6. SITE 105 – LOWER CONTINENTAL RISE HILLS

The Shipboard Scientific Party[1]

INTRODUCTION

In view of the fact that thick sections of Neocomian and Jurassic limestone were found in the region off the Bahama Islands (Holes 99A, 100 and 101), and that two new carbide button roller bits had been received in Norfolk, a hole was selected for drilling between New York and Bermuda at a position where knowledge might be gained about the structure and composition of the lower continental rise hills. In addition, such a hole would ascertain the age of the crust and whether the β reflector indicates the presence of limestone in this area as it did in the south. Accordingly, a site was chosen at 34° 54′ N; 69° 10′ W (Figure 1) where basement comes to within 0.6 to 0.7 second reflection time of the sea floor, and where Horizon β is present (Figure 2a). There are two prominent reflectors in this region, labeled A and A* in Figure 2a, that lie at about 0.30 and 0.35 second below the sea floor. One objective was to determine if either of these reflectors corresponds to the early-middle Eocene cherts cored during Legs 1 and 2. In the immediate vicinity of the hole these two reflectors apparently merge.

OPERATIONS

The ship arrived on site during the morning of 13 May, 1970; and drilling commenced at 2020 hours on the same day. Apparently because of an appreciable amount of silt in the upper part of the section, penetration without circulating water was not possible; consequently, there was no attempt made to take shallow cores. The first four samples taken between the sea floor and the first prominent reflector at 0.30 second consist of gray, silty hemipelagic mud (Figure 3). Presumably the lower continental rise hills are composed of a similar material.

It was hoped that Core 5 would sample the first prominent reflector, presumably A, and it was expected that a change in drilling rate would signal the arrival of the bit at the reflector level. However, the indication of change was very slight and the core was probably taken a few meters below the top of the reflecting zone. The cored material was a multicolored, firm, layered clay indicative of a definite lithologic change from the above, more homogeneous gray-green silty clay. Cores 6, 7 and 8 and the upper part of Core 9 contained similar material which, unfortunately, is very difficult to date. It appears most likely to be of early Tertiary but could be of late Cretaceous age. Although no core here definitely contained Eocene sediment, and no chert was recovered, we judge that the reflector at 0.30 second is Horizon A.

The lower part of Core 9 contains the boundary between the multicolored layer and a very dark carbonaceous clay of early Cretaceous age. This is the most likely lithologic boundary to associate with reflector A*. The drilling-rate graph provides some support for the correlation, although there are two small drilling breaks instead of one. There was no other significant lithologic change until a depth of about 450 meters, where limestones were encountered. The next, and last, major lithologic change was at 623 meters at the top of the basalt. The drilling was continued into the basalt for 9 meters in an effort to determine whether it was a flow or a sill. Recovery of samples was essentially the same as the depth penetrated, and no soft spots were noticed in the drilling; so it can be concluded that at least the upper 9 meters is mainly solid basalt.

STRATIGRAPHY

Biostratigraphy

Foraminifera and Macrofossils

Neogene planktonic foraminifers from only the Holocene and Pleistocene are present at this site (Cores 1 and 2). Other Tertiary foraminifers were not observed, except for some agglutinated benthonic forms that may be contamination from the overlying Quaternary.

Core 1 contains a Holocene assemblage of tropical/subtropical planktonic species and abundant agglutinated benthonic species. Large specimens of *Globorotalia cultrata* (sinistral) are especially abundant. Although many specimens display solution effects, the assemblage is large and contains a high species diversity. This suggests that rapid deposition prevented complete destruction even though deposition occurred below the calcium carbonate compensation depth.

Core 2 contains a Pleistocene fauna dominated by *Turborotalia inflata*; *Globorotalia truncatulinoides* is also present in lower abundance. Nannofossils, however, indicate a Pliocene age for this core, so the foraminifers may be contamination from younger beds.

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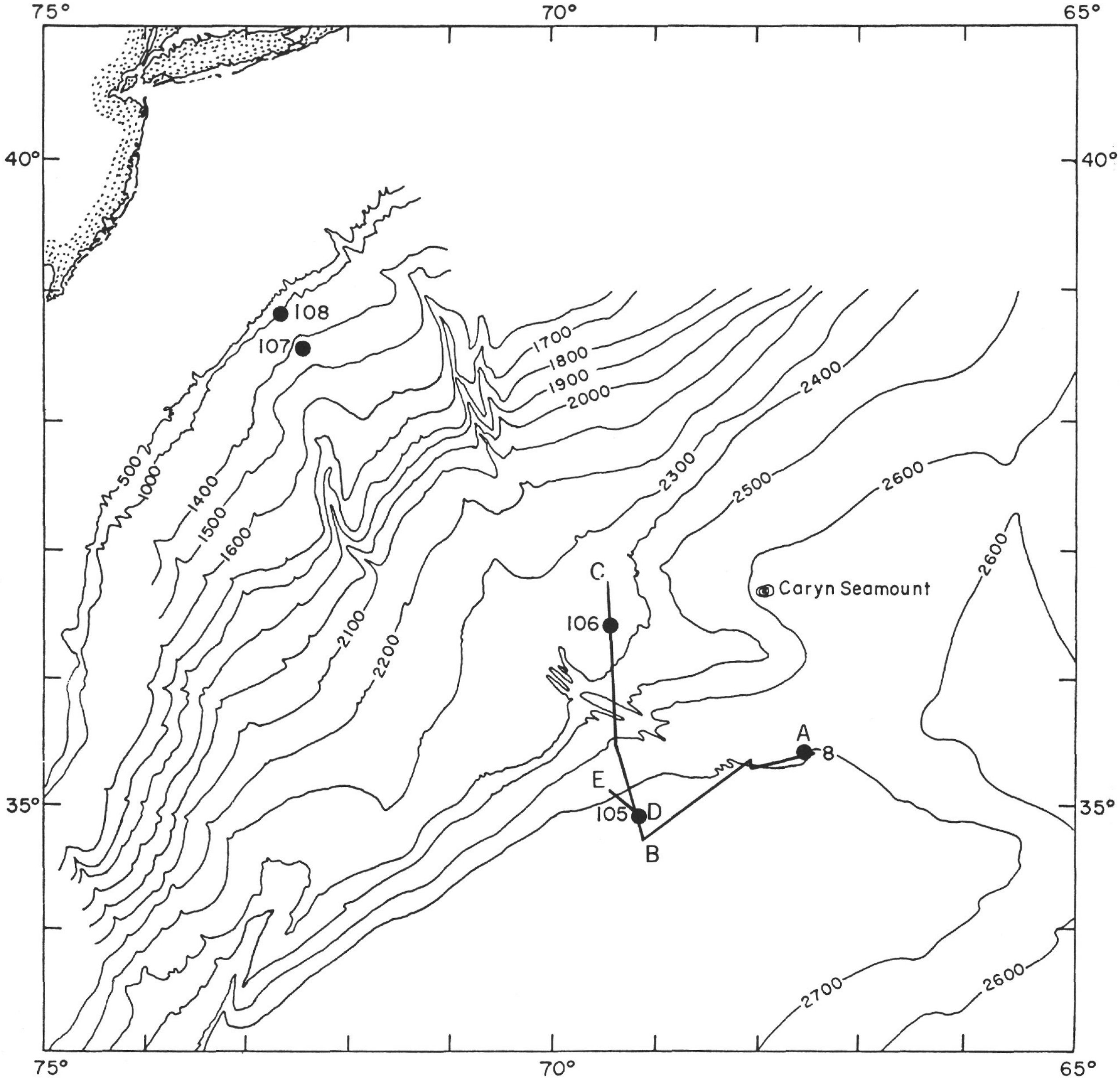

Figure 1. *Bathymetry of the continental slope and rise Southeast of New York. Track AB corresponds to profiler section in Figure 2a; Track BC to Figure 2b; Track DE to Figure 2c. (Track FG corresponds to Figure 2, Chapter 8).*

The five samples washed from Core 9 contain only very rare radiolarians and a few fish scales. The first foraminifers occur in Samples 105-10-1, 52 to 54 centimeters and 120 to 122 centimeters. They are rare and comprise poorly preserved, primitive, agglutinated foraminifers of Cretaceous aspect (*Glomospira* sp., *Reophax* spp., *Bathysiphon* (?) sp., *Haplophragmoides* sp.).

The first planktonic foraminifers occur in Sample 105-10-2, 75 to 77 centimeters, in which a few poorly preserved specimens of *Hedbergella* are present (*H. amabilis* Loeblich and Tappan, *H. planispira* (Tappan), *H. globigerinelloides* (Subbotina)). They indicate a mid-Cretaceous age.

The fossil content of the samples examined from Cores 11 and 12 varies greatly. Samples rich in well-preserved planktonic foraminifers alternate with intervals that are barren or contain only a few badly preserved radiolarians. Fish scales and teeth are present throughout the samples. The most significant species of planktonic foraminifers are: *Rotalipora apenninica apenninica* (Renz), *R. apenninica primitiva* Borsetti, *Planomalina buxtorfi* (Gandolfi), *Praeglobotruncana delrioensis* (Plummer), and *Schackoina cenomana* (Schacko). These species indicate a late Albian or earliest Cenomanian age. Core 105-11 correlates with Core 101A-4.

The samples from the interval represented by the Cores 13, 14, 15 and 16 are either barren, or contain only very few, poorly preserved, in part pyritized, radiolarians.

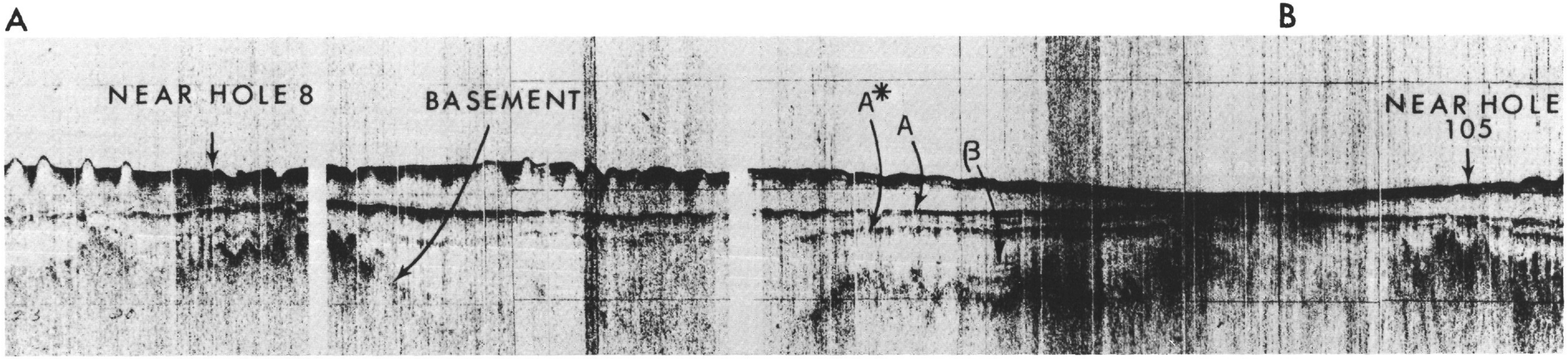

Figure 2a. Vema 23 *seismic profiler record AB between Site 8 and 105. See Figure 1 for location.*

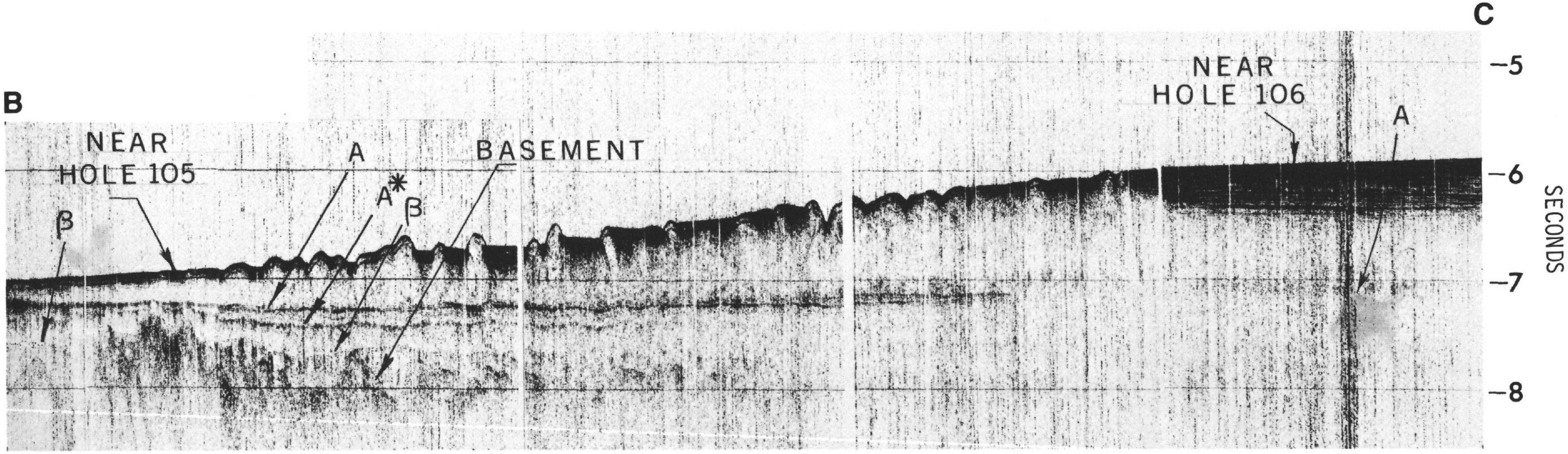

Figure 2b. Vema 23 *seismic profiler record BC between Hole 105 and 106. See Figure 1 for location.*

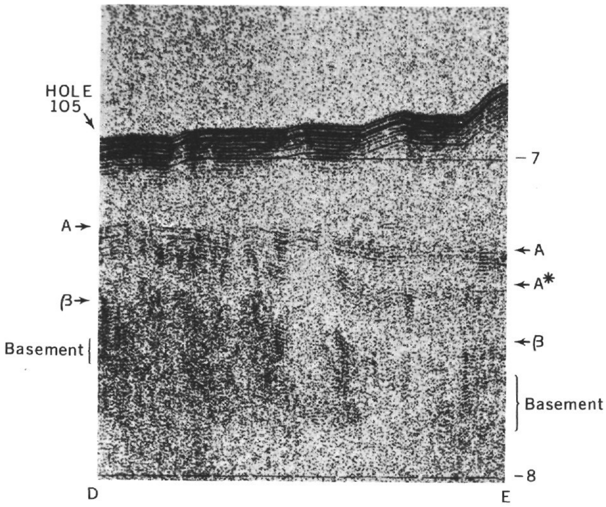

Figure 2c. Glomar Challenger *seismic profiler record DE approaching Hole 105.*

A few dwarfed planktonic foraminifers occur in Core 17 (*Hedbergella* sp. aff. *H. infracretacea* (Glaessner), *H. globigerinelloides* (Subbotina) *H. hauterivica* (Subbotina), *Globigerinelloides ultramicra* (Subbotina)). Similar assemblages are described, although with varying specific names, from Hauterivian to early Aptian deposits of the Alpine-Mediterranean area and Trinidad. The rare associated benthonic foraminifera are mainly lagenids and primitive agglutinated foraminifers.

Sections 4 and 5 of Core 18 yielded a considerable number of well-preserved aptychi (opercular structures of ammonites), among which the following forms could be determined: Lamellaptychus angulocostatus (Peters), L. seranonis (Coquand), L. angulocostatus atlanticus (Henning), L. angulocostatus radiatus (Trauth), and L. joides new form O. Renz (see article by O. Renz in this volume). With the exception of one new form, all the recovered forms are also known from the Alpine-Mediterranean faunal province. Based on their occurrence in this area, the aptychi of Core 18 indicate a Late Valanginian-Hauterivian age. Similar assemblages are also known from the Viñales Formation of Cuba and from the Cape Verde Islands.

The foraminiferal faunas associated with these aptychi are poor and restricted to thin zones. The faunules are excellently preserved in places; they are dominated by lagenids and primitive agglutinated foraminifers. *Lenticulina ouachensis ouachensis* (Sigal) and *Lenticulina ouachensis multicella* Bartenstein, Bettenstaedt and Bolli are the most prominent species. They are both known from the Lower Cretaceous of Trinidad. The range of *Lenticulina ouachensis ouachensis* (Sigal) is given as Hauterivian to early Aptian (Trinidad, northern Europe, circum-Mediterranean, southern Africa).

The foraminiferal faunas of the core catcher samples of Cores 19, 20, and 21 are poor, and badly preserved. The presence of *Dorothia praehauteriviana* Dieni and Massari might have stratigraphic significance. This species was first described from the Valanginian of Sardinia. Lagenids (mainly *Lenticulina* spp., *Vaginulina* spp.) dominate the assemblages.

Most of the samples examined from the interval corresponding to Cores 22 to 32 contain only poorly preserved radiolarians and occasional primitive, agglutinated foraminifers. Rare lagenids were recovered from a few levels. Thin sections from the same interval reveal the presence of nannoconids, questionable tintinnids, and *Stomiosphaera*-like organisms.

Sample 105-33-1, 42-43 centimeters contains tintinnids which can be determined specifically. The most common species *Calpionella alpina* Lorenz and *Tintinnopsella carpathica* (Murgeanu and Filipescu) indicate an earliest Cretaceous or latest Jurassic age for this level (see chapter by R. Lehman in this volume).

The microfaunas recovered from the reddish-brown clay and mudstone of Cores 33 to 40 are again rich and varied. The foraminiferal faunas are mainly composed of lagenids (*Lenticulina* spp., *Astacolus* spp., *Marginulina* spp., *Dentalina* spp., *Pseudonodosaria* spp., *Nodosaria* spp., *Frondicularia* spp., and others), *Spirillina* spp., *Marssonella* (?) sp. and primitive agglutinated foraminifers (*Hyperammina* sp., *Tolypammina* sp., *Bathysiphon* (?) sp., *Placopisilina* (?) sp., *Reophax* spp., *Ammobaculites* spp., *Textularia* spp.) (see chapter by H. P. Luterbacher in this volume). Noteworthy is the occurrence of the genus *Brotzenia* in Cores 36 and 37. "*Globigerina*" *helvetojurassica* Haeusler occurs in Core 37 in clasts of a light limestone which are probably derived from local highs (see chapter by D. Bernoulli in this volume). The foraminiferal assemblages compare very well with those described from the European Upper Jurassic. A few species are also in common with the Jurassic of the western interior of the United States and Saskatchewan. A striking similarity exists with a foraminiferal fauna from the bathyal deposits of the Malm in the central Appennines, probably deposited under similar conditions.

The ostracode faunas of the Cores 33 to 39 are dominated by representatives of the genus *Bairdia*. In addition, a few forms attributed to the genera *Cytherella, Pontocyprella, Monoceratina, Polycope, Saipanetta* and others occur. Of special interest is the presence of two species (*Bairdia italica* Oertli, *Bairdia (Akidobairdia) farinacciae* Oertli), which have been hitherto known only from the Malm of the central Appennines. The ostracode assemblages indicate a deep-water environment (bathyal to slightly outerneritic). A more detailed discussion of the ostracode faunas is given in the chapter by H. Oertli in this volume.

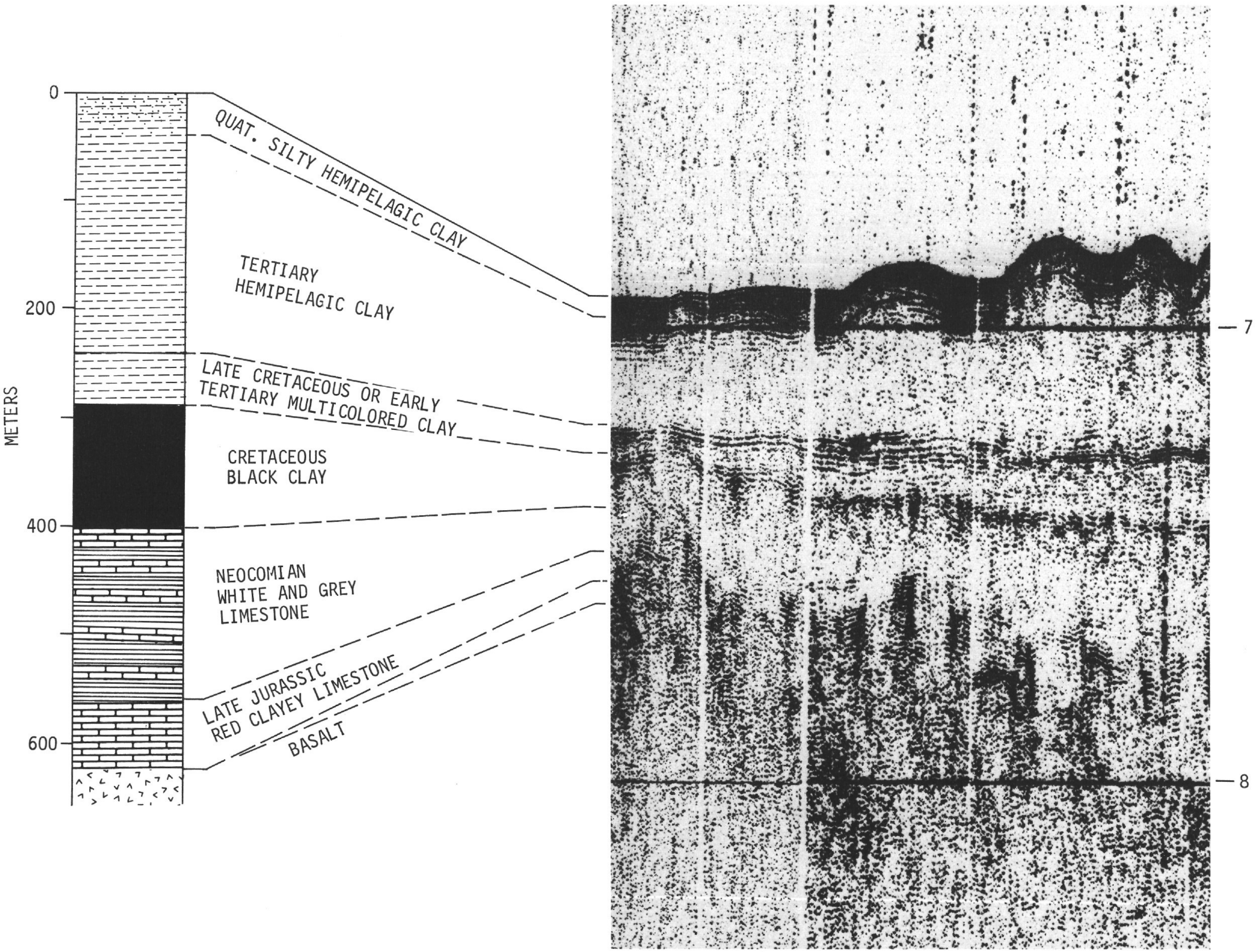

Figure 2d. *Correlations of lithology and seismic stratigraphy at Hole 105.*

Cores 33 to 38 contain skeletal elements of *Saccocoma,* a pelagic crinoid. The presence of *Saccocoma* sp. cf. *S. quenstedti* Sieverts-Doreck and *Saccocoma* sp. cf. *S. schattenbergi* Sieverts-Doreck favor a Kimmeridgian rather than an Oxfordian age for these deposits. The absence of skeletal elements of ophiuroids, which are always associated with the remains of *Saccocoma* in age-corresponding near-shore and neritic deposits, points towards deposition in deep water (see chapter by H. Hess in this volume).

Besides foraminifers, ostracodes and remains of pelagic crinoids, nepionic shells of bivalves, fragments of aptychi, tiny spines of echinoids, holothurian skeletal elements, prisms of *Inoceramus* (?), parts of barnacles, and rhyncholites (ammonite beaks) are found scattered through this interval. Radiolarians are always rare to very rare and badly preserved.

The decisive element for the age-determination of Cores 33 to 37 is the aptychi found in them. The following forms were determined (see chapter by O. Renz in this volume): Lamellaptychus rectecostatus crassocostatus Trauth, Lamellaptychus cf. L. lamellosus (Parkinson), Lamellaptychus punctatus (Voltz), Lamellaptychus beyrichi (Oppel), Lamellaptychus murocostatus Trauth, Laevilamellaptychus of *Haploceras* aporus (Oppel), Punctaptychus monsalvensis Trauth and a Laevaptychus related to L. latus (Parkinson). All the forms determined are common in the Alpine-Mediterranean faunal province, where they are predominantly recorded from the Kimmeridgian-Tithonian. Several forms are also known from the Caribbean area. In Sample 105-37-7, 127 to 130 centimeters, a quarter of a whorl of a flattened ammonite was recovered. It is closely related to *Aspidoceras pawlowi* Burckhardt, which was described from the Kimmeridgian of Mexico.

Calcareous Nannoplankton

The first three cores recovered from this hole contain nannoplankton assemblages of Quaternary and Pliocene age. The second core contains abundant admixtures of Cretaceous, Eocene, Pliocene and Pleistocene forms, but the third core is characterized by an early Pliocene assemblage containing: *Reticulofenestra pseudoumbilica, Discoaster asymmetricus, Ceratolithus tricorniculatus* and *C. rugosus.* Cores 4 through 10 are barren of nannoplankton. Cores 11 through 13 are assigned to the early Cretaceous, Albian and Aptian Stages and are dominated by species of *Watznaueria barnesae, Apertapertra gronosa, Glaukolithus diplogrammus* and *Eiffelithus turriseiffeli.* Cores 14 and 15 are barren of nannoplankton, but Cores 16 and 17 contain assemblages assignable to the Cretaceous Barremian Stage of the Neocomian. Beginning with Core 18, coring was continuous to the bottom of the hole and well-developed nannoplankton assemblages were recovered through the remainder of the early Cretaceous and into the late Jurassic Tithonian and Oxfordian Stages. The last sediment recovered is in a zone in contact with basalt in Core 40. At this contact the nannoplankton assemblage contains principally specimens of *Stephanolithion bigoti, Watznaueria britannica, Zygodisus salillum* and *Cyclagelosphaera margereli* and is assigned to the Oxfordian Stage (see chapter by J. A. Wilcoxon, this volume).

Dinoflagellates

Dinoflagellates and other palynomorphs occur through most of the samples examined. Cores 1, 2 and 3 are composed of a flora of modern aspect, including such long-ranging species as *Tectatodinium pellitum* Wall, *Leptodinium* spp., *Spiniferites ramosus* (Ehrenberg), *Operculodinium centrocarpum* (Deflandre and Cookson), and *Nematosphaeropsis balcombiana* Deflandre and Cookson. In addition *Achomosphaera ramulifera* (Deflandre) was observed in Samples 105-2, core catcher, 105-3-4 (25 to 27 centimeters), and 105-3, core catcher. Although this species is long-ranging, its uppermost occurrence may prove useful for dating late Pliocene-early Pleistocene sediments.

Samples 105-4-6 (40 to 42 centimeters) and 105-4, core catcher contain several Tertiary species, and *Hystrichosphaeropsis obscurum* new species. Although this species is new, its stratigraphic ranges at Holes 103, 104, and 106B suggest that it ranges no higher than Miocene.

Cores 5 and 6 contain a sparse assemblage of dinoflagellates, but the presence of *Leptodinium* spp., *O. centrocarpum*, and *Achomosphaera* sp. aff. *A. triangulata* Gerlach suggest a Tertiary age. The seven samples examined from Cores 7 and 8 were found to be barren of dinaflagellates.

Cores 9 and 10 are of Cretaceous age. The occurrence of *Deflandrea acuminata* Cookson and Eisenack, *Lithosphaeridium siphoniphorum* (Cookson and Eisenack), and *Palaechystrichophora infusorioides* Deflandre indicate a Cenomanian to Albian age, based on dinoflagellates. The presence of *Hexagonifera chlamydata* Cookson and Eisenack in Core 15 suggests that it is no older than Albian. Core 16 contains a dinoflagellate assemblage of Aptian or Barremian age. Cores 17 to 19 contain a large number of species. *Microdinium deflandrei* Millioud, *Dingodinium cerviculum* Cookson and Eisenack, and *Wallodinium krutzschi* (Alberti) new combination date this interval as Barremian-Hauterivian. Cores 20 through 22 are considered early Cretaceous because of the consistent occurrence of *M. deflandrei, W. krutzschi* and *Scriniodinium (Endoscrinium) campanula* Gocht. The latter species has not been observed in assemblages older than Valanginian. Cores 24 through 26 are considered early Cretaceous.

A late Jurassic or early Cretaceous age is suggested for Cores 27 through 29 (see chapter by D. Habib, this volume).

Eleven samples were examined through the interval of Cores 30 to 35. They are largely devoid of dinoflagellates, although a few specimens were observed in Samples 105-30-2 (90 to 92 centimeters) and 32-2 (31 to 33 centimeters). An age determination cannot be made.

Sample 105-35, core catcher through Core 37 contain numerous cysts which indicate a Kimmeridgian or Oxfordian age. An Oxfordian age is preferred because of the occurrence of such species as *Chytroeisphaeridia chytroeides* Sarjeant, *Ch. pococki* Sarjeant, *Gonyaulacysta nuciformis* (Deflandre), *G. ambigua* (Deflandre), *G. scarburghensis* Sarjeant, *Pareodinia ceratophora* Deflandre, and *Tenua verrucosa* Sarjeant. Most of these species range into the lower Kimmeridgian, but species which in the literature have their lowest stratigraphic occurrence in the Kimmeridgian were not observed.

Dinoflagellates were not observed in any of the five samples examined from Cores 38, 39 and 40.

Lithology

A wide variety of sediments, rock types and minerals was recovered in the 43 cores taken at this site (Figure 5). Basalt, glass, palagonite, native copper, barite, limestone, indurated calcareous clay, zeolite beds, multicolored iron and manganese rich beds containing sphalerite, zones of siderite and rhodochrosite, pyrite, hemipelagic carbonaceous mud, and carbonate ooze were identified in material ranging in age from late Jurassic to Holocene (Figures 5 and 6).

This sequence of minerals and sediments may reflect most, if not all, of the depositional history of the western North Atlantic and the following discussion is intended to outline only the major changes in sedimentation that have occurred.

Quaternary-Tertiary Hemipelagic Mud

In Cores 1 through 3 (Holocene-Pleistocene-Pliocene) soft greenish-gray hemipelagic muds and clays contain terrigenous components—quartz, clay minerals (an illite and chlorite rich assemblage, heavy minerals—and biogeneous components—foraminifers and nannoplankton. Foraminifers decrease in abundance with depth until in lower Pliocene sediment, nannoplankton, including discoasters, are the chief biogenous component. Glauconite, pyrite and heavy minerals occur in the younger sediments, but are absent in sediments of early Pliocene age. However, plant debris and siderite are more common in early Pliocene sediments than in younger material.

In Core 4 (late Miocene or older), greenish-gray silty clays contain siderite and silty zones of rhodochrosite pellets, but no calcareous material. Zeolites and sphalerite are also present. Specks and nodules of pyrite are common.

Colorful Clays - Late Cretaceous? - Eocene?

Cores 5 through 9 (undated to Cenomanian at the base) recovered multicolored, firm but plastic, silty clays that contain abundant iron and manganese oxide minerals which usually exhibit the goethite structure. Variations in the amounts of these minerals are largely responsible for the diversity of color bands which range through various shades of reddish brown, yellow, orange, olive green, white, and black. Calcium carbonate is absent and, except for the lower part of Core 9, the multicolored zone is devoid of biogenous components of any kind. The dominant clay mineral is montmorillonite; fine-grained sphalerite and palagonitic grains are common throughout the section. Sphalerite composes about 55 per cent of one small irregular silty zone in Core 9. Zeolites, principally clinoptilolite but including heulandite and phillipsite, occur in many places. In Core 9 the zeolites represent the top of a zeolitic zone that extends through Core 24. Core 9 also contains the top of a zone of alternating beds of black, highly carbonaceous clays, and greenish-gray clays. Pyrite is especially common in this zone. The hydrated manganese-oxide mineral todorokite occurs in a nodule in the core catcher of Core 7.

Black Clays – Early Cretaceous

Cores 10 through 16 (Cenomanian-Aptian/Barremian) are characterized by black highly carbonaceous, zeolitic silty clay alternating with zones of lighter colored material (usually greenish gray) which contain less carbonaceous material, although Core 15 consists almost entirely of black material. The black zones usually contain abundant organic matter, some of which will burn in a match flame. Some thin silt beds in the black layers consist entirely of pyrite cubes; radiolarians are commonly replaced by pyrite. Numerous thin silt layers and some scattered zones of siderite occur. One zone in Core 13 contains 95 per cent siderite. White silt layers that were sampled for X-ray diffraction analyses are composed of as much as 70 per cent clinoptilolite. A white clay-like layer in the core catcher of Core 12 is composed largely of disordered cristobalite; the rest of the sample is montmorillonite. Calcareous nannoplankton are absent from Cores 9, 10, 14 and 15.

Tithonian-Neocomian White and Gray Limestones

Cores 17 through 32 (Neocomian to Late Jurassic) comprise an interval of light gray or white limestone interbedded with laminated dark gray soft clayey limestone which contains abundant organic matter. Lighter zones show irregular and poorly developed bedding, and in white zones bedding appears to have been completely destroyed, possibly by burrowing organisms. Abundant occurrences of truncated, distorted, or faulted laminae alternating with smooth, finely-laminated zones suggest periodic disturbances by bottom currents, slumping, or burrowing organisms. The limestone is characterized by an abundance of recrystallized nanno-calcite and the general absence of clay and plant debris. Flow and slump structures, and clasts, abound in the lower section, but become less abundant toward the abrupt lithologic contact with the overlying, black, Aptian/Barremian clays at about 400 meters below bottom (at the topmost part of Core 17). Below this horizon calcareous nannoplankton, organic material, and recrystallized nanno-calcite are abundant. Micas, zeolites and pyrite are less common than in the overlying black sediments, although radiolarians replaced by pyrite occur in several samples. Zeolites are rare or absent below Core 21.

Red Clayey Oxfordian-Kimmeridgian Limestone

Cores 33 through 39 (late Jurassic) contain pale red, reddish-brown and greenish interbedded deposits of clayey limestone. The dominant colors of these beds are various shades of reddish brown. Green zones usually occur as diffuse bands, irregular patches, or spots. The sediments show a wide variety of slump structures. They contain numerous well-preserved flow rolls, clasts, and other structures usually associated with penecontemporaneous soft sediment deformation (see chapters by D. Bernoulli and by Y. Lancelot *et al.*, this volume). Numerous aptychi, shell fragments, and other fossils characterize these sediments.

Clay minerals, chiefly montmorillonite, minor illite, but little or no kaolinite or chlorite, are usually stained red by hematite or mixtures of hematite and limonite. Calcareous nannoplankton and recrystallized nanno-calcite are also stained red in many samples. Quartz, heavy minerals, zeolites, pyrite and plant debris are rare. Clasts of green palagonite occur in several places. The only chert recovered from Hole 105 was found in Core 34; it consists of planktonic crinoid plates surrounded by sparry calcite and cemented by chalcedonic chert. Barite occurs as relatively large, clear, tabular plates in Core 33, Section 5.

A vein of tiny crystals of native copper occurs in Core 38, Section 2. The vein is bordered by palagonite and filled by palagonite in many places that are not occupied by copper crystals.

Basement

Core 40 (late Jurassic) contains the contact of the upper Jurassic sediments with basalt. The topmost part of the core contains pieces of soft, reddish brown, disturbed clay similar in composition to the overlying sediments. Below this clay is a zone of altered pyroclastics, thinly interbedded or laminated in striking hues of green and red. The uppermost of these beds shows the outlines of relatively fine-grained palagonite fragments that grade downward to coarse particles, then to fine-grained particles in thin laminations; all are altered to montmorillonite. The zone contains essentially no quartz, but sanidine, the high temperature potassium feldspar, is abundant. Below the brightly-colored zone very hard, recrystallized limestones are in contact with the basalt. Except for a sample nearest the contact, these limestones are composed of high magnesium calcite (about 15 mol per cent $MgCO_3$) and contain patches of green palagonite fragments of various sizes.

The underlying basalt is highly fractured and altered; it contains several inclusions of hard limestone and vein fillings of fibrous calcite. In the wider veins much of the fibrous calcite is stained green. Many glassy zones, almost all altered to palagonite-like material, occur throughout the 9 meters recovered; glassy zones surround the included sediments. A detailed description of the petrography of the basalt is given in the chapter by W. B. Bryan (this volume).

Rate of Sediment Accumulation

At this site, sediment accumulated at the rate of 0.6 cm/1000 yr. during the late Jurassic. This is the same accumulation rate as that during the late Jurassic at Site 99, and slightly lower than at Site 100 (0.8 cm/1000 yr. was maintained, but subsided to 0.5 cm/1000 yr. during Albian-Cenomanian time).

An undated interval representing approximately 85 million years of late Cretaceous to late Miocene time is present. Above this interval the rate of sediment accumulation increased to 1.7 cm/1000 yr. from late Miocene through Holocene. The latter rate is greater than that for the same interval at Site 98 (0.4 cm/1000 yr.) and Site 99 (0.3 cm/1000 yr.), but considerably less than that at Site 102 (11.0 cm/1000 yr.).

DISCUSSION AND CONCLUSIONS

The seismic records that best display the regional seismic stratigraphy in the vicinity of Site 105 are shown in Figures 2a and 2b. Figures 2c and 2d show expanded scale recordings at the site. Clearly visible are the two intermediate reflectors, A and A*, that are about 0.30 and 0.35 seconds below bottom at the drilling site. Not so clearly visible at the site, but reasonably so in other parts of the traverse, is the deeper reflector, B. It appears that B is the top of a layer of fill that smooths out preexisting irregularities in basement topography. This reflector is only faintly visible at about 0.5 second subbottom reflection time. Furthermore, the principle of minimum astonishment favors the presence of the layer in the depression where the hole was drilled, as it appears to be of regional extent and fills other depressions.

The drilling rate graph (Figure 3) shows two minor zones near 250 and 300 meters where the drilling rate decreased slightly. These correspond reasonably well with the first two subbottom reflections (A and A*), and indicate an interval velocity of 1.65 km/sec for the upper 250 meters of sediment. Drilling was relatively easy below these two zones (mostly in the black clay) until a depth of about 450 meters, where the curve indicates gradually harder penetration to a depth of about 550 meters. Basement was reached at 620 meters.

The A reflector at this site is easily traceable to the location of Hole 8, Leg 2 (Peterson *et al.,* 1970) where it was correlated with a silicified zone of mid-early Eocene age; this reflection is also traceable as a relatively level horizon extending well under the continental rise (Emery *et. al.,* 1970). This zone was difficult to drill at Hole 8, and a similar difficulty was expected at Hole 105. Consequently, we planned to take Core 5 when a drilling break indicated hard strata. As indicated in the drilling rate graph, a slight decrease in drilling rate occurred just above 240 meters depth. A new section of drill pipe was put in at 241 meters, and Core 5 was taken. Unfortunately, the hard zone had already been penetrated and the core recovered a section of the undatable multicolored zone that apparently lies between A and A*. Although we did not sample Horizon A, it seems most reasonable to assume that it would have the same age as that found at Hole 8. The age of the multicolored zone can only be presumed to be between Cenomanian and middle Eocene. It is interesting, and somewhat difficult to understand, that such a prominent reflector as A was passed through so easily, although a similar result had been found at Site 101. There is also no obvious lithologic change to account for reflector A*. It apparently corresponds approximately to the change from the multicolored zone into the black clay. Whatever the physical property changes are that cause the impedance mismatches, it is possible that they are associated with major changes in sedimentation rates.

The most obvious comparison of the acoustic data with the drilling data would appear to associate the *faint* B reflector at 0.5 second with the drilling break at 450 meters. The faintness of the reflector, in fact, may be attributed to the gradual manner in which the drilling resistance changes. Such a correlation would indicate an interval velocity of 2.0 km/sec between A and B and a seafloor-to-B average velocity of 1.8 km/sec. The basement reflection is not easily recognized, but is probably between 0.60 and 0.65 second below bottom, a reasonable range for correlating with the 620 meters at which basalt was found. Unfortunately, because of the indistinct nature of the reflections from basement, we cannot calculate a reliable velocity for the early Cretaceous and late Jurassic limestone sequence. Similarly, we cannot arrive at a reliable age for Horizon β, but it would appear that a Hauterivian to Valanginian age, as we deduced for β at the Cat Gap sites, would be reasonable at this site also. As the reflectivity seems to be associated with the degree of lithification of the limy beds, we can probably expect the seismic horizon to be at least somewhat time-transgressive, but in a broad sense it represents a reasonably good time boundary for the western Atlantic. Seismic profiling has indicated that β extends eastward to about the longitude of Bermuda (Ewing *et al,* 1966; Windisch *et al,* 1968), and if we assume that it is not a seriously time-transgressive reflector, this indicates an age of 125 to 130 million years for the crust in the Bermuda area—an age in reasonable agreement with that shown by the magnetic anomaly map of Pitman and Talwani (in press).

Sedimentation at Site 105 probably began in late Jurassic time with the accumulation of thin deposits of calcareous nannoplankton ooze on basaltic basement rocks that consist of a series of thin flows and pyroclastic debris. These probably blanketed the region repeatedly and incorporated pieces of the soft calcareous sediments as inclusions. The abundant glassy zones in the basalt suggest pillow lava structure. The episode of repeated thin flows may have extended over a considerable period of time and continually disrupted any accumulation of sediments that may have formed on preceding flows. A discussion of such a mechanism is given in Peterson *et al.* (1970, p. 426). A late stage sequence of eruptions of volcanic ash consisting of highly differentiated material was the probable source of the brightly-colored pyroclastic beds overlying limestone, which is in contact with basalt. The hardness of the limestone and the bright colors of the ash-like beds at first suggested contact metamorphism of all these materials. Sanidine in the ash-like beds could have resulted equally well from a volcanic origin. However, the fine undisturbed laminations of the pyroclastic fragments in the upper part of this interval and the abrupt end of the sanidine-bearing zone suggest that the pyroclastic episode occurred after the emplacement of the basalt. Introduction of magnesium into the limestones in contact with the basalt to form high magnesium calcite and the distorted patches of green palagonite grains in this hardened, recrystallized limestone indicates that contact metamorphism did occur in the calcareous material immediately overlying the basalt. It is less likely that the evenly bedded pyroclastics were present at that time.

The thick sequence of late Jurassic red, clayey limestones contains occasional fragments of palagonite indicating that volcanic activity continued at a greatly reduced rate or at a considerable distance from the area. A vein of palagonite and native copper about 10 meters above the basalt indicated that intrusive or hydrothermal activity occurred at the site at a considerably later time.

The abundance and variety of fossils in the late Jurassic red sediments suggests a bathyal environment shallower than the present depth at the site. Organic material in some layers or zones resulted in reduction and removal of iron oxide associated with the sediment, and allowed the green color to appear. In many places these spots and zones are independent of bedding planes.

The lack of red coloration in the overlying late Jurassic to Neocomian sediments is probably due less to the mobilization of iron oxide than to a change in source or change in climate of the source area of the clay minerals associated with these beds. A temperate to cold climate in the source area would result in a smaller concentration of iron oxide in soils of the source region of the terrigenous clays, and the resulting marine sediments would be free of such material as a coloring agent.

In both the red zones and white to gray zones penecontemporaneous slumping and deformation of the beds had occurred. A discussion of many of these effects is given in the chapter by D. Bernoulli (this volume).

The sediments of Aptian/Barremain to Cenomanian age represent a period of apparent stagnation in which large amounts of carbonaceous material became incorporated in the sediments. Reducing conditions resulted in the formation of much pyrite in these sediments; silica was removed and replaced by pyrite in radiolarians. Such conditions also promoted the formation of siderite, presumably where both reduced iron and carbonate were available. The abundance of montmorillonite and clinoptilolite throughout the interval suggest that volcanic ash was regularly introduced in the area, and that the ash represents an important sediment source.

The multicolored zone, overlying the black Cretaceous zone, probably also resulted from the introduction of large amounts of volcanic material, in the form of ash falls, and possibly also from the precipitation of iron and manganese oxides from hydrothermal emanations by the process described by von der Borch and Rex (1970) and von der Borch, Nesteroff, and Galehouse (in press). These sediments, especially in their color and content of geothite and sphalerite, closely resemble the multicolored iron-rich beds of the Red Sea hot brine deposits (Degens and Ross, 1969; see discussion in chapter by Lancelot *et al.*, this volume).

The rhodochrosite in late Miocene sediments occurs in pellets closely resembling those reported by Peterson *et al.*, (1970, p. 308) from upper Cretaceous sediments of Hole 9A.

The topmost sediments of Hole 105 are typical hemipelagic muds containing abundant terrigenous material. The clay mineral fraction of these sediments contains an illite and chlorite-rich assemblage typical of a relatively cold-climate source.

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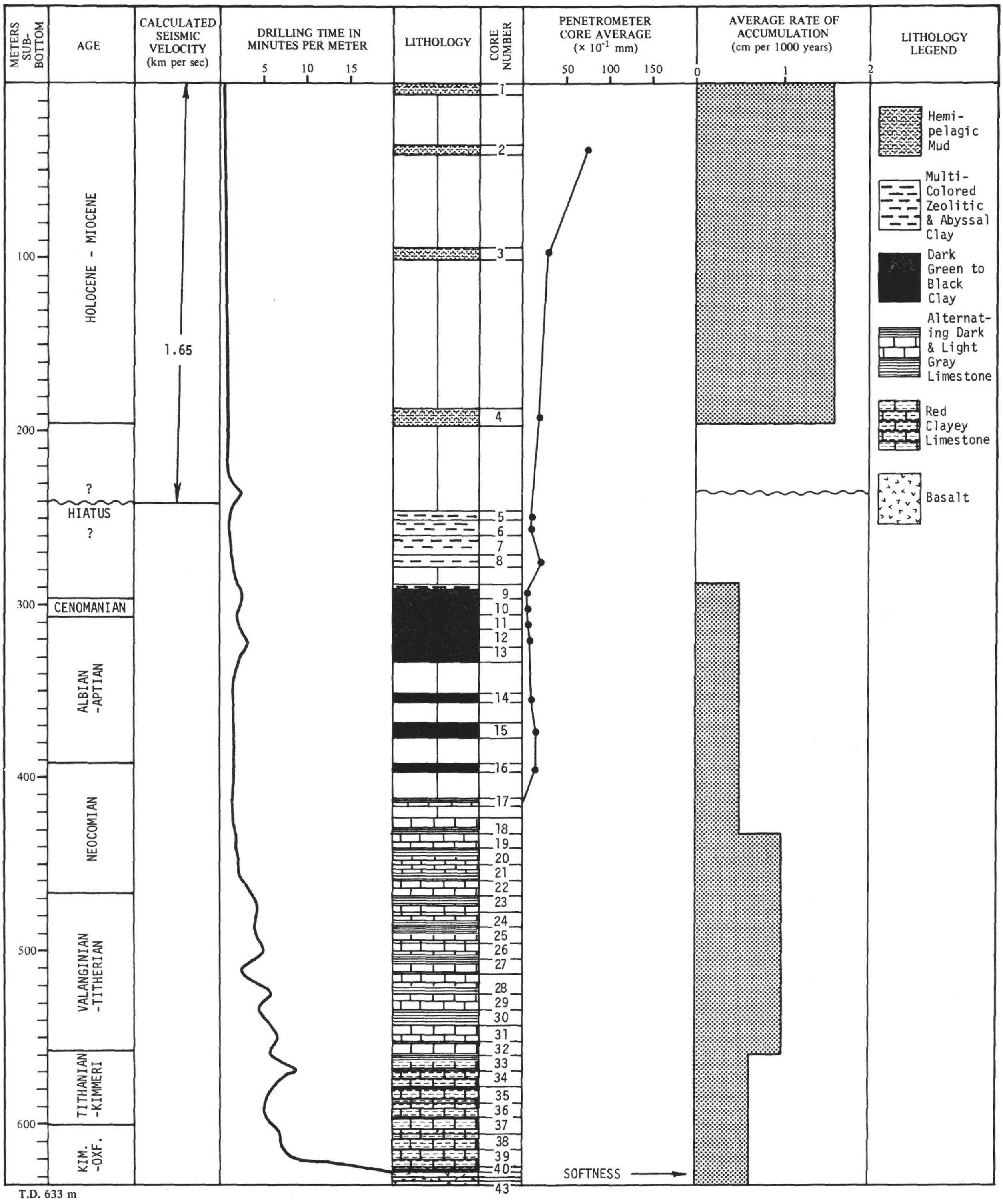

Figure 3. *Site 105 summary chart*

Hole 105
Latitude: 34°53.72′N
Longitude: 69°10.40′W
Water depth: 5251 meters (drill pipe); 5245 meters (PDR)

Core No.	Interval Cored (meters)[a]				Lithology	Age
	Depth	Amount	Recovery	Subbottom Depth		
1	5261-5262	1	0.1	1	Light brown silty clay	Quaternary
(Drilled)	(5262-5292)	(30)		(31)		
2	5292-5301	9	4	40	Dark brown clay and hemipelagic mud	Early-Middle Pliocene
(Drilled)	(5301-5352)	(51)		(91)		
3	5352-5361	9	6	100	Dark gray hemipelagic mud	Early Pliocene
(Drilled)	(5361-5445)	(84)		(184)		
4	5445-5454	9	9	193	Gray hemipelagic mud	Miocene
(Drilled)	(5454-5502)	(48)		(241)		
5	5502-5511	9	3.5	250	Brown silty zeolitic clay	Tertiary?
6	5511-5520	9	2.3	259	Brown, orange, green silty clay	Tertiary?
7	5520-5529	9	9	268	Brown, orange, green silty clay	No determination
8	5529-5538	9	9	277	Brown silty clay	No determination
(Drilled)	(5538-5547)	(9)		(286)		
9	5547-5556	9	9	295	Brown and black clay	Cenomanian
10	5556-5565	9	3.2	304	Green and black clay	Cenomanian
11	5565-5574	9	7.5	313	Green and black clay	Middle Cretaceous
12	5574-5583	9	5.3	322	Dark gray silty clay	Middle Cretaceous
13	5583-5592	9	9	331	Dark gray silty clay	Middle Cretaceous
(Drilled)	(5592-5609)	(17)		(348)		
14	5609-5618	9	0.5	357	Dark gray silty clay	Middle Cretaceous
(Drilled)	(5618-5627)	(9)		(366)		
15	5627-5636	9	8.3	375	Gray and black clay	Middle Cretaceous
(Drilled)	(5636-5646)	(10)		(385)		
16	5646-5653	7	2.2	392	Gray and black clay	Early Cretaceous
(Drilled)	(5653-5664)	(11)		(403)		
17	5664-5673	9	4.2	412	Gray and black clayey limestone	Neocomian
(Drilled)	(5673-5682)	(9)		(421)		
18	5682-5691	9	9	430	Gray and white Limestone and clay	Neocomian
19	5691-5700	9	5.2	439	Black, silty calcareous clay (Hole Cavings)	Neocomian
20	5700-5709	9	1.1	448	Calcareous clay and white limestone	Neocomian
21	5709-5718	9	1.3	457	Calcareous clay and white limestone	Neocomian

Figure 4. *Core Summary table, Site 105.*

Core No.	Interval Cored (meters)[a]				Lithology	Age
	Depth	Amount	Recovery	Subbottom Depth		
22	5718-5727	9	1.7	466	Dark gray and white limestone	Valanginian-Tithonian
23	5727-5736	9	2.4	475	Gray chalk and white limestone	Valanginian-Tithonian
24	5736-5745	9	1.5	484	Gray chalk and white limestone	Valanginian-Tithonian
25	5745-5754	9	4.2	493	Gray chalk and white limestone	Valanginian-Tithonian
26	5754-5763	9	3	502	Gray chalk and white limestone	Valanginian-Tithonian
27	5763-5772	9	3.6	511	Gray chalk and white limestone	Valanginian-Tithonian
28	5772-5783	11	9	522	Light and dark gray limestone	Valanginian-Tithonian
29	5783-5792	9	3.5	531	White and gray limestone	Valanginian-Tithonian
30	5792-5801	9	2.4	540	Light gray limestone	Valanginian-Tithonian
31	5801-5810	9	2.5	549	Dark gray limestone	Valanginian-Tithonian
32	5810-5819	9	1.8	558	Red and green limestone	Valanginian-Tithonian
33	5819-5828	9	7.3	567	Red and green limestone	Late Jurassic
34	5828-5837	9	6.5	576	Red and green clayey limestone	Late Jurassic
35	5837-5846	9	5.0	585	Red and green clayey limestone	Late Jurassic
36	5846-5855	9	3.3	594	Red and green clayey limestone	Late Jurassic
37	5855-5864	9	9+	603	Red and green clayey limestone	Late Jurassic
38	5864-5873	9	8.5	612	Red and green clayey limestone	Late Jurassic
39	5873-5882	9	3	621	Red and green clayey limestone	Late Jurassic
40	5882-5885	3	0.7	624	Red and green clayey limestone, clay and basalt	
41	5885-5888	3	3.5	627	Basalt	
42	5888-5891	3	2.5	630	Basalt	
43	5891-5894	3	2.3	633	Basalt	

[a] All intervals are measured by drill pipe from derrick floor which is 10 meters above water surface.

Figure 4. *Core Summary table, Site 105* (Cont)

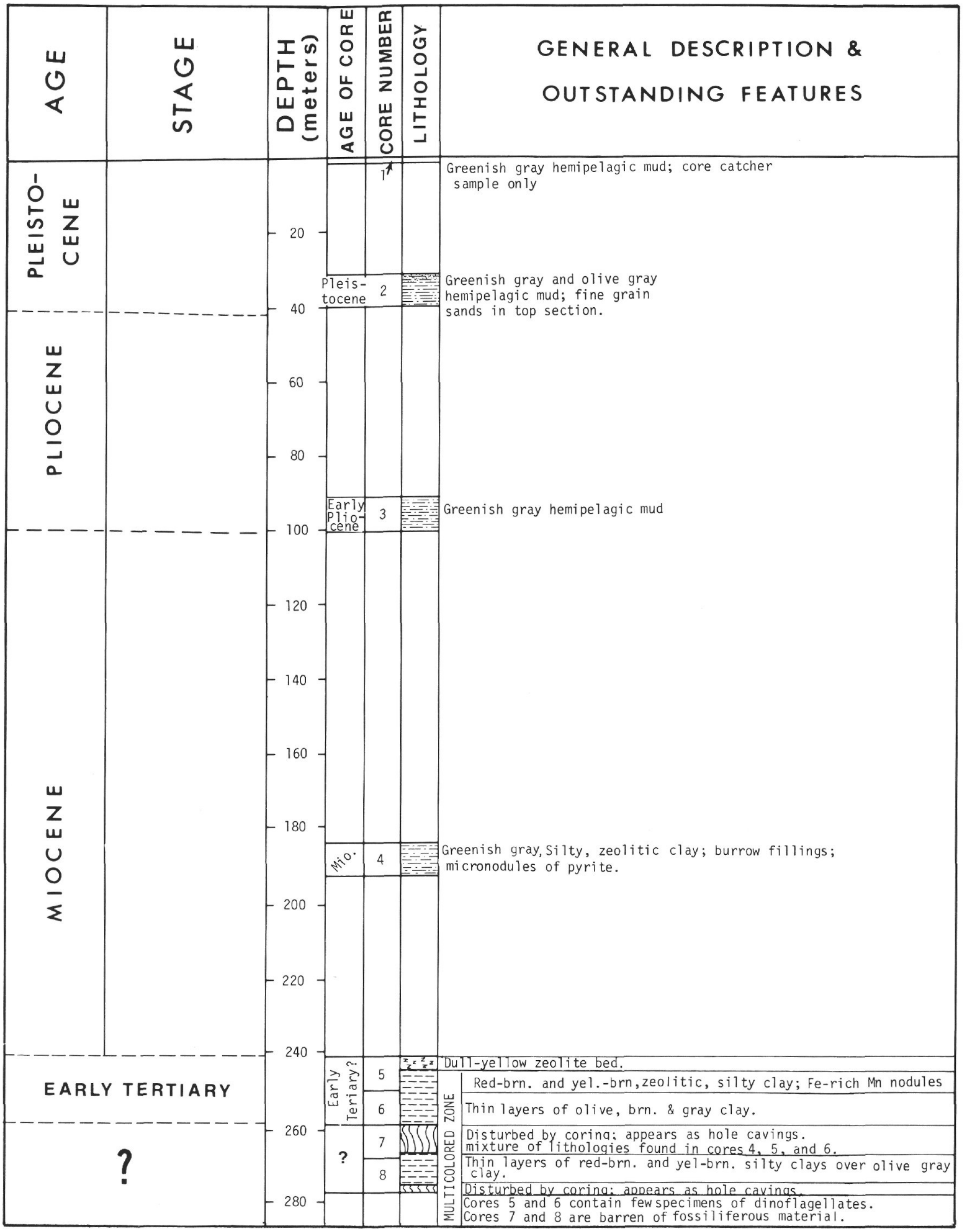

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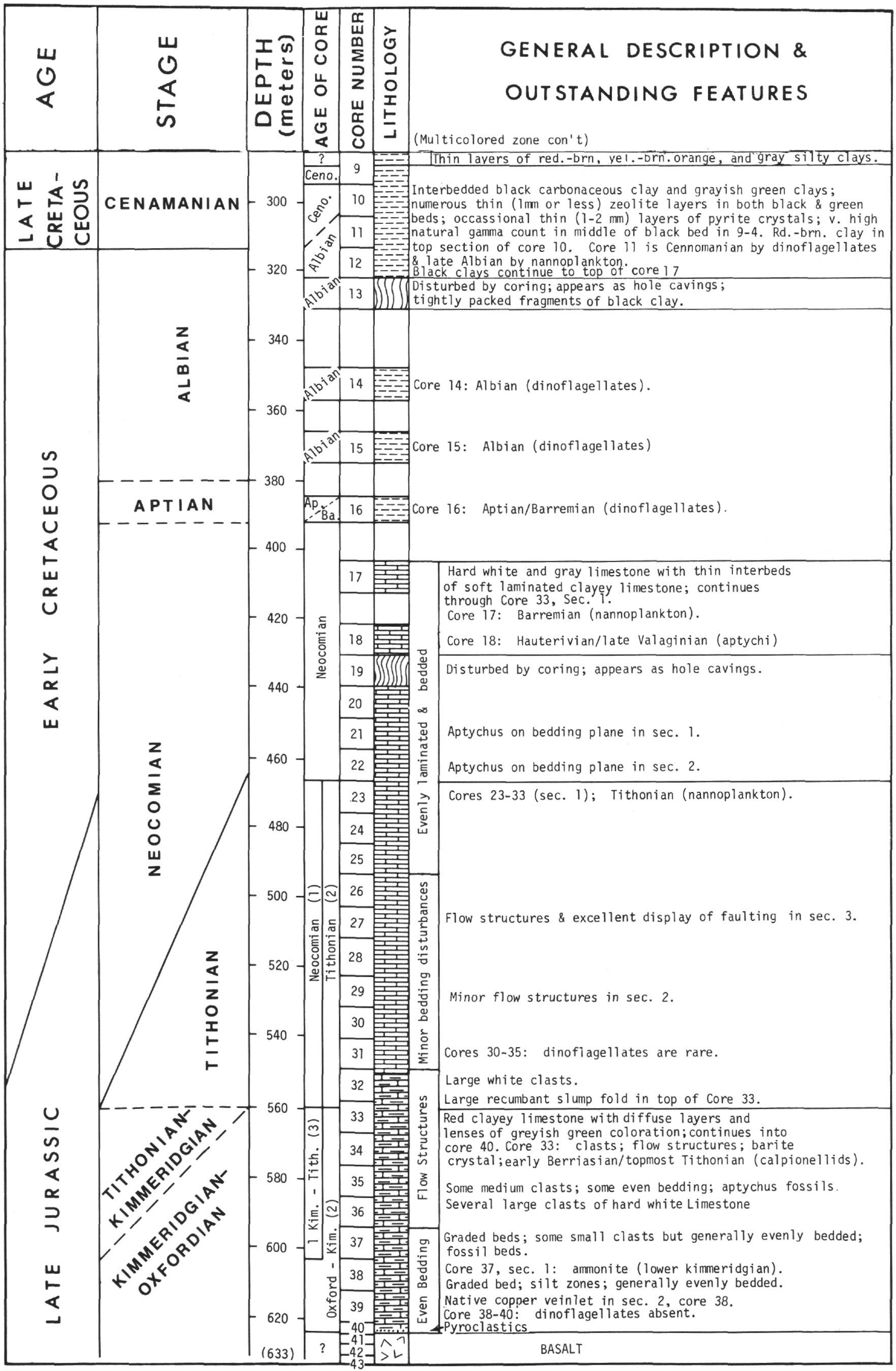
Figure 6. *Stratigraphic summary chart, Site 105.*



(Multicolored zone con't)

Thin layers of red.-brn, yel.-brn.orange, and gray silty clays.

Interbedded black carbonaceous clay and grayish green clays; numerous thin (1mm or less) zeolite layers in both black & green beds; occassional thin (1-2 mm) layers of pyrite crystals; v. high natural gamma count in middle of black bed in 9-4. Rd.-brn. clay in top section of core 10. Core 11 is Cennomanian by dinoflagellates & late Albian by nannoplankton.

Black clays continue to top of core 17

Disturbed by coring; appears as hole cavings; tightly packed fragments of black clay.

Core 14: Albian (dinoflagellates).

Core 15: Albian (dinoflagellates)

Core 16: Aptian/Barremian (dinoflagellates).

Hard white and gray limestone with thin interbeds of soft laminated clayey limestone; continues through Core 33, Sec. 1.

Core 17: Barremian (nannoplankton).

Core 18: Hauterivian/late Valaginian (aptychi)

Disturbed by coring; appears as hole cavings.

Aptychus on bedding plane in sec. 1.

Aptychus on bedding plane in sec. 2.

Cores 23-33 (sec. 1); Tithonian (nannoplankton).

Flow structures & excellent display of faulting in sec. 3.

Minor flow structures in sec. 2.

Cores 30-35: dinoflagellates are rare.

Large white clasts.

Large recumbant slump fold in top of Core 33.

Red clayey limestone with diffuse layers and lenses of greyish green coloration; continues into core 40. Core 33: clasts; flow structures; barite crystal; early Berriasian/topmost Tithonian (calpionellids).

Some medium clasts; some even bedding; aptychus fossils.

Several large clasts of hard white Limestone

Graded beds; some small clasts but generally evenly bedded; fossil beds.

Core 37, sec. 1: ammonite (lower kimmeridgian).

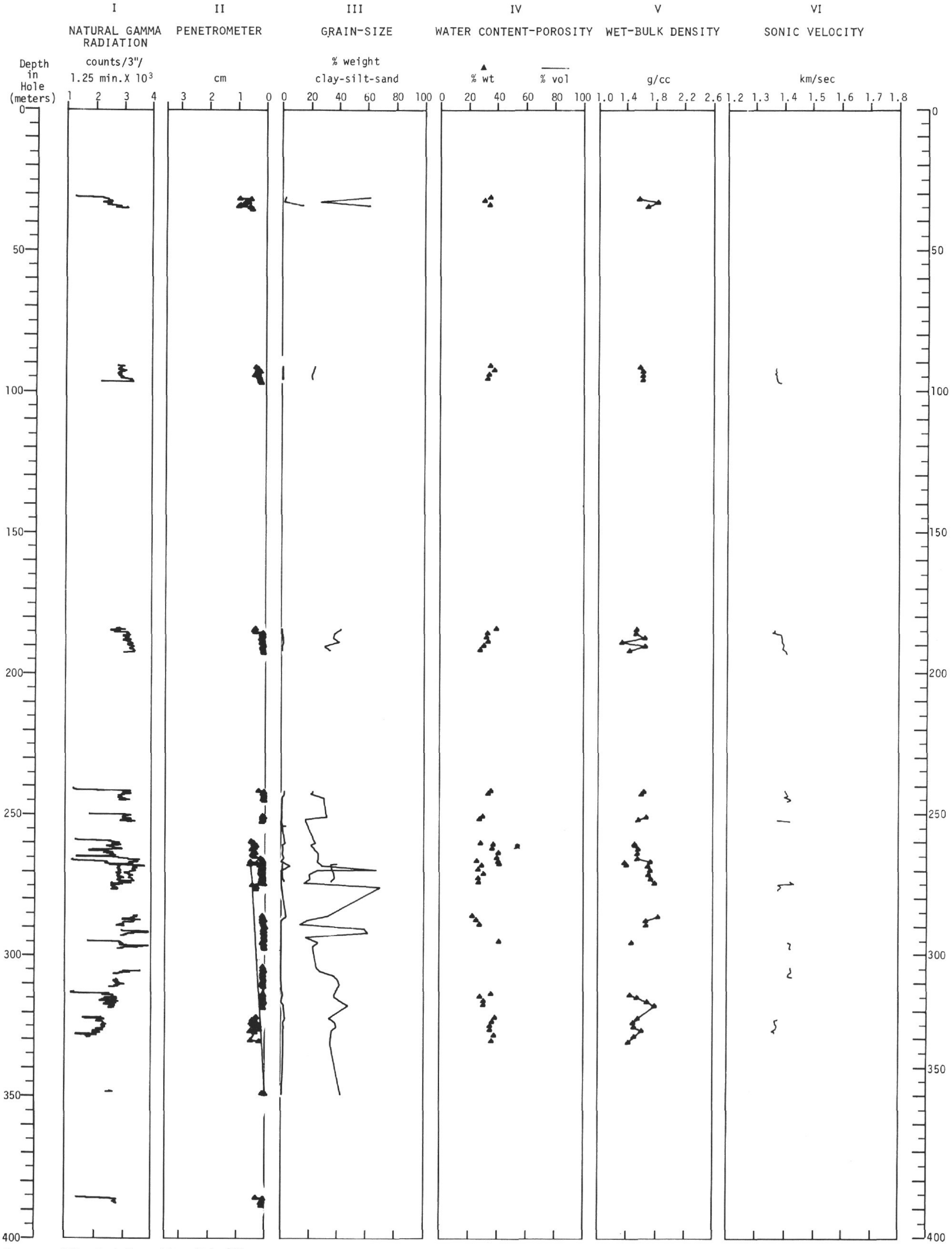
Graded bed; silt zones; generally evenly bedded.

Native copper veinlet in sec. 2, core 38.

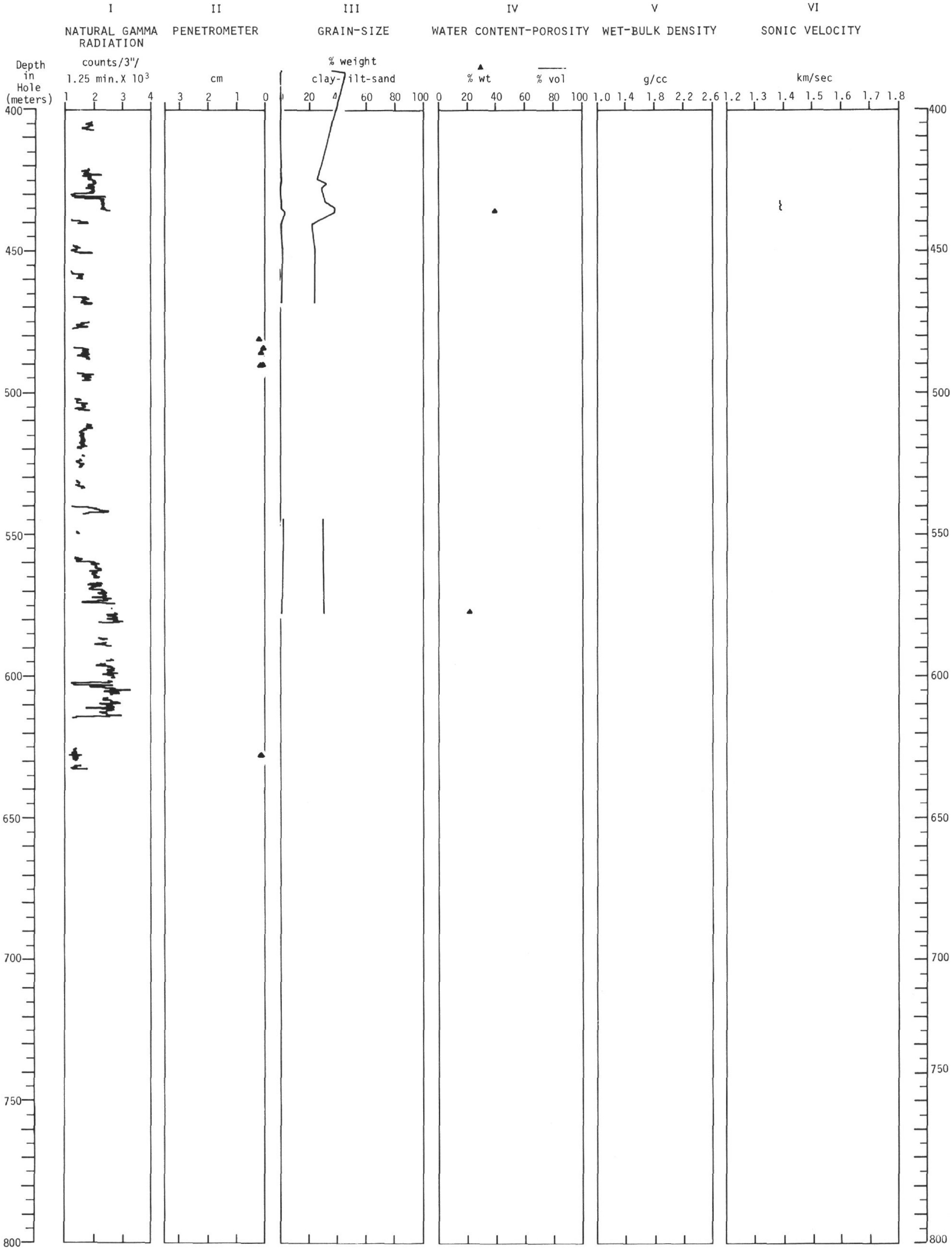
Core 38-40: dinoflagellates absent.

(1) Based on calpionellids. (2) Based on calcareous nannoplankton. (3) Based on aptychi.

Figure 6. *Stratigraphic summary chart, Site 105.* (Cont)

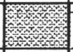


Summary of Physical Properties, Hole 105

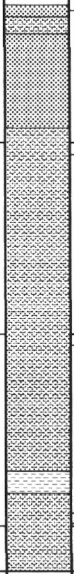


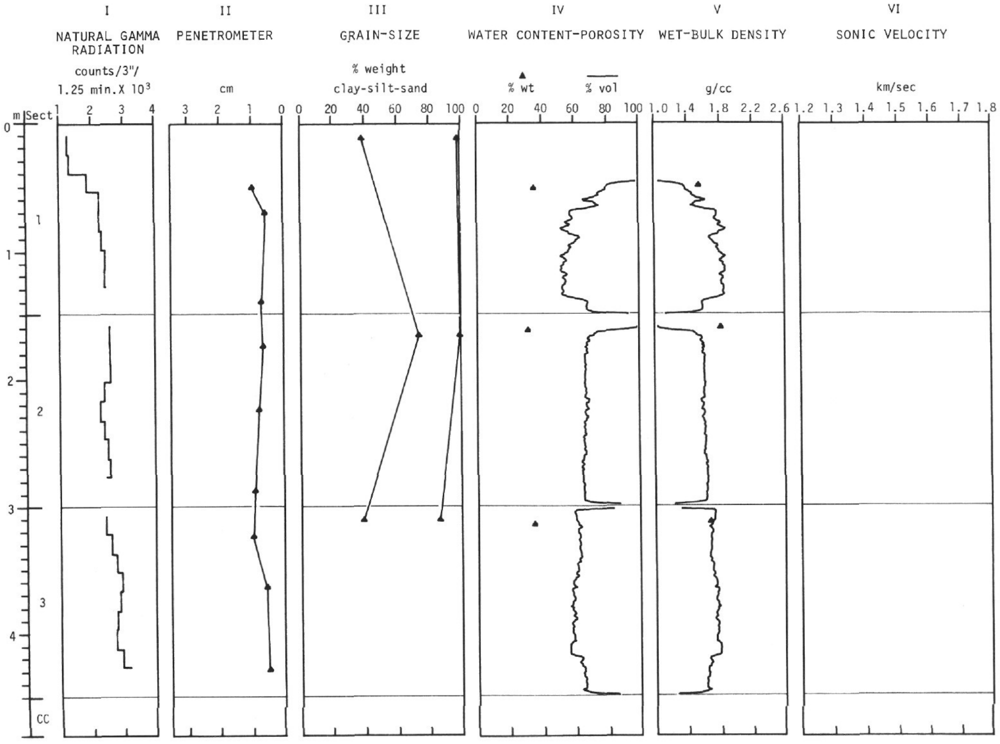
Summary of Physical Properties, Hole 105 (Cont'd)

Hole 105, Core 1 (0m to 1m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
PLEISTOCENE/HOLOCENE	*Gephyrocapsa calida* *Globigerina calida* *Sphaeroidinella excavata* *N. 23*		CC		SS CN, F,D	Core catcher sample only: <u>Hemipelagic mud</u>; soft, plastic, greenish gray (5G5/1), foraminifers common. X-ray diffraction analysis: calcite 20% quartz 15 K feldspar 3 plagioclase 15 kaolinite 5 mica 30 chlorite 10 montmorillonite 3 hornblende trace	*CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Gephyrocapsa oceanica, Ceratolithus cristatus, Umbilicosphaera mirabilis, Cyclococcolithina leptopora, Syracosphaera pulchra* DINOFLAGELLATES: *Operculodinium centrocarpum, Tectatodinium pellitum* PLANKTONIC FORAMINIFERS: *Globorotalia cultrata (sinistral), Gl. truncatulinoides, Globigerina ruber* f. *rosea, Turborotalia inflata, Globigerina calida, Globigerina rubescens* (pink), *Sphaeroidinella excavata*

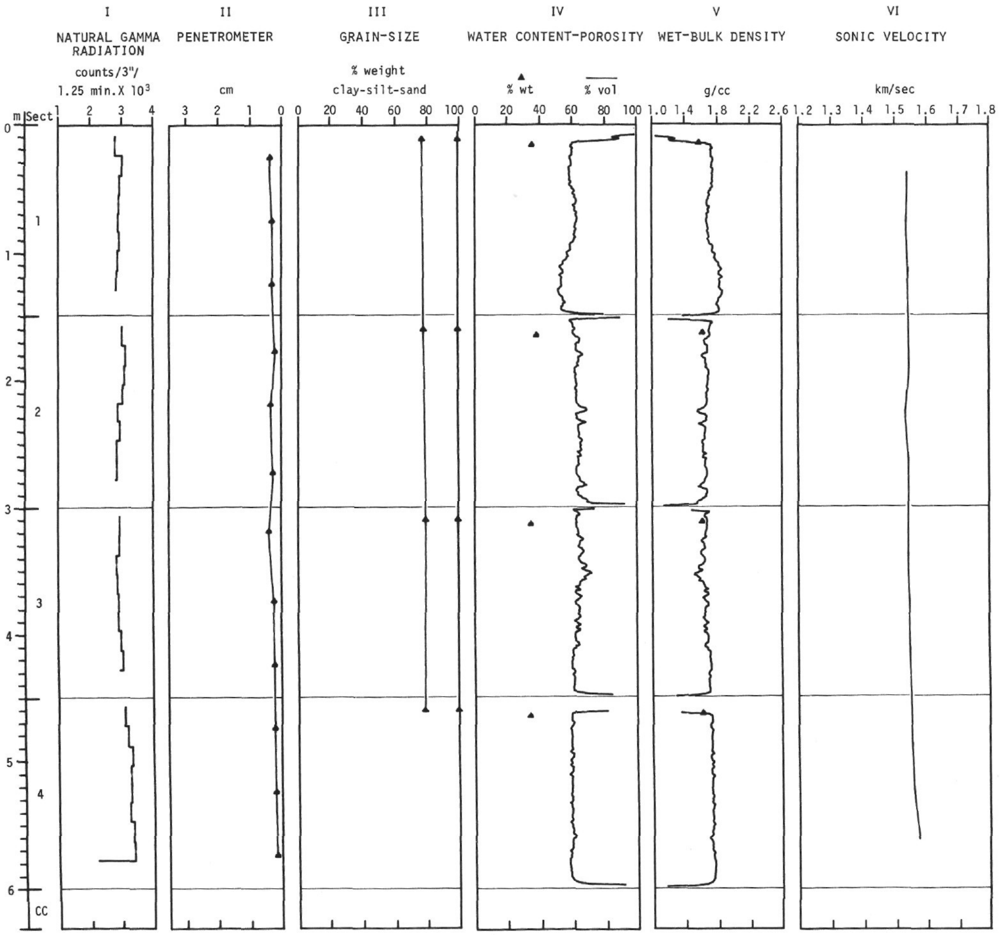
Hole 105, Core 2 (31m to 40m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
PLEISTOCENE WITH MIXED PLIOCENE	*Ellipsoplacolithus lacunosus* *Globorotalia truncatulinoides* *N. 22*	1 2 3 4	1 2 3 CC		SS SS SS SS SS	<u>Sand</u>, fine grained, unconsolidated, terrigenous, forams common. <u>Hemipelagic mud</u>, soft, plastic, mixture of light greenish and brownish gray (5G6/1 and 5YR6/1). Dark greenish gray (5GY5/1) <u>terrigenous sand</u>, fine-grained with inclusions of soft, plastic, olive gray (5Y6/1) <u>hemipelagic mud</u>. <u>Hemipelagic mud</u>, soft, plastic, olive gray to greenish gray (5Y6/1 to 5GY5/1), nannoplankton common. Light yellowish olive gray (5Y7/1). <u>Clayey silt</u>, soft, greenish gray (5GY5/1) with inclusions of <u>hemipelagic mud</u>. <u>Hemipelagic mud</u>, soft, plastic, light olive gray (5Y7/1), nannoplankton abundant, foraminifers, rare, grades to greenish gray (5GY5/1) <u>clayey silt</u> and to <u>fine sand</u>. <u>Light gray (N7) clay</u>. <u>Hemipelagic mud</u>, soft, plastic, brownish gray (5YR 4/1), nannoplankton rare. Core catcher sample: X-ray diffraction analysis: calcite 2% quartz 10 K feldspar 1 plagioclase 10 kaolinite 10 mica 42 chlorite 15 montmorillonite 10	CALCAREOUS NANNOPLANKTON: *Gephyrocapsa oceanica, Ellipsoplacolithus lacunosus, Umbilicosphaera mirabilis, Cyclococcolithina leptopora, Helicopontosphaera kamptneri, Coccolithus pelagicus* *CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Gephyrocapsa oceanica, Ellipsoplacolithus lacunosus, Discolithina japonica, Helicopontosphaera kamptneri* DINOFLAGELLATES: *Achomosphaera ramulifera* PLANKTONIC FORAMINIFERS: *Globorotalia truncatulinoides, Turborotalia inflata, Globigerina pachyderma G. bulloides, Globoquadrina dutertrei*



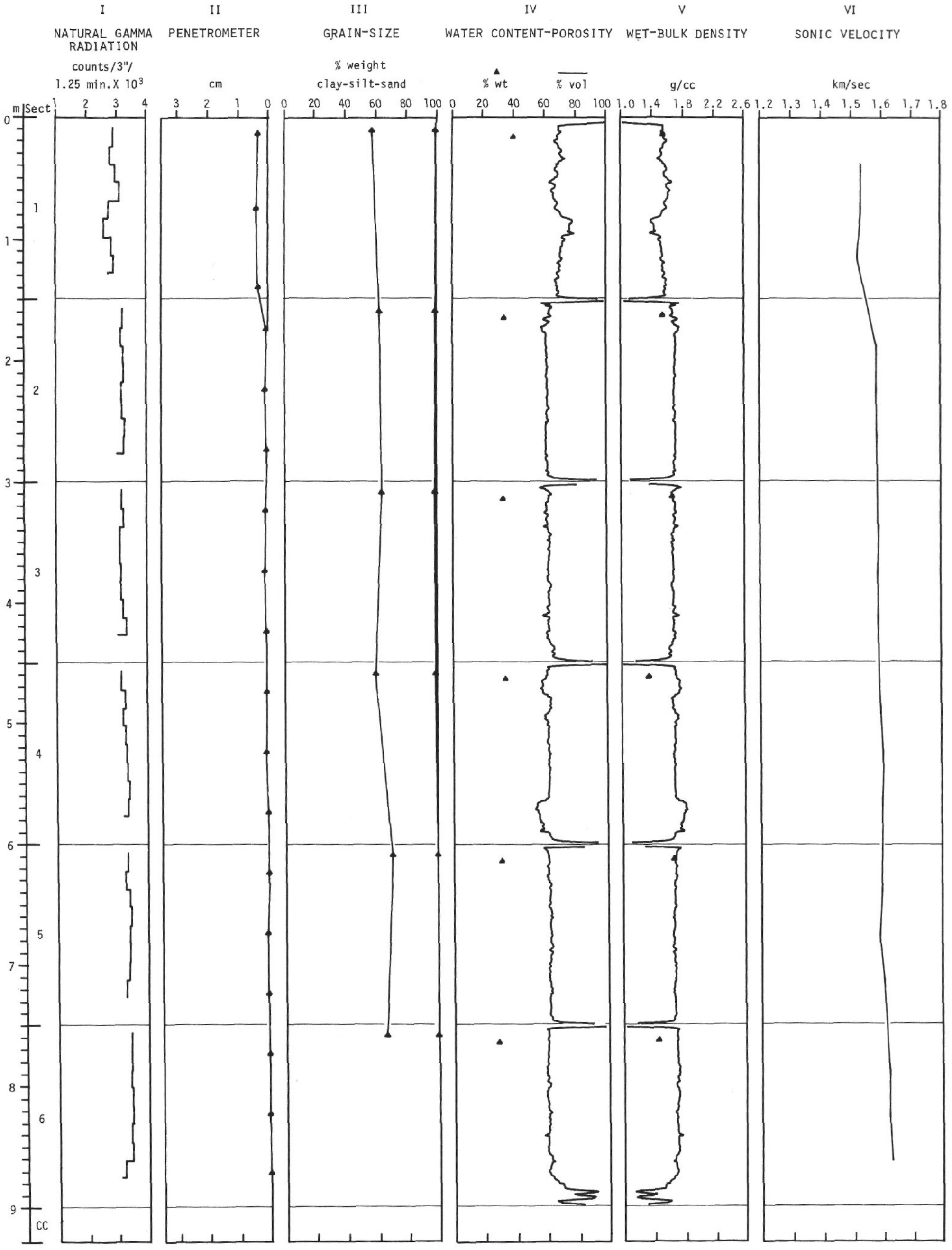
Hole 105, Core 3 (91m to 100m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
EARLY PLIOCENE	*Discoaster asymmetricus*	1	1		SS CN	Hemipelagic mud, soft, plastic, greenish gray (5GY6/1), slight mottling with darker and lighter shades and some dusky yellow (5Y6/4), black specks of iron sulfide, nannoplankton common, foraminifers rare.	CALCAREOUS NANNOPLANKTON: *Discoaster asymmetricus, D. brouweri, D. variabilis, D. pentaradiatus, Ceratolithus tricorniculatus, C. rugosus, Cyclococcolithina macintyrei*
		2	2		SS		
		3 4	3		SS		
		5	4		SS	Greenish gray (5G6/1). Yellowish gray (5Y6/1). Core catcher sample: X-ray diffraction analysis: siderite 3% quartz 16 plagioclase 6 kaolinite 20 mica 20 chlorite 10 montmorillonite 22	*CORE CATCHER* CALCAREOUS NANNOPLANKTON: Barren DINOFLAGELLATES: Barren
		6	CC		SS CN, D		

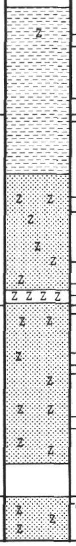


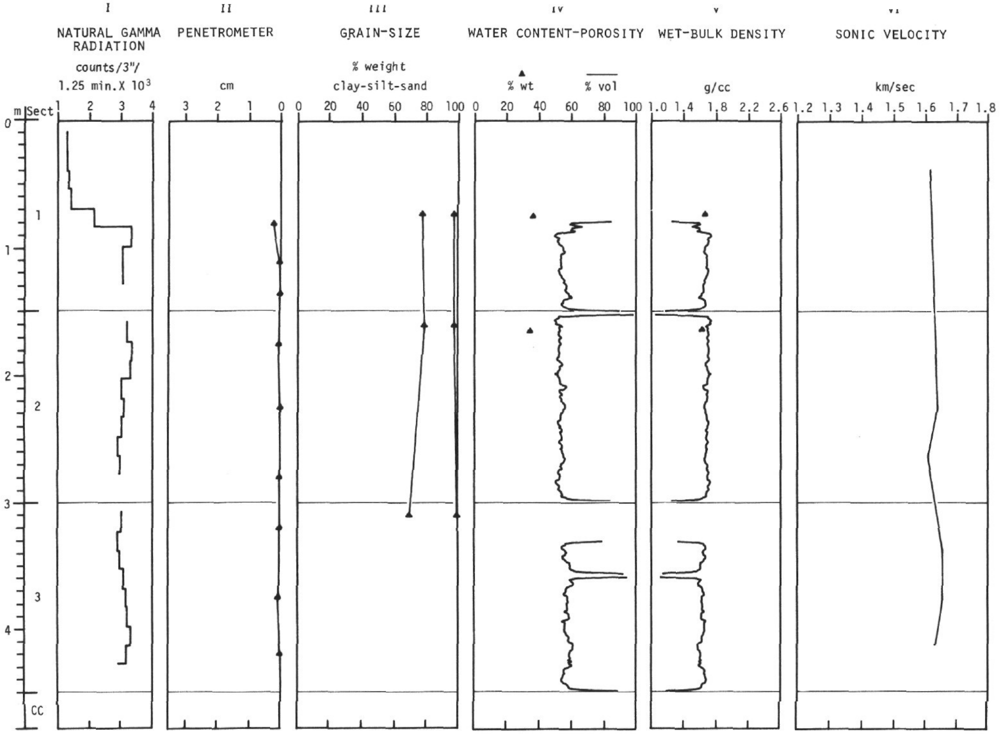
Hole 105, Core 4 (184m to 193m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
TERTIARY (LATE MIOCENE OR OLDER)		1	1		SS	Clay, silty, soft to firm, plastic, greenish gray (5G5/1), slight mottling is due to coring, black specks of iron sulfide.	
		2	2	Z Z Z	SS SS SS	Slightly zeolitic; micronodules of dusky yellow (5Y6/4) siderite, large pyrite filled burrow, abundant small burrows filled with pyrite, quartz, or siderite.	
		3 4	3		SS SS SS	Siderite filled burrow-like structure with "ribs". Dusky yellow (5Y6/4) pellets of rhodochrosite.	
		5	4	Z Z Z Z	SS SS	Clay, silty, zeolitic to slightly zeolitic, firm, plastic, grayish green (5GY5/1), moderate mottling with darker shades, heavy minerals, including sphalerite are common.	
		6 7	5	Z Z Z			
		8	6	Z Z Z	D	Large nodules of pyrite, dusky yellow (5Y6/4), silty spots of rhodochrosite.	DINOFLAGELLATES: *Hystrichosphaeropsis obscurum*, *Achomosphaera ramulifera*, *Achomosphaera* sp. aff. *A. triangulata*
			CC		CN, D		*CORE CATCHER* CALCAREOUS NANNOPLANKTON: Barren DINOFLAGELLATES: Barren

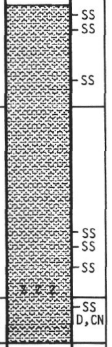


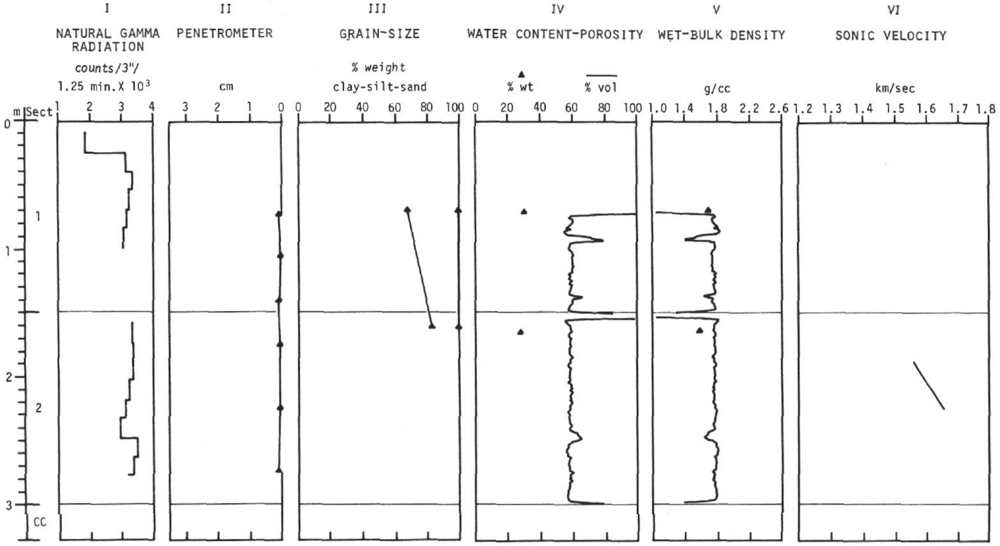
Hole 105, Core 5 (241m to 250m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
TERTIARY?		1 2 3 4	1 2 3 CC		SS SS SS SS SS SS SS SS SS SS SS SS SS SS SS SS D,CN	Clay, silty, firm, plastic, zeolitic, olive gray (5Y 4/2) and alternating bands of darker and lighter olive gray and dusky yellow (5Y6/4), large black spots of iron-manganese oxides, radiolarians common. Zeolitic silt, firm, plastic, dusky yellow (5Y6/4) with thin bands of dark gray (N3) and olive gray (5Y6/2), zeolites (clinoptilolite) dominant to abundant. Zeolites are heulandite and phillipsite. Olive gray (5Y6/2), grayish yellow (5Y8/4) silt layer of quartz and zeolites. Brownish gray (5YR6/1). Light greenish gray (5G8/1) and light brown (5YR6/4). Gradation to olive gray (5Y4/2) with black (N2) spots and faint spots and banding of dusky yellow (5Y6/4).	*CORE CATCHER* CALCAREOUS NANNOPLANKTON: Barren DINOFLAGELLATES: *Operculodinium centrocarpum*



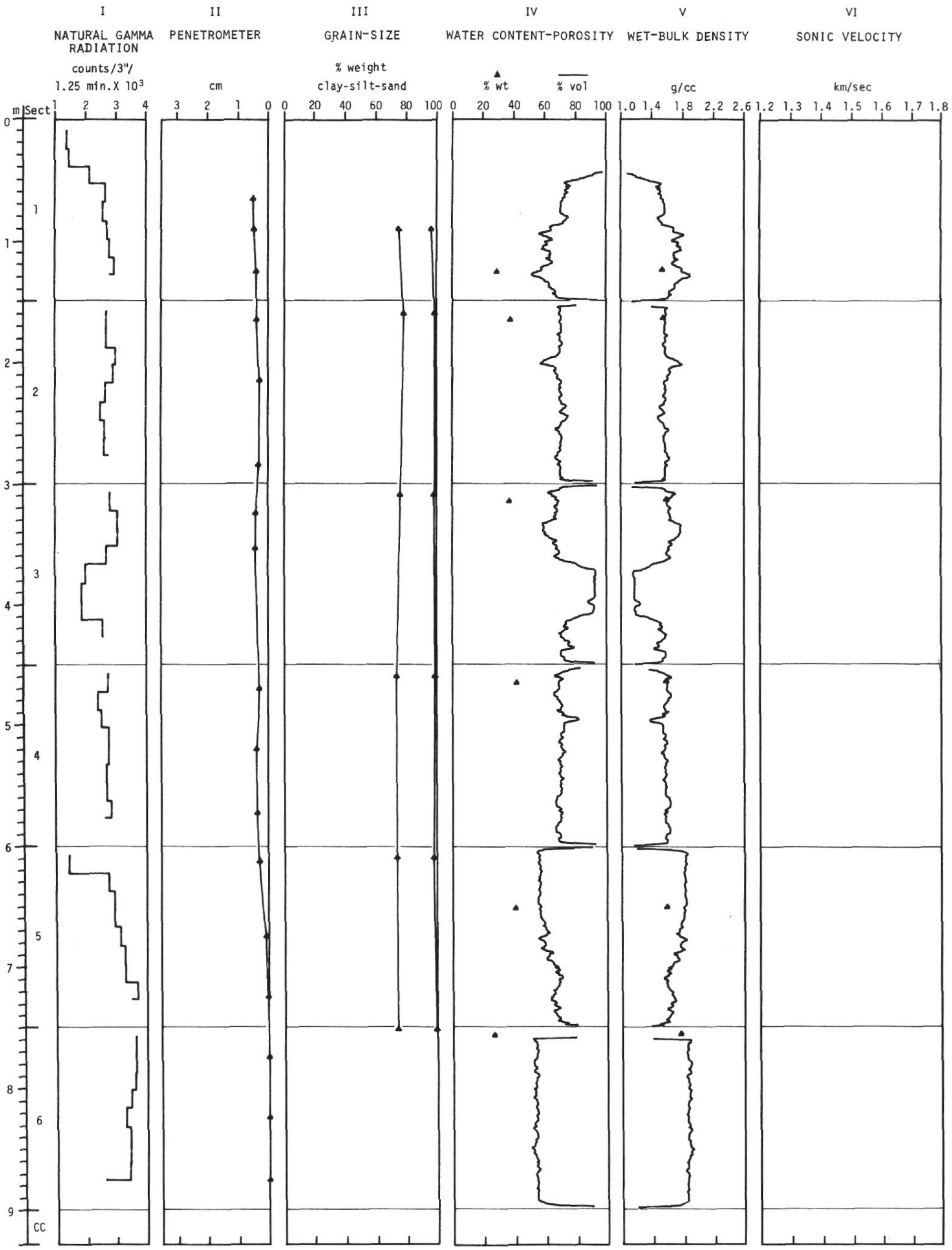
Hole 105, Core 6 (250m to 259m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
TERTIARY?		1 2 3	1 2 CC		SS SS SS SS SS SS SS D,CN	Clay, silty, firm, plastic, interbedded bands of light brown (5YR5/4), olive gray (5Y4/1) and light olive gray (5Y6/2). Clayey quartz sand layers. Heavy minerals, including sphalerite are common, radiolarians rare. Olive gray (5Y4/1). Light brown (5YR5/4). Alternating olive gray and light brown bands. Light brown (5YR5/4) with greenish gray (5G6/1) sandy layers; palagonitic grains abundant. Olive gray with light brown bands and dusky yellow (5Y6/4) layer of zeolitic silt. Core catcher sample: X-ray diffraction analysis: quartz 23% K feldspar 4 plagioclase 1 kaolinite 35 mica 15 chlorite 5 montmorillonite 15	*CORE CATCHER* CALCAREOUS NANNOPLANKTON: Barren DINOFLAGELLATES: *Operculodinium centrocarpum*, *Achomosphaera* sp. aff. *A. triangulata*



Hole 105, Core 7 (259m to 268m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
NO DETERMINATION		1	1		SS	Large and small angular, rounded or squeezed fragments of clay representing every lithology and color found in cores 4, 5, and 6. Appears to be a tightly packed accumulation of uphole cavings; main color is light brown (5YR5/4), olive gray (5Y4/1) is common.	
		2 3	2		SS SS		
		4	3		SS		
		5 6	4		SS		
		7	5		SS SS	Clay, silty, firm, semi-plastic, light brown streaked with olive gray (5Y6/1), dark gray (N5), and pale olive (10Y6/2), heavy minerals, including sphalerite are common, large spots of black Fe-Mn oxide.	
		8	6		SS SS SS		*CORE CATCHER* CALCAREOUS NANNOPLANKTON: Barren DINOFLAGELLATES: Barren
			CC		SS SS SS CN,D	Core catcher sample: Manganese nodule (todorokite)	

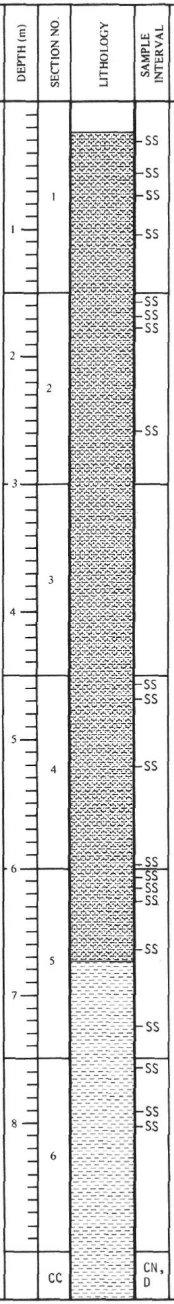


Hole 105, Core 8 (268m to 277m)

AGE

NO DETERMINATION

ZONE



LITHOLOGY

Clay, silty, firm, semi-plastic, light brown (5YR 6/4) and various shades of 5YR4/4, 5YR5/6 and 10YR5/4, top part contains soft black nodules, yellow (5Y7/6) silty patches and lenses contain abundant dark mica and sphalerite, iron manganese oxides common.

Thinly interbedded bands of dark [dusky yellowish brown (10YR2/2) and light reddish brown, (10YR5/4)], with yellow and gray silt zones.

Dusky yellowish brown (10YR2/2).

Light brown (10YR5/4) band; light brown bands have reddish brown (10YR5/4) borders.

Transition from dusky yellowish brown (10YR2/2) to olive, (5Y4/1), with occasional bands of light brown (5YR5/4); dark spots of black (N2) and olive (5Y2/1) throughout.

Olive gray (5Y6/1) with diffuse bands of light brown (5YR5/4); heavy minerals and dark mica common, sphalerite and zeolites are rare.

Yellowish gray (5Y8/1) band; interbedded equal thickness bands of olive gray (5Y6/1), light brown (5YR5/4) and dark olive (5Y3/1).

Bands of blackish olive (5Y2/1).

Bands of yellowish white, blue amphibole sphalerite and zeolites rare.

Bands of black (N2) crumbly iron-manganese oxides.

Large and small angular, rounded or squeezed fragments of clay representing most up hole colors and lithologies. Appears to be a tightly packed accumulation of up hole cavings; mainly light brown (5YR5/4) and olive gray (5Y4/1) with occasional greenish gray chunks.

DIAGNOSTIC FOSSILS

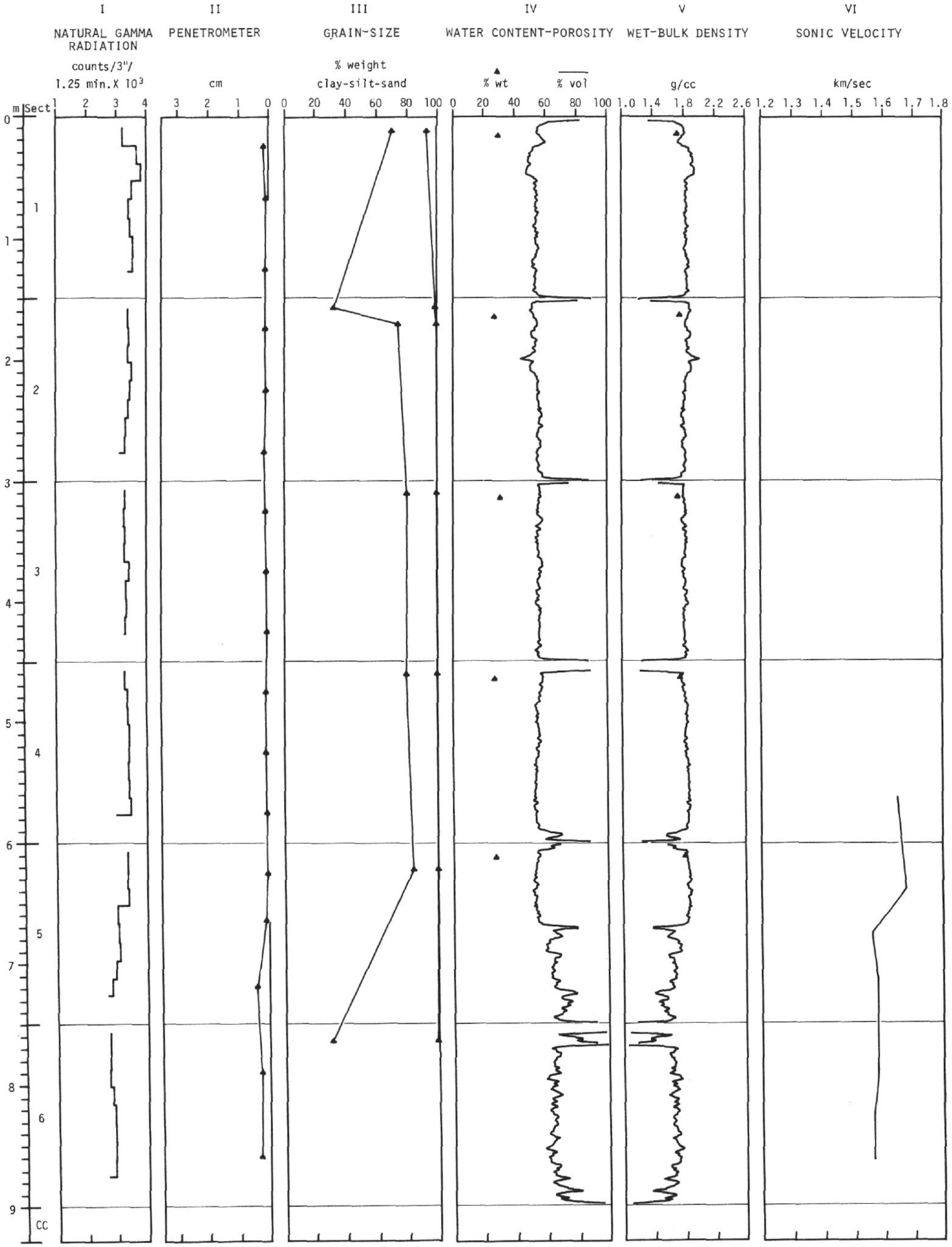
CORE CATCHER

CALCAREOUS NANNOPLANKTON:

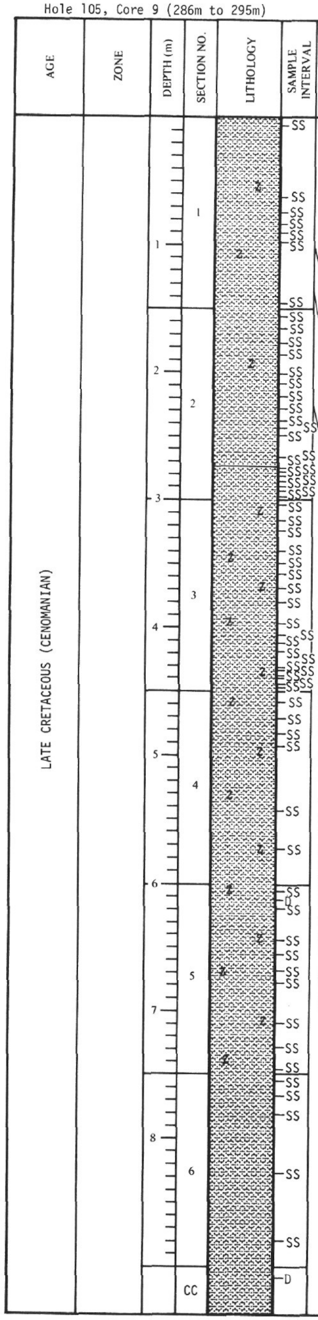
Barren

DINOFLAGELLATES:

Barren



Hole 105, Core 9 (286m to 295m)



LITHOLOGY

Clay, silty, firm, semi-plastic, heavy minerals common, shalerite and zeolites rare.

Dusky yellow brown (10YR3/2) with strong mottling of light brownish gray (5YR6/1).

Band of grayish red (10R5/2) containing strong mottling of light brownish gray (5YR6/1).

Light brown (5YR5/4) grading to reddish brown (10R4/4).

Interbedded yellowish brown (10YR5/4) greenish gray (5G6/1) and pale brown (5YR5/2).

Thinly interbedded yellowish orange (10YR 7/6), grayish green (10GY 5/2) and pale brown (10YR5/2).

Zeolitic clay, silty, firm, semi-plastic, thinly interbedded layers of pale olive (10Y6/2), bluish gray (5B7/1), yellowish orange (10YR6/6), light olive (10Y5/2), grayish green (10G4/2) and dusky yellow (5Y6/4); zeolites are abundant, sphalerite and heavy minerals common.

Black (N1) with thin interbeds of dark greenish gray (5G6/1); zeolites abundant, pyrite and sphalerite common.

Interbedded black (N1) and greenish gray (5G5/1).

Thin (1 mm) white layers of clay minerals and/or zeolites common throughout black and green zones; all green zones have fine to medium generally even laminations of black and white; black/green contacts are generally sharp; pyrite is common in both green and black zones; some black clay is sufficiently carbonaceous as to burn in match flame.

Zeolites are disseminated abundantly throughout the black and greenish gray zones.

DIAGNOSTIC FOSSILS

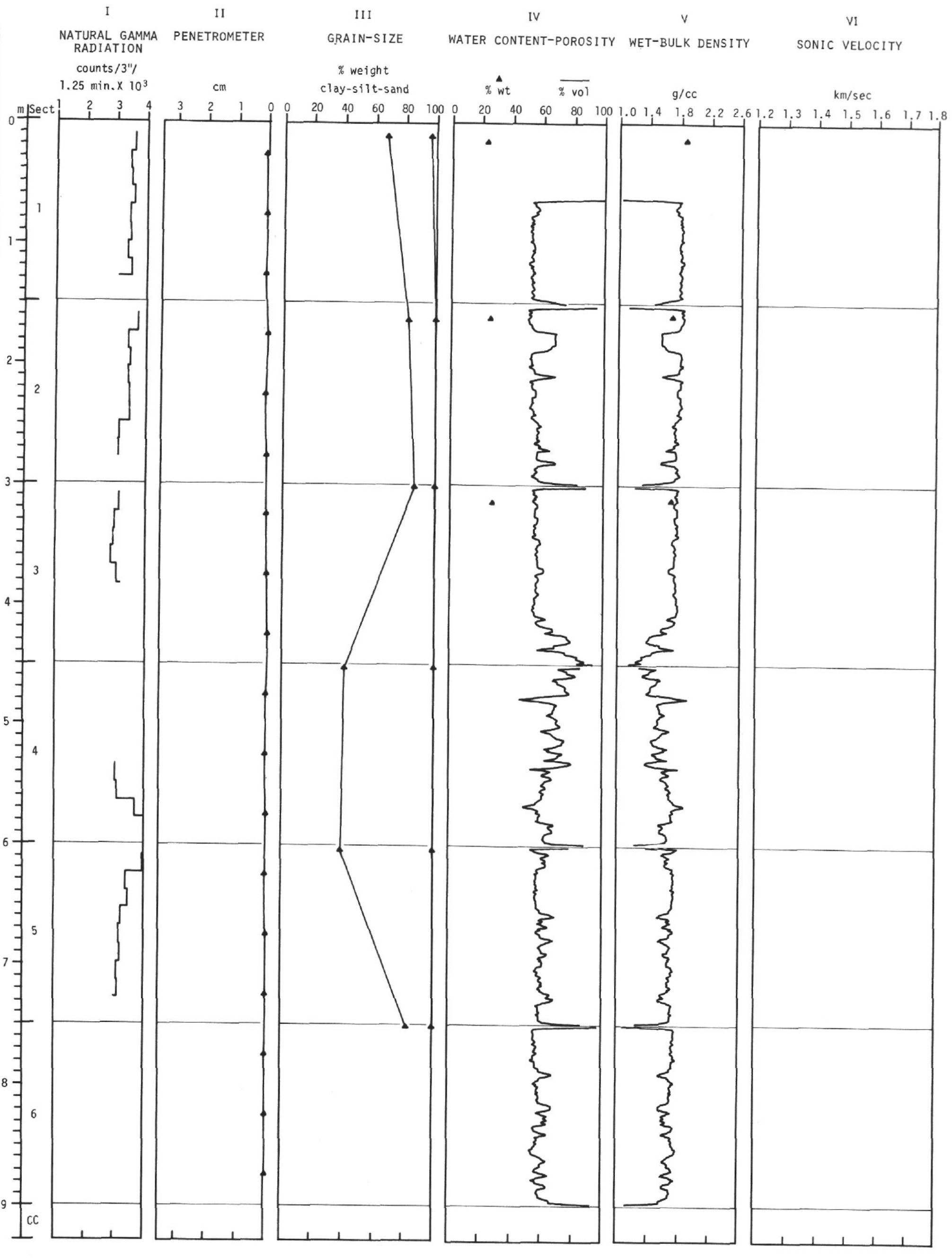
DINOFLAGELLATES:

Deflandrea acuminata, Palaeohystrichophora infusorioides, Litosphaeridium siphoniphorum

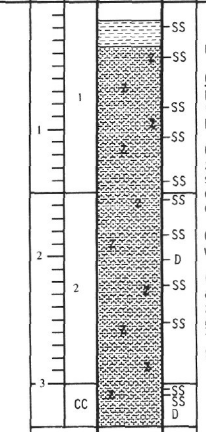
CORE CATCHER

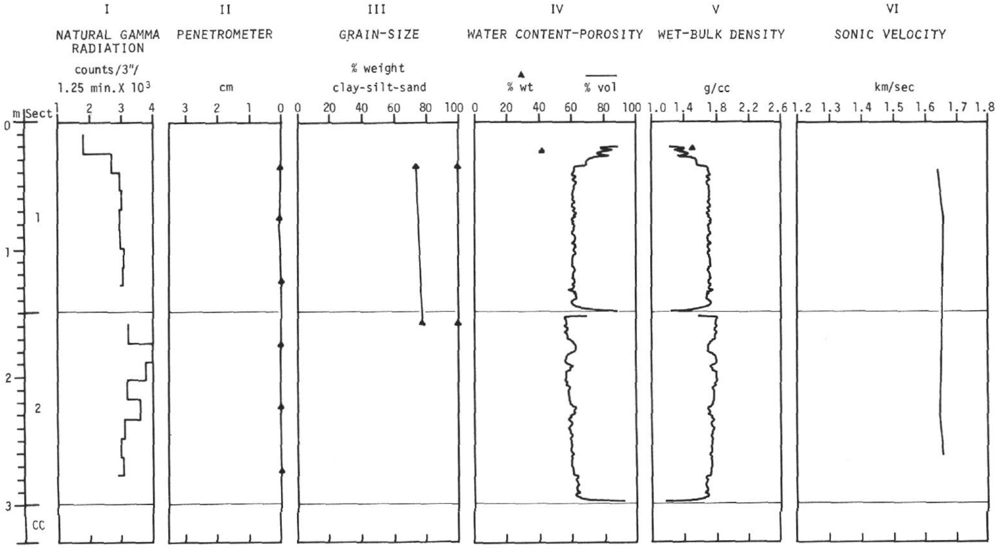
DINOFLAGELLATES:

Deflandrea acuminata, Palaeohystrichophora infusorioides, Litosphaeridium siphoniphorum

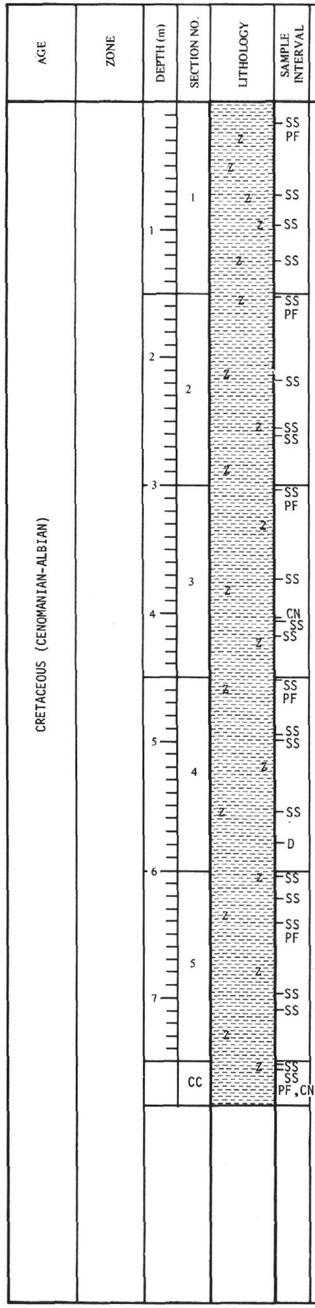


Hole 105, Core 10 (295m to 304m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE CRETACEOUS (CENOMANIAN)						Up hole cavings. *Clay*, silty, zeolitic, firm, semi-plastic, dark yellowish brown (10YR4/2), slight mottling with pale green (10G6/2). Grayish green (10GY5/1) slightly zeolitic; abundant white specks and streaks of quartz and feldspar filled burrows; thin dark yellowish orange (10YR6/6) streaks of limonite. Greenish gray (5G4/1) interbedded with black (N2) carbonaceous beds. Organic matter rare in green zones and abundant in black zones; zeolites common to rare in some green zones; white specks common throughout all green zones. Black/green contacts are usually sharp. Core catcher sample: X-ray diffraction analysis: quartz 11% K feldspar 2 plagioclase 5 kaolinite 10 mica 10 montmorillonite 59 pyrite 4	DINOFLAGELLATES: *Palaeohystrichophora infusorioides* *CORE CATCHER* DINOFLAGELLATES: *Palaeohystrichophora infusorioides, Cyclonephelium vannophorum, Litosphaeridium siphoniphorum*



Hole 105, Core 11 (304m to 313m)



LITHOLOGY

Zeolitic clay, silty, firm, semi-plastic, mainly black (N1, N2) with medium interbeds of dark greenish gray (5G4/1); black clay is highly carbonaceous and some sample will burn when held in match flames; black/green contacts generally sharp; black beds contain occasional thin (1 mm±) white layers of zeolitic silt; green beds contain abundance of both very thin black lenses, streaks and specks and white streaks and specks; zeolites are abundantly dissiminated throughout black and green beds; nannoplankton present in both black and green beds, organic matter rare in green zones and abundant in black shales, foraminifers present in Section 2, radiolarians rare and replaced with pyrite in Section 3.

Lenses and specks, occasional grayish black (N3, N4) zones of very thinly interbedded green and black clay layers, zeolites abundantly disseminated in both black and green beds.

DIAGNOSTIC FOSSILS

PLANKTONIC FORAMINIFERS:

Planomalina buxtorfi, Hedbergella amabilis

PLANKTONIC FORAMINIFERS:

Hedbergella amabilis

PLANKTONIC FORAMINIFERS:

Rotalipora apenninica apenninica, Praeglobotruncana delrioensis, Hedbergella amabilis

CALCAREOUS NANNOPLANKTON:

Apertapetra gronosa, Zygodiscus erectus, Lithraphidites carniolensis, Eiffellithus turriseiffeli, Cretarhabdus decorus, C. splendens, Deflandrius intercisus

PLANKTONIC FORAMINIFERS:

Rotalipora apenninica apenninica, Planomalina buxtorfi, Hedbergella amabilis

DINOFLAGELLATES:

Cleistosphaeridium ancoriferum, Hystrichosphaeridium arundum, Hexagonifera chlamydata, Gonyaulacysta exilicristata, Palaeohystrichophora infusorioides

CORE CATCHER

PLANKTONIC FORAMINIFERS:

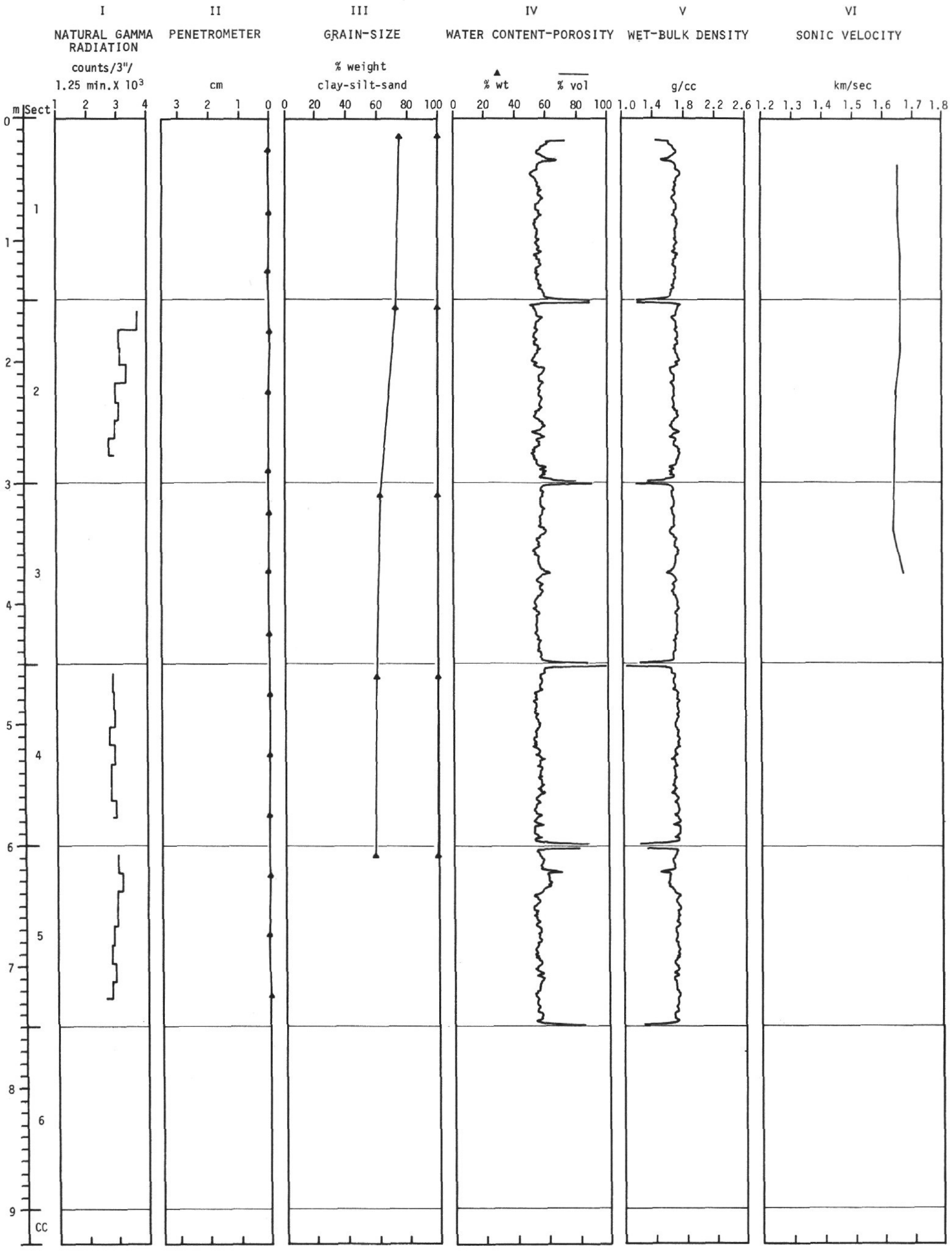
Rotalipora apenninica apenninica, Praeglobotruncana delrioensis, Schackoina cenomana

CALCAREOUS NANNOPLANKTON:

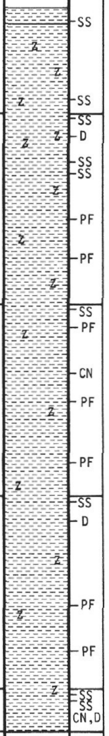
Apertapetra gronosa, Prediscosphaera columnatus, Eiffellithus turriseiffeli, Cretarhabdus splendens, Watznaueria barnesae, W. actinosa

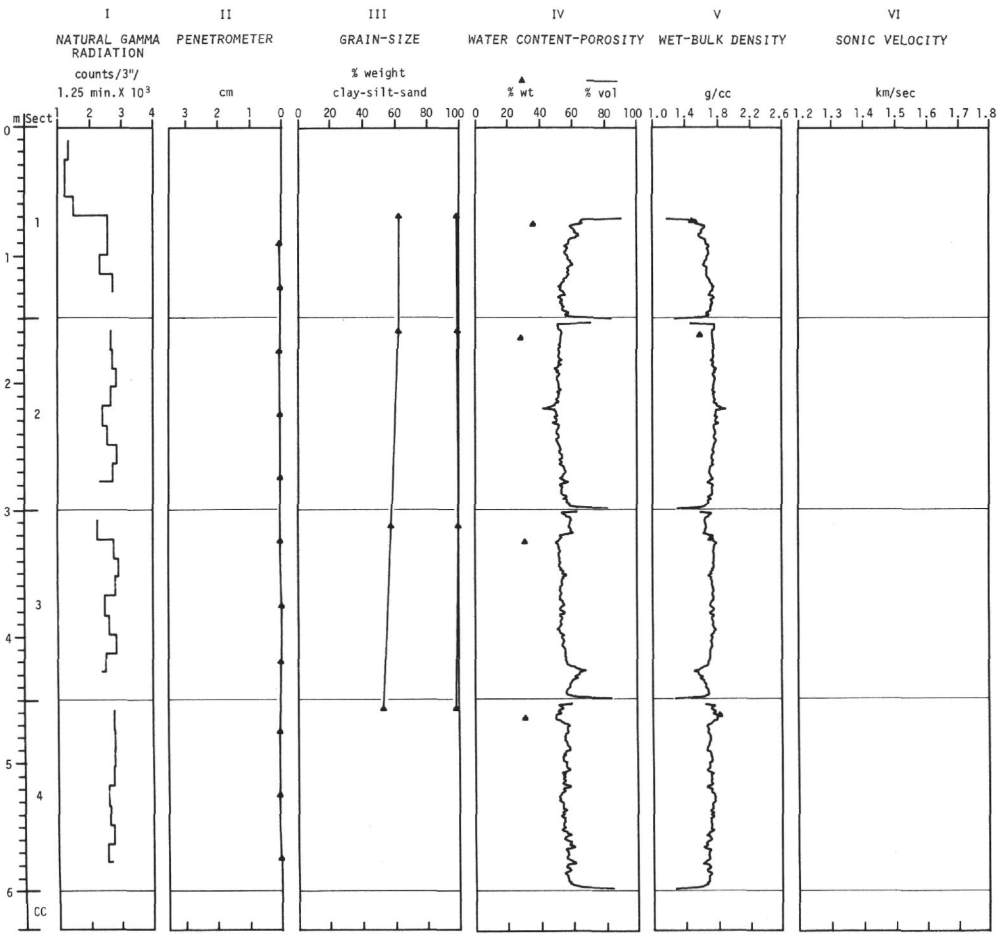
DINOFLAGELLATES:

Cleistosphaeridium ancoriferum, Hystrichosphaeridium arundum



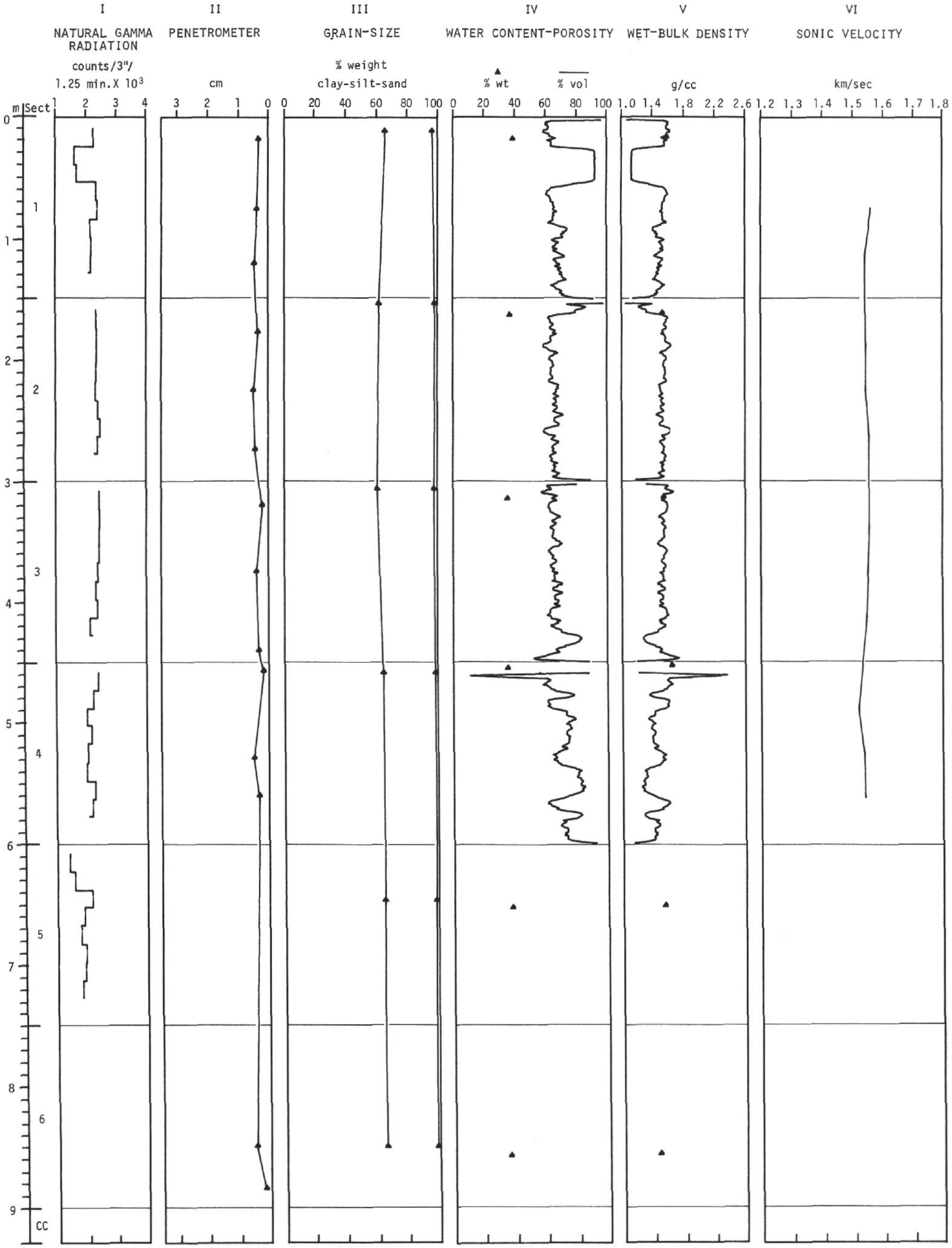
Hole 105, Core 12 (313m to 322m)

AGE	ZONE	DEPTH (m)	SECTION NO	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
CRETACEOUS (CENOMANIAN-ALBIAN)		1	1		SS SS	Drill cuttings. Zeolitic clay, silty, firm, semi-plastic, black (N1) with occasional beds of dark greenish gray (5G4/1); black clay is highly carbonaceous and some samples will burn when held in match flame; black/green contacts generally sharp; thin (1 mm±) white layers are abundant throughout black beds and vary in composition; some being white clay minerals, some hard siderite silt most are layers of zeolite silt; green beds contain numerous thin black layers, lenses and spots as well as abundant white silt layers; organic matter rare in green beds and abundant in black zones; nannoplankton are common throughout; zeolites are disseminated in both black and green beds; radiolarians are common and usually replaced by pyrite, diatoms are rare, fish scales common.	
		2	2		SS D SS SS PF PF		PLANKTONIC FORAMINIFERS: *Planomalina buxtorfi, Hedbergella amabilis* DINOFLAGELLATES: *Palaeohystrichophora infusorioides, Coronifera oceanica, Odontochitina operculata*
		3 4	3		SS PF CN PF PF		PLANKTONIC FORAMINIFERS: *Rotalipora apenninica apenninica, Planomalina buxtorfi, Hedbergella amabilis* CALCAREOUS NANNOPLANKTON: *Eiffellithus turriseiffeli, Apertapetra gronosa, Parhabdolithus embergeri, Watznaueria barnesae, W. actinosa, Lithraphidites carniolensis, Stephanolithion crenulatum, Arkhangelskiella striata*
		5	4		SS D PF PF		PLANKTONIC FORAMINIFERS: *Hedbergella amabilis* DINOFLAGELLATES: *Palaeohystrichophora infusorioides, Hystrichosphaeridium arundum*
		6	CC		SS SS CN,D		*CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Apertapetra gronosa, Parhabdolithus angustus, Eiffellithus turriseiffeli, Zygodiscus erectus, Cretarhabdus decorus, C. splendens, Watznaueria actinosa* DINOFLAGELLATES: *Cleistosphaeridium ancoriferum, Gonyaulacysta exilicristata*
		7					



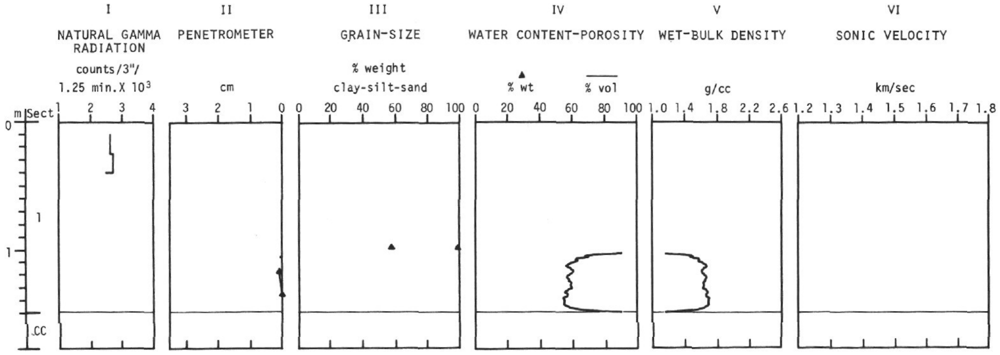
Hole 105, Core 13 (322m to 331m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
EARLY CRETACEOUS (ALBIAN-CENOMANIAN) (APTIAN-nannoplankton)		0–1	1	Z	SS D		DINOFLAGELLATES: *Hystrichosphaeridium arundum, Cleistosphaeridium ancoriferum, Palaeohystrichophora infusorioides*
		2	2	Z	SS D		DINOFLAGELLATES: *Odontochitina operculata, Palaeohystrichophora infusorioides*
		3–4	3	Z	SS CN D	Both small and large angular, rounded and squeezed fragments of clay representing colors and lithologies found in Cores 11 and 12; mainly green and black chunks tightly packed in soft greenish black matrix. Appears to be cavings from up-hole.	CALCAREOUS NANNOPLANKTON: *Apertapetra gronosa, Watznaueria barnesae, Glaukolithus diplogrammus, Lithastrinus* sp., *Cretarhabdus decorus* DINOFLAGELLATES: *Hystrichosphaeridium arundum, Cleistosphaeridium ancoriferum, Hexagonifera chlamydata, Palaeohystrichophora infusorioides*
		5	4	Z	SS		
		6–7	5	Drill cuttings		Highly disturbed soft black clay. Black drill cuttings, mud.	
		8	6	Z		Same as in sections 1 to 4.	
		9	CC	Z	SS CN,D		*CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Glaukolithus diplogrammus, Apertapetra gronosa, Parhabdolithus embergeri, Watznaueria barnesae, W. actinosa, Cretarhabdus decorus* DINOFLAGELLATES: *Hystrichosphaeridium arundum, Cleistosphaeridium ancoriferum, Palaeohystrichophora infusorioides*

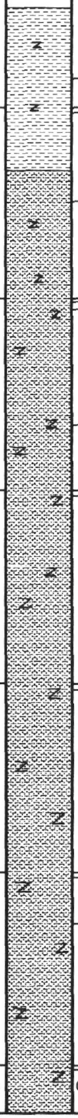


Hole 105, Core 14 (348m to 357m)

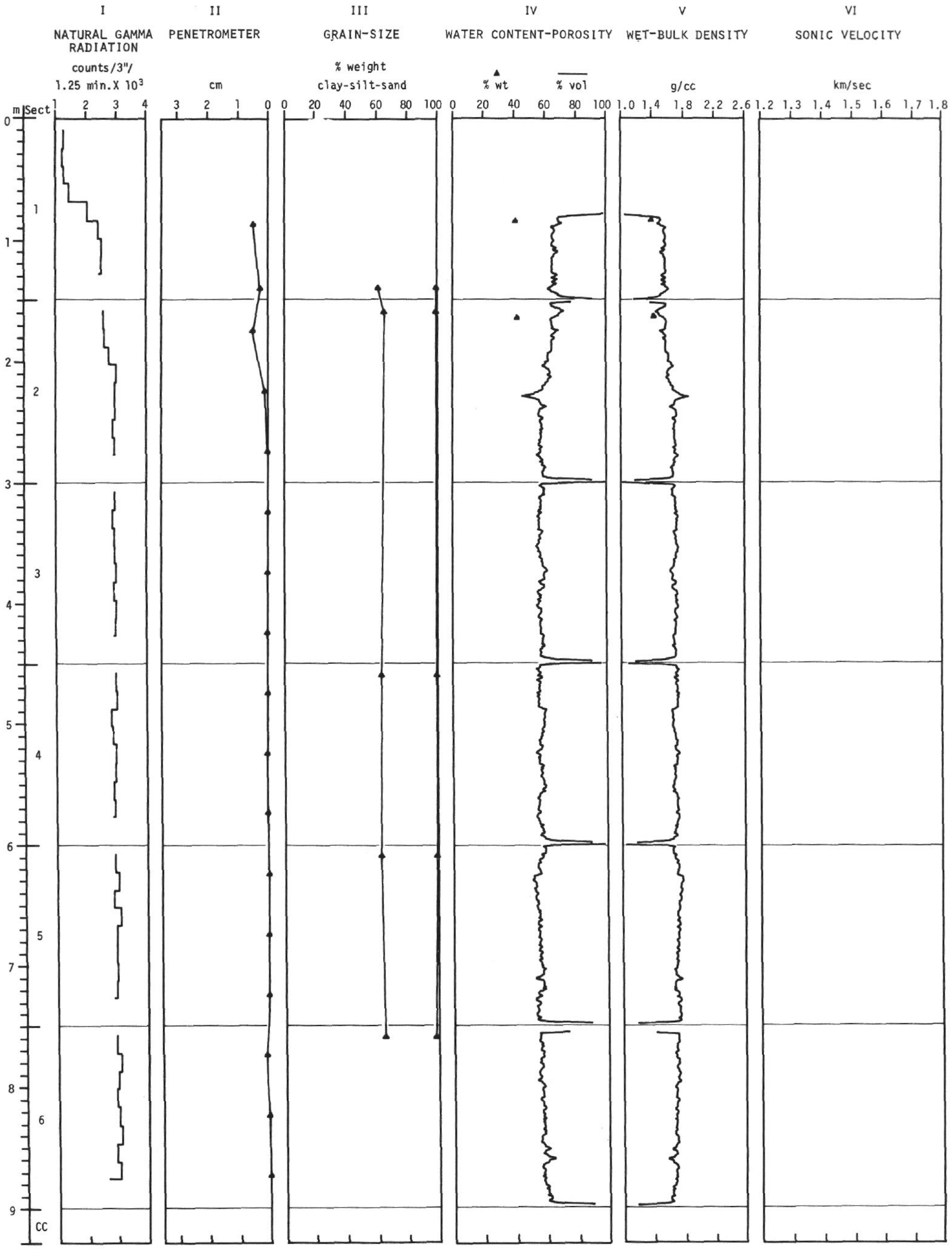
AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
EARLY CRETACEOUS (ALBIAN)		1 CC	1		D SS D	<u>Zeolitic clay</u>, silty, firm, semi-plastic, black (N1) with abundant thin (1 mm±) white layers of zeolite silt.	DINOFLAGELLATES: *Hystrichosphaeridium arundum, Odontochitina operculata, Hystrichokolpoma ferox, Oligosphaeridium complex* *CORE CATCHER* DINOFLAGELLATES: *Hystrichosphaeridium arundum, Gonyaulacysta exilicristata, Odontochitina operculata*



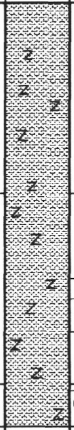
Hole 105, Core 15 (366m to 375m)

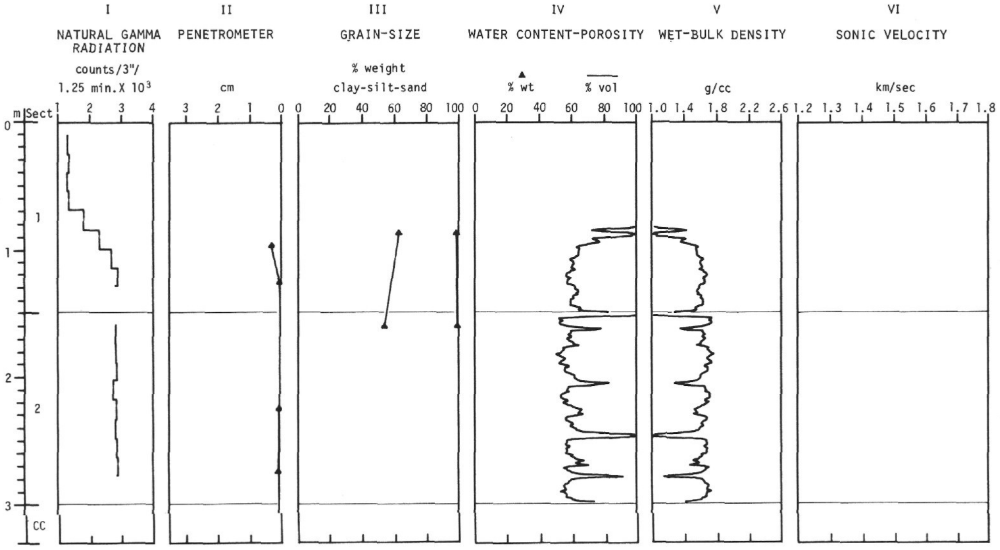


AGE	ZONE	DEPTH (m)	SECTION NO.	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
EARLY CRETACEOUS (ALBIAN)		1	1	D SS	Highly disturbed black (N1) clay, inclusions of greenish gray clay (5G5/1), zeolites common.	DINOFLAGELLATES: *Hystrichosphaeridium arundum, Cleistosphaeridium ancoriferum, Gonyaulacysta exilicristata, Cribroperidinium edwardsi, Palaeohystrichophora infusorioides* (rare)
		2	2	SS		
		3 4	3	SS SS D	<u>Zeolitic clay</u>, silty, firm, semi-plastic, black (N1) with one bed of dark greenish gray (5G4/1); black clay highly carbonaceous and some samples burn when held in match flame; black/green contacts are sharp; zeolites disseminated in both black and green beds; thin (1 mm±) white layers of zeolite silt are abundant throughout black and green beds; occasional thin silt layers in black beds consist entirely of pyrite cubes; pyritic silts contain sponge spicules and radiolarians replaced by pyrite; green beds contain abundant thin black lenses, layers and numerous white silt layers; organic matter common in black beds; radiolarians rare in Section 3.	DINOFLAGELLATES: *Hystrichosphaeridium arundum, Oligosphaeridium complex, Hexagonifera chlamydata, Palaeohystrichophora infusorioides* (rare) *Litosphaeridium siphoniphorum* (one specimen)
		5	4	SS		
		6 7	5	SS		DINOFLAGELLATES: *Hystrichosphaeridium arundum, Cleistosphaeridum ancoriferum, Oligosphaeridium complex*
		8	6	SS D		
			CC	SS CN,D		*CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Watznaueria barnesae, Apertapetra gronosa, Parhabdolithus embergeri* DINOFLAGELLATES: *Oligosphaeridium complex* (abundant)

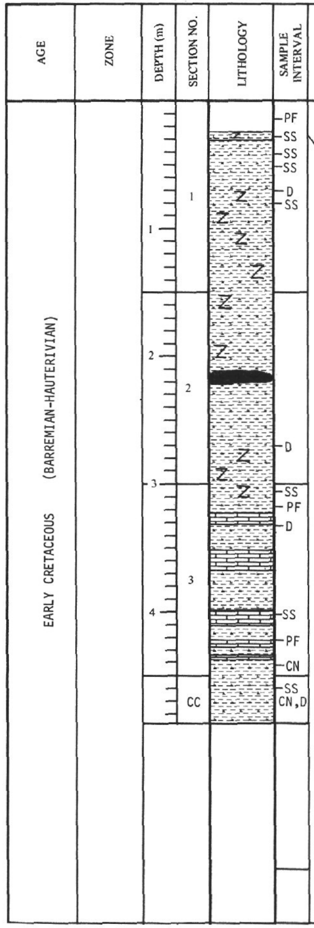


Hole 105, Core 16 (385m to 392m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
EARLY CRETACEOUS (APTIAN/BARREMIAN)		1 2 3	1 2 CC		D CN D SS CN,D	Zeolitic clay, silty, firm, semi-plastic, black (N1), highly carbonaceous; some samples will burn when held in match flame; thin (1 mm±) white layers of zeolite silt abundantly distributed throughout; occasional thin layers of pyrite silt.	CALCAREOUS NANNOPLANKTON: *Nannoconus kamptneri, Apertapetra gronosa, Watznaueria barnesae, Stephanolithion laffittei, Ahmuellerella asper, Cretarhabdus crenulatus, Staurolithites bochotnicae* DINOFLAGELLATES: *Gonyaulacysta helicoidea, G. cassidata, Dingodinium cerviculum, Cribroperidinium muderongensis, Hystrichokolpoma ferox, Oligosphaeridium complex, Coronifera oceanica, Rhombodella* ? sp. A *CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Nannoconus kamptneri, Stephanolithion laffittei, Staurolithites bochotnicae, Parhabdolithus embergeri, Lithraphidites carniolensis, Zygodiscus erectus* DINOFLAGELLATES: *Paranethrelytron strongylum, Odontochitina operculata, Coronifera oceanica, Dingodinium cerviculum*



Hole 105, Core 17 (403m to 412m)



LITHOLOGY

Zeolitic clay, silty, firm, semi-plastic, black (N1), similar to previous cores; base of zone of black highly carbonaceous material.

Very clayey soft limestone, zeolitic, thinly and evenly laminated throughout, interbedded shades of olive gray (5Y6/1), dark gray (N4), and light gray (N5-N7), nannoplankton abundant to dominant, clay, zeolites, and organic matter are common.

Large coarse crystalline pyrite bed.

Chalky limestone, hard, grayish white (N7) interbedded with finely and evenly laminated, clayey, slightly zeolitic soft limestone; laminated zones are olive gray (5Y6/1) with occasional dark gray (N4) and grayish black variations; darker zones characterized by even, fine laminations; lighter zones characterized by distorted and undulating laminations and bedding planes or by the lack of them; distorted laminae and bedding planes appear related to action of bottom currents and burrowing organisms; contacts between white and dark beds are generally gradational; dark zones are dominantly calcareous nannoplankton; white limestones are dominantly recrystallized nanno calcite; organic matter and clay are common to abundant in darker zones and rare to abundant in white limestones.

DIAGNOSTIC FOSSILS

PLANKTONIC FORAMINIFERS:

Hedbergella infracretacea, H. hoterivica, H. globigerinelloides

DINOFLAGELLATES:

Dingodinium cerviculum, Microdinium deflandrei, Wallodinium krutzschi, Dictyopyxis circulata, Paranetrelytron strongylum

DINOFLAGELLATES:

Dingodinium cerviculum, Microdinium deflandrei, Wallodinium krutzschi, Dictyopyxis circulata

PLANKTONIC FORAMINIFERS:

Hedbergella infracretacea

CALCAREOUS NANNOPLANKTON:

Nannoconus kamptneri, Stephanolithion laffittei, Cretarhabdus crenulatus, C. splendens, Arkhangelskiella striata, Zygodiscus erectus, Lithraphidites carniolensis

DINOFLAGELLATES:

Dingodinium cerviculum, Microdinium deflandrei, Wallodinium krutzschi

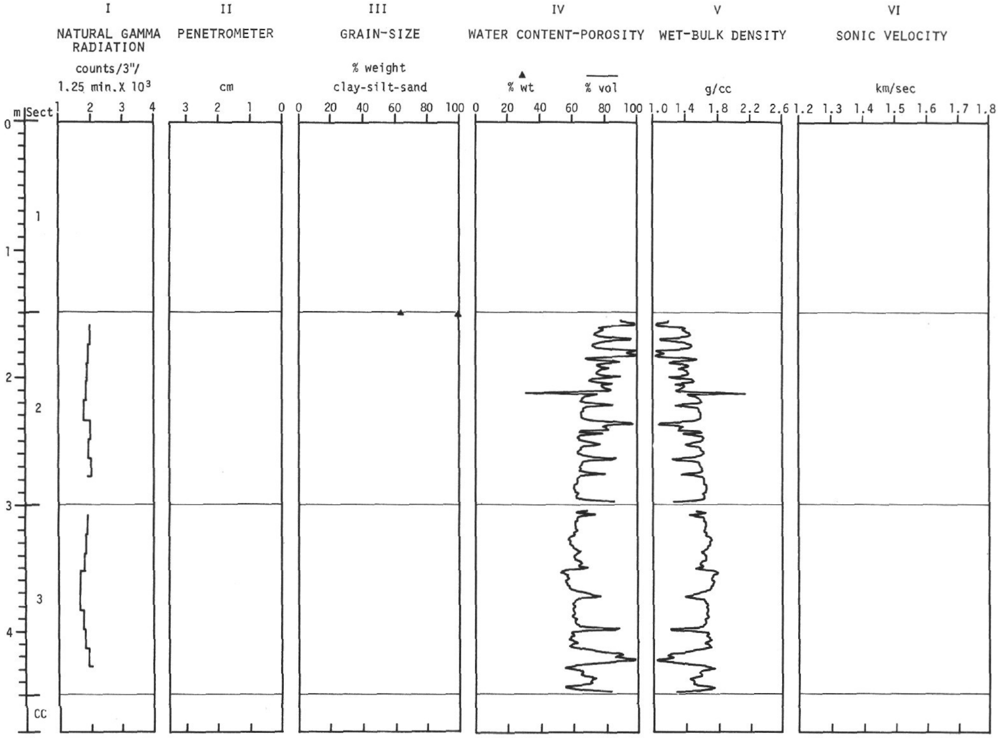
CORE CATCHER

CALCAREOUS NANNOPLANKTON:

Stephanolithion laffittei, Aperapetra gronosa, Zygodiscus erectus, Arkhangelskiella striata, Cretarhabdus crenulatus, C. splendens, Lithraphidites carniolensis

DINOFLAGELLATES:

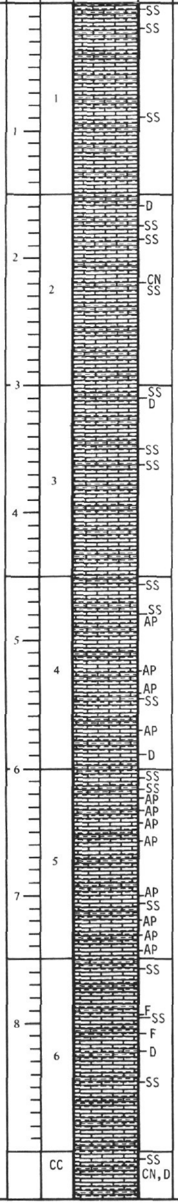
Microdinium deflandrei, Wallodinium krutzschi



Hole 105, Core 18 (421m to 430m)

AGE: EARLY CRETACEOUS (HAUTERIVIAN)

ZONE



LITHOLOGY

<u>Chalky limestone</u>, hard, gray white to white (N8 to N9) interbedded with finely and evenly laminated, <u>clayey, zeolitic soft limestone</u>; laminated zones are olive gray (5Y4/1) and medium gray (N4) with occasional dark to very dark gray laminae all contacts between non-laminated and laminated gray are gradational; lighter zones (N6 to N8) show irregular and poorly developed bedding; bedding in massive white (N9) zone appears to have been completely destroyed by burrowing organisms; abundant occurrences of truncated, distorted or faulted laminae alternating with smooth, finely laminated zones suggests periodic disturbances by bottom currents, minor slumping and burrowing organisms; white limestone are characterized by abundance of recrystallized nanno-calcite and the general absence of clay and organic matter soft dark limestone is dominantly calcareous nannoplankton and clay and organic matter; pyrite crystals are common throughout. Laminated zones in Sections 3 and 5 contain abundant aptychi and bivalve fragments; pyritized radiolarians are rare; dolomite rhombs common in Section 5.

DIAGNOSTIC FOSSILS

CALCAREOUS NANNOPLANKTON:

Braarudosphaera discula,
Lithraphidites carniolensis,
Cretarhabdus crenulatus,
C. splendens
Ahmuelleria asper,
Watznaueria actinosa, W. barnesae

DINOFLAGELLATES:

Dingodinium cerviculum,
Microdinium deflandrei,
Wallodinium krutzschi,
Meiourogonyaulax stoveri

DINOFLAGELLATES:

Dingodinium cerviculum,
Microdinium deflandrei,
Wallodinium krutzschi

AMMONITE APTYCHI:

Lamellaptychus seranonis
L. angulocostatus

DINOFLAGELLATES:

Dingodinium cerviculum,
Microdinium deflandrei,
Wallodinium krutzschi,
Rhombodella? sp. A

AMMONITE APTYCHI:

Lamellaptychus angulocostatus
atlanticus
L. seranonis
L. joides

FORAMINIFERS:

Lenticulina ouachensis ouachensis,
L.ouachensis multicellularis

DINOFLAGELLATES:

Dingodinium cerviculum
Microdinium deflandrei
Wallodinium krutzschi
Odontochitina operculate

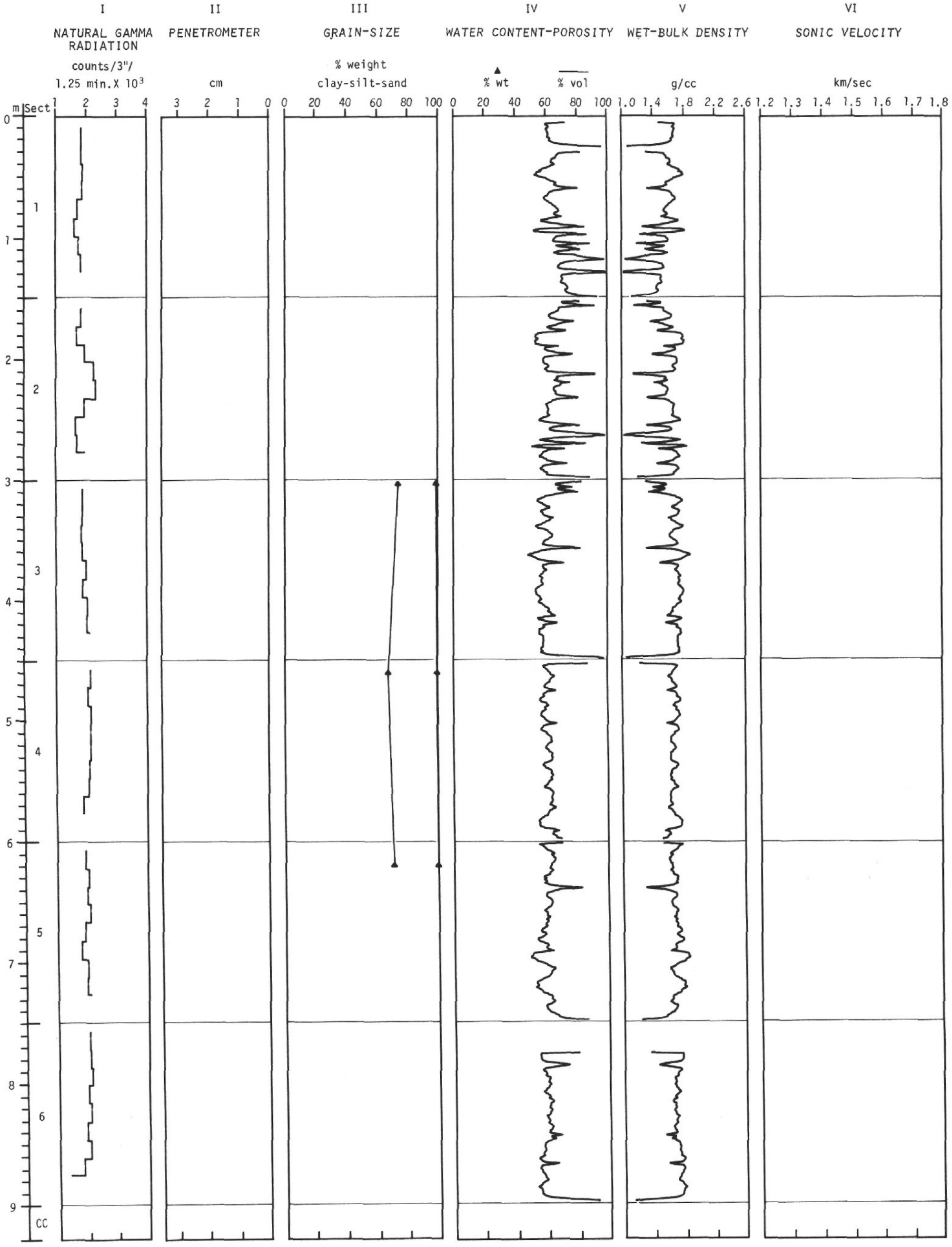
CORE CATCHER

CALCAREOUS NANNOPLANKTON:

Braarudosphaera discula,
Lithraphidites carniolensis,
Glaukolithus diplogrammus,
Watznaueria actinosa, W.barnesae

DINOFLAGELLATES:

Meiouroganyaulax stoveri,
Wallodinium krutzschi

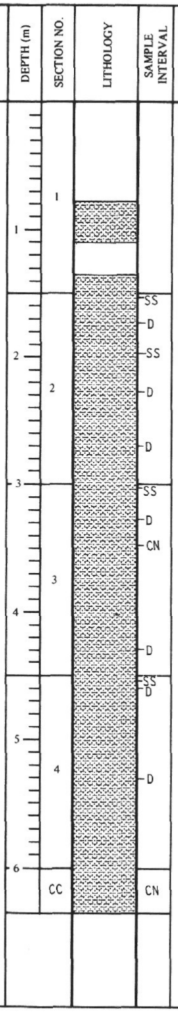


Hole 105, Core 19 (430m to 439m)

AGE

ZONE

EARLY CRETACEOUS (HAUTERIVIAN- VALANGINIAN)



LITHOLOGY

Both small and large angular, rounded, and squeezed fragments of soft and hard black (N1) carbonaceous clay and silty clay; occasional pieces of green silty clay. Appears similar to other highly disturbed cores (7, 8, 13) described as cavings from up-hole.

Reddish brown fragment.

White limestone fragment.

DIAGNOSTIC FOSSILS

DINOFLAGELLATES*:

Dingodinium cerviculum,
Microdinium deflandrei,
Wallodinium krutzschi,
Meiourogonyaulax stoveri,
Oligosphaeridium complex,
Odontochitina operculata,
Cyclonephelium distinctum,

CALCAREOUS NANNOPLANKTON:

Ahmuelleria asper,
Glaukolithus diplogrammus,
Cretarhabdus splendens,
Braarudosphaera discula,
Parhabdolithus embergeri,
Lithraphidites carniolensis,

DINOFLAGELLATES:*

Microdinium deflandrei,
Wallodinium krutzschi,
Deflandrea pirnaensis,
Oligosphaeridium complex,
Cyclonephelium distinctum

DINOFLAGELLATES:

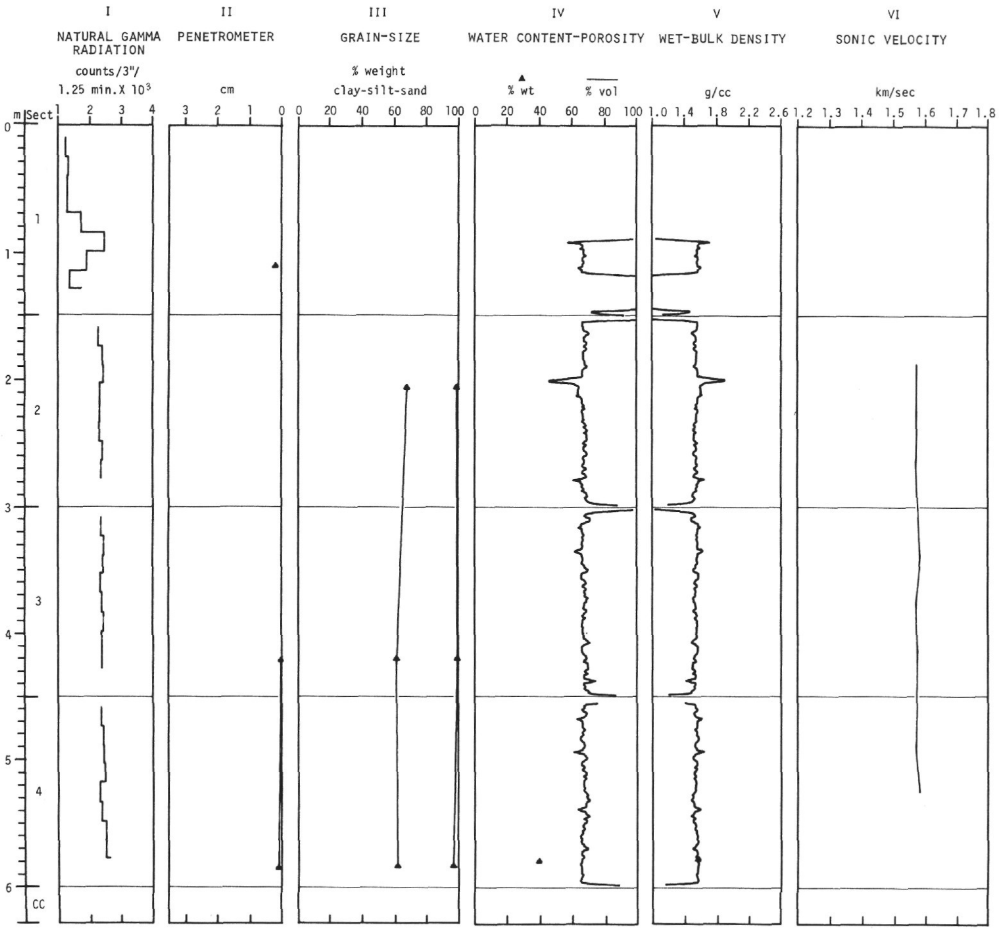
Wallodinium krutzschi
Deflandrea pirnaensis
Oligosphaeridium complex
Cyclonephelium distinctum

* Hole cavings of Albian/ Cenomanian age include:
Hystrichosphaeridium arundum
Hexagonifera chlamydata

CORE CATCHER

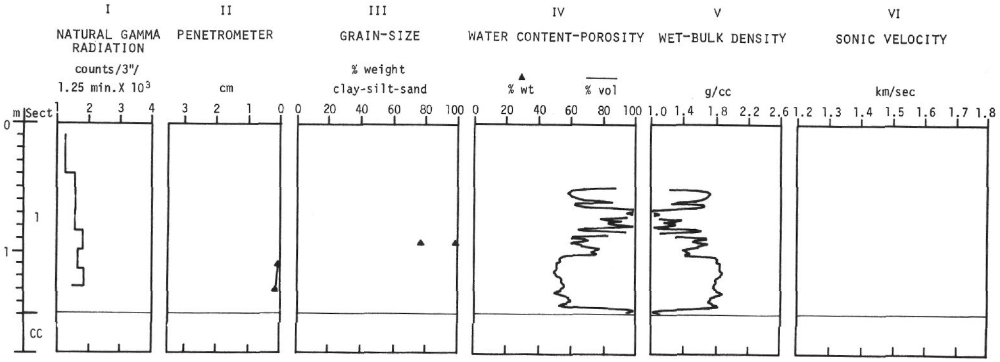
CALCEREOUS NANNOPLANKTON:

Braarudosphaera discula,
Cretarhabdus crenulatus,
Parhabdolithus embergeri,
Arkhangelskiella striata,
Lithraphidites carniolensis



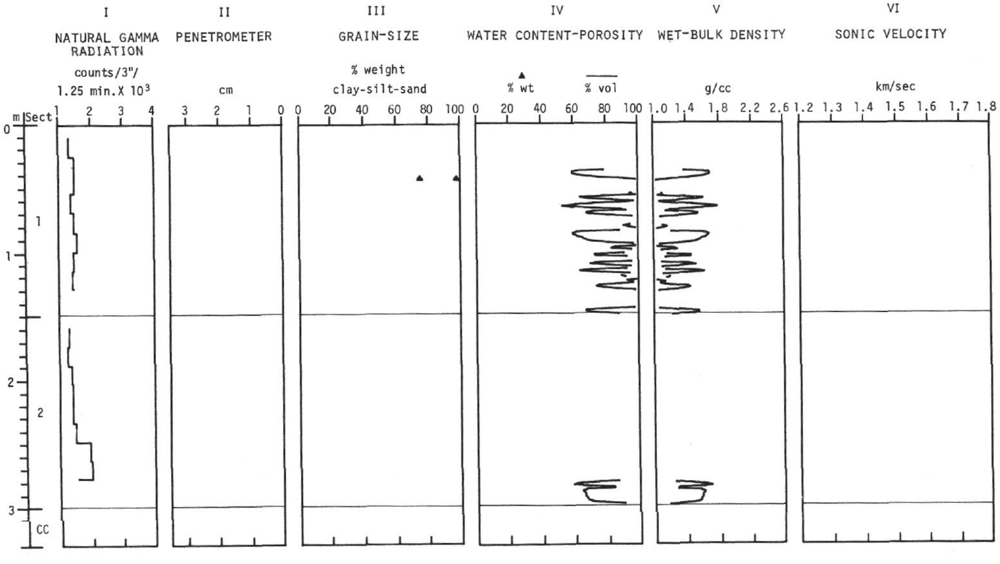
Hole 105, Core 20 (439m to 448m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
EARLY CRETACEOUS (HAUTERIVIAN-VALANGINIAN)		1	1 CC		D SS SS D CN SS SS CN	Chalky limestone, hard, light gray (N7 to N8); non-laminated, bedding disturbed or absent, interbedded with finely and evenly laminated, clayey, dark gray (N4) soft limestone. All contacts between these two lithological types are gradational; abundant occurrences of truncated, distorted, or faulted laminae on bedding planes alternating with smooth, finely laminated zones suggest periodic disturbances by bottom currents, burrowing organisms, and minor slumping. Soft clayey limestone is dominantly calcareous nannoplankton; white limestones are dominantly recrystallized nanno-calcite; organic matter and clay minerals are abundant in darker zones and absent in white beds; pyritized radiolarians are rare in dark zones; laminated zones contain fragments of aptychi and bivalves.	CALCAREOUS NANOPLANKTON: *Braarudosphaera discula,* *Ahmuellerella asper,* *Watznaueria actinosa,* *Lithraphidites carniolensis,* *Parhabdolithus embergeri,* *Zygodiscus erectus* DINOFLAGELLATES: *Microdinium deflandrei,* *Wallodinium krutzschi,* *Dingodinium cerviculum* (one specimen), *Scriniodinium (Endoscrinium) campanula* *CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Braarudosphaera discula,* *Arkhangelskiella striata,* *Ahmuellerella asper,* *Zygodiscus erectus,* *Stephanolithion crenulatus,* *Tintinnida* spp.



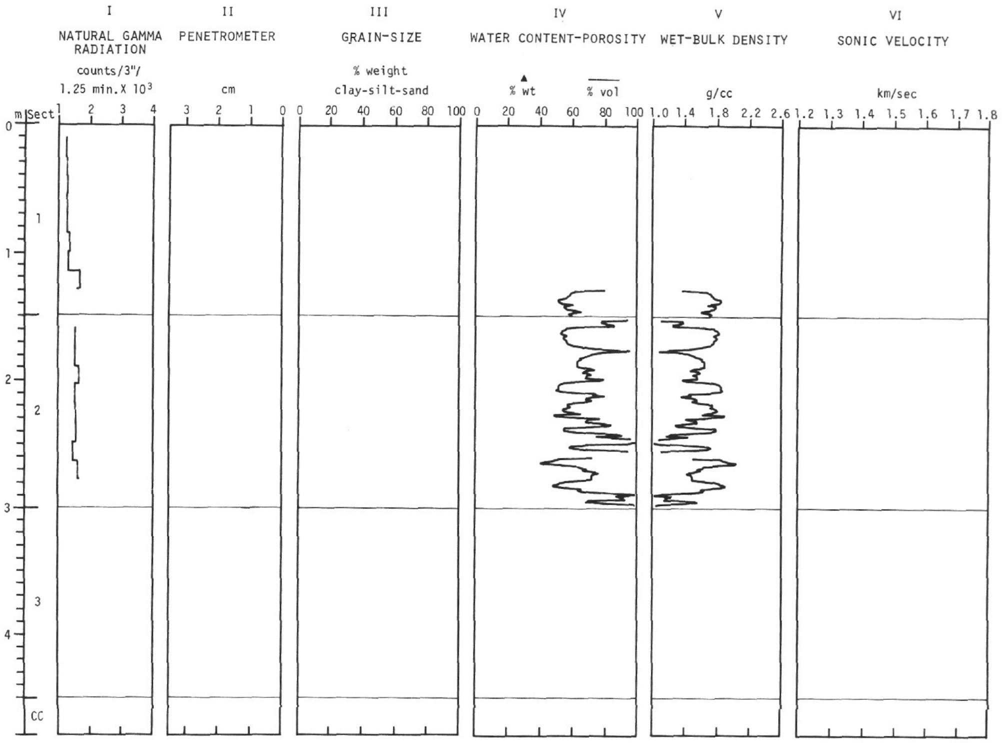
Hole 105, Core 21 (448m to 457m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
EARLY CRETACEOUS (HAUTERIVIAN-VALANGINIAN)		1 2	1 2 CC		D D CN D D SS CN	Chalky limestone, light gray to white (N8-N9), non-laminated, bedding disturbed or absent, interbedded with finely and evenly laminated, clayey, light gray to olive gray (N7 to 5Y4/1) soft limestone; most contacts are gradational; distorted laminae and bedding planes alternating with smooth, finely laminated zones suggest periodic disturbances by bottom currents and burrowing organisms. Clayey zones are dominantly calcareous nannoplankton; white limestone is dominantly recrystallized nanno-calcite; organic matter and clay are common in darker zones and absent in white limestone;pyritized radiolarians are rare. Drill cuttings.	CALCAREOUS NANNOPLANKTON: *Braarudosphaera discula,* *Parhabdolithus embergeri,* *Watznaueria barnesae, W. actinosa* DINOFLAGELLATES: *Microdinium deflandrei,* *Wallodinium krutzschi,* *Scriniodinium (Endoscrinium) campanula,* *S. (Endoscrinium) dictyotum* DINOFLAGELLATES: *Deflandrea* sp. aff. *D. pirnaensis,* *Cyclonephelium distinctum* *CORE CATCHER:* CALCAREOUS NANNOPLANKTON: *Braarudosphaera discula,* *Parhabdolithus embergeri,* *Lithraphidites carniolensis,* *Watznaueria barnesae, W. actinosa*



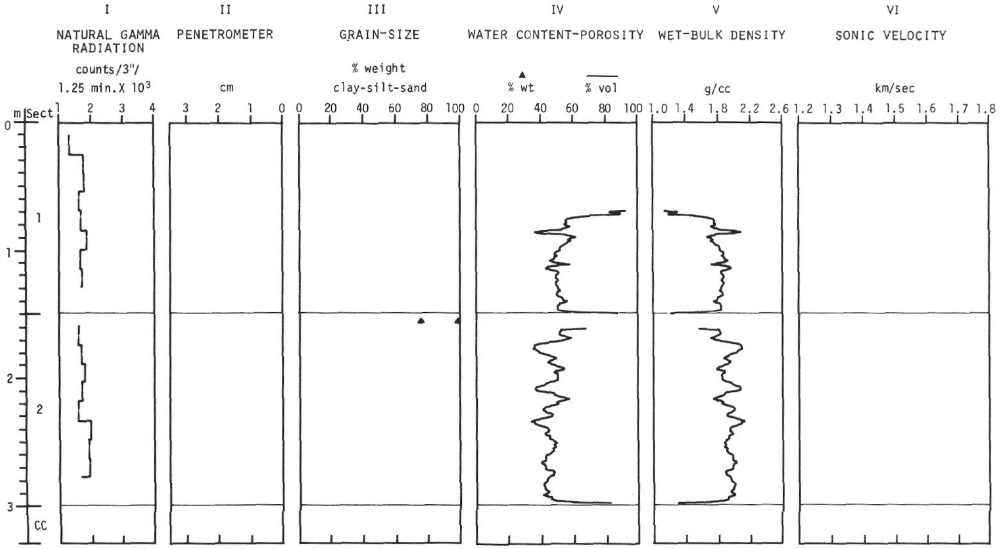
Hole 105, Core 22 (457m to 466m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
EARLY CRETACEOUS (VALANGINIAN)		1 2 3 4	1 2 3 CC		D D D CN D SS CN	<u>Chalky limestone</u>, hard, light gray to white (N7 - N9), non-laminated, bedding disturbed or absent, interbedded with finely and evenly laminated, clayey, dark gray to olive gray (N5 to 5Y4/1) <u>soft limestone</u>; most contacts are gradational; distorted laminae and bedding planes alternating with smooth finely laminated zones suggest periodic disturbances by bottom currents and burrowing organisms. Dark zones are dominantly calcareous nannoplankton; white limestone is dominantly recrystallized nannocalcite; organic matter and clay are abundant in dark zones and absent in white limestone; pyrite crystals are common throughout.	DINOFLAGELLATES: *Scriniodinium (Endoscrinium) dictyotum*, *Microdinium deflandrei* CALCAREOUS NANNOPLANKTON: *Cyclagelosphaera margereli*, *Watznaueria barnesae*, *W. actinosa*, *Zygodiscus erectus*, *Braarudosphaera discula*, *Parhabdolithus embergeri*, *Stephanolithion* sp. *Lithraphidites carniolensis*, DINOFLAGELLATES: *Scriniodinium (Endoscrinium) dictyotum*, *Wallodinium krutzschi*, *Microdinium deflandrei* *CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Cyclagelosphaera margereli* *Ahmuellerella asper*, *Zygodiscus erectus*, *Braarudosphaera discula*, *Parhabdolithus embergeri*

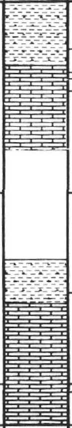


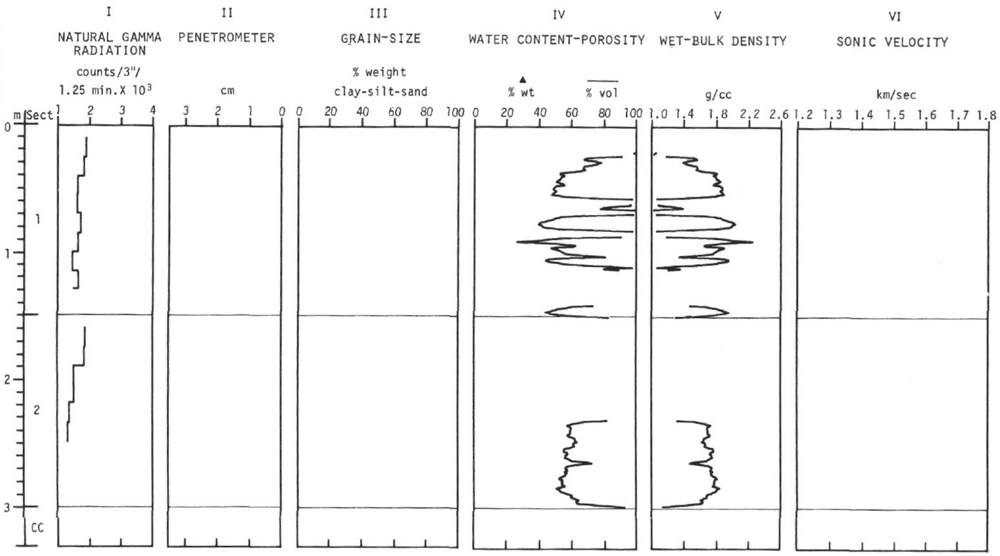
Hole 105, Core 23 (466m to 475m)

AGE	ZONE	DEPTH (m)	SECTION NO	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
VALANGINIAN-TITHONIAN (Foraminifers and Dinoflagellates) TITHONIAN (Calcareous Nannoplankton)		1 2 3	1 2 CC		D D D CN SS SS CN,D	<u>Chalky limestone</u>, hard, light gray to white (N7 - N9), non-laminated, bedding disturbed or absent interbedded with finely and evenly laminated, clayey, gray to olive gray (N5 to 5Y4/1) <u>softer limestone</u>; most contacts are gradational; distorted laminae and bedding planes alternating with smooth, finely laminated zones suggest periodic disturbances by bottom currents and burrowing organisms. Dark zones are dominatly calcareous nannoplankton; white limestone is dominantly recrystallized nannocalcite; organic matter and clay are common to dark zones and absent in white limestone; pyrite crystals are common throughout.	DINOFLAGELLATES: *Scriniodinium (Endoscrinium) dictyotum*, *Microdinium deflandrei* CALCAREOUS NANNOPLANKTON: *Watznaueria britannica*, *W. barnesae* *Diazomatolithus lehmani*, *Cyclagelosphaera margereli*, *Parhabdolithus elongatus*, *Braarudosphaera discula* DINOFLAGELLATES: *Scriniodinium (Endoscrinium) dictyotum*, *Microdinium deflandrei* *CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Watznaueria britannica*, *W. barnesae*, *Diazomatolithus lehmani*, *Cyclagelosphaera margereli*, *Nannoconus dolomiticus* DINOFLAGELLATES: *Microdinium deflandrei*

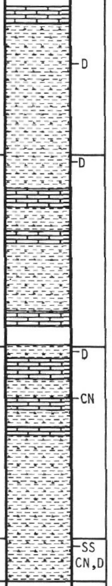


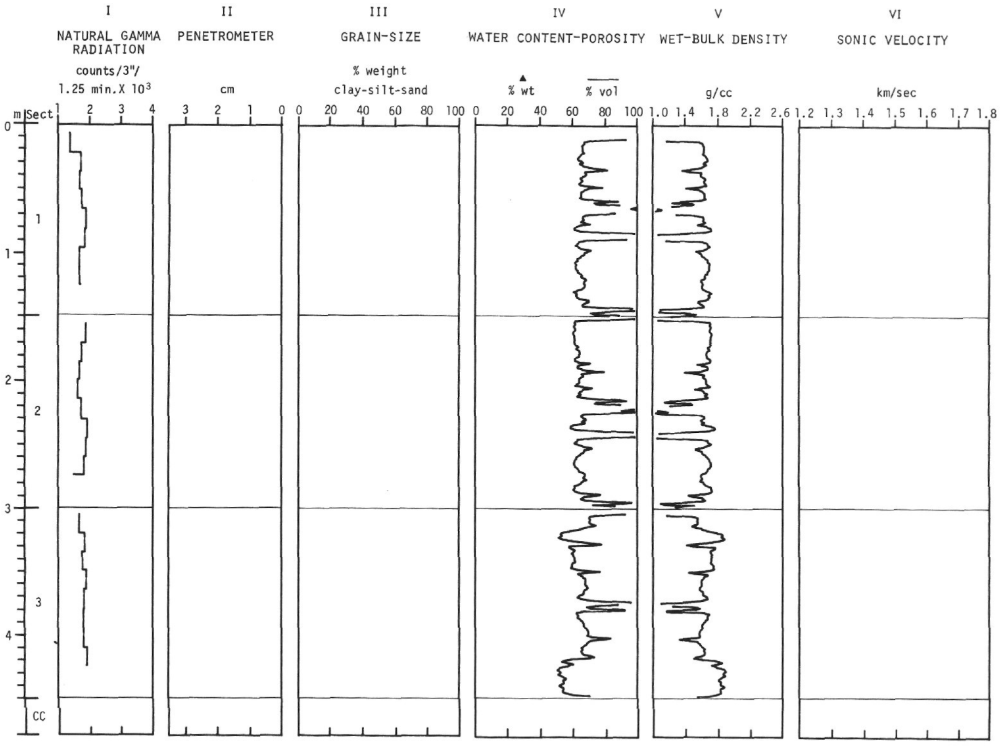
Hole 105, Core 24 (475m to 484m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
VALANGINIAN-TITHONIAN (Foraminifers and Dinoflagellates) TITHONIAN (Calcareous Nannoplankton)		1 2 3	1 2 CC		D CN SS D D SS CN,D	Highly disturbed core. Soft, plastic, mixture of white (N8), gray (N7) and olive gray (5Y4/1). <u>Chalky limestone</u>, hard, light gray to white (N7, N8) with some faint green tint; occasional very faint laminations and bedding; interbedded with finely and evenly laminated, clayey, olive gray (5Y4/1), <u>soft limestone</u>; most contacts are gradational; disturbed laminae and bedding planes alternating with smooth, finely laminated zones suggest periodic disturbances by bottom currents and burrowing organisms. Dark zones are dominantly calcareous nannoplankton; white limestone is dominantly recrystallized nanno-calcite; organic matter and clay are common in dark zones and rare to absent in white limestone; prominent shell layer in Section 2.	CALCAREOUS NANNOPLANKTON: *Watznaueria britannica, W.barnesae, Diazomatolithus lehmani, Braarudosphaera discula, Parhabdolithus elongatus, Cyclagelosphaera margereli, Zygodiscus erectus* DINOFLAGELLATES: *Scriniodinium (Endoscrinium) dictyotum, Biorbifera johnewingi, Diacanthum hollisteri, Microdinium deflandrei, Cometodinium* sp. A DINOFLAGELLATES: *Biorbifera johnewingi, Wallodinium krutzschi, Microdinium deflandrei* *CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Tintinnida* spp., *Watznaueria britannica, Diazomatolithus lehmani, Crepidolithus crassus, Cyclagelosphaera margereli, Parhabdolithus elongatus* DINOFLAGELLATES: *Biorbifera johnewingi, Diacanthum hollisteri, Microdinium deflandrei, Cometodinium* sp. A

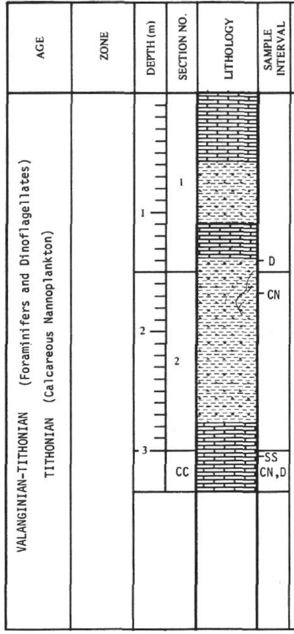


Hole 105, Core 25 (484m to 493m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
VALANGINIAN-TITHONIAN (Foraminifers and Dinoflagellates) TITHONIAN (Calcareous Nannoplankton)		1 2 3 4	1 2 3 CC		D D D CN SS CN,D	<u>Chalky limestone</u>, hard, light gray to white (N7, N8), finely and evenly laminated with occasional burrows; interbedded with finely and evenly laminated, clayey, olive gray (5Y4/1), <u>soft limestone</u>; contacts are gradational. Dark zones are dominantly calcareous nanno-plankton; white limestone is mainly recrystallized nanno-calcite;organic matter and clay are common in dark zones and rare to absent in white limestone.	DINOFLAGELLATES: *Biorbifera johnewingi,* *Microdinium deflandrei,* *Hexagonifera cylindrica* DINOFLAGELLATES: *Biorbifera johnewingi,* *Diacanthum hollisteri,* *Microdinium deflandrei* CALCAREOUS NANNOPLANKTON: *Tintinnida* spp., *Watznaueria britannica,* *Diazomatolithus lehmani,* *Cyclagelosphaera margereli,* *Braarudosphaera discula,* *Podorhabdus quadriperforatus* DINOFLAGELLATES: *Biorbifera johnewingi,* *Microdinium deflandrei* *CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Tintinnida* spp. *Diazomatolithus lehmani,* *Cyclagelosphaera margereli,* *Watznaueria britannica,* *Podorhabdus quadriperforatus,* *Parhabdolithus fischeri* DINOFLAGELLATES: *Biorbifera johnewingi,* *Microdinium deflandrei,* *Diacanthum hollisteri,* *Chlamydophorella wallala,* *Hystrichosphaeridium* sp. A *Hexagonifera cylindrica*



Hole 105, Core 26 (493m to 502m)



LITHOLOGY

Chalky limestone, hard, light gray to white (N7, N8); occasional faint irregular laminations with common burrows interbedded with finely and evenly laminated, clayey, olive gray (5Y4/1), soft limestone; contacts are generally gradational.

Dark zones are predominantly calcareous nannoplankton; white limestone is dominantly recrystallized nanno-calcite; organic matter and clay are common in white limestone; pyrite crystals scattered thoughout; a few fragments of aptychi (?) and bivalves.

DIAGNOSTIC FOSSILS

DINOFLAGELLATES:

Hexagonifera cylindrica,
Biorbifera johnewingi

CALCAREOUS NANNOPLANKTON:

Nannoconus steinmanni,
N. dolomiticus,
Diazomatolithus lehmani,
Watznaueria britannica,
Cyclagelosphaera margereli,
Parhabdolithus embergeri

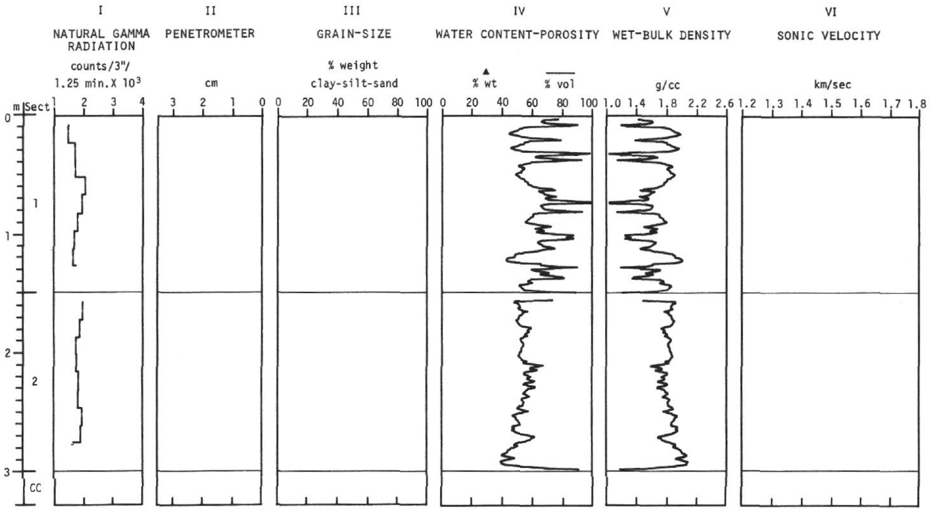
CORE CATCHER

CALCAREOUS NANNOPLANKTON:

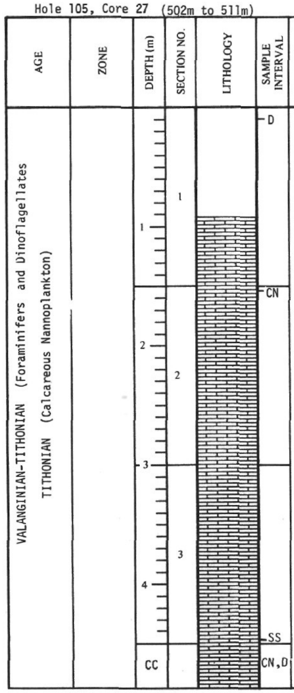
Nannoconus steinmanni,
Diazomatolithus lehmani,
Watznaueria britannica,
Cyclagelosphaera margereli,

DINOFLAGELLATES:

Biorbifera johnewingi,
Diacanthum hollisteri,
Scriniodinium (Endoscrinium) dictyotum,
Prolixosphaeridium granulosum,
Chlamydophorella wallala,
Hystrichosphaeridium sp. A



Hole 105, Core 27 (502m to 511m)



LITHOLOGY

Chalky limestone, hard, white, greenish white, and greenish gray (N7, N8, 5G9/1 & 6/1); occasional faint irregular laminations, but generally massive, non-laminated and heavily burrowed; interbedded with finely and evenly laminated darker zones of clayey, dominantly olive gray (5Y4/1), soft limestone; contacts are generally gradational; bedding planes show pronounced dip; flow structures and faulting characterize Section 3.

Dark zones are dominantly calcareous nannoplankton; white limestone is dominantly recrystallized nanno-calcite; plant debris and clay common in dark zones and rare to absent in white limestone; pyrite common; fragments of aptychi (?) and bivalves are common.

Large slump structures over lying dipping beds.

Small faults in dipping beds.

Excellent display of large normal fault (2cm±throw) in dipping beds.

DIAGNOSTIC FOSSILS

DINOFLAGELLATES:

Systematophora fasciculigera,
Prolixosphaeridium mixtispinosum,
P. granulosum,
Biorbifera johnewingi,
Chytroeisphaeridia pococki,
Hystrichosphaeridium sp. A
Cometodinium sp. A

CALCAREOUS NANNOPLANKTON:

Nannoconus steinmanni,
Podorhabdus quadriperforatus,
Eiffellithus gorkae,
Watznaueria britannica,
W. prolonga,
Diazomatolithus lehmani,
Stephanolithion laffittei

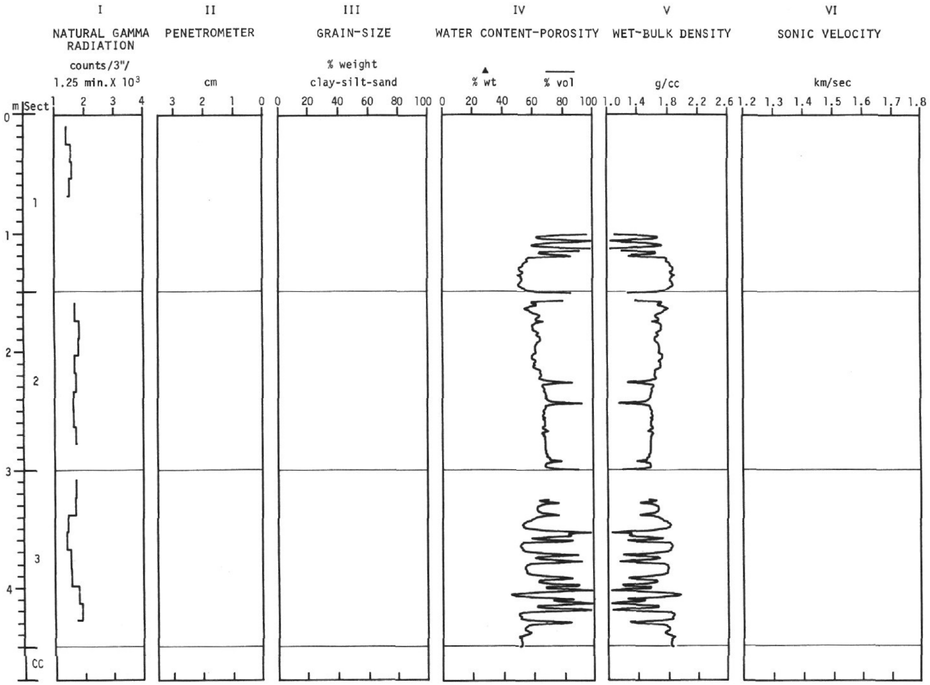
CORE CATCHER

CALCAREOUS NANNOPLANKTON:

Nannoconus steinmanni,
Watznaueria britannica,
Diazomatolithus lehmani,
Stephanolithion laffittei,
Eiffellithus gorkae

DINOFLAGELLATES:

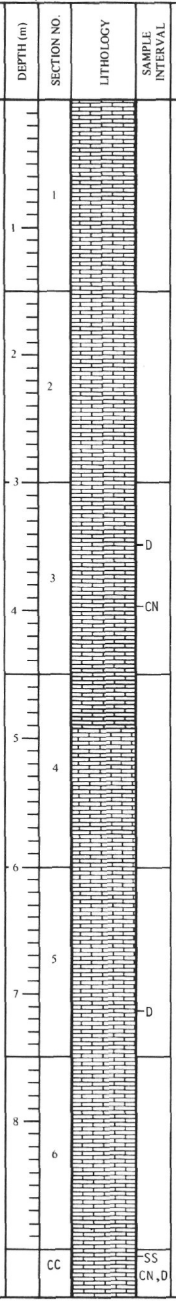
Systematophora fasciculigera,
Prolixosphaeridium mixtispinosum,
Chlamydophorella wallala,
Diacanthum hollisteri,
Biorbifera johnewingi,
Hexagonifera cylindrica,
Hystrichosphaeridium sp. A
Cometodinium sp. A



Hole 105, Core 28 (511m to 522m)

AGE: VALANGINIAN-TITHONIAN (Foraminifers and Dinoflagellates)
TITHONIAN (Calcareous Nannoplankton)

ZONE



LITHOLOGY

<u>Chalky limestone</u>, hard, light greenish gray (5G8/1 to 5G7/1), generally non-laminated and heavily burrowed; inter-bedded with finely and evenly laminated darker zones of clayey, dominantly olive gray (5Y4/1), <u>soft limestone</u>; contacts generally gradational; minor flow structures, truncated laminations, numerous zones of clayey limestone.

Dark zones are predominantly calcareous nannoplankton; white limestone is predominantly recrystallized nanno-calcite; plant debris and clay are common in dark zones and rare to absent in white limestone; a few fragments of aptychi (?) in Sections 1 - 3.

DIAGNOSTIC FOSSILS

CALCAREOUS NANNOPLANKTON:

Cyclagelosphaera margereli,
Diazomatolithus lehmani,
Watznaueria britannica,
W. prolonga,
Prodorhabdus quadriperforatur,
Stephanolithion laffittei

DINOFLAGELLATES:

Systematophora fasciculigera,
Prolixosphaeridium mixtispinosum,
P. granulosum
Chlamydophorella wallala,
Hystrichosphaeridium sp. A
Heslertonia pellucida

DINOFLAGELLATES:

Systematophora fasciculigera,
Chytroeisphaeridia pococki,
Biorbifera johnewingi,
Diacanthum hollisteri,
Cometodinium sp. A

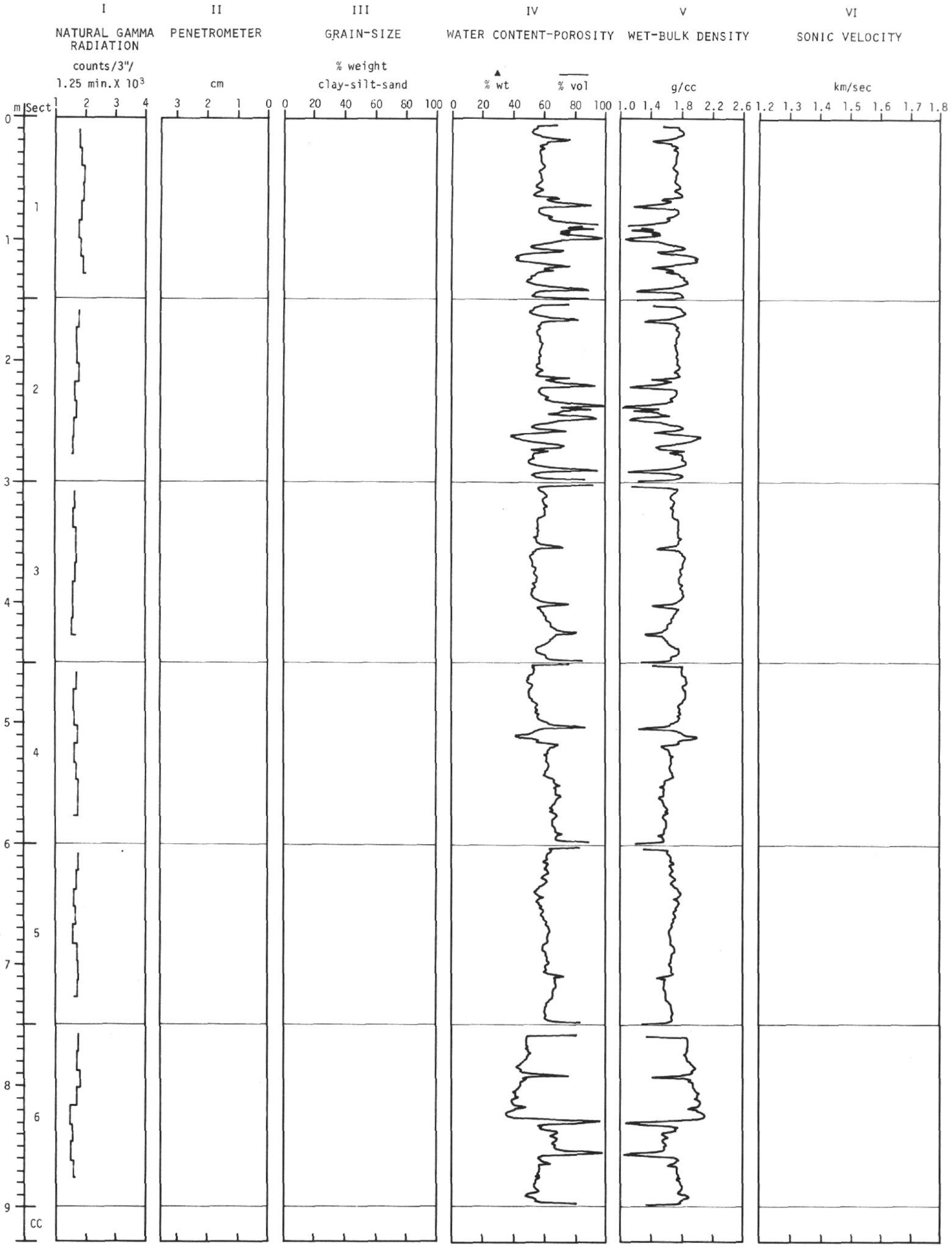
CORE CATCHER

CALCAREOUS NANNOPLANKTON:

Nannoconus steinmanni,
Diazomatolithus lehmani,
Watznaueria britannica,
Podorhabdus quadriperforatus,
Parhabdolithus embergeri

DINOFLAGELLATES:

Systematophora fasciculigera
Prolixosphaeridium mixtispinosum,
Chlamydophorella wallala,
Cometodinium sp. A



Hole 105, Core 29 (522m to 531m)

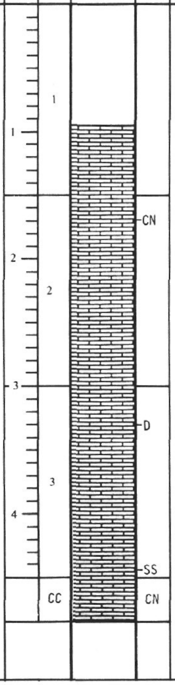
AGE

VALANGINIAN-TITHONIAN (Foraminifers and Dinoflagellates)

TITHONIAN (Calcareous Nannoplankton)

ZONE

DEPTH (m) SECTION NO. LITHOLOGY SAMPLE INTERVAL



LITHOLOGY

Chalky limestone, hard, greenish gray (5G8/1 to 5G7/1), generally non-laminated and heavily burrowed; interbedded with finely and evenly laminated darker zones of clayey, dominantly olive gray (5Y4/1), soft limestone; contacts generally sharp, except those in clayey limestone zones; minor flow structures, minor faulting, truncated laminae suggest bottom current action.

Dark zones are dominantly calcareous nannoplankton; white limestone is mainly recrystallized nanno-calcite; plant debris and clay common in darker zones and rare to absent in white limestone.

Minor faulting overlying minor flow structures.

DIAGNOSTIC FOSSILS

CALCAREOUS NANNOPLANKTON:

Nannoconus steinmanni,
Watznaueria britannica,
Stephanolithion laffittei,
Zygodiscus erectus,
Parhabdolithus embergeri,
Staurolithites bochotnicae

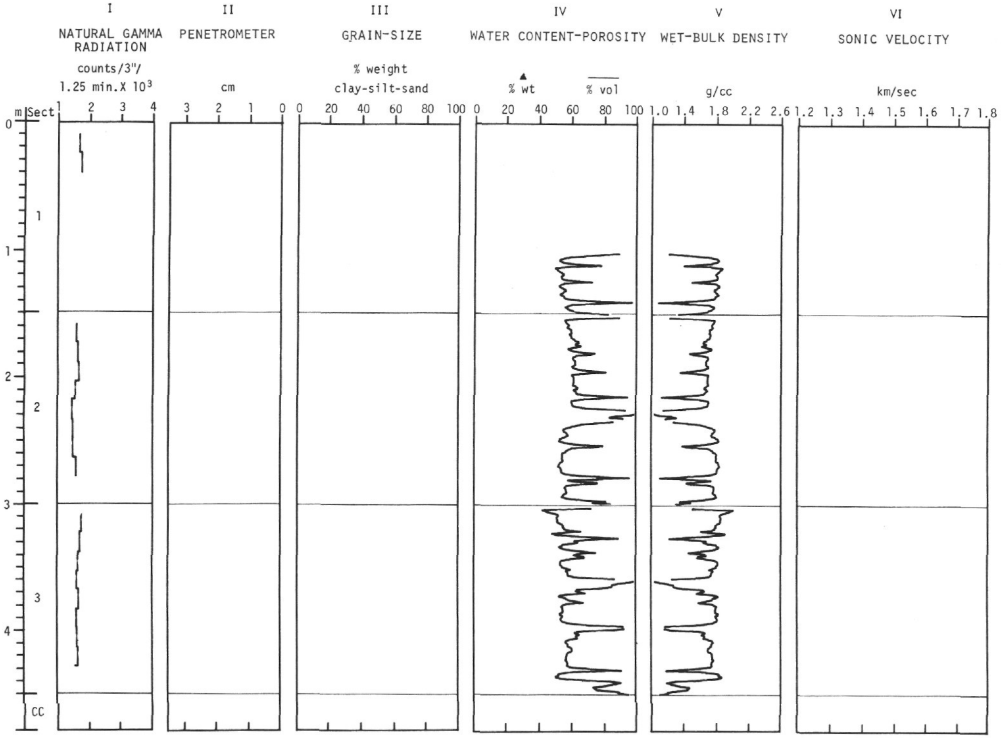
DINOFLAGELLATES:

Systematophora sp.
Heslertonia pellucida,
Prolixosphaeridium mixtispinosum,
Chytroeisphaeridia pococki,
Diacanthum hollisteri,
Gonyaulacysta sp. B,
Cometodinium sp. A

CORE CATCHER

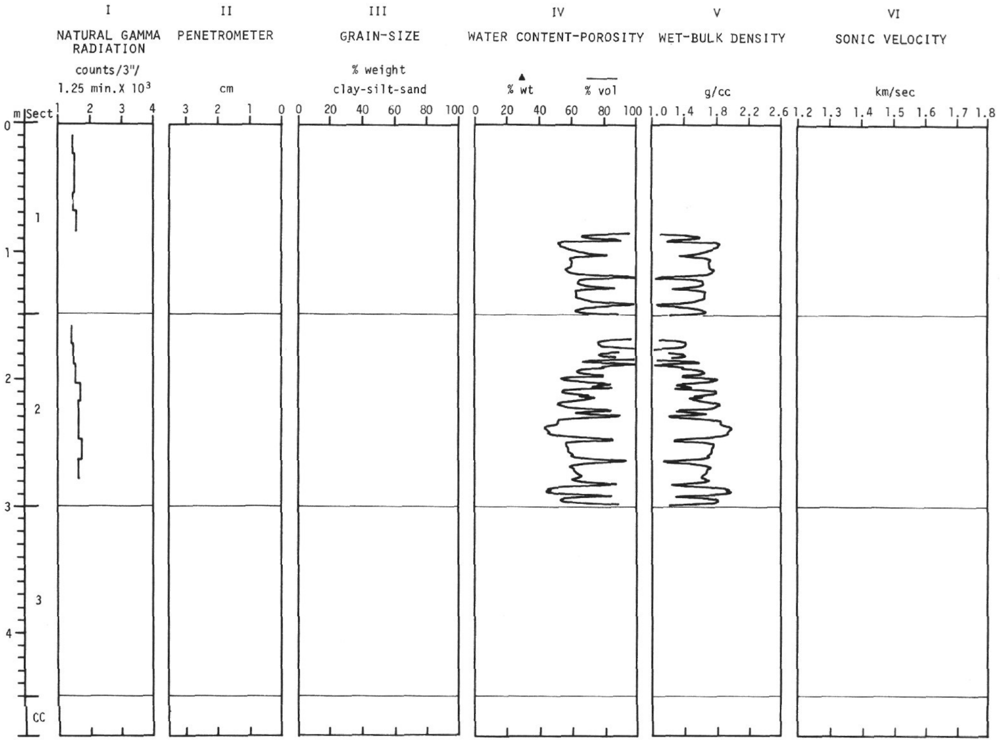
CALCAREOUS NANNOPLANKTON:

Nannoconus steinmanni,
Watznaueria britannica,
Zygodiscus erectus,
Parhabdolithus embergeri,
Stephanolithion laffittei



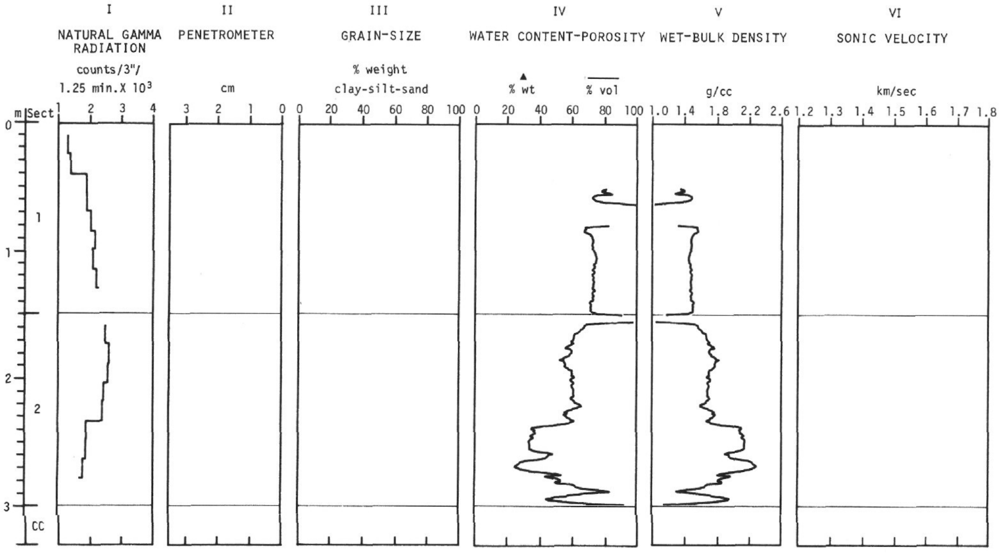
Hole 105, Core 30 (531m to 540m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
VALANGINIAN-TITHONIAN (Foraminifers) TITHONIAN (Calcareous Nannoplankton)		1 2 3 4	1 2 3 CC		CN D SS SS CN	Pebbles (drill cuttings) of indurated nanno ooze and limestone. Chalky limestone, hard, light gray to greenish white (N7 and N8 to 5G9/1), faintly laminated, laminae often undulating and showing minor flow structures; interbedded with finely and evenly laminated darker zones of clayey, dominantly olive gray (5Y4/1) soft limestone; contacts both sharp and gradational; numerous occurrences of minor flow structures and truncated laminae in dark zones. Dark zones are calcareous nannoplankton; white limestone is recrystallized nanno-calcite; plant debris and clay common in darker zones and rare to absent in white limestone; foraminifers and radiolarians are rare; zeolites abundant in soft, dark core catcher sample.	CALCAREOUS NANNOPLANKTON: *Nannoconus steinmanni, Watznaueria britannica, Cyclagelosphaera margereli, Parhabdolithus embergeri, Diazomatolithus lehmani, Podorhabdus quadriperforatus, Stephanolithion laffittei* DINOFLAGELLATES: *Prolixosphaeridium mixtispinosum, Tenua* sp. aff. *T. verrucosa* *CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Nannoconus steinmanni, Watznaueria britannica, Stephanolithion laffittei, Diazomatolithus lehmani*



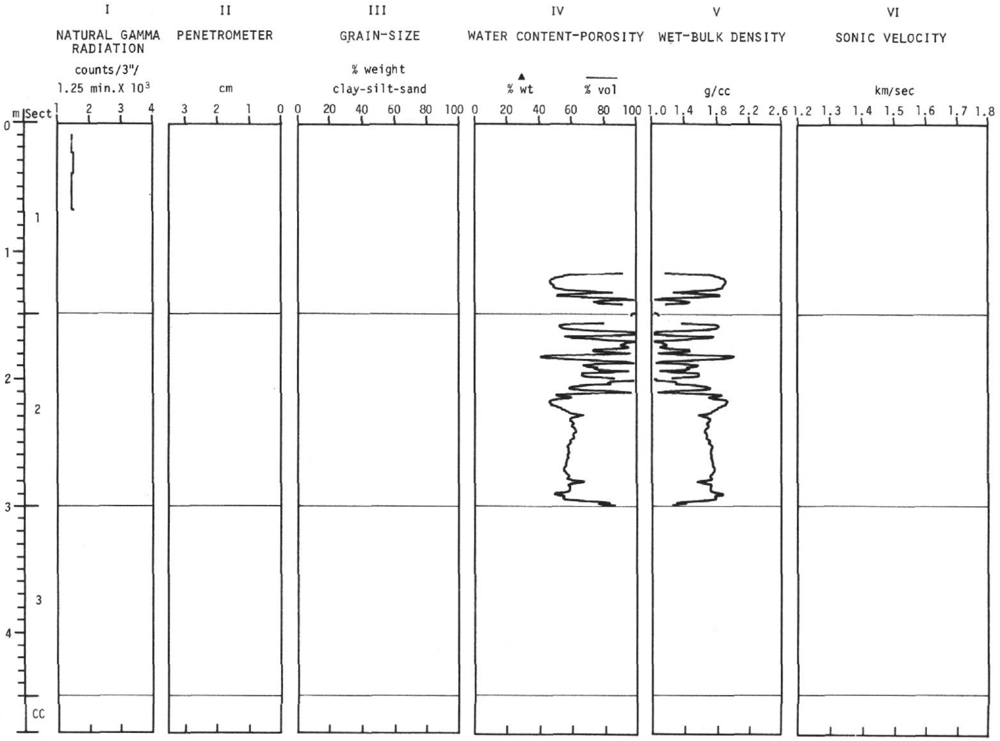
Hole 105, Core 31 (540m to 549m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
VALANGINIAN-TITHONIAN (Foraminifers) TITHONIAN (Calcareous Nannoplankton)		1	1		TIN	Drill cuttings.	TINTINNIDS: *Calpionella alpina*, *Tintinnopsella* sp. aff. *T. carpathica* CALCAREOUS NANNOPLANKTON: *Nannoconus steinmanni*, *Diazomatolithus lehmani*, *Rucinolithus hayii*, *Zygodiscus erectus*, *Podorhabdus quadriperforatus*, *Watznaueria britannica*
		2 3	2		CN	Chalky limestone, hard, white (N9), faint laminations, with slump structures and dipping beds, some finely and evenly laminated; soft clayey limestone at bottom.	
			CC		SS CN		*CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Nannoconus steinmanni*, *Zygodiscus erectus*, *Watznaueria britannica*, *Diazomatolithus lehmani*

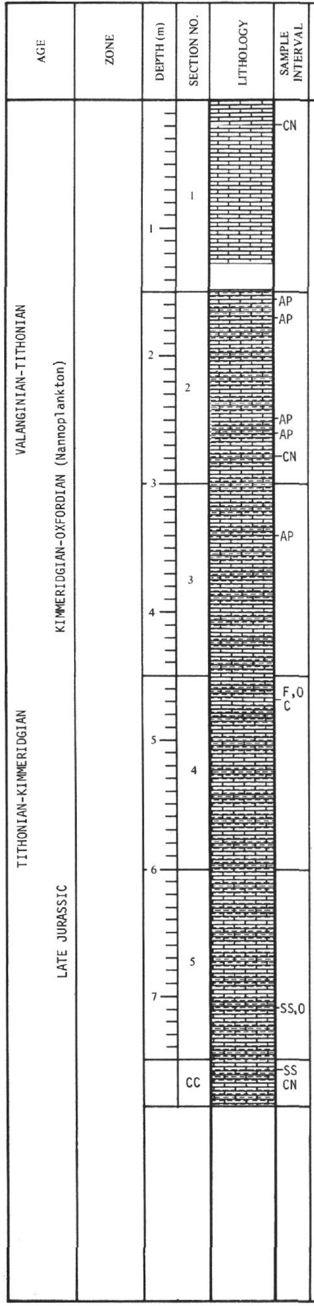


Hole 105, Core 32 (549m to 558m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
VALANGINIAN-TITHONIAN (Foraminifers) TITHONIAN (Calcareous Nannoplankton)		1	1			Chalky limestone, hard, pinkish gray (5YR8/1) and light brownish gray (5YR6/1) in upper half becoming interbedded greenish white (5G9/1) and pale brown (5YR5/2 to 6/2); numerous small pinkish gray clasts lens-like pink clasts; some large white clasts; larger clasts with pitted or corroded surface and subangular to subrounded shape; clasts often associated with flow structures; limestone is dominantly recrystallized nanno-calcite, clay is absent. Note: Small white clasts at 220cm; dipping beds at 225-240cm; small white clasts at 255cm; large and small white clasts at 275cm and 295cm.	
		2	2		D CN		CALCAREOUS NANNOPLANKTON: *Nannoconus steinmanni*, *Zygodiscus erectus*, *Diazomatolithus lehmani*, *Watznaueria britannica*, *Loxolithus armilla*, *Rucinolithus hayii*, *Parhabdolithus embergeri* DINOFLAGELLATES: *Tenua* sp.
		3 4	3				
			CC		SS CN		*CORE CATCHER* CALCAREOUS NANNOPLANKTON: *Nannoconus steinmanni*, *Rucinolithus hayii*, *Zygodiscus erectus*, *Parhabdolithus embergeri*, *Podorhabdus quadriperforatus*



Hole 105, Core 33 (558m to 567m)



LITHOLOGY

Chalky limestone, hard, pinkish white (5YR9/1) with some thin interbeds of greenish gray (5G8/1), pinkish gray (5YR8/1), and pale red (5R6/2) in lower part of Section 1; faintly laminated dipping beds near top; occasional zones of intense burrowing; undulating laminae common in lower part of section; dominantly recrystallized nanno-calcite.

Red and green colorations make their first appearance (in down hole direction) in Section 1 of Core 38.

Clayey limestone, hard, pale red (10R6/2) to pale reddish brown (10R6/4) with abundant relatively thin layer and lenses of pale green (10G8/2); green color appears always to diffuse into red sediment; hematite common in red zones and generally absent in green zones; nannoplankton and clay abundant in both red and green zones; white clasts are hard calcilutite consisting dominantly of recrystallized nanno-calcite; abundant aptychi.

Small red clasts at 325cm, white clast surrounded by narrow band of green at 375cm.

Occasional flow structures (often associated with clasts); truncated laminations and bedding suggest bottom current action; some zones burrowed.

Barite crystal at 700cm.

DIAGNOSTIC FOSSILS

CALCAREOUS NANNOPLANKTON:

Nannoconus steinmanni,
Watznaueria britannica,
Cyclagelosphaera margereli,
Loxolithus armilla,
Parhabdolithus embergeri
Zygodiscus erectus

FORAMINIFERS:

Dentalina oppeli,
D. jurensis,
Pseudonodosaria candela,
P. parallela
Ramulinella suevica

CALCAREOUS NANNOPLANKTON:

Watznaueria britannica,
Diazomatolithus lehmani,
Zygodiscus sallilum, *Z. erectus*,
Parhabdolithus marthae,
Loxolithus armilla,
Discorhabdus patulus

AMMONITE APTYCHI:

Punctaptychus punctatus
Lamellaptychus sp. aff.
L. lamellosus

AMMONITE APTYCHI:

Lamellaptychus rectecostatus
crassacostatus

FORAMINIFERS:

Pseudonodosaria candela,
Lenticulina uhligi,

PLANKTONIC CRINOIDS:

Saccocoma sp.

OSTRACODES:

Bairdia (Akidobairdia) farinacciae

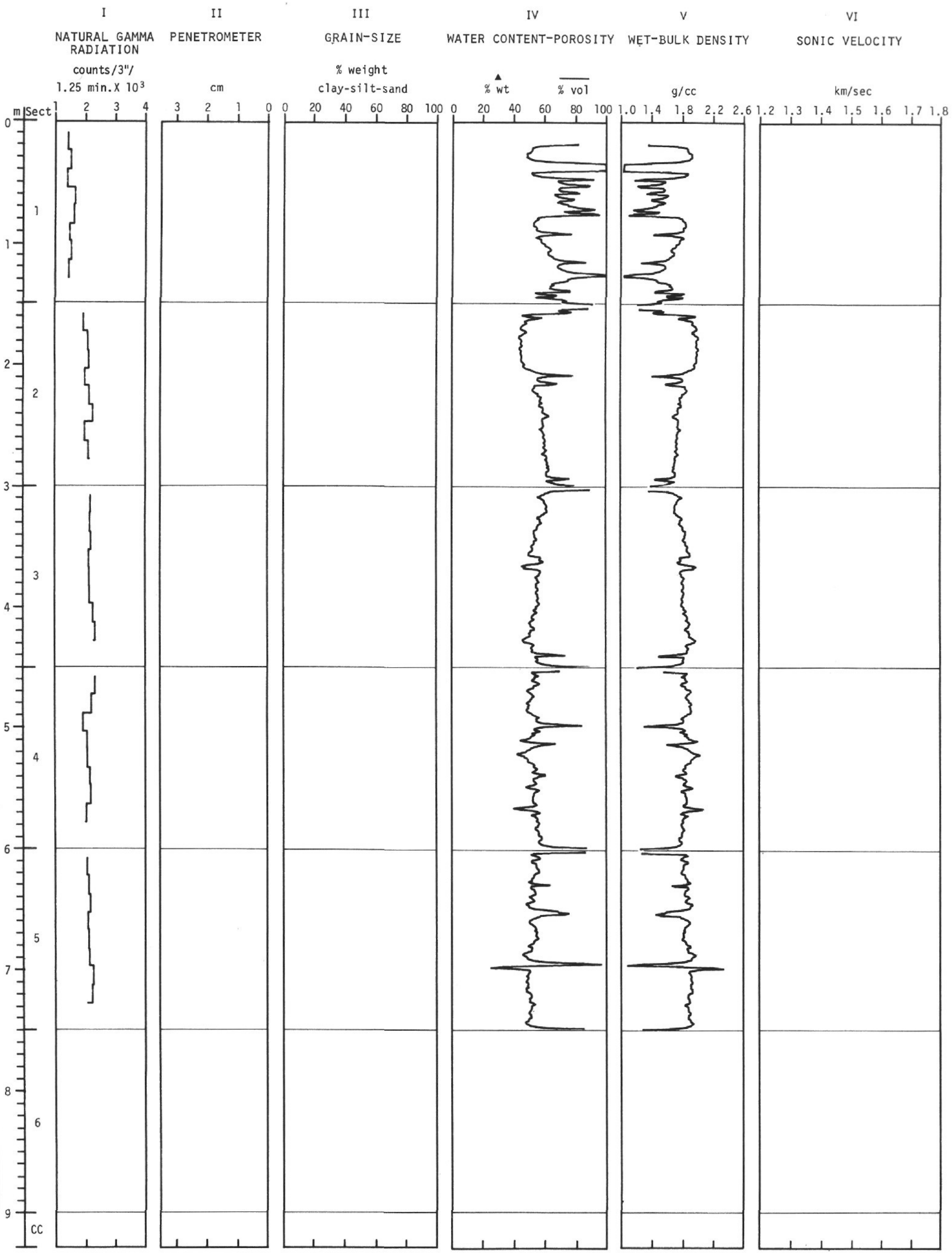
OSTRACODES:

Bairdia (Akidobairdia) farinacciae

CORE CATCHER

CALCAREOUS NANNOPLANKTON:

Watznaueria britannica,
Zygodiscus sallilum,
Z. erectus,
Parhabdolithus marthae,
Discorhabdus patulus



Hole 105, Core 34 (567m to 576m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS

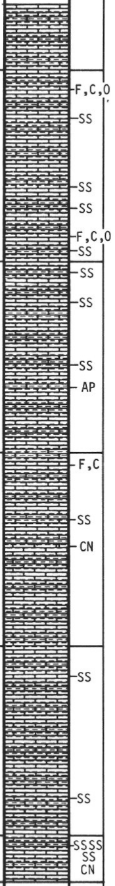
LATE JURASSIC

KIMMERIDGIAN-OXFORDIAN (Calcareous Nannoplankton)

TITHONIAN-KIMMERIDGIAN (Foraminifers)

Depth (m): 1, 2, 3, 4, 5, 6, 7, 8

Section no.: 1, 2, 3, 4, 5, CC



Sample interval: F,C,O; SS; SS; SS; F,C,O; SS; SS; SS; SS; AP; F,C; SS; CN; SS; SS; SSSS SS CN

Clayey limestone, hard, various shades of reddish brown (10R6/2, 10R5/4, 10R3/4, primarily 10R5/4) with occasional light grayish green (5G6/2) beds, lenses and specks; in places laminations; numerous clasts (usually white or pinkish gray calcilutite), occasional flow structures, (often associated with clasts) and truncated laminations suggest bottom current action; burrow fillings. Green color always appears to diffuse into red zone. Clay and nanno-calcite abundant in both red and green zones; hematite common in red zone and absent in green. White and pinkish gray clasts are dominantly recrystallized nanno-calcite.

Note: Pinkish gray (10R8/2) clast at 245cm; cylindrical clast with rounded ends at 265cm: large clast and several small clasts and flow structures at 280 - 300cm; Saccocoma fragments cemented by chalcedony and sparry calcite at 335cm. Flow structures with clasts at 370 - 380cm.

Clasts of grayish white (N8) and grayish pink (10R 8/2), hard calcilutite (dominantly recrystallized nanno-calcite); reddish brown (10R5/4) clasts appear both subangular and pillow or lense shaped; light colored clasts have pitted exterior and are subrounded to subangular; laminations and bedding generally absent except in flow zones. Fragments of aptychi and bivalves throughout Sections 4 and 5.

Note:
Large grayish white clast with small clasts and laminatious draped around surface overlying zone with abundant small clasts at 705 - 720cm.

FORAMINIFERS:

Pseudonodosaria candela,
P. tuberosa
Lenticulina quenstedti

PLANKTONIC CRINOIDS:

Saccocoma sp.

OSTRACODES:

Bairdia (Akidobairdia) farinacciae

AMMONITE APTYCHI:

Lamellaptychus beyrichi

FORAMINIFERS:

Pseudonodosaria candela,
P. parallela,
Ramulina spandeli

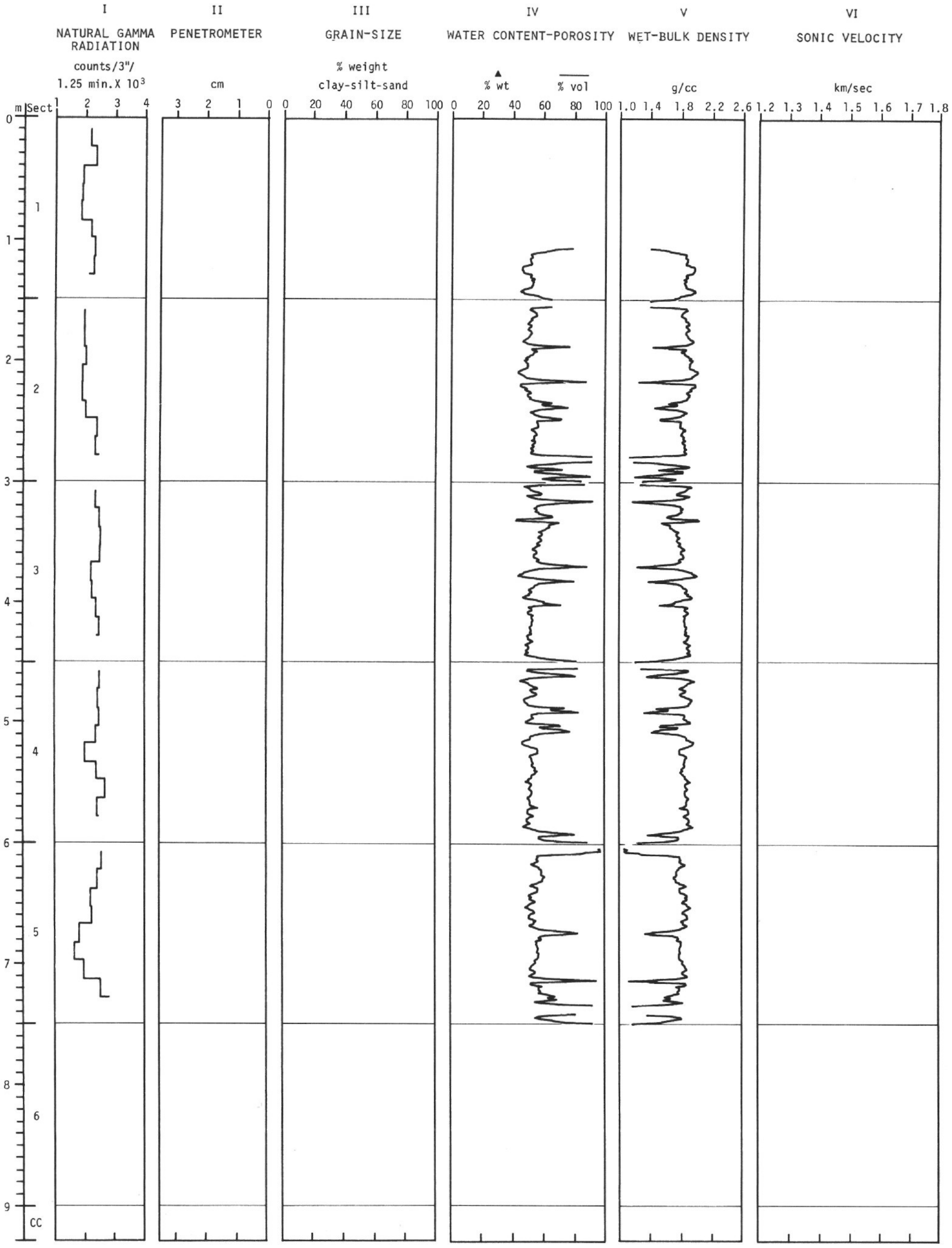
CALCAREOUS NANNOPLANKTON:

Watznaueria britannica,
Zygodiscus sallilum, Z. erectus,
Discorhabdus patulus,
Parhabdolithus aff. *P. fischeri,*
P. marthae,
Staurolithites bochotnicae

CORE CATCHER

CALCAREOUS NANNOPLANKTON:

Zygodiscus sallilum, Z. erectus,
Discorhabdus patulus,
Watznaueria britannica,
Cyclagelosphaera margereli,
Parhabdolithus marthae



Hole 105, Core 35 (576m to 585m)

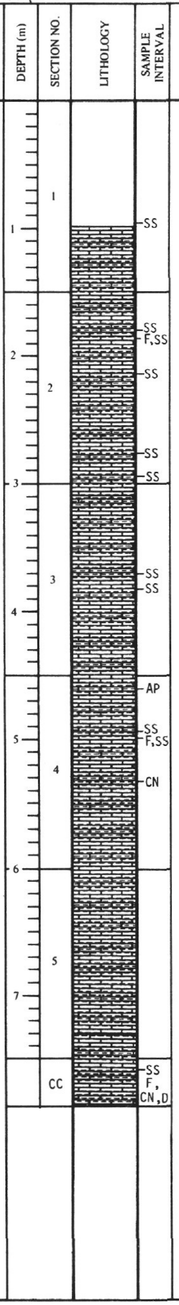
AGE

LATE JURASSIC

KIMMERIDGIAN-OXFORDIAN (Calcareous Nannoplankton and Dinoflagellates)

TITHONIAN-KIMMERIDGIAN (Foraminifers)

ZONE



LITHOLOGY

Clayey limestone, hard, reddish-brown (10R5/6, 4/6, 4/4) with occasional thin greenish gray (5G6/2) lenses and layers; macrofossils occur throughout; pink, green and white clasts are hard calcilutite of predominantly recrystallized nanno-calcite; lens-shaped red clasts appear to have formed during compaction; flow structures often associated with clasts; bedding and laminations generally absent except in flow structures; light clasts have pitted exteriors and are subrounded to subangular.

Grayish green, always diffuses to red; hematite common in red and absent to rare in green; clay and calcite abundant in both red and green.

Note: White clast at 165cm; pale green and pink clasts at 180cm; pink clasts at 225cm and 245cm; lens-shaped red clasts (?) at 330cm; silty zone with recrystallized calcite at 370cm and 500cm; aptychus at 430cm; bivalve at 445cm.

DIAGNOSTIC FOSSILS

FORAMINIFERS:

Lenticulina quenstedti,
Pseudonodosaria candela,
P. parallela,
Frondicularia nikitini,
F. supracalloviensis

FORAMINIFERS:

Frondicularia nikitini,
F. supracalloviensis,
Pseudonodosaria candela,
Dentalina jurensis, *D. seorsa*,

CALCAREOUS NANNOPLANKTON:

Watznaueria britannica
Stephanolithion bigoti
Zygodiscus sallilum, *Z. bussonii*,
Staurolithites quadriarculus,
Crepidolithus crassus,
Hexapodorhabdus cuvillieri

AMMONITE APTYCHI:

Lamellaptychus sp.

CORE CATCHER

FORAMINIFERS:

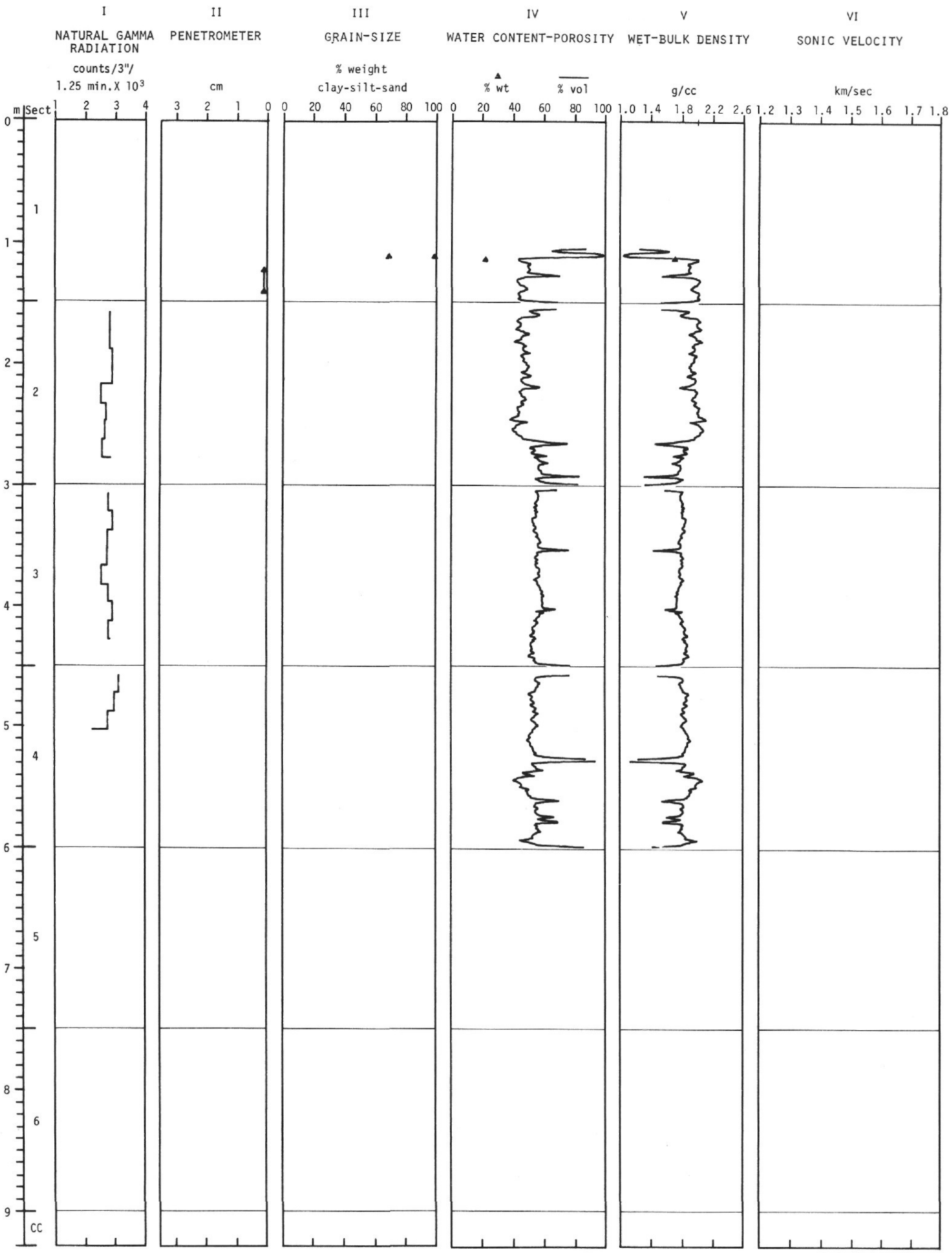
Same as Section 4.

CALCAREOUS NANNOPLANKTON:

Watznaueria britannica,
Stephanolithion bigoti,
Staurolithites quadriarcullus,
Hexapodorhabdus cuvillieri,
Zygodiscus sallilum

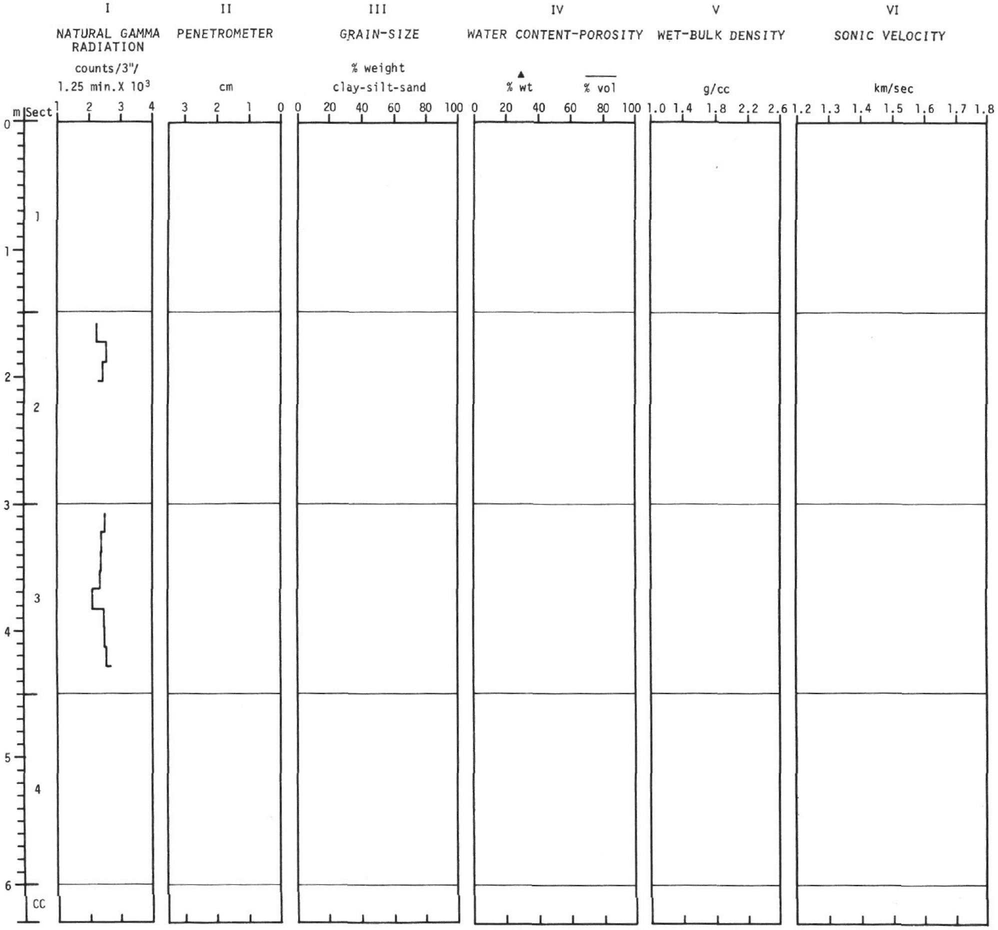
DINOFLAGELLATES:

Gonyaulacysta nuciformis,
G. ambigua,
G. scarburghensis,
Tenua verrucosa, *T. pilosa*,
T. rioulti,
Chlamydophorella wallala,
Cyclonephelium densebarbatum,
Archeotechtatum sarjeanti

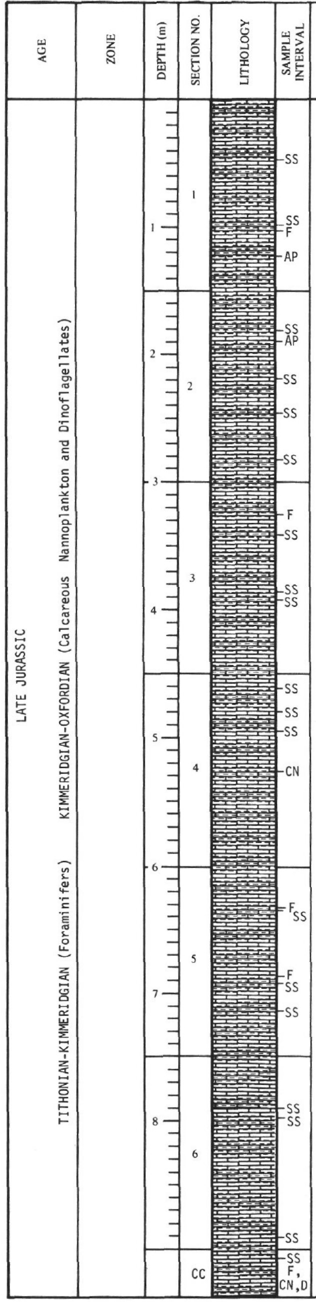


Hole 105, Core 36 (585m to 594m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE JURASSIC TITHONIAN-KIMMERIDGIAN (Foraminifers) KIMMERIDGIAN-OXFORDIAN (Calcareous Nannoplankton and Dinoflagellates)		1 2 3 4 5 6	1 2 3 4 CC		AP SS D,SS SS SS F SS SS CN SS F, CN,D	<u>Clayey limestone</u>, hard, reddish brown (10R4/4) with occasional greenish gray (5G6/2), thin lenses and layers of dark gray (N4) evenly laminated beds; light gray (N7) limestone in Section 2 may be part of a larger clast; flow structures associated with large clasts; white clasts are dominantly recrystallized nanno-calcite (calcilutite); green clasts made of palagonite; white clasts have pitted exterior and are subrounded to subangular; numerous zones of disturbed bedding; common fragments of aptychi and bivalves; grayish green color diffuses into red color; hematite common in red zones and rare to absent in green zones; clay and nanno-calcite abundant in both green and red zones. Note: Green clast at 230 cm; large white clast at 245cm; white clasts at 270cm.	AMMONITE APTYCHI: Punctaptychus monsalvensis FORAMINIFERS: *Spirophtalmidium birmenstorfensis,* *Ophtalmidium carinatum,* *Frondicularia supracalloviensis,* *Lenticulina quenstedti* DINOFLAGELLATES: *Chytroeisphaeridia chytroeides,* *Ch. pococki,* *Tenua verrucosa* CALCAREOUS NANNOPLANKTON: *Stephanolithion bigoti,* *Zygodiscus sallilum, Z. bussonii,* *Hexapodorhabdus cuvillieri,* *Staurolithites quadriarcullus,* *Watznaueria britannica* *CORE CATCHER* FORAMINIFERS: *Brotzenia rjasanensis,* *Brotzenia* ex gr. *B. parastelligera,* *Brotzenia* ex gr. *B. volgensis,* *B. uhligi* CALCAREOUS NANNOPLANKTON: *Stephanolithion bigoti,* *Zygodiscus sallilum, Z. bussonii,* *Hexapodorhabdus cuvillieri,* *Podorhabdus octonarius* DINOFLAGELLATES: *Pareodinia ceratophora,* *Chytroeisphaeridia chytroeides,* *Polygonifera evitti,* *Tenua verrucosa*



Hole 105, Core 37 (594m to 603m)



LITHOLOGY

Clayey limestone, hard reddish-brown (10R3/4 and 10R4/4) with occasional thin greenish-gray (5G6/2) lenses and layers of olive black (5Y2/1); evenly laminated with only occasional zones of minor bedding disturbance caused by burrowing organisms; blackish zones are thinly laminated; few graded (?) beds of detrital carbonates; macrofossils occur throughout (bivalves are conspicuous).

Green diffuses into red; hematite is common in red and rare to absent in green; clay and nannocalcite abundant in both red and green.

Truncated laminae.

Bioclastic graded? bed.

Evenly laminated.

Thin dark gray layer.

(Graded? bed of detrital carbonate.)

DIAGNOSTIC FOSSILS

FORAMINIFERS:

Brotzenia rjasanensis,
Brotzenia ex gr. *B. volgensis*,
Lenticulina quenstedti

AMMONITE APTYCHI:

Aspidoceras sp. aff. A pawlowi

AMMONITE APTYCHI:

Laevaptychus sp. ex gr. L. latus
Lamellaptychus murocostatus
L. lamellosus
Laevilamellaptychus aff.
Haploceras aporus

FORAMINIFERS:

Brotzenia ex gr. *B. mosquensis*,
Lenticulina quenstedti,
L. aeolica,
Ophtalmidium carinatum,
Spirophtalmidium birmenstorfensis,
Dentalina jurensis

PLANKTONIC CRINOIDS:

Saccocoma sp. aff. *S. quenstedti*

CALCAREOUS NANNOPLANKTON:

Stephanolithion bigoti,
Zygodiscus sallilum, *Z. minimus*,
Hexapodorhabdus cuvillieri,
Watznaueria britannica,
Podorhabdus octonarius

FORAMINIFERS:

"Globigerina" helvetojurassica

CORE CATCHER

FORAMINIFERS:

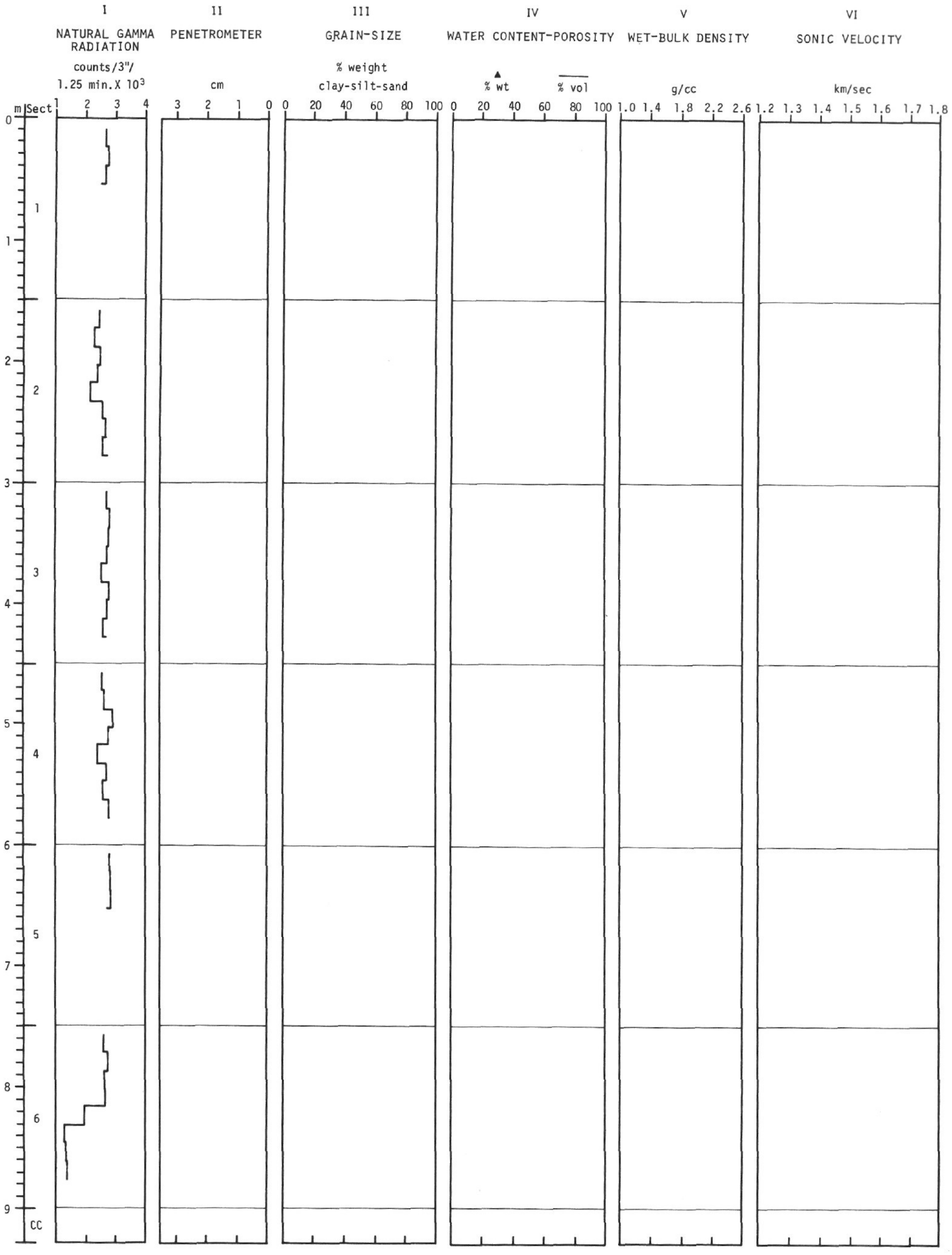
Ophtalmidium carinatum,
Spirophtalmidium birmenstorfensis

CALCAREOUS NANNOPLANKTON:

Stephanolithion bigoti,
Hexapodorhabdus cuvillieri,
Zygodiscus sallilum, *Z. bussonii*,
Watznaueria britannica,
Cyclagelosphaera margereli

DINOFLAGELLATES:

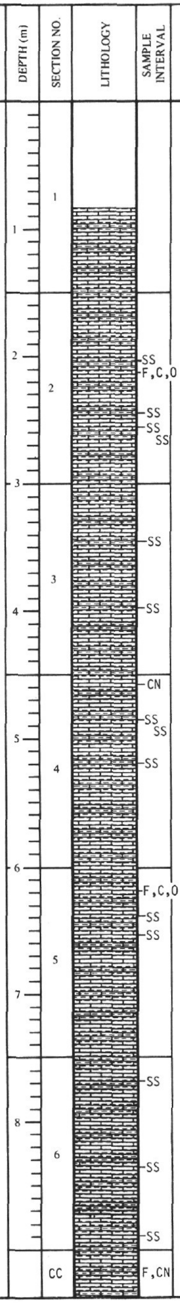
Tenua verrucosa,
Chytroeisphaeridia chytroeides,
Polygonifera evitti



Hole 105, Core 38 (603m to 612m)

AGE: LATE JURASSIC KIMMERIDGIAN-OXFORDIAN

ZONE



LITHOLOGY

<u>Clayey limestone</u>, hard, reddish brown (10R4/4) with occasional thin greenish gray (5G6/2) lenses and layers; generally evenly laminated and evenly bedded;in places with burrow fillings; some thin beds with distinct grading; <u>Native Copper</u> in thin (1mm±) veinlet at 260cm bounded by green palagonite.

Green color diffuses into red zones; hematite common in red and rare to absent in green zones; a few fragments of bivalves (?) scattered throughout entire core.

Note: Prominent bed of graded detrital carbonate at 250cm.

DIAGNOSTIC FOSSILS

FORAMINIFERS:

Brotzenia ex gr. *B. parastelligera*, *Spirophtalmidium birmenstorfensis*

PLANKTONIC CRINOIDS:

Saccocoma sp.

OSTRACODES:

Bairdia italica

CALCAREOUS NANNOPLANKTON:

Stephanolithion bigoti, *Zygodiscus sallilum*, *Z. erectus*, *Staurolithites quadriarcullus*, *Zygodiscus minimus*, *Hexapodorhabdus cuvillieri*, *Watznaueria britannica*, *Cyclagelosphaera margereli*

FORAMINIFERS:

Spirophtalmidium birmenstorfensis

CRINOIDS:

Saccocoma sp. aff.*S. quenstedti*
Saccocoma sp. aff.*S. schattenbergi*

OSTRACODES:

Bairdia italica

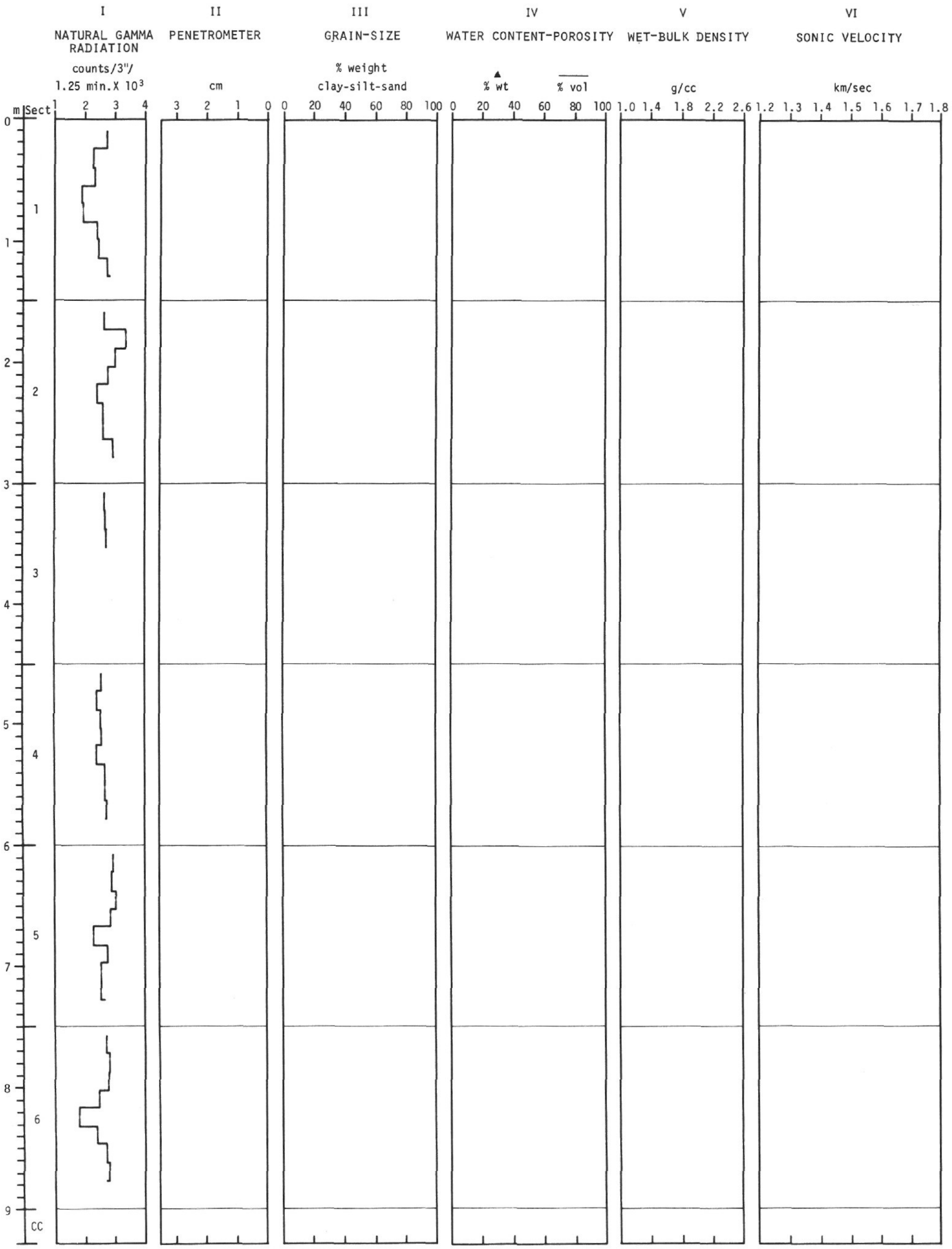
CORE CATCHER

FORAMINIFERS:

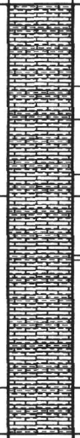
Dentalina jurensis, *D. laevigata*

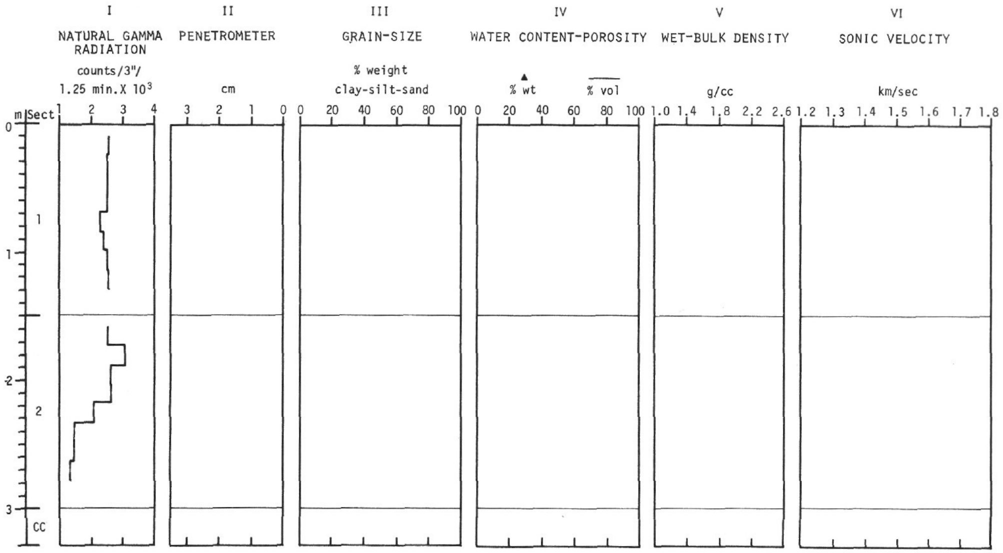
CALCAREOUS NANNOPLANKTON:

Stephanolithion bigoti, *Diazomatolithus lehmani*, *Zygodiscus minimus*, *Z. sallilum*, *Z. bussonii*
Hexapodorhabdus cuvillieri

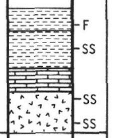


Hole 105, Core 39 (612m to 621m)

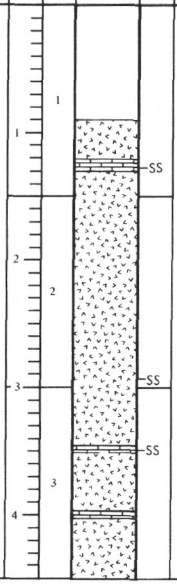
AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE JURASSIC (KIMMERIDGIAN-OXFORDIAN)		1 2 3	1 2 CC		SS SS F,O CN SS F, CN, O	Clayey limestone, hard, reddish brown (10R4/4) with occasional thin greenish gray (5G6/2) lenses and layers; generally evenly bedded and faintly laminated, with a few burrow fillings; fragments of bivalves (?); silty zone with chalcedony at 65cm. Green color diffuses into red zones; hematite common in red zones and rare to absent in green zones; clay and nanno-calcite abundant in both red and green zones.	FORAMINIFERS: *Lenticulina quenstedti, Spirophtalmidium birmenstorfensis, Dentaline jurensis* OSTRACODES: *Bairdia italica* CALCAREOUS NANNOPLANKTON: *Stephanolithion bigoti, Zygodiscus sallilum, Z. bussonii, Staurolithites quadriarcullus, Hexapodorhabdus cuvillieri, Watznaueria britannica, Diazomatolithus lehmani* *CORE CATCHER* FORAMINIFERS: *Frondicularia deslongchampsi, Lenticulina quenstedti* CALCAREOUS NANNOPLANKTON: *Stephanolithion bigoti, Zygodiscus sallilum, Z. bussonii, Staurolithites quadriarcullus, Watznaueria britannica, Discorhabdus patulus* OSTRACODES: *Bairdia italica*



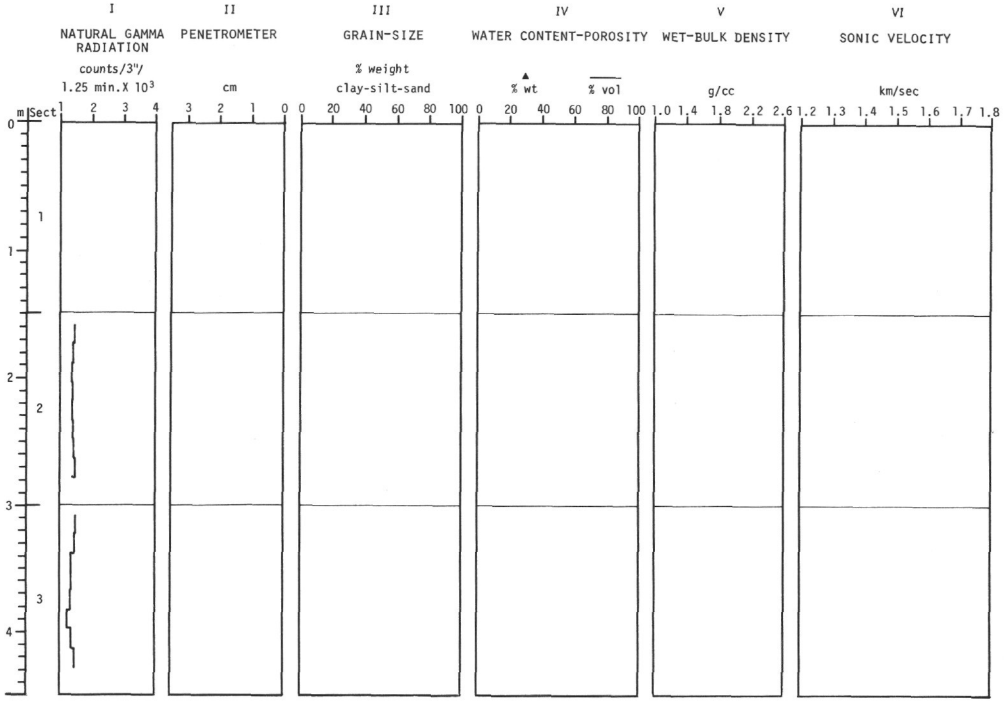
Hole 105, Core 40 (621m to 624m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE JURASSIC (OXFORDIAN)		1	1		F SS SS SS	Clay, soft, reddish brown (10YR4/6) recovered as isolated chunks. Clay, altered pyroclastic fragments; sanidine and glass shards abundant, thinly interbedded red (10R3/4) and green (10GY3/2, 5/2). Limestone, very hard, pale red (10R6/2) and reddish brown (10R4/6) with green palagonite fragments. Basalt, black (N1, N2), abundant fractures filled with white calcite; limestone inclusion at 140cm.	FORAMINIFERS: *Pseudonodosaria candela, P.vulgata, P. parallela* CALCAREOUS NANNOPLANKTON: *Stephanolithion bigoti, Watznaueria britannica, Zygodiscus sallilum, Cyclagelosphaera margereli, Hexapodorhabdus cuvillieri, Diazomatolithus lehmani*

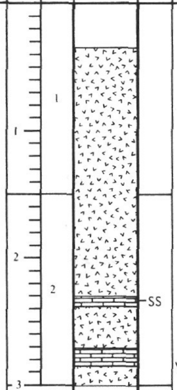
Hole 105, Core 41 (624m to 627m)



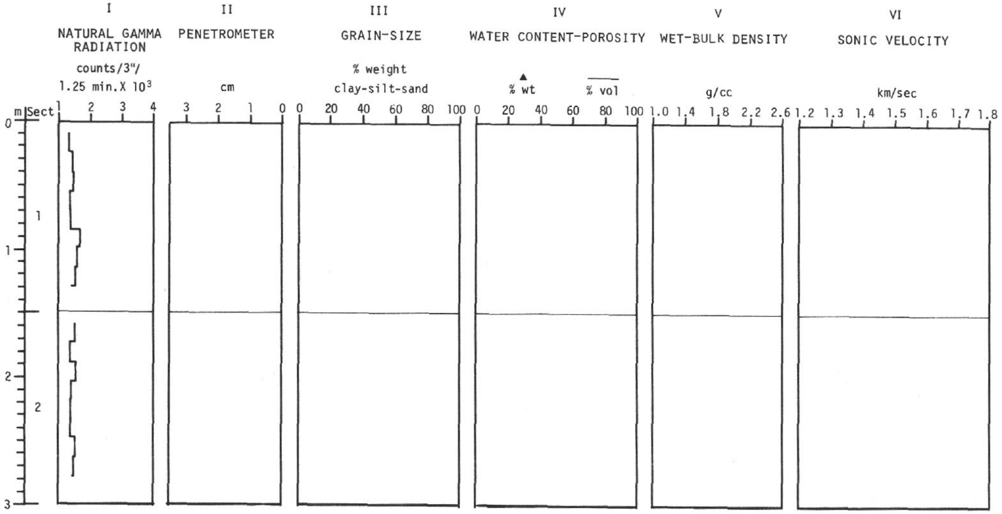
AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
						Basalt, black with faint brownish or pinkish brown tint in irregular zones, highly fractured; fractures filled with white fibrous calcite, widest veins show greenish layering parallel and adjacent to wall of fracture; fine-grained limestone inclusions contain some sparry calcite and palagonite; glassy zones surround most inclusions; glassy zones also occur in places throughout the basalt.	



Hole 105, Core 42 (627m to 630m)

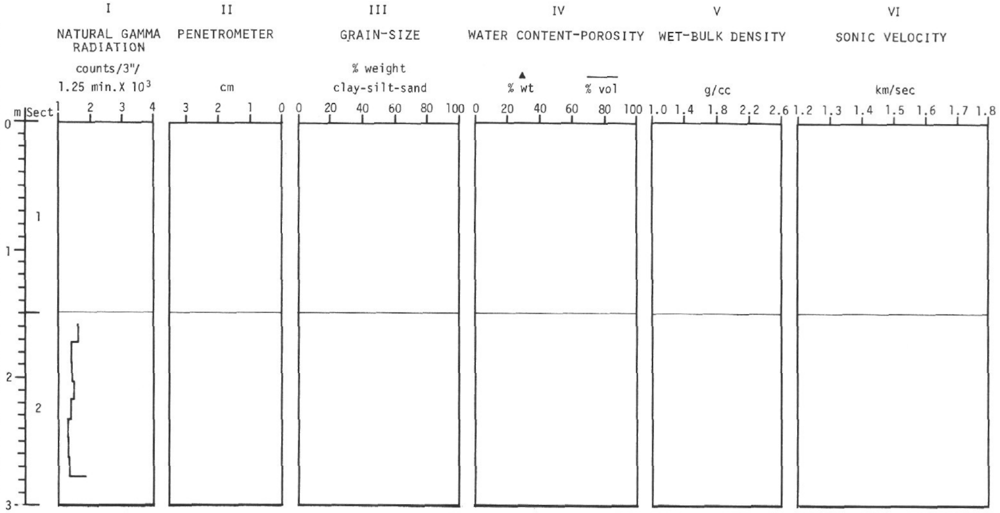


AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
						Basalt, black (N1, N2) with very faint brownish tint generally following trends of calcite veins; highly fractured; fractures filled with white fibrous calcite. Glassy zone. Fibrous calcite veins with green palagonite. Inclusion of recrystallized calcareous clay containing fragments of greenish black glassy basalt; dark reddish brown (10R3/4). Coarse crystalline calcite with fragments of black glassy basalt tinged with greenish black and dark reddish brown; small area of drusy calcite crystals.	

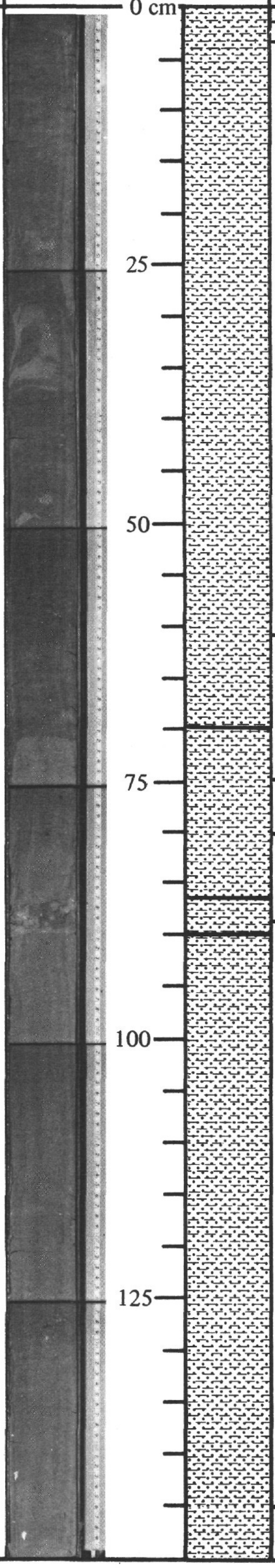


Hole 105, Core 43 (630m to 633m)

AGE	ZONE	DEPTH (m)	SECTION NO.	LITHOLOGY	SAMPLE INTERVAL	LITHOLOGY	DIAGNOSTIC FOSSILS
		1	1			Basalt, black (N1, N2) with very faint brownish tinge generally following trends of calcite veins; highly fractured; fractures filled with white fibrous calcite; some glassy zones and inclusions of light green hard limestone containing inclusions of green palagonite.	
		2	2			Zone of thick white calcite veins enclosing pieces of black glassy basalt. Fibrous calcite veins with green palagonite.	

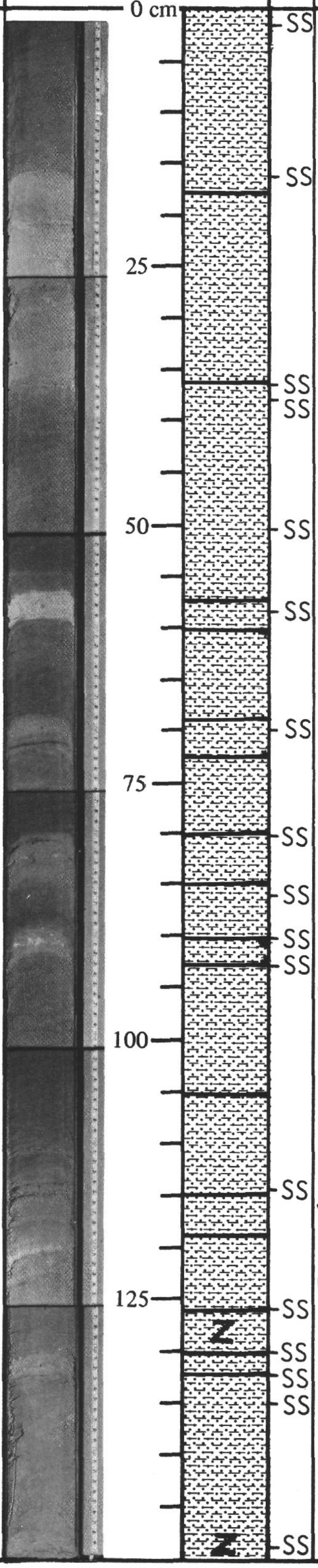


Hole 105, Core 9, Sect. 1

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
			SS SS SS SS SS SS SS	Clay; silty, dusky yellowish brown (10YR3/2), zeolites common. Mottling with light brown (5YR 5/4). Goethite common, zeolites and sphalerite rare. Grayish red (10R 5/2), strongly mottled with light brownish gray (5YR 6/1). Light brown (5YR 5/4) grades to reddish brown (10R 4/4).	

Hole 105, Core 9, Sect. 2

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS



Clay; silty throughout yellowish brown (10YR 5/2).

Greenish gray (5G 6/1).

Pale brown (5YR 5/2) with very faint bands of yellowish brown (10YR 5/2).

Light greenish gray (5G 7/1),

Pale brown (5YR 5/2).

Yellowish orange(10YR 7/6) with shadesof dusky yellow (5Y 6/4).

Pale brown (5YR 5/2), interbedded yellowish orange (10YR 7/6) and grayish green (10GY 5/2).

Pale brown (10YR 5/2).

Greenish gray with whiteish lenses(5G 6/1), quartz and glanconite dominated in lenses.

Pale brown (10YR 5/2).

Yellowish orange(10YR 7/6).

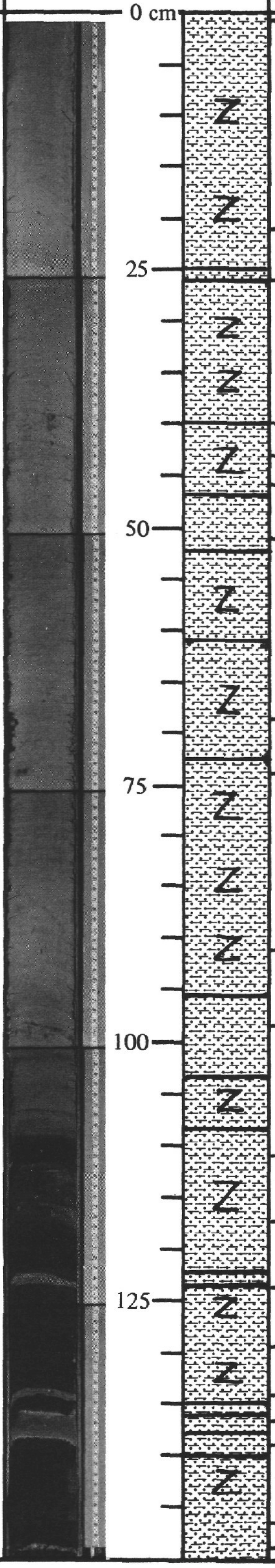
Grayish green (10GY 5/2).

Zeolitic zone.

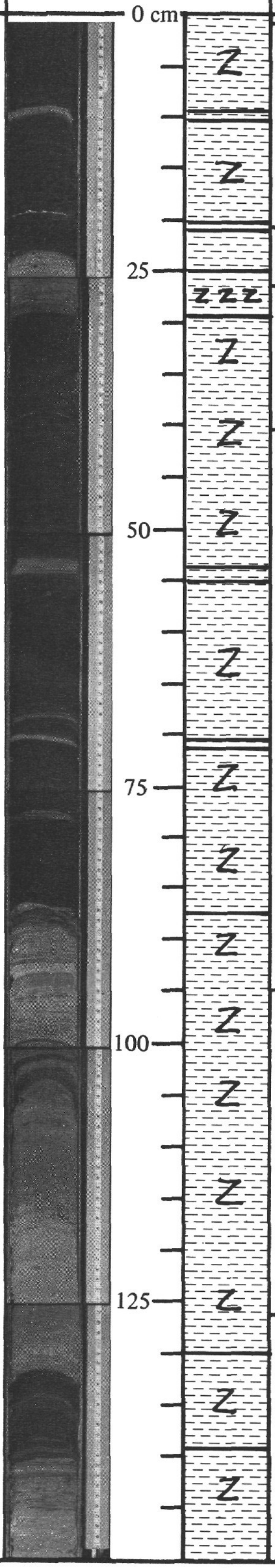
Strongly mottled bluish gray (5B 6/1), yellowish orange (10YR 7/6), grayish green (10GY 5/2).

Zeolites common.

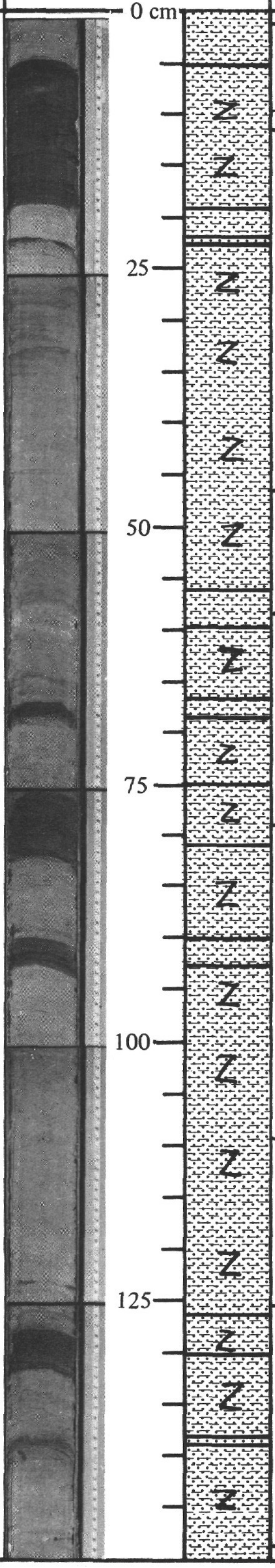
Hole 105, Core 9, Sect. 3

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
			SS SS SS SS SS SS SS SS SS SS SS SS SS SS SS SS SS SS SS SS	Clay; silty, zeolitic, multicolored to 110cm, then black and green; yellowish bands are rich in goethite pale olive (10Y 6/2). Band of light bluish gray (5B 7/1). Pale olive (10Y 6/2). Dark yellowish orange bands (10YR 6/6). Mixed olive-yellow zone. Pale olive (10Y 6/2). Dark yellowish orange (10YR 6/6) bands. Spot of light brown (5YR 5/6). Light olive (10Y 5/2). Bands of dark yellowish orange (10YR 6/6) and grayish green (10G 4/2). Dusky yellow (5Y 6/4). Top of black and green clays; dark greenish gray (5G 4/1) black (N1). Sphalerite abundant. Greenish gray (5G 4/1). Black (N1). Greenish gray (5G 6/1). Black (N1), Medium dark gray (N4). Black (N1). Greenish gray (5G 6/1).	

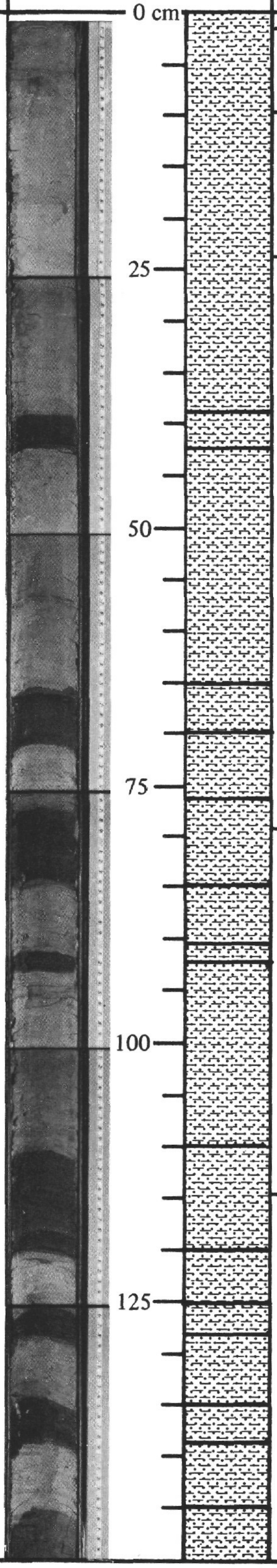
Hole 105, Core 9, Sect. 4

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
			SS SS SS SS SS SS	Clay, silty, zeolitic firm plastic to slightly indurated. Black (N1). Greenish gray (5G 5/1). Black (N1). Thin irregular white clay streak. Greenish gray zeolitic silt irregularly laminated with black and white. Black (N1). Very high natural gamma radioactivity. Laminated dark green. Black (N1). Dark gray-black stringer. Black (N1). Basically greenish gray (5G 5/1) showing fine to medium even or irregular laminations of black and white. Euhedral pyrite crystals. Black and gray interbedded. Greenish gray with white streaks.	

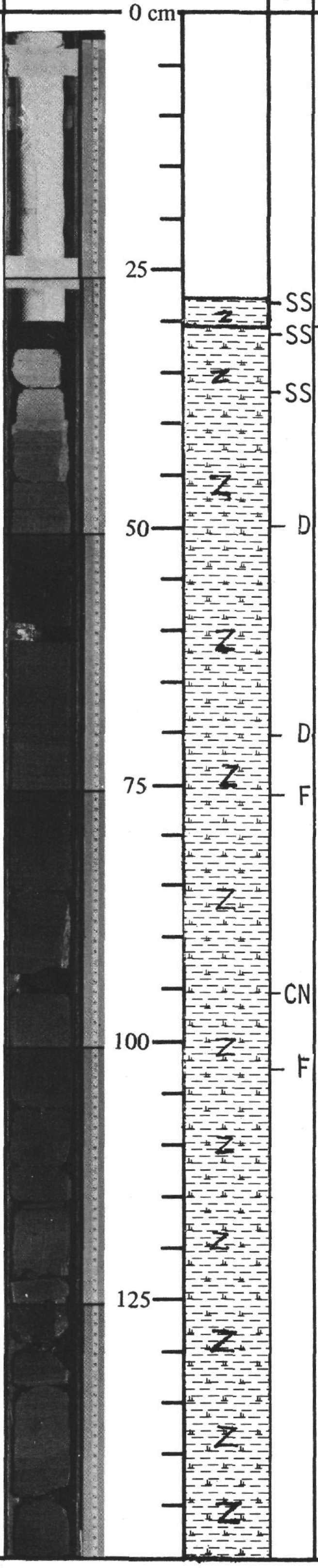
Hole 105, Core 9, Sect. 5

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE CRETACEOUS (Cenomanian)			SS D SS SS SS SS SS SS SS	Clay; silty, firm, slightly indurated, zeolitic. Black (N1). Greenish gray (5G 5/1). Black stringer. Greenish gray (5G 5/1). White specks in green areas. Greenish gray (5G 5/1). Black layer (N1) with speckled gray bed beneath. Greenish gray (5G 5/1). Black (N1). Greenish gray (5G 5/1). Black (N1). Greenish gray (5G 5/1). Black (N1). Greenish gray (5G 5/1). Black stringers.	DINOFLAGELLATES: *Deflandrea acuminata*, *Palaeohystrichophora infusorioides*, *Litosphaeridium siphoniphorum*

Hole 105, Core 9, Sect. 6

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
			SS SS SS SS SS	Clay; silty, zeolitic, firm, slightly indurated. Greenish gray (5G 5/1). Black (N2). Greenish gray (5G 5/1). Black (N2). Black (N2). Black (N2). Thin black stringers. Greenish gray (5G 5/1). Black (N2). Greenish gray (5G 5/1). Black (N2). Greenish gray (5G 5/1). Black (N2). Greenish gray (5G 5/1). Black (N2).	

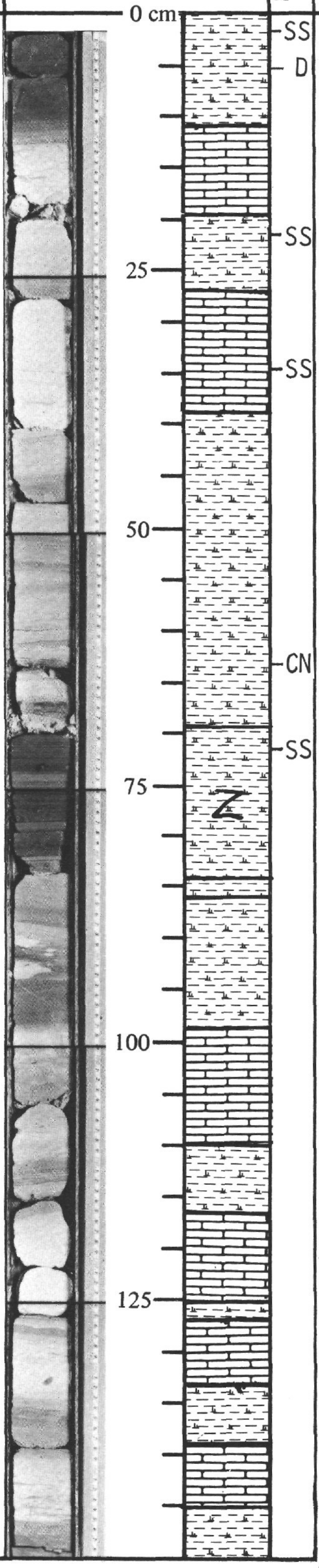
Hole 105, Core 17, Sect. 1

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
EARLY CRETACEOUS (Barremian)				<u>Clay</u>; silty, zeolitic black (N1). <u>Chalky limestone</u>; soft clayey. Zeolitic, finely and evenly laminated, dark gray (N4) with light olive gray (5Y 6/1) with very thin dark laminations and a small green lens near top of zone.	FORAMINIFERA: *Hedbergella infracretacea*, *H. hoterivica*, *H. globigerinelloides*, *Globigerinelloides ultramica*, *Haplophragmoides* sp. aff. *H. concavus* CALCAREOUS NANNOPLANKTON: *Cretarhabdus splendens*, *C. crenulatus*, *Ahmuellerella asper*, *Arkhangelskiella striata*, *Apertapetra gronosa*, *Glaukolithus diplogrammus*, *Lithraphidites carniolensis*, DINOFLAGELLATES: *Dingodinium cerviculum*, *Microdinium deflandrei*, *Wallodinium drutzschi*, *Dictyopysix circulata*, *Paranetrelytron strongylum*.

Hole 105, Core 18, Sect. 2

AGE | ZONE | LITHOLOGY | SAMP. INT | LITHOLOGY | DIAGNOSTIC FOSSILS

EARLY CRETACEOUS (Hauterivian)



Chalky limestone; soft, olive gray (5Y 4/1) with thin laminations.

Limestone, hard, gray (N7).

Indurated, distorted laminae, gray (N7 to N6).

Green streak.

Gray (N7 to N6).

Dark olive black (5Y 2/1) to olive gray (5Y 4/1) with thin regular laminations.

Gray (N6) thin laminations inclusions of light gray (N7).

Olive gray (5Y 4/1) laminations.

Undulating and wavy laminations and burrows, gray (N7 to N6).

Olive gray (5Y 4/1) to medium gray (N4-N6).

Light gray (N8) almost homogeneous chalky limestone.

Gray (N5-N7), thin laminations.

Light gray (N7-N8) with burrowing and undulating laminations.

Olive gray (5Y 4/1) thin regular laminations.

Light gray (N7) with burrows.

Olive gray (5Y 4/1) thin regular laminations.

Aptychus.

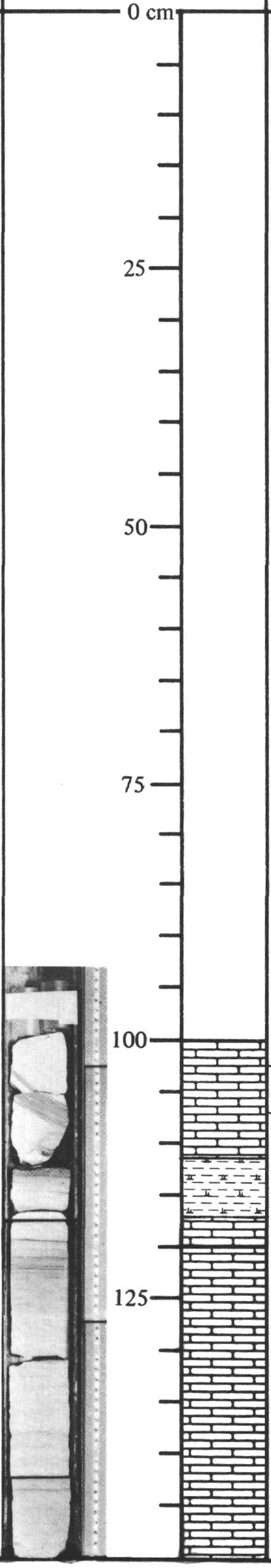
CALCAREOUS NANNOPLANKTON:

Braarudosphaera discula, *Lithraphidites carniolensis*, *Cretarhabdus crenulatus*, *Watznaueria actinosa*, *Ahmuellerella asper*, *Watznaueria barnesae*,

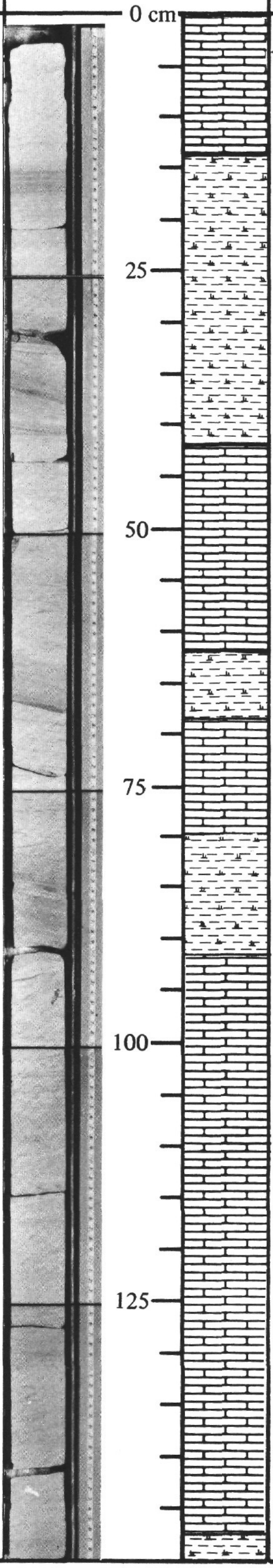
DINOFLAGELLATES:

Dingodinium cerviculum, *Microdinium deflandrei*, *Wallodinium krutzschi*, *Meiourogonyaulax stoveri*.

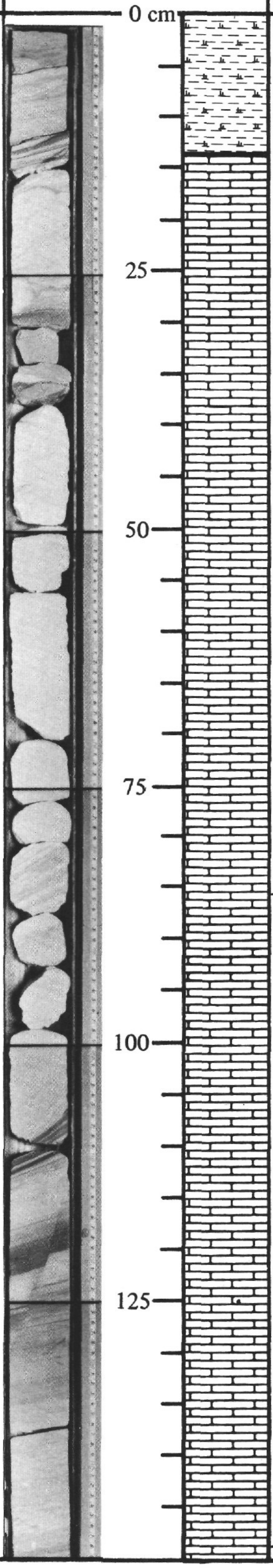
Hole 105, Core 27, Sect. 1

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
VALANGINIAN - TITHONIAN (Foraminifera and Dinoflagellates) TITHONIAN (Calcareous Nannoplankton)			CN D	Interbedded hard white (N8) chalky limestone and soft laminated, olive gray, (5Y 4/1), clayey, chalky limestone. Slump structure. Olive gray (5Y 4/1) thin regular laminations. Thin homogeneous layer dark olive gray (5Y 4/1). Gray (N7-N6) thin regular laminations. White (N8 to N7) laminations very slightly undulated and disturbed.	CALCAREOUS NANNOPLANKTON: *Nannoconus steinmanni*, *Cyclagelosphaera margereli*, *Parhabdolithus embergeri*, *Diazomatolithus lehmani*, *Watznaueria barnesae*, DINOFLAGELLATES: *Systematophora fasciculigera* *Prolixosphaeridium mixtispinosum*, *P. granulosum*, *Biorbigera johnewingi*, *Chytroeisphaeridia pococki* *Hysitrichosphaeridium* sp. A *Cometodinium* sp. A

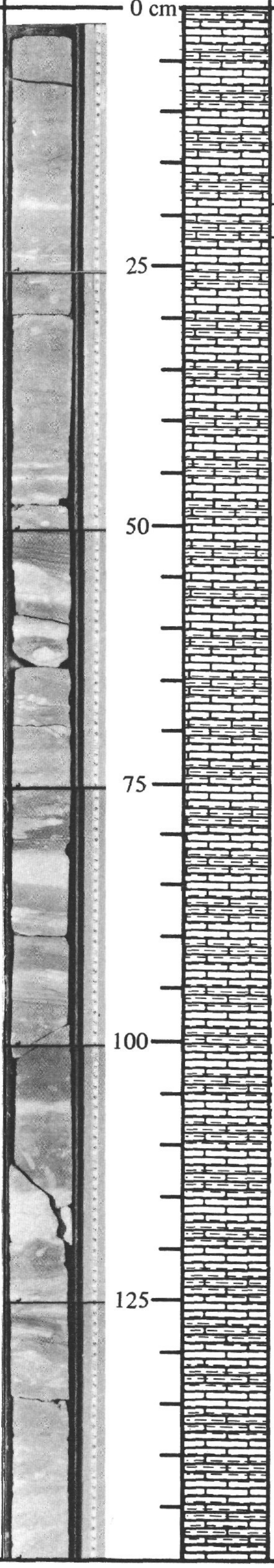
Hole 105, Core 27, Sect. 2

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
TITHONIAN (Calcareous Nannoplankton)			-CN	<u>Chalky limestone</u>; hard, white (N8). Chalky limestone; clayey soft, laminated olive gray (5Y 4/1). Light greenish gray (5G7/1) with faint laminations. Gray (N6) to olive gray (5Y 4/1). Olive gray (5Y 4/1). Light greenish gray (5G 7/1). Olive gray (5Y 4/1) to gray (N6), faint distorted laminations. Fossils (aptychi?). Pyrite. Olive gray (5Y 4/1) thin laminations.	CALCAREOUS NANNOPLANKTON: *Nannoconus steinmanni, Parhabdolithus embergeri, Diazomatolithus lehmani, Watznaueria barnesae, Stephanolithion laffittei, Cyclagelosphaera margereli.*

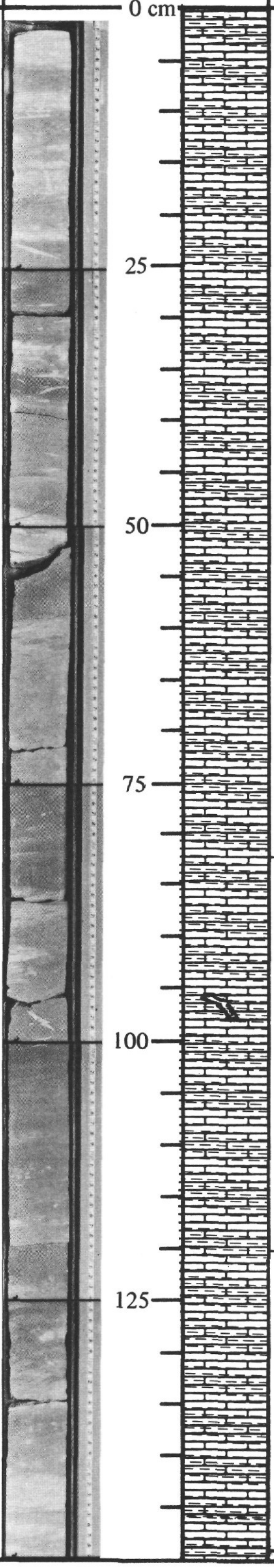
Hole 105, Core 27, Sect. 3

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
TITHONIAN (Calcareous Nannoplankton)			CN SS	Chalky limestone; soft olive gray (5Y 4/1) to greenish gray (5G 6/1). Chalky limestone; hard greenish gray (5G 8/1) to white N8,N7), slump structures. Thin dark greenish gray (5G 4/1), olive gray (5Y 4/1) distorted laminations. Greenish white (5G 9/1) fractured. Greenish gray (5G 8/1). Gray (N4 to N6). Calcite, massive, hard, white (N8 - 5G 9/1). Alternations of white (N8) and greenish gray (5G 6/1), oblique and wavy laminations. White (N8) to greenish gray (5G 6/1) and greenish white (5G 9/1). Olive gray (5Y 4/1) dominant. Slump structures. Greenish white (5G 9/1) undulating laminations. Olive gray (5Y 4/1) fractured. Thin dark greenish gray (5G 4/1). Olive gray to greenish gray thinly laminated, with burrows.	CALCAREOUS NANNOPLANKTON: *Nannoconus steinmanni* *Diazomatolithus lehmani* *Stephanolithion laffittei* *Cyclagelosphaera margereli* *Parhabdolithus embergeri* *Watznaueria barnesae*

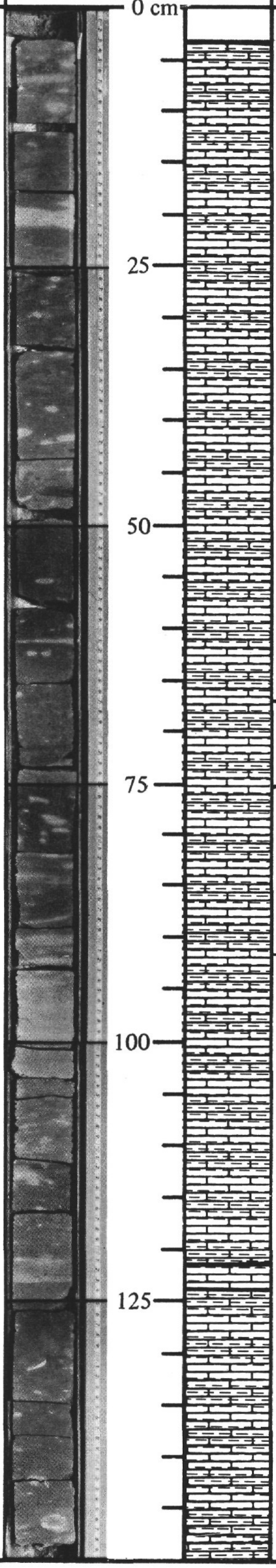
Hole 105, Core 33, Sect. 4.

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE JURASSIC			F,C,O, CN	Clayey limestone; dominantly pale reddish brown (10R 6/4) with abundant green layers, lenses, and clasts. Green lenses. Green lenses. Green lenses. Numerous clasts and flow structures. Pale green (10G 8/2) zones. Clasts and flow structures. Clasts. Flow structures. Clasts. Green zone. Thin regular laminations. Green zone. Fossil (aptychus debris?). Green zone. Burrows and green staining throughout.	FORAMINIFERA: *Lenticulina uhligi*, *Pseudonodosaria candela*, *P. parallela*. CALCAREOUS NANNOPLANKTON: *Watznaueria britannica*, *Zygodiscus erectus*, *Z. sallilum*, *Parhabdolithus marthae*, *Cyclagelosphaera margereli*, *Diazomatolithus lehmani*. PLANKTONIC CRINOIDS: *Saccocoma* sp. OSTRACODES: *Bairdia (Akidobairdia) farinacciae*.

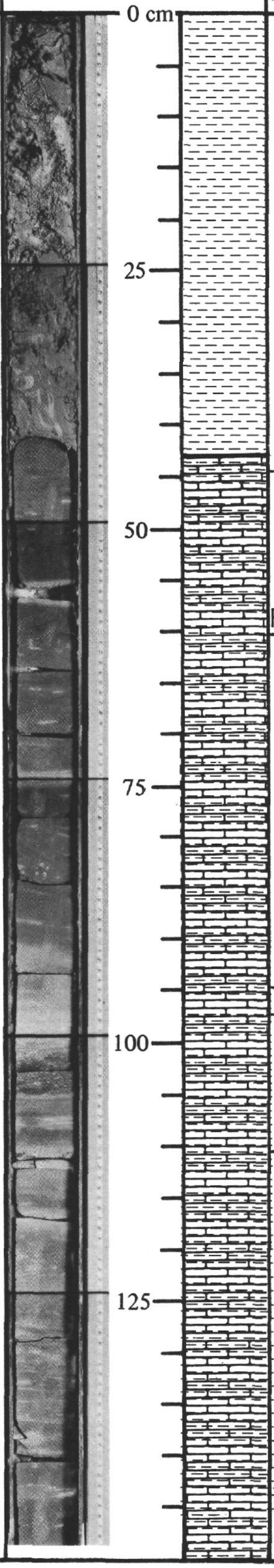
Hole 105, Core 33, Sect. 5

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE JURASSIC			CN 0 SS	<u>Clayey limestone</u>; pale reddish brown (10R 6/4) with abundant green layers and lenses. Flow structures and clasts abundant. Green zone. Green lenses. Pale green (10G 8/2) zone. Thin laminations. Fossil. Flow structures and burrows. Thin laminations. Green lenses. <u>Barite crystal</u>. Green spots. Burrows and flow structures. Green spots. Green zone.	CALCAREOUS NANNOPLANKTON: *Watznaueria britannica, Zygodiscus erectus, Z. sallilum, Parhabdolithus marthae, Cyclagelosphaera margereli,* OSTRACODES: *Bairdia (Akidobairdia) farinacciae.*

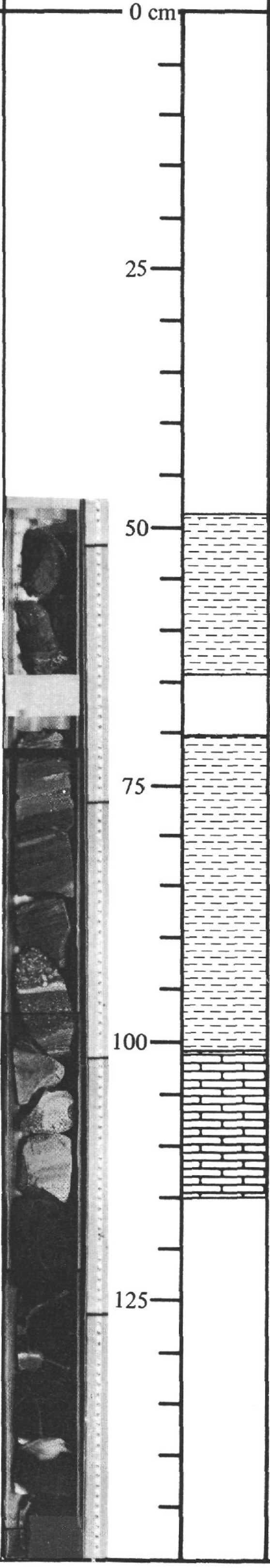
Hole 105, Core 35, Sect. 3

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE JURASSIC			SS SS CN	Clayey limestone; hard reddish brown (10R 4/4) with numerous greenish gray lenses and thin layers (light colored zones). Red silty clay. Green bed with diffuse contacts. Light reddish brown bed. Aptychus. Fossil.	CALCAREOUS NANNOPLANKTON: *Watznaueria britannica*, *Stephanolithion bigoti*, *Hexapodorhabdus cuvillieri*, *Staurolithites quadriarcullus*, *Zygodiscus erectus*, *Cyclagelosphaera margereli*.

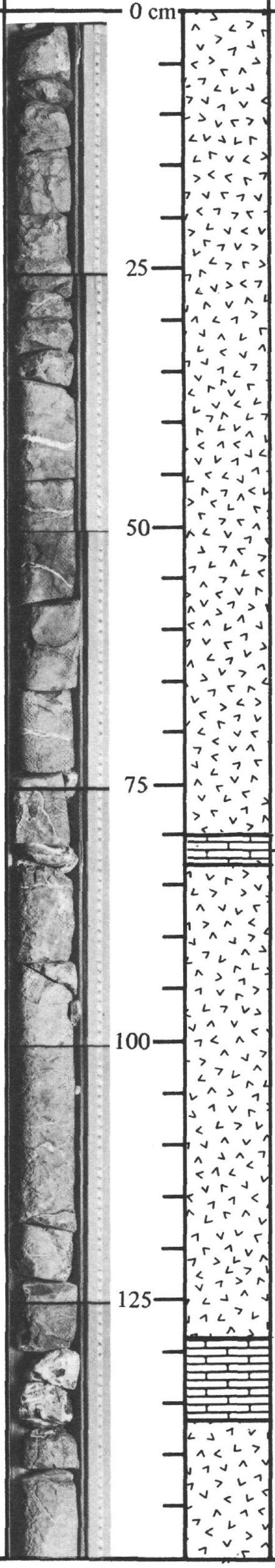
Hole 105, Core 38, Sect. 2

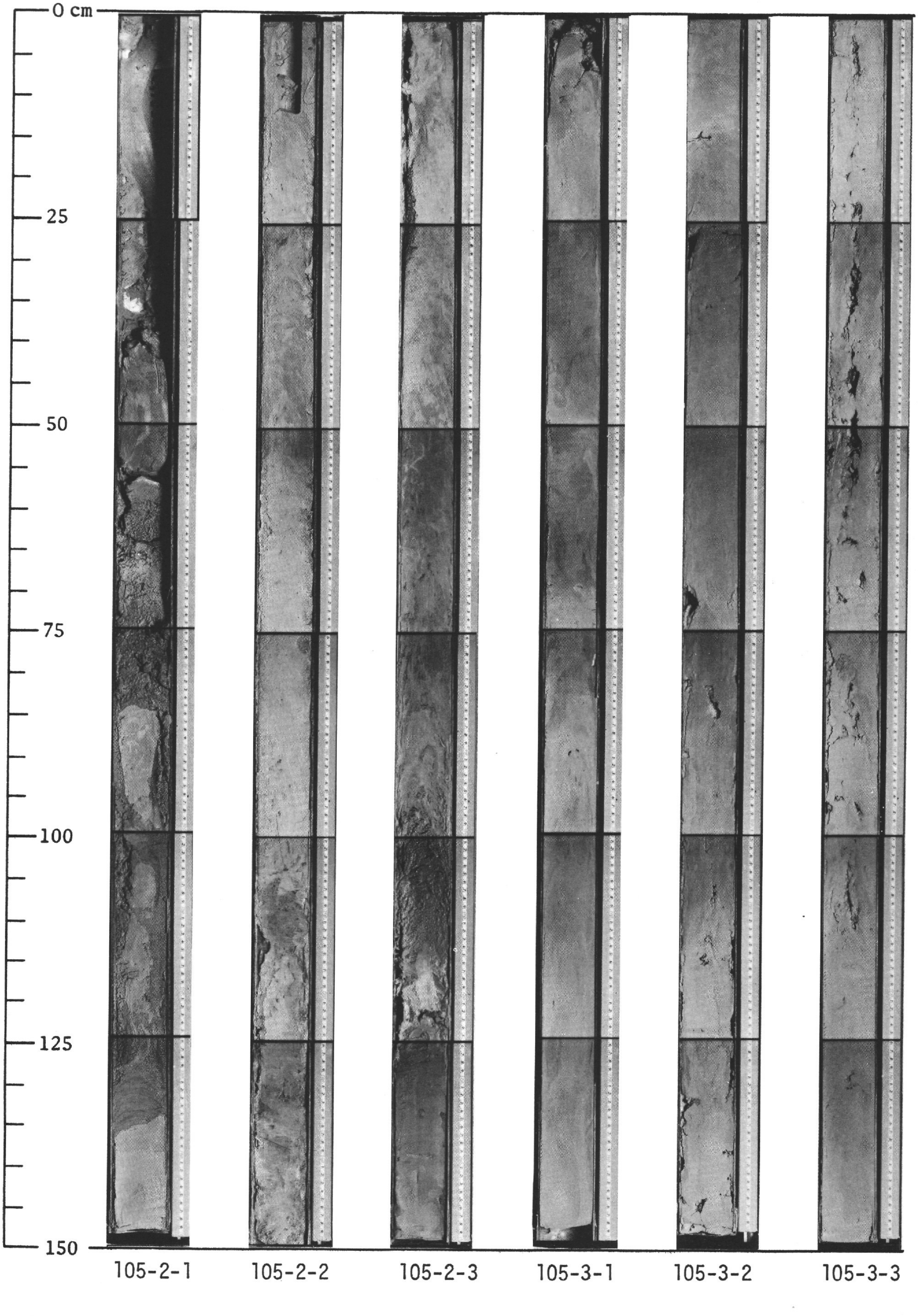
AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE JURASSIC			SS F,C,O SS CN SS	Clayey limestone; soft reddish brown (10R 4/4), highly disturbed. Clayey limestone; hard, reddish brown (10R 4/4), most of core laminated or evenly bedded, some lenses and layers of greenish gray. Graded bed; greenish gray red and white clasts. Veinlet of native copper bordered by palagonite.	FORAMINIFERA: *Brotzenia* ex gr. *B. parastelligera*, *Spirophtalmidium birmenstorfensis*, CALCAREOUS NANNOPLANKTON: *Stephanolithion bigoti*, *Watznaueria britannica*, *Zygodiscus sallilum*, *Staurolithites quadriarcullus*, *Cyclagelosphaera margereli*, PLANKTONIC CRINOIDS: *Saccocoma* sp. OSTRACODES: *Bairdia italica*

Hole 105, Core 40, Sect. 1

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
LATE JURASSIC			F SS SS SS SS CN SS SS SS SS SS SS SS SS SS	Sanidine is abundant in the zone of pyroclastic material between 70 and 101 cm. High-Mg calcite occurs in hard limestone at 114 cm. Clay, soft, moderate reddish brown (10YR 4/6) Tan limestone. Clay, dark reddish brown (10R 3/4). Glass shards abundant. Clay, green (5G 3/2 to 5GY 5/2). Alternations of thin layers of red and green as above; Green layers appear to be coarse grained palagonite fragments. Brecciated layer (10G 4/2). Thin white clay layer. Thin microbrecciated layers. Alternating green and white pale red (10R 6/2) limestone with moderate reddish brown (10R 4/6 areas. Grayish pink (5YR 8/1) to light greenish gray 5GY 8/1 with small grayish green (10G 4/2) palagonite clasts Black (N1 to N2) basalt with veins of white calcite Limestone inclusion. Limestone inclusion.	FORAMINIFERS: *Pseudonodosaria candela, P. vulgata, P. parallela* CALCAREOUS NANNOPLANKTON: *Stephanolithion bigoti, Watznaueria britannica, Cyclagelosphaera margereli, Zygodiscus sallilum, Diazomatolithus lehmani*

Hole 105, Core 42, Section 2.

AGE	ZONE	LITHOLOGY	SAMP. INT	LITHOLOGY	DIAGNOSTIC FOSSILS
			SS	Glassy zone. Wide calcite vein. Fibrous calcite vein with green tinged ends of calcite fibers. Basalt; black (N1) and greenish black, with faint brownish tint where altered along trend of calcite veins. Exposed green tinged calcite vein face. Dark reddish brown (10R 3/4) metamorphosed calcareous mudstone with inclusions of black and greenish black glassy basalt. Coarse crystalline calcite with inclusions of altered black glassy basalt tinged with greenish black and dark reddish brown. Small area of drusy calcite crystals.	


0 cm
25
50
75
100
125
150
105-2-1
105-2-2
105-2-3
105-3-1
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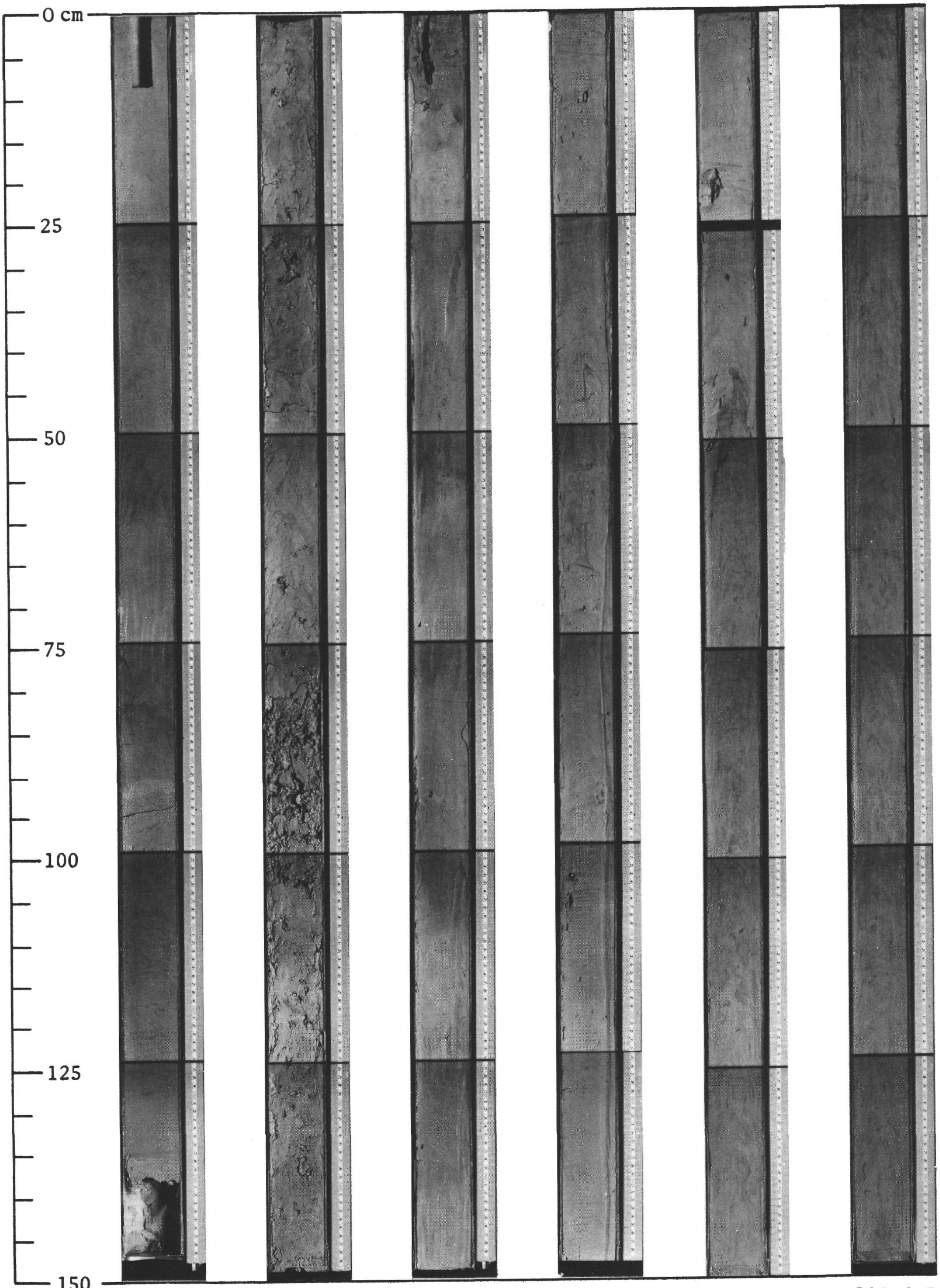
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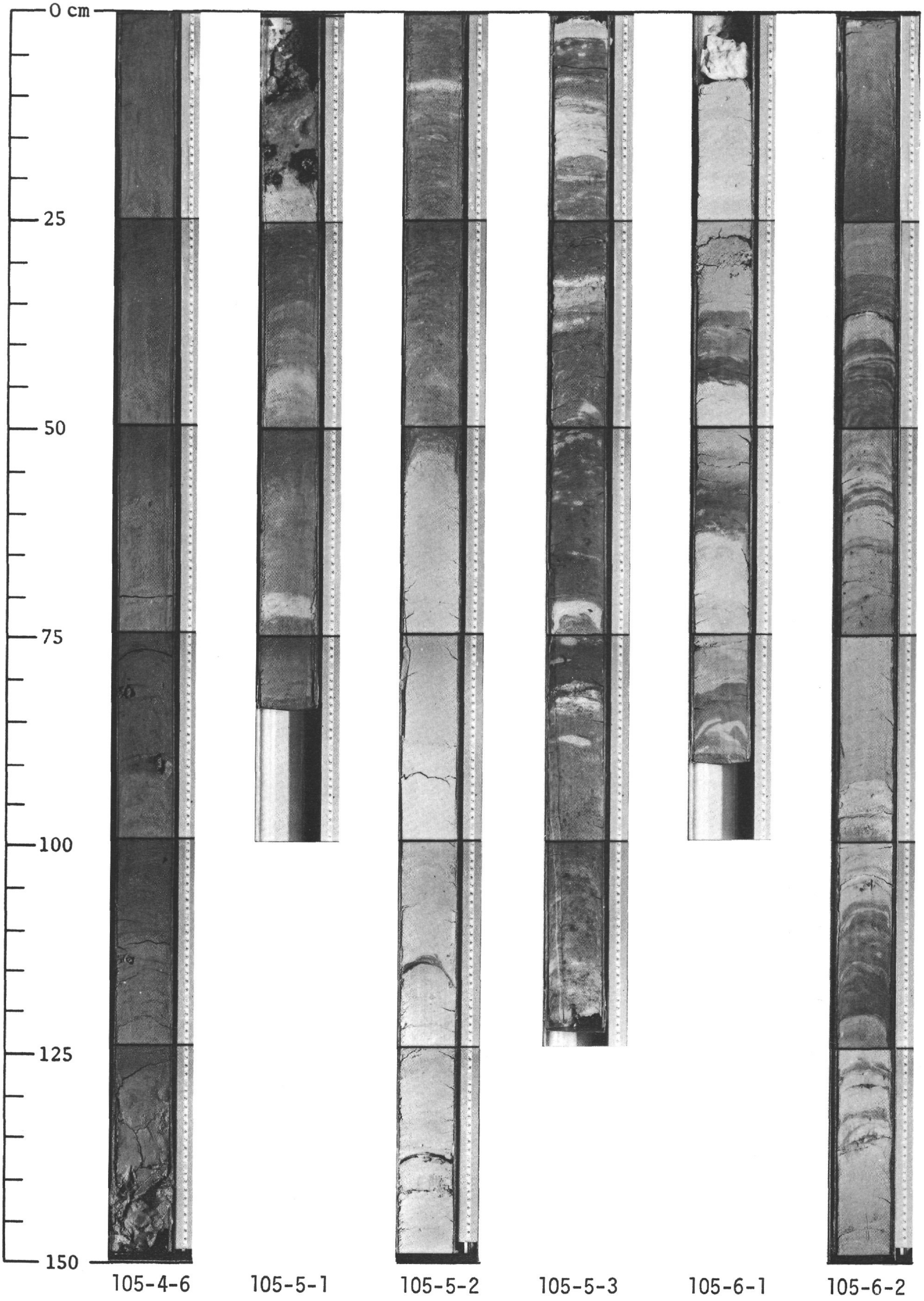
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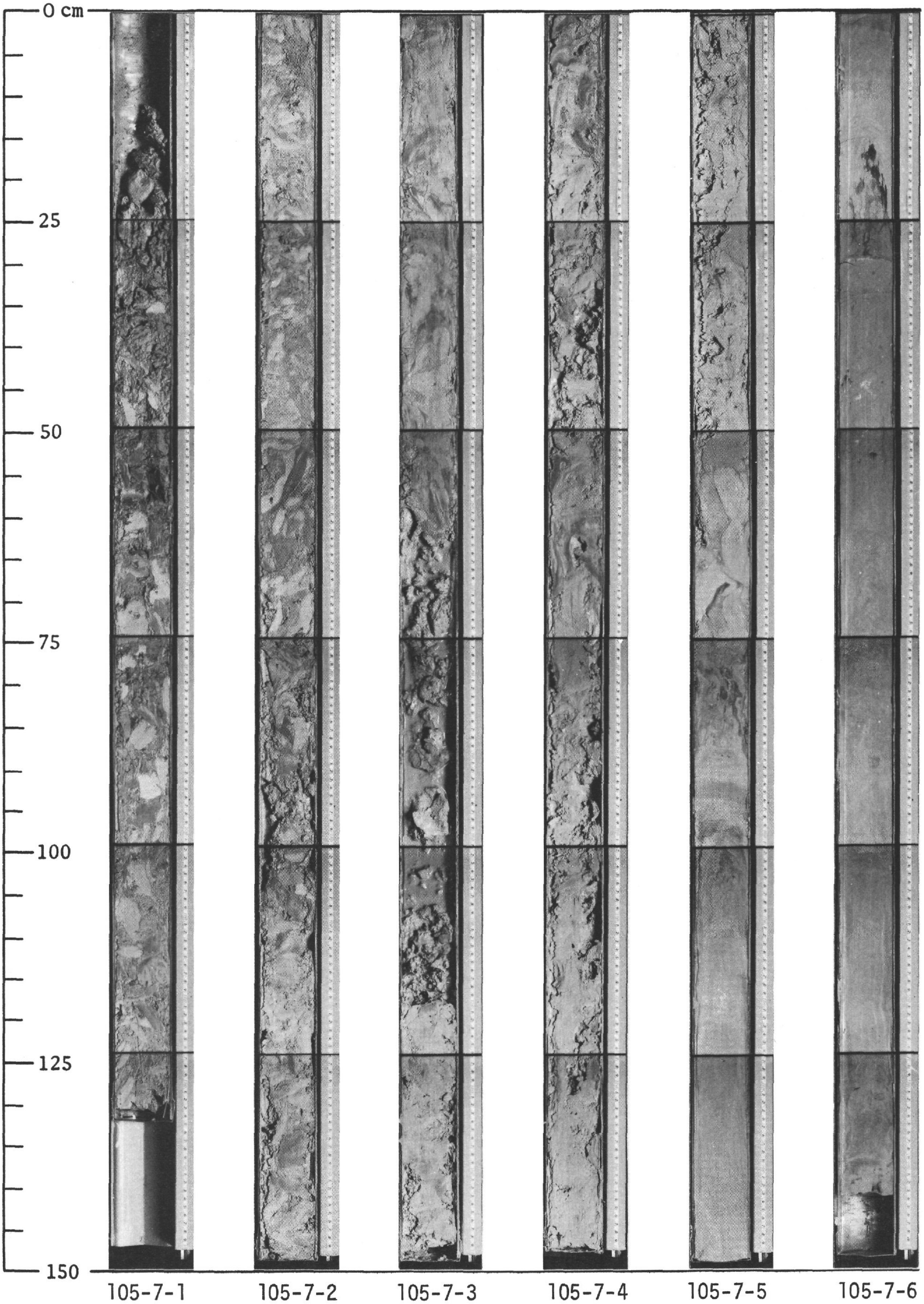
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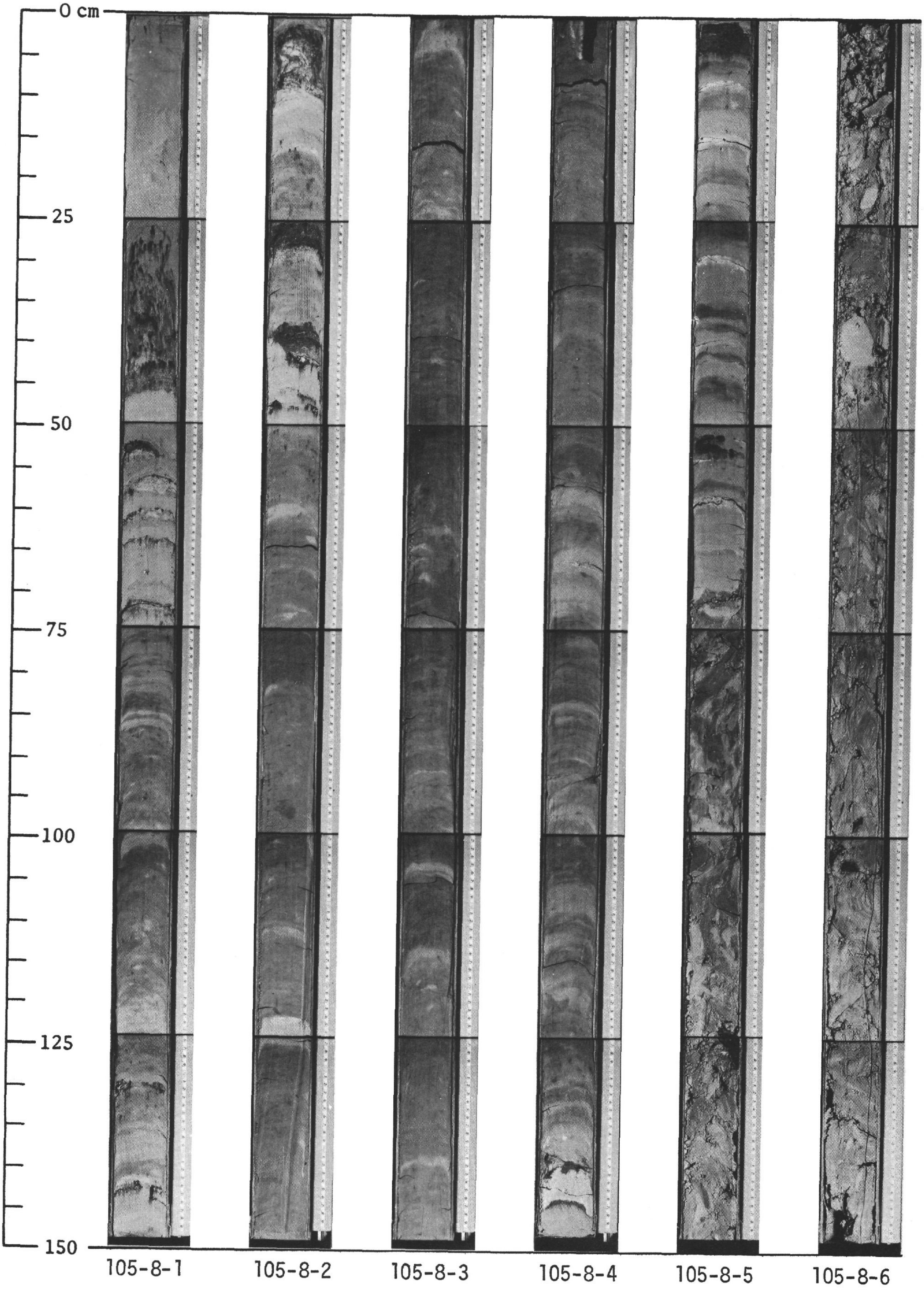
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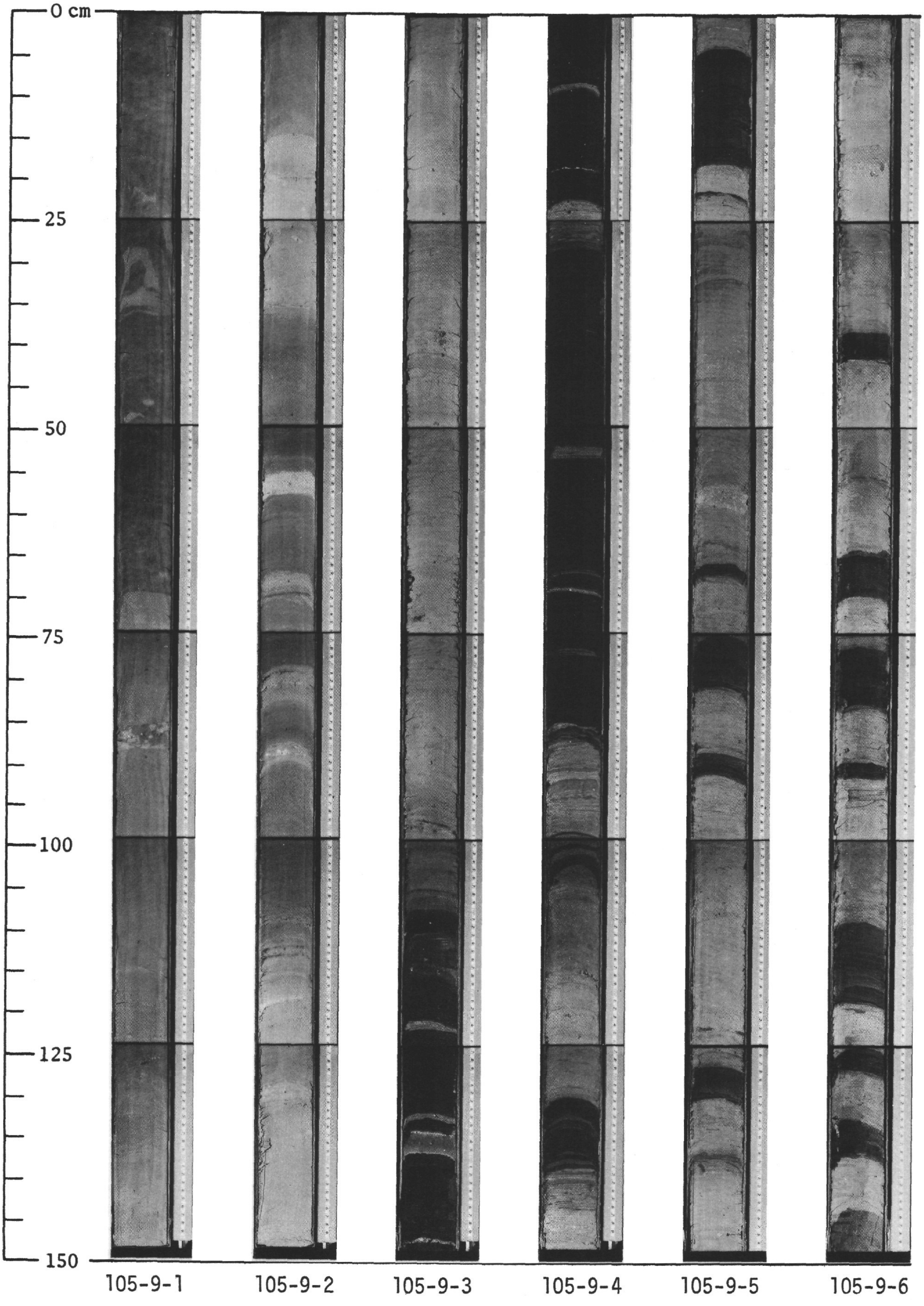
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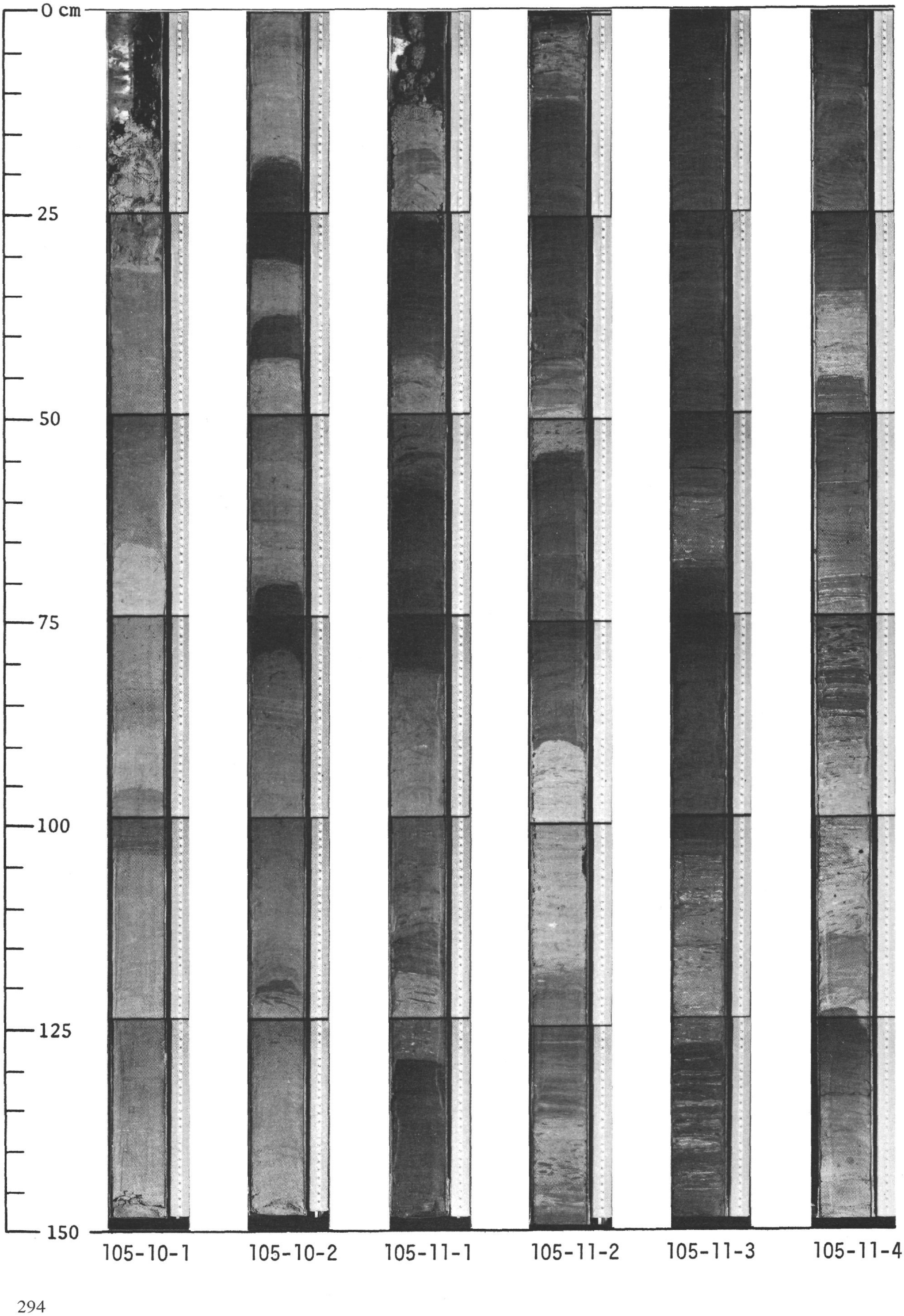
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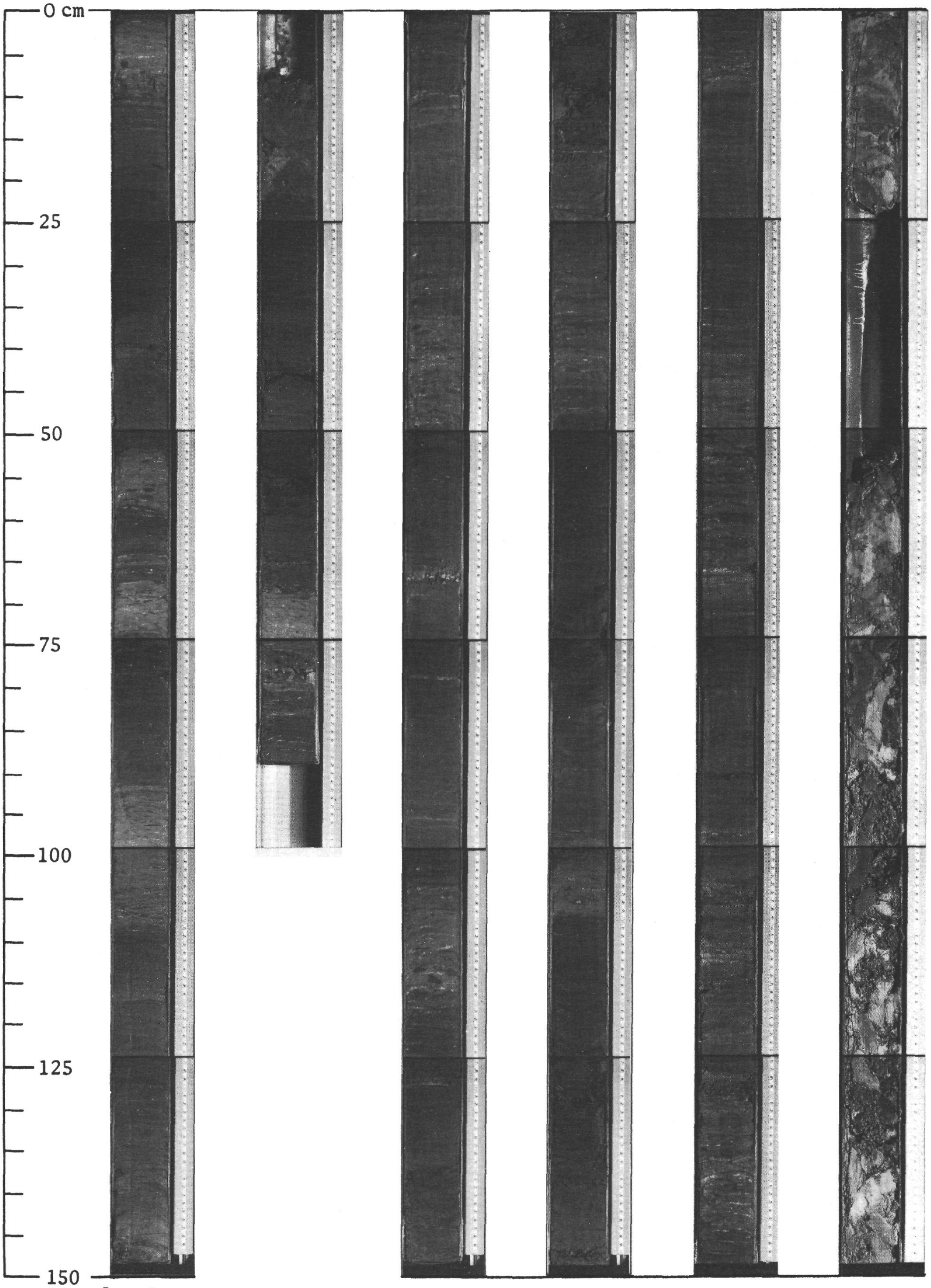
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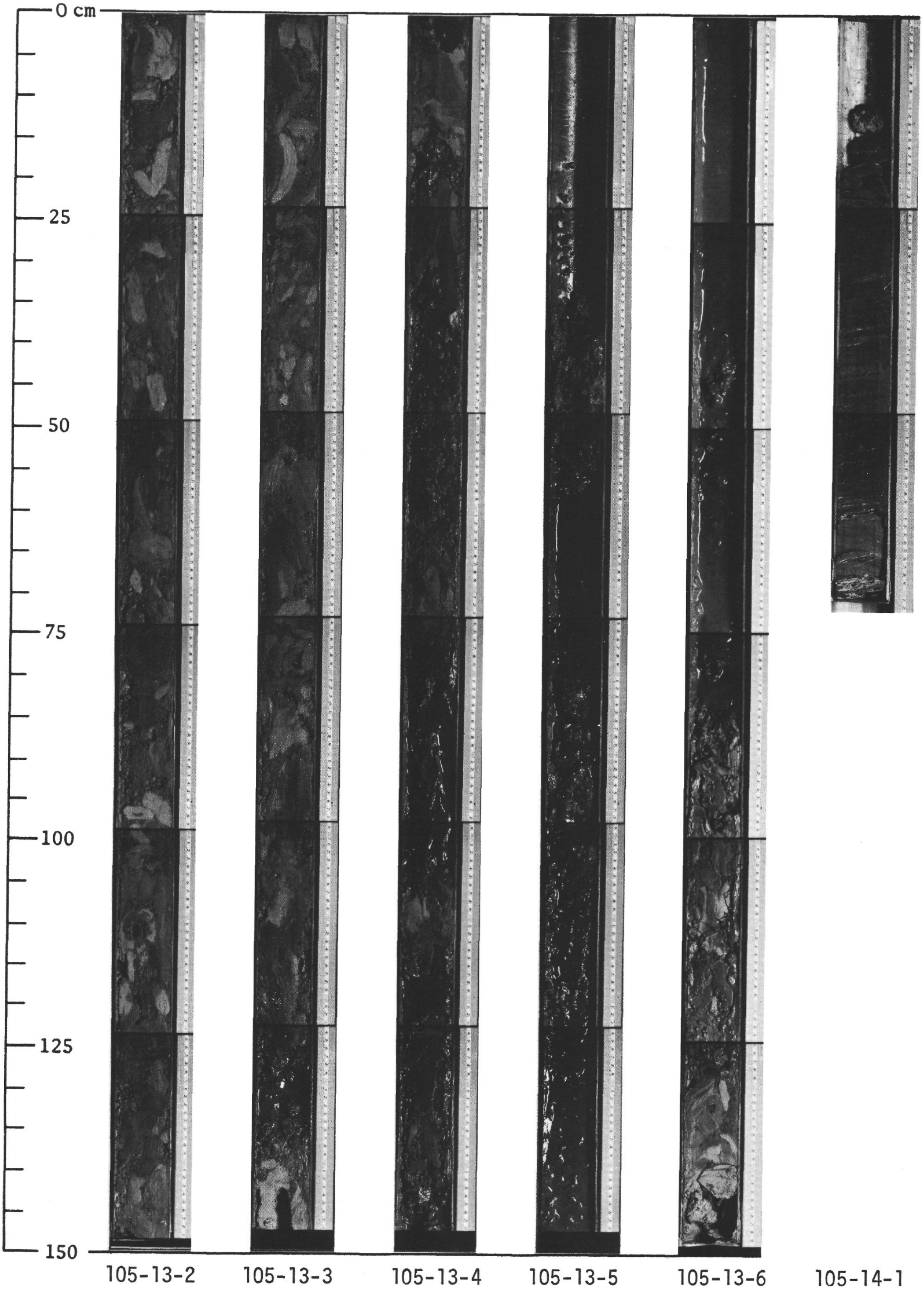
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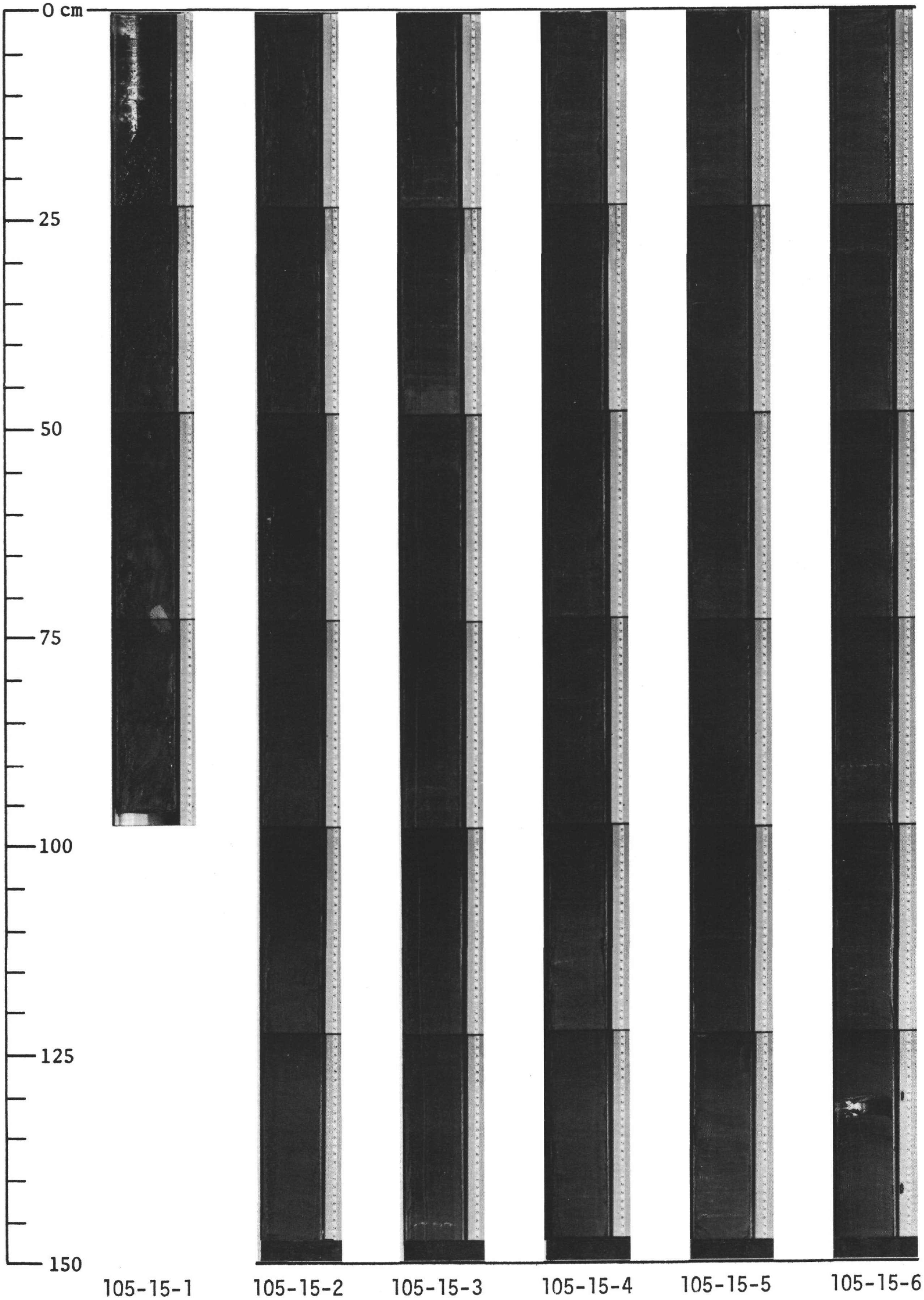
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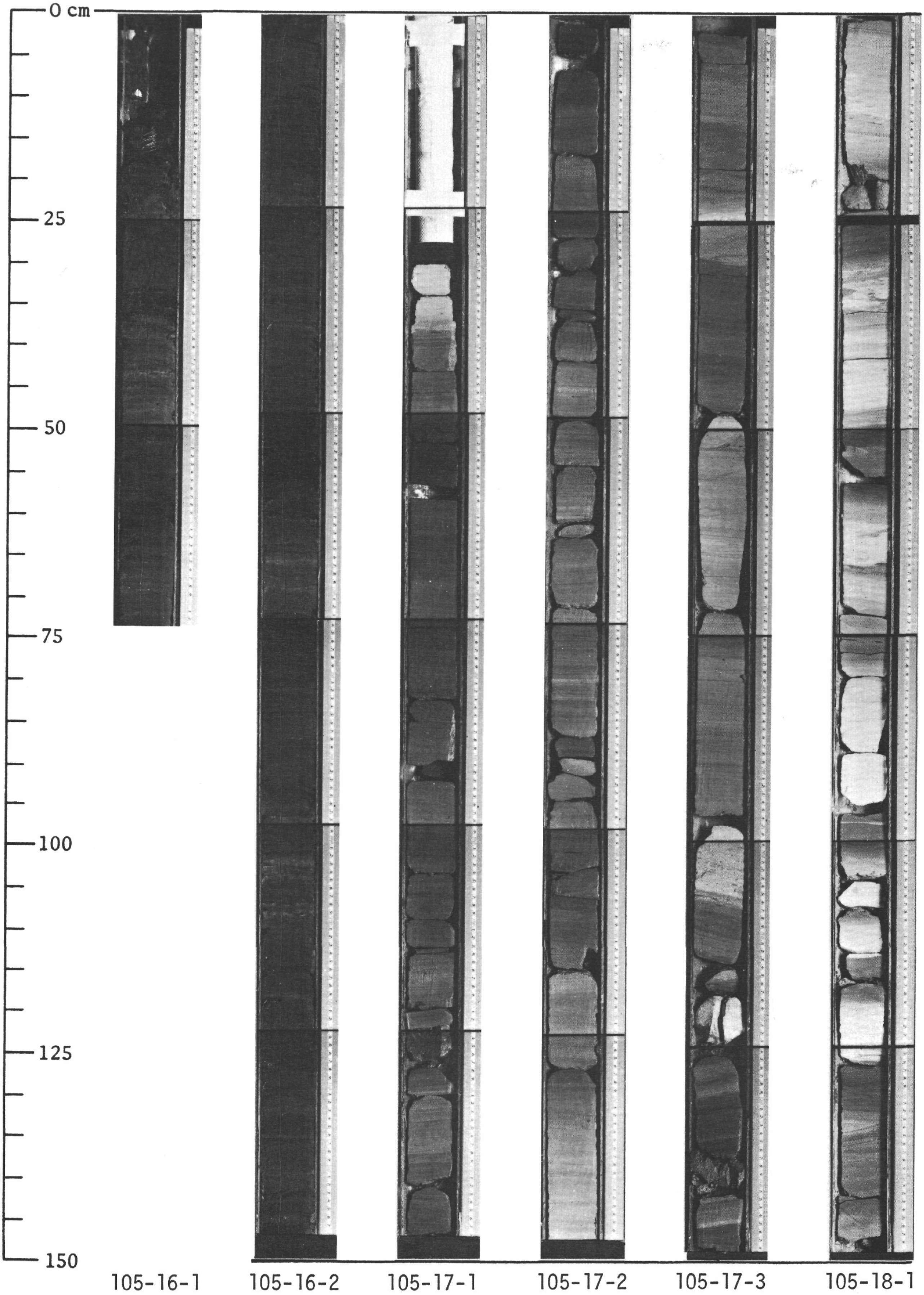
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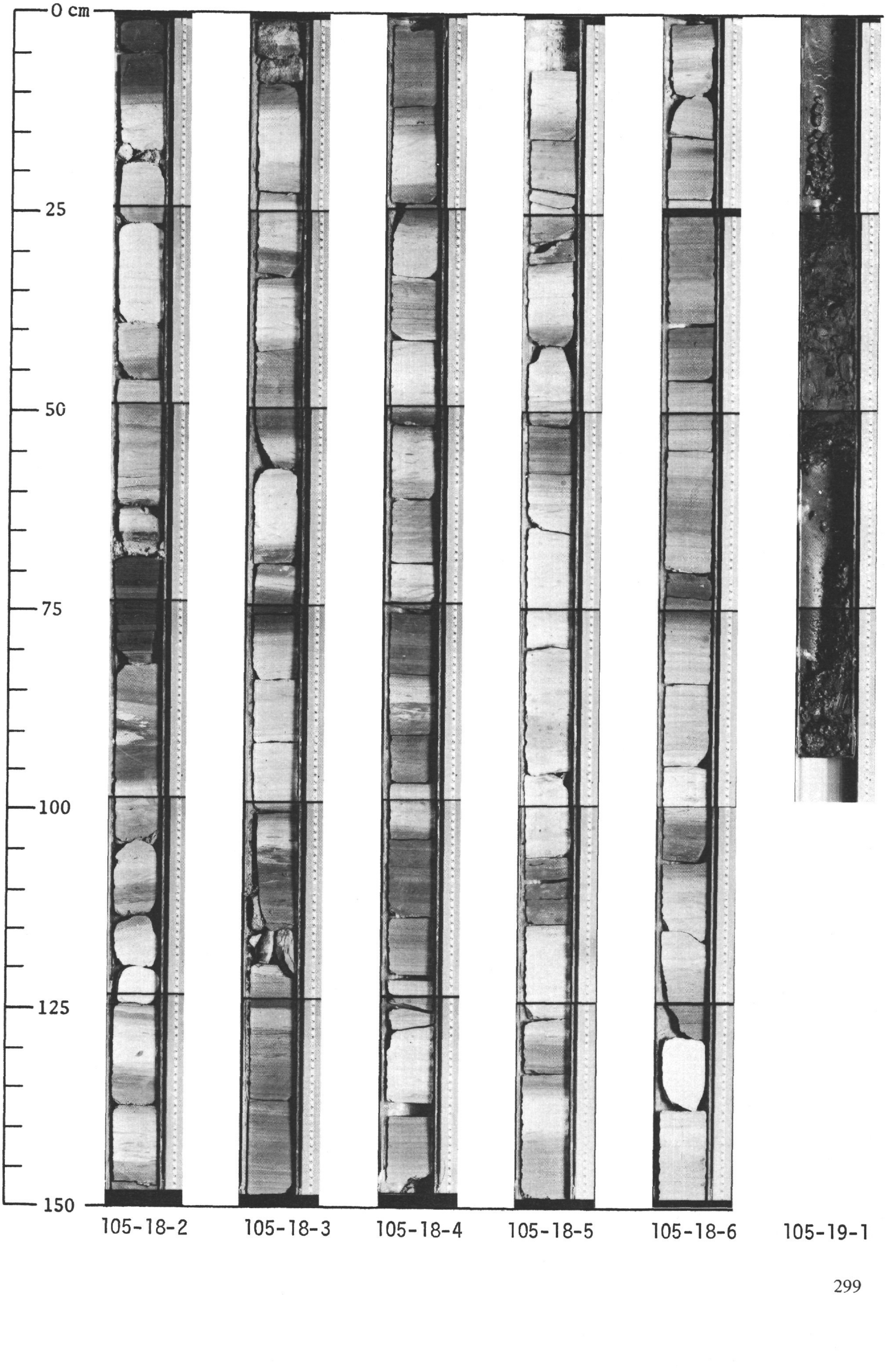
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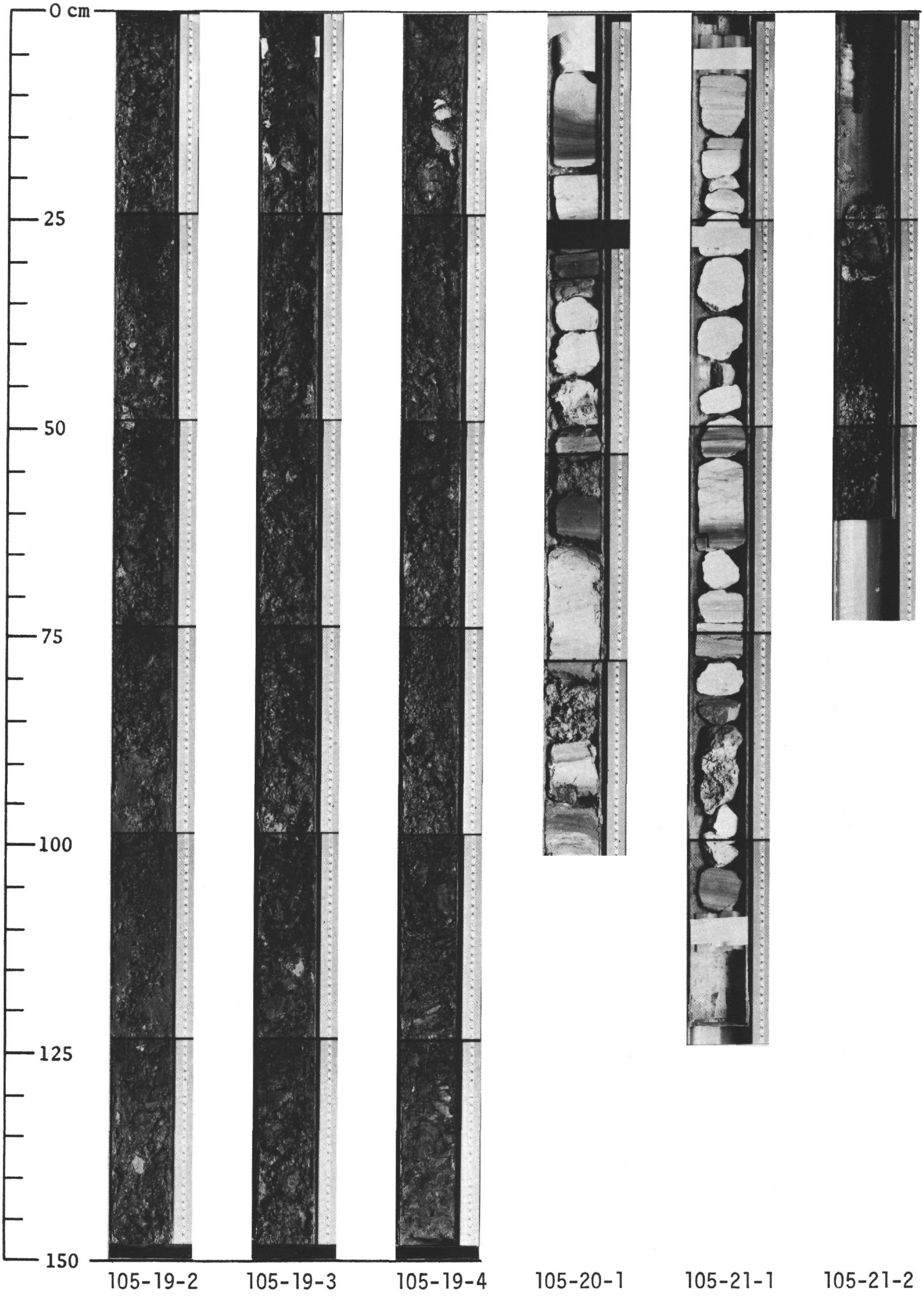
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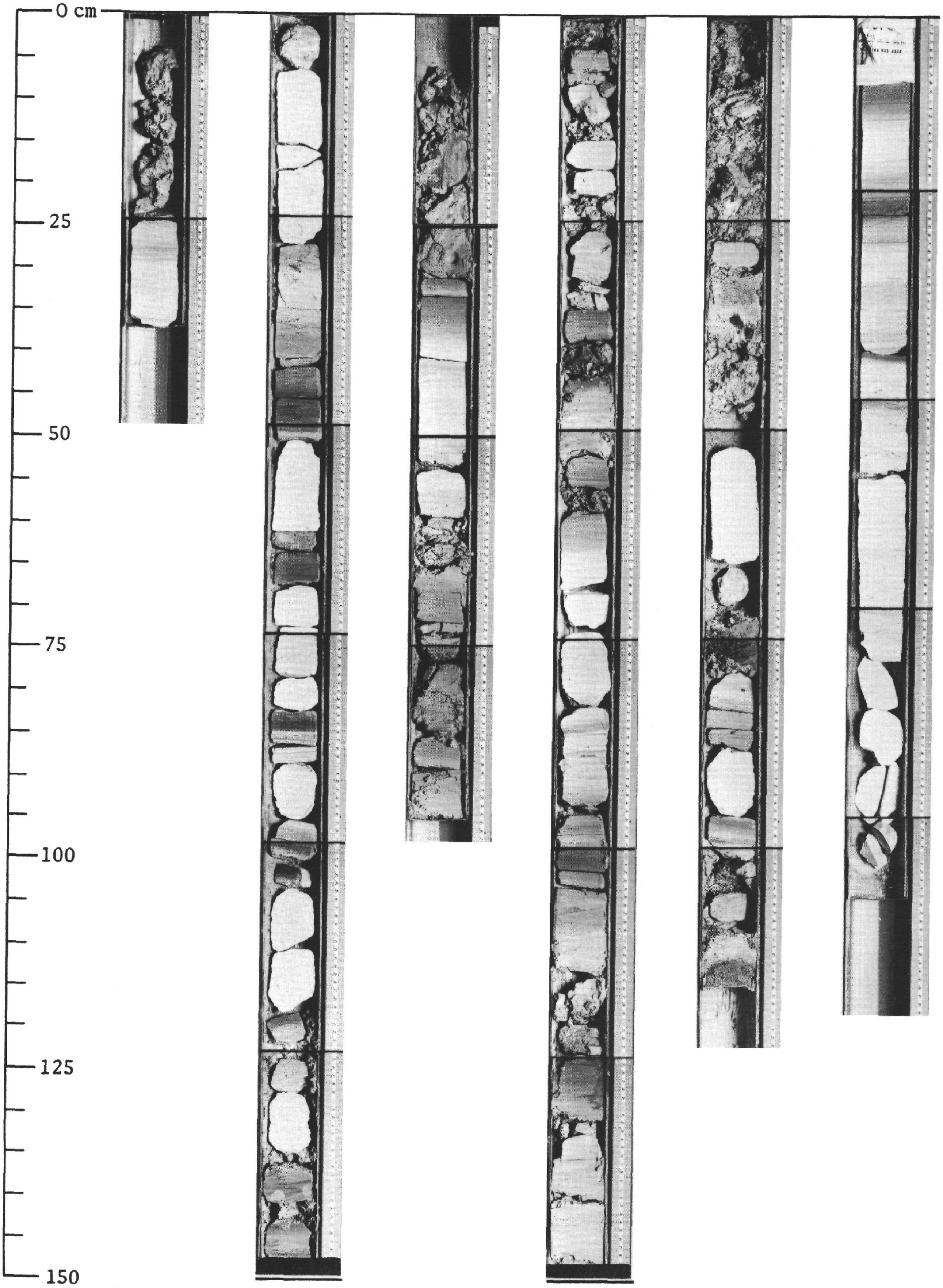
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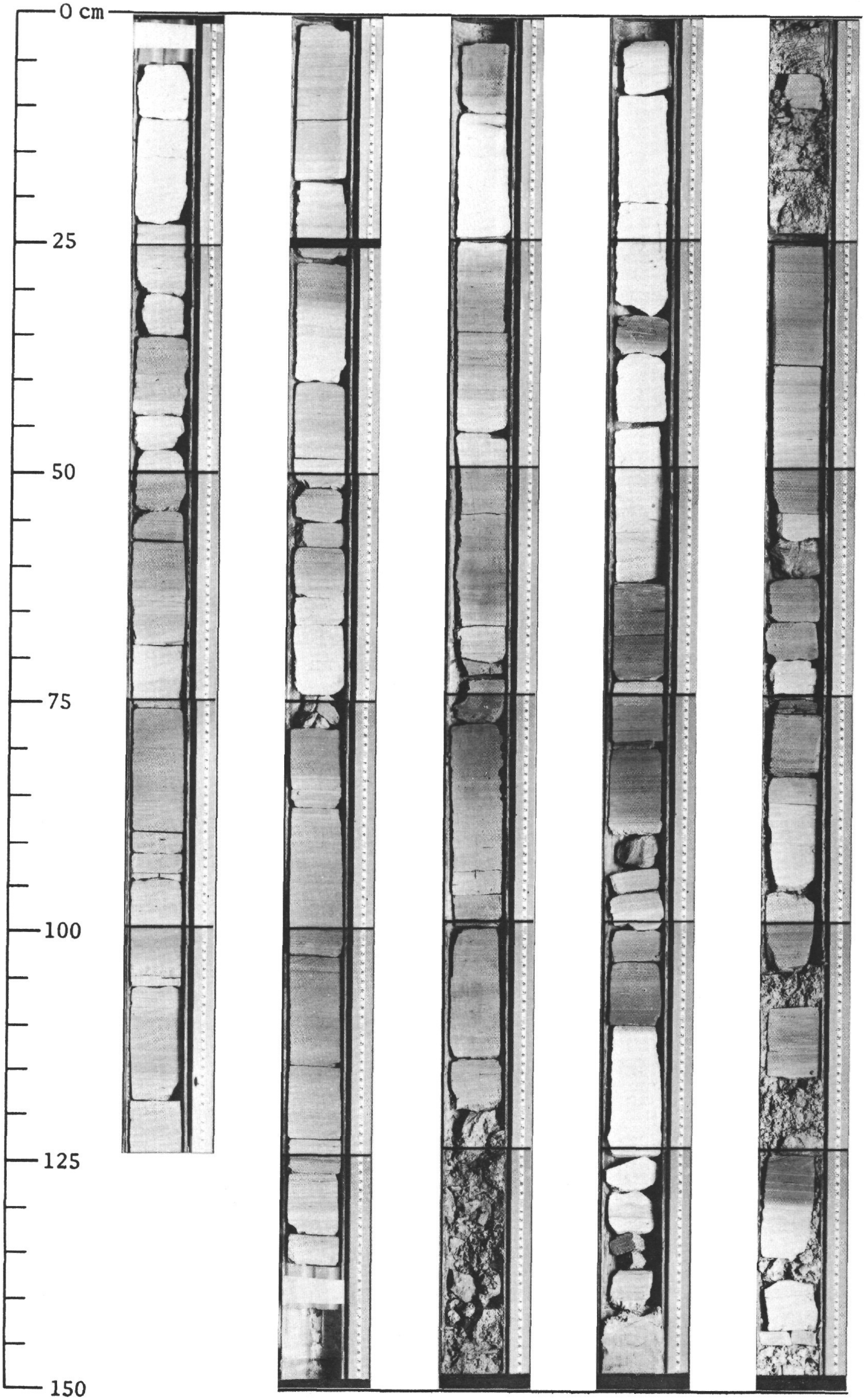

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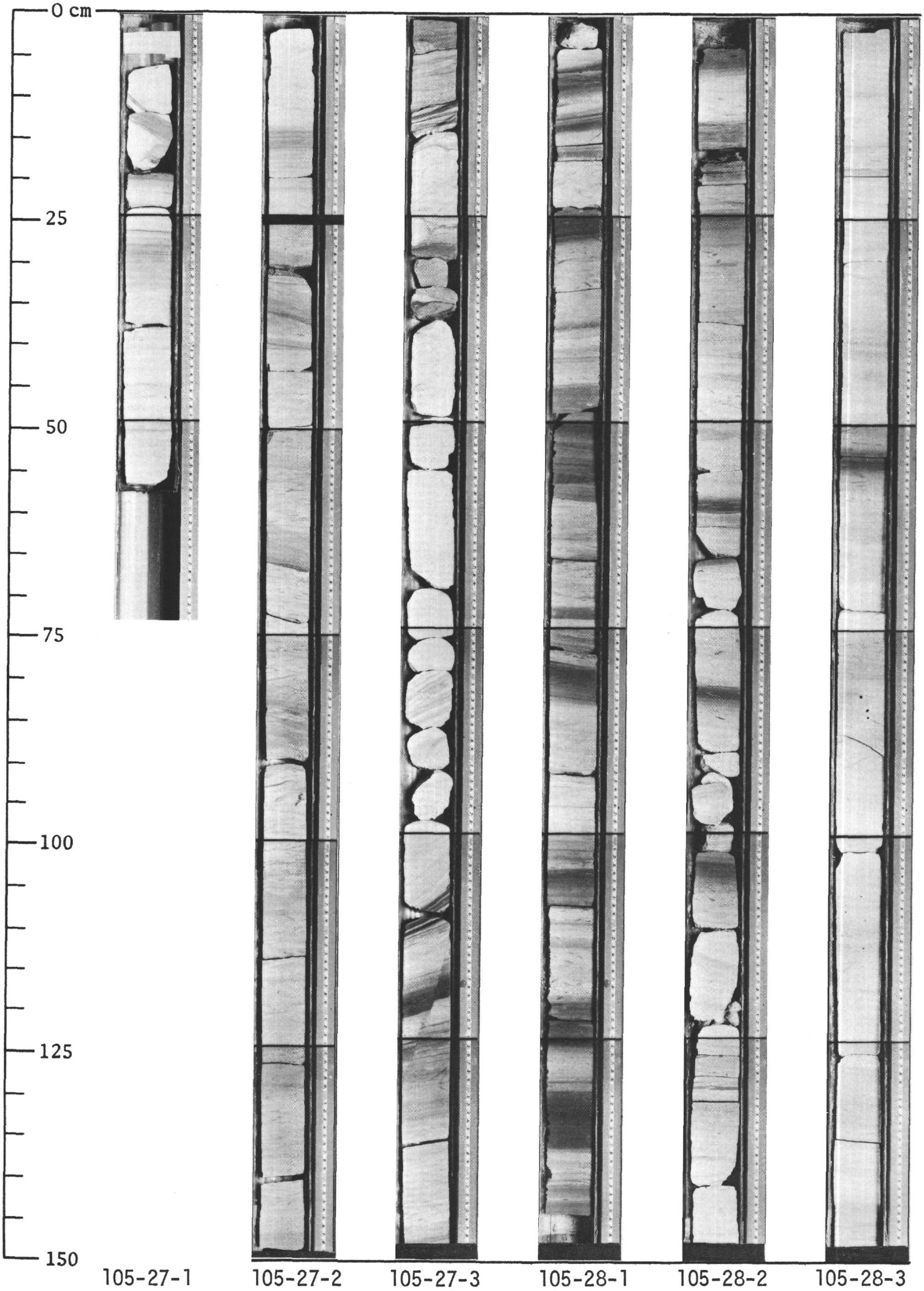
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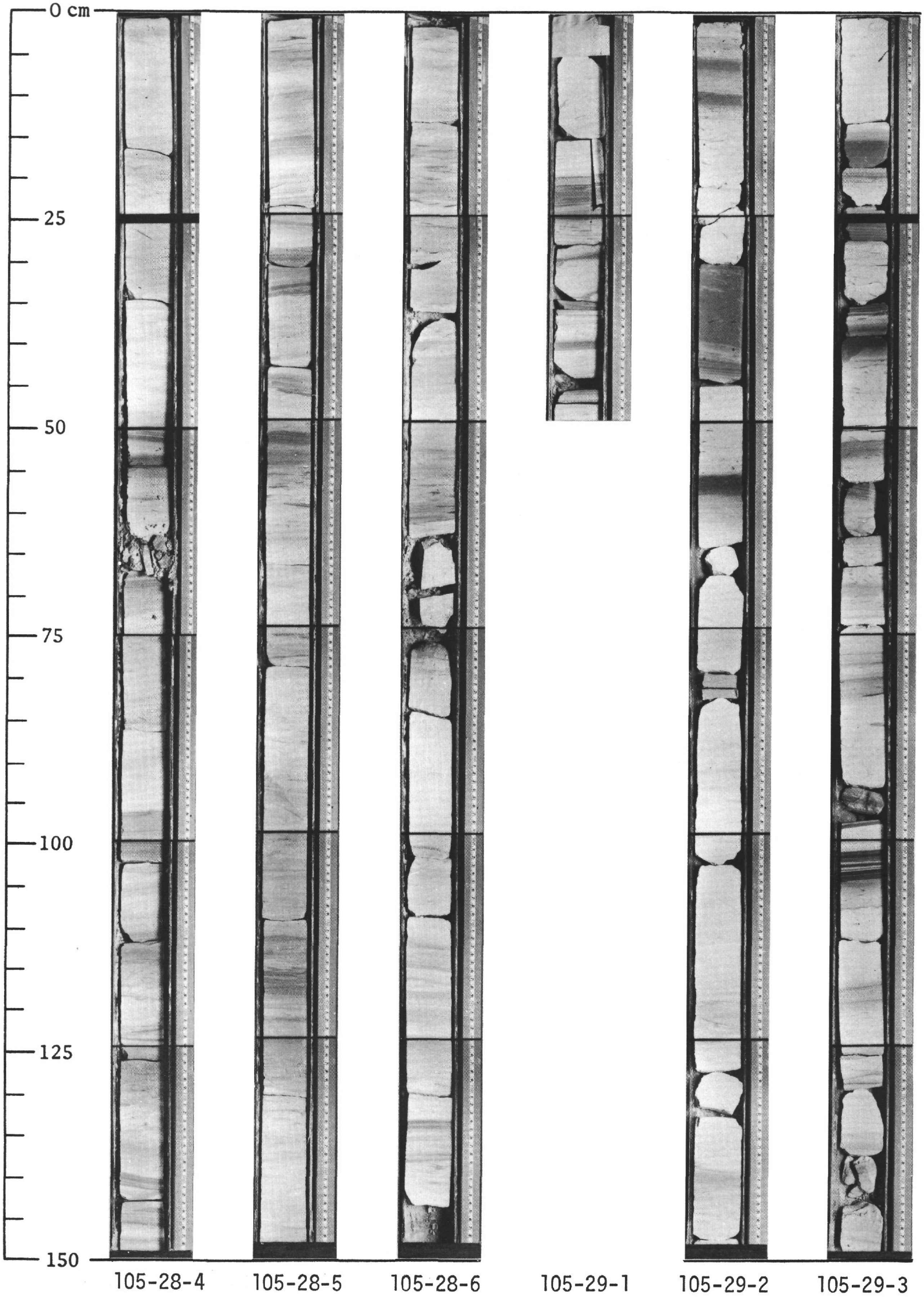
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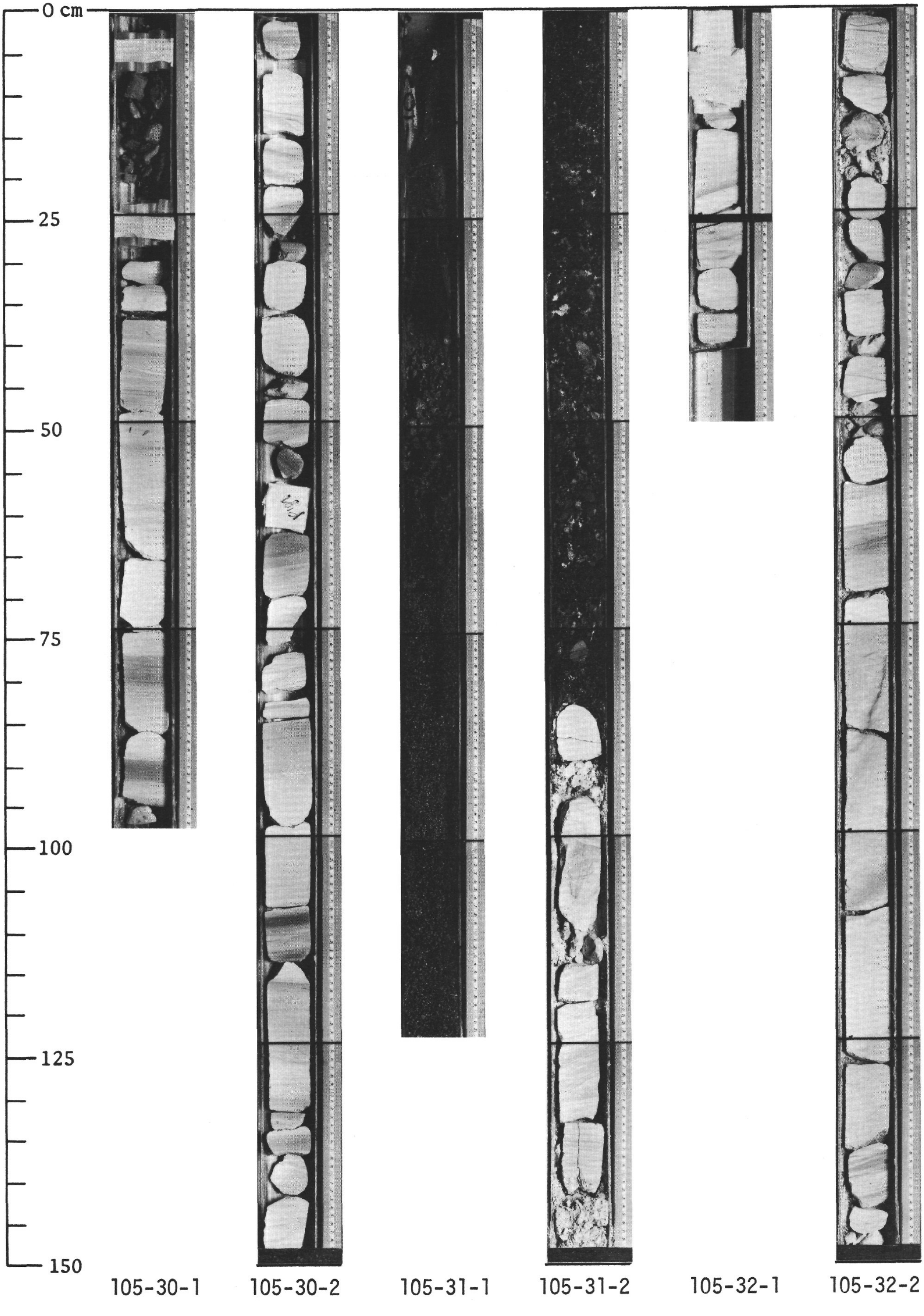
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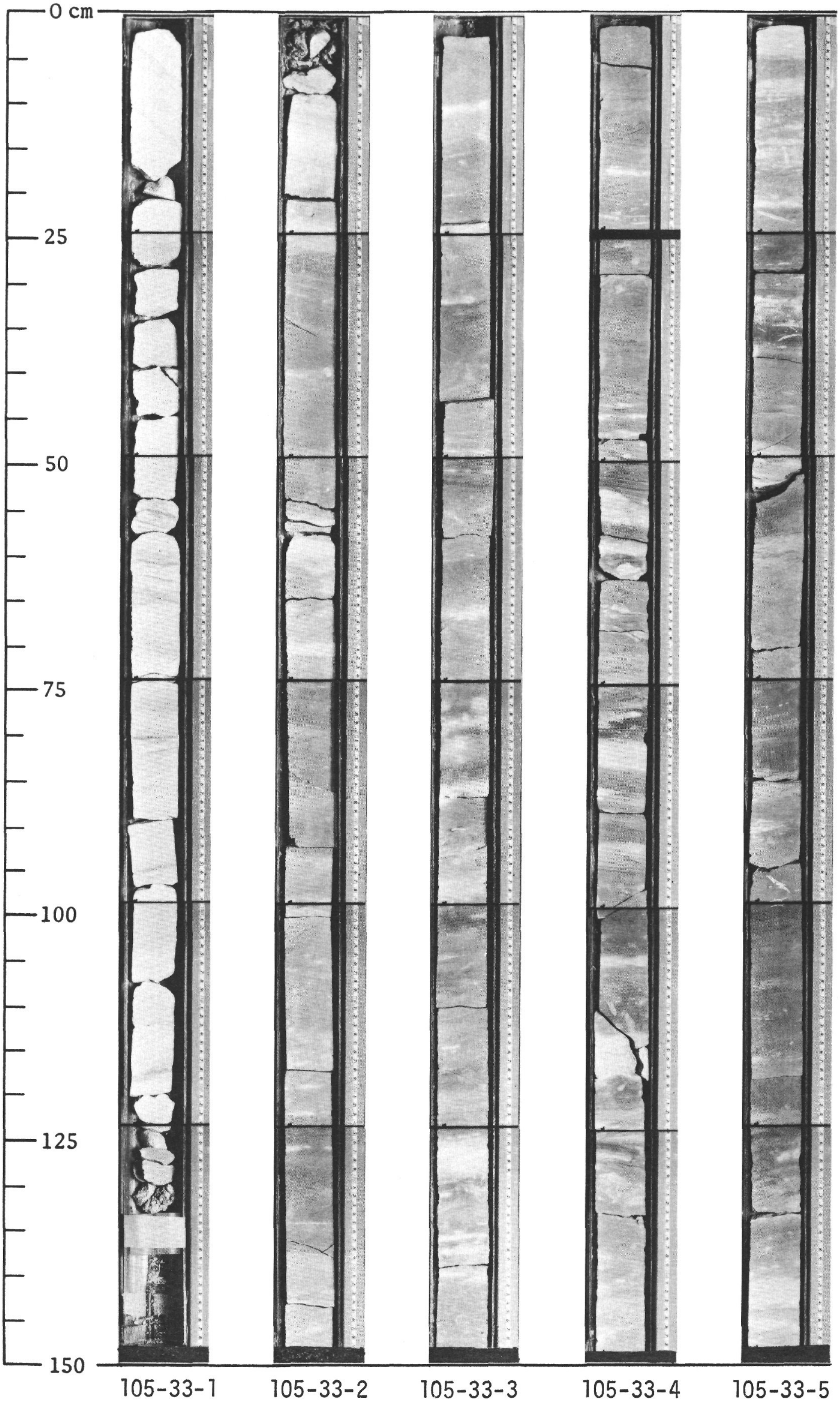
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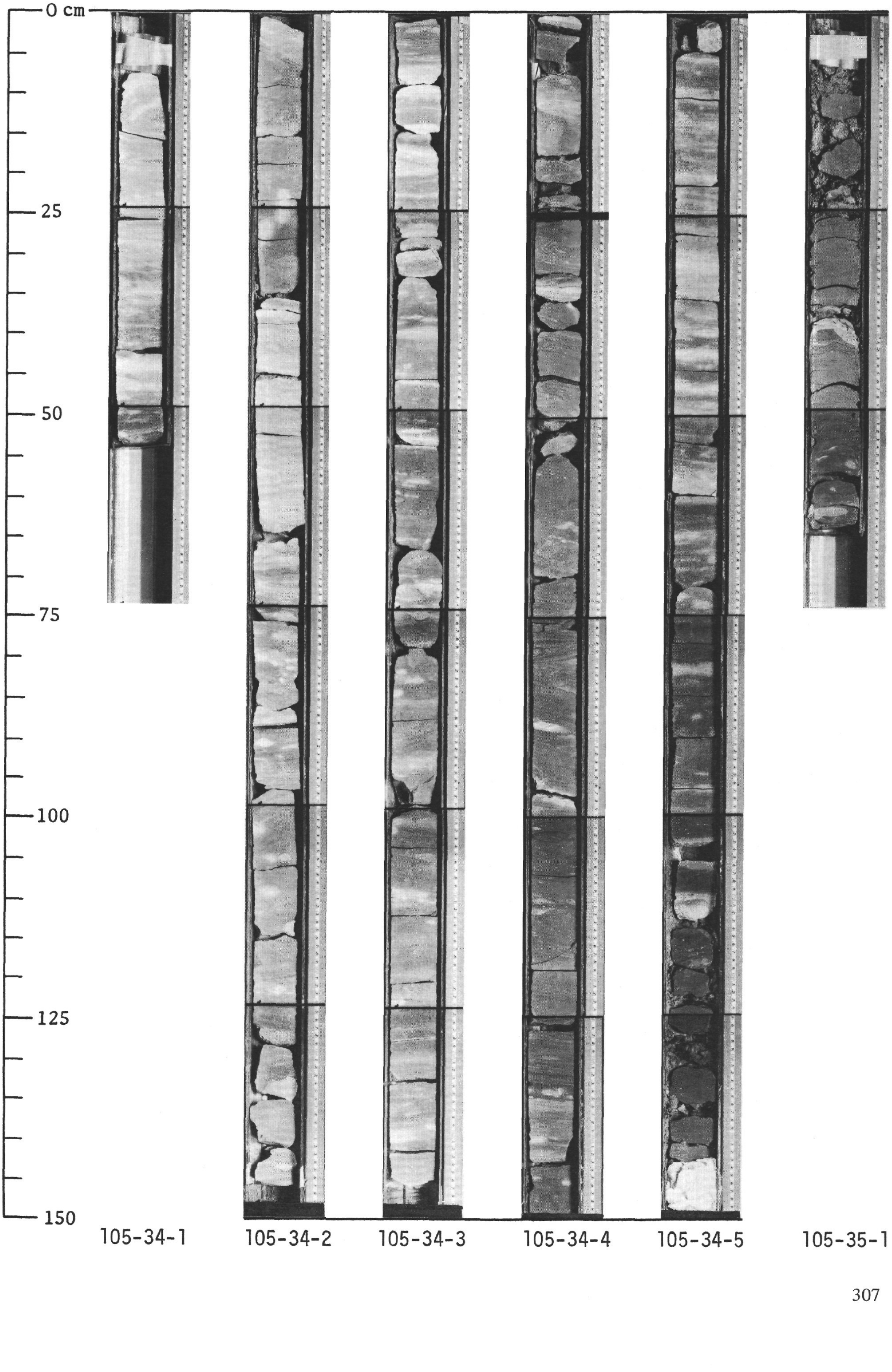
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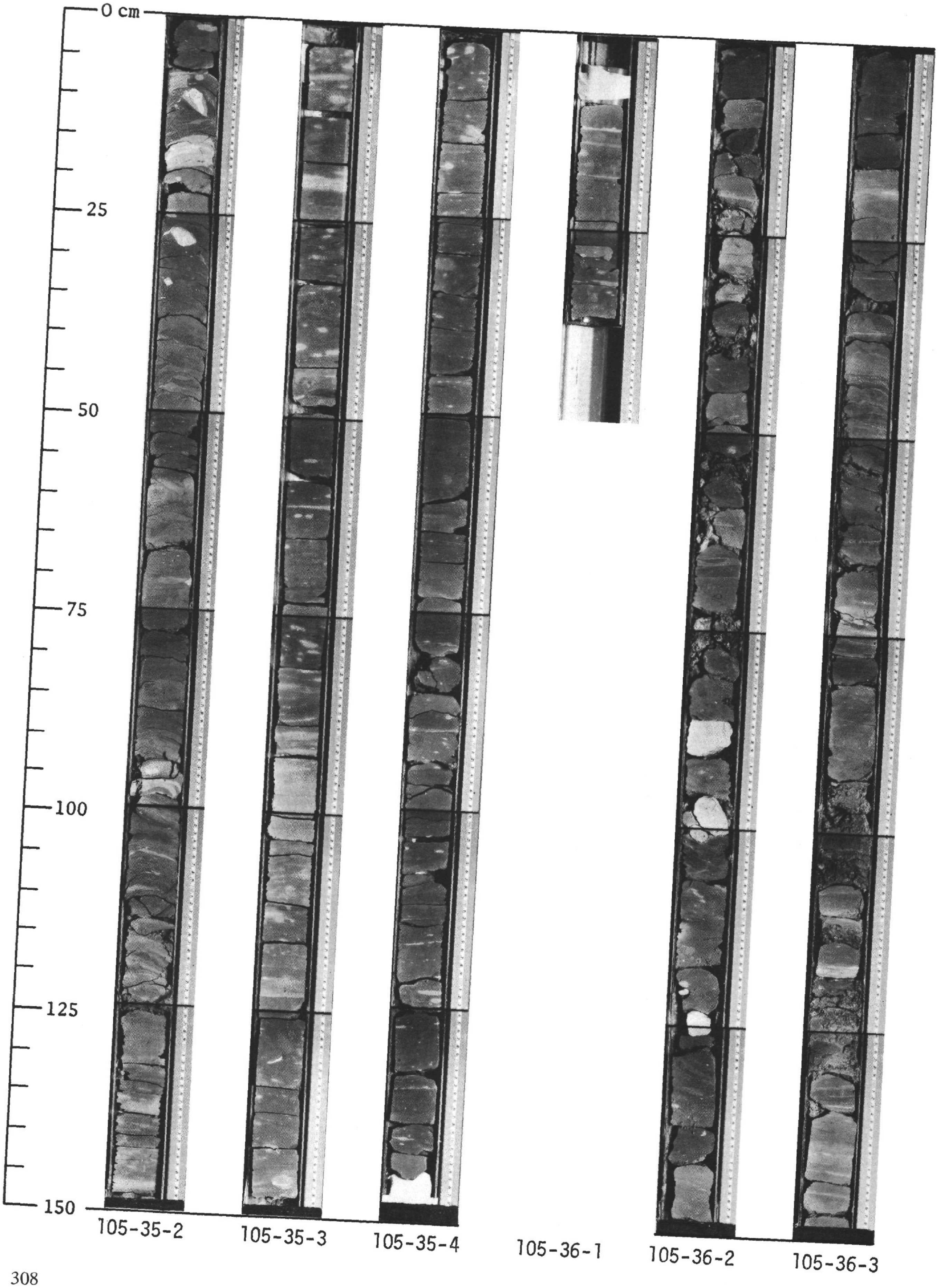
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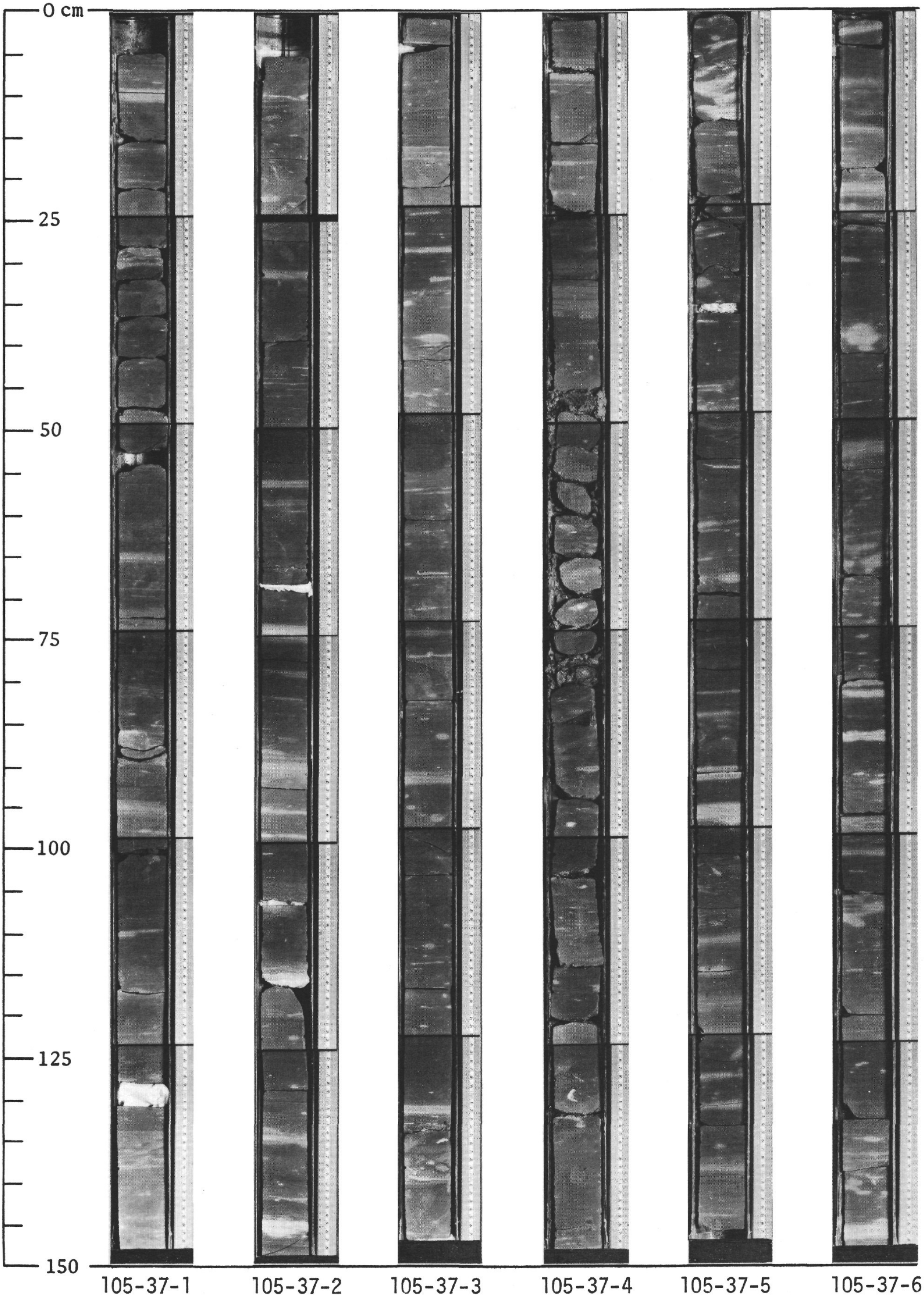
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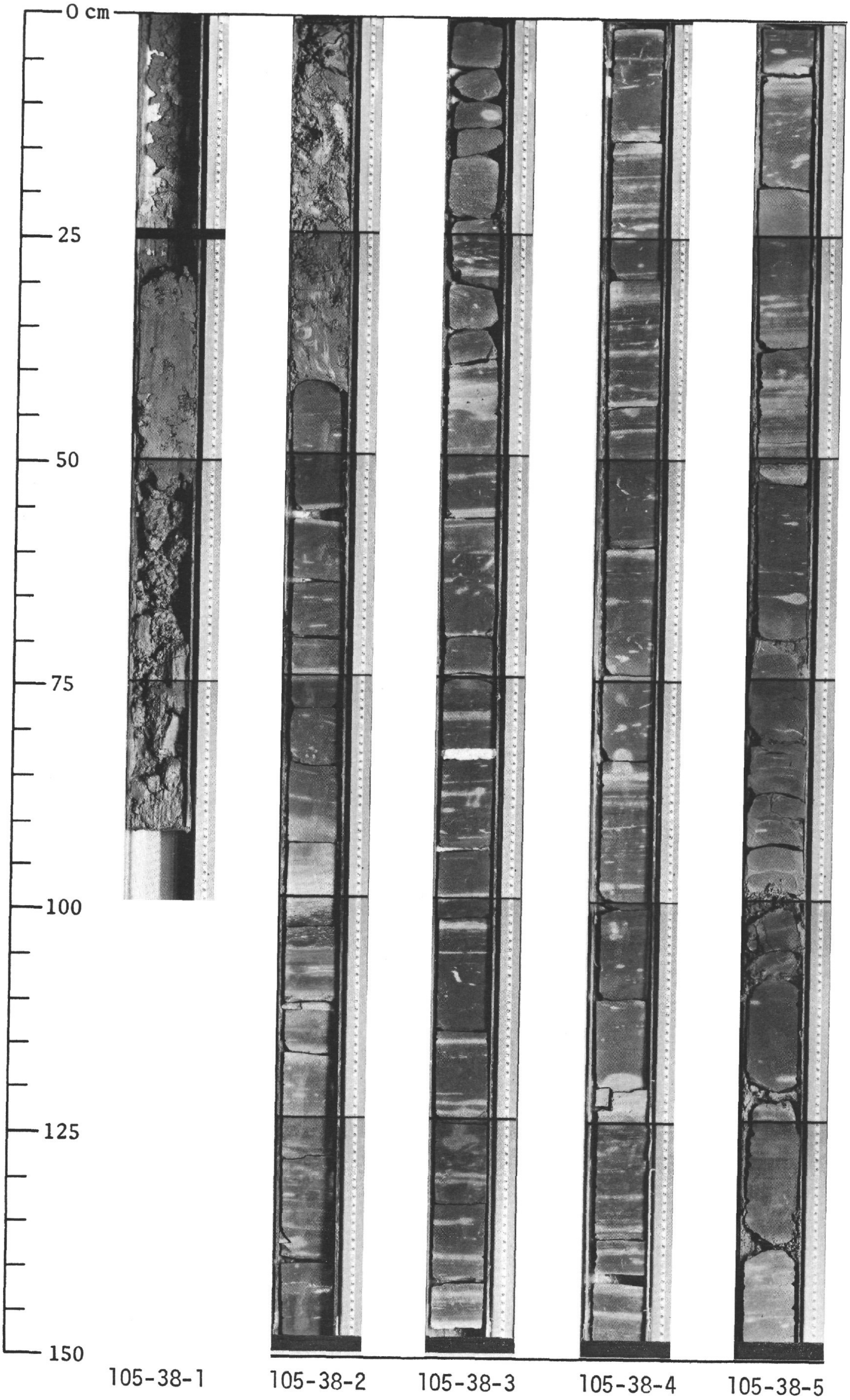
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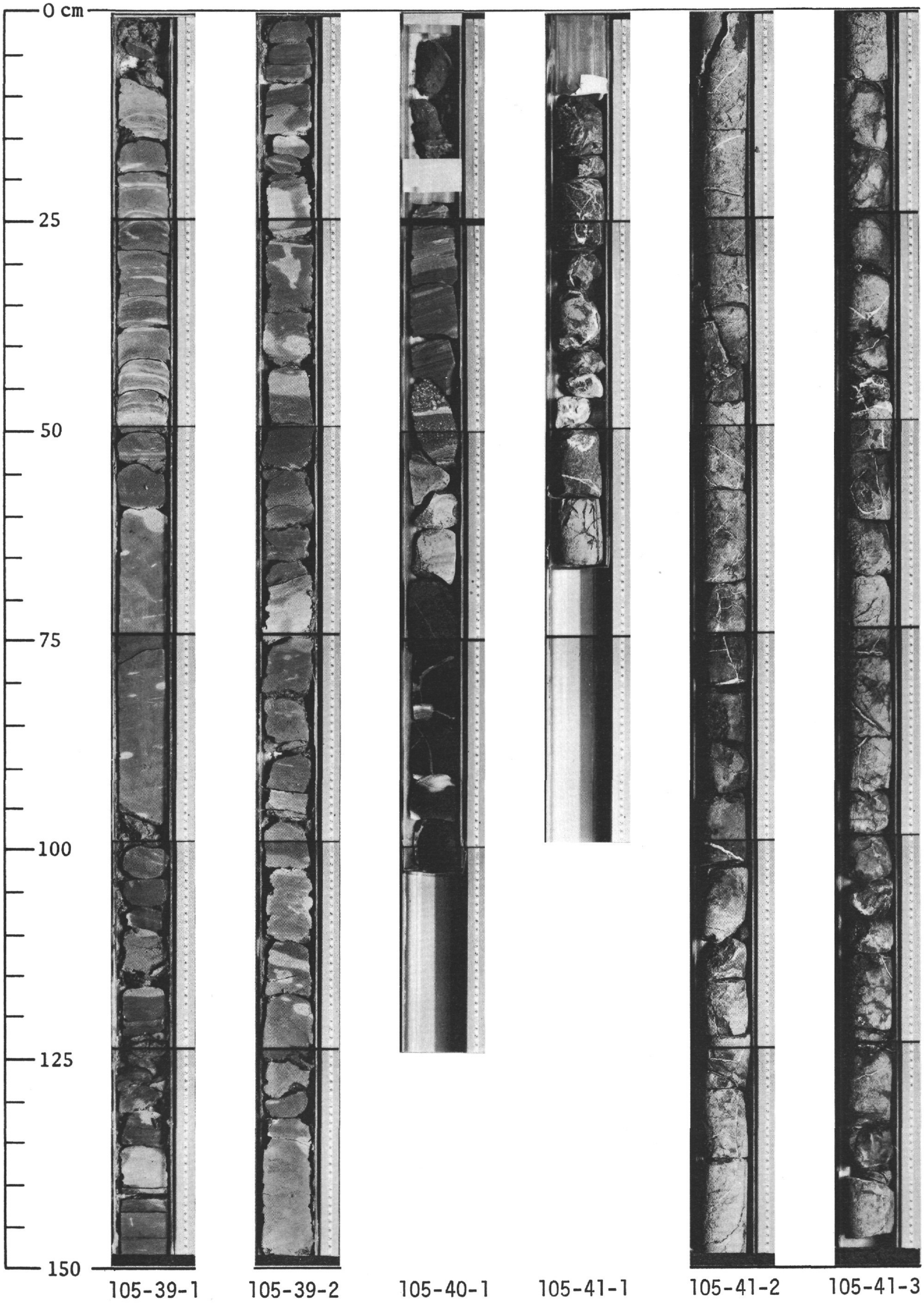
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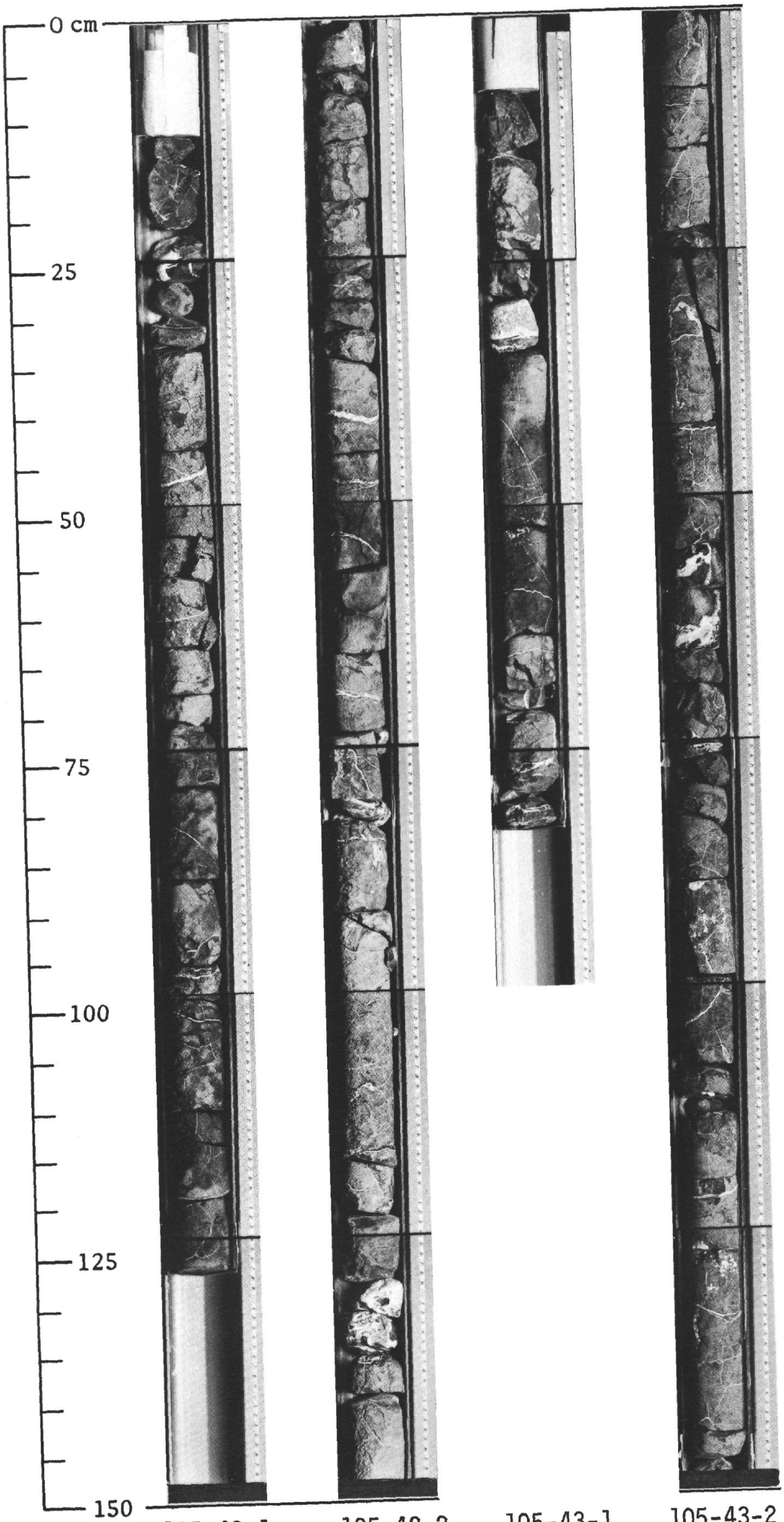
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