General dual-porosity modeling using the exact analytical solution for spontaneous imbibition.

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ABSTRACT: The abstract should be between 150 to 200 words. It must clearly describe the most important contributions of your work.

Flow in carbonate reservoirs is strongly influenced by fractures present in the geological formations. Fractures are often the main flow conduits, leaving much of the oil behind in the low permeability rock matrix and causing early water breakthrough. An accurate characterization of fracture flow is needed to forecast oil recovery and optimize production. The classical dual-porosity models, traditionally used to model naturally fractured reservoirs, do not account properly for diffusive mass transfer due to spontaneous imbibition; fracture matrix transfer coefficients typically cannot include for arbitrary wettabilities and viscosity ratios.

We present a general dual-porosity model. It is based on an unstructured finite element - finite volume technique which solves the governing equations for two-phase flow fully implicitly. Mass transfer between fractures and matrix blocks due to spontaneous imbibition is computed using the only known analytical and general solution of the Darcy equation including capillarity; this provides us with a generalized transfer function for arbitrary wettability, viscosity ratios, rock types, initial water content and boundary conditions.

We provide proof-of-concept simulation results which show that the proposed model with a generalized transfer coefficient for fracture-matrix fluid exchange models oil recovery more precisely and hence predicts oil recovery more accurately.