Author's response to the review suggest by anonymous Referee #1

Journal: SE
Title: Simulating stress-dependent fluid flow in a fractured core sample using real-time X-ray CT data
Authors: Kling et al.
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Date of Response: May 20, 2016

Dear Anonymous Referee,

The authors would like thank for your precious time, your efforts and the short processing time in reviewing the submitted manuscript. We have addressed all recommendations indicated in the review report, and believe that the requested and implemented corrections will improve the quality and consistency of our paper.

Response to Referee #1

Comment → Author's Response → Author's changes

Comment 1:

Page 5, Line 9, if you could add the permeability of the rock matrix in mD that would save a reader from having to think about the conversion. This would be nice elsewhere in the document as well.

Response:

We generally agree. However, we think that the choice of the unit most widely is a point of the geological background. Re-examining the literature indicated that m^2 is as common as mD as the preferred unit. Since we intend to work on with the data we think that maintaining the SI unit (m^2) provides the best way to prevent further confusion when applying the data to further calculations.

Comment 2:

Page 6, lines 17 and 18 discussing the conversion of the original voxel dimension to the isotropic voxel size. This is unclear to me. If a 0.5 x 0.5 x 1 mmˆ3 voxel is converted to four (4) 0.25 x 0.25 x 0.25 mmˆ3 voxels there is a loss of volume somewhere I think.

I think the authors mean for this to be 16 voxels, but I am unsure on the conversion technique in general and would like for some more discussion on this process to be added to the text so that it is clear.

Response:

We fully agree and therefore made some changes to the manuscript. For a more detailed discussion of the conversion technique, please refer to our response to Referee2.

- Page 6, lines 26-28: After reading the five data sets, every CT scan is resampled to an isotropic voxel size (one voxel of 0.5 × 0.5 × 1.0 mm³ to 16 voxels of 0.25 × 0.25 × 0.25 mm³) required for a proper computation of the CFD program.

Comment 3:

Page 6, line 27, 'dense' should be 'density' I think.

Response:

Done.

- Page 7, lines 4-5: Aperture calibration is based on the phenomena that the presence of (low-density) air or water in a homogeneous rock matrix reduces CT numbers of voxels containing present voids and also can affect adjacent voxels.

Comment 4:

The use of the missing attenuation approach in general. Since it is stated on page 7, line 32 that N = 1 for the MA calculations then this isn't really a summation of the HU in the aperture. The authors acknowledge this later on in the text (Page 8, line 10), but then double back in the conclusions and discussion to say that MA is good for identifying the aperture

values. That just doesn't sit very well with me and more clarification on this when describing the results would be preferred. Something like "the modified MA using the primary voxel within the fracture showed good results".

Response:

We agree. The following changes are therefore performed:

- Page 4-5, lines 32-1: This simulation approach consists of (1) an aperture calibration approach for 3D simulations based on a modification of the simplified Missing Attenuation (MSMA) method and (2) a sophisticated simulation method that accounts for fracture and matrix flows by solving the Navier-Stokes-Brinkman equation.

Comment 5:

I'm not as convinced as the authors are that conversion to a PEEK core holder would improve results of the simulation so much. But I'm willing to let that slide, as it would reduce CT noise and improve results somewhat.

Response:

We generally agree. However, we think it would be necessary to implement this approach into systematic investigation to approve this assumption.

Comment 6:

I think the largest issue with the simulations is the constant matrix permeability. The authors discuss this several times and attempt to correct for this by modifying the matrix permeability +/- one standard deviation of the HU (Fig 7b). I think the variability in the matrix would need to be accounted for by modifying the voxel permeability in the matrix to match high HU voxels with very low (zero) permeability and low HU voxels to higher permeability values. But I have no idea if GeoDict could actually handle this level of complexity. If it could, I think it would benefit your analysis and fit to the experimental data.

Response:

Please refer to our responses to Referee2 (Comment 1, 7, 8 and 10).