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Rheology linked with phase changes as recorded by development of shear bands in the South Armorican Shear Zone

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The South Armorican Shear Zone in France represents a major right-lateral strike slip shear zone formed in the late stages of Variscan orogeny. The active deformation in this shear zone is associated with the development of S-C fabrics in granitoids where thin shear bands (C) overprint an earlier higher grade metamorphic foliation (S).
In the studied samples covering low to high intensity of shear band overprint, we identified three stages of shear band evolution associated with distinct microstructures and deformation mechanisms. The initiation of shear bands stage I is associated with the formation of microcracks crosscutting the S fabric and detected namely in the recrystallized quartz aggregates. The microcracks of suitable orientation are filled by microcline, albite, muscovite and chlorite which is a typical assemblage also for the well developed shear bands. Phase equilibrium modeling in PERPLE_X indicates that this assemblage formed at pressure-temperature range of 0.1-0.4 GPa and 300-340 °C. Stage II of shear band evolution is characterized by dynamic recrystallization and grain size reduction of quartz aggregates along the microcracks and replacement of quartz by microcline along grain boundaries. This process leads to disintegration of quartz aggregate fabric and phase mixing in the shear bands. The inferred deformation mechanism for this stage is solution-precipitation creep although recrystallization of quartz is still active at the contact between quartz aggregates and shear bands. The coarse grained microstructure of quartz aggregates with ca $\sim$250 microns average grain size reduces to $\sim$10 microns grain size when recrystallized along extremely thin shear bands/microcracks and to $\sim$20 microns grain size when recrystallized along the thicker shear bands. By using the flow law of Patterson and Luan (1990) for dislocation creep in quartz and the quartz piezometer of Stipp and Tullis (2003) corrected after Holyoke and Kronenberg (2010), the quartz recrystallization along thin shear bands records strain rates of $\sim$10-14 whereas the recrystallization along thick shear bands records strain rates of $\sim$10-15. The contemporaneous operation of solution-precipitation creep in shear bands and dislocation creep in quartz along the shear band boundary suggests low viscosity contrast between the mixed phase shear band matrix and pure quartz aggregate implying that the solution-precipitation creep reflect similar stress and strain rate conditions as the dislocation creep in quartz. Stage III of shear band evolution is characterized by interconnection of dispersed muscovite grains and the deformation becomes accommodated by dislocation creep in thin muscovite bands separating the inactive domains of stage II microstructure.

References:

Holyoke III, C. W., & Kronenberg, A. K. (2010). Accurate differential stress measurement using the molten salt cell and solid salt assemblies in the Griggs apparatus with applications to strength, piezometers and rheology. Tectonophysics, 494(1-2), 17–31.

Paterson, M. S., & Luan, F. C. (1990). Quartzite rheology under geological conditions. In R. J. Knipe & E. H. Rutter (Eds.), Deformation Mechanisms, Rheology and Tectonics (pp. 299–307). London: Geological Society Special Publications.

Stipp, M., & Tullis, J. (2003). The recrystallized grain size piezometer for quartz. Geophysical Research Letters, 30(21), 1–5.