Geochemistry of the Karamea Batholith, New Zealand and comparisons with the Lachlan Fold Belt granites of SE Australia

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Abstract

The Karamea Batholith in the Buller terrane of the South Island New Zealand forms part of an extensive Middle–Late Devonian belt of magmatic activity along, or close to, the Paleo-Pacific margin of Gondwana. The belt includes the I- and S-type granites of the Lachlan Fold Belt in SE Australia and coeval rocks in Antarctica. The northern half of the Karamea Batholith comprises five main intrusive phases: Zetland Diorite, Whale Creek Granite, Karamea Granite, O’Sullivans Granite and Dunphy Granite. To the east of the Karamea Batholith in the Takaka terrane, ultramafic–mafic Devonian igneous rocks are represented by the Riwaka Complex.

The rocks forming the Karamea Batholith are a high-K calc-alkaline suite ranging in composition from metaluminous (ASI for Zetland Diorite = 0.8) to strongly peraluminous (ASI for Dunphy Granite = 1.2–1.3). Initial 87Sr/86Sr ratios exhibit a large range from 0.705 in the Zetland Diorite to 0.719 in the Dunphy Granite. The corresponding values for εNd are −0.3 and −9.2. There is a strong inverse correlation between εNd and initial 87Sr/86Sr, which suggests that the Karamea rocks were generated by a simple mixing process. The mafic end-member (with εNd = 0), which is itself probably derived from a mixed lithospheric source, is taken to be the Zetland Diorite/Riwaka Complex, and the crustal end-member is represented by Ordovician Greenland Group greywackes that form the country rocks to the batholith. Mixing is also supported by recent U–Pb zircon studies. The inherited zircon population in the granites matches the detrital zircon population in the Greenland Group greywackes. The Whale Creek Granite, Karamea Granite and O’Sullivans Granite can be modelled by 20–30% crustal material, whereas the Dunphy Granite appears to represent 65–85% crustal material.

In terms of the I–S classification scheme developed for the Lachlan Fold Belt granites in SE Australia, both types are present in the Karamea Batholith. However, in New Zealand there appears to be a continuum from one extreme to the other, which is consistent with the mixing model presented here.

Keywords: igneous; geochemistry; granite; New Zealand; Devonian; Gondwana

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