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# Magma hybridisation at Soufriere Hills Volcano, Montserrat

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Arc volcanoes commonly show evidence of mingling between mafic and silicic magma. For example, the Soufrière Hills Volcano, Montserrat typically erupts andesitic magma containing basaltic to basaltic-andesite inclusions. However, the andesite also contains a wide variety of phenocryst textures as well as strongly zoned microlites, suggesting that more intimate physical mixing also occurs. Analysis of minor elements in both phenocrysts and microlites allows the discrimination of different crystal populations, and provides insight into their origins.

Microlites of plagioclase and orthopyroxene are chemically distinct from the phenocrysts, being enriched in Fe and Mg, and Al and Ca respectively. However, they are indistinguishable from the compositions of these phases in the mafic inclusions. Microlite compositions also give anomalously high temperatures using standard geothermometry techniques, similar to those of the mafic inclusions. Compositions of clinopyroxene from overgrowth rims on quartz and orthopyroxene and coarse-grained breakdown rims on hornblende, are identical to those from the mafic inclusions, indicating that these rims form during interaction with mafic magma. We infer that the inclusions disaggregated under conditions of high shear stress during ascent in the conduit, transferring mafic material into the andesite groundmass. This implies that the mafic component of the system is greater than previously determined from the volume proportion of mafic enclaves. The presence of mafic-derived microlites in the andesite groundmass also means that care must be taken when using this as a starting material for phase equilibrium experiments.

Melt inclusions and matrix glasses in the erupted include an anomalously K2O-rich population which overlaps with residual (high-K2O, high-TiO2) mafic inclusion glass. These glasses represent the effects of physical mixing with mafic magma, both during ascent and by diffusive exchange during the formation of mafic inclusions. The K-rich glasses probably form by diffusive contamination by high-K mafic inclusion glass; Ti-enriched glasses suggest physical mingling of remnant glass. The preservation of this K-rich, compositionally heterogeneous melt component in the andesite, present on the mm-scale, suggests short timescales between mixing and ascent in intermediate magmatic systems.