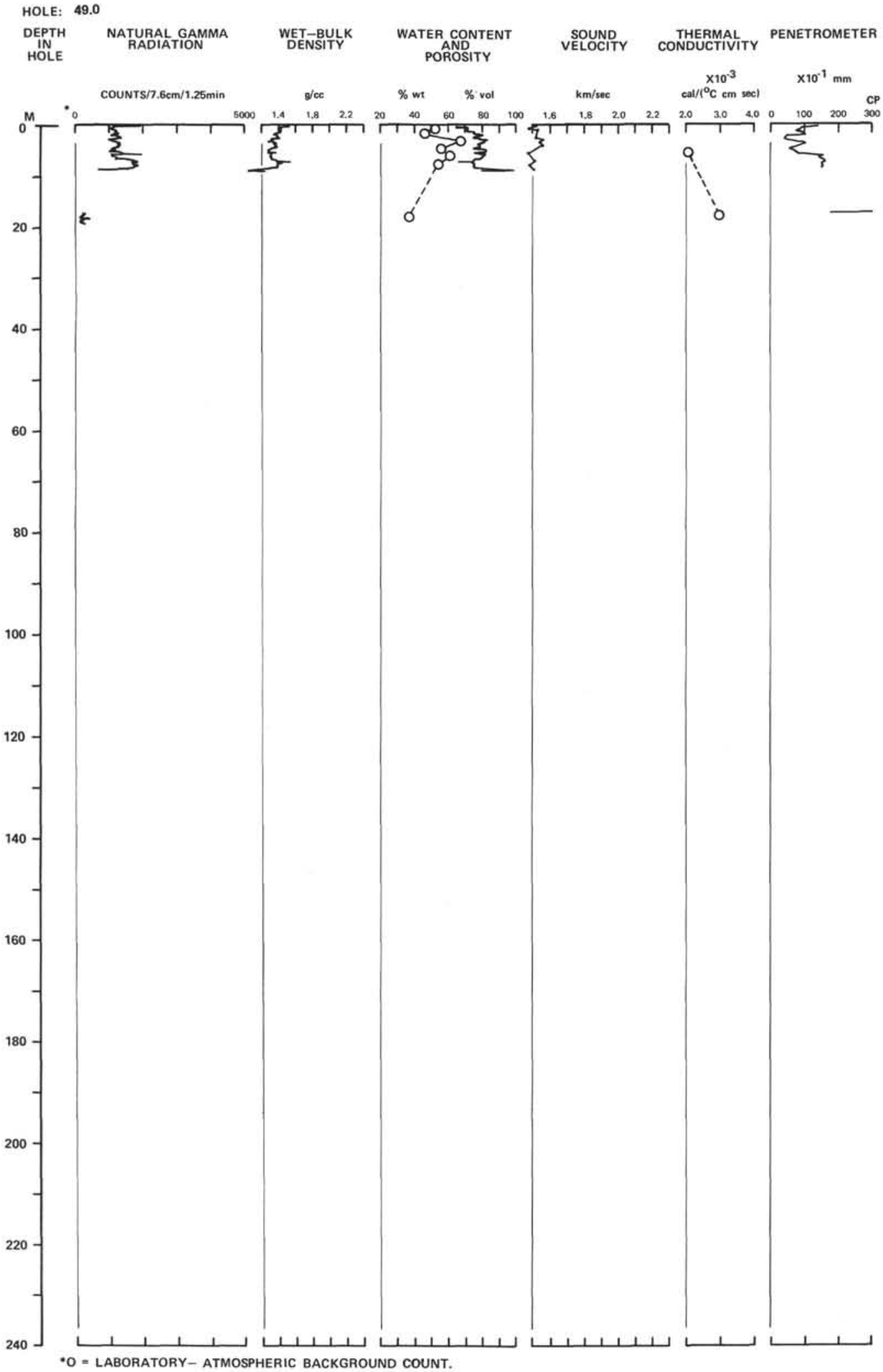

Figure 4. *Summary of physical properties in Hole 49.0.*

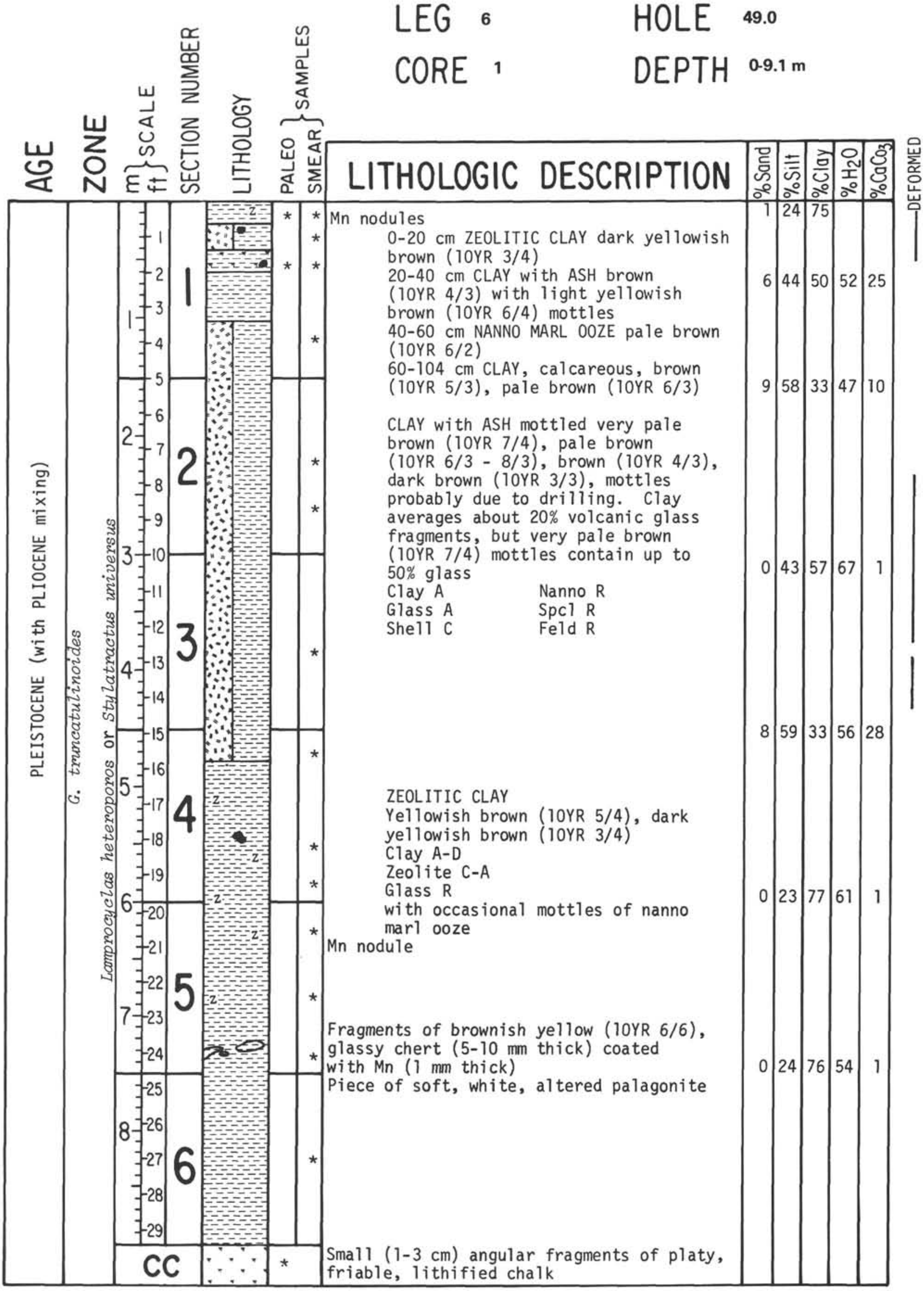

Figure 5. *Summary of lithology in Hole 49.0 Core 1.*

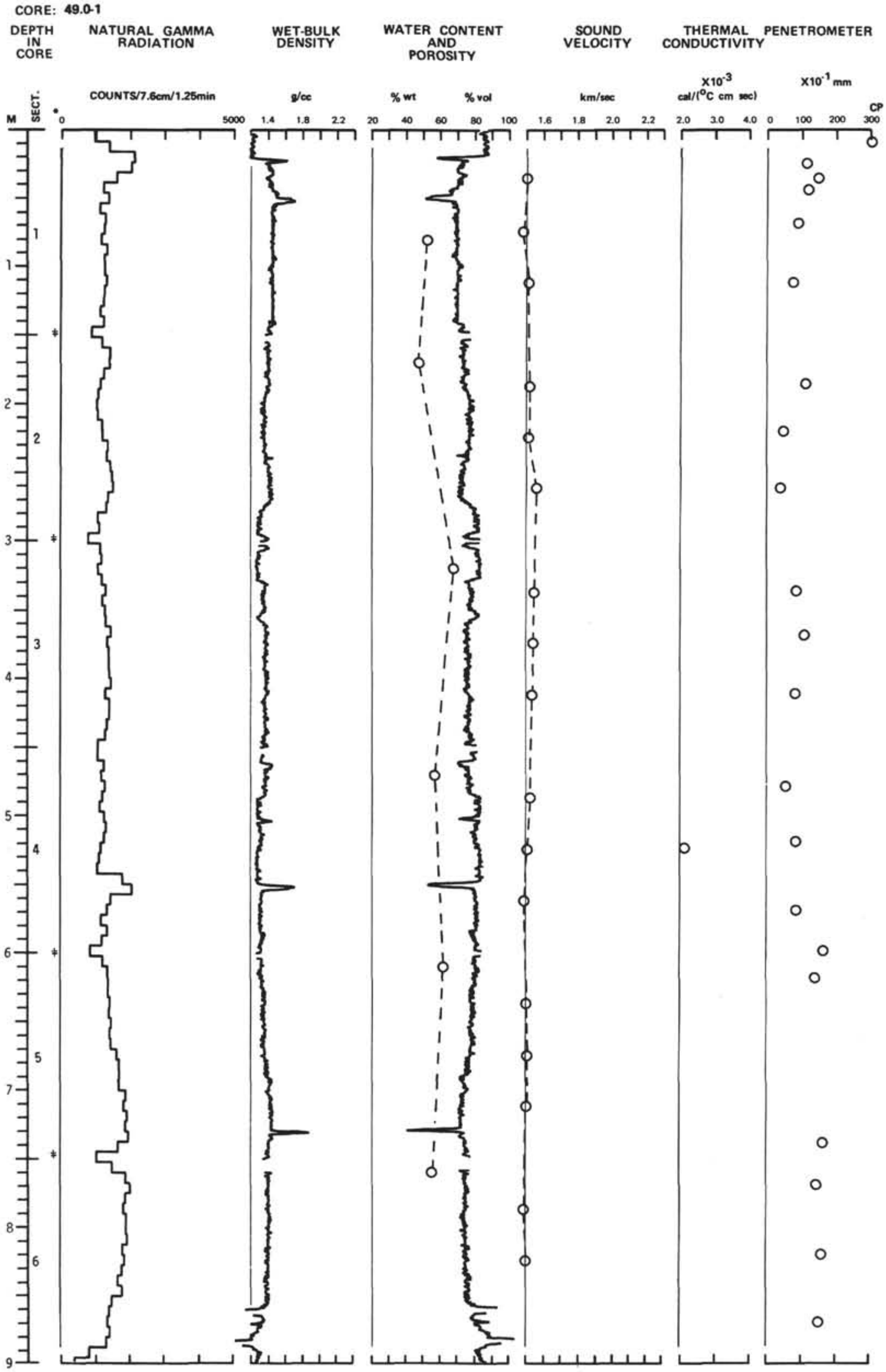

Figure 6. *Summary of physical properties in Hole 49.0 Core 1.*

LEG 6 HOLE 49.0

CORE 1 DEPTH 0.0-9.1 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
None	Pleistocene assemblages are most common in this core but sporadically assemblages containing reworked Pliocene species such as *Discoaster brouweri* and *Ceratolithus rugosus* are present; also some samples are sterile brown clays or have had all small coccoliths winnowed away. Species present include: *Ceratolithus cristatus*, *Coccolithus* sp. cf. *C. doronicoides*, *Cyclococcolithina leptoporus*, *Gephyrocapsa oceanica*, and *Umbilicosphaera mirabilis*.	Radiolaria are fairly abundant at the top of the core but are rare or absent in the lower part. The assemblage at the top, the only complete one, represents at face value the *Stylatractus universus* Zone, but considering the rarety of *Lamprocyclas heteroporos* in this area, the Zone named after that species may be represented instead. TOP: *Eucyrtidium tumidulum*, *E. calvertense*, *Stylatractus universus*, *Druppatractus acquilonius*, and *Lithopera bacca*. BOTTOM: *Druppatractus acquilonius*.

Figure 7. *Summary of biostratigraphy in Hole 49.0 Core 1.*

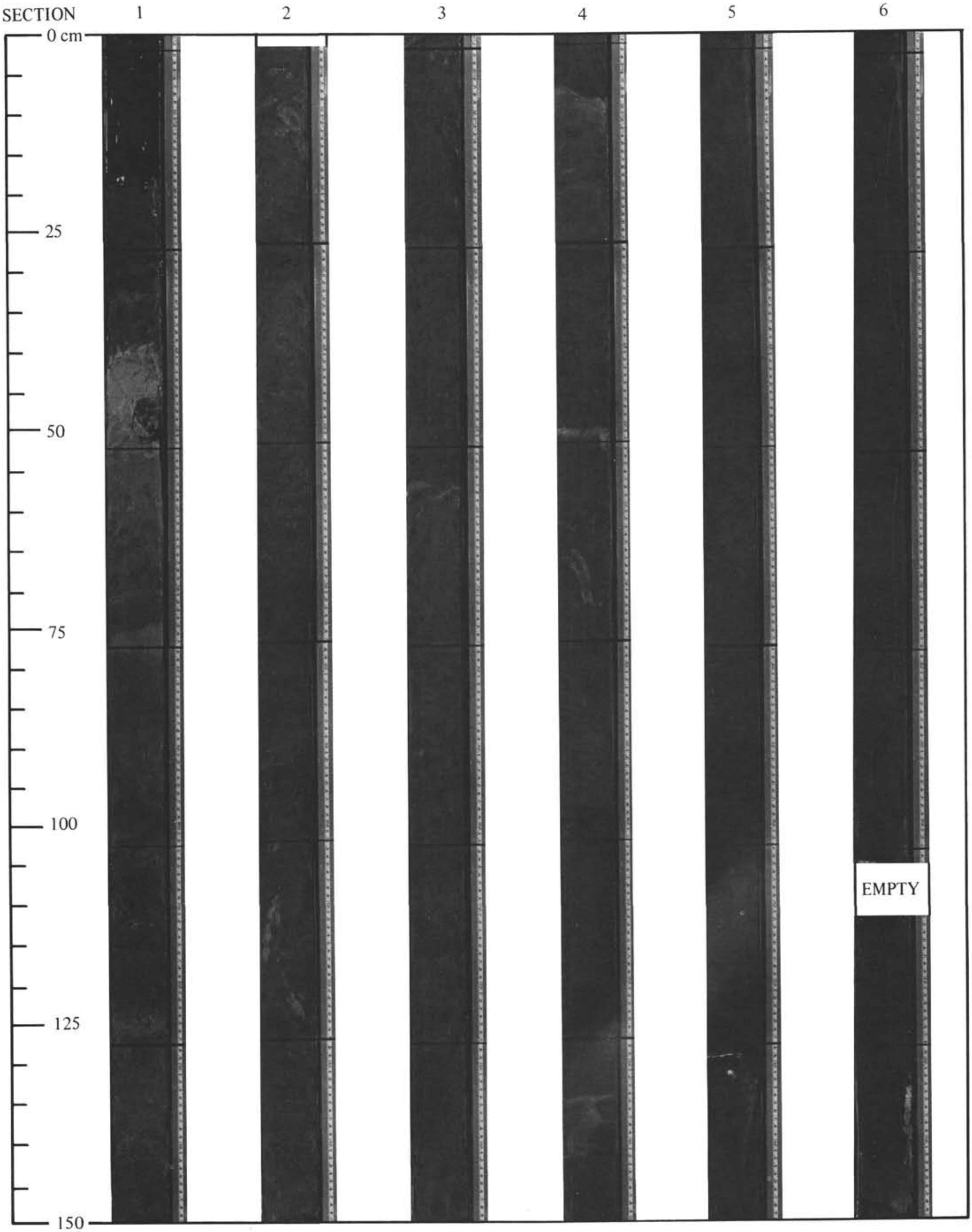

Plate 1. *Photographs of Hole 49.0 Core 1.*

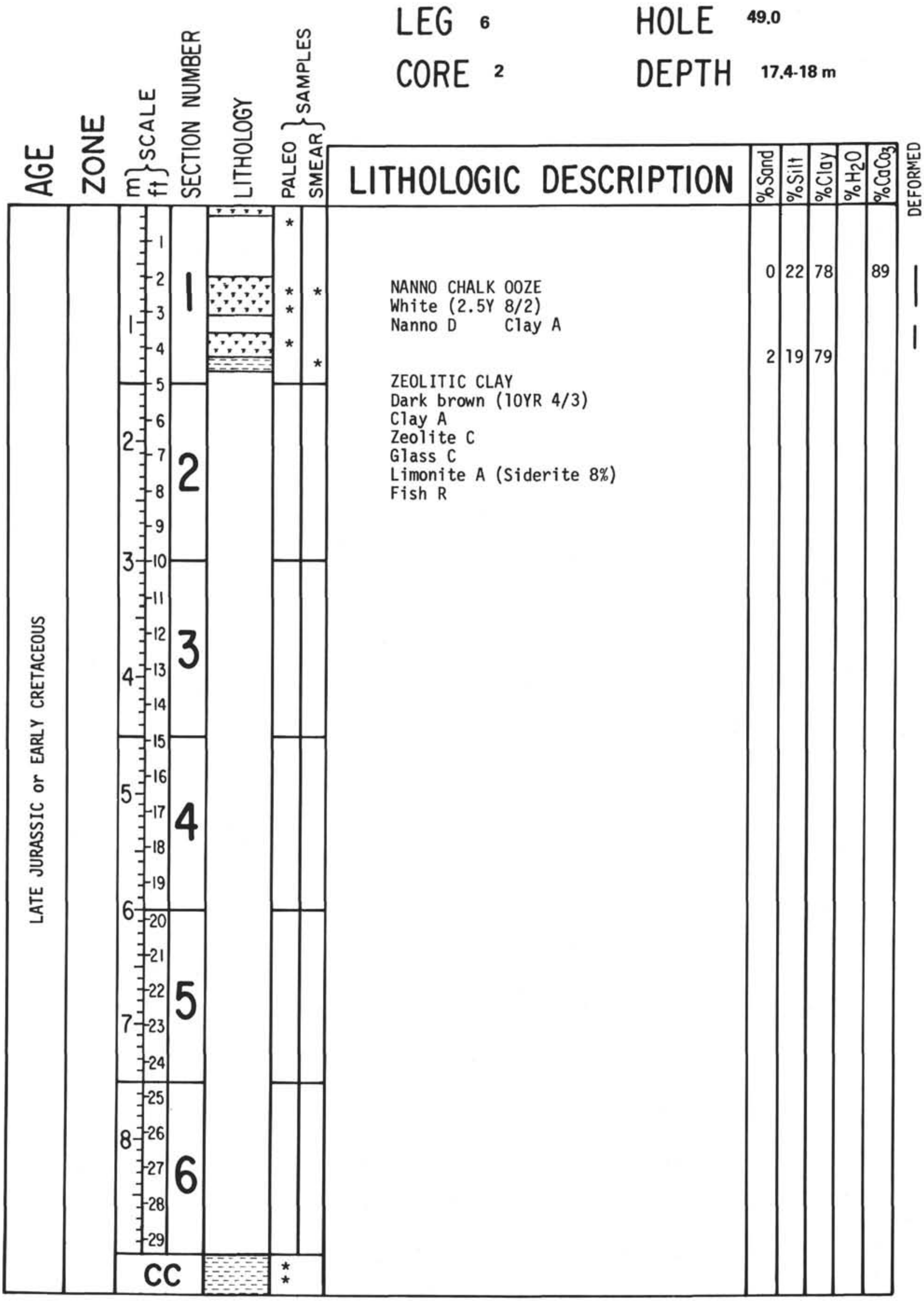

Figure 8. *Summary of lithology in Hole 49.0 Core 2.*

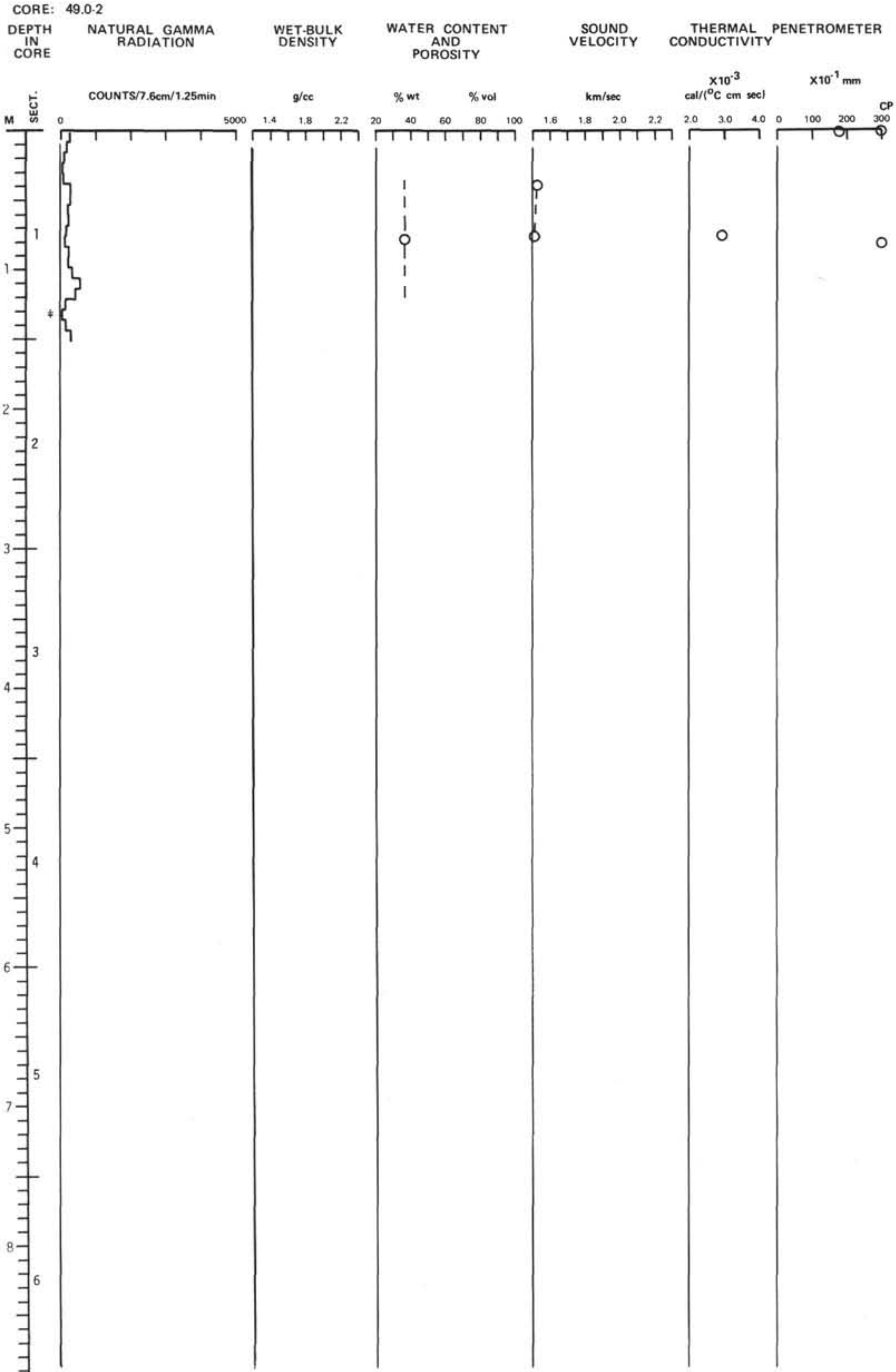

Figure 9. *Summary of physical properties in Hole 49.0 Core 2.*

LEG 6 HOLE 49.0

CORE 2 DEPTH 17.4-18.0 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
None.	An Upper Jurassic or possibly Lower Cretaceous assemblage of nannoplankton is present in this core. Species present include *Diazomatolithus lehmani*, *Discolithina rugosa*, *Parhabdolithus embergeri*, *Rhabdolithus* sp. cf. *R. septrum*, *Stephanolithion laffittei*, *Watznaueria barnesae*, *W. coronata*, *Zygodiscus* sp. cf. *Z. theta*, and several undescribed species. No species of *Nannoconus* are present.	The core catcher sample contains poorly preserved (quartz infilled) radiolarians of Mesozoic (probably Cretaceous) age. CORE CATCHER: "*Dictyomitra*" *spp.*, "*Stichocapsa*" *spp.*, hagiastrins.

Figure 10. *Summary of biostratigraphy in Hole 49.0 Core 2.*

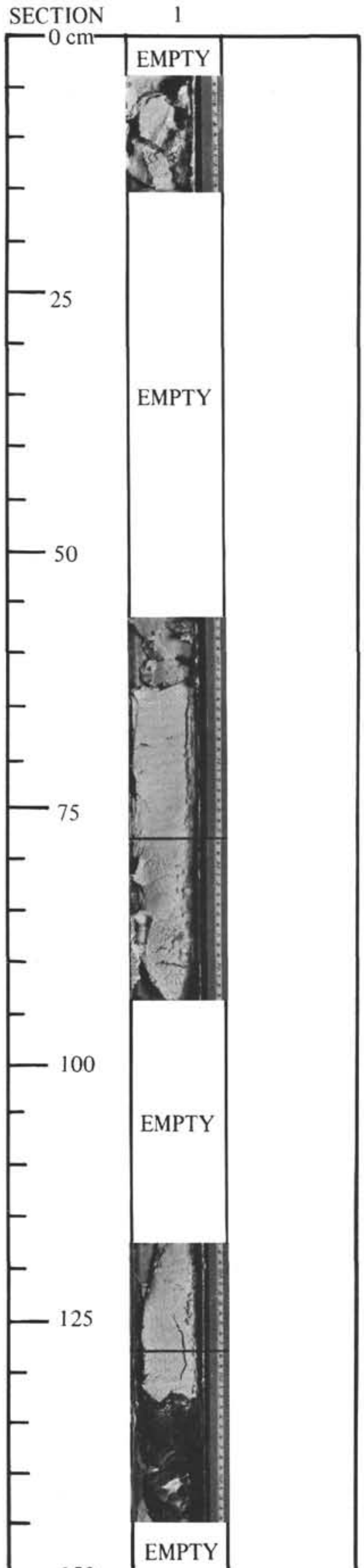

Plate 2. *Photographs of Hole 49.0 Core 2.*

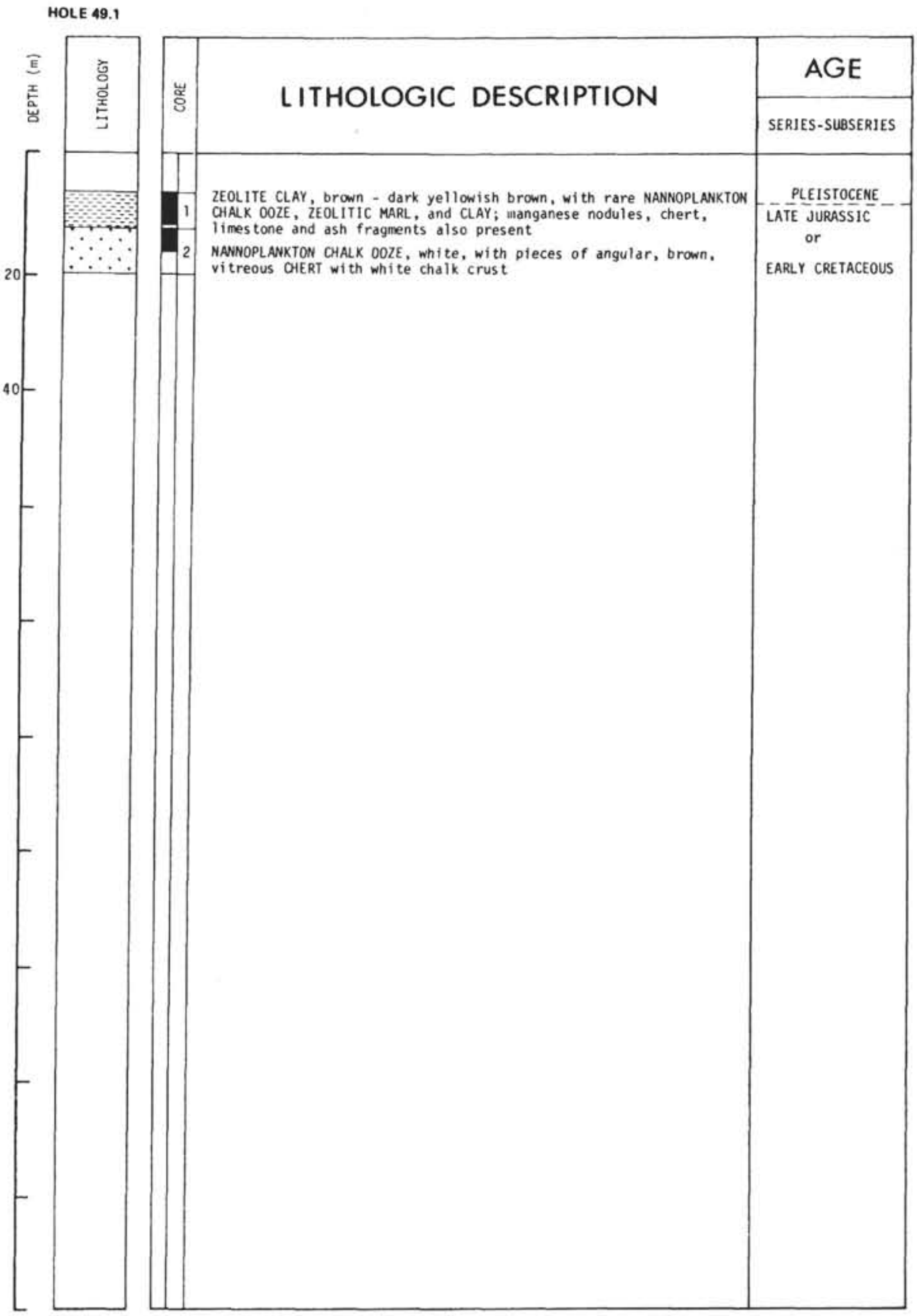

Figure 11. *Summary of lithology in Hole 49.1.*

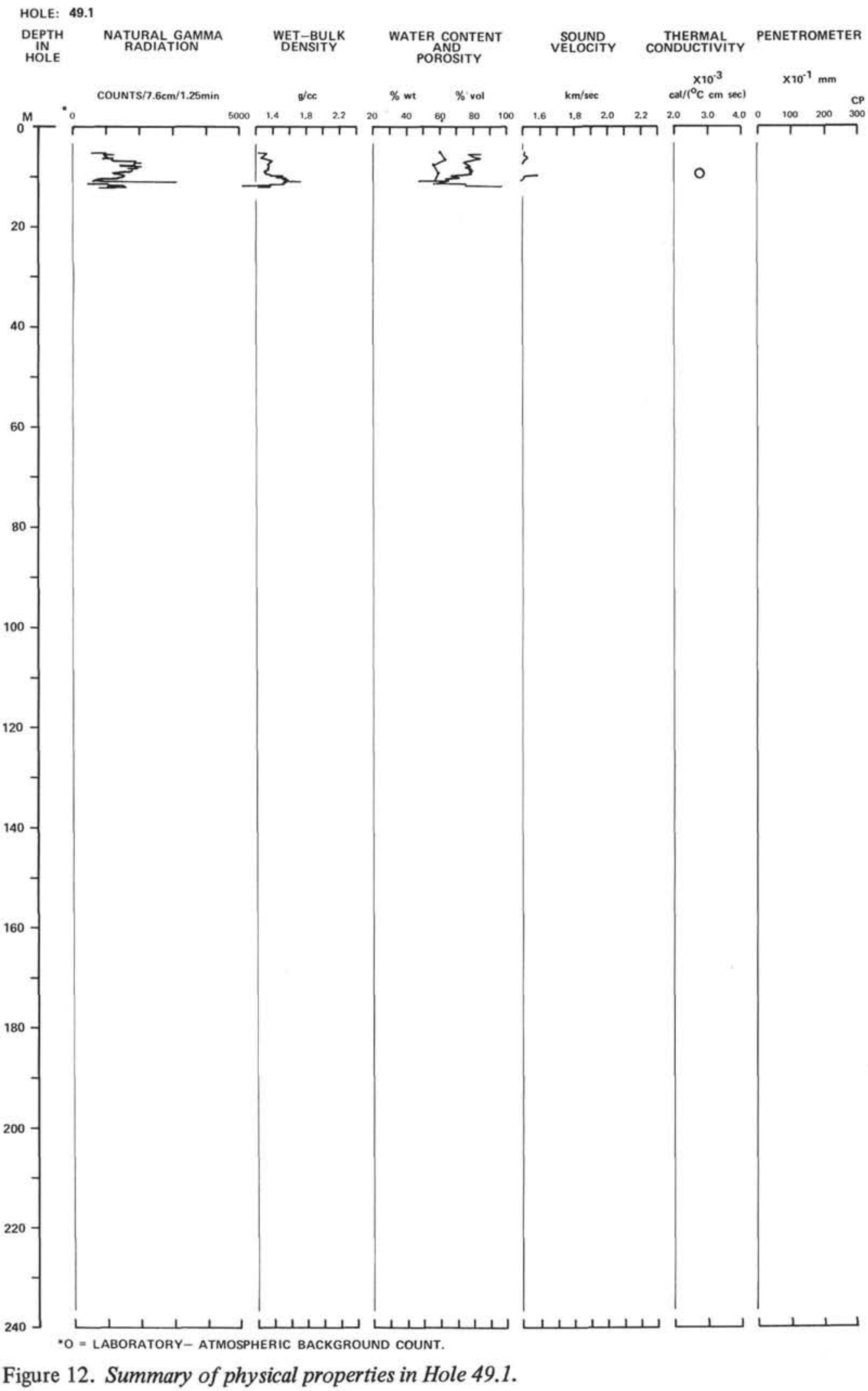

Figure 12. *Summary of physical properties in Hole 49.1.*

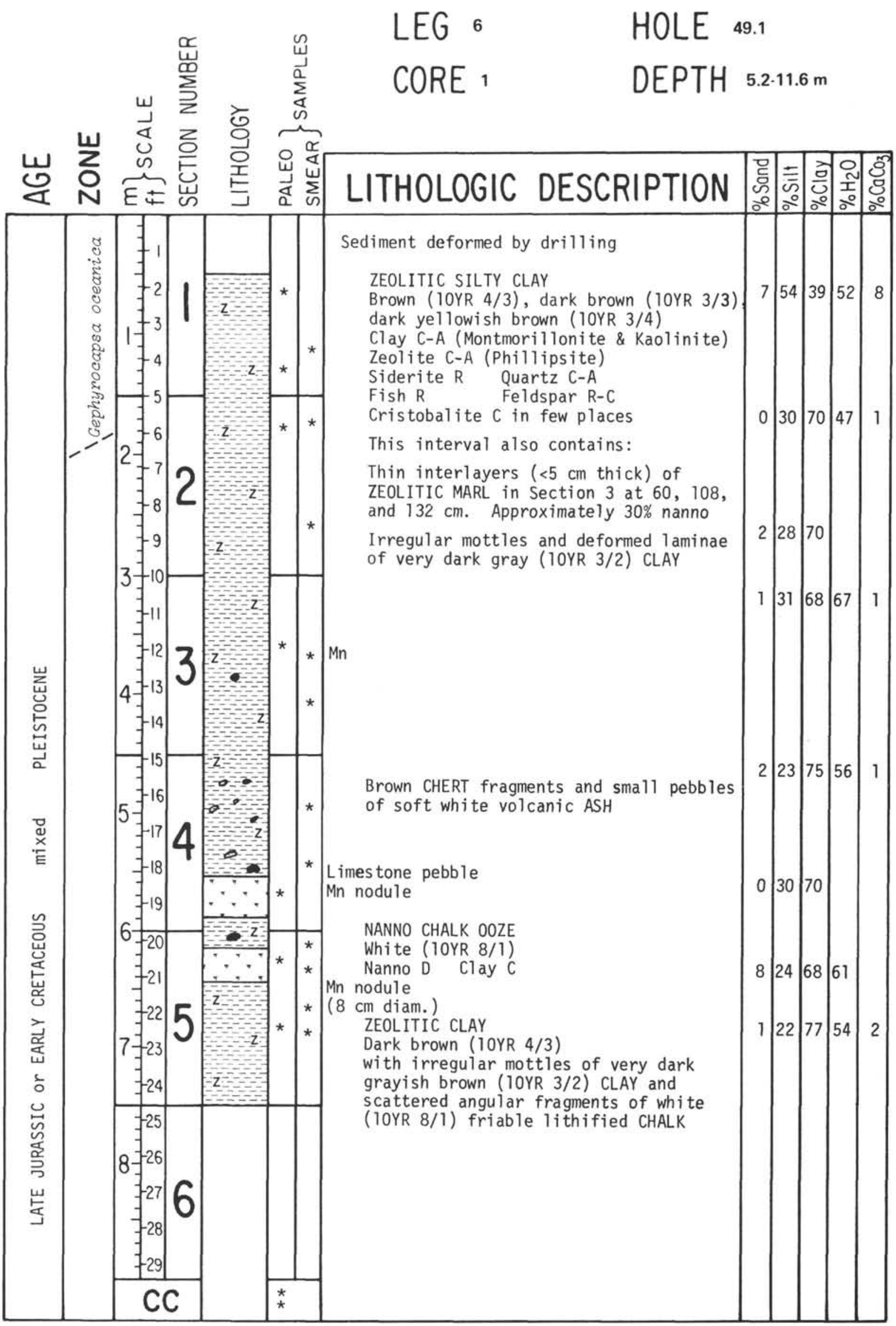

Figure 13. *Summary of lithology in Hole 49.1 Core 1.*

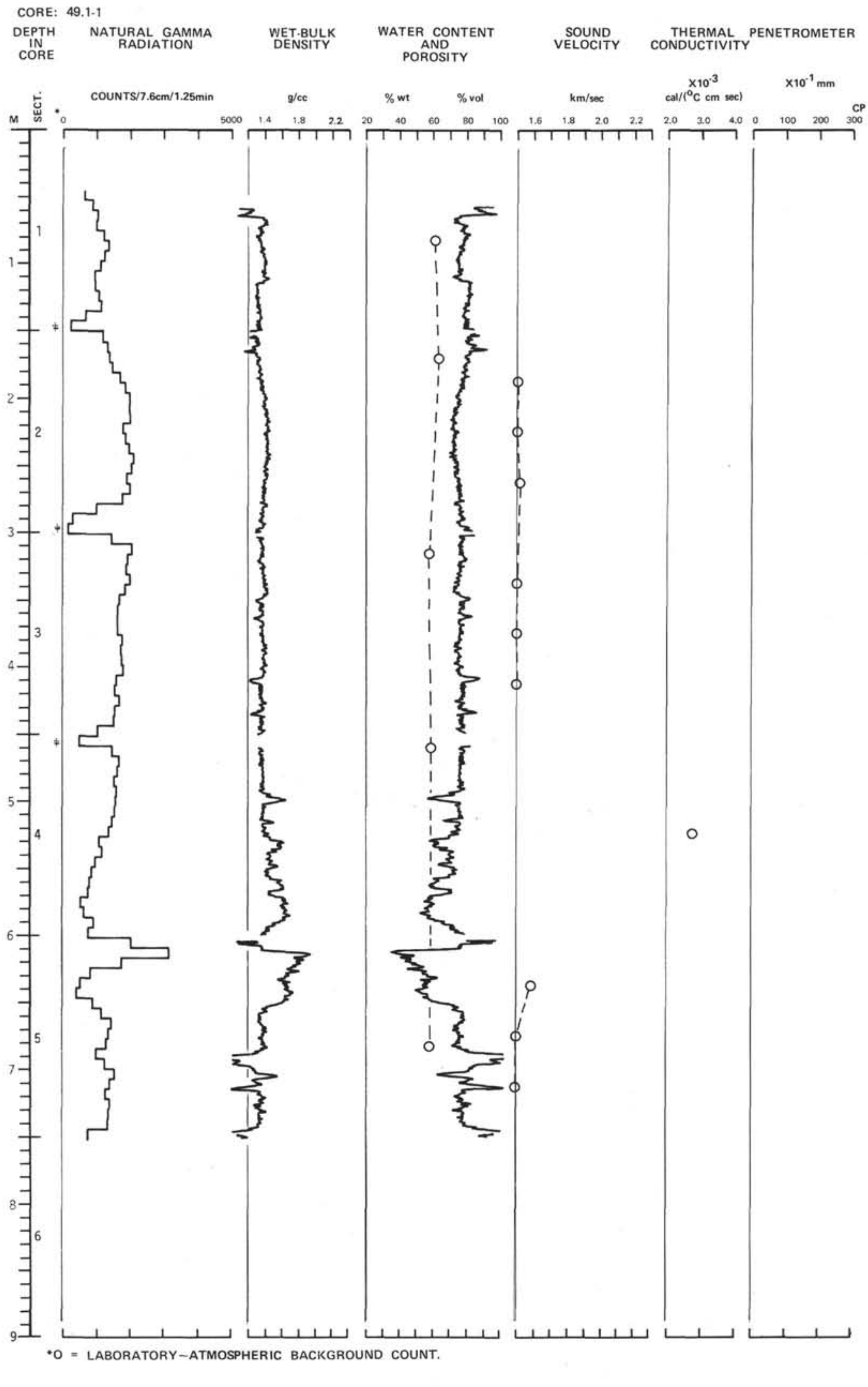

Figure 14. *Summary of physical properties in Hole 49.1 Core 1.*

LEG 6 HOLE 49.1

CORE 1 DEPTH 5.2-11.6 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Thin intercalation of light-brown clay in section 1 contains the assemblage of the Pleistocene planktonic Foraminifera - numerous *Globorotalia crassaformia, G. inflata, G. puncticulata* together with rare *Globorotalia tumida, G. truncatulinoides, Globigerinoides conglobatus, Sphaeroidinella dehiscens, Orbulina universa.*	A Pleistocene assemblage of the *Gephyrocapsa oceanica* Zone is present in the upper section of the core. Below this, lay deposits with sparse reworked Tertiary and Mesozoic nannoplankton are present. The lower sections of the core contain an Upper Jurassic or possible Lower Cretaceous assemblage. Species at the top include *Ceratolithus cristatus, Cyclococcolithina leptoporus,* and *Gephyrocapsa oceanica.* Species in the lower sections include *Diazomatolithus lehmani, Parhabdolithus embergeri, Stephanolithion* sp. aff. *S. bigoti, S. laffittei, Watznaueria barnesae, W. coronata,* and several undescribed species. No species of *Nannoconus* are present.	The core catcher sample contains poorly preserved (quartz infilled) radiolarians of Mesozoic (probably Cretaceous) age. CORE CATCHER: *"Dictyomitra" spp., "Stichocapsa" spp.,* and spiny-ringed saturnalins.

Figure 15. *Summary of biostratigraphy in Hole 49.1 Core 1.*

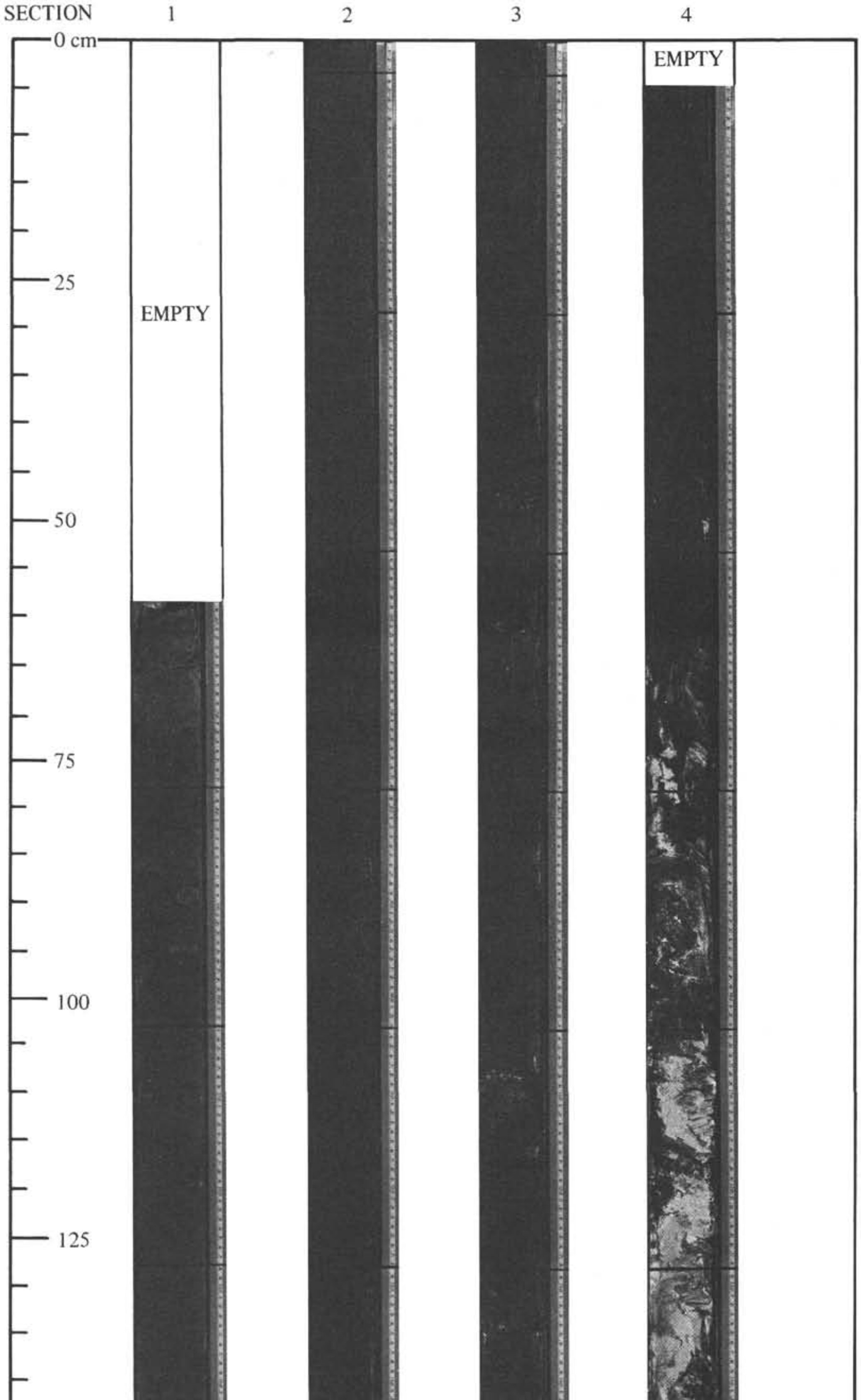

Plate 3. *Photographs of Hole 49.1 Core 1.*

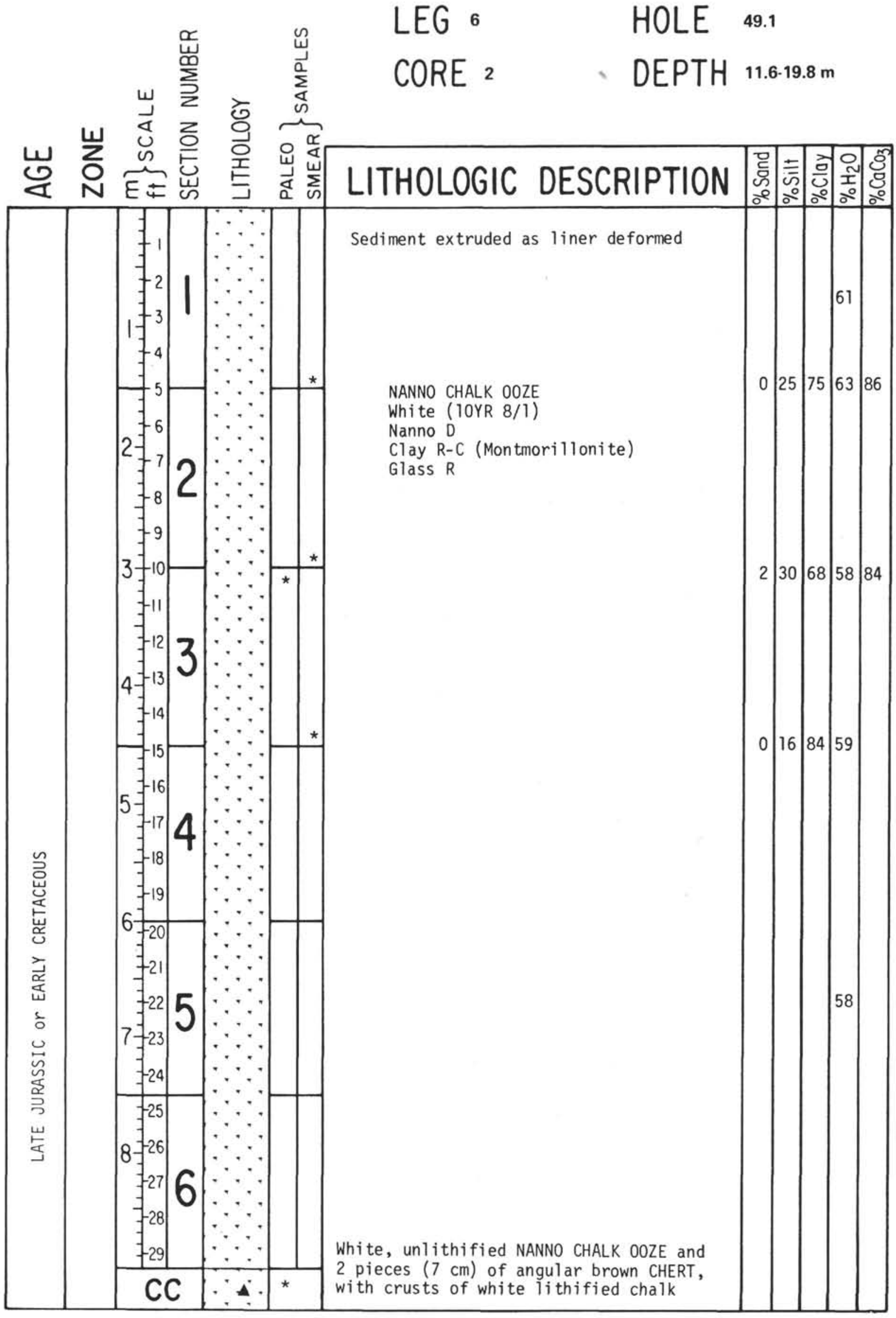

Figure 16. *Summary of lithology in Hole 49.1 Core 2.*

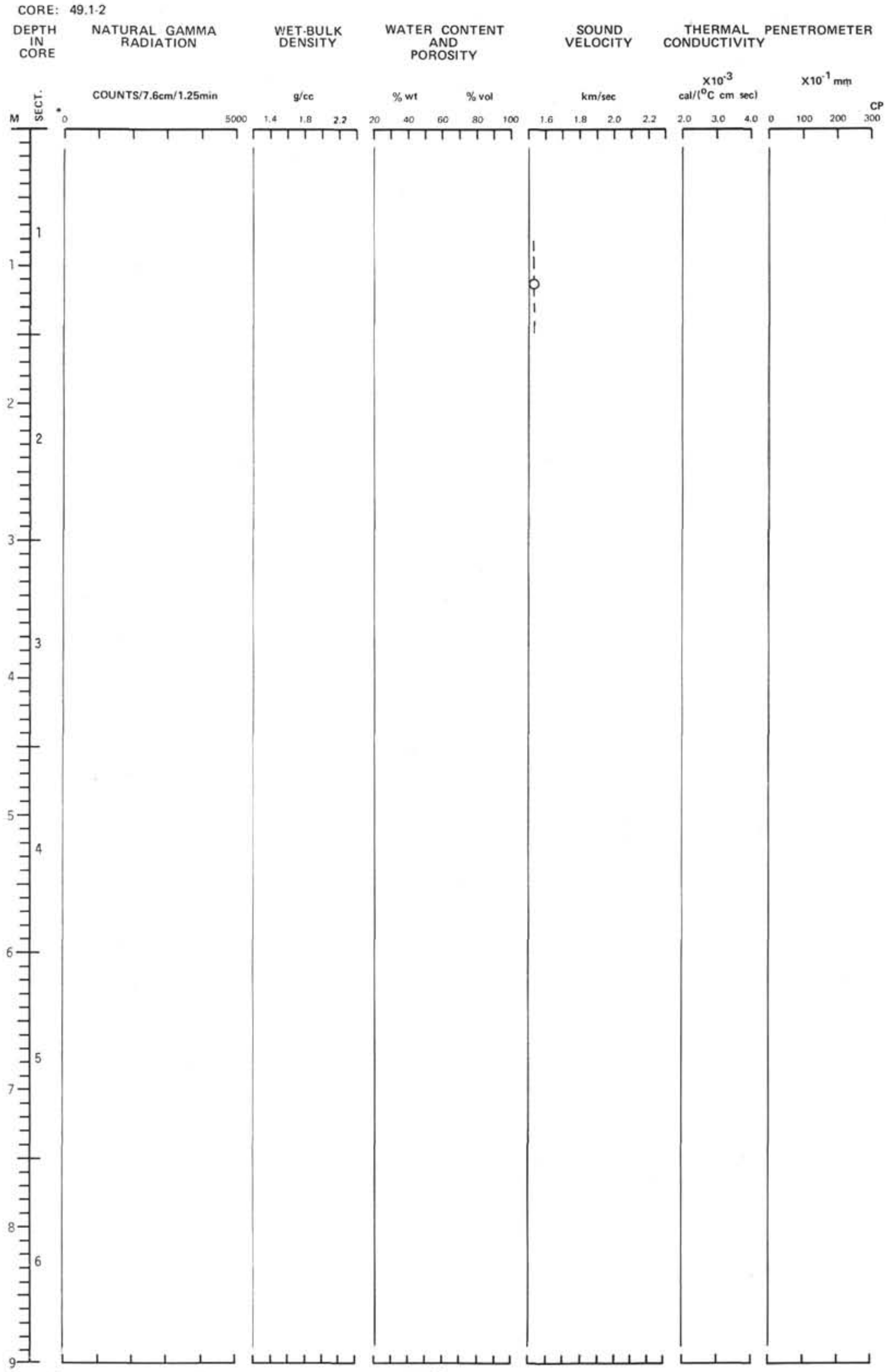

Figure 17. *Summary of physical properties in Hole 49.1 Core 2.*

LEG 6 HOLE 49.1

CORE 2 DEPTH 11.6-19.8 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
None.	Assemblages of Upper Jurassic or possibly Lower Cretaceous nannoplankton are present throughout this core. Species present include *Diazomatolithus lehmani*, *Parhabdolithus embergeri*, *Rhabdolithus* sp. cf. *R. septrum*, *Stephanolithion* sp. aff. *S. bigoti*, *S. laffittei*, *Watznaueria barnesae*, *W. britannica*, *W. coronata*, and several undescribed species. No species of *Nannoconus* are present.	The core catcher sample contains poorly preserved (quartz infilled) radiolarians of Mesozoic (probably Cretaceous) age. CORE CATCHER: *"Dictyomitra" spp.* and *"Stichocapsa" spp.*

Figure 18. *Summary of biostratigraphy in Hole 49.1 Core 2.*