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Geochemistry of the Nornahraun eruption in the Bárðarbunga volcanic system, Iceland

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The on-going Nornahraun fissure eruption north of Dyngjujökull in the Bárðarbunga volcanic system, provides a rare opportunity to study in detail magmatic processes and magma plumbing system dynamics during a moderate- to large-volume fissure eruption, especially since it allows for very high temporal and spatial resolution. Here, we present a comprehensive dataset, involving major and selected trace elements in addition to radiogenic and oxygen isotopes, on the densely sampled on-going fissure eruption.

The Nornahraun magma is an olivine tholeiite (MgO $\sim$6.85 wt.%; TiO_2 $\sim$1.85 wt.%; K2O $\sim$0.20 wt.%: see also Guðfinnsson et al., this session). This is the most common magma type formed within the Icelandic axial rift and is most frequently produced by flood lava eruptions along the fissure/dike swarms of the volcanic systems. Trace element contents (e.g., Ba: 41-47 ppm; Sr: 154-159 ppm; Zr: 101-105 ppm) and trace element ratios (e.g., Zr/Y $\sim$3.5) are also typical for tholeiites of the axial rift in Iceland. The isotope ratios of oxygen (δ18O: 3.78‰ $\pm$ 0.07; n=11) and lead (206Pb/204Pb: 18.41 $\pm$ 0.01; n=8) are indistinguishable from basalts in the Bárðarbunga volcanic system (see also Halldórsson et al., this session), consistent with the magma originating in the Bárdarbunga volcanic system.

The composition of the erupted magma has been remarkably constant during the first two months of eruption (= data coverage thus far). The major element and trace element composition of the lava flow is uniform within the analytical uncertainty (2σ) of the ICP-OES measurements. Trace-element ratios, such as Zr/Y and V/Sc, in addition to oxygen isotope values have been near-constant since the onset of the eruption. Moreover, the isotope ratios of Pb reveal subtle variations only, which barely exceed the analytical uncertainty (2σ), with no systematic trends to towards lower and/or higher values. As significant variation has been detected in Pb isotopes in Icelandic lavas, reflecting a heterogenous Pb isotope composition in the mantle beneath Iceland, the near-uniform Pb isotopic ratios of Nornahraun obtained thus far, are somewhat surprising. This is especially surprising given the long duration of the eruption and the large volume of lava (currently $\sim$1.2 km3). Insignificant changes in the chemical and isotopic composition of the lava are thus consistent with efficient homogenization and effecting filtering of original mantle compositions – a feature commonly associated with short-lived fissure-fed eruptions in Iceland.

References:

Guðfinnsson et al. (this volume): Petrography and Petrology of the Nornahraun eruption of the Bárðarbunga volcanic system, Iceland.

Halldórsson et al. (this volume): Magma types and mantle sources of the Bárðarbunga volcanic system, Iceland.