HORIA HULUBEI NATIONAL INSTITUTE FOR R&D IN
PHYSICS AND NUCLEAR ENGINEERING

EVOLUTION OF RADON CONCENTRATION IN THE MICROBQ LABORATORY AT UNIREA MINE, SLANIC PRAHOVA

PRESENTATION

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INTRODUCTION

The noble gas, Radon is a chemical element, without a stable isotope. The isotopes of Radon, appear from the desintegration of U-238, U-235 and Th-232. The most common Radon isotope is Rn-222, with it’s half-life of 3.82 days.

Medical studies indicate that there is a strong correlation between Radon exposure indoors (at home, or at the workplace) and pulmonary cancer. Radon exposure represents the second most common cause for the occurrence of pulmonary cancer

UNIREA MINE- OVERVIEW

Unirea Mine was excavated within the salt deposit at Slănic Prahova. The salt deposit has impressive dimensions: approximately 5 km in length, 3 km in width, and 500 m in thickness.

Unirea Mine characteristics:

- Floor base elevation: 208 m
- the characteristics of the rock located between the ceiling and the surface: mostly rock salt
- Temperature: 11.5-13.0° Celsius
- Humidity: 65-70 %
- Excavated Volume: 2.9 millions m^3
- Surface: 70000 m^2
- Distance between walls: 32-36 m
- Height: 52-57 m

MICROBQ LABORATORY

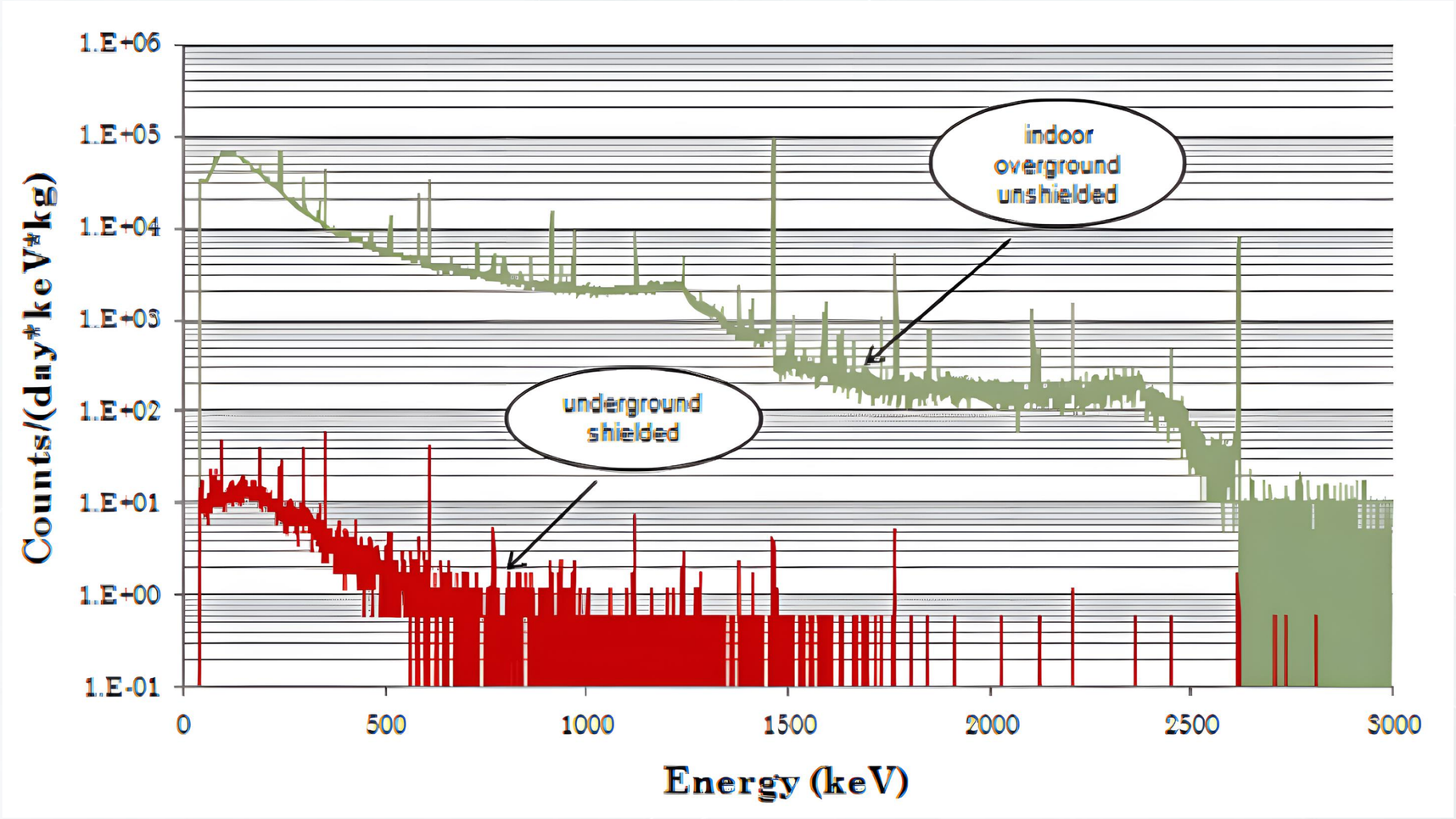
The underground laboratory consists of a compartmentalized, platformed enclosure and ultra-low-level background nuclear radiation measurement equipment; the enclosure is made up of 5 work spaces and a common corridor and is assembled on a horizontal surface of the salt pan floor, solidly attached to it.

The average dose rate in the mine is 1.29 ± 0.30 nSv/h. Normally, in the environment, the radiation field, around the Slanic area is around 84-100 nSv/h

The radiation background in the underground is extremely low due to the fact that in the saline underground environment the presence of natural radionuclides is extremely low, natural salt does not contain natural radionuclides, they are present only in impurities, in concentrations similar to those in the upper continental crust.

The radiation background in the underground mine is aproximatly 80 times lower then the surface level radiation background

BACKGROUND SPECTRA COLLECTED WITH A CANBERRA HPGE DETECTOR WITH 120% REL. EFFICIENCY



METHODOLOGY-RADON MEASUREMENT

An AlphaguardD2000 was placed inside the MicroBq laboratory, inside the gamma spectrometry room. The radon concentration, from air, was measured at a cycle of 3600 seconds (one hour).
The measurements were taken in the following time periods:

- 08.03.2018-18.04.2018
- 21.05.2020-09.12.2020
- 07.12.2022-03.05.2023
- 21.07.2025-01.10.2025

METHODOLOGY

MINE DOSIMETRIC MAPPING

Device:

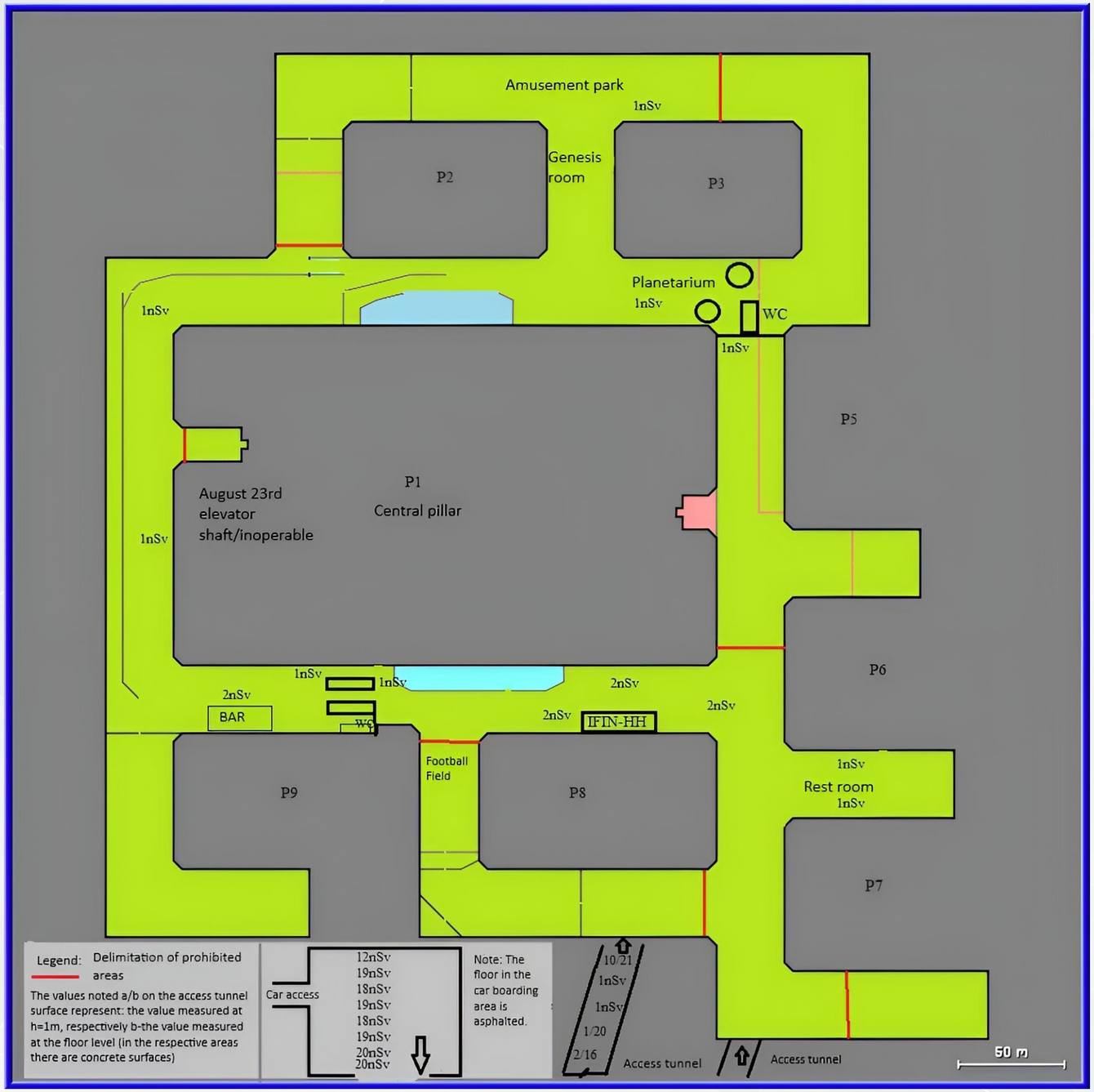
- ✓ Automess 6150AD-b/H scintillator detector

Method

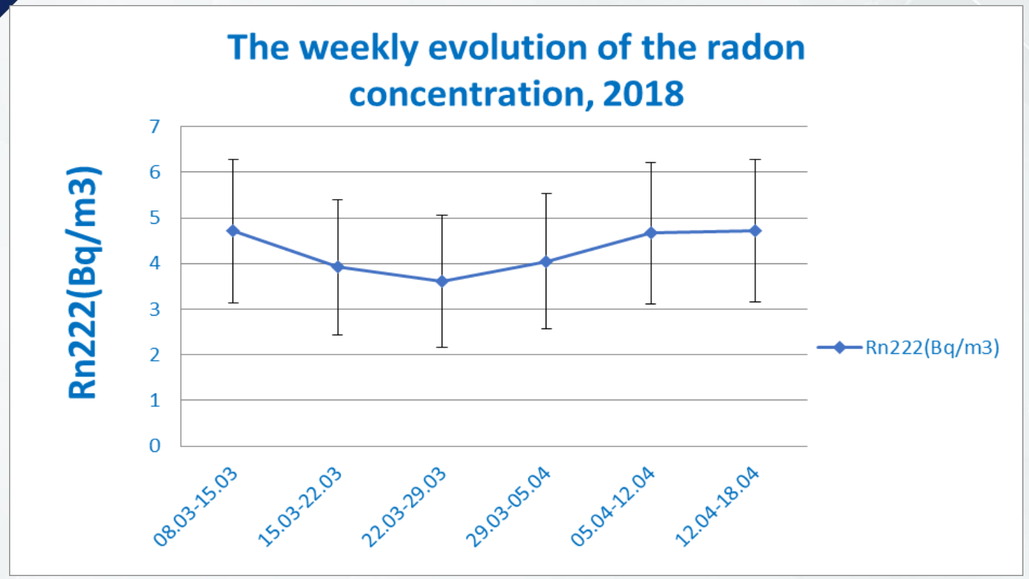
- ✓ measurements taken on the main routes of the horizon
- ✓ Measurements taken at h=1 m from the floor level
- ✓ Additional measurements taken at floor level in areas with concrete
- ✓ Values have been represented on the horizon map

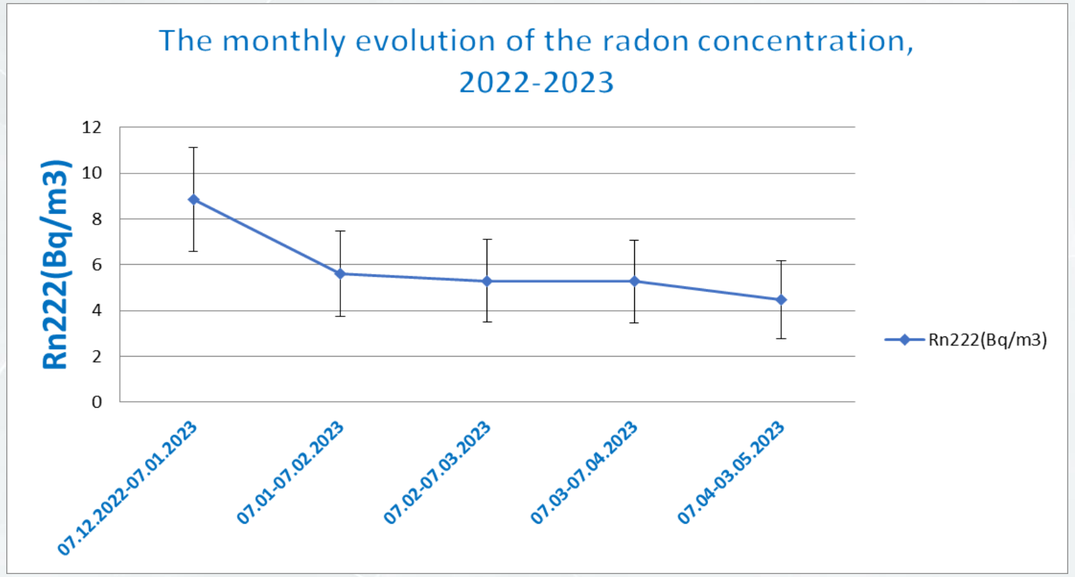
Observation:

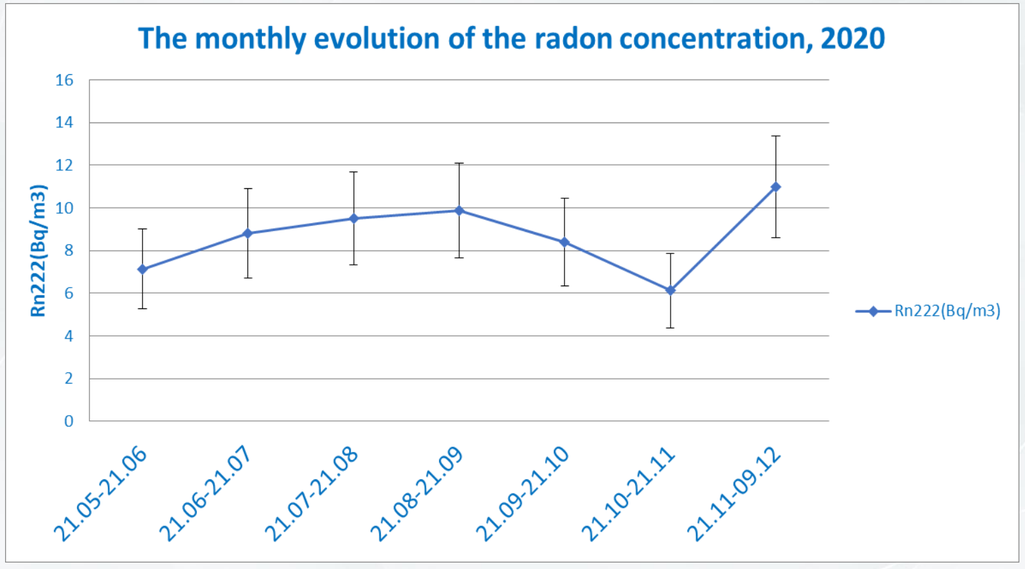
- ✓ The vehicle access route includes a concrete road, for the circulation of turistic and mining vehicles

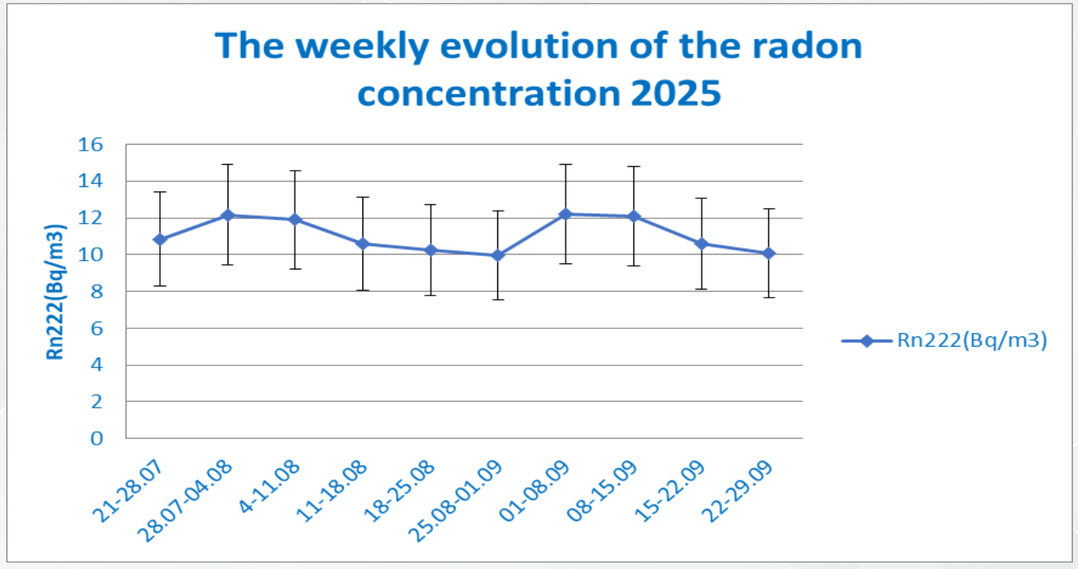


RESULTS


The weekly evolution of the radon concentration, 2018
Rn222(Bq/m3)
0
1
2
3
4
5
6
7
08.03-15.03
15.03-22.03
22.03-29.03
29.03-05.04
05.04-12.04
12.04-18.04
Rn222(Bq/m3)


The monthly evolution of the radon concentration, 2022-2023
Rn222(Bq/m3)
0
2
4
6
8
10
12
07.12.2022-07.01.2023
07.01-07.02.2023
07.02-07.03.2023
07.03-07.04.2023
07.04-03.05.2023
Rn222(Bq/m3)


The monthly evolution of the radon concentration, 2020
Rn222(Bq/m3)
0
2
4
6
8
10
12
14
16
21.05-21.06
21.06-21.07
21.07-21.08
21.08-21.09
21.09-21.10
21.10-21.11
21.11-09.12
Rn222(Bq/m3)


The weekly evolution of the radon concentration 2025
Rn222(Bq/m3)
0
2
4
6
8
10
12
14
16
21-28.07
28.07-04.08
4-11.08
11-18.08
18-25.08
25.08-01.09
01-08.09
08-15.09
15-22.09
22-29.09
Rn222(Bq/m3)

RESULTS

Year	Rn222(Bq/m3)	Rn222+error(Bq/m3)	Humidity rel.%(%)	Temperature(°C)
2018	4.27	1.51	57.98	14.11
2020	8.55	2.06	66.59	14.55
2023	5.96	1.89	50.61	16.60
2025	11.01	2.56	46.04	20.51

CONCLUSION

The road infrastructure for mining and turistic usage, have affected the ventilation conditions inside the mine, the air dynamic and the accumulation and movement of the Radon gas. The dosimetric mapping of the mine horizon where the MicroBq lab is located, supports the hypothesis that the variations of the Radon values are influenced by the modifications brought to the mining infrastructure.

REFERENCES

1. Margineanu, R., et al. "The Slanic-Prahova (ROMANIA) underground low-background radiation laboratory." Applied radiation and isotopes 66.10 (2008): 1501-1506.
2. Mitrica, Bogdan, et al. "Measurements of the atmospheric muon flux in the underground of slanic prahova salt mine." UPB Scientific Bulletin Series A 73.3 (2011): 203-212.
3. Margineanu, R. M., et al. "External dose rate in Unirea salt mine, Slanic-Prahova, Romania." Applied Radiation and Isotopes 67.5 (2009): 759-761.
4. Mitrica, B., et al. "Estimation of mwe (meter water equivalent) depth of the salt mine of Slanic Prahova, Romania." AIP Conference Proceedings. Vol. 1304. No. 1. American Institute of Physics, 2010.

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THANK YOU