Nuclear Materials Authority
P.O.Box 530 Maadi, Cairo, Egypt

ISSN 2314-5609
Nuclear Sciences Scientific Journal
vol. 2, p 83 - 97
2013

WADI LADID AL-JI,DAN ALKALI FELDSPAR GRANITES AND ASSOCIATED PEGMATITES, NORTH EASTERN DESERT, EGYPT: GEOLOGY, MINERALOGY AND RADIOACTIVITY

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ABSTRACT

This article deals with the geology, structure, mineralogy and radioactivity of the alkali feldspar granites at wadi Ladid al-Ji,dan, north Eastern Desert of Egypt. Geologically, the area consists mainly of alkali feldspar granites. These granites are medium to coarse grained, pink to red in colour and form numbers of moderate to relatively high elevated outcrops. These rocks are altered in some parts due to secondary processes especially along the fault zones and contacts.

The area displays primary and secondary structures. Primary structures comprise layering, volcanic flows, vesicular tops of lavas and volcanic bombs. The secondary structures are represented by exfoliation, joints and faults. The granites are dissected by several sets of joints predominating in the N-S direction, dipping 84^0-88^0 mainly to west; E-W direction, dipping 70^o-75^o mainly to south and NW-SE direction, dipping 80^o-82^o to SW direction. The majority of joints are tension ones. These tension joints are commonly filled with quartz, feldspars, epidote, iron oxides, manganese oxides and aplite. The studied area is dissected by major regional faults. Along the fault zones; the granites are marked by fault breccia and alteration features, especially silicification, hematitization, kaolinitization and chloritization. The area is cutting by faults trending mainly in N-S, NE-SW and NNW-SSE directions.

The average uranium and thorium contents of the alkali feldspar granites are 12 and 23 ppm and reaches up to 36 and 37 ppm in the normal pegmatites. In the anomalous pegmatites the maximum values recorded are 91 and 72 ppm. Generally, the averages of uranium and thorium contents in the studied pegmatites are higher than that of the world and Egyptian uraniferous pegmatites**.** The high uranium content in alkali feldspar granites is related to the presence of some accessory minerals such as zircon, fluorite and apatite but the high uranium content in the pegmatites is related to the presence of columbite, pyrochlore, zircon, fluorite as well as iron oxy hydroxides.

INTRODUCTION

Wadi Ladid al-Ji,dan area is located between lat. 27° 33' and 27° 41' N and long. 33° 03' and 33° 12' E (Fig. 1). It is considered as a part of the late-Proterozoic Pan-African belt. It lies at the northern part of the Nubian Shield in the north Eastern Desert of Egypt.

The studied younger granites of the area could be classified as alkali feldspar granites (Azab, 2008). These granites are medium to coarse grained, pink to red in colour and form a number of moderate to relatively high elevated outcrops.

The aim of this paper is to study the geology, mineralogy and radioactivity of Wadi Ladid al-Ji,dan alkali feldspar granites and associated pegmatites.

FIELD GEOLOGY

The rock types exposed in the studied area can be arranged geologic sequence as follows: metavolcanics (oldest), metagabbros, older

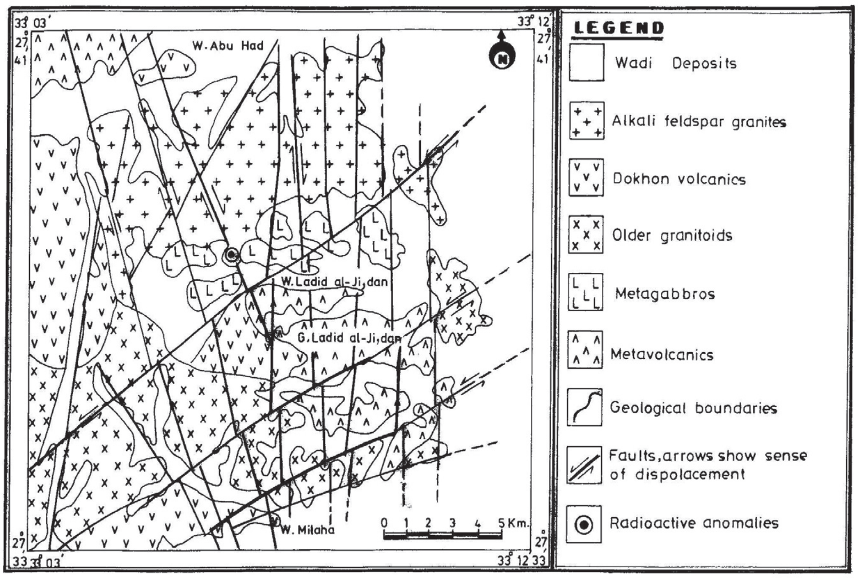

Fig.1: Geologic map of Wadi Ladid al- Ji,dan area, North Eastern Desert, Egypt

granitoids, Dokhan volcanics, alkali feldspar granites and dykes and veins (youngest). This arrangement coincides with the classification of the basement rocks of Egypt by El Ramly (1972).

The metavolcanics related to the meta-pyroclastics represent the oldest rocks in the study area. They are mainly composed of metabasalts and meta-andesites with gradational contact between them. They are intruded by metagabbros, older granitoids and alkali feldspar granites that carry xenoliths of different shapes and sizes from them. The metagabbros are exposed as small isolated and scattered hills at Wadi Ladid al-Ji,dan. These rocks are intruded by the older granitoids and alkali feldspar granites which send several offshoots into them.

The older granitoids range mainly from tonalite to granodiorite. They are characterized by low to moderate relief, exfoliation and bouldery weathering with characteristic monumental shapes. The older granitoids are intruded by Dokhan volcanic and alkali feldspar granites taking xenoliths of various shapes and sizes from them. The Dokhan volcanics are represented by a successive sequence of lava flows ranging in composition from intermediate to acidic varieties with their related pyroclastics. The Dokhan volcanics are intruded by the alkali feldspar granites. The alkali feldspar granites are massive, medium to coarse grained, pink to red in colour and form a number of moderate to relatively high elevated outcrops, their peripheries become fine grained along their contact with the older rocks and become darker in colour due to the assimilation of the enclosed xenoliths. The microfractures along these granites are sometimes filled with quartz veinlets.

The contacts between the alkali feldspar granites and the older rocks are sharp intrusive and usually dip toward the latter. The main features of these younger granites are exfoliation, cavernous and bouldery weathering (Figs. 2, 3 and 4) and carrying xenoliths of the Dokhan volcanics. These rocks are altered in some parts due to secondary processes especially along the fault zones and contacts. The most common alteration features are silicification, hematitization, kaolinitization and chloritization.

Fig.2: Exfoliation in alkali feldspar granites, Wadi Ladid al- Ji,dan area

Fig.3: Cavernous weathering in alkali feldspar granites, Wadi Ladid al- Ji,dan area

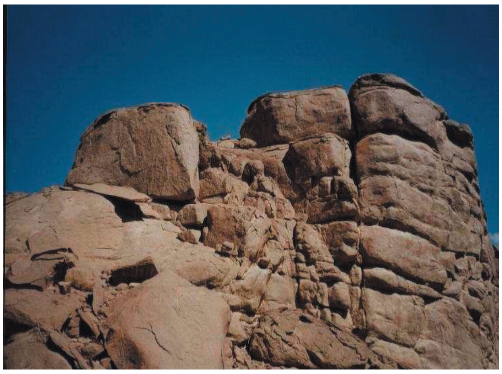

Fig.4: Bouldery weathering in alkali feldspar granites, Wadi Ladid al- Ji,dan area

The post granitic dykes and veins represent the last igneous manifestation in the area. According to the field relationships, the acidic dykes are the oldest while the basic dykes are the youngest. Pegmatites are found as small pockets, lenses or pegmatitic veins along some fault zones (Fig. 5). They are mainly associated with the alkali feldspar granites and exhibiting sharp contact. The pegmatite pockets are of variable size ranging from 0.5 to 1.5 m in width and from 1 to 2.5 m in length.

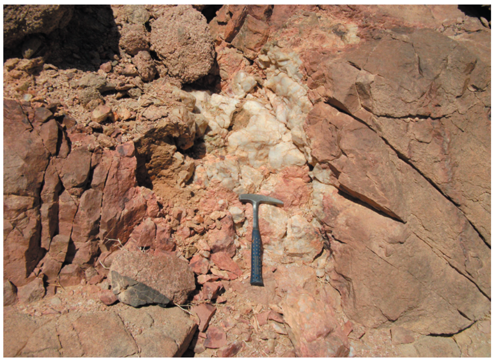

Fig.5: Pegmatite pocket recorded in alkali feldspar granites, Wadi Ladid al- Ji,dan area

At Wadi Ladid al-Ji,dan, one of these pegmatite bodies exhibits high gamma activity in terms of parts per million. Its equivalent uranium content levels range from 90 to 170 ppm, so that it is considered as anomalous pegmatite. This anomalous pegmatite is found as an elongated lens of 2.0 x 8.5 m in dimensions at the south peripheral part of the alkali feldspar granites. This pegmatite body is considered as the most radioactive rocks in the studied area.

STRUCTURE

In the studied area, the secondary structures are mainly represented by exfoliation, joints and faults. The majority of joints are tension ones, being mostly filled with quartz, feldspars, epidote, iron oxides, manganese oxides and aplite. The studied alkali feldspar granites are dissected by several sets of joints predominating in the N-S direction, dipping

84^0-88^0 mainly to west; E-W direction, dipping 70^o-75^o mainly to south and NW-SE direction, dipping 80^o -82^o to SW direction (Fig. 6).

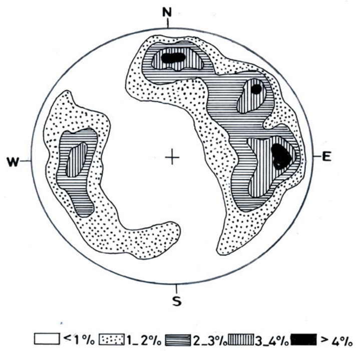

Fig.6:Countor diagrams of 110 joints in the alkali feldspar granites, Wadi Ladid al- Ji,dan area

The studied area is controlled by major regional faults, along the fault zones. The granites are marked by fault breccia and alteration features, especially silicification, hematitization, kaolinitization and chloritization. The number proportions of the measured faults revealed that the most predominant fault trends are N-S and NE-SW directions, also two common regional faults mainly trending NNE-SSW and ENE-WSW directions as well as two less abundant but well developed fault sets in NNW-SSE and NW-SE trends (Fig. 7).

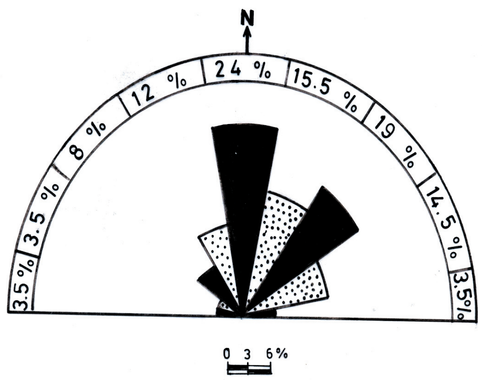

Fig.7: Rose diagrams showing the main directional trends of fault lines according to their number proportion, Wadi Ladid al- Ji,dan area

PETROGRAPHY

Petrographically, the alkali feldspar granites of Wadi Ladid al-Ji,dan area are medium to coarse grained. They are composed of potash feldspars, quartz, plagioclase, biotite and muscovite as essential minerals. The main accessory minerals are zircon, sphene, epidote, fuorite and apatite while the main secondary minerals are iron oxides, muscovite and clay minerals. The presence of two feldspar phases (potash feldspars and plagioclase) suggests that these granites are mostly subsolvus and crystallized under high water pressure (Greenberg, 1981).

Potash feldspar is represented by orthoclase and microcline perthite, but microcline perthite is the predominant. The orthoclase perthite occurs as subhedral prismatic phenocrysts which are slightly sericitized and kaolinitized. The crystals are generally of string, patchy and/or flame-like types and are corroded by quartz. Most of the microcline perthite crystals are of patchy type and poikilitically enclose zircon, apatite, iron oxides and biotite inclusions. Quartz occurs as anhedral to subhedral crystals showing slight wavy extinction and form graphic intergrowth with the potash feldspars. Some quartz crystals poikilitically enclose fluorite and small saussuritized plagioclase crystals.

Plagioclase composed of albite (An_{6-10}) occurs as subhedral prismatic crystals showing simple and lamellar twinning. Biotite is present in minor amounts. The biotite flakes are brown to pale brown in colour, pleochroic and mottled with iron oxides. Muscovite occurs as small anhedral flakes growing in the interstitial spaces between silicate minerals. The presence of primary muscovite as inclusions in plagioclase or as large elongated flakes may reflect the peraluminous nature of these granites.

Zircon is noticed as prismatic euhedral to subhedral crystals (Fig.8). It is usually found as inclusions in quartz and biotite (Fig.9). Some zircon crystals are occasionally surrounded by strong pleochroic halos due to the radiogenic effects (Fig.10). Apatite is recorded as minute euhedral prismatic and needle-like crystals and included in quartz and biotite (Fig.11). Titanite is found as small anhedral to subhedral elongated crystals showing high cracks (Fig.12). It corrodes the feldspars and biotite and is corroded by quartz. Fluorite is found as small, anhedral and colourless or violet colour and usually associated with quartz (Fig.13). Iron oxides are present as secondary minerals and occur as small patches in clusters or scattered in the rock.

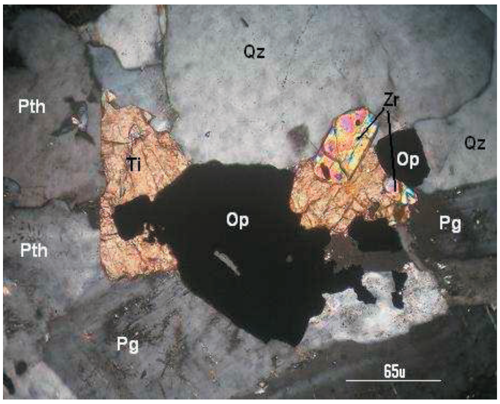

Fig.8: Euhedral crystal of zircon (zr) in alkali feldspar granite, (Pth) perthite, (Op) opaques,(Pg) Plagioclase, (Ti) Titanite and (Qz) Quartz,xpl

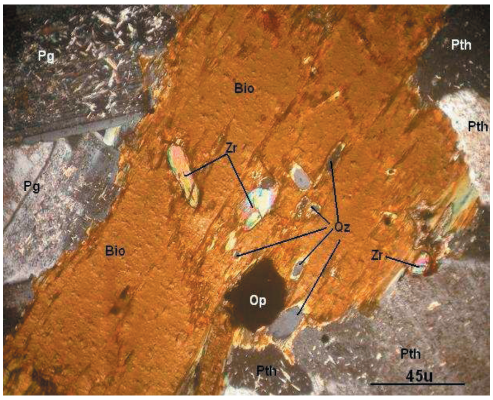

Fig.9: Euhedral crystal of zircon (Zr) as inclusion in biotite (Bio) in alkali feldspar granite (Pth) perthite, (Op) opaques, (Pg) Plagioclase, xpl

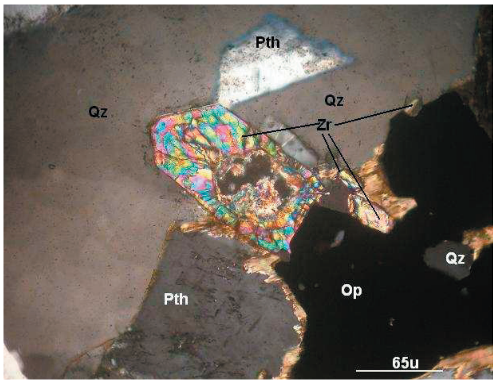

Fig.10:Euhedral crystal of metamecte zircon (Zr) due to the radiogenic effects in alkali feldspar granite, (Pth) perthite, (Op) opaques, and (Qz) Quartz, xpl

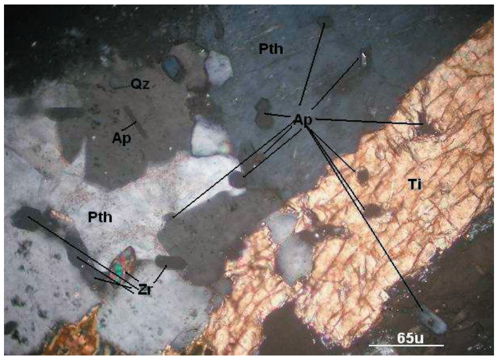

Fig.11:Euhedral crystal of zircon (Zr), apatite (Ap) and high cracks Titanite (Ti) in alkali feldspar granite, (Pth) Perthite, xpl

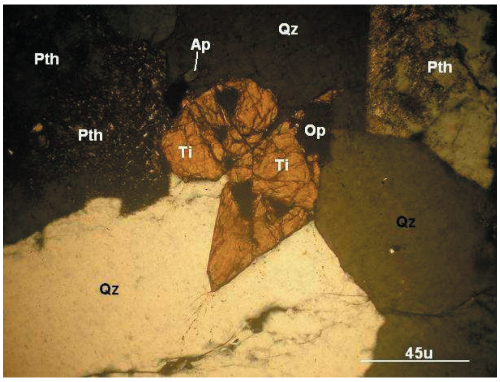

Fig.12:Rhombic euhedral crystal of titanite (Ti) in alkali feldspar granite, (Pth) Perthite, (Op) Opaques, (Qz)Quartz, and (Ap) Apatite ,xpl

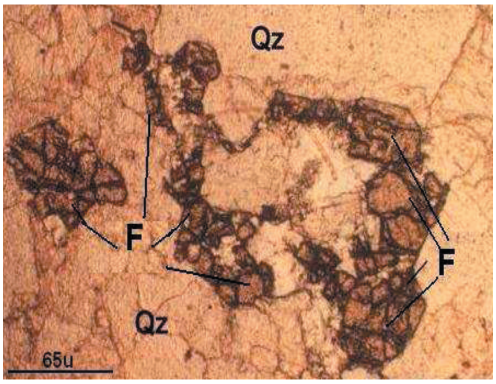

Fig.13: Crystal of fluorite (F) in alkali feldspar granite, (Qz) Quartz , ppl

Most of the studied pegmatites are described as simple unzoned pegmatites. They are equigranular with coarse- grained textures. Individual minerals are ranging from less than 0.5 to 9 mm in length. The pegmatites under investigation are mainly composed of microperthite (90% orthoclase perthite and 10% microcline perthite), quartz, plagioclase and muscovite as essential minerals. Opaques, fluorite, columbite and pyrochlore represent the accessory minerals. While the others are granitic pegmatites and composed of megacrysts of perthite, microcline and quartz associated with few crystals of biotite and opaque.

RADIOACTIVITY

The field radiometric survey of the studied area was made using portable gamma-ray scintillometer detector (Gamma-gun), model FD-3013, which measures the gamma activity of equivalent uranium in terms of parts per million (ppm). Scintillometer detector was calibrated for sensitivity by using the Canadian concrete calibration pads in the Nuclear Materials Authority, Egypt (N.M.A).

After calibration processes, all lithologic types exposed in the studied area of Wadi Ladid al-Ji,dan were radiometrically surveyed; particular attention was paid to all structural features such as contacts, joints and fault zones.

Table (1) summarize the measured equivalent uranium contents expressed in part per million (ppm) after calibration of background level. The field radioactivity levels for Wadi Ladid al-Ji,dan area show very wide range due to lithologic variation. The pegmatites show the highest radioactivity level.

Table 1: Field gamma activity of equivalent uranium contents (ppm) of promising rock types exposed in Wadi Ladid al-Ji,dan area using portable gamma-ray scintillometer (Gamma-gun), model FD-313

Rock type	Number of measurements	Equivalent uranium contents (ppm)	
		Range	Average
Anomalous pegmatites	24	90-170	150
Normal pegmatites	32	25-50	40
Alkali feldspar granites	115	20-30	28

The field radioactivity level of the pegmatites and younger granites is much higher than that of the surrounding rocks. It is noticed that the field radioactivity increases along fractures, joints and fault zones as well as in the pegmatite bodies. The field studies revealed that the recorded pegmatites in the area under discussion can be grouped into two types:

1- Normal pegmatites have an equivalent uranium contents range from 25 to 50 ppm with an average of 40 ppm.

2- Anomalous pegmatites have an equivalent uranium contents range from 90 to 170 ppm with an average of 150 ppm.

The main anomalous pegmatite in the studied area occurs as slightly altered lens at the south peripheral part of the alkali feldspar granites at W. Ladid al-Ji,dan (Fig.14). In some parts, it is highly altered. The most common alteration features are hematitization and kaolinitization. It is considered as the most radioactive rocks in the studied area and contains small radioactive black patches enclosed within smoky quartz (Fig.15). This anomalous pegmatite is affected by joint sets striking NW-SE with dips ranging from 65^{o} to 80^{o} to SW, ENE-WSW with dips range from 65^{o} to 75^{o} to NNW and E-W with dips ranging from

75^o to 80^o to N. The high gamma activity of equivalent uranium contents measured in this anomalous pegmatite reaches up to 170 ppm were recorded in a radioactive dark zone enclosed between the quartz and the orthoclase forming the pegmatite (Fig.16).

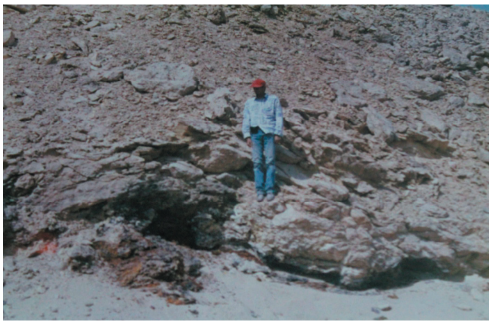

Fig.14: Close up view showing the main promising anomalous elongated pegmatite, Wadi Ladid al- Ji,dan, looking NE

Fig.15:Radioactive black small patches enclosed within smoky quartz of the anomalous pegmatite, Wadi Ladid al-Ji,dan area, looking NNE

Fig.16:Radioactive dark zone enclosed between quartz and orthoclase forming the anomalous pegmatite, Wadi Ladid al-Ji,dan area, looking NNW

RADIOMETRIC ANALYSES

Five samples representing the alkali feldspar granites in the studied area beside five samples from both normal and anomalous pegmatites, were collected and radiometrically analyzed by using gamma-ray spectrometry (Lab of Nuclear Materials Authority , Egypt). The instrument used is "Bicron scintillation detector Na-1 (TI) 76x76 mm with multi-channel analyzer" to determine radiometrically their equivalent uranium (eU) and equivalent thorium (eTh). Table (2) summarizes the results of radiometric analyses in parts per million (ppm).

Table 2: Radiometric analyses of the studied rocks, Wadi Ladid al Ji'dan area

Rock type	Sp. No.	eU (ppm)	eTh (ppm)	Average eU (ppm)	Average eTh (ppm)
Anomalous pegmatites	15	52	73		
	14	45	78		
	13	48	67	48	71
	12	50	71		
	11	49	65		
Normal pegmatites	10	13	38		
	9	13	36		
	8	11	31	13	36
	7	12	34		
	6	15	40		
Alkali feldspar granites	5	7	22		
	4	11	19		
	3	9	20	9	21
	2	9	21		
	1	8	21		

The eU content in alkali feldspar granites ranges from 7 to 11 ppm with an average of 9 ppm and eTh content from 19 to 22 ppm with an average of 21 ppm. The eU content of studied normal pegmatites ranges from 11 to 15 ppm with an average of 13 ppm and eTh content varies from 31 to 40 ppm with an average of 36 ppm. On the other hand the anomalous pegmatites have eU content ranging between 45 and 52 ppm with an average of 48 ppm and eTh content from 65 to 78 ppm with an average of 71 ppm.

DISTRIBUTION OF URANIUM AND THORIUM IN ALKALI FELDSPAR GRANITES

The distribution of the radioactive minerals in the different rock types essentially depends on the lithological and mineralogical characters of these rocks. Accordingly, the radioactivity increases with increasing acidity of rocks (Turekian and Wedepohl, 1961 and Rogers and Adams, 1969). This means that granitoid rocks are more enriched in radioactive minerals than the other more mafic rock types.

In this work, the collected samples being chemically analyzed for some major oxides (TiO_2 and Fe_2O_3) and some trace elements Zr, Nb, U and Th contents. The U and Th contents were chemically determined by spectrophotometric techniques using Arsenazo III at Egyptian Nuclear Materials Authority (NMA). The obtained results of the U and Th analyses as well as the Th/U ratios are given in Table (3). In this Table, the uranium content in the studied alkali feldspar granites ranges from 10 to 14 ppm with an average of 12 ppm and the thorium content vary from 19 to 26 ppm with an average of 23 ppm. The Th/U ratios are ranging from 1.83 to 1.90 with an average of 1.92.

Table 3: Chemical analyses of U, Th, some trace elements and some major oxides of the studied younger granites and pegmatites, W. Ladid al Ji'dan area

Rock type	Sp. No.	U (ppm)	Th (ppm)	Th/U	Zr (ppm)	Nb (ppm)	TiO_2 (wt%)	Fe_2O_3 (wt%)
Anomalous Pegmatites	15	86	69	0.80	371	74	0.03	1.0
	14	96	75	0.78	385	80	0.06	1.5
	13	100	79	0.79	391	81	0.05	1.3
	12	82	66	0.80	364	70	0.04	1.4
	11	93	73	0.78	380	77	0.07	1.1
	Average	91	72	0.79	378.2	76.4	0.05	1.26
Normal Pegmatites	10	34	35	1.03	328	60	0.05	0.99
	9	41	42	1.02	360	49	0.06	0.93
	8	38	39	1.02	351	53	0.04	0.82
	7	31	32	1.03	325	40	0.03	0.78
	6	37	37	1.01	335	42	0.07	0.70
	Average	36	37	1.02	339.8	48.8	0.05	0.84
Alkali-feldspar granites	5	13	23	1.77	250	53	0.10	0.93
	4	10	19	1.90	232	54	0.09	0.99
	3	14	26	1.86	264	42	0.09	1.11
	2	11	20	1.83	235	48	0.08	1.13
	1	14	26	1.86	265	43	0.09	1.01
	Average	12	23	1.92	249	48	0.09	1.03

Abu Steet (2007) and Azab (2008) recorded that the alkali feldspars granites of the studied area are post orogenic, highly differentiated peraluminous granites characterized by high silica and Rb as well as low Ca and Sr contents. The studied alkali feldspar granites could be considered as uraniferous granites.

Rogers and Adams (1969) stated that the normal contents of U and Th in granitic rocks are 4 ppm and 11 ppm respectively. Also Hall and Walsh (1969) suggested that the uraniferous granite is characterized by high uranium content (> 8 ppm) as well as a small amount of fluorite dispersed in granites. Uraniferous granites are defined according to Darnley (1982) as any granitic masses containing U at least twice the Clarke value (4 ppm) whether or not they are associated with U mineralization.

Cuney (1984) suggested that the red-pink post orogenic granitic variety is one of the most important examples of uraniferous granite. He added that uraniferous granite is highly differentiated peraluminous two mica granite characterized by high silica and uranium contents (more than 73% and 8 ppm respectively) with high alumina contents and low contents of calcium and ferromagnesian elements. Bakhit (1987) and Assaf et al. (1997) discussed the favourable environment, on geochemical basis, for U deposits in granitic rocks. They suggested the following items for uraniferous granites: (1) high silica content, (2) high Rb/Sr ratios, (3) low CaO content, (4) high Rb content, (5) high U content and (6) low Th/U ratios.

Shalaby and Moharem (2008) & Moharem and Abdel Warith (2008) suggested that uraniferous granite is charcterized by the following items: (1) It is considered as low calcium, peraluminous, two mica granite, (2) It is highly differentiated and is chracterized by low Sr and high Rb contents as well as low Na_2O/K_2O ratios, (3) The Th /U ratios are very low compared with the ratio of normal granitic rocks which equals 3, and (4) The U content is more than twice that of the Clarke value (more than 8 ppm). The studied younger granites are thus considered as uraniferous granites.

DISTRIBUTION OF URANIUM AND THORIUM IN PEGMATITES

The uranium contents in the studied normal pegmatites range from 31 to 41 ppm with an average of 36 ppm. Moreover thorium contents vary between 32 and 42 ppm with an average of 37 ppm. Their Th/U ratios are ranging from 1.01 to 1.03 with an average of 1.02 (Table 3). On the other hand, the uranium contents in the studied anomalous pegmatite range between 82 and 100 ppm with an average of 91 ppm, while the Th contents vary from 66 to 79 ppm with an average of 72 ppm. Their Th/U ratios are ranging from 0.78 to 0.80 with an average of 0.79 (Table 3). The pegmatite rocks show the highest uranium content in the area. Generally, the average of U and Th contents in the studied pegmatites are higher than that of the world uraniferous pegmatites given by Ford (1982) and Egyptian uraniferous pegmatite given by Heikal et al. (2001), Table (4).

Table 4: Average uranium and thorium as well as Th/U ratio in the studied pegmatites compared with those in other pegmatites

Rock type	U (ppm)	Th (ppm)	Th/U
The studied normal pegmatites	36	37	1.02
The studied anomalous pegmatites	91	72	0.79
The world uraniferous pegmatites (Ford, 1982)	28	21	0.7
The Egyptian uraniferous pegmatites (Heikal et al. 2001)	33	28	0.8

URANIUM AND THORIUM RELATIONSHIPS

The U-Th variation diagram of the study fresh granites indicates a very strong positive relationship between the two elements suggesting their increase with magmatic differentiation (Fig 17). Both alkali feldspar granites and normal pegmatites show poor relationships between U and Th/U, U and Zr, U and Nb, U and TiO_2 as well as U and Fe_2O_3 indicate that U distribution within these rocks is not only controlled by magmatic processes but also by secondary processes to a great extent (Figs.18-21). On Figure (19), the alkali feldspar granites show strong positive relationship between U and Zr; this may be related to trapping most U within zircon crystal lattices.

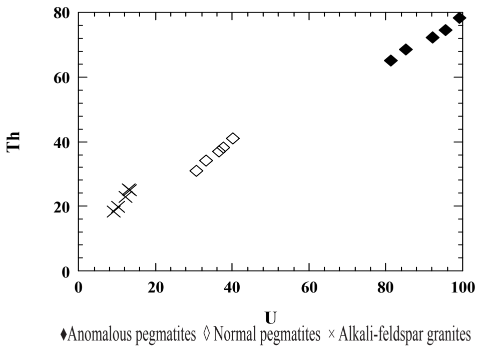

Fig.17: U versus Th variation diagram

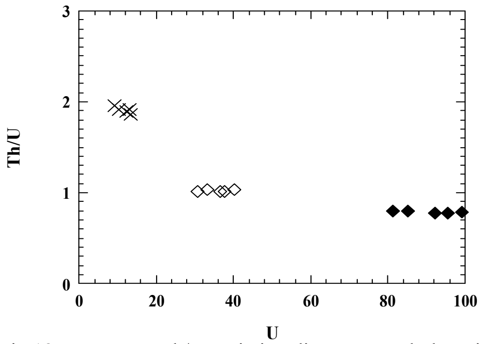

Fig.18: U versus Th/U variation diagram ,symbols as in Fig.17

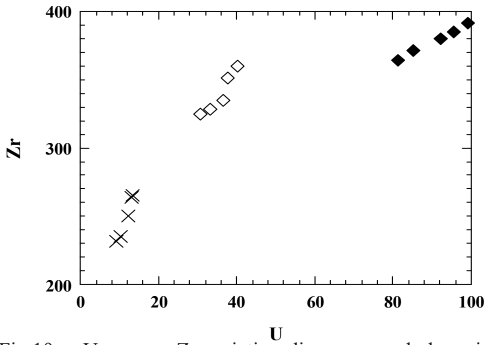

Fig.19: U versus Zr variation diagram ,symbols as in Fig.17

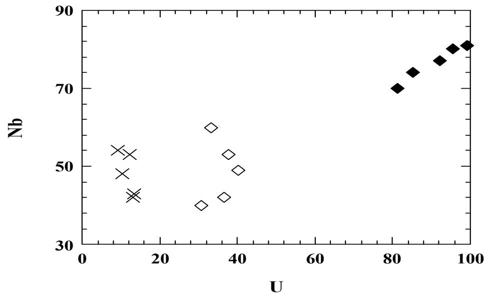

Fig.20: U versus Nb variation diagram,symbols as in Fig.17

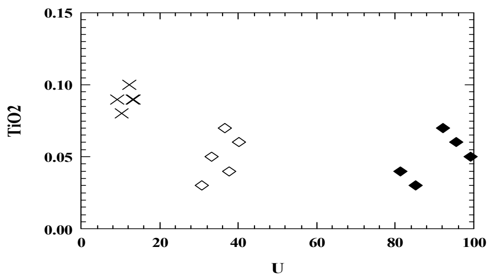

Fig.21: U versus TiO_2 variation diagram,symbols as in Fig.17

Only the anomalous pegmatites show very strong positive relationship between U and Zr, U and Nb, as well as U and Fe_2O_3 (Fig. 19,20&22). This may be related to trapping most U within columbite, pyrochlore and zircon as well as adsorbed by iron oxides.

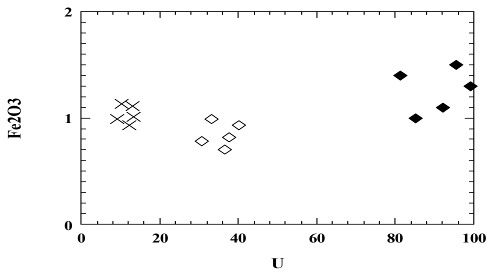

Fig.22: U versus Fe_2O_3 variation diagram,symbols as in Fig.17

URANIUM BEARING MINERALS

The samples of alkali feldspar granites and pegmatites were subjected to heavy liquid separation and picking after grinding to 60 mesh. The separated zircon crystals were analyzed by using Environmental Scanning Electron Microscope (ESEM) , (Figs. 23&24).

Fig.23: General view of separated zircon, from alkali feldspar granites,

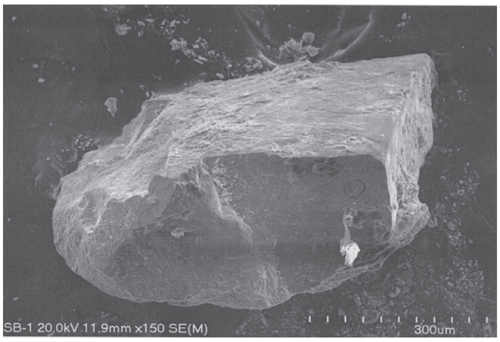

Fig.24: ESEM image of zircon, from alkali feldspar granites

Zircon

It is the most common accessory mineral in granitoid rocks (Deer et al., 1966). It is generally present as small early formed crystals often enclosed in later minerals, but it may form large well developed crystals (consisting of prism and bipyramid) in granites (Deer et al., 1966 and Read, 1984). Read (1984) suggested that uranium is the most important trace element in zircon. The presence of high contents of U in zircon leads to the breakdown of the structure of zircon (metamict state), which causes radial and concentric fractures that are good pathways for uranium in addition to the presence of iron oxides (Moharem, 1999; Abdel Hamid, 2006 and Raslan, 2009).

Zircon is relatively abundant, colourless and/or with brownish and yellowish brown colours. It is characterized by elongated prismatic shape. Zircons that are both coloured and of low birefringence show more radioactivities. Semi-quantitative analyses of zircon were obtained using the ESEM-EDX technique (Fig. 25).

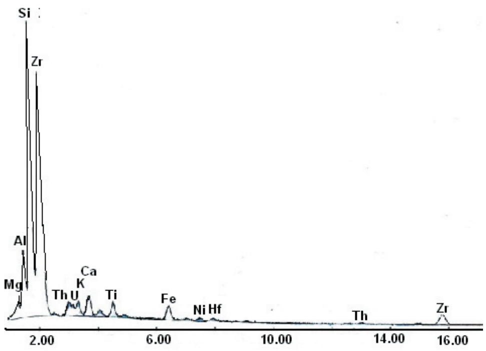

Fig.25: EDX Chart of zircon in Fig.24

Apatite

It occurs as an accessory mineral in almost igneous rocks from basic to acidic types. Read (1984) suggested that uranium is the most important trace elements in apatite especially in fluoro-apatite. Semi-quantitative analyses of apatite were obtained using the ESEM-EDX technique (Figs.26-28).

Fig.26: General view of separated apatite, from alkali feldspar granites

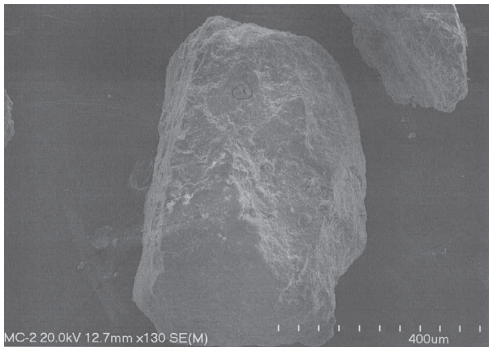

Fig.27: ESEM image of separated apatite, from alkali feldspar granites

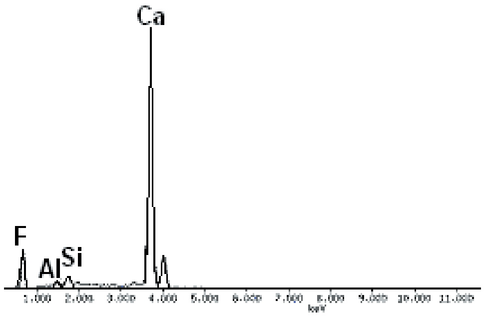

Fig.28: EDX Chart of apatite in Fig. 27

Fluorite

It occurs as anhedral fine crystals. They are usually colourless especially in fresh granites, but violet varieties are common in altered rocks. Fluorite is usually associated with iron oxides. Fluorite was identified by ESEM (Figs 29-31).

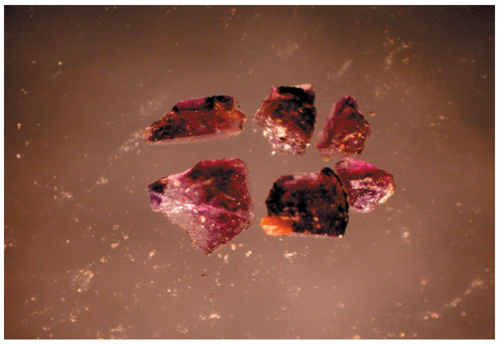

Fig.29: General view of separated fluorite, from alkali feldspar granites

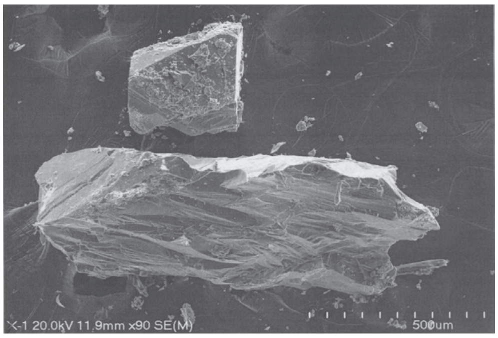

Fig.30: ESEM image of fluorite, from alkali feldspar granites

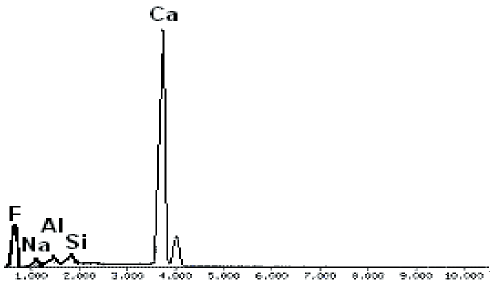

Fig.31: EDX Chart of fluorite of Fig. 30

Columbite

The separated columbite crystals were observed as euhedral to sub-hedral dark brown to black crystals of dull luster. In the anomalous pegmatites, they occur as irregular crystals and show dark brown to black colour. The obtained analysis clarified presence of the radio-elements (U and Th) in the structure of columbite (Figs.32-34). Columbite is the main source of radioactivity in pegmatites (Read, 1984). The presence of hematite and columbite reflect the action of alkaline hydrothermal fluids (Linnen and Keppler, 1997).

Pyrochlore

The separated pyrochlore crystals were observed as euhedral to sub-hedral, dark brown to yellowish brown crystals of greasy luster. In the anomalous pegmatite, they occur as irregular crystals and show dark brown colour and greasy luster (Figs. 35&36). The obtained EDX data clarified presence of the radio-elements (U and Th) in the structure of pyrochlore (Fig. 37).

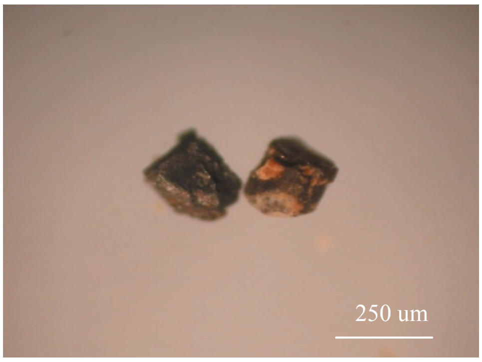

Fig.32: General view of separated columbite, from anomalous pegmatites,

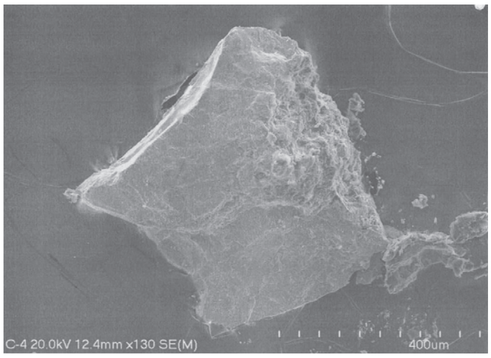

Fig.33: ESEM image of separated columbite, from anomalous pegmatites

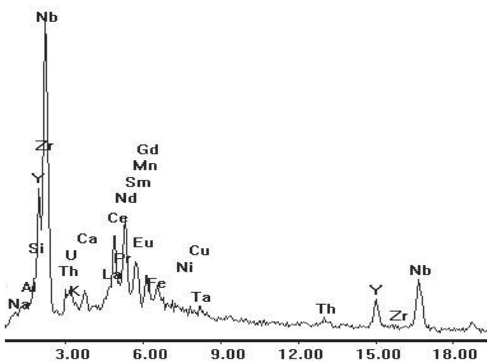

Fig.34: EDX Chart of columbite in anomalous pegmatite in Fig 33

Fig.35: General view of separated pyrochlore, from anomalous pegmatites

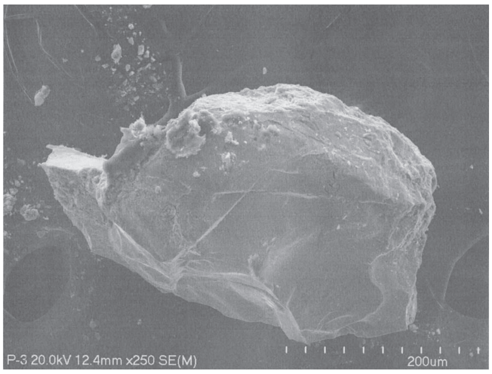

Fig.36: ESEM image of separated pyrochlore, from anomalous pegmatites

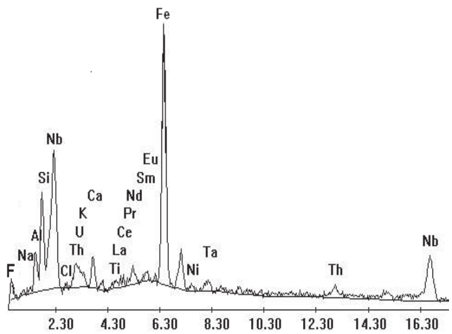

Fig.37: EDX Chart for pyrochlore of Fig 36

Hematite

It occurs as tabular or prismatic reddish brown crystals. Sometimes, it occurs as fine to coarse euhedral elongated crystals.

CONCLUSIONS

Wadi Ladid al-Ji,dan area is located between lat. 27° 33' and 27° 41' N and long. 33° 03' and 33° 12' E. It is considered as a part of the late-Proterozoic Pan-African belt. It lies at the northern part of the Nubian shield in the north Eastern Desert of Egypt. It The studied alkali feldspar granites of the area classified as peraluminous granites.

In the studied area, the majority of joints are tension ones. These tension joints are mostly filled with quartz, feldspars, epidote, iron oxides, manganese oxides and aplite. The studied alkali feldspar granites are dissected by several sets of joints predominating in the N-S direction, dipping 84^0-88^0 mainly to west; E-W direction, dipping 70^o-$75\ ^o$ mainly to south and NW-SE direction, dipping 80^o -82^o to SW direction.

The studied area is dissected by major regional faults. Along the fault zones; the granites are marked by fault breccia and alteration features, especially silicification, hematitization, kaolinitization and chloritization. The most predominant fault trends are N-S and NE-SW directions, also two common regional faults mainly trending NNE-SSW and ENE-WSW directions as well as two less abundant but well developed fault sets in NNW-SSE and NW-SE trends.

The field radioactivity level of the pegmatites and alkali feldspars granites is much higher than that of the surrounding rocks. It is noticed that the field radioactivity increases along fractures, joints and fault zones as well as in the pegmatite bodies.

The radioactive studies revealed that the recorded pegmatites in the area under discussion can be grouped into two types: Normal pegmatites where uranium contents range from 31 to 41 ppm with an average of 36 ppm.

Anomalous pegmatites where uranium contents range from 82 to 100 ppm with an average of 91 ppm. Generally, the averages of uranium and thorium contents in the studied pegmatites are higher than that of the world and Egyptian uraniferous pegmatites**.**

From the mineralogical studies, it could be concluded that the uranium content in the alkali feldspar granites along W. Ladid al-Ji,dan is related to its zircon, fluorite, apatite and iron oxy hydroxide, but in the pegmatites the high uranium content is related to columbite, pyrochlore, zircon and iron oxy-hydroxides.

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جرانيتات وادى لاديد الجعدان و البيجماتيت المصاحب ، شمال الصحراء الشرقية-مصر.

دراسة جيولوجية و معدنية وإشعاعية

أحمد على أبو ستيت و ريمون راغب أيوب وعنتر فهمى بخيت

يقوم هذا البحث بالدراسة الجيولوجية و التركيبية و المعدنية و الاشعاعية للصخور الجرانيتية بوادى لاديد الجعدان شمال الصحراء الشرقية-مصر. و يشمل جرانيتات ذوفلسبارقلوى . يتمثل هذا النوع من الجرانيت بأنه متوسط إلى خشن الحبيبات و من جرانيتات وردية الى حمراء اللون و يظهر فى عدد من المكاشف المتوسطة الى عالية الارتفاع. وقد أظهرت الدراسات أن هذه الصخور الجرانيتية تعرضت الى عوامل التعرية و التغيرات فى بعض الاجزاء نتيجة للعمليات الثانوية وبالخاصة حول نطقات كل من الفواصل و التماس.

كما أظهرت الدراسات أن التراكيب الجيولوجية المختلفة فى منطقة الدراسة ممثلة أساسا فى التطبق و الفواصل و الفوالق. حيث تأثرت الصخور الجرانيتية بعديد من الفواصل والسائدة فى اتجاه شمال-جنوب ويميل غالبا ناحية الغرب بزاويه تتراوح ما بين ٨٤° الى ٨٨° و اتجاه شرق-غرب ويميل غالبا ناحية الجنوب بزاوية تتراوح ما بين ٧٠° الى ٧٥° و اتجاه شمال غرب-جنوب شرق والذى يميل ناحية الجنوب الغربى بزاوية تتراوح ما بين ٨٠° الى ٨٢° ومعظمها فواصل شد غالبا ما تملأ بالكوارتز و الفلسبار و الابيدوت و أكاسيد الحديد والمنجنيز و الابليت. و قد تاثرت المنطقة بفوالق رئيسية تمر خلالها فى اتجاهات شمال-جنوب و شمال شرق- جنوب غرب و شمال غرب- جنوب شرق. و اهم مظاهر التغيرات للصخور الجرانيتية حول نطاقات هذه الفوالق هى السيليكا و الهيماتيت والكاولين و الكلوريت

ونجم عن الدراسات الاشعاعية أن متوسط قيم محتوى اليورانيوم و الثوريوم فى الجرانيتات ذو الفلسبارى القلوى يتراوح ما بين ١٢ و ٢٣ جزء فى مليون و يصل الى ٣٦ و ٣٧ جزء فى مليون فى صخور البيجماتيت العادية ، اما فى صخور البيجماتيت الشاذة يصل اعلى قيمة من محتوى اليورانيوم و الثوريوم الى ٩١ و ٧٢ جزء فى مليون. كما أظهرت الدراسات أن متوسط قيم محتوى اليورانيوم و الثوريوم فى صخور البيجماتيت فى منطقة الدراسة اعلى من نظيراتها فى بعض صخور البيجماتيت المصرية و العالمية.

و يعزى سبب زيادة قيم محتوى اليورانيوم فى صخور الجرانيتات ذو الفلسبارى القلوى الى وجود بعض المعادن المصاحبة مثل الزيركون و الفلورايت و الاباتيت ، و لكن يعذى سبب زيادة قيم محتوى اليورانيوم فى صخور البيجماتيت الى وجود معادن الكلومبيت و البيروكلور و الزيركون و الفلورايت بالاضافة ال اكاسيد الحديد.