Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24535

# Trace Element Zoning in the Bishop Tuff: Possible Insights from Thermal Gradient Experiments

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Silicic tuffs often record systematic compositional zoning that must have existed in the pre-eruptive magma chamber. The Bishop Tuff, an eruption product of Long Valley Caldera (CA) at 0.7 Ma, records systematic thermal and trace element gradients. The mechanism forming these trace element gradients remains poorly understood. We performed a 76-day thermal gradient experiment using a powder of the mafic endmember of the Bishop Tuff in a 10 cm Ag capsule placed in the temperature gradient of a rapid quench cold seal bomb at 1 kb. One end resided at 750°C (hot spot), while the other was measured at ~377°C. The capsule contained 1.7mg $Na_2CO_3$, 14.7 mg hydrous $Na_2Si_2O_5$ (~33wt% $H_2O$), and 263 mg of UCBT (bulk $H_2O$ was ~2%). After quenching, the capsule was mounted and characterized by SEM-EDS and LA-ICPMS— 2 across capsule lines were averaged to obtain trace element contents at 15 positions (~6mm apart) in the capsule. The product mostly consists of a fine-grained mush of quartz and two feldspars— little major element compositional variation occurs over the length. Glass exists around crystals at hotter temperatures. At lower temperatures, a dramatic change in texture to a more tan and powdery crystal aggregate occurs. Despite slight major element variation, trace elements show systematic large variations documenting significant movement throughout the capsule. General enrichment (~80 ppm) of Rb-U-Ta-Th-Nb-Pb occurs within the colder portion of the temperature gradient (~377°C to 600°C). Identical patterns for Tantalum and Niobium provide evidence for systematic partitioning behavior. Conversely, Ba-Sr-Eu are enriched within the higher temperature portion of the gradient (~600°C to 750°C) held presumably in feldspars. A notable spike in Light REE (LREE) occurs near the hot/cold transitional boundary. SEM imaging at the LREE spike shows the presence of monazite (Ce, La, Nd, Th) (PO4SiO4), again reinforcing the interpretation that all trace element concentrations relate to migration to phases having high crystal/melt partition coefficients for a given element. Patterns of element enrichment and depletion resemble the zoning of the Bishop Tuff but at temperatures hundreds of degrees lower. Another experiment is underway to see if this potentially important result can be replicated.