Geophysical Research Abstracts
Vol. 15, EGU2013-13087, 2013
EGU General Assembly 2013

Microstructures and crystallographic fabric evolution during melt-present and melt-absent conditions in the partially molten middle crust: the Patos shear zone (Borborema Province, NE Brazil)

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The Patos shear zone is an exposed segment of the partially molten middle crust characterized by a 600 km long, E-trending transcurrent structure that deforms the Precambrian rocks of the Borborema Province. High-temperature (HT) mylonites with low melt fractions ($\sim$ 5%) constitute most of the shear belt, while a narrow strip of highly strained mylonites to ultramylonites outlines its southern margin. Migmatites and "transitional" mylonites occur sandwiched between these tectonites. A progressive microfabric development is recorded from melt-bearing mylonites to high-strain ultramylonites. A microstructural study was carried out to understand the fabric evolution from melt-assisted to melt-absent deformation. Fabrics were investigated by optical and scanning electron microscopy (SEM), and crystallographic preferred orientations were measured by Electron Backscatter Diffraction (EBSD). Melt-bearing HT-mylonites display solid-state microstructures with coarse quartz ribbons and sutured grain boundaries. K-feldspar clasts are often fractured and show peripheral myrmekite. Towards the contact with anatexites the microfabric becomes typically magmatic with abundant interstitial quartz. Transitional mylonites, located immediately south of the migmatites, are marked by progressive grain size reduction of recrystallized felsic phases. High-strain mylonites have a fine-grained quartz-feldspar matrix with relics of quartz ribbons and fractured K-feldspar. Melt-bearing mylonites display quartz [0001] axes forming maxima mainly on Y, while quartz fabrics in the anatexite are weaker and diffuse, suggesting deformation in the magmatic state. In transitional and high-strain mylonites the measured quartz CPOs show [0001] concentrations between Z and Y. K-feldspar and plagioclase fabrics record mainly the activity of (010)[001] and (010)[100] slip systems in all rock types, with local activity of the (100)[010] slip system in the transitional mylonites. These data suggest that the main deformation mechanisms involved in mylonitisation are high-temperature dislocation creep associated with diffusion, especially through grain boundary migration (GBM) in the northern part, while dislocation creep, extensive dynamic recrystallization and localized brittle behaviour are observed in the southern border. Such characteristics imply in an heterogeneous strain distribution where partial melting enhances high-temperature diffusional activity in the northern part, while the southern sector shows a greater contribution of dislocation creep - embrittlement at high-strain melt-absent conditions. Therefore, the evolution of the Patos shear zone is marked by a main HT/LP metamorphic event coupled with partial melting that generated the melt-bearing mylonites and migmatites, while a subsequent reactivation at slightly lower temperatures formed the high-strain ultramylonites in the southern margin. These results help constrain the roles of partial melting and strain localization in midcrustal shear zones during high-temperature ductile extrusion and subsequent exhumation in ancient orogens subjected to collision.