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Temporal changes of static stress drop as a proxy for poroelastic effects at The Geysers geothermal field, California

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One of the major environmental impacts of shale gas exploitation is triggered and induced seismicity. Due to the similarity of fluid injection process data from geothermal fields can be used as a proxy for shale gas exploitation associated seismicity. Therefore, in this paper we utilize 'The Geysers' dataset compiled within SHale gas Exploration and Exploitation induced Risks (SHEER) project. The dependence of earthquake static stress drops on pore pressure in the medium was previously suggested by Goertz-Allmann et al. (2011), who observed an increase of the static stress drop with the distance from injection well during reservoir stimulation at Deep Heat Mining project in Basel, Switzerland. Similar observation has been done by Kwiatek et al. (2014) in Berlín geothermal field, El Salvador. In this study, we use a high-quality data from The Geysers geothermal field to determine whether the static stress drops and the stress drop distributions change statistically significantly in time or not, and how such changes are correlated with the values of hypocenter depth, water injection rate, and distance from injection well. For the analyses we use a group of 354 earthquakes, which occurred in the proximity of Prati-9 and Prati-29 injection wells. Spectral parameters of these earthquakes were determined using mesh spectral ratio technique. Our results indicate that: (1) the static stress drop variation in time is statistically significant, (2) median static stress drop is inversely related to median injection rate. Therefore, it is highly expected that static stress drop is influenced by pore pressure in underground fluid injection conditions.

References:
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