2. SITE 275

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

Location: Southeast Campbell Plateau

Position: 50°26.34'S; 176°18.99'E

Water Depth:
PDR, from sea level: 2800 meters
From drill pipe measurement from derrick floor: 2837 meters (adopted)

Dates Occupied: 4-6 March 1973

Depth of Maximum Penetration: 62 meters

Number of Holes: 1

Number of Cores: 5

Total Length of Cored Section: 43 meters

Total Recovery:
Length: 17.5 meters
Percentage: 40.6

Age of Oldest Sediment Cored: Late Cretaceous

Summary: Six cores were recovered, representing a total penetration of 62 meters. A thin Pleistocene veneer of foraminifera ooze and manganese nodules indicates that a western boundary current is presently active. The erosional surface immediately beneath the veneer rests on 13 meters of Late Cretaceous (late Campanian) radiolarian diatom ooze, which in turn passes down abruptly into more than 39 meters of marine clayey silt with hard silicified layers. The area was the site of active bottom currents in the Late Cretaceous, under open-ocean conditions. The calcium carbonate solution boundary was possibly shallow in Late Cretaceous, as it is in present-day Antarctic latitudes. Well-preserved siliceous flora and fauna.

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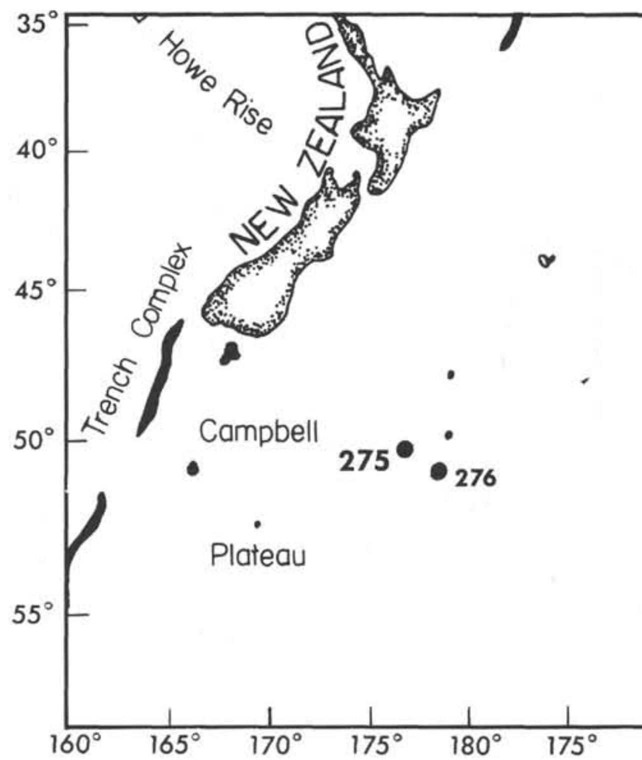


Figure 1. *Location of Site 275, DSDP Leg 29.*

BACKGROUND AND OBJECTIVES

Site 275 is located on the eastern edge of the Campbell Plateau to the southwest of Bounty Islands (Figure 1). Drilling was carried out in a wedge of sediment of varying thickness of up to 1000 meters overlying acoustic basement (Figures 2 and 3).

The site presently is located in central subantarctic waters approximately midway between the Antarctic and the subtropical convergence.

Profiler records over the Campbell Plateau show that approximately 300 meters of sediment have been eroded down to the level of surface sediments at Site 275. The dated age of this surface gives a maximum age for the commencement of the erosional history. The observed erosion is probably closely related to the paleoglacial and bottom-water history of Antarctica and changes in the position of the continental regions during the Late Cretaceous and Cenozoic. The erosion observed may

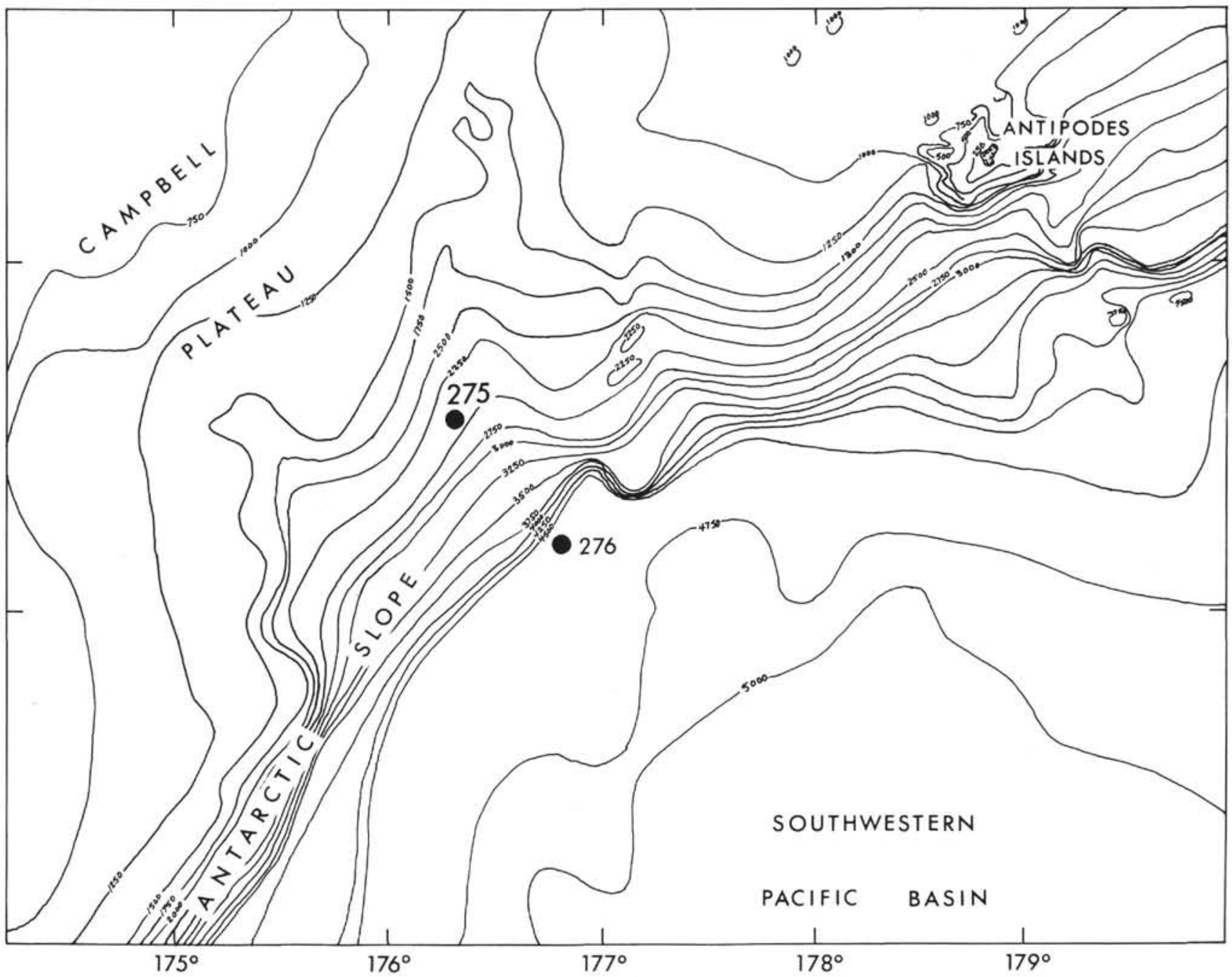


Figure 2. *Bathymetry at Site 275.*

reflect the generation of a western boundary current to the east of the New Zealand region.

There were several major objectives for Site 275: (1) To obtain at least a partial biostratigraphic sequence in subantarctic waters about lat 50°S. (2) To date the erosional surface that occurs over wide areas of the Campbell Plateau and to determine if it is due to bottom erosion. (3) To date the sedimentary sequence immediately overlying basement rocks and to establish the paleoenvironmental conditions at the commencement of deposition of the sedimentary cover. (4) To sample the deepest reflector which is too faint to identify with certainty in the profiler section, but may be basement (Figure 3).

Before the break-up of Gondwanaland, the seaward margin of the Campbell Plateau was joined to Antarctica in the area of the Amundsen-Ross Sea. The separation apparently occurred without the formation of a marginal rift, leading Houtz and Markl (1972) to suggest that the separation began as a shearing motion along this edge of the plateau. This supports Cullen (1967), who first pointed out that the seaward margin of the Campbell Plateau has the appearance of a very long fracture zone. Summerhayes (1969) concluded that the

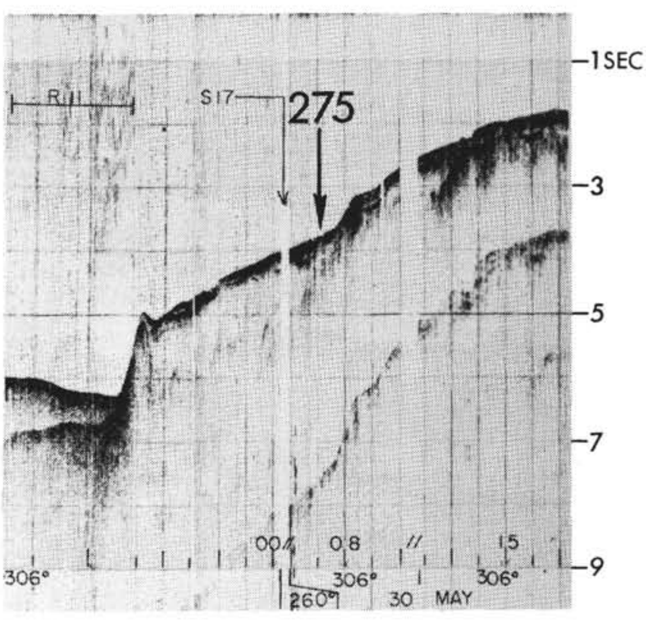


Figure 3. *Profiler section at Site 275.*

Campbell Plateau was eroded to about its present level during earliest Tertiary times, and that since then it has been relatively stable.

The geology of several subantarctic islands associated with the Campbell Plateau and Chatham Rise gives added information about the rocks at Site 275. Basement rocks at the Auckland and Bounty islands are primarily granitic. At Campbell Island they consist of micaceous schists of the Complex Point Series. The results of coring of basement at Site 275 provide information on the distribution of such rock types over the Campbell Plateau. Speculations on these distributions have been made by Fleming (1969) and Hay et al. (1970).

Fleming (1955) and Summerhayes (1969) have suggested that the basement rocks of the Campbell Plateau were uplifted and eroded to base level in the Late Cretaceous. Sedimentation began in the Late Cretaceous with deposition of non-marine quartz conglomerates and carbonaceous mudstones (represented by the Garden Grove Formation of Campbell Island; Oliver et al. [1950]; and the Camp Cove Conglomerate of Auckland Islands; Summerhayes [1969]). In the Campbell Islands these become marine in the upper part as indicated by the presence of benthonic foraminifera. Analyses of benthonic microfossils in the marine sediments above basement enable deposition depths to be determined for the initial sedimentation stages.

On the Campbell Islands a rather sharp transition occurs between the Late Cretaceous Garden Grove Formation, which is primarily non-marine, and the overlying early to middle Oligocene Tucker Cove Formation, which consists of clean foraminiferal limestone reflecting open-ocean conditions. This sequence may represent rapid subsidence of the Campbell Plateau at this time.

Other principal objectives of Site 283 included determining the nature and biostratigraphic changes associated with epoch boundaries: the environment of deposition of the sediments, particularly those that were deposited after formation of basement; the nature and age of an intermediate reflecting horizon at 85 meters; and the composition of basement.

OPERATIONS

Site 275 on the Campbell Slope was approached from the north-northwest following a previous *Eltanin*-43 track (Figure 4). The exact site was selected on topographic expression based on the presite profile seismic

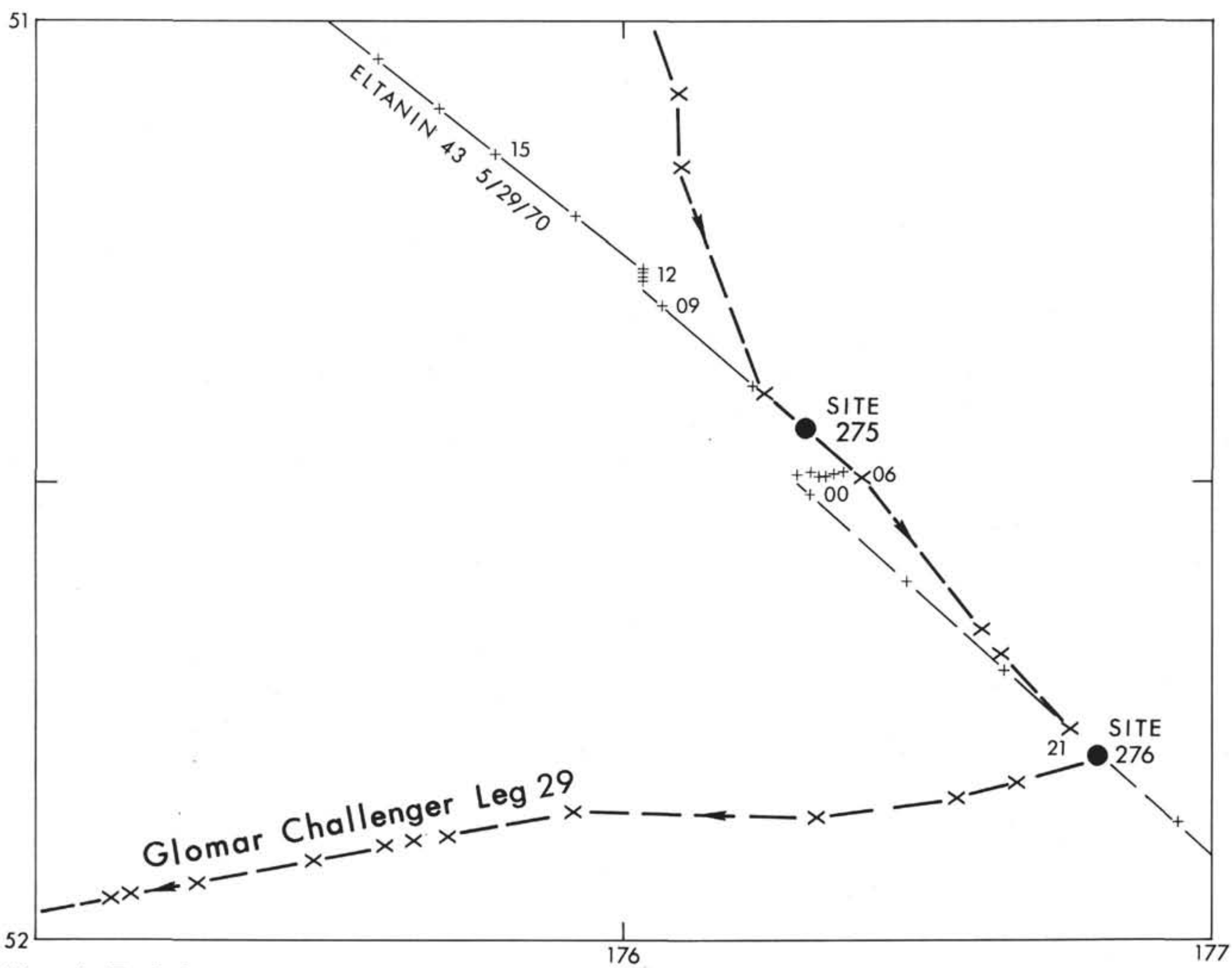


Figure 4. *Track chart.*

information. The beacon was dropped on 4 March 1973 while underway at 9.3 km/hr (5 knots) on a return pass over the site.

The bottom hole assembly and drill pipe were run in. An indefinite bottom was apparent at 2828 meters, and the core barrel was retrieved without any recovery. A definite, firm bottom was found at 2837 meters, and the hole was spudded to cut the first core. When the core barrel reached the surface the swivel assembly shaft broke and the barrel dropped back to bottom. The drill string was pulled to retrieve the core barrel.

After returning to bottom, coring and drilling continued at a slow rate to a total depth of 2899 meters or 62 meters below sea floor (Table 1). A new inner barrel was dropped after retrieving a core at 2899 meters, and the bit was found to be plugged. A core barrel with a center bit was dropped to clear the drill pipe. When the bit was lowered, after being unplugged, 15 meters of hard fill was found on the bottom. This was drilled and cleaned out to 2899 meters and 50 barrels of mud were added to stabilize the hole. Drilling continued for an hour without any penetration. The drill string was pulled and the spline was found to be broken off on the second bumper sub from bottom. The bit, core barrel, three drill collars, and two bumper subs were lost.

TABLE 1
Coring Summary, Site 275

Core	Cored Interval Below Bottom (m)	Cored (m)	Recovery (m)	Recovery (%)
1	0.0-5.0	5.0	5.0	100
2	5.0-14.5	9.5	9.5	100
3	24.0-33.5	9.5	0.0	0.0
4	33.5-43.0	9.5	1.8	19.0
5	52.5-62.0	9.5	1.2	13.0
Total		43.0	17.5	40.6

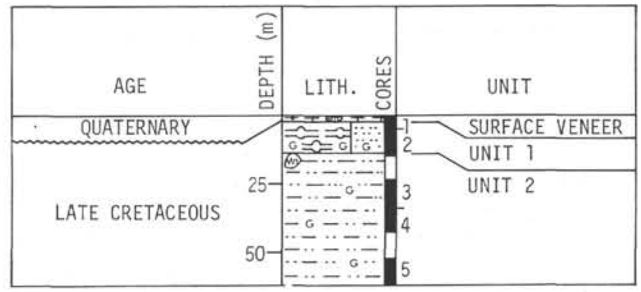


Figure 5. *Stratigraphic sequence, Site 275.*

LITHOLOGY

The upper 62 meters of a two-unit sequence of Late Cretaceous sediments were cored at Site 275 (Figure 5). The presence of a veneer of Quaternary white foraminiferal ooze with scattered manganese nodules probably overlying Unit 1 is inferred from a 1-cm layer of foraminifera tests injected between the core and the core liner in Section 1-3, and from the occurrence of large, black, rounded, spherical-elliptical manganese nodules (some phosphatic) concentrated in those disturbed portions of Unit 1. Quaternary foraminifera occur in the recessed surfaces of some nodules.

Unit 1

Unit 1 is a moderately to intensely mottled, pale-yellow to olive sandy-silt radiolarian diatom ooze. The biogenic fraction consists of predominantly unbroken and unworn diatoms, radiolarians, sponge spicules, and trace amounts of silicoflagellates. The detrital fraction consists of fresh, well-sorted, angular, coarse-silt and fine-sand-size quartz, rock fragments (including schistose and sedimentary rock fragments), brown glauconite pellets (with oxidized rims), some biotite, chlorite, muscovite, and subequal amounts of plagioclase feldspar and potassium feldspar. Heavy minerals include magnetite/ilmenite, leucoxene, zircon, tourmaline, green hornblende, pyrite, sphene, and apatite. Small amounts of kaolin and montmorillonite clay also are present. The glauconite appears to be of detrital origin, perhaps having been reworked from a nearby source. The oxidized rims of the glauconite may reflect reworking. The contact between Units 1 and 2 is distorted and highly disturbed, but probably it was originally a single, sharp bedding plane.

Unit 2

Unit 2 is stiff-lithified, massive-sparsely mottled, dark-olive-gray, glauconite- and micro-nodule-bearing clayey silt. The upper 1 meter, a glauconite and micro-nodule-bearing siliceous, fossil-rich sand-silt-clay, is compositionally and texturally gradational with Unit 1 (Table 2). It is distinguished by its dark color, massive to mottled character, almost complete absence of fossils, persistent small amounts of dark-brown to black spherical micronodules and bright-green fine sand and silt-size botryoidal glauconite, and trace amounts of organic carbon. The scattered diatoms, radiolarians, and sponge spicules are largely broken. In the more lithified lower part of the unit, the rims of some diatoms are pyritized, and a few are filled with green glauconite.

The predominant detrital component is very similar to that of Unit 1, though finer-grained. Quartz, schistose and sedimentary rock fragments, muscovite, biotite, potassium feldspar, plagioclase, chlorite, and montmorillonite predominate. Many of the coarser detrital grains are stained by iron and manganese. The heavy mineral suite is very similar to that occurring in Unit 1 and X-ray diffraction shows small amounts of pyrite to be widely dispersed in the unit.

The unit is distinguished by the presence of cristobalite, tridymite, and, to a lesser extent, clinoptilolite. Cristobalite and tridymite appear to be the diagenetic products of the dissolution of siliceous microfossils. Their appearance marks the first step toward lithification (silicification) which is well developed lower in the unit. This relationship is more clearly illustrated at Sites 280 and 283 (see Site Report Chapters, this volume).

Where stiff, the unit appears massive. However, both the semilithified and lithified sections are characterized

TABLE 2
Sediment Composition as Reported in Smear Slides, Site 275

Sample (Interval in cm)	Diatoms	Radiolaria	Sponge spicules	Silicoflagellates[a]	Quartz	Feldspar	Mica	Heavy Minerals	Clay Minerals	Rock Fragments	Glauconite	Micronodules	Sand	Silt	Clay
Unit 1															
1-1, 117	45	20	10	–	7	1	tr	tr	5	9	2	–	2	83	15
1-1, 145	32	8	5	–	20	1	4	tr	–	15	15	–	15	77	8
1-2, 89	18	12	9	1	20	4	3	1	2	21	9	–	23	69	8
1-2, 93	70	20	2	–	2	tr	2	–	–	2	2	–	3	87	10
1-2, 95	50	11	4	–	8	1	2	tr	4	16	4	–	20	68	12
1-3, 80	40	10	5	–	13	1	2	–	3	13	12	–	18	74	8
1-4, 130	50	12	2	–	14	1	3	1	–	10	7	–	15	75	10
1, CC	45	10	5	–	14	3	1	tr	1	17	4	–	16	74	10
2-2, 49	50	18	2	–	10	3	1	–	–	6	10	–	8	62	30
2-4, 31-33	47	15	3	–	12	3	1	1	2	8	8	–	15	80	5
Transition															
2-6, 60-62	12	4	6	–	28	2	3	1	5	23	10	6	30	40	30
Unit 2															
2-6, 136-138	1	2	2	–	25	4	tr	1	30	17	15	3	20	50	30
4-1, 146	–	1	tr	–	30	3	4	–	25	25	7	5	2	68	30
4-2, 112	–	tr	–	–	15	3	5	4	40	30	tr	2	7	58	35
4-2, 118-120	–	tr	–	–	26	2	3	3	40	18	4	4	12	43	45
5-1, 65	tr	tr	–	–	38	5	4	1	28	10	7	6	1	59	40
5, CC	–	–	–	–	30	3	4	2	30	15	7	9	6	49	45

Note: tr = trace.

[a]Trace quantities of silicoflagellates occur in several samples.

by subhorizontal, discontinuous laminar mottling. Some mottling appears to be discontinuous stratification of current origin; other mottles are probably compressed burrows. Cross-cutting burrow mottles occur at some horizons.

Conclusions

The clay-rich nature of the poorly-sorted sediments of Unit 2, the preservation of some stratification, and the presence of at least a limited infauna, unoxidized authigenic glauconite, and organic carbon, suggest that moderate rates of sedimentation and average circulation conditions, neither totally restricted nor vigorous, prevailed. The sediment probably accumulated in a basin associated with a plateau of undulating topography. This is indicated in the seismic profiles (Figure 3).

Unit 2 is comparable with, and possibly correlative to, the upper part of the Garden Cove Formation (Late Cretaceous-Paleocene) of Campbell Island, 600 km to the west-southwest. Here the Garden Cove Formation rests unconformably on the Complex Point Schist, and consists of quartz pebble conglomerate and pebbly sand passing upwards into interbedded pebbly sandstone and mudstone, then into dark-gray, unbedded though locally laminated, carbonaceous mudstone (Oliver et al., 1950; A. R. Edwards, personal communication). The detrital mineralogy of Unit 2 is also consistent with derivation from the low-grade schists and acid to intermediate igneous rocks of Campbell Plateau (Summerhayes, 1969).

The oxidized nature of the glauconite and the moderately well-sorted nature of the detritus suggests that the Unit 1 sediments accumulated under oxidizing conditions characteristic of open circulation. Bottom currents were strong enough to transport the detritus, but were not sufficiently strong to fragment the delicate siliceous microfossils. The angular and fresh nature of the detritus suggests derivation from a relatively nearby source, probably the schists, and acid and intermediate igneous rocks of the elevated parts of the Campbell Plateau (Summerhayes, 1969). The sediments accumulated on the outer edge of the plateau, possibly at a shallower depth than at present.

GEOCHEMICAL MEASUREMENTS

Alkalinity, *p*H, and salinity measurements are summarized in Table 3 and on Figure 6. The average alkalinity of 2.35 is equal to the surface seawater reference value of 2.35. Alkalinity decreases with depth. Punch-in and flow-through *p*H values were all below that of the seawater reference. The slight decrease in *p*H with depth may be attributed to possible reactions of mineral grains with interstitial waters in the cores. The salinity measurements were all higher than the seawater reference, the highest value being from the deepest sample. It may be significant that the two lithologic units have different salinity values.

BIOSTRATIGRAPHY

The microfossils obtained from Site 275 are dominantly siliceous diatoms, silicoflagellates,

TABLE 3
Shipboard Geochemical Data, Site 275

Core	Section	Sample Interval[a] Top (m)	Avg. (m)	pH Punch-in	Flow-thru	Alkalinity (meq/kg)	Salinity (^{o}/oo)	Lithologic Unit
Surface Seawater Reference				7.81	7.92	2.35	34.1	
1	4	0.0	3.53[b]	7.04	7.67	2.54	35.2	1
2	5	5.0	11.53	7.14	7.20	2.25	35.5	1
Average				7.09	7.43	2.39	35.3	

[a]All samples are 6 cm long. The top of interval refers to the top of the core depth for the sample; the average interval refers to the average of the top and bottom depth of the sampling interval.

[b]Two analyses run, the second on #50 Whatman filter paper. Values are: Flow-thru *p*H=7.45, Alk=2.30, and S=35.2%.

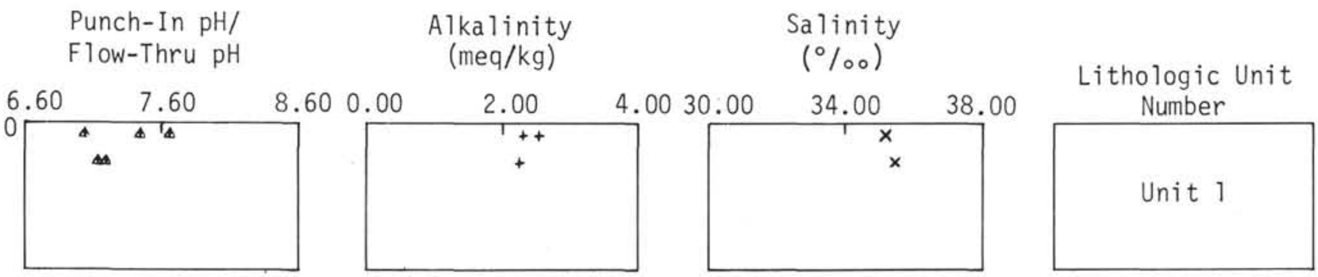


Figure 6. *Shipboard geochemical data versus depth, Site 275.*

radiolarians, dinoflagellate cysts, and miospores (Table 4). Recent-Pleistocene planktonic and benthonic foraminifera and calcareous nannofossils were obtained from the sides of Cores 1 and 2 which had been squeezed in with Recent-Pleistocene sediment. A relatively short-ranging benthonic foraminiferal species was recovered from Sample 275-2, CC. Other organic material includes fish scales and fragments of an inarticulate brachiopod.

The Late Cretaceous (late Campanian) age of the cored sediment was determined from the diatom, silicoflagellate, radiolarian, and palynomorph assemblages.

Foraminifera

Apart from a Pleistocene-Recent fauna which had been squeezed in with sediment into the sides of Cores 1 and 2, the only other species recorded at Site 275 was obtained from Sample 2, CC.

Globorotalia (G.) truncatulinoides Zone

A thin sediment cover of Pleistocene-Recent foraminiferal sand yielded the following planktonic species: *Globigerina (G.) bradyi, G. (G.) bulloides, G. (G.) quinqueloba, Globigerinita incrusta, Globorotalia (G.) truncatulinoides, (G.) (T.)* cf. *crassaformis, G. (T.) inflata, G. (T.) pachyderma, G. (T.) scitula,* and *Orbulina universa.* Also recorded are benthonic foraminiferal genera *Cassidulina, Cibicides, Lagena,* and *Trifarina.*

Late Campanian, Maestrichtian, or Paleocene

Of the eight specimens of *Bolivinopsis spectabilis* (Grzybowski) at least five are microspheric forms and are well preserved except for four specimens that have lost initial portions. Loeblich and Tappan (1964) record the wall of *Bolivinopsis* as "calcareous, possibly of agglutinated fine-grained calcareous particles." The specimens obtained from Site 275 are siliceous. The age range given by Hornibrook (1968) for *B. spectabilis* in terms of New Zealand stages is Haumurian to Teurian. The Haumurian Stage can be correlated with the late Campanian and Maestrichtian (Henderson, 1970; Webb, 1966) and the Teurian Stage with most of the Paleocene (Jenkins, 1964, 1971; Edwards, 1971).

Calcareous Nannofossils

Samples 275-1-2, 90 cm; 275-1-3, 50 cm; 275-2-0, 0 cm; 275-2-4, 50 cm; 275-2-5, 90 cm; and 275-2, CC yielded nannofloras. All of these assemblages are extremely sparse and contain only the cold-water variety of *Cyclococcolithus leptoporus,* rare specimens of *Helicopontosphaera kamptneri, Gephyrocapsa aperta,* and a few specimens of a small indeterminate Prinsiaceae. A Recent-Pleistocene age is inferred, and all six assemblages are considered to represent downhole contamination from surficial sediments. The reason for absence of pre-Pleistocene calcareous nannofossils is not known but it might be due to deposition below the calcite compensation depth.

Diatoms

Cores 1 and 2 are very rich in well-preserved forms. Providing an exact age determination was difficult because many diatom species are undocumented. The flora is very rich in number of specimens and in genera and species. Many of the following diatoms have

TABLE 4
Paleontologic Summary, Site 275

Core	Depth Below Surface (m)	Age	Foraminifera	Nannofossils	Diatoms	Radiolaria
1	0-5	Upper Cretaceous	No foraminifera from cored sediments but 10 species of planktonic foraminifera in sand squeezed down side of core: Age Recent (-? Pleistocene)	1 *C. leptoporus* Recent-Pleistocene downhole contamination	*Trinacria excavata* *Cladogramma jordani* *Stephanopyxis turris* *Coscinodiscus lineatus* Silicoflagellata: *Lyramula furcula* *Corbisema geometrica* Silicospongia spicules	Radiolaria present
2	5-14.5	Upper Cretaceous	*Bolivinopsis spectabilis,* the only species recovered from sediment cored; a few recent (-? Pleist.) planktonic forams squeezed into core.	2 Prinsiaceae, small 6 *C. leptoporus* Recent-Pleistocene downhole contamination	*Trinacria excavata* *Hemiaulus polymorphus* *Micrampulla* sp. *Pterotheca* sp. *Eunotogramma* sp. Silicoflagellata: *Lyramula furcula* *Vallacerta hortoni*	Radiolaria present
3	24-33.5	Upper Cretaceous	No foraminifera	No nannofossils	No diatoms	Radiolaria present
4	33.5-43	Upper Cretaceous	No foraminifera	No nannofossils	*Coscinodiscus* sp. *Hemiaulus* sp. *Stephanopyxis* sp. Silicoflagellata: *Lyramula furcula*	Radiolaria present
5	52.5-62	Upper Cretaceous	No foraminifera	No nannofossils	No diatoms Organic plankton	*Dictyomitra* sp.

previously been recorded from Late Cretaceous shale of Moreno, California, and in the Late Cretaceous of the USSR.

Acanthodiscus antarcticus n. sp., *A. convexus* n. sp., *A. ornatus* n. sp., *Biddulphia cretacea* n. sp., *B. sparsepunctata* n. sp., *Cerataulina cratacea* n. sp., *Chasea bicornis* Hanna, *C. ornata* n. sp., *Cladogramma jordanii* Hanna, *C. simplex* n. sp., *Coscinodiscus circumspectus* Long, Fuge, and Smith, *C. lineatus* Ehr. f. *fossilis* Jousé, *C. morenoensis* Hanna, *Epithelion curvatum* Pantocsek, *E. russicum* Pantocsek, *Eunotogramma fueloepi* n sp., *E. marginopunctata* Long, Fuge, and Smith, *Gladius jouseanus* n. sp., *G. maximus* n. sp., *G. pacificus* n. sp., *G. speciosus* Schulz, *Goniothecium odontella* Ehrenberg, *Hemiaulus curvatulus* Strelnikova, *H. danicus* Grunow, *H. echinulatus* Jousé, *H. gleseri* n. sp., *H. polycystinorum* Ehrenberg, *H. polycystinorum* Ehr. var. *brevicornis* Jousé, *H. polymorphus* Grunow, *H. stradneri* n. sp., *Horodiscus rugosus* n. sp., *Incisoria inordinata* n. sp., *I. punctata* n. sp., *Kentrodiscus armatus* n. sp., *Poretzkia circularis* Jousé, *Pseudopyxilla americana* (Ehr.) Forti, *P. jouseae* n. sp., *P. russica* (Pant.) Forti, *Pterotheca capreolus* (Forti) n. comb., *P. cretacea* n. sp., *P. crucifera* Hanna, *P. danica* Grunow, *P. (Micrampulla) parvula* (Hanna) n. comb., *Rhisosolenia cretacea* n. sp. *Sceptroneis gracilis* n. sp., *Stephanopyxis discrepans* Hanna, *S. simonseni* n. sp., *S. superba* (Grev.) Grunow, *S. turris* (Grev. and Arn.) Ralfs var. *intermedia* Grunow, *Triceratium arietinum* A. Schmidt, *T. kennetti* n. sp., *T. nobile* Witt, *T. praetenue* Greville, *T. sectum* Witt, *Trinacria anissimowii* Jousé, *T. aries* Witt, *T. excavata* Heiberg, *T. insipiens* Witt, *T. pileolus* (Ehr.) Grunow, *T. princeps* Witt, *T. tristictia* Hanna.

The presence of these forms in Cores 1 and 2 thus indicates a late Campanian-Maestrichtian age. All the forms are very well preserved, so the sediment could not be reworked and is considered autochthonous.

All the forms are marine, normally found in normal salinity as neritic or pelagic forms. Most interesting are species of *Trinacria, Hemiaulus, Triceratium, Stephanopyxis* found in Sample 1-1, 118-120 cm. Stephanopyxis forms are abundant. The water may not have been particularly cold, because the Recent *Stephanopyxis* species prefer warmer waters. On the other hand, this form may have had entirely different distributional patterns in the Late Cretaceous.

Radiolaria

Some radiolarians are present, including *Dictyomitra* sp. and *Theoperid* gen. and sp. indet., that have been described by Foreman (1971) from the Late Cretaceous of DSDP Leg 5. The radiolarians are moderately well preserved. Those examined from Samples 1-1, 140 cm, through 4-2, 140 cm, include: *Phaseliforma carinata* Pessagno, *Phaseliforma laxa* Pessagno, *Oribiculiforma renillaeformis* (Campbell and Clark), *Patulibracchium taliaferroi* Pessagno, *Patulibracchium marshensis* Pessagno?, *Staurodictya* (?)*fresnoensis* Foreman, *Peritiviator labyrinthi* Pessagno (n. sp., 1974), *Dictyomitra densicostata* Pessagno (n. sp., 1974), *Neosciadiocapsa diabloensis* Pessagno, *Cornutella* (?)*sanjoaquinensis* (Campbell and Clark), *Amphipyndax teslaensis* (Campbell and Clark). Numerous others, mostly new, also occur.

This assemblage is correlated with the upper part of *Patulibracchium dickinsoni* Zone of California which is latest Campanian (Pessagno, 1974). The *P. dickinsoni* Zone in California is correlative with the *Globotruncana elevata* Subzone, *G. calcarata* Zonule. It is easy to recognize because its base lies above the biohorizon limited by the decline of the *Pseudoaulophacidae* Riedel and the extinction of *Pseudoaulophacus* Pessagno. The top of the zone corresponds to the biohorizon offered by the extinction of the *Phaseliformidae* Pessagno. There are about 30 species present in the assemblage at this horizon. In California there are about 70 species present.

In Sample 5-1, 80 cm, a sparse fauna is present which still appears to be allied to that of the section above. This sample also probably correlates with the latest Campanian *P. dickinsoni* Zone.

Silicoflagellates

Silicoflagellates are common, diverse, and moderately well preserved in the radiolarian-diatom ooze of Unit 1, (Sections 275-1-1 to 275-2-6). Preservation is poorer in Sample 275-2, CC which belongs to Unit 2. In Core 275-4, also within Unit 2, silicoflagellates are very rare and poorly preserved.

The following species were found (see also Chapters 24 and 26, this volume): *Corbisema archangelskiana, C. geometrica, C. geometrica* var. *apiculata, C. latera diata, Dictyocha quadralta, Lyramula deflandrei, L. furcula, L. furcula* var. *minor, L. simplex, Vallacerta hortonii, V. quadrata, V. tumidula.* This rich assemblage indicates a Late Cretaceous (probably Maestrichtian) age for the succession. Similar assemblages have been reported from Late Cretaceous deposits in Northern Europe, the Arctic Sea, and California.

Palynology

Four cores, Core 1 (4 samples), Core 2 (6 samples), Core 4 (1 sample), and Core 5 (1 sample), were examined for palynomorphs. The upper diatom ooze unit yielded very sparse palynomorph assemblages, including a very small number of Eocene dinoflagellate taxa (present in one sample only), presumably resulting from laboratory contamination. The Late Cretaceous pollen species, *Beaupreaidites elegansiformis* Cookson, is the only stratigraphically useful palynomorph species in this unit. All of Core 1 and the middle part of Core 2 are barren.

The lower detrital unit yielded relatively rich assemblages of Late Cretaceous dinoflagellate cysts and miospores. Characteristic dinoflagellate species include *Svalbardella granulata* Wilson, *S.* aff. *australina* Cookson, *Deflandrea cretacea* Cookson, *D. acutula* Wilson, "*Leiosphaeridia ovata*" Wilson, *Cribroperidinium* cf. *orthoceras* (Eisenack), *Dinogymnium* cf. *nelsonense* Cookson, and a distinctive undescribed spinulose species of *Deflandrea,* abundant in the New Zealand Haumurian (late Campanian to Maestrichtian).

The Late Cretaceous colonial green alga, *Palambages morulosa* O. Wetzel, is fairly common. Stratigraphically useful miospore species include *Beaupreaidites elegansiformis* Cookson, *Nothofagus kaitangata* Te Punga, *Tricolpites waiparaensis* Couper, *T. lilliei* Couper, and *Phyllocladidites mawsonii* Cookson, all of which are either restricted to, or are most abundant in, the Haumurian stage.

Palynomorph assemblages from Unit 2 correlate fairly well with those from the Garden Cove Formation of Campbell Island, about 600 km to the southwest. This formation, originally considered entirely lower Tertiary is now thought to include the uppermost Cretaceous (Wilson, 1967, 1972).

The majority of the palynomorphs have been recorded from various New Zealand Haumurian localities. From the results of current work it seems that assemblages of Site 275 are well represented in the New Zealand Late Cretaceous type section of Haumuri Bluffs. (See Chapter 28, this volume).

SEISMIC DATA

The profiler data (Figure 5 in Houtz, Chapter 42, this volume), show that about 300 meters of conformable stratified sediment has been removed by erosion at Site 275. This material is underlain by a layer that rests on basement. The upper surface of this layer is highly reflective, but has very few internal reflectors. The pronounced difference in the acoustic character of the upper and lower layers suggests pronounced differences in their lithologic character and geologic settings. The reflector at this boundary is the strongest and most widespread on the southern part of the plateau, and is therefore a prominent and useful marker. Drilling revealed at Site 275 that it is composed of Upper Cretaceous clastics.

In addition to the highly reflective nature of the outcropping layer, the PDR showed a rough sea floor with small-scale side echoes, substantiating the lack of a soft sediment cover. Lamont-Doherty sonobuoy stations from the plateau indicated that the outcropping layer was composed of material with a sonic velocity of about 2.7 km/sec, a very high value for a surface layer. The most direct evidence of hardness can be seen where numerous submarine canyons, incising the upper stratified layers, rarely penetrate more than a few meters into the highly reflective layer (Figure 4).

SUMMARY AND CONCLUSIONS

Site 275 is in 2837 meters of water on the southeast part of the Campbell Plateau (Figures 1 and 2). Site 275 is located on an exposure of an acoustically reverberant erosional surface that is widespread and can be traced throughout much of the Campbell Plateau.

Sixty-two meters of sediment were drilled before the site was abandoned because of an impenetrable hard layer. Two distinct stratigraphic units of Late Cretaceous age (latest Campanian), covered by a thin layer of Quaternary white foraminiferal ooze and a scattering of manganese nodules were cored. The presence of this layer or veneer is inferred from down-core contamination by this material in the cores.

The first stratigraphic unit (Unit 1) consists of 13 meters of a pale-yellow to olive sandy silt-rich radiolarian diatom ooze. Unit 1 is abruptly underlain by 39 meters of dark-olive-gray, poorly sorted, clayey silt or silty clay with hard siliceous layers (Unit 2). This unit is rich in authigenic glauconite, clay minerals, and muscovite, and contains abundant stained angular quartz and other detrital minerals. While siliceous microfossils are abundant and well preserved in Unit 1, they are generally rare and fairly poorly preserved in Unit 2. The Late Cretaceous siliceous oceanic microfossils are the most southerly available in the Southern Hemisphere.

No calcareous microfossils are present in the Late Cretaceous sediments. The only calcareous foraminifera and nannofossils found are of Quaternary age, and apparently have been reworked downward from the thin surficial sediments.

The two Late Cretaceous lithological units appear to represent deposition in environments with distinctly different conditions. Unit 2 shows the preservation of some stratification, the presence of at least a limited infauna, unoxidized authigenic glauconite and carbonaceous matter, and a clay-rich nature in poorly sorted sediments. These indicate deposition in an area of reduced rather than open-ocean circulation. The general paucity of microfossils supports this interpretation.

Conversely, in Unit 1, the abundance of diatoms and radiolarians, oxidized glauconite, and the moderately sorted detrital fraction suggest that the sediments accumulated under the oxidizing conditions characteristic of open circulation. The abruptness of the boundary between the two units suggests a rapid environmental change between Units 2 and 1. Sorting of the detritus in Unit 1 also suggests the presence of bottom currents although these are inferred to be relatively weak because of the excellent preservation of the delicate microfossils and the angularity and freshness of the quartz grains.

The absence of calcareous foraminifera and nannofossils in both units of the Late Cretaceous sequence and the abundance of siliceous microfossils in Unit 1 further suggest that the sediments were deposited below the calcium carbonate compensation depth. The biogenic characteristics of Unit 1 are strongly analogous to the sediments of similar depths in present day northern Antarctic waters (57°-63°S), where siliceous microfossils are extremely important and calcareous forms are highly reduced because of the relatively shallow depths of dissolution. the absence of calcareous microfossils in the Upper Cretaceous of this site may be evidence of a former more southerly latitude for the Campbell Plateau. This is consistent with the generally accepted hypothesis that the Campbell Plateau was adjacent to the Ross Sea sector of Antarctica in the Cretaceous. It is significant that the well-preserved radiolarian fauna present has a diversity of less than half that of similar-aged sediments of California. (Pessagno, 1974), thus suggesting deposition at a cool, high-latitude region.

Following deposition of the Late Cretaceous sediments on the southern Campbell Plateau, at least 300 meters of Tertiary sediments were deposited. Later in the Tertiary, these sediments were in turn extensively eroded by bottom currents along the southern edge of the Plateau. This erosion may be indicative of the development of a strong western boundary current in the southern Campbell Plateau area.

The presence of the thin veneer of Quaternary sediments associated with a manganese nodule pavement (see also Summerhayes, 1969) indicates that this current is presently active. Stommel (1958) predicted the presence of a northward-flowing boundary current in this region. Warren (1970) proved its presence by hydrographic measurements and has shown that its width is considerably greater than that envisioned in the usual boundary layer analysis. Extensive erosion on the southern part of the Campbell Plateau, shown in the

Eltanin profiles, not only supports this, but also demonstrates that the boundary current extends into much shallower water than generally assumed. The time of initiation of this bottom current system cannot be determined from the sequence at Site 275 as the entire Tertiary has been removed by erosion.

REFERENCES

Cullen, D., 1967. The Antipodes fracture zone, a major structure of the South West Pacific: New Zealand J. Marine Freshwater Res., v. 1 (1), p. 16-25.

Edwards, A. R., 1971. A calcareous nannoplankton zonation of the New Zealand Paleogene: Planktonic Conf., 2nd, Roma 1970, Proc., p. 381-419.

Fleming, C. A., 1955. Ecology of the subantarctic islands: New Zealand Ecolog. Soc. Proc., v. 2 (16), p. 16.

_______, 1969. The Mesozoic of New Zealand: Chapters in the History of the circum-Pacific mobile belt: Quar. J. Geol. Soc. London, v. 125, p. 125-170.

Foreman, H. P., 1971. Cretaceous Radiolaria. *In* Winterer, E. L., Riedel, W. R., et al., Initial Reports of the Deep Sea Drilling Project, Volume 7: Washington (U.S. Government Printing Office), p. 1683-1693.

Hay, R. F., Mutch, A. R., and Watters, W. A., 1970. Geology of the Chatham Islands: New Zealand Geol. Surv. Bull. 83, p. 1-86.

Henderson, R. A., 1970. Ammonoidea from the Mata Series (Santonian-Maastrichtian) of New Zealand: Spec. Pap. Paleontol. 6, (Paleontological Association, London), p. 1-82.

Hornibrook, N de B., 1968. Handbook of New Zealand microfossils: New Zealand Geol. Surv. Handbook, Info. Ser. 62, Wellington, 136 p.

Houtz, R. and Markl, R., 1972. Seismic profiler data between Antarctica and Australia. *In* Hayes, D. E. (Ed.), Antarctic Oceanology II: The Australian-New Zealand Sector, Antarctic Res. Ser., v. 19, Geophys. Union, p. 295-315.

Jenkins, D. G., 1964. Location of the Danian-Upper Paleocene-Eocene boundaries in North Canterbury: New Zealand J. Geol. Geophys., v. 7 (4), p. 890-891.

_______, 1971. New Zealand Cenozoic planktonic foraminifera: New Zealand Geol. Surv. Paleontol. Bull. 42. p. 1-278.

Loeblich, A. R. and Tappan, H., 1964. Treatise on invertebrate paleontology. Part C: Protista 2, Sarcodina chiefly "Thecamoebians" and foraminiferida: Geol. Soc. Am., Univ. Kansas Press.

Oliver, R. L., Finlay, H. J., and Fleming, C. A., 1950. The geology of Campbell Island. New Zealand Dept. Sci. Ind. Res., Cape Expedition Ser. Bull 3, Wellington, New Zealand, p. 1-62.

Pessagno, E., 1974. Radiolarian zonation and stratigraphy of the Upper Cretaceous of the Great Valley sequence, Calif. Coast Ranges. Micropaleo. Spec. Paper 1, p. 1-233.

Stommel, M., 1958. The abyssal circulation: Deep-Sea Res., v. 5 (1), p. 80-82.

Summerhayes, C., 1969. Marine geology of the New Zealand subantarctic seafloor, New Zealand Ocean: Inst. Mem. 50, p. 1-92.

Warren, B. A., 1970. General circulation of the South Pacific: *In* Wooster, W. S. (Ed.), Scientific exploration of the South Pacific: Natl. Acad. Sci., Washington, D. C., p. 33-49.

Webb, P. N., 1966. New Zealand Late Cretaceous foraminifera and stratigraphy. Schofanus & Jens N. V. Utrecht (Nederland), p. 1-19.

Wilson, G. J., 1967. Microplankton from the Garden Cove Formation, Campbell Island: New Zealand J. Bot., v. 5 (2), p. 223-240.

_______, 1972. Age of the Garden Cove Formation, Campbell Island: *In* Notes from the New Zealand Geological Survey—7 (Paleontological). New Zealand J. Geol. Geophys., v. 15 (1), p. 184-185.

APPENDIX A
Summary of X-Ray[a], Grain Size, and Carbon-Carbonate Results, Site 275

Section	Sample Depth Below Sea Floor (m)	Lithology	Age	Bulk Sample Major Constituent			X-Ray[b] 2-20μ Fraction Major Constituents			<2μ Fraction Major Constituents			Grain Size			Classification	Carbon Carbonate			Comments
				1	2	3	1	2	3	1	2	3	Sand (%)	Silt (%)	Clay (%)		Total (%)	Organic (%)	$CaCO_3$ (%)	
1-1	1.2-1.4	**Unit 1** Sandy silt radiolarian diatom ooze	Late Cretaceous	Quar.	Mica	K-Fe	Quar.	Mica	K-Fe	Mont.	Mica	Quar.	37.2	32.2	30.6	Sand-silt-clay	–	–	–	Gyps. (Bulk and <2μ
1-3	3.6			–	–	–	–	–	–	–	–	–	34.0	29.6	36.4	Sand-silt-clay	–	–	–	Amph. in 2-20μ
2-3	9.4			Quar.	K-Fe	Plag.	Quar.	Plag.	K-Fe	Mica	Quar.	Plag.	–	–	–	–	–	–	–	Gyps. in <2μ
2-5	12.2			Quar.	Mica	Plag.	Quar.	Mica	K-Fe	Mont.	Quar.	Mica	31.1	32.4	36.5	Sand-silt-clay	–	–	–	
2-6	13.5	**Unit 2** Glauconite and micronodule-bearing silty clay (clayey silt)	Late Cretaceous	Quar.	Mica	K-Fe	Mica	Quar.	Clin.	Mica	Mont.	Clin.	33.1	36.8	30.1	Sand-silt-clay	–	–	–	Pyri. – in bulk, 2-20μ and <2μ
4-2	35.7-36.2			Mica	Quar.	Cris.	Mica	Quar.	*	Cris.	Mont.	Mica	5.1	42.9	52.0	Silty clay	4.3	0.9	29	*Cris., K-Fe, Plag. equal in abundance Pyri. in bulk, 2-20μ and <2μ

Note: * = see comment column.

[a]Complete results of X-Ray, Site 275 will be found in Appendix I.

[b]Legend for mineralorical Abbreviations – applies to similar tables in Site Report Chapters 4 to 11. (Sites 277 to 284):

Quar. = Quartz
Plag. = Plagioclase
K-Fe = Potash Feldspar
Clin. = Clinoptilolite
Mont. = Montmorillonite
Cris. = Cristobalite

Calc. = Calcite
Kaol = Kaolinite
Trid. = Tridymite
Hali. = Halite
Bari. = Barite
Chlo. = Chlorite

Apat. = Apatite
Arag. = Aragonite
Augi. = Augite
Dolo. = Dolomite
Pyri. = Pyrite
Gyps. = Gypsum

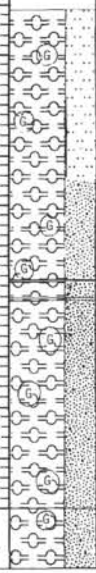
Mixl. = Mixed layer mica-montmorillonite.

Site Hole Core 1 Cored Interval: 0.0-5.0 m

AGE: LATE CAMPANIAN

	FOSSIL	ABUND.	PRES.
Section 1	D	A	VG
	S	A	VG
	R	A	VG
	A	F	VG
	N	—	
	P	—	
	N		
Section 2	N	—	
	P		
	N	R*	M
Section 3	N	R*	
	P		
	F	C*	G
	N		
Section 4	N	—	
	P	—	
	N	—	
Core Catcher	N	—	
	F	—	
	R	C	G
	D	A	G

METERS: 0.5, 1.0 — Section 1: VOID



LITHO. SAMPLE: 117, 145, 89, 93.5, 95, 80, 130, CC

LITHOLOGIC DESCRIPTION

UNIT 1. Pale yellow (5Y 7/3) and olive (5Y 5/3) soft, moderate to intensely mottled GLAUCONITE-BEARING SILT RAD DIATOM OOZE; larger color mottles are either enriched or impoverished in detrital grains (see SS 2-89 and 2-93.5); laminae of pale yellow silt occur at 3-76 and 3-94; Sec. 3 (45-135 cm) has a narrow wall zone parallel to liner, of FORAM OOZE (represents thin sea-floor veneer dragged down during drilling); detrital grains consist of: angular silt to fine sand-size quartz, schistose and indeterminate rock fragments, biotite, chlorite, plagioclase. Glauconite oxidized brown; rare Mn and phosphorous coated small pebbles of Holocene age, incorporated during drilling.

SS 1-117		SS 1-145		SS 2-89 (mottles)		SS 2-93 (mottles)		SS 2-95	
D	-45%	D	-32%	D	-18%	D	-70%	D	-50%
R	-20%	R	- 8%	R	-12%	R	-20%	R	-11%
S	-10%	S	- 5%	S	- 9%	S	- 2%	S	- 4%
Q	- 7%	Q	-20%	Si	- 1%	Q	- 2%	Q	- 8%
Fd	- 1%	Fd	- 1%	Q	-20%	Fd	- TR	Fd	- 1%
Mi	- TR	Mi	- 4%	Fd	- 4%	Mi	- 2%	Mi	- 2%
HM	- TR	HM	- TR	Mi	- 3%	RF	- 2%	HM	- TR
CM	- 5%	RF	-15%	HM	- 1%	G	- 2%	CM	- 4%
RF	- 9%	G	-15%	CM	- 2%			RF	-16%
G	- 2%			RF	-21%			G	- 4%
				G	- 9%				
Sd	- 2%	Sd	-15%	Sd	-23%	Sd	- 3%	Sd	-20%
ST	-83%	ST	-77%	ST	-69%	ST	-87%	ST	-68%
CL	-15%	CL	- 8%	CL	- 8%	CL	-10%	CL	-12%

SS 3-80		SS 4-130		SS CC	
D	-40%	D	-50%	D	-40%
R	-10%	R	-12%	R	-10%
S	- 5%	S	- 2%	S	- 5%
Q	-13%	Q	-14%	Q	-14%
Fd	- 1%	Fd	- 1%	Fd	- 3%
Mi	- 2%	Mi	- 3%	Mi	- 1%
CM	- 3%	HM	- 1%	HM	- TR
RF	-13%	RF	-10%	CM	- 1%
G	-12%	G	- 7%	RF	-17%
				G	- 4%
Sd	-18%	Sd	-15%	Sd	-16%
ST	-74%	ST	-75%	ST	-74%
CL	- 8%	CL	-10%	CL	-10%

X-ray 1-122 (Bulk)

Quar	- A	Chlo	- TR
K-Fe	- P	Mont	- P
Plag	- P	Gyps	- TR
Mica	- P		

Grain Size 1-137(37.2, 32.2, 30.6)
Grain Size 3-63(34.0, 29.6, 36.4)

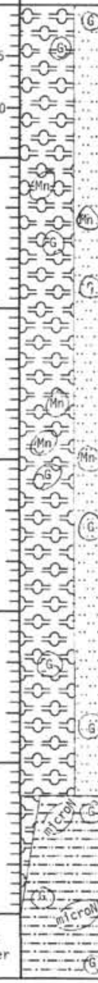
A = Archaeomonads in fossil column
* Downhole contamination

Site 275 Hole Core 2 Cored Interval: 5.0-14.5 m

AGE: LATE CAMPANIAN

	FOSSIL	ABUND.	PRES.
Section 1	N		
	P	R	M
	N	—	
	A	F	G
	R	A	G
	D	A	VG
	S	A	VG
Section 2	N	—	
	P	—	
	N	—	
Section 3	N	—	
	P	—	
	N	—	
Section 4	N	—	
	P	—	
	N	—	
Section 5	N	—	
	P	R	M
	N	R*	M
Section 6	N	—	
	P	A	G
	N	—	
	D	F	G
	S	F	G
Core Catcher	N	R*	M
	F	R	G
	R	C	G

METERS: 0.5, 1.0



LITHO. SAMPLE: 49, 31, 60, 136

LITHOLOGIC DESCRIPTION

UNIT 1 of Core 2 continues to Sec. 6 (30 cm): olive and yellow, fine mottled, GLAUCONITE-BEARING SILTY RAD DIATOM OOZE; phosphatized manganese nodule of Holocene age are concentrated at two horizons. They are black, rounded, spherical to elliptical, and with a botryoidal outer surface. They have been displaced downward from the sea floor, during drilling; clay-rich patches at places (SS 2-49); moderately deformed zone at Sec. 6 (0-30 cm) has patches of UNIT 1 intermixed with UNIT 2; diminishes downward; UNIT 2 (Sec. 6 30-150 cm) very dark gray (5Y 3/1), massive, GLAUCONITE AND MICRO-NODULE-BEARING, SAND-SILT-CLAY, transition zone at top (Sec. 6, 30-130 cm): soft, rich in siliceous fossils, and detrital grains coarser (SS 6-60), passes rapidly into lithology characteristic of next unit (SS 6-136).

SS 2-49		SS 4-31		SS 6-60		SS 6-136	
D	-50%	D	-47%	D	-12%	D	- 1%
R	-18%	R	-15%	R	- 4%	R	- 2%
S	- 2%	S	- 3%	S	- 6%	S	- 2%
Q	-10%	Q	-12%	Q	-28%	Q	-25%
Fd	- 3%	Fd	- 3%	Fd	- 2%	Fd	- 4%
Mi	- 1%	Mi	- 1%	Mi	- 3%	Mi	- TR
RF	- 6%	HM	- 1%	HM	- 1%	HM	- 1%
G	-10%	CM	- 2%	CM	- 5%	CM	-30%
		RF	- 8%	RF	-23%	RF	-17%
		G	- 8%	G	-10%	G	-15%
				Micron	- 6%	Micron	- 3%
Sd	- 8%	Sd	-15%	Sd	-30%	Sd	-20%
ST	-62%	ST	-80%	ST	-40%	ST	-50%
CL	-30%	CL	- 5%	CL	-30%	CL	-30%

X-ray 3-142 (Bulk)
Quar - A
K-Fe - A
Plag - P
Mica - P
Chlo - TR

X-ray 5-103 (Bulk)
Quar - A
K-Fe - P
Plag - P
Mica - P
Chlo - TR

X-ray 6-122 (Bulk)

Quar	- A	Chlo	- TR
Cris	- TR	Mont	- TR
K-Fe	- P	Trid	- TR
Plag	- P	Clin	- TR
Mica	- P	Pyri	- TR

Grain Size 5-120(31.1, 32.4, 36.5)
Grain Size 6-101(33.1, 36.8, 30.1)

Explanatory notes in Chapter 1
*Downhole contamination

Site 275 Hole Core 3 Cored Interval: 24.0-33.5 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
		N	—		Core Catcher					Core catcher only recovery. Consists of mixed: 4-5 cm black spherical or botryoidal Mn nodules with botryoidal surfaces and 3-6 cm dark olive gray (5Y 3/2), subequant and angular fragments of GLAUCONITE-BEARING CLAYEY SILTSTONE.

*Downhole contamination

Site 275 Hole Core 4 Cored Interval: 33.5-43.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
LATE CAMPANIAN					1	0.5 1.0			146	
		N P N D S R	— F — R R R	 M P P P	2				112 118	
		N F R	— — R	G	Core Catcher					

UNIT 2 (Sec. 1 (125 cm) continued: dark olive gray (5Y 3/2), stiff, massive, GLAUCONITE AND MICRONODULE-BEARING CLAYEY SILT; some brecciated horizons of CLAYEY SILTSTONE (semi-lithified); at 2-109 cm, 1 cm lamina of GLAUCONITE-RICH SILTY CLAY; at 2-112 cm, 5 cm bed: dark gray (2.5YR N/4), slightly fine mottled NODULE-BEARING SILTY CLAY, glauconite is bright green and botryoidal throughout; core catcher composition: dark olive gray (5Y 3/2), stiff, GLAUCONITIC CLAYEY SILT and very dark gray (5Y 3/1), with lithified, discontinuous wavy-laminated GLAUCONITE-BEARING CLAYEY SILTSTONE and SILTY CLAYSTONE.

SS 1-146		SS 2-112		SS 2-118	
R	- 1%	R	- TR	R	- TR
S	- TR	Q	-15%	Q	-26%
Q	-30%	Fd	- 3%	Fd	- 2%
Fd	- 3%	Mi	- 5%	Mi	- 3%
Mi	- 4%	HM	- 4%	HM	- 3%
CM	-25%	CM	-40%	CM	-40%
RF	-25%	RF	-30%	RF	-18%
G	- 7%	G	- TR	G	- 4%
Micron	- 5%	Micron	- 2%	Micron	- 4%
Sd	- 2%	Sd	- 5%	Sd	-12%
ST	-68%	ST	-43%	ST	-43%
CL	-30%	CL	-52%	CL	-45%

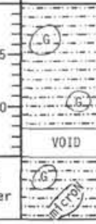
X-ray 2-68 (Bulk)

Quar	- P	Mica	- A
Cris	- P	Chlo	- TR
K-Fe	- P	Mont	- TR
Plag	- P	Trid	- TR
		Pyri	- TR

Grain Size 2-112 (5.1, 42.9, 52.0)

Carbon Carbonate 2-122 (4.3, 0.9, 29.0)

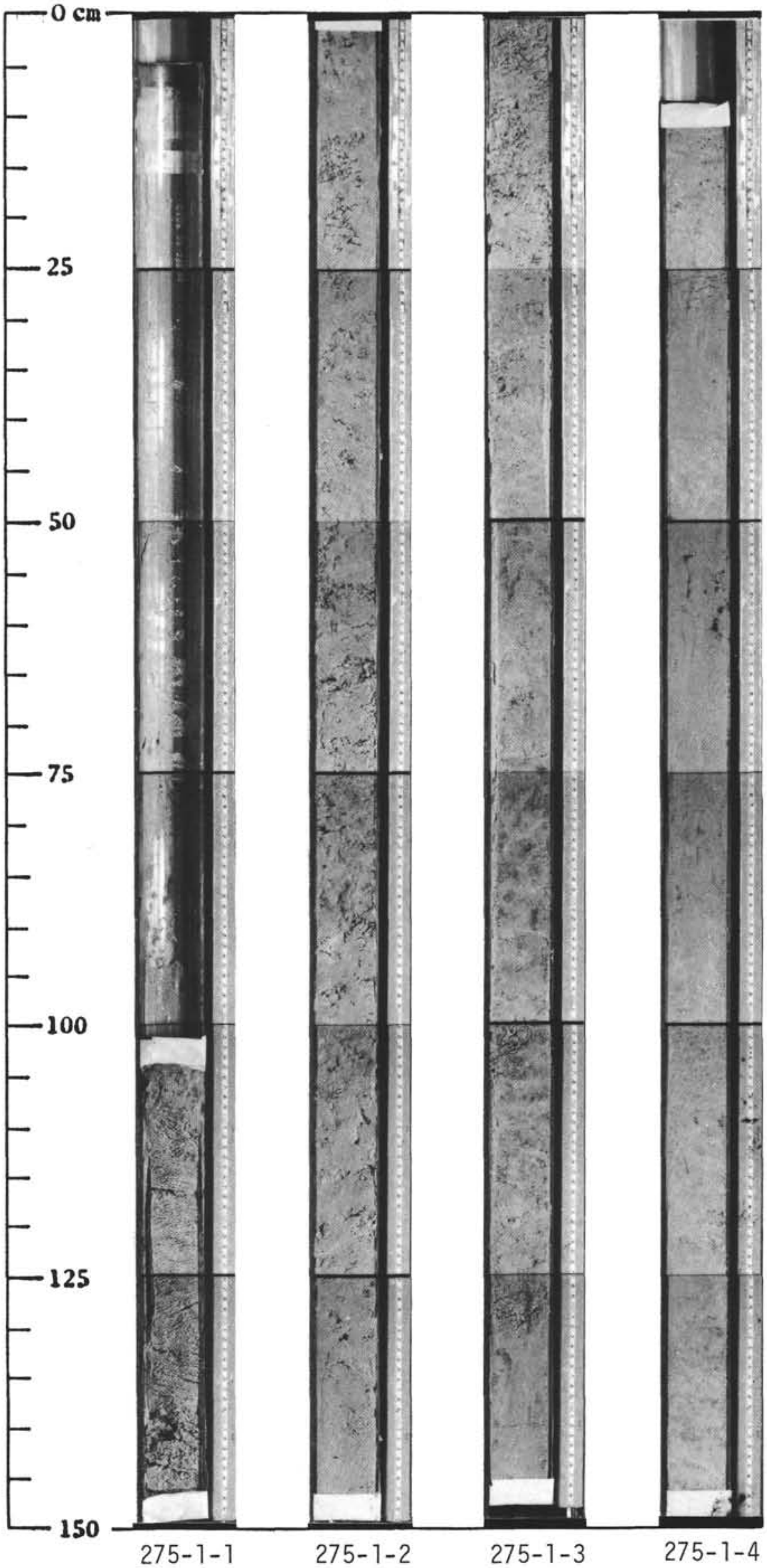
Site 275 Hole Core 5 Cored Interval: 52.5-62.0 m

AGE	ZONE	FOSSIL CHARACTER: FOSSIL	ABUND.	PRES.	SECTION	METERS	LITHOLOGY	DEFORMATION	LITHO. SAMPLE	LITHOLOGIC DESCRIPTION
PROBABLY LATE CAMPANIAN(?)		D S P N R P N	— — F R	 M G	1	0.5 1.0			65	
		N R	— R	G	Core Catcher			▲ ▲	CC	

UNIT 2 continued: dark olive gray (5Y 3/2), lithified and semi-lithified GLAUCONITE AND MICRONODULE BEARING CLAYEY SILTSTONE AND SILTY CLAYSTONE; lithified blocks show discontinuous lenticular to parallel lamination and blocky (brittle) deformation. Sand-size detrital grains comprising UNIT 2 include: quartz, biotite, chlorite, muscovite, feldspar, schistose rock fragments and indeterminate rock fragments, rare sedimentary rock fragments, chert, and colorless volcanic glass. Grains are angular. Heavy minerals in smear slides include (in order of decreasing abundance): magnetite/ilmenite, zircon, leucoxene, tourmaline, green hornblende, pyrite, sphene, and apatite; core catcher composition: angular 0.1-2 cm drilling breccia of dark olive gray (5Y 3/2) GLAUCONITE AND MICRONODULE BEARING SILTY CLAYSTONE AND CLAYEY SILTSTONE.

SS 1-65		SS CC	
CM	-28%	Q	-30%
Mi	- 4%	Fd	- 3%
Q	-38%	Mi	- 4%
G	- 7%	HM	- 2%
HM	- 1%	CM	-30%
Micron	- 6%	RF	-15%
R	- TR	G	- 7%
S	- TR	MN	- 9%
Si	- TR	Sd	- 6%
RF	-10%	ST	-49%
Fd	- 5%	CL	-45%
Sd	- 1%		
ST	-59%		
CL	-40%		

Explanatory notes in Chapter 1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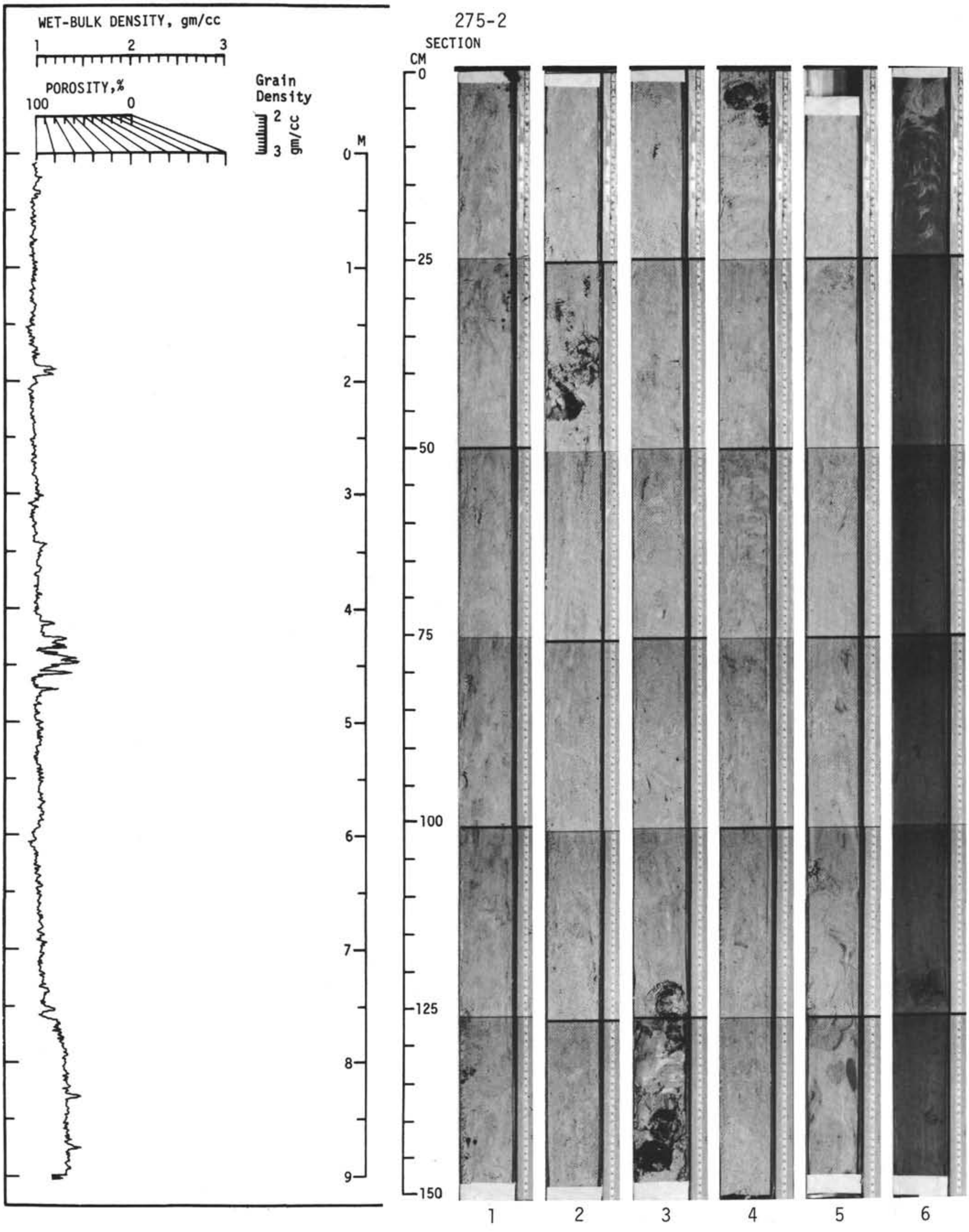
50
75
100
125
150
275-1-1
275-1-2
275-1-3
275-1-4


WET-BULK DENSITY, gm/cc
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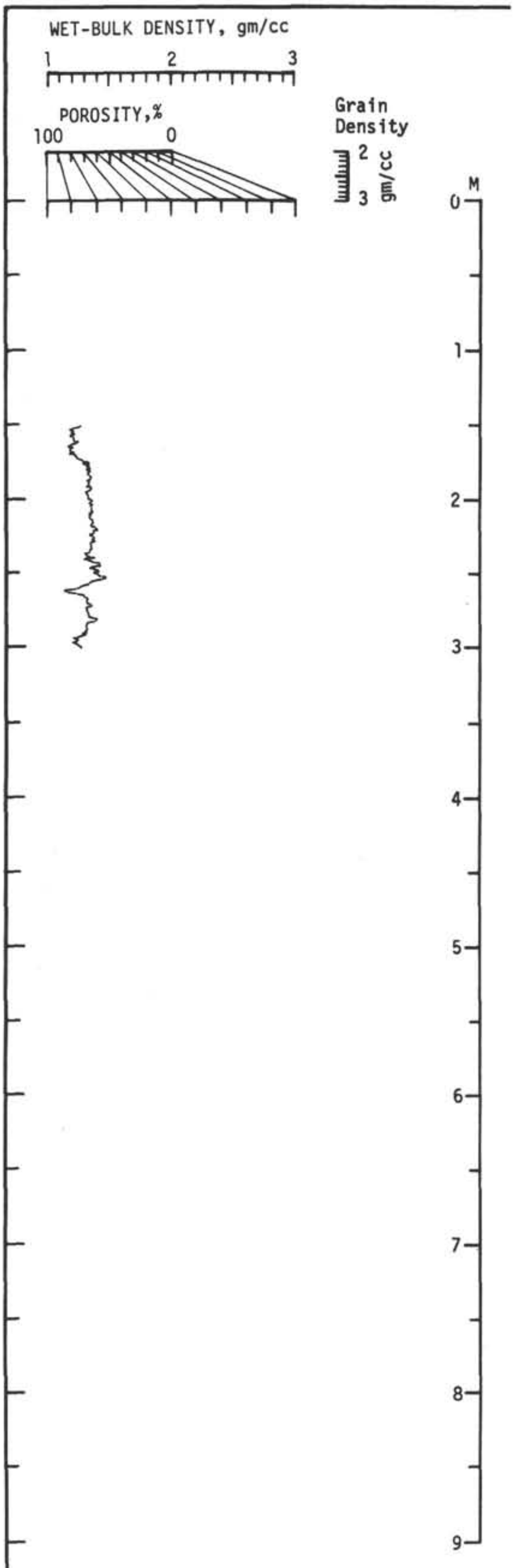
2
3
POROSITY,%
100
0
Grain Density
2
3
gm/cc
M
0
1
2
3
4
5
6
7
8
9
275-2
SECTION
CM
0
25
50
75
100
125
150
1
2
3
4
5
6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POROSITY,%
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Grain Density
2
3
gm/cc
M
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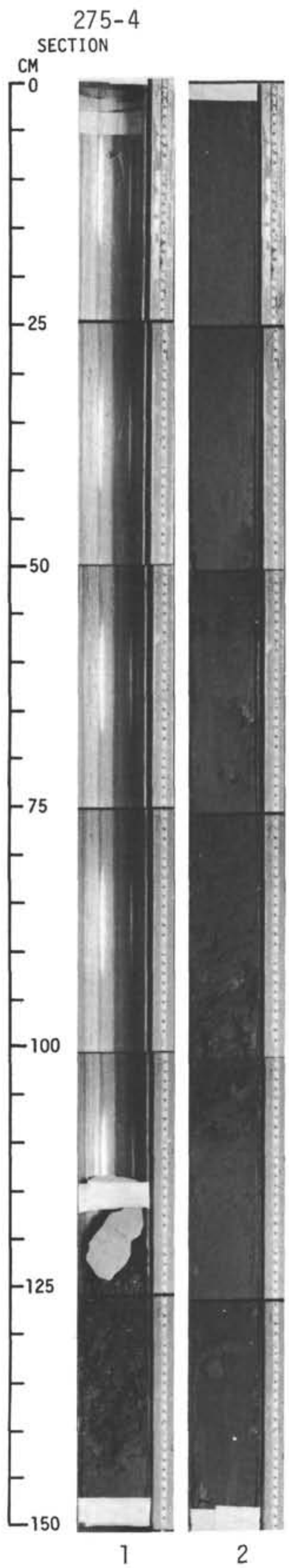
9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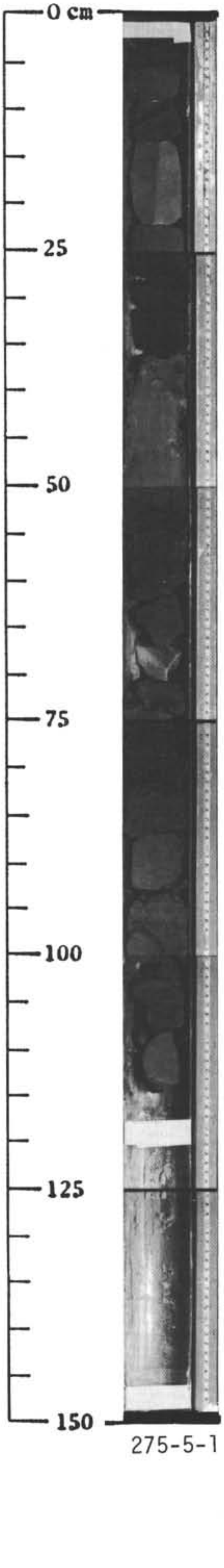
2



275-5-1