Origin of volatile-enriched basalts of the Kverkfjöll volcanic system, Iceland

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The presence of diverse volatile domains in the mantle beneath Iceland is well established from isotope systematics of helium and more recently, chlorine [1]. Such heterogeneity is thought to reflect entrainment of both primordial components and subducted oceanic crust in the Iceland mantle plume. To what extent this heterogeneity is expressed by key volatile elements such as water and sulfur has been left unnoticed thus far. In this regard, basalts erupted at the Kverkfjöll volcanic system, located on the flank of the Northern Rift Zone in Iceland, are unique in comparison with other Icelandic basalts as they are characterized by unusually high dissolved volatile contents [2].

In order to assess the origin of volatile elements in basalts from the Kverkfjöll volcanic system, we report new major and trace element, volatile abundance (H_2O, Cl, F, S) and Pb isotope data acquired from subglacial pillow rim glasses. The Kverkfjöll magma suite comprises a rather narrow compositional range (MgO = 4-8 wt.%) of tholeiitic Fe-Ti basalts, which are relatively enriched in incompatible trace elements. In comparison with other Icelandic tholeiites, the Kverkfjöll glasses are notably enriched in Cl (up to 430 ppm) and H_2O (up to 1 wt.%). Interestingly, the Pb-Pb isotopic signature of Kverkfjöll departs from the main Icelandic array towards the EM-like mantle signature of the Öræfajökull volcano, which is unique in Iceland [3].

High volatile contents are accompanied by low Cl/K (0.09), Cl/Nb (<20) and H_2O/Ce (160-270) ratios, dismissing an origin from assimilation of crustal brines or hydrothermally altered crust. We therefore suggest that the volatile enrichments of the Kverkfjöll basalts result from similar enrichments in their EM-like mantle source rather than from secondary crustal-level processes. Our dataset will be used in conjunction with stable isotopes (δD, $\delta^{18}O$, $\delta^{37}Cl$, $\delta^{33,34,36}S$) to further elucidate the origin of this apparently volatile-enriched domain in the Icelandic mantle.

[1] Halldórsson et al. (2016) Geology 44:8. [2] Sigvaldason et al. (1976) Geochim Cosmochim Ac 40 [3] Manning and Thirlwall (2014) Contrib Mineral Petrol 167:1.