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**Drainage in Two-dimensional Porous Media: From Capillary Fingering to Viscous flow** HUGUE BODIGUEL, CHRISTOPHE COTTIN, ANNIE COLIN, LOF, CNRS UMR 5258, univ. Bordeaux 1, Rhodia — We report some experimental results on two-phase flows in model 2D porous media. Standard microfluidic techniques are used to fabricate networks of straight microchannels having a controlled throat size distribution. We focus on the drainage of a wetting fluid by a non-wetting one of various viscosities and take advantage of image analysis to characterize the velocities of the menisci that are simultaneously moving. In the range of applied capillary numbers ( $Ca$ ) from  $10^7$  to  $10^2$ , the system exhibit a clear transition from a fractal fingering to a stable front, which depends mainly on the size heterogeneity of the medium. The experimental results are accounted by a simple model that accounts for the scaling behaviour of the local velocities as a function of  $Ca$ . We also obtain a very good quantitative agreement when comparing the experimental results to numerical simulations based on a pore network model. This allows us to propose a general prediction of the capillary fingering extent as a function of the capillary number, the channel geometries and the pore size heterogeneity.

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