On two-phase flow in karstic geometry: modeling, analysis and numerical simulations

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Abstract

Multiphase flow phenomena are ubiquitous. In some applications such as flows in unconfined karst aquifers, karst oil reservoir, proton membrane exchange fuel cell, multiphase flows in conduits, and in porous media must be considered together. Geometric configurations that contain both conduit and porous media are termed karstic geometry. In this talk, we derive a diffuse interface model for two-phase flow in karstic geometry utilizing Onsager's extremum principle. The model together with the interface boundary conditions satisfies a physically important energy law. We show that the model admits a global finite-energy weak solution which agrees with the regular solution provided the regular solution exists. Then we present a decoupled unconditionally energy-stable numerical scheme for solving this diffuse interface model.