

Enclave Formation and Magma Mixing at Chaos Crags, California

M.A. SCRUGGS¹, K.D. PUTIRKA^{1,2} AND M.A. CLYNNE³

¹Dept. of Earth & Env. Sciences, CSU Fresno, Fresno, CA 93740, USA. E-mail: melissa.a.scruggs@gmail.com

²E-mail: kputirka@csufresno.edu

³U.S.G.S., 345 Middlefield Rd., MS910, Menlo Park, CA 94025.

E-mail: mclynn@usgs.gov

The details of triggering processes which lead to volcanic eruptions at arcs remain a topic of intense debate. We address the issue by examining the Chaos Crags at the Lassen Volcanic Center, a group of six rhyodacite lava domes that carry spherical to ellipsoidal basaltic-andesitic enclaves. Domes A & B (Group 1) contain 69.5-70% SiO₂ and up to a few % enclaves. Domes C-F (Group 2) contain 66-68% SiO₂ and 10-15% enclaves.

Vesicularity and mineral and whole rock compositions over the entire eruption sequence are examined, with specific attention given to enclave cores and rims. Mineral-melt equilibria are used to calculate crystallization T and P, which are used to estimate ρ and η values for enclaves and host lavas. VSD methods were used to determine percent vesicularity. Group 1 lava and enclave compositions demonstrate discontinuous and incomplete mixing; Group 2 lavas and enclaves are similar, except that a few enclaves define a distinct K-enrichment trend. The majority of enclaves are concentrically zoned with respect to vesicularity, composition, and texture. Histograms of An components show that enclaves are more greatly contaminated by the host than vice versa; Group 1 enclaves are also less contaminated than Group 2 enclaves. Temperature of the mafic magma prior to mixing is 1100±50°C, and it contained ol, plag, and cpx. Cpx-liquid geobarometry indicates that mafic magma originated at P=11.8 ± 1.4 kbar, and ascended to pressures of ~1-2 kbar. Vesicle populations show significant decreases in percent vesicularity (6%-250%) between enclave cores and rims. A population of vesicles identified in some enclaves does not conform to either traditional VSD trends or an inverse-arctangent nucleation and growth trend; this population is inferred to be a pre-eruptive vesicle population.

We present a magma mixing, enclave formation, and eruption triggering model for the Chaos Crags which accounts for the observed variations in eruptive products and heterogeneities within the chamber and over the eruption sequence.