5. SITE 589: LORD HOWE RISE, 30°S[1]

Shipboard Scientific Party[2]

HOLE 589

Date Occupied: 12 December 1982

Date departed: 13 December 1982

Time on hole: 15.5 hr.

Position: 30°42.72′S; 163°38.39′E

Water depth (sea level; corrected m, echo-sounding): 1391

Water depth (rig floor; corrected m, echo sounding): 1401

Bottom felt (m, drill pipe): 1398.3

Penetration (m): 36.1

Number of cores: 4

Total length of cored section (m): 36.1

Total core recovered (m): 35.08

Core recovery (%): 97.2

Oldest sediment cored:
Depth sub-bottom (m): 36.1
Nature: Foraminifer–nannofossil ooze
Age: Quaternary

Basement: Not reached

Principal results: The objectives of Site 589 are those that were eventually fulfilled at Site 590, which is slightly to the south on the Lord Howe Rise. The shipboard positioning computer system failed after only four Quaternary to latest Pliocene HPC cores had been taken, to a total sub-bottom depth of 36.1 m. The section has a clear paleomagnetic polarity stratigraphy from the Brunhes Chron to the upper part of the lower Matuyama Chron. The extrapolated age for the base of the core is 2 m.y., based on an overall sedimentation rate of 18 m/m.y. The section consists of a veneer (0–0.4 m) of orange-colored foraminifer–nannofossil ooze (Subunit IA) underlain by lighter-colored Quaternary foraminifer–nannofossil ooze to nannofossil ooze (Subunit IB) to the base of the cored sequence. This unit exhibits alternations between lighter greenish intervals richer in volcanic ash and those of white to light gray ooze with less important ash. Foraminifers and calcareous nannofossils are well preserved.

OBJECTIVES

Site 589 occurs in the central part of the Lord Howe Rise (30°42′S) to the east of the crest at a water depth of 1391 m (Figs. 1 and 2). Initially, this site was selected to obtain a continuous, high-resolution Neogene–late Paleogene sequence in the transitional water mass and at relatively shallow depths as part of a vertical profile. Unfortunately the objectives were not met at this site because the onboard positioning computer failed during drilling, and the hole was terminated. Only four Quaternary cores were taken. Because of the failure of the computer, to help preserve remaining time on the cruise it was decided to core a new site (Site 590) further to the south, in the same geological setting and with the same objectives. Therefore, objectives originally intended for Site 589 are discussed in more detail in the Site 590 site chapter.

OPERATIONS

Site 588 to Site 589

Transit between sites was completely routine. Fair weather and a following current combined to help the vessel average 10.3 knots for the 304.3 mi. distance. The ship made directly for the coordinates of the site specified in the scientific prospectus. Precise site selection and preliminary surveying were not required, so the beacon (16

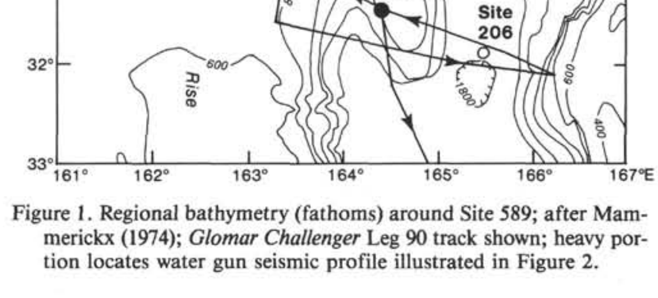

Figure 1. Regional bathymetry (fathoms) around Site 589; after Mammerickx (1974); *Glomar Challenger* Leg 90 track shown; heavy portion locates water gun seismic profile illustrated in Figure 2.

[1] Kennett, J. P., von der Borch, C. C., et al., *Init. Repts. DSDP*, 90: Washington (U.S. Govt. Printing Office).

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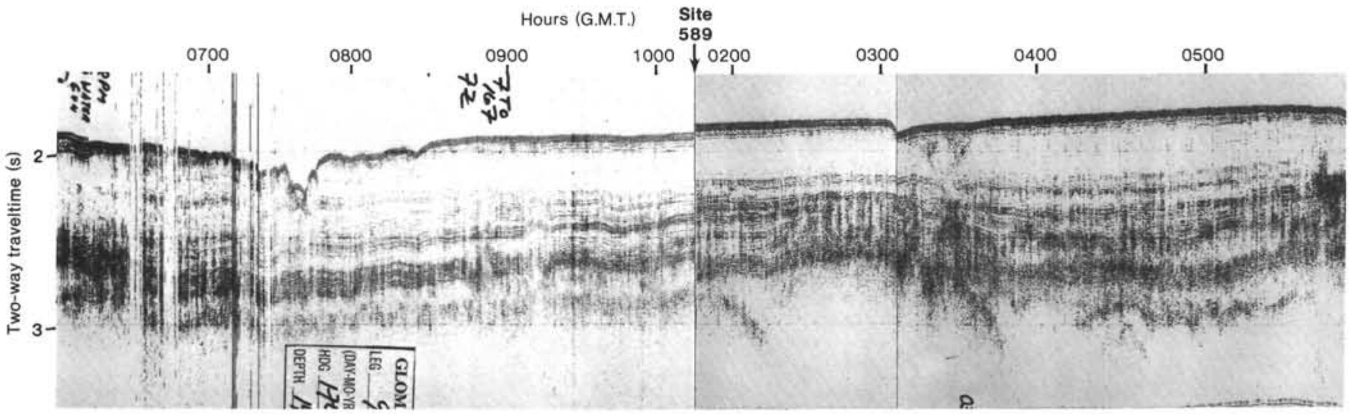


Figure 2. Water gun seismic profile (*Glomar Challenger*) near Site 589; bandpass filter 40–160 Hz.

kHz) was dropped on the first pass at 2110 hr., 12 December 1982.

Site 589: Central Lord Howe Rise

The vessel was steadied over the beacon with some difficulty owing to a bad combination of wind, current, and swell coming from three different directions. Nonetheless, the pipe trip commenced at 2255 hr. A combination short hook-up bottom-hole assembly (BHA) for both piston coring (HPC) and extended core barrel (XCB) coring was again used. The bit was lowered to 1396 m and the first 9.5 m variable-length (VL) HPC was shot at 0338 hr., 13 December, recovering 7.3 m of sediment at the mud line and officially spudding Hole 589 (Table 1). Water depth was thus determined to be 1398 m by drill pipe measurement. Four 9.5 m VLHPC cores were taken, including a successful Von Herzen heat flow measurement with Core 589-4.

As Core 5 was about to be shot, the Dynamic Positioning Computer broke down entirely. Within minutes, it became clear that the vessel had probably taken a severe offset, because the computer was providing no position reference information which could be used for manual positioning. The rig crew was given orders to recover the core barrel and immediately pull the pipe clear of the mud line. The mud line was cleared 30 min. after the computer had failed. One hour and 45 minutes after clearing the mudline the positioning computer still was not functioning so the drill string was tripped for safety. The bit arrived on deck at 1230 hr. Inspection of the drill string as it came on deck showed that no damage had been done to the pipe or BHA. Since the computer was still down at this time and the probability of an immediate repair was low, the decision was made to leave for an alternate site to the south, some 8 hr. distant. The vessel was underway for the alternate site at 1239 hr. 13 December 1982.

Table 1. Coring summary, Site 589.

Core no.	Date (Dec. 1982)	Time	Depth from drill floor (m) Top	Bottom	Depth below seafloor (m) Top	Bottom	Length cored (m)	Length recovered (m)	Percentage recovered
1	13	0410	1398.3	1405.6	0.0	7.3	7.3	7.26	99.4
2	13	0450	1405.6	1415.2	7.3	16.9	9.6	9.53	99.2
3	13	0535	1415.2	1424.8	16.9	26.5	9.6	9.39	97.8
4	13	0625	1424.8	1434.4	26.5	36.1	9.6	8.90	92.7
							36.1	35.08	97.2

LITHOSTRATIGRAPHY

Site 589 consists of one hole that was cored continuously with the HPC from 0 to 36.1 m sub-bottom. The recovered sediment sequence consists of one lithostratigraphic unit which can be divided into two subunits, distinguished by color, grain size, and composition.

Subunit IA (0 to 0.4 m sub-bottom, late Pleistocene) is a foraminifer-nannofossil ooze of grayish orange color. The grain size of Subunit IA is coarser than the remainder of the sediment sequence. The color change that separates Subunit IA from the underlying Subunit IB is a boundary that separates an upper oxidized and a lower reduced facies. The oxidized zone corresponds to Subunit IA in most other sites drilled during Leg 90.

Subunit IB (0.4 to 36.1 m sub-bottom, early Pleistocene) varies from foraminifer-nannofossil ooze to nannofossil ooze with colors of light greenish gray and pale olive to white and very light gray. Noncarbonate components observed in smear slides (see Figure 3) include traces of quartz, feldspar, heavy minerals, and sponge spicules. Volcanic glass and pyrite occur in abundances from traces up to 5%. Burrows are apparent at irregular intervals throughout this unit. Iron sulfide minerals periodically occur as dark spots and streaks throughout the entire unit.

The greenish parts of Subunit IB are characterized by a higher content of both foraminifers and volcanic glass. There appears to be a cyclic alternation between intervals of greenish sediment and intervals of white to light gray sediment. At least 39 of these "color cycles" with an average thickness of 0.9 m can be distinguished in the 36.1 m sequence of Site 589.

SEISMIC STRATIGRAPHY

Figure 4 illustrates a portion of the shipboard water gun seismic profile collected during the approach to Site 589. The uppermost two acoustic units, A and B, are directly comparable to those described for Site 588.

Site 589 was drilled to a total depth of 36.1 m, entirely within the uppermost portion of acoustic Unit A. It comprises the two lithostratigraphic subunits, IA and IB, described in the preceding section.

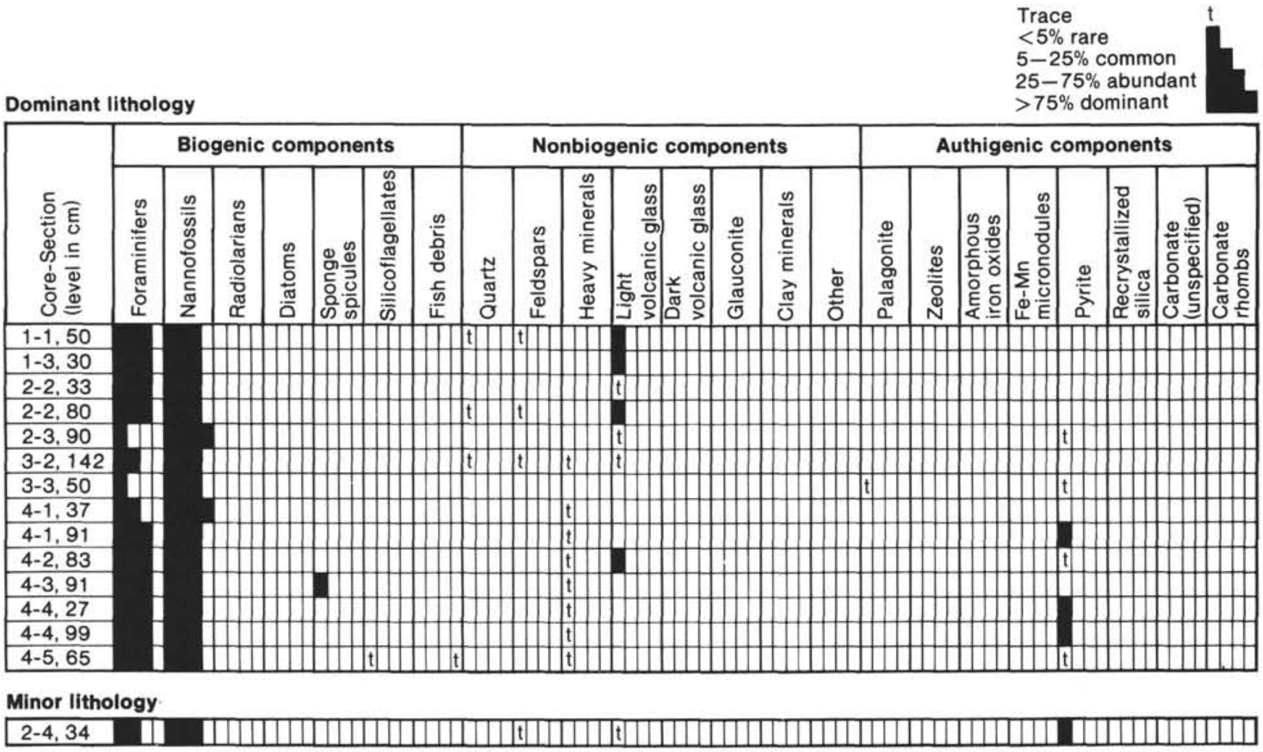


Figure 3. Smear slide summary, Site 589.

BIOSTRATIGRAPHY

Abundant and well-preserved foraminifers and calcareous nannoplankton of Quaternary to latest Pliocene age were recovered from the samples. Some tephra-glass shards were encountered in Core 589-2. Radiolarians, diatoms, and silicoflagellates were not found. For biostratigraphic correlation, see Figure 5.

Foraminifers

Planktonic Foraminifers

Four core-catcher samples were examined for foraminifers. The four cores (36.1 m) belong to the *Globorotalia truncatulinoides* Zone and the *G. truncatulinoides–G. tosaensis* overlap Zone. The fauna, besides the zonal marker, includes *Globorotalia inflata, Pulleniatina obliquiloculata, Neogloboquadrina dutertrei, Globigerinoides ruber, Globigerinoides conglobalus*, and *Globigerina bulloides. Globorotalia tumida* is rare to frequent, whereas *Sphaeroidinella dehiscens* is very rare. *G. tosaensis* is recorded in Cores 589-2 to 589-4.

Benthic Foraminifers

Benthic foraminifers were examined in the $>63\mu m$ fraction from Core 589-1 to 589-4,CC at Site 589. All samples are well preserved and benthics are frequent. The species change little through the four Quaternary samples: most common are *Uvigerina peregrina, U. hispido-costata, Melonis barleeanum, Cassidulina laevigata carinata, Heterolepa kullenbergi, Stilostomella lepidula, Cibicides wuellerstorfi*, and *Oridorsalis umbonatus*. Glacial–interglacial cycles may be discernible in the alternating abundance peaks of *U. peregrina* and cibicides plus *Cassidulina carinata*.

Calcareous Nannoplankton

Some reworking of both Pleistocene and late Pliocene nannoplankton occurs throughout the four cores. Samples 589-1-1, 0–1 cm and 589-1-2, 0–1 cm contain abundant *Emiliania huxleyi* and are placed in the late Pleistocene *Emiliania huxleyi* Zone (NN21). Sample 589-4,CC contains common *Discoaster brouweri* and probably should be placed in the latest Pliocene *Discoaster brouweri* Zone (NN18). The zonal boundary (NN20/NN19) cannot be recognized.

Of some interest are fluctuations of *Scyphosphaera* species, which are fairly common in levels 589-4-5, 589-3,CC to 589-3-5, and 589-2-3.

PALEOMAGNETISM

Paleomagnetic properties of the short sequence recovered were similar to those for Site 588. An upper zone of a few meters of slightly oxidized brownish sediment gave relatively strong intensities (typically 2 μG). Below Core 589-1 the sediment is whiter, with gray streaks and patches (attributed to iron sulfides) and intensities of about 0.1 μG.

Shore-based NRM measurements on two specimens per section defined a clear polarity stratigraphy (Fig. 6). The Jaramillo Event is not recorded. The inferred over-

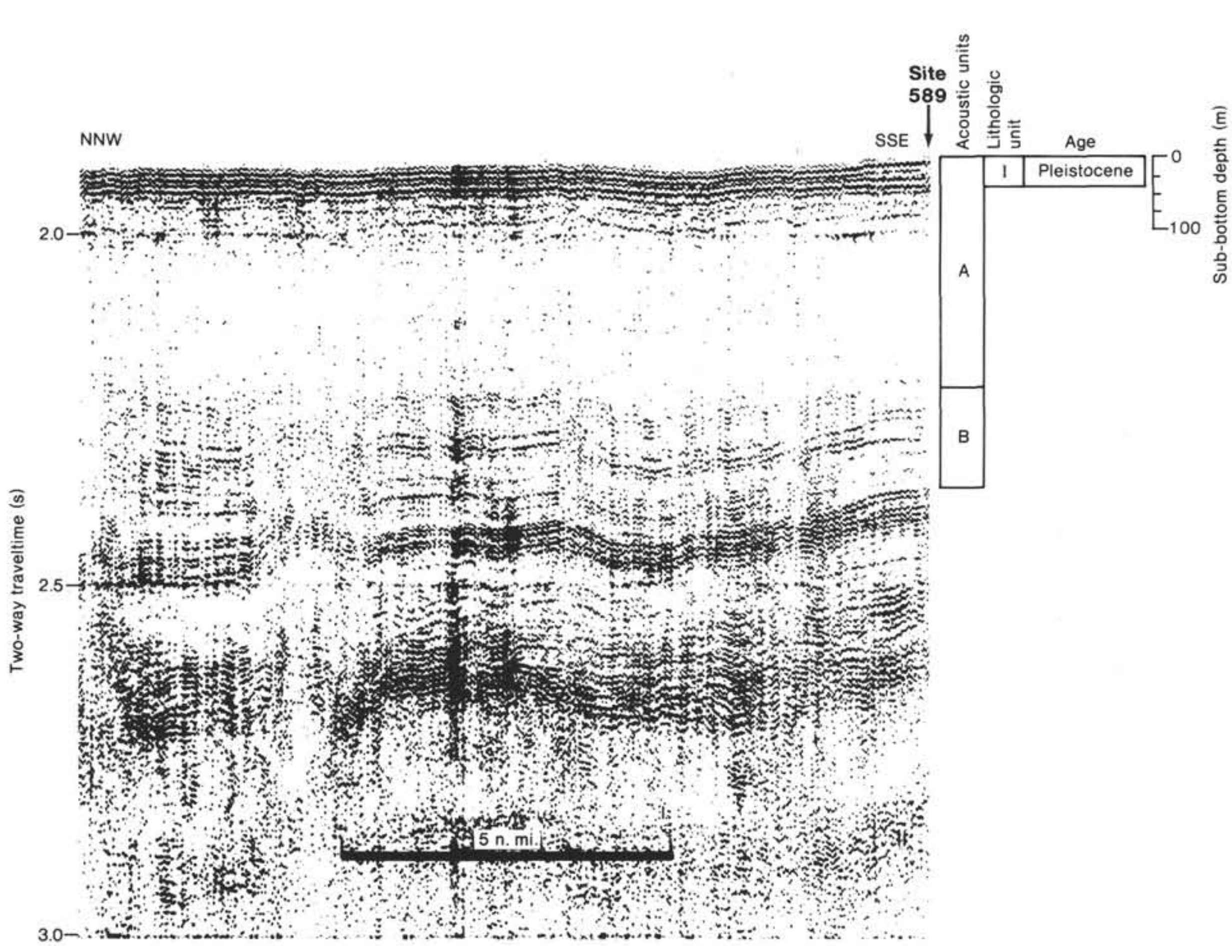


Figure 4. Comparison of acoustic Unit A with lithological Unit I cored at Site 589; shipboard water gun seismic profile collected during site approach; depths in meters estimated by assuming a sediment sound velocity of 2000 m/s.

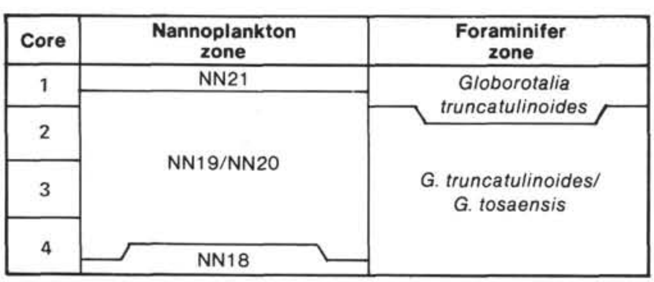


Figure 5. Biostratigraphy of Site 589. Section barren of radiolarians.

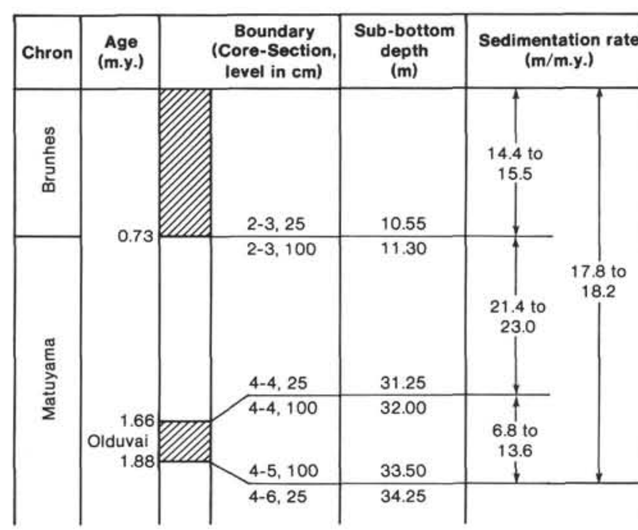


Figure 6. Paleomagnetic stratigraphy for Hole 589 based on NRM data. Estimated bottom age is 2 m.y. The Jaramillo Subchron is not resolved.

all sedimentation rate is 18 m/m.y. Statistics for this data set are:

Geometric mean intensity = 0.159 μG
Scalar mean inclination = 5.7 $\pm$48.6°s.d.
Axial dipole inclination = $-$49.9°
Mean angle between repeats = 3.0°

Shipboard long-core and subsample NRM measurements agreed with the interpretation of Figure 6 but were much less precise. No absolute orientation data were obtained. There are no prominent intensity spikes.

Initial shipboard measurements on fresh specimens from Cores 589-1 and 589-2 gave intensities which were typically two to three times higher than those recorded subsequently in the laboratory after storing samples for 6 mo. This was despite very careful precautions to minimize dessication. Corresponding changes in direction of remanence were not significant for determining polarity. Intensity decay during storage of wet sediments is quite common, though it is not usually so large as noted here. It seems unlikely that small changes in water content could have had such a pronounced effect. Thus the random dispersion of small interstitial grains, and perhaps post-coring diagenesis, may also play important roles.

SUMMARY AND CONCLUSIONS

Coring at Site 589 was a disappointment because failure of the onboard ship-positioning computer forced abandonment of the hole. It was decided to move to a new location (Site 590) further south in order to save some of the lost time.

The four cores obtained provide a Quaternary to latest Pliocene sediment record 36.1 m in thickness. The section exhibits a clear polarity stratigraphy from the Brunhes Chron to the upper part of the Matuyama Chron. The extrapolated age for the base of the core is 2 m.y., based on an overall sedimentation rate of 18 m/m.y. The base of the section contains both *Globorotalia truncatulinoides* and *G. tosaensis* and Pliocene calcareous nannofossils. The sequence contains rich and well-preserved calcareous microfossils.

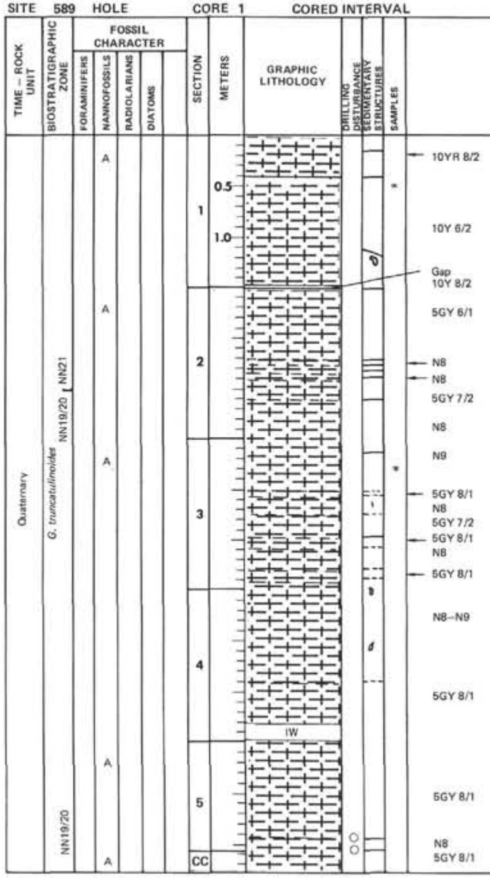
The sediment section consists of a veneer (0–0.4 m) of orange-colored foraminifer–nannofossil ooze (Subunit IA) underlain by lighter-colored Quaternary foraminifer–nannofossil ooze to nannofossil ooze (Subunit IB) to the base of the cored sequence. This unit exhibits alternations between lighter greenish intervals and white to light gray ooze.

REFERENCE

Mammerickx, J. L., Chase, T. E., Smith, S. M., and Taylor, I. L., 1974. *Bathymetry of the South Pacific.* IMR Technical Reports, Scripps Institution of Oceanography, La Jolla, California.

Date of Acceptance: 1 December 1983

SITE 589 HOLE CORE 1 CORED INTERVAL



LITHOLOGIC DESCRIPTION

FORAMINIFER NANNOFOSSIL OOZE, soft, grayish orange (10YR 7/4) clearly coarser than the remainder of the core.

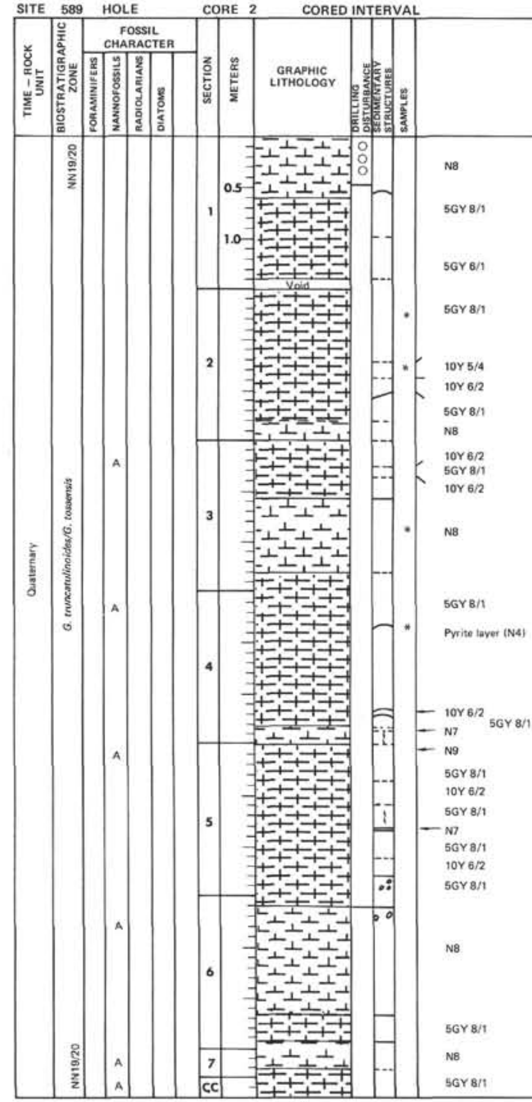
FORAMINIFER NANNOFOSSIL OOZE
Section 1: soft, to 120 cm pale olive (10Y 6/2), base pale greenish yellow (10Y 8/2) near 125 cm burrow (10Y 5/4), 135–145: gray spots (→ iron sulfide).
Section 2–base: soft, white (N9) and very light gray (N8) to light greenish gray (5GY 8/1) color variations, gray (N6–N5) spots in white parts of the sections (→iron sulfide).

Greenish parts → + volcanic ash(?).

SMEAR SLIDE SUMMARY:

	1, 50	3, 30
	D	D
Composition:		
Quartz	T	–
Feldspar	T	–
Volcanic glass	R	R
Foraminifers	A	A
Calc. nannofossils	A	A

SITE 589 HOLE CORE 2 CORED INTERVAL



LITHOLOGIC DESCRIPTION

FORAMINIFER NANNOFOSSIL OOZE, soft, light olive (10Y 5/4) to light greenish gray (5GY 8/1).

NANNOFOSSIL OOZE, soft, white (N9) to very light gray (N8), dark (N5) spots→ iron sulfide.

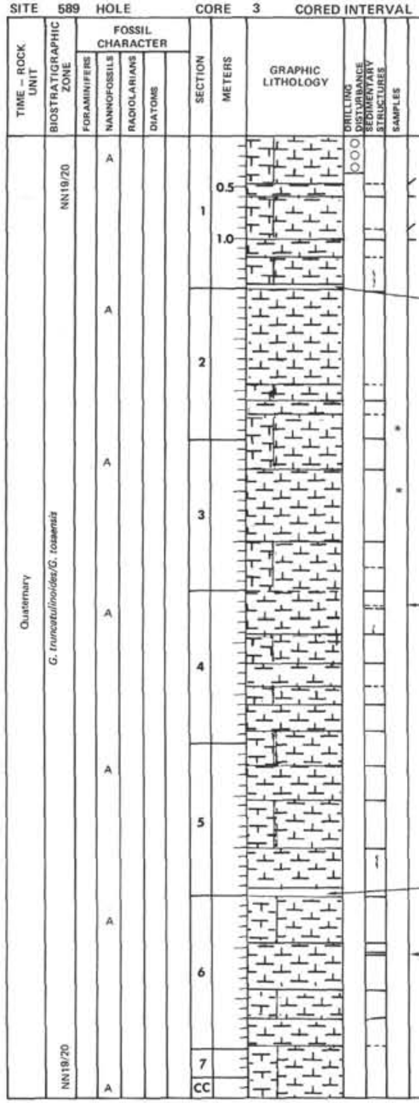
Cyclic(?) variations between FORAMINIFER NANNOFOSSIL OOZE (= → + volcanic ash?) and NANNOFOSSIL OOZE.

Burrowing apparent at irregular intervals.

SMEAR SLIDE SUMMARY:

	2, 33	2, 80	3, 90	4, 34
	D	D	D	M
Composition:				
Quartz	–	T	–	–
Feldspar	–	T	–	T
Volcanic glass	T	R	T	T
Pyrite	–	–	T	R
Foraminifers	A	A	R	C
Calc. nannofossils	A	A	D	A

SITE 589 HOLE CORE 3 CORED INTERVAL



LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE, soft, light greenish gray (5GY 8/1) to pale olive (10Y 6/2).

NANNOFOSSIL OOZE, soft, white (N9) to very light gray (N8).

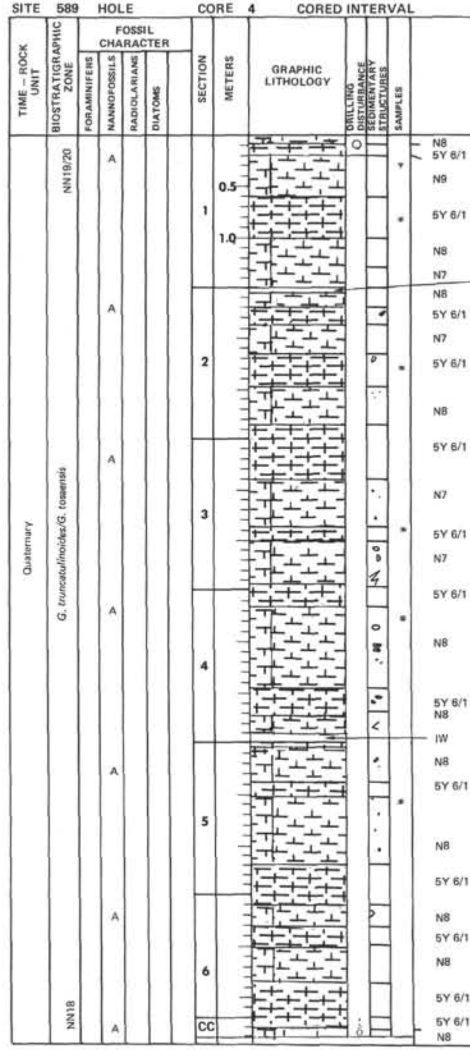
Dark (N6–N5) spots in the whole core.

Cyclic variations between FORAMINIFER-BEARING NANNOFOSSIL OOZE (+ volcanic ash?) and NANNOFOSSIL OOZE.

SMEAR SLIDE SUMMARY:

	2, 142	3, 50
	D	D
Composition:		
Quartz	T	–
Feldspar	T	–
Heavy minerals	T	–
Volcanic glass	T	–
Palagonite	–	T
Pyrite	–	T
Foraminifers	C	R
Calc. nannofossils	A	D

SITE 589 HOLE CORE 4 CORED INTERVAL

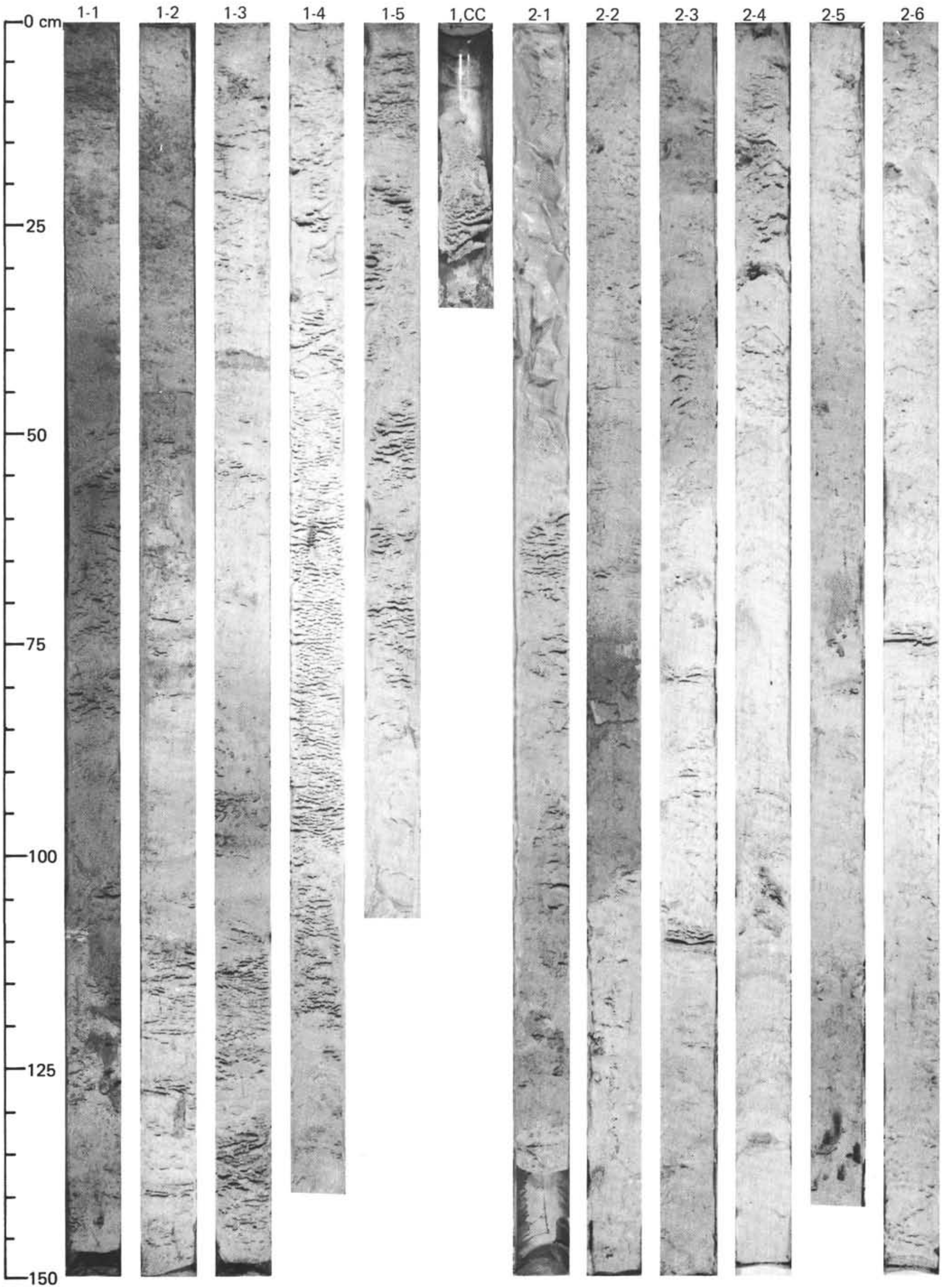


LITHOLOGIC DESCRIPTION

FORAMINIFER-BEARING NANNOFOSSIL OOZE, altering soft, very light gray (N8) and finer, light olive gray (5Y 6/1) dominent lithologies with fairly sharp contacts. Dark gray (N3) iron sulfide blebs and streaks occur periodically. Burrowing apparent at irregular intervals. Light olive gray (5Y 6/1) parts richer in forams.
→ FORAMINIFER NANNOFOSSIL OOZE

SMEAR SLIDE SUMMARY:

	1, 57	1, 91	2, 83	3, 91	4, 37	4, 99	5, 65
	D	D	D	D	D	D	D
Composition:							
Quartz	–	–	–	–	–	–	T
Heavy minerals	T	T	T	T	T	T	T
Volcanic glass	–	–	R	–	–	–	–
Pyrite	–	R	T	–	R	R	T
Foraminifers	C	A	A	A	A	A	A
Calc. nannofossils	D	A	A	A	A	A	A
Sponge spicules	–	–	–	R	–	–	T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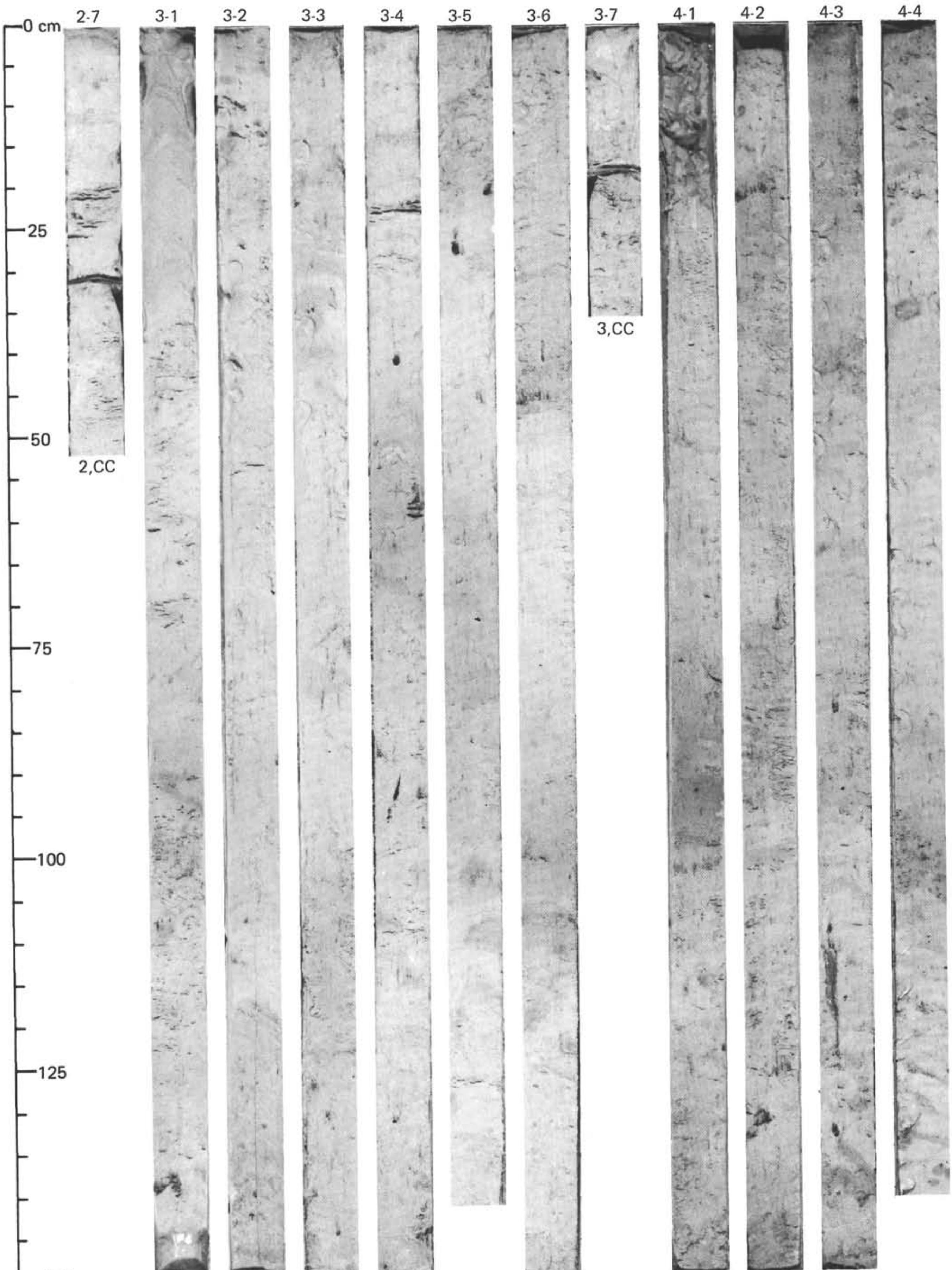
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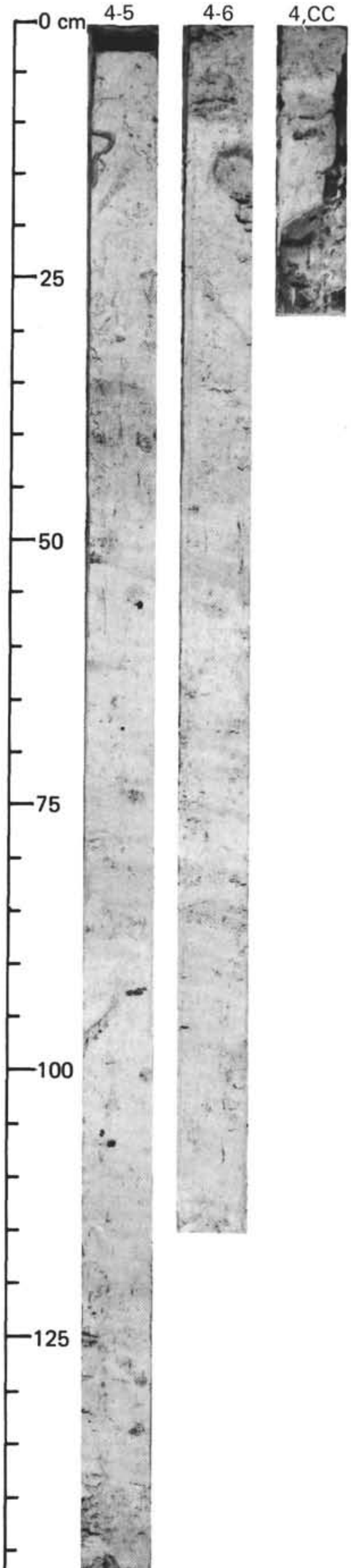
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