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New insights of the strain localisation on major shear zones

Romain AUGIER (1), Hugues RAIMBOURG (1), Paul TURRILLOT (1), Mathieu BELLANGER (1), and Patrick MONIE (2)

(1) Institut des Sciences de la Terre d'Orléans Université d'Orléans – CNRS : UMR6113 – Université François Rabelais - Tours – INSU, Orléans, France. (romain.augier@univ-orleans.fr), (2) Géosciences Montpellier, UMR 5243, Montpellier, France

Mylonite bodies are exhumed extensions at depth of shallow structural level brittle faults. They are characterised by intense strain localisation involving large volumes of middle to lower continental crust. The analysis of shear zone geometry and microstructures is a useful tool to decipher deformation kinematics, though finite strain estimation is still relatively qualitative.
Timing of the deformation has also been the focus of numerous studies using the complete spectrum of geochronometers. However, only rare examples provide geochronological data that can be unambiguously interpreted and cooling, recrystallisation and neocrystallisation are difficult to tell from each other. Thus, time-scales over which major mylonite zones develop and remain active under ductile conditions as well as their strain rate often remain poorly documented.
We investigated two sections across the South-Armorican Shear Zone (SASZ), a crustal-scale pluri-km thick dextral shear zone active during a single tectonic event of late-Variscan age and associated with syntectonic granite emplacement..
Finite strain profiles on these cross-sections, quantified from average Quartz grain-size in 34 samples, show a strong deformation partitioning towards the center of the SASZ, with a decrease, for each section, from 150μm in slightly deformed zones to less than 7-5 μm in the core of the ultramylonite. Furthermore, toward the core of the SASZ, development of a penetrative shear band network progressively eliminates lenses of less deformed rocks and results in homogenisation of the Quartz grain sizes.
In parallel, we performed in-situ UV-laser Ar/Ar dating on the fabric-forming white micas. White micas population can be decomposed into inherited muscovites carried by the folation and newly-formed, syn-tectonic substituted phengites located along the shear bands yielding 2 age groups for each sample. Along the profiles, the difference between these two ages evolves from 10-15 Ma in weakly deformed domains to zero toward the SASZ core. In addition, mylonite-forming phengites yielded the same age irrespectively of their position on the section or of the rock strain..
On the regional point of view, this study brings deformation-ages for the late-orogenic evolution of the South Armorican domain. Strain accumulated along the SASZ in a time-span extending to 300-298 Ma, i.e. contemporaneously with the activity of nearby major extensional shear zones.
These results support a new model of crustal-scale shear zone activity, where the whole body of the shear zone is active throughout its history (defined as the largest age difference through the section), i.e. the actively deforming zone does not get progressively narrower. The strain distribution nevertheless evolves with time, with an increasingly large fraction partitioned in the ultramylonitic core.