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Geochronological constraints on the Main Central Thrust zone in the Bhagirathi valley, NW Indian Himalaya

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Constraining the temporal evolution of a shear zone is a key problem in the study of a collisional belt (Challandes et al. 2003) also because shear zones are characterized by intense deformation and are preferential path for fluid circulation leading to mineral reactions, giving rise to difficulties in the interpretation of geochronological data.
In the Himalayan belt, the Main Central Thrust zone (MCTz) separates the Greater Himalayan Sequence in the hanging-wall from the Lesser Himalayan Sequence in the footwall. To define the location of the MCTz different criteria have been proposed and its evolution has been investigated related to tectonic models. In the Bhagirathi valley (NW India), the km-wide MCTz is bounded by two narrow thrusts with a top-to-the SW sense of shear: the Munsiari at the bottom and Vaikrita at the top. In order to constrain the timing of deformations recorded within the Munsiari and Vaikrita Thrust rocks we combined microstructural, chemical and ^{40}Ar/^{39}Ar geochronological investigations.
Microstructural observations on two mylonitic orthogneisses from the Munsiari Thrust reveal the occurrence of a main disjunctive foliation defined by biotite and rare muscovite. EPMA on biotite reveal that, although similar, biotites from the two samples have different Mg/(Fe+Mg) ratio. The incorporation of Al follows the substitution: $Al_{(tot)}$ <> $^{VI}Me^{2+}$ + Si^{4+} + □; incorporation of Ti is accomplished by: Ti^{4+} + $2O^{2-}$ <> $^{VI}Me^{2+}$ + $2OH^{-}$. ^{40}Ar/^{39}Ar stepheating coupled with Ca-Cl-K correlation diagrams constrains biotite growth on the main foliation at ca. 5 Ma.
The microstructures of one mylonitic micaschist from the Vaikrita Thrust include three different textural generation of micas: a well-preserved relict foliation, a main mylonitic foliation, and a late generation of static muscovite together with static chlorite, the latter forming coronites around garnet porphyroclasts. EPMA reveal variable degrees of phengitic substitution $^{IV}Al^{3+}$ + $^{VI}Al^{3+}$ <> $^{VI}Me^{2+}$ + $^{IV}Si^{4+}$ in muscovites with no differences between the three generations; strongly chloritized biotite is depleted in K. ^{40}Ar/^{39}Ar dating constrains muscovite growth on the main foliation around 8 Ma, similar to age of micas along the main foliation in Dhauliganga valley (Montemagni et al., 2018).
For both Munsiari and Vaikrita Thrust we prepared biotite and muscovite separates with different degrees of purity in order to quantify the bias given by fine-grained intergrowths of impurity phases, which make 100% mica purity unattainable. Argon Differential Release Plots (DRP) discriminate the structure collapse of micas sensu stricto from that of impurities. Combining DRP with Ca-Cl-K signatures identifies the step ages reliably dating deformation.
Therefore, we emphasize the importance of a multidisciplinary approach based on detailed meso and microstructural, chemical and geochronological investigations in dealing with rocks coming from shear zones and showing the occurrence of multiple generations of fine-grained foliations.
In the study area, the Bhagirathi valley (NW Himalaya), our results demonstrate an in-sequence shearing towards the foreland from Vaikrita to Munsiari Thrust from ca. 8 to ca. 5 Ma.

Challandes et al. (2003) Chem. Geol., 197, 3-19.
Montemagni et al. (2018) Geol. Soc. London Spec. Pub., 481, doi: 10.1144/SP481.3