Al Azhar Bulletin of Science Vol. 28, No. 1 (June) 2017, : pp. 1-13

INFERRED RESOURCES AND ENVIRONMENTAL IMPACT OF THE TOP METER BLACK SANDS IN THE COASTAL AREA OF MEDITERRANEAN SEA BETWEEN DAMIETTA SEA PORT AND GAMASA CITY, EGYPT.

Ragab, H.[1], El Afandy, A.H[2]., Khalil, M.[1] and Yousry, A.[1]

1- Faculty of Science, Demietta University,
2- Nuclear Materials Authority, Cairo Egypt.

ABSTRACT

The study area of the Mediterranean Sea Coast was covered by seawater containing detritus sediments transported by White Nile, Blue Nile and Atbara Rivers composed from amphibolite; granulites grade metamorphic rocks of the central African province and alkali basalts of Ethiopian high lands. The study area exposed to river environment, because of clay and organic matter contents in the raw sands. The apparent specific gravity of the top meter in the studied sediments ranged from 1.36 to 1.71 gm. /cm^3 with an average1.533625 gm. /cm^3. These sediments contain heavy economic minerals such as magnetite, ilmenite, leucoxene, rutile, monazite, zircon, garnet, cassiterite, xenotime, thorite, thorianite, gold, copper, zinc and lead, and light minerals such as quartz, feldspars, amphiboles, pyroxenes, mica,…. . The heavy minerals have the highest content in the middle area and the lowest content towards west in the study area.

The radiometric measurements of the study area are important to determine the human radiation exposure and detect the radiation doses by converting the concentrations of Radium (ppm), equivalent Uranium (ppm), equivalent Thorium (ppm) and Potassium percent into absorbed dose and effective dose rates. The calculated values of absorbed dose and effective dose rates were found below the world average values according to (UNSCEAR, 2000). Therefore, there are no side effects to the human beings or the other habitants found near the study area and it is recommended using the beach sands in this area for building constructions and engineering with taking into consideration increasing the ventilations in these buildings to reduce radon emissions if present.

INTRODUCTION

The Egyptian Mediterranean sea coast extends from El-Sallum on the western border to Rafah on the eastern border between longitudes 25º 12' and 34º 10' E. This part of the Mediterranean Sea coast reaches about 900 km in length. Hilmy (1951) divided it into three sectors: the western part to the west of Rosetta, the middle part between Rosetta and Damietta outpourings and the eastern part from the east of Damietta depending mainly on the general difference in topography and lithology. He concluded that the middle and the eastern parts have interesting black sand reserves.

The beach placer deposits along the Egyptian Mediterranean Sea coast exhibit most of the igneous and metamorphic heavy mineral species. The distribution and concentration of these heavy minerals along the northern coast of Egypt is a function of hydrodynamic processes (currents and waves) as well as the proximity from the present outpouring of the River Nile distributaries Rosetta and Damietta branches or the old extinct ones. Black sands deposits at the Mediterranean Sea coast at the north east of Nile Delta attracted the interest of geologists, physicists and other scientists for the last decades. Most of these studies dealt with the surface sediments, the reserves of the black sands and the radiometry of heavy minerals. Mainly, these studies aimed at examination of feasibility of using these deposits as raw materials in mining and at investigation of radiological effects on man and environment of natural radioactivity at these locations.

The mineralogy of the Egyptian black sand was previously studied by many researchers (e.g. El-Hennawi 1964; Kamel 1964; Khairy et al. 1964; Boctor 1966; Hammoud 1966; Zaghloul and Kamel 1966; Anwar and El-Bouseily 1970; Mikhail 1971; Basta 1972; Dabbour 1973; Kamel et al. 1973; Hammoud 1975; Dabbour 1980; Nofal et al. 1980; Wassef and Mikhail 1981; El-Shazly and wassef 1984; Mohamed 1987; Dabbour 1994,1997; Dewedar 1997; Moustafa 1999; El-Nahas 2002; Barakat 2004 &2015; Abu Halawa 2005; Abdel Fattah 2008; Abu Diab 2008;, Moustafa 2007, 2009, 2010; and El-Shafey 2011).

An extensive evaluation attempts of the total economic minerals or with one or more of the six heavy economic minerals were done for the Egyptian black sands. by different authorities and organizations (e.g. El-Shazly 1965;, Dabbour 1973,1980; Hammoud 1985; Robertson Research International (RRI) limited company 1985; Dabbour 1994; El-Hadary 1998; Abdel-Fattah 2008; and El-Shafey 2011).

METHODS

Location of the study area

The study area is located in the northeast of the Nile delta on the coast of the Mediterranean west of Damietta branch. It is bounding by the Mediterranean Sea shoreline to the north, Damietta Sea Port to the east, Gamasa city to the west and international high way to the south. This area is situating between longitudes 31°35'25.26", 31°44'12.66"E, and Latitudes 31°26'37.62", 31°28'41.88"N, figure (1).

Geomorphology of the study area

The present study concerns with the Quaternary - Holocene sediments in the area located on the shoreline between Gamasa and western jetty of the Damietta Harbor. These sediments represent the upper most exposed sub aerial deltaic unit in the sedimentary sequence of the Nile Delta regions. Abdel – Wahab (2002) classified the Holocene sediments of the Smisthonian boreholes according to Chamley (1990) figures (2, 3).

Sampling of the study area

By using a sampler holder, thirty-two samples were collected from the study area depending on the moisture of the sand and its ability to hold on the entire sampler wall where, the sampler goes vertically through the wetted sediments for one meter and then carefully pulled out and perpendicular in plastic bags. The collected samples distributed along four profiles nearly perpendicular to the shoreline and eight profiles nearly pearlier to it. The approximately locations of the collected samples as shown in figure (4).

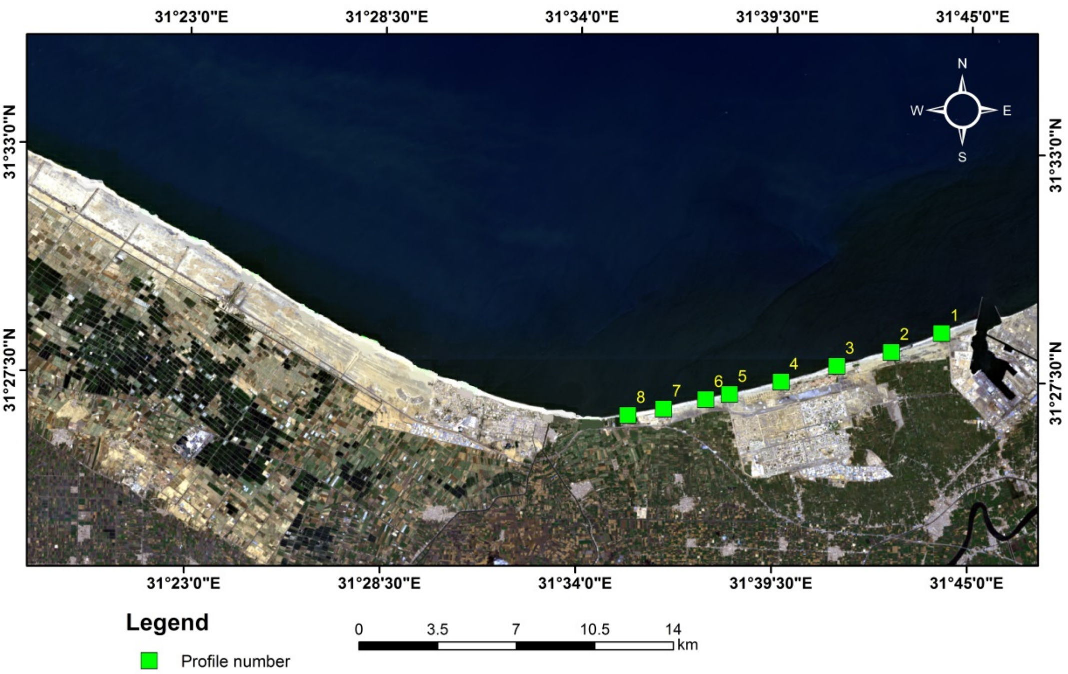


Figure (1): Showing the location of eight profiles nearly perpendicular to the shoreline.

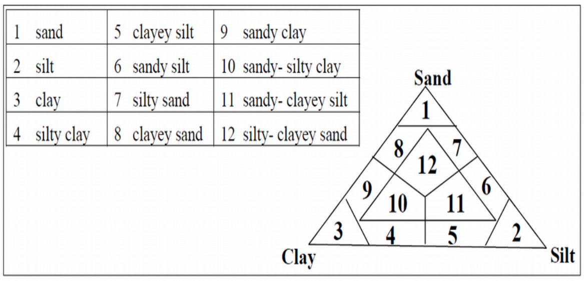


Figure (2): Soft sediments classification according to Chamley (1990).

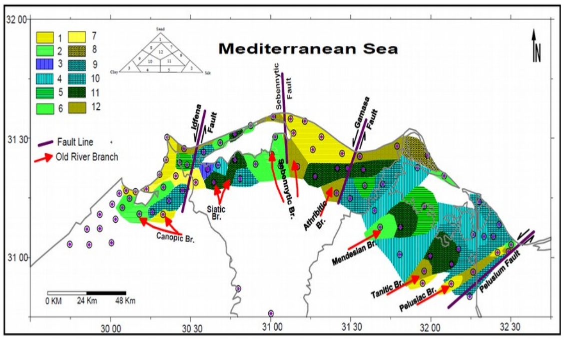


Figure (3): Holocene lithofacies map of the lower delta plain (after Abdel Wahab, 2002).

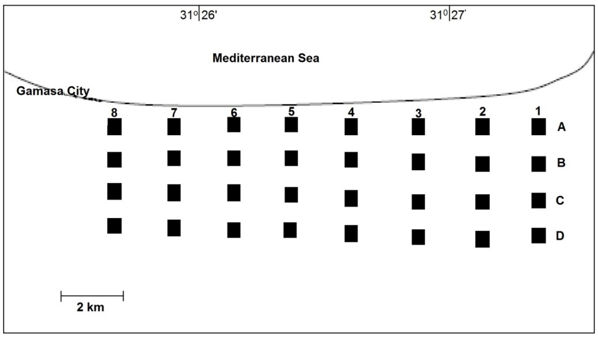


Figure (4): Showing the approximately locations of the collected samples.

Samples Preparations

The collected samples are composed of wet loose sediments. Firstly, each field sample subjected to sun drying and disaggregation process. Each dry field sample (weighing about 4-6 Kg.) split into two halves using John's Splitter. One of them kept in a bag as a reference sample and the other subjected to splitter again to obtain a representative sample weighing about 250 gram for the different analyses while the rest returned to the stored sample.

The second process is concerned with the removing clay, most of silt and the organic matter using the decantation method. Each sample stirred in water and left a suitable time for settling of the coarse particles. After the proper time the water with its suspension were decanted. The process repeated several times until the water becomes clear. After that, the organic matters removed by washing the samples with hot hydrogen peroxide (30%). It periodically stirred with a glass rod until the bubbles that initiated from the reaction disappeared. Finally, the samples washed several times by water and at the end by distilled water to remove any salt remaining. The prepared samples were dried and then weighted. The loss in weight represents the clay, fine silt and organic matters.

Then about 100 grams from each sample took by using rotary splitter and subjected to mechanical analysis. Each sample put on the top of a set of sieves. The aperture diameters for these sieves were 0.8 mm and 0.063 mm. The two sieves arranged in a descending order and the pan beneath them and the cover on the top sieve. The sieves with the sample on the top sieve were shacked for about 30 minutes. The retained material on each sieve and in the pan took and weighed and the frequency for each size was calculated. The intermediate size (0.063–0.8 mm) took as representative samples for mineralogical investigation.

Mineralogical Investigations

Representative samples (intermediate size) weighing about 70 grams put in a 1000 mm separating funnel. A sufficient quantity of Bromoform, enough to make the solid/liquid ratio suitable to give complete freedom for each particle to sink or float, added. The liquid with the sample stirred until the sample completely and homogeneously mixed with the liquid and left a suitable time to free separation. Then, the sample separated into float and sink layers with a clear liquid band between them. The float layer includes the light minerals with specific gravity less than 2.8gm/cm^3 and called light fraction, which mainly composed from quartz and feldspars. While the sink layer consists of the minerals have specific gravities larger than 2.8gm/cm^3 and called the heavy fraction, which constitute all the heavy minerals. After complete separation, the heavy fraction took on a filter paper in a precipitating funnel and the light fraction on another filter paper in another funnel. The two fractions left to precipitate all the Bromoform liquid. The Bromoform liquid again used, while each fraction washed with acetone, to leach the remaining Bromoform film which coating the particles and that exist in the pores between the different grains. After complete washing with acetone, each fraction was dried and weighed. The percentages of the heavy fractions were calculated and tabulated.

Magnetic Fractionation

Each of the heavy minerals exhibits its own magnetic susceptibility, which varies from ferromagnetic to non-magnetic minerals. The magnetic fractionation can help in the differentiation between some heavy minerals during the microscopic examination. Firstly, the magnetite removed by a suitable hand magnet then the magnetite free heavy parts magnetically fractionated. The magnetite free heavy parts for all the samples subjected to magnetic fractionation using the Isodynamic Frantz Separator. The selected separation electric currents are 0.2, 0.5, 1.0 and 1.5 ampere. These magnetic field strengths are chosen to separate the opaque particles into three sub-parts; ilmenite particles in the highly magnetic sub-part, altered ilmenite in the next magnetic sub-part and the rest opaque particles represent opaque rutile (Dabbour, 1995). In addition, the magnetic fractionation used to separate monazite from zircon particles into two different magnetic sub-parts.

Microscopic Investigation

A representative amount of minerals particles magnetite free (nearly about 0.1gm, about 700-1000 grains) took by quartering from each sample and sprinkled on a glass slide, to be fixed under the binocular stereomicroscope, and the weight percent of each mineral in the different samples was calculated and tabulated.

Apparent Density Calculation

Each field sample dried carefully and a representative sample (0.5-0.8 Kg) was taken by using John's splitter. Each representative sample was weighted and slowly poured inside a calibrated cylinder and compacted very well by shaking to be analogous to the field deposit. The sand weight divided by its volume, to calculate the apparent density.

Radiometric Analysis

The radioactivity of the Egyptian black sands was previously studied by many works (e.g. Zaghloul 1960;, Gindy 1961; Meshref 1962; Hammoud and Khazback 1973; Meleik et al. 1978. El-Shazly et al. 1981 a, b, c; Dabbour et al. 1988; Sadek et al. 1990; El-Gamal et al. 2004; Saleh et al. 2004; Ammar et al.2005; Naser et al. 2006; El-Gamal and Saleh 2012).

Sadiq and Agba, (2012) concluded that all common rock types and their related soils contain significant amounts of radioactive elements (radioelements). So, the thirty-two beach sediment samples collected from the study area were subjected to laboratory examinations in Nuclear Materials Authority to determine Radium (ppm), equivalent uranium (ppm), equivalent thorium (ppm) and potassium percent contents and converted into specific activity (Bq/kg) to determine absorbed dose (Gy) and effective dose (mSv/y), and the results tabulated.

RESULTS

Mineralogical Investigation

The heavy minerals percent in the collected samples of the study area are shown in table (1), and graphically represented in figures (5,6) respectively.Where profile (A) is the nearest to the shoreline and profile (1) is in the east side of the study area. From figures (5&6), the average percent of heavy minerals have in general the highest contents in the middle part of the studied area and decreases to the east and have the lowest contents in the west of the study area.

The average values of economic minerals

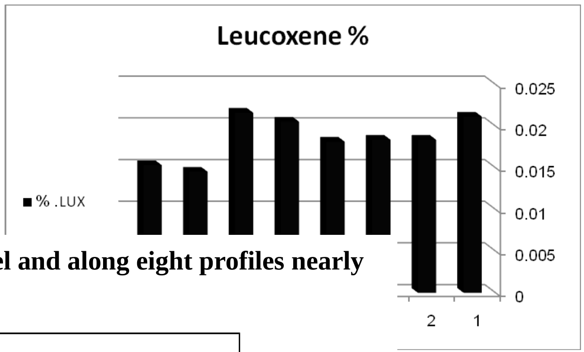
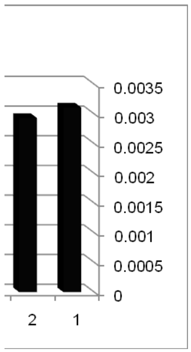
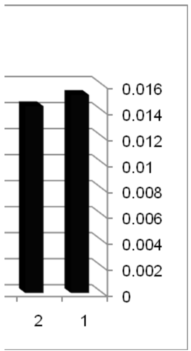


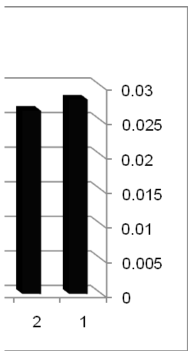
Table (1): The percentages of heavy minerals along four profiles parallel and along eight profiles nearly perpendicular to the shoreline of study area

Profile Number		Heavy minerals percent along four profiles parallel to the shoreline			
		A	B	C	D
nearly the shore	6	4.7643378	7.4172291	8.3375699	8.169944
	7	3.6356384	3.5699044	6.1836252	5.5875974
	8	3.9935147	4.5650569	4.7329432	5.9113777
Average		5.0138757	5.7019999	7.07945	7.5543029

Figure (7): Graphic representation showing the average values of economic minerals







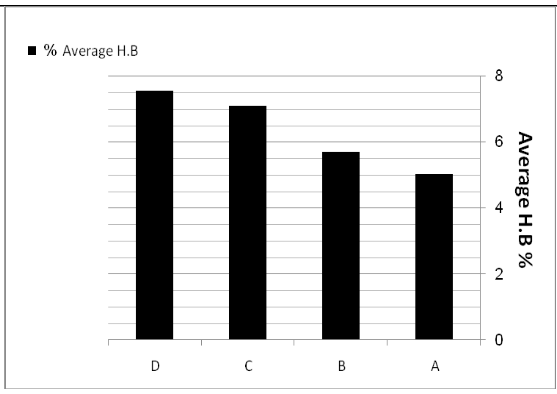


Figure (5): Histogram showing the average percentages of heavy minerals along four profiles parallel to the shoreline of study area.

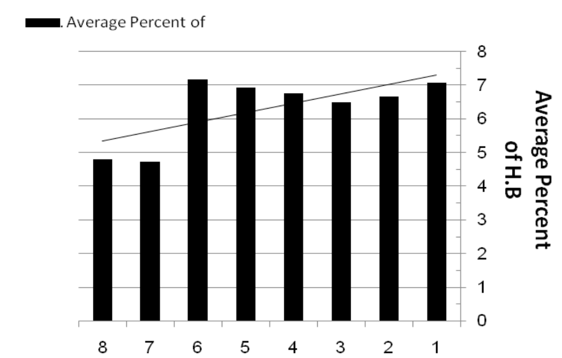


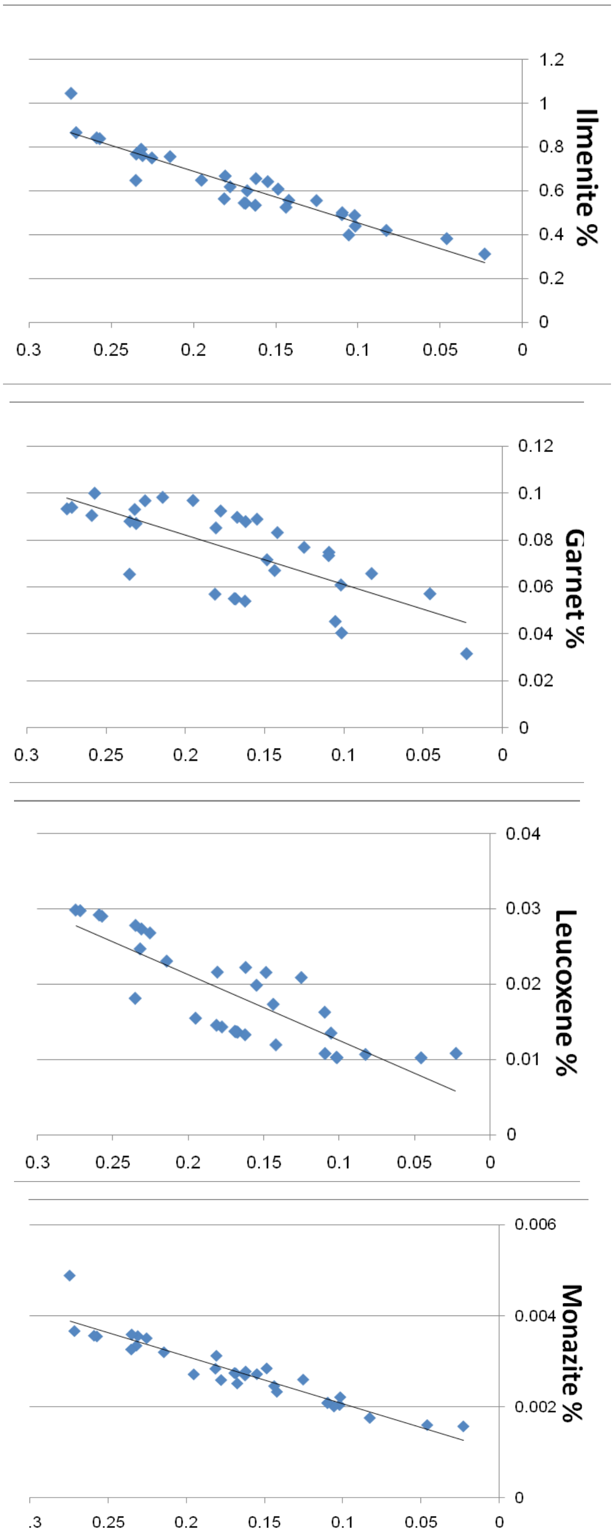
Figure (6): Histogram showing the average percentages of the heavy minerals along eight profiles nearly perpendicular to the shoreline.

Table (2): The average values of economic minerals content along eight profiles nearly perpendicular to the shoreline of study area.

Profiles No.	Mg.%	ILM. %	GAR. %	LUX. %	MON.%	RUT. %	ZR. %
1	0.209974	0.692353	0.087005	0.021136	0.003112	0.015224	0.028077
2	0.188481	0.651039	0.083274	0.018363	0.002934	0.014355	0.026473
3	0.178994	0.635045	0.077399	0.018373	0.002856	0.013973	0.025769
4	0.159992	0.656445	0.070687	0.018132	0.002976	0.014557	0.026847
5	0.200245	0.675518	0.079025	0.02054	0.003045	0.014897	0.027473
6	0.212725	0.695011	0.080616	0.021604	0.00315	0.015409	0.028417
7	0.091811	0.464934	0.061181	0.014533	0.002083	0.010192	0.018797
8	0.105744	0.466004	0.065358	0.015313	0.002108	0.010314	0.019496

Mg=Magnetite ILM=Ilmenite GAR=Ganrnet LUX=Leucoxene MON=Monazite
RUT=Rutile ZR=Zircon

Correlation matrix between the values of magnetite content and the other economic heavy minerals in the studied samples of study area are graphically represented in scatter plot diagrams (Figure 8).



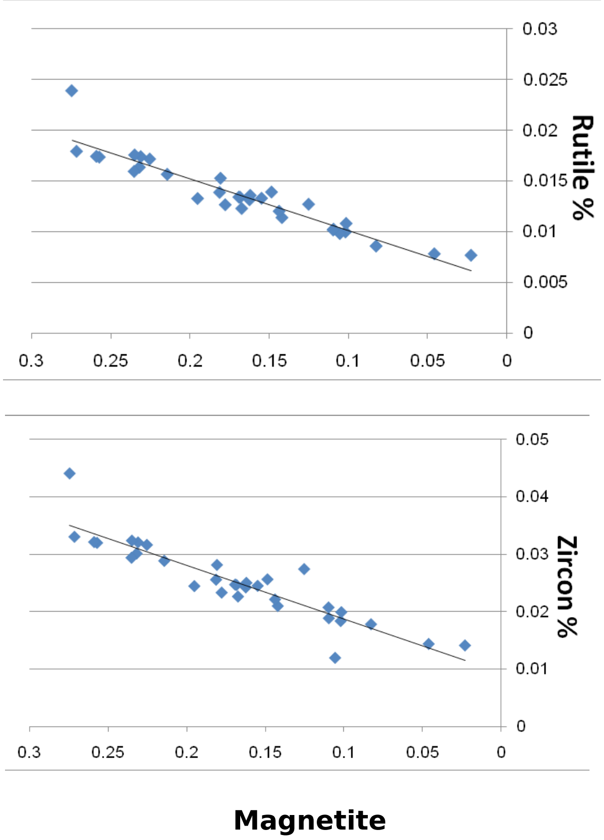


Figure (8): Scatter plot diagrams show the relation between magnetite content and the other economic heavy minerals of study area.

Apparent Specific Gravity Determination

The apparent specific gravity of each field sample of the study area are calculated and tabulated in table (3).

Tonnage of the study area

The study area is nearly flat surface so, the volume of raw sand is approximately calculated by (length (m) x width (m) x depth (m) in m^3). The tonnage of the raw sand was calculated by multiplying the volume (m^3) by the calculated average of apparent density of the raw sand in the study area, and the results are shown in Table (4).

Table (3): Apparent specific gravity of studied samples.

Profiles Number	Sp. Gr (gm/cm^3) in four profiles parallel to the shore line			
	A	B	C	D
1	1.43	1.36	1.41	1.39
2	1.53	1.41	1.48	1.5
3	1.52	1.55	1.51	1.49
4	1.52	1.52	1.6	1.54
5	1.47	1.49	1.56	1.56
6	1.52	1.65	1.6	1.5
7	1.54	1.65	1.54	1.71
8	1.63	1.64	1.65	1.67

Table (4): Volume and tonnage of raw sand of studiedarea.

Volume (m^3)	Average Apparent Density of raw sand (ton/m^3)	Tonnage of raw sand (tons)
14.5 km *200 m * 1m = 2900000 m^3	1.535625	4453312.5

The tonnage of each individual mineral was calculated by multiplying the tonnage of the raw sand of the studied area by the calculated weight percentage of each economic mineral and tabulated in table (5).

Table (5): The average content (Av. cont., Wt. %) and reserve tonnage for each economic mineral in thestudy area.

Economic mineral	Av .cont.wt.%	Reserve (tons)
Magnetite	0.347671	15482.88
Ilmenite	0.617044	27478..9
Garnet	0.081318	3621.34
Leucoxene	0.028318	1261.1
Monazite	0.002783	123.94
Rutile	0.013615	606.32
Zircon	0.025109	1118.18
Total	1.115858	49692.65

Radiometric Investigations

The average values of radiometric measurements of K (%), eU in (ppm), eTh in (ppm) and Ra in (ppm) along eight profiles nearly perpendicular to the shoreline are shown in Table (6).

Specific Activity Calculation

The values of K (percent), eU and eTh in (ppm) converted to activity concentrations (Bq/kg) and tabulated in table (7). Where, the activity concentration of a sample containing 1 % of^{40}K is 313 (Bq/kg),1 ppm by weight of ^{238}U is12.35 (Bq/kg), 1ppm of ^{232}Th is 4.06 (Bq/kg) and 1 ppm of ^{226}Ra is 11.1 (Bq/kg).

Table (6): The average values of radiometric measurements along eight profiles nearly perpendicular to the shoreline.

Profiles No.	K %	eU ppm	eTh ppm	Ra ppm
1	1.38	2.25	1.5	1
2	0.595	1.5	1.5	1
3	0.9725	1.25	2.25	1
4	0.8225	1.5	3	1
5	1.04	1.5	2.25	1
6	2.5825	1	2.25	1
7	0.74	1.5	2.5	1
8	0.835	1.25	1.75	1

Table (7): Values of specific activity concentrations of natural radioelements along four profiles parallel to the shoreline.

Profile Number (A)	K (Bq/kg)	U (Bq/kg)	Th (Bq/kg)	Ra (Bq/kg)
1	478.89	24.7	4.06	11.1
2	122.07	12.35	4.06	11.1
3	319.26	24.7	8.12	11.1
4	353.69	12.35	8.12	11.1
5	400.64	24.7	4.06	11.1
6	375.6	12.35	8.12	11.1
7	297.35	12.35	8.12	11.1
8	322.39	12.35	4.06	11.1

Profile Number (B)	K (Bq/kg)	U (Bq/kg)	Th (Bq/kg)	Ra (Bq/kg)

1	460.11	37.05	8.12	11.1
2	215.97	24.7	4.06	11.1
3	372.47	12.35	8.12	11.1
4	165.89	12.35	8.12	11.1
5	309.87	12.35	8.12	11.1
6	422.55	12.35	8.12	11.1
7	181.54	12.35	8.12	11.1
8	266.05	12.35	8.12	11.1

Profile Number (C)	K (Bq/kg)	U (Bq/kg)	Th (Bq/kg)	Ra (Bq/kg)
1	391.25	37.05	8.12	11.1
2	212.84	12.35	8.12	11.1
3	372.47	12.35	12.18	11.1
4	275.44	12.35	12.18	11.1
5	294.22	12.35	16.24	11.1
6	313	12.35	16.24	11.1
7	269.18	37.05	12.18	11.1
8	200.32	24.7	8.12	11.1

Profile Number (D)	K (Bq/kg)	U (Bq/kg)	Th (Bq/kg)	Ra (Bq/kg)
1	397.51	12.35	4.06	11.1
2	194.06	24.7	8.12	11.1
3	153.37	12.35	8.12	11.1
4	234.75	37.05	20.3	11.1
5	297.35	24.7	8.12	11.1
6	2122.14	12.35	4.06	11.1
7	178.41	12.35	12.18	11.1
8	256.66	12.35	8.12	11.1

(UNSCEAR), 1988) stated that, the conversion factor used to calculate the absorbed dose ratios given as Absorbed Dose (nGy/h)=0.429U+0.666Th+ 0.042K, where U, Th and K are the specific activity concentration of (^{238}U), (^{232}Th) and (^{40}K) in (Bq/kg), respectively. And it is calculated and tabulated in table (8).

Outdoor Effective Dose Calculation

According to, (UNSCEAR, 2000), the annual outdoor effective dose is determined as follows:

E_{ex}, out (mSv/y) = D(nGy/h)x 8760 (h/y) x 0.2 x 0.7 Sv Gy^{-1} x 10^{-6}

Where:

D: Absorbed Dose (nGy/h),

8760 (h/y): Time of hours per one year,

0.2: Occupancy factor for outdoor (5/24),

0.7: Conversion Coefficient for adults from absorbed dose to effective dose.

(UNSCEAR, 2000), the conversion coefficient from absorbed dose in air to effective dose for adults is 0.7, children is 0.8 and infants is 0.9.

Indoor Effective Dose Calculation

According to, (UNSCEAR, 2000), the annual indoor effective dose is determined as follows:

E_{ex}, indoor (mSv/y) = D(nGy/h)x 1.4 x 8760 (h/y) x 0.8 x 0.7 Sv Gy^{-1} x 10^{-6}

Where:

D: Absorbed Dose (nGy/h),

1.4: Population weighted value, because the indoor exposures are 40% greater than the outdoor exposures

8760 (h/y): Time of hours per one year,

Table (8): Absorbed dose rate of the study area along the various profiles.

Profile No.(A)	Absorbed Dose (nGy/h)	Profile No. (B)	Absorbed Dose (nGy/h)	Profile No. (C)	Absorbed Dose (nGy/h)	Profile No. (D)	Absorbed Dose (nGy/h)
1	33.41364	1	40.62699	1	37.73487	1	24.69753
2	13.12905	2	22.371	2	19.64535	2	24.15474
3	29.41314	3	26.34981	3	29.05377	3	17.14761
4	25.56105	4	17.67345	4	24.97851	4	39.27375
5	30.12714	5	23.72061	5	28.47123	5	28.49292
6	26.48127	6	28.45317	6	29.25999	6	97.13199
7	23.19477	7	18.33075	7	35.31189	7	20.90325
8	21.54249	8	21.88017	8	24.41766	8	21.48579

Absorbed Dose Calculation

0.8: Occupancy factor for indoor (19/24),

0.7: Conversion Coefficient for adults from absorbed dose to effective dose.

(UNSCEAR, 2000), the ratios of indoor to outdoor exposures range from 0.6 to 2.3, with a population-weighted value of 1.4. The indoor exposures are 40% greater than the outdoor exposures.

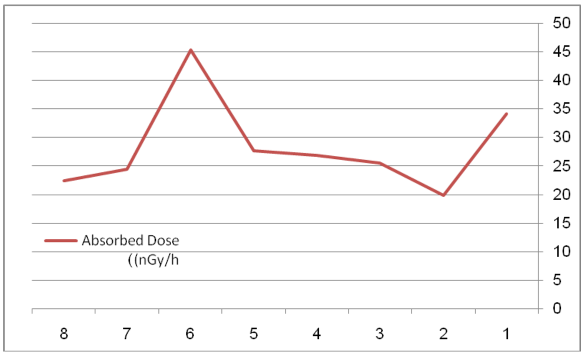
Total External Effective Dose

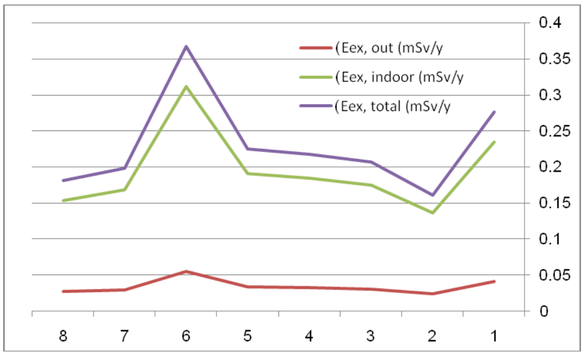
The total annual effective external dose $E_{ex,\ total}$ (mSv/y) is determined by the sum of $E_{ex,out}$ (mSv/y) and $E_{ex,indoor}$ (mSv/y).

Average values of outdoor, indoor and total external effective doses in (mSv/y) along eight profiles nearly perpendicular to the shoreline were calculated and shown in Table (9) and represented in figure (9).

Table (9): Average values of outdoor, indoor and total external effective doses in (mSv/y) along eight profiles nearly perpendicular to the shoreline.

Profiles Number	Absorbed Dose (nGy/h)	Eex, out (mSv/y)	Eex, indoor (mSv/y)	Eex, total (mSv/y)
1	34.11826	0.041843	0.234319	0.276162
2	19.82504	0.024313	0.136155	0.160468
3	25.49108	0.031262	0.175069	0.206331
4	26.87169	0.032956	0.18455	0.217506
5	27.70298	0.033975	0.19026	0.224235
6	45.33161	0.055595	0.31133	0.366925
7	24.43517	0.029968	0.167817	0.197784
8	22.33153	0.027388	0.15337	0.180757





Figure(9): Graphic representation show the Average values of outdoor, indoor and total external effective doses in (mSv/y) along eight profiles nearly perpendicular to the shoreline.

SUMMURY AND CONCLUSIONS

The study area is located in the area between the western jetty of Damietta seaport and Gamasa city. It covers a length of about 14.5 Km and an area 2.9 km^2.The study area is bounded by the Mediterranean Sea to the north, Gamasa City to the west and Damietta seaport to the east.

The study area was covered by 32 samples to a depth of one meter distributed along four profiles parallel to the shoreline took the numbers A, B, C, D. In addition, eight profiles nearly perpendicular to the shoreline numbered from 1 to 8 from east to west.

The apparent specific gravity of top meter sands varies from 1.36 gm/cm^3 to 1.71 gm/cm^3 with an average value 1.535 gm/cm^3.

In the study area, the average value of heavy minerals was 6.337% and the average value of light fraction was 93.663%.

The average percent of magnetite in the study area was 0.347% separated by using a free hand magnet with suitable strength.

The average percent of economic heavy minerals after binuclear stereomicroscope examination were ilmenite 0.617%, garnet 0.0813%, leucoxene 0.028%, monazite 0.0027%, rutile 0.0136% and zircon 0.025%.

The tonnage of raw sand in the study area was 4453312.5 and the tonnage of economic heavy minerals was 49692.65,. The tonnage of each individual economic heavy minerals were magnetite 15482.88, Ilmenite 27478.9, garnet 3621.34, Leucoxene 1261.1, Monazite 123.94, rutile 606.32 and zircon 1118.18.

The average concentration of equivalent Radium (Ra) is 1 ppm, equivalent uranium (eU) reaches1.4687 ppm and equivalent thorium (eTh, ppm) reaches 2.125 ppm, respectively. In addition, the potassium concentration (K, %), attains an average of 1.1209%.

To identify the radioactive environmental effects, the radiometric measurements of Radium (ra, ppm), equivalent uranium (eU, ppm), equivalent thorium (eTh,ppm) and potassium percentage (K, %) were converted into, specific activity concentration, absorbed dose rate and effective dose rate.

The average values of specific activity concentration of radioelements (^{226}Ra, ^{238}U, ^{232}Th, and^{40}K), in the study area are 11.1, 18.13906, 8.6275 and 350.853 Bq/Kg respectively. The increasing trend of (^{40}K) may be due to the presence of loamy and clay sediments in the study area.

The calculate values of absorbed dose were found to be ranged between 13.12905 and 97.13199 (nGy/h) with average value 28.26342 (nGy/h). This is below the world average value of 60 nGy/h, according to (UNSCEAR, 2000).

The average value of the total effective dose from all terrestrial gamma radiations is 0.228771 (mSv/y). It is obvious that our findings are in general below the worldwide measured value 0.50 (mSv/y), (UNSCEAR, 2000). Therefore, the total effective dose rate remains in the safe side and within the maximum permissible safe radiation dose rate.

REFERENCES

Abdel-Fattah, M. F. (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.

AbdElwahab, W. (2002): Environmental geology and environmental geophysics Northern Nile Delta in terms of neotectonics and physical processes. M.Sc. Thesis, Fac. Sci. Damietta University, Egypt.

Abu-Diab, A.A. (2008): Characters and distribution of the economic minerals in the black sand deposits of the coastal area, west El-Burullus, Egypt and their sedimentation condition. Ph.D. Thesis, Fac. Sci., Ain Shams University.

Abu Halawa, A. (2005): Evaluation and mineral processing of some economic minerals in El Burullus – Baltim sand dunes, Nile Delta, Egypt. Ph.D. Thesis, Fac. Sci., El Mansoura University, Egypt.

Ammar, A.A.; Sharaky, A.M.; Shahein, A.N.; El-Sadek, M.A. and El-Khateeb, S.A. (2005): Radiolithologic studies on beach and alluvial black sand deposits, Koam Mashaal area, Egypt, using ground radiospectrometry. In proceeding of the first international conference on the Geology of Tethgs, Vol. 1, pp.125-136.

Anwar, Y.M. and El-Bouseliy, A.M. (1970): Subsurface studies of the black sand deposits at Rosetta Nile mouth, Egypt. Part II, Mineralogical studies. Bull. Fac. Sci., Alexandria University, Vol. 10, pp. 141 – 150.

Barakat, M. G. (2015): Evaluation and mineralogy of beach economic minerals especially ilmenite for the top meter in the Egyptian black sand, East Rosetta, Egypt.Ph.D.Thesis, Fac. Sci. Zagazig University, Egypt.

Barakat, M.G. (2004): Sedimentological studies and evaluation of some black sands deposits on the northern coast of Egypt. M.Sc. Thesis, Fac.Sci. Alexandria University, Egypt, 176 p.

Basta, E.Z. (1972): Different types of ilmenite-magnetite intergrowths and their origin. Bull.; Fac. Sci.; Cairo University, Vol. 44, pp. 195-212.

Boctor, N.Z. (1966): Ore microscopic studies of the opaque minerals in Rosetta and Damietta black sands. M.Sc. Thesis, Fac. Sci., Cairo University, Egypt.

Dabbour, G.A. (1997): Mineralogical study on the opaque minerals and secondary rutile from the Egyptian black sands. Proceed. Egypt. Acad. Sci., Vol.47, pp.105-121

Dabbour, G.A. (1995): Estimation of the economic minerals reserves in Rosetta beach sands, Egypt. Mineral. Vol. 7, pp. 1532 – 166.

Dabbour, G.A. (1994): The Egyptian placer deposits: a potential source for Nuclear Raw Materials. 2nd Arab Conference on the Peaceful Uses of Atomic Energy, Cairo, pp. 191 – 204.

Dabbour, G.A. (1991): Heavy minerals content in relation to the apparent specific gravity of the

Egyptian black sands. Bull., Fac. Sci., EL Mansoura University, Special Issue, pp. 212 – 220.

Dabbour, G.A. (1980): Geological and mineralogical studies on rutile in the black sand deposits from the Egyptian Mediterranean coast. Ph.D. Thesis, Fac. Sci., Cairo University, Egypt, 155 p.

Dabbour, G.A.; Morsy, M.A. and Kamel, A.F. (1988): Radioactivity and heavy economic minerals of some Quaternary sediments at El Arish beach, north Sinai, Egypt. Ann., Geol. Surv. Egypt. Vol. 16, pp. 51 – 56.

Dabbour, G.A. (1973): Physical properties and distribution of zircon in some Egyptian placer deposits. M.Sc. Thesis, Fac. Sci., Cairo University, Egypt.

Dewedar, A.A. (1997): Comparative studies on the heavy minerals in some blach sands deposits from Sinai and east Rosetta with contribution to the mineralogy and economics of their garnets. Ph.D. Thesis, Fac. Sci., El Menoufia University, Shebin El Koum, Egypt, 197 p.

El-Gamal, A.A. and Saleh, I.H. (2012): Radiological and mineralogical investigation of accretion and erosion coastal sediments in Nile Delta region, Egypt.Journal of oceanography and Marine Science, Vol. 3, Issu.3, pp. 41-55.

El-Gamal, A.; Saleh, I.; Nasr, S. and Naim, M. (2004): Radiological assessment of the Egyptian Mediterranean coast. International conference on isotopes in environmental studies.Aquatic forum 2004, Monte. Cairo, Monaco, 25-29October 2004, IAEA-CN-118\31P, PP. 396-397.

El-Hadary, A.F. (1998): Geological, sedimentological and radiometric studies on the black sand deposits, west Rosetta beach with emphasis on the heavy economic minerals. Ph.D. Thesis, Fac. Sci., Cairo Univ., Egypt.

El-Hinnawi, E.E. (1964): Mineralogical and geochemical studies on Egyptian (UAR) black sands. Beitr.Miner.Petrogr. Vol. 9, pp. 519 – 532.

El-Nahas, H.A. (2002): Mineralogy, evaluation and upgrading studies on some economic minerals in beach black sands.El Arish area, Egypt. M.Sc. Thesis, Fac. Sci., El Minufiya University, Egypt, 162 p.

El-Shafey, A.M. (2011): Mineralogical, evaluation and beneficiation of the economic minerals of Egyptian black sands especially Cassiterite, in Abu-Khashaba area, east Rosetta, Egypt.M.Sc. Thesis, Fac. Sci. Zagazig University.

El-Shazly, E.M. and Wassef, S.N. (1984): On the occurrence of a veneer of coarse grained garnet and quartz and marl fragments on part of the Mediterranean Sea beach, east Rosetta, Egypt. Egypt. J. Geol. Vol. 28, pp. 273 – 282.

El-Shazly, E.M.; El Sokkary, A.A. and Dabbour, G.A. (1981 a): Physical properties of beach zircon from the Mediterranean sea coast of Egypt, Part I Grain size, Shape and roundness. Egypt, J. Geol., Vol. 25, pp. 95 – 111.

El-Shazly, E.M.; El Sokkary, A.A. and Dabbour, G.A. (1981 b): Distribution of beach zircon along the Mediterranean coast of Egypt. Egypt, J. Geol., Vol. 25, pp. 112 - 122.

El-Shazly, E.M.; El Sokkary, A.A. and Dabbour, G.A. (1981 c) : Physical properties of beach zircon from the Mediterranean sea coast of Egypt, Part II Radioactivity, magnetic susceptibility and fluorescence. Egypt, J. Geol., Vol. 25, pp. 123 - 130.

El-Shazly, E.M. (1965): Thorium resources in the United Arab Republic and their possible utilization.Panel on utilization of Th in Power Reactors, IAEA, Vienna, pp.186-198.

Gindy, A.M. (1961): Radioactivity in monazite, zircon and radioactive black grains in black sands of Rosetta, Egypt. Econ. Geol., Vol. 56, pp. 257 – 259.

Hammoud, N.S. (1985): Contribution to the evaluation problems of Egyptian beach economic minerals.Annals of Geol. Sur. of Egypt, vol.15, p.45-59.

Hammoud, N.M.S. (1975): A process for recovery of low chromium high grade ilmenite from north Egyptian beach deposits. Proc., 11thIndust.Mineral Process.Conf., RegioneAutonoma Delta, Sardegna, Italy.

Hammoud N. M. S. and Khazback, A.E. (1973): Relative radiometric assay of Egyptian beach monazite.MineraliaSlovaca, Vol. 5, pp. 469 – 475.

Hilmy, M.E. (1951): Beach sands of the Mediterranean coast of Egypt. J. Sed. Petro., Vol. 21, pp. 109 – 120.

Hammoud, N.M.S. (1966): Concentration of monazite from Egyptian black sands employing industrial techniques. M.Sc. Thesis, Fac. Sci., Cairo University, Cairo, Egypt.198 p.

Kamel, O.A.; Rasmy, A.H.; Khalil, A. and Bakir, R. (1973): Mineralogical and evaluation of black sands at eastern part of east side Nile section, Abu Khashaba area, Rosetta, Egypt. Annal. Geol. Surv. Egypt, Vol. 3, pp. 227 – 247.

Kamel, K.E. (1964): Mineralogical and petrographical studies on the transparent economic minerals of the black sands of Rosetta, Egypt. M.Sc. Thesis, Fac. Sci., Assiut Univ., Egypt.

Khairy, E.M.; Hussein, M.K.; Nakhla, F.M. and Tawil, S.S. (1964): Analysis and composition of Egyptian ilmenite ores from Abu Ghalaga and Rosetta. J. Geol. U.A.R., Vol. 8, pp. 1 – 9.

Meleik, M.L.; Fouad, K.M.; Wassef, S.N.; Ammar, A.A. and Dabbour, G.A. (1978) : Aerial and ground radiometry in relation to the sedimentation of radioactive minerals of the Damietta beach sand, Egypt. Econ. Geol., Vol. 73, pp. 1738 – 1748.

Meshref, W.M. (1962): Mineralogical and radiometric study for some black sand deposits on the Mediterranean coast. M.Sc. Thesis, Fac. Sci., Ain Shams University, Cairo, Egypt.

Mikhail, M.A. (1971): Distribution and sedimentation of ilmenite in black sands, west of Rosetta. M.Sc. Thesis, Fac. Sci., Cairo University, Cairo, Egypt.

Mohamed, E.H. (1987): Mineralogical studies for some Quaternary sediment in northern Sinai. M.Sc. Thesis, Fac. Sci., Suez Canal Univ., Ismailia, Egypt.

Moustafa, M.I. (2010): Mineralogical characteristics of the separated magnetic rutile of the Egyptian black sands. Resource geology, Vol. 60, Issue, 3, pp. 300-312.

Moustafa, M. I. (2009): Mineralogical and geochemical studies on monazite – Th, REE silicate series in the Egyptian beach monazite concentrate. Sedimentology of Egypt, Vol. 17, pp. 63-88.

Moustafa, M.I. (2007): Separation flow sheet for high purity concentrates of some Ec. Min. from El-Burullus Baltim sand Dunes Area, North coast, Egypt. The fifth international conference on the geology of Africa, Vol. 1, pp. 111-124.

Moustafa, M.I. (1999): Mineralogy and beneficiation of economic minerals in the Egyptian black sands. Ph.D. Thesis, Fac. Sci., El Mansoura University, El Mansoura, Egypt, 316 p.

Naser, S.; El-Gamal, A.; Hendawi, I. and Naim, M. (2006): Statistical evaluation of natural radio activity in sediments along the Egyptian Mediterranean coast. Proceeding of the 2nd environmental physics conference, pp. 161-166.

Nofal, A.M., El Tawil, S.Z. and Aly, F.H. (1980): Mise en valuer de la magnetite titanifere de gisements de sable cotier due Delta d'Egypte. Industrie Mineral les Techniques, Vol. 80, P. 203.

Robertson Research International (RRI) Limited (1985): An appraisal of the Rosetta black sands deposit.The Nuclear Materials Corporation, Internal Report, No. 4071, Cairo, Egypt.

Sadek, H.S.; Soliman, S.A.; Abdelhadi, H.M. and Hosni, A.A. (1990): Geophysical exploration of the black sands at Abu Khashaba beach, Rosetta coast: Internal Report, NMA, Cairo, Egypt.

Sadiq A.A. and Agba E.H. (2012): Indoor and outdoor ambient radiation levels in Keffi, Nigeria. Facta University

Saleh, I.; El-Gamal, A.; Nasr, S. and Naim, M. (2004): Spatial and temporal variations of uranium and thorium series along the Egyptian Mediterranean coast. International conference on isotopes in environmental studies. Aquatic forum 2004, Monte- Cairo, Monaco, 25-29 October 2004, IAEA- CN- 118\113P, PP. 550-551.

UNSCEAR (2000): Sources and effects of ionizing radiation.Report to the General Assembly of the United Nations with Scientific Annexes, United Nations sales publication E.00.IX.3, New York.

UNSCEAR (1993): Sources and effects of ionizing radiation. Report to General Assembly of the United Nations with Scientific Annexes, United Nations the sales publication E.94.IX.2, New York.

UNSCEAR (1988) Sources and biological effects.Report to the General Assembly of the United Nations with Scientific Annexes, United Nations sales publication E.82.IX.8, New York.

Wassef, S.N. and Mikhail, M.A. (1981): Distribution and mineralogy of ilmenite and other accessory minerals in the beach sands of west Rosetta, Egypt.Desert Instit.Bull., A.R.E., Vol.31, No.1-2, pp.17-29.

Zaghloul, Z.M. (1960): Note on the occurrence of uranothorite and radioactive zircon in the black sands of Rosetta. Egypt. J. Geol., Vol. 4, pp. 89 – 91.

Zaghloul, Z.M. and Kamel, K. (1966) Mineralogical and petrographical features of zircon of the black sands of Rosetta. Bull. Inst. Desert.De Agypten, Vol.16, No.1, pp.1-17.