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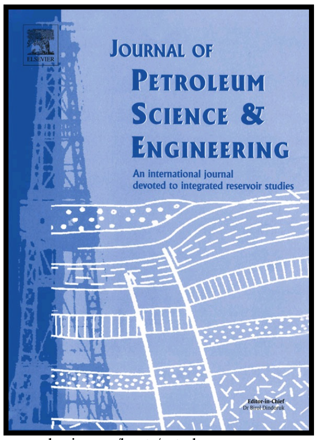

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Development and Validation of an Explicitly Coupled Geomechanics Module for a Compositional Reservoir Simulator

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Abstract

Pore pressure-stress analyses in stress-sensitive reservoirs investigate interactions between the in-situ stress and fluid flow; these interactions help or resist production, or conclude surface subsidence during production. Among the tools for these analyses, an explicitly coupled geomechanics and fluid flow model provides an essential, reliable, and fast production estimate for field planning and development. In this work, we implemented this model in an in-house, three dimensional, compositional reservoir simulator, UTCOMP, using Chin's iterative coupling method. This development integrated a stand-alone geomechanics module based on finite element method with the reservoir simulator, an advantage of our coupling algorithm, and improved our understanding of the production through various enhanced oil recovery processes such as water and CO_2 flooding processes previously coded in UTCOMP. Benefiting from the higher time scales of solution variations due to the geomechanics module, we lowered the frequency of calling this computationally expensive module. Also, we reduced the order of the finite element shape functions for displacement from quadratic to linear, which majorly mitigated the high computational cost of our geomechanics studies while we almost maintained the solution accuracy. To validate our implementation, we investigated a primary oil production case and compared the results from UTCOMP with those from two other simulators: 1) CMG software program using different coupling methods; and 2) another pre-validated in-house reservoir simulator, GPAS. In order to evaluate our improvements in this work, we compared our results with those from a pre-validated in-house reservoir simulator, GPAS. We observed a minor discrepancy between the solutions at very early times which originates from the different structures in these two reservoir simulators, IMPEC in UTCOMP and fully implicit in GPAS.

Abbreviations

UTCOMP: University of Texas COMPositional oil reservoir simulator; GPAS: General Parallel Adaptive Simulator; IMPEC: IMplicit Pressure Explicit Concentration; 3D: Three Dimensional; EOS: Equation of State; VWP: Virtual Work Principle

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