# Measurements of Radon Concentrations Indwelling of Shrqat in Salah Dien, Iraq

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## Abstract

High radon levels are present in granite and grandiosity rocks that spread in Makhol Mountains. Such materials are rich in uranium and widely used in the construction of dwelling in the Shrqat. In the present work, the concentration of radon was measured, by using CR-39 dosimeter. Results suggest that radon concentration range from 66.32 to 45.63 $Bq/m^3$. The maximum value 80.32$Bq/m^3$ and minimum value 24.2 $Bq/m^3$, with standard deviation 12.67$Bq/m^3$. The result provides a framework for future studies that include a large, broader survey of radon concentration in Salah Dein.

**Keywords:** Radon, granite rocks, grandiosity rocks, Makhol mountains.

## قياس تركيز الرادون داخل المنازل في قضاء الشرقاط

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**خلاصة**

تحتوي صخور الكرانيت التي تنتشر على سلسلة جبال مكحول على مستويات عالية من غاز الرادون . حيث تعرف هذه المواد بأنها غنية باليورانيوم و هي شائعة الاستخدام في بناء المساكن في الشرقاط . تم في هذة الدراسة قياس تركيز غاز الرادون في داخل منازل الشرقاط باستخدام كاشف الحالة الصلبة المعروف باسم (CR-39) . و أشارت النتائج أن معدل تركيز الرادون في مكان الدراسة يتراوح بين (66.32-45.63 $Bq/m^3$) . وان أقصى تركيز هو ($80.32Bq/m^3$) وان ادني تركيز هو ( 24.2 $Bq/m^3$) مع متوسط انحراف معياري مقداره (12.67 $Bq/m^3$) و النتائج تشير الى ضرورة القيام بدراسة مستقبلية واسعة النطاق لمسح شامل لقياس تركيز الرادون في محافظة صلاح الدين.

**الكلمات الدالة:**

## Introduction

Radon-222 is a radioactive gas with a half- life of 3.824 days. It is The immediate radioactive decay series products of radium ($^{226}Ra$), in the decay series of uranium($^{238}U$) and thorium ($^{232}Th$). The half- life of thoron ($^{220}Rn$; radon isotop)is 55.6 sec which is much shorter than that of radon. Because of such a Short half-life of thoron, its emanation from building materials, as well as, its infiltration from the ground and further migration is restricted to a few centimeters only [1]. The process of the migration of Radon is a function of radioactivity concentration, and the porosity and permeability of the medium. Radon has long been known to contribute to risk of lung cancer. Radon and its daughter products emit alpha particles that are implicated in the cellular changes leading to lung cancer. Indoor Radon variations occur hourly, diurnally, and seasonally, and are influenced by numerous factors, including Radon infiltration rates, pressure differentials, soil characteristic weather conditions (e.g. rainfall, wind speed) and occupant behavioral [2]. The Radon concentration in air varies

in accordance with location, high level of the houses, material of the houses built, different room in the same house, and ventilation rate [3]. Radon exhalation rates in the areas, where uranium deposits and phosphate rocks is significant, and this is the main source of exposure to uranium. Long-term exposure to elevated levels of Radon increases ones risk of containing lung cancer. In Gaza , recent report of cancer registry unit shows that, the total reported diagnosed cases through the years 1998 -2002 were 2,404 {1.264 male, 1.140 female} cancer cases, number of these (31.4%) bronchus and lung cancer [4]. The purpose of this study is to gather information about the natural radiation and to evaluate the Radon concentration throughout. This is motivated by the concern about the possible consequences of long term exposure to higher concentration of Radon and its short-lived product in air. Since, it is known that Radon of its radioactive decay series products can cause lung cancer, and thus has become a public health concern [5]. Many countries have carried out surveys of prevailing indoor Radon levels [6, 7, 8, and 10]. A program of measurement of Radon concentration has been started in the country. This study will provide the basic data for any future study and project planning from the environmental point of view.

## Methods and Material

Radon concentrations in the houses were measured using passive integral Solid-state track detectors CR-39 [9]. Were prepared and distributed inside the houses of the middle region of Shirqat. These houses are chosen to be representative of the whole region. Our sampling strategy was to distribute the dosimeters in houses located at different geographic parts of the region. Moreover, houses built of different materials, like (stones and concrete), (stone and zinc) and (stone and spouts). The detectors were placed in a room so as to avoid contribution of $^{222}$Rn and its daughters, where the occupants of the house spend most of their time. Some of detectors were placed in bedroom and others in the living room. The detectors were left in the houses for a period of four months, (from May to Aug of 2009). Radon and its daughter's concentrations (C) throughout present work are determined by the following equation [11, 12]

$$C(Bq/m^3) = \frac{C_o(Bq/m^3)\, P\, t_o}{P_o t}$$

Where:

$C_o$: is the radon concentration of the calibrated chamber (90 KBq/m$^3$),

$t_o$: is the calibration time (48 hr),

$P$ : is the measured tracks number density per cm$^2$ on -3q detector inside the dosimeters used in the study,

$P_o$: is the measured tracks number density per cm$^2$ on detectors of the calibrated dosimeters (95754 tracks/cm$^3$),

$t$: is the total exposure time in days for different places of the house (97days)

## Results and Discussions

An overview of the Radon concentrations at houses on all camps is evaluated and given in table 1. The minimum and maximum values of Radon concentrations in the camps of each group measured in Bq/m$^3$ are also determined. The table also shows the average Radon concentrations (C) and the standard deviation (S.D) for each camp in location of the survey. Radon and its daughter's concentrations over the four locations in the middle region of Shrqat trip were varied between 66.32 up to 54.63Bq/m$^3$ and had a maximum value of 80.326 Bq/m$^3$. The average Radon concentration was 24.2 Bq/m$^3$ with average standard deviation of 12.67 Bq/m$^3$. Average Radon concentrations for each site were determined as follows: R Cost S camp 66.32 Bq/m3, camp R Cost N 61.16 Bq/m$^3$, L Cost S camp 45.63Bq/m$^3$, L Cost N camp 52.66 Bq/m$^3$. The average Radon concentrations of (a) and (b) camps were higher than (c) and (d) camps. The result also indicates that the difference between the minimum and maximum Radon concentrations in each camp is very high. This large variation in Radon values inside these camps is due mainly to the difference in the ventilation methods used different types of locations building and elevated floor of building. The types of building materials such as concrete, spouts, stone and concrete…. etc, are also influence the Radon concentration. Indicates that in (c) camp houses are built of stone and spouts where Radon concentration found higher than 1.32 times of these in (a) camp. It was found that Radon concentrations of (a) and (b) houses that built of stone and spouts higher than (c) and (d) houses that built of stone and concrete. This represents that houses built of spouts and stone are 1.4 times higher than of houses built of concrete and stone. The highest values were found in houses where the building substructure consisted of stone and zinc. Houses built of stone and

concrete had low Radon concentrations in all house locations. The ventilation method in these buildings can be understood to be better than other buildings. This indicates that the different materials of houses built are important parameters in determining Radon concentrations and shows that that the highest Radon concentrations are in bedrooms of (c) camp, and the lowest in living rooms in (b) camp. It also shows that highest percentage of Radon concentration is found in the bedrooms 41%, while kitchen 34% and living rooms 25%, within the same housing complex, have about the some Radon levels. The high Radon levels inside bedrooms are due also to the relatively of low ventilation. While living rooms of the houses have large windows, front of open area and well ventilation. In addition, there is an interactive effect between the Radon exposure and smoke cigarettes. Two agents have really causing and developing of lung cancer [12]. The Radon concentration of smoking people in (a) camp is very high comparing to other camps. Thus, higher Radon concentration and smoking together may cause lung cancer. Smokers should keep their exposure to Radon as low as possible. Smokers have many times the risk from Radon than non-smokers. If the house was tested in a frequently used basement, it may have measured a Radon level that is higher than actual level, stop smoking and spend most of your time upstairs [13]

**Table 1. Radon concentrations in each camp.**

| Location | Symbol | No. of det | Ave. C(Bq/m$^3$) | Max. C(Bq/m$^3$) | Min. C(Bq/m$^3$) | S.D. (Bq/m$^3$) |
|---|---|---|---|---|---|---|
| Right Cost South | (a) | 35 | 66.32 | 80.32 | 31.6 | 12.5 |
| Right Cost North | (b) | 29 | 61.16 | 76.14 | 32.2 | 12.5 |
| Left Cost South | (c) | 39 | 45.63 | 59.26 | 24.2 | 12.01 |
| Left Cost North | (d) | 34 | 52.66 | 70.60 | 34.4 | 13.7 |
| Ave. value | | 137 | 56.44 | 71.58 | 30.55 | 12.67 |

**Table 2. Comparison of the study and other studies.**

| Study | Syria[14] | Iraq[16] |
|---|---|---|
| 80.32- 24.4 | 60.3-13.3 | 60.7-18.43 |

**Table 3. Public recommended [15].**

| Authority | Dwelling know | Dwelling future |
|---|---|---|
| ICRP | 400 | 200 |
| CEC | 400 | 200 |
| WHO | 200 | 200 |

## Conclusions

Results indicate that Radon average concentration range from 30.55 up to 71.58 $Bq/m^3$ with a maximum value of 80.32 $Bq/m^3$, a sample of houses in all sites of camps. Despite the small number of building studied, the results provide a framework for future studies that include a larger, broader survey of Radon concentrations indoor and outdoor in Shrqat. Substantial research efforts are also requested all over Shrqat in air, water and soil to evaluate the average Radon concentration of whole country. Certainly, this study undertaken to provide a health oriented Radon assessment of the country to us in addressing long-tang management goals, particularly from the environmental point of view.

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