Sediment accumulation in the Himalayan river valley induced by the out-of-sequence expansion of the range-bounding fault

Related Article: Vaishanavi Chauhan, Sanjay Kumar Mandal, Dirk Scherler, Manoj Kumar Jaiswal, Marcus Christl, Anil D. Shukla (2024). Prolonged sediment aggradation in an internal Himalayan valley due to out-of-sequence lateral fault growth. **Earth and Planetary Science Letters** 647, 119054. `https://doi.org/10.1016/j.epsl.2024.119054`

Abstract

Despite high rates of rock uplift and surface runoff, most Himalayan river valleys exhibit thick fill terraces, a legacy of aggradational episodes. Climate oscillations during the late Quaternary are commonly cited to explain the transitions between river incision and aggradation. While tectonic processes are known to cause transient aggradation, identifying their signatures and potential causes remains a challenge. This study comprehensively analyzes 120-m thick valley-fill deposits exposed above the modern channel of the upper Beas River in the northwestern Indian Himalayan state of Himachal Pradesh. Luminescence dating of the valley fill reveals an aggradation period exceeding 100 kyr during the late Pleistocene, which likely commenced considerably earlier, based on an estimated >400-m thick fill buried beneath the present valley floor. The prolonged aggradation, encompassing several glacial-interglacial cycles, and the absence of systematic changes in ^{10}Be-derived paleo-erosion rates or ^{87}Sr/^{86}Sr and ^{143}Nd/^{144}Nd isotope ratio-derived sediment provenance over time rule out late Quaternary climate oscillations as the sole driver of aggradation. Instead, we explain the longevity and extent of valley aggradation as the fluvial system's response to localized higher rock uplift rates downstream, as substantiated by the southern range flank morphology and the river network topology. We suggest that along-strike variations in thrust kinematics in this sector of the Himalaya likely caused the out-of-sequence lateral range growth and, consequently, triggered aggradation in the upstream valley. The implied temporal changes in stress and strain are critical for seismic hazard assessment.