7. SITE 216

The Shipboard Scientific Party[1]

ABSTRACT

Site 216 was drilled on the crest of Ninetyeast Ridge near the equator, in a water depth of 2237 meters. The stratigraphic column at this site, 457 meters thick, consists of an uppermost Pleistocene to late Maastrichtian nannofossil ooze to chalk unit which is glauconitic at the base and contains several chert stringers. This is underlain by a late Maastrichtian shallow water unit comprising micarb chalk, volcanic clay, and ash beds, in part intensely bioturbated. This is underlain by scoriaceous and amygdalar chloritized basalt containing rare veinlets of native copper. The stratigraphy resembles that of Site 214, 1300 km to the south along the crest of Ninetyeast Ridge. The Cretaceous/Tertiary boundary was cored and could be accurately identified using nannofossils and foraminifera.

SITE DATA

Date Occupied:
216: 18 Feb 72 (2312)
216A: 21 Feb 72 (0330)

Date Departed:
216: 21 Feb 72 (0330)
216A: 21 Feb 72 (2315)

Time on Site:
216: 52 hours 18 minutes
216A: 19 hours 45 minutes

Position:
lat 1°27.73′N
long 90°12.48′E

Water Depth (to rig floor):
2262 meters (Echo sounding)
2247 meters (Drill pipe)

Penetration:
216: 477.5 meters
216A: 158.5 meters

Number of Holes: 2

Number of Cores:
216: 38
216A: 6

Total Length of Cored Section:
216: 353 meters
216A: 57 meters

Total Core Recovered:
216: 170.8 meters
216A: 53.7 meters

Acoustic Basement:
Depth: 457 meters
Nature: Basalt

Age of Oldest Sediment:
216: Maastrichtian
216A: Middle Miocene

Basement: Basalt

BACKGROUND AND OBJECTIVES

In the original cruise plan we anticipated attempting only seven sites. However, because of an unexpected absence of drilling problems we terminated Site 215 about 5 days ahead of schedule and decided to drill another site. Three possibilities were open: (1) a site on the ridge further north than Site 215, (2) a site in the distinctive magnetic anomalies to the west of Site 215, and (3) a distal fan site. The third was rejected due to the difficulty of obtaining clear sections of Curray and Moore (1971) W, Y, and O sediments in the distal fan and because the site would duplicate the two sites planned in the fan further to the north. The second site was rejected because it would involve extra steaming and because we mistakenly thought that the north-south magnetic profile of the *Challenger* away from Site 215 would enable us to unambiguously determine the magnetic age of that site. Consequently, we decided to drill the site originally selected on the Ninetyeast Ridge at 1°N. This site would enable us to obtain both a continuous calcareous and radiolarian

[1]C. C. von der Borch, Flinders University, Bedford Park, South Australia; J. G. Sclater, Scripps Institution of Oceanography, La Jolla, California; S. Gartner, Jr., Rosenstiel School of Marine and Atmospheric Science, University of Miami, Coral Gables, Florida; R. Hekinian, Centre Oceanologique de Bretagne, Brest, France; D. A. Johnson, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts; B. McGowran, University of Adelaide, Adelaide, South Australia; A. C. Pimm, Scripps Institution of Oceanography; La Jolla, California; R. W. Thompson, Humboldt State College, Arcata, California; J. J. Veevers, Macquarie University, North Ryde, N.S.W., Australia; Lee S. Waterman, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts.

sequence back to the Eocene and also to check the rather spectacular tectonic history for the Ninetyeast Ridge that resulted from the drilling of Site 214.

The mid-Paleocene age for Site 214 clearly showed that the Ninetyeast Ridge or at least the area around the site predated the mid-Eocene readjustment of the plates in the Indian Ocean. Thus, clearly the ridge was not formed by the compression of the old fracture zone when the spreading direction of India/Antarctica changed from north-south to northeast-southwest. Clearly the ridge must have been formed prior to this time and possibly is a feature similar to Amsterdam and St. Paul islands. These islands, which lie to the southeast of the southern end of the Ninetyeast Ridge, are basaltic islands on a major transform fault cutting the southeast Indian Ridge. The ridge could have been formed during the Cretaceous and early Tertiary by basaltic intrusion at the junction of the old southeast Indian Ridge and the active Ninetyeast Transform Fault. If this were the case and the extrusion was onto the Indian plate and not the old Australia/Antarctic plate, the ridge should be older to the north. If the magma arises from a point source beneath the Indian plate, Site 216 should be older than Site 214 and have the same age difference as the crust a similar distance to the west of the ridge.

Site 216 is on the Ninetyeast Ridge just north of the equator. In this area the ridge has the more typical asymmetrical shape and a double crest (Figure 1). The R/V *Robert Conrad* performed the presite survey (Figure 2), and the shallow crest at 1200 fathoms was the location chosen for drilling. The sediment over the crest is well stratified and about 0.5 sec thick. Two prominent reflectors were observed at 0.3 and 0.4 sec on the incoming and outgoing *Challenger* profiles. A Cenomanian (Cretaceous) fossil was recovered in a dredge from the east scarp during the R/V *Robert Conrad* site survey.

The objectives were to obtain a continuous Cenozoic biostratigraphic section, specifically pre-upper Miocene Radiolaria and to determine the mode of formation and tectonic history of the Ninetyeast Ridge.

OPERATIONS

Site 216, on the crest of Ninetyeast Ridge, was approached from the west along the seismic reflection profile of R/V *Robert Conrad*. The site was selected in a water depth of 2237 meters, after which *Glomar Challenger* continued across the ridge for an additional 10 nautical miles before returning to the selected area. A light spar buoy was dropped, speed reduced to 5 knots, and the seismic gear secured, after which *Challenger* returned to the buoy and the acoustic beacon was dropped.

Drilling was carried out using a Smith 94 CJS 4-cone chizzel-point bit. The upper 160-meter section of the hole was spot cored with cores separated by 19 meters of drilling (2 joints). The remainder of the hole from 160 meters to the total depth of 477.5 meters was continuously cored. No drilling difficulties were encountered throughout the 457 meters of drilled sediments. The basalt was cored for 20.5 meters. An aggregate of 353 meters of the section was cored in 38 cores, representing 48.3% recovery (Table 1).

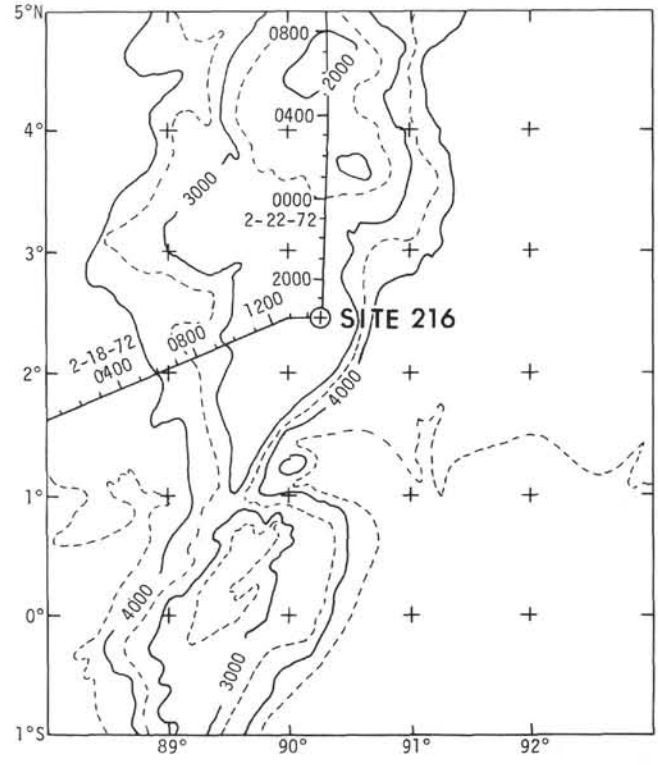


Figure 1. *Bathymetry in vicinity of Site 216.*

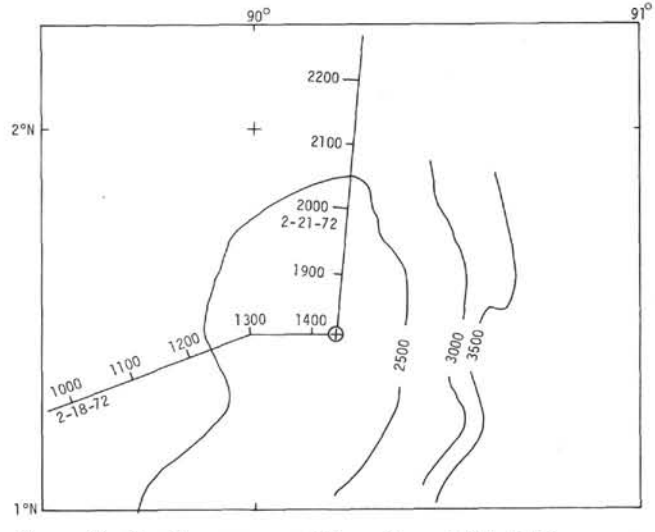


Figure 2. *Presite survey and form lines at Site 216.*

At the conclusion of Hole 216 the drill pipe was pulled to above mud line and Hole 216A was drilled a short distance away. The bit was washed down to 101.5 meters below sediment surface and six additional cores of calcareous ooze taken continuously from 101.5 to 158.5 meters. A total of 57 meters was cored at this offset site and 53.7 meters recovered, representing 94% recovery (Table 2).

Four heat flow runs were made in Hole 216 (Table 1) and details are given in Chapter 13.

LITHOLOGIC SUMMARY

Two holes were drilled at Site 216: the main hole, continuously cored from 158.5 meters to the total depth of 477.5 meters, and a complementary hole, 216A, continuously cored from 101.5 meters to the total depth of 158.5 meters. Taken together, the two holes penetrate a section that was continuously cored except for 70 meters near the surface (Figure 3).

Pleistocene to late Maastrichtian nannofossil ooze and chalk, 348 meters thick, overlies older late Maastrichtian volcanic clay, micarb, and ash, 110 meters thick, which in turn overlies basalt. Three lithologic units are recognized, as shown in Figure 3 and below.

Unit	Depth Below Sea Floor (m)	Lithology	Age	Cores
1a	0 to 187	Nanno ooze to chalk with variable foram content	Pleistocene to late Oligocene	1-7
1b	187 to 332	Nanno chalk	Late Oligocene to Paleocene (Danian)	8-23
1c	332 to 348	Glauconite-bearing clay-rich micarb chalk	Late Maastrichtian	23-24
2a	348 to 396	Glauconitic volcanic clay micarb chalk	Late Maastrichtian	25-29
2b	396 to 457	Intermixed volcanic clay and micarb chalk with discrete beds of ash	Late Maastrichtian	30-36
3	457 to 477.5	Basalt, amygdalar, vesicular, scoriaceous, and minor vitric tuff	?	36-38

Unit 1–Nannofossil Ooze/Chalk (Cores 1-24)

Almost all of Unit 1 is made up of calcareous nannofossils with variable amounts of foraminifera. The bulk of this nannofossil material in the lower part of the unit is in large part disaggregated or calcified, and definite distinguishable nannofossils are rare. There is also some irregular shaped, coarse, silt-sized material definitely not of nannofossil origin. Subunit 1a is white in color and parts contain as much as 50% foraminifera, but most of it contains about 5%. Subunit 1b is almost pure white nannofossil chalk, in which impurities do not exceed 2%, except a few thin layers of chert in its lower part. Subunit 1c is light gray and is made up predominantly of silt-sized carbonate particles, described here as micarbs, with some foraminifera, nannofossils, clay, and glauconite. The latter two constituents and the burrowed structure denote a transition to Unit 2. All other constituents in Unit 1 are siliceous microfossils–radiolarians, diatoms, and sponge spicules. At a depth of 170 meters, Unit 1 changes from ooze above to chalk below. The actual nomenclature change to micarb chalk is arbitrary as there is a progressive increase of nonidentifiable silt-sized carbonate through Unit 1. However, in Unit 1c practically no recognizable nannofossils remain.

Unit 2–Volcanic Clay and Micarb Chalk (Cores 25-36)

Unit 2 is a complex sequence of greenish gray intermixed volcanic clay and micarb chalk. These sediments are burrowed and contain bivalves. The volcanic clay occurs both in the matrix and as sand- and pebble-sized aggregates. Much of this material is chloritized. The remainder of the

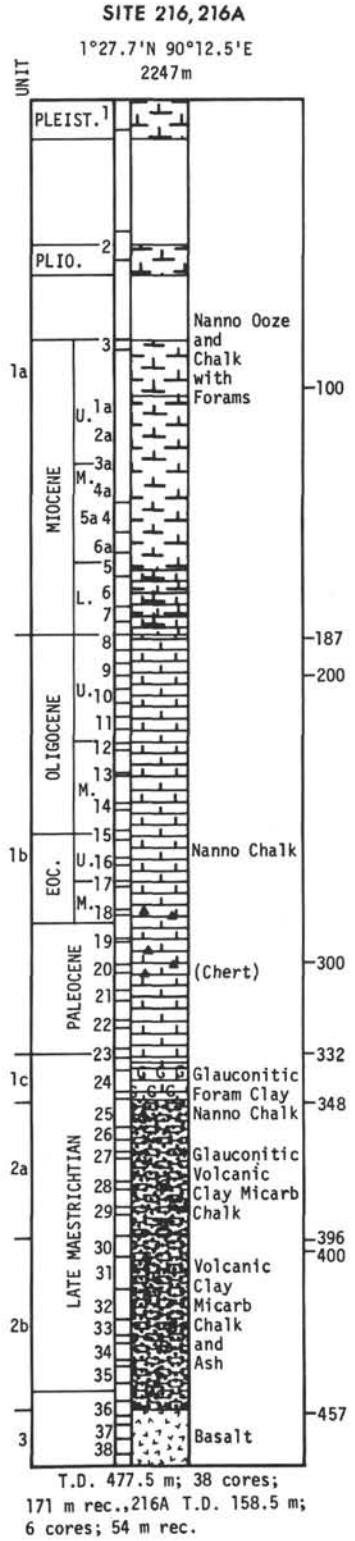


Figure 3. *Lithologic units at Site 216.*

matrix is micarb chalk and contains as much as 5% each of foraminifera and recognizable nannofossils. Subunit 1a is a greenish gray glauconitic volcanic clay micarb chalk. Other constituents, in trace amounts only, are dolorhombs and apatite. Subunit 1b is distinguished from 1a by its higher content of volcanic clay and basaltic glass, some of the latter occurring as discrete ash beds, and reduction of glauconite to trace amounts only. Fossils include bivalve fragments, foraminifera, and trace amounts of radiolarians and diatoms. Apatite locally makes up a few percent of the rock. As in Subunit 1a, clay clasts several millimeters across are common. A few meters above the contact with basalt is a narrow vein of calcite.

Unit 3–Basalt (Cores 36-38)

The volcanics are divided into: (1) tuff with basaltic debris, (2) vesicular and amygdalar basalt, (3) fine-grained basalt with less than 3% vesicles and amygdules, and (4) pale red scoriaceous basalt.

1) The tuff located approximately at 458 meters is interbedded between thin layers of vesicular and amygdalar basalt. This lithic tuff consists of an upper portion (about 40 cm) made up mainly of chloritic material, a few basaltic fragments, and carbonate material; and a lower portion (60 cm thick) containing volcanic debris and chloritic material. The chloritic material is made up mainly of chlorite, vermiculite-chlorite, and it is associated with green mica. Also the chloritic materials fill areas having the shape of volcanic shards.

2) The amygdalar and vesicular basalt located mostly in the lower part of the recovered basalt consists of large vesicles and amygdules (Core 37, Section 3 and Core 38, Sections 3 and 4) varying in size from 1 mm to about 15 mm in diameter. The size increases with depth. There is also an amygdalar zone less than 1 meter thick at the top of the basalt section. The amygdules of this latter zone are filled with calcite. The general textural feature of these zones is intersertal medium to fine grained. Microphenocrysts of partially chloritized and zoned plagioclase are set in a matrix containing plagioclase laths, granules of clinopyroxene, dark mesostasis, calcite, and chlorite.

3) The fine-grained basalt (Core 37, Sections 1, 2, 3, and 4; Core 38, Sections 1 and 2) consists of more crystalline and less vesiculated rocks than the rest of the unit. The general texture is pilotaxitic and trachytic. The major mineral constituents are plagioclase, clinopyroxene, iron ore, and chlorite. Some of the opaques (iron ore) show a reaction rim of hematite. The chlorite occurs as an alteration product of matrix material and also as inclusions in plagioclase microphenocrysts. Thin veins containing native copper were seen at 110-115 cm (Core 38, Section 1).

The upper and lower portion of the fine-grained basalt is limited by the occurrence of highly oxidized scoriaceous basalt.

4) The scoriaceous basalt (Core 36, Section 4; Core 37, Section 1; and Core 38, Section 3) is highly vesicular and contains an abundant dark mesostasis enriched in opaques (iron ore), granules of hematite, and glass. Tiny plagioclase laths show a subparallel arrangement.

CHEMICAL PROPERTIES

Sixteen samples were taken from the 38 cores recovered at this site. All samples were squeezed for pore water and individual subprogram quantity requirements were met in all but one instance. Only 2 ml was recovered from 216-28-3, which was preserved for major elements analysis. Contiguous pairs of minicores were taken from six carbonate cores and in situ pH measurements were made with the punch-in electrodes on one sample from each pair. A special pair of samples was taken from one of the six cores recovered from Hole 216A and used solely for pH studies.

Temperature coefficients and pH values obtained from both punch-in (sediment) and flow-through (pore water) measurements are given below. As before, the punch-in data have been adjusted to the temperature recorded for the flow-through measurements as shown below.

Sample	Slope (mv/°C)	pH (punch-in)	pH (flow-through)	Temperature
216-1-6	0.89	7.31	7.69	25.2
216-2-5	0.84	6.98	6.84	25.0
216-4-5	0.92	6.77	7.10	26.2
216-5-5	0.96	6.73	6.84	27.5
216-6-4	0.87	6.78	6.92	26.5
216-21-2	0.85	7.21	7.10	25.4

The temperature coefficients show the smallest range for any site so far investigated (0.12 mv/°C). The punch-in pH values continue to show a smoother trend with depth than the data obtained with the flow-through electrode.

Since it is necessary to hold minicores for varying periods of time up to 24 hours before slope determinations can be made, the effect of storage was investigated at this site. A contiguous pair of minicores was taken from 216A-4-5 for this purpose. One sample was placed in the refrigerator. The other sample was used immediately for a slope determination and the millivolt change was monitored while warming from the recovery to the laboratory temperature. At the termination of the experiment this sample was resealed and also placed in the refrigerator. Slope checks were made on both minicores after 24 hours storage at 4° C. The results are tabulated below.

Sample	Slope (mv/°C)	pH (20°C)
216A-4-5 (1)	0.85	6.91
216A-4-5 (1) (opposite end)	0.89	6.92
216A-4-5 (2)	0.96	6.92

While the slopes appear to change with storage, this difference can, perhaps, be visualized better in terms of pH units/°C; this value for the first two measurements is 0.015 and for the third, 0.016. In this instance we conclude that the effects of storage are negligible.

TABLE 1
Coring Summary, Hole 216

Core	Date (Feb)	Time	Depth from Drill Floor (m)	Depth Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovery (%)
1	19	0605	2247.0-2256.5	0-9.5	9.5	9.5	100
2	19	0750	2291.5-2301.0	44.5-54.0	9.5	9.5	100
3	19	0915	2329.5-2339.0	82.5-92.0	9.5	2.1	22
4	19	1035	2367.5-2377.0	120.5-130.0	9.5	9.5	100
5	19	1215	2405.5-2414.0	158.5-167.0	8.5	8.5	100[a]
6	19	1310	2415.0-2424.5	168.0-177.5	9.5	9.5	100
7	19	1410	2424.5-2434.0	177.5-187.0	9.5	2.6	30
8	19	1530	2434.0-2442.5	187.0-195.5	8.5	2.6	32[a]
9	19	1600	2443.5-2453.0	196.5-206.0	9.5	4.5	48
10	19	1705	2453.0-2462.5	206.0-215.5	9.5	2.8	29
11	19	1820	2462.5-2471.0	215.5-224.0	8.5	0.9	10[a]
12	19	1920	2472.0-2481.5	225.0-234.5	9.5	2.1	23
13	19	1950	2481.5-2491.0	234.5-244.0	9.5	5.6	6
14	19	2105	2491.0-2499.5	244.0-252.5	8.5	3.5	41[a]
15	19	2145	2500.5-2510.0	253.5-263.0	9.5	3.6	38
16	19	2235	2510.0-2519.5	263.0-272.5	9.5	3.8	40
17	19	2325	2519.5-2529.0	272.5-282.0	9.5	2.8	29
18	20	0035	2529.0-2538.5	282.0-291.5	9.5	0.4	4
19	20	0128	2538.5-2548.0	291.5-301.0	9.5	0.3	3
20	20	0225	2548.0-2557.5	301.0-310.5	9.5	5.4	57
21	20	0336	2557.5-2567.0	310.5-320.0	9.5	2.2	24
22	20	0450	2567.0-2576.5	320.0-329.5	9.5	3.6	38
23	20	0610	2576.5-2586.0	329.5-339.0	9.5	3.6	38
24	20	0720	2586.0-2595.5	339.0-348.5	9.5	6.3	66
25	20	0830	2595.5-2605.0	348.5-358.0	9.5	6.5	67
26	20	1000	2605.0-2614.5	358.0-367.5	9.5	4.0	42
27	20	1130	2614.5-2624.0	367.5-377.0	9.5	3.0	31
28	20	1230	2624.0-2633.5	377.0-386.5	9.5	3.6	38
29	20	1325	2633.5-2643.0	386.5-396.0	9.5	2.5	26
30	20	1412	2643.0-2652.5	396.0-405.5	9.5	7.1	75
31	20	1455	2652.5-2662.0	405.5-415.0	9.5	6.6	70
32	20	1550	2662.0-2671.5	415.0-424.5	9.5	8.2	86
33	20	1655	2671.5-2681.0	424.5-434.0	9.5	3.0	32
34	20	1820	2681.0-2690.5	434.0-443.5	9.5	6.1	64
35	20	1920	2690.5-2700.0	443.5-453.0	9.5	3.4	36
36	20	2040	2700.0-2709.5	453.0-462.5	9.5	5.5	58
37	20	2359	2709.5-2715.5	462.5-468.5	6.0	5.2	87
38	21	0330	2715.5-2724.5	468.5-477.5	9.0	6.0	67
Total					353.0	175.9	48.3

Note: Echo sounding depth (to drill floor) = 2262 meters; drill pipe length to bottom = 2247 meters.

[a]Heat flow runs.

TABLE 2
Coring Summary, Hole 216A

Core	Date (Feb)	Time	Depth from Drill Floor (m)	Depth Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovery (%)
1	21	0945	2348.5-2358.0	101.5-111.0	9.5	8.8	92
2	21	1045	2358.0-2367.5	111.0-120.5	9.5	9.3	98
3	21	1140	2367.5-2377.0	120.5-130.0	9.5	8.7	92
4	21	1220	2377.0-2386.5	130.0-139.5	9.5	9.0	95
5	21	1320	2386.5-2396.0	139.5-149.0	9.5	9.0	95
6	21	1415	2396.0-2405.5	149.0-158.5	9.5	8.9	93
Totals					57.0	53.7	94

Note: Echo sounding depth (to drill floor) = 2262 meters; drill pipe length to bottom = 2247 meters

BIOSTRATIGRAPHIC SUMMARY

General

The carbonate section extends from Pleistocene to late Maastrichtian. Preservation of calcareous fossils is consistently poorer at Site 216 than at Site 214.

A thick basal section consists of glauconites, mudstones, carbonates, volcanics, and the sediments were probably all deposited in relatively shallow water. There are enough nannofossils throughout the interval to suggest rapid accumulation entirely within the *Nephrolithus frequens* Zone (Late Maastrichtian).

The Cretaceous/Tertiary boundary can be pinned down to a horizon at Sample 23-2, 105 cm, which marks a change in sediment structure from bioturbated, variegated, and with well-defined burrows (upper Maastrichtian) to homogeneous and relatively featureless, though well worked over biologically (Danian). A break in sedimentation, representing perhaps 2 m.y. corresponds to the Cretaceous-Tertiary boundary.

Foraminifera

Cores 1 to 4 extend from the Pleistocene to the middle Miocene. Cores 5 to 8 cover the zone interval N.5 to N.3. *Globigerinoides* is associated with the *Globorotalia kugleri* group in 6, CC but not in Core 7, Section 1, and the Oligocene/Miocene boundary is placed tentatively between these samples. However, the *Globigerinoides* record in not good for preservational reasons, and there are indications that N.5 is mixed with N.4. Cores 9 to 16 are progressively less satisfactory, again because of the absence of numerous species. The middle upper Eocene boundary is placed above the disappearance of *Truncorotaloides* and *Acarinina* (i.e., above 17-2); this is a good approximation in low latitudes. Preservation is still poor, but better, and specimen numbers increase downhole dramatically at this level. Successive cores record lower middle Eocene, no lower Eocene, and plenty of Paleocene sediment. The latter ends within Core 23, Section 1; where there is a Zone P.1c (upper Danian) assemblage, identified by the presence of *Planorotalites compressa.* The lowest sample taken with this assemblage is 5 cm above a well-marked contact at 105 cm, and 5 cm below this there is an upper Maastrichtian assemblage. Thus, the Cretaceous/Tertiary boundary is placed at this contact, and there is a hiatus here valued at some 2 m.y. In terms of good correlations, the record ends with Core 24 (upper Maastrichtian). *Globotruncana mayaroensis* is unusually common in 23, CC.

Both benthonic and planktonic species occur consistently in Cores 25 through 35. The latter are represented by *Heterohelix, Guembelitria,* and ? *Hedbergella*—only a small, tough fraction of the oceanic fauna of the time and rare in occurrence. Benthonics are also sparse but rather diverse in terms of total taxonomic accumulation; agglutinated forms are no more common than in open-shelf assemblages; *Lenticulina,* nodosariids, buliminids, and cibicidids are the most persistent, although gavelinellids are common at the top; on the sparse recoveries available no significant change has been detected through the three main lithologies. The data are consistent with the idea of a shallow, somewhat restricted environment into which the "more inshore" planktonics were washed and within which benthonics could exist; salinity was not significantly below normal. That is, age is the main difference between basal Site 216 and basal Site 214.

Nannofossils

Calcareous nannofossils were recovered at Site 216 throughout the sedimentary interval cored, and range in age from Quaternary to late Maastrichtian. Because of discontinuous coring an incomplete Neogene record was obtained. Gaps in the record below the Miocene may correspond to hiatuses as this interval was cored continuously. Core 1 is entirely Pleistocene in age but represents less than half a million years of late Pleistocene history. Core 2 represents a mid-Pliocene interval and Cores 3 through 7 recovered Miocene sediments. The Oligocene-Miocene boundary probably is within Core 8, though the nannofossils do not yield a precise boundary. The rather thick Oligocene section extends through Core 15, Section 3 with a good part of the early Oligocene interval missing or represented in a much attenuated portion of Core 15, Section 2. Late and middle Eocene sediments were

recovered from the core catcher of Core 15 down through Core 18, Section 2, with possible early Eocene sediments in the core catcher of Core 18. An incomplete Paleocene section was recovered in Cores 19 through 23, Section 2, with the Cretaceous-Tertiary boundary contained within Section 2 between 105 and 110 cm. The remaining calcareous sediments are all assignable to the late Maastrichtian *Nephrolithus frequens* Zone.

The preservation of nannofossils throughout the interval is poor except in the Pliocene and Pleistocene. Species diversity is low and many specimens are heavily calcified. It is noteworthy, perhaps, that the late Maastrichtian is marked by the presumed high latitude index species *Nephrolithus frequens* and by the exclusion of the low latitude indicator for this interval, *Tetralithus murus.*

Hole 216A was drilled in order to recover a continuous section of the early Neogene interval which contains well-preserved Radiolaria. The six cores taken for this purpose range in age from the late Miocene (*Discoaster neohamatus* Zone) at the base of Core 216A-1 to the early Miocene at the base of Core 216A-6.

Radiolaria

Radiolaria in cores obtained at Holes 216 and 216A range in age from Quaternary to Upper Cretaceous (Maastrichtian). The Quaternary and Pliocene section (Cores 216-1, 216-2, and 216-3) contains moderately to poorly preserved Radiolaria. The upper Miocene to upper Eocene section (Cores 216A-1 through 216-17) contains generally well-preserved radiolarian assemblages. There is a transition zone near the upper-middle Eocene boundary (Cores 216-18 and 216-19) within which Radiolaria are sparse and poorly to moderately preserved. Within the interval between the upper Eocene sediment and the basaltic "basement" Radiolaria are absent, except for a few specimens of Upper Cretaceous (Maastrichtian) Radiolaria which are present in Cores 30 and 31.

Only three cores were obtained from the Quaternary and Pliocene sediment. Core 216-1 is Quaternary; Core 216-2 is in the lower Pliocene *Spongaster pentas* Zone; Core 216-3 is in the upper Miocene *Stichocorys peregrina* Zone.

The base of the *Stichocorys peregrina* Zone is between Samples 216-3, CC and 216A-1-1, 70-72 cm. The base of the *Ommatartus penultimus* Zone is between Samples 216A-1, CC and 216A-2-1, 66-68 cm. The base of the *Ommatartus antepenultimus* Zone is between Samples 216A-2, CC and 216A-3-1, 43-45 cm. The base of the *Cannartus petterssoni* Zone is between Samples 216A-3, CC and 216A-4-2, 73-75 cm. The base of the *Dorcadospyris alata* Zone is between Samples 216A-5-5, 70-72 cm and 216A-5, CC. The base of the *Calocycletta costata* Zone is between Samples 216A-6, CC and 216-5-1, 110-112 cm. The base of the *Calocycletta virginis* Zone is between Samples 216-8-2, 30-32 cm and 216-8, CC. The base of the *Lychnocanoma elongata* Zone is between Samples 216-8, CC and 216-9-1, 30-32 cm. The base of the *Dorcadospyris ateuchus* Zone is between Samples 216-12-1, 110-115 cm and 216-12-2, top. The base of the *Theocyrtis tuberosa* Zone is between Samples 216-14, CC and 216-15, CC. The base of the *Thyrsocyrtis bromia* Zone is between the base of Core 16 and the top of Core 17. No samples were obtained from the *Podocyrtis goetheana* and *Podocyrtis chalara* zones; consequently, there appears to be a hiatus between the base of Core 16 and the top of Core 17. Cores 17 through 19 contain moderately to poorly preserved Radiolaria which are within the *Podocyrtis mitra* Zone. Below Core 19 Radiolaria are absent, except for several upper Maastrichtian species in the core catcher of Cores 30 and 31.

CORRELATION OF REFLECTION PROFILE AND STRATIGRAPHIC COLUMN

Site 216 is situated on the crest of Ninetyeast Ridge. The seismic reflection profile of the general area shows a sediment cover varying between 0.4 and 0.7 sec in thickness (Figure 4). This sediment appears to be draped over the basement of the ridge.

Generally speaking, acoustic basement in the vicinity of Site 216 is continuous and well defined and can confidently be traced to the actual site area where it occurs at a depth of 0.44 sec. Within the sediment overlying basement, two zones of acoustic layering occur at 0.13 and 0.27 sec. These zones are separated from each other as well as from sediment surface and basement by acoustically relatively transparent layers.

The only correlation that can be made with confidence between the airgun record and stratigraphic column is that of the basalt surface. This occurs at a sediment depth of 457 meters, representing 0.44 sec on the seismic profile. If this correlation is correct, the interval velocity of the entire sediment column is 2.1 km/sec.

The two reflectors within the sediment layer do not correlate well with any obvious lithological parameters. It is possible that the lower reflector may be due to chert stringers which begin at a sediment depth of about 280 meters.

Depths of reflectors and interval velocities are as follows:

Reflector	2-Way Time (sec)	Depth (m)	Interval Velocity (km/sec)	
0	0	0		
1	0.13	130	2.0	2.1
2	0.28	282	2.2	
4	0.44	457	2.0	

SUMMARY AND CONCLUSIONS

Site 216 was selected on the crest of Ninetyeast Ridge approximately 1° north of the equator in a water depth of 2237 meters. The seismic reflection profile of the area indicates a relatively thick sedimentary section overlying seismic basement. In the actual site area the section is about 0.5 sec thick and is composed of acoustically bedded sediments draped over the basement topography. No obvious ponding of the layers is evident, although thickening of sediments occurs in some cases on the flanks of the Ridge, possibly due to slumping.

The stratigraphic column at Site 216 comprises three units, the lowermost of which is a tholeiitic basaltic rock with a composition similar to suites from St. Paul and New Amsterdam islands and significantly different from midocean ridge basalts. Lack of pillow structures and the

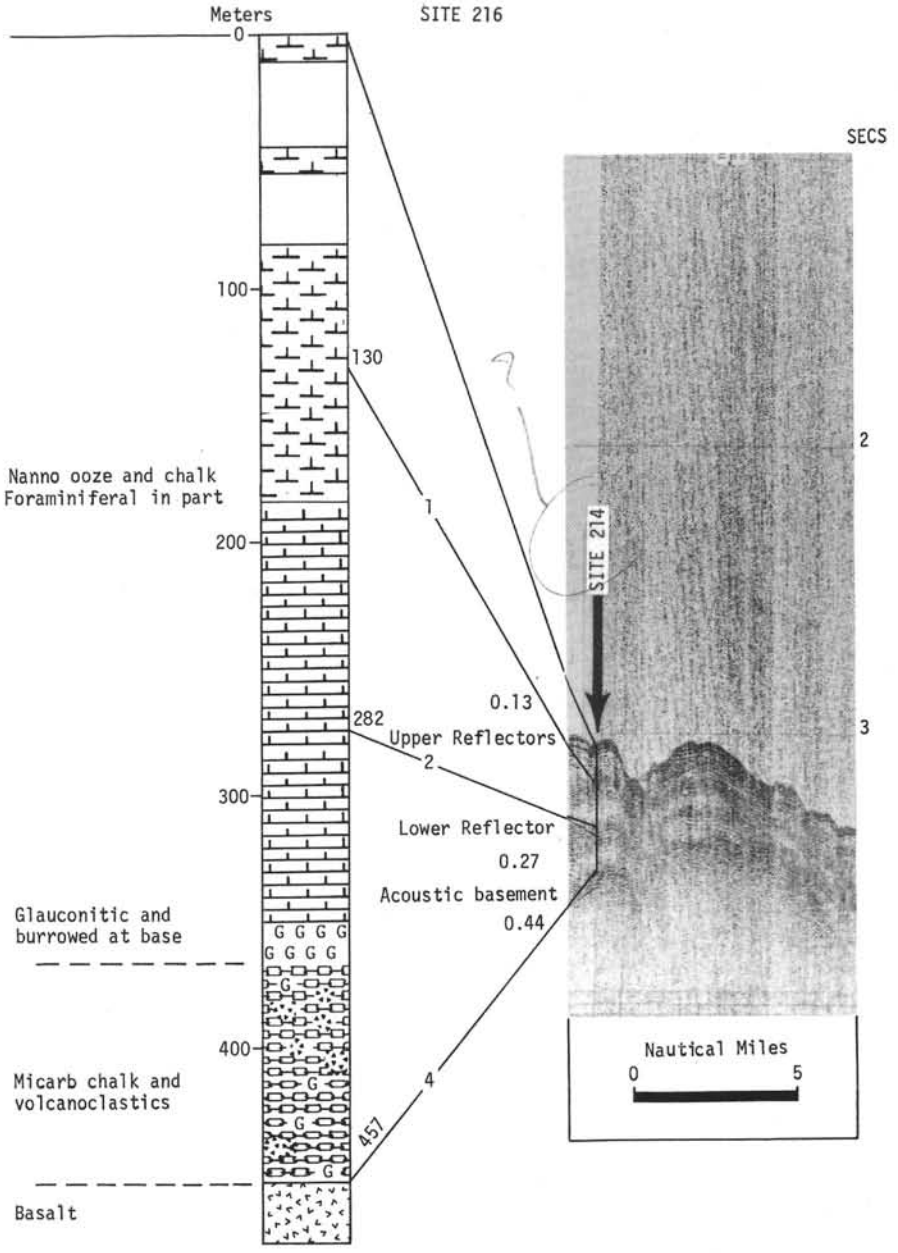


Figure 4. *Correlation of reflection profile and stratigraphic column at Site 216.*

amygdalar and vesicular nature of the rock suggest aerial or near-surface lava extrusion.

The oldest sedimentary unit, immediately overlying the basalt, consists of late Maastrichtian ash beds, chalks, and volcanogenic clays. Microfossil evidence, the presence of a molluscan fauna, and the occurrence of glauconite attest to a shallow water environment. By Paleocene time, paleontological evidence as well as the upward disappearance of glauconite suggest deepening of the area. The uppermost lithologic unit, of late Maastrichtian to Pleistocene or Recent age, is mainly composed of foraminifera-bearing nannofossil ooze and chalk. Sediments of this unit typify pelagic calcareous sedimentation above the $CaCO_3$ compensation depth and document further subsidence of the Ninetyeast Ridge to oceanic depths. This subsidence occurs earlier at this site than at Site 214.

The oldest sediments at Site 216 are 8 to 10 m.y. older than those at Site 214. Site 216 is 1400 km north of Site 214. Thus the "effective" spreading rate on this feature during the Late Cretaceous and early Tertiary is between 18 and 14 cm/yr. This is significantly greater than the spreading rate for the Indian plate during this time span (between 6 and 12 cm/yr). This is strong evidence that the origin of the Ninetyeast Ridge cannot be totally accounted for by a point source magma chamber beneath the Indian plate.

REFERENCE

Curray, J. R. and Moore, D. G., 1971. Growth of the Bengal deep-sea fan and denudation in the Himalays: Geol. Soc. Am., v. 82, p. 563-572.

Site 216 Hole Core 1 Cored Interval: 0-9.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	Emiliania huxleyi Zone / Gephyrocapsa oceanica Zone	N	A	G	1	0.5–1.0			20	NANNO FORAM OOZE yellowish gray (5Y7/2) Volcanic glass (rhyolitic) 2% Forams 55% Nannos 32% Diatoms Tr. Rads 1% Spicules, silicoflag. Tr. Clay 10%
										mottle (dark gray)
					2			TOO WET TO OPEN	40	
										very pale orange (10YR8/2)
					3				70	FORAM NANNO OOZE olive gray (5Y4/1), streaks of light gray Forams 25% Nannos 65% Clay 10%
										10Y8/2, interbeds of olive gray olive gray
					4				140	FORAM NANNO OOZE 10YR8/2, mottles of gray Glass 1% Forams 29% Nannos 60% Clay 10%
										grayish yellow (5Y8/4)
										5Y4/1 5Y8/4
					5				70 90	FELDSPAR BEARING RHYOLITIC GLASS ASH 5Y4/1 Feldspar 7% Hornblende 1% Volcanic glass 90% Forams Tr. Nannos 2%
										10YR8/2 White (N9)
										FORAM NANNO OOZE white (N9) Forams 40% Nannos 60%
					6				120	very light gray (N8) white (N9)
										RHYOLITIC GLASS ASH 5Y4/1 Feldspar 3% Glass 95% Forams Tr. Nannos 2%
	Pseudoemiliania lacunosa Zone N22	N	A	G	Core Catcher					N9 FORAM NANNO OOZE Glass 1% Forams 27% Nannos 70% Diatoms 1% Rads 1%
		F	A	P						
		R	F	P						

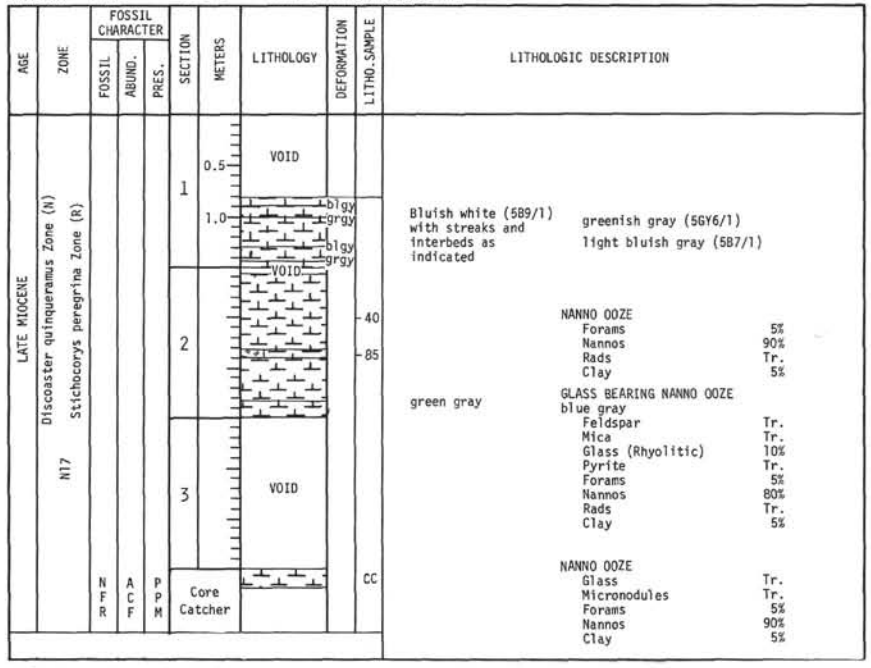
Explanatory notes in Chapter 1

Site 216 Hole Core 2 Cored Interval: 44.5-54.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLIOCENE	Discoaster surculus Zone / Spongaster pentas Zone (R) / Reticulofenestra pseudoumbilica Zone N20	R	F	M	1	0.5–1.0			20	FORAM NANNO OOZE bluish white (5B7/1), massive, vague mottles Forams 30% Nannos 60% Clay 10%
					2				40	FORAM NANNO OOZE pale blue (5PB7/2) 5B9/1 Glass 1% Forams 35% Nannos 54% Clay 10%
					3					
					4					Not opened.
							GEO CHEM SAMPLE			5B9/1
					5				55	FORAM AND NANNO RICH RHYOLITIC ASH dusky yellow green (5GY5/2) 5B9/1 Feldspar 1% Mica 1% Heavy minerals Tr. Glass 70% Forams 14% Nannos 14%
					6					FORAM NANNO OOZE medium light gray (N6) Glass 1% Forams 30% Nannos 59% Clay 10%
									115	FORAM NANNO OOZE Forams 30% Nannos 60% Clay 10%
		N	A	F	Core Catcher					
		F	A	M						
		R	F	M						

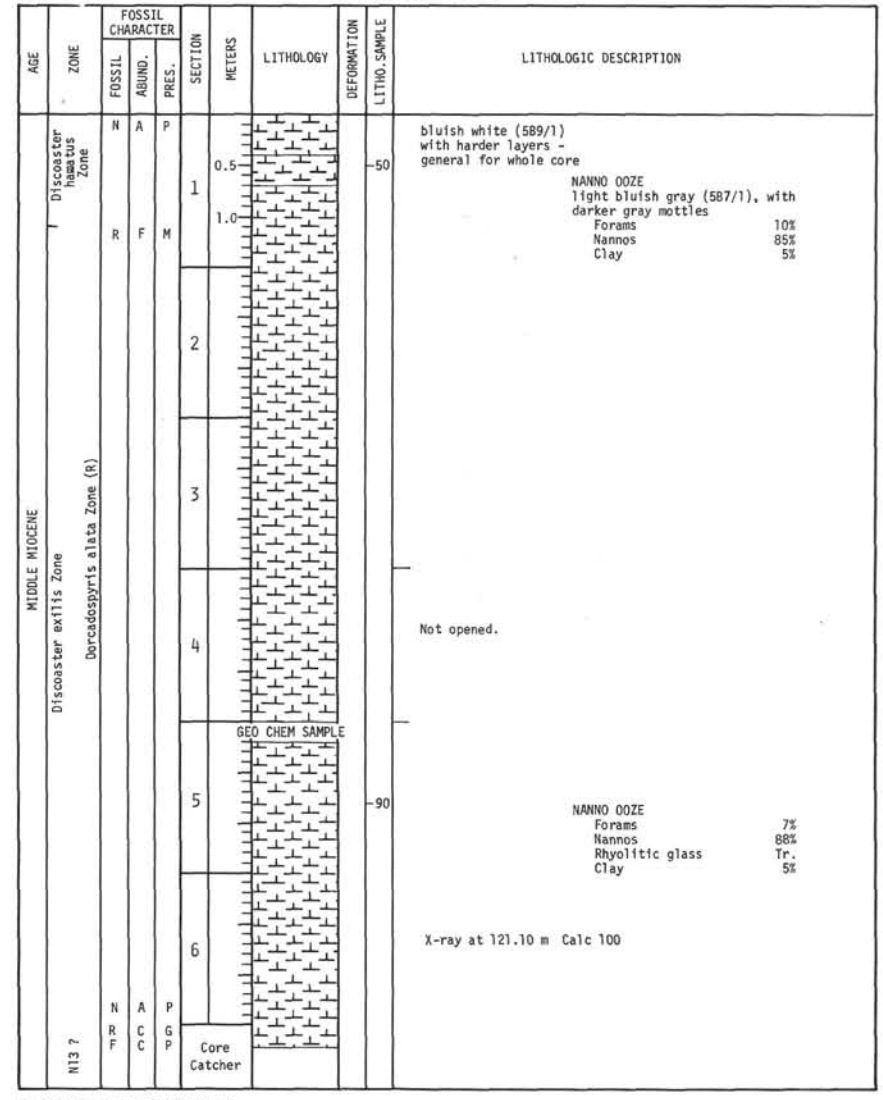
Explanatory notes in Chapter 1

Site 216 Hole Core 3 Cored Interval: 82.5-92.0 m



Explanatory notes in Chapter 1

Site 216 Hole Core 4 Cored Interval: 120.5-130.0 m



Explanatory notes in Chapter 1

Site 216 Hole Core 5 Cored Interval: 158.5-167.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE MIOCENE	Sphenolithus heteromorphus Zone	N R	A C	P G	1	0.5 1.0	VOID			bluish white (5B9/1) (uniform for whole of core 5)
EARLY MIOCENE	? Sphenolithus belemnos Zone	R	C	G	2				67	FORAM RICH NANNO OOZE Forams 15% Nannos 80% Clay 5%
	Calocycletta virginis Zone (R)	R	F	P	3					
		R	C	G	4					
	?	R	C	M	5		GEO CHEM SAMPLE			
	?	R	C	G						
		R	C	G	6					
		F R N	R C A	P G P	Core Catcher					

Explanatory notes in Chapter 1

Site 216 Hole Core 6 Cored Interval: 168.0-177.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
EARLY MIOCENE	N5 (F)	F	C	P	1	0.5 1.0			70	NANNO OOZE white (N9) chalk Forams 5% Nannos 90% Clay 5%
	Calocycletta virginis Zone (R)	R	C	M						
		R	C	G	2					
		R	F	M	3					
		R	C	G						
		R	C	G	4					
		R	C	G	5					
		R	C	G	6					
	N4 (F)	M R	A C	P G	Core Catcher					

Explanatory notes in Chapter 1

Site 216 Hole Core 7 Cored Interval: 177.5-187.0 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
LATE OLIGOCENE	(F) ? upper N3 Calocycletta virginis Zone (R) (F) N3 (F) N3	F R F R N F R	C C C C A C A	P M P M P M G	1 2 3 Core Catcher	0.5 1.0	VOID VOID		95	NANNO CHALK white (N9) Forams 5% Nannos 90% Rads Tr. Spicules Tr. Silicoflag. Tr. Clay 5% Not opened. as above

Site 216 Hole Core 8 Cored Interval: 187.0-195.5 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
LATE OLIGOCENE	Calocycletta virginis Zone (R) L. elongata Zone (R) (F) N3 (F)	R R F R N	C C R C A	M M P G P	1 2 3 Core Catcher	0.5 1.0	VOID		100	Heat flow: not opened. NANNO CHALK white (N9) Forams 1% Nannos 94% Rads Tr. Spicules Tr. Clay 5% as above

Site 216 Hole Core 9 Cored Interval: 196.5-206.0 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
LATE OLIGOCENE	Sphenolithus ciperoensis Zone Dorcadospyris ateuchus Zone (R) ?N2	R R N F R	C C A R C	G G P P G	1 2 3 Core Catcher	0.5 1.0	VOID			NANNO CHALK white (N9) Feldspar Tr. Forams Tr. Nannos 95% Clay 5% Not opened. as above

Site 216 Hole Core 10 Cored Interval: 206.0-215.5 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
LATE OLIGOCENE	Sphenolithus ciperoensis Zone Dorcadospyris ateuchus Zone (R) N2	R R F R	C C R C	G M P M	1 2 3 Core Catcher	0.5 1.0	VOID		84	NANNO CHALK white (N9) Forams Tr. Nannos 95% Rads Tr. Spicules Tr. Clay 5% Not opened. as above

Explanatory notes in Chapter 1

Explanatory notes in Chapter 1

Site 216 Hole Core 11 Cored Interval: 215.5-224.0 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
OLIGOCENE	Sphenolithus distentus Zone N2 Dorcadospyris ateuchus Zone(R)	N F R	A C C	F F M	1	0.5 1.0	VOID			NANNO CHALK white (N9)
					Core Catcher					NANNO CHALK/OOZE white (N9)

Site 216 Hole Core 12 Cored Interval: 225.0-234.5 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
OLIGOCENE	Sphenolithus distentus Zone D. ateuchus Zone (R) T. tuberosa Zone (R) N2	R R F R	C C C C	G G P G	1	0.5 1.0	VOID		110	NANNO CHALK white (N9) Authigenic carbonates 1% Forams Tr. Nannos 94% Clay 5%
					2					Not opened.
					Core Catcher					

Site 216 Hole Core 13 Cored Interval: 234.5-244.0 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
OLIGOCENE	Sphenolithus distentus Zone ? P19-20 Theocyrtis tuberosa Zone (R)	R F R	C C C	G P G	1	0.5 1.0	VOID		110	NANNO CHALK white (N9) Forams Tr. Nannos 95% Rads Tr. Spicules Tr. Clay 5%
					Core Catcher					

Explanatory notes in Chapter 1

Site 216 Hole Core 14 Cored Interval: 244.0-252.5 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
OLIGOCENE	Sphenolithus distentus Zone Theocyrtis tuberosa Zone (R) ? P19	R R N F R	C C P R C	G G F P G	1	0.5 1.0	VOID		135	NANNO CHALK white (N9) Forams Tr. Nannos 95% Rads Tr. Spicules Tr. Clay 5%
					2					Not opened.
		R	C	G	3					as above
					Core Catcher					

Site 216 Hole Core 15 Cored Interval: 253.5-263.0 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
OLIGOCENE / LATE EOCENE	Cyclococcolithina formosa Zone/ Sphenolithus distentus Zone ? T. bramla Zone (R)	N F R N	A R C A	F P G F	1	0.5 1.0	VOID		90	NANNO CHALK white (N9) Forams Tr. Nannos 95% Rads Tr. Spicules Tr. Clay 5%
					2					Not opened.
					3					as above
					Core Catcher					

Explanatory notes in Chapter 1

Site 216 Hole Core 16 Cored Interval: 263.0-272.5 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
(LATE) MIDDLE EOCENE	Discoaster barbadiensis Zone (N) / Thyrsocyrtis bromia Zone (R)	R	C	G	1	0.5 / 1.0	VOID			NANNO CHALK white (N9)
		R	C	G	2					scattered grains of pumice
		R	F	G	3					Not opened.
	?	N F R	A R C	P P G	Core Catcher					as above

Site 216 Hole Core 17 Cored Interval: 272.5-282.0 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
LATE EOCENE / MIDDLE EOCENE	D. barbadiensis (R) Zone (P14) (F) / Chiasmolithus grandis Zone / Podocyrtis mitra Zone / Truncorotaloides rohri Zone	R	A	G	1	0.5 / 1.0	VOID			NANNO CHALK white (N9) Authigenic carbonates 1% Forams 1% Nannos 88% Clay 10%
		F R	C	P G	2				95	
		N F R	C C C	P P G	Core Catcher					same

Site 216 Hole Core 18 Cored Interval: 282.0-291.5 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EOCENE	Morozovella lehneri Zone (P11) (F)	F N R	F A -	P P	1	0.5 / 1.0	VOID			CHERT yellowish gray (5Y8/1) and dark yellowish brown (10YR4/2) bands 1 cm thick. NANNO CHALK white (N9)
					2					
EARLY EOCENE?		F R N	C R R	P M P	3					CHALK AND 2 pieces CHERT moderate reddish brown, gray and white.
					Core Catcher					

Site 216 Hole Core 19 Cored Interval: 291.5-301.0 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
PALEOCENE	Discoaster multiradiatus Zone (N) / Morozovella velascoensis Zone (P5) (F) / M. velascoensis - M. subbotinae Zone (P6a) (F)	F	C	P	1	0.5 / 1.0	VOID		139	NANNO CHALK white (N9) lenses of yellowish gray (5Y8/1) Goethite Tr. Authigenic carbonates 2% Nannos 93% Clay 5%
		N F R	R C -	P P	Core Catcher					X-ray at 292.60 m Calc 87, Quar <1, Paly 12

Explanatory notes in Chapter 1

Explanatory notes in Chapter 1

Site 216 Hole Core 20 Cored Interval: 301.0-310.5 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
PALEOCENE	Discoaster mohleri Zone / Planorotalites pseudomenardii Zone (P4) (F) / Discoaster multiradiatus Zone / Morozovella velascoensis Zone (P5) (F)	N F R	A C -	P F	1	0.5	VOID			MnO_2 MICRONODULES white (N9): also light olive gray 5Y6/1 and grayish orange pink (5YR7/2). MnO_2 dots NANNO CHALK Nannos 95% Clay 5%
						1.0	Mn		90	
					2		VOID		130 157	
					3					
					Core Catcher					

Site 216 Hole Core 21 Cored Interval: 310.5-320.0 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
PALEOCENE	Discoaster mohleri Zone / Planorotalites pseudomenardii Zone (P4) (F)	F	A	F	1	0.5	VOID			grayish orange pink (10R8/2) cherty chalk NANNO OOZE pinkish white Nannos 93% Forams 1% Authigenic carbonates 1% Clay 5%
		F	A	F		1.0	GEO CHEM SAMPLE			chert, dark reddish brown (10R3/4) white chalk
		F	A	F	2		Mn			pink white ooze chert, as above white chalk, MnO_2 micronodules, light gray laminae
		R	-		Core Catcher					white chalk X-ray at 311.20 m Calc 99, Quar 1

Explanatory notes in Chapter 1

Site 216 Hole Core 22 Cored Interval: 320.0-329.5 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
MID PALEOCENE	Planorotalites pseudomenardii Zone (P4) (F)	N F R	C C -	P F	1	0.5	VOID			NANNO CHALK white Auth. carb. 2% Nannos 93% Clay 5%
						1.0	VOID		105	as above
					2					as above
					3		VOID			
					Core Catcher					as above

Explanatory notes in Chapter 1

Site 216 Hole Core 23 Cored Interval: 329.5-339.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PALEOCENE (DANIAN-upper)	low P3 (F)	F	C	F	1	0.5	VOID			CHERT grayish red 5R4/2
						1.0				CHALK white N9
	(F)	F	C	F			VOID			
	P1c	F	C	P	2				-50	very light gray N8 (slightly darker gray streaks and mottles) Glass Tr. Glauc. Tr. Dolo. rhombs Tr. Chert Tr. Forams 2% Nannos 90% Clay 5%
		N	F	P					103	NANNO CHALK Glauc. Tr. Forams 2% Nannos 93% Clay 5%
	(F)	F	C	P					114	light gray N8 and light gray N7, with pale green 10G6/2
	P1c								128	MICARB CHALK Feldspar Tr. Glauc. Tr. Auth. carb. 5% Forams 1% Nannos 89% Clay 5%
CRETACEOUS LATE MAESTRICHTIAN	Nephrolithus frequens Zone	F	R	P	3					MICARB CHALK burrowed N8 and N7
	Globotruncana mayarsensis	F	C	P						ZEOLITE bearing MICARB CHALK Clay 5% Glass Tr. Glauc. Tr. Dolo. rhombs Tr. Zeolite 3% Chert Tr. Forams 2% Nannos 3% Micarb 87%
		R	A	P						
		N		P	Core Catcher					

Explanatory notes in Chapter 1

Site 216 Hole Core 24 Cored Interval: 339.0-348.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MAESTRICHTIAN	Nephrolithus frequens Zone				1	0.5	VOID			
	Globotruncana mayaroensis Zone					1.0			130	FORAM RICH MICARB CHALK very light gray N8 with mottles of light gray N7 Clay 5% Glass Tr. Forams 10% Micarb and Nannos 85%
		N	C	P	2				-91	FORAM bearing CLAY RICH MICARB CHALK burrowed laminae of dark greenish gray 5G4/1 Feldspar Tr. Clay 10% Micarb and Nannos 87% Forams 3%
					3					
					4		G G G		-37	dark greenish gray 5GY4/1 FORAM RICH MICARB GLAUCONITE dusky blue green 5BG3/2 laminated Glauc. 50% Forams 20% Micarb and Nannos 30%
					5		G		102	grayish blue green 5BG5/2 mottled GLAUCONITE bearing FORAM RICH CLAY MICARB CHALK light bluish gray 5B7/1, mottled and burrowed with green Clay 30% Glauc. 5% Forams 25% Micarb and Nannos 40%
		F	R	P	Core Catcher					clast, burrowed with matrix
		R	-	P						X-ray at 345.90 m Calc 95, Quar <1, Clin 5

Explanatory notes in Chapter 1

Site 216 Hole Core 25 Cored Interval: 348.5-358.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
LATE MAESTRICHTIAN	Nephrolithus frequens Zone	N F R	C R -	F P	1	0.5, 1.0			104	GLAUCONITE bearing MICARB VOLCANIC CLAYSTONE white N9 and grayish blue green 5BG5/2 burrowed. Burrows 0.5-1.0 cm across. Rare dusky blue green 5BG3/2 mottles Clay (volcanic origin?) 68% Micarb 25% Forams 5% Nannos Tr. Glauc. 2% Feldspar Tr.
					2				95 107	GLAUCONITE bearing MICARB VOLCANIC CLAYSTONE dark greenish gray 5G4/1 and greenish gray 5G6/1 burrowed, with mottles of greenish black 5G2/1 Clay (volcanic origin?) 65% Glass (basaltic) Tr. Glauc. 2% Dolo. rhombs Tr. Auth. carb. Tr. Apatite Tr. Forams 2% Micarb 31%
					3					black mottle: forams
					4					GLAUCONITE bearing MICARB ASH Clay 25% Glass 40% Glauc. 2% Dolo. rhombs Tr. Carb. 1% Forams 2% Nannos 1% Micarb 29%
									130	oyster (sampled) foram clay carbonate bearing feldspar rich micrite
					Core Catcher					
										X-ray at Section 4, 90 cm Calcite 48% Plagioclase 6% Montmor. 45% Clinopt. 1%

Explanatory notes in Chapter 1

Site 216 Hole Core 26 Cored Interval: 358.0-367.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
MAESTRICHTIAN	Nephrolithus frequens				1	0.5, 1.0	VOID		80	GLAUCONITE bearing CALCAREOUS VOLCANIC SANDY CLAYSTONE dark greenish gray 5G4/1 sandy mudstone with mottles/clasts from sand grain to 1 cm size of greenish black 5GY2/1 and shell fragments, presumably of bivalves variably burrowed. Clay aggregates and clay (volcanic?) 60% Micarb and Nannos 25% Glauc. 10% Forams 5%
					2				65	Mottles/clasts greenish gray 5GY6/1 GLAUCONITE RICH CALCAREOUS VOLCANIC SANDY CLAYSTONE Feldspar 5% Glass 20% Clay grains 25% Glauc. 15% Shell fragments 5% Micarb 25% Forams 5% Calcite veins
					3					
		F R N	R - C	P F	Core Catcher					X-ray at Section 2, 70 cm Calcite 27% Quartz <1% Montmor. 57% Analcite 15% Chabazite present

Site 216 Hole Core 27 Cored Interval: 367.5-377.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO.SAMPLE	LITHOLOGIC DESCRIPTION
MAESTRICHTIAN	Nephrolithus frequens				1	0.5, 1.0				CALCAREOUS VOLCANIC SANDY CLAYSTONE
					2					
		F R N	R - R	P P	Core Catcher					as above

Explanatory notes in Chapter 1

Site 216 Hole Core 28 Cored Interval: 377.0-386.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MAESTRICHTIAN	Nephrolithus frequens				1	0.5				dark greenish gray 5G4/1, with light and dark sand grains, scattered burrows, shells
						1.0				
					2		VOID		105	GLAUCONITE BEARING GLASS RICH VOLCANIC CLAY Clay 20% Glass 20% Clay aggregates 40% Glauc. 5% Forams 5% Nannos 10%
					3				110	
		F R N	R - R	P P	Core Catcher					as above

Site 216 Hole Core 29 Cored Interval: 386.5-396.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MAESTRICHTIAN	Nephrolithus frequens				1	0.5	VOID			greenish black 5GY2/1 with greenish gray mottles 5G6/1 and bivalves
						1.0				
					2					GLAUCONITE bearing CALCAREOUS VOLCANIC SANDY CLAYSTONE dark gray N3 Clay (chlorite) 30% Glass 20% Glauc. 5% Carbonate 5% Micarb 30% Forams 5% Nannos 5%
										gradational boundary
		F	R	P	Core Catcher					grayish black N2

Thin section of C.C.
Altered Vitric Tuff
Mostly devitrified and chloritized glass, few shards still visible. Feldspar phenocrysts more common than clinopyroxene and lava fragments. Few forams present. Some patches of glass show spherulitic texture and a few spherules are lined with zeolite.

Explanatory notes in Chapter 1

Site 216 Hole Core 30 Cored Interval: 396.0-405.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MAESTRICHTIAN	Nephrolithus frequens				1	0.5			40	pale olive 10Y6/2, darker mottles and burrows
						1.0	VOID			NANNO RICH MICARB VOLCANIC CLAY Feldspar 5% Glass 10% Clay aggregates 33% Micarb 30% Nannos 20% Rads Tr. Sponge spic. 2%
					2				19	CLAY MICARB RICH ASH Glass 50% Clay 20% Micarb 23% Nannos 5% Rads Tr. Sponge spic. 2%
									75	
					3					MICARB VOLCANIC CLAY Glass 5% Clay 45% Micarb 43% Forams 1% Nannos 5% Sponge spic. 1%
					4				140	MICARB VOLCANIC CLAY Feldspar 1% Clay 50% Micarb 39% Forams 1% Nannos 5% Diatoms 1% Rads 2% Sponge spic. 1%
					5				119	VOLCANIC ASH black Feldspar 3% Basaltic glass 97% X-ray at Section 1, 90 cm Calcite 69% Quartz 1% Plagioclase 12% Montmor. 2% Pyrite 3% Augite 13%
		F R N	R R F	P M P	Core Catcher					as above

Explanatory notes in Chapter 1

Site 216 Hole Core 31 Cored Interval: 405.5-415.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	FOSSIL CHARACTER: ABUND.	FOSSIL CHARACTER: PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MAESTRICHTIAN	Nephrolithus frequens	N F R	F R R	P P M	1 2 3 4 5 Core Catcher	0.5 1.0	VOID		100 125	GLASS RICH VOLCANIC CLAY MICARB pale olive 10Y6/2, with bivalves, and white and black mottles and burrows, and numerous black sand-sized grains. Feldspar Tr. Clay 30% Volc. glass 20% Glauc. Tr. Auth. carb. 5% Micrite 44% Forams Tr. Sponge spic. 1% X-ray at Section 1, 110 cm Calcite 72% Plagioclase 14% Pyrite 2% Augite 12% MICARB VOLCANIC CLAY Feldspar 2% Clay 30% Glass 30% Micarb 30% Forams 3% Nannos 5%

Explanatory notes in Chapter 1

Site 216 Hole Core 32 Cored Interval: 415.0-424.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	FOSSIL CHARACTER: ABUND.	FOSSIL CHARACTER: PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MAESTRICHTIAN	Nephrolithus frequens	N F R	F R -	P P	1 2 3 4 5 6 Core Catcher	0.5 1.0	VOID		3 36	pale olive 10Y6/2, with black and light gray mottles and burrows Not opened. MICARB VOLCANIC CLAY moderate blue green 5BG4/6 and very light gray N8, burrowed Feldspar Tr. Glass 5% Clay 54% Micarb 40% Sponge spic. 1% 4 not opened GLASS RICH MICARB VOLCANIC CLAY blue green, as in Section 3 Glass 10% Clay 44% Micarb 40% Diatoms 5% Rads Tr. Sponge spic. 1% rare shell fragments Not opened. X-ray at 418.00 m Calc 87, Quar 1, Plag 3, Mont 4, Pyri 1, Augi 4

Explanatory notes in Chapter 1

Site 216 Hole Core 33 Cored Interval: 424.5-434.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MAESTRICHTIAN	Nephrolithus infrequens	N F R	F R -	P P	1	0.5, 1.0			46, 103	MICARB RICH VOLCANIC CLAY grayish olive 10Y4/2 Feldspar 10% Heavies 20% Clay 30% Micarb 22% Forams 2% Diatoms 1% Volc. glass 15%
					2					Section 2 not opened. CHLORITIC VOLCANIC CLAY grayish black N2, hard Feldspar 2% Micarb 5% Clay (chloritized) 53% Glass 25% Heavies 15%
					Core Catcher					X-ray at Section 1, 100 cm Calcite 15% Plagioclase 4% Montmor. 48% Clinoptilolite 3% Phillipsite 18% Pyrite 1% Augite 11%
										as above

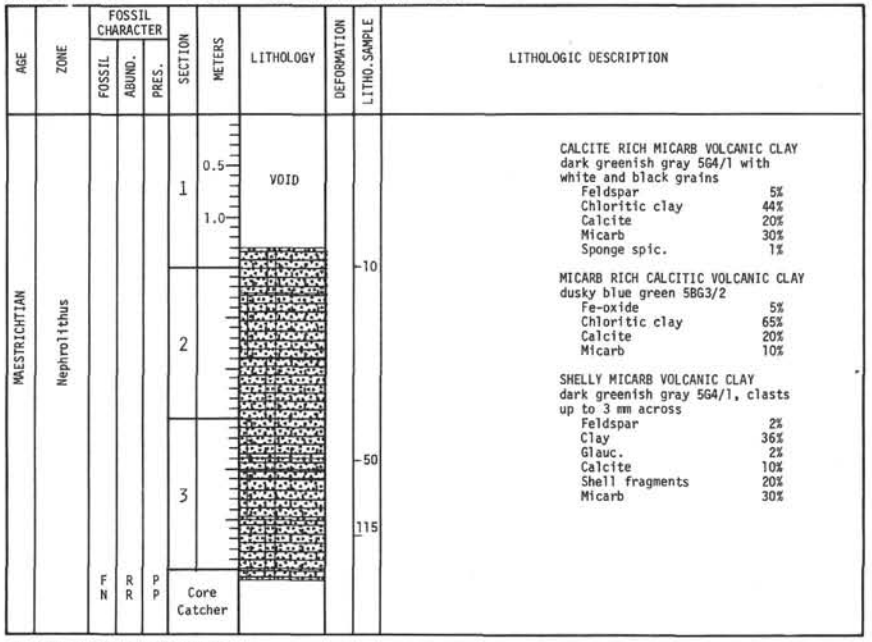
Explanatory notes in Chapter 1

Site 216 Hole Core 34 Cored Interval: 434.0-443.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MAESTRICHTIAN ?					1	0.5, 1.0			85	faint burrows MICARB RICH VOLCANIC CLAY greenish gray 5GY6/1, fine shell fragments Feldspar 1% Clay 71% Glauc. Tr. Pyrite 1% Auth. carb. 2% Apatite 3% Micarb 20% Forams 1%
					2					Not opened.
					3				77	APATITE bearing MICRITE RICH SANDY MUDSTONE Feldspar Tr. Clay (volcanic?) 72% Pyrite Tr. Auth. carb. 5% Apatite 2% Micarb 20% Forams 1% Sponge spic. Tr.
					4				62, 80	burrowed GLASS RICH CLAYEY LIMESTONE moderate blue green 5BG4/6 dense white specks Feldspar Tr. Clay 30% Glass 10% Chlorite 1% Calcite 40% Micrite 19%
		F N	R R	P P	Core Catcher					as at top Vitric Tuff Feldspar 2% Clay 8% Glass 40% Chlorite 50%
										Thin Section at 79 cm Section 4 Vitric Tuff Partially altered and strongly chloritized basaltic glass shards. The glass is very spherulitic with spherules filled with analcite (with some chlorite) and calcite. Some feldspar laths present.
										as above X-ray at 434.50 m Calc 37, Plag 6, Mont 37, Clin 17, Pyri 2 X-ray at 439.20 m Calc 49, Quar 1, Plag 7, Mont 20, Phil 23, Pyri 1 X-ray at 439.20 m Mica 53, Mont 23, Phil 23

Explanatory notes in Chapter 1

Site 216 Hole Core 35 Cored Interval: 443.5-453.0 m



CALCITE RICH MICARB VOLCANIC CLAY
dark greenish gray 5G4/1 with white and black grains

Feldspar	5%
Chloritic clay	44%
Calcite	20%
Micarb	30%
Sponge spic.	1%

MICARB RICH CALCITIC VOLCANIC CLAY
dusky blue green 5BG3/2

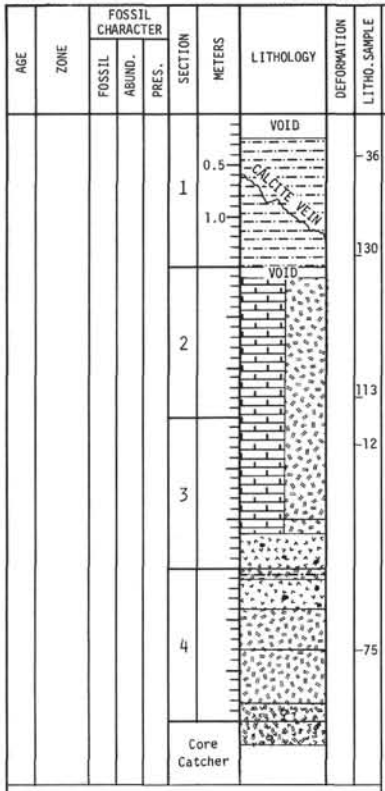
Fe-oxide	5%
Chloritic clay	65%
Calcite	20%
Micarb	10%

SHELLY MICARB VOLCANIC CLAY
dark greenish gray 5G4/1, clasts up to 3 mm across

Feldspar	2%
Clay	36%
Glauc.	2%
Calcite	10%
Shell fragments	20%
Micarb	30%

Explanatory notes in Chapter 1

Site 216 Hole Core 36 Cored Interval: 453.0-462.5 m



light bluish gray 5B7/5 with rusty borders

basalt, amygdalar, med. dark gray N4

pale green 10G6/2 sediment

basalt, amygdalar, N4

grayish red purple 5RP4/2 and pale green

basalt, scoriaceous, oxidized, pale red 5R6/2

VOLCANIC CLAY
dark gray N3 shell fragment, light gray mottles and burrows

Heavies (Fe-oxide)	10%
Clay	75%
Auth. carb.	10%
Forams	Tr.
Zeolite (analcite ?)	5%

CHLORITIZED CLAYEY MICRITE

Feldspar	Tr.
Clay	30%
Glass	Tr.
Auth. carb.	15%
Micarb	55%

CLAYEY CALCAREOUS ASH

Feldspar	1%
Glass	40%
Clay	29%
Auth. carb.	20%
Micarb	10%

CLAYEY LIMESTONE
greenish gray 5G6/1 with dark green burrows

Feldspar	1%
Clay	20%
Auth. carb. and Shell fragments	79%

MICRITE CLAY LIMESTONE
pale blue green 5BG7/2

Clay	30%
Auth. carb.	50%
Micarb	20%

VOLCANOGENIC SEDIMENT
pale green 10G6/2

Plag.	10%
Chlorite	7%
Palagonite	5%
Pyroxene	5%
Dark mesostasis	73%

LITHIC VITRIC TUFF
Thin section at Section 4, 70 cm
Glassy brown altered lava fragments - some trace feldspar laths few microcryst lava, many altered glassy spherulitic chloritized lavas. Few lavas show feldspar phenocrysts, and pyroxene microcrystals abundant FeO in and around lava fragments. Fragments welded with analcite and chlorite needles rimming this or as inclusions within.

Explanatory notes in Chapter 1

Site 216 Hole Core 37 Cored Interval: 462.5-468.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	FOSSIL CHARACTER: ABUND.	FOSSIL CHARACTER: PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
					1	0.5, 1.0	VOID			SCORIACEOUS BASALT Very fine grained. Plag. laths and dark mesostasis. Chloritic patches occur. CHLORITE bearing fine-grained BASALT Dark greenish gray (5GY4/1). Few large vesicles (=3 mm diameter) comprise about 1% of the bulk rock. Clinopyroxene, plagioclase and chlorite are the major constituents.
					2					
					3					VESICULAR BASALTS Pale red (5R6/2) vesicles up to 1 cm in diameter.
					4				0-4 20	Fine-grained BASALT medium gray (N5) General texture: Pilotaxitic Mineral content: Plag. microphen. 1% Plag. matrix 50% Clinopyr. 35% Dark mesostasis. 3% Chlorite <3% Hematite 1% Fe-oxide (Mt?) 7% Altered fine-grained BASALT Light olive gray (5Y5/2). Enriched in iron oxide and hematitic material. A vein containing native copper was seen at about 110 cm. Texture: Pilotaxitic to intersertal Clinopyroxene Phenocryst 1% Plagioclase Microph. 1% Chlorite Matrix Hematite Iron ore
					Core Catcher					

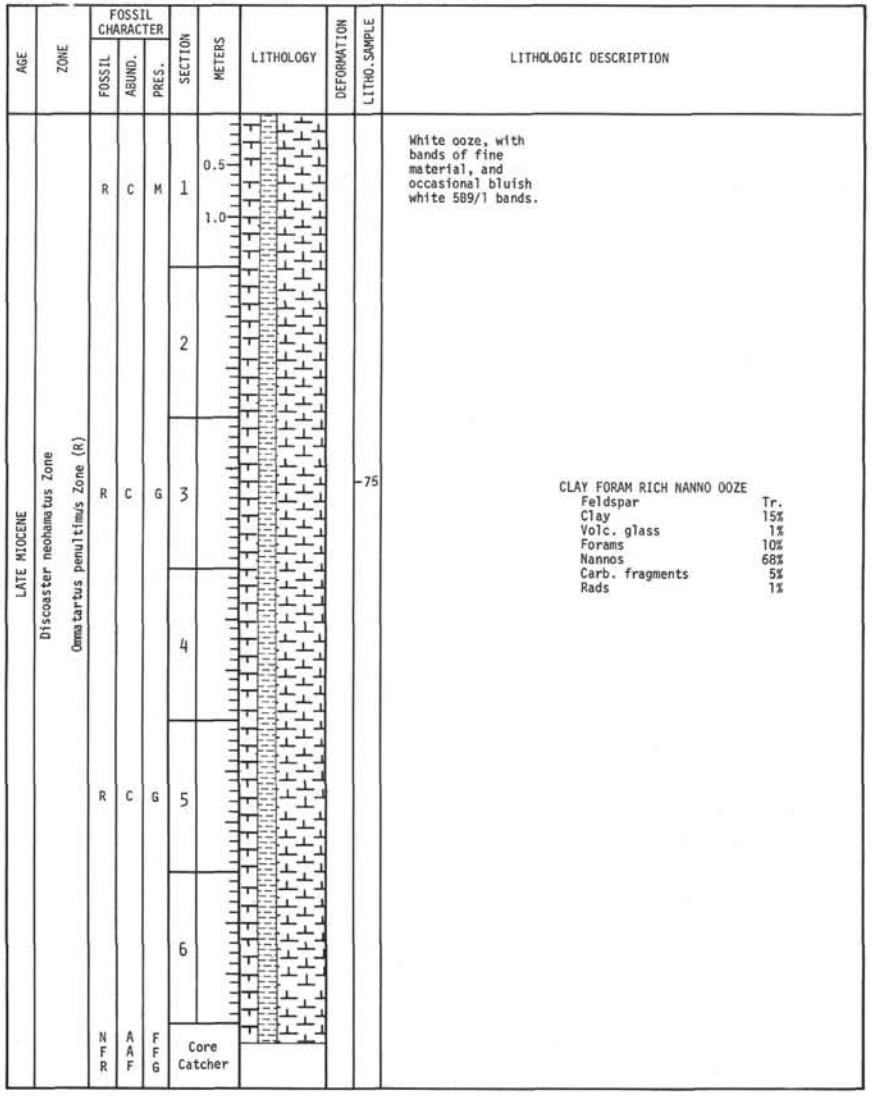
Explanatory notes in Chapter 1

Site 216 Hole Core 38 Cored Interval: 468.5-477.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	FOSSIL CHARACTER: ABUND.	FOSSIL CHARACTER: PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
					1	0.5, 1.0				Altered fine-grained BASALT light olive gray (5Y5/2) Fine-grained medium gray BASALT (N5).
					2					Altered fine-grained BASALT light olive gray (5Y5/2) Fine-grained medium gray BASALT (N5).
					3					SCORIACEOUS BASALT pale red (5R6/2) VESICULAR BASALT Medium dark gray (N4). Plag. and clpx and dark mesostasis. Fine-grained medium gray BASALT (N5).
					4					Vesicular BASALT Medium dark gray (N4). AMYGDALAR BASALT Medium dark gray (N4). Chlorite, plag., clpx., iron ore. The amygdules are filled with calcite. VESICULAR BASALT Medium dark gray (N4). Vesicles comprise about 15% of the bulk rock.
					Core Catcher					

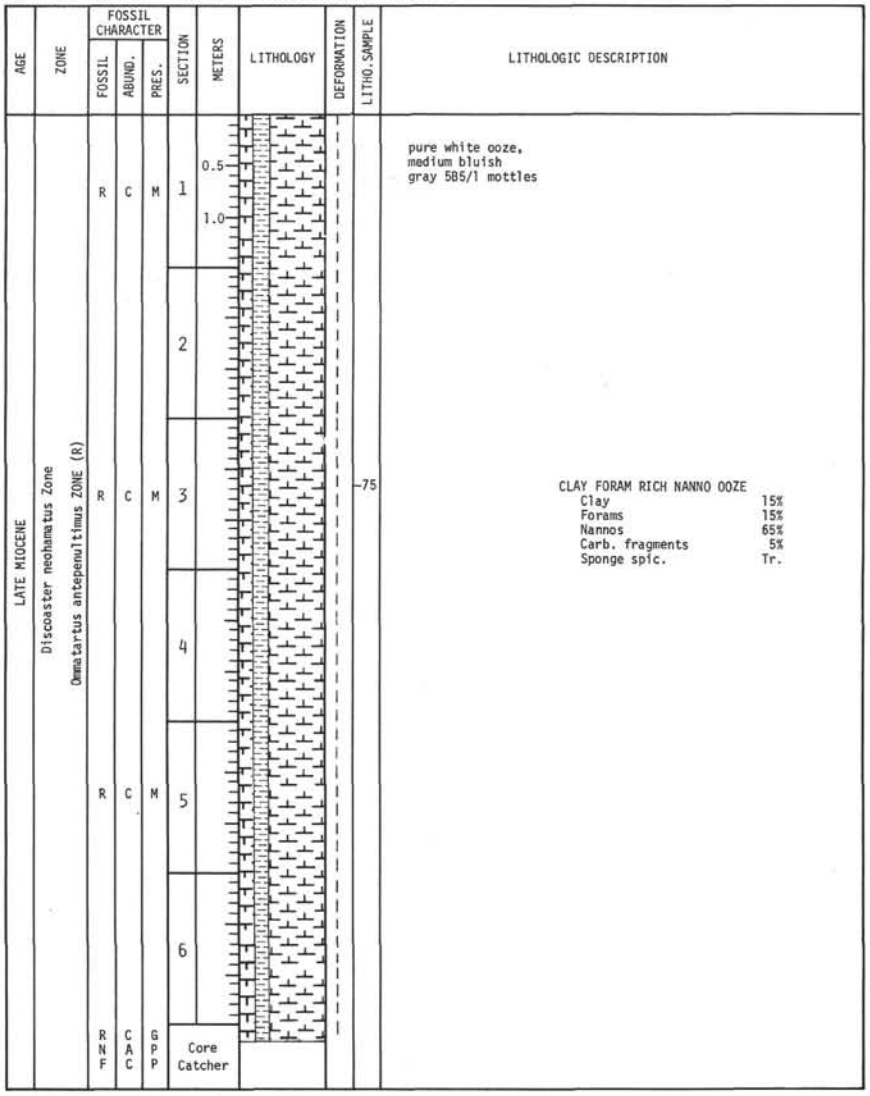
Explanatory notes in Chapter 1

Site 216 Hole A Core 1 Cored Interval: 101.5-111.0 m



Explanatory notes in Chapter 1

Site 216 Hole A Core 2 Cored Interval: 111.0-120.5 m



Explanatory notes in Chapter 1

Site 216 Hole A Core 3 Cored Interval: 120.5-130.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	FOSSIL CHARACTER: ABUND.	FOSSIL CHARACTER: PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE MIOCENE	Catinaster coalitus Zone / Cannartus petterssoni Zone (R)	R	C	G	1	0.5–1.0			75	white ooze CLAY FORAM RICH NANNO OOZE light bluish gray 5B7/1, sharp contacts with adjacent layers Clay 20% Volc. glass 2% Micronodules 1% Forams 20% Nannos 51% Carb. 5% Rads 1% Sponge spic. Tr. Silicoflag. Tr.
					2					white ooze
		R	C	G	3				90	NANNO OOZE Forams 3% Nannos 85% Rads 1% Sponge spic. 1% Clay 10%
					4					
		R	C	G	5					
					6					
		N F R	A C A	P P G	Core Catcher					

Explanatory notes in Chapter 1

Site 216 Hole A Core 4 Cored Interval: 130.0-139.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	FOSSIL CHARACTER: ABUND.	FOSSIL CHARACTER: PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE MIOCENE	Discoaster exilis Zone / Dorcadospyris alata Zone (R)				1	0.5–1.0	VOID			
		R	F	M	2					
		R	R	M	3				75	White NANNO OOZE Glass Tr. Forams 2% Nannos 93% Clay 5% rare firm intervals
					4					
		R	R	M	5		GEO CHEM			
		R	R	P	6					
		N F R	C C C	P P M	Core Catcher					

Explanatory notes in Chapter 1

Site 216 Hole A Core 5 Cored Interval: 139.5-149.0 m

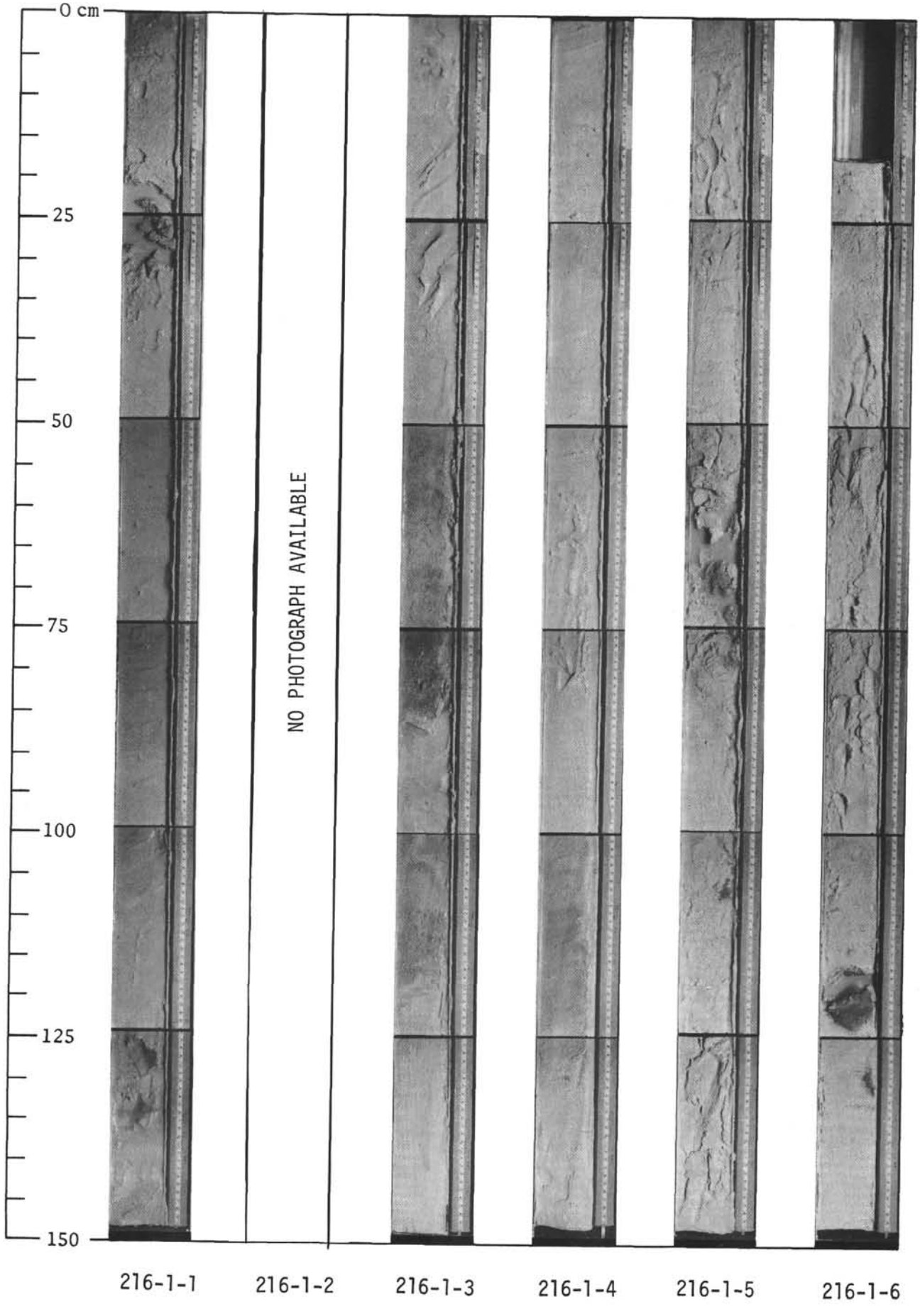
AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE MIOCENE	?	R	C	M	1	0.5, 1.0				pure white, rare bluish white mottles
	?				2					
	Dorcadospyris alata Zone (R)	R	A	G	3				75	FORAM MICARB RICH NANNO OOZE Clay 5% Glass Tr. Forams 15% Nannos 60% Micarb 20% Rads Tr.
	?				4					
	Spenolithus heteromorphus Zone	R	C	G	5					
	C. costata Zone (R)				6					
		N F R	A C C	P P G	Core Catcher					

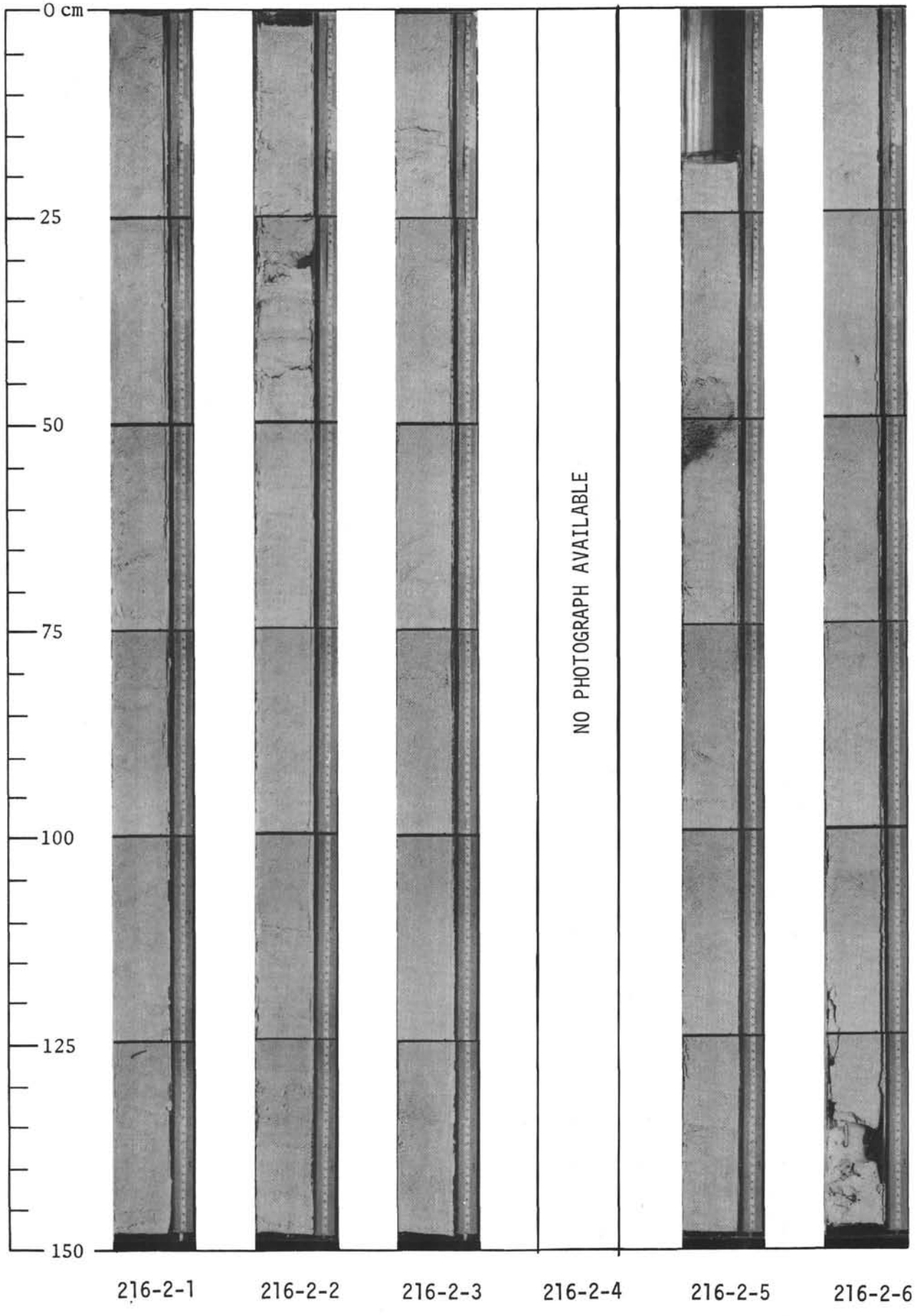
Explanatory notes in Chapter 1

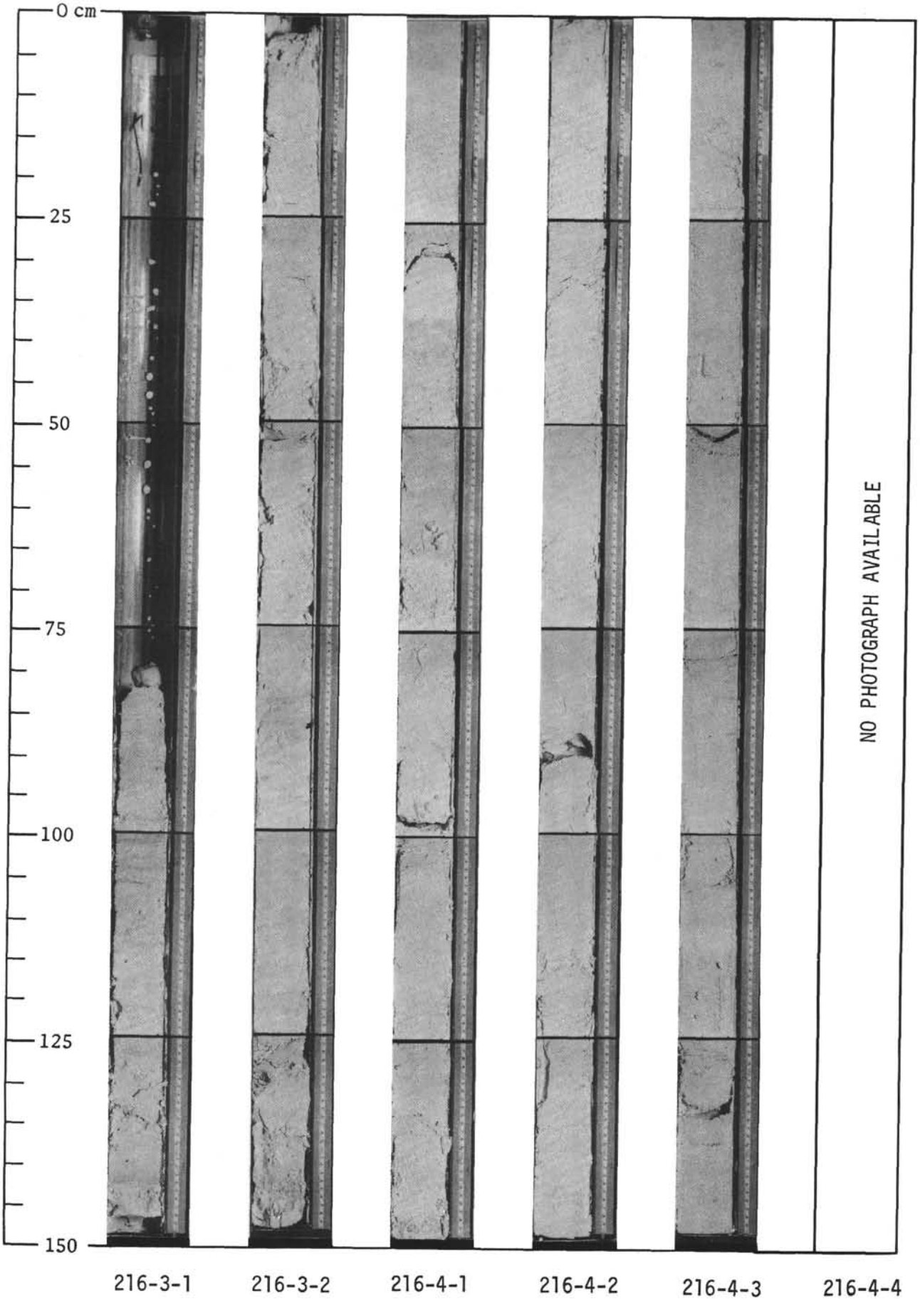
Site 216 Hole A Core 6 Cored Interval: 149.0-158.5 m

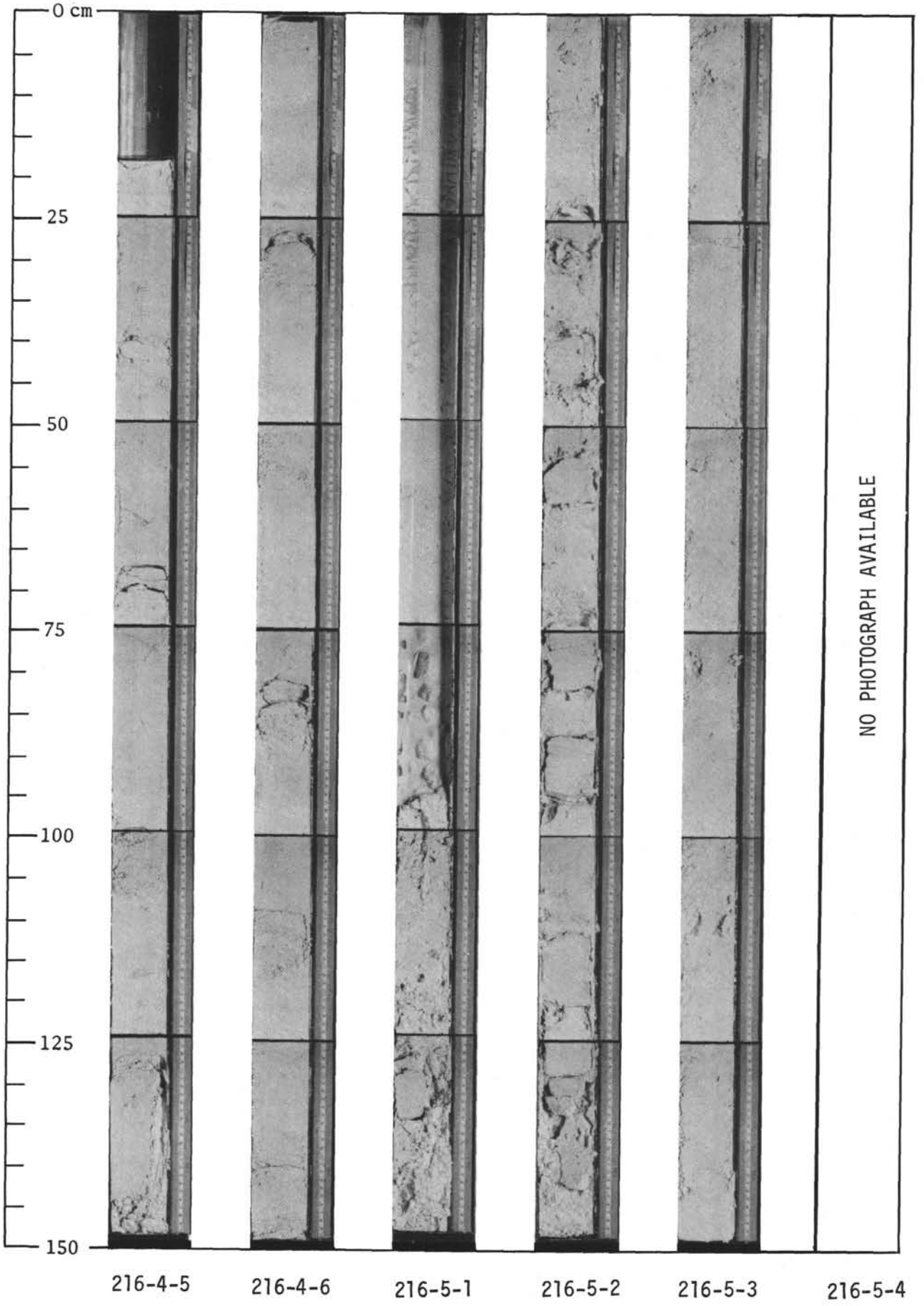
AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE MIOCENE	?	R	C	G	1	0.5, 1.0	VOID			white ooze
	Calocycletta costata Zone				2					
		R	C	G	3				120	
					4					white ooze ASH bearing NANNO OOZE very light gray N8 Glass 5% Forams 3% Nannos 80% Rads 2% Clay 10%
		R	C	G	5					
	Sphenolithus heteromorphus to Sphenolithus belemnos Zone				6					
		N F R	A C C	P P M	Core Catcher					

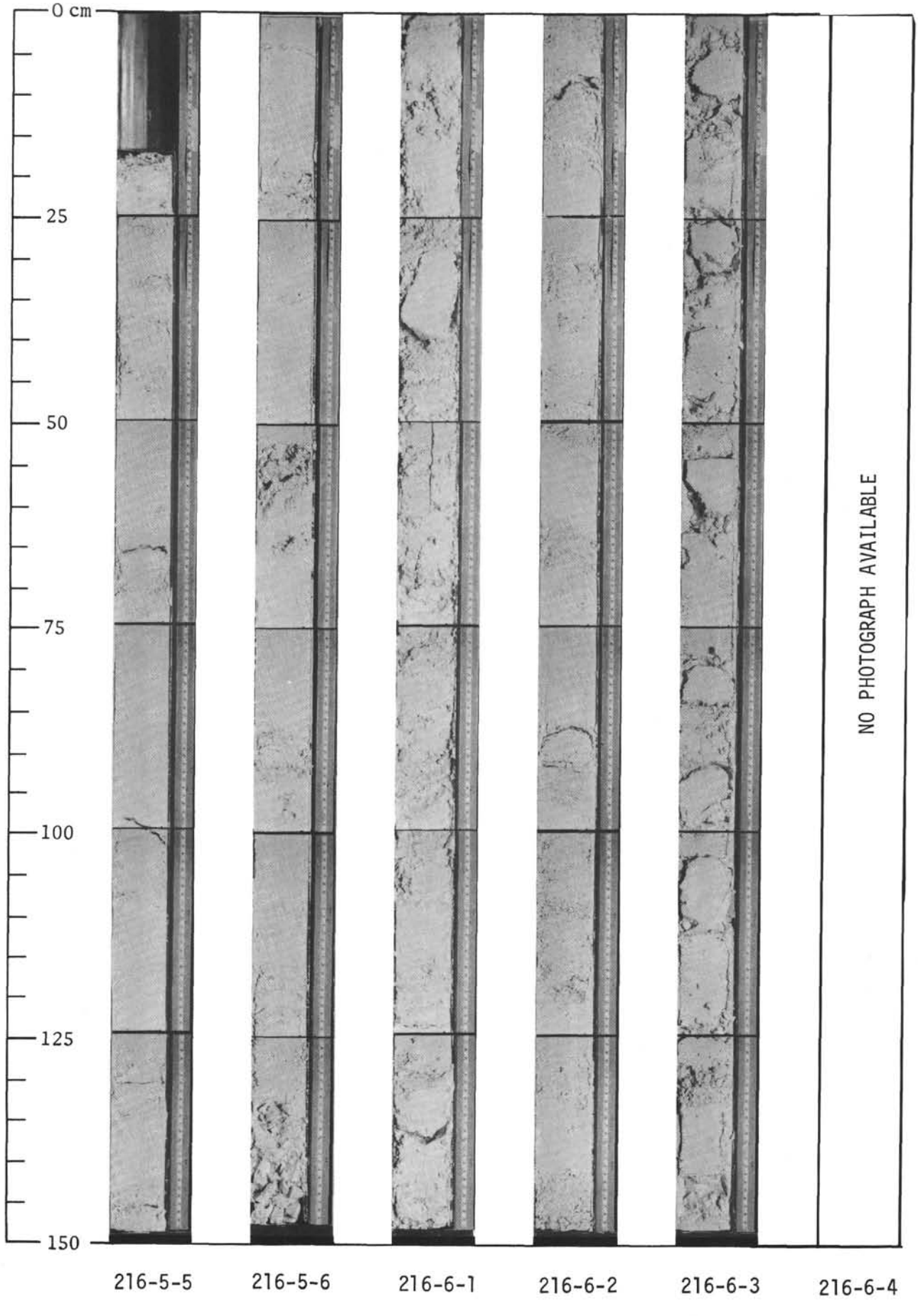
Explanatory notes in Chapter 1

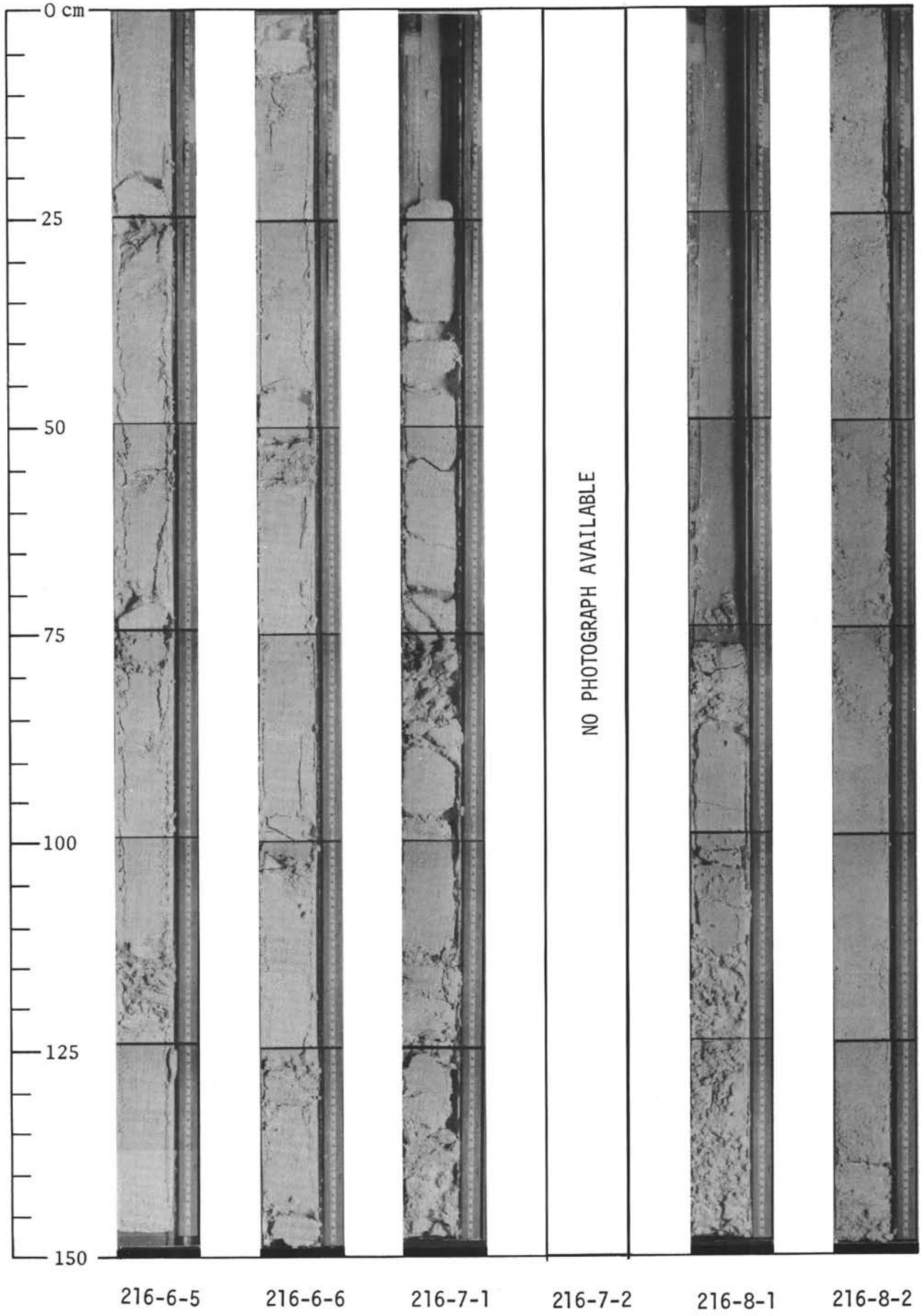

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216-1-1
216-1-2
216-1-3
216-1-4
216-1-5
216-1-6

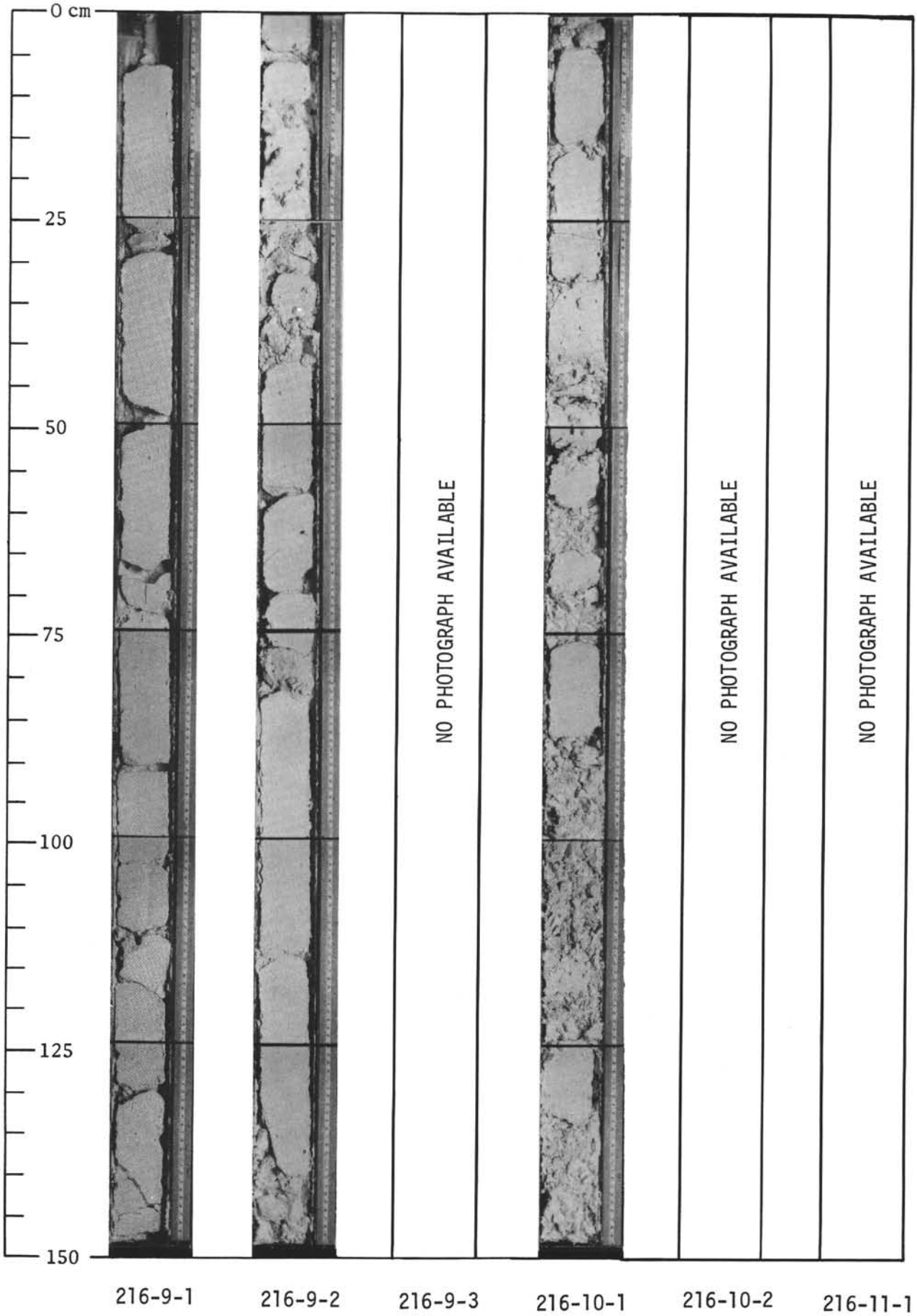

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216-2-1
216-2-2
216-2-3
216-2-4
216-2-5
216-2-6

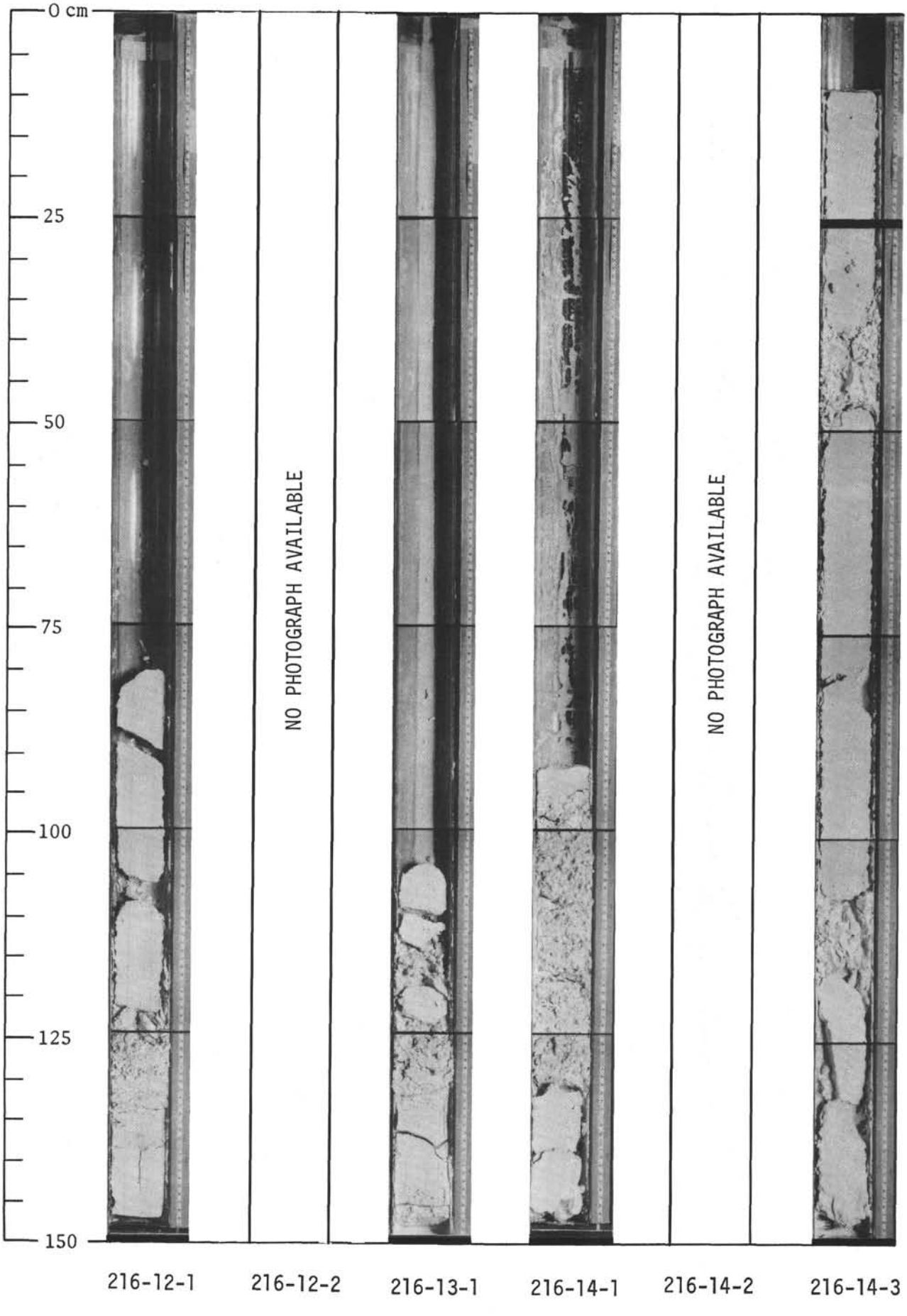

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216-3-1
216-3-2
216-4-1
216-4-2
216-4-3
216-4-4

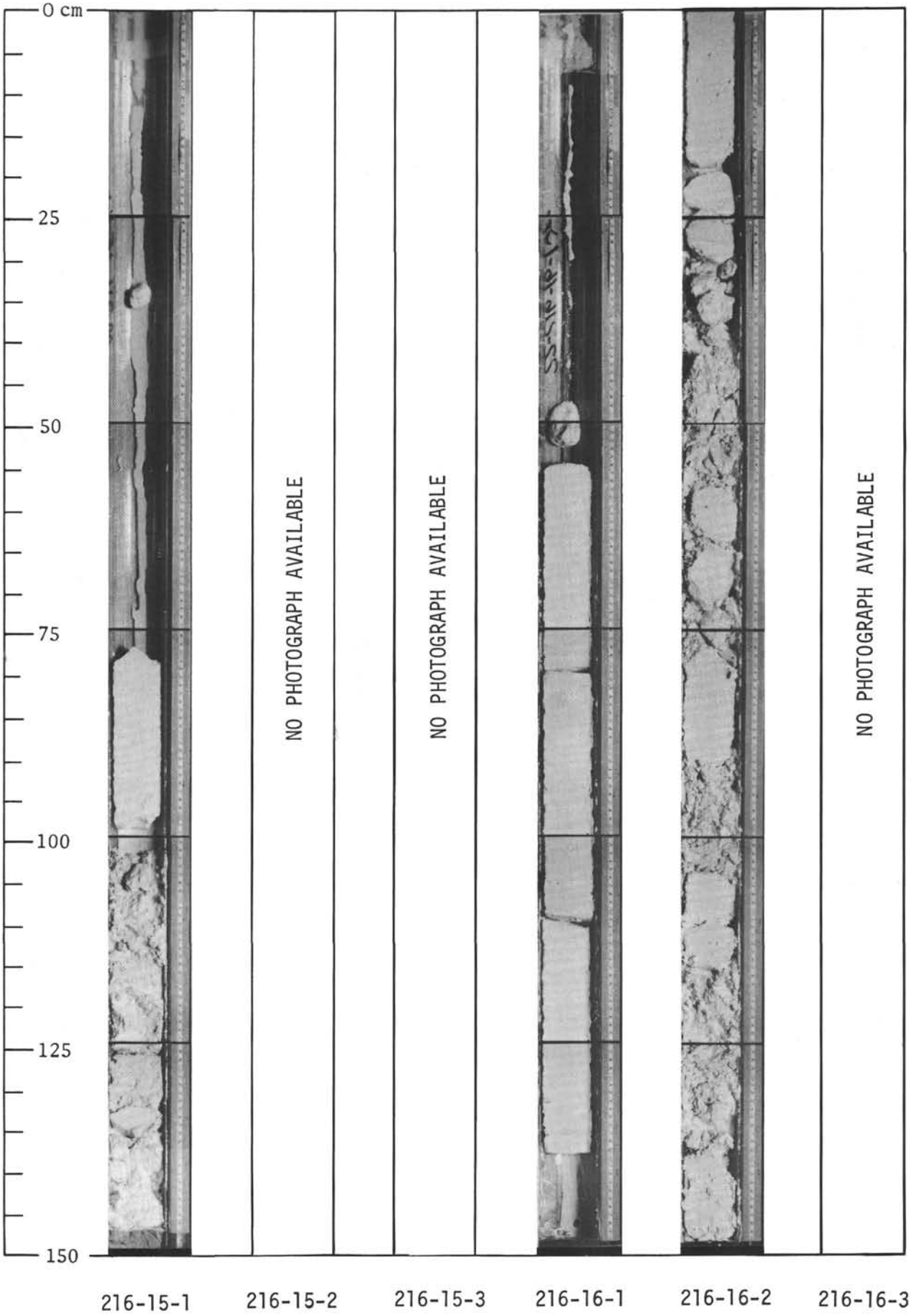

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216-4-5
216-4-6
216-5-1
216-5-2
216-5-3
216-5-4

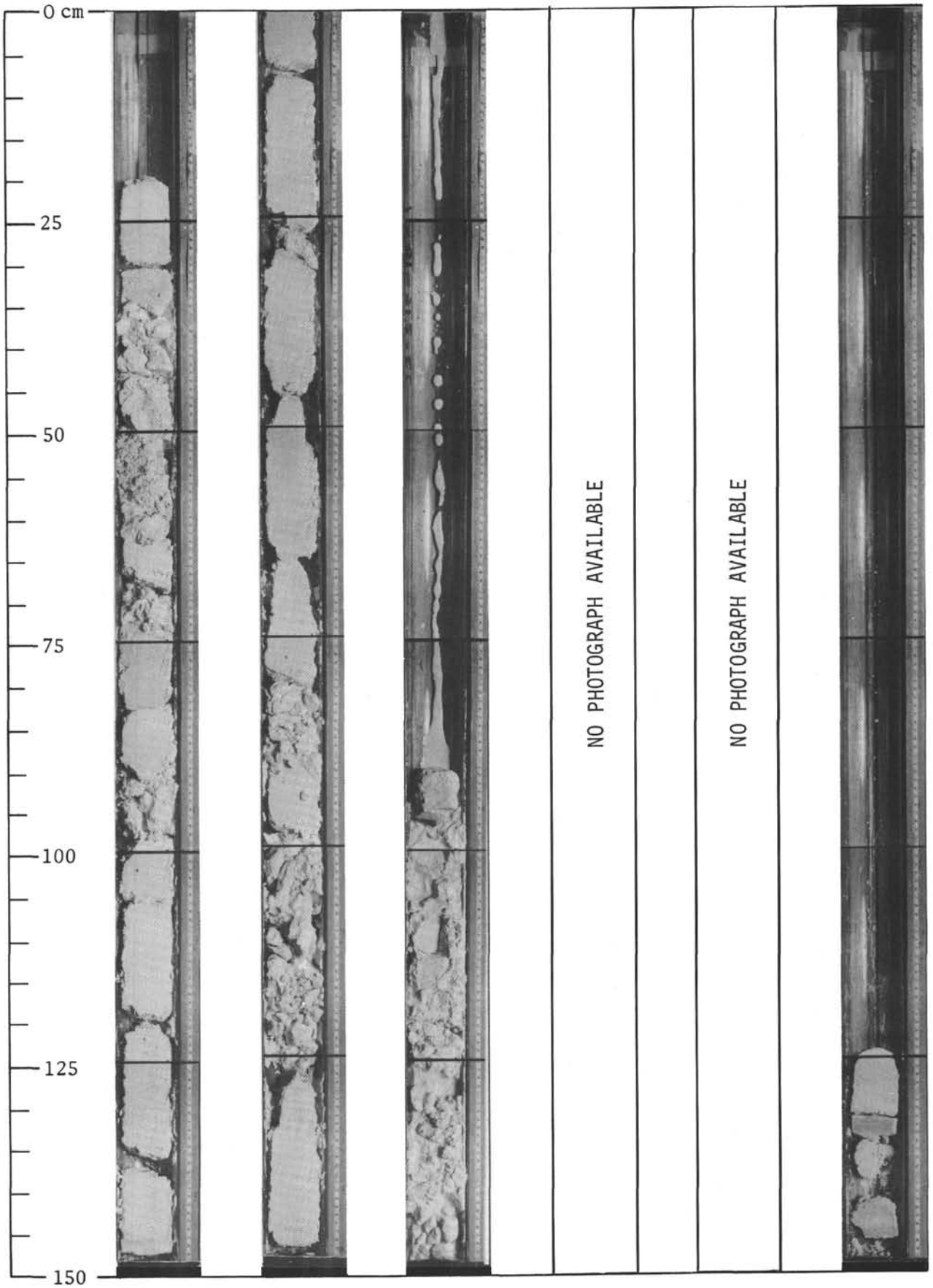

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216-5-5
216-5-6
216-6-1
216-6-2
216-6-3
216-6-4

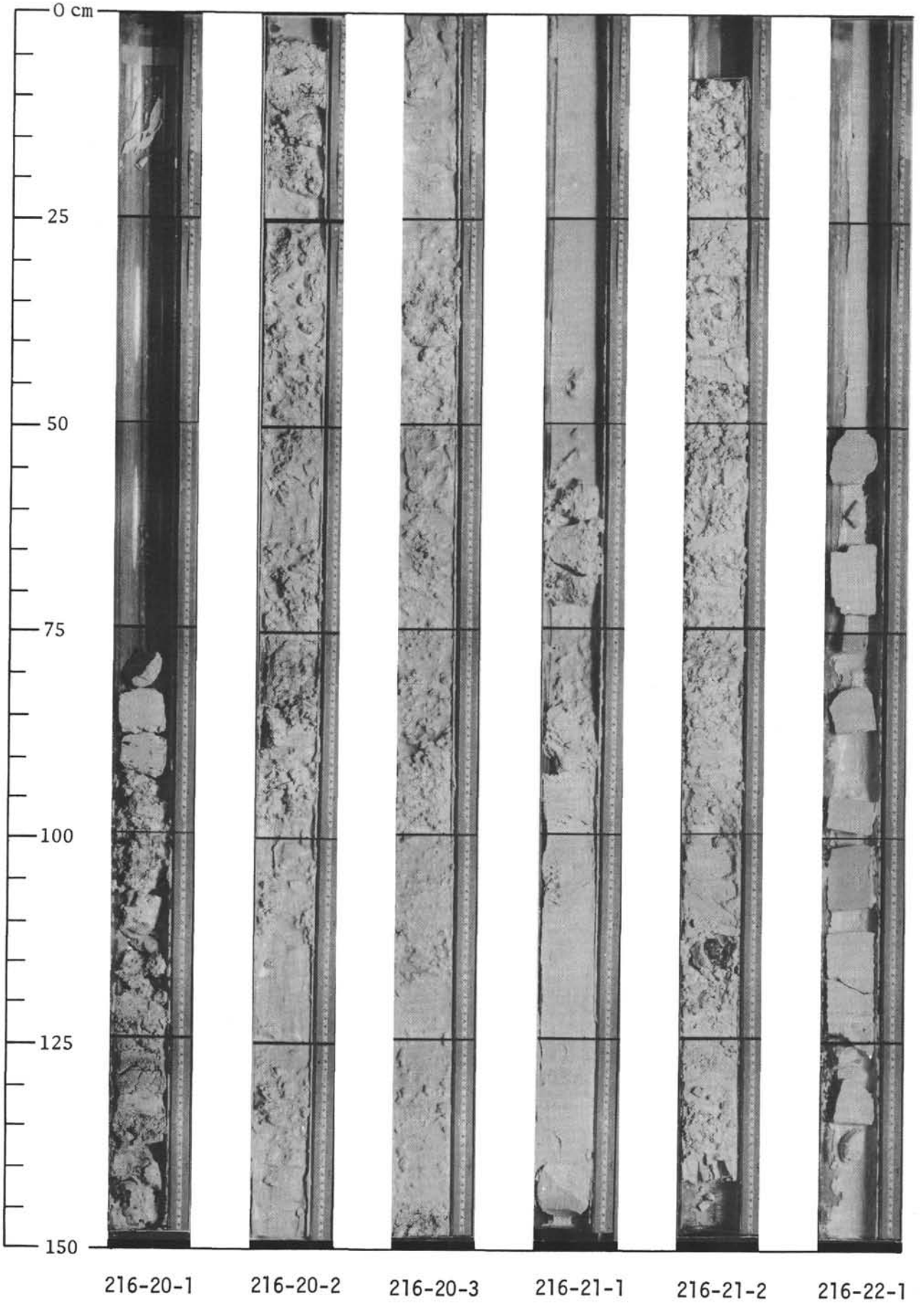

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216-6-5
216-6-6
216-7-1
216-7-2
216-8-1
216-8-2

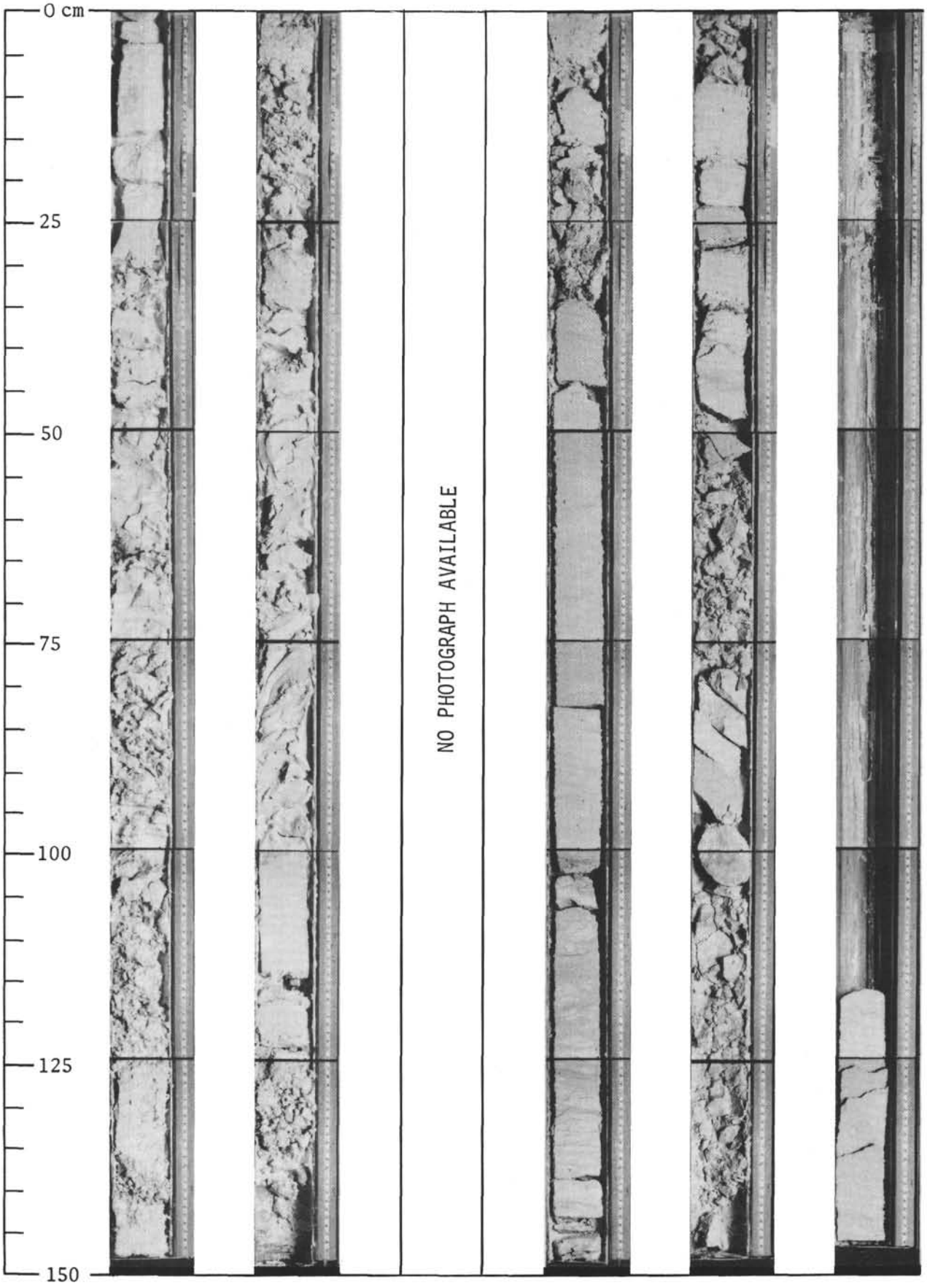

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
216-9-1
216-9-2
216-9-3
216-10-1
216-10-2
216-11-1

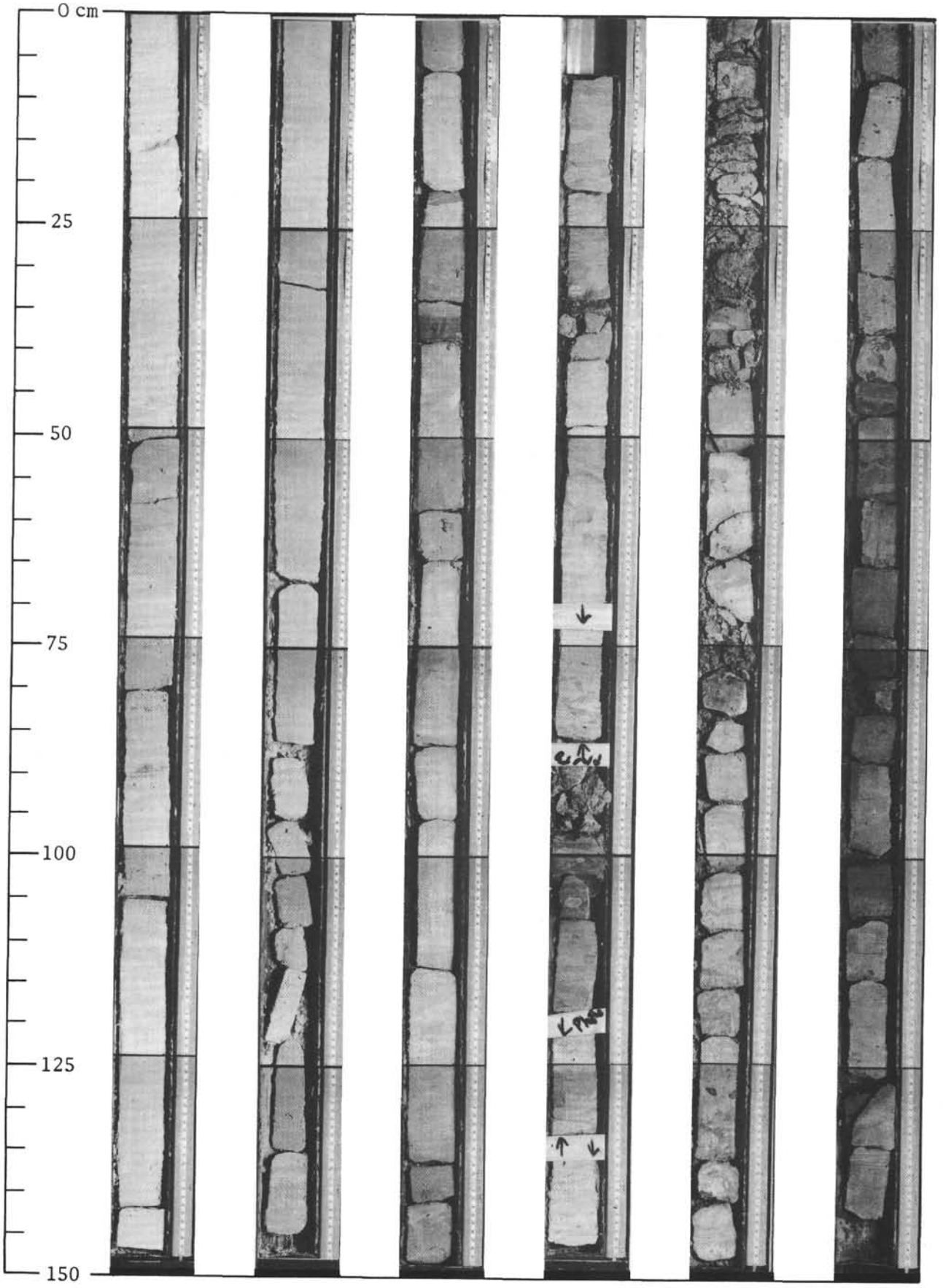

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
216-12-1
216-12-2
216-13-1
216-14-1
216-14-2
216-14-3

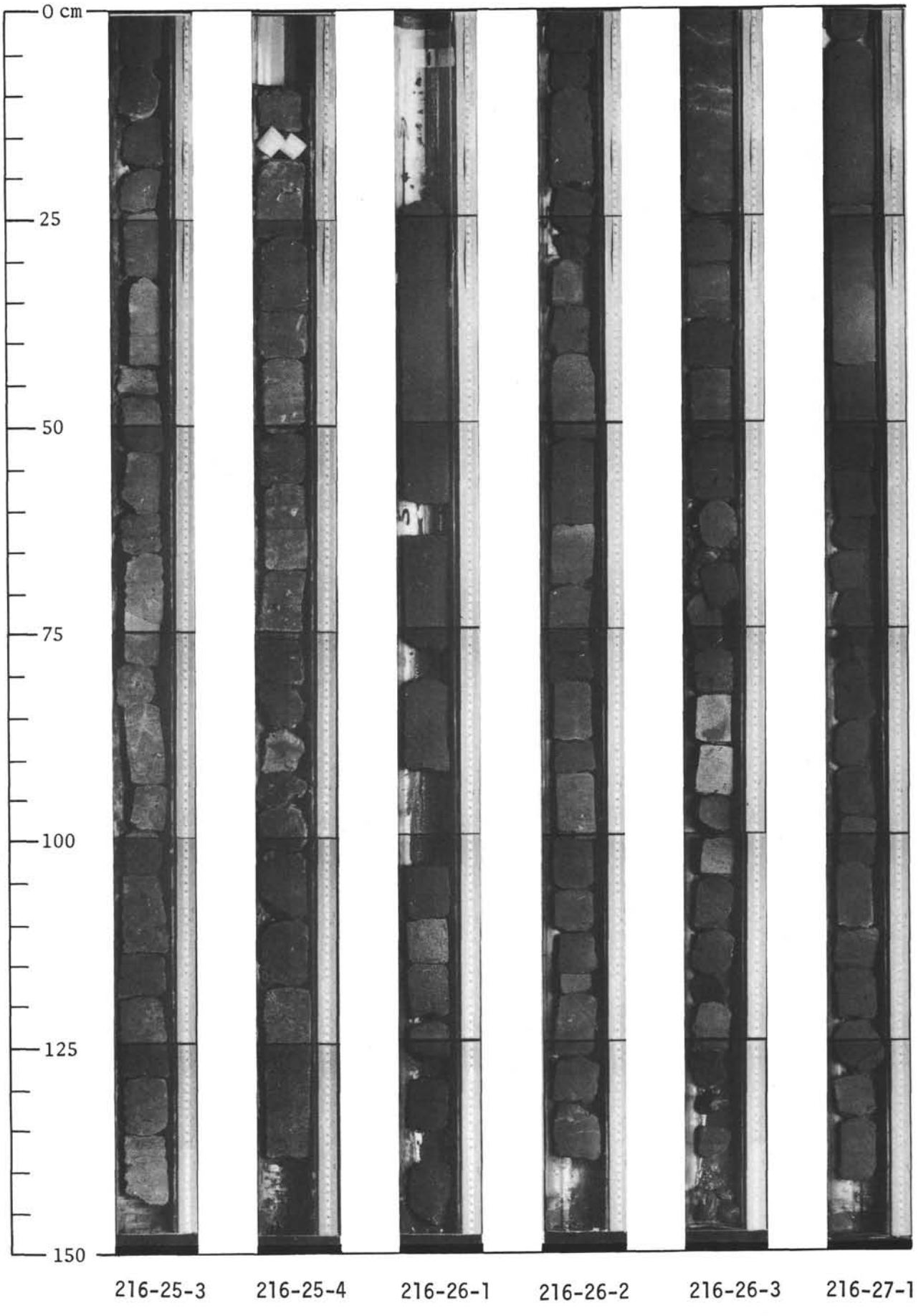

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
216-15-1
216-15-2
216-15-3
216-16-1
216-16-2
216-16-3

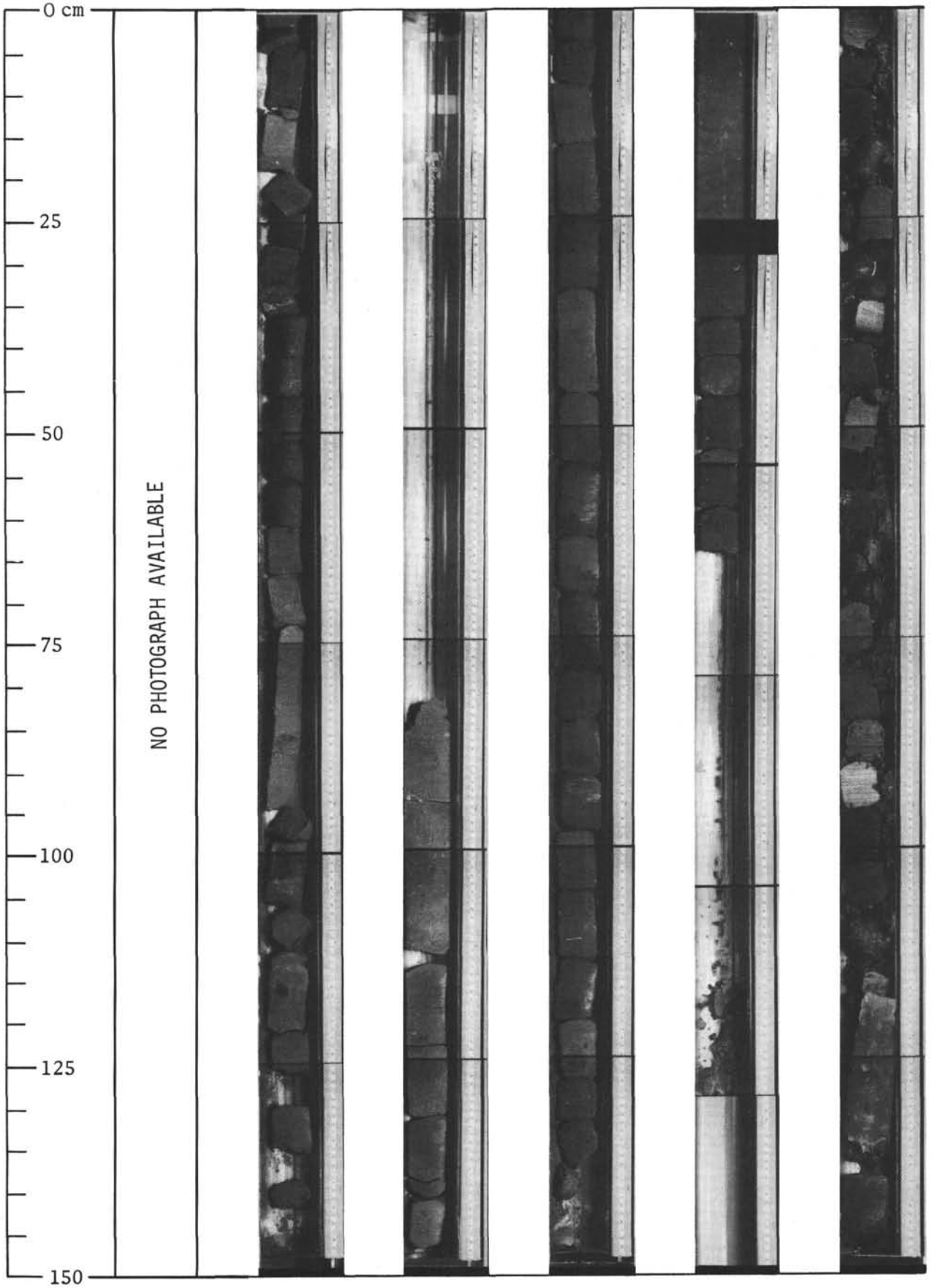

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
216-17-1
216-17-2
216-18-1
216-18-2
216-18-3
216-19-1

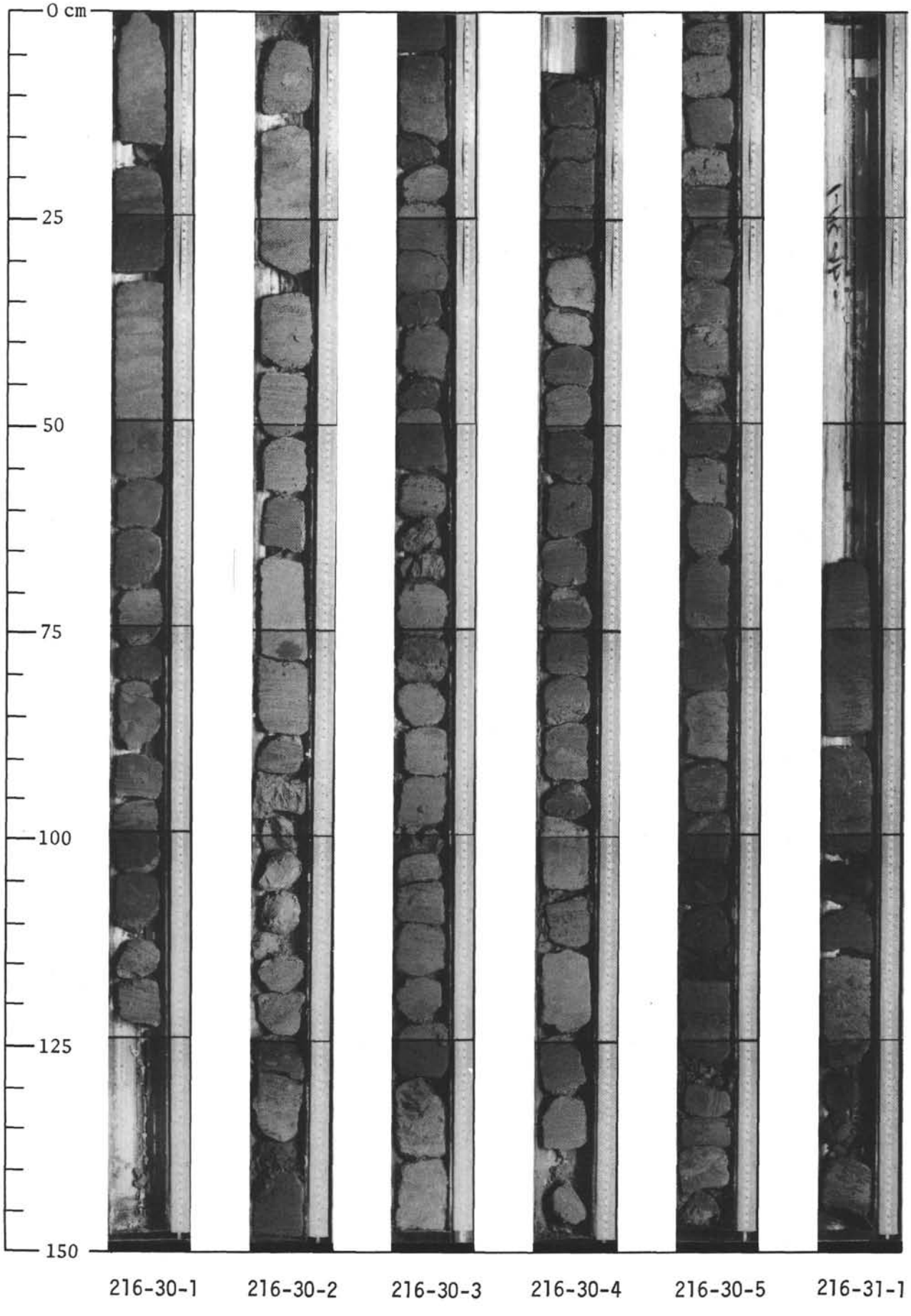

0 cm
25
50
75
100
125
150
216-20-1
216-20-2
216-20-3
216-21-1
216-21-2
216-22-1

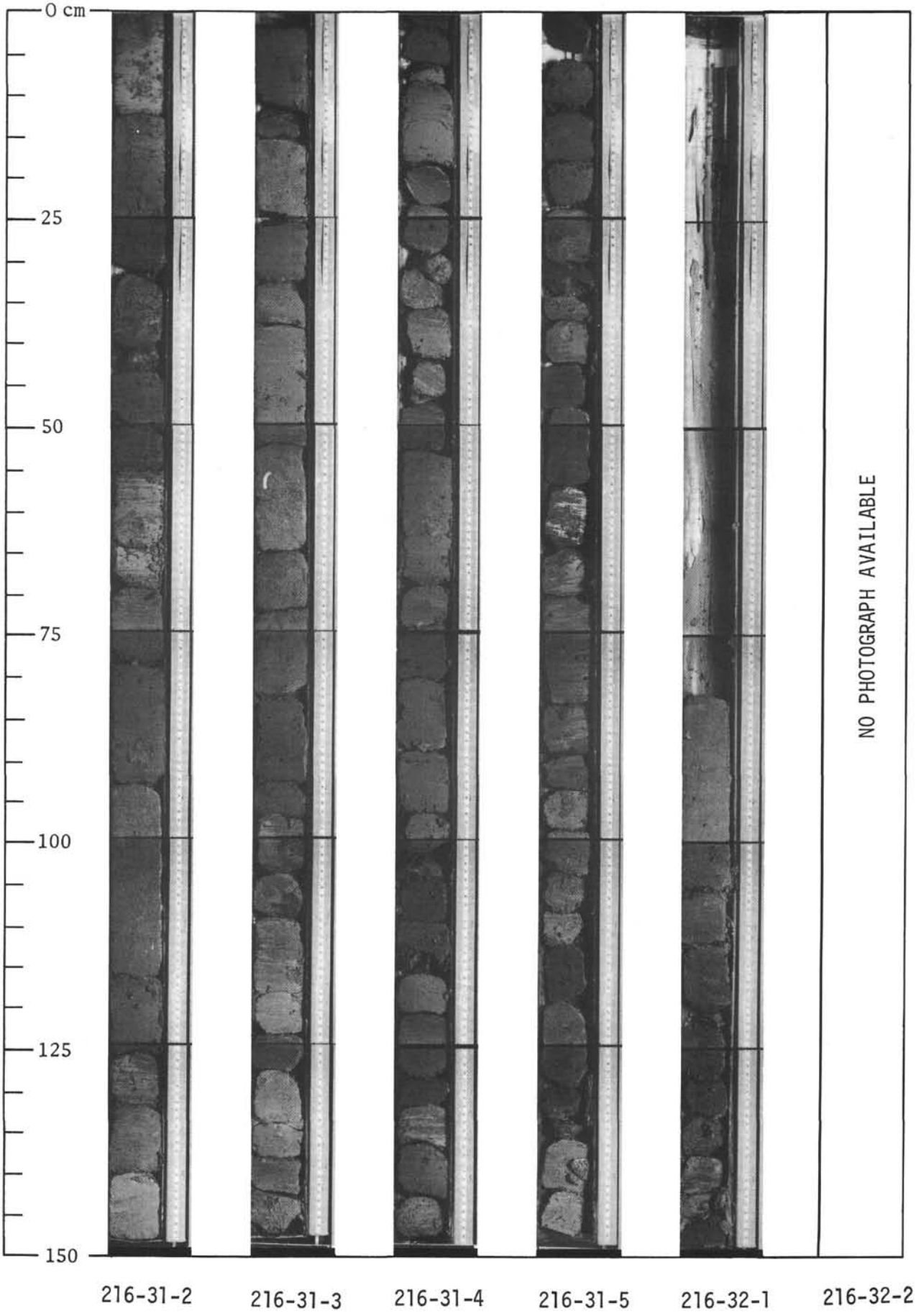

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216-22-2
216-22-3
216-23-1
216-23-2
216-23-3
216-24-1

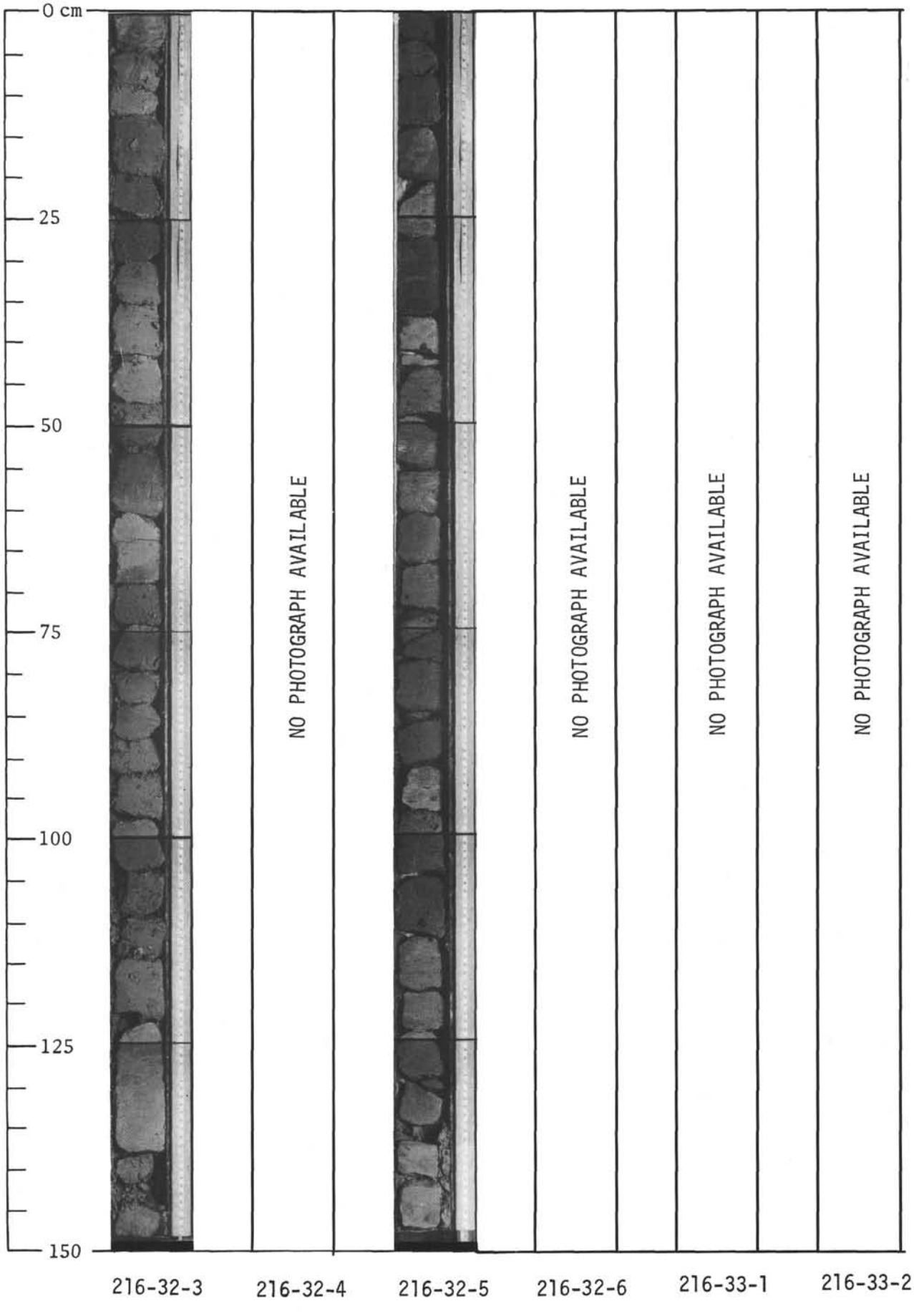

0 cm
25
50
75
100
125
150
216-24-2
216-24-3
216-24-4
216-24-5
216-25-1
216-25-2

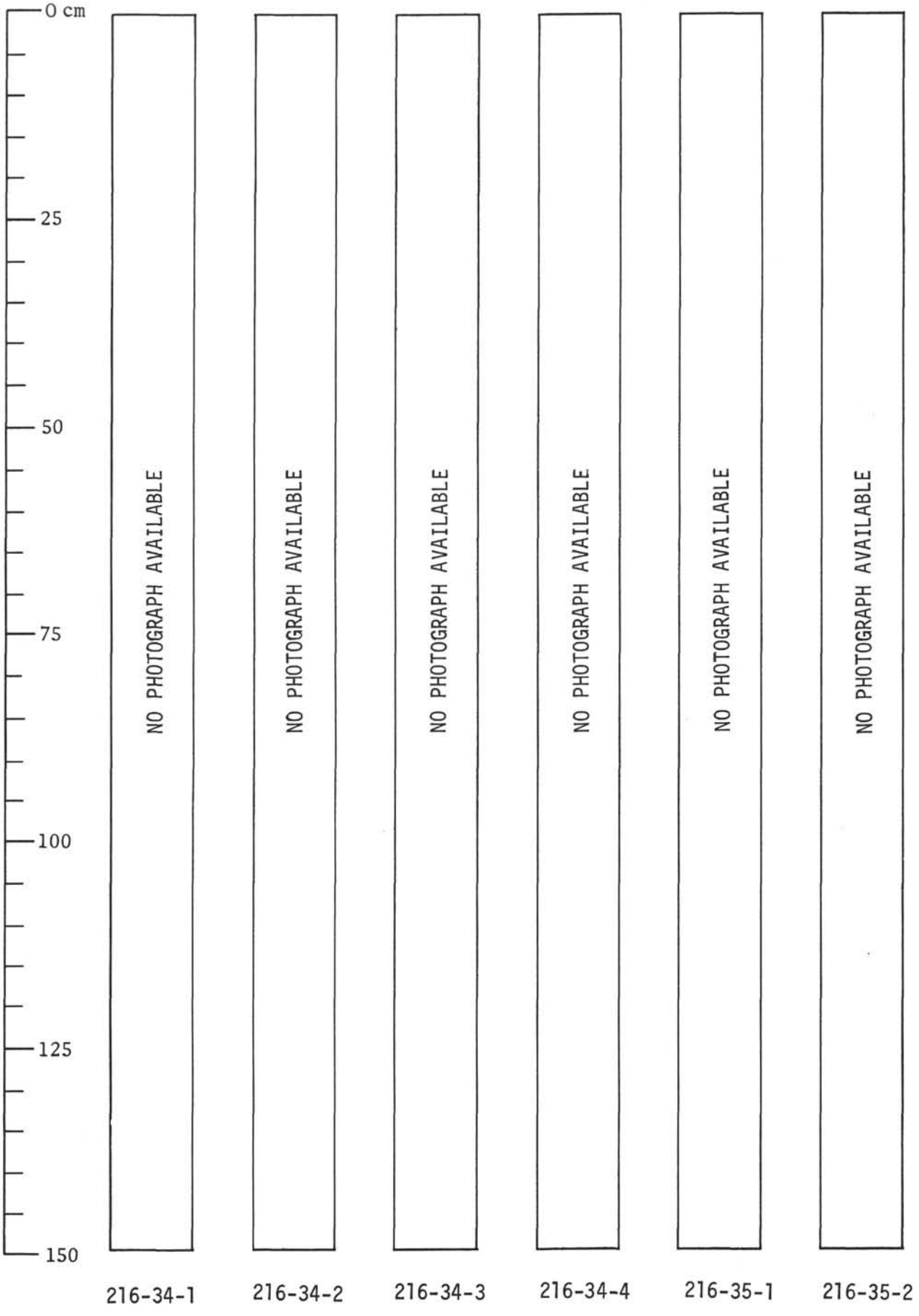

0 cm
25
50
75
100
125
150
216-25-3
216-25-4
216-26-1
216-26-2
216-26-3
216-27-1

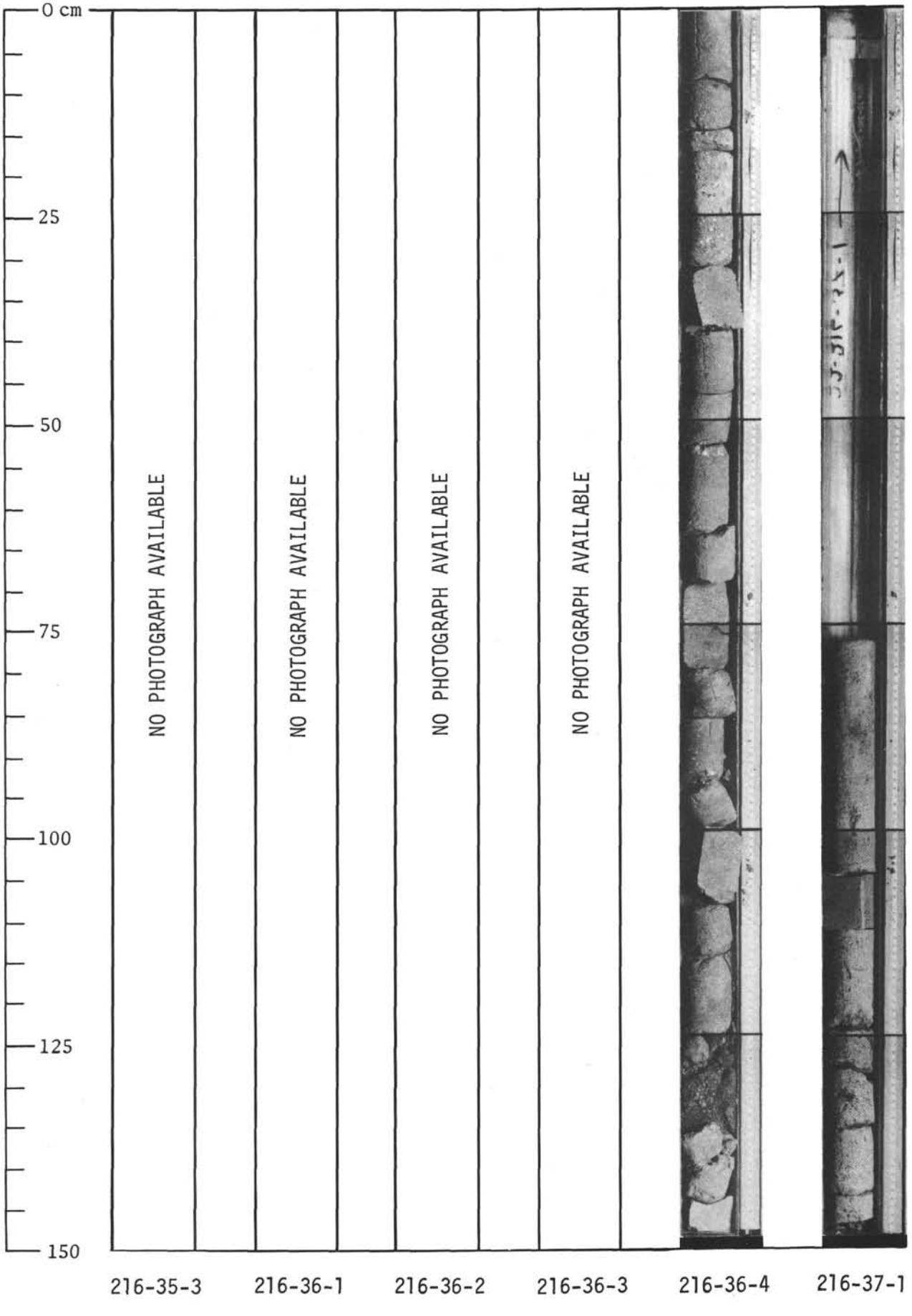

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216-27-2
216-28-1
216-28-2
216-28-3
216-29-1
216-29-2

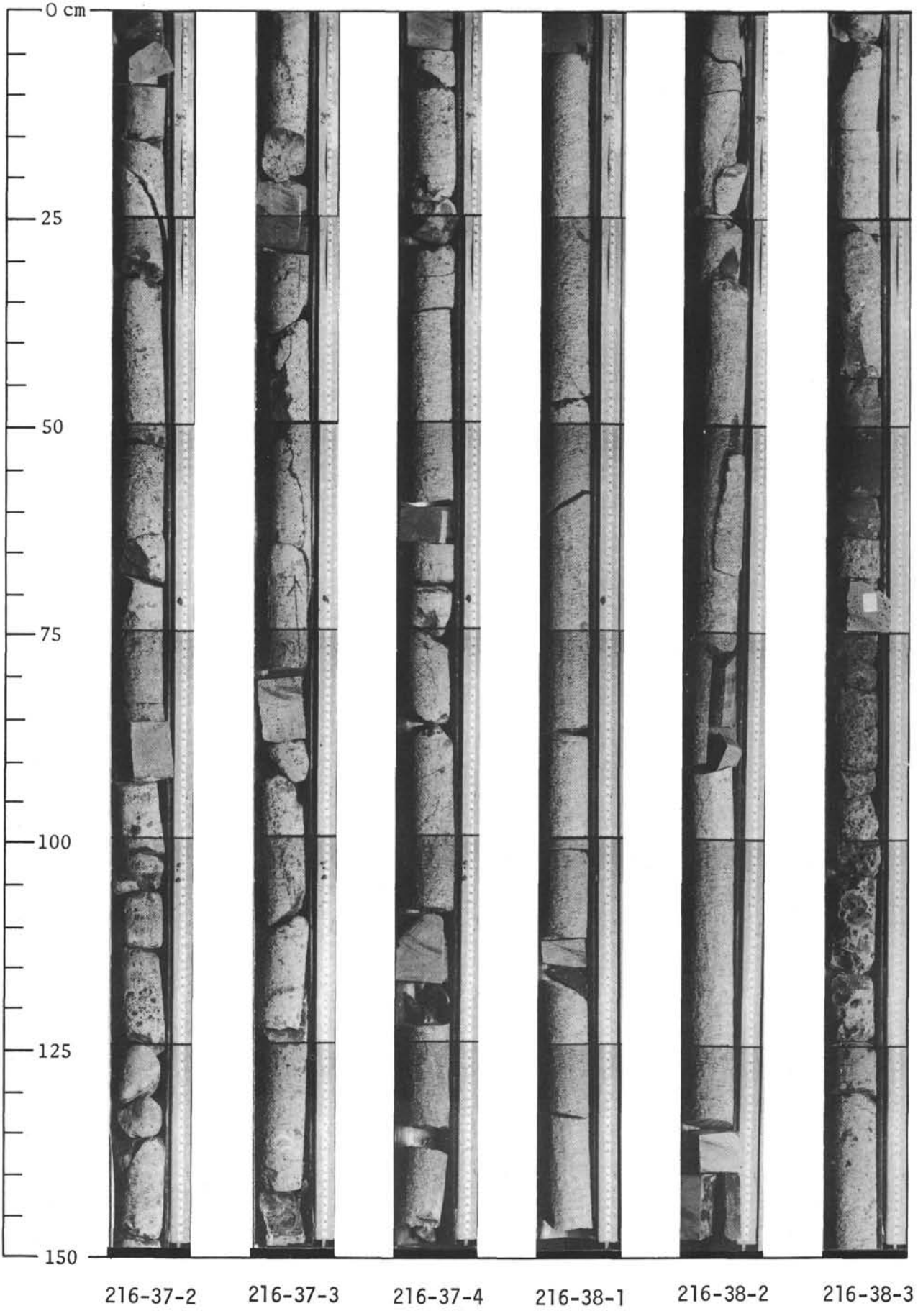

0 cm
25
50
75
100
125
150
216-30-1
216-30-2
216-30-3
216-30-4
216-30-5
216-31-1

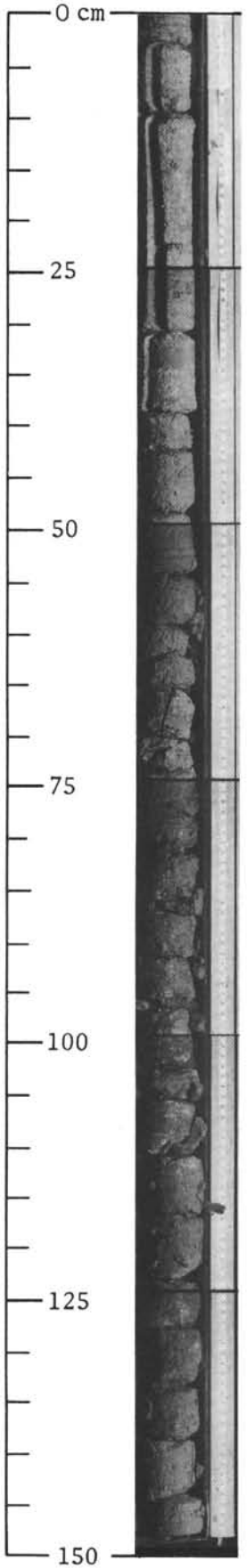

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216-31-2
216-31-3
216-31-4
216-31-5
216-32-1
216-32-2


0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
216-32-3
216-32-4
216-32-5
216-32-6
216-33-1
216-33-2

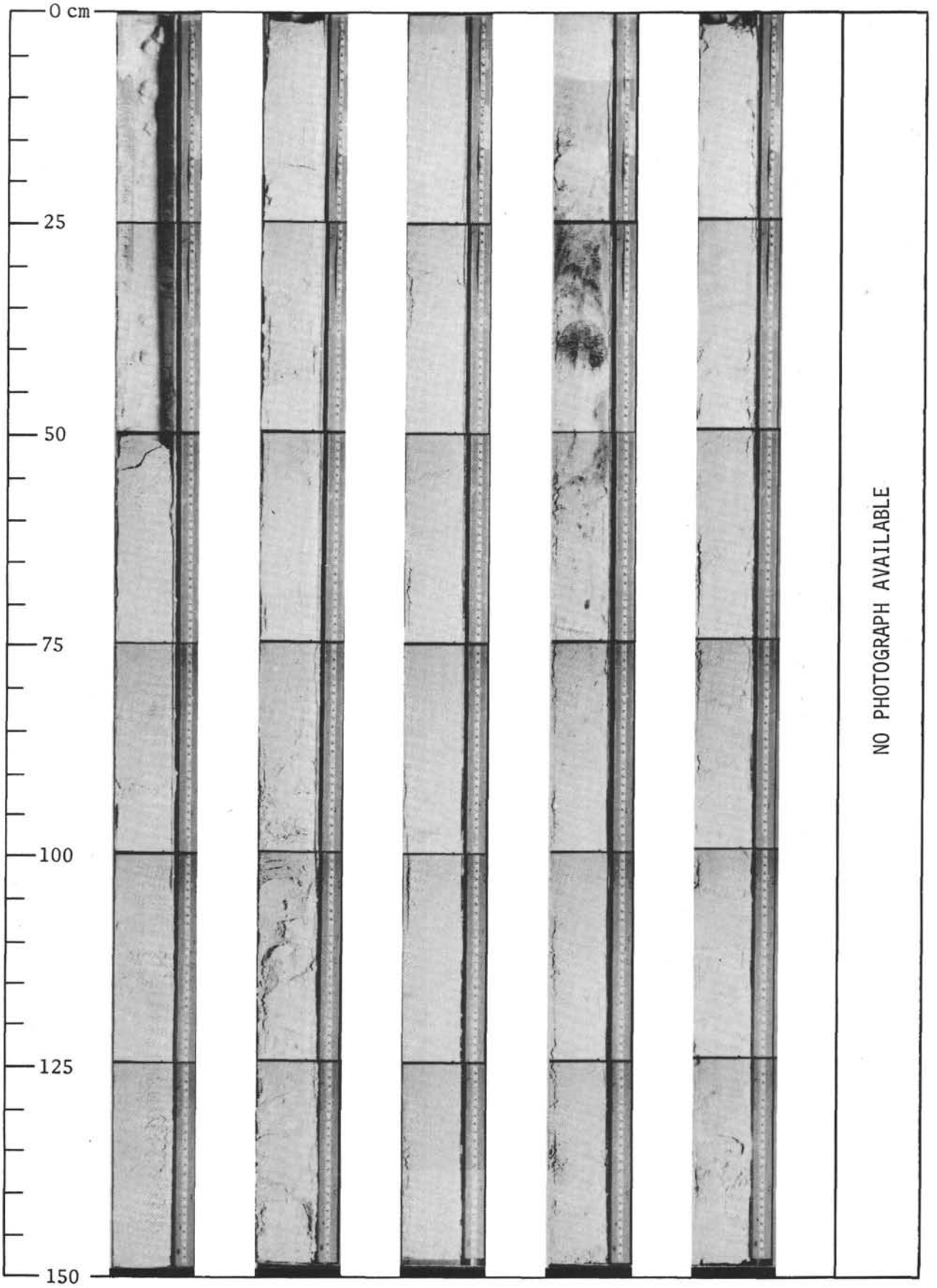

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
216-34-1
216-34-2
216-34-3
216-34-4
216-35-1
216-35-2

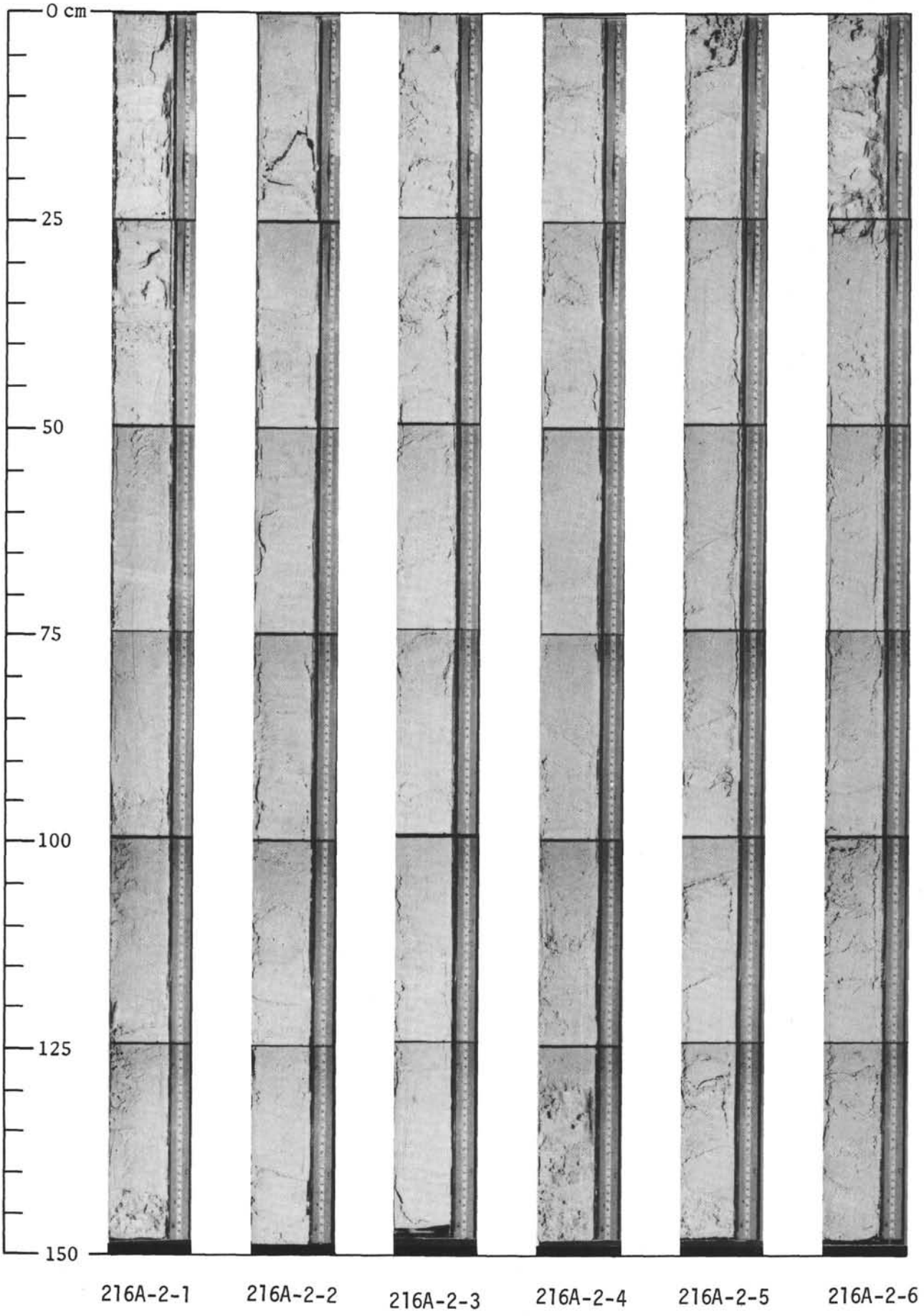

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
NO PHOTOGRAPH AVAILABLE
216-35-3
216-36-1
216-36-2
216-36-3
216-36-4
216-37-1

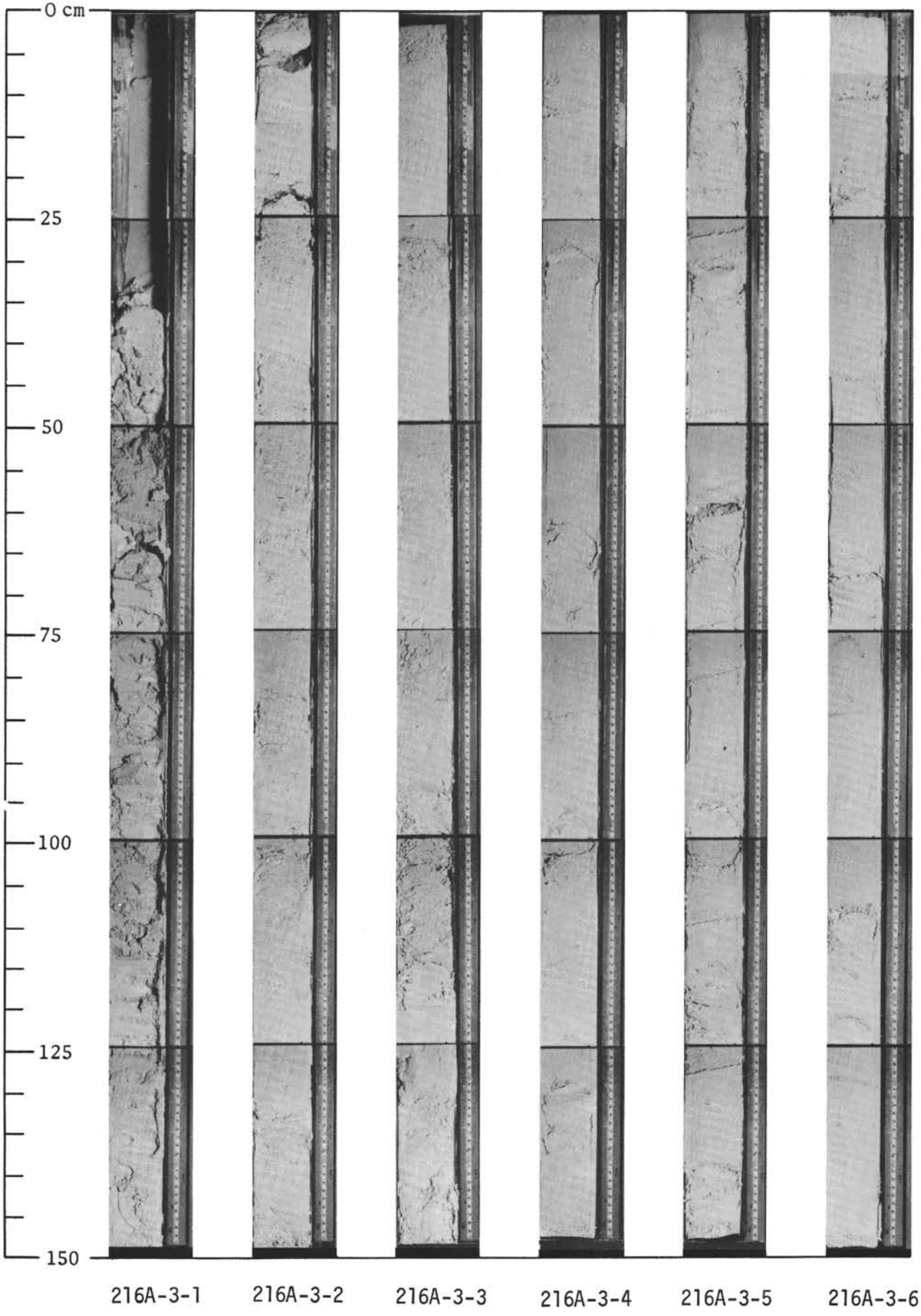

0 cm
25
50
75
100
125
150
216-37-2
216-37-3
216-37-4
216-38-1
216-38-2
216-38-3

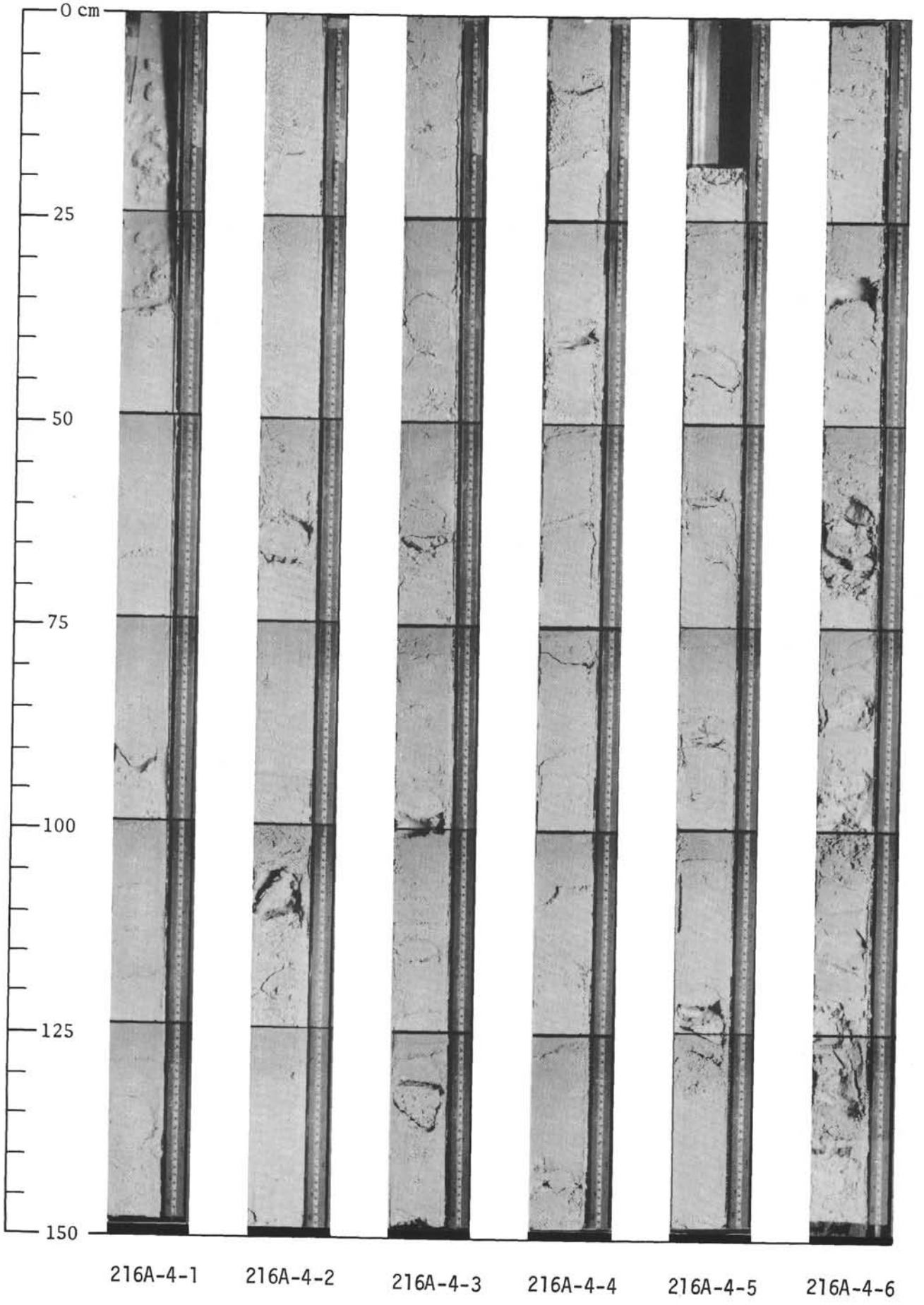


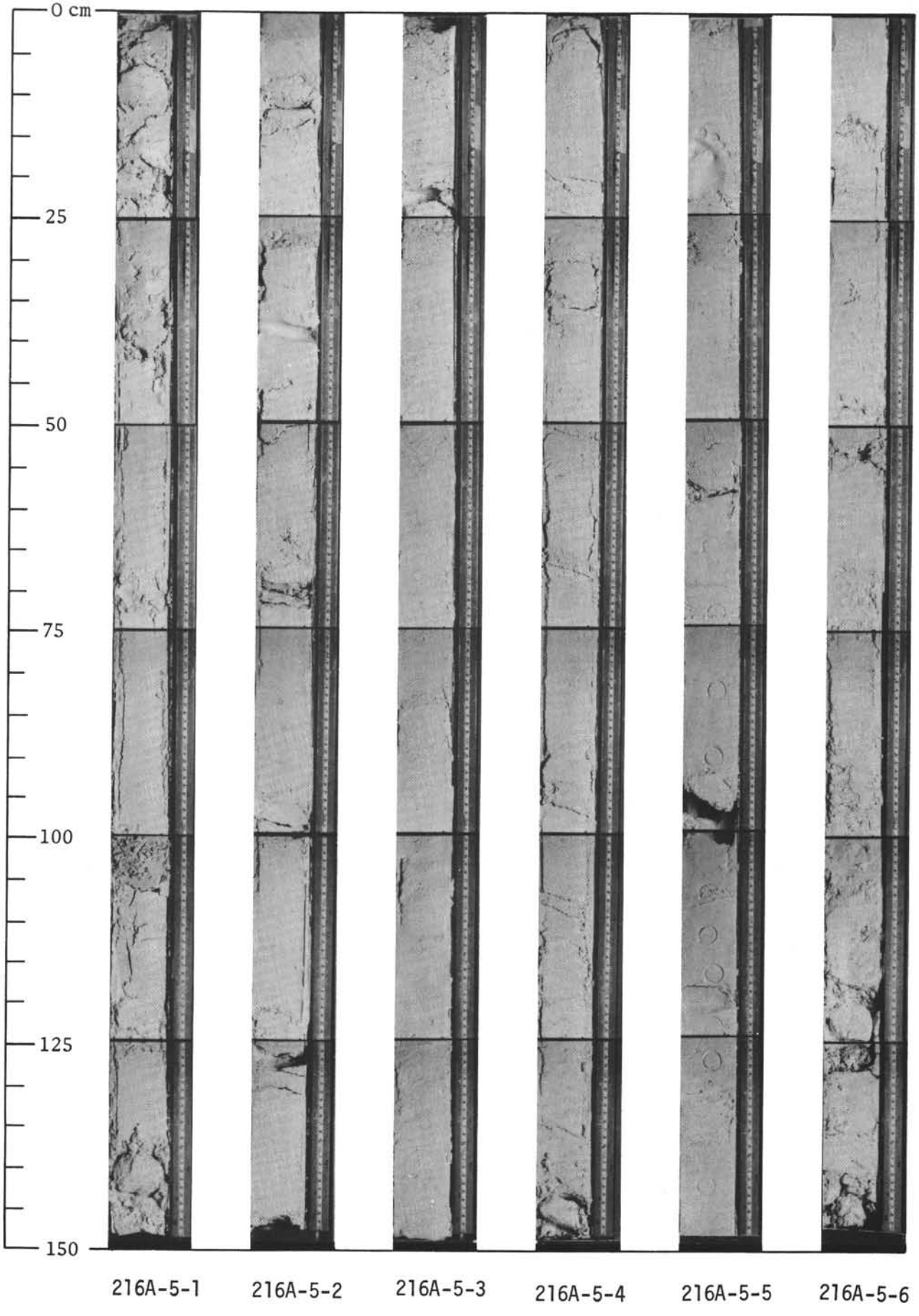
216-38-4

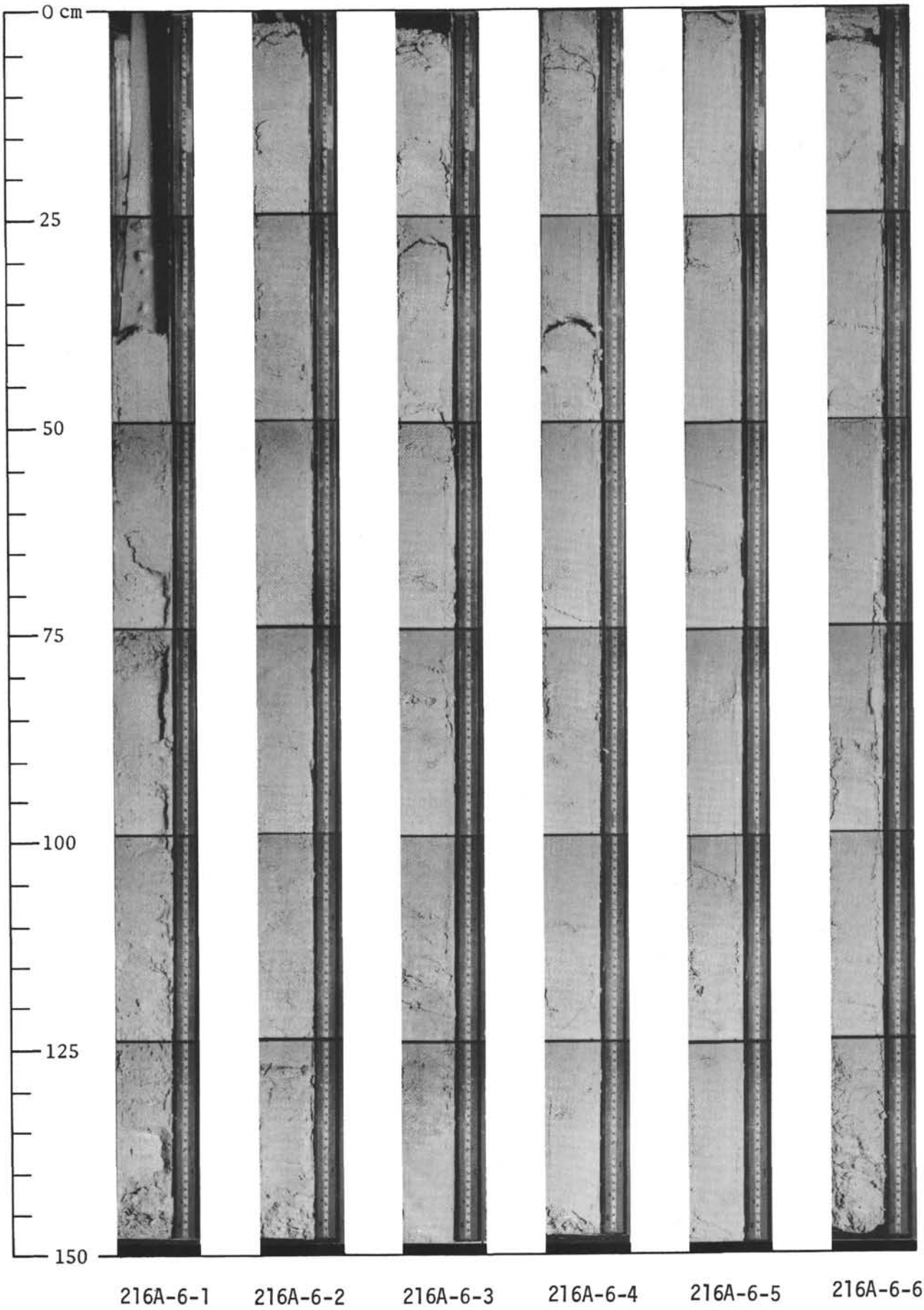

0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
216A-1-1
216A-1-2
216A-1-3
216A-1-4
216A-1-5
216A-1-6


0 cm
25
50
75
100
125
150
216A-2-1
216A-2-2
216A-2-3
216A-2-4
216A-2-5
216A-2-6


0 cm
25
50
75
100
125
150
216A-3-1
216A-3-2
216A-3-3
216A-3-4
216A-3-5
216A-3-6


0 cm
25
50
75
100
125
150
216A-4-1
216A-4-2
216A-4-3
216A-4-4
216A-4-5
216A-4-6


0 cm
25
50
75
100
125
150
216A-5-1
216A-5-2
216A-5-3
216A-5-4
216A-5-5
216A-5-6


0 cm
25
50
75
100
125
150
216A-6-1
216A-6-2
216A-6-3
216A-6-4
216A-6-5
216A-6-6