

Cretaceous lamprophyres in New Zealand: Melting of continental lithospheric mantle during continental break-up

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Continental intraplate magmas often have trace element and isotopic signatures similar to mantle plume-related ocean island basalts. As an alternative to derivation from a mantle plume, an enriched reservoir can exist within the lithospheric mantle. Highly incompatible element enriched, Late Cretaceous (92-69 Ma) alkaline lamprophyres from the Western Province of New Zealand are investigated to test this hypothesis. Ages and orientations of these dikes indicate they mostly precede, but also postdate, opening of the Tasman Sea at 84 Ma. They are found to represent some of the earliest HIMU-like intraplate magmatism within a larger predominantly Cenozoic diffuse alkaline magmatic province (DAMP) that also spans Antarctica and eastern Australia. The composition of primitive low-silica (37-46 wt.% SiO₂) melts corresponds to the melts derived from complex enriched lithospheric veins consisting of variable proportions of amphibole (+apatite +phlogopite +rutile +clinopyroxene) and peridotite. These assemblages occur as rare xenoliths and xenocrysts within the studied lamprophyres. Melts from amphibole-rich assemblages have relatively low HREE concentrations and provides an alternative to melting in the presence of garnet. Age-corrected Pb isotopes form broad positive correlations with Th/Pb and U/Pb. This corresponds to in-situ ingrowth of roughly 50-150 Ma prior to eruption. At this time the region was situated in a back-arc setting during episodic subduction along Gondwana's eastern active margin. Subduction-related enrichment of the lithosphere is tentatively suggested. Limited contemporaneous alkaline intraplate magmatism on the outboard Eastern Province has more radiogenic ²⁰⁶Pb/²⁰⁴Pb, ²⁰⁷Pb/²⁰⁴Pb and ²⁰⁸Pb/²⁰⁴Pb and less radiogenic Nd and Hf isotopic compositions. This shows local variations within the DAMP region in the Cretaceous and corresponds to geographical compositional variations in the lithospheric mantle.