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Geomorphological and sedimentological studies of the valley fill deposits at Tumlang Khola, Teesta river Valley, Sikkim and Darjeeling Himalaya

L. I. Meetei [a,b], S. K. Pattanayak[a], A. Bhaskar[a], M. K. Pandit[a,c], S.K. Tandon[b*]

[a]*Centre for Interdisciplinary Studies of Mountain and Hill Environment, Academic Research Centre Building, Patel Marg, University of Delhi, Delhi-110 007, India*
[b]*Department of Geology, University of Delhi, Delhi-110 007, India*
[c]*University Scholars Programme, BLK ADM, Level 6, National University of Singapore, 10, Kent Ridge Cresent, Singapore 119260, Singapore*

Abstract:

The valley fill deposits and associated geomorphic features occurring along the Teesta river near Tumlang Khola in the Sikkim and Darjeeling Himalaya were mapped; and the lithofacies assemblages occurring in the Terrace and fans of this stretch were analysed to understand the depositional environment. This reach of the Teesta river is located between the Main Central Thrust (MCT) in the north and the Main Boundary Thrust (MBT) in the south. Microseismic activity in the region indicates that this region is tectonically active. The surface runoff is higher in this region; this induces landslides during the monsoon seasons and thereby leads to high sediment discharge in the streams.

The geomorphic units of the region consist of a three-tier terrace system (T3-T2-T1) and tributary stream fan lobes (F2-F1-F0), channel bars, chute bars, floodplains, colluvium, landslides and scarps. In this region, the Teesta river channel is generally sinuous. Most of the tributary streams of the Teesta river on both the valley flanks flow along tectonic features i.e., strike of beds, and lineaments and faults occurring in the Daling Formation. These tributary streams have cut through the older deposits of terrace T3 and the bedrock. The tributary stream fans have conical shape with radial angles ranging from 70^{o}-170^{o}.

A number of active landslides are present in the upstream segments of these tributary streams. A reverse fault with a displacement of 1.5-2m was recognized in the terrace T2 scarp. This fault is oriented NW-SE and trends across the river.

The surface of the T3 terrace is at an elevation of 268-272 m a.s.l., about 40 m above the present day channel, and the thickness of this unit varies from 18 to 28 m. This terrace is paired but is not continuous over the entire stretch. It consists mainly of channel flow units: the lower unit is a thick multi-storied stratified sandy unit, and the upper unit is characterised by clast supported, imbricated, and rounded to subrounded cobble to pebble size gravels.

The terrace T2 of Tumlang khola is located at the left bank of the Teesta river; it has a thickness of about 6-10 m, and covers a larger aerial extent. The characteristic facies of the lower part of Terrace T2 consists of channel flow bedload deposits; and the middle unit of this terrace consists of fining upwards sequences of cobble to pebble sand facies. These are overlain by a silty palaeosol and fine blackish to dark brown humified silty sand. Layers of clast supported angular, poorly sorted cobble to boulder gravels overlie this palaeosol with an erosional contact. The terrace T2 is partly covered by gravel, which is deposited by large flood flows, and occurs downstream south of the fault line.

The Terrace T1 is 1.5-3m thick; its deposits are characterised by clast supported boulder to pebble gravel with well imbricated fabrics. The upper part of T1 is covered by 70 cm thick sandy deposits of overbank facies.

The lithofacies of the stream fan lobes mainly belong to debris flow and hyperconcentrated flood flow facies in the proximal and middle part whereas the hyperconcentrated and channel flows are present in the distal part of the F2 and F1 fan lobes. The F1 lobe and the weakly bedded bedrocks are incised upto 1-2m by the modern tributary channel. The modern floodplain is characterised by fining upward sandy deposits consisting of ripple and cross bedded, and horizontally stratified beds overlying the well imbricated clast supported boulder cobble gravels.

The valley Terrace system at the Tumlang Khola in the Teesta valley belt evolved in four stages: i) lithofacies of terrace T3 corresponds to valley filling events during a wider stage (~750m) of the Teesta Valley at Tumlang Khola; depositional facies consist of channel flow deposits and a single event of hyperconcentrated flood flow is recognised ii) the development of lithofacies in terrace T2 corresponds to valley incision leading to the formation of Terrace T3 and a relatively narrower valley width of ~540m; depositional facies of the terrace T2 include channel flow-debris flow- hyperconcentrated flow deposits from base to top; a distinct palaeosol layer in the upper unit indicates uplift and possibly reduced discharge; iii) further valley incision corresponds to a valley width of ~400m, accompanied by asymmetrical valley development with a westerly tilt, and deposition of channel flow and hyperconcentrated flow lithofacies of terrace T1 and iv) the modern valley corresponding to further incision, a reduced valley width of ~325m, and the deposition of channel floor gravels, bar gravels and sands, and a narrow zone of flood plain sands.

Key words: *geomorphic units, lithofacies, climate, tectonics, faults, hyperconcentrated flood flow, debris flows, channel flows.*

Communicating author's E-mail:- ingocha2000@yahoo.com