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Interactive comment on "Strain localization in brittle-ductile shear zones: fluid abundant vs fluid limited conditions (an example from Wyangala area, Australia)" *by* L. Spruzeniece and S. Piazolo

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Given the peer-review format I will simply add to the summary and comments made by the other reviewer, which I agree with to the extent of my knowledge of those topics. The manuscript is focused on an interesting and relevant topic, it is overall in excellent form (well-written with good figures, and complete captions), and appears to have utilized the proper methodology for addressing the research questions at hand. The authors are commended for submitting a high-quality article. My following points are more discussion than critique, but may help in making improvements to the Discussion section. Potential Discussion topics:

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Interactive Discussion

Discussion Paper

It is postulated that Phyllonite B (Ph-B) develops from an Ph-A-type state through a prolonged episode of fluid influx and precipitation of Qtz, enabled by the dynamic permeability associated with the creep-cavitation (CC) process. It appears that most of the available data are compatible with this model. The authors go on to describe that at some point enough Qtz is deposited to arrest the GBS process and cause a transition to a dislocation creep (DC)-dominated mechanism. This transition makes sense, and implies that this is a self-limiting process. So I am wondering A) how the process is initiated and becomes localized within an originally ∼uniform Ph-A zone (as depicted in Fig. 10B), and B) why GBS and localized fluid flow would persist for long enough in Ph-B to cause a 20x change in volume before the transition to DC. It may be worth discussing if some type of intra-Ph-A heterogeneity or perturbation is required to nucleate the CC-fluid influx process, or if it has only developed locally for some other reason. Then, possibly address why Ph-B would continue to evolve toward a mineralogical/microstructural state that seems less favorable to GBS, and if there may be some mechanical reason why GBS-CC may actually be favored by more Qtz up to some threshold.

The development of the marginal orthogneiss (to fairly high strain it looks like) is envisaged to have occurred simultaneously with shearing and early stages in the development of Ph-A. This is interesting from a rheological perspective because in this scenario Qtz would be behaving very differently in concurrently deforming adjacent regions. In Ph-A Qtz is stronger than the micaceous matrix, but in the gneiss it is weaker than the feldspar. If you do an A>B>C type reasoning then Ph-A should be weaker than the gneiss, and was initiated first by the envisaged fracture process. Yet a significant amount of deformation is accommodated in the gneiss. Why isn't all of the strain localized in Ph-A? I wonder if this could be used to qualitatively discuss the relative strengths of these 2 common crustal rock types and nature of strain localization (Newtonian vs. non-newtonian behavior) and their relationship to specific deformation processes (GBS vs. DC). I also wonder if it is possible that deformation in the gneiss could have happened after stage 3, once the Ph-zones hardened?

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The influx of aqueous fluids seems to have played a major role in the evolution of deformation processes in this shear zone, as they do in many other geological processes. I am wondering if it is possible to estimate the volume of fluid that would be required to deposit that much Qtz and remove that much Na from the system. There may be too many uncertainties to calculate an actual value, but it would be nice to get a feel for the efficiency of fluid transport by the GBS/CC mechanism relative to channelized (fracture) flow or static porous flow, for a given solubility of Si at the ambient conditions.

Minor comment: A table describing the defining characteristics of each type of a particular phase (Qtz1, 2, etc.), and where they are found could be helpful. They could be laid out more clearly in the text as well.

Interactive comment on Solid Earth Discuss., 7, 1399, 2015.

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