COSEISMIQ: First results of high resolution imaging of the shallow crust and relocation of induced seismicity in the Hengill area, Iceland

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For the future development of deep geothermal energy exploitation in Europe, large magnitude induced seismic events are an obstacle. On the other hand, the analysis of induced microseismicity allows to obtain the spatial distribution of fractures within the reservoir, which can help, not only to identify active faults that may trigger large induced seismic events, but also to optimize hydraulic stimulation operations and to locate the regions with higher permeability, enhancing energy production. The project COSEISMIQ (COntrol SEISmicity and Manage Induced) integrates seismic monitoring and imaging techniques, geomechanical models and risk analysis methods with the ultimate goal of implementing innovative tools for the management of the risks posed by induced seismicity and demonstrate their usefulness in a commercial scale application in Iceland.

Our demonstration site is the Hengill region in Iceland. The Hengill volcanic complex is located in SW Iceland on the plate boundary between the North American and Eurasian plates. In this region, the two largest geothermal power plants of Iceland are currently in operation, the Nesjavellir (120MW electricity) and the Hellisheidi (300MW electricity) power stations. In October 2018, we densified the permanent seismic network run by ISOR and IMO in this area (14 stations) with 23 broadband seismic stations.

We present the project and show first results from high resolution imaging of the shallow crust with ambient seismic noise, as well as first results from the relocated seismic events. The ambient noise imaging highlights an area of low seismic velocity close to the Þingvallavatn Lake, characteristic for the presence of supercritical fluids. The main geothermal production area is located as well in a low velocity zone that reaches 200 meters depth below Hellisheidi and around 700 meters below Nesjavellir.