Journal of Physical Science and Environmental Studies
Vol. 2 (2), pp. 30-37, August, 2016
ISSN 2467-8775
Full Length Research Paper
http://pearlresearchjournals.org/journals/jpses/index.html

Evaluation of Natural Radioactivity and Excess Lifetime Cancer Risk Due To Gamma Dose Rates from Egyptian Black Sand and Its Components

ABD El-HALIM, E.S.

Accepted 6 August, 2016

Nuclear Physics Laboratory, Faculty of Women for Arts, Science and Education, Ain Shams University, Cairo, Egypt. E-mail: e.hrs27@yahoo.com.

ABSTRACT

Scientific investigations have long concluded that prolonged exposure to low dose of radioactivity can induce deleterious effects in human. The aim of this work is to investigate the radioactivity in black sand and its components that are suspected to have natural radioactivity radiation risk in Egypt. High-resolution gamma-ray spectrometry (HPGe) detector was used to detect the radioactive elements abundance in "Abu-Khashaba" located at 5 Km east of Rosetta north Nile Delta. It was noticed that, Radium, thorium and potassium are concentrated in black sand and its components especially monazite and zircon. Radium equivalent activity (Raeq), outdoor and indoor external dose and total average annual effective dose were measured. The hazard indices and total excess lifetime cancer risk (ELCR) were measured to be higher than the worlds average values for most samples. The harmful radiation effects are posing to human going to the area under investigation.

Key words: Black sand, HPGe Detector, Activity concentration, Annual effective dose rate, Excess life time cancer risk (ELCR).

INTRODUCTION

The beach area of Rosetta includes most of the economic minerals reserves of the Egyptian black sands due to its relatively great extension and high grade especially on both sides of the Rosetta promontory. The Egyptian black sand deposits were subjected to extensive research. The studies were dealing with the evaluation of a certain economic mineral, for example zircon, rutile, limonite, and garnet. Other studies were dealing with the evaluation of all economic minerals present in the Egyptian black sands (Abdel Fattah, 2008) (Moustafa, 2010). Abu-Khashaba area lies in the extreme northwestern corner of the Nile Delta were investigated. It is located at the Mediterranean coast to the east of Rosetta distributaries and covers 5 km stretch parallel to shoreline with 0.5 km width (Abdel-Aal et al., 2012) as shown in Figure 1. Radiation and radioactive materials in the environment can reach human through many routes. Primordial radioactivity is widespread in the earth crust, mainly in various geological formation and their disintegration products. Because of weathering effects on rocks, the radionuclides carried to the soils, streams and rivers by rain. Black sands are usually sorted and deposited along rivers or river mouths, the heavy mineral sources sometimes being very distant from the placer locations (Margineanu et al., 2014). Black sand and some of its components such as monazite and zircon naturally enriched in uranium and thorium; significantly contribute the increasing of local radioactivity levels from normal background (Cetiner et al., 2011). According to the dose, radiation may damage the cell, where it delivers extra

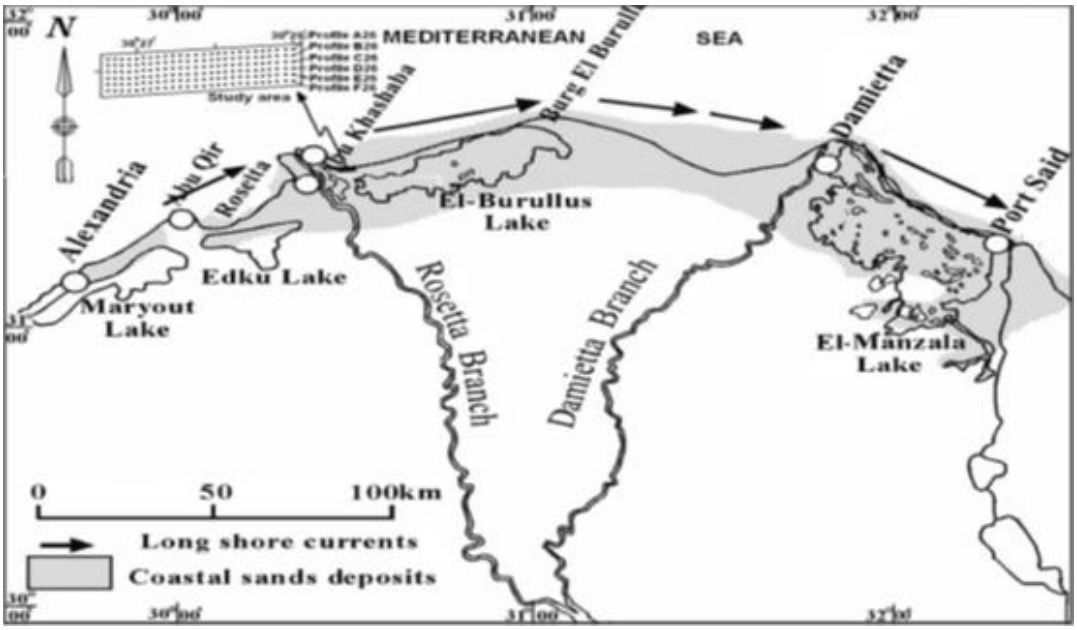

Figure 1. Map of Abu-Khashaba located at 5 Km east of Rosetta north Nile Delta.

energy which causes destroying parts of the cell as well as its function. Exposure to high levels of gamma radiation causes a number of harmful effects in man such as mutation and cancer of various types (Aziz Ahmed et al., 2014). This work aims to study the influences of relatively high levels of gamma radiation from radioactive black sand and its component. Concentration of naturally occurring radionuclides (^{226}Ra, ^{232}Th and ^{40}K) in the black sand and its component from Abu-Khasha beast of Rosetta in order to evaluate the radiation hazard indices and excess lifetime cancer risk (ELCR) for population due to naturally.

MATERIALS AND METHODS

Sampling and Sample Preparation

Ten samples from black sand and its components were taken from Abu-Khashaba. The samples dried in an oven at 110°C for 24 h to remove moisture from the samples. Then each sample was crushed and sieved through 200 mm mesh size. Weighed samples placed in polyethylene containers of 250 cm^3 volume. The bottles were completely sealed for one month in order to obtain the secular equilibrium between ^{226}Ra and its daughters (Hamby and Tynvbkov, 2002).

Measurements Technique

Activity measurements was used by system consists of ORTEC hyper pure germanium (HPGe) detector (ORTEC 572A) of sensitive volume 76.11 cm^3 was used. The energy resolution of HPGe detector is 1.9 keV at 1332.5 keV gammas -ray transition of 60Co with photo peak efficiency 30%.

The detection system calibrated using gamma standard source including Co-60 (1172.5 and 1332.5) keV, Am-241 (59.5 keV) and Ra-226 (186.2, 242.2, 295.2, 351.9 and 609.3) keV Figure 2. The efficiency curve of the (HPGe) detector in the energy range from 186 to 2450 keV was obtained through two stages. In the first "stage" the relative efficiency curve of the detector was performed using 226Ra point source. In the second stage, the average relative curve of the detector was normalized to an absolute potassium chloride has been used (El-Tahawy et al., 1992) as shown in Figure 3. To reduce gamma-ray background, a cylindrical lead shield with a fixed bottom and a movable cover shielded the detector. The lead shield contained two inner concentric cylinders of copper and cadmium to prevent interference X-ray by lead. In order to determine the background distribution in the environment around the detector, an empty bottle was counted in the same manner and in the same geometry as the samples.

The background spectra were used to correct the areas of gamma rays of measured isotopes. Periodical measurements were made to check the background level of radioactivity in the laboratory. Weekly γ-ray measurements of the reference material were done to calibrate the system. The counting time for each sample was 24 h. The gamma transmissions 351.9, 295.1 keV used for activity calculations of (^{214}Pb) and (609.3, 768.4, 934.6, 1120.3, 1729.9 and 1764.5 keV) for (^{214}Bi) were considered for identifying ^{226}Ra. The γ-ray photo of 338.4, 463.1, 968.1, 911 keV) used for activity calculations of

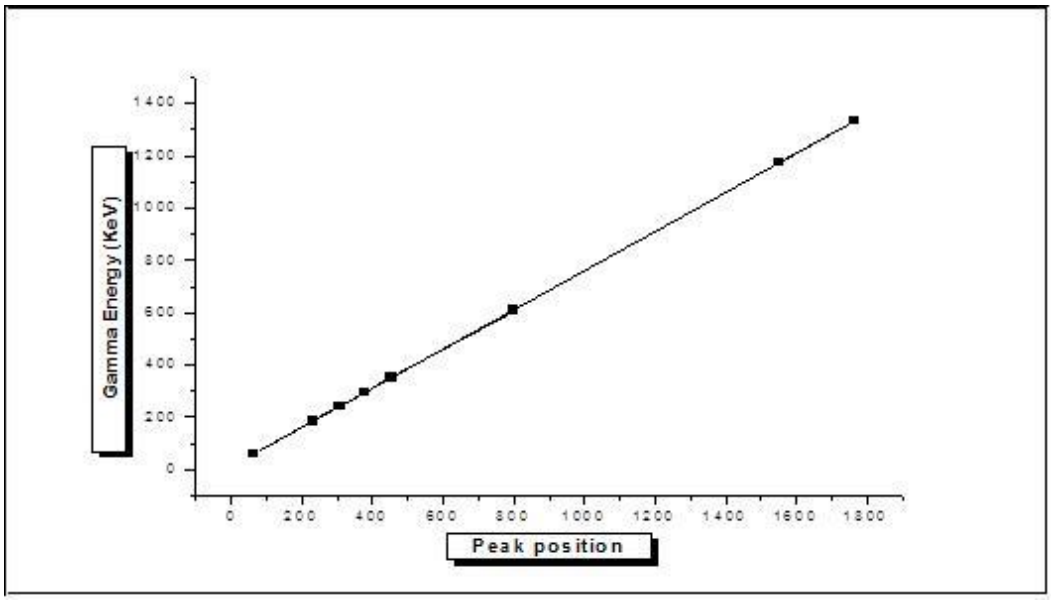

Figure 2. Energy channel calibration curve.

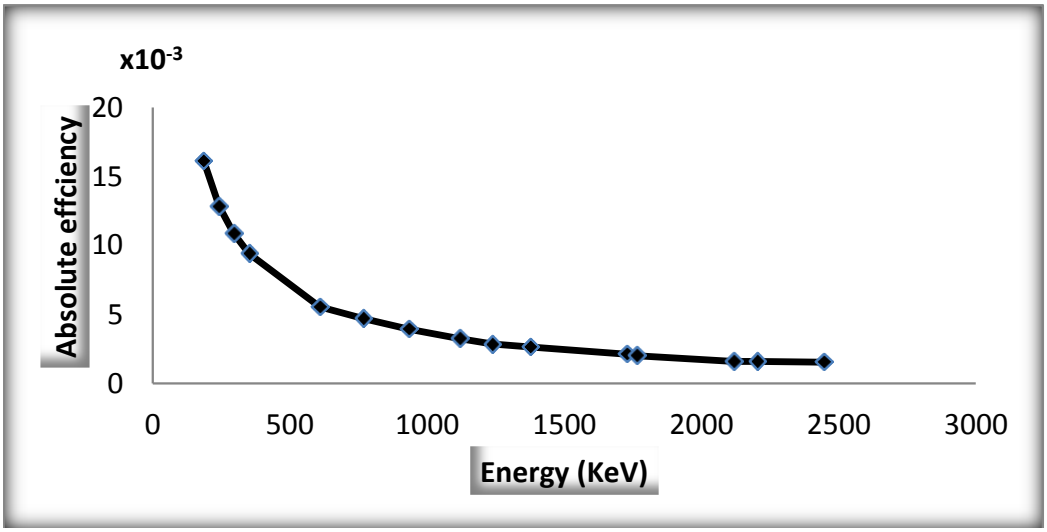

Figure 3. Absolute efficiency curve of Ra-^{226} and its daughter gamma energy lines.

(^{228}Ac), (583.1, 860.1 keV) for activity calculations of (^{208}Ti) and (727.3, 1620.7 keV) for activity calculations of (^{212}Bi) were used to identify ^{232}Th in the samples (Akhtar et al., 2005) (IAEA, 1989) ^{40}K concentration was measured from its (1460 KeV) gamma line.

RESULTS AND DISCUSSION

Activity Concentration of ^{226}ra, ^{232}Th And ^{40}K

The activity concentration of ^{226}Ra, ^{232}Th and ^{40}K in the black sand varies from 802.4 to 920, 2112.1 to 2211.4 and 188.9 to 199.1 Bq.Kg^{-1} with the average values of 852.27, 2171.73 and 194 Bq.Kg^{-1}, respectively as shown in Table 1. The activity concentration of ^{226}Ra and ^{232}Th are higher than the world's averages which are 32, 45 while the concentration of ^{40}K is lower than the world's averages which is 412 (UNSCEAR, 2000). In monazite the activity concentration of ^{226}Ra, ^{232}Th and ^{40}K vary from 20745 to 21018,146372.3 to 157866.3 and 7966.5 to 8357.2 Bq.Kg^{-1} with the average values of 20931.6, 153223.7 and 8148.8 Bq.Kg^{-1}, respectively as shown in Table 1. In monazite these values are higher than the world's averages which are 10000 to 50000 Bq.Kg^{-1} for radionuclides in the ^{226}Ra series and 5000 to 35000

Table 1. Activity concentration of ^{226}Ra, ^{232}Th, ^{40}K for black sand and its component in (Bq/Kg).

Sample No.		Minimum	Maximum	Average
B.S.	^{226}Ra Bq.Kg^{-1}	802.4	920.0	852.3
	^{232}Th Bq.Kg^{-1}	2112.1	2211.4	2171.7
	^{40}K Bq.Kg^{-1}	188.9	199.1	194.0
Mon.	^{226}Ra Bq.Kg^{-1}	20745	21018	20931.6
	^{232}Th Bq.Kg^{-1}	146372.3	157866.3	153223.7
	^{40}K Bq.Kg^{-1}	7966.5	8357.2	8148.9
Zr.	^{226}Ra Bq.Kg^{-1}	3435.4	4029.3	3749.5
	^{232}Th Bq.Kg^{-1}	5339.5	5769.3	5619.9
	^{40}K Bq.Kg^{-1}	323.9	390.1	349.8
Mag.	^{226}Ra Bq.Kg^{-1}	6.16	7.86	6.80
	^{232}Th Bq.Kg^{-1}	6.23	7.59	7.12
	^{40}K Bq.Kg^{-1}	12.81	18.27	15.52
Ilm	^{226}Ra Bq.Kg^{-1}	9.14	9.94	9.24
	^{232}Th Bq.Kg^{-1}	7.97	9.70	8.94
	^{40}K Bq.Kg^{-1}	6.55	10.29	8.33

Bq.Kg^{-1} for radionuclides in the ^{232}Th series and 412 for ^{40}K (UNSCEAR, 2008). In magnetite the activity concentration of ^{226}Ra, ^{232}Th and ^{40}K vary from 6.16 to 7.86, 6.23 to 7.59 and 12.81 to 18.27 Bq.Kg^{-1} with the average values of 6.80, 7.12 and 15.52 Bq.Kg^{-1}, respectively as shown in Table 1. The activity concentration of ^{226}Ra, ^{232}Th and ^{40}K are lower than the world's averages which are 32, 45 and 412 (UNSCEAR, 2000). In Zircon the activity concentration of ^{226}Ra, ^{232}Th and ^{40}K vary from 3435.4 to 4029.3, 5339.5 to 5769.3 and 323.9 to 390.1 Bq.Kg^{-1} with the average values of 3749.55, 5619.95 and 349.8 Bq.Kg^{-1}, respectively as shown in Table 1.

In zircon these values are higher than the world's averages which are 7000 BqKg-1for radionuclides in the 226 Ra series and 300 Bq.Kg-1 for radionuclides in the ^{232}Th series (UNSCEAR, 2008); while the concentration of ^{40}K is lower than the world's averages which are 412. In ilmenite the activity concentration of ^{226}Ra, ^{232}Th and ^{40}K vary from 9.14 to 9.94, 7.97 to 9.70 and 6.55 to 10.29 Bq.Kg^{-1} with the average values of 9.24, 8.94 and 8.33 Bq.Kg^{-1}, respectively as shown in Table 1. The activity concentration of ^{226}Ra and ^{232}Th, ^{40}K is lower than the world's averages which are 32, 45 and 412 (UNSCEAR, 2000).

Radium Equivalent Activity (Ra_{eq})

To represent the activity level of ^{226} Ra, ^{232} Th and ^{40} K by a single quantity, a common radiological index has been introduced. This index called radium equivalent activity (Ra_{eq}). It can be calculated from the following relation (Al-Trabulsy et al., 2011).

$$Ra_{eq} = A_{\mathrm{Ra}} + 1.43\mathrm{A_{Th}} + 0.077A_K$$

Where A_{Ra} A_{Th} and A_K are the activity concentration of ^{226}Ra, ^{232}Th and ^{40}K, respectively expressed in Bq/Kg. The recommended value is equal 370 Bq.Kg^{-1} (UNSCEAR, 2000). Results show that all values of radium equivalent in black sand, monazite and zircon samples at Abu-Khashaba are higher than the recommended maximum value 370 Bq.Kg^{-1} (UNSCEAR, 2000). In magnetite and ilmenite samples in this region is lower than this limitas shown in Table 2.

Outdoor External Dose (D_{out})

The (D_{out}) at 1m above the ground surface is assessed from the gamma- radiation originating from ^{226}Ra, ^{232}Th and ^{40}K supposed to be equally distributed in ground. For the conversion of gamma-radiation originating from ^{226}Ra, ^{232}Th and ^{40}K, the factors of 0.436 nGy h^{-1}per Bq^{-1}kg^{-1} for ^{226}Ra, 0.599 nGy h^{-1}perBq^{-1}kg^{-1} for^{232}Th and 0.0417 nGy h^{-1}perBq^{-1}kg^{-1}for ^{40}K were used for calculating the (D_{out}). The conversion factors have been taken as means of those reported by (Quindos et al., 2004). The (D_{out}) was calculated using the following equation by (Huy and Luyen, 2006)

$$\mathrm{D_{out}} = 0.436\mathrm{A_{Ra}} + 0.599\mathrm{A_{Th}} + 0.0417\mathrm{A_k}\ (\mathrm{nGyh^{-1}})$$

The outdoor external doses (D_{out}) due to the presence of ^{226}Ra, ^{232}Th and ^{40}K in the black sand samples were calculated which range from 1661.7 to1701.4 nGy h^{-1} with an average value of 1680.5 nGy h^{-1} as shown in Table 2. The outdoor external doses (D_{out}) in monazite samples range from 97168.8 to 103771.6 nGy h^{-1} with an average value of 101247 nGy h^{-1} and the outdoor external doses (D_{out}) in zircon samples were calculated which range from 4878.6 to 5205.1 nGy h^{-1} with an average value of 5015.7 nGy h$^{-1.}$ These averages are higher than the worlds' average of 57 nGy h^{-1}. While the outdoor external doses (D_{out}) in magnetite and ilmenite samples were calculated which range from 6.99 to 8.44 nGy h^{-1} with an average

Table 2. The values of radium equivalent (Ra_{eq}) in $Bq.Kg^{-1}$, outdoor external dose (D_{out}), indoor external dose (D_{in}) in $nGyh^{-1}$, annual outdoor effective dose (E_{out}), annual indoor effective dose (E_{in}) in $mSvy^{-1}$ and total annual effective dose ($E_{out}+E_{in}$) in $mSvy^{-1}$for black sand and its component.

Sample No.		Minimum	Maximum	Average
B.S.	Ra_{eq} ($Bq.Kg^{-1}$)	3929.9	4022.9	3972.8
	D_{out} ($nGyh^{-1}$)	1661.7	1701.4	1680.5
	D_{in} ($nGyh^{-1}$)	3148.1	3226.3	3188.7
	($mSvy^{-1}E_{out}$)	2037.2	2086.02	2060.3
	Ein ($mSvy^{-1}$)	15441.6	15825.2	15641.03
	E_{out}+Ein ($mSvy^{-1}$)	17478.9	17911.2	17701.4
Mon.	Ra_{eq} ($Bq.Kg^{-1}$)	230929.5	247319.5	240669
	D_{out} ($nGyh^{-1}$)	97168.8	103771.6	101247
	D_{in} ($nGyh^{-1}$)	180980.7	193581.8	188464.7
	($mSvy^{-1}E_{out}$)	119129	127545.5	124128.8
	Ein ($mSvy^{-1}$)	887710.5	949519	924419.4
	E_{out}+Ein ($mSvy^{-1}$)	1006839.5	1077064.5	1048548.3
Zr	Ra_{eq} ($Bq.Kg^{-1}$)	11482.6	12252.7	11813
	D_{out} ($nGyh^{-1}$)	4878.6	5205.1	5015.7
	D_{in} ($nGyh^{-1}$)	9416.4	10041.1	9659.8
	($mSvy^{-1}E_{out)}$	5981.2	6381.4	6149.3
	Ein ($mSvy^{-1}$)	46187.7	49252	47381.7
	E_{out}+Ein ($mSvy^{-1}$)	52168.9	55633.5	53531
Mag.	Ra_{eq} ($Bq.Kg^{-1}$)	16.12	19.55	18.16
	D_{out} ($nGyh^{-1}$)	6.99	8.44	7.87
	D_{in} ($nGyh^{-1}$)	13.65	16.50	15.36
	($mSvy^{-1}E_{out}$)	8.57	10.37	9.65
	Ein ($mSvy^{-1}$)	66.95	80.97	75.34
	E_{out}+Ein ($mSvy^{-1}$)	75.53	91.34	84.99
IIm	Ra_{eq} ($Bq.Kg^{-1}$)	22.17	24.49	22.67
	D_{out} ($nGyh^{-1}$)	9.28	10.51	9.73
	D_{in} ($nGyh^{-1}$)	18.17	20.54	18.93
	($mSvy^{-1}E_{out}$)	11.38	12.89	11.93
	Ein ($mSvy^{-1}$)	89.17	100.74	93.28
	E_{out}+Ein ($mSvy^{-1}$)	100.56	113.64	105.22

value of 7.87nGy h^{-1} and from 9.28 to 10.51 nGy h^{-1} with an average value of 9.73 nGy h^{-1}. These averages are lower than the worlds' average of 57 nGy h^{-1}(UNSCEAR, 2000).

Indoor External Dose (D_{in})

The gamma -ray dose (D_{in}) imparted by ^{226}Ra, ^{232}Th and ^{40}K present in the indoor is calculated by converting the absorbed dose rate into effective dose using the three conversion factors, 0.92 nGy h^{-1}per $Bqkg^{-1}$ for ^{226}Ra, 1.1 nGy h^{-1}per $Bqkg^{-1}$ for ^{232}Th and 0.081 nGy h^{-1}per Bq kg^{-1} for ^{40}K. By utilizing the above mentioned conversion factors following equation was used to calculate the (D_{in}) (Huy and Luyen, 2006)

$$D_{out} = 0.436A_{Ra} + 0.599A_{Th} + 0.0417A_{k}\ (nGyh^{-1})$$

The indoor external doses (D_{in}) due to the presence of ^{226}Ra, ^{232}Th and ^{40}K present in the indoor (Table 2). In black sand samples were calculated which range from 3148.1 to 3226.3 nGy h^{-1} with an average value of 3188.7 nGy h^{-1}. The indoor external doses (D_{in}) in monazite samples were calculated which range from 180980.7 to193581.8nGy h^{-1} with an average value of 188464.7

nGy h^{-1} and the indoor external doses (D_{in}) in zircon samples were calculated which range from 9416.4 to 10041.1nGy h^{-1} with an average value of 9659.8 nGy h^{-1}. These averages are higher than the worlds' average of75 nGy h^{-1} (UNSCEAR, 2008). While the indoor external doses (D_{in}) in magnetite and ilmenite samples were calculated which range from 13.65 to16.5 nGy h^{-1} with an average value of 15.36 nGy h^{-1} and from 18.17 to 20.54 nGy h^{-1} with an average value of 18.93 nGy h^{-1}. These averages are lower than the worlds' average of 75 nGy h^{-1}(UNSCEAR, 2008).

Annual Effective Dose

The annual effective dose is of two types, the annual outdoor effective dose (E_{out}) and annual indoor effective dose (E_{in}).

Annual Outdoor Effective Dose (Eout)

The (E_{out}) is estimated from the outdoor external dose rate (D_{out}), time of stay in the outdoor or occupancy factor (OF = 20% of 8760 h in a year) and the conversion factor (CF = 0.7 Sv Gy-1) to convert the absorbed dose in air to effective dose. During the present study, the (E_{out}) was calculated using the following equations from (UNSCEAR, 2008)

$$E_{out} = D_{out}\,(nGyh^{-1}) \times 0.2 \times 8760\ h \times 0.7\ (Sv\ Gy^{-}$$

$$E_{out} = D_{out} \times 1.226\mu SV$$

In black sand samples the values of E_{out} were calculated which range from 2037.2 to 2086 mSvy-1 with an average value of 2060.3 $mSvy^{-1}$, in monazite samples ranges from 1191129 to127545.5 $mSvy^{-1}$ with an average value of 188464.7 $mSvy^{-1}$. In zircon samples ranges from 5981.2 to 6381.4 $mSvy^{-1}$ with an average value of 6149.3 $mSvy^{-1}$. These averages are higher than the worlds' average of 0.07 mSvy1 (UNSCEAR, 2008). While annual outdoor effective dose (E_{out}) in magnetite and ilmenite samples were calculated which range from 8.57 to 9.45 $mSvy^{-1}$ with an average value of 9.65 $mSvy^{-1}$ and from 11.38 to 12.89 $mSvy^{-1}$ with an average value of 11.93 $mSvy^{-1}$ respectively. These averages are higher than the worlds' average of 0.07 $mSvy^{-1}$.

Annual Indoor Effective Dose (E_{in})

The (E_{in}) is the dose that a person receives in the indoor environment. The (E_{in}) depends on the indoor external dose (D_{in}) that is the gamma-ray dose within the buildings, dose conversion factor (CF that is 0.7 $SvGy^{-1}$) and the time of stay in the indoor (OF that is 80% of the 8760 h in a year). The annual indoor effective dose (E_{in}) was calculated as per equations given below (Taskin et al., 2009).

$$E_{in} = D_{in}\,(nGyh^{-1}) \times 0.8 \times\ 8760\ h \times 0.7\ (SV\ Gy^{-1})$$

$$E_{in} = D_{in} \times 4.905\mu SV$$

In black sand samples the values of E_{in} were calculated which range from 15541.6 to 15825.2 $mSvy^{-1}$ with an average value of 15641 $mSvy^{-1}$ (Table 2), in monazite samples ranges from 887710.5 to 949519 mSv y^{-1} with an average value of 924419.4 mSv y^{-1}. In zircon samples ranges from 46187.6 to 49252 mSv y_{-1} with an average value of 47381.7$mSvy^{-1}$. These averages are higher than the worlds' average of 0.41$mSvy^{1}$ (UNSCEAR, 2000). While annual indoor effective dose (E_{in}) in magnetite and ilmenite samples were calculated which range from 66.95 to 80.97 $mSvy^{-1}$ with an average value of 75.34 mSv y^{-1} and from 89.17 to 100.7 $mSvy^{-1}$ with an average value of 93.28m Svy^{-1}, respectively. These averages are higher than the worlds' average of 0.41mSvy-1. The total annual effective dose (E_{out} +E_{in}) in black sand samples ranges from 17478.9 to 17911.2 $mSvy^{-1}$ with an average 17701.4 $mSvy^{-1}$. In monazite samples ranges from 1006839.5 to 1077064.5 $mSvy^{-1}$ with average 1048548.3 $mSvy^{-1}$. In zircon samples ranges from 52168.9 to 55633.5 $mSvy^{-1}$ with average 53531 $mSvy^{-1}$. In magnetite and ilmenite samples ranges from 75.53 to 91.34 $mSvy^{-1}$ and from 100.56 to 113.64 $mSvy^{-1}$ with averages 84.99 and 105.22 $mSvy^{-1}$. These values are higher than the criterion limit of 0.48 mSv y^{-1}(UNSCEAR, 2000).

Excess Lifetime Cancer Risk (ELCR)

Lifetime cancer risk (ELCR) was calculated using the following equation

$$ELCR\ (outdoor) = E_{out} \times LE \times RF$$

$$ELCR\ (indoor) = E_{in} \times LE \times RF$$

Where (E_{out}) and (E_{in}) are the annual effective doses, LE life expectancy (66 years) and RF (Sv-1) is fatal risk factor perSievert, which is 0.05 (ICRP 60, 1990). As shown in Table 3, for black sand samples, ranges from 5.48x10-^{3} to 5.61x10-^{3} with an average value of 5.54x10-^{3}, in monazite samples ranges from 320x10-^{3} to 343.3 x10-^{3} with an average value of 334.1x10-^{3} and in zircon samples ranges from 16.09x10-^{3} to17.17x10-^{3} with an average value of 16.55. While in magnetite and ilmenite samples were calculated which range from 0.023 x10-^{3} to 0.027x10-^{3} with an average value of 0.025x10-^{3} and from 0.030 to0.034x10-^{3} with an average value of 0.032x10-^{3}. In black sand samples, ranges from 50.95x10-^{3} to 52.22x10-^{3} with an average value of 51.61x1-0-^{3}, in monazite samples ranges from 2929.4x10-^{3} to 3133.4 x10-^{3} with an average value of 3059.9x10-^{3}.
In zircon samples ranges from 152.4x10-^{3} to162.5x10-^{3}

Table 3. The values of outdoor excess lifetime cancer risk (ELCR) $x10^{-3}_{(out)}$ and indoor excess lifetime cancer risk (ELCR) x $10^{-3}_{(in)}$ and total excess lifetime cancer risk (ELCR) x $10^{-3}_{(Total)}$ for black sand and its component.

Sample No		Minimum	Maximum	Average
B.S.	$(ELCR)x10^{-3}_{(out)}$	5.48	5.61	5.54
	$(ELCR)x10^{-3}_{(in)}$	50.951	52.22	51.61
	$(ELCR)x10^{-3}_{(Total)}$	56.44	57.831	57.16
Mon.	$(ELCR)x10^{-3}_{(out)}$	320.65	343.31	334.11
	$(ELCR)x10^{-3}_{(in)}$	2929.4	3133.4	3059.98
	$(ELCR)x10^{-3}_{(Total)}$	3250.1	3476.7	3394.1
Zr.	$(ELCR)x10^{-3}_{(out)}$	16.09	17.17	16.55
	$(ELCR)x10^{-3}_{(in)}$	152.41	162.53	156.35
	$(ELCR)x10^{-3}_{(Total)}$	168.51	179.70	172.90
Mag.	$(ELCR)x10^{-3}_{(out)}$	0.0231	0.0279	0.0259
	$(ELCR)x10^{-3}_{(in)}$	0.221	0.267	0.248
	$(ELCR)x10^{-3}_{(Total)}$	0.243	0.295	0.274
Ilm	$(ELCR)x10^{-3}_{(out)}$	0.0306	0.0347	0.032
	$(ELCR)x10^{-3}_{(in)}$	0.294	0.332	0.307
	$(ELCR)x10^{-3}_{(Total)}$	0.324	0.367	0.339

with an average value of 156.3, while in magnetite and ilmenite samples were calculated which range from 0.221 $x10^{-3}$ to 0.267$x10^{-3}$ with an average value of 0.248$x10^{-3}$ and from 0.294 to 0.332$x10^{-3}$ with an average value of 0.307$x10^{-3}$. The total (ELCR) blacks, monazite and zircon samples range from (56.44$x10^{-3}$, 3250.1$x10^{-3}$ and 186.1$x10^{-3}$) to (57.83$x10^{-3}$, 3476.7$x10^{-3}$ and 179.7$x10^{-3}$) with average (57.1$x10^{-3}$, 3394.1$x10^{-3}$ and 172.9) is higher than the worlds' average of 1.45$x10^{-3}$ (12). While in magnetite and ilmenite samples range from (0.243$x10^{-3}$ and 0.324$x10^{-3}$) to (0.295 $x10^{-3}$ and 0.367$x10^{-3}$) with average 0.274 $x10^{-3}$ and 0.339x10-3is higher than the worlds' average of 1.45$x10^{-3}$ (UNSCEAR, 2008) (Taskin et al., 2009).

CONCLUSION

Results that Egyptian black sand and its components from the Rosetta area (Abu -Khashaba) are considered as high radioactive background area. Therefore, we recommend that the workers who separate components from black sand must be very careful and take all possible precautions because they receive higher total effective doses due to inhalation of dust containing natural radioactive. Long -term exposure to radiation assumed to have some risk of causing cancer. This means that all people have a risk of getting cancer. The (ELCR) factor assessed during present study on the basis of outdoor (E_{out}) and indoor (E_{in}) annual dose was found to be higher than the world's average of 1.45x 10^{-3} in black sand, monazite and zircon samples, while in magnitudes and limonite are lower than the world's average.

REFERENCES

Abdel-Aal M, Abdel-Karim, Abdel-Hay M. El-Shafey (2012). Mineralogy and chemical distribution studyplacer cassiterite and some associated new recorded minerals, east Rosetta, Egypt. Arab J. Geosci., 5: 807-816.

Abdel Fattah MF (2008). Evaluation, beneficiation and mineralogy of the Egyptian beach leucoxene in Abu Khashaba area, east Rosetta, Egypt, M.Sc. Thesis, Fac. Sci., Zagazig University, Egypt.

Oxford Instruments Analytical System (1994). A certificate of standard sources, USA.

Akhtar N, Tufail M, Ashraf M, Iqbal MM (2005). Measurements of environmental radioactivity for estimation of radiation exposure from saline soil of Lahore, Pakistan. Radiation Measurements, 39: 11-14.

Al-Trabulsy HA, Khater AEM, Habbani FI (2011). Radioactivity levels and radiological hazard indices at the Saudi coastline of the Gulf of Aqaba. Radiation Physics and Chemistry, 343-348.

Aziz AQ, Shahina T, Kamal UD, Shahid M, Chiara C, Abdul W (2014). Evaluation of excessive lifetime cancer risk due to natural radioactivity in the rivers sediments of Northern Pakistan. J. Radiat. Res. Appl. Sci., 7: 438 -447.

Cetiner MA, Gündüz H, Ilgar A (2011). High background radiation areas at Canakkale in Turkey. Radiat. Phys. Chem. 80: 704-709.

El-Tahawy MS, Farouk MA, Hammad FH, Ibrahiem NM (1992). Natural potassium as a standard source for the absolute efficiency calibration of Ge detector. Nucl. Sci.J. 29: 361

Hamby DM, Tynvbekov AK, (2002). Uranium, Thorium and potassium in soils Monitoring and assessment. Environ. Monitor. Asses., 73(2): 101-108

Huy NQ, Luyen TV (2006). Study on external exposure poses from terrestrial radioactivity in Southern Vietnam. J. Radiat. Protect. Dosimetry, 118(3): 331-336.

ICRP 60 (1990). Recommendations of the International Commission on Radiological Protection. Vol. 2, No. 1-3, Publication 60.

IAEA (1989). Technical Report. Construction and use of calibration facilities for radiometric field equipment. 309.

Margineanu RM, Ana-Maria BA, Aurelia C, Claudia-Mariana G, Costea C, Delia D, Adriana I, Duliu OG (2014). Radiometric, SEM and XRD investigation of the Chituc black sands, southern Danube Delta, Romania. J. Environ. Radioact. 138, 72-79.

Moustafa MI (2010). Chemistry and origin of enigmatic monazite and chevkinite/perrierite in the Egyptian black beach sand. Resour. Geol.,

60(3): 271-287.
UNSCEAR Report (2000). Exposure from natural radiation sources. New York.
UNSCEAR Report (2008). Sources and effects of ionizing Radiation. United Nations, NewYork, (1).
Quindos LS, Fernandez PL, Rodenas C, Gomez AJ, Arteche J (2004). Conversion factors for external gamma dose derived from natural radionuclides in soils. J. Environ. Radioact.,71:139-145.
Taskin H, Karavus M, Ay P, Topuzoglu A, Hindiroglu S, Karahan G (2009). Radionuclide concentrations in soil and life time cancer risk due to the gamma radioactivity in Kirklareli., Turkey. J. Environ. Radioact., 100: 49- 53.