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^{222}Radon (^{222}Rn) levels of Thermal Waters in the geothermally active Campi Flegrei volcanic caldera (Southern Italy) using a RAD7 radon detector

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Radon is an inert radioactive and radiogenic gas whose exposure is considered harmful for human health. Radon migrates in the hydrogeological systems and discharge into air when water is exposed to the atmosphere. In hydrothermal and geothermal settings of quiescent volcanoes, the surveillance of dissolved ^{222}Rn can be useful to define the hydrological setting and to track fluids' dynamics. The quantity of dissolved ^{222}Rn depends on different factors such as the characteristics of the aquifer, water-rock-gas interactions, water residence time, radioactive supply. The present study provides measurements of radon concentration levels in 20 thermal waters at the Campi Flegrei volcanic caldera, an important geothermal system with hydrothermal manifestations in the Neapolitan area. We used a Radon-in-air detector (RAD7®, Durridge Co.) equipped with Big Bottle RAD H2O and DRTYSTICK accessories. Water samples are taken from subsurface thermal groundwater, springs, lakes, pools and one submerged thermal spring with different chemical-physical conditions. They are mostly chlorine to bicarbonate waters, with the exception of few sulphate, sampled nearby gas vents of Solfatara and Pisciarelli, with temperature and pH values ranging from 18.1 to 91.3 °C and from 2 to 8 respectively. The hottest and most acidic sulphate waters refer to a small boiling pool at the hydrothermal discharge area of Pisciarelli and have nearly zero Rn levels.

Dissolved radon concentrations vary from 0.1 ± 0.1 to 910 ± 9 Bq/L with an average value of 122.7 Bq/L, using the CAPTURE program, the default RAD7 data acquisition program. Similar values in radon concentration are obtained using the method proposed in De Simone et al. (2015), ranging between 0.1 ± 0.1 and 1037± 60 Bq/L with an average value of 133.0 Bq/L.

The ^{222}Rn levels from this study not exceed the additional reference level of 1000 Bq/L that can be used in specific situations for the protection of human health.

No correlation has been observed between temperature, pH, major anions and radon concentration values, nor between rock composition since it is almost homogeneous at the study sites. Rn levels therefore appear to reflect the local sedimentological, structural or hydrogeological setting.

These results are the first of our investigation of dissolved Rn at the Campi Flegrei caldera, acquired in the ongoing “Pianeta Dinamico” project focused on the hydrothermal system functioning of the quiescent volcanoes and financed by the Istituto Nazionale di Geofisica e Vulcanologia. The final goal will be to define the natural Rn fluctuations in relation to the background levels and eventual anomalies in the hydrogeological system, also for public health safety monitoring. Therefore, a future step in this framework will be integrating more dissolved radon measurements in the Campania territory using the same research approach adopted in this study.

De Simone G., Galli G., Lucchetti C., Tuccimei P. (2015) Calibration of Big Bottle RAD H2O set-up for radon in water using HDPE bottles Radiat. Meas., 76, pp. 1-7.