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Temporal variability in uplift rate in a neotectonically active pericratonic rift basin using river long profile inversion method

Sonam Sonam, Ramendra Sahoo, Rishi N Singh, and Vikrant Jain
Indian Institute of Technology Gandhinagar, Discipline of Earth Sciences, Gandhinagar, India (sonam@iitgn.ac.in)

River long profiles are widely used as tectonic markers. Inversion analysis of river long profile provides a tool to quantify the bed rock incision process by advecting the topography upstream with a local migration velocity which is proportional to the drainage basin area (a proxy for discharge) and rock erodibility. Here we adopt the river long profile inversion methodology to obtain a relatively continuous record of uplift rate history for rivers originating in the Northern Hill Range and flowing towards the Kuchchh Mainland Fault (KMF), western India. Kuchchh Basin has experienced major rifting and associated thermal upwelling events. Subsequent to the plume episode at 65 Ma, the Indian plate collided with the Eurasian plate leading to reversal of the tectonic regime of Kuchchh from an extensional to a compressional setting. The KMF was the epicentre of some of the recent major earthquakes in this region (Bhuj 2001 earthquake, 7.7 M_w). The whole region is undergoing uplift and it is important to estimate the uplift rate which would reflect on the generation and accumulation of stresses in this region.

1-arcsec SRTM DEM was used for long profile extraction and channel slope estimation for the selected rivers. The choice of m/n for inversion analysis was done based on the assumption of collinearity of chi-profiles of the tributaries and main channel. The optimum m/n was equal to 0.2 for the river long profile under analysis. These long profiles have very low concavity and the steepness index value estimated for the long profiles was equal to 0.14 m^{1-2m}/a. The knick point migration velocity coefficient value was estimated to be 0.07 m/a. Erosion rate has been modelled to be linearly proportional to the long profile slope for simplicity of calculation, with an assumption of absence of spikes in long profiles. Rock erodibility has been taken to be spatially and temporally constant. Results for the uplift history show a mean uplift rate of 11 mm/a in the Holocene time period which matches with the uplift rate derived from other independent observations. The maximum uplift rate value goes up to 22 mm/a (within 2σ bounds) around 4 ka. The current methodology helps us to get a high temporal resolution uplift value along a neotectonically active fault.