Outline of a joint research project by ENEL-INGV for the study of the microseismicity in the Larderello geothermal area

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The Larderello geothermal field is located ca. 100 km southeast of Florence, in the northern part of a volcanic zone that extends along the Italian Tyrrhenian coast. Geophysical investigations in the area suggest a crustal thinning and an injection of hot material from the upper mantle into the crust.
The ENEL-company monitors the local seismic activity since 1978, running a network of 26 short-period seismic stations. The automatic online processing system uses the HYPO71 algorithm for the preliminary hypocentral locations. After the manual check of the P and S phase pickings the HYPOELLIPSE algorithm is used for the reprocessing. Batini et al. (1985) reports, that seismic activity recorded in the Larderello area by the ENEL-network is characterized to be several hundred M • 1.5 events per year, never exceeding magnitude M=3.2 in 25 years of seismic monitoring. Seismicity partly is clustered in time and space and sometimes occurs in form of earthquake swarms.
In a collaboration between ENEL and INGV the following scientific tasks will be addressed:
(i) optimization of the seismic monitoring system and (ii) study of the microseismicity in the geothermal areas, with particular emphasis on the origin and the generation mechanism of seismic swarms. Field experiments as well as analyses of waveforms from the ENEL-database will be performed to address those tasks.
Regarding the optimization of the seismic monitoring system, a temporary (10 days) small-scale array was installed in the central part of the Larderello area. The technical features of the 9-element experimental array were similar to the one used in 2000 in the Upper Tiber Valley (Braun et al., 2004). Surprisingly, no coherence was found for local seismic events, making it neither possible to apply array techniques, nor to define trigger values for an automatic detection processing. F-k analysis of regional events revealed unusually high slownesses, possibly caused by the low velocity structure of the geothermal area.
In a second step, related to the improvement of the localization resolution, we apply recently developed relocation algorithms to seismic swarms recorded by the ENEL-network in the past. A test dataset from a seismic sequence, which occurred 1993 in the northern part of the Larderello area, is used to determine the hypocenters by applying processing software, that originally was developed for microseismic monitoring in hydrocarbon reservoirs (Oye & Roth, 2003). A further improvement of the localization resolution is expected after the implementation of a 3D velocity model, published by Vanorio et al. (2004).

References

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