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# Tracking Mountain Belt and Foreland Basin Evolution from Detrital Thermochronology and Numerical Modelling: An Example from the Central Himalaya (Nepal)

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Thermochronological analysis of detrital sediments derived from the erosion of mountain belts and contained in the sedimentary basins surrounding them allows reconstructing the long-term exhumation history of the sediment source areas. The effective closure temperature of the thermochronological system analysed determines the spatial and temporal resolution of the analysis through the duration of the lag time between closure of the system during exhumation and its deposition in the sedimentary basin. High closure-temperature systems such as mica Ar-Ar or zircon fission-track (ZFT) data allow estimating long-term exhumation rates using the lag-time concept (cooling age – depositional age) and for analyzing the overall pattern of exhumation. The complementary, lower temperature apatite fission-track (AFT) system allows testing for shorter-term variations in exhumation rates. Because of its relatively low closure temperature, AFT thermochronology is also sensitive to the thermal evolution of the foreland basin itself. Stratigraphically higher samples will remain unreset and retain a signal of source-area exhumation. More deeply buried samples will lose this information when they have been partially reset, in contrast, they may provide constraints on the thermal and kinematic history of the foreland basin.

Detrital mica Ar-Ar, ZFT and AFT data from Miocene to Pliocene Siwalik Group sediments in central and western Nepal allow to track the long-term exhumation history of the central Himalaya, which has been only poorly constrained so far. The new detrital data provide important new insights in the long-term exhumation history in the central Himalaya, as well as in the thrust propagation sequence and burial-exhumation history of the foreland fold-and-thrust belt. In particular, the high-temperature (Ar-Ar and ZFT) data indicate a rapid and important phase of exhumation at ~15-18 Ma, apparently contemporaneous with major tectonic reorganization of the orogen (transition from extrusion along the Main Central Thrust to forward propagation), and followed by more focused steady-state exhumation at ~1.5 km/Myr, whereas the lower temperature AFT system shows spatial variations in recent exhumation rates not picked up by the higher-temperature systems. We use a 3-D numerical thermo-kinematic model, including lateral motion along faults and evolving surface topography, to predict thermochronological ages for different systems at the surface through time. The probability-density functions of thermochronological ages are compared to the single-grain detrital age distributions in order to quantitatively constrain exhumation scenarios for the central Himalaya that permit to explain the observed detrital age patterns.