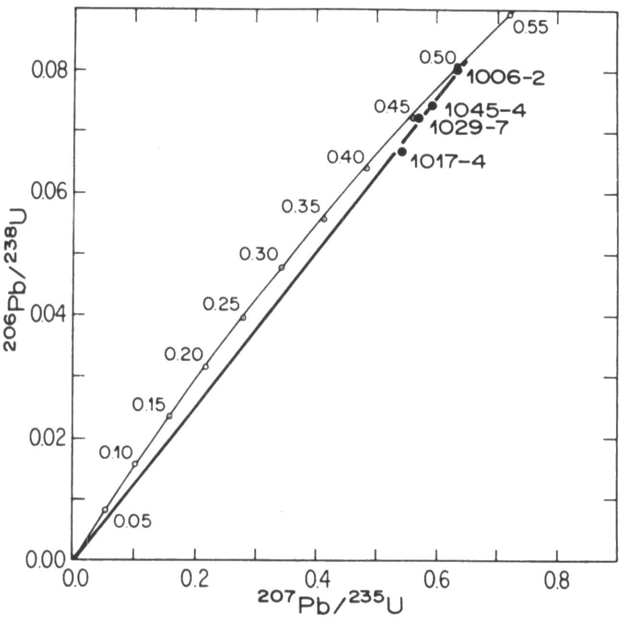

Concordia plot of U-Pb data from zircon in amphibolite-facies rocks of the Mount Provender area, Shackleton Range, Antarctica.

uncertainties associated with each set of data. These uncertainties are particularly large for the Rb-Sr data on sample suite 1006 (Grew and Halpern 1979).

The zircons are interpreted to have crystallized during the amphibolite-facies event or to have lost all of their lead during this event. The 500-to-550-million year dates record the times at which the zircons started retaining lead. This closure of the U-Pb system in zircon occurred soon after final Rb-Sr isotopic closure in total rocks and at about the same time as its closure in biotite. An age in the range 500 to 600 million years is indicated for the metamorphism of the Mount Provender rocks, confirming the conclusions reached by Grew and Halpern (1979).

Stephenson (1966) and Clarkson, Hughes, and Thomson (1979) suggest that the fossiliferous erratics in moraine around Mount Provender are derived from intermediate strata in the Blaiklock Glacier Group, the basal beds of which rest unconformably on the metamorphic rocks. A minimum age of Middle Cambrian (500–540 million years) is thus implied for the metamorphism; this minimum is consistent with the radiometric data.

This research was supported by National Science Foundation grant DPP 75-17390 to the University of California at Los Angeles. Grew thanks V. N. Masolov, Deputy Chief of the 22nd Soviet Antarctic Expedition (SAE) and other members of the 22nd SAE for their logistic support and cooperation.

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Petrologic studies in Enderby Land with the Australian National Antarctic Research Expedition, 1979–80

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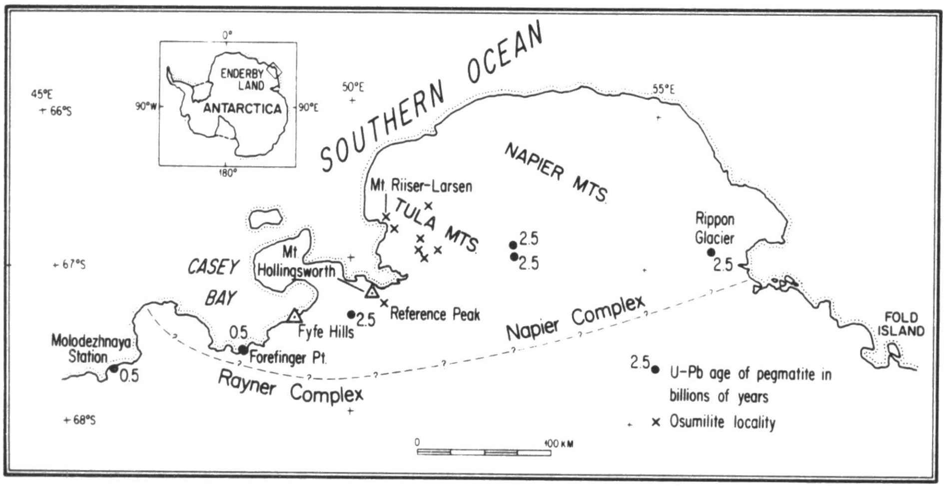
In 1979 I joined the Enderby Land party of the Australian National Antarctic Research Expedition (ANARE) for a second field season in Enderby Land (see figure; also see Grew 1978a). The main objectives of the 1979–80 field program were to investigate (1) the regional distribution of osumilite and of the apparently incompatible mineral assemblages sapphirine-quartz ± garnet and sillimanite-orthopyroxene-quartz and (2) the age relations and mineralogy of pegmatites and of mylonite zones. Between 30 November 1979 and 16 February 1980, I examined in detail the bedrock at 10 localities, collected samples for petrologic studies and radiometric age determination, and, where possible, mapped geologic structures.

Ravich and Kamenev (1975) report the sillimanite-orthopyroxene association in quartzite at three localities (sites 459, 185, and 72), all of which I studied in detail during the 1979–80 season. Two of these localities probably are not part of a distinct sillimanite-orthopyroxene zone. Ravich and Kamenev's (1975) sample from one of these localities, Reference Peak (sample 459A), may represent the



Map of Enderby Land, Antarctica, including the Kemp Coast where Fold Island is located. Uranium-lead ages and boundary between the Napier and Rayner Complexes are from Grew (1978b) and Grew and Manton (1979). Osumilite localities are from Ellis et al. (1980), Sheraton et al. (1980), and Grew (in press).

univariant reaction sapphirine + quartz = sillimanite + enstatite (Grew in press). Reference Peak may thus lie near a sapphirine-quartz "isograd" separating a sappirine-quartz zone exposed in the Tula Mountains from a sillimanite-orthopyroxene zone south of Reference Peak (see maps compiled by Ellis, Sheraton, England, and Dallwitz 1980; and by Sheraton, Offe, Tingey, and Ellis 1980). At Mount Riiser-Larsen, the second location (site 185), some rocks contain sapphirine in direct contact with quartz. The mineralogy of other rocks here suggests that metamorphic conditions may have been close to those of the univariant reaction sapphirine + garnet + quartz = sillimanite + orthopyroxene, which is a potential isogradic reaction within the sapphirine-quartz zone. I also sampled sapphirine-bearing rocks at five localities between Reference Peak and the islands in Casey Bay near Fyfe Hills (see figure), including Ravich and Kamenev's (1975) third sillimanite-orthopyroxene locality (site 72, Mount Cronus—67°18′S 50°03′E).

I collected osumilite at three locations, including Mount Riiser-Larsen and Reference Peak, two exposures where osumilite had not been reported previously. In hand specimens, osumilite is gray or blue, and in some samples it has an opalescence like moonstone. It is associated with quartz, plagioclase, biotite, orthopyroxene, sapphirine, and sillimanite. In general, osumilite is restricted to rocks moderately enriched in alumina (Al_2O_3) and having high magnesium/iron ratios (Ellis et al. 1980; E.S. Grew unpublished data, University of California, Los Angeles, 1980). In general, osumilite (figure) occurs where the assemblage sapphirine-quartz occurs; notable exceptions are the sapphirine-quartz locations in Casey Bay and at Mount Torkler (66° 52′S 52° 44′E) (Ellis et al. 1980; Grew 1979), where osumilite has not yet been reported.

At least two generations of pegmatites cut the granulite-facies rocks. An older generation contains hypersthene, garnet, sillimanite, and rutile. In Casey Bay, surinamite, a magnesium-iron-aluminum silicate, taaffeite, a beryllium-magnesium-iron-aluminum oxide, chrysoberyl, and wagnerite are also present. These rare minerals, identified on the basis of optical properties, electron microprobe analyses, and X-ray diffraction patterns, have not been reported previously from Antarctica. Moreover, surinamite and taaffeite have been described from only a few localities elsewhere (de Roever, Kieft, Murray, Klein, and Drucker 1976; Teale 1980.)

Pegmatites of the older generation sampled during the 1977–78 season have been dated at 2,500 million years (see figure; Grew and Manton 1979). During the 1977–78 season I did not observe any alteration of the granulite-facies country rocks in the vicinity of these pegmatites, but during the 1979–80 season I did note zones of discoloration along their contacts at several locations.

I studied the younger pegmatites on the islands in Casey Bay, in the Fyfe Hills, and at Mount Hollingsworth. These pegmatites are associated with zones of retrograde metamorphism under amphibolite-facies conditions. Muscovite, tourmaline, beryl, columbite-tantalite (another mineral possibly new to Antarctica) and dumortierite are found locally. These pegmatites are similar to those at Forefinger Point and Molodezhnaya Station that have been dated by radiometric methods at 500 to 550 million years (Grew 1978b; Grew and Manton 1979).

Mylonite zones cutting the granulite-facies rocks were studied in Casey Bay and the Tula Mountains. Rocks of pelitic composition recrystallized to mica schist and quartzo-feldspathic gneiss containing kyanite, staurolite, cordierite, and sillimanite, and mafic rocks to amphibolite, minerals and rocks also reported by Kamenev (1979) and Sheraton et al. (1980). Blastomylonite and augen gneiss are characteristic of the zones. Field relations suggest that these zones developed about the time the younger pegmatites were emplaced.

One of the localities I studied in detail was Fold Island (figure); previous work on this island was reported by Trail (1970). This island is underlain by charnockitic gneiss, pyroxene granulite, and minor garnet-biotite gneiss, cut by metamorphosed and deformed mafic dikes. The age of the rocks at Fold Island is not known. These formations may constitute an eastward continuation of the Napier Complex rather than a part of the Rayner Complex as shown in the figure.

During the field season, I worked with P. R. James (University of Adelaide) on Fold Island, with C. J. L. Wilson and M. Sandiford (University of Melbourne) in the Casey Bay and Fyfe Hills areas, and with M. Sandiford on Mount Hollingsworth.

This research is supported by National Science Foundation grant DPP 76-80957. I wish to thank the Antarctic Division of the Australian Department of Science and the Environment for logistic support and S. L. Kirkby (Officer-in-Charge in Enderby Land), P. R. James, C. J. L. Wilson, M. Sandiford, S. Harley, and other members of ANARE for their assistance in the field. I also thank L. A. Offe, J. W. Sheraton, and R. J. Tingey (Bureau of Mineral Resources, Canberra, Australia) and Ye. N. Kamenev (Research Institute of the Geology of the Arctic, Leningrad) for their help.

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