

Seismo-volcanic monitoring at Furnas Volcano (Azores): radon (^{222}Rn) concentration in groundwater

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The Azores archipelago, located in the middle of the North Atlantic Ocean, is composed of nine volcanic islands that formed at the triple junction of the North American, Eurasian and African (Nubian) tectonic plates. These volcanic islands were the sites of several eruptions and destructive earthquakes since human settlement in the 15th century.

S. Miguel Island, the largest and most densely populated island of the Azores, hosts three active strato-volcanoes with calderas. Furnas Volcano is one of these. Its eruptive activity has been essentially explosive, involving magmas with trachytic (s.l.) composition. In the last 5000 years at least 10 explosive eruptions occurred inside the caldera of Furnas. The last one occurred in 1630 and was subplinian in character. Since then an intense hydrothermal activity has persisted, involving four main fumarolic fields, thermal springs, CO_2 -rich springs, several soil diffuse degassing areas (CO_2 and ^{222}Rn), as well as occasional hydrothermal explosions.

In the past decade we have developed a radon survey of Furnas hydrothermal manifestations. Here we report on the radon survey of twelve water springs, located inside the caldera, and representative of the different water types encountered at the volcano (orthothermal, thermal and CO_2 -rich springs). Bimonthly sampling and determination of radon activity and water temperature was performed in the selected springs between years 2007 and 2011. At each sampling point two water samples were collected for radon dosing in laboratory with the RAD7 equipment. A decay correction was applied to each sample. The average radon activities were found to vary between 1.15 Bq/L and 29.77 Bq/L, while water temperatures ranged between 16.5 °C and 76.2 °C. As a whole radon activities inversely correlate with water temperature, with orthothermal springs showing higher radon activity than thermal springs. Temporal variations in both parameters appear to be mainly determined by seasonal variations of environmental conditions as soil temperature, rainfall and soil water content, rather than by volcanic activity, with the exception of one spring where radon activity seems to change more closely relate to the seismic activity of Furnas Volcano.

Because some of the surveyed waters are often drunk by the local population and tourists, our results are also useful in a public health perspective. We conclude that the measured radon activities do not pose any health problem, as they remain under the safety threshold (100 Bq/L) defined by the World Health Organization.

The research performed allowed to define the radon background for each one of the groundwater discharges sampled and to identify the environmental parameters that can influence the radon concentration in the groundwater of Furnas Volcano, allowing more easily to identify a future reactivation of this volcanic system.