Organic Porosity in Shale: Similarities and Differences in Closely Spaced Samples of Barnett Shale

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Small-angle neutron scattering (SANS) and ultra small-angle neutron scattering (USANS) with contrast matching [1] techniques were used to investigate pore structure in Barnett Shale samples. SANS and USANS measurements record scattering from all pores in the size range 10 μm — 10nm, including pores that are inaccessible to fluids, and can be used to determine the material that contains pores and the number of pores as a function of size. By injecting deuterated methane gas (CD_4) at contrast matching pressure it is possible to distinguish which pores are accessible, or open.

We measured the variability in the fraction of accessible pores in two sub-samples 2 mm apart, mainly to examine mm-scale heterogeneity in shale. Preliminary results suggest that the fraction of accessible pores varies between 50-90% in the USANS range (10 μm — 100 nm), with the largest pores being more inaccessible. In the SANS range (100 — 10nm) 60-85% are accessible. The smallest pores (<10nm) were not detected, presumably because of condensation of methane. Pores occur in organic material. These findings differ from previous work [2], which showed that pores were most accessible (80-90%) in the USANS range and less accessible (60-80%) in the SANS range. Some of the pores [2] may be present in inorganic material. Results indicate that data derived from the small samples used to examine porosity in energy systems must be used with care when up-scaling to plays or resources.

[1] Melnichenko *et al* (2012) *Fuel* **91**, 200-208. [2] Ruppert *et al* [2013] *Energy Fuels* **27**, 772-779.