Experiments on the effect of oxygen fugacity and water on tholeiitic basalt phase equilibria

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In hydrogen buffered experiments at elevated pressures, the prevailing oxygen fugacity is coupled with the water activity of the experiment. Before the experiment, the water activity however cannot be defined, it adjusts to the prevailing hydrogen fugacity at the beginning of the experiment resulting in a change in oxygen fugacity and in the production/consumption of a certain amount of water. Phase equilibria as a function of water content, obtained under hydrogen buffered conditions, includes therefore always a change in oxygen fugacity.

The presentation will focus on the individual effects of oxygen fugacity and water on the phase relations and compositions of a primitive tholeiitic basalt at 200 MPa. Generally, an increase in water activity under hydrogen buffered conditions results in an increase in oxygen fugacity. Amongst other things, we will discuss, how the phase relations would change, if the oxygen fugacity would have been buffered and what effect a change of oxygen fugacity on the phase relations has. We will present the individual effects of water and oxygen fugacity on mineral compositions and on the coexisting melt. Finally, we will put the determined effects of water and oxygen fugacity into perspective and compare them with a natural MORB system.

Eclogite fluids vs. 'slab-derivedd' fluids: Simple compositional models

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It is important to distinguish between the eclogite fluids formed during dehydration reactions near the blueschist-eclogite transition in metabasalts and the "slab-derived" fluids that form an important component of the trace element and isotope budget in arc magmas. Eclogite fluids form during a host of continuous and discontinuous reactions in subducted oceanic crust that proceed in response to increasing pressure in the slab. In cold subduction zones, bulk equilibrium between fluid and eclogite is unlikely to be attained, and evidence from natural eclogites indicates that a variety of fluid compositions are present over relatively short length scales. Partition coefficients extrapolated to 600°C and reaction-based models for fluid composition specific to low-temperature slabs are presented, and demonstrate low overall mobility of trace elements in cold slab fluids. Such compositions are in contrast to the standard models for slab-derived fluids delivered to the source region of arc magmas, which must be enriched in Ba, Pb, and Sr, and depleted in HFSE. Fluids formed within the subducting slab interact with a thickness of mantle at least comparable to the thickness of the slab itself prior to reaching the magma source region. Unlike the cold slab, fluids in the hotter mantle wedge are able to equilibrate with the surrounding rock in bulk. Models for compositional modification during fluid transport show that the fluid is enriched in elements like Rb, U, Pb, and Sr during transport through the mantle wedge - characteristics of the slab-derived component in arc magmas. The fluids generated during dehydration reactions in eclogite provide the medium for mass transfer of fluids in a subduction zone, but only a small proportion of the trace element budget for arc magma generation.