# 3. SITE 276

The Shipboard Scientific Party[1]

## SITE DATA

**Location:** Southeast of Campbell Plateau

**Position:** 50°48.11′S; 176°48.40′E

**Water Depth:**
PDR, from sea level: 4671 meters
From drill pipe measurement from derrick floor: 4677 meters (adopted)

**Dates Occupied:** 7-9 March 1973

**Depth of Maximum Penetration:** 23 meters

**Number of Holes:** 1

**Number of Cores:** 1

**Total Length of Cored Section:** 1 meter

**Total Recovery:**
Length: 0 meter
Percentage: 0

**Age of Oldest Sediment Cored:** Paleogene

**Summary:** Drilled to 23 meters in hard sediment. One core catcher sample and one bit sample obtained provide limited information on the section drilled. The sequence consists of a surficial lag of sandy gravel of possibly middle Pliocene age, formed by erosion and winnowing by a western boundary current. The surficial deposits are underlain by an unknown thickness of silicitite of possible Oligocene age, although containing a more abundant Eocene assemblage. Erosion by the current thus appears to have cut down to the Paleogene. Fragments of plutonic and metamorphic rocks in both samples indicate proximity of the Campbell Plateau to Site 276 since at least the Oligocene.

## BACKGROUND AND OBJECTIVES

Site 276 was located in abyssal depths in the southwest Pacific basin (Figure 1) approximately 65 km (40 mi) to the southeast of Site 275. The site is located approximately 16 km (10 mi) southeast of the steep escarpment forming the junction between the Campbell Plateau and the southwest Pacific basin (Figure 2).

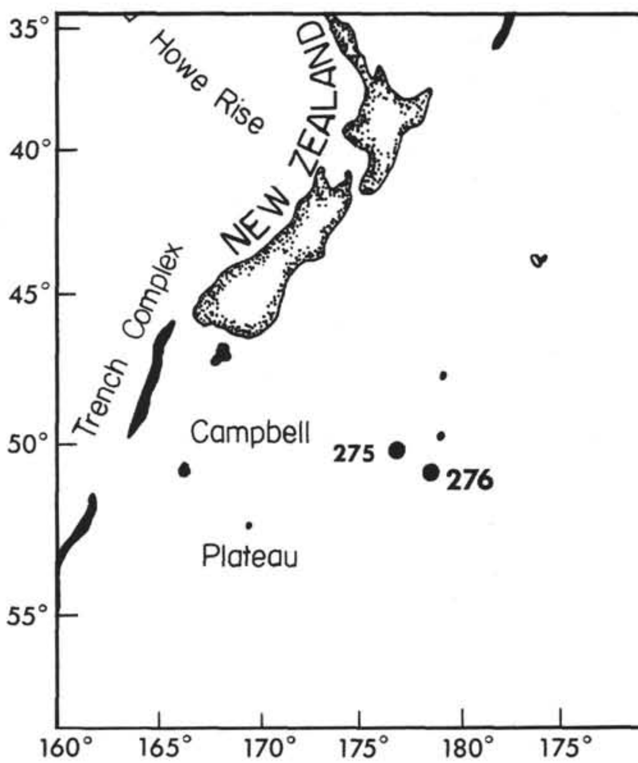


Figure 1. *Location of Site 276, DSDP Leg 29.*

Sediments overlying basement in this area range in thickness from approximately 1000 to 500 meters. Site 276 was drilled at a location with 500 meters of sediment which gave a better chance of reaching basement.

Lamont-Doherty sonobuoy measurements indicate rather high sound velocities of about 2.0 km/sec at the sea floor. The velocity may be even higher than predicted due to remanent consolidation that results from the removal of overburden (Figure 3). Bottom currents here seem to have scoured away several hundred meters of sediment.

Basement at this site has been estimated to be 80-85 m.y. old (Late Cretaceous), based on the presence of anomaly 36 (Christoffel and Falconer, 1972). The margin of the Campbell Plateau at this site is remarkably undisturbed where it fronts on the oceanic plate. Normally, a stable continental margin is obscured by massive accumulations of sediment. However, wherever it can be observed, it will display marginal rifts, magnetic quiet zones, or other inferred evidence of the initial detachment.

Sonobuoy data (Houtz, Chapter 41, this volume) show that typical deep-sea basement material with a sound velocity of 5.6 km/sec exists right up to the foot

[1]James P. Kennett, Graduate School of Oceanography, University of Rhode Island, Kingston, Rhode Island; Robert E. Houtz, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York; Peter B. Andrews, New Zealand Geological Survey, Christchurch, New Zealand; Anthony R. Edwards, New Zealand Geological Survey, Lower Hutt, New Zealand; Victor A. Gostin, University of Adelaide, Adelaide, Australia; Marta Hajós, Hungarian Geological Survey, Budapest, Hungary; Monty Hampton, University of Rhode Island, Kingston, Rhode Island; D. Graham Jenkins, University of Canterbury, Christchurch, New Zealand; Stanley V. Margolis, University of Hawaii, Honolulu, Hawaii; A. Thomas Ovenshine, U.S. Geological Survey, Menlo Park, California; Katharina Perch-Nielsen, Institut for Historisk Geologi, Copenhagen, Denmark.

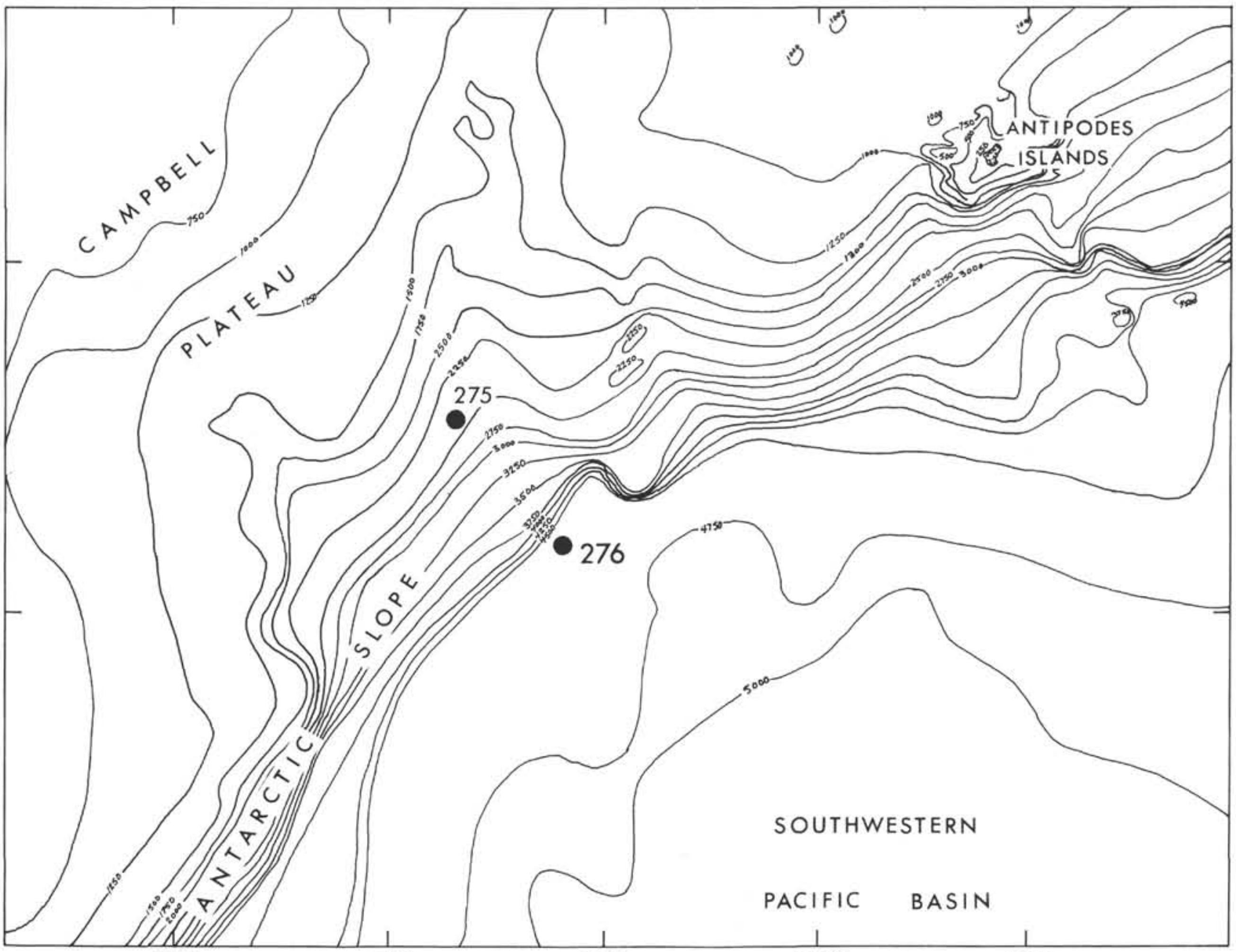


Figure 2. *Bathymetry at Site 276.*

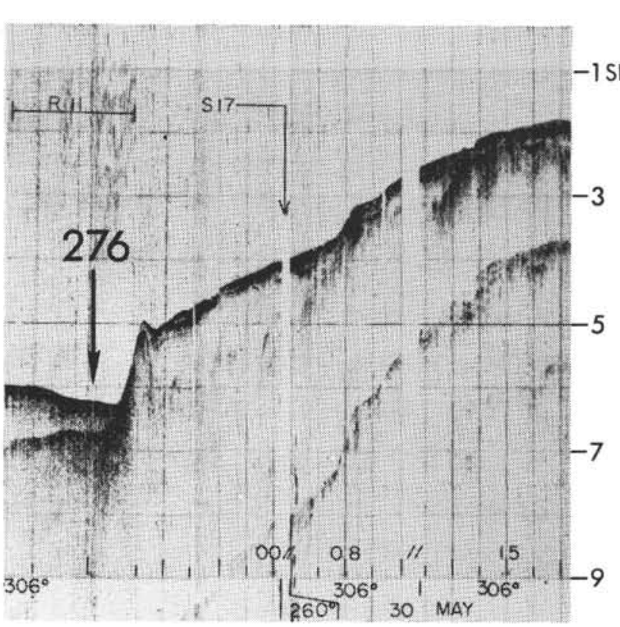


Figure 3. *Profiler section at Site 276.*

of the slope (Figure 3). If the terrigenous clastics that formed when the continents first separated are not found lying on basement at Site 276, they may have been trapped in a marginal rift now buried beneath the outbuilding Campbell slope. This is suggested by Houtz (Chapter 42, this volume).

The primary objectives at Site 276 were: to determine the history of sedimentation as this relates to seafloor spreading from the southeast towards the Albatross Cordillera; to determine age of basement; to assist in the understanding of the structural discontinuity between the Campbell Plateau and the southwest Pacific basin (Antipodes Fracture Zone, Cullen [1967]); and to determine, if possible, the mode of initial separation of the Campbell Plateau from the Ross Shelf by examining the oldest sediments on basement.

## OPERATIONS

Site 276 was approached on an *Eltanin*-43 track from the northwest (Figure 4). A 13.5-kHz beacon was dropped while underway at 5 knots at a location selected on the first pass over the area. Continued loss of acous-

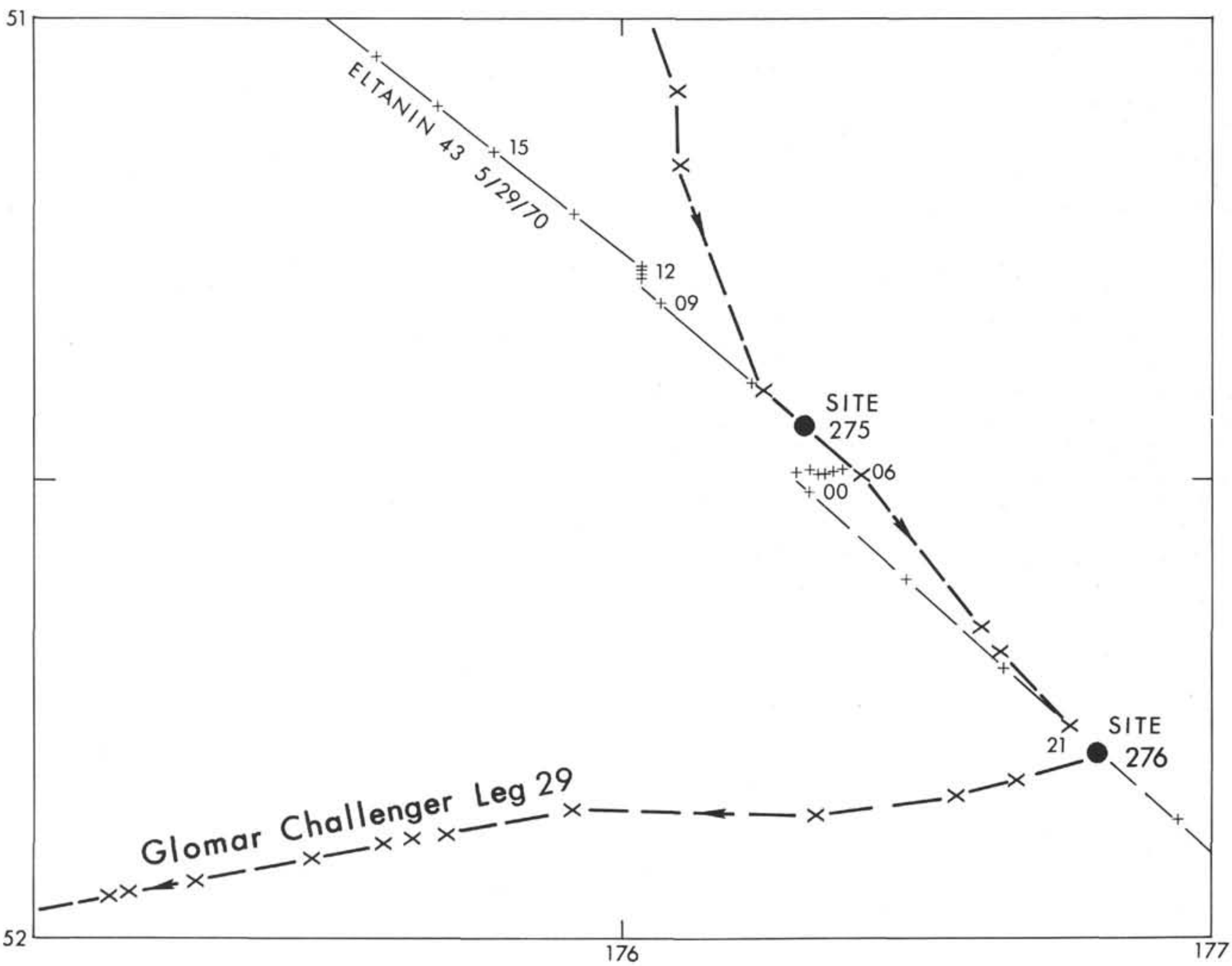


Figure 4. *Track chart.*

tics made it impossible to position over the beacon and a 16-kHz beacon was dropped in an attempt to improve the acoustics. Both beacons appeared to be functioning, but still experienced loss of acoustics 70% of the time, possibly due to bottom currents.

The weather deteriorated with wind velocity increasing to 100 kmph (60 mph). After the weather moderated, the ship returned to the beacon, having drifted 19 km (12 mi) during the gale. Acoustics were intermittent but sufficient to hold position within 60 meters (200 ft) in semi-automatic mode and the drill string was run in.

A firm bottom was tagged at 4677 meters and a punch core attempted with the extended inner barrel; however, only 1 meter of penetration was obtained. An attempt was made to bury the bottom hole assembly by washing down with full pump pressure. Penetration was 23 meters in 2.5 hr with the rate continually decreasing. The site was abandoned because of the inability to safely penetrate the hard formations.

## LITHOLOGY

Cores were not recovered during a subbottom penetration of 23 meters at Site 276, so the lithology at the site is known from a very small amount of sand, granules, small pebbles, and cuttings retained in the core catcher and on the bit. The results of an examination of this material are based principally on inspection of the size fractions remaining on 100- and 62-micron sieves.

### Description

The material recovered consists of fewer than 25 chips of white silty-sandy silicitite and numerous fragments of glauconite, manganese oxide, quartz, and crystalline rocks. The quartz and crystalline rocks are detrital components that occur as clasts in or on top of other sediments. The silicitite probably comprises the non-detrital fraction of the sediment.

The silicitite is white to brownish white, aphanitic to sub-aphanitic with an earthy appearance. Different fragments contain from 0% to 40% sand and silt-sized grains of glauconite, quartz, feldspar, and biotite. Smear slides show the sediment consists of fine silt- and clay-sized grains of isotropic silica, quartz, and feldspar, with traces of an unidentified zeolite (?) and fragments of diatoms. In one chip, the white silicitite occurs as a crust on a light-olive waxy opal that exhibits well-developed conchoidal fractures.

Mineral and rock fragments range to 40 mm in length and are predominantly angular and subangular. Of the eight fragments in the pebble size range, six are leucocratic, medium- to fine-grained plutonic rock, one is saussertized trachytic feldspar-porphyritic volcanic rock, and one is subaphanitic quartzite(?). The largest fragment of plutonic rock is equigranular biotite-quartz diorite consisting of 70% feldspar (oligoclase), 20% quartz, 7% biotite (partly altered to chlorite), 3% magnetite, and traces of chlorite.

The lithology of the coarse sand grains and granules was identified to the extent possible and the results are tabulated in Table 1. However, the proportions of the components listed may not fairly represent the proportions of the clast types present at the site because certain components may have been preferentially comminuted (hence depleted) or fractured (hence increased) during the drilling process. In addition, the fragments could have been selectively sorted by fluid circulating through the bit and core catcher.

Cursory examination of the grain fraction smaller than 1 mm indicates that the fraction consists of manganese micronodules (50%), iron-stained quartz (45%), and minor amounts of feldspar, glauconite, and chlorite. A sponge spicule and a few poorly preserved diatoms comprise the only biogenic constituents observed.

The most notable feature of the coarse sand and granule fraction is the brilliant polish exhibited by many of the quartz grains. This polish occurs principally on the edges, corners, and elevated parts of the grain surfaces. It is a primary feature of the clasts and not an artifact of the drilling process because the polish occurs beneath the black crust of manganese oxide that coats parts of some of the grains.

## Conclusions

The sediment at Site 276 probably consists of manganese-rich gravel-bearing sand and silicitite, developed by diagenetic transformation of siliceous ooze. Fragments of silicitite containing dispersed grains of quartz and feldspar suggest that the detrital and biogenic components were deposited at the same time,

**TABLE 1**
**Lithology of 746 Coarse Sand Grains and Granules Returned in the Core Catcher at Site 276**

| Lithology | Number | Percent | Description |
|---|---|---|---|
| Leucocratic plutonic rocks | 242 | 32 | Dominantly biotite quartz diorite, some aplite and porphyritic quartz diorite |
| Quartz | 230 | 31 | Grains commonly Fe-stained, less commonly Mn-stained; clear, milky, and microcrystalline varieties about equally abundant; many grains highly polished |
| Schist | 67 | 9 | Dominantly very-fine-grained biotite-feldspar-quartz schist; minor quartz-feldspar and garnet-biotite schist |
| Quartzite | 64 | 9 | Fine-grained, light-gray, gray, pink, purple, green, and light-brown quartzite and siltite; category may include aphanitic acidic volcanic rocks |
| Feldspar | 15 | 2 | Numerous grains in which feldspar predominates are included in plutonic rock category |
| Indeterminate | 64 | 9 | Mostly heavily Fe-stained |
| Manganese | 32 | 4 | Occurs as black incrustations on granules, micronodules, and platelets; rarely incorporates silt-sized detrital grains. |
| Silicitite | 22 | 3 | |
| Glauconite | 6 | 1 | Occurs as earthy masses replacing fecal pellets, and as hard, botryoidal grains |
| Opal | 1 | – | |
| Vertebrate remains (fish) | 3 | – | |
| Totals | 746 | 100 | |

and that the distribution of mineral and rock grains is not strictly limited to a surficial pavement. Grains of silicitite lacking coarse detrital components may, however, indicate the absence of mixed detritus at greater depths in the sediment. Veins and layers of hard impervious opal probably occur at depth and could partly account for the difficulty in obtaining drill penetration at the site.

The fragments of granitic rocks, schist, quartz, and quartzite that comprise the detrital fraction of the sediment were derived from an area that had undergone regional metamorphism to at least biotite-garnet grade, by the intrusion of intermediate to acidic plutonic rocks. The location of this source area is unknown, although the biotite quartz diorite and schist fragments and the pebble of trachytic porphyry compare favorably with rocks described from the Campbell and Auckland Islands located approximately 650 and 885 km (400 and 550 mi) west of Site 276. Perhaps similar rocks underlie parts of the Campbell Plateau near Site 276.

The depositional mechanism of the detrital grains is unknown. The highly angular form of some of the larger fragments is consistent with deposition from debris-laden glacial icebergs or with deposition by other mechanisms from a nearby source. The small variation in lithology (granitic fragments, schist, quartz, and quartzite comprise 81% of the detritus) may support derivation from a nearby source, but the preponderance of these constituents could be partly the result of crushing a few pebbles during drilling. The rounded and subrounded grains could indicate: (1) derivation from pre-existing sedimentary rocks; (2) a long history of transportation to the depositional site; or (3) in situ solution, abrasion, or precipitation of silica by bottom currents. A western boundary current, which flows over the area of Site 276 (Warren, 1970) and probably produces current velocities on the order of several tens of centimeters per second, could transport sand grains, but probably could not transport the pebble-sized clasts. More likely, the effects of the western boundary current are limited to winnowing and abrasion of the surficial layer.

## BIOSTRATIGRAPHY

Only two samples were available for study from this site. The first was obtained by scraping the core liner and core catcher of Core 1, which penetrated not more than 1 meter subbottom. This material yielded early Pliocene to early Pleistocene and Paleogene foraminifera, late Pliocene to Pleistocene and early Eocene calcareous nannofossils, and Miocene to Pleistocene and late Eocene diatom fragments. The adopted age of the sample is late Pliocene to Pleistocene, with reworked Eocene.

The second sample was obtained by scraping the bit following its retrieval at the end of drilling. This bit sample yielded mid Oligocene and older Paleogene foraminifera; late Eocene, early Eocene (mostly), and Paleocene calcareous nannofossils; and Pleistocene as well as late Eocene diatoms. The age tentatively adopted is mid Oligocene, with reworked older Paleogene and Pleistocene contamination.

The markedly different ages obtained for these two samples is surprising in view of their apparently similar subbottom positions. This apparent conflict could be explained by any one of the following: (1) thin remnant patches of Pliocene-Pleistocene sediments containing reworked older Cenozoic material unconformably overlie Paleogene bedrock; (2) Pliocene bedrock overlain by a thin, presently forming, lag deposit which includes fragments of Paleogene sedimentary rocks; (3) bit sample comes from cuttings that accumulated on the sea floor around the drill hole and were drilled into during the second attempt to core.

The paucity of paleontological data (Table 2) does not allow any preference between these explanations.

### Foraminifera

For the two samples examined from Site 276, one appears to be of early Pliocene age and the other is probably of a middle Oligocene age.

#### Globorotalia (T.) puncticulata Zone

The presence of the zone species indicates that Sample 1, CC is early Pliocene-early Pleistocene. Also present in the sample are well preserved specimens of *Globorotalia (T.) inflata* which are assumed to be present due to downhole contamination. The following reworked Paleogene taxa were recorded: *Chiloguembelina* sp., *Globorotalia (P.)* cf. *pseudomenardii, G. (M.)* cf. *aequa, Zeauvigerina parri,* and *Z. zelandica.*

#### Globigerina (G.) euapertura Zone

A bit sample was recovered from an unknown level in the sediment, but the presence of *Guembelitria stavensis* indicates that it could be from the lower *G. (G.) euapertura* Zone. *G. stavensis* has been recorded at this stratigraphic level in South Australia (Ludbrook and Lindsay, 1969), and also occurs at a similar level at Sites 277 and 282.

Also present in the bit sample are the following reworked older Paleogene planktonic foraminiferal taxa, some of which show signs of solution: *Chiloguembelina* sp., *Globigerina (G.)* cf. *pauciloculata, G. (S.) angiporoides angiporoides, G. (S.) triloculinoides, Globigerinatheka (G.) index, Globorotalia (M.)* cf. *dolabrata, G. (P.) australiformis, G. (P.)* cf. *pseudoemenardii, Truncorotaloides collactea, Zeauvigerina parri,* and *Z. zelandica.* Reworked benthonic taxa included *Elphidium saginatium, Cibicides parkei, Anomalinoides* sp., *Bulimina* sp., and *Nodosaria* sp.

### Calcareous Nannofossils

Sample 1, CC is considered to be late Pliocene-Pleistocene with reworked Paleogene forms. The bit sample contains Paleogene assemblages indicative of late Eocene, early Eocene, mid-late Paleocene, and early Paleocene.

Sample 1, CC yielded a very small but moderately well-preserved nannoflora including two different assemblages. The younger, slightly more numerous fraction largely consists of *Coccolithus pelagicus,* but also includes the small cold-water variety of *Cyclococcolithina*

TABLE 2
Paleontological Summary

| Sample | Depth Below Surface (m) | Age | Foraminifera | Nannofossils | Diatoms | Radiolaria |
|---|---|---|---|---|---|---|
| 1, CC | 1 | Mid Pliocene | *G. puncticulata* Zone with numerous reworked Paleogene species and Recent *G. inflata* | Poor late Pliocene to Pleistocene assemblage with reworked early Eocene species | Late Eocene to Miocene, poor, *Nitzschia miocenica, N. jouseae, Coscinodiscus vetustissimus, Arachnoidiscus* sp., *Cerataulus marginatus, Naviculopsis* sp. | Two broken specimens |
| Bit | 0.5 to 23 (probably 0.5) | ?Mid Oligocene | *G. euapertura* Zone on the presence of *Guembelitria stavensis* plus numerous reworked Paleogene taxa mainly of lower Eocene age including two New Zealand index benthonic species | Assemblages of late Eocene, early Eocene, late Paleocene, and early Paleocene age. The presence of Oligocene cannot be excluded. | Assemblage of late Eocene, poor, *Trinacria simulacaum, Cerataulus marginatus, Pyxilla* sp. *Pyxilla dubia, Naviculopsis biapiculata* | Common, moderate preservation ?Paleocene and early Eocene |

*leptopora, Helicopontosphaera kamptneri,* small indeterminate Prinsiaceae, and a single specimen of *Reticulofenestra* cf. *pseudoumbilica.* This fraction is considered to be late Pliocene-Pleistocene, and might include subrecent elements. The older fraction includes *Chiasmolithus* sp., *Discoasteroides kuepperi,* and *Zygolithus dubius.* These Paleogene taxa imply that this fraction was reworked from an early- or mid-Eocene source.

The bit sample yielded an abundant, variably preserved, and "highly diverse" nannoflora, a situation obviously resulting from the presence of several assemblages of different ages. The youngest fraction observed includes low numbers of well-preserved *Chiasmolithus oamaruensis, Cyclicargolithus neogammation* (the small, early form), *C. reticulatus, Discoaster saipanensis,* and *Reticulofenestra bisecta,* plus single specimens of *Isthmolithus recurvus* and *Reticulofenestra oamaruensis.* This association implies a late Eocene age, but the additional presence of Oligocene, especially early Oligocene, cannot be excluded. The majority of the nannofossils present represent an early Eocene assemblage. The distinctive taxa present include *Chiasmolithus eograndis, Discoaster barbadiensis, D. lodoensis, Discoasteroides kuepperi, Lophodolithus nascens, Marthasterites tribrachiastus, Sphenolithus radians,* and *Zygolithus dubius.* Rare representatives of the mid to late Paleocene include *Ellipsolithus macellus, E. tympaniformis, Toweius eminens, T. tovae,* and *Z. sigmoides.* The presence of early Paleocene, probably Danian, is indicated by one specimen of *Biantholithus sparsus* and several *Conococcolithus panis.* Other Paleogene, essentially Eocene, species noted include *Braarudosphaera bigelowi, Campylosphaera dela, Coccolithus eopelagicus, Cyclococcolithus formosus, Discoaster binodosus, Ericsonia ovalis* (abundant), *Markalius* sp., *Micrantholithus* sp., *Reticulofenestra dictyoda, R. placomorpha, Sphenolithus* of the "*moriformis* type", *Thoracosphaera* spp., and *Zygrhablithus bijugatus.* The mid Eocene may also be present but is not recognizable as a separate entity.

It is not known how the different assemblages came to be mixed together in the same small bit sample.

All of the Site 276 assemblages appear to have been deposited some distance from land. The presence of *Z. bijugatus* indicates that at least part of the Paleogene was deposited above the lysocline. It is also noteworthy that no Paleogene representatives of the genera *Helicopontosphaera* and *Discolithina* have been found. The late Neogene fraction appears to have been deposited under climatic conditions similar to the subantarctic environment existing at present at Site 276.

### Diatoms

In both samples all diatoms are poorly preserved. Most of them are broken and have been reworked from the Miocene and Eocene (Table 3).

The common occurrence of the marine planktonic diatoms *Nitzschia* sp., *Fragilariapsis kerguelensis,* and *Actinocyclus oculatus* indicates early Pleistocene sediments (Koizumi, 1973). Most of the other siliceous microfossils present have been reworked from the late Eocene (Table 3). Many of the diatoms are known from the late Eocene diatomite deposits of Oamaru, New Zealand.

### Radiolaria

A very few broken Radiolaria were found in Sample 1, CC. Radiolaria were common and fair to well preserved in the bit sample.

## SUMMARY AND CONCLUSIONS

Site 276 is located in 4677 meters of water on the abyssal plain immediately adjacent to the southeast part of the Campbell Plateau, southeast of Site 275 (Figure 1). The site was selected at a location where about 400 meters of sediment has been scoured or prevented from being deposited by an intense western boundary current at the foot of the Campbell slope (Warren, 1970).

Drilling demonstrated that the probable advantage of drilling sediment of mean sonic velocity lower than at Site 275 was offset by the occurrence of very hard sediment at the surface. Although no cores could be obtained at Site 276, a small core catcher sample and a bit

TABLE 3
Distribution of Diatoms, Silicoflagellates, and Porifera Recorded at Site 276

| | Samples | |
|---|---|---|
| | Bit | 1, CC |
| Abundance | R | R, C |
| Preservation | P | P |
| **Diatoms:** | | |
| *Actinocyclus oculatus* Fousé | | C |
| *Arochnoidiscus* sp. | | R |
| *Cerataulus marginatus* Gr. and St. | R | |
| *Coscinodiscus excentricus* Ehr. v. *fasciculata* Hust. | | R |
| *Coscinodiscus paleaceus* (Grun.) Rattray | | R |
| *Coscinodiscus* sp. | R | R |
| *Fragilariopsis kerguelensis* (O'Meara) Hust. | R | C |
| *Hemiaulus* cf. *ambiguus* Grunow | | R |
| *Hemiaulus polymorphus* Grunow | R | R |
| *Nitzschia* sp. | | R |
| *Melosira (Paralia) sulcata* Ehr. cf. *radiata* Cl. | | R |
| *Pterotheca* cf. *uralica* Fousé | | R |
| *Pyrgupyxis* sp. | R | C |
| *Pyxilla dubia* Grunow | R | |
| *Pyxilla (Pterotheca) aculeifera* (Grun.) Kanaya | | R |
| *Sceptroneis* cf. *caducea* Ehrenberg | | R |
| *Sceptroneis* sp. | R | R |
| *Stephanopyxis turris* (Grev. and Arn.) Ralfs | R | R |
| *Thallassionema nitzschioides* Grunow | | R |
| *Thalassiosira nativa* Schulz | | R |
| *Triceratium* sp. | R | R |
| *Trinacria simulacrum* Gr. and St. | R | |
| *Trinacria* sp. | R | |
| **Silicoflagellates:** | | |
| *Dictyocha* sp. | | R |
| *Distephanus minutus* (Bachm.) Bukry | | R |
| *Distephanus* sp. | R | |
| *Mesocena* sp. | | R |
| *Naviculopsis biapiculata* (Lemm.) | R | |
| *Naviculopsis* sp. | | R |
| Porifera Spicules (different) | R | R |

Note: C = common; P = poor; R = rare.

sample provided limited information on the section drilled.

The core catcher sample material yielded Paleogene and late Neogene microfossils. The adopted age is mid Pliocene, with reworked Paleogene. The bit sample contains mid-Oligocene to Paleocene microfossils. The adopted age is mid Oligocene.

Only the coarse fraction of the sediments was examined. This contains fragments or particles of white silty sandy silicitite, glauconite, manganese micronodules, quartz, and granitic and metamorphic rock fragments. No difference is evident between the coarse fraction of the two samples. On the other hand, the bit sample contains far more abundant calcareous nannofossils and planktonic foraminifera, and more common and better preserved Radiolaria than the core catcher sample. These differences as well as distinct ages could indicate that the two samples are from different stratigraphic levels.

Due to erosion and winnowing by the western boundary current, it is possible that Site 276 represents a highly condensed sequence within the Paleogene. Because of insufficient sediment recovery, sedimentation rates could not be calculated.

## Conclusions

The sediment at Site 276 consists of a surficial layer of sand and gravel of middle Pliocene age formed by erosion and winnowing of the western boundary current. The surficial deposits are underlain by an unknown thickness of silicitite of possible Oligocene age that contains abundant reworked older Paleogene material. The most important result derived from the evidence at Site 276 is that erosion by the western boundary current has cut down to a Paleogene sequence (possible Oligocene). The presence of microfossils of various ages within the Paleogene may indicate extensive reworking during its deposition. This reworking may have been caused by a similar current system that was a predecessor to the present western boundary current. Less probably, the mixed assemblage is an artifact of drilling.

The fragments of plutonic and metamorphic rocks in both samples possible reflect the proximity of Site 276 to the Campbell Plateau since at least the Oligocene. Ice rafting of these materials from Antarctica seems less likely.

## REFERENCES


Christoffel, D. and Falconer, R., 1972. Marine magnetic measurements in the Southwest Pacific Ocean and the identification of new tectonic features. *In* Hayes, D. E. (Ed.), Antarctic Oceanology II: The Australian-New Zealand Sector, Antarctic Res. Ser., v. 19, Am. Geophys. Union, p. 197-209.

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.

Koizumi, I., 1973. The late Cenozoic diatoms of Sites 183-193, Leg 19, Deep Sea Drilling Project: *In* Creager, J. S., Scholl, D. W., et al., Initial Reports of the Deep Sea Drilling Project, Volume 19: Washington (U.S. Government Printing Office), p. 808, Table 1.

Ludbrook, N. H. and Lindsay, J. M., 1969. Tertiary foraminiferal zones in South Australia: Planktonic Conf. Microfossil, First, Geneva, 1967, Proc., v. 2, p. 366-375.

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.

Site 276 Hole Core 1 Core catcher : 23 m below seafloor

| AGE | ZONE | FOSSIL CHARACTER: FOSSIL | FOSSIL CHARACTER: ABUND. | FOSSIL CHARACTER: PRES. | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| see text | | R S D F N | T T R C R | P P P G M | Core Catcher | | | ▲ ▲ ▲ | CC | A very small amount of sand and rock fragments recovered from core catcher. The lithology is: MANGANESE AND GLAUCONITE-BEARING DETRITAL GRAVELLY-SANDY SILTY SILICITITE. |

Site 276 Hole Core Bit sample Cored Interval: at 4700 m (23 m below the seafloor)

| AGE | ZONE | FOSSIL CHARACTER: FOSSIL | FOSSIL CHARACTER: ABUND. | FOSSIL CHARACTER: PRES. | SECTION | METERS | LITHOLOGY | DEFORMATION | LITHO. SAMPLE | LITHOLOGIC DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|
| see text | | F S N D R | A T A R C | G P M P G | Core Catcher | | | ▲ ▲ ▲ | | A very small amount of sand and rock fragments recovered from bit. The lithology is: MANGANESE AND GLAUCONITE-BEARING DETRITAL GRAVELLY-SANDY SILTY SILICITITE. |

Explanatory notes in Chapter 1