Background

The McClure Mountain Complex, located in Colorado’s Wet Mountains, is a 5.1 km³ Cambrian syenite intruded into Precambrian migmatitic gneiss (Parker and Hildebrand, 1962). Over a billion years younger than its surrounding lithologies, the McClure Mountain Complex was dated using U-Pb geochronology on chemically abraded zircons at 523.98 ± 1.12 Ma as its age of crystallization (Shoene and Bowring, 2006). The complex’s capability of reproducing dates makes it a prime candidate for use as a standard and therefore is of great interest in the geo- and thermochronologic community. Thermal histories of the complex that are above ~450 °C have been thoroughly explained but no study has been conducted below this regime. Appaite and zircon data was effective at constraining upper crustal temperature ranges. Due to the unit’s relative, we were able to use other minerals such as titanite, baddeleyite, and monazite to offer potential additional constraints to the McClure Mountain Complex’s thermal past.

Our goal for this study are to limit the thermal and tectonic evolution of the McClure Mountain Complex to a probable geologic past and apply that knowledge to Colorado’s Wet Mountains geology. The other is the development of new ways to study thermal histories specific to (U-Th)/He thermochronology.

Methods

Step 1. Hand crush samples with a rock hammer.

Step 2. Pulverize sample in rock crushing lab and classify with sivs.

Step 3. Utilize Willey table to separate light material from the heavies.

Step 4. Dry sample and begin hand magnetic separation.

Step 5. Use heavy liquids, titantium, mafic-ultramafic complex at (Cambrian) Gem Park Complex.

Step 6. Heavy liquids, lithium, heavy liquids, titanium (LIT), with use in centrifuge to further separate materials.


Step 8-10. Use HeFTy to degas grains to measure amount of He. Disolve in acid, measure U-Th content by ICP-MS. Apply data to HeFTy for analysis.

Problems:

- (U-Th)/He thermochronology restricted to low temperature thermal histories by the use of apatite and zircon. Assessment of new minerals will allow evaluation of a broader temperature regime.
- McClure Mountain Complex’s low temperature thermal history is unknown, a complete thermal history can help us understand Colorado’s Wet Mountains and the Ancestral Rockies for that area.

HeFTy Modeling

HeFTy is a program that models different time temperature paths (T-T) and determines “good” and “acceptable” paths based off date, eU, and radius of the grain (Ketcham, 2013).

Results

Thermal History of the McClure Mountain Syenite

- Dates from MMhb standard apatite, zircon, baddeleyite, and titanite reflect highly reproducible ages (1 sample standard deviation).
- Apatite He dates from MM syenite standard range from 140.83 Ma to 69.97 Ma and ages appear to be positively correlated to effective eU variations.
- MM syenite sample 1401 dates from apatite, titanite, baddeleyite, and zircon were not as reproducible as standard and warrant further investigation.

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