

## ***Interactive comment on “Inverted distribution of ductile deformation in the relatively “dry” middle crust across the Woodroffe Thrust, central Australia” by Sebastian Wex et al.***

**Sebastian Wex et al.**

sebastian.wex@erdw.ethz.ch

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1) First, I find it curious that the authors miss the opportunity to discuss the significant increase in shear strain due to the narrowing of the Woodroffe thrust from south to north in light of the strain softening mechanisms they envisage. The relatively lapidary last sentence of the discussion (line 463) does, in my eyes, not explain why the Woodroffe thrust is six-fold narrower in the north, especially if the wetter conditions do not account for the pronounced strain localization there. The observation that the thrust narrows so dramatically would invite a more detailed discussion of the microstructural developments along the strain gradients in the north and south, or, in other words, the

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strain-dependent evolution of the mylonites. Which mechanisms accommodate strain softening in the north and south? Is it possible that the shear zone progressively narrowed during shearing, in analogy with Means' (1995) type 2 shear zones? If so, does this apply to the entire Woodroffe thrust? And if not, why not? I would invite the authors to include a more detailed microstructural description of the evolution from host rock to ultramylonite in both, northern and southern sections, and then integrate these into the discussion of their findings in light of the questions above.

AC/MC: After reconsideration, we agree with the reviewer that our previous conclusion that the narrowing is exclusively controlled by temperature is probably too restrictive and not justified. The last sentence of the discussion has therefore been extended into a more detailed discussion on the potential role of aqueous fluids as an additional or alternative explanation for the narrowing of the Woodroffe Thrust from south to north. We have updated the discussion to argue that an increase in the water content to the north would potentially result in an increase of the effective viscosity ratio between footwall and hanging wall, potential causing a stronger localization toward the interface and a narrower mylonite zone that extends less into the stronger material. Indeed, we envision a progressive narrowing of the Woodroffe Thrust with time, in analogy with Means' (1995) type 2 shear zones. Microstructural and petrological evidence for this is found in the southern outcrops of the Woodroffe Thrust, with the temporal development in detail discussed by Wex et al. (2017). A detailed discussion of the microstructural developments along the strain gradients in the north and south, as requested by the reviewer, has been carried out in the overall framework of our study of the Woodroffe Thrust, but has been drafted into a follow-up companion paper, which focuses particularly on the microstructural gradients parallel to the thrusting direction and the inferred deformation mechanisms in quartz and feldspar, as characteristic for middle to lower continental crust.

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2) Second, the mantle source of the CO<sub>2</sub>-dominated brines. If these are indeed mantle-

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derived, how did they migrate along the shear zone? Was there some form of synkinematic porosity? If there was a fluid migrating along the Woodroffe thrust, what was its micromechanical effect in both, the northern and southern sections?

AC/MC: There is no indication that there is preferentially more calcite in the more strongly mylonitic to ultramylonitic rocks, arguing against channeling of the CO<sub>2</sub>-rich fluids along the Woodroffe Thrust. Furthermore, we agree that the whole calcite isotope story is not conclusive, and our current conclusions based on this data slightly overambitious. The interpretation of the calcite isotopic data has been formulated into more restrained statements and is, in the revised manuscript, restricted to the appendix. A short summary of the isotopic results is still provided in the main manuscript.

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3) With respect to the determination of the modal abundance of the hydrous minerals (S1.3) – global thresholding on the basis of grey value histograms is rather primitive and prone to substantial errors – Fiji/ImageJ offers much more sophisticated segmentation algorithms, in particular trainable WEKA segmentation, a machine learning toolbox.

AC: The Fiji/ImageJ software does provide more sophisticated segmentation tools but it also requires careful checking of the output results. We put particular care in checking that the greyscale histograms of the collected SEM images allowed a clear separation between the hydrous minerals and the anhydrous minerals. We believe that the determined modal abundance of hydrous minerals with our thresholding technique is quite reliable.

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