Solid Earth Discuss.,
https://doi.org/10.5194/se-2018-15-RC2, 2018

Solid Earth Discussions

Interactive comment on "Permeability and seismic velocity anisotropy across a ductile-brittle fault zone in crystalline rock" *by* Quinn C. Wenning et al.

T. Tesei (Referee)

telemaco.tesei@durham.ac.uk

Received and published: 16 April 2018

Wenning et al. present a solid dataset about permeability and elastic properties of core rock materials coming from a shear zone in an underground research facility, with the aim to better understand seismic properties and potential for exploitation of such shear zones. The paper i well written, and combines some microstructural work with solid laboratory measurements of permeability and seismic wavespeeds.

My only major comment on this manuscript is with regard to the terminology used to present the data. The manuscript is presented, in particular in the abstract, as a study of brittle fault zone overprinting a ductile shear zone. Judging from the microstructures

presented in figure 2 and from the location of samples in figure 1, measurements were performed only on cores of a ductile shear zone rather than a brittle fault (i.e. on mylonites and ultramylonites). The authors often refer to ultramylonitic shear bands as "fault core" and mention the importance of inheritance of ductile structures on brittle structures. It is true that localized small scale fracturing, possibly concomitant with hydrothermal alteration and dissolution-precipitation mechanisms, may have acted during the exhumation of the shear zone in the so-called "transition zone" TZ. However the shear zone appeared to be essentially ductile, with only a late reactivation as a brittle fault in the zone named "DZ" within the ultramylonites. DZ rocks, i.e. the only clearly brittle rocks presented, were not characterized in this study, which in turn focused on essentially purely ductile shear zones. Therefore the brittle overprint, supposedly influenced by ductile structures, were not investigated. The conceptual model of the shear zone is correctly depicted by the authors in the discussion section, however I think that they should clearly term the ultramylonites "shear zones" and not fault cores, and avoid using the common terminology of brittle faults, to avoid confusion in the readership. The think that the title may be misleading in the same way. Something like "permeability and seismic velocity anisotropy of ductile shear zones enveloping a brittle fault" would be more appropriate, I reckon.

A part from this point I have only a few other minor comments on this manuscript (below) and I think this should be accepted for publication afte minor modifications.

Telemaco Tesei (Durham University)

Minor Comments P=page L=line P1, L15-16: a few references could be appropriate here. P2, L16-17: a couple of references to mechanical/geological studies of reactivation of previously ductile faults/materials:

Bolognesi, F. and Bistacchi, A., 2016. Weakness and mechanical anisotropy of phyllosilicate-rich cataclasites developed after mylonites of a low-angle normal fault (Simplon Line, Western Alps). Journal of Structural Geology, 83, pp.1-

12. Donath, F. A., 1961. Experimental study of shear failure in anisotropic rocks. Geological Society of America Bulletin, 72(6), 985-989, doi:10.1130/0016-7606(1961)72[985:ESOSFI]2.0.CO;2. P3, L1: are these two shear zones “ductile”? Or are they clay-rich fault cores/principal slip zones? P4: L13 “boundaries”. P4 L 24: I would make another reference to figure 2 here. P5, L4: I would state clearly state the dimensions of the core here (or add a table, but it is impractical to read), before saying that they are not suitable for deformation experiments or seismic velocity experiments, and therefore only permeability measurements were performed on these samples. P5, L7. the samples size mentioned here suggest that for some samples the length/width ratio may be between roughly 1 and 2, contrary to previously stated P8, L2. The “void” is strange in this sentence. I would simply say “lack of ” or “don’t have” open microcracks. P8 L10: indicate that. . .

Figure 1: “Mapped” is spelled wrong in the inset of Fig. 1A. Figure 3: in the caption, mention the experimental conditions, in particular the effective confining pressure. Figure 4 caption: mention which core the measurements are taken from, and at which experimental conditions.

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2018-15, 2018.