10. SITE 179

The Shipboard Scientific Party[1]

ABSTRACT

The 109-meter section continuously cored consists of Pleistocene gray and green silty clay, rich in calcareous and siliceous microfossils in the upper half, but decreasing in abundance with depth to unfossiliferous sediment at 89 meters where a zeolitized ash-bearing clay unit begins. The fragmented and weathered olivine basalt encountered at 108 meters is probably part of a volcanic rubble layer or a sill from the adjacent guyot. Since prospects for obtaining a continuous sequence of calcareous fossils, the objective at this site, looked unfavorable, drilling was terminated. Although the site is above the Alaska Abyssal Plain, sand turbidites, probably from the adjacent seamount, are present. However, sedimentation rates are about 40 to 80 percent less than they are on the abyssal plain at Site 178 indicating the strong influence of turbidity currents on the plain in Pleistocene time.

SITE SUMMARY

Date Occupied: 6-7 July 1971.

Position (Satellite);
Latitude: 56°24.54′N;
Longitude: 145°59.32′W.

Number of Holes: One.

Water Depth: 3781 meters.

Penetration: 109.0 meters below sea floor.

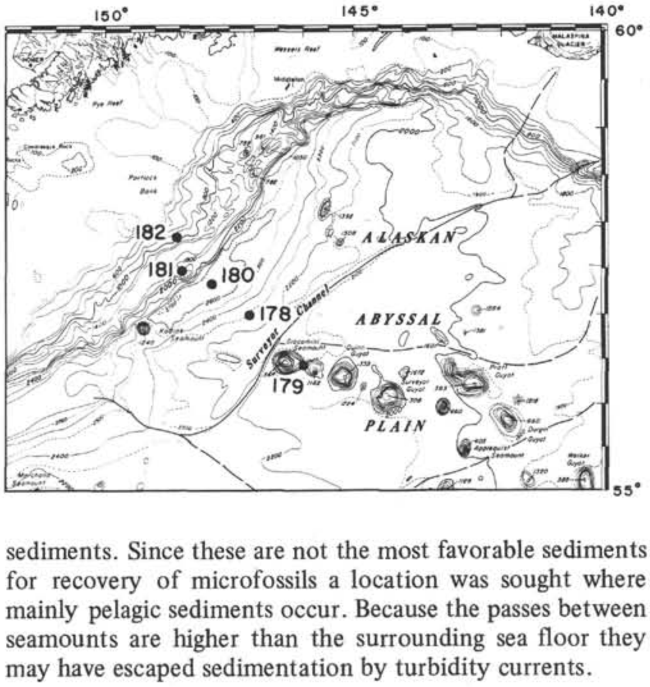
Number of Cores: 13

Total Core Recovered: 69.5 meters, 63.8% recovery.

Age of Oldest Sediment: Pliocene.

Acoustic Basement:
Depth: Unknown.
Nature: Not penetrated.
Inferred velocity: Unknown.

Basement: Basalt was recovered in the last core, but basement was not penetrated.



BACKGROUND AND OBJECTIVES

The Alaska Abyssal Plain is covered with deep-ocean turbidites and some interbedded hemipelagic and pelagic sediments. Since these are not the most favorable sediments for recovery of microfossils a location was sought where mainly pelagic sediments occur. Because the passes between seamounts are higher than the surrounding sea floor they may have escaped sedimentation by turbidity currents.

Site Description

Site 179 is on the eastern side of Giacomini Guyot (or Seamount) in a pass between Giacomini and an adjacent smaller seamount (Figure 1). Its elevation is about 200 meters above the adjacent deep-ocean floor. About 240 meters of sediment, which may represent much of the Tertiary, are indicated in seismic records across the pass. Because of its elevation and possible slow sedimentation, the pass seemed to offer the best chance for preservation of calcareous microfossils.

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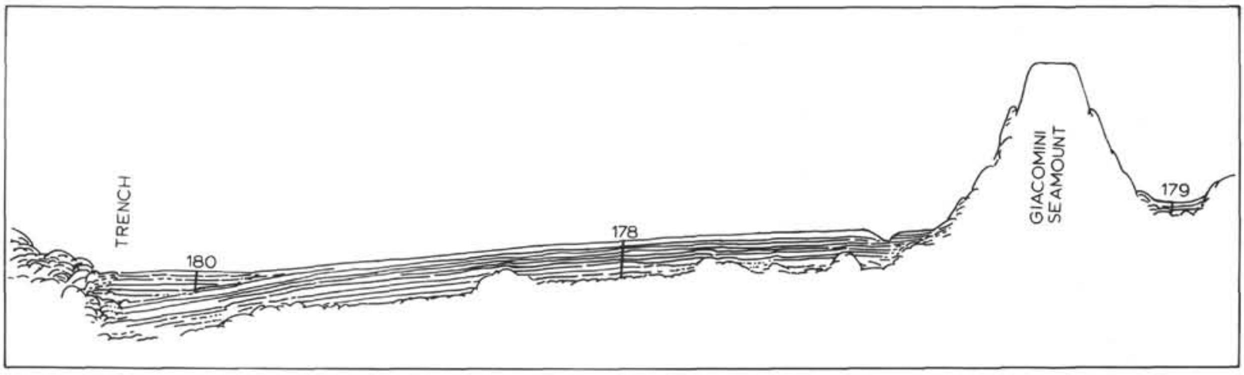

Figure 1. *Cross section of Sites 178, 179, and 180,, showing Giacomini Seamount.*

Site Objectives

The objective of sampling at this site was to recover a microfossil assemblage to help establish a north Pacific microfossil succession.

LITHOLOGIC SUMMARY

General Statement

At Site 179, 109 meters were continuously cored before drilling was terminated. The sediment column can be broken into three units. The upper two are of terrigenous origin and compositionally complex because of the various combinations of biogenous constituents. Unit 3 appears to be of pelagic origin.

Lithologic Units

Unit 1 (0-16 m, Cores 1-3)

In the central part of this unit, the fine muds range from diatom-bearing detrital silty clay to diatom ooze but toward the top and bottom are silty clays containing few diatoms. There are also several intervals of foram diatom ooze and one of nanno diatom ooze. All are medium light gray and massive. Compositional differences are not reflected by color or texture. Interbedded granular sediments are various shades of gray which differ from that of the fine sediments. These sediments are all believed to be of turbidite origin. They comprise 15 percent of Unit 1 and have a high content and variety of biogenous components in addition to the detrital fraction. Typical compositions include foram-rich detrital sand, ash foram-bearing detrital silty clay, and foram-rich diatom nanno silty clay. There are also several sands and silts lacking in biogenous constituents and consisting almost entirely of detrital particles. Individual beds are well-graded and, because the different types of fossils vary in size, a progressive change in biogenous composition takes place from the bottom to the top of a bed. Thus one bed is a foram-rich detrital sand at the base and gradually changes to a nanno diatom-bearing foram detrital silt at the top. The biogenous turbidites are 5 to 45 cm thick, have sharp lower and sharp to gradational upper contacts.

A thin, streaked ash layer occurs at the top of the sediments (possibly Katmai ash). Two additional ash beds 10 and 15 cm thick occur in Section 2-2. Individual pebbles, probably ice-rafted, are present at the tops of Cores 2 and 3.

Unit 2 (16-89 m; Cores 3-10)

A decrease in biogenic constituents is one feature distinguishing Unit 2 from Unit 1. Thus most of the fine sediments are silty clays to clayey silts, although some diatom-bearing silty clays occur in Cores 4, 5, 7, 8, and 9. All sediments are firm and massive. There is also a gradual color change between Units 1 and 2. The fine sediments begin to take on a greenish to light olive green color which becomes more prevalent with depth. Yellowish gray silty clay begins to appear in Core 9 and constitutes much of Core 10. A medium bluish gray silty clay also appears in Core 10. These color changes in the muds may be due to a decrease in the rate of terrigenous sediment influx, which, by decreasing the depositional rate, allows time for greater oxidation. There is supporting evidence for this in Core 10 where two graded sand beds overlie a mud sequence which is dark bluish gray beneath the sand and then grades down into the yellowish gray colors that typify the interval. This suggests a retardation of the oxidation process by the graded beds, allowing the muds at the sediment-water interface to retain their organic matter.

Another distinguishing feature of Unit 2 is the general absence of the biogenous fraction from the sands and silts. This fraction decreases rapidly below a 200-cm-thick foram-rich detrital silt in Core 5. All coarse sediments appear to be graded and have sharp lower and sharp to gradational upper terminations. Individual beds range from 2 to 200 cm thick and some exhibit lamination. Overall, 17 percent coarse sediments occur in this unit (ranging from 1 to 30 percent in individual cores) with the upper portion having the maximum sand which decreases downwards.

Pebbles ranging from 0.5 to 6 cm are found throughout the fine-grained sediments in Unit 2 and are probably ice-rafted.

Ash beds are found in Sections 4-1 and 10-2. The latter bed is distinctive in being mud rich and has the moderate yellow brown color characteristic of Unit 3.

Unit 3 (89-108 m; Cores 11-12)

Unit 3 is predominantly a moderate yellow to dark yellow brown zeolite ash-bearing clayey silt. At first appearances, the sediments look like brown pelagic sediments. However, ferruginous spherules are absent and this unit therefore lacks a prime attribute of a typical pelagic "red clay". It appears to be largely an alteration product of volcanic ashes. Being completely unfossiliferous, the time-span encompassed by Unit 3 cannot be determined. The clay is variegated in various shades of brown ranging into yellow and has a black speckled appearance. It is massive and soft to indurated. Coarse sediments in Unit 3 are all black. From Section 11-4(90) to Section 11-4(145) there is a 55-cm-thick bed of graded black volcanic glassy sediment. This material is granule size at the base where it lies in sharp contact with yellow waxy clays. It grades up into fine sand-sized debris. A 5-cm layer of similar looking sand appears at 11-4(30) and another is present at 12-1(135).

Toward the bottom of Unit 3 (Core 11, CC) there is a poorly sorted conglomerate containing clasts of black glass, yellow waxy clay and brown clay.

Basalt was encountered in Core 12 (CC), but whether the base of the sediment section was reached here could not be determined. The basalt was recovered as a highly weathered, dark brown, 10-cm-long segment of core material. This segment could be either true basement, a volcanic sill, or part of a large boulder. Material recovered from the center bit of Core 13 is equally nondefinitive on this point. The seismic record indicates all three of the above alternatives are possible although there is a fair indication of bedded material below the point where coring ceased.

PETROGRAPHY OF THE BASALT

Hole 179 bottomed in basalt basement or a basalt conglomerate at 109 meters. Core 12 contains one large and three small pieces of weathered brown basalt in the core catcher along with some brown clay. In Core 13, only a few angular pebbles or fragments of basalt were recovered and Core 11 contained a bed of water-sorted basaltic sand and gravel bedded between zeolite-bearing red clay.

All thin sections contain scattered to abundant (10% to 60%) laths of plagioclase. The size ranges up to 0.8 mm but typically is 0.05 to 0.2 mm. In the fine-grained sections, the laths show good *B* lineation indicating some flow structure. Composition of the plagioclase is variable but most small laths have nearly parallel extinction indicating an intermediate composition.

Partly altered phenocrysts of hypersthene or olivine(?) are the principle mafic material and make up about 8 percent of the rock. The hypersthene has neutral to pale pink color and is always mottled by alteration. Maximum size is about 0.2 mm.

Forty to fifty percent of the rock is estimated to be groundmass. Generally the least altered groundmass is cloudy, nearly opaque, and is commonly altered to zeolite, chlorite and iron oxide. The surface of the core and large portions of the thin sections are stained and clouded with brown and yellow palagonite. Small distinct patches and rims are translucent ruby red in thin section and larger patches are translucent yellow. One vesicle was noted that contained three distinct layers of different shades of orange.

The large piece of basalt is vesicular and weathered. It contains scattered vesicles generally 10 to 15 per cm^2 and averaging 0.7 to 0.9 mm in length with a maximum diameter of about 2 mm. The vesicles are rimmed with chlorite and zeolite but are mostly unfilled. Both large and small vesicles occur in thin section and constitute about 20 percent of the rock volume.

The basaltic gravel and sand interbedded with zeolite red clay is entirely glass with fragments up to 5 mm across. Most fragments show some sort of striations or flow alignment and several have elongate rows of small bubbles. Other fragments are nearly opaque and somewhat clouded with palagonite. Phenocrysts of euhedral olivine up to 0.5 mm across occur in two fragments but plagioclase or pyroxene phenocrysts were not found. The angularity of the fragments and uniform composition of the glass in Core 11 indicates a not too distant point of origin for the gravel. The vesicular nature of the basalt and the deep weathering with lack of palagonite suggest a shallow-water origin; however, the zeolitization is similar to the alteration in the immediately overlying red clay and suggests a similar history of submarine weathering for the basalt and clay. The nearby location of two large seamounts along with the nature of the basalt suggests the rock may be a product of the volcanism that formed the seamounts.

PALEONTOLOGIC SUMMARY

Introduction

Calcareous nannofossils and foraminifera are present in Cores 1 through 5 (0 to 41.5 meters) but are absent in the lower half of this hole. Diatoms and radiolarians occur to a depth of 89 meters (Core 10) whereas spore and pollen are rare to absent in all cores.

All microfossils in Cores 1 through 5 (0 to 41.5 meters) are Quaternary in age. The oldest microfossils encountered are Pliocene diatoms present at the base of Core 10 (89 meters). The Pliocene-Pleistocene boundary is arbitrarily placed at 63 meters (Core 8) at the base of NPD Zone IV which is currently correlated with the top of the Olduvai geomagnetic event (Schrader, Chap. 17, this volume).[2] However, the base of the Olduvai event is currently correlated with a radiometric age of 1.85 m.y. (Opdyke, 1972) and in turn with the Pliocene-Pleistocene boundary. Thus, NPD Zone V probably encompasses this boundary but at an unknown horizon. Additional correlations of diatom and radiolarian zones with the paleomagnetic-radiometric time scale allow the following ages to be estimated for Site 179: 13.3 meters (Core 3), 0.26 m.y.; 32 meters (Core 4), 0.4 m.y.; and 53 meters (Core 7), 1.3 m.y. These ages indicate an average rate of sedimentation of 46.2 m/m.y. during the later Pleistocene at this site.

The occurrence of displaced middle and upper bathyal benthonic foraminifera and the abrupt appearances of Pliocene diatoms and Eocene, Oligocene, and Miocene calcareous nannofossils within the 0- to 41.5-meter interval suggest a significant percentage of the sediment penetrated at Site 179 has been displaced from adjacent Giacomini Guyot.

The complete absence of calcareous microfossils below Core 5 (41.5) meters suggests that a downward migration of

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[2] Schrader (Chapter 17) correlates the base of NPD Zone IV with the Pliocene-Pleistocene boundary in terms of diatom biostratigraphy.

the calcium carbonate compensation level (CCL) occurred in the Gulf of Alaska during the past 0.9 m.y.

Calcareous Nannofossils

Cores 1 through 5 (0 to 41.5 meters) contain Quaternary and reworked Neogene calcareous nannofossils. Although radiolarian and diatom determinations indicate that these cores are no older than 1.0 m.y., some reworked Eocene, Oligocene, and Miocene specimens are present in Cores 2, 4, and 5. *Coccolithus pelagicus*, the dominant species present within this interval, is abundant in some samples. Indeed, it forms most of the matrix of a diatom-nannofossil ooze encountered at 8.6 meters in Core 2 (179-2-4, 64cm). The presence of this cold-water form indicates a surface temperature of between 6° and 14°C which is compatable with present temperatures within this area. However, the centers of most specimens of *C. pelagicus* have been etched away, suggesting deposition well below the lysocline.

All samples examined below the core catcher of Core 5 at Site 179 (41.5 meters) are barren of calcareous material. The presence of calcareous fossils only in the top five cores of this hole indicates that Site 179 was below the calcium carbonate compensation level during deposition of the lower portion of the section drilled. During the Lower to Middle Pleistocene (about 0.9 m.y. according to diatom determinations), the site was above the carbonate compensation level, a condition that has apparently prevailed to the present time. A flurry of phytoplankton productivity produced the diatom-calcareous nannofossil ooze in Core 2.

Assuming that the seamount drilled at Site 179 was tectonically stable during the Pleistocene, it appears that the carbonate compensation level in the Gulf of Alaska descended during the Plio-Pleistocene interval, reaching a level of about 3800 meters some 0.9 m.y. ago.[3] The carbonate compensation level then continued its descent until it reached its present position in this area of about 4000 meters. It is interesting to note that sediments in the North Atlantic record a similar drop in carbonate compensation level during this same interval (Gartner, 1970).

Diatoms

Diatoms are common to abundant in fine-grained sediments at Site 179. They are well preserved in the interval from 0 to 92 meters (Cores 1 to 11), but only a few badly corroded to well-preserved displaced species were found below 92 meters. The amount of older reworked microfossils is low; however, exclusively lower Pliocene assemblages were found within a section assigned to Upper Pleistocene NPD Zone I (179-2-2, 120-122cm to 179-2-3, 147-149cm).

The base of Pleistocene NPD Zone I is at 13.3 meters (179-3-1, 30-32cm), the base of NPD Zone II at 43.5 meters (179-6-2, 120-122cm), and the base of NPD Zone III at 53 meters (179-7-2, 65-67cm). The base of NPD Zone IV occurs at 63 meters (179-8-2, 90-92cm) and is correlated with the base of the Pleistocene in terms of the diatom zonation defined elsewhere in this report (Schrader, Chap. 17). The base of NPD Zone V occurs at 72.5 meters (179-9-2, 110-112cm) and the oldest diatom-bearing sediment encountered belongs to NPD Zone VI (89 meters; 179-10, CC) and is of upper Pliocene age.

Planktonic Foraminifera

Abundant and well-preserved Pleistocene planktonic foraminifera were found in Core 1 (0 to 3.5 meters). Unfortunately, the abundance and preservation of foraminifera deteriorates rapidly below this horizon with only a few specimens found in Cores 2, 3, 4, and 5 (3.5 to 41.5 meters); Cores 6 through 11 (41.5 to 98.5 meters) are completely barren except for scattered, broken, and unidentifiable pieces of tests.

All planktonic faunas recovered are Pleistocene in age (Zones N23/22) and are dominated by sinistral coiling populations of *Globigerina pachyderma* s.s., *G. bulloides, Globigerinita uvula,* and rare specimens of *Globorotalia scitula*. Populations of the *Globigerina bulloides* complex include a number of individuals with five chambers in the final whorl assigned to *G. bulloides umbilicata* (Orr). This subspecies may represent a Plio-Pleistocene ecophenotypic member of this complex peculiar to the colder North Pacific water masses. All assemblages recovered exhibit various effects of solution providing evidence of their deposition below the lysocline (Berger, 1970). Indeed, the decrease in abundance of calcareous foraminifera with depth at this site may reflect the decreasing bottom water temperature and consequent rise of the carbonate compensation level during the later portion of the Pleistocene interval.

Benthonic Foraminifera

Characteristic members of a lower bathyal biofacies including *Melonis pompilioides* and *Gyroidina soldani* are present in Cores 1 through 5 (0 to 41.5 meters). Abundances of benthonic specimens are lower than those of planktonic specimens but exhibit better preservation. Smaller percentages of species displaced from shallower depths are also present and include *Cassidulina subglobosa subquadrata*, *C. delicata*, and *Uvigerina hispido-costata.* Rare to common pellets of glauconite and broken mollusk shells provide additional evidence of displaced sediment.

Radiolaria

Radiolarians are generally few to common in Cores 1 through 10 (0 to 89 meters) at Site 179. Diversity is normal for this latitude and preservation is moderate to good. The assemblages are all Quaternary except for reworked Miocene specimens. Incursions of these Miocene assemblages appear to represent descrete introductions of older material rather than reworking up through the column. They are correlated, in fact, with turbidite occurrences.

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[3] In calculating the original depositional depth represented by the carbonate boundary at the base of Core 5, the isostatic effect of loading is accommodated by halving the sample depth below the seafloor in accordance with the procedure suggested by Berger (1972).

Core 1 through the upper part of Core 4 (0 to 26.4 meters) represents the Pleistocene *Artostrobium miralestense* Zone, assuming uncontaminated cores. Near the bottom of this zone, the upper limit of *Stylacontrarium acquilonium* is correlated with a radiometric-paleomagnetic age of 0.3 m.y. (179-3-1, 110-112cm to 179-3-2, 90-92cm). The base of this zone occurs within Samples 179-4-3(87-89cm) to 179-4(CC) (26.4 to 32 meters) and is correlated with an age of 0.4 m.y. The lower part of Core 4 through Core 6 (32 to 47 meters) represents the *Axoprunum angelinum* Zone. The base of this zone occurs within Samples 179-6-2(66-68cm) to 179-6(CC) (43 to 51 meters) and is correlated with an age of 0.9 m.y. The remainder of radiolarian-bearing cores below 47 meters contain *Eucyrtidium matuyamai* and represents the zone named after this species and correlated with an age younger than 1.8 m.y.

Spores and Pollen

Core catcher samples examined at Site 179 were almost barren of pollen and spores. All specimens found (*Pinus* and Graminae) showed signs of oxidation.

PHYSICAL PROPERTIES

Physical properties were measured on cores from Site 179 in the standard manner.

As at Site 178, GRAPE values are roughly 10 percent lower (uncorrected for grain density) than the syringe values. This is similar to previous physical property measurements and, as before, the relative values are considered good but the absolute values are uncertain by about ±10 percent. In Figure 2, carefully compared GRAPE and syringe value differences are compiled.

The original GRAPE records give a good indication of grading and sorting in silts and sands as well as reflecting color and textural changes (i.e., sand or biogenous material).

CORRELATION BETWEEN REFLECTION RECORDS AND THE STRATIGRAPHIC COLUMN

Site 179 is in a small saddle between the eastern slope of Giacomini Guyot and an adjacent unnamed seamount (Figure 3). Three seismic records were made during the pre-drilling site survey, one at 6 knots on a course of 292° t and two at 4 knots on courses of 180° t and 000° t (Figure 4). All of these records show a saddle or possibly a local basin with steep walls. Along 292°, the basin is 1.9 km wide and along 180°-000°, it measures 1.4 km. The sediments extend 0.25 sec below the sea floor (Figure 4). With a basin this narrow, it is difficult to determine whether sloping basement surfaces are under the ship or to the side of it and even though the site was placed in the middle of the basin, there is no assurance that the deepest part lies there.

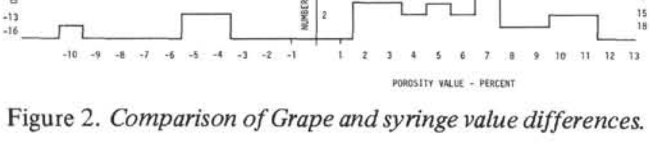

Figure 2. *Comparison of Grape and syringe value differences.*

The long outgoing signal of the air gun on *Challenger* records obliterates any stratigraphic detail in this basin except general horizontal bedding. A slight dip toward Giacomini Guyot is seen in the 292° crossing.

On a precruise site-selection seismic record (Figure 3), high amplitude reflections are seen at 86 to 110 meters (assuming an interval velocity of 1.57 km/sec, and a travel time of 0.11 to 0.14 sec). These reflections correspond well to the depth of conglomerate and weathered basalt fragments recovered. The seismic record indicates a massive bedded fill below a weakly reflecting unit. In the multiple of this record, reflectors in the acoustic basement suggest that it is stratified.

There are two possible explanations for encountering basalt prior to the initially calculated basement. First, the maximum depth of sediment does not occur under the drill-hole location but to one side. Second, the lower part of the basin fill is coarse material from the slopes of adjacent seamounts or there is at least one interbedded coarse conglomerate near the middle of the section. The latter interpretation is favored.

SUMMARY AND CONCLUSIONS

Site 179 is located in a small saddle between the east flank of Giacomini Guyot and the west flank of an unnamed seamount at the southern edge of the Alaska Abyssal Plain. The site is 200 meters above the surrounding abyssal plain which makes it less susceptible to deposition of turbidites. This is desirable since the major objective at this site was to obtain a biostratigraphic section for this high-latitude region. The chance of finding the desired pelagic sediments was the reason for selecting a site perched 200 meters above the surrounding Alaska Abyssal Plain.

Seismic records made across the site by *Challenger* indicated a maximum sediment thickness of 200 meters. However, the seismic system records the dipping irregularities on either side of the ship's track as well as those directly below. Thus, it was not possible to position the ship directly over the thickest sedimentary section with confidence. Site 179 may have been drilled toward one side of the sediment body because pieces of basalt were encountered at 108 meters. The basalt may be incorporated in a layer of volcanic debris that is not thick enough to produce a distinctive reflection or it is possible that the lower part of the section is made up mainly of stratified volcanic debris.

A 109-meter sediment section continuously cored at this site is divided into 3 units. The first unit (0-16 m) consists of gray muds with diatoms, and 5- to 45-cm-thick beds of graded silts and sands rich in microfossils. Occasional ash beds, as well as rare pebbles, probably glacial erratics, occur within this unit. The second unit (16-89 m) is a gray to green mud with limited amounts of biogenous material. The upper coarse sediments have a large biogeneous component which diminishes downward thus becoming true detrital sands and silts. Abundant glacial erratics, and rare ash layers also occur in this unit. The third unit (89-108 m) is mainly a zeolitized ash-bearing clay which contains a thick graded

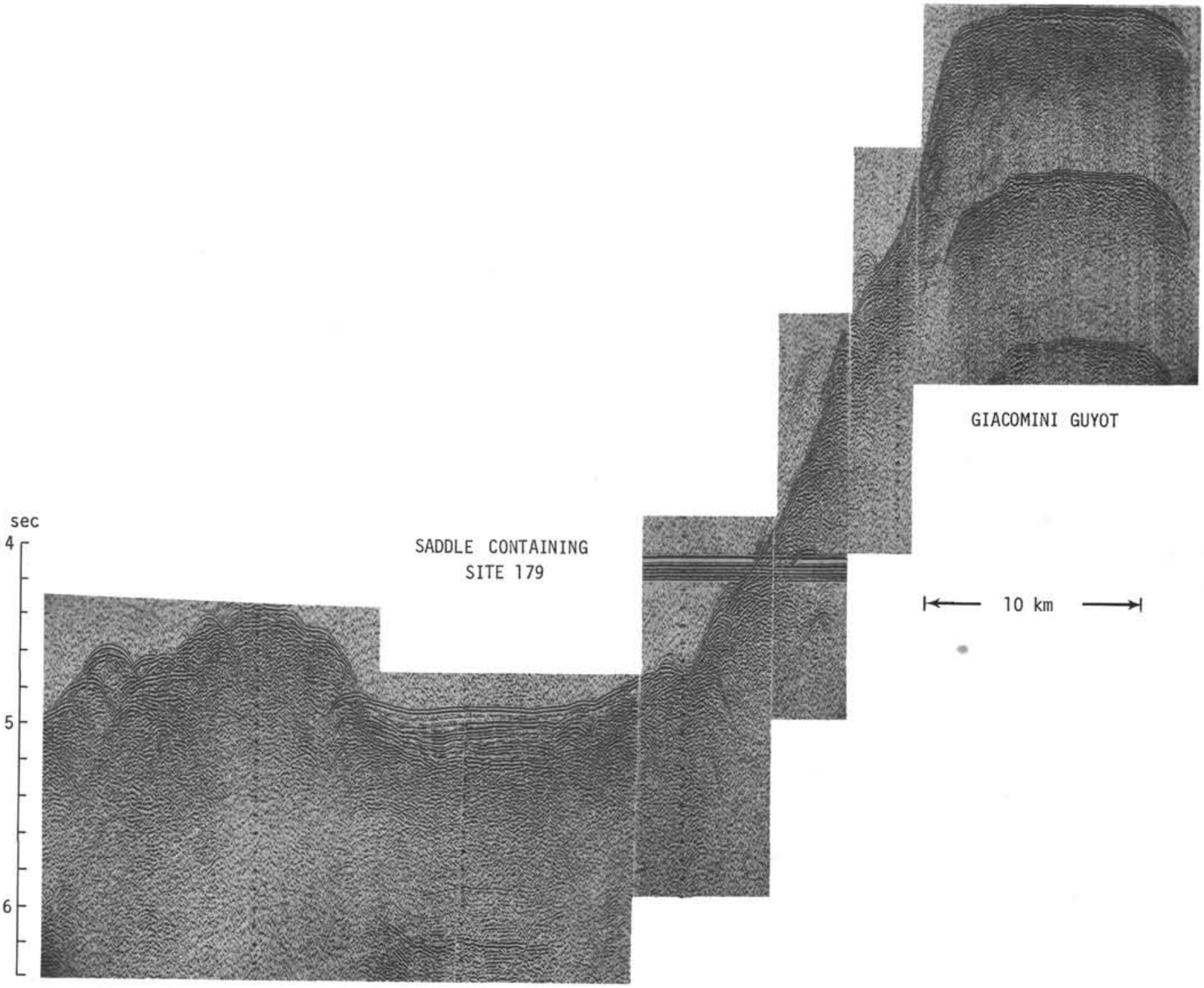

Figure 3. *Seismic records made with a 180 kilojoule spark source used to select Site 179. Note coherent reflections in multiple record suggesting a stratified acoustic basement.*

bed of glassy volcanic clasts. A fragmented weathered olivine basalt occurs below these heterogeneous deposits. The basalt is an oceanic type, vesicular and deeply weathered. It was possibly transported downslope from Giacomini Guyot.

Microfossils from core catcher samples indicate a Pliocene age for the lowermost fossiliferous interval in Unit 2. Unit 3 contains lower Pliocene diatoms. Calcareous nannofossils and foraminifers are found in the upper half of the stratigraphic section but they are absent in the lower part. Between 23 and 41 meters, siliceous and calcareous microfossils are found in roughly equal abundance, an unusual occurrence at this water depth. Displaced shallow-water foraminifers indicate downslope transport of sediment, possibly from the top of Giacomini Guyot. The reworked lower Oligocene and Miocene nannofossils in many of the sandy and silty turbidite layers may also have come from Giacomini Guyot or from turbidity currents flowing across the Alaska Abyssal Plain. However, the site is presently 200 meters above the level of the plain and presumably out of reach of turbidity currents. An analysis of the sand mineralogy may clarify the source of these turbidites.

Radiolarians and diatoms provide the only age control for the lower datable part of the sedimentary section. The diatoms indicate a Pliocene age for the interval from 63 meters to 91 meters whereas the radiolarians indicate a Pleistocene age for most of this interval. Using the diatom zonation for the north Pacific, an average sedimentation rate of 46 m/m.y. is calculated for the last million years at this site. (Sedimentation rate not corrected for compaction).

Although Site 179 is elevated above the Alaska Abyssal Plain, turbidites are still interbedded with the pelagic and hemipelagic sediments, but they represent a smaller percentage of the sedimentary column than at Site 178. Pleistocene sedimentation rates at Sites 178 and 179 are 70 to 180 m/m.y. and 46 m/m.y., respectively, which indicates

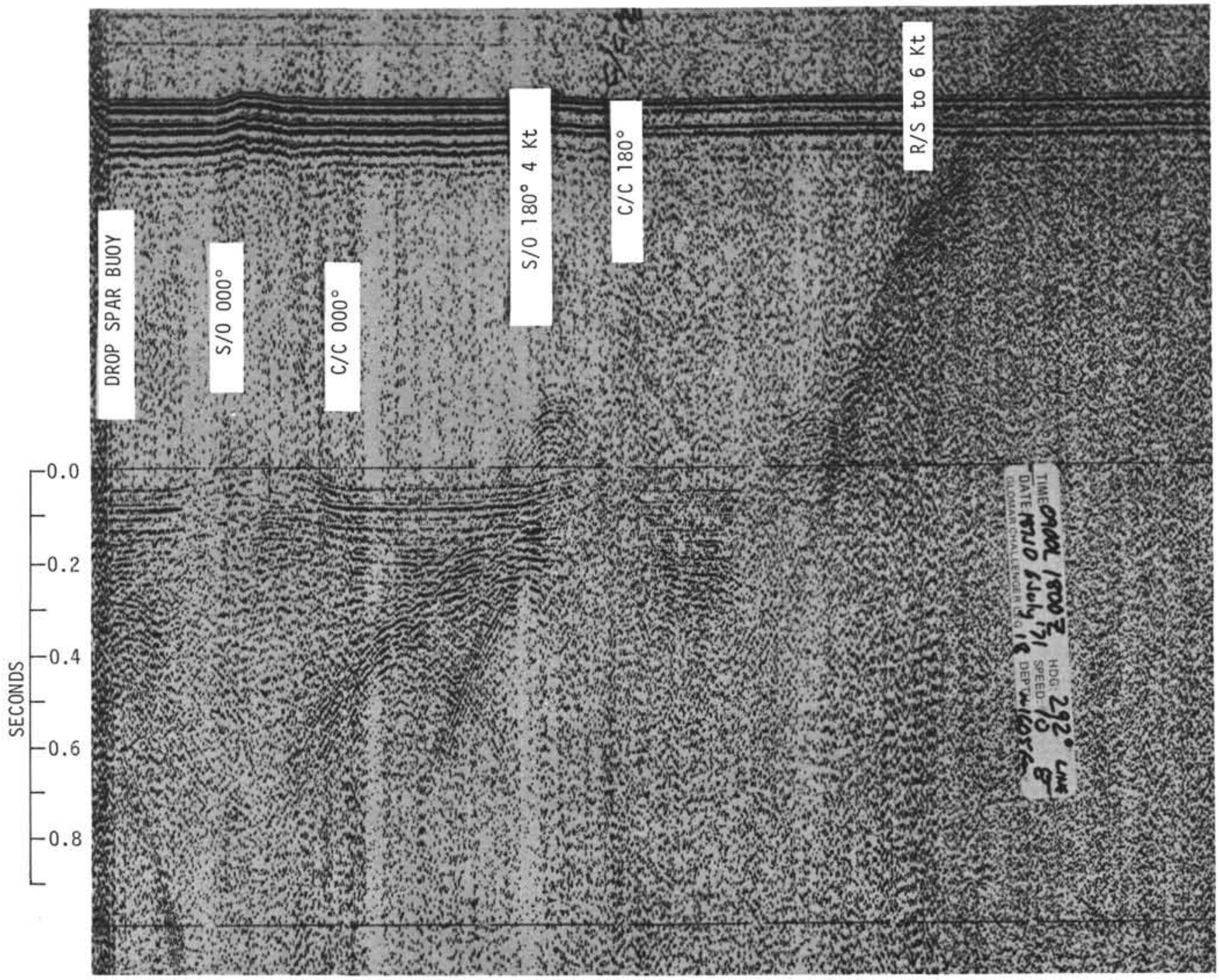

Figure 4. Challenger *seismic profile records made during location of Site 179.*

the strong influence of turbidity current deposition on the Alaska Abyssal Plain during this period.

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APPENDIX A. OPERATIONS

Pre-drilling Site Survey

At 0715 (Local Time), July 6, *Challenger* crossed the basin in which the primary prospective site was located. After crossing the basin at 6 knots to make a seismic record, it was decided that the secondary prospective site would better meet the objectives. Its elevation above the abyssal plain would probably assure greater pelagic deposition and therefore favor a greater abundance of microfossils. *Challenger* came to 292° T and 10 knots and intercepted the second basin at 0920 making 6 knots for a seismic record. The first crossing showed the basin to be about 1 km wide, about one-third the width seen further south on site survey records (Figure 5). *Challenger* came to 180° T (through miscommunication 180° T was steered instead of a reciprocal of 292° T). On the second crossing the basin looked acceptable and the spar buoy was made ready for drop on the third pass. The buoy was dropped at 1015 and the ship came around after retrieving geophysical gear. It stopped about one ship length upwind of the buoy to compensate for buoy drift. The beacon was soaked and dropped 10 minutes later with a release mechanism to test possible retrieval of the beacon.

Drilling Program

Site 179 is at a water depth of 3798 meters. The water depth was calculated using the Matthews Tables for area 44 (the correct area tables were missing) and adding the "Hawaii factor" to this value (i.e.: 3761 + 14 = 3775 meters to transducer and 3791 meters below derrick floor. The drill pipe touched bottom at 3798 meters below the derrick floor. The coring summary is contained in Table 1.

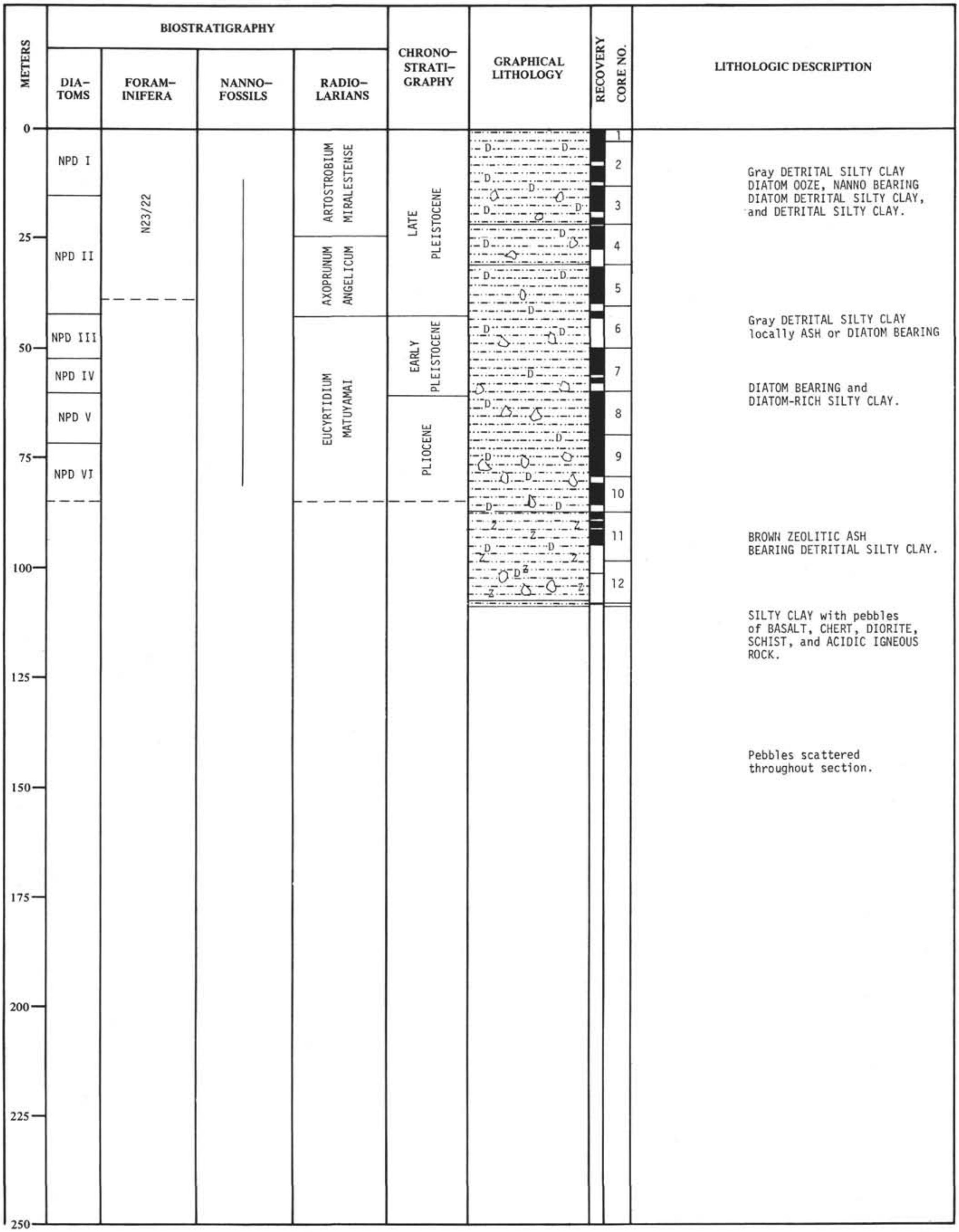
Drilling Specifications

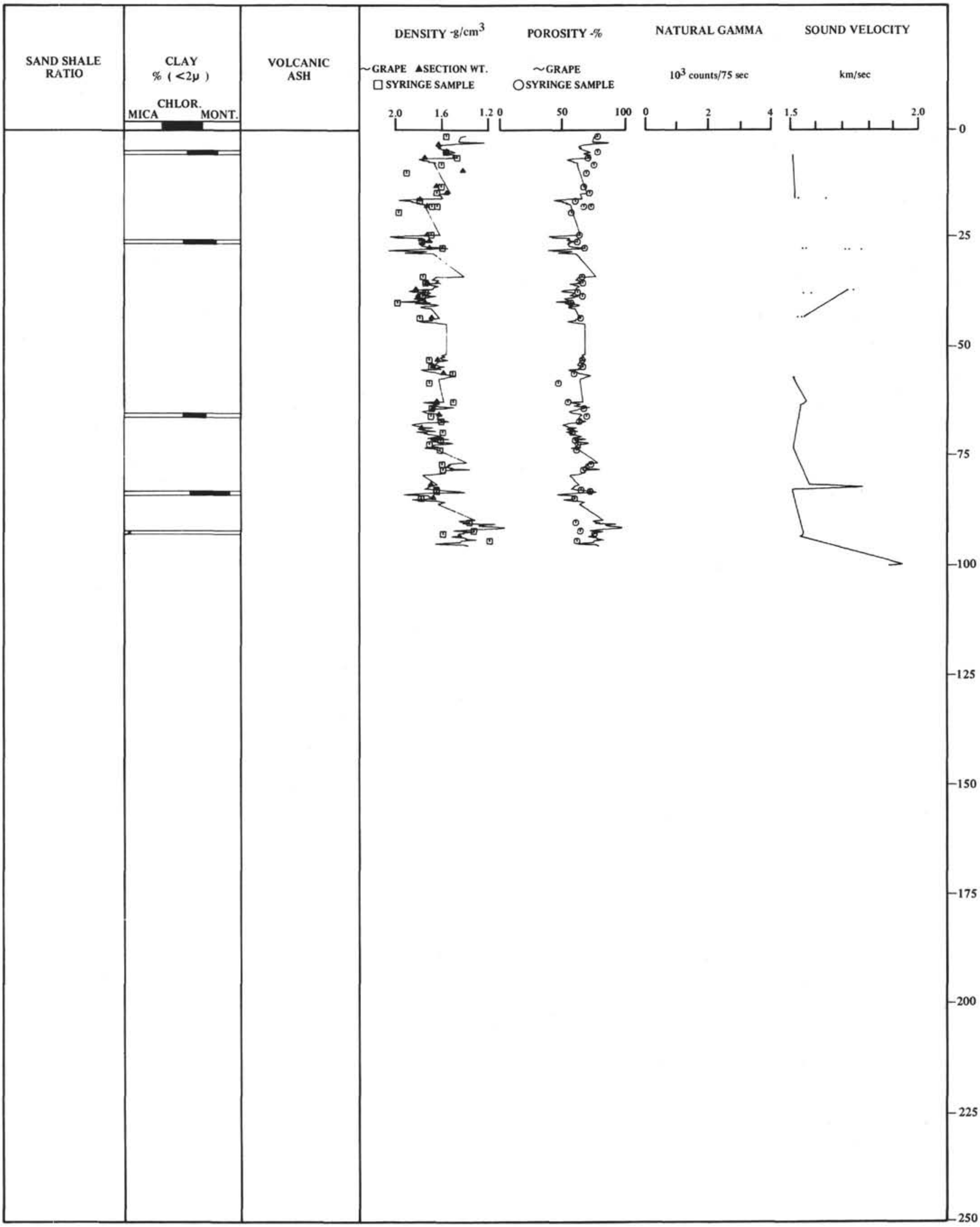
A Smith 3 cone insert type bit used at Site 178 and the same bottom-hole assembly was used again at this site.

The gray mud with sand streaks caused no problems in coring or recoveries. In Core 11, from 3887 to 3896 meters, gravel and volcanic ash caused high toruqe, and to flush out the hole, 25 barrels of gel mud were circulated. Drilling was terminated after recovery of Core 13.

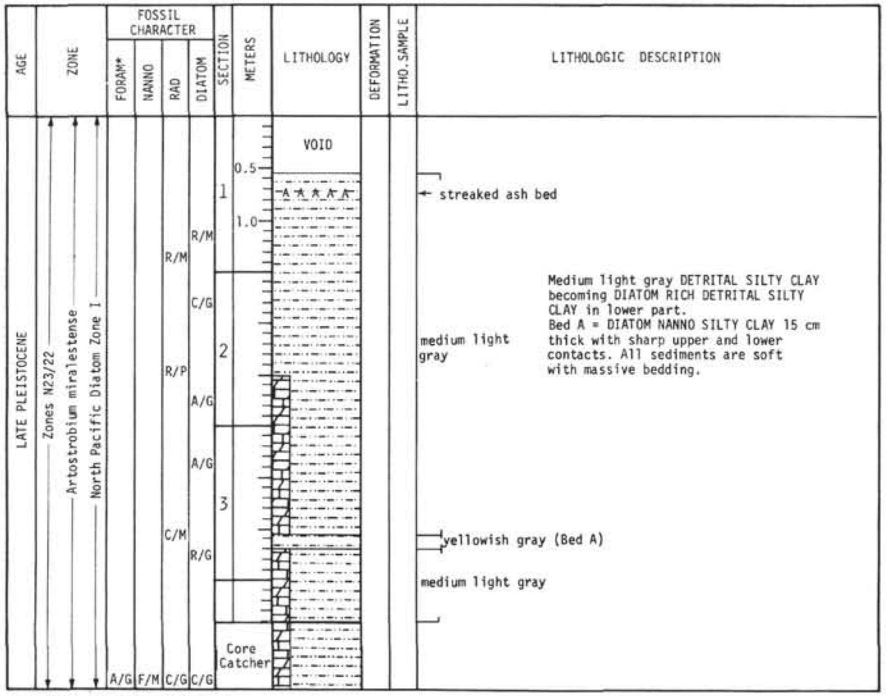
TABLE 1
DSDP Site 179 Coring Summary

	Cored Interval Below			Recovered	
Core	Derrick Floor (m)	Sea Floor (m)	Cored (m)	(m)	(%)
1	3798.0-3801.5	0-3.5	3.5	3.5	100.0
2	3801.5-3811.0	3.5-13.0	9.5	7.0	73.7
3	3811.0-3820.5	13.0-22.5	9.5	7.5	78.9
4	3820.5-3830.0	22.5-32.0	9.5	5.0	52.6
5	3830.0-3839.5	32.0-41.5	9.5	9.0	94.7
6	3839.5-3849.0	41.5-51.0	9.5	1.5	15.8
7	3849.0-3858.5	51.0-60.5	9.5	7.5	78.9
8	3858.5-3868.0	60.5-70.0	9.5	9.0	94.7
9	3868.0-3877.5	70.0-79.5	9.5	8.0	84.2
10	3877.5-3887.0	79.5-89.0	9.5	5.0	52.6
11	3887.0-3896.5	89.0-98.5	9.5	5.5	57.9
12	3896.5-3906.0	98.5-108.0	9.5	0.5	5.3
13	3906.0-3907.0	108.0-109.0	1.0	0.5	50.0
		Total	109.0	69.5	63.8


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
NPD I
NPD II
NPD III
NPD IV
NPD V
NPD VI
N23/22
ARTOSTROBIUM MIRALESTENSE
AXOPRUNUM ANGELICUM
EUCYRTIDIUM MATUYAMAI
LATE PLEISTOCENE
EARLY PLEISTOCENE
PLIOCENE
1
2
3
4
5
6
7
8
9
10
11
12
Gray DETRITAL SILTY CLAY DIATOM OOZE, NANNO BEARING DIATOM DETRITAL SILTY CLAY, and DETRITAL SILTY CLAY.
Gray DETRITAL SILTY CLAY locally ASH or DIATOM BEARING
DIATOM BEARING and DIATOM-RICH SILTY CLAY.
BROWN ZEOLITIC ASH BEARING DETRITIAL SILTY CLAY.
SILTY CLAY with pebbles of BASALT, CHERT, DIORITE, SCHIST, and ACIDIC IGNEOUS ROCK.
Pebbles scattered throughout section.


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
0
25
50
75
100
125
150
175
200
225
250

Site 179 Hole Core 1 Cored Interval: 0-3.5 m



streaked ash bed

medium light gray

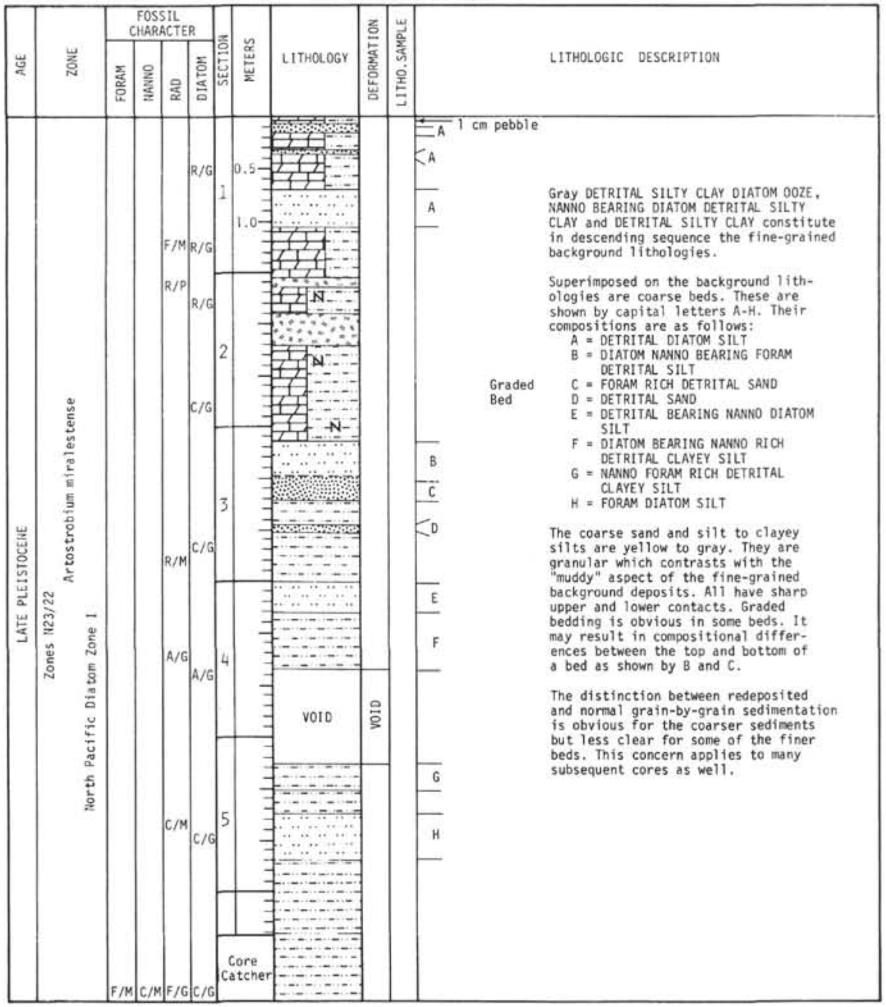
yellowish gray (Bed A)

medium light gray

Medium light gray DETRITAL SILTY CLAY becoming DIATOM RICH DETRITAL SILTY CLAY in lower part.
Bed A = DIATOM NANNO SILTY CLAY 15 cm thick with sharp upper and lower contacts. All sediments are soft with massive bedding.

Explanatory notes in chapter 1
*PLANKTONIC FORAMINIFERA

Site 179 Hole Core 2 Cored Interval: 3.5-13.0 m



1 cm pebble

Gray DETRITAL SILTY CLAY DIATOM OOZE, NANNO BEARING DIATOM DETRITAL SILTY CLAY and DETRITAL SILTY CLAY constitute in descending sequence the fine-grained background lithologies.

Superimposed on the background lithologies are coarse beds. These are shown by capital letters A-H. Their compositions are as follows:

A = DETRITAL DIATOM SILT
B = DIATOM NANNO BEARING FORAM DETRITAL SILT
C = FORAM RICH DETRITAL SAND
D = DETRITAL SAND
E = DETRITAL BEARING NANNO DIATOM SILT
F = DIATOM BEARING NANNO RICH DETRITAL CLAYEY SILT
G = NANNO FORAM RICH DETRITAL CLAYEY SILT
H = FORAM DIATOM SILT

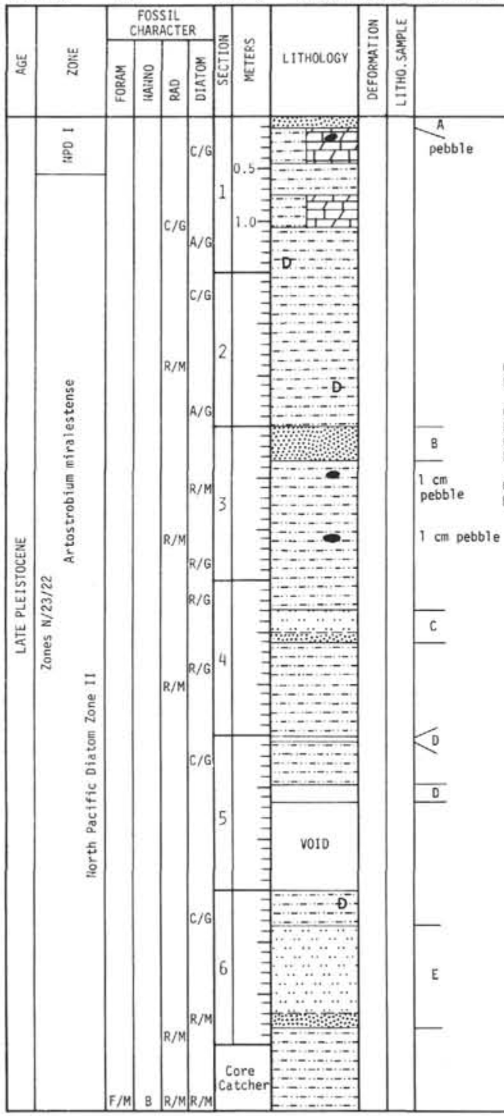
Graded Bed

The coarse sand and silt to clayey silts are yellow to gray. They are granular which contrasts with the "muddy" aspect of the fine-grained background deposits. All have sharp upper and lower contacts. Graded bedding is obvious in some beds. It may result in compositional differences between the top and bottom of a bed as shown by B and C.

The distinction between redeposited and normal grain-by-grain sedimentation is obvious for the coarser sediments but less clear for some of the finer beds. This concern applies to many subsequent cores as well.

Explanatory notes in chapter 1

Site 179 Hole Core 3 Cored Interval: 13.0-22.5 m



Gray DETRITAL SILTY CLAY, DETRITAL SILTY CLAY DIATOM OOZE and DIATOM RICH DETRITAL SILTY CLAY comprise the fine-grained beds.

The coarse beds are as follows:

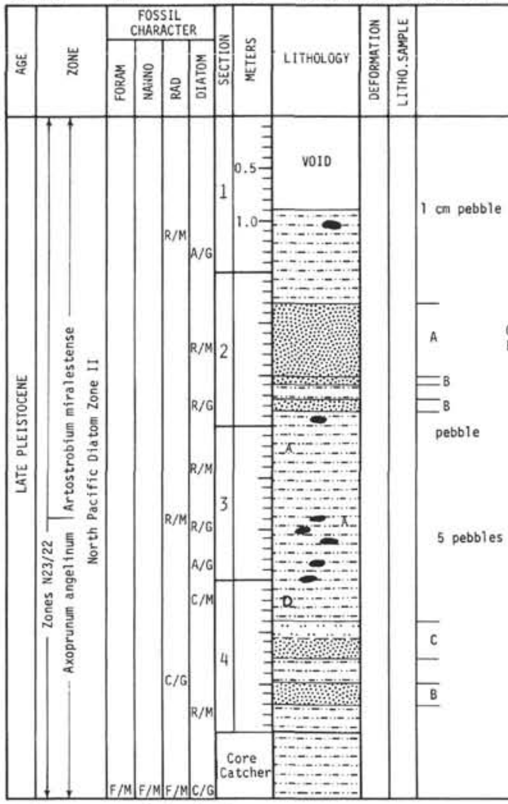
Graded Bed A = DIATOM DETRITAL BEARING FORAM SILT
= DIATOM BEARING DETRITAL SAND
Graded Bed B = FORAM BEARING DETRITAL SAND
= DETRITAL SAND
Graded Bed C = DIATOM FORAM RICH DETRITAL SILT
= DETRITAL SILTY SAND
D = *DETRITAL SILT*
Graded Bed E = DETRITAL SILT
= FORAM RICH DETRITAL SILTY SAND

The coarse sediments are gray have sharp upper and lower contacts and exhibit good graded bedding. They range in thickness from 10-70 cm.

The sediments are soft throughout.

Explanatory notes in chapter 1

Site 179 Hole Core 4 Cored Interval: 22.5-32.0 m



Gray DETRITAL SILTY CLAY locally ASH or DIATOM BEARING constitutes the finer sediments.

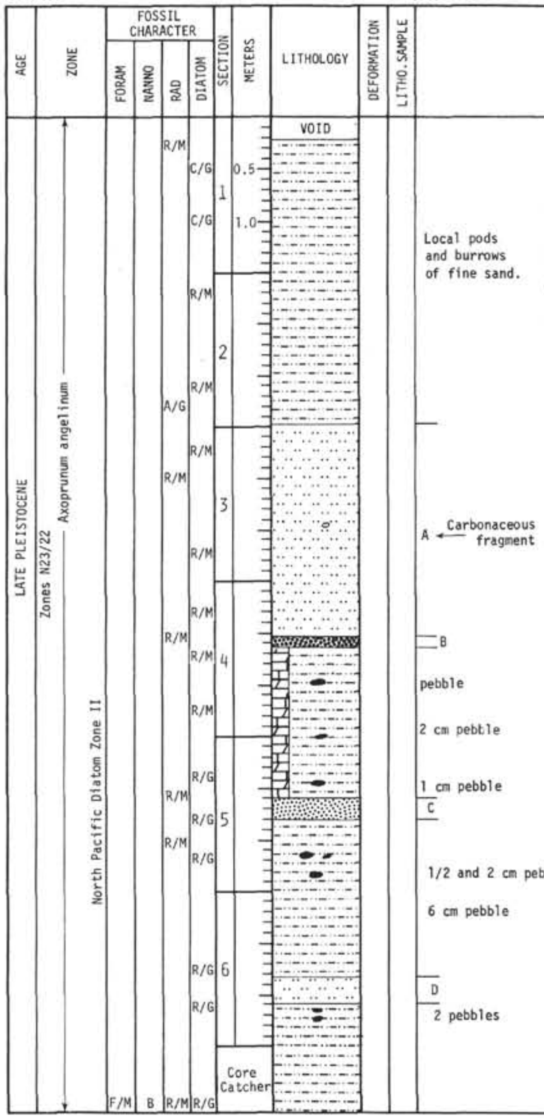
The coarse beds are as follows:

Graded Bed A = FORAM ASH RICH DETRITAL SAND
= FORAM DETRITAL BEARING ASH SAND
B = DETRITAL SAND
C = NANNO BEARING DETRITAL SILT
= DETRITAL SAND

Lower contacts of coarse beds are sharp, upper contacts sharp to gradational. Many show graded bedding. and are gray to yellow in color.

Explanatory notes in chapter 1

Site 179 Hole Core 5 Cored Interval: 32.0-41.5 m



LITHOLOGIC DESCRIPTION

Gray to green DIATOM BEARING becoming DIATOM RICH DETRITAL SILTY CLAY in Section 4 changing to gray DETRITAL SILTY CLAY near bottom of core. The diatom content seems to increase as the shades of green in the sediments become more pronounced.

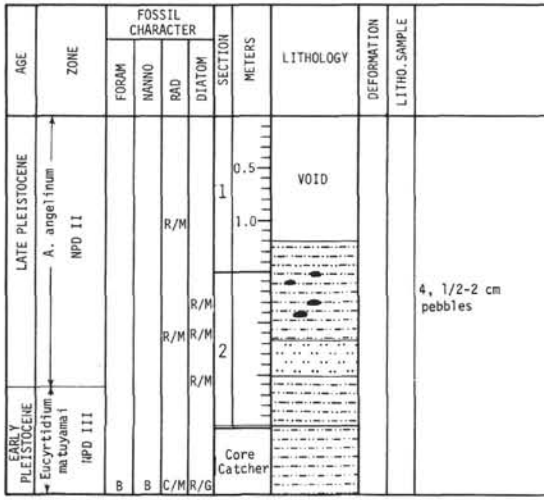
Coarse beds are as follows:
A = FORAM DETRITAL SILT
B = DIATOM FORAM BEARING DETRITAL GRANULE bed
(Detrital minerals = quartz, schist, phyllite, volcanics, lime silicates.)
C = FORAM BEARING DETRITAL SAND
D = NANNO FORAM BEARING DIATOM RICH DETRITAL SILT

Local sand pods in coarse sand beds have sharp lower contacts and in places are laminated.

All sediments firm.

Explanatory notes in chapter 1

Site 179 Hole Core 6 Cored Interval: 41.5-51.0 m



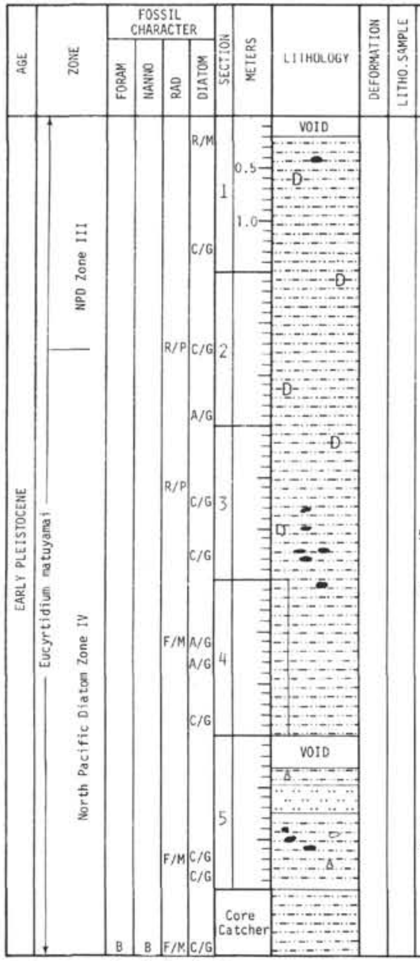
LITHOLOGIC DESCRIPTION

Medium light gray DETRITAL SILTY CLAY with one bed of DETRITAL SILT. The latter contains an ASH BEARING SILTY CLAY clast. This bed shows good graded bedding with sharp upper and lower contacts.

Sediments are firm and massive.

Explanatory notes in chapter 1

Site 179 Hole Core 7 Cored Interval: 51.0-60.5 m



LITHOLOGIC DESCRIPTION

pebble

Medium light gray DIATOM BEARING DETRITAL SILTY CLAY becoming DIATOM RICH in Section 4. ASH BEARING DETRITAL SILT in Section 5, 25 cm thick, grading from very coarse at base to very fine at top.

Bedding is firm and massive.

5 cm pebbles

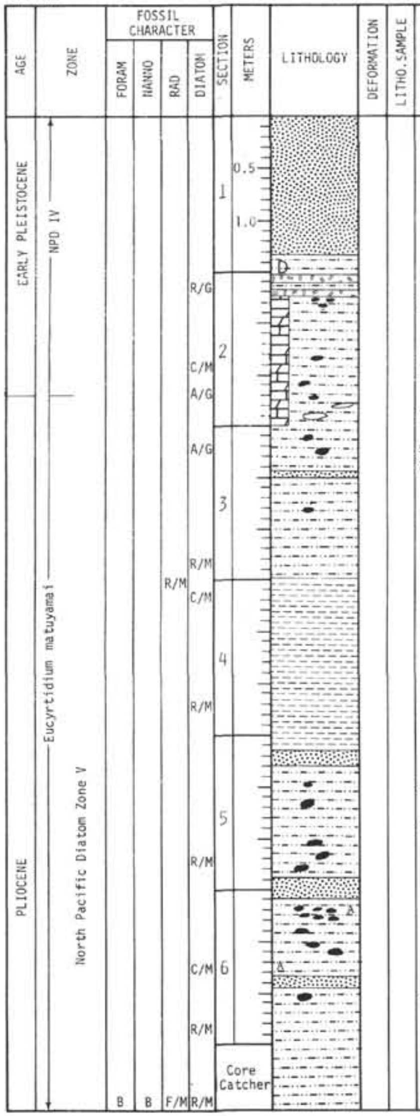
3 cm pebble

1 chloritic clay clast

3 pebbles

Explanatory notes in chapter 1

Site 179 Hole Core 8 Cored Interval: 60.5-70.0 m



LITHOLOGIC DESCRIPTION

Medium light gray DETRITAL SILTY CLAY, DIATOM RICH in Section 2.

Undeformed SAND layers exhibit graded bedding, all have sharp contacts.

3 small pebbles

Abundant pebbles ranging from 1-3 cm.

Some of fine sediments range to greenish shades also some dusky yellow beds in Section 4.

1 cm pebble

pebble

1 cm pebble

several streaks Diatom ooze

2 = 1/2 cm pebbles

1 cm pebble

small pebble

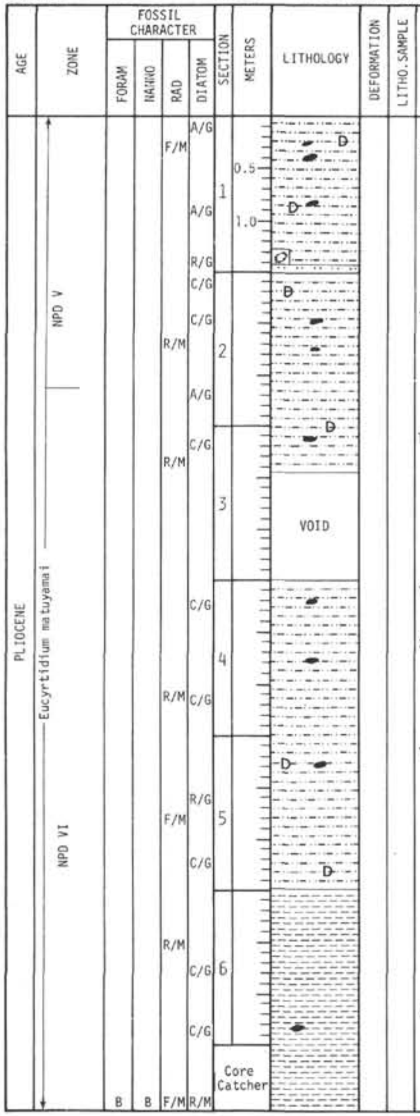
4 = 2 cm pebbles

9 pebbles

3 cm pebble

Explanatory notes in chapter 1

Site 179 Hole Core 9 Cored Interval: 70.0-79.5 m



LITHOLOGIC DESCRIPTION

2 pebbles

2 cm pebbles

1 cm pebble
pebble

1 cm pebble

1 cm pebble

2 cm pebble

1/2 cm pebble

2 cm pebble

Yellowish gray DIATOM BEARING DETRITAL SILTY CLAY becoming clay size in Section 6.

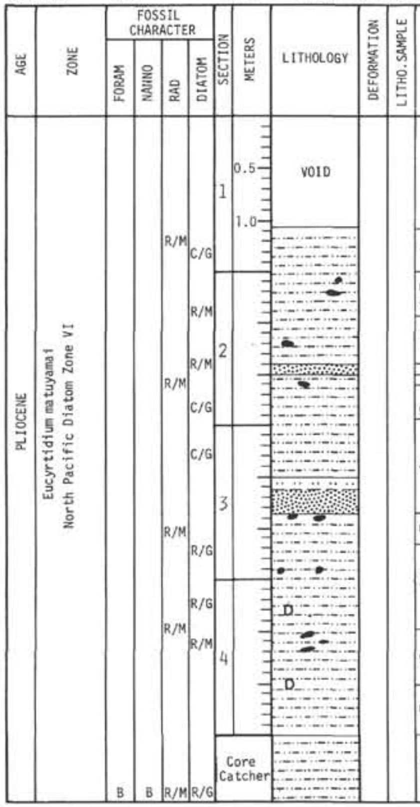
Fine sediments shades of medium and yellowish gray also locally greenish gray.

One 8 cm silt bed in Section 1.

Sediments soupy to firm, locally very firm. They are also slightly mottled.

Explanatory notes in chapter 1

Site 179 Hole Core 10 Cored Interval: 79.5-89.0 m



LITHOLOGIC DESCRIPTION

light olive gray

medium light gray

moderate yellow brown

dark gray

medium bluish gray

greenish gray

yellowish gray

medium bluish gray

yellowish gray

greenish gray

moderate gray

greenish gray

Green, blue and yellowish gray to brown DETRITAL SILTY CLAY. Color changes are sharp (—┤) or gradational (——┤), as shown.

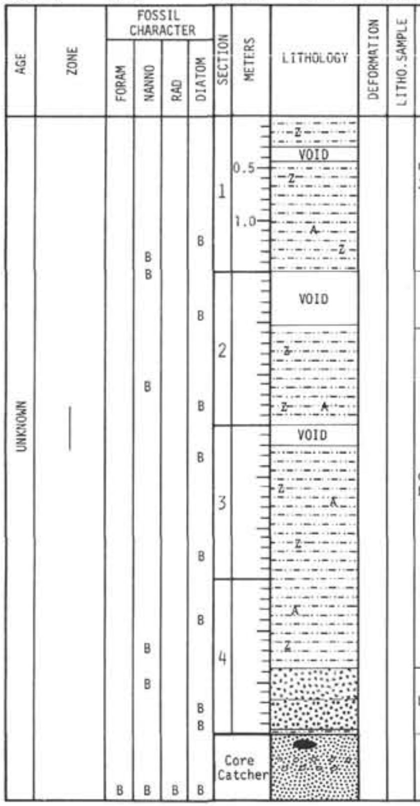
10 cm DIATOM BEARING ASH RICH DETRITAL SILTY SAND in Section 2 and 40 cm graded bed with DIATOM ASH BEARING DETRITAL SILT at top and DETRITAL SILTY SAND at base. Both have sharp contacts and latter is underlain by 2 pebbles.

Pebbles scattered throughout.

Sediments are slightly mottled, firm and massive.

Explanatory notes in chapter 1

Site 179 Hole Core 11 Cored Interval: 89.0-98.5 m



LITHOLOGIC DESCRIPTION

moderate to dark yellow brown

dark yellow brown

black

Brown ZEOLITE ASH BEARING DETRITAL CLAYEY SILT.

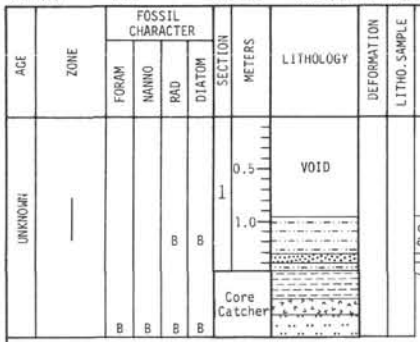
Brown colors variegated in various shades yellowish to medium and dark brown, locally small black specks in Section 4.

A graded SAND in Section 4 (88-145 cm) varies from very fine at the top to granule size at the bottom. It has sharp upper and lower contacts and consists entirely of black VOLCANIC glass particles plus rare olivine crystals.

Core catcher consists of one BASALT pebble also conglomerate with VOLCANIC glass, yellow waxy CLAY and brown CLAY clasts.

Explanatory notes in chapter 1

Site 179 Hole Core 12 Cored Interval: 98.5-108.0 m



LITHOLOGIC DESCRIPTION

dark yellow brown and gray orange

black

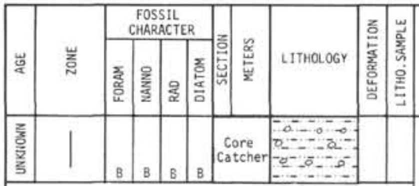
grayish orange

Brown SILTY CLAY with corroded ZEOLITE crystals and indurated black VOLCANIC SAND.

Core Catcher contains
20 cm = yellow waxy fine-grained CLAY at glass shards
10 cm = weathered brown BASALT
4 cm = brown SILTSTONE

All sediments firm to indurated.

Site 179 Hole Core 13 Cored Interval: 108.0-109.0 m



LITHOLOGIC DESCRIPTION

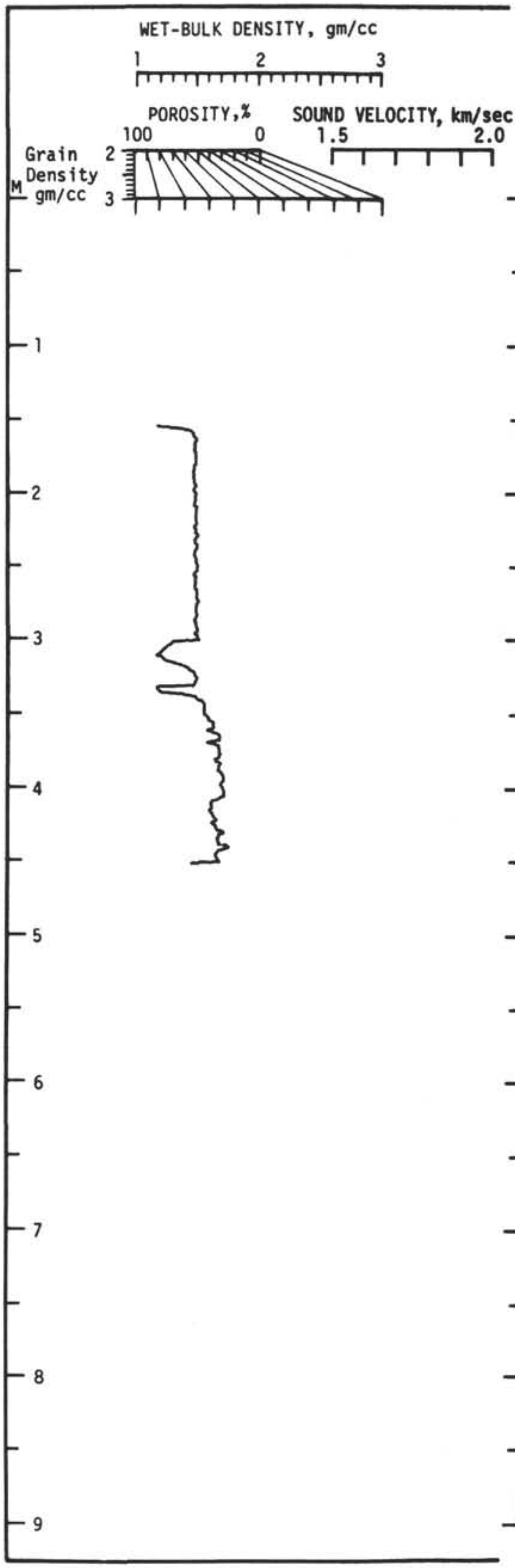
Center Bit Sample:

A) 19 PEBBLES, 1-4 cm long subangular, to subround.
7 = weathered basalt (brown)
3 = calcareous chert
3 = diorite
2 = schist
3 = acid igneous
1 = sediment

B) 70 cc of mostly brown SILTY CLAY also some gray SILTY CLAY and fine yellow waxy fragments.

C) Scattered sand to granule-sized dark clasts.

Explanatory notes in chapter 1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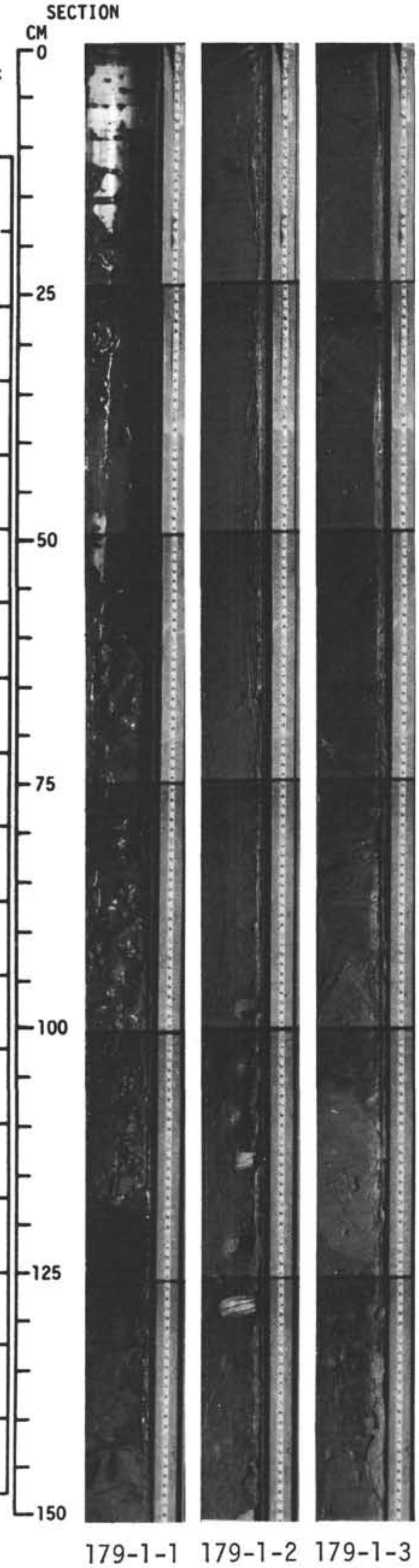
1
2
3
POROSITY,%
100
0
SOUND VELOCITY, km/sec
1.5
2.0
Grain Density gm/cc
2
3
M
1
2
3
4
5
6
7
8
9


SECTION
CM
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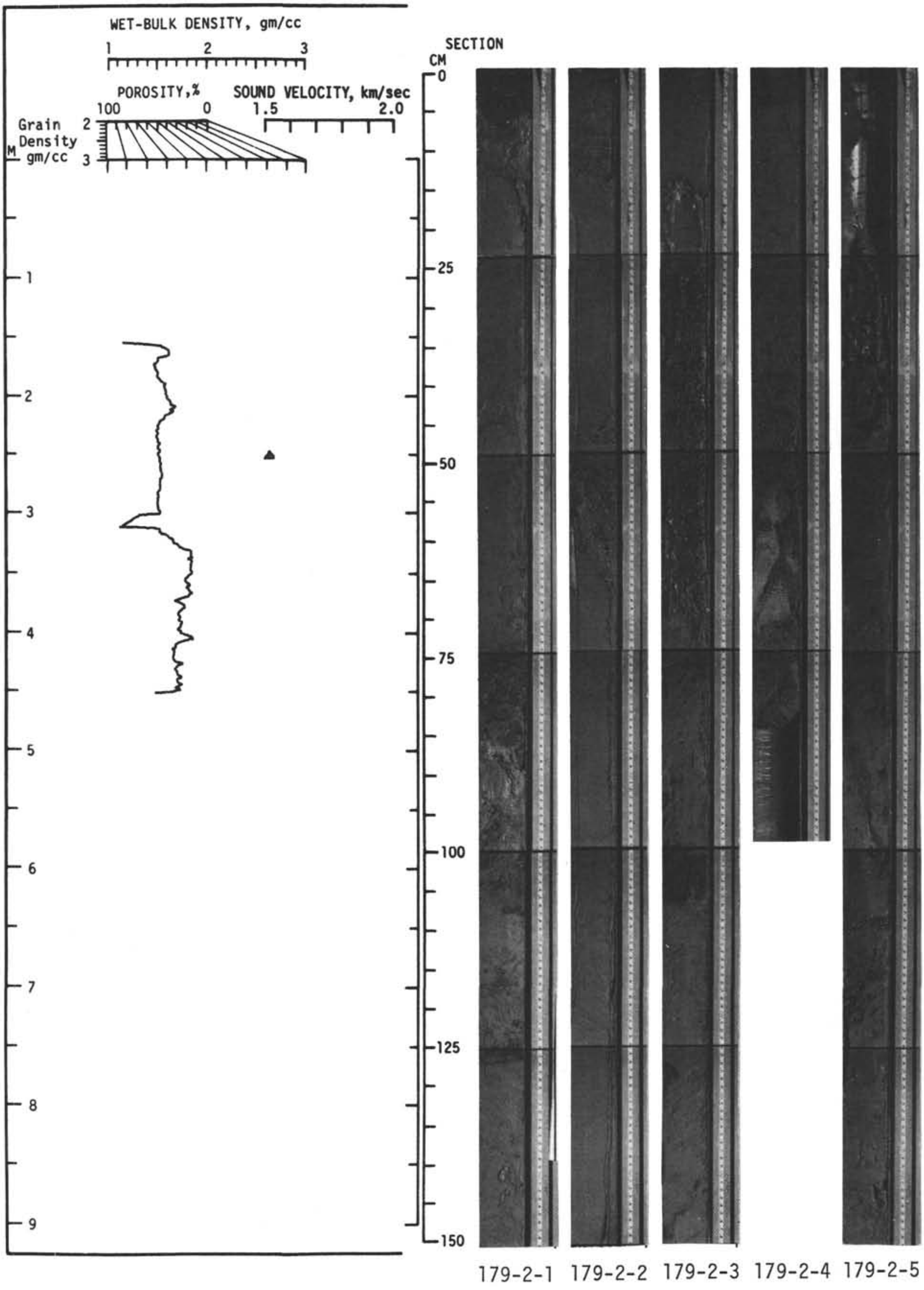
50
75
100
125
150
179-1-1
179-1-2
179-1-3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SOUND VELOCITY, km/sec
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Grain Density gm/cc
2
3
M
1
2
3
4
5
6
7
8
9
SECTION
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100
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150
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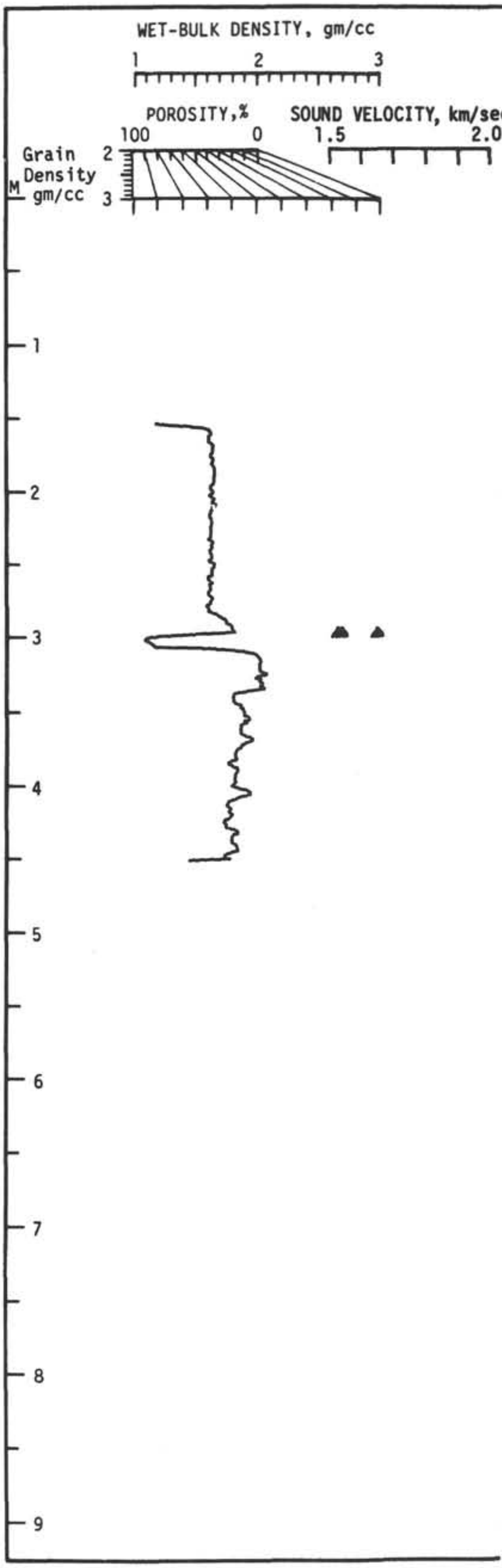
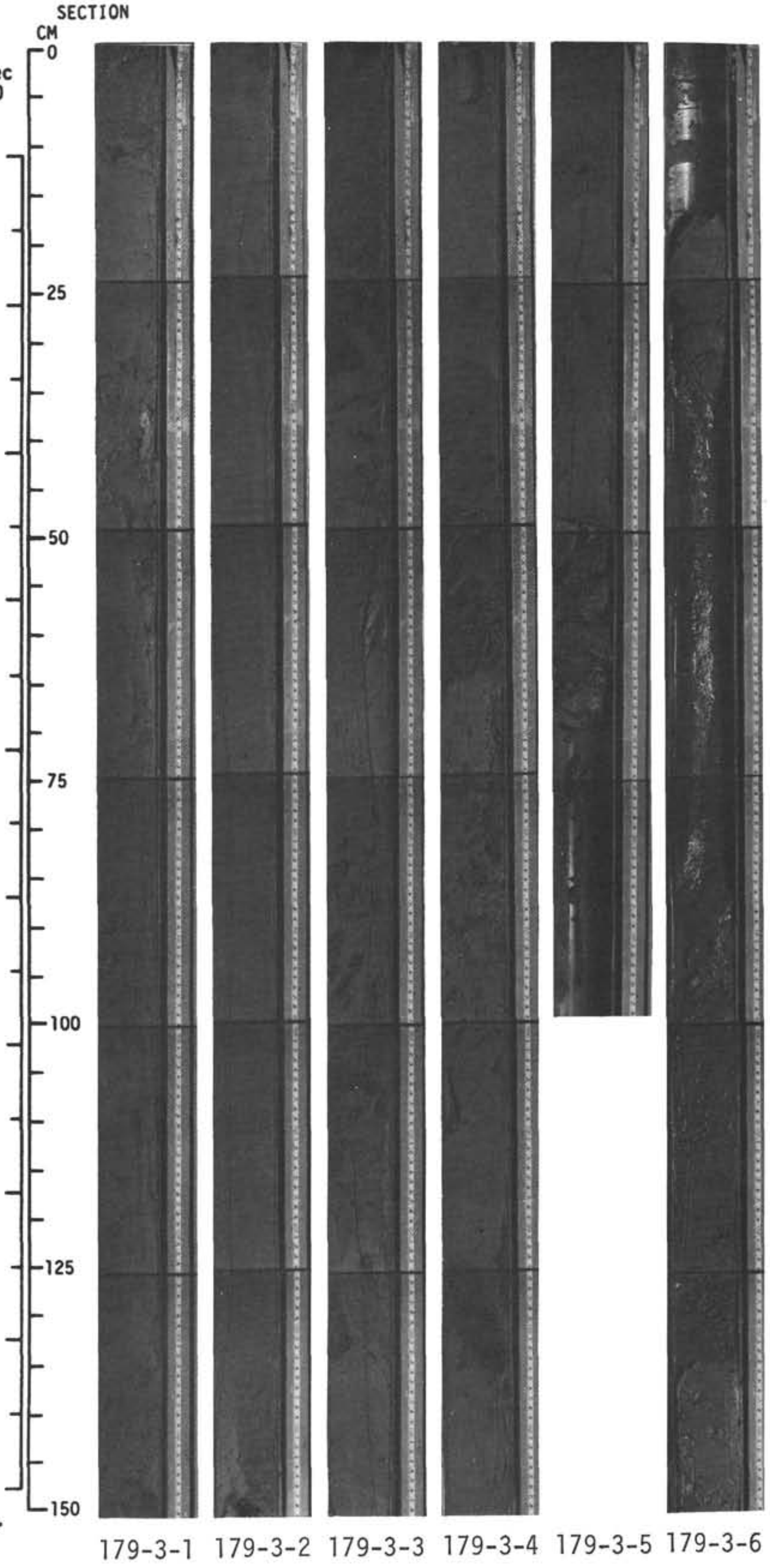
179-2-2
179-2-3
179-2-4
179-2-5





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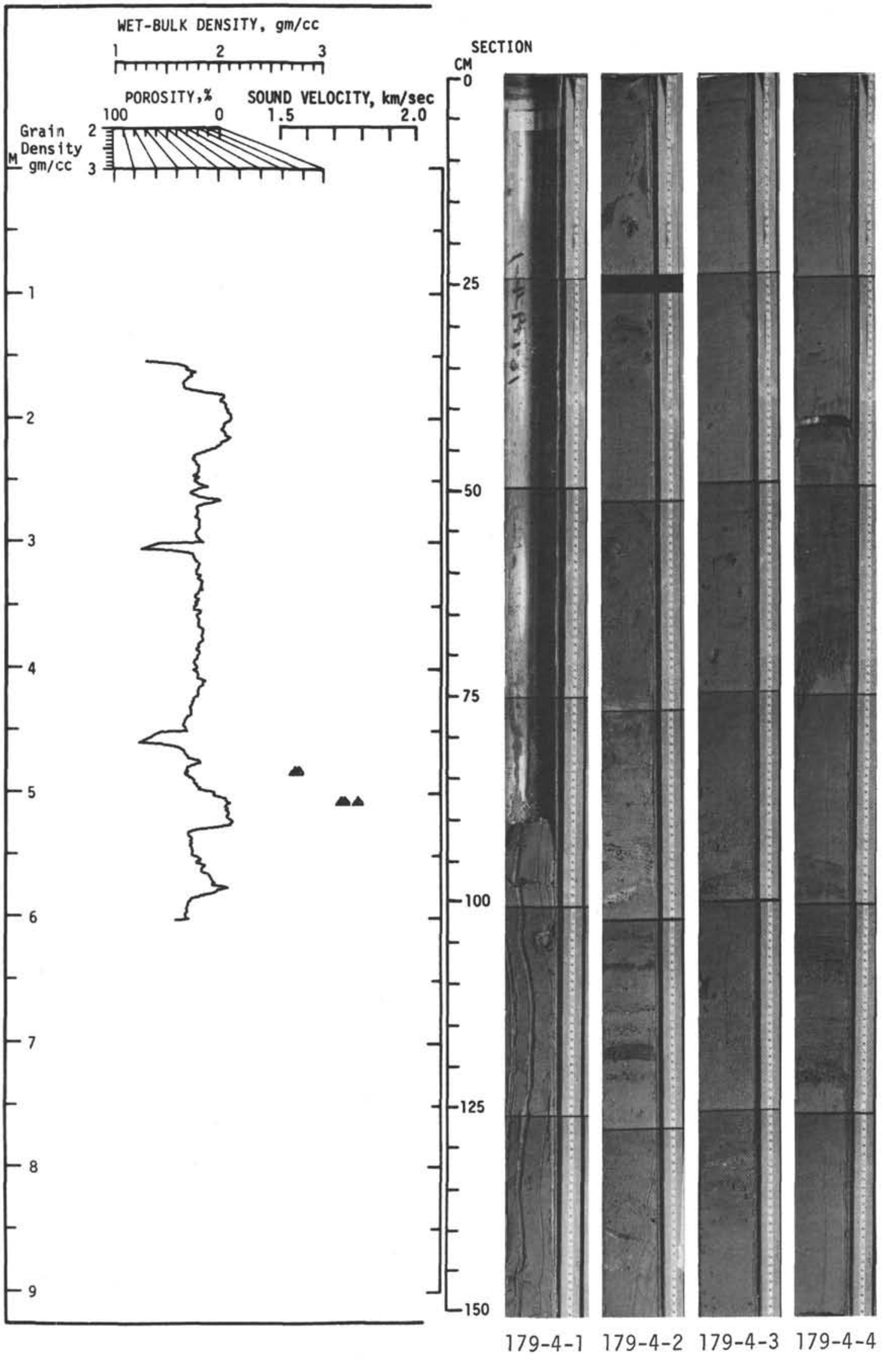
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SOUND VELOCITY, km/sec
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2.0
Grain Density gm/cc
2
3
M
1
2
3
4
5
6
7
8
9
SECTION
CM
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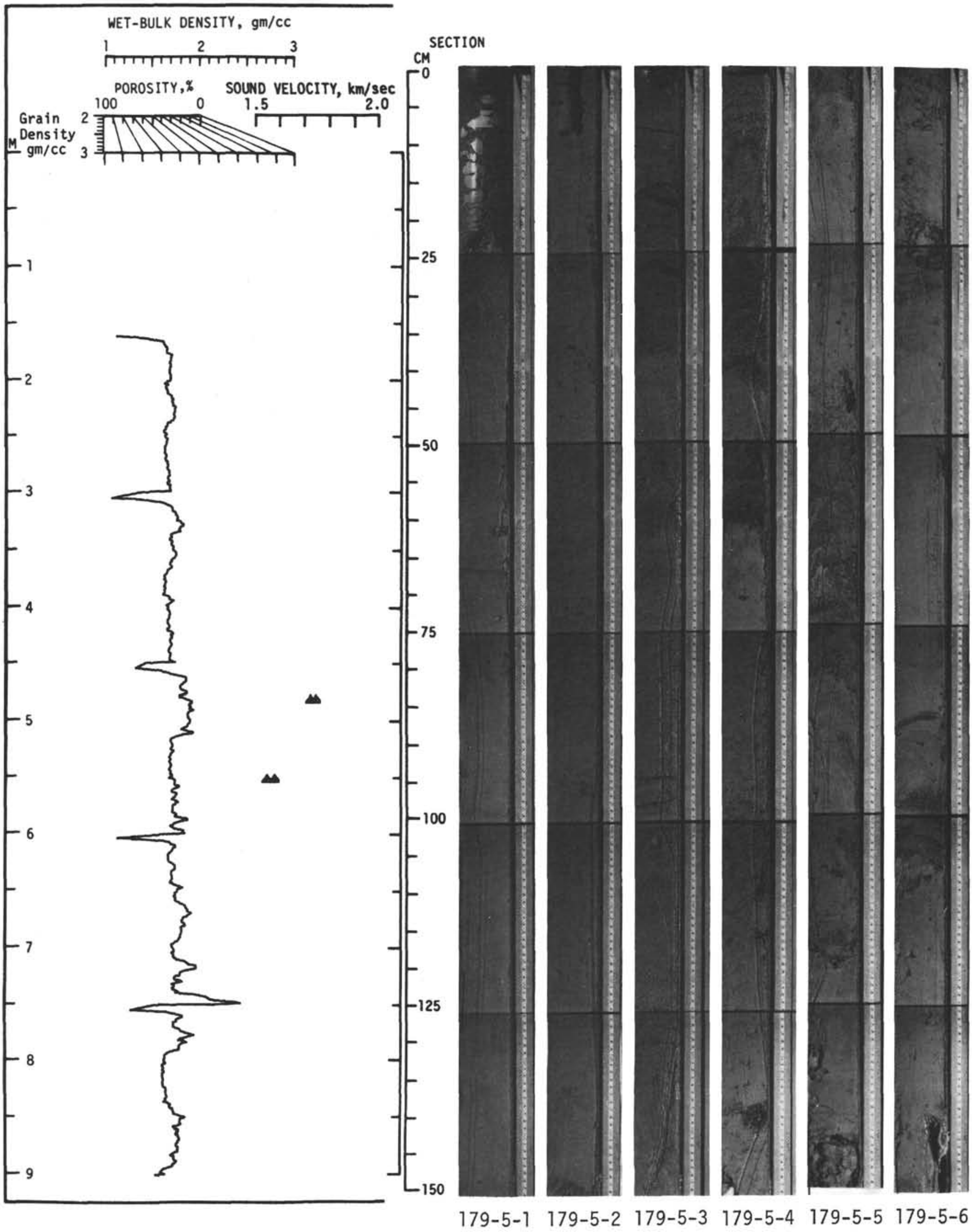
50
75
100
125
150
179-4-1
179-4-2
179-4-3
179-4-4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SOUND VELOCITY, km/sec
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2.0
Grain Density gm/cc
2
3
M
1
2
3
4
5
6
7
8
9
SECTION
CM
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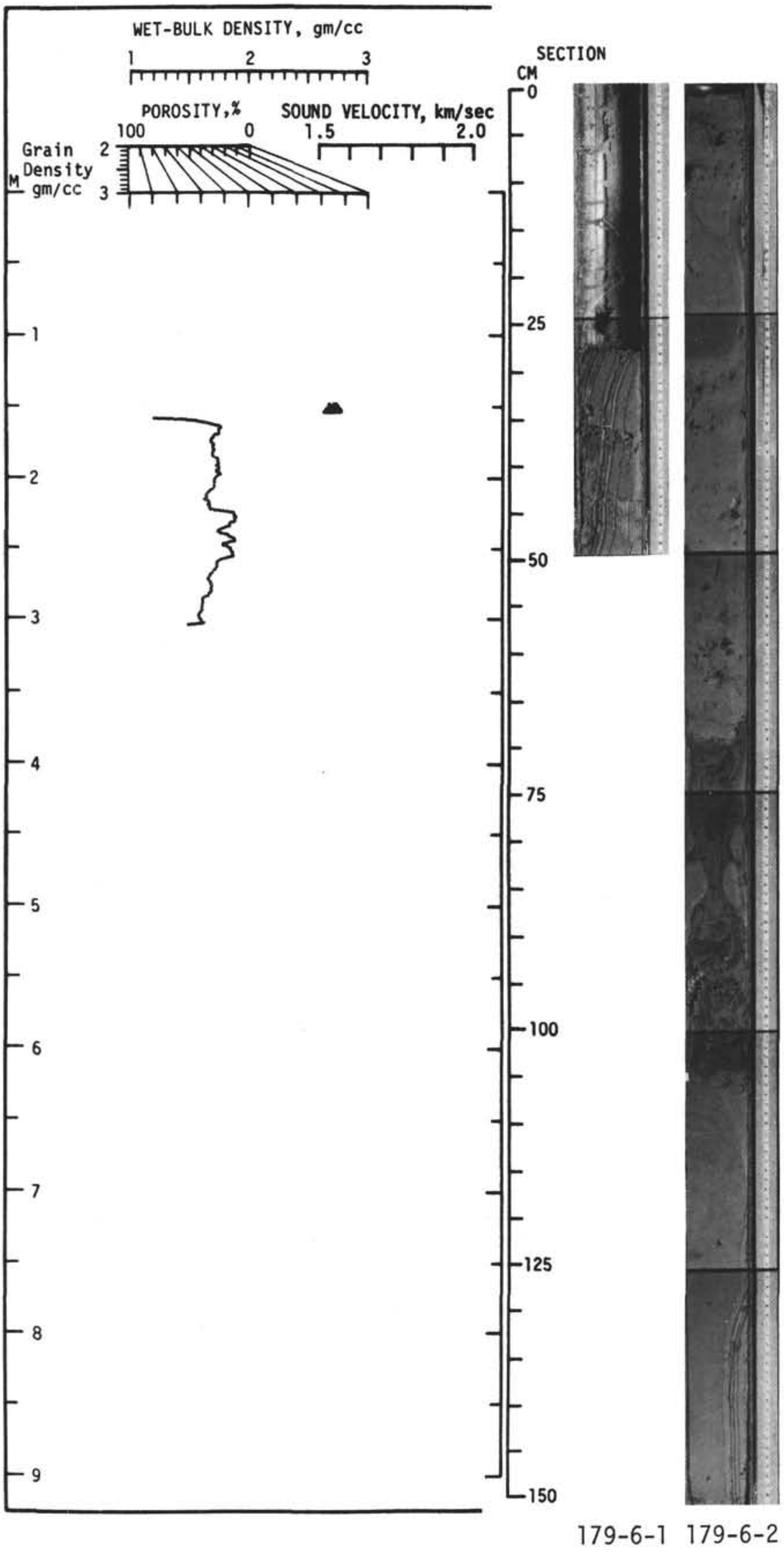
179-5-6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POROSITY,%
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SOUND VELOCITY, km/sec
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2.0
Grain Density gm/cc
2
3
M
1
2
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8
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SECTION
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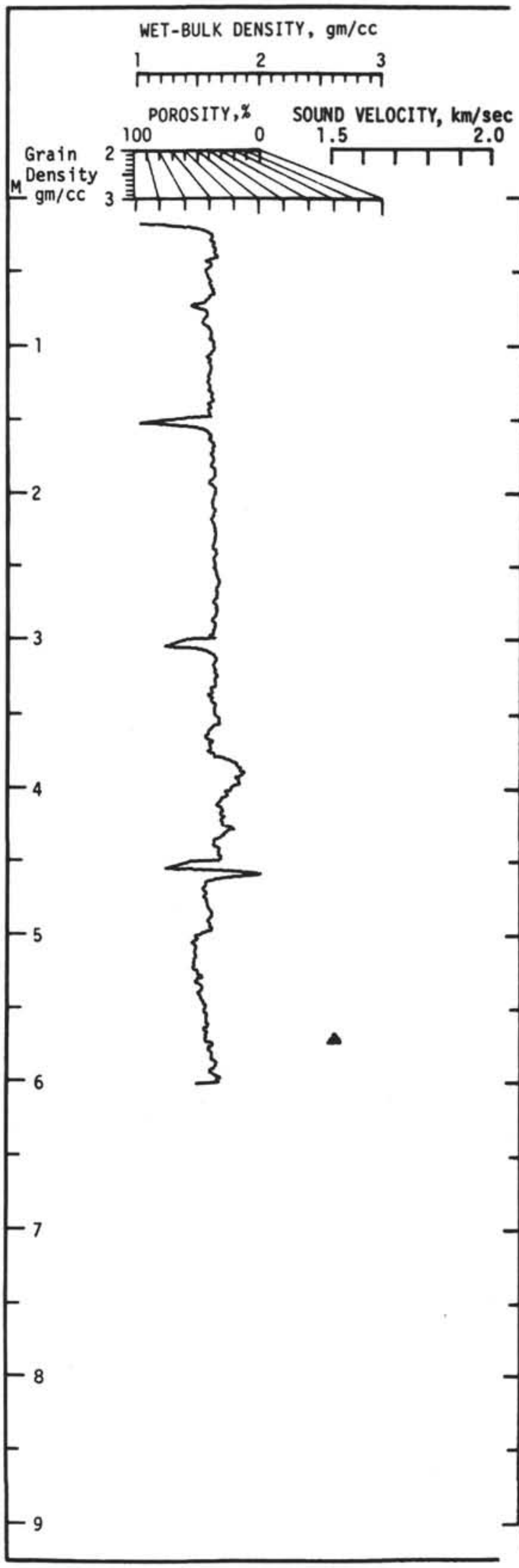
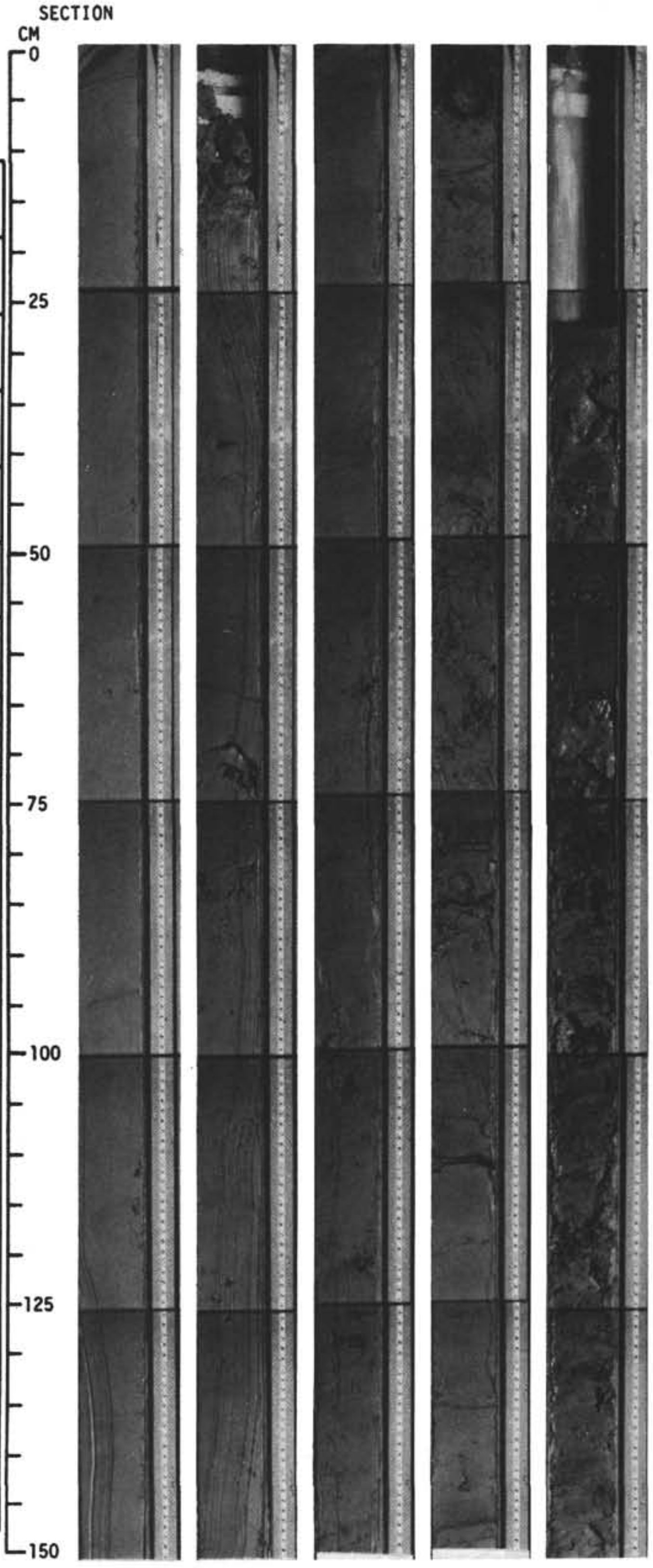
179-6-2





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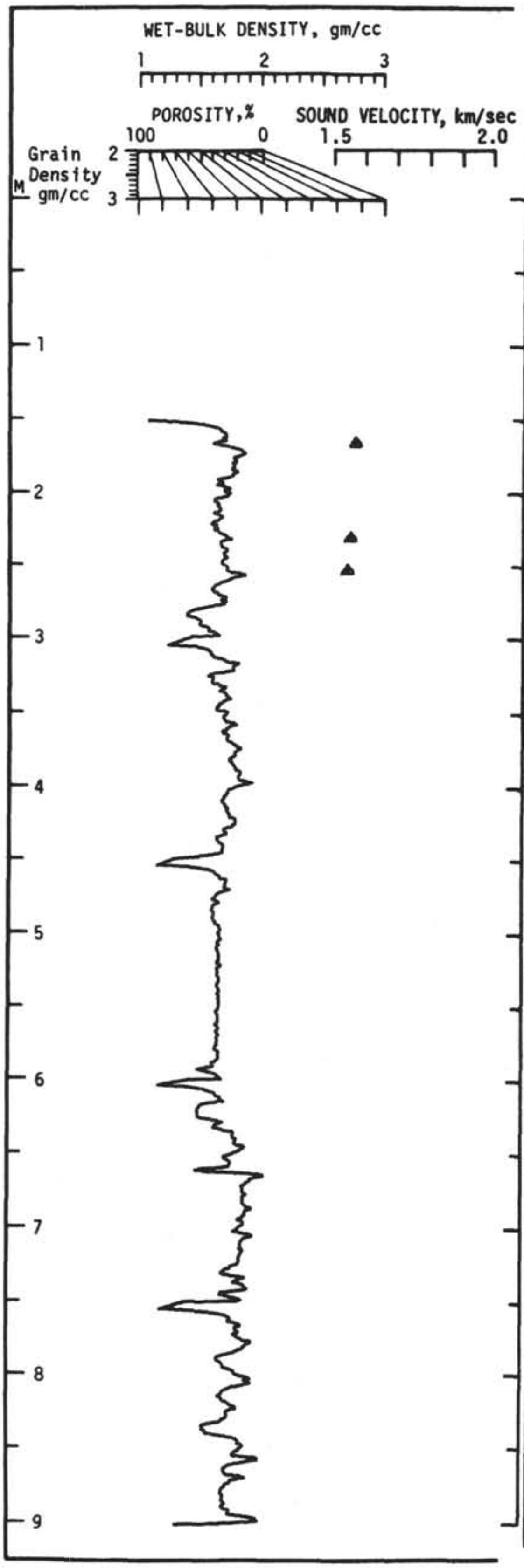

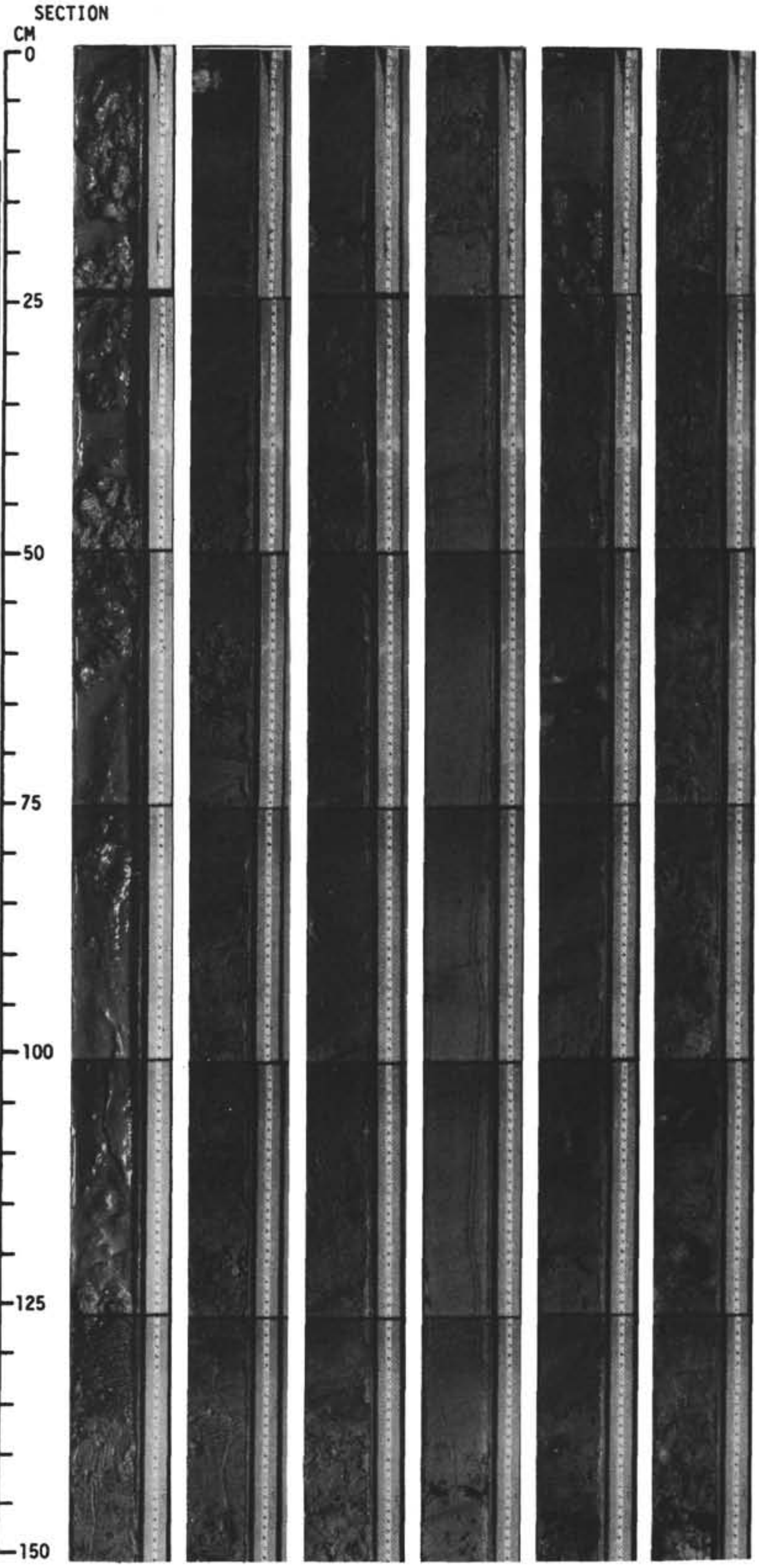

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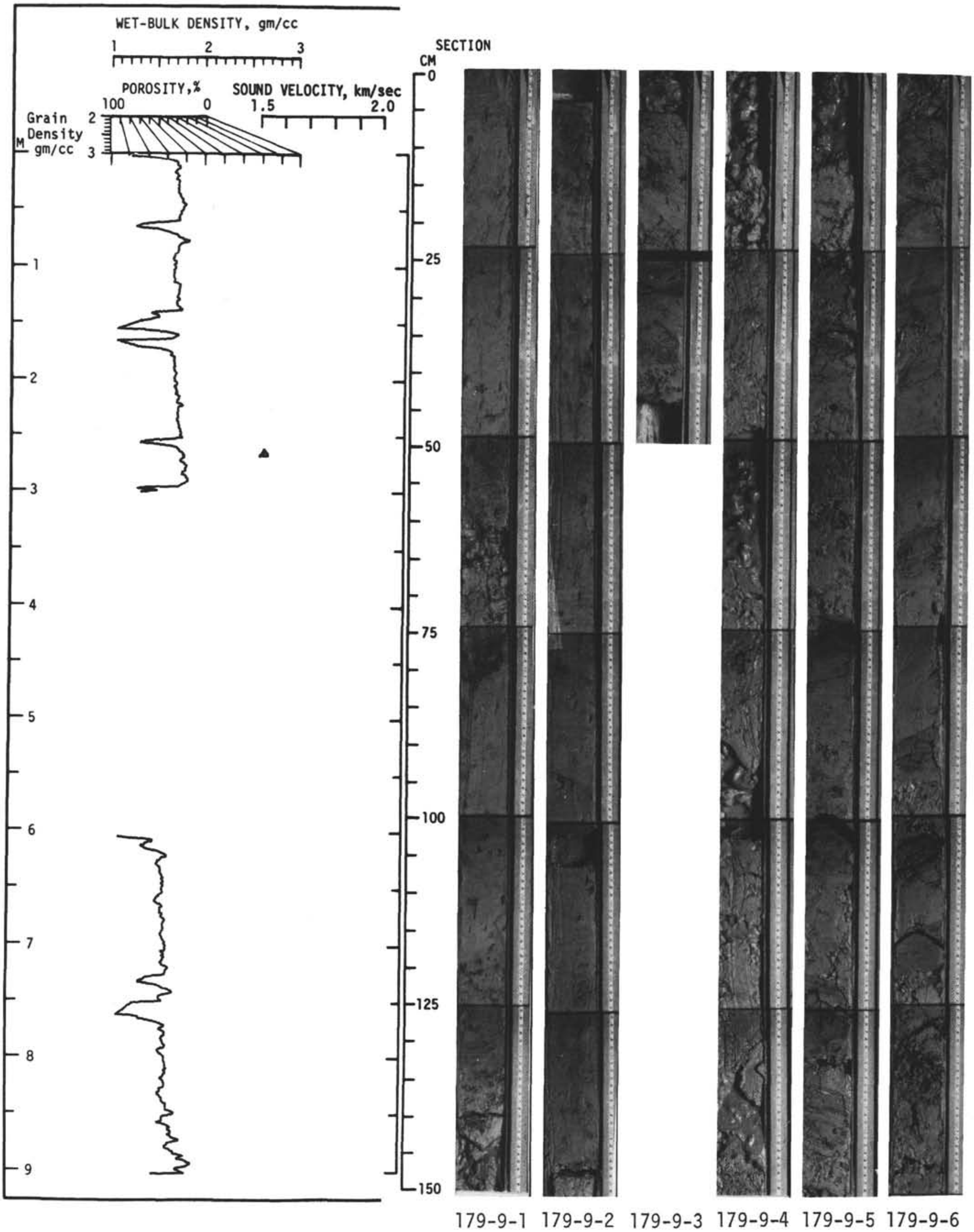
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SOUND VELOCITY, km/sec
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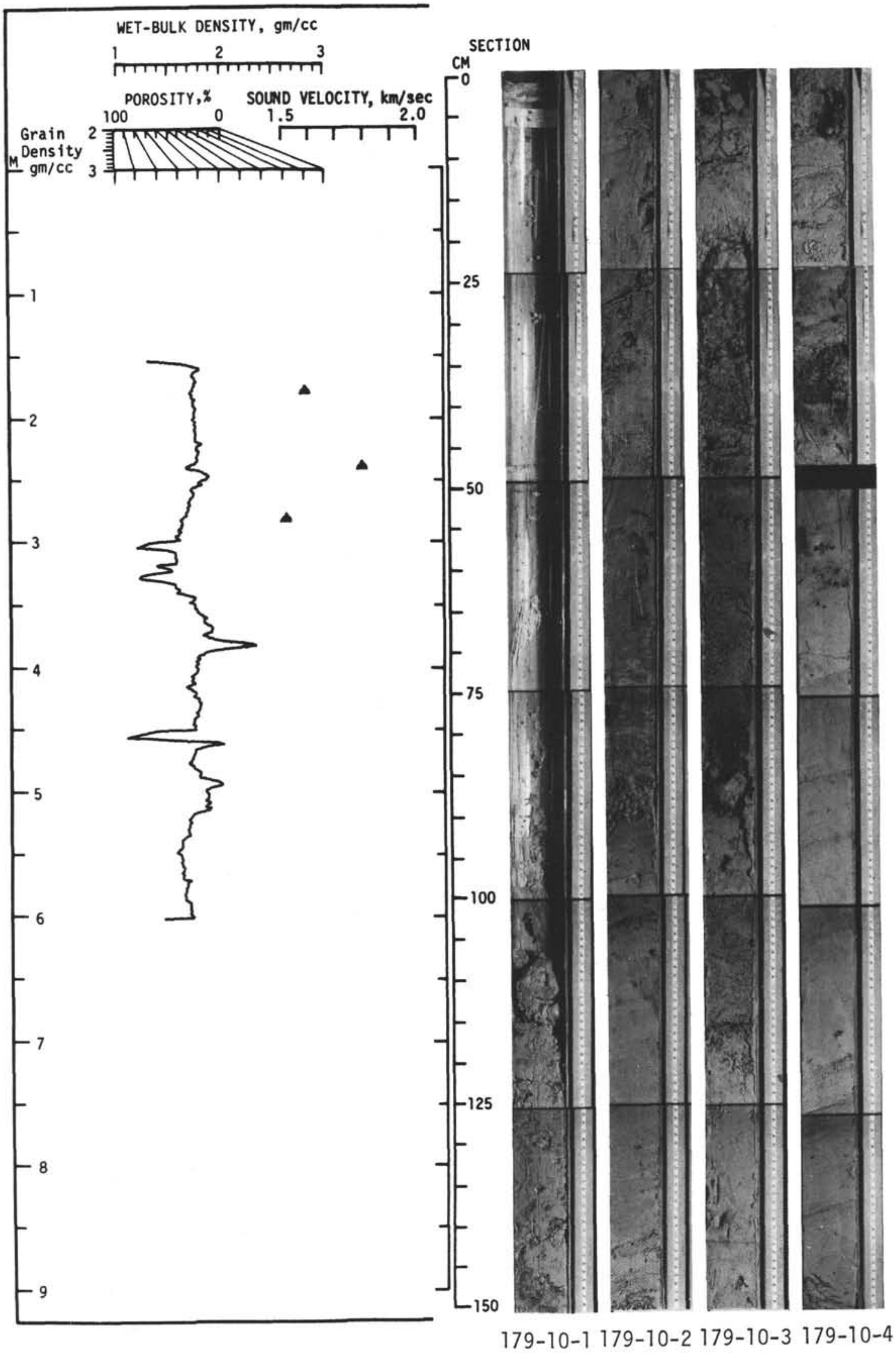
2.0
Grain Density gm/cc
2
3
M
1
2
3
4
5
6
7
8
9
SECTION
CM
0
25
50
75
100
125
150
179-9-1
179-9-2
179-9-3
179-9-4
179-9-5
179-9-6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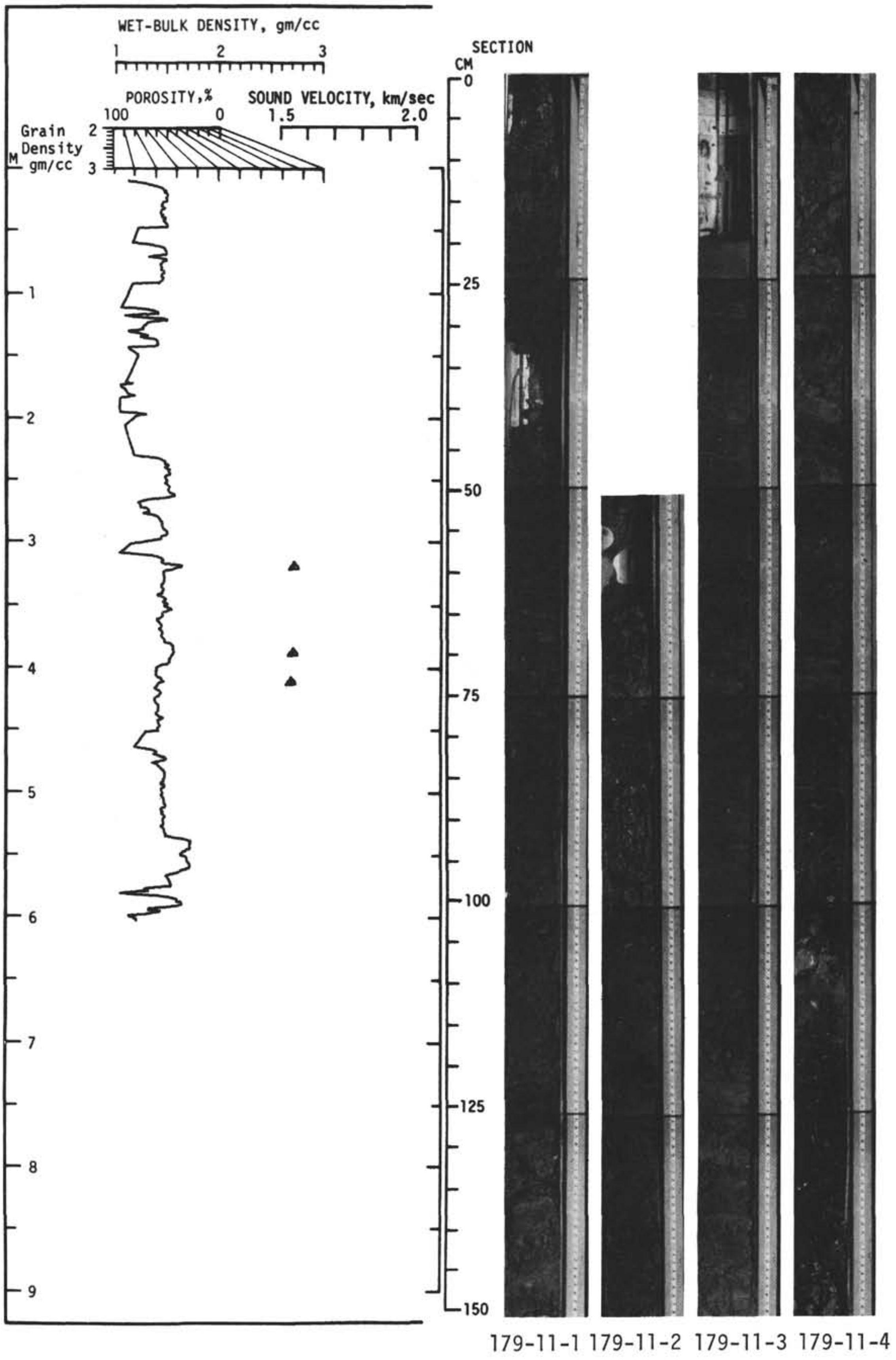
POROSITY,%
100
0
SOUND VELOCITY, km/sec
1.5
2.0
Grain Density gm/cc
2
3
M
1
2
3
4
5
6
7
8
9
SECTION
CM
0
25
50
75
100
125
150
179-10-1
179-10-2
179-10-3
179-10-4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2
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POROSITY,%
100
0
SOUND VELOCITY, km/sec
1.5
2.0
Grain Density gm/cc
2
3
M
1
2
3
4
5
6
7
8
9
SECTION
CM
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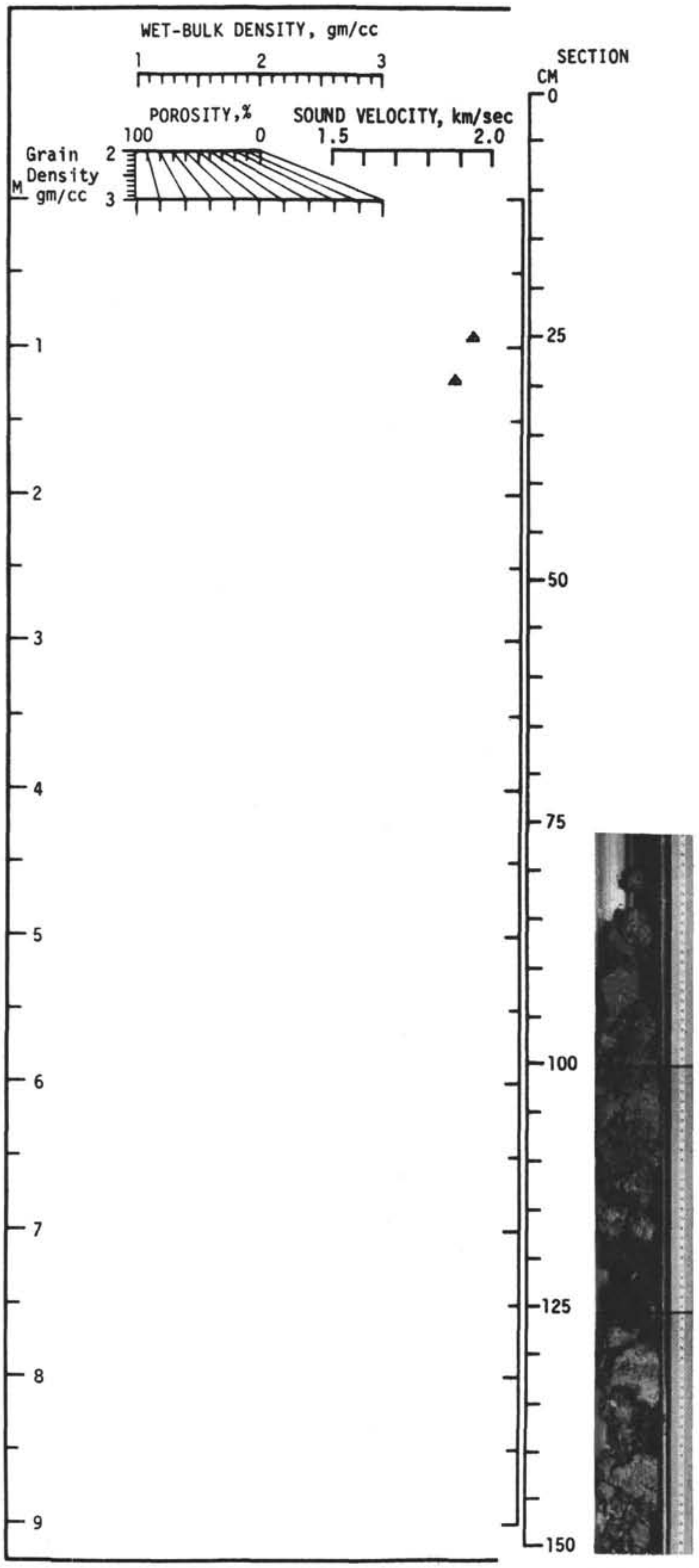
25
50
75
100
125
150
179-11-1
179-11-2
179-11-3
179-11-4


WET-BULK DENSITY, gm/cc
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2
3
POROSITY,%
100
0
SOUND VELOCITY, km/sec
1.5
2.0
Grain Density gm/cc
2
3
M
1
2
3
4
5
6
7
8
9
SECTION
CM
0
25
50
75
100
125
150

179-12-1