COMPARISON OF RADON LEVEL CONCENTRATION IN SOILS WITH THE NATURAL RADIONUCLIDES CONTENT IN SOME REGIONS OF IONAIN COASTAL AREA, IN ALBANIA

Dr., Safet Dogjani
PhD, Hamza Reci
Institute of Geosciences, Energy Water and Environment, Tirana, Albania

Abstract

In this study we present the results taken in south-eastern part of the country, in Ionian coastal area. This study is realized into regions, in the some places in Ksamil town and Uji i Ftohte-Qeparo areas. The main sources of radon gas indoors are entirely related to the geological environment. The measurements of Radon can be realized in several ways such as: radon and permeability in soil; measurements of natural radionuclides (^{40}K, ^{238}U, ^{232}Th) on the ground and soil; radon concentration level in water; measurements radon indoor in dwellings; radon level and soil permeability. Measurements (soil and permeability) have been realized using the Luka-s method. Tests have been carried out indoor at short and long measurement, using active defector with time interval 24h-72h and passive radon detectors in 3months time interval, respectively. The level of in soil Radon concentration has values from 10kBq/m^3 up to160kBq/m^3. From the interpretation of radon level according to Czech Classification, together with permeability of the soils results that in the two studies areas, Ksamil and „Uji i Ftohte- Qeparo“, the radon risk areas are present in 50% up to 60% of the studied area.

Keywords: Permeability, radon, soil gas, red clay

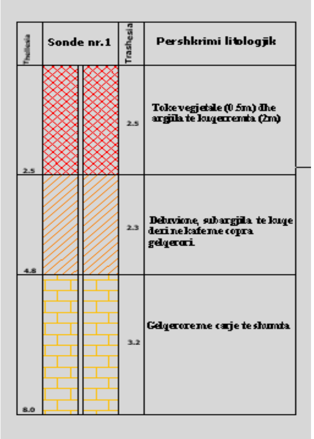
Introduction

Nowadays, fear of the population on radioactivity is focused on artificial radiation sources, especially on nuclear facilities. Most people do not suspect that the greatest exposure to the population is caused by natural sources. So, two of the components of radon in houses and terrestrial gamma, give 63% of dose of general exposure which human gets. From the point of view of human exposure, only some natural radionuclides are important. All geological formations are composed of various elements, among them uranium and thorium.

Their content in rocks and soil is different, depending on different types of rock. Two natural radionuclides, ^{238}U and ^{232}Th, in their process of disintegration contain a gaseous element, Radon, respectively ^{222}Rn and ^{220}Rn. These gaseous elements are released and come towards the surface and the houses constructed on these geological formations. Products of their disintegration are radioactive, especially those of Rn-222. Disintegration of Radon-222 in indoor environments, gives some daughters products, where the most important are isotopes of polonium and bismuth. This products are very small particles of material which during the process of respiration are accumulated in the lungs. In high concentrations they increase the probability of lung cancer (UNSCEAR, 2000).So, rocks and soil are the main source of radon. The radon risk maps serve preferably for determination the level of potential radon release from bedrock. However, the radon entry into houses is strongly influenced by the building quality of the house (Barnet, 1994) Based on geological knowledge and measurement of radon gas in the soil and permeability, are compiled the radon risk maps, which provide a very important roadmap, for making anti-radon measures.

Geological settings

The Ksamili area and the wider belong to the Ionian tectonic zone, and is composed from carbonatic formation of Lower Jurassic (J_1), represented mainly from limestone with thin up to middle interlayer thicknesses, and rarely from conglomerate interlayers. All those geological formations belong to the eastern part of the Butrinti anticline. The Plio-quaternary deposits on the studied area are represented from clays (terrarosa formations) and vegetables soils of Quaternary. The Plio-quaternary deposits are mainly situated inside the town area and belong the laky type or intermediate deposits (laky-alluvium-laky prolluvium). The thickness of these deposits is from 0.5 m up to 6-8m, figure 1a and 1b.



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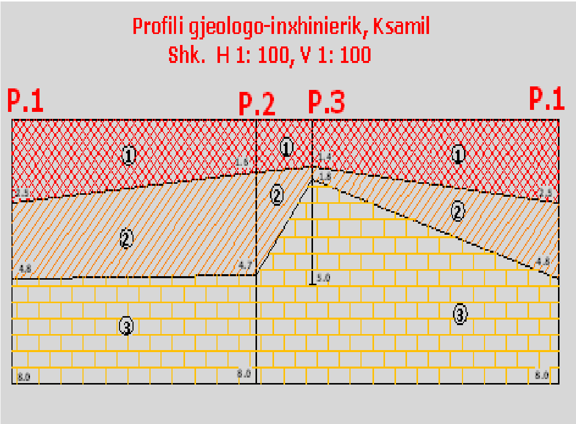

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Figure 1: The lithology of the Ksamili region. A) The lithological column of the Ksamili region. B) Geological cross section from engineering geology works carried out 1) Terrarosa; 2) clayey soils, limestone boulders; 3) Limestone.

The determination of the thickness of terarosa deposits is somehow difficult in that area, that can be studied with engineering geological-geophysical works. In many cases they are covered from alluvium cones and as a consequence they cannot be seen in the surface. In figure 1, we see the thickness of the terrarosa given by geophysical and geotechnical studies in the area which is 0-2.5 m (Photo. 1).

Photo 1: View of a building above thick terrarosa formation

Methodology

In every place, 12-15 test site measurements of the volumetric activity level of Radon concentration in soils (A_vRn) (Matolin, M., 1996), together with permeability(K) measurements has been carried out. Measurement time for the determination of a_vRn is realized 6 minutes after the sample was taken, or after taking the sample from the soil throughout Janet Syringe using Lukas camera of the Instrument Luk-4. The air samples are taken in depth 80-85 cm from the earth surface, according to the well-kown Luka-s methodology (Matolin, M. 1994). The measurement of the soil permeability of the soils was done with the Instrument RADON-JOK (Neznal et al., 1996).

Assurance quality of the data

The used instruments on this study has been calibrated periodically in the National Metrological Center of Czech Republic in Pribram (fig. 2).

Figure 2: Transfer data from Equipment to p.c

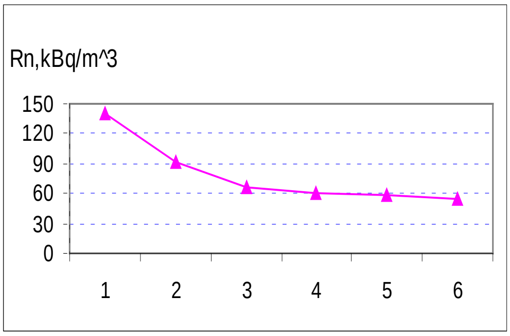
Results

In soil Radon measurements

In the Ksamili town is studied an area with 3.34 km2, with 30 places, in which are determined 430 values of volume Radon activity (a_vRn) and 90 values of permeability coefficient. From the interpretation of results we conclude that there are 5 level groups of a_vRn: there are not low levels smaller than 10kBq/m^3; middle levels from 10 up to 20kBq/m^3, belong to 3 places; increased levels from 20.01 up to 30kBq/m^3, are taken in 5 places; high levels from 30.01 up to 50kBq/m^3 are taken in 5 places; very high levels from 50.01 up to 70kBq/m^3 belong to 9 places; extremely high levels from 70.01 up to 100 kBq/m^3 are taken in 7 places. Whereas in the Uji i ftohte-Qeparo region, are realized 18 insitu measurments, in some sectors where terra rosa deposits.

The nature of radioactive emanation field

The study of natural radionuclides and that of the nature of radioactive emanation field in Ksamili area, has shown that it is complex and composed with ((Rn-222dhe Rn-220) and in any case it is only clean field of Rn-222 as consequence of Thorium concentration predominance. The typical cases of the field nature are shown in (fig. 3).



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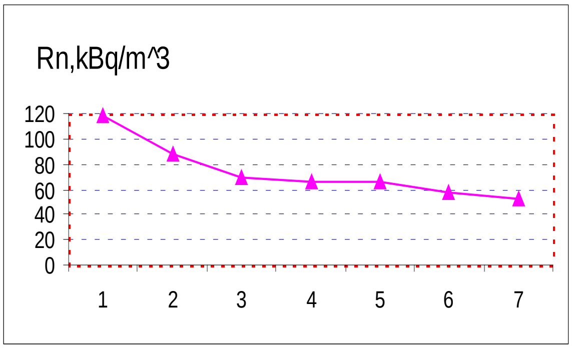

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Figure 3: Study of Radioactive field, area ksamil. a) place 5, K = 0.7%; eU-238 = 8,4ppm; Th-232 = 14.7ppm. b) place 14, K =1.1%; eU-238 = 7.5ppm; Th-232 = 17ppm.

Determination of permeability

The processing of the data according to group levels of permeability are presented in figure 4. So, 50 % of the measurements belong to the group with high permeability smaller than 23s, the other part belongs to the group with middle up to high permeability (23.1 up to 36sek.) or 26.7% of the measurements, and in 10 places that make 33.3 % of the studied area belong to the group with middle permeability from 36.1 up to 200sek.

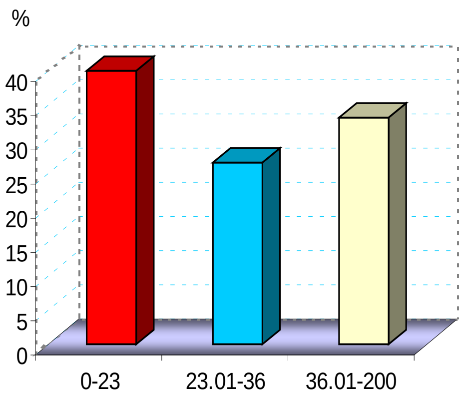


Figure 4: Histogram of permeabillity distribution, area ksamil

The results of in soil radon concentration levels and the permeability in Uji i Ftohte-Qeparo region are given in figures 5 and 6.

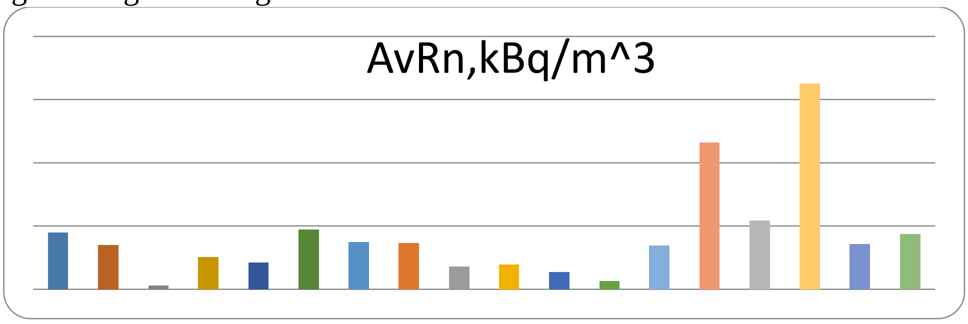


Figure 5: The distribution of radon level conentration in some places of terra rosa developments in Uji I Ftohte – Qeparo area.

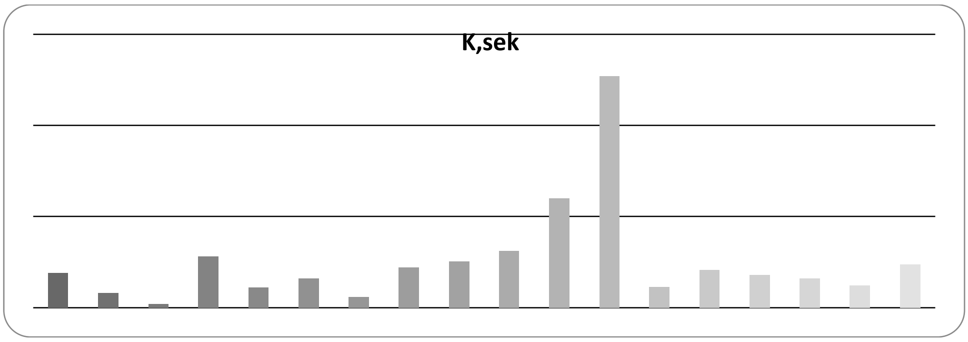


Figure 6: The distribution of in soil permeability, in some places of terra rosa developments in Uji i Ftohte – Qeparo area.

The classification of in-soil Radon risk

In figure 7a and b, are presented the results of Radon risk in Ksamil and Uji i Ftohte – Qeparo areas. Only in one place there is low Radon risk, 14 places are of middle risk and 50% of the area or 15 places show high risk. We point out that in the places with high Radon risk, the level of Radon concentration goes up to $100kBq/m^3$.

a) b)

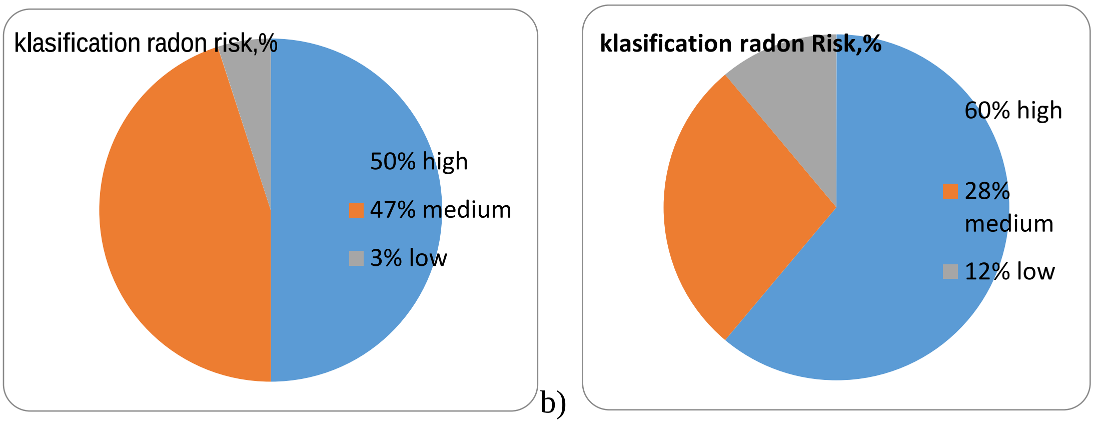
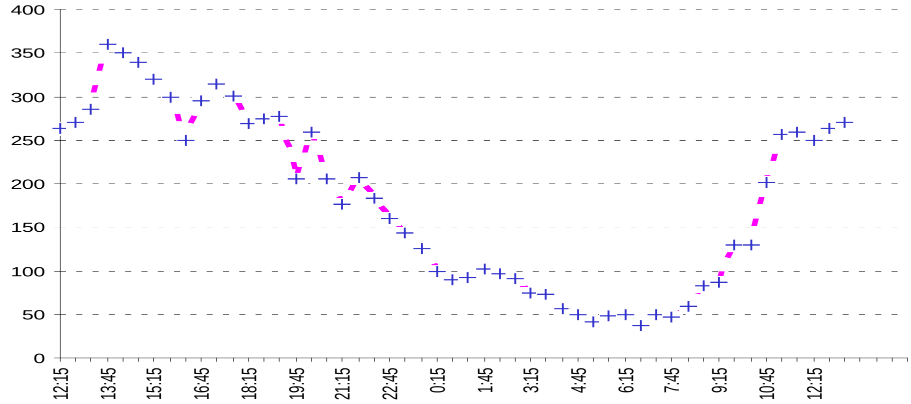


Figure 7: Histogram distribution of in soil Radon risk.
a) in Ksamili area b)Uji i Ftohte – Qeparo area.

The level of indoor radon concentration

Indoor radon measurements are realized in some places, in area Ksamil, with the short term methodology using active detectors Fritra-2 and AlphaGuard. Indoor monitoring is realized during 24 hours with a continuous cycle of measurements. In figure 8a and b, are shown the graphical presentation of indoor radon concentration in two places. As seen from graphs, high level of radon are met which is above the norm. But, the levels of indoor radon concentration on those places should have been much more higher, taking into account the high in soil Radon concentration. This is explained from known different factors that effect the behavior of Radon gas.



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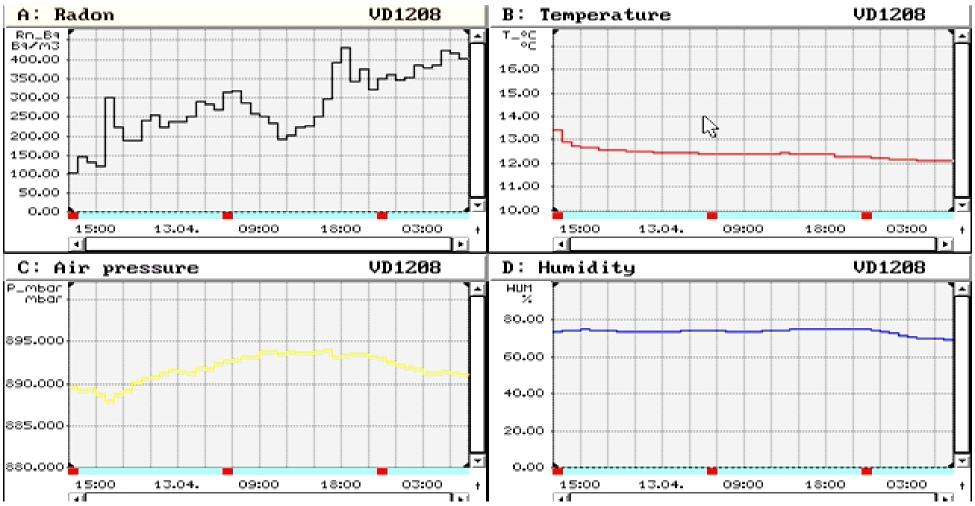

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Figure 8: Monitoring of indoor Radon concentration inside two houses, a,b.

In the map of Radon risk on the Ksamili area are present three categories of Radon risk (fig. 9)

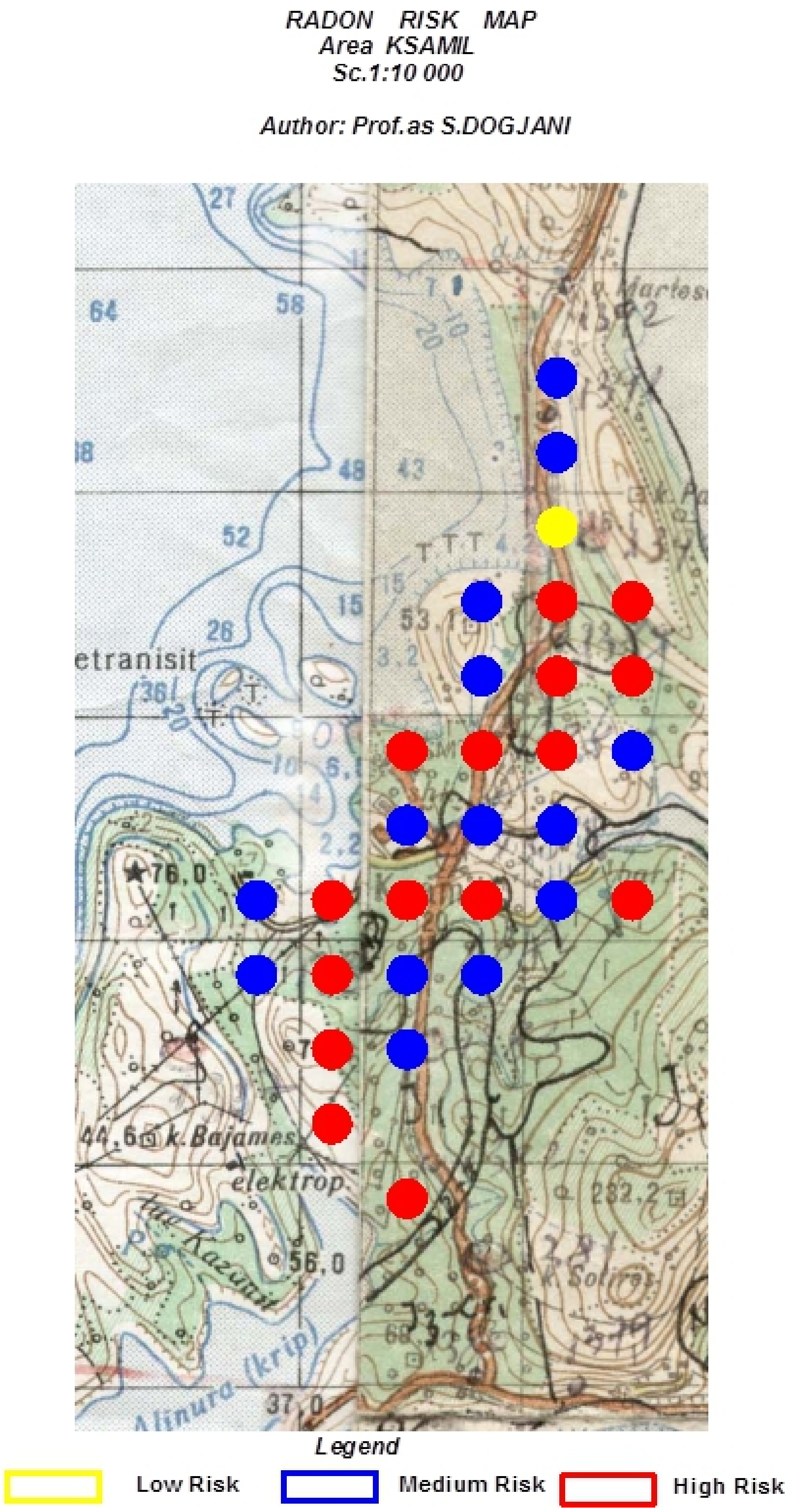

Figure 9: Radon Risk Map, Ksamil area

Discussion

We think that in the studied area(Ksamil), in some places of measurements, due to different spatial extent terrarosa, we see low values of Radon concentration. This phenomenon is shown in figure 6, where there is an unconformity of radon level concentration, with the level of Radon from eU-238, measured with the instrument NaITl,Kristal3x3Inc (fig. 10).

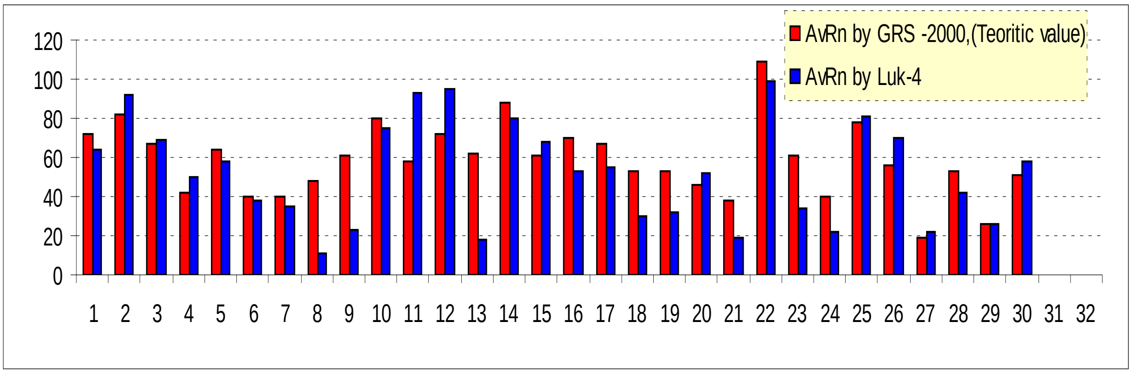

Figure 10: The distribution of Radon level and the natural radionuclides in the places of measurements, area ksamil

Conclusion

The presence of terrarosa in several parts of coastal Ionian area in Ksamili town as well, provokes high levels or in soil radon concentration.

In cases where the thickness of clayey cover is above 1m, high levels or radon concentration are met.

We recommend that the constructions have to be build taking into account the anti-radon measures.

Terrarosa should not be used as a filling material of building basement.

Acknowledgment

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