Analysis of microseismicity in the Hengill Geothermal Area, SW Iceland

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Geothermal systems in the vicinity of the Hengill volcano, SW Iceland, started to be exploited for electrical power and heat production since the late 1960s, and today the two largest operating geothermal power plants are located at the Nesjavellir and the Hellisheidi. This area is a complex tectonic and geothermal site, being located at the triple junction between the Reykjanes Peninsula (RP), the Western Volcanic Zone (WVZ), and the South Iceland Seismic Zone (SISZ). The region is seismically highly active with several thousand earthquakes located yearly. The origin of such earthquakes may be either natural or anthropogenic. The analysis of microseismicity can provide useful information on natural active processes in tectonic, geothermal and volcanic environments as well as on physical mechanisms governing induced events. Here, we investigate the microseismicity occurring in Hengill area to understand physical source mechanisms and the origin of these microseismic events. We use a very dense broadband monitoring network deployed since November 2018 with support of the GEOTHERMICA project COSEISMIQ and apply robust and full-waveform based methods for earthquake location, clustering analysis and source mechanism determination. Our dataset consists of about 637 events with $M_L$ ranging between 0.8 and 4.7 from December 2018 to January 2019. We use this rich and large dataset for testing a workflow for automated processing. Earthquake location and clustering analysis show that seismicity is spatially clustered, with shallower events at the center of geothermal site in proximity to geothermal plants, and deeper earthquakes in the southern part of the study area. Most of our moment tensors can suggest the influence of geothermal activity and geothermal energy exploitation operations on the subsurface. This work is supported by the COSEISMIQ project of the EU GEOTHERMICA program.
