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Multi-scale strain localization within orthogneiss during subduction and exhumation (Tenda unit, Alpine Corsica)

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Strain localization depends upon scale-related factors resulting in a gap between small-scale studies of deformation mechanisms and large-scale numerical and tectonic models. The former often ignore the variations in composition and water content across tectonic units, while the latter oversimplify the role of the deformation mechanisms. This study aims to heal this gap, by considering microstructures and strain localization not only at a single shear zone-scale but across a 40km-wide tectonic unit and throughout its complex polyphased evolution.
The Tenda unit (Alpine Corsica) is an external continental unit mainly composed of granites, bounded by the East Tenda Shear Zone (ETSZ) that separates it from the overlying oceanic-derived HP tectonic units. Previous studies substantially agreed on (1) the burial of the Tenda unit down to blueschist-facies conditions associated with top-to-the-west shearing (D1) and (2) subsequent exhumation accommodated by a localized top-to-the-east shear zone (D2). Reaction-softening is the main localizing mechanism proposed in the literature, being associated with the transformation of K-feldspar into white-mica. In this work, the Tenda unit is reviewed through (1) the construction of a new field-based strain map accompanied by cross-sections representing volumes of rock deformed at different grades related to large-scale factors of strain localization and (2) the structural study of hand-specimens and thin-sections coupled with EBSD analysis in order to target the deformation processes. We aim to find how softening and localization are in relation to the map-scale distribution of strain.
The large-scale study shows that the whole Tenda unit is affected by the two successive stages of deformation. However, a more intense deformation is observed along the eastern margin, which originally led to the definition of the ETSZ, with a present-day anastomosed geometry of deformation. Strain localization is clearly linked to rheological/lithological contrasts as it concentrates either along preexisting intrusive and tectonic contacts. As K-feldspar-poor granites remain relatively undeformed, reaction-softening seems to be a major mechanism during D1. However, evidences suggest that this mechanism is in competition with dynamic recrystallization: at outcrop and hand-specimen scale, the correlation between localized structures such as C-planes and phengite-rich zones is not always observed. This same competition remains active during D2 where top-to-the-east C-planes are common in phengite-rich layers, but an overall grain-size reduction is also observed across the different strain grades, suggesting that dynamic recrystallization remains active during the whole story. Final localization is sometimes observed in phengite-poor aplitic ultramylonites characterized by a very fine quartz-albite matrix suggesting that grain-size sensitive flow would be the major mechanism involved in the final rheology of the ETSZ.