Magma storage conditions of Mutnovsky volcano, Kamchatka

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Mutnovsky is a typical island-arc tholeiitic volcano, located in the southern part of the Eastern Volcanic Front of Kamchatka (Russia). This active volcano hosts a hydrothermal field, one of the largest in Kamchatka, providing an excellent example of modern interaction of magmatic and hydrothermal systems. Investigations of the magma storage conditions such as depth, temperature, volatile budget and redox state beneath Mutnovsky volcano are crucial to understand the input and the role of magmatic component in the course of magma-hydrothermal interactions. We investigated these conditions experimentally and with the help of melt inclusion study.

To evaluate the magma storage conditions, two sets of crystallizaton experiments at 100 and 300 MPa have been performed using the most magnesian basalt of Mutnovsky as a starting composition [1]. The mineral phenocryst assemblage of Mutnovsky basalts (Ol, Pl, CPx, and Mt) was succesfully reproduced at 100 MPa (1025-1100°C, 0.5–3.5 wt.% H_2O) and at 300 MPa (1000-1075°C, 1.5–5.0 wt.% H_2O). The mineral phenocryts compositions in the experimental runs and in Mutnovsky basalts were similar. Compositions of experimental residual glasses saturated with Ol+Pl+CPx+Mt assemblage reproduce well the natural liquid line of descend and confirm a genetic link between primitive and more evolved eruptive products of Mutnovsky volcano.

Olivine-hosted melt inclusions from basaltic tephra (50-55 wt.% SiO_2; 4-6.5 wt.% MgO) contain 1.7-2.7 wt.% H_2O and 0-180 ppm CO_2. According to our experimental data on H_2O-CO_2 solubility in Mutnovsky basalt [1], these volatile abundances correspond to shallow depths (pressures below 110 MPa). The values of S^{+6}/S^{-2} in melt inclusion obtained by XANES correpond to the range of logfO_2 between QFM+0.9 and QFM+1.7 (QFM is quartz-faylite-magnetite buffer).

Our study confirms the presence of a shallow magma reservoir beneath Mutnovsky volcano at about 3 km depth. The phenocrysts in lavas could, however, crytallize at different depths in magmatic conduit during a polybaric crystallization (starting at least from 300 MPa).

[1] Shishkina *et al.* (2010) *Chem. Geol.* **277**, 115–122.

The generation of geochemical asymmetry in MORB around Iceland by radially symmetric plume flow under an asymmetric ridge system

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Geochemical asymmetry in Mid-Ocean Ridge Basalt (MORB) around Iceland was first recognised almost forty years ago and similar spatial patterns of MORB compositions been reported from a number of other plume-influenced ridges. Basalts from the Kolbeinsey Ridge to the north of Iceland are depleted in incompatible trace elements and have low $^{87}Sr/^{86}Sr$ and high $^{143}Nd/^{144}Nd$ when compared with basalts from the Reykjanes Ridge to the south. Previous models that have attempted to account for this asymmetry have typically been based upon the presence of asymmetry in the compositional field, temperature field or flow field in the Icelandic plume. Here we instead propose that the geochemical asymmetry around Iceland is controlled by asymmetry in the geometry of the ridge system. The presence of such geochemical asymmetry does not require radial asymmetry in the plume composition, temperature or flow field other than that imposed by the plate spreading.

Geophysical observations indicate that the plume conduit is centred under south-eastern Iceland. If mantle flows radially in the plume head from this position, then it will arrive at the Reykjanes Ridge without passing under a fully developed spreading system and will therefore have barely been melted before it rises and melts in the corner flow under the Reykjanes Ridge. In contrast, radial plume head flow dictates that the mantle that rises and melts under the Kolbeinsey ridge has travelled through the deep parts of the melting region under the Northern Volcanic Zone of Iceland. While only modest extents of melting may occur in the deep part of the melting region, it is likely that this melting preferentially extracts magma from enriched, fusible heterogeneities in the mantle. Therefore, the mantle rising under the Kolbeinsey Ridge may already have been stripped of an enriched geochemical signature by small extents of melting during transit under the Northern Volcanic Zone. Simple quantitative models of this depletion of mantle flowing radially in the deepest parts of the melting region are able to match the first order observations from Iceland and other plume-influenced ridges such as the Galápagos.