

Garnet pyroxenites in Southeastern Australia: Tracing deep lithospheric events

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Subduction can draw surface, near-surface and shallow mantle materials (including volatiles) into the mantle and result in mantle/fluid interactions. Pyroxenite xenoliths can preserve significant information about such processes ^[1].

Garnet pyroxenite xenoliths from Lakes Bullenmerri and Gnotuk, Southeast Australia were originally clinopyroxene-dominant magmatic cumulates formed by exsolution and recrystallization during cooling to the ambient geotherm. The *high-MgO* garnet websterites have high Cr contents, flat LREE patterns and homogeneous Sr-Nd compositions ($^{87}\text{Sr}/^{86}\text{Sr} = 0.70386\text{-}0.70657$; $^{143}\text{Nd}/^{144}\text{Nd} = 0.51260\text{-}0.51283$), inferred to represent high-pressure cumulates from tholeiitic host magmas formed in an arc-related regime.

Low-MgO garnet clinopyroxenites have low Cr contents and variable REE patterns from LREE-depleted to LREE-enriched, with variable Sr-Nd isotopic compositions ($^{87}\text{Sr}/^{86}\text{Sr} = 0.70374\text{-}0.71548$; $^{143}\text{Nd}/^{144}\text{Nd} = 0.51221\text{-}0.51355$). These suggest an origin as high-pressure cumulates from an evolved host magma derived from mantle-wedge melting with addition of partial melts from altered oceanic crust with added subducted sediments.

These results reveal continental arc magmatic processes at mantle depths. The subduction of the Proto-Pacific oceanic slab beneath southeastern Australia triggered early melting of the convective mantle wedge due to slab dehydration, generating hydrous arc tholeiitic melts. *High-MgO* garnet pyroxenites crystallised when melt intruded overlying lithospheric mantle at 300-500 Ma. Subsequently, fluid-fluxed melting of the mantle wedge mixture of recycled oceanic crust and sediment generated the melts that precipitated the *low-MgO* garnet pyroxenites. Finally, all garnet pyroxenites were uplifted to a shallower level at ~44 Ma (from Sm-Nd isochrons) during back-arc lithosphere extension of southeastern Australia.

[1] Lu, J.G., *in press* Geol. Soc. America Spec. Publ. 526