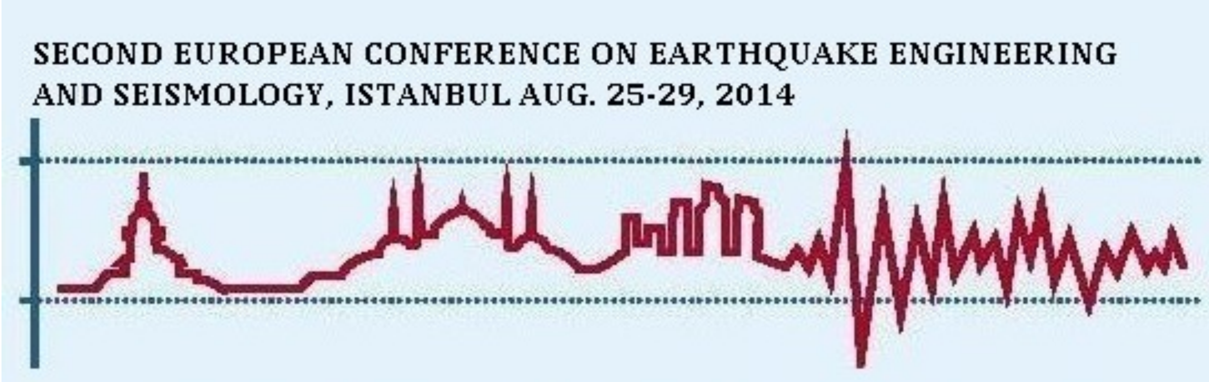

SEISMICITY INDUCED BY ENERGY TECHNOLOGIES IN HIGH AGRI VALLEY (SOUTHERN ITALY)

Tony Alfredo STABILE[1], Alessandro GIOCOLI[2], Angela PERRONE[3], Sabatino PISCITELLI[4], Luciano TELESCA[5] and Vincenzo LAPENNA[6]

It has long been known that some energy technologies are capable of inducing seismicity. The magnitude 6.3, 1967 earthquake occurred in the Koyna-Warna Region in India following the impoundment of a large water reservoir, is the most emblematic case (Gupta and Rastogi, 1976). Other energy technologies may be responsible for inducing seismicity such as the mining activity, enhanced geothermal systems, the injection/withdrawal of fluids into/from the ground associated with the gas storage, the CO_2 sequestration, the exploitation of oil and gas, etc.

To date hundreds of worldwide cases of human-induced seismicity have been reported in literature (e.g., USA National Research Council (2013), and references therein). Even if the basic mechanisms that can induce seismic events related to energy technologies are presently well understood, models to predict the size and location of earthquakes in response to human perturbations are compromised in large part due to the lack of basic data on the interactions among rock, faults, and fluid as a complex system. Therefore, human-induced seismicity is a pioneering research topic and it represents an open matter of debate within the scientific community, due to the strong social impact and its implications for seismic hazard and risk.

Our study is focused on the analysis of seismicity occurred in the High Agri Valley (southern Italy) in order to understand how it is related to energy technologies. The valley is a NW-SE trending intermontane basin formed during the Quaternary age along the axial zone of the Southern Apennines thrust belt chain. It is one of the areas of Italy with the highest seismogenic potential, since the seismogenic normal fault system of the valley is capable of generating up to M = 7 earthquakes, such as the 1857 Basilicata earthquake (Burrato and Valensise, 2008). According to the Italian seismic regulation, the seismic hazard of the valley is very relevant, with an expected maximum acceleration for an exceedance probability of 10% in 50 years within 0.25 and 0.275 g. The two important energy technologies in the High Agri Valley are:

(1) the Pertusillo water reservoir, managed by “Ente per lo Sviluppo dell’Irrigazione e la Trasformazione Fondiaria”, with a capacity of 155 millions cubic meters filled behind a dam of 95 m height;

(2) the exploitation of the largest productive on-shore oil field in West Europe, managed by Eni company, with about 82 thousand oil barrels per day and 3.4 million cubic meters of gas per day.

We collected the seismicity recorded by the local seismic network owned by Eni Company (in operation since July 2001) from January 2002 to December 2012 (the dataset is available at the “Osservatorio Ambientale della Val d’Agri”, Basilicata Region, Southern Italy). The seismic dataset

[1] Ph.D., CNR – Istituto di Metodologie per l’Analisi Ambientale, Tito (Italy), tony.stabile@imaa.cnr.it
[2] Ph.D., ENEA, Centro Ricerche Casaccia, Rome (Italy), alessandro.giocoli@enea.it
[3] Ph.D., CNR – Istituto di Metodologie per l’Analisi Ambientale, Tito (Italy), angela.perrone@imaa.cnr.it
[4] Ph.D., CNR – Istituto di Metodologie per l’Analisi Ambientale, Tito (Italy), sabatino.piscitelli@imaa.cnr.it
[5] Dr., CNR – Istituto di Metodologie per l’Analisi Ambientale, Tito (Italy), luciano.telesca@imaa.cnr.it
[6] Dr., CNR – Istituto di Metodologie per l’Analisi Ambientale, Tito (Italy), vincenzo.lapenna@imaa.cnr.it

has been enriched with further events extracted from the Italian Seismological Instrumental and parametric Data-base (ISIDe, http://iside.rm.ingv.it), available since 16 April 2005.

Absolute locations (Figure 1) were performed by using the 1-D velocity model of the area (Valoroso et al., 2009) considering station corrections. We have found two different spatial clusters of seismicity located around the Pertusillo reservoir (within the area delimited by the dashed box in Figure 1). The final dataset comprises 1,185 events with local magnitude Ml ≤ 3.0 and completeness magnitude Mc = 1.2.

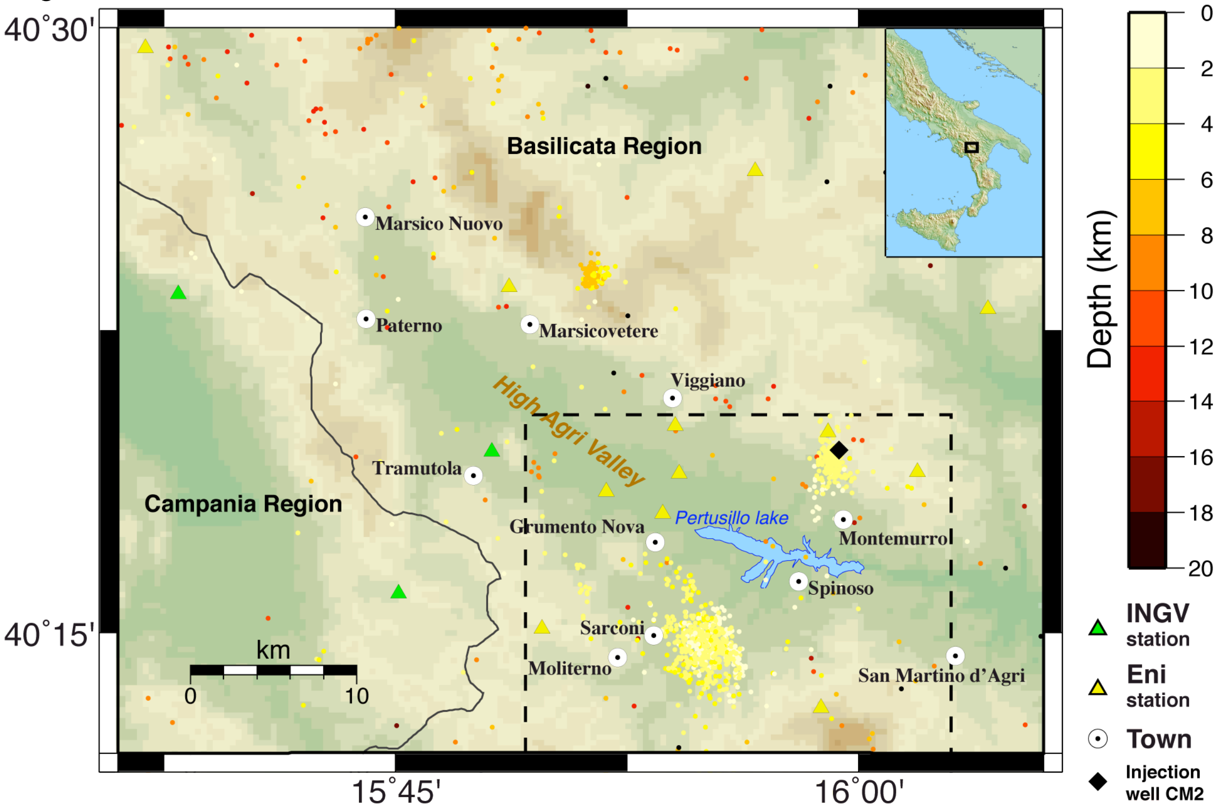

Figure 1. Seismicity in High Agri Valley from January 2002 to December 2012

The two clusters of seismicity at NE and SW of the reservoir are both swarm-type distributed, with high b-value and shallow hypocenters (lower than 5 km depth). However, we have found that only the seismicity at SW of the reservoir is significantly correlated with the water level fluctuations, while the seismicity at NE started in June 2006 only after the wastewater disposal activity was initiated at Costa Molina 2 injection well (CM2, black diamond in Figure 1) and is located near the injection well.

The results of our study suggest continued reservoir-induced seismicity associated with the Pertusillo reservoir for the cluster located at SW of the lake, and fluid-injection-induced seismicity for the cluster located at NE of the lake, near the Costa Molina 2 injection well.

REFERENCES

Burrato P and Valensise G (2008) "Rise and fall of a hypothesized seismic gap: Source complexity in the 16 December 1857, Southern Italy earthquake (Mw 7.0)," *Bull. Seismol. Soc. Am.*, 98(1):139–148

Gupta HK and Rastogi BK (1976) Dams and Earthquakes, Elsevier, Amsterdam

Valoroso L, Improta L, Chiaraluce L, Di Stefano R, Ferranti L, Govoni A, Chiarabba C (2009) "Active faults and induced seismicity in the Val d'Agri region (southern Apennines, Italy)," *Geophys. J. Int.*, 178:488-502

USA National Research Council (2013) Induced Seismicity Potential in Energy Technologies, The National Academies Press, Washington DC