

HIMU lithospheric mantle in the Southwest Pacific: Tracing the roots of Zealandia

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The existence of a widely sampled HIMU reservoir in the Southwest Pacific is well documented from the Pb isotopic compositions of intraplate basalts with $^{206}\text{Pb}/^{204}\text{Pb} > 19.5$. The origin of this signature however, remains controversial with proposed sources including metasomatised subcontinental lithospheric mantle and ancient oceanic lithosphere stored in the deep mantle [e.g. 1-3]. Here we further investigate the origin of HIMU characteristics through a combined petrologic and Sr-Nd-Pb isotopic study of a suite of mantle xenoliths assembled from 12 localities throughout New Zealand. Prior Re-Os isotopic study of this suite [4] demonstrated that a substantial portion of the lithospheric mantle underlying southern New Zealand is Paleoproterozoic in age (c. 1.7 Ga) and thus > 1 b.y. older than the oldest overlying crustal rocks.

For this investigation Sr, Nd and Pb isotopic compositions were determined from leached clinopyroxene mineral separates of the xenoliths using ID-TIMS methods. Pb isotopic compositions were determined using a ^{202}Pb - ^{205}Pb double spike. Initial results show a narrow range of measured $^{206}\text{Pb}/^{204}\text{Pb}$ between 19.5-21.1 and with no simple correlation with $^{238}\text{U}/^{204}\text{Pb}$ or with Os isotopic composition. $^{87}\text{Sr}/^{86}\text{Sr}$ isotopic compositions show a narrow range centered about 0.7025-0.7028, with $^{143}\text{Nd}/^{144}\text{Nd}$ isotopic data having more variability. The CPX leachates had lower $^{206}\text{Pb}/^{204}\text{Pb}$, showing that the HIMU signature does not result from contamination by the host basalts.

The Pb isotopic results are consistent with a widespread HIMU component residing in the lithospheric mantle beneath Zealandia. The homogeneous measured Pb isotopic compositions and lack of correlation with Os model ages imply a multi-stage history for lithosphere development in the region, with Paleoproterozoic melt extraction as reflected in Os isotopic signatures followed by an extensive, but much younger metasomatic event generating the Pb isotopic characteristics.

[1] Panter *et al.* (2006) **JPet** 47, 1673-1704. [2] Timm *et al.* (2009) **JPet** 50, 989-1023. [3] McCoy-West *et al.* (2010) **JPet** 51, 2003-2045. [4] McCoy-West *et al.* (2013) **Geology** 41, 231-234.

Abundance and ubiquity of H₂O in the martian interior

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There is substantial evidence supporting the past existence of abundant flowing water on the martian surface, however the source for this water remains elusive. Earlier studies of martian meteorites resulted in estimates of less than about 35 ppm H₂O [1], which is incompatible with an internal source for the surface water. These earlier studies primarily relied upon bulk rock water contents of the meteorites and were likely affected by magmatic degassing [2]. Even modern efforts to estimate H₂O abundances in martian melt inclusions likely suffer from volatile loss [i.e., 3].

We have revisited the abundance and distribution of H₂O in the martian interior through studies of volatile bearing mineral phases in martian meteorites [4-5], which are more likely to retain their OH components during magmatic degassing. There are water contents available for amphibole and biotite in the Chassigny meteorite [5-7] and apatite in a number of enriched and depleted shergottites [4]. If the water in these minerals was primary to the parental melts, the magmatic source regions from which the parental melts were derived likely have 70-300 ppm H₂O. This would imply that both geochemically depleted and enriched sources on Mars have elevated H₂O abundances and Mars' ancient surface water could be internally derived.

[1] Mysen, B.O. (1998) *Am Min*, 83, 942-946. [2] McSween H. *et al.* (2001) *Nature*, 409, 487-490. [3] Usui T. *et al.* (2012) *EPSL*, 357-358, 119-129. [4] McCubbin, F.M. *et al.* (2012) *Geology*, 40, 683-686. [5] McCubbin, F.M. *et al.* (2010) *EPSL*, 292, 132-138. [6] McCubbin, F.M. *et al.* (2013) *MAPS*, In Press, DOI: 10.1111/maps.12095. [7] Watson, L.L. *et al.* (1994) *Science*, 265, 86-90.