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Interactive comment

Interactive comment on "Fault zone architecture of a large plate-bounding strike-slip fault: a case study from the Alpine Fault, New Zealand" by Bernhard Schuck et al.

Anonymous Referee #2

Received and published: 23 July 2019

The paper by Schuck et al., 2019 shows a combined field and microstructural study of the central part of the Alpine Fault in New Zealand. In particular, the authors focused the study along the fault core and Principal Slip Zones (PSZs) of the fault in four new exposures along riverbeds and within well cores. Results show that, even if the protolith is the same, the fault zone is characterized by different microstructures, mineralogical and geochemical signatures, and by a strong thickness variation of the PSZ. Authors conclude that the studied fault gouges are not part of the same fault plane but represent distinct slip planes within a complex network of anastomosing shear planes, forming the core of the Alpine Fault, surrounded by a broader damage zone. Therefore, conversely from past studies, the Alpine Fault zone architecture can be appropriately

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described with the broad and complex conceptual model of Faulkner et al. (2003). Overall the paper is scientifically sounds and presents a large amount of data (several meso- and microstructures using different techniques, geochemical data, mineralogical analyses) but sometimes is hard to read, probably due to such amount of data. Therefore, the paper is worth of publication after moderate revision, mainly concerning the presentation of the paper.

General comments

The results section is sometimes hard to follow. My suggestion is to avoid wording, long sentences, the different classification of clast within the cataclasite (i.e. matrix clast, bright matrix clasts), the different sub-classification of cataclasite (i.e. hangingwall-proximal gouge, footwall-proximal gouge) and so on. I suggest to the author to shorten and simplify this part, maybe focusing on the striking differences between the different outcrops. In addition, within the description of the results there are several jumps from an outcrop to another. This confuses the reader. One solution can be to divide the results chapter with sub-sections based on the description of the different outcrops (i.e. sub-section 4.1 Havelock Creek, 4.2 Gaunt Creek, 4.3 Waikukupa Thrust, 4.4 Martyr River, 4.5 Borehole microstructures and so on). This will help the reader to have a better idea of the peculiar structures within the different locations.

In addition, I suggest also to split the two figure of microstructures in three, in order to do figure with larger panels. In this way can be easier to see the detail of microstructures. Please, enlarge also Fig. 4 and 5 (two column wide).

I suggest to draw a conclusive general sketch where the main microstructures are highlighted regarding to the different locations. For instance, a similar (but a lit of bit more detailed) sketch as that of Fig. 10, also with the other outcrops, and a map with arrows indicating the different positions of microstructures. In this case the reader will have a complete picture of the different microstructures according to position along the fault.

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Line 525-530. Seismological investigations showed that during a fault rupture the slip distribution along a fault plane is always heterogeneous, with zones characterized by high displacements and zones characterized by low to zero displacements, both at surface and at depth (e.g. Ma et al., 1999; Lin et al. 2001; Tinti et al., 2016). This can affect the production and the thickness of fault gouges and the distribution of fault rocks. The observed differences in gouge thickness could be explained also by different displacements occurred along the same fault plane, rather than the product of multiple displacements along several fault strands? Are there evidence of multiple fault strands at the surface or the area is too vegetated to map such complexity?

Detailed comments are on the attached PDF.

Best regards.

Please also note the supplement to this comment: https://www.solid-earth-discuss.net/se-2019-109/se-2019-109-RC3-supplement.pdf

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