Tracking the development of seismic fracture network by considering the fault rupture method

Taghi Shirzad, Stanisław Lasocki, and Beata Orlecka-Sikora
Polish Academy of Sciences, Institute of Geophysics, Seismology, Krakow, Poland (tshirzad@igf.edu.pl)

In Enhanced Geothermal Systems pressurized injections play a role in developing fracture networks and enhancing the water transmissivity. However, the fractures may also coalesce into undesired pathways for fluid migration to enable the fluids to reach pre-existing faults. The properties of observed seismicity can shed some light on the fracture network development and from the standpoint of the possibility to form such undesired pathways. However, to reach this goal the seismic events should be well parameterized. In particular, the information on fault plane mechanisms is essential, which is often not readily accessible. In this study, we use the rupturing process with an accurate P-wave velocity model, which is obtained by the first arrival P-wave tomography approach, to compensate for an eventual lack of source mechanisms of micro-events. For this purpose, four characteristics of the sources (final/average displacement on the fault, the dimension of fault, rupture velocity and particle velocity) can be considered. A 3D model is defined around the hypocenter of each event, so that the size of this model directly depends on the event magnitude. After calculating the arrival time of the selected phase (e.g., P, S, p or s) for each station, all waveforms are then aligned, and stacked by different stacking (e.g., phase weight, N^th-root) methods. By considering the maximum amplitude of the stacked waveform which is stimulated by each grid, the rupturing plane and the average velocity of rupturing can be obtained. This information of source can be replaced by the double-couple mechanism to investigate the fractures linking and tracking.

This work was supported under the S4CE: "Science for Clean Energy" project, which has received funding from the European Union's Horizon 2020 research and innovation program, under grant agreement No 764810.