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Melt impregnation and reaction processes in the thermal boundary layer: An experimental investigation

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Melt-rock interaction processes (or metasomatism) are known from a variety of ultramafic rocks (e.g. plagioclase peridotite and dunite channels) exposed in ophiolite complexes and are crucial for our understanding of crust-forming processes. The rationale of this experimental study is to derive a consistent set of data to evaluate quantitatively the compositional and time-dependent evolution of migrating magma over a range of temperatures and pressures as a function of initial melt and peridotite composition. These data will be used to interpret petrological and microstructural data from infiltrated peridotites and to adress the potential of these rocks to modify 'primary' liquids. This information might be used for the interpretation of microstructures in infiltrated peridotites, and chemical data of natural examples (phase compositions) could be used in the future to estimate the compositions of the infiltrating magmas.

To simulate melt-peridotite reaction processes we perform nominally dry experiments with a three-layered setup: a bottom layer of diamond or vitreous carbon powder (serving as a melt trap) overlain by a layer of peridotite and on top a layer of olivine tholeiite powder (the "melt"). The peridotite layer, with variable modal compositions and grain sizes, is synthesized by mixing of hand-picked grains from the Balmuccia peridotite (orthopyroxene, clinopyrox-ene and spinel) and San Carlos olivine. The 3-layer setup is contained in a graphite capsule sealed by a tight-fitting lid and this inner container is placed in an outer Pt-capsule that then was welded shut. The inner graphite capsule minimizes Fe loss to the noble metal capsule and constrains the fO2 at the C-CO2-CO equilibrium. Running the experiments is done on a Boyd-England type solid-media piston cylinder apparatus of the high-pressure lab at ETH Zürich using salt-pyrex-MgO assemblies. A friction correction of $\sim$3% is applied to the nominal pressure and temperature is measured with B-type thermocouples with an estimated accuracy of

±10˚C.

A first series of experiments has been per-formed with peridotite powder of variable grain sizes, spanning a temperature range of 1200 to 1320˚C at a constant pressure of 8 kbar. Preliminary results show reaction between the basaltic liquid and the peridotite layer at all temperatures and the intensity increases with temperature and time. At 1320 and 1290˚C, spinel and pyroxenes are being completely dissolved and olivine is newly formed in the peridotite layer. This reaction in which a dunite is formed is well known from the literature. At lower temperature runs (1200, 1230 and 1260˚C), the pyroxenes and spinel are stable and (re-)crystallize in the melt and peridotite layers. All phases, however, show complete to partial re-equilibration, leading to chemical zoning in the crystals. At 1200˚C there is the first occurrence of plagioclase (An47-61). As a result of crystallization and reaction with the mineral phases, the melt composition changes significantly and is different in the melt trap and the melt layer.