



Effects of volatiles on phase equilibria of a basalt from Piton de la Fournaise (Réunion island): experimental results and comparison with natural products.

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The eruptive activity of the Piton de la Fournaise (PdF) hotspot volcano is monitored by geophysical, geochemical and petrological approaches. Nevertheless, the structure of the feeding system and magma reservoirs is still debated.

4 different lava groups occur at PdF: (1) Steady State Basalts (SSB), the dominant group in the recent activity, (2) the Differentiated Lavas group, typical of the early activity, (3) the Picrites group with olivine-rich lavas (oceanites) characteristic of La Réunion volcanism and (4) the Abnormal Group (AbG) that contains lavas with mixed geochemical characteristics. To understand the petrogenetic relations between the 4 groups of lavas, constrain the structure of the feeding system and the magma storage conditions, experimental phase equilibria have been determined under fluid-present conditions, with either H₂O or H₂O+CO₂ added, for a SSB lava from the 2009 eruption.

Experiments have been performed both at high pressures (HP) and 1atm. The HP experiments were carried out in an IHPV, pressurized with Ar-H₂ mixtures, at 50MPa and 400MPa. The 1atm experiments used a vertical CO-CO₂ gas mixing furnace. Experimental products were analyzed by SEM, EMPA and μ -FTIR Spectroscopy. Results at 50 MPa lead to a crystallization sequence in the order olivine (ol, + spinel), clinopyroxene (cpx), plagioclase (plag). Volatile concentrations in experimental glasses range from 0.5 to 1 wt% for H₂O and 30 to 180 ppm for CO₂, within the range of glass inclusions in olivine phenocrysts. Fo contents in ol, Mg# in cpx and An contents in plag are in agreement with compositions of natural phenocrysts, suggesting that our experiments closely approach the shallow magmatic evolution at PdF. Preliminary experiments at 400 MPa indicate a change in the crystallization sequence, olivine being replaced by cpx as the liquidus phase. Our data are in marked contrast with previous experimental results under volatile-free conditions. Experiments at 1 atm are in progress.

To compare our results with appropriate natural products, a petrologic study has been performed on mafic xenoliths (dunite, wehrlite, gabbro) found in Piton Chisny deposits, and considered to be samples of magmatic reservoirs. Both textural and mineralogical evidence (decreasing Fo in ol and variation of cpx composition in dunites, wehrlites to gabbros; inclusions of Ol in Plag) suggests crystallization in the order olivine (+ spinel), cpx, plag. Therefore, experimental data and results of the petrologic study confirm the magma crystallization sequence at PdF and illustrate the importance of volatiles in controlling the order of crystallization even at low concentrations.