Volatile evolution in the magmatic system of Hekla volcano, Iceland

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New measurements and estimations of pre-eruptive volatile concentrations have been obtained on MI in basalts and basaltic icelandites from Hekla volcano, Iceland, with special emphasize on the 2000 eruption. Volatile (S, Cl, F and H_2O) and major element concentrations were measured in both MI trapped in olivine and plagioclase phenocrysts as well as in groundmass glass from the 2000 basaltic icelandite and in a basalt erupted in 1913 in the vicinity of Hekla. The observed compositional range in the MI of basalt to basaltic icelandites is readily explained by fractional crystallization, allowing prediction of dissolved volatile concentrations evolution within the magma plumbing system beneath Hekla.

Volatile concentrations in the basaltic MIs exhibit a clear correlation with K_2O yielding "expected" concentrations, which correspond to the volatile contents in the basaltic icelandite melt just prior to eruption. Such an approach avoids underestimation of the pre-eruptive volatile contents measured in MIs and improves constraints on the volatile mass release into the atmosphere. The difference of volatile contents between "expected" concentrations and groundmass, scaled to the mass of erupted magma indicates that the magma carried 0.102 Mt of HCl, 0.172 Mt of HF and 3.77 Mt of SO_2 into the atmosphere during the 2000 Hekla eruption. In a more global context, the 20^{th} century Hekla eruptions have contributed approximately 0.08% for HCl, 3% for HF and 1.5% for SO_2 to the worldwide volcanic budget. This volcano can thus be considered as an important source of volatiles injected into the atmosphere, especially for HF.