Tracking the history of magma production and intrusion across Idaho using 40 million years of tephragenic zircon

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The Cretaceous was a time of extensive magmatism in the North American Cordillera from Farallon plate subduction, resulting in the formation of large plutonic complexes (e.g., Idaho Batholith, Sierra Nevada, etc.). Magmatism also produced numerous volcanic ash beds (bentonite) in the western US that commonly contain primary zircon, providing a nearly continuous record of linked geochronology and geochemistry from this plutonic system. Bentonites are best preserved in the marine strata of the proximal Western Interior Seaway; 87 of them that span nearly 40 million years of volcanism have been analyzed for bulk geochemistry, including REEs and Sr/Nd isotopic ratios. These data connect the betonites to the Idaho Batholith[1], and show volcanic centers migrating eastwards across Idaho beginning at 85 Ma before stalling in western Montana by Campanian-time, coincident with the emplacement of the Elkhorn Volcanic Complex and Boulder Batholith. A new study is building upon the bulk geochemical data by LA-ICP-MS analysis of primary, unaltered zircon from a subset of the 87 bentonites. The zircon record is being applied to further document changes in magmatism related to shallowing subduction and eastward migration. Zircon preserves a high-resolution chronology and geochemical record of subsurface processes including those that produce explosive volcanism for a system that has been largely obscured by secondary processes. Trace element and REE growth zoning within single grains records changes in crustal assimilation and magma differentiation, linked to intruded basement rock and crustal thickness. Zircon Hf isotopes are used to gauge relative mantle *vs.* crustal inputs, and track changes in basement composition as magmatism migrated eastwards across different basement terranes. High-resolution U-Pb geochronology tracks the tempo of magma flux through the system. Zircon cores, either inherited from intruded Precambrian crust or from earlier phases of magmatism, provide a primary record of early-stage magmatic processes.

[1]Hannon, J.S., Huff, W.D., Sturmer, D.M., 2019. Geochemical relationships in Cretaceous bentonites as inferred from linear discriminant analysis. Sediment. Geol. 390, 1–14. https://doi.org/10.1016/j.sedgeo.2019.07.001

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