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Towards a non-linear theory for induced seismicity in shales

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We here analyze the pore transmission of fluid pressure $p$and solute density ρ in porous rocks, within the framework of the Biot theory of poroelasticity extended to include physico-chemical interactions. In more details we here analyze the effect of a strong external stress on the non-linear evolution of p and ρ in a porous rock. We here focus on the consequent deformation of the rock pores, relative to a non-linear Hooke equation among strain, linear/quadratic pressure and osmosis in 1-D. We in particular analyze cases with a large pressure, but minor than the "rupture point". All this gives relations similar to those discussed by Shapiro et al. (2013), which assume a pressure dependent permeability. Thus we analyze the external stress necessary to originate quick non-linear transients of combined fluid pressure and solute density in a porous matrix, which perturb in a mild (i.e. a linear diffusive phenomenon) or a more dramatic non-linear way (Burgers solitons) the rock structure. All this gives a novel, more realistic insight about the rock evolution, fracturing and micro-earthquakes under a large external stress.