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Local earthquake tomography of a geothermal area in Reykjanes Peninsula (Iceland): Influence of nature, location and migration of crustal fluids on the seismicity.

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In Southern Iceland, the Reykjanes Peninsula is characterized by a system of en-echelon volcano-tectonic segments corresponding on-land exposure of the Mid-Atlantic Ridge. Each segment is affected by high hydrothermal activity related to both magmatic and hydrous-like fluids circulating through crust. In May 2009, we installed for a 6-month period a dense network of 32 seismic stations over a 30 km2 area from Grindavik to Krisuvik. With this network of 19 short-period, 13 5s-period and 3 broad band seismometers, we collected more than 10 000 small-magnitude earthquakes (-0.5<Mw<4.0) describing swarms lasting less than 3 days. Travel time data from a selection of 6100 events (detected by at least 10 stations) were inverted for both hypocenter locations and three-dimensional Vp and Vs structure. The whole seismicity reveals two main active areas. In the westernmost part of the network, North of Grindavik the seismicity appears to be related to the main tectonic fault segment associated with the Mid-Atlantic Ridge opening. North of Krisuvik, in the East, the observed seismic activity is characterized by distinct swarms mostly located in the vicinity of the Kleifarvatn Lake. We observe a time migration of the seismic activity from the southern to the eastern part of the lake. Relocation using HypoDD (Waldhauser, 2001) shows both dense small patches and vertical alignements. These observations suggest a complexe tectonic settings influenced by the intense geothermal activity and magmatic intrusions. These seismic swarms are coeval with a centimetric crustal southward displacement measured by the southernmost Krisuvik continuous GPS station which could indicate a crustal inflation north of the station. We performed time-series of tomographic inversions using tomoDD (Zhang and Thurber, 2003) in order to raise the interplay of crustal fluids nature, statement and migration with the crustal deformation issues.