

Microseismicity recorded before geothermal exploitation at Torre Alfina (Italy)

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The geothermal field of Torre Alfina is located in Central Italy at the northern extremity of the Vulsini quaternary volcanic complex. Wells drilled in the 1970s and 1980s down to depths ranging from 563 to 2710 m revealed that Torre Alfina is a medium-enthalpy ($T=140^{\circ}\text{C}$) geothermal field, hosted in buried fractured Mesozoic limestones. Recently a multinational industrial company received the license for the production of geothermal energy up to a maximum of 5 MW.

In 2013, the INGV was commissioned to realize a monitoring system that includes the observation of gas emissions, microseismicity and ground deformation. Following the recommendations, described in the Ministerial Decree that regulates the geothermal production activity, the seismic monitoring system should be capable to record the local microseismicity during the phase of geothermal energy production and the natural seismicity since 12 months before the beginning of the production operations.

In 2014, we started to install a short-period seismic network called ReMoTA near the future geothermal production site of Torre Alfina. Stations are equipped with 24 bit digitizers and short-period seismometers.

The seismic noise level recorded at the single stations is unfavorably high, due to an intensive colonization and numerous settlements of small and medium industries. Transients as well as persistent monochromatic disturbances are recorded very well especially at the southern stations, probably due to a low wave energy dissipation inside the layer of quaternary volcanic rocks.

During the period from June 2014 – November 2015 ReMoTA recorded 289 local earthquakes and 19 quarry blasts, with respect to 46 seismic events reported by ISIDE.

The depth distribution of the seismic events recorded during 18 months before the beginning of the geothermal exploitation is concentrated inside the upper crust at a depth range between 4 - 8 km. The spatial distribution of the hypocenters seems to dip slightly towards SW beneath the area of Torre Alfina.

This tendency together with the focal solutions of the Dec 2014 seismicity cluster highlights the presence of a normal fault with a weak transverse component striking in NW-SE-direction, within splitting distance to the future geothermal production site. The other two seismicity cluster of Mar-2015 and Nov-2015 seem to delineate antithetic structures with respect to the main fault. Considering that the future production level will be at a depth range between 1500 – 2300 m, and being aware of the hypocentral uncertainties, the discrimination between “natural” earthquakes and seismicity triggered by anthropic activity will be an important challenge.