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Measurement of Natural Radioactivity in different locations of ziggurat of Dur-Kurigalzu by using (HPGe) detector, Baghdad governorate- Iraq

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Abstract :

Measuring of natural radioactivity in soil specimenss were taken from various areas in of ziggurat of Dur-Kurigalzu by using High Purity Germanium,The average A_U, A_{Th} and A_K were (20.604±2.9 Bq/kg, 24.534 ±3.3 Bq/kg, 212.22±25.1 Bq/kg) respectively. While the average values of some other parameters [Ra_{eq}, D_γ, $(AED)_{in}$, $(AED)_{out}$, H_{in}, H_{ex} and I_γ], for each specimens were found to be (72.029±9.1 Bq/kg, 33.187±4.1 nGy/h, 0.163 ±0.02mSv/y, 0.041 ±0.005 mSv/y, 0.250 ±0.03, 0.195 ±0.02, 0.262 ±0.03), respectively.

Keyword: HPGe, Soil specimenss, ziggurat of Dur-Kurigalzu.

قياس النشاط الإشعاعي الطبيعي في مواقع مختلفة من زقورة عقرقوف باستخدام كاشف (HPGe) ، محافظة بغداد – العراق

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مستخلص:

في هذا البحث ، قياس النشاط الإشعاعي الطبيعي في عينات التربة من مواقع مختلفة من زقورة عقرقوف باستخدام كاشف (HPGe) ، أظهرت نتائج القياسات أن متوسط تراكيز النشاط الاشعاعي لـ ^{238}U و ^{232}Th و ^{40}K كانت (20.604±2.9 Bq/kg ، 24.534 ± 3.3 Bq/kg ، 212.22 ± 25.1 Bq/kg) على التوالي ، وهو الحد الأدنى من المتوسط العالمي المحدد بواسطة (UNSCEAR, 2000). بينما وجد أن متوسط قيم بعض المعلمات الأخرى [I_γ, H_{ex}, H_{in}, $(AED)_{out}$, $(AED)_{in}$, D_γ, Ra_{eq}]، لكل عينة كانت (72.029±9.1 Bq/kg ، 33.187±4.1 nGy / h ، 0.163 ± 0.02 mSv/y ، 0.041 ± 0.005 mSv/y ، 0.250 ± 0.03 ، 0.195 ± 0.02 ، 0.262 ±0.03) على التوالي ، كل هذه القيم كانت أقل من قيمة الحد المسموح بها من قبل . (UNSCEAR, 2000)

الكلمات الافتتاحية: النشاط الإشعاعي الطبيعي ، كاشف HPGe ، نماذج التربة ، زقورة عقرعوف.

1-Introduction

It is notable that traces of the radionuclide's are found in (human body's, water, soil and air). Nuclides Radioactive can be found in the nature are categorized generally in 2 distinguished families, namely of emerging either from "Terrestrial" or the Cosmogenic origin. The generally the radionuclides experienced that irradiate the human bodies through external exposure ^{235}U, ^{238}U , ^{232}Th and k-40 [1],Nuclei can undergo a variety of processes which result in the emission of radiation.The most widely recognized types of nuclear radiation are gamma-rays and alpha and beta particles,our bodies contain radioactive materials for example, Carbon-14 and k-40 [2].

Description of Study Area

Dur-Kurigalzu located in the area `Aqar-qūf in Baghdad governorate, Iraq) was a town in southern confluence of the Diyala and Tigris rivers about 29.5 kilometers' west of the center of Baghdad governorate.Founded by a Kassite king of Babylon in 14th century BC and abandoned after the fall of the Kishin dynasty.The city contained temples dedicated to Sumerian gods and a ziggurat, also a royal palace. The ziggurat was bizarrely well-safeguarded, remaining to a tallness of about 171 ft (52 m) [3], see Fig. (1).

Fig. (1) the ziggurat of Dur-Kurigalzu.

2- Preparation and Collection of the specimens

Ten surface soil specimenss were taken from various areas in Dur-Kurigalzu, see Fig. (2). The soil specimenss were squashed to little pieces at the fine powder by using grinder, then almost (850 g) and (250 µm) grain size of the specimenss were obtained.The specimenss were dried at (55 °C) for (two hours) and the package in a (one litter).

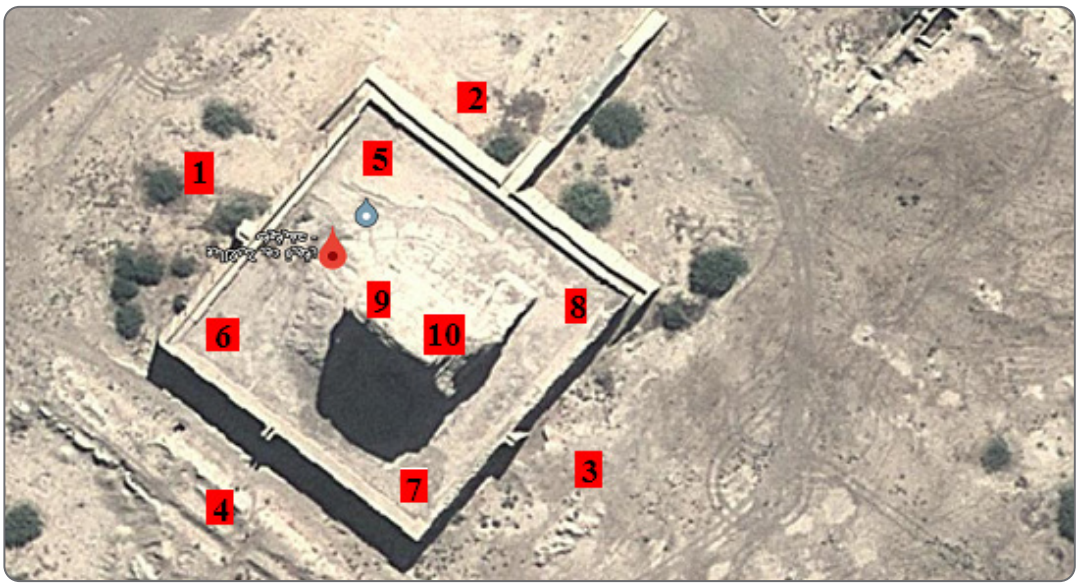

Fig. (2) Sketch map showing locations of the studied of ziggurat of Dur-Kurigalzu.

3- Determination of some Gamma Radiation Parameters:

1. Activity Concentration [4]

$$A = \frac{NET}{\varepsilon * I_{\gamma} * m * t} \quad \text{..... (1)}$$

Where:

A:activity concentrations,

: Energy efficiency,

m: mass of sample. ,

t: time measurement (3600s.).

2- Radium Equivalent (Ra_{eq}) [4]

$Ra_{eq} = 0.077A_K + 1.43A_{Th} + A_U$ .....(2)

Where A_k, A_{Th}, A_U activity concentration of a series of (^{40}K ^{232} وTh , ^{238}U) respectively.

3- Absorbed Dose Rate (D_{γ})5]]

$D_{\gamma} = 0.604A_{Th} + 0.0417A_K + 0.462A_U$ ..... (3)

4- The Annual Effective Dose (AED in, AED out) [6]

(AED)in= 0.80 x (0.7 Sv/Gy)x D_y (nGY/h) x 10^{-6} x 8760h/y ..... (4)

(AED)out= 0.20 x (0.7Sv/Gy) D_y x (nGy/h) x 10^{-6} x 8760h/y .....(5)

5- External and Internal Hazard Index (H_{ex} , H_{in}) [7]

$$H_{ex} = \frac{A_R}{370} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \leq 1 \quad \text{..... (6)}$$

$$H_{in} = \frac{A_R}{185} + \frac{A_{Th}}{259} + \frac{A_K}{4810} \leq 1 \quad \text{..... (7)}$$

6- Activity Concentration Index (I_γ) [8]

$$I_\gamma = \frac{A_U}{300} + \frac{A_{Th}}{200} + \frac{A_K}{3000} \quad \text{..... (8)}$$

4- Results and Conclusions

In Table (1) it we can seen that: A_U was found in specimens 10 which was equivalent (26.620 Bq/kg), while the less estimation of A_U in specimens 2 which was equivalent (16.040 Bq/kg), see Fig. (3) , with rate estimation of (20.604±2.9 Bq/kg). The outcomes have demonstrated that estimations of A_U in ziggurat of Dur-Kurigalzu were minimum (35 Bq/kg) [9].

Most elevated estimation of A_{Th} in specimens 10 which was equivalent (31.480 Bq/kg),while the less estimation of A_{Th} was found in specimens 7 which was equivalent (14.510 Bq/kg), see Fig. (3),with rate estimation of (24.534±3.3 Bq/kg). The outcomes have demonstrated that estimations of A_{Th} in ziggurat of Dur-Kurigalzu were minimum than the recommended (30 Bq/kg) [9].

The highest value of A_k in specimens 9 which was equivalent (266.320 Bq/kg), while the less estimation of A_k in specimens 2 which was equivalent(153.820 Bq/kg), see Figure (3) ,with rate estimation of (212.22±25.1 Bq/kg). The outcomes have demonstrated that estimations of A_k in ziggurat of Dur-Kurigalzu were minimum than (400 Bq/kg) [9].

Most elevated estimation of Ra_{eq} in specimens 10 which was equivalent (88.110 Bq/kg),while the least estimation of Ra_{eq} in specimens 7 which was equivalent(56.314 Bq/kg) , with rate estimation of (72.029±9.1 Bq/kg).The outcomes have demonstrated that estimations of Ra_{eq} in ziggurat of Dur-Kurigalzu were minimum than (370 Bq/kg) [9].

Most elevated estimation of D_γ in specimens 10 which was equivalent

(40.234 nGy/ h),while the less estimation of D_{γ} in specimens 7 which was equivalent (26.587 nGy/h), with a rate estimation of(33.187± 4.1 nGy/h).The outcomes have demonstrated that estimations of D_{γ} in ziggurat of Dur-Kurigalzu were minimum than (55 nGy/h) [9].

The most elevated estimation of $(AED)_{in}$ in specimens 10 which was equivalent (0.197 mSv/y),while the less estimation of $(AED)_{in}$ in specimens 10 which was equivalent (0.130 mSv/y),with rate value of (0.163±0.002 mSv/y). The outcomes have demonstrated that estimations of $(AED)_{in}$ in ziggurat of Dur-Kurigalzu were minimum than (one mSv/y) [9].

The highest value of $(AED)_{out}$ in specimens 10 which was equivalent(0.049 mSv/y) , while the less estimation of $(AED)_{out}$ was found in specimens 7 which was equivalent (0.033 mSv/y), with rate estimation of (0.041± 0.005 mSv/y). The outcomes have demonstrated that estimations of $(AED)_{out}$ in ziggurat of Dur-Kurigalzu were minimum than (one mSv/y).

The most elevated estimation of H_{in} in specimens 10 which was equivalent (0.310),while the less estimation of H_{in} was found in specimens 7 which was equivalent (0.201), with rate estimation of (0.250±0.03). The outcomes have demonstrated that estimations of H_{in} in ziggurat of Dur-Kurigalzu were minimum than (one) [10].

The most elevated estimation of H_{ex} in specimens 10 which was equivalent (0.238), while the less estimation of H_{ex} was found in specimens 7 which was equivalent (0.121), with rate estimation of (0.195±0.02).The outcomes have demonstrated that estimations of H_{ex} in ziggurat of Dur-Kurigalzu were minimum than (one) [9].

The most elevated estimation of I_{γ} in specimens 10 which was equivalent (0.317), while the less estimation of I_{γ} was found in specimens 7 which was equivalent (0.209) , with rate estimation of (0.262±0.03).The outcomes have demonstrated that estimations of I_{γ} in ziggurat of Dur-Kurigalzu were minimum than (one) [9].

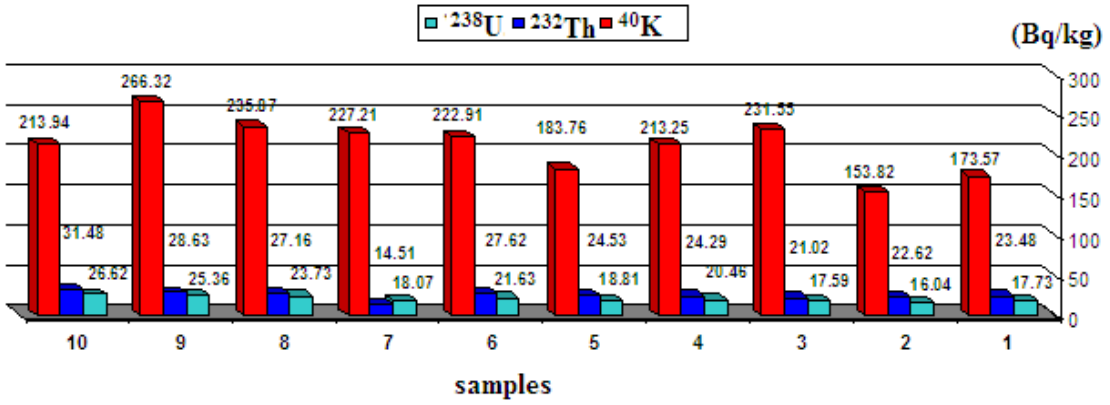

Figure (3) specific activity of (U-238, Th-232 and K-40) in all soil specimenss in ziggurat of Dur-Kurigalzu.

[1] Table (1) A_U, A_{Th} and A_K with some other parameters [Ra_{eq}, D_γ, $(AED)_{in}$, [2] $(AED)_{out}$, H_{in}, H_{ex} and I_γ] in soil specimenss in ziggurat of Dur-Kurigalzu.

No.	^{238}U	^{232}Th	^{40}K	Ra_{eq}	D_γ	(A.E.D)		Hazard index		I_γ
						Ei_n	E_{out}	H_{in}	H_{ex}	
1	17.730	23.480	173.570	64.671	29.611	0.145	0.036	0.223	0.175	0.234
2	16.040	22.620	153.820	60.231	27.487	0.135	0.034	0.206	0.163	0.218
3	17.590	21.020	231.550	65.478	30.478	0.150	0.037	0.224	0.177	0.241
4	20.460	24.290	213.250	71.615	33.016	0.162	0.040	0.249	0.193	0.261
5	18.810	24.530	183.760	68.037	31.169	0.153	0.038	0.235	0.184	0.247
6	21.630	27.620	222.910	78.291	35.971	0.176	0.044	0.270	0.211	0.285
7	18.070	14.510	227.210	56.314	26.587	0.130	0.033	0.201	0.152	0.209
8	23.730	27.160	235.870	80.731	37.204	0.183	0.046	0.282	0.218	0.294
9	25.360	28.630	266.320	86.808	40.114	0.197	0.049	0.303	0.234	0.316
10	26.620	31.480	213.940	88.110	40.234	0.197	0.049	0.310	0.238	0.317
Avr.	20.604 ±2.9	24.534 ±3.3	212.22 ±25.1	72.029 ±9.1	33.187 ±4.1	0.163 ±0.02	0.041 ±0.005	0.250 ±0.03	0.195 ±0.02	0.262 ±0.03
Min.	16.040	14.510	153.820	56.314	26.587	0.130	0.033	0.201	0.152	0.209
Max.	26.620	31.480	266.320	88.110	40.234	0.197	0.049	0.310	0.238	0.317
world-wide [9]	35	30	400	370	55	1	1	1	1	1

Conclusions

The aftereffects in this work concerning values of the A_U, A_{Th}, A_k and determination the parameters [Ra_{eq} ,D_{γ},$(AED)_{in}$,$(AED)_{out}$, H_{in} , H_{ex} and I_{γ}] ,all results less than their corresponding allowed limits.

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