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Mineral Recource Prospecting and Evaluation of Dry Stream Sediments of Wadi UmmGheig– Umm Naggat Area, Eastern Desert, Egypt

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ABSTRACT: The area of Wadi Umm Gheig-Umm Naggat is located at the central part of the Eastern desert, Egypt, 50km south to El-Quseir city at the Red Sea coast. The area is dominated by metavolcanics, Older Granites, Dokhan Volcanics, intrusive cumulate gabbro and Younger Granites. This works focuses on heavy minerals distributed in dry stream sediments of Wadi Umm Gheig and Gabal Umm Nagat. The study has followed up the traditional methods for sample collection from the stream sediments and the plane study for investigation and prospecting, as well as evaluation of heavy mineral deposits.

The studied bed rocks are represented mainly by monzogranite, alkali feldspar granite, syenogranite and alkali granite. The investigated heavy minerals dominating the stream sediments are given by magnetite, ilmenite, rutile, leucoxene, zircon, fluorite and apatite arranged in decreasing orderas percentages of abundances. Few trace minerals are detected in some samples like thorite and monazite, and xenotime as well. The evaluation of heavy minerals concentration reveals higher concentration of magnetite, ilmenite and zircon at the western sector, while fluorite show random distributions within the stream sediments area.

KEYWORDS: Stream sediments, heavy minerals, magnetite, ilmenite, zircon, fluorite, thorite, monzonite,evaluation.

INTRODUCTION

The outcropping rocks of Arabian-Nubian Shield at Central Eastern Desert (CED) of Egypt are given by gneisses, ophiolites, island-arc metavolcanics and their volcaniclastic associations, as well as subducted related plutonic rocks together with within plate mature volcanic rocks and clastic sediments. These rock assemblages were intruded by mafic, intermediate and acidic, syn-to late- and post-tectonic older and younger granites rocks. Later, post granite dykes invaded most of the previously mentioned rocks. Wadi Um Gheig area lies in the Central Eastern Desert, south west of Quseir City forming a part of the Neoporeterozoic evolution of the Nubian Shield in NE Africa. The Shield of NE Africa was Developed because of accretion of intraoceanic island arc, continental microplates, and oceanic plateaus during consolidation of Gondwana (Gass, 1982, Stern, 1994, Kröner et al., 1994, Abdelsalam and Stern, 1996).

Geological and tectonic setting of the basement rocks in the CED of Egypt particularly Umm Gheig-Umm Naggat area has been the focus of many workers (e.g. Kamal El Din et al., 1992; EGSMA, 1992; EI Gaby et al., 1994; Khudeir et al., 1995; Ibrahim and Cosgrove, 2001; Fowler et al., 20o7; Fritz et al., 2013; Abdeen et al., 2014; and others). Also, many authors are interested with studying heavy minerals concentrates in dry stream sediments of Central Eastern Desert (e. g. Harraz et. al., 2012, Abu El Leil et al.; 2015, Abdel Bary, 2018 and El-Metwally. et al., 2019& 2024).

Wadi Umm Gheig -Gabal Umm Naggat area is pertaining to the northern part of the Pan-African Arabian Nubian Shield of Wadi Umm Gheig district. The area is covered bymetavolcanics, Old Granites, mature within plate Dokhan volcanics, intrusive gabbros and Younger Granites and later post granite dykes. The dry stream sediments around Gabal Umm-Naggat area was selected for investigation. The aim of the present study is to investigate the occurrences and distribution pattern of heavy minerals and mineralization associated with stream sediments of Wadi Umm Gheig – Gabal Umm Naggat area, which covered mainly by monzogranites, alkali. Also the study aims to evaluate mineral deposits at the dry stream sediments of tha area. To achieve these goals, the following steps are conducted.

METHODS of SDTUDY

Sampling and Panning Technique

A total of thirty three stream sediment samples were collected at depth 50-60 cm to avoid the intake of the aeolian materials to heavy minerals content with size fraction of minus 1mm and sample weight was about 8-10 Kg. the distribution map of collected samples is given in (Fig. 1).

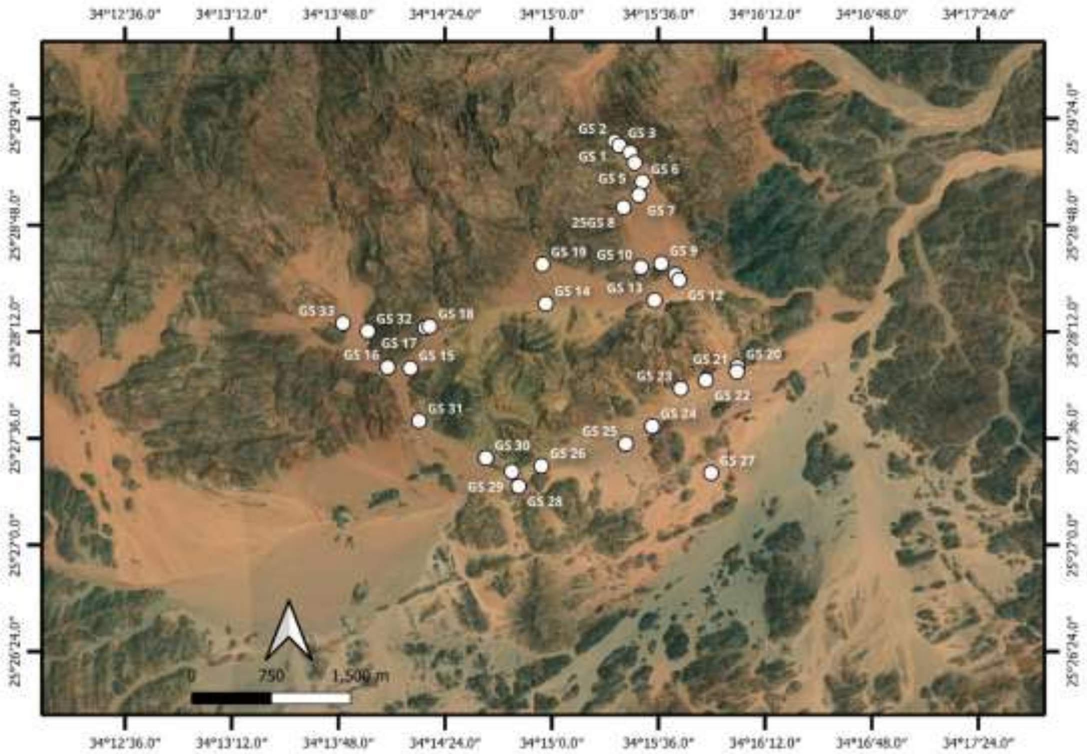

Fig. 1.Satellite image of Wadi Umm Gheig - G. Umm Naggat area shows locations of the studied stream sediment samples.

Panning of the stream sediment samples was undertaken toobtaine the interesting concentrates from the grain size < 2mm. Panning prospecting techniques (Rose et al., 1979; Soliman, 1981&1987) were performed to separate heavy concentrate from stream sediment samples. This was done by sieve 0.063 mm to remove clay minerals by using running water for washing. The obtained samples were dried and the rest were quartered using John's Splitter to obtain representative (60 to 100gm) sample for different mineralogical treatments from each one.

Gravimetric Separation

The panned concentrates were subjected to further concentration of heavy mineral using magnetic fractionation (using walefy table concentrate) and gravimetric separation. The gravimetric separation is used to separate heavy minerals from the light minerals by using heavy liquid (as bromoform (tribrom- methane $CHBr_3$, with specific gravity = 2.87). Each sample was put in a carrot shaped separating funnel of about 250ml volume contain a certain amount of bromoform the sample was stirred with a glass rod and left certain time. Each sample was separated into two main layers; the first layer, represents the float fraction and includes the light minerals as quartz, feldspars and calcite and the second layer, as a sink fraction and includes the heavy minerals. A glass funnel with filter paper was used for collecting the heavy fraction and light fraction. After complete filtration, each sample was washed by acetone or alcohol to remove all the intergranular heavy liquid (bromoform).

The light minerals are neglected and the heavy minerals are dried and weighted and then subjected to isodynamic magnetic separator by using the Frantz Isodynamic Separator (Model L-1). The operation conditionsare; transvers slop 5, longitudinal slop 20, step of current 0.2, 0.5, 1.0, 1.5 magnetic and 1.5 non-magnetic current amperes. Hence, five subfractions were obtained with different magnetic susceptibilities and these subfractions were subjected to different microscopic examinations to identify different mineral species and picking minerals to carry out identification and semi chemical analysis by Environmental Scanning Electron Microscope (ESEM). Evaluate of heavy minerals concentratesis calculated and represented in distribution maps. These investigations were done on the sand size less than 0.5mm. Mohamed (1998) stated that the total heavy minerals were concentrated in the medium, fine, and very fine sand fraction.

GEOLOGICA SETTING

Umm Gheig-Um Naggat area is located at the Central Eastern Desert of Egypt at the water shed of Wadi Um Gheig draining to the Red Sea and Wadi E1-Miyah draining to the Nile basin. The area lies between Latitudes 25° 26′ and 25° 29' N and Longitudes 34° 13' and 34° 16' E. The lithostratigraphic rock units cropping out in the study area comprise metavolcanics, Old Granites, DokhanVolcanics, intrusive cumulate gabbros, Younger Granites and alkaline granites, as well (Fig. 2).

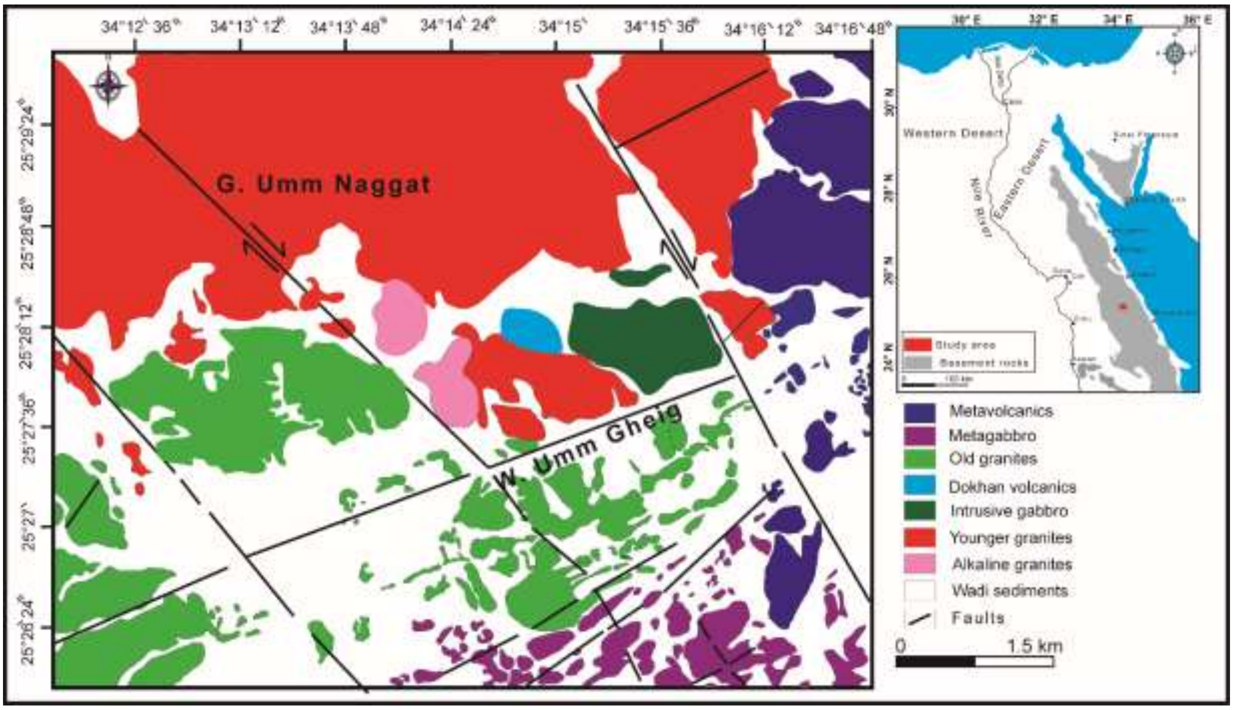

Fig. 2. Geological map of Wadi Um Gheig- Gabal Umm Naggat area, Central Eastern Desert of Egypt.

Metavolcanics are characterized by moderate to low relief, with deep grey colour. They are found in several localities in the north-eastern parts of the studied area (Fig. 2). The contacts between metavolcanics and Younger Granites are usually irregular and sharp. Metavolcanic rocks were interpreted as old metavolcanics of low-K tholeiitic basalts, which are member of ophiolite rock sequence belongs to the island arc association (Stern, 1981; El Gaby et al., 1988).

Older Granites are characterized by moderate to low relief hills of coarse-grain size. They are found at the southern and eastern sector of the studied area. Old granites host microgranular mafic enclave of variable sub-rounded to sub-angular shapes and different size (Fig. 3a). Old Granites have grey to pale grey colours relative to the volumetric per cent of mafic minerals. The composition of the rocks ranges from quartz diorite, tonalite to granodiorite. The rocks are composed of variable percentages of plagioclase, hornblende, biotite and quartz.

The studied area was extruded by **Dokhan Volcanics** at central sector. They have characteristic layers of different basic and intermediate varieties of porphyritic volcanic rocks and porphyry-types, as well. The layers vary in thickness from 1.8m to 12.7m. They form cone-like and cross cut by acidic dyke (1.3m in width). These volcanic varieties composed of porphyritic and porphyry andesite, dacite and basalt, the later out crops as a cape of the extrusive rock (Fig. 3b). They vary in colour from black, pale purple, brown and pale brown. The rocks have both porphyritic and porphyry textures. The rocks are formed of phenocrystals of plagioclase embedded in a matrix of plagioclase, hornblende, biotite, K-feldspar and quartz.

Intrusive cumulate gabbro forms moderate to low mountains releifs and shows intrusive sharp contacts with the invaded rocks. They are not recorded in the area in previous studies. They are dark grey of coarse-grained rocks. They are found in the central-eastern sector of the studied area with clear sharp intrusive contacts with the invading Younger Granites. They constitute of troctolite, gabbro and hornblende gabbro. These rock varieties are composed of plagioclase, olivine, enstatite, augite, and hornblende.They are characterized by orthocumulate and biokilitic textures (Fig. 3c).

The granite rocks crop out at the studied area forming an oval shaped body and characterized by a huge mass possessing the highest relief terrains with irregular boundaries at its eastern side and flatness in the E –W direction. It is composed mainly of medium- to coarse-grained, red cultoured granite (Fig. 2d). The rocks comprise four granitic types, monzogranite, syenogranite, alkali feldspar granite and alkaline granites. Monzogranite is mainly composed of quartz, K-feldspar, plagioclase and biotite. Zircon, apatite, allanite, sphene and opaques are the main accessories. Syenogranite composes of quartz, plagioclase, K-feldspars, biotite and accessory opaques and allanite. Alkali feldspar granite is mainly composed of K-feldspar microperthite, microcline microperthite, plagioclase, antiperthite, quartz, biotite, and muscovite. Alkaline granites are composed of K-feldspars, aegirine, arfvedsonite, riebeckite and quartz. Episyenitation process is conducted at the northern sector of the pluton because of quartz leaching out with red colouration due to the high percent of K-feldspars rich in Rb element. It noticed that wadies in the eastern part of Umm Naggat granitic pluton is covered by red coloured of dry stream sediments (Fig. 3d)m which are derived from the country red granites.

Figure3.a- Close view showing subrounded large microgranular mafic enclave hosted in old granites, b.Dokhan volcanics showing basalt cape rock at the top of variable color rocks and layered rocks, c- Gabbro with appinite appearance showing very coarse hornblende and labradorite crystals, d- High picks of alkali feldspar granite that shows the dry stream sediments of red color covering the whole wadi, e- Sliding surface along fault plane with special striation,and f- Highly sheared and altered alkali feldspar granite of Umm Gheig-Umm Naggat area.

The contacts of the granite dip steeply towards the country rocks. At the eastern sector of alkali feldspar granite, the rock suffered is marked by combined normal and right lateral fault with sliding surface showing characteristic L-shape striation along fault plane (Fig. 3e). On the northern side, the form of the granite is complicated by several dome shaped projections up to 1km in diameter which created favorable structures for intensive metasomatic alteration of the original granite (Fig. 3f) and may be the formation of ore mineralization (Sabet et al., 1976). The granite rocks show a series of metasomatic alterations. The central and the southern parts of the massif are mainly composed of unaltered coarse-grained alkaline granite with characteristic alkali amphibole (arfvedsonite and riebeckite) and alkali clino-pyroxene (aegirine - acmite and aegirine). Pegmatite bodies of lensed shape up to 3.0m long and 1.2m wide are observed along the north marginal zone of alkaline granite. Um Naggat granite has sharp contacts with and later intruded into older granites from the south west and metagabbro and metavolcanics from northern, eastern, and south western parts.

PETROGRAPHY

The rocks crop out at the area are metavolcanics, Older Granites, Dokhan Volcanics, intrusive cumulate gabbros and Younger Granites. The present study concerns mostly with Younger Granite rocks as the main feed of stream sediments of the area.

Metavolcanic rocks constitute mainly of metandesite. The rocks composed of plagioclase (andesine to oligoclase), hornblende, biotite, and minor quartz. The rocks are suffered from alteration and metamorphism in the green schist facies. Plagioclase is the dominant mineral and form euhedral to subhedral elongate crystals range from 1.8mm to 0.5mm in dimensions. The crystals have minute crystals of epidote, carbonate, and chlorite due to metamorphism. Hornblende and biotite occur as euhedral to subhedral fine-grained crystals. Accessory minerals are opaques, sphene and apatite.

Older Granites comprise quartz diorite, tonalite and granodiorite. Quartz diorite rock composes of plagioclase (andesine to oligoclase), hornblende, biotite and quartz and accessory opaques, sphene and zircon. Plagioclase forms elongate subhedral crystals (0.9 – 5.1mm across) and may show resorbed core alteration to kaolinite, sericite and illite (Fig. 4a). Hornblende crystals occur as green to dark green euhedral elongate and six sided crystals and have 1.2 – 4.8mm dimensions. Biotite flacks range from 0.8mm to 3.9mm across and may show iron oxide absorption along cleavage plains. Sphene form euhedral rhombic to subhedral honey brown crystals. Zircon occurs as prismatic grains associated with biotite and sphene crystals.

DokhanVolcanics present as an extrusive plug characterized by layered rocks of basalt, andesite and dacite in composition. The rocks are fresh and have porphyritic and porphyry texture. They constitute of plagioclase phenocrystals embedded in a matrix of plagioclase, hornblende, biotite, and quartz crystals. Opaque, sphene and zircon grains are accessories. Plagioclase phenocrystals range from 1.9mm to 3.7mm in long dimensions. They range from labradorite in basalt through andesite to oligoclase in basalt, andesite and dacite respectively. Hornblende occurs as fine-grained crystals and suffer from alteration to chlorite. Biotite flakes form minute crystals and show alteration to chlorite.

Intrusive cumulate gabbros constitute of troctolite, gabbro and hornblende gabbro. The rocks are marked by orthocumulate textures and the occurrence of poikilitic texture with augite oikocrysts exhibited many euhedral labradorite plagioclase crystals (Fig. 4b). These gabbros compose of cumulus olivine, enstatite, plagioclase, and augite crystals and intercumulus augite and hornblende.Troctolite builds up of plagioclase, olivine, enstatite as cumulus phase and intercumulus augite crystals. Olivine crystals form subhedral to sub-rounded grains marked by cracks filled by chlorite and opaques. Olivine and enstatite are characterized by reaction rims. Plagioclase forms euhedral elongate crystals of labradorite (An_{43-64}) and reach up to 3.4mm long and 2.2mm in width. Cumulus augite usually forms euhedral to subhedral crystals of 1.6mm to 3.5mm across, while the intercumulus augite forms subhedral very coarse-grained crystal (3.9mm – 6.7mm in dimensions) hosted many labradorite euhedral laths.

Younger Granites of the map area constitute of monzogranite, syenogranite, alkali feldspar granite and alkaline granite. The rocks are characterized by coarse-grains (2.3 – 4.2mm across) and exhibite perthitic and antiperthitic textures. **Monzogranite** forms of plagioclase, K-feldspar, quartz, hornblende and biotite (Fig. 4c). Accessory minerals are opaques, sphene, allanite and zircon. Opaques are present in subordinate amounts in the studied granites. Plagioclase form elongate crystals of oligoclase in composition (An_{12-18}). K-feldspars are represented by orthoclase and orthoclase microperthite. They form elongate to stubby crystals and have corroded margin and interaction of quarts grains as an envelope. Quartz fill spaces between the major constitutes. **Syenogranite** compose of orthoclase, perthite, microcline, plagioclase, quartz, and biotite. Accessories are opaque minerals. The rock is marked by microperthitic and antiperthitic textures with markable interpenetrating, rods, and strings-types (Fig. 4d). Plagioclase show resorbed core. Quartz usually fills spaces between the other major constituents.

Alkali feldspar granite constitutes of orthoclase, orthoclase microperthite and microcline microperthite, plagioclase, biotite and muscovite and accessory opaques and allanite. K-feldspars form medium- to coarse-grain crystals of euhedral to subhedral elongate crystals. They suffer from alteration to kaolinite and sericite. Orthoclase microperthite and microcline microperthite are marked by different types of plagioclase overgrowth and replacements. Strings, rods, beads, interpenetrating and replacement-types of perthite (Figs. 4e & f) and antiperthite are recorded. Plagioclase is given by albite and rare oligoclase (An_{8-14}) showing resorbed cores due to alteration. The rock exhibits microperthitic and antiperthitic texture.

Alkaline granite composes of oligoclase, aegirine, aegirine–acmite, arfvedsonite, riebeckite, orthoclase microperthite (Fig. 4) and quartz. Opaques, sphene and allanite are accessories. Oligoclase has euhedral to subhedral grains with anorthite content varies from An_{11} to An_{16}.They show resorbed cores due to suffering from alteration to kaolinite, illite and sericite. Aegirine (Fig. 4g) and aegirine–acmite (Fig. 4h). form euhedral to subhedral elongate crystals and vary in colours from dark green, green to brownish green and have 2.3mm to 3.3mm across.Arfvedsonite and riebeckite vary in colours from blue to dark blue and form minute to medium-grain crystals (0.5 – 2.7mm).

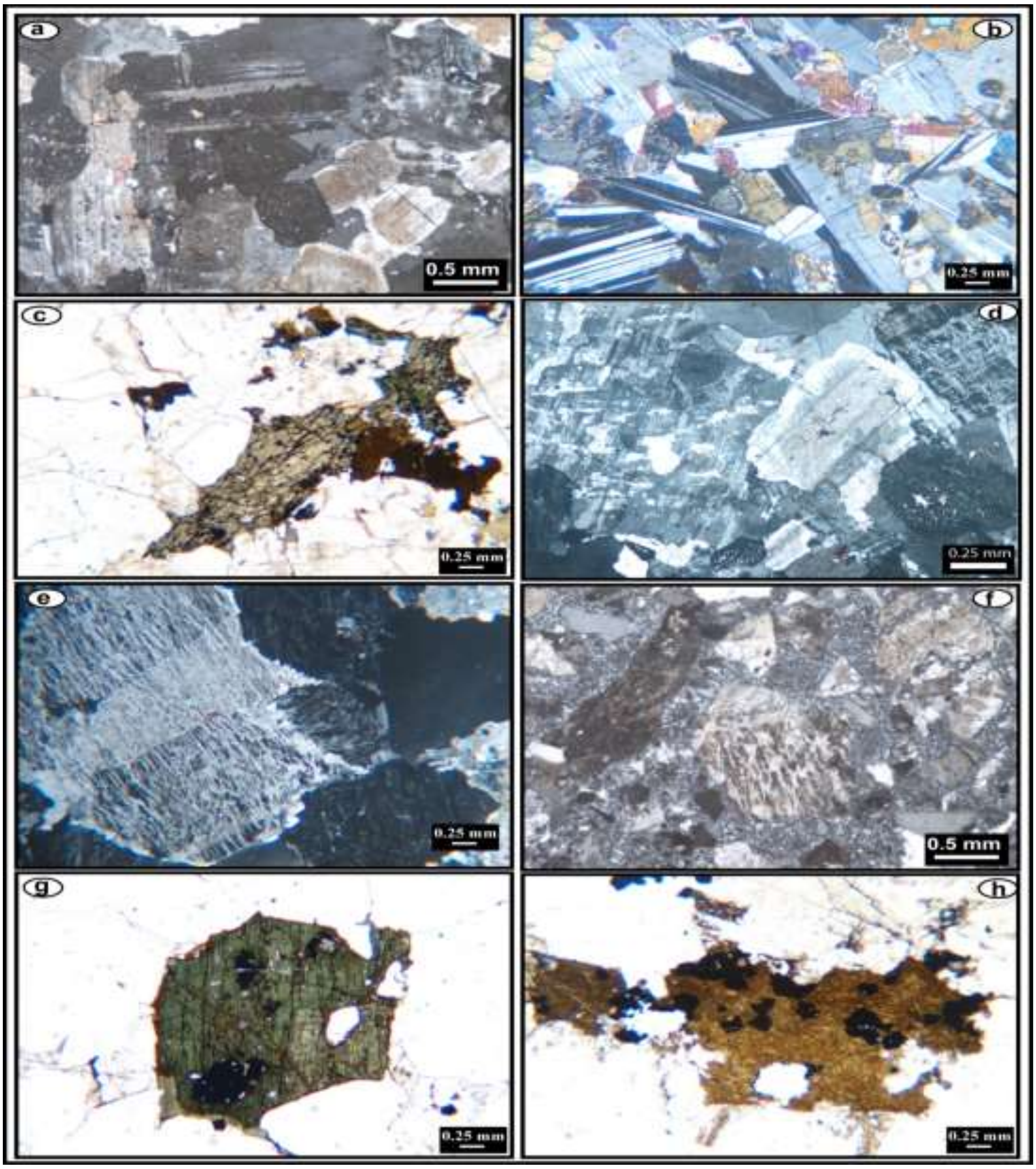

Figure 4. a. Quartz diorite shows resorbed core altered plagioclase crystals, orthoclase, and space filling quartz, b. Intrusive gabbro showing cumulus and poikilitic textures, c. Elongate hornblende crystal adsorbed iron oxide along cleavage plains in association with monzogranite d. Syenogranite shows antiperthitic texture of rods-type, microcline, and resorbed core plagioclase, e. Strings and rods-type perthite showing interaction with quartz grains in alkali feldspar granite,f. Brecciated alkali feldspar granite showing seriated phenocrystals of strings and patchy-types orthoclase microperthite embedded in fine grained quartz, g. Alkaline granite shows aegirine crystals show resorbed rhombic opaque grains and h. Alkaline granite showing riebeckite, aegirine-acmite crystals with opaque grains over growths.

RESULTS

Heavy Mineral separation

The treatment of heavy concentrates by using heavy liquid (Sp.G.=2,87) separates heavy minerals part from light minerals. Heavy minerals part was weighted and recorded in Table (1) and then subjected to isodynamic magnetic separator.

Table (1) Samples weight to be separated by bromoform and then by isodynamic magnetic separator.

Sample No.	Sample Wt.gm.	Heavy minerals Wt. gm.	Total heavy minerals Wt. %	Mgagnetic Separator Wt.%
1	71.04	15.21	21.4	11.96
2	51.52	1.07	2.1	0.6
3	52.71	4.1	7.8	0.2
4	58.09	9.91	17.1	2.2
5	52.81	3.94	7.5	0.21

6	61.26	3.2	5.1	0.2
7	73.86	5.8	7.9	00.3
8	62.92	29.1	46.3	24.6
9	58.4	4.4	7.6	0.19
10	62.16	8.4	13.6	1.13
11	53.95	4.1	7.6	0.23
12	77.1	3.64	4.7	0.2
13	68.91	4.3	6.2	0.22
14	60.25	2.8	4.6	0.13
15	47.24	5.8	12.2	0.31
16	57.57	1.2	2.1	0.4
17	56.27	6.04	10.7	1.1
18	57.33	9.7	16.9	9.4
19	64.26	2.9	4.6	0.9
20	56.44	5.84	10.3	1.3
21	46.43	4.1	8.2	0.3
22	48.75	4.3	8.8	0.32
23	65.73	3.6	5.5	0.2
24	50.87	7.2	14.2	2.1
25	52.47	6.5	12.4	1.7
26	60.07	7.5	12.5	2.5
27	70.11	8.9	12.7	1.6
28	55.07	6.8	12.3	2
29	55.0	3.6	6.6	0.14
30	61.67	3	4.9	0.2
31	43.75	2.3	5.3	0.2
32	42.68	1.8	4.2	0.12
33	43.74	1.8	3.8	0.14
Min.	42.68	1.07	2.1	0.12
Max.	77.1	29.1	46.3	24.6
Ave.	57.6	5.84	9.93	2.04

By using the Frantz Isodynamic Separator (Model L-1), the operation conditions are; transvers slop 5, longitudinal slop 20 and step of current 0.2, 0.5, 1.0, 1.5 magnetic and 1.5 non-magnetic current amperes. Five sub-fractions were obtained according to different magnetic susceptibilities. These sub-fractions were subjected to microscopic examinations to identify heavy minerals, as well as picking mineral grains to carry out scanning and semi-quantitative analysesby Environmental Scanning Electron Microscope (ESEM) at Nuclear Materials Authority of Egypt. The identification of the main constituents of heavy minerals and the evaluation of theirevaluation of concentrations are listed in Table (2).

Table (2) Evaluation of heavy minerals in dry stream sediments of Umm Gheig-Umm Naggat area.

S. No.	Mg.%	Ilm. %	Rut. %	Leuc. %	Zr. %	Flur. %	Apat. %	Heavy Min. %	G. S. %	Total heavies%
1	11.96	4.2	0.01	0.001	0.5	0.3	0.001	16.97	4.43	21.4
2	0.35	0.2	0.01	0.001	0.25	0.2	0.001	1.01	1.087	2.1
3	0.5	0.4	0.03	0.001	0.4	0.42	0.004	1.8	6	7.8
4	2.2	0.9	0.02	0.001	0.5	0.3	0.002	3.92	13,2	17.1
5	0.21	0.2	0.01	0.002	0.4	0.2	0.001	1.02	6.5	7.5
6	0.2	0.1	0.03	0.002	0.2	0.2	0.002	0.73	4.4	5.1
7	0.3	0.2	0.01	0.003	0.3	0.3	0.001	1.11	6.8	7.9
8	24.6	5.1	0.01	0.004	1.2	0.1	0.001	31.02	15.3	46.3
9	0.19	0.14	0.02	0.002	0..5	0.4	0.003	1.26	6.3	7.6
10	1.13	0.8	0.02	0.001	0.9	0.3	0.003	3.15	10.5	13.6
11	0.23	0.1	0.01	0.002	0.3	0.4	0.002	1.04	6.6	7.6
12	0.2	0.13	0.03	0.003	0.4	0.3	0.001	1.06	3.6	4.7
13	0.22	0.11	0.04	0.001	0.6	0.3	0.002	1.27	4.9	6.2
14	0.13	0.12	0.01	0.001	0.2	0.2	0.002	0.66	3.9	4.6
15	0.31	0.15	0.02	0.001	0.3	0.1	0.001	0.88	11.3	12.2

16	0.4	0.1	0.01	0.001	0.1	0.1	0.001	0.71	1.4	2.1
17	1.1	0.8	0.03	0.002	0.4	0.3	0.003	2.64	8.1	10.7
18	9.4	2.3	0.01	0.002	0.1	0.3	0.003	12.12	4.8	16.9
19	0.9	0.16	0.01	0.003	0.3	0.4	0.002	1.78	2.8	4.6
20	1.3	0.7	0.02	0.004	0.2	0.5	0.001	2.73	7.6	10.3
21	0.3	0.1	0.02	0.002	0.1	0.5	0.002	1.02	7.2	8.2
22	0.32	0.15	0.01	0.001	0.1	0.3	0.002	0.88	7.9	8.8
23	0.2	0.14	0.03	0.002	0.3	0.3	0.001	0.97	4.5	5.5
24	2.1	0.9	0.03	0.000	0.2	0.2	0.001	3.43	10.8	14.2
25	1.7	0.8	0.01	0.0001	0.4	0.2	0.003	3.11	9.3	12.4
26	2.5	1.3	0.02	0.0002	0.1	0.1	0.003	4.02	8.5	12.5
27	1.6	1.0	0.01	0.003	0.1	0.1	0.002	2.82	9.9	12.7
28	2	0.9	0.03	0..001	0.2	0.2	0.001	3.33	8.97	12.3
29	0.14	0.2	0.01	0.002	0.3	0.3	0.002	0.95	5.7	6.6
30	0.2	0.3	0.01	0.001	0.2	0.2	0.002	0.913	3.99	4.9
31	0.2	0.22	0.02	0.001	0.1	0.4	0.001	0.94	4.4	5.3
32	0.12	0.15	0.02	0.001	0.2	0.2	0.001	0.69	3,5	4.2
33	0.14	0.2	0.01	0.001	0.1	0.2	0.001	0.65	3.2	3.8
Min.	0.12	0.1	0.01	0.001	0.1	0.1	0.001	0.65	3.2	2.1
Max.	24.6	5.1	0.04	0.002	0.9	0.5	0.004	31.02	3.2	21.4
Ave.	2.04	0.71	0.018	0.0012	0.26	0.27	0.0018	3.35	3.2	8.7

Mineralogy

According to the identification of heavy mineral assemblages under binocular stereomicroscope they can be classified into two main groups according to Folk (1980). The first group is opaque minerals as; magnetite, and ilmenite. The second group is non-opaque minerals includes rutile, leucoxene, fluorite, zircon, and apatite.

Magnetite(Fe_3O_4); Magnetite was picked by hand magnet and the grains are characterized by rounded to sub-rounded shape and exhibit strong magnetic affinity (Fig. 5). Some magnetite grains shows different degree of alteration which lead to change of colour to red like martite. The percentages of magnetite in heavy fraction of stream sediments range from **0.12** % to **24.6** % with an average of **2.04.** The Semi quantitative analyses (EDX) show high iron content (Fig. 5).

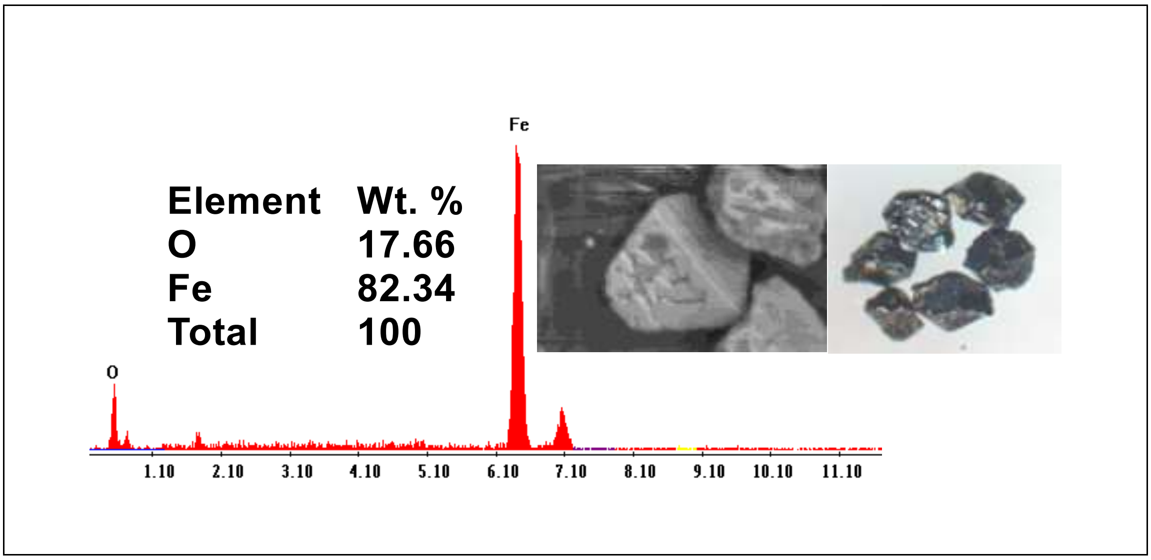

Figure (5). Show Photomicrographs and EDX and BSE of composite grain of magnetite.

Ilmenite ($FeTiO_3$); Ilmenite grains are concentrated in a relatively highly magnetic fraction at 0.2 amp. It is the most abundant Fe-Ti oxide mineral occurred in igneous and some metamorphic rocks and as detritus grains. Ilmenite in the studied samples occurs as irregular, tabular or massive sub-rounded angular grains (Fig. 6). These grains exhibit black to brownish black colours and submetallic to metallic luster. The brownish tint of some ilmenite grains may be due to the partial alteration of these grains. These mineral constituents range from 0.1 % to 5.1 % with an average of 0.71%. The Semi quantitative analyses (EDX) show high Fe and Ti (Fig. 6).

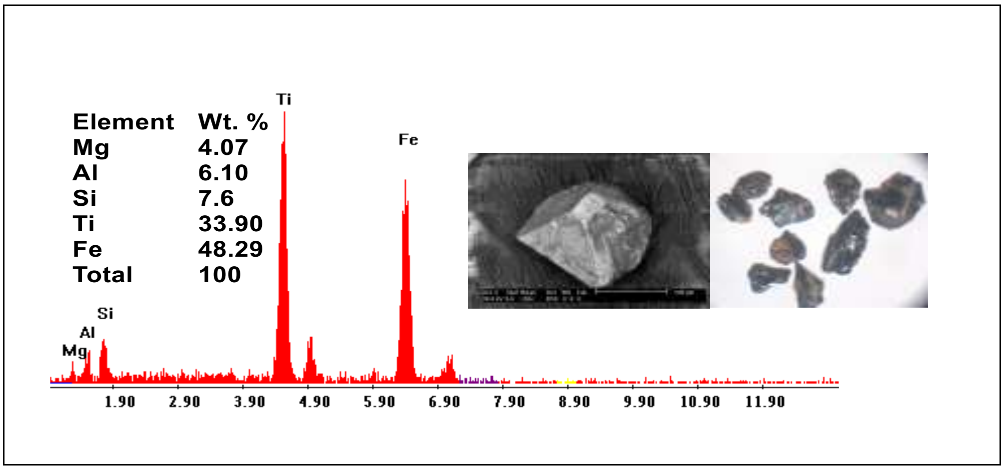

Figure (6). Show Photomicrographs and EDX and BSE of composite grain of ilmenite.

Rutile (TiO_2); Rutile grains are commonly subhedral to anhedral prismatic, elongated, tabular and massive. Rutile are reddish brown graded into red (Fig. 7) and black colour with adamantine luster. Rutile was recorded mostly in the non-magnetic fractions at 1.5 amp. and the magnetic fraction at 1.5 amp. The mineral constituents range from 0.01 % to 0.04 % with an average of 0.018 %/. The semi quantitative analyses (EDX) show higher Ti content with low content of Fe (Fig. 7).

Leucoxene represents the final transition phase during the alteration of ilmenite to form secondary rutile. It appears as amorphous materials and produced through a series of alterations of ilmenite, particularly under humid tropical conditions, where iron dissolves and titanium becomes relatively enriched. The final member in the alteration process is a mixture of leucoxene. The process of alteration is therefore, called leucoxenization. Leucoxenization only occurs above groundwater level and the influence of humid acids, which play an important role during the process. Disintegration of the ilmenite structure and formation of an amorphous iron/titanium oxide mixture have taken places. Finely, the amorphous TiO_2 recrystallizes as rutile and rarely anatase or brookite associated crystals. This crystalline mineral association consisting predominantly of TiO_2 and called leucoxene. The dissolution of the iron oxides induces the relative increase in TiO_2 and the reduction of magnetic susceptibility. Mücke and Chaudhuri (1991) were able to define the conversion of ilmenite to leucoxene series in a mineralogical and crystallographic context;Ilmenite ($FeTiO_3$) →“leached out” ilmenite →pseudo rutile ($Fe_2Ti_3O_9$) →“leached out” pseudo rutile ($FeTi_3O_6(OH)_3$) →leucoxene

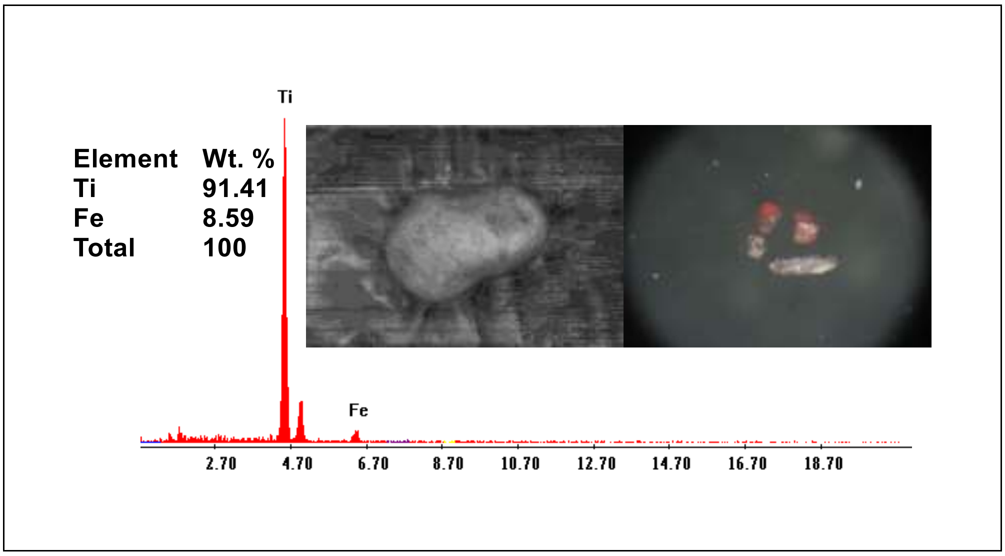

Figure (7). Show Photomicrographs and EDX and BSE of composite grain of rutile.

In the study area, leucoxene was separated at 0.5A and 1.0A by using Frantz Isodynamic Separator. It displays rounded and subrounded habits and smooth or pitted surface. It has yellowish brown and dark brown colour (Fig. 8). The evaluation of leucoxene range from 0.001 % to 0.002% with an average of 0.0012 %/. The EDX/BSE image of leucoxene is shown in Figure 8.

Zircon ($ZrSiO_4$); Zircon is a remarkable mineral due to its ubiquitous occurrence in crustal igneous, metamorphic and sedimentary rocks, as well as in mantle xenoliths, lunar rocks, meteorites and tektite (Speer, 1980). It occurs as euhedral to subhedral grains of long and short prismatic crystals with bi-pyramidal termination (Fig. 9 and 10). Zircon crystals exhibit colourless to yellow and yellowish brown colours of adamantine luster. The EDX chart shows the chemical composition of zircon (Fig. 10). The percentage of zircon occurrences ranges from 0.1 % to 0.9 % with an average of 0.26 %.

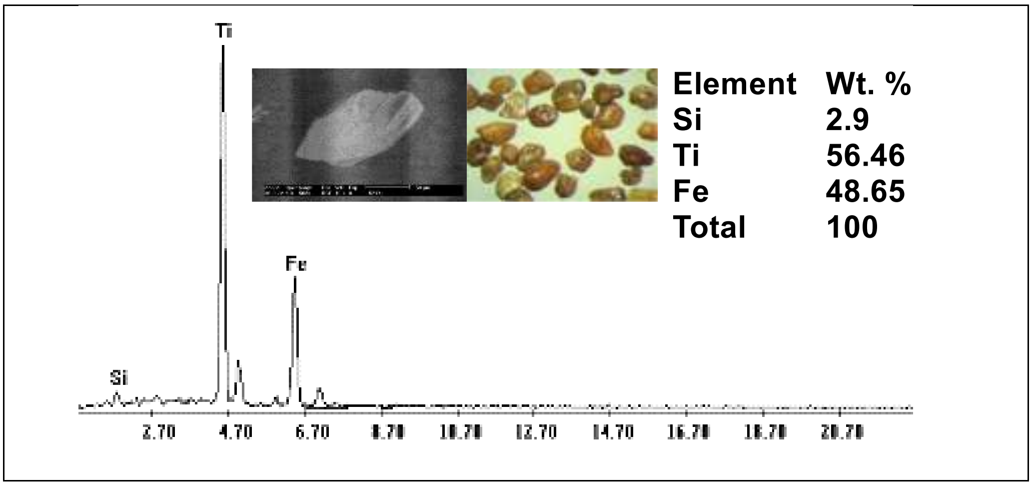

Figure (8). Show Photomicrographs and EDX and BSE of composite grain of leucoxene.

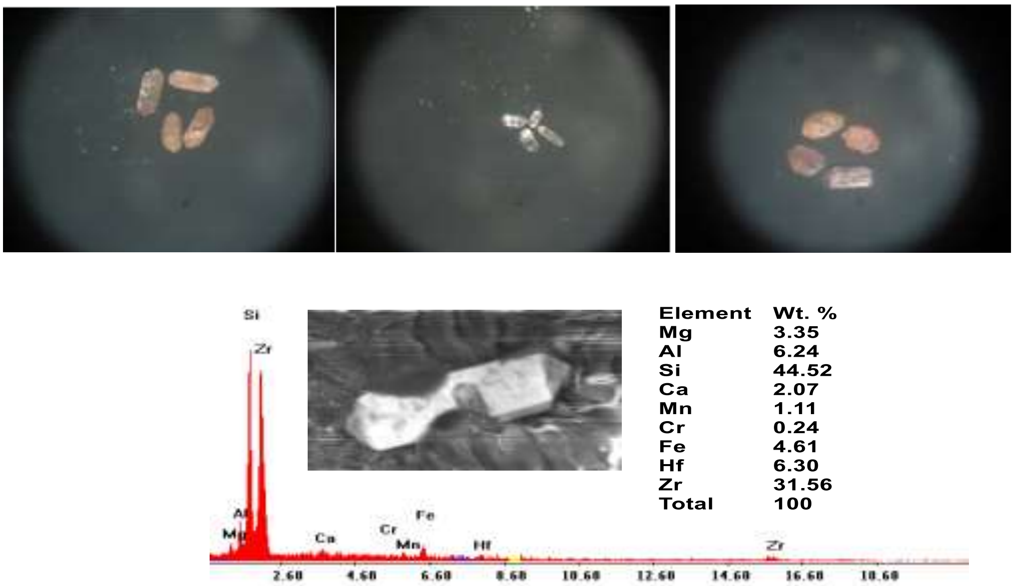

Figure 9, Show photomicrograph ofindevidualezircon grains and the EDX and BSE of composite crystal.

Apatite $Ca_5 (PO_4)_3F$; Apatite is the most common phosphate mineral and is the main source of the phosphorus required for plants nutrition. It was recorded in some studied samples. Its colours range from colorless to yellow and show oval grains (Fig. 10). The EDX/BSE gives image of apatite (Fig. 10). Apatite mineral concentrations in the studied stream sediments range from 0.001 % to 0.004% with an average of 0.0018 %.

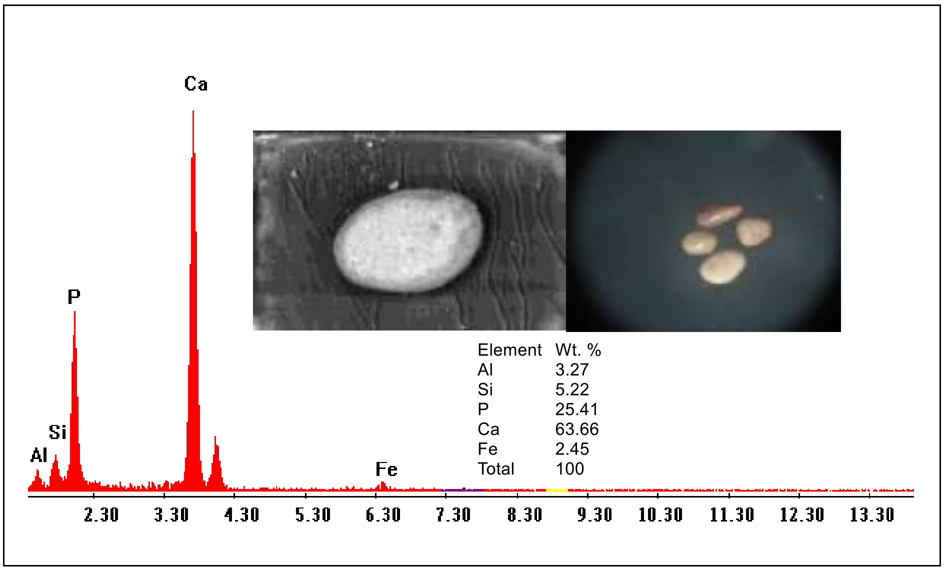

Figure 10, shows photomicrographs, EDX and BSE of composite grain of apatite.

Fluorite CaF_2 ;Fluorite (also known as fluorspar) occurs as fillings of micro fracture reflecting secondary origin from hydrothermal solutions. These fractures often contain metallic ores like sulfides of tin, silver, lead, zinc, copper and other metals. Fluorite is considered as an important industrial mineral since it inters in many chemical, ceramic and metallurgical industries. It shows colourless and yellow colours. Fluorite is common and recorded in all the examined samples of the studied stream sediments. The majority of fluorite grains were separated at magnetic field strength of 1.0A and 1.5A and the rest of fluorite are foundi n nonmagnetic fraction at 1.5A. It has colourless and white (Fig. 11). It is found as massive, euhedral (cube or octahedron), tabular, rounded and sub angular crystals. Fluorite mineral concentrations range from 0.1 % to 0.5 % with an average of 0.27 %. The Semi quantitative analyses (EDX) show high Ca content with moderate content of fluorite (Fig. 11).

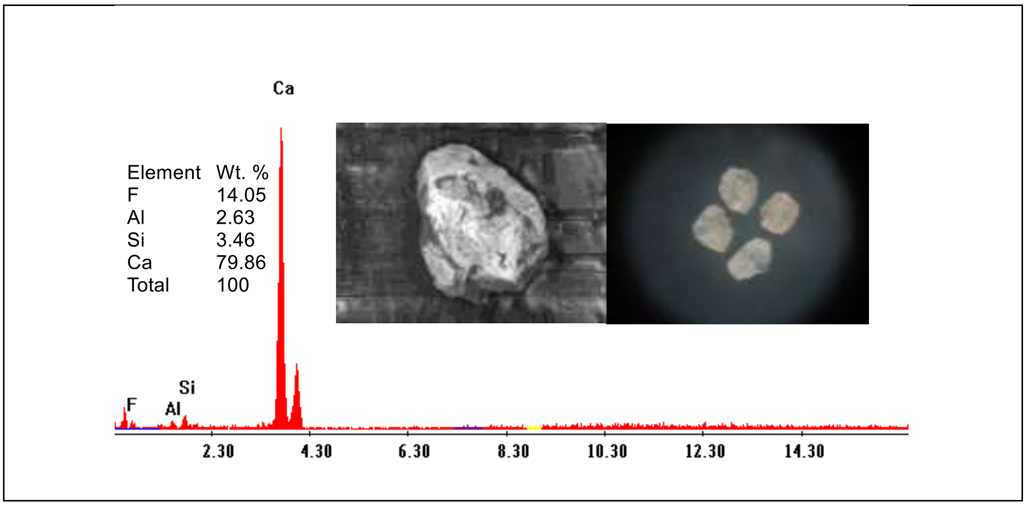

Figure 11, Show photomicrographs.EDX and BSE of individual and composite grains of fluorite.

Thorite [$ThSiO_4$]; Thorite occurs as primary mineral in granite pegmatite and pegmatite. It also occurs as an accessory mineral in black sands and other detrital deposits derived from gneissic or granitic terrains. Thorite belongs to the most important basic commercial minerals of thorium. It occurs in association with zircon, sphene, monazite, xenotime, allanite and various niobate-tantalates. Thorite almost has undergone extensive secondary alteration of both a structural and chemical nature. Structurally, the mineral may lose its crystallinity and assume a glass-like state in metamict state. It occurs as brownish black to black opaque grains of greasy luster. Most of thorite grains are subhedral to anhedral corroded and cracked (Fig. 12a). Rarely, euhedral prismatic thorite grains are present. Thorite is represented in studied samples by thorite, thorite with xenotime and potash field with xenotime and thotite (Fig. 12b-d).The per cent of mineral contents in the studied samples are traces, therfore don't evaluated. The ESEM analysis shows that thorite consists mainly of ThO_2 and SiO_2 with minor and trace elements include Y, U, Ca, Fe and REE (Fig. 12b-d).

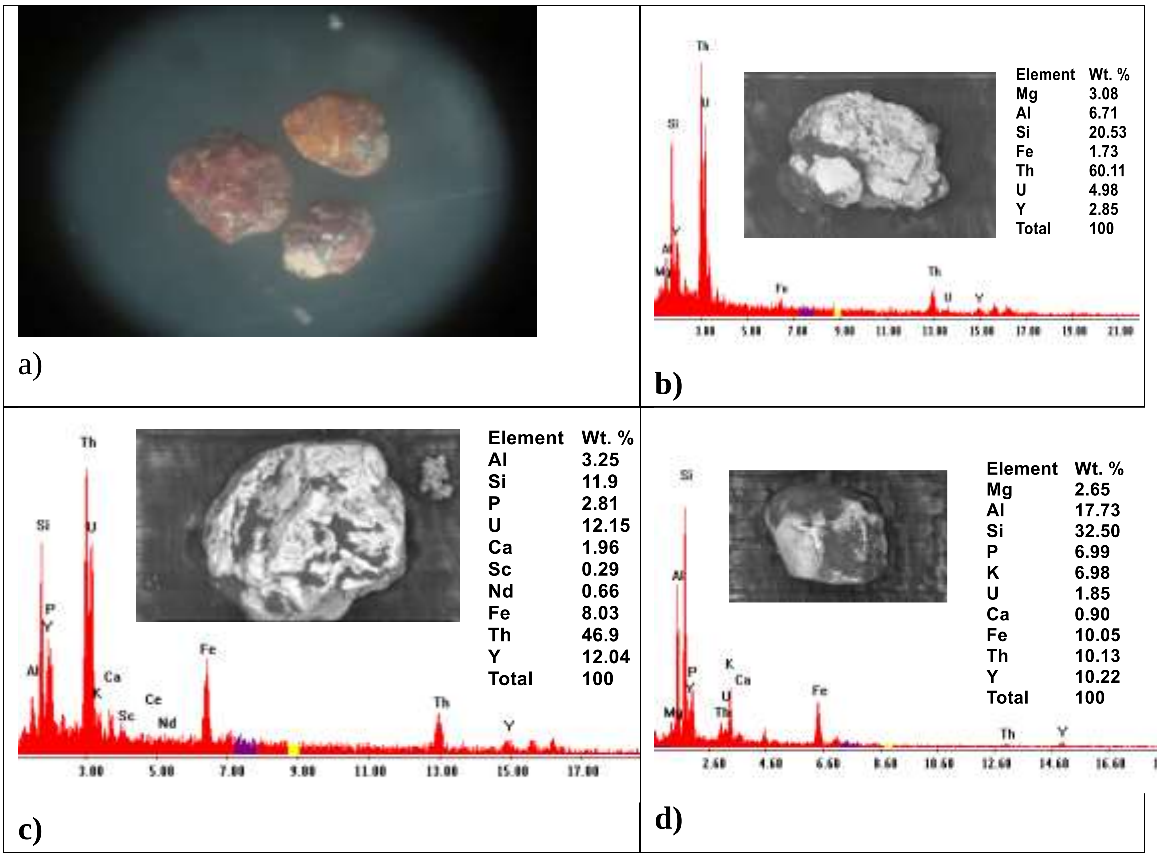

Figure 12. a- photographs of thorite grains, b- EDX chart with chemical composition, c- EDX and BSE of composite grain of thorite with xenotime and d- EDX and BSE of composite grain of K-feldspare with xenotime and thotite.

Monazite in associate with allanite; Monazite [$CePO_4$]is one of important nuclear minerals, being as a major host for REEs and actinides Th and U (Hinton and Paterson 1994, Bea et al. 1994, Bea 1996). Monazite is a rare-earth phosphate mineral that is widely available as a by-product from heavy mineral of black sand sparating operations. Monazite in the studied samples is rare and forms sub-rounded to well-rounded pale yellow, and honey yellow grains (Fig. 13). The mineral content in the samples are rare. Most of these grains are characterized by pitted surfaces. The ESEM analysis is given in Figure 13 and shows higher concentration of Ce, La, Nd and P and U and Th, as well.

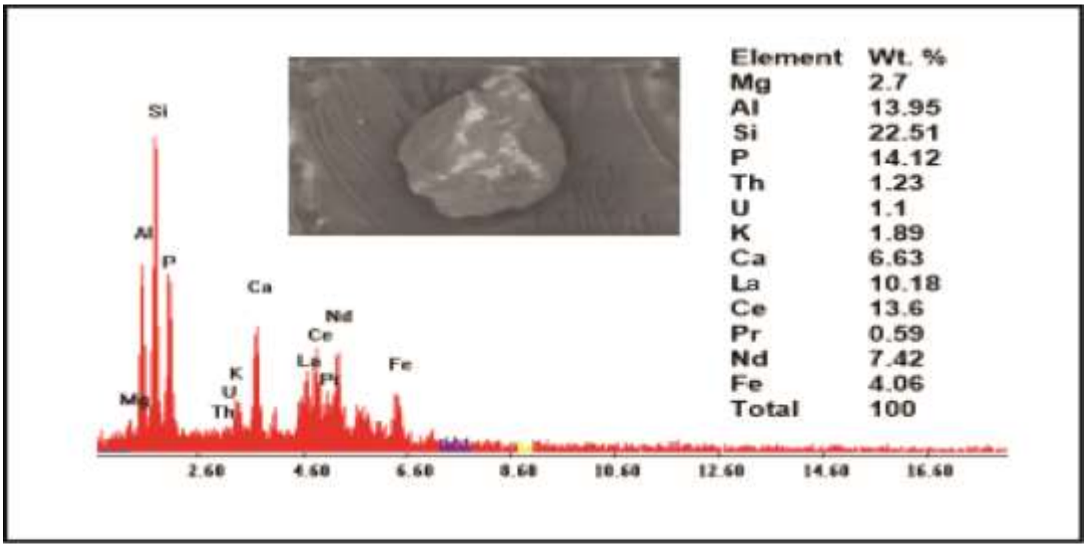

Figure 13,show EDX and BSE of composite grain ofmonazite with allanite.

Distribution maps

The Distribution mapsof the most abundant heavy minerals like magnetite, ilmenite, zircon and fluorite in the studied stream sediments is given in Fig. 14. The maps reveal that the intensive concentrations of magnetite are associated with higher concentrations of ilmenite and zircon. All are appeared at the eastern sector of the distribution map reflection their derivation from the country granite as a bed rocks. While, fluorite concentration map show random distribution in the studied stream sediments and supporting the evidences of their secondary origin.

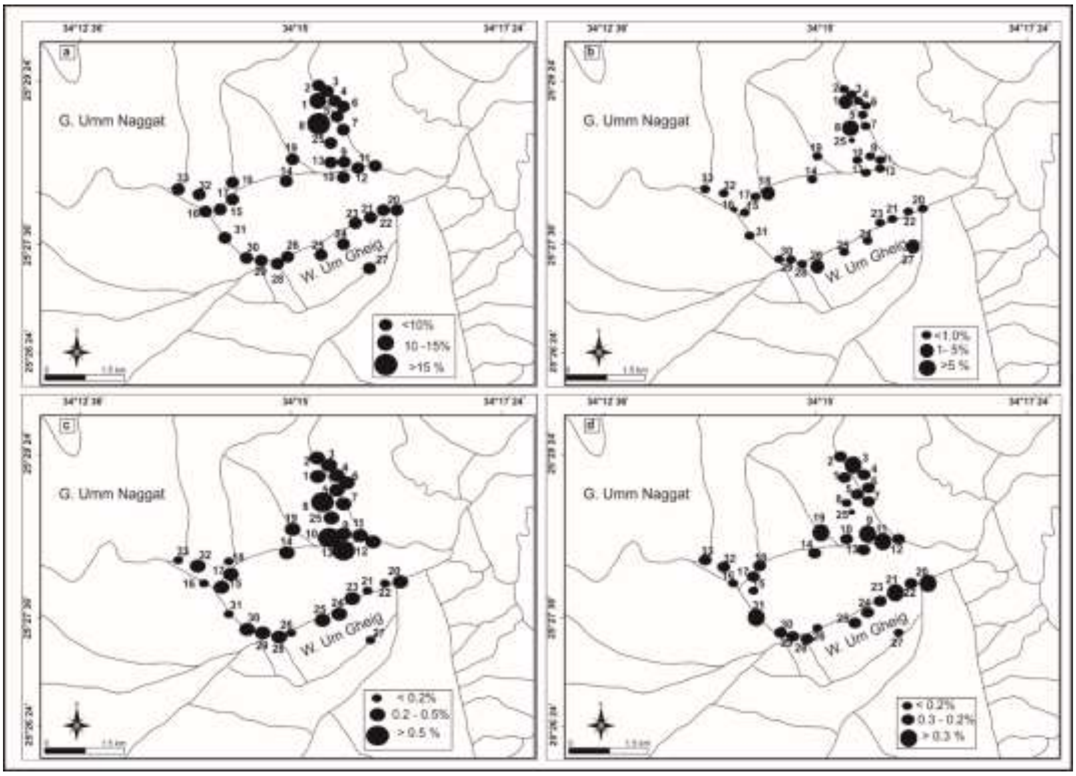

Fig.14. Distribution map heavy minerals shows the concentration of a- magnetite, b- ilmenite, c- zircon and d- fluorite in stream sediments at Umm Gheig–Umm Naggat area.

CONCLUTION

The studied Umm Gheig-Umm Nagat is covered mainly by monzogranite, alkali-feldspar granite, syenogranite and alkali granite with country rocks represented by metandesite, quartz diorite, tonalite and granodiorite, DokhanVolcanics and intrusive cumulate gabbros. The study dry stream sediments were derived mainly from monzogranite, alkali-feldspar granite, syenogranite and alkali granite. Different methods of investigation and evaluation of heavy minerals separated from the stream sediments were conducted and the results are given and analysed. The weight of heavy fractions after panning and subjected to bromoform separation is in between 42 and 77gm with average 57.6gm. The total heavies range between 1.07gm and 29.1gm with an average = 5.84gm. Heavy minerals in the studied stream sediments are given by magnetite, ilmenite, rutile, leucoxene, zircon, fluorite and apatite in relative decreasing order concentrations. Thorite and monazite are in rare occurrences.

The evaluation of the separated heavy minerals from the studied stream sediments reveals that, magnetite and ilmenite attain relative higher concentrations with average values =2.04gm and 0.7gm and the maximum contents =24.6 and 5.1gm respectively. Where, the most intensive concentrations of magnetite and ilmenite are recorded at the western sector of the area study. While, zircon, rutile and fluorite are present in relatively minor amounts and ranges from o.o4, 0.9 and 0.5 as maximum values respectively. Distriburion maps reveal that the easternpart of the studied area possesses the higher concentration of magnetite, ilmenite and zircon and derivation from the country granite bed. On the other hand, fluorite shows uncertain distribution among the stream sediments of the area study.

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