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Monazite fission-track thermochronology as a possible proxy for low-magnitude erosion

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Conventional low-temperature thermochronology can resolve cooling typically associated with ~2 – 6 km of erosion. However, lower magnitudes of erosion produced by structural and surface process are often difficult to quantify. Here, we apply a new, low-temperature thermochronometer (closure temperature <50 – 25 °C), monazite fission-track (MFT), to the Catalina-Rincon metamorphic core complex (MCC), Arizona, USA which has a well-constrained tectonic and paleoclimatic history. In the Catalina-Rincon, traditional low-temperature thermochronology (apatite and zircon fission-track and apatite and zircon [U-Th-Sm]/He) record timing of cooling related to metamorphic core complex detachment faulting and subsequent Basin and Range normal faulting (29 – 20 Ma and 15 – 12 Ma, respectively). We present two monazite fission-track age-elevation profiles across southwestern and eastern extent of the Catalina-Rincon. The southwestern profile (~ 1000 m relief) records a Pleistocene age-elevation trend, with older ages at higher elevations (2.6 – 1.0 Ma). Whereas the eastern profile (~ 500 m) records a late Miocene-Pliocene age-elevation trend, also with older ages at higher elevations (7.4 – 3.0 Ma). The profile from the eastern part of the Catalina MCC likely records a period of upper crustal erosion due to footwall uplift post Basin and Range extension. Whereas the southwestern profile does not correlate with known tectonic activity in the region, yet they are consistent with Pliocene intensification of the North American Monsoon. However, such a low closure temperature could suggest that fission-tracks in monazite are not stable at surface temperatures and lie in the partial annealing zone. Despite this concern, we attribute Pleistocene MFT ages to record climate-enhanced erosion during a known period of increased precipitation. We compare results from the Catalina MCC to MFT data collected along the Main Frontal Thrust in the Nepalese Himalaya and from boreholes in the Anadarko Basin, OK, U.S.A. These results suggest that MFT has potential for dating low-magnitude erosion associated with climate and relief-forming processes.