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# Melt-brine interaction in silicic magma mushes

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Chlorine-rich magmatic fluids form during the late-stage evolution of silicic intrusions and play a major role during the formation of magmatic-hydrothermal ore deposits. However, how these saline fluids, or brines, interact with melts and affect active volcanic processes is poorly understood. Chlorine isotope ratios in volcanic rocks could potentially keep a record of pre-eruptive melt-fluid interaction, but published $\delta^{37}Cl$ data for silicic rocks are limited. To bridge this knowledge gap, we present new $\delta^{37}Cl$ and $\delta^{18}O$ data in a sample set (n = 16) that, together with previously published data, includes rhyolites and corresponding intermediate rocks and basalts from 8 volcanic systems in Iceland [1]. The silicic samples ($SiO_2$ = 65-77 wt.%) have highly variable Cl contents (280-3990 ppm) and $\delta^{18}O$ values (–0.5 to +6.1 ‰) that are within published values for Icelandic rhyolites. The $\delta^{37}Cl$ values of silicic rocks are negative (–1.9 to –0.6 ‰) except for one positive outlier (+0.9 ‰). An unexpected result is that the $\delta^{37}Cl$ values of silicic rocks are systematically shifted towards more negative values by up to -2.9 ‰ compared to basalts from corresponding magma suites. These large $\delta^{37}Cl$ shifts are not correlated with eruption type (effusive vs. explosive) and cannot be explained by the usual suspects, i.e., mineral-melt fractionation, degassing or crustal assimilation. Instead, we attribute the observed negative $\delta^{37}Cl$ shifts to assimilation of up to 0.5 wt.% of low-$\delta^{37}Cl$ magmatic brines that have been formed by previous generations of intrusions in long-lived magmatic mushes. This model is compatible with estimated magmatic brine production rates and may explain observations of positive $\delta^{11}B$ signatures in Icelandic rhyolites, negative $\delta^{37}Cl$ values in fluid inclusions from porphyry-copper deposits and negative $\delta^{37}Cl$ in hydrothermal systems associated with volcanic activity at arc volcanoes. We propose that magmatic brine assimilation is a fundamental, but previously unrecognized form of melt-fluid interaction that takes place in silicic magma mush environments during rhyolite genesis.

[1] Ranta, Halldórsson, Barnes, Jónasson & Stefánsson (2021), *Geochemical Perspectives Letters* 16, 35-39.