Determining Pore Size Distribution Data from X-ray Tomography Images by Neural Networks

Daniel Keszthelyi[1,*], Sigve Bøe Skattum[1], Dag Kristian Dysthe[1], Anders Malthe-Sørenssen, and Bjørn Jamtveit[1]

1 Physics of Geological Processes, Department of Physics and Department of Geosciences, University of Oslo, Norway
* email: danielke@fys.uio.no

ABSTRACT

X-ray tomography is an efficient way of getting insight into a rock sample without destroying it. During the measurement density map slices are obtained from which a 3-dimensional dataset can be obtained by conventional algorithms (e.g. as implemented in the commercial software Avizo).

Conventional image segmentation algorithms work very well with tomography data where structures are significantly larger than the resolution of imaging[1], however they give less reliable results if structures have similar size than the resolution. Analyzing tomography data we found the chalk contains a large amount of microporosity difficult to extract by conventional image segmentation algorithms.

We created a learning algorithm based on the concept of deep learning neural networks to identify pore space in the tomography data. The method was earlier applied to biological tomography data and gives an improved segmentation accuracy compared to standard segmentation methods[2].

Here we present initial results of this new approach which is then used to update results for predicting strain rates in compaction experiments by a theoretical model[3].

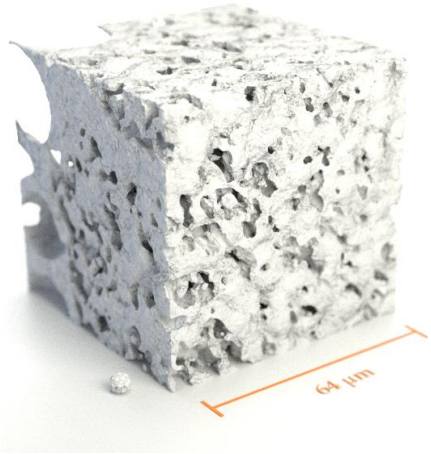

Fig. 1 Tomography data of a Liège chalk sample

References

1. Panahi, H., Kobchenko, M., Renard, F., Mazzini, A., Scheibert, J., Dysthe, D. K., ... & Meakin, P. (2014). A 4D synchrotron X-ray tomography study of the formation of hydrocarbon migration pathways in heated organic-rich shale. arXiv preprint arXiv:1401.2448.
2. Turaga, S. C., Murray, J. F., Jain, V., Roth, F., Helmstaedter, M., Briggman, K., ... & Seung, H. S. (2010). Convolutional networks can learn to generate affinity graphs for image segmentation. Neural Computation, 22(2), 511-538.
3. Keszthelyi, D., Model of compaction creep in carbonates, submitted