Thesis summary

The petrologic and tectonic background of the radon exhalation in the Sopron Mountains - Summary

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1. I have mapped the radium activity concentration of the main rock types around the Sopron Mountains. The radium activity concentration of the original metagranites is 43±3 Bq/kg, of the gneisses is 35±3 Bq/kg, of the micaschists is 47±4 Bq/kg. In case of Harka quarry anomalous radium activity concentration was measured from three metagranite samples, in average: 84±3 Bq/kg, which is two times higher than it was measured in other metagranites. Based on these results the increase of the radium bearing minerals occurred locally during the crystallisation of the rocks. The dispersion of the radium isotopes was already inhomogeneous in the original granites around the Sopron Mountains.

2. I have showed, that deformed gneiss around the Csalóka Spring have 1.5 times higher radium activity concentration than it was measured in the original rocks, this value is in average 68±4 Bq/kg. The radium and (thorium) bearing minerals are zircon, monazite, allanite, xenotime and cheralite, which appear along fissures in thin sections. This is an evidence of the secondary phosphate mineralisation. These results show that the plastic deformation and phosphate mineralisation caused increased radium activity concentration of the rock.

3. I have determined the radon exhalation and radon exhalation ability of the main rock types. I have showed that the deformed gneiss samples around the Csalóka Spring have two times higher radon exhalation and radon exhalation ability (8,8±1 Bq/kg and 12±2%) than it was measured in the original gneiss. During deformation the rock fabric have preferred orientation and the permeability is increasing, thus the radon can exit easier.

4. I have described the thorium activity concentration of the main rock types. The micaschists have more than three times higher thorium activity concentration (41±2 Bq/kg) than the gneisses. The reason of it is, that the initial material of the micaschists has already had higher thorium content.

5. I have measured anomalously high thorium content in the deformed (linear) gneiss around the Róka ház quarry. Here the thorium activity concentration as high as 131±3 Bq/kg, which is one order of magnitude higher than it was measured in other deformed of non-deformed gneisses. I have showed that the thorium bearing minerals are zircon, monazite, allanite, xenotime but most abundant was the cheralite, which appears along fissures in thin sections. These results are important, because thorium anomaly around the Sopron Mountains was unknown so far.

6. I have found, that the leucophyllites, created during Mg-metasomatism, have low radon exhalation and radon exhalation ability, moreover it is nearly zero, 0,8±0,5 Bq/kg and 2,9±2%. It is an unexpected result because the leucophyllites are very schistose thus radon could easily exit along the layers.

7. I have identified two, nearly 10 cm thick and several meters long layers of weathered gneiss behind the Geodynamic Observatory of Sopronbánfalva, which have anomalously high radium activity concentration (253±6 Bq/kg) and radon exhalation (46±3 Bq/kg) compared to the other rock types around the Sopron Mountains. I have stated that iron and phosphates are typical along fissures, furthermore thorium, radium and clay minerals, like smectite are accumulated in the smallest rock part (<64 µm). Based on these results the radium and radon anomaly was caused by low temperature alteration. Using a simple calculation I have estimated that if this material would be 2 m thick around the cave, it can be the source of the anomalously high radon concentration in the Observatory (this is a realistic order of magnitude in the nature).

8. Using a model calculation ($c_{pot} = \frac{M\rho}{p}$), where M is specific radon exhalation of the rocks, ρ is the density and p is effective porosity, I showed that the deformed gneiss around the spring can be the source of the high radon concentration of the water of the Csalóka Spring. I have demonstrated, that in case of spring, summer and autumn months, the radon concentration and precipitation show strong negative correlation: -0,95. Therefore the precipitation can dilute the radon concentration of the spring. I have described the spatial distribution of the radon concentration around the spring, and I have found that the highest radon concentration can be measured at the main discharge point of the spring. The lower radon concentration in the other measuring points was caused by surface radon diffusion and/or dilution effect of meteoric water.

9. I have monitored the radon concentration and physical-chemical properties of eight springs, and the yearly average of the radon concentration was calculated. I demonstrated that between the radon concentration of the springs and the precipitation was in negative correlation, furthermore negative correlation between radon and pH, and electric conductivity was found, too. I showed that springs with higher than 100 Bq/l radon concentrations originating from gneiss or micaschist. The springs discharging from quaternary sediments have lower radon concentration because the lower radon exhalation of these material. Based on these results, the radon concentrations of the springs are influenced by the country-rock.