Subsurface Radon Monitoring at Conrad Observatory – Insight in natural Radon variations and environmental influences

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The radiometry project described here lasted from September 2012 until April 2013. The experiment was set up in the rear section of the seismic tunnel at COBS due to constant environmental parameters like temperature and pressure all over the year. The main goal of this project was to get a first insight in natural Radon (Rn) variation patterns in this region. Combined with measurement of atmospheric environmental parameters (surface temperature, pressure, snow height and precipitation), results showed a distinct correlation between temperature rises above 0°C and subsequent snow melting periods.

Measurements of natural gamma radiation give a first insight on variations of natural Radon (Rn) gas in the area of the Conrad Observatory, Lower Austria. These measurements, executed subsurface in the carbonate host rock of the Trafelberg within a concrete cased tunnel, started in September 2012 and lasted until 1st of April 2013. Besides Rn environmental parameters, which are monitored at the Observatory since November 2012, have been used for correlation with Rn variations and identifying possible environmental influences on the Rn signal, which is the main goal of this study. The experiment has been divided into two stages: 1) Rn monitoring with Pb shielding of the sensor and an additional Rn source until November 2012 and 2) Rn monitoring of natural Rn flux without source and shielding, combined with a contemporaneous monitoring of the environmental parameters temperature, rainfall, snow cover and pressure from November 2012 until April 2013.

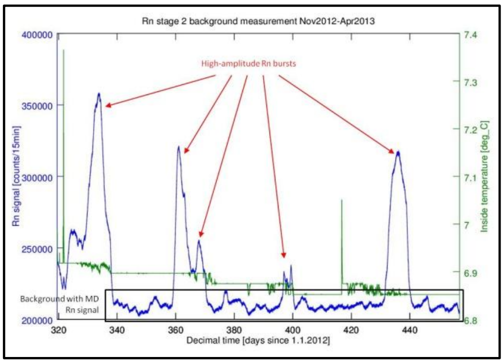

Figure 1: Measured signal of second stage with tunnel temperature lasting from November 2012 until April 2013 (138 days).

The observed Rn signal consists of two different, independent components: a) non-periodic "high-amplitude Rn bursts" and b) non-periodic multi-day (MD) Rn signal in the background as well within the mentioned bursts (Fig. 1) Periodic signals, like diurnal or semi-diurnal, are not found. The temperature inside the tunnel was almost at 6,9°C with variations below 0,1°C throughout this period.

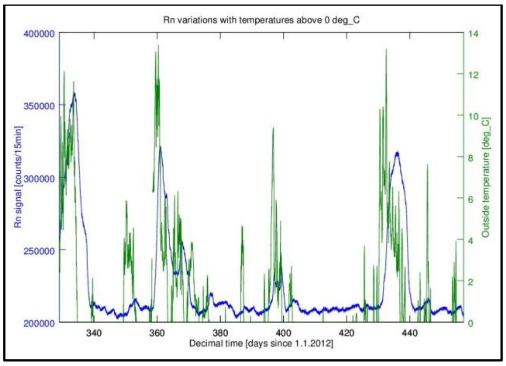

Figure : Rn signal and outside temperatures >0°C from November 2012 until April 2013.

The Rn signal was compared to environmental data, especially outside temperature (Fig. 2) and subsequent changes of snow melting periods (T > 0°C) and periods with T < 0°C. Results showed that the above mentioned "high-amplitude Rn bursts" coincide with melting periods with a small time lag. A model for the origin of this phenomenon was then created, suggesting snow cover as blocker for Rn gas emitting into atmosphere and within melting periods being brought down into the rock with melting water. Analysis of non-periodic multi-day Rn signals combined with atmospheric pressure and temperature may indicate an influence of both but requires additional experiments to verify this hypothesis.

References:

Hasenburger W. (2013) Subsurface Radon Monitoring at Conrad Observatory, Austria. A first insight in natural Radon variations and environmental influences. Bachelor Thesis. University of Leoben.

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