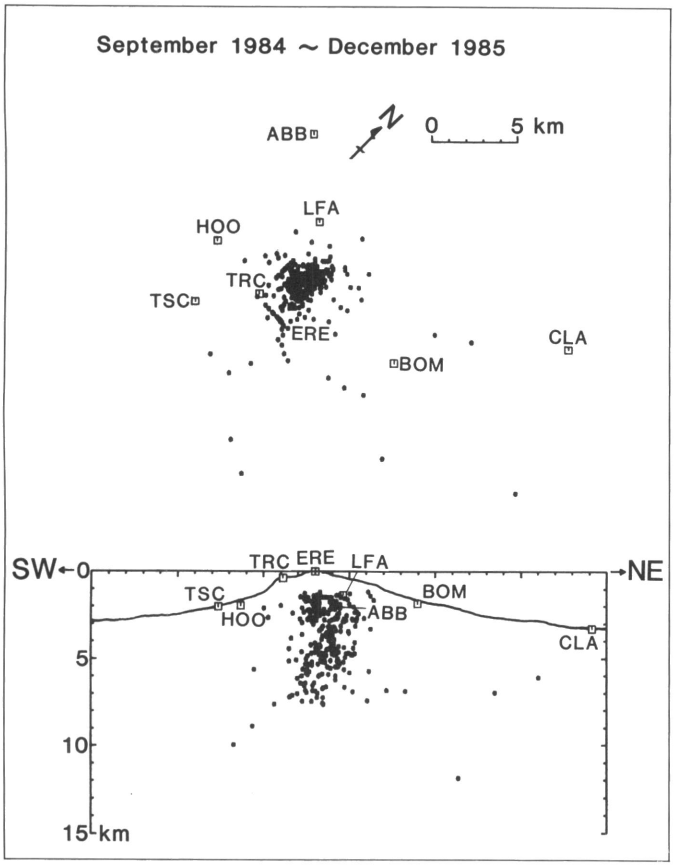

Figure 3. Hypocenter locations of earthquakes from February 1982 to May 1984. ("km" denotes "kilometer.")

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Uranium mineralization in southern Victoria Land, Antarctica

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For the past 10 antarctic field seasons, an airborne gamma-ray spectrometric survey has been conducted over widely separated parts of the continent. Localized accumulations of both primary and secondary uranium minerals have been discovered at several localities scattered along the Transantarctic Mountains from the Scott Glacier to northern Victoria Land. During the 1985–1986 field season, we discovered a number of highly significant radiation anomalies in the area between the Koettlitz Glacier and the Pyramid Trough. The occurrences consist of pegmatite vein complexes which contain an association of primary uranium and thorium minerals. Of still greater significance is the fact that abundant secondary uranium minerals were found in association with the primary deposits, and they indicate clearly that uranium is geochemically mobile under the conditions imposed by the arid polar climate that now exists in southern Victoria Land.

On the ground, we visited two veins which had been identified from the airborne gamma-ray record. The veins are separated by several kilometers. Preliminary results of a uranium analysis performed by neutron activation indicate a concentration of 0.12 percent uranium in a composite sample from the two veins. Even higher levels of thorium are present. The nature of the primary uranium mineralization is currently under investigation. Autoradiographs shown in figures 1 and 2 indicate the distribution of radioactive minerals in polished surfaces of samples from the two radioactive veins. Incrustations of secondary yellow uranium minerals were found in the radioactive vein locality at the head of the Pyramid Trough. In addition, strongly fluorescent coatings of carbonates containing uranium, were distributed along fractures extending inward at least 40 centimeters from outcrop surfaces. They furnish clear evidence of mobilization of uranium in solution in the surface-weathering zone. Our preliminary studies indicate that some of the minerals present may be new and previously unknown forms but many show the typical yellowish green fluorescence

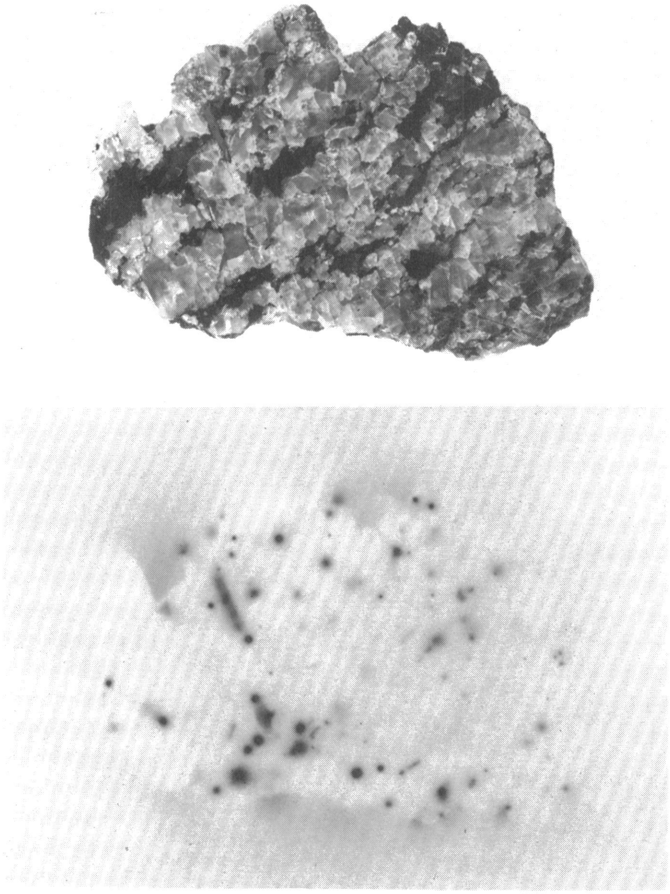

Figure 1. Photograph and autoradiograph of polished slab from radioactive mineral site at the head of Pyramid Trough. Slab is 7 centimeters in length.

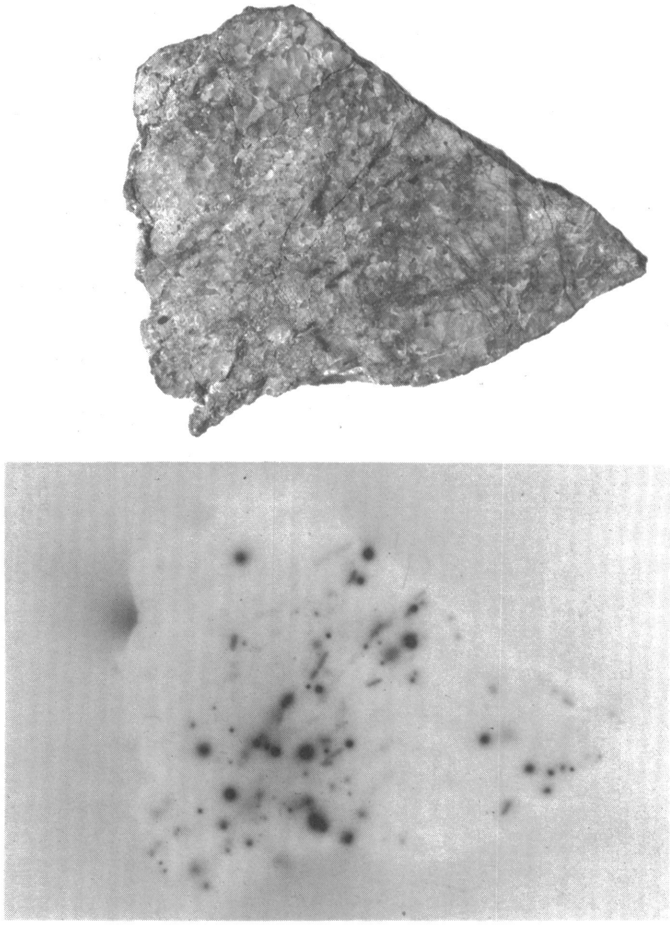

Figure 2. Photograph and autoradiograph of polished slab from radioactive mineral site on the Koettlitz Glacier. Slab is approximately 7 centimeters in length.

(see figure 3) that characterizes uranium-bearing carbonates and phosphates.

The geochemical factors that control uranium leaching in Antarctica may be unique. First, the presence of high levels of nitrate in soils (Claridge and Campbell 1968) and the abundance of nitrate, probably in the form of nitric acid in the antarctic snow (Zeller and Parker 1981; Laird 1983) undoubtedly contribute to the rapid leaching of all but the most refractory uranium-bearing minerals. Second, the distance traveled by uranium-bearing solutions is determined more by the outcrop temperature than by any other factor. In temperate climates, the presence of abundant organic compounds with their attendant effect upon the oxidation-reduction potential of the surface environment have a major influence upon uranium mobility. In Antarctica, outside of the Antarctic Peninsula and the extreme coastal regions, organic activity on rock outcrops is largely confined to a few lichens which may grow on outcrop surfaces and to the endolithic algae living within the upper few millimeters of some porous surface rocks (Friedmann 1977). While it is certainly possible that these plants could exert an influence on the geochemical microenvironment, that influence must be highly localized. Chemical weathering is not necessarily subordinated to physical disintegration processes in an extreme polar environment (Ugolini and Jackson 1982). Furthermore, Miotke and Hodenberg (1980) showed that temperatures a few centimeters below the surfaces of rocks exposed to sunlight were frequently above freezing and temperatures of +30°C were recorded a few millimeters below exposed rock surfaces in the dry valleys. In addition, the freezing point of intergranular water will certainly be depressed by high ion concentrations which must be expected in this arid environment.

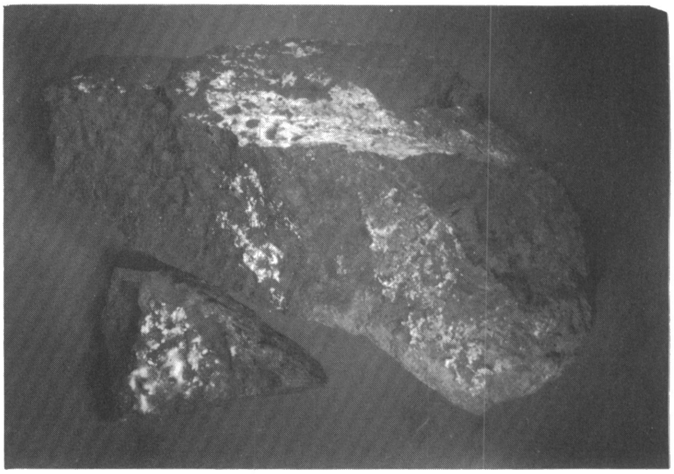

Figure 3. Photograph of fluorescent secondary minerals containing uranium. These coatings have been formed as fracture fillings.

In southern Victoria Land, the occurrences of primary radioactive minerals appear to be associated with large-scale, often concentric, circular structures which are clearly visible in the January 1986 field season when we attempted to locate the radioactive veins in relation to major structural features of the area. The circular structures range in size from nearly 50 kilometers to smaller features only about 20 kilometers in diameter. Gamma-ray survey flight lines from previous years cross the outer boundaries of other circular structures at a number of locations, and they also show increased radioactivity in the boundary zones. We believe that the genesis of the uranium and thorium deposits is related to, and most probably contemporaneous with, the emplacement of the large-scale circular features.

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Late Neogene foraminiferal record and geological history inferred from Dry Valley Drilling Cores 10 and 11, Taylor Valley, Antarctica

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The Late Cenozoic history of the dry valley region of Antarctica has been a focus of study for many workers over the past three decades. Drilling projects in the region—Deep Sea Drilling Project (DSDP) (Hayes, Frakes et al. 1975; Leckie and Webb 1983, 1985), Dry Valley Drilling Project (DVDP) (McGinnis 1981; Webb and Wrenn 1982), Ross Ice Shelf Project (RISP) (Webb et al. 1979), McMurdo Sound Sediment and Tectonic Study (MSSTS-1) (Webb and Harwood in preparation; Barrett 1986), and Cenozoic Investigation of the Ross Sea 2 (CIROS-2) (Barrett 1985)—have contributed to gaining a better understanding of the Cenozoic history of the Ross Sea region. Of these projects, DVDP drillholes 10 and 11 provide the most complete late Miocene/early Pliocene record for this sector.

Preliminary reports on foraminifera (Wrenn 1977; Webb and Wrenn 1982), stratigraphy and sedimentology (McKelvey 1975; Powell 1981), geophysics (Hicks and Bennett 1981), paleomagnetics (Elston and Bressler 1981), and diatoms (Brady 1979) indicate fjord conditions in th Late Neogene Taylor Valley. This nearshore environment, close to the Transantarctic Mountains and outlets of the east antarctic ice sheet, is sensitive to glaciation, tectonic uplift, and glacio-eustatic fluctuations. Benthic foraminifera are reliable indicators of environmental change (Phleger 1960; Murray 1973; Boltovskoy and Wright 1976). Assemblage fluctuations observed in the DVDP 10 and 11 faunas are related to the Late Neogene tectonic and glacial history of the Ross Sea region.

Ninety-four samples from the lower parts of DVDP 10 and 11 (sub-133 meters and sub-193 meters, respectively) yielded a total of 43 genera and 88 species of foraminifera. The fauna is dominated by calcareous benthic taxa. No agglutinated forms are present and only three planktonic species occur. Diversity for individual samples ranged from 3 to 42 species. The biostratigraphic zonation erected for DVDP 10 and 11 is composed of four assemblage zones (based on species present and equitability) (figure 1). Assemblage zones are separated by interval zones that are barren of foraminifera.

The *Trochoelphidiella uniforamina* zone (figure 1) contains the only planktonics recovered from DVDP 10 and 11; *Streptochilus latum* Brönniman and Resig, *Neogloboquadrina pachyderma* (Ehrenberg), and *Candeina antarctica* Leckie and Webb. This is the first report of *S. latum* in the high latitudes. In the southwest Pacific its range is restricted to the late Miocene (Brönnimann and Resig 1971) making it valuable for dating these cores (approximately 7 million years). In addition, diatom data support the age for this assemblage zone with the occurrence of *Thalassiosira torokina* and *Actinocyclus ingens* as well as the absence of Pliocene marker species *Nitzschia praeinterfrigidaria* and *Thalassiosira oestrupi*. Although it has no biostratigraphic utility here, *Candeina antarctica* occurs in the T. uniforamina zone, marking its youngest occurrence (previously believed to be early Miocene; Leckie and Webb 1985). The benthic species *Trochoelphidiella uniforamina* Leckie and Webb is the middle/late Miocene representative of the late Oligocene/Pliocene *Trochoelphidiella* Webb lineage, a group endemic to the antarctic region (Webb 1974; Leckie and Webb 1985). This zone represents relatively deep water (600–900 meters) with bathymetric fluctuations indicated by increase in *Ehrenbergina* spp. abundances (up to 25 percent).

The *Epistominella vitrea* zone (figure 1) exhibits low species diversity (fewer than 20 species), poor equitability, and lacks *Trochoelphidiella uniforamina* Leckie and Webb and members of the Miliolidae. With exception of *E. vitrea*, *Astrononion echolsi*