The Applied Seismology and Structural Dynamics Research Center at DICATAM, University of Brescia, in collaboration with the Ordine Ingegneri della Provincia di Brescia, coordinates the

International Workshop

Studies of seismicity induced by gas storage

Monday 11 December 2017
Aula Consiliare di Ingegneria
Via Branze 38, Brescia

10:30 Dr **Francesco Pizzocolo, TNO Utrecht** -
Problems of Fracture Mechanics in Applied Geoscience

11:30 Dr **Loes Buijze, TNO Utrecht** -

Nucleation and arrest of seismic events induced by reservoir depletion using a slip-weakening fault model

The workshop is free.
Participants are invited to register by sending an email to francesca.fantoni@unibs.it

Nucleation and arrest of seismic events induced by reservoir depletion using a slip-weakening fault model

Loes Buijze

Depletion-induced seismicity has become a growing matter of concern over the last decade, yet the mechanisms and conditions governing nucleation and the final size of the seismic events are not well understood. In 'traditional' geomechanical modeling the stress changes as function of gas depletion can be calculated, as well as the onset of fault reactivation (plastic deformation on faults present in the reservoir) resulting from these stress changes. However, the fault behavior governing deformation on the faults used in these studies was often simplified. From the laboratory and modeling studies on natural seismicity it is known that seismicity (unstable fault slip) is the result of a rapid loss of fault strength. Here we assigned linear slip-dependent weakening of the friction coefficient to simulate fault behavior and seismicity. In the Finite Element package DIANA FEA we first calculate the stress changes resulting from depletion of a faulted reservoir in a 2D quasi-static analysis. These stress changes induce nucleation of an unstable event, after which the analysis is switched to a fully dynamic simulation to compute the acceleration, propagation and arrest of the seismic event, and also wave propagation in the near-source area. Sensitivities to the frictional properties, reservoir properties, and in-situ stress were analyzed, indicating the importance of reservoir geometry, stress drop, fracture energy, and background stress for the size of the seismic events. In a second study we compare the (computer-intensive) dynamic result to a faster, quasi-static approach where we use linear elastic fracture mechanics to calculate the seismic event size.

Problems of Fracture Mechanics in Applied Geoscience

Francesco Pizzocolo

Fracture mechanics plays an important role in many applied Geoscience fields. From studying the formation of breakouts and tensile fractures around a borehole, to solving issues related to Carbon Capture and Storage (CCS) or to under productive geothermal wells.Fracture mechanics plays an important role in many applied Geoscience fields. I will give an overview of the numerical models TNO geomechanics adopts in research (EU) and consultancy projects. In my presentation I will show some of our work related to geothermal energy, underground gas storage (UGS), CO2 capture and storage (CCS). Our customers' portfolio includes ENI, KOC (Kuwait Oil Company), ENGIE, Star Energy (Indonesia), Total, Wintershall.

References:

[1] L. Peters, F. Pizzocolo et al., Consequences of thermal fracture development due to injection of cold CO2 into depleted gas fields, Energy procedia, 2013.
[2] F. Pizzocolo, P.A. Fokker, Coupling flow-geomechanical model for stimulation of fractured geothermal fields, ARMA 17-474, OnePetro, 2017.
[3] F. Pizzocolo et al, Feasibility assessment of hydraulic fracture stimulation treatment in the Wayang Windu geothermal field (West Java, Indonesia), submitted, 2017.
[4] F. Pizzocolo et al, Feasibility of novel techniques to mitigate or remedy CO2 leakage, SPE-185766-MS, 2017.