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Origin of Silicic Magmatism at the Katla Volcanic Complex, South Iceland; the Oxygen Isotope Perspective

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The Katla volcano is a bimodal caldera complex within Iceland's basalt-dominated Eastern Volcanic Zone. To unravel the petrogenesis of silica-rich rocks from Katla, we provide new $\delta^{18}O$ values for almost 60 basaltic, intermediate, and high-silica eruptive rocks, including a number of partially melted felsic xenoliths. The basaltic samples display a range in bulk-rock $\delta^{18}O$ values from +4.3 to +8.5‰ (n=17) and the sparse intermediate samples from +4.1 to +5.9‰ (n=3). In turn, silicic rock samples and feldspar separates range from +2.7 to +6.4‰ (n=38), whereas the felsic xenoliths yield the lowest values from -4.9 to -2.3‰ (n=4). The majority (95%) of the Katla silicic volcanics have $\delta^{18}O$ values below typical MORB (ie. $\leq$ 5.0‰), ruling out an origin via closed-system fractional crystallisation from the basaltic magmas. We utilised the new $\delta^{18}O$ values to model possible assimilation and fractional crystallisation (AFC) scenarios. The results indicate an early stage of FC/AFC at deep- to mid-crustal levels, followed by assimilation of low-$\delta^{18}O$ hydrothermally-altered sub-volcanic materials similar to the low-$\delta^{18}O$ felsic xenoliths at shallow crustal levels. Such a two-stage magma evolution is consistent with available geophysical and geobarometry studies at Katla, indicating mid- to deep-crustal as well as shallow-crustal magma domains. Importantly, mafic rocks show dominantly MORB-like $\delta^{18}O$ values, whereas low $\delta^{18}O$ values occur essentially in silicic rocks only. This implies that the low-$\delta^{18}O$ values at Katla are imposed by interaction with Icelandic crust, rather than reflecting low $\delta^{18}O$ in the underlying mantle sources.