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Magma decompression rates preceding four contrasting eruptions of Okmok Volcano, Alaska

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The rate at which magma decompresses and ascends through the crust exerts a fundamental control on eruption style. Rapid decompression is commonly associated with more explosive behavior and higher mass eruption rate in mafic, single-vent systems [1]; however, no study has systematically evaluated this relationship across multiple eruptions of differing composition, style, and magnitude within a single volcanic system. Here, we investigate four eruptions of Mount Okmok (Alaska-Aleutian arc) spanning a wide range of compositions (rhyodacite to basaltic-andesite), eruptive styles (Strombolian to Plinian), and magnitudes (Volcanic Explosivity Index; VEI 2-6), with the goal of assessing how magma decompression rate scales with these parameters.

Magma decompression rates will be determined via diffusion modeling of hydrogen (H) in clinopyroxene and olivine phenocrysts from rapidly quenched eruptive products of the ~2050 yBP Plinian caldera-forming eruption (VEI 6) and the 1817, 1997, and 2008 phreatomagmatic to Strombolian eruptions (VEI 2-4). To account for composition-dependence and anisotropy of H diffusion in these mineral phases, major element compositions will be measured by electron microprobe and crystallographic orientations will be assessed using electron backscatter diffraction. Forward diffusion models will be used to quantify decompression rates and ascent timescales for each eruption.

We hypothesize that the 1817, 1997 and 2008 eruptions will exhibit magma decompression rates that scale with VEI and eruptive style, whereas the ~2050 yBP caldera-forming eruption may deviate from this trend due to more complex venting dynamics. For the 2008 eruption, magma ascent timescales are expected to correlate with short-duration precursory seismicity (on the order of hours). This work will provide the first magma decompression rate estimates for Mount Okmok, and further offers a unique opportunity to examine the relationship between ascent timescales and diverse eruptive behavior at a high threat arc volcano.

[1] Barth et al. (2019), *J. Volcanol. Geotherm. Res.* 387, 1-16.