ED 398 Géosciences, Ressources Naturelles et Environnement
PhD Position in Geophysics/Geomechanics at MINES ParisTech

Skill area: Geophysics, Geomechanics

Workplace:

MINES ParisTech, PSL Research University
Centre de Géosciences, équipe géophysique
35 rue Saint-Honoré, 77305 Fontainebleau Cedex

Title: Induced seismicity in a rate-and-state asperity model

Key Words: Earthquake mechanics, hydromechanics, friction

Context and description :

Fluid operations at depth performed in the context of georessources exploration (geothermal energy, oil production) trigger a significant amount of seismicity (Ellsworth 2013). This induced seismicity could be interpreted as a hydromechanical activation of preexisting faults in the rock. In this context, interactions between a fluid and a seismogenic fault are complex (McClure et al., 2011, Pellet et al. 2013). First because faults are heterogeneous structures (Bhat 2007, Vallier et al. 2010, Dublanchet et al. 2013) releasing accumulated stress either seismically (earthquakes) or aseismically (slow slip, no radiation).
This project is dedicated to the modeling of seismicity triggered by a fluid flowing inside a planar fault characterized by heteroeneous frictional properties. The objective is to identify the main parameters controlling the triggering and the amount of seismicity, as well as the maximum magnitude. The numerical results will be systematically confronted to observations (Bâle, Soultz or Oklahoma induced sequences).
The outcomes of this research project should provide more insights into both industrial and fundamental issues. In the framework of georessources exploitation, understanding the triggering mechanisms is crucial for two reasons. First, it would allow to interpret microseismicity in terms of deformation, fluid flow and permeability change within a reservoir. Then, it would contribute to better estimate the probability of occurrence of major earthquakes in the vicinity of the reservoir. More generally, fluids might play a key role in the triggering of natural seismicity. The modeling approach proposed here will therefore provide insights into the understanding of natural seismicity as well.

Start date: October 2016

Requirements:

Minimum a master degree in either geophysics, physics or applied mathematics.

The candidate will have to couple a hydro-mechanical model with a rate-and-state earthquake simulator (Dublanchet et al, 2013). Therefore, a good knowledge of solid mechanics (and a strong interest for it) is required, as well as good numerical skills.

Gross Salary: approx. 2000 euros per month

Application Procedure:

Please send the following documents to the address below:

-CV
-A motivation letter
-Degree certificate and official academic transcripts
-Two recommendation letters (or name and adress of two referees)

Dr. Pierre Dublanchet
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Deadline for application:

May 31st 2016

References:

H.S. Bhat (2007), Role of Geometric Complexities and Off-Fault Damage in Dynamic Rupture Propagation, Ph. D. Thesis, Harvard University

P. Dublanchet, P. Bernard, P. Favreau (2013) Interactions and triggering in a 3D rate-and-state asperity model, Journal of Geophysical Research: Solid Earth 118.5 (2013): 2225-2245.

W.L. Ellsworth (2013), Injection-induced earthquakes, Science, 341(6142):1225942.

M.W. McClure, R.N. Horne, (2011) Investigation of injection-induced seismicity using a coupled fluid flow and rate/state friction model, Geophysics: 76(6):WC181-98.

F. Vallier, Y. Mitani, M. Boulon, T. Esaki, F. Pellet (2010), A new shear model for accounting scale effect in rock joints behaviour, Rock Mechanics and Rock Engineering, vol. 43, no 5, pp 581-595.

F.L. Pellet, M. Keshavarz, M. Boulon (2013), Influence of humidity conditions on shear strength of clay rock discontinuities, Engineering Geology, vol 157, pp 33-38