9. SITE 171

The Shipboard Scientific Party[1]
With an Additional Report From
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SITE DATA

Position:
Latitude: 19°07.9'N;
Longitude: 169°27.6'W.

Geography: Horizon Guyot, on a saddle between eastern and western summits.

Water Depth:
2283 meters, by PDR, to derrick floor.
2295 meters, from drill pipe measurement from derrick floor.
2290 meters, adopted.

Dates Occupied: 19-21 May 71.

Time On Location: 56 hours.

Depth of Maximum Penetration: 479 meters.

Cores Taken: 33.

Total Length of Cored Section: 356 meters.

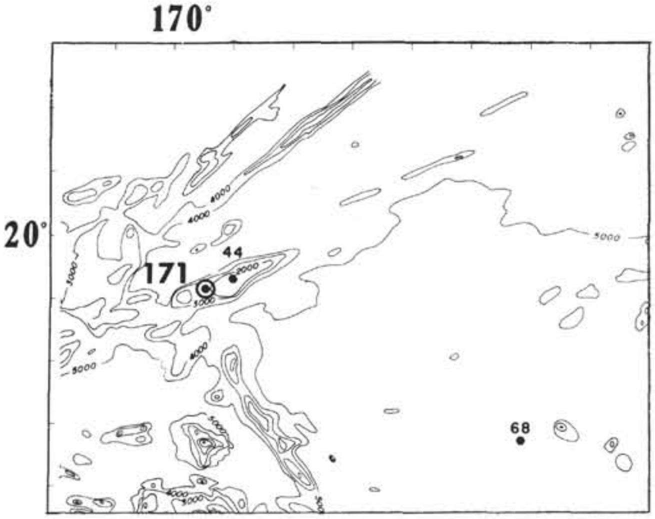
Total Recovery:
Length: 173.3 meters.
Percentage: 48.7.

Percentage of Penetrated Section Cored: 75.

Principal Results: At Site 171, the stratigraphic section consists of 148 meters of middle Eocene to Quaternary calcareous ooze, resting with erosional unconformity on 331 meters of middle Cretaceous to Maestrichtian cherty chalk, volcanic sandstone with plant remains, conglomerate, and detrital limestone with shallow-water fossils. Extrusive basalt occurs at the base of the section and about 140 meters above the base. (See Figure 1.)

BACKGROUND AND OBJECTIVES

An objective of this leg, and of Leg 6 as well, was to drill on or near one of the many guyots of the western Pacific to establish whether or not these features are subsided islands. Dredgings by E. L. Hamilton (1956) produced reef fossils from some of the guyots of the Mid-Pacific Mountains, but similar investigation of other guyots, including Horizon Guyot, had failed to produce any positive evidence that they had ever been at or near sea level (Lonsdale et al., 1972). Horizon Guyot was drilled during Leg 6 of *Glomar Challenger* (Fischer, Heezen et al., 1971), but the drill string was twisted off in Eocene cherts before the deeper part of the sedimentary section had been sampled.



After finishing Hole 170, we had only about three days of station time remaining in the leg, and it was decided that this time would be best spent drilling in the saddle portion of Horizon Guyot. This hole was expected to accomplish the objective of determining whether or not the guyot had been shallow at some time; and because the hole would be drilled in water shallow enough that foraminifera should be well preserved, it was considered likely to be a good site for biostratigraphic studies.

Background information was available in the form of reports of several SIO expeditions in which dredgings, piston coring, and seismic profiling surveys had been done on the main (eastern) peak of the guyot (Lonsdale et al., 1972), and seismic profiles by *R. D. Conrad* and *Thomas Washington*, which showed an appreciable accumulation of sediment in the saddle region.

OPERATIONS

As the previous seismic data in the saddle of Horizon Guyot were recorded on traverses along the axis, *Glomar Challenger*'s approach to the site was designed to show the structure of the sedimentary section in the transverse direction (Figures 2 and 3). On the second crossing of the saddle, a suitable site was picked near the southern lip of the crestal area, where the deepest reflector was at about 0.40 sec below bottom, another prominent reflector was at 0.30 sec, and a lesser reflector could be distinguished at about 0.13 sec reflection time. A medical emergency on

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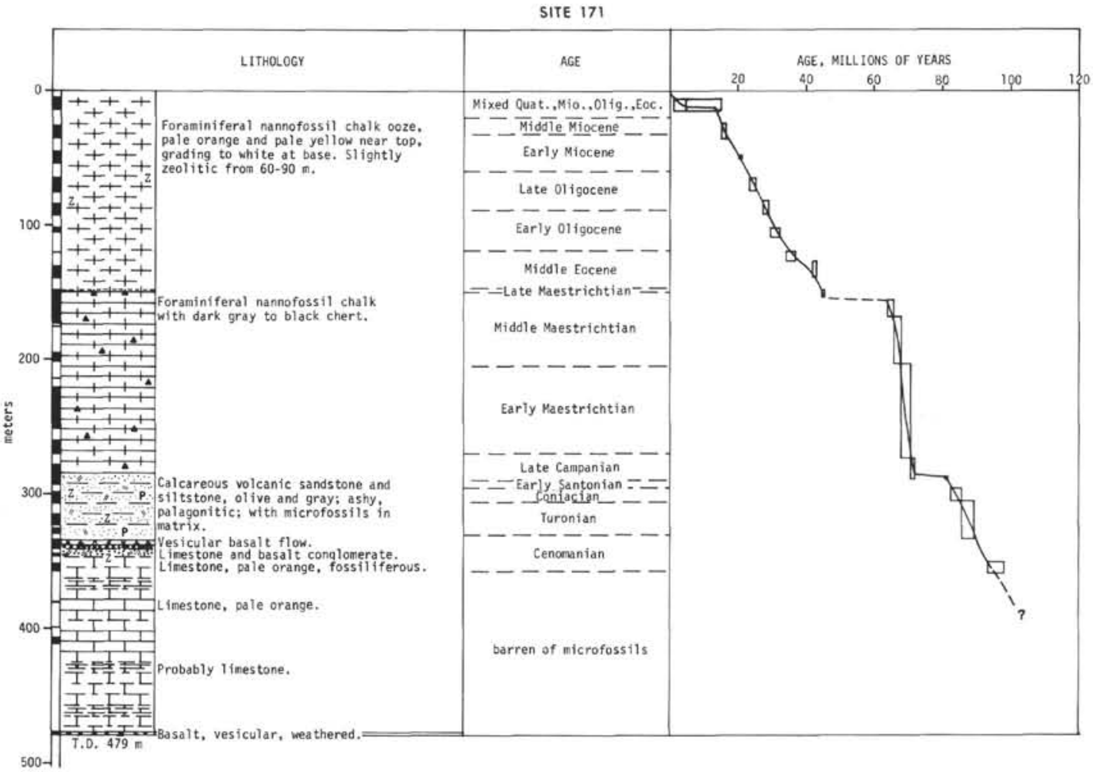

Figure 1. *Graphic log showing lithology, age, and rate of accumulation of sediments at Site 171.*

board caused a delay in starting the hole; and although the ship was later brought back close to this initial site location, the drilled site was rather close in between two peaks or ridges, which created enough complication in the seismic record that we were not certain during the drilling about the depth of the deepest reflector (Figure 2). This uncertainty, coupled with rapidly expiring station time and difficulty in recovering samples, created an unfortunate situation in which the bottom 100-meter interval of the hole may have produced no datable samples.

The hole was spudded at 1830 hours on 19 May 71, and bottom contact was noted on the weight gauge at 2295 meters, 12 meters deeper than calculated from echo sounding. As a compromise, we used 2290 meters as official depth.

Drilling and coring proceeded smoothly and at a good rate to a depth of 335 meters, where a basalt flow was encountered. Core recovery was relatively good in this interval, even though it contained several cherty zones.

The 4-meter basalt flow and a 10 to 12 meter layer of cemented limestone and basalt conglomerate underneath were penetrated in about 4½ hours, with good recovery. Underneath this was a calcareous layer from which only one good core was recovered (352-362 m). Between 362 meters and a basalt layer (basement?) at about 475 meters, every attempt to core failed. The material would wash away if the pumps were used and would stick the drill string if coring was attempted without pumping. With time running out, we decided finally to drill ahead with the core barrel in the string and hope to find something above basement that could be cored. At 464 meters, a drilling break was noticed, so the core barrel was pulled in preparation for trying for a normal core. This barrel contained about 3 meters of limestone chips, apparently cuttings from the drilled interval. The new core barrel was inserted, and the interval between 464 and 479 meters was cored, using the minimum amount of pump pressure considered safe by the drilling crew. This effort gained us a few centimeters of basalt and a few more limestone chips. The hole was reluctantly abandoned, with only faint hope that the limestone chips might contain some datable fossils.

BIOSTRATIGRAPHIC SUMMARY

Three biostratigraphic units were penetrated at Site 171: an incomplete sequence of late Tertiary carbonate ooze; a nearly complete sequence of late Cretaceous carbonates, volcanogenic sediments and basalt; and, a sequence of probably middle Cretaceous bioclastic limestone. An unconformity forms the boundary between the Tertiary and late Cretaceous units and minor stratigraphic gaps or condensed sections occur within each unit. The two units are derived in part from sediments transported from higher on the guyot as evidenced by the reworked or mixed-fossil assemblages and the presence of displaced shallower water benthonic foraminifera and ostracods. The biostratigraphy of the probable middle Cretaceous limestone is poorly understood because of poor recovery and its largely unfossiliferous nature. Molluscan, echinoid, and bryozoan fragments and larger agglutinated foraminifera and ostracods suggest the upper part is of shallow-water origin.

The Tertiary portion of the hole was spot cored and cores were taken at approximately 10 meter intervals between the sea floor and about 138 meters. Portions of

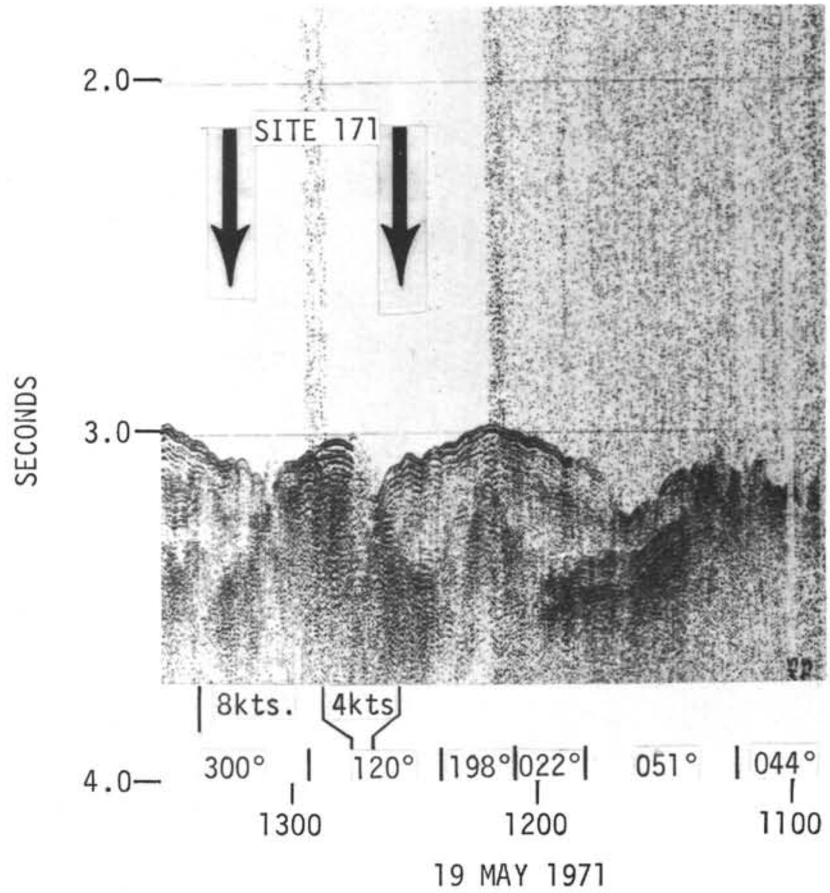

Figure 2. *Seismic profile recorded by* Glomar Challenger *while approaching Site 171.*

the Quaternary, middle and lower Miocene, Oligocene, and middle Eocene were recovered. The upper part of the hole (Core 1) contains a heterogeneous assemblage of mostly middle Miocene nannoflora with some Oligocene and Eocene species, highly mixed Quaternary to late Miocene foraminifera, with rare Eocene and Cretaceous species and no radiolaria, suggesting erosion and transportation of upslope sediments. Early Miocene and Oligocene assemblages (Cores 2 to 7; 27 to 129 m) are more homogeneous, except for the late Oligocene (Cores 4 and 5) which contain a scattering of Paleocene and early Eocene radiolaria and foraminifera. Generally in the Oligocene-Miocene sequence, calcareous and siliceous microfossils are common to abundant and well preserved. Below the Oligocene, however, Radiolaria are poorly represented or absent.

The lower Oligocene appears to rest directly on the middle Eocene which, in turn, rests directly on the Cretaceous. The upper and lower Eocene and Paleocene are missing although reworked microfossils of these ages are common in Cores 8 and 9, Sections 2 to 4 (129 to 153 m). These cores contain a well preserved and diversified calcareous microfauna and flora and a few late Eocene Radiolaria. Presumably the Radiolaria are down-mixed. The foraminiferal assemblage is a mixture of species from middle Eocene three zones (P.12 to P.14) plus numerous reworked early Eocene, late Paleocene, and Maestrichtian species. Nannofossils bracket the cores as within the *Chiasmolithus grandis* to *Nannotetrina fulgens* zones. The numerous reworked Cretaceous and early Tertiary microfossils in the lower part of the middle Eocene cores indicate the Tertiary-middle Eocene rests unconformably on older strata.

A nearly complete upper Cretaceous sequence was recovered in Cores 9 to 26 (153 to 362 m) and includes a thick Maestrichtian to late Campanian section and a thinner and incomplete section of Santonian, Coniacian, Turonian, and Cenomanian. Foraminifera and nannofossils are generally well represented in the Maestrichtian-late Campanian and less abundant and less well preserved in the early part of the Upper Cretaceous. Radiolaria are generally rare and poorly preserved and missing in the Campanian to Coniacian interval (Cores 20 to 23). Species of the *Abathomphalus mayaroensis* Zone occur in Core 9 (late Maestrichtian) and the middle and early parts of the stage are represented in Cores 10 to 19. Late Campanian foraminifera (*Globotruncana calcarata* Zone) and nannofossils (*Tetralithus trifidus* Zone) occur in Cores 20 and 21. At about 287 meters a lithologic change from a chalk ooze to a glauconitic volcanic sand marks a faunal discontinuity and hiatus in Section 1, Core 22. Core 21, CC, and the top 60 cm of Core 22 contains late Campanian foraminifera and nannofossils, but Core 22 below Section 1, 140 to 142 cm, contains middle to early Campanian nannofossils and early Santonian-Coniacian foraminifera. The coarse fraction of

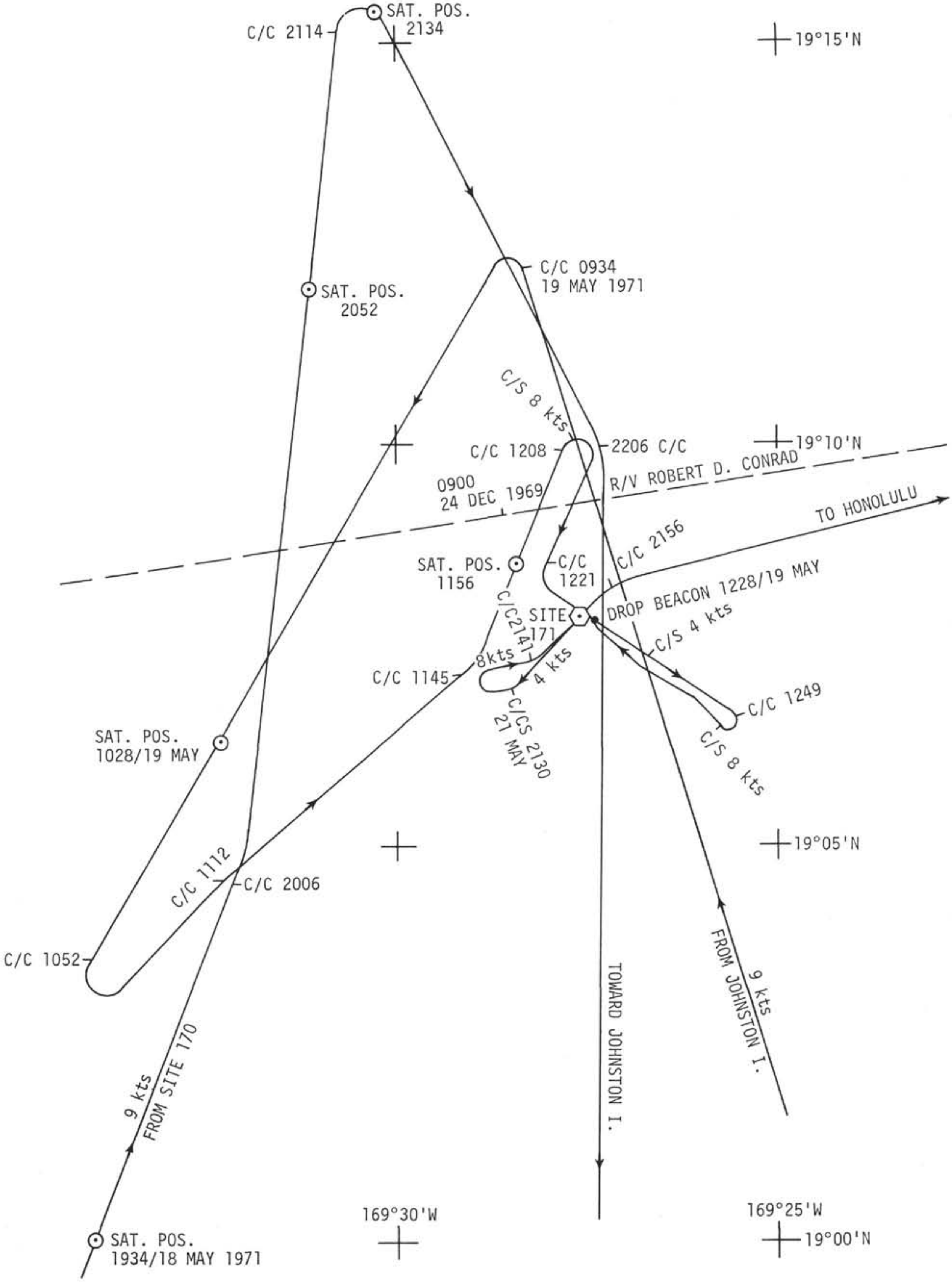

Figure 3. *Tracks of* Glomar Challenger *and* R. D. Conrad *in the vicinity of Site 171.*

Core 22, and of Cores 23, 24, and 25 as well, is volcanogenic fragments, glauconite, and planktonic foraminifera. The microfauna is composed almost entirely of a few globotruncanids which appear to have been winnowed. The apparent age difference between the calcareous microfossil group may indicate the nannofossils were deposited at a later time. Poor preservation and poor core recovery make it difficult to precisely interpret the biostratigraphy of the Santonian to Cenomanian, Cores 23 to 29, but the section is believed to be complete except for perhaps portions of the Cenomanian. Below Core 26, calcareous nannoplankton are lacking and planktonic foraminifera occur only in Core 29. The latter consist of a few poorly preserved late Cenomanian *Hedbergella*. The limestone, of probable shallow-water origin, in Cores 29 to 31, contains ostracods, the large agglutinated foraminifera *Cuneolina* and molluscan debris of probable Cenomanian age. No recognizable fossils were found in Cores 32 or 33.

Uncorrected accumulation rates determined for the hole yielded the following values: 4 m/m.y. for the Tertiary, 22 m/m.y. for the Upper Cretaceous, and 3 m/m.y. for the Middle Cretaceous.

Palynology

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About a dozen Leg 17 samples, mostly from Site 171, were processed for palynomorphs. Only four samples from Core 16 at Site 171 contained organic-walled microfossils.

Core 26, Section 1, 80 cm.
Some plant debris consisting mostly of cuticle and woody fragments. Common microforaminifera (the chitinous inner linings of certain foraminiferids). Also recovered were three nondiagnostic pollen grains and two poorly preserved dinoflagellates bearing a vague resemblance to *Operculodinium israelianum* (Rossignol). Highly questionable *Ophiobolus* also present.

Core 26, Section 1, 123 cm.
Generally similar to above. Aside from microforaminifera, one tricolpate pollen grain and one trilete spore were also recovered (both nondiagnostic). In addition several dinoflagellates resembling *O. israelianum* and a couple of *Spiniferites* sp. were recovered. Highly questionable *Ophiobolus* present.

Core 26, Section 2, 102 cm.
Similar to the preceding samples but with more sapropel. Recovered microfossils include one disaccate "pine" pollen, one dinoflagellate specimen resembling *O. israelianum*, and one specimen resembling *Baltisphaeridium bifidum* Clarke and Verdier. One scolecodont recovered.

Core 26, Section 2, 129 cm.
Barren except for plant debris and microforaminifera. Much more sapropel present than in the previous sample.

No age can be assigned to any of these samples except to say that they are not older than about Cenomanian.

The reason for the scarcity of palynomorphs in the sediments recovered during Leg 17 is probably the great distance from land. Rich assemblages of organic-walled microfossils have been found in deep-sea sediments (e.g., Habib, 1968, 1970, 1972; Wall, 1967) but they were invariably from localities which are relatively close to large land masses.

LITHOLOGIC SUMMARY

Site 171 on Horizon Guyot contains volcanic and calcareous rocks of Cretaceous and Cenozoic age. Core recovery ranged from good to poor, and the depths to some of the contacts listed below are placed to agree with the drilling record. An interpretation of the lithology of the stratigraphic column follows:

1) Upper calcareous group – chalk ooze (0-148 m); chalk ooze and chalk, with chert (148-287 m).

2) Middle volcanic and calcareous group – calcareous volcanic sandstone, siltstone, and mudstone (287-330 m); basalt flow (330-338 m); limestone and basalt conglomerate, and hyaloclastite (338-345 m).

3) Lower calcareous group – probably mainly limestone (345-479 m);

4) Basement – basalt (479 m).

The highest lithologic unit at this part of Horizon Guyot is calcareous ooze. Mainly it is a foraminiferal nannofossil chalk ooze, except for the uppermost few meters where foraminifers are more abundant by volume than nannofossils. The upper part is barren of radiolarians, but radiolarian remains comprise a few percent of the ooze throughout the lower section. Traces of golden yellow silt-sized glass shards are present in Cores 1 through 4. The middle of the section is characterized by 15-micron, slender spindles of clinoptilolite. Pyrite occurs sparingly at several levels. The ooze generally lightens in color value with depth, from yellowish gray and pale orange near the surface to white at Core 8. For the most part the ooze has been strongly disturbed during coring, but the less disturbed portions are slightly mottled and streaked with white and gray.

The limits of the cherty calcareous interval are placed at 148 meters depth, the top of Core 9 containing the highest fragments of chert, and at 287 meters depth, the bottom of Core 21, where the drilling rate changed markedly and the highest volcanic sandstone was recovered. Down to about 222 meters the main rock type, like the overlying unit, is white foraminiferal nannofossil chalk ooze. Below that depth much of the calcite has been recrystallized, binding the fossils into foraminiferal nannofossil chalk. Traces of pyrite, glauconite, and light and dark glass are present in these rocks.

The chert in Core 9 down into the upper part of Section 5 is translucent and colorless to pale blue and gray, whereas the chert at the base of Core 9 and in lower cores is darker shades of brownish black and grayish black. The light chert is middle Eocene, and the dark chert is Cretaceous. The fast drilling rates and the high proportion of chalk and ooze to chert in the sediments recovered in cores indicate that chert beds or nodules are thin and few in number. The relatively weak and discontinuous appearance of seismic reflectors at this interval (Figure 2) supports this conclusion that chert is only a small fraction of the total section.

Between 287 and 345 meters volcanic rocks are dominant. The highest of these is a series of generally well bedded calcareous sandstones and siltstones. The overall olive gray colors and salt-and-pepper aspect of the rocks result from the black, brown, and green grains of basalt, palagonite, glass, and glauconite in the matrix of white nannofossils and foraminifers. Sparry calcite cements these rocks. Clays, analcime, and clinoptilolite are common alteration products of the volcanic grains. The lower part of the section also contains bluish gray mudstones and waxy claystones, some of which show slump features in the bedding. The rocks presumably formed by reworking on the guyot by currents and slumping of one or more piles of hyaloclastite debris from nearby basaltic eruptions and their admixture into the topographic depression at Site 171 with pelagic and benthic calcareous oozes. The lowermost several cm probably is hyaloclastite in place on the underlying basalt flow.

The basalt in the core catcher of Core 26 and in the upper sections of Core 27 is at least 3 meters and may be as much as 8 meters thick, depending on the interpretation of the recovery in those cores. It is dark gray, with abundant veinlets and amygdules of zeolite, celadonite, calcite, and montmorillonite. Although highly altered, its trace-element composition resembles that of tholeiites from spreading ridges.

At about 338 meters depth the flow lies on a conglomerate of limestone and basalt pebbles and small cobbles. The limestone pebbles are highly distinctive, composed of light brown, slightly foraminiferal micrite with small cavities that are the external molds of an assemblage of tiny molluscs. The limestone probably formed in a shallow lagoon. The basalt pebbles and cobbles are rounded and soft from strong weathering. Their highly vesicular nature points to shallow, if not subareal eruption. The matrix of the conglomerate is composed of smaller pebbles and sand of limestone, basalt, and ash, and all is cemented with sparry calcite. The conglomerate seemingly was a talus of shallow-water debris that was dislodged during the mid-Cretaceous volcanic episode.

The hyaloclastite of Core 28 apparently marks the onset of volcanism, unless deeper tuffs or hyaloclastites exist that were not cored and recovered. Grains of the altered glass range up to 2 cm in diameter, are cemented with calcite, and are partly altered to palagonite, clay minerals, and zeolite. Colors range widely across yellow, gray, green, and orange hues. Part of the bedding is graded; some grading is normal from coarse up to fine, and some reversed from fine to coarse.

There was very little recovery in the deepest cores, but the rock that was recovered all appears to be one type of limestone. Therefore, we tentatively interpret the section between 345 and 479 meters as being a single stratigraphic unit. The material recovered is cuttings from the bit, so that it now is a coarse sand to fine gritty gravel of angular, 1 to 4 mm grains of limestone. Only about 5 percent of the total interval was recovered and drilling generally was rapid, so there may have been softer lithologies that were washed away. Most of the micropelsparite and micrite limestone fragments are pale orange to gray and are composed of recrystallized calcite that shows external molds of molluscs, echinoid spines and ossicles, and ostracods, as well as recrystallized algae fragments. Some of the cuttings contain euhedral dolomite rhombs to 0.3 mm in diameter, and some are fragments of mollusc shells and echinoid skeletal remains.

At 479 meters the drilling rate slowed markedly and the core catcher of Core 33 contained several pieces of basalt below a few chips of limestone. Most of the basalt is brown, vesicular, and deeply weathered. The largest and lowest piece in the catcher seems fresher, as it is denser and grayer than the others. These rocks probably are the basement at Site 171.

In contrast to the basalt of Cores 26 and 27, the basalt at the bottom of the hole has a trace element composition indicative of the tholeiitic basalts of oceanic islands. Plagioclase and clinopyroxene predominate; montmorillonite is pseudomorphic after olivine.

Carbonate Petrography and Paleoecology

The upper 287 meters at this site are represented by normal calcareous oozes and chalks. The section from 0 to 148 meters is foraminiferal-nannofossil ooze; in the upper few meters foraminifera dominate over nannofossils. The upper part is lacking Radiolaria, whereas these fossils make up a few percent of the sediment lower in the section. Golden yellow, silt-size glass fragments are present in the upper four cores and zeolites are present in the middle of the section; pyrite was noted at several levels. The sediments are slightly mottled and streaky. At 148 meters the highest chert was encountered and the calcareous sediments are similar to those in the upper levels. Below 222 meters the oozes have been transformed to chalks containing traces of pyrite, glauconite, and light and dark glass. These sediments are much like the pelagic carbonates drilled throughout the region and are not dealt with in detail here except for the description of a sample from Core 21(CC) which is representative of the chalk section. Instead, attention was directed to the bioclastic limestones of shallow-water origin recovered below 287 meters.

Nannofossil-Foraminiferal Chalk

Sample 21(CC) is typical of the chalks recovered in the upper part of the section. The presence of a trace of volcanic silt- to sand-size material was noted in thin section. This includes fretted and altered plagioclase, pyroxene, chlorite, and brown gold palagonite. This material is randomly scattered throughout the rock. The organic contributions include planktonic foraminifera, approximately 60 percent of the rock, among which are globigerinids and uniserial and biserial forms. Locally these form an intact framework; elsewhere these tests float in a matrix of nannofossil chalk. The foraminifera range in size from 0.025 to 0.25 mm in diameter with rare forms up to 0.5 mm. The tests are not collapsed and the sediment does not appear to have undergone a great deal of compaction. The cell walls are fairly well preserved and individual pores are distinguishable. Tests are both filled and empty in seemingly random fashion. Locally they are partly to completely filled by very fine-grained black manganese minerals. Elsewhere blocky calcite and very fine-grained drusy calcite form the fillings.

Limestone Fragments in Reworked Hyaloclastics

In Sections 27-3 and 27-4 angular to rounded clasts of light brown, dense, very fine-grained limestone rich in small gastropods and peleocypods of shallow-water origin (H. S. Ladd, written communication, July, 1972) are abundant. Section 27-4, 15 to 20 cm, contains a typical rounded cobble of limestone in the conglomerate matrix of reworked hyaloclastic fragments. In thin section the rock is revealed as a molluscan biopelsparite. Whole and fragmental remains of small pelecypods and gastropods (plus ostracods?) are embedded in a matrix made up of fragments of green or blue green algal remains, foraminiferal tests, and unidentifiable, probably pelletal, material. All of these elements are firmly cemented by very fine-grained calcite mosaics (Figures 4, 5, 6, 7, 8, 9, 10). The molluscan shell fragments are present in two degrees of preservation.

1) Preserved shell walls in which the original fibrous texture of the shell is still well preserved (Figure 6). The cavity within the articulated valves is filled in part with pelsparite and in part by coarse crystalline mosaics of infilling calcite. These mosaics have not grown into and replaced the shell walls; they are clearly void-filling cements deposited after partial filling of the shell by fine-grained pelletal and foraminiferal debris.

2) Other shells have been completely replaced. In this mode of preservation the shell structure (Figure 7) has entirely disappeared and its original form is only roughly preserved as a coarse-grained calcite mosaic. The boundary between the former shell wall and the surrounding pelsparite and the pelsparite in the cavity fillings is irregular. The majority of the shells seen show this second form of preservation. The state of preservation is interpreted as the result of complete solution of the shell followed by an infilling and subsequent further growth of calcite.

The finer grained matrix holding these shells is made up of a well-sorted intact framework of small thin-walled benthonic foraminifera and ovoid and circular pellets. These range from 30 to 100 microns in diameter. The pellets and bioclastic debris are cemented by a pervasive mass of anhedral calcite mosaics in which the individual grains range from 5 to 10 microns in diameter. The foraminifera include miliolid types and uniserial and biserial forms. Scattered throughout this well-sorted material are elongate fragments that show the internal structures of green algae. They are poorly preserved and have been largely replaced by anhedral mosaics of very fine-grained calcite (Figure 4). Rare echinoid spine and ossicle fragments are also present. At 82 to 83 cm in this core a fragment, 2 by 5 cm, of a large mollusc shell was recovered, also firmly cemented in the hyaloclastite conglomerage. In thin section (Figure 8), the internal shell structure suggests that it is probably a fragment of a heavy-shelled oyster (H. S. Ladd, written communication, July, 1972). The shell is partly coated with limestone identical to the matrix of the biopelsparite described above. This indicates that the oyster was probably part of the fauna that contributed to the formation of the limestones found in the hyaloclastite. These biopelsparites with their molluscan fauna formed in a shallow-water environment. They were subjected to a subaerial solution process that dissolved the original shell material in most cases and caused the cementation of the sediments into limestone. These limestone fragments were then eroded from a subaerial terrane and redeposited in the hyaloclastite. Beginning with Core 29, the drill penetrated

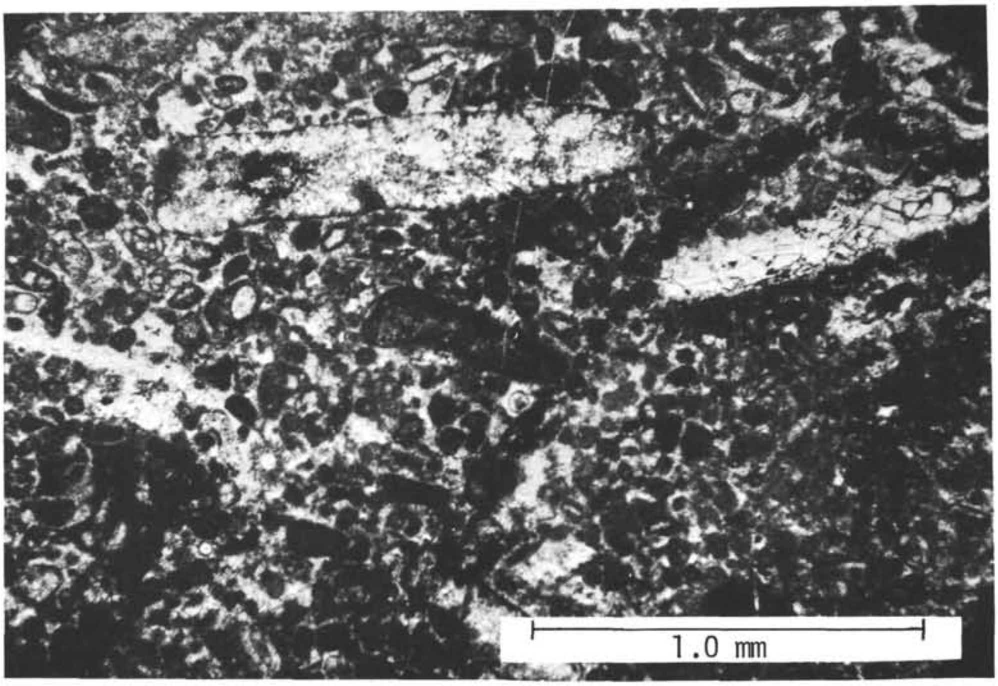

Figure 4. *Limestone of Cretaceous age. Thin section photomicrograph of molluscan biopelsparite from Sample 171-27-4. Large, recrystallized fragments of green algae are in a finer grained matrix of well-sorted pelletal and foraminiferal debris. The cement is a fine-grained mosaic of calcite.*

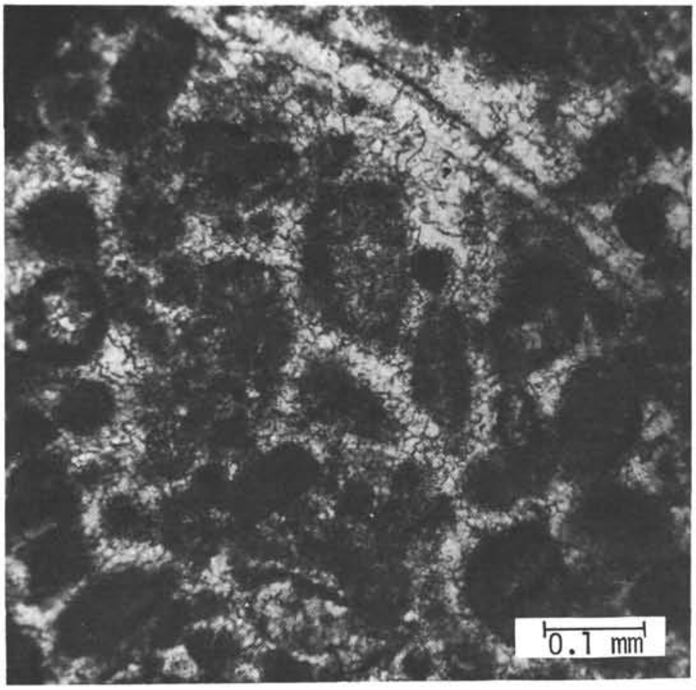

Figure 5. *Limestone of Cretaceous age. Thin section photomicrograph of pelsparite matrix. The individual pellets and foraminiferal remains show blurry boundaries and are shot through with calcite. The cement is seen to be anhedral calcite that has completely permeated the rock.*

only limestone until a few rounded, highly weathered pieces of vesicular basalt were recovered in Core 33, at which point the hole was completed. Only fragments of limestone were recovered in Cores 29 through 32 and most of the material was sand- and granule-size pieces evidently ground up during drilling and recovered only as cuttings. In Core 29 a few pieces, up to 2 cm in diameter, are gray to buff, very friable limestone with molds of pelecypods and gastropods. The voids produced by the solution of the original shells have been partly filled by drusy calcite. Club-shaped, stubby fragments of echinoid spines resisted solution. Smear slides of the finer fraction of the cuttings show an abundance of micritic and sparry calcite. In Core Catcher 30, the limestone fragments are very pale orange, chalky, and calcite cemented. Abundant cavities formed by the solution of molluscs, including high-spired gastropods up to 6 mm long, are present.

The limestone recovered in Core Catcher 32 had been ground during drilling into 1 to 4 mm chips. Thin sections were made of these chips by impregnating masses of them. The chips are both rock fragments and individual pieces of skeletal debris broken out of the rock during drilling. Representative descriptions of these rock types and faunal and floral elements contained in them are listed below:

1. Rock fragments.
   a. Pelletal limestone (micropelsparite) identical in texture to Sample 171-27-4.
   b. Micritic limestone containing recrystallized bioclastic debris. Some micrite fragments contain euhedral crystals of clear dolomite.
   c. Individual crystals and clusters of crystals of euhedral dolomite up to 0.3 mm in length.
   d. Masses of anhedral calcite mosaics.
   e. Calcarenites composed of sand size, 0.5 mm in diameter, bioclastic debris in a fine-grained mosaic of anhedral calcite.
2. Skeletal debris.
   a. Coralline algal (Figure 10). Hemispheric and digital masses showing poorly preserved cellular structures.
   b. Spines and plates of echnoids. These have been impregnated with calcite cement and show optically continuous overgrowths of calcite that have irregular boundaries with an enclosing micritic matrix.
   c. Strongly recrystallized, poorly preserved fragments of green algae.
   d. Fragments of mollusc shells up to 1 mm in diameter. The internal structure of these indicates that they are chips of large molluscs.

These limestones are pure and no volcanic material was noted. Evidently, during the deposition of these limestones, neither vulcanism nor erosion of volcanic terranes contributed any sediments.

Paleoecology and Geologic Events at Site 171

The following geologic events indicated by the lithology of the cores recovered from Site 171:

1. Eruption of shallow-water or subaerial basalts in pre-Cenomanian time (Core 33).

2. Deposition of 134 meters of shallow-water limestone. Algal reefs may have existed with associated lagoonal facies. This period was one of subsidence extending into Cenomanian time (Cores 32 to 29). The moldic porosity

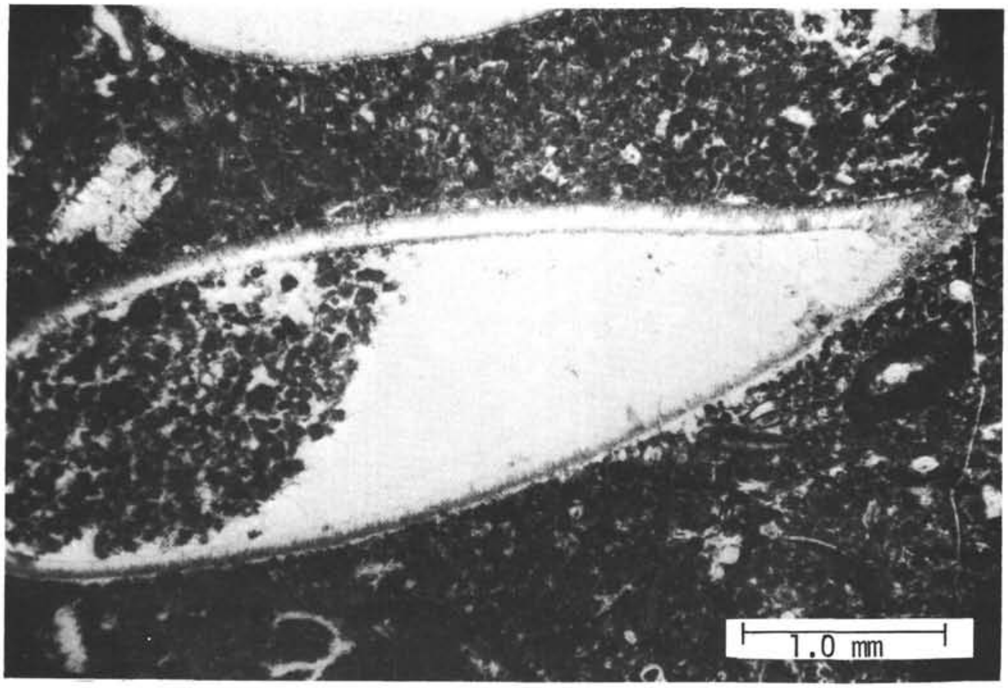

Figure 6. *Limestone of Cretaceous age. Thin section phogomicrograph of Sample 171-27-4. Mollusc shell still shows the original fibrous texture and a previous partial filling of the pelletal and foraminiferal debris.*

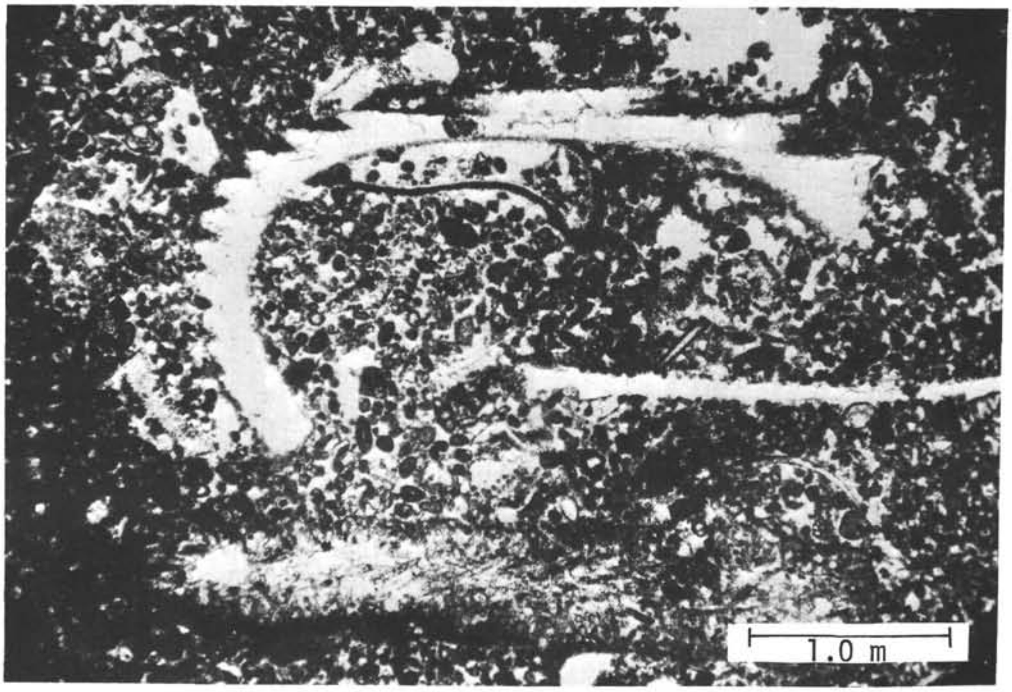

Figure 7. *Limestone of Cretaceous age. Thin section photomicrograph of Sample 171-27-4. Completely replaced mollusc shell and fragment of green algae (?) are embedded in pelsparite limestone. None of the original mollusc shell is present; it has been replaced by a calcite mosaic.*

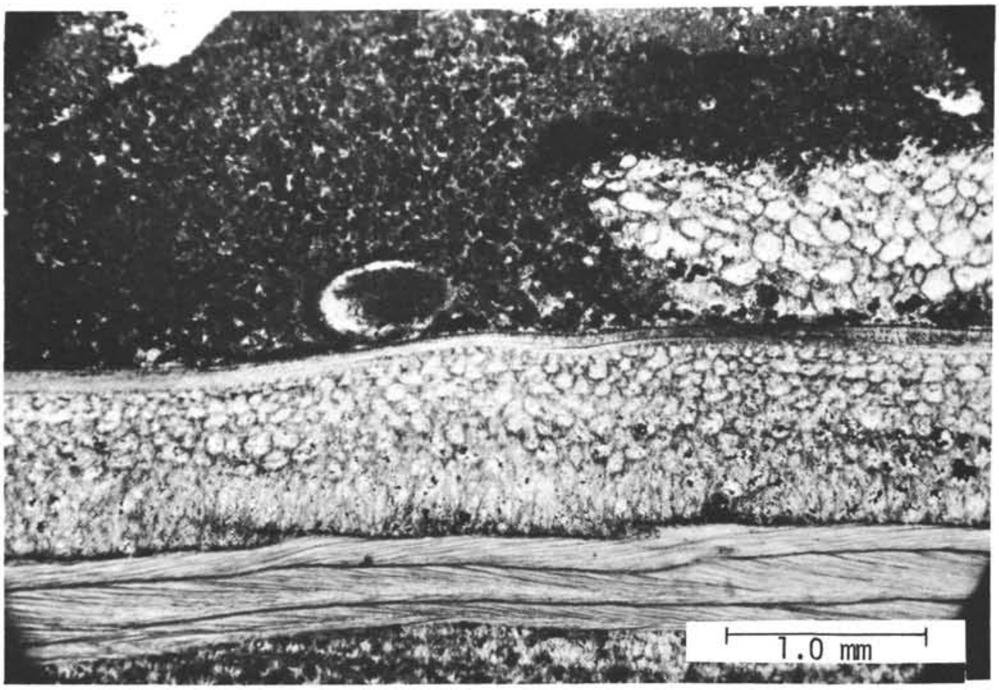

Figure 8. *Fragment of large oyster shell recovered in hyaloclastite conglomerate in Section 27-4. The shell structure is well preserved. Coating the shell is a mass of encrusting foraminifera or bryozoa (upper right) and limestone similar to that described from other parts of Section 27-4.*

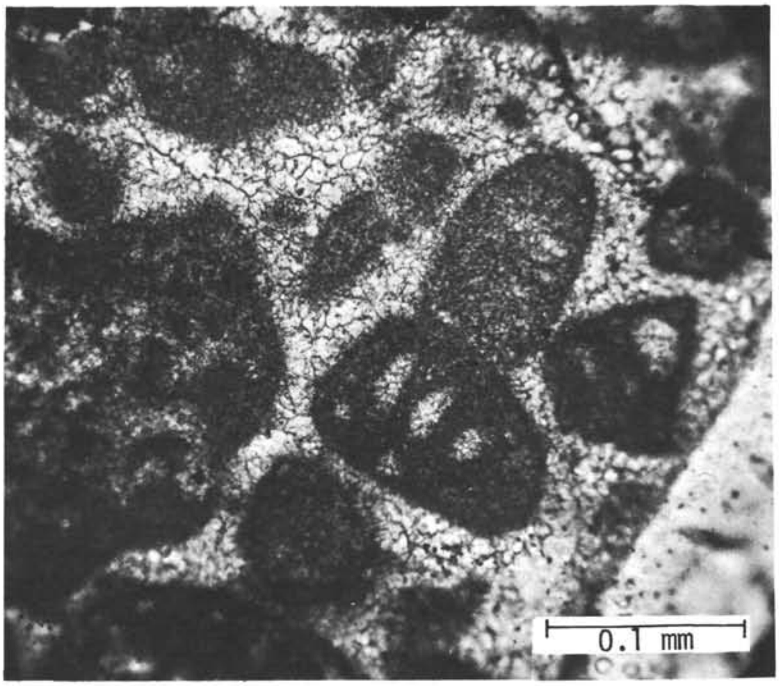

Figure 9. *Limestone of Cretaceous age. Thin section photomicrograph of fragments of drill cuttings recovered in Core 32 showing similarity to texture of limestone fragments found in hyacloclastite conglomerate in Section 27-4.*

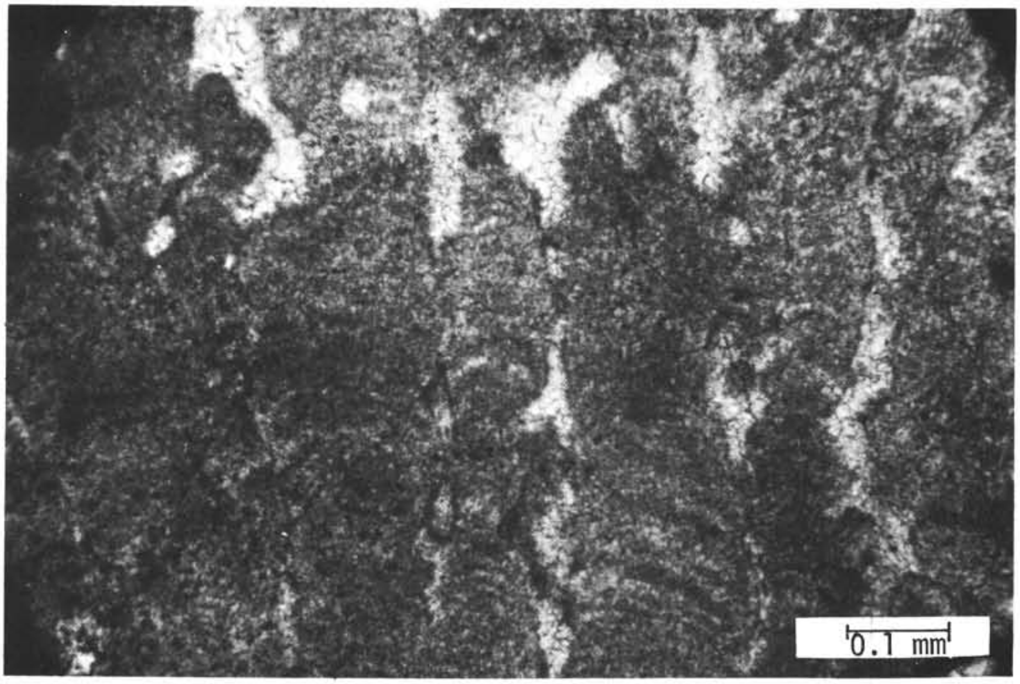

Figure 10. *Fragment of coralline algae as seen in thin section. These algae make up a significant portion of the cuttings recovered in Core 32.*

evident in these limestones, the degree of recrystallization of the components, and the dolomitization point to a long history of diagenetic effects. Emergence of the limestone took place prior to the volcanic activity that marked late Cenomanian time (Core 28). The limestone fragments in Core 27 represent already lithified rock that had undergone emergence and that was caught up in the erosion of a terrane underlain by vesicular, possibly subaerial basalts and hyaloclastites. A final, shallow-water or subaerial basalt flow ended the epoch of volcanism and the island probably began to submerge.

3. The island probably still existed during late Turonian and possibly Coniacian time as evidenced by the plant remains in Cores 25 and 26.

4. However, by Coniacian time subsidence was well under way (Cores 22 to 26) and volcanic material was being eroded into what was formerly the site of shallow-water limestone deposition. The rocks contain nannofossils and planktonic foraminifera. Basaltic eruptions may have been taking place nearby.

5. The former island continued to subside through the remainder of Cretaceous and Tertiary time with the deposition of pelagic carbonates.

PHYSICAL PROPERTIES

Site 171 calcareous oozes and chalks show the low gamma counts characteristic of this lithology. The change from ooze and chalk to volcanic sandstones is obvious as a drastic jump in gamma count. The highest gamma core average, 1700 for Core 26, is from a core which x-ray mineralogy reveals to be rich in montmorillonite and phillipsite, both high in potassium.

As at several other sites, little or no density change is apparent at the transition from ooze to chalk, but, because the transition occurs in a region of disturbed cores, a density change might conceivably have been masked by the drilling process. Like Site 167 (where the Tertiary is also represented by calcareous oozes), Site 171 shows an increasing density from the sea floor to 30 to 50 meters, which then levels off to a relatively constant density of 1.6 to 1.7 for a great distance. This interval is Quaternary to early Miocene at Site 171, whereas it is probably only Quaternary to Pliocene at Site 167.

CORRELATION BETWEEN STRATIGRAPHIC SECTION AND SEISMIC REFLECTION PROFILE

Three seismic records are available for correlation with the stratigraphic section – one made when the beacon was dropped, one made during a pass over the beacon before the hole was drilled, and one made during a pass over the beacon after the drilling. The one chosen for illustration is the first of these; also included is a pass over the site before the beacon was dropped (record to the right side of C/C in Figure 2). Because of the structural and acoustic complexities, neither of the records clearly shows all of the important reflecting interfaces, but by examining all three records, one can distinguish them well enough to arrive at a reasonably satisfactory correlation.

The first subbottom reflector is probably the most indistinct and variable in intensity. In the vicinity of the site it is approximately 0.14 sec below the sea floor reflector and gives a reasonable correlation with the uppermost chert beds, which are of middle Eocene age and begin at 148 meters. The cherts occur in a layer of foram-nanno chalk ooze that makes up most of the section from the sea floor to about 287 meters. It is noteworthy that, as at most of the other drilling sites of this leg, there is an interval a few meters below the Eocene cherts where a rapid change in age occurs, in this case from middle Eocene to late Maestrichtian. The results at this site are somewhat anomalous in that the reflector is far less prominent than it has been at the other sites, and the chert was penetrated more easily, causing only a moderate drilling break. There is only a negligible change in the physical properties across the unconformity.

The next level in the stratigraphic section that produces a consistent reflection is near the top of a basalt flow at 335 meters. The flow rests on a layer of limestone-basalt conglomerate and is covered by a few meters of volcanic sandstone. The main reflection appears to be the top of the basalt flow and in some places a fainter, shallower echo sequence seems to correlate with the transition from the foram-nanno ooze to the sandstone, which occurs at about 285 meters. A definite, although not major, drilling break occurred at the sandstone, and a very strong break coincides with the basalt. Laboratory sound velocity measurements on the basalt gave an average value of 3.9 km/sec. The layer of conglomerate was also quite hard, with sound velocity ranging between 2.67 and 3.83 km/sec.

Another layer of carbonates, which, unfortunately, was barely sampled, was found underneath the conglomerate. One good core of chalk was recovered from this layer just below the conglomerate, and a small piece of shelly limestone was recovered from the interval between 381 and 390 meters. The only other information obtained about its composition is that this layer drilled uniformly and easily with only a moderate amount of pumping, but would bind the drill string quickly without circulating water. Three meters of cuttings recovered after a drilled interval of 408 to 464 meters consisted of limestone fragments, and more of the same were recovered with basalt at the bottom of the hole at 479 meters. If we correlate this lower basalt with the deepest reflector, the mystery layer appears to have an interval velocity of about 1.9 km/sec. Taking these various bits of information into consideration, we deduce that the layer is a soft, possibly porous limestone, containing some shell and other fragments.

The basalt from the bottom of the hole, although appearing to be considerably more weathered than that from the flow higher in the section, has an appreciably higher sound velocity–4.73 km/sec, compared with 3.90 km/sec.

CONCLUSIONS

The stratigraphic column at Site 171 contains five major units:

1) 0 to 148 meters – foraminiferal nannofossil chalk ooze, ranging in age from middle Eocene to middle Miocene. This unit rests unconformably on

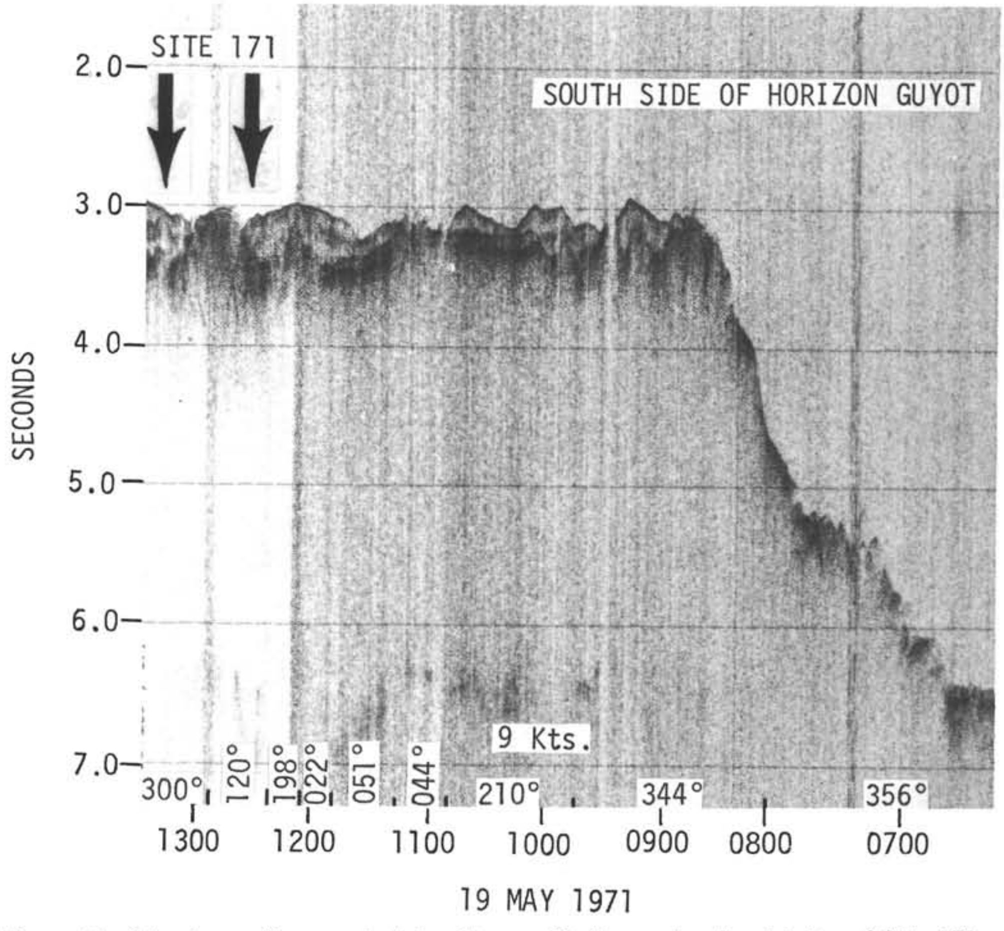

Figure 11. *Seismic profile recorded by* Glomar Challenger *in the vicinity of Site 171, showing south edge of guyot.*

2) 148 to 287 meters – cherty foraminiferal nannofossil chalk, ranging in age from late Campanian to late Maestrichtian.

3) 287 to 345 meters – volcanogenic sandstone, siltstone and conglomerate; fossiliferous. This unit includes a 4-meter basalt flow and a 2-meter layer of conglomerate near the base. The age of the unit ranges from Cenomanian to Santonian or early Campanian.

4) 345 to 479 meters – pale orange limestone, with shallow-water fossils in the upper part of the unit. No identifiable fossils of stratigraphic value were found in the shipboard examination of samples from this unit, which rests on

5) vesicular basalt, which appears weathered.

The most striking feature of the column is the evidence for shallow water, and perhaps even nonmarine environments at close hand to the drilled site. The evidence consists of the shallow-water types of molluscs and agglutinated foraminifera in the upper part of Unit 4, in the Cenomanian; the woody plant fragments in the volcanic sandstones in the Turonian and Coniacian; and, in the limestone-basalt conglomerate, the highly vesicular and weathered basalt fragments that resemble subaerial flow rocks.

The most likely large areas that may actually have been above water during part of the time of accumulation of the sediments at Site 171 are, of course, the shallow parts of Horizon Guyot. The difference in depth between the top of the guyot and the beds with shallow-water or terrestrial materials is now about 1100 meters.

Very close to the site, the basement rocks appear to crop out on the southern edge of the saddle region, about 2 km south of the site (see Figure 11), and shallow-water conditions may have prevailed there during deposition of sediments at Site 171. In fact, the presence of fragments of cemented molluscan limestone in the core catcher of Core 2, which are most likely cavings from the present sea floor, suggest that reef limestones may still be exposed on the basement highs today, available to the dredge.

The age of the oldest sediments at the site could not be determined from shipboard study of the samples. Rocks of Cenomanian age occur about 125 meters above the base of the section, and a straight-line extrapolation of accumulation rates (Figure 1) would carry the base back to about 120 m.y. It seems more likely that the coarse shallow-water debris accumulated more rapidly than the *average* rate in the overlying deeper water glauconitic and volcanogenic section, which may well contain an unconformity near the top. It should be kept in mind that planktonic foraminifera of Albian age have been found in cracks in volcanic rocks dredged from the north side of Horizon Guyot (E. C. Allison, personal communication). The volcanic edifice is, therefore, at least that old (~104 m.y.).

Another notable feature of the geologic history at Site 171 is the recurrence of volcanism, at least 5 m.y. and perhaps as much as 30 m.y. after the eruption of the older basalt.

The rate of accumulation curve (Figure 1) shows a pronounced change in slope between middle Eocene and late Cretaceous, which may be in part an erosional unconformity, since reworked lower Eocene and Paleocene fossils are present. Another change in slope occurs in an Oligocene core at this site between the late Campanian and the Coniacian. Glauconitic (?) sediments occur in the cores just below this break.

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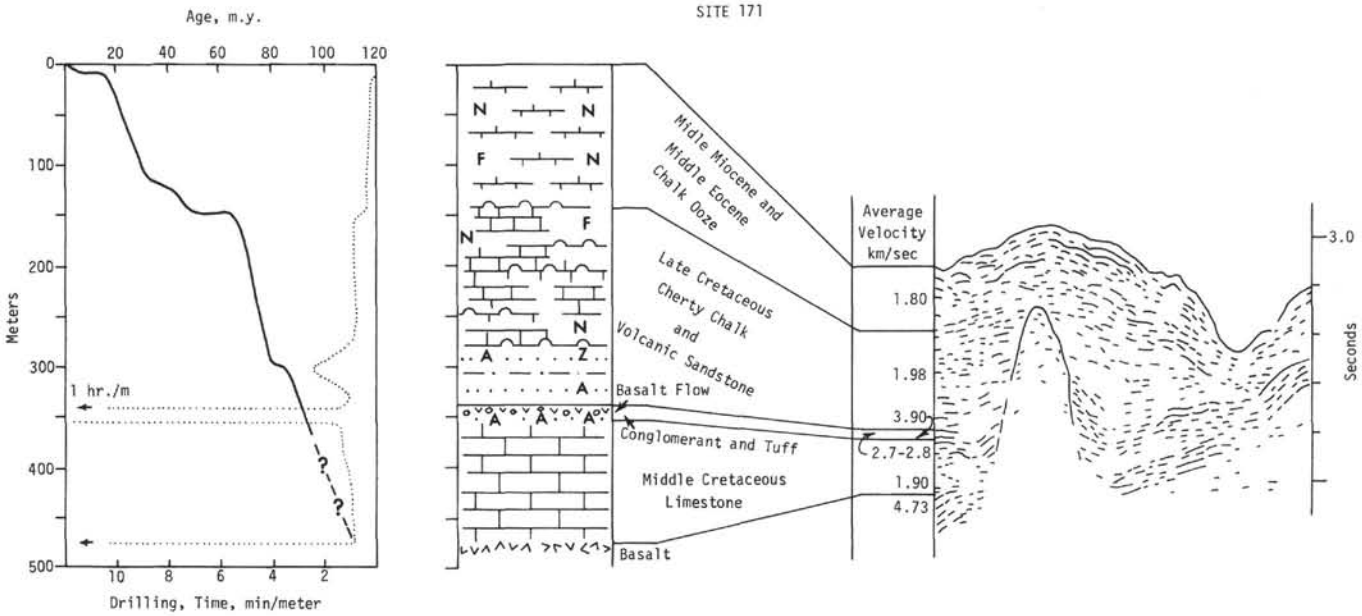


Figure 12. *Correlation of lighology, seismic stratigraphy, drilling rates, and sediment accumulation rates at Site 171.*

APPENDIX A
Core Inventory – Site 171

	Depth Below Sea Floor (m)		Total Depth[a] (m)					
Core	Top	Bottom	Top	Bottom	Cored (m)	Recovered (m)	Lithology	Age
1	5	14	2290	2304	9	8.5	Nannofossil foraminiferal ooze	Quaternary to Middle Miocene
2	27	36	2317	2326	9	9	Foraminiferal nannofossil ooze	Middle Miocene
3	46	55	2336	2345	9	9	Foraminiferal nannofossil ooze	Early Miocene
4	64	73	2354	2363	9	8.7	Foraminiferal nannofossil ooze	Late Oligocene
5	83	92	2373	2382	9	9	Foraminiferal nannofossil ooze	Late Oligocene
6	102	111	2392	2401	9	2.5	Foraminiferal nannofossil ooze	Early Oligocene
7	120	129	2410	2419	9	Tr	Foraminiferal nannofossil ooze	Early Oligocene
8	129	138	2419	2428	9	9	Foraminiferal nannofossil ooze	Middle Eocene
9	148	157	2438	2447	9	9	Foraminiferal nannofossil ooze, with chert	Middle Eocene and Late Maastrichtian
10	157	166	2447	2456	9	7.5	Foraminiferal nannofossil ooze, with chert	Late Maastrichtian
11	166	176	2456	2466	10	7	Foraminiferal nannofossil ooze, with chert	Middle Maastrichtian
12	176	185	2466	2475	9	CC	Foraminiferal nannofossil ooze, with chert	Middle Maastrichtian
13	195	204	2485	2494	9	7	Foraminiferal nannofossil ooze, with chert	Middle Maastrichtian
14	213	222	2503	2512	9	Tr	Foraminiferal nannofossil ooze, with chert	Early Maastrichtian
15	222	231	2512	2521	9	8.5	Foraminiferal nannofossil chalk, with chert	Early Maastrichtian
16	231	241	2521	2531	10	9	Foraminiferal nannofossil chalk, with chert	Early Maastrichtian
17	241	250	2531	2540	9	9	Foraminiferal nannofossil chalk, with chert	Early Maastrichtian
18	250	260	2540	2550	10	1	Foraminiferal nannofossil chalk, with chert	Early Maastrichtian
19	260	269	2550	2559	9	9	Foraminiferal nannofossil chalk	Early Maastrichtian
20	269	278	2559	2568	9	1	Foraminiferal nannofossil chalk	Late Campanian
21	278	287	2568	2577	9	9	Foraminiferal nannofossil chalk, with minor volcanic sandstone	Late Campanian
22	287	297	2577	2587	10	4.5	Volcanic siltstone, sandstone and claystone	Early Santonian to Campanian
23	297	306	2587	2596	9	3+	Volcanic siltstone, sandstone and claystone	Coniacian
24	306	315	2596	2605	9	1	Volcanic siltstone, sandstone and claystone	Turonian
25	315	325	2605	2615	10	7.6	Volcanic siltstone, sandstone and claystone	Turonian
26	325	334	2615	2624	9	4	Volcanic siltstone, sandstone and siltstone; basalt at base	Turonian
27	334	343	2624	2633	9	5.5	Basalt, and basalt-limestone conglomerate	?
28	343	352	2633	2642	9	3	Hyaloclastite, and volcanic-rich limestone	?
29	352	362	2642	2652	10	5.5	Limestone	Cenomanian (?)
30	381	390	2671	2680	9	Tr	Limestone	Cenomanian (?)
31	399	408	2689	2698	9	Tr	Limestone	Cenomanian (?)
32	408	464	2698	2754	6	3	Limestone	?
33	464	479	2754	2769	15	CC	Limestone and basalt	?

[a] Measured from the derrick floor.

APPENDIX B
Physical Properties – Site 171

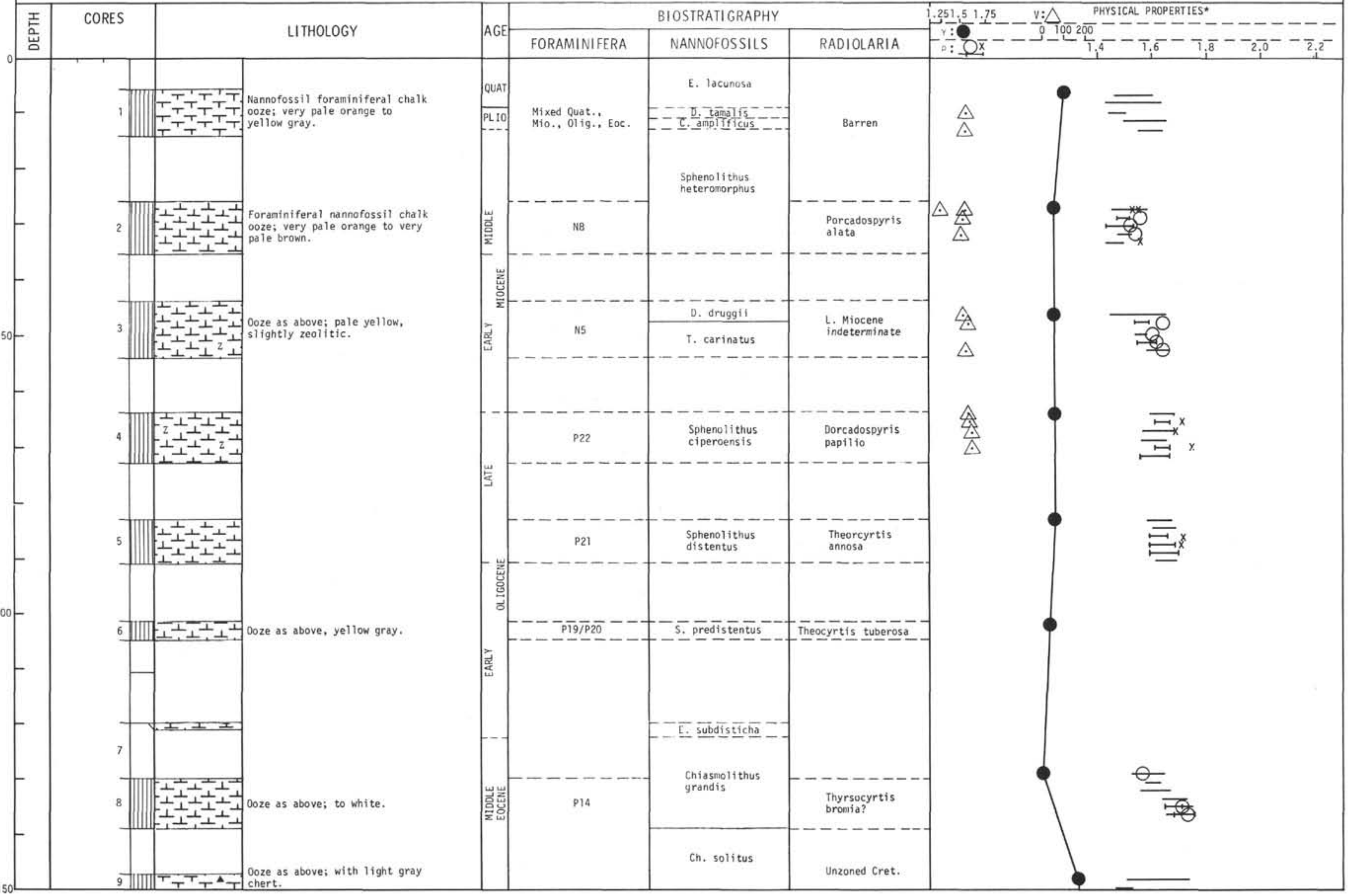
Core Section	Section Weight Wet Bulk Density (g/cc)	GRAPE					Syringe				Natural Gamma Radiation		Sonic Velocity	
		Wet Bulk Density		Assigned Grain Density (g/cc)	Porosity		Interval Sampled (cm)	Wet Bulk Density (g/cc)	Grain Density (g/cc)	Porosity (%)	Total Count	Net	Interval Sampled (cm)	(km/sec)
		Total Range (g/cc)	Undisturbed (g/cc)		Total Range (%)	Undisturbed (%)								
1-2		1.47-1.61		2.71	65.2-73.5						1400	100		
1-3		1.43-1.64		2.71	63.4-75.9									
1-4		1.45-1.51		2.71	71.1-74.7								89	1.55
1-5		1.50-1.66		2.71	62.2-71.7									
1-6		1.55-1.64		2.71	63.4-68.8						1350	50	30	1.55
2-1		1.46-1.59	1.46-1.59	2.71	66.4-74.1	66.4-74.1	33	1.55	2.17	53.8			46	1.55
							45	1.53	2.29	59.7			91	1.32
2-2	1.56	1.48-1.52	1.48-1.52	2.71	70.5-72.9	70.5-72.9							48	1.52
													91	1.54
2-3	1.52	1.44-1.53	1.44-1.53	2.71	69.9-75.3	69.9-75.3								
2-4	1.54	1.48-1.53	1.48-1.53	2.71	69.9-72.9	69.9-72.9								
2-5		1.44-1.50		2.71	71.7-75.3		59	1.56	2.43	62.1			50	1.51
													102	1.53
3-1		1.45-1.65		2.71	62.8-74.7						1350	50	83	1.54
3-2	1.64	1.54-1.59	1.54-1.59	2.71	66.4-69.3	66.4-69.3							60	1.57
													107	1.57
3-4	1.60	1.54-1.58		2.71	67.0-69.3									
3-5	1.62	1.55-1.62	1.55-1.62	2.71	64.6-68.8	64.6-68.8								
3-6	1.64	1.48-1.57		2.71	67.6-72.9								49	1.55
													102	1.55
4-1		1.59-1.68		2.71	61.0-66.4						1350	50	38	1.56
													106	1.58
4-2		1.61-1.66	1.61-1.66	2.71	62.2-65.2	62.2-65.5	89	1.71	2.55	54.9			45	1.58
													100	1.58
4-3		1.57-1.67		2.71	61.6-67.6		68	1.68	2.49	55.3			52	1.62
													104	1.59
4-4		1.56-1.65		2.71	62.8-68.2									
4-5		1.61-1.66	1.61-1.66	2.71	62.2-65.2	62.2-65.2		1.74	2.72	57.9			28	1.58
													98	1.60
4-6		1.56-1.66	1.56-1.66	2.71	62.2-68.2	62.2-68.2								
5-1		1.58-1.67		2.71	61.6-67.0						1350	50		
5-2		1.60-1.69		2.71	60.4-65.8									
5-3		1.59-1.65	1.59-1.65	2.71	62.8-66.4	62.8-66.4	139	1.71	2.59	56.4				
5-4		1.59-1.68	1.59-1.68	2.71	61.0-66.4	61.0-66.4	22	1.70	2.36	56.5				
5-5		1.59-1.69	1.59-1.69	2.71	60.4-66.4	60.4-66.4								
5-6		1.61-1.69		2.71	60.4-65.2									
6-2											1325	25		
8-1	1.56	1.52-1.64		2.71	63.2-70.5									
8-2		1.57-1.63		2.71	64.0-67.6									
8-3		1.55-1.66		2.71	62.2-68.8									

APPENDIX B – *Continued*

		GRAPE						Syringe				Natural Gamma Radiation		Sonic Velocity	
		Wet Bulk Density			Porosity										
Core Section	Section Weight Wet Bulk Density (g/cc)	Total Range (g/cc)	Undisturbed (g/cc)	Assigned Grain Density (g/cc)	Total Range (%)	Undisturbed (%)	Interval Sampled (cm)	Wet Bulk Density (g/cc)	Grain Density (g/cc)	Porosity (%)	Total Count	Net	Interval Sampled (cm)	(km/sec)
8-4		1.63-1.72		2.71	58.7-64.0									
8-5	1.70	1.64-1.74	1.64-1.70	2.71	57.5-63.4	57.5-59.9								
8-6	1.72	1.65-1.75	1.67-1.74	2.71	56.9-62.8	56.9-61.6								
9-1		1.50-1.72		2.71	58.7-71.7						1475	150		
9-2		1.46-1.52		2.71	70.5-74.1									
9-3		1.56-1.61		2.71	65.2-68.2									
9-4		1.54-1.61		2.71	65.2-69.3									
9-5		1.48-2.10		2.71	36.1-72.9		64	1.61	2.36	56.1				
9-6		1.54-1.79		2.71	54.5-69.3									
10-1		1.42-1.52		2.71	70.5-76.5						1475	150		
10-2		1.47-1.57		2.71	67.6-73.5									
10-3		1.50-1.57		2.71	67.6-71.7									
10-5		1.57-2.15		2.71	33.2-67.6									
11-2		1.58-1.67		2.71	61.6-67.0						1375	50		
11-5		1.62-1.70		2.71	59.9-64.6		147	1.75	2.37	46.4				
13-2		1.56-1.75		2.71	56.9-68.2						1350	50		
13-4		1.56-1.70		2.71	59.9-68.2									
13-5		1.57-1.76		2.71	56.3-67.6									
15-2							104	1.62	2.21	51.4	1375	75		
15-3		1.63-1.78		2.71	55.1-64.0									
15-5		1.76-1.92		2.71	46.8-56.3									
15-6		1.61-2.08		2.71	37.3-65.2									
16-1		1.56-1.72	1.56-1.72	2.71	58.7-68.2	58.7-68.2					1375	75		
16-3		1.68-2.12		2.71	34.9-61.0									
16-5		1.63-1.72		2.71	58.7-64.0									
17-2		1.65-1.73		2.71	58.1-62.8						1375	50		
17-3							115	1.72	2.60	56.1				
17-4		1.58-1.69	1.61-1.69	2.71	60.4-67.0	60.4-65.2								
17-5							13	1.62	2.21	49.8				
17-6		1.67-2.12		2.71	34.9-61.6									
18-1		1.62-1.75		2.71	56.9-64.6						1400	75		
19-2	1.51	1.55-1.82		2.71	52.7-68.8						1475	150		
19-3	1.64	1.57-1.67		2.71	61.6-67.6		63	1.71	2.66	58.1				
19-4	1.68													
19-5	1.72	1.61-1.72		2.71	58.7-65.2		11	1.59	2.31	55.9				
19-6	1.78													
21-3		1.60-1.73			58.1-65.8						1425	100		
22-1		1.59-1.83	1.59-1.83	2.75	53.3-67.2	53.3-67.2					2100	775		
22-2	1.74													
22-3	1.72	1.58-1.73	1.58-1.73	2.75	59.0-67.7	59.0-67.7								

23-2		1.07-1.09		2.75	96.1-97.8						2200	875		
23-4		1.07-1.69	1.56-1.69	2.75	61.4-97.8	61.4-68.9								
23-5		1.52-1.74	1.52-1.74	2.75	58.5-71.2	58.5-71.2								
24-1		1.52-1.85	1.52-1.85	2.75	52.1-71.2	52.1-71.2					1750	425		
25-2		1.57-1.67	1.57-1.67	2.75	62.5-68.3	62.5-68.3					2550	1225		
25-4		1.55-1.60	1.55-1.60	2.75	66.6-69.5	66.6-69.5								
25-6		1.49-1.78	1.49-1.78	2.75	56.1-73.0	56.1-73.0								
26-1		1.50-1.73	1.50-1.73	2.75	59.0-72.4	59.0-72.4					3000	1700		
26-2		1.47-1.80	1.47-1.80	2.75	55.0-74.1	55.0-74.1								
26-3		1.62-1.85	1.62-1.85	2.75	52.1-65.4	52.1-65.4								
27-2											1700	400	50	3.74
													90	3.88,4.08
													30	3.66
													90	3.83
28-1		1.77-1.98	1.77-1.98	2.75	44.6-56.7	44.6-56.7					2000	700	73	2.67
													128	3.46
28-2		1.75-1.98	1.75-1.98	2.75	44.6-57.9	44.6-57.9							10	3.52
													132	2.68
29-1		1.75-1.93		–							1600	300		
29-2		1.92-2.00		–										
29-3	2.07	1.95-2.00		–										
29-4		1.97-2.07		–										
33-CC														4.73

LEG XVII SITE 171 LAT. 19°07.8'N LONG. 169°27.6'W DEPTH 2290 m SHEET 1 OF 4



Nannofossil foraminiferal chalk ooze; very pale orange to yellow gray.

Foraminiferal nannofossil chalk ooze; very pale orange to very pale brown.

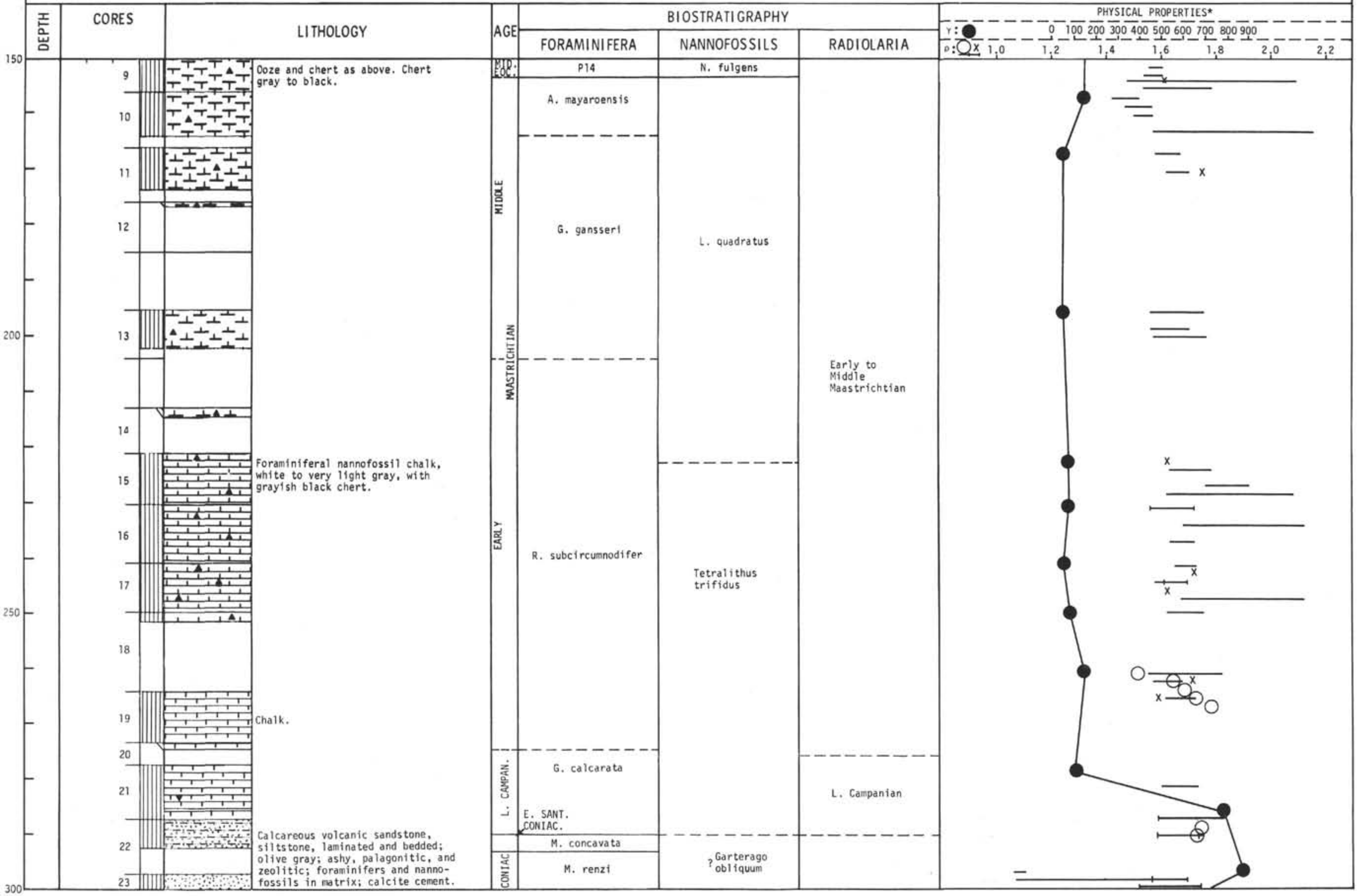
Ooze as above; pale yellow, slightly zeolitic.

Ooze as above, yellow gray.

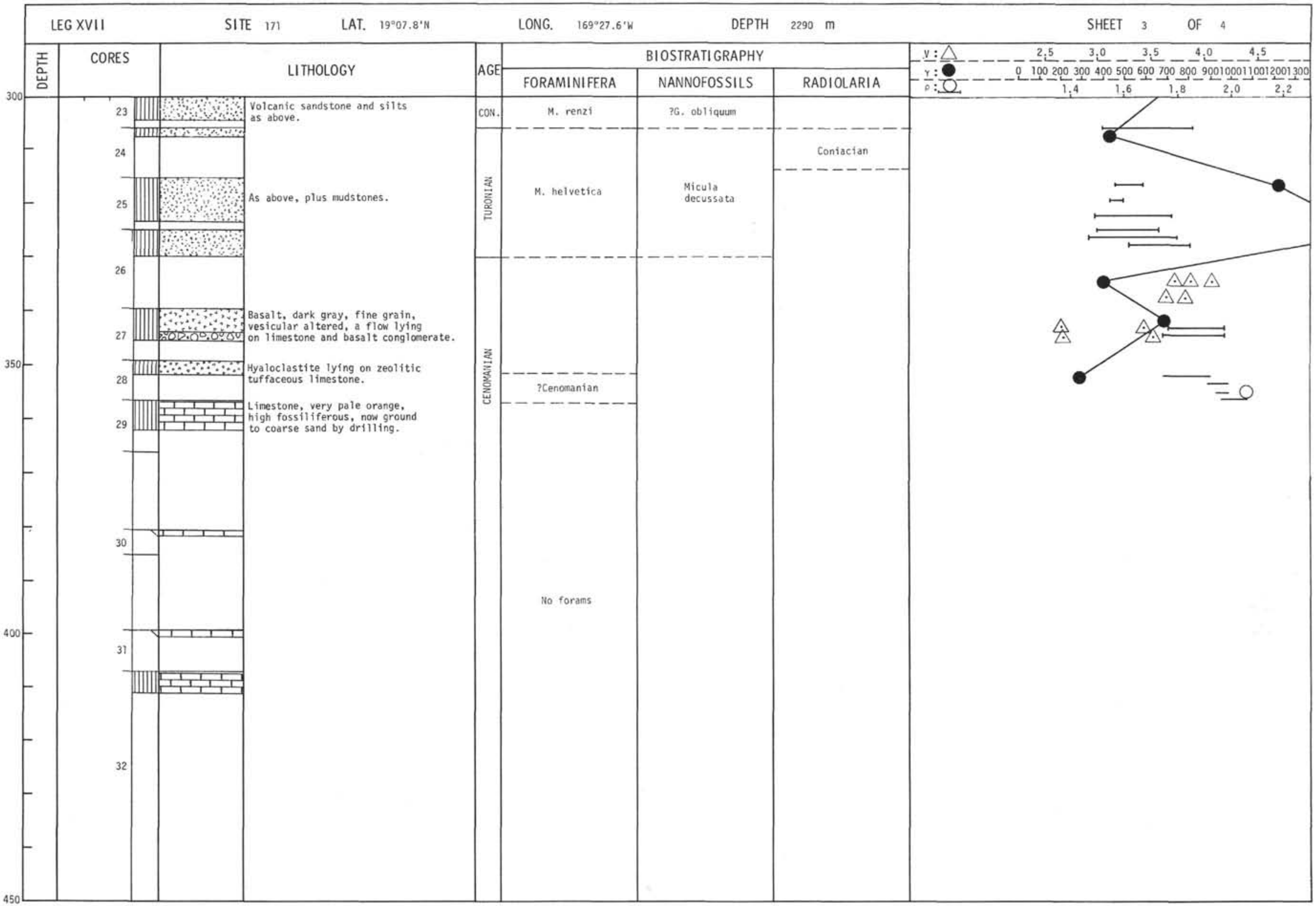
Ooze as above; to white.

Ooze as above; with light gray chert.

LEG XVII SITE 171 LAT. 19°07.8'N LONG. 169°27.6'W DEPTH 2290 m SHEET 2 OF 4



LEG XVII SITE 171 LAT. 19°07.8'N LONG. 169°27.6'W DEPTH 2290 m SHEET 3 OF 4



Volcanic sandstone and silts as above.

As above, plus mudstones.

Basalt, dark gray, fine grain, vesicular altered, a flow lying on limestone and basalt conglomerate.

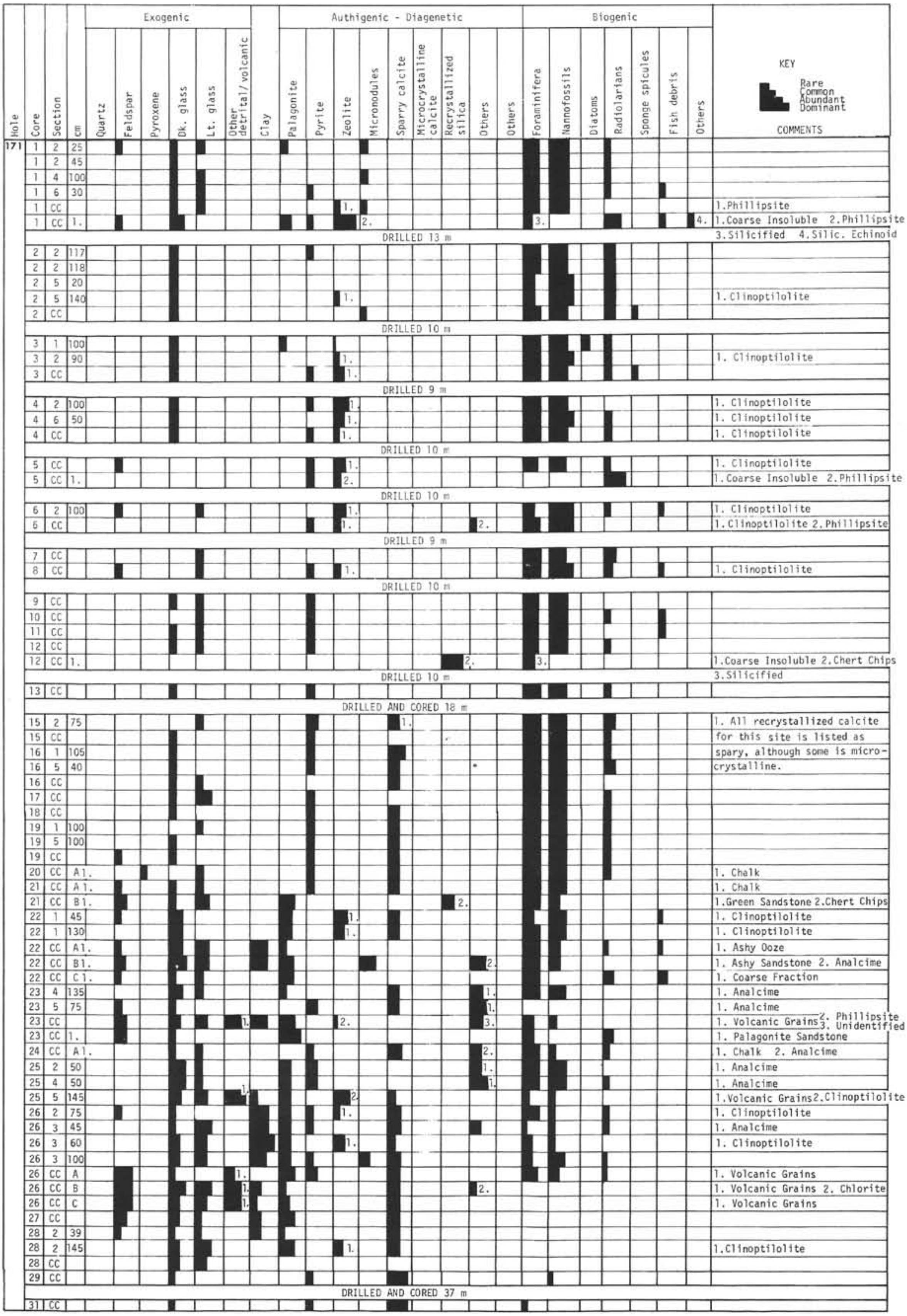
Hyaloclastite lying on zeolitic tuffaceous limestone.

Limestone, very pale orange, high fossiliferous, now ground to coarse sand by drilling.

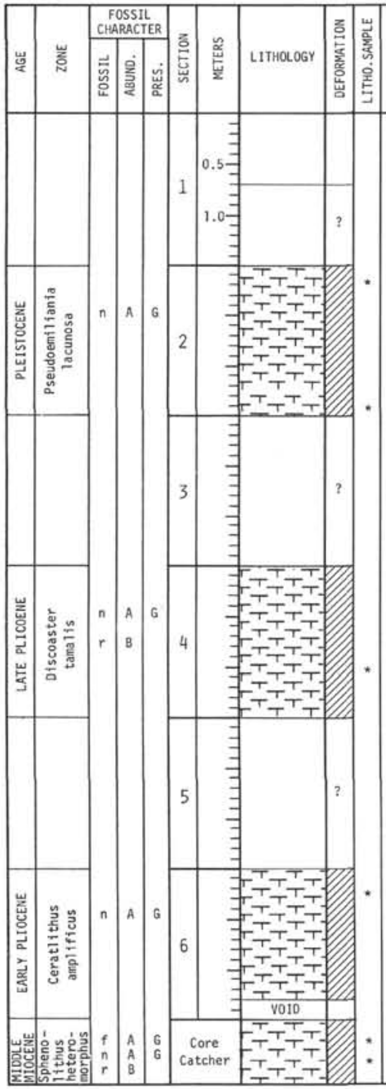
LEG XVII SITE 171 LAT. 19°07.8'N LONG. 169°27.6'W DEPTH 2290 m SHEET 4 OF 4

DEPTH	CORES	LITHOLOGY	AGE	BIOSTRATIGRAPHY: FORAMINIFERA	BIOSTRATIGRAPHY: NANNOFOSSILS	BIOSTRATIGRAPHY: RADIOLARIA	V:△ PHYSICAL PROPERTIES* 4.5 4.75
	32					Barren	△
	33	Limestone fragments as above. Basalt, brown, weathered, vesicular.					
	T.D. 479 m						

SITE 171
SMEAR SLIDE SUMMARY



Site 171 Hole Core 1 Cored Interval: 5 to 14 m



LITHOLOGIC DESCRIPTION

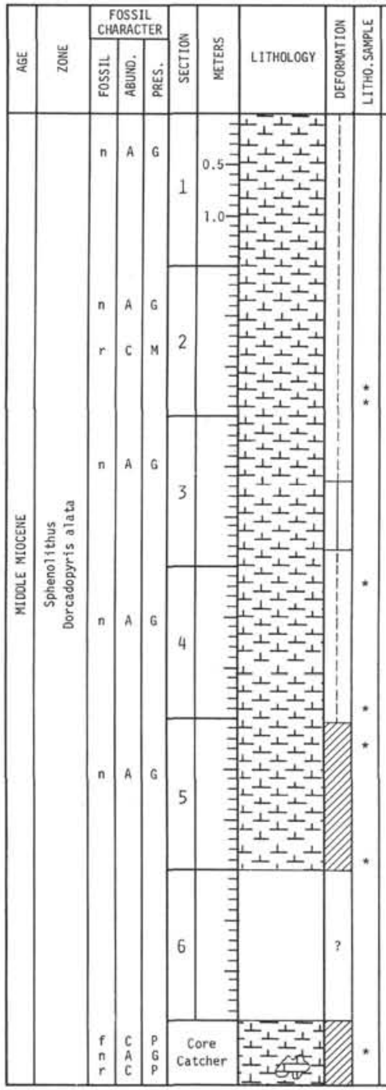
Sections 1, 3, and 5 not opened.

Nannofossil Foraminiferal Chalk Ooze:

Very pale orange (10YR 8/2) to yellowish gray (5Y 8/1); homogenized by drilling.

Explanatory notes in Chapter 1

Site 171 Hole Core 2 Cored Interval: 27 to 36 m



LITHOLOGIC DESCRIPTION

Foraminiferal Nannofossil Chalk Ooze:

Very pale orange (10YR 8/2) to very pale brown (10YR 8/3); radiolarian-bearing; slightly mottled with gray and white.

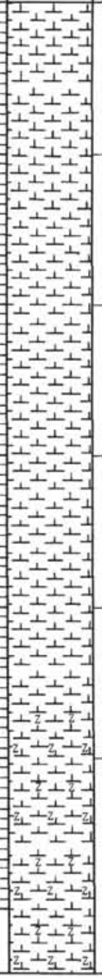
Section 6 not opened

Foraminiferal Nannofossil Chalk Ooze with Limestone:

fragmental mollusks, foraminifers ?, and echinoids, cemented by spar.

Explanatory notes in Chapter 1

Site 171 Hole Core 3 Cored Interval: 46 to 55 m



AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHO. SAMPLE
		FOSSIL	ABUND.	PRES.			
EARLY MIOCENE	Triquetrorhabdulus carinatus	n	A	G	1	0.5 1.0	*
		n r	A B	G	2		*
		n	A	G	3		
		n r	A B	G	4		
		n	A	G	5		
		n	A	G	6		
		f n r	A A R	M G P	Core Catcher		*

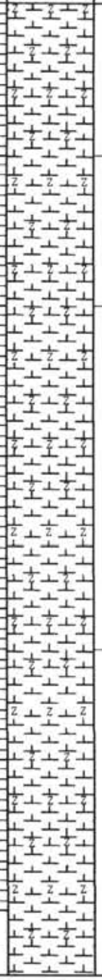
LITHOLOGIC DESCRIPTION

Foraminiferal Nannofossil Chalk Ooze:

Pale yellow (2.5Y 7/4), slightly mottled with white (N9);
zeolitic (clinoptilolite) toward base of core.

Explanatory notes in Chapter 1

Site 171 Hole Core 4 Cored Interval: 64 to 73 m



AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHO. SAMPLE
		FOSSIL	ABUND.	PRES.			
LATE OLIGOCENE	P22 Sphenolithus ciperoensis Dorcadopyris papilio	n f	A A	G G	1	0.5 1.0	
		n r	A R	G P	2		*
		n f	A A	G G	3		
		n r	A F	G P	4		
		n f	A A	G G	5		
		n f r	A A F	G G P	6		*
		f n r	A A F	G G M	Core Catcher		*

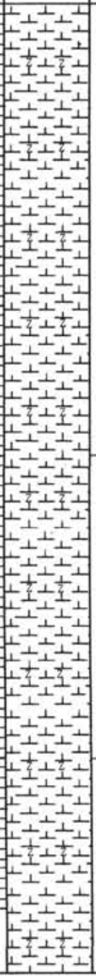
LITHOLOGIC DESCRIPTION

Foraminiferal Nannofossil Chalk Ooze:

Very pale orange (10YR 8/2) to light gray (2.5Y 7/2),
slightly streaked and mottled with light gray and white;
slightly zeolitic.

Explanatory notes in Chapter 1

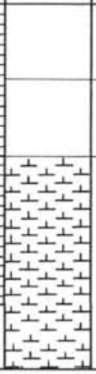
Site 171 Hole Core 5 Cored Interval: 83 to 92 m



AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
LATE OLIGOCENE	P21 Sphenolithus distentus Theocyrtis annosa	n f	A A	G G	1	0.5 1.0				Foraminiferal Nannofossil Chalk Ooze: Yellowish gray (2.5Y 8/2) to white (N8-9); slightly streaked and laminated with white and gray; slightly zeolitic and radiolarian-bearing. Note: There was a "zero section" for this core; not opened.
		n r	A F	G P	2					
		n f	A A	G G	3					
		n r	A F	G P	4					
		n f	A A	G G	5					
		n r	A R	G P	6					
		f n r	A A C	G G P	Core Catcher				* *	

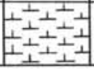
Explanatory notes in Chapter 1

Site 171 Hole Core 6 Cored Interval: 102 to 111 m



AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
EARLY OLIGOCENE	P19/20 Sphenolithus predistentus Theocyrtis tuberosa	f	A	G	1	0.5 1.0		?		Section 1 not opened.
		f n r	A A F	G G P	2				*	Foraminiferal Nannofossil Chalk Ooze: Yellowish gray (5Y 8/1), with a few white streaks.
		f n r	A A C	G G P	Core Catcher				*	

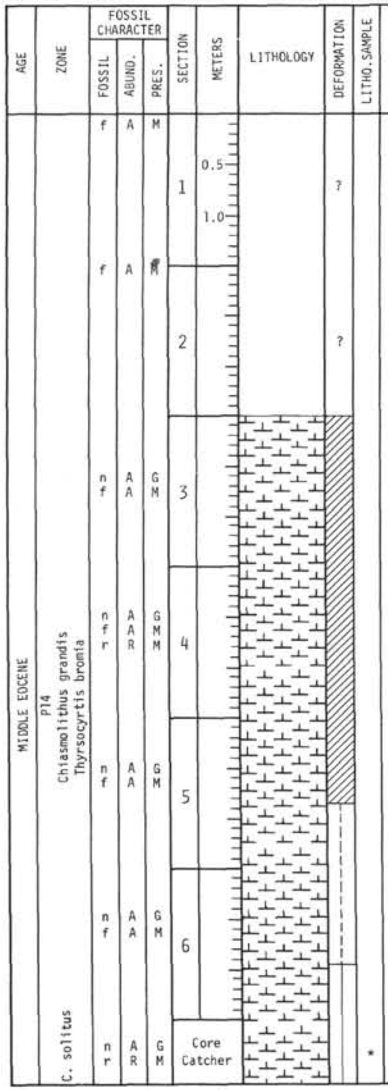
Site 171 Hole Core 7 Cored Interval: 120 to 129 m



AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
E. OLIGOCENE	E. subdisticha	n	A	G	Core Catcher				*	Foraminiferal Nannofossil Chalk Ooze: Only a trace recovered.

Explanatory notes in Chapter 1

Site 171 Hole Core 8 Cored Interval: 129 to 138 m



LITHOLOGIC DESCRIPTION

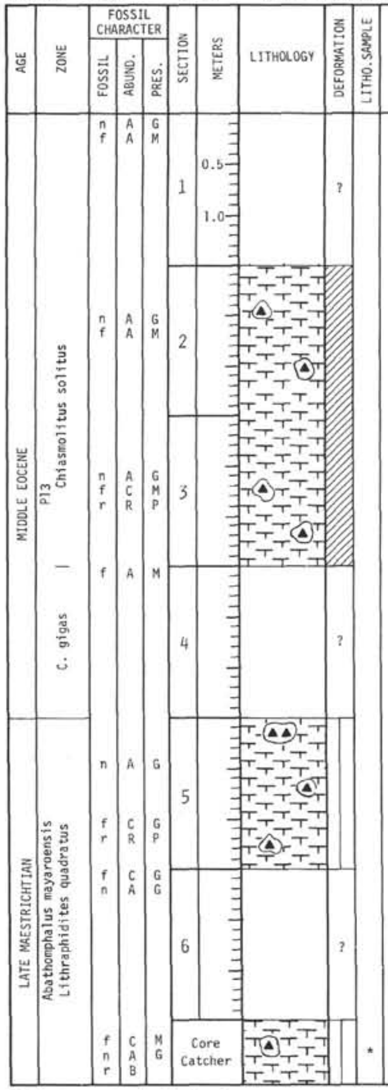
Sections 1 and 2 not opened

Foraminiferal Nannofossil Chalk Ooze:

Yellowish gray (5Y 8/1) to white (N9). Badly disturbed during coring; portions very watery.

Explanatory notes in Chapter 1

Site 171 Hole Core 9 Cored Interval: 148 to 157 m



LITHOLOGIC DESCRIPTION

Sections 1, 4, and 6 not opened.

Nannofossil Foraminiferal Chalk Ooze:

White (N8 to N9) to light yellowish gray (5Y 8/1); very watery; gassy (smells like musty leather). Abundant angular chips (1-3 mm) of clear, colorless to translucent light yellow Chert.

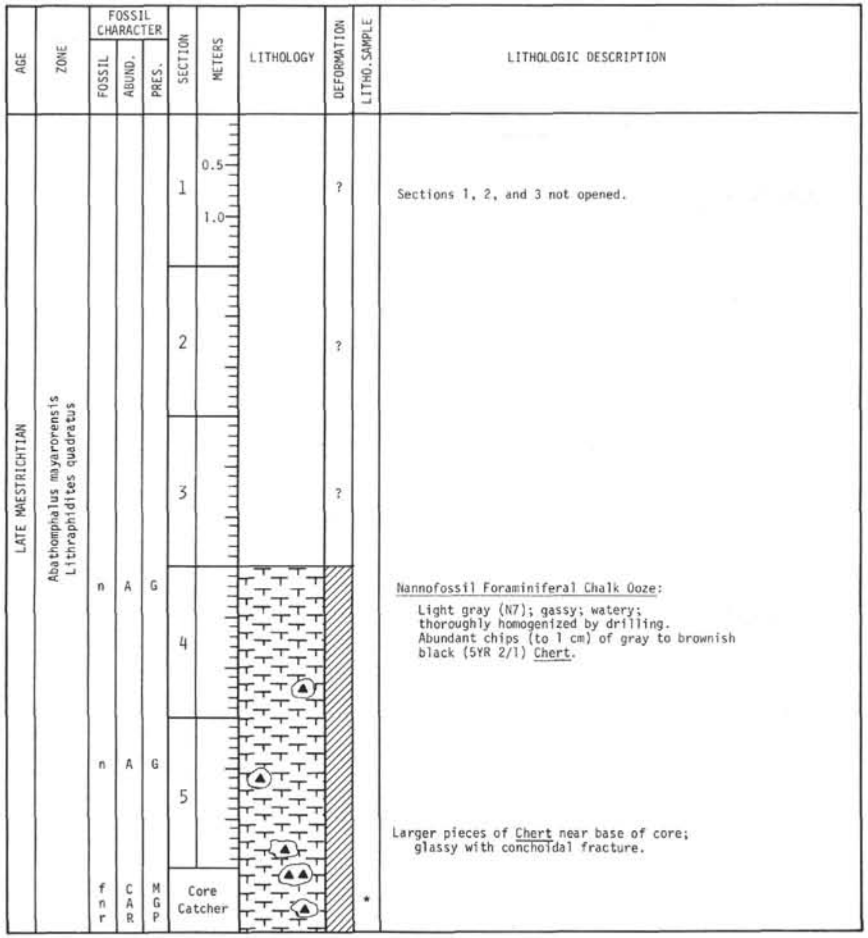
At 5 to 10 cm, a large fragment of

Chert:

Light gray (N6 to N8), laminated in 0.5-1.0 cm layers. Chert chips below this mainly dark brown colors.

Explanatory notes in Chapter 1

Site 171 Hole Core 10 Cored Interval: 157 to 166 m



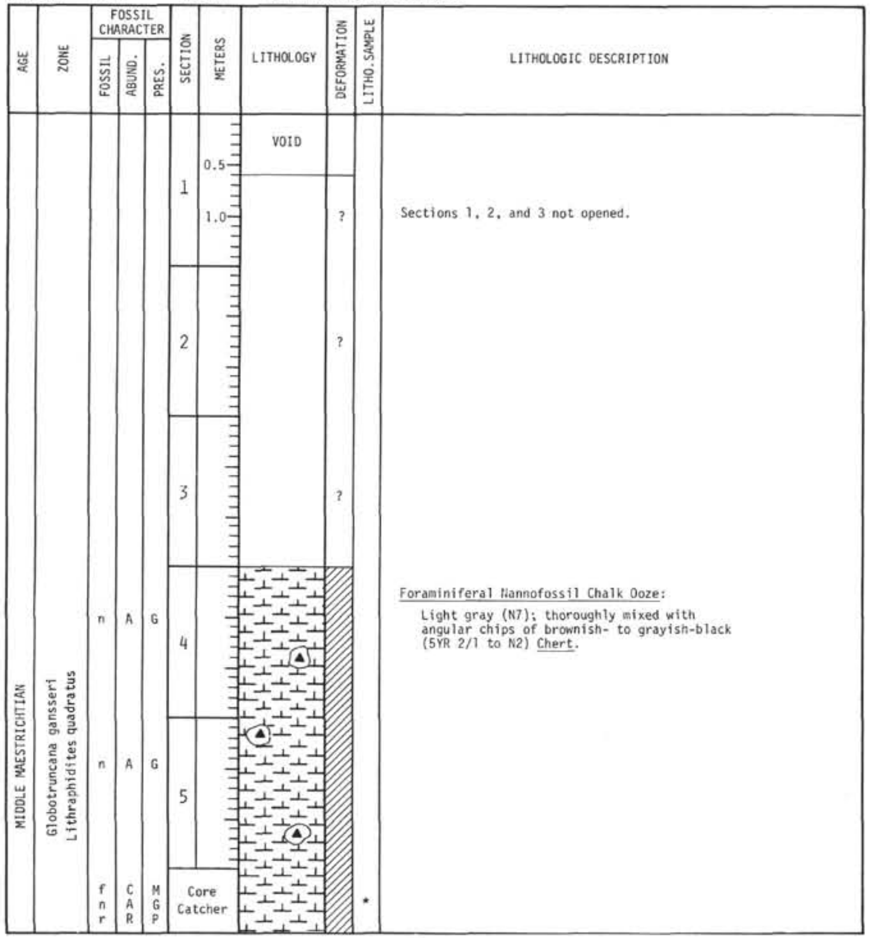
Sections 1, 2, and 3 not opened.

Nannofossil Foraminiferal Chalk Ooze:
Light gray (N7); gassy; watery; thoroughly homogenized by drilling. Abundant chips (to 1 cm) of gray to brownish black (5YR 2/1) Chert.

Larger pieces of Chert near base of core; glassy with conchoidal fracture.

Explanatory notes in Chapter 1

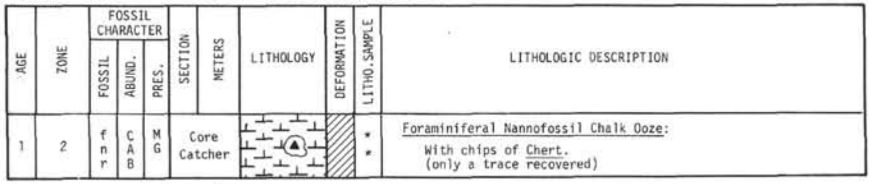
Site 171 Hole Core 11 Cored Interval: 166 to 176 m



Sections 1, 2, and 3 not opened.

Foraminiferal Nannofossil Chalk Ooze:
Light gray (N7); thoroughly mixed with angular chips of brownish- to grayish-black (5YR 2/1 to N2) Chert.

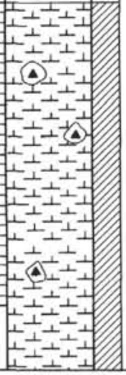
Site 171 Hole Core 12 Cored Interval: 176 to 185 m



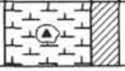
Foraminiferal Nannofossil Chalk Ooze:
With chips of Chert.
(only a trace recovered)

Explanatory notes in Chapter 1
1 M. MAESTRICHTIAN
2 G. gansseri L. quadratus

Site 171 Hole Core 13 Cored Interval: 195 to 204 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
MIDDLE MAESTRICHTIAN	Globotruncana gansseri Lithraphidites quadratus				1	0.5 1.0		?		Sections 1, 2, and 3 not opened.
					2			?		
					3			?		
		n	A	G	4					Foraminiferal Nannofossil Cnalk Ooze: Light gray (N7); thoroughly mixed with angular chips of grayish-black (N2) Chert.
		n	A	G	5					
		f n r	A A B	M G	Core Catcher				*	

Site 171 Hole Core 14 Cored Interval: 213 to 222 m

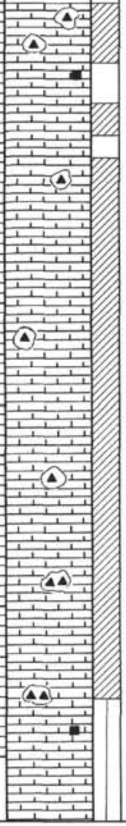
AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
1	2	f n	C A	G G	Core Catcher					Foraminiferal Nannofossil Chalk Ooze: With angular chips of Chert. Only a trace recovered.

Explanatory notes in Chapter 1

1 E. MAESTRICHTIAN

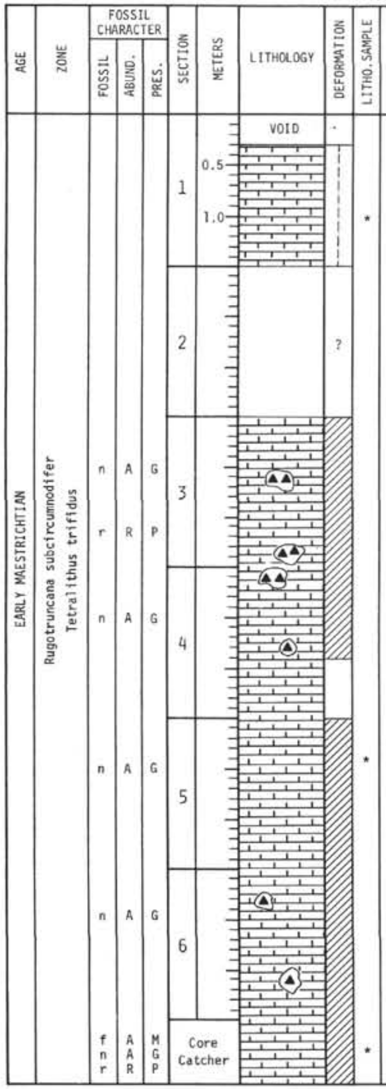
2 L. quadratus

Site 171 Hole Core 15 Cored Interval: 222 to 231 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
EARLY MAESTRICHTIAN	Rusotruncana subcircumnodifer Lithraphidites quadratus				1	0.5 1.0	VOID	?		Section 1 not opened.
		n	A	G	2				*	Foraminiferal Nannofossil Chalk to Chalk Ooze: Light gray (N7 to N8); pyritic in part. firmer (to chalk) near base. Thoroughly mixed with angular chips and a few larger fragments of Chert: Gray to grayish Black (N4 to N2); glassy.
		n r	A F	G P	3					
		n	A	G	4					
		n r	A R	G P	5					
					6					
		f n r	A A F	M G P	Core Catcher				*	

Explanatory notes in Chapter 1

Site 171 Hole Core 16 Cored Interval: 231 to 241 m



LITHOLOGIC DESCRIPTION

Nannofossil Foraminiferal Chalk:

White (N9) to very light gray (N8).

Section 2 not opened.

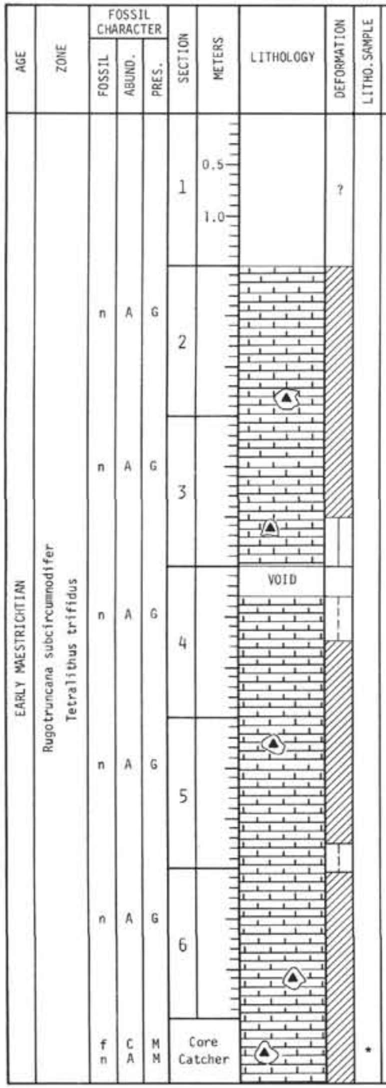
Foraminiferal Nannofossil Chalk:

White (N9) to very light gray (N8). Perhaps in part Chalk Ooze, but mostly churned by drilling.
Mixed with chips and larger fragments of grayish-black (N3 to N2) Chert.

At 90 cm:

Chalk shows faint medium light gray (N6) laminations against white (N9).

Site 171 Hole Core 17 Cored Interval: 241 to 250 m



LITHOLOGIC DESCRIPTION

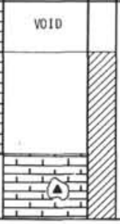
Section 1 not opened.

Foraminiferal Nannofossil Chalk:

White (N9) to light gray (N7); mainly thoroughly mixed with fragments of grayish-black Chert. Where not churned by drilling, shows medium-gray (N6) laminations. Portions very watery.

Site 171 Hole Core 18 Cored Interval: 250 to 260 m

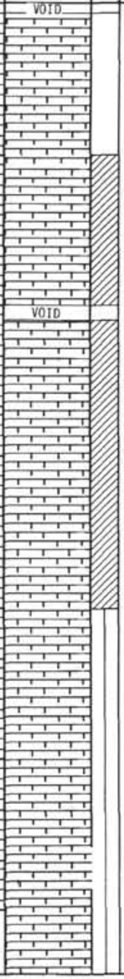
AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
EARLY MAESTRICHTIAN	Rugotruncana subcircumnodifer Tetralithus trifidus				1	0.5 1.0	VOID			Section 1 not opened; seen through the liner, appears to be an artificially graded bed of Chert fragments.
		f n r	C C R	M M P	Core Catcher				*	Foraminiferal Nannofossil Chalk: With fragments of Chert.



Explanatory notes in Chapter 1

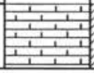
Site 171 Hole Core 19 Cored Interval: 260 to 269 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
EARLY MAESTRICHTIAN	Rugotruncana subcircumnodifer Tetralithus trifidus	n f	C C	M P	1	0.5 1.0	VOID		*	Nannofossil Foraminiferal Chalk: Very light gray (N8); most is homogenized by drilling. The lesser-disturbed lumps show gray (N5 to 7) laminations.
		n	C	M	2					
		n	C	M	3		VOID			
		n	C	M	4					
		n	C	M	5				*	
		n	C	M	6					
		f n r	C C R	P M P	Core Catcher				*	



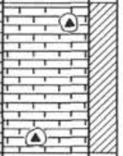
Explanatory notes in Chapter 1

Site 171 Hole Core 20 Cored Interval: 269 to 278 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
LATE CAMPANIAN	Globotruncana calcarata Tetralithus trifidus				1	0.5 1.0	VOID	?		Section 1 not opened.
		f n r	C C B	M M	Core Catcher			▨	*	<u>Foraminiferal Nannofossil Chalk</u>.

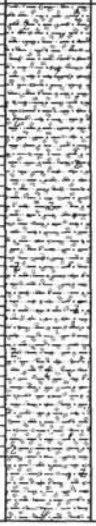
Explanatory notes in Chapter 1

Site 171 Hole Core 21 Cored Interval: 278 to 287 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
LATE CAMPANIAN	Globotruncana calcarata Tetralithus trifidus	f	C	M	1	0.5 1.0		?		All sections very watery; Sections 1, 3, 4, 5, and 6 not opened.
					2			▨		<u>Nannofossil foraminiferal Chalk</u>: Light gray (N7); watery from drilling disturbance; chips of <u>Chert</u>: Olive gray (5Y 4-6/1); translucent, conchoidal fracture.
		f n r	C C B	M M	3			?		
					4			?		
					5			?		
					6			?		<u>Chalk</u> and <u>Chert</u> as above; churned in with pieces of
		f n r	C C R	M M P	Core Catcher			▨	* *	<u>Volcanic - Sandstone</u>: greenish black (5GY 2/1); ashy and palagonitic; probably altered hyaloclastite

Explanatory notes in Chapter 1

Site 171 Hole Core 22 Cored Interval: 287 to 297 m

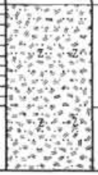
AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
L. CAMPANIAN	G. calcarata	f	C	M	1	0.5 1.0			*	Volcanic Sandstones and Siltstones: Overall olive colors (10Y 6/2 to 5Y 6/4); of salt-and-pepper aspect; laminated black, brown, green, etc. granules, sand and silt grains in a calcareous white matrix. Grains are ashy and palagonitic; clinoptilolite is abundant and clays common. White matrix of foraminifers and nannofossils. Bedding distinct. Reworked hyaloclastite (?).
E. SANTONIAN-CONIACIAN	M. concavata	f	C	M					*	
		n f	F C	M M	2					
CONIACIAN	Marginotruncana renzi	f n	C F	M M	3					Analcime common at base.
		f n	C R	P P	Core Catcher				* * *	

Explanatory notes in Chapter 1

Site 171 Hole Core 23 Cored Interval: 297 to 306 m

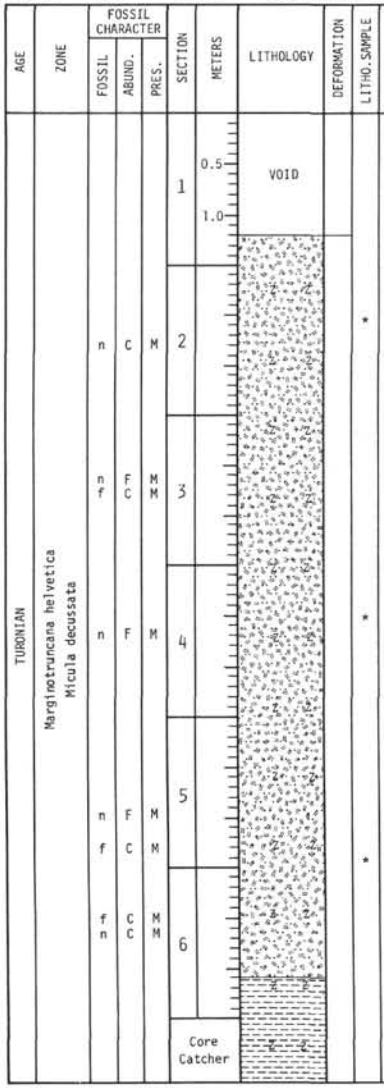
AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
CONIACIAN	Marginotruncana renzi				1	0.5 1.0		?		Sections 1, 2, and 3 watery; not opened.
					2			?		
					3			?		
		n	F	M	4			▨		Top section 4 mainly drilling mud. Volcanic Sandstones and Siltstones: Pale olive colors (5Y 5/2 to 10Y 6/2) of salt-and-pepper aspect; coarse to fine dark volcanic grains (glass, palagonite, zeolite, basalt) in a calcareous white matrix of nannofossils and foraminifers. Spary calcite cement. Bedding distinct; grains poorly sorted. Probable reworked hyaloclastite, but possibly a tuff.
		f	A	P					*	
		n	R	M	5				*	
		f n r	F R B	P M	Core Catcher				* *	

Site 171 Hole Core 24 Cored Interval: 306 to 315 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
TURONIAN	M. helvetica Micula decussata	f	A	M	1	0.5 1.0	VOID 			Volcanic Siltstone: Dark greenish gray (5GY 4/1); sandy beds; fossiliferous matrix (part of core catcher sample is Foraminiferal Chalk; calcite cement; zeolitic.
		n	F	M						
		f n r	C F F	M M G	Core Catcher				*	

Explanatory notes in Chapter 1

Site 171 Hole Core 25 Cored Interval: 315 to 325 m



LITHOLOGIC DESCRIPTION

Volcanic Siltstone:

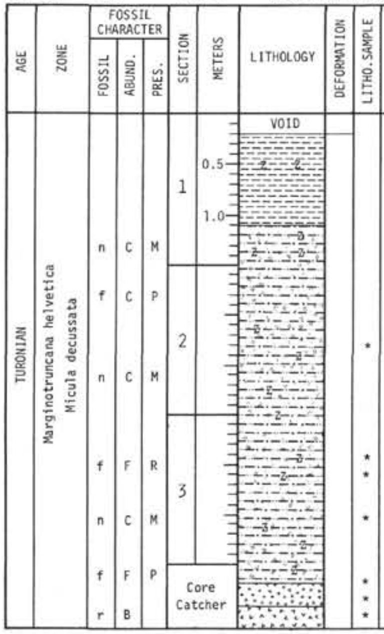
Speckled, overall olive gray (5Y 3/2 to 4/1) to medium gray (N4 to N5); finely laminated in part; ashy and zeolitic; sandy beds, of basalt and glass grains, especially below section 2. Pyritized foraminifera present. Foraminifera and nannofossils in calcareous matrix; sparry calcite cement.

110 to 150 cm
Claystones:

Medium bluish gray (5B 5/1); waxy; with contorted laminae of calcareous volcanic siltstone.

Explanatory notes in Chapter 1

Site 171 Hole Core 26 Cored Interval: 325 to 334 m



LITHOLOGIC DESCRIPTION

Claystone:

Medium bluish gray (5B 5/1); hard; waxy.

Volcanic Siltstone and Sandstone:

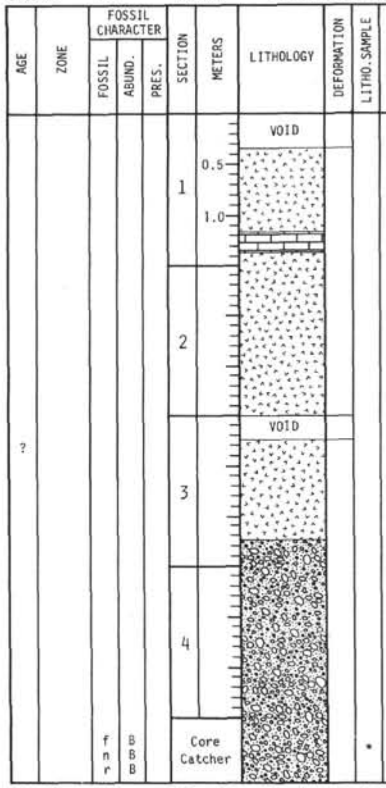
Olive to greenish gray (5GY 6/1, etc.); friable; with zeolites, nannofossils, foraminifers, and volcanic grains. Some Mudstone and Claystone. Portions have vague to faint laminae and mottles.
Some Mudstone and Claystone. Portions have vague to faint laminae and mottles.

Core catcher contained

Calcareous Volcanic Claystone, over
Hyaloclastite, over
Basalt:
Dark gray (N2); fine grained; vesicular.

Explanatory notes in Chapter 1

Site 171 Hole Core 27 Cored Interval: 334 to 343 m



LITHOLOGIC DESCRIPTION

Basalt:

Grayish black (n2); fine grained; abundant veinlets and amygdules of calcite, zeolite, and montmorillonite. Near base of Section 1, glassy selvages and engulfed sediment (?). Basalt is interpreted as a flow, not a sill.

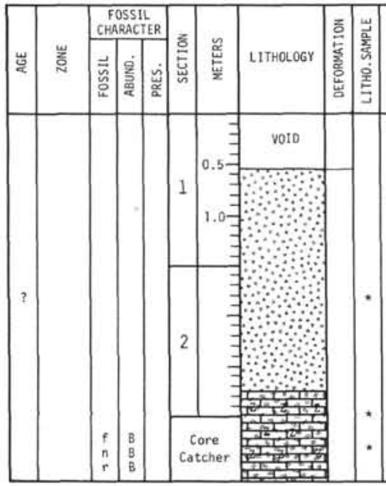
0 to 150 cm same as dominant lithology of Sect. 1.

25 to 117 cm same as dominant lithology of Sect. 1.

117 to 150 cm
Limestone and Basalt Conglomerate:

Limestone clasts to 3 cm diameter; angular to rounded; light brown (5YR 6/4) micritic limestone with external molds of small mollusks. Basalt clasts to 10 cm diameter; rounded; deeply weathered; commonly highly vesicular. Matrix of limestone and basalt sand. Sparry calcite cement. Limestone predominates in higher intervals, basalt does in lower intervals.

Site 171 Hole Core 28 Cored Interval: 343 to 352 m



LITHOLOGIC DESCRIPTION

Hyaloclastite:

Grayish orange overall (10YR 7/4); altered fragments range in color from yellowish green (5GY 7/4) to dark yellowish orange (10YR 6/6) and in size from a few mm to 2 cm diameter. Moderately altered to clay and palagonite. Calcite cemented. Distinct bedding.

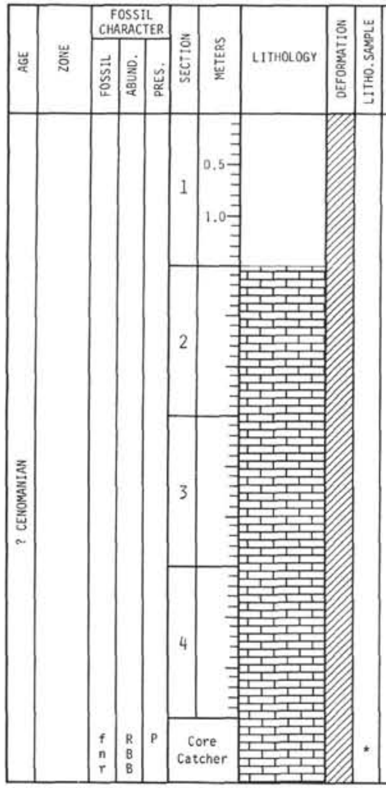
At 2-118 cm:

Zeolitic, Volcanic-rich, Limestone:

Grayish orange (10YR 7/4). Calcite is sparry; silt-sized grains of glass, palagonite, and clinoptilolite.

Explanatory notes in Chapter 1

Site 171 Hole Core 29 Cored Interval: 352 to 362 m



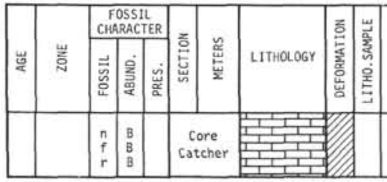
LITHOLOGIC DESCRIPTION

Section 1 not opened; appearance through liner same as lower sections.

Limestone:

Now a loose artificial coarse sand, ground and washed by the drilling process. Very pale orange (10YR 8/2); recrystallized calcite; highly fossiliferous, mainly as external molds of mollusks and echinoids.

Site 171 Hole Core 30 Cored Interval: 381 to 396 m



LITHOLOGIC DESCRIPTION

Limestone:

Very pale orange (10YR 8/2); molds of tiny mollusks. All in sand-sized fragments.

Explanatory notes in Chapter 1

Site 171 Hole Core 31 Cored Interval: 399 to 408 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
		f n r	B B B		Core Catcher				*	Limestone: Only a trace of sand-sized limestone fragments recovered.

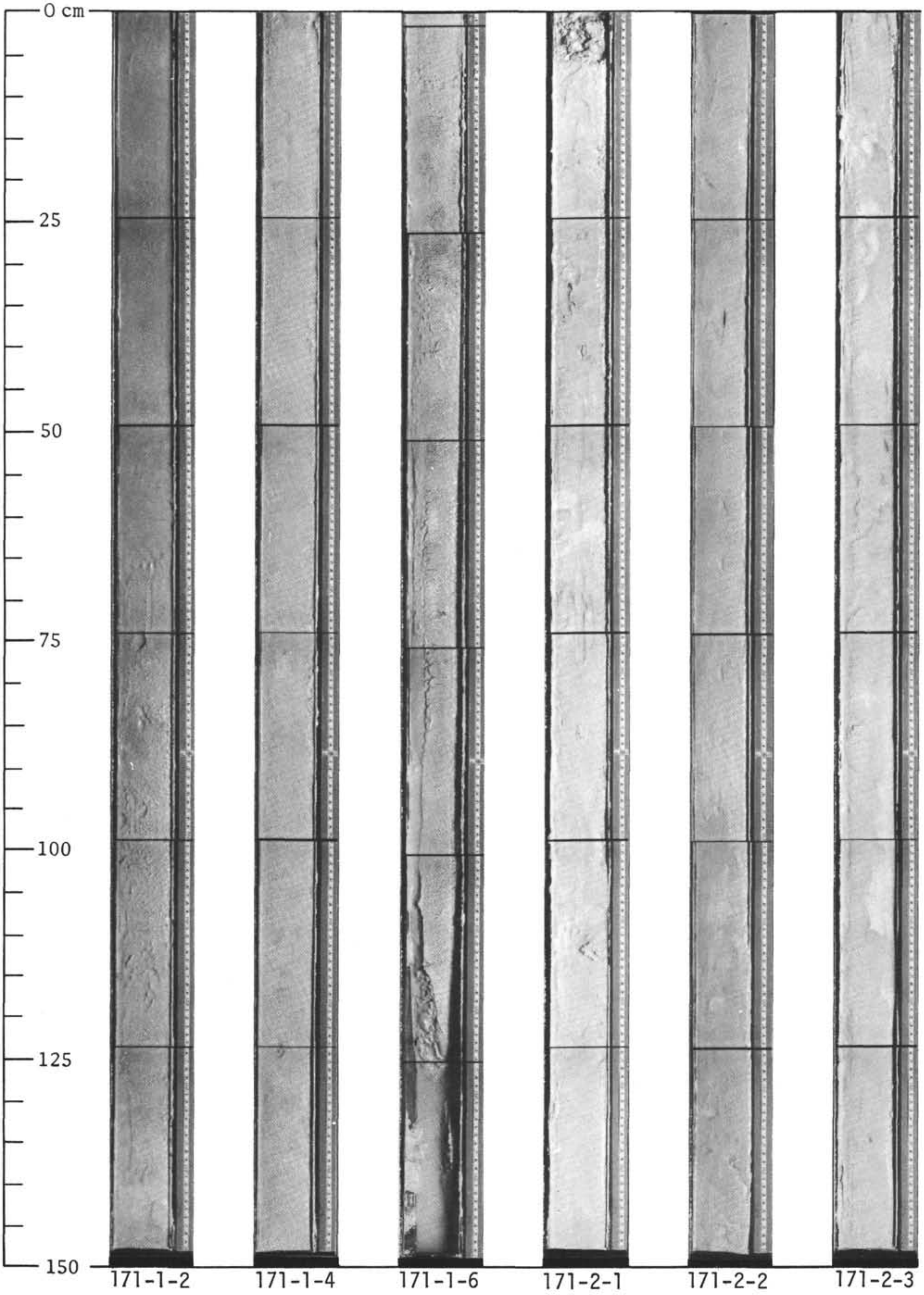
Site 171 Hole Core 32 Cored Interval: 408 to 464 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
					1	0.5 1.0				Limestone: Ground and washed by drilling process to a coarse sand, 1 to 4 mm diameter. Light gray to dark yellowish gray (10YR 6/6); Molds of fossils; now all is recrystallized calcite.
					2					Section 2 not opened. Appearance through liner same as Section 1.
		f n r	B B B		Core Catcher					

Site 171 Hole Core 33 Cored Interval. 464 to 479 m

AGE	ZONE	FOSSIL CHARACTER			SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		FOSSIL	ABUND.	PRES.						
		f n r	B B B		Core Catcher					Fragments of: Limestone: Yellowish chips; recrystallized; and Basalt: Brown; weathered; vesicular; 5 cm maximum diameter. No piece shows obvious cutting by bit. Three larger and several smaller pieces.

Explanatory notes in Chapter 1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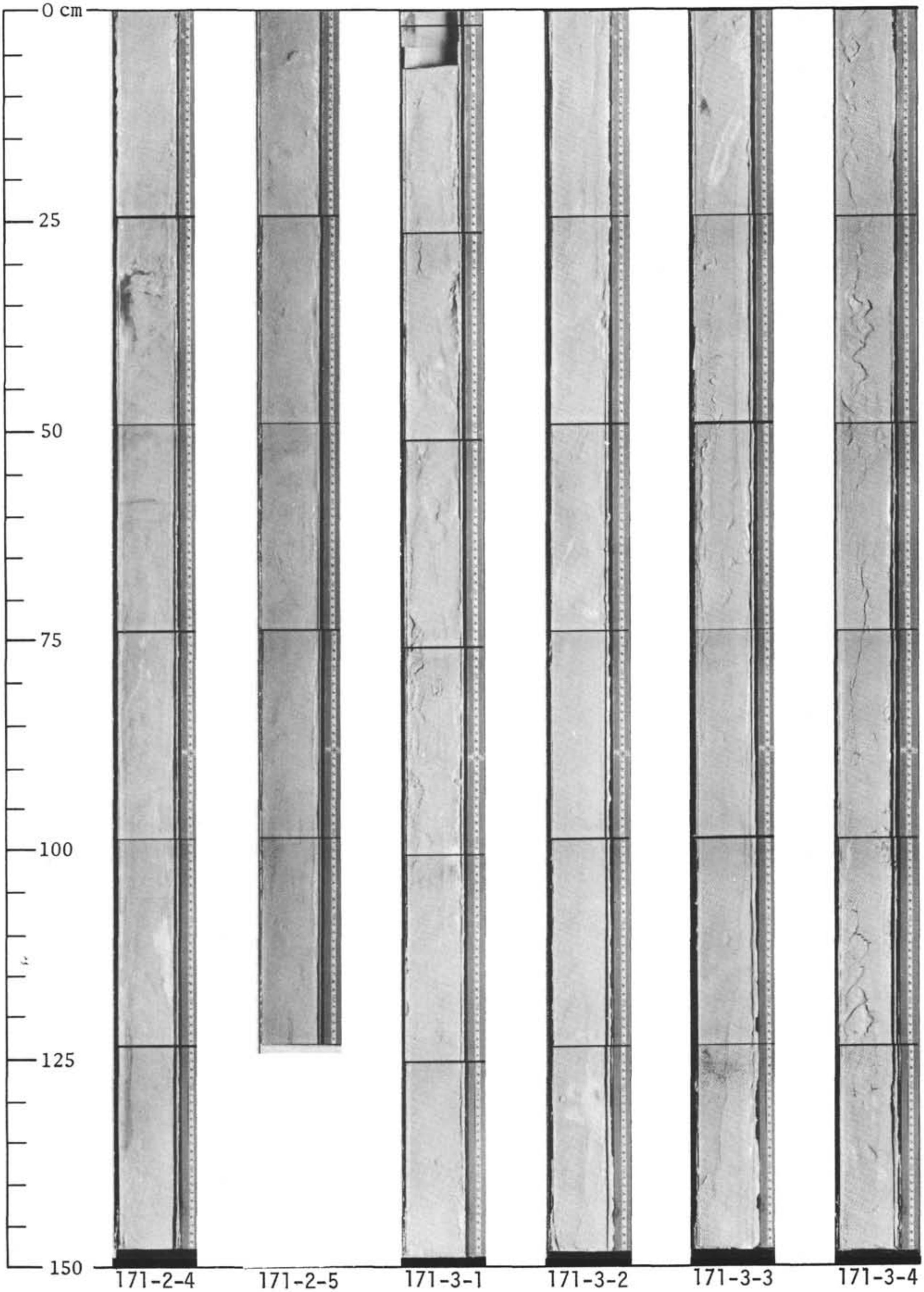
171-1-4
171-1-6
171-2-1
171-2-2
171-2-3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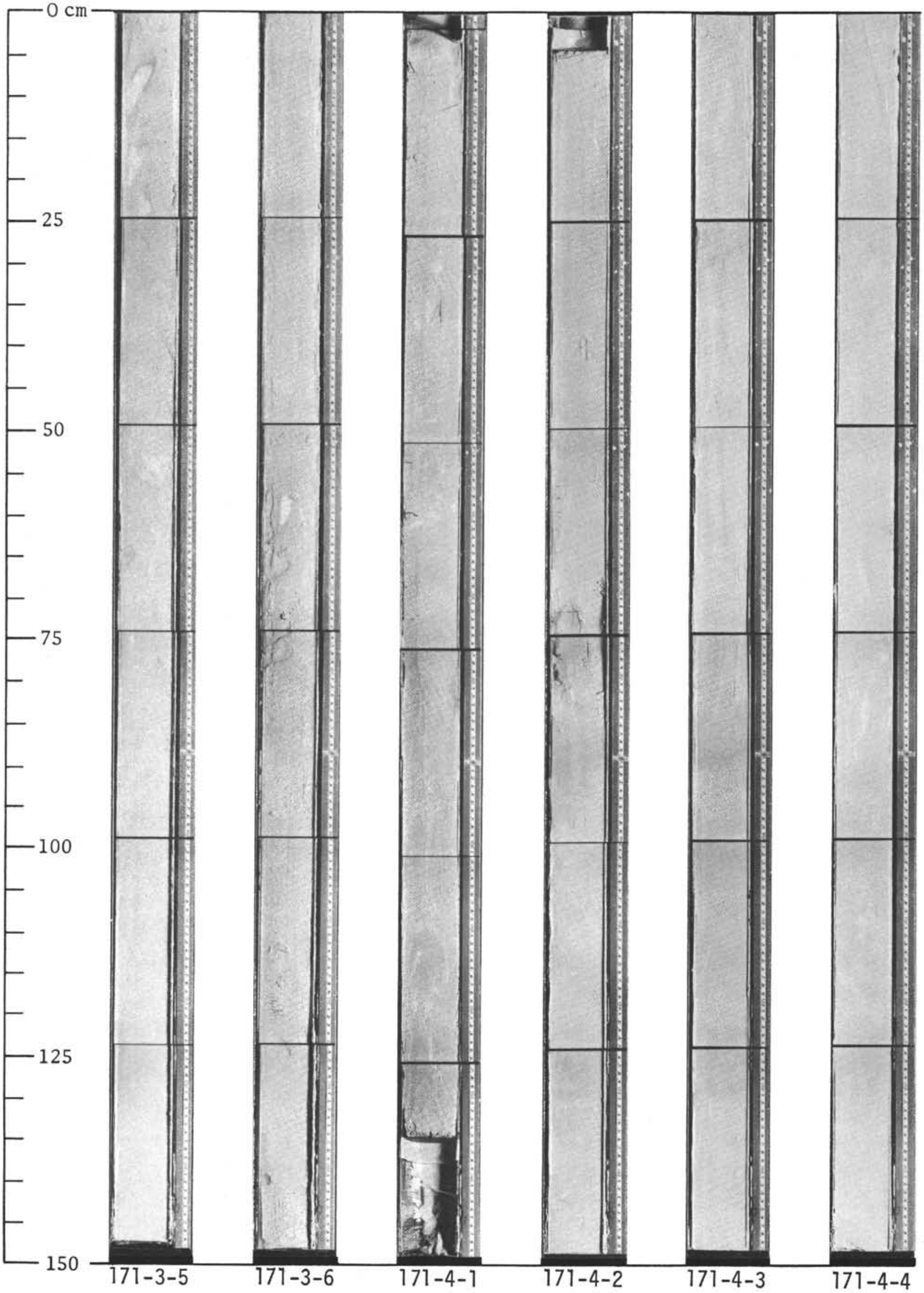
171-3-1
171-3-2
171-3-3
171-3-4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171-4-2
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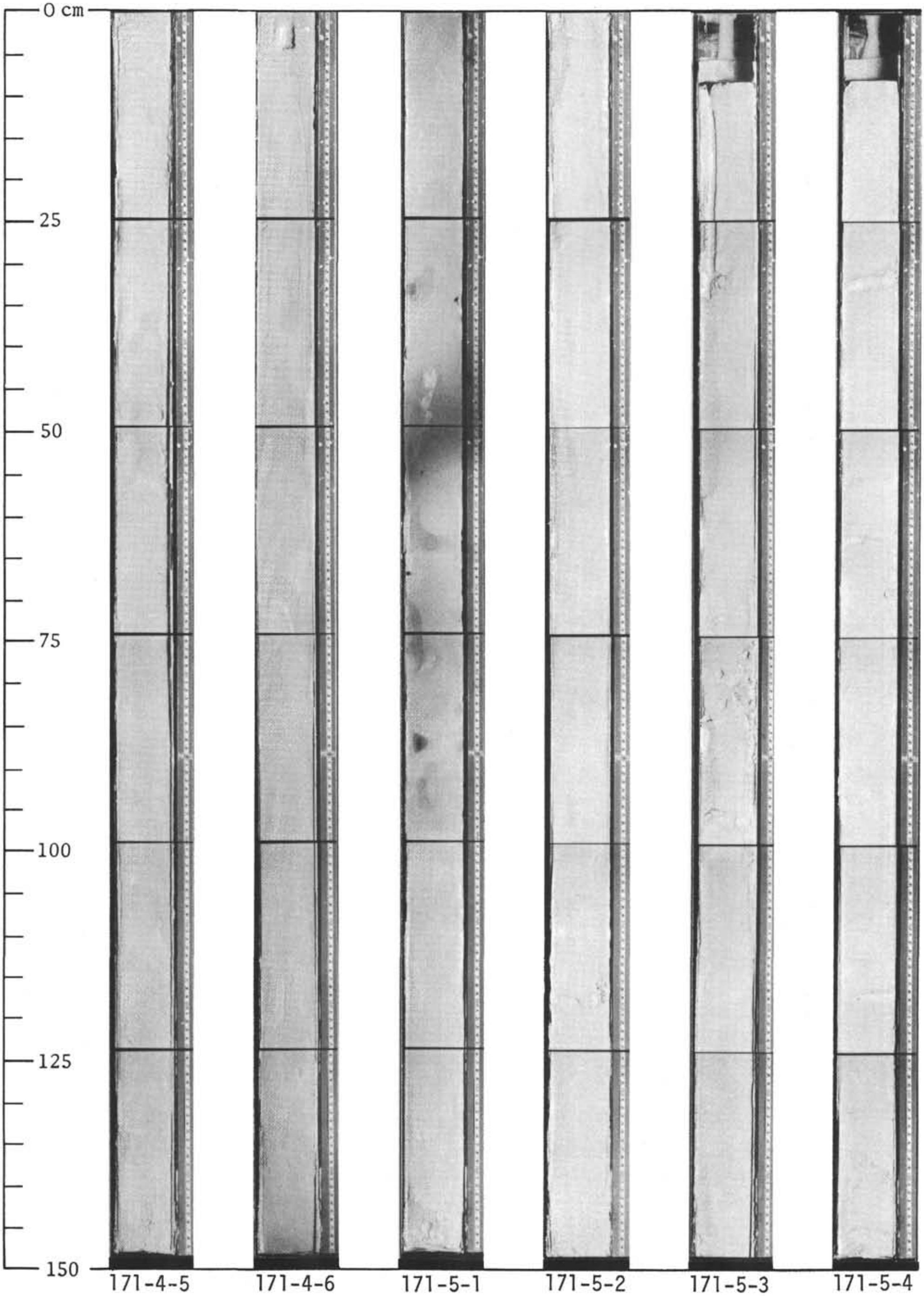
171-4-4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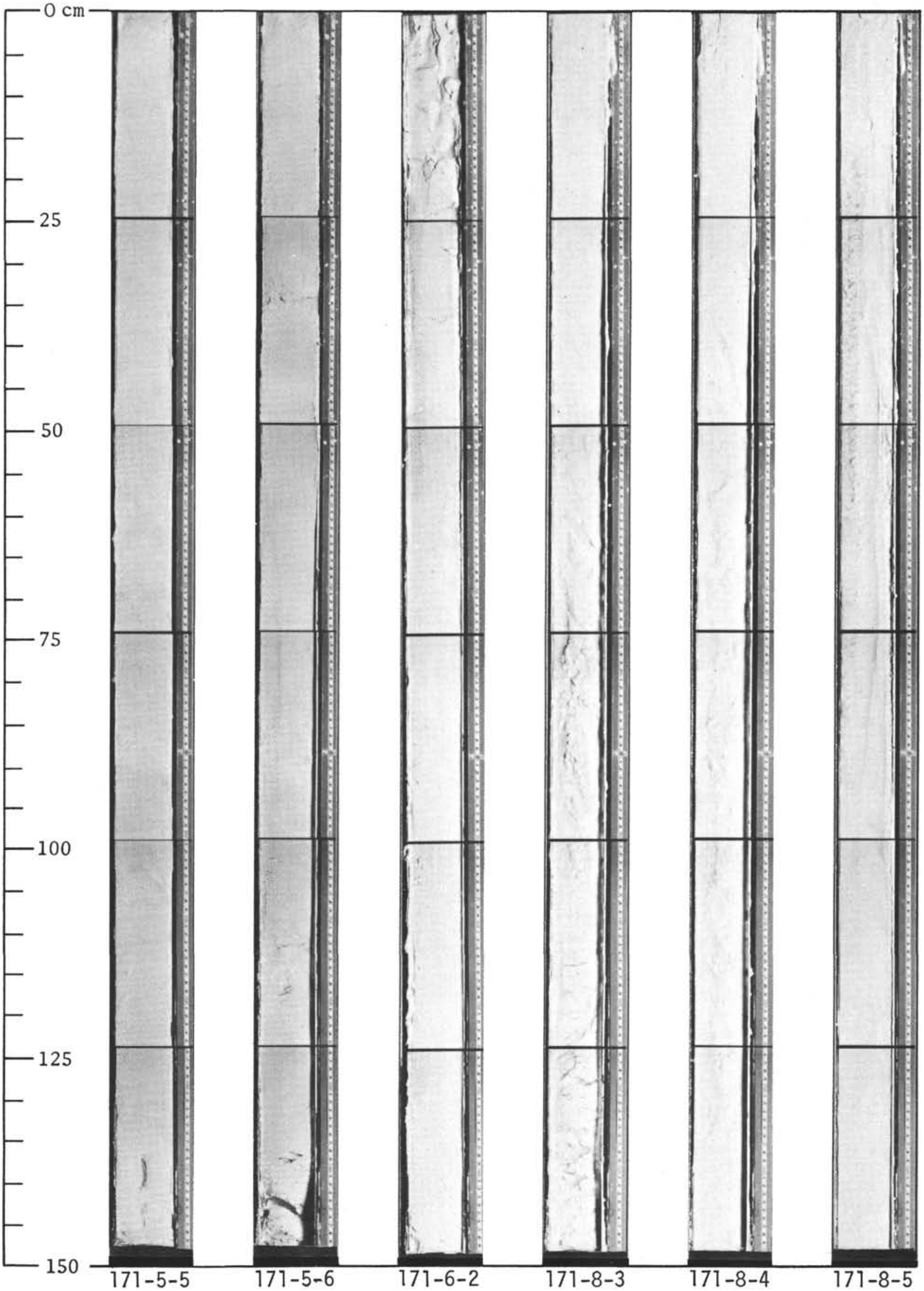
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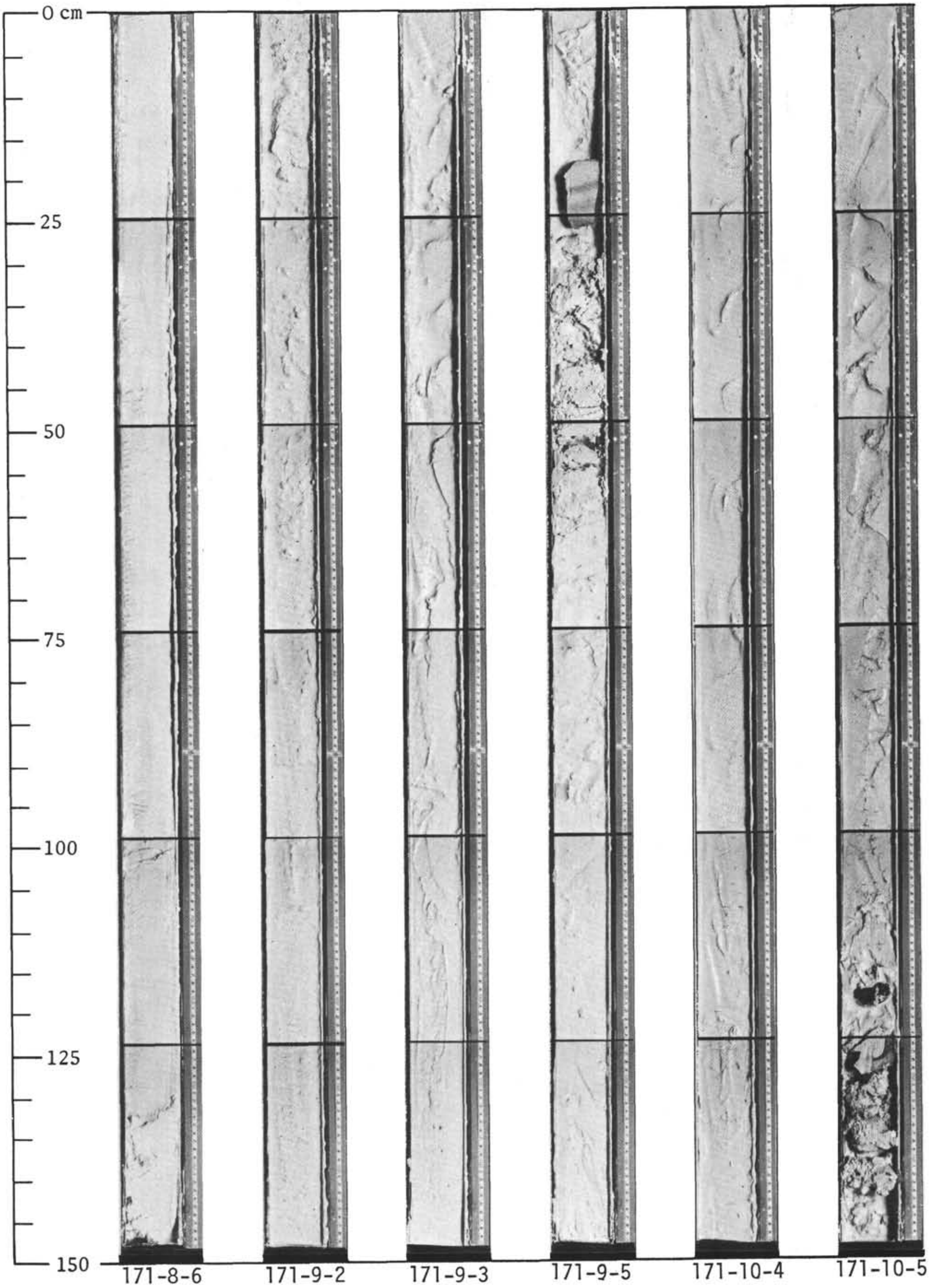
171-8-5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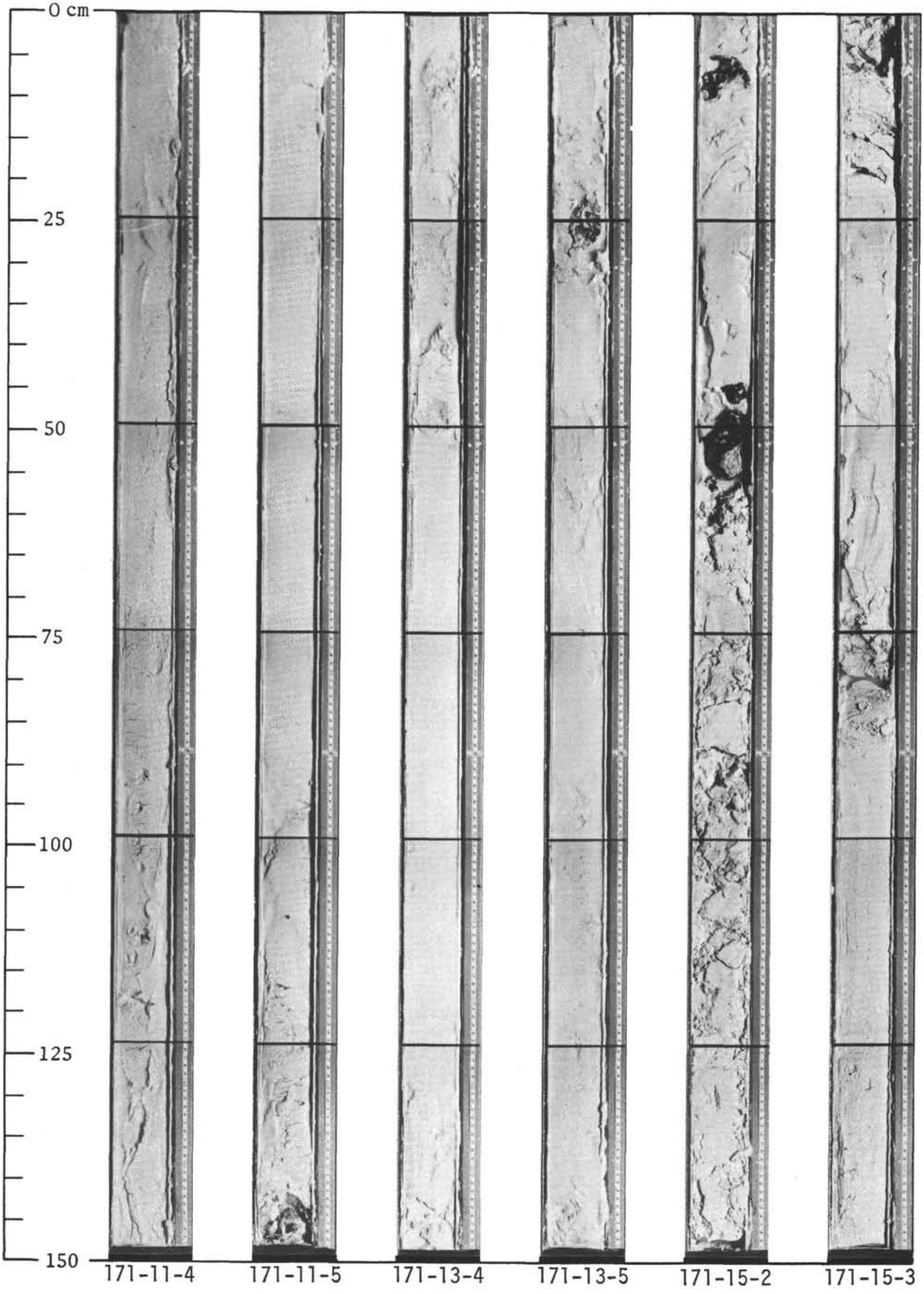
171-9-5
171-10-4
171-10-5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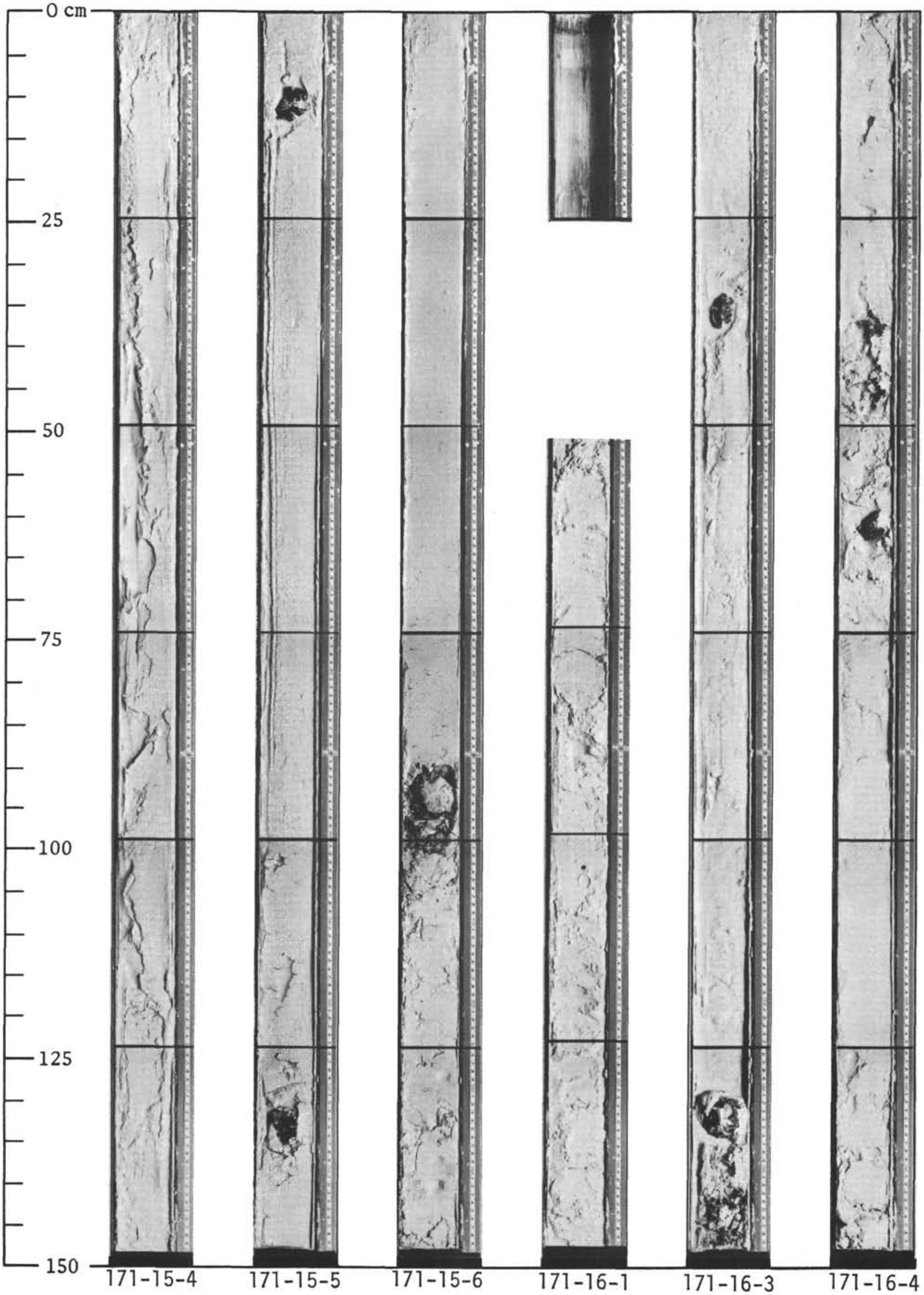
171-13-5
171-15-2
171-15-3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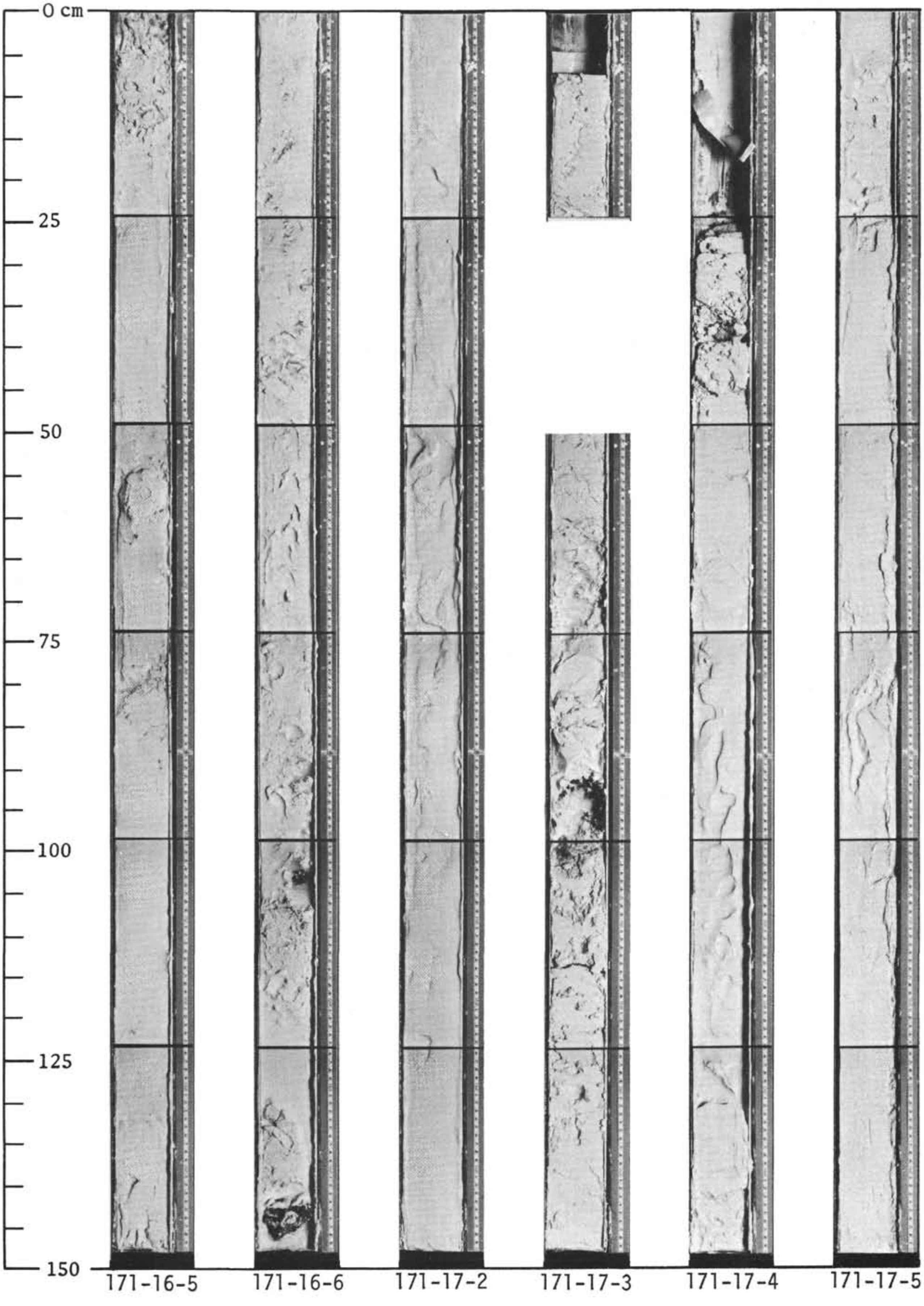
171-16-4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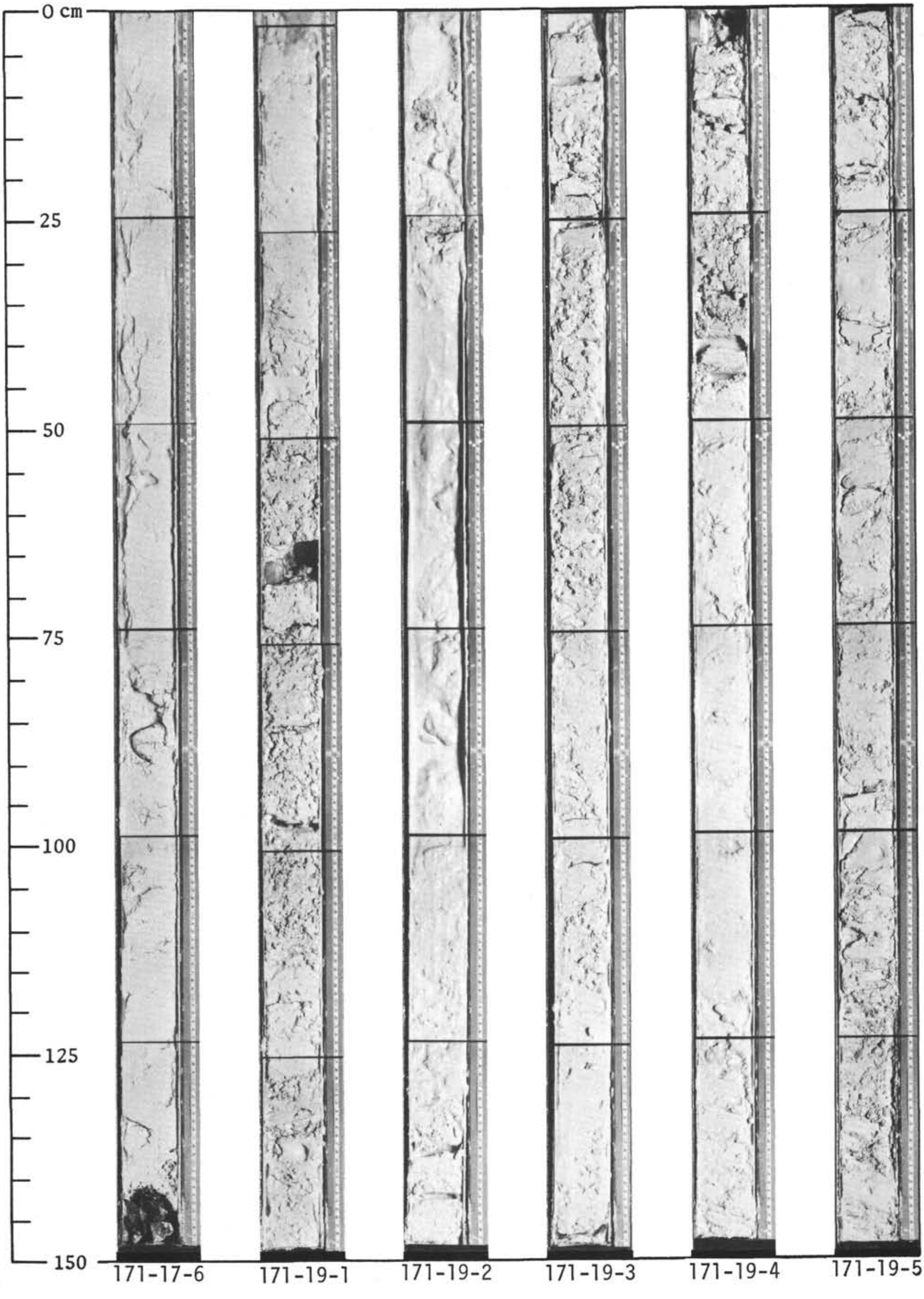
171-17-5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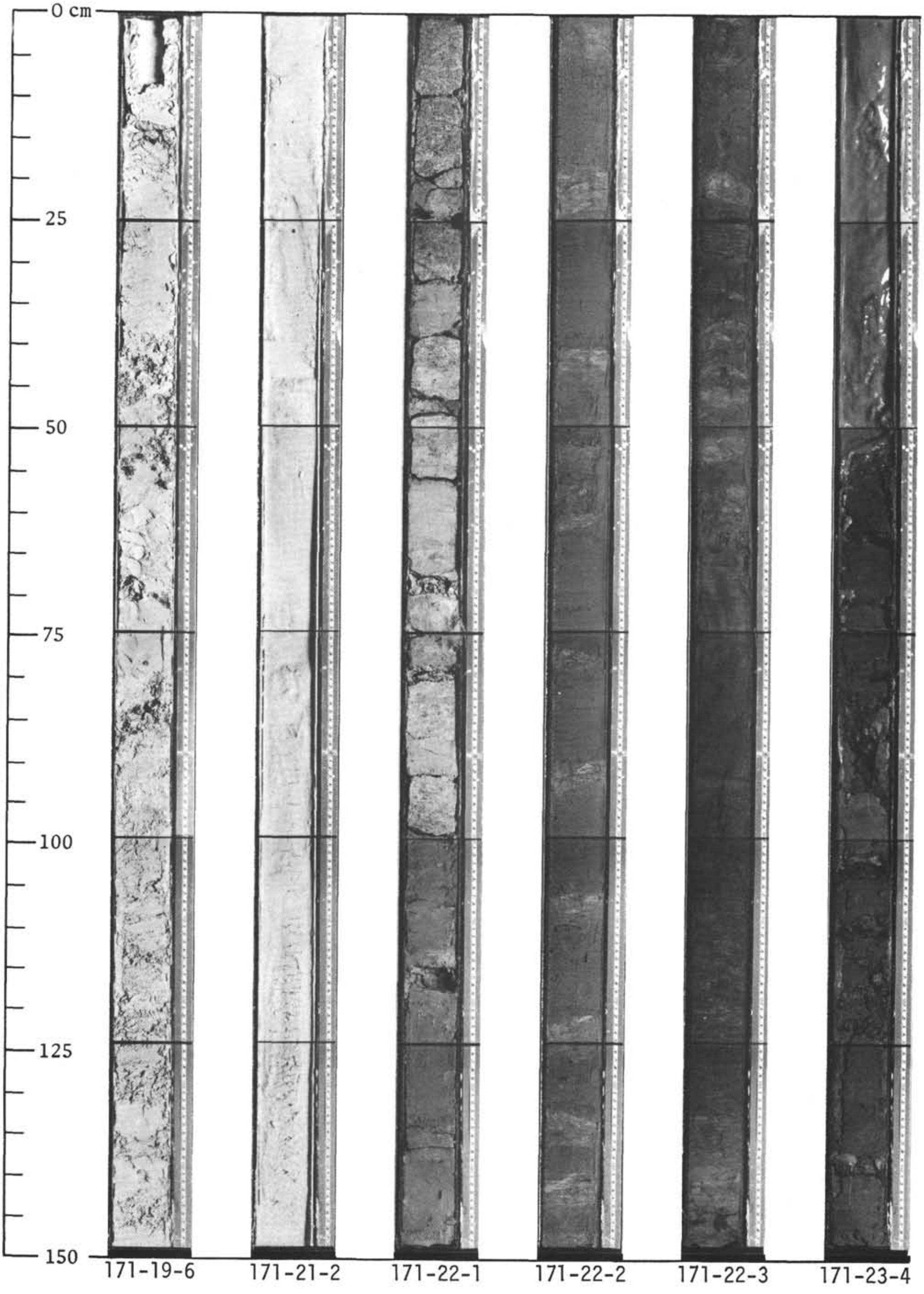
171-19-3
171-19-4
171-19-5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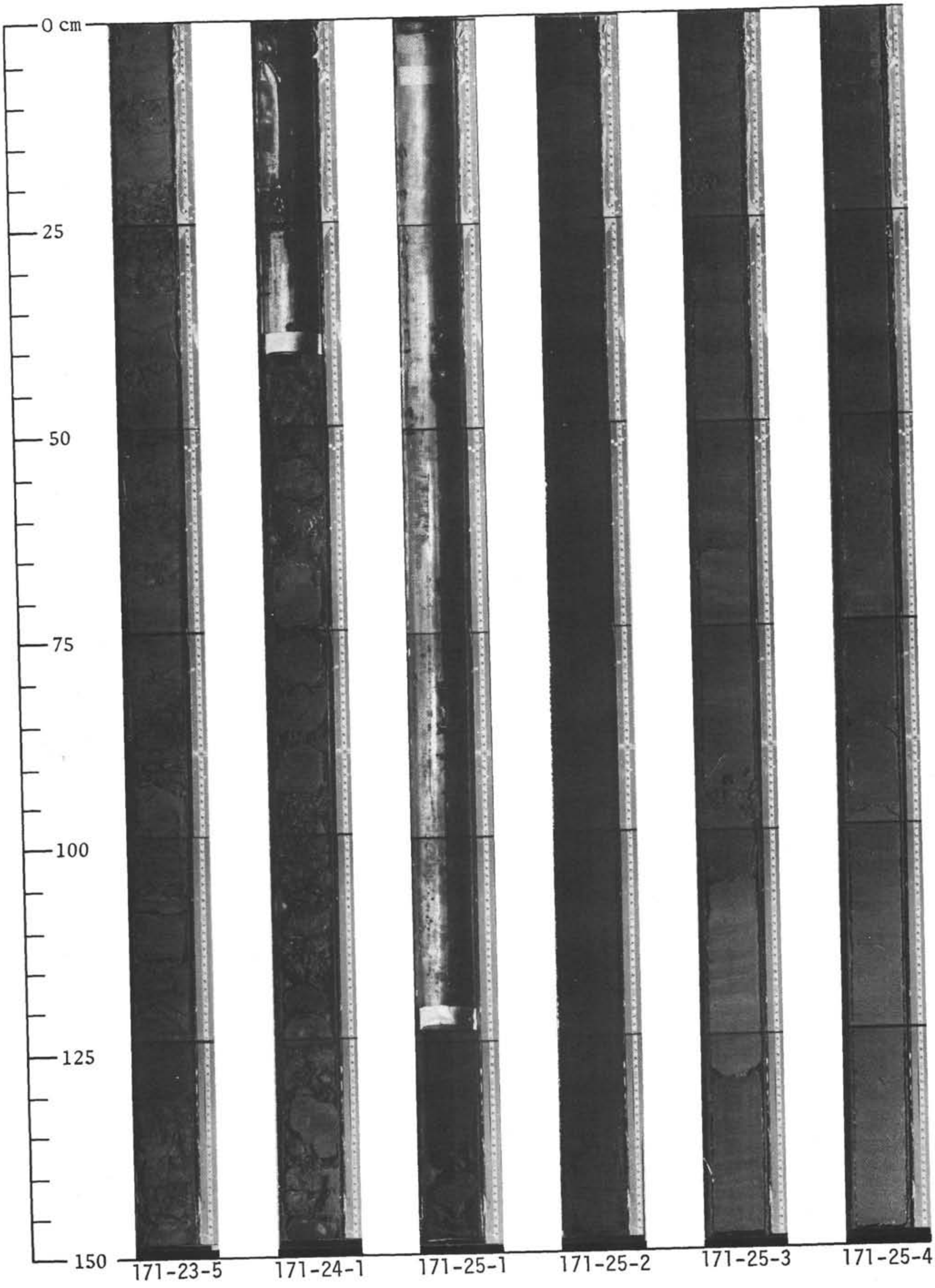
171-22-1
171-22-2
171-22-3
171-23-4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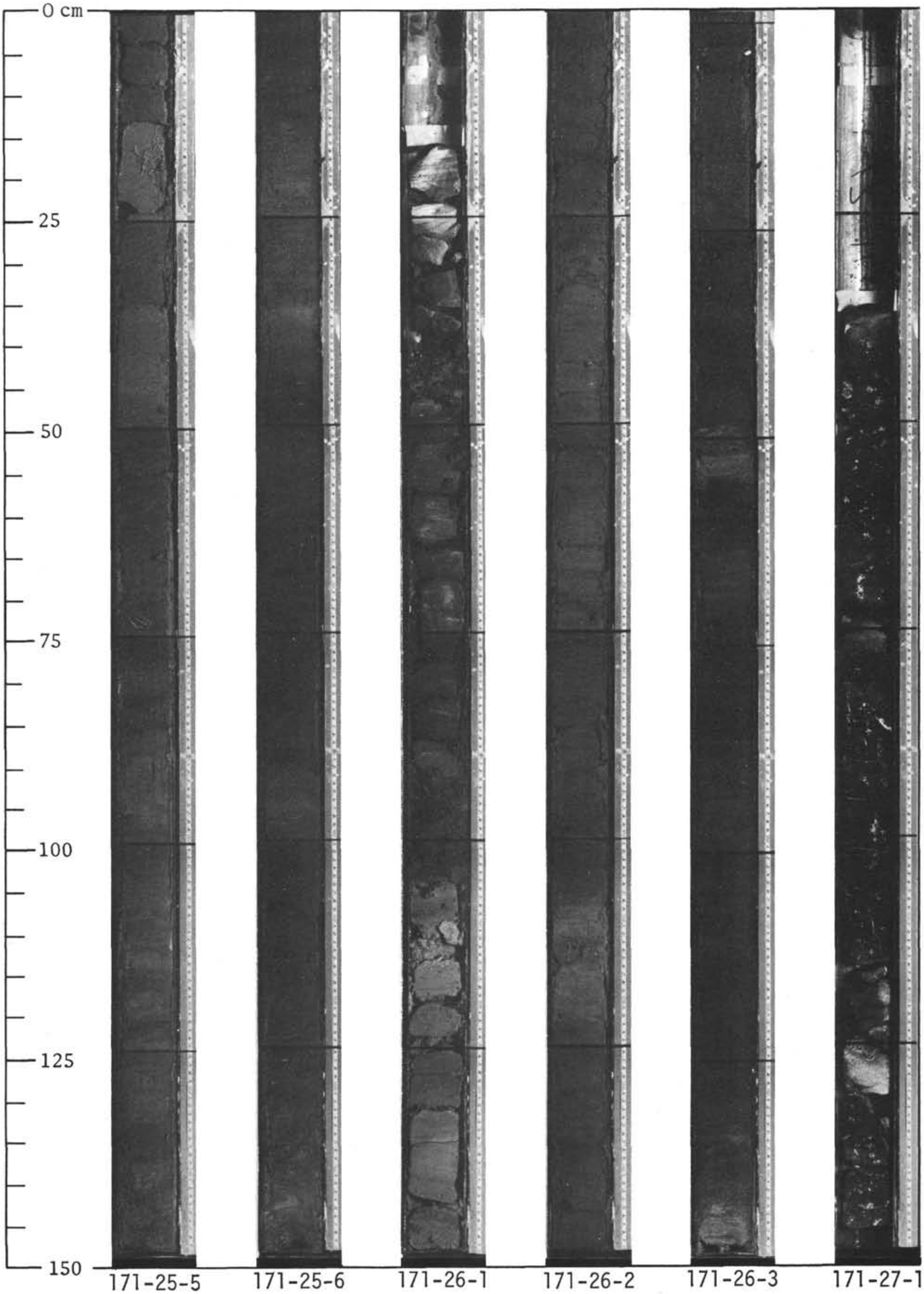
171-25-1
171-25-2
171-25-3
171-25-4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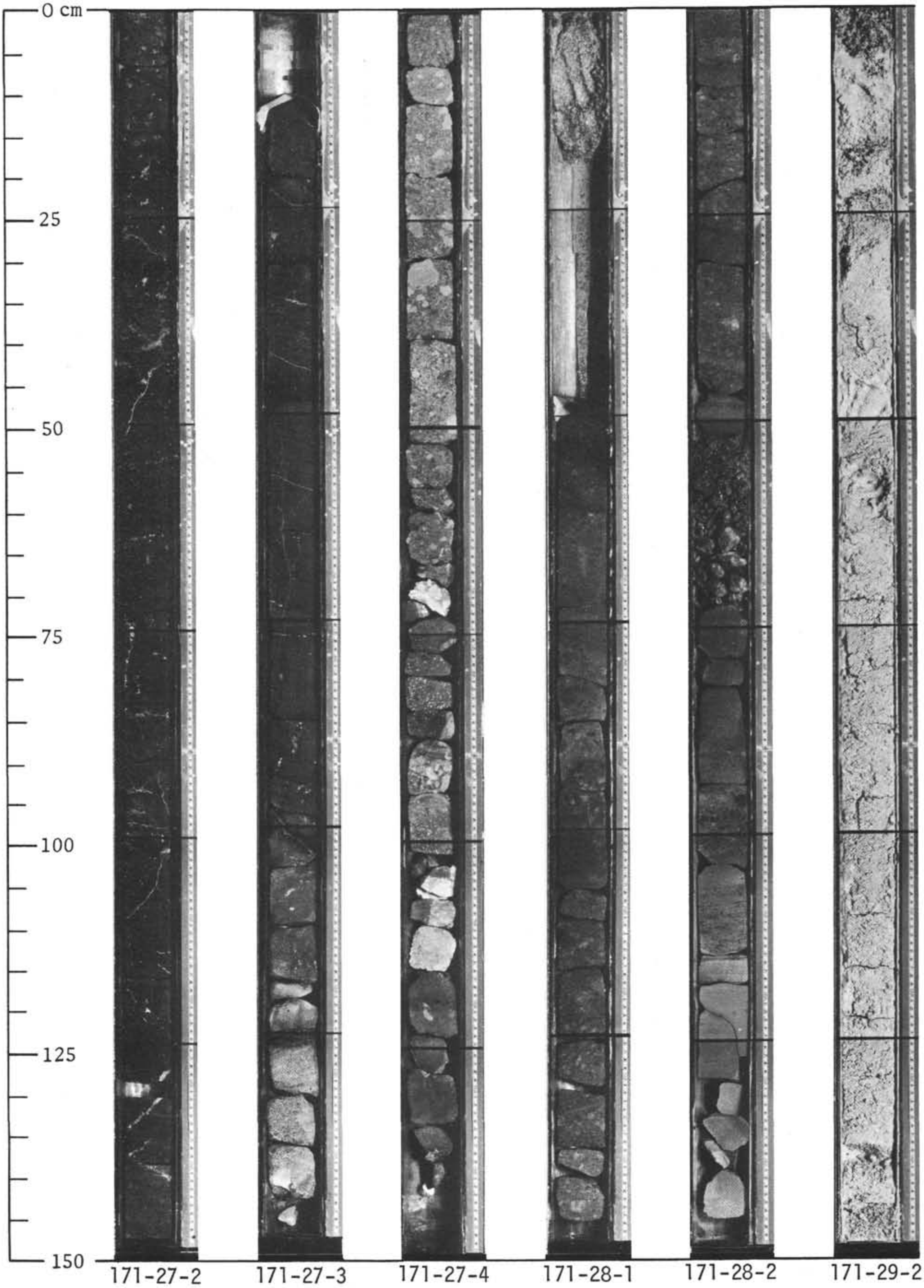
171-25-6
171-26-1
171-26-2
171-26-3
171-27-1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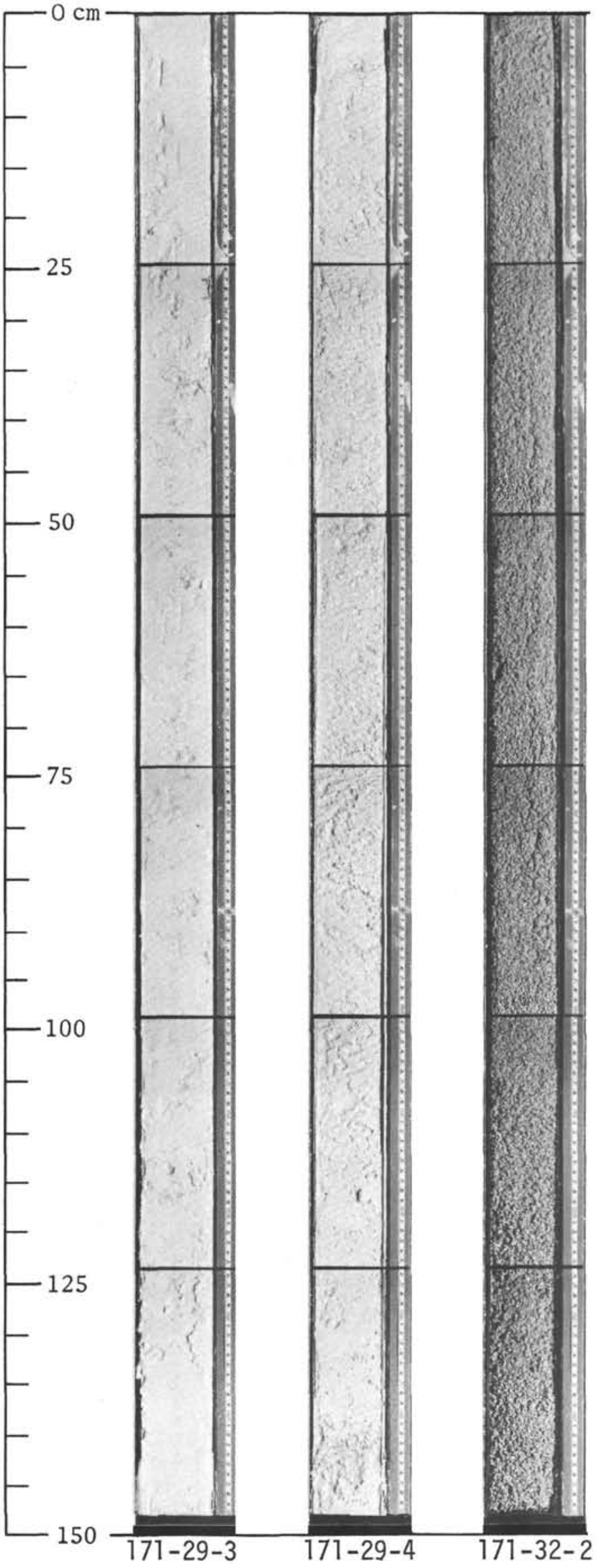
171-28-1
171-28-2
171-29-2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