ZIRCON AS A MULTI-FACETED TOOL FOR PETROGENETIC MODELLING: APPLICATIONS TO EASTERN AUSTRALIAN GRANITOIDS

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The crystal morphology, trace-element signatures, U-Pb ages and Hf isotopic compositions of magmatic zircons from I- and S-type granitoids from the Lachlan Fold Belt (Berridale adamellite and Kosciusko tonalite) and New England Fold Belt (Dundee rhyodacite), Eastern Australia were used to model petrogenetic processes. U-Pb analyses of zircons are carried out in situ by laser-ablation microprobe inductively coupled mass spectrometry (LAM-ICPMS), Hf-isotope data on the same grains are collected by LAM-multicollector (MC)-ICPMS and trace-element data are obtained by electron microprobe and LAM-ICPMS analyses. This integrated study of zircon populations provides a new, valuable approach to better understand the petrogenesis of granitic rocks. The complex morphology of the investigated zircons reflects changes in both temperature and composition of the source magmas and provides a qualitative record of magma evolution. The trace-element patterns of zircons define a fingerprint that can be used to characterise original magma types and trace their evolution. Zircon Hf-isotope composition helps to evaluate the relative contribution of mantle-derived and crustal-derived components in the production of the host granitoids, and to track the mixing of magmas with different sources. U-Pb data can distinguish age populations, including recognition of inherited grains, and test the crystallisation sequence of the recognized zircon types. Several examples demonstrate that changes in morphology generally correlate with changes in trace-element and Hf-isotope signatures showing the mixing of magmas and the direction of magma evolution. The results of this study indicate that the zircons from the Kosciusko tonalite were derived from a single source of crustal origin, whereas the S-type Berridale adamellite had two distinct sources including a significant I-type magma contribution. Complex morphology together with variations in Hf-isotope composition in zircons from the I-type Dundee rhyodacite indicate there was a moderate contribution from a crustal component in the genesis of this granitoid.