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Impact of small-scale capillary heterogeneity effects on large-scale multiphase flow in geological formations

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Abstract:

Multiphase flow in subsurface formations includes capillary effects at the interface between fluids and pore surfaces. The Darcy scale expression for these effects is through empirically measured properties: relative permeability (kr) and capillary pressure (Pc), which are functions of saturation. In typical oil reservoir flow models, capillary pressure can be neglected as the viscous forces dominate the flow. However, in many other applications, such as enhanced oil recovery or CO2 storage in aquifers, these effects are important, particularly when reservoir heterogeneity is significant. One of the important questions in reservoir flow modeling is how to incorporate the small-scale capillary effects into larger-scale models. In this talk, new methods of characterizing effective and upscaled multiphase flow properties (kr and Pc), in cases with capillary heterogeneity effects, will be presented. Two main problems will be discussed in the context of CO2 storage in aquifers for reducing anthropogenic emissions. The first is characterizing the effective properties of core samples extracted from aquifers, subjected to brine drainage by CO2. The second is upscaling CO2-brine numerical flow models, while considering gravity-capillary-driven flow, i.e., gravity segregation under the influence of capillary heterogeneity.

Date & Location:

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