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Does tectonics drive topography ? Insights from low – temperature thermochronology and numerical modeling along the Himalayan range

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Although the Himalayan range is commonly presented as cylindrical along-strike, geological structures, topography, precipitation rate, convergence rates and low – temperature thermochronological ages all vary significantly from west to east. Here, we focus on the interpretation of thermochronological datasets in term of cylindricity in geometry and kinematics of the MHT along the Himalayan range.

We propose a structural and kinematic model of the major crustal Himalayan thrust, the MHT, based on apatite fission-track (AFT) ages collected along north – south transects in western and eastern – central Nepal (Kali Gandaki and Trisuli Rivers). AFT ages are consistently young ($< 3\ My$) along both N-S transects in the MCT zone and increase (4 to $6\ My$) toward the south in the Lesser Himalaya. We constrain the geometry of the MHT ramp with 2 age-elevation transects, one in the MCT zone and one in the outer Lesser Himalaya, interpreted in terms of exhumation rate. The data can be fit without invoking out-of-sequence thrusting in the Main Central Thrust zone by varying the geometry of the MHT along strike, in accord with independent geodetic and geophysical data.

We compare our data to published low-temperature thermochronological datasets for western – central Nepal, eastern – central Nepal, western India and the Bhutan Himalaya. We use these data to constrain numerical thermal-kinematic models using a modified version of the PECUBE code, in order to quantify potential along-strike variations in the kinematics of the Himalayan range. Our results show that lateral variations in geometry of the MHT (in particular the presence or absence of a major ramp) strongly control the kinematics, the exhumation history and the topography of the orogen. Where a major crustal ramp is present, the topography shows a steep gradient that focuses exhumation and orographic precipitation whereas the topography is more gentle and exhumation less focused in the absence of a ramp. Our results imply that along-strike climatic variations in the Himalaya respond to tectonics rather than driving it.