Evaluating the tectonic significance of the Moore Gulch shear zone, central Arizona with geochronologic, geochemical, and isotopic analysis of Paleoproterozoic plutonic rocks

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Introduction

• Proterozoic crust of southwestern Laurentia is widely considered to be an example of continental growth by accretionary processes. In a broadly accepted model, Laurentia grew by the sequential addition of crustal provinces, each having their own distinctive geologic histories. Two key provinces in this model are the ca. 1.6-1.7 Ga Yavapai and ca. 1.7-1.6 Ga Mazatzal provinces, delineated by marked differences in lithology, metamorphic grade, and structural style across the Moore Gulch shear zone in central Arizona.

Hypothesis 1

• Karlstrom et al. [1987] proposed two endmember hypotheses have been proposed to account for the differences between crustal provinces. In Hypothesis 1, rocks of the Mazatzal province are alkali-tholeiitic with respect to the Yavapai province, and were juxtaposed by accretion-related thrusting, with the Moore Gulch shear zone representing a reacted thrust-zone that marks the approximate crustal boundary.

Hypothesis 2

• In Hypothesis 2, rocks of the Mazatzal province were deposited unconformably atop rocks of the Yavapai province, and the difference in lithotectonic character is ascribed to the juxtaposition of different crustal levels across the Moore Gulch shear zone.

Hypothesis

A crucial test of these opposing hypotheses is evaluating the petrogenetic history of ca. 1.74 Ga plutonic rocks on either side of the Moore Gulch shear zone. We present paired U-Pb zircon geochronology and Hf-isotope analysis and bulk-rock major and trace element geochemistry of intermediate plutonic rocks on either side of the Moore Gulch shear zone.

Results

• To the southeast of the Moore Gulch shear zone the Gibson Creek Batholith displays a range of calc-alkaline to calc-alkalic major element compositions.

• To the northwest of the Moore Gulch shear zone the Cherry Creek Batholith, and Bland Creek, Government Canyon, and Study Butte suites show a similar range of calc-alkalic compositions.

• Trace element geochemical analysis of the Gibson Creek Batholith shows enriched high field strength elements (HFSE) relative to large ion lithophile elements (LILE) with pronounced negative Nb, Ta, P, and Ti anomalies.

• This is similar to samples HO2-ASH-2, HO2-019, and HO2-030 taken from northeast of the Moore Gulch shear zone.

• Together, these results indicate that plutonic rocks on both sides of the Moore Gulch shear zone shared a common source.

Conclusions

• Our results indicate that ca. 1.74 Ga plutonic rocks on both sides of the Moore Gulch shear zone share similar petrogenetic histories. Both suites of rocks have a range of calc-alkaline to calc-alkalic major element compositions. Both suites of rocks show enriched high field strength elements relative to large ion lithophile elements with pronounced negative Nb, Ta, P, and Ti anomalies. Both suites of rocks are isotopically juvenile at ca. 1.74 Ga, with εNd(t) values ranging from ca. -2 to +4.

• These results favor the second hypothesis, indicating that ca. 1.74 Ga basement characteristic of the Yavapai province is present beneath the Mazatzal province, and that the Mazatzal province is para-autochthonous with respect to the Yavapai province.

References


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