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On the seismicity recorded in the geothermal area of Mt. Amiata

Thomas Braun (1,4), Marco Caciagli (1,2), Torsten Dahm (3), Daniela Famiani (4), Alessandro Gattuso (4), Frank Krueger (5), and Matthias Ohrnberger (5)

(1) INGV, Seismological Observatory, Arezzo, Italy (thomas.braun@ingv.it), (2) INGV, Bologna, Italy (marco.caciagli@ingv.it), (3) GFZ, Potsdam, Germany, (torsten.dahm@gfz-potsdam.de), (4) INGV, Seismology and Tectonophysics, Rome, Italy (daniela.famiani@ingv.it), (5) Inst. of Earth & Environmental Sciences, Potsdam University, Potsdam, Germany (frank.krueger@gfz-potsdam.de)

Mt. Amiata in Tuscany (Italy) is an extinct volcano whose last eruptive activity was dated about 200 ky ago. Being still characterized by a high geothermal gradient the area lends itself for geothermal exploitation. Beneath the Tuscan Geothermal Areas seismicity is exclusively observed in the upper crust and is confined in depth by the so called K-horizon (400°C isotherme). The structure above contains permeable layers of highly fractured, volcanic rocks saturated with hot water and steam. Geothermal exploitation from these layers started in the 1960's. Shallow earthquakes have occurred close to the geothermal wells, and the question is raised whether these event are of natural origin or related to the exploitation of heat.

To monitor the seismic activity inside the geothermal field, an 8 station seismic network and a 7 element small aperture seismic array were installed in 2015 in the vicinity of the geothermal power plants during a joint field experiment by the Istituto Nazionale di Geofisica e Vulcanologia, the University of Potsdam and the GFZ-German Research Center of Geoscience. Already during the first 24 hours of seismic recording the array and the neighboring network stations recorded a M0.5 seismic event in the vicinity of the geothermal field of Bagnore. Since then micro-earthquake activity was recorded regularly.

One of the main challenges of the seismic array/network installation, deployed in direct proximity to the geothermal energy production, is to identify seismic events caused by human operations. As hypocenters are located close to the geothermal power plants, at a similar depth as the production level, it is very difficult - if not impossible - to discriminate between natural earthquakes and anthropogenic events. The main goal of the seismic array/network deployed in the framework of our project is to shed some additional light on this question.

The monitoring capabilities of the recording system permit a lowering of the detection threshold for local seismic events, performing high-resolution hypocentral determination, especially in the vicinity of the industrial operations, and calculating focal mechanisms. Array techniques and relative location methods will be used for a precise hypocentral determination. Polarization and spectral analysis, will be applied to discriminate seismic recordings from Mt. Amiata that sometimes resemble rather volcano-seismic waveforms with long-period characteristics, than typical tectonic events.