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One year of geochemical monitoring of groundwater in the Abruzzi region after the 2009 earthquakes.

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The presence of a deep and inorganic source of CO2 has been recently recognized in Italy on the basis of the deeply derived carbon dissolved in the groundwater. In particular, the regional map of CO2 Earth degassing shows that two large degassing structures (Tuscan Roman degassing structure, TRDS, and Campanian degassing structure, CDS) affect the Tyrrhenian side of the Italian peninsula. The comparison between the map of CO2 Earth degassing and of the location of the Italian earthquakes highlights that the anomalous CO2 flux suddenly disappears in the Apennine in correspondence of a narrow band where most of the seismicity concentrates. A previous conceptual model proposed that in this area, at the eastern borders of TRDS and CDS, the CO2 from the mantle wedge intrudes the crust and accumulate in structural traps generating over-pressurized reservoirs. These CO2 over-pressurized levels can play a major role in triggering the Apennine earthquakes.
The 2009 Abruzzo earthquakes, like previous seismic crises in the Northern Apennine, occurred at the border of the TRDS, suggesting also in this case a possible role played by deeply derived fluids in the earthquake generation. Detailed hydro-geochemical campaigns, with a monthly frequency, started immediately after the main shock of the 6th of April 2009. The new campaigns include the main springs of the area which were previously studied in detail, during a campaign performed ten years ago, constituting a pre-crisis reference case. Almost one year of geochemical data of the main dissolved ions, of dissolved gases (CO2, CH4, N2, Ar, He) and of the stable isotopes of the water (H, O), CO2 (13C) and He (3He/4He), highlight both that the epicentral area of L'Aquila earthquakes is affected by an important process of CO2 Earth degassing and that that the gases dissolved in the groundwater reflects the input in to the aquifers of a deep gas phase, CO2- rich, with an high He content and with low 3He/4He ratios, similar to the gases emitted by natural manifestations located in the northern Apennines which are fed by deep pressurized reservoirs. Furthermore a systematic increase in the content of the deeply derived CO2 dissolved in the aquifers occurred respect to the July 1997 samples. This increase, followed by a gentle decline of the anomaly, can be compatible with the occurrence of an episode of deep CO2 degassing concurrently with the earthquakes. The origin of this regional variation is under investigation and, at the present moment, an unambiguous interpretation of the data is not possible because the lack of a systematic monitoring of the springs before the seismic events and because eventual seasonal effects on observed variation in CO2 flux are still under investigation.