Geophysical Research Abstracts
Vol. 16, EGU2014-4362, 2014
EGU General Assembly 2014

Contrasting water contents of Hawaiian peridotite and pyroxenite: Implications for the origin of EM-mantle reservoirs and the electrical conductivity of the oceanic mantle.

Michael Bizimis (1) and Anne Peslier (2)

(1) Earth and Ocean Sciences, University of South Carolina, Columbia, SC 29208, United States (mbizimis@geol.sc.edu), (2) Jacobs, NASA Johnson Space Center, Houston, TX 77058, United States (anne.h.peslier@nasa.gov)

Water (as hydrogen) dissolved in nominally anhydrous minerals exerts a strong influence on the physical properties of the mantle, but most water concentration estimates of oceanic mantle reservoirs are inferred from erupted lavas. Mantle xenoliths brought to the surface by volcanism in oceanic plates provide direct access to the convective mantle and can place unique constrains on the water distribution in mantle reservoirs. Here we report FTIR water concentration data on spinel peridotite (residual lithosphere) and garnet pyroxenite xenoliths from Salt Lake Crater, Oahu, Hawaii. We use these data to test whether enriched mineralogies (pyroxenites) can generate the water variability inferred for different mantle reservoirs. Reconstructed bulk peridotite concentrations (70-114 ppm H_2O) fall at the low side of the MORB source estimates (50-200 ppm H_2O)[1] and consistent with an oceanic lithosphere (i.e. residual) origin. In turn, the garnet pyroxenites have higher bulk water concentrations (200-460 ppm H_2O) that mostly reflect the high modal abundance and high water concentration in cpx (up to 570 ppm H_2O). The pyroxenite bulk H_2O concentrations are significantly higher than the MORB source, but also have low H_2O/Ce ratios (<100), both close to estimates of EM-type OIB sources [1,2]. Even accounting for the presence of trace phlogopite (up to 0.5% modal) with $\sim$5 wt% H_2O the bulk pyroxenites do not have the high water concentrations inferred for FOZO-type OIB sources (>700ppm, [1]).

We suggest that EM-type OIB reservoirs with high H_2O concentrations and low H_2O/Ce ratios may be sourced from recycled oceanic lithosphere that is mineralogically enriched with pyroxenite veins as high pressure cumulates produced from previously unerupted melts. This model is consistent with other trace element and isotopic models for EM-type sources [2,3], and relaxes the requirements for the presence of dehydrated recycled slab in the source of EM basalts [1]. Finally, pyroxene-rich lithologies with high H_2O contents, as seen in the Salt Lake Crater samples, will have at least an order of magnitude higher electrical conductivity than the peridotitic lithosphere [4] and $\sim$3-4% slower calculated seismic wave velocities. The low velocity, high conductivity zone at the base of the oceanic lithosphere may then be in part due to the presence of pyroxene-rich lithologies trapped there as unerupted melts.

[1] Dixon et al., 2002, Nature 420, 385-389; [2] Workman et al., 2006, EPSL 241, 932- 951; [3] Niu and O'Hara 2003, JGR 108, 2209. [4] Wang et al., 2008; Phys. Chem. Min, 35, 157-162.