A SIMULATION-BASED STUDY OF MICRON SCALE, BINARY FLOWS IN POROUS ROCKS

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The microscopic properties of the multiphase flows in the pore networks of reservoir rocks have important implications for the large-scale flow properties. However, detailed empirical studies of porous flows at the micron scale are difficult. Numerical fluid simulations can provide additional insight. In the recent years, the lattice Boltzmann method has become a standard tool in simulating microscopic porous flows [1]. By solving the lattice Boltzmann equation on three-dimensional unstructured meshes, we have efficiently modelled single-phase fluid flow in real rock samples and used the resulting fields to numerically estimate the single-phase permeability and the particle dispersion in the samples [2]. By extending our model with a free-energy based method, we are now able to simulate binary fluid systems with moderate density ratios in a thermodynamically consistent way. This allows us to investigate binary flows in complex geometries when principal control parameters, such as the surface tension and the contact angle, can be adjusted. In this talk, we present the results of a numerical study of multiphase flows in the pore networks of both artificial and real rock samples. The goal of this study is to determine the behavior and fluctuations of relative permeabilities for an oil and water system, in response to varying water saturation, surface tension and wettability properties, and to compare the simulation results to the existing, experimental measurements.

References

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