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Relationships between radon concentration and temperature and barometric pressure variation in the Sopronbánfalva Geodynamic Observatory, Hungary

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ABSTRACT

The Sopronbánfalva Geodynamic Observatory is located on the Hungarian-Austrian border in the Sopron Mountains belonging to the extensions of the Eastern Alps. The Sopron Mountains consist of metamorphic rocks of Palaeozoic age such as gneiss and different mica schists. The observatory is an artificial gallery at a depth of about 60 m driven horizontally in an outcrop of the bedrock formed by gneiss. The observatory is thermally insulated by three doors but not perfectly hermetically sealed. It means that there is a slow air circulation which does not change the temperature in the gallery but it ensures that the indoor and outdoor barometric pressures are the same. So, we can safely assume that the transport of radon to the outside is very slow. The yearly mean temperature in the gallery is 10.4 ºC and the yearly and daily temperature variations are less than 0.5 ºC and 0.05 ºC, respectively. The relative humidity is 90% and it is nearly constant. Radon concentration variations have been monitored in the observatory since 2009. The radon concentration is extremely high, 100 – 600 kBq m^{-3} in summer and some kBq m^{-3} in winter. The relationships between radon concentration and the temperature and barometric pressure were separately investigated in the summer and winter months by Fast Fourier Transformation, Principal Component and Multivariant Regression Analyses in different frequency bands. The long-period radon concentration variations are mainly governed by the temperature (20 kBq m^{-1} $°C^{-1}$) both in summer and in winter. The regression coefficients between long-period radon concentration and barometric pressure are –1.5 kBq m^{-3} hPa^{-1} in summer and 5 kBq m^{-3} hPa^{-1} in the winter months. In the 0.072-0.48 cpd frequency range, the effect of the temperature is about –1 kBq m–3 $°C^{-1}$ and the effect of barometric pressure is –5 kBq m^{-3} hPa^{-1} in summer and –0.5 kBq m^{-3} hPa^{-1} in winter. In frequency range above 0.48 cpd all regression coefficients are one order of magnitude smaller than in the range of 0.072-0.48 cpd. The investigations contribute to a better understanding of the nature of radon emanation and the effect of meteorological processes on it.

Key words: Radon concentration; air pressure; temperature; underground gallery; data analysis.

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