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INVESTIGATING PETROLOGIC INDICATORS OF MAGMATIC PROCESSES IN VOLCANIC ROCKS

Pre-eruptive magma mixing and crystal transfer revealed by phenocryst and microlite compositions in basaltic andesite from the 2008 eruption of Kasatochi Island volcano†

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Abstract

The August 7–8, 2008, eruption of Kasatochi Island volcano, located in the central Aleutians Islands, Alaska, produced abundant, compositionally heterogeneous basaltic andesite (52–55 wt% SiO_2) that has been interpreted to result from pre-eruptive magma mixing. The basaltic andesite contains two populations of plagioclase phenocrysts. The first, volumetrically dominant population consists of oscillatory-zoned phenocrysts with an overall normal zonation trend toward comparatively sodic rims ($An_{55–65}$), interrupted by dissolution features and spikes in calcium content (up to ~An_{85}). The second population consists of phenocrysts with highly calcic compositions (~An_{90}). These phenocrysts contain sharp decreases in calcium content close to their rims (reaching as low as ~An_{60}), but are otherwise texturally and compositionally homogeneous. Groundmass plagioclase microlites are generally much more calcic than rims of the first phenocryst population, with more than 50% of measured microlites containing >An_{80}. Major, minor, and trace element concentrations of plagioclase microlites and phenocrysts indicate that oscillatory-zoned phenocrysts derived from cooler (800–950 °C), more silicic mixing magma, while unzoned, calcic phenocrysts were associated with hotter (900–1050 °C), mafic magma. The mixing of these magmas just prior to eruption, followed by decompression during the eruption itself created high effective undercoolings in the mafic end-member, and lead to the nucleation of high-An microlites. MgO and FeO concentrations of plagioclase microlites and high-An phenocryst rims (up to ~0.4 and ~1.3 wt%, respectively) provide further evidence for high mixing- and eruption-induced effective undercoolings.

Keywords: Kasatochi, Aleutian volcanism, magma mixing, plagioclase, microlites