

Interactive comment on “Enhanced pore space analysis by use of μ -CT, MIP, NMR, and SIP” by Zeyu Zhang et al.

Anonymous Referee #1

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General comments:

The analysis of pore space geometry in rocks is of great relevance to many areas of earth sciences. In this study, the authors propose to compare the results obtained from different pore space characterization techniques in two sandstones, the Bentheimer and the Rotthbacher.

Though I think this is a great topic to investigate, I find that the work itself does not bring significant value in its present form. A lot of research has already been conducted in this domain and it is difficult to see what new element the paper provides, aside perhaps from the spectral induced polarization part which I unfortunately had a very hard time following. Maybe the work could be augmented with a better review of previous findings and a more thorough extraction of information from the microCT images.

In the abstract, the authors announce that they are going to characterize the pore space geometry, although nothing is done beyond acquiring and tracing various cumulative curves. In the abstract again, the concept of fractals is used but it is unclear (1) whether it is warranted to compute a fractal number from these curves as it is not demonstrated that they represent distributions of objects and (2) what the authors recommend what one should do with that value.

Regarding the work that is done on images and the comparison between different data sets, I wish the authors had provided more information and figures on the image segmentation result as well as the result of the maximum inscribed sphere (MIS) computation. Also, the authors may be aware that such computation (MIS) can be used as a starting point for performing a digital equivalent to MIP which becomes then valuable to compare with the experimental mercury injection curve. In fact, a comparison between experimental MIP and digital MIP on one hand, and between MIS and NMR on the other would have made more sense.

Because the reader does not have access to the state of the images prior to the tracing of the cumulative 'pore size' curve (MIS), it is very difficult to check whether the result is consistent. I have a doubt regarding the offsets observed in Figures 2 and 6 and I am wondering if what is plotted for the MIS is really the radius or rather a diameter. Please check. Also I am surprised to see that virtually no 'objects' with dimension smaller than 20 microns was detected in either sandstone considering the image resolution of 1.75 microns per voxel and 1.5 microns per voxel for the Bentheimer and the Rothbacher, respectively.

I don't think that I can speak at length to the SIP part because I am not familiar with it. I would like to see a more intuitive explanation as to why it is appropriate to compare SIP data with a drainage (MIP) curve. Also I don't understand how the data of Figure 5 on frequency-dependent complex conductivity is converted into relaxation times (assuming this is what is being done).

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In terms the organization of the paper, I found the figures confusing in the fact that they convey more information than is being discussed at first, forcing the authors to go back and forth when describing their results.

I am convinced the authors have at they disposal a great starting point to a valuable study. The sandstones picked are definitely materials of interest to the community and the high resolution microCT images can certainly be exploited further.

Other comments:

*I think the English could probably be improved (grammar and choice of words mostly)

*In the conclusion, an image resolution of 3.5 microns per voxel is quoted - please decide.

*I did not see the benefit of plotting the curves starting from the smallest injection radii - it puts an emphasis on the fraction where there is less data and also that likely contributes nearly nothing to flow, while dwarfing most of the important information.

*How were the injection steps chosen for the MIP curves? It seems nearly random, and also very sparse in the case of the Rothbacher.

*Table 2 would be easier to look at if some mineral names were added to it.

*The resolution of the microCT images is great, the authors should be able to show much more detail at the grain scale. Have the authors attempted to determine whether the voxel dimension was a true image resolution?

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2018-42>, 2018.

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