12. SITE 54

Shipboard Scientific Party[1]

SITE DATA

Occupied: July 17-19, 1969.

Position: Sediment apron west of Iwo Jima Ridge:
Latitude: 15° 36.6′N.
Longitude: 140° 18.10′E.

Water Depth: 4990 meters.

Cores: Nine cores.

Total Depth: 294 meters in pre-Middle Miocene basalt.

MAIN RESULTS

Site 54 confirms the history recorded at Site 53: an episode of basaltic flows–of Paleogene or earliest Miocene age–was succeeded by an episode of explosive vulcanism and ash deposits in Miocene time. The regional scale of the basalt flows suggests that the underlying crust may be of Tertiary age, though we cannot exclude the possibility that the basalts form only a blanket over older basement.

The Miocene ash falls were concentrated on the western flank of the Iwo Jima Ridge, suggesting that this ridge was the source.

BACKGROUND

The general background for drilling in the Philippine Sea has been dealt with in connection with Site 53. The discovery there of Miocene tuff and ash on a complex of basaltic flows and pyroclastics with interbedded limestone, of Oligocene or early Miocene age, resembling the section on Guam, suggested that this sequence might be regional rather than local; more drilling seemed essential to substantiate or reject this interpretation.

At the same time, the authors' plans were restricted (1) by the limited distribution of a sufficient sediment cover for spudding in, and (2) by the need to meet the M.V. *Ran Annim,* coming out of Saipan with an additional supply of beacons, on July 19. The ship steamed somewhat west of south from Site 53, searching for a prospective drill site in the more westerly parts of the sediment apron flanking the Iwo Jima Ridge. Further west lay rough basement topography with little sediment; to the east lay, presumably, thick and coarser volcanoclastics. The seismic profile continued to show fairly flat, well-defined sediments lapping out against basement highs. On approaching the 15th parallel a site was chosen on the flank of a high (Figure 1, also see Chapter 11, Figure 1), a short section which could be drilled quickly, if necessary–leaving enough time to meet the *Ran Annim* closer to Saipan if this ship should be unable to meet *Glomar Challenger* so far out to sea.

The geologic setting appeared rather similar to that at Site 53; the profiler showed sediments overlapping onto the flanks of basement highs. But some of the individual basins showed very flat tops, and a strikingly level stratification, with more distinct wedging-out of units on the gentle flanks; a suggestion that turbidity current sedimentation may have played a larger role here.

Bottom soundings in the area of Site 54 are given as Figure 2.

OPERATIONS

The beacon was dropped at 1200 hours July 17, and the hole spudded at 2000 hours. A tungsten carbide bit cut the volcanic ash section somewhat more rapidly than the light diamond bit used at Site 53. Nine cores were cut, the upper seven in ash, the lower two in basalt.

An attempt was made to log this hole, but the logging tools met an obstruction 55 meters above the bit. The center bit was similarly stopped. The hole, therefore, had to be abandoned, and on bringing out the drill string the obstruction turned out to be a piece of basalt which had dropped out of the core barrel and lodged in the pipe.

M.V. *Ran Annim* from Saipan met the *Glomar Challenger* at this site. It brought a supply of new beacons, and W. Allinder, to replace Dan R. Bullard, as operations manager.

The site was abandoned at 2200 hours, July 19.

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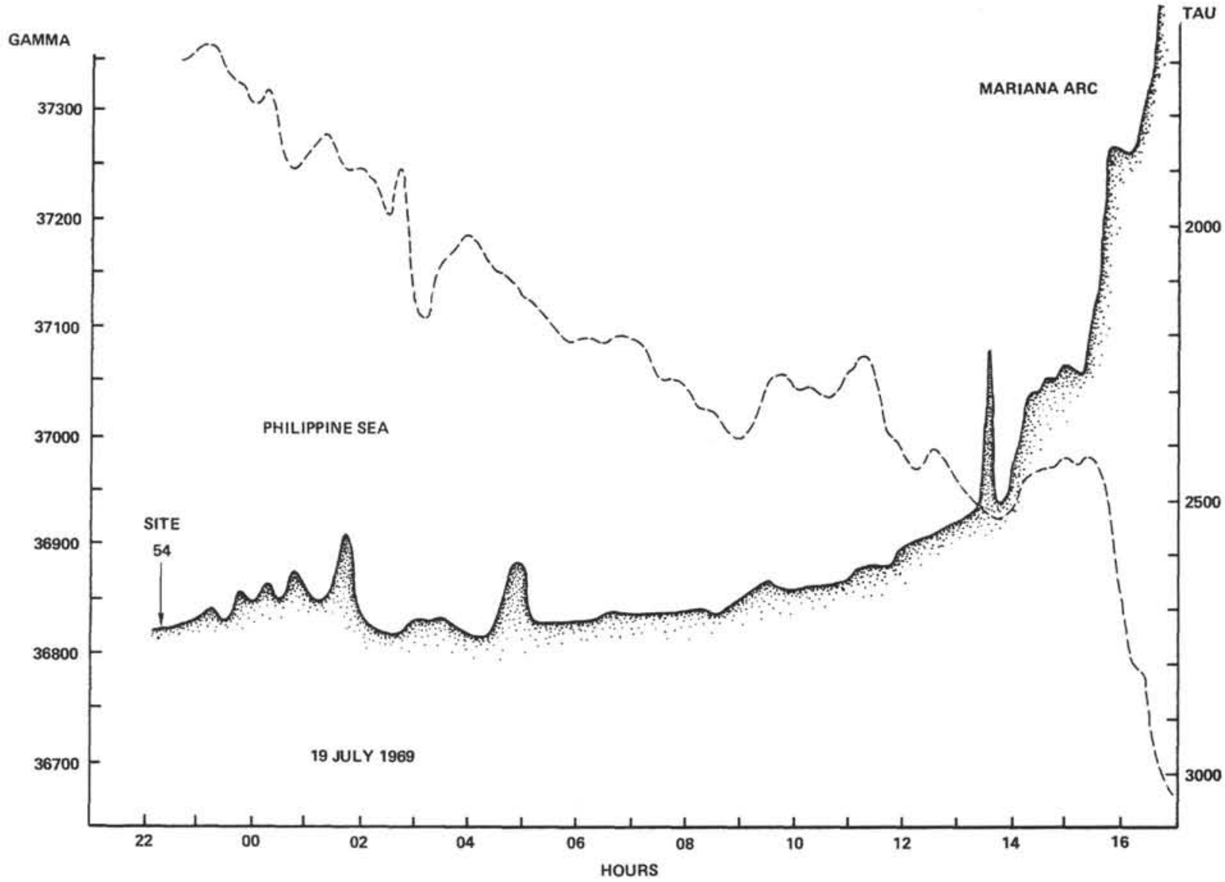


Figure 1. Challenger *bathymetric and magnetic profile at Site 54.*

NATURE OF THE SEDIMENTS

Nine cores taken from one hole at this site provide spot samples of the interval between 83 and 294 meters below mudline. Two lithologic units were encountered:

(1) Gray volcanic ash, comparable in age and lithology to Unit C at Site 53. This unit is over 187 meters thick at Site 54 (the top and bottom contacts were not cored), compared to the approximately 153 meters present at Site 53. At Site 54 this unit is present in Cores 1 through 7.

(2) Volcanic rocks, comparable in lithology to Unit E at Site 53; sampled by Cores 8 and 9.

Units A, B, and D of Site 53 were not encountered at Site 54, probably because the appropriate intervals were not cored.

The volcanic ash at this site very closely resembles Unit C of Site 53. The major difference, aside from increased thickness, is that at Site 54 the volcanic ash is calcareous wherever sampled, whereas only the top part is calcareous at Site 53.

The ash is generally poorly sorted and contains, in addition to the dominant volcanic glass, common to abundant clay minerals. The glass is predominantly colorless and unaltered, and is commonly in the form of elongate shards with tubular vesicles, as at Site 53. Also present are small amounts of light brown glass (Chapter 38) and weakly birefringent, altered glass. Calcareous nannofossils, most notably large discoasters, are an abundant constituent in all ash samples examined (Chapter 38). Throughout the ash there are also substantial amounts (5 to 10 per cent) of very fine-grained, anhedral calcite particles that are mostly less than 5 microns across; although this material may represent altered or disaggregated nannofossils, it is tentatively considered of non-skeletal, possibly diagenetic origin. Minor constituents of the ash include tests of planktonic foraminifera and Radiolaria, sponge spicules, and angular grains of plagioclase, quartz, amphibole, pyroxene, mica and opaque minerals. X-ray studies by Rex suggest in addition the presence of considerable amounts of cristobalite which, however, was not identified visually in the smear slides.

Predominant grain sizes in the ash are in the silt to sand range, but there are a few dominantly clayey and

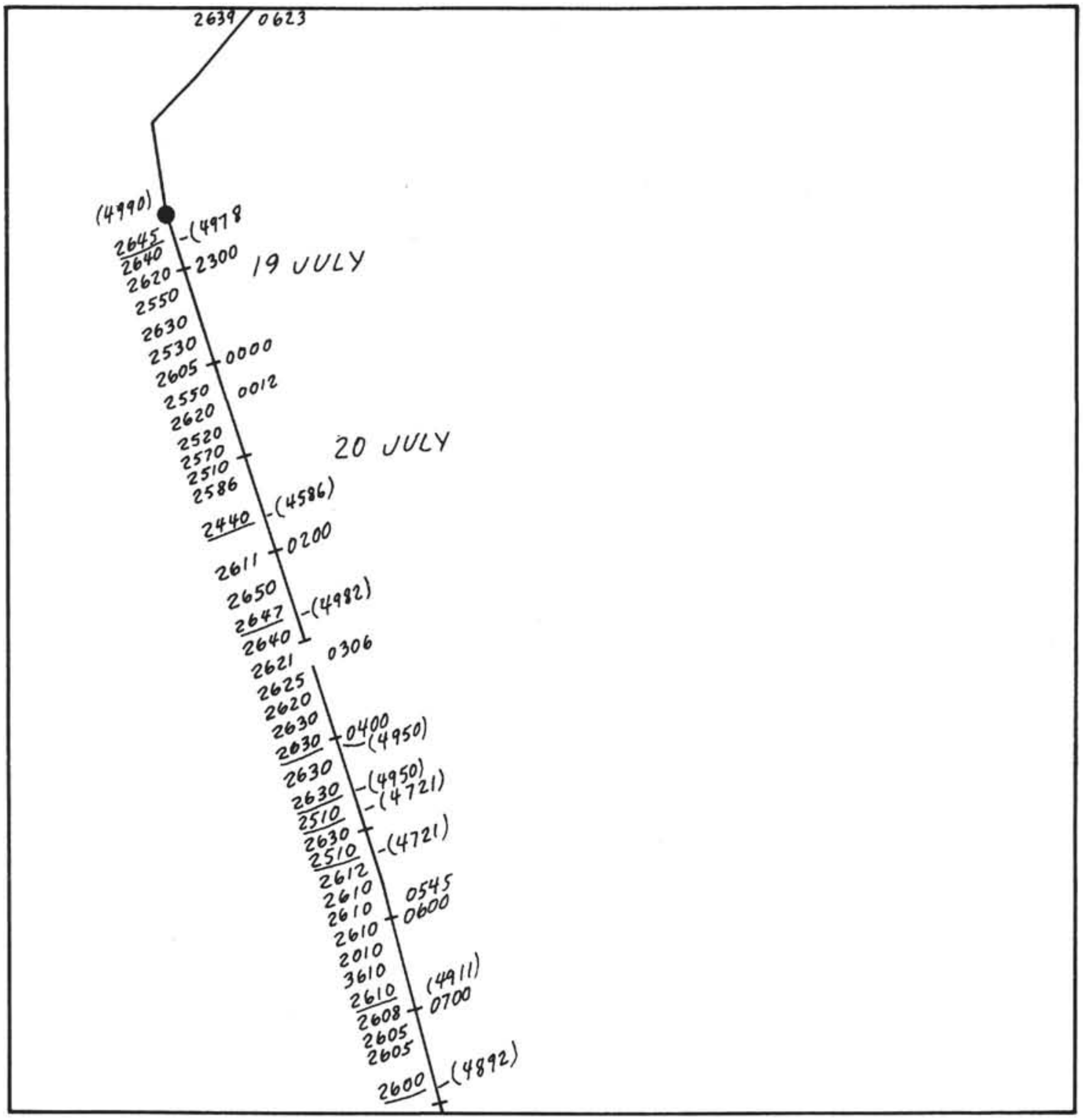


Figure 2. *Bottom soundings in area of Site 54.*

pebbly layers. There are also a few obviously graded beds in which the grain size decreases upward from a basal portion composed of coarse pumice pebbles. In consistency, the ash varies from water-rich, incoherent layers (usually the coarse sandy ash layers) to firm and coherent beds (typically the finer-grained layers); some of the latter appear moderately cemented. The color is dominantly gray to dark gray-brown although Core 5 recovered pebble size clasts of gray, black, white, green and red pumice and lithified tuff.

Cores 8 and 9 recovered about 160 centimeters of volcanic rock capped by a breccia (Plate 1). The breccia (Plate 1A, Figure 1), 15 to 20 centimeters of which was recovered, consists of angular clasts of vitreous black volcanic glass and dark gray, aphanitic volcanic rock cemented in a fine-grained, white to pink tuffaceous matrix containing clay minerals, fine-grained plagioclase, zeolites (?) and iron oxides, and sand-size grains of volcanic glass. The matrix is cut by thin, randomly oriented calcite veins. Most of the clasts are elongate, with their long dimensions oriented at high angles to the core margins. Most of the clasts of glass have outer rims, 2 to 3 millimeters thick, of yellow-brown palagonite. Refractive index measurements of the black unaltered glass give n = 1.585, indicating a basaltic composition (48 to 50 per cent silicon dioxide, d = 2.80).

The top of the underlying volcanic rock is marked by a thin (5 to 10 millimeters), discontinuous rim of

TABLE 1
Summary of Coring at Site 54

Core No.	Interval Cored (below mudline) (ft)	(m)	Recovery (ft)	(m)
54.0-1	273-303	83.2-92.4	16	4.8
54.0-2	452-482	127.8-146.9	21	6.4
54.0-3	639-669	194.8-203.9	6	1.8
54.0-4	669-699	203.9-213.1	6	1.8
54.0-5	699-729	213.1-222.2	4	1.2
54.0-6	729-759	222.2-231.3	21	6.4
54.0-7	857-887	261.2-270.4	13	3.9
54.0-8	958-961	292.0.292.9	3	0.9
54.0-9	961-963	292.9.293.5	2	0.6

Water depth: 4990.2 meters (16,372 feet)

banded, black vitrous glass which resembles the rim of a pillow lava (Plate 1, Figure 2). This contact is very irregular and locally appears to have been offset along small faults. Erosion along the contact has removed the glass rim in places, and this probably supplied clasts for overlying breccia.

Most of the volcanic rock is dark gray-brown, hydrothermally altered olivine basalt with variolitic texture and is described by Melson elsewhere in this report. The basalt is laced by a network of veins and pockets of secondary calcite (see Chapter 38), and Plate 1, Figure 3, fine-grained tuffaceous material, and clear euhedral zeolite crystals (probably harmotome). Some of the thicker veins are composite, having sparry calcite along one or more margins and white tuffaceous material in the middle; others change along the length of the vein from calcite-filled to zeolite-filled. Although no interlayered limestone beds were encountered, as at Site 53, a small light brown limestone clast is enclosed in basalt at about 15 centimeters above the base of Core 8.

PHYSICAL PROPERTIES

Coring disturbance prevented these physical properties from accurately representing *in situ* conditions.

Natural Gamma Radiation

Natural gamma radiation emitted from Miocene calcareous volcanic ash, recovered from 83 meters to 266 meters below mudline in Hole 54.0, averaged 550 counts/7.6-cm core segment/1.25 minutes. Radiation limits were 200 to 900 counts, which is small. There is no consistent variation with depth. What small variations occur between cores are probably due to porosity changes or the relative amounts of volcanic glass and clay present in these ash beds.

Porosity, Wet-Bulk Density and Water Content

Porosities and wet-bulk densities of Miocene calcareous volcanic ash (83 to 266 meters) averaged about 62 per cent and 1.54 g/cc at Hole 54.0, with a minimum porosity of 43 per cent and a maximum density of 1.75 g/cc. Water content ranged from 38 to 54 per cent, typically being 42 per cent. Porosities and water contents did not appear to decrease with depth. Some porosity variations were probably related to grain size variations.

Sediment Sound Velocity

Sound velocities through the Miocene calcareous volcanic ash, at Hole 54.0 (83 to 266 meters), ranged from 1.59 to 1.89 km/sec, averaged 1.72 km/sec, and varied irregularly with increasing depth. Between 82 and 270 meters below the mudline, the sediment is compact gray volcanic ash with average core sound velocities ranging from 1.64 to 1.83 km/sec. The volcanic glass content of this ash varies from 55 to 70 per cent. There is a close correlation between sediment compactness and sound velocity. The lowest sound velocities were 1.64 km/sec (averaged over the interval of 83 to 90 meters) and here the penetrometer values averaged 38 $\times 10^{-1}$ millimeters. The highest sound velocities were 1.77 to 1.88 km/sec through sediments recovered between 223 and 231 meters, which were associated with a low average penetrometer measurement of only 0.4 $\times 10^{-1}$ millimeters.

At a depth of 292 meters below mudline, hard volcanic rock was encountered by the drill. The uppermost 15 centimeters of this rock comprised black vitreous volcanic glass fragments in a matrix of fine-grained volcanic glass. Two sound velocity measurements of 3.68 and 3.74 km/sec were obtained. Below the glassy breccia was an altered basaltic rock with sediment sound velocities ranging from 5.16 to 5.74 km/sec. The average of five measurements was 5.44 km/sec.

Penetrometer

Average penetrometer values for each core recovered in Hole 54.0 ranged from 4 to 38 $\times 10^{-1}$ millimeters in this Miocene volcanic ash (83 to 270 meters), the complete range being from zero to complete penetration. The penetrometer completely penetrated the coarse soft watery ash in the top 50 centimeters of Core 1 (82.2 meters below mudline). The penetrometer values have a direct variation with the sediment sound velocity values.

Thermal Conductivity

Two thermal conductivity measurements were made in volcanic ash from Hole 54.0. Core 1 (depth of 86 meters below mudline) had a thermal conductivity of 2.13×10^{-3} cal-°C^{-1}cm^{-1} sec^{-1}, and Core 3 (depth of 195 meters to 204 meters) 2.04×10^{-3} cal-°C^{-1}cm^{-1} sec^{-1}.

CONCLUSIONS

As at Site 53, the sediments consist mainly of Miocene volcanic ash. They include some beds of pumice tuff, somewhat coarser than those seen at Site 53. The composition of the glass, as determined by refractive indices, ranges from andesitic to basaltic. The occurrence of some graded beds supports the view that some of these ash beds may have been resedimented by turbidity currents.

The bulk of the section penetrated is of Middle Miocene age.

Although the water depth is similar to that at Site 53, and the sediments are of the same general character, Site 54 shows a much better preservation of calcareous fossils. Foraminifera are common, as are heterococcoliths, whereas at Site 53, the biota was largely reduced to the most solution-resistant discoasters.

The sediments are underlain by a basaltic lava flow, with a mantle of basaltic glass breccia.

The general history at Site 54 seems to correspond closely to that at Site 53, and at Guam. The eastern Philippine Sea appears to have as geophysical basement a basaltic (on Guam, andesitic also) lava complex with interbedded sediments of Eocene-Oligocene and possibly early Miocene age; and, this is succeeded by mixed andesitic-basaltic pumice tuffs and ashes, erupted from the ridges in Miocene time. Site 54 has made no direct contribution to the age of the basal flow sequence, other than that it is pre-Middle Miocene.

PLATE 1

Volcanic rock recovered from acoustic basement at Site 54 in the Philippine Sea.

Figure 1	Breccia comprising angular clasts of black glass and dark gray aphanitic rock in a fine-grained white to pink tuffaceous matrix. Most of the clasts have outer rims of yellow-brown palagonite.
Figure 2	Contact between breccia above and volcanic rock. Note very irregular and discontinuous rim of black glass along contact. Veins of calcite and white tuffaceous material cut volcanic rock.
Figure 3	Hydrothermally altered olivine basalt cut by veins similar to those described in Figure 2.

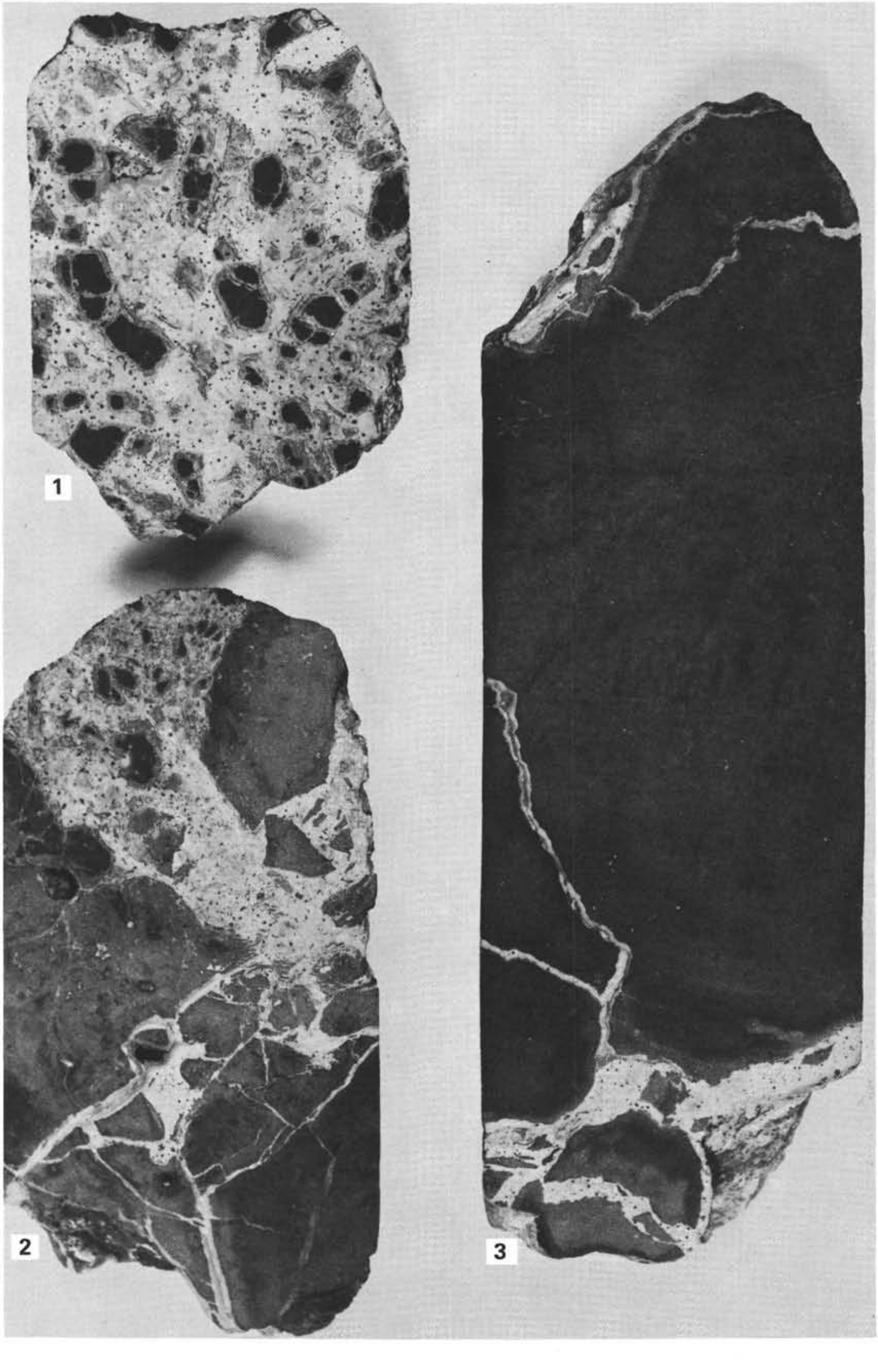


Plate 1.

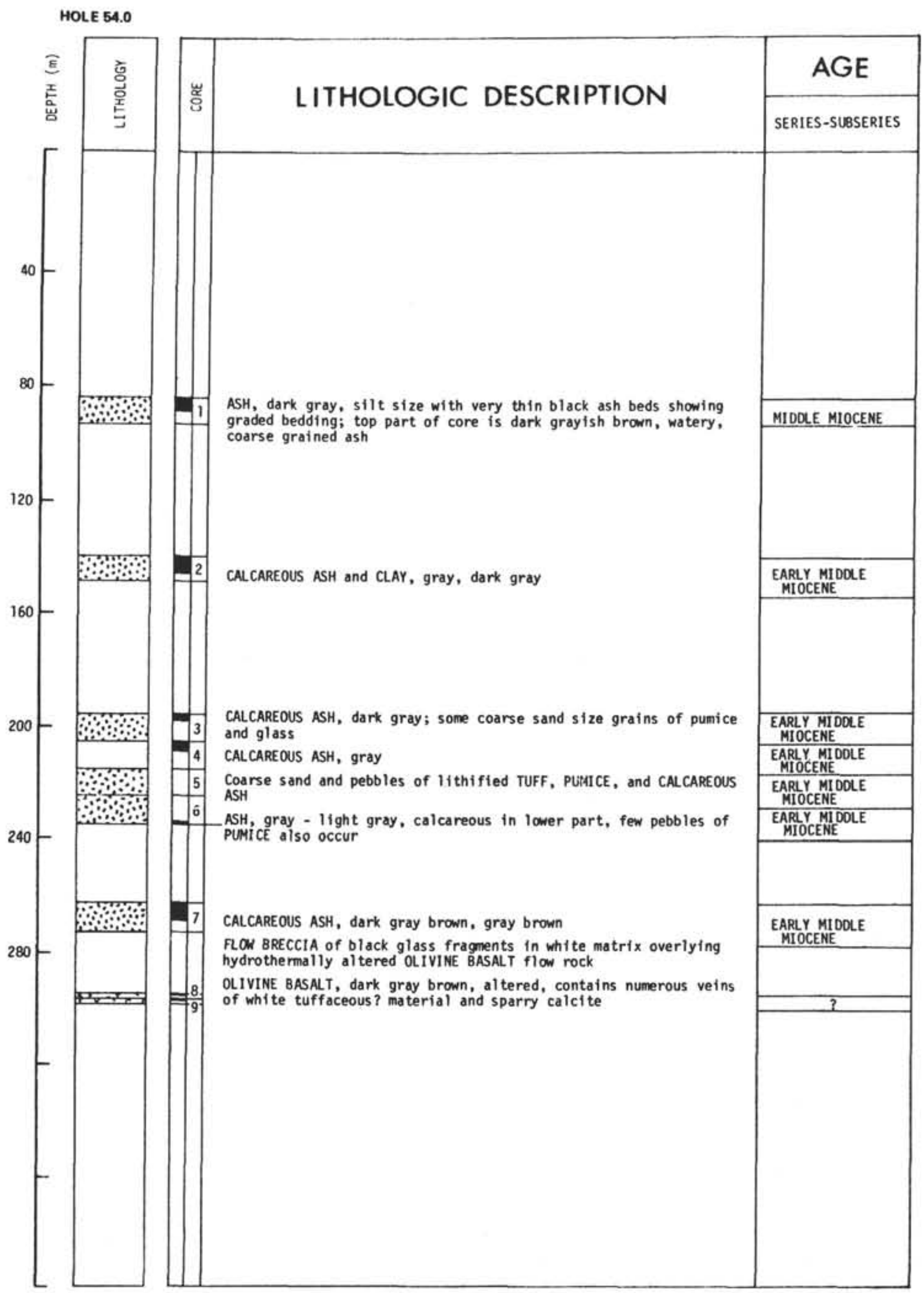


Figure 3. *Summary of lithology in Hole 54.0.*

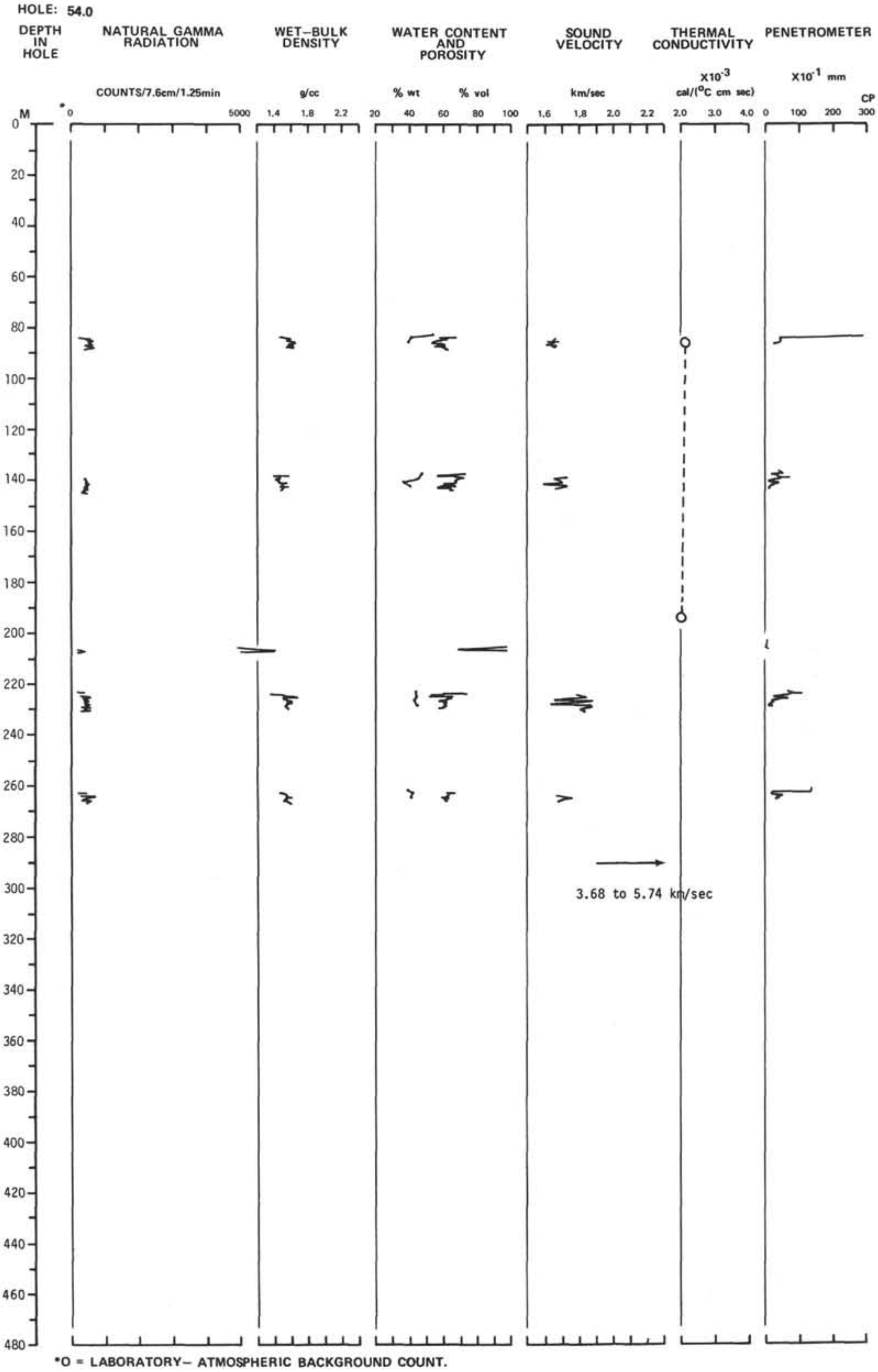


Figure 4. *Summary of physical properties in Hole 54.0.*

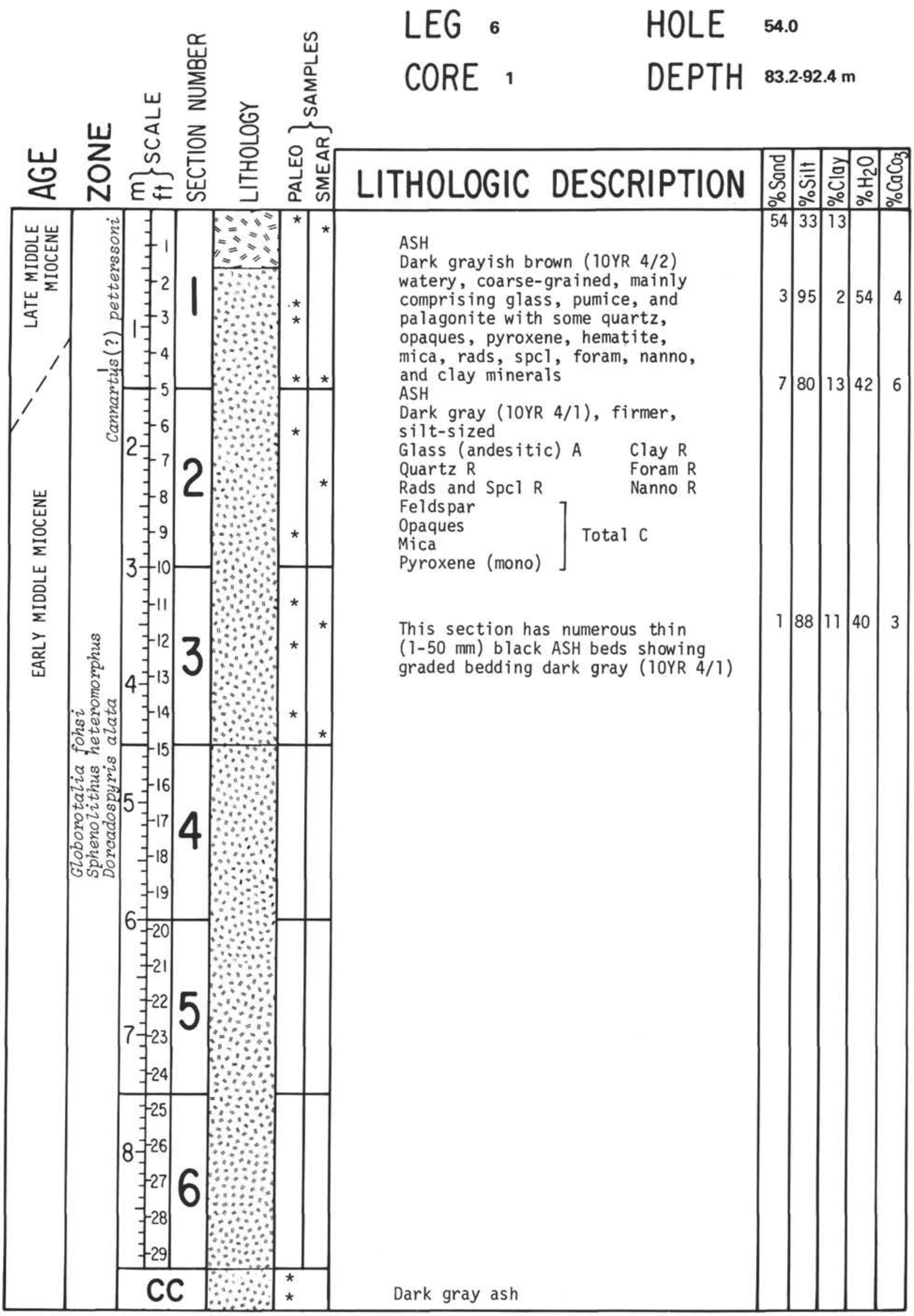


Figure 5. *Summary of lithology in Hole 54.0 Core 1.*

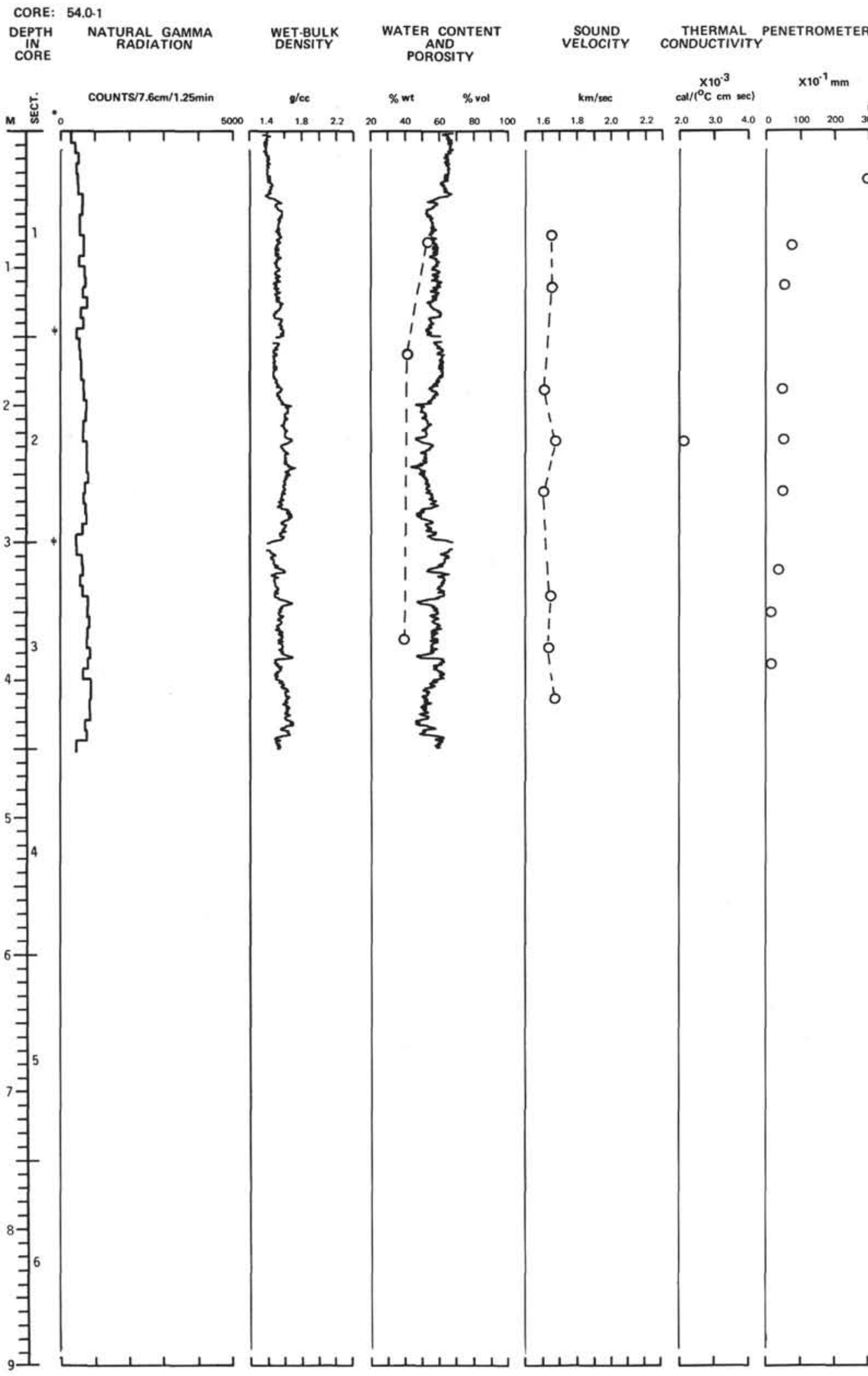


Figure 6. *Summary of physical properties in Hole 54.0 Core 1.*

LEG 6 HOLE 54.0

CORE 1 DEPTH 33.2-92.4 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Very scarce and small *Orbulina universa, Candorbulina universa, Globigerina bulloides, G. concinna, G. parabulloides, G. quinqueloba, G. falconensis* determine the age of sediments only as the Middle Miocene (perhaps the upper part of the *Globorotalia fohsi* Zone, lower Middle Miocene).	Assemblages of the lower middle Miocene *Sphenolithus heteromorphus* Zone are present throughout the core. Species present include *Cyclococcolithina leptoporus, C. neogammation, Discoaster aulakos, D. brouweri s.l., D. deflandrei, D. exilis, D. variabilis, Helicopontosphaera kamptneri,* and *Spehnolithus heteromorphus. Reticulofenestra pseudoumbilica* is present only at the top of the core.	Radiolaria are common (not abundant) in the top of the core and rare in the middle and bottom parts. Section one contains species probably of the middle Miocene *Cannartus petterssoni* Zone. Species in section 2 represent the next lower zone, *Dorcadospyris alata,* also middle Miocene. Below section 2 radiolarians are too rare to indicate a definite zone. TOP: *Cannartus laticonus, Stichocorys delmontense, Cyrtocapsella cornuta, Lithopera neotera, L. bacca, L. thornburgi,* and *Cyrtocapsella tetrapera.* SECTION 2: *Stichocorys delmontense, Calcocycletta costata, Cyrtocapsella cornuta.*

Figure 7. *Summary of biostratigraphy in Hole 54.0 Core 1.*

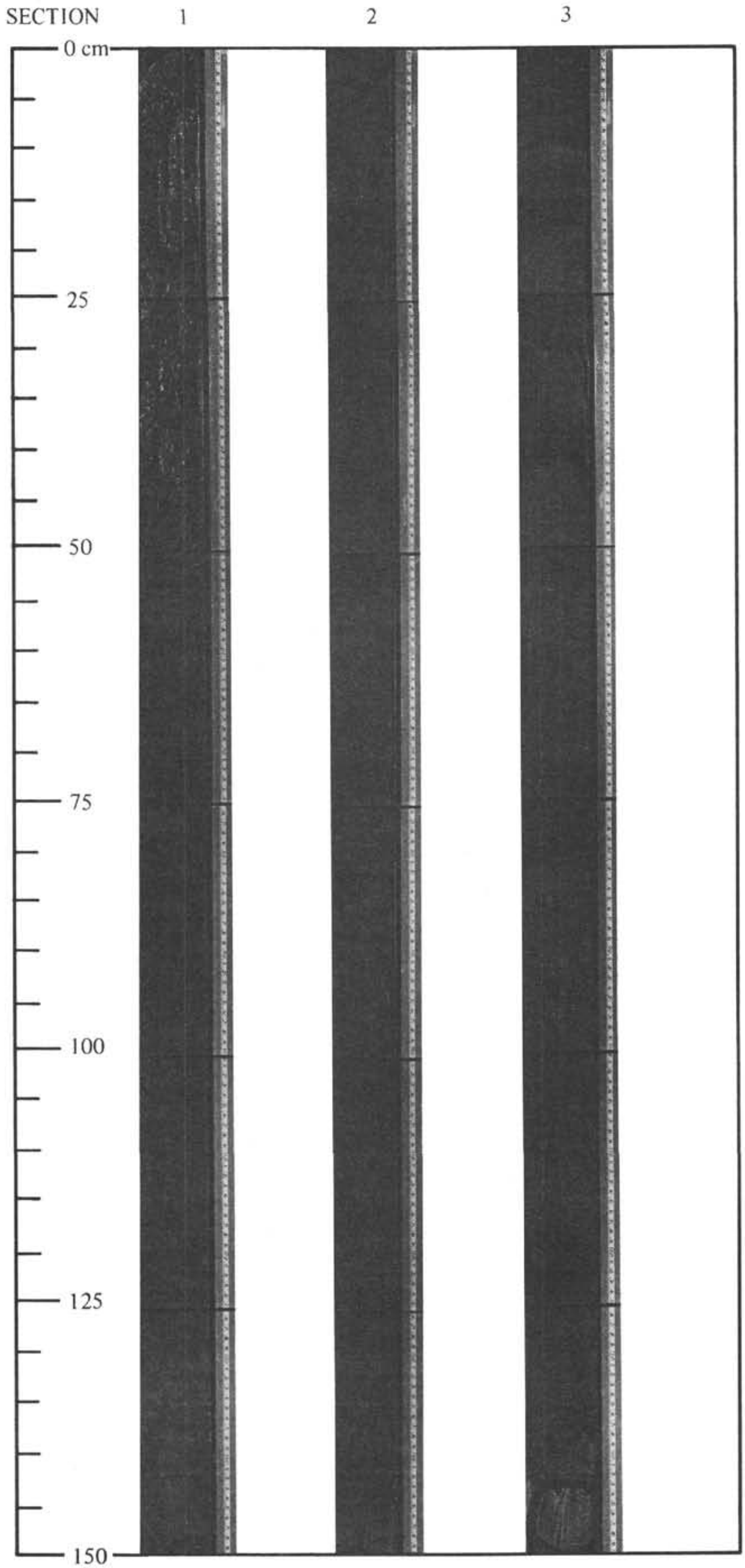


Plate 2. *Photographs of Hole 54.0 Core 1.*

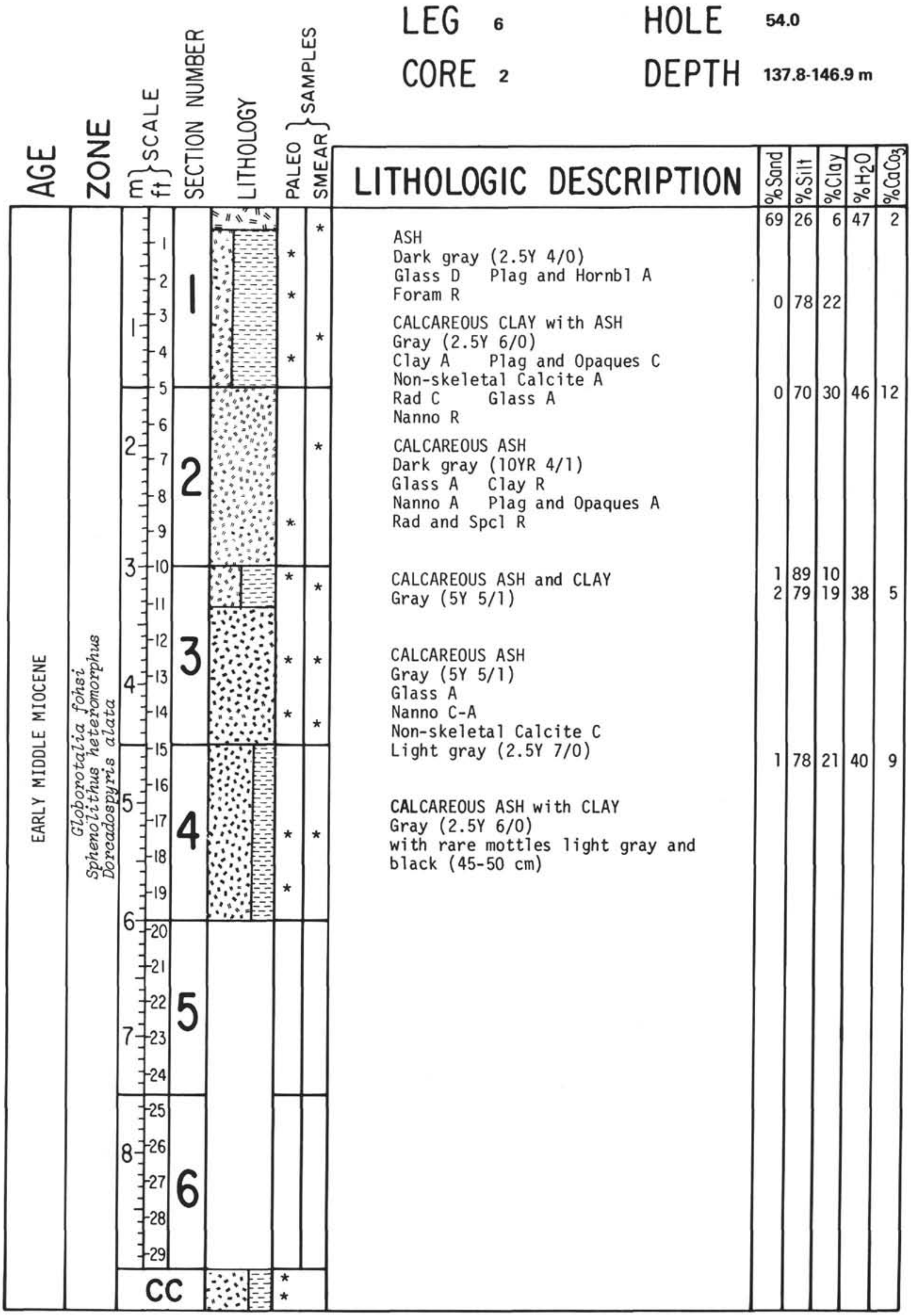


Figure 8. *Summary of lithology in Hole 54.0 Core 2.*

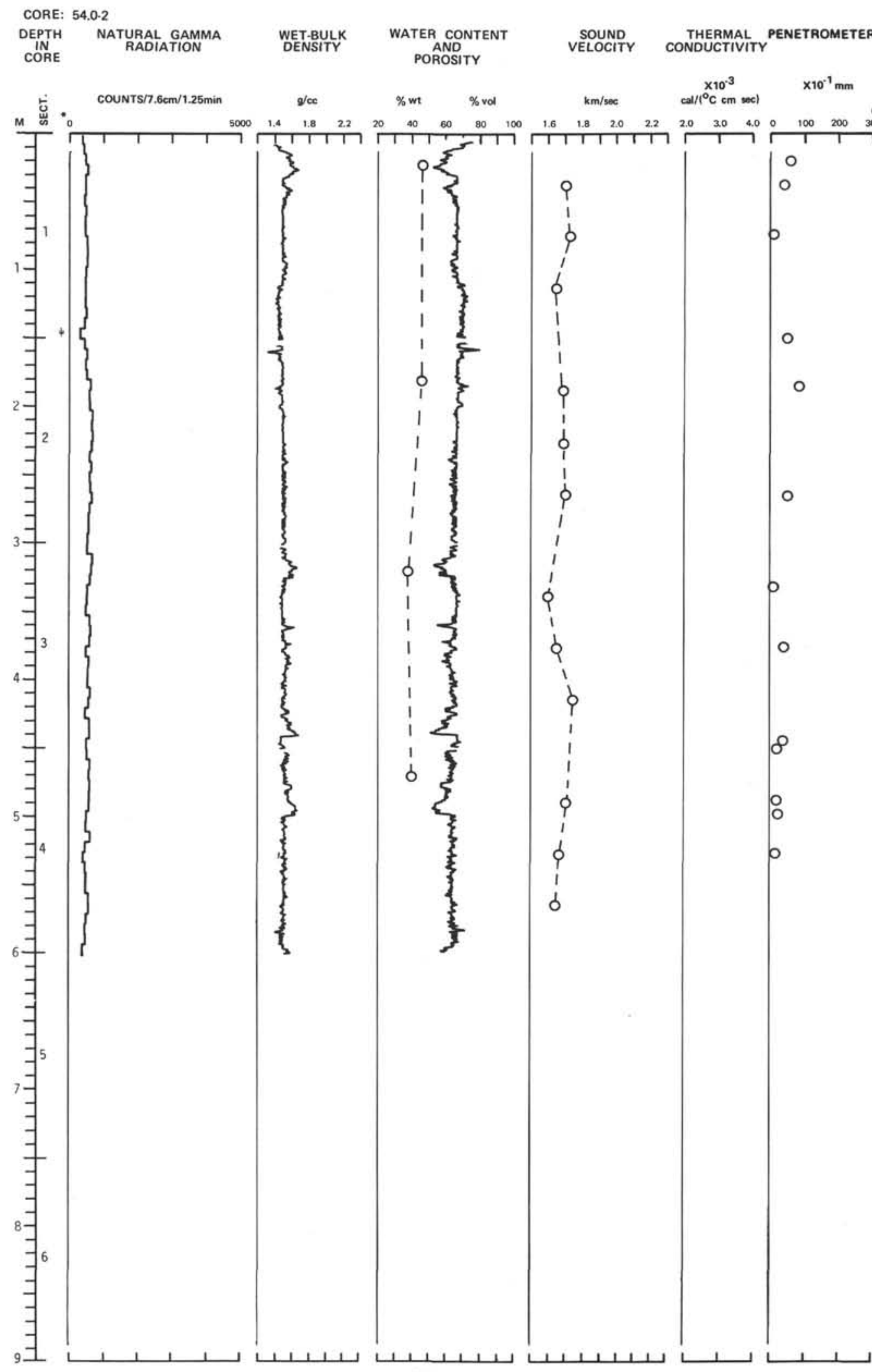


Figure 9. *Summary of physical properties in Hole 54.0 Core 2.*

LEG 6 HOLE 54.0

CORE 2 DEPTH 137.8-146.9 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Some samples of this core contain rare and small planktonic Foraminifera of the *Globorotalia fohsi* Zone, lower Middle Miocene. Assemblages include *Candorbulina universa, Globorotalia praemenardii, G. obesa, G. scitula praescitula, G. mohleri, Globigerinoides irregularis, G. trilobus, Globigerina parabulloides, G. juvenilis* and single specimens of *Orbulina universa, Globigerinoides bisphaerica, Globoquadrina dehiscens, Sphaeroidinellopsis grimsdalei.*	Assemblages of the lower middle Miocene *Sphenolithus heteromorphus* Zone are present throughout the core. Species present include *Cyclococcolithina neogammation, Discoaster brouweri s.l., D. challengeri, D. deflandrei, D. exilis, D. variabilis, Discolithina* sp. [large], *Helicopontosphaera kamptneri,* and *Sphenolithus heteromorphus.*	Radiolaria are common at the top of this core, rare toward the bottom. Well preserved assemblages are of the lower middle Miocene *Dorcadospyris alata* Zone. TOP: *Stichocorys sp., Cannartus laticonus, Cyrtocapsella cornuta, Lithopera neotera, Dorcadospyris alata, Lithopera renzae,* and *L. baueri.* BOTTOM: *Stichocorys worffii.*

Figure 10. *Summary of biostratigraphy in Hole 54.0 Core 2.*

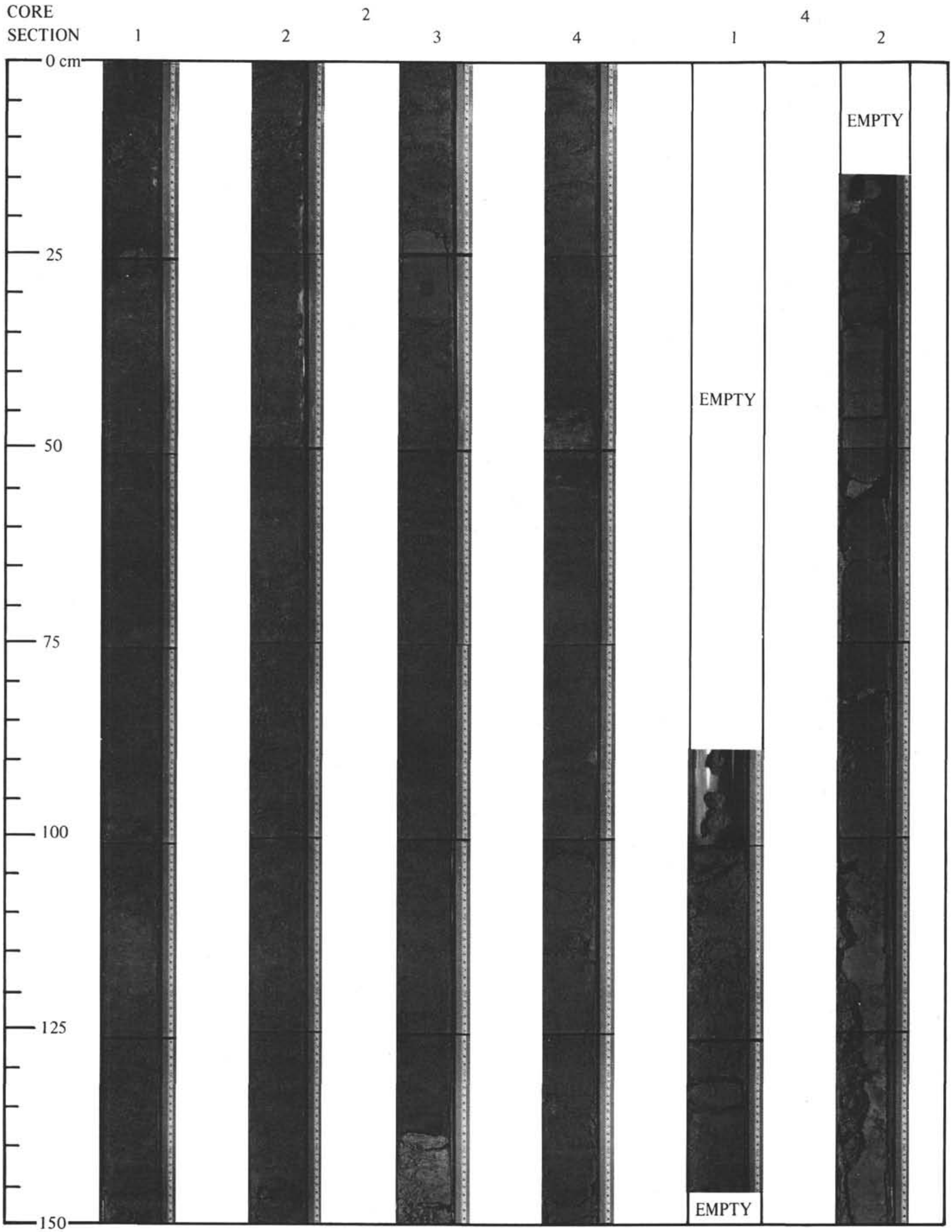


Plate 3. *Photographs of Hole 54.0 Cores 2 and 4.*

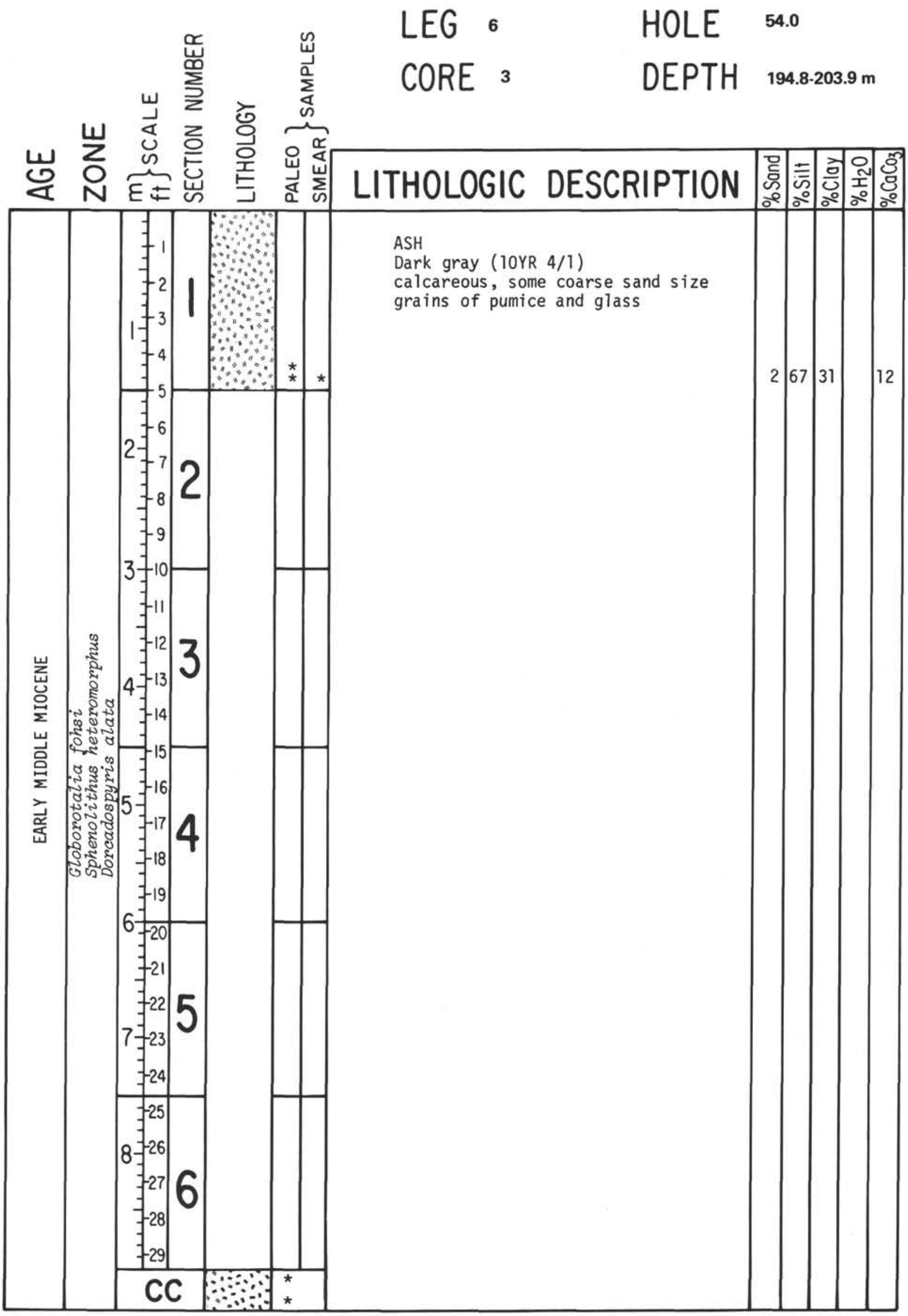


Figure 11. *Summary of lithology in Hole 54.0 Core 3.*

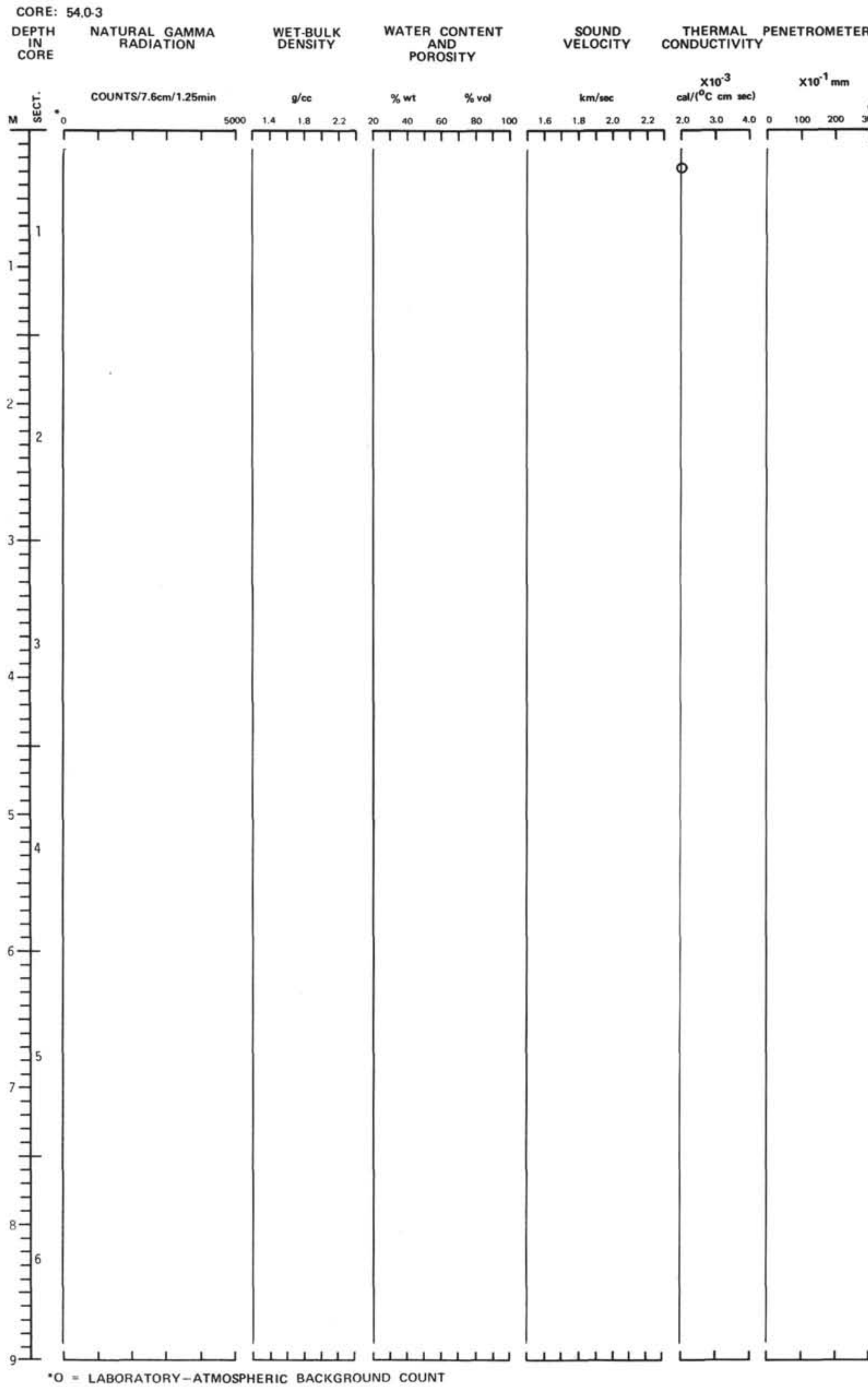


Figure 12. *Summary of physical properties in Hole 54.0 Core 3.*

LEG 6 **HOLE** 54.0

CORE 3 **DEPTH** 194.8-203.9 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
This core can be attributed to the *Globorotalia fohsi* Zone of lower Middle Miocene. Poor assemblages of planktonic Foraminifera consist of rare *Candorbulina universa*, *Globigerinoides trilobus*, *G. irregularis*, *Globigerina foliata*, *Sphaeroidinellopsis grimsdalei*.	Assemblages of the lower middle Miocene *Sphenolithus heteromorphus* Zone are present throughout the core. Species present include *Cyclococcolithina neogammation*, *Discoaster brouweri s.1.*, *D. challengeri*, *D. deflandrei*, *D. exilis*, *D. variabilis*, *Discolithina* sp. [large], *Helicopontosphaera kamptneri*, and *Sphenolithus heteromorphus*.	Radiolaria are abundant at the top of the core, rare at the bottom. The assemblages present probably represent the lower middle Miocene *Dorcadospyris alata* Zone. TOP: *Stichocorys delmontense*, *Cannartus laticonus*, *Cyrtocapsella cornuta*, and *Dorcadospyris sp.* BOTTOM: *Stichocorys delmontense*, *S. wolffii (?)*, and *Cannartus laticonus*.

Figure 13. *Summary of biostratigraphy in Hole 54.0 Core 3.*

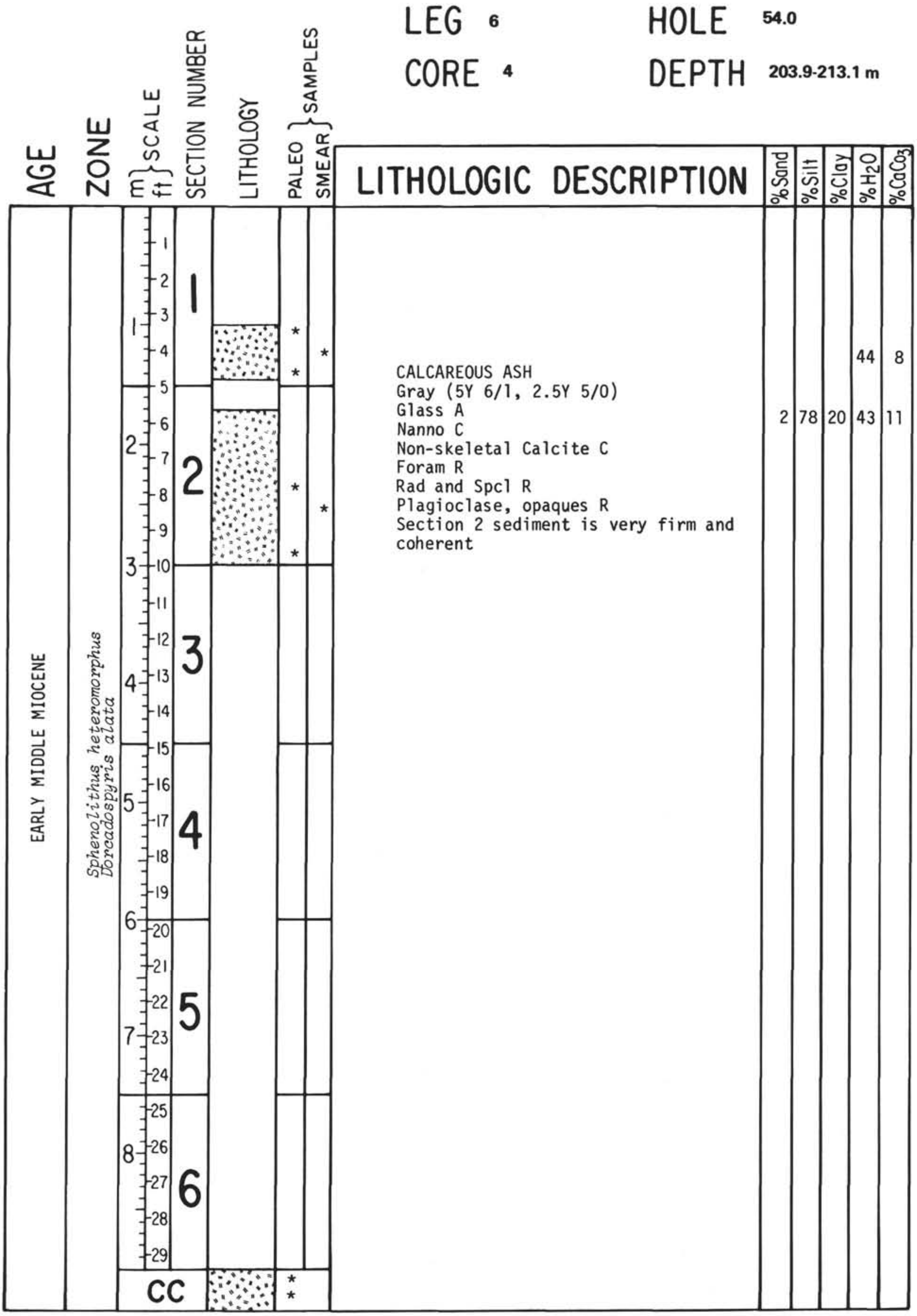


Figure 14. *Summary of lithology in Hole 54.0 Core 4.*

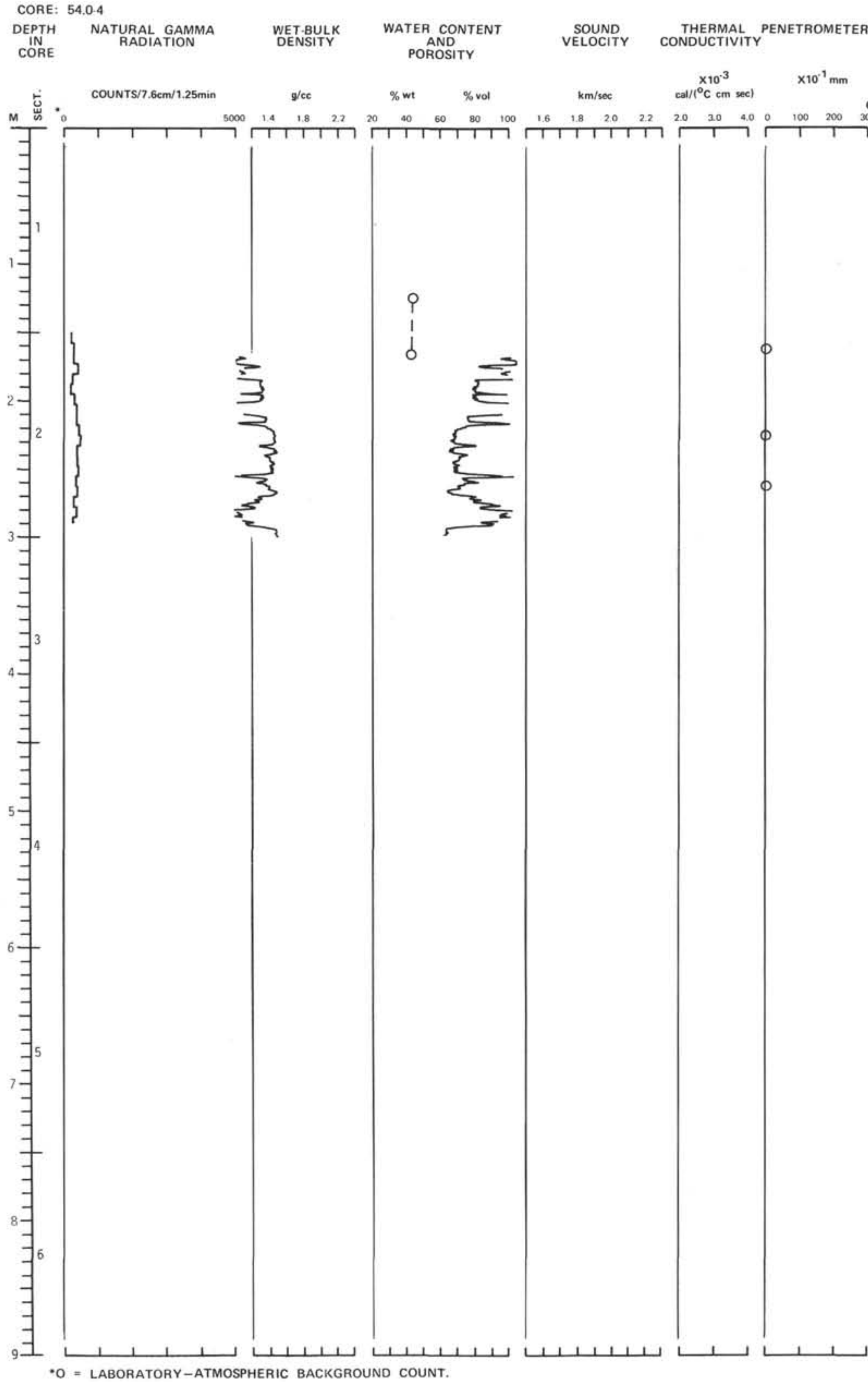


Figure 15. *Summary of physical properties in Hole 54.0 Core 4.*

LEG 6 **HOLE** 54.0

CORE 4 **DEPTH** 203.9-213.1 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
Very poor assemblages of the *Globorotalia fohsi* Zone, lower Middle Miocene, were traced throughout the core. Planktonic Foraminifera are presented but rare *Candorbulina universa*, *Globorotalia obesa*, *G. mayeri*, *Globigerina foliata*, *G. concinna*, *Globigerinoides trilobus*, *Sphaeroidinellopsis grimsdalei*.	Assemblages of the lower middle Miocene *Sphenolithus heteromorphus* Zone are present throughout the core. Species present include *Cyclococcolithina neogammation*, *Discoaster brouweri s.l.*, *D. challengeri*, *D. deflandrei*, *D. exilis*, *D. variabilis*, *Discolithina* sp. [large], *Helicopontosphaera kamptneri*, and *Sphenolithus heteromorphus*.	Radiolaria are abundant in the top of the core and rare at the bottom. The assemblage represents the lower middle Miocene *Dorcadospyris alata* Zone. TOP: *Stichocorys delmontense*, *Calocyclas costata*, *Cytocapsella cornuta*, *C. tetrapera*, and *Dorcadospyris alata*. BOTTOM: *Stichocorys wolffii*.

Figure 16. *Summary of biostratigraphy in Hole 54.0 Core 4.*

LEG 6 HOLE 54.0

CORE 5 DEPTH 213.1-222.2 m

AGE	ZONE	SCALE m / ft	SECTION NUMBER	LITHOLOGY	SAMPLES PALEO	SAMPLES SMEAR	LITHOLOGIC DESCRIPTION	%Sand	%Silt	%Clay	%H_2O	%$CaCO_3$
EARLY MIDDLE MIOCENE	*Globorotalia fohsi* / *Sphenolithus heteromorphus* / *Dorcadospyris alata*		1									
			2				Core liner collapsed - sediment stored in plastic boxes. Recovered sediment of two types: 1. Rounded coarse sand to pebble size clasts of multicolored (gray, black, white, green, red) lithified TUFF and PUMICE. Material is well sorted, but this may be a drilling phenomenon. Many elongate pumice slivers with pipe-like vesicles. 2. Soft, gray, calcareous ASH components of sand size: Glass A Nanno A Non-skeletal Calcite C Feldspar and Hematite C Clay R					
			3		* ?							
			4									
			5									
			6									
			CC		* *	*						

Figure 17. *Summary of lithology in Hole 54.0 Core 5.*

LEG 6 HOLE 54.0

CORE 5 DEPTH 213.1-222.2 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
None.	Assemblages of the lower middle Miocene *Sphenolithus heteromorphus* Zone are present throughout the core. Species present include *Cyclococcolithina neogammation*, *Discoaster brouweri* s.l., *D. challengeri*, *D. deflandrei*, *D. exilis*, *D. variabilis*, *Discolithina* sp. [large], *Helicopontosphaera kamptneri*, and *Sphenolithus heteromorphus*.	This core contains common representatives of the lower middle Miocene *Dorcadospyris alata* Zone. TOP: not examined. BOTTOM: *Stichocorys delmontense*, *S. wolffii*, *Dorcadospyris alata*, and *Cyrtocapsella japonica*.

Figure 18. *Summary of biostratigraphy in Hole 54.0 Core 5.*

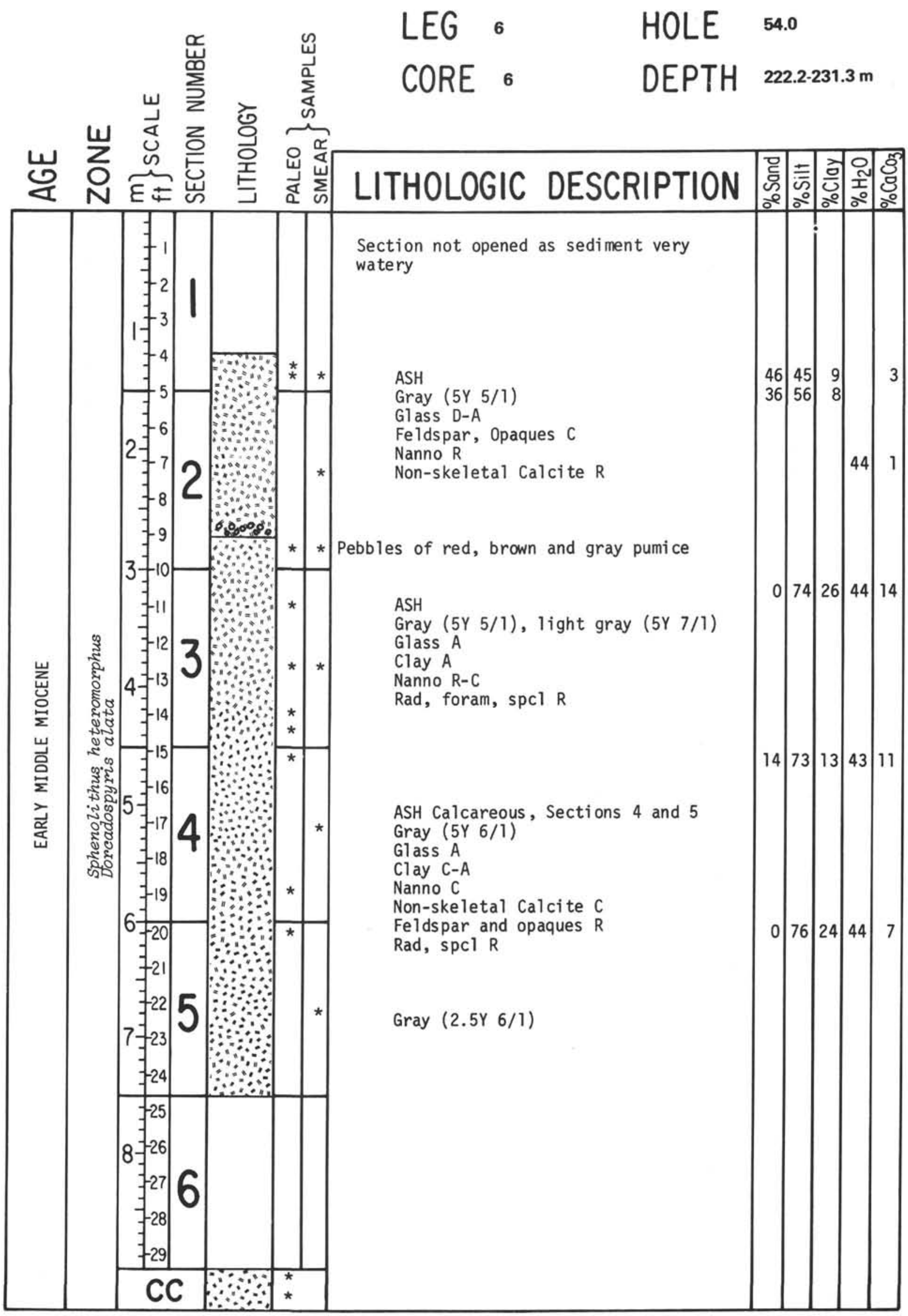


Figure 19. *Summary of lithology in Hole 54.0 Core 6.*

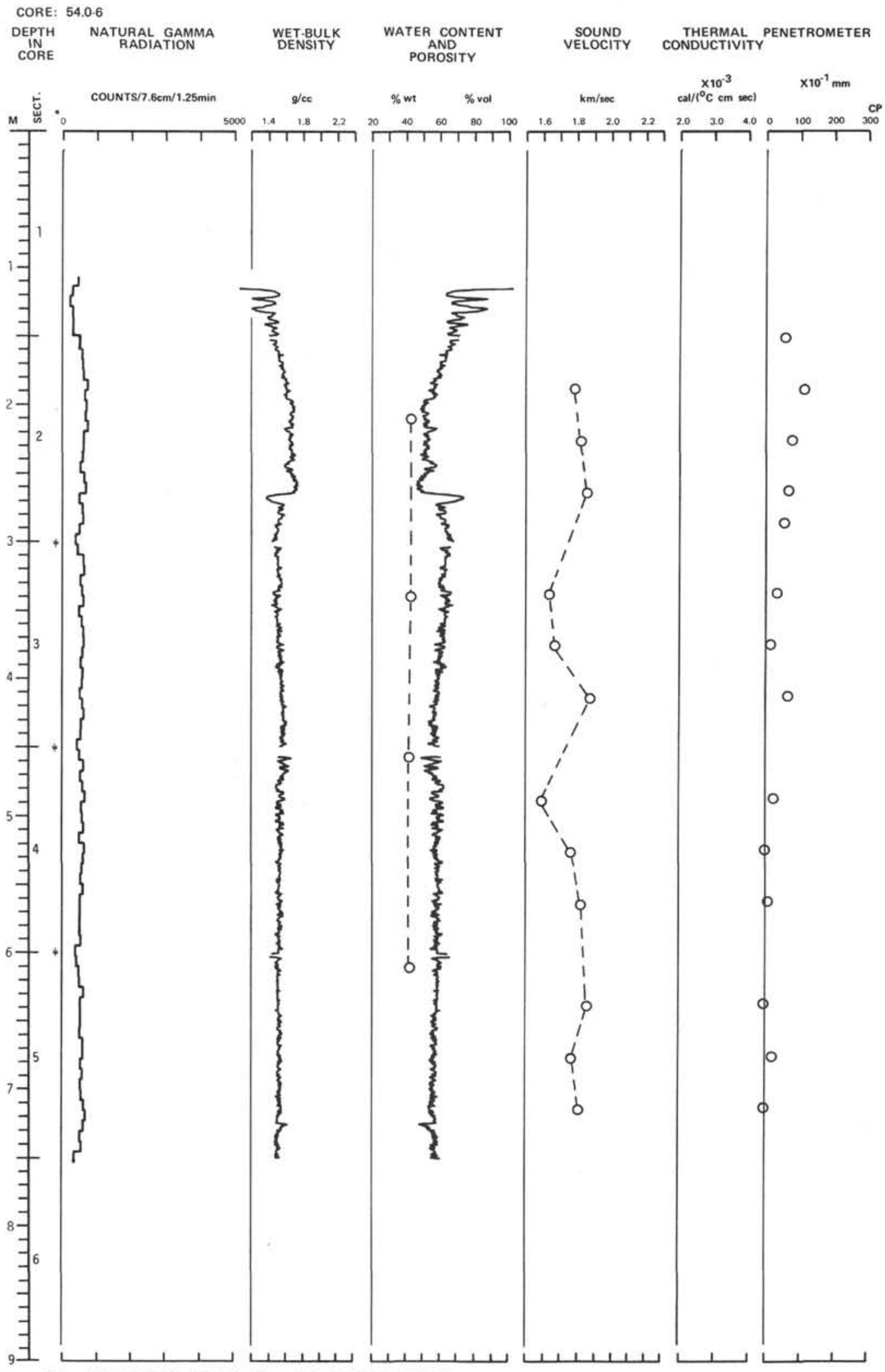


Figure 20. *Summary of physical properties in Hole 54.0 Core 6.*

LEG 6 HOLE 54.0
CORE 6 DEPTH 222.2-231.3 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
None.	Assemblages of the lower middle Miocene *Sphenolithus heteromorphus* Zone are present throughout the core. Species present include *Cyclococcolithina neogammation*, *Discoaster brouweri* s.l., *D. challergeri*, *D. deflandrei*, *D. exilis*, *D. variabilis*, *Discolithina* sp. [large], *Helicopontosphaera kamptneri*, and *Sphenolithus heteromorphus*.	The top part of this core contains no Radiolaria, but they are abundant in the middle part and somewhat less abundant at the bottom. Species of the lower middle Miocene *Dorcadospyris alata* Zone are present. MIDDLE: *Stichocorys delmontense*, *Dorcadospyris alata*, *Cannartus laticonus*, *Cyrtocapsella japonica*, and *Calocycletta costata*. BOTTOM: *Stichocorys delmontense*, *S. wolffii*, *Cyrtocapsella japonica*, *Cannartus laticonus*, and *Calocycletta costata*.

Figure 21. *Summary of biostratigraphy in Hole 54.0 Core 6.*

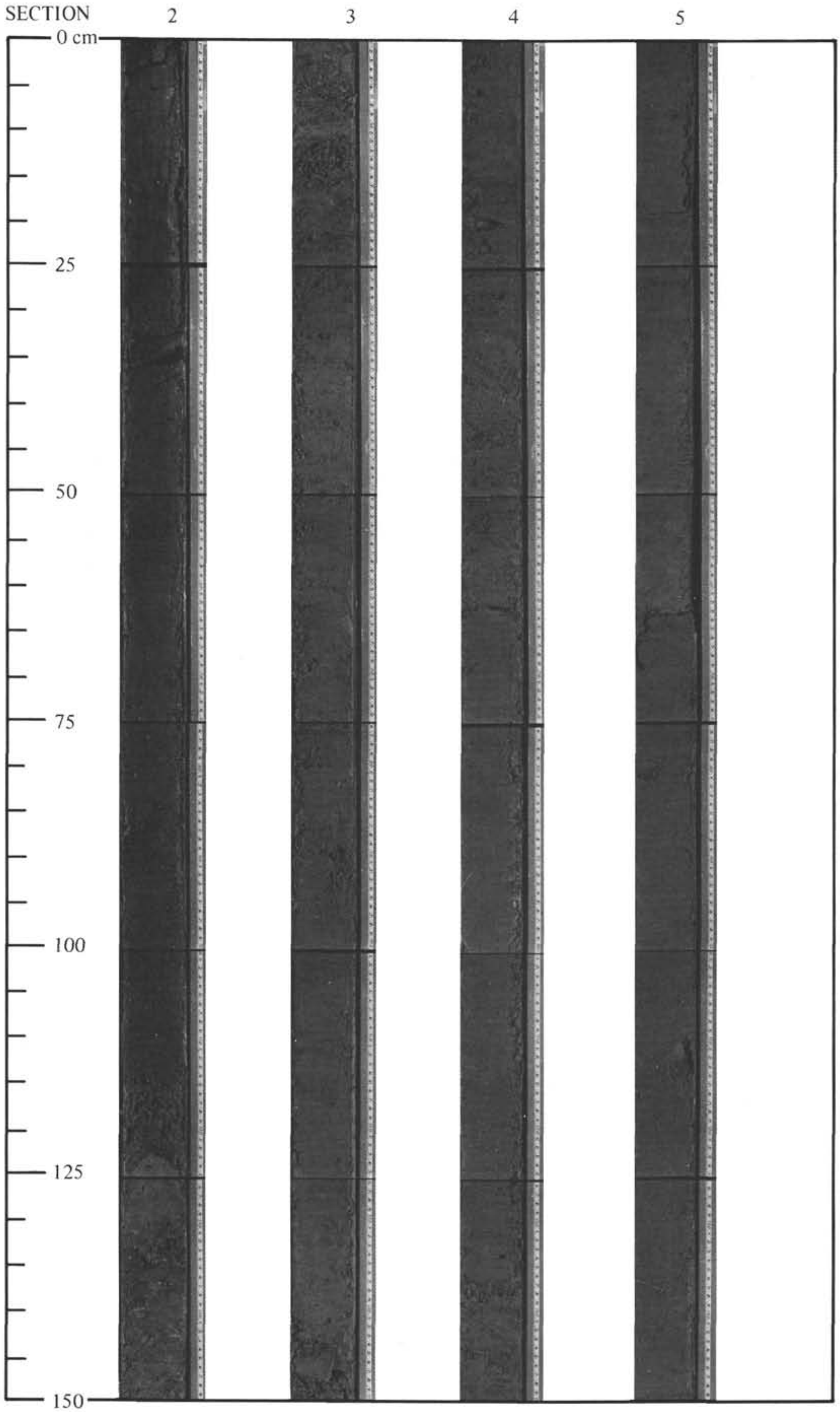


Plate 4. *Photographs of Hole 54.0 Core 6.*

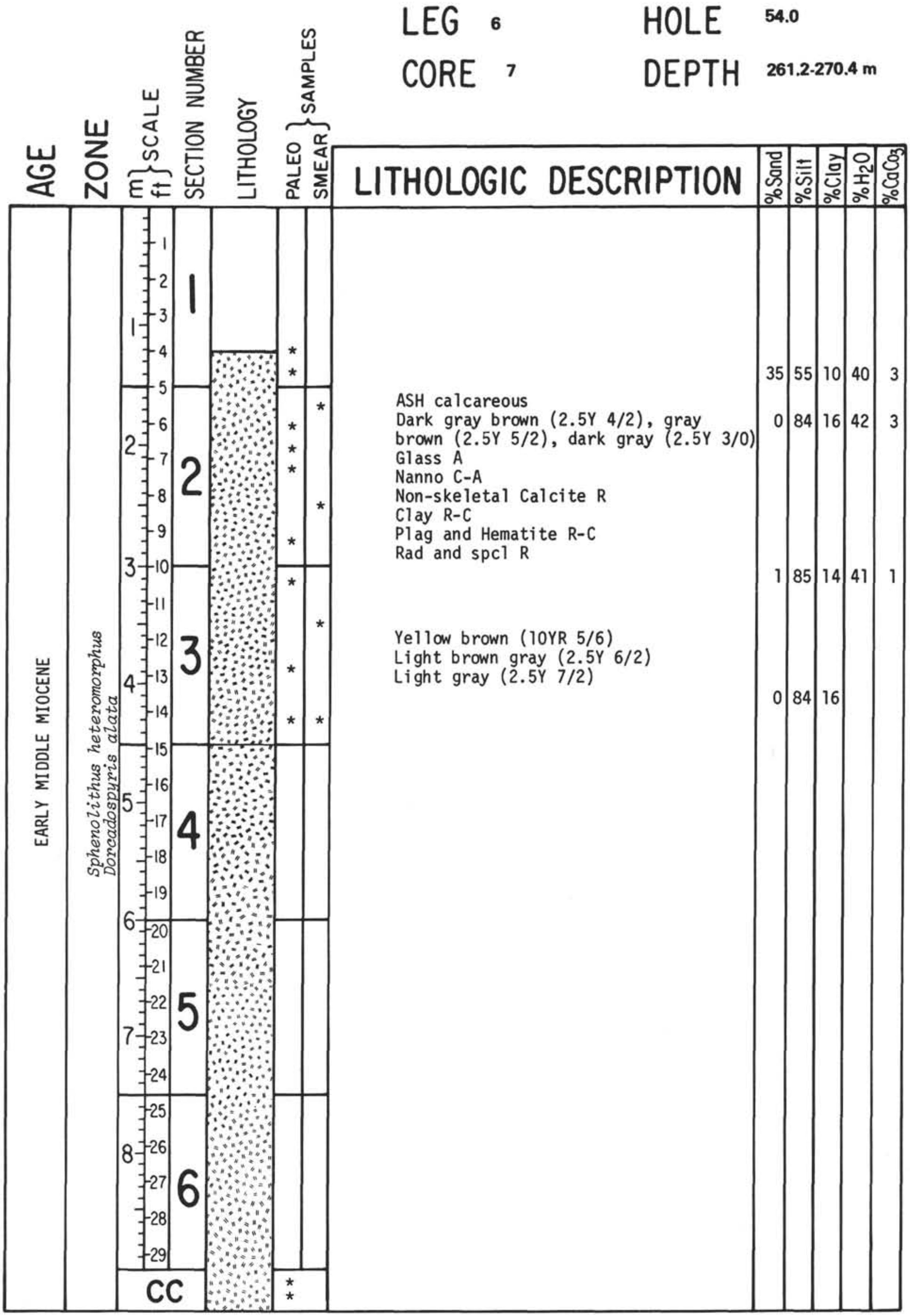


Figure 22. *Summary of lithology in Hole 54.0 Core 7.*

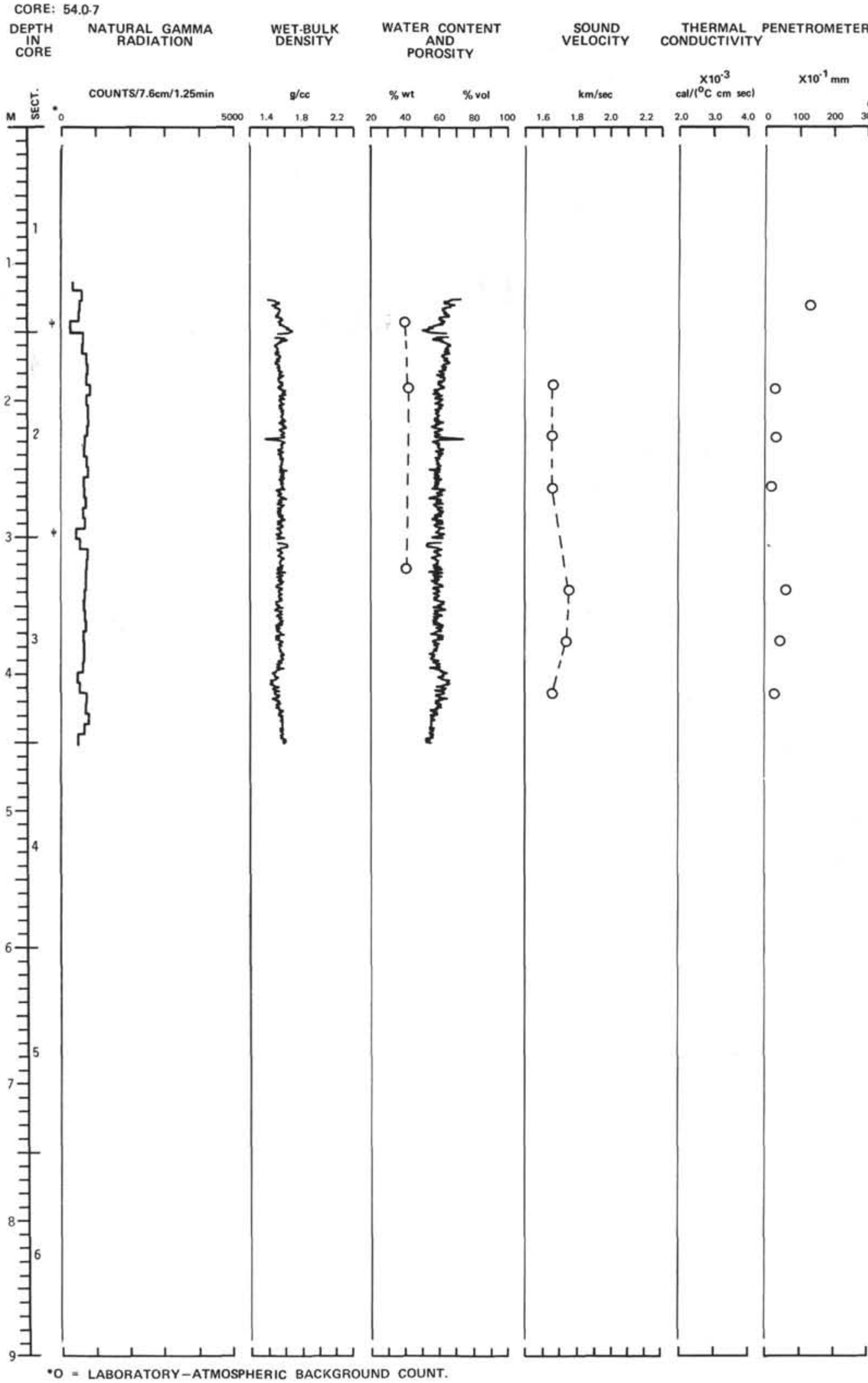


Figure 23. *Summary of physical properties in Hole 54.0 Core 7.*

LEG 6 HOLE 54.0

CORE 7 DEPTH 261.2-270.4 m

FORAMINIFERA	NANNOPLANKTON	RADIOLARIA
None.	Assemblages of the lower middle Miocene *Sphenolithus heteromorphus* Zone are present throughout the core. Species present include *Cyclococcolithina neogammation*, *Discoaster brouweri* s.l., *D. challengeri*, *D. deflandrei*, *D. exilis*, *D. variabilis*, *Discolithina* sp. [large], *Helicopontosphaera kamptneri*, and *Sphenolithus heteromorphus*.	Radiolaria are rare throughout this core. Species present indicate a middle Miocene age, probably the *Dorcadospyris alata* Zone. TOP: *Stichocorys* sp. BOTTOM: *Stichocorys delmontense*, *Cyrtocapsella japonica*.

Figure 24. *Summary of biostratigraphy in Hole 54.0 Core 7.*

LEG 6 HOLE 54.0

CORE 8 DEPTH 292-292.9 m

AGE	ZONE	SCALE (m / ft)	SECTION NUMBER	LITHOLOGY	SAMPLES: PALEO	SAMPLES: SMEAR	LITHOLOGIC DESCRIPTION	%Sand	%Silt	%Clay	%H2O	%CaCo3
?		0–5 ft; 0–1.5 m	1			*	FLOW BRECCIA - angular pieces of black glass, partly to completely palagonitized, in matrix of whitish, fine grain ?tuffaceous matrix					
		5–10 ft; 1.5–3 m	2				HYDROTHERMALLY ALTERED OLIVINE BASALT FLOW ROCK - dark gray brown, amygdaloidal rock with felted mass of reddish brown, prismatic plagioclase, sometimes in rosettes, in a fine grain matrix. Veins of white ?tuffaceous material and sparry calcite common					
		10–15 ft; 3–4.5 m	3				See section description					
		15–20 ft; 4.5–6 m	4									
		20–25 ft; 6–7.5 m	5									
		25–29 ft; 7.5–9 m	6									
			CC									

Figure 25. *Summary of lithology in Hole 54.0 Core 8.*

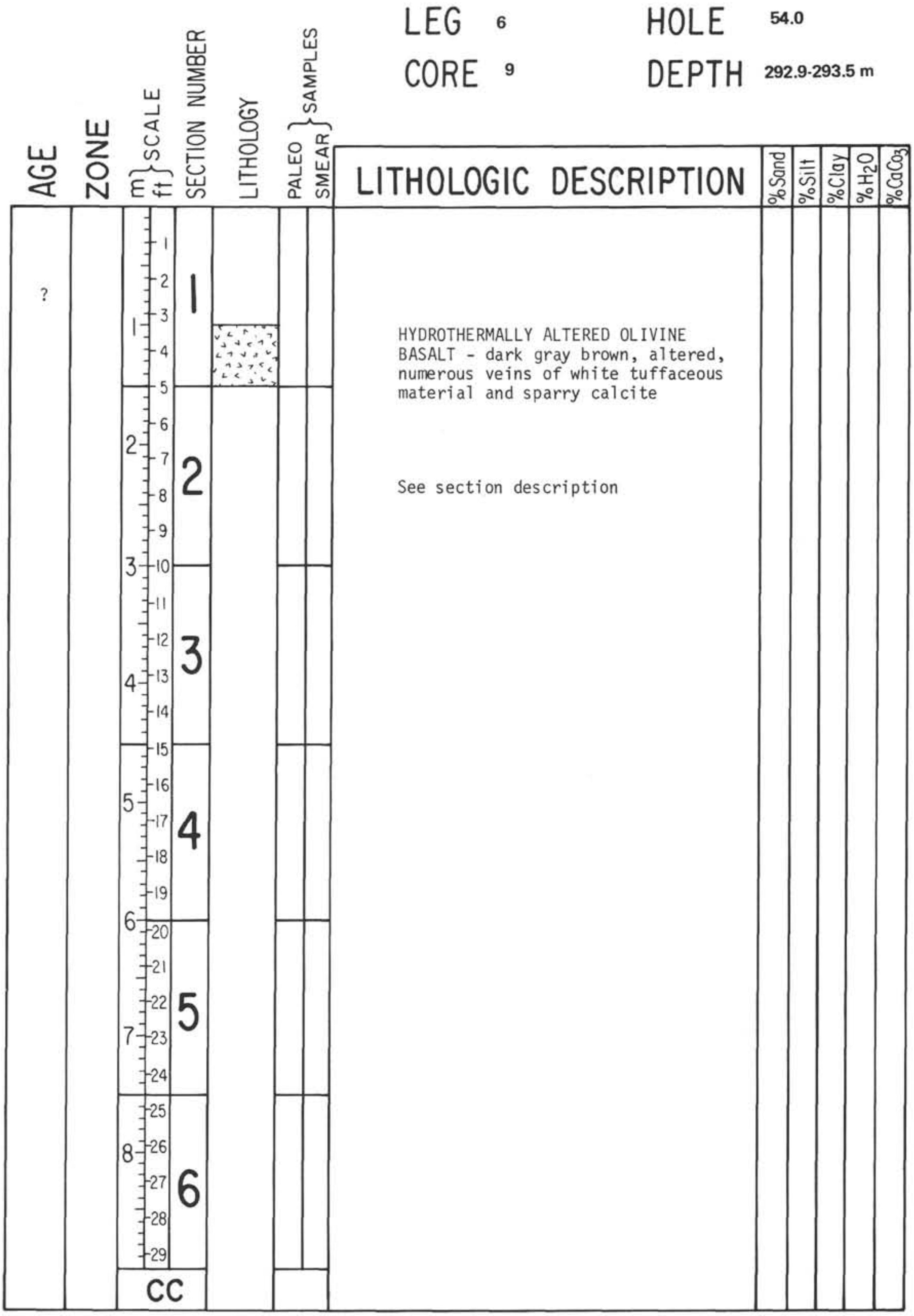


Figure 26. *Summary of lithology in Hole 54.0 Core 9.*

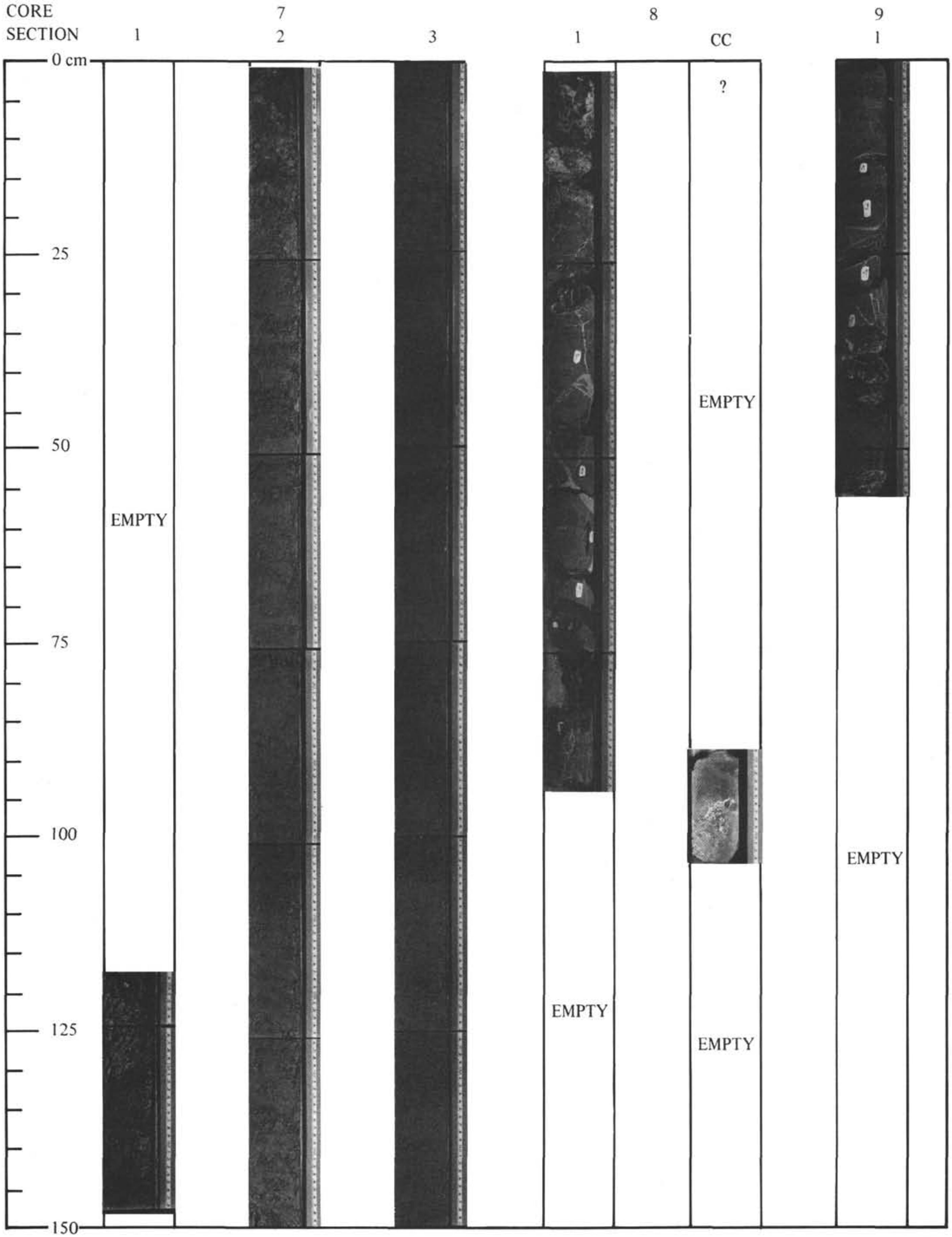
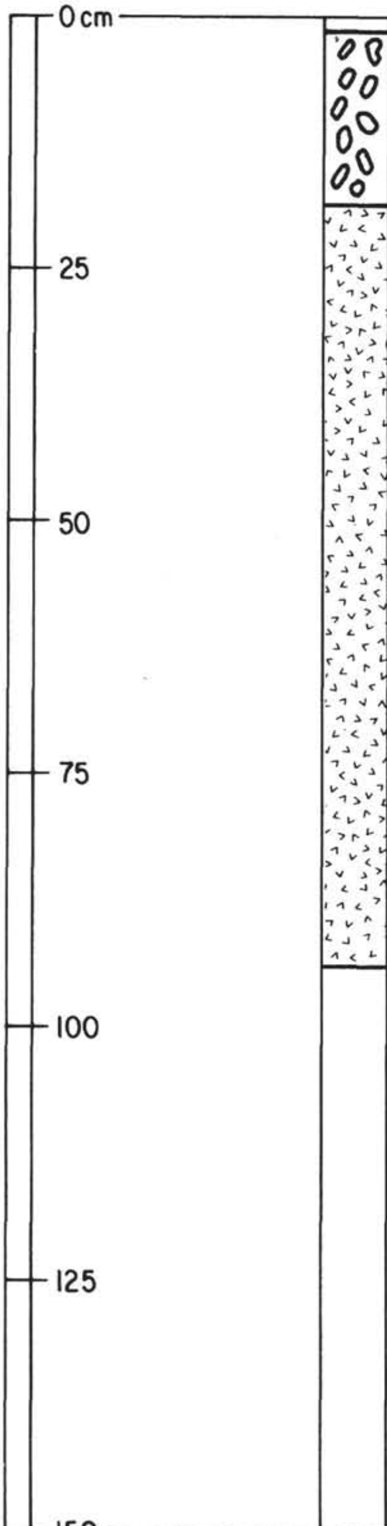


Plate 5. *Photographs of Hole 54.0 Cores 7, 8 and 9.*

HOLE 54.0
CORE 8
SECTION 1



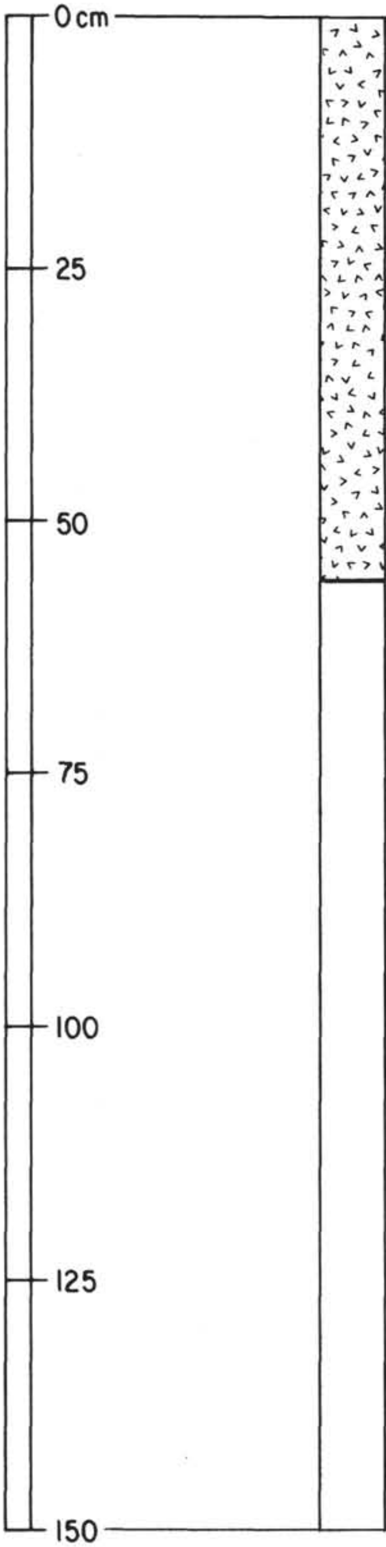
FLOW BRECCIA: angular pieces of black glass in white to pinkish matrix. The glass fragments tend to be elongate, are orientated at an angle to long axis of core, and range in size from 1 to 30 mm. Most of glass has thin rims (2-3 mm thick) of yellowish brown & red brown palagonite & some is completely connected to palagonite. The matrix comprises very fine glass fragments, clay minerals & zeolites(?), and small amounts of carbonate. Calcite-filled veins also present.

CONTACT: this is very irregular and is in places marked by a thin rim (5-10 mm thick)of banded, vitreous black glass. In other places the black glass has a very irregular wispy appearance, or has been completely removed & contributed clasts to the overlying breccia. The contact has been offset along small fractures. The basal part of the flow breccia along the contact contains some angular, very large (8 cm) pieces of the underlying volcanic rock.

OLIVINE BASALT: strongly hydrothermally altered pillow lava. Rock contains felted mass of reddish brown prismatic calcite, sometimes in rosettes, in a fine grained dark gray brown matrix. Numerous veins of sparry calcite and white tuffaceous sediment; many of the latter veins have palagonitic walls in the country rock. In places there are unfilled vugs in some of the veins.

Figure 28. *Summary of lithology in Hole 54.0 Core 8 Section 1.*

HOLE 54.0
CORE 9
SECTION 1



OLIVINE BASALT: Dark gray brown hydrothermally altered flow rock - same as 54.0-8-1. Thin section shows subophitic texture with irregularly shaped patches of altered groundmass, scattered olivine granules, rare areas composed mainly of olivine and plagioclase with but minor pyroxene. Plagioclase laths reach 1 mm in length, but are mainly smaller. Microphenocrysts of plagioclase & olivine up to 1.5 mm across. Olivine and groundmass extensively altered. Numerous veins of 2 types:

1. thin (1-3 mm) veins entirely to partially filled with sparry calcite
2. thicker (up to 10 mm) veins containing white to yellow white tuffaceous material, slightly calcareous; material in veins is a mixture of sand-size glass fragments, light colored tuff, fine frain glass, clay minerals, & calcite. Many of these veins have a thin sparry calcite margin.

Figure 29. *Summary of lithology in Hole 54.0 Core 9 Section 1.*