4. SITE 537[1]

Shipboard Scientific Party[2]

SITE 537

Date occupied: 1928 hr., 11 January 1981

Date departed: 2336 hr., 13 January 1981

Time on hole: 2 days, 4.13 hr.

Position: 23°56.01′N; 85°27.62′W

Water depth (sea level; corrected m, echo-sounding): 3123

Water depth (rig floor; corrected m, echo-sounding): 3133

Bottom felt (m, drill pipe): 3148.0

Penetration (m): 225.0

Number of cores: 17

Total length of cored section (m): 153.5

Total core recovered (m): 15.87

Core recovery (%): 10

Oldest sediment cored:
Depth sub-bottom (m): 187.5
Nature: Coarse-grained arkose
Age: Early Cretaceous
Measured velocity (km/s): 4.6

Basement:
Depth sub-bottom (m): 197.0
Nature: Metamorphic rock, phyllite
Velocity range (km/s): 4.4

Principal results: See Summary section.

SUMMARY

Site 537 was located on the top of a small knoll about 25 km north of the Campeche Escarpment in the vicinity of Catoche Knoll (Fig. 1). The site was one of three sites primarily designed to test basement and to determine its nature, age, and origin. In spite of limited penetration of only 225 m and poor recovery, we drilled an extremely diverse suite of rocks including metamorphic basement, alluvial to shallow-marine terrigenous clastic rocks, shallow-water carbonates, and a cap of pelagic sediments. The primary results of this site are summarized in Figure 2.

Five major lithologic sequences were drilled as follows:

1. mainly deep-water nannofossil ooze (0–92.5 m), early Pliocene to early Aptian (spot-cored)
2. limestone (skeletal-oolitic grainstones and packstones) (92.5–149.8 m), Cretaceous (Valanginian-Berriasian)
3. shallow-marine dolomitic marl, arkosic sandstone, and muddy dolomite (149.8–168.5 m), Berriasian
4. nonmarine(?) arkosic conglomerate and sandstone (168.5–197.0 m); earliest Cretaceous (Berriasian)
5. phyllite (197.0–216.0 m); early Paleozoic metamorphic age (~500 Ma) (see Dallmeyer, this volume)

The Cretaceous-Tertiary pelagic sequence is devoid of turbidites and shows low rates of deposition and numerous hiatuses. From the Maestrichtian on, the area was thus deep-water but elevated above the abyssal plain. A peculiarity of this site as well as Site 536 is the nearly total lack of Late Cretaceous deposits. We cannot decide if they were eroded during the Maestrichtian, if they were never deposited because of intensive current activity throughout the Late Cretaceous, or if they slid off the fault block when it was tilted. The last explanation would require major faulting near the end of the Cretaceous.

The underlying unit consists of 58 m of limestone with predominantly neritic biota such as crustose (blue green?) algae, echinids, thick-shelled molluscs, and ooids in a packstone-to-grainstone fabric. Mixed with the neritic grains in more muddy portions of the rock are calpionellids and very thin-shelled bivalves of planktonic origin. We interpret this limestone as a deposit of the deep photic zone at the outer margin of a carbonate platform that developed gradually from the underlying shallow-water clastic environment. However, we recovered only 5% of this formation and observed no contacts with the overlying pelagic sediments and the underlying littoral sediments. It is possible, therefore, that, analogous to Site 536, the limestones represent tongues of platform talus in deep-water sediments (not recovered) and that the mixture of planktonic and neritic biota is a result of reworking.

The Lower Cretaceous clastic sequence resting on basement is about 44 m thick. It begins with Berriasian varicolored, very coarse-grained arkoses with bentonite beds. These are overlain by gray, finer-grained, and better-sorted arkosic sandstones, passing upward into quartzose dolomites and marls with marine fossils. The con-

[1] Buffler, R. T., Schlager, W., et al., *Init. Repts. DSDP*, 77: Washington (U.S. Govt. Printing Office).

[2] Richard T. Buffler (Co-Chief Scientist), Institute for Geophysics (formerly Marine Science Institute), The University of Texas at Austin, Austin, Texas; Wolfgang Schlager (Co-Chief Scientist), School of Marine and Atmospheric Science, University of Miami, Miami, Florida (present address: University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149); Jay L. Bowdler, Union Oil Company of California, Houston, Texas; Pierre H. Cotillon, Département de Géologie, Université Claude Bernard, 69622 Villeurbanne Cedex, France; Robert B. Halley, Branch of Oil and Gas Resources, U.S. Geological Survey, Denver, Colorado; Hajimu Kinoshita, Department of Geophysics, Chiba University, Chiba 260, Japan; Leslie B. Magoon III, U.S. Geological Survey, Menlo Park, California (present address: U.S. Geological Survey, 3475 Deer Creek Road, Palo Alto, California 94304); Charles L. McNulty, Department of Geology, University of Texas at Arlington, Arlington, Texas; James W. Patton, Marathon Oil Company, Littleton, Colorado; Kenneth A. Pisciotto, Scripps Institution of Oceanography, University of California at San Diego, La Jolla, California (present address: Sohio Petroleum, 50 Fremont Street, San Francisco, California 94105); Isabella Premoli Silva, Istituto di Paleontologia, Università di Milano, Milano, Italy; Otmara Avello Suarez, Oceanological Institute, Havana, Cuba; Margaret M. Testarmata, Institute for Geophysics (formerly Marine Science Institute), The University of Texas at Austin, Austin, Texas; Richard V. Tyson, School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, United Kingdom; David K. Watkins, Department of Geology, Florida State University, Tallahassee, Florida.

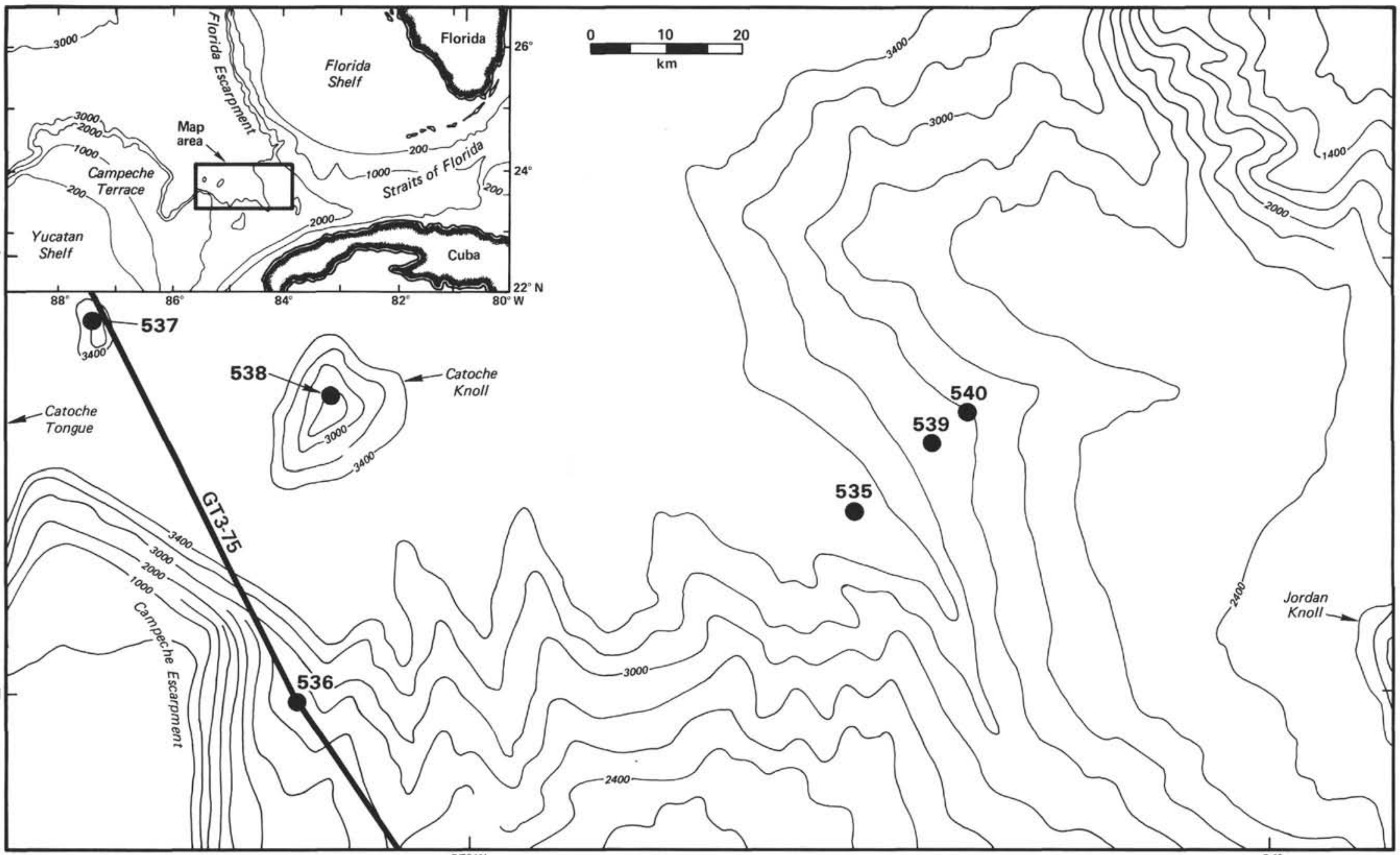


Figure 1. Location map of Leg 77 sites in the western Straits of Florida.

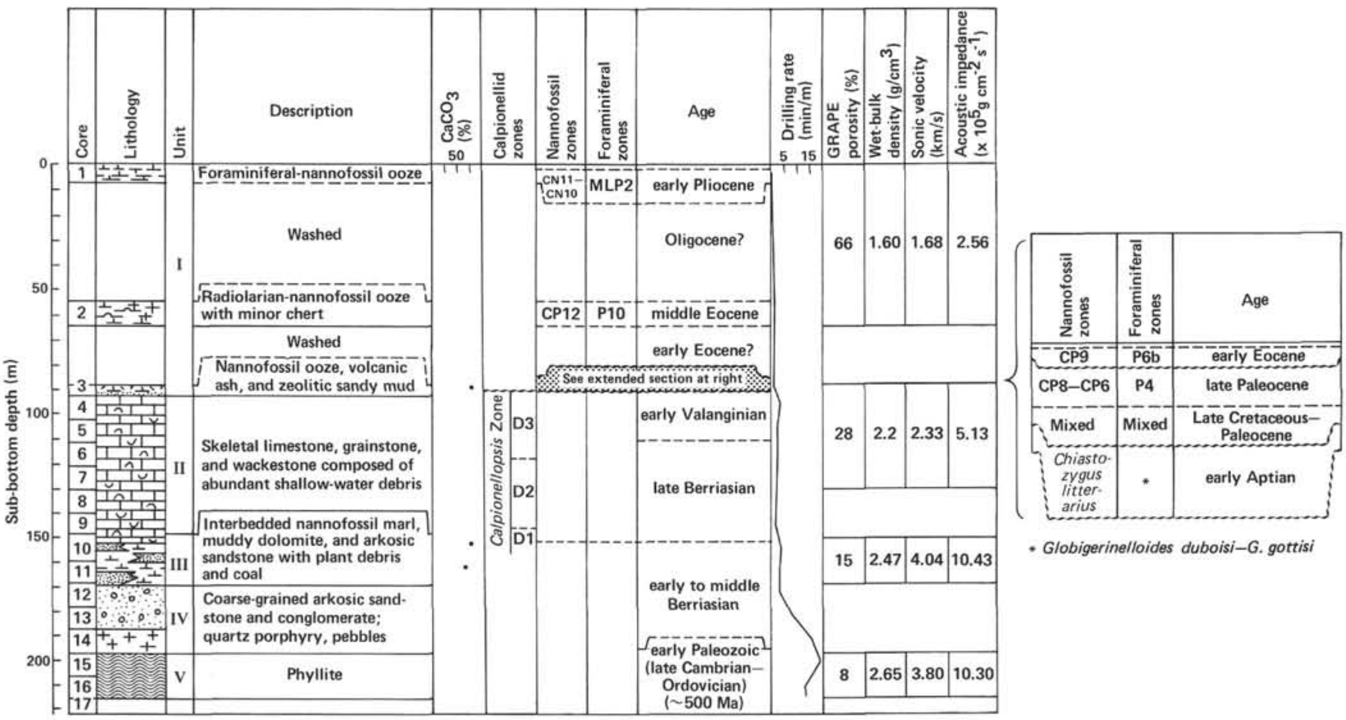


Figure 2. Stratigraphic summary of Site 537. See Introduction and Explanatory Notes chapter for lithologic symbols.

tact between red arkoses and gray arkoses was not recovered, but a similar grain assemblage of red and white feldspars and quartz suggests that it may be gradational. The rocks are interpreted as a transgressive sequence that changes upward from alluvial arkoses to shallow-marine, nearshore sandy deposits. A similar sequence of red beds with bentonite, sandstone, and dolomite makes up the Todos Santos Group in Belize and Guatemala and has been drilled at the base of Cretaceous carbonates in several wells on Yucatan.

The basal phyllites with thin, gently dipping, graded beds of sandstone-siltstone have a metamorphic age of late Cambrian (~500 Ma) and form part of a pre-Mesozoic rifted continental basement or transitional crust.

BACKGROUND AND OBJECTIVES

The crust beneath the deep southeastern Gulf of Mexico is postulated to be rifted and attenuated continental crust formed during the early evolution of the deep Gulf basin (Buffler et al., 1980, 1981). Both thickness and refraction velocities of this "transitional crust" are intermediate between continental and oceanic crust. In particular, the crust is thicker and its velocities are lower than the inferred oceanic crust in the deep central Gulf to the north. On regional seismic reflection data, this crust is very complex. In places there is a strong acoustic basement that is inferred to represent true igneous-metamorphic basement. This basement often appears as large tilted fault blocks with adjacent basins filled with thick sedimentary sequences. In other places, tilted blocks seem to consist of older (prerift?) sediments and thick rift sequences that have been truncated at prominent unconformities and appear to form part of the faulted basement complex.

Neither crystalline basement or its early sediment cover have been sampled in the southeastern Gulf of Mexico, but considerable variation might be expected based on comparison with adjacent areas such as Yucatan and Florida. Many of the tilted blocks are postulated to represent fragments of old continental basement, perhaps similar to the Precambrian-Paleozoic igneous and metamorphic rocks that underlie Florida and Yucatan. Some of the prerift layered blocks may represent Paleozoic sedimentary rocks, whereas some of the rift sequences may be equivalent to the extensive Triassic–Early Jurassic rift basins that occur all along the east coast of the United States and into the northern Gulf coast and Mexico. Much of the basement could consist of early Mesozoic volcanic rocks similar to those that occur in the subsurface of central Florida. One of the main objectives, therefore, of Leg 77 was to drill several holes into this basement complex in order to provide some clues as to the nature, age, and origin of both crystalline basement as well as its early sediment cover.

Site 537 was one of three sites designed to test basement in an area where it occurs near the seafloor and has only a thin (200–300 m) sedimentary cover. This area occurs along the western part of the deep southeastern Gulf just northeast of the Campeche Escarpment in the vicinity of Catoche Knoll (Fig. 1). The site itself is located on the top of a small knoll about 25 km north of the Campeche Escarpment and just northeast of the mouth of Catoche Tongue (Fig. 1). The knoll stands about 300 m above the level of the flat-lying abyssal gulf.

The site was chosen on the basis of the interpretation of seismic Line GT3-75, which crosses the eastern flank of the knoll (Fig. 3). The knoll is thought to represent

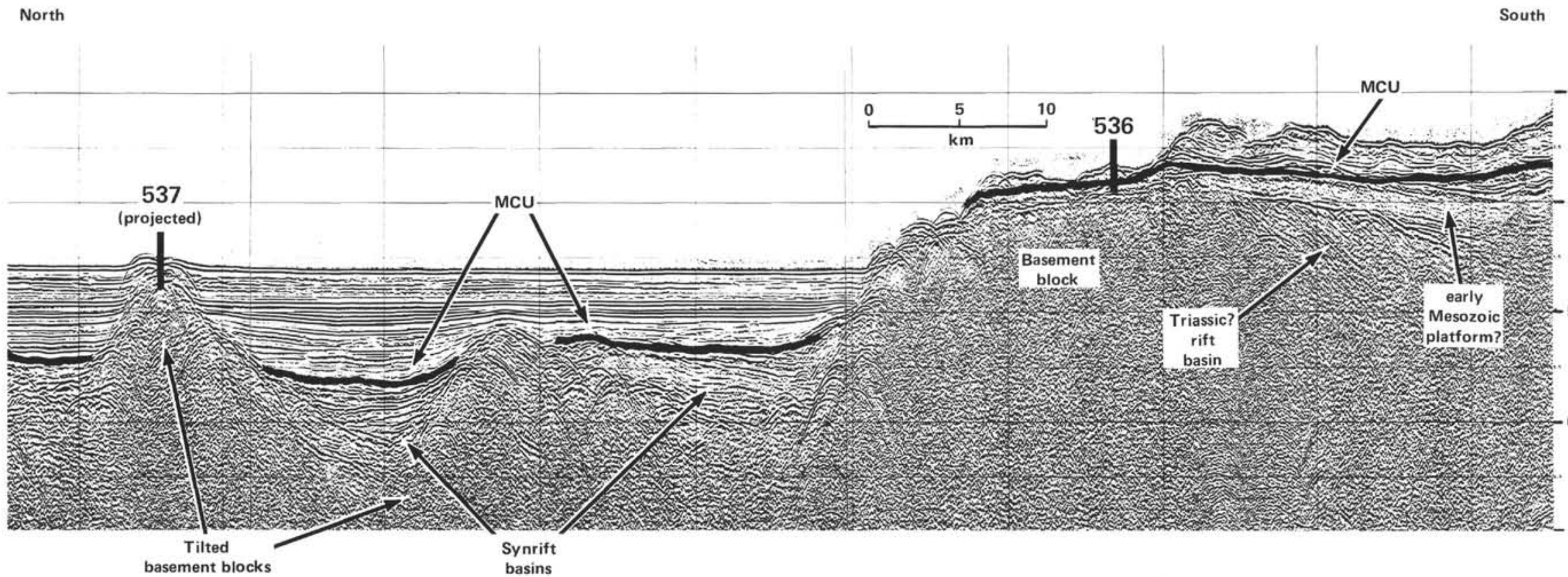


Figure 3. Regional seismic Line GT3-75 showing geologic setting of Sites 536 and 537. MCU = mid-Cretaceous unconformity. See Figure 1 for location of line.

the uplifted end of one of several tilted basement blocks (Fig. 3). This interpretation is based partly on the apparent asymmetry of the blocks and the apparent sediments (synrift?) filling the basins between the blocks. This particular knoll was chosen because basement appeared to be very close to the seafloor and to be overlain by only a minimal thickness of sediment, probably only several hundred meters.

It was anticipated that most of the sediments would be Tertiary pelagic sediments deposited above the general level of the turbidite plain, similar to sediments from nearby Site 96 (Worzel, Bryant, et al., 1973). It was also anticipated that a thin sequence of older sediments might be present on top of the basement. For safety reasons, the actual site was located near the crest of the knoll.

OPERATIONS

Site 537 (ENA-14B) is located on an isolated knoll just northeast of the Campeche platform (Fig. 1). *Glomar Challenger* approached the site on 11 January afternoon, profiling with 12 kHz, 3.5 kHz, and air guns slightly west of existing seismic Line GT3-75, to cross over the knoll near its flat top rather than on the relatively steep flanks where spudding might be difficult. The plateau on top of the knoll turned out to be only 500 m across. The ship ran over it and dropped the beacon on the first pass at 1928 hr., 11 January, then continued to profile down the other flank and returned for final positioning. At 2024 hr., the ship was in position. The bottom-hole assembly was made up with a F94CK bit and run in. Either because of irregular, small-scale topography or because of slight inaccuracies in the precision depth recorder, we succeeded only in the third attempt to core the mudline. Winds were up to 40 knots when Hole 537 was finally spudded on 12 January, 0650 hr., in 3148 m water depth. According to the operations plan worked out at DSDP, the upper section was to be sampled by HPC at the end of the drilling operation. We thus spot-cored until hard material was encountered. The second core was taken at 54.5–64 m; continuous coring started at 88 m in firm ooze, chalk, and chert. Drilling in the underlying limestone (92.5–149.5 m) and sandstone (159–197 m) was fast, but recovery was down to less than 10% even with low pump pressures (which may indicate alternation of soft and lithified material in the formations). Drilling rates decreased and hole conditions deteriorated when fractured basement rocks were cut at 197 m. Although the hole was flushed with guar before every core, the bit was plugged and the pipe stuck 10 m off bottom after Core 17 had been recovered at 1600 hr., 13 January. The pipe broke loose at 1635 hr. after several pulls to near 500,000 lbs. It was decided to terminate drilling. The plan to HPC the upper section was also dropped because a continuous Tertiary sequence had been recovered at nearby Site 536 and because shallow layers of chert and cemented ash made it impossible to reach the early Tertiary and Cretaceous sediments. Pipe was on deck and the site abandoned by 2336 hr., 13 January, and *Glomar Challenger* got underway for Site 538.

A summary of coring is presented in Table 1.

Table 1. Coring summary, Hole 537.

Core	Date (Jan. 1981)	Time	Depth from drill floor (m)	Depth below seafloor (m)	Length cored (m)	Length recovered (m)	Percent recovery
1	12	0727	3148.0–3155.0	0.0–7.0	7.0	6.81	97
2	12	1023	3202.5–3212.0	54.5–64.0	9.5	1.63	17
3	12	1234	3236.0–3240.5	88.0–92.5	4.5	2.20	49
4	12	1359	3240.5–3250.0	92.5–102.0	9.5	0.25	3
5	12	1507	3250.0–3259.5	102.0–111.5	9.5	0.30	3
6	12	1613	3259.5–3269.0	111.5–121.0	9.5	0.15	2
7	12	1713	3269.0–3278.5	121.0–130.5	9.5	0.10	1
8	12	1836	3278.5–3288.0	130.5–140.0	9.5	0.05	1
9	12	2007	3288.0–3297.5	140.0–149.5	9.5	0.06	1
10	12	2133	3297.5–3307.0	149.5–159.0	9.5	0.40	4
11	12	2255	3307.0–3316.5	159.0–168.5	9.5	1.75	18
12	13	0023	3316.5–3326.0	168.5–178.0	9.5	0.03	<1
13	13	0226	3326.0–3335.5	178.0–187.5	9.5	1.72	18
14	13	0547	3335.5–3345.0	187.5–197.0	9.5	0.04	<1
15	13	0949	3345.0–3354.5	197.0–206.5	9.5	0.12	1
16	13	1245	3354.5–3364.0	206.5–216.0	9.5	0.26	3
17	13	1550	3364.0–3373.0	216.0–225.0	9.0	0.00	0
					153.5	15.87	10

SEDIMENTOLOGY

Figure 2 and Table 2 summarize the sequence of sediments and rocks recovered at Site 537. We distinguished five lithologic units on the basis of distinct compositional differences. The sequence includes: (1) a Pliocene to lower Aptian section of nannofossil ooze with significant hiatuses and mixed microfossil zones; (2) a thick sequence of Lower Cretaceous (late Berriasian?) limestone; (3) a complex series of interbedded dolomitic marls, muddy dolomites, and arkosic sandstones of Berriasian age; (4) a sequence of coarse-grained arkosic sandstone also of Berriasian age; and (5) Cambrian phyllite. Contacts between successive units at this site are uncertain and placed at drilling breaks because of discontinuous coring and poor recovery.

Unit I: 0–92.5m; Cores 1 to 3; Early Pliocene to Early Aptian with Hiatuses

Because of discontinuous coring in the upper 88 m at this site, we have grouped the largely pelagic ooze in Cores 1 through 3 as Unit I. However, to convey the important compositional differences, each core is described separately.

Core 1 consists of grayish orange, yellowish gray, and very pale orange to bluish gray and very light gray nan-

Table 2. Summary of lithologic units at Hole 537.

Unit	Core (or Core-Section)	Depth (m)	Age	Lithology
I	1	0.0–7.0	early Pliocene	Nannofossil-foraminiferal and foraminiferal-nannofossil ooze
	Washed	7.0–54.5		
	2	54.5–64.0	middle Eocene	Radiolarian-nannofossil ooze
	Washed	64.0–88.0		
	3	88.0–92.5	early Eocene–middle Paleocene	Ash and nannofossil ooze
			mixed Late Cretaceous, Paleocene and Eocene(?)	Green zeolitic sandy mud
			early Aptian	Nannofossil ooze
II	4 through 10-1	92.5–149.8	Early Cretaceous (late Berriasian)	Limestone
III	10-1 through 11	149.8–168.5	Berriasian	Sandy dolomitic marl, arkosic sandstone, and muddy dolomite
IV	12 through 14	168.5–197.0	Berriasian	Arkosic sandstone and conglomerate
V	15 through 16	197.0–216.0	late Cambrian (~500 Ma)	Phyllite

nofossil-foraminiferal to foraminiferal-nannofossil ooze. Foraminifers are common near the top of the core (about 60%) and decrease towards the base (about 20%). Nannofossils show a corresponding increase from 30 to 70%. Clay averages about 20%. Several pale greenish yellow patches contain glauconite and manganese oxide.

Core 2 consists of grayish orange and very pale orange to yellowish gray and pinkish gray radiolarian-nannofossil ooze. The compositional range of this sediment is 55–60% nannofossils, 20–30% radiolarians, 10–15% diatoms, and 0–10% clay, minor sponge spicules, and volcanic glass. Several angular fragments of moderate yellowish brown chert with chalk coatings occur at the top of this core. A wash core taken between Cores 1 and 2 contains mostly yellowish gray foraminiferal-nannofossil ooze suggesting that it is the dominant sediment type in the upper part of the section. However, several patches of yellowish brown nannofossil marl also occur in this wash core.

The composition of Core 3 is variable. A 12-cm-thick layer of medium gray vitric volcanic ash occurs at the top and contains several thin laminations and a large burrow filled with light nannofossil ooze. The nannofossil ooze below this ash layer is mottled pinkish gray to grayish yellow and light yellowish brown and contains scattered black manganese oxide fragments; one fragment is a concretion with a light-colored, irregular core. A thin pale brown to pale yellow interval of zeolitic-calcareous sandy mud occurs between 12 and 41 cm of Section 2. It has a thin manganese crust at its top and contains a mixture of unspecified carbonate fragments, zeolites [clinoptilolite(?) and phillipsite(?)], a green clay with a botryoidal surface texture and spherulitic cross sections (smectite and/or palygorskite from X-ray diffraction data), silt-size dolomite rhombs, nannofossils, and foraminifers. A thin layer of light yellowish brown nannofossil chalk-limestone underlies this sandy mud (41–51 cm). A sharp contact occurs between this layer and the underlying white to pinkish white nannofossil ooze. This ooze is firm, possible cemented at the top.

Unit II: 92.5–149.8 m; 537-4 to 537-10-1; Early Cretaceous (Early Valanginian–Late Berriasian)

White to pale yellow limestones composed of poorly sorted skeletal debris and carbonate lithoclasts compose Unit II. Recovery was less than 5% in this unit and the cored pieces were usually small, unoriented fragments. Texturally, most of these limestones are grainstones or packstones with fewer wackestones and one boundstone. Constituent grains include, in decreasing order of abundance, oncolites, peloids, limestone lithoclasts, echinoderm fragments, coral fragments, mollusk fragments, and shallow-water foraminifers. A lime mudstone containing ammonites occurs at the top of Core 4. Calpionellids were noted in the micritic parts of two packstone fragments. Microspar and spar cement are patchy areas in the micrite of some samples; coarser, bladed (originally fibrous?) calcite cement occurs in more than half of the specimens examined. Primary interparticle porosity is common, as is secondary moldic porosity resulting from the dissolution of skeletal fragments. Empty micritic envelopes and spar-lined cavities are the result of this dissolution.

Unit III: 149.8–168.5 m; 537-10-1 to 537-11; Berriasian

Interbedded light greenish gray sandy dolomitic marl, greenish gray to dark greenish gray muddy dolomite, and arkosic sandstone compose Unit III (Fig. 4). The upper contact of this unit occurs somewhere in Core 10 but has been destroyed by drilling. All three lithologies of this unit are mixed with and grade into one another so that sharp contacts are uncommon. The marls are composed of silt-size, elongate carbonate crystals (about 90%), clay (±10%), and dolomite rhombs (±3%). Burrows are common. Fragments of coal and plants, thin pelecypod fragments, and ostracodes occur in this rock type. Muddy dolomites are massive, and contain clay, silt, and scattered terrigenous sand grains up to coarse sand size; pelecypod molds are common. Pollen grains are present in some intervals. The sandstone is poorly sorted and consists of fine-grained to coarse-grained, subangular fragments of quartz, feldspar, reddish and white igneous lithic fragments, and minor biotite (Fig. 4). Dolomite and clay contents vary in these sandstones. Except for some indistinct layering, we observed no sedimentary structures or grading. One sandstone piece contains a large pelecypod fragment.

Unit IV: 168.5–197.0 m; Cores 12 to 14; Berriasian

The arkosic sandstone and conglomerate of Unit IV is blotchy or mottled pale red purple, grayish purple red to weak red, light greenish gray and white. It is structureless and very poorly sorted, consisting of grains ranging from fine sand to pebble size (Fig. 5). Subangular quartz, feldspar, and reddish and white lithic fragments are the most common detrital constituents. Lithic fragments include mostly brick red quartz porphyry and minor granitic fragments, phyllite, and dark green, highly weathered rocks almost exclusively composed of mafic minerals (pyroxenite?) (Fig. 5B). A thin, light greenish gray, irregular layer of clay occurs in Core 13. Several white calcite-cemented intervals also occur, accompanied by a light greenish alteration, perhaps altered ash. This white mineralization fills one large fracture at the top of Section 537-13-2 and forms globular masses on the round side of the same section (Fig. 5A). Patchy olive yellow mineralization occurs in the middle of Section 537-13-1.

A single, rounded pebble-size fragment of reddish brown quartz porphyry was recovered in Core 14. Phenocrysts in the porphyry are large (1–2 mm), euhedral crystals of clear quartz, sanidine, and perthite-twinned and Carlsbad-twinned oligoclase (approximately An_{10-15}). Several smaller altered phenocrysts of green hornblende are also present. The groundmass is principally microgranular (0.01–0.02 mm) quartz (80%), with some altered mesostasis. Feldspar phenocrysts are partly altered to clays.

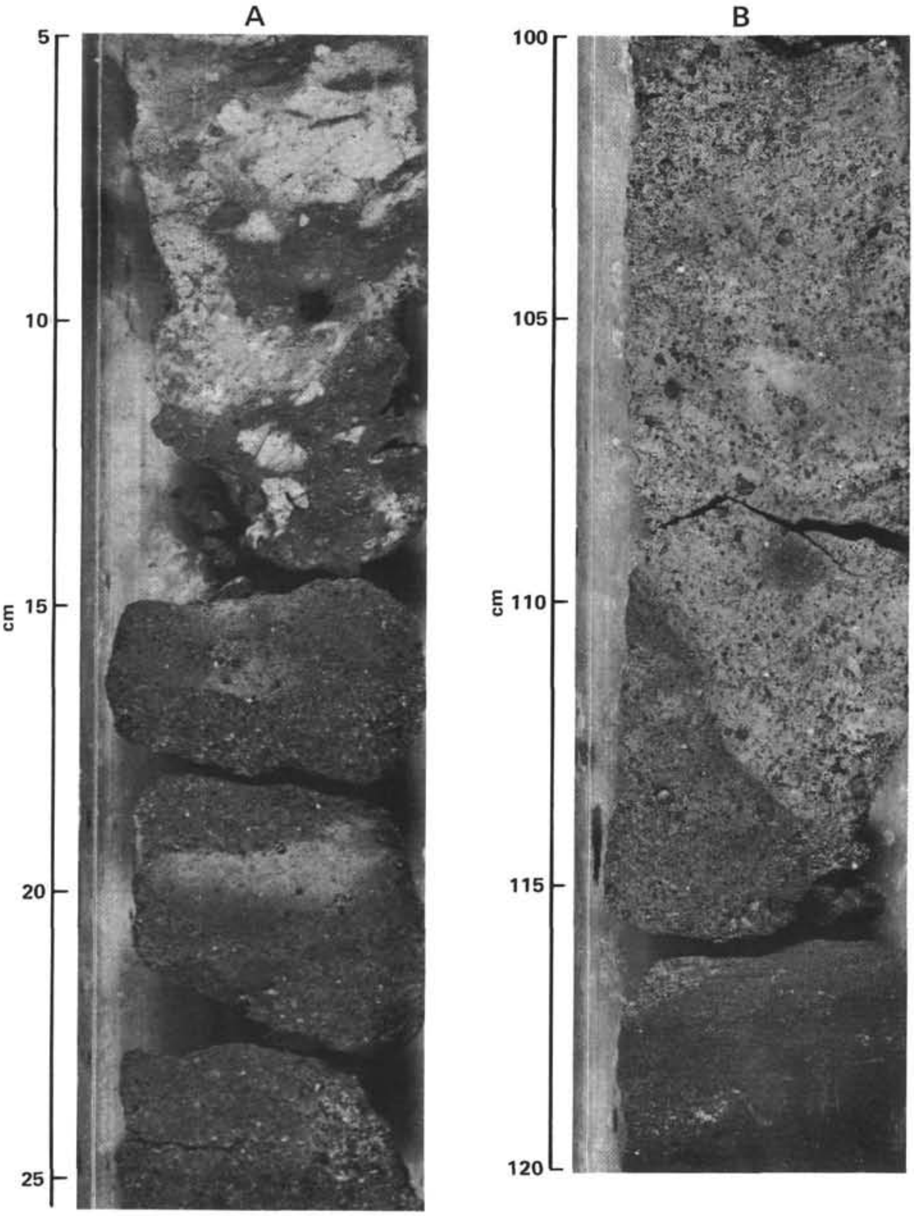


Figure 4. Interbedded muddy dolomite, sandy dolomitic marl, and sandstone making up Unit III, Site 537. A, Sample 537-11-1, 5–25 cm; B, Sample 537-11-1, 100–120 cm.

Unit V: 197.0–216.0 m; Cores 15 to 16; About 500 Ma; Cambrian(?)–Ordovician(?)

Foliated and gently dipping, light brownish gray to brownish gray phyllite composes Unit V (Fig. 6). Weak red and dusky green hues and slight compositional banding occur in Core 16. Compositional variations largely result from differences in concentration of microgranular quartz. Some laminae have sharp tops and bases; others have sharp bases and appear graded. Discontinuous quartz laminae and lenses are common where the rocks are fractured. Some laminations are simply folded, others are kink banded. A three-dimensional alignment of sericitic white mica imparts a well-defined foliation throughout the metamorphic sequence. It is coupled with observed compositional variations. X-ray diffraction data confirm the mineral assemblage of quartz, mica, chlorite, and albite. Fractures with light brownish gray alteration haloes are common.

Discussion

The Mesozoic sedimentary sequence at Site 537 was deposited on a basement of Cambrian metasedimentary rocks. These phyllites probably represent metamorphosed shales and siltstones. Possible graded silt layers suggest that they may have been originally deposited as distal turbidites. The albite-quartz-chlorite-mica mineral assemblage and well-developed lineation and cleavage indicate that these sediments were subsequently metamorphosed to greenschist facies.

The quartz porphyry fragment overlying the metamorphic rocks may represent an *in situ* igneous body as suggested by drilling rate data. If so, it must be a small body, perhaps a sill or dike because it cannot be more

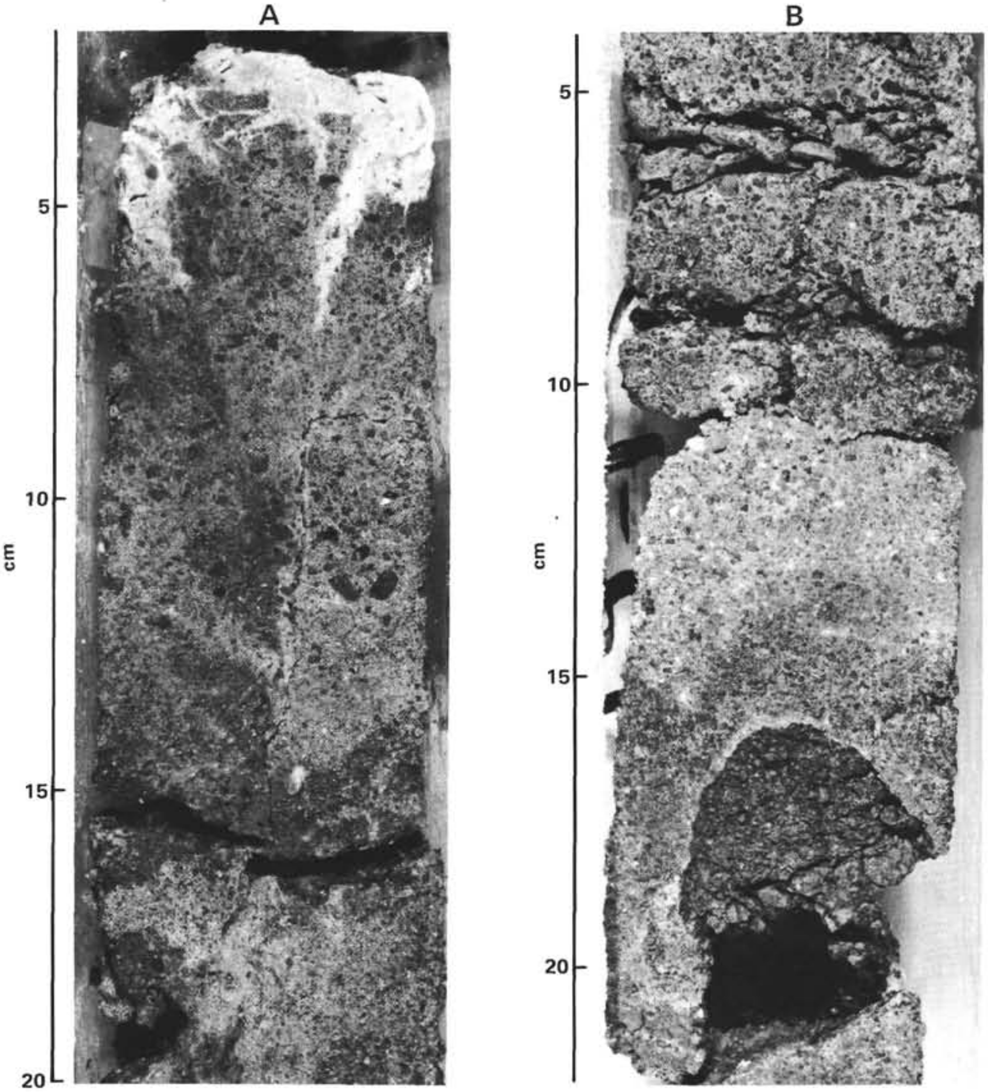


Figure 5. A. Sample 537-13-2, 2-20 cm. Arkosic sandstone showing white mineralization. B. Sample 537-13-1, 4-22 cm. Arkosic sandstone and conglomerate of Unit IV, Site 537, with large, dark mafic clast.

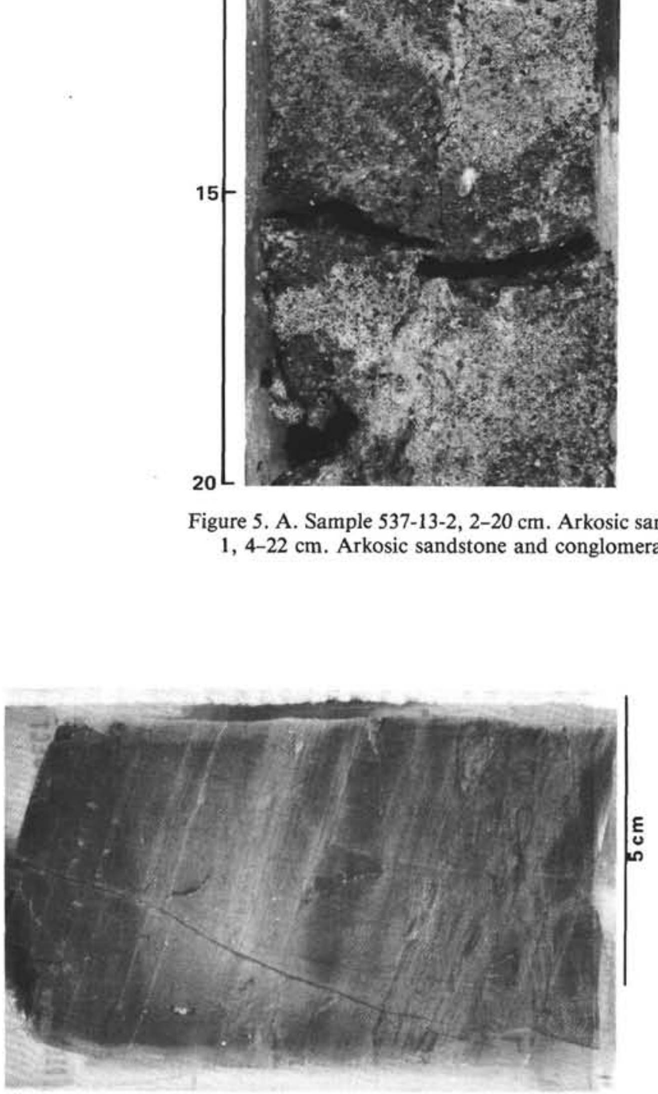


Figure 6. Phyllite of Unit V, Site 537; from Section 537-15-1.

than 20 m thick, probably much less. We prefer the interpretation as a clast from the overlying arkosic conglomerate sandstone, because it is rounded and of the same composition as the most common lithic fragments observed in Unit IV. In either case, its presence signals acid or silicic igneous activity in the area prior to and perhaps contemporaneous with the deposition of Unit IV.

The mottled reddish arkosic sandstone and conglomerate overlying the metamorphic rocks are derived from a varied igneous and metamorphic terrane, which included quartz porphyry; granitic, ultramafic, or mafic rocks; and phyllite. The abundance of coarse-grained, subangular quartz and feldspar grains and the predominance of red quartz porphyry lithic fragments in this sandstone point to acidic plutonic and volcanic rocks as the principal source. Extremely poor sorting, lack of sedimentary structures, the mottled reddish coloring and caliche-like calcareous cementation of this sandstone suggests that it may represent a nonmarine to perhaps marginal marine depositional environment (e.g., fluvial-alluvial settings and/or an arid to semiarid estuarine environment). Volcanism may have been contemporaneous, as suggested by an included thin clay (bentonite?) seam.

The nature of the overlying mixed, greenish sandy dolomitic marls, muddy dolomite, and arkosic sandstone suggests a transition to marine conditions. The presence of plant and coal fragments, pollen, possible brackish water ostracodes, and shelly (pelecypod) debris imply deposition in an estuarine environment or perhaps a shallow-marine shelf setting. Dolomite is ubiquitous and appears to be a replacement of lighter colored marls. It may have formed in the subsurface mixed zone of salt water and fresh water.

The depositional setting of the limestones that overlie the shallow-marine or estuarine marl-dolomite-sandstone facies is uncertain. The predominant poorly sorted grainstone lithofacies contains abundant skeletal debris (including coral fragments), oncolites, and rare algal crusts, which indicate deposition within, or derivation from, an open-marine carbonate platform environment. The paucity of wackestones and mudstones argues against a very shallow platform interior setting.

There are two possible interpretations for Unit II:

1. The limestones are *in situ* deposits of a relatively deep carbonate platform. If the algal crusts are in place, they indicate sedimentation within the euphotic zone. The presence of calpionellid-bearing packstones may represent local accumulations of the pelagic material.

2. The limestones are primarily redeposited, with shallow-water skeletal debris and fragments of algal crust resedimented into a deep-water environment characterized by autochthonous calpionellid packstone deposition. Pieces of skeletal grainstone in the core barrel may represent either lithoclasts and/or redeposited unconsolidated sediments.

The very poor recovery of this unit does not allow a definitive interpretation. The second hypothesis is only necessary (and the first invalid) if it is considered that fine-grained, calpionellid-bearing sediments are only deposited in truly pelagic deep-water environments. However, planktonic organisms are widespread, and it is possible that calpionellids might have accumulated in the comparatively shallow areas that periodically experienced very slow sedimentation rates. Even if the grainstones do represent lithoclasts rather than redeposited loose sediment, they may still have been derived from within a carbonate platform and are not necessarily eroded from a much shallower area. No sedimentary structures or textures indicative of redeposition were observed but this might be entirely the result of the poor recovery. The ordered and unmixed sequence of calpionellid zones observed in Unit II is not an unequivocal argument for either hypothesis, but the very rapid transition from Units IV to II, which occurs entirely within the Berriasian (about 2 Ma in duration) may slightly favor the interpretation as an *in situ* limestone cap (see Schlager et al., this volume, for further discussion).

Secondary moldic porosity in the Unit II limestones suggests possible leaching by fresh water percolating through the interparticle pores.

The first clear shift to deeper-water pelagic sedimentation is marked by the occurrence of lower Aptian nannofossil ooze directly overlying the limestone facies. Deposition was not continuous; the most significant break is represented by a thin interval of zeolitic clay or sandy mud (altered volcanic glass?) containing mixed microfossil zones ranging from Late Cretaceous to Eocene(?). This condensed interval represents either a long period of nondeposition or sustained erosion. Catastrophic conditions (i.e., Cretaceous/Tertiary boundary event) combined with slumping of material from a submarine high and/or current reworking could have produced this anomaly. The overlying younger sequence suggests that pelagic sedimentation persisted to the late Pliocene, but discontinuous coring precludes any detailed reconstruction. An apparent pulse of radiolarian productivity occurred in the Eocene. Calcareous phytoplankton and zooplankton dominated again in the Pliocene. Minor glauconite and Mn-oxides in these Pliocene sediments may indicate periods of slow or intermittent deposition.

BIOSTRATIGRAPHY

Summary

Unit I

Unit I (Cores 1–3) consists of Tertiary and Cretaceous sediments of predominantly pelagic, biogenic origin. Much of the Tertiary portion of this unit was only intermittently cored. The biostratigraphic succession recovered is, therefore, an incomplete reflection of the Tertiary sedimentary record at Site 537. The sediment that was recovered, however, allows the following statements.

Section 537-1-1 is composed of upper Pleistocene foraminiferal-nannofossil ooze. Section 537-1-2 through 537-1,CC consists of lower Pliocene (MLP2; CN11–CN10) foraminiferal-nannofossil ooze. The washed Core H1 contains microfossils of Oligocene age. Core 2 consists of radiolarian-nannofossil ooze of middle Eocene age (P10; CP12). The relatively large siliceous biogenic component of the Core 2 sediments is probably a reflection of the high biogenic silica production that has been documented from many middle Eocene sequences in oceanic areas. Assemblages in the washed Core H2 indicate an early Eocene age (P6b). Nannofossil ooze of early Eocene age (P6b; CP9) occurs in 537-3-1, 12–40 cm. A volcanic ash layer that overlies the ooze in Core 3 is probably also of early Eocene age. The lower Eocene sediment is separated by a lithologic boundary from the underlying upper Paleocene (P4; CP8–CP6) nannofossil ooze. This upper Paleocene ooze occurs from 537-3-1, 41 cm through 537-3-2, 12 cm, the base of which contains evidence of reworking from Upper Cretaceous pelagic sediments and Lower Cretaceous shelf sediments.

Underlying the upper Paleocene nannofossil ooze is a 29-cm bed of green, zeolitic sandy mud. Nannofossil assemblages from this interval (537-3-2, 14–43 cm) are dominated by upper Paleocene species, although some Upper Cretaceous species are also present. Foraminiferal preparations recovered a wide variety of microfossil material, including Aptian and Maestrichtian planktonic foraminifers, Valanginian shallow-water benthic foraminifers and crinoid skeletal debris, and upper Campanian to lower Maestrichtian skeletal debris. A single upper Campanian to lower Maestrichtian larger benthic foraminifer was also recovered. This zeolitic sandy mud contains the youngest (Maestrichtian to late Paleocene) influx of shallow-water debris observed at Site 537.

The base of Unit I contains 20 cm of soft white chalk of early Aptian age (*Globigerinelloides duboisi–G. gottisi* foraminiferal Zone: *Chiastozygus litterarius* nannofossil Zone). Echinoderm skeletal debris, as well as the shallow-water benthic foraminifers *Trocholina* and *Patellina,* occur within this chalk. Thus, reworking of shallow-water sediment during the Aptian at Site 537 is evident.

Unit II

Unit II (from 537-4 through 537-10-1, 29 cm) consists of Lower Cretaceous limestone. Two distinct microfossil assemblages are present in this unit: a shallow-water platform assemblage and a pelagic, calpionellid-bearing assemblage. The calpionellids indicate an early Valanginian–late Berriasian age (Subzones D3, D2, and D1 of the *Calpionellopsis* Zone) for this unit. The diverse nature of the shallow-water debris, as well as the shallow-water benthic foraminifers, that were recovered from this interval, indicate nearby platform conditions. The fact that the planktonic calpionellid assemblages occur as intercalations in the limestones with shallow-water assemblages supports the view that the shallow-water material was transported into the pelagic realm from a carbonate platform.

Unit III

Unit III (537-10-1, 30 cm through 537-11) consists of sandy, dolomitic marls, arkosic sandstones, and muddy dolomite. An ostracode fauna, consisting mainly of species with homomerodont and amphidont hinges, suggests a Neocomian age for this unit (see Oertli, this volume). The upper portion of this unit is marine, although the depositional environment of the lower portion is uncertain. This unit contains a depauperate benthic foraminiferal fauna and is devoid of nannofossils.

Unit IV

Unit IV consists of arkosic conglomeratic sandstones. A palynologic assemblage from Section 537-13-1 indicates an early to mid-Berriasian age for this unit.

Foraminifers and Calpionellids

Several units, representing very different environments, have been recovered at Site 537; fossil content varies widely in those units, as might be expected.

Unit I

In 537-1-1, 10–12 cm, the planktonic foraminiferal assemblage is late Pleistocene in age, whereas the core catcher sample yielded an early Pliocene assemblage belonging to the *Globorotalia margaritae* Zone (Zone MPL2). Planktonic foraminifers are clearly affected by dissolution.

The core catcher of Core H1 (washed core) contains an upper Oligocene planktonic foraminiferal assemblage. Different lithologies have been observed in this core, and they are expected to contain some of the missing stratigraphic intervals between lower Pliocene and upper Oligocene.

Core 2 yielded a planktonic foraminiferal assemblage of early middle Eocene age (*Hantkenina aragonensis* Zone = P10). The core catcher of Core H2 (washed core) yielded a planktonic foraminiferal assemblage of the *Morozovella subbotinae* Zone (P6b) of the early Eocene. The same fauna is recorded also in the upper part of Section 537-3-1 from below 17 cm through 40 cm. At 41 cm, in correspondence with a marked change in lithology, the planktonic foraminifers are late Paleocene in age (*Planorotalites pseudomenardii* Zone = P4). Then, a hiatus of about 3 Ma occurs at that level, spanning the earliest Eocene and the latest Paleocene (Zones P6a through P5). The late Paleocene *Planorotalites pseudomenardii* Zone (= P4) was recorded through the remainder of Section 537-3-1 and in the upper 12 cm of Section 537-3-2, to just above a 30-cm-thick, greenish zeolitic sandy mud layer.

Benthic foraminiferal assemblages contain forms characteristic of the lower bathyal environment. Some reworking is evident in the top part of Section 537-3-2. Reworked forms include species of *Globotruncana* and *Stensioina* of Late Cretaceous age, common crinoid debris, and several *Trocholina,* which are shallow-water forms of the Early Cretaceous.

The greenish layer is barren at the top (except for very rare fish debris at 537-3-2, 15 cm), whereas at the bottom the washed residue contains large amount of echinoid and crinoid fragments, shallow-water skeletal debris, fish debris, benthic foraminifers, and apparent ooids. Zeolite, altered volcanic glass(?), fragments of microcrystalline, possibly dolomitic limestone, and clay minerals are also abundant, whereas quartz is a minor component. Among the small benthic foraminifers, the most frequent forms are those belonging to the genus *Trocholina,* an apparent shallow-water indicator. The other genera present in the assemblage are *Aragonia, Muttaloides,* and *Gavelinella.* They are typical of the lower bathyal to abyssal zone (less than 2000 m). The *Trocholina* are interpreted as reworked from Early Cretaceous carbonate platforms.

The bottom of the greenish layer was destroyed by drilling. A mixture of different assemblages and lithotypes occurs injected between this layer and the hard white chalky limestone at 43 cm. They can be summarized as follows.

1. large fragments of white chalky limestone, probably belonging to the indurated upper portion of the underlying white chalky unit, possibly early Aptian in age
2. strongly altered volcanic glass and other volcanic products, including clay minerals.
3. large fragments of skeletal debris, including pelecypod shells and a single specimen of *Pseudorbitoides* (larger foraminifer), of late Campanian–early Maestrichtian age
4. abundant crinoid fragments associated with *Lenticulina* gr. *ouachensis* and *L.* aff. *busnardoi,* suggesting

an outer shelf environment and a Valanginian age (Sliter, 1977, 1980)

5. planktonic foraminiferal assemblage of very chalky aspect, which may belong to the late Maestrichtian

6. a better-preserved, relatively rich, planktonic foraminiferal fauna of early Maestrichtian age

7. a large population of small hedbergellids and *Globigerinelloides* of early Aptian, probably belonging to the underlying chalk unit

Section 537-3-2 ends with 20 cm of soft white chalk. It yielded a large amount of small *Hedbergella* and *Globigerinelloides,* the same as mentioned above, attributable to the *Globigerinelloides duboisi–G. gottisi* Zone of the early Aptian.

The autochthonous benthic fauna (including common *Gavelinella,* various nodosariids, and *Spirillina*) is characteristic of the upper bathyal zone. Reworked *Trocholina* and much crinoid debris also occur.

Unit II

From Core 537-4 through 537-10-1, 29 cm, the recovered carbonate unit contains two distinct assemblages: (1) a shallow-water assemblage typical of carbonate platform, and (2) a pelagic assemblage constituted by calpionellids and nannoconids.

The calpionellid assemblage allow us to date the sequence as late Berriasian, and they can be attributed to the *Calpionellopsis* Zone (= Zone D of Remane, 1978). In particular, Subzone D3, which is the youngest one and characterized by *Calpionellopsis oblonga,* is recorded in Cores 5 through 6; the Subzone D2, characterized by the concurrence of *C. simplex* and *C. oblonga,* is present in Core 7, whereas Core 10 is attributable to the Subzone D1 on the basis of the occurrence of *C. simplex* associated with *Calpionella* cf. *alpina.*

The shallow-water assemblage is mainly composed of pelecypod shell fragments, crinoids, echinoids, rare corals, gastropods, bryozoans, rare dasycladacean algae, and by abundant oncolites. Oolites are abundant in some samples. The associated benthic foraminifers are *Trocholina* cf. *valdensis,* other species of *Trocholina, Lenticulina* spp., *Dorothia praeoxycona,* and other lagenids. The assemblages are very monotonous except in Core 10, where rare specimens of *Evertycyclammina*(?), a complex agglutinated lituolid, occur. Among the Lituolidae, *Evertycyclammina* is one of the few genera that range as high as the Early Cretaceous. This occurrence suggests that the age of the carbonate platform elements recovered at Site 537 is very close to that inferred from the associated calpionellids.

From a paleontologic point of view, the carbonate sequence recovered in this interval at Site 537 is best interpreted as a talus deposit in a deep-water environment, particularly if one takes into account the abundance of the pelagic assemblages in some samples (537-7-1, 3–4 cm) versus the very poor recovery in this interval (4%).

Unit III

In 537-11-1, 1–10 cm, a silty marly layer at the top of the terrigenous sequence yielded a rich ostracode fauna associated with a few benthic foraminifers, some molds of pelecypods, and frequent echinoid fragments. The sequence at least in its upper part is interpreted as a marine deposit. Among the benthic foraminifers, *Glomospira, Dentalina, Hyperammina,* and *Pseudonodosaria*(?) are poor age indicators. Among the ostracode fauna, the evolutionary stage of the hinges, mainly of amphidont type, suggests that they may not be older then Late Jurassic and may be as young as the Early Cretaceous.

Unit IV

The coarse sandstone unit recovered in Cores 13 through 15 contains no foraminifers or calpionellids.

Calcareous Nannofossils

Site 537 was not cored continuously from mudline to terminal depth. Core 1 contained the near-surface sediments and 6.8 m of biogenous ooze. The hole was subsequently washed to a depth of 54 m, where Core 2 was cut. It recovered 1.63 m of radiolarian-nannofossil ooze. The hole was again washed to 88 m. Core 3 was cut, recovering 2.2 m of firm nannofossil ooze, ash, limestone, and calcareous "sandy mud." The hole was subsequently cored continuously to terminal depth. Cores 4 through 17 contained limestone, dolomite, and metamorphic basement rocks. These latter lithologies contained no age-diagnostic nannofossils and, therefore, will not be discussed further.

Section 537-1-1 is an unconsolidated soupy sediment and was not sampled.

The interval from 537-1-2 through 537-4 contains a well-preserved assemblage including *Reticulofenestra pseudoumbilica, Sphenolithus abies,* and *Ceratolithus rugosus.* This interval is assigned to the *R. pseudoumbilica* Zone (CN11) of early Pliocene age. Section 537-1-5 through 537-1,CC contains the same assemblage with the addition of *Amaurolithus tricorniculatus.* This sample is placed in the *A. tricorniculatus* Zone (CN10) of early Pliocene age.

The interval from Sample 537-2-1, 31–32 through Sample 537-2-1, 47–48 cm, contains *Rhabdosphaera inflata* and *Discoaster sublodoensis.* This interval is assigned to the *R. inflata* Subzone (CP12b) of middle Eocene age. The brownish ooze changes abruptly to light gray or bluish firm ooze or chalk at 537-2-1, 85 cm. Below this boundary, Core 2 contains *D. sublodoensis* but no *R. inflata.* This interval is assigned to the *Discoasteroides kuepperi* Subzone (CP12a) of middle Eocene age.

Sample 537-3-1, 0–12 cm contains a 12-cm-thick ash bed. Sample 537-3-1, 27 cm was taken in the white ooze just below this ash bed. It contained *Discoaster barbadiensis* and *D. diastypus. D. lodoensis* was not present. This white ooze is assigned to the *D. diastypus* Zone (CP9) of early Eocene age. The white ooze grades into a firm brown ooze with manganese fragments near 40 cm in 537-3-1. The brown ooze in 537-3-1, 40–95 cm contains *Fasciculithus tympaniformis, D. mohleri,* and *D. multiradiatus.* This interval is assigned to the *D. multiradiatus* Zone (CP8) of late Paleocene age. The interval from 537-3-1, 128 cm through 537-3-2, 5 cm is the same firm brown ooze. It contains *D. mohleri, F. tympaniformis, Heliolithus kleinpellii,* and *Ellipsolithus macellus.* This interval is assigned to the *D. mohleri* Zone (CP6) of late Paleocene age. The absence of the *D. nobilis* Zone (CP7) may be the result of sampling gaps, as is suggested by the homogeneous lithology across this interval.

The interval from 18 to 43 cm in Section 537-3-2 contains a mixture of Eocene-late Paleocene and Late Cretaceous floras. The Cretaceous/Tertiary boundary is represented by a mixed zone from 537-3-2, 18-43 cm. The hardground on the top of the white chalk unit and the biostratigraphic data suggest a hiatus involving the Late Cretaceous through early Paleocene. There is a hardground in the interval 537-3-2, 43-50 cm followed by white chalk containing *Chiastozygus litterarius, Nannoconus colomi,* and *Micrantholithus obtusus. Lithastrinus floralis* was not noted. This white chalk is assigned to the *C. litterarius* Zone of early Aptian age.

Palynology

Palynomorph assemblages were determined for only one sample at Site 537 by M. Parington (Sample 537-13-1, 114-117 cm). The assemblage includes:

Spores: *Exisipollenites scabarosus* (Balme 1958), common; *Classopollis alexi* (Burger 1965), rare; *C. norrisi* n. sp., common; *Klukisporites pseudoreticulatus* (Couper 1958), 1 specimen; *Cicatricosisporites* indet., 1 specimen; *Ephedripites* spp., 1 specimen; *Classopollis rugosa* n. sp., rare; *Abietineaepollenites minimus* (Couper 1958), 1 specimen.

Cuticles: *Circulina* spp., 1 specimen; *Bennettitales* (*Zamites buchianus;* Brogniart), 2 specimens; *Gymnospermae,* rare; *Cheirolepidiaceae,* moderate to rare.

This palynologic assemblage is strongly dominated by *Classopollis norrisi* and *Exisipollenites scabarosus* (95%). Many of the *C. norrisi* specimens (including occasional tetrads) have been broken or damaged, allowing the thick pitted nexinous internal bodies (characteristic of *C. norrisi*) to become separately dispersed, and can easily be misidentified as *Spheripollenites* (Couper). *Exisipollenites* forms 40-50% of the palynomorph assemblage and is characteristically covered with distinctive spherules, which may be a feature of biogenic degradation (Srivastava, 1976). Most of the *Exisipollenites* specimens are united into characteristic pairs (diads) by distinctive "joining hairs" (Trevisan, 1973).

The cuticle debris is rare to moderately abundant and is almost exclusively dominated by gymnosperms, in particular the *Cheirolepidiaceae*. Some distinctive Bennettitalean cuticles are also present and are referable to the plant genus *Zamites* (c.f., Seward, 1913).

The age of the sample is early to middle Berriasian based on the occurrence of the following forms: *C. norrisi* n. sp. (ranges no higher than the *Iceniisurites [Bojarkia] stephanomaphalus* Zones of the Berriasian); *C. alexi* (early Berriasian-early Valanginian, range amended from that reported in Burger, 1966); *C. rugosa* n. sp. (mid-Jurassic-Albian).

The paleoclimate indicated by the palynologic assemblage is arid to semiarid. This is deduced on the basis of:

1. nexine-bearing circumpolles (*Classapollis*) pollen grains (exclusive to *Classopollis* pollen found in arid habitats—xerophytes)
2. the presence of *Ephedra* spp. (found only in present-day arid climates)
3. similar assemblages dominated by *Cheirolepidiaceae-C. norrisi* n. sp. that have been recorded from the Purbeck (Tithonian-Berriasian) beds of Dorset, England (our sample differed in having an increased number of *Exisipollenites scabarosus,* with *Ephedripites,* which would indicate a more arid environment—south of the semiarid Purbeck deposits of southern England)

SEDIMENTATION RATES

The poor recovery and long hiatuses coupled with the washing out of most of the Tertiary section result in insufficient data for an accurate sediment accumulation curve.

GEOCHEMISTRY

There were no rocks encountered at Site 537 that had organic matter; therefore, no samples were collected for analysis. There were no shows of hydrocarbons.

Three carbonate bomb analyses were run for lithology. The percent $CaCO_3$ was as follows: 81% for Sample 537-3-1, 119-20 cm; 77% for Sample 537-10-1, 42-44 cm; and 63% for 537-11,CC.

Two interstitial water samples were taken and run for chemistry. The results are shown in Table 3.

PHYSICAL PROPERTIES

Only 16 samples were collected for the physical property measurements from cores of Site 537. Velocity, density, and porosity measurements were run on individual samples. In addition to poor recovery, the middle part of the entire section (Cores 4 through 10) is highly fragmented and gives no clear information on bedding. Of 16 samples, 14 measurements are meaningful; the remaining two samples (Section 537-6-1 and Sample 537-13-1, 94-97 cm) are either highly altered or composed of coarse-grained sand and show only a poor transmittance of the sonic wave.

Table 3. Interstitial water geochemistry, Site 537.

	Surface seawater	Sample 537-1-4, 110-120 cm	Sample 537-3-1, 144-150 cm
Sub-bottom depth (m)		5.6	89.5
pH	8.2	7.4	7.4
Alkalinity (meq/liter)	2.58	2.49	2.56
Salinity (‰)	37.3	35.3	36.3
Calcium (mmol/liter)	11.71	10.20	11.62
Magnesium (mmol/liter)	56.13	52.91	48.63
Chlorinity (‰)	19.93	19.44	18.98

The sonic velocity data are divided into four groups based on gross lithology and similarity of velocities, as follows:

Group	Cores	Lithology	Lithologic unit
A	1, 2	Ooze	I
B	3–7	Ooze and limestone	II
C	10, 11	Muddy dolomite and sandstone	III
D	15, 16	Metamorphic rocks	IV

In Cores 1 through 10, the horizontal and the vertical component of the sonic velocity could not be differentiated and, therefore, they were treated as identical.

The results of measurements are listed in Table 4 and the four groups are summarized in Table 5 and are plotted in Figure 7.

SEISMIC STRATIGRAPHY

Site 537 is located on top of a small knoll 25 km north of the Campeche Escarpment (Fig. 1). The knoll stands about 300 m above the general level of the abyssal plain. This knoll can be seen on regional seismic Line GT3-75, which crosses the eastern flank of the knoll (Fig. 3). Before drilling, this knoll was interpreted as the uplifted end of one of several tilted basement fault blocks (Fig. 3). This interpretation is based partly on the apparent asymmetry of the blocks plus the sediments (synrift?) filling the basins between the blocks. A close-up view of the site as shown on the seismic section is included as Figure 8. It was anticipated that most of the thin sediment cores would be Tertiary ooze and chalk similar to that drilled at nearby Site 96, although a thin section of older rocks was also possible.

On its approach, the *Glomar Challenger* crossed the top of the knoll once roughly parallel to Line GT3-75 in order to obtain a complete cross-section using the shipboard seismic system. A blowup of the seismic record at the site is included as Figure 9.

The four main lithologic groups recovered at Site 537 include 92.5 m of Tertiary to Lower Cretaceous ooze (Lithologic Unit I), 57.3 m of Lower Cretaceous skeletal limestone (Lithologic Unit II), 47.2 m of Lower Cretaceous sandstones (Lithologic Units III–IV), and 19 m of phyllite. An attempt is made to correlate these lithologic

Table 4. Physical properties for Site 537.

Core-Section (interval in cm)	Depth (m)	Sonic velocity (km/s) H	Sonic velocity (km/s) V	GRAPE Wet-bulk density H	GRAPE Wet-bulk density V	GRAPE ϕ (%)	Gravimetrics Wet-bulk density (g/cm^3)	Gravimetrics ϕ (%)	Gravimetrics Water content (%)	Acoustic impedance (V)($\times 10^5$ g cm^{-2} s^{-1})	Torvane shear strength (kPa)	Lithology
1-3, 53–55	4	1.566					1.6	67	43	2.506	9.67	
1-4, 53–55	5	1.521					1.6	66	41	2.435	6.70	
2-2, 123–126	56	1.556					1.6	66	42	2.490	4.78	Ooze
2-5, 43–45	59	1.740					1.6	65	40	2.784	4.78	
3-1, 130–132	89	2.300		1.76		56.1	1.7	60	35	3.910	25.9	
3-2, 70–72	90	2.290		2.00		41.8	1.9	43	23	4.351	45.96	
4-1	93	2.401		2.45		14.9	2.5	11	4	6.003		
5-1	102	2.381		2.53		10.1	2.5	11	4	5.953		
6-1	112	1.697		2.28		25.1	2.3	24	11	3.903		Limestone
7-1	121	2.275		2.10		35.8	2.4	15	6	5.460		
10-1	150	4.979		2.38		19.1	2.4	15	6	11.950		
11-1, 121–124	160	3.258	3.103	2.38		19.1	2.4	21	9	7.447		Gray silty sandstone, muddy
11-2, 0–3	161	4.663	4.577	2.59		6.6	2.6	12	5	11.900		dolomite, and dolomitic
13-1, 94–97	179	a	2.242	2.02		4.06	2.0	33	16	4.484		marl; very loose, brown, coarse-grained (sand) gravels?
15-1, 10–12	197	5.416	3.575	2.59		6.6	2.6	9	4	9.295		Phyllite
16-1, 8–10	207	4.544	4.028	2.74		±0	2.7	6	2	10.876		

Note: Centimeter interval not given for Cores 4–10 because of the nature of recovered material (see Sediment Lithology section of text). H = horizontal; V = vertical; ϕ = porosity.
[a] Measurement not possible.

Table 5. Groupings of physical properties, Site 357.

Group	Sub-bottom depth (m)	Number of samples	Density (g/cm^3)	ϕ (%)	Sonic velocity (km/s) V	Sonic velocity (km/s) H	Acoustic impedance V ($\times 10^5$ g cm^{-2} s^{-1})[a]	Lithology
A	0–59	4	1.60	66	1.68		2.56	Ooze
B	89–121	5	2.20	28	2.33		5.13	Ooze and limestone
C	150–161	3	2.47	15	4.04	4.12	10.43	Muddy dolomite and sandstone
D	197–207	2	2.65	8	3.80	4.98	10.30	Phyllite

Note: Section 537-6-1 and Sample 537-13-1, 94–97 cm were omitted from these averages for reasons given in the text. ϕ = porosity; V = vertical; H = horizontal.
[a] Corrections applied on the average values based on Boyce (1976).

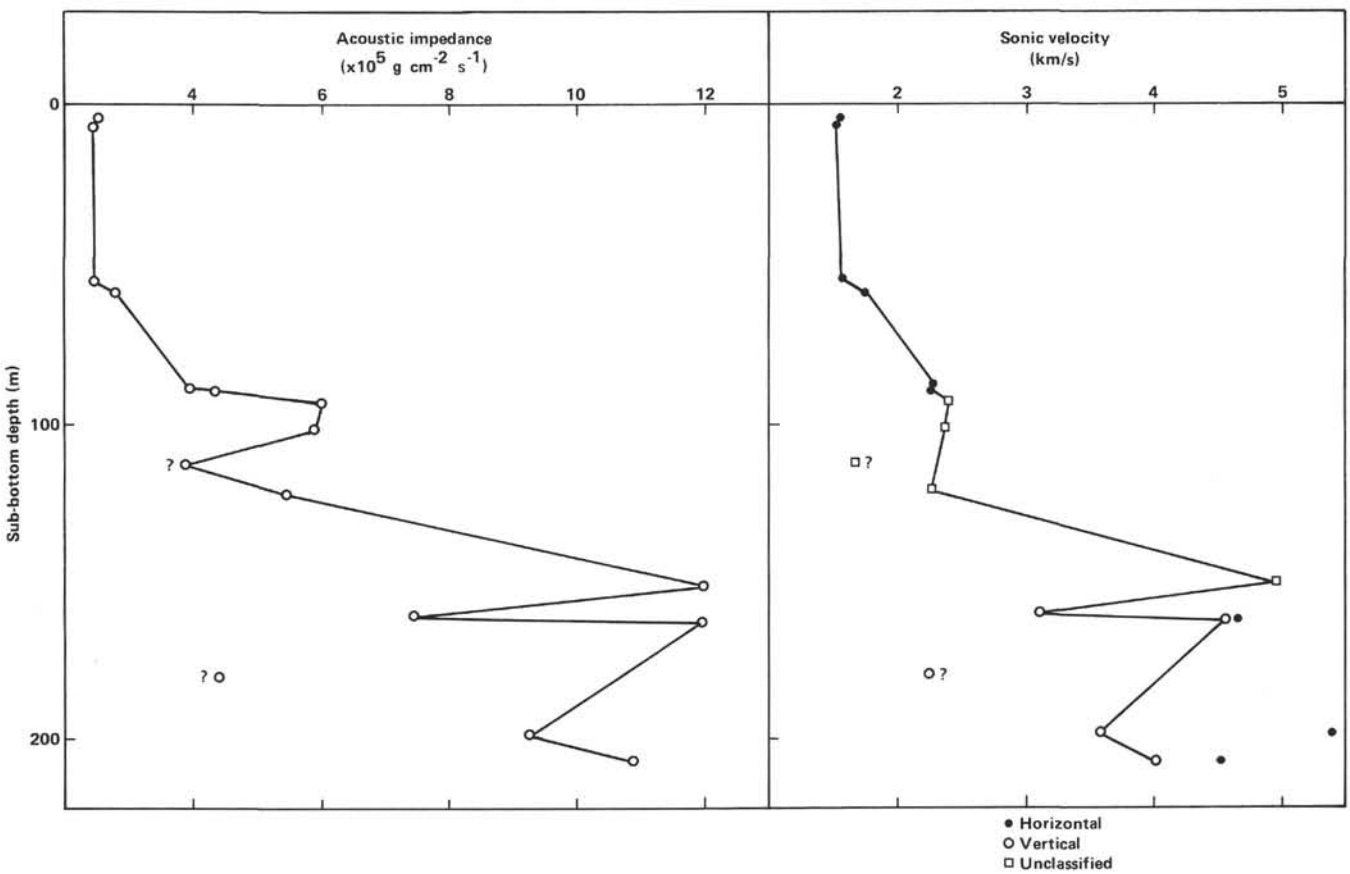


Figure 7. Profiles of selected physical properties, Site 537. Question marks indicate questionable values.

units with the seismic section. Using average velocities for the units as determined from shipboard measurements of core samples, thicknesses in two-way time were calculated for each of the groups and were plotted on the shipboard seismic section (Fig. 9). Although the resolution of the seismic data is poor, there actually is a fair correlation between the lithology and the seismic data. The upper, somewhat transparent cap on the knoll evidently correlates well with the ooze section, whereas the layered sequence of reflections at about 4.3 s seems to correlate well with the skeletal-oolitic limestone sequence. A thin zone of weak reflections below this may represent acoustic basement, which may reflect the lack of a large difference in acoustic impedance between the sandstones and the phyllites. Basement on the seismic record probably consists of the transparent zone just below the last distinct reflection at about 4.4 s, just slightly below the projected depth (Fig. 9).

CONCLUSIONS

The conclusions concerning this site are given in the Summary section earlier in this chapter.

REFERENCES

Boyce, R. E., 1976. Definitions and laboratory techniques of compressional sound velocity parameters and wet-water content, wet-bulk density, and porosity parameters by gravimetric and gamma ray attenuation techniques. *In* Schlanger, S. O., Jackson, E. D., et al., *Init. Repts. DSDP,* 33: Washington (U.S. Govt. Printing Office), 931–958.

Buffler, R. T., Shaub, F. J., Huerta, R., Ibrahim, A. B. K., and Watkins, J. S., 1981. A model for the early evolution of the Gulf of Mexico basin. *Oceanol. Acta,* 26th Int. Geol. Congr., Geol. Continental Margins Symp., pp. 129–136.

Buffler, R. T., Watkins, J. S., Schaub, F. J., and Worzel, J. L., 1980. Structure and early geologic history of the deep central Gulf of Mexico basin. *In* Pilger, R. H. (Ed.), *The Origin of the Gulf of Mexico and the Early Opening of the Central North Atlantic Ocean:* Baton Rouge, Louisiana (Louisiana State University), pp. 3–16.

Burger, D., 1966. Palynology of the Upper Jurassic–Lower Cretaceous in E. Netherlands. *Leidse Geol. Meded.,* 35:209–276.

Remane, J., 1978. Calpionellids. *In* Haq, R. U., and Boersma, A. (Eds.), *Introduction to Marine Microplaeontology:* Amsterdam (Elsevier Publ. Co.), pp. 161–170.

Seward, A. C., 1913. A contribution to our knowledge of Wealden floras. *Q. J. Geol. Soc. London,* 69:85–116.

Sliter, W. V., 1977. Cretaceous foraminifera from the southwestern Atlantic Ocean, Leg 36, Deep Sea Drilling Project. *In* Barker, P. F., Dalziel, I. W. D., et al., *Init. Repts. DSDP,* 36: Washington (U.S. Govt. Printing Office), 519–575.

________, 1980. Mesozoic foraminifers and deep-sea benthic environments from Deep Sea Drilling Project Sites 415 and 416, eastern North Atlantic. *In* Lancelot, Y., Winterer, E. L., et al., *Init. Repts. DSDP,* 50: Washington (U.S. Govt. Printing Office), 353–427.

Srivastava, 1976. Biogenic infection in Jurassic spores and pollen. *Geosci. Man,* 15:95–100.

Trevisan, 1973. Peculiar structures connecting fossil pollen grains in pairs (S. Tuscany, Italy). *Proc. 3rd Int. Palynol. Conf. 1971,* pp. 28–31.

Worzel, J. L., Bryant, W., et al., 1973. *Init. Repts. DSDP,* 10: Washington (U.S. Govt. Printing Office).

Date of Initial Receipt: July 5, 1983
Date of Acceptance: July 6, 1983

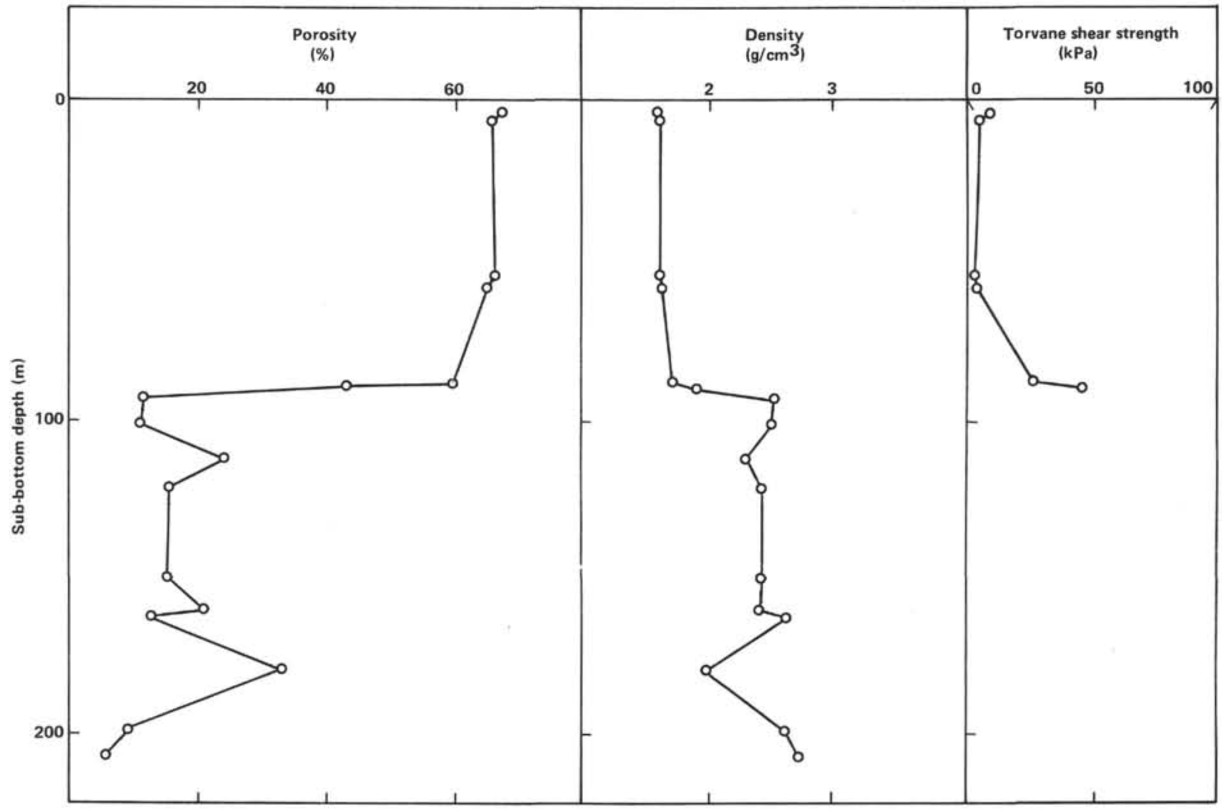


Figure 7. (Continued).

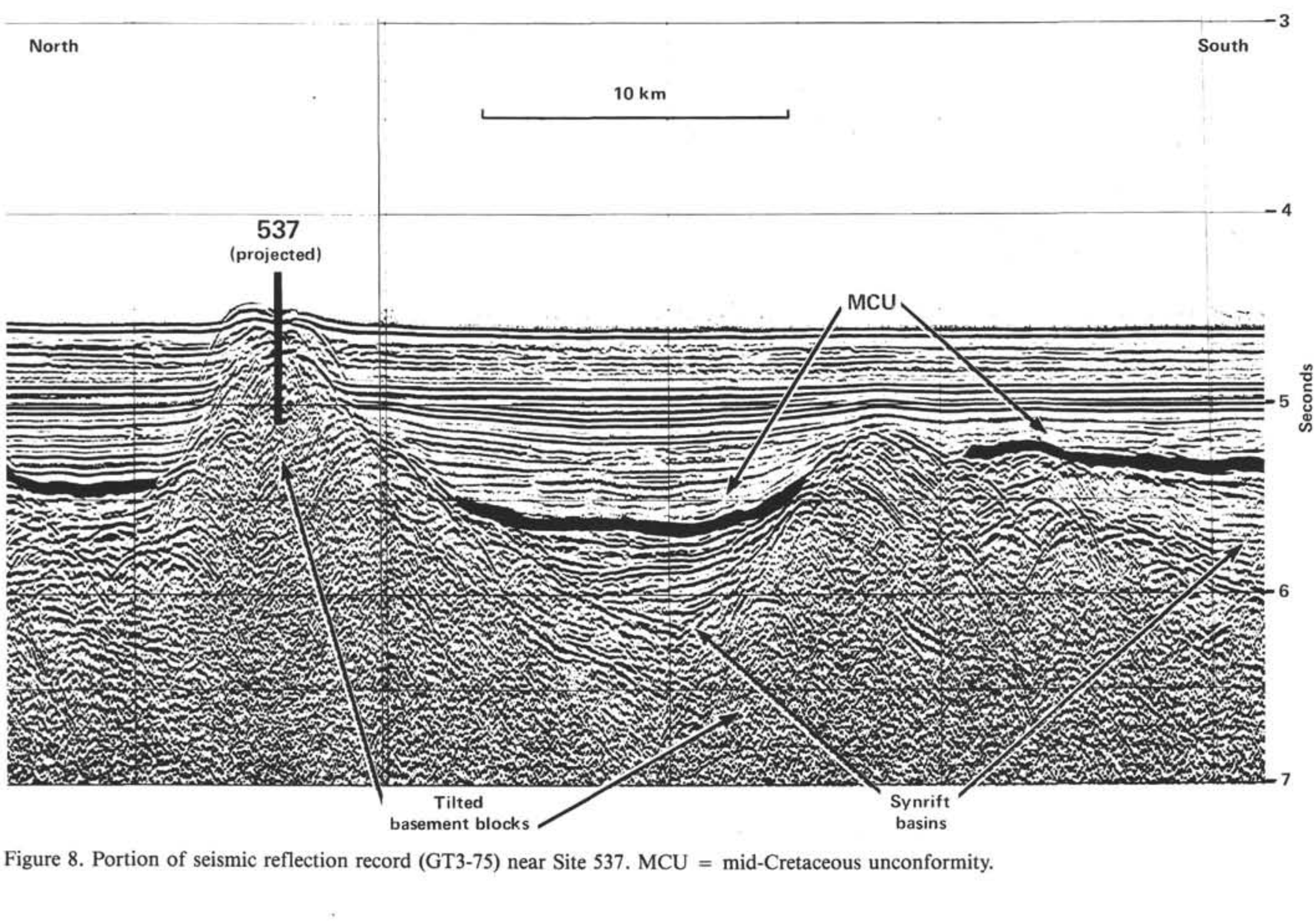


Figure 8. Portion of seismic reflection record (GT3-75) near Site 537. MCU = mid-Cretaceous unconformity.

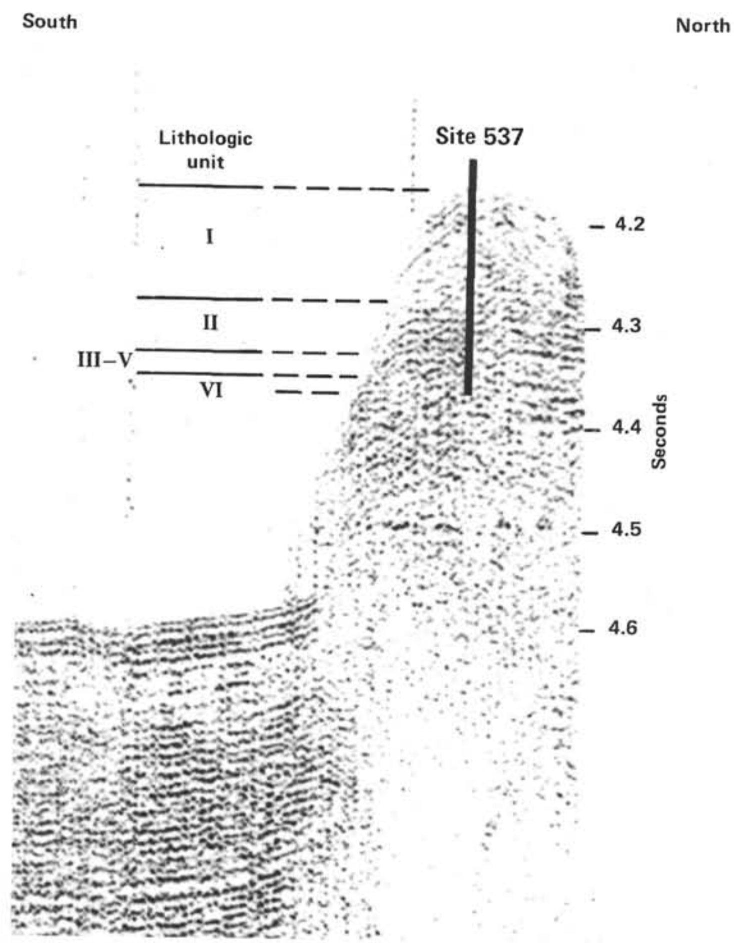
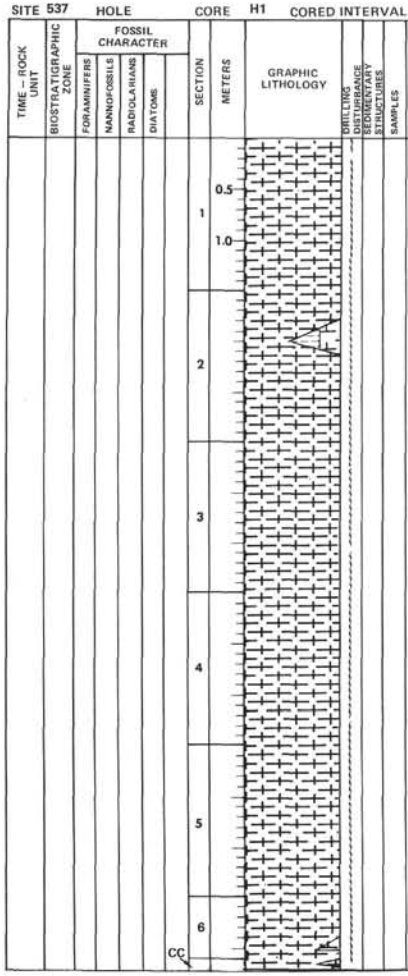


Figure 9. Enlargement of *Glomar Challenger* single-channel seismic record at Site 537. Positions of lithologic units are also shown.

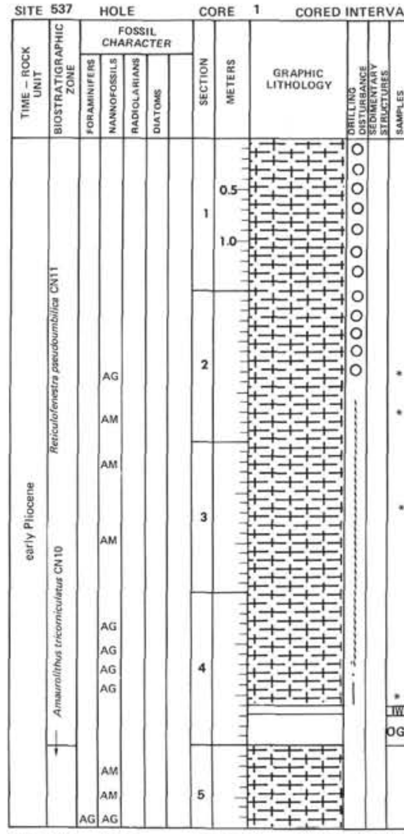
SITE 537 HOLE CORE H1 CORED INTERVAL 7.0–54.5 m (wash core)



LITHOLOGIC DESCRIPTION

Wash core over the drilled interval 7.0–54.5 meters. Sediment is predominantly yellowish gray (5Y 8/1) to pale yellow (2.5Y 7/4) FORAMINIFERAL-NANNOFOSSIL OOZE. Section 2 contains several, moderate yellowish brown patches of MARLY NANNOFOSSIL OOZE several centimeters across. Section 6 plus part of Core-Catcher contains light bluish gray (5B 7/1) FORAMINIFERAL-NANNOFOSSIL OOZE with some darker greenish patches. Base of Section 6 and Core-Catcher also contain sticky white (N9) NANNOFOSSIL OOZE.

SITE 537 HOLE CORE 1 CORED INTERVAL 0.0–7.0 m



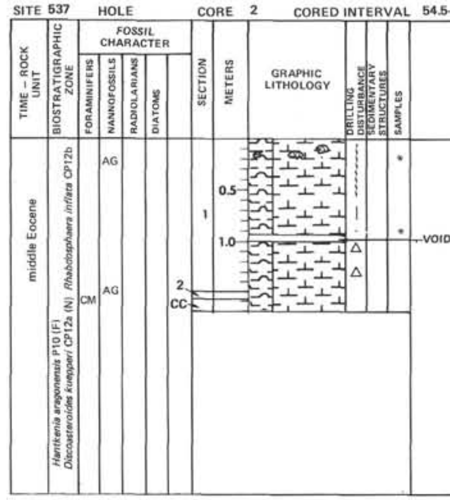
LITHOLOGIC DESCRIPTION

NANNFOOSSIL-FORAMINIFERAL OOZE and FORAMINIFERAL-NANNOFOSSIL OOZE, grayish orange (10 YR 7/4) and foraminifer-rich in Sections 1 and top Section 2, changing to yellowish gray (5Y 8/1), very pale orange (10YR 8/2), and finally light bluish gray (5B 7/1) to very light gray (N8) and nannofossil-rich near base of core. Patch at 60–70 cm, Section 4 is pale greenish yellow (10Y 8/2). Intense drilling deformation but several deformed laminae near base Section 2.

SMEAR SLIDE SUMMARY (%):

	2, 80	2, 120	3, 64	4, 100
	D	D	M	D
Texture:				
Sand	60	10	2	20
Silt	30	80	88	70
Clay	10	10	10	10
Composition:				
Quartz	–	–	2	–
Clay	10	10	10	10
Glauconite	–	–	40	–
Carbonate unspec.	–	–	5	–
Foraminifers	60	20	–	20
Calc. nannofossils	30	70	–	70
Dolomite rhombs	–	Tr	–	Tr
Mn-oxide	–	–	40	

SITE 537 HOLE CORE 2 CORED INTERVAL 54.5–64.0 m



LITHOLOGIC DESCRIPTION

RADIOLARIAN-NANNOFOSSIL OOZE, grayish orange (10YR 7/4) and yellowish gray (5Y 7/2) to very pale orange (10YR 8/2) with patches and streaks of moderate orange pink (5YR 5/4) and pinkish gray (5YR 8/1). Several small fragments of moderate yellowish brown (10YR 5/4) CHERT with chalky rinds in top Section 1. Intense drilling deformation.

SMEAR SLIDE SUMMARY (%):

	1, 20	1, 90
	D	D
Texture:		
Sand	30	20
Silt	60	70
Clay	10	10
Composition:		
Clay	–	10
Volcanic glass	–	Tr
Foraminifers	Tr	–
Calc. nannofossils	55	60
Diatoms	15	10
Radiolarians	30	20
Sponge spicules	Tr	Tr

SITE 537 HOLE CORE 3 CORED INTERVAL 88.0–92.5 m

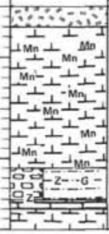
TIME – ROCK UNIT: late Paleocene – early Eocene; early Aptian; Cretaceous/Tertiary mixture

BIOSTRATIGRAPHIC ZONE: a, b, c, d, e

FOSSIL CHARACTER: FORAMINIFERS: AM, AM, FP; NANNOFOSSILS: AG, AP, AM, AM, AM, AM, AM, CM, CP, AM

SECTION: 1, 2 METERS: 0.5, 1.0

GRAPHIC LITHOLOGY



DRILLING DISTURBANCE / SEDIMENTARY STRUCTURES / SAMPLES

LITHOLOGIC DESCRIPTION

Interbedded NANNOFOSSIL OOZE, VOLCANIC ASH, LIMESTONE, and ZEOLITIC-CALCAREOUS "SANDY MUD". Nannofossil ooze is most abundant. In Section 1 and top Section 2 it is mottled pinkish gray (5YR 8/1) to grayish yellow (5Y 8/4) and light yellowish brown (5Y 6/4) and contains scattered manganese and plant fragments. Manganese concretion at 65 cm, Section 1 has an irregular white core. Ooze is white (N9) to pale yellow (5Y 8/3) in base of Section 2 and contains abundant nannoconids. Ash at top Section 1 is medium gray (N6) and soft. Several laminations near top and base and one large burrow filled with light nannofossil ooze. Another possible thin (0.5 cm) ash layer at 28 cm, Section 1. "Sandy mud" in Section 2 is pale brown to pale yellow, consists mostly of fine sand-size grains of smectite/palygorskite(?) (some spherulitic) and unspecified carbonate and silt-size dolomite rhombs and common phillipsite(?) and clinoptilolite(?) laths. It fines upward. Limestone fragments at 50 cm, Section 2, are white (N9) to pinkish white (5YR 8/1) and massive.

SMEAR SLIDE SUMMARY (%):

	1, 3 M	1, 110 D	2, 3 D	2, 13 M	2, 63 D
Texture:					
Sand	Tr	–	–	20	–
Silt	98	90	85	70	95
Clay	2	10	15	10	5
Composition:					
Clay	Tr	10	15	10	–
Volcanic glass	95	–	–	–	–
Glauconite	–	–	–	20	–
Carbonate unspec.	2	5	10	30	10
Calc. nannofossils	2	80	75	2	90
Sponge spicules	1	–	–	–	–
Dolomite	–	1	–	5	–
Clinoptilolite	–	–	–	35	–

ORGANIC CARBON AND CARBONATE (%):

	1, 119
Organic carbon	–
Carbonate	81

a – *Discoaster diastypus* CP9
b – *Discoaster multiradiatus* CP8
c – *Discoaster mohleri* CP6
d – ?
e – *Chiastozygus litterarius*

SITE 537 HOLE CORE 4 CORED INTERVAL 92.5–102.0 m

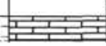
TIME – ROCK UNIT: Valanginian? Early Cretaceous

BIOSTRATIGRAPHIC ZONE: Not zoned

FOSSIL CHARACTER: FORAMINIFERS: AP†; Rare Nondiagnostic

SECTION: 1

GRAPHIC LITHOLOGY



LITHOLOGIC DESCRIPTION

LIMESTONE (peloidal-skeletal grainstone and packstone), white (N9) to pale yellow (2.5Y 7/4) with poorly sorted skeletal debris and one identifiable ammonite. Dissolved skeletal material yields secondary moldic porosity. Drilling breccia.

Thin Section:

1, 20: Limestone (grainstone–packstone) – composed of limestone lithoclasts (20%), micritic peloids (20%), echinoderm grains (20%), molluscs (10%), foraminifers, green algae (10%) and indeterminate grains. Cement (10%) forms remainder of rock. Large limestone lithoclast boundary runs through thin section.

†Only benthics

SITE 537 HOLE CORE 5 CORED INTERVAL 102.5–111.5 m

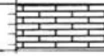
TIME – ROCK UNIT: Berriasian-Valanginian? Barremian-Aptian undifferentiated; Berr.

BIOSTRATIGRAPHIC ZONE: Valanginian or younger; *Calpionellid* Zone D-3? (reworked?) Not zoned; D-2

FOSSIL CHARACTER: FORAMINIFERS: FP†, FP†, FP†, FP†; NANNOFOSSILS: Barren; CALPIONELLIDS: FP, FP, FP, FP, Rare, Rare

SECTION: 1

GRAPHIC LITHOLOGY



LITHOLOGIC DESCRIPTION

LIMESTONE (grainstone and wackestone), light gray (2.5Y 7/2) to pale yellow (2.5Y 7/4), consisting of very poorly sorted skeletal fragments up to 2 cm across. Coral fragments at ~10 cm; bored clasts at 40 cm. Drilling breccia.

Thin Sections:

1, 7: Limestone (oncolitic wackestone) – mostly micrite (80%), with about 20% grains including coated grains (50%), peloids (20%), echinoderms (20%), and mollusc (10%). Many irregular voids – secondary porosity.

1, 24: Limestone (grainstone–boundstone) – composed of coral (50%), algal grains (35%), peloids (10%), and foraminifers (5%; encrusting types). Very well-cemented with fibrous calcite. Some borings in cement and grains and minor leaching. No obvious clast boundary in thin section.

1, 37: Limestone (peloidal packstone-grainstone) – composed of about 60% grains, 20% microspar-spar cement and 20% micrite. Grains include micritized grains (30%), coated grains (30%), mollusc fragments (10%), echinoderms (5%), and indeterminate types (5%). Coated grains are lithoclasts in part and have "girvarella" coatings (oncolites).

1, 40: Limestone (peloidal grainstone) – consists of micritic grains (~20%; peloids), limestone lithoclasts (20%), echinoderm fragments (15%), mollusc (10%), foraminifers (1%), "girvarella" algae (1%), and coated grains (3%). Some *calpionellids* also present. Secondary moldic porosity well-developed. Cement is microspar (<5 μm crystals) with some fibrous(?) calcite.

†Only benthics

SITE 537 HOLE CORE 6 CORED INTERVAL 111.5–121.0 m

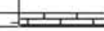
TIME – ROCK UNIT: Valanginian or younger

BIOSTRATIGRAPHIC ZONE: Not zoned; Rare Nondiagnostic

FOSSIL CHARACTER: FORAMINIFERS: RP†, RP†; CALPIONELLIDS: FP

SECTION: 1

GRAPHIC LITHOLOGY



LITHOLOGIC DESCRIPTION

LIMESTONE (packstone and wackestone), white (2.5Y 8/2) to yellow (2.5Y 7/8), consisting of poorly sorted skeletal fragments including echinoid spines and bivalves. Drilling breccia.

Thin Sections:

1, 1: Limestone (packstone) – consists of about 30% micrite-microspar matrix and 30% grains with well-developed moldic porosity (40%). Grains include shell fragments, foraminifers, circular grains with radial sparite, gastropods(?), echinoiderm fragments and possible sponge and corals. Micritic envelopes common; spar lines some cavities. Moldic porosity developed best in circular, elongate, and round grains.

1, 14: Limestone (oncolitic wackestone-packstone) – consists of micrite-microspar matrix, micritized peloids and foraminifers and intraclasts and coated grains (oncolites) (30%), echinoderm debris (10%) with other bioclasts and about 15% moldic and interparticle porosity. Poor contrast between grains and matrix. Patchy microspar occurs in micritic matrix. Poorly sorted with coarse sand-size grains.

†Only benthics

SITE 537 HOLE CORE 7 CORED INTERVAL 121.0–130.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	CALPIONELLIDS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
Valanginian or younger	Indeterminate / Not zoned	FP[†] / Barren-rare	Nondiagnostic			FP	1			△		*	LIMESTONE (grainstone and wackestone), white (2.5Y 8/2) to yellow (2.5Y 7/8), consisting of very poorly sorted skeletal debris and lithoclasts. Drilling breccia.

Thin Sections:

1, 3: Limestone (oncolitic grainstone-wackestone) – micrite with *calpionellids* (Tr) and foraminifers (Tr) and grains including coated grains (60%; oncolites), micritized peloids (20%), echinoderm fragments (5%), dissolved molluscs (5%) and indeterminate grains (5%). Leached grains and interparticle primary porosity present.

1, 10: Limestone (oncolitic graintone) – 50% grains, 30% cement, 20% micrite. Grain stypes include coated grains (50%, oncolites), micritic peloids (20%), limestone lithoclasts (5%), echinoderm fragments (5%), molluscs (5%), foraminifers (2%), and indeterminate grains (10%). Good primary porosity.

[†]Only benthics

SITE 537 HOLE CORE 8 CORED INTERVAL 130.5–140.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	CALPIONELLIDS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
Valanginian or younger	Not zoned / Indeterminate	CP[†] / Barren-rare	Nondiagnostic			RP	1			△		*	LIMESTONE (skeletal packstone), white (2.5Y 8/2) to yellow (2.5Y 7/8) consisting of very poorly sorted skeletal debris and limestone lithoclasts. Drilling breccia.

Thin Section:

1, 3: Limestone (packstone) – consists of echinoderm debris (45%), micrite (25%), microspar (15%), shell debris (5%), and about 10% moldic and interparticle porosity. Moderate to well sorted, contains possible mudstone burrow-fill or intraclast.

[†]Only benthics

SITE 537 HOLE CORE 9 CORED INTERVAL 140.0–149.5 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	CALPIONELLIDS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
Valanginian or younger	Not zoned / Indeterminate	RP[†] / Rare	Nondiagnostic			RP	1					*	LIMESTONE (grainstone), white (2.5Y 8/2) to yellow (2.5Y 7/8), consists of very poorly sorted skeletal debris and limestone lithoclasts. Small, angular fragment of dark yellowish brown (2.5Y 4/3) CHERT also occurs in recovered material. Drilling breccia.

Thin Section:

1, 10: Limestone (oncolitic grainstone) – section thick, contains coated grains, green algae, peloids and echinoderm fragments. Some leaching and probable submarine cement.

[†]Only benthics

SITE 537 HOLE CORE 10 CORED INTERVAL 149.5–159.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	CALPIONELLIDS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
Berriasian?	*Capionellid* Zone D-1 (reworked)	R, R, FP[†], CP[†], CP[†]				Rare, RP, RP, RP	1			△		*, *, +	LIMESTONE (grainstone and wackestone), DOLOMITE, and SANDSTONE. Limestone comprises fragments between 0–30 cm. Upper 15 cm are white (2.5Y 8/2) to pale yellow (2.5Y 7/8) consisting of poorly sorted skeletal fragments. Very porous (cavernous) with some iron staining and coating. Limestone from 15–30 cm is white to light brownish gray (2.5Y 6/2), coarser than that above with several large coral fragments. Grayish olive (10Y 4/2) to light olive gray (5Y 5/2) dolomite and sandy dolomite containing arkosic sandy lenses, several banded zones and iron stained and altered bivalve fragments. Sand mixed with dolomite is medium grained and contains quartz, pink and white feldspar, biotite, and muscovite. Coarse grained sandstone at base of section contains quartz, pink and white feldspars altered somewhat to white clay(?).
Valanginian or younger	Not zoned												

Thin Section:

1, 5: Limestone (wackestone) — consists of about 60% micrite and 30% grains. Fragments include micritic peloids (30%), coral fragments (30%), molluscs (20%), foraminifers and/or radiolaria (5%), echinoderm fragments (5%), and indeterminate grains (10%). Good secondary moldic porosity; very little cement.

1, 13: Limestone (grainstone) – consists of grains in bladed to fibrous calcite cement. Grain types are micritic peloids (50%), coated grains (20%), molluscs (2%), echinoderms (1%), and unidentified fragments (20%). No primary porosity; some moldic porosity.

1, 23: Limestone (grainstone) – porous grainstone consisting of micrite (~48%), microspar (20%), micritized grains (30%), molluscs (1%), and foraminifers (1%). Some micritic grains have relict oolitic or intraclast textures, others are peloidal looking. Large (~1 mm) mollusc fragment is not micritized. Blotchy, clotted pattern of micrite and microspar is common. Porosity is irregular, mostly secondary moldic; original grain centers and walls dissolved.

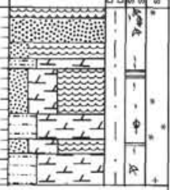
ORGANIC CARBON AND CARBONATE (%):

	1, 42
Organic carbon	–
Carbonate	77

[†]Only benthics

SITE 537 HOLE CORE 11 CORED INTERVAL 159.0–168.5 m

Time-rock unit: Barren / Berriasian? / early? Berriasian / Unknown
Biostratigraphic zone: Not zoned / Indeterminate
Fossil character: Foraminifers RP† ; Ostracods CP, Common
Sections: 1, 2 (meters 0.5, 1.0)



LITHOLOGIC DESCRIPTION

Interbedded SANDY DOLOMITIC MARL, ARKOSIC SANDSTONE, and MUDDY DOLOMITE. Marls are light greenish gray (5GY 8/1) to greenish gray (5GY 6/1), darker color contains more clay and dolomite. Carbonate of marl is mostly fine silt-size "laths" of calcite. Coaly fragments and plant debris as well as mollusc shells and ostracods occur in the marl. Coarse sand is mixed in chaotically. Arkosic sandstone is greenish gray (5GY 8/1) to dark greenish gray (5GY 7/1), poorly sorted with fine- to coarse-grained, subrounded quartz and feldspar grains and minor biotite. Some feldspars altered to green clay. Dolomite is fine-grained with mixed coarse sand grains and several pelecypod molds. Reddish lithic fragments occur in dolomite at base of Section 2.

SMEAR SLIDE SUMMARY (%):

	1, 3 D	1, 92 D	1, 119 D	1, 129 D
Composition:				
Quartz	–	–	5	–
Feldspar	–	–	5	–
Clay	–	–	28	10
Pyrite	–	–	–	2
Carbonate unspec.	97	97	–	48
Plant debris	–	–	2	–
Dolomite	3	3	60	40

ORGANIC CARBON AND CARBONATE (%):

	2, 25
Organic carbon	–
Carbonate	63

†Only benthics

SITE 537 HOLE CORE 12 CORED INTERVAL 168.5–178.0 m

Time-rock unit: Indeterminate / Unknown
Biostratigraphic zone: Indeterminate
Fossil character: Barren
Section: 1

LITHOLOGIC DESCRIPTION

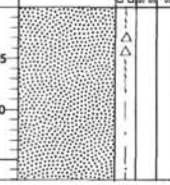
ARKOSIC SANDSTONE, three small pieces, reddish (10R 4/6) and very poorly sorted. Two pieces are hard and contain several brick red lithic fragments (quartz porphyry?) and coarse clear grains of quartz and white feldspar with some greenish lithic(?) fragments. Several large cavities have greenish yellow clay(?) lining. No reaction with HCl. One soft piece (smear slide) contains greenish clay, quartz, and untwinned feldspar.

SMEAR SLIDE SUMMARY (%):

	1, 5 M
Texture:	
Sand	40
Silt	30
Clay	30
Composition:	
Quartz	5
Feldspar	35
Heavy minerals	10
Clay	40
Dolomite	10

SITE 537 HOLE CORE 13 CORED INTERVAL 178.0–187.5 m

Time-rock unit: Indeterminate / Unknown
Biostratigraphic zone: Indeterminate
Fossil character: Barren
Sections: 1, 2 (meters 0.5, 1.0)



LITHOLOGIC DESCRIPTION

SANDSTONE, mottled pale red purple (5RP 6/2) and grayish purple red (5RP 4/2) to weak red (10R 4/3), light greenish gray (5GY 8/1), and white (N9). Consists principally of fine to coarse sand grains of subangular quartz feldspar and lithic fragments in a fine sand matrix. Small lithic fragments are common red quartz porphyry clasts. Larger fragments are up to 4 cm across and include granite, quartz, quartz porphyry, phyllite, and ultramafic rocks (one large clast at ~15 cm Section 1 of extremely weathered pyroxenite[?]). White blotchy calcite cement at 80–110 cm, Section 1 and top Section 2. Some patchy olive yellow (5Y 6/6) mineralization at 54–61 cm, Section 1. Thin light gray clayey patch at ~120 cm, Section 1. No grading or obvious sedimentary structures.

SITE 537 HOLE CORE 14 CORED INTERVAL 187.5–197.0 m

Section: 1

LITHOLOGIC DESCRIPTION

QUARTZ PORPHYRY, reddish brown with large 1–2 mm clear quartz and slightly altered feldspar phenocrysts. Single fragment recovered.

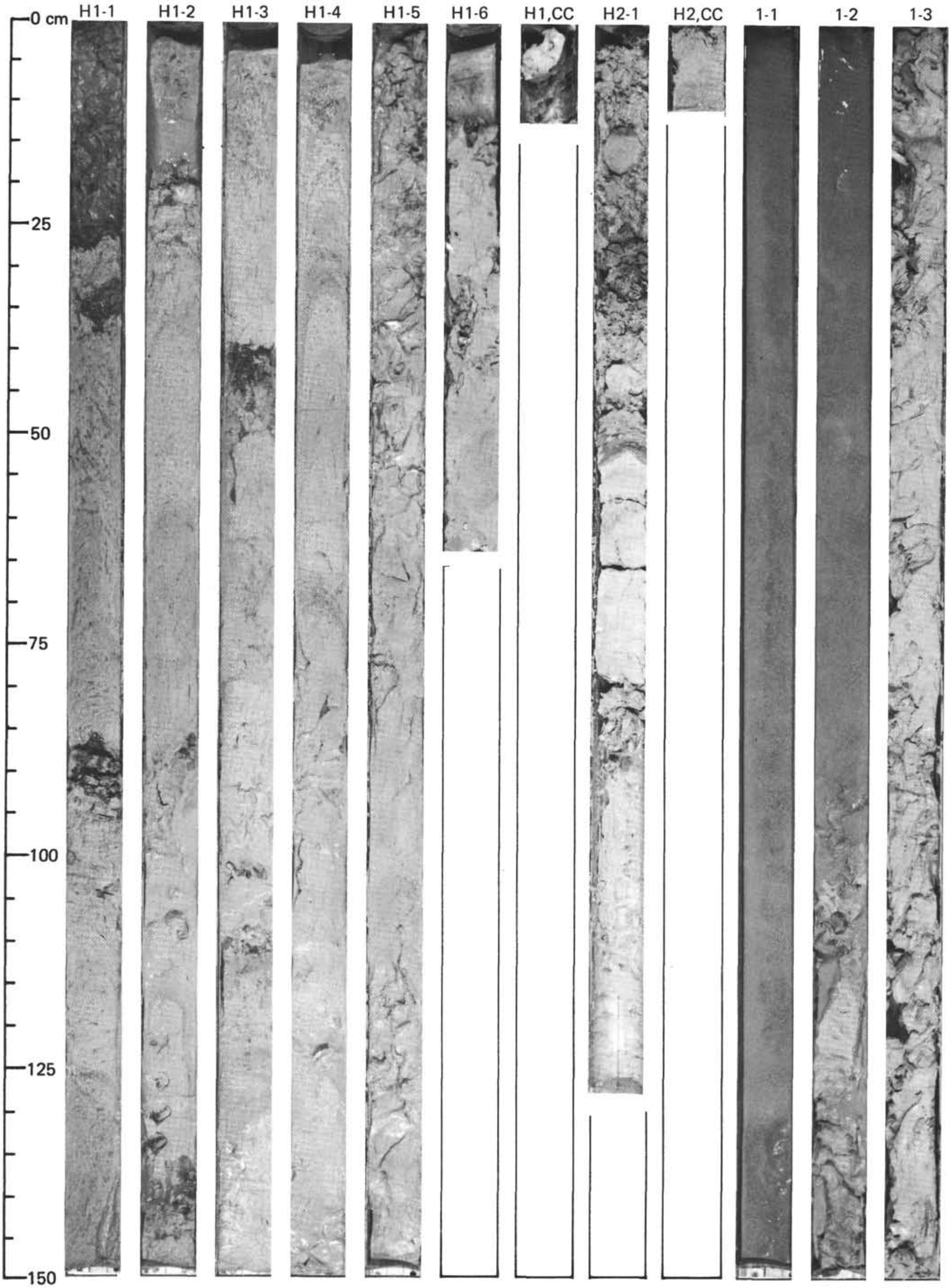
Thin Section:
Phenocrysts include – large 1–2 mm phenocrysts of euhedral to slightly subhedral quartz (~2%), sanidine (~1%), and perthite- and Carlsbad-twinned oligoclase (~2%) (~An_{10-15}). Several altered phenocrysts (~0.5 mm) of green hornblende also present. Groundmass is principally (80%) microgranular quartz (0.01–0.02 mm), some green hornblende altered to clay, euhedral to subhedral opaque minerals and reddish mesostasis (aphanitic). Feldspar phenocrysts partly altered to clays.

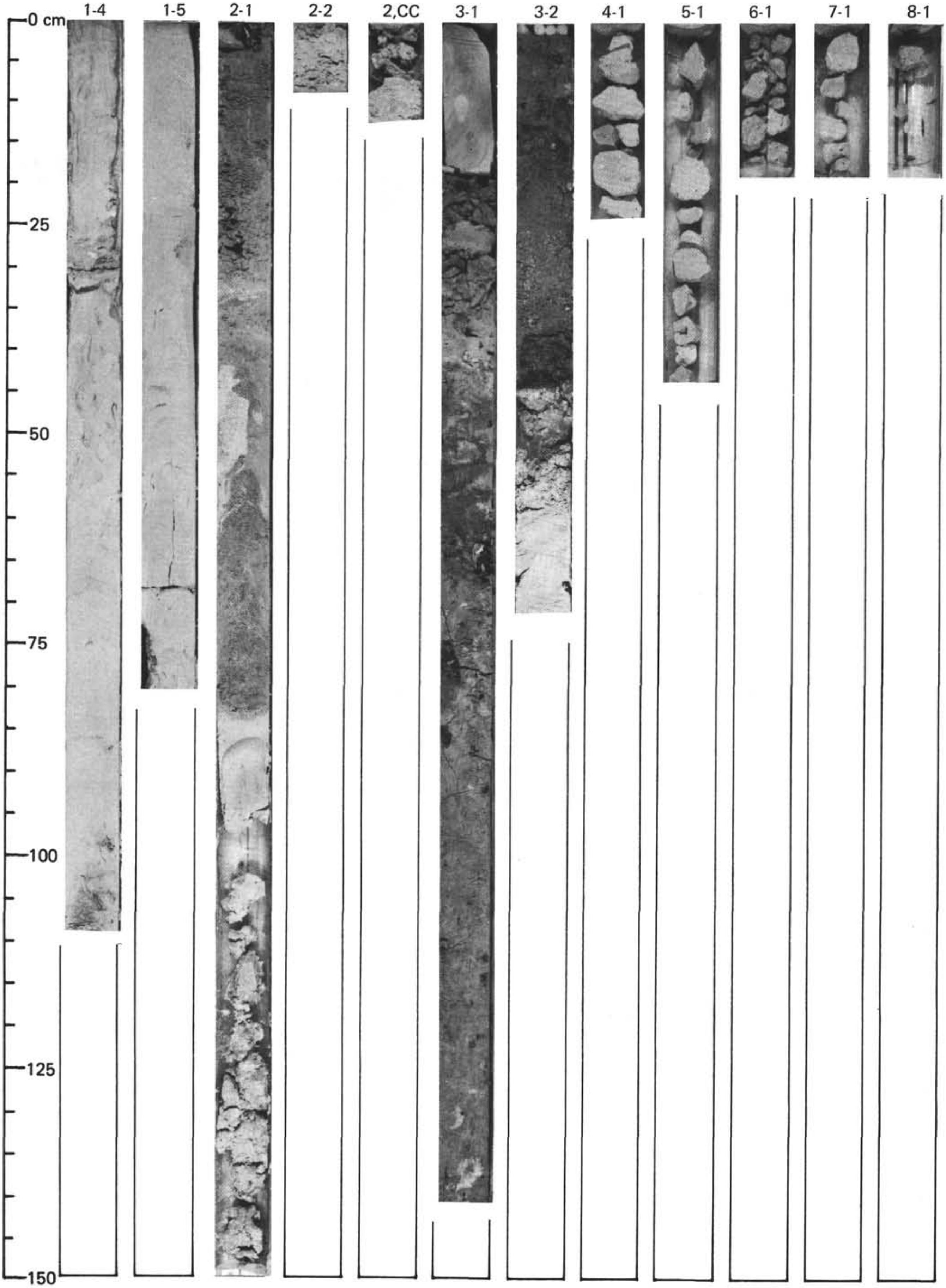
SITE 537 HOLE CORE 15 CORED INTERVAL 197.0–206.5 m

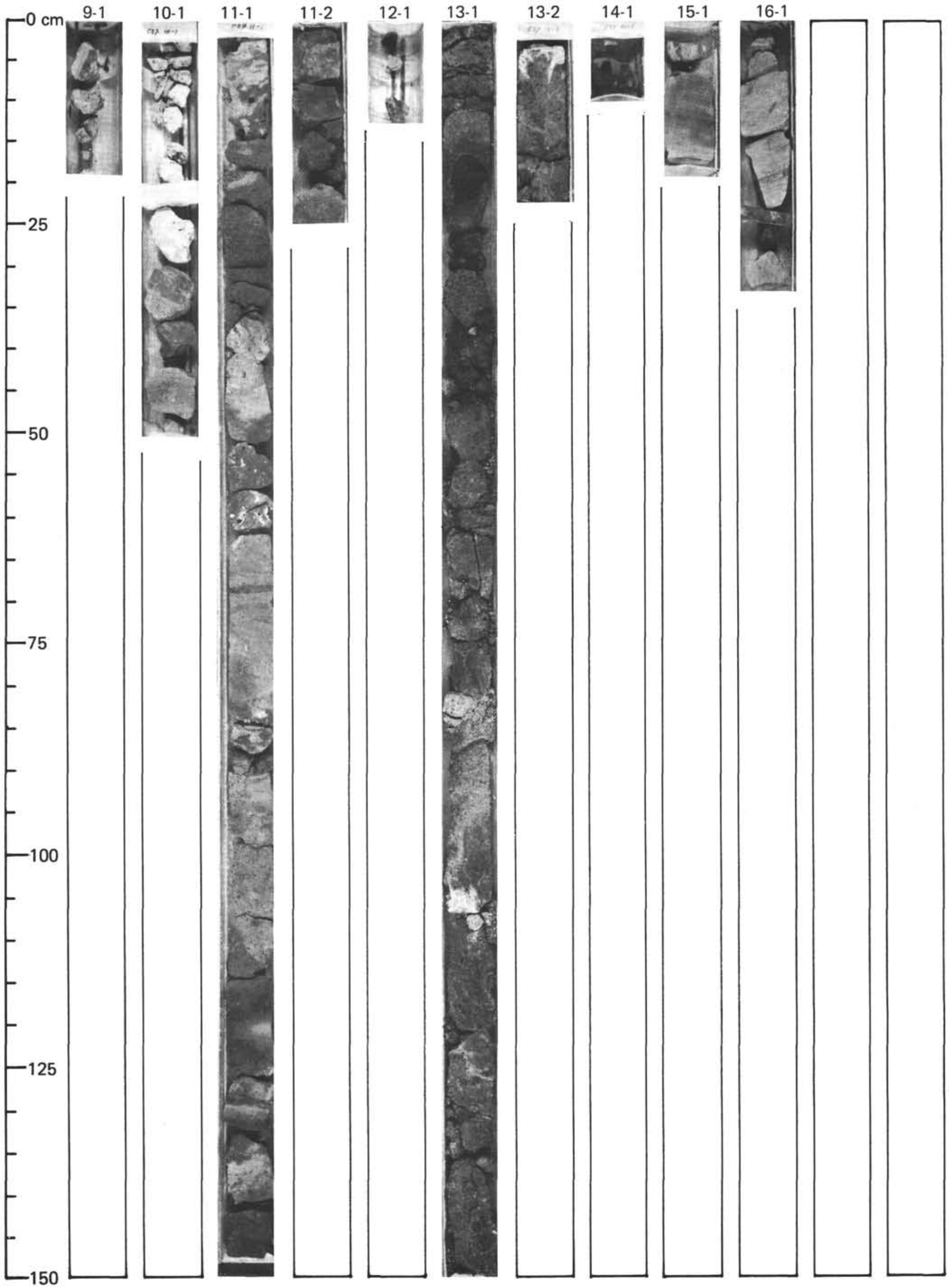
TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
						1					*	PHYLLITE, brownish gray (2.5Y 6/2). Top, smaller piece has thin simple folded laminations at top and base with moderately well developed schistosity. Larger lower piece (~3–15 cm) is layered to laminated, not as schistose as upper piece. Color is mainly light brownish gray (2.5Y 6/4) with soft reddish and gray green hues. Small offset along fracture displaces laminations near top of piece. Lower part of piece is complex with some sharp low angle offsets, lenses of clear quartz(?) and complex fracturing. Top of piece shows well developed cleavage; base shows strong lineation. Layering slightly inclined. Thin Section: 1, 2: Phyllite – consists principally of iron-oxide-stained clay with thin layers of microcrystalline quartz. Layers mostly about 0.1–1.0 mm thick with thinner laminae 10–20 μm thick. Some have sharp top and bottom boundaries, others have sharp bases and gradational tops and appear graded; small quartz grains decrease in abundance and, to some extent, size away from base. Some quartz grains appear flattened, but otherwise little recrystallization is apparent (also no micas or other metamorphic minerals observed). Darker interlayered clay bands are 2 mm to 2 cm thick. Fractures cut layers. Schistosity marked by only slight deformation or laminae and slight wavy extinction in polarized light. Iron-oxide scattered throughout section and along fractures.

SITE 537 HOLE CORE 16 CORED INTERVAL 206.5–215.0 m

TIME – ROCK UNIT	BIOSTRATIGRAPHIC ZONE	FOSSIL CHARACTER: FORAMINIFERS	NANNOFOSSILS	RADIOLARIANS	DIATOMS	SECTION	METERS	GRAPHIC LITHOLOGY	DRILLING DISTURBANCE	SEDIMENTARY STRUCTURES	SAMPLES	LITHOLOGIC DESCRIPTION
						1					*	PHYLLITE, mottled light brownish gray (2.5Y 6/2), weak red (10R 4/3) to dusky green (5G 3/2), banded with several laminations or thin layers that show single, hinged kink fold (~15–20 cm). Fracture sets at ~400°; light olive brown zones bound most of the fractures. Top piece in core is light gray (N7) quartz with lazy areas of weak red, light olive brown, dusky green and yellow (2.5Y 8/6). Thin Section: 1, 29: Phyllite – banded and laminated, alternating between recrystallized quartz and darker clay and mica. Iron-oxide scattered throughout. Quartz is crystalline and forms continuous laminae top of section, lenses and discontinuous layers below. Some appear to be cut but low angle shears. No obvious grading. Recrystallized quartz suggests slightly stronger metamorphism than in Core 15. X-ray diffraction seam of this sample shows quartz-mica-chlorite-albite present. **NOTE: Core 17, 216.0–225.0 m: no recovery.**


0 cm
25
50
75
100
125
150
H1-1
H1-2
H1-3
H1-4
H1-5
H1-6
H1,CC
H2-1
H2,CC
1-1
1-2
1-3


0 cm
25
50
75
100
125
150
1-4
1-5
2-1
2-2
2,CC
3-1
3-2
4-1
5-1
6-1
7-1
8-1


0 cm
25
50
75
100
125
150
9-1
10-1
11-1
11-2
12-1
13-1
13-2
14-1
15-1
16-1