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Quantifying oil- and water-wettable pore networks of the lacustrine- and marine-sourced shale oil reservoirs

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Microscopic pore structure (both geometry and connectivity) characteristics control fluid flow and hydrocarbon movement in shale oil reservoirs. Considering the uniquely wide spectrum of pore sizes (nm to sub-mm), microscale mixed wettability, as well as the interplay of pore structure and wettability in organic-rich shale oil reservoirs, this work presents various approaches to quantifying the oil- and water-wettable pore networks for several important tight oil formations in China and USA with different depositions, as well as a range of maturation and mineral compositions. The approaches include the utility of different wetting fluids (deionized water or API brine, n-decane and/or toluene, isopropyl alcohol or tetrahydrofuran or dimethylformamide), fluid pycnometry, fluid immersion porosimetry after vacuum saturation, mercury intrusion porosimetry, nuclear magnetic resonance, and field emission-scanning electron microscopy. In particular, (ultra-) small angle neutron & X-ray scattering techniques, (U)SANS & (U)SAXS, are used to quantify the total (both edge-accessible and isolated) porosity and characterize pore size distribution in a pore length size from 1 nm to 10 ⊠m; in addition, the employment of contrast matching technique of (U)SANS enables the discrimination of accessible (open) pores and inaccessible (closed) pores to a particular liquid fluid. For example, our results show that the marine-sourced Bakken samples in USA have a relatively high total porosity (8.87-12.95%) with no more than 30% of the pores are accessible from sample surface, and are not preferentially wet by oil or water.

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