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Anatectic melting or extreme fractionation? Chemical and temporal evolution of Quaternary small-volume, high-silica rhyolites from Mineral Mountains, Utah, USA

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The origins and evolution of small-volume, high-silica intercontinental rhyolites have been attributed to numerous processes such as derivation from granitic partial melts or small melt fractions remaining from fractional crystallization. Investigations into the thermo-chemical-temporal evolution of these rhyolites has provided insights into the storage and differentiation mechanisms of small volume magmas. In the Mineral Mountains, Utah, high-silica rhyolites erupted through Miocene granitoids between ca. 0.8 and 0.5 Ma, and produced numerous domes, obsidian flows, and pyroclastic deposits. Temporally equivalent basalts erupted in the valleys north and east of the Mineral Mountains, hinting at a potential relationship between mafic and felsic volcanic activity. Here we test competing hypotheses. Are the rhyolites products of extreme fractionation of the coeval basalts? Or do they represent anatectic melts of the granitoids through which they erupted? We address these questions through modeling with new whole rock geochemical data and zircon trace element chemistry, thermometry, and U/Pb LA-ICPMS dates. We couple these data with new $^{40}Ar/^{39}Ar$ eruption ages to improve upon the volcanic stratigraphy and address the recurrence interval for the most evolved rhyolites. Geochemical data from zircon crystals extracted from six domes suggest increasing differentiation with age and eruptive location, however there is minimal evidence for recycling of earlier crystallized zircon. These data suggest that magma batches were isolated from one another and zircon nucleation and crystallization occurred close to the eruption, thus limiting the residence time of the magmas. These data also perhaps suggest that the magmas were generated in small batches within each of the granitoids rather than from a large crystal mush body underlying the region, as seen at large silicic systems. Our preliminary geochemical models and zircon petrochronology eliminate extreme fractionation and favor local anatectic melting of different granitoids as a mechanism to produce chemical signatures observed in the Quaternary rhyolites in the Mineral Mountains.