Application of Neutron Scattering Technique in Shale Pore Accessibility and Connectivity Study

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ABSTRACT

Rock wettability and pore structure are two critical factors controlling the fluid migration in porous reservoir rocks, especially in tight shales. Previous work using complementary approaches of mercury injection capillary pressure (MICP) analysis, liquid imbibition, tracer diffusion, vacuum-saturation, and Wood's metal impregnation has confirmed that the pore spaces in many shales are only well-connected for ~250-500 μm from the sample edge (e.g., fracture face), but sparsely connected further into the matrix. Our recent work of MICP has indicated an increasing edge-accessible porosity present with decreasing shale test specimen size, which we hypothesize is related to the damage zone generated during particle size reduction of the specimen. To study the size effect on shale matrix accessibility, an ultra small- and small- angle neutron scattering (USANS and SANS) technique will be applied to quantify the total porosity (connected and isolated porosity) of (1) dry and (2) fluid-saturated shale specimens. This work is of significance to understand fluid flow behavior in shale reservoirs before and after hydraulic fracturing, as well as oi and gas recovery.

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