Geophysical Research Abstracts
Vol. 18, EGU2016-13224, 2016
EGU General Assembly 2016

Perturbation of geothermal reservoirs to fluids stimulation: numerical modelling and implication on induced seismicity.

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Fluid withdrawal and injection into the crust produces changes in the local stress field and pore pressure, involving different rock volumes depending on the injection flow rate and duration as well as on the medium permeability. This process is in different cases correlated to induced seismicity. In the case of geothermal power plants (e.g. fluids withdrawal and in several case withdrawal/reinjection) this correlation is vague and sometimes not well constrained by experimental data. We report here a set of simulations of withdrawal, injection and withdrawal-reinjection-cycles from/in the same geothermal reservoirs, by using the numerical code TOUGH2®. The simulations are applied to conceptual models of different geothermal reservoirs already published in previous works, whose main difference is in the permeability features and the depth of wells (Soultz, France; Campi Flegrei caldera and Ischia island, Italy). The numerical simulations are aimed to compare the time growth of perturbed volumes obtained with withdrawal reinjection cycle to those obtained during simple withdrawal or injection, using the same flow rates. Our results clearly point out that reinjection is much less critical than simple injection or withdrawal, because the perturbed volumes are remarkably small and, moreover, remain constant over the simulated time, of whatever duration. This fact reduces significantly the potential of the seismicity induced by pressure variation into the reservoirs.