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Elasticity-Driven Backflow of Fluid-Driven Cracks[1] CHING-YAO LAI, ZHONG ZHENG, Department of Mechanical and Aerospace Engineering, Princeton University, USA, EMILIE DRESSAIRE, Department of Mechanical and Aerospace Engineering, New York University Tandon School of Engineering, USA, GUY RAMON, Department of Civil and Environmental Engineering, Technion - Israel Institute of Technology, Israel, HERBERT E. HUPPERT, Institute of Theoretical Geophysics, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, UK, HOWARD A. STONE, Department of Mechanical and Aerospace Engineering, Princeton University, USA — Fluid-driven cracks are generated by the injection of pressurized fluid into an elastic medium. Once the injection pressure is released, the crack closes up due to elasticity and the fluid in the crack drains out of the crack through an outlet, which we refer to as backflow. We experimentally study the effects of crack size, elasticity of the matrix, and fluid viscosity on the backflow dynamics. During backflow, the volume of liquid remaining in the crack as a function of time exhibits a transition from a fast decay at early times to a power law behavior at late times. Our results at late times can be explained by scaling arguments balancing elastic and viscous stresses in the crack. This work may relate to the environmental issue of flowback in hydraulic fracturing.

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