University of PANNONIA
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Unified Knowledge and Technologytransfer platform on the extended Middle Transdanubian axis
NEW SZÉCHENYI PLAN

Conference Program

VII. Hungarian Radon Forum and Radon in Environment Satellite Workshop

16-17th May 2013

Veszprém, Hungary

16/05/2013 THURSDAY

09.00 OPENING CEREMONY

Session one – Biological effects of radon

Session chairs: Tibor Kovács, Bui Dac Dung

09.05 Radon a tapolcai barlangban – *J. Somlai, A. Kopek, G. Szeiler, T. Kovács, A. Várhegyi*

09.20 Biophysical modelling of mutation induction by inhaled radon progeny – *B. Madas, I. Balásházy*

09.40 Értjük egymást? Légutak és részecskék: terminológiai káosz a tudományágak közötti kommunikációban – *P. Herke, M. Szabó*

10.00 The medical uses of radon – *E. Deák, K. Nagy*

10.20 Biomedical effects of low-dose radon/hyperthermia therapy – *M. Gaisberger, H. Dobias, A. Moder, M. Ritter*

10.40 ***COFFEE BREAK***

Session two – Radon measurements in soil

Session chairs: János Somlai, Stanisław Chałupnik

11.00 Influence of geogas seepage on indoor radon – *I. Csige, S. Csegzi, S. Gyila*

11.20 Radon surface flux measurements in Serbia – *P. Kolarž, S. Atić, Z. Ćurguz, Z. S. Zunić*

11.40 The annual effective dose from natural radionuclides soil surface of Uzhgorod area – *I. Potoki, O. Parlag, V. Maslyuk, S. Lengyel, Z. Tarics*

12.00 Soil-gas radon intercomparisons – *M. Neznal, M. Neznal, M. Matolín*

12.20 ***LUNCH***

13.30 **POSTER SECTION**

Session three – Radon and thoron measurements

Session chairs: Ákos Horváth, Janja Vaupotič

14.40 Intercomparison of Tn devices in the RRI Tn calibration chamber – *F. Fábián, A. Csordás, A. Shahrokhi, Y. Omori, J. Somlai, T. Kovács*

15.00 Radon and thoron activity concentrations in adobe dwellings at the Great Hungarian Plain – *Zs. Szabó, Gy. Jordan, Cs. Szabó, Á. Horváth, Ó. Holm, G. Kocsy, I. Csige, P. Szabó, Zs. Homoki*

15.20 Thoron equilibrium factors based on long-term measurements of thoron and its progeny concentration around a high background radiation area in Orissa, India – *Y. Omori, G. Prasad, V. Sagar, S. K. Sahoo, A. Sorimachi, M. Janik, T. Ishikawa, S. Tokonami, R. C. Ramola*

15.40 Application of new image analyzer software in the scanner based nuclear track detector evaluation method – *G. Bátor, T. Kovács, A. Csordás, D. Horváth*

16.00 Calibration of thoron progeny monitors with use of liquid scintillation counting technique – *S. Chałupnik, B.i Lei, J. Tschiersch, K. Skubacz*

16.20 ***COFFEE BREAK***

Session four – Radon mitigation techniques

Session chairs: Imre Balásházy, Martin Neznal

16.40 Influence of the ventillation system on indoor radon variability – *V. Udovicic, A. Dragic, R. Banjanac, D. Jokovic, D. Maletic, N. Veselinovic, J. Filipovic*

17.00 Indoor ^{222}Rn time series analyzed by the stochastic complexity method – *M. Krmar, D. Mihailovic, V. Udovicic, I. Arsenic*

17.20 Implementing and testing radon mitigation techniques in a pilot house from Baita-Stei radon prone area (Romania) – *C. Cosma, B. Papp, A. D. Cucos, R. Begy, L. Suciu, G. Banciu, C. Sainz*

17.40 Measurements of Radon-222 in some houses by using SSNTDs in Qena city, Egypt – *S. Harb*

19.00 ***CONFERENCE DINNER*** – departure to Nereus Restaurant in Balatonalmádi from University Restaurant

17/05/2013 FRIDAY

09.15 OPENING OF SECOND DAY

Session five – Radon surveys I

Session chairs: Katalin Nagy, Miodrag Krmar

09.20 B. D. Burghele: Radon measurements in a CO_2 controlled environment – *B. D. Burghele, F. Fábián, A. Shahrokhi, T. Kovács*

09.40 Radon and thoron measurements in mineral sand mining area of Ha Tinh province – Vietnam – *B. D. Dung, T. V. Giap, T. Kovacs, T. N. Toan, L. D. Cuong, T. K. Minh*

10.00 Continual monitoring of radon in underground environments in Slovakia – *I. Smetanová, K. Holý, M. Briestenský, J. Zelinka, J. Omelka*

10.20 Radon survey within a regular grid in homes in Slovenia – *J. Vaupotič, A. Gregorič, M. Leban, M. Bezek, P. Žvab, B. Zmazek*

10.40 ***COFFEE BREAK***

Session six – Radon surveys II

Session chairs: István Csige, Vladimir Udovicic

11.00 Monitoring the population by radon exposure – A preliminary study for the North-East region of Romania – *I. A. Popescu, A. Teodor, C. Borcia, A. Cucu*

11.20 Mapping the soil gas radon concentration and soil permeability and their relation to pedological and geological background – *K. Zs. Szabó, Gy. Jordan, Á. Horváth, Cs. Szabó*

11.40 Status report of indoor Rn/Tn survey in V4 countries – *A. Csordás, T. Kovács, M. Neznal, M. Neznal, K. Holy, M. Mullerova, J. Mazur, K. Kozak*

12.00 Radon emanation and exhalation influencing parameters of building materials; effect of heat-treatment on clays – *Z. Sas, J. Somlai, G. Szeiler, J. Jónás, T. Kovács*

12.20 CLOSING CEREMONY

List of poster presentations:

1. Comparative study of gamma-ray background and radon concentration inside ground level and underground low-level laboratories – *R. Banjanac, A. Dragić, V. Udovičić, D. Joković, D. Maletić, N. Veselinović, M. Savić*
2. A simple method for Monte Carlo simulation of radon induced background of HPGe detectors – *D. Jokovic, V. Udovicic, R. Banjanac, D. Maletic, A. Dragic, N. Veselinovic, B. Grabez*
3. The efficiency calibration of the GeHp gamma spectrometers with ThO_2 descendents – *B. Biró, V. Simon, L. Dărăban*
4. Possible factors affecting accumulation of airborne ^{210}Pb in urban soil – M. Krmar, A. Mihailovic, N. Todorovic, J. Hansman, M. V. Vasic
5. Results of radon monitoring in different family houses – *M. Műllerová, K. Holý, I. Smetanová, O. Holá*
6. Relationship between the radon exhalation and the geological background in the metamorphic rocks of the Sopron hills – *Á. Freiler, Á. Horváth, K. Török*
7. Estimation of the lung cancer deaths due to residential radon in Cluj County – *A. Paula, D. R. Oana, D. Tiberius*
8. Development of an micro-controller based soil Radon measuring device for Earthquake prediction – *H. Simon, R. Cs. Begy, C. Cosma*
9. Egykori északi táróvágat és a kővágószőlősi radon probléma kapcsolatának vizsgálata complex mérésekkel – *T. Pataki, A. Várhegyi*
10. A mecseki rekultivációt követő hosszú távú radon monitoring néhány eredménye – *A. Várhegyi, Z. Gorjánácz, T. Pataki*
11. Radon-222 and radium-226 concentration in groundwater from NW of Romania – *M. Moldovan, D. C. Nita, B. D. Burghele, C. Cosma*
12. The new instrumental methods of nuclear spectroscopy for environmental studies – *V. Maslyuk, V. Zheltonizhskij, O. Parlag, O. Shpenik, O. Symkanich, N. Svatyuk*
13. Determination of Natural Radioactivity and Dose Estimation in Ground Water from Qena Governorate, Egypt – *S. Harb, K. S. Din, A. Abbady, K. Ali*
14. Combined effect of deposition and clearance on the microdosimetry of inhaled radon daughters – *Á. Farkas, I. Balásházy*
15. Measurements of radon and thoron decay products in air – An application of LSC and TLD methods – *S. Chałupnik, O. Meisenberg, L. Bi, J. Wang, K. Skubacz, J. Tschiersch*
16. Radon and thoron indoor seasonal variations in the south part of Vaslui County, Romania – *B. D. Burghele, C. Cosma*
17. Indoor radon and thoron survey in Hungary – *J. Somlai, T. Ishikawa, Y. Omori, R. Mishra, B. K. Sapra, Y. S. Mayya, S. Tokonami, A. Csordás, T. Kovács*

RADON SURFACE FLUX MEASUREMENTS IN SERBIA

Predrag Kolarž[1], Slobodan Atić[2], Zoran Ćurguz[3], Zora S. Zunić[4]

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[3]*Faculty of transport Doboj, University in East Sarajevo, Republic of Srpska*
[4]*Institute of Nuclear Sciences „Vinča", Serbia*

Abstract

Over 300 radon flux measurements have been done at 3 different measuring sites in Serbia. Measured points were selected to form a network of 40 m x 40 m distance from point to point mostly in plow fields, two in Vojvodina and one in Central Serbia. Two continual radon monitors RAD-7, soil temperature and soil humidity meter were employed for all measurements. Measuring of moderate and low radon flux levels showed many difficulties concerning high measurement uncertainty, artifacts and measuring procedure.

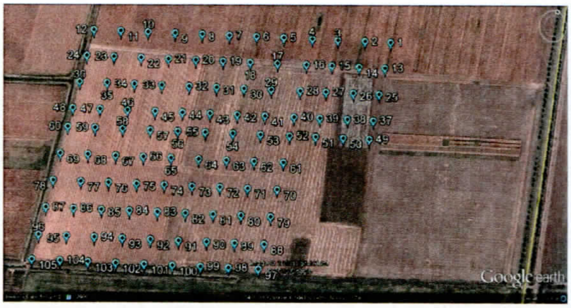
Introduction

Radon flux i.e. radon surface emission is the rate of introduction of new radon into the defined gas volume just above the unit area in a certain time. After decay of ^{226}Ra in the soil, small fraction of new formed ^{222}Rn atoms reaches the interstitial space. This process is known as emanation and is driven by processes of diffusion and advection where radon is dissolved either in water or in carrier gases on its way to the soil surface. Emanation depends significantly on the soil moisture, mineral grain size, while radon flux at the soil surface is influenced by weather conditions. Wet soil reduces the flux of radon at the surface by reducing the diffusion rate of radon through the soil matrix. The seasonal cycle of soil temperature can also introduce a seasonal radon cycle because diffusion becomes more intensive at higher temperatures(1).

The land-surface flux of radon varies in space and time. Diurnal and seasonal variations of radon flux are ascribed to the hydro-meteorological parameters. Sudden changes in temporal scale can be attributed to seismic activity of a region while high radon flux values in spatial scale can be found along tectonic or geological faults. Radon flux is expressed in $Bq\cdot m^{-2}\cdot s^{-1}$, and world continental average varies between 16 and 26 mBq $s^{-1}m^{-2}$(2).

Site description

During dry weather period in October 2012 and rainy period in March 2013, over 300 flux measurements have been done on 3 different sites in Serbia. Measurement on every site lasted no longer than two weeks. Two nearby measuring sites in Vojvodina were measured during different seasons. The third site in central Serbia was measured in winter. Measuring sites in Vojvodina were plowed fields of sugar beet while measuring site in central Serbia was also plowed field but with different types of crops. Measuring points was set to be on every 40 m to cover the area of 1600 m^2 (*1. figure*). Radon flux, soil temperature and moisture (to a depth of 0.2 m) were measured on every point simultaneously.



1. figure: Measuring points arrangement on site in Vojvodina presented in Google earth

Methods and instruments

2. figure: Radon flux measuring setup on the plow field of sugar beet during the draught

Radon flux measurements and instrument setup were performed by the Rad7 manufacturer's instructions (Durridge Company)[(3)] and according to reference literature as Ferry et al. (2001)[(4)], Vaupotič et al. (2010)[(5)], etc.

Closed loop setup is chosen as most suitable due to sensitivity, low levels of emissions and the accuracy of the measurements at moderate and high concentration. This kind of measuring setup means that the air is sampled and returned back into the exhalation chamber. Radon flux measuring setup is shown in *2. figure*.

The total volume of the system (V) is multiplied by the coefficient of increase of radon concentration within the emission chamber. Coefficient of increase is obtained using radon concentration linear fit, i.e. slope of increase (*3. figure*). Dividing these values with the ground surface covered by emission chamber (s) results the radon flux (ϕ)

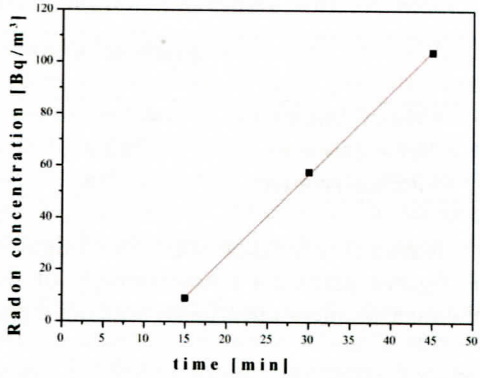
$$\phi = slope \cdot V/s \quad (1)$$

Measuring uncertainty is calculated by:

$$\Delta\phi/\phi = \Delta s/s + \Delta h/h \quad (2)$$

h – height of emission chamber sampling vessel.

The radon concentration in the radon flux measuring system increases due to the radon exhalation from the ground, but under irregular conditions it also decreases due to the radon decay and due to the losses of radon caused by penetration of ambient air in the system. As a consequence, the linear fit of experimental data can be evaluated as exponential[(6)]. This kind of uncertainty and also residual radon in the system from previous measurements take part in overall measuring conditions, where 20% of relative uncertainty should be added based on subjective evaluation[(7)]. Square root of the sum of the measurement errors results (~32%).



3. figure: Example of radon concentration increase linear fit

The measurements of radon surface flux at each point consist of:

- Preparation of the measuring point. Flattering and removing the porous surface layer of the soil which was very difficult in plowed fields of sugar beet since it was necessary to remove 0.3 m plowed soil from surface.
- Discharge of residual radon from measuring system. Purging the system 20-30 min. to reduce radon concentration close to zero in the whole air loop. Skiping this step may lead to fault measurements.
- Lowering the relative humidity in the measuring chamber below 10% by drawing the closed loop air through the dehumidifier (5-10 min.).
- Measurements are taken in the sniff mode of Rad7 instrument that covers the total countdown of α particles from 5.40 to 6.40 MeV including particles ^{218}Po with the half-life of $t_{1/2}$=3.05 min, which means that most of them will decay within 6 minutes of their formation. To avoid the impact of delayed response of these particles on the coefficient of growth in the emission chamber, first quarter of measurement is rejected. This period can also be used for lowering the relative humidity.

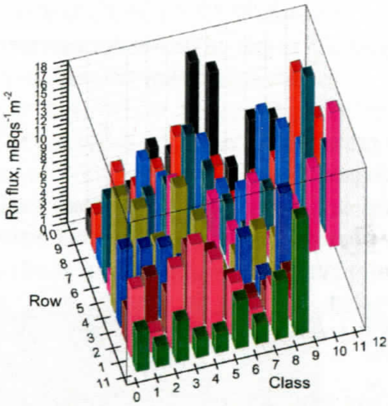
Measuring results and discussion

In *1. table* average values of radon flux, soil moisture content, soil temperature are shown. Having on mind that soil content of water could not be over 50%, difference in soil moisture between autumn and winter periods are significant affecting also the radon flux.

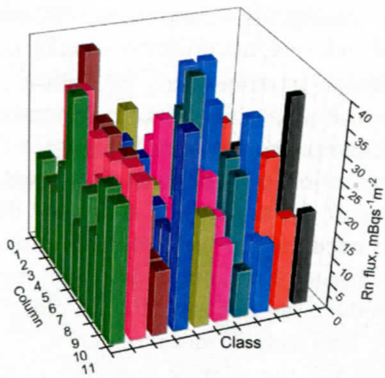
1. table: Average values of radon flux, soil moisture (0.2 m), soil temperature (0.2 m)

	ϕ (Bq·m^{-2}·s^{-1})	**Soil moisture content (%)**	***Soil temperature* (°C)**
Vrbas (autumn)	19.2±6.3	22	16.6
Vrbas (winter)	6.7±2.0	34	8.6
Svilajnac (winter)	5.6±1.8	36	5.3

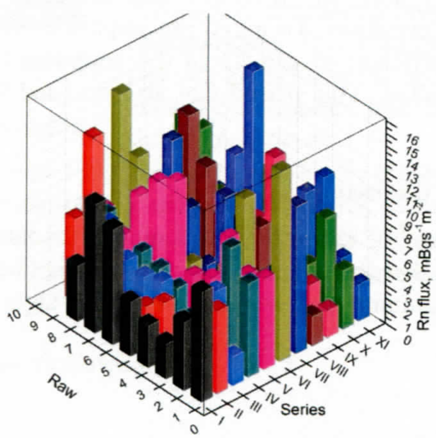
Radon flux for each point for all three measuring sites is presented graphically in *4-6. figures* particular inhomogeneity of flux values that significantly stands out from the measurement uncertainty was not measured.



4. figure: 3-D measured values of radon flux on Vojvodina site - winter period



5. figure: 3-D measured values of radon flux on Vojvodina site - autumn draught period



6. figure: 3-D measured values of radon flux on central Serbia site - winter period

Conclusion

Measuring results showed low and homogeneous distribution of radon flux and high dependence on the soil water content (lower porosity resulting in lover gas diffusion) and temperature in the subsurface layer. Increase of temperature is followed by decrease of humidity and increase of radon flux. Measuring values of radon flux on all 3 places does not show any surface geological anomalies (faults) or increased concentration of uranium in the soil. For reliable tracing of geological faults it is necessary to remove surface soil layers in order to eliminate possible effects of screening by soil layers of small permeability(8).

We did not noticed dependence of radon flux on time of day or meteorological factors that are influencing top surface layers. In order to minimize artifacts, special attention should be paid to purge the instrument between two measurements because small amounts of radon in the system can result in enormous high radon concentrations and negative radon increase. This process can last up to 30 min. which is significantly prolonging time of measurements.

References

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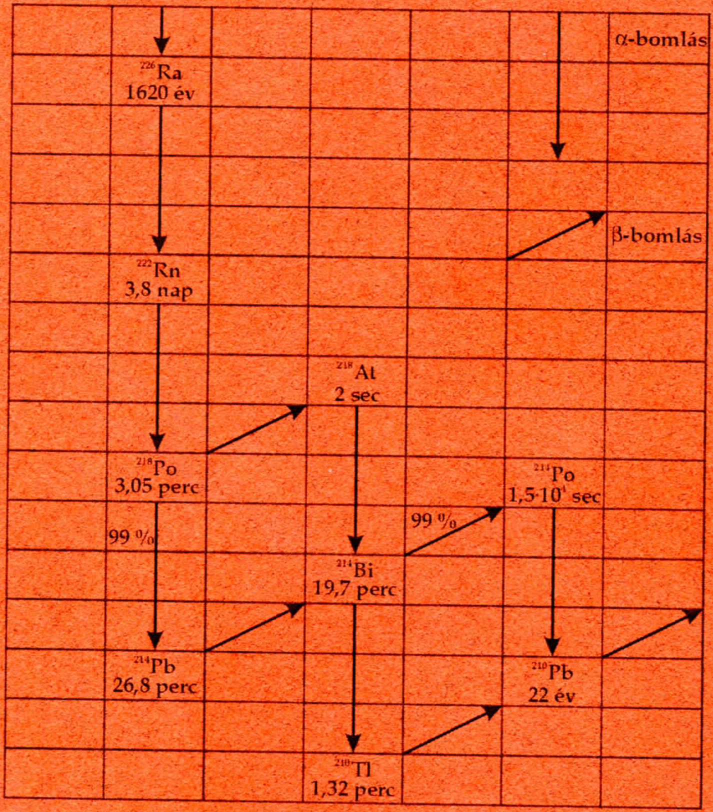

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