

V31B-3038 Thermobarometry of a shallow-level granite and the transition from magmatic to hydrothermal crystallization conditions

The lowest pressure and temperature conditions for granitic melt crystallization remains controversial. Many thermobarometric methods applied to low-pressure (i.e., <5 kbar) granitic composition rocks yield temperature estimates ~75 to 100°C lower than the currently accepted haplogranite water-saturated solidus. To address thermobarometric discrepancies, we investigated a shallow-level granitic pluton with a “normal” composition (i.e., not enriched in fluxing elements such as Li, B, F). The Rito del Medio pluton (RDMP) near Questa, New Mexico contains numerous minerals and inclusions suitable for thermobarometric estimates, and it has abundant miarolitic cavities that represent the final crystallization stages. The RDMP has two distinct paragenetic contexts. Field and petrographic relations show that groundmass minerals crystallized from a water-saturated magma (e.g., occurrences of coexisting melt and fluid inclusions). After groundmass crystallization, the pluton transitioned to a fluid-dominated system manifested by the crystallization of freestanding minerals contained in the miarolitic cavities. The granite contains micas, feldspars, quartz, primary fluid inclusions in quartz, and accessory minerals including garnet with quartz inclusions. We used minerals and their inclusions in both paragenetic contexts to track changes in P, T, and mineral and fluid compositions that accompanied the magmatic-to-hydrothermal transition. We deployed a suite of thermobarometric methods including two-feldspar thermometry, Ti-in-quartz solubility, fluid inclusion microthermometry, Ti-saturation biotite thermometry, and quartz-in-garnet elastic thermobarometry on minerals from the groundmass and miarolitic cavities. Resultant univariant curves for the groundmass minerals converge at ~2 kbar and ~590 to 625°C indicating final magmatic crystallization. Univariant curves for thermobarometric approaches applied to the miarolitic cavity minerals converge at ~1.6 to 1.8 kbar and 500 to 525°C signifying a transition to hydrothermal crystallization conditions. The RDMP is another example of a normal granitic composition magma that records crystallization temperatures below the widely used haplogranite solidus.