A hydrous mantle reservoir in the Paleoarchean?

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A recent study of melt inclusions in highly magnesian olivines (Fo 92.4-Fo 94.2) in 2.7 Ga komatiites of the Abitibi Greenstone Belt, Canada [Sobolev *et al*, Nature, 2016] records early contamination of melts by seawater as indicated by high Cl concentrations. Yet the melt inclusions in the most magnesian olivines (Fo 94-94.5) lack the seawater signature but contain up to 0.8 wt.% H_2O suggesting the presence of a hydrous reservoir in the Neoarchean deep mantle. The present contribution may extend the age of this reservoir by 800 million years.

Here we report EPMA, SIMS and LA-ICPMS analyses of water and other volatile components and major and trace elements in melt inclusions in highly magnesian olivines (Fo 93-95.8) from komatiites of the 3.5 Ga Komati Formation and 3.3 Ga Weltevreden Formation in the Barberton Greenstone Belt, South Africa. Inclusions were heated for 5 minutes at 1450ºC at the QFM buffer and quenched. The melt inclusions originally contained 0.2-0.8 wt.% H_2O and 50 ppm to 2.5 wt.% Cl at MgO concentrations between 23-30 wt.%. A positive correlation between H_2O and Cl contents in chlorine rich melt inclusions (over 1000 ppm of Cl) suggests seawater derived brine contamination. Inclusions with lower Cl contents (250-1000ppm) show no correlation between these components and thus could potentially represent the source water from the ancient 3.3-3.5 Ga mantle hydrous reservoirs.

Melt inclusions with the lowest Cl contents (<100 ppm) occur in the most Mg-rich olivines from the Weltevreden Formation (Fo 95.3-95.8) and in olivine Fo 92 of Komati Formation. These melts were not affected by seawater contamination and record the composition of primary melts and their mantle sources.