Analysis of persistent seismic multiplets at the EGS reservoir of Soultz-Sous-Forêts, France

Authors:
Cauchie L. (cauchiecaruso@unistra.fr), Lengliné O. (lengline@unistra.fr), Schmittbuhl J. (jean.schmittbuhl@unistra.fr)

Affiliation:
EOST/IPGS, Université de Strasbourg/CNRS, France

During the exploitation of geothermal reservoirs, abundant seismicity is generally observed, especially during phases of hydraulic stimulations. The induced seismicity at the Enhanced Geothermal System of Soultz-Sous-Forêts in France has been related to both fluid pressure increase during stimulation and aseismic creeping movements. The fluid-induced seismic events often exhibit a high degree of similarity and the mechanism at the origin of these repeated events is thought to be associated with slow slip processes where asperities on the rupture zone act several times.

To have a better understanding of the sources associated with such events and on the damaged zones involved during the hydraulic stimulations, we investigate the behavior of the multiplets and their persistent nature over several water injection intervals. For this purpose, we analyzed large datasets recorded from a borehole seismic network for several water injection periods (1993, 2000, ...). We classified the events on the basis of their waveforms similarities and their location within the multiplets, this latter by estimating their sources dimensions and inter-event distances. We examined the seismic events properties (locations, sizes, dimensions) within the multiplets and compared them to the general behaviour of the induced seismicity observed at Soultz-sous-Forêts. We then investigated how these properties vary within and over several hydraulic tests. Hopefully these steps will lead to increase the knowledge on the repetitive nature of these events and the investigation of their persistence will outline the heterogeneities of the structures (regional stress perturbations, fluid flow channeling) regularly involved during the different stimulations.