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EVIDENCES OF NEOTECTONICS IN TONS RIVER BASIN, DEHRADUN DISTRICT, UTTARANCHAL

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ABSTRACT

The Quaternary sediments deposited in the Tons river basin, Dehradun district are of glacial, glaciofluvial and fluvial in origin and rest on Proterozoic rocks of Garhwal, Deoban and Jaunsar Group and Tertiary rocks of Subathu and Siwalik groups. The morphogenetic landforms developed in the Himalayas in the form of terraces, intermontane valleys, deep gorges and wide flood plains are the result of various Quaternary processes in operation during the course of last 1.8 Ma. The imprints of neotectonic activity are well preserved on the surfaces, which help in deciphering the Quaternary events.

Tonns river basin is stil int he process of isostatic adjustment of the Himalayan Mountain ranges where the reactivation of structural lineaments and neotectonic activities are operative.

The paper deals at length wiht the 7 level of terraces demarcated on the basis of relative elevation, degree of oxidation, weathering, slope morphometry, degree of consolidation and composition of clasts.

Key words : Neotectonics, Tons River Basin, Dehradun, Uttaranchal.

INTRODUCTION

The Himalayan Mountain ranges have very youthful and rugged topography with deep river gorges, steep valley slopes, wide flood plains, asymmetric river basins with sinuous rivers and streams. The Tons river proper comes into being at a place named Devasu Thoch where two rivers-Harkidun Gad from Jaundar Bamak glacier and Ruinsara Gad from Bandarpunch glacier-meet1 (fig.1). It travels for a distance of about 190 km before it confluences with the Yamuna river at Haripur. Its course is sinuous, which flows roughly in NE-SW, NS & NW-SE directions respectively from its source in the North to the outlet in the South.

GEOLOGICAL SET-UP

Geologically, the Tons river basin in Dehradun district comprises of Proterozoic rocks of Garhwal, Deoban and Jaunsar groups and Tertiary rocks of Subathu and Siwalik groups over which the Quaternary sediments have been deposited (Table.1). The above litho-stratigraphic units are composed of quartzite, limestone, shale, phyllite & basics. The area is traversed by the Main Boundary Thrust in the South and the Tons thrust and many other thrusts, faults & lineaments. The Tons river basin is still in the process of isostatic adjustment of the Himalayan Mountain ranges where the reactivation along these structural lineaments and neotectonic activities are operative.

EVIDENCES OF NEOTECTONISM

The Quaternary sediments of Tons river basin have witnessed several phases of adjustment along the major thrusts, faults and lineaments in the recent past. Both diect and indirect evidences of neotectonic activities are present in the form of wide and extensive depositional terraces, tilting of beds and terraces, faulting in terraces, bench like terraces between the major ones, shattering in clasts, presence of active landslide areas, subsidence

Table 1: Stratigraphic Succession of rocks exposed in Tons valley[2] (After Kotiyal *et. al.*, 2002)

Quaternary	Quaternary Depositis	
	Siwalik Group	
Tertiary		
	Subathu Group	
----------Unconformity----------		
Neo-Proterozic	Janunsar Group	Nagthat Formation
		Morar-Chakrata Formation
		Mandhali Formation
	Deoban Group	Atal/Dharagad Formation
Meso-Proterozoic		Uttarkashi Formation
	Garhwal Group	Rautgarha Formation

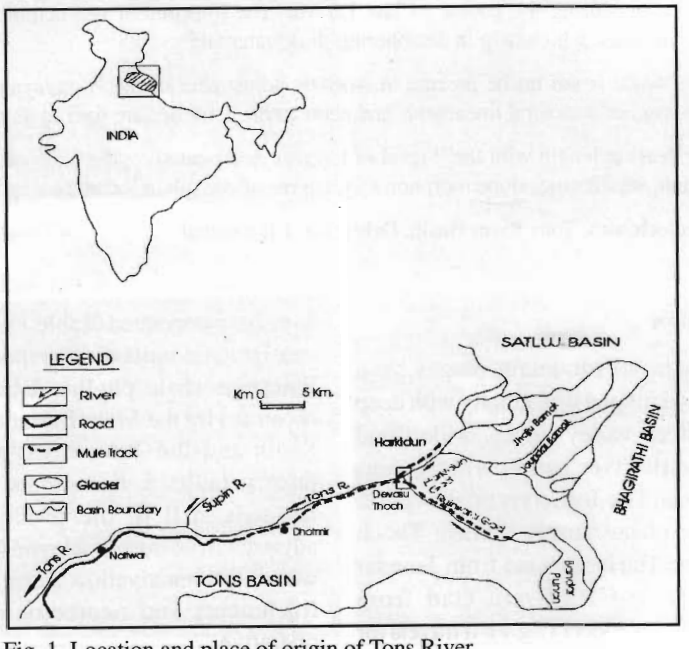

Fig. 1. Location and place of origin of Tons River

zone, elbow turning of river course, vertical scarps associated with deep gorges and asymmetric drainage basin of Tons (fig.2).

DIRECT EVIDENCES

The 3-7 levels of depositional terraces in the Tons river basin indicate many pulses of uplift in the Quaternary period[3]. Depositional terraces up to 4th le el at Shamberkhera, up to 5th level at Atal and Anu, up to 6th level at Kwanu and 7th level terrace at Asoi indicate the number of major periods of uplift and simultaneous fast downcutting duringthe Quaternary period. The levels of terraces are differentiated mainly on the basis of degree of oxidation and relative elevation from the riverbed. The deositional terraces in the Tons basin are mostly unpaired. The vertical height difference between 2nd and 3rd level terraces ranges from 12m to 28m, which is maximum

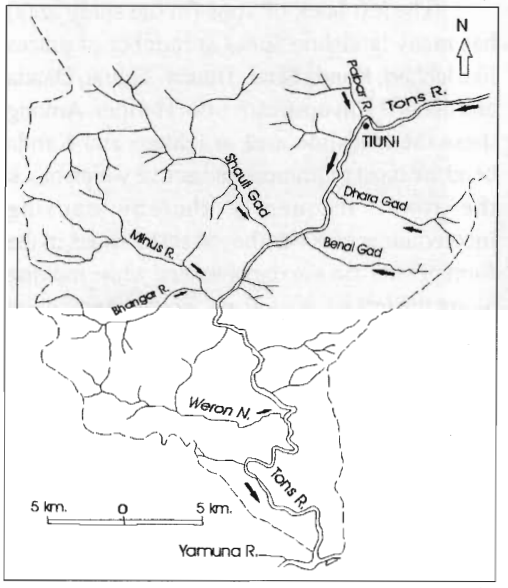

Fig. 2. Drainage system of parts of Tons basin

between any two successive levels of terraces. It indicates a major period of uplift and fast down cutting of the basin during that period.

At Kwanu, narrow bench like terraces of height 1m to 1.5m between any two successive terraces from T_3 to T_6 are observed (fig. 4a), which indicate neotectonic activity throughout the period of development of these terraces.

The terraces T_3 and T_4 at Shamberkhera are cut by a postdate fault. The terraces are also tilted at an angle of 7° towards hillslope (east) on the left bank of Tones. the relative elevation of the T3 terrance on the right bak is also higher (appx. 1m) than that on the left bank at this place (fig.4b).

At Asoi, the T7 terrace is traversed by two parallel faults trending in NE-SW direction. These faults have divided the terraces into three lobes. Vertical fault scarps are developed due to these faulting where fluvial sediments are exposed. Microfaults are observed in the phyllite bed, which is underlain by this fluvial terrace. Crushed and pulverised material is observed towards north and south direction of this terrace in the limestone bedrock.

The cemented pebble beds below the terraces at Kwanu and Asoi and tilted at an angle of 9° towards NE and the orientation of longer axis of pebbles of quartzite, granite gneiss etc. is parallel to the direction of tilting of the beds (fig. 4c, d).

The clasts of quartzite, grnaite gneiss etc. at Kwanu and along the road cut below Asoi are fractured and shattered (fig.5a). The clasts are shattered obliquely to the longer axis of orientation, which is a direct evidence of neotectonic activity in the basin.

At Ichhari, abotu 1Km upstream from Koti the road is subsiding between two faults. At present the road has subsided to a depth of 1.5 feet. Ichhari landslide (fig.5b) area is situated at about two Km upstream of this area of subsidence. Alluvial fan deposit also observed on the left bank of Tons at this place by the Gariyar nala. This subsidence zone at Ichhari dam site and presence of active landslide nearby depict the neotectonic activity in the area. Figure 3 shows some of the terraces developed along the banks of tons river along with neotectonic activities.

INDIRECT EVIDENCES

The Tons river basin is asymmetric in nature. The drainage basin has a distinct pattern and geometry due to its development in the presence of active tectonic deformation during Quaternary period. the asymmetry factor is more than 50. (AF=100 x Ar/At; Ar-area of the basin to the right, facing downstream of the trunk stream and At- total area of the basin). The area of the basin to the right (west direction) is more than that to the left (east direction) of the trunk stream (fig. 2). The tributaries flowering from the right valley wall are longer, deeply dissected and more sinuous than those flowing from the left valley wall. This nature of the basin indicates it is tilted towards left side i.e. towards

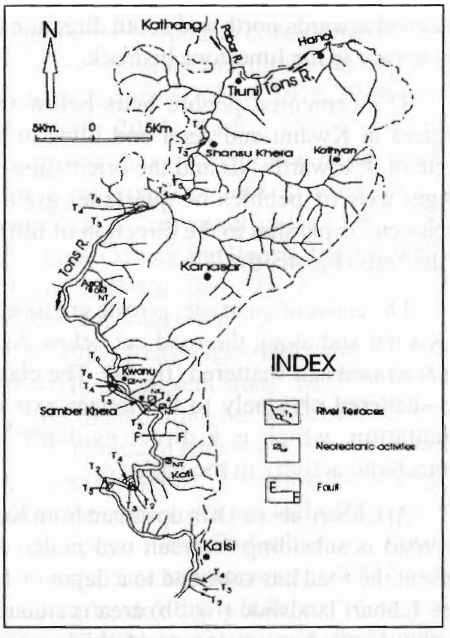

Fig. 3. River Terraces along the Tons valley Dehradun district, Uttaranchal

the east direction, perpendicular to the trend of the trunk river[4]. Further, the transverse topographic symmetry factor (T) is between 0-1 and approaches towards 1, in the right valley direction which indicates the asymmetrical nature of the drainage basin of Tons due to its uplift during the Quaternary period.

The presence of hanging valleys is anotherphenomena, which infers neotectonic activity in the area. The number of waterfalls on the right valley wall is more than that on the left valley wall. The most prominent waterfall existing on the right side of the river near Tharoch has attained a height of 90m, whereas the highest waterfall on the left side is 40m (Chuli gad-40m, Shili gad-30m, Mashak gad-24m). This type of uneven distribution and differences in heights of the hanging valleys is an indirect implication of neotectonic activity operating in the basin.

The left bank of Tons (in the study area) has many landslide zones at number of places like Ichhari, Kanda bend, Tiuntar, Timrar, Danda and about 7 Km upstream from Haripur. Among these the landslide area at Ichhari and Kanda bend are most prominent and active which block the roads frequently thereby causing inconvenience. A number of scree zones in the form of fans can also be observed while moving along the left bank of Tons. This phenomenon of hill slope failure may be attributed to theneotectonic activity.

The original 'U' shape glacial valley of Tons has been transformed inti 'V' shape due to active incision of the river channel commonly associated with uplift during Quaternary periods (fig. 5c). The valley in higher reaches is 'U' shaped whereas in the lower parts i.e. in the valley floor area it is 'V' shaped due to fluvial action and tectonic activities. Active flood plains are present where valley floor is wide (at Rohru and Muree). At several places the river flows through deep gorges from Hanol in upstream to Haripur ind ownstream direction, where down cutting of the river channel is more leaving behind vertical scarps (fig. 6a). The river also makes elbow turnings, 'Z' type or inverted 'S' type (fig. 6b) and sharp 'U' shape bends. This nature of river channel/course is due to tectonic adjustments along the major thrusts and faults during the Quaternary period.

CONCLUSIONS

The direct and indirect evidences stated above provide more or less eloquent testimony of neotectonic activity in the b asin, which represent the morphogenetic phase of Quaternry diastrophism. The various geomorp-hic features with extremely rugged and youthful topography described above imply the uplift and reshaping of the Tons river basin due to neotectonic movements along major structural lineaments is still going on.

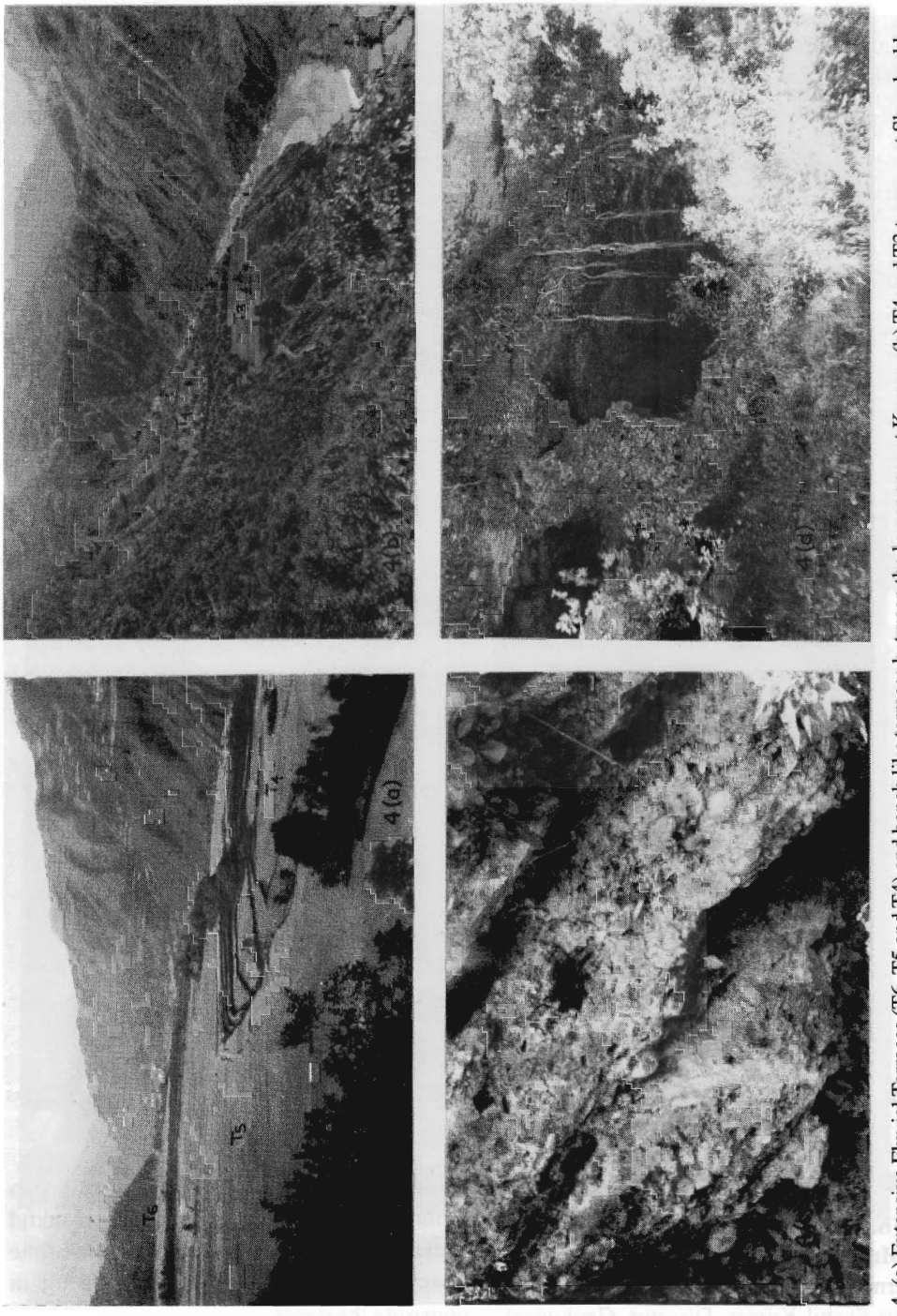

Fig. 4. (a) Extensive Fluvial Terraces (T6, T5 and T4) and bench like terraces between the larger ones at Kwanu, (b) T4 and T3 terraces at Shamberkhera (faulted and tilted), (c) Tilted pebble bed at Kwanu, (d) Tilted pebble bed at Asoi.

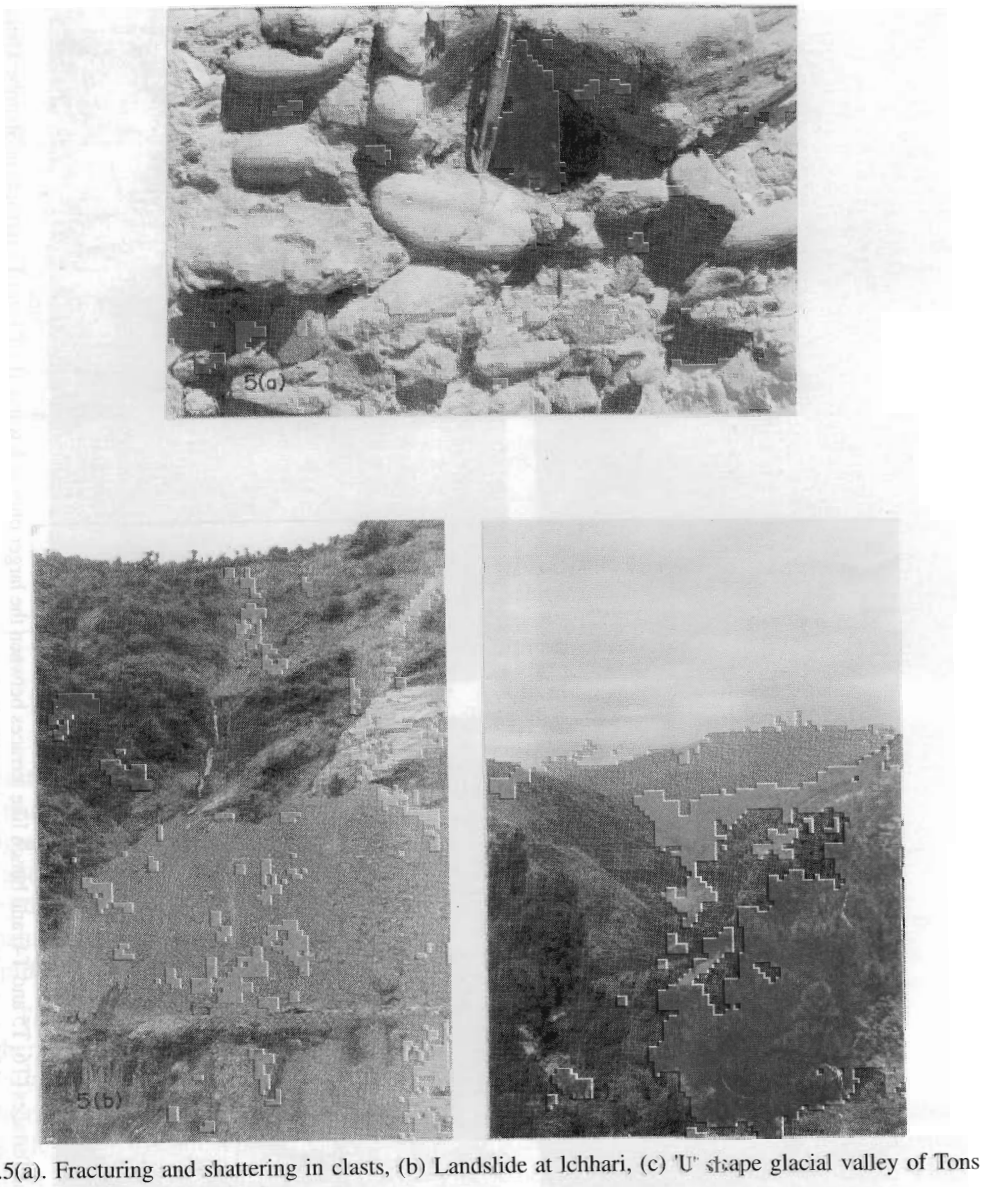

Fig.5(a). Fracturing and shattering in clasts, (b) Landslide at Ichhari, (c) 'U' shape glacial valley of Tons transformed into 'V' shape

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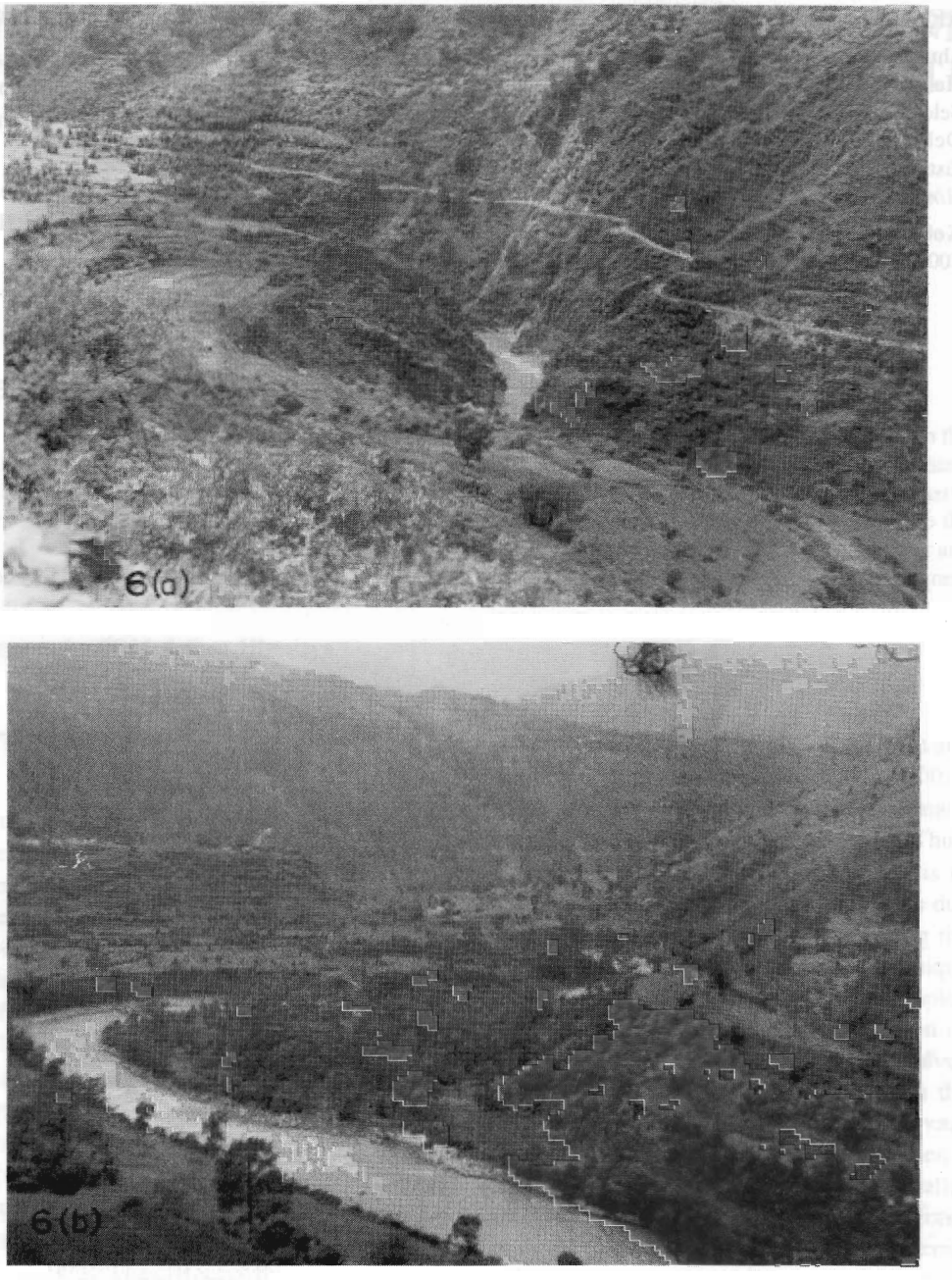

Fig. 6. (a) Tons flowing through deep gorge, (b) Inverted 'S' type bend of Tons at Maindrath.

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