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**Free fingering at the contact between spreading viscous fluids** JEROME NEUFELD, BP Institute, Department of Earth Sciences, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, LAURA GELL, Department of Physics, University of Cambridge, FINN BOX, BP Institute, University of Cambridge — The spreading of viscous fluids is an everyday phenomena with large-scale applications to the flow of glaciers and the dynamics of mountain formation in continental collisions. When viscous fluids spread on an undeformable base the contact line is stable to perturbations. In contrast, when less viscous fluids displace more viscous fluids, as in a Hele-Shaw cell or porous matrix, the contact line is unstable to a fingering phenomena. Here we show, experimentally and theoretically, that when a viscous fluid spreads on a pre-existing layer of fixed depth and differing viscosity the geometry of the contact line depends sensitively on the ratio of fluid viscosities, the input flux and the initial layer depth. When the injected fluid is less viscous the contact line may become unstable to a fingering pattern reminiscent of Saffman-Taylor fingering. We explore the parameter space of this new instability, and highlight its applicability to understanding mountain formation and glacial ice streams.

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