EGU21-16290
https://doi.org/10.5194/egusphere-egu21-16290
EGU General Assembly 2021

Insights of Spatiotemporal evolution of Yamuna Valley, Garhwal Himalaya: Derived from Fission track dating and Morphotectonic analysis

Prerna Gahlaut and Ramesh Chandra Patel
HNBGU, Srinagar Garhwal, India, Department of Geology, Jaspur, India (prernagahlaut93@gmail.com)

Substantial set of recent documentation with sophisticated statistical and analog models have recognized dynamic interchange between subsurface crustal distortion and exogenic erosional processes as the root of geomorphic evolution of Himalaya. Low temperature thermochronology provides insights to enumerate nature and timing of tectonic course from extracted thermal records of vertical moving rock block over geological past. In present study, we used Apatite fission track technique to calculated exhumation rates of Yamuna valley, Garhwal Himalaya. AFT ages of Lesser Himalaya Sequence of Purola region various between 4.0 ±0.8 myr to 9.5±0.6 myr. While AFT ages of LHS along Yamuna River varies form 2.3±0.5 myr to 5.6±0.6 myr and exhumation rates are 2.3-1.2 mm/yr. calculated age of Apatite sample near Main Central Thrust (MCT) is 2.3±0.5 myr which exhumed at the rate of 2.3 mm/yr. Exhumation rates of Purola region are 0.8-1.6 mm/yr.

To link the exhumation rates with present day morphology we used 2 methods; 1) Calculate morphotectonic parameters of Yamuna River valley; 2) compare our AFT ages and exhumation rates with early studies. Drainage pattern in the tectonically active zone is vigorously susceptible to mechanisms such as folding, faulting and basin tilting. Such deformation processes influence the phase of geomorphology, drainage pattern, river incision, elongation, asymmetry, and diversion. Mathematical quantification of drainage morphology elucidate spatio-temporal effect of tectonics. Morphotectonic parameters are stream length gradient index (SL), valley floor height to width ratio (Vf), asymmetry factor (Af), basin shape index (BS) and hypsometric integral (HI) extracted from SRTM DEM with resolution of 30m and are calculated in ArcGIS 10.3. These parameters further integrated to define a single Indaex of relative Active Tectonic (IRAT). Value of IRAT is very high in upper Yamunotri region and low to moderate in Purola region. The exhumation rates are further compared with erosion rates from early studies. Erosion rates derived from ^{10}Be nuclides (Scherler et al 2014) show very slow erosion rate in Purola region (~ 0.13±0.01 mm/yr) while for Yamunotri region higher erosion rate (>4.9 mm/yr) is recorded. These erosion rates are attributed to subsurface geometry of MCT.

All three approaches together construct an evolution record of study area over geological past. Exhumation history of Apatite and erosion rates from early studies conclude Yamuna river valley, specifically upper region of valley is very active while Purola region is less active. Morphotectonic parameters harmoniously present similar picture. These combined study point toward relegate

control of climate and dominance of ongoing sub-surficial deformation along MCT in Yamuna River valley on geological time scale.