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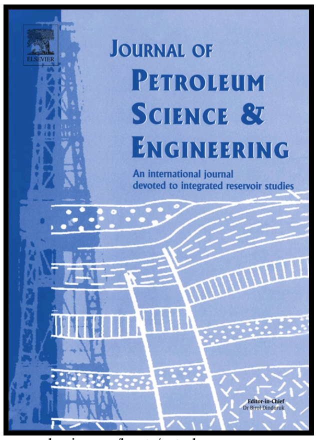

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A Fully Compositional Model Considering the Effect of Nanopores in Tight Oil Reservoirs

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Abstract

Conventional compositional simulators are usually difficult to interpret the different gas oil ratio (GOR) from tight oil reservoirs, and this also indicates an unreliable prediction of ultimate hydrocarbon recovery. We realize that there are two issues related to the compositional simulation of production in tight oil reservoirs. Firstly, tight oil reservoirs typically exhibit extremely small matrix pore size in the order of nanometers, so the capillary pressure between vapor and liquid phases is considerable such that the PVT of the confined fluid deviates from that of the bulk fluid with capillary pressure ignored. Secondly, during depletion process, rock compaction causes pore space reduction and brings remarkable changes in rock properties. In this work we implement rigorous confined fluid phase behavior calculation depending on capillary pressure and rock compaction in a fully compositional simulator. Capillary pressure in matrix nanopores is calculated by Leverett J-function. Further, the impact of capillarity on phase equilibrium is taken into account through modifying the stability test and two-phase flash calculation. Dynamic rock compaction is considered in the simulator via rock compaction tables, such that fluid mobility decreases with permeability reduction and capillary effect is simultaneously coupled. The unique implementation in the simulator captures the dynamic behavior of rock and fluid properties in tight oil reservoirs. Typical suppression of bubble point pressure and reduction of oil viscosity and density is observed from our simulation results. Reservoir scale simulation results shows that this model resolves the problem of the inconsistent GOR in tight oil production and greatly facilitate the history matching process. The enhanced compositional simulation will ultimately improve our understanding of tight oil reservoirs and provide better guidance for recovery prediction.

Keywords:

Tight oil reservoirs; compositional simulation; vapor-liquid equilibrium; capillary pressure; rock compaction

Nomenclature

Acronyms