Geochemical evaluation and igneous petrogenesis of hydrothermally altered evolved rhyolites, southern Wah Wah Mountains, Utah

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The Red Beryl and Tetons rhyolites of the Blawn Formation in the southern Wah Wah Mountains, Utah, are highly evolved A-type rhyolites that formed in an anorogenic setting that contain elevated concentrations of incompatible trace elements when compared to common I-type granites and rhyolites. The ~22 Ma Red Beryl and ~18 Ma Tetons units are geochemically similar, suggesting they were derived from a similar source. Both suites are variably evolved and have undergone differing degrees of hydrothermal alteration, with the Tetons units being largely unaltered and the Red Beryl units ranging from fresh to altered.

The precipitation of REE-rich phases are likely to have depleted the Red Beryl rhyolite in the REE+Y+F prior to alteration. Post-emplacement hydrothermal alteration also most likely only affected the concentrations of major elements such as Si, Ca, Mg, Na, and Al, and likely did not remobilize or concentrate the incompatible trace elements of interest. When viewing evolved, A-type rhyolites as a potential future low-grade, high-tonnage resource of REE and other critical trace elements, this removal-by-fractionation of most of the elements of interest has implications for their overall prospectivity because these fractionated REE-rich phases need to exist somewhere in the system, likely at greater depth in the volcanic pile or parental chamber.

Trace element fractionation modeling suggests that the melts that formed the Blawn Formation rhyolites and dacites were generated by the prolonged fractional crystallization of somewhat-enriched mantle-derived basalts that may have experienced a very small degree of crustal contamination. These results also show that extreme degrees of fractional crystallization of an evolved rhyolite is not necessarily good for producing higher grade deposits of incompatible trace elements because past a certain point, these elements themselves form discrete minerals and are efficiently removed from the evolving system.