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## Preliminary report on diatoms from the Deep Lake terraces, Vestfold Hills, Antarctica

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Deep Lake\* (latitudes 68°22' and 68°40'S longitudes 77°49' and 78°33'E) is one of the two most saline lakes in the Vestfold Hills. (See figure 1.) This thalassic lake is one of the largest in area (1.1 by 0.7 kilometers) and has a depth of 36 meters. Deep Lake originated from the sea. Through slow evaporation, its salinity increased and its elevation decreased over time until it attained its present-day levels: a salinity of 28 parts per thousand and an elevation of 50.4 meters below sea level. The lake is thermally stratified with a surface temperature of -20°C during winter and +10°C in summer while the bottom 15 meters remain constant at about -14°C throughout the year (Kerry et al. 1974). Figure 2 shows depth, temperature, and daily wind run at Deep Lake from October 1973 through July 1975. A variety of blue-green algae, diatoms, and bacteria live at all depth of the lake (Kerry et al. 1974).

During December 1974, K.R. Kerry and R. Williams of the Antarctic Division of the Australian Department of Science and Technology collected 72 samples (numbered ACTC-1 through

ACTC-36 for samples from the southeastern shore terrace and ACTC-37 through ACTC-72 for samples from the western shore terrace). Samples were collected at 1.6-meter intervals. We then studied sediment composition, faunal content, and diatom structures of the samples.

The sediment is loose, powdery, and unconsolidated. It is composed of coarse, angular, and rounded grains of sand to silt-size fractions. Its constituents are pyroxene, garnet, biotite, and quartz with fragments of pyroxenite, quartzite, permatite, gneiss, and glacial debris. Halite and mirabilite crystals are common.

Crespin (1960) made a general study of foraminifera of the lake sediments of the Vestfold Hills. She restricted her report to the six new species identified and some rare forms, but Setty, Williams, and Kerry (1980) made a detailed study of all the foraminifera occurring in Deep Lake terraces. The associated ostracode fauna revealed the presence of psychrospheres in the sediment (Setty and Williams in press).

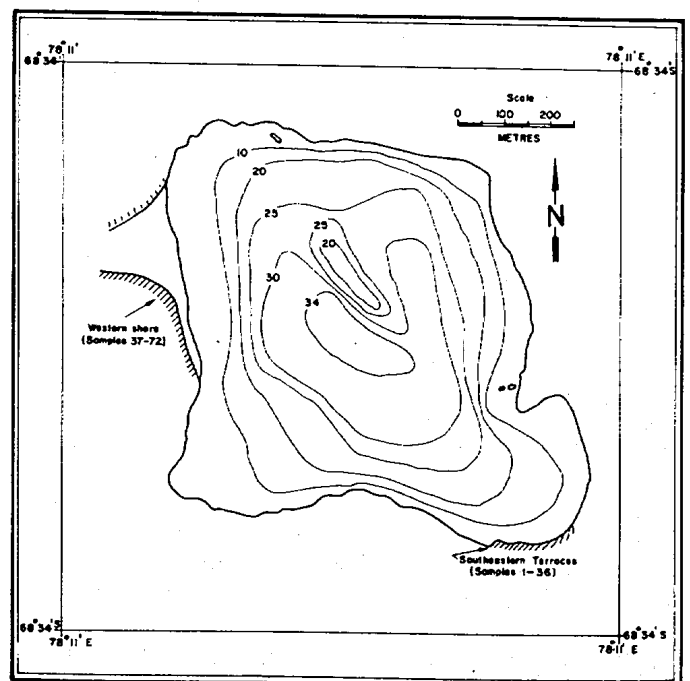


Figure 1. Map of Deep Lake and its terraces, Vestfold Hills, Antarctica (Setty et al. 1980).

\*The Deep Lake referred to in this article is located in the Vestfold Hills, Princess Elizabeth Land and is shown in a map produced by the Division of National Mapping, Department of Resources and Energy, Canberra, Australia in Association with the Antarctic Division, Department of Science and Technology, Hobart, Tasmania. "Deep Lake" is not an official name.

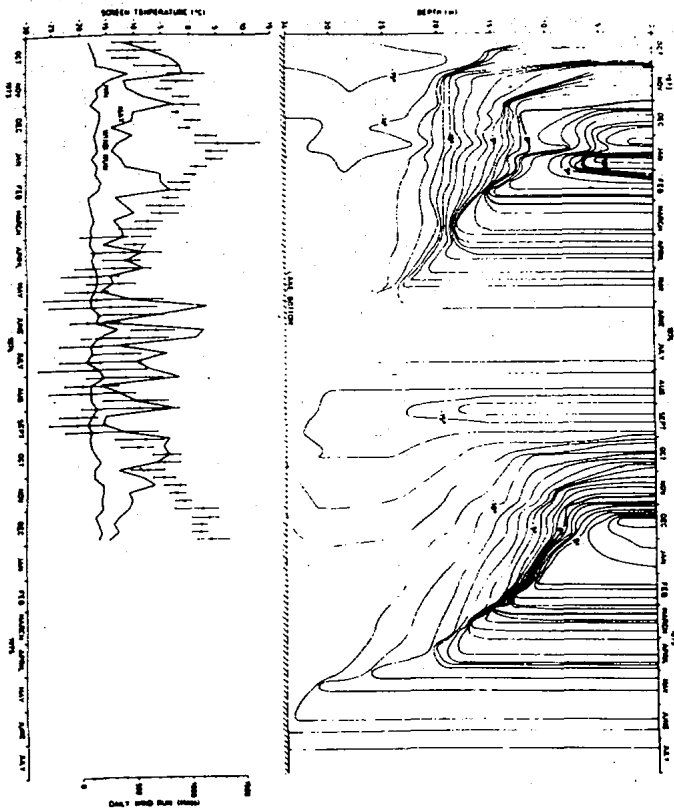


Figure 2. Depth, temperature, and daily wind run data from October 1973 to July 1975 of Deep Lake area, Vestfold Hills, Antarctica (Setty et al. 1980).

The faunal content of the sediment is sparse and restricted to a few stations. This disparity in abundance, scarcity, or even total absence of microfauna at various stations of the two transects at identical depth levels/terraces appears to be unnatural; however, it may possibly be due to the changes in the wind run, velocity, and wind direction in the region and the continuous decrease in salinity of the lake. It is likely that the microfossils are wind blown differentially and deposited elsewhere. A few benthonics are common to both the Ross Sea and Deep Lake.

Ten samples from the Deep Lake terraces were prepared for diatom analysis using the method described by Setty (1966). Prepared samples were examined using a Leitz Dialux 20 microscope at 630x and 1000x (oil immersion). Each sample was examined exhaustively. Five of the samples (ACTC-39 7-4, ACTC-39 7-5, ACTC-39 7-6, ACTC-38 3-2, and ACTC-38 3-3) were barren. One sample (ACTC-39 7-7) was broken and could not be examined. The remaining four samples contained a total of only eight diatom specimens. Therefore, the results reported here are tentative and subject to modification when more material from the Deep Lake terraces becomes available.

Sample ACTC-39 7-1 contained one specimen of the genus *Cyclotella*, possibly *C. stelligera* Cleve and Grunow in van Heurck (1881) or *C. glomerata* Bachmann (1911). Samples ACTC-39 7-2 and ACTC-39 7-3 contained a total of three specimens of the genus *Triceratium*, which we tentatively identify as *T. arcticum* Brightwell (1853). Sample ACTC-38 3-1 contained four specimens of the genus *Porosira*, probably *P. glacialis* (Grunow) Jorgensen (1905), of all which appeared to be relatively large for this genus.

The paucity of the diatom flora in the Deep Lake terrace samples would normally inhibit us from publishing for lack of

data. In the present case, however, data are presented because several details concerning these samples have not been noticed previously in antarctic material, suggesting that further work might provide information useful for describing diatom distributions in the Antarctic.

*Cyclotella stelligera* and *C. glomerata* are common non-marine species (Hustedt 1930, p. 340) found in lacustrine deposits, melt ponds, and lakes in the dry valley region of Antarctica (D. Kellogg et al. 1980; unpublished data). They are also present in low abundance in marine sediments from the Ross and Weddell Seas (D. Kellogg, unpublished data), although they were not previously mentioned by Truesdale and Kellogg (1979) or Kellogg and Truesdale (1979). We believe that occurrences in marine sediments represent transport of diatom frustules from adjacent non-marine environments, possibly by ice rafting. This belief stems from our observation that both species are commonly found in melt ponds and sediments on the McMurdo Ice Shelf (Kellogg and Kellogg 1984). The presence of either *C. stelligera* or *C. glomerata* in Deep Lake terrace sample ACTC-39 7-1 is completely consistent with the fossil distributions of these species in the dry valley region of Antarctica.

The four specimens of *Porosira* found in sample ACTC-38 3-1 are somewhat larger than other specimens of this genus we have seen previously. We have observed the species *Porosira pseudodenticulata* (Hustedt) Jouse (1962) in sea-ice samples from McMurdo Sound. In these samples, collected at various times during the year, *P. pseudodenticulata* was abundant in summer ice. Krebs (1977) found both *P. pseudodenticulata* and *P. glacialis* in sea-ice samples from Arthur Harbor, and also reported *P. glacialis* in plankton samples from Arthur Harbor. The arrangement of areolae in our samples more closely resembles *P. glacialis*, but if our four specimens from the Deep Lake terraces belong to either of these species, we would have to infer a marine component in the diatom flora. Because the large size of the specimens (over 100 micrometers) in ACTC-38 3-1 exceeds the published size for *P. glacialis* (30–70 micrometers), we are unable to assign the specimens to this species with certainty (we may be looking at a new species). We know of no other species of the genus *Porosira* that have been reported from Antarctica.

We have not encountered the genus *Triceratium* previously in our studies of antarctic sediments, but McCollum (1975, figure 8) apparently recorded three different species in Deep Sea Drilling Project site 274 (collected north of the Ross Sea). Most species of this genus inhabit the littoral marine environment (Hustedt 1930). Our specimens are tentatively identified as *T. arcticum* Brightwell (1853), a marine species (Hustedt 1930, p. 816–818) not reported by McCollum (1975). This is the same taxon reported by Krebs (1977) as *Trigonium arcticum* (Brightwell) Cleve (1868), a benthic species. We follow Hustedt (1930), who preferred Grunow's (1880) classification of this species as *Triceratium arcticum*.

The one clear conclusion we can draw from diatoms in the Deep Lake terraces is reworking, or mixing, of marine and non-marine material. This conclusion is based on the co-occurrence of marine (*Porosira* and *Triceratium*) and non-marine (*Cyclotella* cf. *stelligera*/*glomerata*) diatoms. Further support for the presence of marine material comes from the foraminiferal study of the Deep Lake terraces by Setty et al. (1980). Documentation of reworking suggests that further diatom work in the Vestfold Hills area has the potential for providing useful information on the glacial history of this portion of the east antarctic ice sheet, following procedures like those used in our earlier studies (Kellogg, Truesdale, and Osterman 1979; Kellogg and Kellogg 1981). This is a particularly important conclusion because little is cur-

rently known about this part of Antarctica, much less its glacial history.

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## Recycled palynomorphs and the age of sedimentary sequences in the eastern Weddell Sea

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Surficial sediments on the seafloor near Antarctica are often rich in recycled palynomorphs—spores, pollen and dinoflagellates. These derive from the erosion of sedimentary sequences either on the continent, where they are usually hidden beneath thick ice cover, or on the continental shelf. The palynomorphs have been transported seaward by processes of glacial entrainment, followed by meltout beneath grounded ice shelves or floating ice. Their distribution and density are useful in predicting the location of hidden sedimentary sequences; their value is much enhanced where patterns of ice flow to the depositional area are understood, allowing constraints to be placed on the provenance of the recycled fossils. For example, in the Ross Sea, Truswell and Drewry (1984) correlated high palynomorph densities in the southeastern Ross Sea with discharge from Ice Streams D and E flowing from West Antarctica; source beds

were thus predicted to lie in the catchment areas of these streams near the head of the Ross Ice Shelf.

*Palynomorphs in the Weddell Sea.* In the Weddell Sea, recycled palynomorphs were reported previously (Kemp, 1972; Truswell, 1983) but sampling was too sparse for these occurrences to be related to source areas. Recently, more material has become available from the eastern Weddell Sea, and, although geographic coverage of the region is still meagre, there is now enough information to make 'educated guesses' about the position and age of sedimentary sequences on the continental shelf. Samples were obtained by piston coring during cruises of the USCGC *Glacier* in 1969-1970, and the ARA *Islas Orcadas* in 1978. They cover an area from the Princess Martha Coast, where the samples come from the continental shelf and slope offshore from the Riiser-Larsen Ice Shelf (sites 3-11-4, 3-13-1, 3-17-1 and 1578-28) southwest to a region on the continental shelf offshore from the Luitpold Coast and immediately to the north of the Filchner Ice Shelf (sites G15, G16, 3-1-2, G17, G2 and 2-19-1 (see figure). Lithologically, samples at the sites include both basal tills and transitional glacial marine sediments.

Palynomorphs were recovered, in varying densities, from all sites. At most sites several samples were examined from each core, from depths of up to 2 meters. No appreciable vertical variation in palynomorph composition was observed at any site. At all sites, palynomorph assemblages are dominated by taxa which elsewhere have stratigraphic ranges spanning the Late Jurassic to Late Cretaceous. Tertiary forms are present at most sites but are a very minor component. Most of the material suggests derivation from source beds of Neocomian through Cenomanian age. This situation differs from that of the Ross Sea, where Paleogene palynomorphs dominate.

The sites fall into two regions or provinces on the basis of their palynomorph content. The northeastern suite of sites, off the Princess Martha Coast (viz, sites 3-11-4, 3-13-1, 3-17-1 and