Geophysical Research Abstracts
Vol. 15, EGU2013-6495, 2013
EGU General Assembly 2013


# Clast Rotation and Nature of Strain Localization in Thick Ultramylonites: the El Pichao Shear Zone (Sierra de Quilmes), NW Argentina.

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Ultramylonite formation is integral to understanding the accommodation of high strain in ductile shear zones, mountain building and crustal movement. The El Pichao Shear Zone (PSZ) is 3–7km thick ductile thrust zone in the Sierra de Quilmes, NW Argentina. Sinistral thrusting along the PSZ has placed granulite facies migmatites of the Tolombón Complex on top of amphibolite metasedimentary rocks of the Agua del Sapo Complex, separated by a sheared granitic body intruded by pegmatites. The fabric varies from protomylonite to ultramylonite. Ultramylonites in the core of the shear zone reach ∼1km in thickness. Ultramylonites of this thickness are extremely rare, and thus the El Pichao Shear Zone provides a unique opportunity to investigate the origin of such high strain rocks. We used microstructural and quantitative textural analysis, quartz crystallographic preferred orientation (CPO), clast vorticity and geochemical data to investigate the origin of the thick ultramylonites, and variable strain accommodation associated with the mylonitization process. The mylonitic rocks have granitic composition and consist of a matrix of Bt+Qtz+Ms+Pl+Kfs, Qtz ribbons, mica bands and feldspar porphyroclasts. Feldspar clasts have been variably rotated and their deformation behaviour varies between brittle faulting and partial to complete dynamic recrystallisation. In the ultramylonite Qtz ribbons or strong S-C fabrics are lacking and the matrix tends to be homogeneous with only weak foliation defined by the preferred orientation of micas. There is also a systematic decrease in matrix grain size and mica connectivity towards ultramylonite. Quartz CPO suggests changes in deformation mechanisms associated with strain increase. The transition between mylonite and ultramylonite in the PSZ occurred due to a switch from dominant dislocation creep to dominant diffusion creep. Major and trace element data show no geochemical variation between samples, indicating that the mylonite-ultramylonite transition took place in a closed system with fixed P-T conditions.

We argue that the formation of thick ultramlyonites can occur where strain is high enough to instigate intense clast rotation. The homogenization of the originally banded mylonite results from continual rotation of clasts, which disaggregated the anisotropic matrix and thus inhibited strain localisation. The relative rotation of clasts in the matrix was a function of their vorticity and geometry, which may have influenced the variable deformation behaviours of feldspars in the mylonites. Strain softening at the clast matrix interface may have also played a role in increasing the vorticity of clasts and promoting rotation-induced strain accomodation. Ultramylonite thickness may be explained, at least in part, by the homogenisation of the matrix by clast rotation, where the loss of effective slip planes resulted in strain being dispersed over larger areas in the ultramylonite.