

## ***Interactive comment on “Mechanical models to estimate the paleostress state from igneous intrusions” by Tara L. Stephens et al.***

**Tara L. Stephens et al.**

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We thank Nicolas (Reviewer 2) for his concise and constructive comments on the above manuscript. Below we present a full breakdown of the changes we have made, and our response to individual comments. Based on the comments, the main amendments to the manuscript are:

1) Fracture Mechanics: Reviewer 2 suggested that more explanation was required for the effect of pre-existing fractures on hydrofracture propagation. We have added a short section to address how pre-existing fractures that are oriented at a high angle to  $\sigma_3$  can influence hydrofracture propagation: See L138-152.

Reply to Reviewer 2

C1

Major comments: Despite being short, I think the paper lacks references especially on the role of pre-existing fractures on magma intrusions, and on the mechanics of fracture propagation. Line 328: “Failure of intact rock requires a higher fluid pressure than for reactivation of pre-existing structures”. I don’t agree with that. As you said yourself in the paper it depends on the magma pressure and the orientation of the fractures, as well as if it sealed or not. In addition, the propagation of the tip of a crack would tend to have a fracture to not reopen pre-existing ones due to their angular orientations with the local stress (or maybe on short distance [Gaffney et al., 2007]).

Reply: Thank you for pointing this out, we agree and Lines 328 – 333 have been removed. Additionally, we understand why Reviewer 2 suggests to include fracture mechanics literature, however the model proposed here does not refer to hydrofracture initiation or propagation; it simply calculates the opening angle for fractures that were linked to the fluid system. We have added in a short section to address how pre-existing fractures that are oriented at a high angle to  $\sigma_3$  can influence hydrofracture propagation: See L138-152.

Additional references have also been added into the paper regarding the geometry of extensional-shear fractures formed via failure of intact rock: Hancock, 1985; Sibson, 1996; and Ramsey and Chester, 2004.

Minor comment: Line 57: “dilation of a fluid-filled pre-existing: : :”. I think there is a mistake here. I don’t believe you mean to dilate a fracture with liquid in it?

Reply: Correct: “fluid-filled” has been changed to “cohesionless”.

Recommend references

Gaffney, E. S., B. Damjanac, and G. A. Valentine (2007), Localization of volcanic activity: 2. Effects of pre-existing structure, *Earth and Planetary Science Letters*, 263(3-4), 323-338.

Reply: Thank you for the suggestion, the reference has been cited where appropriate.

C2

Please note: A tracked-changes version of the manuscript has been added as a supplement to the reply to Reviewer 1.

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Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2018-17>, 2018.