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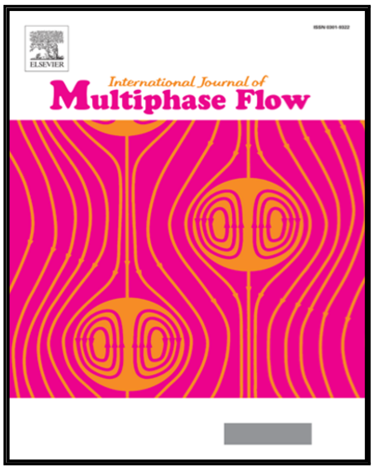


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# Higher-Order Black-Oil and Compositional Modeling of Multiphase Compressible Flow in Porous Media

Mohammad Amin Amooie[a,*], Joachim Moortgat[a]

[a]*School of Earth Sciences, The Ohio State University, Columbus, OH 43210, USA*

**Abstract**

We present continuum-scale modeling of multiphase compressible flow in porous media with applications to hydrocarbon reservoir engineering. A new black-oil model is developed and compared with a fully compositional simulator to model the thermodynamic phase behavior. In the context of black-oil modeling, where components are lumped into a gas and liquid pseudocomponent with only the gas transferring between liquid and gas phases, we allow for a variable bubble point pressure (e.g., when gas enters an undersaturated zone). Traditionally, a primary variable switching strategy has been used, which is known to be prone to convergence and phase identification issues. Instead, we adopt an overall molar composition-based framework that can robustly model phase appearance or disappearance. Phase properties across a broad range of pressures for different black-oil compositions are constructed from compositional phase split calculations to correctly model the phase transition. Mass transport is updated explicitly by a locally mass conserving multilinear discontinuous Galerkin method. Globally continuous pressure and velocity fields are obtained through an implicit mixed hybrid FE scheme. The robustness and accuracy of our FE simulator are demonstrated in several problems, where we have attained considerable speed-up and maintained the accuracy with the new black-oil model.

*Corresponding author.
Tel.: +1 (614) 648-8287
Address: 302 Mendenhall Laboratory, 125 South Oval Mall, Columbus, OH 43210
*Email addresses:* amooie.1@osu.edu (Mohammad Amin Amooie ), moortgat.1@osu.edu (Joachim Moortgat)