2. SITE 366: SIERRA LEONE RISE

The Shipboard Scientific Party[1], [2]

SITE DATA

Date Occupied: 22 February 1975 (1140Z)

Date Departed: 1 March 1975 (1614Z)

Time on Site: 7 days, 4 hours, 34 minutes

Position:
Holes 336 and 336A: 05°40.7'N, 19°51.1'W

Accepted Water Depth: 2853 corrected meters (echo sounding)

Bottom Felt With Drill Pipe at: 2870 meters, below rig floor

Penetration: 850.5 meters

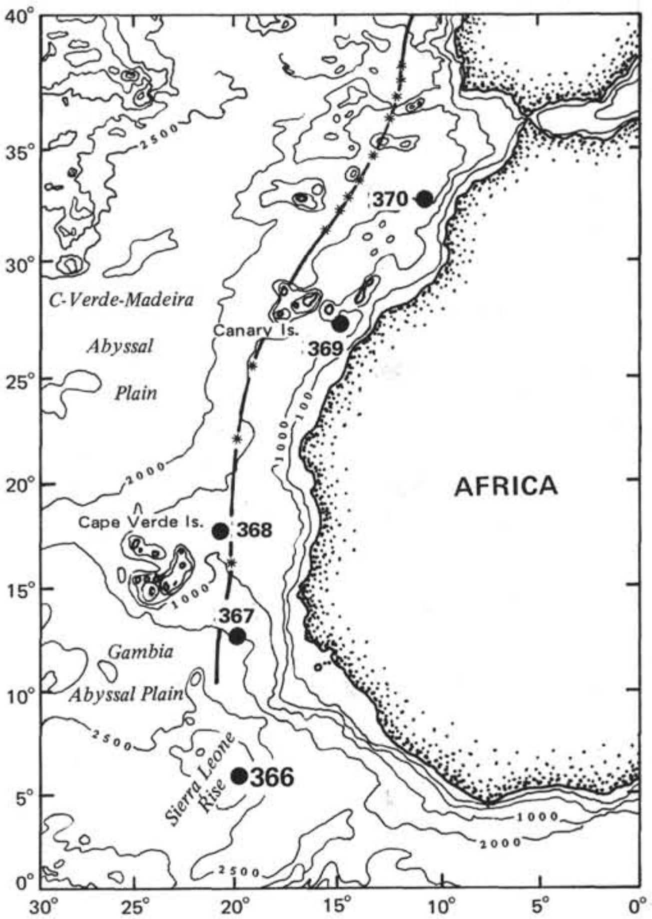
Number of Holes: 2

Number of Cores:
Hole 336: 55
Hole 336A: 39

Total Length of Cored Section: 850.5 meters

Total Core Recovered: 582 meters

Oldest Sediment Cored:
Age: Maestrichtian
Nature: Limestone



BACKGROUND AND OBJECTIVES

Background

The Sierra Leone Rise can be considered the boundary between the eastern basins of the North and South Atlantic. It is a broad elevation, oriented southwest-northeast and centered around 5°N (Figures 1 and 2). At the 4000 meter contour the rise is about 600 km in length and up to 400 km in width. It is separated from the Guinea Plateau to the northeast by a narrow depression, probably the trace of the Guinea Fracture Zone. The Sierra Leone Rise consists of two morphological provinces separated by a broad southwest-northeast depression. Seismic profiles of the rise recorded by Lamont-Doherty Geological Observatory's R/V *Vema* show that the northwestern province exhibits a rough topography with high and steep basement peaks penetrating the sediment cover. The topography in the southeastern part of the rise is much smoother, and the rise consists of a broad basement swell covered with regularly although moderately stratified sediments forming a southwest-northeast trending plateau with dimensions of about 100 by 150 km in 2700 to 2900 meters of water (Figure 3). A relatively strong reflector observed in the middle part of the sedimentary section can be traced to the deep basin where it appears to be the equivalent of Horizon A defined in the western Atlantic. The maximum thickness of the sedimentary cover observed on the profiles reaches 1.0 sec in the southern part of the plateau and 0.9 sec in the northern part where Site

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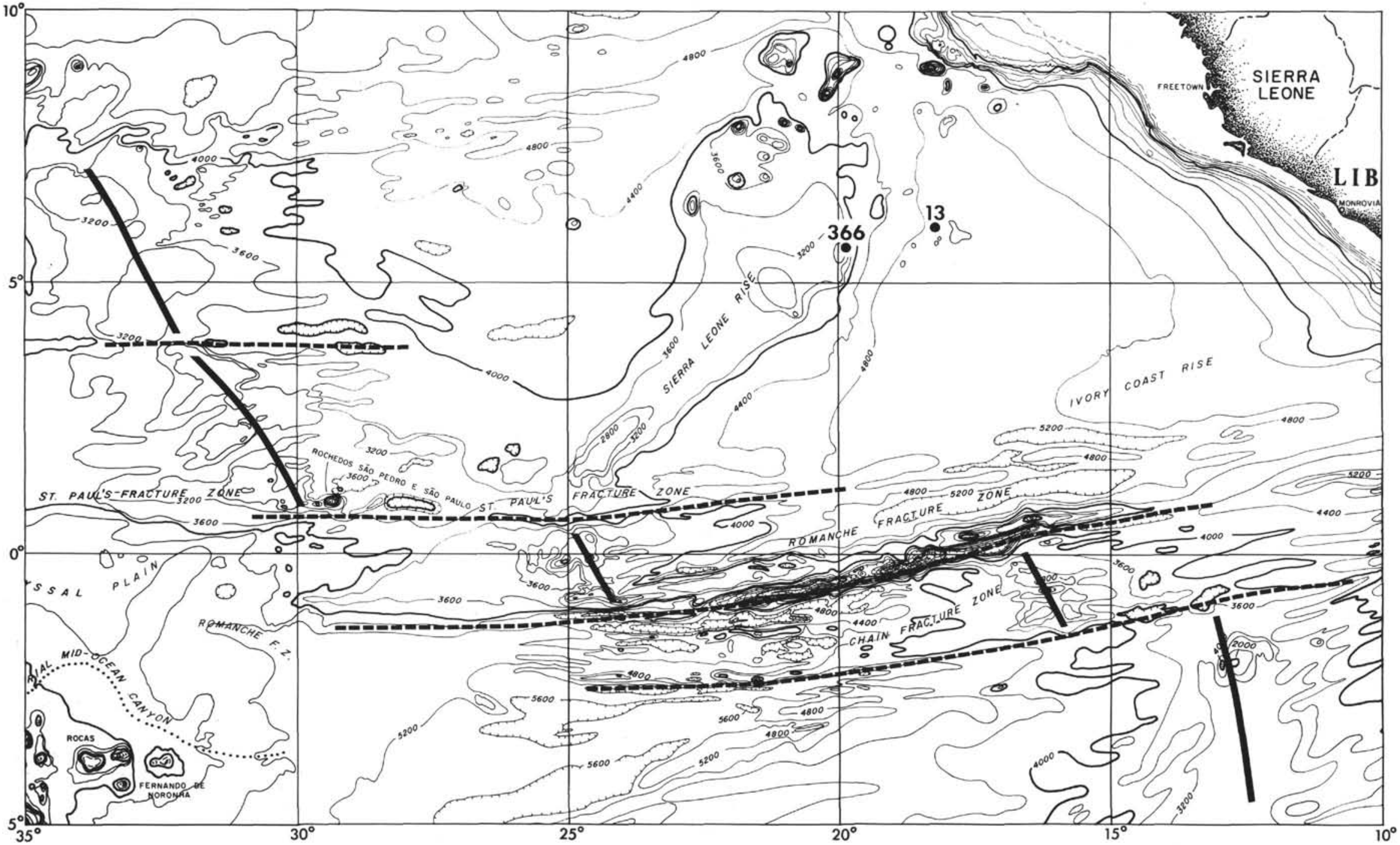

Figure 1. *General location of Site 366 with indication of the main structural trends in the vicinity of Sierra Leone Rise. Solid heavy line indicates the ridge axis; dashed lines indicate major fracture zones. Bathymetry from Uchupi (1971).*

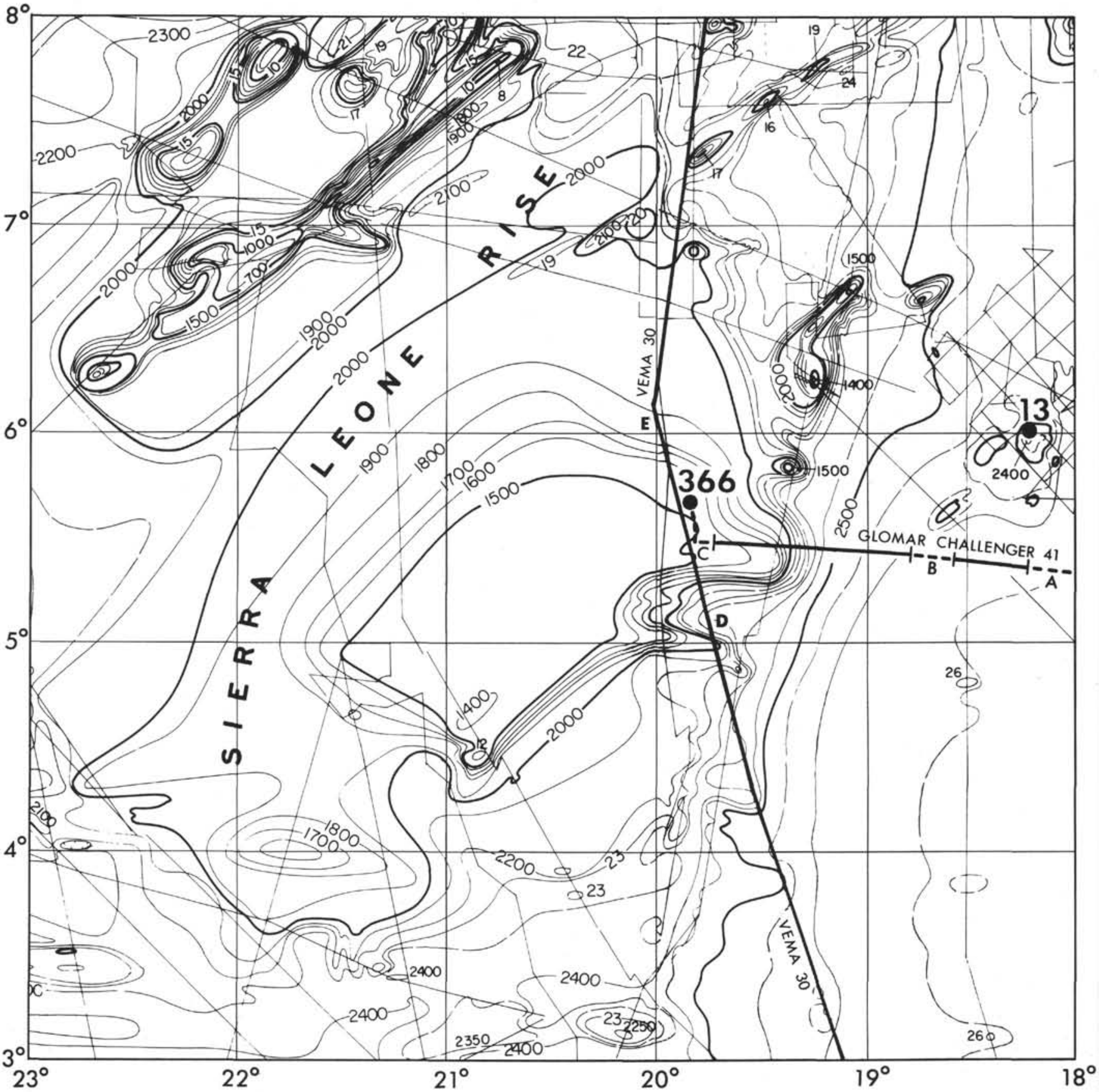

Figure 2. *Bathymetry of Sierra Leone Rise in the vicinity of Site 366 (Jacobi and Hayes, in preparation) A, B, and C, on the* Glomar Challenger *track refer to PDR profiles displayed in Figure 6.*

366 is located, although the acoustic basement is not always clearly visible. The nature of the acoustic basement is unknown and, although good continuity with what is believed to be the oceanic basement of the adjacent basins can sometimes be observed in the middle part of the rise, the picture is not as clear in the northern area. In any case, the nature and age of the basement, between the rise and the African margin off Guinea, Sierra Leone, and Liberia, are very poorly known. The age of the oceanic crust on the western side of the rise is also poorly known because of the lack of interpretable magnetic lineations. This results in part from the low latitude of the area.

During Leg 3 of the Deep Sea Drilling Project, Site 13 was drilled on a small satellite rise near the base of the eastern flank of the Sierra Leone Rise in 4588 meters of water (Maxwell et al., 1970). Only part of the scientific objectives of that site could be met because of technical difficulties. The section sampled consists of Tertiary carbonate ooze and clay with radiolarian ooze and chert occurring in the Eocene sediments. The Upper Cretaceous section was sparsely sampled but

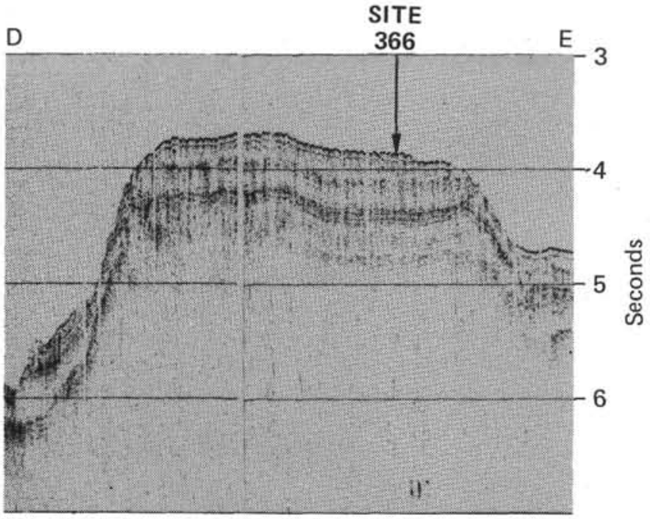

Figure 3. Vema *30 seismic reflection profile recorded on the eastern part of Sierra Leone Rise (see location on Figure 2).*

consists of chert, limestone, and shale; the oldest sediments recovered are of Senonian age. Prior to Leg 41, the Tertiary and Upper Cretaceous history of the rise was still poorly known and the early Cretaceous history totally unknown.

Objectives

Improvements in the drilling technique and especially the use of new drill bits which are capable of better penetration in hard rock led the JOIDES Atlantic Advisory Panel to consider another attempt at obtaining a better record of the Cenozoic and Mesozoic sediments from Sierra Leone Rise. It was decided to select a site near the top of the rise in order to obtain a more complete and better-preserved carbonate section. Furthermore, the Sierra Leone Rise appears to be one of the few elevated areas of the eastern North Atlantic clearly separated from the margin and hence from any large source of terrigenous material.

The three major objectives assigned to this site were to: (1) obtain a good stratigraphic record for Late Cretaceous and Tertiary; (2) decipher the subsidence history of the rise and its possible role as a barrier capable of restricting the circulation of bottom water between the North and South Atlantic in the past and; (3) eventually determine the nature of the basement, if it could be reached.

Biostratigraphic Record

Sierra Leone Rise was judged to offer one of the best chances to sample a complete section of the Upper Cretaceous and Tertiary in a low latitude area. The main hiatuses observed on many other rises both in the Atlantic and in other oceans were expected to be either absent or restricted in time because the rise was permanently beneath a relatively high-productivity environment. Therefore, particular attention was to be directed toward sampling critical stratigraphic units in the middle Miocene, the Oligocene, lower Eocene to lower Paleocene, and the Cretaceous/Tertiary boundary sections, all times of observed hiatuses on other rises and in the basins.

Paleocirculation and Subsidence

The major hiatuses mentioned above are probably directly related to paleocirculation. The Paleocene to middle Eocene hiatus appears to be of worldwide significance because it has been observed in various parts of the Atlantic and Pacific oceans. A late Eocene to Oligocene hiatus has been consistently observed in the North and South Atlantic and appears to be correlated with a major acoustic reflector on the North African margin. This reflector extends from Rockall Bank and Bay of Biscay (Leg 12) to the African margin (Leg 14) and south in the eastern and western South Atlantic basins (Legs 39 and 40). A middle Miocene hiatus was also found during Leg 39 in the southwestern Atlantic. It is not clear if some of these Tertiary hiatuses can be directly related to erosion or nondeposition caused by the initiation of vigorous circulation of Antarctic Bottom Water, or if they result from a sudden increase in the dissolution of carbonates, or possibly from a combination of these two factors. The occurrence of such hiatuses on Sierra Leone Rise would help to confirm their oceanwide significance. This site was also judged to offer a good opportunity to study dissolution facies during the critical periods indicated above because of the anticipated purely pelagic (undiluted) calcareous section. In addition, the possible occurrence of shallow-water carbonate sediments near the base of the section should help document the subsidence history of the Sierra Leone Rise.

Nature of the Basement

The seismic reflection profile recorded at the proposed site (Figure 3) does not provide a good picture of the acoustic basement and the nature of this lowermost reflector is problematical. Although geometric reconstructions of the Atlantic Ocean for the Early Cretaceous suggest that Sierra Leone Rise lies on oceanic crust, the origin of such an elevation remains unclear and it was hoped that by sampling basement rocks new information could be obtained relative to the nature of the underlying crust and the mode of formation of the rise.

STRATEGY

Because the re-entry device was not available for Leg 41, we decided to use the alternate strategy recommended and successfully used by Schlanger, Jackson, et al. (1976) during Leg 33. This strategy consists of washing down with very limited coring in the upper part of the section until hard layers are encountered, and continuous coring until the maximum penetration permissible with one drill bit. Then, if it is judged that a new bit is necessary for continuously coring the previously by-passed upper section, the drill string is retrieved and lowered again. Another option is to pull the string out of the hole and punch core continuously the upper soft sediment with the damaged bit used for the first run. This strategy presents the advantage of minimizing the rotation time of the bit before it reaches the harder layers. It also considerably reduces the total time spent within the hole and therefore reduces chances of having the hole collapse before the deep objectives can be reached.

OPERATIONS

The site was approached from the south (Figure 4) on a course parallel to that of the reference profile *Vema* 30 from Lamont-Doherty Geological Observatory. The Lamont track was nearly intercepted on a 274° course at 0936 hr (local time) on 22 February 1975. The ship then steamed north for about 35 minutes and altered course to 340° for the final approach to the site. The seismic record obtained onboard (Figure 5) compared relatively well with the Lamont *Vema* 30 reference profile so it was decided to reduce speed and drop the beacon underway whenever a suitable location could be observed.

Ideally, the site should be located in a syncline and as far away as possible from the northern slope. Such a location was reached at 5°41'N and 19°51'W. The seismic reflection profile shows a series of parallel reflectors comparable to those observed on the Lamont profile.

A pre-soaked beacon was dropped at 1040 hr (local time) and several minutes later, after observing that the sediment section appeared undisturbed and complete on the profile, the seismic gear was retrieved and the ship reversed course to "lock on" over the beacon. The PDR water depth read 2847 meters corrected.

Running in drill pipe commenced immediately and the bottom was felt by the driller at 1948 hr (local time) when the total length of pipe below the rig floor reached 2870 meters. The drill pipe water depth of 2860 meters was accepted as the Site 366 water depth.

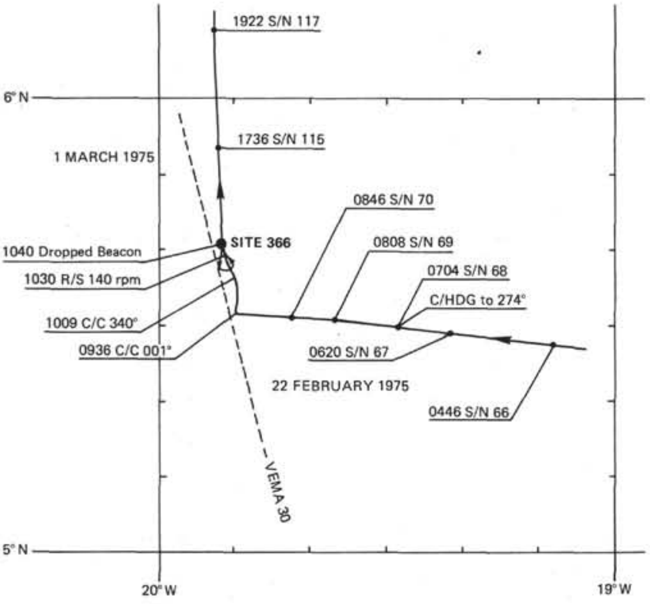

Figure 4. *Track of* Glomar Challenger *approaching and leaving Site 366. Dotted line is track of* Vema *30 used as a reference profile for selection of the site.*

The first core was punched without rotation or circulation for five meters. Another core, immediately below the first one, was obtained in the same manner. Then the intermittent coring of the upper section began, down to 366 meters. Below that level, coring was continuous (Table 1). Recovery was generally good to excellent in chalk except in the most cherty part of the section. The rate of penetration varied with minor changes in the lithology and ranged from about 25 minutes to over 1 hr per core, depending mainly on the chert content. After a succession of long marly limestone cores, characterized by a very good recovery (Table 1), Core 52 recovered only a small, tapered core-catcher sample. Core 53 yielded the same result. Because the water pressure gauge indicated an anomalously high reading while pumping the core barrel down, it was felt that the bit might be plugged and the center bit was dropped in order to clear it. Another attempt at coring (Core 54) was unsuccessful and the operation was repeated with mud pumped down at high pressure. The core barrel was dropped for Core 55 and again retrieved empty. The continuing high water pressure indication suggested that the bit was still plugged and it was decided to pull out of the hole, terminating Hole 366 at a total depth of 850.5 meters sub-bottom.

The drill string was retrieved and the bit was on deck at 1130 hr (local time) on 27 February. It was found plugged by tightly packed sediment, as predicted. The sediment plug was thick enough so as to prevent correct seating and latching of the core barrel. Otherwise the drill bit was in good condition except for slightly sticky cones and some missing inserts. The Teflon rings of the bit seal were broken, although none of them blocked the entrance of the core barrel. The rings were replaced before the bit was put back in place. It was decided to use the same bit to continuously core the relatively soft upper part of the section down to 366 meters sub-bottom. Drill pipe was run down for drilling Hole 366A and the sea floor was reached at 2041 hr (local time) when the total length of the drill string recorded 2869 meters below the rig floor.

Coring was continuous with a relatively good recovery except in some of the soft chalk layers. Neither broken circulation nor minor pumping seemed to prove very effective in solving that problem. Coring was terminated after Core 39A had been cut at 0918 hr on 1 March. At that time, the total penetration in Hole 366A was 367 meters sub-bottom, 1 meter deeper than the depth at which continuous coring started in Hole 366. The drill string was recovered and the ship was underway on 2 March at 1514 hr. The post-site survey consisted of a run at 5 knots over the beacon on the same course as the final approach (see profile on Figure 5). Cruise speed was resumed shortly thereafter and the course was set toward Site 367.

A sonobuoy record was attempted on site, using various frequency settings, but because the buoy had to be tethered, neither wide-angle reflections nor refractions were expected. The sonobuoy record was terminated when the ship began backing over the airguns. Weather conditions were excellent during the entire week spent on site and this probably accounts in

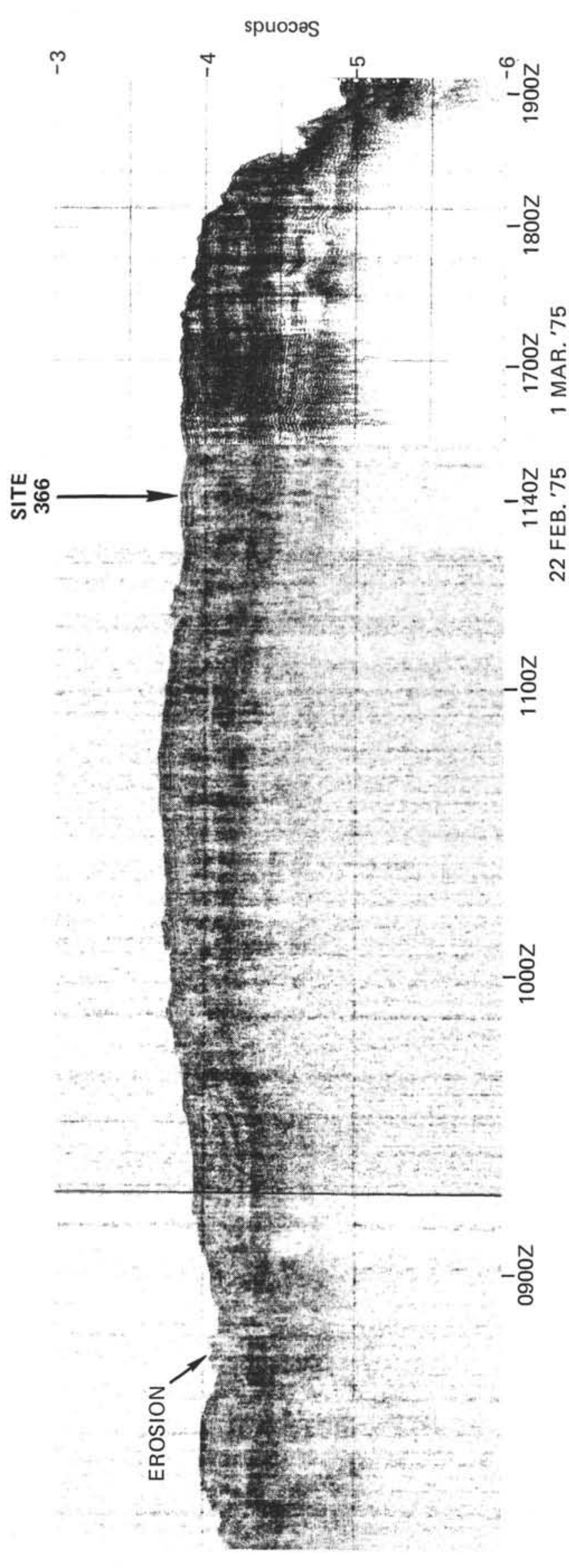

Figure 5. Glomar Challenger *seismic reflection profile recorded while approaching and leaving Site 366.*

part for the good record of the drill bit prior to its plugging.

UNDERWAY OBSERVATIONS

The PDR profiles (Figure 6) recorded along the approach courses exhibit some interesting features. The record obtained in the Sierra Leone Basin abyssal plain (Figure 6a) shows a smooth sea floor and several (up to four) subbottom reflectors. Such penetration with a 12-kHz PDR can be related to the possible occurrence of very fine-grained and soft sediments at the sea floor, which suggests a low-energy environment with minimal bottom-water circulation in recent times. While approaching the base of Sierra Leone Rise, the character of the PDR record changed and the occurrence of small depressions at the base of basement peaks (Figure 6b) is indicative of some bottom-current circulation. Finally the upper part of the rise (Figure 6c) exhibits a relatively rough microtopography suggesting some erosion by bottom currents. The seismic reflection profile recorded while approaching the site (Figure 3) shows particularly good evidence of such erosion where a channel is cutting relatively deep within the upper part of the sedimentary section.

LITHOLOGY

Introduction

The sediments of Site 366 are predominantly a pelagic carbonate facies. We subdivided the section into four units, based on composition and color. Table 2 summarizes the lithologic sequence.

Lithologic Descriptions

Unit 1—Nannofossil Marl and Ooze
(Cores 1A through 15A, Section 4)

This unit is composed of nannofossil marl and ooze with varying abundances of foraminifers, radiolarians, and diatoms. The first seven cores sampled nannofossil ooze and marl of moderate yellowish brown (10YR5/4) to dark yellowish brown (10YR5/8) color with $CaCO_3$ contents ranging from 47% to 88%. The next eight cores are classified as nannofossil oozes on the basis of higher $CaCO_3$ content (64% to 86%). They are very light gray (N8) to light olive-gray (5Y6/1). The whole unit is mottled, and in places contains very thin (5 to 15 cm) clay interbeds. This unit contains rare to common (1% to 25%) foraminifers, rare radiolarians (only in the Pleistocene section), diatoms, black ferromanganese (?) flecks, and fish debris. Cores 1 and 2 contain both marine and fresh-water diatoms and opal phytoliths.

Intense drilling disturbance in this unit precludes any further detailed description of sedimentary structures, contacts, or interbeds.

Unit 2—Cyclic Alternations of Nannofossil Ooze or Nannofossil Chalk and Nannofossil Marl or Pelagic Clay
(Cores 15A, Section 5 [Hole 366A], through Core 16 [Hole 366])

This unit consists of cyclic alternations of nannofossil ooze and nannofossil marl ($CaCO_3$ ranges from

TABLE 1
Coring Summary, Site 366

Core	Date (Feb. 1975)	Time	Depth From Drill Floor (m)	Depth Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovery (%)
Hole 366							
1	22	2029	2870.0-2875.0	0.0-5.0	5.0	5.2	100
2	22	2138	2875.0-2884.5	5.0-14.5	9.5	7.7	81
3	22	2345	2989.0-2998.5	119.0-128.5	9.5	9.4	99
4	23	0255	3112.5-3122.0	242.5-252.0	9.5	3.8	40
5	23	0600	3236.0-3245.5	366.0-375.5	9.5	9.5	100
6	23	0709	3245.5-3255.0	375.5-385.0	9.5	8.1	85
7	23	0815	3255.0-3264.5	385.0-394.5	9.5	6.75	71
8	23	0930	3264.5-3274.0	394.5-404.0	9.5	4.85	51
9	23	1050	3274.0-3283.5	404.0-413.5	9.5	5.95	63
10	23	1158	3283.5-3293.0	413.5-423.0	9.5	9.1	96
11	23	1327	3293.0-3302.5	423.0-432.5	9.5	1.65	17
12	23	1451	3302.5-3312.0	432.5-442.0	9.5	5.8	61
13	23	1612	3312.0-3321.5	442.0-451.5	9.5	3.4	36
14	23	1725	3321.5-3331.0	451.5-461.0	9.5	6.9	73
15	23	1847	3331.0-3340.5	461.0-470.5	9.5	3.1	33
16	23	2011	3340.5-3350.0	470.5-480.0	9.5	3.2	34
17	23	2205	3350.0-3359.5	480.0-489.5	9.5	0.5	5
18	24	0023	3359.5-3369.0	489.5-499.0	9.5	0.5	5
19	24	0202	3369.0-3378.5	499.0-508.5	9.5	1.1	12
20	24	0415	3378.5-3388.0	508.5-518.0	9.5	1.8	19
21	24	0635	3388.0-3397.5	518.0-527.5	9.5	3.5	37
22	24	0821	3397.5-3407.0	527.5-537.0	9.5	3.2	34
23	24	1035	3407.0-3416.5	537.0-546.5	9.5	3.1	33
24	24	1322	3416.5-3426.0	546.5-556.0	9.5	4.9	52
25	24	1533	3426.0-3435.5	556.0-565.5	9.5	1.8	19
26	24	1733	3435.5-3445.0	565.5-575.0	9.5	3.2	34
27	24	1938	3445.0-3454.5	575.0-584.5	9.5	7.5	79
28	24	2139	3454.5-3464.0	584.5-594.0	9.5	6.5	68
29	24	2316	3464.0-3473.5	594.0-603.5	9.5	6.0	63
30	25	0125	3473.5-3483.0	603.5-613.0	9.5	0.6	6
31	25	0338	3483.0-3492.5	613.0-622.5	9.5	5.6	59
32	25	0545	3492.5-3502.0	622.5-632.0	9.5	7.0	74
33	25	0747	3502.0-3511.5	632.0-641.5	9.5	6.4	67
34	25	0940	3511.5-3521.0	641.5-651.0	9.5	6.7	71
35	25	1140	3521.0-3530.5	651.0-660.5	9.5	7.8	82
36	25	1319	3530.5-3540.0	660.5-670.0	9.5	7.1	75
37	25	1444	3540.0-3549.5	670.0-679.5	9.5	8.8	93
38	25	1601	3549.5-3559.0	679.5-689.0	9.5	8.3	87
39	25	1720	3559.0-3568.5	689.0-698.5	9.5	8.1	85
40	25	1845	3568.5-3578.0	698.5-708.0	9.5	8.8	93
41	25	2004	3578.0-3587.5	708.0-717.5	9.5	8.2	86
42	25	2140	3587.5-3597.0	717.5-727.0	9.5	9.5	100
43	25	2344	3597.0-3606.5	727.0-736.5	9.5	9.5	100
44	26	0213	3606.5-3616.0	736.5-746.0	9.5	7.5	79
45	26	0444	3616.0-3625.5	746.0-755.5	9.5	8.5	90
46	26	0715	3625.5-3635.0	755.5-765.0	9.5	3.6	38
47	26	0915	3635.0-3644.5	765.0-774.5	9.5	9.5+	100+
48	26	1225	3644.5-3654.0	774.5-784.0	9.5	9.5+	100+
49	26	1408	3654.0-3663.5	784.0-793.5	9.5	8.7	92
50	26	1610	3663.5-3673.0	793.5-803.0	9.5	6.4	67
51	26	1759	3673.0-3682.5	803.0-812.5	9.5	9.5+	100+
52	26	1941	3682.5-3692.0	812.5-822.0	9.5	0.2	2
53	26	2119	3692.0-3701.5	822.0-831.5	9.5	0.2	2
54	27	0036	3701.5-3711.0	831.5-841.0	9.5	0.0	0
55	27	0440	3711.0-3720.5	841.0-850.5	9.5	0.0	0
					518.0	304.0	59
Hole 366A							
1	27	2124	2869.0-2875.0	0.0-6.0	6.0	6.0	100
2	27	2227	2875.0-2884.5	6.0-15.5	9.5	9.5	100
3	27	2318	2884.5-2894.0	15.5-25.0	9.5	8.6	91
4	28	0008	2894.0-2903.5	25.0-34.5	9.5	9.2	97
5	28	0058	2903.5-2913.0	34.5-44.0	9.5	9.3	98
6	28	0144	2913.0-2922.5	44.0-53.5	9.5	8.6	91

TABLE 1 – *Continued*

Core	Date (Feb. 1975)	Time	Depth From Drill Floor (m)	Depth Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovery (%)
Hole 366A – *Continued*							
7	28	0233	2922.5-2932.0	53.5-63.0	9.5	6.0	95
8	28	0320	2932.0-2941.5	63.0-72.5	9.5	8.8	93
9	28	0415	2941.5-2951.0	72.5-82.0	9.5	8.4	88
10	28	0511	2951.0-2960.5	82.0-91.5	9.5	1.6	17
11	28	0604	2960.5-2970.0	91.5-101.0	9.5	8.4	88
12	28	0656	2970.0-2979.5	101.0-110.5	9.5	8.8	93
13	28	0748	2979.5-2989.0	110.5-120.0	9.5	7.3	77
14	28	0846	2989.0-2998.5	120.0-129.5	9.5	9.5	100
15	28	0935	2998.5-3008.0	129.5-139.0	9.5	9.5	100
16	28	1045	3008.0-3017.5	139.0-148.5	9.5	7.4	78
17	28	1145	3017.5-3027.0	148.5-158.0	9.5	9.5	100
18	28	1237	3027.0-3036.5	158.0-167.5	9.5	8.6	91
19	28	1325	3036.5-3046.0	167.5-177.0	9.5	0.0	0
20	28	1433	3046.0-3055.5	177.0-186.5	9.5	3.5	37
21	28	1545	3055.5-3065.0	186.5-196.0	9.5	9.5	100
22	28	1633	3065.0-3074.5	196.0-205.5	9.5	2.5	26
23	28	1730	3074.5-3084.0	205.5-215.0	9.5	9.1	96
24	28	1818	3084.0-3093.5	215.0-224.5	9.5	2.4	25
25	28	1914	3093.5-3103.0	224.5-234.0	9.5	1.5	16
26	28	2009	3103.0-3112.5	234.0-243.5	9.5	7.2	76
27	28	2058	3112.5-3122.0	243.5-253.0	9.5	8.3	87
28	28	2157	3122.0-3131.5	253.0-262.5	9.5	9.5	100
29	28	2251	3131.5-3141.0	262.5-272.0	9.5	8.6	91
30	28	2347	3141.0-3150.5	272.0-281.5	9.5	9.3	98
	March						
31	1	0048	3150.5-3160.0	281.5-291.0	9.5	6.5	68
32	1	0225	3160.0-3169.5	291.0-300.5	9.5	0.2	2
33	1	0319	3169.5-3179.0	300.5-310.0	9.5	8.4	88
34	1	0424	3179.0-3188.5	310.0-319.5	9.5	8.7	92
35	1	0523	3188.5-3198.0	319.5-329.0	9.5	7.9	83
36	1	0624	3198.0-3207.5	329.0-338.5	9.5	6.6	70
37	1	0720	3207.5-3217.0	338.5-348.0	9.5	8.0	84
38	1	0820	3217.0-3226.5	348.0-357.5	9.5	6.2	65
39	1	0918	3226.5-3236.0	357.5-367.0	9.5	6.1	64
Total					367.0	278.0	76

41% to 90%) which grade into cycles of nannofossil chalk (60% to 90% $CaCO_3$) and pelagic clay in Cores 23A through 16. The nannofossil ooze and nannofossil chalk are typically light greenish-gray (5GY8/1). The ooze becomes semilithified at 366 meters and thus is classified as chalk. The $CaCO_3$ content of these sediments varies from 65% to 90%. Burrows are common in this facies (see Harrington, this volume), especially *Chondrites* and *Zoophycos*, and some *Helminthoida*. Clay, foraminifers, radiolarians, fish debris, and ferromanganese(?) flecks and liesegang halos are rare to common and appear throughout these sediments. The halos are especially common around burrows (Figure 7).

The nannofossil marl and pelagic clay are yellowish brown (10YR5/4; marl) to dark greenish gray (5G6/1; pelagic clay). They are both burrowed with *Zoophycos* and *Chondrites* and some sections show thin parallel, horizontal laminations. Smear-slide analyses show rare to common nannofossils, radiolarians, sponge spicules, fish debris, and common diatoms. The varying abundance of nannofossils and lack of foraminifers distinguish this facies from the nannofossil ooze and chalk.

Each cycle of Unit 2 is characterized by a nannofossil ooze overlying a nannofossil marl, or chalk over pelagic clay. The cycles vary from 10 cm to over 50 cm in thickness, and the more calcareous facies is always the thicker of the two components. Within each cycle the contact between the lower marl and the upper ooze is gradational, but the boundary separating individual cycles is generally sharp. See Dean et al., this volume, for more detailed description of these cycles.

Unit 3—Cyclic Alternations of Nannofossil Chalk and Porcellanite or Chert, and Siliceous Limestone (Cores 17 through 37)

Cyclic alternations of nannofossil chalk and siliceous limestone, porcellanite, and minor chert nodules characterize Unit 3. The nannofossil chalk is similar in most respects to that of Unit 2. They are light greenish gray (5GY8/1), semilithified, burrowed with *Zoophycos*, *Chondrites*, and some halo-rimmed burrows, and are laminated in some sections. The chalks have rare foraminifers and radiolarians and common euhedral and subhedral calcite. This facies grades into a siliceous limestone with depth, the

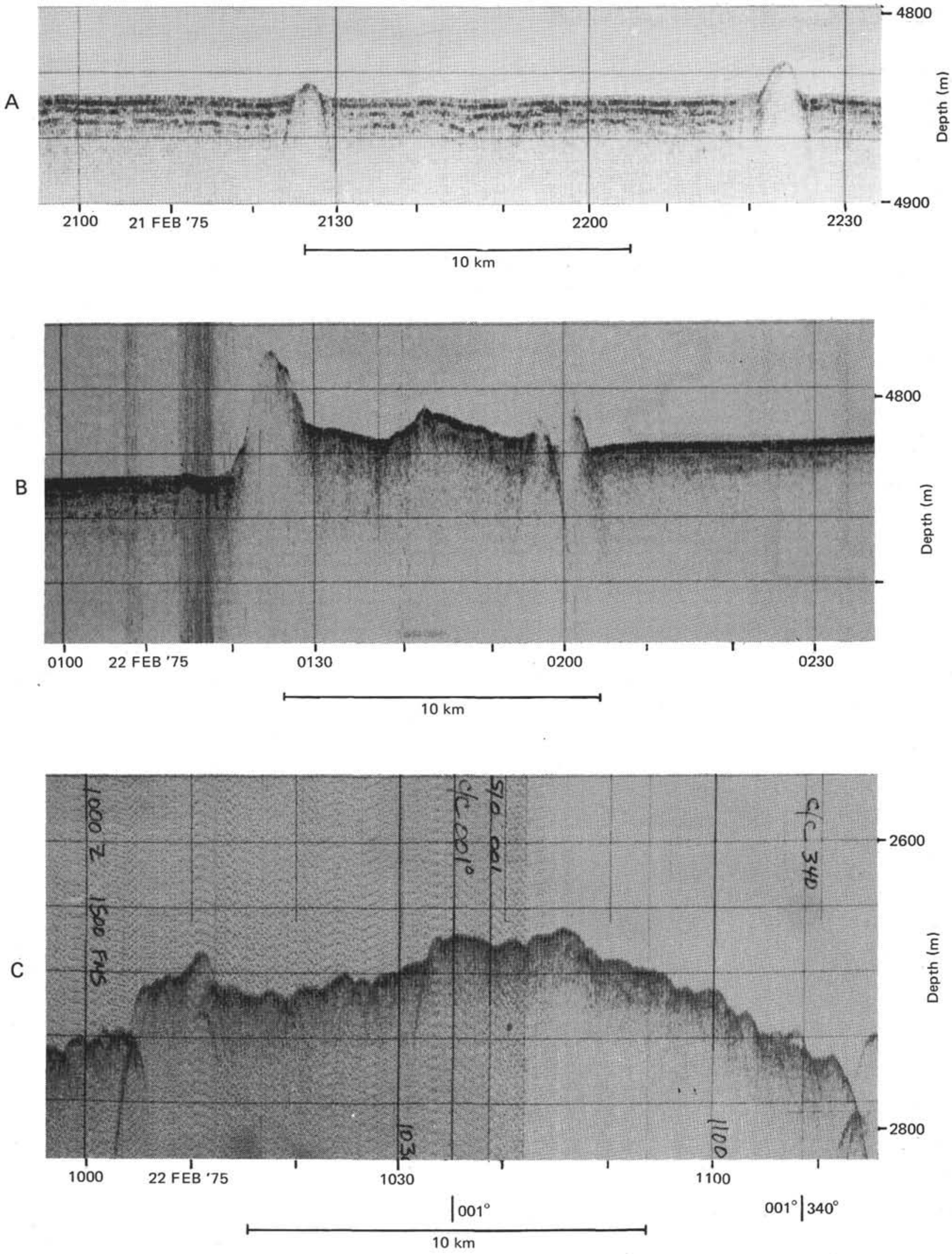

Figure 6. *Precision Depth Recorder (PDR) profiles recorded while approaching the Sierra Leone Rise (see location on Figure 2).*

TABLE 2
Lithostratigraphy at Site 366

Unit	Lithology	Cores	Age
1	Nanno marls and oozes	1A through 15A (0 to 136 m)	Pleistocene through middle Miocene
2	Cyclic alternations of nanno oozes or chalks and marls or pelagic clays	15A through 39A 5 through 16 (136 to 480 m)	Middle Miocene through middle Eocene
3	Cyclic alternations of nanno chalks and porcellanites/ cherts or siliceous limestones	17 through 37 (480 to 679.5 m)	Middle Eocene through early Eocene
4	Limestones and marlstones	38 through 55 (679.5 to 850.5 m)	Early Eocene to Upper Cretaceous

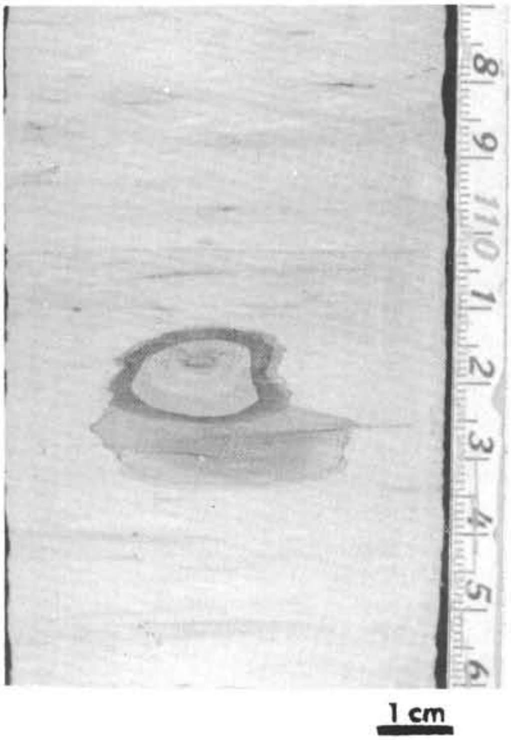

Figure 7. *Section of Sample 41-366-21-2, 117-126 cm, showing manganese (?) liesegang halos which are common throughout Unit 2.*

uppermost occurring in Core 26, Section 2 (567 m). The youngest cherts occur in Core 19, Section 1 (508 m).

The porcellanite is light gray (N7) and shows subconchoidal fracturing. These often grade into light olive-gray (5Y6/1) chert, especially in burrows and within thin laminae. A typical sequence consists of about 15 cm of chalk, overlying about 10 cm of silicified limestone, or porcellanite. Chert nodules, when present, occur in the bottom 5 cm of the siliceous limestone or porcellanite.

By Core 29 (594 m) the nannofossil chalk grades into an argillaceous limestone-siliceous limestone ($CaCO_3$ ranges from 68% to 84%). These are light gray (N8) to light greenish gray (5GY8/1) and have abundant ferromanganese(?) flecks, streaks, and laminae. The limestone is faintly laminated and contains abundant burrows. Thin interbeds of shale occur within the argillaceous limestone. Recrystallized calcite and calcite overgrowths on nannofossils are common in smear slides. Each cycle in this interval averages about 25 to 40 cm in length (4 to 6 cycles per core section), with about two-thirds of the cycle being the argillaceous limestone and one-third being the chert, porcellanite, or siliceous limestone.

The biogenic compositions of the two facies (siliceous limestone and argillaceous limestone), based on smear-slide descriptions, are quite similar; the clay and silica content are the main differences between facies. Both lithologies have abundant euhedral and subhedral calcite, rare foraminifers and radiolarians, and common nannofossils.

Unit 4—Limestone and Marlstone (Cores 38 through 55)

The principal lithologies of Unit 4 are greenish gray (5G6/1) argillaceous limestone and light gray (N7) siliceous limestone which grade with depth into light olive-gray (5Y6/1) marlstone (Core 48, Section 3, 776 m) having carbonate contents between 62% and 71%. This unit is thinly laminated and burrowed, with common thin (2 to 4 cm) shaly interbeds. Smear slides contain rare foraminifers and nannofossils, and abundant recrystallized calcite. Radiolarians become very rare to absent in this unit. Disseminated pyrite occurs in zones from Cores 44 through 46.

Thin (~5 cm) interbeds and lenses of calcarenite occurs from Core 41, Section 6, 130 cm, through Core 44, Section 5. These calcarenites contain abundant foraminifers ($CaCO_3$ content around 75%) with rare to common clay. They could represent lag deposits caused by current winnowing. The calcarenite lenses are commonly rimmed by a darker halo.

By Core 48, Section 3 (776 m), the above siliceous and argillaceous limestones have graded into a light olive-gray marlstone ($CaCO_3$ content 60%). The marlstone differs from the overlying limestone not only in composition but also in degree of cementation. Burrows, especially *Chondrites* and *Zoophycos*, are well developed in this lithology.

Summary

Overall, the sediments recovered at Site 366 provide an almost continuous record of open-marine pelagic conditions for the entire Cenozoic. The high $CaCO_3$ content of the section indicates that the Sierra Leone Rise has been above the CCD throughout the Cenozoic.

Unit 4 contains evidence of current winnowing, the only apparent breaks in sedimentation found in the entire section. The induration of the sediments and the occurrence of flattened burrows suggest a considerable amount of compaction.

The lower to middle Eocene section (Unit 3) consists of chalk and limestone of varying clay content. The variations in relative proportions of clay and $CaCO_3$ are interpreted as the result of $CaCO_3$ dissolution, and by dilution by terrigenous material (Dean et al., this volume). Cycles of $CaCO_3$ and clay, with periodicities on the order of 7000 to 21,000 years, are modified by post-depositional cementation by SiO_2 and $CaCO_3$.

Sediments with the highest $CaCO_3$ content were selected for both $CaCO_3$ and SiO_2 cementation, during diagenesis, which in alternations of siliceous limestone, and either chalk, marl, or argillaceous limestone, all containing more clay than the siliceous limestone.

The middle Eocene to middle Miocene chalks and marls (Unit 2) are also cyclic, but the cycles are relatively simple variations in proportions of $CaCO_3$ and clay and unmodified by $CaCO_3$ of SiO_2 cementation. Here, the two lithologies which make up a cycle, nannofossil ooze or chalk alternating with nannofossil marl or pelagic clay, are also interpreted as being mainly the result of $CaCO_3$ dissolution. The periodicities of these dissolution cycles are on the order of 30,000 to 50,000 years.

The middle Miocene to Holocene sediments (Unit 1) probably represent conditions prevailing on the Sierra Leone Rise today. Unfortunately, drilling disturbance was too intense to allow interpretation of any cyclicity.

The section sampled at Site 366 represents an excellent example of progressive diagenesis with depth in pelagic carbonate sediments (see Gardner et al., this volume). Unit 1 shows no obvious diagenetic features and minimal compaction, but Unit 2 shows evidence of compaction in some zones. This is followed in Unit 3 by calcite overgrowths on nannofossils, an increase in the number of zones showing compaction, and extensive cementation by $CaCO_3$ and SiO_2. Unit 4 shows extensive calcite overgrowths on nannofossils, sparry calcite infilling of foraminifer tests and almost all of the unit shows evidence of compaction and cementation.

The carbonate cycles of Site 366 can be correlated with equivalent cycles recovered from Leg 40, Site 363 and 362A, on the Walvis Ridge and Leg 39, Site 354, on the Ceará Rise (see Dean et al., this volume).

GEOCHEMICAL MEASUREMENTS

Carbon/Nitrogen Measurements

A method for shipboard measurements of organic carbon to total nitrogen ratios was developed while at this site using the Hewlett-Packard Model 185B CHN Analyzer. Details of the method are given in the Introduction (this volume).

Results for organic carbon and carbon:nitrogen determinations for Site 366 are given in Table 3. All weight percentages have been converted to total dry weight basis or atomic ratio for carbon:nitrogen. The sparsity of sampling in the upper sediment as well as low precision encountered in the method prevents any meaningful interpretation. An electronic problem in the CHN Analyzer prevented analyses of sediments from Hole 366A.

Interstitial Gas Analysis

No cores at Site 366 yielded noticeable gas; however, gas bubbles formed in Cores 8A, 19A, and 21A while waiting to be split. Sampling both through the end caps and liner failed to detect light hydrocarbons. Sections 8A-6 and 18A-4 had elevated CO_2. Assuming 300 ppm CO_2 for ocean air, the CO_2 concentration was 1817 ppm of gas recovered for Section 8A-6 and 1631 ppm for Section 18A-4. Gas in Section 21A-1 had no significant increase in CO_2.

Carbonate Bomb Measurements

The results of the "Carbonate Bomb" measurements for percent $CaCO_3$ are given in Table 4 and Figure 8 for Site 366. In order to help interpret the wide variations in percent $CaCO_3$, the lithology at each sampling interval in the cores is also given in Table 5. This lithology is based on the visual description and smear-slide examination made as soon as the cores were split.

Interstitial Water Chemistry

At Site 366, five whole sections, 6 cm long, were squeezed to collect samples for interstitial water chemistry. By Core 20-1, the sediment is so lithified that excessive hydraulic pressures are necessary, hence preventing further sampling down in the section. An additional six samples were squeezed at Hole 366A. Results are tabulated in Table 5 and graphic representation appears in Figure 9.

PHYSICAL PROPERTIES

Lithologic variations throughout the sequence are strongly reflected in the physical properties data (see Trabant, this volume, for description of techniques used). This site allows a comparison of physical properties to be made between siliceous and calcareous sediments. No major unconformities were discovered at this site, thus all changes in physical properties may be attributed directly to primary variations in sedimentation and to diagenetic effects caused by compaction, cementation, and dissolution.

Bulk Properties

Bulk-property measurements were taken from one section of each core for bulk density, water content, void ratio, porosity, and specific gravity solids. Sound velocity and shear strength data were obtained, where feasible, prior to sampling for bulk properties measurements.

Porosities are equitable values in the description of sediment bulk properties but any of the other parameters would have been just as descriptive. A plot of porosities against depth is shown in Figure 10. The lithologic boundaries correspond with sharp changes in porosity values. Each unit is characterized by definite porosity ranges. The lowest values (10% to 15%) occur within the interbedded cherts and porcellanites of Unit 3. Two zones with relatively high porosities occur within the early Miocene (150 to 250 m) and early Eocene (600 to 700 m) where accumulation rates were high 40 and 60 m/m.y., respectively. Porosities within the lower Miocene section of nannofossil ooze and marl range between 60% and 65%. The chalk and limestone within the lower Eocene interval have porosities ranging between 35% and 45%. It is possible that overlying chert layers and argillaceous limestone layers have sealed off this lower zone and subsequently reduced the process of compaction by preventing the upward flux of pore water.

TABLE 3
Carbon and Nitrogen Analyses at Site 366

		% Organic C (total dry wt. basis)		C/N (atomic ratio)		
Sample (Interval in cm)	Depth (m)	*x*	SD	*x*	SD	Remarks
3-4, 84-85	126	0.046	0.010	7.0	1.0	
3-5, 76-77	127	0.049	0.012	4.8	0.4	
7-3, 71-72	394	0.113	0.020	2.7	1.0	
12-3, 76-77	441	0.094	0.003	5.5	0.4	Residue from CO_3 Bomb
16-2, 7-8	471	0.082	0.060	4.4	1.8	
19-2, 103-104	508	0.129	0.021	7.6	1.2	
22-1, 49-50	528	0.148	0.017	6.6	1.9	Residue from CO_3 Bomb
25-2, 60-61	565	0.106	0.014	4.6	1.6	
26-2, 1-2	574	0.567	0.001	11.6	1.8	Green clay layer
31-2, 111-112	620	0.084	0.005	7.4	1.2	
34-5, 133-134	651	0.080	0.014	6.4	1.9	
37-3, 25-26	675	0.100	0.014	3.0	1.2	
40-3, 77-78	705	0.047	0.013	8.0	3.6	
44-3, 86-87	740	0.126	0.030	5.0	2.7	

Shear Strengths

Only a few shear strength measurements were obtained to a depth of 160 meters below the sea floor due to the limited upper sequence of soft unconsolidated sediments, and the disturbed nature of these samples. Variations in shear strength (cohesion as measured by the miniature-vane apparatus) strongly reflect the lithologic change from Unit 1 to Unit 2. Shear strengths range between 0.3 and 1.8 kg/cm^2 with the nannofossil marl and ooze of Unit 1, whereas they increase to over 5.0 kg/cm^2 within the firmer chalk and marl of Unit 2.

Acoustic Velocities

Compressional wave velocities (Vp) were obtained using the Hamilton Frame velocimeter. Soft sediments were tested in split liners, but the more indurated chalk, limestone, and chert were cut into small cubes (20 to 50 cm^3 each) and velocities obtained both vertically and horizontally.

A plot of velocity versus depth is presented in Figure 11. These show a slow increase in velocity down to 400 meters, where nannofossil ooze and marl grade into indurated chalk. Velocities at this depth begin increasing rapidly to nearly 3.0 km/sec, and interlayered chert produces velocities at and above 4.0 km/sec. Below this interval a noticeable reduction in velocities is observed between a depth of 600 to 700 meters which corresponds to the previously discussed high porosity zone. Velocities within the deepest sediments penetrated range between 2.8 and 2.9 km/sec.

Anisotropy between horizontal and vertical measurements of Vp within chert layers is quite large. Vertical velocities are markedly *lower*, as was found to be the case for similar cherts retrieved during Leg 32 (Site 303). This directional dependence was attributed by Marshall (1975) to the presence of unsilicified or less silicified (porcellanite) interlayers within the chert.

Summary

Mass physical properties data for Site 366 (summarized in Trabant, this volume) do not display simple relationships which can be correlated with either depth or time. Diagenetic processes other than compaction appear to have taken place.

The upper Eocene chert and limestone section has higher velocities (Vp) and lower porosities than adjacent lithologic units.

Lower Eocene sediments are highly porous, considering the depth of burial (600 to 700 m) and the Vp values are consequently low (1.9 to 2.3 km/sec). This lower Eocene section can be considered under consolidated in terms of physical property data, whereas the overlying chert and limestone unit appears overcompacted due to cementation effects.

BIOSTRATIGRAPHY

The most noteworthy feature of this site is the biostratigraphic continuity of the Cenozoic, based on identification of the zonal succession of foraminifers, nannofossils, and radiolarians. Only minor hiatuses were detected. A substantial portion of the Cenozoic section contains well-preserved diatom assemblages as well. Consequently, there exists at this site an excellent opportunity to establish a more precise diatom zonation for the tropical Atlantic, and to determine precise correlations between the zonal boundaries for *all* of the microfossil groups. The proposed correlation between the principal zonal successions is included in the biostratigraphic synthesis (Cepek et al., this volume).

The Cretaceous-Tertiary boundary occurs near the base of the site, but was not sampled due to technical difficulties (see operations resume). Two foraminiferal zones (*Globorotalia eugubina* Zone-*G. pseudobulloides* Zone, and *Abathomphalus mayaroensis* Zone) and two nannofossil zones (*Markalius inversus* Zone and *Nephrolithus frequens* Zone/*Micula mura* Zone), which correspond to the lowermost Danian and uppermost Maestrichtian stages, were not recovered. Presumably, these zones are represented in the unsampled stratigraphic intervals (about 20 m thick) at the base of the hole. The evidence suggests that there is no depositional hiatus at the Cretaceous/Tertiary boundary on the Sierra Leone Rise.

TABLE 4
% $CaCO_3$ - Carbonate Bomb Analyses, for Site 366

Sample (Interval in cm)	Depth (m)	% $CaCO_3$	Lithology
Hole 366			
3-1, 25-26	120	72	Nanno ooze
3-2, 25-26	121	83	Nanno ooze
3-4, 84-85	125	59	Nanno ooze
3-5, 82-83	127	62	Nanno ooze
4-2, 136-137	249	79	Nanno chalk
6-3, 64-65	380	79	Nanno chalk
7-3, 71-72	391	83	Nanno chalk
9-3, 61-62	411	79	Nanno chalk
10-2, 58-59	415	72	Nanno chalk
11-1, 52-53	430	75	Nanno chalk
12-3, 76-77	439	58	Clay and nanno chalk
13-2, 82-83	449	54	Nanno chalk
14-3, 82-83	457	14	Nanno chalk
15-1, 54-55	467	83	Nanno chalk
16-2, 7-8	477	73	Nanno chalk
19-1, 103-104	508	83	Nanno chalk
20-2, 131-132	517	79	Nanno chalk
21-2, 81-82	525	92	Nanno chalk
22-1, 49-50	534	83	Nanno chalk
23-1, 63-64	544	37	Siliceous limestone/ porcellanite
23-1, 68-69	544	87	Chalk
24-2, 105-106	552	37	Porcellanite
24-2, 110-111	552	79	Chalk
25-2, 60-61	563	40	Porcellanite
26-3, 81-82	574	73	Chalk
27-2, 79-80	579	62	Siliceous limestone
28-3, 58-59	590	62	Argillaceous limestone
29-2, 37-38	599	67	Argilaceous limestone
30-1, 111-112	613	29	Chert limestone
31-2, 134-135	619	14	Argillaceous limestone
34-5, 133-134	650	55	Argillaceous limestone
35-3, 113-114	655	56	Argillaceous limestone
36-3, 33-34	665	58	Argillaceous limestone
37-3, 25-26	673	37	Argillaceous limestone
38-3, 47-48	683	46	Argillaceous limestone
39-3, 123-124	693	55	Argillaceous limestone
40-3, 77-78	702	47	Argillaceous limestone
41-3, 76-77	712	56	Argillaceous limestone
42-3, 123-124	722	71	Argillaceous limestone
43-3, 128-129	731	72	Siliceous limestone
44-3, 24-25	740	4	Shale
45-3, 43-44	750	71	Limestone
46-3, 64-65	764	65	Siliceous limestone
47-3, 42-43	769	65	Siliceous limestone
48-3, 44-45	778	58	Marlstone
49-3, 85-86	788	57	Marlstone
50-3, 107-108	798	65	Marlstone
51-2, 77-78	805	72	Argillaceous limestone
Hole 366A			
2-3, 66-67	10	56	Nanno marl
3-3, 63-64	19	68	Nanno marl
4-3, 24-25	28	49	Nanno marl
5-3, 76-77	38	66	Nanno marl
7-3, 44-45	57	46	Nanno marl
8-3, 104-105	67	92	Nanno ooze
9-3, 77-78	76	86	Nanno ooze
10-1, 54-55	90	84	Nanno ooze
11-3, 54-55	95	83	Nanno ooze
12-3, 110-111	105	72	Nanno ooze
14-3, 91-92	124	68	Nanno ooze
15-3, 103-104	134	60	Nanno ooze
16-3, 140-141	145	60	Nanno ooze
17-3, 90-91	152	72	Nanno ooze

TABLE 4 – *Continued*

Sample (Interval in cm)	Depth Subbottom (m)	% $CaCO_3$	Lithology
Hole 366A – *Continued*			
18-3, 83-84	162	81	Chalk
20-3, 104-105	186	77	Chalk
21-3, 74-75	190	79	Chalk
23-1, 26-27	205	7	Pelagic clay
23-1, 45-46	205	71	Chalk
23-3, 72-73	208	80	Chalk
23-3, 78-79	208	22	Clay
24-2, 95-96	223	80	Chalk
26-3, 113-114	240	80	Chalk
27-3, 108-109	247	78	Chalk
28-3, 76-77	257	76	Chalk
29-3, 72-73	266	79	Chalk
30-3, 54-55	276	73	Chalk
31-3, 84-85	287	81	Chalk
33-3, 84-85	305	76	Chalk
34-3, 78-79	314	76	Chalk
35-3, 73-74	323	80	Chalk
36-3, 53-54	334	69	Clay
37-3, 96-97	343	84	Nanno ooze
38-3, 45-46	353	85	Chalk
39-3, 91-92	364	86	Chalk

Foraminifers

Cenozoic

Foraminiferal assemblages of Cores 1, 2, 1A, 2A, and 3A are Pleistocene in age. They contain rich and diverse assemblages of planktonic foraminifers. However, specimens of *Globigerina bulloides* and *Globorotalia inflata* are rare. This assemblage has a tropical-subtropical character and very good preservation.

The presence of pink *Globigerina ruber* and *Globigerinoides rubescens* in Cores 1 and 1A indicates a late Pleistocene age but the occurrence of *Globorotalia tumida flexuosa* gives a minimum age of 80,000 yr B.P.. We have subdivided the Pleistocene sequence (*Globorotalia truncatulinoides* Zone) into *Globorotalia crassaformis viola* Subzone, the *Globorotalia crassaformis hessi* Subzone, and the *Globigerina calida calida* Subzone.

Benthic foraminifera are scarce and represented by *Pullenia*, *Sphaeroidina*, *Cassidulina*, *Uvigerina*, thin-walled miliolids and nodosariids, all deep-water forms.

Pliocene assemblages were recovered in Cores 4A through 9A. The upper zone of Pliocene (the *Globorotalia tosaensis* Zone) was identified in Core 4A, Section 1 through 3, but the index species is missing.

The *Globorotalia miocenica* Zone is found in Cores 4A through 6A and was divided into two subzones; the *Globorotalia exilis* Subzone and the *Globigerinoides fistulosus* Subzone.

The assemblage of planktonic foraminifers from Cores 6A through 9A are assigned to the *Globorotalia margaritae evoluta* Zone.

Tropical and subtropical species of planktonic foraminifers are well-preserved, abundant and, with the

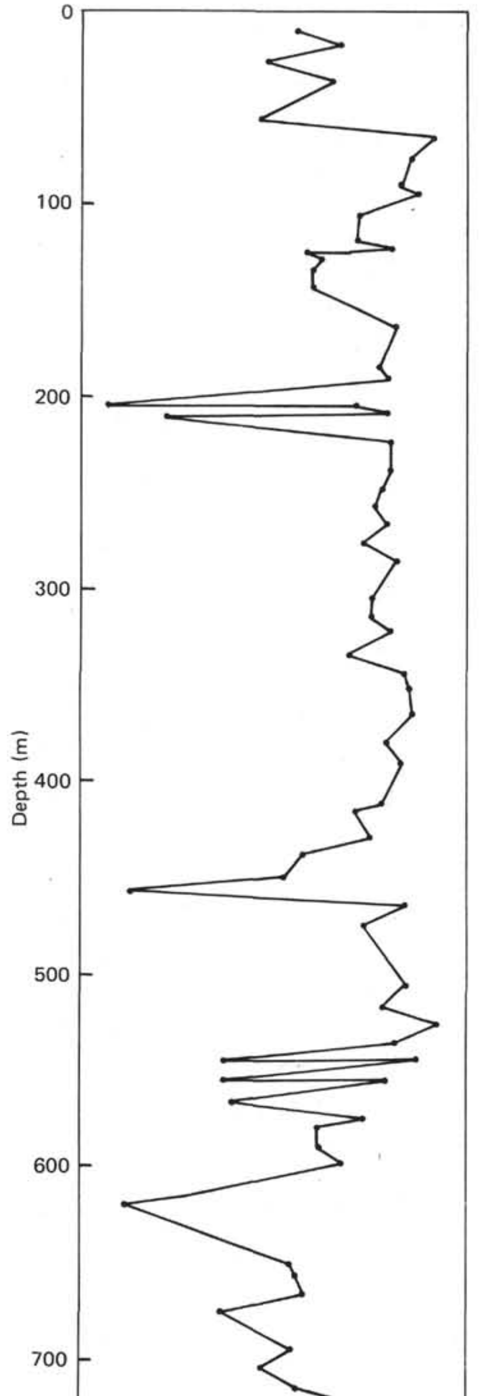

Figure 8. *Plot of* $CaCO_3$ *versus depth at Site 366.*

scarcity of benthic foraminifers, testify to open marine pelagic environments.

Cores 10A, 11A, and the upper part of the 12A have rich assemblages of tropical-subtropical planktonic foraminifers which are correlated with the *Globorotalia margaritae margaritae* Zone, a transitional zone between Pliocene and Miocene. *Globorotalia tumida tumida* was not found. Evidently, in the Sierra Leone Rise section as well as in other areas of the Atlantic and Caribbean regions, this species appears later in the Pliocene.

Faunas of lower and upper Miocene are well developed and can be divided into a number of zones, whereas the section of middle Miocene is condensed and only three zones are recognized. Our use of upper Miocene includes the Messinian and Tortonian stages. The abundant planktonic foraminifers of the *Globorotalia plesiotumida* Zone (Cores 12A and 13A) are well or moderately preserved and have tropical to subtropical affinities. Low benthic/planktonic foraminifer ratios suggest deep-water pelagic conditions.

The *Globorotalia acostaensis* Zone (Cores 3, 14A, and 15A, upper part) has numerous specimens of *Globorotalia acostaensis*, but *G. plesiotumida*, *G. dutertrei*, and *Candeina nitida nitida* are absent. The microfauna has a tropical to subtropical affinity, good preservation, and indicates deep-water conditions.

Upper and middle Miocene sediments are separated by a small hiatus with three zones missing: the *Globorotalia continuosa* Zone; *Globigerina nepenthes/Globorotalia siakensis* Zone; and the *Sphaeroidinellopsis subdehiscens/Globigerina druryi* Zone.

Middle Miocene faunas are found in Cores 15A and 16A. They belong to the *Globorotalia fohsi lobata* Zone, *Globorotalia fohsi/fohsi* Zone, and *Globorotalia peripheroronda* Zone. Good to moderately preserved faunas are seen throughout this interval. A peculiar feature of the microfauna is the presence of *Cl. bermudezi* and a scarcity of *Orbulinas*. We separated the middle and lower Miocene by a hiatus within Core 16A, which corresponds to two zones: the *Orbulinas suturalis-Globorotalia peripheroronda* Zone and the *Praeorbulina glomerosa* Zone.

The only zone of the lower Miocene not found is the *Praeorbulina glomerosa* Zone. Cores 16A through 18A are attributed to the *Globigerinatella insueta-Globigerinoides trilobus* Zone. The specific composition of planktonic foraminifers enables a precise zonal definition even though the zonal marker (*G. insueta*) is extremely rare. Cores 20A through 22A contain faunas correlated with the *Globigerinita stainforthi-Globigerinita dissimilis* zones. Cores 23A through 26A represent the *Globigerinita dissimilis* Zone. Cores 4 and 26A, 28A, Section 1 include the oldest Miocene microfauna, the *Globigerinoides primordius-Globorotalia kugleri* Zone. We consider the lower Miocene planktonic foraminifers to be tropical to subtropical assemblages. The ratios between planktonic and benthic foraminifers indicates deep-water conditions through the early Miocene.

Rich planktonic foraminiferal assemblages in the upper part of the section allowed us to carry out the standard Oligocene zonation but in the lower part of the section foraminifers are fairly rare, badly preserved, and our zonation becomes tentative.

TABLE 5
Summary of Shipboard Geochemical Data From Interstitial Water at Site 366

Sample (Interval in cm)	Depth (m)	pH	Alkalinity (meq/kg)	Salinity (°/oo)	Ca^{++} (mmoles/l)	Mg^{++} (mmoles/l)	Cl (°/oo)
Hole 366							
1-2, 0-6	1.5	7.30	3.43	35.2	11.72	52.90	19.24
3-5, 0-6	131.5	6.86	5.90	35.5	19.90	54.57	19.11
4-2, 144-150	248.5	6.79	5.82	35.8	24.19	56.53	17.98
5-5, 142-150	375.5	6.78	5.42	36.0	27.03	56.24	19.38
10-4, 144-150	419.5	7.07	4.22	38.0	33.67	56.24	19.31
15-2, 0-10	462.5	6.82	4.47	36.3	34.92	57.41	19.31
30-1, 135-150	510.0	6.85	0.60	36.0	42.75	56.39	19.05
Hole 366A							
1-3, 144-150	4.5	7.52	3.22	35.2	11.34	53.84	19.48
5-4, 144-150	40.5	7.13	4.06	35.8	13.42	54.58	19.72
9-5, 144-150	80.0	7.03	4.70	35.8	15.80	55.39	19.96
14-5, 144-150	127.5	6.93	5.98	36.0	20.06	56.86	19.82
20-2, 144-150	180.0	6.84	6.47	36.0	23.82	58.12	19.82
26-3, 144-150	238.5	6.76	6.99	36.3	28.18	59.15	20.06

The uppermost zone (*Globorotalia kugleri* Zone s. s.) of the Oligocene appears in Cores 28A and 29A. Sample 29A, CC contains planktonic foraminifers transitional to the microfauna of the underlying *Globigerina ciperoensis* Zone. Cores 30A through 33A, Section 1, are correlated to the *Globigerina ciperoensis* Zone. Cores 33A through 39A, Section 1, belong to the *Globorotalia opima opima* Zone. Sediments of the *Globorotalia kugleri* s. s., *Globigerina ciperoensis*, and *Globorotalia opima opima* zones are marked by abundant or common planktonic foraminifers with good to moderate states of preservation, suggesting tropical to subtropical conditions.

By contrast, planktonic foraminifers of the lower part of the Oligocene (Cores 39A and 5 through 9) are few or even rare with poor to moderate preservation. We have correlated the sediments of Cores 39A, 5, and 6, Section 1 through 5, to the *Globigerina ampliapertura* Zone. Core 6, Section 6, is correlated to the *Globigerina sellii* Zone and Cores 7 through 9, Section 4, to the *Globigerina sellii-Globigerina tapuriensis* zones.

Benthic foraminifers in Cores 39A and 5 through 9 are more numerous and diverse compared to benthic microfauna or overlying zones. However, they also suggest deep-water conditions.

The upper and middle Eocene section has impoverished and poorly preserved microfaunas but the lower Eocene has relatively rich planktonic foraminifer faunas. Upper Eocene faunas are found in Cores 9, CC through 15. The uppermost zone of the upper Eocene (the *Globigerina gortanii-Globorotalia centralis* Zone), transitional to the Oligocene, is found in Core 10. Corroded deep-water benthic foraminifers are common. Cores 16 through 19 include comparatively diverse planktonic foraminifers and can be assigned to the *Truncorotaloides rohri* Zone. The microfauna is poor in underlying sediments. Core 20 is assigned to the *Truncorotaloides rohri-Orbulinoides beckmanni* zones. Cores 24 through 26 are assigned to the *Globorotalia lehneri-Globigerapsis kugleri* zones. Cores 27 and 28 belong to the *Globigerapsis kugleri-Hantkenina aragonensis* zones. Representatives of *Orbulinoides*, *Hantkenina*, *Globigerinatheca*, and keeled *Globorotalia* are missing or nearly absent. Benthic foraminifers are also very rare.

A thick succession of lower Eocene sediments contain very distinctive assemblages of planktonic foraminifers and all four zones of lower Eocene are found. Cores 29 through 31 correspond to the *Globorotalia palmeri* Zone. Cores 32 through 37 are attributed to the undifferentiated *Globorotalia palmerae*/*Globorotalia aragonensis* zones. Cores 38 through 40 belong to the *Globorotalia aragonensis* Zone. Core 40, Section 5 to Core 41, Section 5 has the microfauna of the *Globorotalia formosa formosa* Zone. Core 41, Section 6, contains poorly preserved planktonic foraminifers. The appearance of *Globorotalia subbotinae* suggests the transition to the underlying zone of this name. Cores 42 and 43, Section 1 are characterized by a typical assemblage of the *Globorotalia subbotinae* Zone.

The late Paleocene is well represented but the lower Paleocene is relatively condensed. The lowermost part of the Danian stage (the *Globigerina eugubina* Zone and the *Globigerina pseudobulloides* Zone) is missing due to drilling difficulties. Cores 43 through 47, Section 2, correspond to the upper Paleocene *Globorotalia velascoensis* Zone. Cores 47 through 49, Section 3, are attributed to the *Globorotalia pseudomenardii* Zone. Core 50 is correlated to the *Globorotalia pusilla* Zone s.s. of the lower Paleocene. Core 51, Section 1, belongs to the *Globorotalia angulata* Zone. Core 51, Section 2 through CC is correlated with the *Acarinina uncinata* Zone of the lower Paleocene. Cores 52 and 53 have been assigned to the *Globorotalia trinidadensis* Zone. *Chiloguembelina* are common in this section. Preservation of the planktonic foraminifers is poor in the upper part of the upper Paleocene and abundance is rare to few. In the lower part of the upper Paleocene and the lower Paleocene, the preservation is better and foraminifers are more numerous. Benthic foraminifers are rare, suggesting deep-water sedimentation.

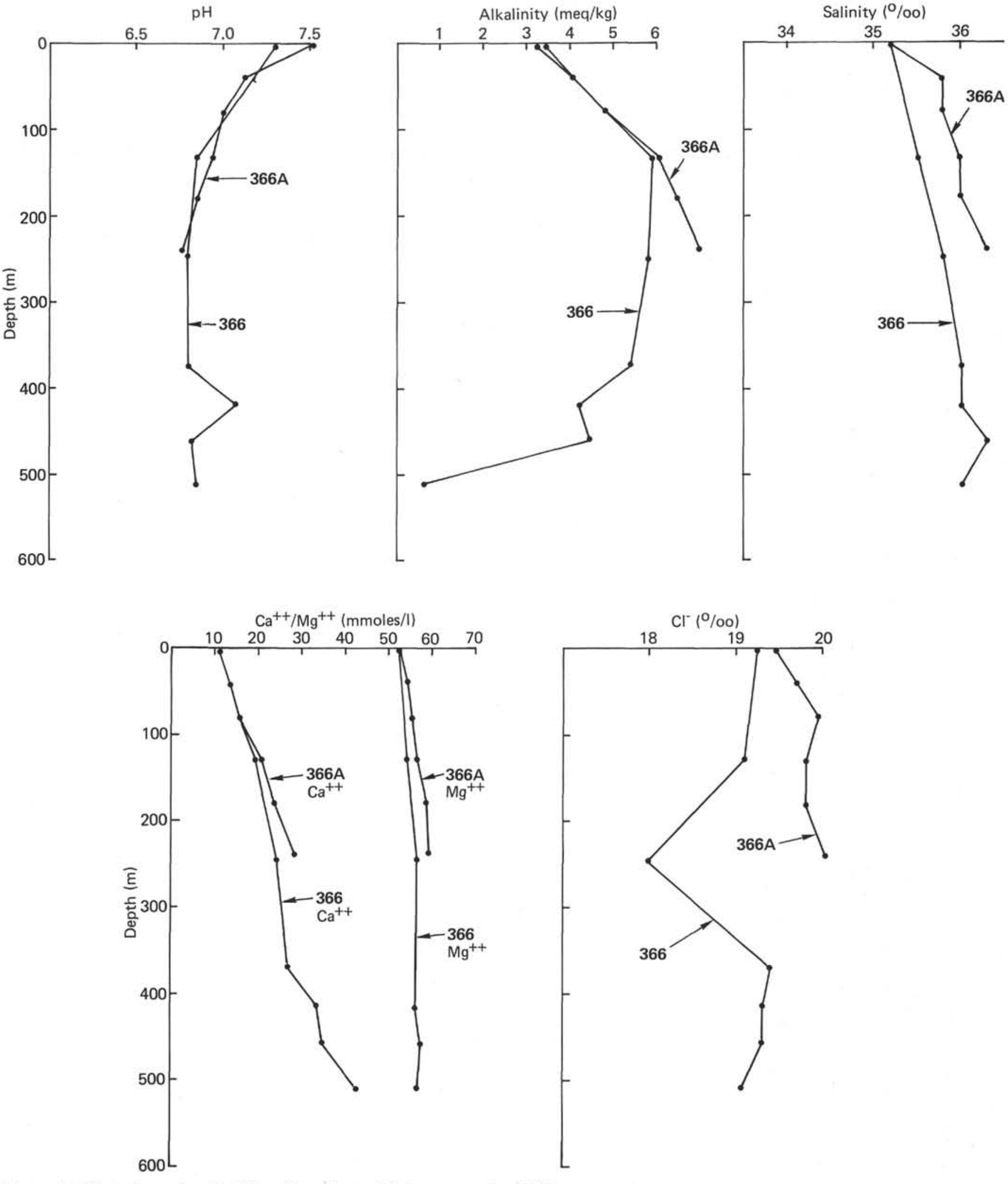

Figure 9. *Plot of geochemical data from interstitial water at Site 366.*

Mesozoic

Upper Cretaceous (Maestrichtian) faunas were encountered only in a sample recovered from the bit after retrieval of the drilling equipment. The depth of the sample is uncertain because the lowermost two cores were empty. The foraminifer fauna contains abundant planktonic specimens and large benthic forms. Preservation is moderate and, in comparison with Upper Cretaceous faunas from Tethys-Caribbean tropical to subtropical regions, the size of planktonic foraminifers is diminished. The Maestrichtian stage,

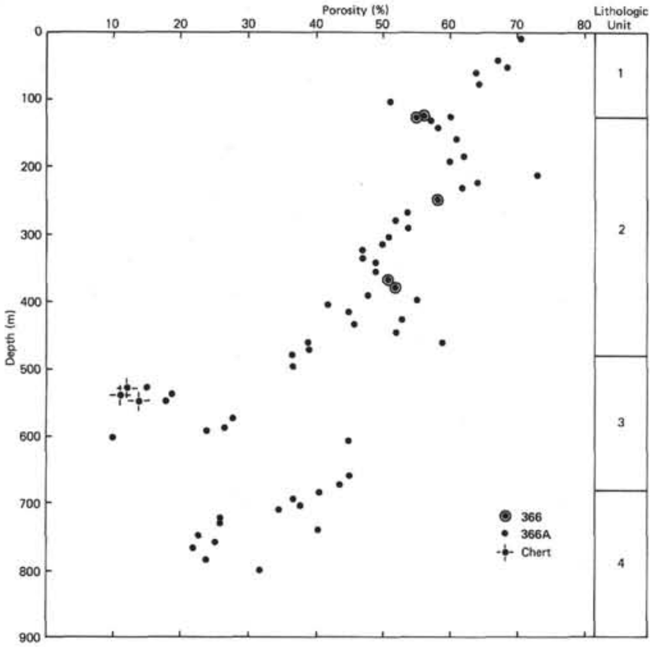

Figure 10. *Plot of porosities versus depth at Site 366.*

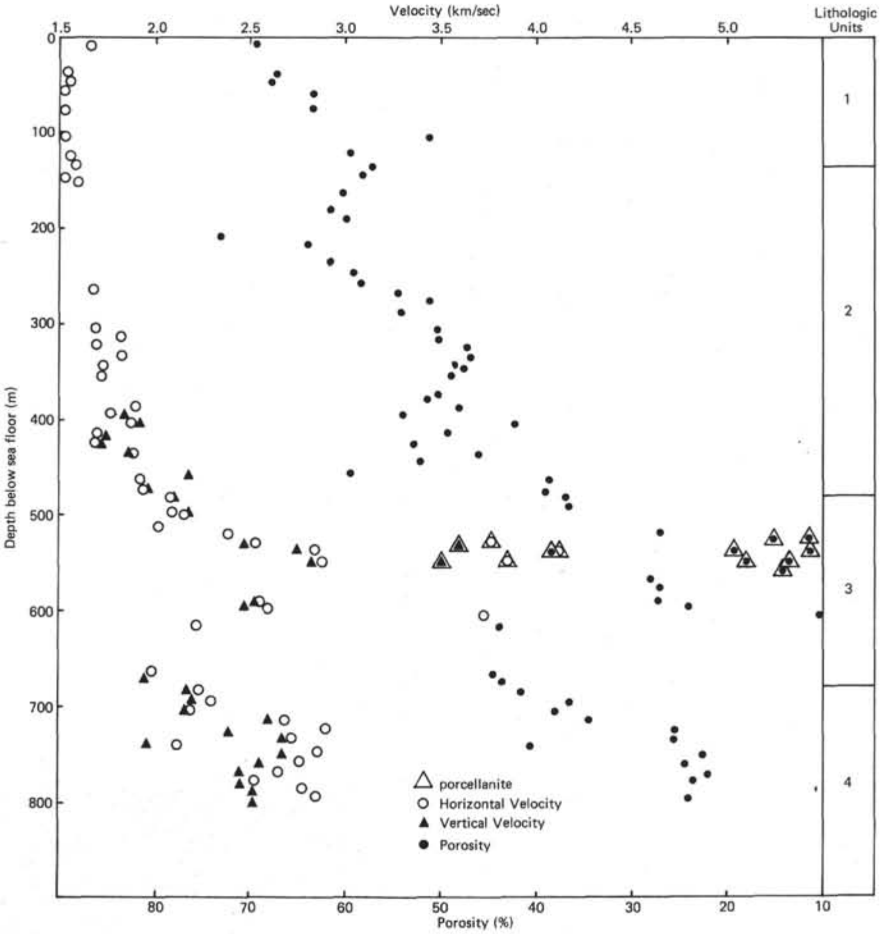

Figure 11. *Plot of sonic velocity versus depth at Site 366.*

Globotruncana contusa Zone is identified in these samples. *Globotruncana* (*Abathomphalus*) *mayaroensis* was not found in the material, so the uppermost zone of the Maestrichtian may not be represented. Benthic species consist of agglutinated primitive forms and higher developed species as well as calcareous forms. The benthic biofacies suggests an environment not as deep as indicated for the Paleogene. The reduced size of most planktonic foraminifers suggests unfavorable conditions at the sea surface.

Calcareous Nannoplankton

A rich sequence of moderately preserved nannofloras, ranging in age from uppermost Cretaceous (*Lithraphidites quadratus* Zone) to Quaternary (*Emiliania huxleyi* Zone), was recovered at Site 366. After preliminary investigation, the nannofossils show no evidence for significant hiatuses and reworked specimens are extremely rare.

Representatives of the genus *Braarudosphaera*, which are indicators of shallow water and which are reported from South Atlantic legs (Leg 3, Sites 14, 17, 19, 20, 22; Leg 40, Sites 362, 363) in Oligocene chalks, were not found at this site.

Cenozoic

Pleistocene assemblages were recovered in Hole 366, Cores 1 and 2, and in Hole 366A, Cores 1A, 2A, and 3A. The assemblage of coccoliths is rich and fairly well preserved. Core 1 in Hole 366 from the top to Section 1, and Core 1A in Hole 366A from the top to Section 4, belong to the *Emiliania huxleyi* Zone. The *Gephyro-*

capsa oceanica Zone is represented in Hole 366 in the interval Core 1, Section 2, to Sample 1, CC and in Hole 366A in the interval below Core 1, Section 4. Core 2 in Hole 366, and Cores 2A and 3A in Hole 366A, belong to the *Emiliania ovata* Subzone. No reworked coccoliths were found and no significant overgrowth or dissolution was observed.

Pliocene floras were recovered in Hole 366A to a depth of 82 meters. Common to abundant and generally well-preserved Pliocene coccolith assemblages of a rich tropical flora are indicative of the *Discoaster brouweri* Zone in Cores 4A to 6A and the *Reticulofenestra pseudoumbilica* Zone in Cores 7A and 8A. The samples are rich in discoasters, especially *D. pentaradiatus* and *D. brouweri*, which suggests warm waters. Many of the discoasters are broken in some slides but no significant overgrowth was observed. We use the Miocene/Pliocene boundary as the level between the *Ceratolithus acutus* Subzone and *Triquetrorhabdulus rugosus* Subzone which is found in Cores 9A and 10A.

Miocene assemblages are found in Cores 3 and 4 and 10A to 28A, giving the Miocene at least a 142.5 meter thickness. Upper Miocene coccoliths are abundant in Cores 10A to 12A and preservation is moderate. From Core 13A (~110 m) to the Paleocene, the coccoliths are poorly to moderately preserved. Core 13A is assigned to the *Catinaster calyculus* Subzone. The middle Miocene is represented in Cores 13A to 18A. Assemblages of coccoliths are abundant, but moderately or poorly preserved. Great abundances of tropical zonal marker species, such as *Discoaster hamatus*, *Catinaster coalitus*, *Discoaster exilis*, and *Spenolithus heteromorphus* aid zonation. Cores 20A to 28A and Core 4 are lower Miocene and the floras indicate the presence of the *Helicopontosphaera ampliaperta* Zone, *Sphenolithus belemnos* Zone, and *Triquetrorhabdulus carinatus* Zone. Specimens are slightly to moderately overgrown. Warm-water taxa, *Discoaster*, *Sphenolithus*, and *Triquetrorhabdulus* are abundant. We place the Oligocene/Miocene boundary (Cores 27A and 28A) within the *Discoaster deflandrei* Subzone of the *Triquetrorhabdulus carinatus* Zone.

Cores 29A to 39A are of Oligocene age. The highest three Oligocene zones are present in these cores: *Sphenolithus ciperoensis* Zone, *Sphenolithus distentus* Zone, and *Sphenolithus predistentus* Zone. *Cyclicargolithus floridanus* and sphenolith species dominate the assemblages. The continuation of the Oligocene section is found in Hole 366, which was continuously cored from Cores 5 to 53 (366 to 832 m) through the Paleogene. The lowest sample of Hole 366A (39A, CC) is from the same stratigraphic level as sample 366-5, CC. In Hole 366 (Cores 6 to 10) Oligocene sediment from the *Helicopontosphaera reticulata* Zone and *Sphenolithus predistentus* Zone were recovered. Discoasters, which are the indicators for warm waters, are sparse or missing in the lower Oligocene in Cores 6 to 8. Species present are *Discoaster deflandrei*, *D. nodifer*, and *D. tanii*.

Core 10, CC contains a late Eocene coccolith assemblage including *Discoaster barbadiensis* and *Reticulofenestra reticulata*. Discoasters outnumber chiasmoliths, which are absent from many samples in upper Eocene Cores 10 to 16. Only low-latitude zonation can be applied. Determination of coccoliths in Cores 14 to 18 is difficult because of moderate to thick overgrowth and fragmentation of specimens. This part of the Eocene belongs to the *Reticulofenestra umbilica* and *Discoaster barbadiensis* zones. The coccoliths are no better through the middle Eocene (Cores 18 to 32). Only *Discoaster barbadiensis* and *D. strictus*, among the discoasters, retain their identity in the limestone and chert lithology.

Discoasters are few or common in the lower Eocene (Cores 32 to 41). Eocene assemblages are very poorly preserved and not common. They show partial overgrowth and partial dissolution.

Our Paleocene/Eocene boundary is assumed between the *Discoaster multiradiatus* Zone and the *Discoaster diastypus* Zone which is represented in Cores 41 or 42. Paleocene assemblages of coccoliths are found in Cores 42 to 53. The following zones were identified: *Discoaster multiradiatus* Zone, *Discoaster mohleri* Zone, *Heliolithus kleinpellii* Zone, *Fasciculithus tympaniformis* Zone, and *Cruciplacolithus tenuis* Zone. The abundance of coccoliths is few to abundant, and preservation is moderate to poor.

It is possible that the section on Sierra Leone Rise is continuous from uppermost Cretaceous to Paleocene. However, a distance of about 20 meters exists between the lowest Paleocene *C. tenuis* Zone (Core 53) and the upper Maestrichtian *L. quadratus* Zone (Sample 55, CC).

Mesozoic

Rich assemblages of late Maestrichtian age coccoliths were identified in Sample 55, CC belonging to the *Lithraphidites quadratus* Zone.

Radiolarians

Radiolarians are common and well preserved only within two stratigraphic intervals cored at Site 366: the late Pleistocene and the middle Miocene to lower Eocene. Radiolarians are absent in all other samples examined. It is possible that some calcified radiolarian tests may be present in the Paleocene and lower Eocene sediments, but none have been identified by standard preparation procedures.

The following Cenozoic radiolarian zonal boundaries (see Johnson, this volume; Riedel and Sanfilippo, 1974) have been identified within the early Neogene and Paleogene sediments cored at Site 366.

The base of the *Dorcadospyris alata* Zone lies between 157 and 158 meters in Core 17A. The base of the *Calocycletta costata* Zone lies between 163 and 164 meters in Core 18A. The base of the *Stichocorys wolffii* Zone lies between the bottom of Core 20A and the top of Core 21A. The base of the *Stichocorys delmontensis* Zone lies between the bottom of Core 25A and the top of Core 26A. The base of the *Cyrtocapsella tetrapera* Zone lies between 246 and 248 meters in Core 27A. The base of the *Lychnocanoma elongata* Zone lies between 270 and 277 meters in Cores 29A and 30A. The base of the *Dorcadospyris ateuchus* Zone lies between 341 and 342 meters in Core 37A. The base of the *Theocyrtis* *tuberosa* Zone lies between 405 and 413.5 meters in Core 9. The base of the *Theocyrtis tuberosa* Zone lies between 489.5 and 499 meters between Sample 17, CC and Core 19, Section 1. The *Podocyrtis goetheana* Zone was identified only in Section 19-1. The base of the *Podocyrtis chalara* Zone lies between 519 and 520 meters in Core 21. The base of the *Podocyrtis mitra* Zone lies between 530 and 537 meters in Core 22. The base of the *Podocyrtis ampla* Zone lies between 540 and 546.5 meters in Core 23. The base of the *Thyrosocyrtis triacantha* Zone lies between 590 and 591 meters in Core 28. The base of the *Theocampe mongolfier* Zone lies between 601 and 603.5 meters in Core 29. The base of the *Theocotyle cryptocephala cryptocephala* Zone and *Phormocyrtis striata striata* Zone lies in the interval below 622.5 meters in Core 31. Radiolarians were very rare and poorly preserved in all samples examined from below this depth.

The absence of identifiable radiolarians in much of the upper Neogene section and in the Paleocene section is noteworthy, and may have significant paleo-oceanographic implications. The Sierra Leone Rise evidently was not receiving significant siliceous skeletal material during a 15 m.y. interval from the middle Miocene until the late Pleistocene. Evidently the present locations of the zones of upwelling and high productivity in the equatorial Atlantic do not correspond with the positions of these zones during most of the late Neogene. A more precise documentation of this late Pleistocene shift in the circulation characteristics of the region will require a more extensive examination of the late Neogene depositional record over a wide geographic region within the equatorial Atlantic, including Site 354, Leg 39, Ceará Rise, where similar observations were reported.

The absence of Radiolaria from the earliest Cenozoic sediments at this site may have a similar paleoclimatic explanation, or alternatively may be explained in terms of diagenetic effects. The increasingly poorer preservation of the radiolarian assemblages with depth in the Eocene sediments strongly suggests a diagenetic alteration of the siliceous skeletal material, perhaps to calcite. However, examination of the coarse fractions before acid treatment failed to reveal identifiable calcified radiolarian tests, suggesting that perhaps siliceous sedimentation did not occur in the region during the earliest Cenozoic. An additional possibility is that silica was indeed deposited during the early Paleogene, but that diagenetic effects caused vertical migration of the silica and redeposition as chert in the overlying middle and late Eocene sediments. The resolution of the questions of silica accumulation during the early Cenozoic requires a more detailed examination of the cherts and of the coarse fraction within the early Cenozoic material.

Summary

Several additional preliminary observations can be made concerning the biostratigraphic succession recovered at Site 366:

1) The abundance and the degree of preservation of the different microfossil groups vary considerably within the sampled interval. Diagenesis, dissolution, and variations in primary productivity all appear to be controlling factors in producing the variations observed. For example, the absence of Radiolaria from the middle Miocene to upper Pleistocene sediments is almost certainly indicative of substantial geographic migrations in the location and/or the intensity of upwelling in the eastern equatorial Atlantic. The increasingly poorer preservation of nannofossil assemblages with increasing age between the middle Miocene and Paleocene is probably a consequence of diagenetic overgrowths of calcite on the nannofossil specimens. The impoverished and poorly preserved foraminiferal faunas of the middle Eocene through lower Oligocene is perhaps a result of selective dissolution. All of these factors (diagenesis, dissolution, productivity) and perhaps others have played a major role in controlling the rates and types of sediments supplied to the sea floor and the effects of post-depositional alterations which we can observe.

2) Assemblages of *all* microfossil groups are remarkably free of contamination by reworking. None of the samples examined yielded evidence of vertical mixing or lateral redeposition. Particle-by-particle deposition of pelagic skeletal debris has been the dominant sedimentation process on this portion of the Sierra Leone Rise during the entire Cenozoic.

3) All microfossil groups represent tropical to subtropical assemblages for the entire Cenozoic. There is no evidence for any intrusions of extra-tropical water masses for significant periods of time during the Tertiary.

4) The water depth at Site 366 did not change substantially during the Cenozoic. The character of the benthic foraminiferal assemblages and the relative proportion of benthic to planktonic foraminifers requires that the site remained at intermediate depths (>2000 m) for most of the Cenozoic. However, the benthic foraminifers from the uppermost Cretaceous assemblages suggest that the water depth over the Sierra Leone Rise may have been somewhat shallower during the pre-Cenozoic.

ACCUMULATION RATES

The zonation of core-catcher material by the different planktonic organisms leads to similar trends in accumulation rate over a large time interval, although there are some differences between the absolute ages estimated for the different microfossil assemblages within individual core-catcher samples. Age assignment by nannofossils have been correlated to the Cenozoic time scale after Martini (1976); planktonic foraminifer zones have been assigned absolute ages following the zonation schemes of Berggren (1971), Blow (1969), and Saunders et al. (1973); and radiolarian zones have been correlated to the principal epoch boundaries according to the revised Cenozoic zonation of Riedel and Sanfilippo (1974). The data from the individual microfossil groups have been combined in Figure 12 to yield an approximate accumulation rate curve. The accumulation rates are not corrected for compaction.

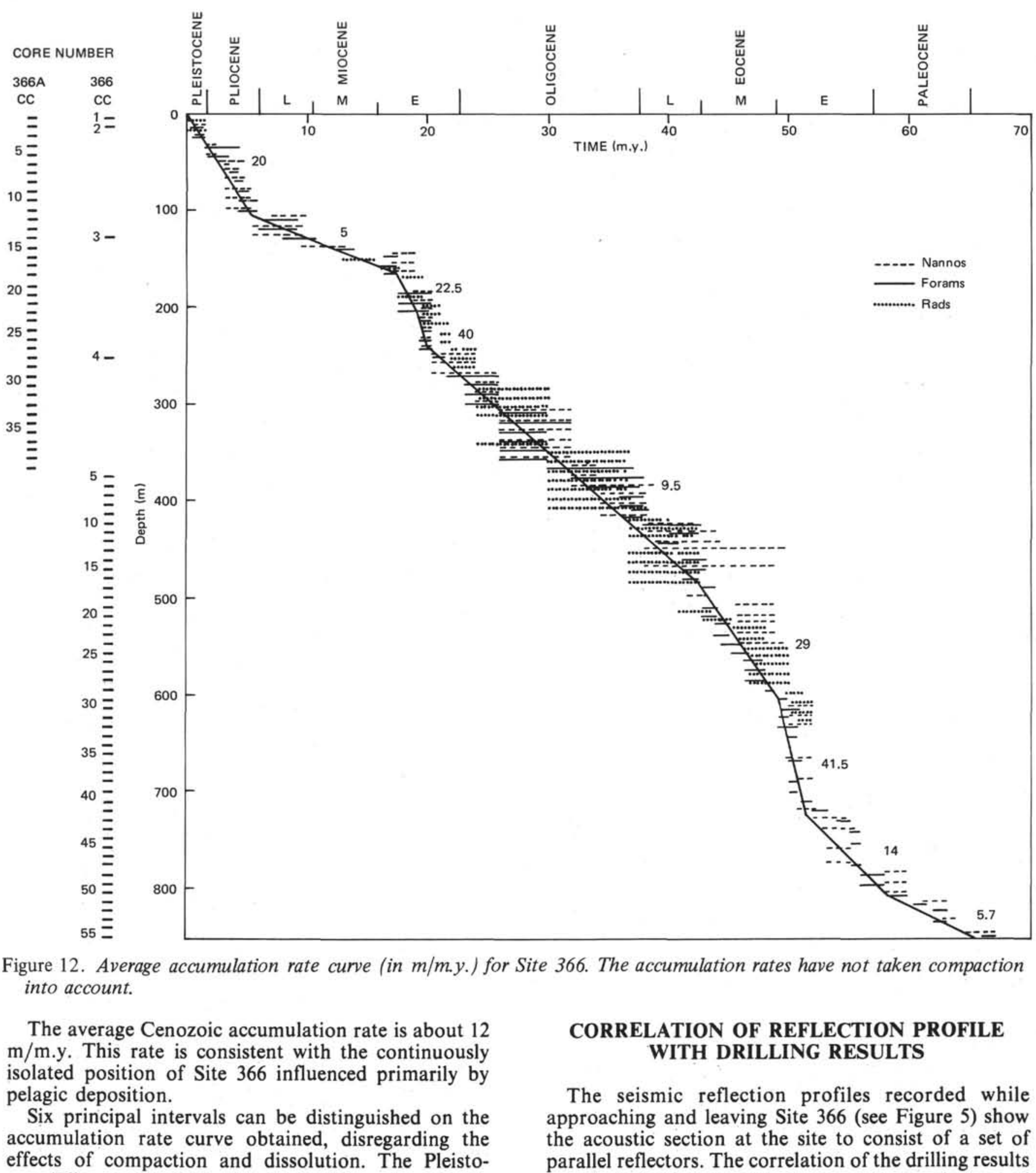

Figure 12. *Average accumulation rate curve (in m/m.y.) for Site 366. The accumulation rates have not taken compaction into account.*

The average Cenozoic accumulation rate is about 12 m/m.y. This rate is consistent with the continuously isolated position of Site 366 influenced primarily by pelagic deposition.

Six principal intervals can be distinguished on the accumulation rate curve obtained, disregarding the effects of compaction and dissolution. The Pleistocene/Pliocene time interval shows rates of about 20 m/m.y. The late and middle Miocene rate is about 5 m/m.y. There are quite constant deposition rates of about 10 m/m.y. from the early Miocene to the top of the middle Eocene, with an increased rate to 29 m/m.y. Rates of accumulation during the lower part of the lower Eocene are about twice as high (41.5 m/m.y.) as in the overlying interval. The lower part of the early Eocene and the Paleocene show normal rates of 5 to 15 m/m.y.

CORRELATION OF REFLECTION PROFILE WITH DRILLING RESULTS

The seismic reflection profiles recorded while approaching and leaving Site 366 (see Figure 5) show the acoustic section at the site to consist of a set of parallel reflectors. The correlation of the drilling results with these reflectors is based mainly on the record obtained while leaving the site at slow speed. Comparison with Lamont-Doherty seismic profiles recorded on the rise show that the reflectors observed on *Glomar Challenger* profiles are clearly of regional extension and significance.

The uppermost reflector observed at 0.26 sec below the sea floor is relatively faint. It probably corresponds with the younger stage of lithification of the calcareous sediments, as at several other DSDP sites located on carbonate-covered oceanic rises. At this site, however, drilling disturbances encountered in the soft chalk make the transition between ooze and chalk appear rather gradational. Therefore, no definite correlation between the lithology and the acoustic section can be established for this reflector, and no estimate of the interval sound velocity could be obtained for this uppermost part of the section. If a range of values of 1.60 to 1.70 km/sec (Figure 11) is considered probable for this interval, then the first reflector should correspond to layers situated at 210 to 225 meters below the sea floor.

A highly reflective horizon or set of closely spaced reflective horizons is observed at about 0.5 sec. Only the top of this reflective zone can be significantly correlated with drilling results because of intense reverberation within this horizon, probably resulting from multiple internal reflections. The top of this zone correlates quite well with the first (younger) occurrence of hard porcellanite layers appearing in the sedimentary column at about 480 meters subbottom. A definite decrease in the drilling rate is also recorded at that depth. Below that level, porcellanite and chert (below 508 m for the chert) are quite common down to about 680 meters. This correlation gives an estimate of 1.82 km/sec for the interval sound velocity of the layer between the sea floor and the first silicified layers. This value compares well with the velocities measured on core samples, and with interval velocities obtained from sonobuoys by Hoskins et al. (1974) on Sierra Leone Rise about 80 km southwest of Site 366.

Below the strong reflector, the seismic profile shows the presence of two lower ones. The uppermost of these lies at about 0.78 sec below the sea floor and the lowermost one is at 0.9 sec. The sedimentary layers corresponding with the latter were not reached at Site 366. The correlation between the reflector at 0.78 sec and a lithological change in the sedimentary column is questionable. A break in the drilling rate observed at about 740 meters subbottom does not seem to correspond with any marked change in the lithology. Moreover, a correlation between this drilling break and the reflector is unlikely because it would result in an unreasonably low interval velocity (2.0 km/sec for the limestone, siliceous limestone, and chert recovered between 480 and 740 m). An important change from limestone grading downward to marl is recorded at about 775 meters subbottom. This marl corresponds to a zone with a noticeable increase in the drilling rate.

A correlation between the reflector at 0.78 sec and the top of the marl gives an interval velocity of 2.11 km/sec, a rather low value, for the overlying lithologies. It is possible that the layers corresponding to that reflector were not sampled in Hole 366 because they lie at depths greater than total penetration (850.5 m). However, if the reflector corresponds with sedimentary layers from anywhere below the total depth, the sound velocity for the interval between that depth and the reflector at 0.5 sec would be greater than 2.65 km/sec. This value seems slightly too high, considering the relatively low proportion of chert versus marl and chalk in that part of the section.

No indication about the nature of the lowermost reflector was obtained, because drilling terminated above them.

Figure 13 is a schematic interpretation of these results.

SUMMARY AND CONCLUSIONS

Figure 14 is a summary of the coring, lithology, biostratigraphy, and drilling rates at Site 366. The site was drilled in the upper part of the Sierra Leone Rise in a region where the seismic reflection profiles suggest the sedimentary section may be complete and undisturbed. The water depth of 2860 meters, well above the present level of the CCD, was a determining factor in the accumulation of a thick, relatively well preserved, and complete carbonate section. The Mesozoic part of the sedimentary record could not be sampled because of technical difficulties, but the almost complete Cenozoic section recovered makes the results of this site particularly interesting. The section was continuously cored from the sea floor to a subbottom depth of 850.5 meters. 582 meters of sediment, representing 68% of the drilled interval, were recovered. This overall recovery is close to the average recovery per core so, except for some cherty and porcellanitic horizons in the middle part of the section and for the lowermost 38 meters, the samples recovered can be considered representative of the entire section.

Most Significant Results

A nearly complete section of the Cenozoic was obtained. It represents a typical pelagic record for an oceanic rise and can be compared with the record obtained on similar elevated oceanic areas in the western Atlantic (Ceará Rise, in particular), and in the South Atlantic (Walvis Ridge and Rio Grande Rise), as well as in the Pacific (Shatsky, Hess, Magellan Rise, and Manihiki Plateau). This network of biostratigraphic reference sections covers different latitudes as well as different basins. The Sierra Leone Rise record appears to provide an ideal reference section for the low-latitude Atlantic Cenozoic record. Two characteristics make this record particularly useful:

1) the section is nearly complete and only very minor stratigraphic hiatuses are present; and

2) the presence of abundant planktonic foraminifers, nannoflora, radiolarians, and, to some extent diatoms, provides an excellent opportunity to correlate zonal boundaries obtained from these different microfossil groups in the tropical-subtropical environment.

Another aspect of the results obtained at this site is the very good opportunity to study the mode of deposition and diagenetic alterations of open marine deep-water carbonate facies. The relative importance of sediment input versus diagenesis can be studied in detail at this site because of generally constant and relatively high rates of accumulation. Also, of particular interest is the occurrence of cyclic sedimentation where the respective roles of dissolution and dilution can be estimated.

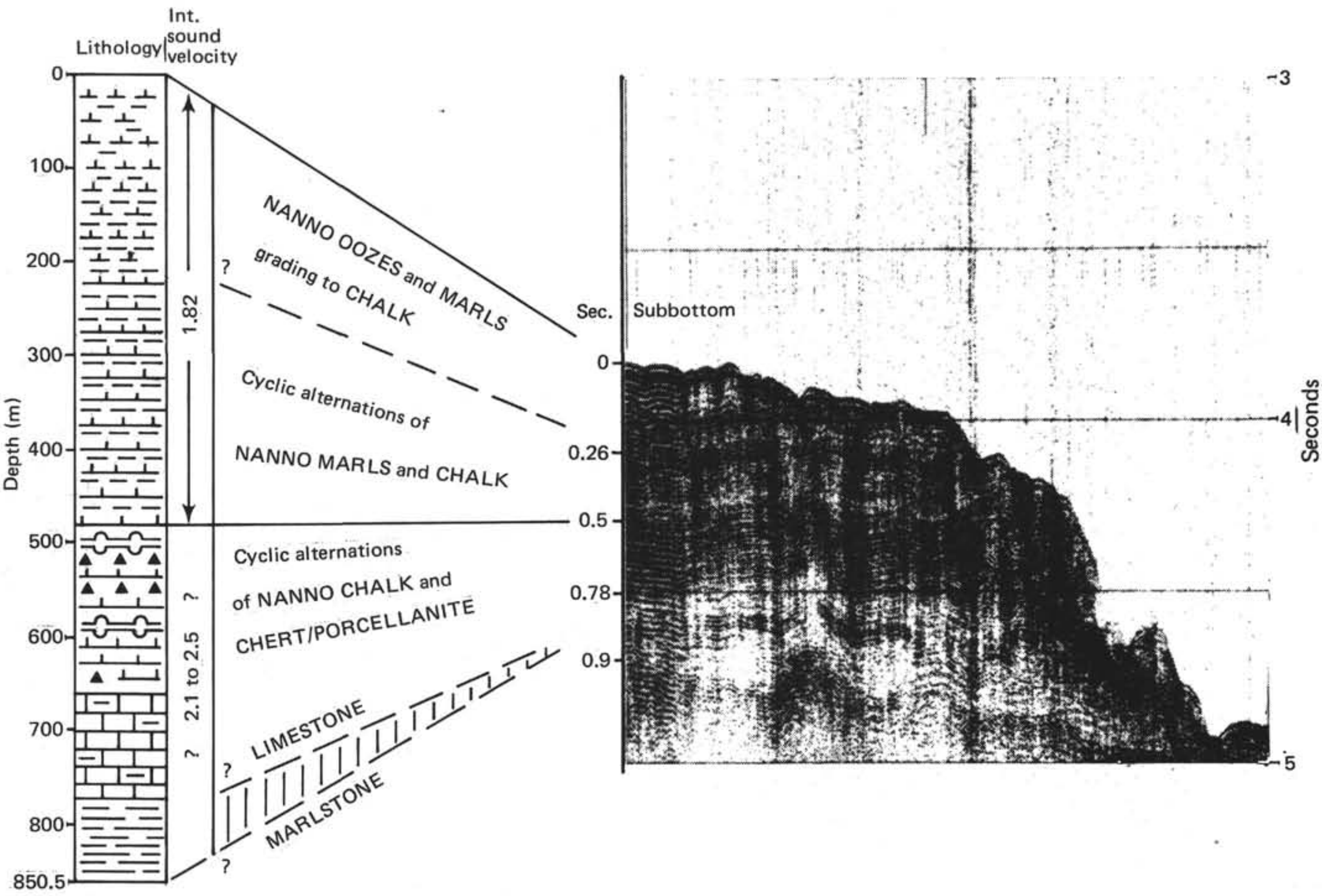

Figure 13. *Correlation of seismic profile and drilling results at Site 366.*

Nature of the Sediments

The section sampled consists of predominantly calcareous pelagic facies with carbonate values ranging from about 40% to 80%. The sediments are nannofossil ooze and marly ooze with common foraminifers, grading downward to chalk and marl, and then to limestone and marlstone. The middle to lower Eocene sediments show classical occurrences of silicified sediments in the form of interbedded porcellanite and chert. Most of the chalk, marl, and limestone show evidence of cyclic bedding with alternations of clay-rich and clay-poor calcareous beds. The average porosity of the sediment shows a general decrease toward greater depth from about 70% to 25%. The color varies within shades of brownish, grayish, and greenish gray with light greenish gray being largely dominant. Organic carbon content is always very low and averages about 0.1%.

Stratigraphy

Apart from minor hiatuses near the upper and lower boundaries of the middle Miocene, the Cenozoic record was completely sampled. In the lowermost part, however, near the Cretaceous/Tertiary boundary the lowermost zone of the Danian stage as well as the uppermost zone of the Maestrichtian stage were not recovered. However, the fact that these missing zones correspond to a sampling gap of about 38 meters, strongly suggests the absence of any hiatus at the Cretaceous/Tertiary boundary. Radiolarians are absent in upper Miocene, Pliocene, and early Pleistocene sediments, but below the lower Eocene they rapidly disappear. If the absence of radiolarians in the upper Miocene and the Pliocene sediments seems to correspond to a lack of radiolarians in the overlying waters at these times, then the relative influence of low input versus diagenetic dissolution in the lower part of the section is not clearly defined. Diatoms, usually well preserved, are present in many intervals (see Schrader, this volume). The complete absence of *Braarudosphaera* among the Oligocene nannofossils is noteworthy because it has been reported as abundant in the South Atlantic. This contrast provides a control over the lateral northern extension of the *Braadrudosphaera* chalks.

Paleoenvironment

The entire Cenozoic section was deposited in relatively deep water. Benthic assemblages and benthic/planktonic foraminifer ratios in the uppermost Cretaceous sediment, however, suggests a slightly shallower environment at that time. In any case, the sea floor on Sierra Leone Rise has always remained above the level of the CCD since at least the latest Cretaceous.

Bottom circulation is believed to have remained permanent during the entire Cenozoic, keeping the sediment-water interface always well oxygenated.

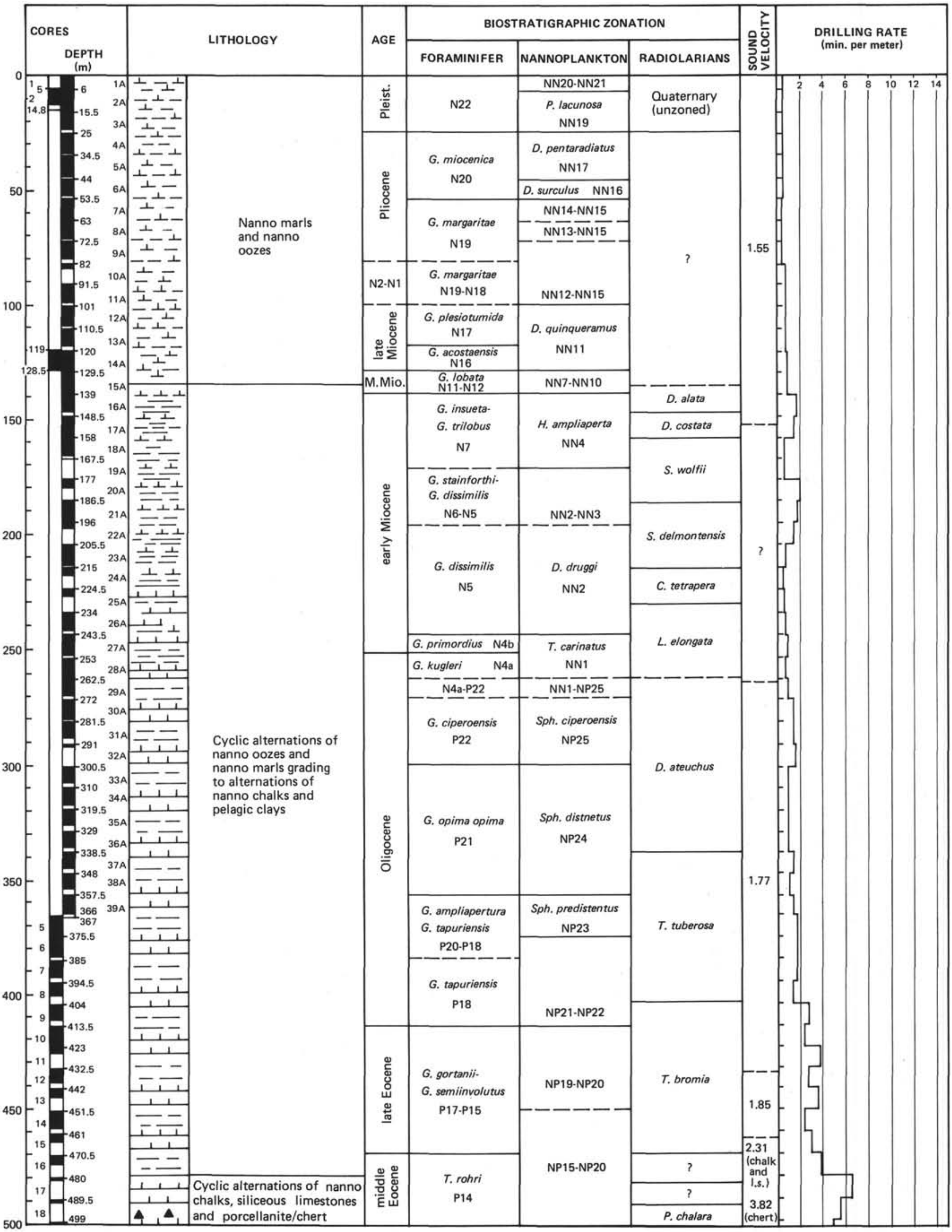

Figure 14. *Summary of coring, lithology, biostratigraphy, and drilling rate at Site 366.*

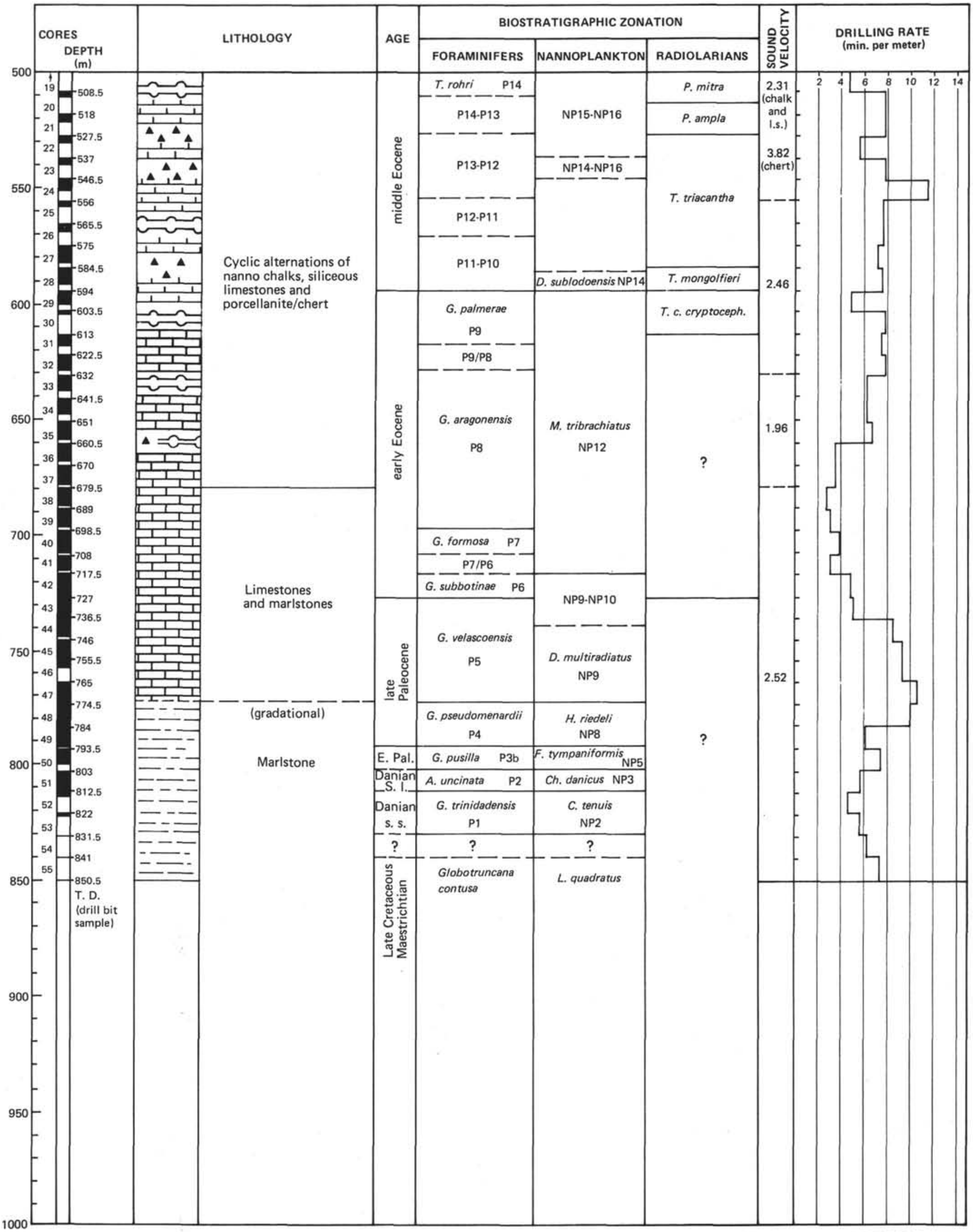

Figure 14. *(Continued).*

Bottom currents, however, were never strong enough to produce significant removal or non-deposition of sediments. The oxygenation of the bottom is attested to by the great abundance of burrows, thus the occasional occurrence of pyrite is believed to be related to reducing microenvironments within the sediment. The circulation during the early Eocene might have been slightly more vigorous, because lenses and thin layers rich in foraminifers indicate winnowing. Apparently the only period of very active bottom circulation has been relatively recent, suggested by evidence of erosion from both PDR and seismic reflection profiles (Figures 5, 6B, 6C).

The productivity of the surface waters probably always remained relatively high. The distribution of radiolarians, however, suggests a reduction in the productivity during the early Pleistocene-Pliocene and the upper Miocene, as well as before the middle Eocene.

The rate of accumulation is controlled primarily by productivity in the surface waters and dissolution on the bottom because terrigenous input is only of minor importance. Excellent stratigraphic control provides a very detailed rate of accumulation curve (Figure 12). The average value of 12 m/m.y. for the entire Cenozoic compares well with other oceanic rises. Maxima occur in the early Eocene (41.5 m/m.y.) and in the early Miocene (40 m/m.y.) and minimum occurs during the middle to late Miocene. Similar trends have been observed on the Ceará Rise during Leg 39 (Site 354). There appears to be a very good correlation between the minima observed in the rate of accumulation curve on the Sierra Leone Rise (this site) and the occurrence of hiatuses in the deep basins, particularly in the South Atlantic (as well as on Ceará Rise in the southwestern North Atlantic). This observation compares well with similar trends observed in the western Pacific during Leg 32 (Lancelot and Larson, 1975) where the large hiatus observed at the Cretaceous/Tertiary boundary in the basin corresponds to shorter hiatuses or mere drops in the rate of accumulation on rises. If drops in productivity of the surface waters were responsible for these hiatuses, then the role of bottom circulation in producing hiatuses or slow deposition, even on the rises, could be overestimated. However, PDR and seismic reflection profiles on top of Sierra Leone Rise clearly show recent erosion.

The cyclic sedimentation observed in the lower to middle Eocene and in the upper Eocene to middle Miocene sediments (see Dean et al., this volume) poses interesting problems. Bedding in the lower to middle Eocene sediments is mainly an alternation of cherty or porcellanitic layers with nannofossil chalk, and it is not clear whether this is due in part or totally to differences in the original silica content of these different beds, or if the original physical properties such as porosity and permeability (possibly related to the composition also) have played a major role in producing a selective silica recrystallization. Apparently "chertification" seems to have been favored by the most permeable environments. This seems logical if one considers the necessity for migration and concentration of relatively large amounts of silica in the pore waters in order to precipitate chert layers or nodules. The cyclic bedding observed in upper Eocene, Oligocene, lower Miocene, and lowermost middle Miocene sediments is of a different nature. It closely resembles the widespread limestone/marl sequences well known in many geological formations on land. The cycles represent variations in the relative amounts of terrigenous and biogenous components being delivered to the sea floor. The marly layers might only reflect dilution by increased amounts of clay minerals, or they might also reflect dissolution cycles (Dean et al., this volume). The purely pelagic nature of the cycles suggests influence of climatic variations because Sierra Leone Rise is clearly separated from the African margin and because it is standing well above the level of the adjacent basins.

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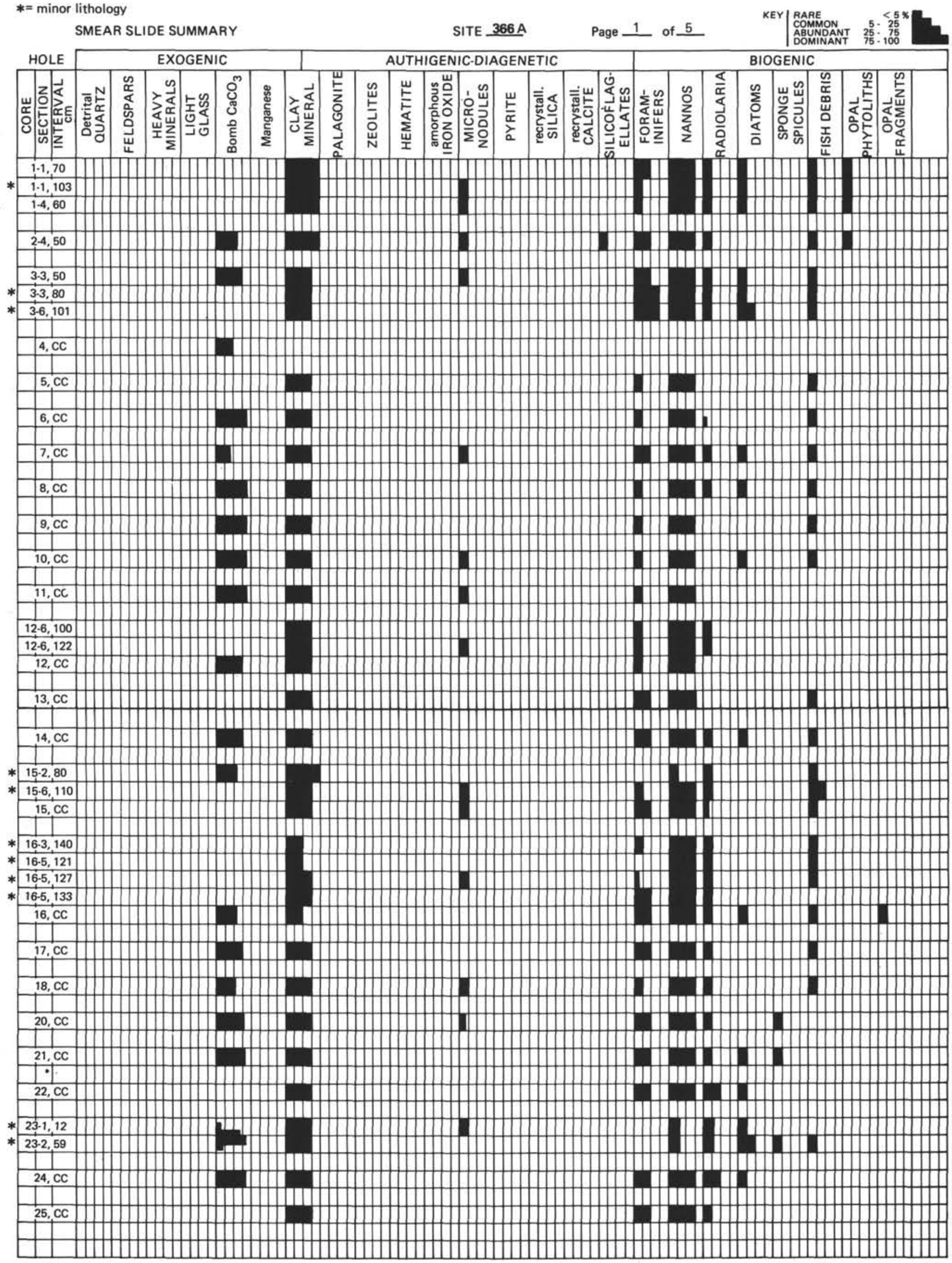
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SMEAR SLIDE SUMMARY
SITE 366A
Page 1 of 5
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RARE <5%
COMMON 5 - 25
ABUNDANT 25 - 75
DOMINANT 75 - 100
HOLE
CORE
SECTION
INTERVAL cm
EXOGENIC
Detrital QUARTZ
FELDSPARS
HEAVY MINERALS
LIGHT GLASS
Bomb CaCO3
Manganese
CLAY MINERAL
AUTHIGENIC-DIAGENETIC
PALAGONITE
ZEOLITES
HEMATITE
amorphous IRON OXIDE
MICRO-NODULES
PYRITE
recrystall. SILICA
recrystall. CALCITE
BIOGENIC
SILICOFLAG-ELLATES
FORAM-INIFERS
NANNOS
RADIOLARIA
DIATOMS
SPONGE SPICULES
FISH DEBRIS
OPAL PHYTOLITHS
OPAL FRAGMENTS
1-1, 70
* 1-1, 103
1-4, 60
2-4, 50
3-3, 50
* 3-3, 80
* 3-6, 101
4, CC
5, CC
6, CC
7, CC
8, CC
9, CC
10, CC
11, CC
12-6, 100
12-6, 122
12, CC
13, CC
14, CC
* 15-2, 80
* 15-6, 110
15, CC
* 16-3, 140
* 16-5, 121
* 16-5, 127
* 16-5, 133
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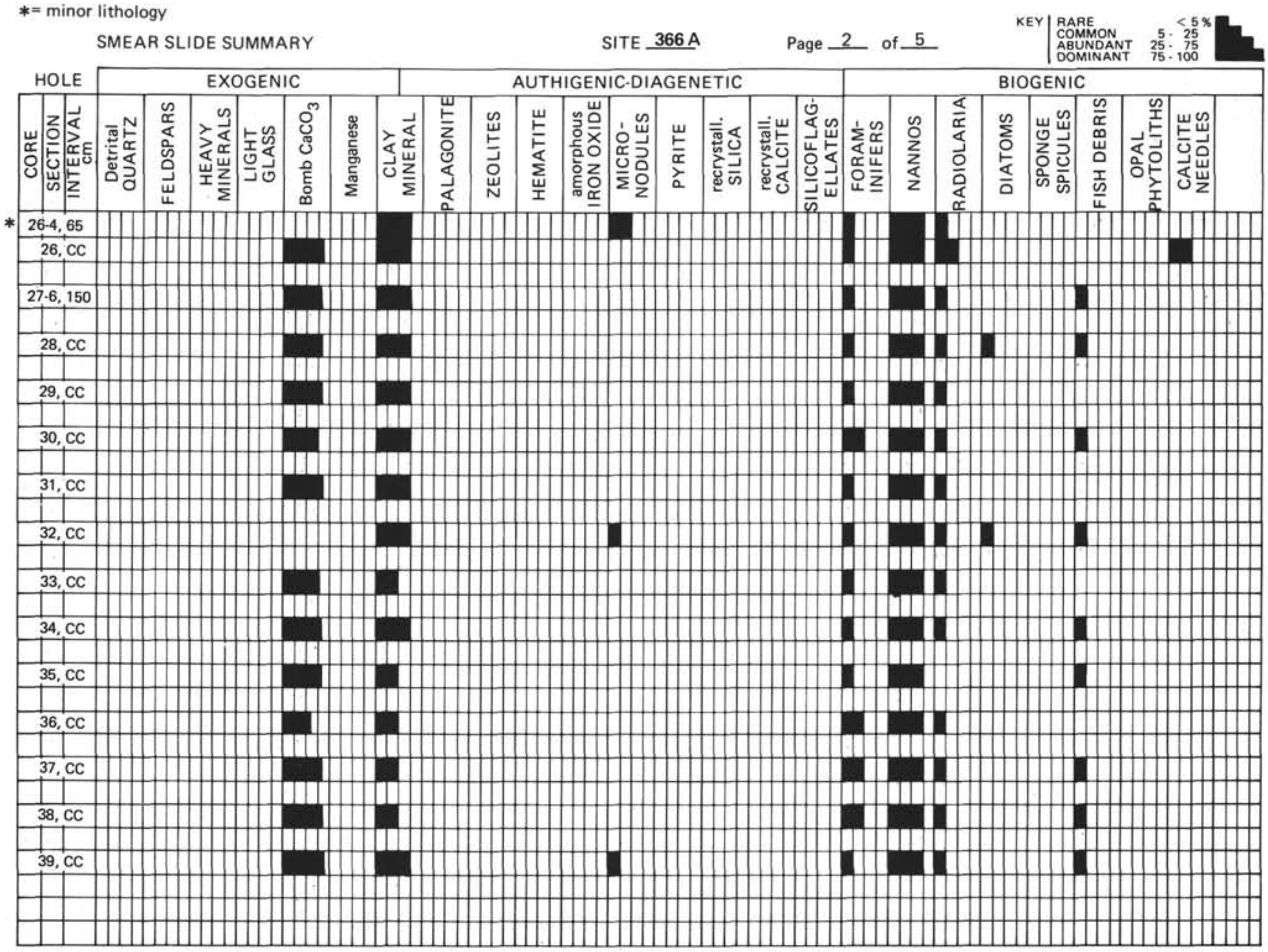
* 23-2, 59
24, CC
25, CC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SMEAR SLIDE SUMMARY
SITE 366 A
Page 2 of 5
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RARE < 5%
COMMON 5 - 25
ABUNDANT 25 - 75
DOMINANT 75 - 100
HOLE
EXOGENIC
AUTHIGENIC-DIAGENETIC
BIOGENIC
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INTERVAL cm
Detrital QUARTZ
FELDSPARS
HEAVY MINERALS
LIGHT GLASS
Bomb CaCO3
Manganese
CLAY MINERAL
PALAGONITE
ZEOLITES
HEMATITE
amorphous IRON OXIDE
MICRO-NODULES
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SILICOFLAG-ELLATES
FORAM-INIFERS
NANNOS
RADIOLARIA
DIATOMS
SPONGE SPICULES
FISH DEBRIS
OPAL PHYTOLITHS
CALCITE NEEDLES
✱ 26-4, 65
26, CC
27-6, 150
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31, CC
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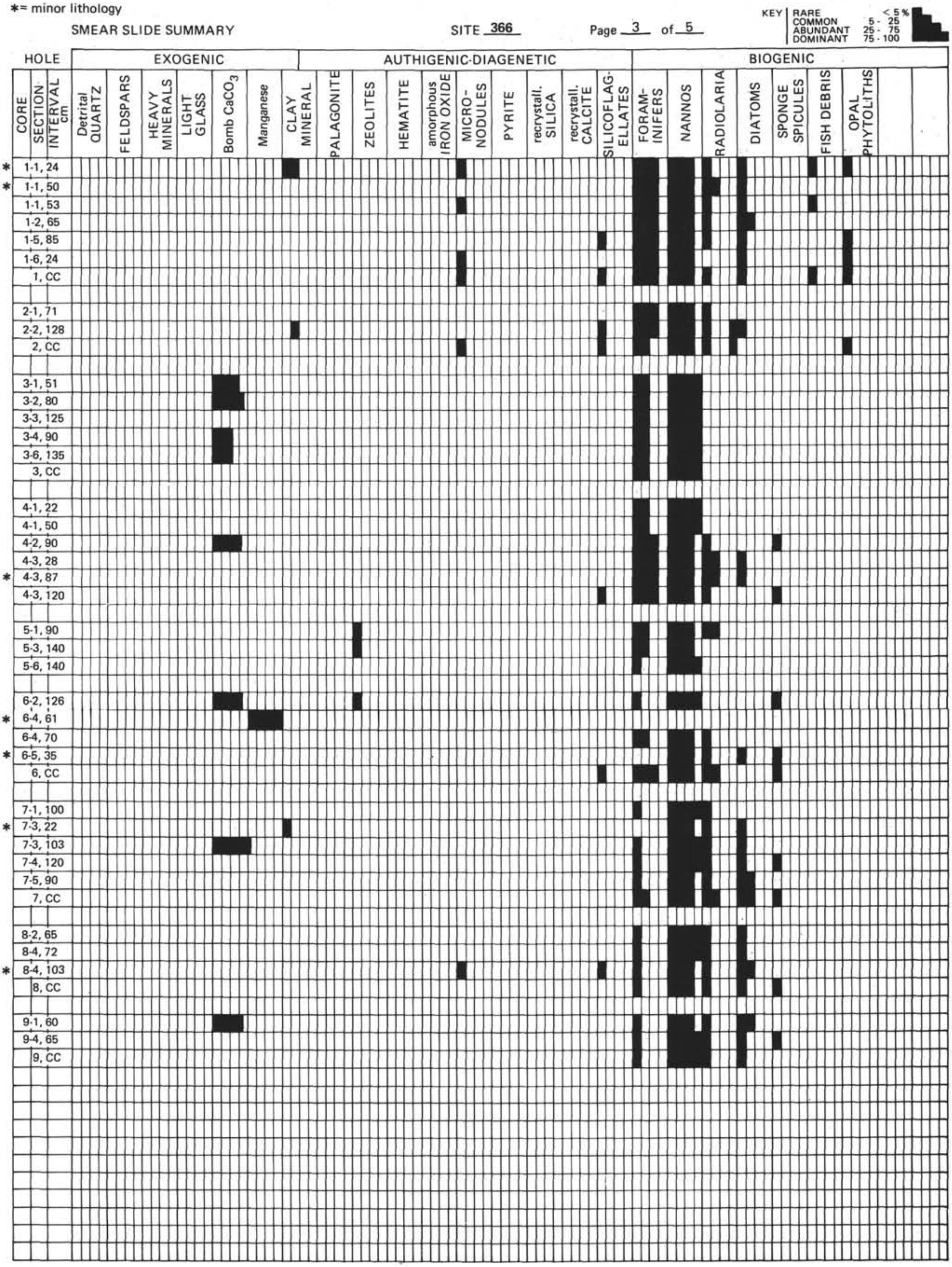
39, CC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SMEAR SLIDE SUMMARY
SITE 366
Page 3 of 5
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COMMON 5 - 25
ABUNDANT 25 - 75
DOMINANT 75 - 100
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SECTION
INTERVAL cm
EXOGENIC
Detrital QUARTZ
FELDSPARS
HEAVY MINERALS
LIGHT GLASS
Bomb $CaCO_3$
Manganese
CLAY MINERAL
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PALAGONITE
ZEOLITES
HEMATITE
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MICRO-NODULES
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recrystall. CALCITE
BIOGENIC
SILICOFLAGELLATES
FORAMINIFERS
NANNOS
RADIOLARIA
DIATOMS
SPONGE SPICULES
FISH DEBRIS
OPAL PHYTOLITHS
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* 1-1, 50
1-1, 53
1-2, 65
1-5, 85
1-6, 24
1, CC
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2-2, 128
2, CC
3-1, 51
3-2, 80
3-3, 125
3-4, 90
3-6, 135
3, CC
4-1, 22
4-1, 50
4-2, 90
4-3, 28
* 4-3, 87
4-3, 120
5-1, 90
5-3, 140
5-6, 140
6-2, 126
* 6-4, 61
6-4, 70
* 6-5, 35
6, CC
7-1, 100
* 7-3, 22
7-3, 103
7-4, 120
7-5, 90
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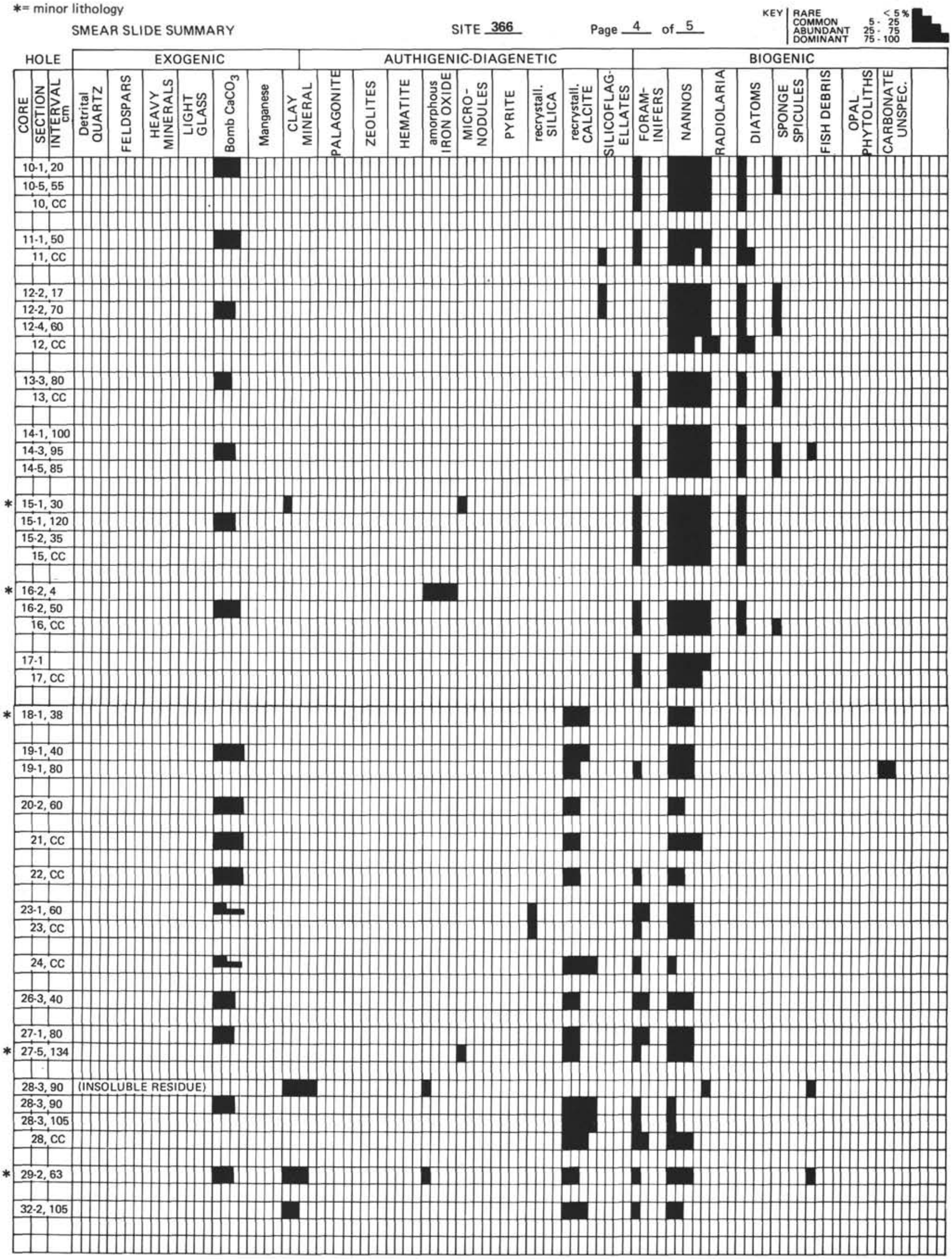
8-4, 72
* 8-4, 103
8, CC
9-1, 60
9-4, 65
9, CC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SMEAR SLIDE SUMMARY
SITE 366
Page 4 of 5
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COMMON 5 - 25
ABUNDANT 25 - 75
DOMINANT 75 - 100
HOLE
EXOGENIC
AUTHIGENIC-DIAGENETIC
BIOGENIC
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INTERVAL cm
Detrital QUARTZ
FELDSPARS
HEAVY MINERALS
LIGHT GLASS
Bomb CaCO$_3$
Manganese
CLAY MINERAL
PALAGONITE
ZEOLITES
HEMATITE
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SILICOFLAG-ELLATES
FORAM-INIFERS
NANNOS
RADIOLARIA
DIATOMS
SPONGE SPICULES
FISH DEBRIS
OPAL PHYTOLITHS
CARBONATE UNSPEC.
10-1, 20
10-5, 55
10, CC
11-1, 50
11, CC
12-2, 17
12-2, 70
12-4, 60
12, CC
13-3, 80
13, CC
14-1, 100
14-3, 95
14-5, 85
* 15-1, 30
15-1, 120
15-2, 35
15, CC
* 16-2, 4
16-2, 50
16, CC
17-1
17, CC
* 18-1, 38
19-1, 40
19-1, 80
20-2, 60
21, CC
22, CC
23-1, 60
23, CC
24, CC
26-3, 40
27-1, 80
* 27-5, 134
28-3, 90
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28-3, 90
28-3, 105
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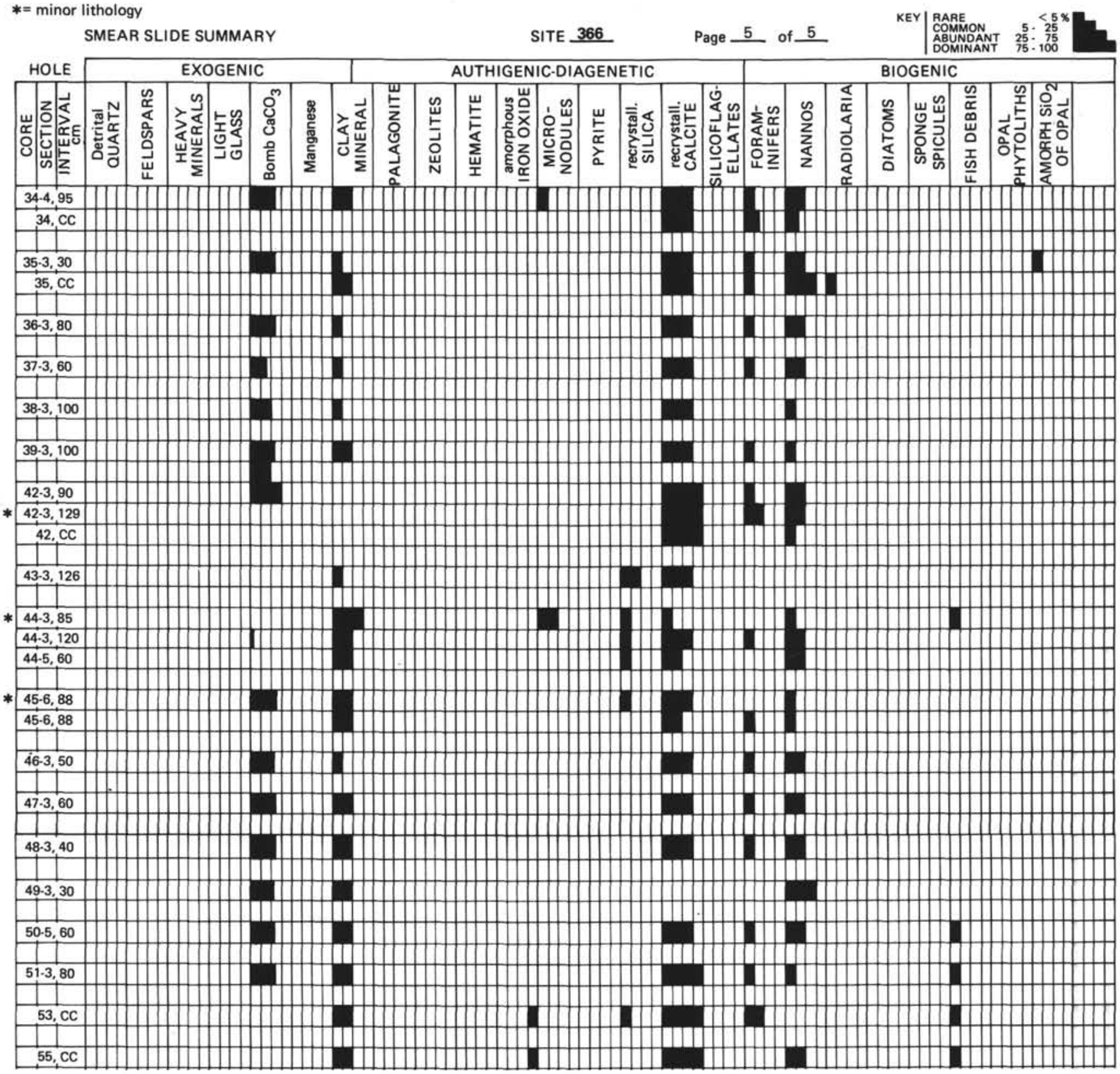
* 29-2, 63
32-2, 105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SMEAR SLIDE SUMMARY
SITE 366
Page 5 of 5
KEY
RARE <5%
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ABUNDANT 25 - 75
DOMINANT 75 - 100
HOLE
CORE
SECTION
INTERVAL cm
EXOGENIC
Detrital QUARTZ
FELDSPARS
HEAVY MINERALS
LIGHT GLASS
Bomb CaCO3
Manganese
CLAY MINERAL
AUTHIGENIC-DIAGENETIC
PALAGONITE
ZEOLITES
HEMATITE
amorphous IRON OXIDE
MICRO-NODULES
PYRITE
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SILICOFLAGELLATES
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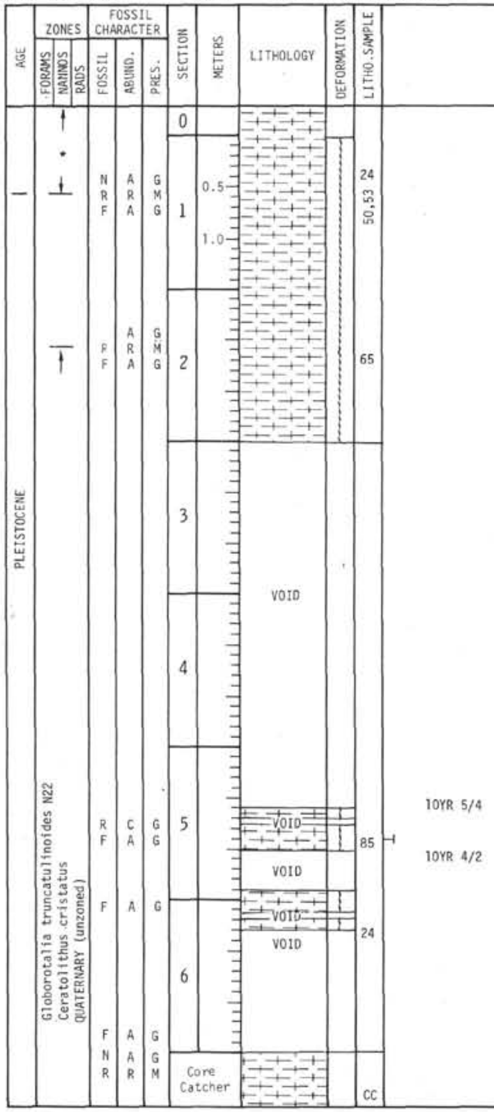
NANNOS
RADIOLARIA
DIATOMS
SPONGE SPICULES
FISH DEBRIS
OPAL PHYTOLITHS
AMORPH SiO2 OF OPAL
34-4, 95
34, CC
35-3, 30
35, CC
36-3, 80
37-3, 60
38-3, 100
39-3, 100
42-3, 90
* 42-3, 129
42, CC
43-3, 126
* 44-3, 85
44-3, 120
44-5, 60
* 45-6, 88
45-6, 88
46-3, 50
47-3, 60
48-3, 40
49-3, 30
50-5, 60
51-3, 80
53, CC
55, CC

Site 366 Hole Core 1 Cored Interval: 0.0-5.0 m



LITHOLOGIC DESCRIPTION

FORAM NANNO OOZE, mottled dark yellowish orange (10YR 6/6), dark yellowish brown (10YR 4/2), and dusky yellow brown (10YR 2/2), intense drilling disturbance, soft. Section 1 has common pelagic clay component, opal phytoliths, and fresh water diatoms, rare rads and diatoms. Section 5 has rare silicoflagellates.

SS at 1-24 (minor lithology)

Pelagic clay	C	Diatoms	R
Micronodules	R	Rads	R
Forams	A	Fish debris	R
Nannos	A	Opal phytoliths	R

SS at 2-65 (dominant lithology)

Forams	A	Diatoms	C
Nannos	A	Rads	R

SS at 5-85 (dominant lithology)

Forams	A	Rads	R
Nannos	A	Silicoflagellates	VR
Diatoms	R-C	Opal phytoliths	R

SS at CC (dominant lithology)

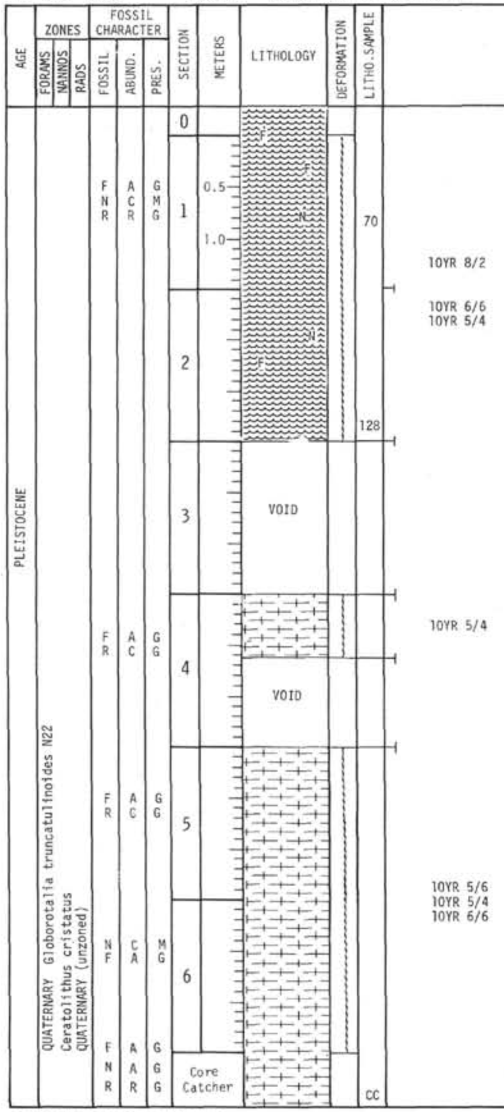
Micronodules	R	Rads	VR
Forams	A	Silicoflagellates	VR
Nannos	A	Fish debris	R
Diatoms	R	Opal phytoliths	R

CARBON-CARBONATE
2-10 (8.0-02.-65)
5-7 (7.6-0.2-62)

GRAIN SIZE
2-7 (33.1-24.2-42.7) Sandy clay
5-8 (7.4-31.4-61.2) Silty clay

* Emiliania huxleyi

Site 366 Hole Core 2 Cored Interval: 5.0-14.5 m



LITHOLOGIC DESCRIPTION

FORAM NANNO MARL, intense mottling, very pale orange (10YR 8/2), moderate yellowish brown (10YR 5/4), intense drilling disturbance; soft.

SS at 1-70 (dominant lithology)

Forams	A
Nannos	A
Rads	R

SS at 2-128 (dominant lithology)

Forams	A	Rads	R
Nannos	A	Silicoflagellates	R
Diatoms	C	Clay	R

SS at CC (dominant lithology)

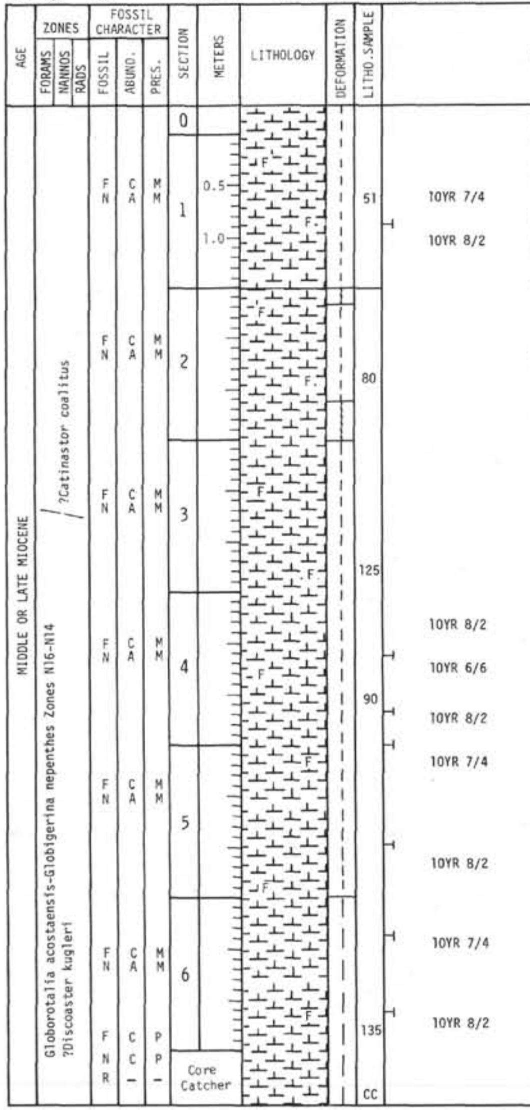
Forams	C	Rads	R
Nannos	A	Silicoflagellates	R
Diatoms	R	Opal phytoliths	R

CARBON-CARBONATE
2-23 (5.6-0.1-45)
5-15 (6.1-0.1-49)

GRAIN SIZE
2-20 (6.3-31.8-61.9) Silty clay
5-17 (9.4-20.9-69.7) Silty clay

Explanatory notes in Chapter 1

Site 366 Hole Core 3 Cored Interval: 119.0-128.5 m



LITHOLOGIC DESCRIPTION

FORAM-BEARING NANNO OOZE, dominant colors: grayish orange (10YR 7/4), very pale orange (10YR 8/2); slight drilling disturbance for most of core; intensely bioturbated throughout; stiff ooze.

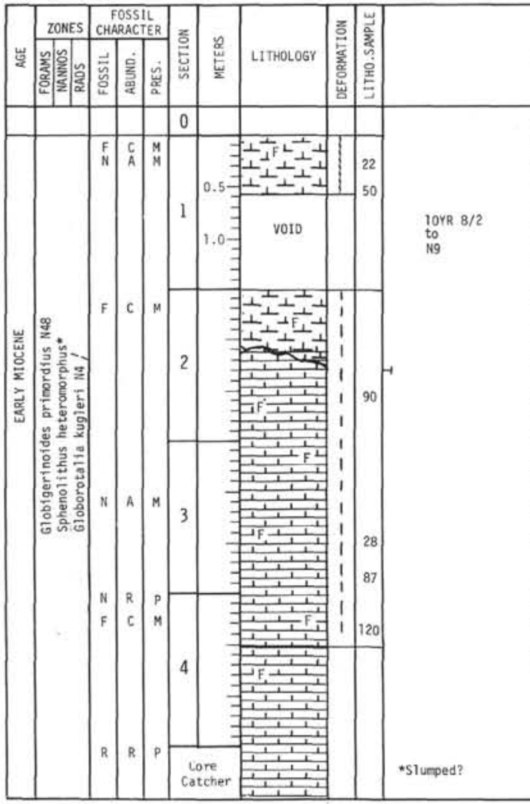
SS at 1-51, 2-80, 3-125, 4-90, CC (dominant lithology)
Forams C
Nannos D

Carbonate Bomb: 1-25 to 26 cm = 72%
2-25 to 26 cm = 83%
4-84 to 85 cm = 59%
5-82 to 83 cm = 62%

CARBON-CARBONATE
2-10 (10-0.0-83)
5-80 (4.9-90-40)

GRAIN SIZE
2-11 (6.5-50.2-43.3) Clayey silt
5-78 (0.7-22.1-77.2) Clay

Site 366 Hole Core 4 Cored Interval: 242.5-252.0 m



Explanatory notes in Chapter 1

LITHOLOGIC DESCRIPTION

FORAM-BEARING NANNO OOZE, very pale orange (10YR 8/2) to white (N9), firm to stiff, slight drilling disturbance, except for first 55 cm which are intense. Main lithology is mottled with grayish orange (10YR 7/4) and light grayish green (5GY 8/1) colors throughout core. Section 3 shows presence of Radiolaria. Fresh water diatoms. Lithology becomes a CHALK within Section 2.

SS at 1-22 (dominant lithology)

Forams	C	Nannos	D

SS at 2-90 (dominant lithology)

Forams	A	Rads	R
Nannos	A	Sponge spicules	VR

SS at 3-28 (dominant lithology)

Forams	A	Diatoms	R-C
Nannos	A	Rads	C

SS at 3-87 (minor lithology)

Forams	A	Diatoms	R
Nannos	A	Rads	C

SS at 3-120 (dominant lithology)

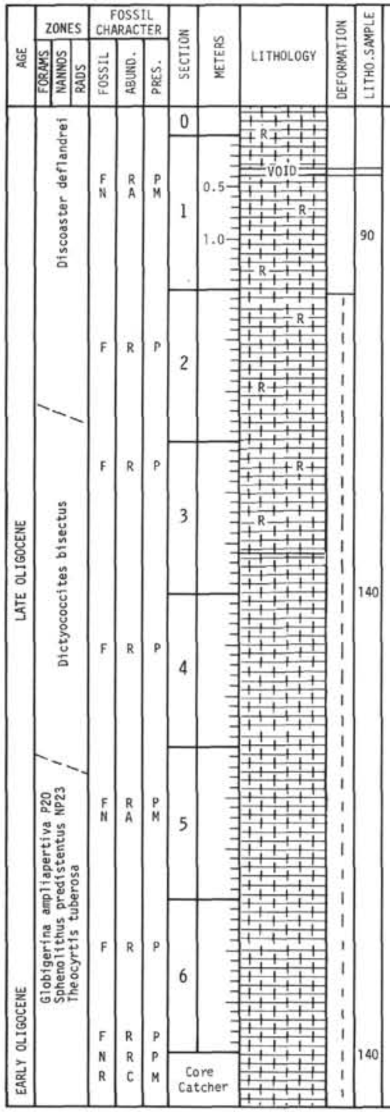
Forams	A	Rads	R
Nannos	A	Sponge spicules	VR
		Silicoflagellates	VR

Carbonate Bomb: 2-136 to 137 cm = 79%

CARBON-CARBONATE
2-133 (10.1-0.0-84)

GRAIN SIZE
2-130 (7.4-49.1-43.5) Clayey silt

Site 366 Hole Core 5 Cored Interval: 366.0-375.5 m



'5GY 8/1'

LITHOLOGIC DESCRIPTION

RAD-BEARING FORAM NANNO CHALK, light greenish gray (5GY 8/1), mottled, little to slight drilling disturbance, stiff, burrowed zones 0-30, 108-125 and in Core 2. Biogenic calcite needles prominant in Section 3. FORAM NANNO CHALK, light bluish gray (5B 7/1), slight drilling disturbance, stiff, with Zoophycos tracks and burrowing, especially in Sections 5 and 6.

SS at 1-90 (dominant lithology)

Zeolites(?)	VR	Forams	A
Rads	C	Nannos	A

SS at 3-140 (dominant lithology)

Zeolites(?)	R	Nannos	A
Forams	A	Calcite needles	C

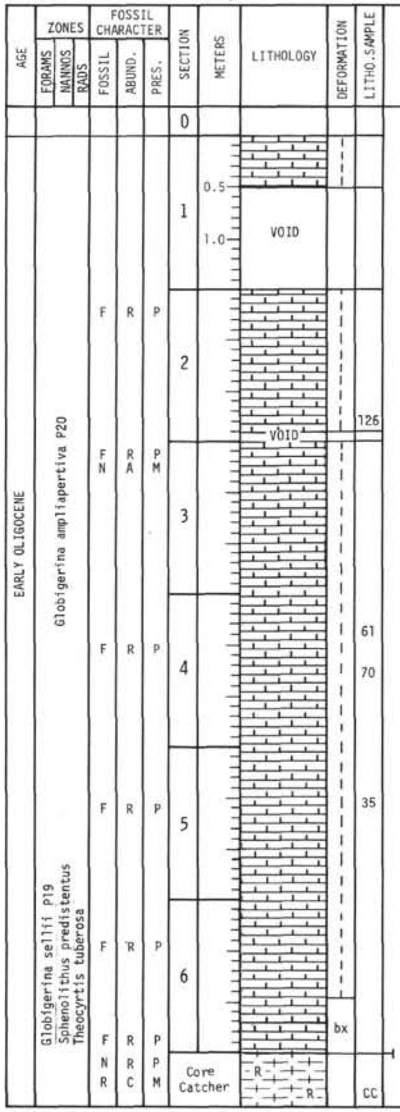
SS at 6-140 (dominant lithology)

Forams	R	Rads	R
Nannos	D		

CARBON-CARBONATE
2-1 (9.7-0.1-81)
5-140 (10.1-0.1-83)

GRAIN SIZE
2-1 (8.5-45.3-46.2) Silty clay
5-142 (8.6-37.0-54.4) Silty clay

Site 366 Hole Core 6 Cored Interval: 375.5-385.0 m



5B 9/1

LITHOLOGIC DESCRIPTION

NANNO CHALK, bluish white (5B 9/1) with mottles and bands of light bluish gray (5B 7/1), slight drilling disturbance, stiff, commonly burrowed and Zoophycos tracks. Mn laminations and liesegang banding common. Drilling breccia from 6-100 to 6-150 cm. Core Catcher is RAD-BEARING FORAM NANNO CHALK, bluish white (5B 9/1), stiff.

SS at 2-126 (dominant lithology)

Zeolites(?)	R	Sponge spicules	R
Forams	R	Nannos	D

SS at 4-70 (dominant lithology)

Forams	C	Rads	R
Nannos	A		

SS at 5-53 (minor lithology)

Nannos	A	Rads	R
Diatoms	R	Sponge spicules	R

SS at CC

Forams	A	Rads	C
Nannos	A	Sponge spicules	R
		Silicoflagellates	R

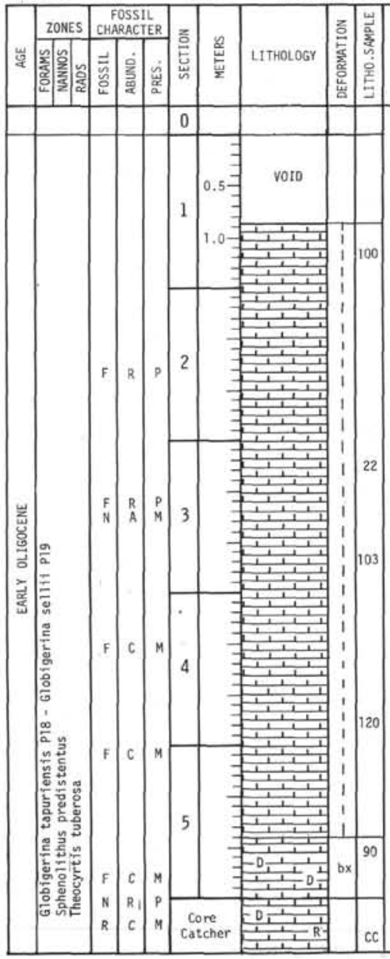
Carbonate Bomb: 3-64 to 65 cm = 79%

CARBON-CARBONATE
2-4(10.5-0.1-87)
5-3 (10.2-0.1-85)

GRAIN SIZE
2-1 (3.6-41.5-54.9) Silty clay
5-1 (3.3-51.0-45.7) Clayey silt

Explanatory notes in Chapter 1

Site 366 Hole Core 7 Cored Interval: 385.0-394.5 m



5B 9/1

LITHOLOGIC DESCRIPTION

NANNO CHALK, bluish white (5B 9/1), mottled with light greenish gray (5G 8/1), slight drilling disturbance, stiff, Mn laminations, burrows, and Zoophycos tracks common throughout. Diatoms appear in bottom of Section 5. Core Catcher lithology DIATOM-BEARING, RAD-BEARING NANNO CHALK.

SS at 1-100 (dominant lithology)

Forams	R	Rads	R
Nannos	D	Sponge spicules	R

SS at 3-22 (minor lithology)

Pelagic clay	R-C	Diatoms	R-C
Nannos	A	Rads	R

SS at 4-120 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	VR

SS at 5-90 (dominant lithology)

Forams	R	Diatoms	C
Nannos	A	Rads	R

SS at CC

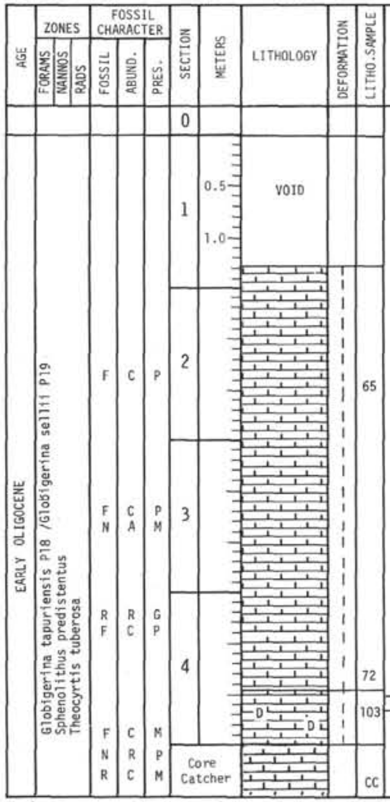
Zeolites(?)	R	Diatoms	C
Forams	C	Rads	C
Nannos	A	Sponge spicules	R

Carbonate Bomb: 3-71 to 72 cm = 83%

CARBON-CARBONATE
2-9 (9.7-0.1-80)
5-2 (9.4-0.1-78)

GRAIN SIZE
2-10 (2.0-40.1-57.9) Silty clay
5-1 (4.0-45.1-50.9) Silty clay

Site 366 Hole Core 8 Cored Interval: 394.5-404.0 m



5G 8/1

5GY 8/1

LITHOLOGIC DESCRIPTION

NANNO CHALK, light greenish gray (5G 8/1) with interbeds of green gray (5G 6/1) and olive gray (5Y 4/1). Interbeds are 5 to 10 cm thick. Sediments are firm with slight drilling disturbance. Whole core is burrowed, Mn nodules with liesegang banding are scattered throughout and fine Mn banding is found commonly. DIATOM-BEARING NANNO CHALK, dark greenish gray (5GY 6/1), firm, slight drilling disturbance at 95-105 cm in Section 4.

SS at 2-65 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R

SS at 4-72 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R

SS at 4-103 (minor lithology)

Micronodules	R	Diatoms	C
Forams	R	Rads	R
Nannos	A	Silicoflagellates	R

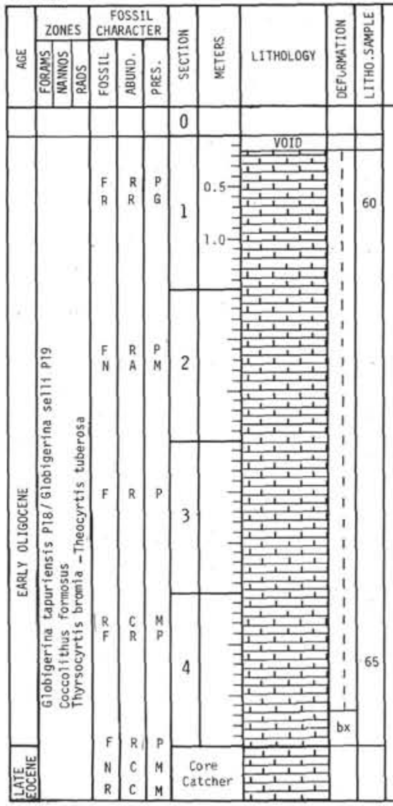
SS at CC (dominant lithology)

Forams	R	Diatoms	R
Nannos	A	Rads	R
		Sponge spicules	R

CARBON-CARBONATE
2-83 (9.2-0.1-76)

Explanatory notes in Chapter 1

Site 366 Hole Core 9 Cored Interval: 404.0-413.5 m



LITHOLOGIC DESCRIPTION

5GY 6/1

NANNO CHALK, dark greenish gray (5GY 6/1) with mottles of (5G 8/1) and greenish gray (5GY 6/1) and light olive gray (5Y 6/1), slight drilling disturbance, sediment burrowed, and has Mn laminations and nodules, some showing liesegang banding. Zoophycos tracks apparent at 4-15 to 20 cm. Diatoms are common.

SS at 1-60 (dominant lithology)

Forams	R	Diatoms	C
Nannos	A	Rads	R

SS at 4-65 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	VR

SS at CC (dominant lithology)

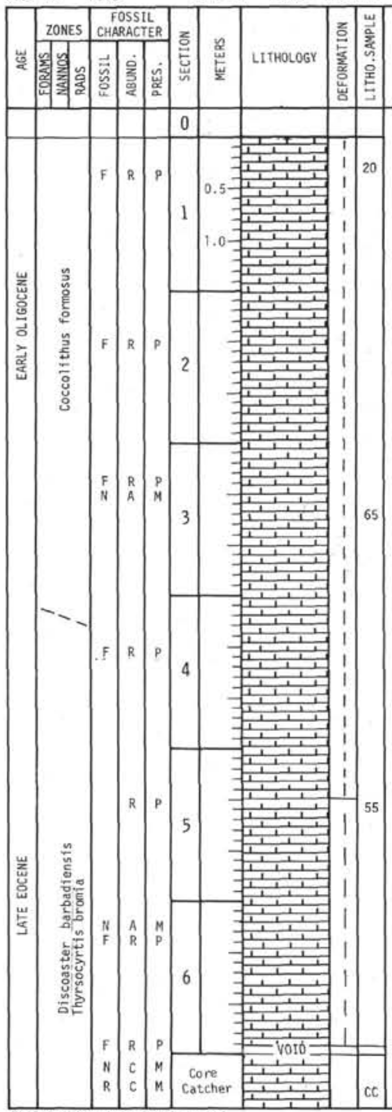
Forams	R	Diatoms	R
Nannos	D	Rads	R

Carbonate Bomb: 3-61 to 62 cm = 79%

CARBON-CARBONATE
2-2 (8.7-0.1-72)
4-2 (8.9-0.1-73)

GRAIN SIZE
2-1 (1.2-43.0-55.8) Silty clay
4-1 (1.2-37.8-61.0) Silty clay

Site 366 Hole Core 10 Cored Interval: 413.5-423.0 m



LITHOLOGIC DESCRIPTION

5GY 8/1

NANNO CHALK, light greenish gray (5GY 8/1), firm, slight to moderate drilling disturbance, intense burrowing and Fe/Mn banding throughout core. Some liesegang banding around Mn nodules, Zoophycos tracks apparent, core generally mottled throughout. Lighter sediment intensely burrowed, darker sediment only moderately burrowed.

SS at 1-20 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	R

SS at 3-65 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	R

SS at 5-55 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	R

SS at CC (dominant lithology)

Forams	R	Rads	R
Nannos	D	Diatoms	R

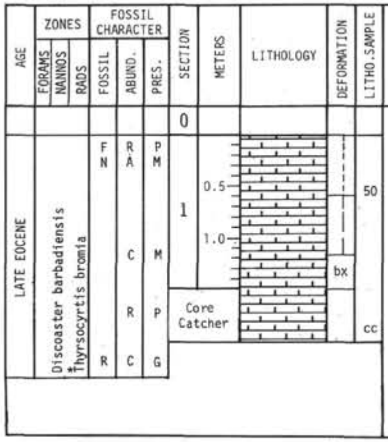
Carbonate Bomb: 2-58 to 59 cm = 72%

CARBON-CARBONATE
2-59 (9.3-0.1-77)
4-44 (8.6-0.1-71)

GRAIN SIZE
2-60 (1.3-35.5-63.3) Silty clay
4-45 (1.7-36.5-61.8) Silty clay

Explanatory notes in Chapter 1

Site 366 Hole Core 11 Cored Interval: 423.0-432.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1

NANNO CHALK, light greenish gray (5GY 8/1) with mottles and interbeds of 5G 8/1, firm, slight to moderate drilling disturbance in first 100 cm then drilling breccia for remaining 50 cm. Sediment is burrowed throughout with Fe/Mn nodules, some with liesegang banding.

SS at 1-50 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R

SS at CC (dominant lithology)

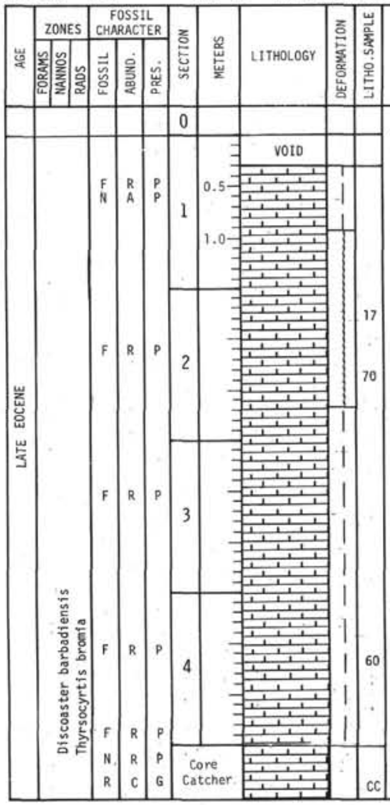
Forams	VR	Rads	R
Nannos	A	Silicoflagellates	VR
Diatoms	C		

Carbonate Bomb: 1-52 to 53 cm = 75%

GRAIN SIZE
1-45 (1.6-33.5-64.9) Silty clay

* Isthmolithus recurvus-Sphenolithus pseudoradians NP19-NP20

Site 366 Hole Core 12 Cored Interval: 432.5-442.0 m



LITHOLOGIC DESCRIPTION

5GY 8/1

NANNO CHALK, light greenish gray (5GY 8/1) with mottles of greenish gray (5GY 6/1). Drilling disturbance moderate to intense, firm. Sediment burrowed throughout and has common Fe/Mn bands and nodules, some showing liesegang banding. Zoophycos tracks apparent in Section 3. Faint greenish laminations occur, especially in Sections 3 and 4.

SS at 2-70 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	R

SS at 4-60 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	R

SS at CC

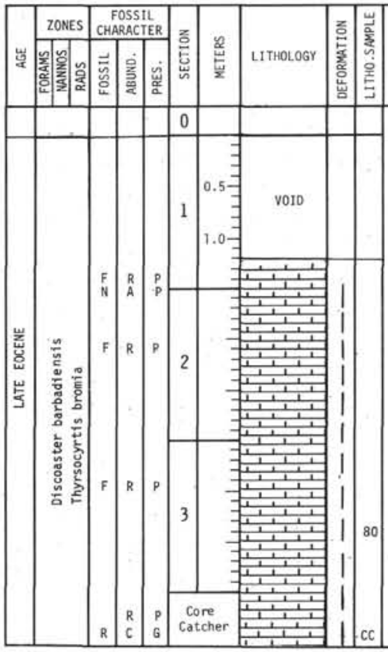
Forams	R	Diatoms	C
Nannos	A	Rads	C

Carbonate Bomb: 3-76 to 77 cm = 58%

CARBON-CARBONATE
2-12 (7.9-0.1-65)
3-74 (8.5-0.1-71)

GRAIN SIZE
2-10 (1.3-33.3-65.4) Silty clay
3-61 (2.0-35.0-63.0) Silty clay

Site 366 Hole Core 13 Cored Interval: 442.0-451.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1

NANNO CHALK, light greenish gray (5GY 8/1) with mottles of slightly darker color. Sediment is firm and has moderate drilling disturbance. Common faint green laminations.

SS at 3-80 (dominant lithology)

Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	R

SS at CC

Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	VR

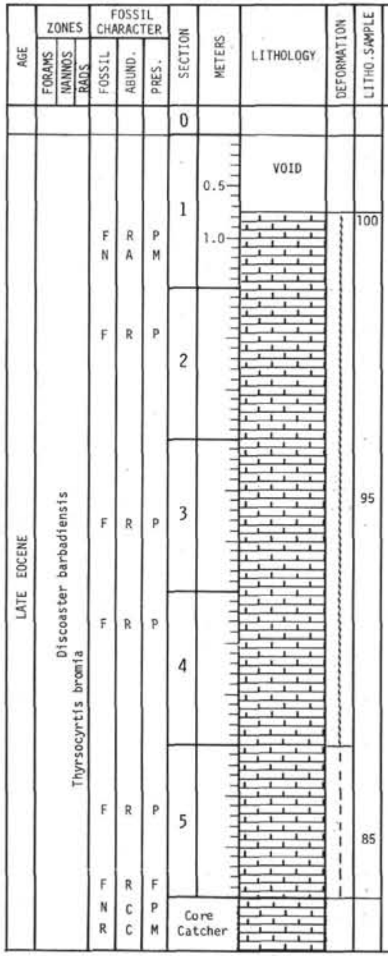
Carbonate Bomb: 2-82 to 83 cm = 54%

CARBON-CARBONATE
2-76 (8.5-0.1-70)

GRAIN SIZE
2-74 (1.7-36.7-61.6) Silty clay

Explanatory notes in Chapter 1

Site 366 Hole Core 14 Cored Interval: 451.5-461.0 m



LITHOLOGIC DESCRIPTION

5GY 8/1

NANNO CHALK, light greenish gray (5GY 8/1), with small (5 cm) zones of grayish green (5G 6/1). Sections 1 through 4 have intense drilling disturbance. Entire core has moderate mottling and burrowing with Zoophycos apparent and Fe/Mn specks common. Some faint green laminations occur.

SS at 1-100 (dominant lithology)			
Forams	R	Diatoms	R
Nannos	D	Rads	R

SS at 3-95 (dominant lithology)			
Forams	R	Rads	R
Nannos	D	Sponge spicules	R
Diatoms	R	Fish debris	VR

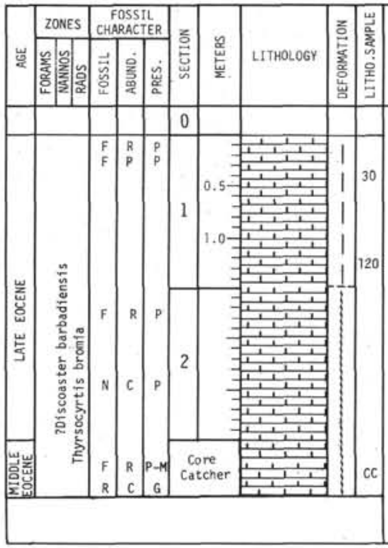
SS at 5-85 (dominant lithology)			
Forams	R	Rads	R
Nannos	D	Sponge spicules	R
Diatoms	VR		

Carbonate Bomb: 3-82-83 cm = 58%

CARBON-CARBONATE
2-53 (9.0-0.1-75)
5-69 (10.0-0.1-83)

GRAIN SIZE
2-54 (1.5-39.8-58.7) Silty clay
5-67 (3.5-42.5-54.0) Silty clay

Site 366 Hole Core 15 Cored Interval: 461.0-470.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1

NANNO CHALK, light greenish gray (5GY 8/1), with greenish gray (5GY 6/1) interbeds 5 cm thick, firm, moderate to severe drilling disturbance, thin Mn laminae, burrowed.

SS at 1-30 (minor lithology)			
Clay	R	Nannos	D
Micronodules	R	Diatoms	R
Forams	R	Rads	R

SS at 1-120 (dominant lithology)			
Forams	R	Diatoms	R
Nannos	D	Rads	R

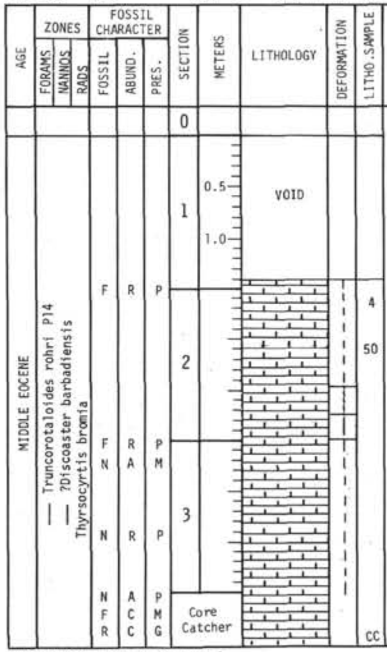
SS at 2-35 (dominant lithology]			
Forams	R	Diatoms	R
Nannos	D	Rads	R

SS at CC			
Forams	R	Diatoms	R
Nannos	D	Rads	R

Carbonate Bomb: 1-54 to 55 cm = 83%

CARBON-CARBONATE
1-55 (9.9-0.1-82)

Site 366 Hole Core 16 Cored Interval: 470.5-480.0 m



LITHOLOGIC DESCRIPTION

5GY 8/1

NANNO CHALK, light greenish gray (5GY 8/1), stiff, drilling disturbance slight to intense, faint black, green, and dark gray laminations, intense burrowing and Zoophycos tracks, a few Fe/Mn nodules with liesegang banding.

SS at 2-4 (minor lithology)
Ferromanganese oxide layer

SS at 2-50 (major lithology)			
Forams	R	Diatoms	R
Nannos	D	Rads	R

SS at CC			
Forams	R	Diatoms	R
Nannos	D	Rads	R
		Sponge spicules	R

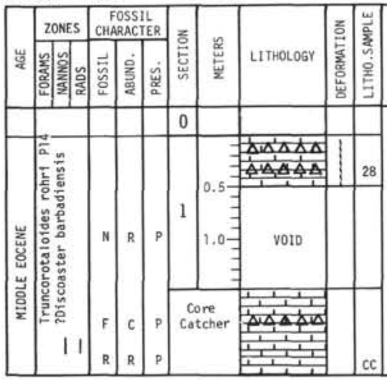
Carbonate Bomb: 2-7 to 8 cm = 73%

CARBON-CARBONATE
2-9 (8.7-0.1-72)

GRAIN SIZE
2-12 (3.3-38.0-58.7) Silty clay

Explanatory notes in Chapter 1

Site 366 Hole Core 17 Cored Interval: 480.0-489.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1

INTERBEDDED NANNO CHALK AND PORCELLANITE IN CYCLES

NANNO CHALK, light greenish gray (5GY 8/1), laminated, stiff, severe drilling disturbance, burrowed.

PORCELLANITE, light gray (N7).

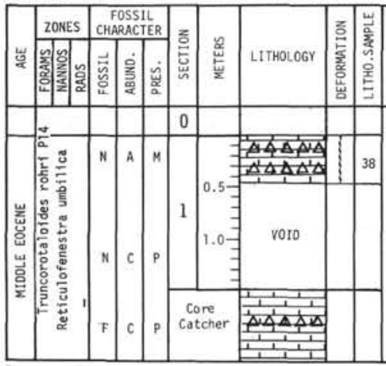
SS at 1-28 (minor lithology)

Forams	R	Nannos	D
Rads	R		

SS at CC

Forams	R	Nannos	D

Site 366 Hole Core 18 Cored Interval: 498.5-499.0 m



LITHOLOGIC DESCRIPTION

5GY 8/1

INTERBEDDED PORCELLANITE AND NANNO CHALK IN CYCLES

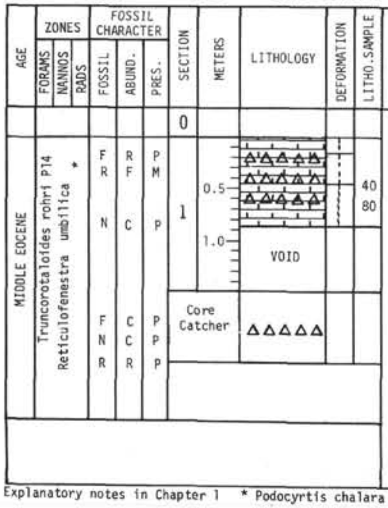
NANNO CHALK, light greenish gray (5GY 8/1), well-indurated but not cemented, disturbed by drilling, discontinuous laminae of greenish gray (5GY 6/1) nanno chalk.

PORCELLANITE, light gray (N7), subconchoidal fracturing.

SS at 1-38 (minor lithology)

Recrystallized calcite	A	Nannos	A

Site 366 Hole Core 19 Cored Interval: 499.0-508.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1

INTERBEDDED PORCELLANITE AND NANNO CHALK IN CYCLES (~25 cm)

NANNO CHALK, light greenish gray (5GY 8/1), well-indurated but not cemented, severe drilling disturbance, laminated and burrowed.

PORCELLANITE, light gray (N7) becoming cherty in center of burrows(?). Chert is light olive gray (5Y 6/1).

SS at 1-40 (dominant ltihology)

Recrystallized calcite	A	Nannos	A

SS at 1-80 (dominant lithology)

Recrystallized calcite	C	Forams	R

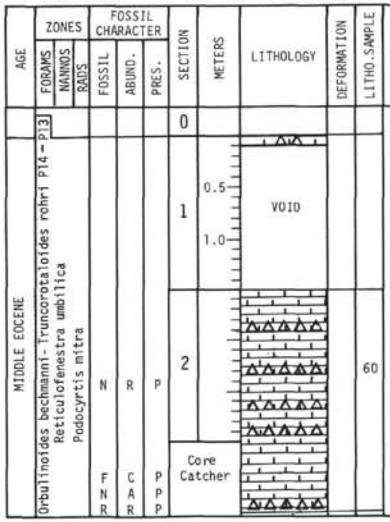
Carbonate Bomb: 1-103 to 104 cm = 83%

CARBON-CARBONATE
1-102 (10.6-0.1-88)

GRAIN SIZE
1-98 (9.5-44.6-45.8) Silty clay

Explanatory notes in Chapter 1 * Podocyrtis chalara

Site 366 Hole Core 20 Cored Interval: 508.5-518.0 m



LITHOLOGIC DESCRIPTION

5GY 8/1

PORCELLANITE, CHERT, NANNO CHALK IN CYCLES (~25 cm)

PORCELLANITE, light gray (N7) grading into CHERT nodules and stringers, very light gray (N8) to light gray (N7). NANNO CHALK is light greenish gray (5GY 8/1). This series of nanno chalk, porcellanite, chert occurs of about a 40 cm interval.

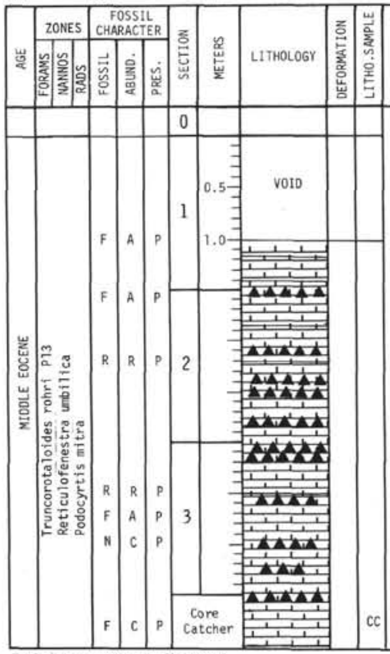
SS at 2-60 (dominant lithology)

Recrystallized calcite	C	Nannos	C

Carbonate Bomb: 2-131 to 132 cm = 79%

CARBON-CARBONATE
2-131 (9.7-0.1-80)

Site 366 Hole Core 21 Cored Interval: 518.0-527.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1

PORCELLANITE, CHERT, NANNO CHALK IN CYCLES (~25 cm). PORCELLANITE, light gray (N7) grading into CHERT nodules and stringers, very light gray (N8) to light gray (N7). NANNO CHALK is light greenish gray (5GY 8/1). This series of nanno chalk, porcellanite, chert occurs of about a 40 cm interval.

SS at 2-60 (dominant lithology)

Recrystallized calcite	C	Nannos	C

Carbonate Bomb: 2-131 to 132 cm = 79%

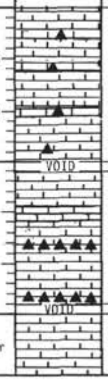
CARBON-CARBONATE
2-81 (10.9-0.1-91)

Explanatory notes in Chapter 1

Site 366 Hole Core 22 Cored Interval: 527.5-537.0 m

AGE	ZONES			FOSSIL CHARACTER			SECTION	METERS	DEFORMATION	LITHO.SAMPLE
	FORAMS	NANNOS	RADS	FOSSIL	ABUND.	PRES.				
	P12-P13						0			
MIDDLE EOCENE	Globorotalia lehneri-Orbulinoides beckmanni	?Reticulofenestra *	Podocyrtis ampla	F	A	P	1	0.5 1.0		
				F N	A C	P P	2			
				N	R	P				
				F	C	PM				
				R	R	P	Core Catcher			
				N	R	P				CC

LITHOLOGY



LITHOLOGIC DESCRIPTION

5GY 8/1

INTERBEDDED NANNO CHALK, SILICIFIED LIMESTONE, AND CHERT IN CYCLES (~25 cm)

NANNO CHALK, light greenish gray (5GY 8/1), well-indurated, laminated. Grades into SILICIFIED LIMESTONE.

CHERT, light gray (N7), shows burrows, laminated.

SS at CC

Recrystallized calcite	C	Forams	R
		Nannos	C

Carbonate Bomb: 1-49 to 50 cm = 83%

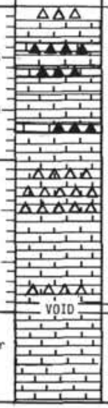
CARBON-CARBONATE
1-48 (10.5-0.1-87)

GRAIN SIZE
1-46 (25.4-44.0-30.6) Sandy clay

Site 366 Hole Core 23 Cored Interval: 537.0-546.5 m

AGE	ZONES			FOSSIL CHARACTER			SECTION	METERS	DEFORMATION	LITHO.SAMPLE
	FORAMS	NANNOS	RADS	FOSSIL	ABUND.	PRES.				
							0			
MIDDLE EOCENE	Globorotalia lehneri – Orbulinoides beckman P12-P13	?Reticulofenestra umbilica	Thyrsocyrtis triacantha	F	A	P	1	0.5 1.0		60
				F N	A C	P P	2			
				N	R	P	Core Catcher			
				F	C	P				
				R	R	M				CC

LITHOLOGY



LITHOLOGIC DESCRIPTION

5GY 8/1

INTERBEDDED NANNO CHALKS, SILICIFIED LIMESTONES, AND CHERT IN CYCLES (~20 cm).

NANNO CHALK, light greenish gray (5GY 8/1), well-indurated, laminated, grading into silicified limestone.

CHERT, medium light gray (N6) grading into porcellanites.

SS at 1-60

Forams	C	Nannos	A
Recrystallized calcite	C		

SS at CC

Chert	R	Forams	R
Nannos	A		

Carbonate Bomb: 1-68 to 69 cm = 87%
1-63 to 65 cm = 37%

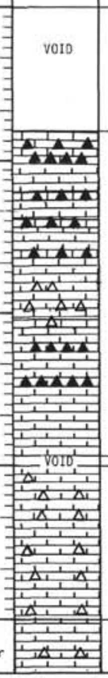
CARBON-CARBONATE
1-73 (10.7-0.1-88)

GRAIN SIZE
1-72 (30.9-39.6-29.4) Sandy clay

Site 366 Hole Core 24 Cored Interval: 546.5-556.0 m

AGE	ZONES			FOSSIL CHARACTER			SECTION	METERS	DEFORMATION	LITHO.SAMPLE
	FORAMS	NANNOS	RADS	FOSSIL	ABUND.	PRES.				
							0			
MIDDLE EOCENE	Globigerapsis kugleri-Globorotalia lehneri P11-P12	Coccolithus staurion	Thyrsocyrtis triacantha				1	0.5 1.0		
				F N	R R	P P	2			
				F	R	P	3			
				F	R	P	4			
				F	C	P				
				N	R	P	Core Catcher			
				R	R	P				CC

LITHOLOGY



LITHOLOGIC DESCRIPTION

5GY 8/1

INTERBEDDED NANNO CHALK, SILICIFIED LIMESTONE, AND CHERT IN CYCLES (~25 cm)

NANNO CHALK, light greenish gray (5GY 8/1), well-indurated, laminated and burrowed, grading into silicified limestone.

CHERT, light gray (N7), grades into porcellanite. Chert/porcellanite minor in occurrence.

SS at CC

Recrystallized calcite	D	Forams	R
		Nannos	R

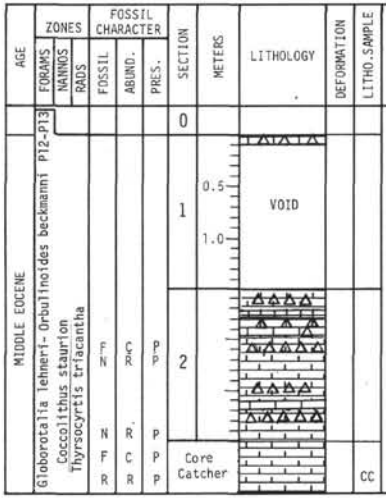
Carbonate Bomb: 2-105 to 106 cm = 37%
2-110 to 111 cm = 79%

CARBON-CARBONATE
2-105 (5.0-0.1-42)
2-112 (10.4-0.1-86)

GRAIN SIZE
2-113 (24.1-37.6-38.3) Sandy clay

Explanatory notes in Chapter 1

Site 366 Hole Core 25 Cored Interval: 556.0-565.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1

INTERBEDDED NANNO CHALK, SILICIFIED LIMESTONE, AND CHERT, IN CYCLES OF ABOUT 20 cm.

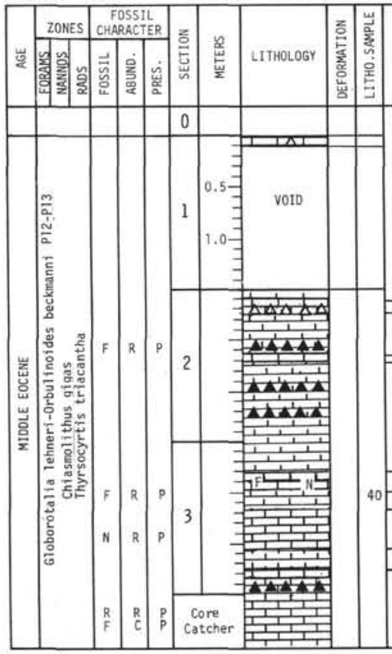
NANNO CHALK, light greenish gray (5GY 8/1), well-indurated, laminated, grading into SILICIFIED LIMESTONE.

CHERT, medium light gray (N6) grading into PORCELLANITE, light gray (N7).

Carbonate Bomb: 2-60 to 61 cm = 40%

CARBON-CARBONATE
2-55 (9.0-0.1-75)

Site 366 Hole Core 26 Cored Interval: 565.5-575.0 m



LITHOLOGIC DESCRIPTION

N7 to N8
5B 7/1 to 5GY 8/1
N7 to N8
5B 7/1 to 5GY 8/1
N7 to N8
5B 7/1 to 5GY 8/1
N7 to N8
5B 7/1 to 5GY 8/1
N7 to N8
5B 7/1 to 5GY 8/1
N7 to N8

INTERBEDDED CHALK, LIMESTONE AND PORCELLANITE/CHERT IN CYCLES (~20 cm)

CHALK, light bluish gray (5B 7/1) to light greenish gray (5GY 8/1), well-indurated, wavy Mn-high laminations, burrows, and a few liesegang bands.

LIMESTONE, light gray (N7) to very light gray (N8), laminated.

PORCELLANITE/CHERT, light bluish gray (5B 7/1), occurs as thin (~3 cm) beds above CHALK units, or as nodules in silicified limestone segments.

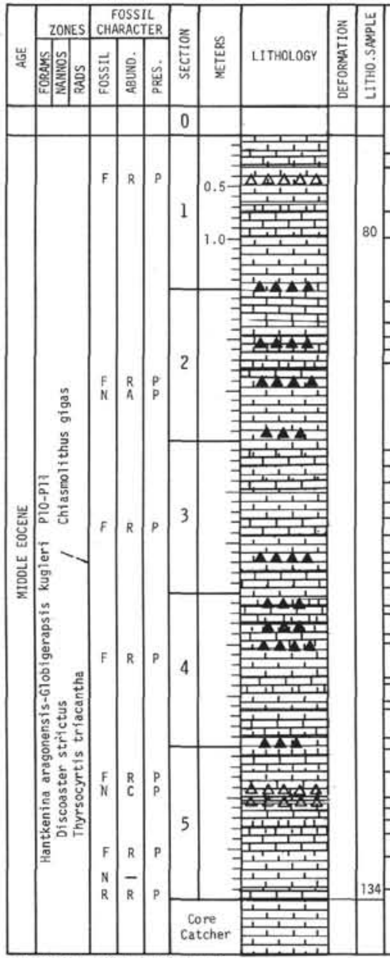
SS at 3-40 (dominant lithology)

Recrystallized calcite	C	Forams	C
		Nannos	A

Carbonate Bomb: 3-81 to 82 cm = 73%

CARBON-CARBONATE
2-94 (10.5-0.2-86)
3-83 (9.3-0.0-77)

Site 366 Hole Core 27 Cored Interval: 575.0-584.5 m



LITHOLOGIC DESCRIPTION

Limestone:
N8 to
5G 8/1

Chalk:
5GY 8/1 to
5GY 6/1

INTERBEDDED LIMESTONE, CHALK, AND MINOR CHERT IN CYCLES (~20 cm)

CHALK, light greenish gray (5GY 8/1) to greenish gray (5GY 6/1), well-indurated, laminated, burrowed, Fe/Mn specks, a few with liesegang banding, chalk becomes shaly in more argillaceous sections.

LIMESTONE, very light gray (N8) to light greenish gray (5G 8/1), burrowing, dark Fe/Mn laminations common, varying degrees of cementation.

CHERT, very light gray (N8) to light bluish gray (5B 7/1), occurs within or just above each limestone segment.

Complete cycles consist of:
4 cm CHERT
8 cm LIMESTONE } 20 cm
8 cm CHALK

SS at 1-80 (dominant lithology)

Recrystallized calcite	C	Forams	C
		Nannos	A

SS at 5-134 (minor lithology)

Fe/Mn nodules	R	Forams	R
Recrystallized calcite	C	Nannos	A

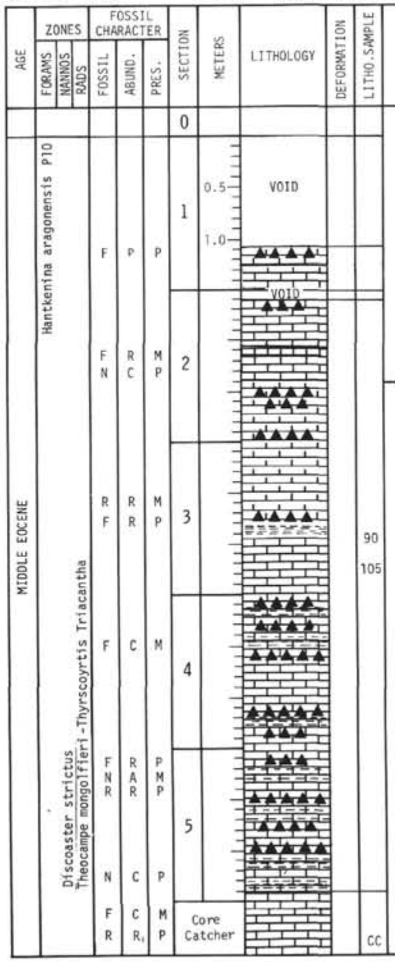
Carbonate Bomb: 2-79 to 80 cm = 62%

CARBON-CARBONATE
2-83 (8.3-0.2-67)
4-75 (9.1-0.1-75)

GRAIN SIZE
2-81 (17.4-40.6-42.0) Silty clay
4-72 (19.9-43.3-36.8) Clayey silt

Explanatory notes in Chapter 1

Site 366 Hole Core 28 Cored Interval: 584.5-594.0 m



LITHOLOGIC DESCRIPTION

5B 7/1
to
5GY 8/1

5GY 6/1
to
5G 6/1
to
5G 4/1

INTERBEDDED CHALK, LIMESTONE, AND CHERT IN CYCLES (∿20-25 cm)

CHALK, greenish gray (5GY 6/1 to 5G 6/1) to dark greenish gray (5G 4/1), wavy laminations, Fe/Mn specks, becomes shaly in a few places, burrowed, SHALES layers 1 to 2 cm thick.

LIMESTONE, light bluish gray (5B 7/1) grading to light greenish gray (5GY 8/1), Fe/Mn specks, some with liesegang banding, burrowed, wavy laminations.

CHERT, medium light gray (N6), occurs as nodules or layers (∿4 cm) just above limestone sections.

SS at 3-90 (minor lithology, insoluble residue)

Clay	D	Fe/Mn nodules	R
Rads	R	Fish debris	R

SS at 2-90 (dominant lithology, chalk)

Recrystallized calcite	D	Forams Nannos	R R

SS at 3-105 (dominant lithology, limestone)

Recrystallized calcite	D	Forams Nannos	R R

SS at CC

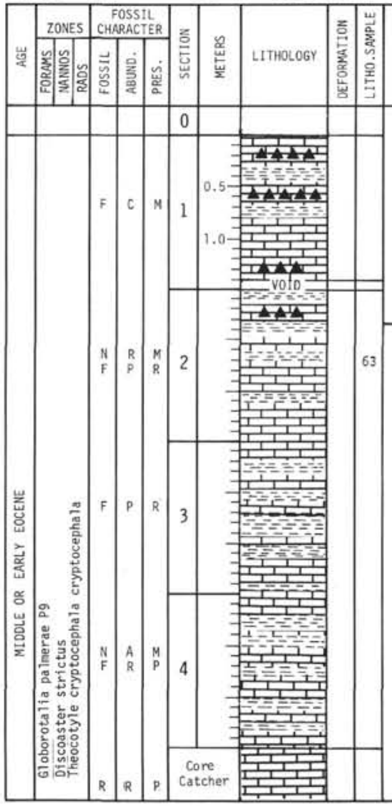
Recrystallized calcite	A	Forams Nannos	C A

Carbonate Bomb: 3-58 to 59 cm = 62%

CARBON-CARBONATE
2-104 (10.1-0.1-83)
3-54 (10.0-0.1-83)

GRAIN SIZE
2-102 (15.2-48.3-36.5) Clayey silt

Site 366 Hole Core 29 Cored Interval: 594.0-603.5 m



LITHOLOGIC DESCRIPTION

N8

N8
to
5GY 8/1

INTERBEDDED ARGILLACEOUS LIMESTONE, AND SILICEOUS LIMESTONE WITH CHERT IN CYCLES (∿50 cm)

ARGILLACEOUS LIMESTONE, very light gray (N8) to light greenish gray (5GY 8/1), faintly laminated, burrowed, Fe/Mn specks. Occasionally a small (∿3 cm) interbed of SHALE occurs.

Grades into SILICEOUS LIMESTONE, light gray (N8), faintly laminated, burrowed, capped by chert nodules.

CHERT, medium light gray (N6), about 3 to 4 cm thick.

This core is a more argillaceous and more siliceous gradation of the previous core. The transition occurs over several cores.

SS at 2-63 (minor lithology)

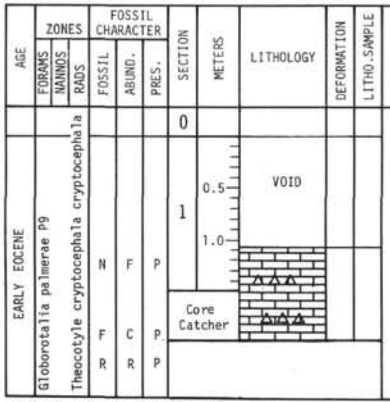
Clay	A	Fe/Mn	R
Forams	R	Nannos	R
Recrystallized calcite	C	Fish debris	R

Carbonate Bomb: 2-37 to 38 cm = 67%

CARBON-CARBONATE
2-33 (10.2-0.1-84)
4-54 (8.2-0.1-68)

GRAIN SIZE
4-52 (16.5-42.6-40.9) Clayey silt

Site 366 Hole Core 30 Cored Interval: 603.5-613.0 m



LITHOLOGIC DESCRIPTION

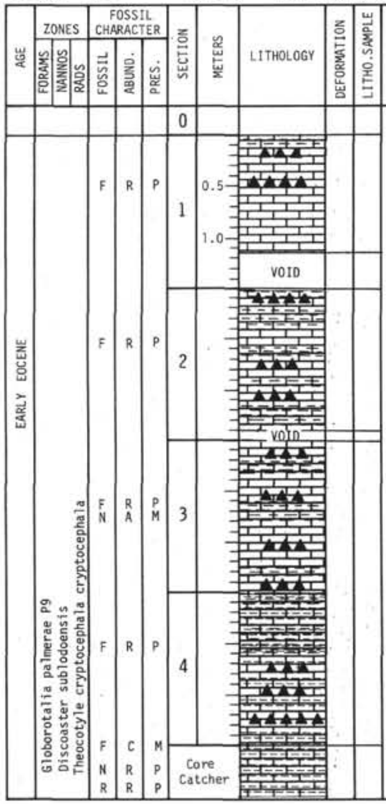
N7
to
N8

SILICEOUS LIMESTONE, light gray (N7) to very light gray (N8), some faint laminations, burrowed.

Carbonate Bomb: 1-111 to 112 cm = 29%

Explanatory notes in Chapter 1

Site 366 Hole Core 31 Cored Interval: 613.0-622.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1

ARGILLACEOUS LIMESTONE WITH THIN CHERT LAYERS IN CYCLES

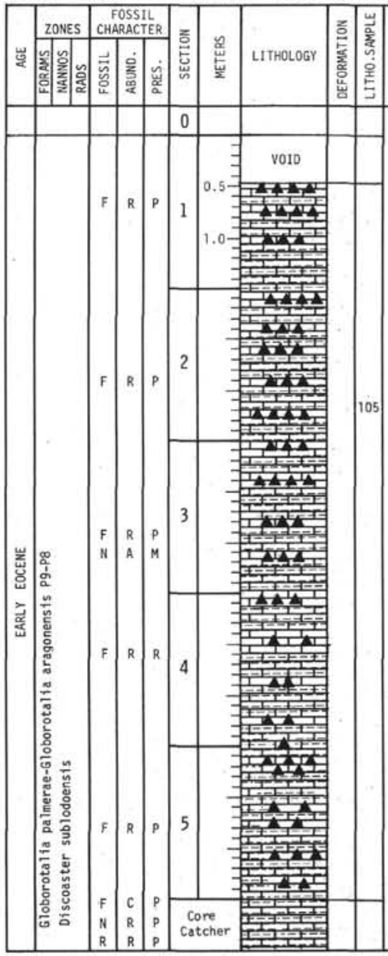
ARGILLACEOUS LIMESTONE, light green gray (5GY 8/1), faint wavy laminations, burrowed, with thin (~2 cm) Fe/Mn bands, ~5 cm cherty layers and ~5 cm thick SHALE beds. Limestone grades into and back out of siliceous bands at about 20 to 25 cm intervals, CHERTY regions are light to very light gray (N7 to N8).

The cherty sections cap each limestone interval (~30 cm).

Carbonate Bomb: 2-134 to 135 cm = 14%

CARBON-CARBONATE
2-132 (2.0-0.1-15)
4-53 (2.4-0.1-19)

Site 366 Hole Core 32 Cored Interval: 622.5-632.0 m



LITHOLOGIC DESCRIPTION

5GY 8/1
to
5GY 6/1
and
N7
to
N6

INTERBEDDED ARGILLACEOUS LIMESTONE AND CHERT IN CYCLES (~30 cm)

ARGILLACEOUS LIMESTONE, light greenish gray (5GY 8/1) to greenish gray (5GY 6/1), faint wavy laminations, burrowed, Fe/Mn streaks and blebs.

CHERT TO CHERTY LIMESTONE, light gray (N7) to medium light gray (N6), finely laminated.

The cycles of argillaceous limestone to cherty limestone/chert occur at regular 30-35 cm intervals.

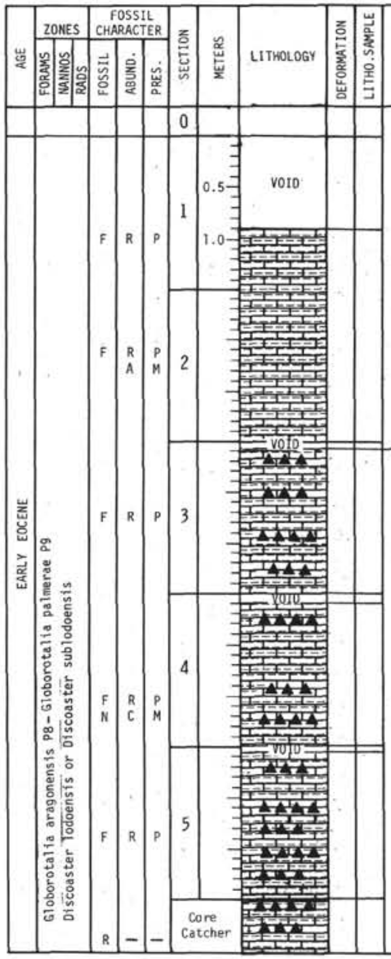
SS at 2-105 (dominant lithology)

Clay	C	Recrystallized calcite	A
Forams	R		
Nannos	C		

CARBON-CARBONATE
2-106 (3.5-0.1-28)
4-75 (8.4-0.1-69)

Explanatory notes in Chapter 1

Site 366 Hole Core 33 Cored Interval: 632.0-641.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1
to
5G 6/1

5GY 8/1
to
5G 6/1
and N7

INTERBEDDED ARGILLACEOUS LIMESTONE AND CHERTY LIMESTONE IN CYCLES

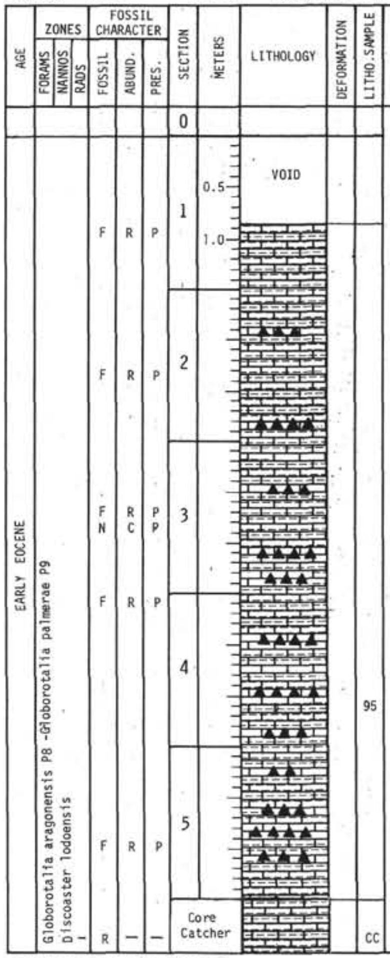
ARGILLACEOUS LIMESTONE, light greenish gray (5GY 8/1) to greenish gray (5G 6/1), faint wavy laminations, burrowed.

CHERTY LIMESTONE, light gray (N7), caps the top of the argillaceous limestones (each zone 10 to 20 cm thick).

Cycles of argillaceous then cherty limestone average 25 to 30 cm thick and consist of:
10 cm Cherty limestone
15 cm Argillaceous limestone

CARBON-CARBONATE
2-58 (8.2-0.1-68)
5-134 (5.4-0.1-45)

Site 366 Hole Core 34 Cored Interval: 641.5-651.0 m



LITHOLOGIC DESCRIPTION

N7
to
5G 6/1
to
5B 5/1

ARGILLACEOUS LIMESTONE WITH THIN SILICEOUS LIMESTONE INTERBEDS IN CYCLES

ARGILLACEOUS LIMESTONE, light gray (N7) to greenish gray (5G 6/1) to medium blue gray (5B 5/1), laminated, bioturbated.

SILICEOUS LIMESTONE, light gray (N7), to light greenish gray (5GY 8/1), laminated and burrowed.

Each cycle, 30 to 50 cm thick, consists of:

5 cm Siliceous limestone

25-45 cm Argillaceous limestone

SS at 4-95 (dominant lithology)

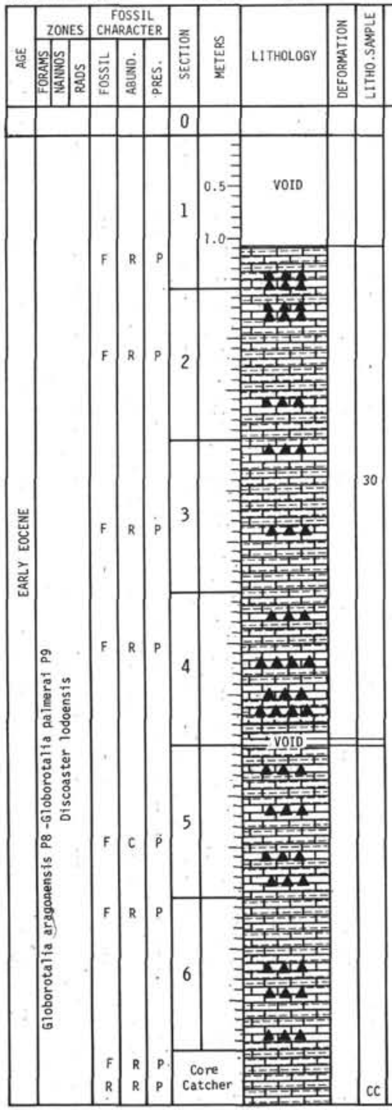
Clay	C	Recrystallized calcite	A
Fe/Mn nodules	R		
Forams	R	Nannos	C

Carbonate Bomb: 5-133 to 134 cm = 55%

CARBON-CARBONATE
2-103 (6.8-0.1-56)
5-132 (6.9-0.1-57)

Explanatory notes in Chapter 1

Site 366 Hole Core 35 Cored Interval: 651.0-660.5 m



LITHOLOGIC DESCRIPTION

INTERBEDDED ARGILLACEOUS LIMESTONE AND SILICEOUS LIMESTONE IN CYCLES

ARGILLACEOUS LIMESTONE, light greenish gray (5GY 8/1) to greenish gray (5G 6/1), finely laminated, burrowed.

SILICEOUS LIMESTONE, light gray (N7), finely laminated, burrowed.

Siliceous limestone caps each argillaceous limestone unit.

5GY 8/1
to
5G 6/1
and
N7

TYPICAL CYCLE: 5 cm Siliceous limestone
~70 cm Argillaceous limestone

SS at 3-30 (dominant lithology)

Clay	R	Recrystallized	
Forams	R	calcite	A
Nannos	C	Amorphous silica	R

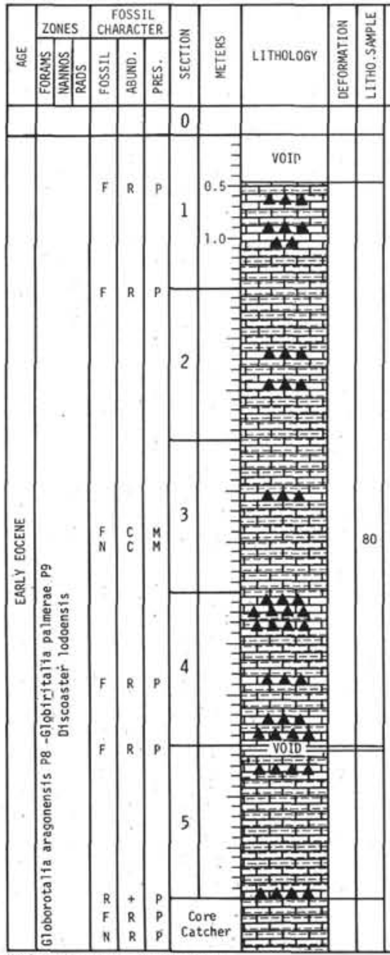
SS at CC

Clay	C	Recrystallized	
Forams	R	calcite	A
Nannos	A	Rads	R

Carbonate Bomb: 3-113 to 114 cm = 56%

CARBON-CARBONATE
2-65 (3.7-0.1-30)
3-114 (7.9-0.1-66)

Site 366 Hole Core 36 Cored Interval: 660.5-670.0 m



LITHOLOGIC DESCRIPTION

INTERBEDDED ARGILLACEOUS LIMESTONES AND SILICEOUS LIMESTONES IN CYCLES

ARGILLACEOUS LIMESTONE, light greenish gray (5GY 8/1 to 5G 8/1), finely laminated, burrowed.

SILICEOUS LIMESTONE, light gray (N7), finely laminated, burrowed.

Siliceous limestone caps each argillaceous limestone unit.

Typical cycle, 20 to 80 cm thick, consists of:

5GY 8/1
to
5G 8/1
and
N7

5 cm Siliceous limestone
15-75 cm Argillaceous limestone

SS at 3-80 (dominant lithology)

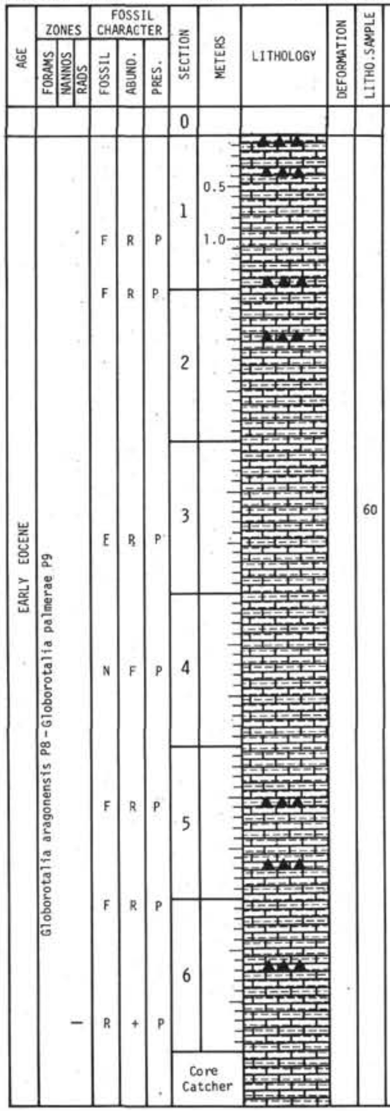
Clay	R	Recrystallized	
Forams	R	calcite	A
Nannos	C		

Carbonate Bomb: 3-33 to 34 cm = 58%

CARBON-CARBONATE
3-35 (7.1-0.1-59)

Explanatory notes in Chapter 1

Site 366 Hole Core 37 Cored Interval: 670.0-679.5 m



LITHOLOGIC DESCRIPTION

5GY 8/1
to
5G 4/1

INTERBEDDED ARGILLACEOUS LIMESTONE AND SILICEOUS LIMESTONE IN CYCLES

ARGILLACEOUS LIMESTONE , light greenish gray (5GY 8/1) to dark greenish gray (5G 4/1), finely laminated, burrowed, a few shaly interbeds (~4 cm thick).

SILICEOUS LIMESTONE, light greenish gray (5GY 8/1) to light gray (N7), finely laminated, burrowed.

Siliceous limestone caps each argillaceous limestone unit.

TYPICAL CYCLE {
5 cm Siliceous limestone
50-75 cm Argillaceous limestone

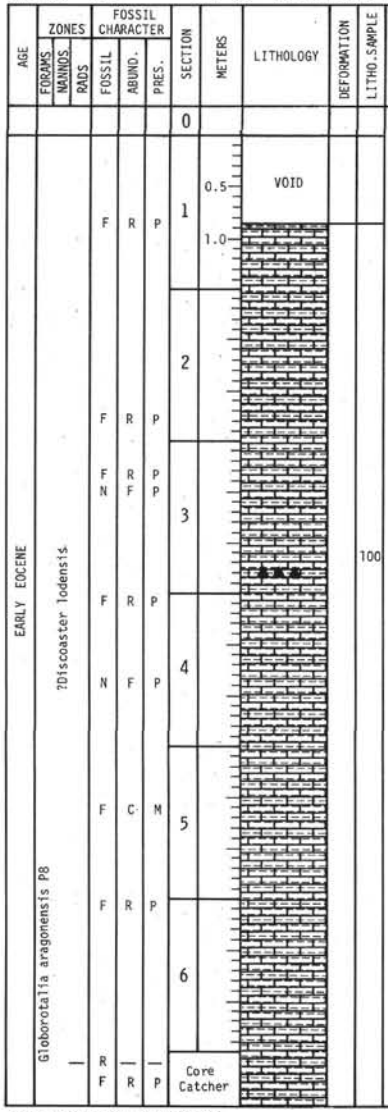
SS at 3-60 (dominant lithology)

Clay	C	Recrystallized calcite	A
Forams	R		
Nannos	C		

Carbonate Bomb: 3-25 to 26 cm = 37%

CARBON-CARBONATE
2-17 (6.4-0.1-53)
3-23 (5.2-0.1-43)

Site 366 Hole Core 38 Cored Interval: 679.5-689.0 m



LITHOLOGIC DESCRIPTION

5G 6/1

ARGILLACEOUS LIMESTONE, *greenish gray* (5G 6/1), finely laminated, burrowed. A few 2 to 4 cm thick shaly interbeds occur in Sections 3, 5 and 6 and a siliceous interbed occurs in Section 3 at 130 to 137 cm.

SS at 3-100 (dominant lithology)

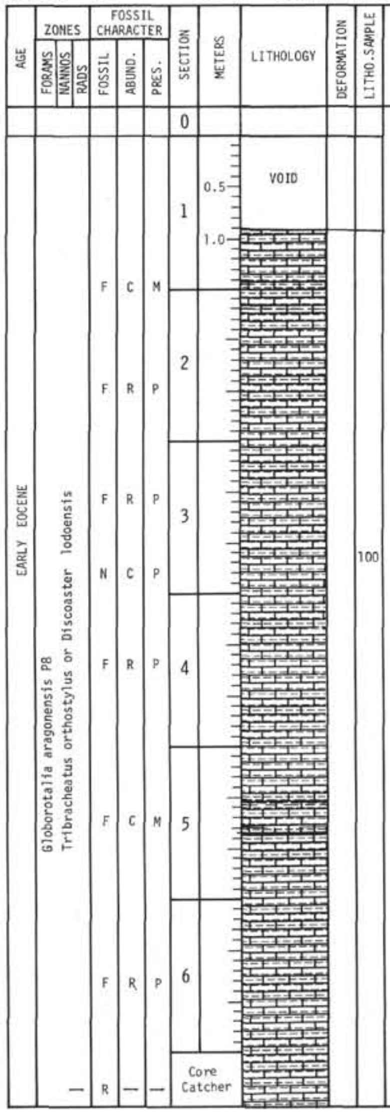
Clay	R	Recrystallized calcite	A
Nannos	R		

Carbonate Bomb: 3-47 to 48 cm = 46%

CARBON-CARBONATE
3-45 (5.9-0.1-49)

Explanatory notes in Chapter 1

Site 366 Hole Core 39 Cored Interval: 689.0-698.5 m



LITHOLOGIC DESCRIPTION

ARGILLACEOUS LIMESTONE, light gray green (5G 8/1) to light greenish gray (5GY 8/1), finely laminated, burrowed. Thin shaly layers (~4 cm thick) occur in Section 1-140 cm, 2-15 cm, 5-55 cm.

SS at 3-100 (dominant lithology)

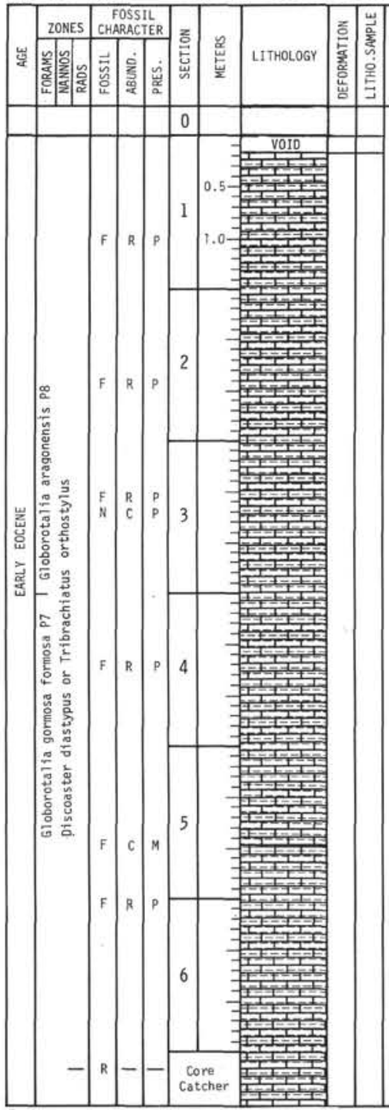
Clay	C	Recrystallized calcite	A
Forams	R		
Nannos	R		

Carbonate Bomb: 3-123 to 124 cm = 55%

CARBON-CARBONATE
3-124 (7.1-0.1-59)

5G 8/1
to
5GY 8/1

Site 366 Hole Core 40 Cored Interval: 698.5-708.0 m



LITHOLOGIC DESCRIPTION

ARGILLACEOUS LIMESTONE, light greenish gray (5GY 8/1 to 5G 8/1) to greenish gray (5G 6/1), finely laminated, burrowed. Shaly interbed at 5-117 cm.

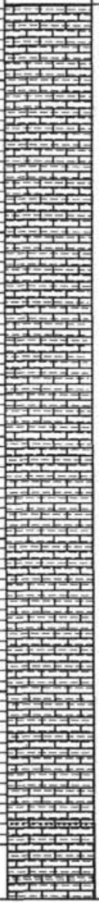
Carbonate Bomb: 3-77 to 78 cm = 47%

CARBON-CARBONATE
3-76 (5.9-0.1-48)

5GY 8/1
to
5G 8/1
to
5G 6/1

Explanatory notes in Chapter 1

Site 366 Hole Core 41 Cored Interval: 708.0-717.5 m



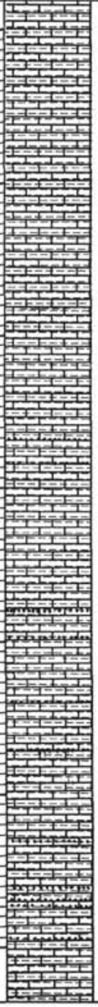
AGE	ZONES FORAMS	ZONES NANNOS	ZONES RADS	FOSSIL CHARACTER FOSSIL	FOSSIL CHARACTER ABUND.	FOSSIL CHARACTER PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
							0					
EARLY EOCENE				F	R	P	1	0.5 1.0	VOID			
	Globorotalia formosa formosa P7	Discoaster diastypus		F N N	R R R	P P P	2					
				F N	R C	P P	3					5GY 8/1
				F	R	P	4					N7
				F	P	P	5					
	Globorotalia subbotinae P6			F	R	P	6					
							Core Catcher					

ARGILLACEOUS LIMESTONE, light grayish green (5GY 8/1), grading in Section 4 to light gray (N7), finely laminated, burrowed. Shaly interbeds occur at 2-52 cm, 3-90 cm. A winnowed deposit rich in forams occurs at 6-130 cm, very light gray (N8) (CALCARENITE).

Carbonate Bomb: 3-76 to 77 cm = 56%

CARBON-CARBONATE
3-77 (6.9-0.1-57)

Site 366 Hole Core 42 Cored Interval: 717.5-727.0 m



AGE	ZONES FORAMS	ZONES NANNOS	ZONES RADS	FOSSIL CHARACTER FOSSIL	FOSSIL CHARACTER ABUND.	FOSSIL CHARACTER PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
							0					
EARLY EOCENE			•		R	P	1	0.5 1.0				
				F	C	P	2					
				F N	C C	P P	3				90 127	N7 to 5GY 8/1
				F	C	P	4					
	Globorotalia subbotinae P6	Campylosphaera eodela		F	R	P	5					
				F N	R R	P P	6					
			—	R	—	—	Core Catcher				CC	

ARGILLACEOUS LIMESTONE, greenish gray (N7) to light greenish gray (5GY 8/1), finely laminated, burrowed. Winnowed layers of CALCARENITE, occur at 3-100, 3-127, 4-118, 4-145, 5-60, 5-105, 5-130, 6-45, 6-90, 6-103, 6-110, 6-120, 6-140.

SS at 3-90 (dominant lithology)

Clay	R	Recrystallized calcite	A
Forams	R		
Nannos	C	Rads	R

SS at 3-127 (minor lithology)

Recrystallized calcite	A	Forams	C
		Nannos	C

SS at CC

Recrystallized calcite	A	Nannos	R

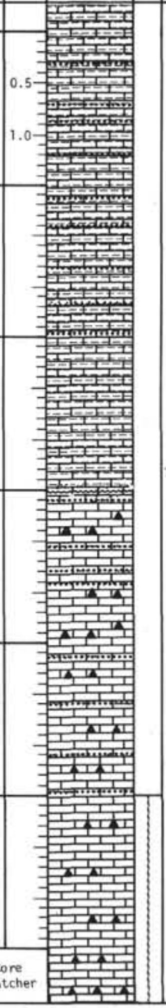
Carbonate Bomb: 3-123 to 124 cm = 71%

CARBON-CARBONATE
3-122 (9.2-0.1-76)

Explanatory notes in Chapter 1

Site 366 Hole Core 43 Cored Interval: 727.0-736.5 m

AGE	ZONES FORAMS	ZONES NANNOS	ZONES RADS	FOSSIL CHARACTER FOSSIL	FOSSIL CHARACTER ABUND.	FOSSIL CHARACTER PRES.	SECTION	LITHO.SAMPLE
							0	
EARLY EOCENE	Globorotalia subbotinae P6			F N	C C	P P	1	
LATE PALEOCENE				F	C	P	2	
		Campylosphaera eodela		F	C	P	3	
				N	F	P	3	126
				F	C	P	4	
	Globorotalia velascoensis P5			F	C	P	5	
				F	C	P	6	
				F	R	P	6	
				N	R	P	Core Catcher	
			—	R	—	—	Core Catcher	



N7

LITHOLOGIC DESCRIPTION

ARGILLACEOUS LIMESTONE, light gray (N7), finely laminated, burrowed, with winnowed layers of CALCARENITE at 1-30, 1-70, 1-85, 1-120, 1-130, 2-12, 2-42, 2-83, 2-115, 2-142. Small (3 cm) thick shaly interval occur at 1-46, 1-98, 2-14. This argillaceous limestone grades to:

SILICEOUS LIMESTONE, light gray (N7), finely laminated, burrowed, with bluish black flakes scattered throughout. CALCARENITE layers occur at 4-10, 4-55, 4-80, 40-90, 5-15, 5-60, 5-110, 5-148. Dark greenish gray bands occur at 4-135, 5-2, 5-6, 6-70, 6-100 and 6-140. These are shaly at 5-2 especially.

Core has been severely fractured during drilling.

SS at 3-126 (dominant lithology)

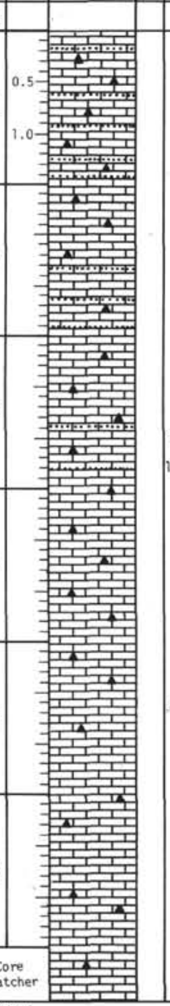
Clay	R	Quartz(?)	C
Recrystallized calcite	A		

Carbonate Bomb: 3-128 to 129 cm = 72%

CARBON-CARBONATÊ
3-126 (9.1-0.0-76)

Site 366 Hole Core 44 Cored Interval: 736.5-746.0 m

AGE	ZONES FORAMS	ZONES NANNOS	ZONES RADS	FOSSIL CHARACTER FOSSIL	FOSSIL CHARACTER ABUND.	FOSSIL CHARACTER PRES.	SECTION	LITHO.SAMPLE
							0	
UPPER PALEOCENE	Globorotalia velascoensis P5			F	R	P	1	
				F	C	M	2	
				F N	R —	P —	3	85 120
				F	R	P	4	
				F	R	P	5	60
							6	
							Core Catcher	



N7

LITHOLOGIC DESCRIPTION

SILICEOUS LIMESTONE, light gray (N7), finely laminated, burrowed, with stringers of winnowed layers, CALCARENITE , at 1-14, 1-60, 1-90, 1-123, 1-140, 2-18, 2-82, 2-111, 2-140, 3-88, 3-129, 4-11, 4-140, 5-96. Argillaceous bands occur at 3-10, 3-14, 3-39 and disseminated pyrite occurs in a zone from 3-50 to 3-55 and throughout Sections 4 and 5.

SS at 3-85 (minor lithology)

Clay	A	Recrystallized calcite	R
Fe/Mn	C	Nannos	R
Quartz(?)	R		
Fish debris	R		

SS at 3-120 (dominant lithology)

Clay	C	Recrystallized calcite	A
Quartz(?)	R	Nannos	C
Forams	R		

SS at 5-60 (dominant lithology)

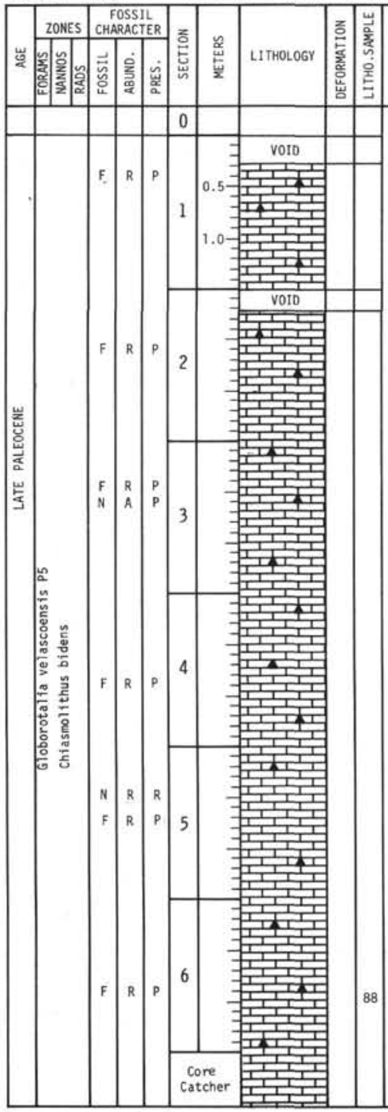
Clay	C	Recrystallized calcite	C
Quartz(?)	R		
Nannos	C		

Carbonate Bomb: 3-74 to 75 cm = 4%

CARBON-CARBONATE
3-75 (0.5-0.1-3)

Explanatory notes in Chapter 1

Site 366 Hole Core 45 Cored Interval: 746.0-755.5 m



LITHOLOGIC DESCRIPTION

SILICEOUS LIMESTONE, light gray (N7), finely laminated, burrowed, with flecks of blue-black submetallic matter scattered throughout the core. Also, at Section 5 burrows within burrows(?) (see diagram below) are common.

burrows within burrows?

<u>SS at 6-88</u> (minor lithology)

Clay	C	Recrystallized calcite	A
Quartz(?)	R		
Nannos	R		

<u>SS at 6-88</u> (dominant lithology)

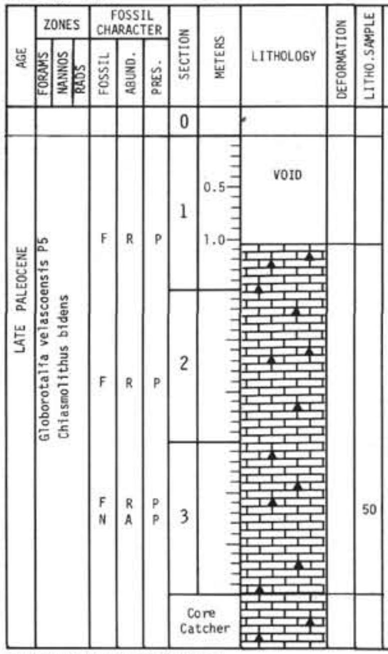
Clay	C	Recrystallized calcite	C
Calcite crystals	R		
Forams	R	Nannos	R

Carbonate Bomb: 3-43 to 44 cm = 71.5%

<u>CARBON-CARBONATE</u>
3-42 (3.7-0.1-71)

N7

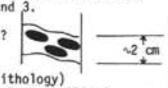
Site 366 Hole Core 46 Cored Interval: 755.5-765.0 m



LITHOLOGIC DESCRIPTION

SILICEOUS LIMESTONE, light gray (N7), finely laminated, burrowed, flecks of blue-black submetallic matter scattered throughout core, burrows within burrows(?) occurs in Sections 2 and 3.

burrows within burrows?



<u>SS at 3-50</u> (dominant lithology)

Clay	R	Recrystallized calcite	A
Calcite crystals	R		
Nannos	C		

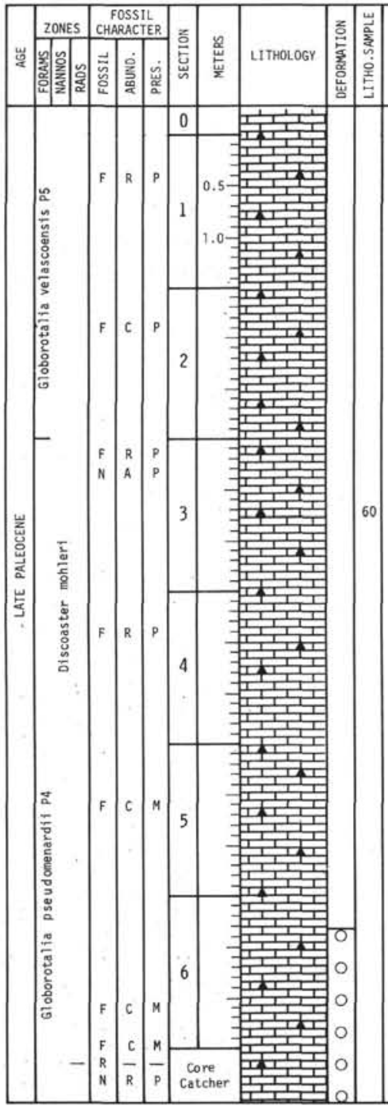
Carbonate Bomb: 3-64 to 65 cm = 65.5%

<u>CARBON-CARBONATE</u>
3-63 (7.8-0.1-64)

N7

Explanatory notes in Chapter 1

Site 366 Hole Core 47 Cored Interval: 765.0-774.5 m



LITHOLOGIC DESCRIPTION

N7

SILICEOUS LIMESTONE, light gray (N7), finely laminated, burrowed.

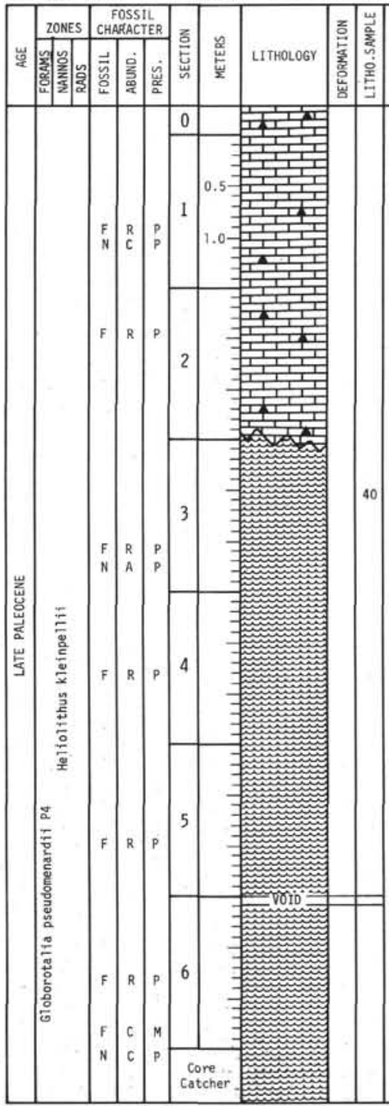
SS at 3-60 (dominant lithology)

Clay	C	Recrystallized		
Calcite crystals	R	calcite		A
Forams	R	Nannos		A

Carbonate Bomb: 3-43 to 44 cm = 65%

CARBON-CARBONATE
3-41 (7.5-0.1-62)

Site 366 Hole Core 48 Cored Interval: 774.5-784.0 m



Explanatory notes in Chapter 1

LITHOLOGIC DESCRIPTION

N7

5Y 6/1
to
5Y 7/1

SILICEOUS LIMESTONE, light gray (N7), finely laminated, burrowed, intensely burrowed in Section 2.

MARLSTONE, light olive gray (5Y 6/1) to yellowish gray (5Y 7/1), finely laminated, burrowed. Differs from the siliceous limestone only in not being cemented but well-indurated.

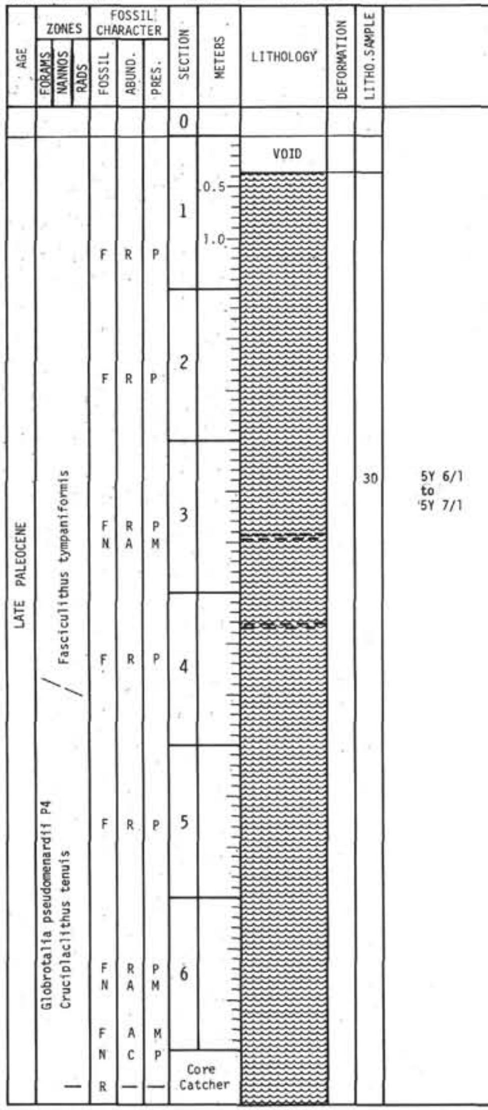
SS at 3-40 (dominant lithology)

Clay	C	Recrystallized	
Forams	R	calcite	A
Nannos	C		

Carbonate Bomb: 3-44 to 45 cm = 58%

CARBON-CARBONATE
3-46 (7.5-0.1-62)

Site 366 Hole Core 49 Cored Interval: 784.0-793.5 m



LITHOLOGIC DESCRIPTION

MARLSTONE, light olive gray (5Y 6/1) to yellowish gray (5Y 7/1), finely laminated, burrowed. Shaly interbeds (~4 cm thick) at 3-91 and 4-30.

Burrowing, especially Zoophycos and chondrites well-developed in Sections 5 and 6.

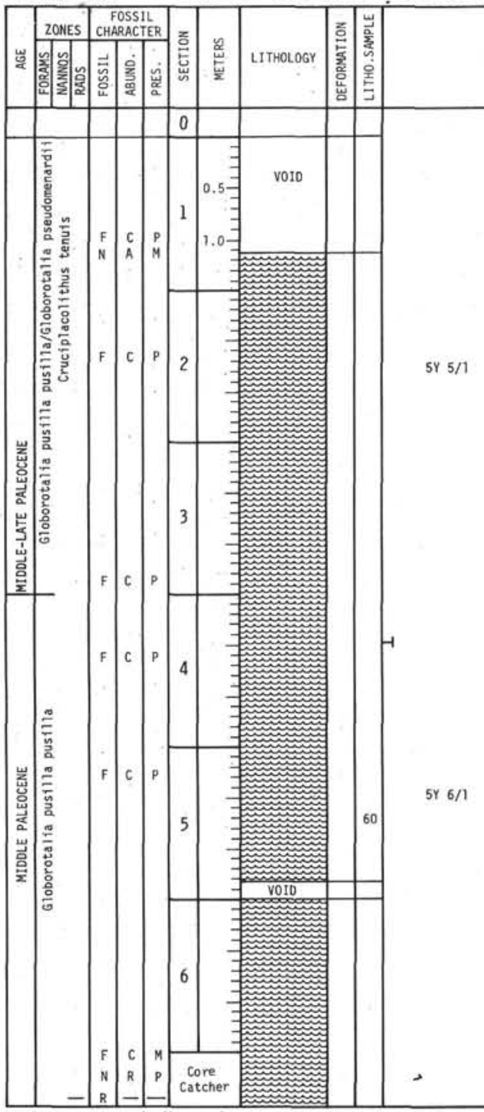
SS at 3-30 (dominant lithology)

Clay	C	Recrystallized calcite	A
Calcite crystals	R		
Nannos	A		

Carbonate Bomb: 3-85 to 86 cm = 57.5%

CARBON-CARBONATE
3-84 (8.2-0.1-67)

Site 366 Hole Core 50 Cored Interval: 793.5-803.0 m



LITHOLOGIC DESCRIPTION

MARLSTONE, medium olive gray (5Y 5/1), finely laminated, burrowed. Becomes light olive gray (5Y 6/1) at 4-45.

SS at 5-60 (dominant lithology)

Clay	C	Recrystallized calcite	A
Calcite crystals	R	Nannos	C
Forams	R		
Fish debris	R		

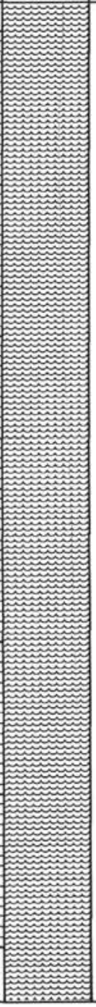
Carbonate Bomb: 3-107 to 108 cm = 65.5%

CARBON-CARBONATE
3-105 (8.6-0.1-71)

Explanatory notes in Chapter 1

Site 366 Hole Core 51 Cored Interval: 803.0-812.5 m

AGE	ZONES FORAMS	ZONES NANNOS	ZONES RADS	FOSSIL CHARACTER FOSSIL	FOSSIL CHARACTER ABUND.	FOSSIL CHARACTER PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
							0					
MIDDLE PALEOCENE	Globorotalia angulata						1	0.5 1.0				
EARLY PALEOCENE	Acarinina uncinata P2	Cruciplacolithus tenuis		F	C	P	2					
				F N	C C	P M	3				80	5Y 6/1
				F	C	P	4					
				F	C		5					
				F	C		6					
				F N	C R	M P	Core Catcher					



MARLSTONE, light olive gray (5Y 6/1), finely laminated, burrowed.

SS at 3-80 (dominant lithology)

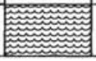
Clay	C	Calcite crystals	C
Recrystallized calcite	A	Forams	R
Fish debris	R	Nannos	R

Carbonate Bomb: 2-77 to 78 cm = 72%

CARBON-CARBONATE
2-76 (8.4-0.1-69)

Site 366 Hole Core 52 Cored Interval: 812.5-822.0 m

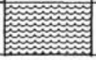
AGE	ZONES FORAMS	ZONES NANNOS	ZONES RADS	FOSSIL CHARACTER FOSSIL	FOSSIL CHARACTER ABUND.	FOSSIL CHARACTER PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
							0					
EARLY PALEOCENE	Globorotalia trinidadensis P1	Cruciplacolithus tenuis		F N	A R	M P	Core Catcher					5Y 6/1



MARLSTONE, light olive gray (5Y 6/1).

Site 366 Hole Core 53 Cored Interval: 822.0-831.5 m

AGE	ZONES FORAMS	ZONES NANNOS	ZONES RADS	FOSSIL CHARACTER FOSSIL	FOSSIL CHARACTER ABUND.	FOSSIL CHARACTER PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
							0					
EARLY PALEOCENE	Globrotalia trinidadensis P1	Cruciplacolithus tenuis		F N	A C	M M	Core Catcher				CC	5Y 6/1



MARLSTONE, light olive gray (5Y 6/1).

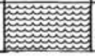
SS at CC

Clay	C	Recrystallized calcite	A
Quartz	R	Calcite crystals	C
Fe/Mn micronodules	R	Forams	C
Fish debris	R		

Site 366, Core 54, Cored Interval: 831.5-841.0 m: NO RECOVERY

Site 366 Hole Core 55 Cored Interval: 841.0-850.5 m

AGE	ZONES FORAMS	ZONES NANNOS	ZONES RADS	FOSSIL CHARACTER FOSSIL	FOSSIL CHARACTER ABUND.	FOSSIL CHARACTER PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
							0					
MAESTRICHTIAN	Globotruncana contusa	Lithraphidites quadratus		F N	A R	M P-M	Core Catcher				CC	5Y 6/1



ONLY SCRAPINGS OFF OF CORE CATCHER

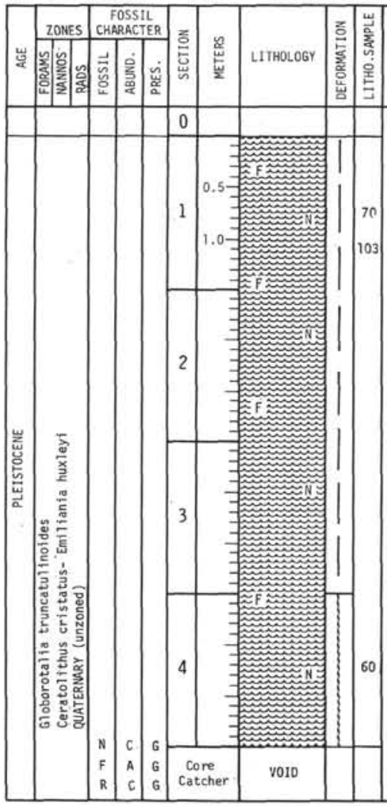
MARLSTONE, light olive gray (5Y 6/1).

SS at CC

Clay	C	Fe/Mn micronodules	R
Recrystallized calcite	A	Calcite crystals	R
Nannos	C	Fish debris	R

Explanatory notes in Chapter 1

Site 366 Hole A Core 1 Cored Interval: 0.0-6.0 m



LITHOLOGIC DESCRIPTION

10YR 4/2
to
10 YR 2/2

FORAM-BEARING NANNO MARL, dark yellowish brown (10YR 4/2) to dusky yellow brown (10YR 2/2), soft, moderate to severe drilling disturbance, mottled. Thin, disturbed zones show more clay (1-100 to 110) or increased foram content (1-60 to 100; 1-110 to 120; 2-90 to 105). Drilling disturbance is too severe to be certain about these zones.

SS at 1-70 (dominant lithology)

Clay	A	Forams	C
Nannos	A	Rads	R
Diatoms	R	Opal phytoliths	R
Fish debris	R		

SS at 1-103 (minor lithology)

Clay	A	Fe/Mn	R
Forams	R	Nannos	A
Diatoms	R	Rads	R
Opal phytolith	R	Fish debris	R

SS at 4-60 (dominant lithology)

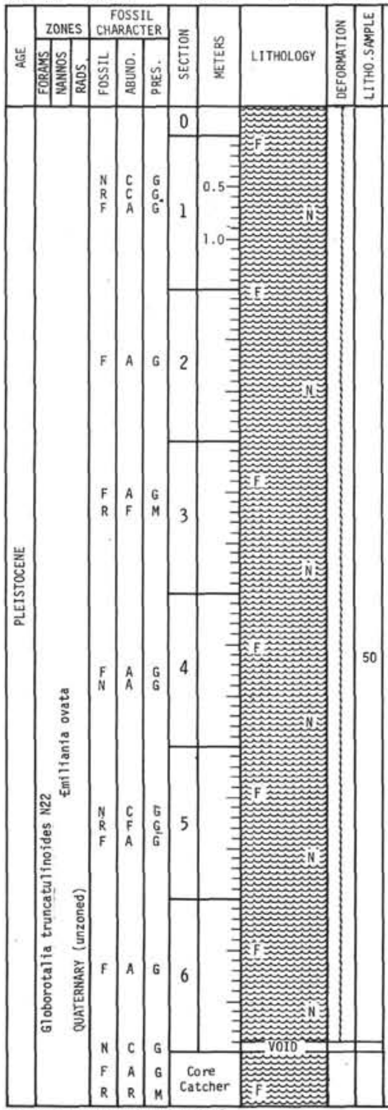
Clay	A	Fe/Mn	R
Forams	R	Nannos	A
Diatoms	R	Rads	R
Opal phytolith	R	Fish debris	R

All smear slides showed both marine and fresh water diatoms (Melasira granulata) and opal phytoliths.

CARBON-CARBONATE
2-65 (7.8-0.2-63)

GRAIN SIZE
2-66 (29.0-29.5-41.5) Sandy clay

Site 366 Hole A Core 2 Cored Interval: 6.0-15.5 m



LITHOLOGIC DESCRIPTION

10YR 5/4
to
10YR 6/2

FORAM-BEARING NANNO MARL, moderate yellowish brown (10YR 5/4) to pale yellowish brown (10YR 6/2) to grayish orange (10YR 7/4), very soft, intense drilling disturbance, some mottling but drill disturbance too severe to be certain if it is real.

SS at 4-50 (dominant lithology)

Clay	A	Fe/Mn nodules	R
Forams	C	Nannos	A
Rads	R	Silicoflagellates	R
Opal phytoliths	R	Fish remains	R

Both fresh water and marine diatoms occur.

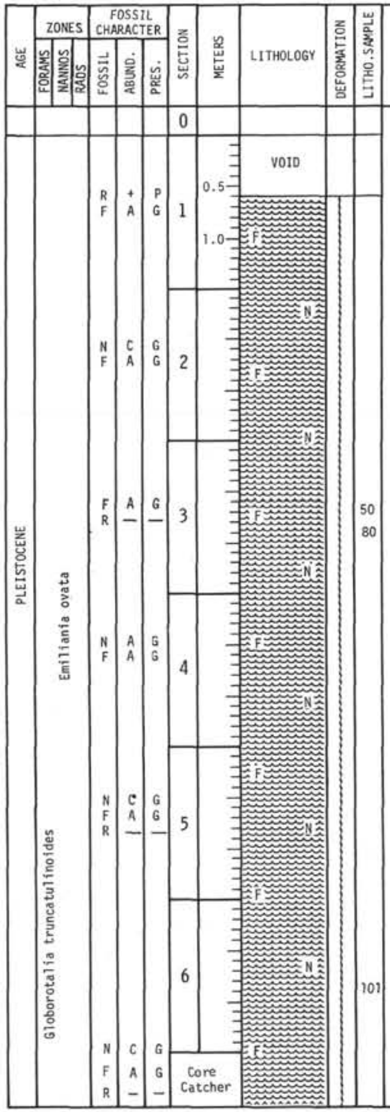
Ceratoliths appear in smear slide.

Carbonate Bomb: 3-66 to 67 cm = 56%

CARBON-CARBONATE
3-65 (7.0-0.1-57)

Explanatory notes in Chapter 1

Site 366 Hole A Core 3 Cored Interval: 15.5-25.0 m



LITHOLOGIC DESCRIPTION

10YR 5/4
10YR 6/4
10R 7/3
to
10YR 5/8

FORAM-BEARING NANNO MARL, varicolored because of disturbance, from moderate yellowish brown (10YR 5/4), yellowish brown (10YR 6/4), grayish orange (10R 7/3) to dark yellowish brown (10YR 5/8), soft, intense drilling disturbance, disrupted mottling(?).

SS at 3-50 (dominant lithology)

Clay	A	Fe/Mn nodules	R
Forams	C	Nannos	A
Diatoms	R	Rads	R
Fish debris	R		

SS at 3-80 (minor lithology)

Clay	A	Forams	A
Nannos	A	Diatoms	R
Rads	R	Fish debris	R

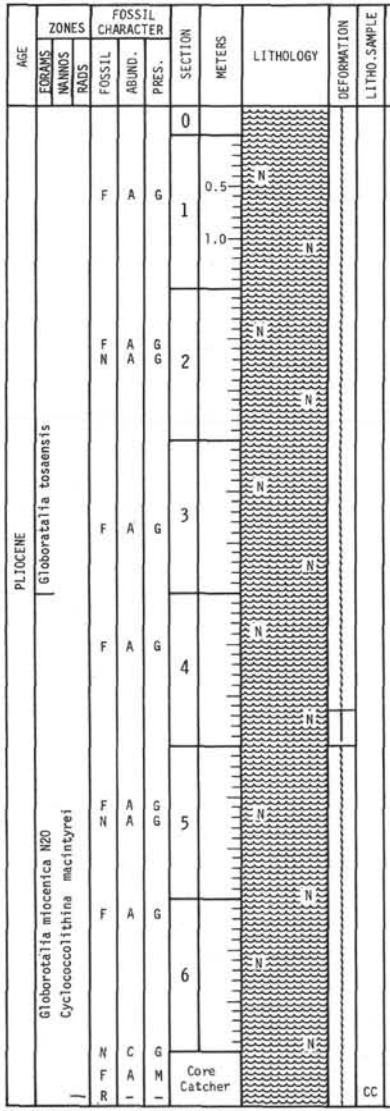
SS at 6-101 (minor lithology)

Clay	A	Forams	A
Nannos	A	Diatoms	C
Fish debris	R	Rads	R

Carbonate Bomb: 3-63 to 64 cm = 68%

CARBON-CARBONATE
3-61 (7.6-0.1-62)

Site 366 Hole A Core 4 Cored Interval: 25.0-34.5 m



LITHOLOGIC DESCRIPTION

5Y 8/1

NANNO MARL, white (5Y 8/1), soft, intense drilling disturbance, thin (~10 cm) clayey bands occur at 1-40 to 55 cm; 1-145 to 150 cm; 2-0 to 30 cm; 3-15 to 45 cm; 4-110 to 150 cm; 5-0 to 50 cm; these clays are greenish gray (5GY 6/1) and show mottling. Black mottling occurs in 4-0 to 30 cm.

SS at CC (dominant lithology)

Clay	A	Fe/Mn	R
Forams	R	Nannos	A
Diatoms	R	Rads	R
Fish debris	R		

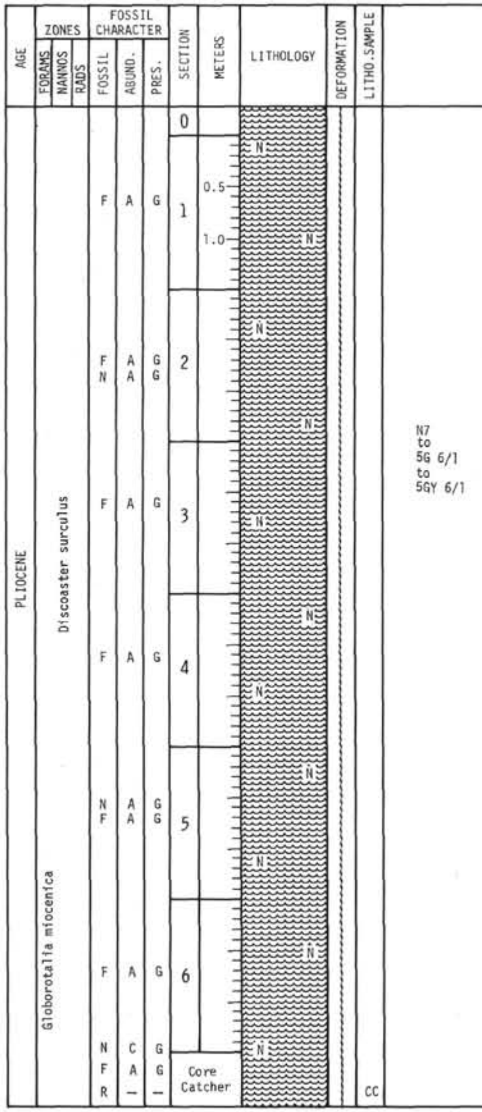
Carbonate Bomb: 3-24 to 25 cm = 49%

CARBON-CARBONATE
3-22 (6.1-0.1-50)

GRAIN SIZE
3-20 (9.0-23.3-67.7) Silty clay

Explanatory notes in Chapter 1

Site 366 Hole A Core 5 Cored Interval: 34.5-44.0 m



LITHOLOGIC DESCRIPTION

NANNO MARL, varicolored because of drilling disturbance, from white (N7) to greenish gray (5G 6/1) to dark yellowish green (5GY 6/1), soft, intense drilling disturbance, black mottling occurs at 3-0 to 70 cm; 4-20 to 90 cm; 5-0 to 35 cm; 5-40 to 90 cm.

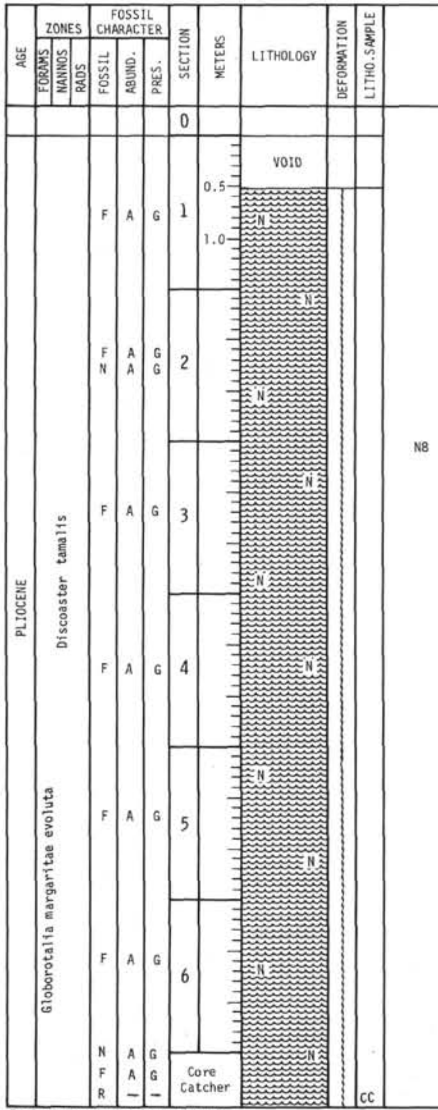
SS at CC (dominant lithology)

Clay	A	Forams	R
Nannos	A	Fish debris	R

Carbonate Bomb: 3-76 to 77 cm = 66%

CARBON-CARBONATE
3-74 (9.0-0.1-75)
3-80 (8.8-0.1-73)

Site 366 Hole A Core 6 Cored Interval: 44.0-53.5 m



Explanatory notes in Chapter 1

LITHOLOGIC DESCRIPTION

NANNO MARL, very light gray (N8) with greenish gray (5G 6/1) mottles, soft, intense drilling disturbance. Bottommost 5 cm is white (N9).

SS at CC

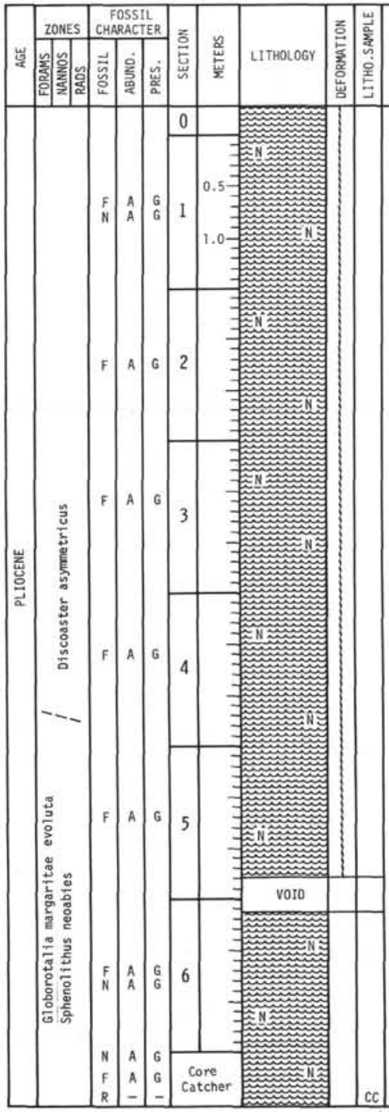
Clay	A	Forams	R
Nannos	A	Fish debris	R

Carbonate Bomb: 3-70 to 71 cm = 92%
(taken in a disturbed zone)

CARBON-CARBONATE
3-71 (10.6-0.1-88)

GRAIN SIZE
3-76 (33.0-24.8-42.1) Sandy clay

Site 366 Hole A Core 7 Cored Interval: 53.5-63.0 m



LITHOLOGIC DESCRIPTION

NANNO MARL, very light gray (N8) to white (N9) with mottles of greenish gray (5GY 6/1), soft, intensely disturbed. Black streaks common throughout core.

SS at CC

Clay	A	Fe/Mn	R
Forams	C	Nannos	A
Diatoms	R	Rads	R
Fish debris	R		

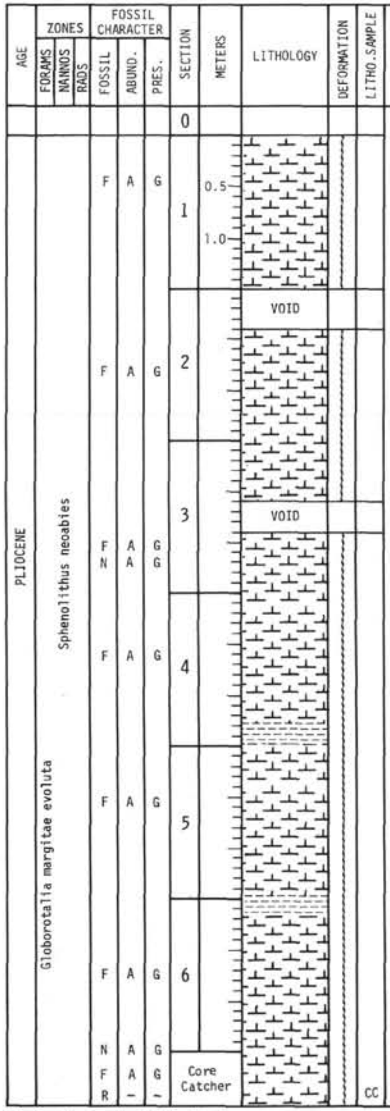
Carbonate Bomb: 3-44 to 45 cm = 46%

CARBON-CARBONATE
3-45 (5.7-0.1-47)

GRAIN SIZE
3-50 (3.6-20.9-75.5) Clay

N8
to
N9

Site 366 Hole A Core 8 Cored Interval: 63.0-72.5 m



LITHOLOGIC DESCRIPTION

NANNO OOZE, very light gray (N8) to white (N9) with light olive gray (5Y 6/1) mottling and black streaks. Mottling becomes yellowish gray (5Y 8/1) toward bottom of core, soft, intense drilling disturbance, clayey band occurs at 4-130 to 145 and 6-0 to 12 cm.

SS at CC

Clay	A	Forams	R
Nannos	A	Diatoms	R
Rads	R	Fish debris	R

SCYPHOSPHAERA appear in core catcher sample.

Carbonate Bomb: 3-104 to 105 cm = 92%

CARBON-CARBONATE
3-106 (10.4-0.0-86)

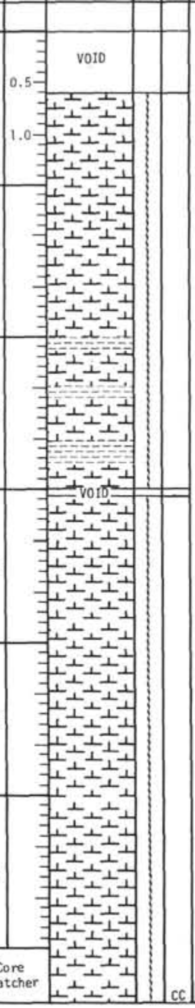
GRAIN SIZE
3-107 (22.0-24.9-53.1) Sandy clay

N8
to
N9

Explanatory notes in Chapter 1

Site 366 Hole A Core 9 Cored Interval: 72.5-82.0 m

AGE	ZONES: FORAMS	ZONES: NANNOS	ZONES: RADS	FOSSIL CHARACTER: FOSSIL	FOSSIL CHARACTER: ABUND.	FOSSIL CHARACTER: PRES.	SECTION
							0
PLIOCENE	Globorotalia margitae evoluta	Ceratolithus rugosus		F N	A A	G M	1
		/ /		F	A	G	2
		Ceratolithus acutus		F N	A A	G G	3
				F	A	G	4
				F	A	G	5
				F	A	G	6
				N F R	A A –	M G –	Core Catcher



LITHOLOGIC DESCRIPTION

N9
to
5Y 8/1

NANNO OOZE, white (N9) to yellowish gray (5Y 8/1) mottled together, soft, intense drilling disturbance. Clayey bands occur at 3-0 to 10 cm; 3-50 to 55 cm; 3-100 to 120 cm.

SS at CC

Clay	A	Forams	R
Nannos	A	Fish debris	R

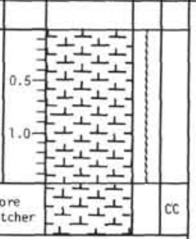
Carbonate Bomb: 3-77 to 78 cm = 86%

CARBON-CARBONATE
3-74 (10.1-0.1-83)

GRAIN SIZE
3-79 (11.9-27.4-60.7) Silty clay

Site 366 Hole A Core 10 Cored Interval: 82.0-91.5 m

AGE	ZONES: FORAMS	ZONES: NANNOS	ZONES: RADS	FOSSIL CHARACTER: FOSSIL	FOSSIL CHARACTER: ABUND.	FOSSIL CHARACTER: PRES.	SECTION
							0
PLIOCENE-MIOCENE	Globorotalia margaritae margaritae	Triquetrorhabdulus rugosus		F N	A A	G G	1
				N F R	A A –	M G –	Core Catcher



LITHOLOGIC DESCRIPTION

N9
and
5Y 6/1

NANNO OOZE, white (N9) and light olive gray (5Y 6/1) mottled, soft, intense drilling disturbance.

SS at CC

Clay	A	Fe/Mn	R
Forams	R	Nannos	A
Diatoms	R	Fish debris	R

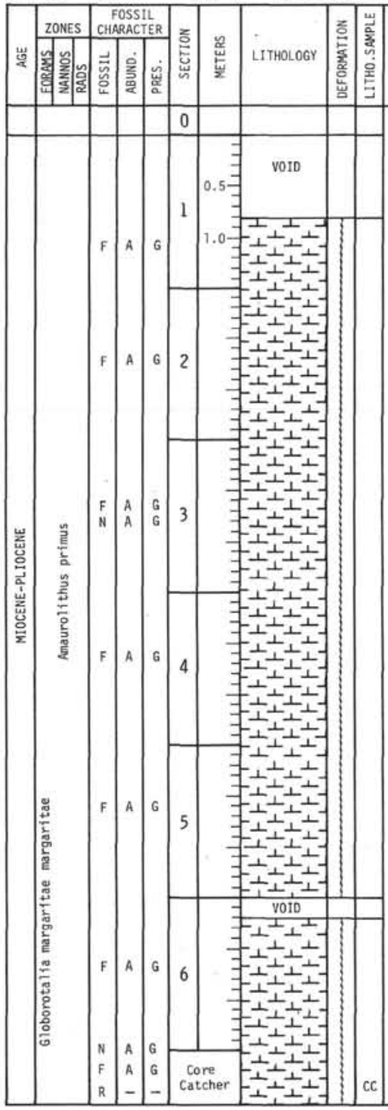
Carbonate Bomb: 1-54 to 55 cm = 84%

CARBON-CARBONATE
1-56 (10.3-0.1-85)

GRAIN SIZE
1-57 (19.7-27.9-52.5) Silty clay

Explanatory notes in Chapter 1

Site 366 Hole A Core 11 Cored Interval: 91.5-101.0 m



LITHOLOGIC DESCRIPTION

5Y 8/1

NANNO OOZE, yellowish gray (5Y 8/1) with white (N9) mottles. Soupy, intense drilling disturbance, Section 4 has black streaks throughout. Color gradually changes to very pale brown (10YR 7/3) with white (N9) mottles by Section 4.

SS at CC

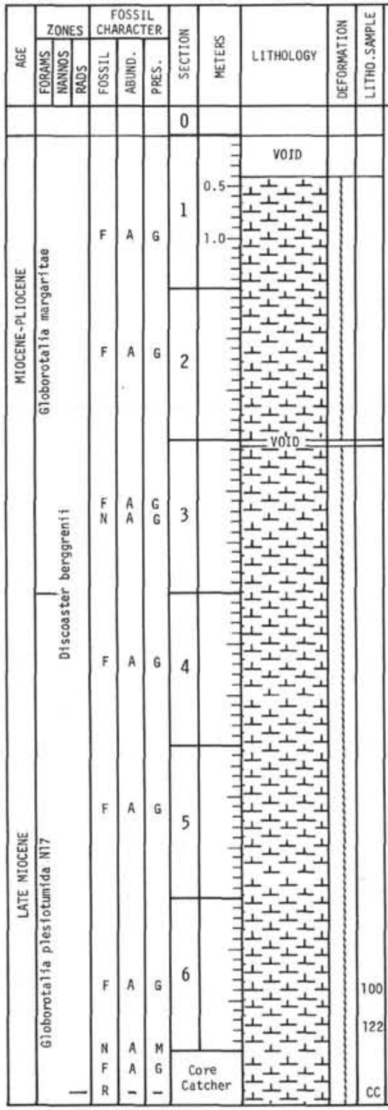
Clay	A	Fe/Mn	R
Forams	R	Nannos	A

Carbonate Bomb: 3-54 to 55 cm = 83%

CARBON-CARBONATE
3-56 (9.7-9.1-80)

GRAIN SIZE
3-57 (5.9-27.8-66.3) Silty clay

Site 366 Hole A Core 12 Cored Interval: 101.0-110.5 m



LITHOLOGIC DESCRIPTION

N9

NANNO OOZE, white (N9) with mottles of yellowish gray (5Y 8/1), soupy in upper section, soft in lower 4 sections, intense drilling disturbance. Black streaks throughout Sections 2, 3 and 6.

SS at 6-100 (dominant lithology)

Clay	A	Forams	R
Nannos	A	Rads	R
Fish debris	R		

SS at 6-122 (dominant lithology)

Clay	A	Nannos	A
Fe/Mn	R	Rads	R
Forams	R	Fish debris	R

SS at CC

Clay	A	Forams	R
Nannos	A	Fish debris	R

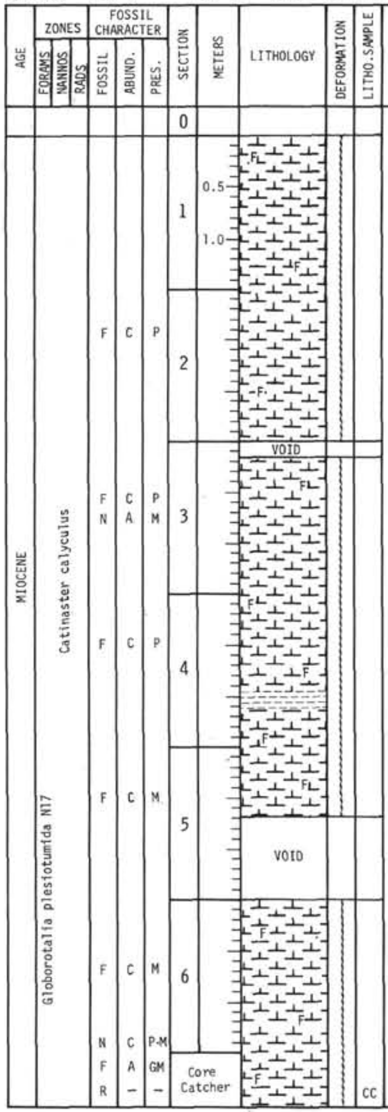
Carbonate Bomb: 3-110 to 111 cm = 72%

CARBON-CARBONATE
3-107 (8.2-0.1-67)

GRAIN SIZE
3-111 (2.5-31.5-66.0) Silty clay

Explanatory notes in Chapter 1

Site 366 Hole A Core 13 Cored Interval: 110.5-120.0 m



LITHOLOGIC DESCRIPTION

FORAM BEARING NANNO OOZE, pale orange (10YR 8/3) with mottling of moderate yellowish brown (10YR 6/4) and very pale yellow brown (10YR 7/4), soft to soupy, intense drilling disturbance, clayey bands at 4-95 to 104.

SS at CC

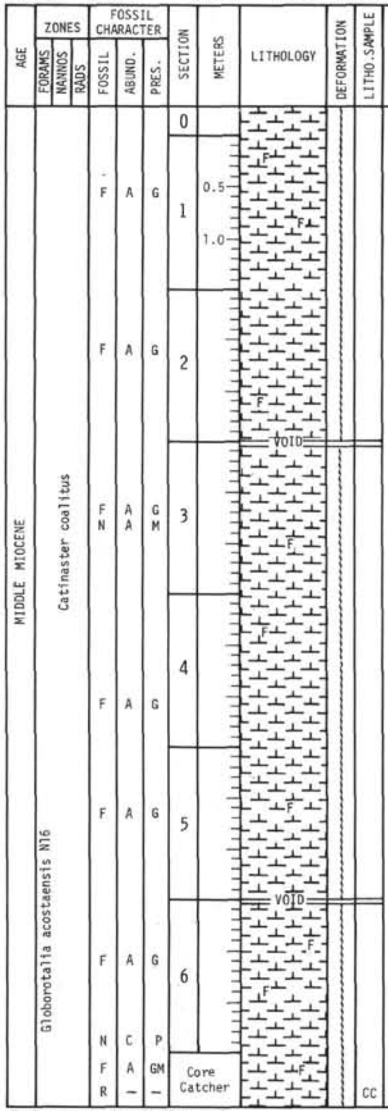
Clay	A	Nannos	A
Forams	C	Fish debris	R

CARBON-CARBONATE
3-56 (9.9-0.0-82)

GRAIN SIZE
3-58 (3.6-51.9-44.6) Clayey silt

10YR 8/3

Site 366 Hole A Core 14 Cored Interval: 120.0-129.5 m



LITHOLOGIC DESCRIPTION

FORAM BEARING NANNO OOZE, very pale orange (10YR 8/2) becoming mottled after Section 2 with yellow brown (10YR 5/6) and light yellow brown (10YR 6/4) and white (1oYR 8/2), soft, intense drilling disturbance.

SS at CC

Clay	A	Forams	C
Nannos	A	Diatoms	R
Rads	R	Fish debris	R

Carbonate Bomb: 3-91 to 92 cm = 68%

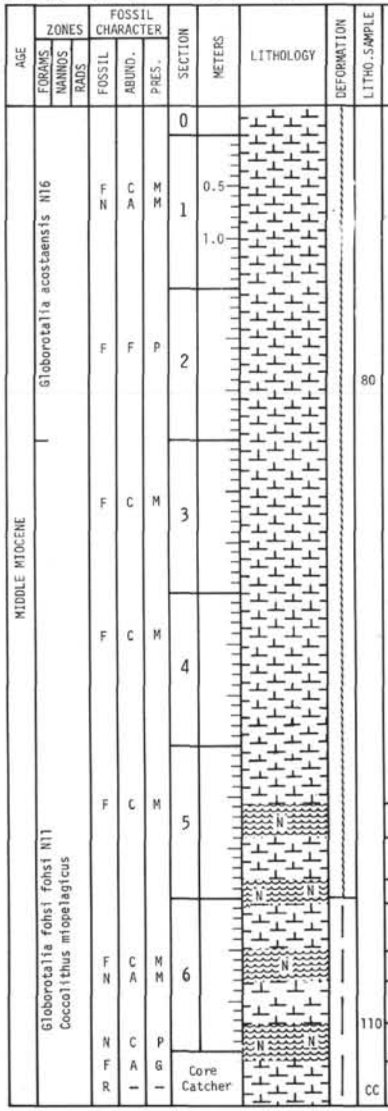
CARBON-CARBONATE
3-90 (7.8-0.1-65)

GRAIN SIZE
3-87 (6.7-38.7-54.6) Silty clay

10YR 8/2

Explanatory notes in Chapter 1

Site 366 Hole A Core 15 Cored Interval: 129.5-139.0 m



LITHOLOGIC DESCRIPTION

10YR 5/6
to
10YR 7/4
to
10YR 8/3

10YR 4/2 to
10YR 6/6
10YR 5/6 to
10YR 7/4 to
10YR 8/3
10YR 4/2 to
10YR 6/6
10YR 5/6 to
10YR 7/4 to
10YR 8/3
10YR 4/2 to
10YR 6/6
10YR 5/6 to
10YR 7/4 to
10YR 8/3
10YR 4/2 to
10YR 6/6
10YR 5/6 to
10YR 7/4 to
10YR 8/3

NANNO OOZE becoming interbedded with NANNO MARL

NANNO OOZE, moderate yellowish brown (10YR 5/6) to grayish orange (10YR 7/4) to very pale yellow (10YR 8/3), soft to stiff, intense drilling disturbance.

NANNO MARL, dark yellowish brown (10YR 4/2) to brownish yellow (10YR 6/6), stiff, intense drilling disturbance but more cohesive than the nanno ooze.

The nanno oozes and nanno marls tend to be in cycles of 30 to 50 cm thick, that look like dissolution cycles. They consist of:

20-40 cm *Nanno ooze*

~10 cm Nanno marl

SS at 2-80 (minor lithology, marl)

Clay	D	Nannos	R
Rads	R	Fish debris	C

SS at 6-110 (minor lithology, marl)

Clay	A	Fe/Mn	R
Forams	R	Nannos	A
Rads	R	Fish debris	C

SS at CC (dominant lithology)

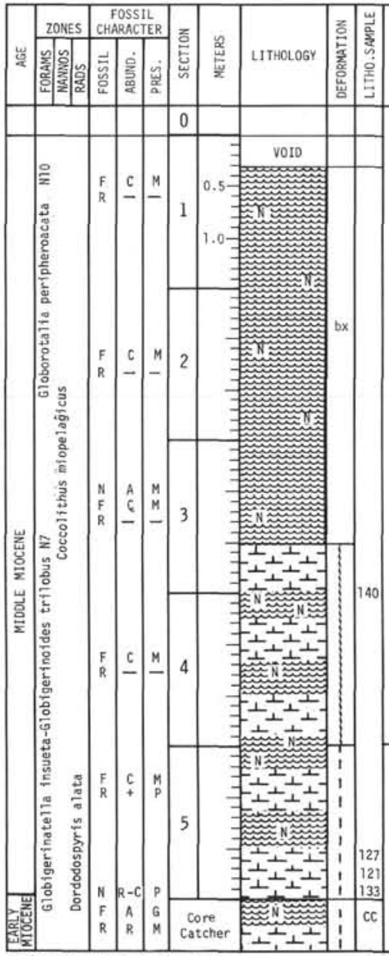
Clay	A	Fe/Mn	R
Forams	C	Nannos	A
Rads	R	Fish debris	R

Carbonate Bomb: 3-103 to 104 cm = 60%

CARBON-CARBONATE
3-101 (8.6-0.1-71)

GRAIN SIZE
3-104 (9.8-33.6-56.6) Silty clay

Site 366 Hole A Core 16 Cored Interval: 139.0-148.5 m



Explanatory notes in Chapter 1

LITHOLOGIC DESCRIPTION

10YR 8/4
to
10YR 5/3

5GY 6/1
to
5GY 8/1

10YR 8/1
and
10YR 7/4

DRILLING BRECCIA OF PELAGIC CLAY/MARL AND NANNO OOZE IN SECTION 1 AND 2. Pale grayish orange (10YR 8/4) to yellowish brown (10YR 5/3). Soft to stiff, drilling breccia.

At 3-102 cm:
NANNO MARL, greenish gray (5GY 6/1) to light greenish gray (5GY 8/1) with mottles of light brown (10YR 7/4), stiff, intense drilling disturbance.

Section 5:
Cyclic alternations of the above NANNO MARL and a NANNO OOZE, white (10YR 8/1), stiff, slight drilling disturbance. The nanno marls are generally grayish orange (10YR 7/4).

Each cycle is about 20 cm thick but they gradually shorten to about 10 cm thick the last third of Section 5.

SS at 3-140 (minor lithology)

Clay	A	Forams	R
Nannos	A	Rads	R
Fish debris	R		

SS at 5-127 (minor lithology)

Clay	D	Fe/Mn	R
Forams	R	Nannos	A
Rads	R	Fish	R

SS at CC (dominant lithology)

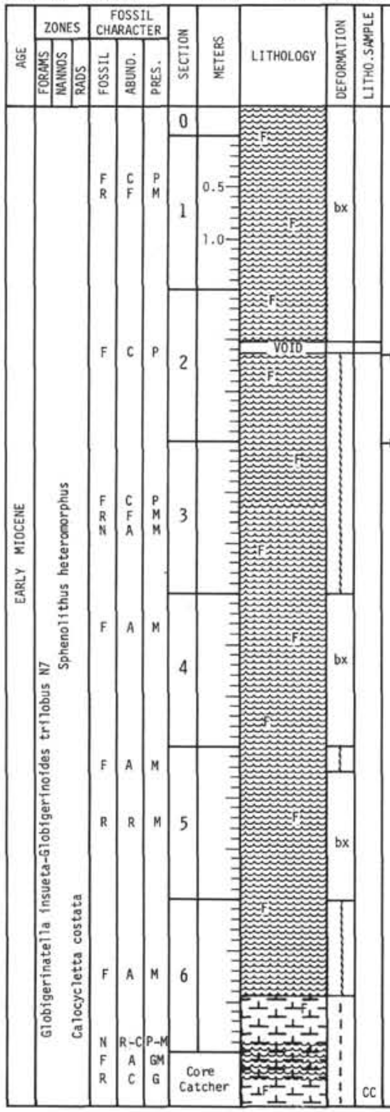
Clay	A	Fe/Mn	R
Amorph SiO_2	R	Forams	C
Nannos	A	Diatoms	R
Rads	R	Fish	R

Carbonate Bomb: 3-140 to 141 cm = 60%

CARBON-CARBONATE
3-137 (9.3-0.1-77)

GRAIN SIZE
3-135 (8.2-34.2-57.6) Silty clay

Site 366 Hole A Core 17 Cored Interval: 148.5-158.0 m



LITHOLOGIC DESCRIPTION

10YR 7/4

N9

DRILLING BRECCIA OF NANNO MARL AND NANNO OOZE SIMILAR TO 16-5.

Last 50 cm of SECTION 6

FORAM BEARING NANNO OOZE, bluish white (5B 9/1), stiff, slight drilling disturbance, interbedded with pale brown (10YR 6/3) to greenish gray (5GY 6/1) NANNO MARL, stiff, slight drilling disturbance.

SS at CC

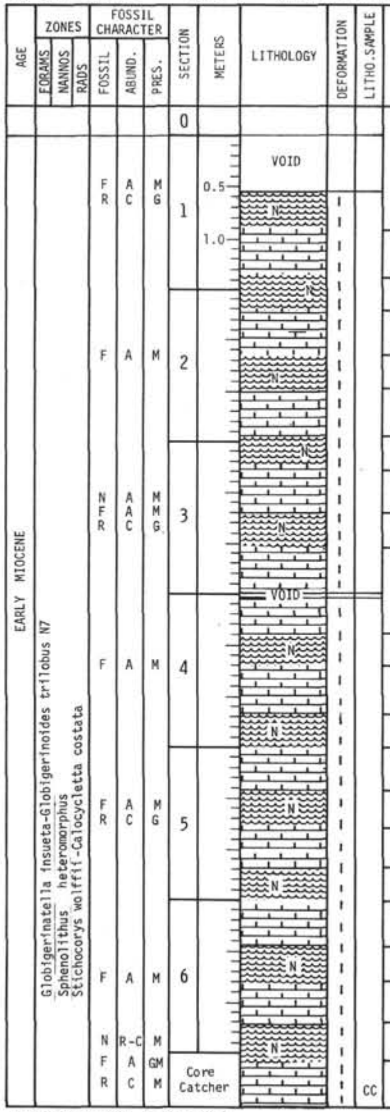
Clay	A	Forams	C
Nannos	A	Rads	R
Fish debris	R		

Carbonate Bomb: 3-90 to 91 cm = 72%

CARBON-CARBONATE
3-93 (9.4-0.1-78)

GRAIN SIZE
3-95 (9.2-41.3-49.5) Silty clay

Site 366 Hole A Core 18 Cored Interval: 158.0-167.5 m



LITHOLOGIC DESCRIPTION

10YR 5/4
5GY 8/1 to 5Y 8/1
10YR 5/4
5GY 8/1 to 5Y 8/1
10YR 5/4
5GY 8/1 to 5Y 8/1
10YR 5/4
5GY 8/1 to 5Y 8/1
10YR 5/4
5GY 8/1 to 5Y 8/1
10YR 5/4
5GY 8/1 to 5Y 8/1
10YR 5/4
5GY 8/1 to 5Y 8/1
10YR 5/4
5GY 8/1 to 5Y 8/1
10YR 5/4
5GY 8/1 to 5Y 8/1
10YR 5/4
5GY 8/1 to 5Y 8/1

CYCLES OF NANNO MARL AND NANNO CHALK

NANNO CHALK, light greenish gray (5GY 8/1) to yellowish gray (5Y 8/1), stiff, slight drilling disturbance.

NANNO MARL, yellowish brown (10YR 5/4), stiff, slight drilling disturbance.

Cycles seem to have no regular wave length. Everything from 50 to 25 cm thick. The marl is always the thinner of the two components of each cycle.

SS at CC (Chalk)

Clay	A	Fe/Mn	R
Forams	R	Nannos	A
Rads	R	Fish debris	R

Carbonate Bomb: 3-83 to 84 cm = 81%

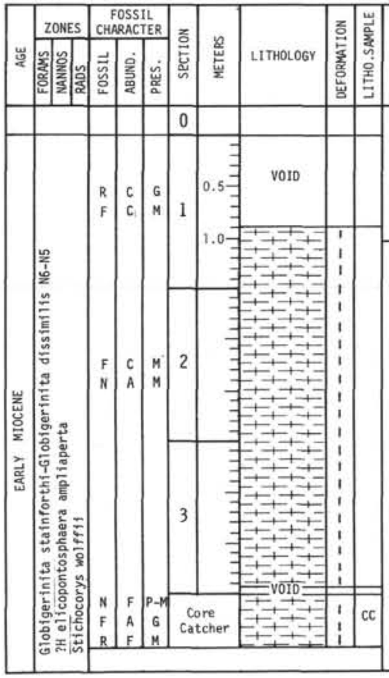
CARBON-CARBONATE
3-80 (10.0-0.1-83)
4-17 (9.3-0.1-77)
4-27 (8.2-0.1-68)
4-37 (9.0-0.1-75)
4-47 (9.6-0.1-79)
4-57 (9.6-0.1-79)
4-77 (8.6-0.1-71)
4-87 (9.1-0.1-75)
4-97 (10.0-0.1-82)
4-107 (10.2-0.1-84)
4-117 (10.0-0.1-83)
4-127 (10.3-0.1-85)
4-137 (10.2-0.1-84)
4-148 (9.7-0.1-80)

GRAIN SIZE
3-78 (15.6-46.2-38.2) Clayey silt

Explanatory notes in Chapter 1

Site 366, Hole A, Core 19, Cored Interval: 167.5-177.0 m: NO RECOVERY

Site 366 Hole A Core 20 Cored Interval: 177.0-186.5 m



5GY 8/1

LITHOLOGIC DESCRIPTION

FORAM NANNO CHALK, light greenish gray (5GY 8/1), stiff, slight drilling disturbance. Mottled with yellowish gray (5Y 8/1).

SS at CC

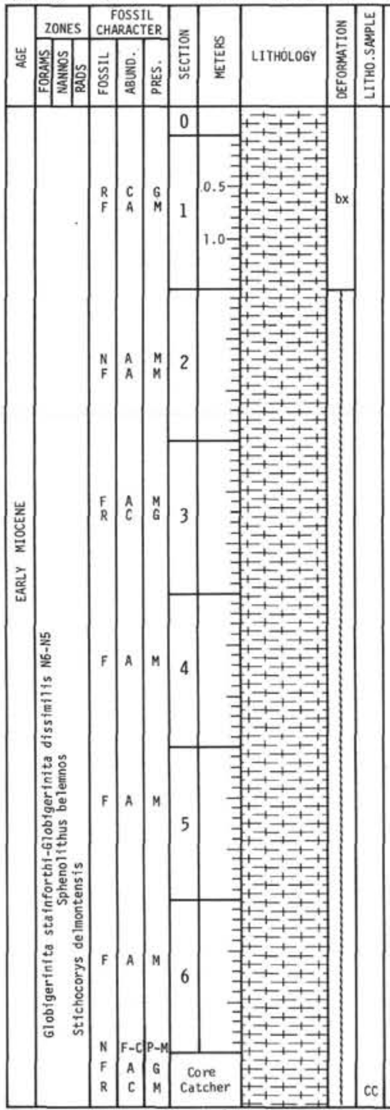
Clay	A	Fe/Mn	R
Forams	A	Nannos	A
Rads	R	Sponge spicules	R

Carbonate Bomb: 3-104-105 cm = 77%

CARBON-CARBONATE
3-107 (9.5-0.1-78)

GRAIN SIZE
3-109 (16.5-36.5-47.0) Silty clay

Site 366 Hole A Core 21 Cored Interval: 186.5-196.0 m



5GY 8/1

LITHOLOGIC DESCRIPTION

FORAM NANNO CHALK, light greenish gray (5GY 8/1), soupy to severe drilling disturbance, stiff, burrowing apparent in some sections. Some green (5G 6/1) bands in Section 6.

SS at CC

Clay	A	Forams	A
Nannos	A	Diatoms	R
Rads	R	Sponge spicules	R

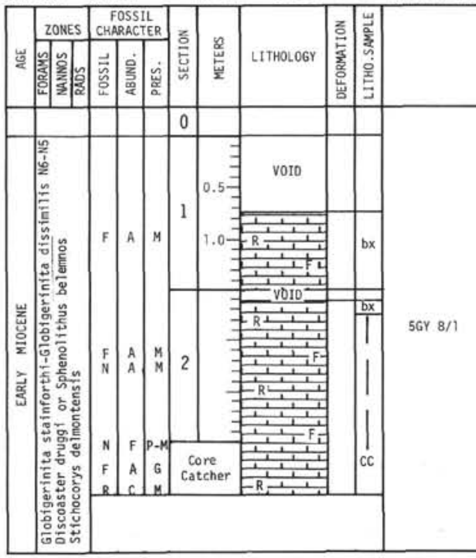
Carbonate Bomb: 3-74 to 75 cm = 79%

CARBON-CARBONATE
3-76 (10.0-0.1-82)

GRAIN SIZE
3-72 (16.1-45.7-38.2) Clayey silt

Explanatory notes in Chapter 1

Site 366 Hole A Core 22 Cored Interval: 196.0-205.5 m



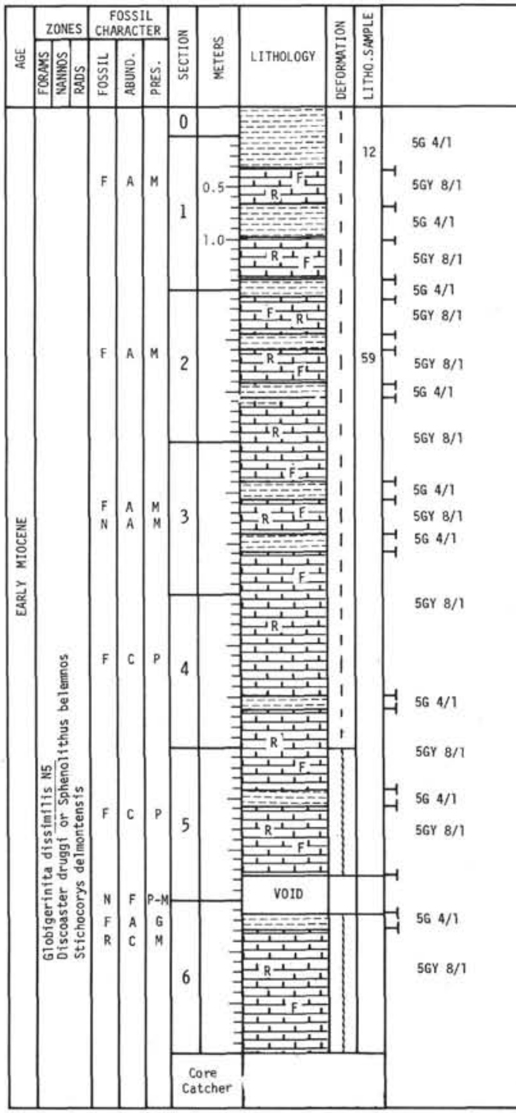
LITHOLOGIC DESCRIPTION

RAD-FORAM-BEARING NANNO CHALK, light greenish gray (5GY 8/1), stiff, soupy to moderate drilling disturbance, several dark green (5G 6/1) bands and laminae occur, mottles and faint burrows common.

<u>SS at CC</u>

Clay	A	Forams	C
Nannos	A	Diatoms	R
Rads	C		

Site 366 Hole A Core 23 Cored Interval: 205.5-215.0 m



Explanatory notes in Chapter 1

LITHOLOGIC DESCRIPTION

CYCLES OF INTERBEDDED PELAGIC CLAY AND RAD-FORAM-BEARING NANNO CHALK

PELAGIC CLAY, dark greenish gray (5G 4/1), burrowed (excellent chondrites), stiff, slight drilling disturbance.

<u>SS at 1-12</u> (pelagic clay)

Clay	A	Fe/Mn	R
Nannos	R	Diatoms	R
Rads	R		

<u>SS at 2-59</u> (minor lithology)

Clay	A	Nannos	R
Diatoms	C	Rads	R
Sponge spicules	R	Fish debris	R

RAD-FORAM-BEARING NANNO CHALK, light greenish gray (5GY 8/1), stiff, slight drilling disturbance. Burrows abundant and filled with lighter material.

These cycles appear to be dissolution cycles.

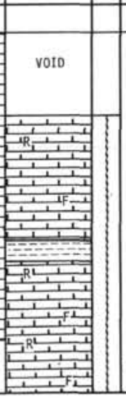
Carbonate Bomb: 1-26 to 27 cm = 7%
1-45 to 46 cm = 71%
3-72 to 73 cm = 80%
3-98 to 99 cm = 22%

<u>CARBON-CARBONATE</u>
1-2 (2.1-0.2-16)
1-12 (1.6-0.2-12)
1-22 (1.1-0.2-8)
1-32 (1.6-0.2-12)
1-42 (8.3-0.2-67)
1-62 (8.0-0.1-66)
1-72 (7.0-0.2-56)
1-82 (3.1-0.2-24)
1-92 (7.9-0.2-64)
1-102 (9.9-0.1-81)
1-112 (10.1-0.1-83)
1-122 (9.8-0.1-81)
1-132 (9.3-0.1-76)
1-142 (2.0-0.2-15)
2-2 (6.2-0.2-50)
2-12 (9.9-0.1-81)
2-22 (9.7-0.1-80)
2-32 (9.3-0.1-76)
2-42 (3.4-0.2-26)
2-52 (0.9-0.2-6)
2-62 (10.1-0.1-83)
2-82 (10.1-0.1-83)
2-92 (9.9-0.1-82)
2-102 (10.0-0.1-82)
2-112 (10.5-0.1-87)
2-122 (10.3-0.1-85)
2-13? (10.3-0.1-85)
2-142 (9.2-0.1-76)
3-100 (2.5-0.1-20)

<u>GRAIN SIZE</u>
3-102 (1.2-39.1-59.7) Silty clay

Site 366 Hole A Core 24 Cored Interval: 215.0-2 24.5 m

AGE	ZONES (FORAMS / NANNOS / RADS)	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHO.SAMPLE
					0		
EARLY MIOCENE	Globigerinita dissimilis N5 Discoaster druggi or Sphenolithus belemnos Stichocorys delmontensis	R F	C C	G M	1	0.5 1.0	
		R F	C C	M M	2		
		N F R	C A C	P-M G M	Core Catcher		CC



5GY 8/1

5G 4/1

5GY 8/1

LITHOLOGIC DESCRIPTION

CYCLES OF INTERBEDDED PELAGIC CLAY AND RAD-FORAM-BEARING NANNO CHALK

PELAGIC CLAY, dark greenish gray (5G 4/1), burrowed (chondrites), stiff, severe drilling disturbance.

RAD-FORAM-BEARING NANNO CHALK, light greenish gray (5GY 8/1), stiff, severe drilling disturbance, burrowed.

Cycles appear to be dissolution cycles.

SS at CC (dominant lithology)

Clay	A	Forams	C
Nannos	A	Diatoms	R
Rads	C		

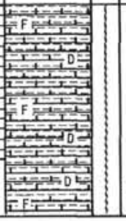
Carbonate Bomb: 2-95 to 96 cm = 80%

CARBON-CARBONATE
2-92 (9.8-0.1-81)

GRAIN SIZE
2-96 (20.4-37.8-41.9) Sandy clay

Site 366 Hole A Core 25 Cored Interval: 224.5-234.0 m

AGE	ZONES (FORAMS / NANNOS / RADS)	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHO.SAMPLE
					0		
EARLY MIOCENE	Globigerinita dissimilis N5 Discoaster druggi Stichocorys delmontensis	R	C	G	1	0.5 1.0	
		F N	C A	M M			
		N F R	R-C A R	M G M	Core Catcher		CC



5GY 8/1

LITHOLOGIC DESCRIPTION

FORAM-DIATOM-BEARING CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, severe drilling disturbance, some darker green burrowed segments. Ethmodiscus rex common.

SS at CC

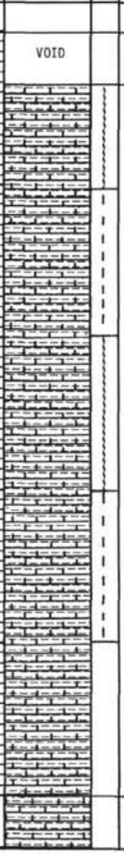
Clay	A	Forams	C
Nannos	A	Diatoms	C
Rads	R	Silicoflagellates	R

CARBON-CARBONATE
1-119 (10.1-0.1-84)

GRAIN SIZE
1-117 (26.5-31.4-42.1) Sandy clay

Site 366 Hole A Core 26 Cored Interval: 234.0-243.5 m

AGE	ZONES (FORAMS / NANNOS / RADS)	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHO.SAMPLE
					0		
EARLY MIOCENE	Globigerinoides primordius-Globorotalia kugleri N4 Discoaster deflandrei Cyrtocapsella tetrapera	F R	A C	G M	1	0.5 1.0	
		N F	A A	G G	2		
		F	A	G	3		
		F	A	G	4		65
		R F	C A	G G	5		
		N F R	C A R	M G M	Core Catcher		CC



5GY 8/1

LITHOLOGIC DESCRIPTION

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, slight to severe drilling disturbance, burrowed. Thin (10 cm) interbeds of slightly darker green occur at 2-70 to 80 cm; 3-47 to 54 cm; 3-85 to 100 cm; scattered throughout Section 4 and at 5-20 to 30 cm.

These slightly darker green layers appear to have less carbonate and may be part of the previous dissolution cycle sequence.

SS at 4-65 (dominant lithology)

Clay	A	Fe/Mn	C
Forams	R	Nannos	A
Rads	R		

SS at CC

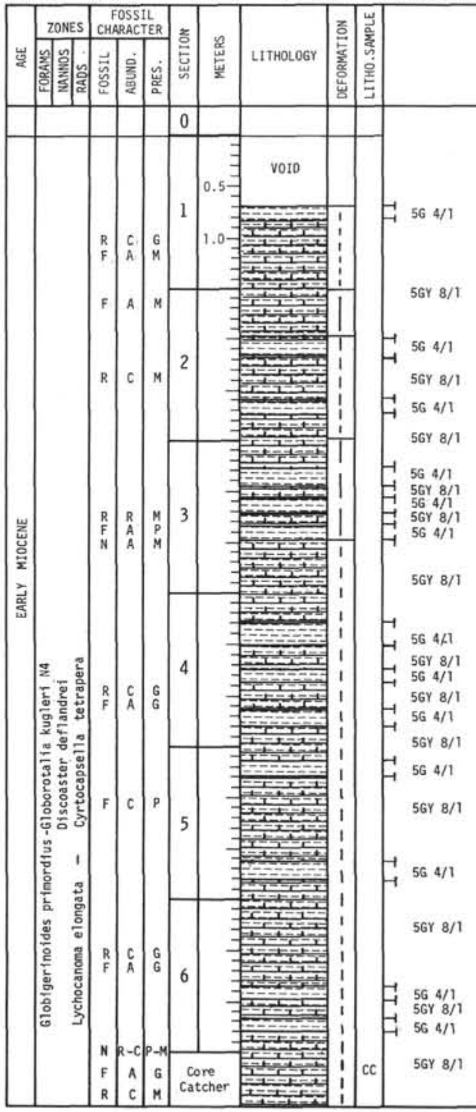
Clay	A	Forams	R
$CaCO_3$ needles	C	Nannos	A
Rads	C		

Carbonate Bomb: 3-113 to 114 cm = 80%

CARBON-CARBONATE
3-114 (10.2-0.1-85)

Explanatory notes in Chapter 1

Site 366 Hole A Core 27 Cored Interval: 243.5-253.0 m



LITHOLOGIC DESCRIPTION

CYCLES OF INTERBEDDED PELAGIC CLAY AND CLAYEY NANNO CHALK

PELAGIC CLAY, dark greenish gray (5G 4/1), burrowed with chondrites common, stiff, slight to moderate drilling disturbance.

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, slight to moderate drilling disturbance, burrowed.

Cycles appear to be dissolution cycles.

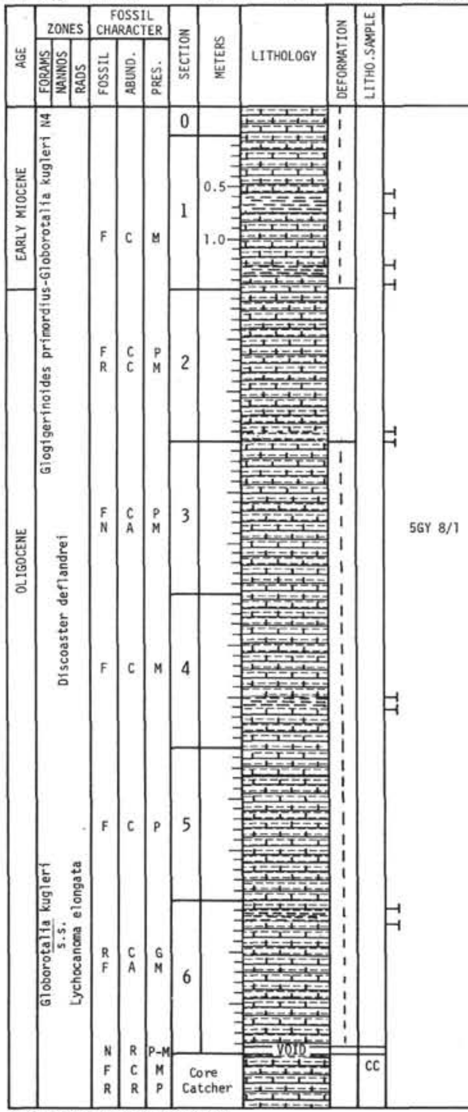
SS at CC (Clayey nanno chalk)

Clay	A	Forams	R
Nannos	A	Rads	R
Fish debris	R		

Carbonate Bomb: 3-108 to 109 cm = 78%

CARBON-CARBONATE
3-2 (10.1-0.1-83)
3-12 (9.7-0.1-80)
3-22 (9.4-0.1-77)
3-32 (8.3-0.1-63)
3-42 (9.1-0.1-75)
3-52 (9.8-0.1-81)
3-62 (7.1-0.1-59)
3-72 (8.1-0.1-67)
3-82 (9.0-0.1-74)
3-90 (8.3-0.1-68)
3-105 (10.5-0.1-86)
3-115 (10.0-0.1-83)
3-125 (10.3-0.1-85)
3-135 (10.6-0.1-88)
3-145 (10.6-0.1-88)
4-2 (10.5-0.1-87)
4-12 (10.5-0.1-87)
4-22 (10.2-0.1-84)
4-32 (9.6-0.1-79)
4-42 (4.8-0.1-39)
4-52 (9.9-0.1-82)
4-62 (9.3-0.1-77)
4-72 (9.6-0.1-79)
4-82 (8.6-0.1-71)
4-92 (9.9-0.1-82)
4-122 (9.0-0.1-74)
4-132 (9.8-0.1-81)
4-142 (10.1-0.1-84)

Site 366 Hole A Core 28 Cored Interval: 253.0-262.5 m



LITHOLOGIC DESCRIPTION

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, no to slight drilling disturbance, burrowed.

Thin (~10 cm) interbeds of pelagic clay occur at 1-60 to 70 cm; 1-128 to 135 cm; 2-140 to 150 cm; 4-101 to 110 cm; 6-15 to 20 cm; the pelagic clay is burrowed.

These thin interbeds appear to be part of the dissolution cycles.

SS at CC (Clayey nanno chalk)

Clay	A	Forams	R
Nannos	A	Rads	R
Sponge spciules	R	Fish debris	R

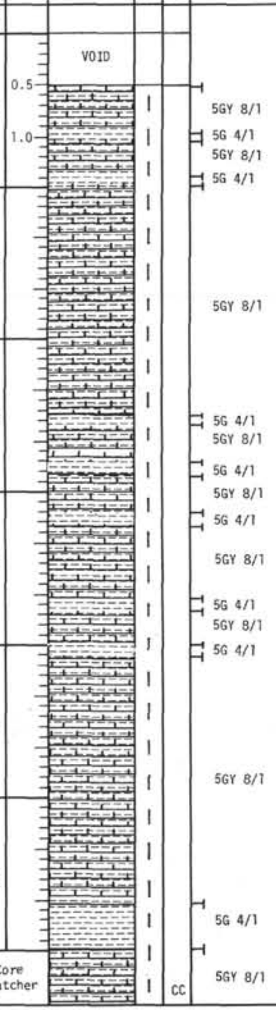
Carbonate Bomb: 3-76 to 77 cm = 76%

CARBON-CARBONATE
1-76 (9.8-0.1-81)
3-74 (10.3-0.1-85)

Explanatory notes in Chapter 1

Site 366 Hole A Core 29 Cored Interval: 262.5-272.0 m

AGE	ZONES			FOSSIL CHARACTER			SECTION
	FORAMS	NANNOS	RADS	FOSSIL	ABUND.	PRES.	
							0
OLIGOCENE	Globorotalia kugleri s.s.	Discoaster deflandrei	Lychnocanoma elongata	F	C	P	1
				F	C	P	2
				N F R	A C C	M P G	3
				F R	A C	G P	4
				F R	C R	P P	5
				F	C	P	6
				N F R	C A —	P-M M —	Core Catcher



LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY, light greenish gray (5GY 8/1), stiff, slight drilling disturbance, burrowed. Thin interbeds of pelagic clay occur at 1-95 to 110 cm; 1-135 to 142 cm; 3-72 to 82 cm; 3-121 to 135 cm; 4-23 to 34 cm; 4-106 to 116 cm; 5-0 to 10 cm.

PELAGIC CLAY, dark greenish gray (5G 4/1), burrowed, stiff, slight drilling discurbance. Appear to be dissolution cycles.

<u>SS at CC</u> (dominant lithology)

Clay	A	Forams	R
Nannos	A	Rads	R

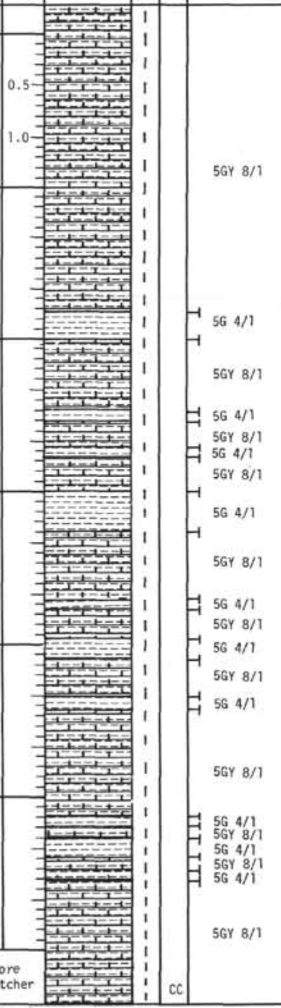
The alternations appear to be dissolution cycles.

Carbonate Bomb: 3-72 to 73 cm = 79%

CARBON-CARBONATE
1-74 (9.9-0.1-82)
3-73 (9.8-0.1-81)

Site 366 Hole A Core 30 Cored Interval: 272.0-281.5 m

AGE	ZONES			FOSSIL CHARACTER			SECTION
	FORAMS	NANNOS	RADS	FOSSIL	ABUND.	PRES.	
OLIGOCENE		Cyclicargolithus abisectus					0
				F R	A +	G P	1
				F R	A +	G P	2
				F N R	C A +	P M P	3
				F	A	G	4
	Globigerina ciperoensis P22	Sphenolithus ciperoensis	Dorcadospyris ateuchus	F R	A F	G P	5
				F	A	G	6
				N F R	R A R	P-M G M	Core Catcher



LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, slight drilling disturbance, burrowed. Mn specks and liesegang bands common. Black specks occasional.

PELAGIC CLAY, dark greenish gray (5G 4/1), stiff, slight drilling disturbance, burrowed, some sequences laminated.

<u>SS at CC</u> (dominant lithology)

Clay	A	Forams	C
Nannos	A	Rads	R
Fish debris	R		

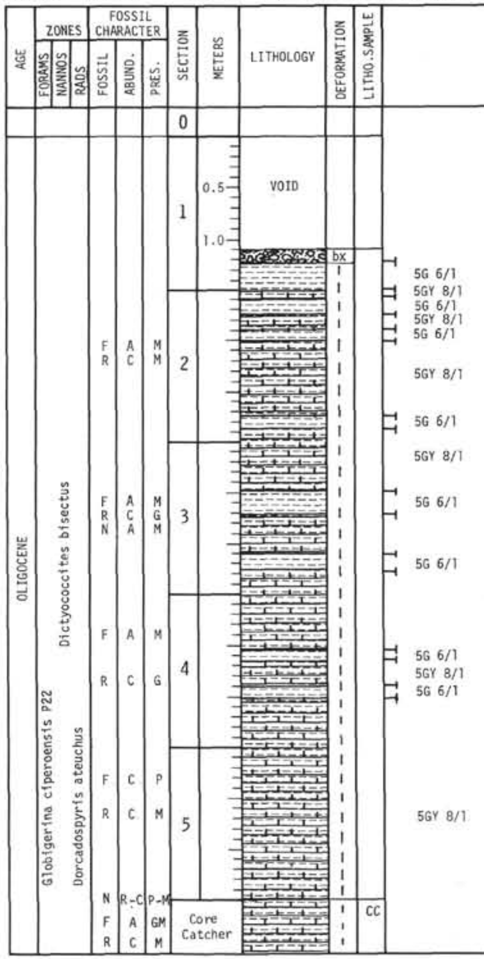
These alternations appear to be dissolution cycles.

Carbonate Bomb: 3-54 to 55 cm = 73%

CARBON-CARBONATE
1-85 (10.4-0.1-86)
3-51 (10.1-0.1-83)

Explanatory notes in Chapter 1

Site 366 Hole A Core 31 Cored Interval: 281.5-291.0 m



LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, slight drilling disturbance, burrowed, Mn spots with liesegang halos scattered throughout.

PELAGIC CLAY, dark greenish gray (5G 6/1), stiff, slight drilling disturbance, burrowed, sometimes laminated.

These appear to be dissolution cycles.

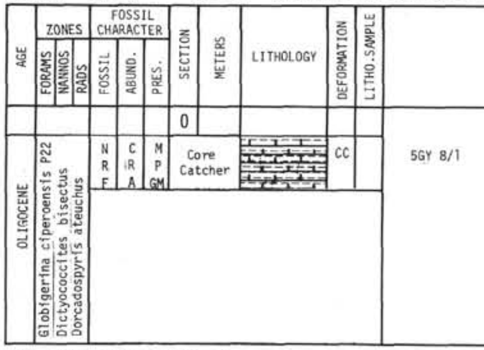
<u>SS at CC</u> (dominant lithology)

Clay	A	Forams	R
Nannos	A	Rads	R

Carbonate Bomb: 3-84 to 85 cm = 81%

<u>CARBON-CARBONATE</u>
2-76 (10.2-0.1-85)
3-81 (10.8-0.1-89)

Site 366 Hole A Core 32 Cored Interval: 291.0-300.5 m



LITHOLOGIC DESCRIPTION

Only small sample

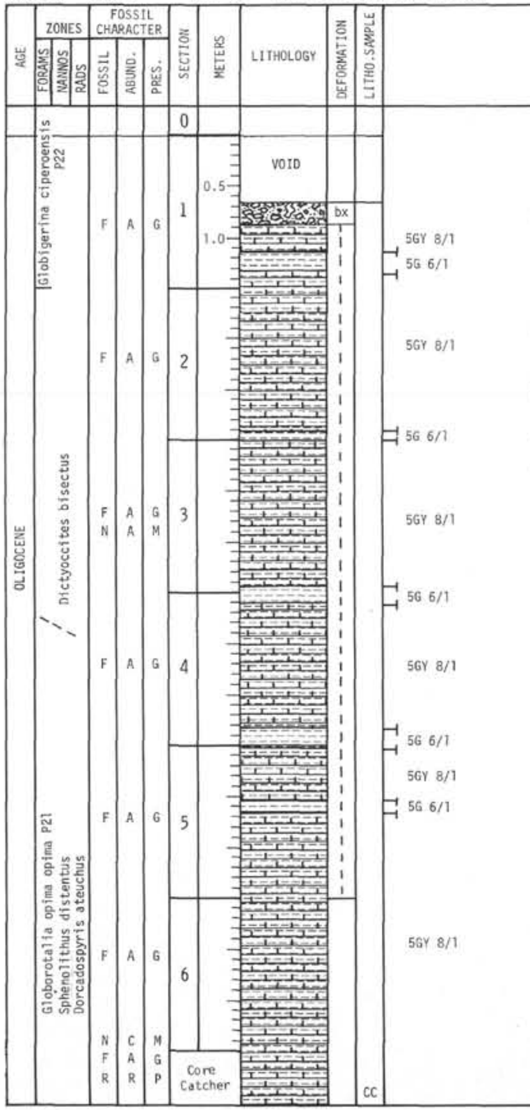
CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff.

<u>SS at CC</u>

Clay	A	Fe/Mn	R
Forams	R	Nannos	A
Diatoms	R	Rads	R
Fish debris	R		

Explanatory notes in Chapter 1

Site 366 Hole A Core 33 Cored Interval: 300.5-310.0 m



LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, slight drilling disturbance, burrowed, Mn and Fe flecks, some with liesegang bands and halos, scattered throughout. Good Zoophycos burrows. Bluish-gray laminae occur scattered.

PELAGIC CLAY, dark greenish gray (5G 6/1), stiff, slight drilling disturbance, burrowed, some zones laminated.

These alternations appear to be dissolution cycles.

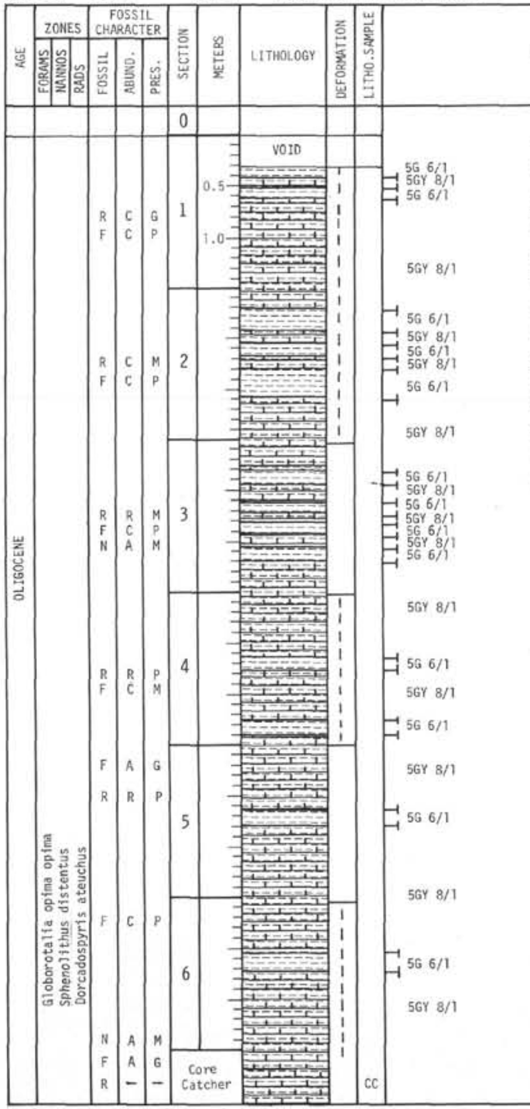
SS at CC (dominant lithology)

Clay	C	Forams	R
Nannos	A	Rads	R

Carbonate Bomb: 3-84 to 85 cm = 76%

CARBON-CARBONATE
1-91 (10.9-0.1-90)
3-81 (10.2-0.1-84)

Site 366 Hole A Core 34 Cored Interval: 310.0-319.5 m



Explanatory notes in Chapter 1

LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, slight to no drilling disturbance, burrowed, Mn halos around Zoophycos tracks, liesegang bands, some blue-gray laminations scattered throughout.

PELAGIC CLAY, dark greenish gray (5G 6/1), stiff, slight to no drilling disturbance, intensely burrowed.

These alternations appear to be dissolution cycles.

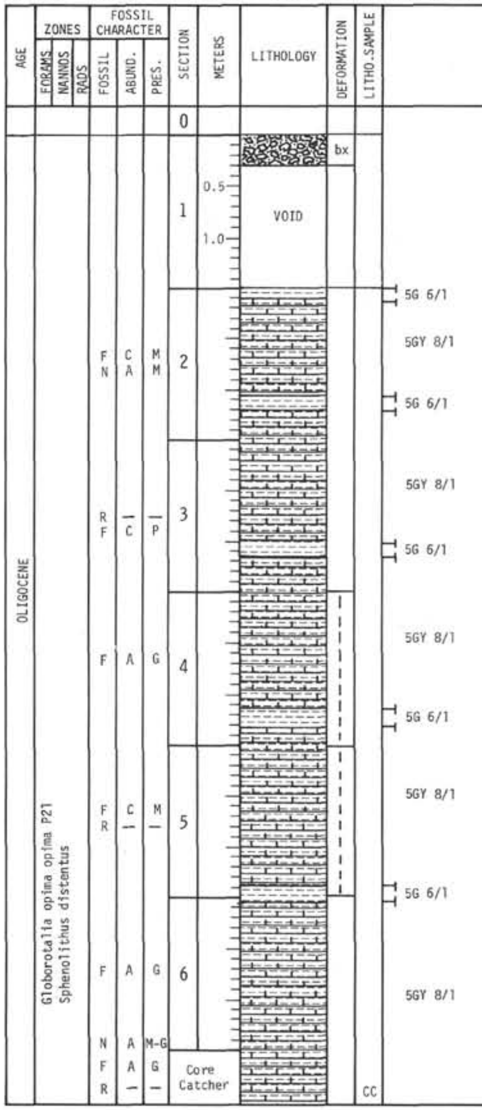
SS at CC (dominant lithology)

Clay	A	Forams	R
Nannos	A	Rads	R
Fish debris	R		

Carbonate Bomb: 3-78 to 79 cm = 76%

CARBON-CARBONATE
1-101 (10.6-0.1-88)
3-76 (9.8-0.1-81)

Site 366 Hole A Core 35 Cored Interval: 319.5-329.0 m



LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, slight to no drilling disturbance, burrowed, Mn flecks and liesegang bands scattered throughout, laminated zones present throughout.

PELAGIC CLAY, dark greenish gray (5G 6/1), stiff, slight to no drilling disturbance, burrowed.

These alternations appear to be dissolution cycles.

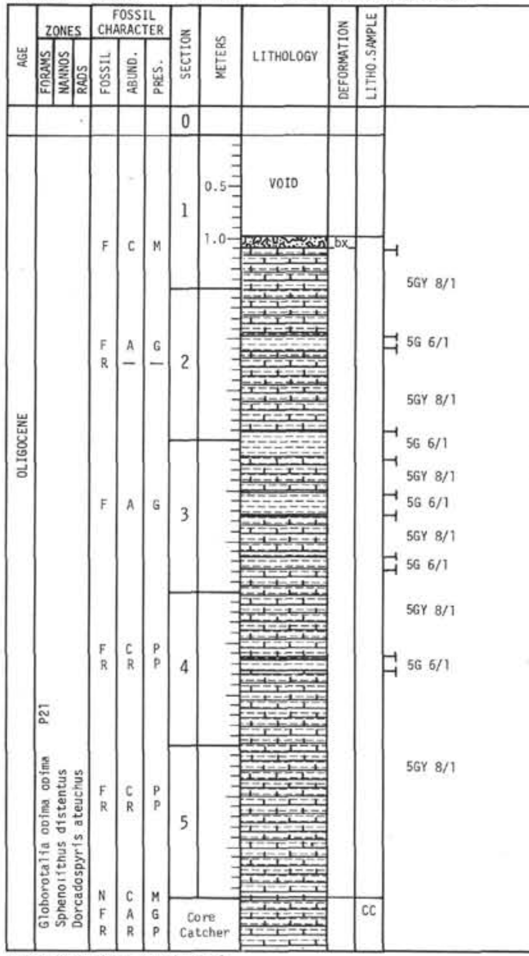
SS at CC (dominant lithology)

Clay	C	Forams	R
Nannos	A	Fish debris	R

Carbonate Bomb: 3-73 to 74 cm = 80%

CARBON-CARBONATE
2-26 (10.6-0.1-87)
3-70 (10.4-0.1-86)

Site 366 Hole A Core 36 Cored Interval: 329.0-338.5 m



LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, no drilling disturbance, burrowed, Mn bands, laminae, halos abundant, some layers laminated.

PELAGIC CLAY, dark greenish gray (5G 6/1), stiff, no drilling disturbance, burrowed.

Sometimes the contact between pelagic clay below clayey nanno ooze is gradational but the other contact is always sharp.

These alternations appear to be dissolution cycles.

SS at CC (dominant lithology)

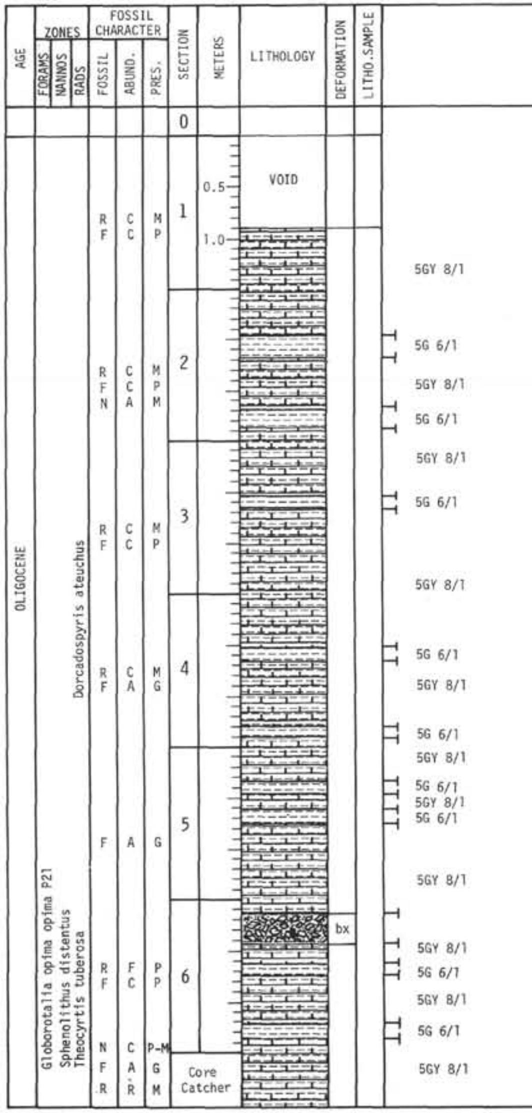
Clay	C	Forams	R
Nannos	A	Rads	R

Carbonate Bomb: 3-53 to 54 cm = 69%

CARBON-CARBONATE
1-126 (10.6-0.1-88)
3-51 (9.9-0.1-81)

Explanatory notes in Chapter 1

Site 366 Hole A Core 37 Cored Interval: 338.5-348.0 m



LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, no drilling disturbance, burrowed, abundant Mn flecks, bands, and halos, some laminated layers blue-gray and green.

PELAGIC CLAY, dark greenish gray (5G 6/1), stiff, no drilling disturbance except in Sec.6, burrowed.
These alternations appear to be dissolution cycles.

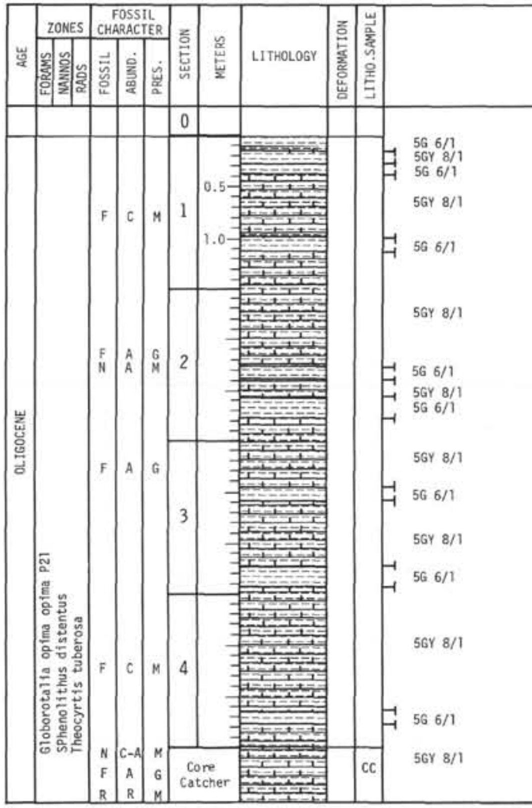
SS at CC (dominant lithology)

Clay	C	Forams	C
Nannos	A	Rads	R
Fish debris	R		

Carbonate Bomb: 3-96 to 97 cm = 84%

CARBON-CARBONATE
1-126 (10.2-0.1-84)
3-94 (10.5-0.1-87)

Site 366 Hole A Core 38 Cored Interval: 348.0-357.5 m



LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, no drilling disturbance, burrowed, abundant Mn flecks, bands, and liesegang halos, some zones are laminated and are blue-gray and green.

PELAGIC CLAY, dark greenish gray (5G 6/1), stiff, no drilling disturbance, burrowed.

These alternations appear to be dissolution cycles.

SS at CC (dominant lithology)

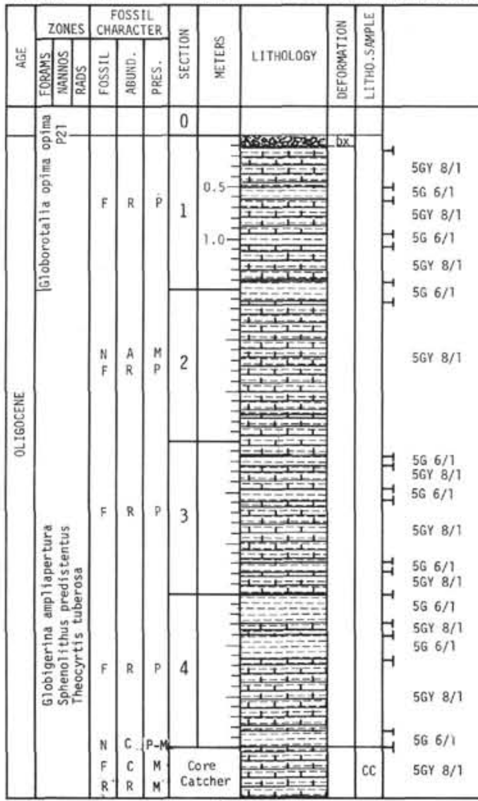
Clay	A	Forams	C
Nannos	A	Rads	R
Fish debris	R		

Carbonate Bomb: 3-45 to 46 cm = 85%

CARBON-CARBONATE
1-131 (10.9-0.1-90)
3-43 (10.7-0.1-89)

Explanatory notes in Chapter 1

Site 366 Hole A Core 39 Cored Interval: 357.5-367.0 m



LITHOLOGIC DESCRIPTION

INTERBEDDED CLAYEY NANNO CHALK AND PELAGIC CLAY

CLAYEY NANNO CHALK, light greenish gray (5GY 8/1), stiff, no drilling disturbance, burrowed, abundant Mn flecks, laminations, liesegang halos, common blue-gray and green laminae.

PELAGIC CLAY, dark yellowish gray (5G 6/1), stiff, no drilling disturbance, burrowed and sometimes laminated.

These alternations appear to be dissolution cycles.

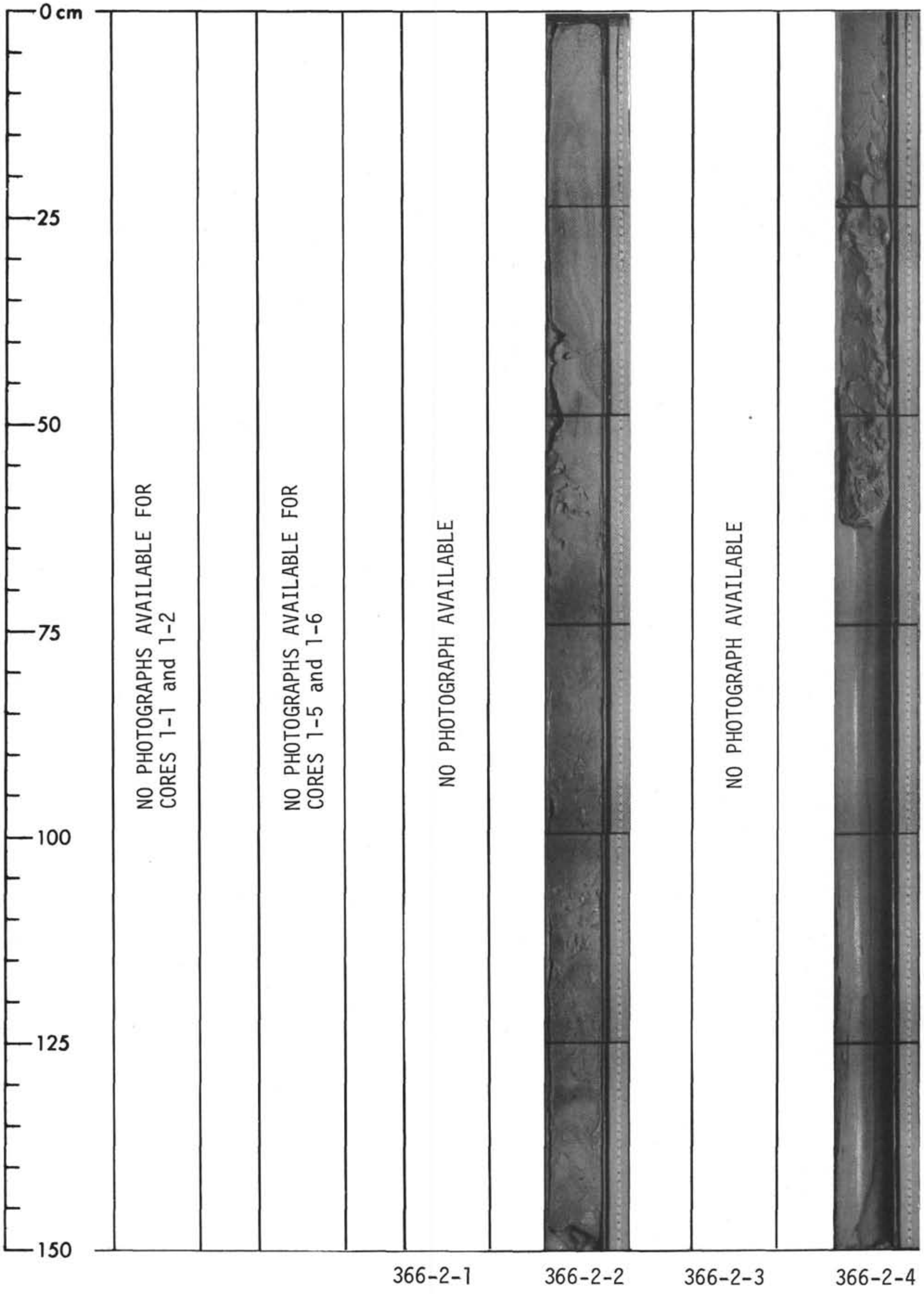
SS at CC (dominant lithology)

Clay	A	Fe/Mn	R
Forams	R	Nannos	A
Rads	R	Fish debris	R

Carbonate Bomb: 3-91 to 92 cm = 86%

CARBON-CARBONATE
1-25 (10.5-0.1-87)

Explanatory notes in Chapter 1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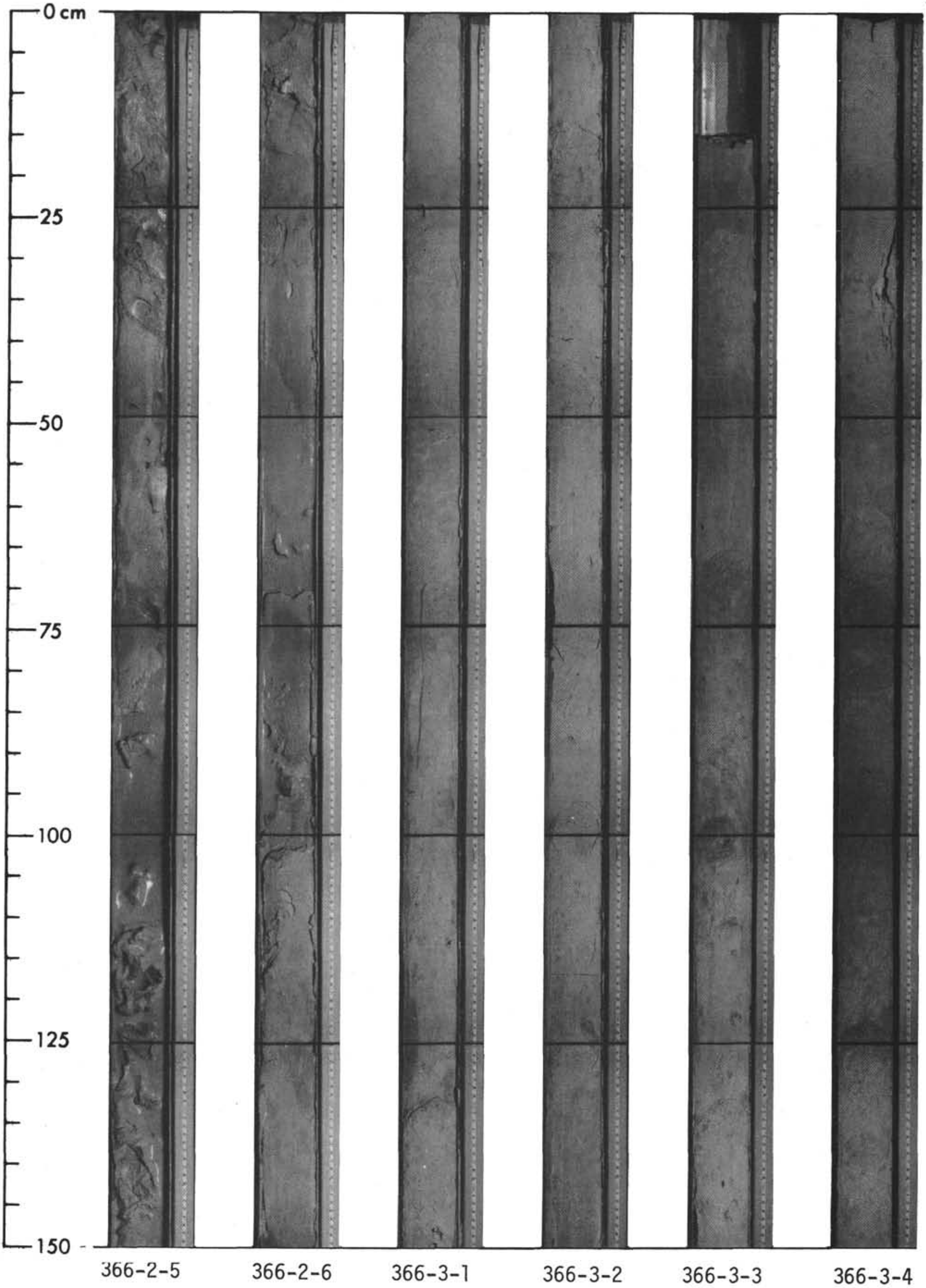
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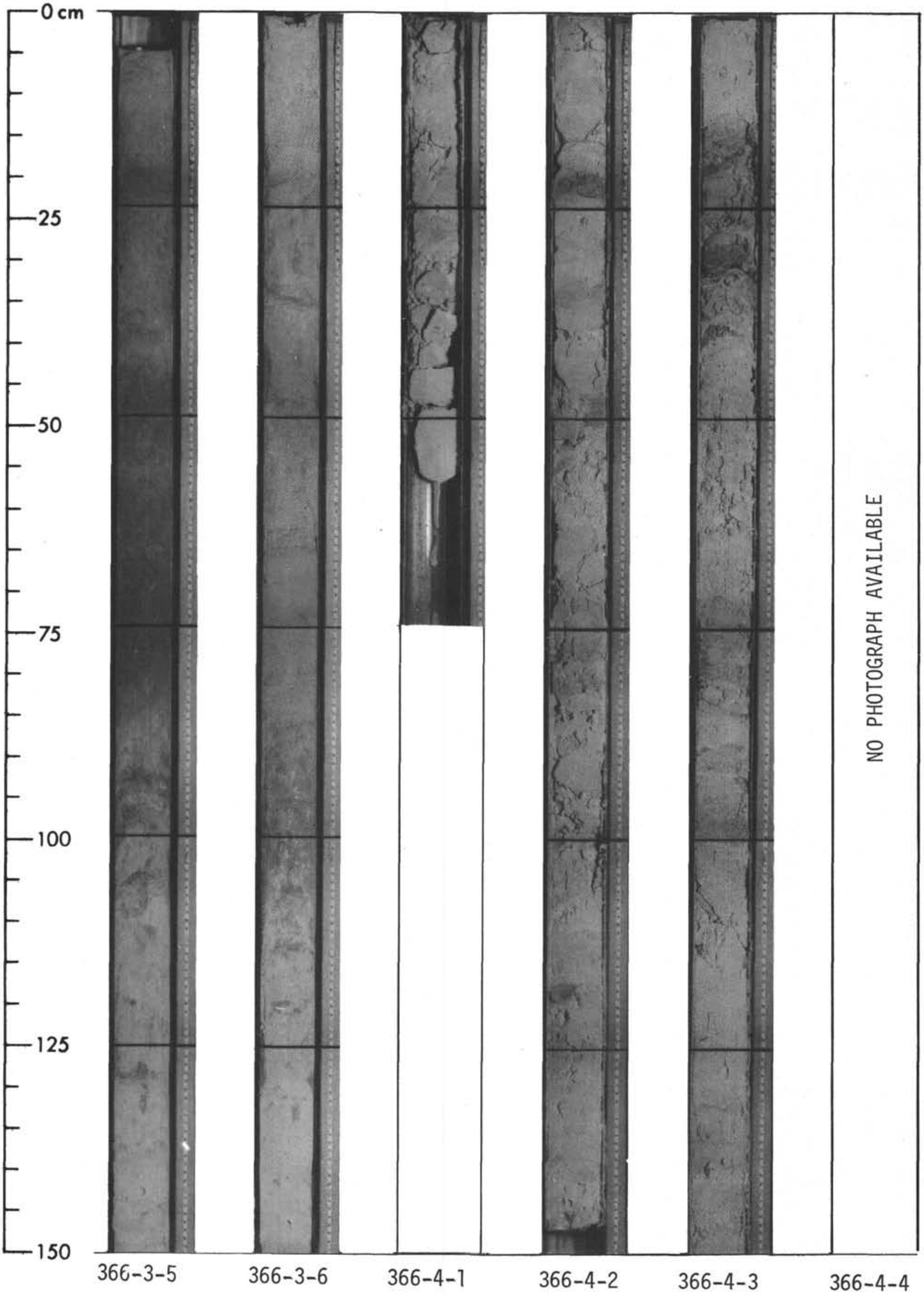
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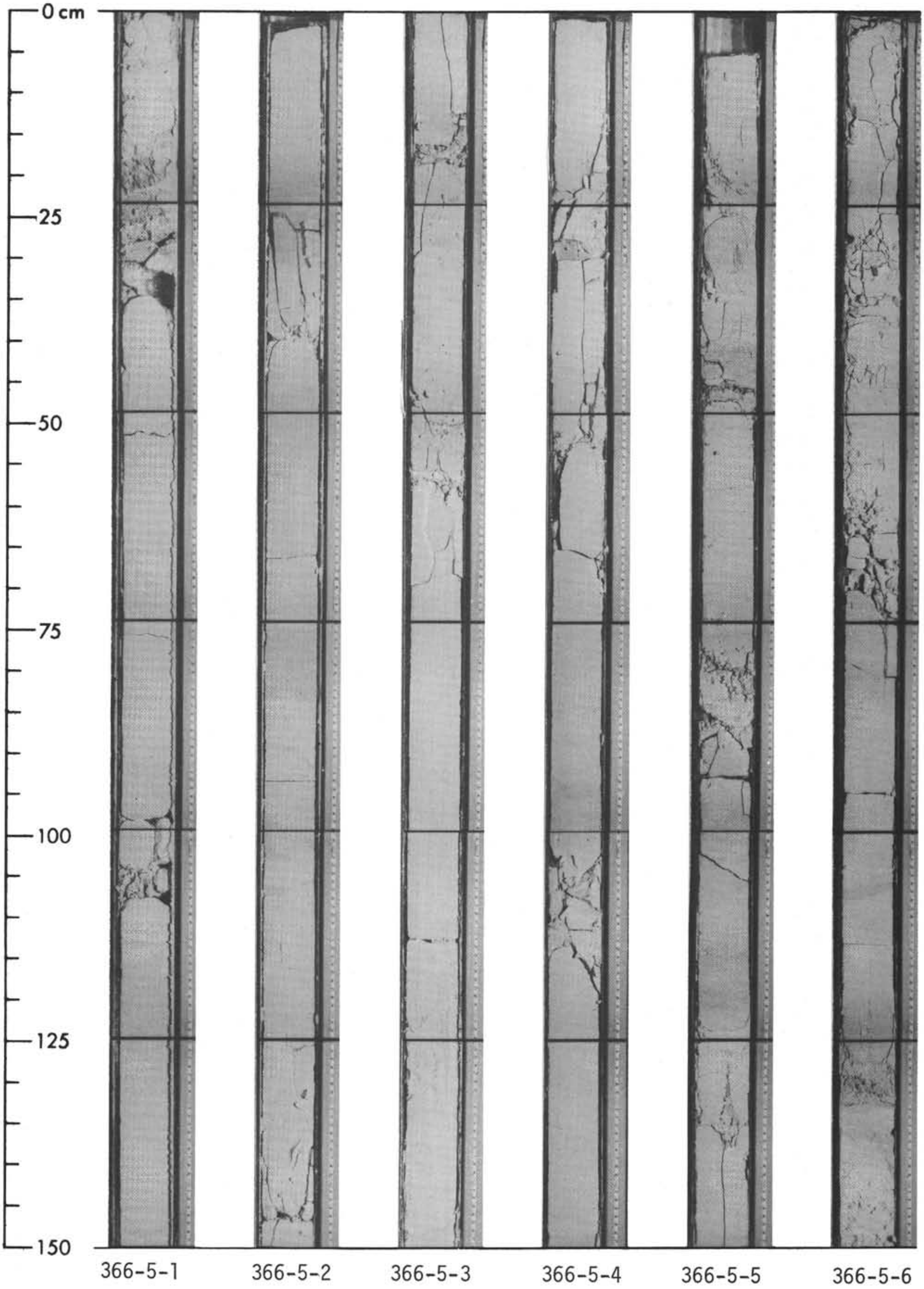
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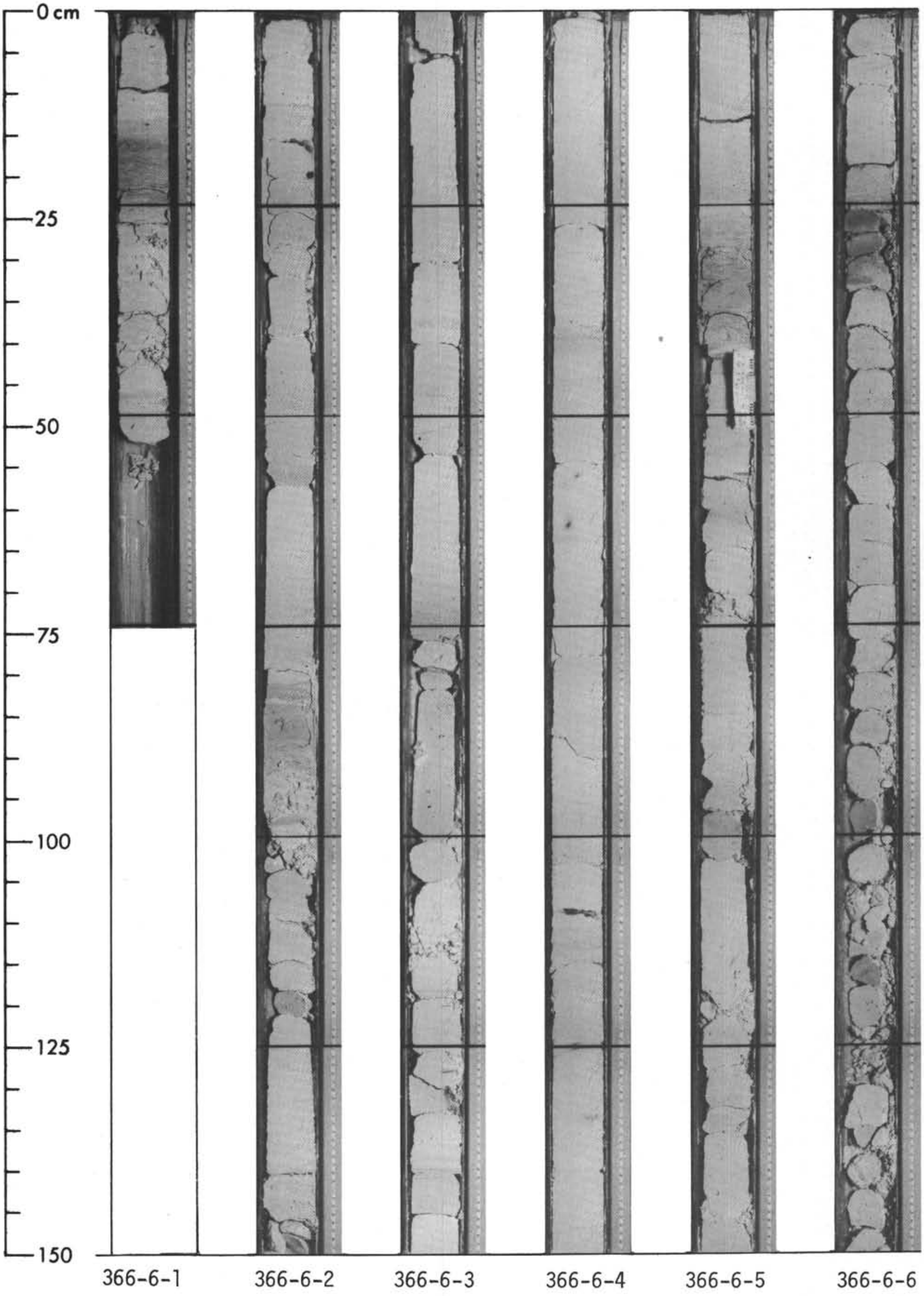
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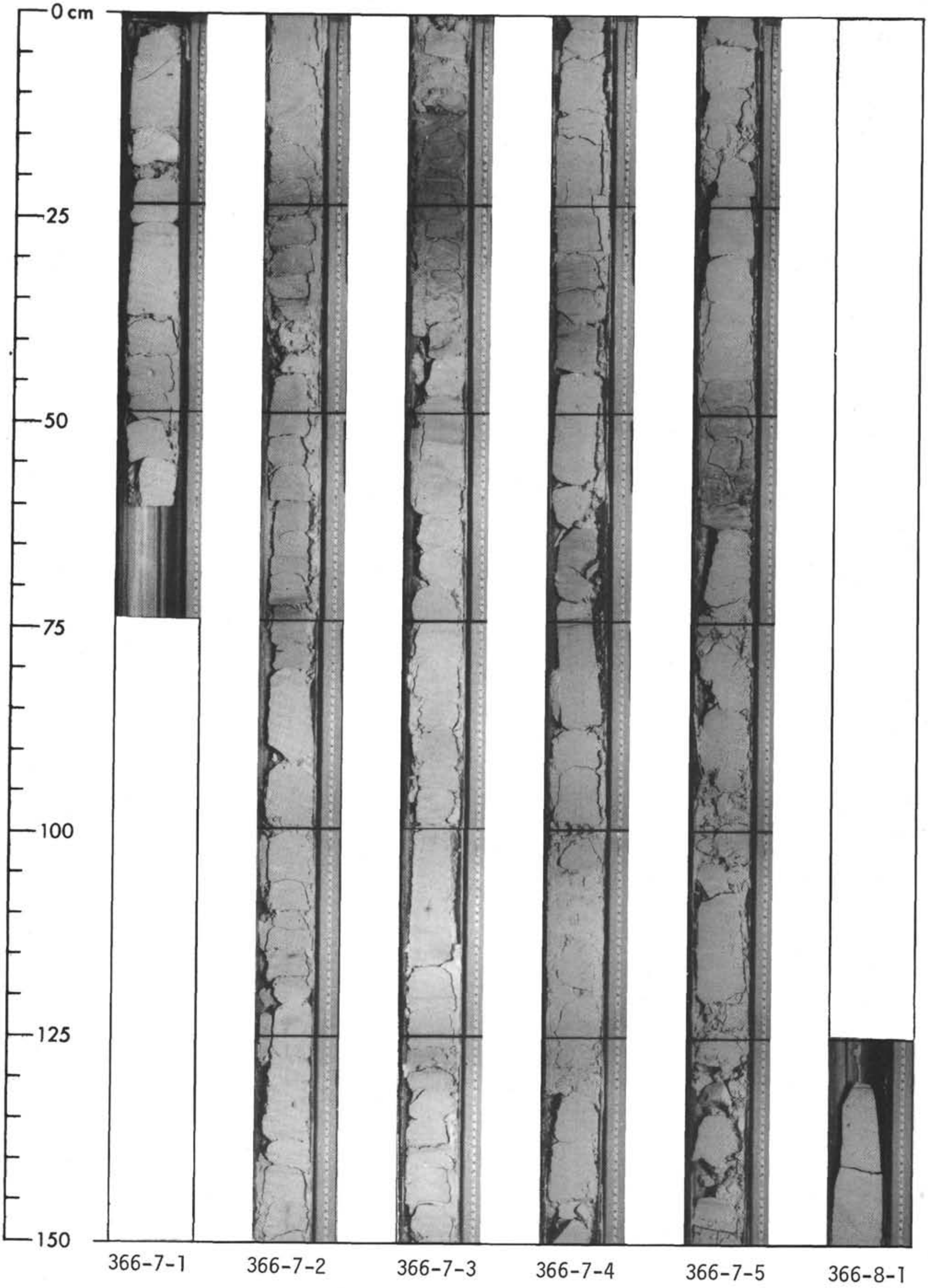
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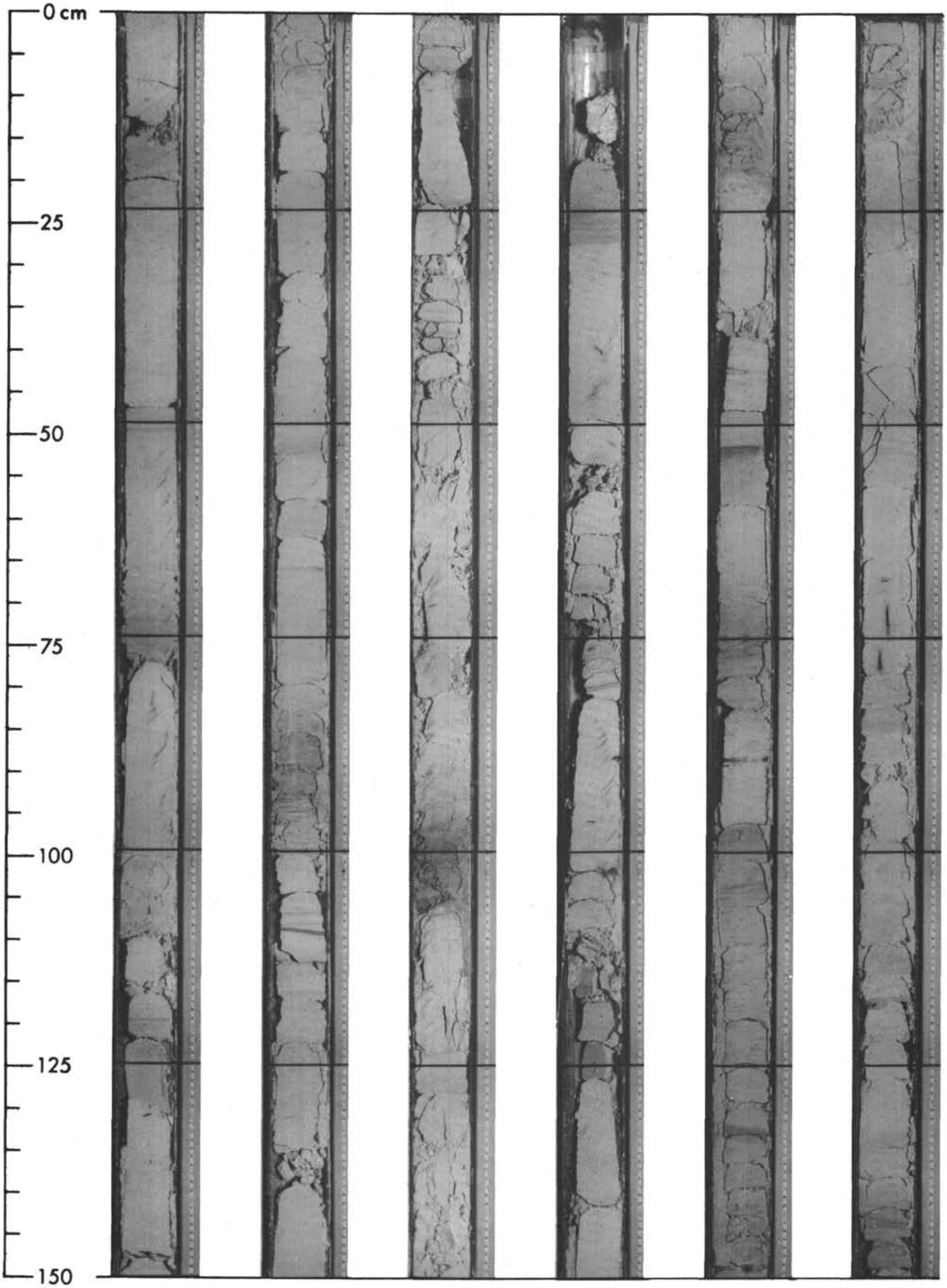
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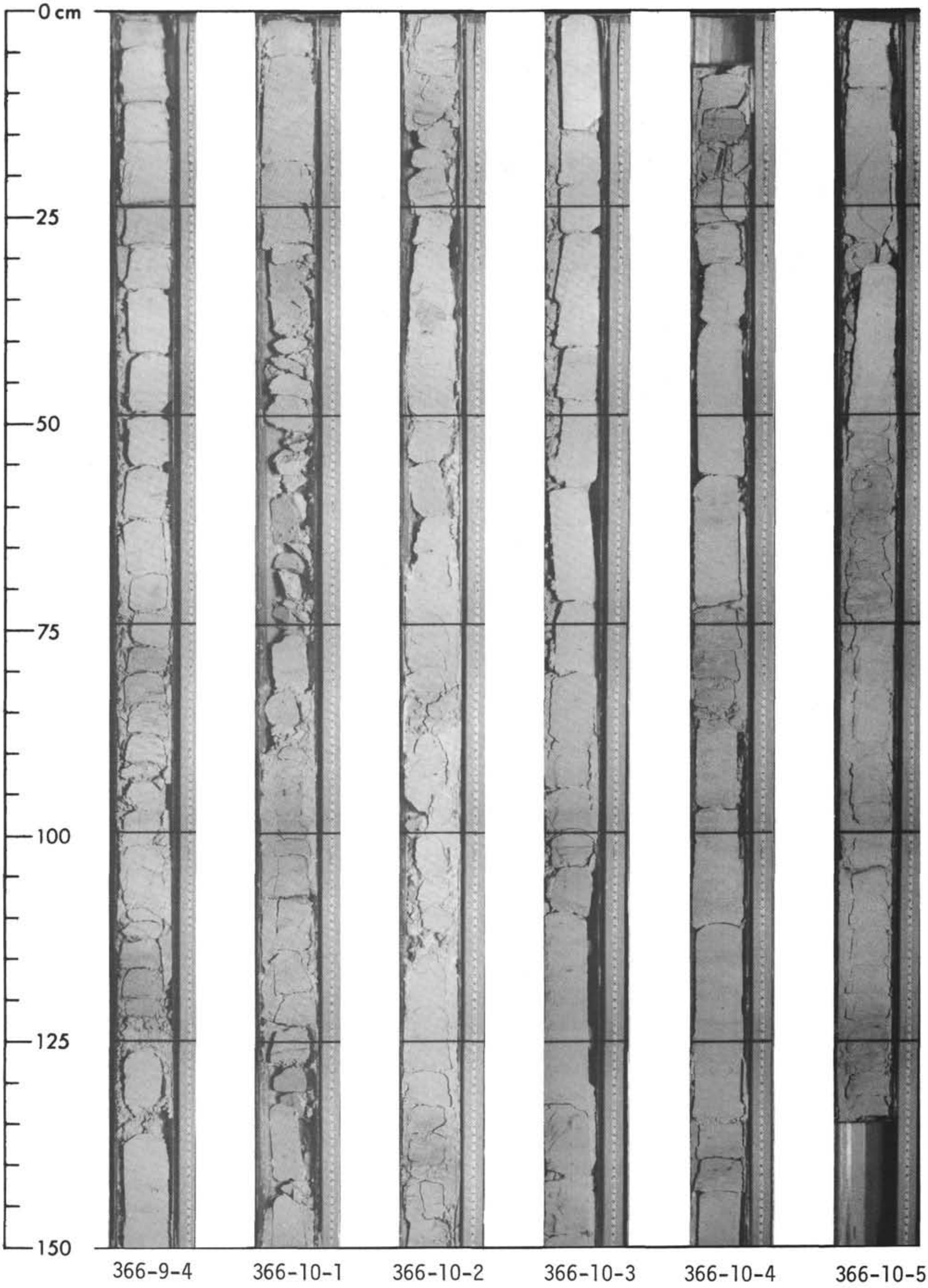
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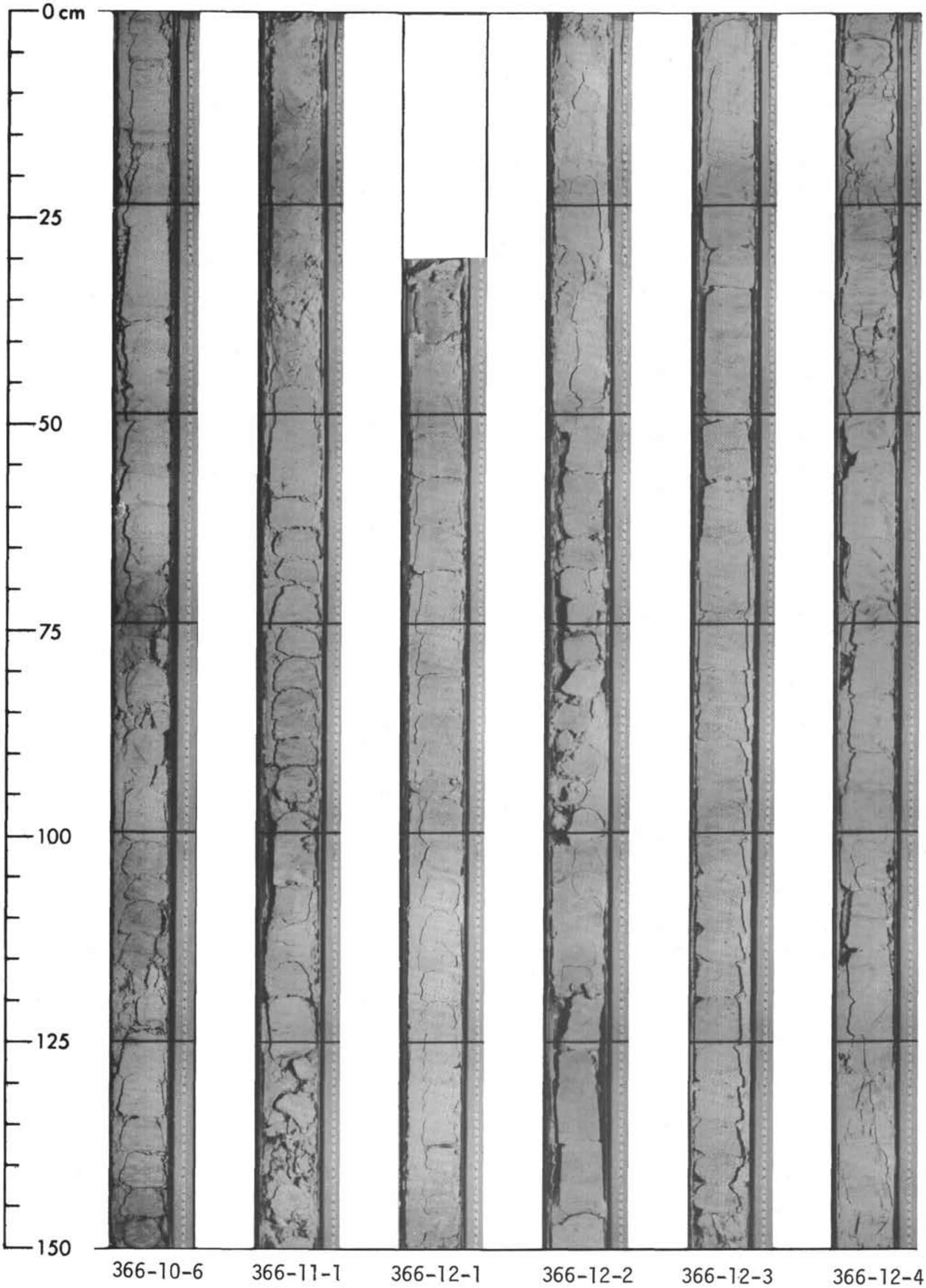
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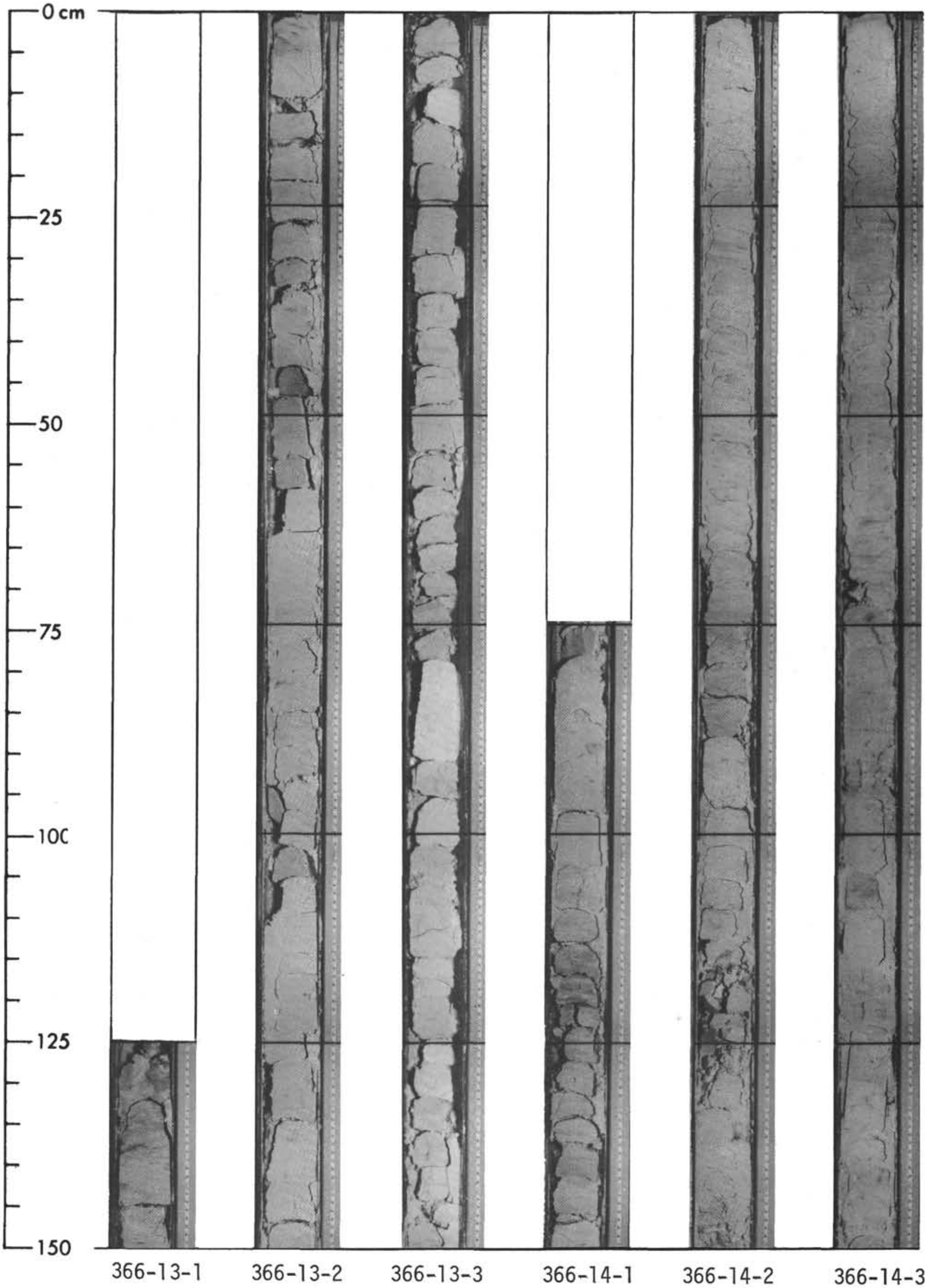
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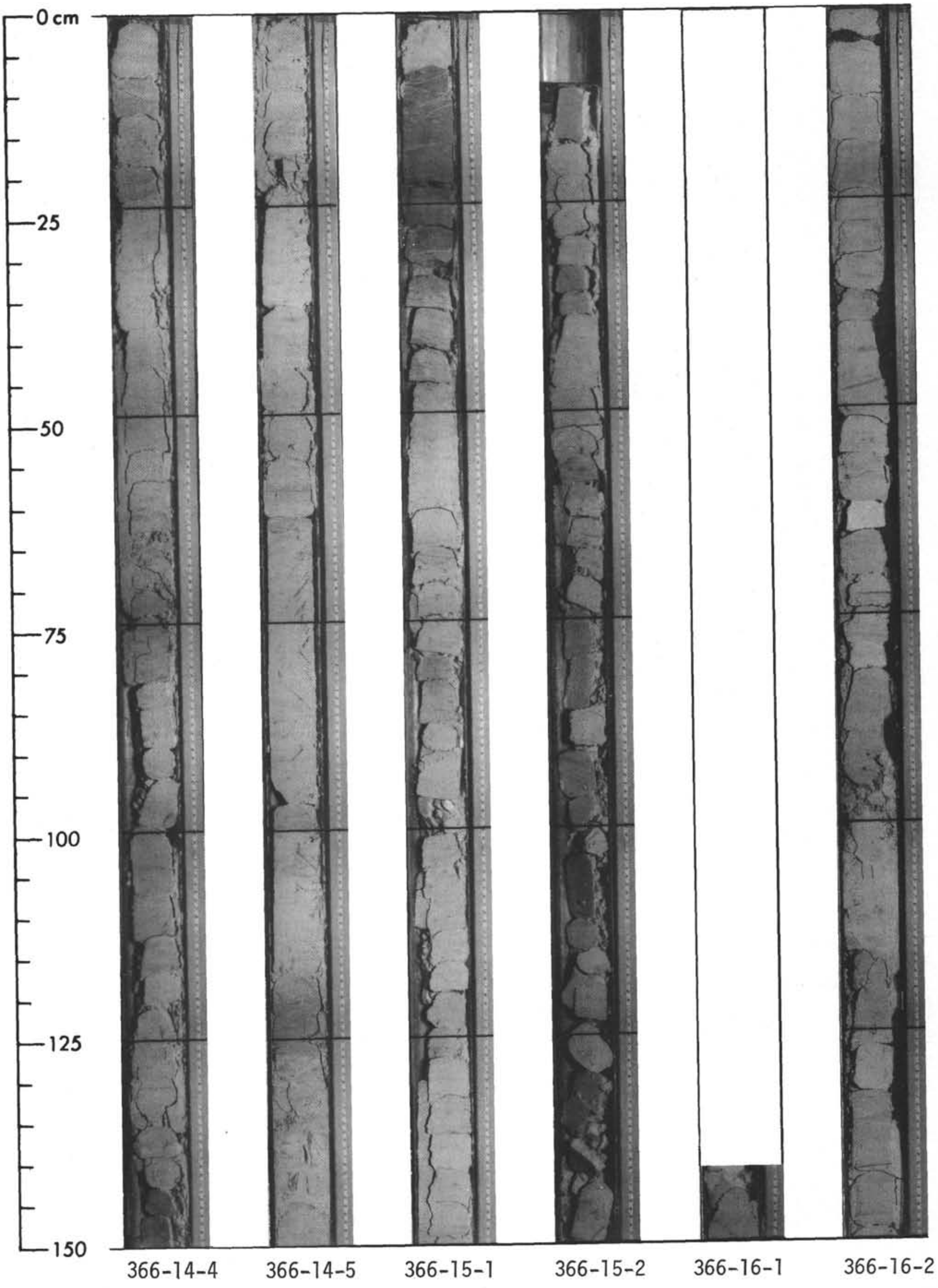
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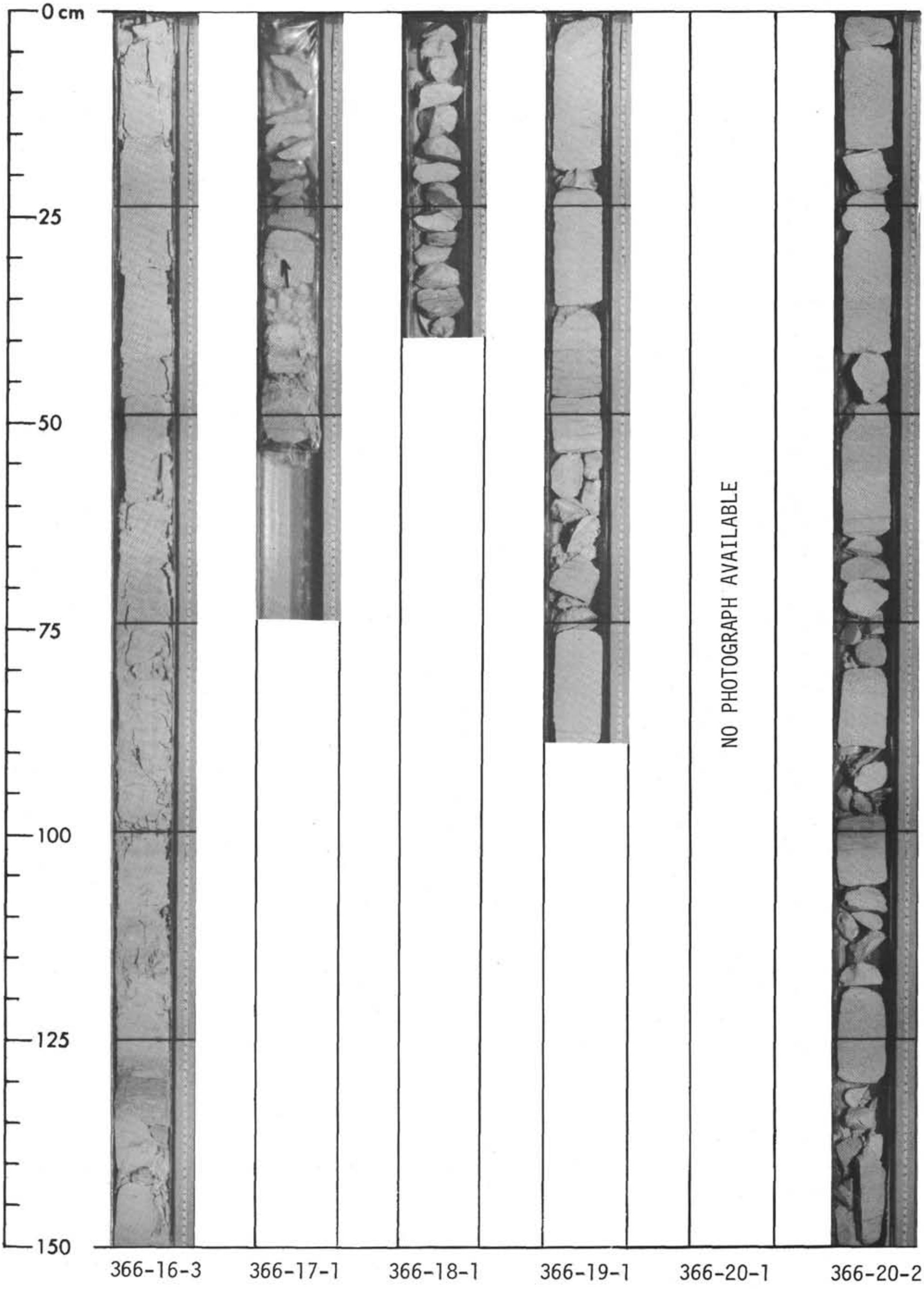
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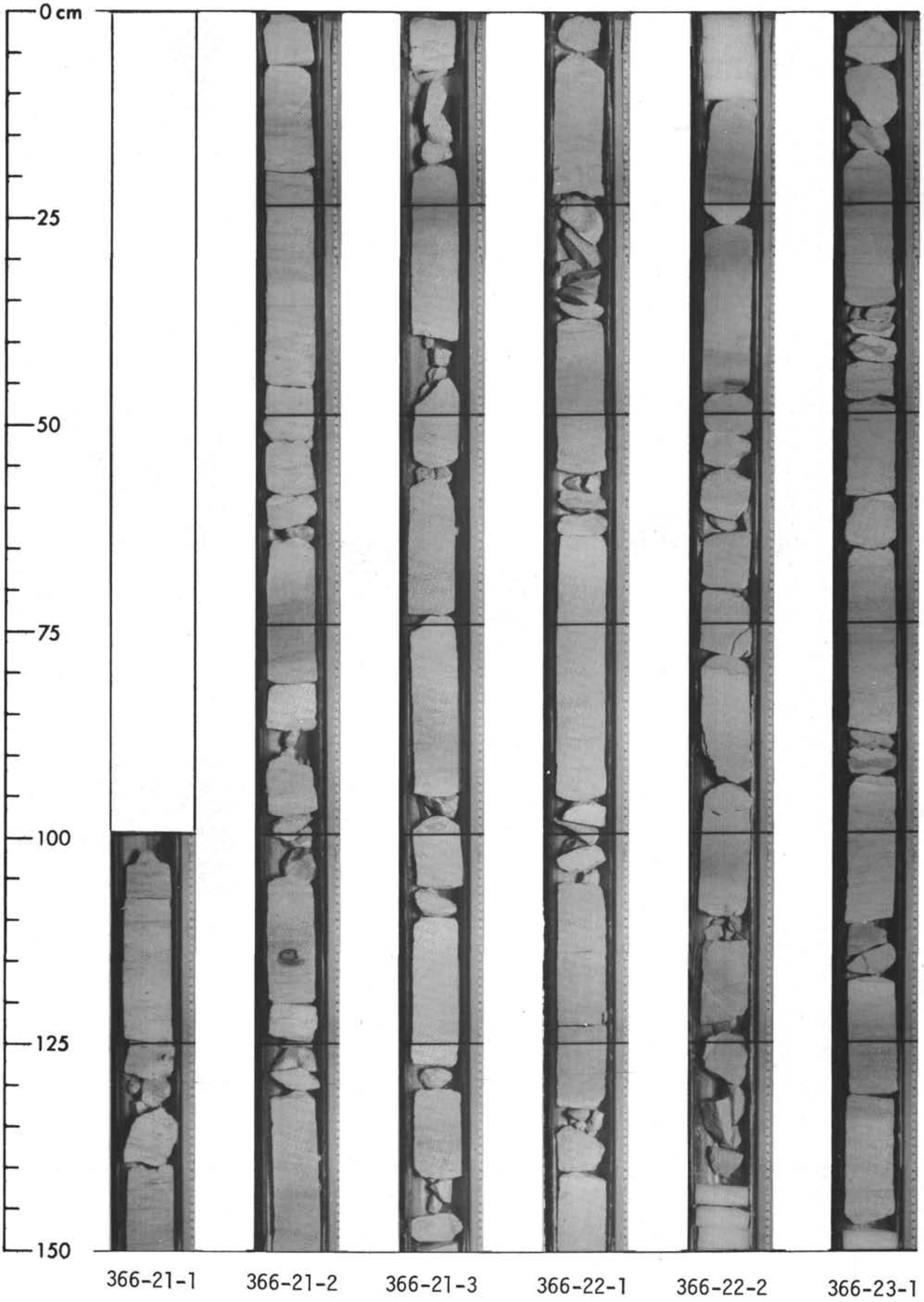
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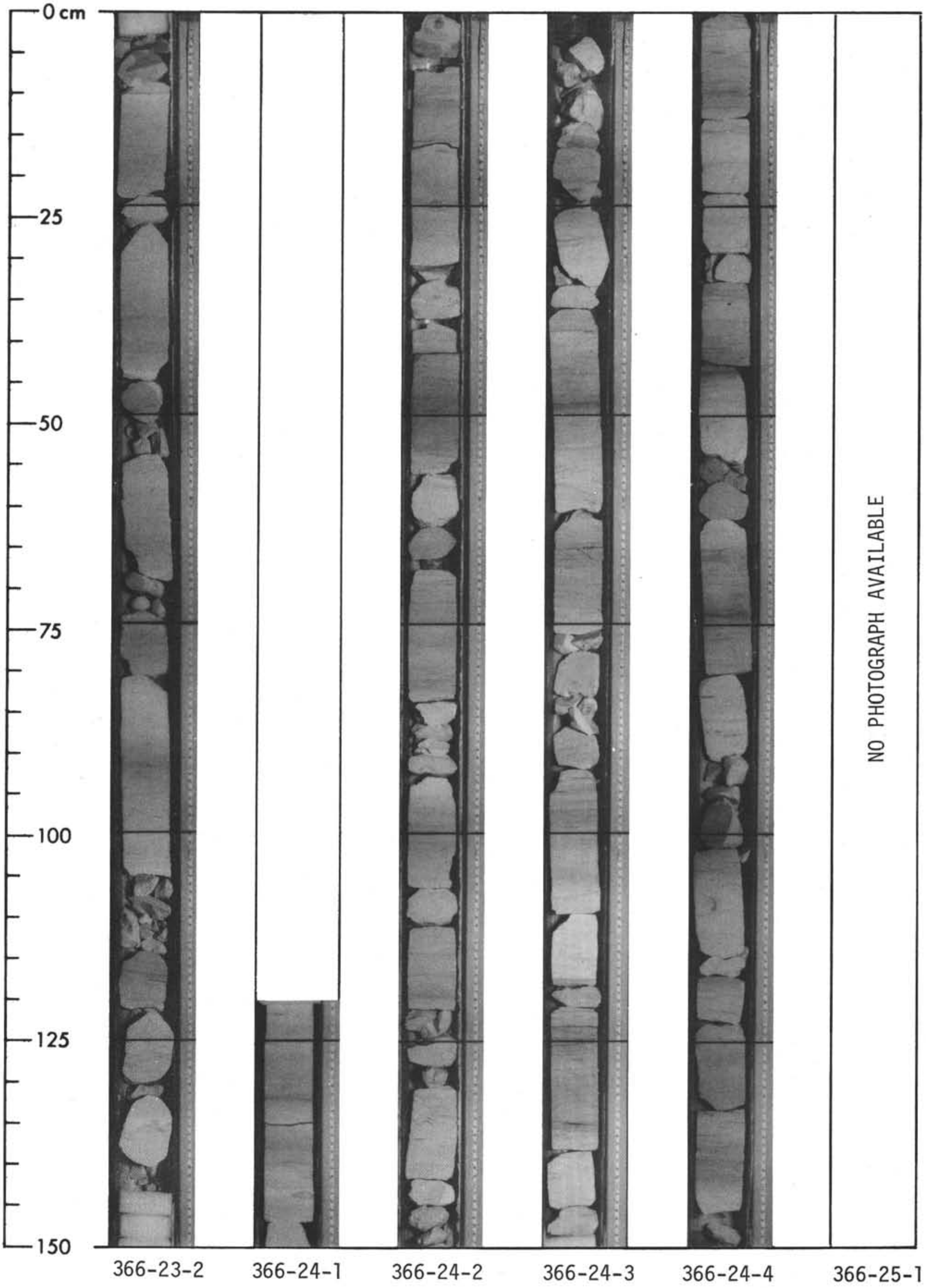
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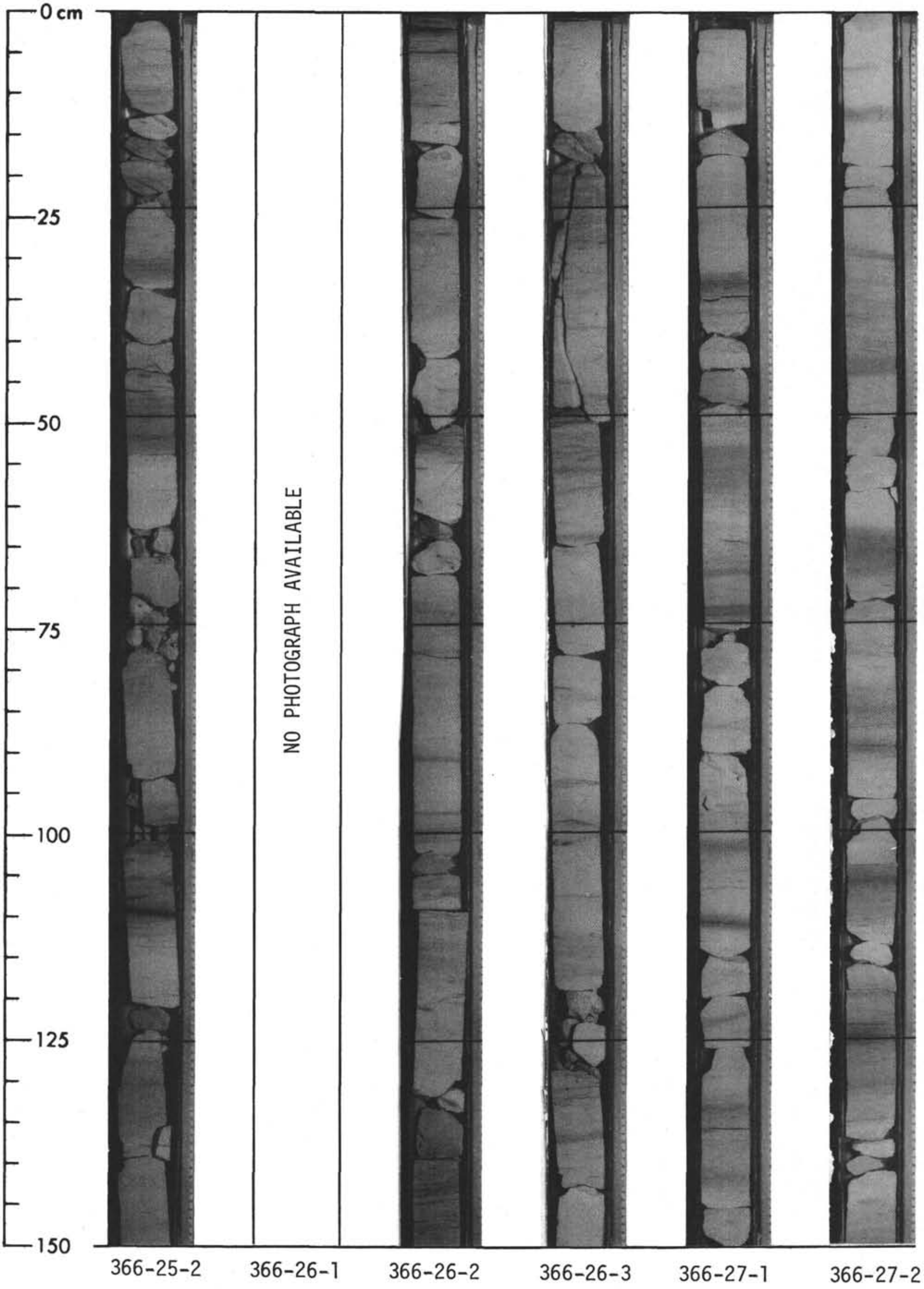
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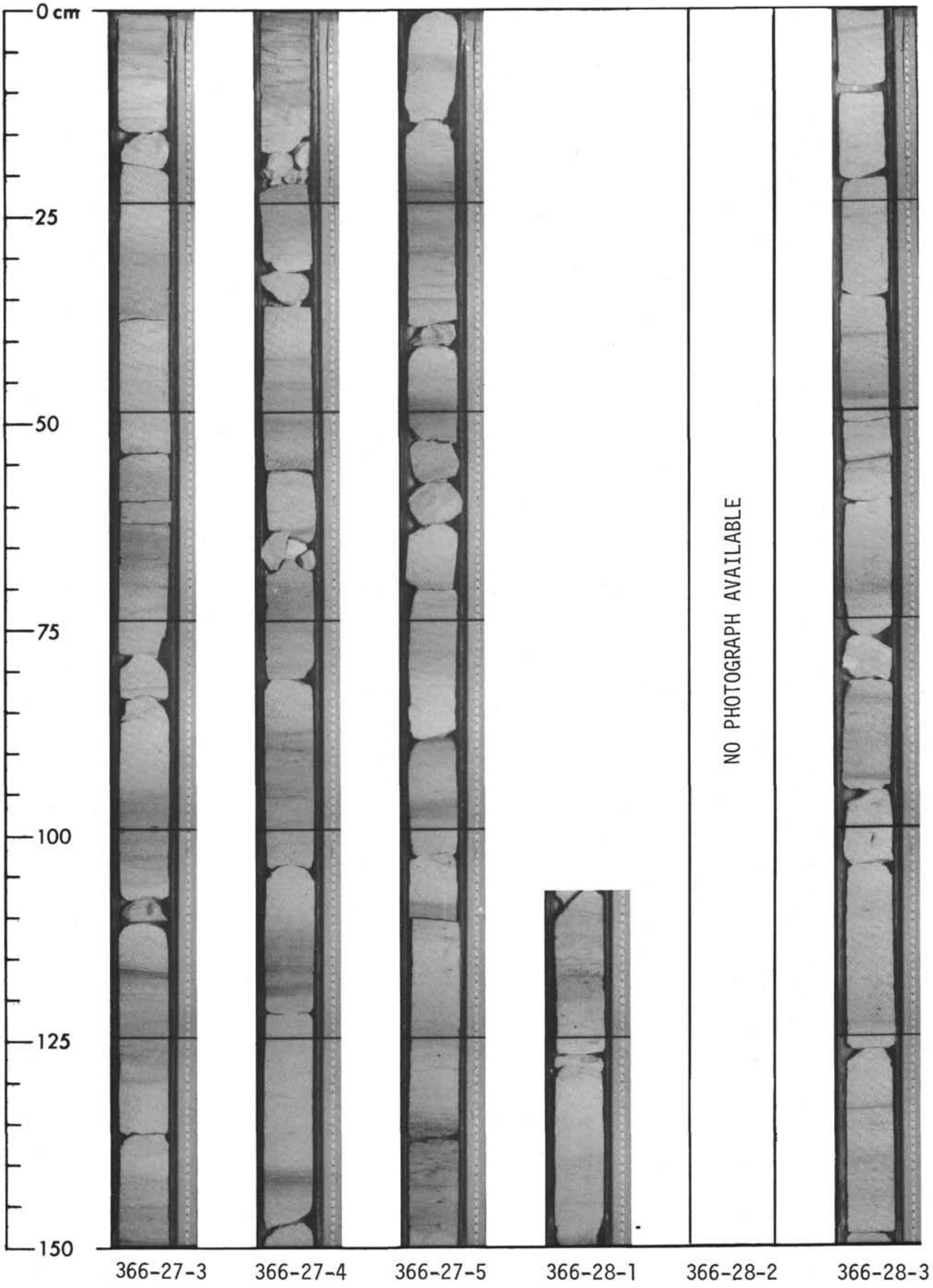
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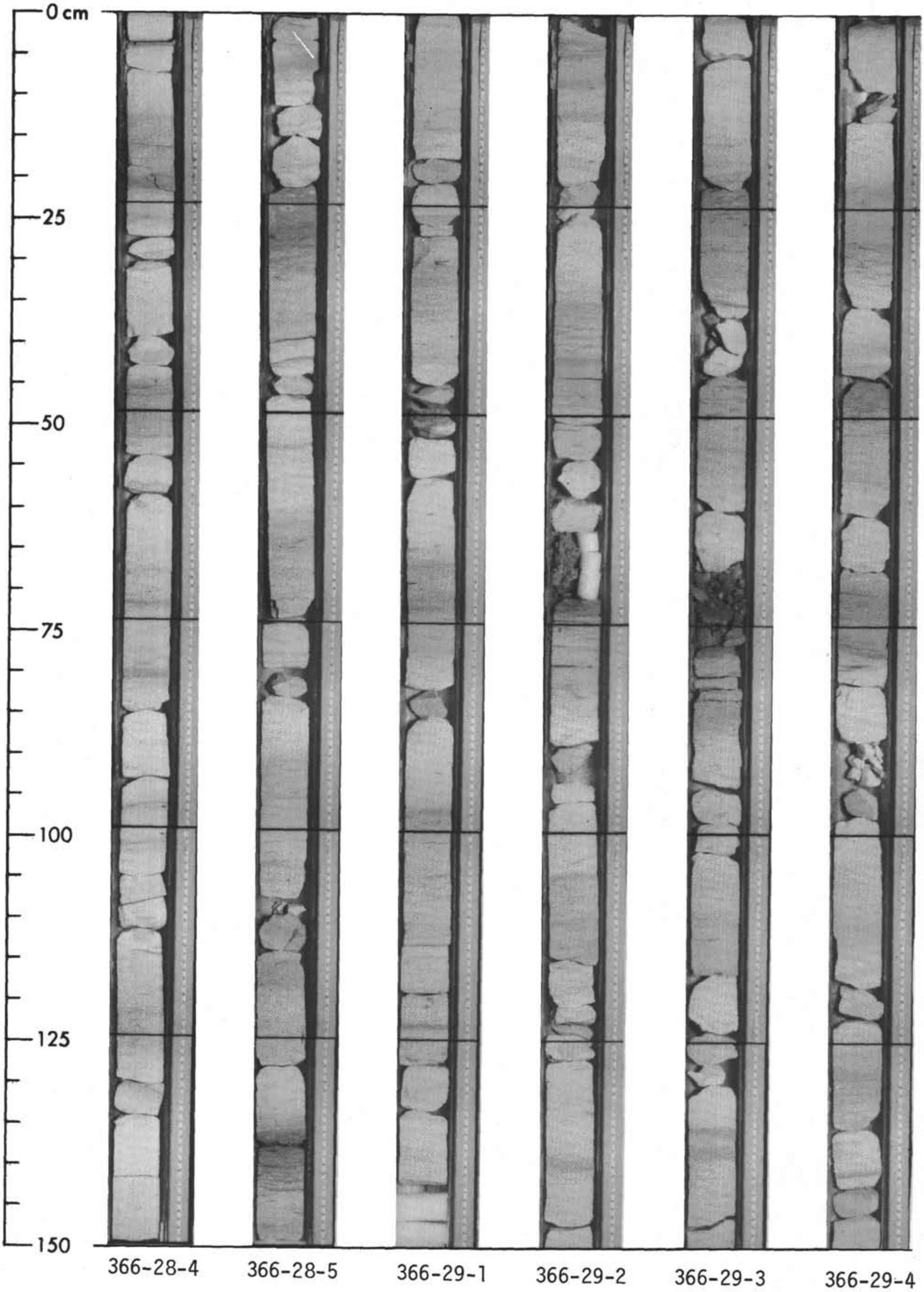

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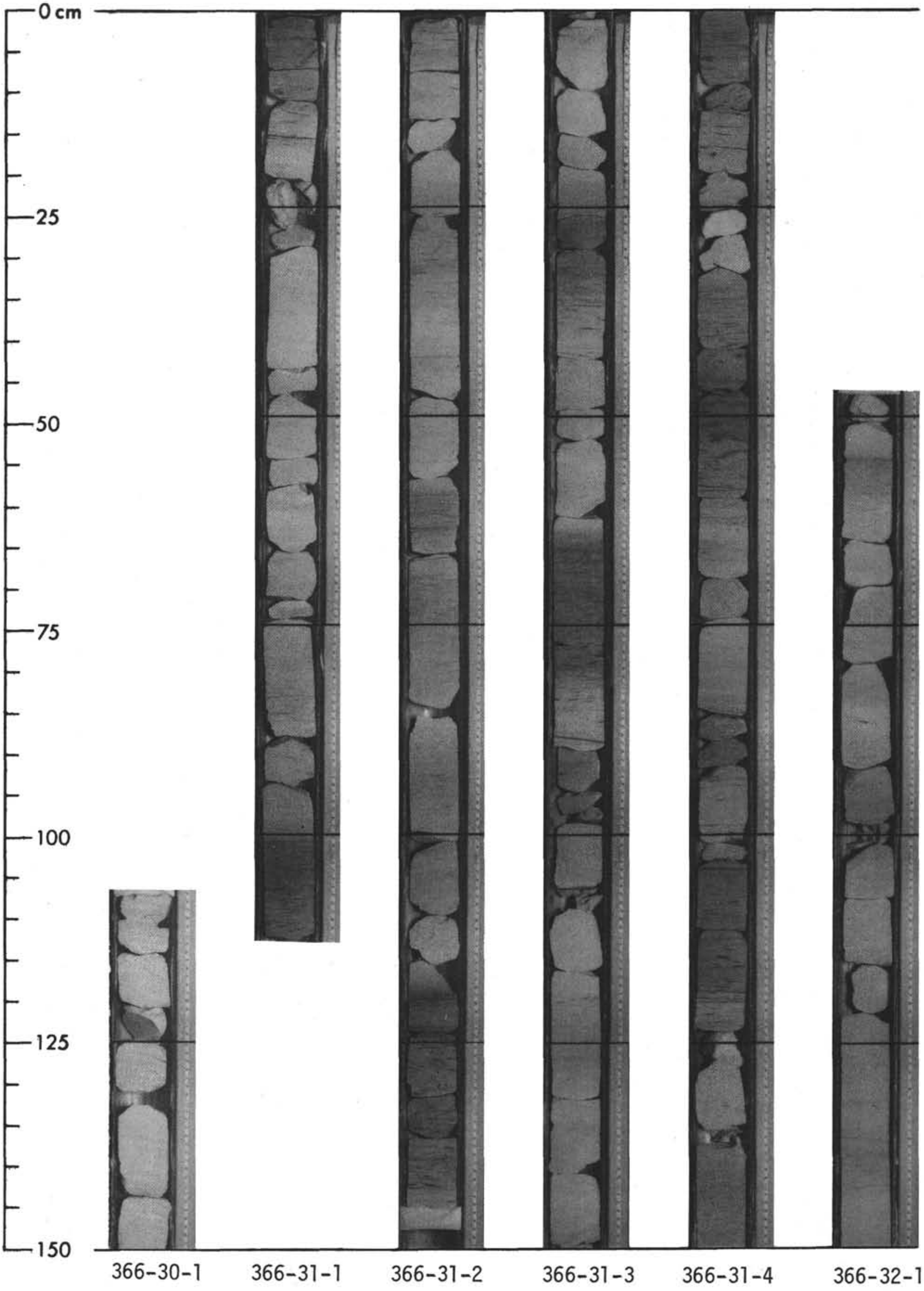
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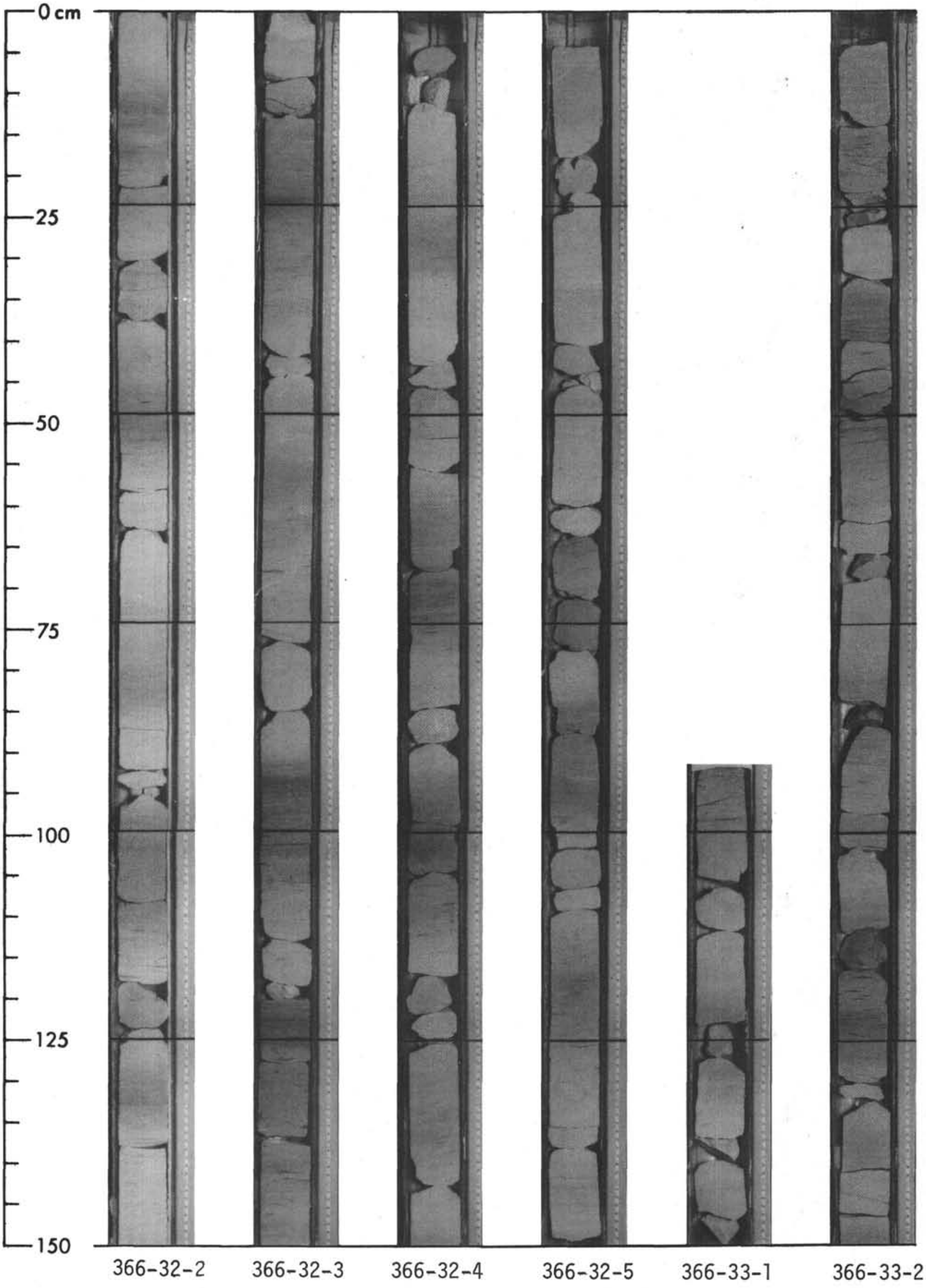
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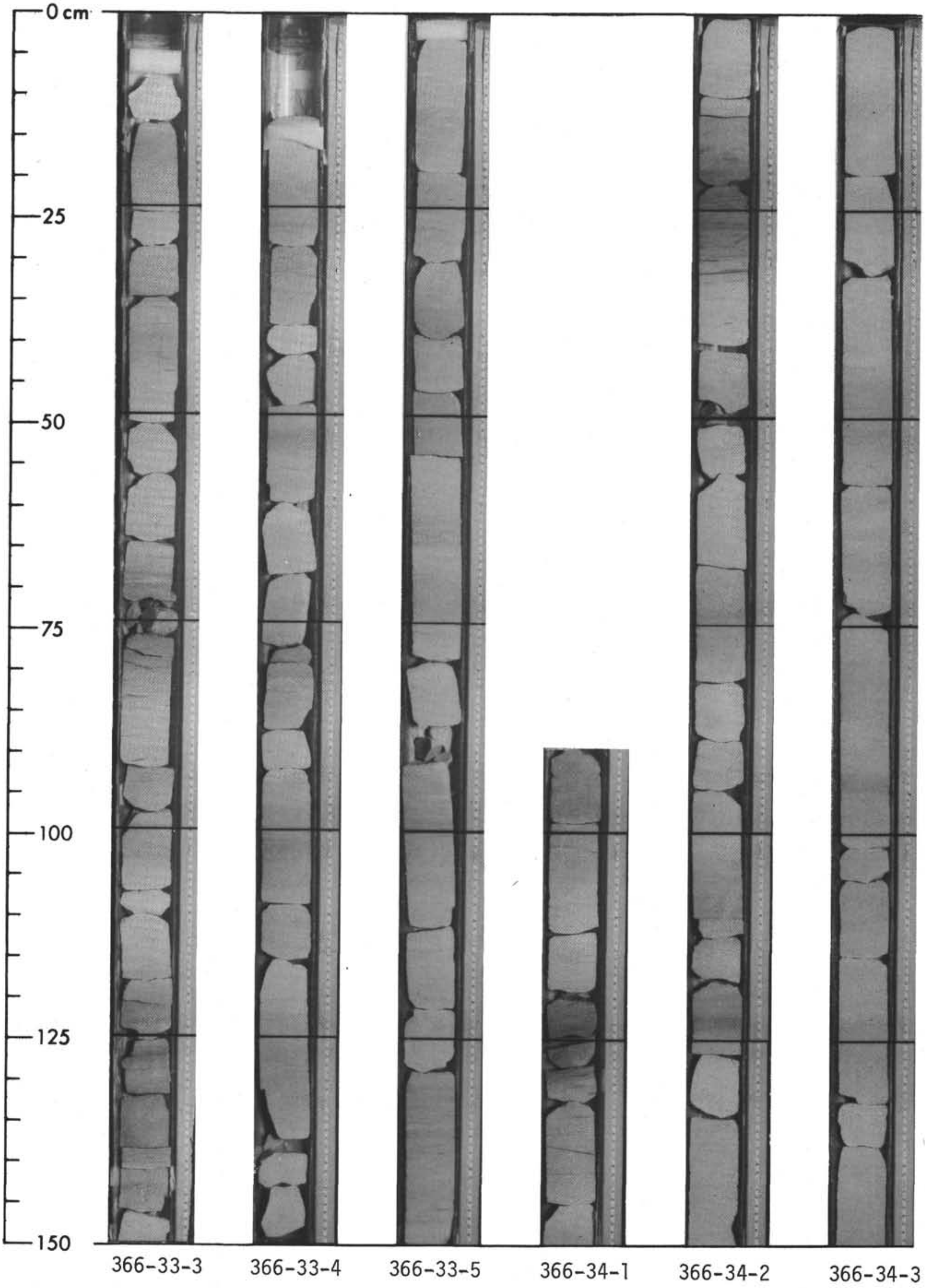
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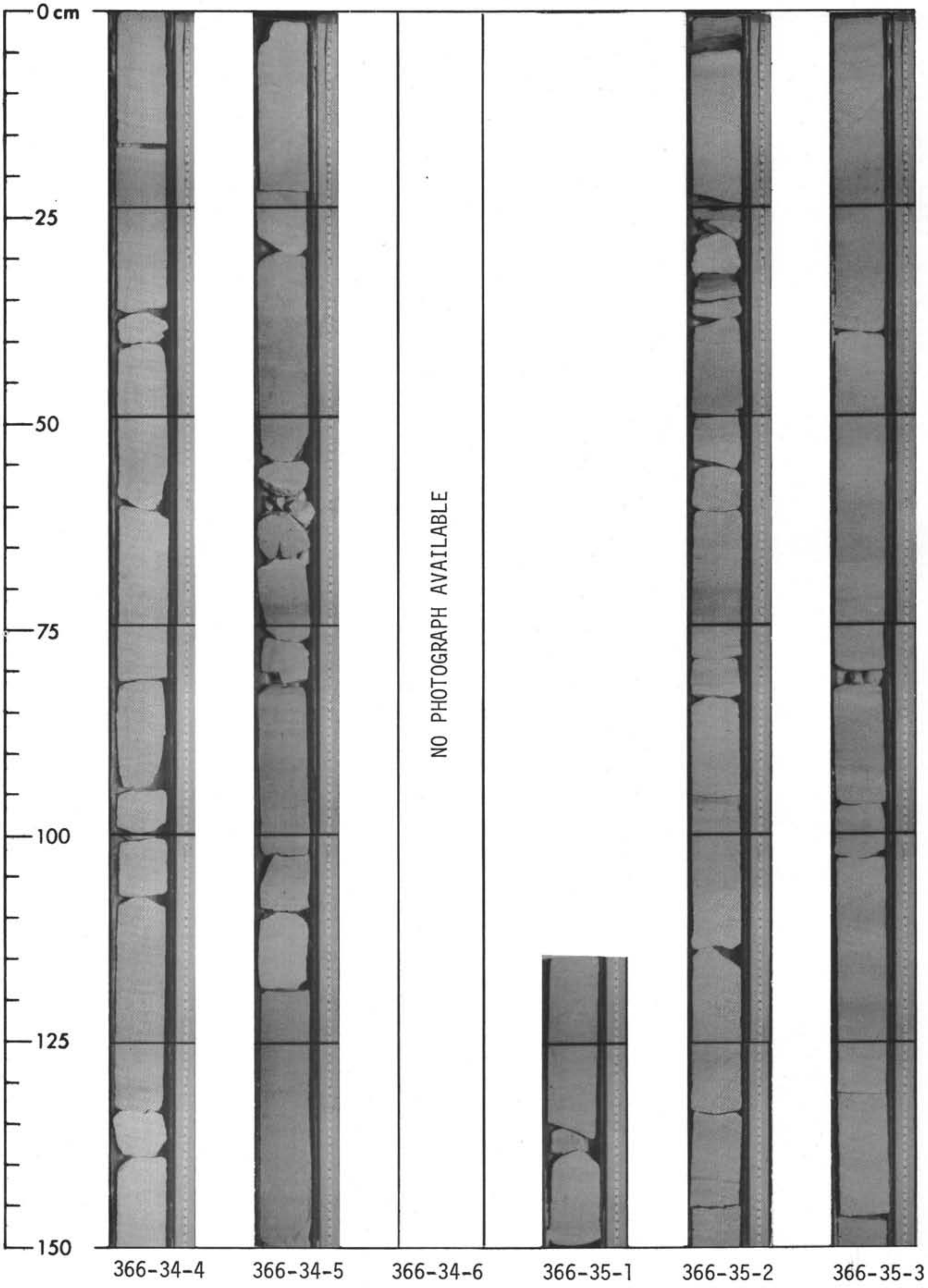
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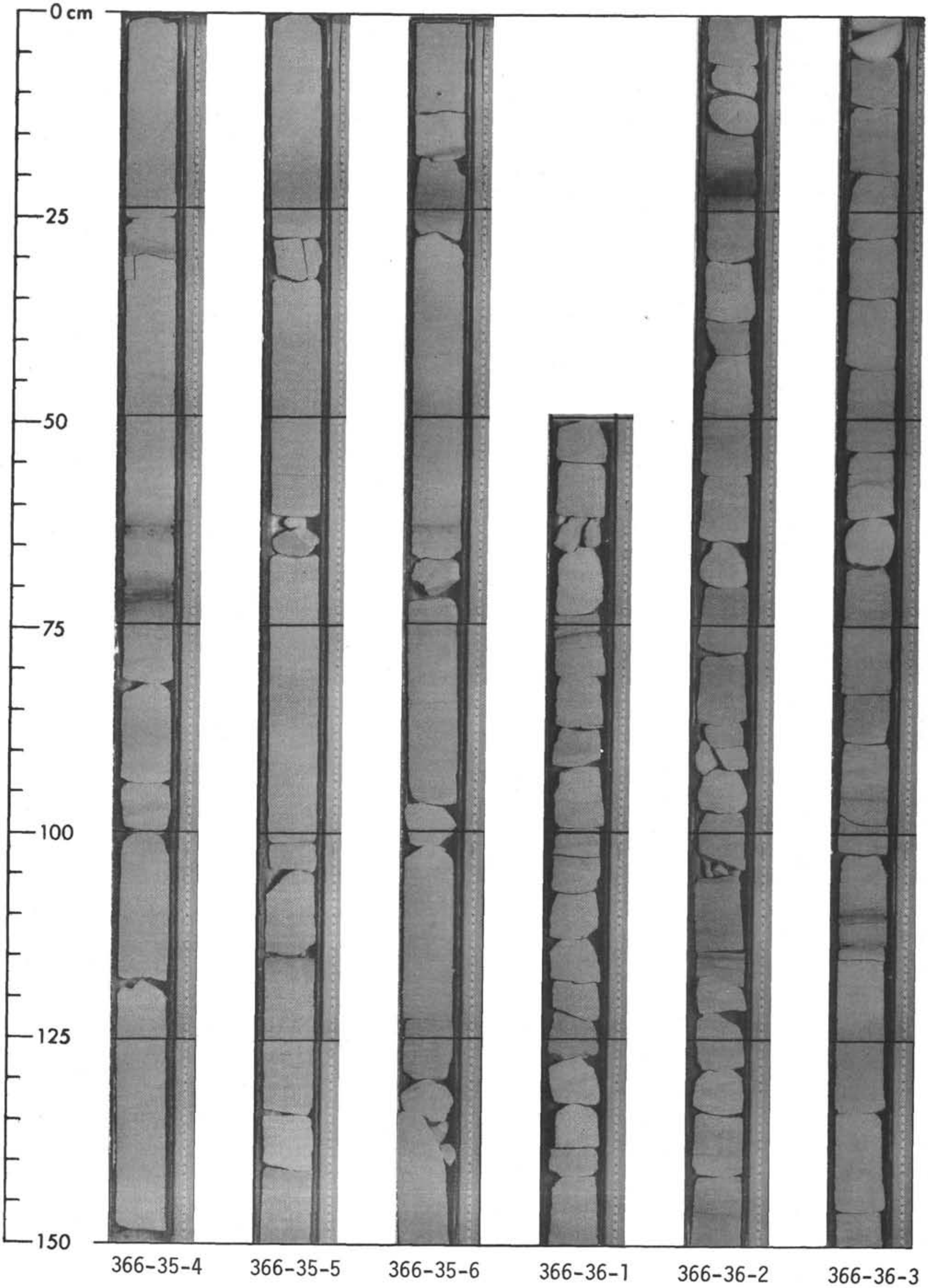
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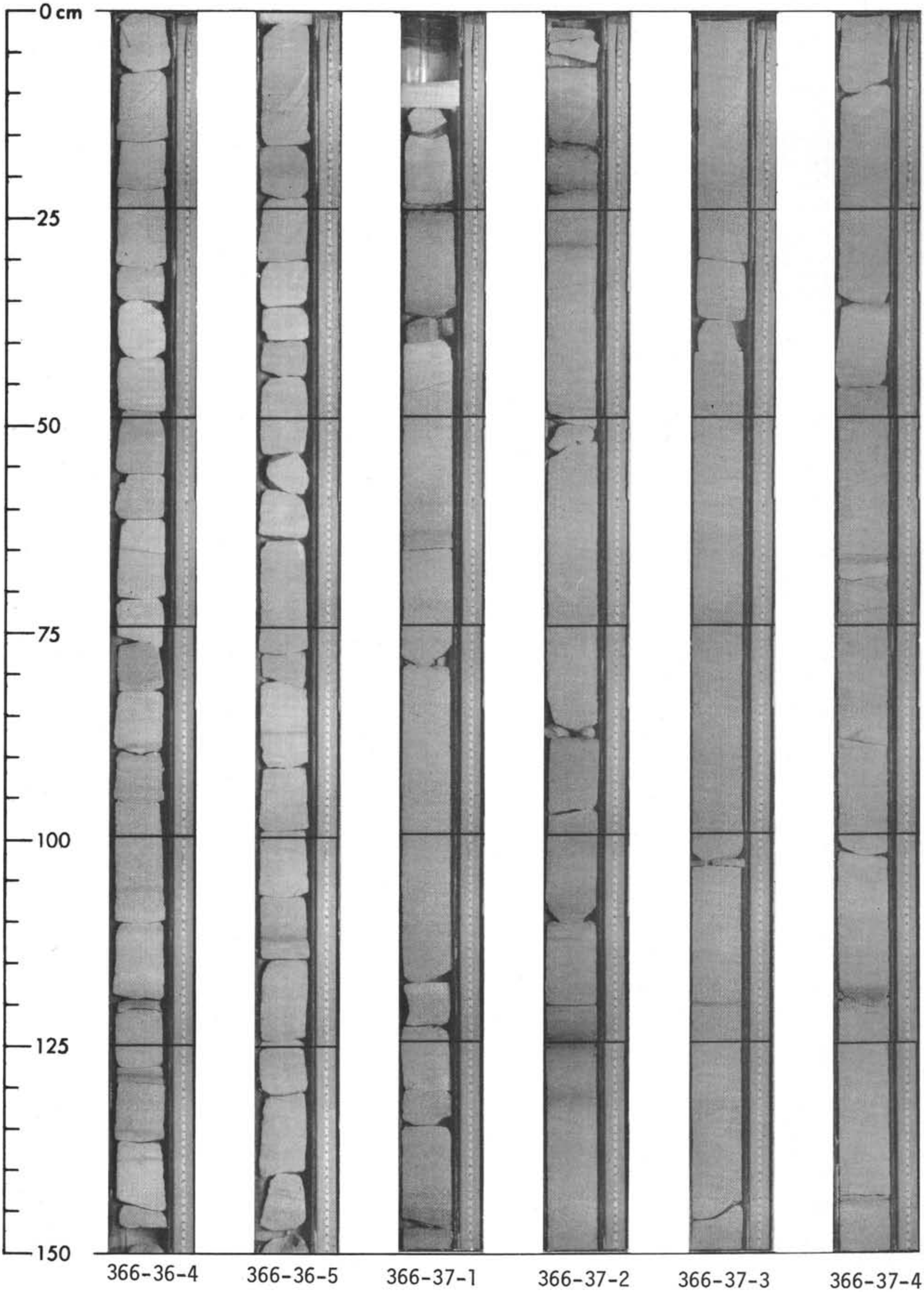
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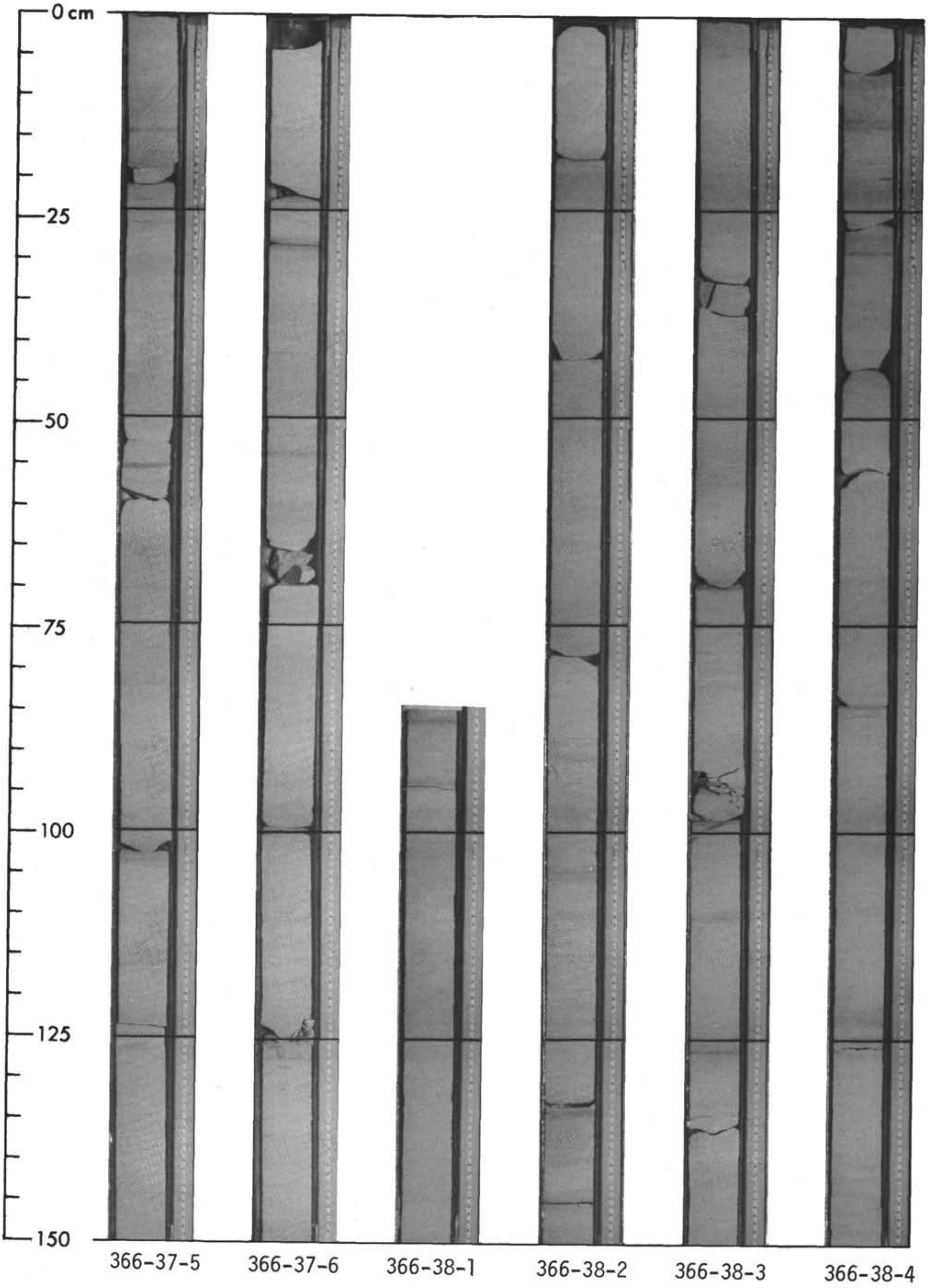
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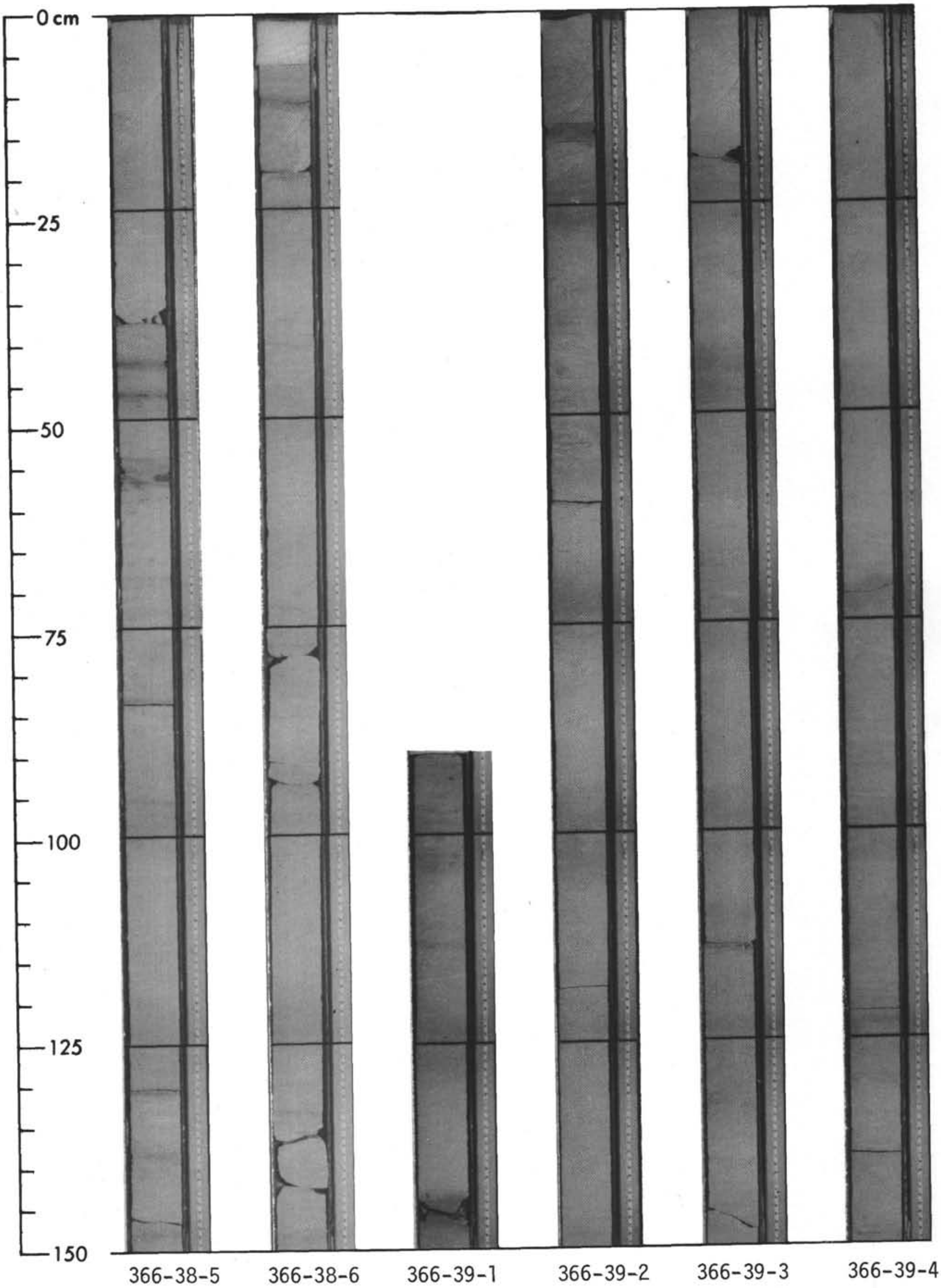
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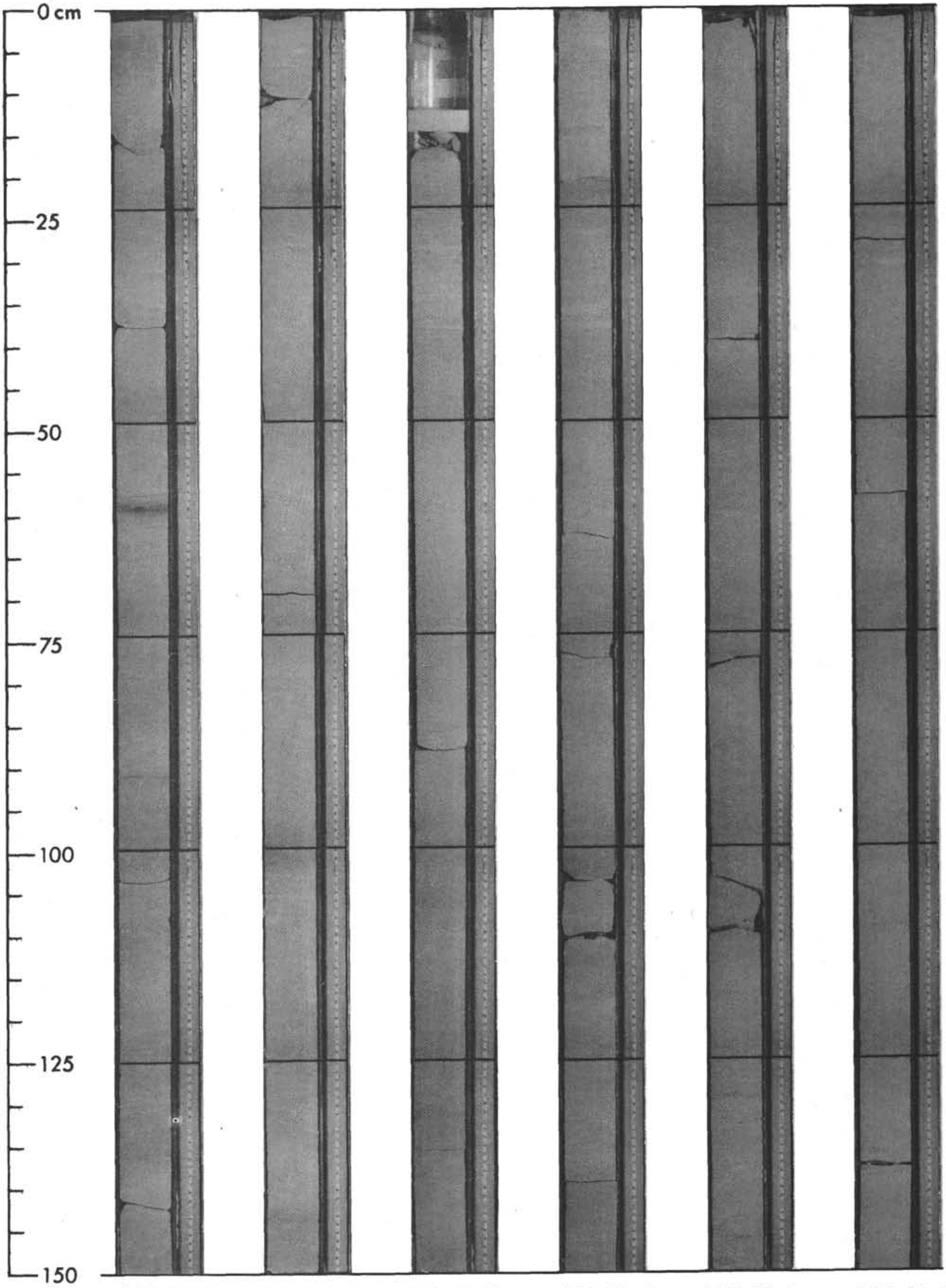
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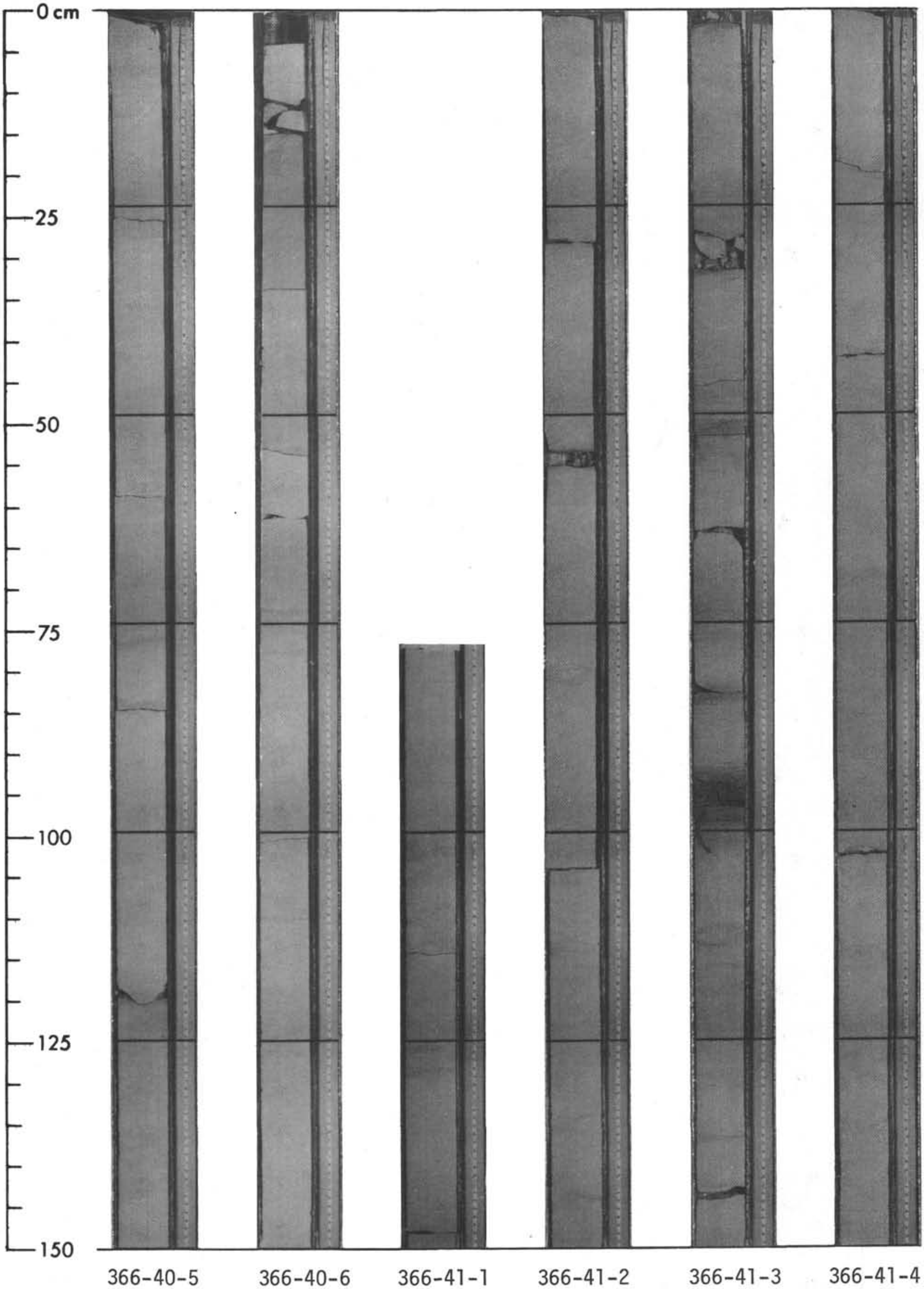
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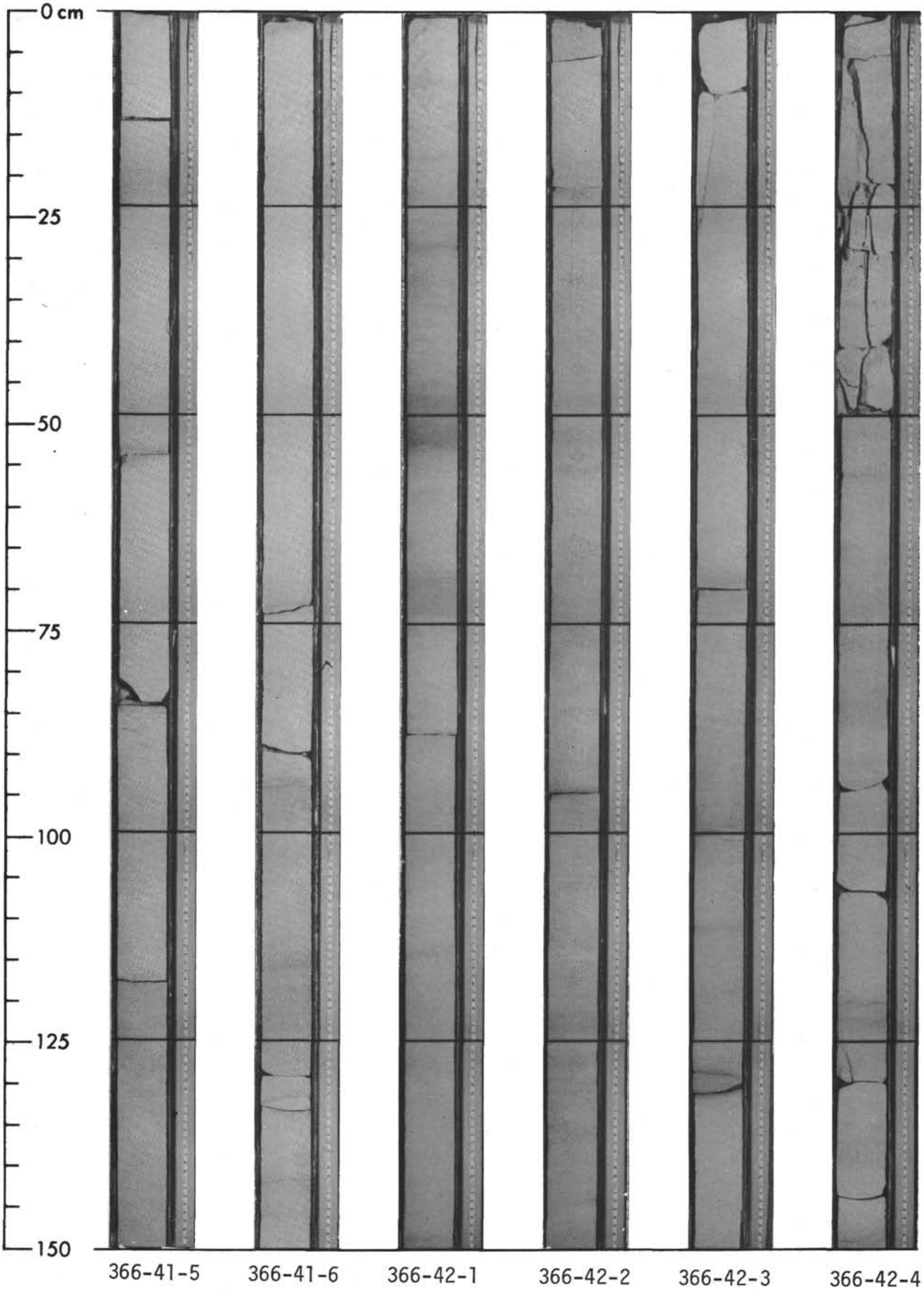
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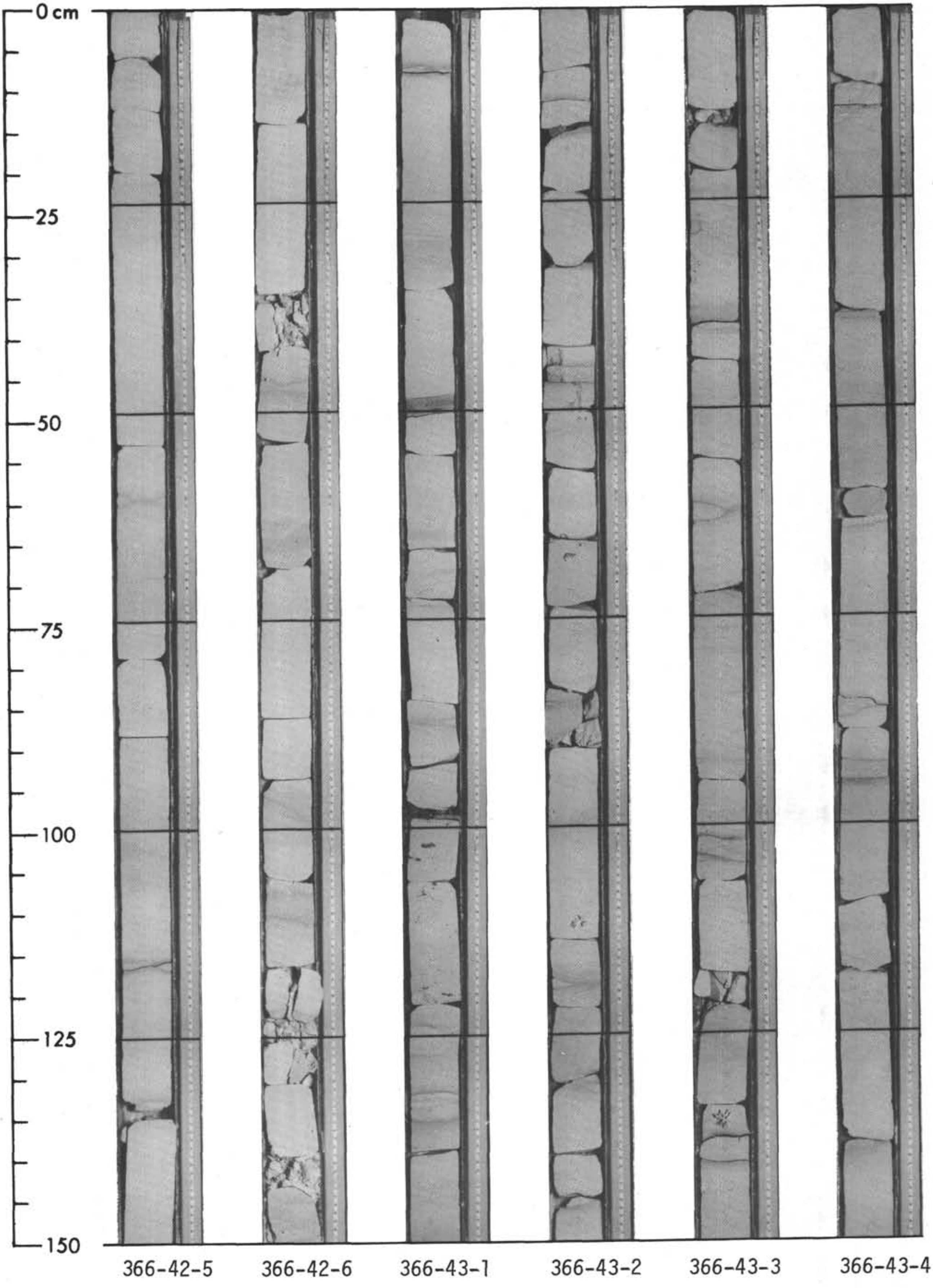
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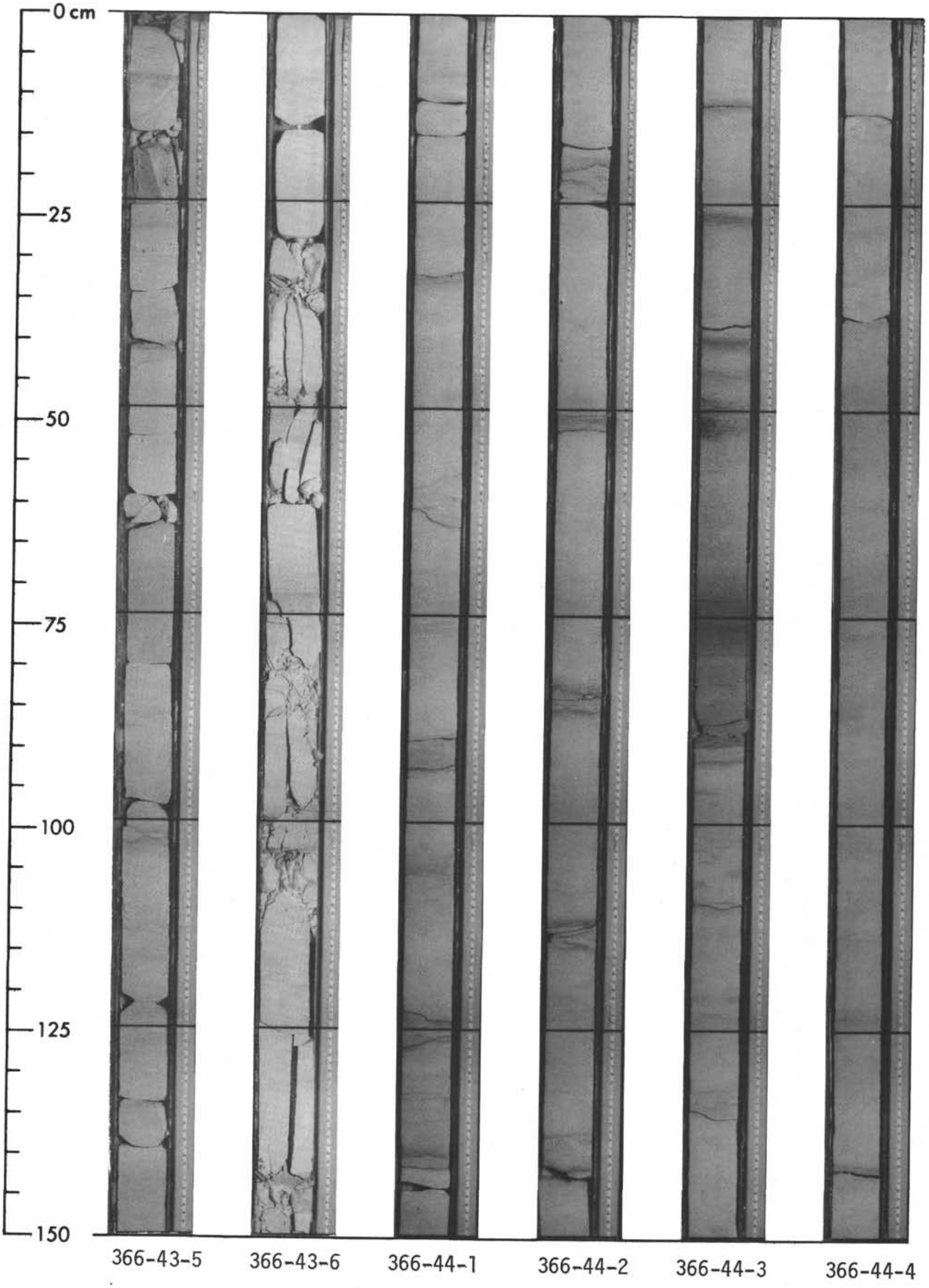
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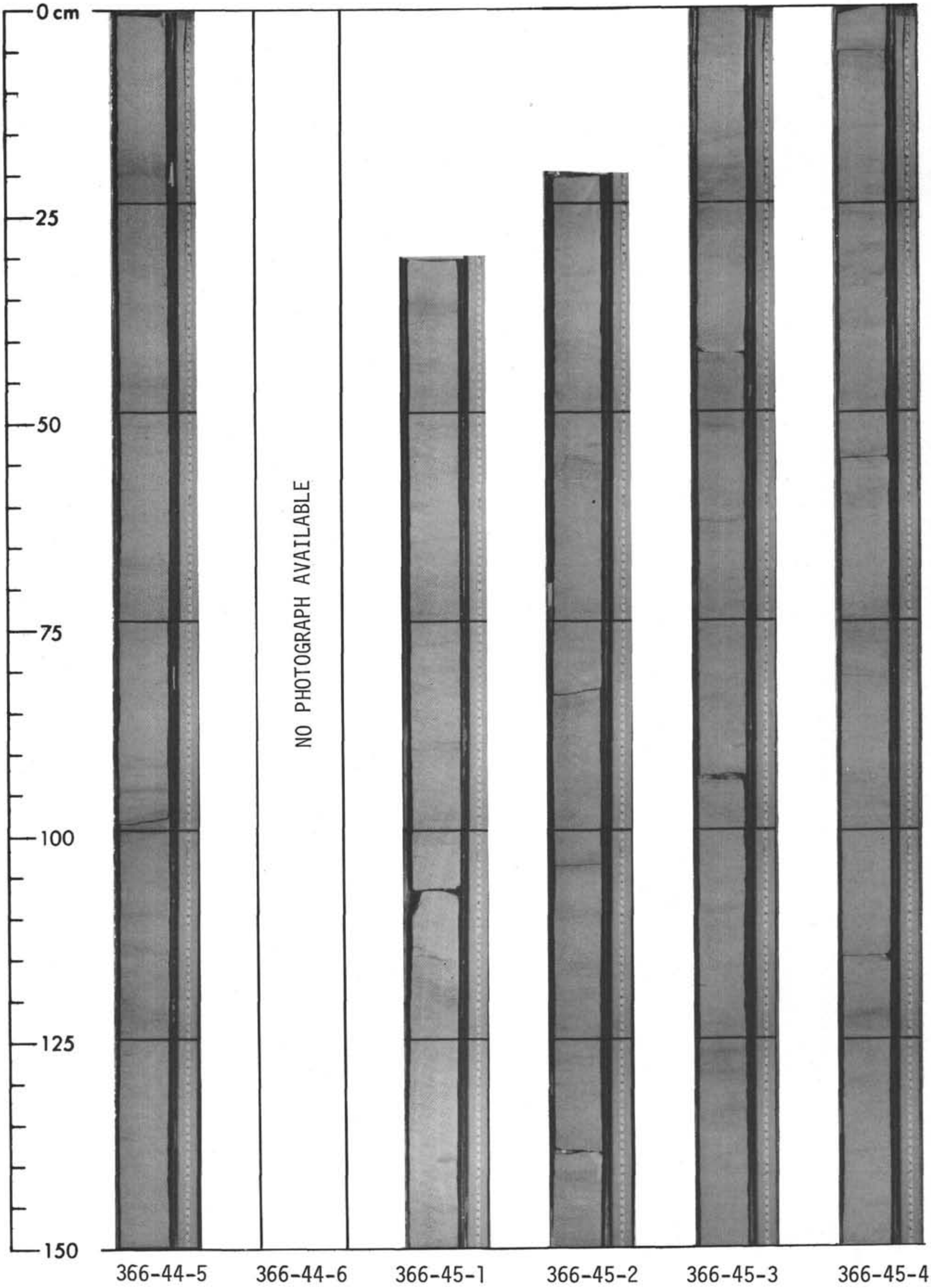
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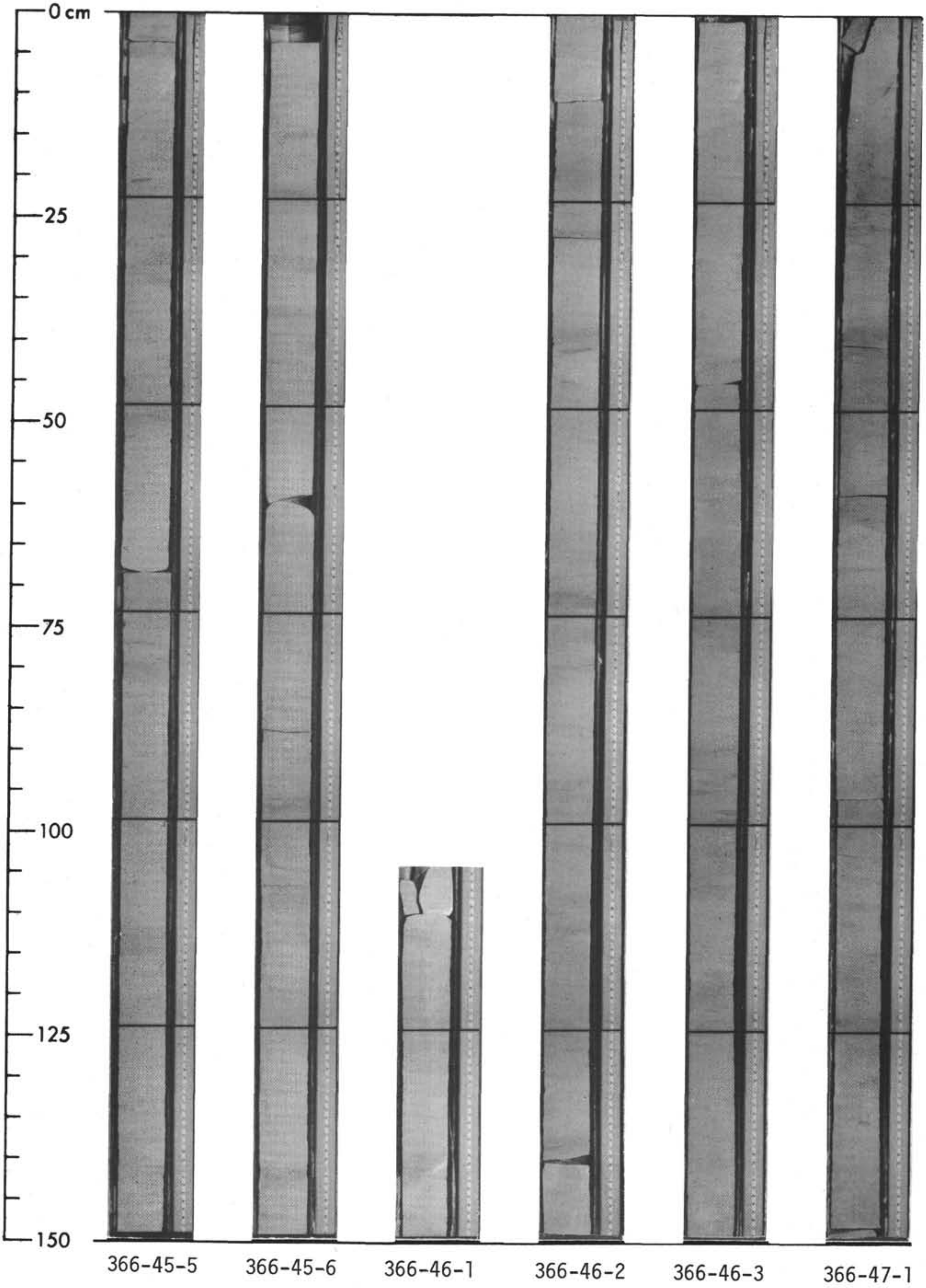
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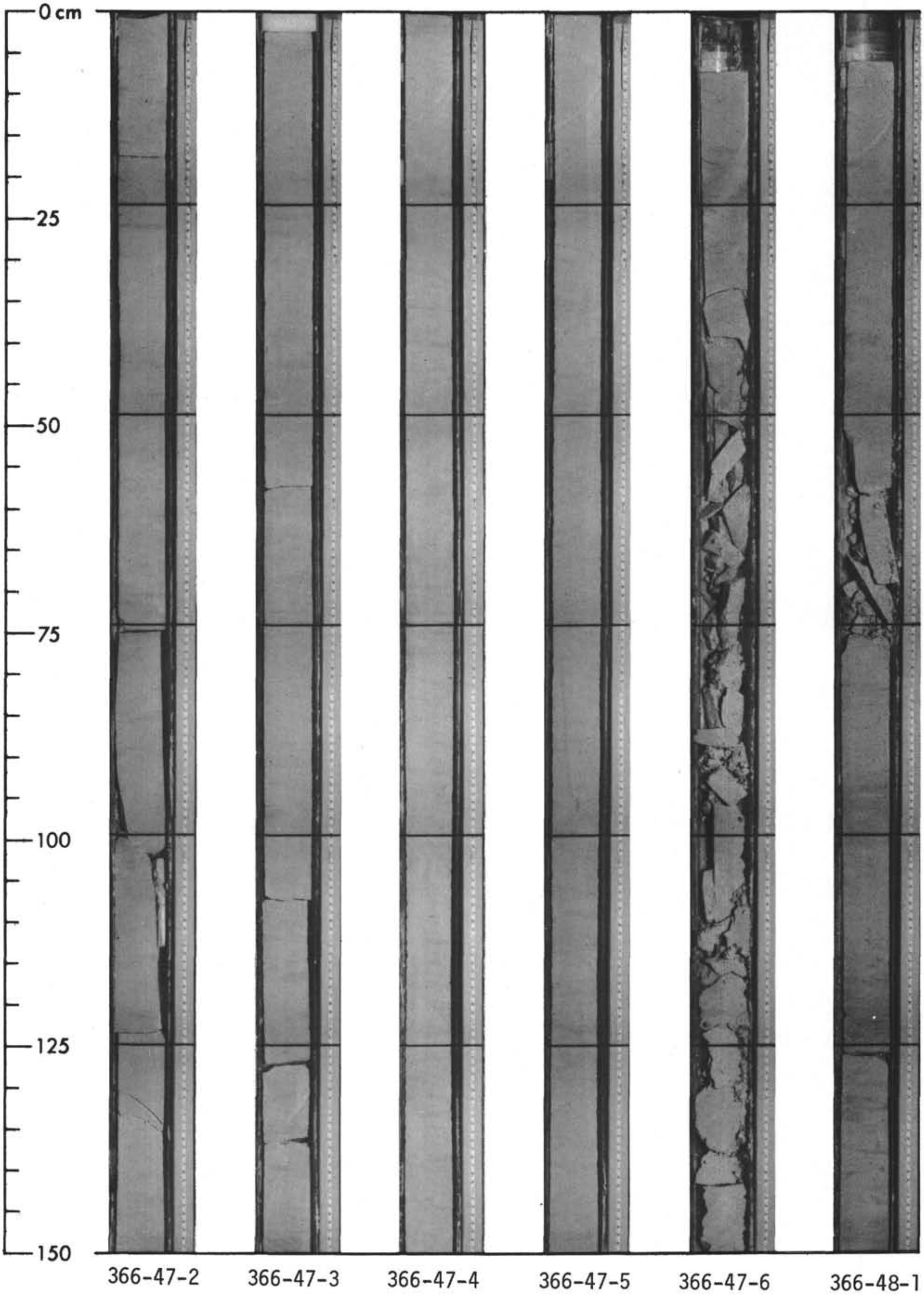
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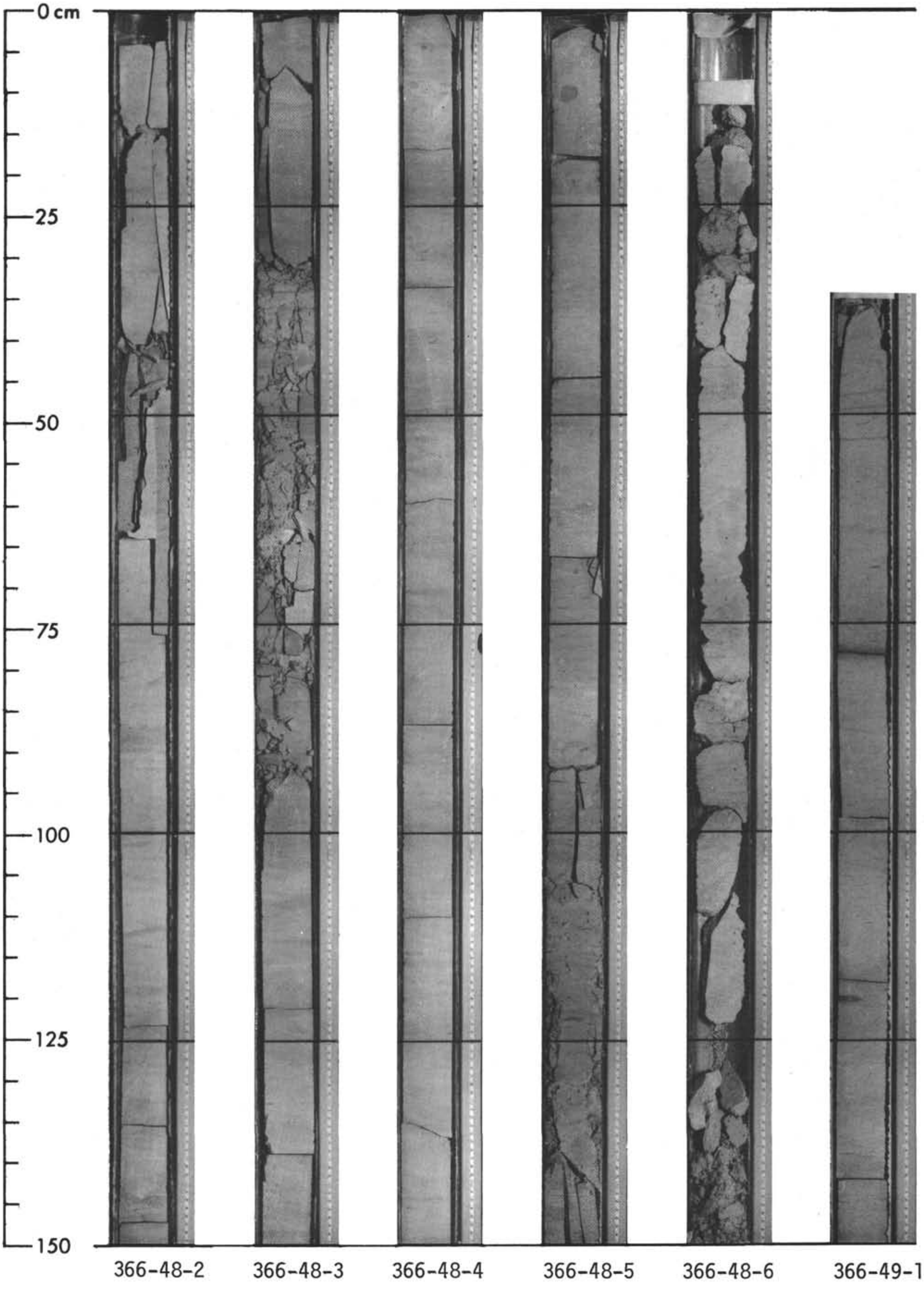
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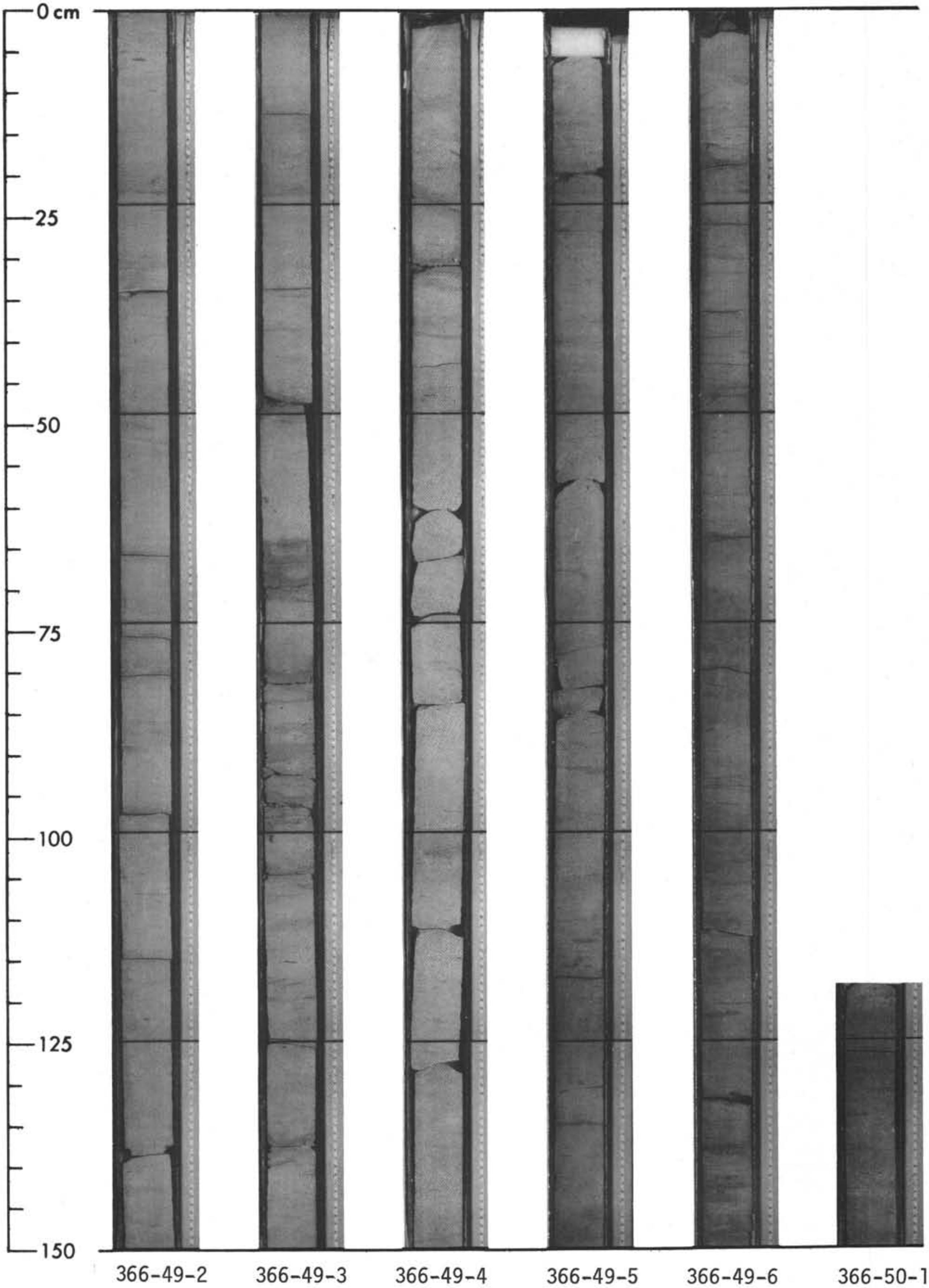
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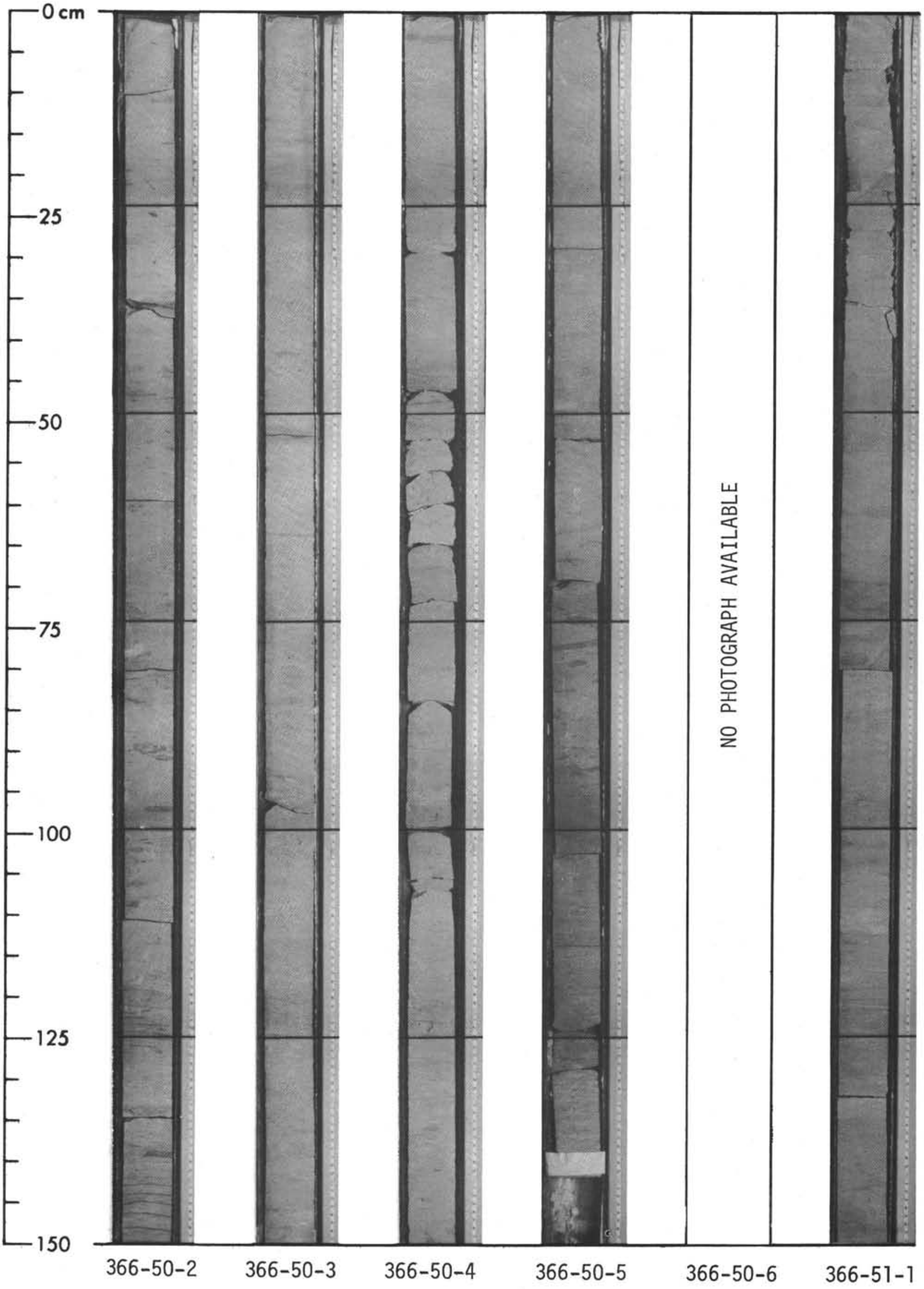
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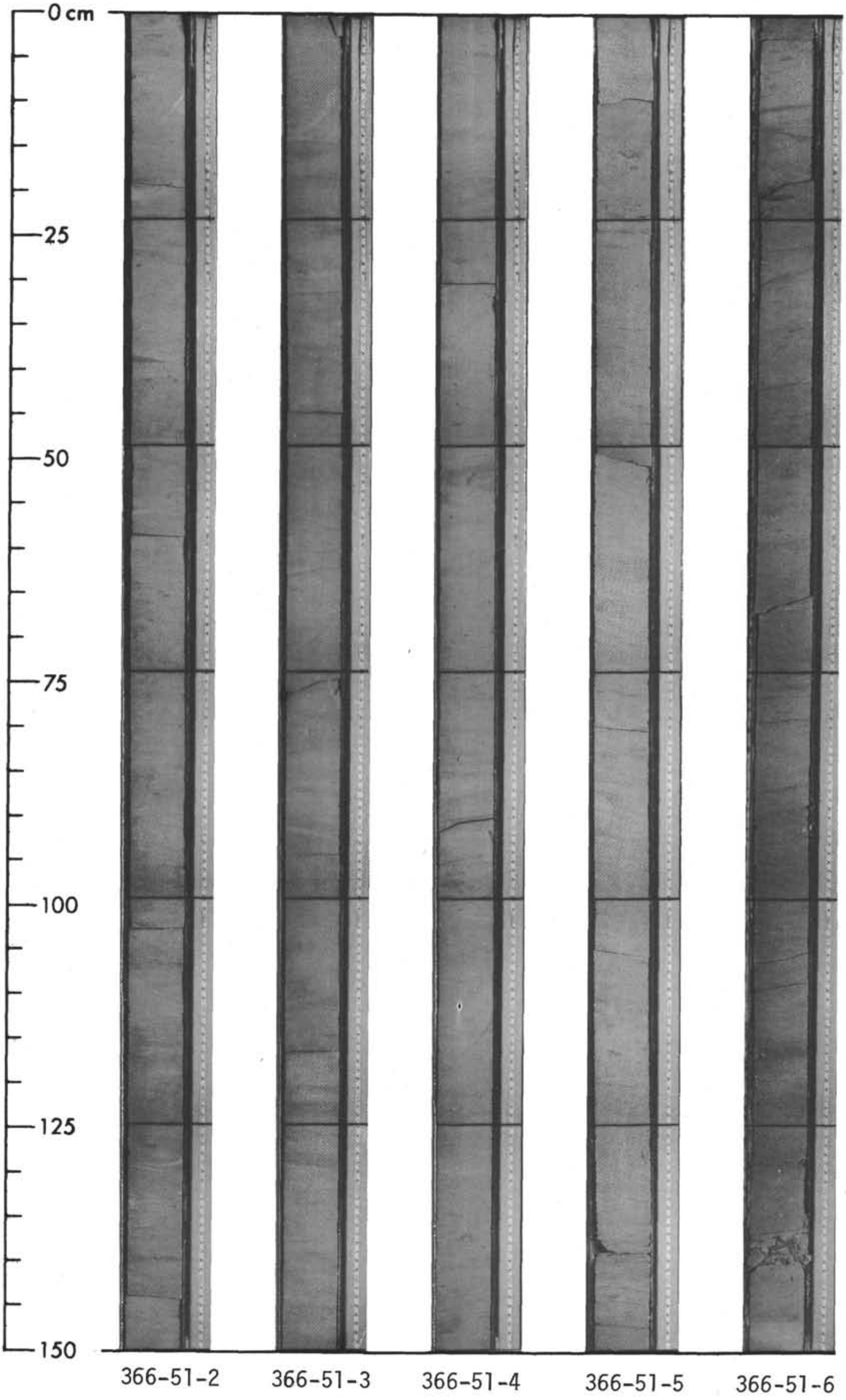
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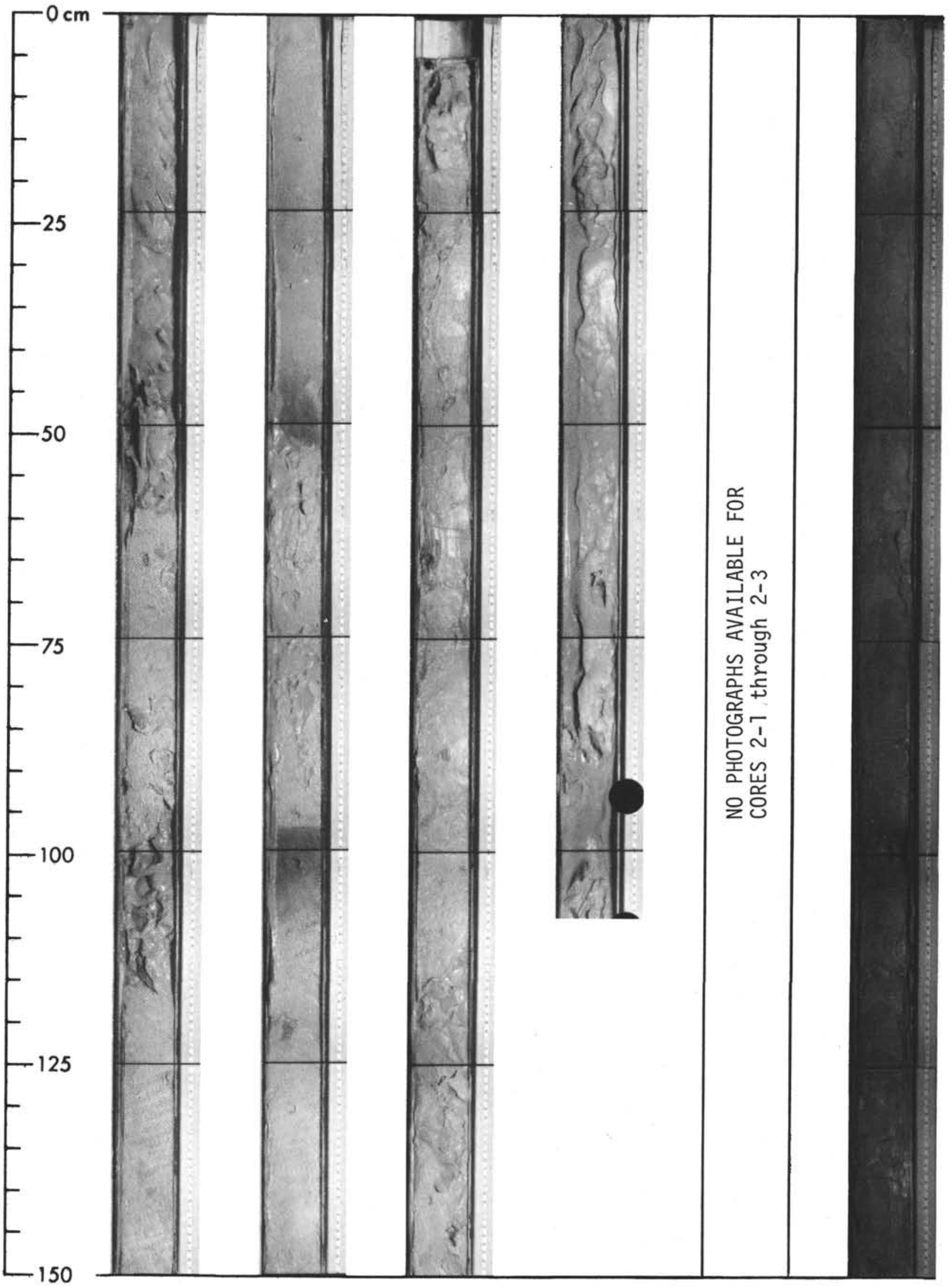
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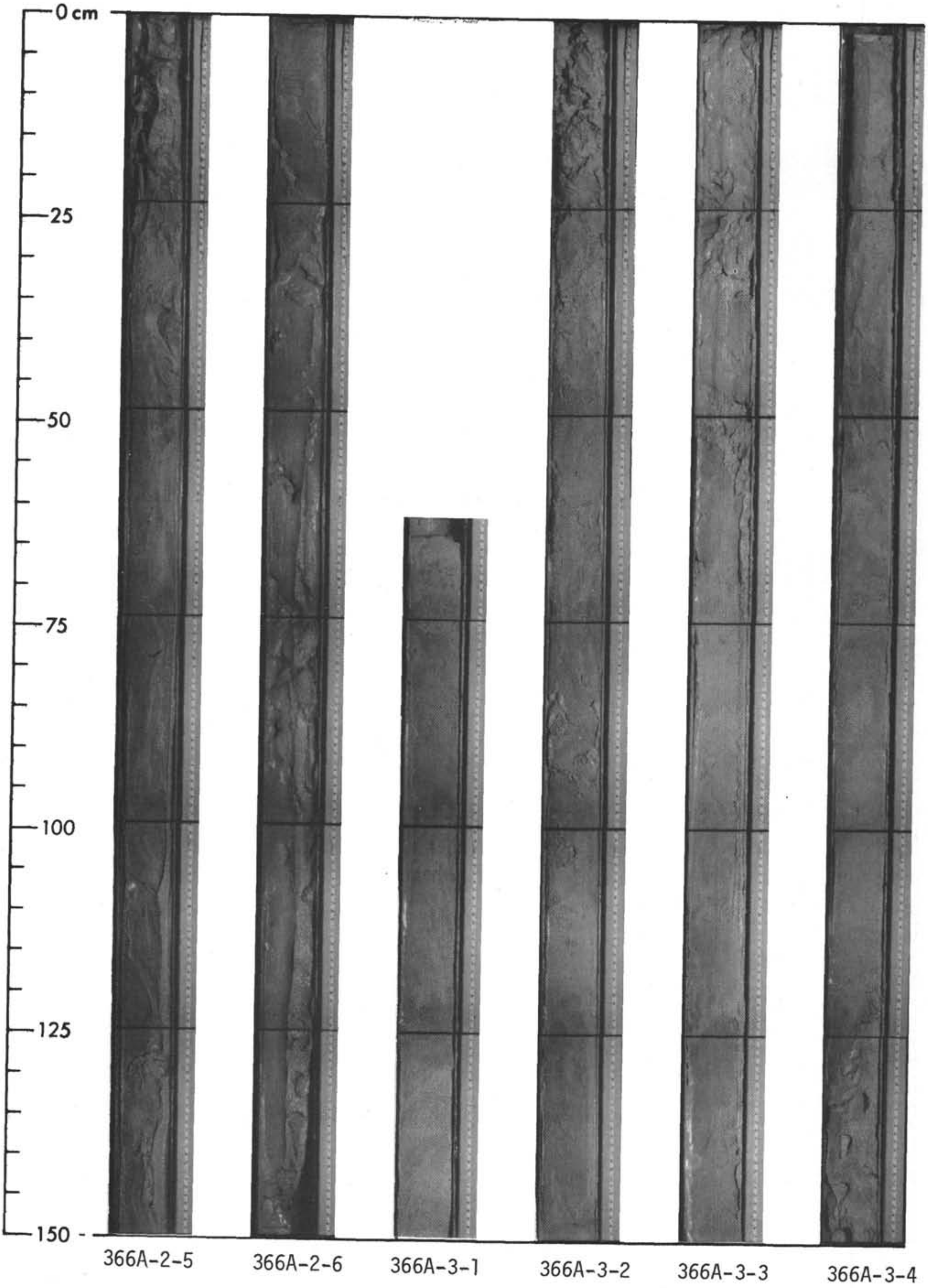
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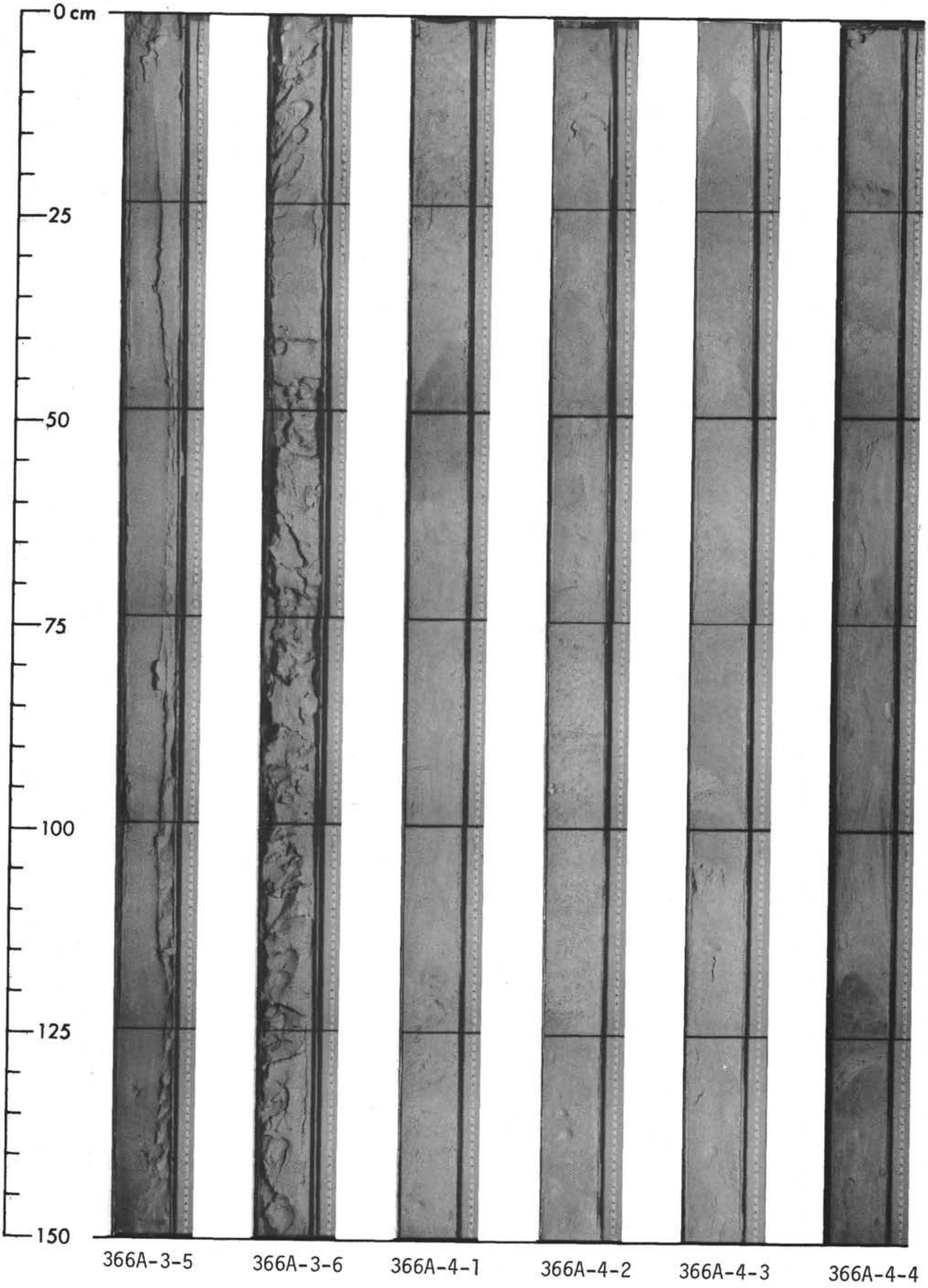
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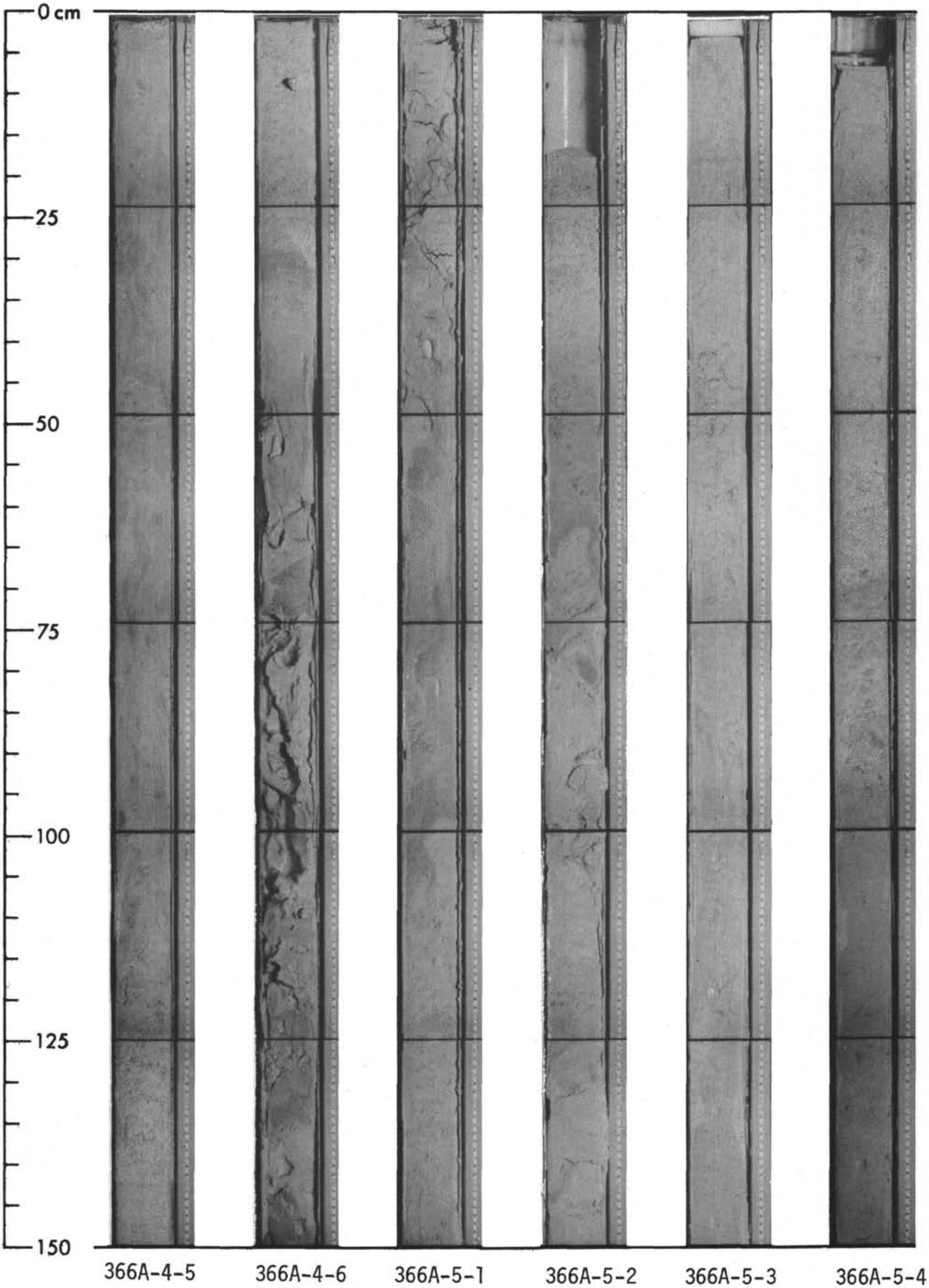
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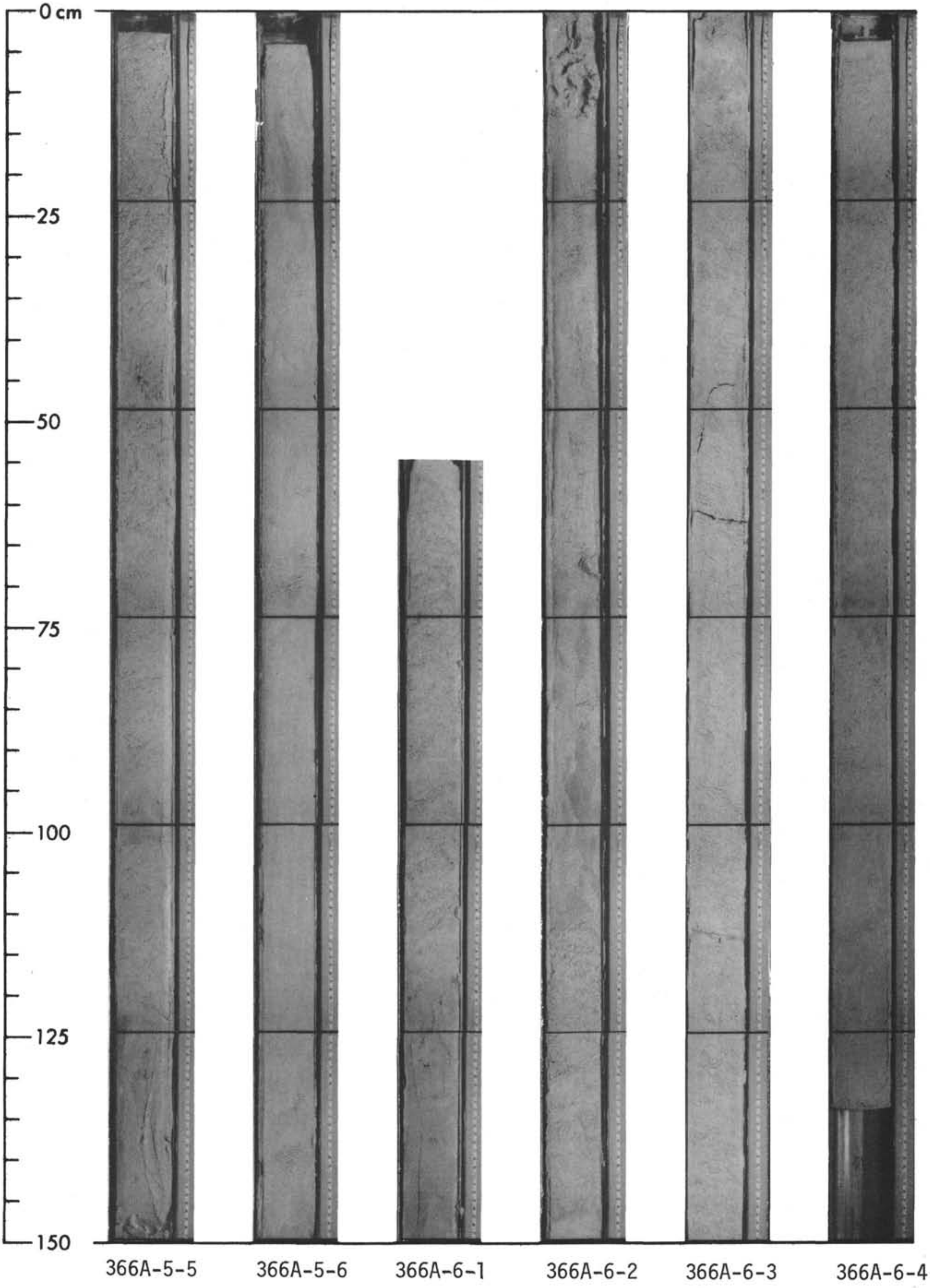
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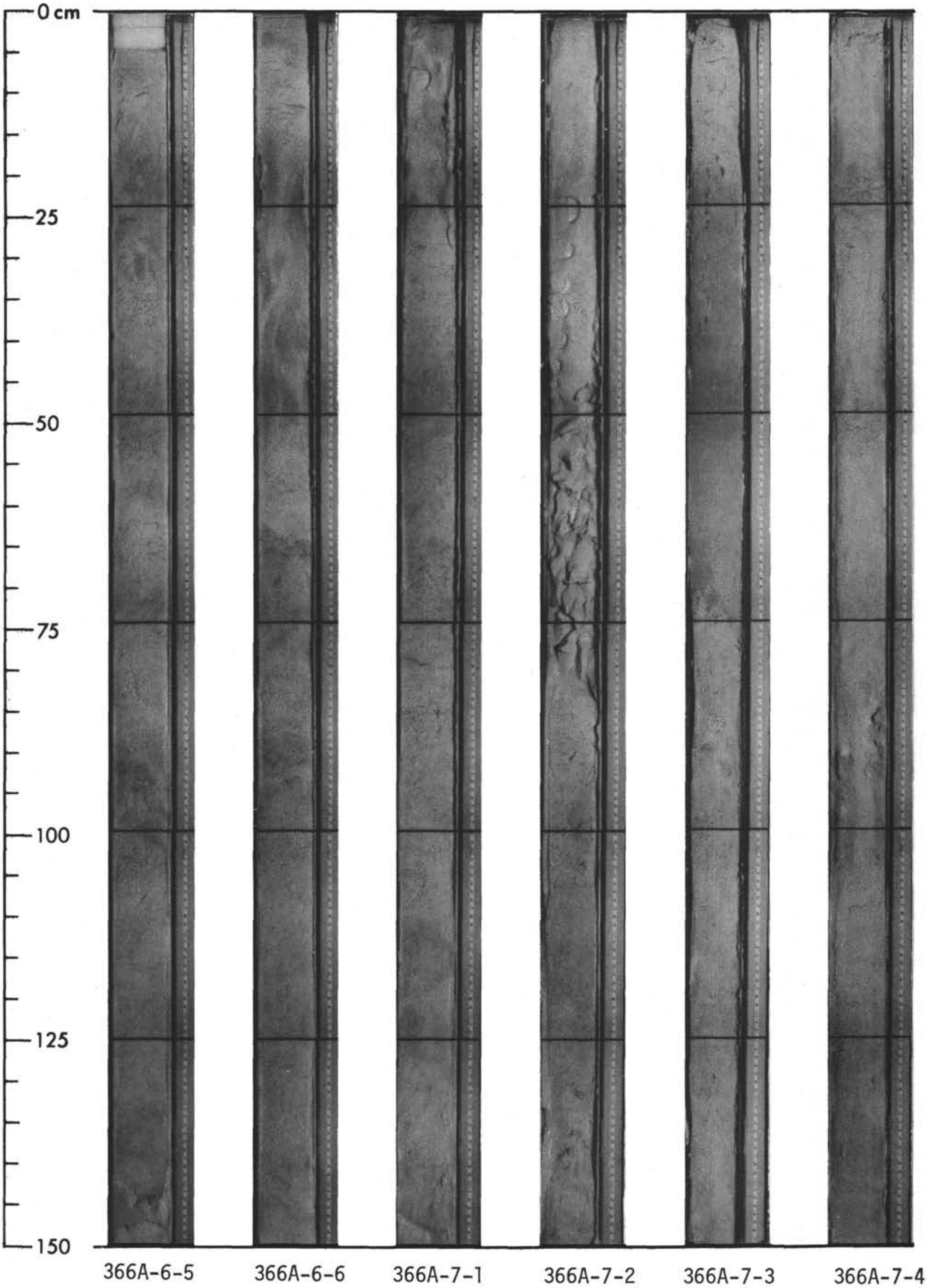
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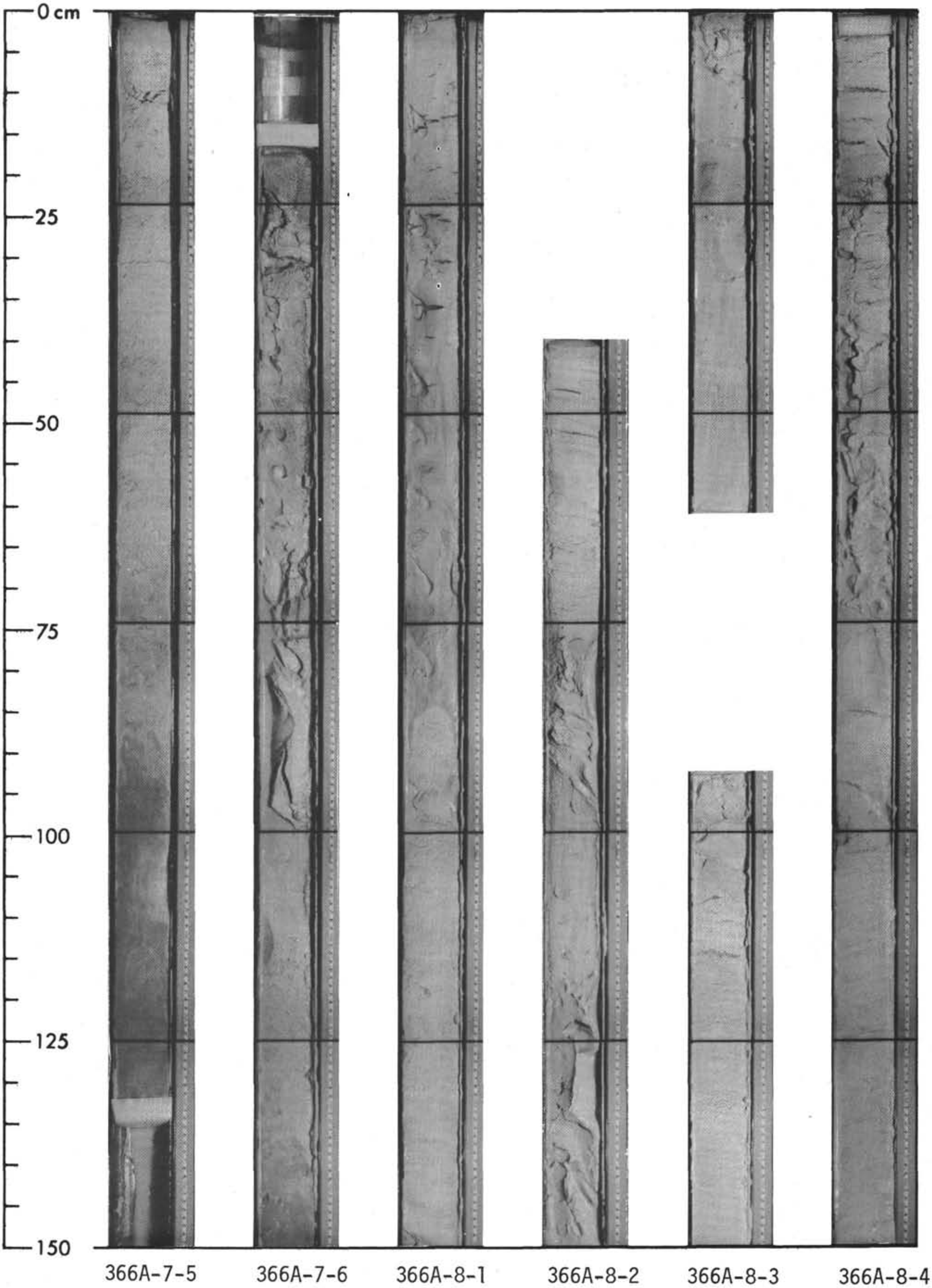
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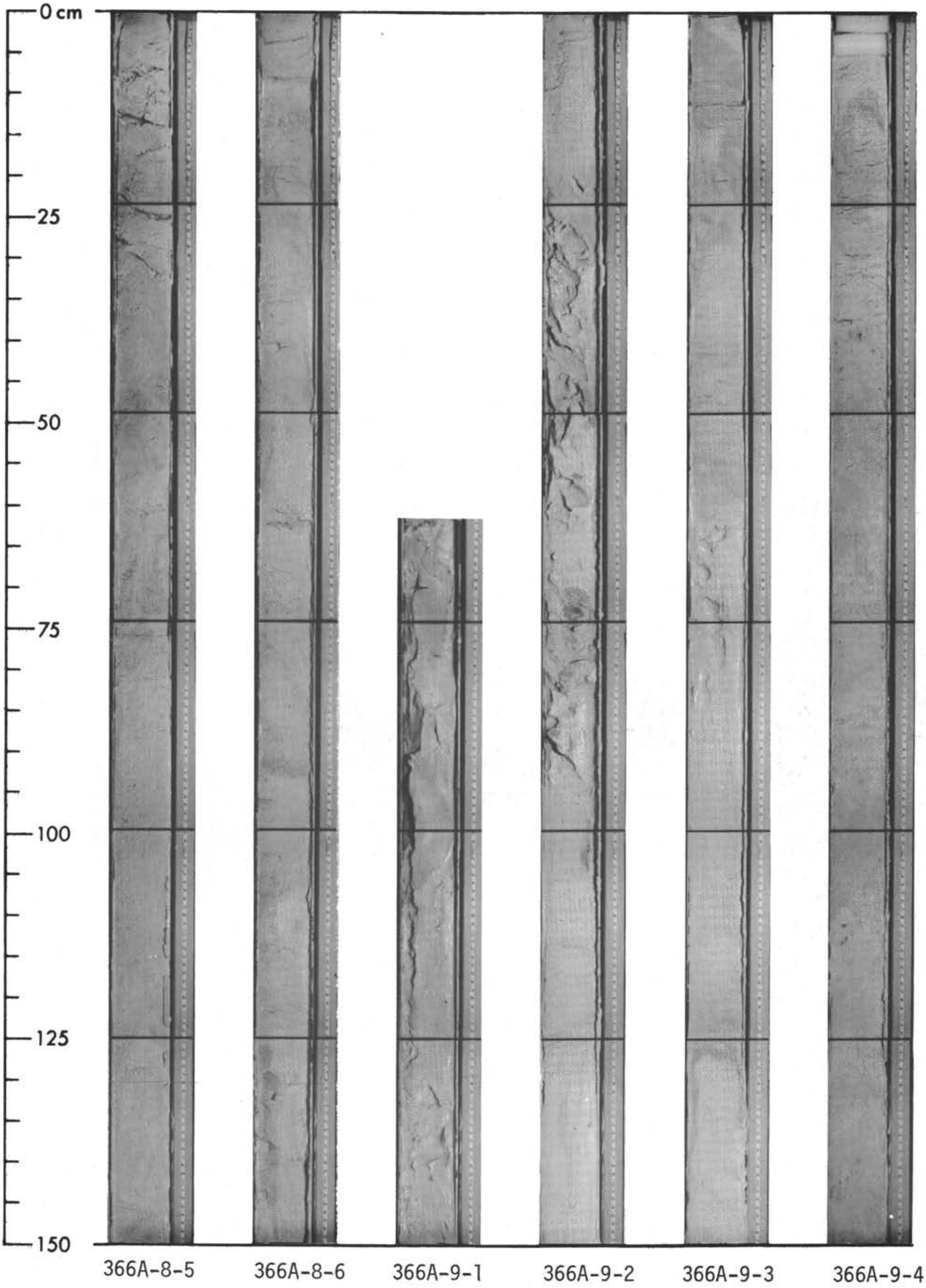
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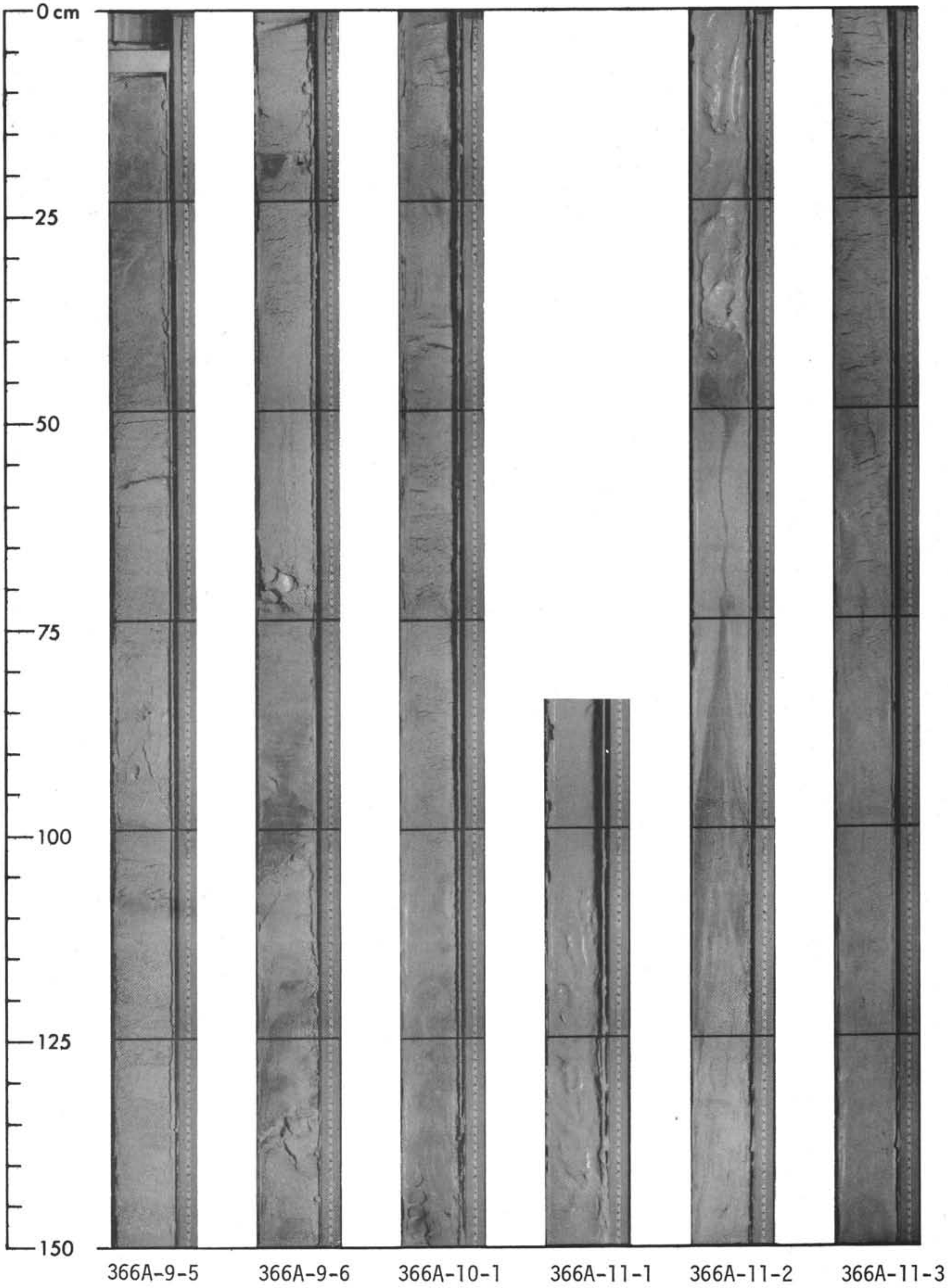
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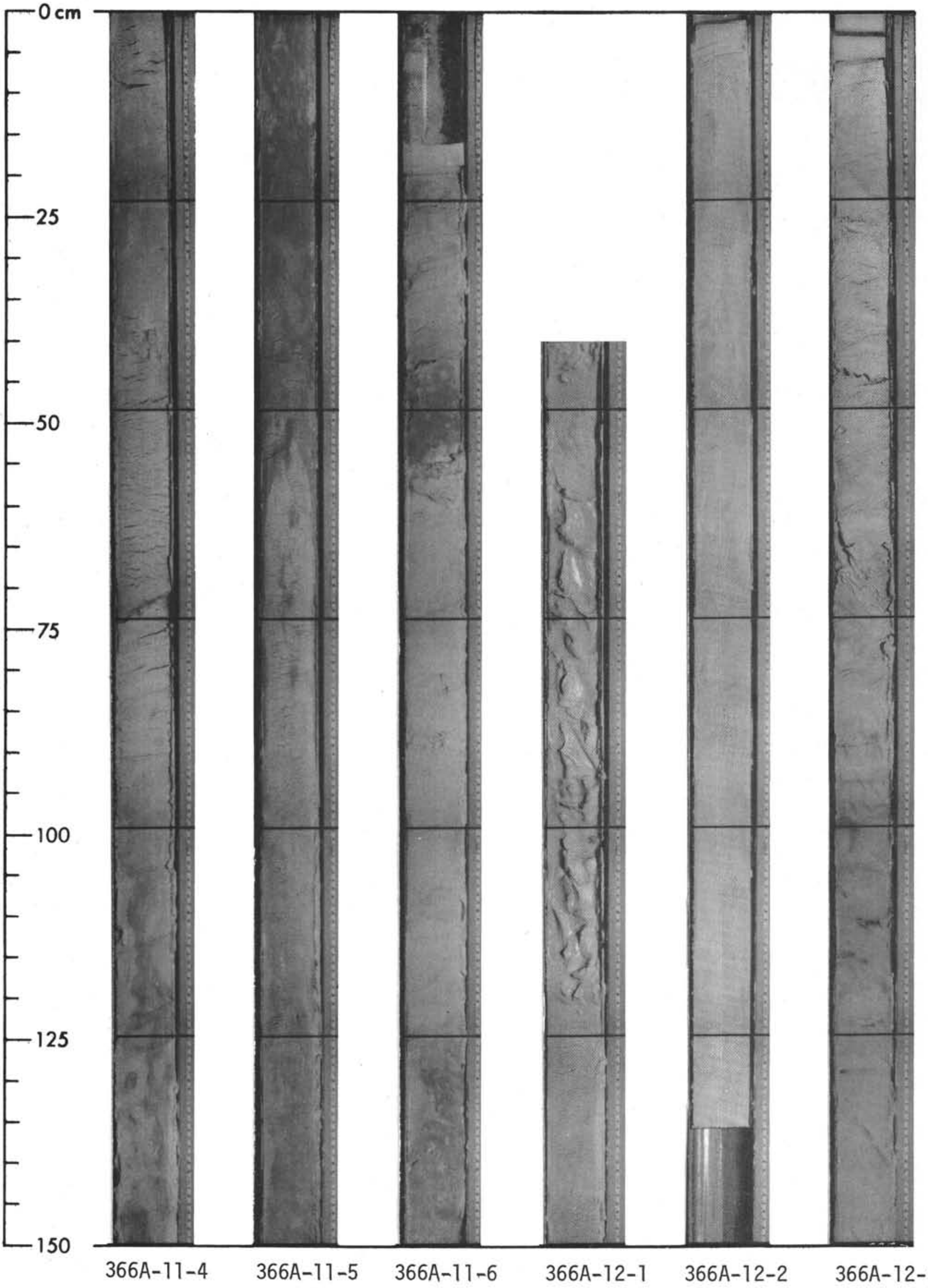
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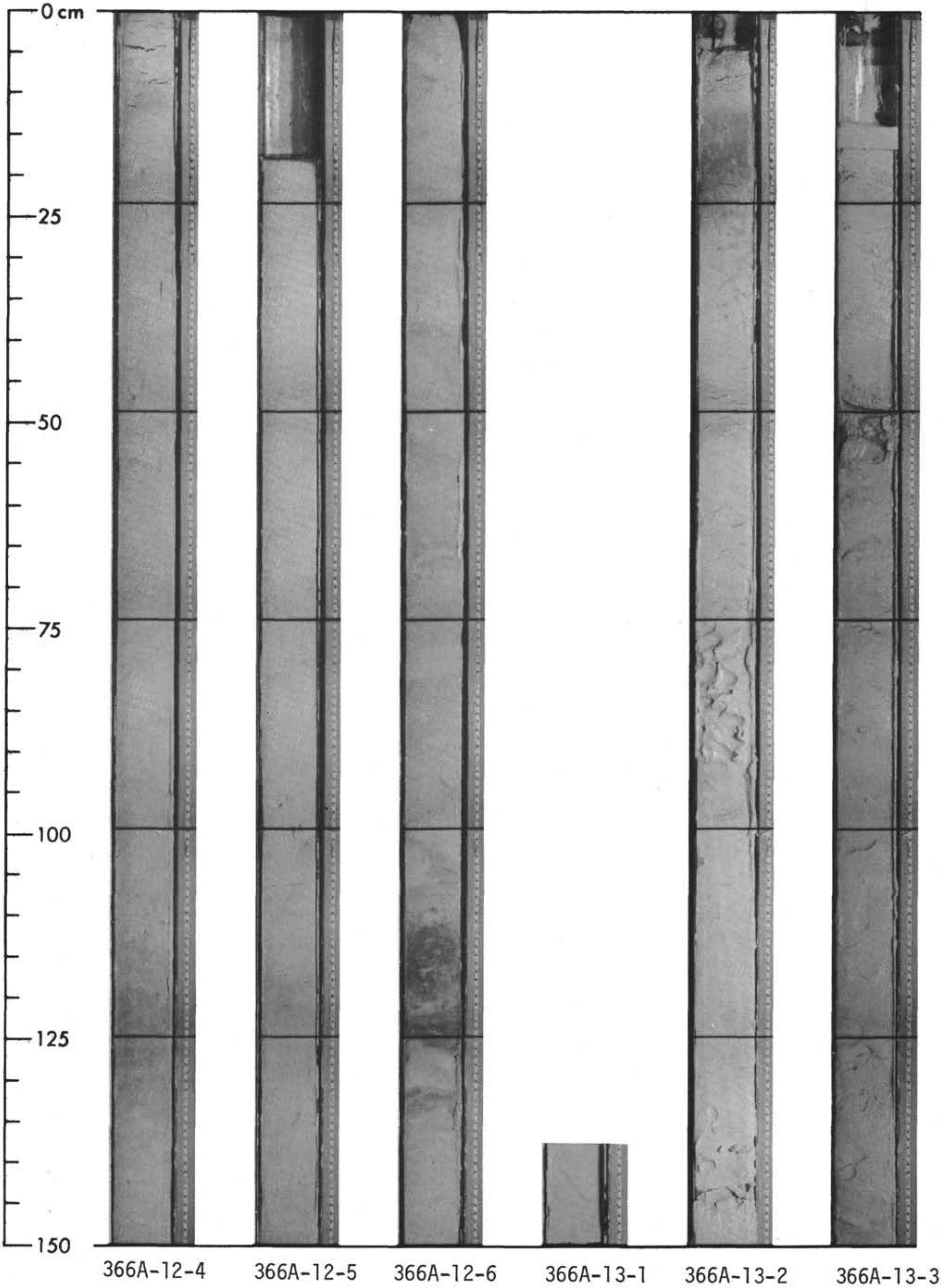
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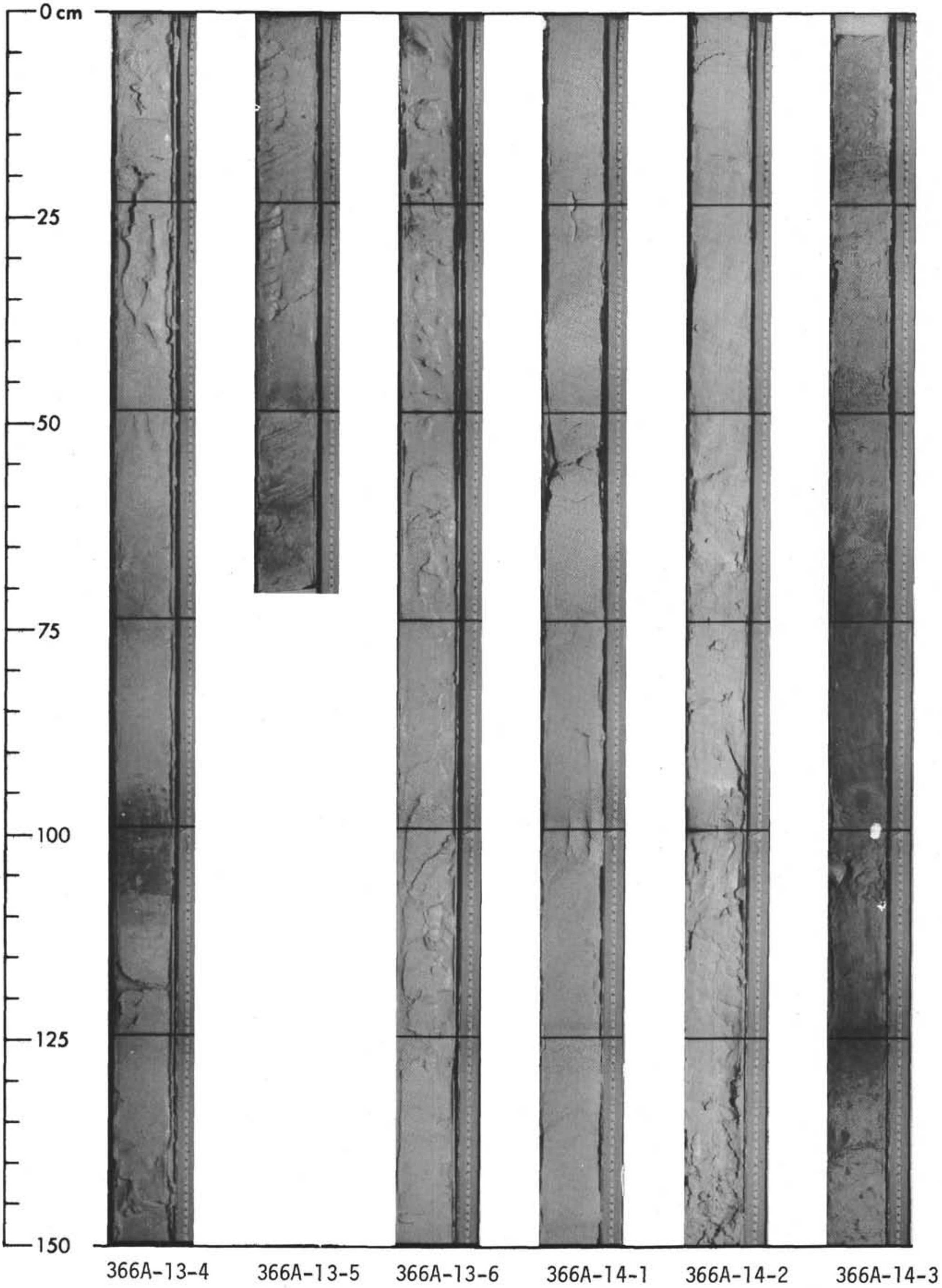
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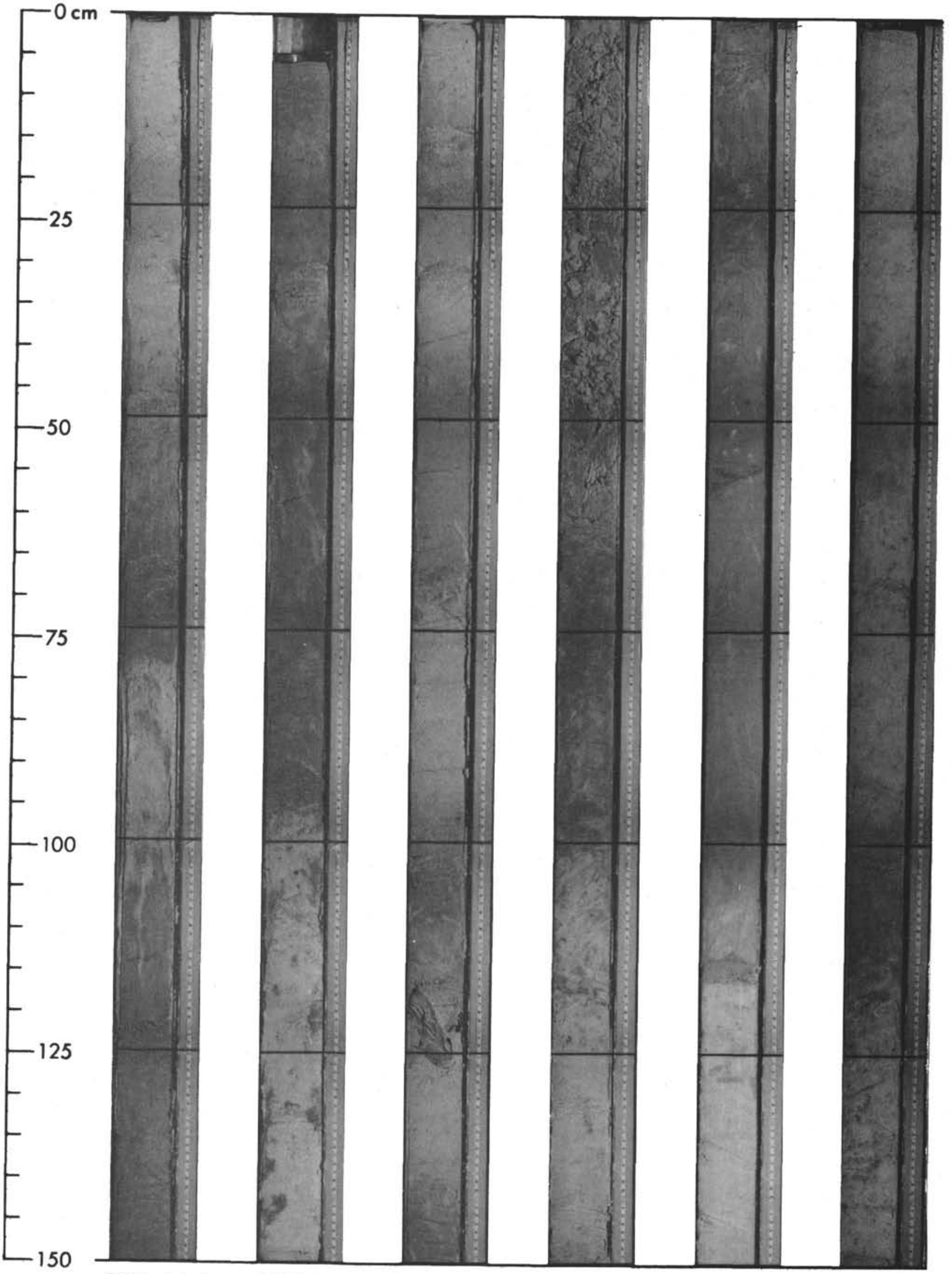
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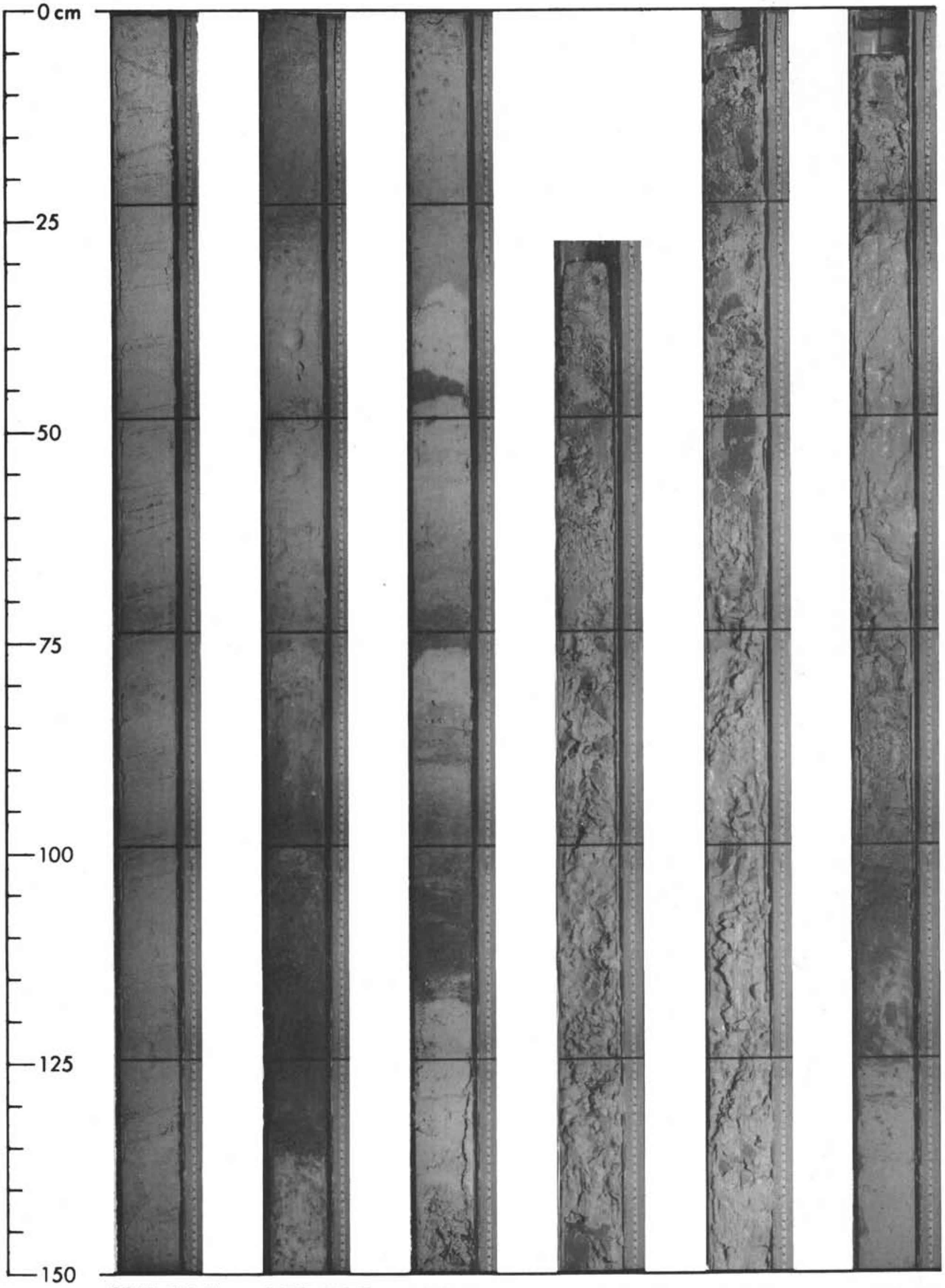

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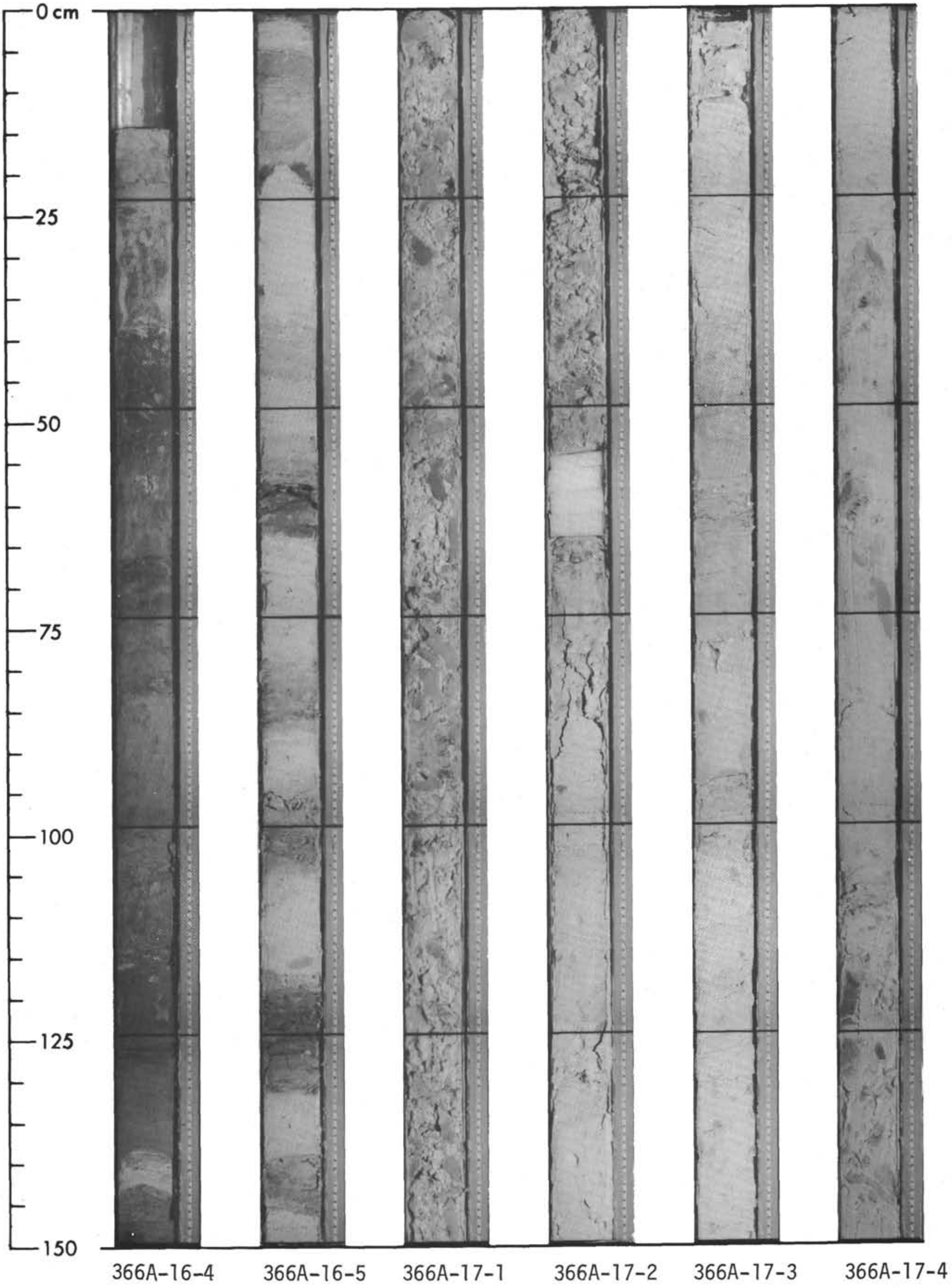
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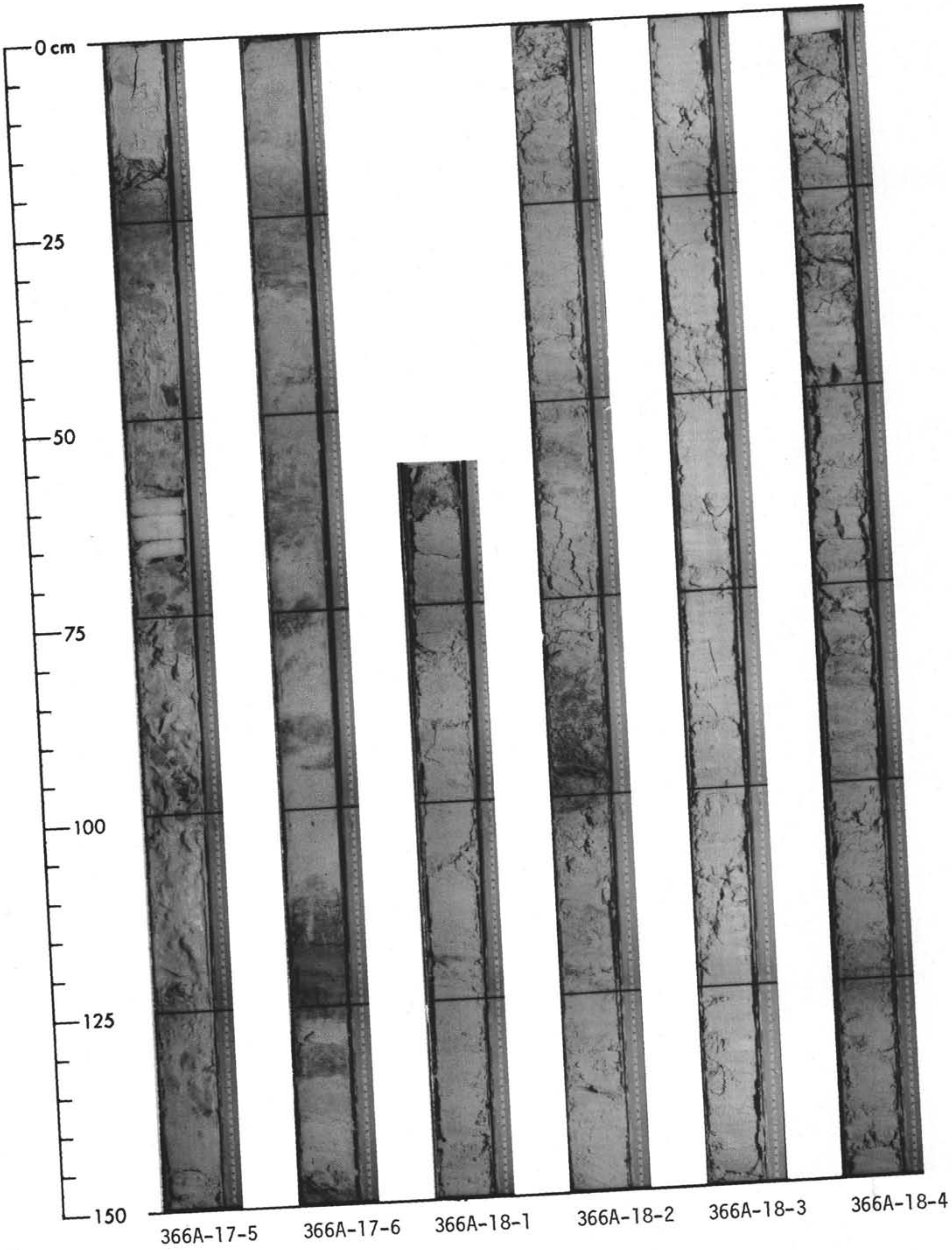
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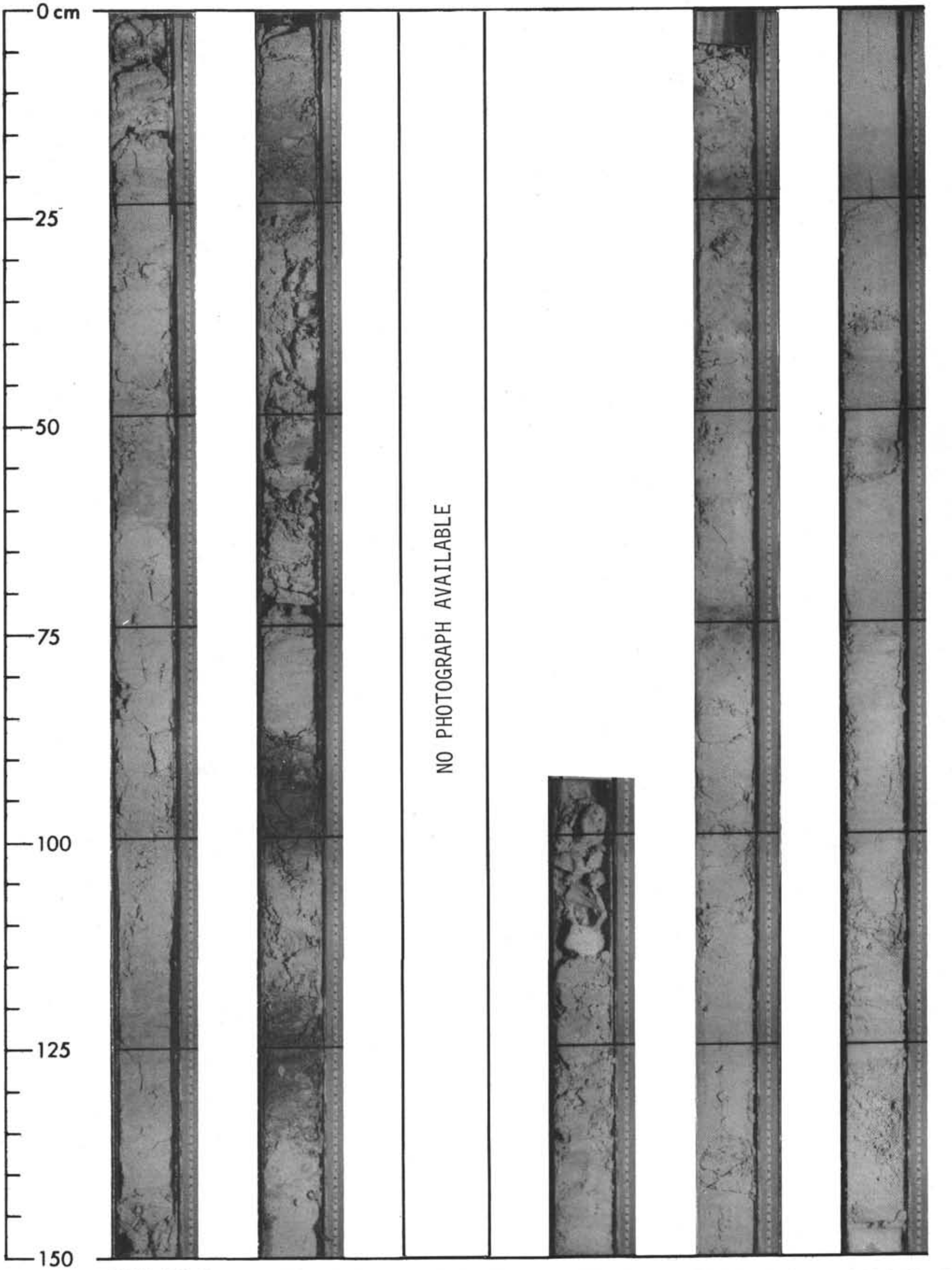
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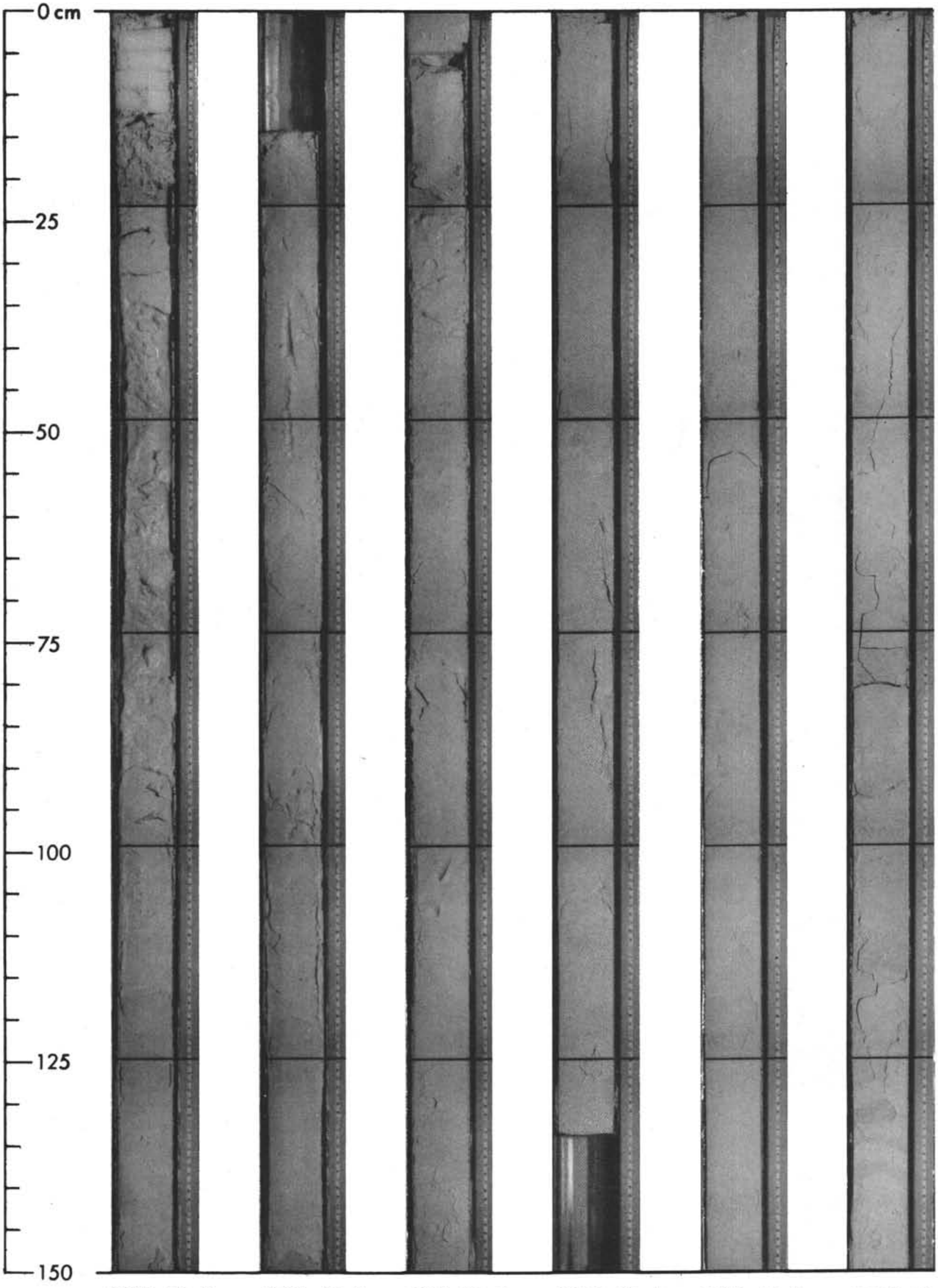
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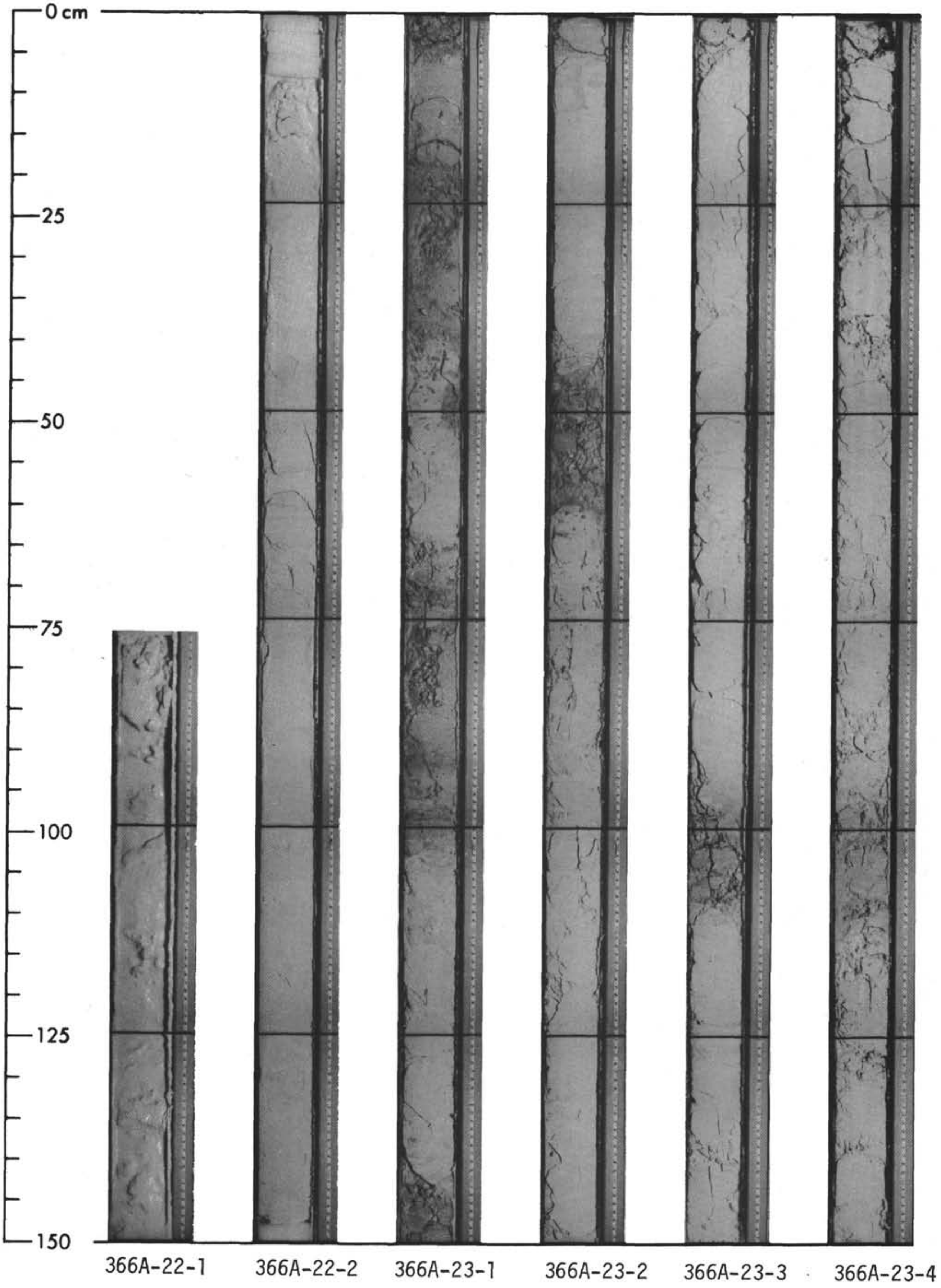
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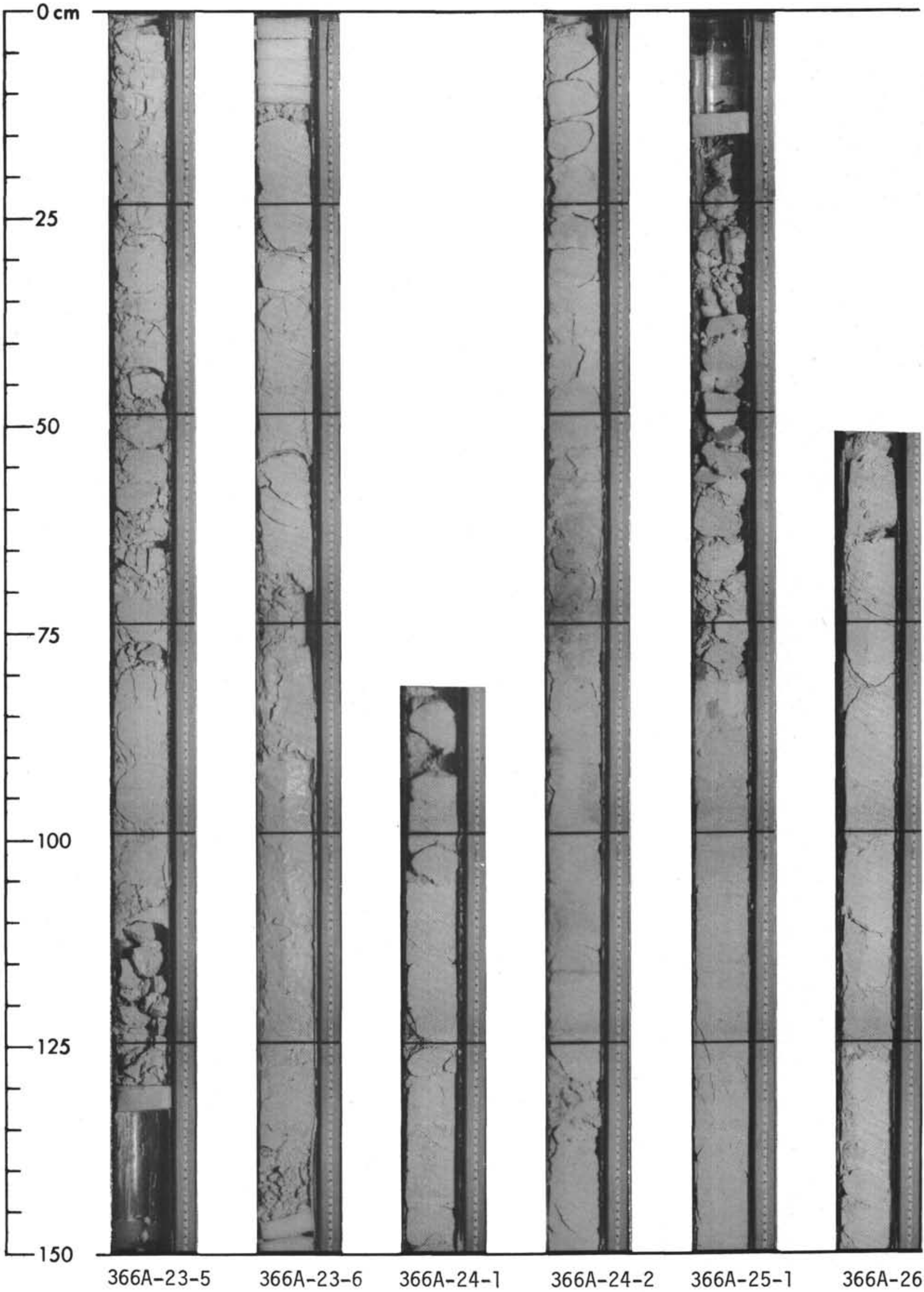
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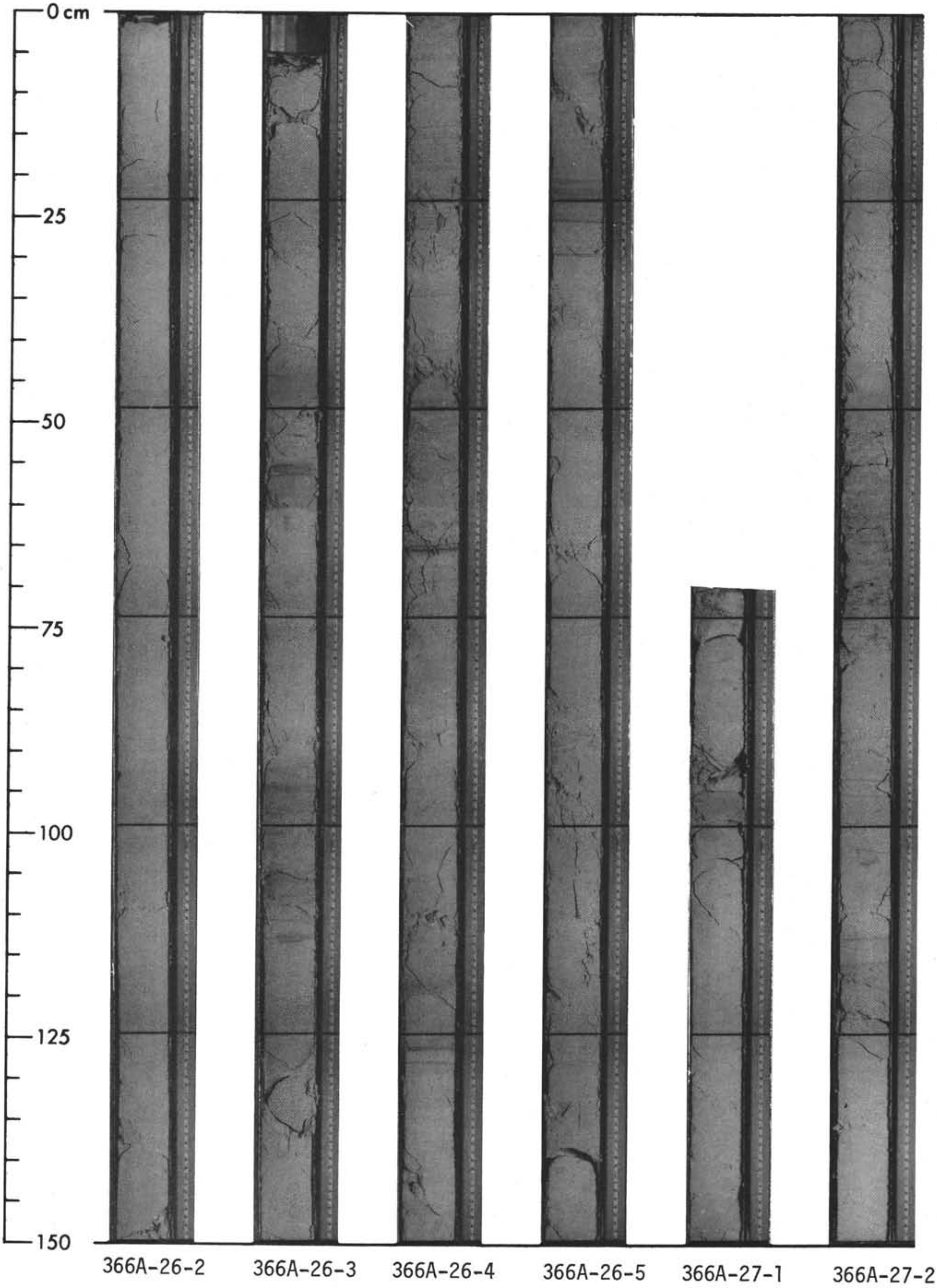
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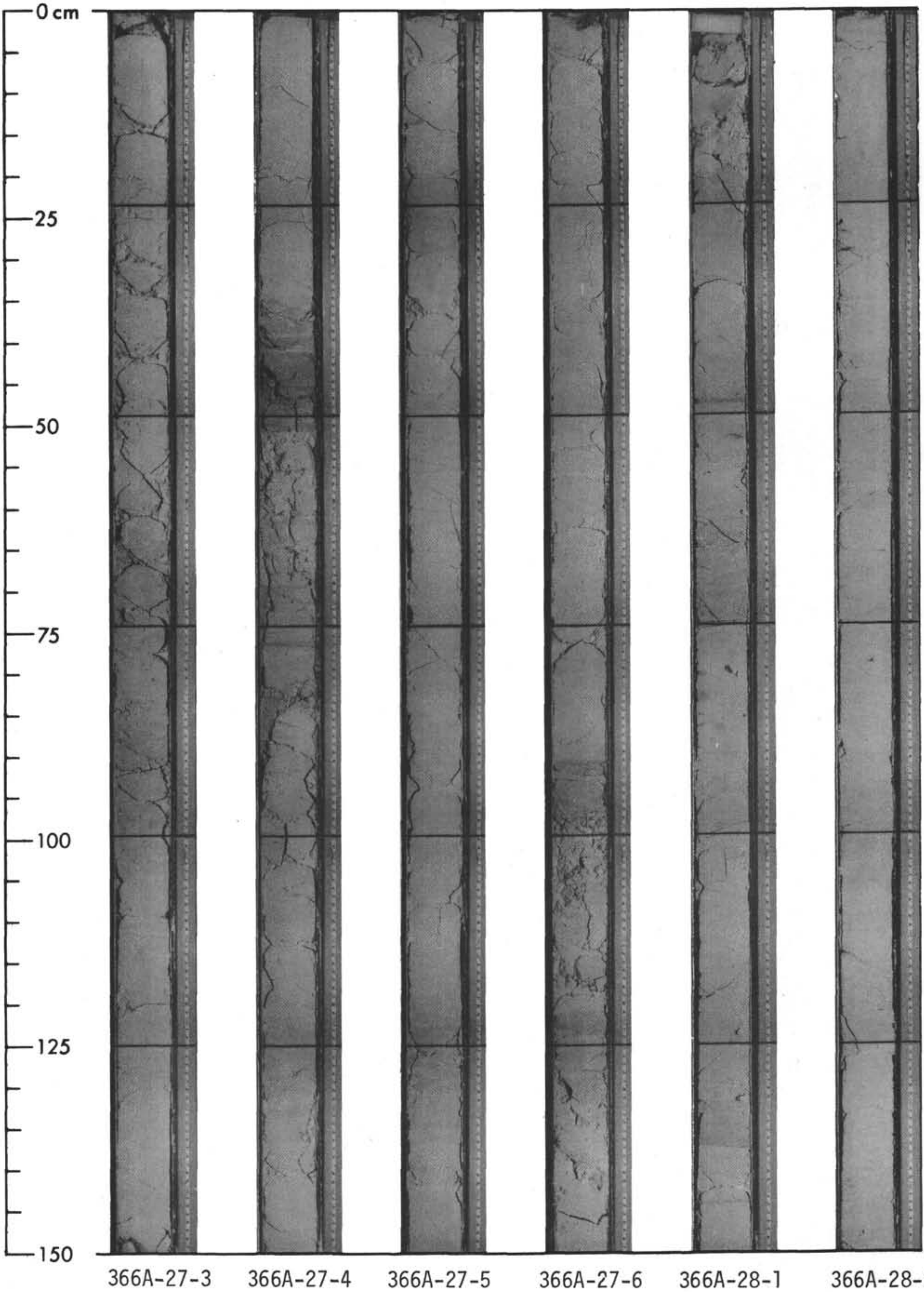

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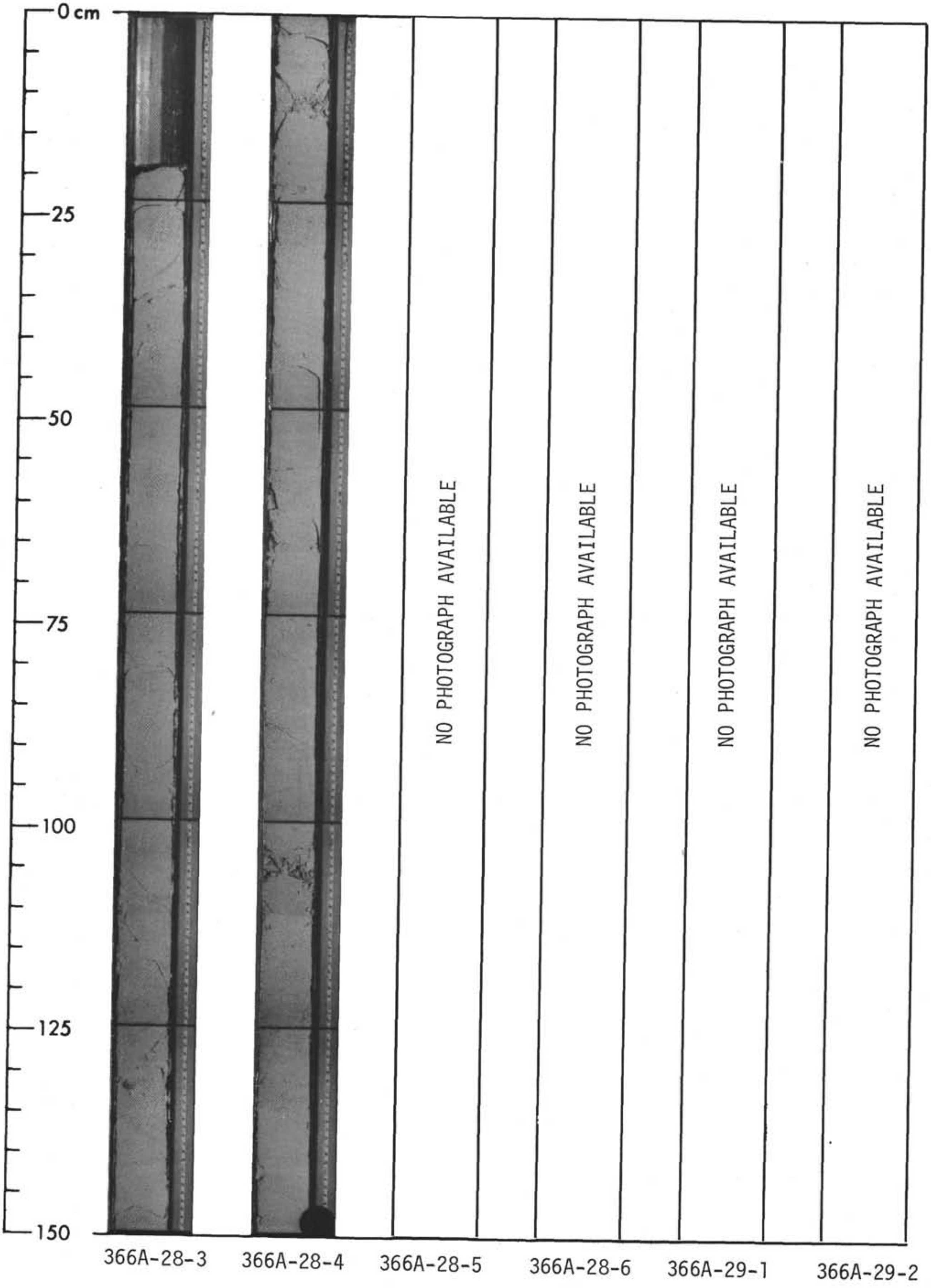
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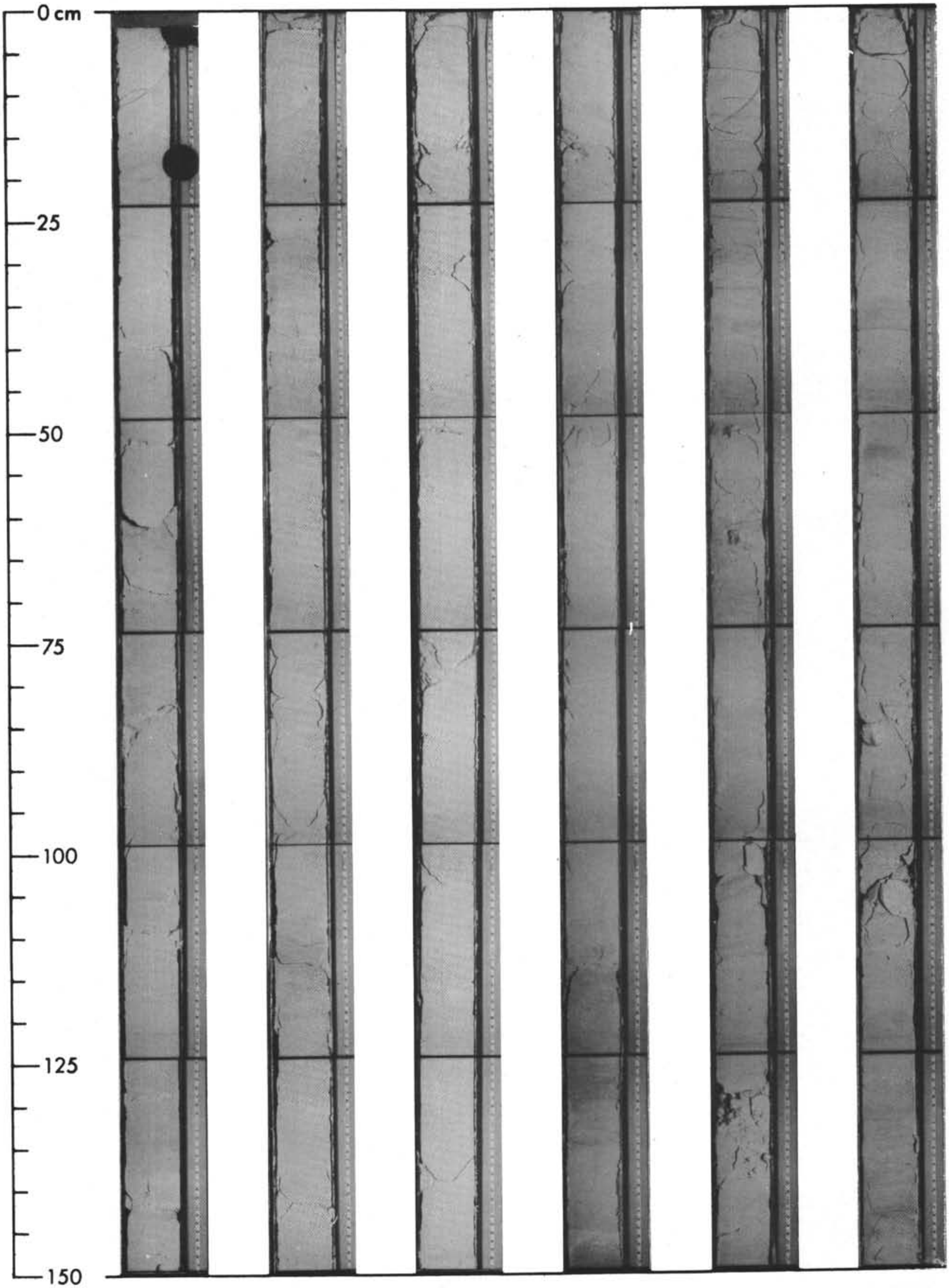
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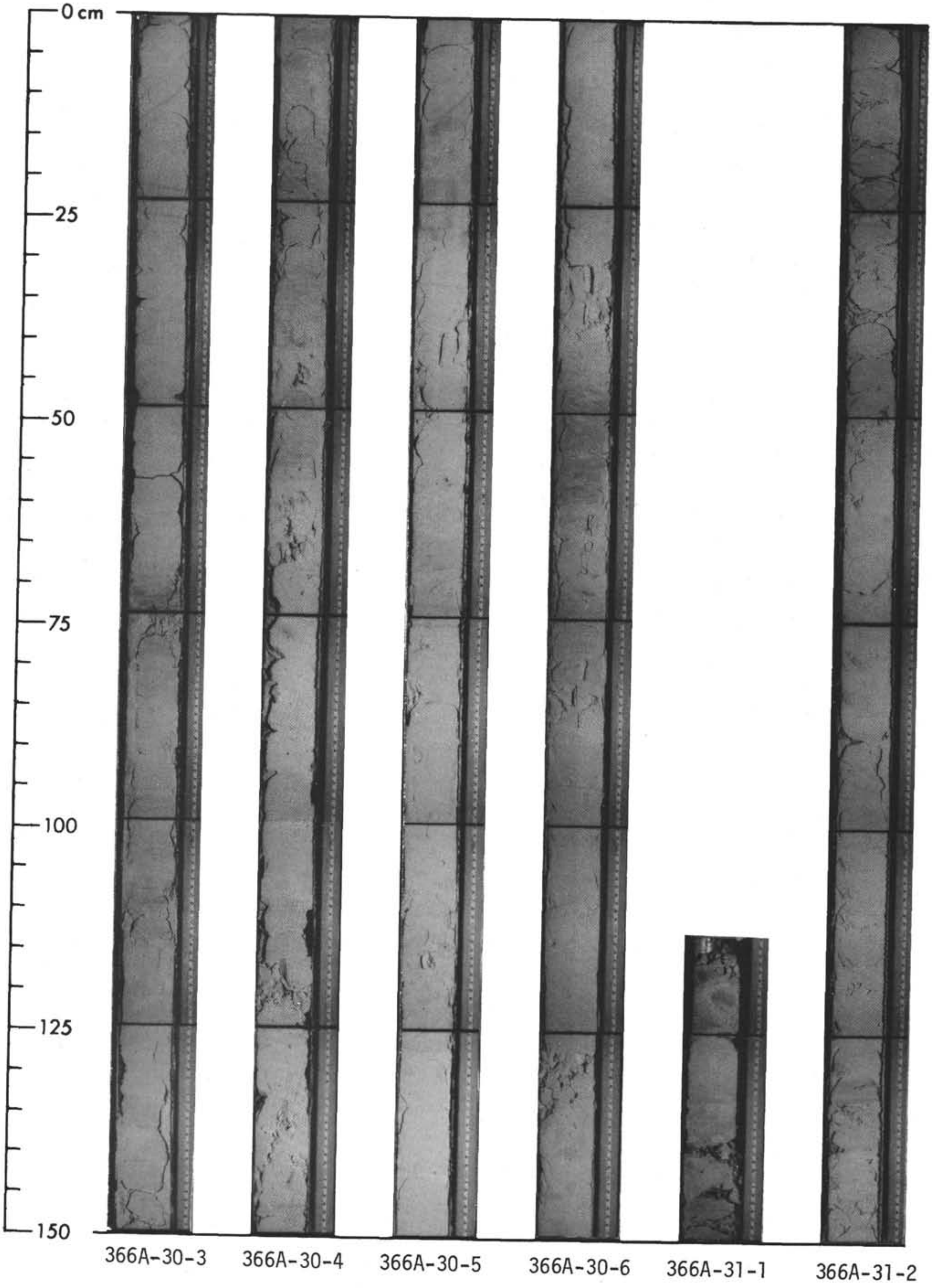
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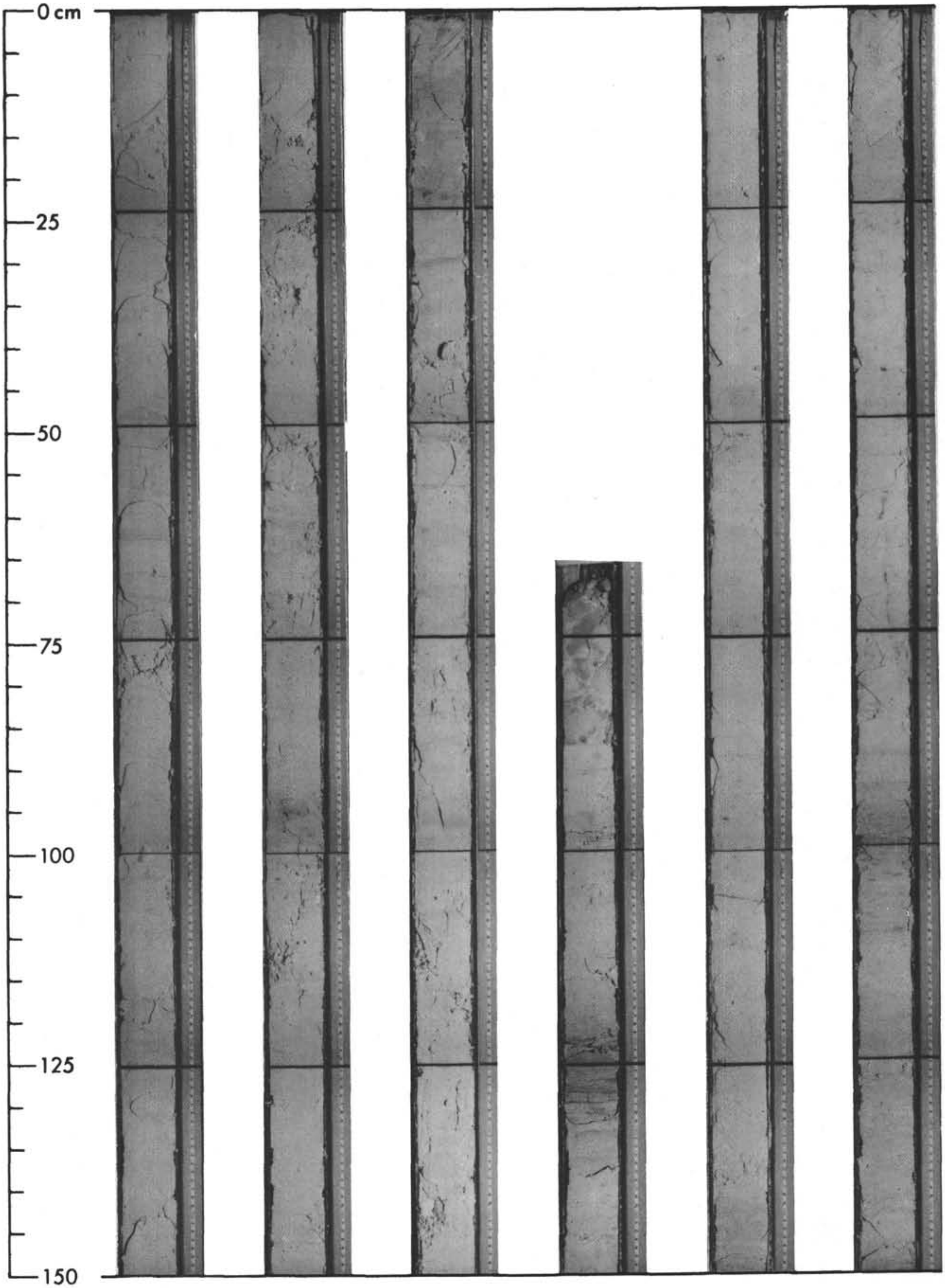

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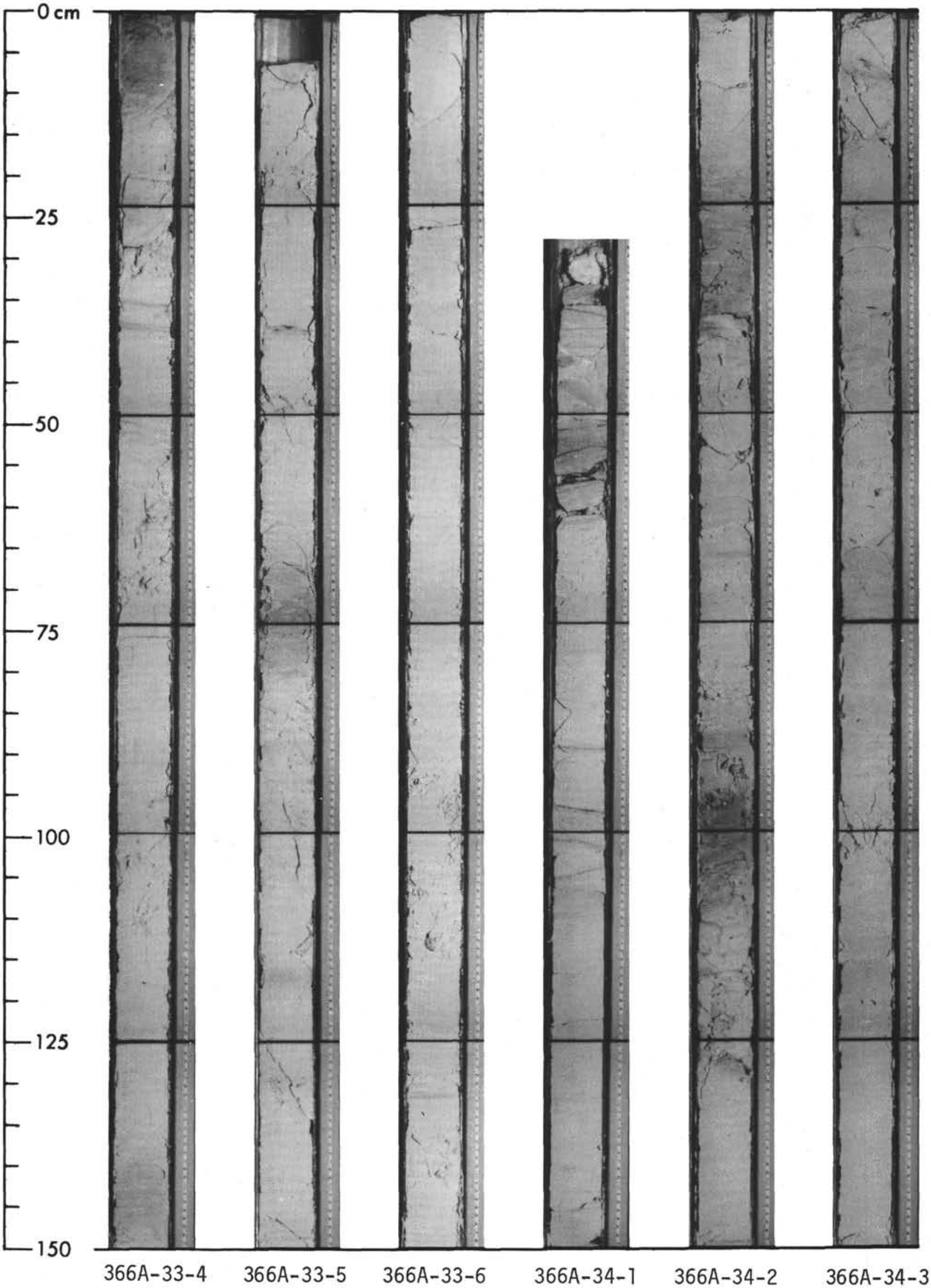
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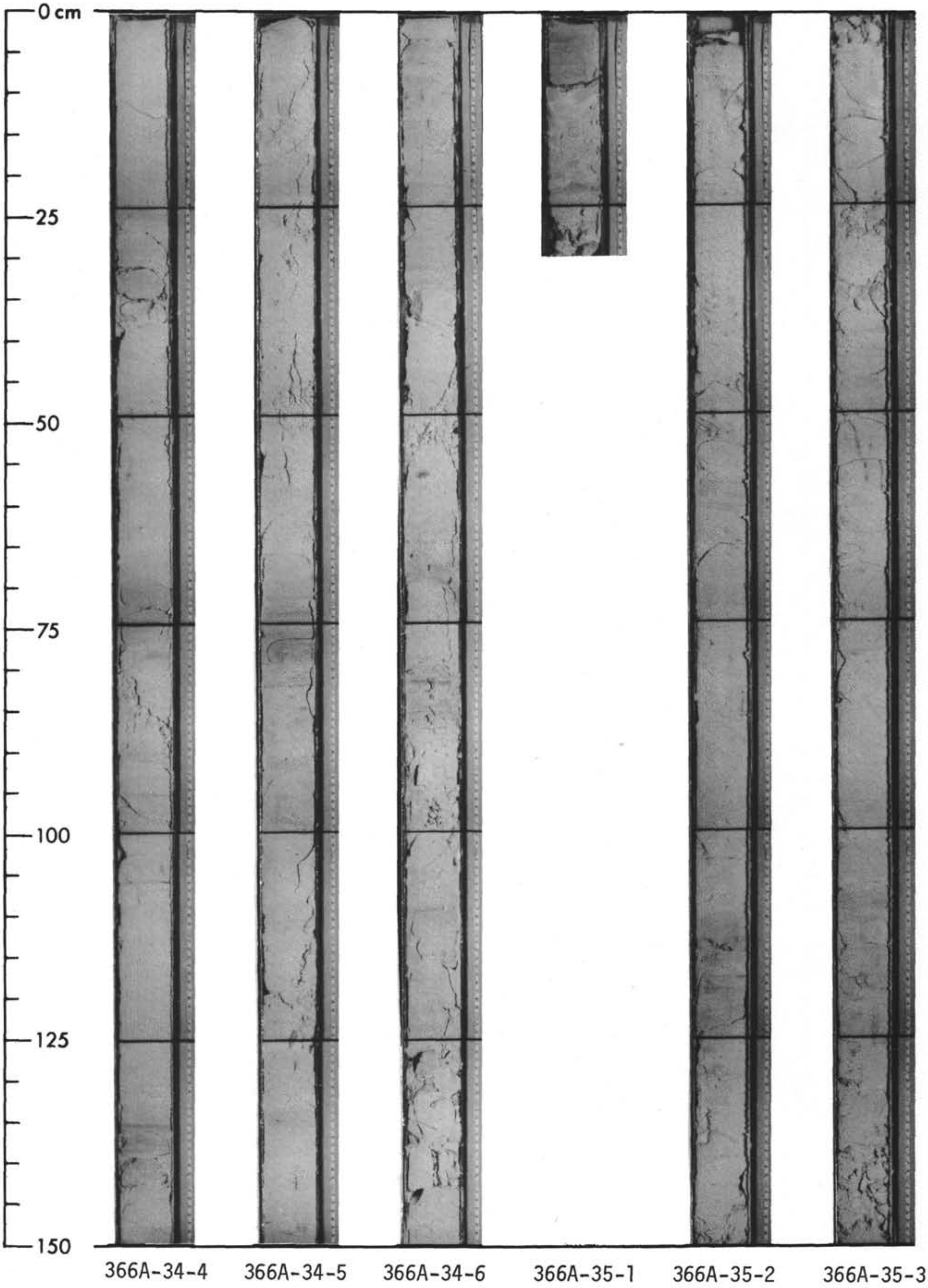
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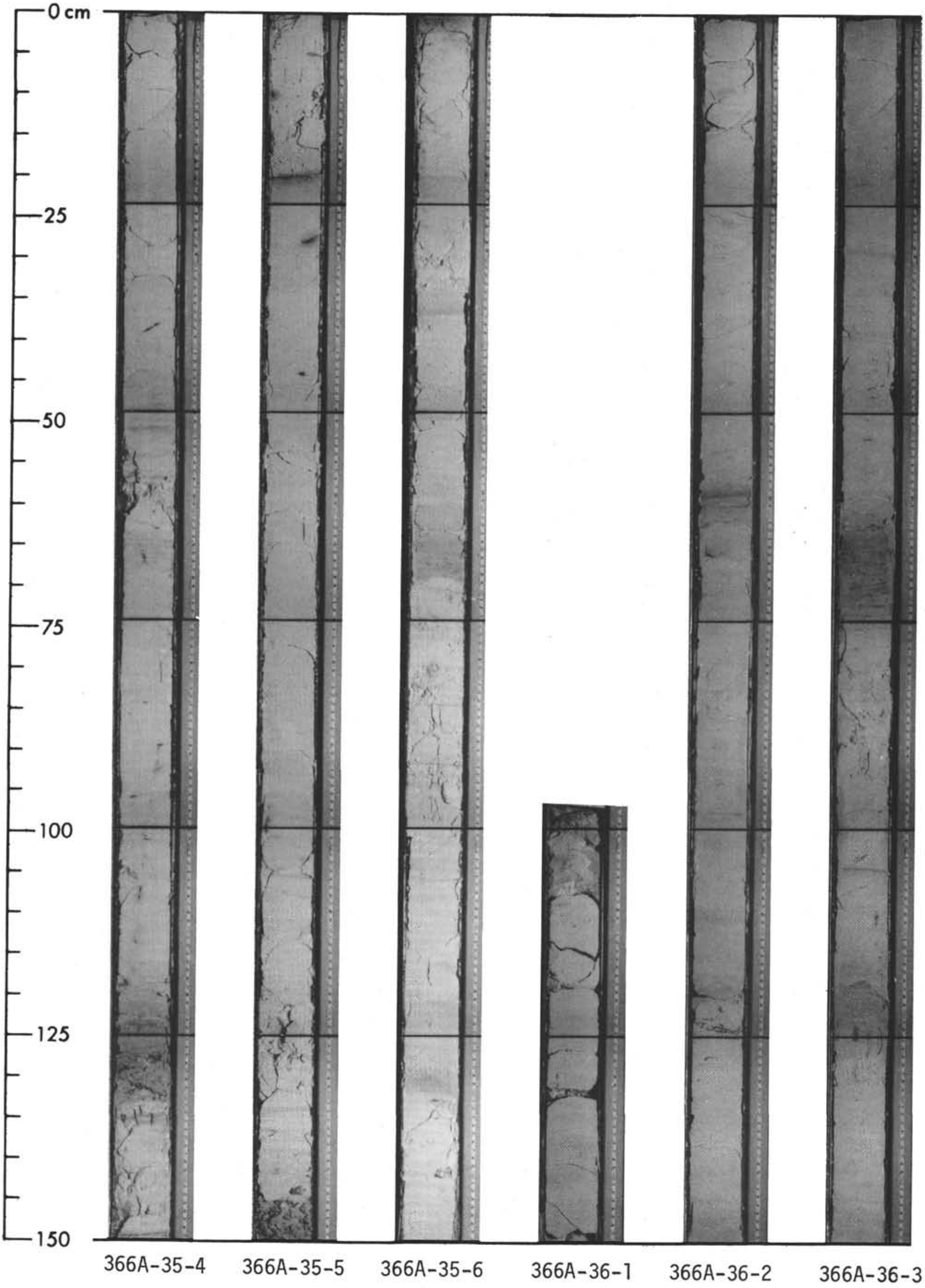
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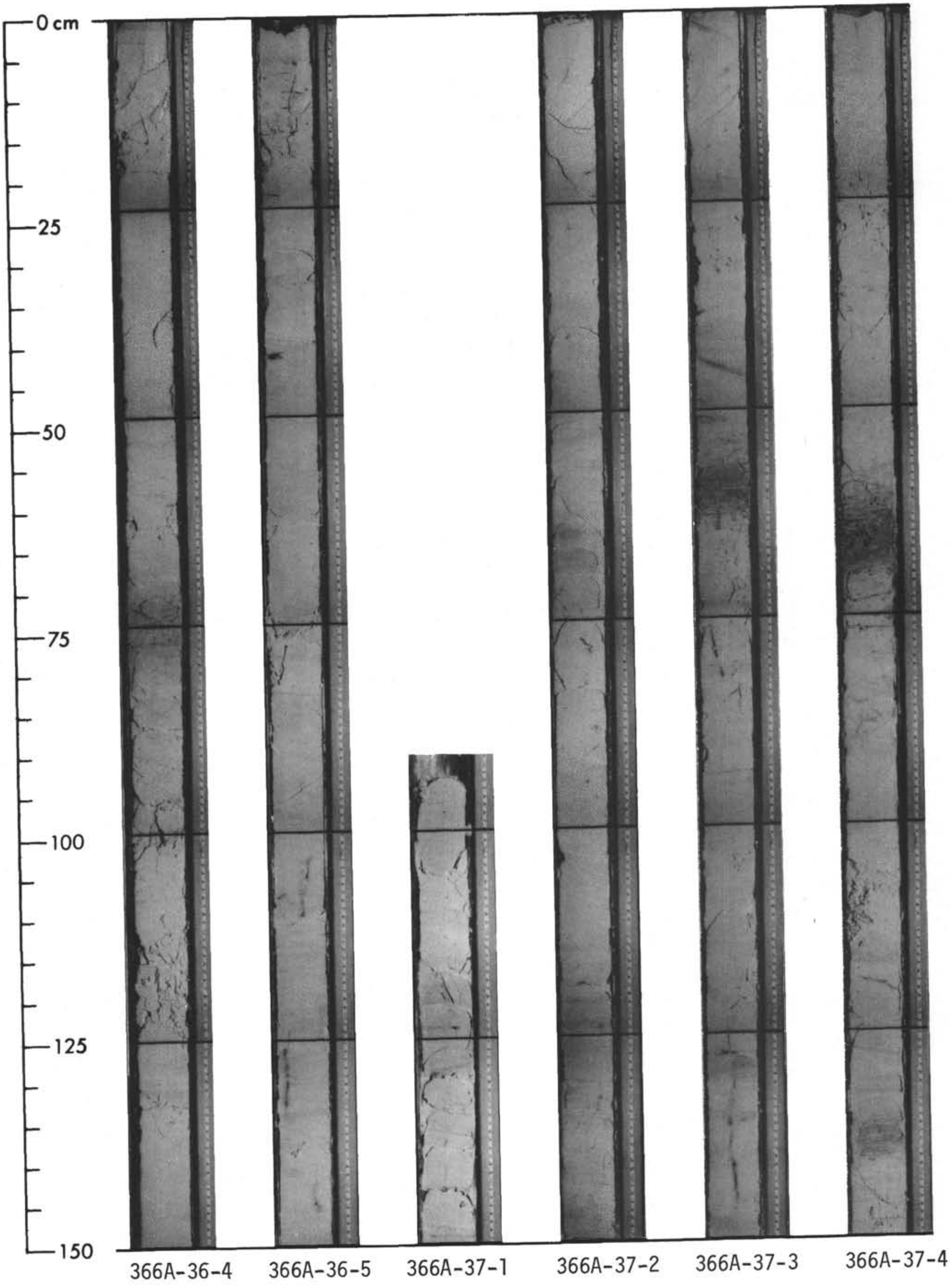
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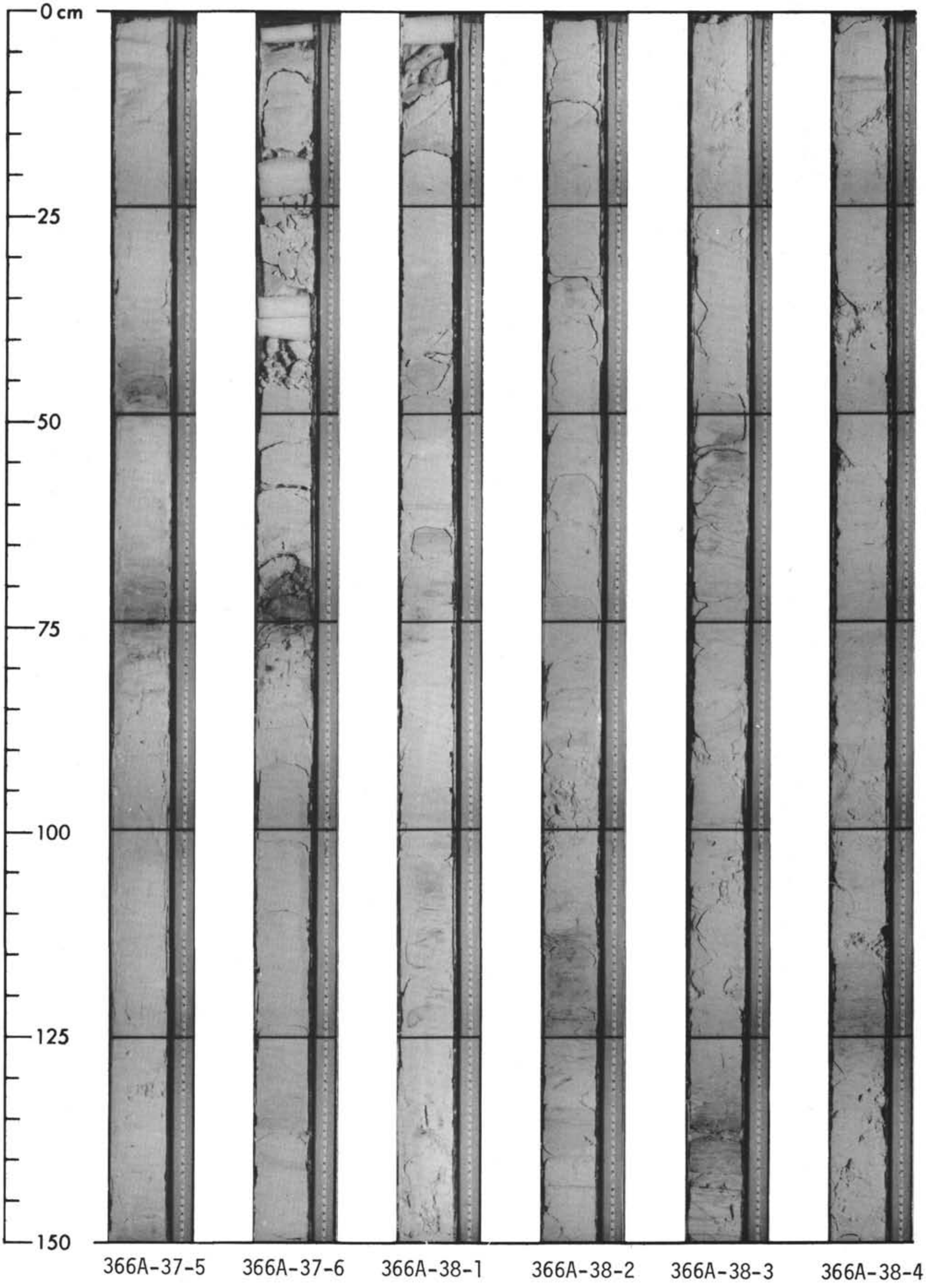
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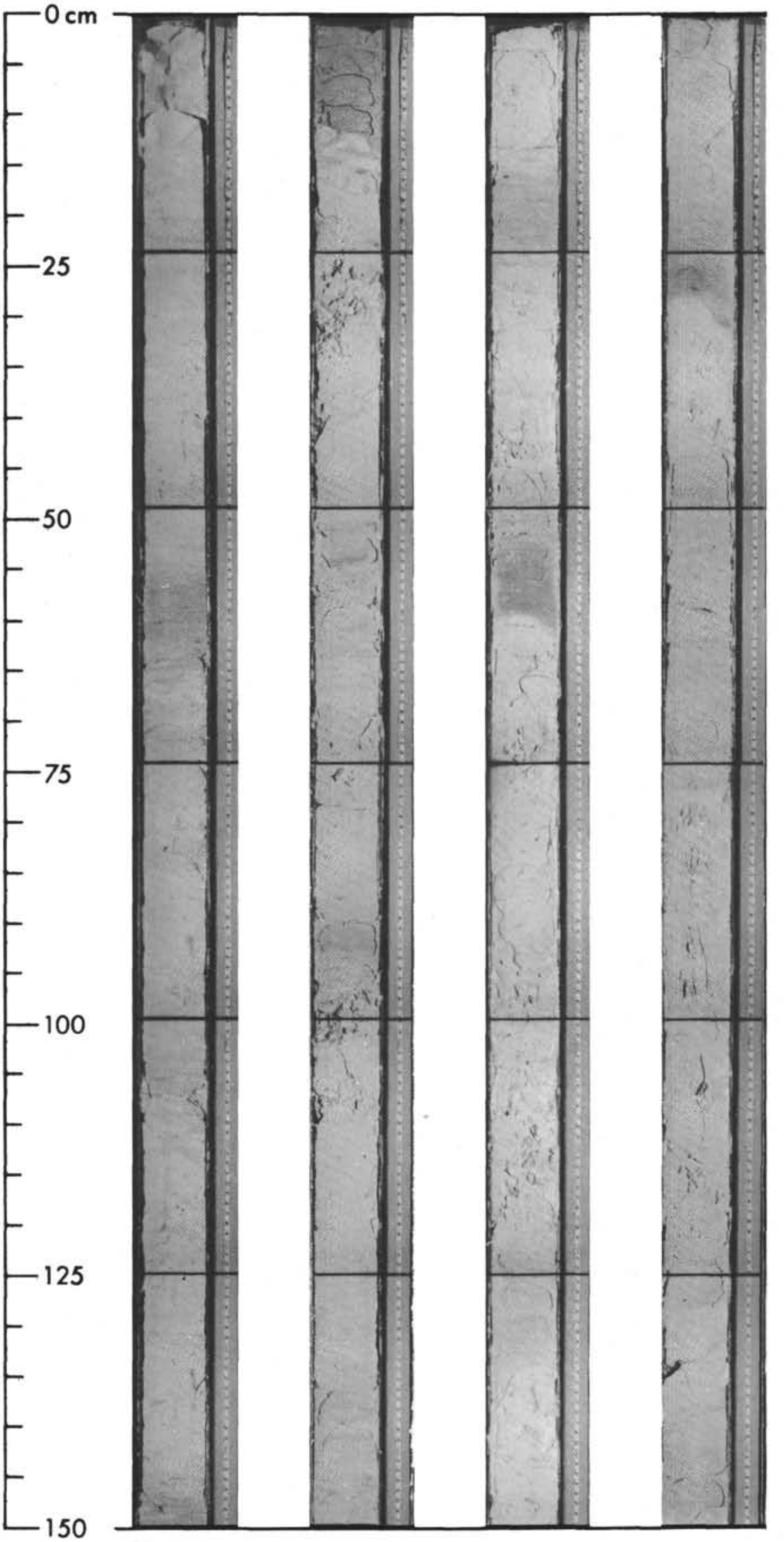
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