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FOLD PROFILE GEOMETRY OF THE ROCK OF THE AREA AROUND PITHORAGARH, UTTARAKHAND

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Abstract

In the present work an attempt has been made to study the fold profile geometry of the folds developed in the area around Pithoragarh. The study of fold geometry exhibits the possible mechanism of fold development. The F_1 fold of the area are developed by Flexural slip mechanism and F_2 folds are developed by Shear mechanism.

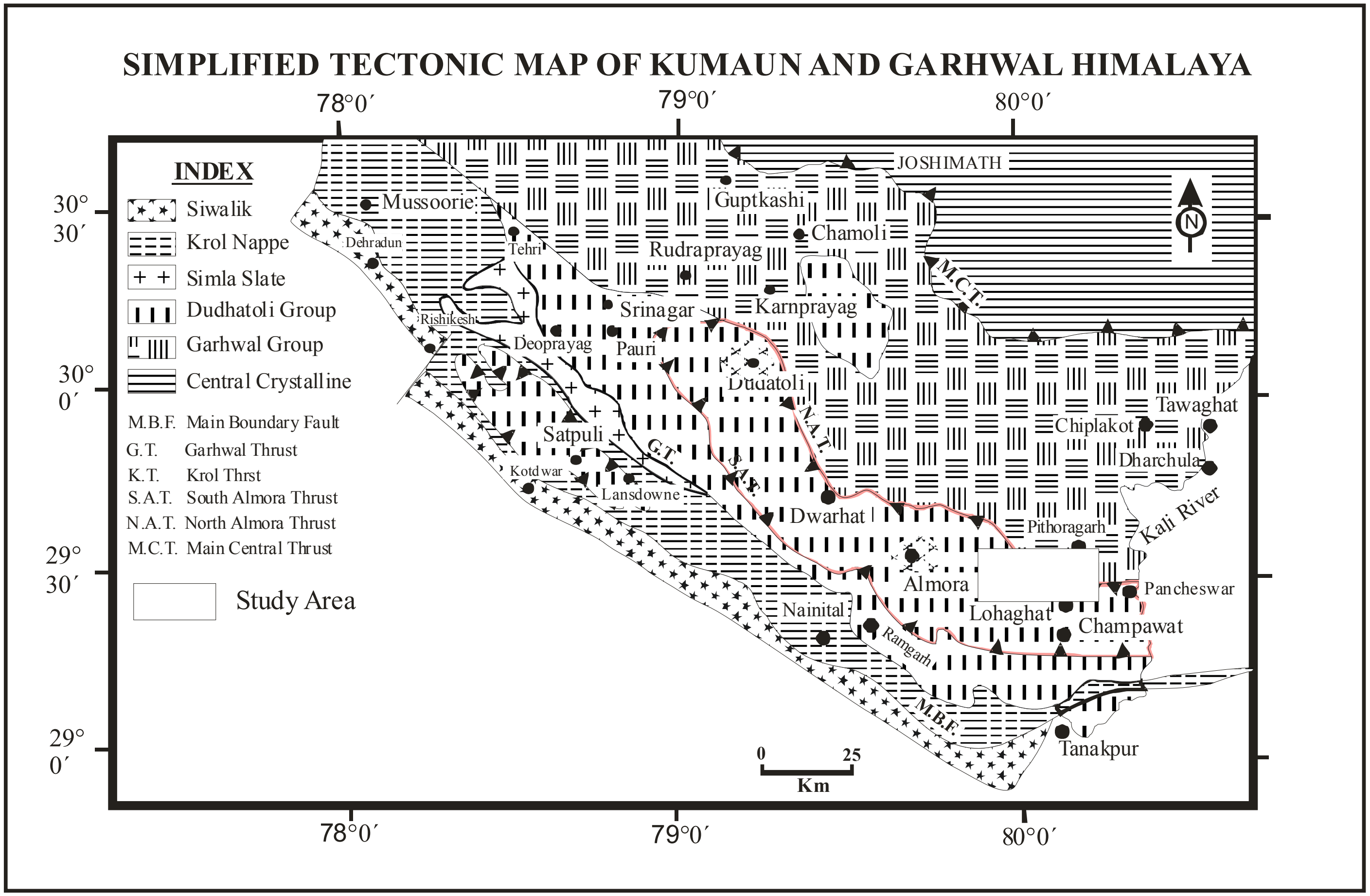
Introduction

The study of the morphology of folds helps to understand the tectonic movement of the rocks (Turner and Weiss, 1963; Fleuty, 1964; Elliot, 1965; Powell, 1967; Ramsay, 1967; Srivastava and Sinha, 1987). For describing the geometry of folds, Elliot (1965) has introduced the method of dip isogons. Ramsay (1967) has suggested modifications in the Elliot (1965) method and has further described the fold profile geometry on the basis of thickness of the folded layers.

The area around Pithoragarh, forms a part of Lesser Kumaun-Garhwal Himalaya, where the rocks of Almora nappe, are thrust over the quartzite and limestones of Garhwal Group, along the North Almora Thrust. The fold geometry of both the tectonic units exhibit variations in its fold profile and geometry. In the present work an attempt has been made to study the fold profile geometry and mechanism of fold development in the rocks of Garhwal Group and in the crystalline rocks.

Geology of the area

The earlier works of Auden (1937) and Heim and Gansser (1939) demonstrate that the rocks of Pithoragarh area embraces the rocks of two tectonic units, one belonging to the Almora Crystalline Zones and the other to the sedimentary zone of Garhwal Group


SIMPLIFIED TECTONIC MAP OF KUMAUN AND GARHWAL HIMALAYA
78°0′
79°0′
80°0′
30° 30′
30° 0′
29° 30′
29° 0′
INDEX
Siwalik
Krol Nappe
Simla Slate
Dudhatoli Group
Garhwal Group
Central Crystalline
M.B.F. Main Boundary Fault
G.T. Garhwal Thrust
K.T. Krol Thrst
S.A.T. South Almora Thrust
N.A.T. North Almora Thrust
M.C.T. Main Central Thrust
Study Area
JOSHIMATH
Mussoorie
Dehradun
Tehri
Guptkashi
Chamoli
Rudraprayag
Karnprayag
Srinagar
Rishikesh
Deoprayag
Pauri
Dudatoli
Satpuli
Kotdwar
Lansdowne
Dwarhat
Almora
Nainital
Ramgarh
Lohaghat
Champawat
Pithoragarh
Pancheswar
Tawaghat
Chiplakot
Dharchula
Kali River
Tanakpur
M.C.T.
N.A.T.
S.A.T.
G.T.
M.B.F.
N
0 25
Km

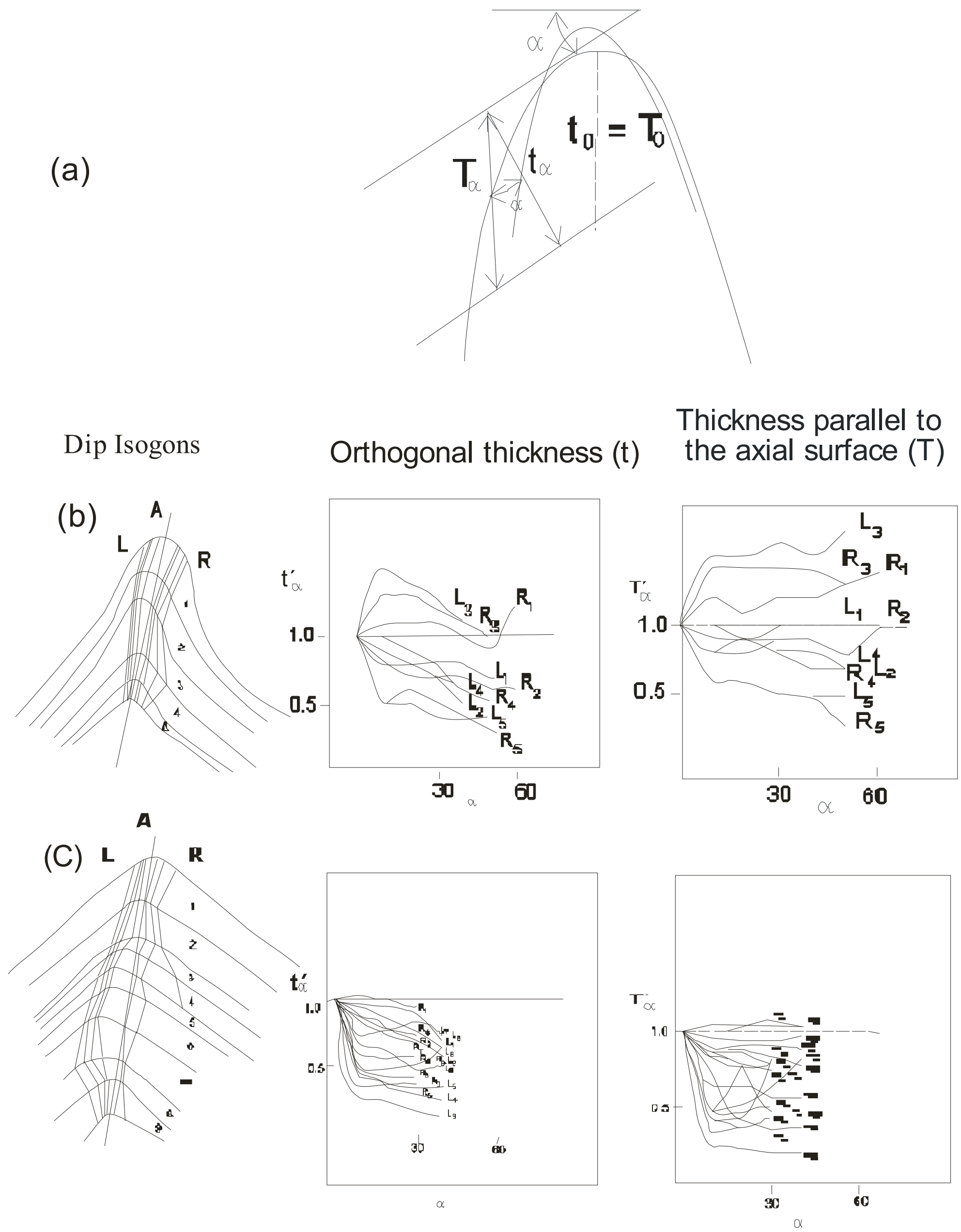


Fig. 2

Figure illustrates the pattern of dip isogons of folds and the plot of thickness t'= tα /to, and T'= Tα /To plot against the angle of dip α (limb dip) on the fold profile.

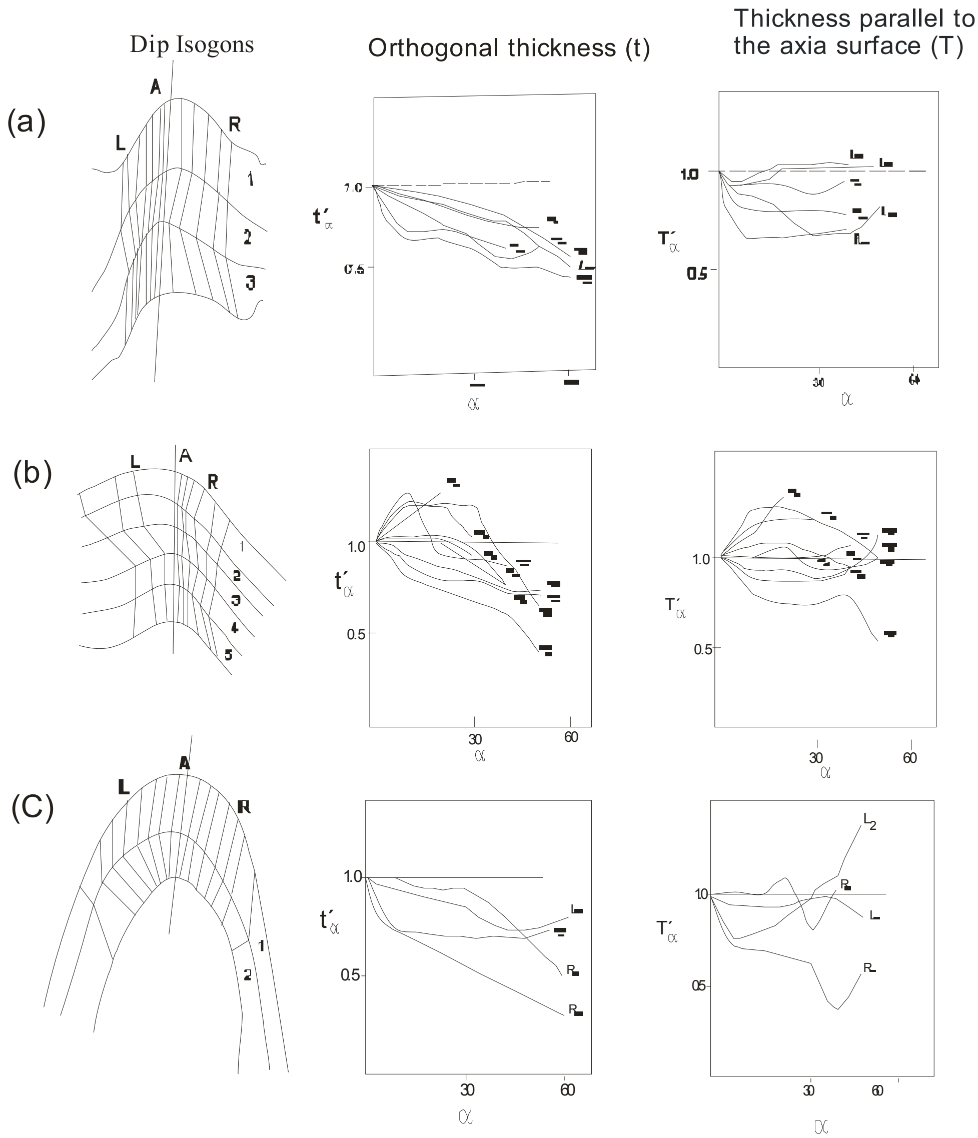


Fig. 3
Figure illustrates the pattern of dip isogons of folds and the plot of thickness t'= tα /to, and T'= Tα /To plot against the angle ofdip α (limb dip) on the fold profile

separated by north dipping North Almora Thrust (Fig.1). Mishra and Valdiya (1961) have given a detailed account of the geology of the Chandwak area. Valdiya (1962) recognised three stratigraphic formations in the southern part of Pithoragarh area viz-the calc Zone, the quartzite zone and the crystalline Zone.

Study of Fold Profile Geometry

In the rocks of the area the study of fold profile geometry has been carried out on the basis of dip isogons pattern and the orthogonal thickness as well as thickness parallel to the axial plane of the folded layer (Ramsay, 1967). The traced profiles of the folds were obtained from the photographs and from mesoscopic fold specimens, which have been utilized to study the dip isogons and thickness parameters. The divergent convergent and parallel isogons exhibit a variety of fold classes. The mesoscopic folds of the area exhibit variation in the dip isogons pattern and classes i.e. slightly convergent isogons (Figs. 2b and 3b) parallel (Figs.3a &3c) divergent to slightly convergent isogons (2b) (Figures are given earlier)

The orthogonal thickness (t) and thickness parallel to axial surface (T) were calculated at different angles (α) of the fold profile (Fig.2 &3). Thickness ratio $t' = t\alpha / to$ and $T' = T\alpha / To$ were plotted against different values of α to locate the fold classes. The graph denotes that the folds belong to 1C (Fig.3b) & Class 2 (Fig.3a and 3c) and Class 3 of Ramsay (1967).

Discussion

The dip isogons pattern from different fold geometry show a weakly convergent isogons pattern for outer arc to inner arc of the fold, belong to Class 1C reveal concentric fold and hence suggest Flexural Slip mechanism for their development. Parallel isogons of outer arc to inner arc reveal similar fold & thus suggest a shear mechanism for the origin of the folds (Ramsay, 1967).

The study of thickness parameters (Ramsay, 1967) also reveal that the folds of the area mainly belong to class 1 and Class 2 type. The F_1 folds are concentric folds where the F_2 folds are similar type. It is suggested that the F_1 folds are developed by Flexural slip mechanism and F_2 folds are developed by Shear mechanism.

Near the thrust plane the divergent patterns of the isogons have been observed where the curvature of outer arc is greater than inner arc belong to class 3 (Ramsay, 1967). The divergent pattern of isogons is probably due to rotation of fold hinges and superposition of stress during thrusting (Srivastava and Sinha, 1987). Further, the rapid change in dip isogon patterns from one layer to the other is due to variation in lithologies or grain size from one a layer to other.

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Fig.1

Simplified tectonic map of Kumaun Garhwal Himalaya (modified after Valdiya, 1975).