# Extensional movement in the Main Cetnral Thrust zone restraining the uplift of Himalayas: examples in the Langtang area

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We made precise structural analyses of the MCT zone in the Langtang area, where the MCT zone trends NNW-SSE. Shear sense in the kyanite-bearing gneisses in the Higher Himalayan sequence commonly shows thrust (top-to-the-WSW) movement.The augen gneiss in the upper part of the MCT zone has asymmetric porphyroclast-tail systems indicating southward thrust-dextral shear sense. This suggests that the ductile deformation took place as a lateral ramp presumably accompanied with the southward overthrusting of the Kathmandu Nappe. The crystalline schists underlying the augen gneiss bears both ductile thrust shear sense and semibrittle extensional shear sense. This is the first report of the extensional shear overprinted in the MCT zone.

The Himalayan Main Central Thrust (MCT) zone is the major tectonic boundary of Lesser Himalayan crystalline schists (footwall) and Higher Himalayan kyanite-bearing gneisses (hanging wall), and involves the kinematic and tectonic evidence of continent-continent collision in Neogene time. We made precise structural analyses of the MCT zone at Syabru Bensi, Langtang area, 50 km north of Kathmandu, where the MCT zone trends NNW-SSE. The results are as follows.

1. The Higher Himalayan sequence is commonly composed of mid-pressure type amphibolite facies pelitic gneiss. The foliation strikes NNW-SSE and mineral lineation commonly plunges to the ENE. Shear sense in the pelitic gneisses commonly shows a thrust (top-to-the-WSW) movement.

2. The Ulleri-type augen gneiss is widely distributed in the upper part of the MCT zone and it commonly constitutes the uppermost part of the Lesser Himalayan sequence. Asymmetric porphyroclast-tail systems clearly indicate southward thrust-dextral shear sense suggesting that the ductile deformation of the MCT zone in this area took place as a lateral ramp. This oblique southward movement along the upper part of the MCT zone was presumably associated with the southward overthrusting of the Kathmandu Nappe.

3. The crystalline schists in the lower part of the MCT zone contain many quartz lenses arranging as asymmetric boudins. This asymmetry together with shear bands connecting asymmetric quartz lenses clearly indicates extensional (top-to the NE) shear sense. Under the microscope, such an extensional shear sense is demonstrated by brittle shear bands. Extensional shear sense can be also detected in fault gouges in the crystalline schists. On the contrary, ductile thrust sense can be also determined by various kinematic indicators in the same crystalline schists.

Accordingly, the extensional shear movement dominantly recorded in the crystalline schists in the MCT zone must be taken plase after the major thrust-dextral movements observed mainly in the augen gneiss. K-Ar age of muscovite in fault gouge suggests that the brittle extensional movement along the MCT zone occurred during the end of Pliocene (3 Ma or younger).

The evidence of the extensional movement has been reported along the South Tibetan Detachment System to the north, however, this is the first report of the extensional shear overprinted in the MCT zone.