21-2 - EVIDENCE OF LATEST ARCHEAN TO HADEAN CRUSTAL MATERIAL IN THE NORTHERN WYOMING PROVINCE AND THE DEEP-TIME TECTONOTHERMAL HISTORY OF THE BRIDGER RANGE, MONTANA

Sunday, September 22, 2024

8:20 AM - 8:35 AM

304A (Anaheim Convention Center)

Abstract

The Wyoming Province of Laurentia, which hosts some of the oldest known crustal material on Earth including zircon $^{207}Pb/^{206}Pb$ ages up to 3.96 Ga in the Beartooth Mountains, Montana, has been subjected to multiple periods of orogenesis and burial from Proterozoic time to present. We present new zircon U-Pb geochronology and zircon (U-Th)/He thermochronology from Archean-Proterozoic metamorphic rocks exposed in the Bridger Range, Montana, to resolve details of their origins and reconstruct their deep-time tectonothermal history.

Zircon U-Pb geochronology and cathodoluminescence imaging, paired with whole rock geochemistry and petrography, was obtained from four metamorphic samples including quartzofeldspathic and garnet-biotite gneisses proximal to the “Great Unconformity” (GU), where Archean-Proterozoic metamorphic rocks are unconformably overlain by ~7.5-9 km of compacted Phanerozoic strata. Single grain $^{207}Pb/^{206}Pb$ ages range from 4099 ± 44 Ma to 1776 ± 24 Ma, extending the age of known crustal material in the northern Wyoming Province into the Hadean and recording high-grade conditions during the Paleoproterozoic Great Falls/Big Sky orogeny.

Zircon (U-Th)/He thermochronology from five metamorphic samples proximal to the GU record cooling ages ranging from 705 Ma to 10.3 Ma, reflecting the variable He diffusivity of individual zircon grains with a large range of radiation damage as proxied by effective uranium (eU) concentrations, which range from ~5 to ~3000 ppm. A negative correlation between cooling age and eU is observed across the five samples suggesting the zircon (U-Th)/He system is sensitive to Proterozoic through Miocene thermal perturbations. Ongoing thermal history modeling seeks to reconstruct the temperature-time histories of these metamorphic rocks, including testing whether this dataset is sensitive to thermal effects imparted by the rifting of Rodina and erosion related to Cryogenian glaciation (i.e., hypotheses related to formation of the GU), and the onset of modern, active extension. These datasets and models provide crucial new constraints on the obscured Proterozoic tectonic history of the northern Wyoming Province and have important implications for our understanding of the formation of early crustal material on Earth.

Geological Society of America Abstracts with Programs. Vol. 56, No. 5, 2024
doi: 10.1130/abs/2024AM-404615

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