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Orogenic Exhumation History Using Multi-Mineral Detrital Thermochronology

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Thermochronologic studies aimed at constraining orogenic exhumation rates traditionally rely on bedrock transect datasets, such as bedrock age-elevation profiles. Several limitations to this approach include difficult terrain, limited access to appropriately steep traverses, lack of a range in closure ages as a function of elevation and perhaps insufficient relief to resolve age-elevation trends adequately from often-noisy data. Detrital thermochronology can mitigate some of these obstacles by utilizing easily accessible sediment from active orogenic catchments. These sediments are typically rich in rock-forming and accessory minerals suitable for dating. Many studies typically combine conventional geochronology and thermochronology methods to "double date" an individual crystal, allowing determination of both sedimentary provenance and thermal history for each crystal. However, new advances in laser ablation double dating (LADD) of paired U/Pb and (U-Th-Sm)/He dating of accessory minerals has advantages over conventional methods for detrital applications due to simplified procedures and increased sample throughput capacity. When combined with other dating techniques, such as $^{40}Ar/^{39}Ar$, multi-mineral detrital thermochronology has the ability to constrain both high- and low-temperature thermal evolution from crystallization to exhumation through the shallow crust. Expanding the approach presented in Gallagher and Parra, (2020), we have developed the capability to model the thermal history of detrital thermochronologic data to infer regional exhumation patterns using multiple detrital chronometers. We apply this method to the active catchments of the southeastern Sierra Nevada, CA, using LADD U/Pb and (U-Th-Sm)/He of apatite and zircon as well as $^{40}Ar/^{39}Ar$ hornblende and biotite. Preliminary results confirm that exposed bedrock structural levels in the eastern Sierra Nevada record rapid exhumation at ca. 80 Ma, followed by much slower subsequent exhumation through much of the Cenozoic.