Lithospheric mantle evolution of the western Ross Sea area in the West Antarctic rift system

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Mantle xenoliths from the Western Ross Sea area of the West Antarctic Rift System (WARS) record multiple stages of lithospheric mantle evolution in an area of complex tectonic history. Here we report bulk and in-situ mineral major and trace element abundances, integrated with Os model (T_{RD}) ages and Sr-Nd isotopes to reconstruct the geochemical and dynamic evolution of the lithospheric mantle. WARS xenoliths reveal multiple depletion and metasomatic re-enrichment events that appear to have occurred prior to the main episodes of rifting.

Franklin Island xenoliths define two groups: (1) depleted harzburgite with a 1.8 Ga aluminachron (T_{PUM}) stabilization age, and (2) fertile lherzolite and wehrlite with coexisting cpx+amph+phlog, reflecting refertilized domains. Carbonate is observed in two of these samples. Trace element patterns are strongly controlled by cpx/amph partitioning. Whole rock compositions are calculated from modal abundances and mineral compositions. Continuous trends between the two groups extending towards high Ca/Al, Nb/La, Zr/Hf, and low Ti/Eu are consistent with carbonatite metasomatism, possibly reflecting variable distances to the metasomatic front. Petrographic features indicate localized deformation of cpx, suggesting refertilization may have occurred prior to rifting.

Ongoing efforts to measure Hf-Pb isotopes can further constrain the timing of metasomatism. Metasomatic refertilization trends will place constraints on the composition of the carbonatitic metasomatizing melt.