

Paper Number: 413

Decoding fluvial archives along River Tista at the frontal Himalayan foreland, India

Gupta, S.¹, Ghatak, S.²

¹Geological Survey of India, New Delhi, smt_74@yahoo.co.in

²36th IGC Secretariat, C/O Geological Survey of India, New Delhi

The Quaternary history along the braided course of River Tista in the tectonically active frontal foredeep of east central Himalayas is represented by alluvial fan, terrace and flood plain deposits between Sevok and Jalpaiguri (~ 60 line km), West Bengal. Tista drains through a wide array of rock units, viz. Central Crystalline Gneisses, Daling Group, Gondwana Supergroup, Siwalik Group and Quaternary sediments and tectonic discontinuities, viz. MCT, MBT and MFT from north to south. Earlier, the Quaternary record of Tista has been classified into Samsing, Matiali and Chalsa formations of Pleistocene age and Baikunthapur Formation of Pleistocene-Holocene age, Jalpaiguri, Shaugaon formations and present day deposits of Holocene age (morphostratigraphic classification) [1]. The Tista alluvium has been recently documented as a climatically controlled multi-lobe megafan with three major spatially distributed fan lobes (with a spread of 18,000 km² in India and Bangladesh) [2]. The phase of active aggradation of Tista fan has also been postulated to have occurred within 3-40 ka [3].



Figure 1: Fluvial scarp section at Tista fan apex

In order to evaluate the controls on Quaternary fluvial morphodynamics of river Tista, fluvial scarp sections on the proximal fan lobe (Fig. 1) and exposed/excavated sections on adjacent flood plains from north to south along the course of River Tista were studied and were analysed in terms of lithofacies associations and clay mineralogy, with chronometric control defined by OSL dating.

The fan apex (~fan lobe 3/Baikunthapur Formation) is a debris flow and sheet flood dominated, poorly pedogenised laminated to bedded sequence of off-white, coarse, semi-oxidised sand with gravel and clay units (50 m thick) with a temporal span of 63.3±6ka (~MIS IV, weakened monsoon), at the bottom to 26.5±2 ka (top) ~LGM. The fining upward sub units (with occasional reverse grading) have micro faults and palaeoseismites. A debris flow dominated sandy-gravelly fan facies at Ellenbari has the temporal span from 34±2.3 ka (~MIS III, weakened monsoon) and extends beyond 19±1.3 ka, indicating considerable time overlap and lateral facies variation with the fan apex sediment. The OSL dates from Tista-Ghish confluence is 17 ka and represents entrenchment of the oldest fan lobe, possibly at the onset of deglaciation. Flood plain sediments (fan lobe 1 ~ Shaugaon Formation) yield dates of 9±0.5 and 7.4±0.4 ka. These deposits preserve water escape structures, viz. sand dykes and micro faults. Clay mineralogy shows predominance of Illite/Chlorite and illite-vermiculite inter layers in fan lobes and flood plain of Tista, indicating that the river had cut varied rock units and deposited in an overall tropical humid climate. The study indicates major episode of fan aggradation started before 63.3 ka and continued in the Holocene (~7-3 ka). However, during the Holocene (~MIS I, heightened monsoon) floodplain aggradation and fan re-sedimentation dominated, although fan building continued even during phases of weakened monsoon

(as indicated by OSL dates of litho- packages). This coupled with evidence for multiple provenances for the sediments, palaeoseismic features, sudden influx of coarse grained sediments indicates the varied nature of sediment generation due to fault segment activation/reactivation along major discontinuities. The study reveals coupled influences of tectonics and climate in shaping the landscape in this area.

References:

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