A new geochemical approach to model periodically replenished magma chambers: Application to the EPR axis at 17-19°S.

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A new theoretical approach

This model reproduces the geochemical evolution of steady-state magma chambers, continuously replenished and tapped. To traduce cyclic magma supplies, the injection is modelled through a sinusoidal function independent of the reservoir size, contrary to the expulsion and crystallization rates. The resolution of the model is based on the knowledge of several geological and geochemical parameters. In a first step, the range of REE contents in the lavas and the ratio between expulsion and crystallization rates are used to constrain the REE composition of the injected magma. By introducing the mean rate of injection and the range of the reservoir size variations, the period of the cycle and the crystallizing/expelling magma volumes can be calculated.

Application to the EPR 17-19°S

Lagabrielle and Cormier (1999) have connected magma supply with ridge axial morphology of EPR. The spatial evolution of the morphology between segments traduces the time-related reservoir size and so the cyclic temporal variation of the magma budget. Geochemistry is also variable along axis: lavas sampled from incised domes displaying greater variability and higher REE contents. So, chemical data could be used to constrain the reservoir evolution. Among the results, three of them deserve a particular attention: the REE composition of replenishment liquid, corresponding to a N-MORB with MgO=9.4 wt%, the cycle period, equal to ca. 800 years, and the residence time, close to 300 years.

Reference

Lagabrielle Y. and Cormier M.-H. (1999). *J. Geophys. Res.* **104**, 12971-12988.

Near-solidus melt compositions from natural carbonated lherzolite

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Carbonate melt is considered an important metasomatic agent and may be associated with very deep melting in the Earth's mantle, but constraints on mantle carbonatite formation, stability, and composition are incomplete. Near-solidus partial melting of carbonated peridotite generates carbonatitic melt above ~2 GPa, but detailed experiments on natural peridotite-CO_2 are absent above 3.5 GPa (e.g., [1]). Thus little is known about the location of the carbonated peridotite solidus or the compositions of near solidus melts produced from natural carbonated lherzolite during upwelling of oceanic upper mantle.

To determine the solidus of carbonated fertile peridotite and the composition of near-solidus carbonatitic liquid, iterative sandwich experiments were performed at 6.6 GPa and 1120-1325 ºC in which a layer of carbonatite was equilibrated with fertile peridotite similar to KLB-1, prepared from a mixture of natural minerals. Near-solidus equilibrium between melt and 4-phase lherzolite was approached iteratively by adjusting the run temperature and the initial carbonatite composition. Added carbonatite compositions were successive approximations of the near-solidus (F=0) equilibrium melt, C_L, derived from the relation $C_L=C_0/D$, where C_0 is the elemental concentration in the peridotite layer and D is the peridotite/melt partition coefficient obtained from the previous experiment.

Results indicate that the solidus of carbonated natural peridotite at a depth of *ca.* 200 km is ≥ 1100 ºC, which is 150-250° cooler than estimates derived from experiments in simple systems [2, 3]. Near solidus melts have ≤ 9 wt.% SiO_2, ≤ 2 wt.% TiO_2 and Al_2O_3, ~7 wt.% FeO, and ~4.5 wt.% Na_2O. The molar Ca/(Ca+Mg) is 0.30-0.35, distinctly lower than 0.45-0.49 found for model CMAS-CO_2 peridotite [2] at similar depth.

References

[1] Falloon T.J. & Green D.H. (1989). *Earth Planet Sci. Lett.* **94,** 364-379.
[2] Dalton J.A. & Presnall D.C. (1998). *Contrib. Mineral. Petrol.* **131,** 123-135.
[3] Canil D. & Scarfe C.M. (1990). *J. Geophys. Res.* **95,** 15805-15816.