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Seasonal variations of hazardous gases in near-surface cavities: Case of study of Rull cave

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Subsurface environments as shallow caves generally accumulate gases such as ^{222}Rn and CO_2. Due to their inherent characteristic of isolation, the air quality in these confined environments with low ventilation rates may reach harmful concentrations of these gases. Especially based on the radon monitoring, some guidelines and protecting strategies might be proposed aiming to ensure the safety of both visitors and workers against the exposure to this radioactive gas. The gas composition of indoor air mainly depends on the degree of ventilation controlling the aerodynamic processes between the cave environment and open atmosphere. In this study, microenvironmental monitoring of Rull cave (Alicante, southeast Spain) was conducted along a 5-year period. ^{222}Rn and CO_2 concentrations and other climatic variables (temperature, relative humidity and atmospheric pressure) were recorded to understand the diurnal, synoptic and seasonal cycles of ventilation in this show cave as well as to determine the variations on gas composition of its subterranean atmosphere. Both, diurnal and seasonal concentrations depend on external temperature variations. In Rull cave, maximum concentration of gases in the cave air is reached in the warmer months, with ^{222}Rn and CO_2 concentration higher than 3500 Bq/m^{3}and 3500 ppm, respectively. However, within the coldest periods concentration of both gases is, in average, lower than 500 Bq/m^3 and 500 ppm for ^{222}Rn and CO_2, respectively. The maximum concentration of gases is reached by diffusion processes responsible for the gas transport to the cave through soil and rock. Some evidences are presented related to the control of rock and soil pore structure on this gaseous transport. The entrance of external air (with low CO_2 and ^{222}Rn concentration) significantly decreases the gases concentration of cave air in the coldest periods.