

Melt meets Moho: An experimental study of reactive melt percolation

G. VAN DEN BLEEKEN¹, O. MÜNTENER² AND P. ULMER³

¹Institute of Geological Sciences, University of Berne, Switzerland (greg.vandenbleeken@geo.unibe.ch)

²Institute of Mineralogy and Geochemistry, University of Lausanne, Switzerland (othmar.muntener@unil.ch)

³Institute for Mineralogy and Petrology, ETH Zürich, Switzerland (peter.ulmer@erdw.ethz.ch)

Melt-rock reaction in the upper mantle is testified in a variety of ultramafic rocks and is an important process in modifying melt composition on its way from the source towards the surface.

This experimental study evaluates the evolution of tholeiitic basalts upon reaction with depleted peridotite at uppermost-mantle conditions. Infiltration-reaction processes are simulated by employing a 3-layered setup: primitive basaltic powder ('melt layer') is overlain by a 'peridotite layer' and a layer of vitreous carbon spheres ('melt trap'). Melt from the melt layer is forced to move through the peridotite layer into the melt trap. Experiments were conducted at 0.65 and 0.8 GPa in the temperature range 1170 to 1290°C. In this P-T range, representing conditions encountered in the transition zone between the thermal boundary layer and the top of the asthenosphere underneath oceanic spreading centres, the melt is subjected to fractionation and the peridotite is partially melting ($T_s \sim 1260^\circ\text{C}$). The effect of reaction between melt and peridotite on the melt composition was investigated across each experimental charge.

Generally, quenched melts in the peridotite layers display more compositional variation than melt layer glasses. A difference between glasses in the melt and peridotite layer is increasingly developed at decreasing temperature through a combination of enrichment in incompatible elements in the melt layer and less diffusive equilibration in the melt phase. At 1290°C, preferential dissolution of pyroxenes enriches the melt in silica and dilutes it in incompatible elements. Moreover, liquids become increasingly enriched in Cr_2O_3 at higher T 's due to dissolution of spinel. Silica contents of liquids decrease at 1260°C, whereas incompatible elements start to concentrate in the melt due to increasing levels of crystallization. At the lowest T 's, increase in alkalis causes silica to increase as a consequence of percolative fractional crystallization. Percolation of tholeiitic basalt through a well-developed cold mantle lid can thus impose a high-Si 'low-pressure' signature on MORB.

Comparing the electronic structure of the aqueous interface of uranyl with corundum and hematite (1-102) surfaces

MARY VAN DER HOVEN^{1*}, SHELA ABOUD², JENNIFER WILCOX² AND GORDON E. BROWN, JR.^{1,3}

¹Surface and Aqueous Geochemistry Group, Department of Geological and Environmental Sciences, Stanford University, 450 Serra Mall, Building 320, Stanford, California, 94305-2115, USA

(*correspondence: vanderhoven@stanford.edu)

²Department of Energy Resources Engineering, Stanford University, 367 Panama Street, Green Earth Sciences 065, Stanford, CA 94305

³Stanford Synchrotron Radiation Lightsource, Stanford, CA 94305

Quantum Mechanical modeling is a useful tool in providing insight into the electronic structure of surface adsorption complexes. This study compares the electronic structure of uranyl (UO_2^{2+}) adsorbed to the (1 $\bar{1}$ 02) surface of corundum (Al_2O_3) and of hematite (Fe_2O_3). Experimental evidence [1] suggests that uranyl is monodentate on the corundum surface, and bidentate on the hematite surface. We have used the Vienna ab-initio Simulation Package, which uses Density Functional Theory and periodic boundary conditions to simulate extended surfaces, to investigate the energies, geometries, and electronic structures of these aqueous surface complexes.

[1] Catalano, Trainor, Eng, Waychunas & Brown, G.E. (2005) *Geochim. Cosmochim. Acta* **69**, 1888.