

Microstructures of the Higher and Lesser Himalayan sequences near Taliha, Arunachal Himalaya, India

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ABSTRACT

In the upper Subansiri District of Arunachal Pradesh, India, Higher Himalayan Crystallines are exposed in and around Taliha and the outcrop of MCT in the immediate south of Taliha is recognizable with the development of tourmaline bearing leucogranite dykes representing melting of the crustal rocks. The gneisses of the Taliha area consist of mainly quartz, mica, K-feldspar and garnet. The Quartz clasts of the Taliha gneiss are internally fractured and deflected the foliation defined by mica. Mica and feldspar fish are seen in the quartz-mica schist with right lateral sense of shear in the Lesser Himalayan sequences in the south of Taliha. The gneisses represent two generations of schistosity. The leucogranite of Taliha area bears tourmaline and shows alignment of mica. The leucogranite dykes are boudinaged at places indicating an extension in the NW direction. The micro scale structures in the gneisses and schists thus represent ductile deformation. A top - to - ENE sense of shear is displayed by asymmetric trapezoid shaped minerals and the mineral fish can act as reliable shear sense indicators.

Keywords: Arunachal Himalaya, Crystallines, Taliha, Microstructures

I. INTRODUCTION

The Himalayan Orogenic System is a classic example of continental collision tectonics. Arunachal Himalaya occupies the easternmost segment of Himalaya Between the $91^{\circ}30'$ and 96° longitudes. The Lesser and Higher Himalayan sequences of Subansiri River section of the Subansiri District have been studied by various workers; however the investigations are mainly confined to the field studies and detail interpretations of the meso to microscopic structures are not carried out ([1], [2], [3], [6], [5], [4]).

In the upper Subansiri districts of Arunachal Pradesh, Higher Himalayan Crystallines are exposed in and around Taliha (Fig.1). The MCT is trending ENE and this trend is continued NE ward. In the NNW of Taliha the Higher Himalayan Crystallines (HHC) continues up to the Siyom valley (Fig.2). In the immediate south of Taliha, the outcrop of MCT is recognizable with the development of tourmaline bearing leucogranite dykes representing melting of the crustal rocks. About 3 km SSE of Taliha, a sequence of phyllite, quartzite,

crystalline limestone, and graphite schist is mapped. The southern continuation of the sequence is traceable up to about 12 km from the MCT zone. Higher Himalayan Crystallines are exposed in and around Taliha. The sequences are observed in the immediate north of the MCT zone. The MCT zone is marked as occurrence of the leucogranite dykes in the North of the metasedimentary sequence.

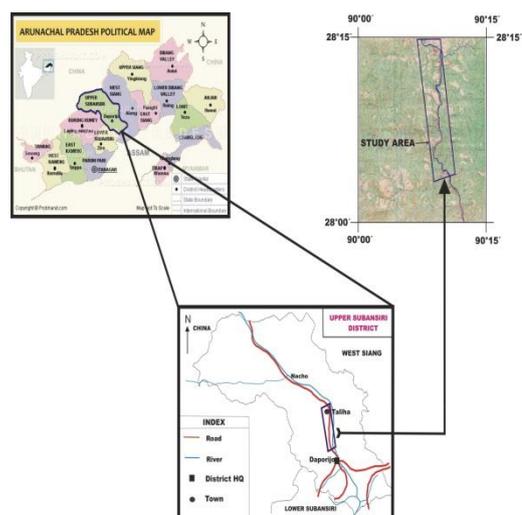


Figure 1: Location map of India, Arunachal Pradesh, the Subansiri River in the Google image and the study area in the Upper Subansiri District of Arunachal Pradesh shown.

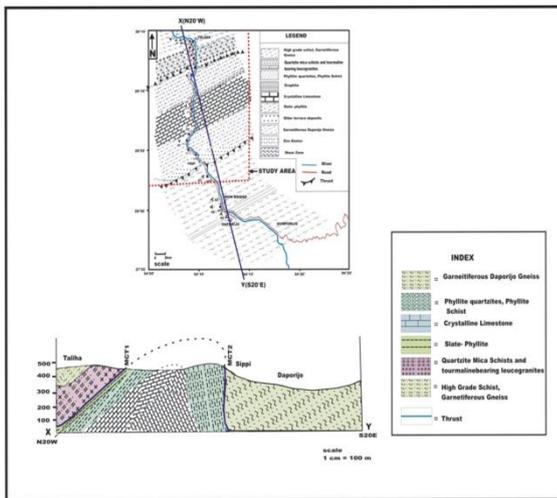


Figure 2: The geological map of the area around Taliha along with a cross section along N20°W-S20°E shown. MCT is folded and MCT-2 is reappearing near Daporijo.

Leucogranite are forming some asymmetric sigmoid with right lateral shear sense. This indicates that MCT zone at this place represent a ductile shear zone with various kinematic indicators showing top to the NE or to the ENE sense of shear. The higher Himalayan crystallines in the north of MCT zone show three phases of deformation followed by a brittle phase towards the waning phase of the deformational history.

II. MICROSTRUCTURES

A. Intrafolial folds

Rootless intrafolial folds are common in the mylonitic gneisses and schist of the Higher and Lesser Himalayan sequences of the area. Their axial traces dip to the ENE or ESE directions (Fig.3e) which indicate top to-ENE or top- to- ESE sense of shear. The enveloping surfaces of these folds are composed mostly of mica and define the C-surfaces [7]. These folds define class 2 type of shape [9]. These rootless folds indicate very high level of shearing which led them to be broken from the limbs of the train of folds of the earlier generation.

B. Mineral fish

Mineral fish are lozenge-shaped Porphyroclasts, single crystals in a finer grained matrix, which occur in ductile shear zones and which are commonly used as shear sense indicators. Mineral fish of biotite, tourmaline, K-feldspar, garnet, hypersthene and quartz occur in mylonites but most common are white mica fish. These mica fish can be subdivided into different morphological groups that develop by different mechanisms determined

by different initial shapes and orientations. The principal mechanisms of formation are intracrystalline deformation combined with rigid body rotation [10].

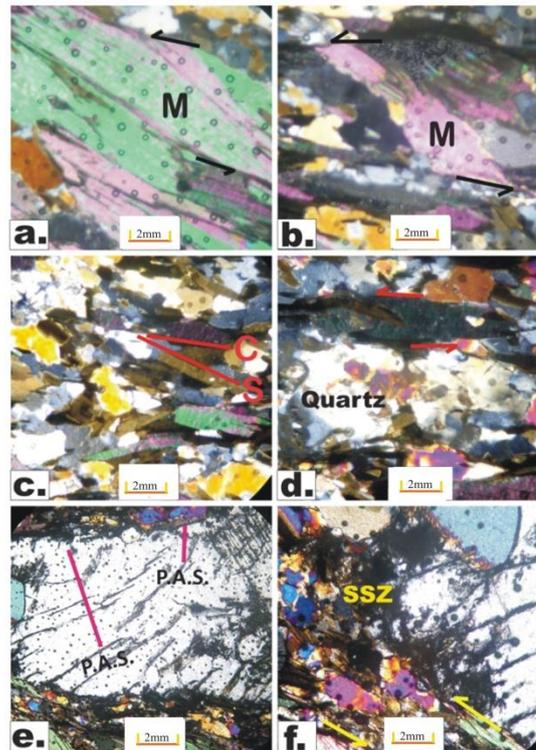


Figure 3: a & b: trapezoid shaped mica show left lateral top-to-NE sense of shear with the angle between the mica and the shear planes around 30-35°. c. The angle between the S and C planes reduced to around 15°. d. Quartz fish with notch at one end shows top-to NE sense of shear. The rootless intrafolial folds with sheared out limbs (see lower part of the photograph) e. Pull apart structure in a feldspar porphyroclast showing top-to-NE sense of shear. f. The marginal part of the previous photograph enlarged shows rootless intrafolial folds.

In the studied thin sections (Fig.3a and b) the micas show left lateral (top-to NE) shear senses while in the Fig.3c the angle between the S and C is nearly 15°. Quartz fish with notch at one end shows top-to NE sense of shear (Fig.3d). In fig.3e, a parallel pull apart or a boudin of feldspar grain with the highly sheared mica and quartzofeldspathic minerals show prominent top-to-NE sense of shearing. The marginal parts with the mica and quartzofeldspathic minerals are magnified in Fig.3f. The rootless intrafolial folds are defined by the quartz grains (Fig.4 a and d). The sigmoid mica fish is affected by top-to-ENE sense of shear (Fig.4b). Weakly parallelogram shaped tourmaline grain also observed to be deflecting the quartz grains in leucogranite dykes along the MCT zone (Fig.4c). Quartz and feldspars in the leucogranite are weakly deformed and only few trapezoid shaped grains are observed (Fig.4e).

C. Other microstructures

Top-to ENE or top-to-ESE sense of shear is mostly shown by the trapezoid shaped minerals mostly by micas. This plane of shearing is defined as Y planes while the trapezoids define the P –planes [11]. The brittle shear planes dip to WNW or WSW and these brittle planes are parallel to the ductile shear C-plane [12]. In some cases the minerals are observed to be strongly fractured and dragged along these planes (Fig.4 f).Top-to-ESE shear is displayed by asymmetric duplexes in mica as observed in Figs.3b and 4b.It has also been observed that micas are most vulnerable to ductile and brittle deformations may be because of their lower competence.

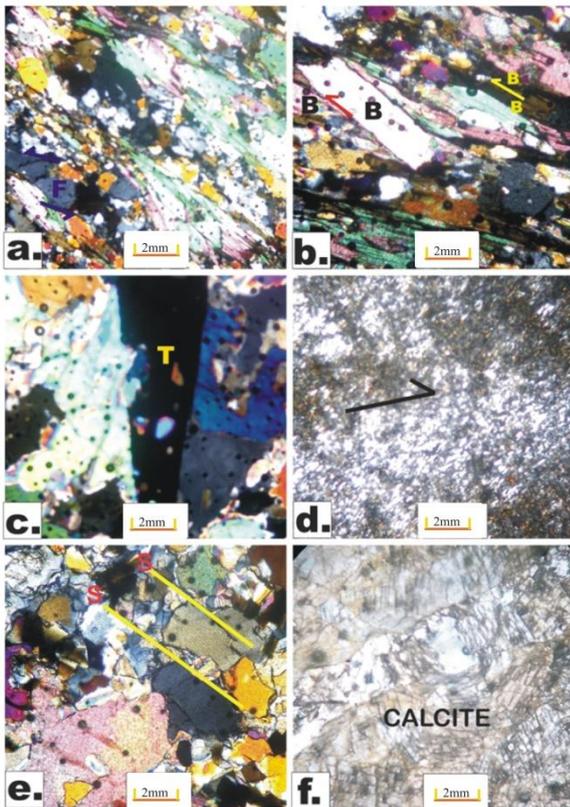


Figure 4 a & b: Trapezoid shaped mica in the mylonitic gneisses indicate top-to-ENE sense of shear. **c** Weakly parallelogram shaped tourmaline grain also observed to be deflecting the quartz grains in leucogranite. **d**. Rootless intrafolial folds in mylonitic gneisses. **e**. Only few trapezoid shaped grains are observed in the weakly deformed leucogranites. **f**. Fracturing followed by dragging of the minerals in the crystalline limestones. The drag is along the C-plane.

III. CONCLUSION

Microstructural study in the Higher and Lesser Himalayan sequence in and around Taliha indicate top-

to-the ENE and top-to-the ESE sense of ductile shearing. Since these metamorphic sequences swing from an E-W trend to ENE-WSW trend, there may be combined effect of pure shear followed by simple shear in the development of these microstructures. The asymmetry of the shape and orientations of the cleavage plane with respect to the C-planes served as a reliable shear sense indicators. The brittle Y-shear planes are sometimes very pervasive. The pull apart structure within a large porphyroclast indicates extension during rotation along the shear plane.

IV. REFERENCES

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