Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Modeling the Effect of Fluid Flow on a Growing Network of Fractures in a Porous Medium MOHAMMED ALHASHIM, DONALD KOCH, Cornell Univ — The injection of a viscous fluid at high pressure in a geological formation induces the fracturing of pre-existing joints. Assuming a constant solid-matrix stress field, a weak joint saturated with fluid is fractured when the fluid pressure exceeds a critical value that depends on the joint's orientation. In this work, the formation of a network of fractures in a porous medium is modeled. When the average length of the fractures is much smaller than the radius of a cluster of fractured joints, the fluid flow within the network can be described as Darcy flow in a permeable medium consisting of the fracture network. The permeability and porosity of the medium are functions of the number density of activated joints and consequently depend on the fluid pressure. We demonstrate conditions under which these relationships can be derived from percolation theory. Fluid may also be lost from the fracture network by flowing into the permeable rock matrix. The solution of the model shows that the cluster radius grows as a power law with time in two regimes: (1) an intermediate time regime when the network contains many fractures but fluid loss is negligible; and (2) a long time regime when fluid loss dominates. In both regimes, the power law exponent depends on the Euclidean dimension and the injection rate dependence on time.

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Date submitted: 23 Jul 2015 Electronic form version 1.4