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Multiphase Flow Behavior and Numerical Simulation in Fractured-vuggy Porous Media

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he geological features of fractured-vuggy carbonate reservoirs are complex, primarily manifested in the multi-scale nature, diverse distribution, and complex connectivity and combination of fractures and vugs. The fluid flow behavior in such media is complex, involving both porous flow in the matrix and fractures and free flow in vugs. This results in the internal flow showing features of coupled flow of two-phase or even multi-phase free flow coupling. Currently, research on the coupling of single-phase porous media flow and free flow has been very mature at home and abroad. However, the research on multiphase flow is not perfect, and the coupling mechanism is not clear, especially three-phase flow of oil, gas, and water, leading to immature development theories and methods for fractured-vuggy reservoirs and low recovery rates.As proven the behavior of three-phase flow of oil, gas, and water in fractured-vuggy reservoirs, this study, based on typical reservoir geology and flow features, designed and fabricated a physical model of fractured-vuggy media and conducted physical simulation experiments. Numerical simulation studies were then conducted based on these experiments, with the simulated flow trends being generally consistent with the experimental results. By combining numerical modeling with experimental approaches, a fundamental theoretical study on the three-phase flow of oil, gas, and water in fractured-vuggy reservoirs was conducted, illustrating the features of the three-phase flow in such media. This research has a certain guiding significance for the efficient development of fractured-vuggy reservoirs.

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