Nanopore and Spontaneous Imbibition Characterization of the Woodford Shale from West Texas

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ABSTRACT

The Woodford Shale in the Permian Basin is considered as one of the principal source rocks. In this study, we have investigated a continuous Woodford Shale core from Reliance Triple Crown well in Pecos County, Texas,for pore structure and imbibition behavior using the following complementary tests: mercury injection capillary pressure (MICP) and fluid imbibition into initially dry shale. The imbibition tests use two types of wetting fluids (dionized [DI] water and n–decane). Our results indicate that different core depths of Woodford Shale have different reservoir characteristics (e.g., porosity and permeability). At the time of the imbibition test, Woodford Shale showed a late-time imbibition slope close to 0.25 for DI water and 0.5 slope for n–decane. High tortuosity value from mercury injection capillary pressure analysis and spontaneous water imbibition indicate that Woodford Shale matrix has low pore connectivity. MICP analysis of shale in the Woodford indicates that median pore throat diameter for this shale is 3.7 to 4.5 nm, and almost 70–80% pore throats by volume are smaller than 100 nm. The overall conclusions from the above experimental approaches show low connectivity of tortuous nanopore spaces and imbibition characteristics, which could implicate overall hydrocarbon recovery in Woodford Shale.