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Estimate the types and the natural radioactivity element contents and the radiological hazard values of some sediment samples at Benghazi coast–Libya

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Abstract: The natural radioactivity element type sand their concentrations of some sediment samples collected from Benghazi coast (Libya)were determined by used high pure germanium (HPGe) gamma-ray spectroscopy. The radioactivity contents of the radionuclides were used to calculate the radiological hazard values. The results showed that the average activity concentrations of ^{238}U, ^{232}Th and ^{40}K were 11.03, 4.185 and 27.94 Bq/kg respectively. The external radiation hazard values were ranged between (0.039 - 0.137 Bq/kg). The recorded values which obtained in the this study for the sediment samples under investigation were less than the recommended of safe values and permissible limits which given by UNSCEAR.

Keywords: Radioactive elements, Benghazi, sediments.

INTRODUCTION

The radioactivity occurs naturally in the environment. The radionuclide content of a depends on mineralogical and chemistry of sediment in the Benghazi area. The natural radionuclides of major sources in sediments have different origins, like weathering and recycling of terrestrial minerals and rocks (igneous or metamorphic) containing radionuclides of uranium and thorium radioactive series and potassium[1]. Human exposure to ionizing radiations is one of important subjects for public attention, since natural radiation is responsible for most of the total radiation exposure of the human body[2]. Human

should be wear of their natural environment with regard to the radiation effects due to the naturally occurring and induced radioactive elements[3]. In this study some of sediment samples were collected from the Benghazi coast (Libya). The main aim of this study is detect the types of the radioactive elements beside measure their contents by using HPGe gamma spectroscopy, also calculate the radiological hazard effects.

MATERIALS AND METHODS

Samples Collection : Ten sediment samples were collected from the near shore locations at ten different stations along Benghazi city coast ,Benghazi city is the second larger city in Libya .It contains many harbors (Commercial , petroleum(Ras El –Monghar) beside many industrials companies. The locations of the samples were distributed along the coast from the east to the west of the city Benghazi and including the following stations **Table (1)**.

Table (1): The sample stations.

Station No	Station Name	(degree)N	E (degree)
1	Ras ALmingar		
2	Al – Lthama	32º 11′ 39.16″	20 ˚ 7′ 26. 52 ″
3	Al Sabri	32º9 ` 24.36″	20 ˚5′ 19. 76 ″
4	Right of the port area	32º 8` 7.62″	20 ˚ 4′ 23. 91 ″
5	port area	32º 7` 13.55″	20 ˚ 3′ 21. 36 ″
6	Lift of the port area	32º 6` 50.80″	20 ˚ 3′ 31. 43 ″
7	Joliana Resort	32º 5` 46.96″	20 ˚ 3′ 6. 87 ″
8	Neroz Resort	32º 4` 41.07″	20 ˚ 2′ 4. 37 ″
9	Nakhel Resort	32º4` 0.84″	20 ˚2′ 15. 57 ″
10	Qanfoudha	32º 2` 46.54″	20 ˚ 1′ 5. 01 ″

One kg of surface sediment sample was collected from each location. The samples were identified by used by GPS system and given in Table (1) and Figure (1).

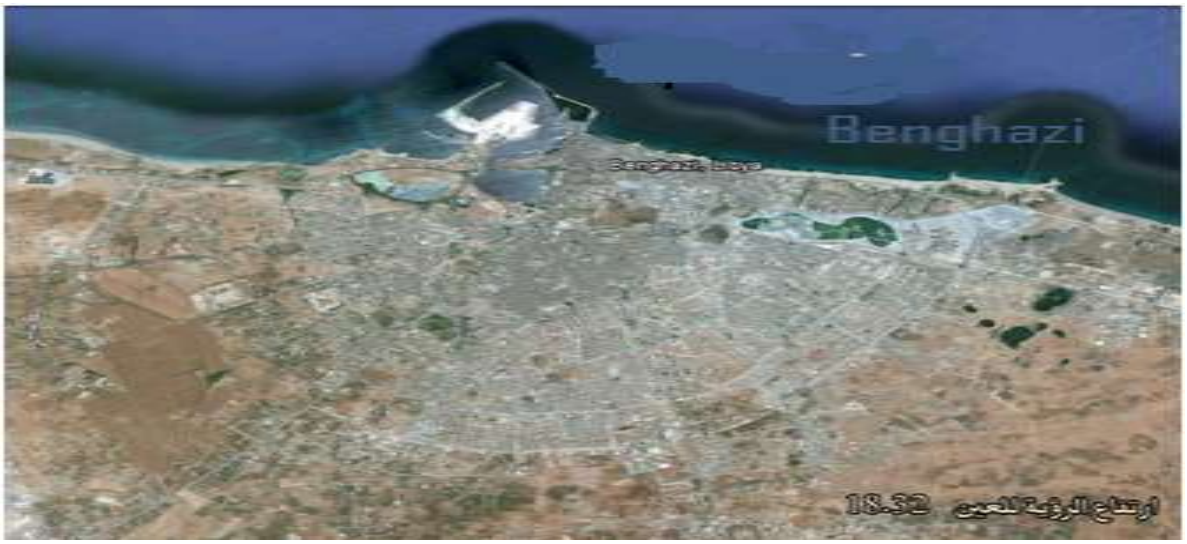

Fig. 1: The Benghazi city coast.

Experimental Setup: In this study, the technique of spectroscopy of natural gamma radiation by used high pure germanium (HPGe) spectroscopy was used to estimate the radioactive elements. It is based on the principle of the reaction of radiation with the reagent due to its high efficiency and reliable practical advantages when coupled with the availability of highly efficient and highly efficient radiation detectors supported by advanced processing systems Information on the computer. The samples were prepared by taken about 500g in a special container called Marinelli Baker that is installed around the crystallization of the detector and surrounded by thick shielding from lead reached to(10 cm). Measurement time for each sample taken 10 hours, the detector communicates with the successive parts, the primary amplifier of the electronic signal, then the main amplifier, and then the multipoint computer, which includes a multi-channel analyzer to record and analyze the gamma-ray spectrum. The levels of the radioactive elements were measured by the Atomic Energy Commission at (Nasr City, Cairo, Egypt).

The Calculation of external hazard index (Hex) : The concept of the risk guide previously proposed in 1983 by the World Radiation Protection Association was adopted to establish general limits that combine the dose rate for both external exposure and gamma radiation internal exposure, where this information was collected in fracture coefficients in a relationship involving activity .Natural radioactivity specific radionuclide to give evidence indicates the external hazard index (H_{ex}) due to emitted from gamma ray of the samples to estimate the biological hazard was calculated according to the following relationship:

$$H_{ex} = \frac{C_{Ra}}{185} + \frac{C_{Th}}{259} + \frac{C_K}{4810} \leq 1$$

Where: C_{Ra}, C_{Th} and C_K are the activity concentrations[5] for ^{238}U,^{232}Th, and ^{40}K in $Bq.kg^{-1}$.Where that the risk guide is calculated from the above mathematical relationship and then compares with a reference value.

RESULTS AND DISCUSSION

The results obtained of the sediments under investigation of the Benghazi city showed presence of some radioactive elements including: ^{238}U, ^{232}Th and ^{40}K with relative variations in their contents from side to side .The external index hazard was calculated, the radionuclides and the external hazard values were showed in **Table (2)**.

The results of the present study indicate that there are different values of ^{238}U in the sediments of the studied area with an average of (11.03 Bq/ Kg) and ± 3.58 SD. The highest value of the specific radioactivity of ^{238}U was recorded at station (1) (17.6 Bq / Kg), while the lowest radiation activity of ^{238}U in sample (2), which is the shore opposite the Al-Lathamaha station. All the recorded contents of ^{238}U of the studied sediment samples were lower than those values of permissible limits.

Also the results of the samples showed that the ^{232}Th is available in the studied stations with an average of (4.185 Bq /Kg ± 2.74 SD) .The highest value of specific radiation of ^{232}Th was recorded in the sample of station no (5) (7.8Bq / Kg) and it is within the permissible limits (40 Bq / Kg) on the other side the study showed that the samples of stations of (1, 2, 3 , 4, 6 and 9) were free of any specific radiological activity of ^{232}Th.

Table (2): The activity concentrations of ^{238}U, ^{232}Th and ^{40}K of the sediments of the studied area.

Samples	Locations	N (degree)	E (degree)	Activity concentrations			Hex
				^{238}U (Bq/kg)	^{232}Th (Bq/kg)	^{40}K (Bq/kg)	
1	Ras ALmingar	32º 11′ 39.16″	20 ˚ 7′ 26. 52 ″	17.6	< D.L	< D.L	0.095
2	Al – Lthama	32º9 ` 24.36″	20 ˚5′ 19. 76 ″	7.2	< D.L	< D.L	0.039
3	Al Sabri	32º 8` 7.62″	20 ˚ 4′ 23. 91 ″	10.5	< D.L	< D.L	0.057
4	Right of the port area	32º 7` 13.55″	20 ˚ 3′ 21. 36 ″	10.3	< D.L	< D.L	0.057
5	port area	32º 6` 50.80″	20 ˚ 3′ 31. 43 ″	17.3	7.8	62.6	0.137
6	Lift of the port area	32º 5` 46.96″	20 ˚ 3′ 6. 87 ″	8.3	< D.L	15.04	0.056
7	Joliana Resort	32º 4` 41.07″	20 ˚ 2′ 4. 37 ″	9.7	1.74	9.8	0.052
8	Neroz Resort	32º4` 0.84″	20 ˚2′ 15. 57 ″	11.3	4.8	55.2	0.049
9	Nakhel Resort	32º 2` 46.54″	20 ˚ 1′ 5. 01 ″	9.6	< D.L	9.6	0.054
10	Qanfoudha	32º 1` 47.01″	20 ˚0′ 13. 15 ″	8.5	2.4	15.4	0.058
Average				11.03	4.185	27.94	0.058
±Standard devotion				3.58	2.74	24.22	-

D.L: Detection Limits.

The results showed that the sediment samples of stations of (1, 2, 3 and 4)not recorded specific radioactivity of ^{40}K, , whereas , the ^{40}K contents in stations (5, 6, 7, 8, 9 and 10)showed relative variations in the values of ^{40}K with average of (16.764 Bq/Kg ±24.22) where the highest radiation activity value was recorded in stations sample (5) of (62.7Bq / Kg) whereas the lowest value was recorded in sediment sample (9) of station (9.6 Bq /Kg) . By comparing the ^{40}K values which recorded in this study with those of permitted limits of (500 Bq/Kg), It clear they are lower than them.

The United Nations Scientific Committee on the Effects of Atomic Radiation[6], in its publications on the permissible limits of natural radiation has determined that the rate of specific radioactive activity[7] of ^{238}U is (40 Bq / Kg).

Some studies pointed that the most common source of natural radiation for the elements in the earth is potassium $^{40}K$and some other elements, which explains the presence of radioactive potassium in sediment samples. While some studies indicated that there are also industrial sources of some elements with radioactivity, the most important of which are man-made[8], nuclear weapons tests, radioactive materials from some phosphate rocks and radioactive elements of nuclear waste which using in x-rays in medical treatment[9].There are some sequences of natural radioactive elements, most notably, some of the rocks

that make up the soil, where the uranium meets in the volcanic acid, while its concentration in the igneous rocks depends on the abundance of some compounds such as silicates[10].

CONCLUSION

This study showed low contents of some radionuclide's in the sediment samples of Benghazi coast (Libya) . The study recorded presence of ^{40} K , ^{238}U and ^{232}Th with variations in their contents from location to location.

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