8. SITE 208

The Shipboard Scientific Party[1]
With Additional Contributions From
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and
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Location: North Lord Howe Rise

Position: 26°06.61′S, 161°13.27′E

Water Depth: 1545 meters

Total Penetration: 54 meters

Summary: Foram nannofossil ooze to chalk overlies the regional unconformity (Late Oligocene/Middle Eocene). Siliceous fossil-bearing nannofossil chalk to nannofossil-bearing radiolarite or diatomite underlies the unconformity and becomes calcic chalk at deepest penetration (Late Cretaceous).

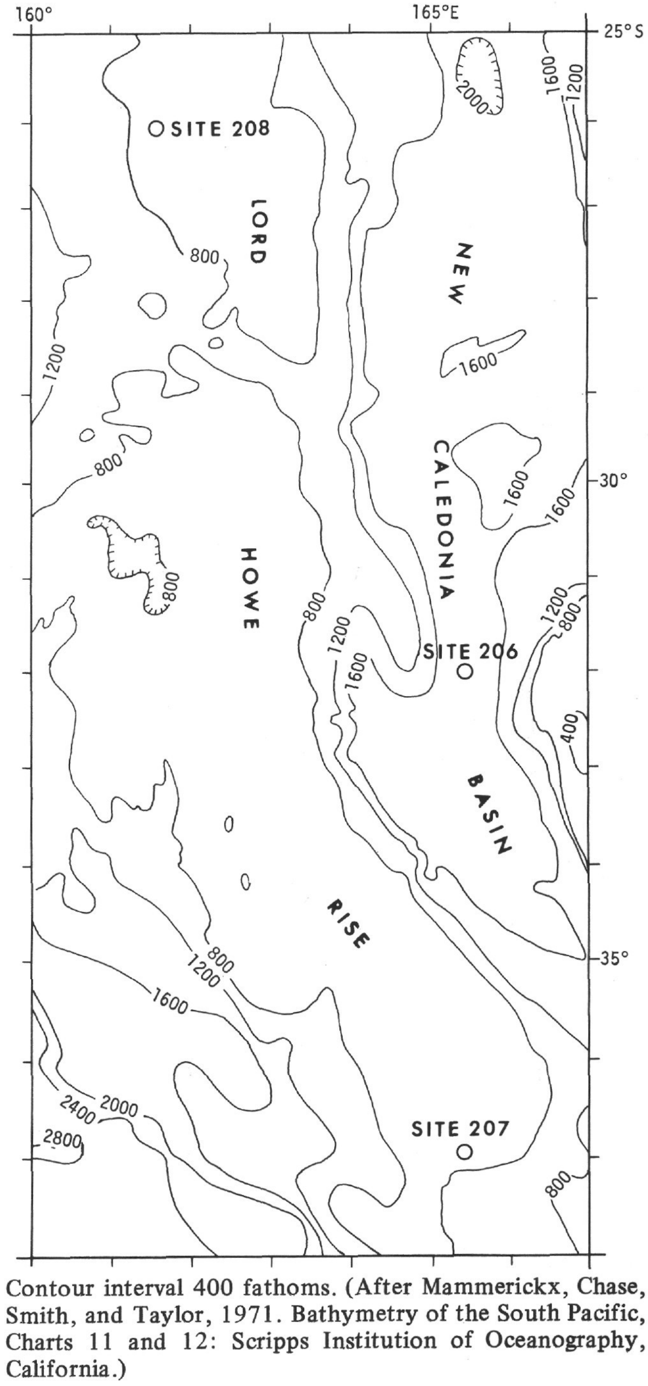
BACKGROUND AND OBJECTIVES

General

Site 208 is located on the northern portion of the Lord Howe Rise just west of the crest. Along with Site 207, this site was proposed to provide information on the history and structural development of the rise and to provide a biostratigraphic section intermediate between the one at Site 206 and the subequatorial area to the north.

Prior to site survey by R/V *Kana Keoki*, the available data indicated a general situation comparable to that at Site 207. Features on this portion of the rise are generally smoother both on the sea floor and at the dominant regional deep acoustic reflector. As at Site 207 there are frequent indications of deeper structure below the deep reflector.

Review of the proposed site by the JOIDES Panel on Pollution Prevention and Safety indicated that the site and the drilling program were acceptable with continuous coring throughout, except that the section above the major regional acoustic reflector could be cored intermittently if the comparable section at Site 207 had not shown



Contour interval 400 fathoms. (After Mammerickx, Chase, Smith, and Taylor, 1971. Bathymetry of the South Pacific, Charts 11 and 12: Scripps Institution of Oceanography, California.)

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hydrocarbons. Maximum drilling precautions were required and abandonment was to include filling the hole with mud if hydrocarbons were observed.

Site Survey

Site 208 was surveyed by R/V *Kana Keoki* during September 1971. Features on this northern portion of the Lord Howe Rise are generally smoother both at the sea floor (Figure 1) and the acoustic basement (Figure 2). The sea floor slopes gently to the west (at about 8m/km), and the basement shows only slightly greater slope (about 9.5 m/km).

The regional basement reflector is quite broad, reaching thicknesses of as much as 0.3 sec. Below this apparent basement, intermittent and indistinct deeper reflectors slope downward toward the west, giving the appearance of a series of dipping beds which thin toward the site. Sediment thickness above the acoustic basement is rather uniform in the range of 0.45 to 0.55 sec subbottom (Figure 3). Although the true basement relief may be considerably greater over the region, this cannot be adequately supported by available profiles. The site magnetics do not provide any indication of basement structure, suggesting that the deep structure is in older lithified sedimentary horizons.

OPERATIONS

Site Approach

The site approach was from the southeast and paralleled the *Kana Keoki* survey track so that site location and the underway beacon drop were accomplished with no difficulties.

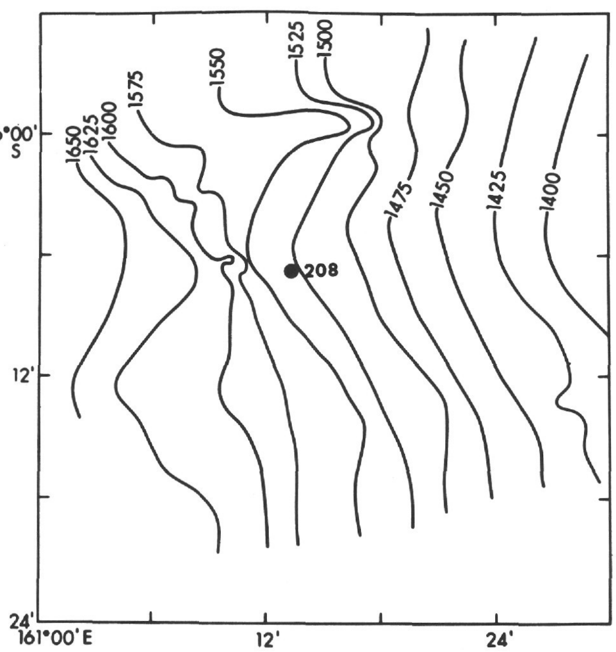

Figure 1. *Bathymetry at Site 208 (uncorrected meters).* Kana Keoki *site survey September 1971.*

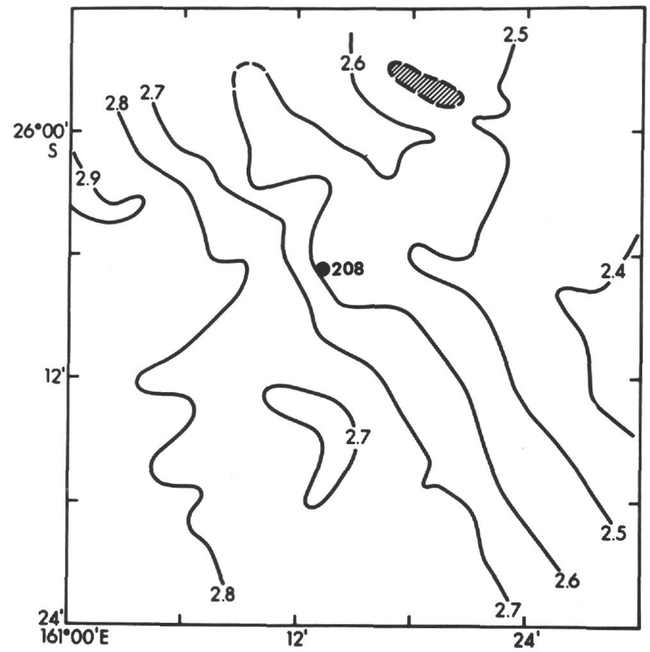

Figure 2. *Acoustic basement (seconds of reflection time) at Site 208.* Kana Keoki *site survey.*

Sonobuoy

The site 208 sonobuoy profile (Figure 4) shows a series of well-defined reflectors to a depth of 0.74 sec subbottom. Table 1 summarizes initial reflector data and estimates.[2] Reflector 4 (underway acoustic basement) is part of a broad band of signals. Limits of the band (both upper and lower) vary with recording frequencies, the upper limits being most clearly defined (Reflector 3) in the 106 to 32 Hz range and the lower limit (Reflector 9) most clearly seen at 10 to 40 Hz. Noise in the record decreased rapidly as the sonobuoy drifted away from the ship. The sonobuoy resolves the detail of the underway acoustic basement layer. The deeper reflectors (8 and 9) are not apparent on the site approach profile.

Drilling Program

A total of 34 cores was collected (Table 2) to a depth of 594 meters below the sea floor. Continuous coring was not required above the regional unconformity but, with three wash intervals of 4 meters each, the upper 111 meters (through Core 11) were cored continuously to provide a continuous Pleistocene-Pliocene section for biostratigraphic correlations. An alternating wash-and-core routine was carried out through the interval from 111 to 548 meters where the degree of sediment consolidation became high enough to preclude further washing. Continuous coring was conducted from 548 to 594 meters at which depth the hole was abandoned. Although basement was not reached, the sonobuoy profile indicated the deepest reflector was at

[2]Final correlations of sonobuoy profiles using laboratory-measured velocities, other physical properties, and lithologic boundaries are presented in Part II of this Initial Report.

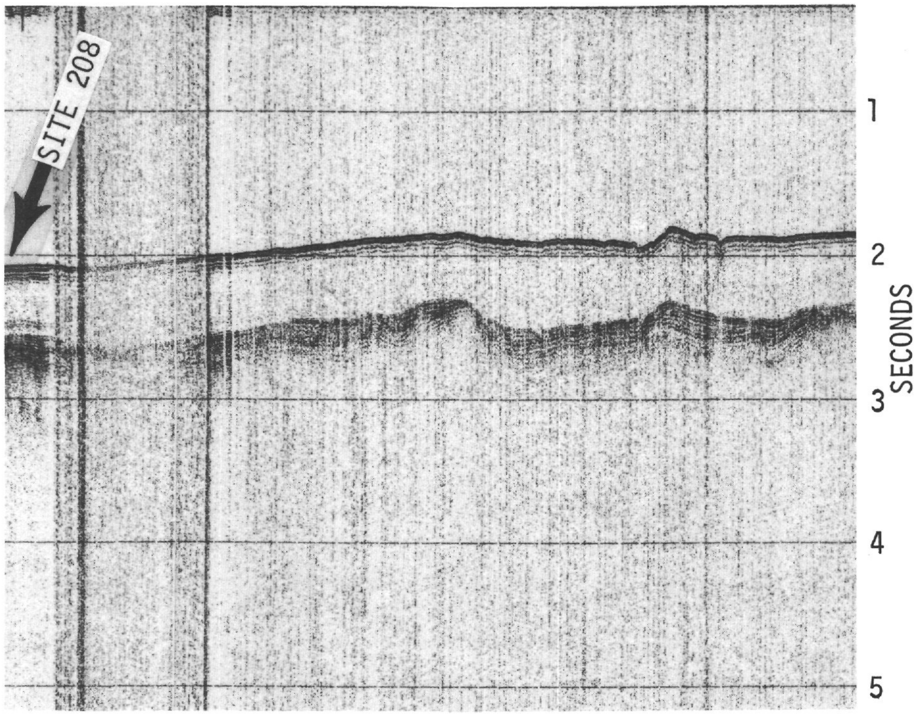

Figure 3. *Seismic profile along approach to Site 208.* Glomar Challenger *December 1971.*

least 50 meters deeper than the maximum penetration achieved at this site.

Three attempts were made to obtain downhole temperature measurements with the retractable probe. These were unsuccessful and the instrument package was damaged by impacting upward in the core barrel. Two additional trials were made to attempt to rectify the problem, but these were inconclusive.

The site was abandoned at 1800 on 24 December 1971 to the tune of sleigh bells and the smell of reindeer.

LITHOLOGY

General

Summaries of each core are given in the Appendix. The cored sequence can be divided into two lithologic units.

1) Unit 1 (0 to 488 m)–late Oligocene to late Pleistocene. Unconsolidated to semilithified foraminiferal-nannofossil ooze to foraminiferal-rich nannofossil ooze with subordinate nannofossil foraminiferal ooze and foraminiferal-bearing nannofossil ooze.

2) Unit 2 (488 to 594 m)–late Cretaceous to early middle Eocene. Siliceous fossil-bearing nannofossil chalk to nannofossil-bearing radiolarite or diatomite. Calcic chalk occurs at the base of the unit.

Unit 1

This unit consists mainly of foraminiferal-nannofossil ooze and foraminifera-rich nannofossil ooze with subordinate nannofossil-foraminiferal ooze and foraminifera-bearing nannofossil ooze. Due to lithification, ooze changes to chalk at about Core 21. This unit starts at the top of Core 1 and continues to the top of Core 27. The color of the sediment is mainly white to light gray with streaks and patches of shades of gray, green, and yellow. Dark gray to black spots, streaks, and occasional nodules are due to pyrite concentrations. In the more lithified part of the unit, pyrite concentration is often restricted to (part of) burrow fills. In the ubiquitous *Zoophycos*-type burrows, pyrite is frequently found concentrated at the ends of burrow "arms." Apart from these concentrations, pyrite is also found disseminated in small quantities throughout the unit (up to a few percent). Calcite spicules (probably sponge spicules) are found, especially in the top third (up to about Core 15) of the unit. They constitute up to a few percent of the sediment.

In the more lithified parts of the unit, the sediment is not deformed by drilling, and sedimentary structures are preserved. These are mainly burrows, which have partly destroyed the original stratification.

Smear slides of the sediments were regularly searched for clay with the aid of an oil immersion objective. None could be detected. Later X-ray and infrared spectrophotometry analyses did not detect any clay minerals either. The only nonbiogenic materials detected were traces of quartz and a poorly ordered kaolinitic material.

Unit 2

This unit was sampled from the middle of Core 27 to the bottom of the hole at 208-34, CC. It is characterized by its siliceous component. Because of the varying amounts of the different components (mainly nannofossils, radiolarians, diatoms, sponge spicules, and chert), sediment names vary. At one end of the range is siliceous fossil-bearing nannofossil chalk, and at the other end nannofossil- (and sponge spicule-) bearing radiolarite or diatomite. At the base of the

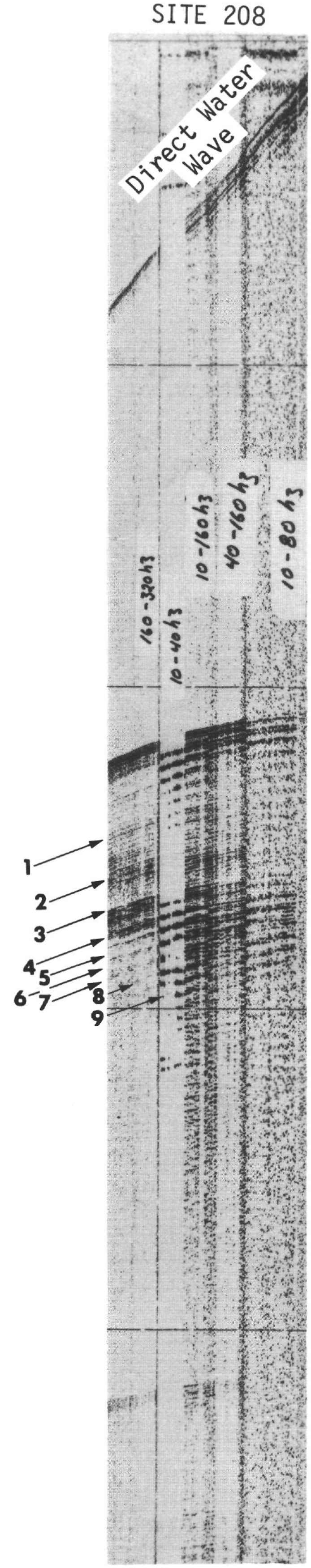

Figure 4. *On-site sonobuoy profile at Site 208.*

TABLE 1
Site 208 Sonobuoy Data

Reflector	Depth (sec)	Nature	Estimated Velocity Structure (m/sec)	Estimated Depth (m)
1	0.23	Moderate/weak, some low frequency	1500	173
2	0.35	Moderate/strong, no low frequency	1500	270
3	0.48	Strong/moderate, low frequency	1800	378
4	0.54	Strong, good low frequency	1900	435
5	0.575	Moderate/strong, good low frequency	2500	481
6	0.65	Moderate/strong, good low frequency	2500	552
7	0.67	Weak, weak low frequency	2500	603
8	0.70	Weak/moderate, weak low frequency	3000	648
9	0.74	Moderate, good low frequency	3000	708

unit (from Core 31 downwards), calcite particles became an important constituent of the sediment, changing the sediment in Cores 33 and 34 to calcic chalk. Scanning electron microscopy shows that these particles consist of both fossil fragments (mainly nannofossil fragments) and authigenic (diagenetic) calcite grains. Where no siliceous fossils are present, the sediment is either wholly (chert) or partly silicified. This again (see also lithologic summary of Site 207) points to solution of biogenic silica and its recrystallization in certain horizons. Glauconite is found near the top boundary. Pyrite is found throughout the unit. No clay could be detected in the smear slides, nor by later X-ray analyses.

The main colors of the sediments are light shades of gray. Chert colors vary from black to gray.

The whole unit is intensely burrowed and, as in Unit 1, includes many *Zoophycos*-type burrows.

Discussion

Environment of Deposition

The depth of deposition of both units was well above the calcium carbonate compensation depth. It need not have been much different from today's depths. Foraminifera are almost exclusively planktonic throughout the cored sequence, indicating open ocean conditions. There are no obvious signs of terrigenous material in the smear slides. However, minute quantities of quartz grains are found in the insoluble resisdues down to Core 17 (middle Miocene). Some of these are rounded, and occasionally oxide coated. X-ray analyses show traces of quartz down to Core 27. Some of this quartz is probably of eolian origin.

TABLE 2
Coring Summary – Site 208

Core	Date	Time	Depth from Drill Floor (m)	Depth Below Sea Floor (m)	Cored (m)	Recovered (m)	Recovery (%)
1	12/23	0545	1555-1564	0-9	9	9.4	100
2	12/23	0630	1564-1573	9-18	9	8.7	97
3	12/23	0710	1577-1586	22-31	9	8.3	92
4	12/23	0755	1590-1599	35-44	9	6.4	71
5	12/23	0830	1599-1608	44-53	9	9.0	100
6	12/23	0905	1608-1617	53-62	9	9.0	100
7	12/23	1000	1617-1626	62-71	9	7.8	87
8	12/23	1040	1626-1635	71-80	9	9.0	100
9	12/23	1120	1639-1648	84-93	9	8.4	93
10	12/23	1200	1648-1657	93-102	9	9.0	100
11	12/23	1235	1657-1666	102-111	9	9.0	100
12	12/23	1315	1675-1684	120-129	9	8.2	91
13	12/23	1400	1694-1703	139-148	9	9.0	100
14	12/23	1430	1712-1721	157-166	9	9.0	100
15	12/23	1510	1731-1740	176-185	9	9.0	100
16	12/23	1545	1749-1758	194-203	9	8.7	97
17	12/23	1635	1777-1786	222-231	9	3.0	33
18	12/23	1730	1786-1795	231-240	9	8.2	91
19	12/23	1825	1814-1823	259-268	9	3.0	97
20	12/23	1930	1842-1851	287-296	9	4.1	46
21	12/23	2020	1870-1879	315-324	9	9.4	100
22	12/23	2120	1899-1908	344-353	9	8.4	93
23	12/23	2225	1926-1935	371-380	9	9.4	100
24	12/23	2340	1954-1963	399-408	9	5.3	59
25	12/24	0120	1983-1992	428-437	9	9.4	100
26	12/24	0310	2011-2020	456-465	9	9.4	100
27	12/24	0425	2039-2048	484-493	9	8.0	89
28	12/24	0535	2067-2076	512-521	9	8.5	94
29	12/24	0755	2094-2103	539-548	9	9.4	100
30	12/24	0855	2103-2112	548-557	9	8.7	97
31	12/24	0955	2113-2122	558-567	9	3.3	37
32	12/24	1115	2122-2131	567-576	9	0.0	0
33	12/24	1230	2131-2140	576-585	9	6.9	77
34	12/24	1340	2140-2149	585-594	9	3.1	34
Total					306	255.4	83

Note: Echo sounding depth (to drill floor) = 1554 meters;
drill pipe length to bottom = 1555 meters.

Regional Disconformity

The boundary between Units 1 and 2 represents a major disconformity. Deposits representing the time span between middle Eocene and late Oligocene are missing. This disconformity was also detected at Sites 206, 207, 209, and 210.

BIOSTRATIGRAPHY

General

The 594-meter-thick Latest Cretaceous through early mid Paleocene, mid Mid Eocene, and late Oligocene to late Pleistocene microfossil sequence represented in the 34 semicontinuously cored cores obtained from Hole 208 is of particular paleontological interest for the following reasons:

1) The Mesozoic-Cenozoic boundary was obtained in Section 33-1.

2) Diverse siliceous microfossil assemblages have been obtained from the Danian (as dated by calcareous nannofossils). As might be expected there are many new species present.

3) The association of siliceous and calcareous microfossils in the Late Cretaceous through early mid Paleocene and middle Eocene allows improved intercorrelations.

4) Lastly, the sequence obtained fulfilled the major biostratigraphic justification for this hole, namely, it provided assemblages correlatable in large part with both low and southern midlatitude assemblages.

As mentioned above, the sequence is not complete, most of the Paleogene being absent due to the presence of three sedimentary breaks. The upper, between the early middle Eocene and the late Oligocene, has regional significance. The middle break, between the middle Paleocene and early middle Eocene, also appears to be of regional significance, for it has a counterpart in Sites 207 and, less certainly, 206. The lowest break occurs between the Mesozoic and Cenozoic.

The four episodes of sedimentation referred to above can be characterized paleontologically as follows:

Pleistocene to late Oligocene containing abundant, well to moderately well preserved planktonic foraminifera and calcareous nannofossils throughout (208-1 to 208-27-3, 54 cm.

Early middle Eocene containing abundant, well-preserved calcareous nannofossils and Radiolaria plus common to few moderately well preserved planktonic foraminifera (208-27, CC to 208-29-1, 38 cm).

Middle to early Paleocene (208-29-1, 45 cm to 208-33-1, 36 cm). This interval contains abundant, well-preserved Radiolaria; abundant to few, poorly preserved calcareous nannofossils; and variable frequencies of benthonic foraminifera.

Maastrichtian (208-33-1, 60 cm to 208-34, CC) containing relatively abundant, calcareous nannofossils, abundant to common planktonic foraminifera, and rare Radiolaria; all three groups having poor to moderate preservation.

Thus, the overall picture obtained at Site 208 is of an abundance of siliceous planktonic microfossils (including Radiolaria, diatoms, silicoflagellates, etc.) in the early to mid Paleogene and of an almost total dominance of calcareous planktonic microfossils in the remainder of the sequence.

Paleodepth Analysis

From the Eocene to the present day, middle bathyal depths have persisted, based on the occurrence of benthonic foraminiferal forms including hispidocostate uvigerinids, *Oridorsalis, Pullenia bulloides, Globocassidulina*, and diverse nodosariids. A slight shallowing took place during the late middle Miocene from lower mid bathyal depths in the older parts of the sequence to middle mid bathyal depths, based on a distinct upward increase in frequency of bolivinids and cassidulinids.

It is also suggested that Maastrichtian sediments were elevated prior to the onset of Paleocene sedimentation and slightly truncated in the course of the early Paleocene transgression. The appearance of planktonic foraminiferal taxa in the higher levels of the Paleocene and the upward increase in the planktonic/benthonic foraminiferal ratio suggests rapid deepending of the basin and a return to possible middle bathyal conditions similar to those prevailing during the Maastrichtian.

Foraminifera

Site 208 represents one of the finest two late Oligocene to Recent planktonic foraminiferal sequences available from transitional waters of the Southern Hemisphere; the other being Site 206 in the southern part of the New Caledonia Basin. Site 208, being in lower latitudes (26°S), is of particular importance because the faunas in this sequence are even more intermediate between tropical and temperate regions than those in Site 206 (32°S). Site 208 thus represents a particularly important linkage between the zonal schemes established for both tropical and temperate areas.

The sampled section at Site 208 consists of 34 cores. The interval from 0 to 111 meters (208-1, CC to 208-11, CC) was continuously cored; the interval from 111 to 539 meters (208-12, CC to top of 208-29, CC was cored intermittently; and the interval from 539 to 594 meters (208-29, CC to 208-34, CC) was continuously cored.

Four distinct phases of sedimentation are separated by disconformities as shown by the following:

Pleistocene to early late Oligocene containing abundant, well-preserved planktonic foraminifera in the Pleistocene to middle Miocene and moderately preserved faunas in the early Miocene and late Oligocene (208-1-CC to 208-27-3, 54 cm)

(Disconformity)

Early middle Eocene containing few to common planktonic foraminifera with moderate preservation (208-27, CC to 208-28, CC)

(Disconformity)

Early to middle Paleocene containing variable numbers of planktonic and benthonic foraminifera (208-29-1, 45 cm to 208-33-1, 21 cm)

(Disconformity)

Maastrichtian sediments containing abundant to common, well-preserved planktonic foraminifera (208-33-1, 9 cm to 208-34-3, 124 cm)

The Pleistocene (208-1, CC and 208-4-1, 100 cm) is fairly condensed compared with the other drilled sites and may reflect lower productivity at these latitudes. Cool- and warm-water cycles can be distinguished, as expected, at these latitudes, but are less distinct than at Site 206 which is admirably placed to reflect faunal fluctuations in response to climatically related paleo-oceanographic oscillations. The faunal changes in the Pleistocene at Site 208 reflect movement of subtropical and southern tropical water masses.

The Pliocene, which is 69 meters thick (208-4-3, 50 cm to 208-11-3, 50 cm) is notable in that preservation of planktonic foraminifera is excellent, and species are present that are normally destroyed during very early stages of dissolution. A combination of the relatively shallow depth at Site 208 and the relatively low latitudinal position has resulted in a distinct reduction in dissolution. Warm- and cold-water cycles present are of lower amplitude than those that occur in the Pleistocene. A combination of tropical and temperate elements is present, and the sequence is of value in correlation between paleooceanographic cycles in both regions.

The late Miocene is highly extended (about 120 meters thick) compared with the other sites and thus offers fine biostratigraphic resolution for this interval. In general, the late Miocene appears to be considerably warmer at these latitudes than that of the Pliocene.

The middle Miocene (208-18-3, 50 cm to 208-21-3, 62 cm) and the early Miocene (208-21-4, 46 cm to 208=25-3, 43 cm) likewise contain important tropical elements such as *Globorotalia peripheroacuta* that are essentially absent in sections further to the south. The middle Miocene Zones N8 and N9 are missing in a minor unconformity occurring between 208-21-3, 62 cm and 208-21-4, 46 cm. Much of the *Orbulina* bioseries is missing in this unconformity.

The early Miocene continues downwards into the late Oligocene (208-25, CC to 208-27-3, 54 cm). The Oligocene-Miocene boundary is based on the upward appearance of *Globorotalia kugleri* and *Globigerinoides primordius.* The late Oligocene is in turn separated by a disconformity from underlying sediments of early middle Eocene age (208-27, CC and 208-28, CC) as shown by the association of *Pseudogloboquadrina primitiva* and *Globigerina angiporoides* and an absence of *Globigerapsis index* and *Globorotalia crater*.

Below this interval, yet another disconformity separates these middle Eocene sediments from middle Paleocene sediments.

Early to middle Paleocene sediments occur between 208-29-1, 45 cm and 208-33-1, 21 cm.

The interval from 208-29-1, 45-47 cm to 208-30-3, 39-41 cm, contains rich and varied assemblages of benthonic and planktonic foraminifera. Taxa present include: *Zeauvigerina teuria* Finlay, *Globigerina* (Subbotina) *triloculinoides* (Plummer), *Globorotalia (Turborotalia) pseudobulloides* (Plummer), *Globorotalia* cf. *uncinata* Bolli, *Globorotalia (Planorotalites) laevigata* Bolli, *Globorotalia pusilla pusilla* Bolli, *Globorotalia* cf. *ehrenbergi* Bolli, *Globorotalia (Planorotalites) pseudomenardii* Bolli, *Globorotalia (Acarinina) acarinata* (Subbotina), and *G. (A.) mckannai* (White). This interval is the approximate equivalent of Jenkins *G. triloculinoides* Zone (mid Teurian to early Waipawan). Further work will probably enable close correlation with the Bolli and Berggren zonations. For instance, it seems likely that this interval can be correlated with the *G. uncinata* Zone, *G. pusilla pusilla* Zone, and lowermost *G. pseudomenardii* Zone.

Planktonic taxa first appear upwards within the Paleocene in Sample 208-31-3, 111-113 cm. Taxa occurring up to Sample 208-30-3, 112-114 cm include: *Globigerina* (subbotina) *triloculinoides* Plummer, *Globorotalia (Turborotalia) pseudobulloides* (Plummer), *Globorotalia (Turborotalia) compressa* (Plummer), and *Chiloguembilina subtriangularis* Bechmann. This interval is probably a correlative of Jenkins *G. pauciloculata* Zone (early Teurian; Danian). The important taxon *Globoconcusa daubjergensis* (Bronniman) was not encountered.

The interval 208-29-1, 45-47 cm to 208-31-3, 111-113 cm contains the Teurian Stage index taxa *Gaudryina whangaia* Finlay, *Pseudoclavulina anglica* Cushman, *Conotrochammina whangaia* Finlay, *Neoflabellina semireticulata* (Cushman and Jarvis), *Frondicularia teuria* Finlay, and *Bolivinoides delicatulus delicatulus* Cushman.

An abrupt faunal change occurs between 208-33-1, 21 cm and 208-33-1, 91 cm which marks the Mesozoic-Cenozoic boundary. Below this level, a sparse early Paleocene fauna is replaced by a righ foraminiferal fauna of Maastrichtian age.

An abundant and well-preserved Maastrichtian fauna occurring between 208-33-1, 91 cm and 208-34-3, 124 cm includes: *Gaudryina healyi* Finlay, *Dorothia elongata* Finlay, *Frondicularia rakauroana* Finlay, *Bolivinoides draco* (Marsson), *Heterohelix globulosa* (Ehrenberg), *Pseudotextularia deformis* Kikoine, *Planoglobulina carseyae* (Plummer), *Globigerinelloides volutus* (White), *G. subcarinatus* (Bronnimann), *Hedbergella monmouthensis* (Olsson), *Rugoglobigerina rugosa* (Plummer), *R. rotundata* Bronniman, *Globotruncana (Rugotruncana) circumnodifier* (Finlay), and *Globotruncana (Abathomphalus) mayaroensis* Bolli. Planktonic taxa dominate the fauna with the most common taxa being species of *Pseudotextularia, Heterohelix,* and *Rugoglobigerina.* Agglutinated taxa make up only a minor part of the total fauna. Practically all taxa are known in the New Zealand Late Cretaceous. The presence of *G. (R.) circumnodifier* allows correlation with the *G. circumnodifer* Zone (late Haumurian) of Webb (1966, 1971), while the upward entry of *G. (A.) mayaroensis* in 208-33-2, 112-114 cm allows correlation with the *G. mayaroensis* Zone of Trinidad (Bolli, 1966). The entire interval is Maastrichtian, and the upward entry of *G. (A.) mayaroensis* and *Pseudotextularia deformis* 208-33-2, 30-32 cm, high in the interval, is taken as evidence for separating the interval into middle and upper Maastrichtian. Site 208 microfaunas indicate an oceanic environment which was both deeper and farther offshore than correlative microfaunas described from the New Zealand area by Webb (1971).

Calcareous Nannofossils

This long and biostratigraphically important latest Cretaceous to late Pleistocene sequence is particularly interesting nannoflorally not only because of its strategic geographic position midway between the tropics and temperate New Zealand, but also because it contains the paleontologically highly intriguing Mesozoic-Cenozoic boundary. Unfortunately, most of the Paleogene is not represented due to the presence of a sedimentary break between the early mid Paleocene and the mid mid Eocene and of another break, known to be of regional significance, between the mid mid Eocene and the late Oligocene.

Pleistocene (208-1-1, 30 cm to 208-1-2, 105 cm)

The Pleistocene sediments contain abundant, well-preserved calcareous nannofossils. Species commonly present are: *Emiliania huxleyi, Gephyrocapsa oceanica,* other *Gephyrocapsa* spp., *Pseudoemiliania lacunosa, Cyclococcolithus leptoporus, Cyclococcolithina macintyrei, Helicopontosphaera kamptneri, Oolithotus antillarum, Rhabdosphaera claviger, Syracosphaera pulchra, Scapholithus ganerotus,* and *Umbilicosphaera mirabilis.* Other species present in small numbers or as isolated specimens are: *Pontosphaera alboranensis, Pontosphaera japonica, Pontosphaera multipora, Pontosphaera dicopora, Pontosphaera pacificus, Pontosphaera messinae, Thoracosphaera heimi, Sychosphaera apstenii, Ceratolithus cristatus, Discoaster perplexus, Anaplosolenia brasiliensis, Cyclolithella annula, Scyphosphaera campanula, Coccolithus pelagicus,* and a holococcolith species.

Small fluctuations in environmental conditions have occurred during the Pleistocene at Site 208, but are not as clearly marked as those at Site 207. The environment of deposition was warm subtropical in the lowest Pleistocene sediments (Section 208-2-6), corresponding to the present-day latitudinal position of Hole 208. This warmed briefly to southern tropical conditions (Section 208-2-5). Environmental interpretation of the overlying sediment (208-2-4, 105 cm) is obscure as it is winnowed. Following this sediment scouring, warm subtropical conditions prevailed (208-2-4, 30 cm) but with a continual introduction into the area of battered, transported, tropical species (208-2-3, 105 cm). Another winnowed sediment occurs above this horizon (208-2-3, 30 cm). Southern tropical conditions followed, which changed by gradual cooling through a marginal tropical/warm subtropical (Section 208-2-1) to a warm subtropical environment. This warm subtropical environment persisted throughout the period of uppermost sediment deposition and corresponds to conditions found in the most recent sediment of this latitude (Burns, in press).

The Pleistocene sediment can be fitted to the zonal scheme of Martini (1971) as follows: 208-1-1, 30 cm to 208-1-2, 105 cm, NN21; 208-1-3, 30 cm to 208-1-6, 105 cm, NN20; and 208-1, CC to 208-2, CC, NN19.

Late Pliocene (208-3-1, 105 cm to 208-5-6, 105 cm; nannofossil ooze)

The late Pliocene sediments contain abundant, moderately preserved calcareous nannofossils. Species commonly present are: *Cyclococcolithina macintyrei, Syracosphaera pulchra, Discoaster brouweri, Discoaster pentaradiatus,* and *Discoaster surculus.* Other species present in smaller numbers or as isolated specimens are: *Oolithotus antillarum, Umbilicosphaera mirabilis, Helicopontosphaera kamptneri, Pontosphaera* spp., *Rhabdosphaera claviger, Scyphosphaera apstenii, Scyphosphaera campanula, Scyphosphaera* cf. *cohenii, Coccolithus pelagicus, Discoaster perplexus,* and *Thoracosphaera heimi.*

Some small fluctuations in environmental conditions have occurred during the late Pliocene, but environmentally this section is more stable than that of the Pleistocene. Environments of deposition have been generally warm subtropical, similar to those of the present-day position of Hole 208. However, brief changes to warmer marginal southern tropical (Sections 3-4 and 3-6; also 5-1 to 5-6) or cooler mid-subtropical conditions (208-4-2, 105 cm) have occurred.

The late Pliocene sediment can be fitted to the zonal scheme of Martini (1971) as follows: 208-3-1, 105 cm to 208-3-3, 105 cm, NN18; 208-3-4, 30 cm to 208-3-5, 30 cm, NN17; and 208-3-5, 105 cm to 208-5-6, 105 cm, NN16.

The late Pliocene and Pleistocene yielded abundant, well-preserved, warm-water oceanic nannofloras which could be readily correlated with the zonal scheme of Martini (1971). The same situation also occurs, although to a lesser extent, in the mid Miocene and late Oligocene, but the intervening assemblages are essentially those encountered at Sites 206 and 207 to the south. This pattern could be interpreted as indicating an alternation at this site of tropical and subtropical water masses during the late Oligocene to Recent. Alternatively, it may reflect changing paleoenvironmental tolerances of the taxa chosen as zonal fossils.

The mid mid Eocene nannofloras appear to vary greatly in abundance, preservation, and diversity, no doubt in response to the varying amounts of siliceous microfossils present. The assemblage obtained from 208-27, CC is exceptionally well preserved and, at first impression, appears to be a correlative of the upper part of the Porangan Stage of New Zealand.

The Early (including Danian) and mid Paleocene nannofloras vary between abundant in Core 29 through to common in Cores 31 and very sparse in Section 33-1, but all have poor preservations and, as is typical of this time, are mainly composed of a few cosmopolitan species. However, a species so far only known from the New Zealand region, namely, the very distinctive *Hornibrookina teuriensis*, forms a conspicuous element of the early Paleocene flora.

The Mesozoic-Cenozoic boundary is present at 208-33-1, 56 cm; between 208-33-1, 60 cm (*Nephrolithus frequens* Zone, Late Maastrichtian) and 208-33-1, 54 cm (*Conococcolithus panis* Zone, basal Danian). The boundary, represented by a 2-mm, slightly undulating layer of rounded white (reworked chalk?) granules, occurs 26 cm above a major change in sediment type from chalk below the silica-rich strata above.

The Latest Cretaceous (late Maastrichtian) nannofloras, although of rather varaible abundance and preservation, are the best known in this region and include a number of species not previously recorded from the southwest Pacific. It is also of interest to note that, like equivalent New Zealand floras, these assemblages contain the mid latitude zonal species *Nephrolithus frequens* rather than the low latitude zonal species *Tetralithus murus.*

Radiolaria and Silicoflagellates

Radiolarians are practically absent in the first 26 cores, which represent a continuous sequence of pelagic sediments, late Oligocene to Quaternary in age. A few specimens, partly corroded, were found only in 208-1, CC, scattered in a residue of volcanic glass.

Radiolarians and other siliceous microfossils occur in the last eight cores (208-27, CC to 208-34, CC recovered at this site. They belong to three distinct assemblages of different age, abundance, and mode of preservation.

1. Middle Eocene assemblage (208-27, CC and 208-28, CC) consisting of abundant and well-preserved radiolarians, silicoflagellates, ebridians, diatoms, and sponge spicules. Dinoflagellates with siliceous shells were also recorded in both core-actcher samples. The radiolarian association is similar to that encountered in the middle Eocene at Sites 206 and 207, being particularly represented by *Lophocyrtis biaurita, Lychnocanium bellum, Velicucullus magnificus, Sethochytris babylonis, Petalospyris argiscus, Dictyophimus craticula, Theocampe urceolus,* etc., *Naviculopsis biapiculata, H. foliacea,* and *Corbisema* ex. gr. *triacantha* are the most common silicoflagellates. Among ebridians the most frequent taxa belong to *Ebriopsis mesnilii* and *Parammodochinm dictyoides.*

2. Early mid Paleocene-early Paleocene (Danian) assemblage (208-29, CC through 208-32, CC) with abundant and well-preserved siliceous microfossils. The ebridians are missing. Radiolarians are represented by a monotonous association of numerous specimens of a few species. Most species are new and belong to *Stichomitra* and to other related genera. Almost none of the species described by Foreman (1973) from the rich late Paleocene assemblages recovered on Leg 10 in the Gulf of Mexico region were encountered at this site.

Amount the silicoflagellates, large forms of *Corbisema inermis*, with a stout skeleton and a particular superficial ornamentation, are a common element besides the radiolarians. The species shows an evolution from triangular (208-31, CC) to bipolar forms (208-29, CC). The intermediate sample at 208-30, CC contains both triangular and bipolar forms.

The discovery of these early mid Paleocene to early Paleocene (Danian) radiolarian assemblages and their cooccurrence with calcareous nannofossils are of great interest. This represents the first well-dated radiolarian assemblage of this age at such a latitude.

3. The last two cores (33 and 34) contain a rare and poorly preserved late Maastrichtian assemblage made up of a few radiolarian species and frequent sponge spicules of the Lythistid type. The radiolarians belong to *Dictyomitra andersoni, Amphipyndax* sp., *Stichomitra asymbatos, Stichomitra* sp., *Myllocercion* sp., almost all known from the Upper Maastrichtian of California.

Black or gray cherts occur at several levels in these two cores. Three samples were studied in this section. The results are as follows:

Sample 208-33-1, 68-70 cm is a black chert. The organic content consists of abundant sponge spicules and pyritized radiolarians containing the above species.

Sample 208-33, 19-21 cm is a gray chert, containing abundant foraminifera and rare radiolarians.

Sample 207-34-2, 115-117 cm is a black chert with no siliceous remains, but only abundant foraminifera.

PHYSICAL PROPERTIES

Bulk Density

Bulk density was determined on all cores using the GRAPE device. These results are plotted against subbottom depth in the hole summary illustration. Cores 23 to 34 consisted of individual pieces of solid rock. In addition to GRAPE measurements, density determinations were made on these cores by weighing pieces of rock of known volume.

Down to about 75 meters (Cores 7 and 8) the density of the sediment is in the range 1.6 to 1.7 gm/cc. Below 75 meters the effects of compaction are seen, and the density rises into the range 1.62 to 1.79 gm/cc. It remains in this range down to 300 meters (Core 20), at which depth the effects of lithification begin to appear, and the density rises once more to reach a value of 2.02 gm/cc in Core 25. The general range of density from 350 to 500 meters is 1.9 to 2.0 gm/cc.

In Cores 27 to 31 there is an inexplicable drop in density into the range 1.42 to 1.78 gm/cc. Below this (Cores 33 2.0 gm/cc. A fragment of porcellanite (impure chert) from Core 29 gave the density of 2.6 gm/cc.

Sonic Velocity

Sonic velocity is plotted against subbottom depth in the hole summary illustration. The sound velocity remains almost constant at 1.50 to 1.59 km/sec all the way down through the sediments to a depth of about 300 meters. Below this level, as the effects of lithification are felt, the velocity rises to reach a value of 1.99 km/sec in Core 23 (375 m) and 2.21 km/sec in Core 27 (490 m).

Corresponding to the density drop of Cores 28 to 31 the sonic velocity drops into the range 1.78 to 1.90 km/sec before rising abruptly into the range 2.23 to 2.42 km/sec in the bottom 35 meters of the hole. It should be noted that whereas the density increase from the anomalously low values into high values at the bottom of the hole occurs between Cores 31 and 33, the corresponding velocity increase occurs between Cores 30 and 31. The piece of procellanite measured from Core 29 gave a velocity of 4.06 km/sec for this lithology.

Thermal Conductivity and Heat Flow

Thermal conductivity values, as measured by the needle probe method on sediment cores, range between 2.8 and 3.4 m cal/°C cm sec (TCU), uncorrected for ambient temperature and pressure at the sea floor, these extend to Core 20, recovered from a depth of 290 meters, below which the cores are too indurated for measurements with this technique.

The range of values is similar to that at Site 207, most likely because of the similar sediment lithology. Unlike Site 207, however, there is not a marked increase in values with depth in this section, at least not below Core 8 (75 m). Below Core 15 (180 m), the values actually seem to decrease. Other than the possibility that disturbed sections of these cores were selected for measurement because the needle probe was more easily inserted, it is difficult to account for the decrease with depth; the other measured physical properties (density and sonic velocity) do not show similar trends.

Again due to operational problems, no reliable downhole temperature measurements were made at this site.

SUMMARY AND CONCLUSIONS

Along with Sites 206 and 207, Site 208 is one of the north-south series of sites providing correlation of low latitude and southern midlatitude faunal and floral assemblages. It is located on the northern portion of the Lord Howe Rise. At this site an excellent section through the Cretaceous-Tertiary boundary was recovered, passing from latest Maastrichtian to early Danian. A unique siliceous microfossil assemblage occurs in the Danian.

Stratigraphically two units are present in the section penetrated. Unit 2 is a late Cretaceous (latest Maastrichtian) to mid Eocene siliceous fossil-bearing nannofossil chalk extending from 488 meters to the bottom of the hole at 594 meters. Unit 1 is a late Oligocene to late Pleistocene foraminiferal-nannofossil ooze (chalk) extending to 488 meters subbottom. Eolian quartz, found in trace amounts in the late middle Miocene to late Pleistocene oozes, is assumed to be related to a period of aridity in Australia. The relative continuity of mid bathyal deposition and the paucity or absence of clastic detritus suggest that the Lord Howe Rise has existed as a feature isolated from Australia since at least the Maastrichtian. Normal oceanic conditions have prevailed at the site throughout the sequence sampled. A small amount of subsidence is suggested from the Late Cretaceous fauna.

Late Eocene to mid Oligocene sediments are absent in the regional unconformity at this site as they are at Sites 206, 207, 209, and 210. Late Paleocene and early Eocene sediments are also missing as at Sites 206 and 207.

The site is on an apparent basement high as defined by the deepest reflector. The true extent of this feature is not known, as the deepest reflector becomes deeper and fades out away from the site. Some of the deeper reflectors may be truncated as they approach the high from the east and the west side of the rise.

This site reinforces the picture developed by the coring at Site 207. The site was already oceanic and apparently separated from Australia by latest Cretaceous as was the southern rise. A small amount of subsidence continued, but this portion of the rise had reached upper bathyal depths much earlier than the southern rise. This pattern of later deepending to the southeast can be traced across the Challenger Plateau to New Zealand's South Island. The rise appears to have been stable at about its present depth along its length since middle Eocene.

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NOTE CONCERNING THE APPENDICES

The appendices consist of tables of shore laboratory determinations of grain size, carbon content, and mineralogical composition, summary visual descriptions of the cores recovered from the site, photographs of the cores and, finally, an overall summary of the results of drilling at the site. The symbols used to represent lithology in the core summary forms are explained in Chapter 2 of this volume. The lithologic description of each core contains typical results of shipboard examination of smear slides of each lithology. In order to make the lithologic descriptions more complete we have also included many of the shore laboratory results. These are identified by being placed in square brackets.

APPENDIX A
Carbon-Carbonate Determinations, Site 208

Core, Section, Top of Interval (cm)	Depth in Hole (m)	Carbon Total (%)	Organic Carbon (%)	$CaCO_3$ (%)
1-1,30.0	0.3	11.3	0.0	94
2-2,40.0	10.9	11.2	0.0	93
3-4,50.0	27.0	10.8	0.0	90
4-4,40.0	39.9	11.2	0.0	93
5-4,40.0	48.9	11.5	0.0	95
6-5,40.0	59.4	11.5	0.0	95
7-5,40.0	68.4	11.6	0.0	96
8-4,40.0	75.9	11.5	0.0	95
9-5,40.0	90.4	11.6	0.0	96
10-4,40.0	97.9	11.5	0.0	96
11-3,40.0	105.4	11.6	0.0	97
12-4,40.0	124.9	11.4	0.0	95
13-3,40.0	142.4	11.6	0.0	97
14-3,40.0	160.4	11.7	0.0	98
15-2,40.0	177.9	11.6	0.0	96
16-3,40.0	197.4	11.6	0.0	96
17-2,40.0	223.9	11.3	0.0	94
18-3,40.0	234.4	11.4	0.0	94
19-2,80.0	261.3	11.1	0.0	92
20-2,40.0	288.9	11.1	0.0	92
21-4,16.0	319.7	11.0	0.0	91
22-3,11.0	347.1	10.2	0.0	85
23-3,148.0	375.5	10.1	0.0	84
24-4,90.0	404.4	10.5	0.0	87
25-3,27.0	431.3	9.3	0.1	77
26-3,137.0	460.4	9.8	0.1	81
27-3,89.0	487.9	9.4	0.1	78
28-2,128.0	514.8	6.0	0.1	49
29-1,98.0	540.0	10.4	0.0	87
30-3,89.0	551.9	8.9	0.1	74
31-2,31.0	559.8	7.7	0.0	64
33-3,93.0	579.9	9.3	0.1	77
34-3,127.0	589.3	10.3	0.0	86

APPENDIX B
X-ray Mineralogy Determinations, Site 208

Core	Cored Interval Below Sea Floor (m)	Sample Depth Below Sea Floor (m)	Diff.	Amor.	Calc.	Quar.	Cris.	K-Fe.	Plag.	Mica	Mont.	Trid.	Clin.	Bari.
30	548-557	551.9	61.2	39.4	99.6	0.4	–	–	–	–	–	–	–	–
33	576-585	579.9	54.7	29.2	88.3	0.5	7.4	–	–	–	–	2.6	1.2	–
34	585-594	589.3	52.4	25.6	91.8	0.5	6.5	–	–	–	–	–	1.2	–
2-20μ Fraction														
30	548-557	551.9	95.0	92.2	–	26.8	–	–	–	–	39.0	–	–	34.2
33	576-585	579.9	85.6	77.6	–	7.9	64.4	1.9	2.0	1.5	–	6.5	14.0	1.8
34	585-594	589.3	74.2	59.7	–	17.1	11.4	2.4	3.5	2.9	–	6.4	48.2	8.1
<2μ Fraction														
30	548-557	551.9	93.9	90.5	–	9.3	–	–	–	–	76.2	–	–	14.5
33	576-585	579.9	91.6	86.8	–	2.4	70.2	1.5	–	1.5	10.8	11.2	0.7	1.7
34	585-594	589.3	88.6	82.2	–	3.4	70.8	2.1	1.4	–	10.3	8.3	1.3	2.6

APPENDIX C
Thermal Conductivity Measurements, Site 208

Core, Section, Interval Below Top (cm)	Thermal Conductivity (mcal/°C cm sec)	Standard Deviation	Ambient Core Tempera-ture (°C)	Remarks
2-3,75	0.002847	0.004478	21.09	
3-3,75	0.000108	0.005644	20.92	
5-3,75	0.002896	0.007244	20.57	
6-3,75	0.002892	0.008837	19.70	
7-3,92	0.003038	0.004964	22.23	
8-3,91	0.002985	0.007146	21.55	
10-3,94	0.003034	0.007472	21.98	
11-3,94	0.003019	0.005229	22.47	
12-3,89	0.003034	0.007630	21.33	
13-3,77	0.003164	0.008637	21.62	
14-3,74	0.003147	0.008495	21.68	
15-3,77	0.003211	0.006410	21.10	
16-3,75	0.002908	0.010983	22.47	
17-2,80	0.003119	0.012700	22.87	
18-3,72	0.003196	0.006478	22.17	
19-2,82	0.003131	0.006961	22.60	
20-3,63	0.003346	0.005765	22.05	

Site 208 Hole Core 1 Cored Interval: 0-9 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
LATE PLEISTOCENE	NN21	N	A	G	1	0.5	C.Sp.	3	CC
		F	A	G			C.Sp.		
		N	A	G		1.0			
		N	A	G	2		C.Sp.	4	
		N	A	G			C.Sp.		
	N22 NN20	N	A	G	3			4	
		F	A	G					
		N	A	G					
		N	A	G	4			4	
		N	A	G					
		N	A	G	5			4	
		F	A	G					
		N	A	G					
		N	A	G	6			4	
		N	A	G					
	NN19	N F R	A A -	G G -	Core Catcher				

LITHOLOGIC DESCRIPTION

10YR7/3 to 10YR8/2

[94% $CaCO_3$]

CALCAREOUS SPICULE (SPONGE SPICULE?) BEARING FORAM RICH NANNO OOZE
Very pale brown to white. Moderately to totally disturbed. Soupy texture.

Smear Slide at Section 1, 75 cm:
83% nannos
15% forams
2% calcareous spicules

Smear Slide at Section 2, 75 cm:
84% nannos
15% forams
1% calcareous spicules

10YR8/2

FORAM NANNO OOZE
White. Soupy. No sedimentary structures visible.

Smear Slide at Section 3, 75 cm:
67% nannos
30% forams
1% calcareous spicules
1% iron oxide
1% glass

light gray (2.5Y7/2) gray white (5Y9/1) FORAM NANNO OOZE

FORAM NANNO OOZE 68% nannos 30% forams 1% sponge spicules 1% glass

Site 208 Hole Core 2 Cored Interval: 9-18 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE
PLEISTOCENE	N22 NN19	N	A	G	1	0.5	Gl.(A)	4	
		F	A	G		1.0	Gl.(A)		
		N	A	G	2			3	CC
		N	A	G	3			3	
		F	A	G					
		N	A	G	4			4	
		N	A	G	5			3	
		F	A	G					
		N	A	G	6			3-4	
		N F R	A A -	G G -	Core Catcher				

LITHOLOGIC DESCRIPTION

10YR8/2

GLASS BEARING FORAM NANNO OOZE
White, very pale brown and gray white. Soupy to creamy. Totally disturbed.

Smear Slide at Section 1, 110 cm:
60% nannos
35% forams
1% calcareous spicules
1% plant debris
2% glass

10YR7/4
2.5Y9/1

[93% $CaCO_3$]

5Y9/1

FORAM RICH NANNO OOZE
Gray white. Creamy texture. Moderately disturbed. Irregular dark gray (N3) patches at 40 and 72 cm.

Smear Slide at Section 2, 75 cm:
86% nannos
10% forams
1% iron oxide
1% glass
1% feldspar
1% calcareous spicules

5Y9/1

FORAM NANNO OOZE
Gray white. Creamy. Upper part (to 110) moderately disturbed. Below 110 cm intensely disturbed.

Smear Slide at Section 3, 75 cm:
67% nannos
30% forams
1% opaque
1% quartz(?)
1% calcareous spicules

5Y9/1
2.5Y8/2
5Y9/1

NANNO FORAM OOZE
Gray white (yellowish white between 60-75 cm). Creamy. Moderately disturbed.

Smear Slide at Section 6, 75 cm:
55% forams
43% nannos
1% calcareous spicules
1% opaque

NOTE: Calcareous spicules are probably (in part) sponge spicules.

FORAM RICH NANNO OOZE 83% nannos 15% forams 1% calcareous spicules 1% iron oxide

Site 208 Hole 3 Core Cored Interval: 22-31 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22 / NN18	N F	A A	G G	1	0.5 1.0	EMPTY			5Y9/1 NANNO FORAM OOZE Gray white. Creamy. Smear Slide at Section 1, 75 cm: 60% forams 37% nannos 1% opaque 1% iron oxide 1% calcareous spicules
		N	A	G	2			2 to 3		In Section 2 dark gray/black (N2) spots (mottled) → continue through entire core.
		F N	A A	G G	3			2/3		5Y9/1 FORAM NANNO OOZE Creamy. Smear Slide at Section 3, 75 cm: 59% nannos 40% forams 1% calcareous spicules
	NN17	N N	A A	G G	4			3	CC	5Y9/1 NANNO FORAM OOZE Creamy. Smear Slide at Section 4, 75 cm: 50% forams 48% nannos 1% calcareous spicules 1% opaque
		N F N	A A A	G G G	5			3		5Y9/1 FORAM NANNO OOZE Smear Slide at Section 5, 75 cm: 79% nannos 20% forams 1% opaque
	NN16	N N	A A	G G	6			3		↓color change to 5Y8/2 (yellowish white) ↓color return to 5Y9/1
		N F R	A A -	G G -	Core Catcher					FORAM RICH NANNO OOZE 78% nannos 20% forams 1% sponge spicules 1% glass

Site 208 Hole Core 4 Cored Interval: 35-44

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PLEISTOCENE	N22	F N	A A	G G	1	0.5 1.0	EMPTY	4		5Y9/1 FORAM NANNO OOZE Gray white. Creamy texture. Smear Slide at Section 1, 120 cm: 64% nannos 35% forams 1% calcareous spicules
MIDDLE PLIOCENE	N21 / NN16	N	A	G	2			3/4		5Y9/1 & 5Y8/2 FORAM RICH NANNO OOZE Gray white and white. Creamy. With black spots (patches).
		N F	A A	G G	3					Smear Slide at Section 3, 75 cm: 79% nannos 20% forams 1% calcareous spicules
		N	A	G	4			3	CC	[93% $CaCO_3$]
		N F	A A	G G	5			3		Smear Slide at Section 5, 75 cm: 79% nannos 20% forams 1% iron oxide Sediment becomes stiffer and less deformed.
	N20	N F R	A A -	G G -	Core Catcher					FORAM NANNO OOZE 69% nannos 30% forams 1% glass

Site 208 Hole Core 5 Cored Interval: 44-53 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE PLIOCENE	N20 NN16	N F	A A	M G	1	0.5 1.0		3/4		5Y9/1 FORAM RICH NANNO OOZE Gray white. Creamy. Black spots throughout. Smear Slide at Section 1, 75 cm: 84% nannos 15% forams 1% calcareous spicules
		N	A	M	2			3/4		
		N F	A A	M G	3			3/4		
		N	A	M	4			3/4	CC	Becoming stiffer, but still creamy. [95% $CaCO_3$]
		N F	A A	M G	5			3/4		5Y9/1 FORAM NANNO OOZE Smear Slide at Section 5, 75 cm: 60% nannos 40% forams
		N	A	M	6			3/4		FORAM RICH NANNO OOZE Smear Slide at Section 6, 75 cm: 78% nannos 20% forams 1% opaque 1% glass
		N F R	A A -	M G -	Core Catcher					FORAM RICH NANNO OOZE 77% nannos 20% forams 1% sponge spicules 1% iron oxide 1% glass

Site 208 Hole Core 6 Cored Interval: 53-62 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLIOCENE	N20 NN16	N F	A A	M G	1	0.5 1.0		3/4		N9 to 5Y9/1 FORAM NANNO OOZE White to gray white. Soupy to creamy. Smear Slide at Section 2, 75 cm: 70% nannos 30% forams
		N	A	M	2			3/4		
		F	A	G	3			3/4		
		N	A	M	4			3/4		Smear Slide at Section 4, 75 cm: 69% nannos 30% forams 1% iron oxide
		F N	A A	G M	5				CC	N9 to 5Y9/1 [95% $CaCO_3$] FORAM RICH NANNO OOZE Megascopically as above. Smear Slide at Section 5, 75 cm: 85% nannos 15% forams
	NN13-NN15	N N	A A	M M	6					
	N19	N F R	A A -	M G -	Core Catcher					FORAM RICH NANNO OOZE 83% nannos 15% forams 1% sponge spicules 1% glass

Site 208 Hole Core 7 Cored Interval: 62-71 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLIOCENE	N19 NN13-NN15				1	0.5 1.0	EMPTY EMPTY	4		5Y9/1 FORAM NANNO OOZE Gray white. Creamy texture.
		N	A	M	2			3		5Y9/1 FORAM NANNO OOZE Gray white. Creamy. Blue black streaks throughout. Smear Slide at Section 2, 75 cm: 80% nannos 20% forams
		F	A	G	3			3		
		N	A	M	4			3/4		
		F	A	G	5			3/4	CC	[96% $CaCO_3$]
					6			3/4		5Y9/1 FORAM RICH NANNO OOZE Megascopically as above. Smear Slide at Section 6, 75 cm: 80% nannos 20% forams
		N F R	A A -	M G -	Core Catcher					FORAM RICH NANNO OOZE 84% nannos 15% forams 1% sponge spicules (calcareous spicules)

Site 208 Hole Core 8 Cored Interval: 71-80 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLIOCENE	N19 NN13-NN15	N F	A A	M G	1	0.5 1.0		3/4		5Y9/1 FORAM BEARING NANNO OOZE gray white. Creamy. Dark gray and black spots. Smear Slide at Section 1, 75 cm: 90% nannos 9% forams 1% glass
					2			3/4		
		F	A	G	3			3/4		Smear Slide at Section 3, 75 cm: 89% nannos 10% forams 1% calcareous spicules
		N	A	M	4			3/4	CC	[95% $CaCO_3$]
		F N	A A	G M	5			3/4		
		N	A	M	6			3/4		5Y9/1 to N9 (white) Smear Slide at Section 6, 75 cm: 90% nannos 9% forams 1% glass
		N F R	A A -	M G -	Core Catcher					FORAM RICH NANNO OOZE 80% nannos 20% forams

Site 208 Hole Core 9 Cored Interval: 84-93 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLIOCENE	N19	N F	A A	M G	1	0.5 1.0		4		N9 **FORAM RICH NANNO OOZE** White. Soupy texture. Smear Slide at Section 1, 140 cm: 79% nannos 20% forams 1% glass
					2			3/4		SAME AS SECTION 1. White; creamy.
		F	A	G	3			3/4		SAME AS SECTION 1. With irregular patches of greenish gray (5Y7/2) and medium gray (N4). Smear Slide at Section 3, 75 cm: 80% nannos 20% forams
EARLY PLIOCENE (BASED ON FORAMINIFERA)	NN13-NN15				4			3/4		
	N18	F	A	G	5			3/4	CC	In Section 5 sediment becomes a little stiffer. [96% $CaCO_3$] Smear Slide at Section 5, 75 cm: 80% nannos 20% forams
					6			2/3		In Section 6 some banding in shades of gray and greenish white.
		N F R	A A -	M G -	Core Catcher					**FORAM RICH NANNO OOZE** 80% nannos 19% forams 1% glass

Site 208 Hole Core 10 Cored Interval: 93-102 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLIOCENE (BASED ON FORAMINIFERA)	NN13-NN15	N F	A A	M G	1	0.5 1.0		3/4		N9 **FORAM BEARING NANNO OOZE** White; mottled with irregular patches of medium dark gray (N4). Black material is probably pyrite. Smear Slide at Section 1, 75 cm: 89% nannos 10% forams 1% opaque (pyrite?) Black lump at Section 1, 85 cm: 36% nannos 33% forams 30% pyrite 1% feldspar
		N N	A A	M M	2			2/3		N9 Similar lithology as Section 1. Some large pale yellow (5Y7/5) mottles, and trace of bedding in lower 50 cm.
	N18 NN12 (upper)	F N	A A	G M	3			2/3		N9 **FORAM RICH NANNO OOZE** Similar lithology, somewhat stiffer and less deformed. Smear Slide at Section 3, 75 cm: 85% nannos 15% forams
					4			2/3	CC	[96% $CaCO_3$]
		N F	A A	M G	5			2/3		N9 **FORAM BEARING NANNO OOZE** Megascopically similar as above. Smear Slide at Section 5, 75 cm: 90% nannos 8% forams 1% iron oxide 1% calcareous spicules 1% quartz(?)
					6			2/3		
		N F R	A A -	M G -	Core Catcher					**FORAM RICH NANNO OOZE** 80% nannos 20% forams

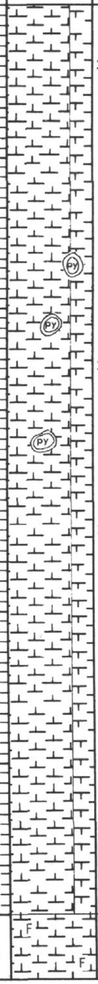
Site 208 Hole Core 11 Cored Interval: 102-111 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PLIOCENE (BASED ON FORAMINIFERA)		N	A	M	1	0.5, 1.0		3/4		N9 FORAM RICH NANNO OOZE White. Creamy texture. Smear Slide at Section 1, 75 cm: 80% nannos, 19% forams, 1% sponge spicules
					2					
		F	A	G	3		F	2/3	CC	N9, with: 5B3/1 & 5Y7/3 [97% $CaCO_3$] FORAM BEARING NANNO OOZE White. Creamy. Stiffer and less deformed than Sections 1 and 2. Mottled with blue-gray and pale yellow. Some suggestion of bedding. Smear Slide at Section 3, 75 cm: 90% nannos, 9% forams, 1% iron oxide
LATE MIOCENE	N18	N	A	M						
					4		F	2/3		
					5		F	2/3		Smear Slide at Section 5, 75 cm: 90% nannos, 8% forams, 1% quartz, 1% calcareous spicules
					6		F, PY	2/3		← Large (8 cm long; 1 cm diameter → tapering to 0.5 cm) branch-shaped pyrite nodule.
		N F R	A A -	M G -	Core Catcher					FORAM BEARING NANNO OOZE 95% nannos 5% forams

Site 208 Hole Core 12 Cored Interval: 120-129 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MIOCENE	N18				1	0.5, 1.0	EMPTY; F	4		N8 to N9 FORAM BEARING NANNO OOZE Very light gray to white, with dark gray (N3) to medium dark gray (N4) and light olive gray (5Y6/1) streaks. Creamy texture. Smear Slide at Section 2, 75 cm: 90% nannos, 10% forams
		N	A	M	2		F	4		
		F	A	G	3		F	4		
					4		F	4	CC	[95% $CaCO_3$]
					5			3/4		FORAM RICH NANNO OOZE Megascopically similar to above. Smear Slide at Section 5, 75 cm: 78% nannos, 20% forams, 1% opaque (pyrite?), 1% glass
					6			3/4		
		N F R	A A -	P G -	Core Catcher		F			FORAM BEARING NANNO OOZE 95% nannos 5% forams

Site 208 Hole Core 13 Cored Interval: 139-148 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MIOCENE	N17	N	A	P	1	0.5 1.0		3/4		N9 to N8
					2			3/4		
		F	A	G	3			3/4	CC	
					4			3/4		
					5			3/4		
					6			3		
		N F R	A A -	P G -	Core Catcher					

FORAM RICH NANNO OOZE
White to light gray. Creamy texture. Dark gray (N3) flecks throughout core.

Smear Slide at Section 2, 75 cm:
82% nannos
15% forams
1% sponge spicules
1% opaque (pyrite?)
1% iron oxide

← 5 cm long pyrite nodule (1 cm ϕ)

[97% $CaCO_3$]

Section 3, 25-30 cm: large pyrite nodule (5x1 cm). Pyrite is covered with chalcedony and has botryoidal texture. From 132 to 134 cm: nodule 3x1 cm.

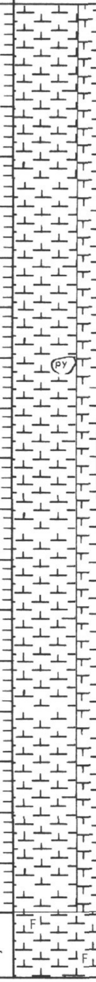
In Section 5 some suggestions of bedding.

Smear Slide at Section 5, 75 cm:
85% nannos
15% forams

Section 6 is somewhat stiffer.

FORAM BEARING NANNO OOZE 95% nannos 5% forams

Site 208 Hole Core 14 Cored Interval: 157-166 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MIOCENE	N17	N	A	P	1	0.5 1.0		3/4		N8 to N9
					2			3/4		
		N F	A A	M G	3			3/4	CC	
					4			3/4		
		N	A	M	5			3/4		
		N	A	M	6			3/4		
		N F R	A A -	M G -	Core Catcher					

FORAM RICH NANNO OOZE
Light gray to white, mottled with dark gray (N3) and olive gray (5Y7/3). Creamy texture.

Smear Slide at Section 2, 75 cm:
84% nannos
15% forams
1% calcareous spicules

[98% $CaCO_3$]

← pyrite nodule at 65 cm (Section 3).

Smear Slide at Section 5, 75 cm:
84% nannos
15% forams
1% opaque (pyrite)

FORAM BEARING NANNO OOZE 93% nannos 7% forams

Site 208 Hole Core 15 Cored Interval: 176-185 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MIOCENE	N17	N	A	P	1	0.5, 1.0		3/4		N9 to N8 FORAM RICH NANNO OOZE White to light gray. With dark gray (N4) flecks. Creamy texture. Some trace of bedding.
					2			3/4	CC	[96% $CaCO_3$] Smear Slide at Section 2, 75 cm: 79% nannos, 20% forams, 1% opaque, 1% feldspar(?)
		F	A	G	3			3/4		
					4			3/4		
					5			2/3		In Section 5 sediment is becoming stiffer and less disturbed. Similar lithology. Smear Slide at Section 5, 75 cm: 80% nannos, 20% forams
					6			2/3		
		N F R	A A -	P G -	Core Catcher					FORAM RICH NANNO OOZE 89% nannos, 10% forams, 1% glass

Site 208 Hole Core 16 Cored Interval: 194-203 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MIOCENE	N17				1	0.5, 1.0	EMPTY	3		N9 to N8 FORAM RICH NANNO OOZE White to light gray. Stiffer than before, but still quite disturbed. Some mottling: olive gray (5Y7/2) and dark gray (N4).
		F	A	G	2			2/3		
	N16	F	A	G	3			2/3	CC	[96% $CaCO_3$]
					4			2/3		
					5			2		FORAM NANNO OOZE Same lithology. Smear Slide at Section 5, 75 cm: 69% nannos, 30% forams, 1% quartz(?)
					6			2		
		N F R	A A -	P G -	Core Catcher					FORAM RICH NANNO OOZE 87% nannos, 12% forams, 1% glass

Site 208 Hole Core 17 Cored Interval: 222-231 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MIDDLE MIOCENE	N14-N15	F	A	G	1	0.5, 1.0		2		N8 FORAM NANNO OOZE Light gray. Stiff, semilithified and lithified. Smear Slide at Section 2, 75 cm: 65% nannos 35% forams
					2			2	CC	[94% $CaCO_3$]
		N F R	A A -	G G -	Core Catcher					FORAM RICH NANNO OOZE 79% nannos 20% forams 1% glass

Site 208 Hole Core 18 Cored Interval: 231-240 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MIDDLE MIOCENE	N14-N15	F	A	G	1	0.5, 1.0	EMPTY	2		5Y9/1 FORAM NANNO OOZE Pale gray. Stiff (not semilithified). Smear Slide at Section 2, 75 cm: 60% nannos 40% forams
					2			2/3		
					3			2/3	CC	[94% $CaCO_3$]
					4			2		Section 4: semilithified from 100 to 105 cm.
					5			2		Section 5: stiff with patches of semilithified sediment. No structures visible. Smear Slide at Section 5, 75 cm: 59% nannos 40% forams 1% opaque (pyrite)
					6			2		
		N F R	A A -	G G -	Core Catcher					FORAM RICH NANNO OOZE 88% nannos 12% forams

Site 208 Hole Core 19 Cored Interval: 259-268 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MIDDLE MIOCENE	N13				1	0.5, 1.0		2		N9 to N8 FORAM NANNO OOZE. *White to pale gray. Stiff to semilithified.* No structures visible. Smear Slide at Section 2, 75 cm: 60% nannos, 40% forams
		F	A	G	2			2	CC	[92% $CaCO_3$]
		N F R	A A -	P G -	Core Catcher		F			FORAM BEARING NANNO OOZE 95% nannos 5% forams

Site 208 Hole Core 20 Cored Interval: 287-296 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE MIDDLE MIOCENE	N13				1	0.5, 1.0	EMPTY		1	N9 to N8 FORAM RICH NANNO OOZE. White to light gray. Semilithified to lithified. No structures visible.
					2				CC 1	[92% $CaCO_3$] Smear Slide at Section 2, 75 cm: 80% nannos, 20% forams
		F	A	G	3					
		N F R	A A -	P G -	Core Catcher					FORAM RICH NANNO OOZE 80% nannos 20% forams

Site 208 Hole Core 21 Cored Interval: 315-324 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE EARLY MIOCENE	N12	F	A	G	1	0.5, 1.0		1		N8 to N9 FORAM RICH NANNO CHALK. Light gray with white mottling. Lithified. No other structures visible.
	N10-N11	F	A	G	2			1		Smear Slide at Section 2, 75 cm: 75% nannos, 24% forams, 1% opaque (pyrite?)
		F	A	G	3			1		Section 3: occasional mottles of pyrite (dark gray-N3).
		F	A	G	4			1	CC	[91% $CaCO_3$]
	N7				5			1		Smear Slide at Section 5, 75 cm: 85% nannos, 15% forams
					6			1		
		N F R	A A -	M M -	Core Catcher					FORAM NANNO CHALK 70% nannos 30% forams

Site 208 Hole Core 22 · Cored Interval: 344-353 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
MIDDLE EARLY MIOCENE	N5-N6				1	0.5, 1.0	EMPTY	1		5Y7/1 to 5Y7/2 FORAM NANNO CHALK Light gray. Lithified, uniform, with moderate mottling. Coarser grained than Core 21. *Zoophycos* burrow at Section 1, 84 cm.
					2			1		Smear Slide at Section 2, 75 cm: 57% nannos, 40% forams, 2% opaque (pyrite), 1% iron oxide
					3			1	CC	[85% $CaCO_3$]
					4			1		
					5			1		Similar lithology (megascopically) as above. FORAM RICH NANNO CHALK Smear Slide at Section 5, 75 cm: 82% nannos, 15% forams, 2% pyrite, 1% iron oxide
					6			1		
		N F R	A A -	P G -	Core Catcher					FORAM RICH NANNO OOZE 80% nannos, 20% forams

Site 208 Hole Core 23 Cored Interval: 371-380 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY EARLY MIOCENE	N5				1	0.5, 1.0	PY	1		5Y7/2 PYRITE BEARING FORAM NANNO CHALK Light gray. Moderately mottled. Lithified.
					2		PY	1		Smear Slide at Section 2, 75 cm: 57% nannos, 40% forams, 2% pyrite, 1% iron oxide
					3		PY	1	CC	[84% $CaCO_3$] In Section 4: *Zoophycos* type burrows at 85, 102, 111, 117 and 134 cm.
					4		PY	1		
					5					5Y5/1 Section 5: darker gray color, intensely mottled area from 108 to 113 cm. Smear Slide at Section 5, 75 cm: 70% nannos, 30% forams
					6					
		N F R	A A -	M M -	Core Catcher					FORAM NANNO CHALK 70% nannos, 30% forams

Site 208 Hole Core 24 Cored Interval: 399-408 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLIEST MIOCENE	N4				1	0.5	EMPTY			
						1.0		1		N8 FORAM RICH NANNO CHLAK Gray. Indurated. Moderately mottled. *Zoophycos*-type burrows at Section 1 - 102, 120, 128, 133, 135 and 144 cm.
					2			1		Smear Slide at Section 2, 75 cm: 89% nannos 10% forams 1% opaque (pyrite)
					3			1		
					4			1	CC	[87% $CaCO_3$]
		N F R	A A -	M M -	Core Catcher					FORAM NANNO CHALK 70% nannos 29% forams 1% quartz

Site 208 Hole Core 25 Cored Interval: 428-437 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLIEST MIOCENE	N4 ? / NP25 (upper)				1	0.5 1.0		1		N7 FORAM RICH NANNO CHALK Pale gray. Indurated. Slightly mottled. No other structures visible.
					2			1		Smear Slide at Section 2, 75 cm: 75% nannos 25% forams
		F	A	G	3			1	CC	[77% $CaCO_3$] Section 3: *Zoophycos*-type burrows throughout.
		N N	A A	M M	4			1		
LATE OLIGOCENE	NP24 (lower)-NP25 (lower)	N	A	M	5			1		Megascopically similar to above. FORAM NANNO CHALK *Zoophycos*-type burrow from 17-32 cm (Section 5). Smear Slide at Section 5, 75 cm: 69% nannos 30% forams 1% opaque (pyrite)
					6			1		
		N F R	A A -	M M -	Core Catcher					FORAM NANNO CHALK 70% nannos 30% forams

Site 208 Hole Core 26 Cored Interval: 456-465 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE OLIGOCENE	NP24 (lower)-NP25 (lower)	N	A	M	1	0.5, 1.0	F	1		5Y7/1 to 5Y6/1
					2		F	1		
					3		F	1		
					4		F	1		
		N	A	M	5		F	1		
					6		F	1		
		N F R	A A -	P M -	Core Catcher					

FORAM BEARING NANNO CHALK
Light gray, laminated with greenish (5G4/1) throughout. Slight mottling. Burrows are generally filled with pyrite.

Zoophycos-type burrows at Section 1 - 136 and 146 cm.

Smear Slide at Section 2, 75 cm:
92% nannos
8% forams

[81% $CaCO_3$]

Section 4: *Zoophycos*-type burrows throughout.

Section 5: large burrow (83-90 cm) filled with pyrite.
Many *Zoophycos*-type burrows below 5-105 cm.

Smear Slide at Section 5, 75 cm:
91% nannos
9% forams

FORAM NANNO CHALK
64% nannos, 30% forams
4% zeolites(?), 1% glass
1% quartz

Site 208 Hole Core 27 Cored Interval: 484-493 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE OLIGOCENE	NP24 (lower)-NP25 (lower)				1	0.5, 1.0	EMPTY; F, G	1		N8
		N	A	P	2		S, F, G, S	1		
		F	C	M	3		F, G, S	1	CC	5G6/1
MIDDLE MIDDLE EOCENE	Chiphragmalithus cristutus (upper)	N	A	P						
		N	A	P						
					4			1		
					5		A, D, A	1		5Y6/1
					6		D, A, D	1		
		N F R	A C A	M M G	Core Catcher					

GLAUCONITE, SPONGE SPICULE AND FORAM BEARING NANNO CHALK
Light gray. Slightly mottled and burrowed.

Section 2: *Zoophycos*-type burrows throughout.

Smear Slide at Section 3, 75 cm:
85% nannos
9% forams
2% sponge spicules
2% glauconite
1% pyrite
1% zeolites
1% rads

[78% $CaCO_3$]

SPONGE SPICULE AND RAD RICH NANNO CHALK
Gradual change from light gray to greenish gray (with flecks of dark greenish gray). Moderately to intensely mottled throughout in shades of gray.

Smear Slide at Section 3, 110 cm:
67% nannos
1% forams
15% rads
15% sponge spicule
1% glauconite
1% glass

GLASS AND DIATOM BEARING RAD. SPONGE SPICULE NANNO CHALK
Megascopically similar to directly above. Intense mottling.

Smear Slide at Section 5, 75 cm:
33% nannos
30% rads
30% sponge spicules
5% diatoms
2% glass

SPONGE SPICULE RICH RAD DIATOM NANNO CHALK
30% nannos, 30% diatoms
26% rads, 11% sponge spicules
1% forams
1% glass

Site 208 Hole Core 28 Cored Interval: 512-521 m

AGE: MIDDLE MIDDLE EOCENE

ZONE: Chiphragmalithus cristatus (upper)

Section	Fossil	Abund.	Pres.	Deformation
1	N	A	P	1
2				1
3				1
4				1
5				1
6				1
Core Catcher	N / F / R	A / F / A	M / M / G	

Meters: 0.5, 1.0

LITHOLOGIC DESCRIPTION

5Y8/1 GLASS AND DIATOM BEARING SPONGE SPICULE RAD NANNO CHALK
Same lithology (megascopically) as Core 27. Pale yellowish gray (5Y8/1), with thin bands of greenish gray (5G6/1) to pale green (10G6/2). Entire part is intensely burrowed (pale yellowish brown, 10YR6/2, fillings).

Smear Slide at Section 2, 75 cm:
31% nannos
30% rads
30% sponge spicules
5% diatoms
1% zeolites
2% glass
1% pyrite

[49% $CaCO_3$]

Megascopically similar lithology.
DIATOM BEARING NANNO RICH SPONGE SPICULE RADIOLARITE

Smear Slide at Section 5, 75 cm:
35% rads
35% sponge spicules
24% nannos
5% diatoms
1% opaque (pyrite)

Core Catcher: SPONGE SPICULE BEARING RAD RICH NANNO DIATOMITE
39% diatoms, 30% nannos, 10% sponge spicules, 20% rads, 1% glass

Site 208 Hole Core 29 Cored Interval: 539-548 m

AGE: MID EOCENE (top); MIDDLE PALEOCENE; EARLY PALEOCENE (core catcher)

ZONE: Discoaster elegans; Heliolithus kleinpelli; Fasciculithus tympaniformis (upper); Fasciculithus tympaniformis (lower) (core catcher)

Section	Fossil	Abund.	Pres.	Deformation	Litho. Sample
1	N	A	P		
1	N	A	P		CC
2	N	A	P		
3	N	A	P	1	
4	N	A	P		
4	N	A	M		
6	N	A	M		
Core Catcher	N / F / R	A / - / A	P / - / G		

Meters: 0.5, 1.0

LITHOLOGIC DESCRIPTION

IMPURE CHERT (porcellanite)
Olive gray (5Y6/1) and greenish gray, with traces of burrows preserved (with more $CaCO_3$).
As below 47 cm.
As from 0 → 20 cm. [87% $CaCO_3$]

Very hard silicified sediment (porcellanite?). Similar in appearance as Core 28. Occasional lenses of softer, unsilicified sediment.

* Smear Slide at Section 2, 75 cm:
97% nannos
2% forams
1% opaque (pyrite)

NOTE: Smear Slide is made of scrapings of sediment → no signs of siliceous cement.
Name: FORAM BEARING NANNO CHALK

Megascopically similar to directly above. Very hard chert horizons at Section 3 - 20 to 50 cm; 60 to 90 cm and 143 to 150 cm.

Smear Slide of material in between:
Section 3, 7 cm:
98% nannos
1% forams
1% glass

Name: NANNO CHALK

Section 4: similar lithology as above. Chert horizon at 40-48 cm.

Section 5: megascopically similar.

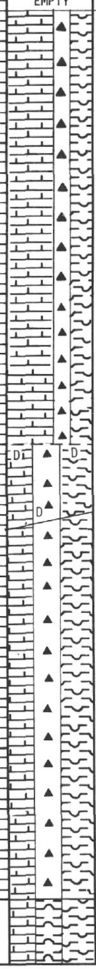
Smear Slide at Section 5, 75 cm:
39% nannos
30% rads
30% sponge spicules
1% glass

Giant vertical burrow: 69-90 cm
Zoophycos-type burrows throughout section.
Name: RAD SPONGE SPICULE NANNO CHALK

Section 6: similar lithology. Very hard. Intensely mottled.

Core Catcher: SPONGE SPICULE BEARING RAD RICH DIATOM NANNO CHALK
40% nannos, 28% diatoms, 20% rads, 1% forams, 10% sponge spicules, 1% glass

Site 208 Hole Core 30 Cored Interval: 548-557 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PALEOCENE	Fasciculithus tympaniformis (lower)	N	C	P	1	0.5, 1.0	EMPTY 			
	Prinsius martinii	N	C	P	2					
					3			1	CC XM	
		N	A	M	4					
		N	C	P	5					
					6					
		N F R	C - A	P - G	Core Catcher					

5YR8/1 RAD AND SPONGE SPICULE RICH NANNO CHALK
Pinkish gray. Much similarity with Core 29, but less cherty. Still somewhat silicified. Streaks and laminae of pale green (10G6/2).
Intensely mottled and burrowed throughout (5Y6/1).
Zoophycos-type burrows throughout.

Smear Slide at Section 1, 75 cm:
50% nannos
24% rads
24% sponge spicules
2% forams

[74% $CaCO_3$]
X-ray - 39% amorphous, 61% crystalline:
99% calcite, 1% quartz

Megascopically similar. DIATOM BEARING RAD, SPONGE SPCIULE NANNO CHALK

Smear Slide at Section 4, 77 cm:
32% nannos
30% rads
30% sponge spicules
5% diatoms
1% pyrite
1% glass
1% ?

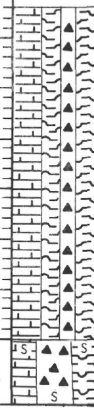
At 4/82 is a fault (inclined) with slickensides. Below this fault the color changes: very light gray (N8) to light gray. Intense mottling throughout with pinkish gray (5YR8/1). RAD SPONGE SPICULE NANNO CHALK

Smear Slide at Section 4, 80 cm:
40% nannos
30% rads
30% sponge spicule
1% glass

NOTE: No fundamental lithologic difference above and below fault.

RAD SPONGE SPICULE NANNO CHALK: 40% nannos, 30% rads, 30% sponge spicules

Site 208 Hole Core 31 Cored Interval: 558-567 m

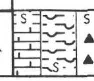
AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PALEOCENE	Prinsius martinii				1	0.5, 1.0	EMPTY 			
					2			1	CC	
	Chiasmolithus danicus	N	C	P	3					
		N	C	P						
		N F R	F - A	P - G	Core Catcher					

[64% $CaCO_3$]
Similar to bottom part of Core 30. Color changes slightly, becoming more yellowish gray (5Y8/1) to greenish gray (5GY7/1). Burrows occur throughout (olive gray 5Y6/1), including *Zoophycos*-type burrows.
CALCITE BEARING RAD DIATOM AND SPONGE SPICULE RICH NANNO CHALK

Smear Slide at Section 2, 75 cm:
35% nannos
25% sponge spicules
20% diatoms
15% rads
5% calcite

SPONGE SPICULE BEARING RAD RICH DIATOM NANNO CHALK: 40% nannos, 37% diatoms, 11% rads, 10% sponge spicules, 1% forams, 1% silcoflag.

Site 208 Hole Core 32 Cored Interval: 567-576 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PALEOCENE	Chiasmolithus danicus	N R	F A	P G	Core Catcher					

SPONGE SPICULE BEARING DIATOM RICH RAD NANNO OOZE: 40% nannos, 33% rads, 20% diatoms, 5% sponge spicules, 1% forams

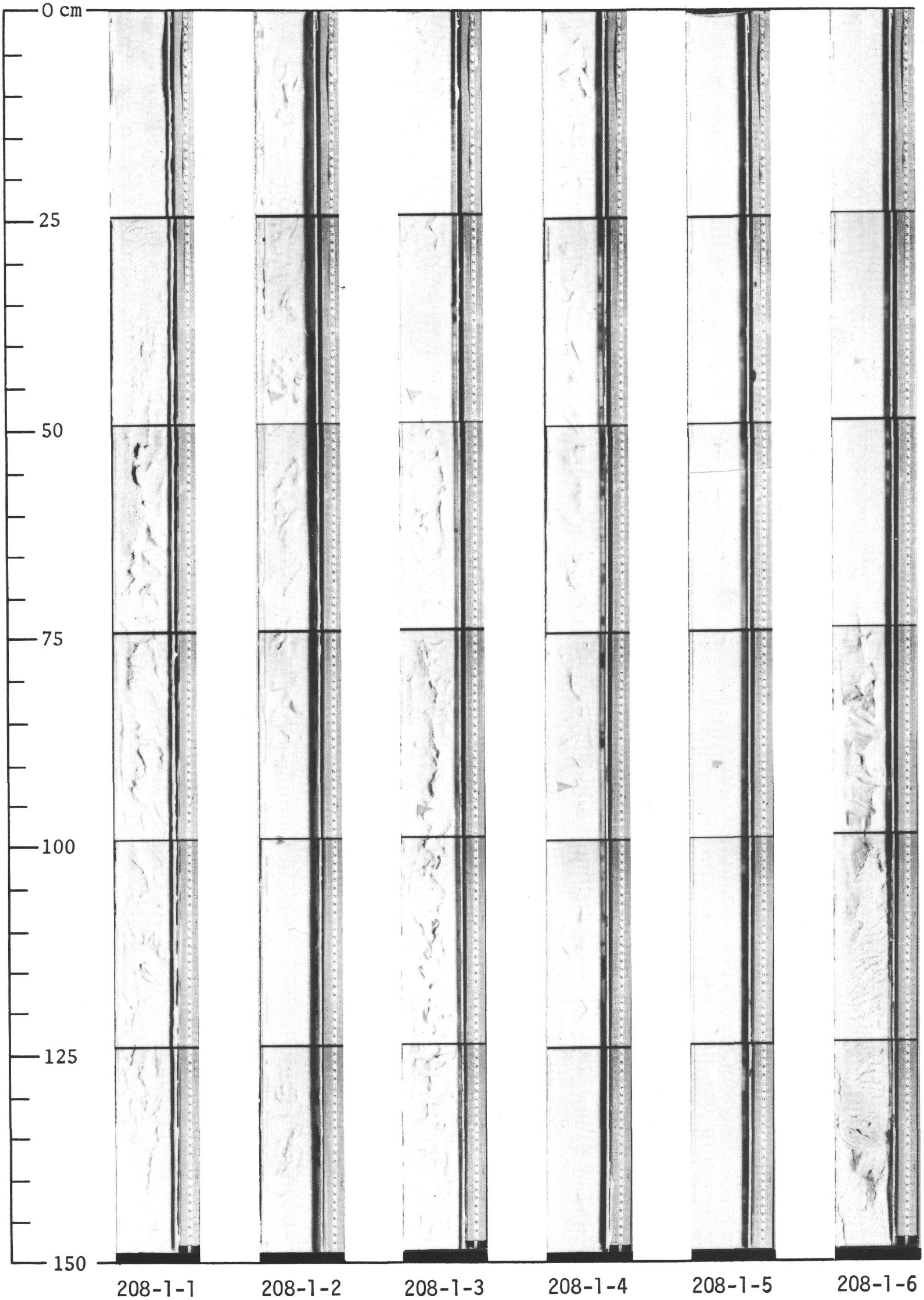
Site 208 Hole Core 33 Cored Interval: 576-585 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
EARLY PALEOCENE	1*	N	R	P	1	0.5		1		Lithology similar to Core 31. Light gray (N8), burrowed and laminated with greenish gray (5G4/1) and black (5G2/1). *Zoophycos*-type and other burrows very common. Mostly silicified (not yet chert).
	2*									
	3*	N	R	P						
		N	A	P		1.0	EMPTY			Black (5G2/1) CHERT with ghosts of lamination and burrowing. Section 1: 0 → 83 looks compressed.
LATE MAESTRICHTIAN	Nephrolithus frequens (lower)				2			1		Hard, light gray NANNO BEARING CALCIC CHALK. Highly burrowed (including *Zoophycos*-type) throughout core. Smear Slide at Section 1, 95 cm: 90% calcite, 8% nannos, 2% opaque (pyrite)
					3			1	XM CC	In Section 3: gray chert from 22-28 cm. NANNO BEARING CALCIC CHALK. X-ray - 29% amorphous, 71% crystalline: 88% calcite, 3% tridymite, 1% qtz., 1% clin., 7% cristobalite [77% $CaCO_3$]
					4			1		Smear Slide at Section 4, 75 cm: 89% calcite, 10% nannos, 1% black opaque
					5			1		Section 5: harder silicified horizon at 78 cm.
		N F R	C C R	P M P	Core Catcher					FORAM BEARING NANNO CALCIC CHALK: 65% calcite, 30% nannos, 5% forams

1* = Cruciplacolithus tenuis Zone
2* = Conococcolithus panis Zone
3* = Nephrolithus frequens (upper) Zone

Site 208 Hole Core 34 Cored Interval: 585-594 m

AGE	ZONE	FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE MAESTRICHTIAN	Nephrolithus frequens (lower)				1	0.5, 1.0	EMPTY			
		N	C	M	2					N8. NANNO RICH CALCIC CHALK. Light gray, laminated with gray (5G6/1) and pale green (10G6/2). Burrowing (including *Zoophycos*-type) throughout (shades of gray, N6 → N7, and olive gray → 5Y6/1). Black chert at Section 2 115-122 and 148-150, as well as at Section 3 123-125. Smear Slide at Section 2, 75 cm: 84% Calcite, 15% nannos, 1% forams, 1% opaque (pyrite)
					3				CC XM	[86% $CaCO_3$] X-ray - 26% amorphous, 74% crystalline: 92% calcite, 1% quartz, 6% cristobalite, 1% clinoptilolite
		N F R	F A R	M M P	Core Catcher					Glass bearing NANNO CALCIC CHALK: 56% Calcite, 40% nannos, 3% glauconite, 1% feldspar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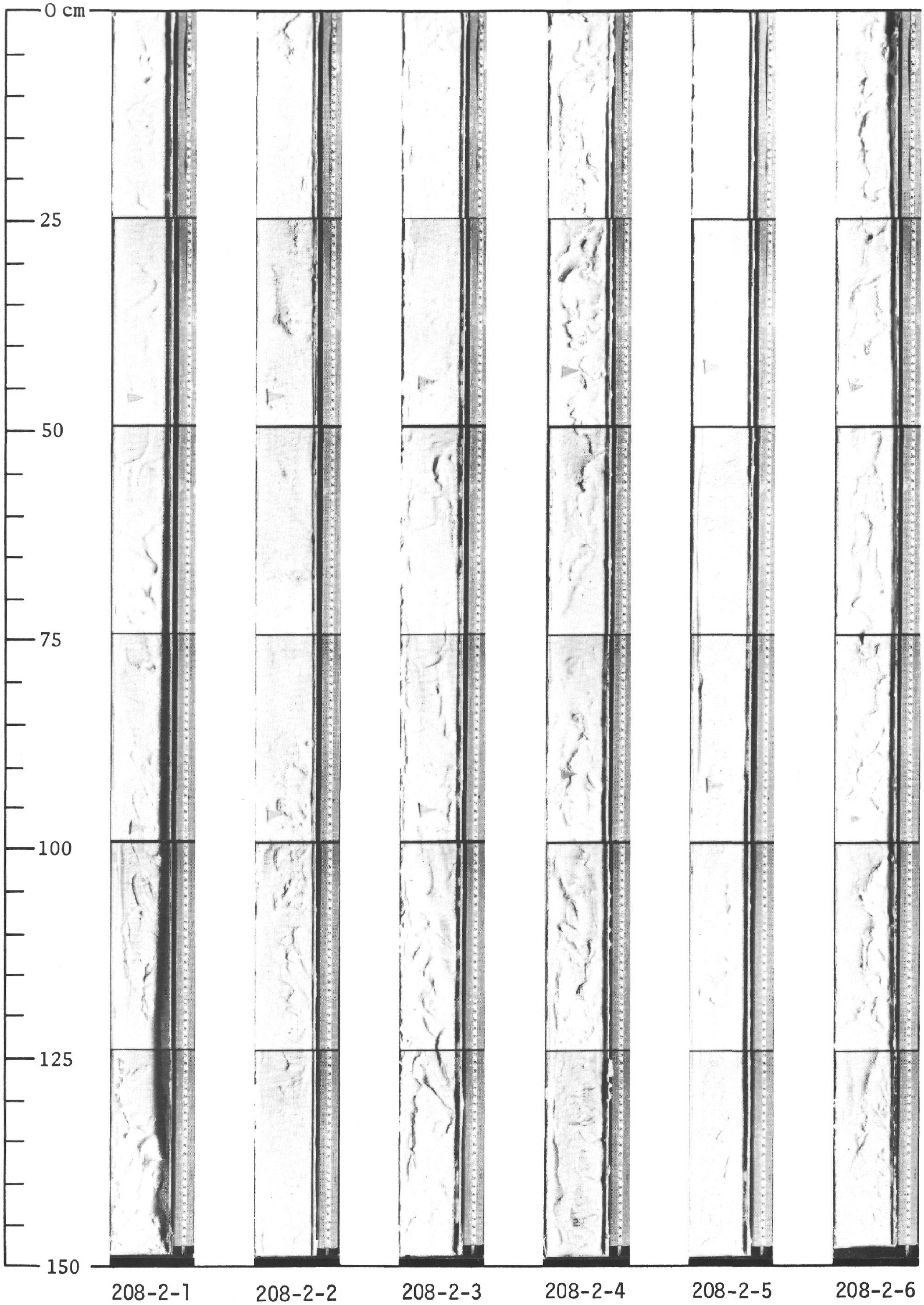
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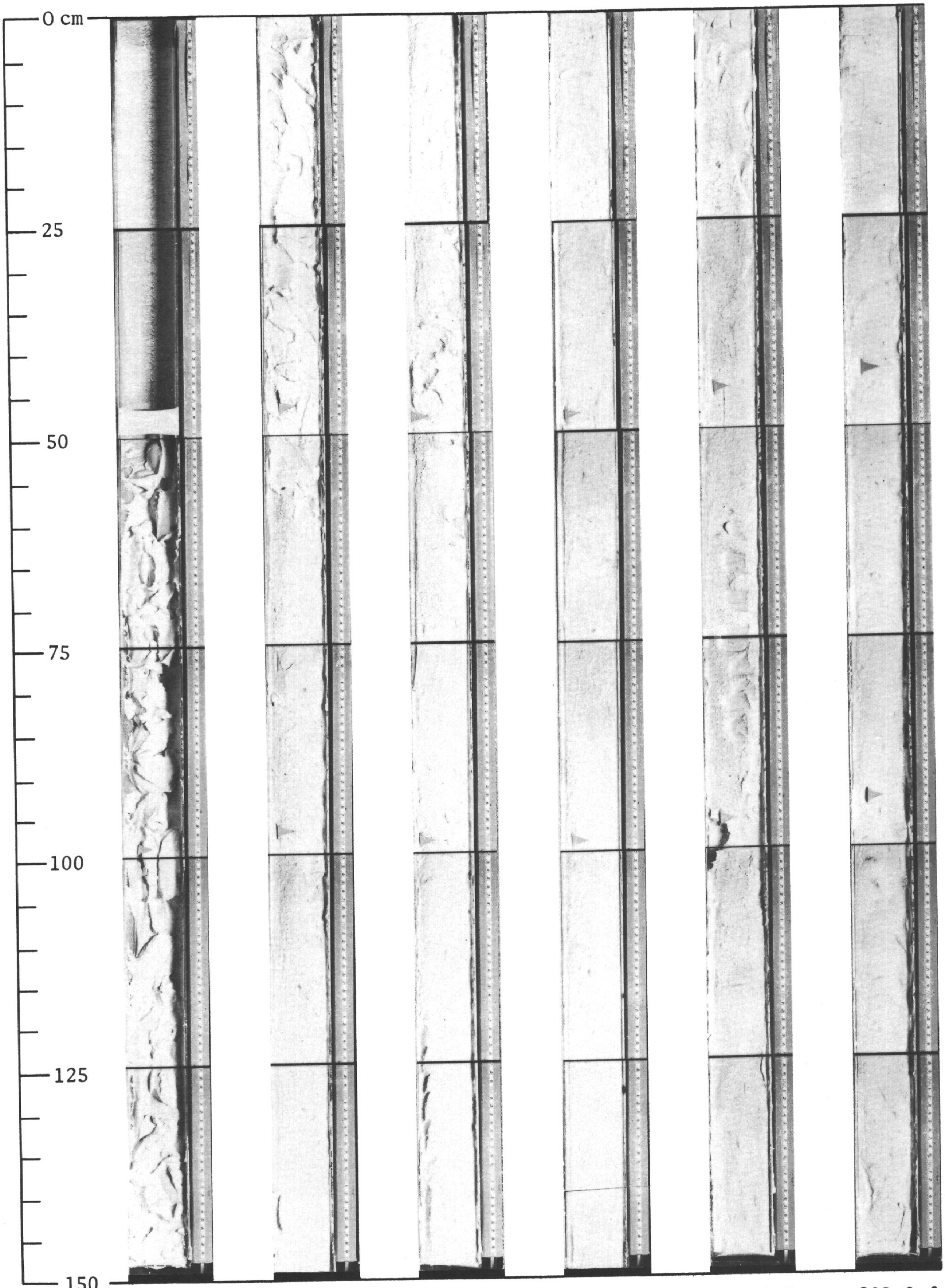

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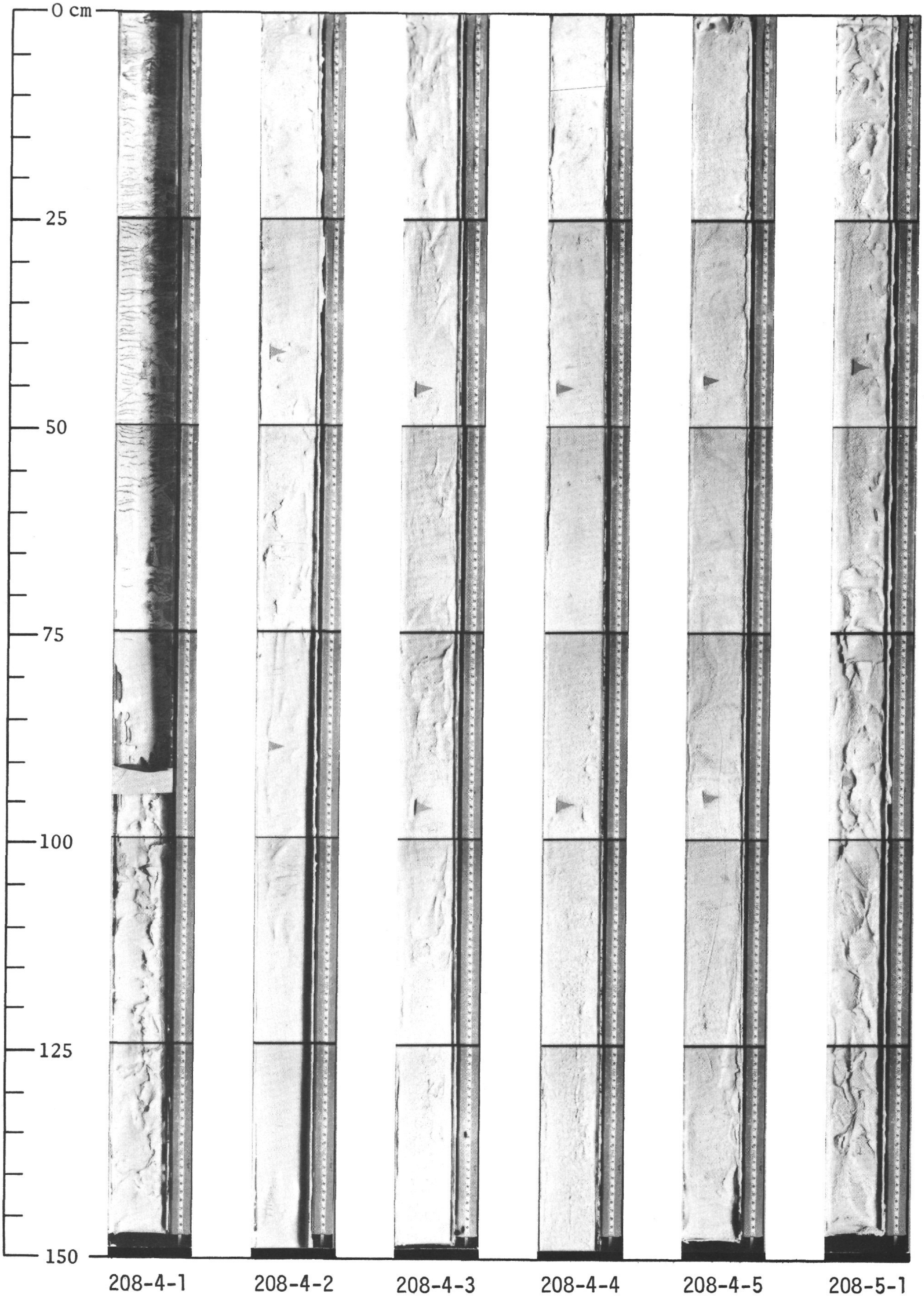
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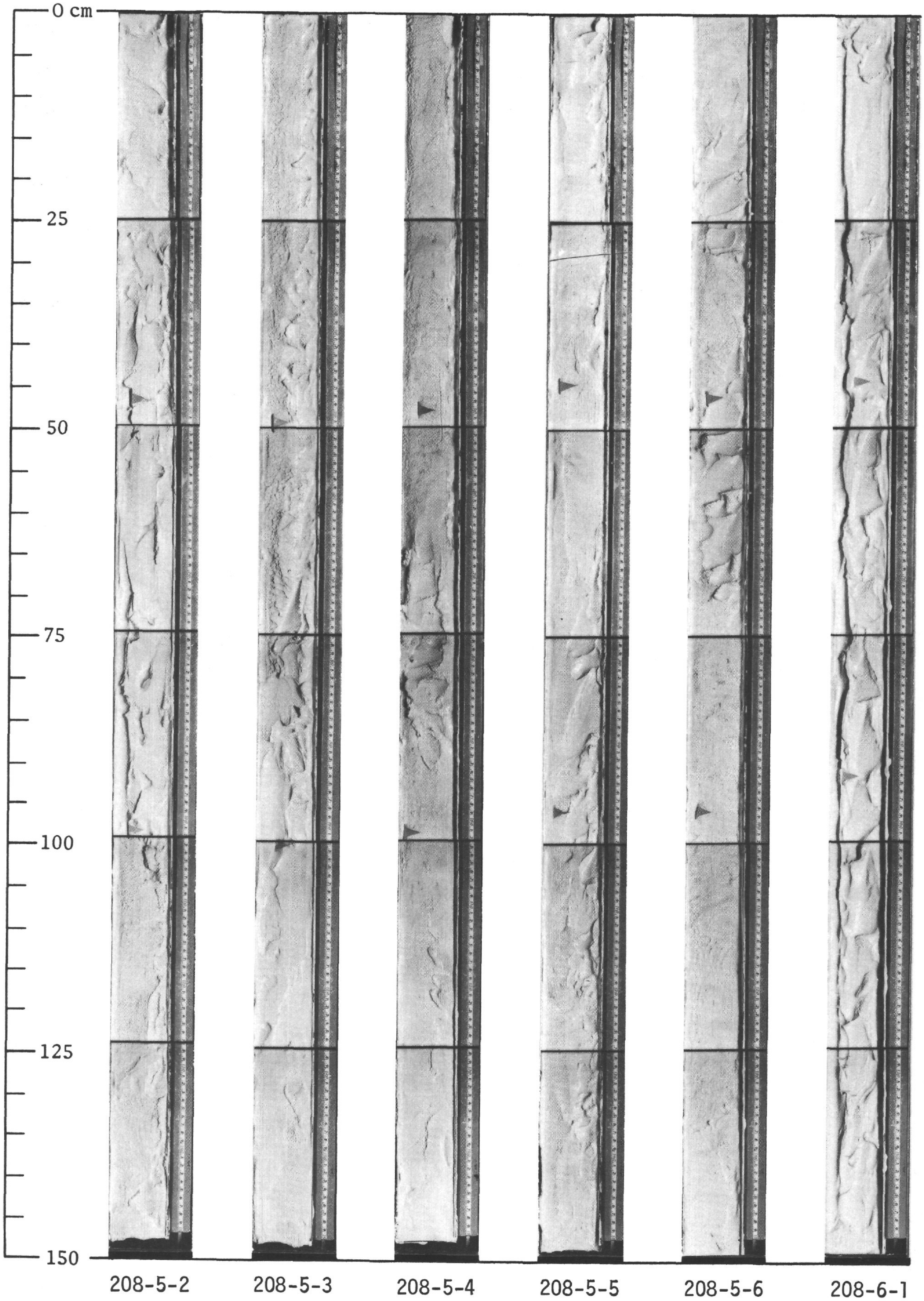
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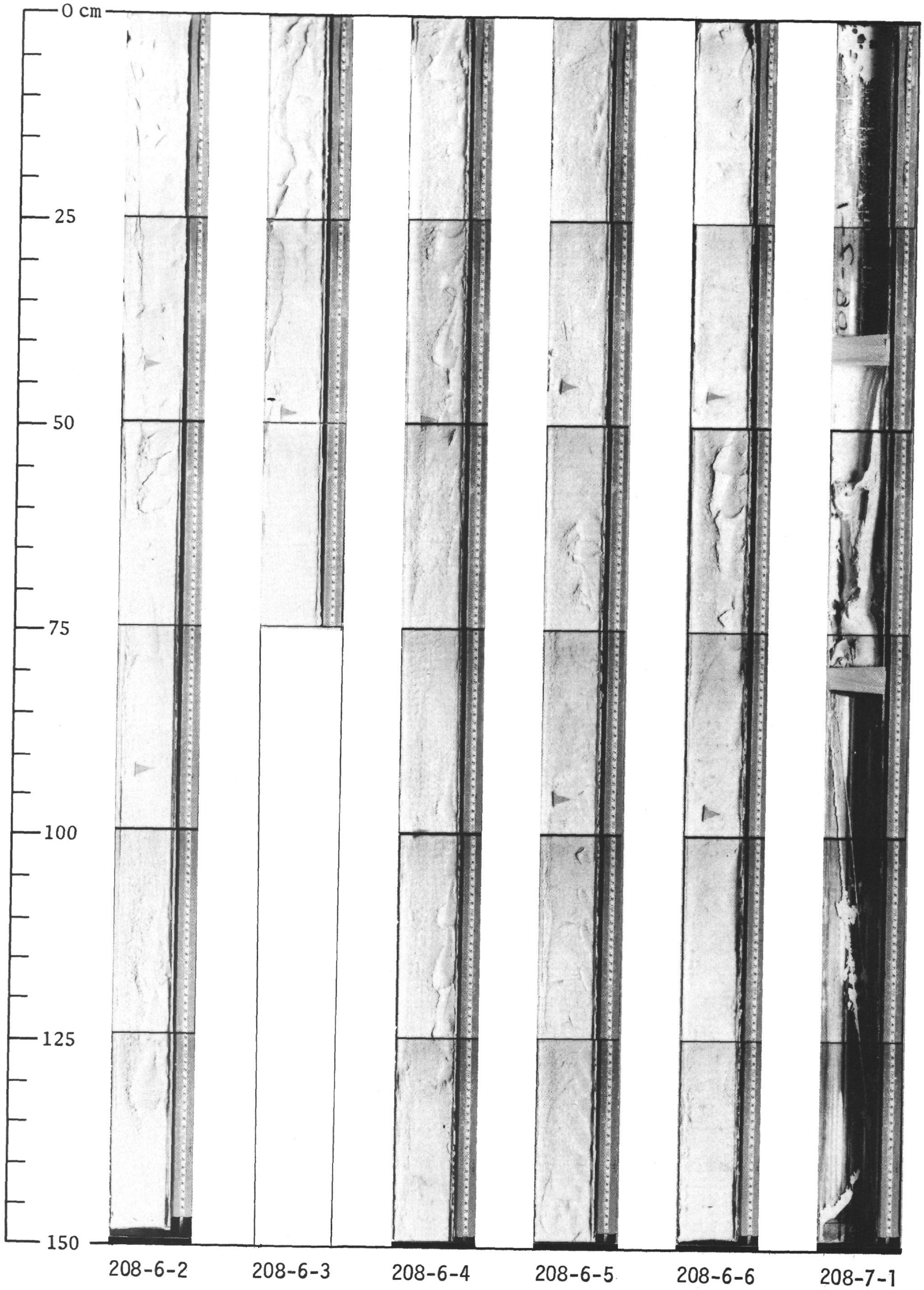
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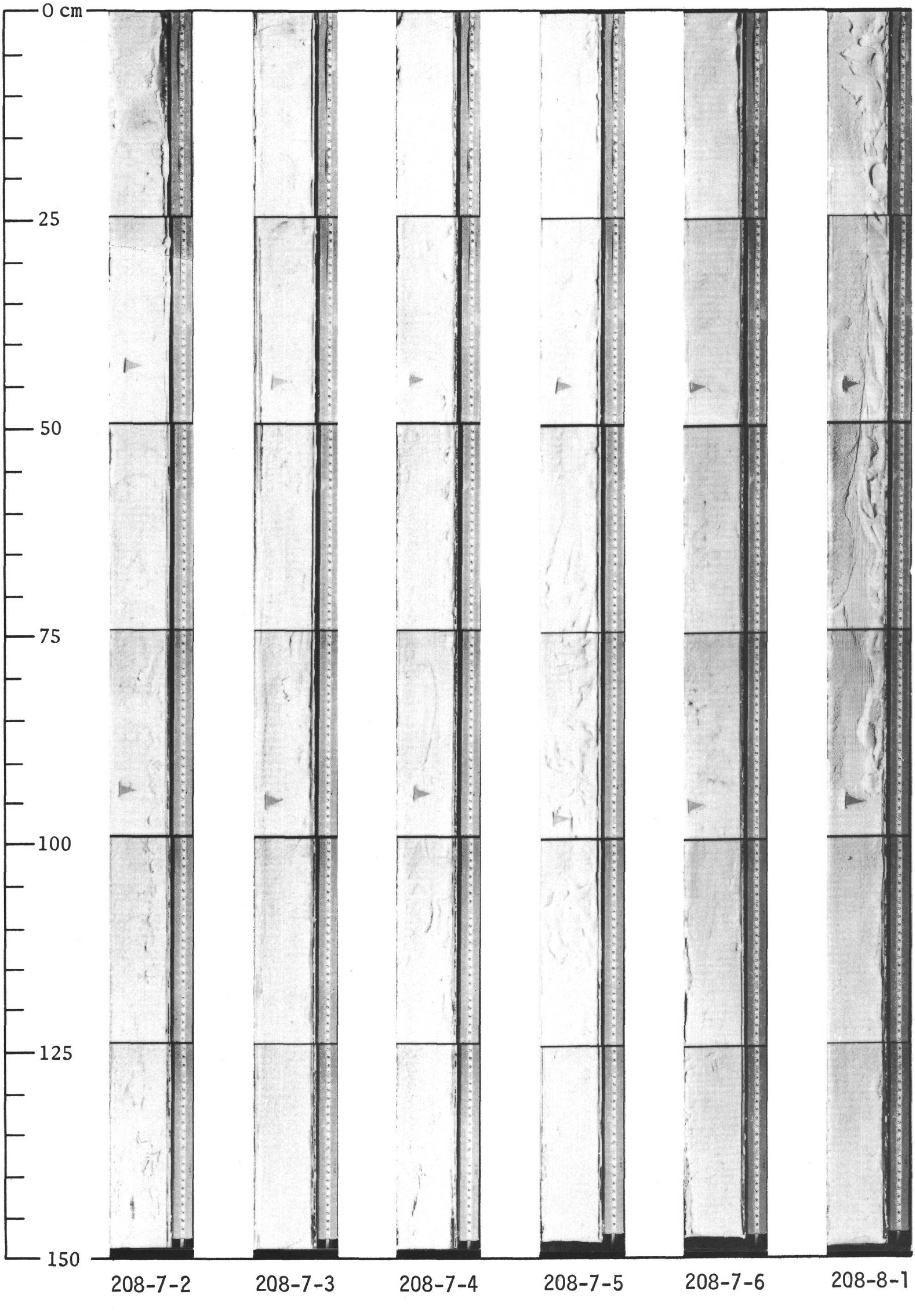
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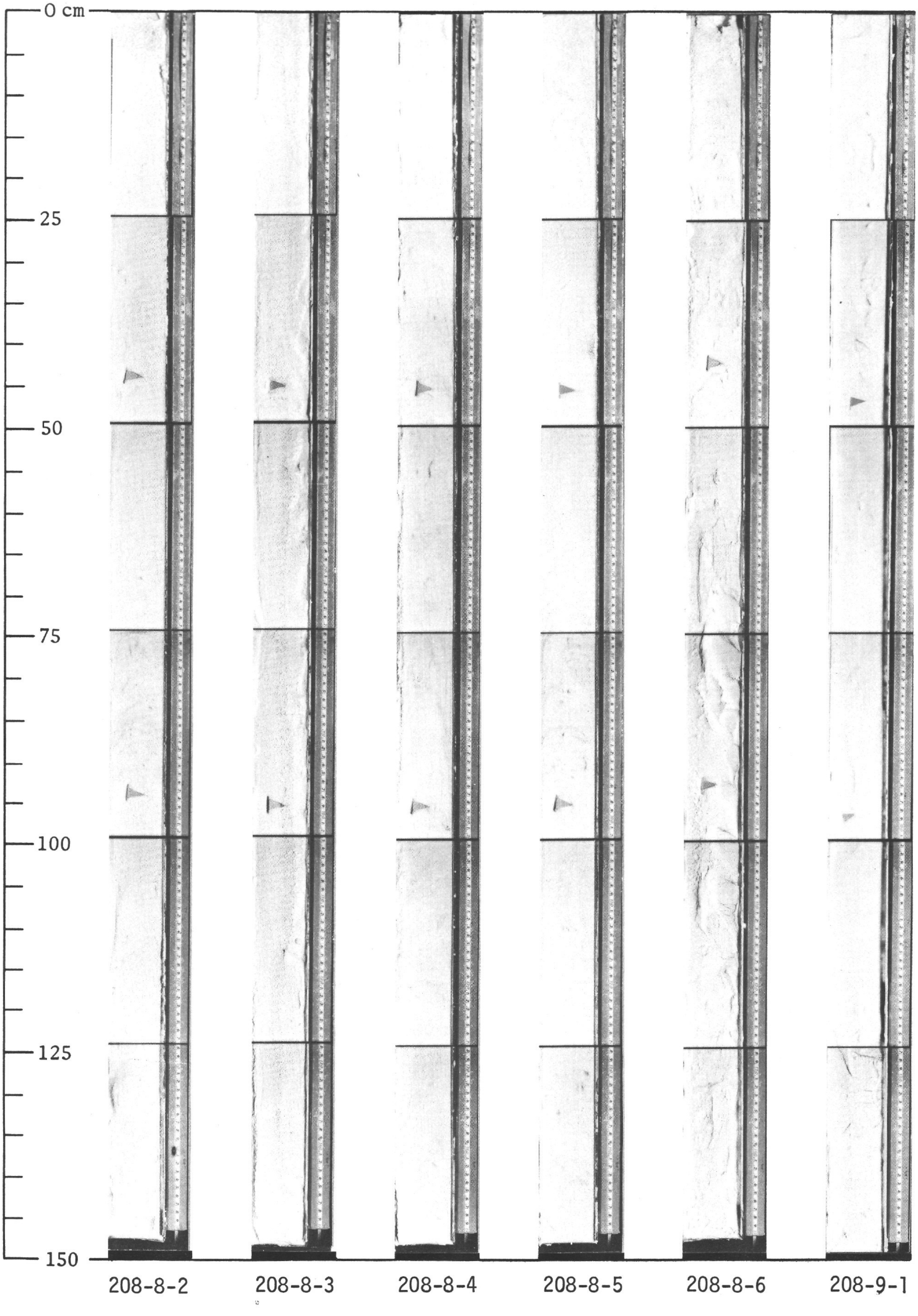
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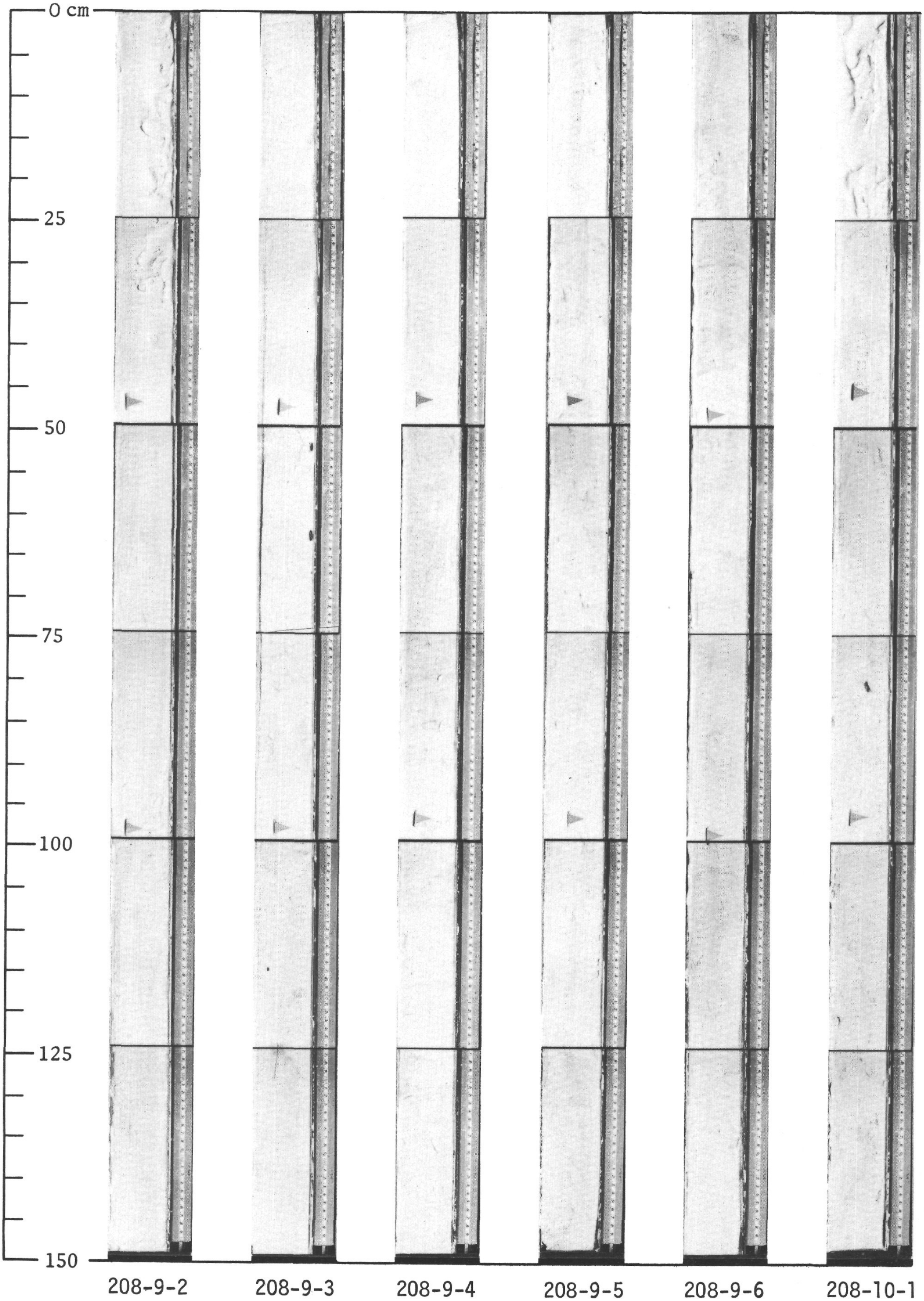
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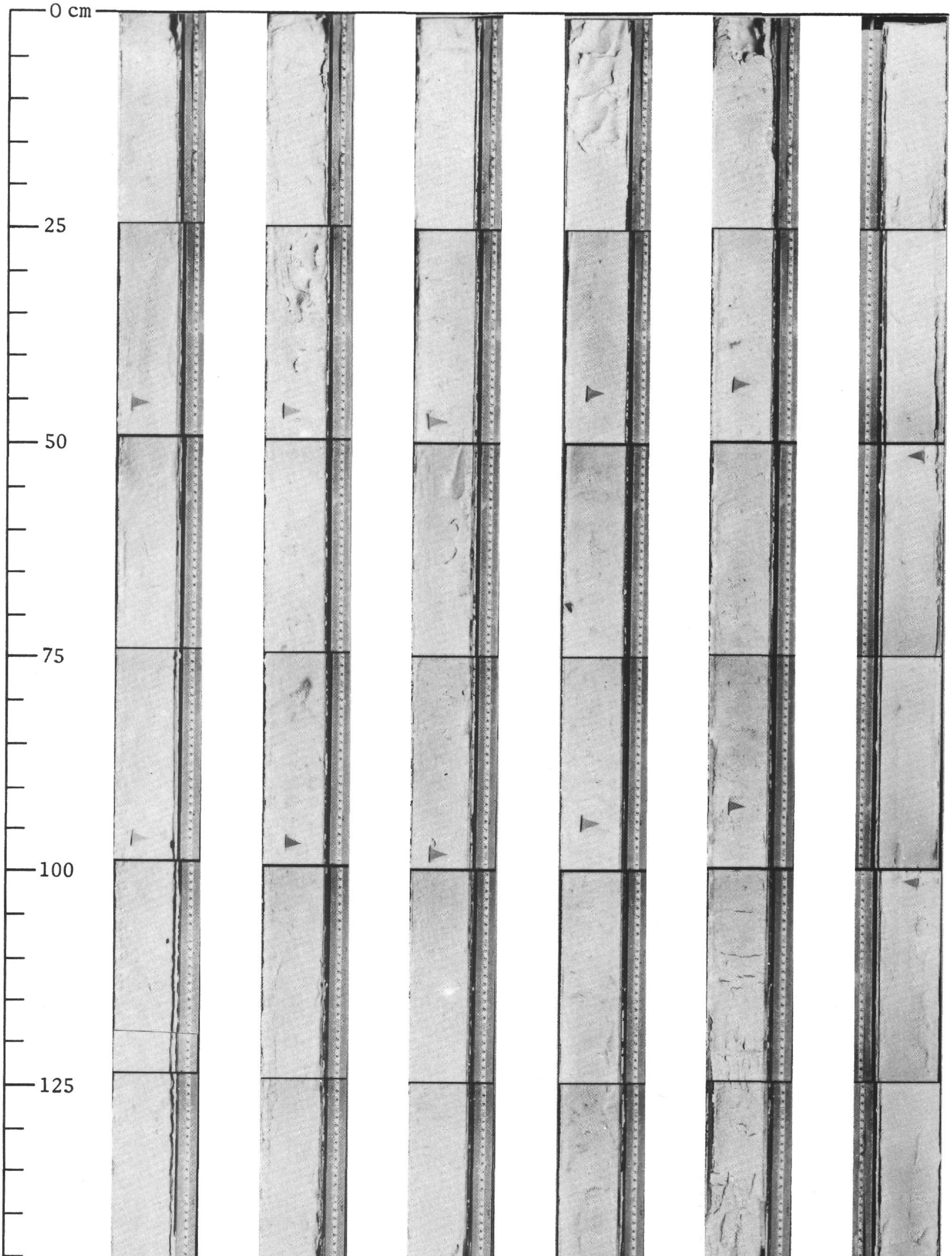
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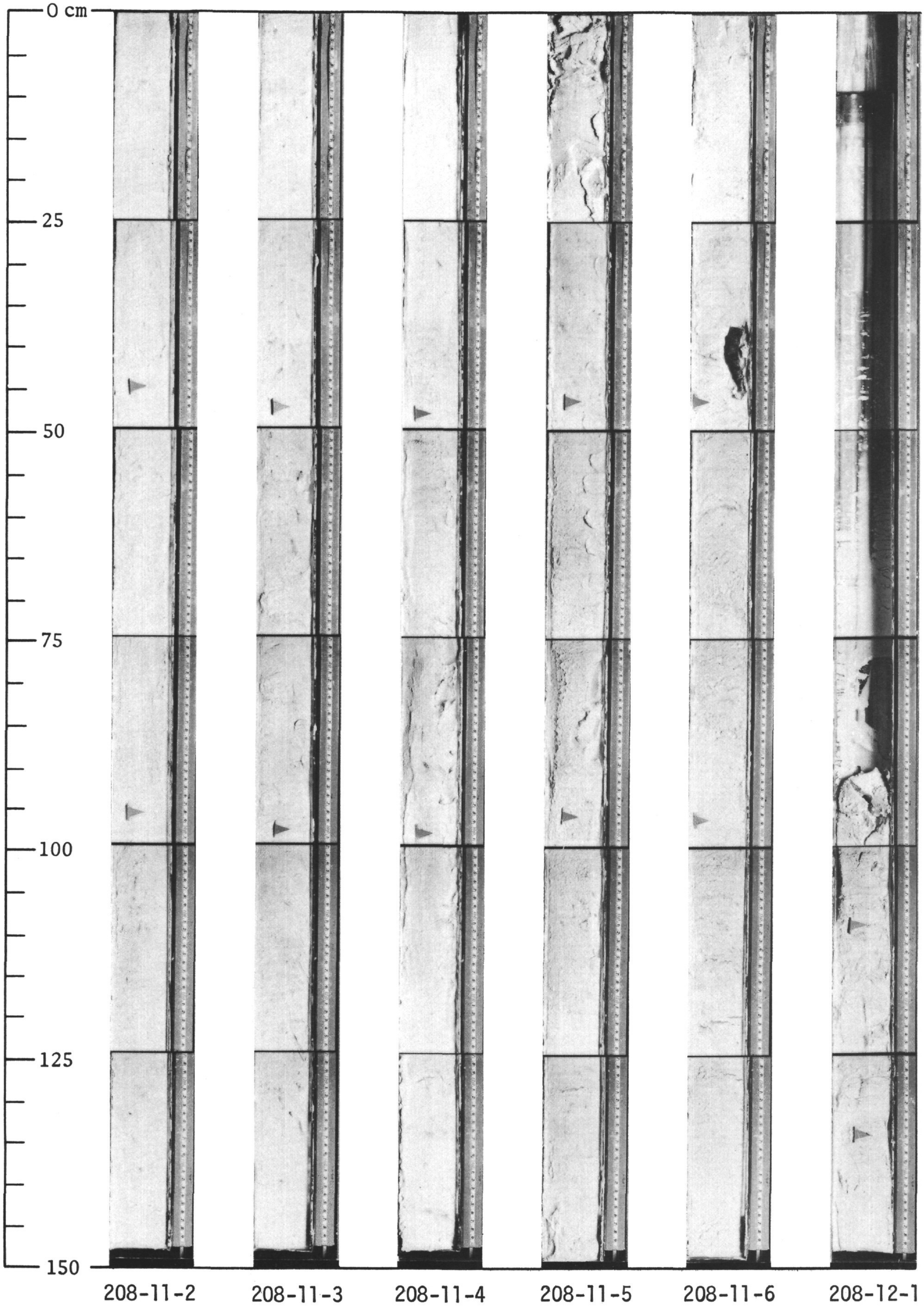
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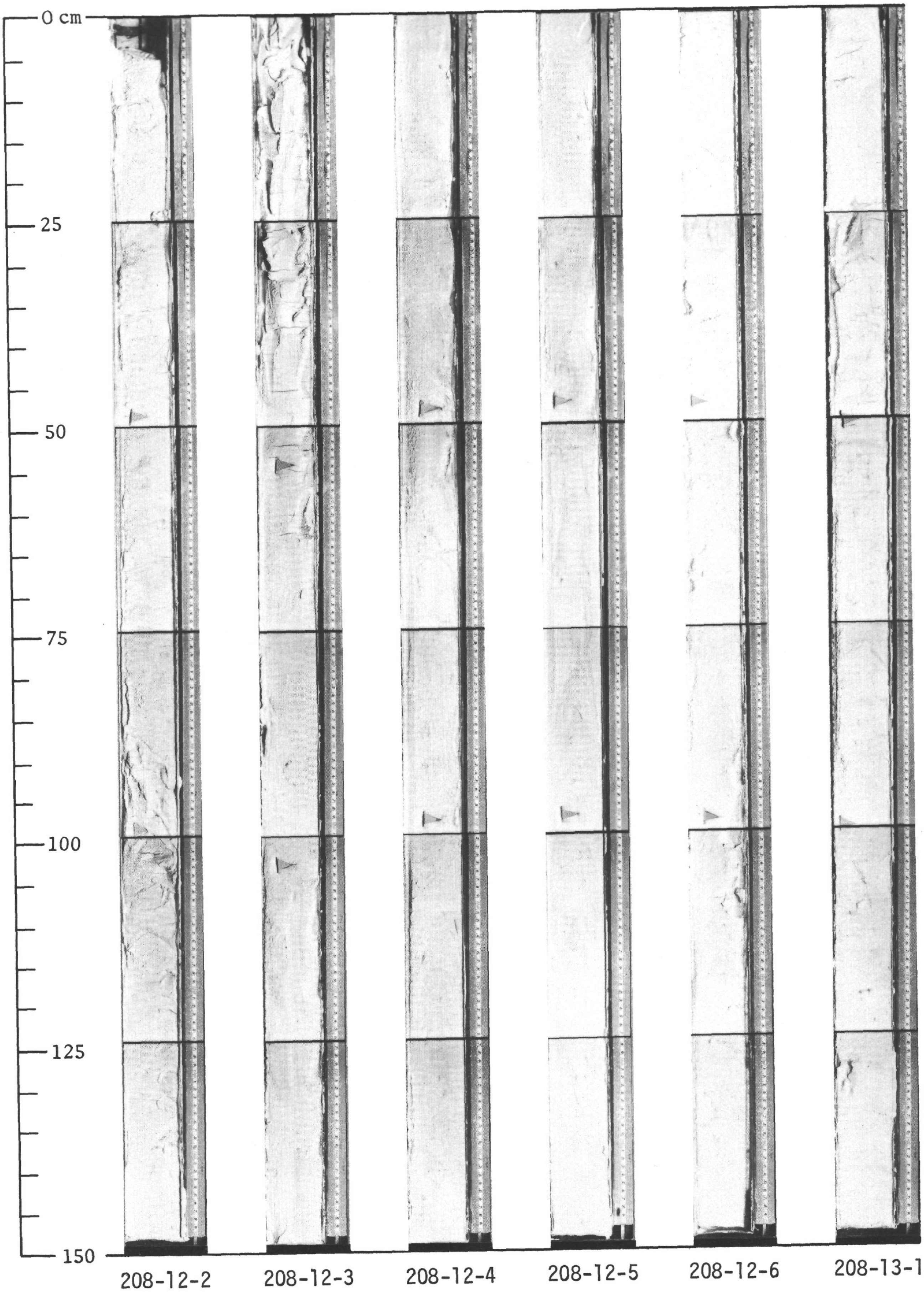
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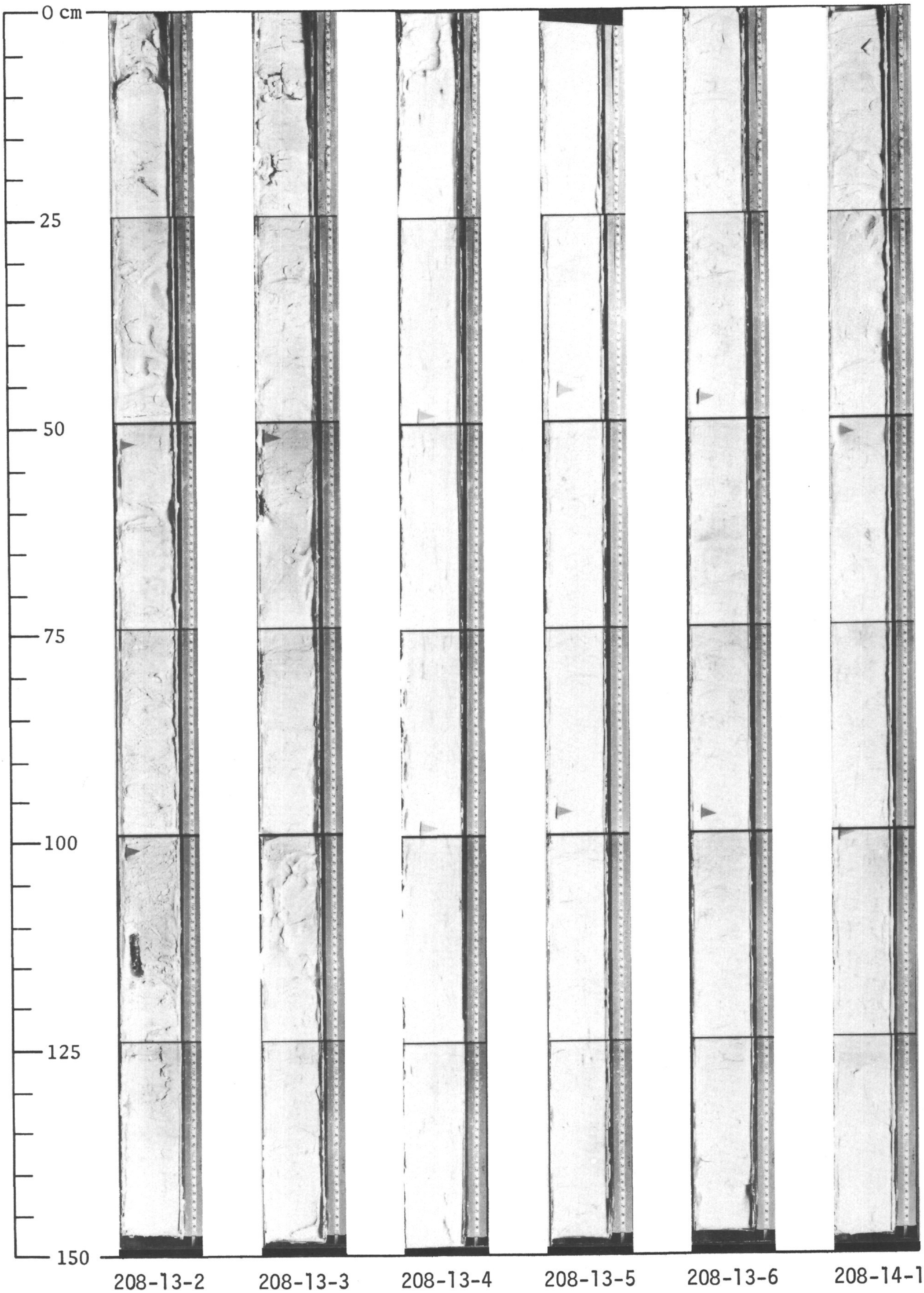
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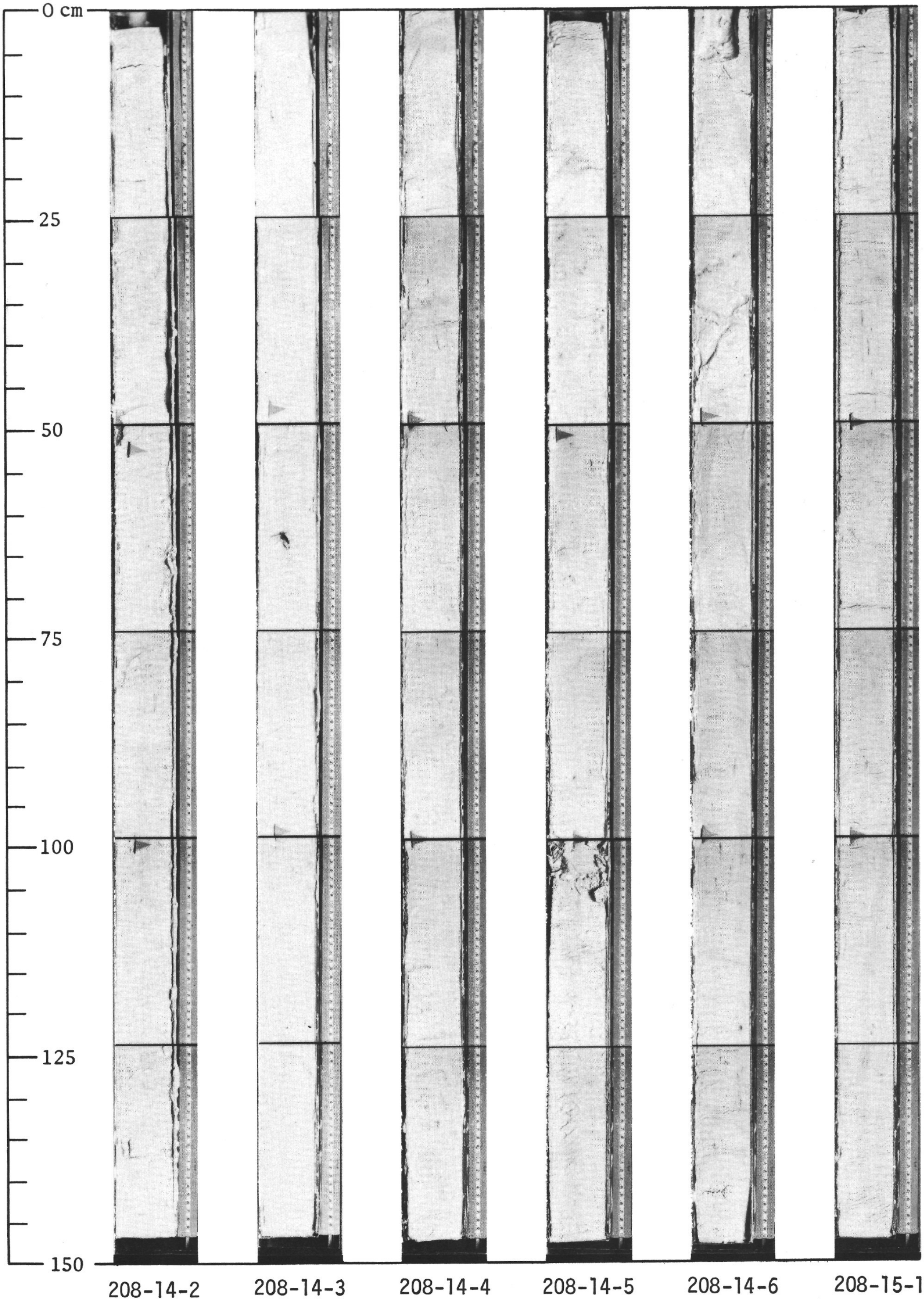
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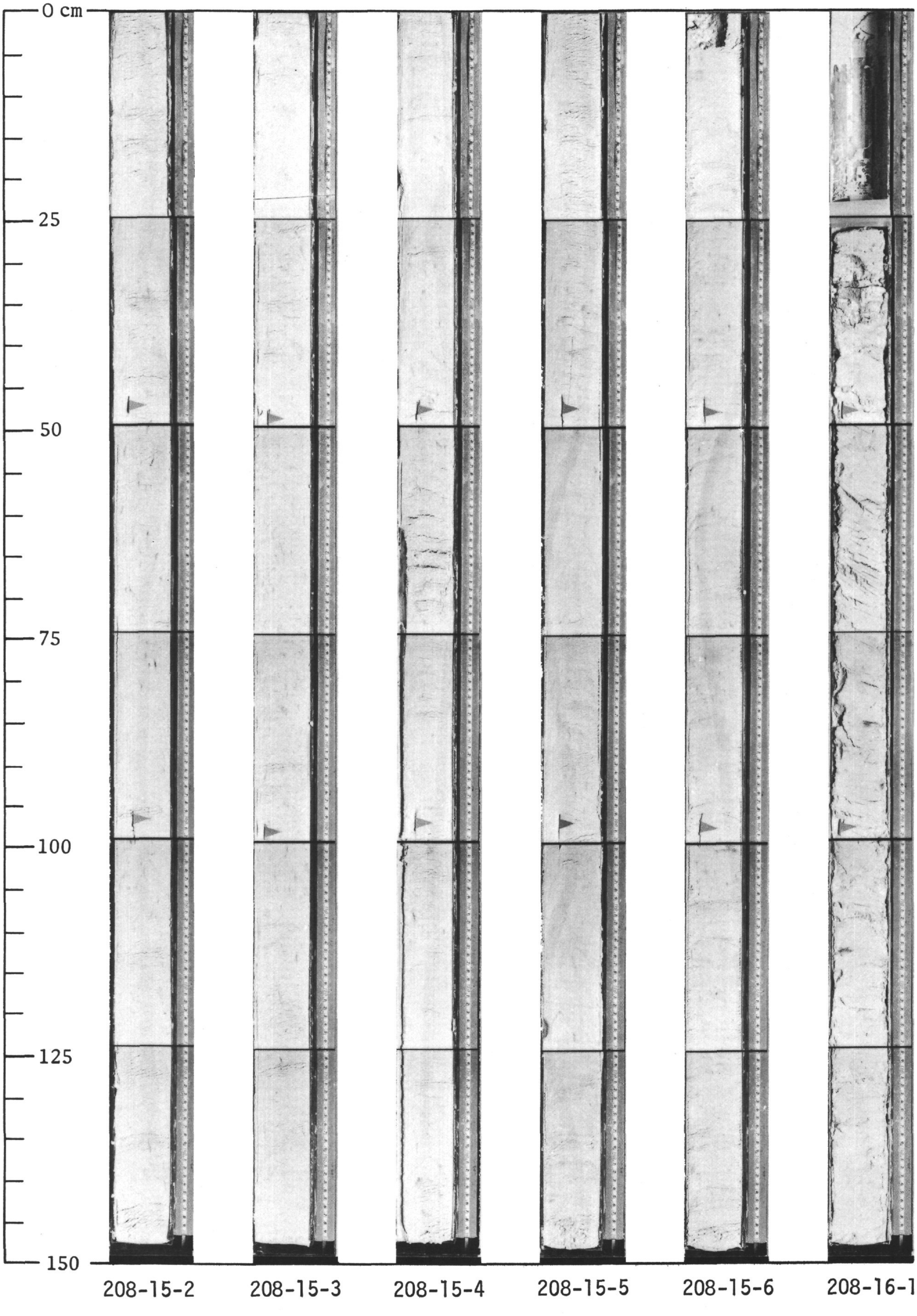
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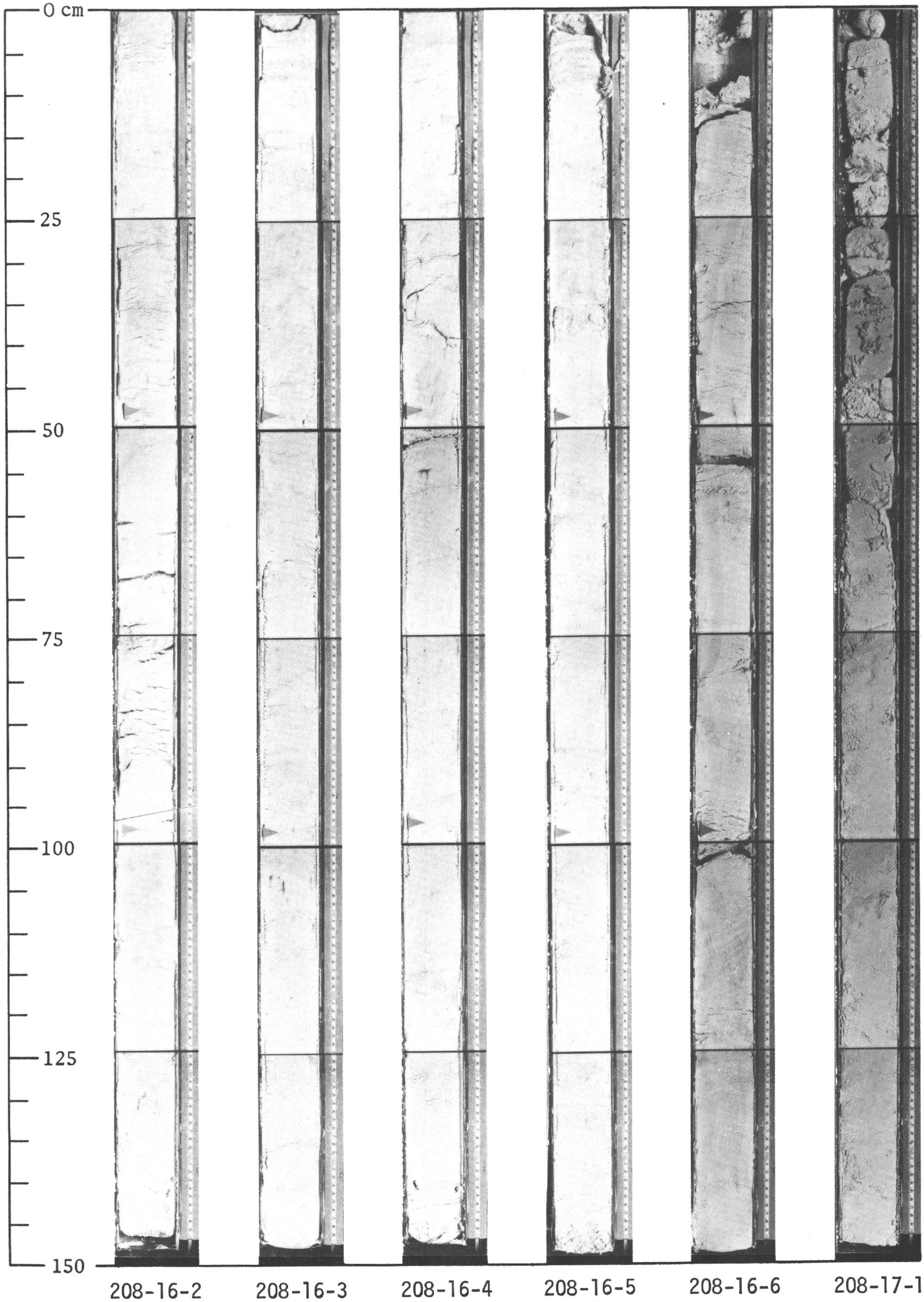
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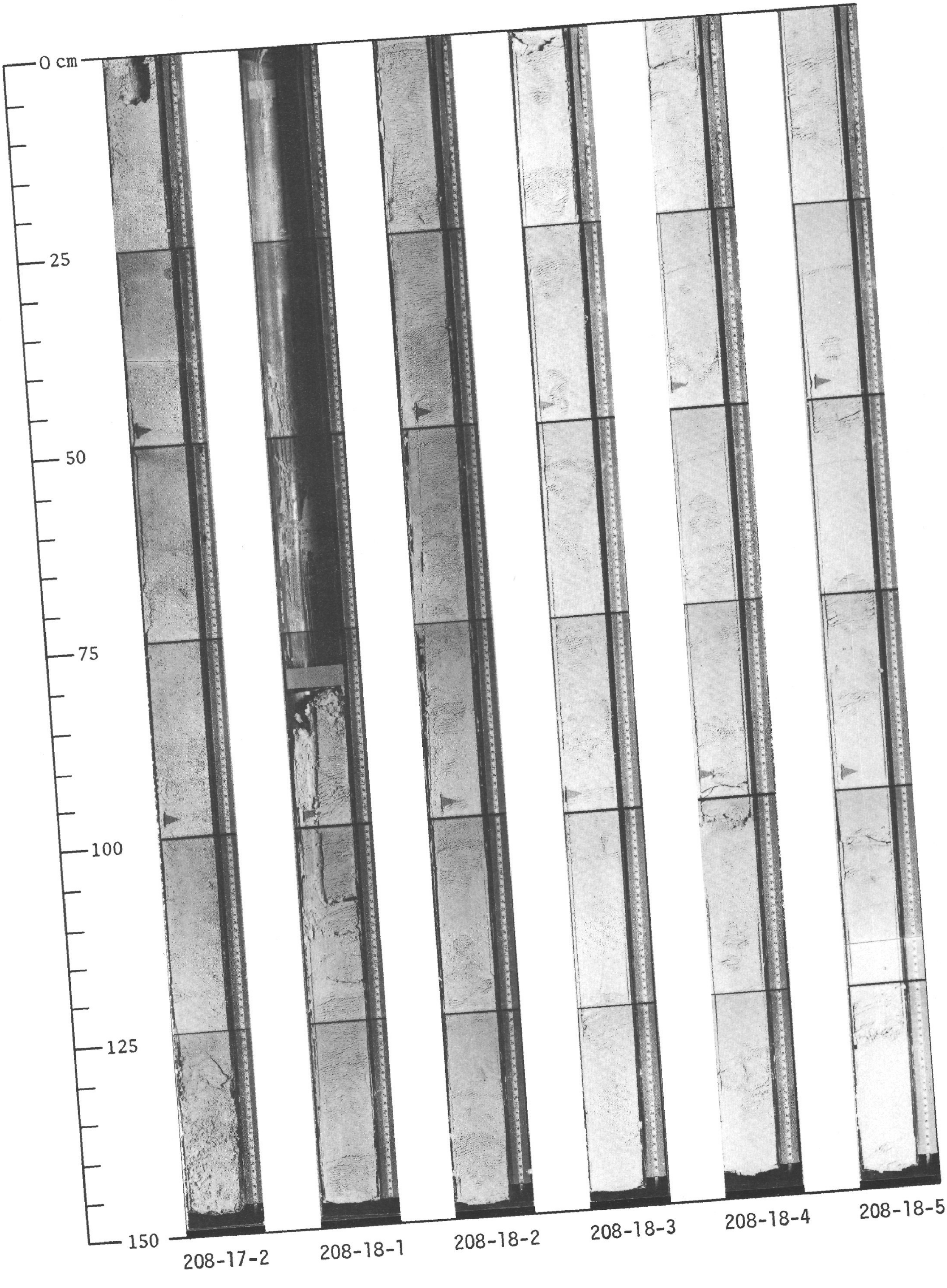
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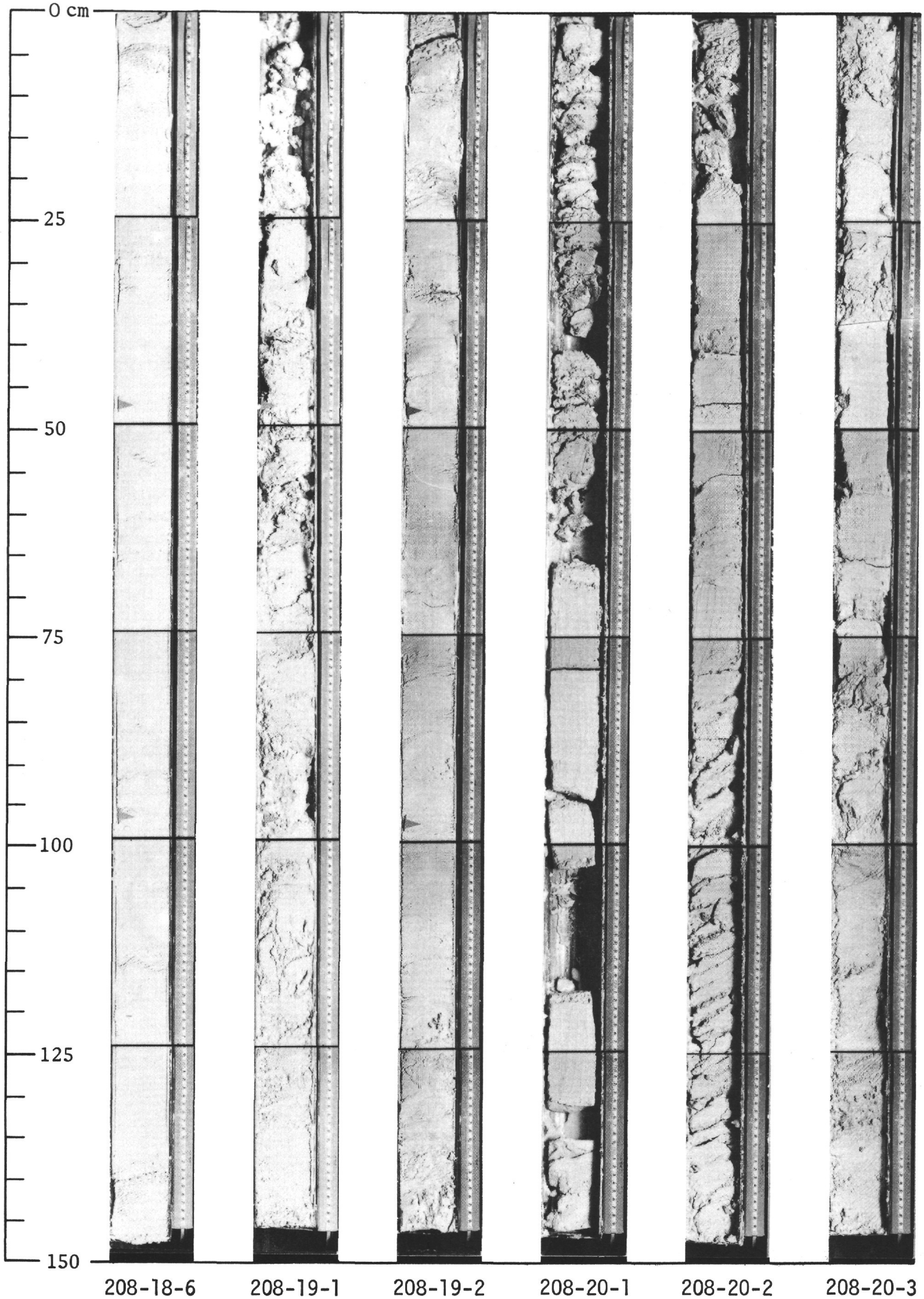
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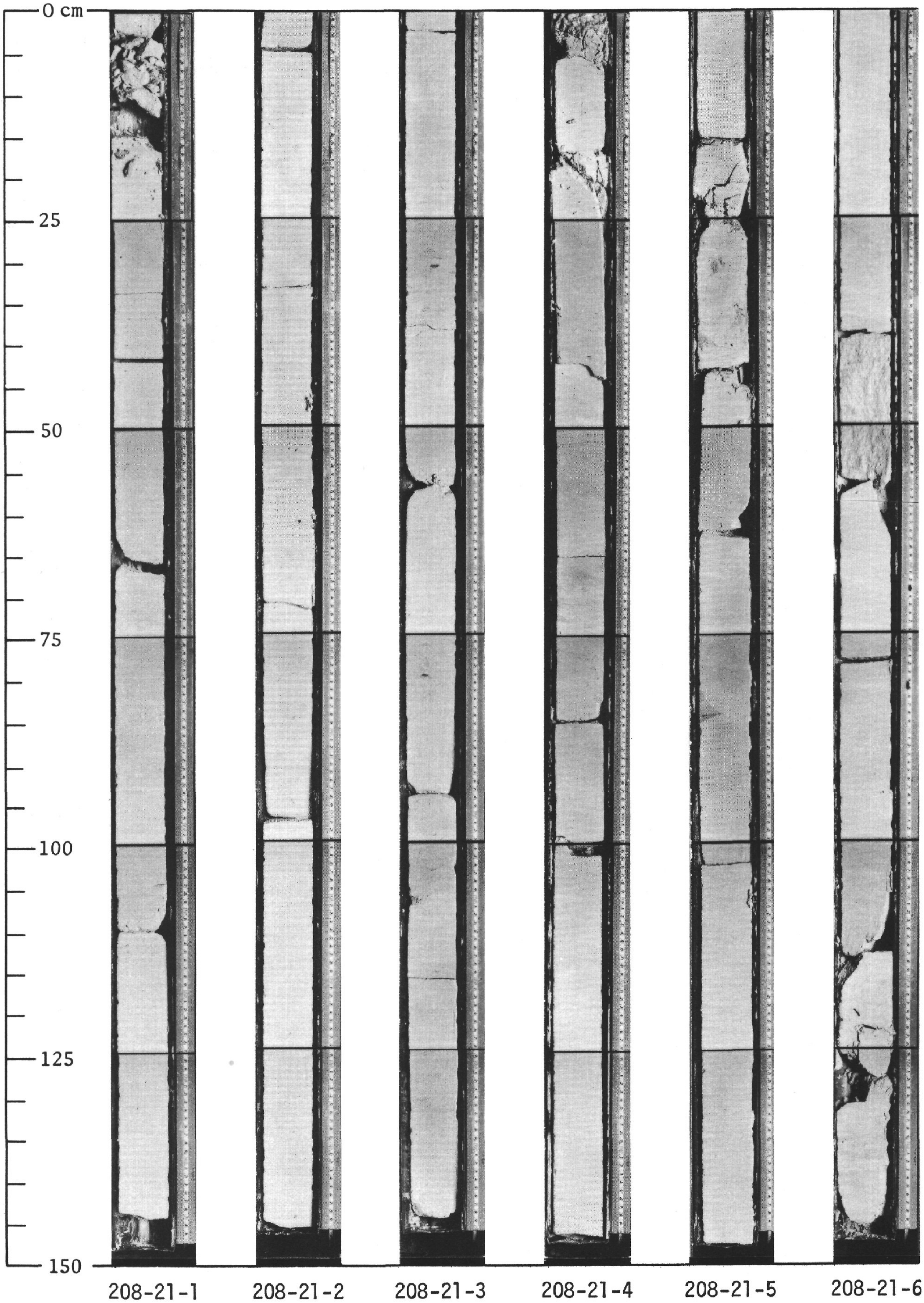
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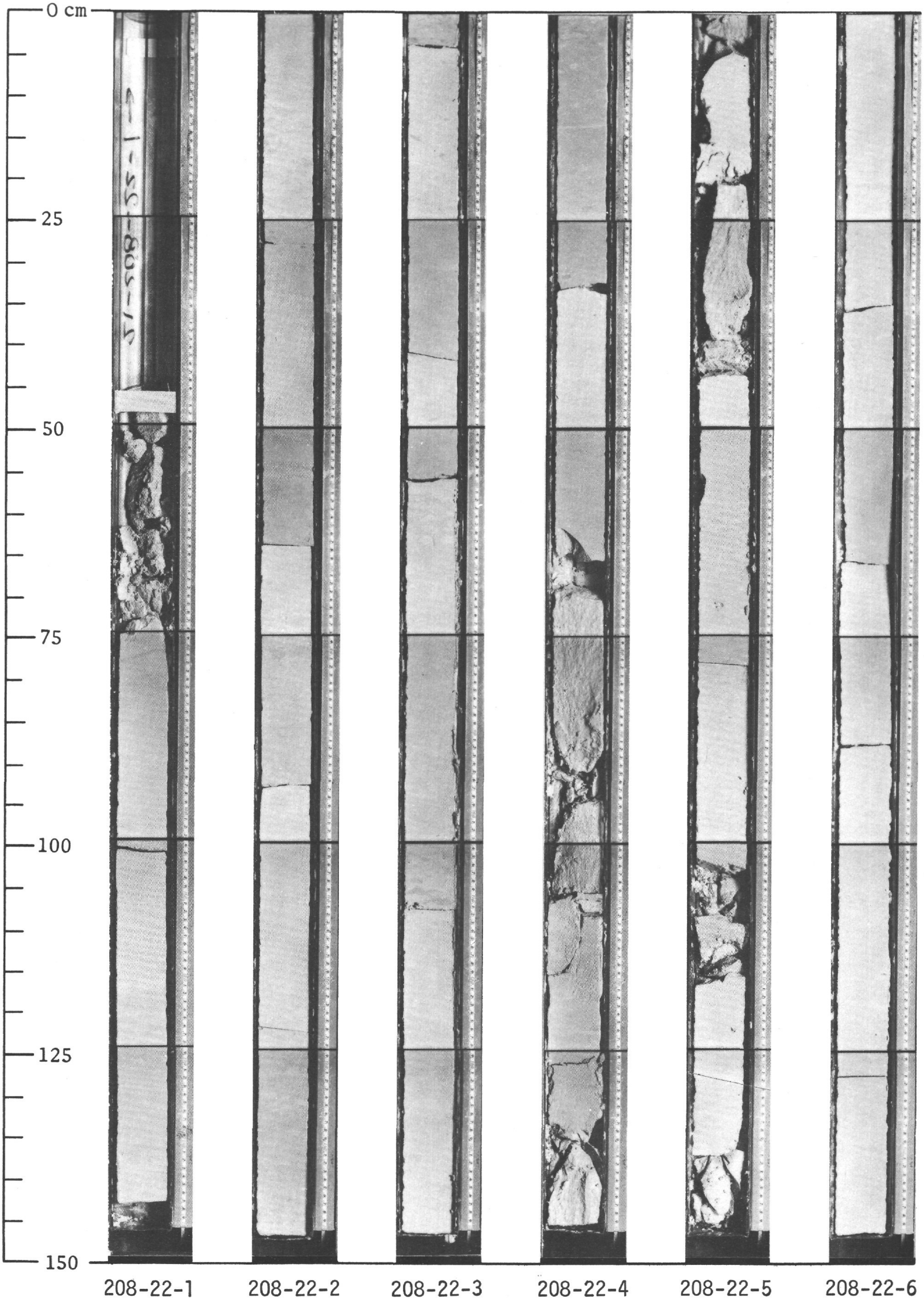
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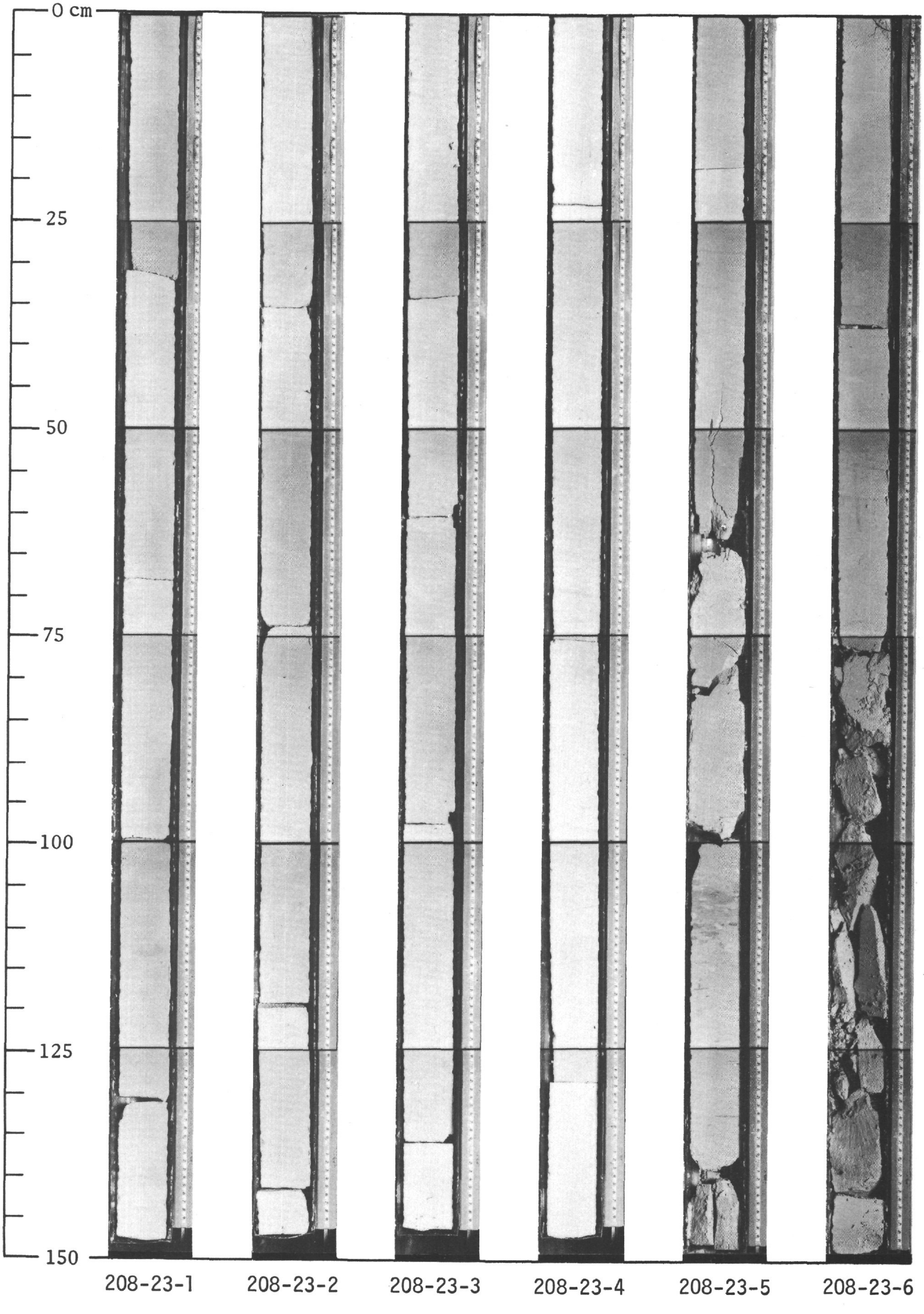
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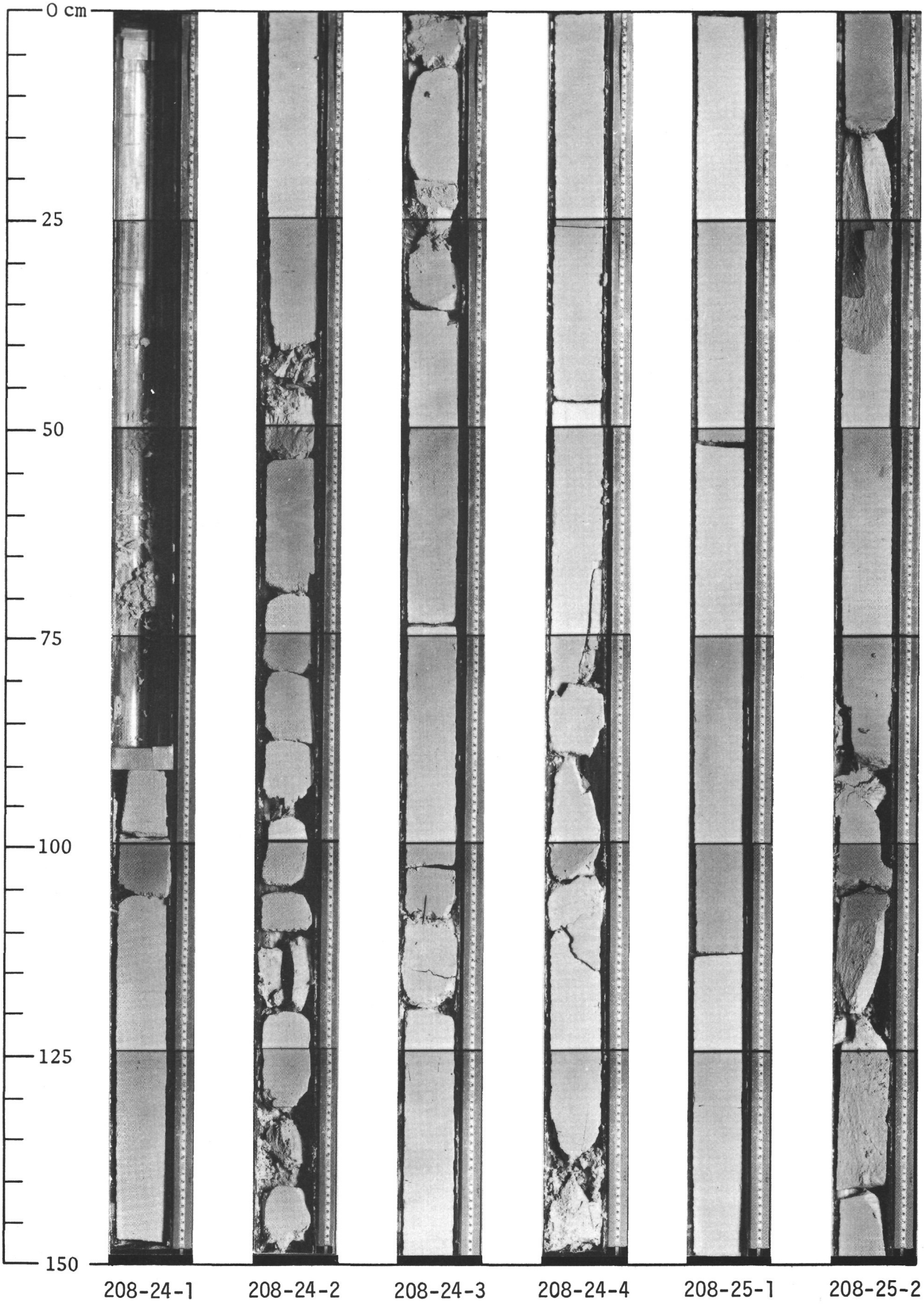
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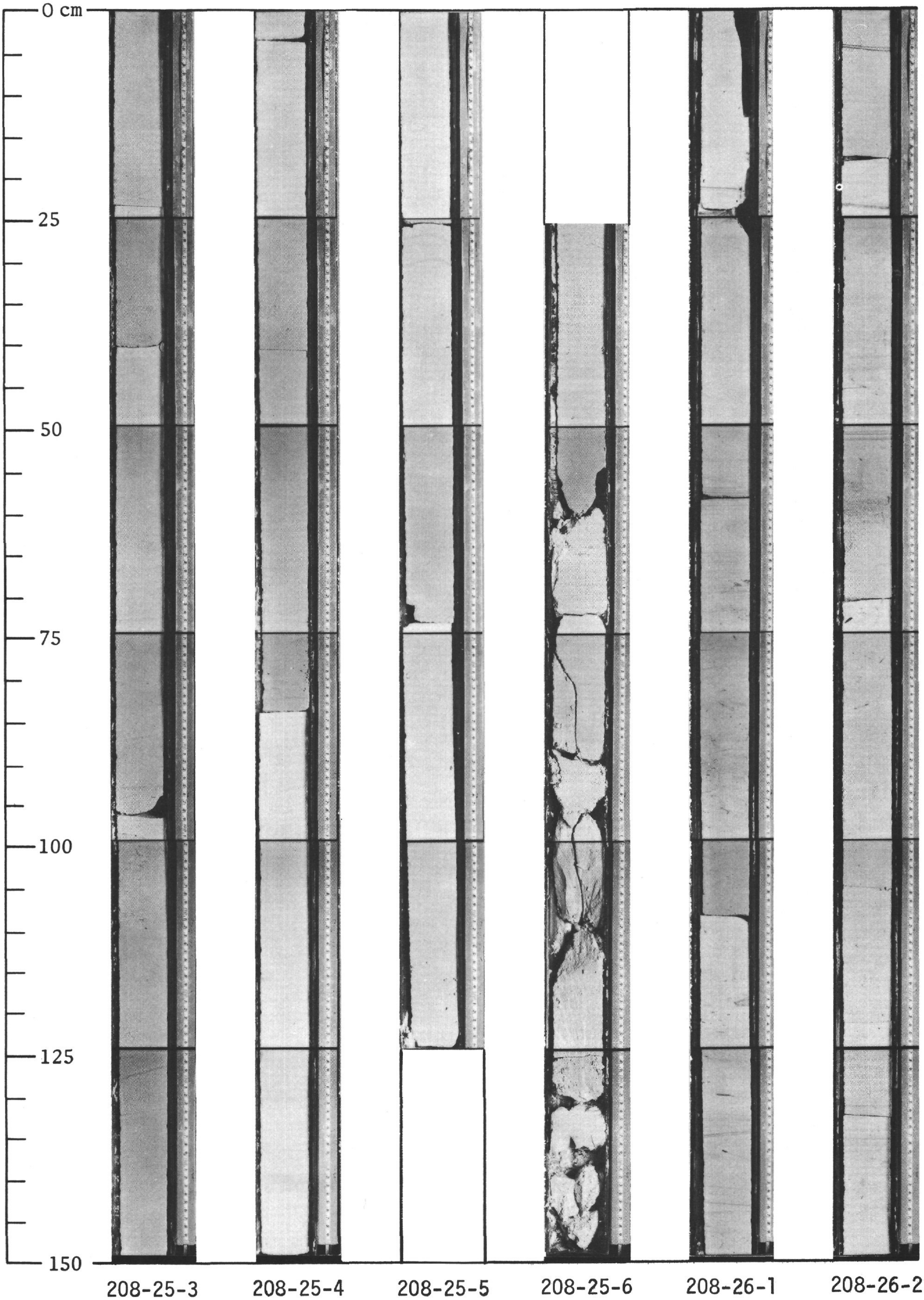
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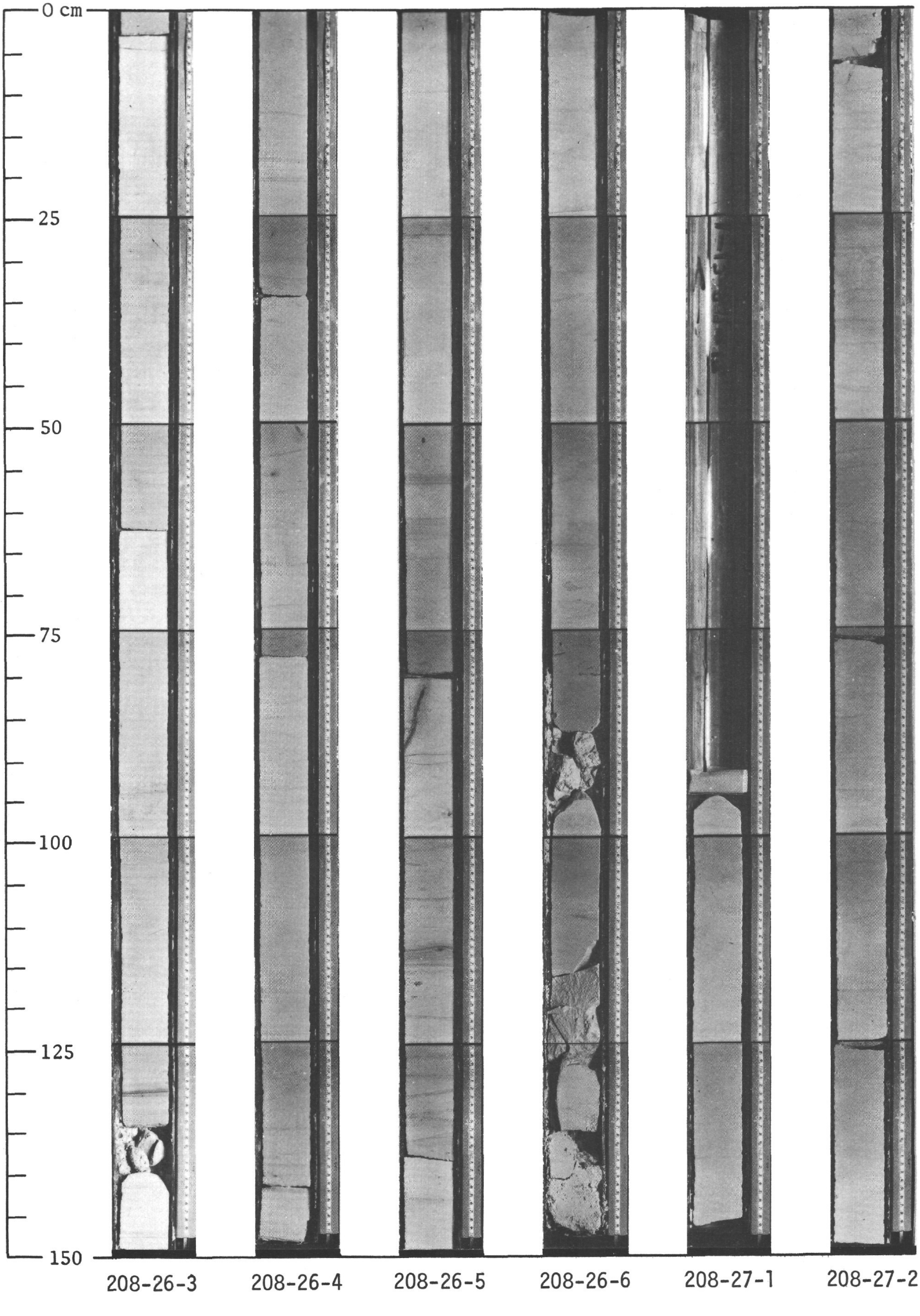
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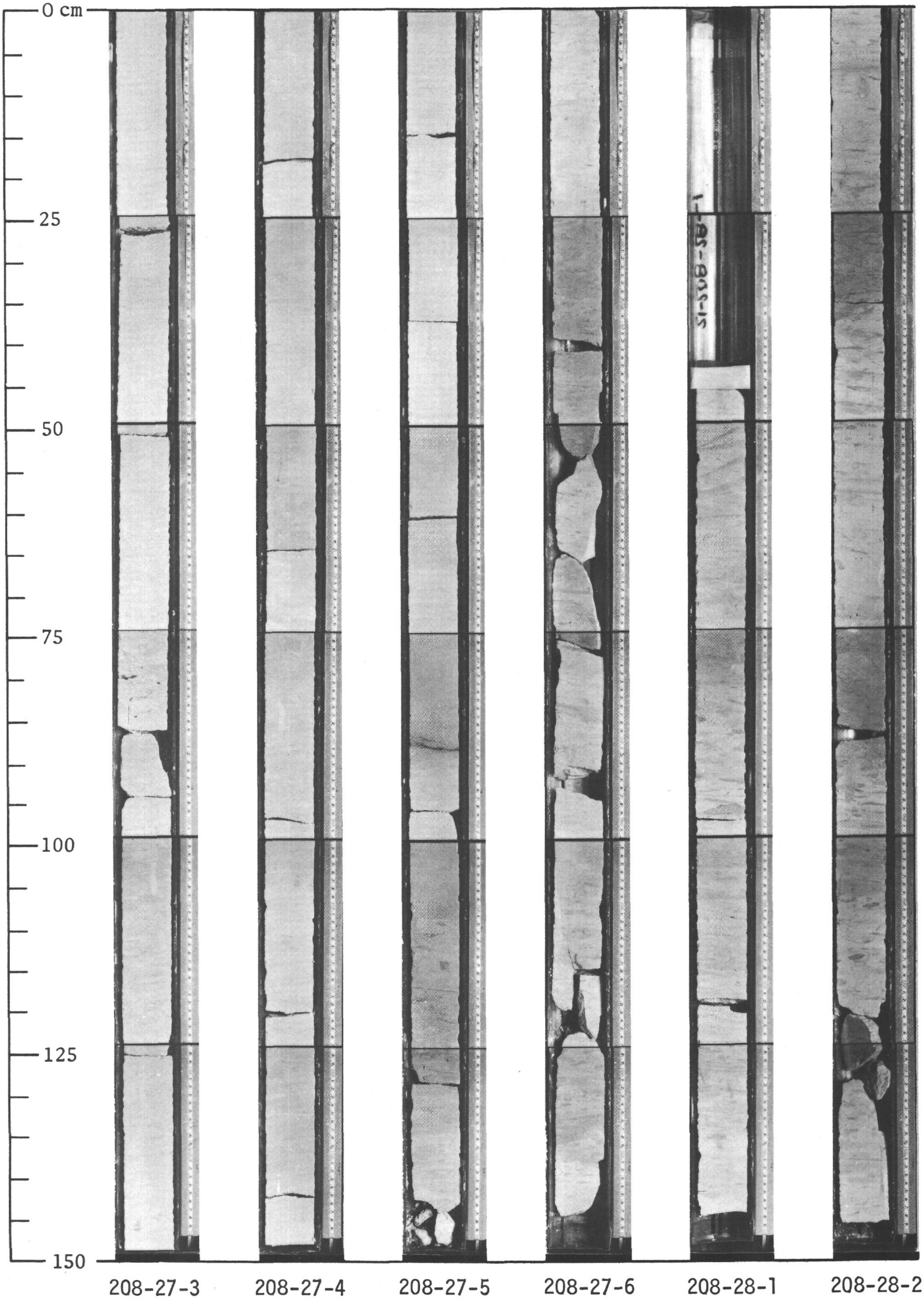
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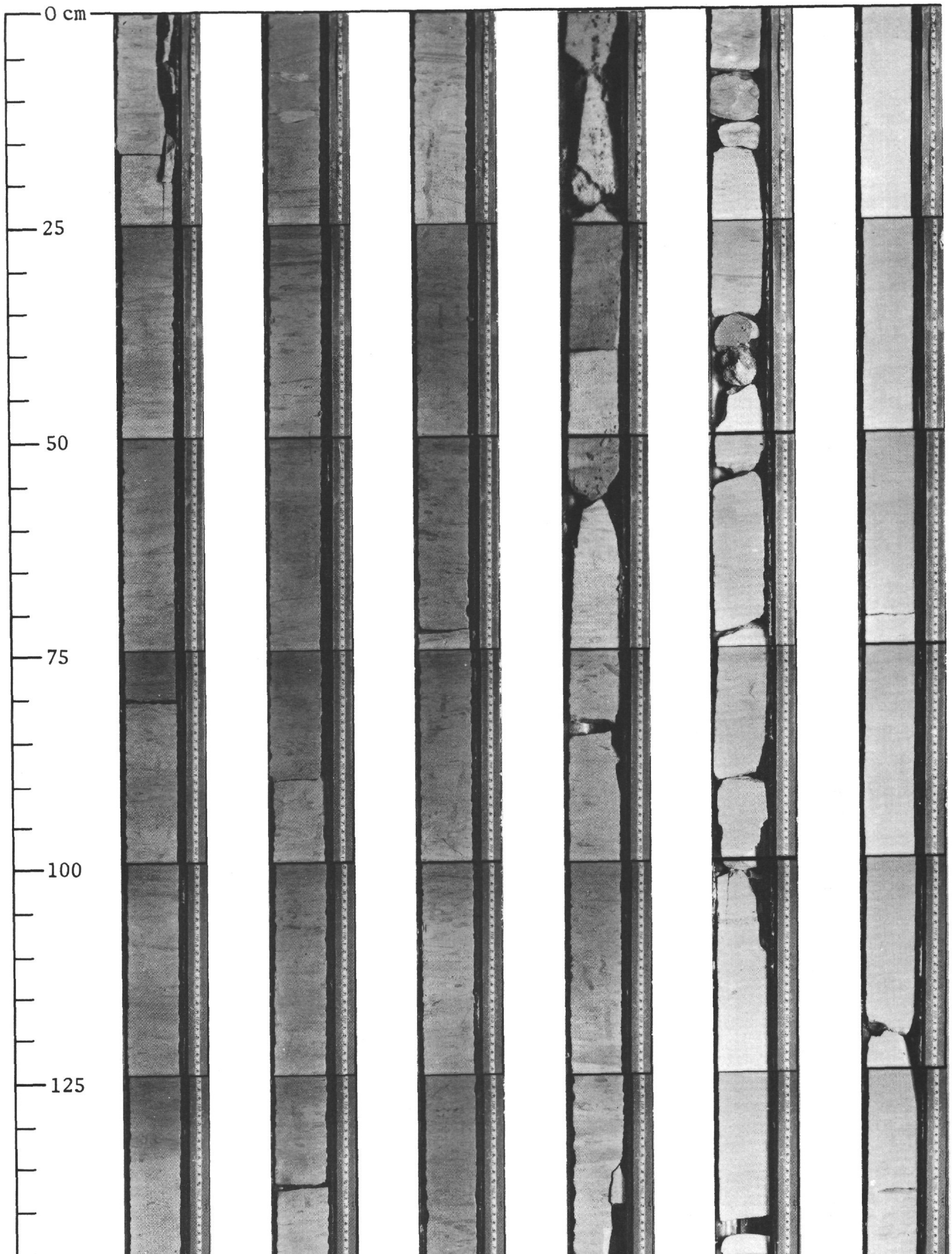

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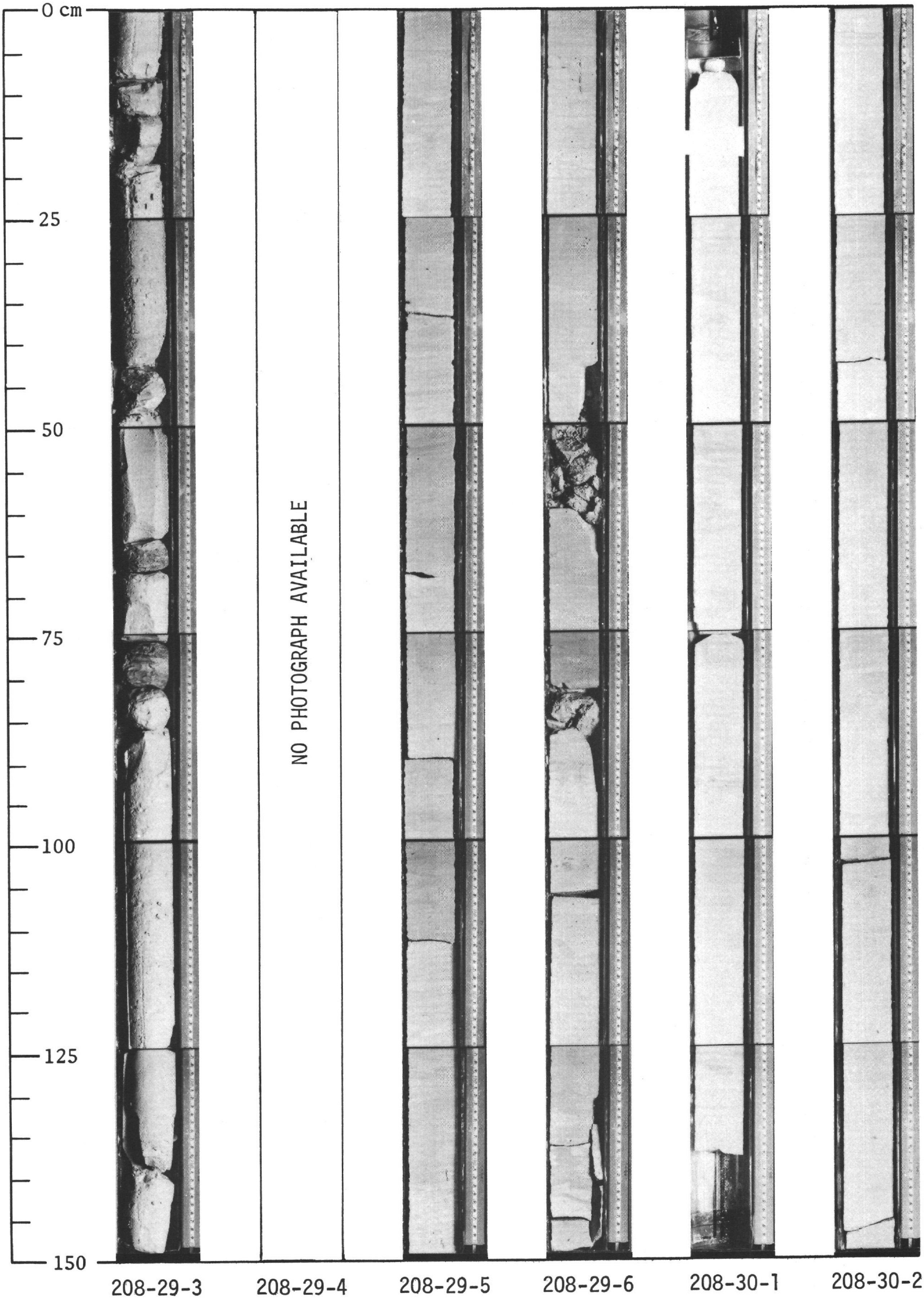
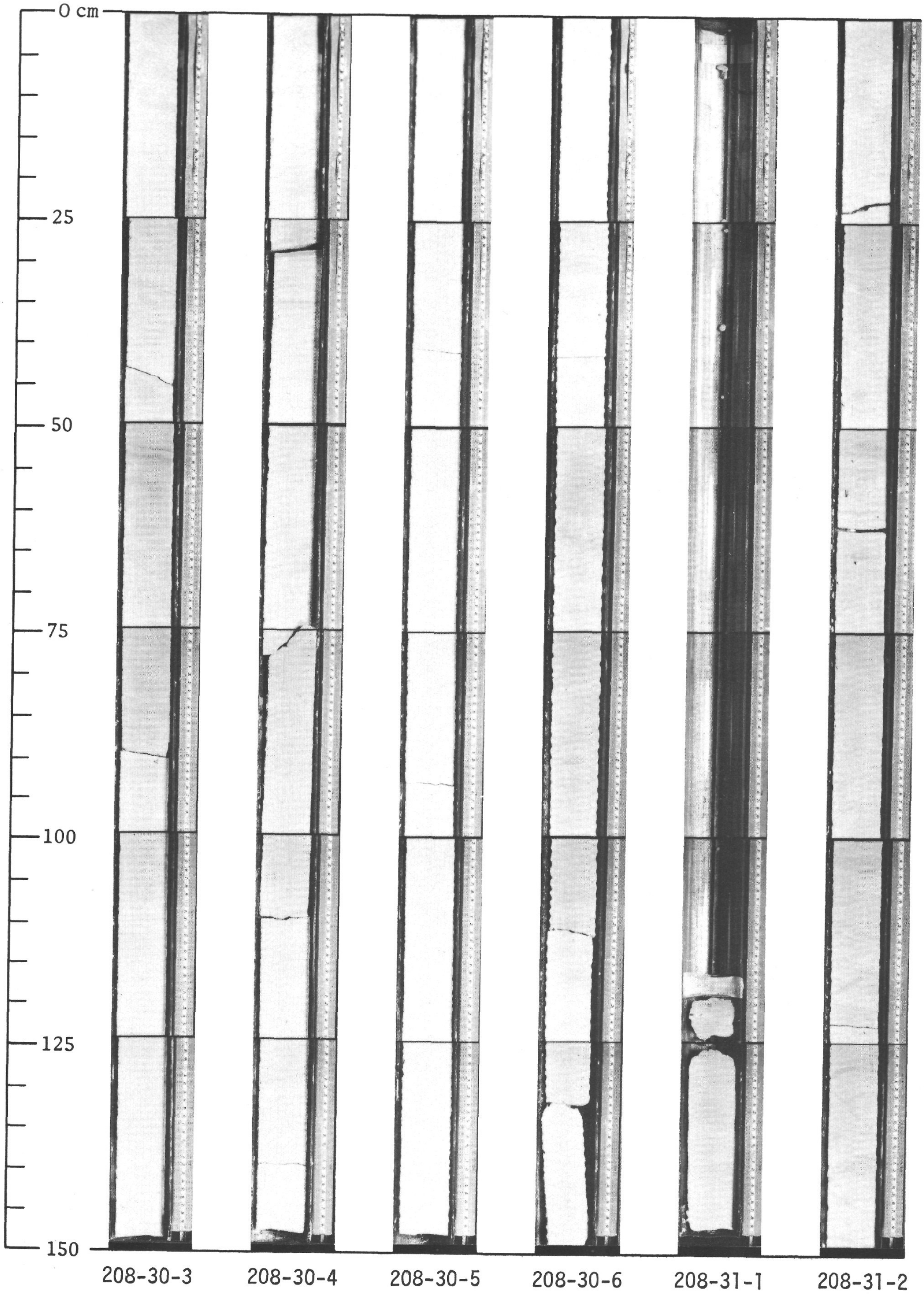
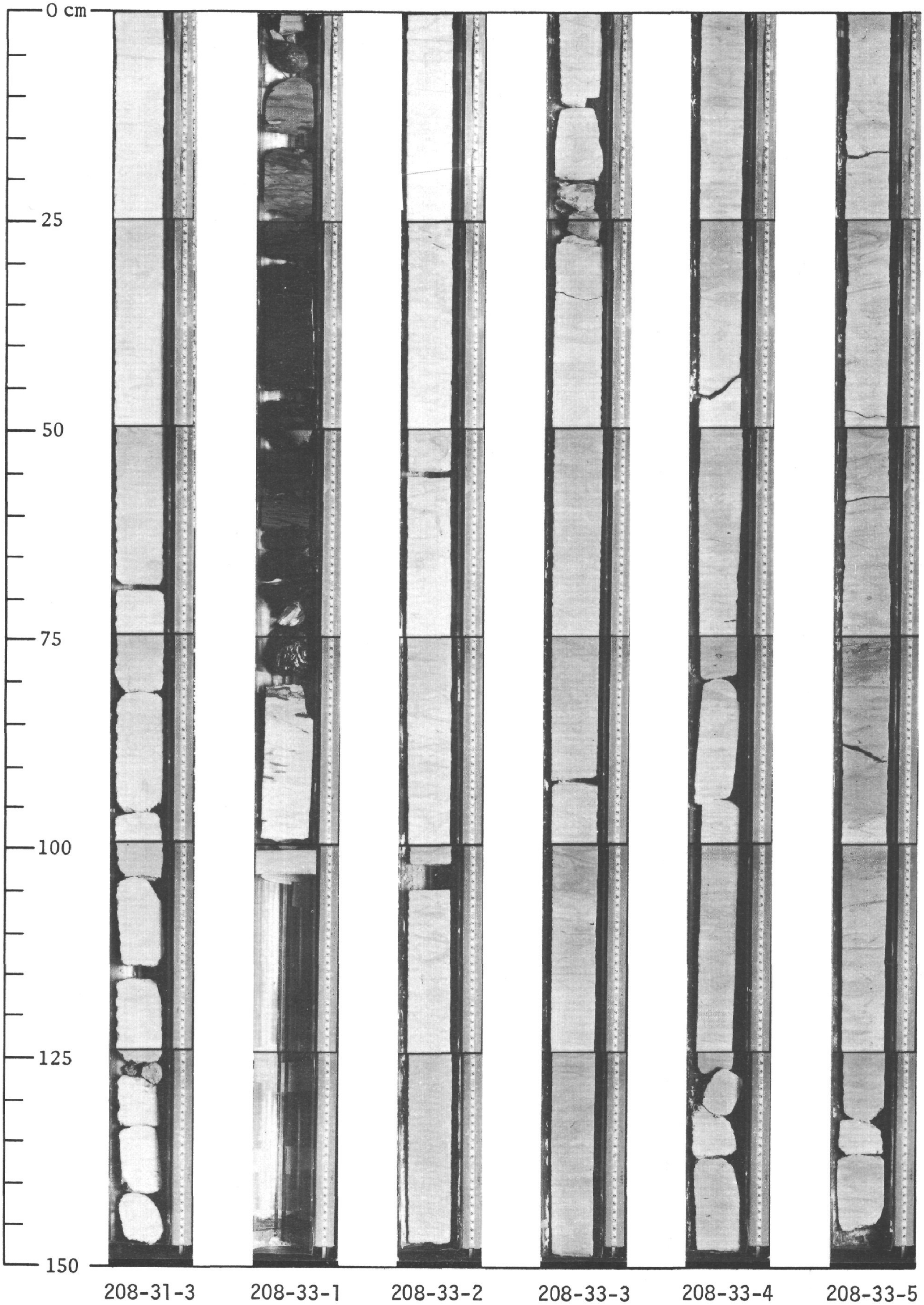
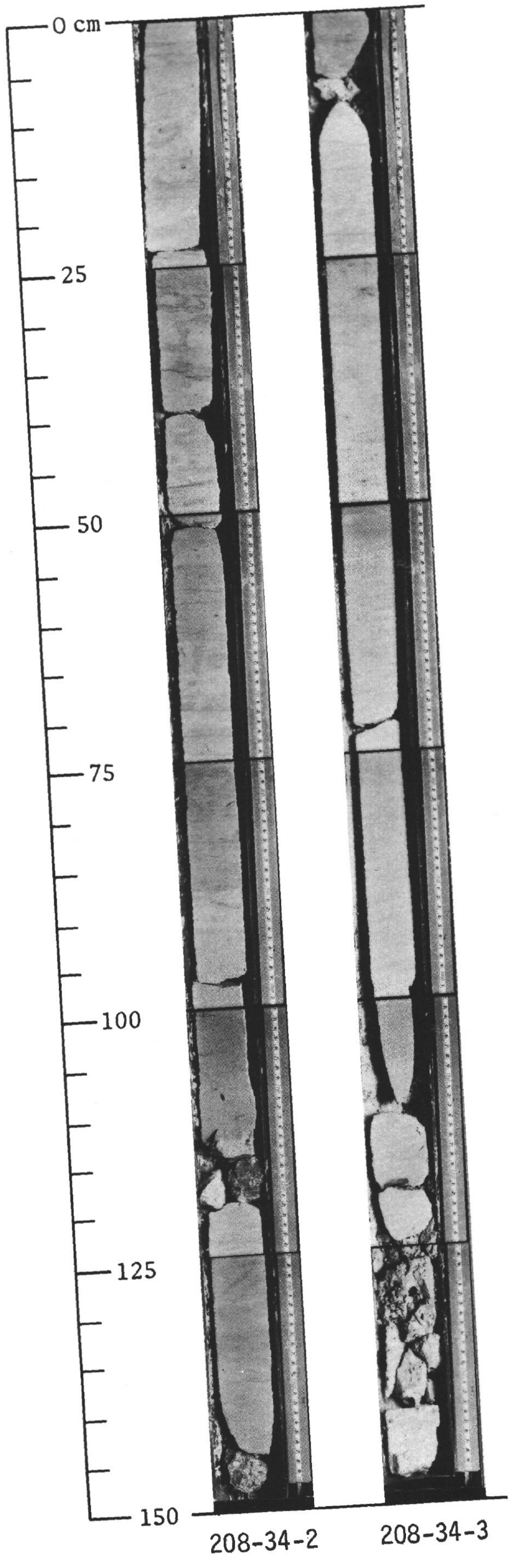
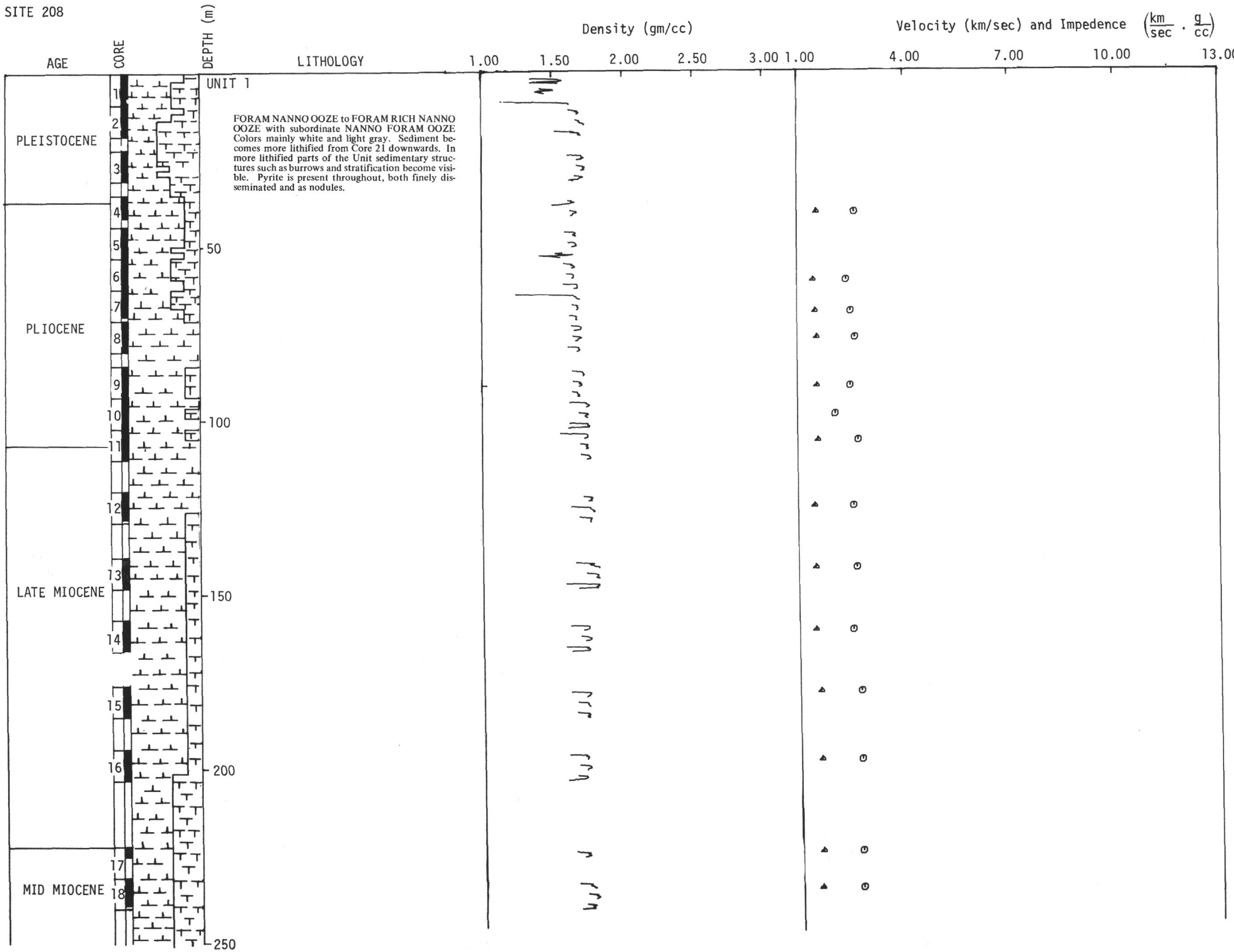
208-29-1
209-29-2


0 cm
25
50
75
100
125
150
NO PHOTOGRAPH AVAILABLE
208-29-3
208-29-4
208-29-5
208-29-6
208-30-1
208-30-2


0 cm
25
50
75
100
125
150
208-30-3
208-30-4
208-30-5
208-30-6
208-31-1
208-31-2

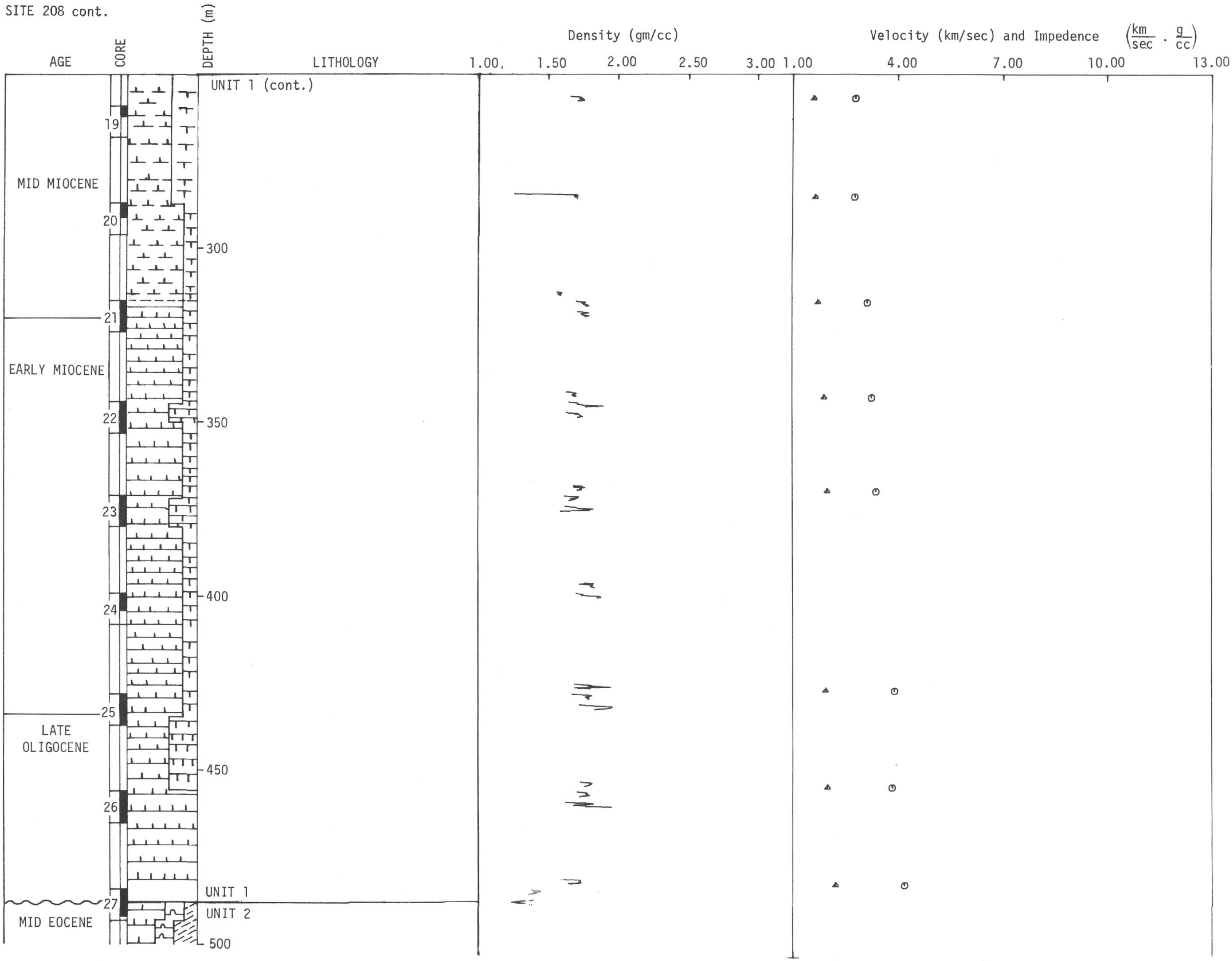

0 cm
25
50
75
100
125
150
208-31-3
208-33-1
208-33-2
208-33-3
208-33-4
208-33-5


0 cm
25
50
75
100
125
150
208-34-2
208-34-3



SITE 208
AGE
CORE
DEPTH (m)
LITHOLOGY
Density (gm/cc)
Velocity (km/sec) and Impedence (km/sec · g/cc)
1.00 1.50 2.00 2.50 3.00 1.00 4.00 7.00 10.00 13.00
UNIT 1
FORAM NANNO OOZE to FORAM RICH NANNO OOZE with subordinate NANNO FORAM OOZE Colors mainly white and light gray. Sediment becomes more lithified from Core 21 downwards. In more lithified parts of the Unit sedimentary structures such as burrows and stratification become visible. Pyrite is present throughout, both finely disseminated and as nodules.
PLEISTOCENE
PLIOCENE
LATE MIOCENE
MID MIOCENE
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
50
100
150
200
250

SITE 208 cont.



SITE 208 cont.