Geophysical Research Abstracts, Vol. 8, 06897, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06897

On earthquake precursors through electromechanical coupling

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The present paper gives unified theoretical results in terms of percolation theory for hydraulic and electrical conductivity (K and EC) and electromechanical properties under conditions of applied external pressure gradients and changing fracture porosity. The model is taken to be a fractal system of fractures with constrained maximum and minimum apertures, but with a probability density function which increases linearly in time up until rupture occurs. Such a linear increase in fracture pdf is associated with a linear increase in porosity. Under the conditions that the smallest fracture has an aperture of at least a few tenths of a millimeter, the critical (percolation) fracture densities for K and EC may be approximated as being identical, but under a wide range of conditions EC obeys simple universal scaling, while K is controlled by the fracture size distribution. However, the electromechanical coupling constant G also obeys universal scaling, with the result that it is not possible to generate a significant electric field (proportional to G/EC) using this theory under preseismic conditions.