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A study on the correlation between Rn index and geology in Cluj-Napoca area, Romania

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Titlul Proiectului: *Sisteme inteligente privind siguranța populației prin controlul și reducerea expunerii la radon corelate cu optimizarea eficienței energetice a locuințelor din aglomerări urbane importante din România - **SMART-RAD-EN***

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SmartRADON

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Introduction

In this paper we present the results of radon in soil and permeability measurements from Cluj-Napoca area, Romania, as an integrating part of the SMART_RAD_EN project.

The relationship between Rn Index and geology is well known.

The aim of this research was to investigate the distribution of radon gas concentration in soil and to better understand the influence of geology on the concentration of radon levels in homes, in order to further identify other risk areas in terms of exposure to radon.

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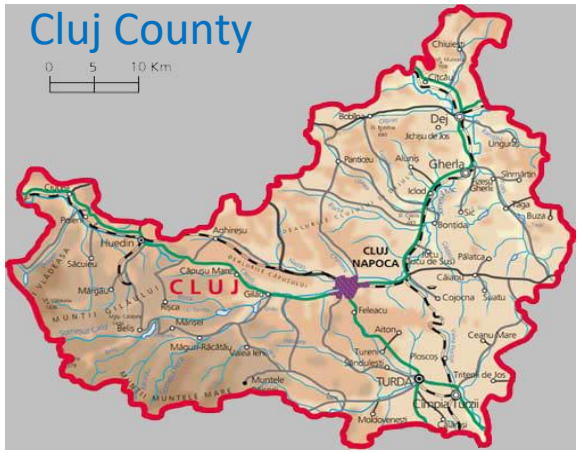
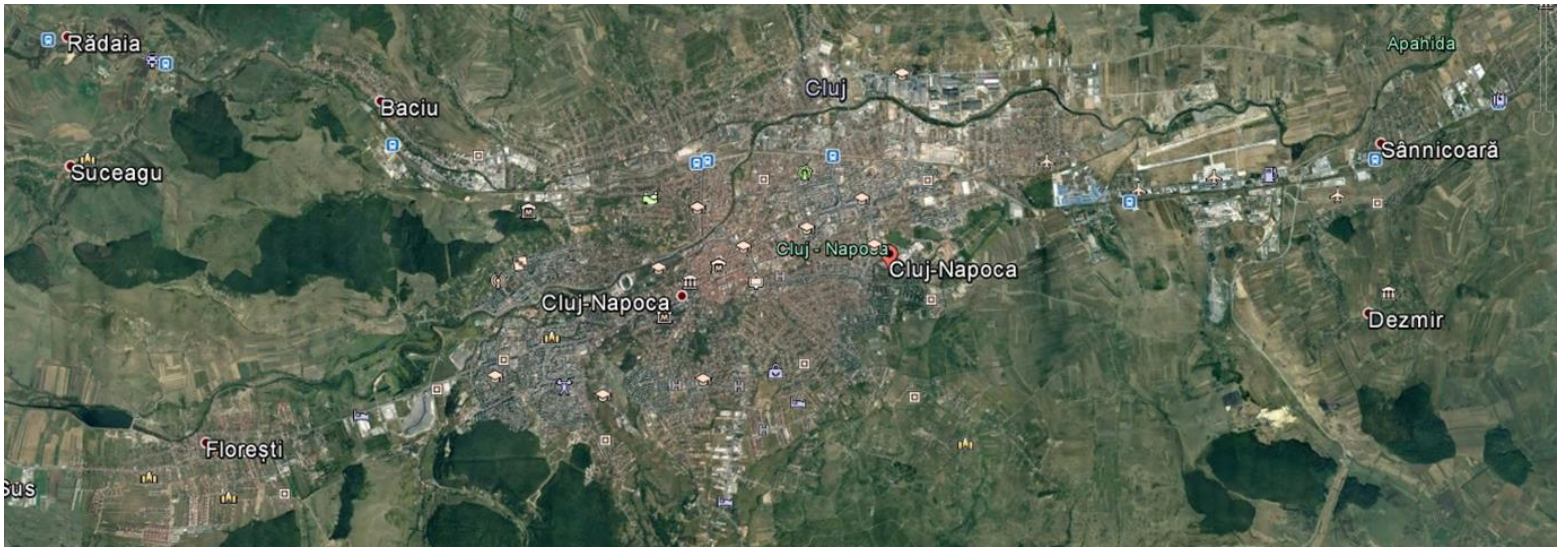
Location





Cluj- Napoca urban and periurban area (Google Earth)

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Materials and Methods

Indoor radon

Passive indoor radon measurements were performed by using CR-39 nuclear track detectors exposed for 1 year (in two stages of 6 months each), in 256 residential buildings from Cluj-Napoca urban and periurban area.

All the detectors were processed by my collegue in our laboratory. Our laboratory is accredited at a national level and follows the required ISO protocols (SR EN ISO/CEI1702522005: SR EN ISO 9000:2001:ISO/FDIS 11665-4) for such measurements.

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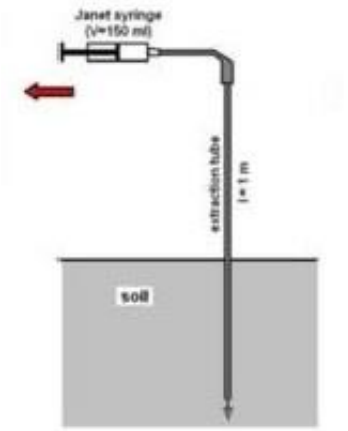
Materials and Methods



RM-2 radon detector

Radon-Jok permeameter

In soil measurments:

A total number of 21 radon in soil measurments were carried out throughout the whole city and periurban area using the RM-2 system together with the Neznal probe. The permeability of the soil was also investigated using the RADON-JOK pearmeameter.

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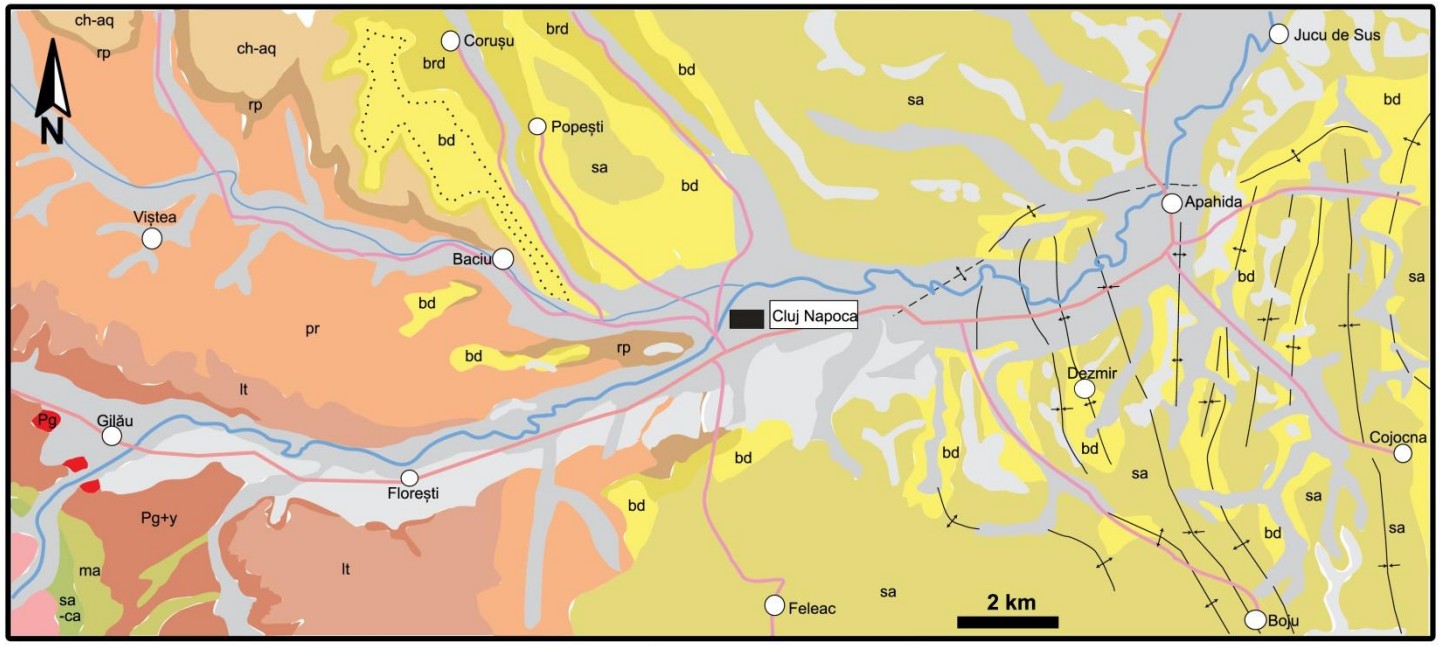
Geological setting



Legend

1 2 sa-ca 3 ma 4 Pg 5 Pg+y 6 lt 7 pr 8 rp 9 ch-aq 10 brd 11 bd 12 sa

13 Pl 14 H 15 16 17 18 19 20

The region which the city belongs to, comprises a large diversity of rocks and lithostratigraphic units involving: magmatic, metamorphic and sedimentary rocks.

Geological map of Cluj-Napoca Area (simplified after IGR map, L-34-XII, 1:200 000) 1: Proterozoic, 2: Cretaceous (Santonian-Campanian), 3: Cretaceous (Maastrichtian), 4: Paleogene andesitic dykes, 5: Paleogene (Paleocene-Ypresian), 6: Eocene (Lutetian), 7: Eocene (Priabonian), 8: Oligocene (Rupelian), 9: Oligocene-Miocene (Chattian-Aquitanian), 10: Miocene (Burdigalian), 11: Miocene (Badenian), 12: Miocene (Sarmatian), 13: Quaternary (Pleistocene), 14: Quaternary (Holocene), 15: faults, 16: Syncline axis, 17: Anticline axis, 18: Roads, 19: Rivers, 20: Locality

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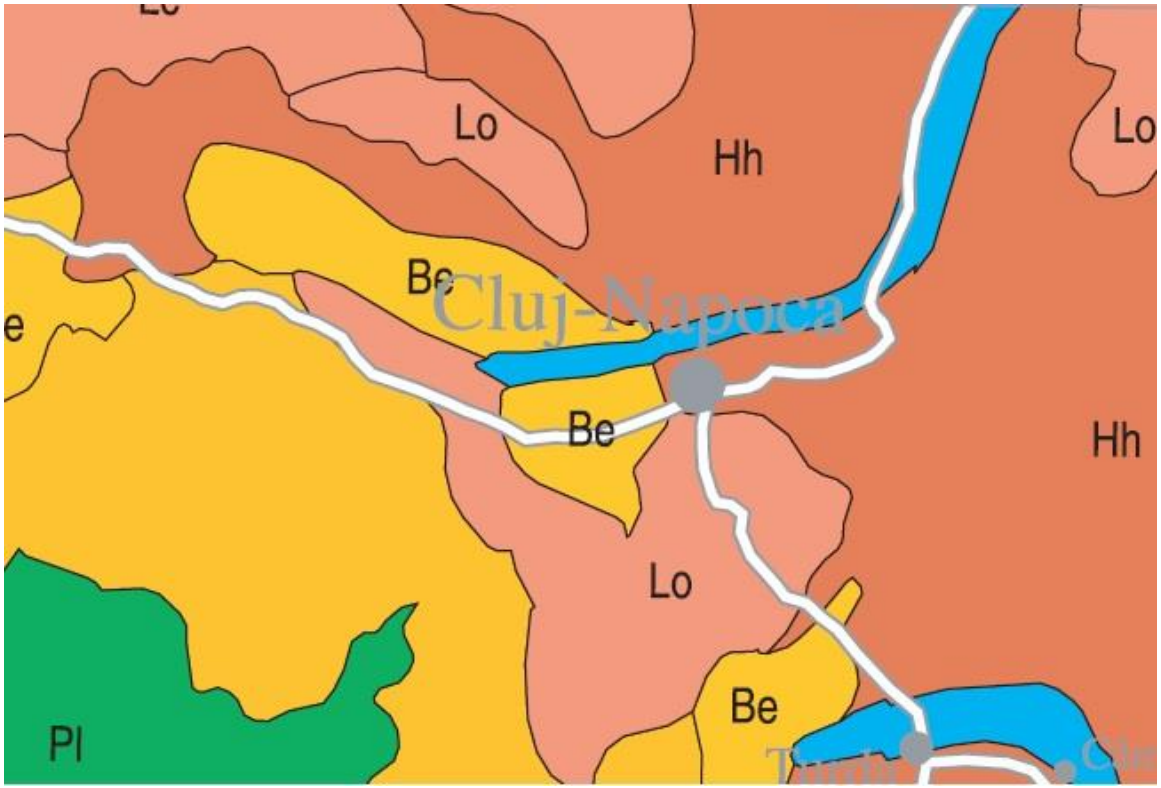
Pedology



Soil map of Cluj-Napoca area, Modified after Atlas Soils of Europe 1:500.000

Lo- Haplic luvisol (FAO)- parental rock: sands, cemented sandstones and deluvial deposits

Hh- Haplic phaeozem (FAO)- parental rock:clay

Be- Eutric cambisol (FAO)- parental rock:deluvial deposits

Jeg- Calcari-gleyic fluviosol (FAO)- parental rock Eocene limestones

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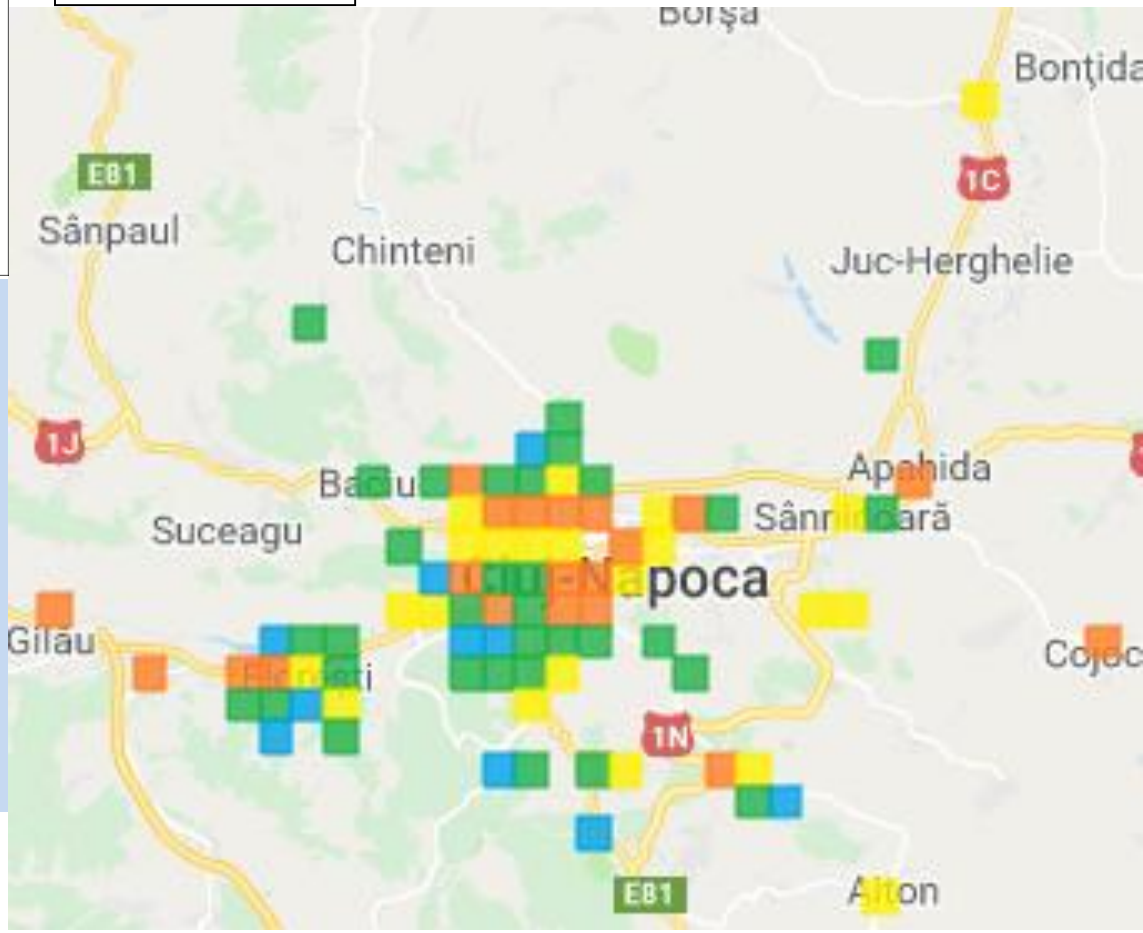
Results and discussion

1 to 20
20 to 50
50 to 100
100 to 200
200 to 500
500 to 1000
1000 to 2000
2000 to 10120

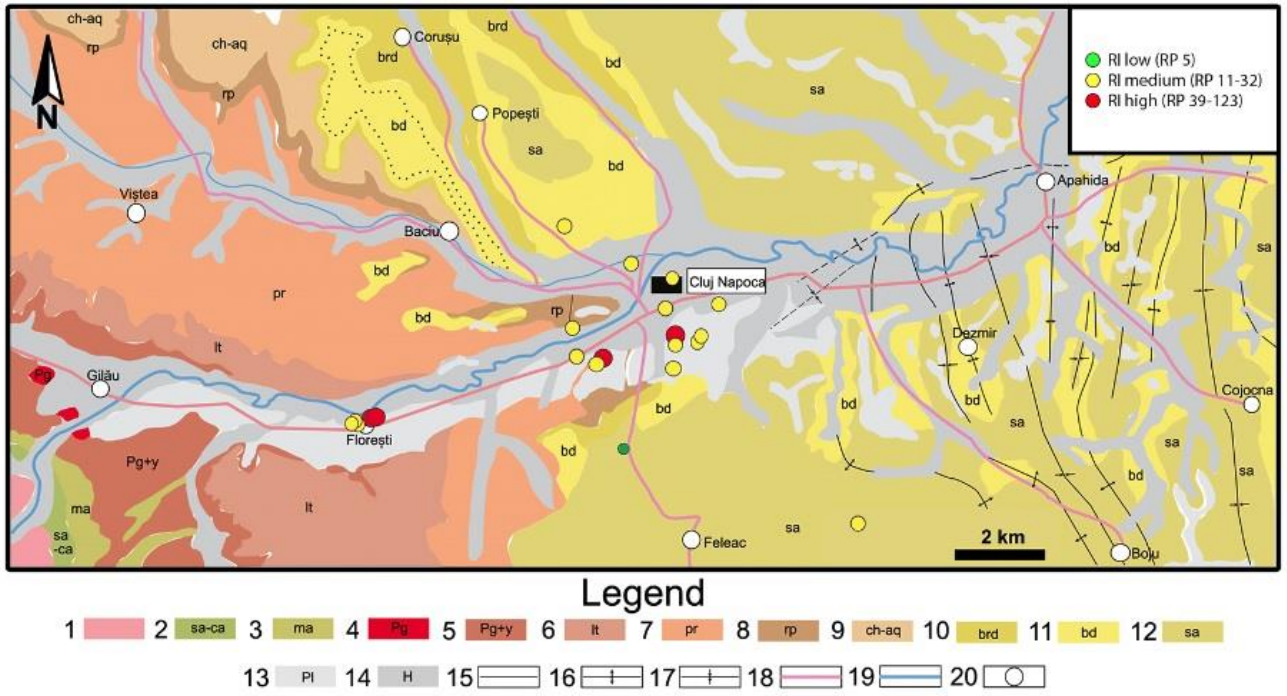
1 km x 1 km



Statistics:

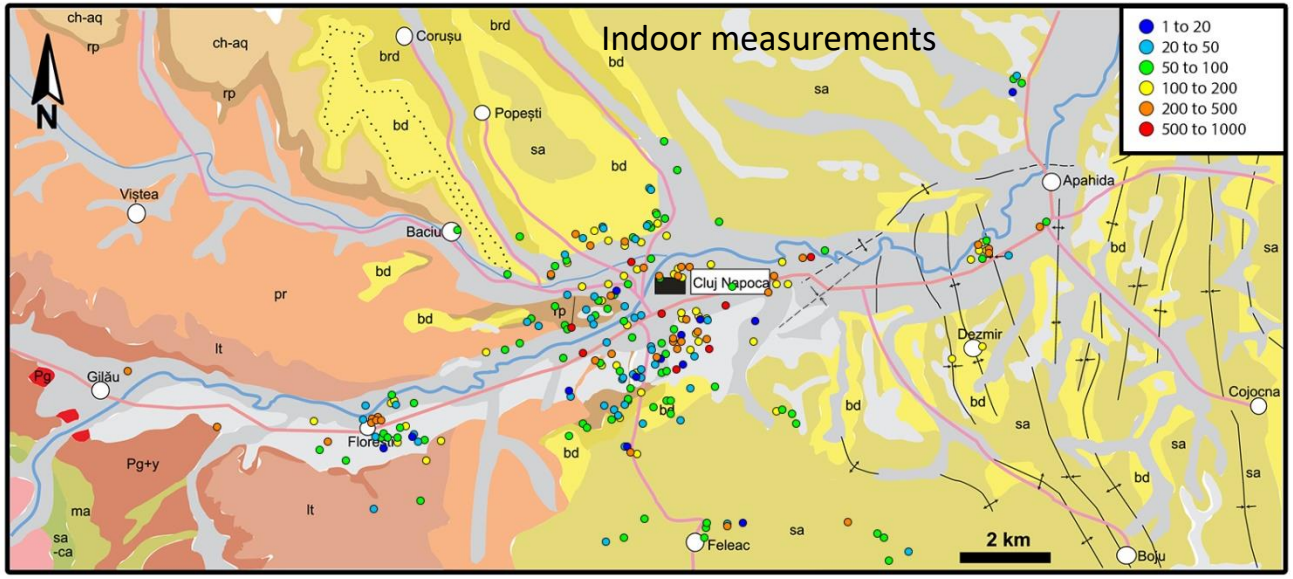
No. of investigated houses: 256
No. of investigated cells: 85
Median for measurment per cell: 2
Min. Number of measurment per cell: 1
Max. Number of measurments per cell: 13
AM (Bq/m3)±CV(%) per cell: 142±71
Cell median: 100
Percentege cell with AM >300 Bq/m3: 8

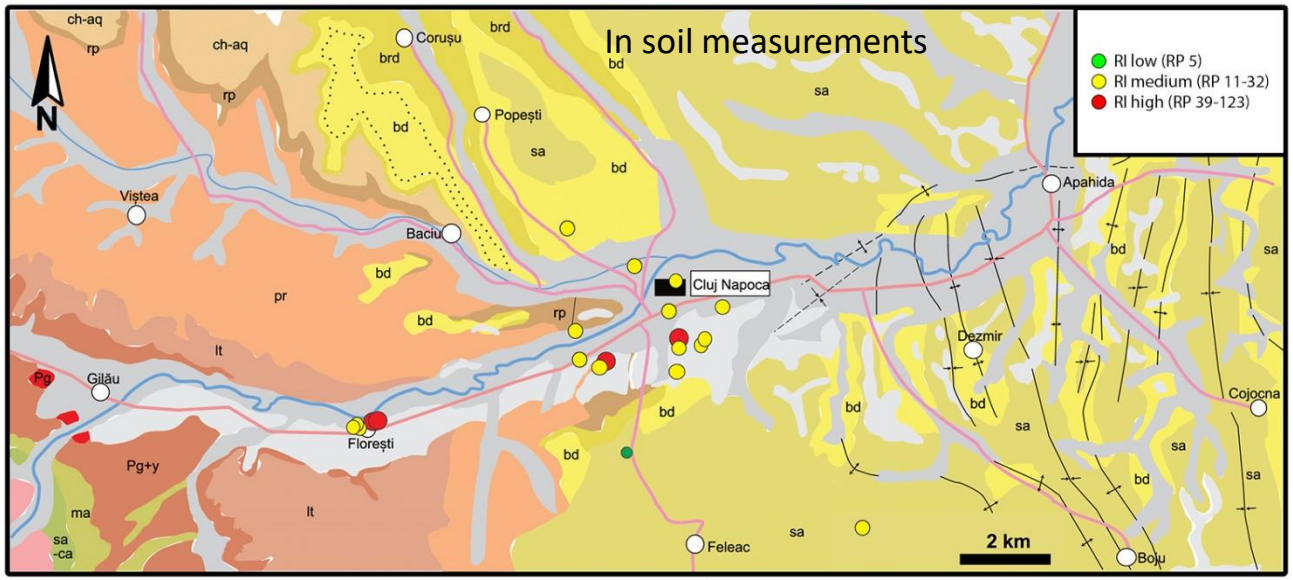
Results and discussion

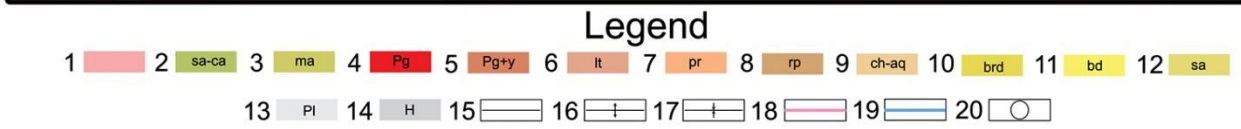


Geological map of Cluj-Napoca Area (simplified after IGR map, L-34-XII, 1:200 000) 1: Proterozoic, 2: Cretaceous (Santonian-Campanian), 3: Cretaceous (Maastrichtian), 4: Paleogene andesitic dykes, 5: Paleogene (Paleocene-Ypresian), 6: Eocene (Lutetian), 7: Eocene (Priabonian), 8: Oligocene (Rupelian), 9: Oligocene-Miocene (Chattian-Aquitanian), 10: Miocene (Burdigalian), 11: Miocene (Badenian), 12: Miocene (Sarmatian), 13: Quaternary (Pleistocene), 14: Quaternary (Holocene), 15: faults, 16: Syncline axis, 17: Anticline axis, 18: Roads, 19: Rivers, 20: Locality

21 in soil radon measurements were undertaken in those locations where the indoor radon concentration exceeded the limit of 300 Bk/m3. A medium Radon Index was predominant, with RP values between 11 and 32. Exceptions of low values, such as RP values of 5 were rare. Four measurements have indicated high radon indexes with RP-s of 39, 48, 51 and 123







Geological map of Cluj-Napoca Area (simplified after IGR map, L-34-XII, 1:200 000)

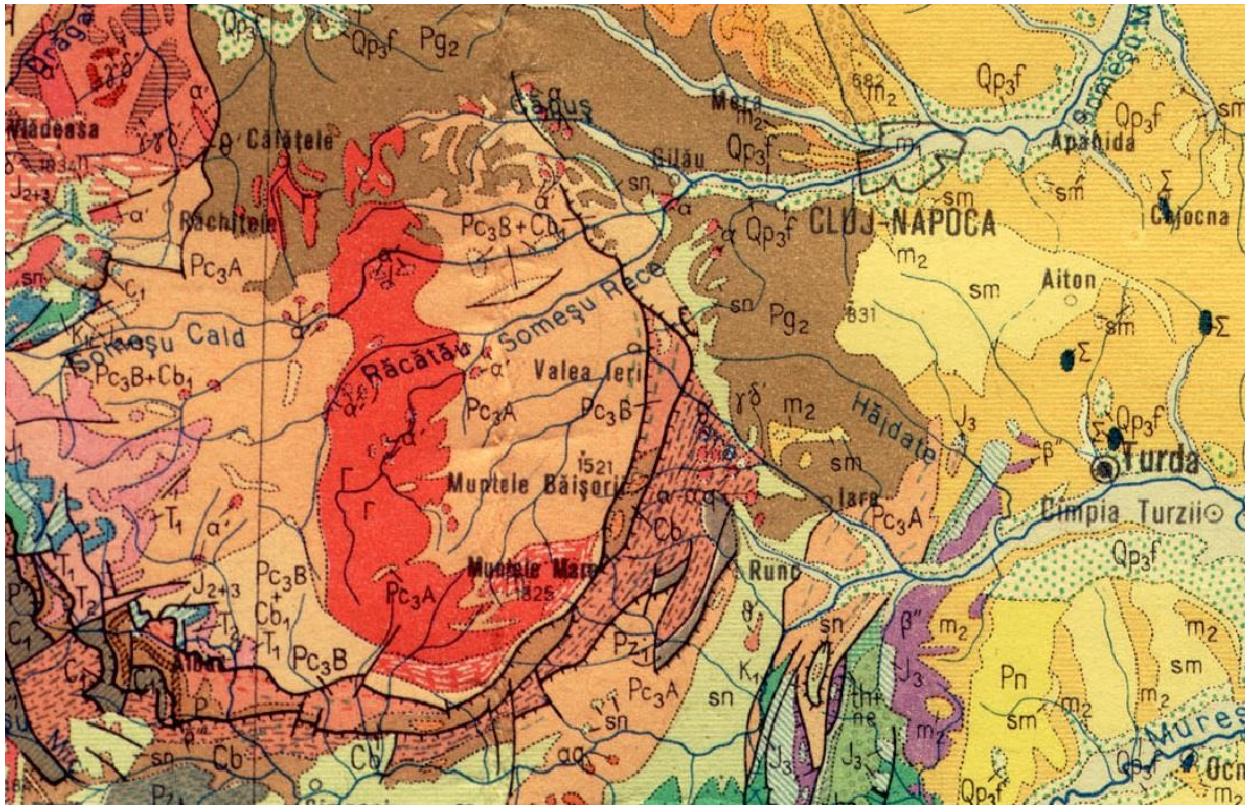
-The indoor and soil measurements indicate that the higher than average radon values follow a distribution pattern which is related to the presence of Quaternary (Pleistocene and Holocene) formations in the basement.

-The same pattern is common for the high measurement levels.

-Measurements made over Latorfian, Rupelian, Badenian and Sarmatian deposits indicate lower values if compared with the same type of measurements deployed on Quaternary or alluvial deposits.

-The sediments of these sedimentary formations may have a pronounced radioactive character.

-This feature can be strongly influenced by the source area of the sediments.



Geological map of Muntele Mare granitic body and Cluj-Napoca area, modified after Geological map of Romania, ICU 1:200.000

-The Somesul Mic tributtaries intercept some amfibolitic bodies and also a large granitic body (Muntele Mare)
-During Quaternary, such magmatic rocks were eroded and transported on large distances, rolled and deposited on both sides of the Somesul Mic river, and formed terraces and fluvial deposits.
-The radioactive potential of granitic rocks and minerals is well known.
-The high values from Quaternary deposits may be related to this granitic composition of the reworked sediments.

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FUTURE PERSPECTIVES MAIN FORTHCOMING CHALLENGES

- To undertake other in soil measurments on different geological profiles wich may cover all the sedimentary formations for the studied area.
- To validate the supposition of the Quaternary deposits source area with a detailed mineralogical study of these deposits.
- To determine radioactivity potential of different geological formations and soils using gamma spectometry .
- To better understand the relationship between RI and geology, also the influence of geology on the concentration of radon levels in homes.
- To further identify other risk areas in terms of exposure to radon.

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Thank you for your attention!

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