Abstract Submitted
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Fracturing of rocks by ice IOANNA VLAHOU, GRAE WORSTER, University of Cambridge — Fracturing of water-saturated rocks occurs frequently in cold climates and is caused by water freezing inside their pores. It is an important problem for both engineers and scientists as it can affect pavements and the foundations of buildings, and is a major erosional force in rocks. We consider the problem of the propagation of an ice-filled three-dimensional penny-shaped cavity in a water-saturated elastic porous medium. Between the ice and the rock, disjoining thermomolecular forces create a pre-melted film of water and cause flow of pore water from the surrounding rock into the cavity. The Darcy flow of water through the medium is limited by the permeability of the rock. Linear elasticity is used to describe the pressure distribution on the rock and to determine the propagation rate of the tip of the cavity. The Gibbs-Thompson relation dictates a maximum curvature for the ice tip, hence the extent of the ice depends on the aspect ratio of the cavity and the temperature of the ice front. We obtain a set of linear integro-differential equations coupled with two non-linear conditions on the crack tip propagation and the ice extent. We investigate the existence of solutions describing the evolution of the cavity, identifying the important physical parameters and applying the results to examples of rocks and clays.

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