Nanopore structures, statistically representative elementary volumes, and transport properties of chalk

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Scientific Achievement

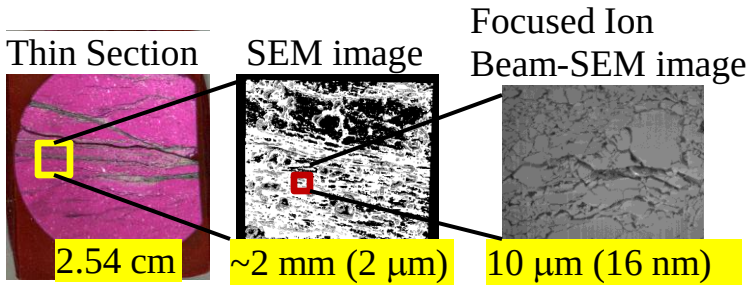
Performed a quantitative analysis of nano-pore structures of Chalk sample to identify the size of the statistically representative elementary volume (SREV)

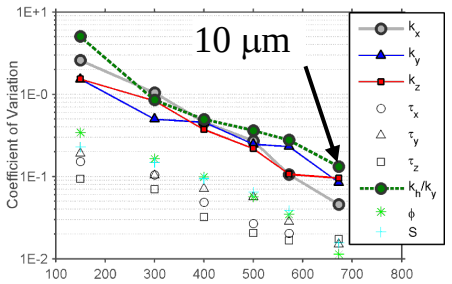
Significance and Impact

Improved multi-scale imaging capabilities with sub-micron FIB-SEM techniques to accurately account for nanopore structural features impacting pore-scale flow and transport properties in caprock materials

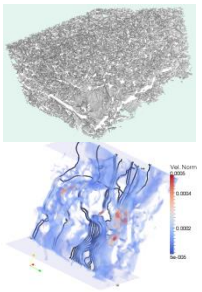
Research Details

- Lattice Boltzmann simulations and topological analysis of nano-pore structures
- Quantitative analysis for Chalk sample shows FIB-SEM sample volume has a size of SREV at ~ 10 μm
- Permeability and surface area can be strongly affected by image resolution, highlighting the importance of features at the sub-micron scale for petrophysical and multiphase flow properties in caprock materials
- For multi-scale digital rock reconstruction, segmented 3-D FIB-SEM data at the SREV scale can be directly mapped to a thin section or micro-CT data





Coefficient of variations for permeability, tortuosity, anisotropy, porosity, & surface area



3D segmented pore structure (top) and flow field (bottom)

H. Yoon and T. Dewers, GEOPHYSICAL RESEARCH LETTERS, VOL. 40, 4294–4298, (2013)

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