Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05914, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05914
EGU General Assembly 2008

Pre-eruptive dynamics of a fournaisian picrite inferred from olivine morphologies and melt inclusions

B. Welsch (1), F. Faure (2), P. Bachèlery (1) and V. Famin (1)

(1) LGSR 15 avenue René Cassin 97410 Saint Denis messag cedex 9, (2) Nancy Université, CNRS / INSU CRPG 15 rue Notre Dame des Pauvres 54501 France
(benoit.welsch@univ-reunion.fr / Fax: (+262) 262 97 82 66 / Tel: (+262) 262 97 82 10)

Since 1998, Piton de la Fournaise volcano (La Réunion ocean shield) displays an unusual activity, consisting in an increasing frequency of large picrite effusions. We have conducted a petrological investigation on lava-flow and scoriae samples of the December 2005 eruption, in order to constrain the magmatic processes leading to picrite emissions. Throughout one month of eruption, picrites display matrix glass embedding numerous crystal populations: Fo_{85-83} macrocrysts (5 - 0.5 mm), Fo_{84-81} mesocrysts (500 - 100 μm), Fo_{83-73}olivine and An_{73-55} plagioclase microcrysts (100 - 50 μm). Only augite crystals have anhedral shapes and present a decreasing size (from 500 μm to complete extinction in last melts), that both suggest progressive dissolution in the magma.

We have interested to olivine microcrysts because their features contrast with host melts. Microcrysts present cores with inconsistent coefficients of distribution (K_D,[1]). They contain primary melt inclusions ($<$ 10 μm) displaying increasing CaO / Al_2O_3 (0.48 to 1.06) and decreasing K_2O / TiO_2 ratios (0.54 to 0.19) throughout the eruption, which are also inconsistent with steady compositions of the melts (0.79-0.83 and 0.25-0.30, respectively). Microcrysts shapes (closed hopper, complex swallow-tail) do not correspond to morphologies produced by single cooling of the melt: they only result of cooling-heating cycles suggesting thermal convection of the magma [2].

We interpret the peculiar compositions of melt inclusions as a result of the rapid growth of olivine microcrysts. It induces that the melt immediately in contact with crystals, i.e. boundary layer, is depleted in olivine components (Fe, Mg) and enriched in rejected impurities (Al, Ti) [3, 4]. Consequently, the melt trapped as inclusions has low CaO / Al_2O_3 and high K_2O / TiO_2 ratios such as measured in early samples. However, the gradual destabilization of clinopyroxene enriches locally the magma in Ca and Ti, yielding increasing CaO / Al_2O_3 and decreasing K_2O / TiO_2 ratios in the melt inclusions throughout the eruption.

Overall, our data suggest that olivine microcrysts are inherited grains from a shallow magma heart. Their growth occurred during convective transport within cooler and hotter zones of the system. Clinopyroxene crystals were injected prior to or at the beginning of the eruption, and became unstable in this convective-styled system. Because picrite eruptions initiate at very shallow depth (not deeper than 2 km) [5], it appears necessary that clinopyroxene have grown at greater pressure within a deeper reservoir. Presence of augite relicts in lavas and/or clinopyroxene components enrichment of olivine microcrysts-hosted melt inclusions then could constitute indices of re-fillings of the shallow magma chamber.

References

[1] P.L. Roedder, R.F. Emslie, Contrib. Mineral. Petrol. 29 (1970) 275-289.

[2] F. Faure, P. Schiano, Earth Planet. Sci. Lett. 220 (2004) 331-344.

[3] C.H. Donaldson, Lithos 8 (1975) 163-174.

[4] F. Faure, P. Schiano, Earth Planet. Sci. Lett. 236 (2005) 882-898.

[5] A. Peltier, V. Famin, P. Bachèlery, V. Cayol, Y. Fukushima, T. Staudacher, (EPSL submitted).