Numerical investigation of Reservoir Induced Seismcity: poroelastic response of a layered media

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Water level reservoir affects the underlying crust stress state through the poroelastic response to the weight of the water volume stored and by the consequent fluid movement. The perturbation of crustal stress state has been associated to seismic events with maximum magnitudes up to 6.3, as recorded in the largest confirmed case of Reservoir-Induced Seismicity (RIS), that took place at the Konya reservoir in India. In this work, we present results of forward numerical modeling (finite element), to evaluate the poroelastic effect on the possible triggering of induced events, especially considering the undrained and the drained response of a layered crustal model. The 3-dimensional model presented here allows inclusion of heterogeneous elastic and hydraulic properties. Stress and strain are calculated for a transient evolution of the water level, and the calculation allows to compute dCFS (change in Coulomb failure stress) and to identify promotion of failure on different planes at different time of reservoir activities. The short-term undrained response strongly depends on the elastic properties and can be amplified in a heterogeneous layered elastic media, especially for a media being stiffer with increasing depth. The long-term response depends on the hydraulic properties and it can play a role even if the reservoir is hydraulically isolated from the underlying units.

Keywords: RIS, poroelasticity, Induced seismicity, Layered crust, fault reactivation

