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# Quartz and feldspar rheology at mid-crustal conditions: the example of the Pernambuco shear zone (NE Brazil)

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Rheological models that predict the strength of the middle- to upper continental crust are mainly based on the behaviour of the two most common silicate minerals, feldspar and quartz. At natural pressure-temperature conditions typical of the middle crust, quartz is expected to be mechanically weaker than feldspars if deformation is accommodated by crystal plasticity. Dislocation creep in quartz localizes in recrystallized layers while feldspar forms stronger porphyroclasts. However, the presence of mineral reactions may promote a drastic change in feldspar rheology, causing marked grain size reduction and weakening due to activation of diffusion creep. Under such conditions, the feldspar-derived reaction products represent the mechanically weak rheological phase that accommodates most of the bulk strain while quartz deforms via dislocation creep. The Pernambuco shear zone (northeastern Brazil) is a large-scale strike-slip fault that, in its eastern segment, deforms granitoids at upper-greenschist/amphibolite facies conditions, thus representing a preserved section of the middle continental crust. Initially coarse (> 50 $\mu$m) grained feldspar crystals are intensively fractured and reduced to an ultrafine-grained mixture consisting of fractured albite and K-feldspar grains ($\sim$ 5-8 $\mu$m in size) localized in C' oriented shear bands. Detailed microstructural observations and EBSD analysis do not show any evidence of intracrystalline plasticity in feldspars and/or uid-enhanced reaction weakening. Quartz occurs either as thick ($\sim$ 1mm) monomineralic bands or as thin ribbons dispersed in the feldspathic mixture. The microstructure and recrystallized grain size ($\sim$ 20 $\mu$m) are similar in both the thick monomineralic band and in the thin ribbons. Elongated quartz grains form [0001] axis maxima around Y, while recrystallized grains tend to scatter their c-axes between Y and Z in a girdle-like pattern in both the monomineralic band and in the thin ribbons embedded in the feldspathic matrix. Fine-grained feldspar do not show any clear crystallographic orientations and has the same composition as the fractured porphyroclasts, suggesting that it deformed either by cataclastic ow/diffusion creep and that no chemical changes were involved in feldspar deformation. Quartz ribbons embedded in the fine-grained feldspathic matrix are not boudinaged or folded, suggesting that quartz layers and feldspar aggregates were deformed at comparable viscosities. Overall, our dataset indicates that feldspar underwent a brittle-viscous transition while quartz was deforming via crystal plasticity. The resulting rock microstructure consists of a two-phase rheological mixture (fine-grained feldspars and recrystallized quartz) without a clear apparent viscosity contrast. The Pernambuco shear zone represents therefore a case in which extensive grain-size reduction and weakening of feldspars is attained mainly via fracturing without a prominent role of metamorphic hydration reactions.