Solid Earth Discuss.,
https://doi.org/10.5194/se-2020-17-RC1, 2020

Solid Earth Discussions

Interactive comment on "Resolved stress analysis, failure mode, and fault-controlled fluid conduits in low-permeability strata" *by* David A. Ferrill et al.

Tiago Alves (Referee)

alvest@cardiff.ac.uk

Received and published: 19 February 2020

Dear authors

I liked reading your paper, particularly after acknowledging that the analysis in this work is similar to that we have developed at Cardiff since we first contacted SWRI in 2013 - and collaborated with this latter institute. With this in mind, se-2020-17 is an excellent addition to what has been an attempt at characterising fault-related fluid flow using high-quality seismic data. I was very pleased with having a field analogue of what we see on seismic.

I think this paper needs a moderate revision, and I appended an annotated .pdf to this review. The main points to be improved are:

Title - is the analysis in this work only valid for low-permeability data? I feel the analysis is broader than the title suggests.

1-Very old references are used at the start of the paper. Why such broader references when the paper is very much about fault slip and associated tendency to leak?

2 and 3-Seismic-based analyses have been undertaken by N. Ward et al. (2016). Tectonophysics and Roelofse et al. (2019) in basins posed for CO2 capture and storage. I would suggest the authors to indicate that low-permeability intervals have been characterised in detail using high-quality seismic data and borehole information.

4-Case studies are missing at the end of Page 1.

5 & 6 - This part hints at the problem of scale in fault segment interaction. At what scale this interaction occurs? Could you kindly complete this introduction with the comments and ideas in Tao and Alves (2017) Reply letter and Tao and Alves (2019). Tectonophysics? These are important papers that review the importance of understanding fault segment length at several scales of analysis - without under-interpreting data - as fluid flow will be controlled by elusive roughness, pull aparts and local refraction features in faults. It is reassuring to see this paper (se-2020-17) confirm the aspects in Tao and Alves (2017; 2019).

7-Once again, examples exist of similar approaches in Ward et al. (2016) and Roelofse et al. (2019). Mattos et al. (2016; 2018) are also interesting papers from Cardiff.

8-low permeability, rather than 'impermeable' strata. There is no such thing as impermeable strata.

9-Total/maximum lengths of faults need to be stressed at the start of the paragraph. Which stratigraphic section? Detail needed.

10 (page 8) - The 'scale problem' arises once again. Do the fault segments obey the rules in Tao and Alves (2019) that we need to collect T/Z data at a minimum spacing of 5% of a fault zone length to identify the presence of discrete segments; otherwise faults will resemble large constant-length structures? I am not asking for the inclusion of T/Z data in your paper, but it would be good to understand if the 5% rule is clearly recognised in the field - note: some longer faults require T/Z measurements at 3% of the length of a fault zone so that one can identify discrete segments. I think 2-3 paragraphs confirming how the segments are identified in se-2020-17 is very important in this page 8.

11-Add examples with work undertaken by the Cardiff group using seismic data. The stress tensors are rather similar to some of our work.

12-Segment scale needs to be referred to once again. Do they obey the field observations, which are seemingly based on the recognition of linkage points and inflexion/trend changes in discrete fault segments? (see Tao and Alves, 2017 Reply).

In essence, I overly enjoyed to read this work. The comments above will broaden the scope of this paper - particular those referring to the scale of fault and joint segments in the field and the way(s) they are recognised.

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2020-17/se-2020-17-RC1-supplement.pdf

---

Interactive comment on Solid Earth Discuss., https://doi.org/10.5194/se-2020-17, 2020.