

KINEMATIC AND EROSION HISTORY OF THE GREATER HIMALAYAN SEQUENCE, CENTRAL NEPAL, FROM INTEGRATED THERMOCHRONOLOGY AND NUMERICAL MODELING

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Controversy exists in Himalayan geology concerning whether all Plio-Pleistocene, Indo-Tibetan convergence has been accommodated along the Main Himalayan Thrust (MHT) and expressed at the distal margin of the orogen or whether some significant fraction of the Plio-Pleistocene convergence has been accommodated by active deformation within the orogen, particularly in the vicinity of the Main Central Thrust (MCT). Resolving this conflict is essential to understanding the Neogene activity of Himalayan structures and the role of climate in exhumation of the Greater Himalayan Sequence (GHS). We analyzed 82 bedrock apatite fission-track (AFT) sample ages from a 40x40 km area of the Marsyandi River valley in central Nepal. AFT samples have a mean age of ~1 Ma with a range of 0-3.8 Ma. Muscovite ⁴⁰Ar/³⁹Ar ages for 38 of these samples have an average age of ~6 Ma and range of 2.5-17.2 Ma. These cooling ages are sensitive to their thermal history, which is a function of the pathway they take to the surface during exhumation and expressed in a spatial pattern of cooling ages at the surface. We interpret these ages by considering two tectonic scenarios: (1) slip only on the Main Himalayan Thrust with a major ramp beneath the Higher Himalaya and (2) slip on the MHT accompanied by out-of-sequence thrusting on the MCT, near the physiographic transition from the Higher Himalaya to the foothills.

We use a 3D thermo-kinematic finite element model to simulate the tectonic and erosional cooling history of rocks and predict cooling ages based on simulated sample thermal histories. We compare observed AFT and Ar/Ar cooling ages to model predictions to evaluate the likelihood of each tectonic scenario. Model free parameters include the rates of fault motion, basal heat flux, radiogenic heat production, thermal conductivity, magnitude of shear heating and fault geometry. Thrust motion is partitioned between the MHT and MCT, with rates ranging between 1-15 mm/yr and 0-9 mm/yr, respectively. Results suggest that (1) AFT data are consistent with both tectonic scenarios if the average erosion rate of the GHS is between 3.5-5 mm/yr, (2) scenario 1 is possible only if a major ramp in the MCT is present beneath the Higher Himalaya, and (3) work in progress indicates predicted Ar/Ar ages only match observed ages in models where the MCT is active.

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