

Abstract Submitted
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Fracturing of rocks by ice IOANNA VLAHOU, M. GRAE WORSTER, DAMTP, University of Cambridge — Frost damage, caused by the freezing of water-saturated media, affects plant roots, pavements and the foundations of buildings, and is a major erosional force in rocks. The process has been studied extensively in the case of soils, and mechanisms such as the formation of ice lenses have been identified. Here, we consider the freezing of water in a three-dimensional cavity in a water-saturated, porous, elastic rock. Initially, the expansion of water as it freezes causes flow away from the solidification front, into the porous rock. The Darcy flow in the porous medium controls the pressure field and therefore the freezing temperature. At later times, disjoining thermomolecular forces create a pre-melted film of water between the ice and the rock and cause flow of pore water from the surrounding rock into the cavity. We find that the disjoining forces between the ice and the rock have the dominant effect, so we focus on those later times when the cavity is ice-filled. We solve the coupled set of integro-differential equations governing the elastic stress in the rock and the flow through its pores to determine the evolution of the shape and extent of the ice-filled cavity.

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