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The study of Natural Radioactive Pollution in the Samples Water of Natural Spring in the Governorate of Irbid

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ABSTRACT

In this study the author studied the natural radioactive pollution in the samples water of natural spring in the governorate of Irbid due to leakage of radon gas to natural springs from the source of radon (the soil). The study started from June 20, 2015 to August 30, 2015. After 70 days the collected dosimeters were chemically etched under the conditions (30% solution of KOH at a temperature of 70 C° for 8 h).Samples of groundwater from eight springs in the governorate of Irbid were used, which were respectively from Rahoop spring, Ash Shalalah spring, *Wadi Al Ruman* spring, Sama Al-Rousan spring, Tabqet *Fahel* spring, Dhiraj spring, Al-Wadi spring, and Taqat al Ain spring. The radon concentrations were found to be 4.1 Bq/l for Rahoop spring water, 3.7 Bq/l for Ash Shalalah spring water, 3.2 Bq/l for *Wadi Al Ruman* spring water, 2.1 Bq/l for Sama Al-Rousan spring water, 2.6 Bq/l for Tabqet *Fahel* spring water, 4.9 Bq/l for Taqat al Ain spring water, 1.8 Bq/l for Al-Wadi spring water and 1.6 Bq/l for Dhiraj spring water. The average concentration of radon in the water for these springs was 3.0 Bq/l. The radon concentration in the water samples in this study was less than the allowable upper value, which is equal to (18 Bq/l), and it does not cause danger to human life.

Introduction

Monitoring environmental radioactivity level is very important in ensuring the security and safety of the community. We must know the amount of the increasing at this level because of its negative health effects physically and genetically [1]. These unwanted increases are known as radioactive pollution which is part of the environmental pollution. Pollution is known as the presence of an element concentration higher than the concentration allowed by the local and global environmental standard determinants. Hence we are interested in knowing radon concentration; the author studied the natural radioactive pollution in the samples water of natural spring in the governorate of Irbid (study area) due to leakage of radon gas to natural springs from the source of radon.

Radon is a radioactive noble gas such as helium; it is invisible, tasteless, odorless, and heavier than air seven and a half time [2]. Radon is able to move considerable distances from its birth place during its lifetime. It can diffuse out of soil surface to ambient atmosphere, basements, houses and natural springs. So ^{238}U decay chain is paid more attention in the environmental and radiological studies (See Fig 1).

^{222} Rn is one of the important elements in the areas of nuclear research for measuring the natural radioactive pollution of different material and the various elements of the environment. In many areas of the country, however, ground water is used as the main water supply for homes and communities. During previous years, several studies have been conducted all over the world to measure the radon level in water, where it was found that the concentration of radon in groundwater depends on the type of water source. Here in Jordan, several studies were conducted to measure the concentration of this gas.

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For example, the radon concentration in cold water (3.3 10.7 Bq/λ), the hot spring water (3.2 – 5.5 Bq/λ), drinking water (2.5 – 4.7 Bq/λ) and sea water (4.3 – 6.4 Bq/λ) [4].

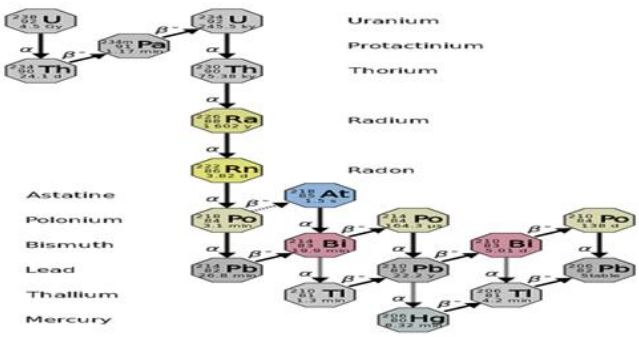

Fig 1. Shows the uranium - 238 series (the source of ^{222} Rn) [3].

The man is in direct contact with radon gas, which comes from the soil, building materials, holds by air and water. The daughters of the negative effects on public health make it necessary to conduct continuous measurements to determine the natural radioactive pollution. Hence we are interested in knowing radon concentration; the author studied the natural radioactive pollution in the samples water of natural spring in the governorate of Irbid (study area) due to leakage of radon gas to natural springs from the source of radon.

Irbid governorate (study area) is located about 80 km north of Amman; its highlands oversee on the plains of Horan. The total area of Irbid governorate is (1571.74 km^2), altitude about 600 meters above sea level. Irbid governorate consists of (9) regions, Irbid, Ar Ramtha, Kora, Bani Kanana, Al-Aghwar Shamaliyyeh, Bani Obaid, Mazar Shamali, Tayybeh, and Wastiyyeh (See Fig.2 & Fig 3).

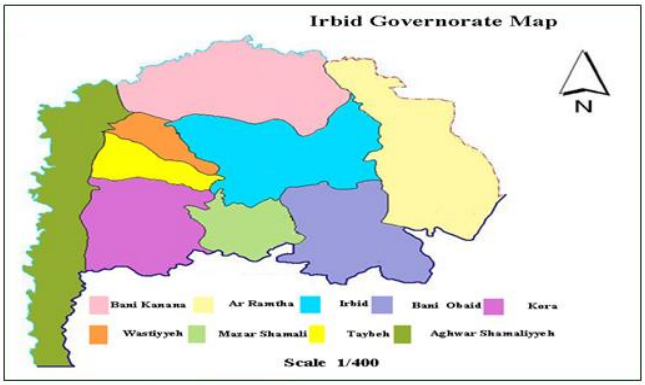

Fig 2. Shows the locations of regions that have been studied.

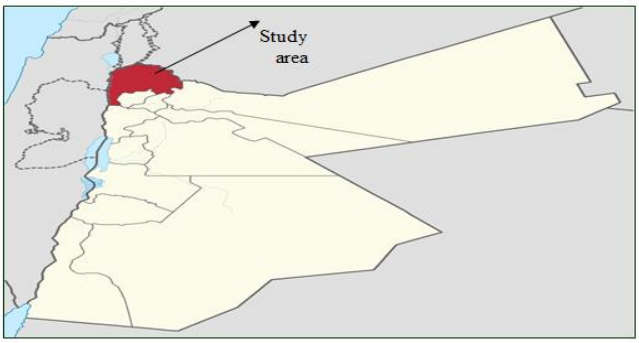

Fig 3. Shows the location of area that have been studied.

Measuring procedures

This study focused to study the natural radioactive pollution in the samples water of natural spring in the governorate of Irbid (study area). This study is conducted in the governorate of Irbid in northern Jordan. An integrated passive radon dosimeter has been used to study the natural radioactive pollution in the samples water of natural spring in the governorate of Irbid by measuring radon gas in the water of some natural springs in study area (north of Jordan).

Measurements carried out using SSNTDs. Solid state nuclear track detectors (SSNTDs) have become an important tool in the investigation of the presence of radon gas, not only in indoor air but also in soil and water [5][6]. SSNTDs have the extra advantage of retaining their record after readout, which leads to their rapid application in a wide variety of fields. The initial application of the etched track radon dosimetry was at J. Stefan institute [7].

The author studied radon concentration in the natural spring's water of Irbid governorate, where samples of spring's water were taken from eight springs in the Irbid governorate. The author studied the concentration of radon in the water of springs named as (Rahoop spring, Ash Shalalah spring, Wadi Al Ruman spring, Sama Al-Rousan spring, Tabqet Fahel spring, Dhiraj spring, Al-Wadi spring, Taqat al ain spring (See Table.1).

Water was tested in the laboratory. 56 plastic bottles of the same type (liter and a half) were brought. The researcher divided the water samples into these bottles (7 samples of each spring), installed detectors CR-39 on the inner face of the bottle cover and stored half a liter of each sample of water inside the bottle, left the samples for 70 days from the date (June 20, 2015 to August 30, 2015). After 70 days the collected dosimeters were chemically etched under the conditions (30% solution of KOH at a temperature of 70 C° for 8 h). An optical microscope was used to count track densities on the detectors surfaces.

Result and discussion

The author in this study found that the average concentrations of radon in the natural springs of the study area. The general average concentration of radon in Irbid governorate water was equal to (3.0 Bq/l), while the average for radon concentration was higher in the water of Taqat al ain spring and in the water of Rahoop spring, and the lowest concentration was in the water of Dhiraj spring (See Table.2 & Fig. 2).

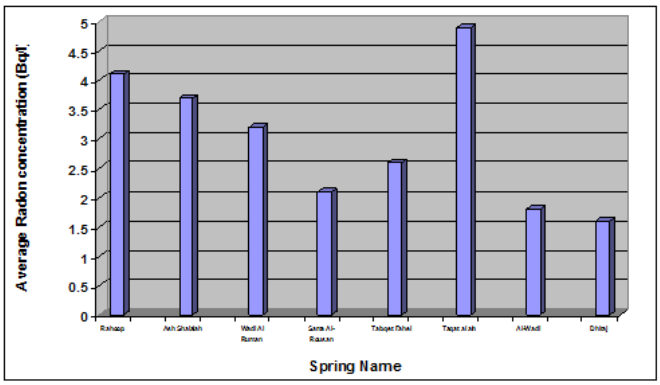

Fig 2. Shows a comparison between the radon concentrations in the spring's water of the study area.

Table 1.Shows the spring's names in the regions of the study area.

Regions	Center	Samples Number	Spring Name
Irbid	Irbid	7	Rahoop spring
Ar Ramtha	Ar Ramtha	7	Ash Shalalah spring
Kora	Der Abi saeed	7	*Wadi Al Ruman* spring
Bani Kanana	Sama Al-Rousan	7	Sama Al-Rousan spring
Aghwar Shamaliyyeh	North Shuneh	7	Tabqet *Fahel* spring
Bani Obaid	Al-Hisn	None	None
Mazar Shamali	Mazar Shamali	7	Taqat al ain spring
Taybeh	Taybeh	7	Al-Wadi spring
Wastiyyeh	Kufr Asad	7	Dhiraj spring

Table 2. Shows the average radon concentrations in water of springs in study area.

Q	Wertyu543	Spring Name	Mean (Bq/l)
Irbid	Irbid	Rahoop spring	4.1
Ar Ramtha	Ar Ramtha	Ash Shalalah spring	3.7
Kora	Der Abi saeed	*Wadi Al Ruman* spring	3.2
Bani Kanana	Sama Al-Rousan	Sama Al-Rousan spring	2.1
Aghwar Shamaliyyeh	North Shuneh	Tabqet *Fahel* spring	2.6
Bani Obaid	Al-Hisn	None	-
Mazar Shamali	Mazar Shamali	Taqat al ain spring	4.9
Taybeh	Taybeh	Al-Wadi spring	1.8
Wastiyyeh	Kufr Asad	Dhiraj spring	1.6

From Fig.2, we Note that the radon concentration in the water of Taqat al Ain spring is greater than the concentration in the other springs; the reason for this might be due to the nature of the rocks that water passes through before it ascends to the surface. These rocks may contain a proportion of uranium which helps in increasing the concentration of the radon gas.

Conclusion

The author studied radon concentration in the natural springs of Irbid governorate. The highest concentration of radon gas in water of Taqat al ain spring at an average concentration of 4.9 Bq/l and less concentration in water of Dhiraj spring at an average concentration of 1.6 Bq/l. This is due to the nature of the plutonic rocks that make up the tanks that contain this water into the ground, which may vary from one region to another.

The general average concentration of radon in Irbid governorate water was equal to (3.0 Bq/l). In general, the radon concentration in the water samples under study have appeared less than the allowable upper value, which is equal to (18 Bq/l), and it does not constitute a danger to human life (See Fig.3).

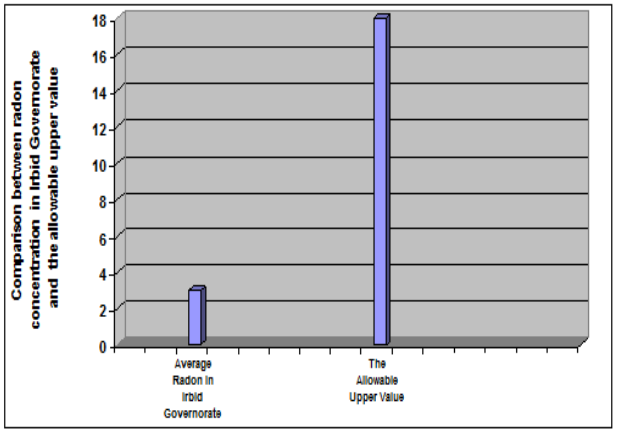

Fig 3. Shows a comparison between radon in Irbid Governorate and the allowable upper value.

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