The role of H_2O on multiple saturation, the case of Shatsky Rise ocean plateau basalts

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We present results of crystallization experiments conducted on primitive (8.6 wt% MgO; melt inclusion, Ori massif), intermediate (8.0 wt% MgO; Ori massif) and differentiated (6.4 wt% MgO; Tamu massif) basalts recovered by IODP Expedition 324 from the Shatsky Rise ocean plateau. Experiments were conducted in an IHPV at pressures 100, 200, 400 and 700 MPa and temperatures between 1225 and 1075°C. Two experiemental setups were used to simulate differrent H_2O activities and redox conditions. In *dry* and reduced (~FMQ-1) set of experiments the small H_2O contents (<0.1 wt% H_2O, FTIR) were maintained by using graphite Pt-lined capsules. The use of Fe-presaturated AuPd capsules in the 2nd set of experiements allowed us to simulate more *hydrous* (0.4-1 wt% H_2O, FTIR) and oxidized (~FMQ+1) conditions. As a result we constructed 6 phase diagrams and obtained detailed information on the influence of pressure, temperature and water content on mineral stabilities and residual liquid evolution. In general, our experiments reproduced the natural phase assemblage of the Shatsky Rise basalts (*Ol+Plag+Cpx*). We observed major differences in the crystallization sequences and in the phase compositions depending on the starting composition, pressure and H_2O content. In comparison to dry system (<0.15 wt% H_2O), under hydrous conditions (0.4-1 wt% H_2O) the liquidus of all basalts was found to be 20-50°C lower. The experimental results support the results of our thermobarometry [1] and an assumption of low pressure magma differentiation beneath Shatsky Rise, leading to the formation of evolved basalts at Tamu and Ori Massifs. In contrast, partial crystallization of less evolved magmas of Ori Massif seems to be proceeded in deeper crustal reservoirs, supporting an assumption of a multilevel magma plumbing system [1]. We also demonstrate, that in addition to pressure, the small amounts of H_2O strongly controls the conditions of multiple saturation (when basaltic melt saturated with *Ol*, *Plag* and *Cpx*). Our experiments show that addition of 0.4 wt% of H_2O results in the same decrease of the CaO/Al_2O_3 ratio which would be caused by a pressure increase from 100 MPa to ~300 MPa at dry conditions (200 MPa difference corresponding to ~6 km of oceanic crust). Thus, the effect of small amounts of H_2O needs to be accounted in barometric calculations of nominally "dry" MORB magmas.

[1] Husen *et al* (2013). G^3, **14**, 3908–3928