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Hybrid channel flow-type mechanisms in the Greater Himalayan Sequence (West Nepal): new constraints from vorticity of flow and quartz petrofabric analyses.

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Three main tectono-metamorphic units are classically recognized along the Himalayan belt: the Lesser Himalayan (LH), the Greater Himalayan sequence (GHS) and the Tibetan Sedimentary sequence (TSS). The GHS may be interpreted as a low-viscosity tabular body of mid-crustal rocks extruded southward in Miocene times beneath the Tibetan plateau between two parallel and opposite-sense crustal-scale shear zones: the Main Central thrust at the base, and the South Tibetan Detachment system at the top. The pre-/syn-shearing mineral assemblage documented within these crustal-scale shear zones indicates that the metamorphic grade increases toward the core of the GHS producing an inverted and a normal thermal gradient respectively on the top and on the bottom of the slab. In addition, thermal profiles estimated using both petrology- and microstructures/fabrics-based thermometers indicate that the metamorphic isograds are condensed.

Although horizontal extension and vorticity estimates collected across the GHS could be strongly biased by the criteria used to define the map position of the MCT, published vorticity data document general shear flow (1>Wk>0) within the slab with a pure-shear component of flow slightly predominant within the core of the GHS whereas the simple-shear component seems to dominate at the top of the slab. The lower boundary of the GHS records a general shear flow with a comparable contribution of simple and pure shearing. The associated crustal extrusion is compatible with Couette - Poiseuille velocity flow profile as assumed in crustal-scale channel flow-type models

In this study, the quartz c-axis petrofabrics, vorticity and deformation-temperature studies are integrated with microstructures and metamorphic studies to individuate the location of the MCT and to document the spatial distribution of ductile deformation patterns across the lower portion of the GHS exposed in the Chaudabise river valley in western Nepal. My results indicate that the Main Central Thrust is located ∼5 km structurally below the previous mapped locations. Deformation temperature increases up structural section from ∼450°C to ∼650°C and overlaps with peak metamorphic temperature indicating that penetrative shearing was responsible for the exhumation of the GHS occurred at "close" to peak metamorphic conditions. I interpreted the telescoping and the inversion of the paleo-isotherms at the base of the GHS as produced mainly by a sub-simple shearing (Wm = 0.88-1) pervasively distributed through the lower portion of the GHS. The results are consistent with hybrid channel flow-type models where the boundary between lower and upper portions of the GHS, broadly corresponding to the tectono-metamorphic discontinuity recently documented in west Nepal, represents the limit between buried material, affected by dominant simple shearing, and exhumed material affected by a general flow dominates by pure shearing. This interpretation is consistent with the recent models suggesting the simultaneous operation of channel flow- and critical wedge-type processes at different structural depth.