Simulation on Reservoir-induced Seismicity Considering Thermo-hydro-mechanical Couplings

Yujie Zhu[1] , Xiaoli Liu[1 *], Enzhi Wang[1], Jianwen Zhong[1]

[1] State Key Laboratory of Hydro-Science and Engineering, Tsinghua University, Beijing, China
* Xiaoli.liu@tsinghua.edu.cn

Abstract

Reservoir-induced seismicity (RIS) might happen when impounding over a critical level, changing the water load and seepage field. Statics show that the depth of seismic source increases gradually after thousands of seismicity inside or near the reservoir, implying that water might be a factor to break the initial balance and propagate fractures. The process is a coupling of multiple fields, such as stress field, permeability field and thermodynamic field. This paper presents a 2D Finite Element Model(FEM) to simulate the effect of Thermo-Hydro-Mechanical(THM) coupling on a 2-meter pre-existing crack placed at a different inclination. Elastic and damage model are introduced to simulate generation and propagation of crack under the conditions of differernt temperature at the corresponding depth. A discover is summarised that inclination of fracture could determine length of crack propagation and thermal field definately has influence in reservoir-induced seismicity, while the deformation of crack depends on thermal expansion and softening of rock. When the inclination of fault is above 45°, either wall will have obvious movement. Therefore, fault will be triggered to active if the angle is above 45°, relative displacement will rise with the increasing temperature.