Geophysical Research Abstracts
Vol. 20, EGU2018-15161, 2018
EGU General Assembly 2018

High temperature crystal-melt reaction in mafic igneous complexes

Julien Leuthold
ETH Zürich, Geochemistry and Petrology, Zürich, Switzerland (julien.leuthold@erdw.ethz.ch)

Igneous complexes are built up incrementally by repeated injections of hot melt that may induce partial melting of cumulate and remobilization of crystal mush. Crystal-melt reactions modify both the cumulate and the reactive liquid, changing their modal composition, chemistry and texture: new and secondary phases crystallize (Leuthold et al., 2014, 2015). Here, we quantify the effect of gabbro cumulate assimilation by invading picrite using 1-atm gas-mixing furnace. We have run hybrid equilibrium (homogeneous mixture of gabbro and picrite powders) and kinetic experiments (reaction of gabbro powder with a picritic mush) to test the effect of gabbro assimilation on the picrite liquid and solid lines of descent. We have also run gabbro rock low degree partial melting to catch the first melt composition.
In hybrid picrite-gabbro equilibrium experiments, the clinopyroxene and plagioclase stability and the crystallization rate are increased. Cr-spinel abundance in picrite, gabbro and hybrid experiments is <0.5 vol%, unless under oxidizing conditions ($\geq$NNO). The glass SiO_2 and Mg# are increased, the olivine Mg# is increased and the clinopyroxene Mg# is increased and Al-content is decreased. The clinopyroxene REE concentration is decreased, despite a lower DREE.
In picrite-gabbro kinetic experiments reacted for 60 minutes at conditions where olivine, plagioclase and clinopyroxene are stable in gabbro but only olivine is stable in high-MgO basalt melt (1210°C, NNO-2), gabbro olivine and clinopyroxene are anhedral and plagioclase is euhedral. In the reaction rim, clinopyroxene is absent, olivine anhedral grains are small and Cr-spinel abundance strongly increased (to 1.8 vol%). With extended reaction duration, the reaction rim thickness is increased. Gabbro clinopyroxene grains are overgrown by high Mg# and Cr-rich rim, except in the direct proximity of spinel-rich layer.
In addition, gabbro rock was partially molten for 92 hours at 1160°C (i.e. 10°C above the dry solidus). Low melt fraction occurs at olivine-plagioclase-clinopyroxene triple junctions and along pre-exiting cracks. Products are Mg-rich clinopyroxene, olivine, pigeonite and orthopyroxene (+plagioclase?) in an andesitic liquid. New low degree partial melting experiments with previously dried gabbro rock at 1130°C are currently run.
As consequences:
1) High Mg# clinopyroxene in spreading ridges are frequently interpreted as crystals crystallized at high pressure, but may alternatively result from mafic rock assimilation. Rocks microtextural and geochemical observations help to discreminate between processes. We may question whether troctolite cumulate result from gabbro partial melting and crystallization of olivine.
2) Ore-bearing chromitite may crystallize from a hybrid melt, produced by gabbro assimilation by hot high-MgO basalt. Associated anorthosite are restitic and low-Ca pyroxene may crystallize from SiO_2-enriched melt.

Leuthold J. et al., 2014. Contrib. Mineral. Petrol. 167: 1021
Leuthold J. et al., 2015. Contrib. Mineral. Petrol. 170: 12