5. SITE 174

The Shipboard Scientific Party[1]

ABSTRACT

Two major stratigraphic units are present in this lower Astoria Fan drilling site. Unit 1 (0-284 m) is dominated by upper Pleistocene medium to very fine turbidite sands. Unit 2 (284-879 m) consists of upper-lower Pleistocene and Pliocene thin-bedded, fissile silty clays with graded basal silt intervals. A well-defined acoustic discontinuity on seismic reflection records corresponds approximately to the break between the two lithologic units. This discontinuity marks the base of Astoria Fan which is prograding over abyssal plain sediments. Basement depth is estimated at 911 meters or 32 meters below the bottom of the hole.

SITE SUMMARY

Date Occupied: 14-18 June 1971.

Position (Satellite):

	Hole 174	Hole 174A
Latitude:	44°53.38′N;	44°53.38′N;
Longitude:	126°20.80′W.	126°21.40′W.

Number of Holes: Two (Holes 174 and 174A).

Water Depth:
Hole 174: 2815 meters below sea level.
Hole 174A: 2799 meters below sea level.

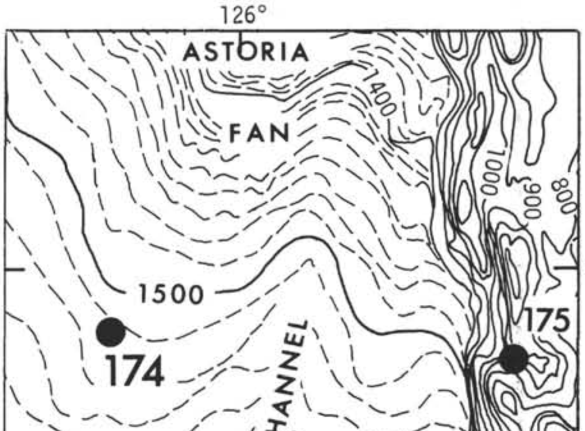
Penetration:
Hole 174: 19 meters below sea floor.
Hole 174A: 879 meters below sea floor.

Number of Cores:
Hole 174: 3.
Hole 174A: 43.

Total Core Recovered:
Hole 174: (3m–15.8%).
Hole 174A: (200 m–49.4%).

Age of Oldest Sediment: Pliocene.

Acoustic Basement: Not penetrated, but was calculated to be 911 meters below sea floor.



BACKGROUND AND OBJECTIVES

Site Description

Site 174 is located on the distal portion of Astoria Submarine Fan which lies off the Columbia River (Figures 1 and 2). Astoria Fan has an area of approximately 20,000 km^2 and is an asymmetrical wedge of sediments radiating to the southwest of the mouth of Astoria Canyon (Nelson et al., 1970). It lies between the base of the Oregon continental slope on the east and Cascadia Channel on the west. Astoria Submarine Canyon feeds the fan and is joined with Astoria Channel near the base of the continental slope forming an avenue for sediment dispersal from the continental shelf to the deep sea. Numerous smaller fan valley systems radiate from the apex of the fan and split into distributaries on the central part of the fan (Nelson et al., 1970). Levees occur on Astoria Channel and rise above the general fan level.

The Columbia River has been the main supplier of coarse- and fine-grained detritus to the fan, at least from the late Pleistocene to the present (Nelson, 1968; Duncan and Kulm, 1970). Fairly coarse-grained turbidite units are characteristic of the late Pleistocene deposits. Near the end of the late Wisconsin glaciation, the fan turbidites became fine-grained with hemipelagic deposition predominating

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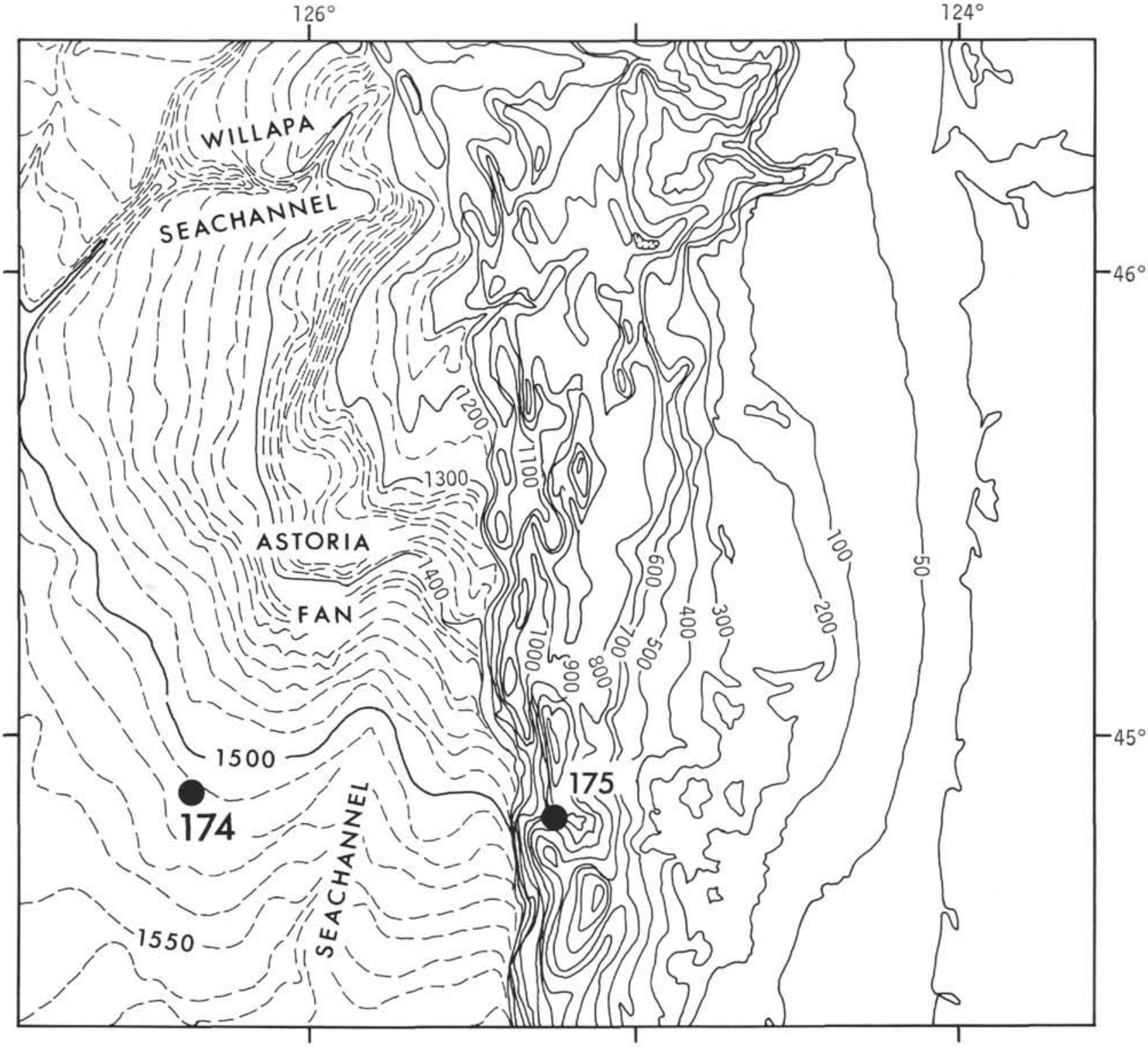

Figure 1. *Bathymetry in the vicinity of Site 174 (McManus, 1964). Contours in fathoms.*

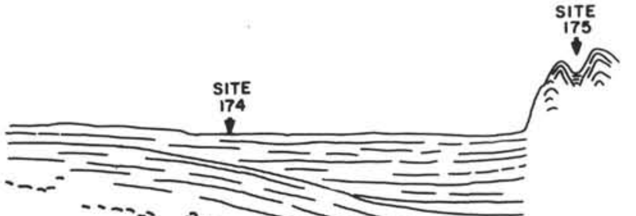

Figure 2. *Diagrammatic section (based on reflection records) across Astoria Fan and adjacent lower continental slope off central Oregon.*

during the Holocene. Turbidity current activity has been largely confined to the fan valleys during the latter part of the Holocene.

Seismic reflection profiles made across Astoria Fan between Cascadia Channel and the continental slope show a thick wedge of sediment lying upon an acoustic basement (Figure 3). The wedge is about 2 sec in the vicinity of Cascadia Channel. A semitransparent layer overlies the acoustic basement on the western side of the wedge which changes to a strongly reflecting unit above basement near the base of the continental slope. An acoustic discontinuity occurs within the upper part of the sedimentary wedge (Kulm et al., this volume). Overlying reflectors onlap this surface in a time-transgressive sequence from east to west—or seaward of the continental margin—and extend as far west as Cascadia Channel.

Site Objectives

Several objectives were sought at Site 174. The prime objective was to determine the age of the seismic discontinuity upon which the sediments of Astoria Fan were laid down and hence date the deposits of the fan. If the sediment below the discontinuity represents a time of underthrusting of the Juan de Fuca Plate, then it is essential that we determine whether the overlying transgressive

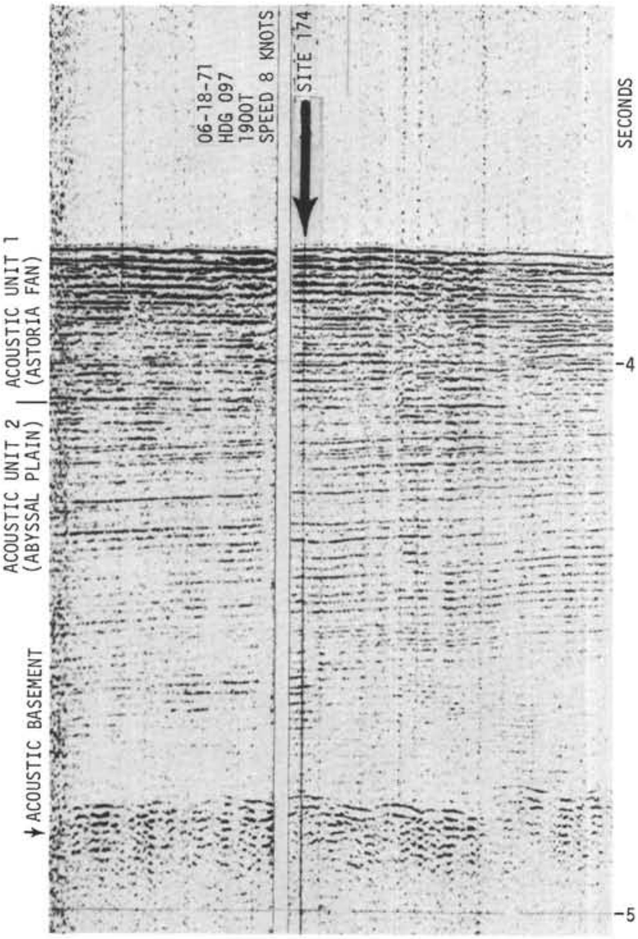

Figure 3. *Seismic reflection profile across Site 174 (from* Glomar Challenger). *Note two acoustic units drilled at this site. Upper unit corresponds to Astoria Fan sediments (lithologic unit 1) and lower unit represents abyssal plain sediments (lithologic unit 2).*

sequence developed as a result of an exceptionally high sedimentation rate during the Pleistocene on a downgoing slab or whether this sequence actually marks the end of underthrusting in this region.

Limited mineralogical data from the lower continental slope off Oregon suggest that there may have been right-lateral motion between the Juan de Fuca Plate and North American Block during late Cenozoic time (Fowler and Kulm, 1971). With known continental sediment sources (Scheidegger et al., 1971) and a rather complete stratigraphic column on Astoria Fan, a shift in the depositional site with respect to the associated source area can be tested.

Another objective was to determine the depositional history of the distal portion of Astoria Fan. Nelson's (1968) detailed studies of the development of Astoria Fan during the late Pleistocene and Holocene can then be related to the entire depositional history of the fan.

LITHOLOGIC SUMMARY

General Statement

Due to the abundance of unconsolidated sands encountered in these holes, caving was a problem. The following summary excludes core sections where caving is thought to have occurred and sediments recovered are not representative of the particular interval cored.

The 879-meter deep-sea section penetrated is composed of late Pleistocene to Pliocene terrigenous sediments and consists of two major stratigraphic units. Unit 1 (0-284 m) is late Pleistocene in age and is dominated by thick- to thin-bedded, medium to very fine sands. These sands grade distinctly to indistinctly upward into silts and silty clays and have sharp basal contacts with the underlying silty clays. Thin, graded silt to silty clay beds are also present, but in minor proportions. The overall uncompacted sand-shale ratio is 1.6 to 1. Unit 2, late Pleistocene to Pliocene in age, occurs below 284 meters and mainly consists of thin-bedded, fissile silty clays with graded basal silts. Very fine sand intervals rarely are present.

The nature of the contact between the two stratigraphic units is uncertain but apparently is abrupt. The contact is placed near 284 meters where a harder drilling interval (fissile calcareous silty clay) was first encountered; no core was recovered for 10 meters below this depth.

Lithologic Units

Unit 1 (0-284 m, Cores 1-27)

Sand intervals comprise 62 per cent of Unit 1 (0-284 m), while silty clay and silt constitute 29 and 9 per cent, respectively. Individual beds generally consist of a basal sand grading upwards to silt or silty clay with a sharp contact between the silty clay and the next sand interval above. These beds range in thickness from 5 to 733 cm but generally are between 50 and 100 cm. Occasionally, beds grading from silts to silty clays occur. They are generally about 10 to 20 cm thick though they range from 2 to 95 cm. These silt to silty clay beds usually occur in sets, comprising intervals up to 200 cm thick.

The modal grain size of the sand intervals ranges from medium to very fine sand, but fine is most abundant. The sands contain little or no clay, and the sorting of the sand-size fraction ranges from well to poor with most of the intervals being moderately sorted. In contrast, the silts are usually coarse and well sorted. Individual grains of sand and silt are predominantly subangular, and some are angular; this suggests first cycle deposition. Quartz, feldspar, and rock fragments all are abundant (lithic arkose). Heavy minerals are common, especially hornblende and augite.

There are five intervals in which silty clay dominates over sand and silt in Unit 1 (43-51, 64-75, 130-136, 180-200, and 237-248 m depth). These intervals are not restricted to warm climatic intervals (interglacial stades) when presumably less sand reached the deep-water environments.

The silty clays are composed of slightly more detrital clay than silt, and biogenic components occur only in trace amounts. Silt mottles frequently are present, indicating bioturbation. Olive gray (5 Y 4/1) is the dominant color of the silty clays, but three intervals (72-90, 128-134, and 244-252 m depth) have dark greenish gray (5 GY 4/1) silty clays. The significance of this color change is not understood; perhaps the dark greenish gray silty clays have a slightly higher organic carbon content.

At 207 meters (Core 19), a 2-cm-thick bed of greenish gray (5 GY 6/1) fissile micrite is present. It consists of 95 per cent carbonate grains, 0.5 to 1.5 microns in diameter, and 5 per cent fine silty and clay detritus. A 25-cm-thick interval of micrite of similar character occurs at 229 meters (Core 22), except that the carbonate grains are 1 to 3 microns in diameter and fine silt and clay comprise 10 per cent of the sediment.

Unit 2 (284-879 m, Cores 28-43)

In contrast to the overlying sand-dominant section, the late Pleistocene to Pliocene section below 284 meters (Unit 2) predominantly consists of thin beds of compacted silty clay with a thin basal silt or, rarely, a very fine sand interval. Individual beds generally consist of basal silt, with a sharp lower contact, grading upwards into olive gray silty clay (5 Y 4/1) which in turn grades into dark greenish gray (5 GY 4/1) fissile silty clay. These beds range in thickness from 2 to 60 cm but are generally 10 to 20 cm thick. The basal silt comprises up to 40 per cent of the bed but averages about 10 to 20 per cent. With increasing depth in the section, the silt portion tends to decrease to a few millimeters or may be completely absent.

The dark greenish gray (5 GY 4/1) silty clay, which tops each bed, sometimes is finer grained than the underlying olive gray silty clay and frequently is calcareous, effervessing when HC1 is applied. Between 645 and 750 meters (Cores 38 and 39), silty clay intervals of different color are still present in each bed, but the silty clay next to the basal silt is olive black (5 Y 2/1) and the top silty clay is brownish black (5 YR 2/1).

In sections from the 503.5 to 512.5 meters depth interval (Core 37) and at the 750.0 to 759.5 meter interval (Core 39), the sediments are relatively undisturbed by the coring process, and sedimentary structures are well preserved. At the basal contact between the silt and underlying silty clay, grooves occur with coarser sediment deposited in them (Core 37). The basal silts display laminations and cross laminations, and a few small mud clasts (less than 5 mm) are present in the silts (Core 39). Worm burrows (Cores 37 and 39) and structures due to loading or bioturbation (Core 39) are visible in the silty clays.

At 750 to 759.5 meters (Cores 39 and Core 39, CC) a few thin beds (less than 5 cm) of mica-bearing calcareous sandstone are present. The rock is composed of very fine sand with a carbonate matrix making up 40 to 50 per cent of the rock. Light mica grains (80 microns thick and 1.1 mm long) make up a few per cent of the rock; they lie parallel to the bedding plane. Otherwise, the angularity, sorting, and petrology of the detrital grains are similar to those in the unconsolidated sands of Unit 1.

At 759.5 meters (Core 39, CC), fragments of micrite are present. These fragments contain radiolarians preserved in a manner typical of Mesozoic forms. However, no known Mesozoic species could be found.

A 5-cm-thick limestone bed is present at 766 meters (Core 40). It is finely laminated and cross laminated and consists of 80 per cent micrite and 20 per cent silt and clay. A similar limestone, but with about 60 per cent micritic carbonate, was found in the bit when it was pulled out of the hole at a depth of 879 meters.

PALEONTOLOGIC SUMMARY

Introduction

Benthonic and planktonic foraminifera are the most common microfossils within the sequence penetrated at Site 174. Calcareous nannofossils, radiolarians, and diatoms are generally sparse and only sporadically present in Holes 174 and 174A except in near-surface sediments. Pollen, although never abundant, is intermittently present in the upper 322 meters at Hole 174A. Variable dilution of all faunal and floral elements encountered at this site is apparently a function of rapid deposition of turbidite sands and finer sediments associated with the construction of Astoria Fan and earlier deposition on an associated abyssal plain. Upper Pleistocene planktonic foraminifera and calcareous nannofossil assemblages were identified in Cores 1 through 33 (0-350 m) of Hole 174A. Specifically the lower Pleistocene *Pseudoemiliania lacunosa* Zone (coccolith) (herein called the *Emiliania annula* Zone) was encountered in Cores 35 through 36 (379 to 456 m) and Pliocene planktonic species are first encountered in Cores 36 through 40. The Pliocene-Pleistocene boundary is thought to occur within an unsampled interval between Cores 35 and 36 (417.5 to 446 m) suggesting that the sequence penetrated at Site 174 represents a major portion of the Pleistocene interval.

All fossil groups studied at this site exhibit low species diversity characteristic of high-latitude planktonic biotas in general and the northern California Current province specifically. Stratigraphic variations in species composition, coiling ratios, and abundance of planktonic foraminifera as well as variations in abundance and generic composition of pollen represent apparent signatures of glacial-interglacial climatic maxima and minima. Significantly, the paleontologic evidence of climatic oscillations extends below the turbidite sand interval (0-284 m) suggesting that the abrupt appearance of sand at this site represents a shift in depositional locus rather than a climatically induced sedimentologic event.

Diatoms

Diatoms occur frequently only in the uppermost portion (to 28 m) of Hole 174 with a few frustules encountered sporadically in Hole 174A. Abundance and preservation of diatoms are generally marginal in this sequence. Recovered thanatocöenoses consist of displaced, large robust freshwater and marine benthonic species in the lower portions of Hole 174. No diatom species of known stratigraphic significance were found at this site.

Calcareous Nannoplankton

Core 1 of Hole 174 contains the coccoliths *Braarudosphaera bigelowi, Coccolithus pelagicus, Gephyrocapsa* sp., *Cyclococcolithus leptoporus*, and small (2-3μ) placoliths which are probably *Emiliania huxleyi*. The latter indicates a late Pleistocene age for these sediments. Cores 2 and 3 are barren.

Coccoliths are generally few, rare, or absent in the forty cores recovered at Hole 174A. Assemblages here have been highly diluted by clastic sediments. Species diversity is low, particularly in the Pliocene where seldom more than two or three forms are encountered in any given sample. The presence of *Coccolithus pelagicus* in thirteen of the cores taken at Hole 174A is indicative of cool-water conditions as is the low species diversity in general. A slight warming trend is indicated for Core 11 by the presence of *Helicopontosphaera kamptneri* and *H. sellii*. The presence of *Cyclococcolithina* in Cores 34 to 39 is also interpreted as an indication of somewhat warmer surface water conditions. *Braarudosphaera bigelowi*, which is indicative of near shore environments of deposition, is present in Cores 7, 11, 16, and 31.

The first seventeen cores from Hole 174A may be assigned to the *Gephyrocapsa oceanica* Zone although electron microscopy may show that Cores 1 through 6 can be placed in the *Emiliania huxleyi* Zone. Cores 18 to 29 are essentially barren of calcareous nannoplankton. Cores 30 through 33 can be assigned to the *Coccolithus doronicoides* Zone if the zonation of Bukry (1971) is used. However, the top of Gartner's (1969) lower Pleistocene *Pseudoemiliania lacunosa* Zone (herein called the *Emiliania annula* Zone) is not encountered until Core 33 and continues through Core 36. Core catcher 35 contains the first common specimens of *Cyclococcolithina leptopora* encountered in the lower portion of this hole. This datum apparently indicates a warming trend which may be of local importance for correlation purposes. The presence of rare specimens of *C. leptopora* having element counts of close to 40 units is thought to indicate a close proximity to the Pliocene-Pleistocene boundary. This boundary probably lies within the 30 meter interval drilled between Cores 35 and 36. Rare specimens of *Cyclococcolithina macintyrei* in some cores below this level suggest a Pliocene age for the lower portion of the section as well as somewhat warmer surface water conditions. However, a few *Gephyrocapsa* spp are present in this part of the section, so the placement of the Pliocene-Pleistocene boundary here is rather tenuous.

Foraminifera

Well to moderately well preserved planktonic and benthonic foraminifera are common throughout the sequence encountered at Site 174. However, rapidly deposited turbidite sand intervals contain only rare specimens of benthonic species and are essentially barren of planktonic specimens due to dilution by terrestrial clastic debris. Planktonic specimens are most abundant in the silt-rich horizons or upper subunits of a given turbidite interval.

Pleistocene planktonic foraminiferal faunas are present in Cores 1 through 3 of Hole 174 and Cores 1 through 35 of Hole 174A. Individual assemblages of planktonic foraminifera at Site 174 are dominated by abundances of *Globigerina pachyderma* and significant percentages of *G. bulloides* along with minor percentages of *G. quinqueloba, Globigerinita uvula, G. glutinata, Globorotalia scitula, G. hirsuta,* and *"Orbulina universa"*. This group of species represents a typical cool-temperate planktonic biofacies characteristic of the California Current system north of lat. 35°N today (Bradshaw, 1959) as well as during most of the Neogene (Ingle, 1967; Bandy and Ingle, 1970).

Coiling ratios among populations of *Globigerina pachyderma* were utilized to identify warm and cool climatic oscillations within the Pliocene-Pleistocene sequence encountered at Site 174 as was done at Site 173. Sinistral coiling populations of this species (representing surface temperatures of less than 10°C) dominate most Pleistocene assemblages in Holes 174 and 174A, with dominantly dextral populations (representing surface temperatures higher than 15°C) being encountered only in Cores 11 and 24 of Hole 174A. Rare appearances of the transitional zone species *Globorotalia (T.) inflata* also occur in Core 11, emphasizing the major increase in surface temperature apparent during this interval.

Pliocene planktonic foraminiferal faunas characterized by predominantly dextral populations of *Globigerina pachyderma* and the persistent presence of members of the *Globorotalia (T.) inflata-puncticulata* complex, were initially encountered in Core 36 at Hole 174A and are present in Cores 37, 39, and 40. *Globorotalia (T.) crassaformis oceanica* and *G.* aff. *miozea* occur as rare elements of faunas in Core 36 which together with evidence of a major climatic warming indicated by the dextral populations of *Globigerina pachyderma* suggests that the Pliocene-Pleistocene boundary occurs within the unsampled interval between Cores 35 and 36.

Moderately diverse middle bathyal benthonic foraminiferal assemblages characterized by significant percentages of *Uvigerina senticosa* and occasional occurrences of *Melonis pompilioides* were found throughout the entire sequence penetrated at Site 174. This biofacies is virtually identical with the species group to be expected at the sediment-water interface at this site today. Turbidite sands in Hole 174A commonly contain rare examples of species displaced from littoral-neritic depths including *Buliminella elegantissima, Elphidium incertum,* and *Buccella frigida.*

Radiolaria

A few well-preserved radiolarians occur sporadically in Holes 174 and 174A. Both abundance and diversity are low. No assignments to radiolarian zones can be made; however, no indications of ages older than Pleistocene were observed. It is important to note that Core 39 of Hole 174A contains fairly large numbers of poorly preserved and recrystallized radiolarians. These specimens exhibit the appearance normally associated with Mesozoic material in this area, but no known Mesozoic species could be found.

Spores and Pollen

The occurrence of palynomorphs varies from abundant to rare at Site 174. Pollen frequency is highest in Cores 1 and 2 of Hole 174 and Cores 1, 5, 6, 7, 11-14, 17, 18, 22, 27, 28, 31, and 33 of Hole 174A. Pollen frequency below Core 35 (417 m) is so low that statistically reliable counts could not be made. Below 280 meters, the percentage of "reworked" grains increases dramatically. This phenomenon is probably related to the lithologic change which also occurs at this point.

Criteria used for determining climatic periods in this area are discussed more thoroughly in Chapter 18, this volume, but indicative of warm periods on the adjacent landmass is a mature coniferal forest where the *Tsuga* frequency and genetic diversity are high, and the pine frequency is low. This occurs at 31.1 meters (174-1-1, 138-140), 94.5 meters

(174A-7-CC) and 132.5 meters (11-CC). The warm period at 132.5 meters is the most striking, since at this point *Tsuga* comprises almost 50 per cent of the sample. Forams and nannoplankton found in this interval also indicate a warm period.

It is important to note that turbidite deposition may play an important role in masking and diluting palynomorphs at this site. Rapid deposition of sediments may explain the frequent and sudden extinctions of all palynomorphs and the common occurrence of reworked material.

PHYSICAL PROPERTIES

The standard shipboard suite of physical properties (porosity, bulk density, sonic velocity, and natural gamma radiation) was measured on each core from Site 174. Only two sections per core were measured because of time limitations. Sonic velocity, syringe porosity and bulk density, and GRAPE porosity are shown in the site summary graphic log and core summaries.

Relatively low porosity (45% to 60%) and high bulk density (1.8 to 2.0 g/cc) and high sonic velocity (1.7 km/sec) characterize the sediments at Site 174. No significant change in physical properties is seen between Astoria Fan and the underlying sequence of sediments. The values for physical properties observed at Site 174 would be expected with the high percentages of sand. A curve of average porosity with depth would be begin at about 55 percent and decrease from about 45 percent to 40 percent at 1000 meters.

Various difficulties were experienced with physical property measurements. First, the GRAPE was set incorrectly on the first sixteen cores and an analysis must be made to salvage these records. The standards were changed after an evaluation visit by Adrain Richards, and the accuracy of previous values is questioned. Similarly, the accuracy of syringe values is questioned even after recalibration of the syringe because of distortion in taking samples of hard material. Sonic velocities were impossible to measure on some samples because of the large amounts of gas within them. The measurements were often obviously erroneous.

The plotted values are estimated to be accurate to ±5 per cent syringe porosity, ±5 per cent GRAPE porosity, ±0.1 g/cc syringe bulk density, and ±50 m/sec velocity. Questionable values measured were not plotted.

CORRELATION BETWEEN REFLECTION RECORDS AND THE STRATIGRAPHIC COLUMN

There are two acoustic units within the layered sequence at Site 174. The upper is a series of strong reflectors that are somewhat discontinuous and slightly irregular (Figure 3). This unit is thought to represent sediments of Astoria Fan. The lower has weaker reflectors that are more continuous and regular than those in the upper unit. Under the layered sequence is a rough acoustic basement.

Sonic velocities in the upper unit were measured on material from cores with the Hamilton Frame apparatus. In most cases the muds were expanded by methane gas and the signal could not penetrate through even a thin sample. Only very consolidated pieces were measurable, biasing values toward greater velocities. An interval velocity of 1.75 km/sec was estimated from seven values, but, from travel time (0.36 sec 2 way) and a depth to the base of Astoria Fan as shown by drilling (284 m), an interval velocity of 1.60 km/sec was calculated.

Sonic velocities in the lower unit were easier to measure and six values were used to estimate the thickness of this unit. An interval velocity of 1.9 km/sec was derived from the laboratory measurements, and the unit thickness is estimated at 627 meters (travel time = 0.66 sec 2-way time). This gives a basement depth of 911 meters; 879 meters were drilled, suggesting that basement is about 30 meters from the bottom of the hole.

Summary and Conclusions

Site 174 (Holes 174 and 174A) is located on the distal portion of Astoria Fan in 2799 meters of water. Coring was continuous to a depth of 332 meters below the sea floor and from this point coring was at selected intervals down to a total depth of 879 meters. Two major stratigraphic units were encountered in the section which ranges in age from late Pleistocene into the Pliocene.

Unit 1 (0-284 m, Cores 1-27): This unit consists mainly of upper Pleistocene medium to very fine turbidite sands. Individual beds have a basal sand which grades upwards into a silt or silty clay. A sharp contact commonly occurs between the underlying silty clay and the overlying coarser basal interval. Occasionally thin interbeds of graded silts and silty clays occur within the main sandy sequence.

Unit 2 (284-879 m, Cores 28-43): This unit is Upper Pleistocene to Pliocene. It is characterized by beds consisting of a basal silt which grades upward into an olive gray silty clay and then into a dark greenish gray fissile silty clay. Most of the beds are separated by a sharp basal contact and display the graded bedding typical of turbidites. Although both stratigraphic units are a series of turbidites, the basal portions of the beds in Unit 1 are noticeably coarser grained than those of Unit 2. All sands found in the Pleistocene glacial intervals contain displaced benthonic foraminifera indicative of inner shelf environments.

Some warm and cool climatic oscillations within the Pleistocene sequence can be identified by determining the coiling ratios among populations of *Globigerina pachyderma* and the abundance and generic diversity of spores and pollen. Although there is probably a correlation between climatic oscillations and changes in lithologies on Astoria Fan (see Duncan and Kulm, 1970, for Holocene and Late Pleistocene comparisons), the sedimentation processes associated with fan development, such as shifting fan channels, probably obscures it.

The acoustic discontinuity noted on the seismic reflection records corresponds approximately to the break between the two major lithologic units. There is no indication, based upon the fauna, flora, and lithologies, that the discontinuity is an erosional surface or represents a major break in the depositional record. The glacial and interglacial intervals occur above and below it suggesting that this surface is not solely the result of increased rates of sedimentation associated with the glacial Pleistocene.

The medium to very fine sand turbidites of the upper stratigraphic unit represent the distal deposits of a prograding fan. Site 174 is located 275 km south of the Columbia River, the principal source of these sediments (Nelson, 1968; Duncan and Kulm, 1970). Coarser grained deposits have been piston cored in the proximal environments near the mouth of Astoria Canyon which supplies sediment to the fan (Nelson, 1968). In contrast, the finer grained deposits of the lower stratigraphic unit most likely represent abyssal plain sedimentation, similar to that found in the western part of Cascadia Basin during the late Pleistocene (Duncan, 1968).

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APPENDIX A. OPERATIONS

Pre-drilling Survey

The pre-drilling site survey of 174 on Astoria Fan was made from a point starting at the base of the continental slope off southern Oregon (43°38.7'N and 125°30.0'W) (Figure 4). The *Challenger* came around to a course of 333°T and profiled at speeds varying between 6 and 10 knots to a position located at 44°49'N and 126°19'W. The acoustic discontinuity was displayed on the seismic records at 3 sec and 4 sec sweeps. At 0705, June 14, the vessel came to 270°T and reduced speed to 8 knots. At 0748, a reciprocal course of 090° was completed. At 0823, speed was reduced to 4 knots and the beacon was dropped underway.

A rather poor reflection profile was obtained on course 333°T and acoustic basement was not evident, although sediment cover is known to be less than 2 sec. The only acceptable record was obtained at a speed of 4 knots in the immediate vicinity of Site 174 (Figure 3).

Drilling Program

Hole 174 is located at a water depth of 2815 meters on Astoria Submarine Fan, a gently sloping undulatory surface. The vessel was offset 458 meters to the east of the beacon. Hole 174 was continuously cored to a total depth of 19 meters before the fine sand encountered throughout the first three cores began to run and fill in the hole (see Table 1). After excessive caving, a decision was made to abandon Hole 174 and move 1067 meters to the west (270°) of the first hole.

Hole 174A was spudded in at a water depth of 2799 meters below sea level and continuously cored to a depth of 332 meters below the sea floor. Below this depth the sedimentary column was cored at selected intervals to a total depth of 879 meters. Commencing at 854.5 meters, three water cores were pulled before the hole was abandoned.

Although very fine to fine sands were recovered from the upper 384 meters of the hole, there still were enough interbedded muds to maintain the hole. Some slumping of material from higher to lower levels is indicated in the cores.

As at the previous sites (172 and 173), there was a discrepancy between the calculated water depth from Matthews' tables and that determined from the length of drill pipe. At Hole 174, we used Matthews' plus the Hawaii correction factor of 14 meters (i.e., 2795 + 14 = 2809 m from the vessel's transducer to bottom or 2815 m below sea level). Even with these corrections the bottom was shallow (2825 m) with respect to the drill pipe (2837 m). At Hole 174A, only a Matthews correction was used and the bottom was 9 meters shallow.

The recovery rate at Hole 174A was 49.4 percent. This is somewhat poorer than at the previous site, but can be explained by the loose, very fine sand encountered throughout most of Hole 174A. Also, the three water cores at the bottom of the hole lowered the recovery rate about 3 percent. In general, the sands were washed in the upper portions of the cores.

Drilling Specifications

The bottom hole assembly used on Site 174 was the same as that used at Site 172 except that a float was added. Bottom was established at 2818 meters below the derrick floor by drill pipe measurements in Hole 174A. This hole was drilled from 2818 to 2828 meters with no recovery from 2828 to 2846 meters, and then continuously cored to

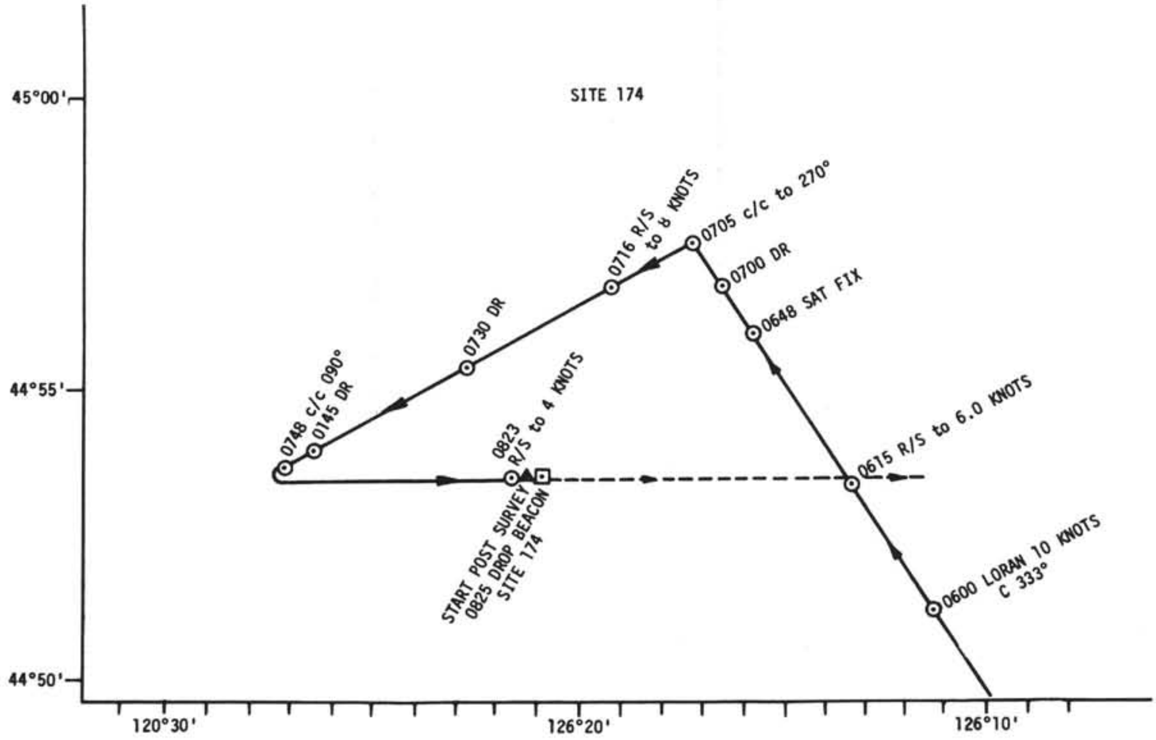


Figure 4. Glomar Challenger *pre-site survey of Site 174.*

3150 meters (332 m below the sea floor). This interval was cored with 5,000 to 10,000 pounds of weight on bit, 35 RPM, and circulation was broken only three times in short intervals. Drilling with spot coring occurred from 3150 meters to 3697 meters. Thirty-seven cores were recovered from the forty-three attempted. Coring operations were suspended at 3697 meters after the last three coring attempts failed to produce a core. Our initial observations suggested that the core barrel was not latched into its coring position. However, because of the back flow of water through the drill pipe during connections, it was evident that the problem was the float valve. When the bottom hole assembly was returned to the surface, we found that the pin in the hinge part of the flapper valve had sheared and the flapper had fallen down into the bearing area, preventing the inner core barrel from dropping into its latch position.

While drilling and coring hole conditions were better than had been expected, minimal circulation was used while coring and circulation was broken only enough to prevent the bit from balling up. While drilling, maximum pump was utilized (600 psi and 500 gpm). On four different occasions, twenty-five barrels of mud were circulated to clean the hole and lower drill string torques.

When the drilling was completed, 300 barrels of weighted mud (10.5 ppg) were displaced in the hole. When the drill pipe was being pulled out of the hole, a tight spot was encountered and the drill pipe stuck at a depth of 3088 meters below the derrick floor. The drill pipe pulled free after 3 hours of circulating water and spotting gel and water-mud around the bottom hole assembly.

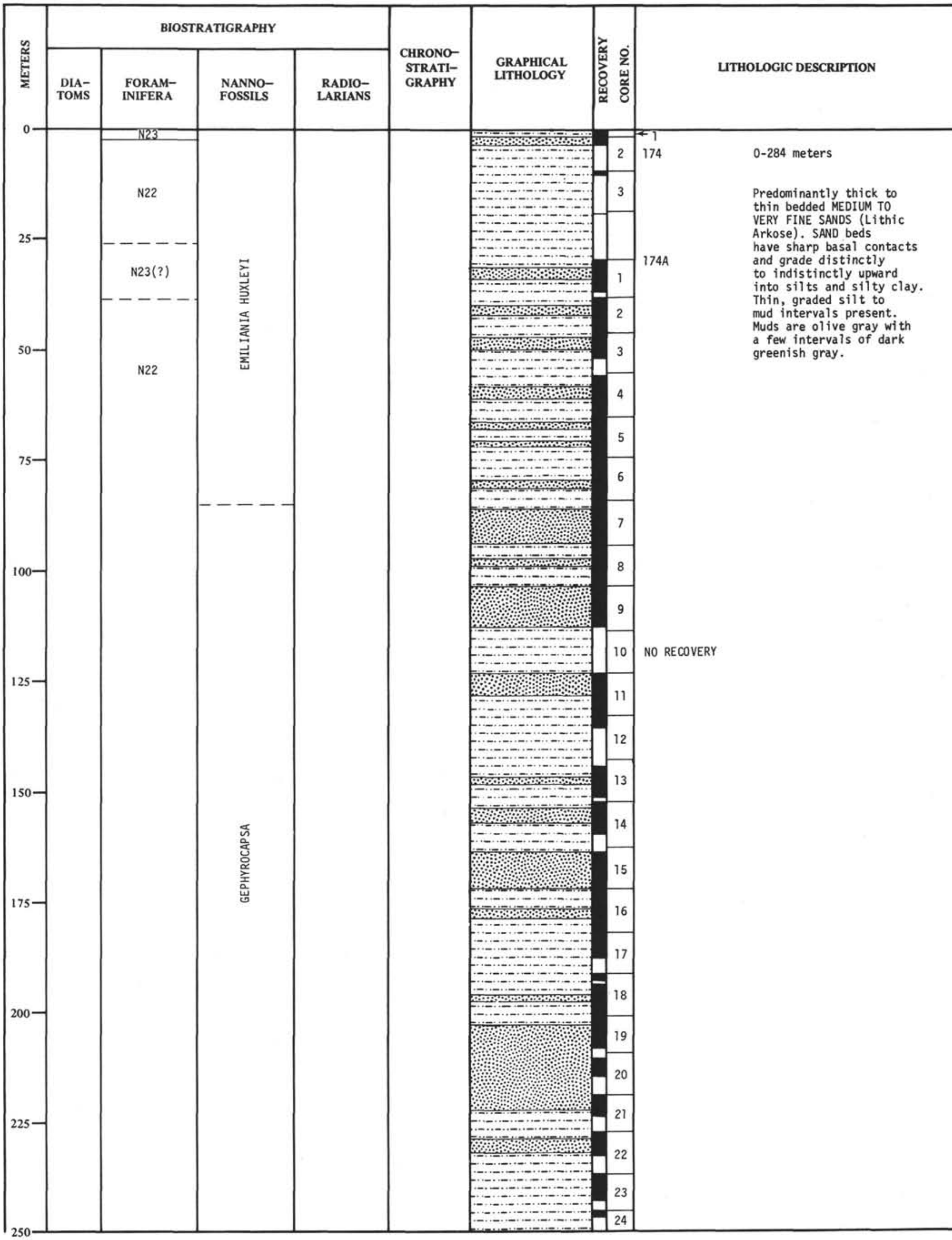
Post-drilling Survey

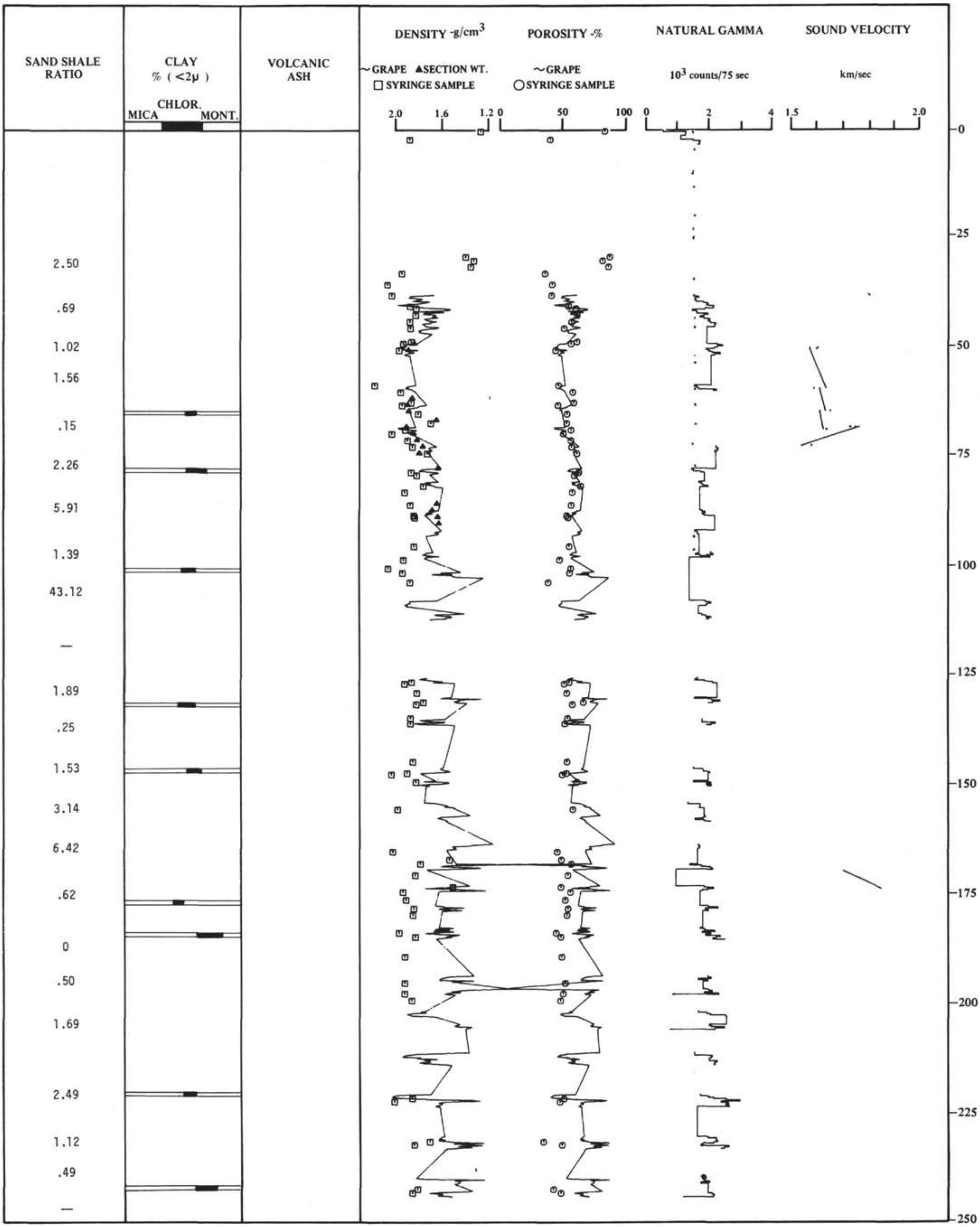
A course was set to provide a continuous track line between Site 174 and the next site (175) on the lower continental slope. This was done to trace the seismic discontinuity from Site 174 to the base of the continental slope. The beacon's signal strength was tested at various distances from 1727 to 1855 hours. At 1855 hours, the seismic line commenced to the west of the beacon and passed over it on the way east toward Site 175.

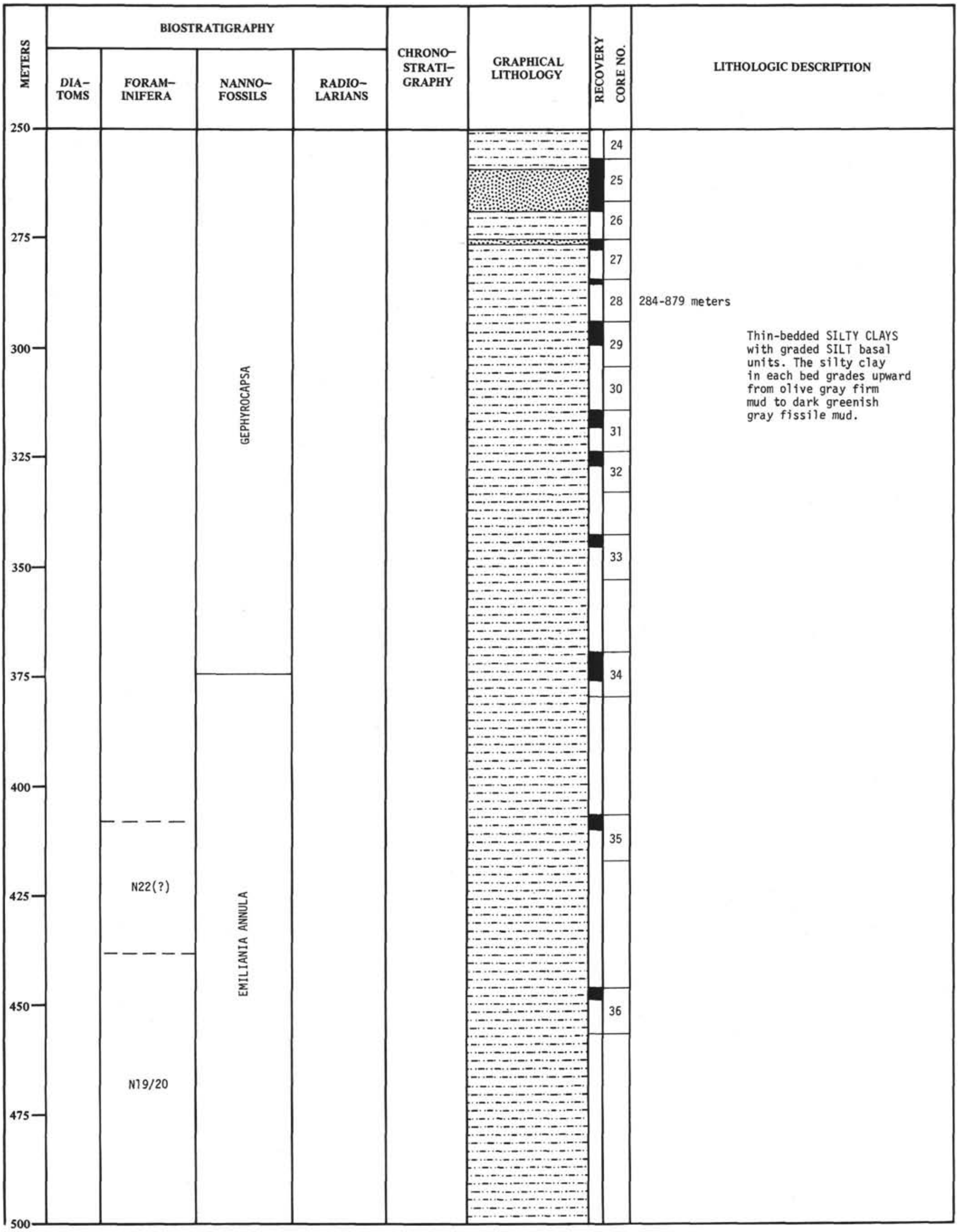
TABLE 1
DSDP Sites 174 and 174A Coring Summary

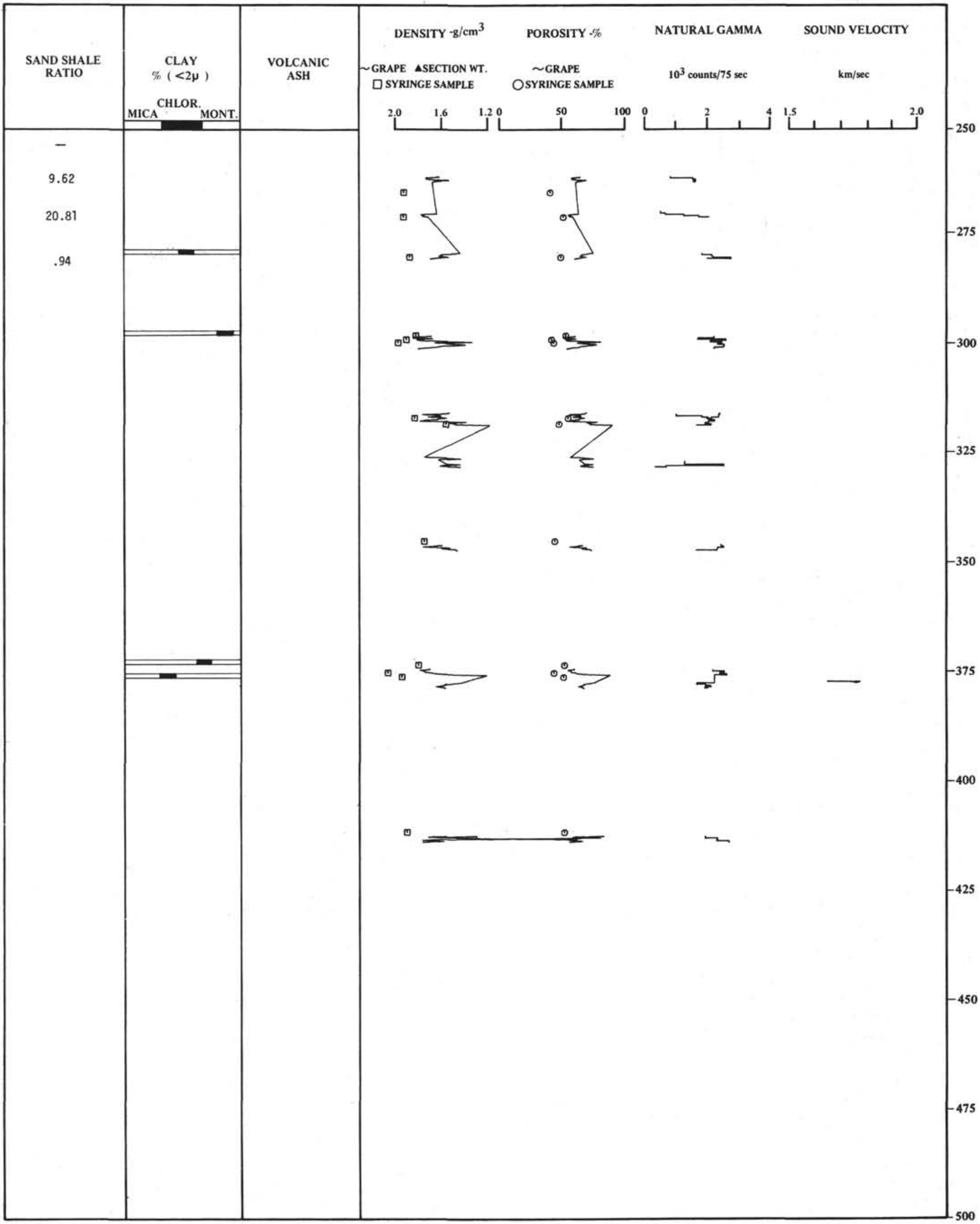
Core	Cored Interval Below Derrick Floor (m)	Cored Interval Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovered (%)
Hole 174					
1	2837.0-2839.0	0-2	2.0	1.5	75.0
2	2839.0-2846.5	2.0-9.5	7.5	1.5	20.0
3	2846.5-2856.0	9.5-19.0	9.5	CC	–
Hole 174A					
1	2846.0-2855.5	28.0-37.5	9.5	6.5	68.4
2	2855.5-2865.0	37.5-47.0	9.5	9.0	94.7
3	2865.0-2874.5	47.0-56.5	9.5	4.0	42.1
4	2874.5-2884.0	56.5-66.0	9.5	8.0	84.2
5	2884.0-2893.5	66.0-75.5	9.5	9.0	94.7
6	2893.5-2903.0	75.5-85.0	9.5	9.0	94.7
7	2903.0-2912.5	85.0-94.5	9.5	9.5	100.0
8	2912.5-2922.0	94.5-104.0	9.5	9.5	100.0
9	2922.0-2931.5	104.0-113.5	9.5	7.0	73.7
10	2931.5-2941.0	113.5-123.0	9.5	None	–
11	2941.0-2450.5	123.0-132.5	9.5	9.5	100.0
12	2950.5-2960.0	132.5-142.0	9.5	2.0	21.1
13	2960.0-2969.5	142.0-151.5	9.5	6.0	63.2
14	2969.5-2979.0	151.5-161.0	9.5	5.0	52.6
15	2979.0-2988.5	161.0-170.5	9.5	8.0	84.2
16	2988.5-2998.0	170.5-180.0	9.5	9.5	100.0
17	2998.0-3007.5	180.0-189.5	9.5	4.0	42.1
18	3007.5-3017.0	189.5-199.0	9.5	9.5	100.0
19	3017.0-3026.5	199.0-208.5	9.5	7.5	78.9
20	2036.5-3036.0	208.5-218.0	9.5	3.5	36.8
21	3036.0-3045.5	218.0-227.5	9.5	4.0	42.1
22	3045.5-3055.0	227.5-237.0	9.5	3.5	36.8
23	3055.0-3064.5	237.0-246.5	9.5	5.5	57.9
24	3064.5-3074.0	246.5-256.0	9.5	CC	–
25	3074.0-3083.5	256.0-265.5	9.5	8.5	89.5
26	3083.5-3093.0	265.5-275.0	9.5	3.0	31.6
27	3093.0-3102.5	275.0-284.5	9.5	2.5	26.3
28	3102.5-2112.0	284.5-294.0	9.5	0.5	5.3
29	3112.0-3121.5	294.0-303.5	9.5	3.5	36.8
30	3121.5-3131.0	303.5-313.0	9.5	Water Core	–
31	3131.0-3140.5	313.0-322.5	9.5	3.0	31.6
32	3140.5-3150.0	322.5-332.0	9.5	2.5	26.3
33	3159.5-3169.0	341.5-351.0	9.5	2.5	26.3
34	3188.0-3197.5	370.0-379.5	9.5	5.5	57.9
35	3226.0-3235.5	408.0-417.5	9.5	2.0	21.1
36	3264.0-3273.5	446.0-455.5	9.5	0.5	5.3
37	3321.0-3330.5	503.0-512.5	9.5	6.0	63.2
38	3454.0-3463.5	636.0-645.5	9.5	0.5	5.3
39	3568.0-3577.5	750.0-759.5	9.5	4.0	42.1
40	3587.0-3596.5	769.0-778.5	9.5	6.5	68.4
41	3672.5-3679.5	854.5-861.5	7.0	–	–
42	3679.5-3689.0	861.5-871.0	9.5	–	–
43	3689.0-3697.0	871.0-879.0	8.0	–	–
Totals/Average			404.5	200.0	49.4
Total Depth		879.0 meters[a]			

[a]Stuck in hole for 2½ hours on retrieving pipe.

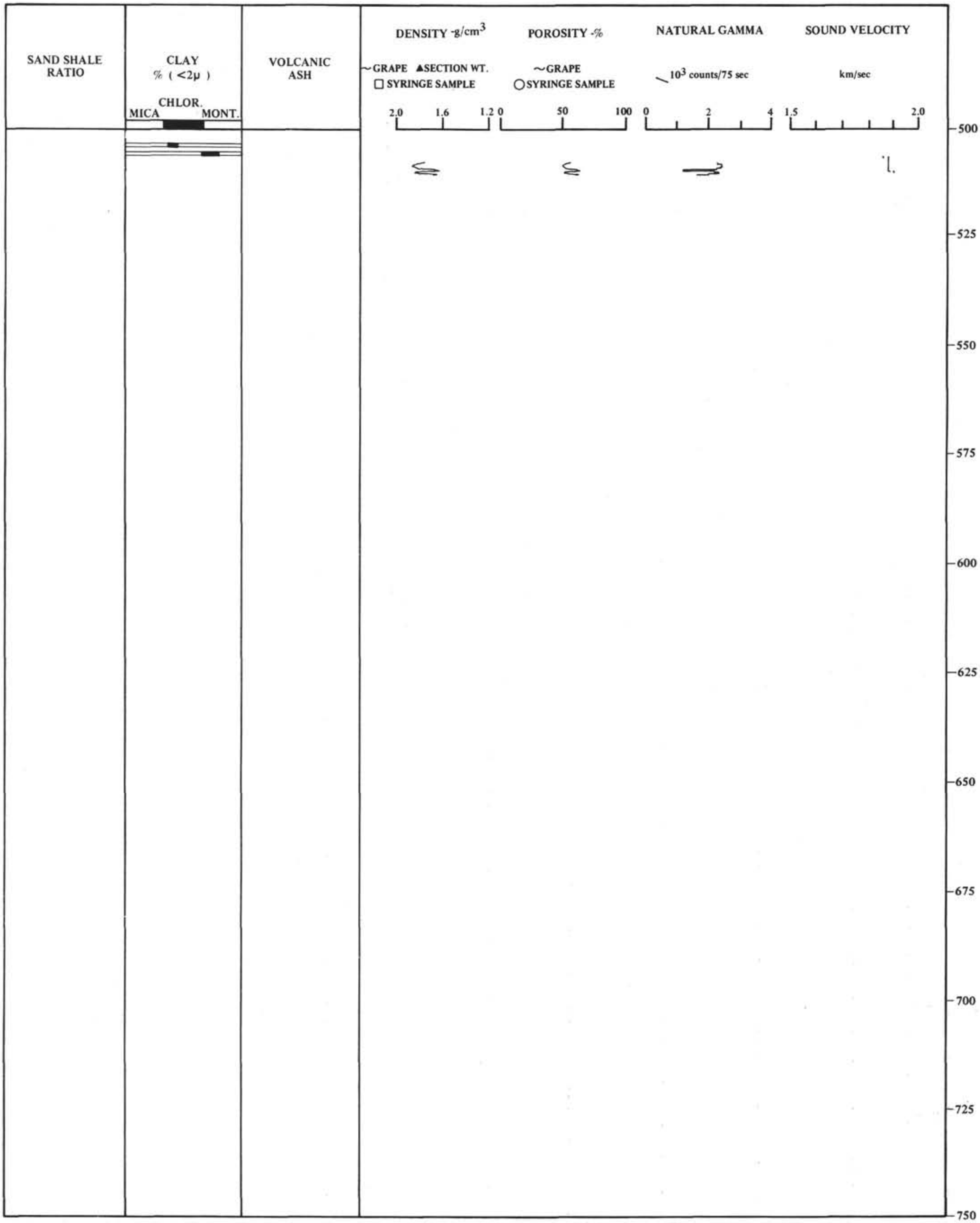

METERS
BIOSTRATIGRAPHY
DIA-TOMS
FORAM-INIFERA
NANNO-FOSSILS
RADIO-LARIANS
CHRONO-STRATI-GRAPHY
GRAPHICAL LITHOLOGY
RECOVERY
CORE NO.
LITHOLOGIC DESCRIPTION
0
25
50
75
100
125
150
175
200
225
250
N23
N22
N23(?)
N22
EMILIANIA HUXLEYI
GEPHYROCAPSA
1
2
3
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
174
174A
0-284 meters
Predominantly thick to thin bedded MEDIUM TO VERY FINE SANDS (Lithic Arkose). SAND beds have sharp basal contacts and grade distinctly to indistinctly upward into silts and silty clay. Thin, graded silt to mud intervals present. Muds are olive gray with a few intervals of dark greenish gray.
NO RECOVERY


SAND SHALE RATIO
CLAY % (<2μ)
MICA CHLOR. MONT.
VOLCANIC ASH
DENSITY -g/cm3
~GRAPE ▲SECTION WT.
□ SYRINGE SAMPLE
2.0 1.6 1.2
POROSITY -%
~GRAPE
○SYRINGE SAMPLE
0 50 100
NATURAL GAMMA
10[3] counts/75 sec
0 2 4
SOUND VELOCITY
km/sec
1.5 2.0
2.50
.69
1.02
1.56
.15
2.26
5.91
1.39
43.12
—
1.89
.25
1.53
3.14
6.42
.62
0
.50
1.69
2.49
1.12
.49
—
0
25
50
75
100
125
150
175
200
225
250

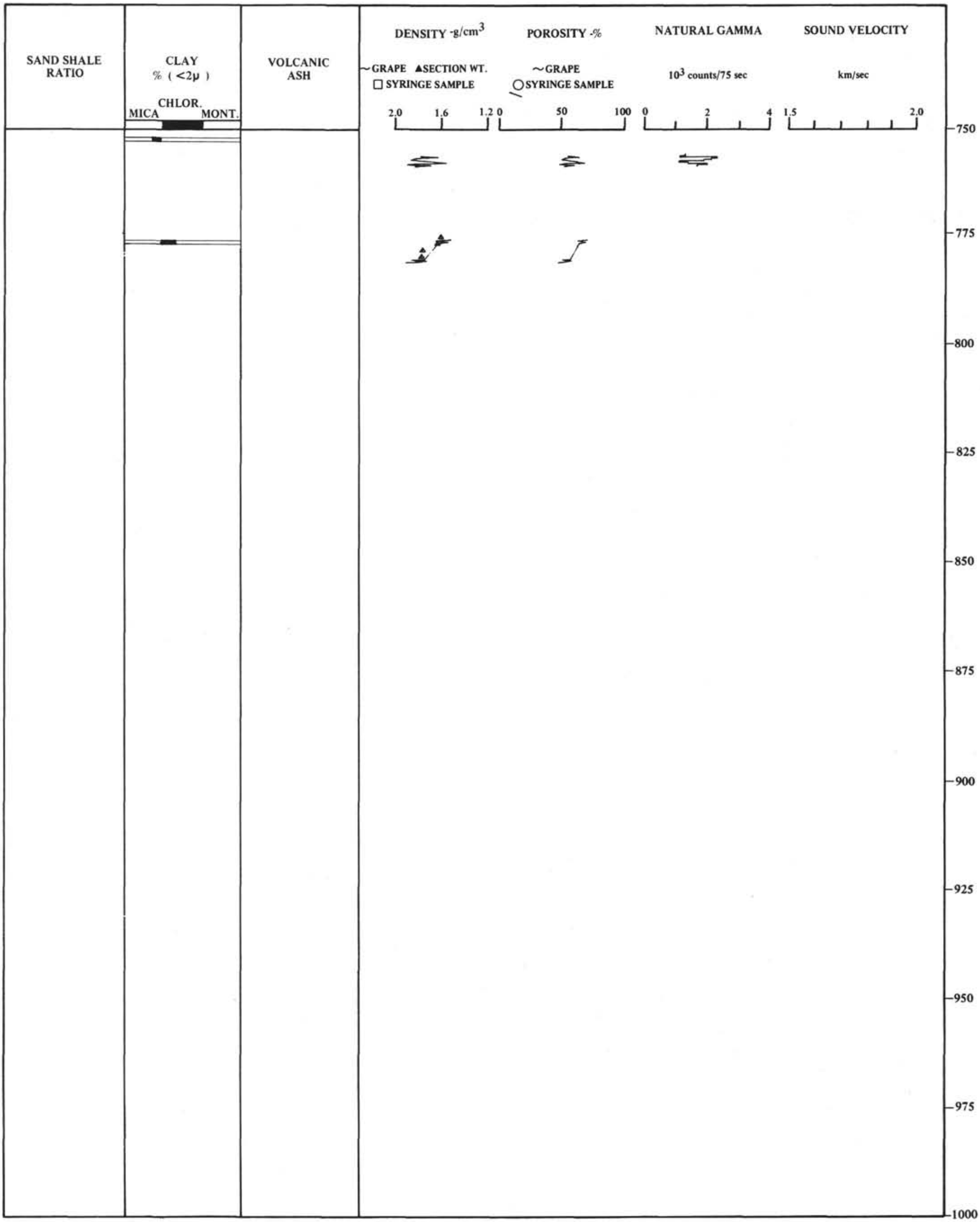

BIOSTRATIGRAPHY
METERS
DIA-TOMS
FORAM-INIFERA
NANNO-FOSSILS
RADIO-LARIANS
CHRONO-STRATI-GRAPHY
GRAPHICAL LITHOLOGY
RECOVERY
CORE NO.
LITHOLOGIC DESCRIPTION
250
275
300
325
350
375
400
425
450
475
500
GEPHYROCAPSA
EMILIANIA ANNULA
N22(?)
N19/20
24
25
26
27
28
29
30
31
32
33
34
35
36
284-879 meters
Thin-bedded SILTY CLAYS with graded SILT basal units. The silty clay in each bed grades upward from olive gray firm mud to dark greenish gray fissile mud.


SAND SHALE RATIO
CLAY % (<2μ)
CHLOR.
MICA
MONT.
VOLCANIC ASH
DENSITY -g/cm3
~GRAPE ▲SECTION WT.
□ SYRINGE SAMPLE
POROSITY -%
~GRAPE
○SYRINGE SAMPLE
NATURAL GAMMA
10³ counts/75 sec
SOUND VELOCITY
km/sec
2.0
1.6
1.2
0
50
100
0
2
4
1.5
2.0
—
9.62
20.81
.94
250
275
300
325
350
375
400
425
450
475
500

METERS	BIOSTRATIGRAPHY				CHRONO-STRATI-GRAPHY	GRAPHICAL LITHOLOGY	RECOVERY	CORE NO.	LITHOLOGIC DESCRIPTION
	DIA-TOMS	FORAM-INIFERA	NANNO-FOSSILS	RADIO-LARIANS					
500								37	
525									
550									
575									
600									
625		N19/20	EMILIANIA ANNULA						
								38	
650									
675									
700									
725									
750									


SAND SHALE RATIO
CLAY % (<2μ)
CHLOR.
MICA
MONT.
VOLCANIC ASH
DENSITY -g/cm³
~GRAPE ▲SECTION WT.
□ SYRINGE SAMPLE
2.0 1.6 1.2
POROSITY -%
~GRAPE
○SYRINGE SAMPLE
0 50 100
NATURAL GAMMA
10³ counts/75 sec
0 2 4
SOUND VELOCITY
km/sec
1.5 2.0
500
525
550
575
600
625
650
675
700
725
750

METERS	BIOSTRATIGRAPHY: DIATOMS	BIOSTRATIGRAPHY: FORAMINIFERA	BIOSTRATIGRAPHY: NANNOFOSSILS	BIOSTRATIGRAPHY: RADIOLARIANS	CHRONOSTRATIGRAPHY	GRAPHICAL LITHOLOGY	RECOVERY	CORE NO.	LITHOLOGIC DESCRIPTION
750								39	
		N19/20	E. ANNULA						
								40	
775									
800									
825									
850									
								41	
								42	NO RECOVERY
875								43	
900									
925									
950									
975									
1000									


SAND SHALE RATIO
CLAY % (<2μ)
MICA CHLOR. MONT.
VOLCANIC ASH
DENSITY -g/cm3
~GRAPE ▲SECTION WT.
□ SYRINGE SAMPLE
2.0 1.6 1.2
POROSITY -%
~GRAPE
○SYRINGE SAMPLE
0 50 100
NATURAL GAMMA
10³ counts/75 sec
0 2 4
SOUND VELOCITY
km/sec
1.5 2.0
750
775
800
825
850
875
900
925
950
975
1000

Site 174 Hole Core 1 Cored Interval: 0-2 m

AGE	ZONE	FORAM*	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N23 (?) E. huxleyi	F/M R/M C/G			C/G	1, Core Catcher	0.5, 1.0	VOID			Olive gray, SILTY CLAY, interbedded with FINE SAND having a well sorted, subangular sand-size fraction. (5Y3/2) Smear Slide: Sand 5%, Silt 40%, Clay 55%, Rad 5%, Forams Tr.

Site 174 Hole Core 2 Cored Interval: 2-9.5 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 E. huxleyi	R/M			R/M	1, Core Catcher	0.5, 1.0				SAND, fine to medium, moderately sorted, subangular. Smear Slide: Quartz 45%, Feldspar 45%, Pyroxene Tr., Chlorite Tr., Dark Mica Tr., Hornblende 3%, Hyperstlene 3%

Site 174 Hole Core 3 Cored Interval: 9.5-19.5 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEIST.	N22 E. huxleyi		R/P		R/M	Core Catcher					CC: FINE SAND. Smear Slide: Quartz 60% Chlorite 1% Hornblende 1% Feldspar 35% Dark Mica 1% Lt. glass Tr.

Explanatory notes in chapter 1

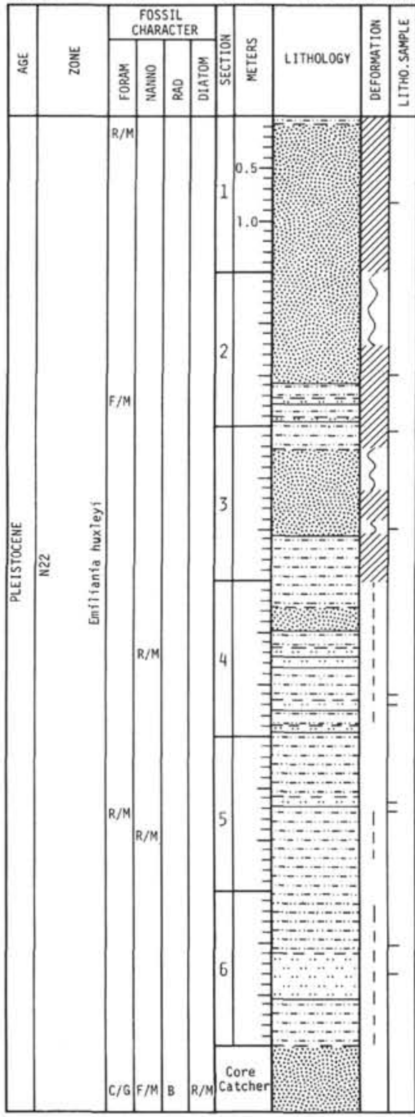
*PLANKTONIC FORAMINIFERA

Site 174 Hole A Core 1 Cored Interval: 28.0-37.5 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N23 (?) Emiliania huxleyi	C/G C/G	F/M		F/M	1, 2, 3, 4, 5, Core Catcher	0.5, 1.0	VOID, VOID, VOID			SAND, grading upwards from medium to very fine sand overlain by SILTY CLAY, olive gray (5Y3/2) with traces of forams and rads. Smear Slide SAND: Quartz 60%, Feldspar 35%, Chlorite 1%, Hornblende 1%, Dk. Mica Tr., Rock frags. Tr. CC: Mixed FINE SAND and SILTY CLAY

Explanatory notes in chapter 1

Site 174 Hole A Core 2 Cored Interval: 37.5-47.0 m



LITHOLOGIC DESCRIPTION

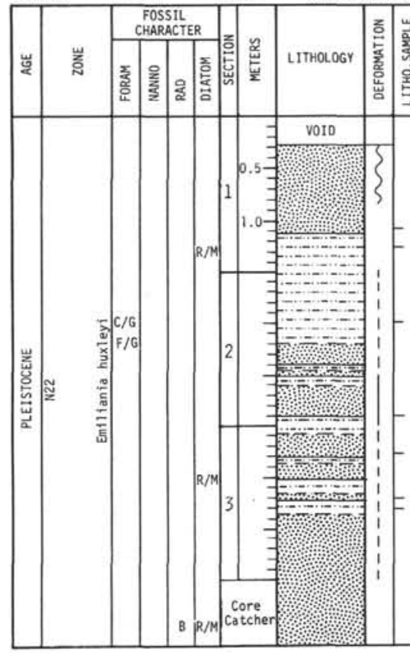
Graded beds of FINE SAND, VERY FINE SAND, or well sorted laminated SILT at base to olive gray (5Y4/1) SILTY CLAY at top.

Smear Slide
FINE SAND

Quartz	40%
Feldspar	50%
Dk. Mica	1%
Hornblende	2%
Pyroxene	Tr.
Chlorite	Tr.
Rock frags.	Tr.

Explanatory notes in chapter 1

Site 174 Hole A Core 3 Cored Interval: 47.0-56.5 m



LITHOLOGIC DESCRIPTION

Graded beds of FINE SAND or SILTY SAND at base to olive gray (5Y4/1) or greenish black (5G2/1) SILTY CLAY at top. Thick silty clay intervals contain rare laminae of SILT.

Explanatory notes in chapter 1

Site 174 Hole A Core 4 Cored Interval: 56.5-66.0 m

AGE	ZONE	FOSSIL CHARACTER: FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22, *Emiliania huxleyi*	R/M	R/M, R/M			1, 2, 3, 4, 5, 6	0.5, 1.0	VOID			Graded beds of MEDIUM SAND, FINE SAND, or SILT at base to SILTY CLAY, olive gray (5Y4/1) at top thick silty clay intervals contain few silt laminae.
		F/G	R/P	B	R/M	Core Catcher					

Explanatory notes in chapter 1

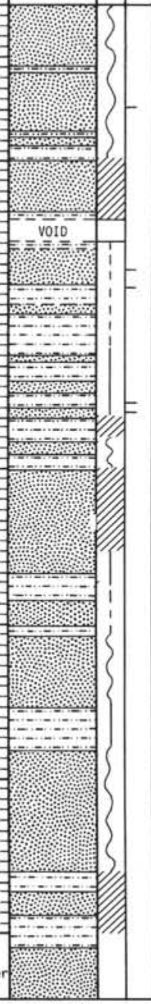
Site 174 Hole A Core 5 Cored Interval: 66.0-75.5 m

AGE	ZONE	FOSSIL CHARACTER: FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22, *Emiliania huxleyi*	F/G	B, R/P			1, 2, 3, 4, 5, 6	0.5, 1.0				0-140 cm SILTY CLAY, olive gray (5Y4/1) with few laminae of SILT, less than 2 cm thick. Graded beds of VERY FINE SAND or COARSE SILT at base to SILTY CLAY, olive gray (5Y4/1), at top. Indistinct bands of dark green (5G2/1) color that are pyrite rich occur within the SILTY CLAYS. The COARSE SILTS are laminated and well sorted, and the FINE SANDS are moderately sorted.
		C/G	R/P	R/G	R/G	Core Catcher					

Explanatory notes in chapter 1

Site 174 Hole A Core 6 Cored Interval: 75.5-85.0 m

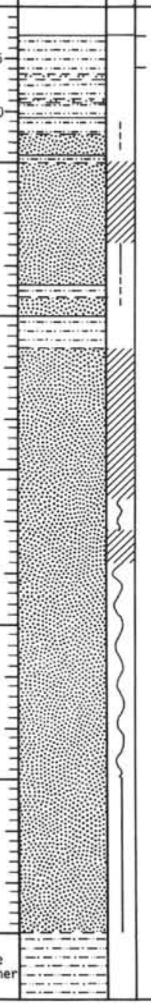
AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 *Emiliania huxleyi*					1	0.5, 1.0	FINE SAND and VERY FINE SAND interbedded with SILTY CLAY, dark greenish gray (5GY4/1). A few bioturbated silt mottles are present in the silty clay beds.
		R/P	R/P			2		Graded
		C/G				3		
						4		
			R/M			5		
						6		
		C/G	F/M	B	R/M	Core Catcher		



Explanatory notes in chapter 1

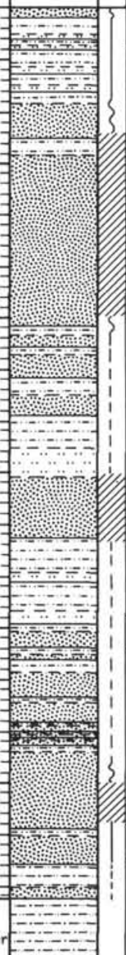
Site 174 Hole A Core 7 Cored Interval: 85.0-94.5 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 *Gephyrocapsa*	R/M R/M	R/P			1	0.5, 1.0	Graded beds of VERY FINE SAND, moderately sorted, or COARSE SILT, well sorted, at base to SILTY CLAY, dark greenish gray (5GY4/1) and olive gray (5Y4/1) at top. Bioturbated mottles of SILT are occasionally present in the SILTY CLAY.
		R/M				2		
						3		
						4		
		R/M				5		
						6		
		C/G	R/M	B	B	Core Catcher		



Explanatory notes in chapter 1

Site 174 Hole A Core 8 Cored Interval: 94.5-104.0 m

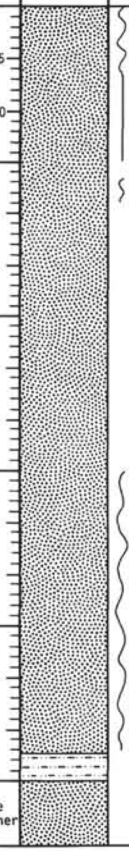
AGE	ZONE		FORAM	NANNO	RAD	DIATOM	SECTION	LITHOLOGY	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22	Gephyrocapsa	R/M, R/M, R/P, R/P	R/M, B, R/M	B	B	1, 2, 3, 4, 5, 6, Core Catcher		Graded beds of FINE SAND, VERY FINE SAND or COARSE SILT at the base to SILTY CLAY, olive gray (5Y4/1) at top. Grading is distinct to indistinct.

Smear Slide
FINE SAND

Quartz	60%
Feldspar	35%
Chlorite	1%
Dk. Mica	Tr.
Hornblende	2%
Rock frags.	Tr.

Explanatory notes in chapter 1

Site 174 Hole A Core 9 Cored Interval: 104.0-113.5 m

AGE	ZONE		FORAM	NANNO	RAD	DIATOM	SECTION	LITHOLOGY	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22	Gephyrocapsa	B, B, F/M	R/M	B		1, 2, 3, 4, 5, Core Catcher		0-720 cm graded bed of MEDIUM SAND at base to FINE SAND at top. The sands are well sorted. 720-750 cm SILTY CLAY, olive gray (5Y4/1) CC: MEDIUM SAND

Site 174 Hole A Core 10 Cored Interval: 113.5-123.0 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
						1	0.5, 1.0				NO CORE RECOVERED. POSSIBLY ALL SAND. VALVE STUCK AND SAND FLOWED OUT OF BARREL ON PLATFORM.

Site 174 Hole A Core 11 Cored Interval: 123.0-132.5 m

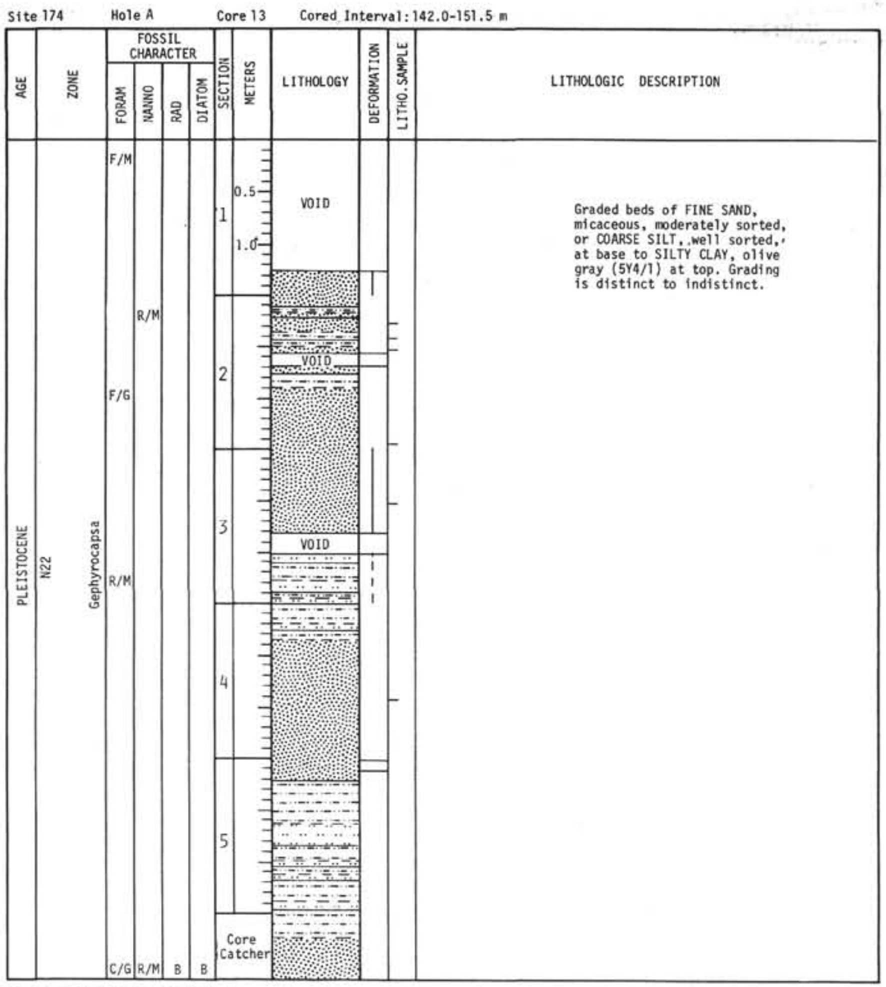
AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 Gephyrocapsa	R/M	R/M			1	0.5 1.0				Graded beds of MEDIUM-FINE SAND or COARSE SILT at base to SILTY CLAY, olive gray (5Y4/1) and dark greenish gray (5GY4/1) at top. The sands are moderately sorted and distinctly to indistinctly graded. Bioturbated silt mottles are frequently present in the silty clays.
		F/M				2					
						3					
		F/M	R/M			4					
						5		VOID	V		
		C/G	R/M			6		VOID	V		← VOID
		C/G	F/M	R/M	R/M	Core Catcher					

Explanatory notes in chapter 1

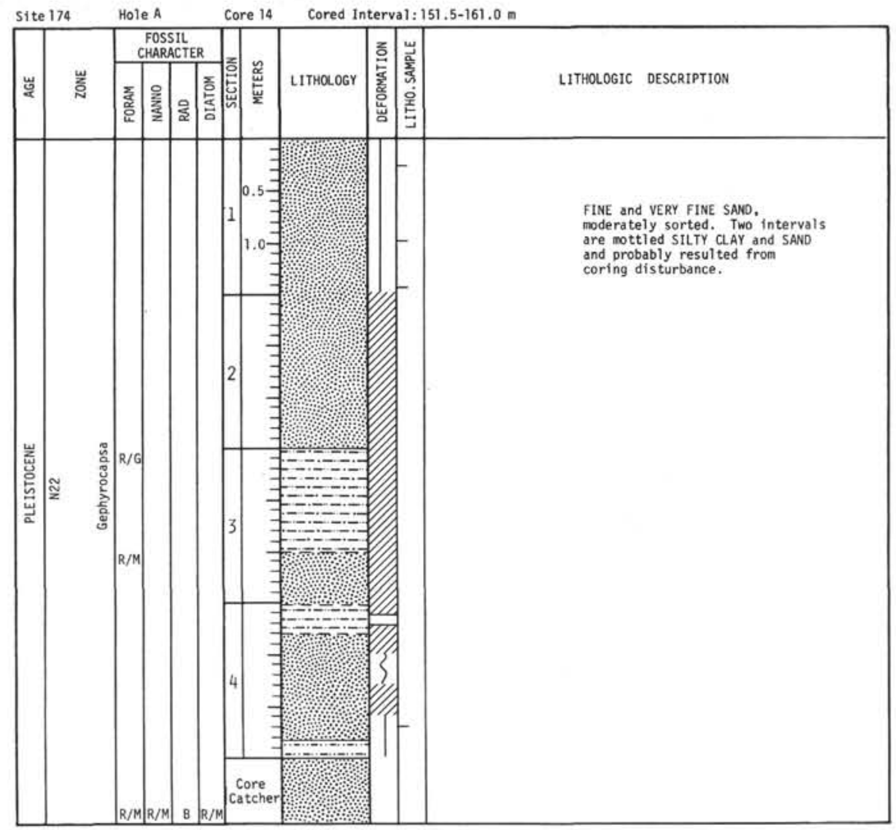
Site 174 Hole A Core 12 Cored Interval: 132.5-142.0 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 Gephyrocapsa	C/G	R/M			1	0.5 1.0	VOID			Interbeds of MEDIUM SAND and SILTY CLAY, olive gray (5Y4/1) to dark greenish gray (5GY4/1). Grading not evident.
								VOID	V		
		F/G				2					
		C/G	R/G	B	B	Core Catcher					CC: Stiff, fissile SILTY CLAY

Explanatory notes, in chapter 1

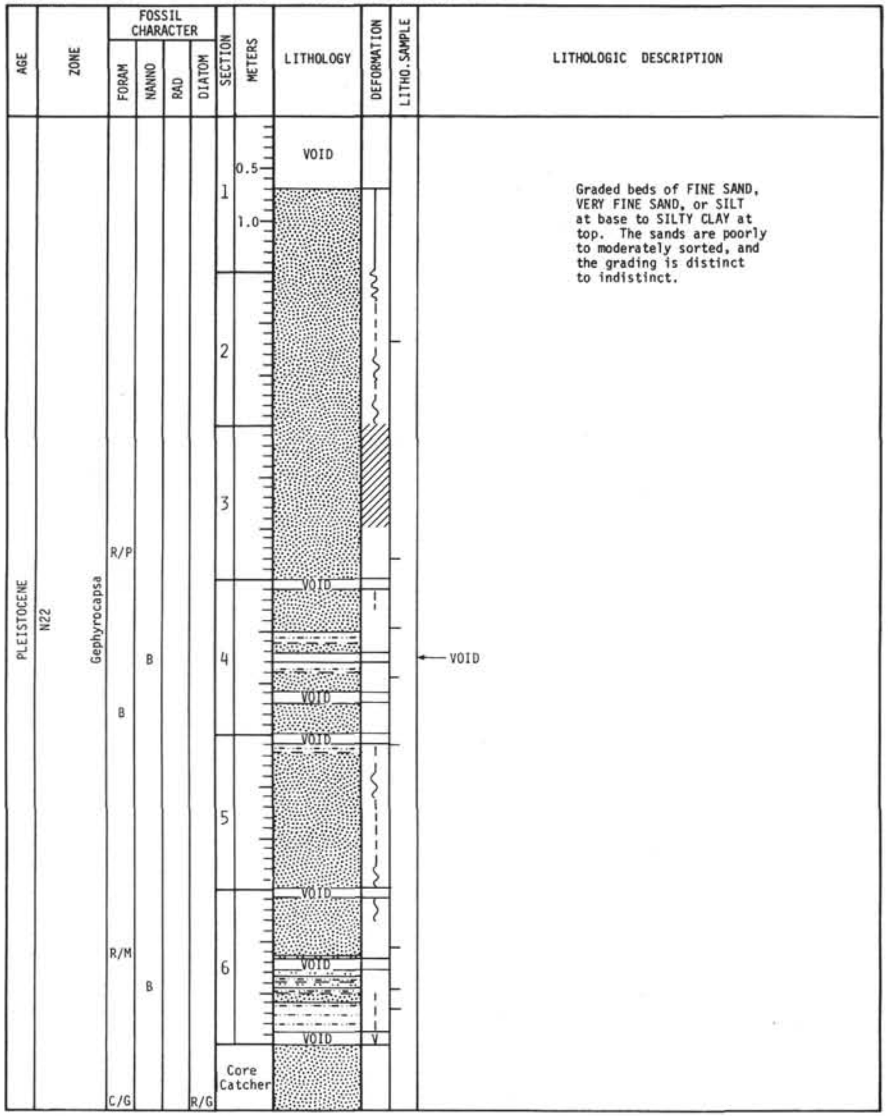


Explanatory notes in chapter 1



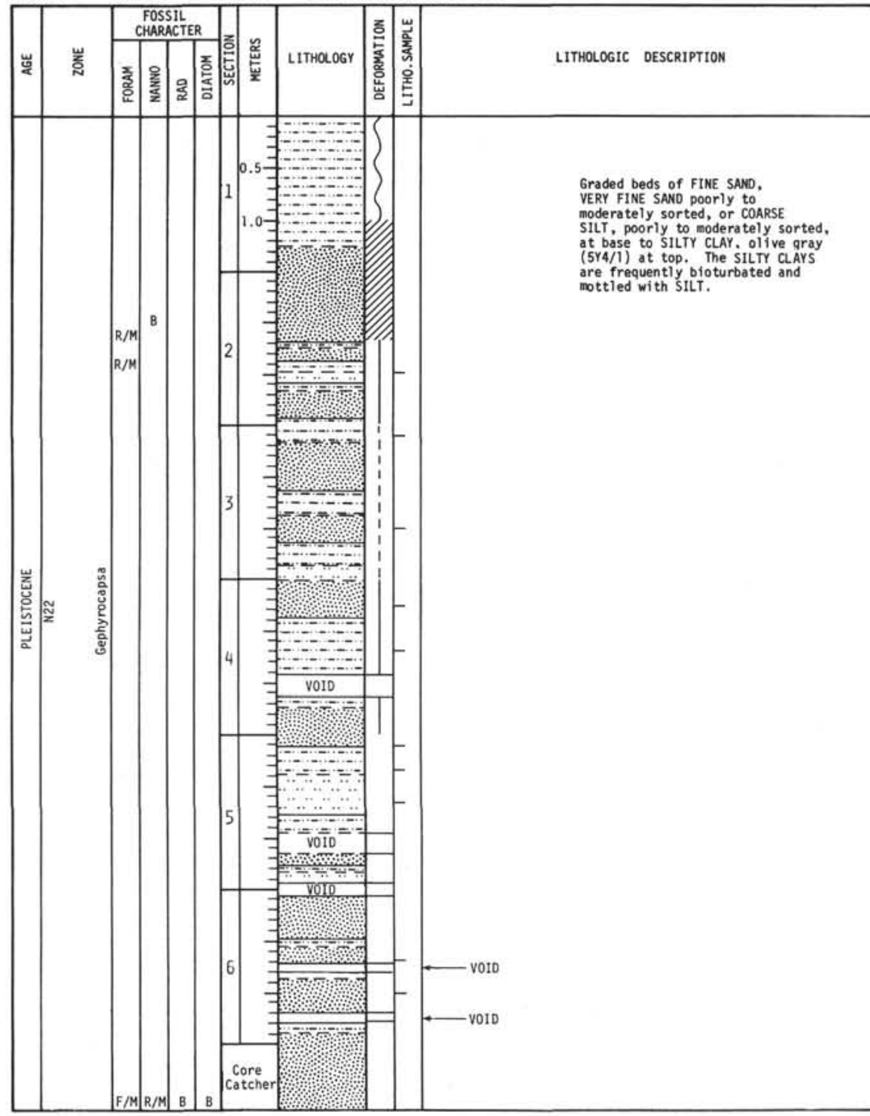
Explanatory notes in chapter 1

Site 174 Hole A Core 15 Cored Interval: 161.0-170.5 m



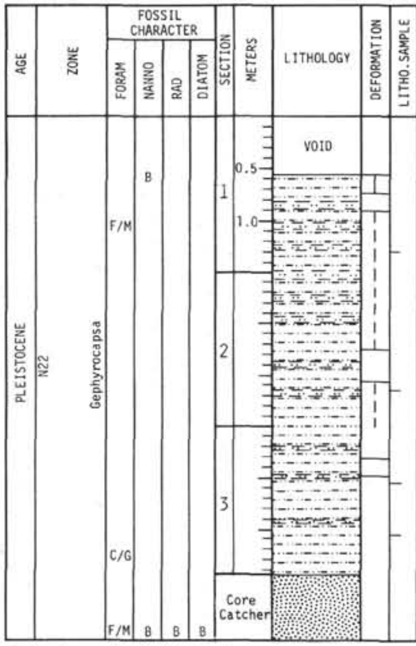
Explanatory notes in chapter 1

Site 174 Hole A Core 16 Cored Interval: 170.5-180.0 m



Explanatory notes in chapter 1

Site 174 Hole A Core 17 Cored Interval: 180.0-189.5 m



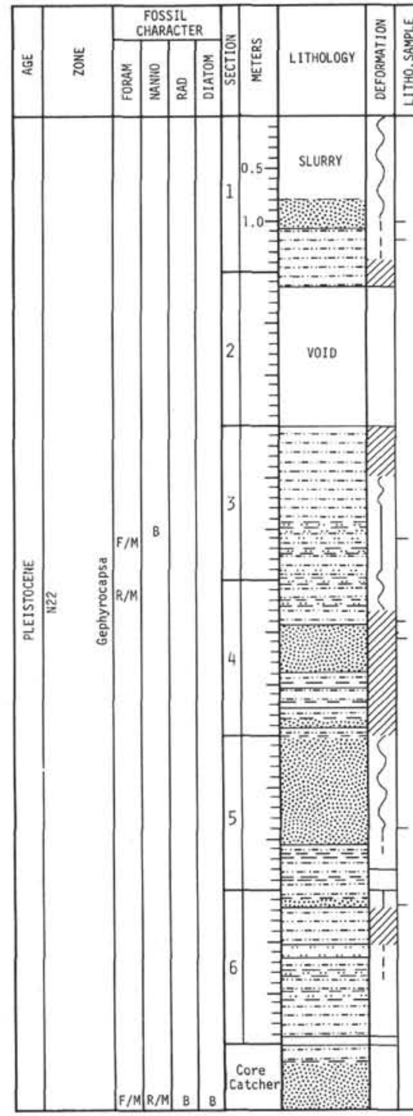
LITHOLOGIC DESCRIPTION

Interbedded SILT, CLAYEY SILT, and SILTY CLAY, olive gray (5Y4/1).

H_2S odor

Explanatory notes in chapter 1

Site 174 Hole A Core 18 Cored Interval: 189.5-199.0 m



LITHOLOGIC DESCRIPTION

Interbeds of poorly sorted FINE SAND and VERY FINE SAND, SILTY CLAY, CLAYEY SILT, and SILT.

VOID

Explanatory notes in chapter 1

Site 174 Hole A Core 19 Cored Interval: 199.0-208.5 m

AGE	ZONE		FOSSIL CHARACTER: FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22	Geophyrocapsa	R/M				1	0.5 1.0				0-360 cm graded bed of MEDIUM SAND at base to VERY FINE SAND at top.
							2					
							3					360-345 cm graded bed of FINE SAND at base to SILTY CLAY at top.
							4					450-610 cm mainly COARSE SILT, poorly sorted, gaseous.
			F/M				5					610-612 cm CALCAREOUS SILTY CLAY, fissile, grn gry (5GY6/1) 612-740 cm CLAYEY SILT with few thin beds and laminae of VERY FINE SAND and silt.
				B	B	B	Core Catcher					

Explanatory notes in chapter 1

Site 174 Hole A Core 20 Cored Interval: 208.5-218.0 m

AGE	ZONE		FOSSIL CHARACTER: FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22	Gephyrocapsa					1	0.5 1.0	VOID			
							2					MEDIUM SAND, well sorted
							3					
							Core Catcher					

Site 174 Hole A Core 21 Cored Interval: 118.0-227.5 m

AGE	ZONE		FOSSIL CHARACTER: FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22	Gephyrocapsa					1	0.5 1.0				Graded beds of MEDIUM SAND, FINE SAND or SILT laminae at base to SILTY CLAY, OLIVE GRAY (5Y4/1) at top.
			C/M				2					
			F/M				3					Smear Slide MEDIUM SAND Quartz 45% Feldspar 45% Rock frags. 8% Hornblende 2%
			R/M	B	B	B	Core Catcher					

Explanatory notes in chapter 1

Site 174 Hole A Core 22 Cored Interval: 227.5-237.0 m

AGE	ZONE		FOSSIL CHARACTER FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22	Gephyrocapsa	F/M R/P R/P	B	B	B	1 2 3 Core Catcher	0.5 1.0	VOID VOID			Interbedded FINE SAND, VERY FINE SAND, SILT, and SILTY CLAY. The sands are moderately to well sorted. No grading is evident. 135-160 cm CALCAREOUS SILTY CLAY, grn gry. (5GY6/1)

Explanatory notes in chapter 1

Site 174 Hole A Core 23 Cored Interval: 237.0-246.5 m

AGE	ZONE		FOSSIL CHARACTER FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22	Gephyrocapsa	C/M R/M R/M R/P	B	B	R/G	1 2 3 4 Core Catcher	0.5 1.0	VOID VOID VOID			0-177 cm graded bed of moderately sorted FINE SAND at base to VERY FINE SAND at top. 177-595 COARSE SILT, moderately sorted with few thin beds of SILTY CLAY, olive gray (5Y4/1). ← VOID

Site 174 Hole A Core 24 Cored Interval: 246.5-256.0 m

AGE	ZONE		FOSSIL CHARACTER FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLST.	N22	*	C/G	R/M	B	B	Core Catcher					NO CORE RECOVERED; LINER JAMMED IN BARREL. CC: MEDIUM SAND and SILTY CLAY

Explanatory notes in chapter 1
* Gephyrocapsa

Site 174 Hole A Core 25 Cored Interval: 256.0-265.5 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 / Gephyrocapsa	B, B, R/M, R/M	R/M	B	B	1, 2, 3, 4, 5, Core Catcher	0.5, 1.0	VOID			19-21 cm SILTY CLAY, olive gray (5Y4/1), firm, fissile. 0-650 cm very disturbed by coring and consists of a mixture of FINE SAND, VERY FINE SAND, and SILTY CLAY 650-660 FINE SAND 660-687 SILTY CLAY, olive gray (5Y4/1) 687-750 same as 0-650 cm

Explanatory notes in chapter 1

Site 174 Hole A Core 26 Cored Interval: 265.5-275.0 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 / Gephyrocapsa	B	R/M			1, 2, Core Catcher	0.5, 1.0	VOID			0-280 cm FINE SAND and VERY FINE SAND, well sorted 280-300 cm SILTY CLAY, olive gray (5Y4/1)

Site 174 Hole A Core 27 Cored Interval: 275.0-284.5 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 / Gephyrocapsa	R/M, R/M, C/G	R/M	B	B	1, 2, Core Catcher	0.5, 1.0	VOID			Graded beds of FINE SAND or VERY FINE SAND at base to olive gray SILTY CLAY at top. VOID VOID VOID

Explanatory notes in chapter 1

Site 174 Hole A Core 28 Cored Interval: 284.5-294.0 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLST.	N22(?) *	B	R/M	B	Core Catcher					NO CORE RECOVERED CC: SILTY CLAY, very firm, fissile, calcareous, greenish gray (5GY6/1)

Explanatory notes in chapter 1
*Gephyrocapsa

Site 174 Hole A Core 29 Cored Interval: 294.0-303.5 m

AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 Gephyrocapsa	B C/M F/M	R/M	B	B	1 2 3 Core Catcher	0.5 1.0	VOID VOID VOID			SILTY CLAY, olive gray (5Y4/1) to dark greenish gray (5GY4/1) with SILT beds few mm to 20 cm thick. Few mottles of silt present in SILTY CLAY. SITE 174, HOLE A, CORE 30: No recovery; cored interval, 303.5-313.0 m.

Explanatory notes in chapter 1

Site 174 Hole A Core 31 Cored Interval: 313.0-322.5 m

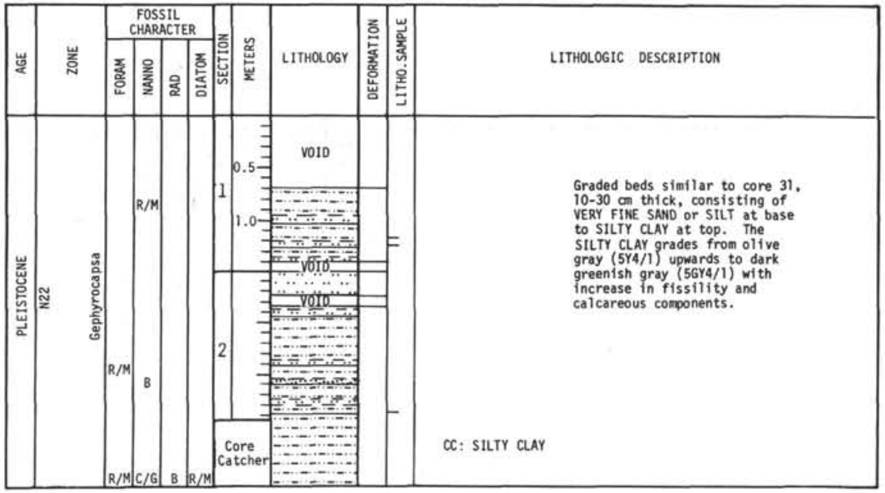
AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 Gephyrocapsa	C/M C/G	F/G C/G	B	R/G R/G	1 2 Core Catcher	0.5 1.0				Graded beds, 8-50 cm thick, of COARSE SILT at base (1-15 cm thick) to SILTY CLAY (4-40 cm thick) at top. The SILTY CLAY grades from olive gray (5Y4/1) upwards to dark greenish gray (5GY4/1) with increase in fissility and calcareous material.

Site 174 Hole A Core 32 Cored Interval: 322.5-332.0 m

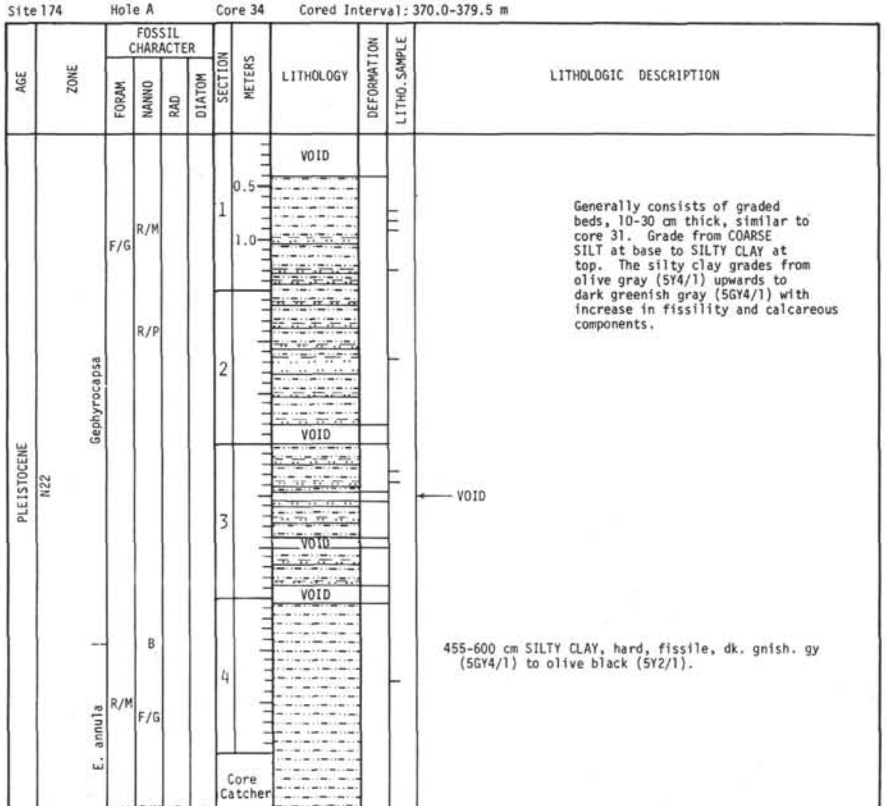
AGE	ZONE	FORAM	NANNO	RAD	DIATOM	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 Gephyrocapsa	R/M R/M C/G	F/M	B	R/G	1 2 Core Catcher	0.5 1.0	VOID VOID			←VOID Graded beds, similar to core 31, 7-30 cm thick, consisting of COARSE SILT or FINE SAND at base to SILTY CLAY at top. The silty clay grades from olive gray (5Y4/1) upwards to dark greenish gray (5GY4/1) with increase in fissility and calcareous material. CC: SILTY CLAY

Explanatory notes in chapter 1

Site 174 Hole A Core 33 Cored Interval: 341.5-351.0 m

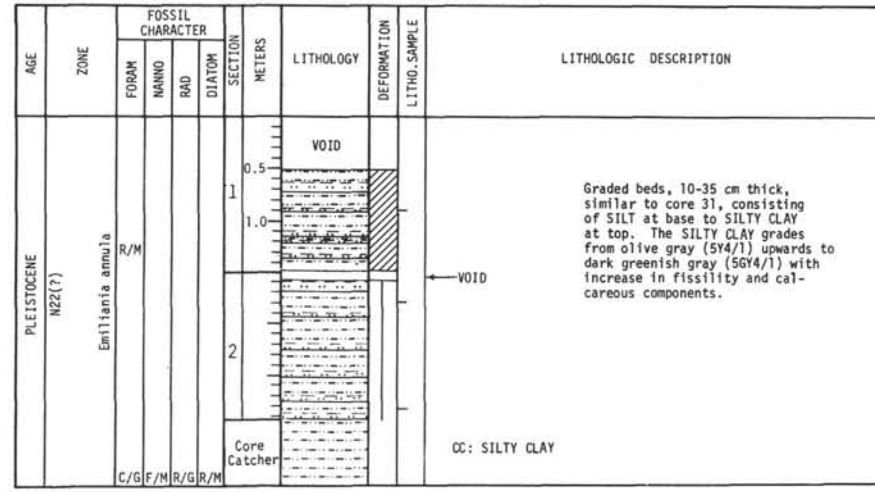


Site 174 Hole A Core 34 Cored Interval: 370.0-379.5 m

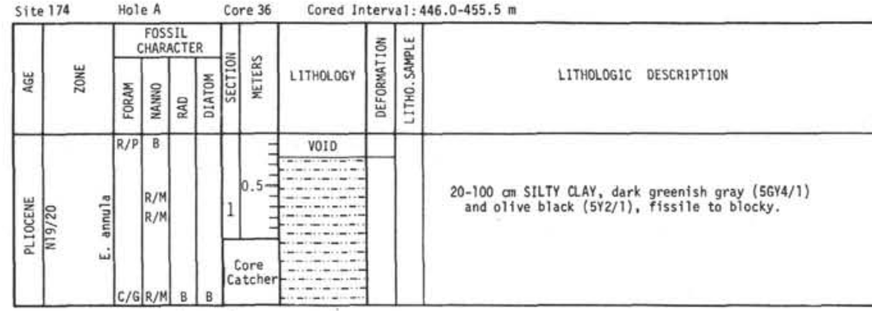


Explanatory notes in chapter 1

Site 174 Hole A Core 35 Cored Interval: 408.0-417.5 m



Site 174 Hole A Core 36 Cored Interval: 446.0-455.5 m



Explanatory notes in chapter 1

Site 174 Hole A Core 37 Cored Interval: 503.5-512.5 m

AGE	ZONE	FOSSIL CHARACTER: FORAM	NANNO	RAD	DIATOM	SECTION	LITHOLOGIC DESCRIPTION
PLIOCENE	N19/20, Emiliania annula	R/P, R/P, R/P	B, R/M, F/M, B			1, 2, 3, 4	Graded beds, 8-20 cm thick of SILT at base to SILTY CLAY at top. SILTY CLAY grades from olive gray (5Y4/1) upwards to dark greenish gray (5GY4/1) with increase in fissility and calcareous components. The SILTY CLAY is very firm and structures are well preserved including: worm burrows, groove casts and laminations.
		F/M	B	B	B	Core Catcher	

LITHOLOGY: VOID (top of Section 1); VOID (Section 3); ← VOID

Site 174 Hole A Core 38 Cored Interval: 636.0-645.5 m

AGE	ZONE	FOSSIL CHARACTER: FORAM	NANNO	RAD	DIATOM	SECTION	LITHOLOGIC DESCRIPTION
PLIOCENE	N19/20	B	B			1	Interbedded FINE SAND and SILTY CLAY, olive gray (5Y4/1).
		R/P	R/M	F/P	R/P	Core Catcher	

LITHOLOGY: VOID (top of Section 1)

Explanatory notes in chapter 1

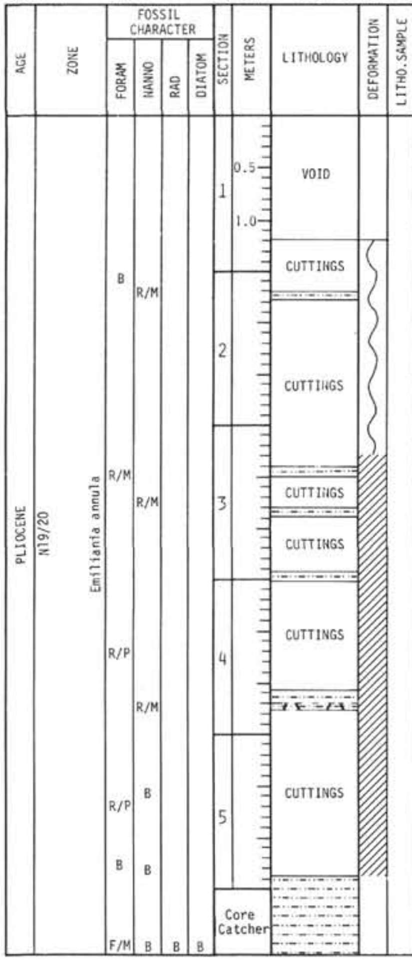
Site 174 Hole A Core 39 Cored Interval: 750.0-759.5 m

AGE	ZONE	FOSSIL CHARACTER: FORAM	NANNO	RAD	DIATOM	SECTION	LITHOLOGIC DESCRIPTION
PLIOCENE	N19/20, Emiliania annula	F/M, R/M	R/M, R/M, B, B, B			1, 2, 3	70-150 cm badly disturbed by coring and consists of SILTY CLAY, FINE SAND and hard SILTY CLAY fragments. 150-152 cm SILTY VERY FINE SANDSTONE with calcareous cement. 158-160 cm same as 150-152 cm. 160-418 cm graded beds of a thin (often absent) SILT at base to SILTY CLAY at top. 418-423 cm VERY FINE SANDSTONE with calcareous cement.
		C/M	R/M	B	B	Core Catcher	

LITHOLOGY: VOID (top of Section 1)

Explanatory notes in chapter 1

Site 174 Hole A Core 40 Cored Interval: 769-778.5 m



LITHOLOGIC DESCRIPTION

Most of core is badly disturbed and consists of drill cuttings of SAND, SILTY CLAY, hard SILTY CLAY fragements. Intervals of coherent sediment are noted and consist of hard SILTY CLAY or CALCAREOUS MUDSTONE.

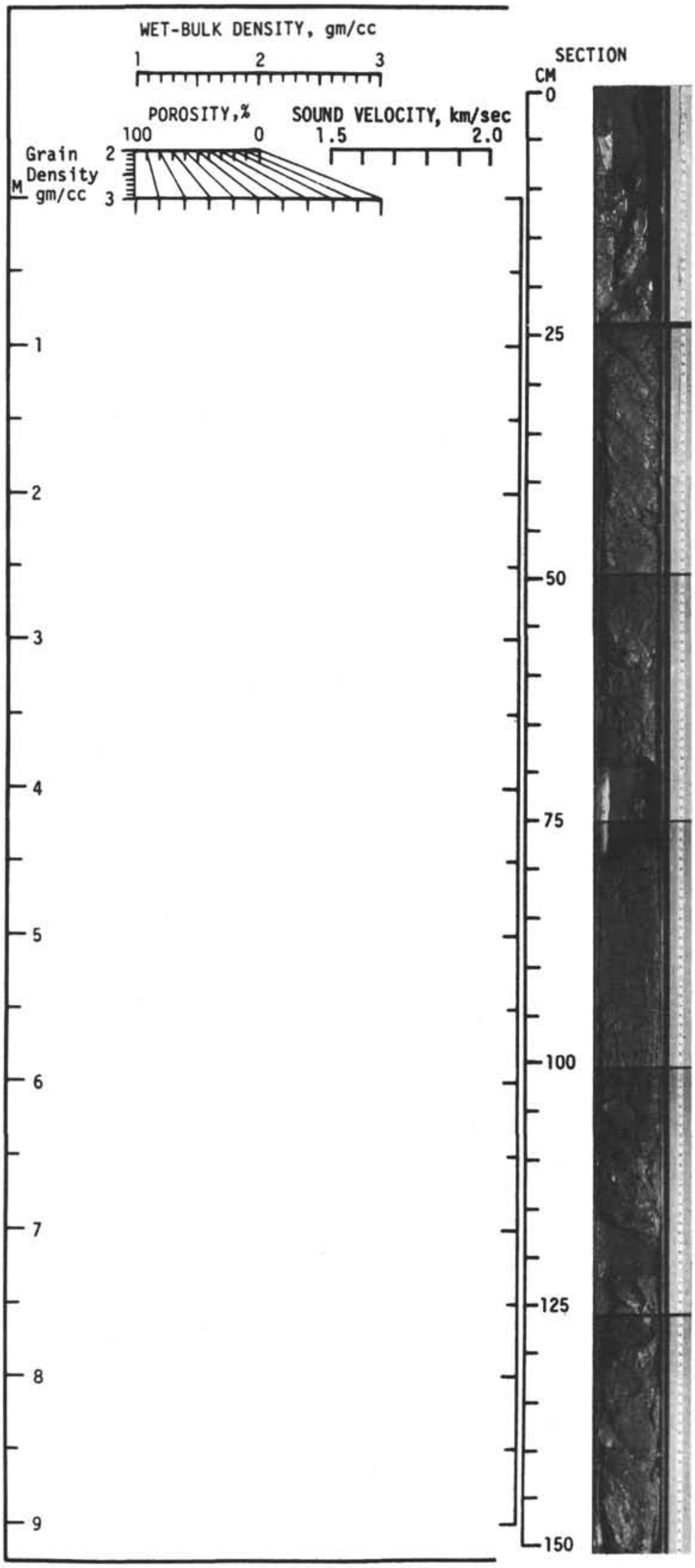
571-576 CALCAREOUS MUDSTONE

SITE 174, HOLE A, CORE 41: No recovery; cored interval, 854.5-861.5 m.

SITE 174, HOLE A, CORE 42: No recovery; cored interval, 861.5-871.0 m.

SITE 174, HOLE A, CORE 43: No recovery; cored interval, 871.0-879.0 m.

Explanatory notes in chapter 1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Grain Density gm/cc
2
3
M
1
2
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8
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SECTION
CM
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50
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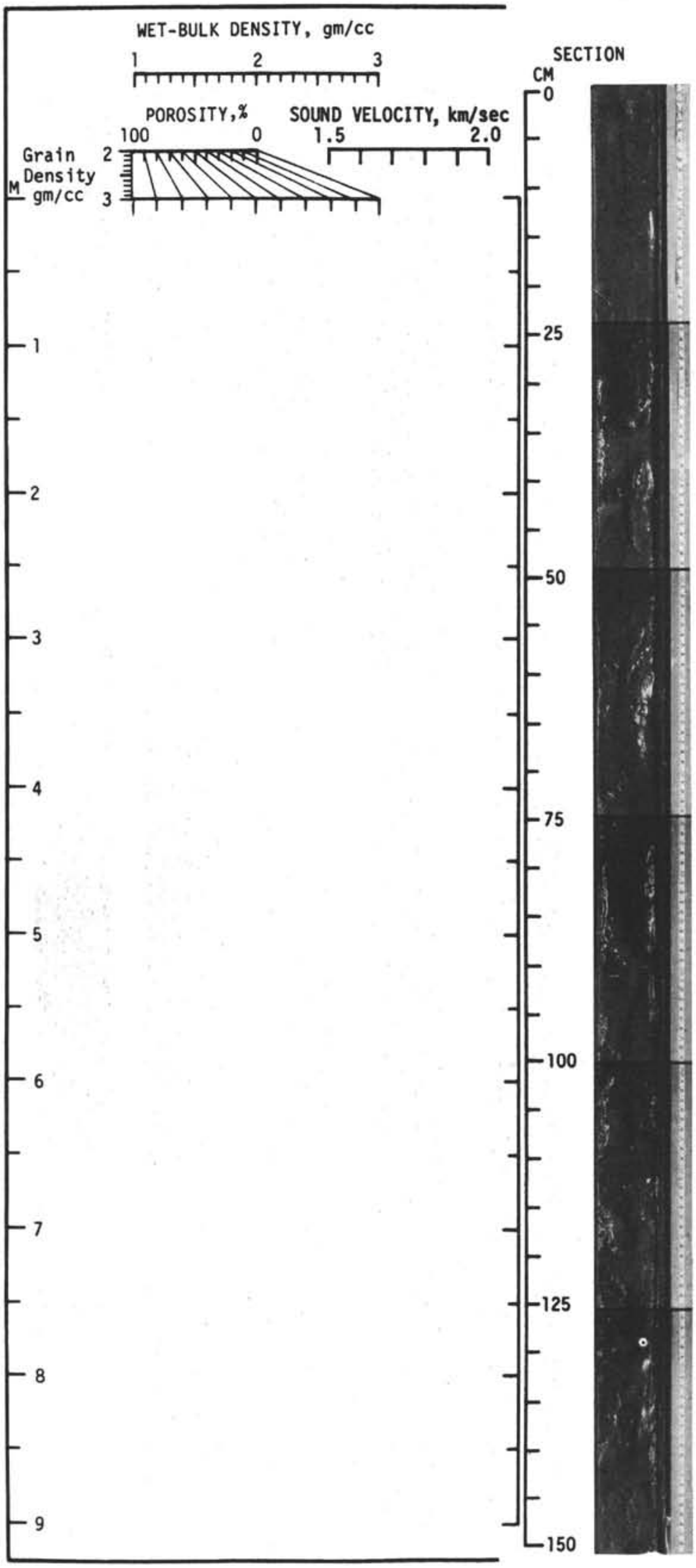
174-1-1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2.0
Grain Density gm/cc
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3
M
1
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SECTION
CM
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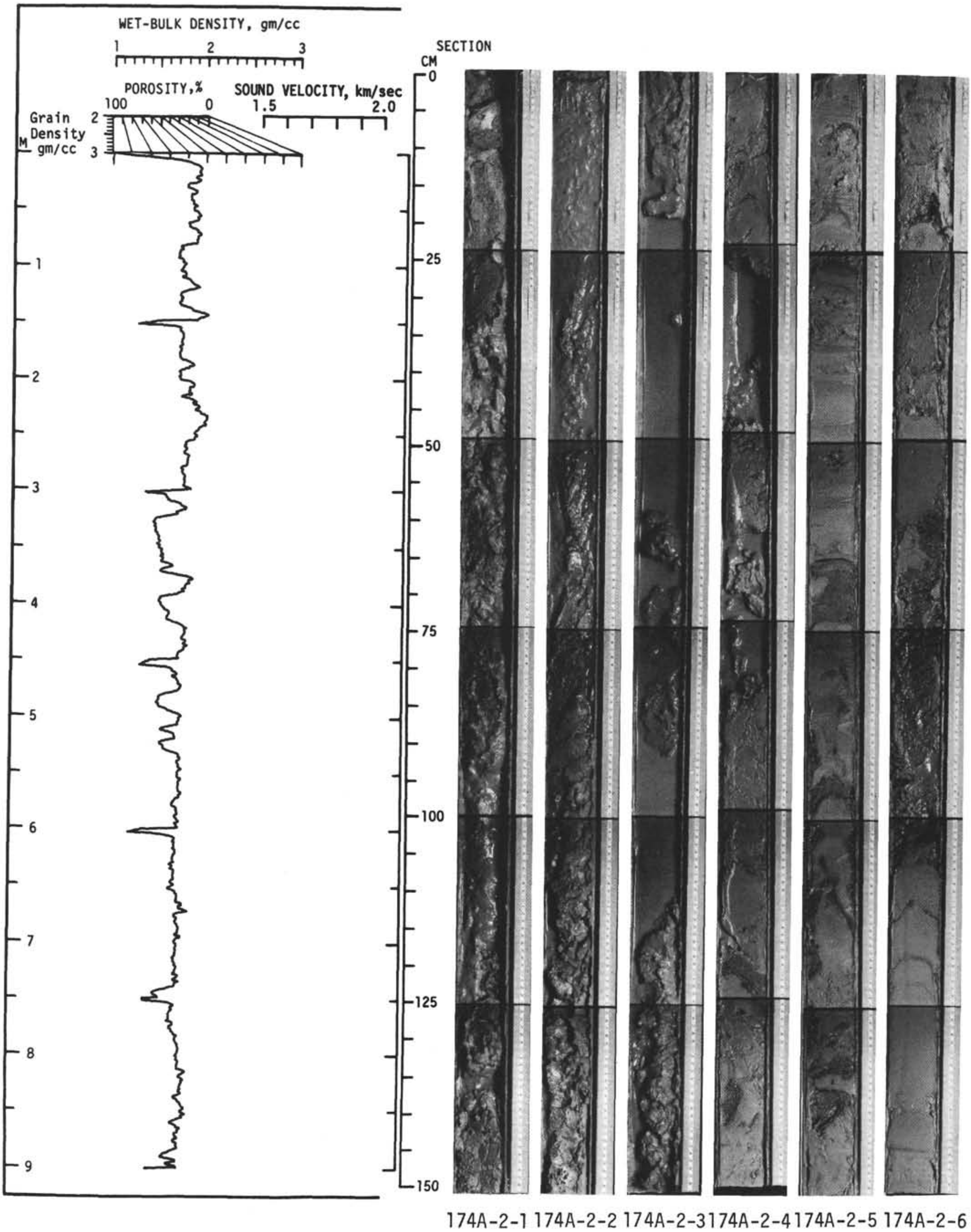
75
100
125
150

174-2-1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SOUND VELOCITY, km/sec
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Grain Density gm/cc
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3
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SECTION
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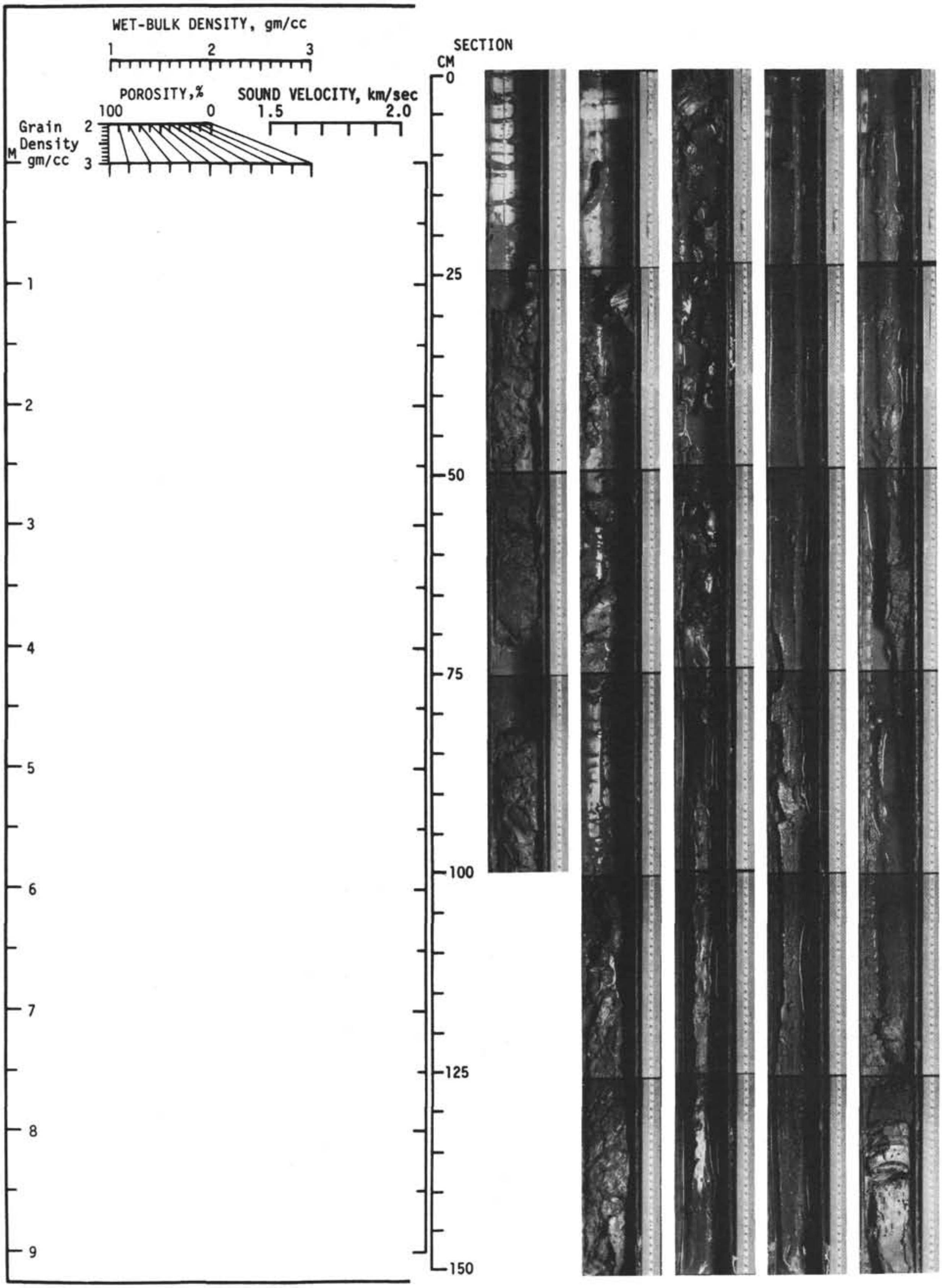
174A-2-5
174A-2-6



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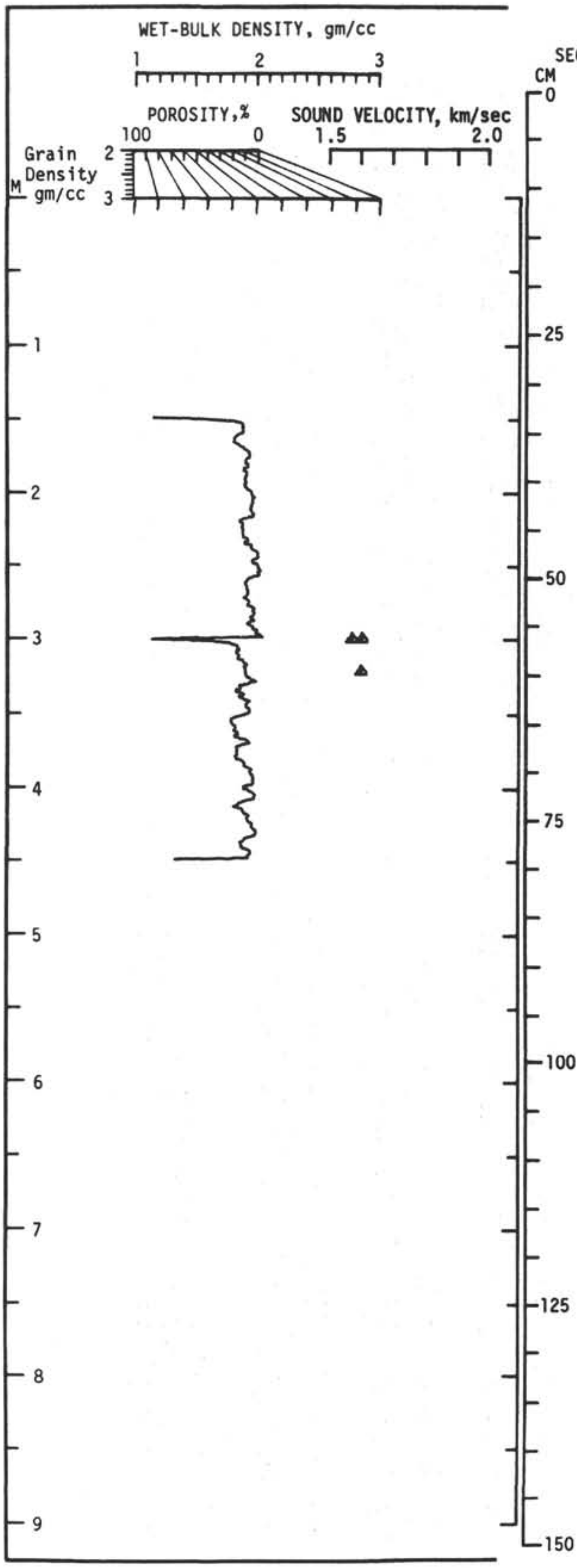

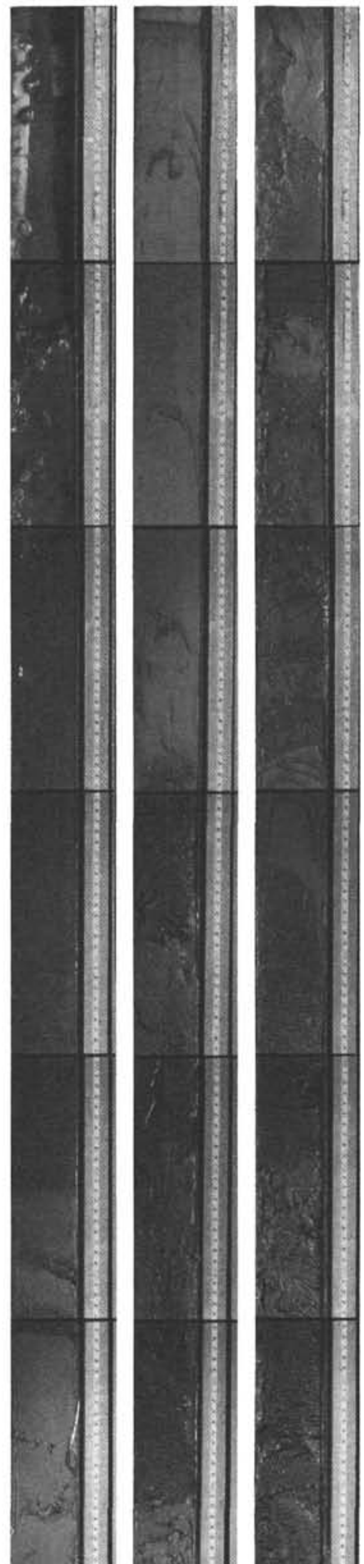

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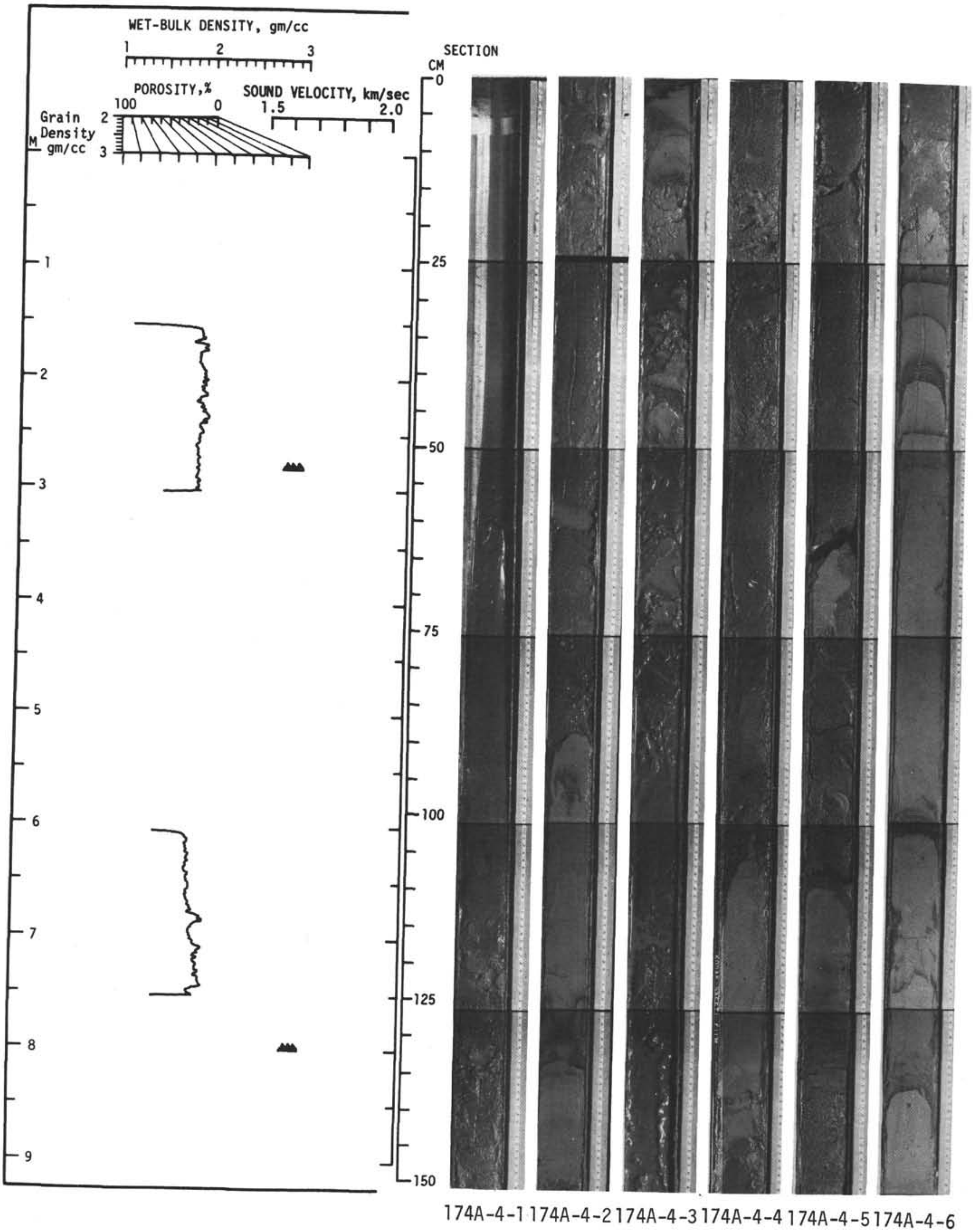
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Grain Density gm/cc
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1
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SECTION
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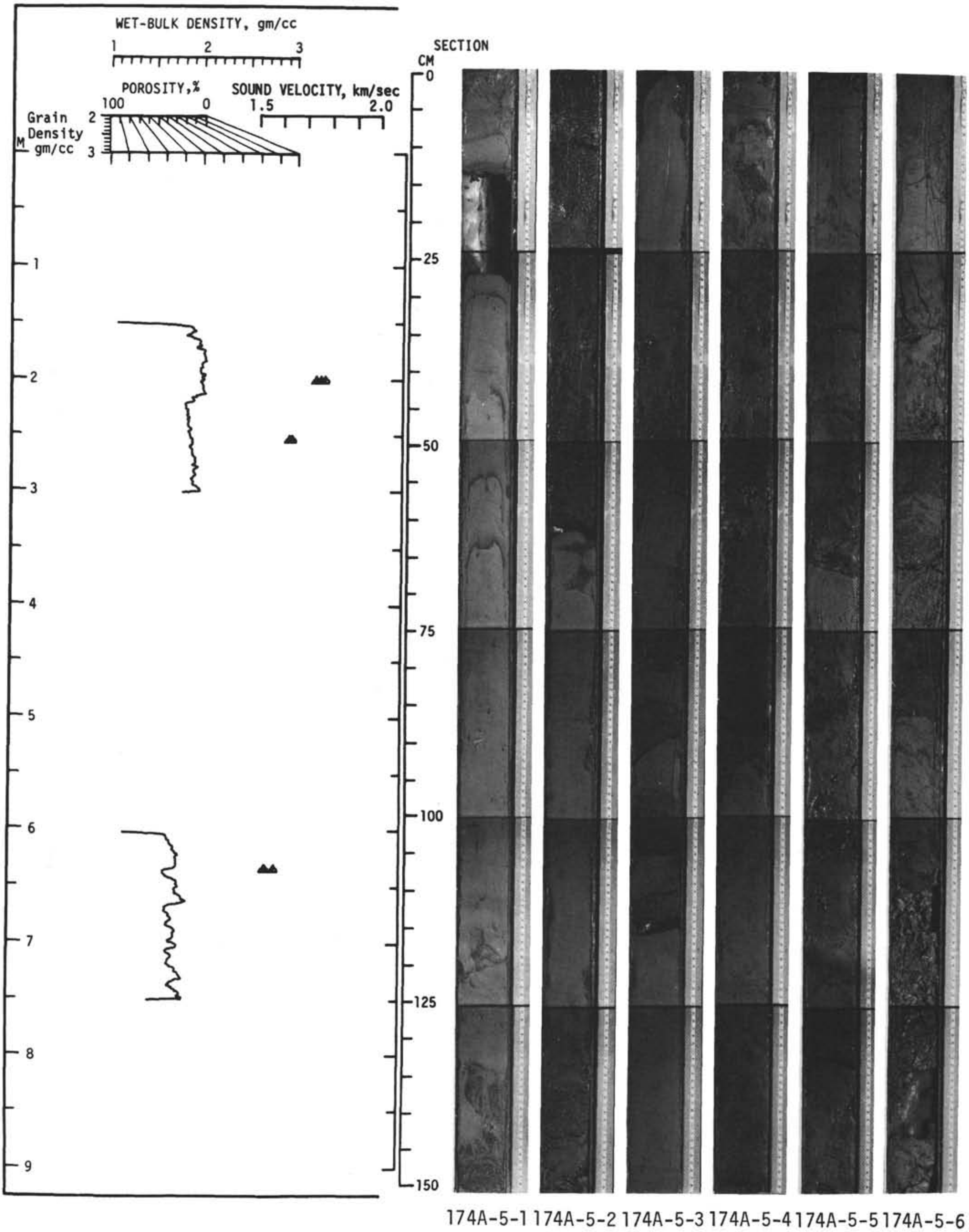
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POROSITY,%
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SOUND VELOCITY, km/sec
1.5
2.0
Grain Density gm/cc
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SECTION
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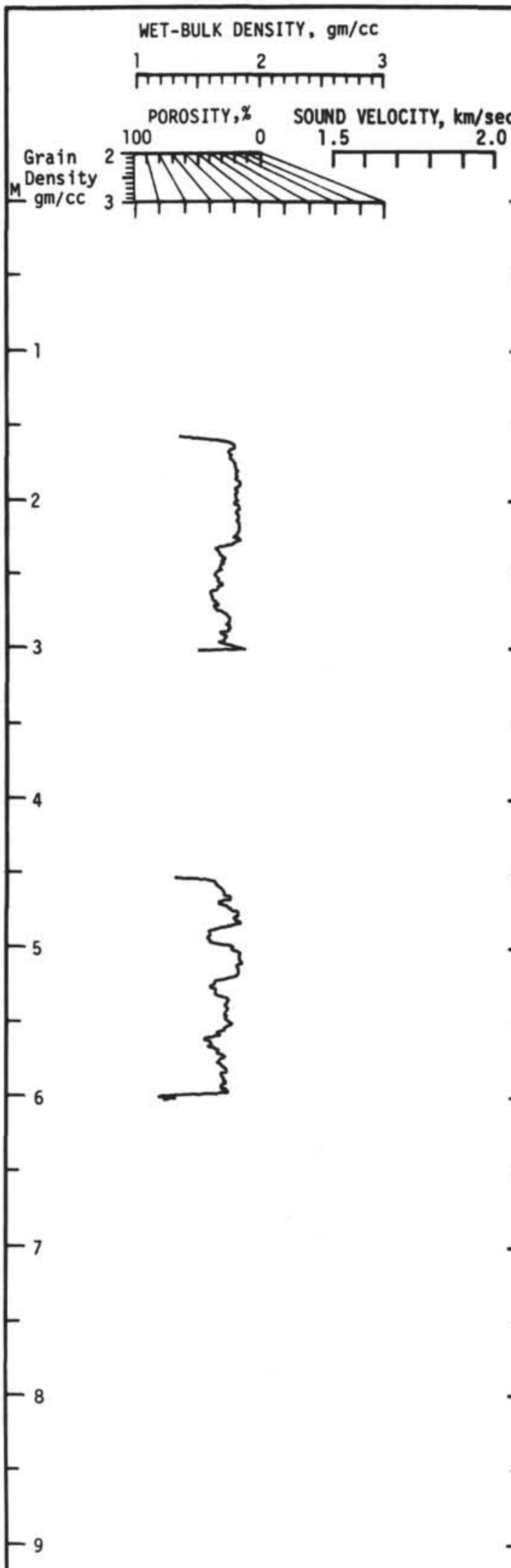
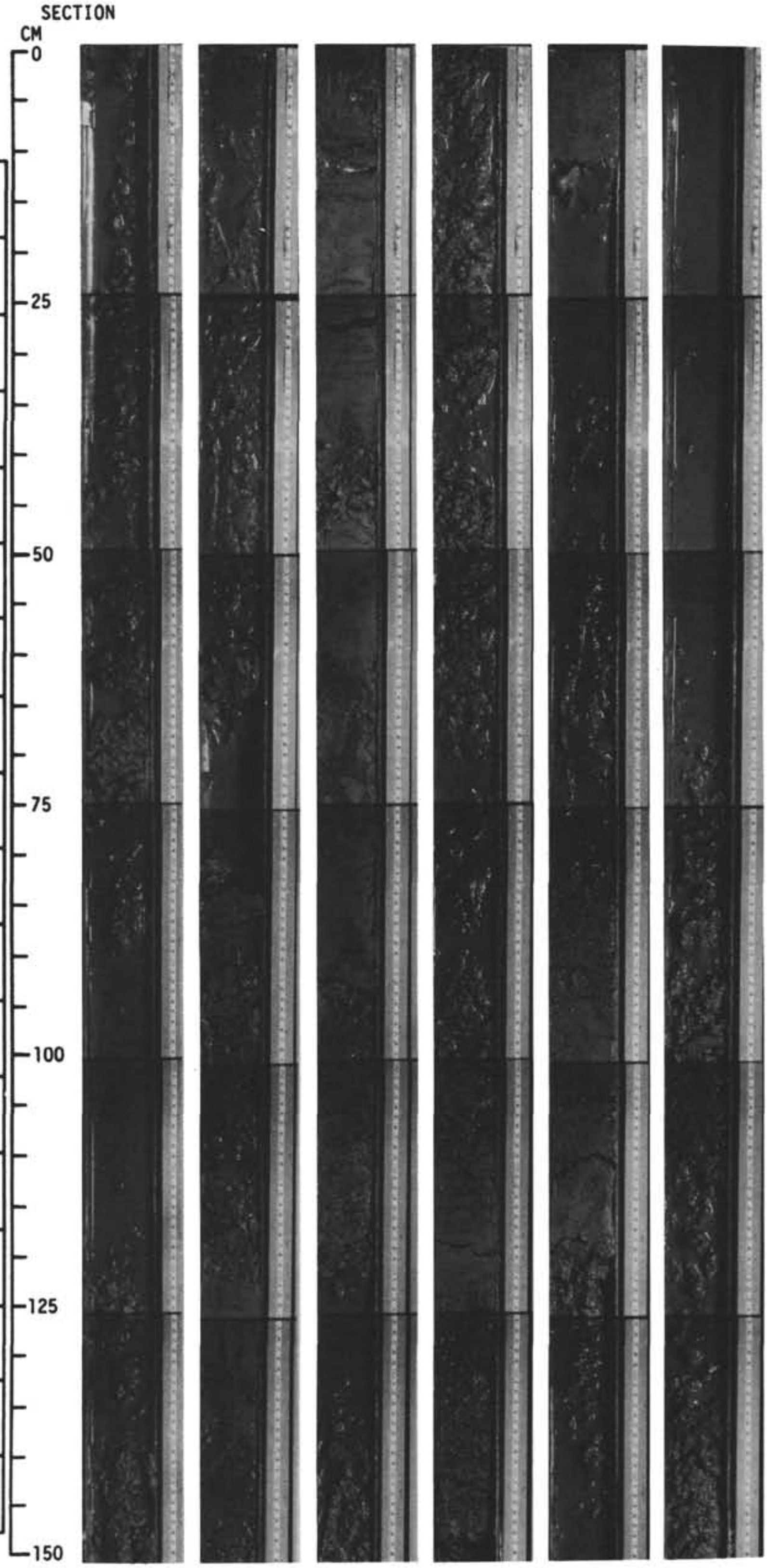
174A-5-6





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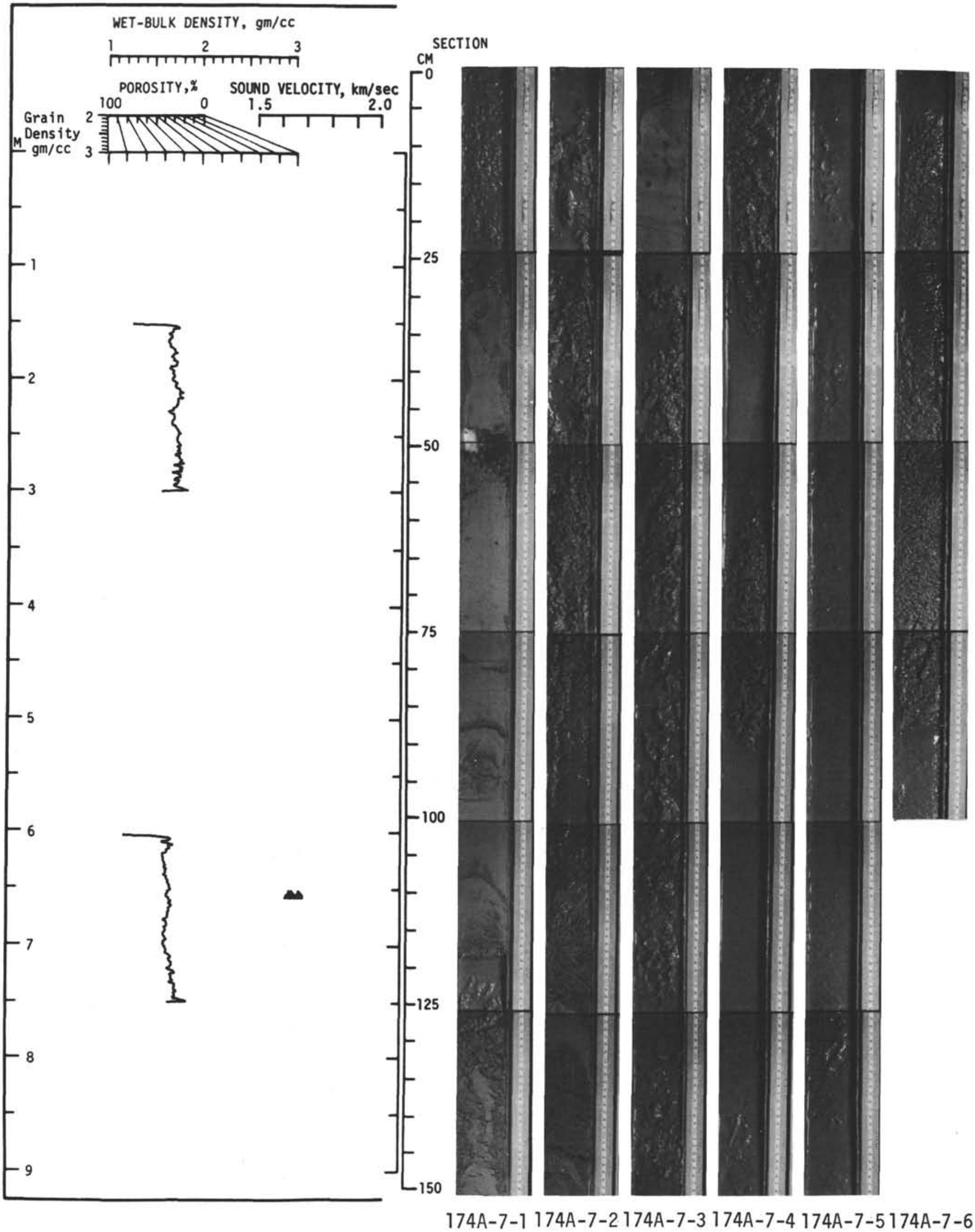
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SOUND VELOCITY, km/sec
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2.0
Grain Density gm/cc
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SECTION
CM
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25
50
75
100
125
150
1
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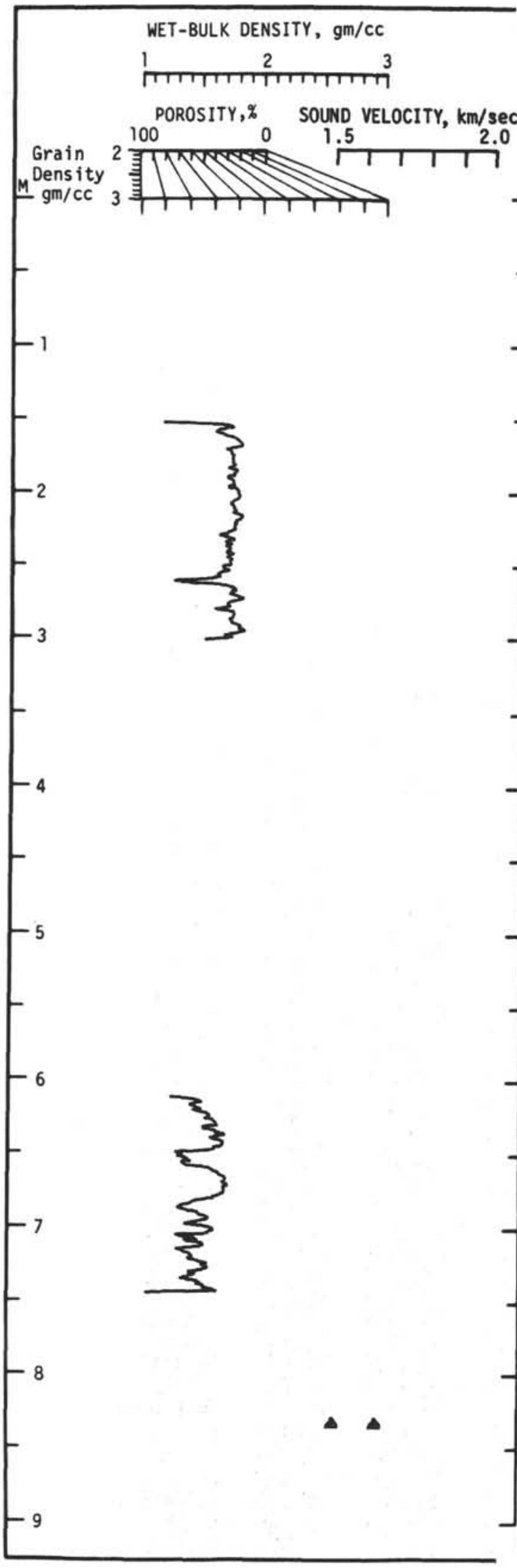

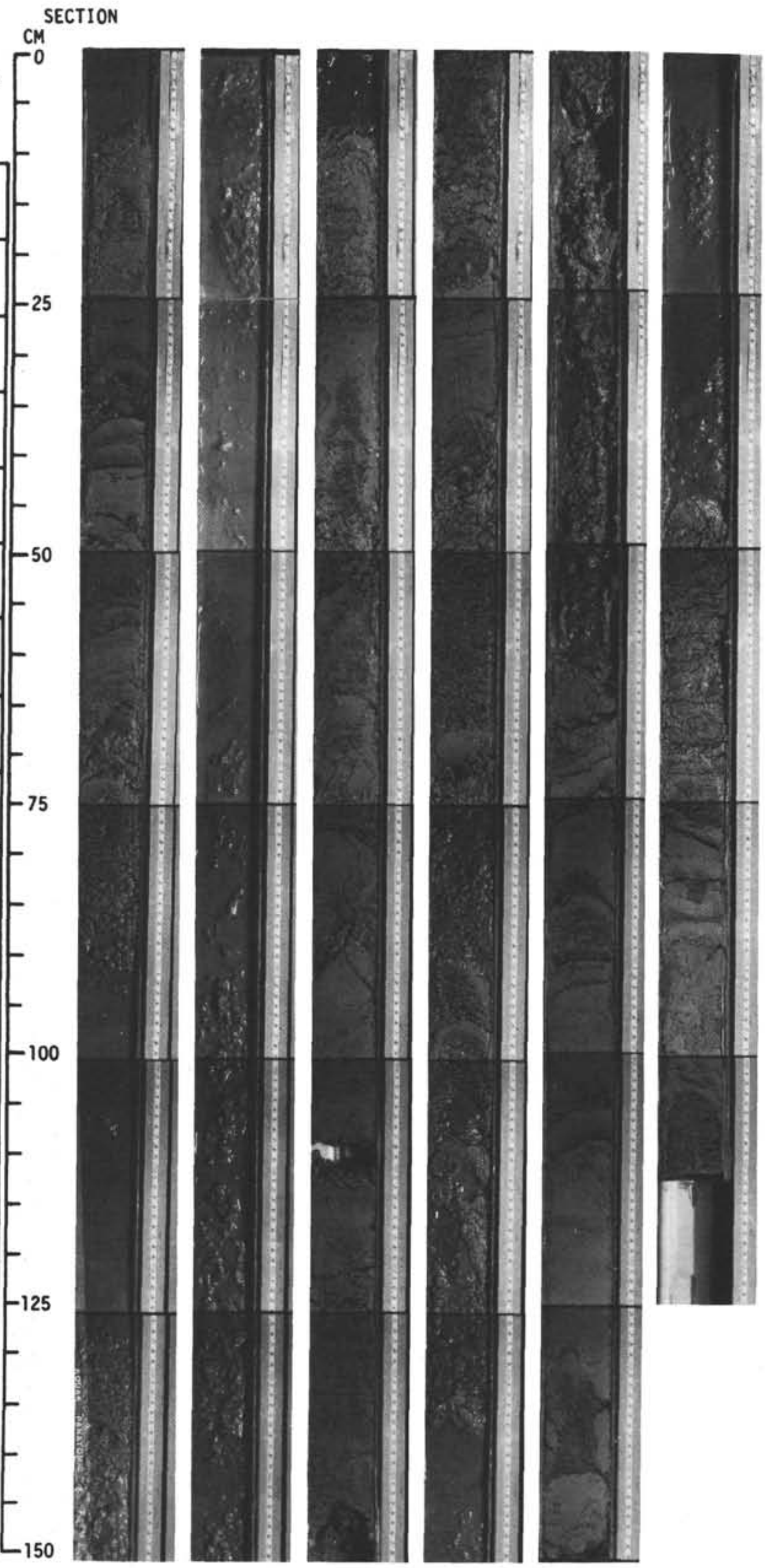

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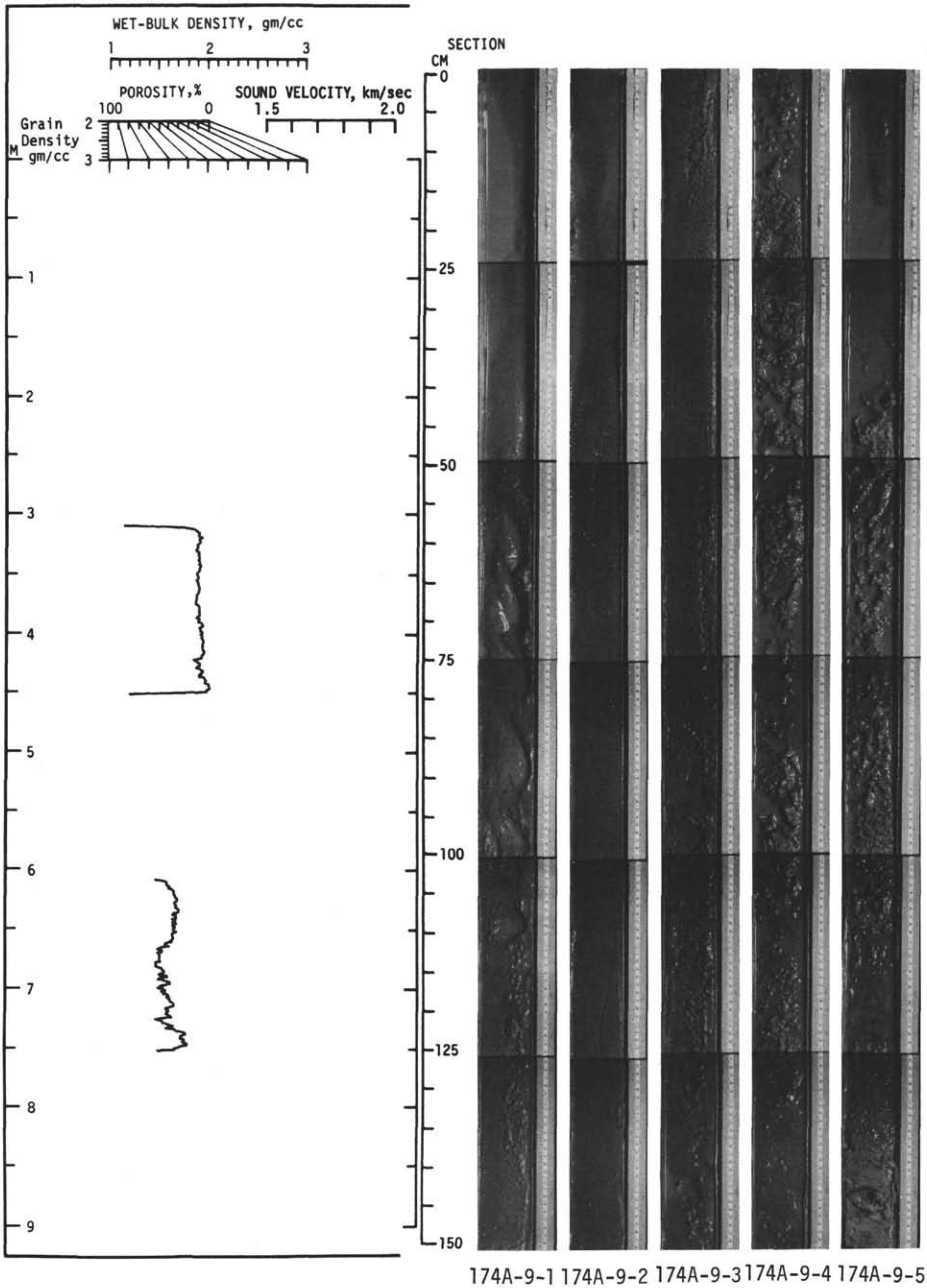
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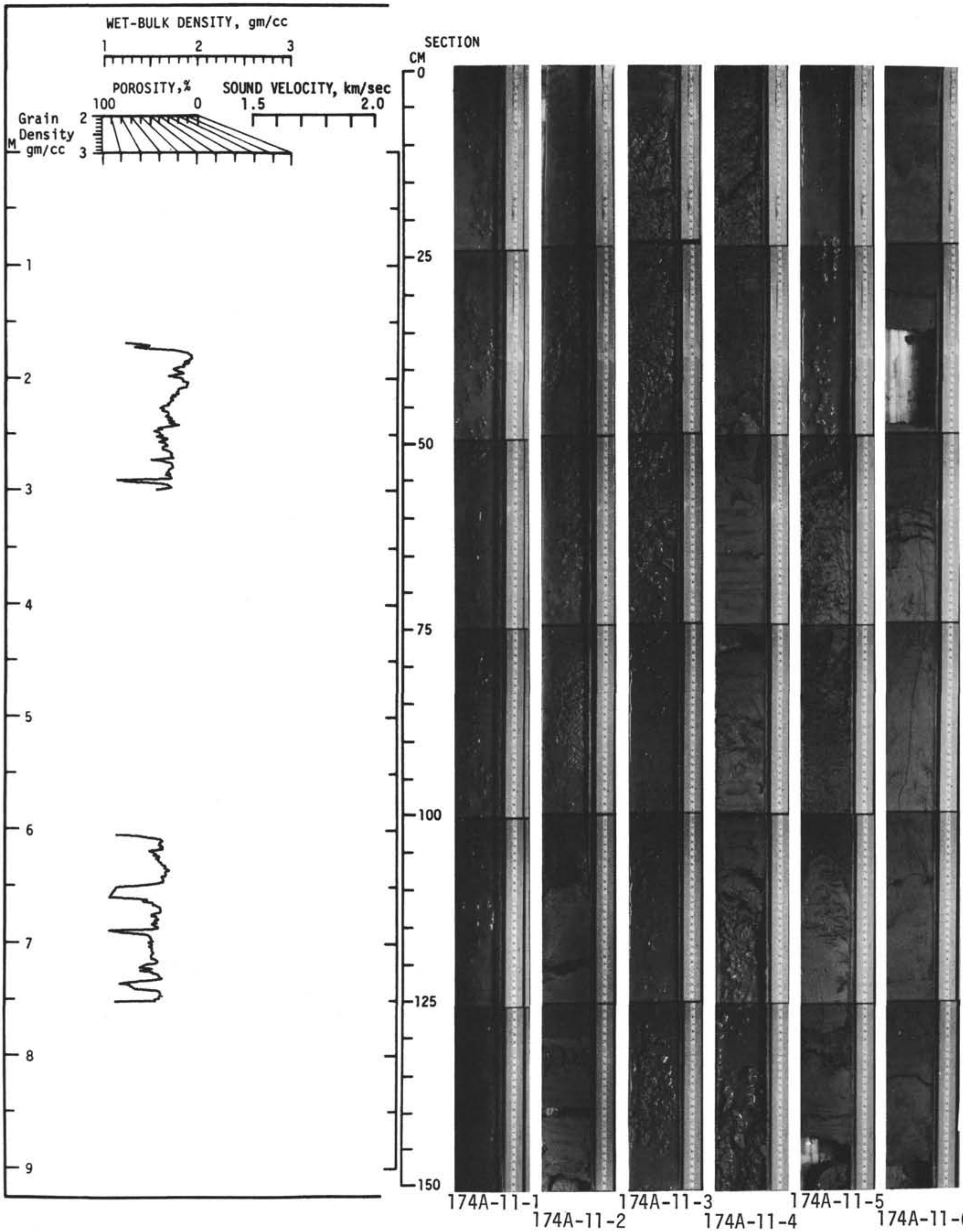
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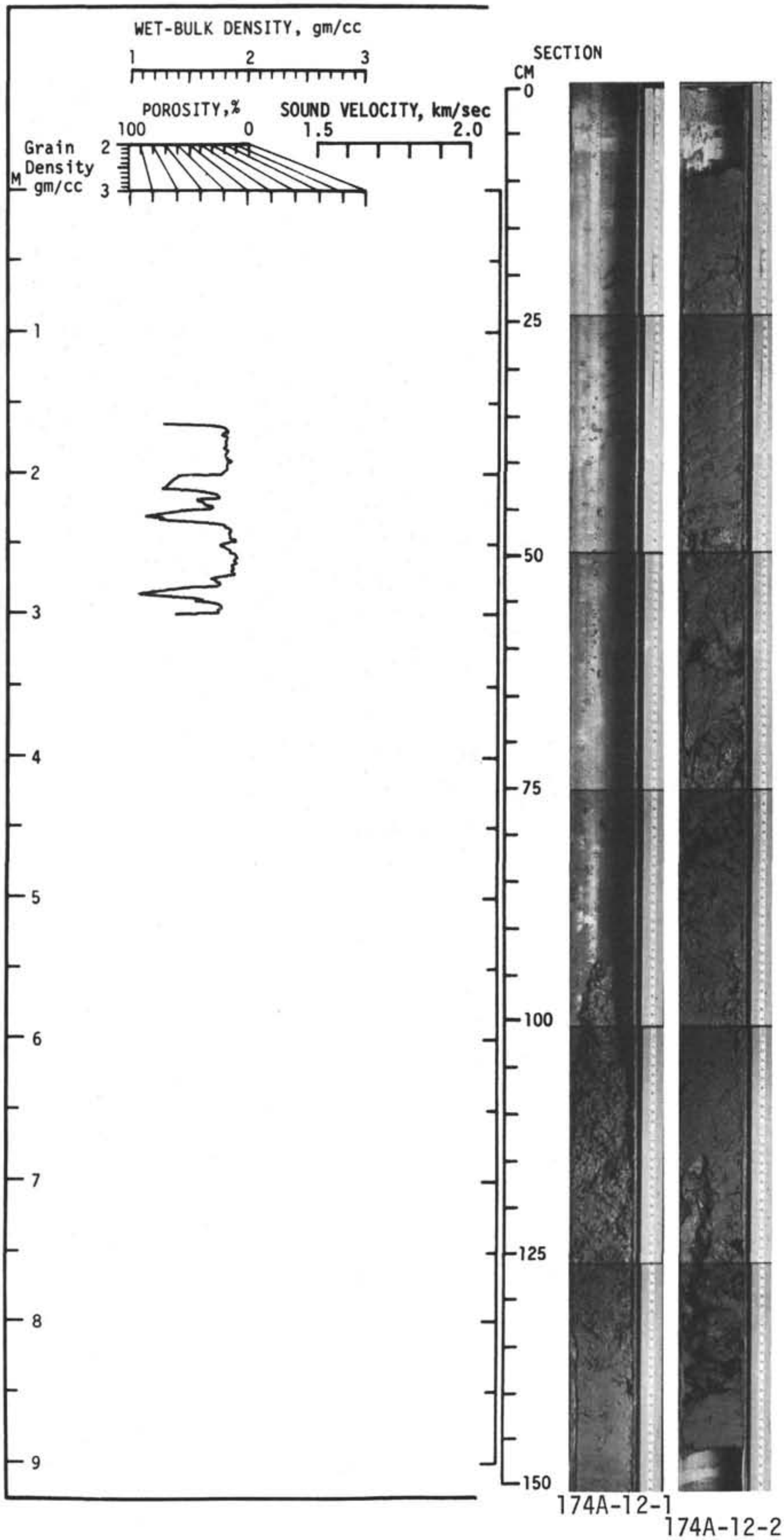
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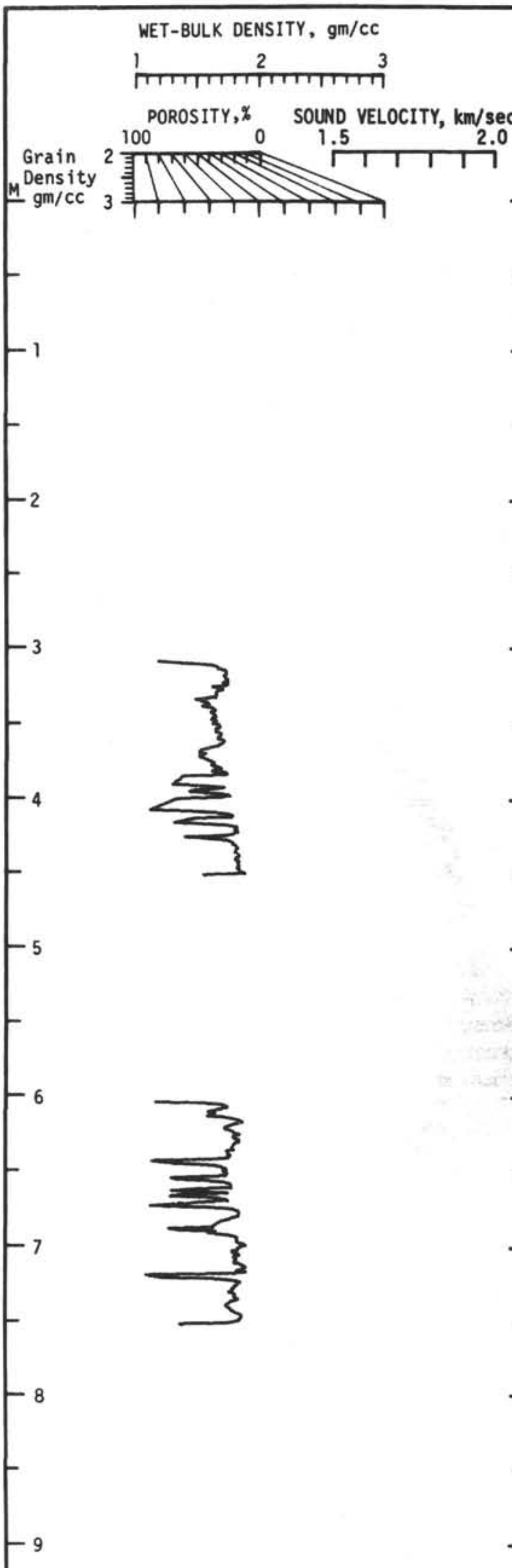
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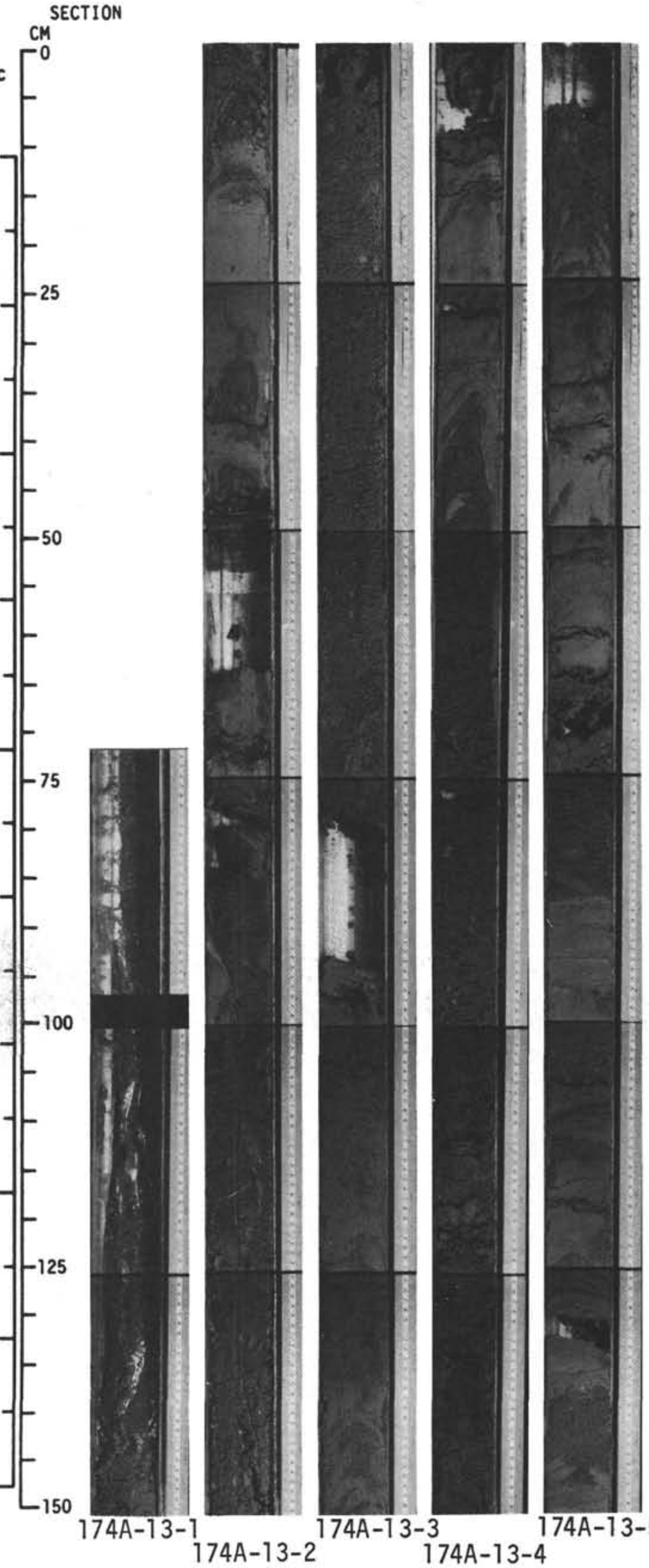
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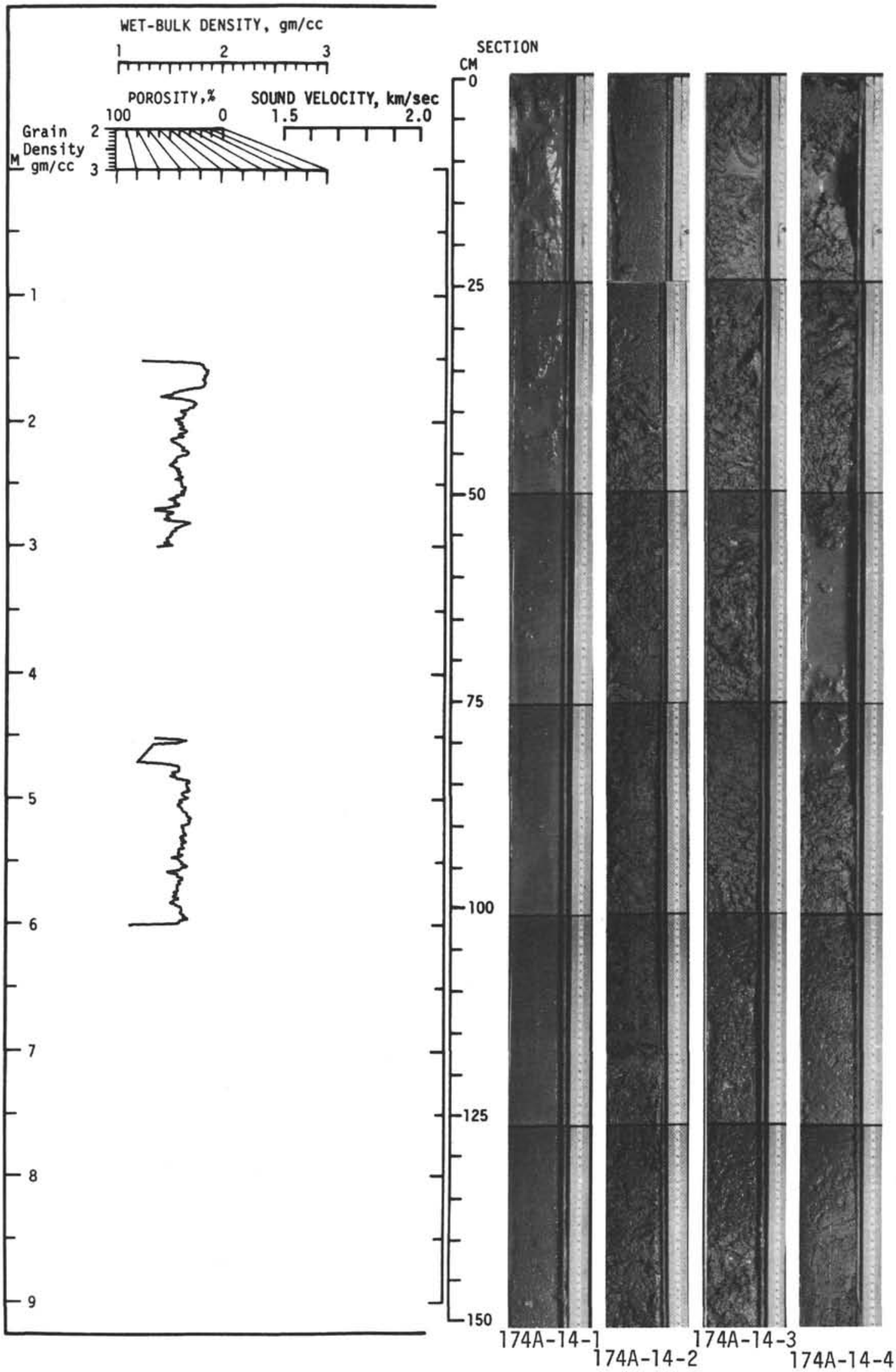
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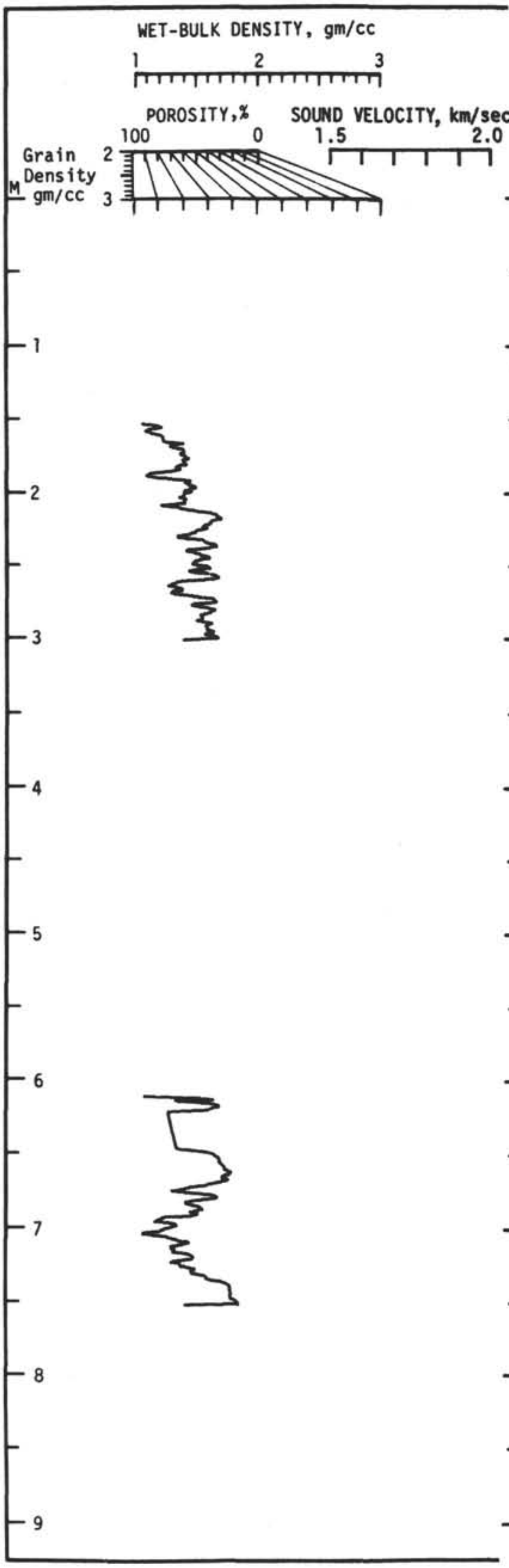
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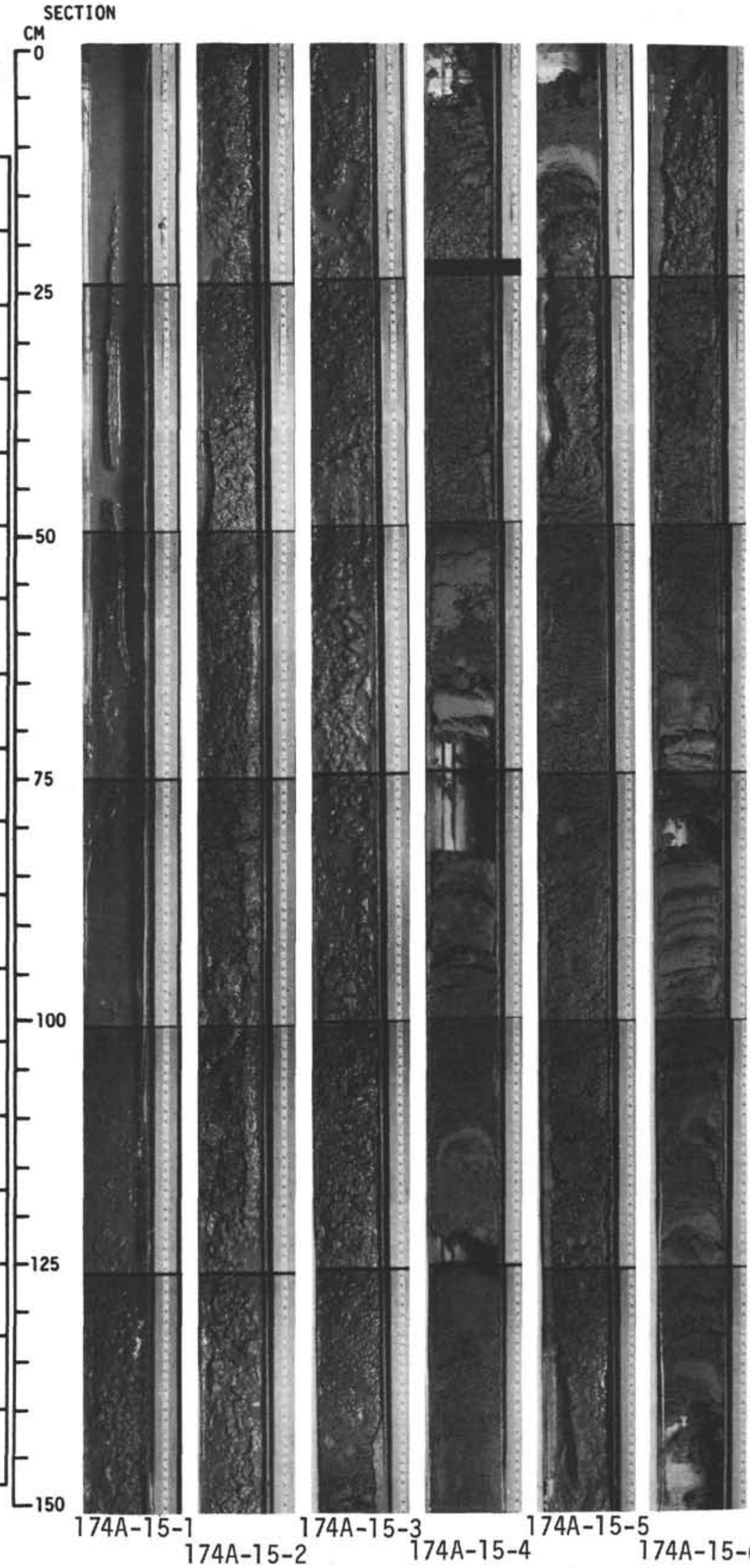
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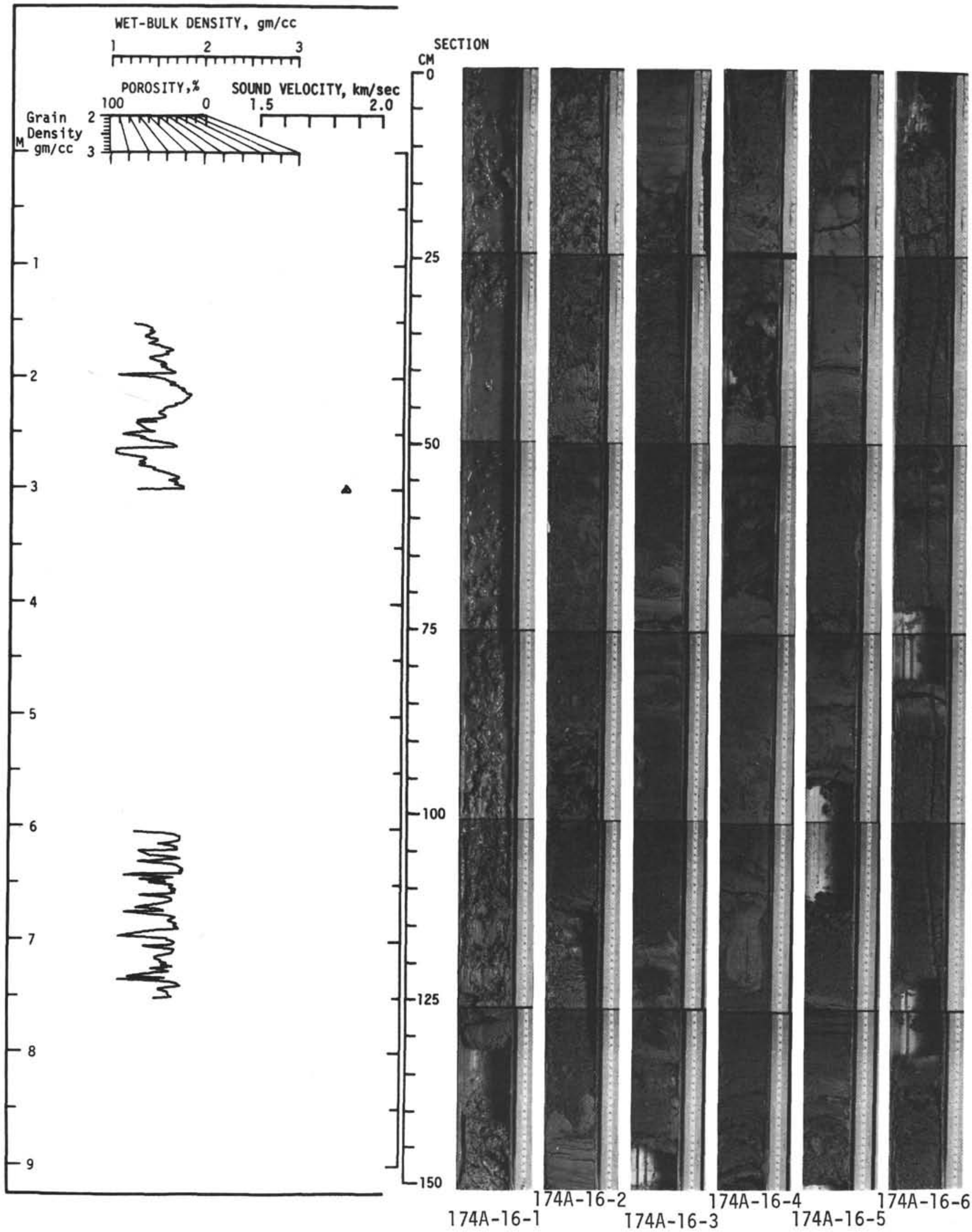
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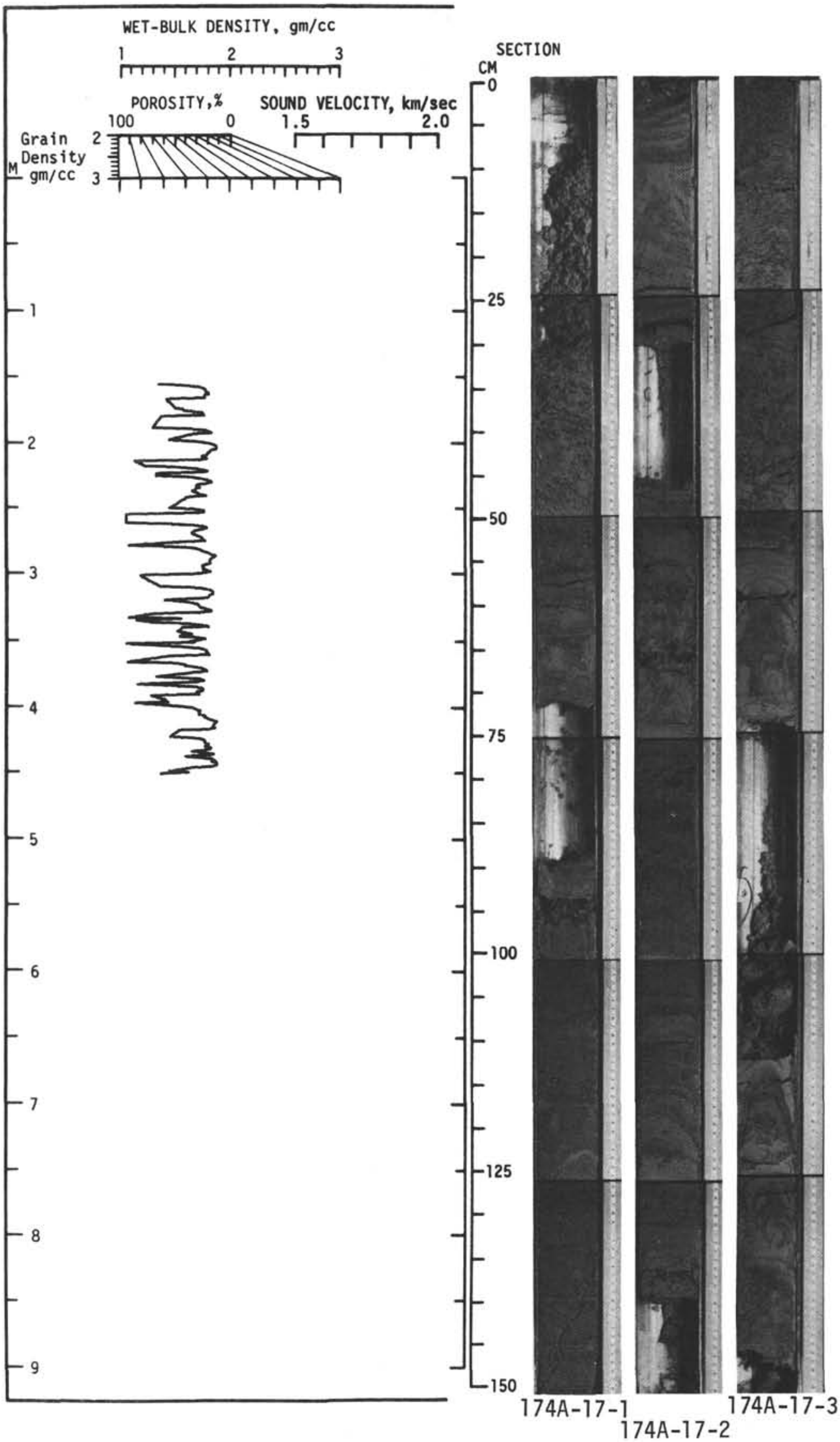
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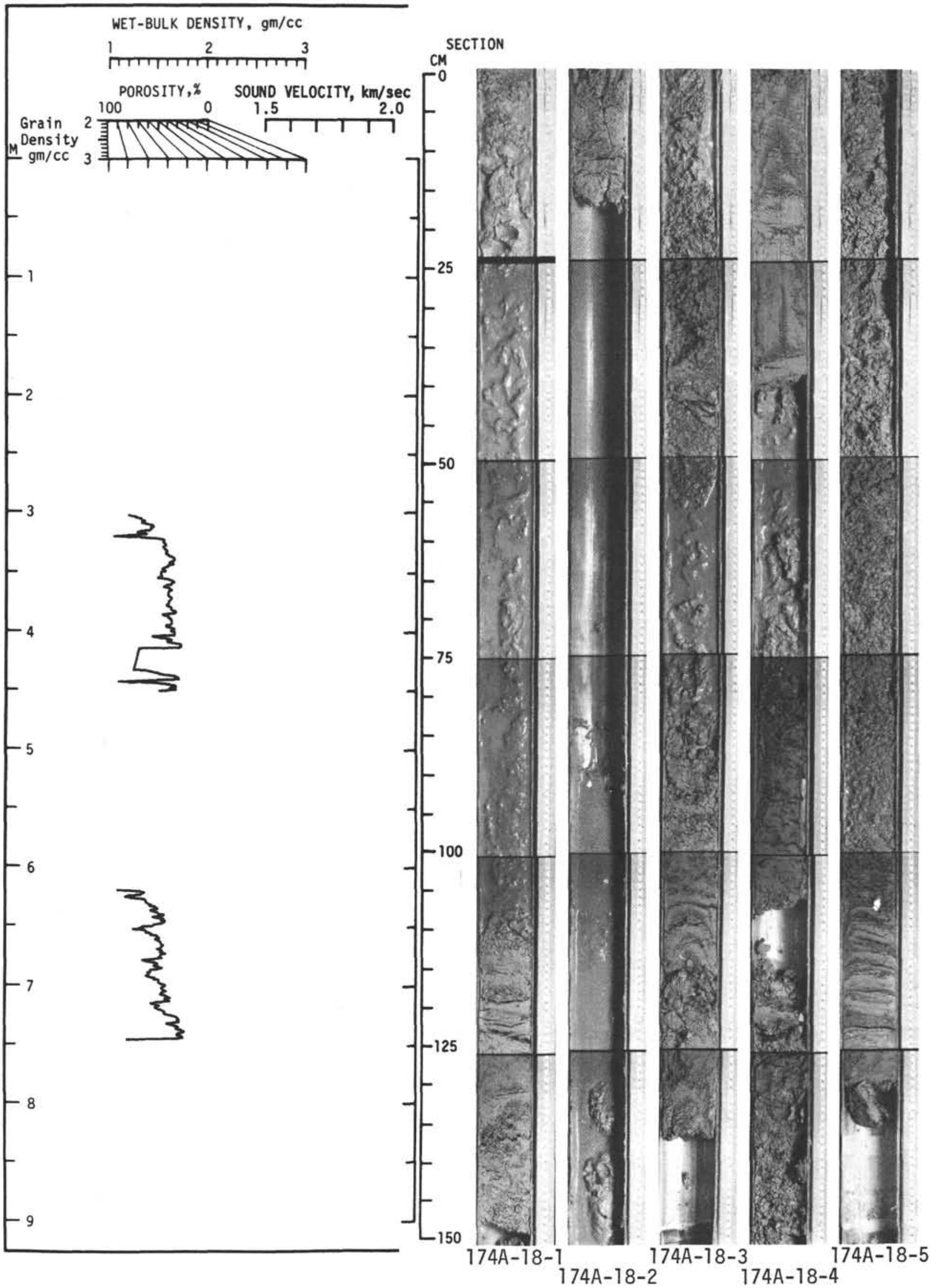
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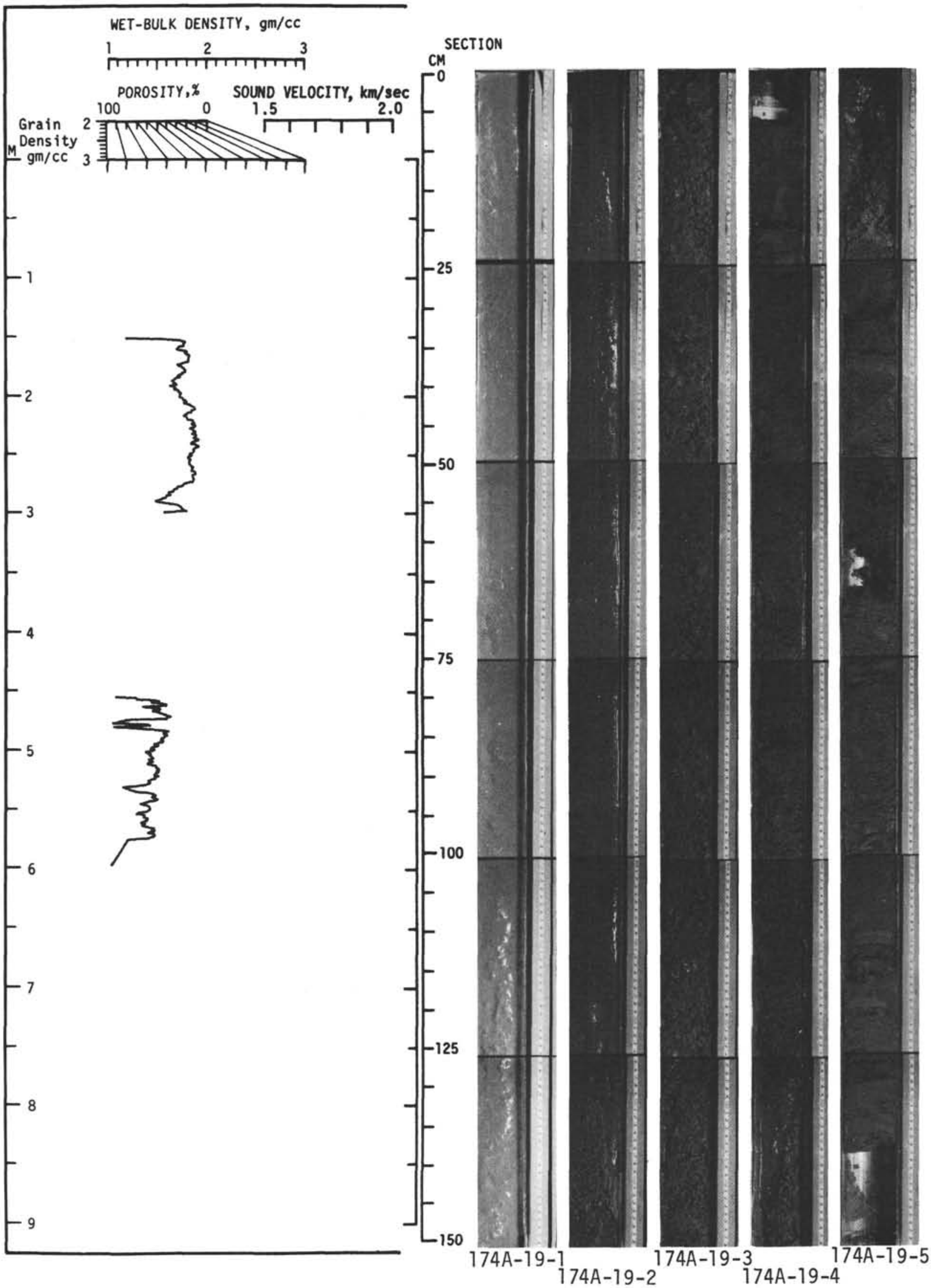
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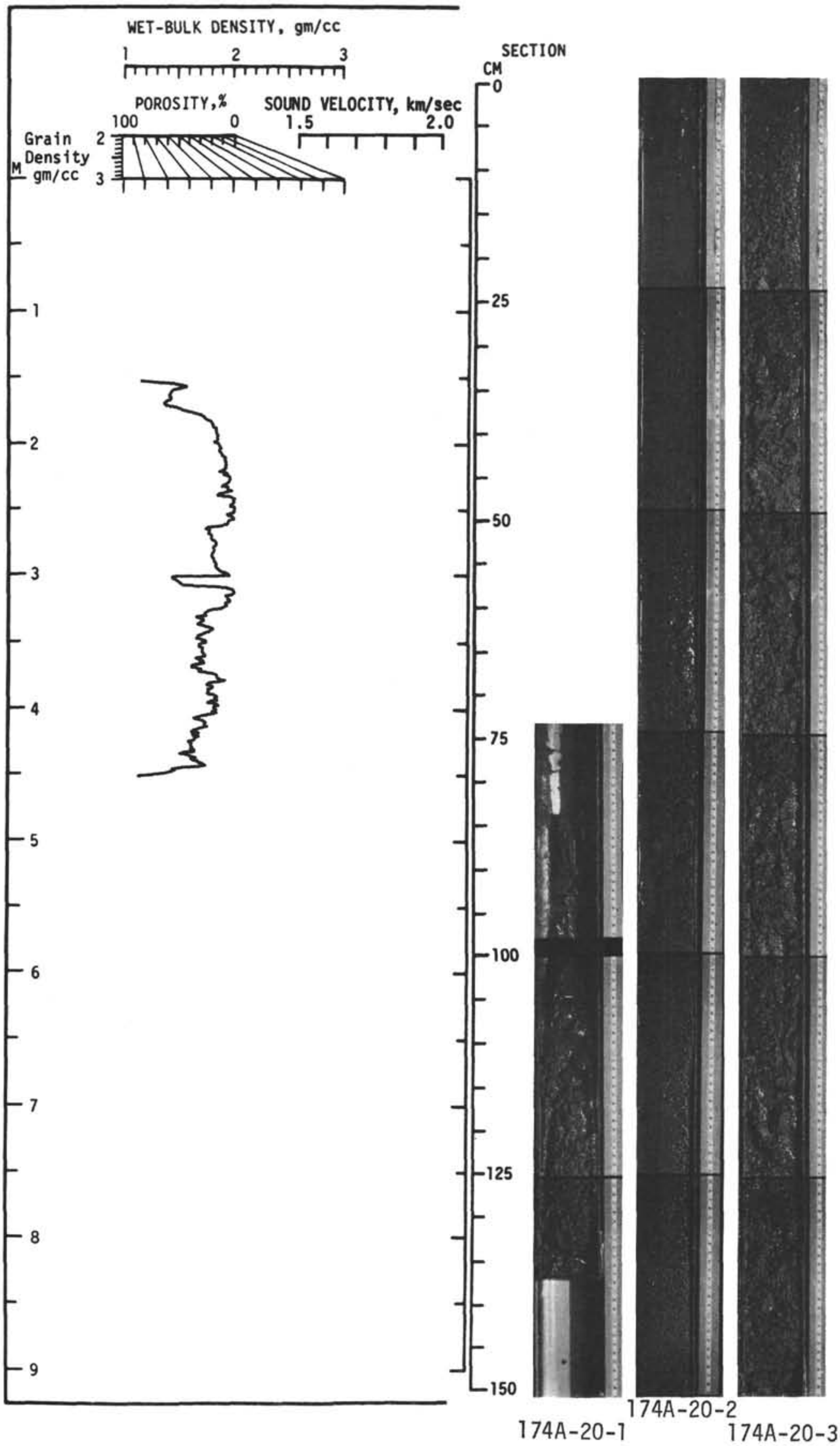
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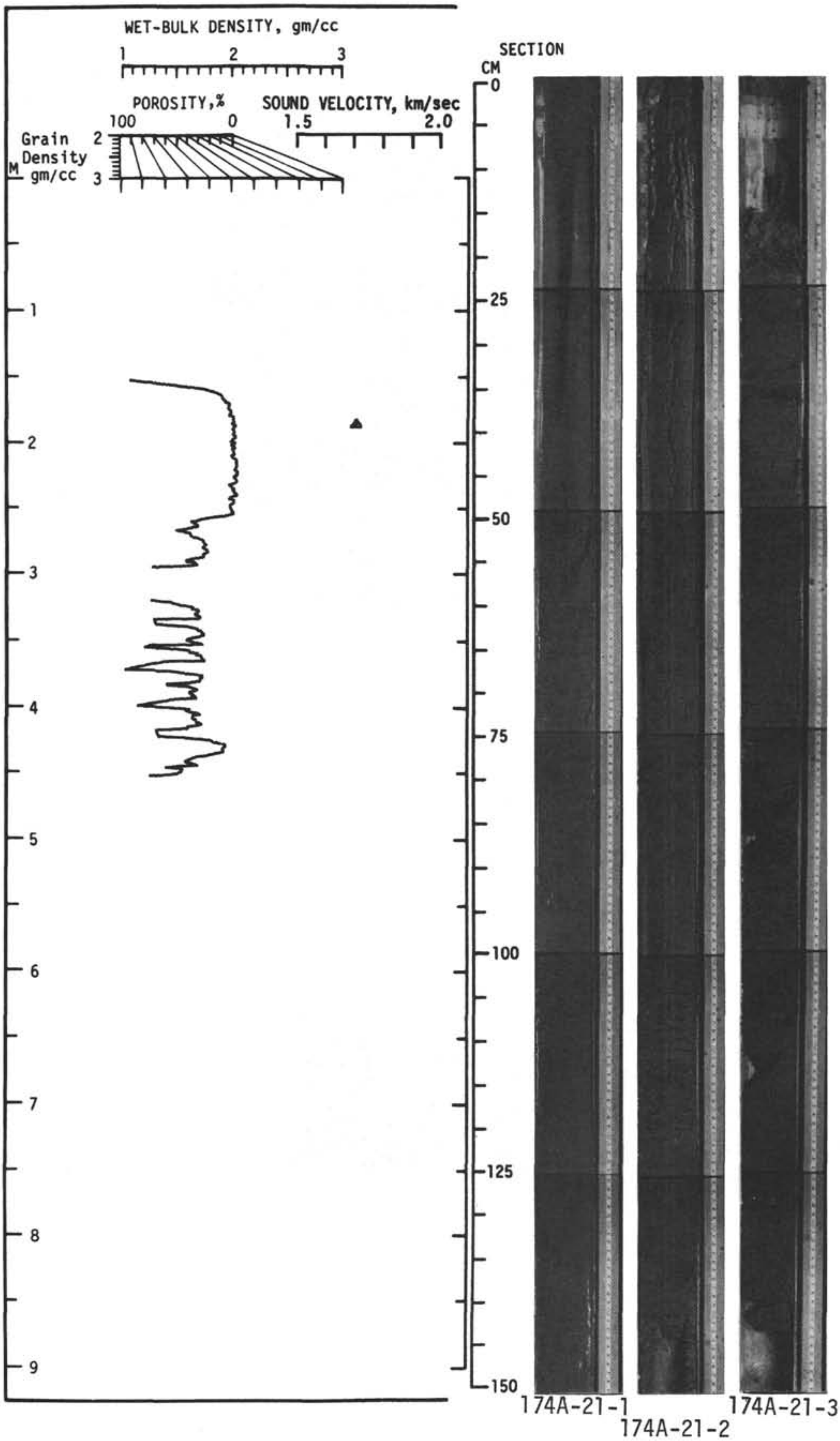
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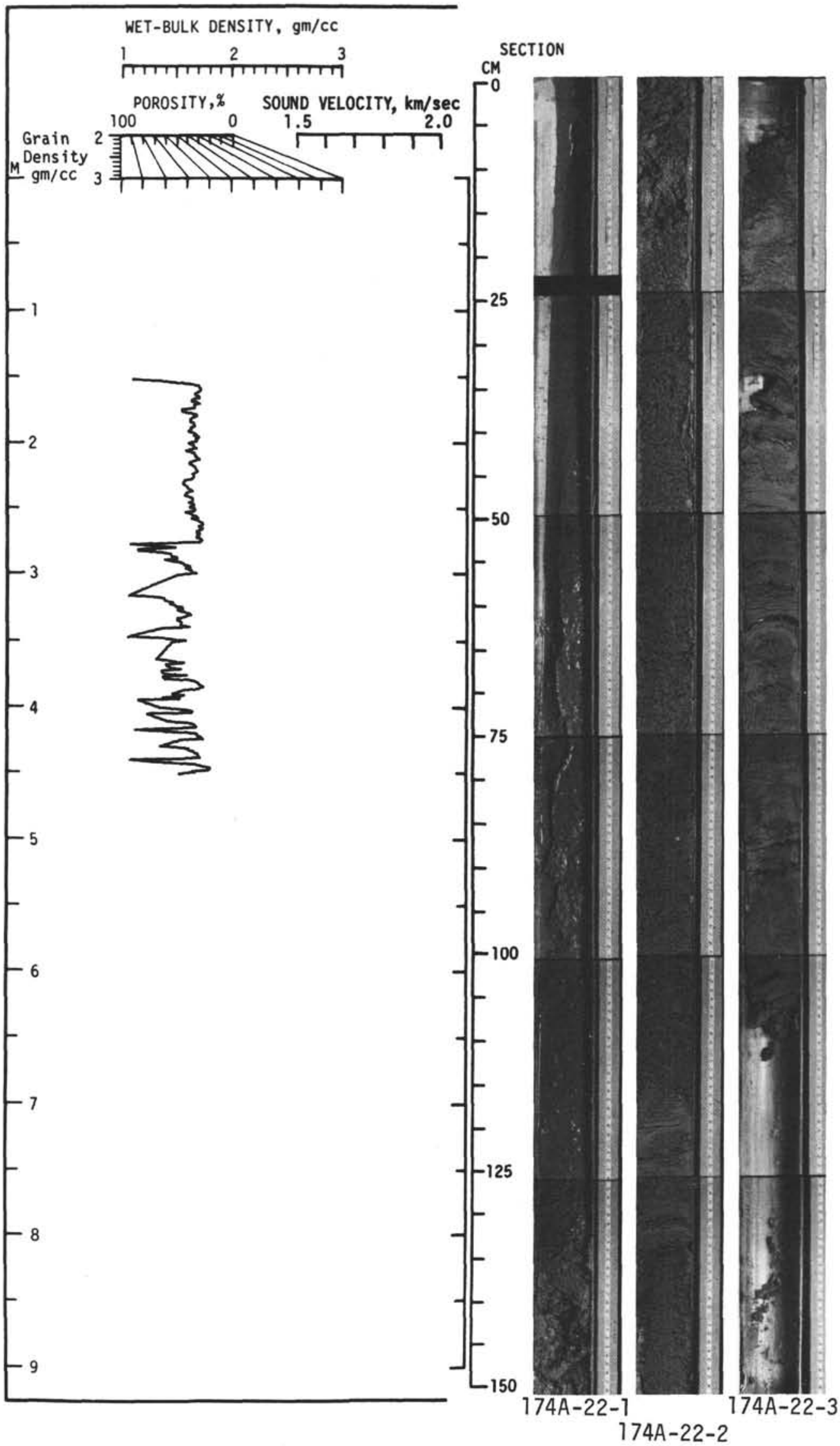
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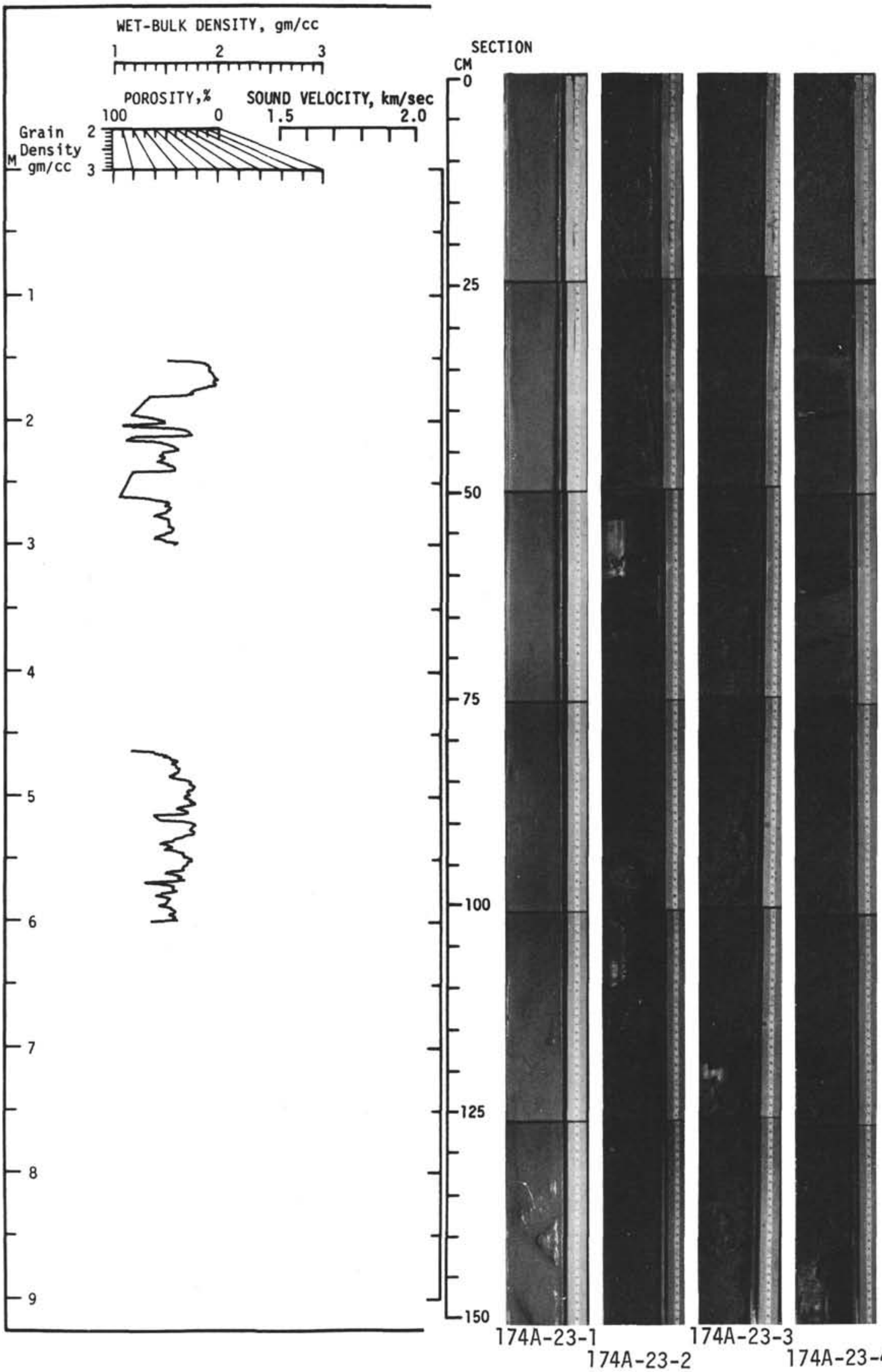
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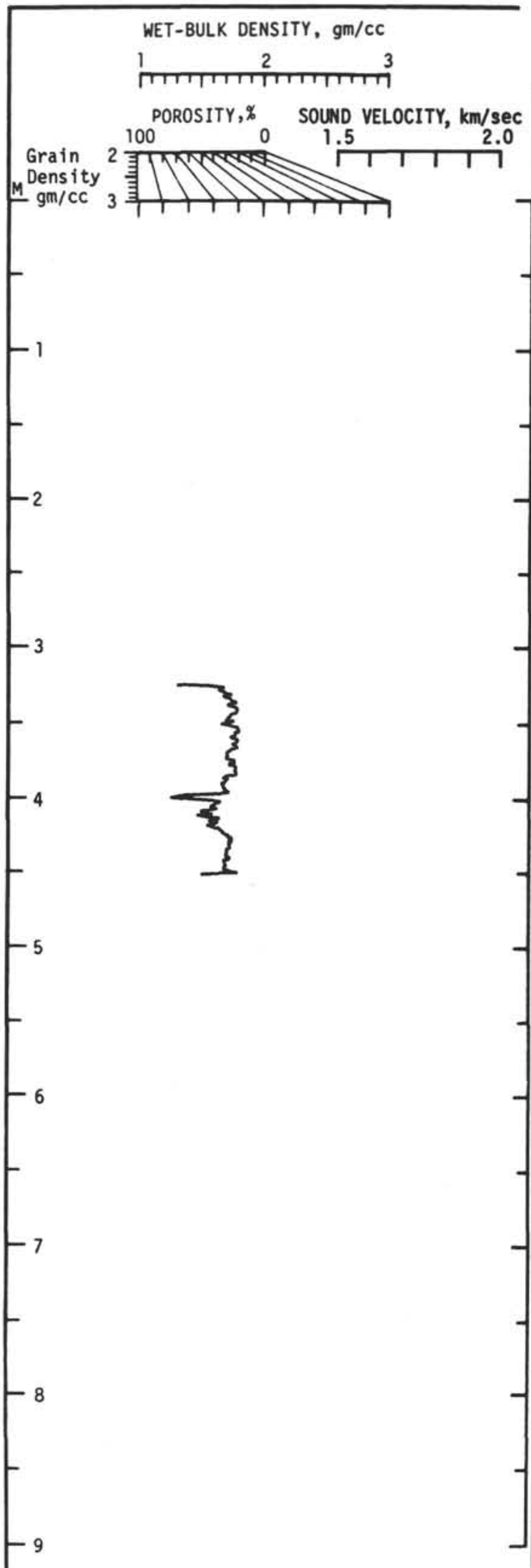
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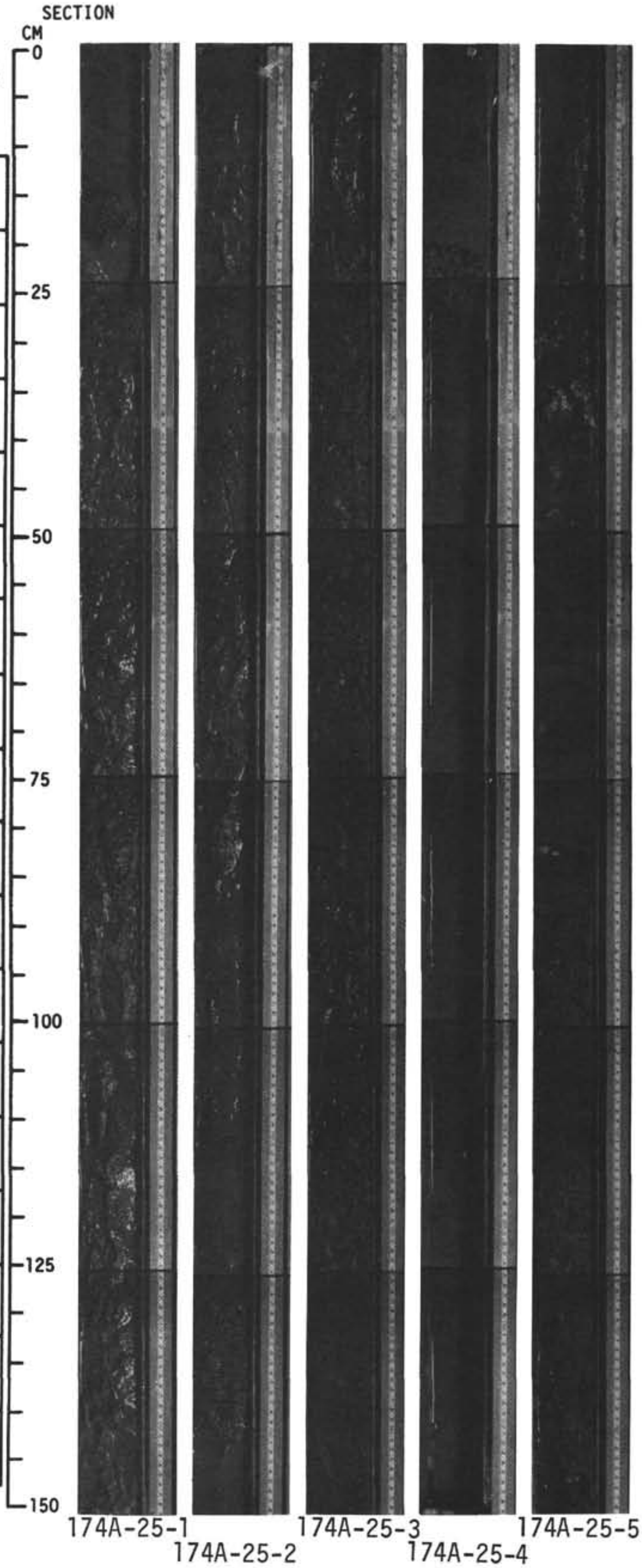
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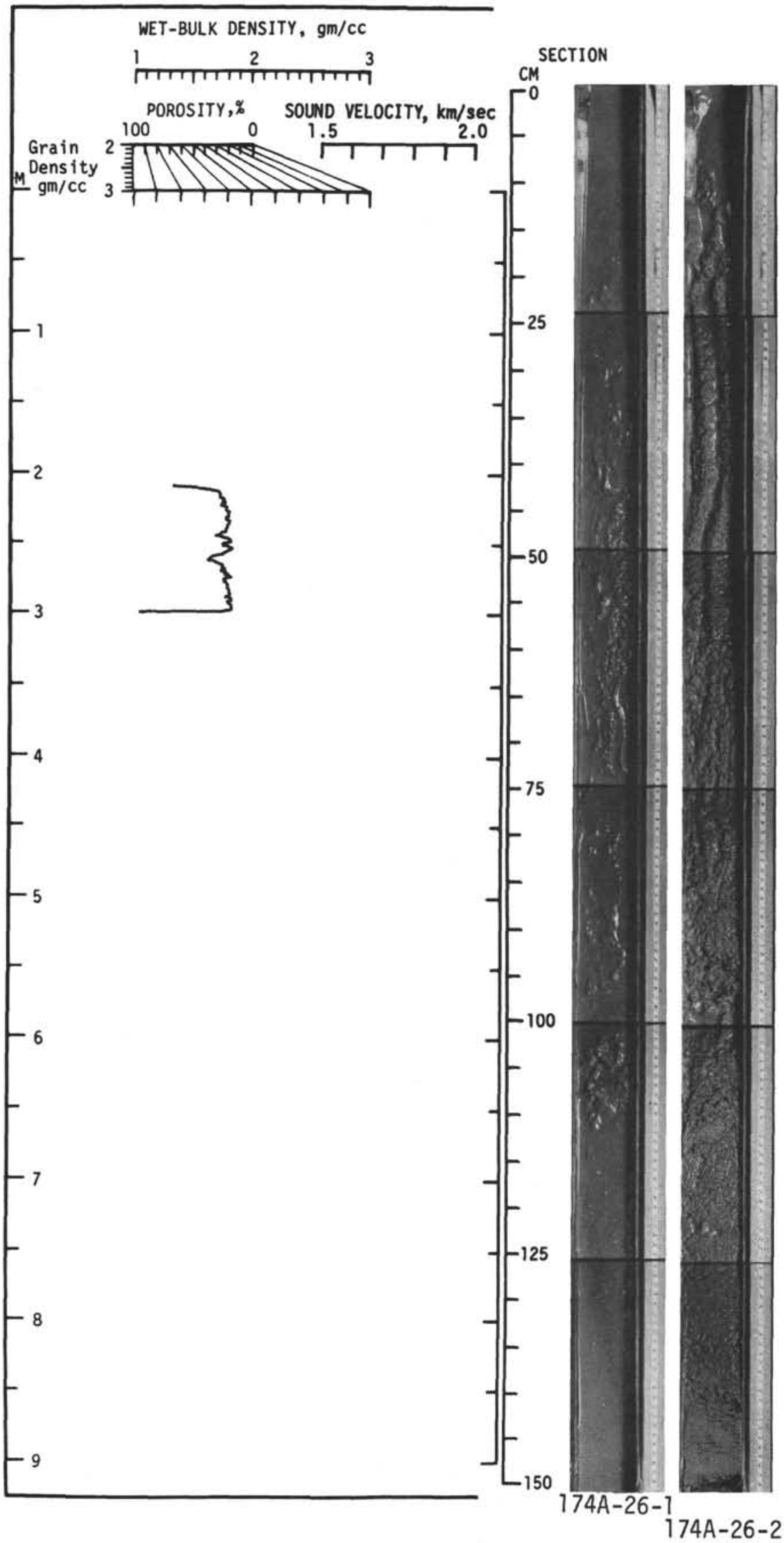
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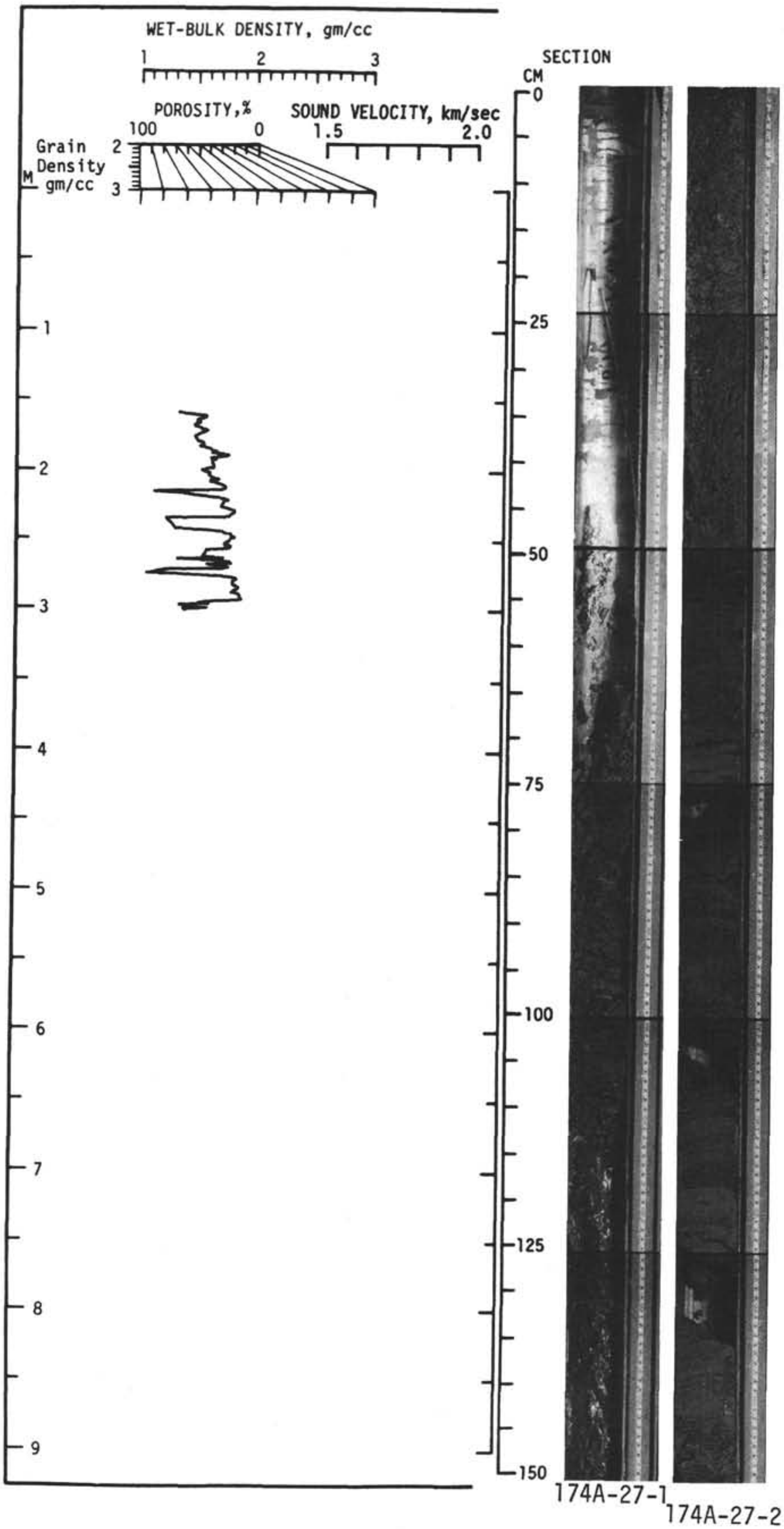
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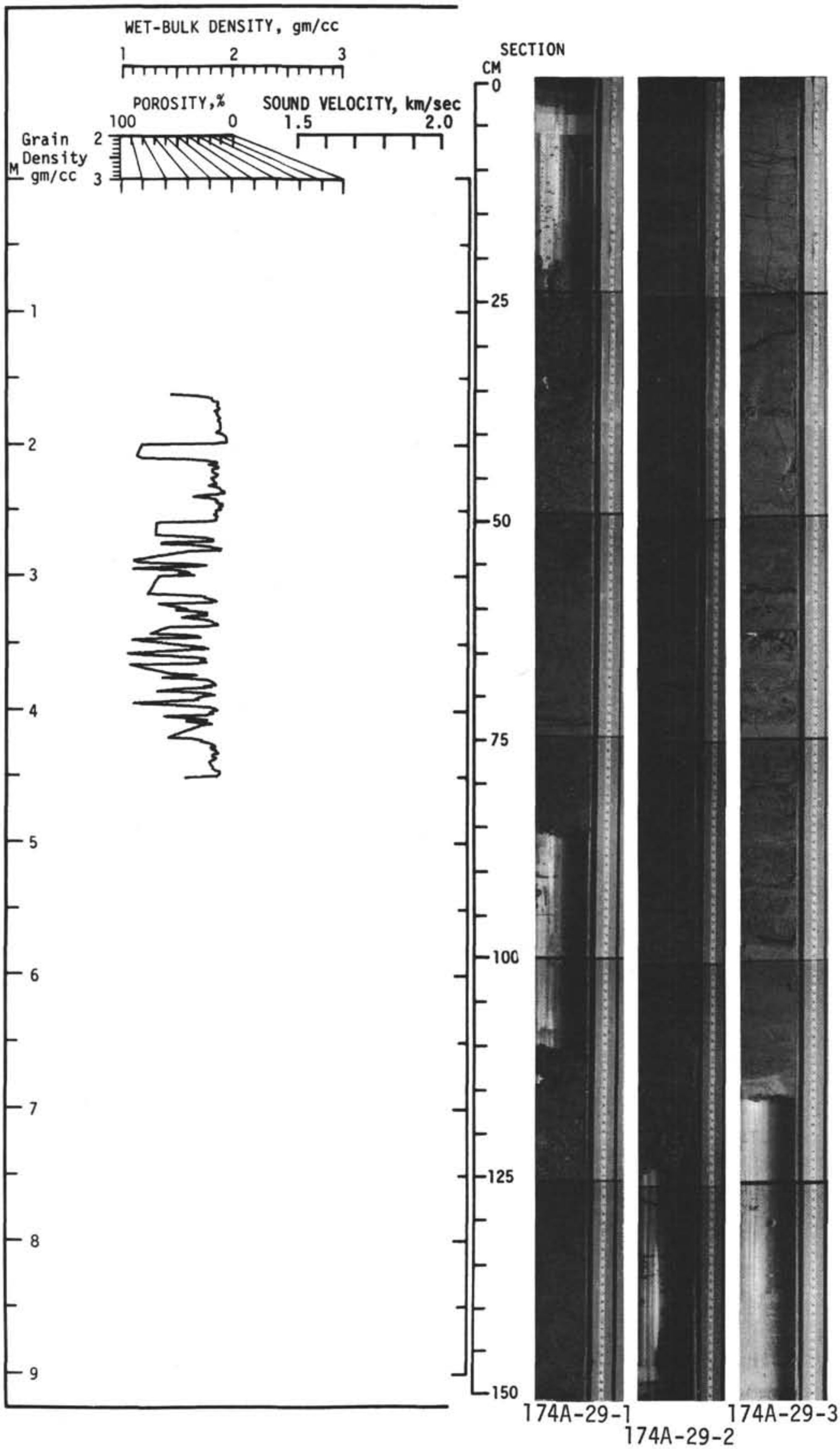
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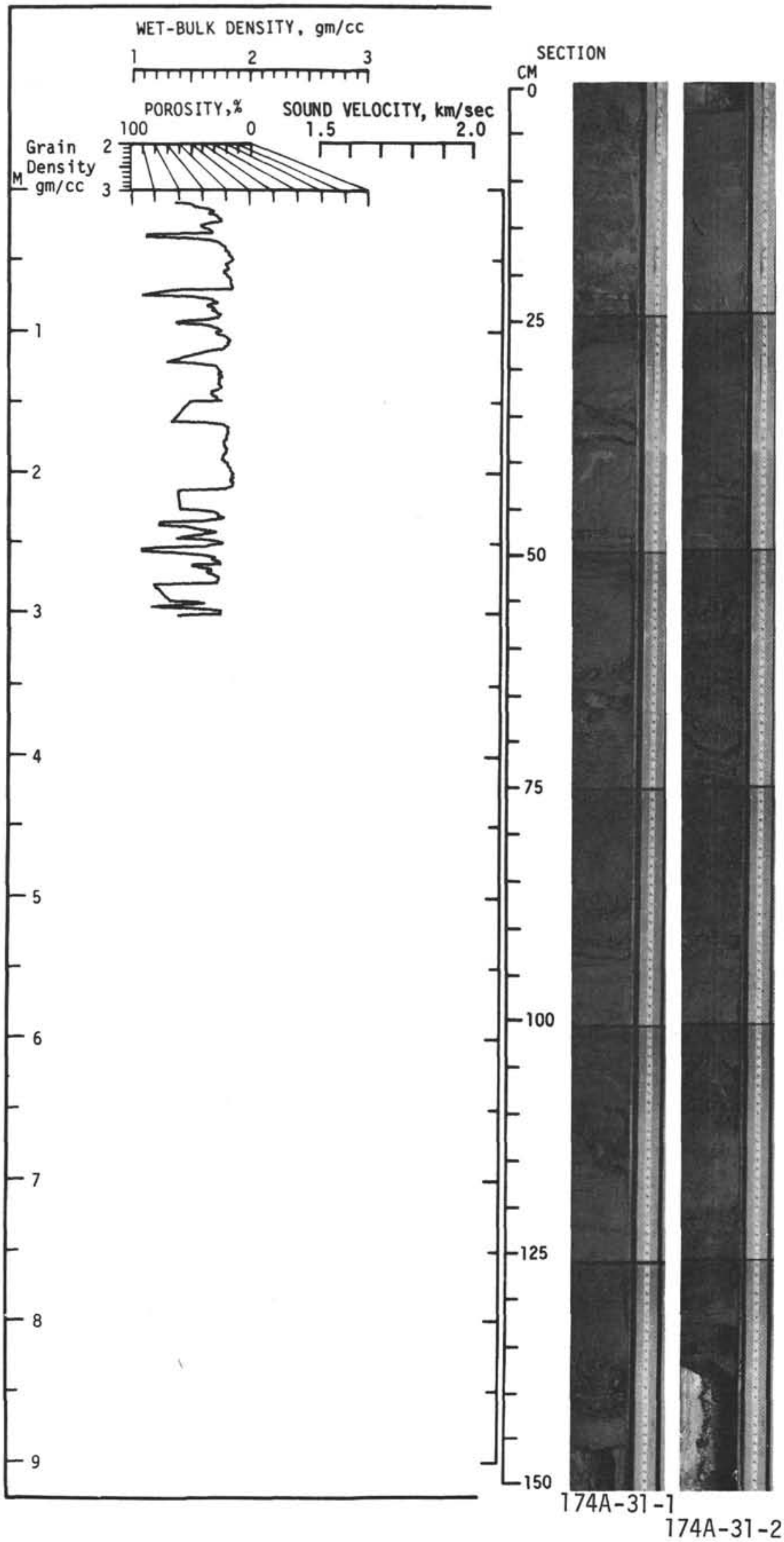
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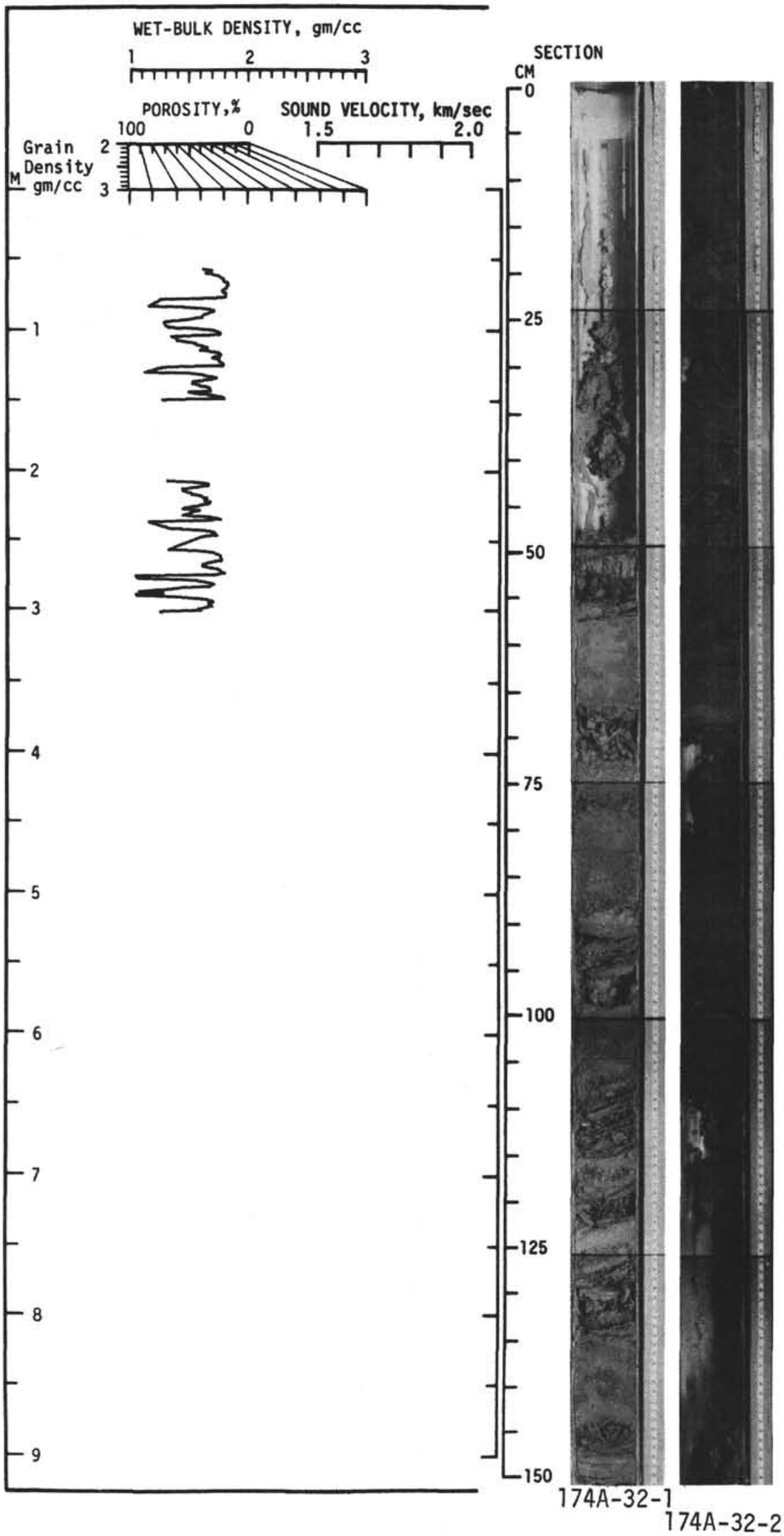
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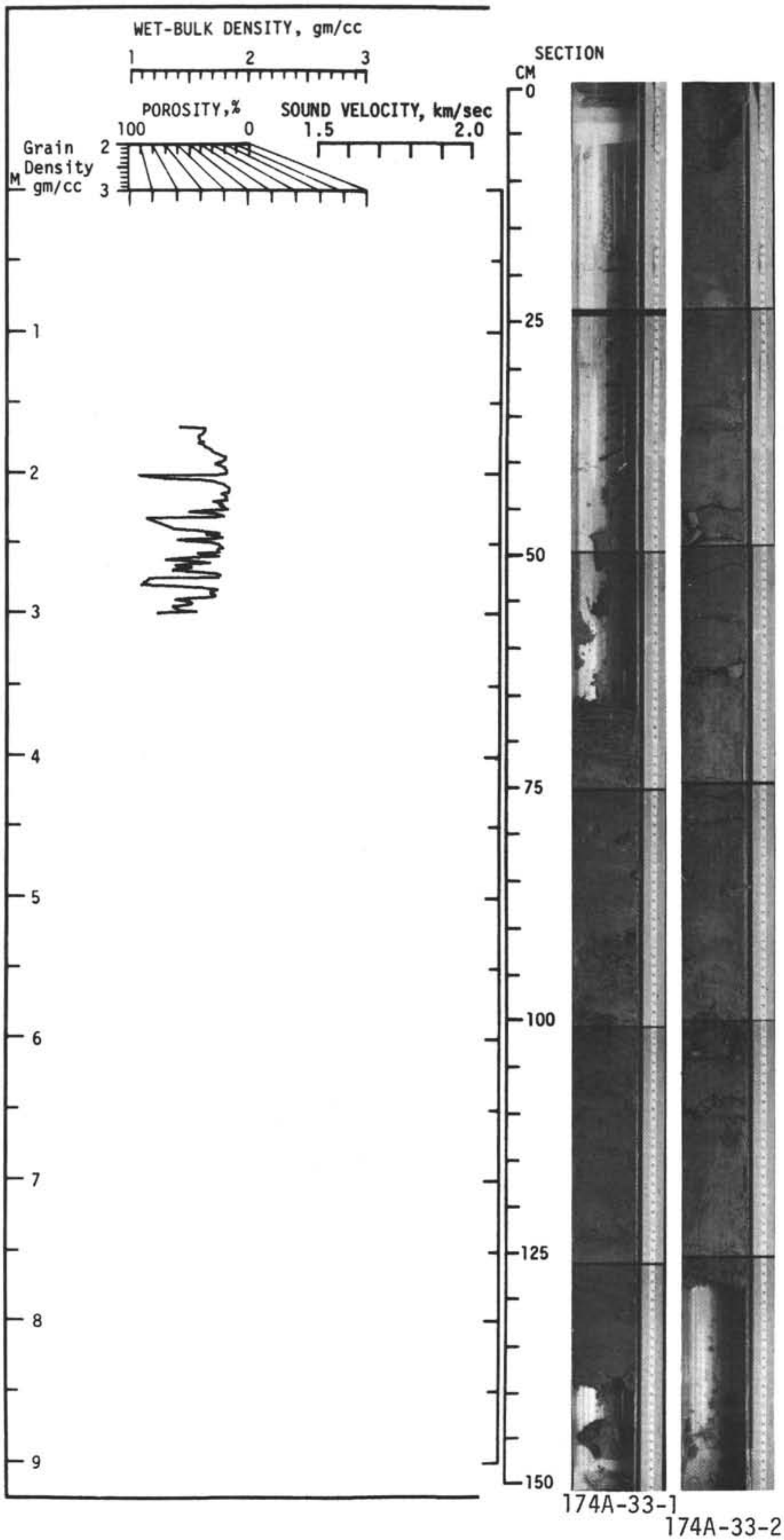
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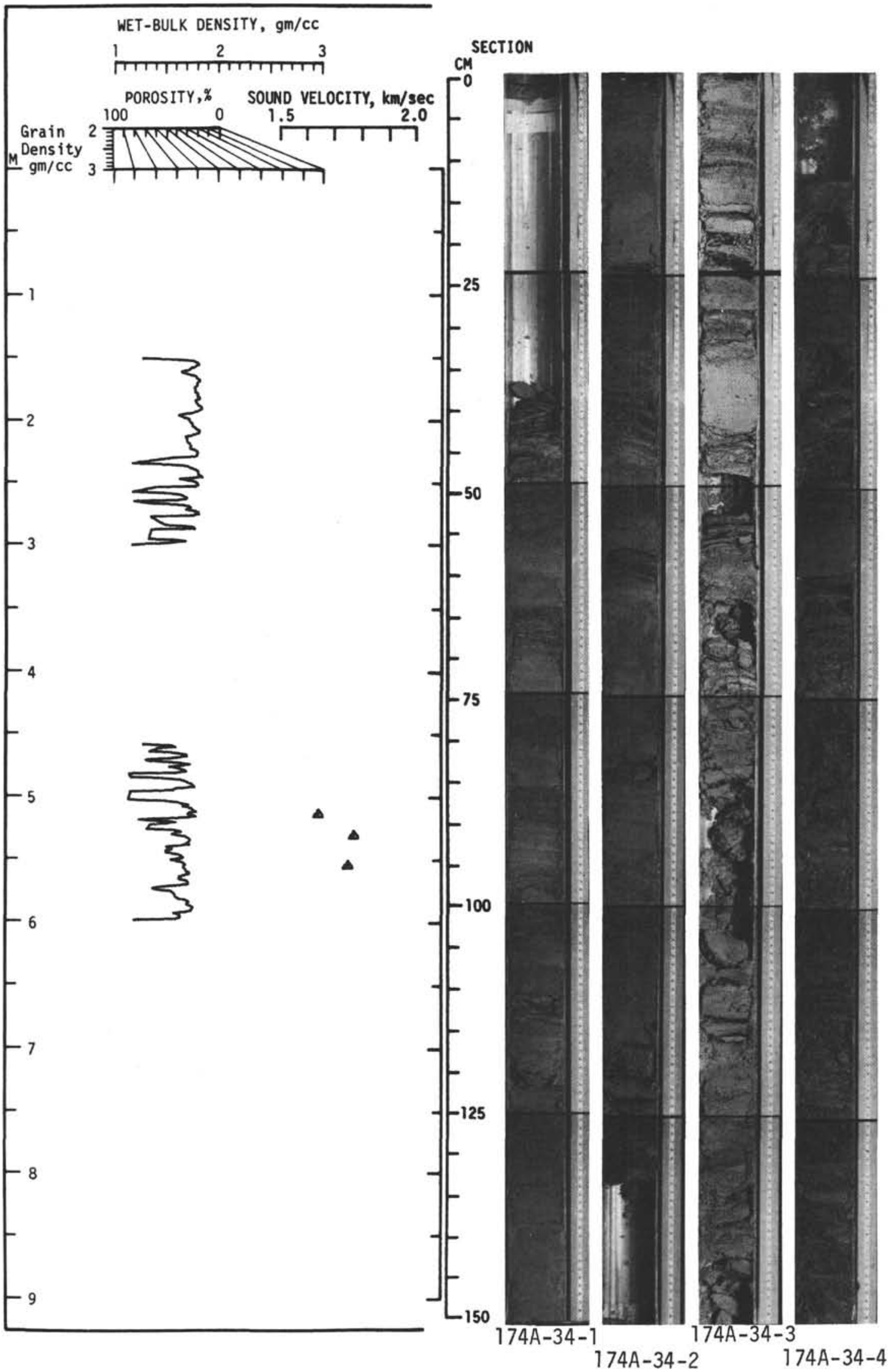
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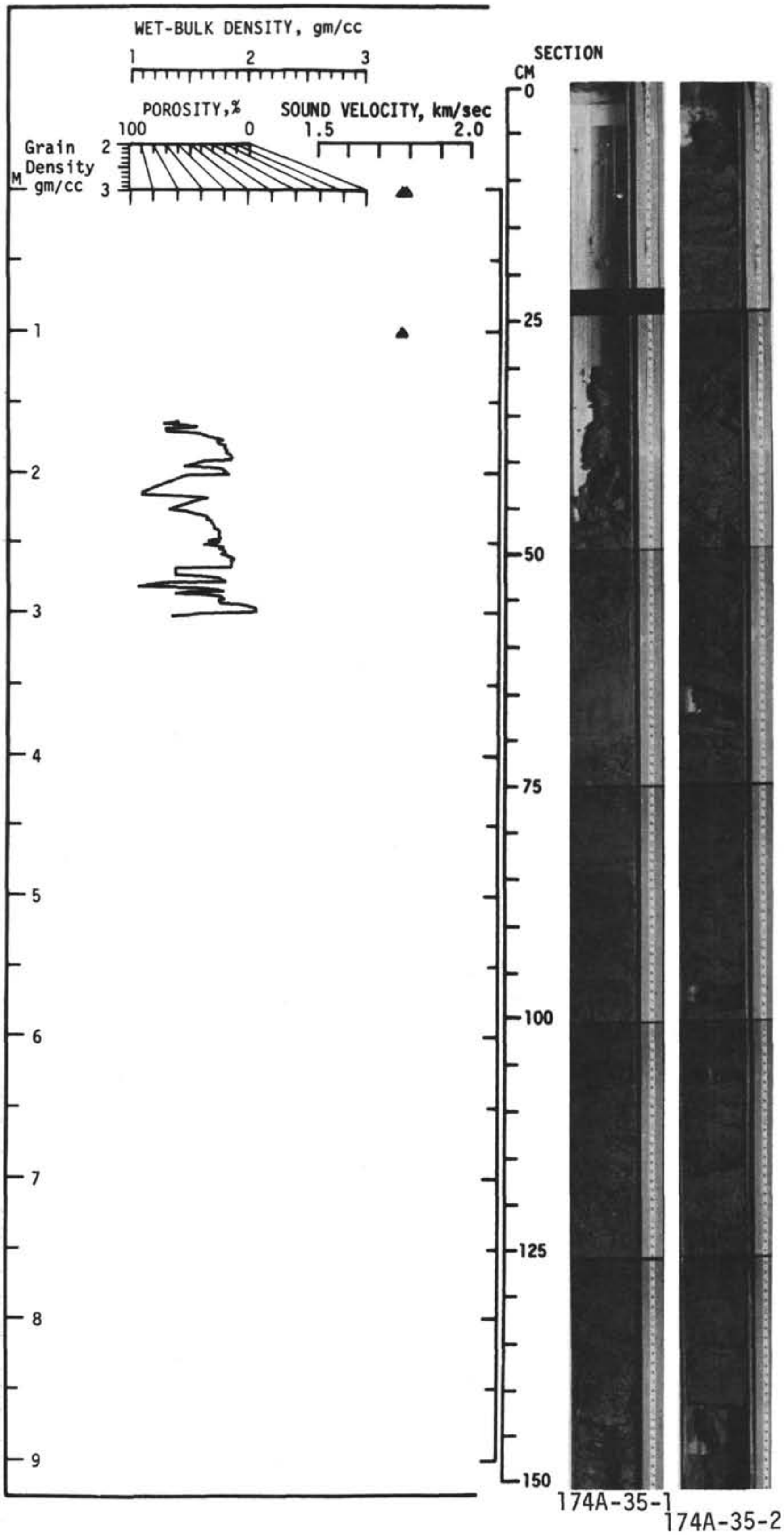
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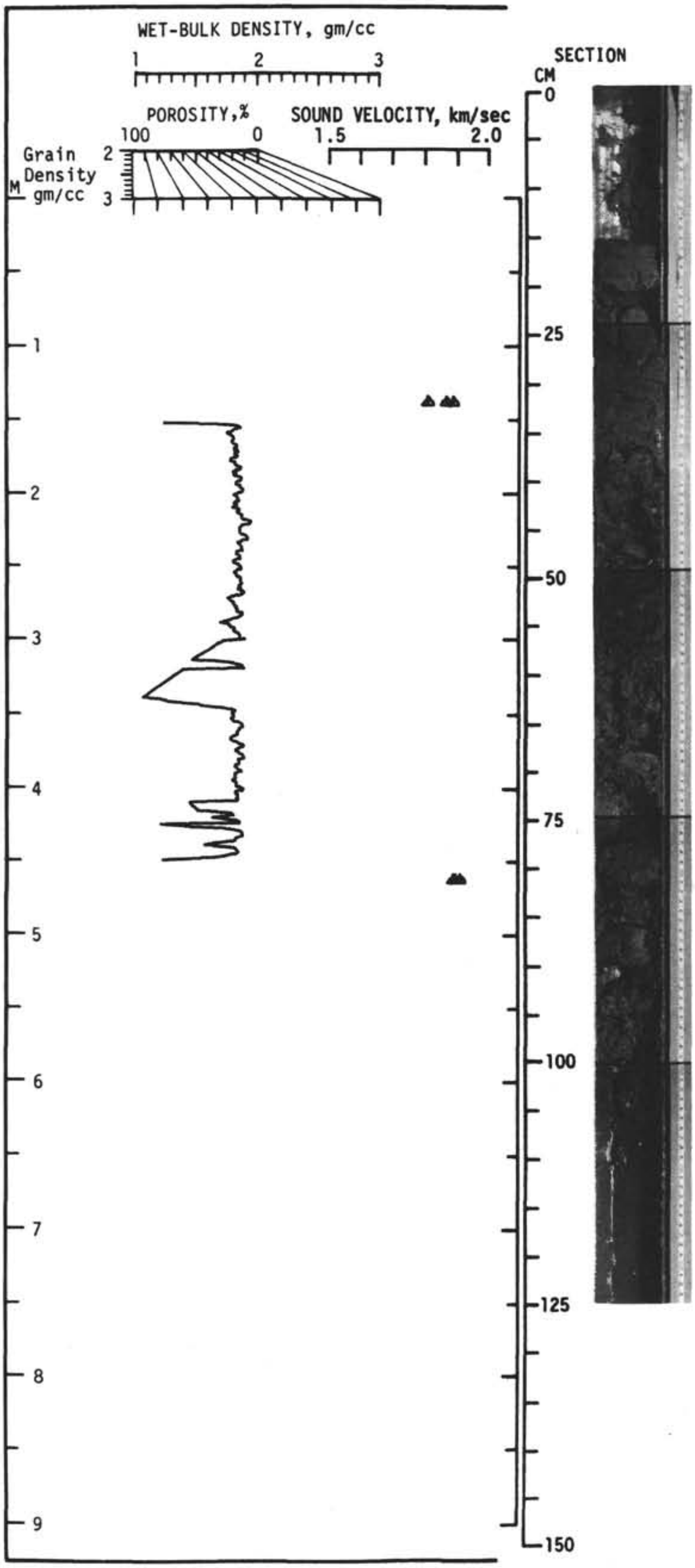
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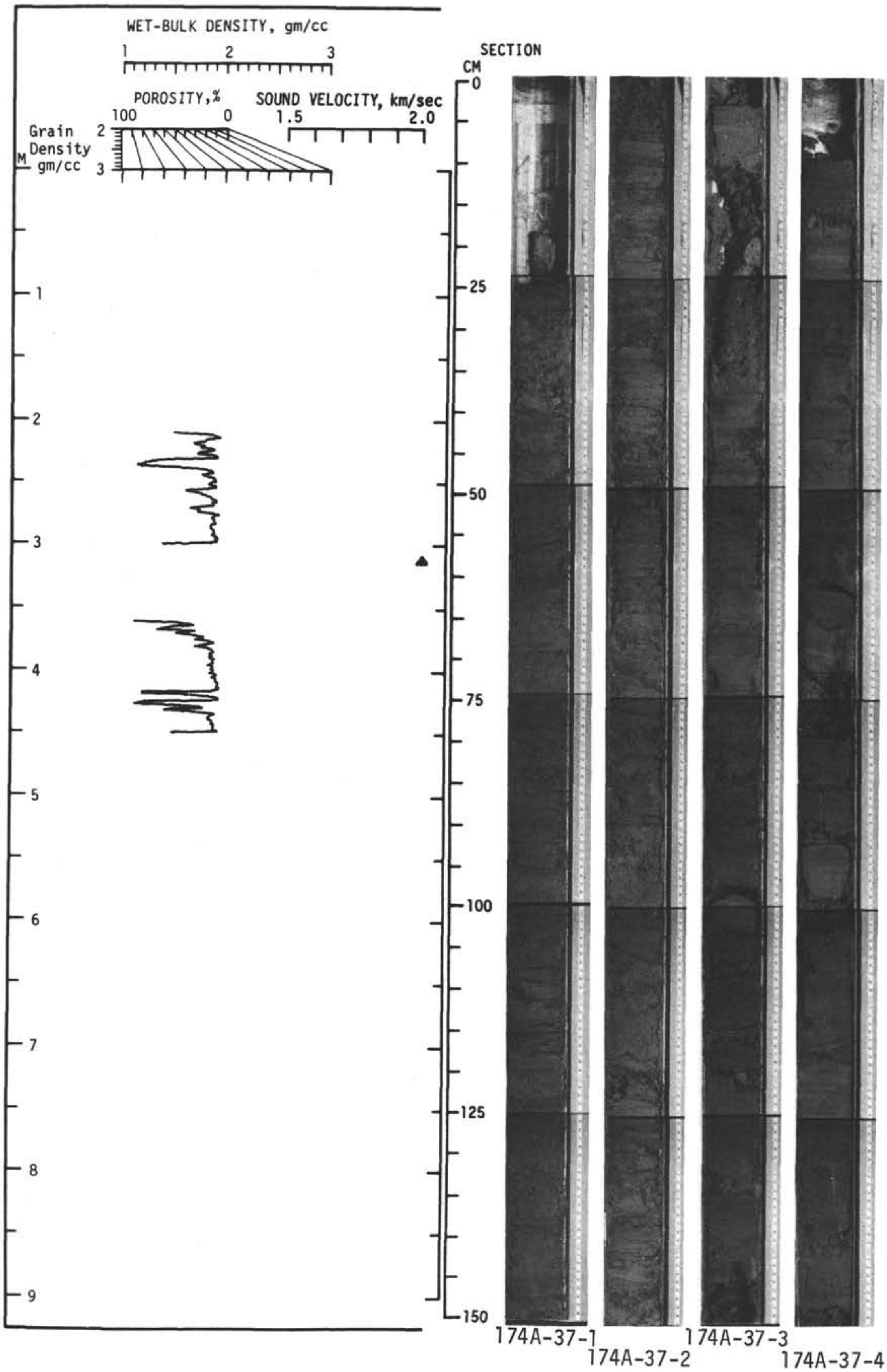
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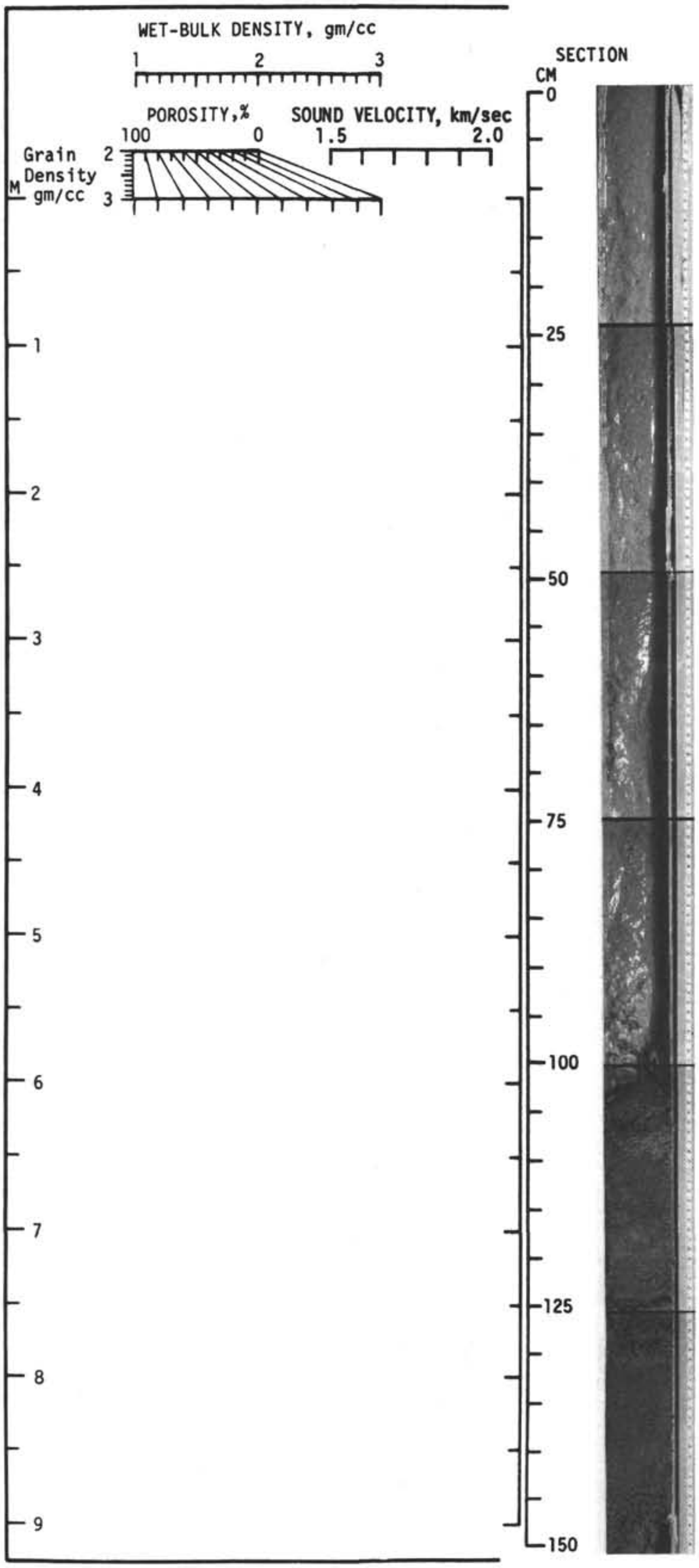
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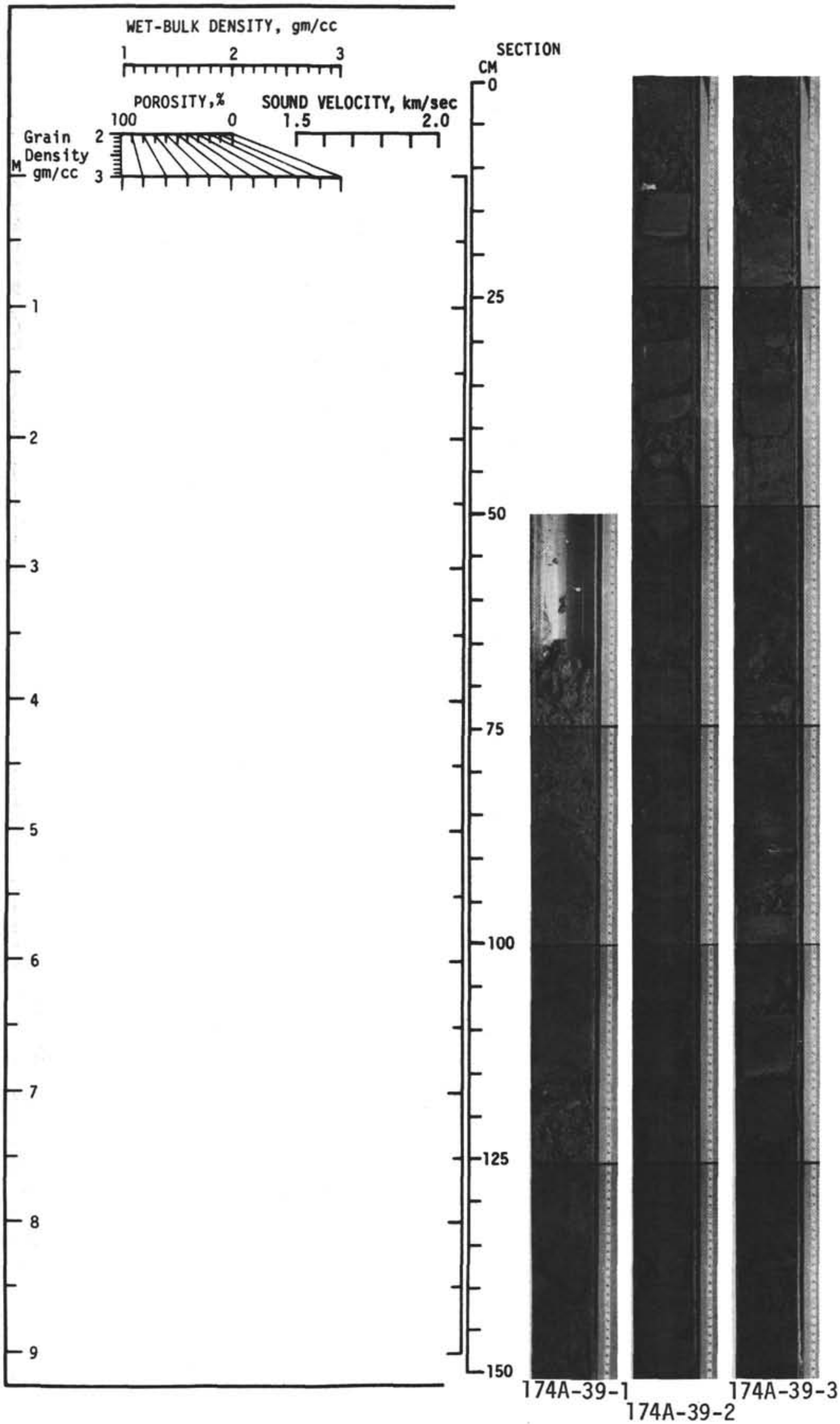
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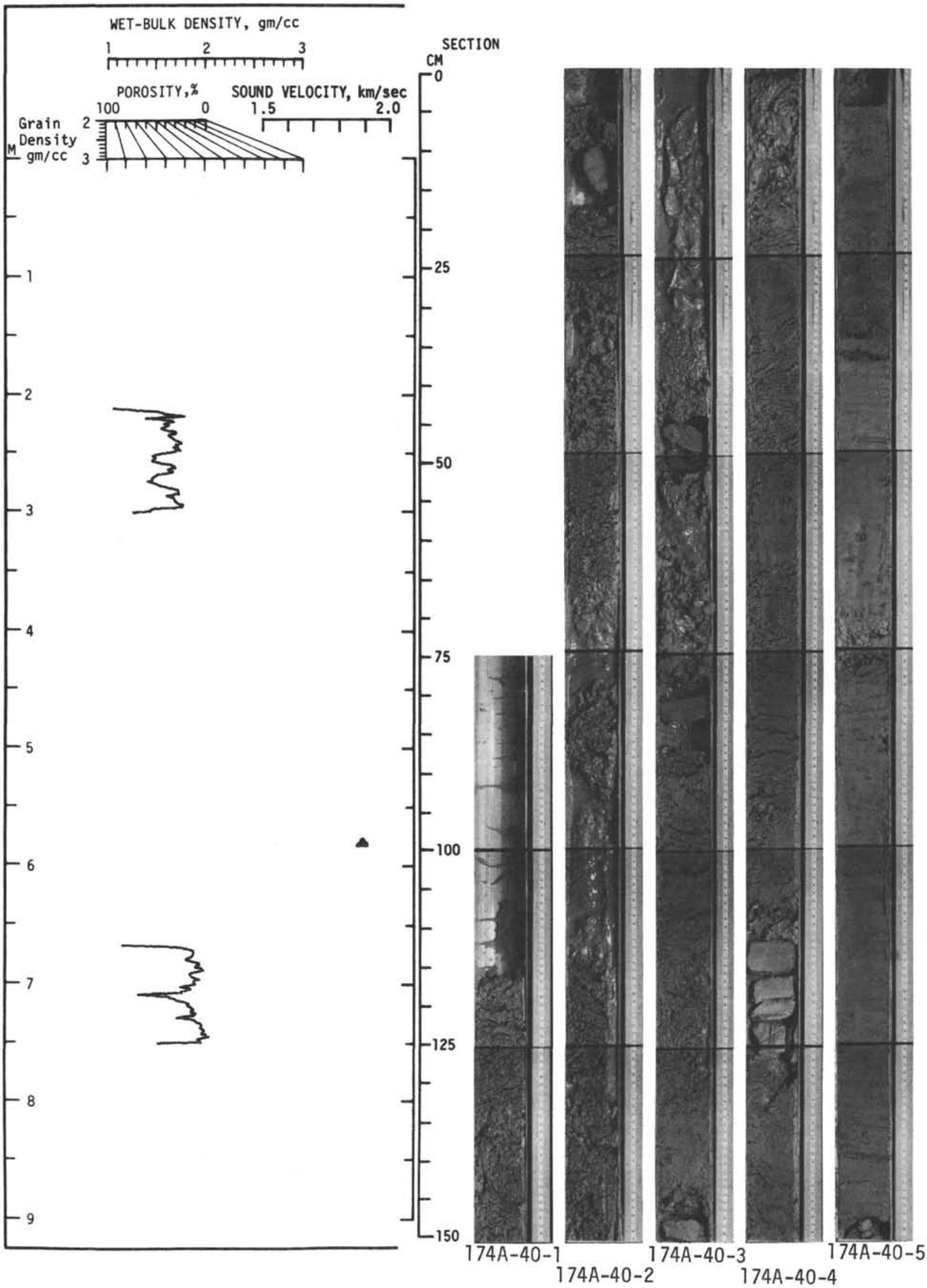
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