

Aggradation and Incision Phases in the Upper Reaches of the Ganga River System; Timescales and Implications for Hinterland-Foreland Relationships

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The Ganga (Ganges) river system originates in the Himalaya and debouches into its foreland after cutting through all the major morpho-tectonic units of the orogen. The river traverses vast alluvial plains before falling into its ultimate sink, the Bay of Bengal. The upper reach of the Ganga river system comprises two major tributaries i.e. the Alaknanda and Bhagirathi rivers that drain out through the major litho-tectonic units of the Himalayan orogen. This region also shows a varied climatic regime where precipitation ranges from ~3000 mm/year at the mountain front of the Higher Himalaya to 1200 mm/year at the foothills. Thus the river system provides a natural laboratory to study the generation of fluvial landforms in response to climatic perturbations and tectonic pulsation, the two major forcing factors for the development of river terraces during the Late Pleistocene-Holocene in the mountainous catchment of the Himalaya.

The geomorphic study, in terms of the total height of the bedrock steps and overlying alluvial cover records three types of fluvial terraces in this valley: (i) Cut-and-fill terraces with thick alluvial cover over a thin bedrock step; (ii) terraces with almost equal thickness of alluvial cover and underlying bedrock step; and (iii) terraces with thicker bedrock steps and thin alluvial cover. Sedimentologically the alluvial cover is composed of clast-supported massive gravel (Gcm), matrix-supported gravel (Gmg), clast-supported horizontally stratified gravel (Gh) and horizontally stratified sand (Sh). These deposits are formed by (a) the aggrading channel bars, (b) episodic flash floods and (c) by the local landslides (Srivastava and others, 2008).

The luminescence chronology shows that the aggradational events are in two major phases; first from 49-25 ka and secondly from 18-11 ka. These phases are in coherence with global climatic oscillations. The Aggradation in these valleys is focused at Marine Isotope Stage 3 (MIS 3) and during the transition phase of MIS 2 and MIS 1. Glaciation-deglaciation processes in the upper reaches produced copious sediment during 63-11 ka, which were deposited by these rivers in several cycles and lead to extensive aggradation. The climatic changes at ~11 ka and then the completion of deglaciation process lead to increased fluvial discharge and decreased sediment supply, a condition favorable for incision of alluvial fills. Available literature from the Ganga plain and from the Ganga delta shows that the phase of aggradation is regional but the incision in the foreland initiated at least 2-3 ka later, after 7 ka (Srivastava and others, 2003 a, b; Tandon and others, 2006).

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