New experimental constraints on the Martian basalt source mantle

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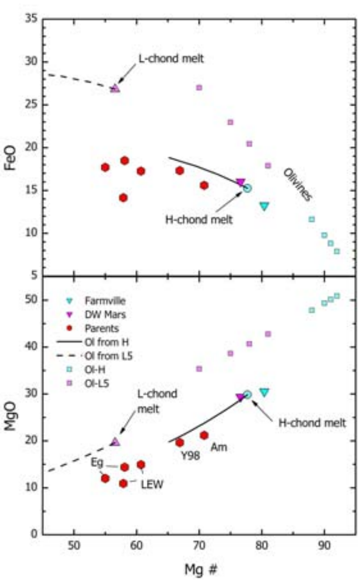
High pressure melting of Farmville H4 ordinary chondrite at 9 GPa and 1960ºC produces komatiitic liquid that closely matches the major element composition of the shergottite parent magma source region. This mass balance match can be interpreted as a simple two stage magmatic process: 1) melting of H-chondrite like mantle at 750 km depth (9 GPa), 2) fractionation of olivine from the melt in the shallow mantle or crust at lower pressures. Our earlier work [1] showed that high pressure melts of Homestead L-chondrite (equivalent to the Dreibus and Wänke [2] model martian mantle) are much more FeO-rich than are calculated shergottite parent liquids.

Figure 1 illustrates the very good mass balance by which shergottite parent melts can be derived from high pressure H-chondrite melt via olivine fractionation. Equilibrium fractionation of up to 40% olivine from high pressure H-chondrite melt (solid curves) closely approximates the martian parent magma trend. In contrast, L-chondrite fractionation (dashed curves) yields very poor matches. It is possible that slightly more magnesian starting compositions, with Mg#>80, might yield even better matches for martian parent melts. Our new data thus support the hypothesis [1, 3] that the shergottite-parent source mantle is less iron-rich (Mg#≥80) than the model Mars mantle of Dreibus and Wänke [2] (Mg#=75).



References

[1] Agee and Draper (2004) *EPSL, 224,* 415–429.

[2] Dreibus, G. and Wänke, H., (1985) *H. S. Festschrift, 20,* 367-381.

[3] Borg L. E. and Draper D. S. (2003), *MAPS, 38,* 1713-1731.

Effect of Al^{3+} and H^+ on elasticity of stishovite

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The elasticity of water-bearing aluminous stishovite has become an important issue in relation to the both the properties of subducting slabs and also the transport and retention of water in the deep mantle. There were numerous studies on elasticity of stishovite, however most of them were performed on pure SiO_2 compositions, which is not representative of natural stishovite as it would form in the MORB layer of a subducting slab. We performed elasticity measurements of SiO_2 stishovites with various Al^{3+} and H^+ contents with Brillouin scattering and x-ray diffraction techniques at ambient and high pressures. We have determined the single crystal elastic moduli (Cij) and equation of state of Al-rich H- bearing SiO_2 stishovites by Brillouin spectroscopy and synchrotron x-ray powder diffraction at pressures from ambient up to 60 GPa. The sample composition varied from pure SiO_2 to 6% wt Al_2O_3 and about 4000 ppm or more of H^+ These compositions covers the likely range of impurities expected to be found in stishovite that would coexist with aluminous Fe- and Al-bearing Mg-silicate perovskite in subducted slabs. Our results help to elucidate the effect of Al^{3+} and H^+ on single crystal elastic moduli as well as the bulk elastic properties (bulk and shear modulus) of stishovite. Our results suggest that Al and H are retained in stishovite under extreme P-T conditions and that stishovite is an agent for transporting water to the deepest lower mantle.