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Soil gas profiles across buried fault and exposed coseismic ruptures during the Amatrice and Norcia earthquakes, Central Italy

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Following the earthquake (ML=6.0) of 24 August 2016 that affected large part of the central Apennine between the municipalities of Norcia (PG) and Amatrice (RI) (Central Italy), two soil gas profiles (i.e. 222Rn, 220Rn, CO_2 and CO_2 flux) were carried out across buried and exposed coseismic fault rupture of the Mt. Vettore fault during the seismic sequence.
Two months later, another event with MW=6.5 (30th of October at 06:40 UTC) occurred in the northernmost sector of the activated area among Norcia, Preci (PG), and Castel Sant'Angelo sul Nera (MC) causing large surface fracturing also overlapped to the previous ones. A couple of weeks before and few days after the main shock, two soil gas profiles (i.e. 222Rn, 220Rn, CO_2 and CO_2 flux) were carried out across coseismic fault rupture in the Castelluccio Plain, SW of the Mt. Vettore.
The objective of the surveys was to explore the mechanisms of migration and the spatial behaviour of different gas species near still-degassing active fault. Results provide higher gas and CO_2 flux values (about twice for 222Rn and CO_2 flux) in correspondence of the buried sector of the fault than those measured across the exposed coseismic rupture. Anomalous peaks due to advective migration are clearly visible on both side of the buried fault (profile 1), whereas the lower soil gas concentrations measured across the exposed coseimic rupture (profile 2) are mainly caused by shallow and still acting diffusive degassing associated to faulting during the seismic sequence. Moreover, soil gas profiles crossing a coseismic rupture and a buried conjugate of the Mt. Vettore fault in the Castelluccio plain, highlighted an increase of CO_2 and 222Rn values after the earthquake of 30 October, and a decreasing of 220Rn values, indicating a shallow circulation mechanism.
These results confirm the usefulness of the soil gas survey to spatially recognise the shallow geometry of hidden faults, and to discriminate the geochemical migration mechanisms occurring at buried and exposed faults related to seismic activity.