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A unified expression for the dependence of single- and multi-phase permeability on capillary pressure BOJAN MARKICEVIC, NED DJILALI, University of Victoria, ZHONG-SHENG LIU, National Research Council Canada — It has been shown experimentally (Katz and Thompson, Phys. Lett. B, 34:8179,1986) that the single-phase permeability of a porous medium is proportional to the square of the characteristic length devised from the capillary pressure curve. We extend this approach for displacement type flows to predict single-phase and mobile phase permeabilities simultaneously, by using the capillary pressure at the breakthrough point to calculate: (i) characteristic length, and (ii) equilibrium saturation. These two parameters are combined and a novel set of mixing rules is formulated. This framework is tested using a set of numerical results obtained from capillary network simulations using a model that accounts for invasion percolation with trapping in a drainage flow. These simulations show that with increasing medium heterogeneity, the porous medium permeability (single-phase) decreases, whereas the mobile phase permeability increases. The size of the domain is also found to influence the equilibrium saturation. Numerical results obtained for a range of domain sizes and heterogeneities are compared with predictions from the analytical model and excellent agreement is found. Based on the single expression unifying single and multi-phase flow, we are able to show that the multiphase flow is similar in nature to a single-phase flow occurring at the distinct scales.

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