Amherst College Geology Department
presents

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The Proterozoic to Eocene evolution of the Clearwater complex, northern Idaho: A record of continental growth to Cretaceous mountain building

Beneski Earth Sciences Building - Room 107
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ABSTRACT

The Clearwater metamorphic core complex in northern Idaho contains rocks that record a range of metamorphic, magmatic, and fluid-flow processes recording over two billion years of geologic history, spanning the formation of the North American craton to the uplift of the Rocky Mountains and northern Basin and Range extension. Complex metamorphic terranes like the Clearwater often preserve a variety of mineral textures and assemblages as well as dateable accessory phases that provide an opportunity to evaluate the tectonic evolution and timescales of geologic processes. However, the common approach of obtaining age data is often hampered by the absence of a petrographic context of the mineral being dated, as well as the uncertainty in knowing exactly what event or portion of a Pressure-Temperature (P-T) path is being dated. How dateable accessory phase growth links to major phase reactions, such as the growth of garnet, is a critical piece of information in unraveling the history of metamorphic rocks with complex histories. Using mineral assemblage stability diagrams, in situ laser ablation split stream (LASS) petrochronology of monazite and xenotime, and garnet geochronology, these complex tectonic histories can be constrained. Within the Clearwater complex, all garnet Lu-Hf age dates, as well as monazite and xenotime grains that occur as inclusions in garnet, are Mesoproterozoic, typically ranging in age from 1.5 to 1.3 Ga. This range of dates spans the deposition, rifting, and subsequent burial metamorphism and/or crustal thickening of the Proterozoic Belt basin protolith sediments. Within the western hanging wall of the complex, exclusively Mesoproterozoic Ar-Ar biotite and U-Pb monazite dates are preserved. The eastern hanging wall preserves Mesoproterozoic dates as inclusions in metamorphic porphyroblasts, but matrix monazite grains record protracted Cretaceous tectonism. In contrast, the high grade foot wall of the complex was strongly overprinted by Cretaceous regional metamorphism and Eocene extension and associated magmatism and fluid flow from 80-46 Ma. Coupled with geochemical and P-T data, these data indicate that a significant and protracted Mesoproterozoic tectonic event affected a large region of rocks along the northwestern margin of the North American craton, which is preserved despite significant Cretaceous to Eocene tectonism.