A CENTRAL APENNINE TEST SITE FOR LONG-TERM MONITORING: RELATIONSHIP BETWEEN SEISMICITY AND GROUNDWATER DURING 2016-17 EARTHQUAKES

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Since historic times, the response of aquifer systems to earthquakes has caught the attention of people. Macroscopic effects like increase of spring discharge, changes in river flow rate, and the sudden disappearance of springs or the generation of new ones have been recognized without the need for sophisticated equipment. By contrast, because most measurements of groundwater composition require discrete sampling of water and expensive and time-consuming laboratory analysis, observational data for earthquake-induced changes in water composition are limited. The aim of this study was to identify potential patterns of level changes in response to several earthquakes, and possible variations of ion concentrations, gas compositions and isotopic ratios in groundwater. Doglioni et al. (2014) propose that in the tensional tectonic environment, the triangle of crust above the brittle ductile transition remains "suspended" while a dilated area forms during the interseismic period. Fluids may enter the fractured volume and water level decreases, when the triangle of crust above the brittle ductile transition starts to drop, the fracture confines and water level hence rises. This increase of water level culminates in the coseismic period. The Bussi sul Tirino monitoring area in Central Italy, located in a region with abundant groundwater resources has been selected. It is located near the active normal faults of the Sulmona basin, along the southeast-ward prolongation of the faults that nucleated the L'Aquila 2009 Mw 6.3 event. This area is characterized by low strain rate, an indicator of potential future larger earthquake. In the site, seismic and GPS stations are acquiring data. Since July 2014, an experimental monitoring station is collecting data of piezometric level, electrical conductivity and temperature on a groundwater well 100 m deep, coupled with a time discrete sampling of the main springs for chemical and isotopic analyses. The recorded data have been subsequently filtered and correlated with the seismic events recorded by the National Seismic Network in a distance range of about 40 km from the monitoring well. The preliminary comparison shows statistically supported correlation between groundwater level changes and seismic activity. In detail, in several considered time slots, seismic events are preceded by a slight, but significant decrease of the water table and followed or accompanied by a strong increase of the water table itself in the monitoring well. The seismic sequence of 2016-17 in Central Italy affect the monitoring site showing a reversal trend respect with the depletion phase. In fact, as a result of earthquakes, piezometric levels raised approximately of 30 cm in August, 20 cm in October and 80 cm in January, testifying the

regional influence on groundwater flow caused by the seismic sequence .The results of chemical and isotopic analysis, repeated over time, highlight very steady characteristics due to the regional groundwater flowpaths, while trace metals content shows a different trend before and during the recent seismic sequences. Taking into account that the epicenters are located tens kilometers away from the study area, both water table and hydrochemical minor changes are in agreement with the theoretical previsions of seismic response for areas characterized by extensional tectonics.

References

Doglioni C., Barba S., Carminati E. & Riguzzi F. 2014. Fault on-off versus coseismic fluids reaction. Geoscience Frontiers, doi: 10.1016/j.gsf.2013.08.004.