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A comprehensive analysis on the wettability in shale oil rocks

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Abstract: Fracturing-Soaking-Producing (FSP) is considered one of the effective methods in the development of shale oil. Improving the imbibition efficiency during the FSP process cannot be achieved without accurate understanding of reservoir wettability. Here, we used contact angle wettability method, spontaneous imbibition wettability method with nuclear magnetic resonance, centrifugation wettability method, and freeze-emission electron microscopy method to evaluate the wettability of core samples withdrew from Ordos Basin. At the same time, we developed a characterization method for pore-scale wettability based on the capillary bundle model then quantified the pore-scale wettability characteristics. The freeze-emission electron microscopy experimental results behaved that the oil is mainly adsorbed on the pore surface, while the water is present as a free fluid in the pores. The capillary pressure curves during waterflooding agree with the ones during gasflooding, and the wettability index is between 0.55 and 0.65, indicating that our core samples exhibit oil-wet. Furthermore, the pore-scale wettability illustrated that the average proportion of oil wet pores is about 60%, and the average proportion of water wet pores is about 40%. The oil-wet pores are mainly distributed in mesopores, and the micropores and macropores account for a relatively small proportion. The water-wet pores are mainly distributed in macropores and micropores, and the mesopores account for a relatively low proportion. Our research work enriches the understanding of the wettability of shale oil and has certain significance for optimizing the parameters such as the amount of liquid entering the shale oil reservoir.
Keywords: shale oil; wettability; pore structure; pore scale

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