Provinciality of lithospheric mantle, E. Australia: Source of enriched components in the Cenozoic basalts

M. ZHANG, S.Y. O'REILLY

GEMOC ARC National Key Centre, Department of Earth and Planetary Sciences, Macquarie University, Sydney, NSW 2109, Australia (mzhang@els.mq.edu.au, soreilly@els.mq.edu.au)

Systematic differences in geochemical signatures characterise the Cenozoic basalts in eastern Australia, including North Queensland (NQld), New South Wales (NSW), Victoria, Tasmania and the leucitite suite, along a zone > 4000 km-long. These differences are defined by contrasting trace-element and radiogenic isotopic trends between the provinces and can be explained as recording interactions between melts generated from depleted asthenospheric mantle (with either Pacific-MORB and Indian-MORB signatures) and the post-Archean, variably metasomatised subcontinental lithospheric mantle (SCLM) in eastern Australia. All the "traditional" enriched mantle components, EM1, EM2, and HIMU, as defined by the oceanic island basalts, are recognised in the geochemical signatures of the Australian basalts, and are consistent with derivation by contamination of underlying SCLM provinces.

The alkaline basalts in NQld and NSW show a series of two-component mixing relationships, each reflecting dynamic interactions between two mantle terranes that contribute to magma generation: an Indian-MORB type asthenosphere and an EM2 SCLM terrane for the late Cenozoic (<6 Ma) basalts in NQld; and a Pacific MORB-source asthenosphere and an analogous SCLM component for the NSW basalts (55–12 Ma). Phanerozoic subduction along the eastern margin of the Tasman Foldbelt may have imparted the EM2 signature to the SCLM. . Two dominant mantle sources for the Tasmanian Tertiary basalts are a Pacific-MORB mantle and a HIMU component which should reside in the SCLM. The composition of the Victorian Newer basalts is dominated by the Australian Plume which may have sourced the central-volcanoes tracks during the northward movement of the Australian plate during the past 35 years.

The distinctive basaltic geochemical signatures reflect heterogeneous lithospheric mantle domains ~200–1000 km across. Secular distribution of these mantle sources correlates with the Phanerozoic geodynamic evolution of eastern Australia. The SCLM composition inferred from the basalt compositions reflect the direct observations of the compositions of mantle xenoliths from the region. Recognition of geochemical signatures of EM1, EM2, and HIMU in the SCLM that can "contaminate" primitive basaltic magmas, removes the necessity for mysterious deep reservoirs in the convecting mantle.