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Wetting behaviors and oil occurrence status of shale reservoirs

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A contrast-variation technique in small-angle neutron scattering (CV-SANS) is employed to investigate the interfacial chemistry of shale oil reservoirs using reagents that span a range of polarities, including water, toluene, and dimethyl methanamide. Through five different experimental strategies, the work demonstrates a modification of shale wettability, ranging from enhancement, weakening, to reversal. This study also presents an innovative approach for characterizing the status of oil occurrence at the nanometer scale, and new insights into the scattering vector-particle size (q-r) relationship in polydisperse systems. The unique CV-SANS technique shows that shale with low contents of total organic carbon, clays, and porosity typically indicates better oil mobility, associated with larger particle scales. Meanwhile, the results indicate that an increase in pore scale does not necessarily accompany the rise in radius of gyration when mass density spatial variation occurs in the system. Collectively, this work establishes a direct correlation between size r in real space and q in reciprocal space and decodes the interfacial wettability traits in nanopores of shale oil reservoirs.

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