Mineralogy and Spectrometric Prospecting Of Stream Sediments In Abu Ramad Area, Southeastern Desert, Egypt

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ABSTRACT

◖ The stream sediments of three wadis are W. Yoider, W. Ekwan and W. Eishimbai in study area, South Eastern Desert, Egypt. The commonly detected alluvial minerals are: magnetite, ilmenite, pyroxenes, amphiboles and Mg-rich mica. The associate mineralizations are represented by columbite, zircon, pyrite, allanite, fluorite and cassiterite. It is observed that a pronounced high frequency of columbite and pyramidal zircon is usually located near the granitoid rocks. This confirms the fact that Nb and Zr tend to be mechanically dispersed in the form of the heavy resistant minerals among stream sediments.

➢Keywords: Mineralogy, spectrometric prospecting, Abu Ramad:

◖ Abu Ramad area lies at the extreme Southern part of the Eastern Desert, Egypt. It is roughly bound by latitudes 22° 13`- 22° 20` N and longitudes 36° 08`- 36° 17`E.It is a part of Shalatin-Halaib triangle (Fig.1) and characterized by moderate to high relief. Many mineralogical and radiometric studies were carried out by Assaf et al., (1998 and 1999), Rashed (2001) and Ibrahim et al., (2005) .

◖ Wadies are wide and connected to each other at the northeastern part to form a flat area, representing the backshore of the Red Sea Coast.

➢ Geologic Setting

◖ The rocks covering the investigated area are essentially composed of metamorphic association intruded by granitic plutons (Fig.2). The igneous rocks comprise both older and younger granitoids. The older granitoids are consist mainly of tonalities. They form lower to moderate relief intrusive association and traversed by dyke swarms of variable composition and trends. The younger granitoids (G.Qash Amir and G.Silla) commonly occur in the form of smaller intrusions and associated dykes, which intrude the older rocks with intrusive contacts. They are generally classified as muscovite granites (Ibrahim et al., 2005),. G. Qash Amir characterized by its high relief that rises up to 720 m (above sea level), while G. Silla is composed of several isolated elongated hills trending NNW direction with moderate relief that rises up to 420 m.

➢ SAMPLING AND METHODOLOGY

◖ A total of 40 stream sediment samples were taken from three wadis in the study area, where 20 samples collected from W. Yoider, 10 samples from W. Ekwan and 10 samples from W. Eishimbai ***(Tab.1).*** The magnetite was separated by hand magnet. It is well known that the heavy minerals are mainly concentrated in the sand size of most sediments (Pettijohen, 1975), accordingly the studied sample was sieved to separate sand size from gravels (> 2mm), and silt and clay as finer size (<0.06mm).

◖ The heavy minerals of sands size were separated using bromoform and methylene iodide. This was followed by counting of different heavy minerals and hand picking under binocular microscope in order to obtain pure mineral separates. Identification of minerals was carried out using Binocular Microscope and the Environmental Scanning Electron Microscope (ESEM). Trace elements determination was carried out using X-ray fluorescence (XRF) techniques at the Nuclear Materials Authority, Egypt.

➢ SIZE DISTRIBUTION OF STREAM SEDIMENTS

◖ Mechanical analysis of the studied stream sediments revealed that, the sand fraction constitutes the main component of these sediments. It has a percentage not less that about 70%. While the coarser fraction (gravels and pebbles) does not exceed 20% and the fines (silt and clay) content reach about 7%. The sand size fractions were mechanically analyzed to describe their texture nature. About 120 g each sample was screened using the following set of screens: 1mm, 0.5mm, 0.250 mm, 0.125 mm and 0.063 mm. (***Table 1)*** shows grain size distribution of the studied samples. in the same time grain size parameters of Folk and Ward(1957) was calculated and the sands of the stream sediments was described as fine to coarse sand, poorly sorted. And ranged from strongly fine to coarse skewed and from very leptokurtic to very platy kurtic.

➢ Heavy Minerals Distribution

◖ The heavy mineral content ranges between 18% and 38% of the stream samples. The heavy mineral assemblage recognized in the samples nclude the following major minerals; magnetite, ilmenite, leucoxene and hematite. Minor amounts of other minerals are also present in small percentages e.g. epidotes, staurolite, garnet, zircon, rutile and biotite. Associated minerals as kasolite, columbite, pyrite, allanite, pyrolusite, fluorite and cassiterite present. The maximum, minimum and average of heavy minerals content were represented in ***(Table 2).***

◖ These minerals were studied using Binocular Microscope and confirmed by ESEM ***(Fig.3).*** Kasolite [Pb (UO2) SiO4.H2O]. It is recorded in W. Yoider only with dark yellowish brown colour. Black radioactive Columbite [(Fe, Mn) (Nb, Ta)2 O6] has been recorded in the studied stream sediments. The crystal habit of zircon in the sediments of study area is short prismatic euhedral with rounded blunted edges. They are colourless to pale yellow and the ajority is honey and sometimes stained with iron oxides. Pyrite occurs as coarse - grained (up to 2mm) euhedral crystals in the studied sediments with slightly corroded outlines and include grains of finer sulphides or gangue. Allanite [(Ce, Ca, Y,) (Al, Fe)3 (SiO4)3.OH] is a member of the epidote group. It occurs as tabular, long prismatic crystals and has brown to black colour. It often occurs in the metamict state due to the estruction of the crystalline structure by the alpha particle emission (Kerr, 1977).

◖ Some of fluorite grains have various colour gradations. Some grains are pale, violet or deep violet. Cassiterite is a brown or black tetragonal mineral. The crystals of cassiterite take the prismatic form and massive or compact with concentric structure.

◖ The main contributions of these minerals lie in the nearby basement exposures.

◖ The heavy minerals distribution map ***(Fig.4)*** shows that in Wadi Yoider area the non-opaque minerals are enriched at samples from granitoid terrain, whereas, iron oxide minerals are enriched at sample from metavolcanic and serpentinite rocks.

◖ In Wadi Ekwan area the non-opaque minerals have lower frequencies whereas, opaque iron oxides and the green silicates have higher frequencies. In Wadi Eishimbai area micas, iron oxide minerals and the green silicates have nearly equal concentrations in sample from granite and metavolcanic source rocks. Iron oxide minerals (magnetite, ilmenite and hematite) are enriched in sample contributed from serpentinites and ophiolitic mélange rocks. Green silicates and translucent minerals are enriched at stream sediment sample from granitoid and metavolcanic rocks.

➢ Radiometry

◖ These variations of radioactivity are mainly attributed to the wide variations in rock composition, mineralizations, alterations, and other secondary features, which -inpart- are controlled by structural parameters. Therefore radiometric analysis of natural radioactivity is a good tool for distinguishing between different rock types and rapid geological mapping (Faul, 1954; Adams and Gasparini, 1970).

◖ The $_eU$, $_eTh$ and K contents were determined in the different sand size fractions of stream sediment samples of W. Yoider, W. Ekwan and W. Eishimbai basins. Also were calculated the radio-element ratios for Th/U, K/U and K/Th. These ratios were calculated from the average $_eU$, $_eTh$ and K contents of the fractions (1-0.5 mm) + (0.5-0.25 mm) representing the coarse and medium sand fractions and the fractions (0.25-0.125 mm) + (0.125-0.063 mm) representing the fine and very fine sand fractions, silt fraction .

◖ In the upstream area of Wadi Yoider surrounding the known U-deposit at G. Qash Amir ***(Tab.3),*** most samples show anomalous $_eU$ values ranging from 1 to 12 ppm and eTh values from 5 to 171 in the coarse and medium sand fractions. In the fine and very fine sand fractions the anomalous eU values range from 1to 60 ppm and eTh values from 0 to 127 ppm, K-contents which are very close to the granitic values ranging from 1.46 to 4.76 %. The systematic decrease in K contents in the finer fractions indicates that the weathering debris in the coarser fractions is dominated by

K-feldspars and micas. The decreases of K-content in the fine and very fine sand fractions indicate the break-down of K-feldspar and biotite during weathering. This may indicate that eU and eTh are controlled by heavy accessory minerals enriched in $_e$Th.

◖ $_e$Th/$_e$U ratios in the samples show ***(Tab. 4)*** the value in the coarse and medium sand fraction ranging from 1.30 to 6. Samples show eTh/eU ratio values in the fine and very fine sand fraction ranging from 0.28 to 3.30. Also some samples show low $_e$Th/$_e$U ratio values in the silt + clay fraction ranging from 0.49 to 9.50. Since the majority of the samples show that their lowest $_e$Th/$_e$U ratio values indicate that a significant proportion of $_e$U has been mobilized and remixed by adsorption phenomena.

◖ The contents of $_e$U, $_e$Th and K in the five samples from Wadi Ekwan are shown in ***(Table 5)*** for the different grain size fractions of the studied stream sediments. It shows that the high U contents are exclusively observed in the fine , very fine sand and silt + clay fractions. It should be stated that all the samples from this catchment area was collected from main third or fourth order streams, which might explain the concentration of the radio-elements in the fine , very fine sand and silt+clay fractions , ***(Table 5)*** shows that only one sample has anomalous U contents 41 ppm in sample No. 5 and average is 7 ppm. It should be stated that these.

◖ Samples were collected from sites facing small granitic exposures, i.e., parts of Gabal El-Sella. These two samples also have high anomalous Th-content, ranging from 50 to 63 ppm in the fine and very fine sand and silt + clay fractions. This might indicate that the $_e$U and $_e$Th in the stream sediments of these catchment area was mainly present in heavy accessory minerals transported and concentrated within the alluvial deposits. The variant ion in K-contents among the different grain size fractions, ***(Table 5),*** shows a systematic decrease from the high K-contents 171% to 1.62% which is similar to that of the bedrocks which are eliminated by metavolcanics and granitoids to lower K-contents in the fine and very fine sand fractions ranging from 5.35% to 1.26%, then it increase again in the silt + clay (-0.063 mm) fractions. This pattern is similar to the pattern of K-content variations among a large sample population of W. Yoider area discussed above. The K content variation in W. Ekwan can similarly be explained that the detritus in the very coarse sand (coarse and medium) sand fractions are dominated by K-feldspars and quartz with the quartz grain increasing as the grains getting finer, whereas K-feldspars are broken by weathering. The increase in K-content in the very fine and very fine sand fractions may be attributed to the increase of K-clay minerals such as illite and sericite.

◖ The contents of U, Th and K in five samples are shown in ***(Table 6)*** for the different grain size fractions of the studied stream sediments. The variations in the U and Th contents among the different grain size fractions are shown in the histograms ***(Fig. 5)*** for U and Th respectively. Show that the high U contents are exclusively observed in the silt + clay fraction especially three samples. These histograms are all unimodal and positively skewed except one sample which exhibit some bimodality and symmetry of distribution. Also, ***(Fig. 5)*** shows that the Th distribution histograms are unimodal except one sample is bimodal, but all the samples are positively skewed where the highest Th-contents are in the finest fractions. It should be stated that all the samples from these areas were collected from main third or fourth order streams, which might explain the concentration of the radio-elements in the silt + clay fractions only. ***(Table 7)*** show that three samples have anomalous U contents 22, 24 ppm respectively in the s ilt + clay fraction. It should be stated that these samples were collected from sites facing or draining from small granitic exposures. Four samples have high anomalous Th-content 48, 37 and 40 ppm respectively in the silt + clay fraction. This might indicate that the U and Th in the stream sediments of these areas are mainly locked in heavy accessory minerals transported and concentrated within the alluvial deposits.

◖ The variant ion in K-contents among the different grain size fractions, ***(Table 7),*** shows a systematic increase from K-contents 2.97% to 3.39% which is similar to that of the bedrocks which are dominated by metavolcanics and granitoids to lower K-contents in the fine and very fine sand fractions ranging from 0.91% to 2.14%, then it increases again in the silt + clay fractions. This pattern is similar to the pattern of content variations among a large sample population of W. Yider catchment's area discussed above. The K-content variation in W. Ekwan can similar ly be explained that very coarse sand and coarse and medium sand fractions are dominated by K-feldspars and quartz with the quartz grain increasing as the grains getting finer. The K-feldspars are broken by weathering the increase in K-content in the silt + clay fraction may be attributed to the increase of K-clay minerals such as illite and sericite.

◖ The calculated elemental ratios Th/U, K/U and K/Th shown in ***(Table 8)*** indicate that the four samples associated with U and Th-contents show very low Th/U ratios ranging from 0.47 to 1.78 in the silt + clay fractions. This might indicate more mobilization of the U relat ive to Th during the weathering process. The spatial distribut ion of U, Th and K are shown on ***(Fig. 5)*** for the coarse and medium sand, fine and very fine sand and silt + clay fractions respectively, which indicate that the high U and K values show close relationship to the granitic exposures, therefore, confirming the effect of the bed rocks on the elemental abundances in the nearby stream sediments.

➢ Prospecting

The total count map ***(Fig. 6)*** shows three anomalous zones. The main zone is situated at the Eastern part of the granitic pluton and show intensity >100 Ur. The other two zones are located in the central part with total intensity up to 75 Ur. The relative abundance of $_{e}U$ to $_{e}Th$ is higher in the western and central parts of the area as opposed to the eastern and southern parts, which is related to the geographic position of the sampled sites with respect to the location of the $_{e}U$-deposit. This pattern is more confirmed in the fine and very fine sand fraction. The distribution of K% follows closely that of $_{e}U$ which can be explained as related to the distribution of granitic rocks in the area and the association of the $_{e}U$-deposit with G. Qash Amir–El-Sella pluton. The Low abundance of $_{e}U$ relative to $_{e}Th$ and K in the western downstream area can be explained by the dominance of serpntinites and related rocks and metavolcanics as bedrocks covering the area. This also explains the absence of anomalous $_{e}U$ or $_{e}Th$ in the five samples. However, the two samples show anomalous $_{e}U$ content (41 and 44 ppm respectively) in the silt + clay fraction (-0.063 mm). Only three samples show low $_{e}Th/_{e}U$ ratios and $K/_{e}Th$ ratios in silt + clay fractions. The distribution of the radioelements in three samples is much clarified in the histograms which show more sorting in these downstream samples relative to the upstream ones.The uranium is close to the total count map, the higher radioactive zones, which is shown in the total radiometric map, could be traced from the uranium map. The highest uranium values are encountered in the Eastern par t of part and reach up to 75 ppm. The central part of the pluton reflects a group of scattered anomalies ranging from 50 to 75 ppm. The Thorium map ***(Fig. 7)*** shows two pronounced anomalies. The first in the Eastern part, and coincide with high total count and uranium measurements, reach up to 30 ppm. The second anomaly is located in the central part and varies from 10-30 ppm. The potassium contour map ***(Fig. 8)*** shows a prominent anomaly (4-6%) associated with the granites. The volcanic rocks have lower K values ranging from <2 to<4%. The three spectrometric maps (Tc, $_eU$ and $_eTh$) have almost the same isolated zones and closures with similar comparable contents, i.e. high Tc, $_eU$ and $_eTh$.

◖ The $_eU/_eTh$ ratios map shows two anomalies; one at the Eastern part, the same as delineated from uranium and thorium maps, with values ranging from I to 2 ***(Fig. 9).*** The second anomaly is in the central part of the granitic pluton and reaches up to 3.7. Some parts of the granitic pluton do not show high $_eU/_eTh$ ratio values. Some high values of $_eU/_eTh$ are located at the northwestern part of the studied area, ranging from 1 to 2. In general, the lower $_eU/_eTh$ rat io in the granitic pluton may be due to the mobilization of the uranium from these parts and redeposit ited in neighboring parts which show high $_eU/_eTh$ ratio values. The high values of volcanic rocks could be attributed to the enrichment of some accessory minerals rich in uranium; the other alternative interpret at ion is that these volcanic rocks are product of depleted-Th magma.

◖ Results of gamma-ray spectrometric analyses of the stream sediments are illustrated in the form of histograms in ***(Fig. 5).*** Correlat ion between uranium and thorium concentrations within the stream sediments is illustrated in ***(Fig. 6).*** The relationship between $_eU$ with $_eTh$ and the $_eU$ with $_eU/_eTh$ reflected direct relation, while the relation between $_eTh$ and $_eU/_eTh$ shows random distribution.

a) U-Th/U Variation Diagram

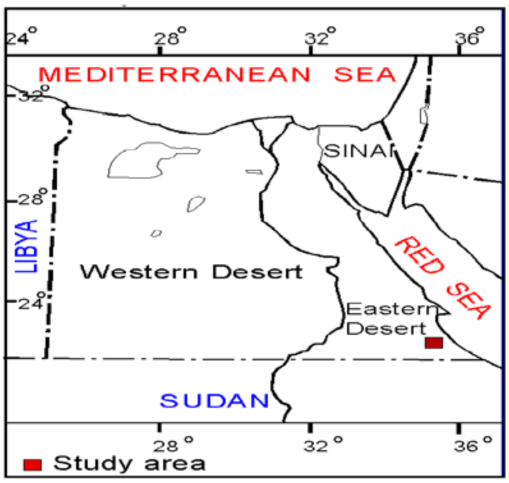
◖ Normally, thorium is three times as abundant as uranium in natural rocks and in the stream sediments. When this ratio is disturbed, it indicates the depletion or enrichment of uranium. This is very clear that U-Th/U variant ion diagrams of the three localities ***(Fig. 7),*** shows the decrease in Th/U ratio is accompanied by enrichment in uranium.

b) <u>Th-Th/U Variation Diagrams</u>

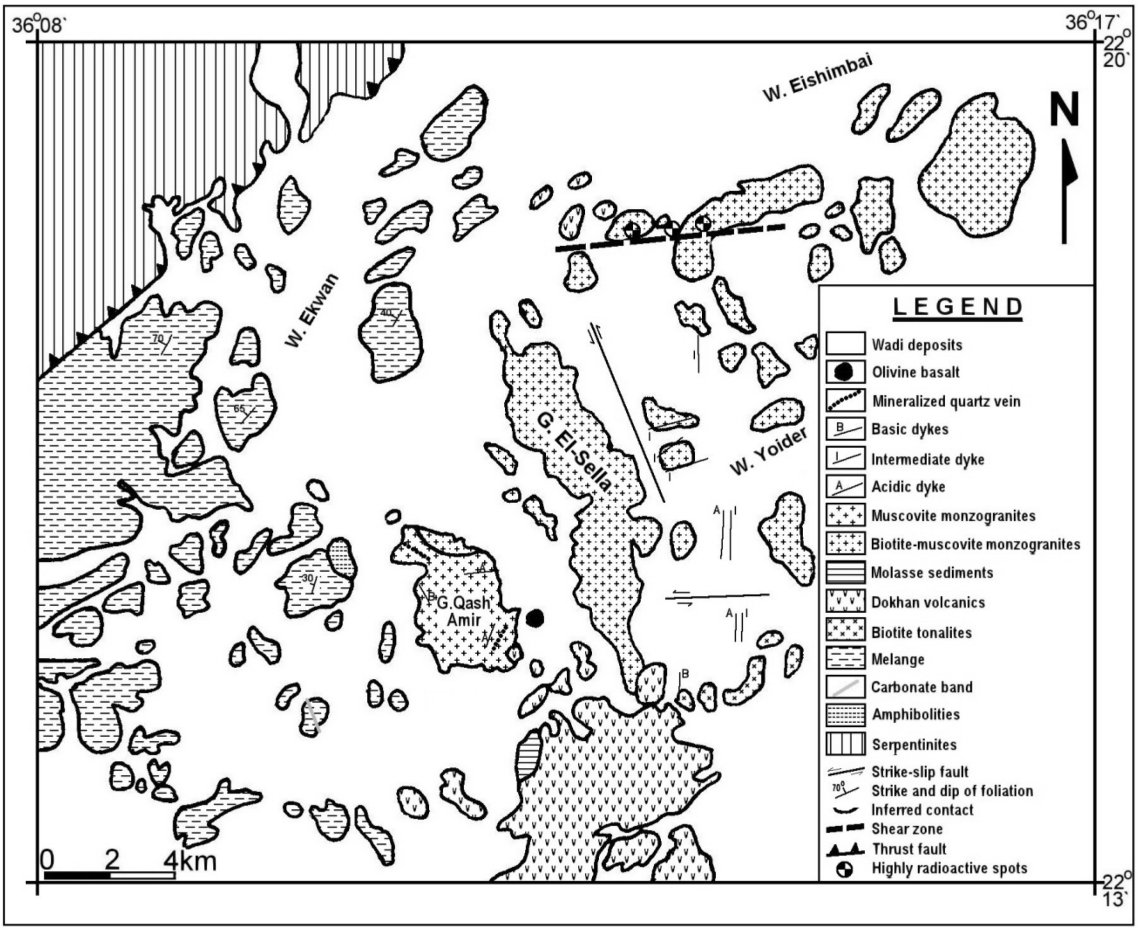
◖ The Th-Th/U variation diagrams for the studied stream sediments show that Th/U ratio increases with the enrichment of thorium in W.Yoider, W. Ekwan and W. Eishimbai localities ***(Fig. 7).***

➢ Relations of U with some Trace Elements

◖ The relations of U with some of trace elements in the studied stream sediments are shown in ***(Fig. 8)*** whereas the relation of U with the frequency of total heavy fraction and the frequency of zircon in the studied stream sediment samples are shown in ***(Fig.9).*** It is clear that in W. Yoider U shows strong positive correlation with Th, Ga and V as well as the heavy minerals content, while shows negative correlation with the zircon content and no correlation with total iron. In W. Ekwan uranium has strong positive correlation with Th, Ga, V, total iron and the total heavies, negative correlation with, negative correlation with Zr, Y, Nb, Ni and Zn and poor correlation with Pb. In W. Eishimbai locality, U shows strong positive correlation with Th and Ga while shows negative correlation with Rb and Zircon content and shows weak correlation with total Fe, Zr, and the total heavies ***(Fig. 10).***

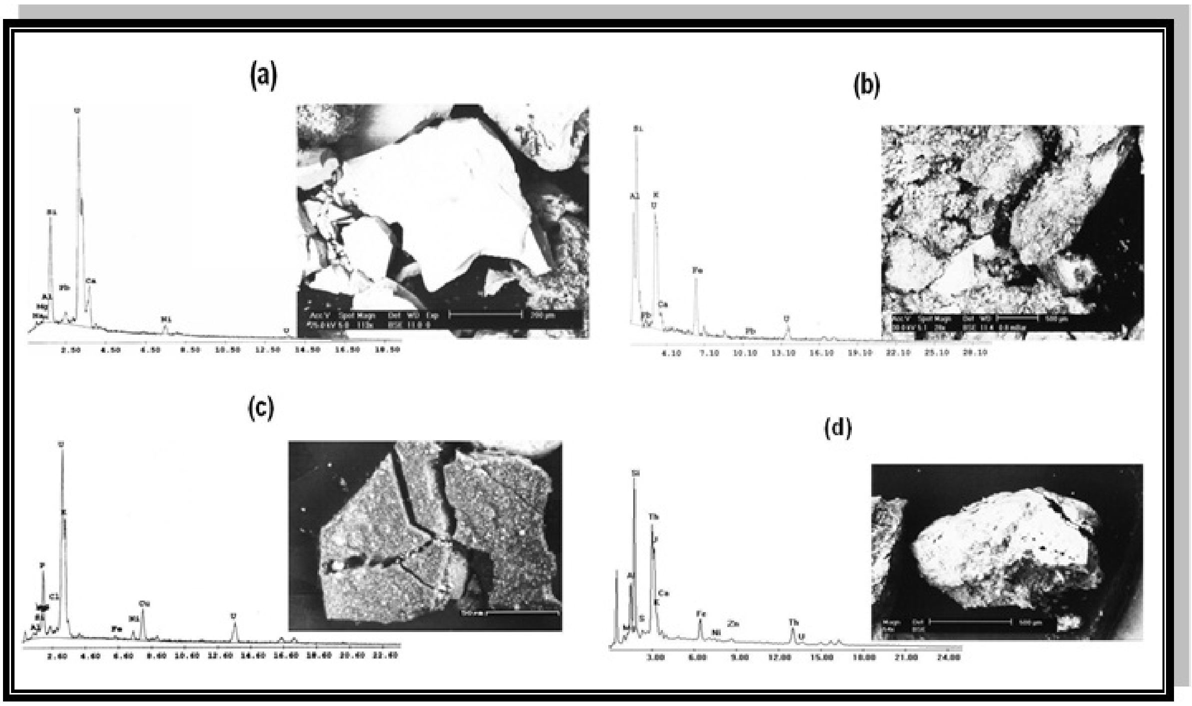


■ **<u>Figure (1)</u>: Location Map of Abu Ramad Area, SED, Egypt.**

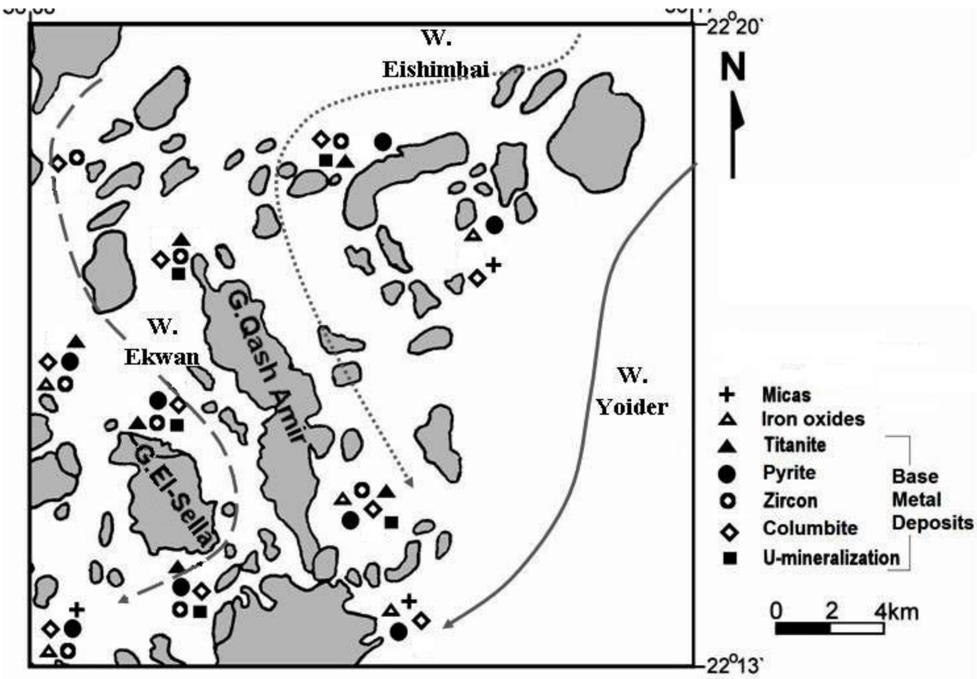


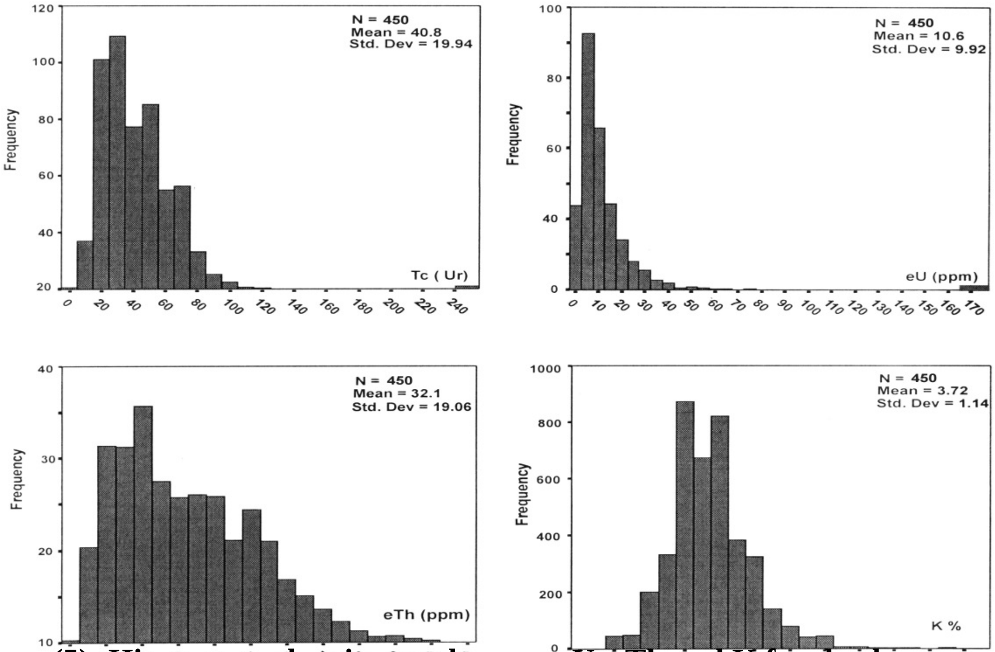
■ **<u>Figure (2)</u>: Geological map of the study area at the southern part of Eastern Desert of Egypt. (after Ibrahim et al., 2005).**

■ **Figure (3): ESEM image showing; a) uranophane; b) beta-uranophane; c) kasolite and d) uranothorite minerals separated in Abu Ramad area, SED, Egypt.**

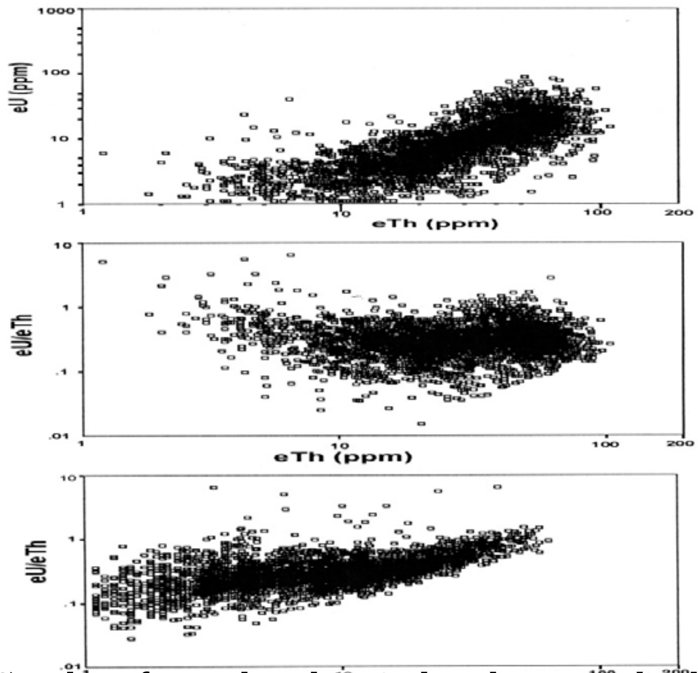


■ **Figure (4): Mineralogical map showing the relative distribution of heavy minerals in stream sediments of study area, SED, Egypt.**

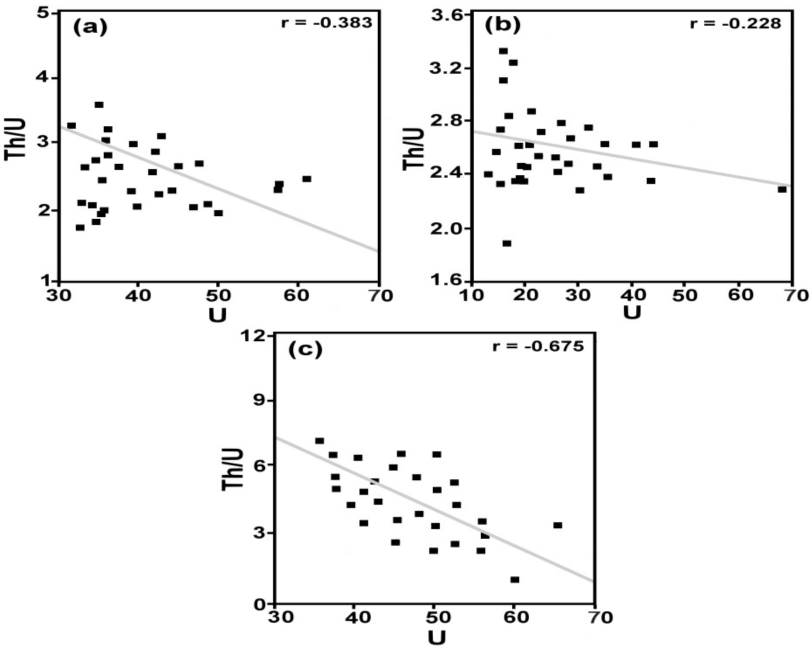




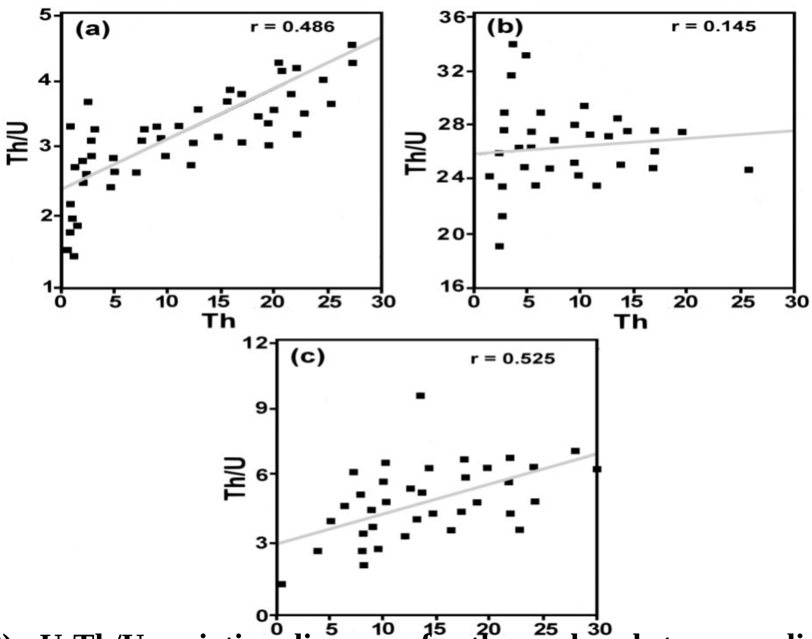
▪ **Figure (5): Histograms showing total count, eU, eTh and K for the by gamma ray spectrometry for study area, SED, Egypt**



▪ **Figure (6): Plots of eU-eTh, eTh-eU/eTh and eU-eU/eTh relations for the stream sediments of study area, SED, Egypt.**



■ **Figure (7): Plots of eU-eTh, eTh-eU/eTh and eU-eU/eTh relations for the stream sediments of study area, SED, Egypt.**



■ **Figure (8): U-Th/U variation diagrams for the analyzed stream sediment samples of Wadi Yoider (a), Wadi Ekwan (b) and Wadi Eishimbai (c) areas, SED, Egypt.**

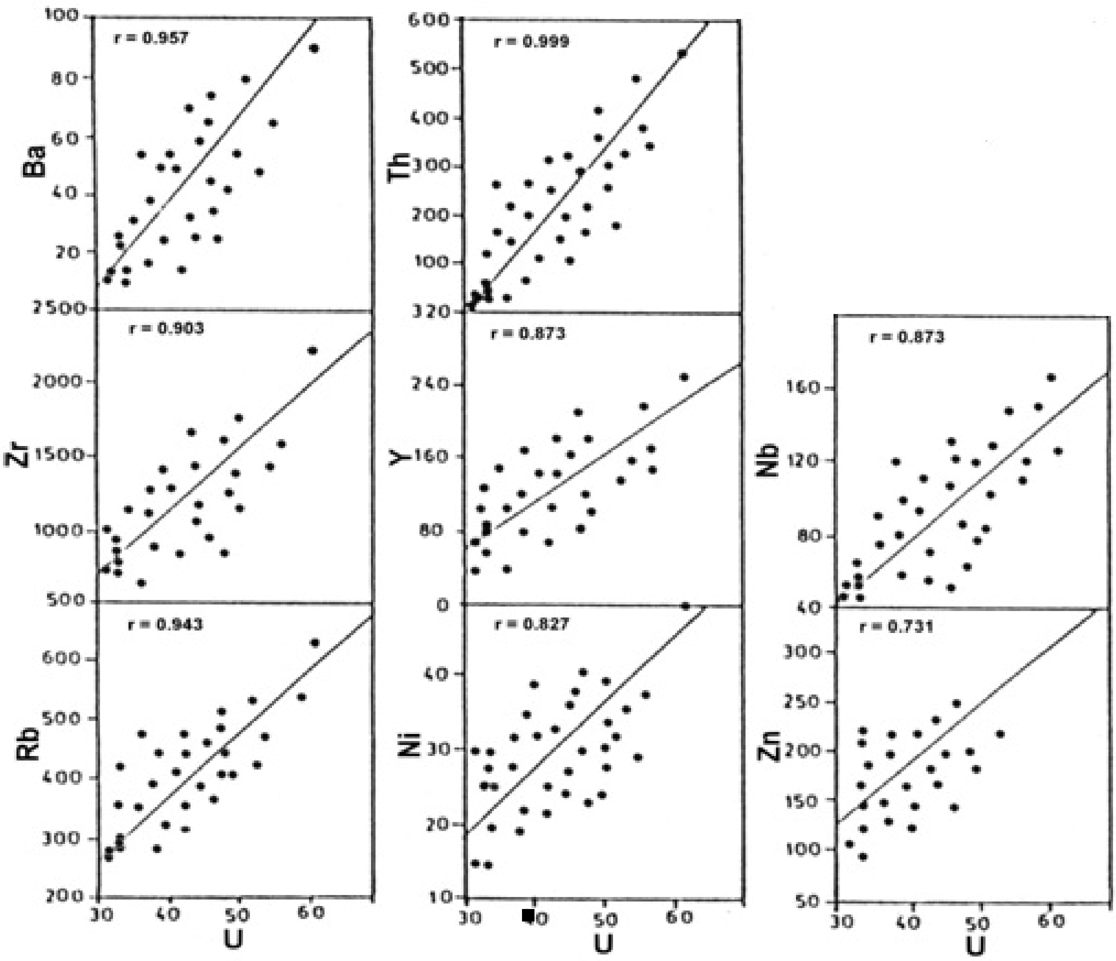
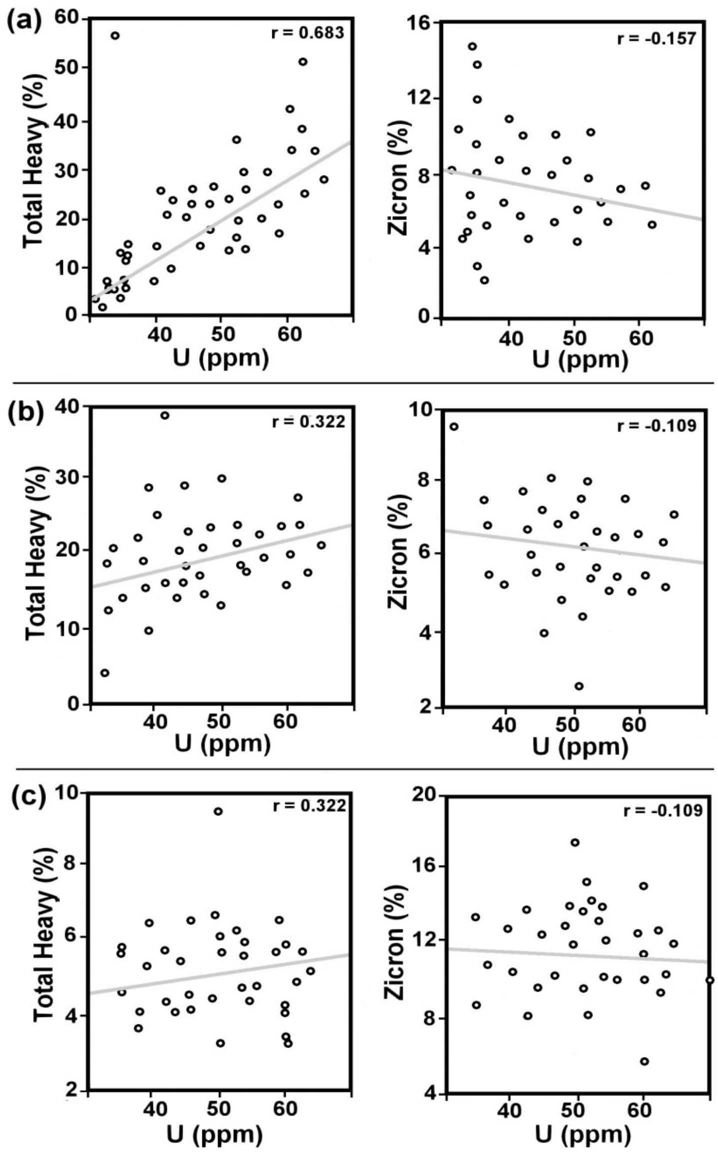


Figure (9): Th-Th/U variation diagrams for the analyzed stream sediment samples of Wadi Yoider (a), Wadi Ekwan (b) and Wadi Eishimbai (c) areas, SED, Egypt.



▪ **<u>Figure (10)</u>: Variation diagrams of total heavy minerals and zircon content versus U in stream sediment samples of Wadi Yoider (a), Wadi Ekwan (b) and Wadi Eishimbai (c) areas, SED, Egypt.**

- **Table (1): Grain size distribution (%) of the size fractions of stream sediments in study area, SED, Egypt.**

			Gravels	Sand					Silt+ clay
Serial No.	**Sample Name**	**Locality**	>2 mm	2-1 mm	1-0.5 mm	0.5-0.250mm	0.250-0.125mm	0.125-0.063mm	<0.063 mm
1	**Y-1**	**Wadi Yolder**	2.64	10.57	21.58	26.57	21.95	12.49	4.2
2	**Y-2**		4.43	17.7	20.12	17.25	20.24	17.31	2.95
3	**Y-3**		4.7	18.82	19.61	15.6	25.49	14.24	1.54
4	**Y-4**		5.26	21.04	18.31	19.99	20.97	11.62	2.81
5	**Y-5**		6.24	24.96	20.13	14.79	18.37	13.6	1.91
6	**Y-6**		5.12	20.48	9.9	7.52	25.85	21.57	9.56
7	**Y-7**		3.57	14.3	16.84	26.34	22.19	13.63	3.13
8	**Y-8**		5	19.98	19.04	23.27	19.68	11.17	1.86
9	**Y-9**		6.25	25.01	28.06	21.75	12.55	5.6	0.78
10	**Y-10**		4.12	16.14	23.61	17.86	18.58	15.36	4.33
11	**Y-11**		6.36	25.46	24.27	21.12	15.62	5.98	1.19
12	**Y-12**		3.32	13.27	6.84	4.62	30.19	35.5	6.26
13	**Y-13**		4.61	18.45	11.9	7.58	27.01	23.48	6.97
14	**Y-14**		2.48	9.9	11.46	11.17	38.6	21.35	5.04
15	**Y-15**		5.55	22.19	27.87	24.4	12.14	6.33	1.52
16	**Y-16**		3.78	15.14	19.09	31.25	18.48	11.73	0.53
17	**Y-17**		5.22	20.9	37.05	22	9.9	4.07	0.86
18	**Y-18**		7.2	28.86	31.6	25.89	4.53	1.38	0.54
19	**Y-18**		4.74	18.97	40.83	25.16	5.54	2.12	2.64
20	**Y-20**		14.78	59.1	13.66	12.46	-	-	-
21	**Ek-1**	**Wadi Ekwan**	4.69	18.75	13.68	9.87	27.03	18.89	7.09
22	**Ek-2**		5.01	20.06	30.81	25.33	11.68	5.51	1.60
23	**Ek-3**		7.94	31.78	25.6	15.82	13.21	4.4	1.25
24	**Ek-4**		5.7	22.8	29.2	18	12.88	9.72	1.68

					2					
25	**Ek-5**		5.72	22.86	29.29	19.19	12.54	9.25	1.15
26	**Ek-6**		12.38	49.54	18.61	19.47	-	-	-
27	**Ek-7**		12.04	48.16	12.84	26.96	-	-	-
28	**Ek-8**		11.53	46.13	17.65	24.69	-	-	-
29	**Ek-9**		11.3	45.16	18.72	24.82	-	-	-
30	**Ek-10**		15.21	60.84	13.23	10.72	-	-	-
31	**E-1**	**Wadi Eishimbai**	7.25	28.99	13.32	26.77	15.19	7.73	0.75
32	**E-2**		7.3	29.19	27.05	16.27	13.45	5.35	1.39
33	**E-3**		7.1	28.19	27.82	16.47	12.22	7.28	0.92
34	**E-4**		3.84	15.36	15.82	31.37	20.03	11.67	1.91
35	**E-5**		4.45	17.78	18.98	32.17	16.81	7.04	2.77
36	**E-6**		2.53	10.1	33.07	26.04	19.19	8.2	0.87
37	**E-7**		16.12	64.5	10.41	8.97	-	-	-
38	**E-8**		12.53	50.13	14.94	22.4	-	-	-
39	**E-9**		15.1	60.36	12.83	11.71	-	-	-
40	**E-10**		14.4	57.6	15.2	12.8	-	-	-

- **Table (2): Percentage of heavy minerals relative to heavy fraction in the stream sediments of studied area.**

Sample Name	**Locality**	**Mgt. & Hem %**	**Ilm. %**	**Amph. &pyro**	**Zir. %**	**Rut. %**	**Opaques %**	**Gar. %**	**Biot. & Micas**	**Epidot %**
Y1	Wadi Yolder	39.58	10.69	8.97	10.38	5.36	6.46	2.81	5.09	10.66
Y2		39.68	9.98	8.66	9.01	4.03	8.57	5.73	5.64	8.70
Y3		33.86	11.86	10.94	10.25	5.99	6.66	4.19	7.68	8.57
Y4		41.76	10.86	10.06	8.36	3.04	11.02	4.06	5.99	4.85

Y5		37.81	12.46	9.36	8.04	4.65	8.92	5.65	6.34	6.77
Y6		41.69	13.68	9.08	10.56	5.02	7.02	3.08	5.34	4.53
Y7		39.69	13.49	9.04	10.49	5.01	6.62	2.82	6.04	6.80
Y8		37.49	10.94	10.02	8.54	3.86	12.46	3.79	6.48	6.42
Y9		39.67	12.39	9.68	8.33	3.99	8.28	5.46	5.64	6.56
Y10		39.74	9.97	11.67	11.89	4.88	9.46	3.06	5.02	4.31
Y11		34.92	9.95	11.49	13.57	4.02	9.34	3.02	6.49	7.20
Y12		37.68	9.37	11.68	12.58	3.69	9.96	3.04	5.32	6.68
Y13		38.73	12.69	9.07	8.06	3.95	9.02	5.56	6.11	6.81
Y14		37.86	10.97	10.02	8.59	3.03	12.45	4.33	6.51	6.24
Y15		37.64	13.29	8.89	10.92	4.67	6.55	3.21	5.11	9.72
Y16		38.91	9.27	11.48	11.97	3.59	10.01	3.20	5.01	6.56
Y17		39.67	10.68	10.04	9.03	2.68	10.76	4.08	6.75	6.31
Y18		33.84	12.67	9.04	8.05	4.02	9.05	5.49	8.46	9.38
Y19		38.67	13.49	8.84	10.63	4.99	6.68	3.06	4.55	9.09
Y20		36.66	12.49	9.33	8.01	4.06	9.07	5.64	8.61	6.13
Ek1	Wadi Ekwan	39.62	10.68	10.04	9.01	3.02	12.42	4.01	6.09	5.11
Ek2		33.93	9.91	11.69	12.74	3.69	10.02	3.03	7.06	7.93
Ek3		36.26	9.67	11.76	11.62	4.01	10.31	3.04	8.34	4.99
Ek4		38.61	11.46	8.77	10.69	4.95	6.57	2.86	8.67	7.42
Ek5		38.49	10.93	9.68	9.08	3.02	10.64	3.67	7.11	7.38
Ek6		35.68	12.68	9.01	8.04	4.02	9.55	5.44	8.21	7.37
Ek7		33.94	9.97	11.96	10.95	4.01	9.02	2.62	8.69	8.84
Ek8		35.68	9.96	11.46	11.65	3.99	10.37	2.86	8.04	5.99
Ek9		35.55	10.69	10.02	9.03	3.02	12.69	4.01	10.01	4.98
Ek10		40.69	11.86	9.04	10.55	4.67	6.54	2.44	6.71	7.50
E1	Wadi Eishimbai	41.83	10.64	10.06	8.43	3.02	10.68	4.01	5.66	5.67
E2		39.46	12.69	9.08	8.62	3.95	9.02	5.41	6.04	5.73
E3		41.57	13.79	9.21	10.68	4.55	6.66	3.02	5.04	5.48
E4		40.49	10.95	10.03	9.06	3.04	9.68	3.99	6.32	6.44
E5		37.34	12.97	9.31	8.22	4.32	8.67	5.64	4.36	9.17
E6		38.64	11.68	9.41	9.49	4.65	6.95	2.98	5.41	10.79
E7		37.59	12.46	9.08	8.07	3.89	9.08	5.75	8.32	5.76
E8		36.76	9.94	11.61	13.89	3.02	9.91	2.97	7.02	4.88
E9		37.59	9.93	11.45	12.39	4.31	9.76	2.86	6.94	4.77
E10		35.67	10.69	10.07	9.05	3.01	12.55	4.03	8.49	6.44

- **Notes:** W. Yoider, W. Ekwan and W Eishimbai .

: Mgt. = magnetite, Hem. = Hematite, Ilm. = Ilmenite, Amph = Amphipole, Pyro = Pyroxene, Zer = Zercone, Rut = Rutile, Gar = Garnet, Biot. = Biotite, .

- **Table (3): Radioelements contents [U, Th (ppm) and K%] in different grain sizes of the stream sediments of Wadi Yoider area, SED, Egypt.**

Size fraction	Ele-ment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
-2+ 1mm	U	9	7	3	5	7	8	12	7	2	7	1	6	3	10	5	5	1	1	1	1
	Th	20	23	17	14	13	18	17	27	13	15	1	17	10	26	14	19	15	0	4	6
	K(%)	3.37	3.55	3.80	2.87	3.49	3.9	2.8	2.8	4.43	3.43	4.6	3.03	3.76	2.91	4.46	3.69	3.49	2.36	1.7	1.93
-1+ .5mm	U	12	8	14	8	2	10	22	82	8	10	6	4	1	10	5	5	2	1	1	1
	Th	26	20	29	7	12	22	24	37	23	22	16	18	16	23	12	86	12	11	5	5
	K(%)	4.21	3.48	3.39	3.03	3.75	3.49	3.83	3.98	3.91	3.33	4.18	3.31	4.42	3.93	4.13	4.18	3.83	2.54	1.84	1.58
-1.5+ .25mm	U	28	12	73	5	1	48	18	13	28	27	21	17	27	6	16	7	B	3	1	1
	Th	77	29	171	13	12	08	27	42	66	46	50	38	75	36	47	27	24	13	5	5
	K(%)	2.56	2.4	2.89	2.03	3.37	2.97	3.21	3.2	3.11	3.18	3.39	4.23	2.82	4.76	3.17	3.11	3.6	2.16	1.46	1.57
-1.25+ .125mm	U	1	1	41	4	1	51	22	1	24	30	51	20	25	31	25	16	13	3	1	3
	Th	26	13	104	8	8	127	28	24	57	51	77	62	61	85	63	43	42	20	7	11
	K(%)	1.57	1.81	1.27	1.83	1.5	1.73	1.67	2.14	1.71	1.61	1.79	1.53	1.95	2.68	1.74	1.54	1.4	1.52	1.62	1.36
-1.125+ 065mm	U	6	4	17	4	4	22	20	6	14	36	36	16	18	43	60	14	1	5	3	3
	Th	11	11	37	13	11	51	33	13	35	39	75	36	33	74	11	28	26	20	2	21
	K(%)	1.25	1.42	1.3	1.76	1.12	1.67	1.69	1.4	1.55	2.07	.2	1.32	.64	1.76	2.04	1.36	1.2	1.49	1.39	1.26
-.063mm	U	10	6	19	5	4	15	35	8	12	48	4	24	23	44	54	54	4	4	41	44
	Th	19	15	56	14	7	36	41	18	31	58	50	46	35	44	00	59	38	30	20	63
	K(%)	1.37	1.15	4.37	1.25	1.21	2.05	2.98	1.35	2.6	2.69	4.21	2.51	2.79	1.59	6.57	3.41	2.61	2.36	2.25	3.29

- **Table (4): Calculated radioelement ratios (Th/U, K/U and K/Th) in different grain sizes of the stream sediments of Wadi Yoider area, SED, Egypt.**

Grain Size	Ratios	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Coars	Th/U	3	3	2	2	6	2	1	3	3	2	2	3	2	4	3	4	4	6	5	5

e and medium sand size	K/U*	2	3	1	4	18	1	2	3	2	2	3	3	2	5	3	6	7	12	16	16
	K/Th*	1	1	0	2	3	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3
Fine and very fine sand size	Th/U	2	4	2	3	3	2	1	5	2	1	2	2	2	2	1	2	5	5	5	5
	K/U*	2	5	0	5	4	0	1	2	1	1	0	1	1	1	0	1	2	4	8	4
	K/Th*	1	1	0	2	1	0	1	1	28	0	0	0	0	0	1	0	0	1	2	1
Silt + clay size	Th/U	2	3	3	3	4	2	1	2	3	1	13	2	1	1	1	1	10	8	0	1
	K/U*	137	192	230	250	303	137	85	169	217	56	###	105	121	36	122	63	653	590	55	75
	K/Th*	72	77	78	89	71	57	73	75	84	90	84	55	93	36	131	87	69	79	113	52

* (K/U) x 10^3; (K/Th) x 10^3.

- **<u>Table (5):</u> Radioelements contents [U, Th (ppm) and K%] in different grain sizes of the stream sediments of W. Ekwan area, SED, Egypt.**

Size fraction	Element	1	2	3	4	5
(<2-1mm)	U	4	-	-	-	-
	Th	11	9	10	9	5
	K%	4.5	3.32	3.29	2.71	2.98
(<1-0.5mm)	U	3	-	-	-	1
	Th	14	8	13	7	10
	K%	3.88	3.23	2.41	3.12	2.02
(<0.5-0.25mm)	U	8	5	10	-	7
	Th	44	17	39	15	23
	K%	2.42	2.58	2.0	1.85	1.62
(<0.25-0.125mm)	U	24	2	10	11	18
	Th	63	29	45	50	27
	K%	1.56	1.55	2.66	1.83	171

(-0.125-0.063mm)	U	15	5	6	4	41
	Th	34	20	44	35	54
	K%	1.59	1.26	5.96	2.68	5.35
<0.063mm	U	26	9	1	8	1
	Th	31	57	45	30	9
	K %	3.03	3.89 5.9-1	1.59	3.3	5.55

■ **<u>Table (6):</u> Calculated radioelements ratios (Th/U, K/U and K/Th) in different grain sizes of the stream sediments of W. Ekwan area, SED, Egypt.**

Grain size	Ratios	1	2	3	4	5
Coarse sand-medium sand size	Th/U	4.83	4.33	4.33	11	4.25
	K/U*	5.26	9.71	3.73	25	4.55
	K/Th*	1.09	2.24	0.86	2.26	1.07
Fine and very fine sand size	Th/U	2.45	6.25	5.63	5.38	1.37
	K/U*	0.79	2.27	5.38	2.99	1.18
	K/Th*	0.32	0.57	0.96	0.53	0.86
Silt + clay size	Th/U	1.19	6.33	45	3.75	9
	K/U*	116.54	432.22	5940	198.75	3300
	K/Th*	97.74	68.25	132	53	366.67

* (K/U) x 10^3; (K/Th) x 10^3.

■ **<u>Table (7)</u>: Radioelements contents [U, Th (ppm) and K%] in different grain sizes of the stream sediments of W. Eihimbai area, SED, Egypt.**

Size fraction	Element	1	2	3	4	5
(<2-1mm)	U	-	-	3	2	-
	Th	6	6	12	11	7
	K%	3.18	3.39	2.97	3.35	2.98
(<1-0.5mm)	U	-	1	-	2	1
	Th	8	7	11	12	7
	K%	2.76	4.25	2.66	3.71	3.39
(<0.5-0.25mm)	U	1	5	5	4	1
	Th	8	19	27	16	7
	K%	2.29	3.16	2.19	2.98	3.24
(<0.25-0.125mm)	U	1	2	10	9	3
	Th	12	21	31	26	15
	K%	1.55	1.68	1.63	1.46	1.67

(-0.125-0.063mm)	U	6	6	4	12	6
	Th	16	17	7	18	22
	K%	2.14	0.92	0.91	1.45	1.2
<0.063mm	U	36	27	1	75	14
	Th	40	48	37	35	24
	K%	2.64	1.59	1.71	1.85	1.6

- **Table (8): Calculated radioelements ratios (Th/U, K/U and K/Th) in different grain sizes of the stream sediments of W. Eihimbai area, SED, Egypt.**

Grain size	Ratios	1	2	3	4	5
Coarse sand-medium sand size	Th/U	8	4.33	6.33	4.67	7
	K/U*	25	12.38	8.26	11.11	33.33
	K/Th*	3.16	286	1.31	2.39	4.74
Fine and very fine sand size	Th/U	3.5	4.75	2.71	2	3.8
	K/U*	4.63	4.5	2.53	1.33	2.88
	K/Th*	1.32	0.95	0.93	0.66	0.76
Silt + clay size	Th/U	1.11	1.78	37	0.47	1.71
	K/U*	117.5	134.07	950	42.93	117.86
	K/Th*	105.75	75.42	25.68	92	68.75

* (K/U) x 10^3; (K/Th) x 10^3.

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