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Hydrogeochemical response of groundwater springs during central Italy earthquakes (24 August 2016 and 26-30 October 2016)

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Co-seismic hydrological and chemical response at groundwater springs following strong earthquakes is a significant concern in the Apennines, a region in central Italy characterized by regional karstic groundwater systems interacting with active normal faults capable of producing Mw 6.5 to 7.0 seismic events. These aquifers also provide water supply to major metropolitan areas in the region.

On August 24, 2016, a Mw 6.0 earthquake hit Central Italy in the area where Latium joins Umbria, Marche and Abruzzi; this was immediately followed one hour later by a Mw 5.4 shock. The epicenter of the event was located at the segment boundary between the Mt. Vettore and Mt. Laga faults. On October 26, 2016 and on October 30, 2016, three other big shocks (Mw 5.5, Mw 6.0 and Mw 6.5) ruptured again the Vettore Fault and its NW extension.

Immediately after Aug. 24, we sampled springs discharging different aquifers in the Rieti area, including the Peschiera spring, which feeds the aqueduct of Rome. Thermal springs connected with deep groundwater flowpaths were also sampled. These springs, sampled previously in 2014 and 2015, provide some pre-earthquake data. Moreover, we sampled 4 springs along the Mt. Vettore fault system: 3 small springs at Forca di Presta, close to the trace of the earthquake surface ruptures, and two in Castel Sant'Angelo sul Nera. The latter are feeding the Nera aqueduct and the Nerea S.p.A. mineral water plant, which also kindly allowed us to collect bottled water samples from the pre-seismic period.

The aim of this study is to evaluate the strong earthquake sequence effects on the hydrochemistry and flow paths of groundwater from different aquifer settings based on analysis before and after seismic events. The comparison between the responses of springs ca. 40 km from the epicenter (Rieti basin) and the springs located near the epicenter (Castelsantangelo sul Nera and Forca di Presta) is especially significant for understanding the resilience of groundwater systems in an active tectonic zone because these springs are located near parallel active fault segments within the same extensional regime. The epicentral springs are subject to the direct effects of the shaking and coseismic fault displacement; the more distal ones to the tectonic displacement of large hydrogeologic structures, which affect the chemical composition and flow path even with late responses, lasting for weeks and months after the mainshocks.

Temporal trend analysis, based on pre-earthquake and post-earthquake chemical-physical data, point out alteration of different parameters. For example, the lowering of different trace metals in all areas after the first earthquake. These changes could be due to fluctuations in redox equilibria related to degassing and/or interactions with deeper fluid flow. In the Rieti springs, the EC, alkalinity, and trace metals show small transient responses within 1-3 days following the main shocks, however δ^2H vs. δ^{18}O remain stable and plot with previous data, indicating no major change in recharge source. Analysis is ongoing and preliminary results will be presented here.