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Climate-driven sediment aggradation and incision phases since the Late Pleistocene in the NW Himalaya, India

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Deciphering the response of sediment routing systems to climatic forcing is fundamental for understanding the impacts of climate change on landscape evolution and depositional systems. In the Sub-Himalaya, late Pleistocene to Holocene alluvial fills and fluvial terraces record periodic fluctuations of sediment supply and transport capacity on timescale of 10^3 to 10^5 years, most likely related to past climatic fluctuations. To evaluate the climatic control on sediment supply and transport capacity, we analyze remnant alluvial fans and terraces in the Kangra Basin of the northwestern Sub-Himalaya.

Based on field observations and OSL and CRN-dating, we recognized two sedimentary cycles with major sediment aggradation and subsequent re-incision phases. The large one developed over the entire last glacial period with ∼200 m high alluvial fan (AF1) and the second one during the latest Pleistocene/Holocene with ∼50 m alluvial fan (AF2) and its re-incision . Surface-exposure dating of six terrace levels with in-situ cosmogenic nuclides (^{10}Be) indicates the onset of channel abandonment and ensuing incision phases. Two terrace surfaces from the highest level (T1) sculpted into the oldest-preserved AF1 dates back to 48.9 ± 4.1 ka and 42.1 ± 2.7 ka (2σ error). T2 surfaces sculpted into the remnants of AF1 have exposure ages of 16.8 ± 2 ka and 14.1 ± 0.9 ka, while terraces sculpted into the late Pleistocene- Holocene fan (AF2) provide ages of 8.4± 0.8 ka, 6.6± 0.7 ka, 4.9± 0.4 ka and 3.1± 0.3 ka. Together with previously-published ages on the timing of aggradation, we find a correlation between variations in sediment transport with oxygen-isotope records from regions affected by Indian Summer Monsoon. During stronger monsoon phases and post-LGM glacial retreat manifested by increased sediment delivery (moraines and hillslope-derived) to the trunk streams, causing aggradation in the basin; whereas, weakened monsoon phases characterized by reduced sediment-delivery from the hillslope or moraines resulted into incision of the transiently-stored sediments. Sediment cycles in the Kangra Basin are largely synchronous with those documented from other NW Himalayan valleys.