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Microstructures and TitaniQ geothermometry in high – temperature dynamically recrystallized mylonites, Ribeira belt (SE Brazil)

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The Ribeira belt (southern Brazil) was formed by the collision between the São Francisco and West Congo cratons at around 670 – 480 Ma, during the western Gondwana amalgamation. It consists of dextral strike-slip shear zones trending NE-SW to NNE-SSW. The ∼20 km wide and ∼120 km long Três Rios – Além Paraíba – Pádua shear zone is one these shear zones, in which quartzfeldspathic mylonites were formed at upper amphibolite to granulite conditions. The deformation of these rocks was accompanied by dynamic recrystallization and intense grain-size reduction that is reflected by the large amount of recrystallized grains with sizes >30 – 150 μm. Grain-size reduction is often pointed out as a process that promotes changes in the mechanical behavior of rocks, from grain-size insensitive (GSI) to grain-size sensitive (GSS) deformation mechanisms. However, it is still not clear if the switch from GSI to GSS deformation mechanisms may occur in coarsed grain recrystallized rocks. Furthermore, it is also not clear what is the effect of dynamic recrystallization on the titanium retention in quartz. Here we apply the TitaniQ geothermometer to coarse recrystallized quartz, coupled with detailed microstructural characterization to investigate thermal conditions and deformation mechanisms during recrystallization/deformation of quartz. Quartz grains show typically high temperature microstructure, such as irregular-lobate grain boundaries and subgrain walls. The average titanium contents are ∼30 ppm for samples from the Três Rios region, 46 to 54 ppm for samples from Além Paraíba, and 74 to 86 ppm for samples from Santo Antônio de Pádua. The calculated temperatures are fairly homogenous at ∼800 °C throughout the studied segments of the shear zone, which is compatible with the observed microstructures. The crystallographic orientation in these rocks is fairly weak, possibly due to static recovery and/or strong activity of such as diffusion processes due to the high deformation temperatures. The TitaniQ temperatures and microstructure of the recrystallized mylonites indicate that at upper amphibolite to granulite conditions, deformation may be assisted by GSS deformation mechanisms even if the grain-size reduction results in coarse recrystallized quartz, providing that the temperature is high enough to trigger solid-state diffusion. Furthermore, the estimated temperatures suggest that TitaniQ geothermometry is a powerful tool to investigate the thermal conditions during syntectonic recrystallization.