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Radon monitoring in a volcanic cave: El Viento Cave (Canary Islands, Spain)

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Radon (^{222}Rn , $t_{1/2} = 3.82$ days) is by far the dominant radionuclide in indoor air and constitutes a health hazard in poorly ventilated environments, such as caves, mines or tunnels. In these contexts, radon gas can accumulate, reaching harmful concentrations due to the ionizing radiation from ^{222}Rn and its progeny. To minimize the exposure risk, a radon monitoring program is required to adopt mitigation measures for the radiological protection of workers, cavers and visitors. The Directive 2013/59/EURATOM sets the recommended occupational and public effective dose limits being 20 and 1 mSv/year, respectively.

El Viento Cave is a volcanic lava tube located in the northern flank of Pico-Viejo volcano, in the Icod Valley, (Tenerife, Canary Islands, Spain). It was formed during the early eruptions of the Pico Viejo volcano, 27,030 \pm 430 years ago, from basaltic, plagioclase-rich pahoehoe lavas. The cave has an extraordinary complexity, with several sinuous tubes and branches in three superimposed and interconnected levels and is considered the 5th longest volcanic cavity on Earth (Carracedo and Troll, 2013). A 200 m long segment of this lava tube, named "El Sobrado Cave", is enabled for touristic visits. Only in 2019 the cave received more than 28000 visitors.

Monthly radon profiles were obtained during one year (from 2020/10/01 to 2021/09/30) in the touristic section of the cave by using SSNTD (CR-39), installed approximately every 35 m. Besides, a RadonScout monitor (SARAD GmbH) was set up at about 100 m from the cave entrance, for continuous monitoring (integration time of 1 hour) of radon and environmental parameters (air temperature, relative humidity, and barometric pressure).

^{222}Rn levels inside the cave ranged from 0-5.000 Bq/m³, exhibiting seasonal, diurnal and semidiurnal fluctuations. Short-period radon variations (24 and 12 h frequencies) are related to air temperature and humidity. Long-period radon fluctuations (annual-seasonal) are correlated with rainfall, with lower radon levels in winter (rainy season) and higher in summer (dry season).

Annual mean effective dose due to ^{222}Rn gas exposure was estimated from the geometric mean of radon concentration during the studied period, assuming an average indoor occupancy of 10 working hours/week during 48 weeks/year for guides and a punctual visit of 1 hour for tourists. In these conditions, the resulting annual effective dose computed for guides is below 2mSv/year.

References:

Carracedo, J.C. & Troll, V.R. (Eds.). (2013). Teide Volcano: Geology and Eruptions of a Highly Differentiated Oceanic Stratovolcano. Active Volcanoes of the World, Springer Berlin Heidelberg, 296 pp.