Geophysical Research Abstracts
Vol. 21, EGU2019-8791, 2019
EGU General Assembly 2019

Chemical and isotopic investigation in aquifers of the terrigenous "Flysch della Laga" Formation during the 2016-2017 seismic sequence in central Italy

Luca Pizzino (1), Gianfranco Galli (1), Lorenzo Brusca (1), Daniele Cinti (1), Anna Cipriani (2,3), Fausto Grassa (1), Francesco Italiano (1), Federico Lugli (2), Alessandra Sciarra (1,4)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Italy , (2) UNIMORE, Università degli Studi di Modena e Reggio Emilia, Italy, (3) Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, 10964, USA, (4) National Research Council, Institute of Environmental Geology and Geoengineering, CNR-IGAG, Italy

Hydrogeochemistry of 12 moderate-flow springs located in the Rieti and L'Aquila Provinces was investigated immediately after the August 24, 2016 Accumoli-Amatrice earthquake (Mw 6.0). Physico-chemical parameters (pH, temperature, electrical conductivity), alkalinity, major, minor and trace components, stable isotopes (O, H and C), 87Sr/86Sr ratios, as well as dissolved gases were measured/analysed on a monthly basis up to October 2017; extra-samplings were done soon after the 26 October (Visso village, Mw 5.9 and 5.4) and 30 October (Norcia village, Mw 6.5) earthquakes. Two additional samplings were carried out in June and July 2018 in order to obtain observations in periods of reduced tectonic activity, when seismic energy release returned to pre-August 2016 levels. These springs had previously been sampled in 2009 and 2010, providing some pre-earthquake data. Investigated aquifers are hosted in the permeable layers of the terrigenous/turbiditic "Flysch della Laga" Formation overlaying the Mesozoic carbonates, the largest groundwater bodies in central Italy.

The main goals of this research were to i) evaluate the effects on the hydrochemistry and flow paths of groundwater induced by a long-lasting seismic sequence characterised by around 100.000 events, 9 of which having Mw > 5.0; ii) individuate the mechanisms causing the observed changes and iii) tentatively compare hydrochemical and water dynamic responses to earthquakes between the two different hydrogeological frameworks existing in the epicentral area (i.e Laga Formation and carbonates). During the 2016-2017 seismic sequence Barberio et al. (2017) and Rosen et al. (2018) investigated Mesozoic carbonate aquifers, highlighting notable hydrochemical transient variations in groundwater springs. They attributed most of the observed transient chemical changes to fracture clearing and shaking of fluids from isolated dead-end karstic pore spaces, also taking into account the release of geothermal fluids and deeply trapped CO_2 from the deep subsurface through dilation of fault conduits.

Our geochemical data were displayed in conventional time-series plots and processed by using a multivariate statistical approach (Factor Analysis). It was accomplished for each spring with the main goals to constrain more quantitatively the observations on the time-series graphs and better infer the possible correlation between seismic and geochemical patterns.

Main results highlight: i) a remarkable increase in the alkali components (Na and K) as well as in some trace element contents (Fe, B, Sr, V) just after the main earthquakes (Mw > 5.0). These trends, together with a noticeable pH increase, were also observed prior to the Visso and Norcia earthquakes (mid October sampling); ii) a general stability of O, H, C and Sr isotope values for all the considered period, iii) negligible alkalinity variations over time.

We tentatively interpreted most of the transient chemical changes observed in the monitored aquifers as the result of within-aquifer changes through release of slow-moving pore fluids into the main flow paths after an increase in pore pressure, hydraulic conductivity, and shaking from coseismic (and possibly pre-seismic) aquifer stress. On the contrary, other processes such as mixing among groundwater having different chemical compositions, geothermal fluids, or rapid upward movement of deep CO_2-rich fluids were assumed negligible or minimised.