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Cycles of Sediment Aggradation and Incision in the Western Sub-Himalaya

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The magnitude of sediment delivery from the Himalayan mountains to the foreland, is characterized by large fluctuations on different timescales. At the first order, these fluctuations are manifested by periods of sediment aggradation, associated with the formation of large alluvial fans during times of high sediment delivery and re-incision and remobilization during reduced sediment delivery. At longer timescale (10^6-10^7 yr) sediment delivery is controlled by tectonic processes, whereas at shorter timescales (10^3-10^5 yr) climatic fluctuations such as variations in monsoonal strength or Quaternary glacial and interglacial oscillations dictate sediment production and transport. However, detailed stratigraphic information and chronologies of Quaternary sediment aggradation and incision cycles within the Sub-Himalaya are lacking and the degree of variability in sediment delivery during these episodes has remained unclear.

In this study, we investigate Quaternary sediments exposed within the Sub-Himalaya of the Kangra re-entrant to the west of the Beas river. Here, the outlets of the drainage basins provide an ideal location to analyze aggradation and re-incision of transiently-stored sediments. The sediment-source region for this area is the Dhauladhar range, in the Higher Himalaya, which has been uplifting since the Late Miocene, thus restricting the potential source region for Late Cenozoic sediments supplied to the foreland. Folded and faulted Siwalik sediments of the Sub-Himalaya have formed sediment-filled intramontane piggy-back basin and have been progressively excavated. Thus far, we document a prolonged sediment-aggradation period by a thick sequence of boulder conglomerates. Subsequent re-incision of this fill, has left atleast three distinct terrace levels, which are recognized regionally at elevations $\sim$5-10m, 65$\pm$10m and 140$\pm$10m above the present-day riverbed. The composition of the fill unit is dominated by 60% granitic clasts and is therefore distinct from the regionally exposed Siwalik conglomerates ($>$65% quartzite). We interpret the provenance signal to mean that the exposed lithologies in the catchment most likely had changed from quartzite-rich Higher Himalayan cover units to unroofed granites between the time of deposition of the Upper Siwalik conglomerates and sedimentary basin fill.

Preliminary river profile analyses and topographic profiles along the terrace surfaces revealed tilting of some of the older, higher terrace levels in certain sections towards the north-east when compared to the gradient of the present-day river, suggesting ongoing internal shortening within the Sub-Himalaya.

DEM-based geomorphic analysis, surface exposure dating and burial dating of well-shielded sediments using cosmogenic nuclides are in progress. With the expected results, we anticipate to determine the chronology of terrace levels, determine deformation rates, reconstruct the fluvial incision history and ultimately the minimum sediment-flux rate in the study area.