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Capillary fracturing in granular media MICHAEL SZULCZEWSKI, Massachusetts Institute of Technology, RAN HOLTZMAN, The Hebrew University of Jerusalem, MATHIAS TROJER, University of Leoben, RUBEN JUANES, Massachusetts Institute of Technology — The invasion of gas into liquid-saturated, deformable porous media occurs in many processes including gas venting, hydrocarbon recovery, and geologic CO_2 sequestration. While fracturing during gas invasion has been observed in several studies, the underlying mechanisms and macroscopic patterns remain poorly understood. Here, we experimentally investigate the fracturing mechanism and resulting patterns during the invasion of air into a thin bed of water-saturated glass beads. The control parameters are the air injection rate, the bead size, and the vertical confining stress applied to the top of the bed. We identify three invasion regimes: capillary fingering, viscous fingering, and "capillary fracturing," where capillary forces overcome frictional resistance and induce the opening of fracture-like conduits. We show that the transitions between the regimes are governed by a modified capillary number and a fracturing number. We then extend the experiments to investigate the effect of wettability. Our analysis predicts the emergence of fracturing in fine-grained media under low confining stress, a phenomenon that likely plays a fundamental role in many natural systems.

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