Contribution ID: **434** Type: **Poster Presentation**

Use of semi-automatic deep learning algorithms for the segmentation and classification of cavities in carbonate fault rocks

Monday, 30 May 2022 15:10 (1h 10m)

Accurate knowledge of pore space in fault zones in stratified carbonate and marl sequences is important because fault zones play an important role in reservoir properties (e.g. Agosta et al., 2010, Caine et al., 1996). However, estimating pore space in these structures is difficult due to their heterogeneity, and sampling is also complicated due to the often non-cohesive properties of fault rocks and the gouge. Here we briefly review sampling and processing methods and discuss automated analysis approaches using deep learning algorithms to analyse microscopic and CT images. We have developed a semi-automated tool for facies analysis of fault rocks, with particular emphasis on mineral phase porosity and automatic identification and segmentation of fractures.

Orientated transfer sample were taken from a limestone quarry in Ittlingen, Baveria in Germany. We used transfer preparations perpendicular to the fault plane to obtain, large (45x60x20 cm) samples which offers the opportunity to obtain samples from the fault zone including the damage zone and fault core with known orientation. Subsamples of the transfer preparations were measured by using scanning electron microscopy in combination with broad ion beam polishing. At the macro-scale CT imaging was used to obtain the fracture networks and spatial distribution of the different building blocks of the fault zone.

We mainly use image data from backscattered electron and energy dispersive X-ray spectroscopy measurements and develop a tool for rock facies segmentation with superpixel algorithms (e.g. Stutz et al., 2018). The tool also enables automatic segmentation of mineral phases based on a customisable decision tree (Jiang et al., 2021) after superpixel generation. We then analyse the void space using secondary electron images with a trained deep learning model (Klaver et al., 2021) based on a U-Net structure. To distinguish between fractures and pores, a decision tree was created based on the shape of the segmented pores, e.g. eccentricity, circularity, aspect ratio and size.

Initial results show that the semi-automated tool provides a simple and fast way to determine the distribution of mineral phases and that the trained deep-learning algorithm for pore segmentation has an accuracy of about 98 % for two different fault facies. By iteratively integrating the training data into the existing model, the results are continuously improved. In future work, we aim to train the deep-learning algorithms to analyse and classify multiple fault facies and minimise the manual labour and expertise required to automatically segment and classify pores and fractures in faults in carbonates

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Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

Online

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Session Classification: Poster

Track Classification: (MS10) Advances in imaging porous media: techniques, software and case studies