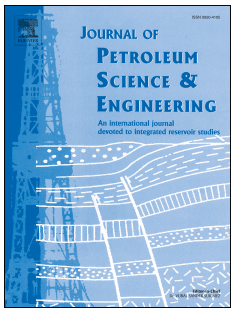
Accepted Manuscript



Lattice Boltzmann simulations of the capillary pressure bump phenomenon in heterogeneous porous media

H.A. Warda, S.H. Haddara, E.M. Wahba, M. Sedahmed

PII: S0920-4105(16)30796-3

DOI: 10.1016/j.petrol.2017.06.058

Reference: PETROL 4070

To appear in: *Journal of Petroleum Science and Engineering*

Received Date: 24 October 2016

Revised Date: 3 May 2017

Accepted Date: 21 June 2017

Please cite this article as: Warda, H.A., Haddara, S.H., Wahba, E.M., Sedahmed, M., Lattice Boltzmann simulations of the capillary pressure bump phenomenon in heterogeneous porous media, *Journal of Petroleum Science and Engineering* (2017), doi: 10.1016/j.petrol.2017.06.058.

Lattice Boltzmann Simulations of the Capillary Pressure Bump Phenomenon in Heterogeneous Porous Media

H.A. Warda, S.H. Haddara, E.M. Wahba*, M. Sedahmed

Mechanical Engineering Department, Alexandria University, Alexandria 21544, Egypt

**Corresponding author email: emwahba@yahoo.com*

ABSTRACT

In this work, the Lattice Boltzmann method (LBM) is used to simulate the fluid displacement processes of primary drainage and imbibition in a randomly generated heterogeneous porous medium. The present procedure is based on the single-relaxation-time Bhatnagar–Gross–Krook (BGK) approximation and the original Shan-Chen multi-component multiphase (MCMP) model. The developed model is validated against classical single and multiphase flow problems, which include the single-phase Poiseulle flow and lid driven cavity flow, and the multiphase miscibility test, bubble test, and contact angle test. Simulation results show that the Lattice Boltzmann method successfully captures the capillary pressure bump phenomenon, which is a frequently encountered phenomenon in petroleum reservoirs. The bump in capillary pressure is shown to correspond to the instant when the fluid invades the narrow pore throats, which require a higher capillary pressure threshold.