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Viscous fingering patterns in rectangular grid geometry

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We report the results of experimental and numerical studies of two-phase flow in a simple analog model of porous medium using a rectangular network of microfluidic channels. This geometry promotes the formation of anisotropic, dendrite-like structures during viscous fingering experiments. The dendrites then compete with each other for the available flow, which may lead to the appearance of a scale-free, hierarchical growth pattern. Combining experiments and numerical simulations, we analyze different growth regimes in such a system, depending on the network characteristics and fluid miscibility.