10. SITE 299

The Shipboard Scientific Party[1]

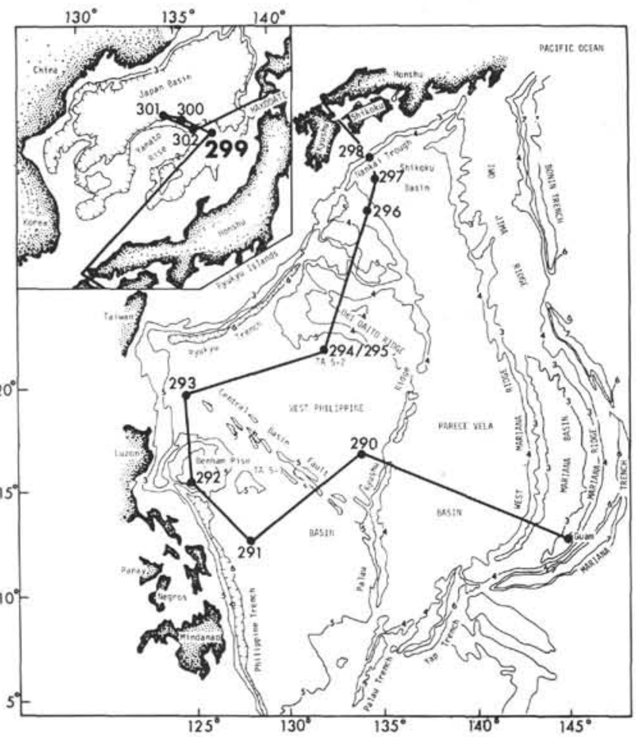

Figure 1. *Location map of DSDP Sites and* Glomar Challenger *track in the Sea of Japan. From map: "Topography" of North Pacific," T. E. Chase, H. W. Menard, and J. Mammerickx, Institute Marine Resources, Geol. Data Center, Scripps Institution of Oceanography, 1971. Contour depths in kilometers. Scale 1:6,500,000.*

SITE DATA

Position: 39°29.69′N; 137°39.72′E

Water Depth (from sea level): 2599 corrected meters (echo sounding)

Bottom Felt At: 2604.5 meters (drill pipe)

Penetration: 532 meters

Number of Holes: 1

Number of Cores: 38

Total Length of Cored Section: 361 meters

Total Core Recovered: 172.3 meters

Percentage of Core Recovery: 47.7%

Oldest Sediment Cored:
Depth below sea floor: 532 meters
Nature: Silty claystone
Age: Early Pliocene

Principal Results: Site 299 was drilled in the northeast Yamato Basin in the Sea of Japan. Penetrated about 475 meters of late Pleistocene through early Pliocene sand, silt, and clay submarine channel overbank deposits representing deposition in the Toyama Trough complex. The underlying 57 meters of clay and siltstone apparently represent early Pliocene distal turbidites deposited as the submarine fan initially transgressed westward.

BACKGROUND AND OBJECTIVES

Background For Sea of Japan Sites

The Sea of Japan constitutes one of the most intensely studied of the many marginal seas rimming the western Pacific. It is commonly viewed as a classic example of a marginal sea fronted by a volcanic arc-trench complex, displaying high heat flow, as well as a large area apparently underlain by oceanic-type crust. The advent of plate tectonics has stimulated several recent reviews of the available geological, geophysical, and paleontological data from the Sea of Japan (Iwabuchi, 1968; Kaseno, 1971, 1972; Ludwig, et al., in preparation). Attempts have also been made to place the origin of the sea within the context of this scheme of crustal evolution and tying the history of the sea to the geological evolution of the Japanese Islands (Karig, 1971; Sleep and Toksoz, 1971; Packham and Falvey, 1971; Hilde and Wageman, 1973; Uyeda and Miyashiro, 1974).

Despite the relative abundance of geological information from the Japanese Islands and a recent flurry of geophysical measurements within the Sea of Japan proper, the age and origin of this feature remain somewhat controversial. The predominant view holds that the sea originated by tensional subsidence and rifting during the Oligocene-early Miocene interval in concert with a major pulse of volcanism represented in part by the well-known green tuff sequences of northern Honshu. The subsequent subsidence and basin-filling phases are thought to be recorded in the mid Miocene through Pleistocene marine sequences exposed in

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northwestern Honshu (Asano et al., 1969) and Korea (Kim, 1965). Thus, evidence for a mid-Tertiary origin of the Sea of Japan has been gleaned primarily from data derived from island geology (Ingle, this volume). The youthful bathymetry of the Sea, together with the fact that no marine sedimentary rocks older than Miocene have been recovered from the sea, lend direct support for this proposed age.

A second, somewhat more speculative, origin for the Sea of Japan involves a proposed proto-sea representing an extensional basin complex formed in the late Mesozoic interval as a function of subduction in an active trench. This would be represented in part by the Shimanto sequence of southeastern Japan (Matsumoto, 1963; Uyeda and Miyashiro, 1974). Marine Cretaceous rocks exposed elsewhere on Honshu, Shikoku, and Hokkaido also include ophiolitic sequences (e.g., Sorachi group) and bathyal turbidites (e.g., Yezo group) reflective of trench or trench-apron deposition. However, there is no direct evidence of Cretaceous marine deposition in the Sea of Japan proper, with only nonmarine Cretaceous deposits present in southern Korea, mainland Asia, and southwestern Japan adjacent to the sea (Matsumoto, 1963). Perhaps late Mesozoic subduction led to early rifting of the continental margin west of the trench, but was not extensive enough to allow marine transgression in this area. Paleogene deposits tell a similar story with coal-bearing nonmarine or littoral marine sequences the rule in western Japan, Kamchatka, and the adjacent Asian mainland (Asano, 1963; Minato et al., 1965). Major subsidence and basin formation then took place later during the mid-Tertiary interval in conjunction with a pulse of subduction along the Japan Trench perhaps initiated by a change in vector of the Pacific plate (Hilde and Wageman, 1973; Uyeda and Miyashiro, 1974).

Proposed Leg 31 drilling sites in the Sea of Japan had the potential for yielding critical data bearing on these types of tectonic questions in terms of establishing basement age and variation of paleobathymetry with time.

Significantly, the paleooceanographic history of the Sea of Japan may well rival the complexity of the tectonic evolution of the sea. In fact, tectonically induced changes in configuration of the sea and adjacent proto-Japanese islands during the later Cenozoic are known to have produced variations in communication between surface waters of the sea and those of the open Pacific based upon the distribution of Neogene marine sediments in the islands (Takai and Tsuchi, 1963). These latter patterns are almost certainly overprinted with variations in planktonic biofacies induced by major Neogene climatic events. For example, modern zoogeographic patterns of planktonic floras and faunas within the Sea of Japan are clearly influenced by both the warm Tsushima Current sweeping subtropical water north along the western coast of Japan, and subarctic water moving south along the western margin of the Sea (Uda, 1934). Biofacies patterns are further enhanced because the sea straddles a mid through high latitude zone (35° to 51°N) encompassing highly contrasting subtropical through subarctic faunas. Quantitative studies of Neogene planktonic faunas from marine strata exposed in northwestern Honshu have already demonstrated, in a preliminary manner, that paleoclimatically induced biofacies variations have occurred in this area (Asano et al., 1969), as have studies of Holocene-Pleistocene foraminiferal and diatom assemblages from the Sea of Japan proper (Ujiié and Ichikura, 1973; Koizumi, 1970). Thus, major biostratigraphic goals in the Sea of Japan included drilling both the eastern and western portions of the sea, establishing detailed correlation with Neogene sequences on the Japanese islands, and analysis of faunal changes with time in terms of major paleoclimatic, paleooceanographic, and tectonic events as they operated to modify surface water character.

The Sea of Japan is roughly divisible into a southeastern area of complex bathymetry characterized by major basins and rises, and a northern and western area of relatively simple but deep bathymetry termed the Japan Abyssal Plain (Figure 1). Two sites were originally planned for the Japan Sea portion of Leg 31 in each of these major areas of the sea; one site in the Yamato Basin and another site in the Japan Abyssal Plain (Japan Basin). Unfortunately, significant shows of ethane gas, caving sands, and a medical emergency caused premature abandonment of the four sites ultimately drilled with the consequence that information bearing on the ultimate age of the sea was not obtained. Nevertheless, Sites 299, 301, and 302 provide new and important information concerning the later Neogene history of this marginal sea.

Objectives

Site 299 was located in an extension of the Toyama Trough within the northeastern Yamato Basin of the Japan Sea utilizing *Vema*-28 (LDGO) seismic records (Figures 1 and 2). These same records along with *Glomar Challenger* records (Figures 3 and 4) indicate that this portion of the basin is underlain by at least 500 meters of turbidite deposits and an equal thickness of pelagic sediment. Acoustic basement does not appear to represent basalt and may represent a volcaniclastic sequence equivalent to the early Miocene green tuffs of Honshu. The upper seismic sequence appears similar to the Neogene sedimentary column exposed in northwestern Honshu where Pleistocene through late Miocene turbidites overlie late to middle Miocene diatomaceous shales and mudstones (Asano et al., 1969). The prime objective at Site 299 was the recovery of a fossil-rich section containing a relatively undisturbed, if somewhat telescoped, record of Neogene paleontologic and sedimentologic events manifest in these much studied, thicker, and deformed Neogene deposits exposed in northwestern Honshu. In addition, it was hoped that drilling would allow dating of acoustic basement thought to represent a hard sedimentary unit perhaps correlative with the Daijima nonmarine deposits or early Miocene green tuffs.

OPERATIONS

Site 299, in the northwest corner of the Yamato Basin, lay along a *Vema* seismic reflection profile (*Vema*-28, 2076-1500) which showed the large Toyama Channel 20

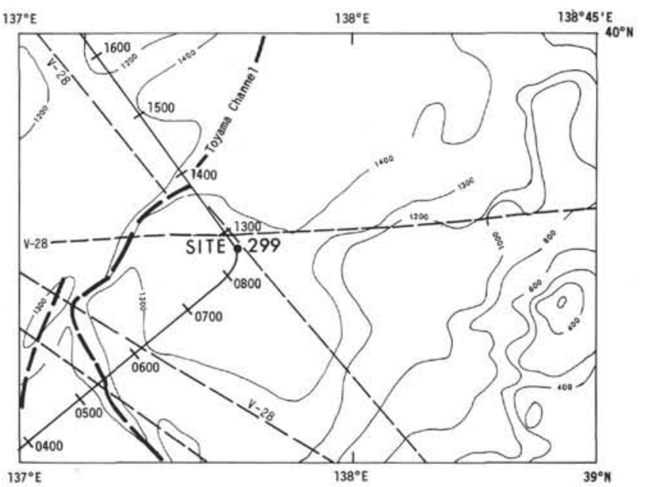

Figure 2. *Bathymetry in vicinity of Site 299 (in uncorrected fathoms) updated from Chase and Menard (1969) using* Glomar Challenger *and LDGO (*Vema-*28) data. Toyama Channel is located using these two data sets and data from Hilde et al. (1969). Heavy* Vema-*28 track line is illustrated in Figure 4.*

km to the west and a thickening sediment section to the east (Figure 2). It was hoped to penetrate the edge of the flat-lying acoustic basement, which was probably sedimentary, and to bottom in the rougher, possibly igneous basement which appears beneath the western edge of the Yamato Basin (Figures 3, 4). Because the profiling system was not capable of penetrating to the basement at 1.3 sec, we steamed to the position indicated on the LDGO profile on a course of 051°, and at 1610 LCT, 26 July, slowed to 6 knots in a futile attempt to record basement. A 13.5-kHz beacon was dropped on the first pass over the site, but it failed to transmit a usable signal. A second, 16-kHz beacon was then dropped 1 km further along the same track, which functioned normally.

The drill string was lowered and the hole spudded in 2604 meters at 2300 LCT, 26 July. The drilling began with a continuous coring program, but a very high rate of sedimentation, very poor fossil content, and increase of coarser turbidites in which recovery was quite poor, led to interval coring beginning at 247 meters (Table 1). Continuous coring was to be resumed again in the underlying pelagic section. However, gas in small quantities, but with falling methane/ethane ratios, began appearing beyond Core 33 (418 m). The ratio decreased to approximately 2×10^{-3} in Cores 36 to 38, and considering the safety standards used to abandon Holes 271 and 272 on DSDP Leg 28, the decision was made to pull out of the hole. To prevent possible fluid escape, the hole was filled with 150 barrels of heavy mud and capped with 40 barrels of cement. The mudline was cleared at 2100 LCT, 28 July, and the ship was underway toward Site 300.

LITHOLOGY

Site 299 was drilled through a series which can be interpreted from bathymetric and sediment data as a submarine canyon fan complex. A distinct lack of

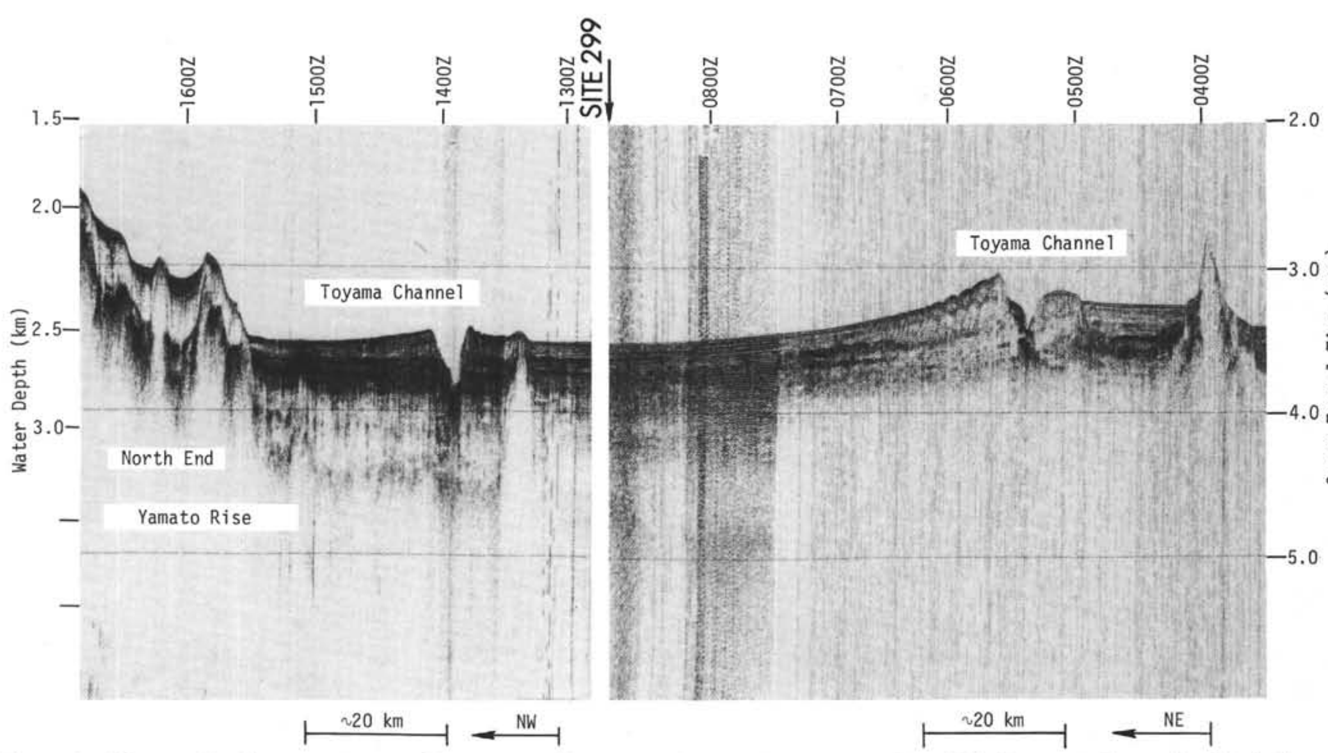

Figure 3. Glomar Challenger *seismic reflection profile approaching and departing Site 299. Toyama Channel with its levees and overflow deposits is crossed twice.*

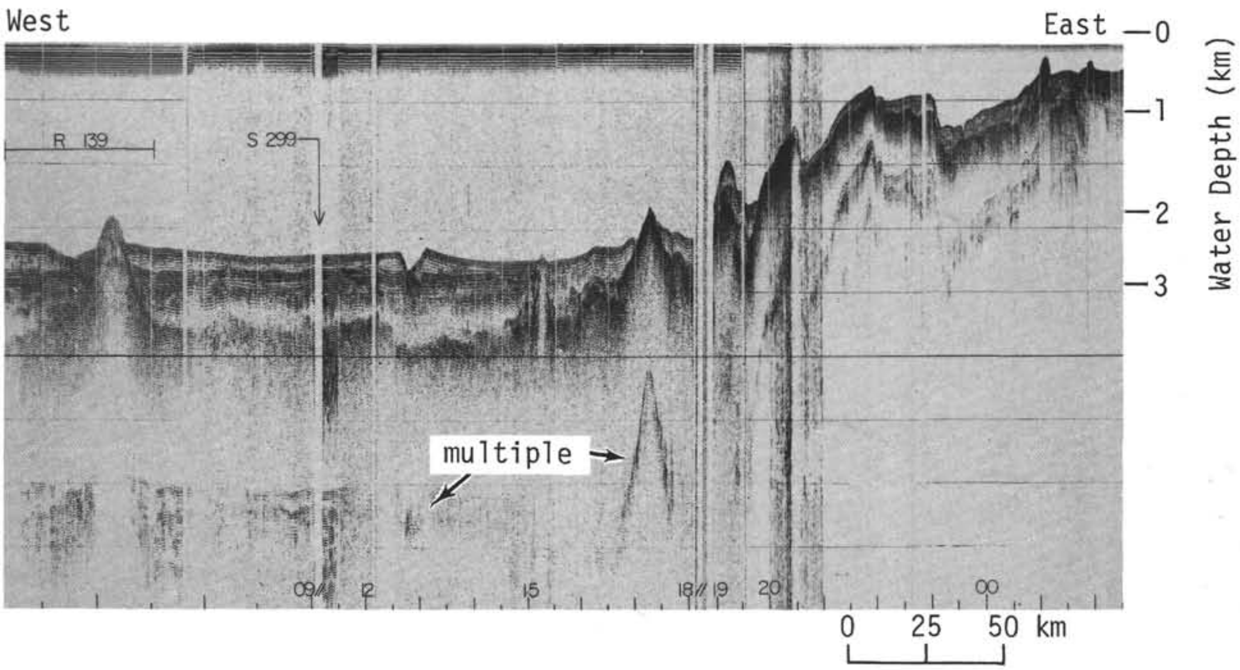

Figure 4. Vema-*28 (Lamont-Doherty Geological Observatory) seismic reflection profile across the Toyama Trough. This profile shows the configuration of acoustic basement, which is probably not basalt.*

lithological changes prevents a breakdown into units. However, various stages of depositional events can be distinguished in this lateral and vertical migrating complex of fan-channel, levee, and overbank deposits (Figures 5, 6). The stages are transitional to one another in three dimensions. An alternative interpretation, that of basinal turbidites, is also presented in Figure 6.

The major lithologies are a clayey silt and a silty clay, with various intercalations of more sandy or more clayey deposits noted. Volcanic ash layers as well as sediment layers with a noticeable carbonate content were observed.

Sedimentation Stage 1A (Cores 1 to 8, 0-76 m)

This group of cores consists primarily of alternating beds of clayey silt and silty clay. A few clayey sand and clay beds were observed, as well as some volcanic ash beds and clay oozes. Feldspar, quartz, and clay minerals form the bulk of the sediment constituents, with minor amounts of mica, heavy minerals, spherical micronodules, volcanic glass, glauconite, unidentified carbonate, nannofossils, diatoms, and sponge spicules.

Little study could be made of sedimentary characteristics due to coring disturbances, but Cores 1 and 5 present enough data to establish a sedimentary cycle (Table 2). However, no pattern could be observed on the thickness ratios between these minor lithological and color divisions.

Two interpretations concerning the depositional conditions are presented in Figure 6. Although these sediments may be called distal turbidites, it is more logical to interprete them as proximal overbank deposits on a submarine fan. When the bottom division (Table 2) is light brown in color (5YR 6/1), it consists of laminated sandy clays with a high foraminifera content. Some of the laminations present more evidence for bottom traction and some winnowing effects that fall out from a suspension.

Sedimentation Stage 1B (Cores 9 to 15, 76-142.5 m)

The main difference between this sedimentation stage and the overlying one is an increase in the amount of sand beds in a downward direction. The cyclic scheme (Table 2) seems to change, but core disturbance prevents good observations. The colors are also less spectacular.

The presence of sand beds favors the interpretation of channel deposits over proximal outer fan sediments (Bouma, 1973). It is not possible to tell if these sands are from a channel axis, or from channel sides. The lateral shifting of channels normally results in gradational and abrupt vertical changes (Nelson and Kulm, 1973).

Sedimentation Stage 2 (Cores 16 to 20, 142.5-190 m)

Sandy laminae or beds are absent, and the lithology is dominated by alternations of slightly sandy silt, clayey silt, and silty clay. Coring disturbance is moderate to intense, but some indistinct graded bedding was observed, underlain by distinct contacts.

The alternating lithologic character leads to an interpretation of these deposits as levee accumulations. The possibility exists, however, that an interpretation as distal-like turbidites close to proximal ones may be correct.

Sedimentation Stage 3 (Cores 21 to 25, 190-237.5 m)

Only clayey silts and silty clays were observed in this sedimentation stage. Feldspar, clay minerals, quartz, and volcanic glass form the bulk of the detrital minerals. Some of the indurated clays show slight fissility.

TABLE 1
Coring Summary, Site 299

Core	Cored Interval Below Bottom (m)	Cored (m)	Recovered (m)	Recovered (%)	Remarks[a]
1	0.0-9.5	9.5	9.5	100	Punch core
2	9.5-19.0	9.5	6.3	66	
3	19.0-28.5	9.5	4.8	51	
4	28.5-38.0	9.5	5.2	55	
5	38.0-47.5	9.5	7.5	79	
6	47.5-57.0	9.5	6.7	71	
7	57.0-66.5	9.5	5.6	59	
8	66.5-76.0	9.5	3.1	33	
9	76.0-85.5	9.5	7.5	79	
10	85.5-95.0	9.5	6.1	64	
11	95.0-104.5	9.5	9.1	96	
12	104.5-114.0	9.5	6.6	69	
13	114.0-123.5	9.5	7.0	74	
14	123.5-133.0	9.5	7.2	76	
15	133.0-142.5	9.5	6.9	73	
16	142.5-152.0	9.5	5.5	58	
17	152.0-161.5	9.5	4.8	51	
18	161.5-171.0	9.5	4.7	49	
19	171.0-180.5	9.5	6.9	73	
20	180.5-190.0	9.5	4.1	43	
21	190.0-199.5	9.5	1.3	14	
22	199.5-209.0	9.5	5.1	54	
23	209.0-218.5	9.5	1, CC	0	
24	218.5-228.0	9.5	1.7	17	
25	228.0-237.5	9.5	1.0	11	
26	237.5-247.0	9.5	1.5	16	
Wash	247.0-256.5				
27	256.5-266.0	9.5	0.0	0	
Wash	266.0-275.5				50 bbls mud
28	275.5-285.0	9.5	0.9	9.0	
Wash	285.0-294.5				
29	294.5-304.0	9.5	0.5	5.0	
Wash	304.0-323.0				
30	323.0-332.5	9.5	7.5	79.0	
Wash	332.5-351.5				
31	351.5-361.0	9.5	2.7	28.0	
Wash	361.0-399.0				
32	399.0-408.5	9.5	1.9	20.0	
Wash	408.5-418.0				
33	418.0-427.5	9.5	2.7	28.0	
Wash	427.5-437.0				
34	437.0-446.5	9.5	0.3	3.0	
Wash	446.5-475.0				
35	475.0-484.5	9.5	3.0	32.0	
Wash	484.5-494.0				50 bbls mud
36	494.0-503.5	9.5	5.6	59	
Wash	503.5-513.0				
37	513.0-522.5	9.5	3.4	36	
38	522.5-532.0	9.5	8.1	85	
Total	532.0	361.0	172.3	48.0	

The fine-grained lithologic nature may indicate overbank deposits on a submarine fan (Nelson and Kulm, 1973), rather than to the distal end of distal turbidites.

Sedimentation Stage 4 (Cores 26 to 29, 237.5-315 m)

The sediments of this stage are comparable to those of Stage 2. Clayey silts, silty clays, silty sands, and sandy silts are the dominant lithologies. Only Core 26 contains diatom-rich clays. The following sedimentary cycle could be observed in less-disturbed sections (from bottom to top): olive-gray (5Y 4/1) silt—greenish-gray (10YR 4/2) silty clay—bluish-green (5G 4/1) slightly silty clay. Bottom contacts of these cycles are distinct, and a general upward grading was noted.

The sediments of this sedimentation stage are interpreted as inner levee deposits in the lower half, gradually becoming outer levee deposits in an upward direction. This is based on the presence of diatoms, assuming more or less quiet water conditions. The sediments can also be classified on their lithological aspects as distal turbidites.

Sedimentation Stage 5 (Cores 30 to 35, 315-488 m)

Silty clay and clayey silt-type sediments with a few volcanic ash and carbonate interbeddings characterize the lithology. Faint irregular laminae, lenses, lenticular laminae, and bioturbation were observed. This sedimentation stage is comparable to Stage 3. Due to its fine-grain size and bioturbation, it is thought to represent a slow accumulation rate. The mineralogy does not differ from overlying sedimentation stages, which indicates the same source supplied the sediment cored at this site.

The sediments of this stage are interpreted as outer overbank deposits, but at the same time show similarities to distal turbidites.

Sedimentation Stage 6 (Cores 36 to 38, 488-532 m)

The sediments of this stage differ lithologically from the overlying sedimentation stages. Characteristic are the alternating thin and medium bedded claystones, slightly silty clays, and volcanic ash beds. Some of the ash beds reveal graded bedding, foreset and parallel lamination, indicating bottom traction. The clayey beds sometimes have a high zeolite content. In Core 38, Section 3 a 70-cm-thick slump zone occurs overlying a sand. The sands normally are not cemented, and sedimentary structures are disrupted by the coring process.

The deposits from this sedimentation stage are the most difficult to interpret. The high clay content favors outer levee sedimentation. The sand may be an interruption, such as a point bar. The presence of gas makes a submarine fan area more likely than outer proximal turbidites.

Lithologic Interpretations

The lithologic characteristics of the sediments at Site 299, together with a few distinguishable sedimentary structures, favor a complex submarine fan environment over outer proximal and distal turbidites. Transport mechanisms in a fan area vary between extremes and encompass slumping, debris flow, channelized bottom currents, bottom traction, and hemipelagic/pelagic deposition. The hole location also makes it possible that the sediment series started with distal turbidites that overlie undifferentiated clays (cf Site 293). The turbidites then become more proximal, and finally fan deposits accumulated. The proximity of a deep channel may preclude real turbidity current throughways, in which case all sediments indicate a fan complex.

The mineralogy is rather similar throughout the cored sequence which indicates that all sediment arrived from one source, presumably a southern one.

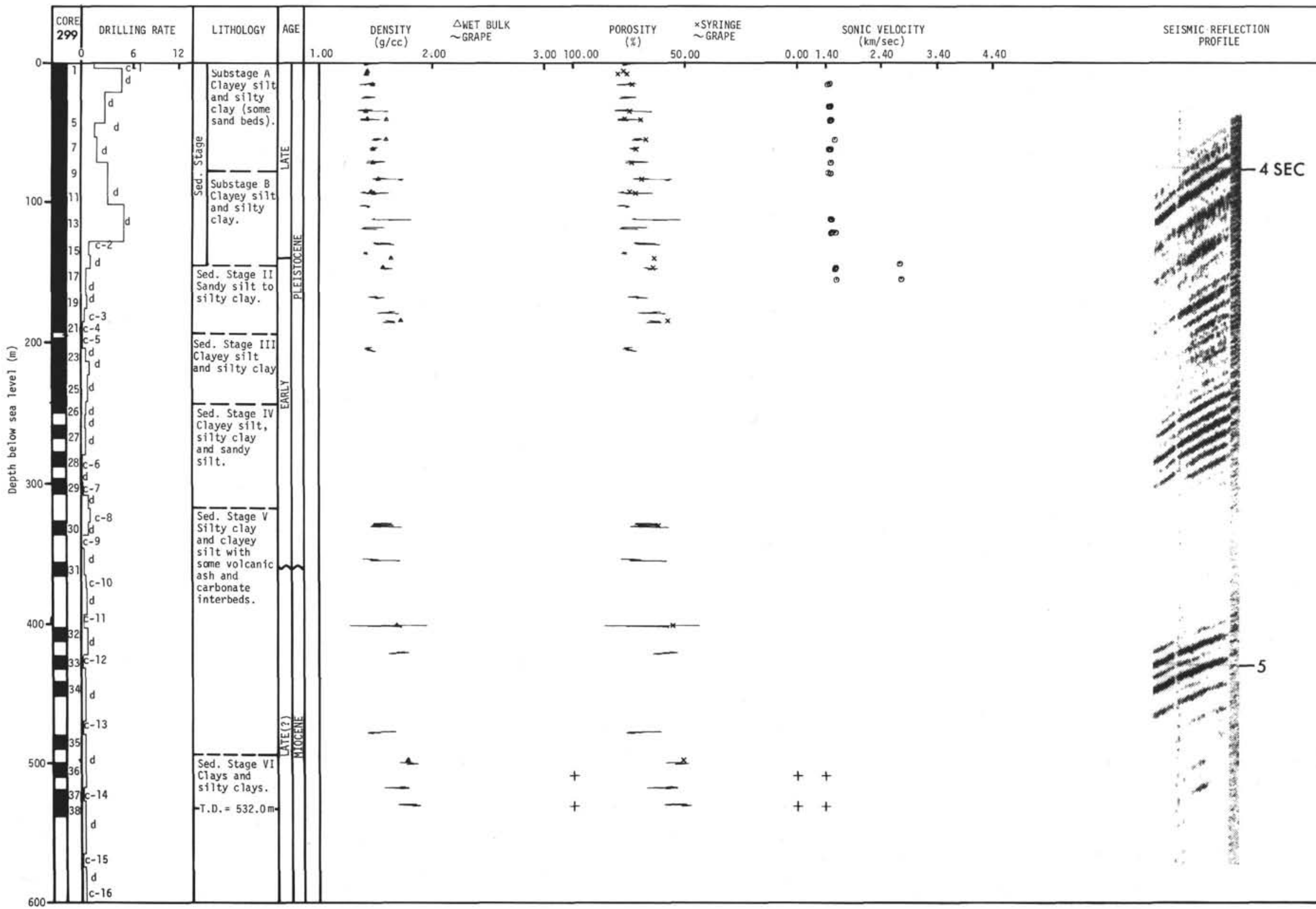

Figure 5. *Hole summary diagram, Site 299.*

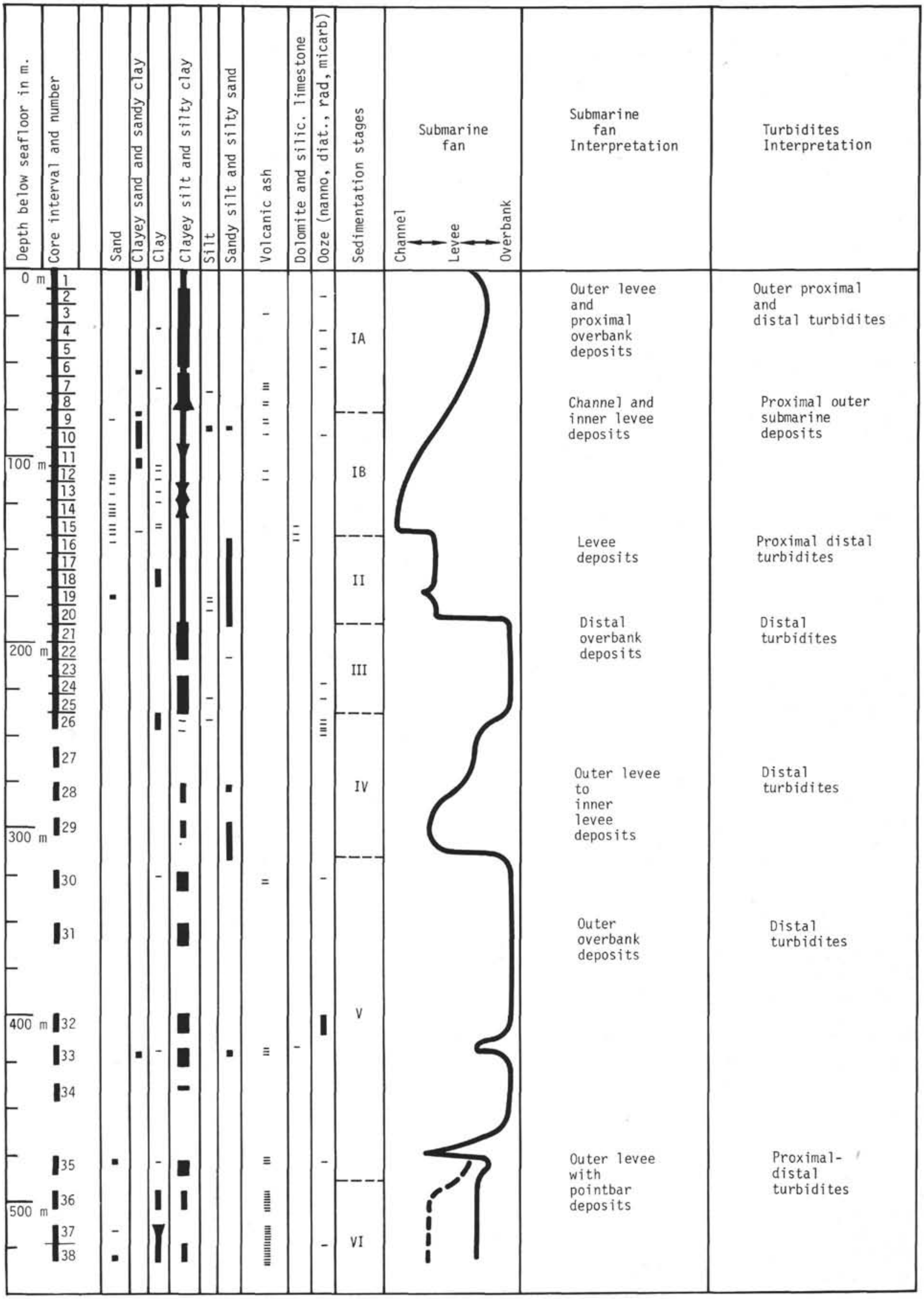

Figure 6. *Lithologic summary and interpretations, Site 299.*

TABLE 2
Sedimentary Cycle Observed in Sedimentation Stage 1A, (Cores 1-8)

Top:	light green-gray (5G 7/1) clay dusky green (5G 3/2) very slightly silty "dry" clay greenish-gray (5G 5/1) slightly silty clay olive-gray (5Y 5/1) very silty clay light olive-black (5Y 3/1) sandy-silty clay
Bottom:	olive-black (5Y 2/1) or light brownish-gray (5YR 6/1) clayey sand with thin parallel lamination and micrograded bedding.

Note: Contacts between the divisions normally are vague to transitional.

PHYSICAL PROPERTIES

Bulk Density, Porosity, and Water Content

The GRAPE density and porosity measurements show only very slight increases and decreases downhole. The gassy nature of the cores from the lower portion of the hole is probably the major factor lowering their measured density. Cores dominated by sand give relatively high density values (see Figure 5, 100-200 m). The densities and porosities determined by the syringe method generally show trends similar to densities and porosities determined by the GRAPE.

Vane Shear

Vane-shear measurements were taken from Cores 2 to 20. The data show a reasonably well-defined trend to 60 meters, but they are scattered below 80 meters. This range of measurements is probably due to drilling deformation and small-scale variations in consolidation/lithification occurring below 80 meters. Further discussion will be found in Bouma and Moore (this volume).

Sonic Velocity

Sonic velocities were measured from Cores 2 through 17 as the material permitted. At greater depths the rocks included many small fractures which made accurate measurements impossible. The sonic-velocity data show a gradual increase from about 1.5 km/sec to about 1.6 km/sec to a depth of 160 meters. The anomalously high velocities (~5 km/sec) observed in Core 15 are due to a localized clastic limestone. The data are presented in Table 3 and in Figure 5.

TABLE 3
Sonic Velocity Measurements, Site 299

Sample (Interval in cm)	Depth in Hole (m)	Velocity (km/sec)
2-4, 40.0	14.40	1.487
2-4, 100.0	15.00	1.452
4-2, 23.0	30.23	1.496
4-2, 57.0	30.57	1.469
4-2, 79.0	30.79	1.493
5-2, 134.0	40.84	1.491
5-2, 109.0	40.59	1.511
5-2, 70.0	40.20	1.500
6-5, 88.0	54.38	1.577
7-3, 110.0	61.10	1.491
7-3, 140.0	61.40	1.501
8-3, 125.0	70.75	1.510
8-3, 134.0	70.84	1.506
9-2, 54.0	78.04	1.465
9-2, 104.0	78.54	1.509
12-5, 35.0	110.85	1.506
12-5, 60.0	111.10	1.511
12-5, 89.0	111.39	1.524
13-5, 43.0	120.43	1.531
13-5, 69.0	120.69	1.598
13-5, 111.0	121.11	1.511
15-5, 150.0	140.50	5.249
16-1, 51.0	143.01	2.745
16-3, 19.0	145.69	1.601
16-3, 61.0	146.11	1.268
16-3, 115.0	146.65	1.590
17-2, 51.0	154.01	2.770
17-2, 76.0	154.26	1.612

Thermal Conductivity

Thermal conductivity was measured by the needle-probe method in the least-disturbed section of each core. The results are summarized in Table 4 and on Figure 7.

Thermal conductivity values decrease from the surface to a depth of 60 meters and gradually increase below 60 meters. At depths greater than 100 meters, the sediment was gassy and fractured. Since the gas and the fractures, which generally lessen apparent thermal conductivity, increased with depth, there is a possibility that the undisturbed thermal conductivity values might increase more rapidly from at least 100 meters. However, the measurements were made carefully on selected and least-disturbed parts on the cores.

GEOCHEMICAL MEASUREMENTS

Alkalinity, *p*H, and salinity measurements are summarized in Table 5.

Alkalinity

The average alkalinity of eight samples is 16.39 meq/kg. All values are higher than the surface seawater reference value of 2.22 meq/kg. The highest values occurring are: 28.92 for Core 10, Section 4 and 27.37 for Core 20, Section 2. Two cores—Core 32, Section 1 and Core 36, Section 2—show significant lower values of 6.55 and 2.54, respectively.

TABLE 4
Thermal Conductivities Measured at Site 299

Sample (Interval in cm)	Hole Depth (m)	Thermal conductivity (10^{-3} cal/cm sec °C) Needle Probe	Average	From Water Content
1-4, 40	5	1.81	1.77	
1-4, 110	6	1.73		1.86 ±0.10
2-4, 40	14	1.75	1.85	
2-4, 110	15	1.94		1.97 ±0.11
4-4, 50	32	1.61	1.62	
4-4, 120	32	1.63		1.89 ±0.11
5-2, 40	40	1.66	1.61	2.14 ±0.12
5-2, 110	41	1.56		
6-5, 50	56	1.86	1.86	2.18 ±0.13
6-5, 120	57	1.86		
7-3, 40	60	1.53	1.48	
7-3, 110	61	1.42		2.00 ±0.11
8-3, 40	70	1.49	1.49	
8-3, 110	71	1.48		1.97 ±0.11
9-5, 40	85	1.56	1.58	2.09 ±0.11
9-5, 90	86	1.59		
10-5, 32	92	1.79	1.88	
10-5, 113	93	1.97		2.01 ±0.11
11-5, 28	101	1.83	1.83	
12-5, 26	111	1.92	1.98	
12-5, 121	112	2.05		
13-5, 37	120	1.90	1.82	
13-5, 100	121	1.74		
16-3, 32	146	2.03	2.05	2.22 ±0.13
16-3, 106	147	2.07		
17-2, 46	154	2.34	2.05	
19-2, 72	154	1.75		
20-3, 23	184	2.28	2.22	
20-3, 104	185	2.16		

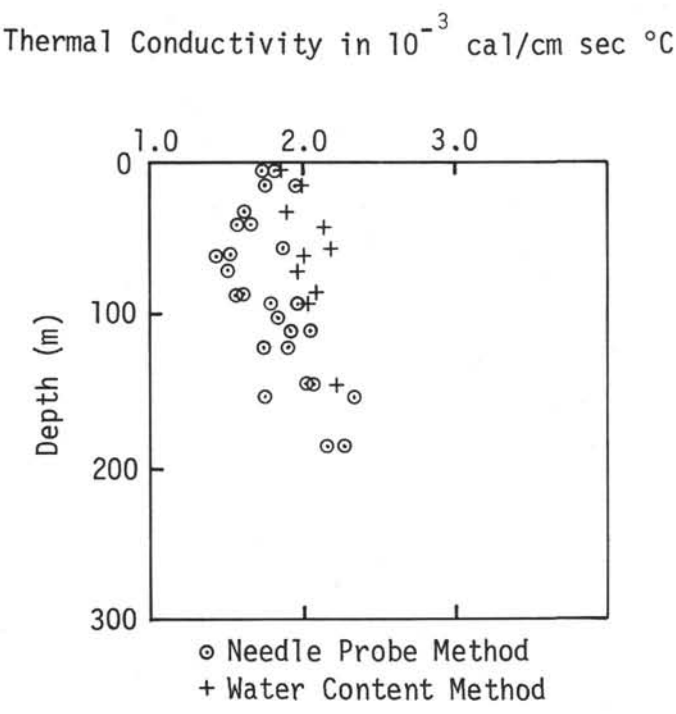

Figure 7. *Thermal conductivity ($\times 10^{-3}$ cal/cm sec °C) versus depth, Site 299.*

pH

The average *p*H values in the cores obtained by punch-in and flow-through methods were all below that of the seawater reference at the site (8.04 and 8.12). The five punch-in *p*H values averaged 7.49, while the eight flow-through values averaged 7.88. The most noticeable change in flow-through *p*H is the decrease from Core 5 to Core 15 (8.27 to 7.53) and the increase from Core 15 to Core 20 (7.53 to 7.99). These trends correspond to similar alkalinity trends reported for these cores.

Salinity

Eight salinity measurements averaged $32.6^{0}/_{00}$. A fairly definite increase in salinity with depth is noticed, except for some variability between Cores 15 and 32. All eight values and their average were below the overlying seawater reference value of $34.4^{0}/_{00}$.

PALEONTOLOGIC SUMMARY

Introduction

The Sea of Japan represents a much cooler zoogeographic province than the Philippine Sea, and, as expected, diatoms and silicoflagellates played a major role in biostratigraphic determinations at Site 299 as well as at other sites in this area. The presence of calcareous nannofossils, planktonic foraminifera, and radiolarians is sporadic. Foraminifera are completely absent from sediments below Core 18 (165 m), with the exception of one productive sample in Core 31 (353.5 m). Both calcareous and siliceous microfossils are absent in Cores 32 through 38 (399-532 m). The entire sequence penetrated is thought to be no older than early Pliocene.

A late Pleistocene age for Core 1 through a portion of Core 10 (0-95 m) was determined on the basis of diatom zonation. A horizon correlative with the Jaramillo Event (0.9 m.y.B.P.) is thought to occur at the base of Core 10 (95 m) based on correlations with Donahue (1970). This same horizon is nearly coincident with a change in dominant coiling of the planktonic foraminifer "*Globigerina*" *pachyderma* from sinistral to dextral, marking the base of the intense period of refrigeration associated with the late Pleistocene.

Scattered calcareous nannofossil floras suggest Cores 1 through 8 (0-76 m) are Holocene-late Pleistocene in age (*Emiliani huxleyi* Zone), with Cores 9 through a portion of Core 15 (76-136 m) included in the remainder of the late Pleistocene.

Diatom zonation indicates that the Pliocene-Pleistocene boundary occurs within the base of Core 17 (158-161 m). Silicoflagellate zonation is somewhat less precise, but does suggest that this same boundary occurs within the interval represented below Core 13, but above Core 15. Calcareous nannofossil floras, within Cores 15 through 30 (133-332.5 m), lack discoasters suggesting an early Pleistocene age. The absence of these important index fossils in sediments at this latitude is apparently not a definitive criterion for the division of Pliocene and Pleistocene units; in addition, samples from cores through this interval contain the early Pleistocene

TABLE 5
Summary of Shipboard Geochemical Data, Site 299

Sample (Interval in cm)	Depth Below Sea Floor (m)	*p*H Punch-in	*p*H Flow-through	Alkalinity (meq/kg)	Salinity (°/₀₀)	Lithologic Units
Surface seawater reference		8.04	8.12	2.22	34.4	
1-5, 144-150	7.5	7.56	8.27	10.17	33.3	Sedimentation
5-1, 144-150	39.5	7.46	7.55	22.29	32.2	Stage 1A
10-4, 144-150	91.5	7.42	7.88	28.93	32.4	Sedimentation
15-4, 144-150	139.0	7.18	7.53	20.14	33.0	Stage 1B
20-2, 144-150	183.5	7.82	7.94	27.37	32.7	Sedimentation Stage 2
30-4, 144-150	329.0	–	7.99	13.10	32 2	Sedimentation
32-1, 144-150	400.5	–	7.92	6.55	33.0	Stage 5
36-2, 144-150	497.0	–	7.98	2.54	31.9	Sedimentation Stage 6
Average		7.49	7.88	16.39	32.6	

species *Gephyrocapsa caribbeanica*. Calcareous nannofossils are completely absent from Cores 30 through 38 (323-532 m).

Variations of temperature-sensitive species of diatoms and planktonic foraminifera at Site 299 clearly record a number of significant oscillations of surface temperature in the Sea of Japan during this period.

Calcareous Nannofossils

The generally poor state of preservation as well as the paucity of nannofossil forms (except for the youngest assemblages) reflect the influence of cold-water currents encroaching upon this portion of the Sea of Japan from the north. Only the Pleistocene nannofossil zones can be recognized with any confidence, as no discoasters were recovered from the older samples.

Samples from Cores 1 through 8 contain abundant, well-preserved specimens indicative of Holocene-late Pleistocene *Emiliania huxleyi* Zone. Cores 9 through 15, Section 2 contain rare to few, poorly to moderately preserved specimens displaying low species diversity which can best be referred to the late Pleistocene *Gephyrocapsa oceanica* Zone.

Samples from Core 15, Section 4, and Cores 16, 17, 18, 22, 23, 26, and 30 also contain rare, poorly preserved specimens. However, the presence of *Gephyrocapsa caribbeanica* and the absence of *G. oceanica* suggest that these samples belong in the early Pleistocene *G. caribbeanica* Subzone.

The remaining samples from Site 299 are either barren of nannofossils, or the recovered specimens are not significant for age determination.

Foraminifera

Moderate to well-preserved foraminifera are present in varying abundances in Cores 1 through 18 at Site 299. Significantly, all samples in Cores 19 through 38 (base of hole) proved to be barren of foraminifera, with the single exception of a Pliocene sample Core 31, Section 2. Dominant planktonic foraminifera include *Globigerina bulloides* (and varieties), "*Globigerina*" *pachyderma*, and *Globigerina quinqueloba*, representing a characteristic subarctic-cool temperate biofacies common to the cooler water masses of the North Pacific today (Bradshaw, 1959). All of these assemblages are assigned a Pleistocene age, but precise zonal assignment is precluded due to the absence of critical warm-water index species. However, *Globigerina bulloides umbilicata* is present within this sequence and may ultimately prove of value in differentiating Pleistocene and Holocene sediments in light of its apparent absence in modern cool-water biofacies in this region. A major shift from dominantly dextral to dominantly sinistral coiling within populations of "*Globigerina*" *pachyderma* occurs in Core 10, Section 3 and is interpreted as the initiation of the intense period of refrigeration associated with the later or "glacial" Pleistocene. This has been dated as 0.9 to 0.7 m.y.B.P. elsewhere in the North Pacific.

Scattered benthonic species occur within the fossiliferous Pleistocene sequence, and these faunas are dominated by littoral, shelf (neritic), and upper bathyal species displaced downslope via turbidity currents and debris flows.

The abrupt and essentially complete loss of foraminiferal tests in Cores 19 through 38 may be related to anaerobic bottom conditions induced by climatic and tectonic control of sill depths with the Sea of Japan. Abundant framboidal pyrite is found within these same sediments, lending some support to this hypothesis.

Radiolarians and Silicoflagellates

Among the 38 samples examined, radiolarian abundance ranges from few to rare, and nearly one-third of the samples are barren of this group of microfossils.

It is interesting to note that although the site may be presently located under the regime of the Tsushima Current (a branch of the warm-water Kuroshio in the western Pacific), Core 1 contains *Stylochlamydium venustum*, *Triceraspyris* (?) spp., and others which are generally found in surface sediments north of the so-called subarctic boundary in the Pacific Ocean and in the Bering and Okhotsk seas. Furthermore, no warm-temperature species are present in this sample.

Samples from sediments of Cores 2 through 29 which range in age from Pleistocene to Pliocene and radiolarians of either contain long-ranging species or rare occurrence of guide forms. The sequence from Core 30 through Core 38 is essentially barren of radiolarians.

Diversified and relatively abundant silicoflagellate assemblages were encountered, in contrast to the paucity of radiolarians. Silicoflagellate zonation at Site 299 can be compared with the zonation proposed by Ling (1973) for adjacent areas of the North Pacific: Cores 1 through 4, Section 2 are included within the *Distephanus octangulatus* Zone. The sediments in Core 8 through at least Core 13 belong to the *Distephanus subarctius* Zone. However, it should be noted that there is an interval prior to the initial appearance of *Distephanus subarctius*, and subsequent to the youngest occurrence of *Ammodochium rectangulare*, which likely corresponds to the Pliocene-Pleistocene boundary. The *Ammodochium rectanglare* Zone is tentatively assigned to sections through Sample 19, CC. Silicoflagellates were completely absent in Cores 30 through 38.

Diatoms

The Pliocene-Pleistocene species, *Actinocyclus ochotensis*, *Coscinodiscus excentricus* var. *leasareolatus*, *Denticula seminae*, *Nitzschia reinholdii*, and *Rhizosolenia curvirostris*, occur throughout Cores 1 through 30. These species are accompanied by many sublittoral and freshwater species and some reworked specimens of mainly Miocene age: *Actinocyclus ingens*, *Coscinodiscus lewisianus*, and *Denticula lauta*.

Based on diatom analysis, the Plio-Pleistocene boundary is placed between Core 17, Section 4 and Sample 17, CC, because of the occurrences of *Pseudoeunotia dolidus* in Core 17, Section 4 and *Thalassiosira antiqua* in Sample 17, CC.

The beginning of the "glacial" or late Pleistocene is reflected in diatom assemblages recovered from Core 10 where many warm-water species such as, *Hemidiscus cuneriformis*, *Nitzschia fossilis*, and *Pseudoeunotia dolidus*, disappear or are very scarce.

Core 35 is characterized by a simple assemblage consisting of *Coscinodiscus marginatus* and *Denticula kamtschatica*. Strata on land containing these forms are classified as late Miocene in age according to Japanese stratigraphic custom based on planktonic foraminifera and Radiolaria. However, according to the equatorial diatom zonation by Burckle (1971, 1972) and in the eastern Pacific by Schrader (1973), as well as current investigations being conducted jointly with paleomagnetic stratigraphy, the age of these species may be as young as early Pliocene.

SUMMARY AND INTERPRETATIONS

Summary

Site 299 was drilled in the northwest portion of the Yamato Basin, one of a series of elongate basins forming pocked bathymetry in the southern half of the Sea of Japan. A very clear *Vema* 28 (LDGO) seismic record across this area displays a 1.3-sec thick sedimentary section divisible into an upper unit of reflective character assumed to be turbidite deposits derived from a nearby distributary channel emanating from the Toyama Trough (Figures 2 and 4). *Glomar Challenger* GDR trace and underway seismic records illustrate (Figure 3) that Site 299 is situated on the eastern flank of the fan of debris sloping gently away from this channel system. An acoustically transparent layer underlies these coarse deposits and is assumed to represent diatom-rich pelagic sediments based on gross correlation with Neogene marine sections exposed on adjacent northwest Honshu (Figure 3). Acoustic basement in this area consists of a relatively smooth reflector most likely representing a hard sedimentary unit perhaps correlative with the nonmarine Daijima deposits or well-known green tuffs exposed on Honshu Island, and an underlying rougher surface perhaps indicative of basalt. *Glomar Challenger* records essentially duplicated this seismic picture as did an on-site sonobuoy survey, however, neither of these records penetrated to acoustic basement in contrast to the *Vema* 28 records (Figure 3).

Drilling in Hole 299 penetrated a 532-meter thick series of Holocene/late Pleistocene through early Pliocene sediments representing various depositional phases within the debris cone emanating from the Toyama Trough, and easily correlated with the upper reverberating acoustic unit. This section was sampled in 38 cores and is divisible into six subunits (Sedimentation Stages 1A through 6). The subunit division is based on sedimentary characteristics allowing identification of outer levee and proximal overbank deposits, channel and inner levee deposits, and outer overbank deposits all associated with the developing and migrating system of distributary channels and fan of the Toyama Trough (Bouma, this volume). Lithologies are predominantly clayey silt and silty clay, with scattered clayey sands, clay beds, clayey oozes, and volcanic ashes. Thin horizons of concentrated foraminiferal tests contain high percentages of benthonic species displaced from littoral and neritic depths providing direct evidence of the source and distance of transport of these sediments from the insular shelf and slope of Honshu. Bedded clays appear near the bottom of the hole, and correlation with the on-site sonobuoy record indicates this unit is near the base of the turbidite reflector and just above the transparent unit throught to represent pelagic (diatomaceous) deposits of Miocene age.

Unfortunately, steadily increasing amounts of ethane gas were detected in the hole beginning at 142 meters, with critical values reached between 494 and 532 meters forcing abandonment of this site for reasons of safety and pollution prevention. Thus, two of the primary of objectives at this site, basement age and pelagic sedimentary history, were not achieved. It is significant to note that the highest ethane gas shows occurred within horizons just above the presumed diatom-rich pelagic unit, a likely source for generation of hydrocarbons especially when coupled with the high heat flow in the Japan Sea (Yasui, et al., 1968), and capping sediments containing alternating sands and clays. In fact, a thicker but similar lithologic sequence is the target for oil exploration and production in coastal northwest Honshu (Ingle, this volume).

Planktonic foraminifera, calcareous nannoplankton, radiolarians, silicoflagellates, and diatoms all occur within the younger portion of the sequence drilled, with all groups characterized by a dominance of boreal species. However, calcareous benthonic and planktonic foraminifera are absent in sediments below Core 18 (165 m) with the exception of Core 31, and siliceous microfossils are absent below Core 32 (399 m). Primary biostratigraphic control at the site is based on diatoms, with the entire sequence thought to be no older than early Pliocene. Variations in abundance and character of planktonic foraminifera and diatoms are utilized to define Pleistocene sea-surface temperature fluctuations.

Interpretations

The 532 meters of early Pliocene through Pleistocene sands, silts, and clays penetrated provide a detailed history of the development and outbuilding of the distributary channel-fan system of the Toyama Trough as it has proceeded to fill the northwest portion of the Yamato Basin over the past 4-5 m.y. This same process has been duplicated in other adjacent basins in this portion of the Japan Sea, with those basins nearest the strandline filled and deformed in the latest Pleistocene, whereas others, including the Yamato Basin farther from the strandline, are still in the process of filling.

A gross division of the sediments at Site 299 into dominantly distal and dominantly proximal turbidite deposits (or alternately channel-levee deposits versus overbank deposits) can be made conveniently near the Plio-Pleistocene boundary. Sedimentation rates within these two intervals varies by a factor of almost 2, with the Pliocene distal fan deposits accumulating at a rate of about 125 m/m.y. (Figure 8) in the preglacial early Pleistocene, whereas the sustained interval of eustatically lowered sea level initiated in the glacial late Pleistocene (900,000 B.P.) resulted in a sedimentation rate of about 115 m/m.y. (Figure 8). Presumably, lowered sea level allowed more direct and greater transport of debris to the basins from exposed shelf margins during this latter period. The exaggerated rate of Pliocene deposition may reflect basic differences in the nature of deposition of overbank deposits versus channel and levee deposition, as well as reflecting episodes of climatic refrigeration and change of sea level.

The early Pliocene deposits are characterized by the initial stages of the deposition of fan deposits as they encroached westward across pelagic sediments of the Yamato Basin. The oldest of these sediments recovered are characterized by increasing percentages of pelagic debris containing common diatom frustules indicative of the transition with the underlying but unsampled pelagic unit. Extrapolation of the estimated rate of sedimentation suggests the Miocene-Pliocene boundary (5 m.y.) occurs about 55 meters below the base of Hole 299, essentially coincident with the top of the pelagic unit.

Correlation of the limited section drilled at Site 299 with the standard marine section exposed on northwestern Honshu suggests that the Plio-Pleistocene sequence encountered in the Yamato Basin roughly corresponds to the Shibikawa (Pleistocene), Wakimoto (Pleistocene), and Kitaura (Pliocene) formations of the Oga Peninsula (Ingle, this volume). The latter section exceeds 1500 meters in thickness, and is composed principally of turbidite sands and shales deposited at depths exceeding 1500 meters during the Pliocene through Pleistocene interval. The same interval of time at Site 299 is represented by only 532 meters of generally finer sediments deposited in a similar manner, but at a much greater distance from the Neogene strandline.

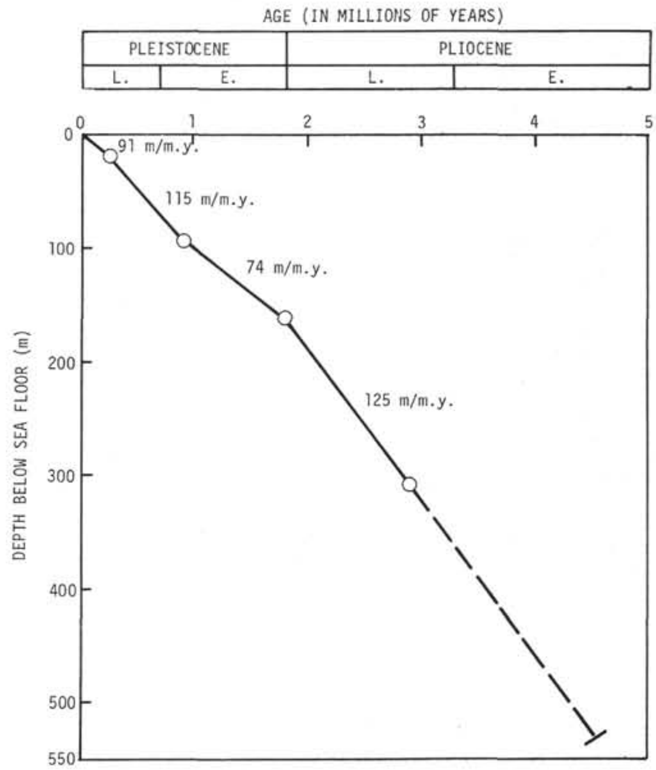

Figure 8. *Estimated rate of sedimentation at Site 299 based on correlation of the radiometric and paleomagnetic time scales with high latitude diatom zonation (Koizumi, this volume). Note that extrapolated Pliocene-Miocene boundary (5 m.y.B.P.) occurs approximately 55 meters below base of Hole 299.*

Planktonic faunas encountered provide important information on the variation of sea-surface temperatures in this portion of the Japan Sea during the later Pliocene and Pleistocene. The subarctic and arctic character of both calcareous and siliceous microfossils within late Pleistocene sediments indicate that sea-surface temperatures were well below those prevailing today in this same area. A change from dominantly dextral to dominantly sinistral coiling populations of the planktonic foraminifer "*Globigerina*" *pachyderma* occurs at 89 meters (Core 10) clearly marking the initiation of severe cooling associated with the late Pleistocene elsewhere in the Pacific (Ingle, this volume; 1973), and commonly dated as 0.9 m.y. (Hays and Berggren, 1971; Berggren and van Couvering, in press).

The abrupt and complete loss of calcareous foraminiferal tests in Cores 19 through 38 may well be related to either effects of the relatively shallow CCD in the Japan Sea (Ujiié and Ichikura, 1973), and/or anaerobic bottom conditions induced by climatic and tectonic control of sill depths of the sea. Framboidal pyrite is common in these same deposits which also suggests anaerobic bottom conditions. The present extremely shallow sill depths of the Japan Sea (Kaseno, 1971), and the certainty of major drops in sea level of 130 to 150 meters during glacial maxima, dictate that the sea was isolated during Plio-Pleistocene periods of intense refrigeration. This refrigeration in turn created a somewhat unusual biological, geochemical, and sedimentologic environment (Miyake et al., 1968; Niino, et al., 1969; Ujiié and Ichikura, 1973).

In contrast, the character of earlier preglacial Pleistocene faunas implies that surface temperatures during this period approached those prevailing today for significant lengths of time, but with a general deterioration of the warm northward-flowing Tsushima Current toward the late Pleistocene as the Tsushima Straits were closed for increasingly lengthy intervals via lowered sea level.

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APPENDIX A
Summary of X-Ray, Grain Size, and Carbon-Carbonate Results, Site 299

Section	Sample Depth Below Sea Floor (m)	Lithology[a]	Age	Bulk Sample Major Constituent			2-20μm Fraction Major Constituent			<2μm Fraction Major Constituent			Grain Size			Classification	Carbon Carbonate			Comments
				1	2	3	1	2	3	1	2	3	Sand (%)	Silt (%)	Clay (%)		Total (%)	Organic (%)	$CACO_3$ (%)	
299-2-4	15.0	Unit 1A	Late										1.0	39.0	60.1	Silty clay	1.3	0.4	7	
299-6-5	54.4-54.5	Clayey silt & Silty clay	Pleistocene to	Quar.	Mica	Plag.	Quar.	Mica	Plag.	Mica	Quar.	Plag.	2.3	43.4	54.3	Silty clay	0.5	0.3	2	Dolo. in bulk, (1.8%) Pyri. in bulk (1.7%); 2-20μm (2.6%).
299-6-5	54.7-54.8		Holocene	Quar.	Mica	Plag.	Quar.	Plag.	Mica	Mica	Quar.	Plag.	2.8	47.6	49.6	Silty clay	6.0	3.1	25	Pyri. in bulk, 2-20μm, <2μm (7.8, 10.1, 6.6%).
299-9-3	80.4	Unit 1B	Early										89.8	7.1	3.1	Sand				
299-9-5	82.5-82.7	Clayey silt and silty clay w/ sand beds	to late Pleistocene	Quar.	Plag.	Mica	Plag.	Quar.	K-Fe.	Mont.	Quar.	Mica	10.7	83.0	6.3	Silt	1.3	1.0	3	Pyri. in bulk 2-20 <2μm (3.5%, 5.7%, 3.4%); Kaol. in bulk (3.5%) 2-20μm (3.1%) <2μm (6.1%).
299-9-5	83.0												17.4	71.3	11.3	Sandy silt				
299-9-5	83.2												20.9	65.7	13.4	Sandy silt				
299-9-5	83.3												26.2	59.8	14.0	Sandy silt				
299-9-5	83.4												26.5	64.7	8.8	Sandy silt				
299-12-3	108.2												12.4	59.8	27.8	Clayey silt				
299-13-4	118.5																1.7	0.4	10	
299-13-4	119.3												0.7	35.7	63.6	Silty clay				
299-14-4	128.7-128.8												0.5	27.8	71.6	Silty clay	0.7	0.5	2	
299-15-4	137.6-137.7												2.0	56.1	41.9	Clayey silt	0.6	0.5	1	
299-15-5	139.7												66.9	19.5	13.6	Silty Sand				
299-16-2	144.4	Unit 2	Early										86.6	9.6	3.9	Sand				
299-16-3	145.7	Sandy silt	Pleistocene										2.1	60.4	37.5	Clayey silt	1.1	0.8	2	
299-16-3	146.2	silty sand											4.6	37.5	57.9	Silty clay				
299-17-4	157.0	Clayey silt											18.8	30.8	50.4	Silty clay				
299-18-4	166.9	silty clay		Quar.	Plag.	Mica	Quar.	Plag.	K-Fe.	Mont.	Quar.	Mica	0.3	54.6	45.0	Clayey silt	0.6	0.5	1	Clin. in <2μm (1.3%).
299-18-9	174.4												0.2	56.3	43.5	Clayey silt				
299-19-4	176.3												0.3	56.6	43.1	Clayey silt				
	176.3												1.1	90.1	8.8	Silt				
299-20-1	181.3												11.3	84.9	3.9	Silt				
299-20-1	181.4												0.4	57.0	42.6	Clayey silt				
299-24-1	219.4	Unit 3	Early										0.4	43.8	55.8	Silty clay	1.5	1.2	2	
299-26-1	238.5	Clayey silt and silty clay	Pleistocene	Quar.	Plag.	Mica	Quar.	Plag.	K-Fe.-Mica	Mont.	Quar.	Mica	0.1	50.7	49.2	Clayey silt				Pyri. in bulk, 2-20μm, <2μm (3.0, 3.7, 2.5%).
299-33-2	419.7-420.4	Unit 5 Silty clay &	Late Miocene	Quar.	Mica	Plag.	Quar.	Mica	Plag.	Mica	Mont.	Quar.	48.5	40.1	11.4	Silty sand	1.1	0.8	2	Pyri. in bulk (1.2%) Clin. in 2-20μm (1.6%).
299-35-1	475.9	Clayey silt w/ash	to ?										81.7	12.2	6.1	Sand				
299-36-4	499.4	Unit 6	?										0.6	68.9	30.5	Clayey silt				
299-36-4	499.4	Clays, silty											1.5	26.0	72.4	Silty clay				
299-38-1	523.6	clays and vol. ash		Mont.	Quar.	Mica	Quar.	Plag.	Mica	Mont.	Quar.	Mica	1.1	29.7	69.2	Silty clay	1.4	0.9	5	Pyri. in bulk (2.7), 2-20μm (4.0%) Clin. in bulk (2.7%) 2-20μm (4.2%).

Note: Complete results X-ray, Site 299, will be found in Part V, Appendix I. X-ray mineralogical legend in Appendix A, Chapter 2.

[a]Units are sedimentation stages; see lithology report, Site 299.

Site 299 Hole Core 1 Cored Interval: 0.0-9.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE-HOLOCENE	Emiliania huxleyi / Denticula seminae (D) / Distephanus octangulatus (S)	Cg	B, B, Rg	Rm, Rm, Fm, Rm	Cm	1, 2, 3, 4, 5, 6, Core Catcher	0.5, 1.0	GEOCHEM SAMPLE		*02 *16 *25, * CC	Sed. Stage 1A; 5G 6/1 with 5Y 4/1; 5YR 6/1; 5GY 4/1

Dominant color: greenish gray (5G 6/1) with olive gray (5Y 4/1) and light brown gray (5YR 6/1) in cyclic bedding. Intense-moderate drilling deformation, medium-thin bedded; some parallel laminations; micro-graded bedding in Sections 5 and 6.

SILTY CLAY
Smears: 1-02; CC

Texture	Composition
73-75% Clay	50-58% Clay minerals
25% Silt	15% Feldspar
2- 5% Sand	3-12% Volcanic glass
	5-10% Quartz
	2- 5% Carbonate (micarb)
	2% Heavy minerals
	1- 3% Pyrite
	1- 3% Diatoms
	1- 3% Radiolarians
	1% Mica
	1% Foraminifera
	Tr- 3% Glauconite
	Tr- 1% Sponge spicules
	Tr% Silicoflagellates

FORAM-RICH CLAYEY SILT
Smear: 1-16

Texture	Composition
67% Silt	40% Quartz, feldspar
30% Clay	20% Carbonate
3% Sand	15% Clay minerals
	10% Foraminifera
	7% Pyrite
	5% Micronodules
	1% Heavy minerals
	1% Glauconite
	1% Radiolarians
	Tr% Mica
	Tr% Diatoms
	Tr% Nannofossils
	Tr% Sponge spicules

VOLCANIC ASH
Smear: 1-25

Texture	Composition
75% Sand	76% Volcanic glass
20% Silt	10% Feldspar
5% Clay	5% Quartz
	5% Pyrite
	3% Heavy minerals
	1% Carbonate (micarb)
	Tr% Mica
	Tr% Diatoms
	Tr% Radiolarians
	Tr% Sponge spicules

Explanatory notes in chapter 1

Site 299 Hole Core 2 Cored Interval: 9.5-19.0 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE-HOLOCENE	Emiliania huxleyi / Denticula seminae (D) / Distephanus octangulatus (S)	Rp	Cp, B, Cm	Rm, Rm, Fm, Rm		1, 2, 3, 4, 5, Core Catcher	0.5, 1.0	VOID; VOID		* 100, * CC	5YR 6/1, 5G 6/1, 5Y 4/1 color base; 5GY 4/1

Colors as bedding: light brown gray (5YR 6/1) greenish gray (5G 6/1) and olive gray (5Y 4/1). Intense-moderate drilling deformation; turbidites(?)= color bedding, order: light brown, light green, dark green, light brown.

SILTY CLAY
Smear: CC

Texture	Composition
65% Clay	52% Clay minerals
30% Silt	21% Feldspar
5% Sand	5% Quartz
	5% Volcanic glass
	3% Diatoms
	3% Carbonate (micarb)
	3% Pyrite, opaques
	3% Heavy minerals
	2% Radiolarians
	1% Nannofossils
	1% Glauconite
	1% Mica
	Tr% Foraminifera

FORAM-RICH SILTY CLAY
Smear: 4-100

Texture	Composition
70% Clay	38% Clay minerals
25% Silt	25% Carbonate (micarb)
5% Sand	15% Foraminifera
	10% Quartz
	5% Pyrite, opaques
	3% Heavy minerals
	3% Feldspar
	1% Volcanic glass
	Tr% Mica
	Tr% Glauconite
	Tr% Radiolarians
	Tr% Sponge spicules

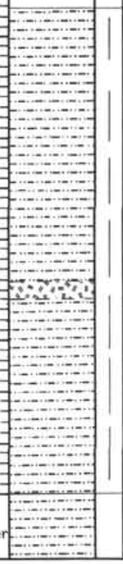
Grain Size 4-101
1.0, 39.0, 60.1

Carbon Carbonate 4-97
1.3, 0.4, 7

Explanatory notes in chapter 1

Site 299 Hole Core 3 Cored Interval: 19.0-28.5 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE	Emiliania huxleyi; Rhizosolenia curvirostris (D) Distephanus octangulatus (S)		B	Rm		1	0.5, 1.0	VOID			
						2					5GY 4/1
						3				*92	5GY 6/1
			B	Rm		4					5GY 4/1
		Rg	Fm	Fm	Cm, Fm	Core Catcher				*CC	5GY 4/1



Intensely disturbed; varigated with dominant colors in dark greenish grays (5GY 4/1); bedding variable with disturbed sand pockets.

SILTY CLAY
Smear: CC

Texture	Composition
65% Clay	46% Clay minerals
25% Silt	15% Feldspar
10% Sand	10% Pyrite
	7% Diatoms
	5% Carbonate (micarb)
	5% Quartz
	3% Nodules
	3% Heavy minerals
	2% Radiolarians
	1% Sponge spicules
	1% Silicoflagellates
	1% Mica
	1% Glauconite
	Tr% Zeolite
	Tr% Foraminifera

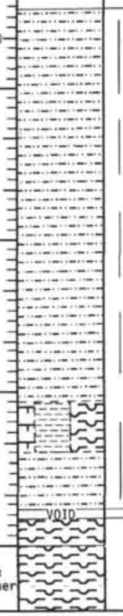
VOLCANIC ASH
Smear: 3-92

Texture	Composition
50% Silt	82% Volcanic glass
39% Clay	10% Feldspar
11% Sand	5% Quartz
	2% Heavy minerals
	1% Glauconite

Explanatory notes in chapter 1

Site 299 Hole Core 4 Cored Interval: 28.5-38.0 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE	Emiliania huxleyi; Rhizosolenia curvirostris (D) Distephanus octangulatus (S)			Fm	Rm	1	0.5, 1.0	VOID			
			B			2					base cycle; 5YR 4/1; 5YR 6/1; base cycle; 5GY 6/1; 5G 6/1
						3					base cycle
			B	Fm	Fm	4		VOID		*75	5G 6/1; 5YR 4/1; 5YR 6/1; 5GY 6/1
		Rm	Fm	Fm	Cg, Rm	Core Catcher				*CC	5GY 4/1



Variagated brownish gray (5YR 4/1), light brown gray (5YR 6/1), greenish gray (5GY 6/1), light greenish gray (5G 6/1); intense to moderate drilling deformation; layers 3-6 cm. *Distal turbidite-like (green-browns).*

SILTY CLAY

FORAM-RICH CLAYEY DIATOM OOZE
Smear: 4-45

Texture	Composition
50% Clay	50% Diatoms
40% Silt	30% Foraminifera
10% Sand	9% Quartz
	5% Pyrite
	2% Mica
	2% Heavy minerals
	2% Glauconite
	Tr% Radiolarians
	Tr% Sponge spicules

DIATOM OOZE
Smear: CC

Texture	Composition
67% Clay	85% Diatoms
30% Silt	5% Quartz, feldspar
3% Sand	3% Radiolarians
	2% Opaques
	2% Sponge spicules
	1% Mica
	1% Heavy minerals
	1% Foraminifera

Explanatory notes in chapter 1

Site 299 Hole Core 5 Cored Interval: 38.0-47.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO-DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE	Emiliania huxleyi Rhizosolenia curvirostris (D)					1	0.5 1.0	GEOCHEM SAMPLE			Intense-moderate drilling disturbance - color interbedding: olive black (5Y 2/1) = 1; greenish gray (5GY 6/1) = 2; olive gray (5Y 6/1) = 3; pumice fragments; color cycle: light green, green, olive, brown, yellow brown.
			B	B	Rm	2				* 32	5Y 2/1 5GY 6/1 5Y 6/1
						3		VOID			
						4		VOID			
				B	Cm						
			B			5					
		Cg	Fm	Cm	Cg Fm	Core Catcher					5GY 6/1

SILTY CLAY
Smear: 2-32

Texture	Composition
70% Clay	56% Clay minerals
25% Silt	15% Pyrite, opaques
5% Sand	10% Quartz
	7% Glauconite
	5% Carbonate (micarb)
	2% Heavy minerals
	2% Feldspar
	1% Mica
	1% Volcanic glass
	1% Sponge spicules
	Tr% Diatoms
	Tr% Radiolarians

Explanatory notes in chapter 1

Site 299 Hole Core 6 Cored Interval: 47.5-57.0 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO-DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE	Emiliania huxleyi Rhizosolenia curvirostris (D)					1	0.5 1.0	VOID			Moderate drilling deformation; color variations are olive gray (5Y 4/1), brownish gray (5YR 4/1), moderate yellow brown (10YR 5/4), and greenish gray (5G 6/1); turbidites.
			B	B	Rm	2					base cycle 5Y 4/1 5YR 4/1 10YR 5/4 5G 6/1
						3					base cycle
			Ag	Cg	Rm	4					5Y 4/1 5YR 4/1 10YR 5/4 5G 6/1
						5					base cycle base cycle
		Ag	Am	Rm	Cm Rm	Core Catcher					5G 6/1

SILTY CLAY

Grain Size 5-86	Grain Size 5-123
2.3, 43.4, 54.3	2.8, 47.6, 49.6

Carbon Carbonate 5-89
0.5, 0.3, 2

Carbon Carbonate 5-126
6.0, 3.1, 25

X-ray 5-83 (Bulk)	X-ray 5-121 (Bulk)
41.4% Quar	32.5% Quar
23.9% Mica	24.7% Mica
19.9% Plag	16.9% Plag
5.6% Chlo	7.8% Pyri
3.4% K-Fe	5.7% Calc
2.3% Mont	4.9% K-Fe
1.8% Dolo	4.2% Chlo
1.7% Pyri	3.2% Mont

Explanatory notes in chapter 1

Site 299 Hole Core 7 Cored Interval: 57.0-66.5 m

AGE: LATE PLEISTOCENE

ZONE: *Rhizosolenia curvirostris* (D)

FOSSIL CHARACTER (FORAMS / NANNOS / RADS / SILICO. DIATOMS): Am Cm; B; Rm B; B; Rg B Rm Cm Fm

SECTION: 1, 2, 3, 4, Core Catcher

METERS: 0.5, 1.0

LITHOLOGY: VOID

LITHO. SAMPLE: *37, *112, *115

LITHOLOGIC DESCRIPTION

Moderate-intense drilling deformation; color variations are olive gray (5Y 4/1), brownish gray (5YR 4/1), moderate yellow brown (10YR 5/4), greenish gray (5G 6/1); distal-like turbidites; bedding thickness variable, parallel lamination and indistinct graded bedding.

5YR 4/1

5G 6/1

5Y 4/1

varigated colors

SILTY CLAY
Smear: 3-115

Texture	Composition
56% Clay	34% Clay minerals
54% Silt	30% Carbonates
1% Sand	18% Feldspar
	4% Opaques
	4% Sponge spicules
	4% Radiolarians
	2% Quartz
	2% Diatoms
	1% Heavy minerals
	1% Volcanic glass

ASH-RICH SILTY CLAY
Smear: 2-37

Texture	Composition
74% Silt	30% Feldspar
25% Clay	27% Clay minerals
1% Sand	10% Quartz
	10% Volcanic glass
	5% Heavy minerals
	5% Glauconite
	3% Diatoms
	3% Pyrite, opaques
	2% Radiolarians
	2% Carbonate (micarb)
	1% Mica
	1% Foraminifera
	1% Sponge spicules
	Tr% Zeolite

VOLCANIC ASH
Smear: 2-112

Texture	Composition
61% Clay	79% Volcanic glass
38% Silt	15% Feldspar
1% Sand	2% Quartz
	2% Heavy minerals
	1% Glauconite
	1% Carbonate (micarb)

Grain Size 2-26
1.24, 64.52, 34.24

Grain Size 2-38
0.78, 74.7, 24.52

Grain Size 3-112
0.37, 38.15, 61.48

Total Carbonate 3-112
0.47

* Additional Smear Slide 3-98 described on Core 8 form.

Explanatory notes in chapter 1

Site 299 Hole Core 8 Cored Interval: 66.5-76.0 m

AGE: LATE PLEISTOCENE

ZONE: *Emiliania huxleyi*; *Rhizosolenia curvirostris* (D); *Dictyocha subarctios* (S)

FOSSIL CHARACTER (FORAMS / NANNOS / RADS / SILICO. DIATOMS): Rm Cm Cm; Fm Rm Rm Cm Fm

SECTION: 1, 2, 3, Core Catcher

METERS: 0.5, 1.0

LITHOLOGY: VOID

LITHOLOGIC DESCRIPTION

Intense-moderate drilling deformation; greenish gray (5G 6/1), dark greenish gray (5G 4/1), olive gray (5Y 4/1) in varigated beds.

SILTY CLAY

*SILTY CLAY (DIATOMITE)
Smear: Core 7, Section 3, 98 cm.

Texture	Composition
85% Clay	65% Diatoms
15% Silt	15% Feldspar
	5% Heavy minerals
	4% Volcanic glass
	3% Radiolarians
	3% Quartz
	2% Opaques
	2% Sponge spicules
	1% Mica

5G 6/1

5G 4/1

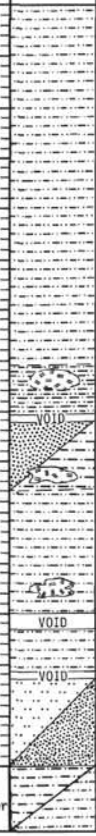
5Y 4/1

5G 4/1

Explanatory notes in chapter 1

Site 299 Hole Core 9 Cored Interval: 76.0-85.5 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE	Gephyrocapsa oceanica; Rhizosolenia curvirostris (D); Dictyocha subarctios (S)	Juvenile	B	Rm	Cg	1 (0.5, 1.0)					Sed. Stage 1B
			B	B	Cg	2, 3, 4, 5					
		Rm	Rp	Rp	Rp, Rm	Core Catcher					



Colors olive gray (5Y 4/1), pale green (5G 6/1), light olive gray (5Y 6/1), brownish gray (5YR 4/1) and ash is a very light gray (N8); interbeds; moderate drilling deformation; bedding thicknesses vary.

SILTY CLAY

CLAYEY SAND

5Y 4/1
5G 6/1
5Y 6/1
5YR 4/1
N8

Grain Size 5-71
10.7, 83.0, 6.3

Grain Size 5-97
17.4, 71.3, 11.3

Grain Size 5-115
20.9, 65.7, 13.4

Grain Size 5-132
26.2, 59.8, 14.0

Grain Size 5-142
26.5, 64.7, 8.8

Grain Size 3-140
89.8, 7.1, 3.1

Carbon Carbonate 5-49
1.3, 1.0, 3

X-ray 5-53 (Bulk)
30.5% Quar
26.2% Plag
15.0% Mica
10.3% Mont
4.6% K-Fe
3.8% Calc
3.5% Kaol
3.5% Pyri
2.6% Chlo

5GY 2/1

5YR 4/1

Grain Size 5-40
1.53, 38.73, 54.37

5Y 4/1
5G 6/1
5Y 6/1
5YR 4/1

Total Carbonate 5-40
2.26

5Y 4/1
5G 6/1

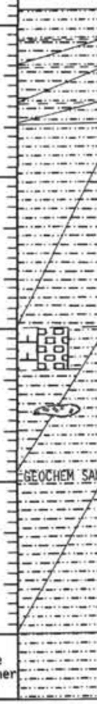
5Y 4/1

5G 4/1

Explanatory notes in chapter 1

Site 299 Hole Core 10 Cored Interval: 85.5-95.0 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE	Gephyrocapsa oceanica; Rhizosolenia curvirostris (D); Dictyocha subarctios (S)	Juvenile	Fm	B	Fg	1 (0.5, 1.0), 2, 3		VOID			
			Fm	B	B	4, 5				* 17	
		Rm	Fp	Rp	Cm, Fm	Core Catcher					



Colors dark greenish gray (5GY 4/1), olive black (5Y 2/1), greenish gray (5G 6/1) in thick and thin laminae;

SILTY CLAY

CLAYEY SAND

base of cycle

base of cycle

5GY 4/1
5Y 2/1
5G 6/1

NANNOFOSSIL-RICH CARBONATE SILTY CLAY
Smear: 4-17

Texture	Composition
55% Clay	40% Clay minerals
40% Silt	38% Carbonate
5% Sand	12% Nannofossils
	3% Feldspar
	3% Volcanic glass
	1% Quartz
	1% Heavy minerals
	1% Glauconite
	1% Pyrite

5GY 4/1
5Y 2/1
5G 6/1

5GY 4/1

Explanatory notes in chapter 1

Site 299 Hole Core 11 Cored Interval: 95.0-104.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE	Dictyocha subarctios (S)		B	Rm	Cg	1	0.5, 1.0				Variagated colors - brownish gray (5YR 2/1), olive gray (5Y 4/1), pale greenish gray (5G 7/1), and very light gray (N8); intense drilling deformation. SILTY CLAY CLAYEY SAND
						2					
						3					5YR 2/1 5Y 4/1 5G 7/1 N8
			B	Rm	Cg	4					
						5					
	Gephyrocapsa oceanica Rhizosolenia curvirostris (D)					6					
		B	Rp	Rm	Cm Fm	Core Catcher					5Y 4/1

Explanatory notes in chapter 1

Site 299 Hole Core 12 Cored Interval: 104.5-114.0 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE PLEISTOCENE	Dictyocha subarctios (S)					1	0.5, 1.0	VOID			Colors olive gray (5GY 4/1) and dark greenish gray (5G 4/1): drilling breccia to intensely deformed; interbeds - 5 to 30 cm interval.
			B	B	Fm	2					5Y 4/1 5GY 6/1 10Y 4/2
						3				* 68	10Y 4/1
	Rhizosolenia curvirostris (D)					4					5GY 4/1
				Rm	Rm	5					5B 5/1 10Y 4/2 5GY 4/1
		BF Fm	B	B	Fm Rm	Core Catcher				* CC	5G 4/1

CLAYEY SILT
Smear: 3-68

Texture	Composition
60% Silt	34% Clay minerals
28% Clay	24% Feldspar
12% Sand	12% Quartz
	10% Heavy minerals
	10% Diatoms
	5% Volcanic glass
	5% Sponge spicules
	Tr% Nannofossils

SILTY CLAY WITH SANDS

ASH-RICH CLAYEY SILT
Smear: CC

Texture	Composition
65% Silt	33% Clay minerals
30% Clay	17% Feldspar
5% Sand	15% Micarb
	15% Quartz
	10% Volcanic glass
	5% Micarb
	2% Heavy minerals
	1% Mica
	1% Glauconite
	1% Sponge spicules
	Tr% Radiolarians
	Tr% Diatoms
	Tr% Nannofossils

Grain Size 3-66
12.4, 59.8, 27.8

Explanatory notes in chapter 1

Site 299 Hole Core 13 Cored Interval: 114.0-123.5 m

AGE: LATE PLEISTOCENE

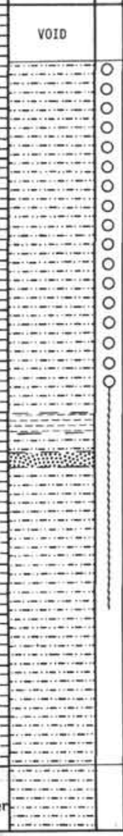
ZONE: Gephyrocapsa oceanica; Rhizosolenia curvirostris (D); Dictyocha subarctios (S)

FOSSIL CHARACTER (FORAMS, NANNOS, RADS, SILICO. DIATOMS): Fm; Fm Rm; Rm Rm; B; Fm; B Rm B B

SECTION: 1, 2, 3, 4, 5, Core Catcher

METERS: 0.5, 1.0

LITHOLOGY: VOID



LITHO. SAMPLE: * 82

10Y 4/2
5B 5/1
5GY 4/1

5Y 3/2
5GY 4/1

5Y 3/2

5Y 3/2
5B 5/1
10Y 4/1

5G 4/1

LITHOLOGIC DESCRIPTION

Colors in streaks; gray olive (10Y 4/2), medium blue gray (5B 5/1), dark green gray (5GY 4/1); drilling breccia - banding 20 to 40 cm; pebble erratic(?) at 4 to 70 cm.

SILTY CLAY
Smear: 4-82

Texture	Composition
63% Clay	59% Clay minerals
36% Silt	20% Feldspar
1% Sand	10% Quartz
	5% Heavy minerals
	5% Micarb
	1% Opaques
	Tr% Radiolarians

Grain Size 4-82
0.7, 35.7, 63.6

Carbon Carbonate 4-85
1.7, 0.4, 10

Explanatory notes in chapter 1

Site 299 Hole Core 14 Cored Interval: 123.5-133.0 m

AGE: LATE PLEISTOCENE

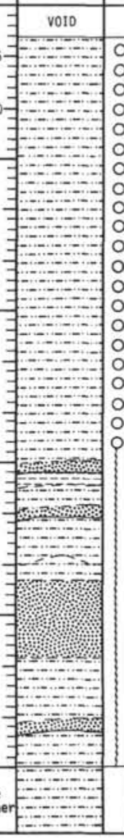
ZONE: Gephyrocapsa oceanica

FOSSIL CHARACTER (FORAMS, NANNOS, RADS, SILICO. DIATOMS): Rp; Rp Rm; B B; B; Cg Rm Rp Cm Rm

SECTION: 1, 2, 3, 4, 5, Core Catcher

METERS: 0.5, 1.0

LITHOLOGY: VOID



LITHO. SAMPLE: * 75

5B 5/1
with
5Y 4/1

5B 5/1
10Y 4/2
5B 5/1

10Y 4/2
5GY 4/1

10Y 4/2

5Y 4/1
5B 5/1

5GY 4/1

LITHOLOGIC DESCRIPTION

Colors medium blue gray (5B 5/1) with minor olive gray (5Y 4/1); drilling breccia to intense deformation; graded beds in Section 4; sands with sharp lower contacts; silty clay - 70%: sands - 30%.

SILTY CLAY
Smear: 4-75

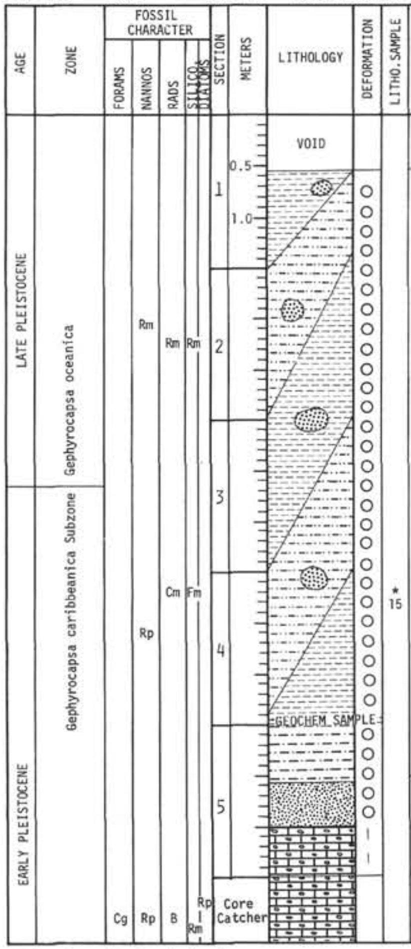
Texture	Composition
71% Clay	45% Clay minerals
28% Silt	15% Micarb
1% Sand	10% Feldspar
	10% Heavy minerals
	8% Volcanic glass
	5% Quartz
	5% Micronodules
	1% Radiolarians
	1% Sponge spicules
	Tr% Diatoms

Grain Size 4-73
0.5, 27.8, 71.6

Carbon Carbonate 4-75
0.7, 0.5, 2

Explanatory notes in chapter 1

Site 299 Hole Core 15 Cored Interval: 133.0-142.5 m



LITHOLOGIC DESCRIPTION

Variagated colors - medium blue gray (5B 5/1), olive gray (5Y 4/1); drilling breccia.

SILTY CLAY

SAND

CLAYEY SILT
Smear: 4-15

	Texture	Composition
5B 5/1	56% Silt	49% Clay minerals
5Y 4/1	42% Clay	12% Feldspar
	2% Sand	11% Diatoms
		7% Quartz
		5% Heavy minerals
		5% Volcanic glass
		5% Micronodules
		5% Sponge spicules
		1% Radiolarians

Calcarenite (Section 5, 100-150 cm).

5B 5/1
5Y 4/1

Grain Size 4-13
2.0, 56.1, 41.9

Grain Size 5-67
66.9, 19.5, 13.6

Carbon Carbonate 4-15
0.6, 0.5, 1

5B 5/1
5Y 4/1

5GY 4/1

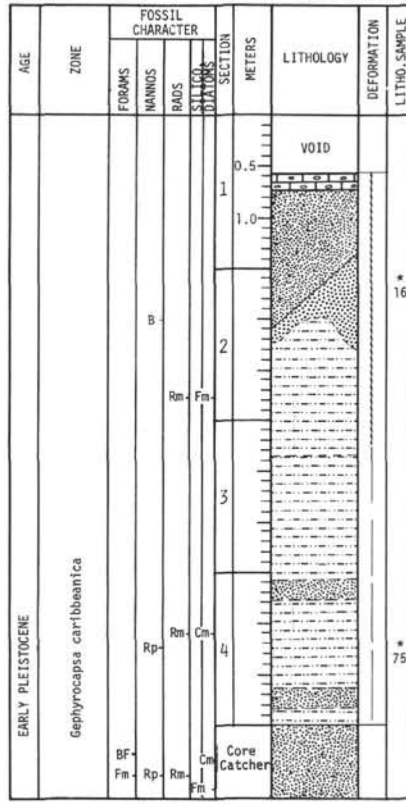
10Y 4/2

5Y 6/1

5Y 6/1

Explanatory notes in chapter 1

Site 299 Hole Core 16 Cored Interval: 142.5-152.0 m



LITHOLOGIC DESCRIPTION

Sed. Stage 2

Colors: gray olive (10Y 4/2); olive black (5Y 2/1) sands, with dark green gray (5GY 4/1); clay, silty clay - 75%; sand - 25%, graded.

10Y 4/2

SILTY SAND
Smear: 2-16

	Texture	Composition
5Y 2/1	50% Sand	25% Micronodules and opaques
	40% Silt	20% Heavy minerals
	10% Clay	15% Feldspar
		12% Quartz
		10% Micarb
		7% Clay minerals
		5% Diatoms
		3% Micas
		2% Radiolarians
5GY 4/1		1% Sponge spicules

SILTY CLAY
Smear: 4-75

	Texture	Composition
5GY 4/1	70% Clay	50% Micarb
	28% Silt	15% Diatoms
	2% Sand	13% Volcanic glass
5Y 3/2		5% Radiolarians
		5% Sponge spicules
5GY 4/1		5% Feldspar
		4% Clay minerals
		2% Heavy minerals
		1% Micronodules

5Y 4/1

Grain Size 2-39
86.6, 9.6, 3.9

Grain Size 3-13
2.1, 60.4, 37.5

5GY 4/1
5G 4/1

Grain Size 3-69
4.6, 37.5, 57.9

Carbon Carbonate 3-18
1.1, 0.8, 2

Grain Size 3.22
3.66, 59.4, 36.94

5GY 4/1

Total Carbonate 3-22
1.97

Explanatory notes in chapter 1

Site 299 Hole Core 17 Cored Interval: 152.0-161.0 m

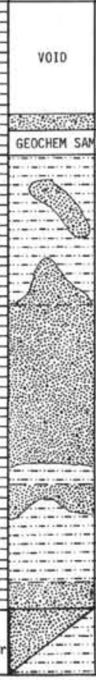
AGE: EARLY PLEISTOCENE

ZONE: Gephyrocapsa caribbeanica; Ammodochium rectangulare (S)

FOSSIL CHARACTER (FORAMS, NANNOS, RADS, SILICO. DIATOMS):
- Section 2: Fp, Rm, Cm
- Section 4: Juvenile, B, Rm, Cm
- Core Catcher: Fm, Rp, B, Cm, Rm

SECTION / METERS: 1 (0.5, 1.0), 2, 3, 4, Core Catcher

LITHOLOGY: VOID; GEOCHEM SAMPLE



LITHO. SAMPLE: * 51

Colors: 5GY 4/1; 10Y 4/2, 5Y 3/2; 5GY 4/1; 5GY 4/1; 10Y 4/2; 5G 4/1; 5GY 4/1

LITHOLOGIC DESCRIPTION

Colors: greenish gray (5GY 4/1), greenish olive (10Y 4/2) and olive gray (5Y 3/2); intensely deformed; some lithification in clay; sands graded.

SILTY CLAY (Claystone)
Smear: 4-51

Texture	Composition
50% Clay	35% Clay minerals
31% Silt	15% Diatoms
19% Sand	10% Micarb
	10% Radiolarians
	10% Feldspar
	5% Quartz
	5% Heavy minerals
	5% Volcanic glass
	5% Sponge spicules

SILTY SAND

Grain Size 4-51
18.8, 30.8, 50.4

Explanatory notes in chapter 1

Site 299 Hole Core 18 Cored Interval: 161.5-171.0 m

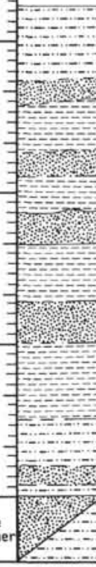
AGE: EARLY PLEISTOCENE

ZONE: Gephyrocapsa caribbeanica; Ammodochium rectangulare (S)

FOSSIL CHARACTER (FORAMS, NANNOS, RADS, SILICO. DIATOMS):
- Section 2: Rp, Rm, Cm
- Section 4: B, Rm, Cm
- Core Catcher: Fm, B, Rm, Rp, Rm

SECTION / METERS: 1 (0.5, 1.0), 2, 3, 4, Core Catcher

LITHOLOGY: VOID



LITHO. SAMPLE: * 97

Colors: 5GY 4/1; 5B 5/1; 5GY 4/1; 5B 5/1; 5GY 4/1; 5B 5/1; 5GY 4/1; 5B 5/1; 5Y 4/1; 5GY 4/1

LITHOLOGIC DESCRIPTION

Colors, medium blue gray (5B 5/1) and dark green gray (5GY 4/1); intense drilling deformation; grading; contacts - sharp to indistinct.

CLAY (Claystone)

SILTY SANDS

SILTY CLAY (Claystone)
Smear: 4-97

Texture	Composition
51% Clay	52% Clay minerals
48% Silt	22% Feldspar
1% Sand	10% Quartz
	4% Volcanic glass
	3% Heavy minerals
	3% Sponge spicules
	2% Diatoms
	2% Pyrite
	1% Mica
	1% Radiolarians

Grain Size 4-91
0.3, 54.6, 45.0

Grain Size 4-94
0.2, 56.3, 43.5

Carbon Carbonate 4-88
0.6, 0.5, 1

X-ray 4-86 (Bulk)
39.3% Quar
25.7% Plag
15.6% Mica
11.4% Mont
5.8% K-Fe
2.1% Chlo

Grain Size 4-98
0.83, 48.4, 50.77

Total Carbonate 4-98
1.69

Explanatory notes in chapter 1

Site 299 Hole Core 19 Cored Interval: 171.0-180.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
EARLY PLEISTOCENE	Ammodochium rectangulare (S)		B	Rm	B	1	0.5, 1.0	VOID			5GY 4/1, 5B 5/1	
						2					5GY 4/1, 5B 5/1	
						3					5GY 4/1	
			B	Rm	Rm	4				77 * * 83	5Y 2/1, 5GY 4/1	
						5					5Y 2/1, 5GY 4/1	
		B	B	B	Rp B	Core Catcher					5GY 4/1	

Colors: dark greenish gray (5GY 4/1), medium blue gray (5B 5/1); interbedded silty clays, clays, silty sands; graded.

SILT (Siltstone)
Smear: 4-83

Texture	Composition
90% Silt	32% Clay minerals
9% Clay	25% Feldspar
1% Sand	20% Volcanic glass
	5% Quartz
	5% Pyrite
	4% Micarb
	3% Heavy minerals
	3% Sponge spicules
	2% Diatoms
	1% Radiolarians

CLAYEY SILT
Smear: 4-77

Texture	Composition
57% Silt	35% Feldspar
43% Clay	25% Quartz
	20% Volcanic glass
	10% Pyrite
	5% Heavy minerals
	5% Clay minerals

Grain Size 4-76	Grain Size 4-83
0.3, 56.6, 43.1	1.1, 90.1, 8.8

Explanatory notes in chapter 1

Site 299 Hole Core 20 Cored Interval: 180.5-190.0 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
EARLY PLEISTOCENE	Ammodochium rectangulare (S)					1	0.5, 1.0	VOID		83 * * 87		
			B	Rm	Rm	2		GEOCHEM SAMPLE			5Y 3/2, 5GY 4/1	
						3						
		B	B	Rm	Rp B	Core Catcher					5GY 4/1	

Colors, olive gray (5Y 3/2), dark greenish gray (5GY 4/1). Moderate drilling deformation.

CLAYEY SILT (Claystone)
Smear: 1-87

Texture	Composition
57% Silt	43% Clay minerals
42% Clay	25% Feldspar
1% Sand	10% Volcanic glass
	10% Quartz
	4% Heavy minerals
	3% Sponge spicules
	2% Pyrite
	1% Glauconite
	1% Diatoms
	1% Radiolarians

SILT
Smear: 1-83

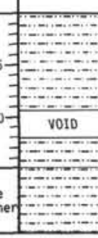
Texture	Composition
85% Silt	30% Feldspar
11% Sand	20% Quartz
4% Clay	20% Volcanic glass
	10% Heavy minerals
	10% Clay minerals
	9% Pyrite
	1% Mica
	Tr% Foraminifera

Grain Size 1-82	Grain Size 1-86
11.3, 84.9, 3.9	0.4, 57.0, 42.6

Explanatory notes in chapter 1

Site 299 Hole Core 21 Cored Interval: 196.0-199.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
EARLY PLEISTOCENE	Ammodochium rectangulare (S)		B	B	Rm	1	0.5, 1.0	VOID			Sed. Stage 3; 5GY 4/1, 10Y 4/2; 5GY 4/1	
		B	B	Rm	Fm Rm	Core Catcher					5GY 4/1	



Colors: greenish olive (10Y 4/2), dark greenish gray (5GY 4/1).

SILTY CLAY (Claystone)

Explanatory notes in chapter 1

Site 299 Hole Core 22 Cored Interval: 199.5-209.0 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLEISTOCENE	Gephyrocapsa caribbeanica; Ammodochium rectangulare (S)		B	Rm	Fm	1	0.5, 1.0	VOID			Colors: gray olive (10Y 4/2), medium blue gray (5B 5/1), olive gray (5Y 3/2); drilling breccia. SILTY CLAY (Claystone) SILTY SAND (Minor)
						2					
						3					10Y 4/2, 5B 5/1, 5Y 3/2
		juvenile	Rp	B	Fm	4					
		Rm	Rp	Rm	Fm Rm	Core Catcher					5G 4/1, 5B 5/1

Explanatory notes in chapter 1

Site 299 Hole Core 23 Cored Interval: 209.0-218.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLEISTOCENE	★	B	Rp	Rm	Ag Cm	Core Catcher				* CC	10YR 4/2, 5Y 3/2

★ Ammodochium rectangulare (S)

Core catcher only: olive gray (5Y 3/2), and dark yellow brown (10YR 4/2).

SILTY CLAYSTONE
Smear: CC

Texture	Composition
53% Clay	25% Clay minerals
45% Silt	24% Feldspar
2% Sand	15% Quartz
	15% Diatoms
	10% Sponge spicules
	3% Radiolarians
	3% Pyrite
	2% Volcanic glass
	1% Mica
	1% Heavy minerals
	1% Foraminifera

Explanatory notes in chapter 1

Site 299 Hole Core 24 Cored Interval: 218.5-228.0 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLEISTOCENE	Ammodochium rectangulare (S)		B-	B	Fm	1	0.5, 1.0	VOID		* 85	10Y 4/2
						2		VOID			10Y 4/2
		B-	B-	Cm-	Fm Cm	Core Catcher					10Y 4/2

Color gray olive (10Y 4/2); intense-moderate drilling deformation; chunky.

DIATOM-RICH SILTY CLAYSTONE
Smear: 1-85

Texture	Composition
62% Silt	40% Clay minerals
37% Clay	25% Diatoms
1% Sand	15% Feldspar
	10% Sponge spicules
	4% Pyrite
	3% Micarb
	2% Quartz
	1% Radiolarians

Grain Size 1-86
0.4, 43.8, 55.8

Carbon Carbonate 1-85
1.5, 1.2, 2

Grain Size 1-87
0.86, 62.02, 37.12

Total Carbonate 1-87
3.18

Explanatory notes in chapter 1

Site 299 Hole Core 25 Cored Interval: 228.0-237.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLEISTOCENE	Ammodochium rectangulare (S)		B	Rm	Fm	1	0.5, 1.0	VOID		* 107	10Y 4/2, 5G 4/1
		B	B	Rm	Cm Rm	Core Catcher		VOID			

Interbedded; gray olive (10Y 4/2), dark greenish gray (5G 4/1); fissile claystone.

DIATOM RICH-SILTY CLAY (Claystone)
Smear: 1-107

Texture	Composition
75% Clay	28% Clay minerals
20% Silt	25% Diatoms
5% Sand	15% Feldspar
	10% Radiolarians
	8% Pyrite
	5% Sponge spicules
	3% Mica
	3% Volcanic glass
	3% Quartz

Explanatory notes in chapter 1

Site 299 Hole Core 26 Cored Interval: 237.5-247.0 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
EARLY PLEISTOCENE	Gephyrocapsa caribbeanica; Ammodochium rectangulare (S)		B	Rm	Rm	1	0.5, 1.0		o o o	*100 *112
		B	Rp	Rp	Cm Fm	Core Catcher				

LITHOLOGIC DESCRIPTION

Sed. Stage 4

Interbedded dark green gray (5G 4/1) grayish olive (10Y 4/2) and dark greenish gray (5GY 4/1); 1-5 cm interbeds. Drilling breccia to slight deformation; pelagic versus distal turbidites with cycle of silt (5GY 4/1), silty clay (10YR 4/2), clay (5G 4/1).

10Y 4/2 - 5GY 4/1

CLAYEY SILT (DIATOM-RICH) (Claystone)
Smear: 1-100

Texture	Composition
51% Silt	30% Clay minerals
49% Clay	20% Feldspar
	18% Diatoms
	10% Radiolarians
	5% Sponge spicules
	5% Pyrite
	5% Volcanic glass
	5% Mica
	2% Heavy minerals

CLAYEY SILT
Smear: 1-112

Texture	Composition
50% Silt	25% Clay minerals
45% Clay	22% Feldspar
5% Sand	15% Volcanic glass
	10% Radiolarians
	8% Diatoms
	5% Sponge spicules
	5% Pyrite
	5% Heavy minerals
	5% Quartz

Grain Size 1-99
0.1, 50.7, 49.2

Carbon Carbonate 1-99
1.2, 1.0, 1

X-ray 1-99 (Bulk)
35.7% Quar
23.9% Plag
13.8% Mica
12.9% Mont
8.6% K-Fe
3.0% Pyri
2.1% Chlo

Explanatory notes in chapter 1

Site 299 Hole Core 27 Cored Interval: 256.5-266.0 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
EARLY PLEISTOCENE	Ammodochium rectangulare (S)	BF Rp	B	B	Fm B	Core Catcher				CC*

LITHOLOGIC DESCRIPTION

N5

Core catcher only: medium gray (N5)

VOLCANIC ASH
Smear: CC

Texture	Composition
85% Sand	75% Volcanic glass
10% Silt	20% Feldspar
5% Clay	5% Heavy minerals
	Tr% Diatoms
	Tr% Radiolarians
	Tr% Sponge spicules

Explanatory notes in chapter 1

Site 299 Hole Core 28 Cored Interval: 275.5-285.0 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
EARLY PLEISTOCENE	Ammodochium rectangulare (S)		B	Rp	Rm	1	0.5, 1.0	VOID		
		B	B	B	Fm B	Core Catcher				

LITHOLOGIC DESCRIPTION

Interbedded; dark green gray (5GY 4/1), dusky yellow (5Y 6/4), moderate olive brown (5Y 4/4).

SILTY CLAYSTONE

5GY 4/1
5Y 4/4
5Y 6/4

SILTY SAND

5GY 4/1
5GY 2/1

Explanatory notes in chapter 1

Site 299 Hole Core 29 Cored Interval: 294.5-304.0 m

AGE	ZONE	FOSSIL CHARACTER: FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
EARLY PLEISTOCENE			B	B	B	1	0.5, 1.0	VOID		*105
		B	B	Rm	Ag Fm	Core Catcher				

LITHOLOGIC DESCRIPTION

Colors: greenish black (5GY 2/1), olive gray (5Y 4/1) and greenish gray (5G 4/1); moderate drilling deformation.

SILTY CLAY (Claystone)

5GY 2/1
5G 4/1

SILTY SAND (Slightly Sandy Silt)
Smear: 1-105

Texture	Composition
75% Silt	31% Feldspar
15% Sand	25% Lithic fragments
10% Clay	16% Quartz
	9% Pyrite
	8% Heavy minerals
	2% Volcanic glass
	2% Sponge spicules
	2% Micarb
	2% Glauconite
	2% Mica
	1% Diatoms
	Tr% Radiolarians
	Tr% Foraminifera

Explanatory notes in chapter 1

Site 299 Hole Core 30 Cored Interval: 323.0-332.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLEISTOCENE	Gephyrocapsa caribbeanica			Rm	B	1	0.5, 1.0			* 27, * 140	Sed. Stage 5
			B			2					
				B	B	3		GEOCHEM SAMPLE			
			B			4		GEOCHEM SAMPLE			
				B	B	5					
		B	Rp	Rp	Fm B	Core Catcher					

Color dominant bluish gray (5B 5/1); slight drilling deformation; thin laminae.

5B 5/1

DIATOM SILTY CLAYSTONE
Smear: 1-27

Texture	Composition
75% Clay	40% Clay minerals
25% Silt	40% Diatoms
	7% Feldspar
	5% Radiolarians
	3% Quartz
	3% Sponge spicules
	1% Heavy minerals
	1% Micarb

5B 5/1

N8

CLAY MICARB OOZE (Limestone)
Smear: 1-140

Texture	Composition
63% Clay	40% Micarb
25% Silt	30% Clay minerals
12% Sand	10% Feldspar
	5% Quartz
	5% Pyrite
	4% Sponge spicules
	2% Nannofossils
	2% Glauconite
	1% Radiolarians
	1% Heavy minerals
	Tr% Diatoms
	Tr% Foraminifera
	Tr% Mica

N8

5B 5/1

5B 5/1

Explanatory notes in chapter 1

Site 299 Hole Core 31 Cored Interval: 351.5-361.0 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MIOCENE?	Denticula kamtschatica (D) ?		B	B	B	1	0.5, 1.0	VOID			
						2					
		B	B	B	Rp B	Core Catcher				* CC	

Color medium bluish gray (5B 5/1) with irregular lamination; some brownish gray (5YR 4/1), olive gray (5Y 4/1) zones; slight drilling deformation.

5B 5/1

SILTY CLAYSTONE
Smear: CC

Texture	Composition
75% Clay	65% Clay minerals
20% Silt	10% Pyrite
5% Sand	7% Feldspar
	3% Sponge spicules
	3% Micronodules
	3% Mica
	3% Quartz
	2% Micarb
	2% Volcanic glass
	1% Heavy minerals
	1% Radiolarians
	Tr% Diatoms

5YR 4/1

5Y 4/1

5B 5/1
5GY 2/1

Grain Size 1-80
1.81, 51.77, 46.42

Total Carbonate 1-80
0.09

Explanatory notes in chapter 1

Site 299 Hole Core 32 Cored Interval: 399.0-408.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
?	juvenile					1	0.5, 1.0	VOID, GEOCHEM SAMPLE			
			B	B	B	2					
		Rm	B	B	B B	Core Catcher				* CC	

Medi m bluish gray (5B 5/1), olive gray (5Y 3/1) and dark greenish gray (5GY 4/1); thin-thick laminae with slight deformation; bioturbation; some calcareous zones.

MICARB-RICH CLAYSTONE (Silty Clay)
Smear: CC

Texture	Composition
77% Clay	57% Clay minerals
18% Silt	20% Micarb
5% Sand	7% Feldspar
	5% Pyrite
	5% Micronodules
	2% Quartz
	1% Mica
	1% Heavy minerals
	1% Volcanic glass
	1% Nannofossils
	Tr% Foraminifera

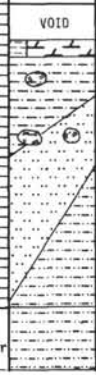
5B 5/1
5Y 3/1
5GY 4/1

5GY 4/1
5B 5/1

Explanatory notes in chapter 1

Site 299 Hole Core 33 Cored Interval: 418.-427.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
?		B	B, B, B	B	B, B	1, 2, Core Catcher	0.5, 1.0	VOID		* CC	5Y 8/1; 5G 6/1	see below



Colors: yellow gray (5Y 8/1), dark greenish gray (5G 6/1). Some lamination, bioturbation, and volcanic glass spots.

CLAYEY DOLOMITE

CLAYEY SAND

SILTY CLAYSTONE (Silty Clay)
Smear: CC

Texture	Composition
68% Clay	66% Clay minerals
30% Silt	16% Feldspar
2% Sand	5% Glauconite
	5% Pyrite
	5% Micarb
	2% Quartz
	1% Sponge spicules
	Tr% Nannofossils

Grain Size 2-15
48.5, 40.1, 11.4

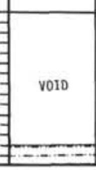
Carbon Carbonate 2-85
1.1, 0.8, 2

X-ray 2-88 (Bulk)
30.8% Quar
25.2% Mica
17.1% Plag
16.2% Mont
5.6% Chlo
3.8% K-Fe
1.2% Pyri

Explanatory notes in chapter 1

Site 299 Hole Core 34 Cored Interval: 437.0-446.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
?			B			1	0.5, 1.0	VOID		* 140	5G 4/1	see below



Dark greenish gray (5G 4/1), olive gray (5Y 3/1); lenticular, bioturbation.

SILTY CLAYSTONE
Smear: 1-140

Texture	Composition
55% Clay	74% Clay minerals
35% Silt	7% Feldspar
10% Sand	3% Quartz
	3% Micronodules
	3% Volcanic glass
	3% Micarb
	2% Glauconite
	2% Heavy minerals
	1% Mica
	1% Zeolite
	1% Sponge spicules
	Tr% Radiolarians

Explanatory notes in chapter 1

Site 299 Hole Core 35 Cored Interval: 475.0-484.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
LATE MIOCENE	Denticula kamtschatica (D)	B	B, B, B	Rm	B, Ag	1, 2, Core Catcher	0.5, 1.0			* 85; * 78; * CC	N4; 5GY 4/1; 5YR 6/1; 5GY 4/1	see below

Medium dark gray (N4), dark greenish gray (5GY 4/1); some bioturbation; slight deformation and laminated.

VOLCANIC SAND
Smear: 1-85

Texture	Composition
82% Sand	55% Volcanic glass
12% Silt	25% Feldspar
6% Clay	12% Quartz
	3% Micarb
	3% Opaques
	1% Heavy minerals
	1% Glauconite
	Tr% Foraminifera

SILTY CLAYSTONE
Smear: CC

Texture	Composition
75% Clay	49% Clay minerals
25% Silt	21% Feldspar
	6% Micronodules
	5% Sponge spicules
	5% Quartz
	4% Opaques
	3% Radiolarians
	2% Mica
	2% Volcanic glass
	1% Heavy minerals
	1% Micarb
	1% Diatoms

CLAYEY MICARB OOZE
Smear: 2-78

Texture	Composition
90% Clay	65% Micarb
10% Silt	30% Clay minerals
	5% Quartz
	Tr% Heavy minerals
	Tr% Nannofossils
	Tr% Sponge spicules

Grain Size 1-85
81.7, 12.2, 6.1

Explanatory notes in chapter 1

Site 299 Hole Core 36 Cored Interval: 494.0-503.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
?		BF Rm	B B B	B	B B	1 2 3 4 Core Catcher	0.5 1.0	VOID GEOCHEM SAMPLE		*48 *94 *91 *102 *CC	see below

Sed. Stage VI

Color: olive gray (5Y 4/1), dark greenish gray (5GY 4/1) interbedded; slight deformation. Some (N4) medium dark gray and brown gray (5YR 4/1) ash zones; some grading in ash beds.

5Y 4/1
5GY 4/1
N4
5Y 4/1
5GY 4/1
N4
5Y 4/1
5GY 4/1
N4
5Y 5/2

SILTY CLAYSTONE
Smear: 4-102, CC

Texture	Composition
78% Clay	44-79% Clay minerals
15-20% Silt	15% Plant debris
2% Sand	5-20% Feldspar and quartz
	3- 8% Pyrite
	1-10% Heavy minerals
	Tr- 3% Micarb

VOLCANIC ASH
Smear: 4-91

Texture	Composition
88% Silt	55% Feldspar
10% Clay	20% Volcanic glass
2% Sand	10% Heavy minerals
	5% Clay minerals
	5% Pyrite
	5% Micarb

ZEOLITE-RICH SILTY CLAY (Claystone)
Smear: 4-94

Texture	Composition
72% Clay	54% Clay minerals
26% Silt	20% Zeolite
2% Sand	10% Feldspar
	5% Heavy minerals
	5% Pyrite
	4% Volcanic glass
	2% Nannofossils

(Organic) SILT
Smear: 4-48

Texture	Composition
70% Silt	40% Plant debris
15% Sand	20% Feldspar
15% Clay	15% Volcanic glass
	10% Heavy minerals
	9% Clay minerals
	5% Lithic fragments
	1% Micarb

Grain Size 4-89
0.6, 68.9, 30.5

Grain Size 4-92
1.5, 26.0, 72.4

Grain Size 4-61
1.68, 47.61, 50.71

Total Carbonate 4-61
0.37

Explanatory notes in chapter 1

Site 299 Hole Core 37 Cored Interval: 513.0-525.5 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
?		B	B B	B	B B	1 2 3 Core Catcher	0.5 1.0	VOID		*60 *120 *CC	see below

Colors: olive gray (5Y 4/1) and medium dark gray (N4); slight deformation; other colors: dark green gray (5GY 4/1) and medium gray (N5). Some grading with volcanic ash reworked.

5Y 4/1
with N4
N4
N4
5Y 4/1
N4
N5
5GY 4/1

SILTY CLAYSTONE
Smear: 2-120

Texture	Composition
84% Clay	82% Clay minerals
15% Silt	6% Feldspar
1% Sand	3% Volcanic glass
	3% Pyrite
	2% Micarb
	2% Quartz
	1% Mica
	1% Zeolite

VOLCANIC ASH
Smear: 2-60

Texture	Composition
65% Silt	40% Feldspar
35% Clay	35% Clay minerals
	15% Volcanic glass
	5% Pyrite
	3% Zeolite
	1% Mica
	1% Heavy minerals
	Tr% Nannofossils

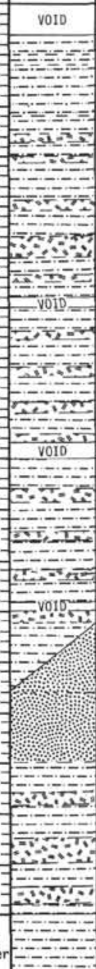
CARBONATE-RICH ZEOLITE CLAY
Smear: CC

Texture	Composition
84% Clay	35% Micarb
16% Silt	28% Clay minerals
0% Sand	25% Zeolite
	5% Volcanic glass
	5% Feldspar
	1% Heavy minerals
	1% Plant debris

Explanatory notes in chapter 1

Site 299 Hole Core 38 Cored Interval: 522.5-532.0 m

AGE	ZONE	FORAMS	NANNOS	RADS	SILICO. DIATOMS	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE		LITHOLOGIC DESCRIPTION
						1	0.5, 1.0	VOID	|	*102, *113		
			B			2			|			
						3		VOID	|		5Y 4/1, 5Y 5/1, 5GY 4/1	
						4		VOID			5Y 3/2, 5Y 4/1, 5GY 4/1	
						5					5Y 4/1	
?			Rp			6					5Y 4/1, 5GY 4/1	
		B	B	B	B	Core Catcher					5Y 4/1	



Colors: olive gray (5Y 4/1), dark green gray (5GY 4/1); slight drilling deformation; graded - current bedding; turbidite - (distal-like).

SILTY CLAYSTONE
Smear: 1-113

Texture	Composition
57% Clay	48% Clay minerals
42% Silt	25% Quartz
1% Sand	18% Feldspar
	3% Pyrite
	2% Mica
	2% Zeolite
	1% Volcanic glass
	1% Micarb

CLAY SANDY SILT
Smear: 1-102

Texture	Composition
60% Silt	38% Feldspar
20% Clay	25% Quartz
20% Sand	20% Clay minerals
	10% Volcanic glass
	5% Pyrite
	1% Heavy minerals
	1% Mica

Grain Size 1-109
1.1, 29.7, 69.2

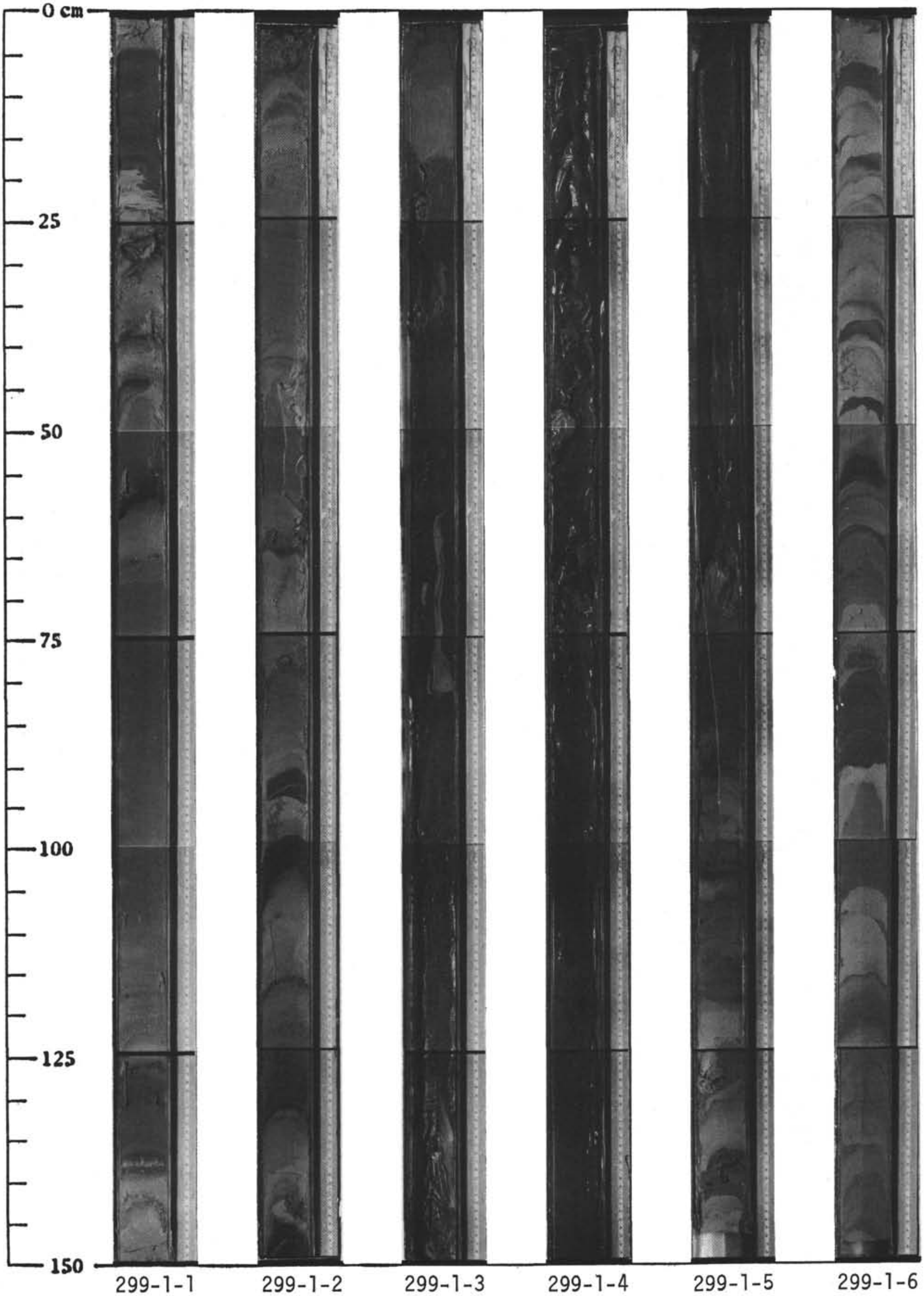
Carbon Carbonate 1-108
1.4, 0.9, 5

X-ray 1-112 (Bulk)
30.3% Mont
24.6% Quar
16.5% Mica
14.3% Plag
5.1% Chlo
3.7% K-Fe
2.7% Clin
2.7% Pyri

Grain Size 1-110
0.69, 42.0, 57.31

Total Carbonate 1-110
2.06

Explanatory notes in chapter 1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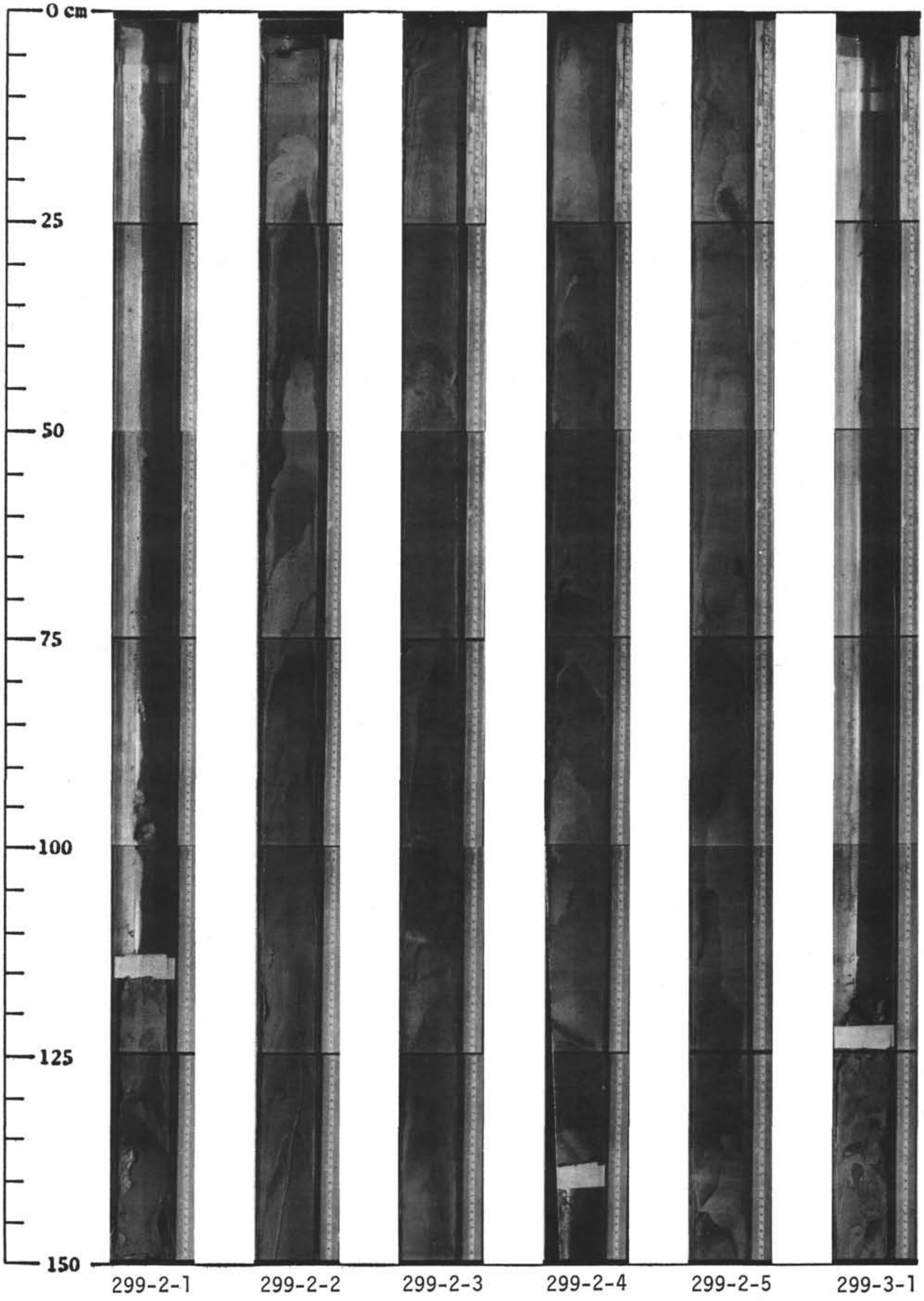
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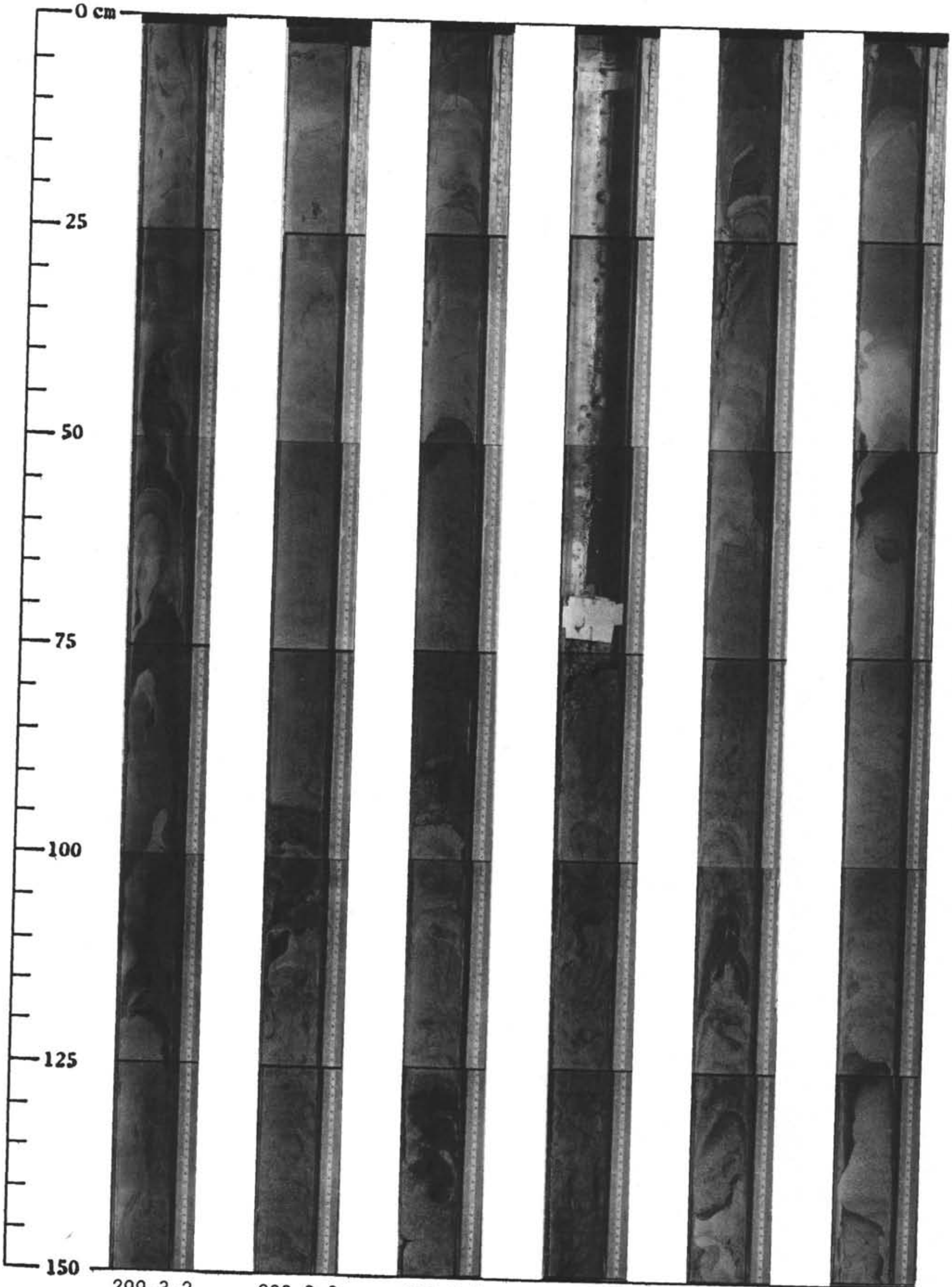

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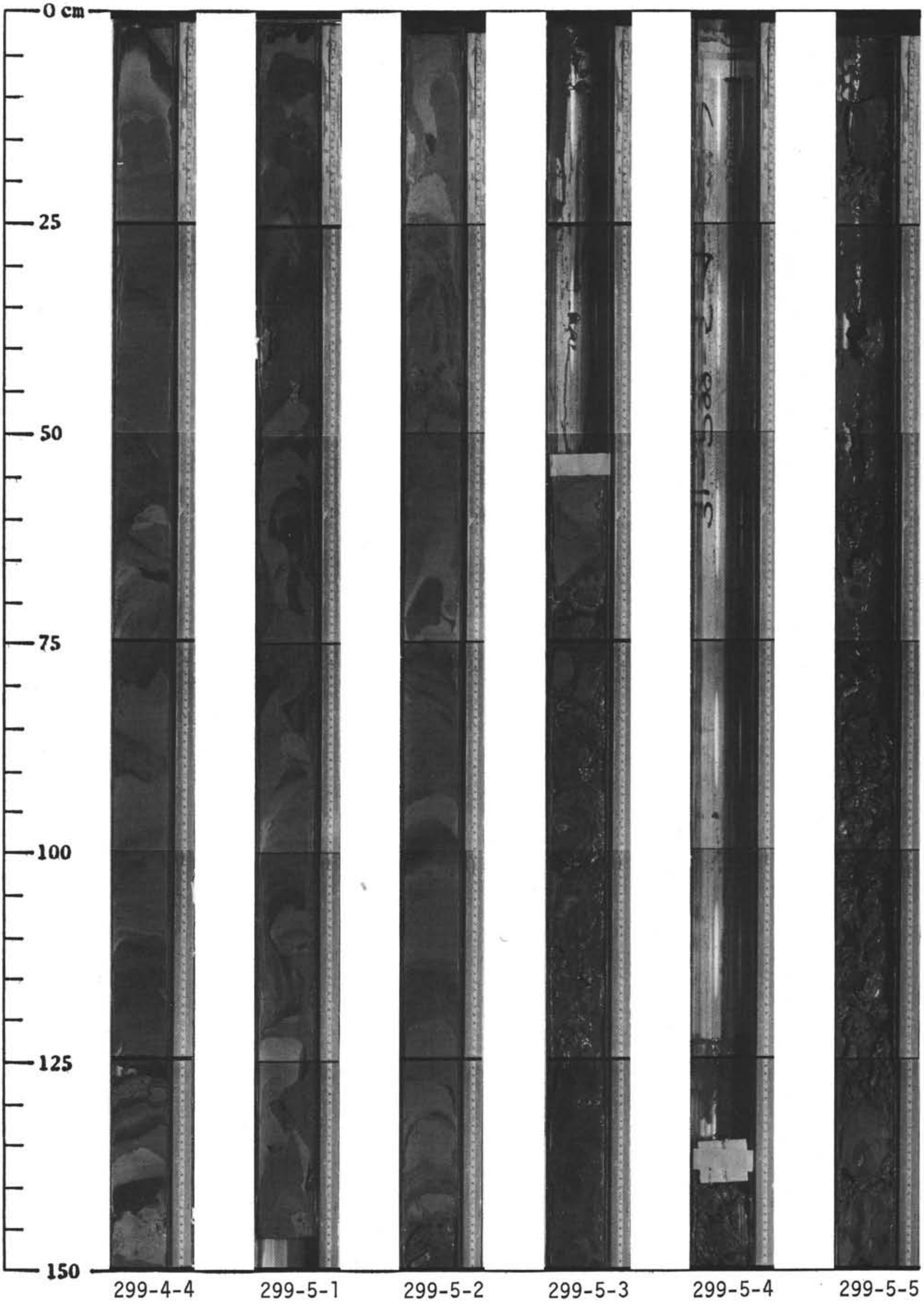
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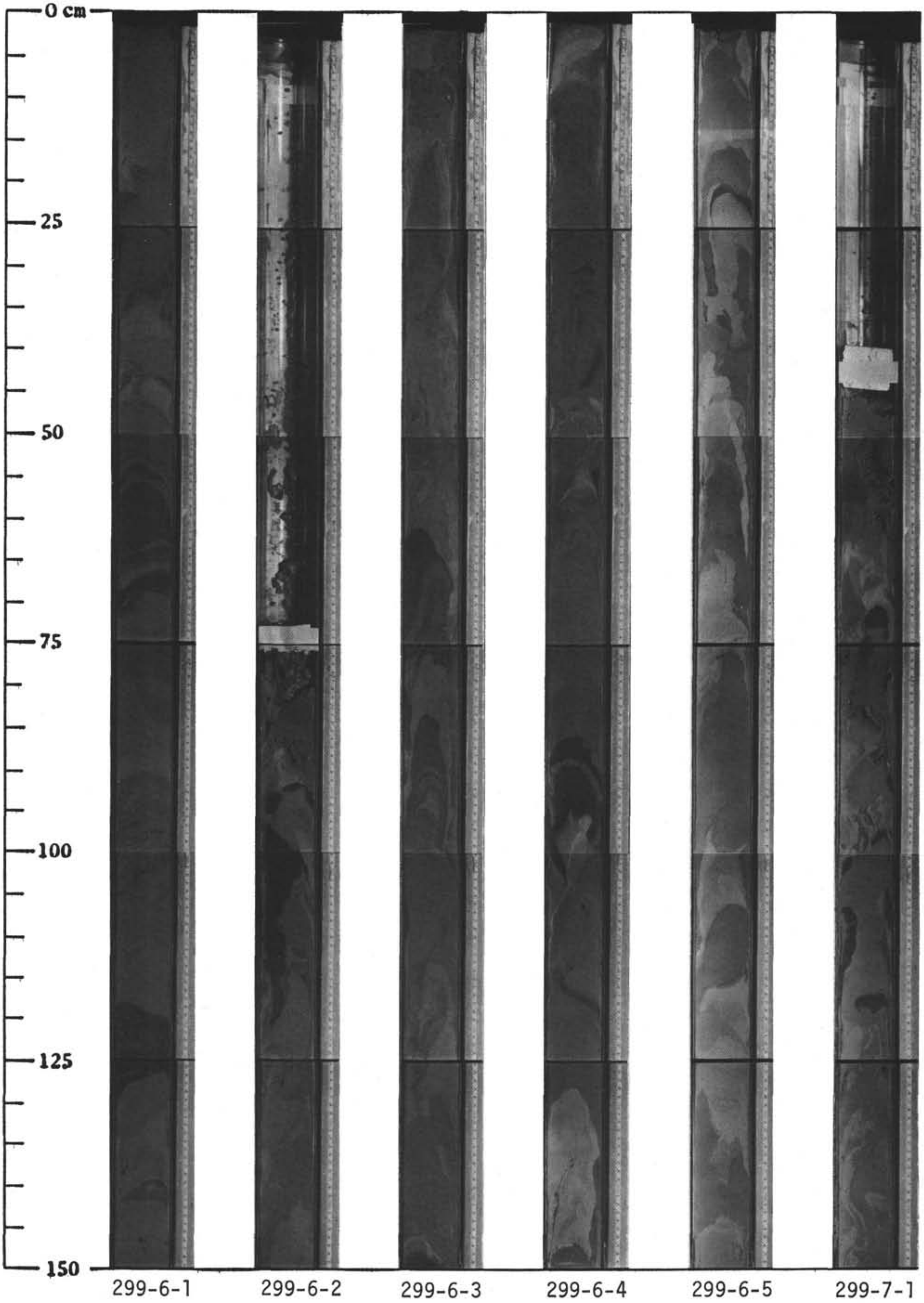
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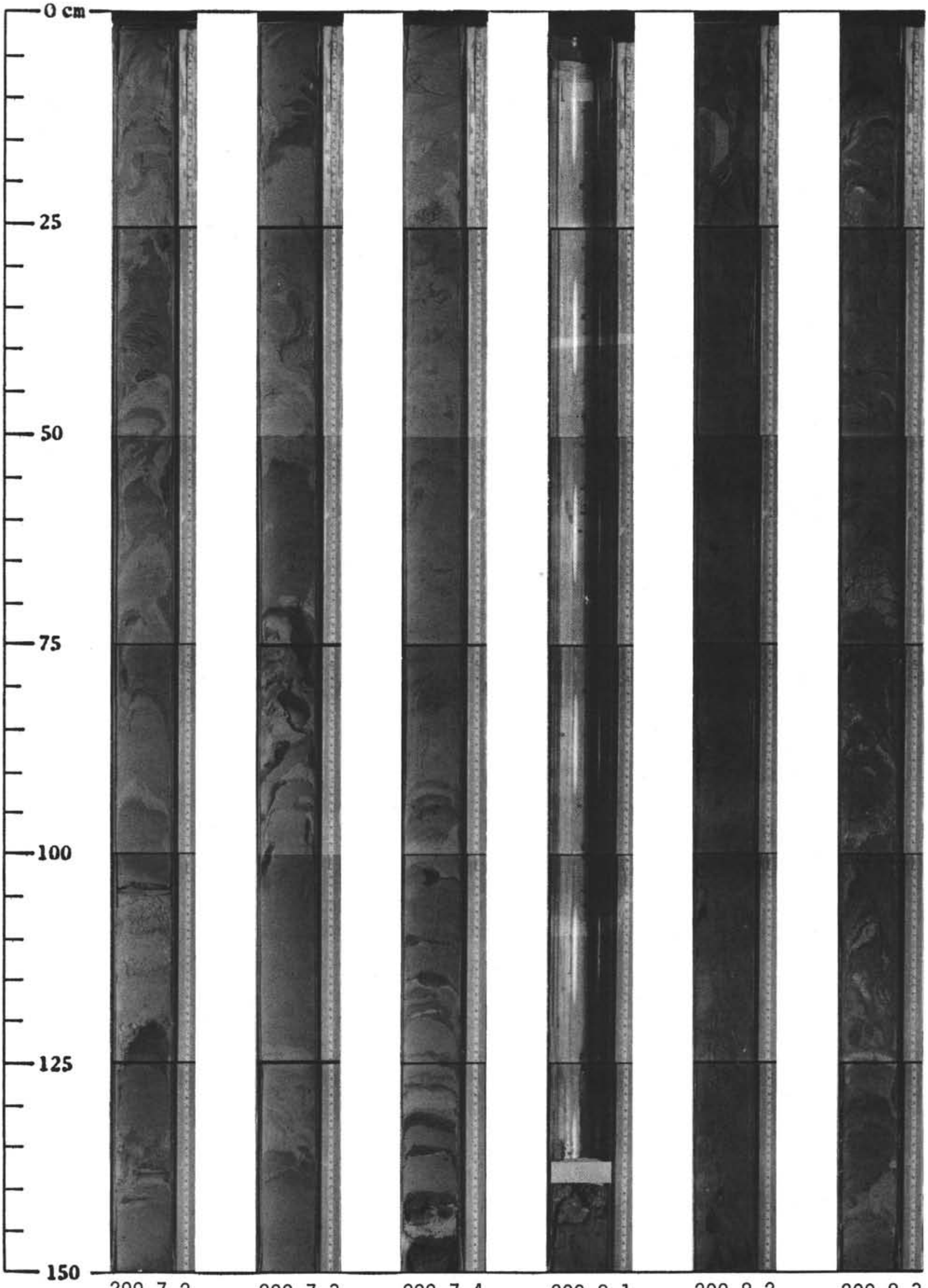
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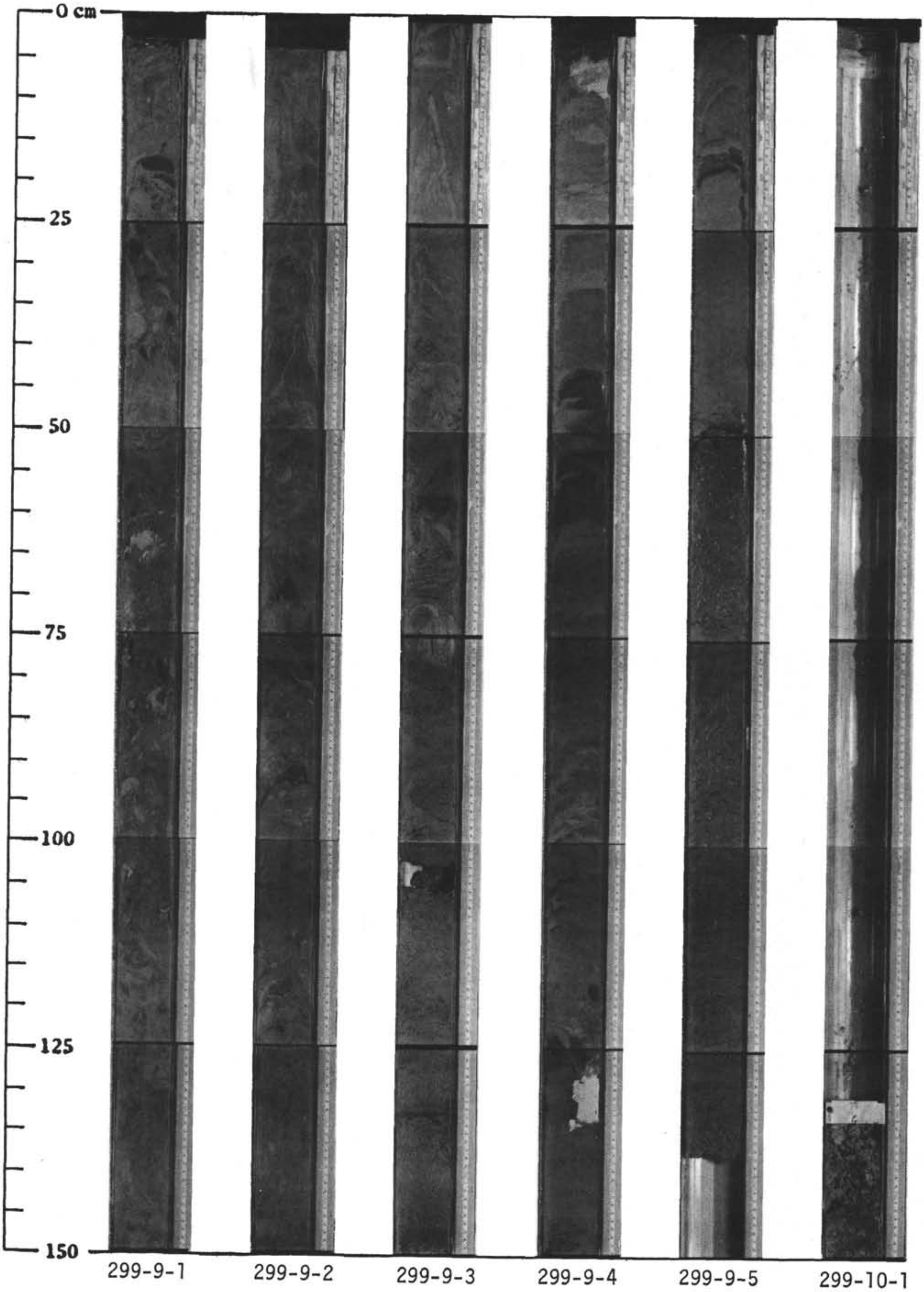
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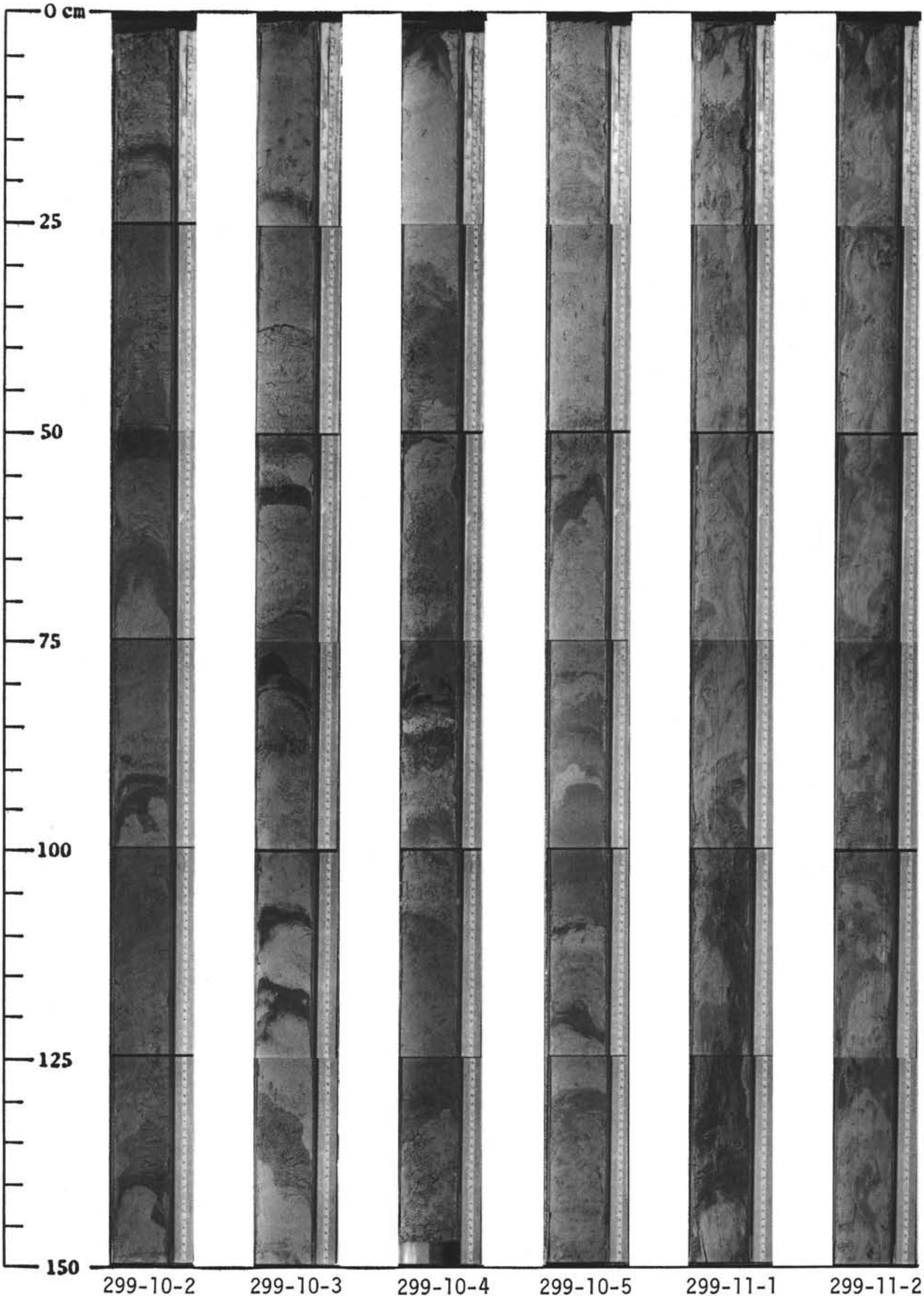
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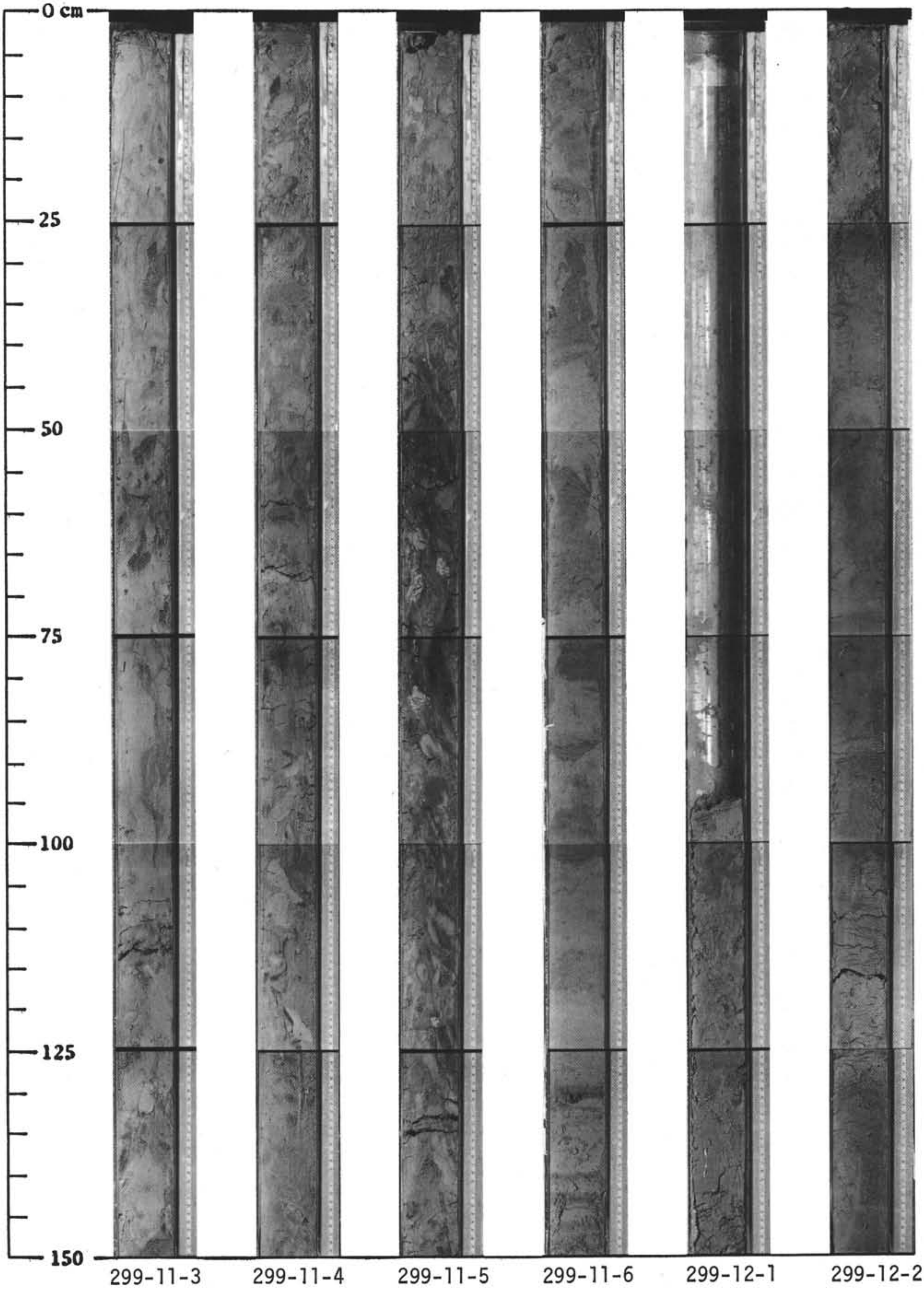
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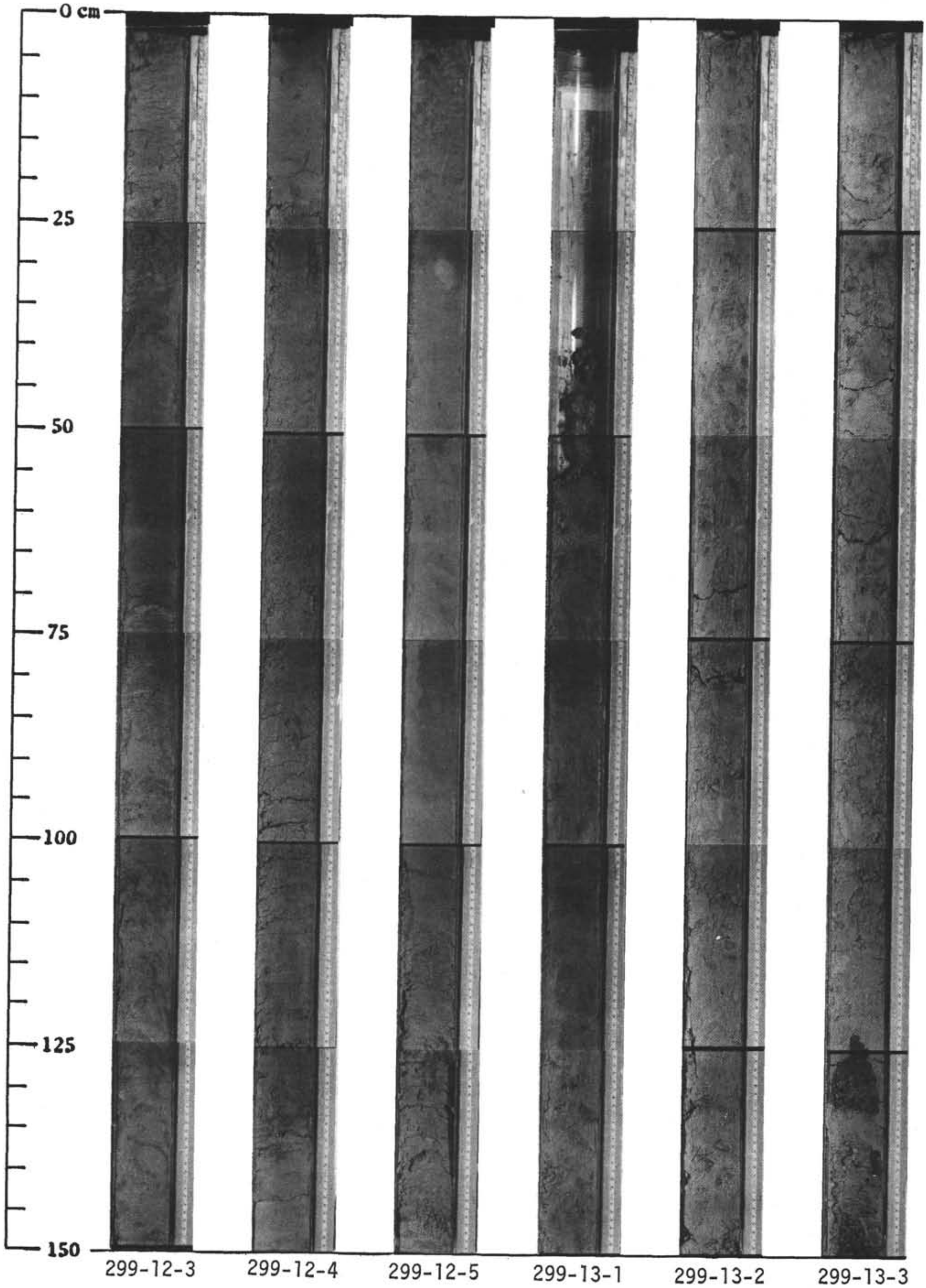
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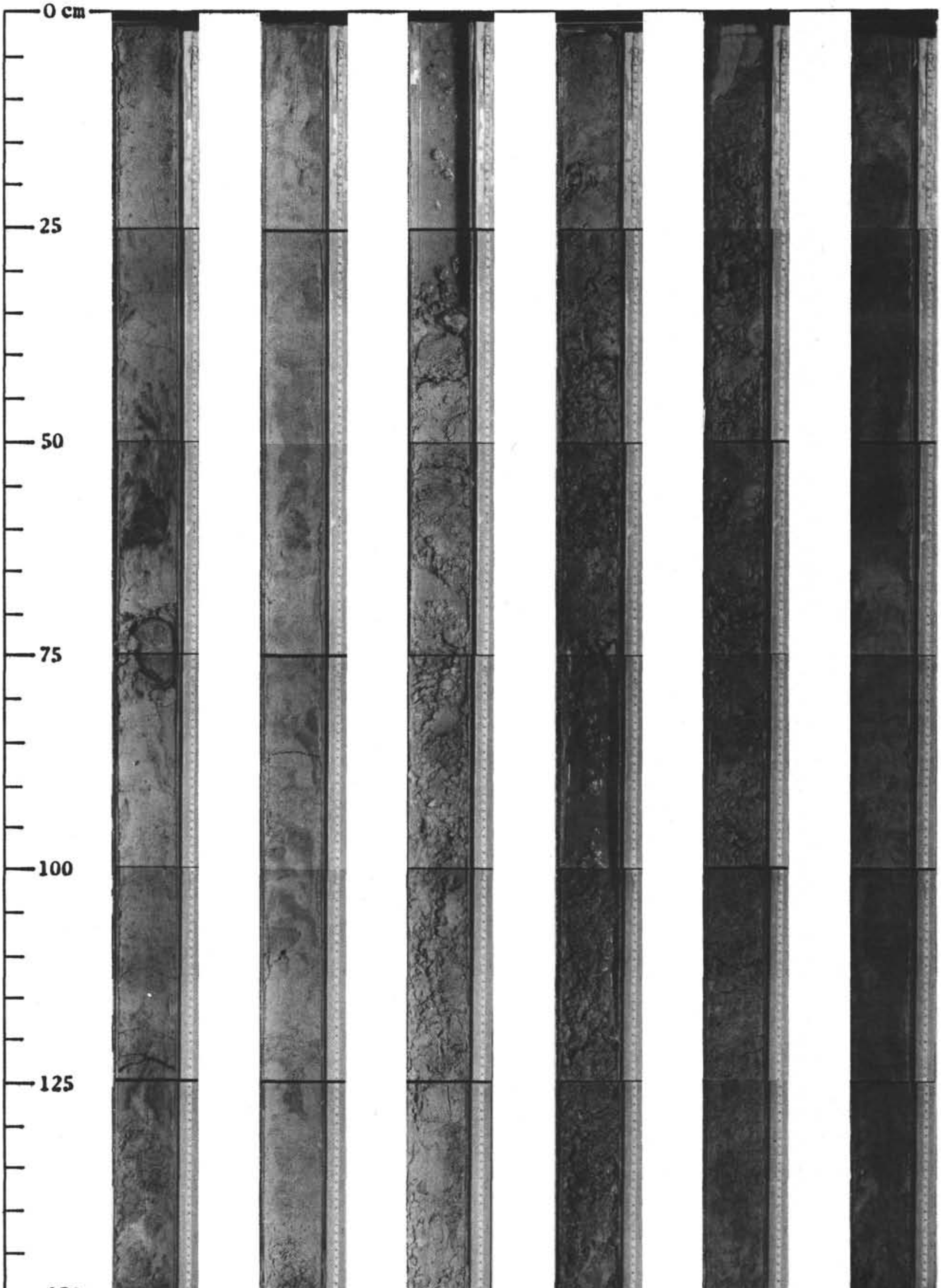

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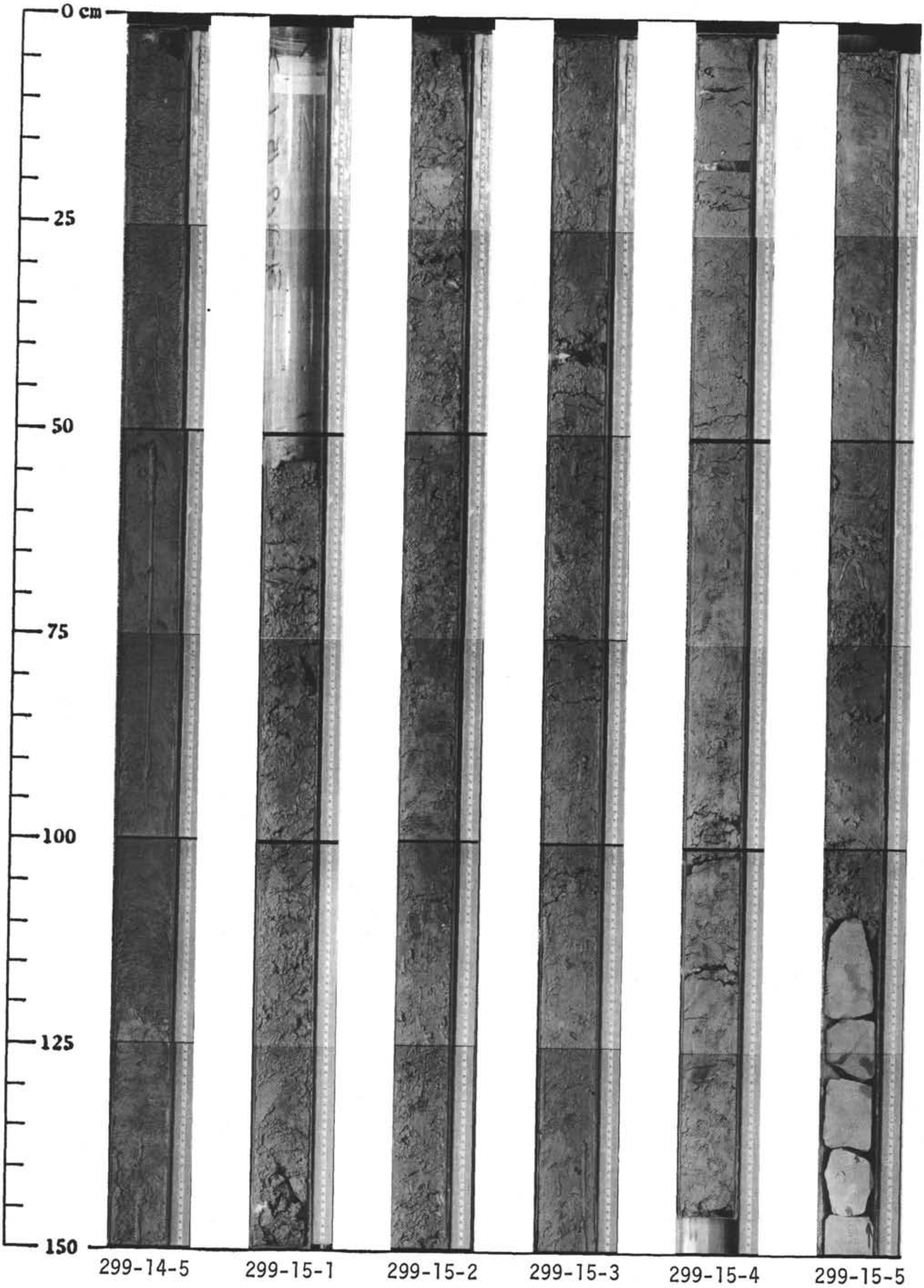
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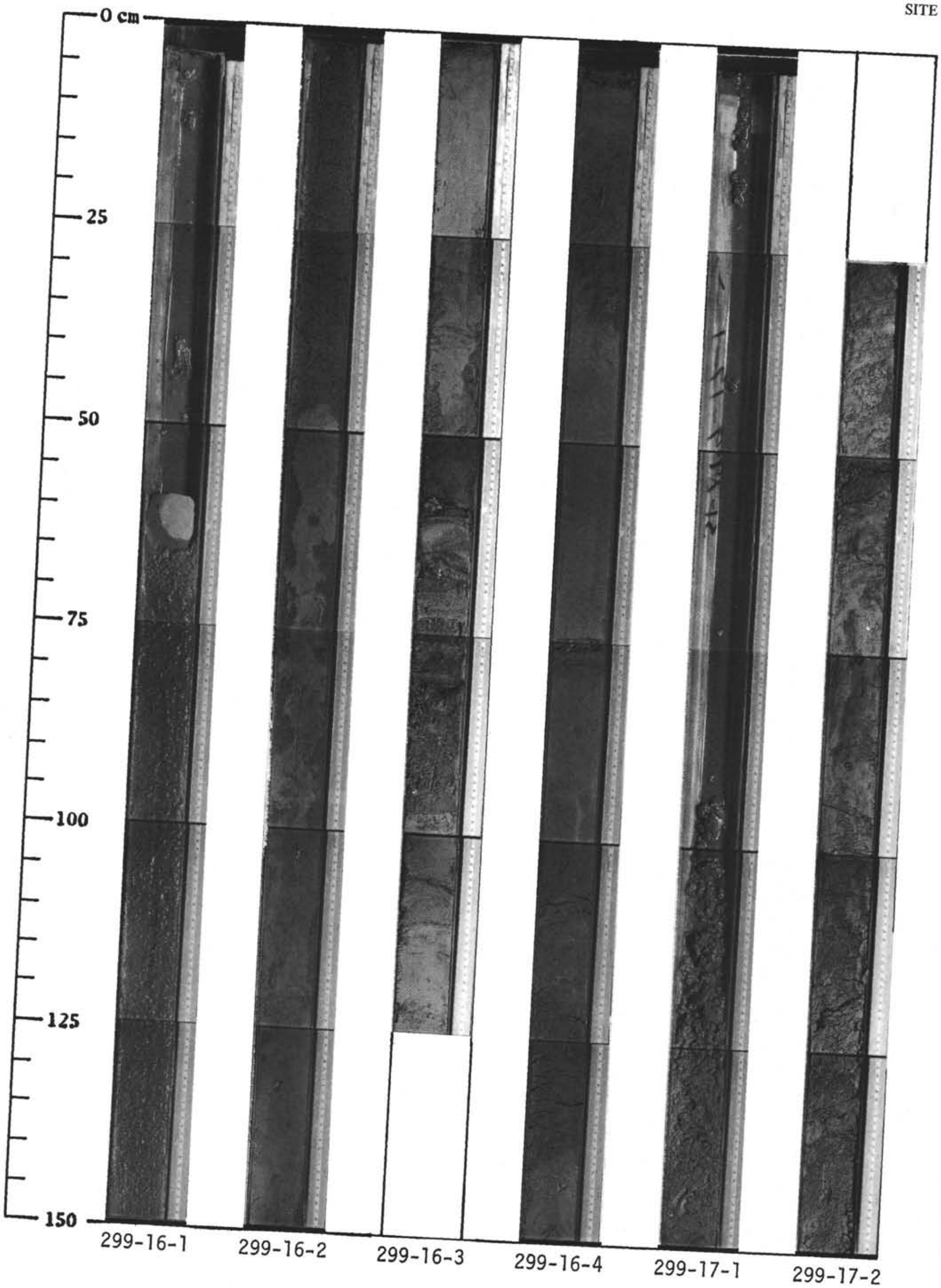
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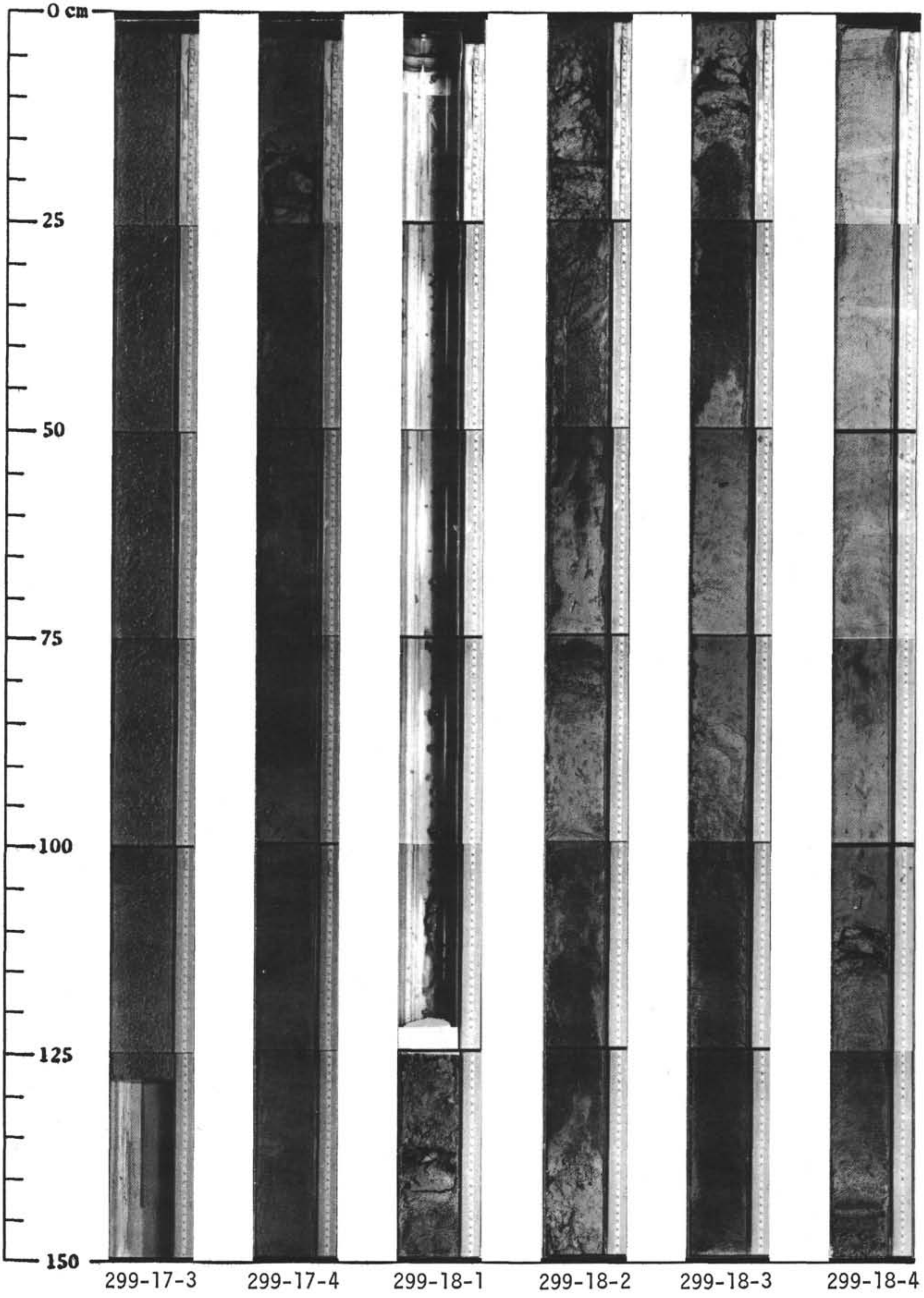
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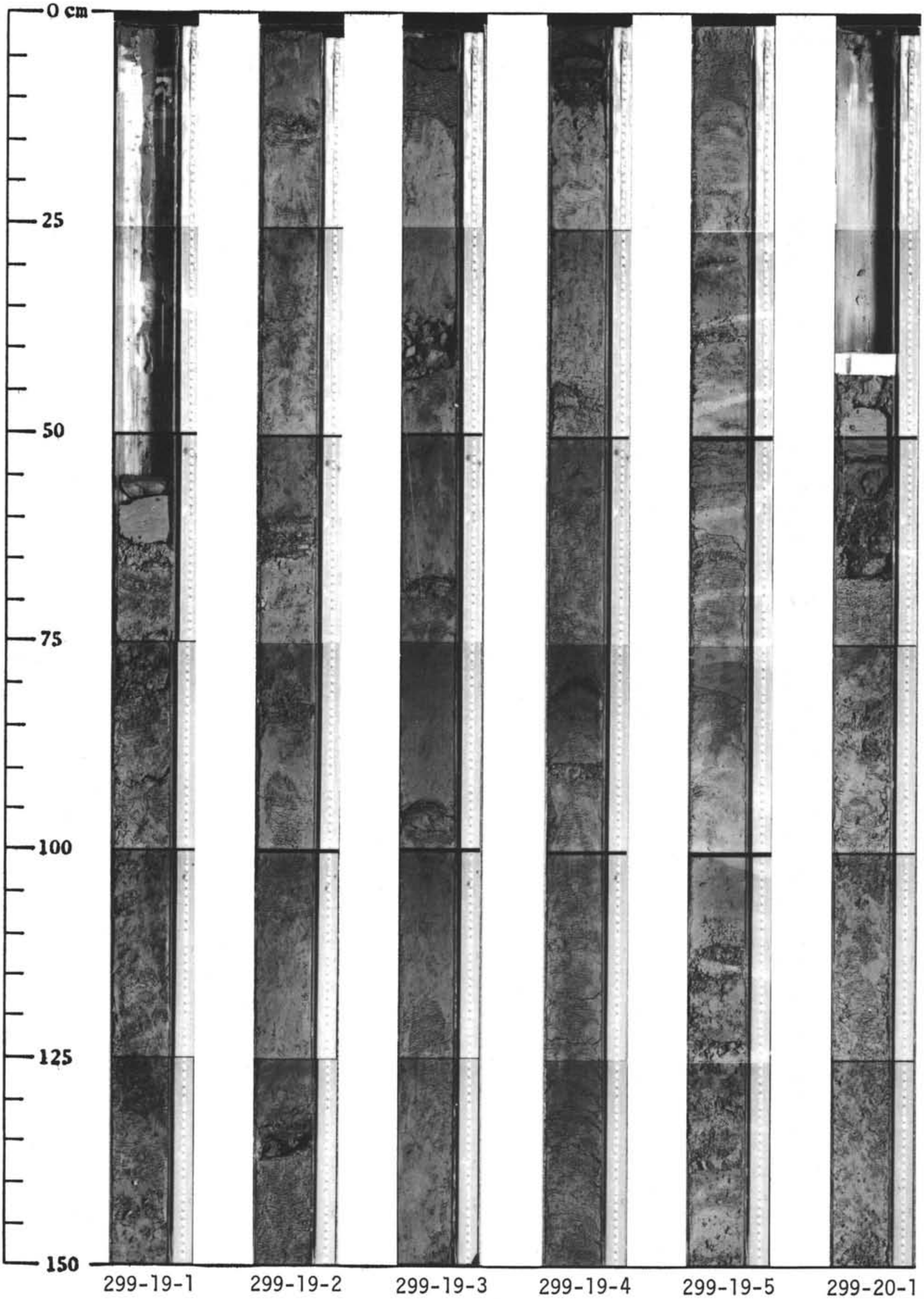
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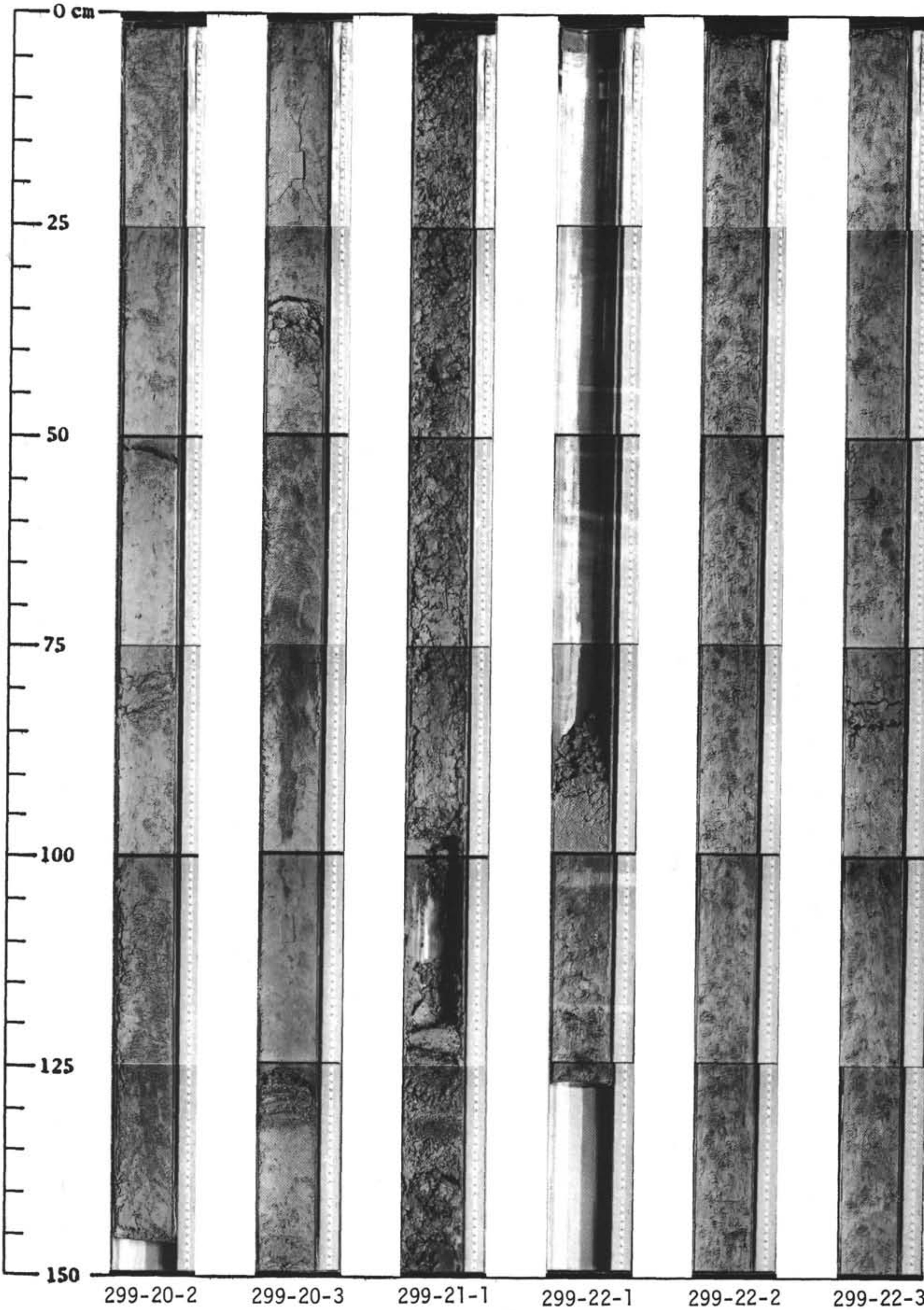
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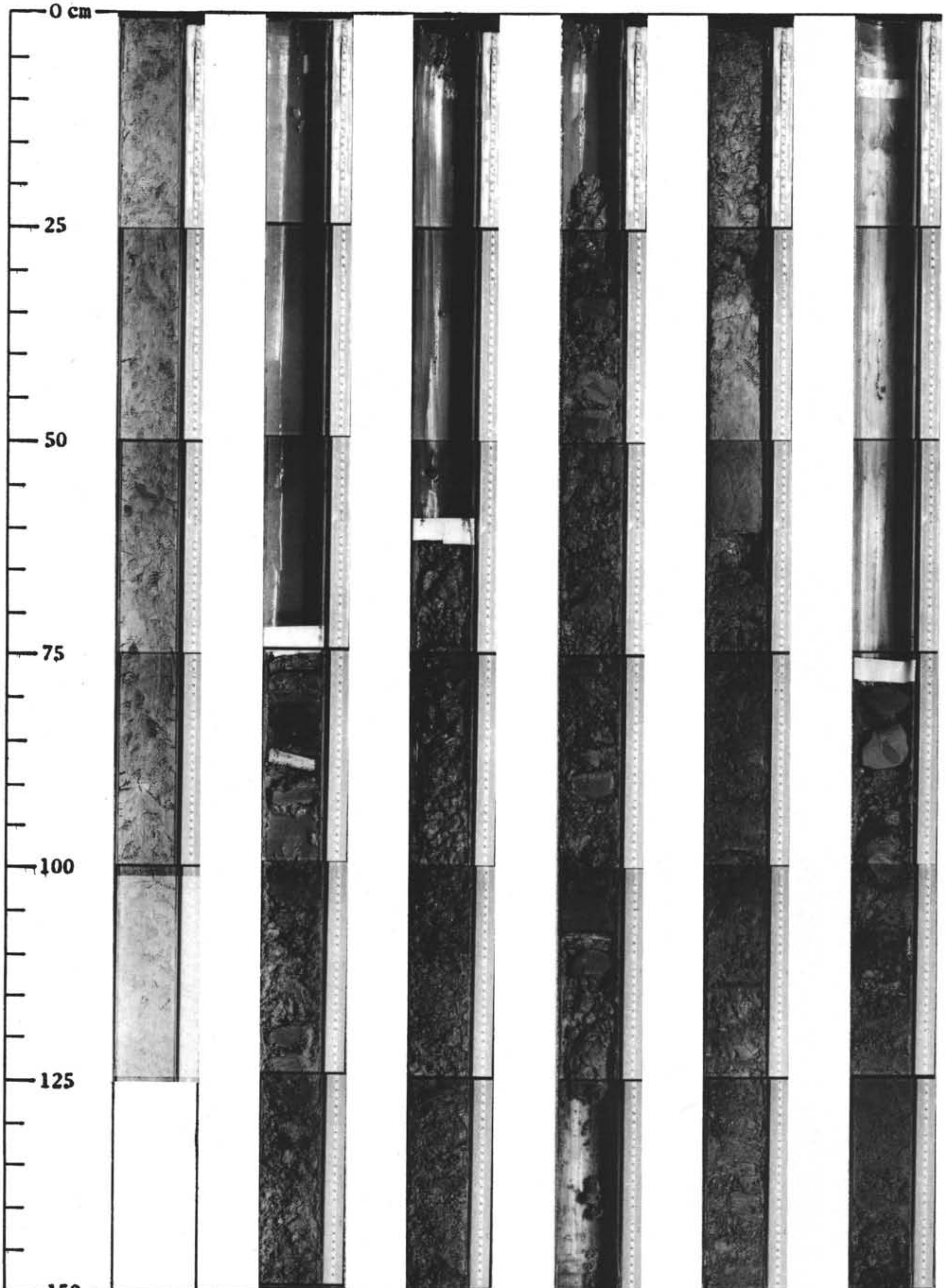
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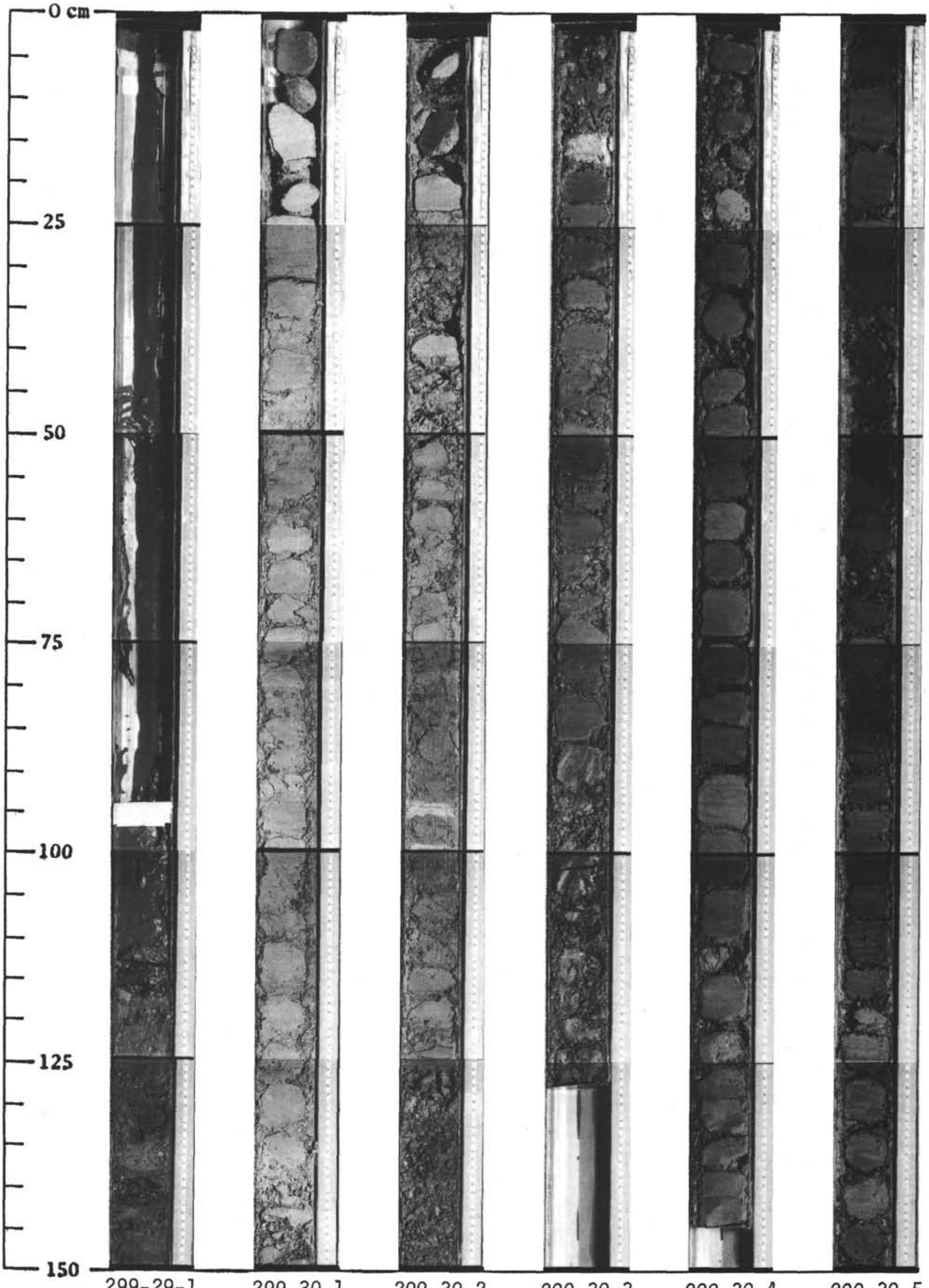
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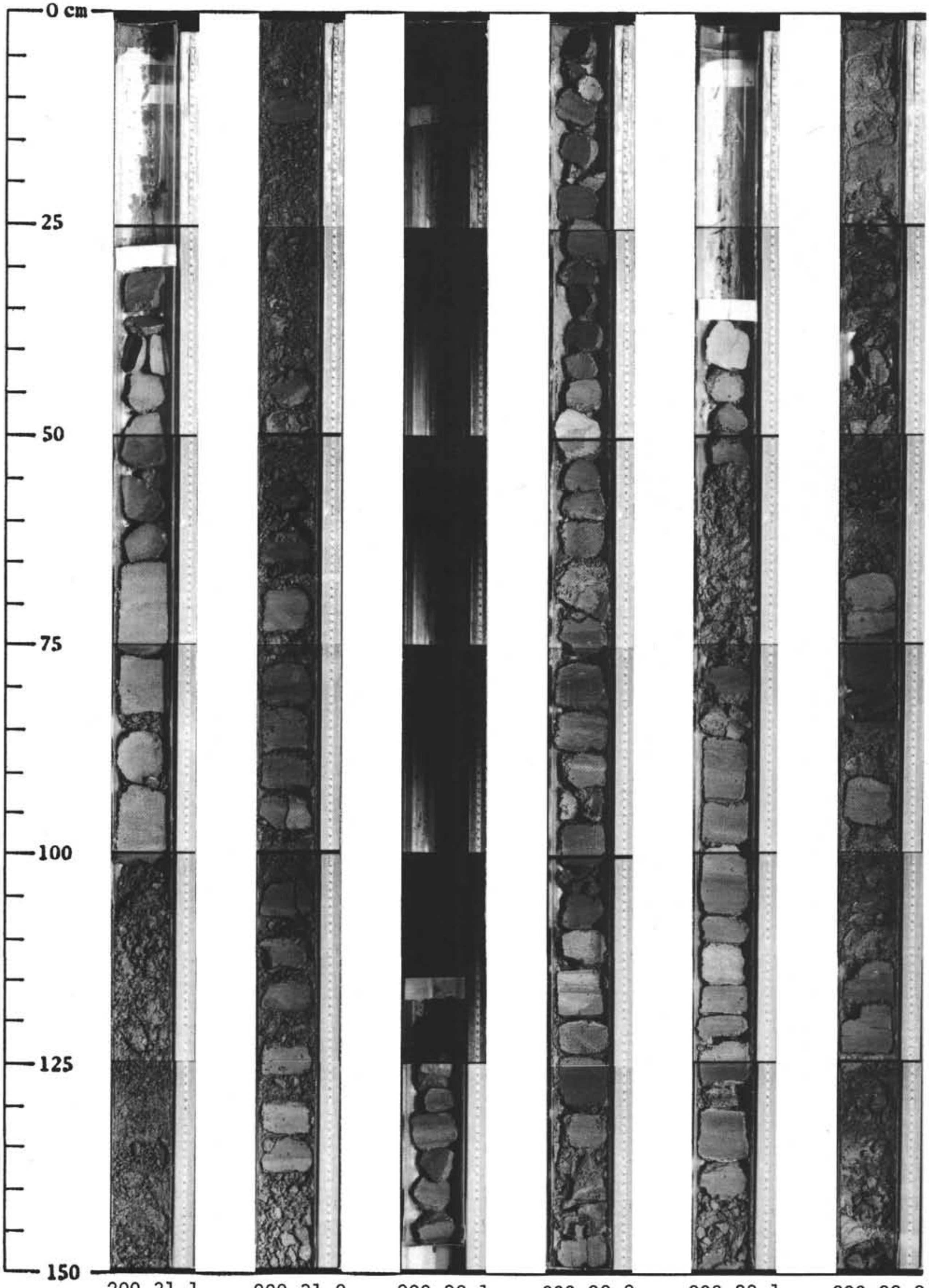
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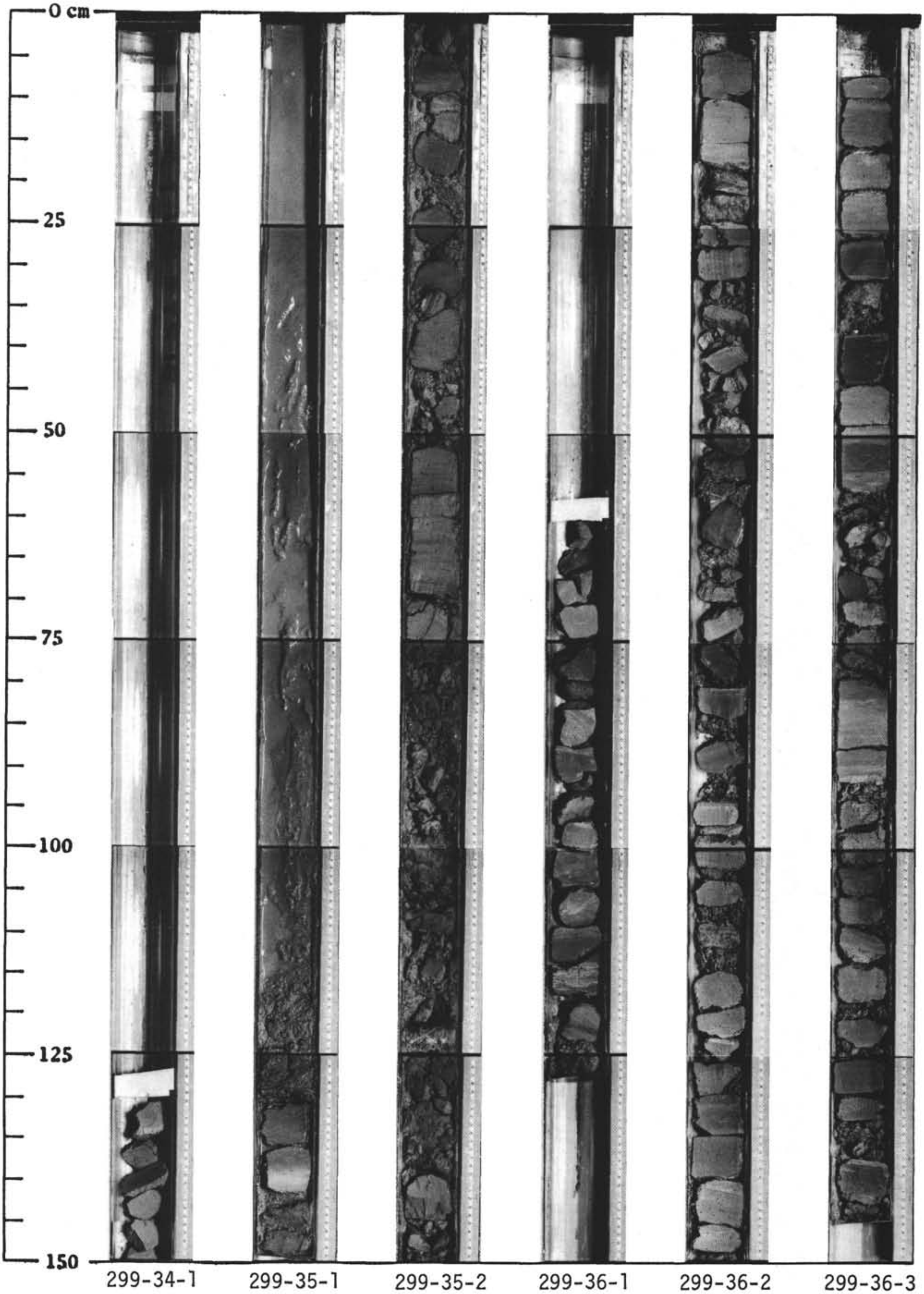
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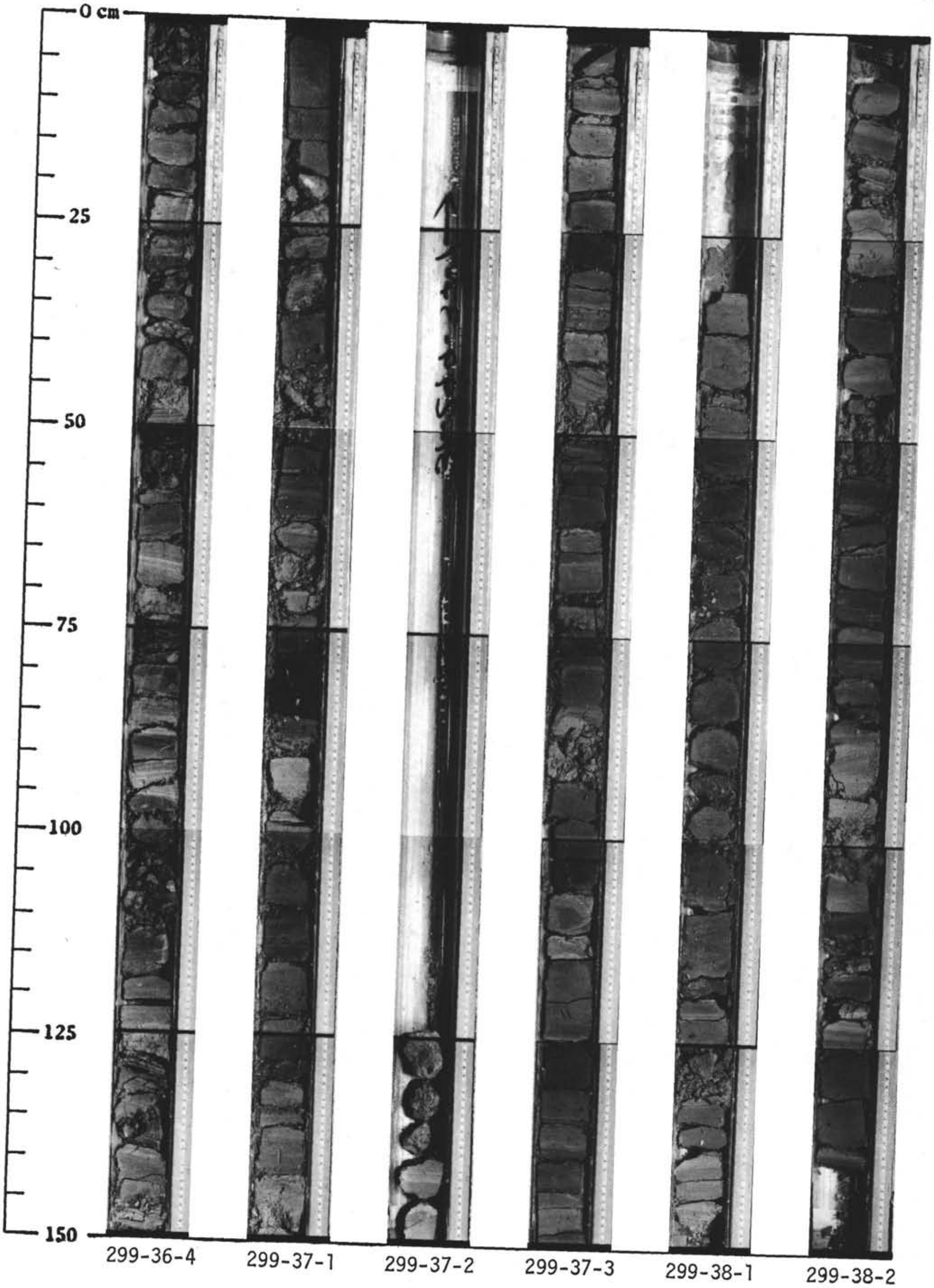
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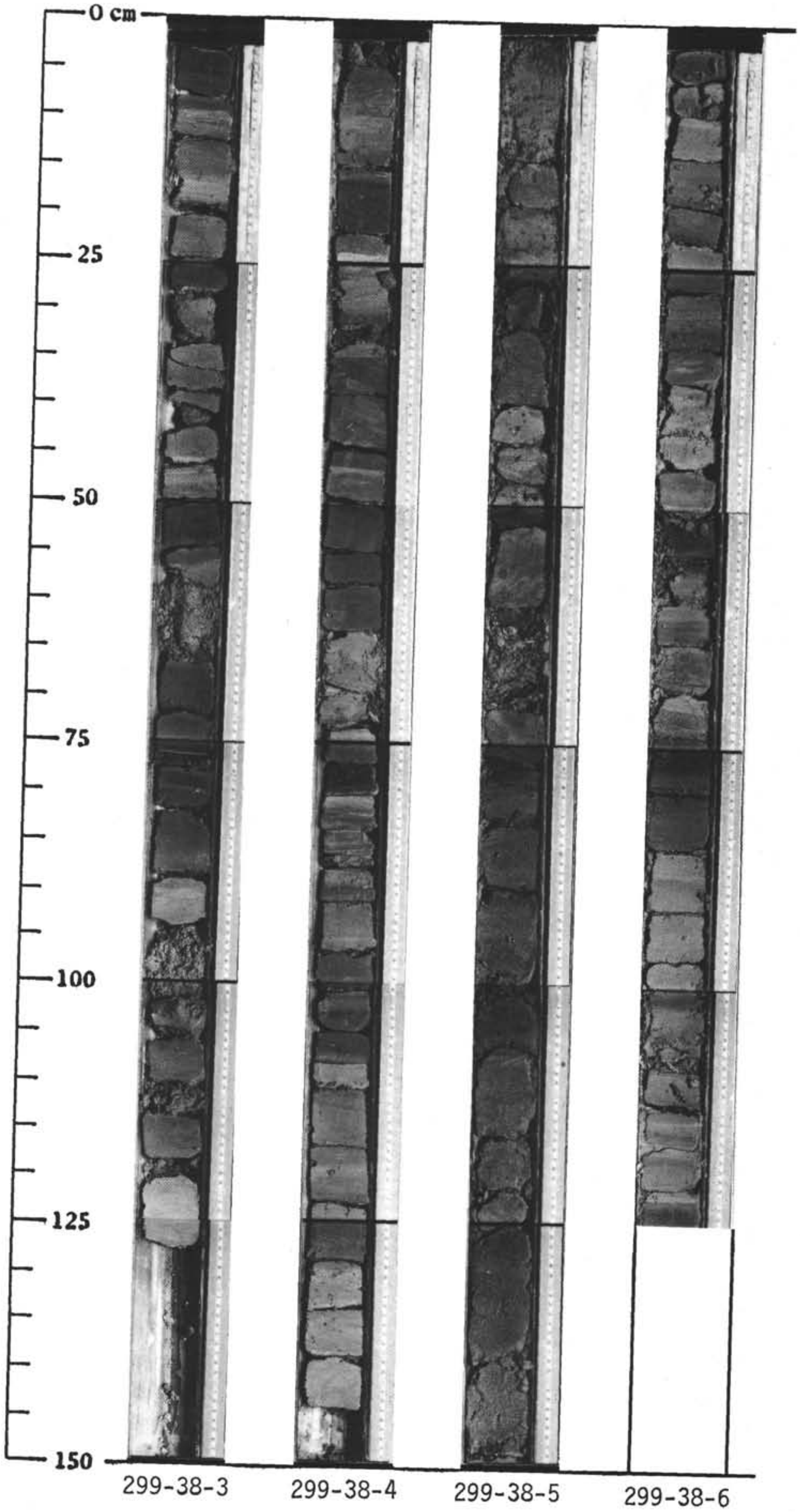
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