EXAMINATION OF TWO GRANITE PHASES ALONG WADI ABU ZAWAL AREA, NORTH EASTERN DESERT, EGYPT

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ABSTRACT

The present work deals with the two granite phases along Wadi Abu Zawal area, North Eastern Desert, Egypt. G.Ad-Dub is located at the northeastern part of the mapped area as an elongate granitoid belt covering collectively about 0.5Km2 , trending NE and shows zonal composition ranging from monzogranite in the outer rim to alkali feldspar granite in the core but it hardly to be traced in the field. G. Hadrabiyyah mass is located in the southwestern part of the mapped area as an elongated body covering collectively about 1.4 Km^2 and trending NW and composed of alkali feldspar granite .

Geochemically, the granitoids of the studied area seem to have originated from metaluminous to peraluminous calc-alkaline magmas with many chemical features similar to I-type granites that developed in volcanic arc tectonic setting in a compressional regime.

The studied granitoids were generated at somewhat intermediate depths (8-19 km) equivalent to 3-7 Kb under temperature ranging from 760°-840°. This is consistent with the high K/Rb ratios, and the high K/Ba ratios indicate involvement of ocean sediments in magma generation.

The concentrations of U and Th in the granitoid rocks were controlled by magmatic processes which are clear from the positive relation between U and Th and negative relation between U-Th/U. They are also controlled by the presence of some accessory minerals (zircon and apatite) and iron oxides. Iron oxides and hydroxides are known to absorb U from circulating fluids.

INTRODUCTION

Based on lithologic differences,tectonic styles and age patterns, Stern and Hedge (1985) divided the Precambrian basement rocks of the Eastern Desert into three distinctive terrains each of which has its own characteristic features, namely; North, Centeral and South Eastern Desert. A line extending in about N60E direction across the basement rocks between Qena-Safaga, is regarded as the major lithotectonic discontinuity that forms the border contact between the Centeral and North Eastern Desert tectonic blocks. The North Eastern Desert block is dominate by late and post- tectonic granites.

Different schemes for classifying the granites of Egypt were proposed depending on different of views. One scheme gave weight to relative ages e.g. Hume (1935) and El Ramly & Akaad (1960). Another classification emphasized type localites;Shurmann (1957), where a third considered to orogenesis e.g. El-Shazly (1964). The fourth classification depended primarily on chemical composition; El Gaby & Habib (1982) and Hussien *et. al* . (1982).

Other interest classifications were suggested for the younger granites only: Sabet et.al. (1976), El Sokkary *et.al.* (1976), Greenberg (1981) El-Shatoury *et.al* (1984), Kabesh *et.al.* (1987),and Noweir et.al.(1990).The present study are deal with petrology , geochemistry , and radiometery of Gabal Ad-Dub and Gabal Hadrabiyyah as two granitic phases . The area under investigation is located in the North Eastern Desert, about 10 km,to north (El-Nasr village) Qena –Safaga road . It lies across Wadi Abu Zawal (fig.1); between latitude 26° 37′ - 26° 45′ and longitude 33° 15′ - 33° 26′.

These two granitic masses and its surrounding areas were generally described by Hume (1934), Shurman (1966), Sabet *et. al.* (1972). El-Tahe (1978) mentioned that; the main geosynclinal volcanics represent the oldest rock unit studied in the area . The synorogenic plutonite rocks are represented by quartz diorite in the southwestern part of the area, and hornblende granodiorites to the west of G. Hadrabiyyah,while biotite bearing granodiorite

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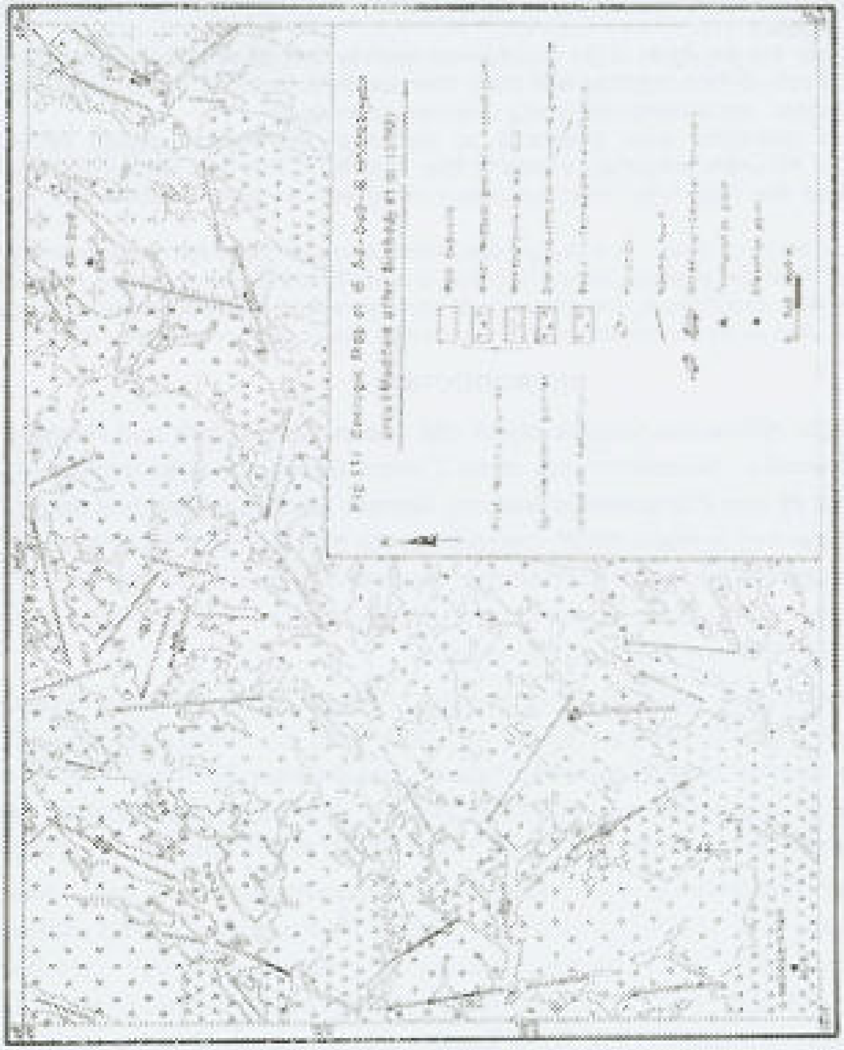
cover a vast area around Wadi Abu Zawal and Wadi Fatira El Bida. The late orogenic plutonites are represented by medium-coarse grained pink granites at G. Abu Shihat, G.El Urf and G.Hadrabiyyah as well as by red pegmatite granite at G. Abu Shihat. Aplite, pegmatite, and quartz veins intrude all the granitic masses and the metavolcanics . Sharara *et.al.* (1990) in their investigations on the area of G. El Urf- including Abu Zawal area; revealed the presence of a number of rock units, namely gneisses, island arc associations and post-kinematic granites as well as post-granite dykes. They added that the granitic rocks are differentiated into syn-kinematic granitoids represented by Abu Zawal granodiorites , and post – kinematic granites including three distinct phases, namely Abu Shihat pegmatite granite (oldest), El Urf - Ad-Dub granite, and Hadrabiyyah alkaline granités (youngest) .



Bishady *et. al.* (1999); classified Abu Zawal rocks into granodiorites which related to quartz-monzonite and monzonite classes. The granites are mainly syeno-granites, whereas the pegmatites are scattered in the field of syeno-granites and alkali-granites. All the rocks are of the I-type granites.They add that:tectonically, Abu Zawal granodiorites are related to pre-plate collision,whereas the granites are related to syn-collision granites.The pegmatites tend to be attributed to late orogenic tectonism .

Geologic Setting

G. Ad-Dub is located at the northeastem part of the mapped area as an oval shape pluton .It forms a moderate relief occupy about 0.8 x 0.6 km.(Fig.2) . G. Ad-Dub Intrusion is located in the northeastem part of the mapped area. It is grayish pink biotite monzogranite. It is heterogeneous in grain size, and mafic content.This pluton shows zonal composition ranging from monzogranite in the outer rim to alkalifeldspar granite in the core but it hardly to be traced in the field. It is Generally coarse grained and composed mainly of quartz, plagioclase, alkalifeldspar, with variable amount of biotite. Locally a small part of the granite is stained with hematite especially in the outer rim. Joints and exfoliated weathering surfaces are well developed. Consequently ENE, NS and NE are the main joint sets (Fig.3). This pluton directly intruded to syn-cllision-granite in a sharp contact.These granite is traversed by several faults mostly trending NNE and NW (Fig.4). It is intruded by basic, intermediate and acidic dykes, generally parallel to the fault trends.

G. Hadrabiyyah mass is located in the southwestem part of the mapped area.It is form an elongated body (2.7 x 0.5km.) with moderate relief . This granite are medium to coarse grains , pink to pale pinkish colour, composed essentially of pink alkali-feldspars, plagioclase, quartz, and minor amount of biotite. G. Hadrabiyyah intruded in surrounding metavolcanics (Fig.5), quartzdiorite, and it is intruded by some basic, intermediate, and acidic dykes as well as pegmatite , and quartz veins(fig.6) . Jointing and boulder weathering are well developed .The main joint sets effected on G.Ad-Dub monzogranite are,WNWand ESE, whereas the main joint sets effected on G. Hadrabiyyah alkalifeldspar granite areWNW, SSE, and NE consequently. The main joint trends observed are plotted at two rose diagrams for G.Ad-Dub monzogranite and G. Hadrabiyyah alkalifeldspar granite (fig.7). The dominant trends observed from the two diagrams are N.NE, NWand E-W directions. These trends mostly related to thermal contraction.

The close similarity between the two collective joint diagrams indicate that the two granite phases were intruded along the same structural planes ,generally , the regional structure of the area indicating that emplacement of G.Ad-Dub and G. Hadrabiyyah masses were still controlled by the final phase of orogenic stress and situated under one extensional environment .

Fig.(2): General view for G. Ad-Dub mass showing intrusive contact between granodiorite and monzogranite. Photo looking NW.

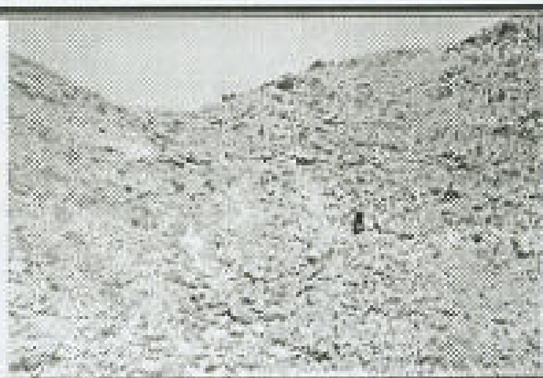


Fig.(5):Sharp contact between G.Hadrabiyyah alkali-feldspar granite and island arc metavolcanics . Photo looking NE.

Fig.(3): General view for the main trending of the joint sets effected at the coarse graind Ad-Dub monzogranite . Photo looking SE.

Fig(.6): Intrusion contact between G.Hadrabiyyah alkali-feldspar granite (to left) and quartz-diorite(to right). Photo looking NW.

Fig.(4): A normal fault with pegmatite vein at the eastern part of G.Ad-Dub monzogranite . Photo looking NW.

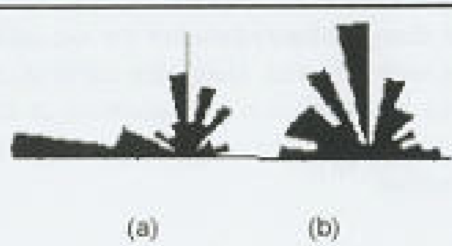


Fig.(7): Rose diagrams collective for joint:
(a) G. Ad-Dub monzogranite.
(b) G. Hadrabiyyah alkalifeldspar granite.

Petrography

Petrographically, G. Ad-Dub monozogranite is composed mainally of variable proportions of quartz, plagioclase, and potash feldspar together with subordinate biotite (Fig.8). Iron oxides , zircon, and apatite are accessories (Fig.9) whereas cholorite, muscovite, sericite and kaolinite are secondary constituents. Quartz occurs as drops form, made up of one or more clear anhedral crystals, and less commonly as small anhedral crystals filling the interstices between the feldspars. This is besides its occurrence as worm- like myrmikitic intergrowth (Fig.10). Plagioclase form slightly to moderately saussuritized and tabular crystals. It is commonly replaces potash feldspar and corroded by quartz. Potashfeldspar are represented mainly by microcline and microperthite with subordinate orthoclase-microperthite (Fig.11). Microperthite is mainly of the exsolution type. Biotite forms subhedral flakes variably altered into and interleave with cholorite.

G. Hadrabiyyah alkalifeldspar granite consists chiefly of potash feldspar, and quartz together with subordinate plagioclase, biotite, amphibole, muscovite (Fig.12). Iron oxide, zircon, alanite and apatite are accessories (Fig.13). Potashfeldspar is mainly perthite, microcline-microperthite and less commonly orthoclase-microperthite (Fig.14). Quartz forms anhedral crystals filling the inerstices between feldspar crystals and show corrosive action against them (Fig.15). Plagioclase (An 8-12) is subordinate and occurs as tabular crystals, slightly altered to epidote. Biotite forms irregular flakes and clots. Amphibole occurs as subhedral prismatic crystals, or fibrous aggregates.

Geochemistry of Granitoid Rocks

1-Variation in chemical composition

In this section, it is intended to determine the petrochemical features of granitoid rocks of G. Ad-Dub – G. Hadrabiyyah area and to solve the genetic relation between these rocks. Also, to determine the magma types and the tectonic settings under which these granitoid magmas were generated. To achieve these objectives, 10 samples including Gabal Ad-Dub and (7 samples) from G. Hadrabiyyah. All samples were chemically analyzed in the laboratory of Nuclear Material Authority (NMA) for major oxides and the trace elements Rb, Sr, Ba, Y, Zr, Nb, Cu, Zn, Ni, Co, Cr, V and Ga. The analytical results of the major oxides and trace elements are shown in Tables (1&2). The tables also show the CIPW normative compositions and some petrochemical parameters. The average of the differentiation index of granitoids of G. Ad-Dub – G. Hadrabiyyah area are 89.43 and 89.05 respectively.

2- Nomenclature

We can observe the Petrochemical Nomenclature, the genetic classifications for the studied granitoids by using some variation diagrams proposed by Chappell and White (1974), Middlemost (1985), Le Maitre, (1989), Gunther *et al.*, (1989) and Harris *et al.*, (1984) as follow.

Middlemost (1985) and Le Maitre, (1989) used the binary relation between SiO_2 and Na_2O+K_2O (wt %) to differentiate between different rock types as showing in (Figs.16, 17). It is clear from the figure that studied samples of G. Ad-Dub – G. Hadrabiyyah area are lie in the granite field.

The studied granitoids can also be classified according to their normative Or -Ab, An, contents using the following diagrams. The (Or-Ab-An) diagram of Hietanen, (1963), shown in (Fig. 18), indicates that the granitoid rocks of G. Ad-Dub– G. Hadrabiyyah area plot in the granite field . The (Ab-An -Or) diagram of Streckeisen (1976), shown in (Fig. 19) indicates the studied granitoids rocks of G. Ad-Dub – G. Hadrabiyyah area plot in the alkali feldspar granite fields and some samples lie in the syenogranite field.

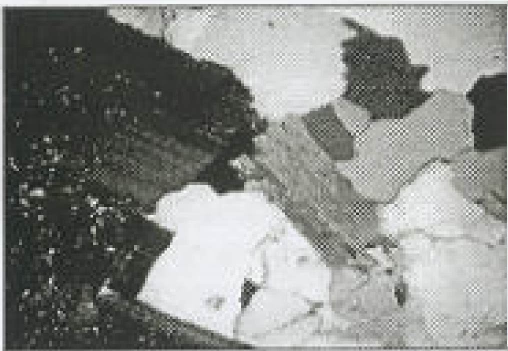


Fig.(8): Quartz , plagioclase , potash feldspar and biotite

Fig.(9): Zircon , and apatite are accessories

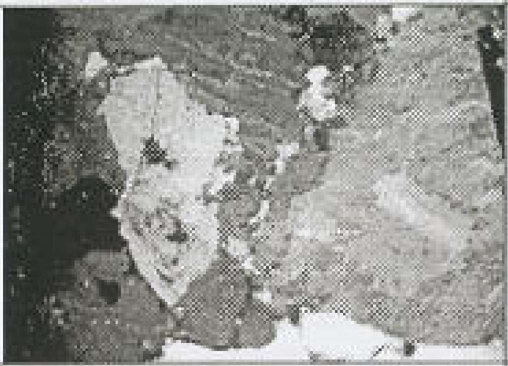


Fig.(10): Myrmikitic intergrowth

Fig.(11) Microperthite and orthoclase-microperthite

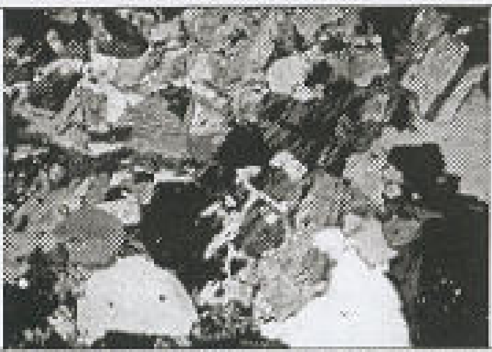


Fig.(12): Potash feldspar , quartz ,plagioclase and biotite

Fig.(13): Iron oxide , zircon , alanite and apatite

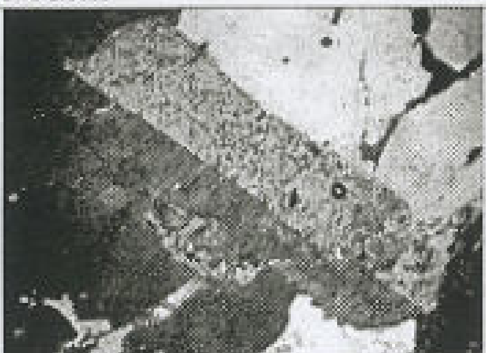


Fig.(14): Microperthite and orthoclase-Microperthite

Fig.(14): Quartz forms anhedral crystals filling the inerstices between feldspar crystals

Table (1):Chemical analysis of major and trace elements of granitoid rocks of G. Ad-Dub, area

S. No.	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-10
SiO_2	71.38	72.01	72.42	71.48	70.93	73.39	74.01	73.31	73.15	73.41
TiO_2	0.34	0.26	0.19	0.26	0.38	0.35	0.47	0.28	0.43	0.31
Al_2O_3	12.88	13.05	12.92	13.11	13.21	12.90	12.63	11.99	12.25	12.01
Fe_2O_3	0.88	1.54	1.58	1.08	1.25	1.29	1.27	1.43	1.44	1.45
FeO	1.92	1.46	1.40	1.60	1.16	1.81	1.78	1.96	1.88	1.71
MnO	0.92	0.63	0.50	0.83	0.56	0.60	0.49	0.63	0.59	0.57
MgO	0.36	0.60	0.46	0.68	0.82	0.43	0.45	0.53	0.49	0.62
CaO	1.43	1.12	1.22	1.15	1.68	0.56	0.63	0.75	0.63	0.89
Na_2O	4.61	4.32	3.75	4.35	4.32	3.62	3.49	3.93	3.81	3.87
K_2O	3.72	4.42	4.40	4.11	3.92	4.24	4.18	4.47	4.13	4.60
P_2O_5	0.49	0.23	0.28	0.38	0.32	0.33	0.28	0.35	0.31	0.36
L.O.I	0.87	0.21	0.67	0.73	0.88	0.38	0.31	0.39	0.63	0.28
Total%	99.80	99.65	99.78	99.79	99.45	99.90	99.99	100.04	99.74	100.07
Qz	26.67	27.38	30.62	26.80	26.80	34.02	35.47	30.53	33.00	30.44
Or	22.24	25.98	26.26	24.54	23.52	25.20	24.80	26.53	24.65	27.26
Ab	39.38	36.28	31.97	37.12	37.04	30.74	29.59	33.33	32.49	32.77
An	3.47	3.11	4.45	3.51	5.11	0.85	1.49	1.67	1.32	1.78
Di	0.69	0.90	0.00	0.00	1.18	0.00	0.00	0.00	0.00	0.44
Hy	4.54	3.17	3.06	4.87	3.07	3.89	3.49	4.50	3.91	3.82
Cor	0.00	0.00	0.36	0.22	0.00	2.04	1.81	0.06	1.03	0.00
Mt	1.29	2.22	2.31	1.58	1.84	1.88	1.85	2.08	2.11	2.11
Il	0.65	0.49	0.36	0.54	0.73	0.67	0.90	0.53	0.82	0.59
Ap	1.08	0.50	0.62	0.84	0.71	0.71	0.61	0.77	0.68	0.79
Zr	98	105	110	112	83	120	125	118	113	116
Y	5	6	7	6	4	8	7	6	5	5
Sr	47.3	13.6	37.2	13	7.9	19.3	17	6.3	5.2	9.4
Rb	65.2	155.6	126.3	83.6	46.7	67.6	93.3	81	36.8	56.4
Nb	8	9	6	7	8	10	6	9	7	6
Ba	663	590	601	580	610	505	498	601	570	560
Cu	12	18	16	11	12	24	10	15	14	16
Ni	30	36	67.9	51	46	35	28	57	48	46
Co	9.2	8.1	8.3	11.4	15	14	13	17	18	13
Cr	109.8	183	66.8	314	114	83	119	89.9	105	113
V	6	8	7	6	5	9	7	8	6	9
Zn	27.9	18.3	22.1	22.6	17.5	23.4	29.4	30	26.6	28
Ga	22	18	16	21	24	19	17	23	20	19
Pb	10.3	10.6	13.2	7.9	8.3	5.9	6.1	7.9	10.6	15.9
U	11.7	13	16	14	19	23	17	19	20	22
Th	44	58	64	53	54	69	44	58	63	66
Th/U	3.76	4.46	4.0	3.78	2.84	3.0	2.59	3.05	3.15	3.0
D.I.	88.29	89.62	88.85	88.46	87.37	89.96	89.86	90.39	90.14	90.48
R1	1866	1912	2102	1898	1866	2314	2410	2139	2271	2118
R2	428.3	403.3	410.7	418.3	486.9	336.1	338.7	343.2	335.2	362.6
Agp. I	0.90	0.91	0.85	0.89	0.86	0.82	0.81	0.94	0.88	0.95

Table (2): Chemical analysis of major and trace elements of granitoid rocks of G. Hadrabiyyah area.

S.No.	H-1	H-2	H-3	H-4	H-5	H-6	H-7
SiO_2	71.64	72.09	71.96	70.89	73.18	71.99	71.86
TiO_2	0.24	0.28	0.34	0.25	0.43	0.37	0.41
Al_2O_3	13.24	13.01	13.21	13.11	12.96	13.86	13.68
Fe_2O_3	1.97	1.92	1.71	1.81	1.98	1.98	1.97
FeO	0.69	0.73	0.88	0.92	0.88	0.98	1.02
MnO	0.36	0.41	0.32	0.37	0.18	0.43	0.38
MgO	0.65	0.82	0.68	0.78	0.49	0.53	0.48
CaO	1.34	1.53	1.23	1.42	0.75	1.31	1.41
Na_2O	4.39	4.29	4.24	4.86	3.81	3.98	3.86
K_2O	3.75	3.81	3.93	4.18	4.23	3.42	3.31
P_2O_5	0.29	0.25	0.32	0.38	0.29	0.31	0.36
L.O.I	0.73	0.38	0.93	0.87	0.68	0.83	0.92
Total%	99.49	100.33	99.77	99.84	99.88	99.90	99.66
Qz	28.91	29.19	29.70	24.15	33.45	33.19	34.25
Or	22.46	22.73	23.52	24.98	25.22	20.42	19.83
Ab	37.57	36.57	36.26	41.50	32.46	33.95	33.04
An	5.01	5.00	4.28	1.59	2.19	4.73	4.95
Di	0.00	0.92	0.00	2.60	0.00	0.00	0.00
Hy	1.93	1.69	1.96	1.21	1.23	1.52	1.49
Cor	0.13	0.00	0.42	0.00	1.31	1.90	1.97
Mt	2.89	2.81	2.51	2.65	2.19	2.90	2.89
Il	0.46	0.54	0.65	0.48	0.82	0.71	0.79
Ap	0.64	0.55	0.71	0.84	0.64	0.68	0.80
Zr	134	167	159	145	150	173	128
Y	4	3	5	7	6	5	8
Sr	9.5	6.8	5.5	9.1	7.3	6.1	8.1
Rb	96	113	73	95	101	118	87
Nb	11	8	6.3	7	5.9	9	8.1
Ba	414	397	480	391	401	361	350
Cu	11	9	7	13	8	15	14
Ni	86	51	50.7	56	78	62	68
Co	11	9.0	7.6	8.1	6.9	13	12
Cr	510	312	219	281	499	231	278
V	7	6	8	9	8	6	9
Zn	26	29	33	35	26	35	32
Ga	18	23	19	21	20	22	25
Pb	11	19	21	16	17	12	13
U	16	19	23	18	20	22	17
Th	53	62	68	59	69	78	60
Th/U	3.31	3.26	2.96	3.28	3.45	3.55	3.53
D.I.	88.94	88.50	89.48	90.63	91.14	87.56	87.12
R1	1961.7	1990.1	2006.8	1630.8	2216.9	2194.9	2255.4
R2	441.2	464.02	429.79	452.9	364.9	442.7	448.9
Agp.I	0.85	0.86	0.85	0.96	0.84	0.74	0.73

3-Magma Types

The magma types of the present granitoids are investigated using major and trace elements contents, some geochemical parameters and normative compositions (Tables 1 and 2).

Agpaitic index is a geochemical parameter defined as [$(Na_2O+K_2O)/Al_2O_3$] (in molecular proportion), (Goldschmidt 1954). The average agpaitic index of G. Ad-Dub granites is about 0.88 and G. Hadrabiyyah about 0.83 which means that the studied granitoid rocks are miaskitic in nature.

The total alkalies of the studied samples are plotted against SiO_2 content (Irvine and Baragar, 1971) shown in (Fig. 20), where the studied samples plot in subalkaline field.

Maniar and Piccoli (1989) used the Shand index to distinguish between the peralkaline, metaluminous and peraluminous rocks, where the data points of G. Ad-Dub – G. Hadrabiyyah granitoid rocks plot in the metaluminous and peraluminous fields (Fig. 21).

Bailey and McDonald (1969) and McDonald and Bailey (1973) used the ternary diagram SiO_2–Al_2O_3-Na_2O+K_2O (Fig.22) to distinguish between the calc-alkaline, alkaline and peralkaline rocks where the data of G. Ad-Dub – G. Hadrabiyyah granitoid rocks plot in the calc– alkaline field.

Figure (23) shows AFM diagram (Irvine and Baragar, 1971) for the studied granitoid rocks, where the studied samples plot in calc-alkaline field and the samples show a trend parallel to the compressional trend.

Chappell and White (1974) used the binary relation between Na_2O and K_2O to differentiate between S- and I-type granites (Fig.24) the figure shows that the studied granitoid are I-type granites. The I-type granites include those which represent mantle derived rocks, while S-type granites are products of partial melting of crustal material during continental collision (Pitcher, 1983).

Also, Harris *et al.*, (1984) used the binary diagram between Rb/Zr and SiO_2 to differentiate between S and I- types (Fig. 25). It is clear that the studied samples plot in I-type volcanic arc granites.

To summarize, the studied miaskitic Granitoid rocks originated from metaluminous to peraluminous calc-alkaline magma types.

4-Tectonic Setting

The variation diagram of Nb-Y discriminates between the oceanic ridge granites which is enriched in Y contents and volcanic arc and syncollision granites which are depleted in Y (Pearce et al., 1984) as shown in (Fig. 26). The data of the studied granitoid samples plot in the volcanic arc and syn-collision granites field.

The variation diagram Rb-Y+ Nb is used to discriminate between volcanic arc granites depleted in Rb contents and collision granites enriched in Rb as shown in (Fig. 27). This indicates that the granitoid of G. Ad-Dub – G. Hadrabiyyah plot in the volcanic arc granites field.

The tectonic setting of the studied granitoids is determined using bivariante plot of Rb/Zr vs. SiO_2 (Harris et al., 1984) which discriminate between the syn-collisional granites and volcanic arc granites as shown in (Fig. 25), where the studied samples plot in the volcanic arc granite (VAG) field.

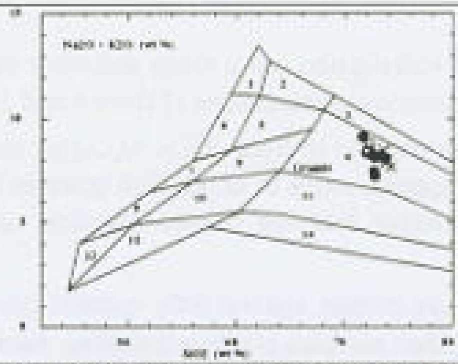


Fig. (16): SiO_2- Na_2O+K_2O (Middlemost, 1985)

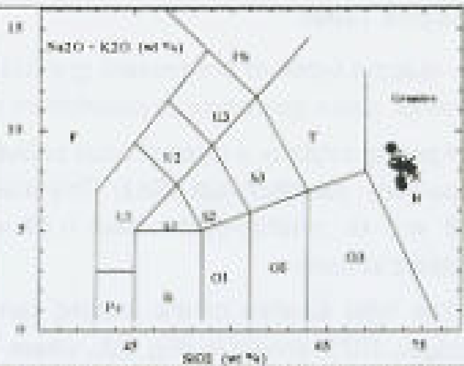


Fig. (17) : SiO_2- Na_2O+K_2O diagram (Le Maitre 1989)

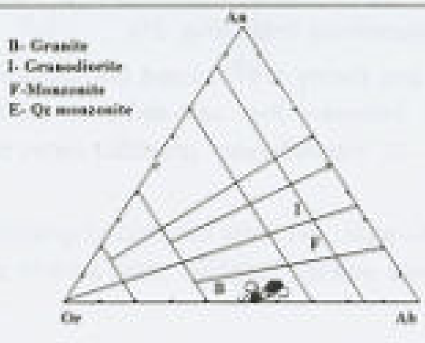


Fig. (18): Or-Ab-An diagram (Hitannen,1 963)

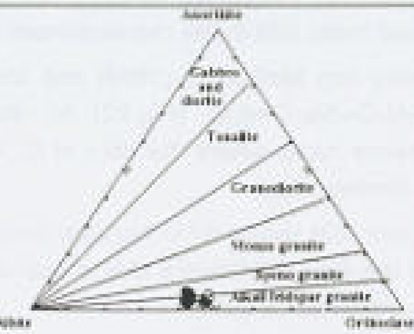


Fig. (19): Ab-An-Or (Streckeisen (1976)

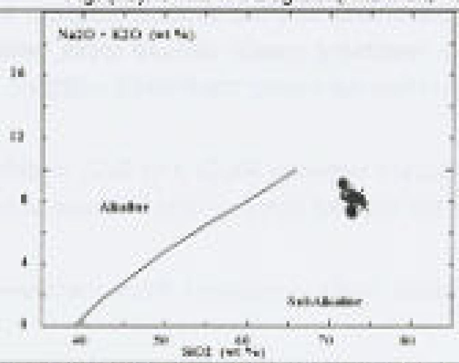


Fig. (20): Na_2O+K_2O against SiO2 diagram (Irvine and Baragar, 1971)

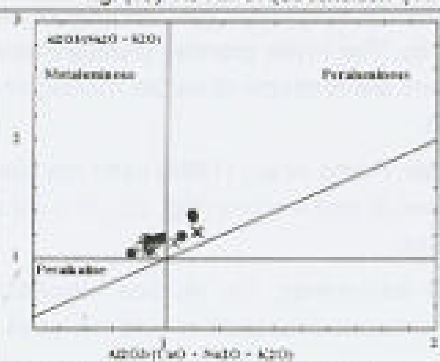


Fig. (21): Shand index (Maniar and Piccoli ,1989)

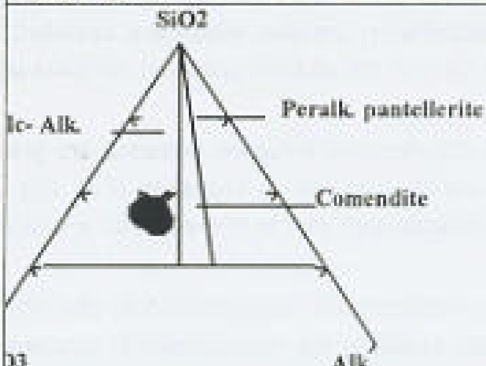


Fig. (22): Al_2O_3-SiO_2-Na_2O+K_2O ternary diagram

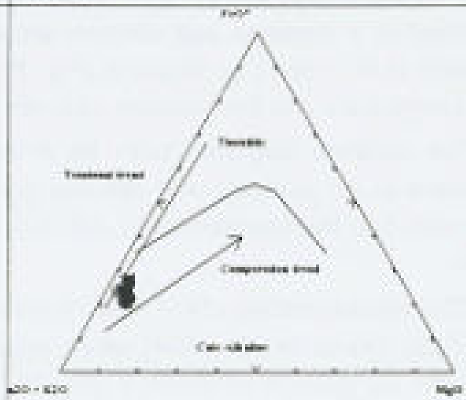


Fig. (23) : AFM variation diagram .

The studied rocks show a very common trace elements abundance pattern as shown by spider diagram (Fig.28), which shows that the studied granitoid of G. Ad-Dub – G. Hadrabiyyah have similarity in the abundances of the elements distribuation.

From the above results, it can be said, that the granitoid rocks of G. Ad-Dub – G. Hadrabiyyah were originated from a metaluminous calc-alkaline magmas that developed in volcanic arc tectonic setting which is an a compressional regime.

5-Crystallization condition

The environmental conditions of the granitoid rocks can be deduced from the normative (Ab–An- Or) and (Qz–Ab–Or) systems as follow.

Figure (29) shows the Ab-An-Or system with the fields of rock types after O'Connor, (1965) and Barker, (1979). The effect of PH2O on the position of cotectic boundary between orthoclase and plagioclase at 1 Kb and 5Kb PH_2O are also shown after Tuttle and Bowen (1958). The G. Ad-Dub – G. Hadrabiyyah samples plot in the granite field and the magma was generated at somewhat intermediate depths equivalent to 3-6 Kb.

The Qz–Ab–Or system is shown in (Fig. 30). The cotectic boundaries at 0.5 and 10kb are also shown. The studied granitoid samples are plotted in the region which indicates formation at water pressure 3-7kb at depth range from (8 -19 km) Wilson, (1989).

Figures (31) show the quartz–albite-orthoclase system illustrating the temperature isotherms. The studied samples crystallized under temperature ranging from 760°-840° (James and Hamilton, 1969 and Winkler *et al.* 1975).

6-Petrogenesis of Granitoid Rocks

In order to understand the petrogenesis of the granitoid rocks, the origin and possible conditions of crystallization of these rocks can be discussed in terms of their chemical composition and discussed within the framework of the evolution of the Egyptian Shield. By about (660-650) Ma ago most of the Egyptian Shield had been unified into a single crustal plate, and subduction related (Na_2O-dominated) magmatism had ceased. The change to mainly crustal derived (K_2O- dominated) magmas was abrupt and characterized by onset of Dokhan type volcanism (Abdel Monem *et al.*, 1996). It should also be noted that the composition of the region controls the bulk chemistry of the initial melt. The degree and temperature of melting determine the CaO content of the melt which with high degrees of melting produces more calcic melts (Wyllie, 1977).

The initial melts of the Egyptian Shield calc-alkaline island arc volcanics and continental crust source regions are probably granitic in composition with moderate to high K_2O. The post-accretion granitic magmas with moderate to high CaO (>1.5%) probably reflect moderate to high degree of melting. The residual source regions after extraction of the initial granitic melts will be poor in the volatiles and alkalis and rich in refractory calcic plagioclases, pyroxenes, amphiboles and accessory minerals such as sphene, magnetite, apatite and zircon. High temperature melting of such residual source regions in the presence of volatiles derived either from the dehydration of residual amphiboles or biotite or degassing of basaltic magmas, (Hildreth, 1981) could account for the characteristics of the alkali and alkali feldspar granites in the Egyptian Shield (Collins *et al.*, 1982). The proposed deep source regions for the Egyptian post-tectonic granites are supported by the commonly observed low initial 87Sr/86Sr ratios (0.702-0.703).

The identification of the source regions from which granitic magmatic liquids were derived as well as the nature of these magmatic liquids can be recognized from the variation patterns

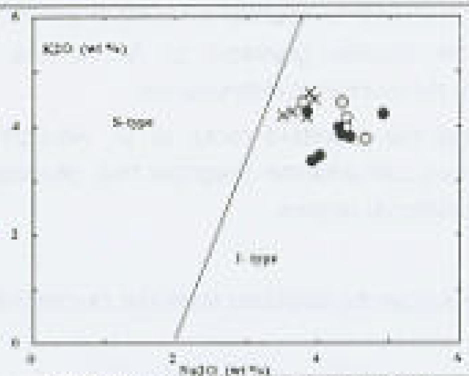


Fig. (24) : Na_2O-K_2O variation diagram

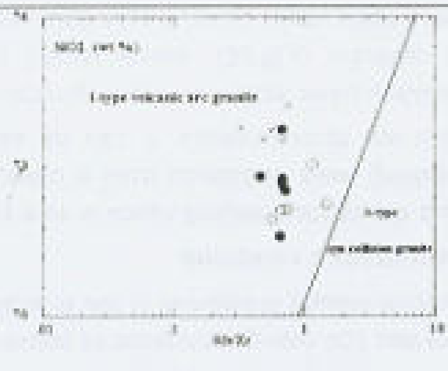


Fig. (25) : SiO_2-Rb/Zr (Harris et al., (1984)

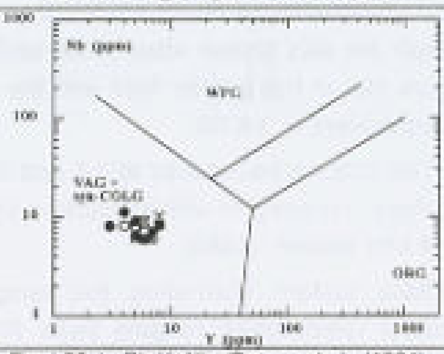


Fig. (26) : Rb-Y+Nb (Pearce et al., (1984)

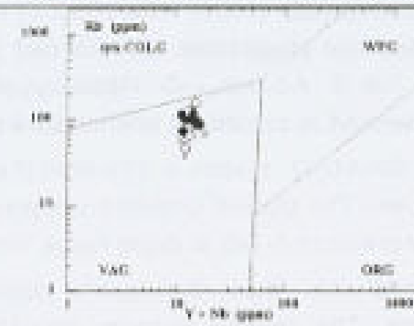


Fig. (27) : Nb-Y (Pearce et al., (1984)

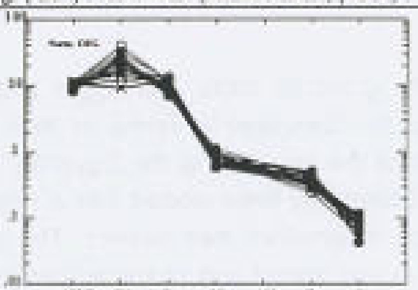


Fig. (28) : ORG-normalized trace elements for the studied granodiorite rocks

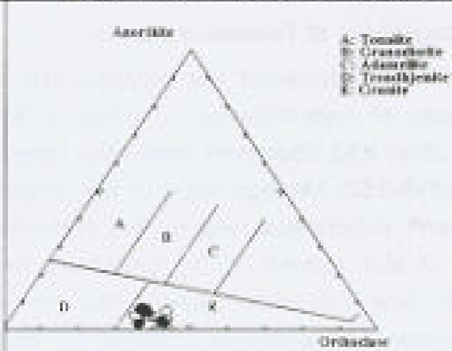


Fig. (29) : An-Ab-Or ternary diagram

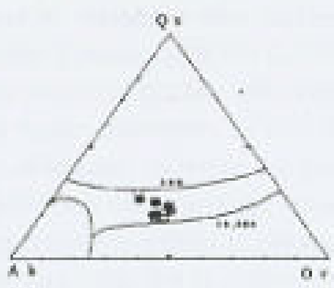


Fig. (30) : Qz-Ab-Or ternary diagram

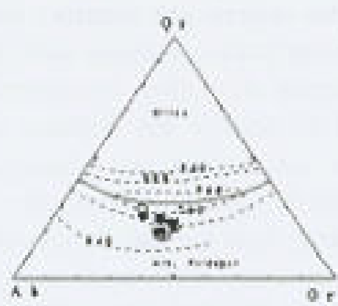


Fig. (31) : An-Ab-Or ternary diagram

and inter-relationships between some elements such as K, Rb, Sr and Ba because their behavior in these systems is strongly tied to the major minerals, e.g., plagioclase, K-feldspars, biotite and muscovite.

The K-Rb variation diagram of the studied granitoid rocks is shown in (Fig. 32). The average values of studied granitoid are higher than the crustal average value of 250 (Taylor, 1965). The higher K/Rb ratio indicates sources regions for magma generation in the lower crust (Heier, 1973) or upper mantle (Gast, 1965). Also, the higher K/Rb ratios for the more fractionated granitic phase probably indicate magma generation mechanism involving dehydration of amphiboles at deeper levels in the lower crust (Griffin and Murthy, 1969).

The K-Ba variation diagram is shown in (Fig. 33). The valus of K/Ba is nearly equal to the average crustal ratios line (K/Ba=65) which indicate that they are enriched in Ba.

The Ba-Rb variation diagram is shown in (Fig.34). It can be used to signify the degree of fractionation of granitoid rocks. The line representing the average Ba/Rb ratio for the crust is about (4.4) (Mason, 1966). The Ba/Rb ratios of the studied granitoid show that they have equal values to the average crustal ratio that is consistent with the suggestion that these samples originated from an enriched Ba source.

From the above it is clear that the granitoid rocks of Gabal Ad-Dub– G. Hadrabiyyah area are generated at depth of about 8-19 km equivalent to 3-7 Kb and temperature ranging from 760°c to 840°c with multi-processes of both assimilation and fractional crystallization involving plagioclases, hornblende and Fe-Ti oxides from a partial melted lithospheric magma.

7- Geochemistry of U and Th.

Uranium and thorium contents were determined chemically in 17 samples. The obtained results of uranium and thorium analyses are indicated by ppm as well as Th/U are shown in Tables (1&2). From this table, the Uranium content of G. Ad-Dub ranges from 11.7 to 23 ppm with an average 15.7ppm and thorium ranges from 44 to 66 ppm with an average 57.3ppm. The averages of uranium of the G. Hadrabiyya ranges from 16 to 23 ppm with an average 19.3 ppm and thorium ranges from 53to 78 ppm with an average 64.1 ppm which is coincided with the average U of the granitic rocks of Clark et al.(1966), and also introduce in the range of the acidic intrusive rocks of Adams et al.(1959) and the silicic intrusive rocks of Rogers and Adams(1969).

The geochemical behaviour of U and Th in the studied areas can be examined as follows:

The U-Th variation diagrams for the studied rocks indicate strong positive relations between the two elements due to magmatic origin as shown in (Fig. 35). This reflects the enrichement with magmatic differentiation due to magmatic.

Fig. (36) show that the variation of Th/U ratios versus U in the studied rocks . It is clear that from the figure the decreasing of Th/U accompanied with enrichment in U. From the above and from the figure (37) it is clear that the U and Th cotents are controlled by the presence of some accessory minerahs (zircon and apatite) and iron oxides, whereas iron oxide and hydroxides are know to absorb U from circulating fluids.

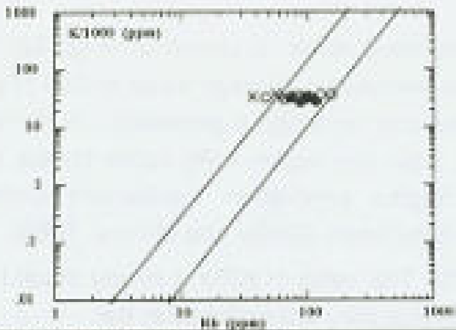


Fig. (32) : K-Rb variation diagram.

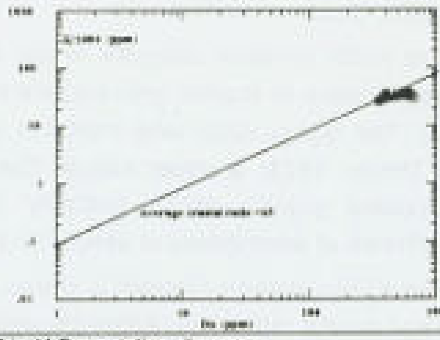


Fig. (33) : K-Ba variation diagram.

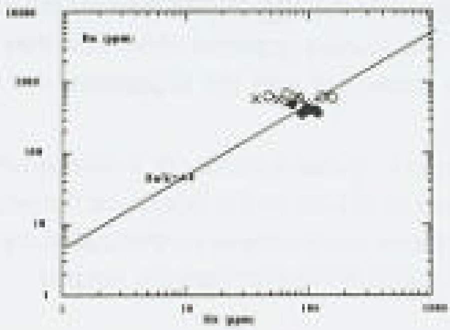


Fig. (34) :Ba-Rb variation diagram .

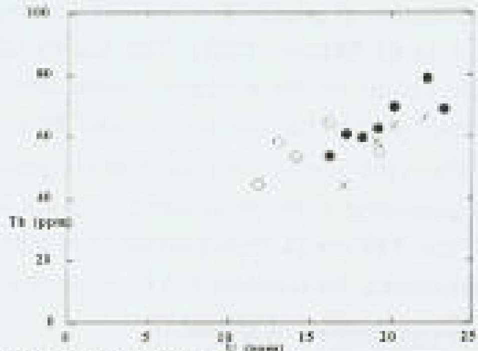


Fig. (35) : Th-U variation diagram .

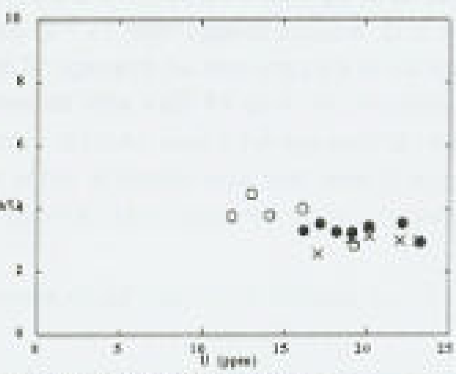


Fig. (36) :Th/U-U variation diagram.

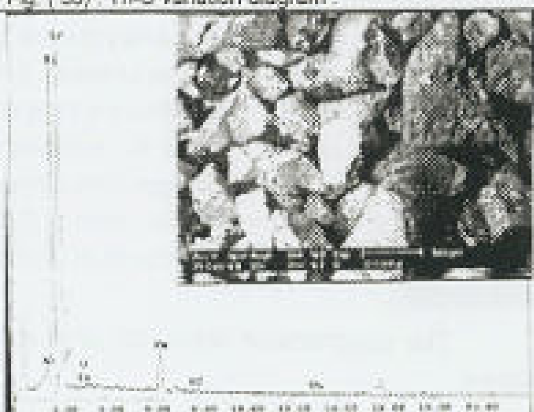


Fig. (37) :EDX for zricon.

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فحص ودراسة طورين من الجرانيت بمنطقة وادي أبو زوال – شمال الصحراء الشرقية- مصر

وفقي السيد النجار- عطا عبد الشافي

هيئة المواد النووية

يتناول هذا البحث ودراسة طورين من الجرانيت بمنطقة وادي أبو زوال ، شمال الصحراء الشرقية، مصر وقد تمثل هذا الجرانيت في كلا من جبل الدب الذى يغطى ٥،. كم٢ تقريبا ويمتد في اتجاه شمال شرق ويتكون من نوع مونزوجرانيت في الحواف ومن جرانيت الفلسبار القلوي فى الوسط، وجبل حضربية الذى يغطي ٤، ١ كم٢ تقريبا ويمتد في شمال غرب ويتكون من جرانيت الفلسبار القلوي. جيوكيميائيا ومن خلال التحاليل الكيميائية للعناصر الأساسية والشحيحة وعنصري اليورانيوم والثور يوم ثبت أن هذه الجرانيتات من نوع الوقد نشأت من مجما كلس قلوية فوق الوصنية في بيئة قوس بركاني تحت ضغط من ٣-٧ كيلو بار ضغط مائي على عمق ٨-١٩ كم وفي درجة حرارة من ٧٦٠-٨٤٠ م. كما ثبت أيضا أن تركيز اليورانيوم والثور يوم مرتبط بالعمليات المجماتية ويتواجد مع معادن الزركون والأباتيت وأكاسيد الحديد.