Abstract Submitted
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Fluid-driven fracturing of adhered elastica: evolution of the vapour tip THOMASINA V. BALL, BP Institute, Department of Earth Sciences, University of Cambridge, JEROME A. NEUFELD, BP Institute, Department of Earth Sciences, Department of Applied Mathematics and Theoretical Physics, University of Cambridge — The transient spreading of a viscous fluid beneath an elastic sheet is controlled by the dynamics at the tip. The large negative pressures needed to drive the viscous fluid into the narrowing gap necessitates a vapour tip separating the fluid front and the crack tip. Adhesion of the elastic sheet imposes a curvature at the tip giving rise to an elasto-capillary length scale and the possibility of a balance between elastic deformation and the strength of adhesion. Two dynamical regimes are therefore possible; viscosity dominant spreading controlled by the pressure in the vapour tip and adhesion dominant spreading controlled by interfacial adhesion. A series of constant flux experiments using clear PDMS elastic sheets allow for direct measurement of the vapour tip in the bending (thick sheet) limit. For small fluid fluxes, the experimental results can be explained by a constant interior pressure and a viscous boundary layer near the fluid front and result in an asymptotic model for the advance of adhesion and viscosity dominated fracture fronts resolving the vapour tip. Understanding the fluid-driven fracturing of adhered elastica provides insight into the spreading of shallow magmatic intrusions in the Earth's crust, and the fluid-driven fracturing of elastic media more generally.

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