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GEOCHEMISTRY AND PETROGENESIS OF A HYDROTHERMALLY ALTERED EVOLVED RHYOLITE, SOUTHERN WAH WAH MOUNTAINS, UTAH: IMPLICATIONS FOR THE IGNEOUS DISTRIBUTION OF CRITICAL ELEMENTS

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A-type rhyolites are often highly geochemically evolved and are characteristically enriched in incompatible trace elements relative to I-type rhyolites and may represent potential low grade, high-tonnage critical metal resources or may have driven trace element mineralization. ~50 – 0.06 Ma A-type rhyolites crop out in the western USA from western Texas through western Montana and likely formed due to magmatic activity induced by the rollback of the Farallon Slab which affected this region of the Great Basin between ~31 – 20 Ma in and pre-dates the onset of Basin and Range extension in this region. This study focuses on the Red Beryl Rhyolite member of the ~22–18 Ma Blawn Formation within the Wah Wah Mountains of Utah. This rhyolite was emplaced at ~22.1 ± 0.8 Ma and has undergone variable hydrothermal alteration. It is divided into two sub-units based on stratigraphic, petrographic, and geochemical differences, the earlier, less altered and evolved Red Beryl Lower unit and the later, more altered and evolved Red Beryl Upper unit. Both units have undergone post-emplacement feldspar alteration and accessory phase mobility after this initial stage of alteration, but alteration does not appear to have affected the concentrations of most trace elements.

Several models have been proposed to explain how A-type magmas are generated and become enriched in incompatible trace elements, including: 1) partial melting and fractionation of quartzofeldspathic crustal rocks, 2) partial melting and fractionation of mafic lower crustal material, 3) pure fractional crystallization of mantle-derived magma, and 4) partial melting of mafic or mantle-hybridized crust produced by intrusion of basaltic magmas. Trace element modeling indicates that the melts that formed the Blawn Formation were generated by extensive fractional crystallization (up to ~70%) of somewhat-enriched, mantle-derived basalts that possibly experienced a small degree of crustal contamination. The significant REE-Y-F-depletions present in the Red Beryl Upper unit were caused by fractionation and removal of REE-Y-F-rich minerals prior to eruption of this unit, causing the most evolved samples to often contain the lowest concentrations of these elements which has strong implications for the overall prospectivity of these types of deposits.