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Monazite occurrence, chemistry, and chronology in the granitoid rocks of the Lachlan Fold Belt, Australia: An electron microprobe study

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Abstract

In-situ electron-microprobe dating of monazite holds the promise of being an effective technique for obtaining chronologic data. Our research focuses on I- and S-type granitoids of the Lachlan Fold Belt, Australia, whose petrology and zircon chronology have been thoroughly characterized. This study documents the textural relationships, morphology, zoning, and ages of monazite in these granitoid rocks. The I-type granitoids that lack monazite usually contain other mineral phases enriched in rare earth elements, such as allanite, titanite, and bastnasite. Only silica-rich, highly evolved I-type granitoids contain monazite. This preference in I-type rocks for phases other than monazite to host the REE and Th limit the applicability of monazite dating for this group of igneous rocks. On the other hand, monazite is ubiquitous in S-type rocks, both as interstitial and included grains. High-resolution X-ray maps of individual monazites reveal complex patterns of chemical zoning. Weighted averages of multiple analyses for individual chemical domains show small but systematic differences in age. These weighted averages of the chemical domains are considered the best estimate of the age of the monazite. Monazites from 8 different S-type samples range in age from 405 to 759 Ma, with the majority being 490 Ma and older. These are premagmatic ages for these granitoids, which have crystallization ages of 400 to 430 Ma. These premagmatic ages are similar to Cambro-Ordovician ages obtained from inherited zircon cores in the same granitoids, indicating that monazite can survive anatexis in peraluminous rocks. Thus, monazite dating in peraluminous rocks may illuminate characteristics (composition and age) of source rocks and anatectic processes.

Keywords: Monazite, in-situ dating, electron microprobe, granite, Lachlan Fold Belt, chronology