Geochronologic studies in East Antarctica: Age of pegmatites in Casey Bay, Enderby Land

EDWARD S. GREW

Department of Earth and Space Sciences
University of California-Los Angeles
Los Angeles, California 90024

WILLIAM I. MANTON

Department of Geosciences
University of Texas-Dallas
Richardson, Texas 75080

MICHAEL SANDIFORD

Department of Geology
University of Melbourne
Parkville, Victoria 3052, Australia

The Napier Complex of Enderby Land is an Archean granulite-facies terrain bounded and intersected by zones metamorphosed and deformed in the Late Proterozoic about 1,000 million years ago (Rayner Complex) and the Early Paleozoic 500 million years ago (DePaolo et al. in press; Grew and Manton 1979; James and Black 1981; Ravich and Kamenev 1975; Sheraton et al. 1980). Available data indicate that the precursors of the Napier Complex metamorphics may be as old as 3,500 million years and have been affected by several deformational, metamorphic, and plutonic events between 3,000 and 2,500 million years ago. However, there is considerable debate regarding not only the relative timings of these events, but also the extent of the areas affected by post-Archean events.

The islands in the eastern part of Casey Bay lie in one of the problematic areas. Ravich and Kamenev (1975), Sheraton and associates (1980), and James and Black (1981) map these islands in the transition zone between the Rayner and Napier Complexes. However, mineral assemblages in pelitic rocks in Casey Bay, such as sapphirine-quartz, and undeformed mafic dikes suggest that the islands in Casey Bay are composed of Napier Complex rocks little affected by post-Archean events. Post-Archean activity is restricted to discrete zones of intense deformation, retrograde metamorphism, and pegmatite emplacement.

We report here uranium-lead data on zircons collected during the 1979–80 austral summer from two pegmatites in Casey Bay: Sandiford locality R25730 on McIntyre Island (67°22'S 49°05'E) and Grew locality 2233 on an unnamed rocky point about 2 kilometers south of McIntyre Island ("Zircon Point" in Grew 1981). The sampled pegmatites (early generation of Grew 1981) appear to be coeval with the granulite-facies metamorphism and associated deformation. The beryllium-bearing minerals chrysoberyl, taaffeite, and surinamite are found in a similar pegmatite at locality 2234 (250 meters south of locality 2233) and in a second one on an unnamed island 5 kilometers west-southwest of McIntyre Island (Grew 1981).

Pegmatites at locality 2233 form discordant pods up to 1 meter thick in a garnetiferous gneiss. The pods trend N30°E and consist of quartz and feldspar, with accessory garnet, magnetite, monazite, and zircon. The pegmatite at R25730 is an irregular pod up to 0.5 meter across formed in the pressure shadows between boudins of garnet-feldspar-sillimanite gneiss. The pegmatite consists of mesoperthite, quartz, garnet, and accessory rutile, zircon, and monazite. The boudins and associated pegmatites formed during the D_2 structural event (terminology of James and Black 1981). The only apparent effect of post-D_2 deformation is recrystallization of some feldspar and quartz grain boundaries. Sapphirine occurs with quartz in other D_2 pegmatites nearby and in the host gneisses, indicating that the sapphirine-quartz association was stable during the D_2 structural event. Consequently, the D_2 structural event and associated pegmatites were coeval with the peak of metamorphism in Casey Bay.

The analyzed zircons are euhedral or subhedral and one to several millimeters across. They were crushed and any surface contamination was removed before analysis by standard techniques for uranium and lead isotopes (table). Lead isotope ratios corrected for a 2,500-million-year lead are plotted in the figure. The data for three zircons from locality R25730 are nearly concordant at 2,500 million years, while the data for two zircons from locality 2233 lie close to a chord intersecting concordia at 2,500 and 1,000 million years. We conclude that the zircons and pegmatites at both localities crystallized 2,500 million years ago and thus are coeval with the 2,500-million-year-old pegmatites from other parts of the Napier Complex dated by Grew and Manton (1979). Moreover, the two pegmatites containing beryllium minerals, which are similar in structural relations to the sampled pegmatites, most likely are also 2,500 million years old.

Our zircon data provide a well-constrained age of 2,500 million years for the D_2 structural event and peak of the granulite-facies metamorphism in Casey Bay. This age assignment is consistent with the 2,500-million-year age assigned to the granulite-facies metamorphism of the Napier Complex by Grew and Manton (1979) and by DePaolo and associates (1982). In contrast, James and Black (1981) suggest an approximate 3,000-million-year age for D_1 and D_2 and the peak metamorphic conditions.

In: Antarctic Journal of the United States 1982 review V.17, No.5, 1-2

Uranium (U) and lead (Pb) contents of zircons from pegmatites on McIntyre Island (locality R25730) and on a nearby point (locality 2233) in Casey Bay, East Antarctica

Sample	U (ppm)[a]	Pb (ppm)[a]	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{206}Pb$	$^{208}Pb/^{206}Pb$	$^{207}Pb^{b}/^{235}U$	$^{206}Pb^{b}/^{238}U$
2233a	3,023	1,278	4.0×10^4	6.393	59.49	9.017	0.4189
b	1,168	538.8	3.8×10^4	6.291	12.56	9.461	0.4326
R25730a	2,265	1,071	2.3×10^4	6.175	33.01	10.29	0.4610
b	3,327	1,575	$\sim 5 \times 10^4$	6.148	48.38	10.44	0.4654
c	3,400	1,579	$\sim 5 \times 10^4$	6.156	49.26	10.23	0.4568

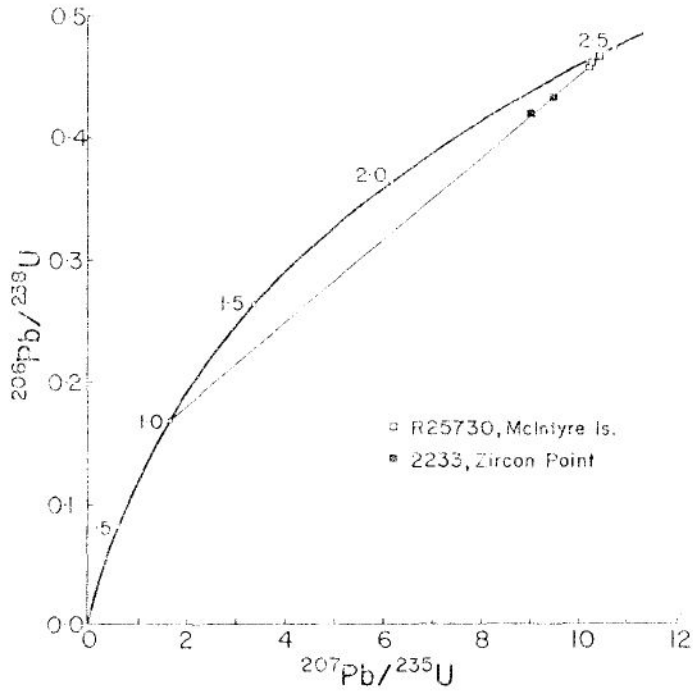
[a]Parts per million.

[b]Radiogenic component.

They assign the 2,500-million-year age to D_1 and a later metamorphism.

The lower intercept of 1,000 million years suggests lead loss about 1,000 million years ago. This is the first evidence within the Napier Complex for a Late Proterozoic event coeval with the Rayner event. Further east in Enderby Land, isotopic data lie on a 2,500–600-million-year chord, indicating an Early Paleozoic event (Grew and Manton 1979). Heating related to the discrete shear zones may have caused the lead loss 1,000 million years ago in the Casey Bay zircons. We plan to analyze more zircons from locality 2233 to better constrain the age of lead loss at this locality.

This research was supported by National Science Foundation grants DPP 76-80957 and 80-19527. Sandiford was supported by an Australian Commonwealth Postgraduate Research Award. We thank the Antarctic Division of the Australian Department of Science and the Environment for logistic support and S. L. Kirkby and C. J. L. Wilson for their assistance in the field.



Concordia diagram for zircons from pegmatites on "Zircon Point" and McIntyre Island, Casey Bay, East Antarctica. Pb = lead; U = uranium.

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