# Tectono-metamorphic evolution of the far-Eastern Nepal Himalaya

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In far-Eastern Nepal, the Lesser Himalayan Sequence (LHS) exposed in the Taplejung Window and in frontal belt between the Main Boundary Thrust (MBT) and the southern extension of the Main Central Thrust (MCT) comprises greenschist to amphibolite facies rocks such as phyllite, schist, metasandstone, quartzite, amphibolite, marble and augen gneiss of granitic origin (Ulleri-type augen gneiss) (Rai et al. 2001). Two-mica granite bodies have intruded the phyllite and quartzite in the lower section of the Taplejung Window (Upreti et al. 2003). The $^{40}Ar/^{39}Ar$ muscovite plateau age from the granite of the LHS in the Taplejung Window was found to be 1.5 Ga (Upreti et al. 2002). Further analyses of the rocks yielded 1.5-1.6 Ga $^{40}Ar/^{39}Ar$ muscovite age spectrum of same granite indicating the pattern of degassing of Ar gas, at 960-1300 °C (about 88% 39 K). This result indicates that the granitic rocks have undergone weak metamorphism and the magmatic age must be older than 1.6 Ga (Takigami et al. 2002). The thrust sheet comprising the Higher Himalayan Crystallines (HHC) and forming the hanging wall of the MCT exposed around the window, and which has traveled far south reaching very close to the MBT, consists of amphibolite facies rocks, such as garnet-kyanite-sillimanite banded gneiss, calcic gneiss, granitic gneiss, and quartzite with incipient traces of mobilization in the upper section.

The area is affected mainly by two deformational episodes: (1) syn-MCT metamorphic deformation and (2) post-MCT metamorphic deformation. The syn-MCT metamorphic deformation is represented by S-C structure preserved in phyllite, schist, and augen gneiss indicating the top-to south shearing sense and NNE trending mineral lineation marked by mica and kyanite, related to the direction of the movement along the MCT. The post-MCT metamorphic deformation is well marked by the formation of Taplejung Window, Tamor River anticlinal dome, new generation foliations, longitudinal folds and extensional features, during the southward propagation of the MCT. In the northern part of the Taplejung window of LHS and HHC, the rocks dip towards north-northeastwards while in the southern part, the rocks dip towards south. The rocks dip due east in the eastern part. The window is thus a large dome shaped anticline, known as Tamor Khola Dome (Schelling and Arita 1991). In the southern part of the frontal belt near to MBT, the rocks of LHS and HHC dip towards north.

At least two metamorphic episodes are observed in the region. The phyllite and quartzite of the LHS exhibit a relict, pre-MCT isotropic fabric (deformed granoblastic mosoic), incorporated by prominent anisotropic fabric imposed during the syn-MCT metamorphism. The syn-MCT metamorphism is marked by the inverted metamorphic zonation with well-characterized Barrovian type isograds in the footwall of the MCT. The isograd in the LHS gradually decreases from garnet to the chlorite in the lower section. The kyanite isograd is achieved above the MCT and the silliminaite appears towards the upper section of the HHC. 16 to 25 Ma $^{40}Ar/^{39}Ar$ muscovite ages from the augen gneiss (Ulleri-type augen gneiss) of the LHS in the Taplejung Window clearly belong to the Neo-Himalayan metamorphic event or syn-MCT metamorphic episode. The chlorite crystals in the HHC gneiss are obliquely oriented with respect to the main foliation, and the conversion of the garnet to chlorite suggests the incipient of the retrogressive metamorphic event occurred during the post-MCT metamorphic deformation. The pressure-temperature conditions of the LHS and HHC rocks are not calculated.

The tectono-metamorphic evolution of the LHS and the HHC can be summarized as follows: The pre-MCT phase is characterized by prograde regional metamorphism. The syn-MCT phase resulting from the movement along the MCT gave rise to the inverted metamorphic event. The movement along the MCT exhumed the metamorphic rocks of HHC to the mid crustal level. During the continued movement along the MCT, a domal uplift resulted into the Tamor River domal anticline, and the HHC thrust sheet moved southwards over the LHS to reach near the MBT. This domal structure and the development of the longitudinal folds in the HHC may be related to the southward propagation of the MCT. Finally, the tectonic uplift and intense denudation resulted into deep incision of the rocks of HHC, and the rocks of LHS exposed forming the Taplejung Window during the post-MCT deformation.

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