Inverted metamorphic gradient in large-hot orogens: The case of the Main Central Thrust zone in the Alaknanda-Dhauli Ganga Valleys, Garhwal Himalaya, India

Iaccarino S[1], Montomoli C[2], Carosi R[1], Montemagni C[3], Massonne HJ[4], Jain A[5], Villa I[3], Visonà D[6]

[1]Univ. of Torino, Italy [2]Univ. of Pisa, Italy [3]Univ. of Milano-Bicocca, Italy [4]Univ. Stuttgart, Germany [5]IIT Roorkee, India [6]Univ. of Padova, Italy

In the Alaknanda-Dhauli Ganga valleys (Garhwal Himalaya, NW India) a complete and well-exposed structural section of the Himalayan belt is present (Jain et al. 2014) starting from the Lesser Himalayan Sequence (LHS), up to the Tethyan Himalayan Sequence. This portion of the belt is a classical area where sheared rocks of the Main Central Thrust zone (MCTz) between the LHC and the Greater Himalayan Sequence (GHS) have been mapped. Classically, the MCTz in this area is mapped as bounded by two discrete thrust-sense shear zones, the Vaikrita Thrust at the top and the Munsiari Thrust at the bottom. Moreover, despite this zone was characterized by geochemical, isotopical and geochronological data (e.g. Ahmad et al. 2000), structural, microstructural and petrofabric constraints (e.g. Valdiya 1980; Jain et al. 2014, Hunter et al. 2018; Hunter et al. in press) and petrologic estimates (Spencer et al. 2012; Thakur et al. 2015), there are still some open questions regarding, for instance, the MCT location and its structural evolution.

In this contribution a detailed meso- and micro-structural and petrological reappraisal along the MCTz transect is presented, focusing also on the distribution of index-minerals and the relationship between blastesis and deformation.

The metamorphic evolution of selected key-samples along the MCTz has been reconstructed after detailed electron microprobe work using multi-equilibrium geothermobarometry, P-T grids and equilibrium assemblage diagrams. U-(Th)-Pb in situ monazite geochronology allowed us to put an absolute temporal constraint both on the prograde metamorphic history and on the exhumation-related metamorphic overprint of the upper part of the MCTz. Particularly along the MCTz, a clear inverted metamorphic gradient (from ca. 500 up to ca. 700°C) is well constrained and also discernible by the distribution of Al-rich minerals (e.g. chloritoid, staurolite, kyanite) in sheared quartzites. Particularly, “peak” temperatures obtained by this work along the MCTz, are only partially in agreement with the (lower) T suggested by microstructural-based thermometry. These new P-T-D-t data, joined with the data available in the geological literature, shed new light on the tectono-metamorphic evolution of the Himalayan metamorphic core in this portion of the belt.

References

Ahmad T, Harris N, Bickle M, Chapman H, Bunbury J, Prince C (2000) Isotopic constraints on the structural relationships between the Lesser Himalayan Series and the High Himalayan Crystalline Series, Garhwal Himalaya. GSA Bull 112: 467-477.

Hunter NJR, Weinberg RF, Wilson CJL, Luzin V, Misra S (in press) Microscopic anatomy of a “hot-on-cold” shear zone: Insights from quartzites of the Main Central Thrust in the Alaknanda region (Garhwal Himalaya). GSA Bull.

Hunter NJR, Weinberg RF, Wilson CJL, Law RD (2018) A new technique for quantifying symmetry and opening angles in quartz c-axis pole figures: Implications for interpreting the kinematic and thermal properties of rocks. J Struct Geol 112: 1-6.

Jain AK, Shreshtha M, Seth P, Kanyal L, Carosi R, Montomoli C, Iaccarino S, Mukherjee PK (2014) The Higher Himalayan Crystallines, Alaknanda–Dhauli Ganga Valleys, Garhwal Himalaya, India. J Virtual Explorer 47: Paper 8.

Spencer CJ, Harris RA, Dorais JM (2012) The metamorphism and exhumation of the Himalayan metamorphic core, eastern Garhwal region, India. Tectonics 31: TC1007.

Thakur SS, Patel SC, Singh AK (2015) A P-T pseudosection modelling approach to understand metamorphic evolution of the Main Central Thrust Zone in the Alaknanda valley, NW Himalaya. Contribution Mineral Petrol 170: 1-26.

Valdiya KS (1980) Geology of the Kumaun Lesser Himalaya. Wadia Inst. of Himalayan Geology, Dehra Dun, India, 249p.