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Microscale heterogeneous pore occupancy with variable background pressure gradient OLIVER MCRAE, Boston University, T.S. RAMAKRISHNAN, Schlumberger-Doll Research, JAMES BIRD, Boston University —

Fluid flow through small length scale networks—porous rock, or tumor vasculature—is typically governed by a pressure driven flow dominated by viscous resistance. In the displacement of an immiscible nonwetting fluid, in addition to an external pressure, an internal capillary pressure at the interface of the fluids causes spontaneous movement of the fluid interface. This creates two characteristic regimes: one dominated by capillarity (imbibition), and one dominated by viscosity (drainage). However, the role of the background pressure gradient and heterogeneity on microscale displacement dynamics, and subsequent pore occupancy is unclear. Here we show that the interaction between two parallel pores and a common node with a background resistance is the simplest system to exhibit two distinct imbibition regimes. With this pore doublet model and numerical simulations, we uncover a crossover in pore occupancy as a function of channel size ratio and outlet resistance, and remarkably obtain the same relationship between capillary number and the global residual fluid saturation previously observed in sandstone cores.

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