

Tianchi Volcano Millennium Eruption (VEI 7): differentiation processes and timescale

J. Gill¹, F. Ramos², C. Dunlap³

¹UCSC, Santa Cruz CA 95064, USA, ²NMSU, Las Cruces NM 88003, USA, ³CRDF Global, Arlington VA 22209, USA

E-mail: gillord@ucsc.edu

Although the first and largest phase of the Millennium Eruption magma was >95% almost aphyric comendite (SiO₂ 73, Al₂O₃ >11, FeO* <5), the second phase contains a mafic component that occurs as dark streaks in white pumice and as isolated mafic scoria. This mafic component extends from trachyte (SiO₂ 65, MgO=0.1-0.5) through trachyandesite (SiO₂ 60, MgO=1.8-2.7) to trachybasalt (SiO₂ 50, MgO=4.6). Trachyte is the most common. This mafic component contains diverse glass that is intimately mixed at the mm-scale, and a bimodal mineral population: Fo₅₀₋₈₀ and Fo₈₋₁₁; En₃₁₋₄₃ and En₁₄₋₂₀; An₁₄₋₆₆ and An₄₋₅. Comendite has more differentiated and more uniform mineral compositions. Comendite can be derived from trachyte by about 70% fractional crystallization of Kfs»Cpx>Ilm>Ol and Ap»Chevkinite. The mafic component is slightly more depleted isotopically than the comendite with ⁸⁷Sr/⁸⁶Sr and ¹⁴³Nd/¹⁴⁴Nd at least 0.00005 lower and higher, respectively, and ²⁰⁶Pb/²⁰⁴Pb about 0.060 lower, based on bulk pumice analyses. Trace element systematics within both comendites and trachytes demonstrate mixing with something more mafic than either, but relatively little mixing between comendite and trachyte. The comendite magma was already 10-20 Ka old at eruption based on U-Th disequilibria in its trace chevkinites and zircons and ²²⁶Ra-²³⁰Th equilibrium in bulk comendite pumice. However, the mafic mixing component is younger, with higher ²³⁰Th/²³²Th and greater ²²⁶Ra-²³⁰Th disequilibrium. Therefore, separate comendite and trachyte bodies resided beneath the volcano throughout the Holocene, and both experienced a major recharge event that triggered the Millennium Eruption. The comendite may have received mostly heat from the recharge event whereas the trachyte mixed thoroughly with the recharging magma.