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Solid Earth
Discussions

Interactive comment on "Transverse jointing in foreland fold-and-thrust belts: a remote sensing analysis in the eastern Pyrenees" *by* Stefano Tavani et al.

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Comment 1
In the revised version, you mention in lines 30-31 of p7 "we conclude that foredeep parallel extension has occurred in the foredeep of the Pyrenean belt since the Paleocene and until the end of convergence" Do you consider here that Sigma 3 is negative as proposed in Figure 1b and introduction ? Extension is an unclear deformation term not synonym to tension or extensional stresses (i.e. negative stresses). Clarify this in the text please.

Response
We consider sigma 3 negative. The new text is: "Thus, we conclude that foredeep-parallel tension has established in the foredeep of the Pyrenean belt since the Paleocene and until the end of convergence"

Comment 2
On this negative stresses as shown in Figure 1b, although we can agree on your interpretation, the paper suffers considering the significant contributions from experimental tests which have been compared to natural joints from the past decade. You mention extensional stresses (negative) but what about splitting without negative stresses (and even with a slightly compressive sigma 3) such as demonstrated in dry axi-symmetric, oedometric, plane strain and poly-axial experiments by Chemenda et al. (JGR,2011) and Jorand et al (Tectonophysics 2012) ? These studies shows joints formed under dry contraction without negative sigma 3, which are not so far than uniaxial splitting fractures observed in triaxial cells (e.g. Holzhausen and Johnson, 1979), but here clearly without the triaxial boundary effect mentionned by Fakhimi and Hemami (2015).

Response
We have no doubt that it is possible to replicate the morphology of a joint at the specimen size in an experimental apparatus using a Sigma3 > 0. However, we have some concerns about the possibility of upscaling such an experimental result at the basin scale and for tens of meters long systematic joints. Also, the occurrence of orthogonal cross-joints is not compatible with compressive sigma 3. We have added this text: "This indicates that E-W striking joints are cross-joints formed perpendicular to, and about synchronously with, the N-S striking joint set and that N-S joints formed in response to a negative (tensile) minimum stress (e.g. Bai and Gross, 1999; Bai et al., 2002)"

Comment 3

A common species of joints show very low displacement gradients compared to other fractures (veins, faults) (Pollard and Aydin, 1998; Schultz et al., 2008), which also support the general fact that joint sets do not require significant amount of negative stresses perpendicular to them. Have you measured the mean opening of the observed fractures ? Can this help to discuss this point ?

Response
We have not collected joint aperture data

Comment 4
I recommend you to better support the hypothesis mentionned in lines 31-32 p2 and 1-3 p3, which only relies on one reference, while others works previously described stress permutation during LPS. For example, stress permutation in foreland basin has been proposed from field observations and stress path calulations by Soliva et al. (2013), and reused with nearly the same concept in Fossen's book 2015 version. Addition of such references is just a fair strengthening of the hypothesis on which the work relies

Response
We have added this text " This is evidenced by the occurrence of bedding-perpendicular pressure solution-vein pairs (e.g Railsback and Andrews, 1995; Evans and Elmore, 2006; Quintà and Tavani, 2012; Weil and Yonkee, 2012) and/or conjugate strike-slip faults at a high angle to bedding (e.g. Marshak et al., 1982, Hancock, 1985, Erslev, 2001; Lacombe et al., 2006; Amrouch et al., 2010, Weil and Yonkee, 2012) occurring in foreland areas and in the adjacent fold and thrust belts worldwide, although in many cases structures associated with this strike-slip regime do not develop during layer parallel shortening (Soliva et al., 2013). "

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