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Magmatic storage conditions along the Mono Craters chain, Eastern California

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We employ a variety of petrologic tools to characterize the pre-eruptive storage conditions of individual units erupted from Mono Craters. The Mono Craters chain represents one of the systems within the Long Valley volcanic field in Eastern California, which has been a regional center for effusive to cataclysmic volcanism from 800 ka until recent times. The Long Valley system has been the focus of much research; however, there are little published petrologic data for the Mono Craters chain. Understanding the Mono Craters chain is critical because it was the center for the most recent eruptions in the region. Eruptions along the chain occurred from 20 ka to ~660 years ago, and it is the most likely focus for future volcanic activity in the Long Valley region. Thus, petrologic data from Mono Craters must provide excellent constraints on the development and nature of the existing magmatic system. The Mono Craters chain contains 27 high silica rhyolite domes and flows and 1 dacite dome that were erupted along a gently arcuate trend that extends for ~15 km south of Mono Lake. The high silica rhyolites can be subdivided based on phenocryst assemblages into the following groups: biotite-bearing rhyolite, orthopyroxene-bearing rhyolite, fayalite-bearing rhyolite, sparsely porphyritic rhyolite, and aphyric rhyolite. We collected samples from 14 of the domes and flows within the Mono Craters chain, obtaining samples from each of the groups. We examined the composition of the mineral phases using electron microprobe analyses. Biotite-bearing rhyolites contain phenocrysts of quartz, plagioclase (Ab74-77), sanidine (Or66-68), Fe-rich hornblende, Ti-rich biotite, pyroxene, and magnetite with lamellae of ilmenite. Fayalite-bearing rhyolites contain phenocrysts of quartz, plagioclase (Ab75-80), sanidine (Or61-69), fayalite (Fa92-93), Fe-rich hornblende, Ti-rich biotite, pyroxene, magnetite and ilmenite. Sparsely porphyritic rhyolites contain a similar phenocryst assemblage to Fayalite-bearing rhyolites, but phenocrysts are much rarer. Aphyric rhyolites contain sparse microphenocrysts of magnetite and ilmenite up to 100 microns in diameter. FTIR analyses of quartz-hosted glass inclusions in samples of fayalite-bearing and sparsely porphyritic rhyolite indicate the pre-eruptive dissolved volatile content of the magma was at least 4.0 wt. % H_2O and 150 ppm CO_2. The volatile data suggest the storage condition for those flows was 120 MPa but the glass inclusions contained an exsolved vapor phase so we consider this pressure to be a low estimate. Aluminum-in-hornblende geobarometry indicates the magmas were stored much deeper, at 300 ±20 MPa. Importantly, aluminum-in-hornblende pressure estimates are indistinguishable, regardless of phenocryst assemblage or geographic position along the chain. Fe-Ti thermometry suggests the older rhyolites were stored at ~750 °C whereas more recently erupted sparsely porphyritic and aphyric rhyolites were stored at ~810 °C. Taken together, the barometry and thermometry results imply volcanic activity along Mono Craters for the past 13 ka has been sustained by a magma chamber located at consistent depth, and a significant thermal pulse may have disrupted the cooling trend of the system approximately 2 ka.

Keywords: Mono Craters, high-silica rhyolite, volcanism, geothermometry, geobarometry, igneous petrology