Petrological evidence for magma supply from multiple reservoirs during the 1975-1984 Krafla Fires, NE Iceland

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A decade-long rifting event at Krafla volcano in NE Iceland has been well documented by geophysical studies but there are further insights to be drawn from the petrology and geochemistry of the accompanying basaltic lavas. We present a detailed EPMA study of minerals and glasses involving an unprecedented large dataset covering all nine of the Krafla Fires volcanic events from December 1975 to September 1984. Lava chemistry as well as preliminary olivine-plagioclase-augite-melt (OPAM) [1] and clinopyroxene-liquid [2] geobarometric calculations indicate that the eruptions likely tapped two distinct magma reservoirs: a primitive (MgO = 7.3 ± 0.8 wt.%) mid-crustal reservoir at 15.8 ± 6.2(1σ) km depth and a more evolved and compositionally uniform (MgO = 5.8 ± 0.2 wt.%) shallow-crustal reservoir at 7.7 ± 1.2(1σ) km depth beneath the caldera. Interestingly, the two basalt types were erupted from geographically separate parts of the same fissure; the boundary between them coincides with the Krafla caldera faults. Moreover, during the most volumetrically significant eruption, in September 1984, these reservoirs were sampled simultaneously without evidence for significant magma mixing or mingling, suggesting that there were multiple mechanisms of magma supply from two distinct crustal depths. The widely accepted model that mid- to large-volume basaltic fissure eruptions are fed by lateral flow from a well mixed mid-crustal reservoir – as for the 2014-2015 Holuhraun eruption – cannot account for the bimodality of the 1975-1984 Krafla Fires lavas. The volume and accessibility of extrusive igneous material in the supramarine Icelandic rift zone presents a unique opportunity for geobarometric studies to be used as an additional constraint on fissure eruption dynamics and the mechanisms of crustal accretion at mid-ocean ridges and continental rifts.

[1] Yang *et al*. (1996) *Contrib Mineral Petrol* **124**, 1-18. [2] Neave and Putirka (2017) *Am Mineral* **102**, 777-794.