Evolution of the Paleo-Pacific Gondwana margin: integrating lithospheric mantle Os ages from east Australia and West Antarctica

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Post-Archean continental lithospheric mantle is a potentially long-lived reservoir, even in tectonically complex terranes, and can preserve age information that is valuable for interpreting continent evolution - information that may not be available through more conventional crustal studies. Several key aspects of the regional geologic evolution of eastern Australia and West Antarctica, which formed part of the Paleo-Pacific Gondwana margin, remain contentious, largely owing to a lack of exposure of deep crustal rocks.

In particular, the age of the basement to several of the Phanerozoic fold belts that comprise the Paleo-Pacific Gondwana margin is uncertain. Cenozoic volcanism however, has transported large numbers of lithospheric mantle xenoliths to the surface, and the Re-Os isotopic systematics of these samples may constrain the age of lithosphere formation.

The Re-Os isotopic system is particularly useful for constraining the age of mantle depletion events (and by inference, isolation and incorporation into the lithosphere), because of the contrasting compatibility of Re and Os during mantle melting. In particular, the compatible behaviour of Os distinguishes it from other more common isotopic systems, and renders it less susceptible to subsequent metasomatic disruption.

We have integrated previously published xenolith Re-Os data and model ages (McBride et al., 1996; Handler et al., 1997; Handler and Bennett, 2001; Handler et al., in press) with some new Re-Os data for mantle-derived xenoliths from the Paleo-Pacific Gondwana margin. The results indicate the preservation of Proterozoic lithospheric mantle in each region, with a remarkably consistent pattern of ages along part of the margin. In particular, there are indications of a significant mantle melting event at ca. 1000-1200 Ma, which may relate to a major crust formation or orogenic event along the Gondwana margin that is currently reflected in large ca 1000-1200 Ma peaks in detrital zircon U-Pb age spectra of the vast turbidite deposits that comprise much of the fold belt system in both eastern Australia and West Antarctica (e.g. Lachlan Fold Belt sediments and the Swanson Formation; Ireland et al., 1994). In other regions of the margin however, the mantle xenolith Os model ages record younger mantle melting and lithosphere addition events.

References

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