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Interactive comment on "Control of pre-existing fabric in fracture formation, reactivation and vein emplacement under variable fluid pressure conditions: An example from Archean Greenstone belt, India" *by* Sreyashi Bhowmick and Tridib Kumar Mondal

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Review of ms. se-2020-30 "Control of pre-existing fabric in fracture formation, reactivation and vein emplacement under variable fluid pressure conditions: An example from Archean Greenstone belt, India" by Sreyashi Bhowmick and Tridib Kumar Mondal

The manuscript describes the study of vein systems and associated brittle structures developed in metabasalt at the shallow crustal level. Several methodologies have been

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used by the author to define the stress state and the fluid pressure conditions at the time of vein formation. This is a topic of wide interest for the journal readership. The manuscript is well organized and clearly written, the data sets are important and well described and the methodologies used provided a sound science. Overall this is a very nice piece of work describing the role of fluids at the upper crustal level and their interaction with tectonic deformation. Two issues should better have defined by the authors: 1) Fault valving: the authors propose that fault valving was the driving mechanism to pump fluids. I think this may be possible but both “fragments of host rock” occurrence within veins and mutually cross-cutting relationships are not exclusively indications of fault-valving. These may also indicate a very high fluid pressure surge and “hydrofracturing” of the host rock (fragments) and coeval emplacement of all the veins (mutual crosscutting veins). Probably a fabric analysis of vein may disentangle this point, the occurrence of crack and seal textures in the veins may clearly indicate cyclic fluid ingressions and fault valve mechanism. 2) Cluster analysis: In analysing the veins distribution the authors define a clear vein cluster (NNW-SSE veins). If the Jolly and Sanderson method is applied to a cluster of vein clearly it will indicate a cluster distribution. So it is not possible to differentiate different episodes of fluid injection from a large single event where most of the fluid injected the well-oriented NNW-SSE trending fractures (they attain also the maximum vein thicknesses) and also reactivated the other fractures. Moreover, other clusters are apparent in the distribution (for example that around the s2 pole). I suggest to expand the cluster analysis of the data sets and to apply the Jolly and Sanderson method to all the clusters and also to the data set minus the NNW-SSE cluster.

Minor points are listed below and in the annotated manuscript.

In summary, I think this is a very nice piece of work that after a minor/moderate revision (see points 1 and 2) may be ready for acceptance. I hope my comments may help authors to finalize their efforts.

Sincerely Francesco Mazzarini

Main comments linked to line position

Lines 47-48. This is not completely true. Fault valve action develops when fluid pressure shows a cyclic increase. All veins forms because of dilation of fracture's walls. Please reword the sentence

Lines 55-58. not clear, please reword

Line 124. angular enclaves suggest high fluid pressure at the time of vein formation with rupture of wall rocks (hydrofracture). Fault valving is testified by crack and seal fabric of veins. The occurrence of striated veins suggests active stress field after the vein formation.

Lines 147-148. this is not clear. Why mutually cross-cutting relationships do imply several cycles of emplacement? It is possible that this pattern of veins indicates a coeval formation of veins?

Lines 256-259. This is an important point. Looking at the veins' pole distribution also a cluster around the intermediate stress (s2) is apparent. Construction of data set from clustered data clearly will lead to a cluster distribution. I suggest here to provide a clear cluster analysis of the data and to extend the analysis to all the resulting clusters. Once these results are obtained, the question to face is: are these different pluses of fluid injections? Is clustering inherited by the fracture network exploited by fluids?

Lines 348-356. These sentences are repetitive. You may expand the geological background and cut off here these sentences.

Line 387. This is ok from a tectonic point of view. Now rocks are exposed. When did rocks' exposure occur? Unloading form a few kilometres to the surface did not generate any jointing? This point here should be discussed.

Line 427. please expand this point to clearly state that these fracture systems are coeval.

Line 470. as in the above comment. How do you ascribe to vein formation the cluster? The cluster my be inherited by the existing fracture network at the time of vein emplacement.

Lines 474-476. As discussed above. Angular fragments of hosting rock within veins indicate hydrofracture with rupture of wall rocks. This is not directly associated with fault-valve action. Moreover, it is not clear if indications of hydrofracturing are observed in all vein sets or only in the NNW-SSE set. To clearly define a fault-valve action a look at the vein microfabric (crack and seal textures) will help.

Figure 1. Add definition of TTG and Supracrustals in the key legend Figure 6. label (c) is poorly visible Figure 10. The stress field in (c) has s1 vertical while the cartoon has ESE-WNW contraction (yellow arrows). If fluid overpressure acted this should put into the figure caption

Please also note the supplement to this comment:
https://www.solid-earth-discuss.net/se-2020-30/se-2020-30-RC1-supplement.pdf

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