Microstructural and geochronological investigations of the Main Central Thrust Zone and the South Tibetan Detachment System in the Alaknanda–Dhauli Ganga Valleys, NW India

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Shear zones play a major role in the tectonic evolution of the orogens and in the exhumation of crystalline rocks. In the Himalaya, two crustal scale shear zones having opposite kinematics bound the Greater Himalayan Sequence (GHS), the metamorphic core of the orogen, along the entire belt: the Main Central Thrust zone (MCTz) and the South Tibetan Detachment System (STDS). The activity time-span of these shear zones has been addressed by many studies, which unsurprisingly give very scattered results, as each study focused on different geological features and followed different mapping, sampling, analytical and interpretive strategies. In the Alaknanda–Dhauli Ganga valleys (Garhwal, NW India) both the STDS and the MCTz crop out in the same transect. The MCTz is a > 1-km thick zone delimited by two distinct thrusts, the Munsiari Thrust at the base and the Vaikrita Thrust, the MCT sensu stricto in the study area, at the top.

We selected three representative samples from the Vaikrita Thrust, which crops out in the South of the transect, and three from the STDS, which crops out in the North of the study area, in order to compare the timing of their activity along the same transect using the same analytical and interpretive approach. Microstructural observations on one garnet-staurolite-bearing quartzite and two garnet-bearing mylonitic micaschists from the Vaikrita Thrust prove the occurrence of three different textural generation of micas: a rare relict foliation, a main mylonitic foliation, and a late generation of static micas forming coronites after garnet breakdown. $^{40}Ar/^{39}Ar$ step-heating coupled with EMP analyses and with Ca-Cl-K correlation diagrams constrain mica growth on the main foliation around 9 Ma, and coronitic micas at ca. 6 Ma (Montemagni et al. 2018b).

The STDS deforms the small Malari granite. Deformation microstructures vary according to structural level. In the uppermost sample, a pegmatite intruding the Malari main body, low temperature deformation features are expressed by bulging recrystallization in quartz, bent twins in plagioclase, and kink bands in muscovite. $^{40}Ar/^{39}Ar$ dating on muscovite give 16.46 ± 0.06 Ma. Structurally below, another pegmatite, intruding the HT-mylonites, was formed during a later, waning deformation stage. It shows undulose extinction in quartz and rare kink bands in mica which yields a younger $^{40}Ar/^{39}Ar$ age of ca. 16.0 Ma. The structurally lowest sillimanite-bearing migmatite shows high temperature deformation microstructures (chessboard extinction and grain boundary migration recrystallization in quartz), followed by static growth of undeformed muscovite, which yields a $^{40}Ar/^{39}Ar$ age of 14.36 ± 0.06 Ma. This is the minimum age for the cessation of ductile deformation (Montemagni et al. 2018a).

Our results demonstrate a diachroneity of STDS and MCT in the Garhwal Himalaya. Any model of exhumation of the GHS should account for this lack of contemporaneity.

References

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