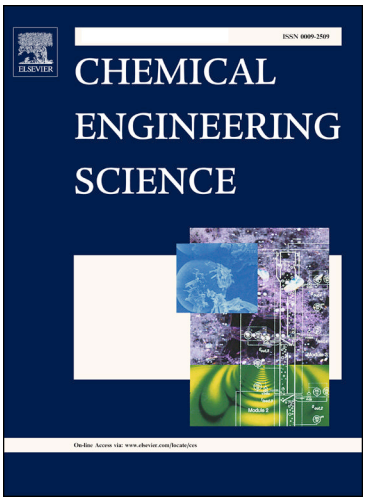

Pore scale characteristics of gas flow in shale matrix determined by the regularized lattice Boltzmann method

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Pore scale characteristics of gas flow in shale matrix determined by the regularized lattice Boltzmann method

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Abstract: The flow mechanism of natural gas in the shale matrix is closely related to the high efficient development of shale gas reservoirs. However, the flow characteristic of shale gas in nanometer pores is scale dependent, and is also affected by the formation condition, adsorption layer, residual water saturation and detailed pore structure. In this study, a lattice Boltzmann model with a regularization procedure was applied to simulate shale gas flow in a 2D porous medium, and the effects of slippage, adsorption layer, residual water saturation and surface area on the apparent permeability were discussed. Simulation results indicate that the apparent permeability decreases with the increasing formation pressure, and increases with the increasing formation temperature and characteristic pore size. The adsorption layer and residual water affect the apparent permeability by changing the effective pore space for gas flow. And the effect is more obvious under the large Knudsen number conditions. When the porosity of the porous media is constant, the apparent permeability decreases with the increasing surface area, and the large surface area would even offset the positive effect of slippage on the apparent permeability.

Keywords: shale gas; porous media; apparent permeability; lattice Boltzmann;

1. Introduction

The shale gas revolution in the U.S. has greatly triggered a universal passion for the exploration and development of this unconventional resource. In recent years, researchers have done much work during the processes of shale gas exploration and exploitation, and have accumulated techniques like reservoir characterization [1, 2], horizontal well drilling and completion [3, 4], hydraulic fracturing stimulation [5],

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