Zone I (late Oligocene). Shallow water facies; gradual subsidence from near sea level (unit 4–estuary) to inner shelf (subunit 2J), probably diachronous in Ross Sea; characteristically contains an agglutinated fauna, with calcareous benthic taxa becoming increasingly more prominent in the younger and deeper water sediments embraced by this zone; glaciomarine sedimentation initiated about 25 million years ago; tentative correlation with New Zealand mid-Tertiary.

Zone II (latest Oligocene/early Miocene). Deep, outer shelf environment, widespread in Ross Sea; diverse calcareous benthic fauna; zone I/II hiatus of bathymetric origin; unstable shelf throughout much of zone, with numerous diastems; ice-rafting the predominant sediment transport mechanism, with varying rates of deposition; gradual decrease in species diversity toward the upper limit reflects changing oceanographic conditions in response to deteriorating antarctic climate; fauna developing endemic character; no known correlatives.

Zone III (early Miocene). Characteristically represented by an agglutinated fauna of composition different than that found in zone I; zone II/III hiatus marked; harsher, more acidic bottom conditions reflecting continued climatic deterioration; ice-rafted glaciomarine sediments; no known correlatives.

Zone IV (early Miocene). Intense glacial conditions in Ross Sea, as evidenced by very low foraminiferal abundance and diversity; possible first major advance into Ross Sea by proto-Ross Ice Shelf; zone III/IV haitus marked; thick ice-rafted unit, probably widespread in Ross Sea; no known correlatives.

Zone V (late Pleistocene). Basal till representing numerous ice shelf advances across the Ross Sea; contains mixture of reworked Miocene, Pliocene, and Pleistocene fauna and flora.

These interpretations are supported by the chemostratigraphic results reported from site 270 (Hayes et al. 1975) and parallel trends observed in oxygen-isotope paleotemperature curves from the subantarctic region (Shackleton and Kennett 1975). The late Oligocene/early Miocene paleoenvironmental trend is one of gradual development of a severe polar marine environment, culminating in the earliest recorded, and possibly first, ice shelf incursion into the Ross Sea late in the early Miocene. One of the most significant contributions of this investigation is the establishment of biostratigraphic framework for late Oligocene/early Miocene sediments in the Ross Sea. Until more complete sedimentary sections are drilled in the continental shelf, this site must serve as a representative of the mid-Tertiary period in attempting marine correlation within and close to Antarctica.

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Interpretation of mid-Miocene to Recent lithostratigraphy and biostratigraphy at DSDP site 273, Ross Sea

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Deep Sea Drilling Project (DSDP) leg 28 explored one site in the western Ross Sea. Site 273 is located on the western flank of the Pennell Bank (74°32.29'S 174°37.57'E) in the west-central portion of the Ross Sea in 491 meters of water. Detailed reexamination of the lithologic descriptions and analyses provided in the initial reports (Hayes et al. 1975) and the study of foraminifera from 97 samples reveals two major variations in an otherwise apparently constant sedimentary regime and one major and four minor faunal fluctuations.

Two holes (273 and 273A) were drilled and 346.5 meters cored. A total of 83.4 meters (or 25 percent) were recovered. Two lithologic units were recognized by Hayes and others (1975) and their designations are adopted with little modification. Lithologic unit 1 is subdivided into two subunits. Subunit 1A consists of 0.8 meter of soupy to soft diatomaceous silty clay, which is common in Ross Sea core tops and widely correlated about the Ross Sea. This material has been assigned a Bruhnes/Holocene age by many authors (Fillon 1974, 1975, 1977; Kellog and Truesdale 1978; Osterman and Kellog 1979). Subunit 1B comprises 40.2 meters of soft to stiff diatomaceous silty clay. It is similar to and probably the equivalent of unit B as discussed by Kellog, Osterman, and Stuiver (1979) and sediment designated as Pliocene (Gauss) by Fillon (1974, 1975, 1977). A Pleistocene/Holocene age was assigned to all of unit 1 by McCollum (1975), based on the abundant occurrence of diatoms of the Pleistocene *Coscinodiscus lentiginosus* zone mixed with mid-Miocene taxa. Unit 2 comprises 305.5 meters of stiff to semilithified diatomaceous silty clay and is very similar to subunit 1B in terms of grain-size distribution. It is subdivided at 166.5-meter depth on the basis of sporadic bedding above and the absence of bedding below. McCollum (1975) placed the diatom flora of unit 2 in the mid-Miocene *Denticula antarctica* zone down to 272 meters deep and left the remainder unzoned.

There are two major variations from the normal diatomaceous silty clay in the sedimentary sequence of site 273. The occurrence of two beds of coarser, graded, diatomaceous spicule-rich silt at the base of unit 1 probably marks deposition soon after the grounding line of the retreating Ross Ice Shelf passed site 273 during the Pliocene-Pleistocene. Core 21A (272 meters) contains a 30-centimeter interval of sand attributed to winnowing by active bottom currents.

Two assemblages have been recognized by D'Agostino (1980) in this sedimentary sequence: an upper assemblage, which occurs in and above core 4cc (33 meters), and a lower assemblage, which is present in and below core 5 section 1 (138 to 143 centimeters; 41.7 meters).

Twenty species occur exclusively in the upper assemblage. *Globocassidulina biora, G. crassa, Trifarina earlandi, Neogloboquadrina pachyderma*, and *Globigerina megastoma* are the dominant taxa. There are also 24 species that are either long ranging or reworked and are found in both assemblages. This group is dominated by *Globocassidulina subglobosa, Epistominella exigua*, and *Nonionella bradyi*. In general, taxa of the upper assemblage are large, thick-walled, robust, and moderately to very well preserved.

The lower assemblage contains 81 species, of which 79 are calcareous benthics and 2 are planktonic. The benthic assemblage is dominated by *Globocassidulina subglobosa, Trifarina fluens, Elphidium magellanicum*, and *Trochoelphidiella* sp. Several hundred specimens of *Candeina* sp. occur that are morphologically between *Candeina zeocenica* and *C. nitida*. The abundant *Trochoelphidiella* sp. may be the ancestor to the Pliocene *Trochoelphidiella onyxi* (Webb). Taxa of the lower assemblage are typically small, thin-walled, lightly abraded, frequently affected by dissolution, and generally depauperate.

Further refinement of the diatom-based ages is not possible because planktonic diversity is very low and correlation is difficult. There is no foraminiferal evidence that disputes the determinations of McCollum (1975). The upper assemblage has strong affinities to Pleistocene and Holocene assemblages of the Antarctic (Anderson 1975; Fillon 1974; Leckie 1980; Webb and Wrenn 1974). The lower assemblage is similar to the early Miocene fauna from site 270 in the eastern Ross Sea discussed by Leckie (1980). It is also very similar to the mid-Miocene material recovered at the McMurdo Sound Sediment and Tectonic Study site during the 1979–80 season.

Current literature contains many references to the late Miocene/early Pliocene event that resulted in the widespread disconformity and erosion surface in the Ross Sea. This disconformity is recognized at site 273 at the 41-meter depth. The lithologic boundary at the base of core 5 (Hayes et al. 1975) has now been raised 1.5 meters to the base of the graded silt. The boundary initially was located on the basis of an increase of lithification between cores 5 and 6. D'Agostino (1980) relocates the boundary (and disconformity) at the contact between units 1 and 2. The occurrence of the foraminiferal assemblages supports this change. Intervals 5–1 (61–65 centimeters) and 5–1 (71–75 centimeters contain small populations of taxa that fall into the long-ranging or reworked category and sample 4cc contains the distinctive upper assemblage, while sample 5–1 (138–143 centimeters) contains the equally distinctive lower assemblage.

When sedimentation rates determined by Hayes and others (1975, pp. 338–339) are used in calculations, the material at the base of unit 1 dates back to 2.94 million years ago (late Pliocene). The occurrence of *Neogloboquadrina pachyderma* with *Globigerina megastoma* indicates a maximum age of 2.5 million years (Blow 1969). An age minimum of 10.5 million years for the top of unit 2 is adopted on the basis of the diatom zonation (McCollum 1975). The resulting conclusion is that approximately 7.6 to 8.0 million years of geologic records are lost at the disconformity. This implies removal of all but the earliest late Miocene and the Pliocene. Sedimentation may have been faster, and the bottom of unit 1 may not be late Pliocene, because no characteristic late Pliocene microfossils were found.

Significant faunal fluctuations were noted in Miocene sediments. In cores 6A, 7A, and 24A diversity (and populations) drop to zero; this can be attributed to loss by dissolution. Core 7cc contains a heavily corroded fauna. The dissolution may have been caused by intersection of the CCD with the sea floor or by the flow of fresher, more acidic bottom water of site 273. Cores 15A and 21A have low populations because of winnowing by currents which removed fine material. Faunal fluctuations within the Miocene succession are attributed to oceanographic changes related to the evolution of the Ross Ice Shelf rather than direct contact with the ice shelf itself. The major disconformity recognized at the top of the Miocene at site 273 is directly attributed to erosion by a grounded Ross Ice Shelf.

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Regional distribution of late Quaternary and Holocene sedimentary facies in the southeast Pacific subantarctic and antarctic

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The distribution of modern sedimentary facies in the far southeastern Pacific-Antarctic region is controlled by the regional circulation pattern, biogenic productivity, the extent of seasonal sea-ice development, regional bathymetry, the influx of terrigenous detritus from antarctic continental margin by ice-rafting, bottom and turbidity currents, and the level of the calcite compensation depth.

The complex interaction of these factors results in the occurrence of three primary sedimentary facies within the region: calcareous ooze, siliceous ooze, and glacially derived clayey silts and silty clays. Regional facies boundaries are characterized by transitional lithologies comprised of mixed calcareous-siliceous ooze near the Polar Front Zone and muddy siliceous ooze and diatomaceous muds with the ephemeral sea-ice zone.

A cross section of the regional spatial and temporal distribution of sedimentary facies deposited throughout the study area during the last 194,000 years is illustrated in figure 1. This diagram clearly documents paleo-oscillations in the characteristic sedimentary facies encountered in modern antarctic sediments. The core profile can be divided into three groups based on the latitudinal distribution and sedimentary facies. (See table 1.)

The sequential evolution of regional sedimentary facies for the last 194,000 years can be delineated from the 11 cores used in this study. The data shown in table 2 are presented in the context of chronostratigraphic oxygen isotope stages (OIS). (See figure 2.)

Eltanin core 17–17 contains three clayey silt intervals that occur in OIS–2, 5, and 6 (figure 1.) The terrigenous intervals