167-10 - QUANTIFYING CRYSTAL ACCUMULATION IN SCHLIEREN-BOUND MAGMATIC STRUCTURES: INSIGHTS INTO MAGMA DIFFERENTIATION PROCESSES

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Abstract

Schlieren-bound magmatic structures record local magma dynamics during crystallization, resulting in the selective accumulation of hornblende, biotite, magnetite, apatite, titanite, and zircon by flow-sorting. Questions remain about the timing of schlieren formation, extent of accumulation, and the scales at which these structures may preserve differentiation processes.

Petrography and cathodoluminescence images of Tuolumne Intrusive Complex (TIC) samples identify relative crystallization sequences and microstructures in schlieren and the nearby host. For example, in Cathedral Peak (CP) schlieren, plagioclase shows relict cores, truncated zoning, glomerocryst clusters, and anhedral rims with lower anorthite contents. In the host, defrosting indicators are abundant, including strongly rounded and embayed plagioclase within poikilitic alkali feldspar. Mineral thermometry constrains crystallization and defrosting between ~900-700 °C in each unit, overlapping between host and schlieren. We interpret that phases listed above were present within a crystal-rich mush before flow-sorting and that defrosting, affecting feldspars and quartz, may have occurred repeatedly to mobilize magmas before and after schlieren formation.

Crystal accumulation estimates were attained through mineral-melt equilibrium and Zr-in-hornblende tests (Barnes et al. 2019). Calculated melt compositions indicate that plagioclase and hornblende in the schlieren and host across TIC units formed from rhyolitic melts. Using the Barnes et al. (2019) method, host samples experienced minor zircon accumulation (1-5%) although their bulk compositions are controlled by non-zircon accumulation and melt loss. In contrast, CP schlieren accumulated 5-10% zircon relative to the host (1%). This difference is also seen in modal abundances in schlieren which are higher than the host by a factor of 4-8. Preliminary calculations suggest a typical schlieren may require ~1-100 m^3 of surrounding magma to accumulate the necessary assemblage, about the same map scale as observed schlieren spacing in the TIC. Extrapolating to the entire TIC would require << 1 km^3 of magma to form the >9,000 schlieren predicted by Paterson et al. (2016). Although schlieren appear to be volumetrically minor contributors to TIC differentiation, they preserve a record of widespread dynamic processes in the complex.

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