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Digital rock physics: Segmentation of sub-resolution features

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Digital rock physics (DRP) became a complementary part in reservoir characterization during the last two decades. Deriving transport, thermal, or effective elastic rock properties from a digital twin requires a three-step workflow: (1) Preparation of a high-resolution X-ray computed tomography image, (2) segmentation of pore and grain phases, respectively, and (3) solving equations due to the demanded properties. Despite the high resolution µ-CT images, the numerical predictions of rock properties have their specific uncertainties compared to laboratory measurements. Missing unresolved features in the µ-CT image might be the key issue. These findings indicate the importance of a full understanding of the rocks microfabrics. Most digital models used in DRP treat the rock as a heterogeneous, isotropic, intact medium which neglect unresolved features. However, we expect features within the microfabrics like micro-cracks, small-scale fluid inclusions, or stressed grains which may influence the elastic rock properties but have not been taken into account in DRP, yet. Former studies have shown resolution-issues in grain-to-grain contacts within sandstones or inaccuracies due to micro-porosity in carbonates, this means the micritic phase. Within the scope of this abstract, we image two different sandstone samples, Bentheim and Ruhrsandstone, as well as one carbonate sample. Here, we compare the mentioned difficulties of X-ray visualization with further analytical methods, this means thin section and focused ion beam measurements. This results into a better understanding of the rocks microstructures and allows us to segment unresolved features in the X-ray computed tomography image. Those features can be described with effective properties at the µ-scale in the DRP workflow to reduce the uncertainty of the predicted rock properties at the meso- and fieldscale.