(U)SANS and imaging analysis of changes in multiscale porosity in the St. Peter sandstone with burial diagenesis

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The multiscale pore structure of the rocks and the mineralogy associated with those pores are critical factors for estimating a number of reservoir properties including fluid mass in place, permeability, and capillary pressures as well as geochemical interactions between the rock and the fluid. Combination of small and ultrasmall angle neutron scattering (U)SANS with backscattered electron and/or X-ray computed tomographic imaging provides a means by which the pore structures can be quantified at scales ranging from aproximately 1 nm to 1 cm – 7 orders of magnitude.

To examine the effects of burial diagenesis on sandstone, and compare those to the effects of overgrowth formation [1] we obtained samples of St. Peter Sandstone from drill cores obtained in Sangamon, Clinton, Marion and Montgomery counties in Illinois and Arenac county in Michigan at depths of ~ 2700, 3200, 4100, 5200 and 10800 feet, respectively. Larger-scale (< 10 microns) porosity shows the expected decrease in porosity with depth, although there is significant variation in in each sample group. However, (U)SANS data show that small-scale porosity increases with depth, and more careful analysis of the results suggest that pore structures exist and change at several distinct scales within these rocks.

[1] Anovitz *et al* (2013) *GCA* **102**, 280-305