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Fluid-fracturing: shaping permeability patterns according to time dependent pumping

M. Niebling (1,2), R. Toussaint (1), E.G. Flekkoy (2), and K.J. Maloy (2)

(1) Institut de Physique du Globe de Strasbourg, CNRS / Universite de Strasbourg, Geophysics, Strasbourg Cedex, France (renaud.toussaint@eost.u-strasbg.fr), (2) Complex, University of Oslo, Norway

We investigate the formation of fracture of a porous rock due to pressurization of the intersticial fluid. Depending on the viscosity and compressibility of the fluid, of the system size and porous medium geometry, we show that the fluid permetaion can occur through simple permeation, smooth deformation of the matrix, or generation of fractal fluid-cracking trees of high permeable pathways.

This is demonstrated numerically and experimentally: in a rectangular Hele-Shaw cell a dense but permeable two-dimensional (2D) granular layer is fractured by an imposed pressure gradient of the compressible interstitial gas. For this purpose the pressure at the inlet of the cell is increased while at the opposing side a semipermeable boundary only lets the gas-phase pass through. A discrete numerical molecular dynamics model is employed to investigate the dynamics of the fractures and fingers of the granular phase. By systematic variation of the controlling parameters we can identify and describe a mechanism which controls the

evolution of the emerging fractures and fingers as a function of the interstitial gas properties and the characteristics of the granular phase.