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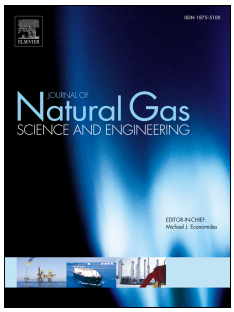

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PII: S1875-5100(17)30077-X

DOI: 10.1016/j.jngse.2017.02.024

Reference: JNGSE 2077

To appear in: *Journal of Natural Gas Science and Engineering*

Received Date: 2 June 2016

Revised Date: 14 February 2017

Accepted Date: 18 February 2017

Please cite this article as: Xia, Y., Jin, Y., Chen, K.P., Chen, M., Chen, D., Simulation on gas transport in shale: The coupling of free and adsorbed gas, *Journal of Natural Gas Science & Engineering* (2017), doi: 10.1016/j.jngse.2017.02.024.

Simulation on gas transport in shale: the coupling of free and adsorbed gas

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Abstract

The shale reservoirs contain not only a lot of nano-micro scale pores, but the coupling phenomenon between free and adsorbed gas, which leads to complexity when estimating shale-gas production. Currently, different models have been applied to describe the gas transport in shale, especially in different flow regions. However, the role played by adsorbed gas on the production performance is still difficult to evaluate due to the fact that the coupling of free and adsorbed gas is rarely considered.

This study incorporates various gas transport mechanisms in nanopores including viscous flow, Knudsen diffusion (combination of both is slip flow) and surface diffusion of adsorbed gas with a nonlinear and non-equilibrium gas adsorption-desorption kinetics to formulate a simplified model for studying the dynamic production performance for multi-stage fractured horizontal wells in shale gas reservoirs. A method is developed and used to evaluate the respective contributions from the stored free gas and the adsorbed gas to the total gas production rate. Sensitivity of the production rate to key physical parameters is performed. It is found that desorption process dominates the production within very short times after the start of production. The production rate is shown to be particularly sensitive to the pore size and porosity while largely unaffected by the surface diffusion of the adsorbed gas with the fact that the surface diffusion is a much slower process compared with the diffusion of free gas, especially when the permeability in Stimulated Reservoir Volume (SRV) is