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L'Aquila April 6 2009 earthquake-related hydrochemical changes in the Gran Sasso carbonate aquifer (central Italy)

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In central Italy the Paganica fault, a SW-dipping active normal fault, which crosses the Gran Sasso carbonate-fissured aquifer, was responsible for L'Aquila earthquake (April 6 2009; Mw: 6.3). Co-seismic changes in spring discharge were caused distinctly by the earthquake and in order to understand the earthquake-related hydrological changes also spot measurements of the main physico-chemical parameters of spring waters (T, pH, EC, Eh, major ions - Ca+2, Mg+2, Na+, K+, HCO3-, SO4-2, Cl-, NO3- -, several minor ones - Sr+2, F-, Br- - and Rn-222) were performed. The goal was to compare hydrochemical spot monitored data of the interseismic period (pre- and post-seismic) and those of the co-seismic one (i.e. ten days after the mainshock) for characterizing the effects of the L'Aquila earthquake on groundwater at regional and local scale.
Actually shear zone of active faults facilitates upwelling of deep crustal fluids such as CO2 and Rn-222, which may modify groundwater of carbonate aquifer, like the Gran Sasso one, becoming more aggressive and their rising up may have a considerable impact on the Gran Sasso hydrochemistry. But comparing spot-measured data, however, it should consider also that hydrochemical changes are mainly linked to the hydrogeological cycle and the effect of fluid upwelling may be taken into account within this cycle.
The spot monitoring surveys were carried out respectively on April 2002 and 2006 (pre-seismic period); on April 2009 (co-seismic period); and September 2009 and April 2010 (post-seismic period). At regional scale about 25 springs were sampled, while at local scale about 15 drainage sites of INFN underground laboratories and 5 springs of Vera-Tempera spring group were sampled.
The main results are as follows:
at regional scale: in the co-seismic period, pH and SI calcite values abruptly get lower in the epicentral area; in the post-seismic one, they decrease in the more peripheral aquifer areas and are again normal in the epicentral area;
at local scale: the Vera-Tempera springs, along the fracture zone of the Paganica fault, get higher their 222Rn activity (+63%), T (+7%) and EC (+14%), simultaneously get lower their pH (-4%) and SI calcite (from 0.1 to -1.2) in the pre-seismic period compared to the co-seismic and post-seismic ones. All these in spite of the measured discharge increase (+25%), considering also ions concentration decrease by dilution effect;
at local scale: at the aquifer core (underground INFN Gran Sasso laboratories), in the co-seismic period, groundwater is temporarily undersaturated in calcite and characterised also by lower pH values and this fact cannot be entirely attributed to seasonal recharge.