Geophysical Research Abstracts
Vol. 15, EGU2013-13969, 2013
EGU General Assembly 2013

Dynamic aerofracture or hydrofracture of dense granular packing: pressure and viscosity control of the fracture patterns

Michael J. Niebling (1,2), Renaud Toussaint (2,3), Eirik G. Flekkøy (1,3), Knut Jørgen Måløy (1,3)

(1) Department of Physics, University of Oslo, P.O. Box 1048, 0316 Oslo, Norway, (2) Institut de Physique du Globe de Strasbourg, Ecole et Observatoire des Sciences de la Terre, Université de Strasbourg, CNRS, 5 rue Descartes, F-67000 Strasbourg, France, (3) Centre for Advanced Study at the Norwegian Academy of Science and Letters, Drammensveien 78, 0271 Oslo, Norway

Stress induced by fluid or gases can cause diverse materials to break and fracture. Such hydraulic fractures are a natural and common phenomenon in the field of volcanism and are artificially initiated to enhance the recovery of natural gas and mineral oil by fracturing the reservoir rock with pressurized fluids. A procedure also known as fracking. Recently a new perspective on hydrofractures was added with the storage of supercritical CO_2. In this respect two scenarios are considered. First it is one option to inject CO_2 into existing hydrofractures, and second the injection of the CO_2 can create additional fractures. The typical components for such fractures are a porous material and a compressible gas.

The dynamics of such fractures and displacement patterns are simulated and studied in a rectangular Hele-Shaw cell filled with a dense but permeable two-dimensional granular layer. The model used, mixing highly deformable solid and fluid components, can simulate sedimentation problems [1,2], as well as hydrofracture or aerofracture ones.

The emerging displacement patterns and fractures variate according to the properties of the injected fluid or gas and the characteristics of the granular phase [3].

The physics behind these variations is discussed and explained. The role of the fluid viscosity and system size shows to lead to a transition from fracturing to compaction, depending on the dynamics of convection versus diffusion of overpressure. The dependence of the obtained patterns on the injection pressure is also explored [4].

References:

[1] Niebling, M.J., E.G. Flekkøy, K.J. Måløy, R. Toussaint, Sedimentation instabilities: impact of the fluid compressibility and viscosity, Phys. Rev. E 82, 051302, 2010. doi: 10.1103/PhysRevE.82.051302

[2] Niebling, M.J., E.G. Flekkøy, K.J. Måløy, R. Toussaint, Mixing of a granular layer falling through a fluid, Phys. Rev. E 82, 011301 (2010) doi: 10.1103/PhysRevE.82.011301

[3] Niebling, M., R. Toussaint, E.G. Flekkøy and K.J. Måløy, Dynamic aerofracture of dense granular packings, Phys. Rev. E 86, 061315 (2012).

[4] Niebling, M., R. Toussaint, E.G. Flekkøy and K.J. Måløy, Estudios numéricos de Aerofractures en medios poros / Numerical Studies of Aerofractures in Porous Media, Revista Cubana de Fisica, 29, 1E, 1E66, 2012.