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# Brittle grain size reduction of feldspar, phase mixing and strain localization in granitoids at mid-crustal conditions (Pernambuco shear zone, NE Brazil)

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The Pernambuco shear zone (northeastern Brazil) is a large-scale strike-slip fault that, in its eastern segment, deforms granitoids at mid-crustal conditions. Initially coarse (> 50 $\mu$m) grained feldspar porphyroclasts are intensively fractured and reduced to an ultrafine-grained mixture consisting of plagioclase and K-feldspar grains (< 15 $\mu$m in size) localized in C' shear bands. Detailed microstructural observations and EBSD analysis do not show evidence of intracrystalline plasticity in feldspar porphyroclasts and/or fluid-assisted replacement reactions. Quartz occurs either as thick (˜ 1-2 mm) monomineralic bands or as thin ribbons dispersed in the feldspathic mixture. The microstructure and c-axis crystallographic preferred orientation are similar in the thick monomineralic band and in the thin ribbons, and suggest dominant subgrain rotation recrystallization and activity of prism <a> and rhomb <a> slip systems. However, the grain size in monophase recrystallized domains decreases when moving from the monomineralic veins to the thin ribbons embedded in the feldspathic C' bands (14 $\mu$m vs 5 $\mu$m, respectively).The fine-grained feldspar mixture has a weak crystallographic preferred orientation interpreted as the result of oriented growth during diffusion creep, as well as the same composition as the fractured porphyroclasts, suggesting that it generated by mechanical fragmentation of rigid porphyroclasts with a negligible role of chemical disequilibrium. Assuming that the C' shear bands deformed under constant stress conditions, the polyphase feldspathic aggregate would have deformed at a strain rate one order of magnitude faster than the monophase quartz ribbons. Overall, our dataset indicates that feldspar underwent a brittle-viscous transition while quartz was deforming via crystalline plasticity. The resulting rock microstructure consists of a two-phase rheological mixture (fine-grained feldspars and recrystallized quartz) in which the feldspathic material localized much of the strain. Extensive grain-size reduction and weakening of feldspars is attained in the East Pernambuco shear zone mainly via fracturing under relatively fluid-absent conditions which would trigger a switch to diffusion creep and further strain localization without a prominent role of metamorphic reactions.