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**Impact of ductility on hydraulic fracturing in shales** LUCY AUTON, CHRIS MACMINN, University of Oxford — Hydraulic fracturing is a method for extracting natural gas and oil from low-permeability rocks such as shale via the injection of fluid at high pressure. This creates fractures in the rock, providing hydraulic access deeper into the reservoir and enabling gas to be collected from a larger region of the rock. Fracture is the tensile failure of a brittle material upon reaching a threshold tensile stress, but some shales have a high clay content and may yield plastically before fracturing. Plastic deformation is the shear failure of a ductile material, during which stress relaxes through irreversible rearrangements of the particles of the material. Here, we investigate the impact of the ductility of shales on hydraulic fracturing. We consider a simple, axisymmetric model for radially outward fluid injection from a wellbore into a ductile porous rock. We solve the model semi-analytically at steady state, and numerically in general. We find that plastic deformation greatly reduces the maximum tensile stress, and that this maximum stress does not always occur at the wellbore. These results imply that hydraulic fracturing may fail in ductile rocks, or that the required injection rate for fracking may be much larger than the rate predicted from purely elastic models.

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