The hydration state of West Antarctic lithospheric mantle

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Cenozoic volcanism in Western Antarctica is sourced in lithospheric mantle that is thought to have been enriched in volatiles, either by plume-derived melts and hydrous fluids[1] or by slab-derived fluids[2]. Moderately high (300 Ω-m) resistivity in the upper 100 km of the western Antarctic lithosphere is consistent with a relatively dry, high viscosity lithosphere[3], while lower resistivity (30 Ω-m, [3]) together with slow seismic velocities at depths > 100 km[4], could represent the head of a warm, buoyant plume with H contents of ~200 ppm H_2O[4]. Here we seek to constrain the hydration state of lithospheric mantle sampled by volcanism in Marie Byrd Land (MBL), West Antarctica.

We measured the H content of nominally anhydrous minerals in harzburgite, lherzolite and dunite lithospheric mantle xenoliths from volcanic centres in the Executive Committee Range, Usas Escarpment, and Fosdick Mountains. The xenoliths are thought to sample lithospheric mantle from depths of 40-70 km[5]. The H contents of olivine (0 to 5 wt. ppm. H_2O), orthopyroxene (opx: 34-153 ppm), and clinopyroxene were measured using polarized Fourier transform infrared spectroscopy. Allowing for diffusive loss of H from olivine, we calculate pre-eruptive H contents of 7-30 ppm H_2O, based on equilibrium with coexisting aluminous opx. Overall, the measured and reconstructed H contents of olivines are comparable to those of 'normal' olivine in cratonic xenoliths from other continents and in oceanic lithosphere, but are significantly lower than those seen in metasomatized regions[6]. If the MBL volcanism taps metasomatized lithosphere, the entrained xenoliths either are sampling shallower lithosphere that has not seen significant volatile enrichment, or do not retain their pre-emplacement volatile contents. Alternatively, H_2O may be decoupled from other metasomatizing agents.

[1] Panter et al. (2000) *Chem. Geol.* [2] Gaffney and Siddoway (2007) *USGS Open-File Rep. 07-1047* [3] Wannamaker et al. (2017) *Nat. Comm.* [4] Heeszel et al. (2016) *JGR* [5] Chatzaras et al. (2015) *JGR* [6] Peslier et al. (2017) *Space Sci. Rev.*