PALAEOCURRENT PATTERN IN THE UPPER TAL ROCKS OF NIGALI, KORGAI SYNCLINES (H.P.) & MUSSOORIE SYNCLINE (U.P.)

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Introduction: During the course of detailed mapping of the Upper Tal rocks of H.P. and U.P. the author collected systematically palaeocurrent data from the Upper Tal rocks of Nigali, Korgai and Mussoorie synclines with a view to knowing the provenance for these rocks. The results of the studies are presented in the paper.

Stratigraphy: The Tal Formation overlies the Krol Formation with a transitional to disconformable contact in the Mussoorie area, while in Garhwal, in the region of Guingadhera and Medigad the contact is an erosional unconformity. The Tal Formation passes upward into Subathu Formation with intervening occasional local conglomerate in the Mussoorie area, while in the Nigali and Korgai areas the complete sequence of Tal Formation is not exposed.

The Tal Formation can be classified lithostratigraphically as given in Table I,

TABLE I

(LITHOSTRATIGRAPHY OF TAL FORMATION)

Sub-division	Member	Lithology	Thickness in meters
Upper Tal	Shell limestone	Bluish grey sandy limestone with fragments of bivalves, bryozoa and forams	12
	Upper quartzite	Protoquartzite, minor buff sandstone and shale	494
	Algal limestone	Algal limestone interbedded with quartzite	93
	Arkosic quartzite	Arkose, subarkose with sporadic shale, conglomerate	359
	Shale	Greenish grey shale with occasional rain prints and mud cracks interbedded with minor quartzite	32
	Lower quartzite	Protoquartzite, orthoquartzite, pebble beds, sporadic shale and calcarenite at base	235
Middle Tal		Siltstone very finely laminated with dark shales	187
Lower Tal	Argillaceous member	Shale, dark grey, carbonaceous	202
	Chert member	Bedded chert and chert shale alternations with phosphorite	
Upper Krol Formation		Dolomite and shaly limestone	

modified after Bhargava (1972). The complete succession of the Tal Formation is met with in the Mussoorie syncline and thickness given in the Table pertains to the same area.

Ganesan (1971) on the basis of clay mineral studies suggested that the entire Tal Formation of Mussoorie area was deposited under shallow marine conditions. The quartzites of Upper Tal are mainly constituted by detrital quartz, metaquartz, microcline and accessory quantities of zircon and tourmaline, which clearly suggests a granitic provenance for these rocks.

Palaeocurrent studies: There are abundant primary sedimentary structures showing current lineation in the Upper Tal, important among them being cross bedding, current ripples and flute casts. Cross bedding is most abundant in the Lower quartzite member, Arkosic quartzite member and quartzite beds in the Algal limestone member. The quartzite beds in shale member as well as algal limestones also show cross bedding. The scale of the cross bedding varies generally from 10 to 80 cm; in the Arkosic quartzite member the scale reaches up to 120 cm. The angle between the bedding and foreset is 15° to 40°. Oscilation wave ripples, current ripples as well as interference ripples are seen in the Upper Tal quartzites and their wave length varies from 4 to 8 cm, although smaller ripples of wave length of 1.5 cm are also seen. These primary sedimentary features provide valuable data for deciphering the palaeocurrent directions.

The azimuth of the current direction with the present position of the beds was recorded by noting the maximum dip direction of the foreset beds or by the use of asymmetrical ripple marks. The data was collected systematically in all the synclines.

The recorded azimuth of the current direction was corrected for tectonic tilt of the bed, for arriving at the palaeocurrent direction. This correction was made by using the two tilt methods of stereographic projection. By this the bed was made horizontal by tilting it around its strike and noting the corresponding changed position of the current direction in space. The corrected current directions have been plotted in the locations of observation and the palaeocurrent map of the three synclines along with the overall average current rose of each syncline is given in Fig. 1.

Nigali Area: Sixty one palaeocurrent observations were recorded in the different mappable members of the Upper Tal of Nigali syncline. The palaeocurrent direction varies from N40°W to N40°E. Majority of the values fall between north and N20°E. There is not much variation in the current direction as observed in the different mappable members.

Korgai Area: Sixty palaeocurrent observations were recorded in the different mappable members of Upper Tal of Korgai syncline. The palaeocurrent direction varies from N40°E to N40°W. Majority of the observations fall in between north and N20°E. There is no noticeable variation in the palaeocurrent trends between the different members of Upper Tal.

Mussoorie Area: One hundred and six palaeocurrent directions were recorded from the different mappable members of Upper Tal in the Mussoorie area. Majority of observations in the Upper Tal as a whole (55% of total observations) show palaeocurrent direction between N40°W and S40°W. A smaller number of measurements (28% of total observations) show a palaeocurrent direction between north and N60°E. This reveals the existence of two distinct palaeocurrent directions--one major westerly direction and the other less important northeasterly direction. Comparing the current rose diagrams of Lower quartzite member, Arkosic quartzite member

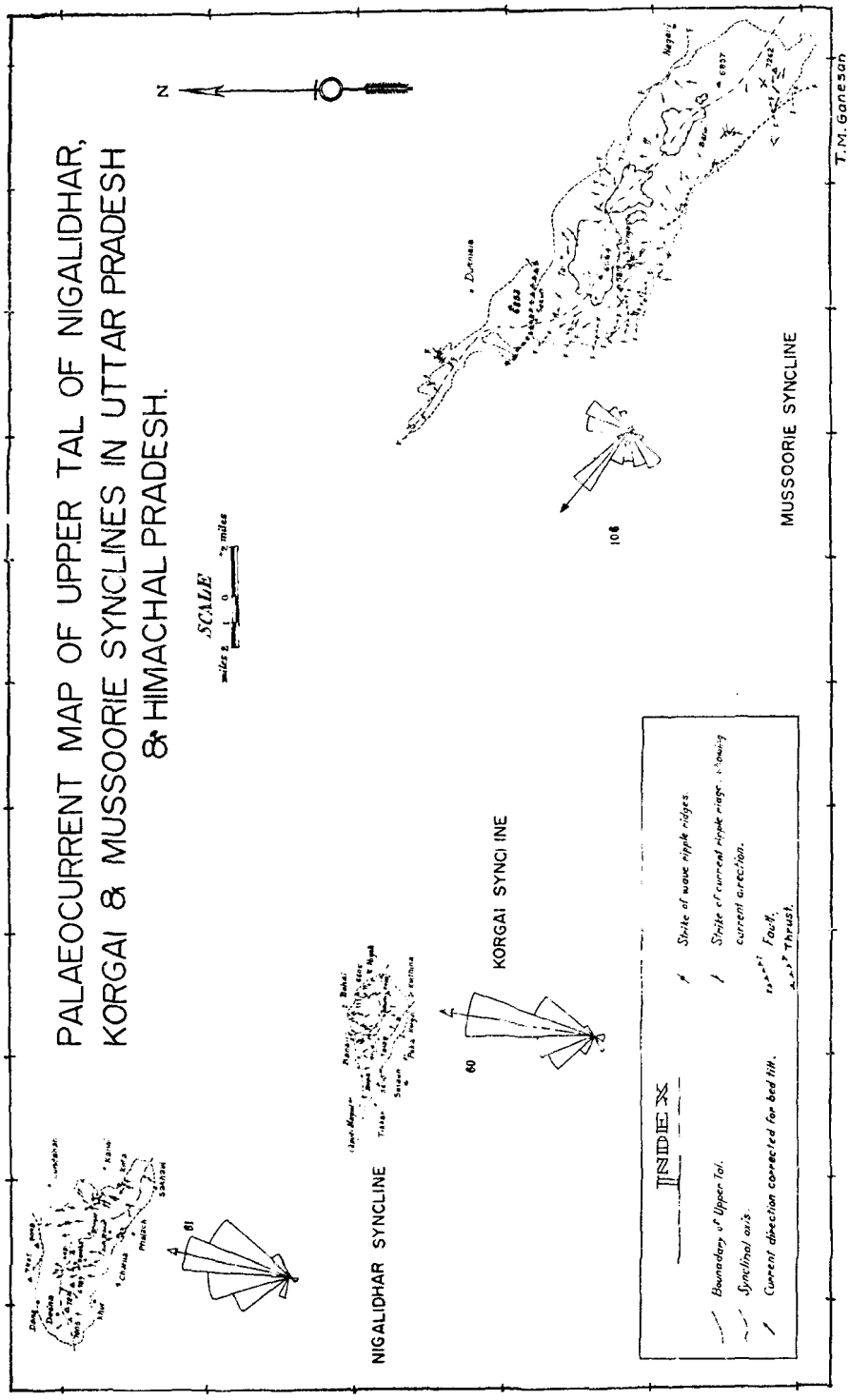
PALAEOCURRENT MAP OF UPPER TAL OF NIGALIDHAR,
KORGAI & MUSSOORIE SYNCLINES IN UTTAR PRADESH
& HIMACHAL PRADESH.
N
SCALE
miles 2 1 0 2 miles
INDEX
Boundary of Upper Tal.
Synclinal axis.
Current direction corrected for bed tilt.
Strike of wave ripple ridges.
Strike of current ripple ridges showing current direction.
Fault.
Thrust.
NIGALIDHAR SYNCLINE
KORGAI SYNCLINE
MUSSOORIE SYNCLINE
61
60
108
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Figure 1.

and Upper quartzite member (Fig. 2) where the number of observed measurements are considerable, it is seen that 54% of the total observations in the Lower quartzite member show palaeocurrent direction between north and N60°E, while in the Arkosic quartzite member only 20 – 25% of the total observations show palaeocurrent direction between north and N60°E. This probably would imply that the northeasterly current played a more dominant role in contributing the coarse grained quartzite and pebble beds of Lower quartzite member, while the westerly current dominated in contributing the quartzites of Arkosic and Upper quartzite members. This probably suggests two source areas—a distant southeastern source area and a near southwestern source area that contributed to the Upper Tal sediments of the Mussoorie area. It is also observed that the dominant northwesterly current direction indicated in the sequence above Lower quartzite member in Mussoorie area, tallies well with the observed pinching out of the limestone of Algal limestone member and shale of Shale member towards east and southeast and presence of stray pebbles of quartz and quartzite in the Upper quartzite member.

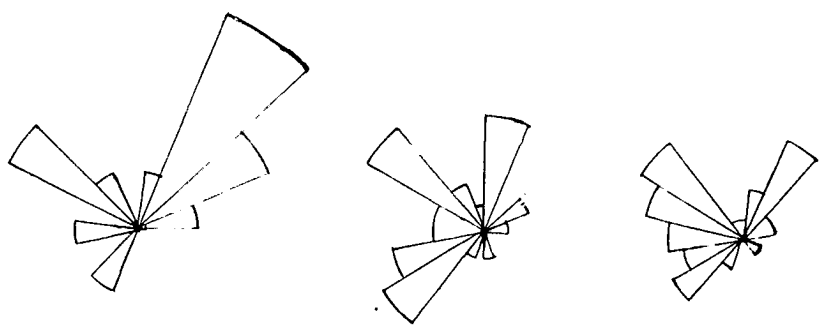

Figure 2. Current rose diagrams of the different members of the Upper Tal of Mussoorie syncline.

Discussion: It is seen from the regional palaeocurrent map that the dominant current direction is N10°E for Nigali and Korgai areas and N50°W for Mussoorie area. Hence the provenance of these sediments is from south of Nigali and Korgai synclines and southeast and southwest of Mussoorie syncline. This readily suggests that the Peninsular granitic brow should be the source area that had contributed the Upper Tal sediments and not the Pre-Tertiary Himalayan granites as suggested by Auden (1934). Further, the uniformity in the palaeocurrent pattern of the Nigali and Korgai areas, suggests that these two synclines were part of one and the same basin and their present isolated occurrence is only due to structure. Similarly, comparing the palaeocurrent pattern of Korgai and Mussoorie areas, there is no evidence to suggest that the intervening area between the present limits of Upper Tal rocks of Mussoorie and Korgai areas could contribute to the Upper Tal sediments of these areas. In addition the observed similarity in the lithostratigraphy of the entire Tal Formation in all these three synclines as well as Garhwal syncline tend to suggest that all these areas formed parts of one continuous Tal basin and did not form isolated synclinal basins as suggested by Auden (1934).

The observed variation in facies and thickness of the Tal Formation from Nigali in the northwest to Garhwal in the southeast (Fig. 3) also tallies well with the observed current pattern in the Upper Tal rocks of these areas. There is a gradual increase in thickness of Tal sediments towards northwest from Mussoorie area and

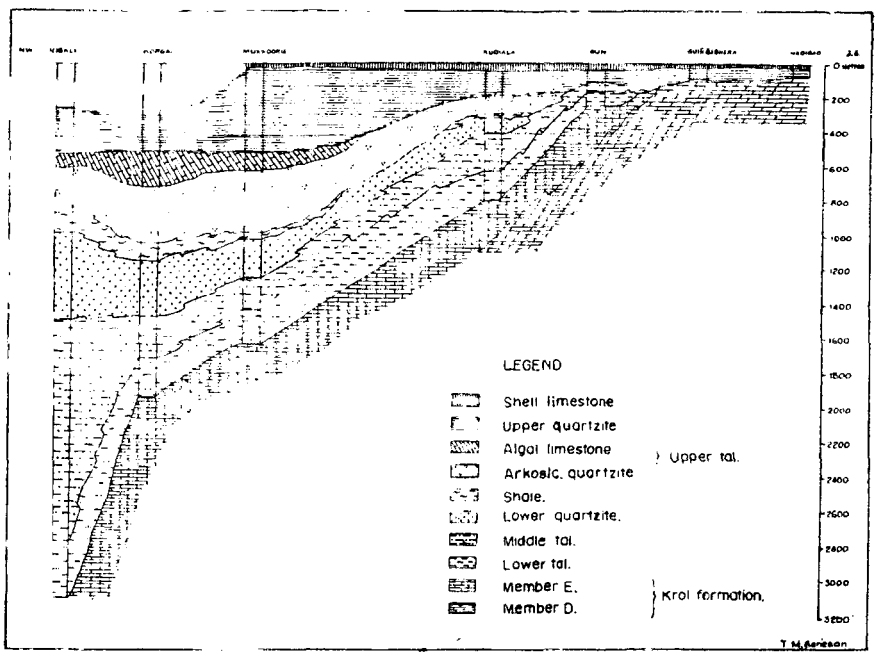

Figure 3. Diagrammatic sections showing the development of Tal sediments from Nigali (H.P.) in northwest and Medigad (U.P.) in southeast. (Horizontal scale approximate).

decrease towards southeast towards Garhwal area. In Garhwal area, the Guingadhera-Medigad region appears to have formed a land area even during most of the time of deposition of Tal Formation, thereby delimiting the main Tal basin to its northwest, though very thin sequence of Tal Formation is met with further southeast of Medigad up to Rikhnikhal in the southeastern closure of Garhwal syncline. The dominant westerly to northwesterly current directions observed in the southeastern closure of the Mussoorie syncline very well suggests that the land condition should be very near in the southeast direction towards Garhwal syncline.

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