

Interactive comment on “Three-dimensional phase-field study of crack-seal microstructures – insights from innovative post-processing techniques” by K. Ankit et al.

Anonymous Referee #2

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Review of “Three-dimensional phase-field study of crack-seal microstructures – insights from innovative post-processing techniques” by Ankit, Selzer and Nestler

Paper type: Model Assessment Methods Paper (note: Purpose and Scope of Model Assessment Methods paper (from http://www.geoscientific-model-development.net/submission/manuscript_types.html): Model Assessment Methods include work on developing new benchmarks for assessing model performance, or novel ways of comparing model results with observational data. Also included are discussions of novel methods for data analysis or visualisation with relevance to geoscientific modelling, or the application of existing techniques to this field. These papers may be theoretical, in which case an example implementation should be

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provided as a supplement. They may also be based on the description of a full-fledged software tool. Descriptions of software tools will be subject to the same criteria as model descriptions (version must be identified in the title, code supplied for the peer-review process, etc.).

Summary: The submitted article “Three-dimensional phase-field study of crack-seal microstructures – insights from innovative post-processing techniques” presents a 3D model for vein growth, with the possibility to model in principle crack sealing microstructures together with a modified tracking tool to track the growth of a crystal both numerically and in principle in thinsection. The model itself has already been presented in a recent publication in *Contr. Mineral. Petrology*. There is little difference between the already published work and the presented work here. No direct comparison with real rocks are given. Furthermore, there is a general misconception of the use of the term “Crack-seal”. The presented model does not show crack-seal behaviour – but only seal behaviour. There is no true repetitive cracking and sealing going on. There is 1 crack event and then a continuous sealing event (growth of crystals). This needs to be rectified.

General comments: A) Title: This is Uniaxial Vein Growth not Crack Sealing – needs rectification

B) Organisation of paper: The paper is generally correctly organized, however, it is not made clear what really the difference between this contribution and the latest publication of Ankit (*Contr. Mineral. Petrology*) is. The General tracking method has already been presented in that very paper (Ankit et al. 2013). The dependence of grain number with rate of crack opening has also already been shown. To warrant publication especially as a Model Assessment paper – direct comparison with experiments or nature need to be given.

C) Abstract: The paper promises to look at realistic boundary conditions, but how realistic is the fractal surface used – this is not being tested/discussed or questioned in

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the contribution and not even based on any natural examples of cracks in nature. Thus the abstract promises research that is not presented.

D) Introduction: Generally fine. However, should go more into the literature of how veins crack, what governs crack opening rates, and the known surface roughness in different rocks. Needs more review of data from the geological community as input for the numerical simulation presented here. Work by Koehn et al. in the early 2000 on fringe development should be discussed and cited as there they have shown the clear dependence of growth behaviour and crack roughness.

E) Methods: As far as I can see, the numerical method is the same model as presented in Ankit et al. 2013. In general it is o.k. like this, however since the model was already explained it would have been good to provide an extra figure showing graphically how the model works (to complement figures in Ankit et al. 2013).

F) Results. The Tracking efficiency that is written in the results section, should really be in the methods section. The emphasis of this paper is this tracking efficiency as actually the boundary conditions are not varied or tested. This is a slightly refined version of the Ankit et al. 2013 version. Please put method of tracking into the Methods section. In the results you can have the tracking results, and the statistics of grains. Again none of this is really new or novel though.

G) Discussion Actually, the results presented are very few and not new and not compared to nature. For an Model assessment paper there should be some comparison as the Model itself has been already presented. This seem very much a double-dipping technique. If you compare with experimental or natural samples, then you give this publication an extra dimension (which is necessary)

H) Conclusion Conclusions are very similar to that given in Ankit et al. 2013. And has little to do with the abstract “realistic boundary conditions” – I do agree that 3D models are very valuable, however a lot can be learnt from 2d models and in many cases it is much easier to assess if results are just an artefact of the numerical method used or

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true. This needs to be discuss

Final remarks: It is difficult to warrant publication of this work, this does not mean that the 3D model has not a great potential. There is a lot you can do with that. But it needs to be applied to the real world and at the moment it is not. As such I suggest to refocus, compare with natural samples and truly test the boundary conditions (roughness of crack surface) – AND it is not crack-sealing the authors are modelling it is uniaxial vein growth as far as I can see

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