

MEASUREMENT OF RADON CONCENTRATION IN SOIL GAS USING RAD7 FROM BYUT MYAUNG AND KALAIN GOLD MINES AT BAGO REGION

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Abstract

Soil gas Radon, ²²²Rn, concentrations were measured in Byut Myaung and Kalain gold mines of Shwe Kyin Township at Bago region. The soil samples were tested by using RAD7 radon technique detector. In each location of four different depths were taken for soil gas measurements, starting from the ground surface. It was found that the largest radon concentration was 29.5 ± 1.37 Bqm-3 at 6ft depth and smallest radon concentration was 11.2 ± 0.91 Bqm-3 at 12ft depth from Byut Myaung gold mine. The largest radon concentration was 25.7 ± 1.49 Bqm-3 at 6 ft depth and the smallest radon concentration was 10.9 ± 0.68 Bqm-3 at 12 ft depth from Kalain gold mine. All the mentions were taken by using International Commission on Radiological Protection (ICRP) method for under or over safety concentration level that effects on human inspiration system especially lung's tissue. The results obtained from this study are not dangerous for that region.

Keywords: Soil, Radon, Gold Mines and RAD7.

Introduction

Radon gas (²²²Rn) exhalation rate and concentration are associated with its ultimate precursor uranium in the earth crust. Uranium, a radiotoxic element, is a naturally occurring radioactive element and its decay lead to radon in the environment such as gas, oil, groundwater and soil deposits. The half-life of radon isotope ²²²Rn takes enough for long 3.82 days. And then, it spreads out through the soil and freely moves to the atmosphere and the environment where the human live. Radon- 222 gas, commonly called radon is colorless, odorless and tasteless and therefore undetectable by human senses. Radon can only be detected or measured with special detectors. Two methods can be used for measuring of radon concentration as short term and long term methods. In this research, RAD-7 solid state detector (short term) was used because RAD-7 was simply set up of its all apparatus. It could work out the data faster than other machines not to be waste time. So, it was used to determine the radon concentration in soil samples from Byut Myaung and Kalain gold mines, Shwe Kyin Township, Bago Region.

Health Effects of Radon

Radon mainly occurs as gaseous condition in the environment. Radon gas decays or breaks down continuously to form radioactive elements that can be inhaled into the lungs. In the lungs, decay continues, creating radioactive particles that release small bursts of energy. When long-term exposure (drinking water and breathing air) occurs radon increases the chances of developing lung cancer. Radon can only cause cancer after several years of exposure. Radon may be radioactive, but gives off little actual gamma radiation.

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Natural Decay Series of Uranium

Radon exhalation and concentration rate are different from one place to another place according to the content of uranium and radium. Radioactive decay occurs when an unstable (radioactive) isotope transforms to a more stable isotope, generally by emitting a subatomic particle such as an alpha or beta particle. Radon is part of the natural decay series of uranium (U) and thorium (Th) found in all soils and rocks to a varying concentration. There are three radioisotopes of radon naturally present in the environment: Radon-222 from the Uranium-238 decay series, Radon-220 from Thorium-232 decay series and Radon-219 from Uranium-235 decay series. Radon is formed in the ground from the radioactive decay of uranium-238, which is present in small quantities in all rocks and soils. The schematic diagram of the radioactive decay of uranium-238 is shown in Figure 1.

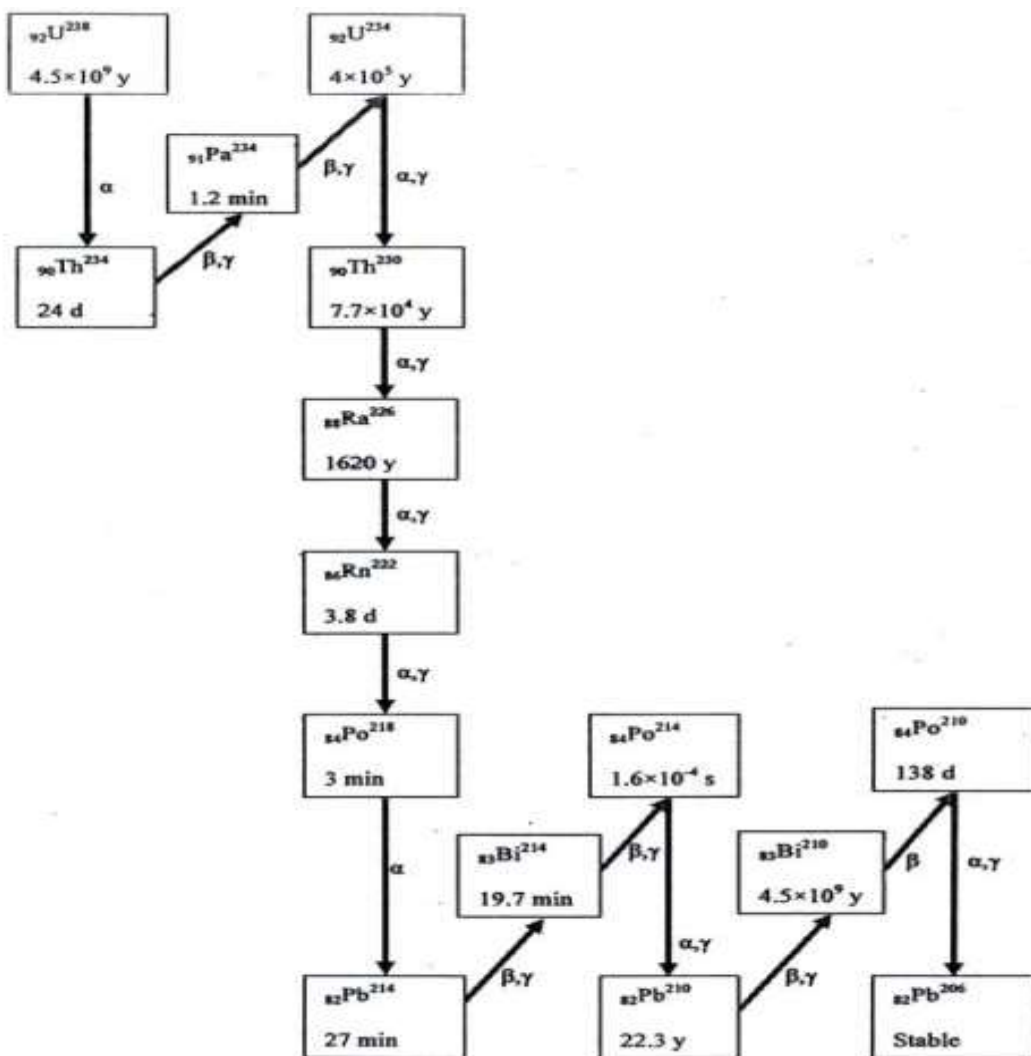


Figure 1 U-238 decay chain and the half-life associated with each element

A Safe Level of Radon Gas

ICRP recognizes that an action level can have two distinct purposes which are to define workplaces either in which intervention should be undertaken and to identify where the system of protection for practice should be applied. There were generally mentioned as three circumstances by ICRP's record. There is no action required for the concentration volume which was lower than $200\text{Bq}/\text{m}^3$ as shown in table 1.

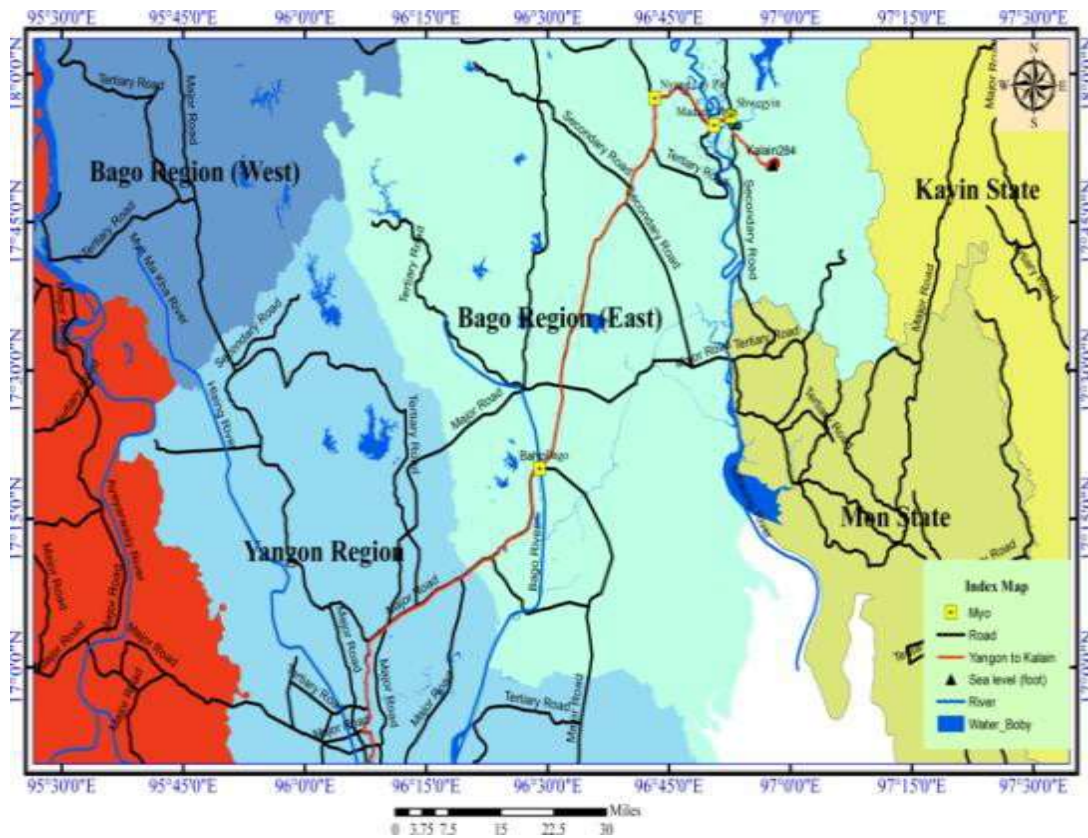
Table 1 Remedial exposure time of concentration period

Radon concentration	Recommended Remedial Exposure Time	References
Greater than 600 Bq/m ³	In less than 1 year	[5,6]
Between 200 Bq/m ³ and 600 Bq/m ³	In less than 3 years	
Less than 200 Bq/m ³	No action required	

Material and Methods

Sample Collection

The RAD 7 detector was performed on soil samples at Byut Myaung and Kalain gold mines at 284 ft above sea level. The samples are collected at 17° 50' 46.08' north latitude, 96° 57' 46.80' east longitude and Kalain and Byut Myaung gold mines with GPS MAP 62 S as shown in figure 2. Soil samples were collected from various depths, recording their depths with long tape measurement as shown in figure 3 and figure 4.



Source: Department of Agricultural Land Management and Statistics, Shwe Kyin Township

Figure 2 Location map of Kalain and Byut Myaung gold mines from Shwe Kyin Township



Figure 3 Kalain gold mine at Shwe Kyin Township



Figure 4 Byut Myaung gold mine at Shwe Kyin Township

Measurement Procedure

After taking an arrangement consists of RAD7 professional DurrIDGE and small drying tube filled with fresh descendant (CaSO_4) positioned vertically, soil gas sample plastic can was filled through a sampling point. Soil gas is normally so high in radon that it is not necessary to use long cycle times to gain precision. Soil sample were placed in to the small tube inlet, and passed through the inlet filter after small drying tube as shown in figure 5 and then took out the results from its clear wide monitor as shown in figure 6. Five minutes cycle times (purge 5 minutes, pumping 5 minutes, waiting 5 minutes and counting 5 minutes) are sufficient. In total, each set of readings included four 5 minutes cycles that took half hour. Other rested depths can also be taken out by running the test and interpretation of the data as the previous processes.

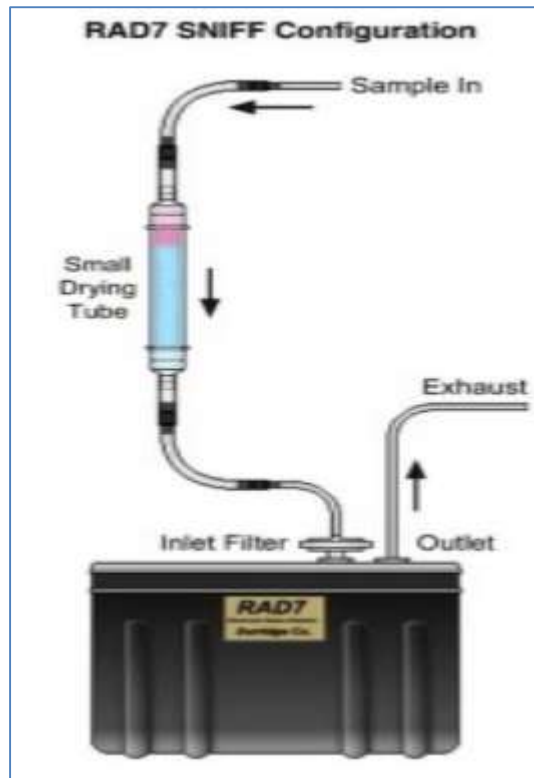


Figure 5 Durrige RAD 7 radon monitor



Figure 6 Experiment of soil samples by using RAD7

Results

In active method, RAD7 radon gas detector will measure the radon concentrations in soil samples at the end of the half hour period. After the determination of the soil sample was used RAD7 detector, coming out four different results. It could be easily note that radon concentration was showing topmost at 6ft depth. These different results data were also described with (chart) in figure 11 and below table 2 and table 3. As shown in table 2, the radon concentration of Byut Myaung gold mine higher than that of Kalain gold mine as shown in table 3. In during testing these samples, the diagrams of alpha energy spectrum of them were also respectively mentioned as below figure 7, figure 8, figure 9 and figure 10.

Table 2 Radon concentration of soil samples with different depths at Byut Myaung gold mine

Samples No:	Depth	Radon concentration(Bqm ⁻³)
1	91.44 cm (3 ft)	18.6 ± 1.21
2	182.88 cm (6 ft)	29.5 ± 1.37
3	274.32 cm (9 ft)	14.4 ± 1.14
4	365.76 cm (12 ft)	11.2 ± 0.91

Table 3 Radon concentration of soil samples with different depths at Kalain gold mine

Samples No:	Depth	Radon concentration(Bqm ⁻³)
1	91.44 cm (3 ft)	16.4 ± 1.41
2	182.88 cm (6 ft)	25.7 ± 1.49
3	274.32 cm (9 ft)	13.1 ± 1.33
4	365.76 cm (12 ft)	10.9 ± 0.68

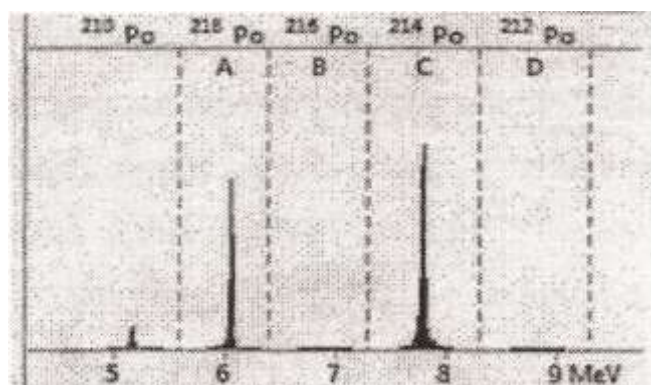


Figure 7 Alpha energy spectrum for 6 ft depth at Byut Myaung gold mine

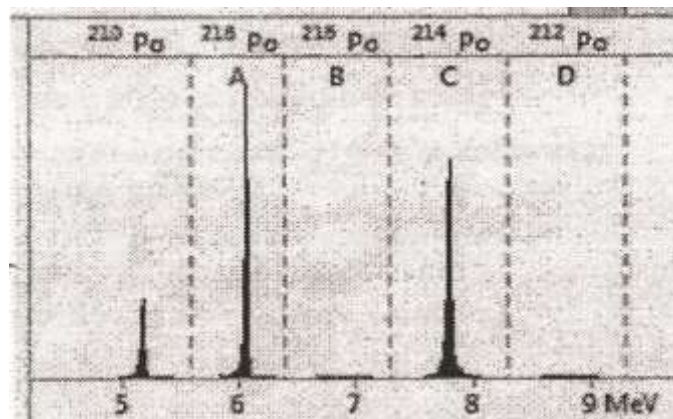


Figure 8 Alpha energy spectrum for 6 ft depth at Kalain gold mine

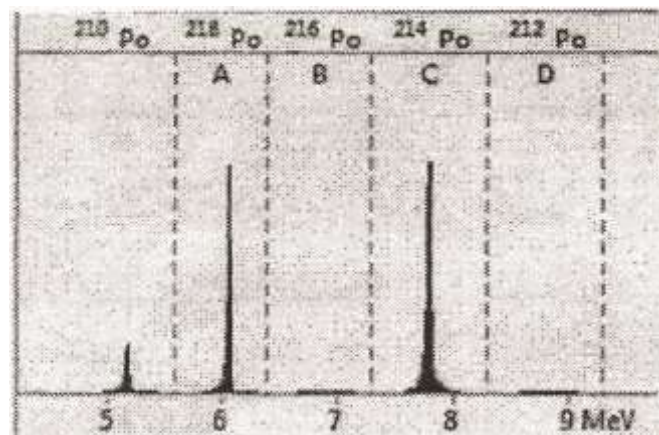


Figure 9 Alpha energy spectrum for 12 ft depth at Byut Myaung gold mine

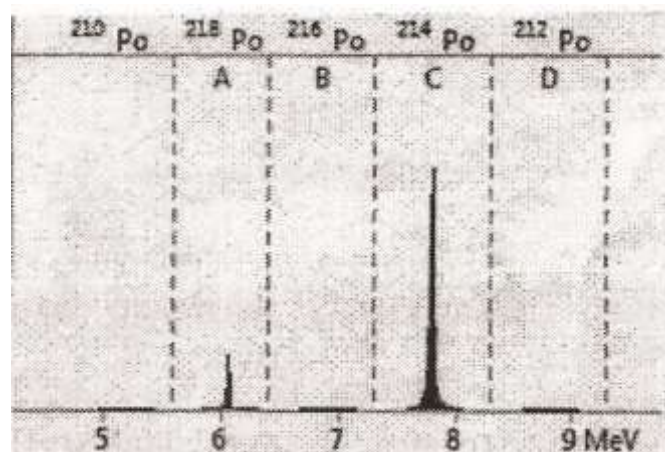


Figure 10 Alpha energy spectrum for 12ft depth at Kalain gold mine

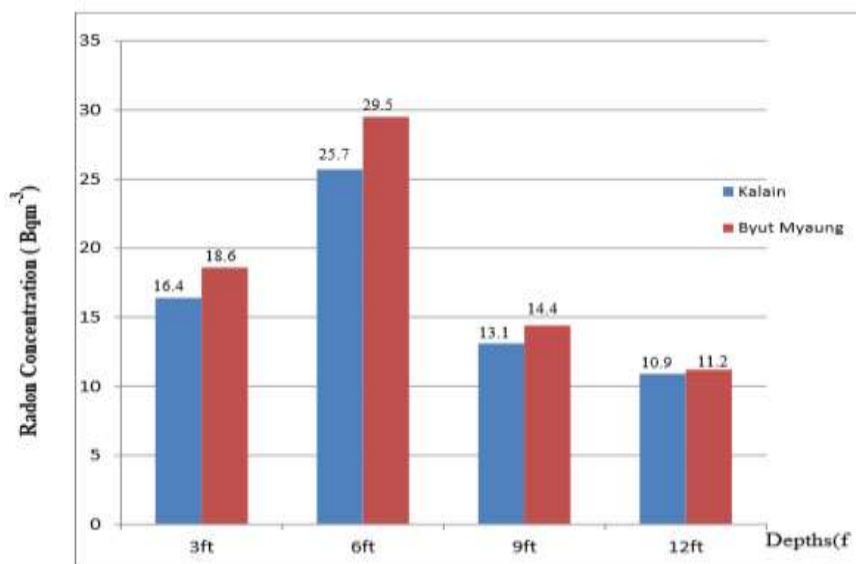


Figure 11 The radon concentrations of soil samples at Byut Myaung and Kalain goldmines by RAD7

Discussion

According to table 2 and table 3, it was found that the radon concentration in soil samples of Byut Myaung gold mine is higher than that of Kalain gold mine. The heights of the peaks on the spectrum depend on the concentration of the radon and to which radon had exposed. Operational Radon Spectra for soil samples at 3 ft, 6 ft, 9 ft and 12 ft depths were obtained from the results of peaks. There were easily can be seen that the highest radon concentration was at 6 ft depth and the lowest was at 12 ft depth. In my practice, concentrations were mentioned to highest at around 6 ft depths even the lowest at 12 ft and deeper. The major cause of this difference should be the states of varies the viscosity, density and air volume in these soil. Then, about the energy spectrum of these different four depths were described as following continue. At 5.3 MeV, a persistent peak will be developed as resultant of Polonium-210 buildup. At 6.00 MeV, after less than one hour of exposure to radon are called new radon Po-218 peak A. At 6.78MeV, the RAD7 spectrum while continuous sampling thoron laden air (new thoron) Po-216 peak B. At 7.69 MeV, the RAD 7 spectrum after purging the instrument with radon-free air for more than 10 minutes (old radon) following exposure to radon Po-214 peak C. At 8.78 MeV, the spectrum after discontinuing a lengthy (old thoron) are sampling of thoron laden air, Po 212 Peak D.

Conclusion

The purpose of this research is focused on the public health point of view why radon is believed to be the second largest cause of lung cancer, after that of smoking. The results evidently show maximum and minimum concentration of radon activity in soil gas having in depths of 6 ft and 12 ft respectively. For the depths of upper soil layer (less than 6 ft) radon prevalence more easily to the air, the activity should be less, although in the depth more than 6 ft the rock soil grains as constituted more compact as to decrease radon activity. No action may be required for maximum concentration activity ($29.5 \pm 1.37 \text{ Bqm}^{-3}$) in 6ft depth at Byut Myaung and ($25.7 \pm 1.49 \text{ Bqm}^{-3}$) in 6 ft depth at Kalain gold mines was less than 200 Bqm^{-3} that had been defined by International Commission on Radiological Protection (ICRP) standard. However it did not seriously effect on people at this location, we have to continuously and widely study

on radon concentration which is usually effected by the moisture, humidity, and temperature in seasonal differences. And it is very important in future for human healthy deal with unseenable radioactive leaking such as radon because of being upon the changes of types of soil and other unpredictable challenges.

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