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Temporal and spatial characteristics of drainage fracture networks in elastic media with internal fluid generation

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Escape of internally generated fluids from low permeability elastic solids plays an important role in several natural environments. In geological systems, primary migration of hydrocarbons, dehydration
of sediments and hydrated mantle rocks in subduction zones are examples where the existing permeability cannot accommodate transport of generated fluids in low permeability rocks and fluid pressure build-up may alter the permeability by fracturing. Fractures form and propagate in the
rock due to internal pressure build-up. We have performed experiments on shales and model materials using X-ray microtomography, 2D imaging and pressure burst recordings to study the spatiotemporal evolution of drainage fracture networks and released fluids. The local growth of fractures due to internal pressure build up has been characterized and modeled. The spatial organization of the fracture networks have been characterized in a novel manner as intermediate between tree networks and hierarchical fracture networks. The dynamics of intermittent fluid release on the network show both periodic, 1/f and 1/f2 dependence of fluid release spectrum. Discrete element, algorithmic and finite element models have been used to reproduce different aspects of the drainage fracture network behavior.