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Insights into reconstructing REE compositions of melt from zircon-melt partition coefficients using zircon-hosted melt inclusions from the Yellowstone Volcanic Province.

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Establishing the major and trace element composition of the Earth's melts (Hadean to recent) is essential for understanding crustal evolution. Due to its physical-chemical resilience, zircon spans the complete age spectra of Earth's history, and thus provides the only physical record from the early Earth. However, the petrological context i.e., the melt from which zircon crystallised, is often lost, except for inclusions of melt preserved within zircon. Melt inclusions in zircon (MI) provide a valuable tool to constrain zircon-melt REE partition coefficients (D_{REE}), which are used with the zircon REE chemistry to reconstruct melt compositions. Such reconstruction requires accurate partition coefficients, which are particularly sensitive to temperature, but also to pressure and melt composition.

We determined the major and trace element compositions of 60 co-existing zircon-MI pairs from two ~ 2 Ma age rhyolites (the caldera-forming Huckleberry Ridge Tuff; HRT-C and the post-caldera Blue Creek Flow; BC-1) of the Yellowstone Plateau volcanic field by EPMA and SIMS, and calculated a set of 60 zircon-MI partition coefficients. The MI from both units are glassy with average silica contents of 78.30 ± 0.74 and 77.19 ± 1.11 wt %, and Ti-in-zircon crystallisation temperatures are 839 ± 36 and 835 ± 35 ºC. Measured D_{REE} patterns for each population (n = 30) are tightly constrained and exhibit a smooth pattern spanning ~ six orders of magnitude from La to Lu, (with exceptions at Ce and Eu), and for the HRT exhibit greater curvature (i.e., flatter) between the MREE to HREE compared to the BC-1. D_{REE} patterns for the HRT have small to moderate Ce anomalies (Ce/Ce^*_{Di} 50 ± 40), whereas those in the BC-1 are larger (Ce/Ce^*_{Di} 98 ± 45), and both units exhibit negligible to positive Eu anomalies (Eu/Eu^*_{Di} 1.07 ± 0.89 and 1.80 ± 2.01, respectively). We compare the trace element compositions of the MI to bulk-glass compositions from Yellowstone to assess any differences, which are small, then compare the measured MI compositions to those reconstructed using published partition coefficients (natural, empirical and experimental). The choice of D_{REE} for reconstruction of the melt REE pattern results in differing petrogenetic interpretations.