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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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The paper reports findings from a microstructural study of shear zones that formed in a granitic protolith. Along a cross section, several structural domains were identified and interpreted in the context of microfabrics evolving with increasing strain but differing amounts of synkinematic fluid influx. The microfabrics are described in great detail; descriptions focus on four representative samples and are based on data gathered through light- and electron microscopy, electron backscatter diffraction, point counting and whole rock geochemical analysis. I think that the "results" section of this paper is exemplary in its detail and objectivity. The data indicate a significant change in rock

composition in what the authors identify as the most highly strained phyllonites. The authors interpret their data from these samples in the context of strain localization involving precursory fracturing, a resulting fluid influx that triggered hydration reactions, and the subsequent synkinematic generation of permeability by creep cavitation controlling fluids transfer through a granular fluid pump. In contrast, they attribute the formation of an orthogneiss that mediates between the phyllonites and the granite to dynamic recrystallization with limited fluid availability.

While it seems that this hypothesis would have been best tested along a longitudinal strain gradient, I think that this is a very good paper that could be published as is (after proofreading, see below). However, I also think that the paper's impact can be improved significantly if a few minor further bits of data are presented and the discussion section of the paper is upgraded:

- Obviously strain localization in granites has been studied extensively – to my surprise I found that some references that I think can add to the discussion, in particular of the microfabrics, are missing. Most notably these would be Fliervoet & White (1995), Fliervoet et al. (1997), possibly also Obee & White (1985).

- Given the weight that the authors give to the effect of fluids and their sources, I did miss information on these. In particular the argument that the fluids involved in the formation of the orthogneiss were different from those infiltrating the phyllonite could be supported by stable isotope and/or fluid inclusion thermometry data. Andrew McCaig has demonstrated how we can elucidate on the nature of fluids affecting the deformation of granitoids. His work should certainly be discussed alongside Rob Kerrich's (McCaig et al 1990 and McCaig 1997 would be good starting points). While I see that stable isotope analyses might be beyond feasible at this stage, I would still invite the authors to describe the fluid inclusions and discuss the internally/externally derived fluids in greater detail.

- A similar set of retrograde hydration reactions from a very similar setup has been

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discussed by Pryer & Robin (1995). Although Spruzeniece and Piazolo do not report on flame perthite, the “cyclic reactions” of Pryer and Robin could still be a good frame for a discussion of their own, in particular since they integrate element transport over distances of many grain diameters.

- And lastly, I still think Win Mean’s short 1995 paper is an excellent background for a discussion of the rheological evolution of the Wyangala shear zones.

- The authors involve creep cavities and a granular fluid pump to transmit fluids through the phyllonites, however, no pores are ever shown. While I am the strongest advocate of their significance, I would like to see the authors support their claims by images of contextualised grain boundary porosity acquired by either SEM or, ideally, x-ray microtomography. Billia et al (2013) have recently demonstrated how synkinematic porosity can be described using the same methods that Spruzniece and Piazolo applied and I would encourage the authors to attempt something similar to support their interpretation. It should be born in mind that transient fluid-pathways, especially during volume-changing rehydration reactions, can be created by other mechanisms than creep cavitation.

- The most intriguing finding I take away from the paper is the point where grains in ultramylonites that deform by grain-size sensitive creep grow again and potentially trigger a reversed transition to dominant dislocation creep. Again, the authors use solely compositional arguments to support their hypothesis. I was wondering whether there might have been different ways to locally increase the quartz content in their phyllonites? – The first that came to my mind is quartz veins obliterated by the mylonitic deformation? However, I do acknowledge the significance of their claim and would encourage the authors to support this aspect by more detailed observations.

Minor points: The manuscript should be carefully proofread once more. I am sure that I missed a few, but I also believe that the following are some of the points that require attention:

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Pg 1409, line 11-12: “but do not display significant displacement in respect to each other”. Why is the displacement of the grains WITH respect to each other relevant, when you describe their internal fragmentation?

Line 23: aspect ratios

Pg 1410 line 15: Why is the direct contact to feldspar grains relevant here / out of context.

Pg 1411 line 14 : All muscovite is referred to as Ms2

Line 25-26: Consider reformulating for style

Pg 1413 line 8: I believe there should be no comma after Qtz1 in “Qtz1, typically”

Pg 1417 line 1: “recycling” in a “closed system” conditions – remove “a”

Pg 1418 line 20: Double-check referencing style where you write “documented by (Menegon et al., 2011)”.

Pg 1419 line 23 : “Minor fraction of” should be “A minor fraction of”

Pg 1421 line 27 : I am almost certain that the gentleman is called J.D. Fitz Gerald

Pg 1422 line 28 : “as being indicative to deformation” should be “as being indicative of deformation”

Pg 1424 line 8: “is interpreted to represents the” should be “is interpreted to represent the”

Line 9: “highly permeable” is a very vague descriptor that may mean completely different things to a reservoir engineer than to a hard rock geologist. Possibly reformulate?

Line 10: “rock with a restricted pathways” should be “rock with restricted pathways”

Pg 1426 line 2: In which sense does a pressure shadow represent a fabric anisotropy, and why does fabric anisotropy lead to more (“higher”) dilation?

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Pg 1427 line 4: I believe there should be a comma after “As a result”.

Pg 1427 line 16, 18: Castlemaine’s barley pop is correctly acknowledged as XXXX.

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