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Natural Radiation Doses Due to Radioactivity in Northern Part of Jordan

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Abstract

The aim of this study is to present an assessment of radiation doses received by the public in selected areas of northern part of Jordan, due to Background Radiation. This region included a 330 km length area, in five governorates in northern Jordan: Irbid, Mafraq, Zarqa, Jarash, and Ajloun.
Using a portable Geiger–Muller counter, and NaI(Tl) detector, the area has been surveyed. The measured absorbed dose rates in air were in the range of 10 –250 nSv/h. Further studies should be implemented to determine the concentrations of natural radioactive materials.

Keywords: Jordan; Irbid, Mafraq, Zarqa, Jarash, Ajloun; natural radioactivity; external gamma dose; NaI(Tl) detector; low radiation

Introduction

There are many systems and processes that transfer radioactivity into the surroundings. Human industrial activities involving those related to (including mining, milling, reprocessing, and waste storage) leading to significant creation and release of radioactivity, which comes from pre-existing natural radionuclides, like potassium-40, uranium -238, and 235, radium-226 and radon-222, which would

otherwise remain trapped in the earth's crust. Radionuclides released into atmosphere are subjected to a variety of physical processes that determine their fate. These processes are complicated and poorly understood, and affected by physical and chemical forms of the radionuclides [SCOPE50- 93].

The northern part of Jordan is mostly an agricultural area. A broad assessment of radiation impact on people and environment of this part of Jordan is a essential, as this is the first study to be done by active radiation measurments. The need to have clean environment, and to protect people from natural or industrial sources of radiation, if it is nationally generated or that comes across the boarders, pushes toward establishing a strong program for radiation protection.

This study matches with the other studies, which were conducted at different locations in Jordan (Ahmad et al., 1997; Al-Jundi, 2002, Al-Jundi et al., 2003, Al Hamarneh et al., 2003, Ajlouni et al., 2009, Ajlouni et al., 2010, Abu-Haija, et al., 2010, Salameh et al., 2011, Ajlouni et al., 2011 and Saraireh et al., 2012). The aim of this work is to determine the gamma-ray-absorbed doses due to background radiation originating from naturally occurring radioactivity, along Irbid- Mafraq-Zarqa-Jarash-Ajloun Highways, as well as internal roads inside each city. This study represents a pre-project study to make a preliminary assessment of the radiation doses in this part of the country. The results will be used to establish a radio-dose map for the named region. This map will be used as reference information to evaluate any changes in the radioactivity background level due to the change natural or man-made intervention in the environment.

Experimental

External gamma dose-rate levels were measured in different areas of the northern part of Jordan. These measurements conducted on The investigated area, which is about 350 Km long, includes five governorates in northern part of Jordan: Irbid, Mafraq, Zarqa, Jarash, Ajloun. (Fig. 1).

Fig. 1: Jordan map

Dose rates were measured twice, primarly by a portable radiation monitor (RADIAGEM 2000) which is an energy-compensated Geiger-Muller counter a survey meter that includes an. It can measure gamma energy from 40 keV to 1.5MeV with 15% accuracy (Fig. 2). The second measurements are performed by Smart SG-1R external probe connected to RADIAGEM 2000. The new CSP (Canberra Smart Probes) energy-independent gamma probe with NaI(Tl) $1'' \times 1''$ detector, designed for gamma radiation measurements, and measures dose-rate equivalent. It is used for medium sensitivity with a dose-rate range from 10 nSv/h to 200μSv/h (Fig. 3).

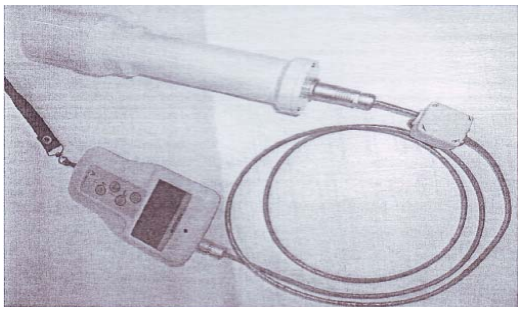

Fig. 2: RADIAGEM 2000 **Fig. 3: Smart SG-1R Probe connected to RADIAGEM 2000**

Results and discussion

The gamma dose rates at 1 m above ground in the investigated regions measured by survey meters were between 10 nSv/h and 250 nSv/h. External exposures are created mostly from gamma radiation from radionuclides in the U-238 and Th-232 series. Table (1) below presents the registered gamma absorbed dose rates in investigated area.

Table (1) Registered Gamma Absorbed Dose Rates in investigated area

region	Characteristics of Location	Total Distance (Km)	Dose rate in air (nSv/ h)
1	Irbid - Mafraq Highway	40	20 - 250
2	Mafraq - Zarqa, Highway	50	15 - 150
3	Zarqa – Jarash, Highway	40	25 - 230
4	Jarash - Ajloun Highway	30	15 - 50
5	Ajloun- Irbid Highway	40	10 - 50
6	Irbid main streets	50	25 - 60
7	Mafraq main streets	30	25 - 100
8	Zarqa main streets	30	20 - 100
9	Jarash main streets	20	20 - 50
10	Ajloun main streets	20	20 - 50

The important result which could be stated is that, the highest gamma dose rate registered, due to gamma radiation was measured to be 250 nSv/h. According to UNSCEAR (2000) report [2], the dose rate in outdoor air due to terrestrial gamma-rays in normal circumstances is about 57 nSv/h. The world-wide average annual effective dose is approximately 70 μSv while the national average ranges from 24 to 160 nSv/h[5].
After comparing the measured absorbed dose measured in this work, with the registered, national or international, dose rates resulting from natural radiation areas, the gamma dose rates registered in northern part of Jordan represents a potential source of natural radioactivity, mainly Uranium especially on Irbid - Mafraq Highway, and Zarqa – Jarash, Highway.

Conclusions

This study presents data regarding Natural Radiation Doses measured during the investigations we have already carried out in Selected Areas in a northern Part of Jordan. The investigated area, which is 350 Km long, includes five governorates in Jordan: Irbid, Mafraq, Zarqa, Jarash and Ajloun. These data highlighting on outcomes of natural gamma radiation dose rates, to classify the potential and known impacts of exposures in these areas of this part of the country on public health, and also to make recommendations for further investigations. A substantial portion of dose contribution is due to natural sources comes from terrestrial gamma radionuclides. The measured absorbed dose rates in air were in the range of 10 –250 nSv/h. The most existing dose was about 25 nSv/ h.

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