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PETROGRAPHY AND MINERAL CHEMISTRY AT WADI BALLI AREA, CENTRAL EASTERN DESERT, EGYPT.

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Abstract: The Gattar granites are composed mainly of quartz and feldspars as essential minerals and biotite hornblende, zircon, apatite and sphene as accessory minerals, some secondary minerals as epidote, chlorite and sericite are found. The Gattar granites originated from calc-alkaline magma and tectonically it is volcanic arc granites. The study includes some mineral as feldspars, biotite and, amphiboles from Wadi Balli under Environmental Scanning electron Microscopy (ESEM) attached by Energy Dispersive E-ray analyses (EDX) in nuclear Materials Authority (NMA), gave that the feldspars composed under temperature 850°C and biotite in Wadi Balli originated from magmatic origin.

INTRODUCTION

The Egyptian Eastern Desert, northern Sudan, western Saudi Arabia and Yemen have collectively been termed the Arabian Nubian Shield, which is characterized by four principal rock association: i.e. (1) an older shelf sequence of ortho- and paragnesis, (2) arc assemblages, (3) ophiolitic suits and (4) granitoid intrusive (Koener et al., 1987). The Egyptian granitoid rocks have been subdivided in different ways (Greenberg, 1981). They can be in general classified into two main types, the older and younger granites (El-Ramly and Akaad, 1960). Gabal Gattar and Wadi Balli areas are part of the Northern Easter Desert (NED), of Egypt. They are cover by Pan-African basement rocks. Salman et al, (1990 & 1991), Sayyah and Attawiya (1990), Shalaby (1990, 1995 and 1996) and Mahmoud (1995) mentioned that the granites of Gabal Gattar are calc alkaline granites and tectonically volcanic arc type.

The present study deals with the geology of Gabal Gattar granitic rocks and mineral chemistry of the granite at Wadi Balli by using (ESEM attached by (EDX)).

General geology

Gabal Gattar and Wadi Balli areas are located in the (NED) of Egypt between latitudes 26° 52\ to 27° 08\ N and longitudes 33° 13\ to 33° 26\ E (Fig. 1). It comprises the Gattar granite pluton which forms a

mountainous terrain with G. Gattar (1963m asl) and G. Umm Disi (1556 m), G. Abu El Hassan, G. Abu El Hassan El-Ahmar, G. Reddah, G. Theima and G. Abu Samyuk. The main wadis are W. Balli and W. El Ghozah (Fig. 1). The Gattar plouton is oval in shape stricking lone at NE-SW direction with the same direction o G. El Eglab (Ayoub and awadalla, 2008), and G. Uqab El Nugum south Eastern Desert Egypt (Samaan, 2000). G. Gattar covers an area of about 455km2 with about 30km length and 20km wide. It is dissected by various faults trending mainly ENE-WSW, NNW-SSE, NW-SE and NNE-SSW (El Rakaiby and Shalaby, 1992). The basement rocks in the studied area are classified according to Takla classification (2002), into

Inter plate Magmatism and sediments

Felsic and mafic dykes

Younger granites (G. Gattar granites)

Hammamat sediments

Subduction-related granitoids (Arc granites)

Diorites and granodiorites

Arc metavolcanics

Metavolcanics

Gabal Gattar granites are light pink in color, hard, holocrystalline and cars grained. Microscopically, it is composed mainly of quartz, potash feldspars and plagioclase as essential minerals, biotite, hornblende, zircon, apatite, opaqus and sphene as accessory minerals, epidote, chlorite and sericite are secondary minerals (Iliase, 2003).

Quartz occurs as the predominant minerals constituting about 40% of the rock. It forms coarse anhedral crystals, showing wavy extinction, and enclosing zircon, biotite, perthite, plagioclase and hornblende.

Feldspars occur as perthite and plagioclase, the perthite is more predominant than plagioclase. Orthoclase perthite build simply twinned, coarse, subhedral to anhedral crystal, partially altered to epidote. Some plagioclase crystals are zoned while other show saussuritization (epidote + sodic plagioclase) occur in more calcic in central part of the plagioclase crystals. The plagioclase crystals enclose zircon and apatite (Iliase, 2003).

Biotite occurs as euhedral flaky crystals, pleochroic from dark brown to yellow, and partially altered to chlorite. Some biotite crystals enclosed zircon.

Hornblende occurs as coarse prismatic crystals, green in color, pleochroic from dark green to light green. Some hornblende crystals enclose opaqus and zircon, patially altered to chlorite.

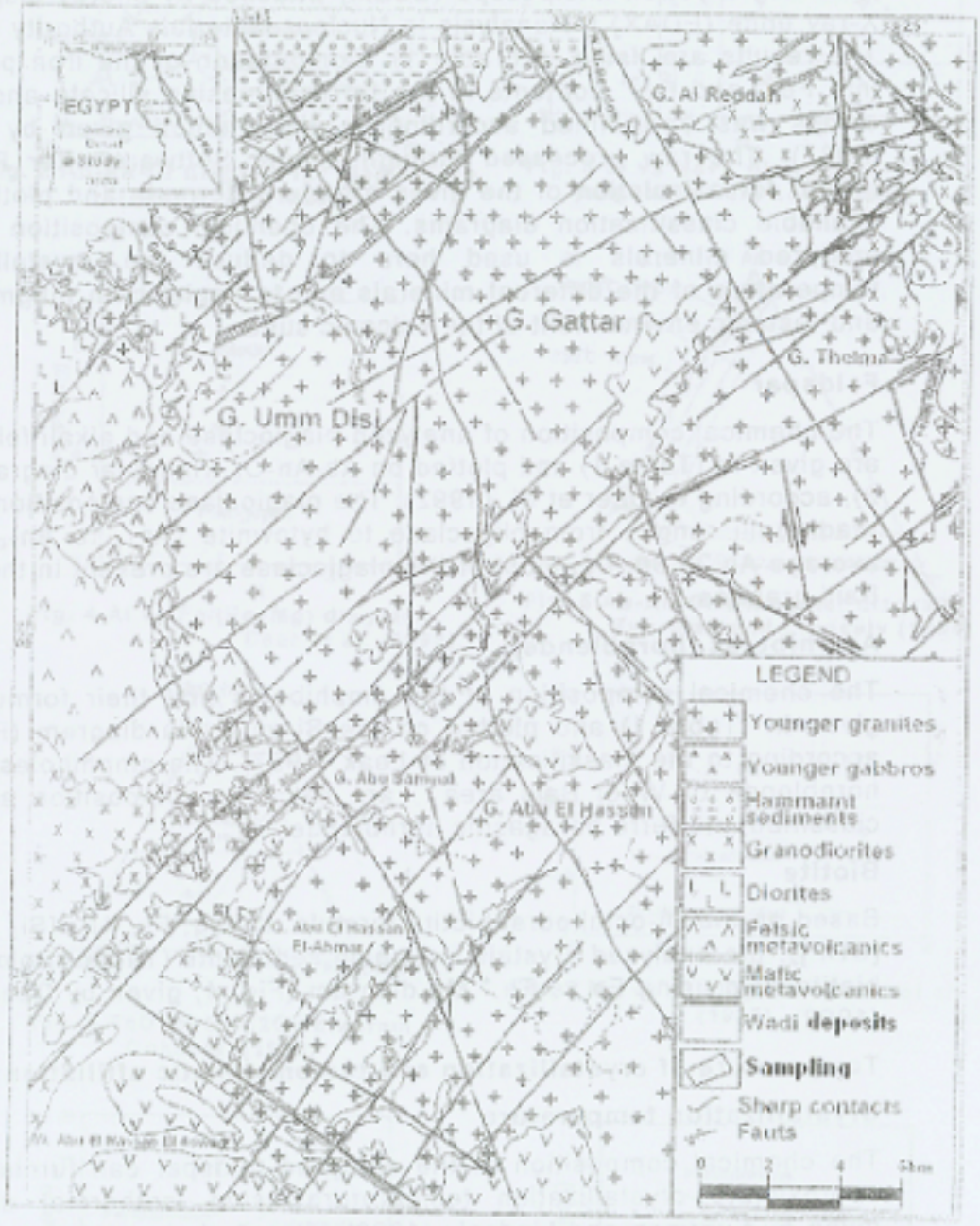

Fig. (1): Geological map of Gabal Gattar area Northern Eastern Desert, Egypt, showing the location map of the studied area at the top left side. (After El Rakaiby and Shalaby. 1992)

Table (1) Chemical composition and structural formula for plagioclase, biotite and hornblende of Wadi Balli *granites*

Rock types	*Plagioclase*					*Biotite*					*Hornblende*				
S. No.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
SiO2	66.33	64.6	62.36	64.57	48.27	36.9	37.10	35.21	32.84	34.90	31.09	29.27	32.61	31.09	33.04
TiO2	-	-	-	-	-	0.19	2.98	2.30	2.17	2.95	0.01	0.01	0.60	0.20	0.30
Al2O3	21.50	22.66	23.05	23.15	32.14	14.90	15.12	16.03	16.01	16.63	21.32	20.50	21.48	21.08	19.01
FeO	0.07	0.31	0.29	0.32	0.27	20.10	22.31	25.30	25.01	24.31	28.01	29.04	26.01	29.00	27.03
MgO	0.10	0.25	0.23	0.26	0.20	15.01	10.74	10.03	11.63	10.90	17.01	17.14	16.33	17.01	17.05
CaO	0.31	3.26	4.02	4.36	16.38	0.40	0.60	.81	0.72	0.95	0.01	0.03	0.05	0.08	0.52
Na2O	11.97	9.89	8.01	7.30	2.57	0.31	0.40	0.35	0.39	0.37	2.54	2.99	3.01	1.52	0.03
K2O	0.26	0.05	0.04	0.04	0.17	10.19	10.75	9.97	10.23	8.99	0.01	0.02	0.01	0.02	0.02
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Cations on basis 32 oxygen					Cations on basis 24 oxygen					Cations on basis 23 oxygen				
Si	11.79	11.27	11.01	10.09	8.99,	5.99	6.01	2.92	6.81	6.10	3.98	4.10	5.03	4.31	4.12
AlIV	0.21	0.73	0.99	1.91	3.01	0.01	1.00	2.08	1.19	1.90	2.20	1.42	2.70	3.10	3.10
AlVI	4.22	3.97	3.92	3.01	3.93	2.44	1.71	0.93	1.58	0.91	0.92	1.65	1.10	0.32	0.50
Fe	0.01	0.05	0.04	0.05	0.04	2.37	2.10	3.18	2.67	2.81	3.60	3.41	2.91	3.61	3.31
Mg	0.3	0.07	0.06	0.07	0.06	2.95	2.11	1.73	3.31	3.27	3.51	3.79	1.91	3.51	3.61
Ca	0.15	0.61	0.71	0.72	3.02	0.13	0.12	0.12	0.11	0.12	0.01	0.01	0.10	0.12	0.13
Na	3.72	3.37	3.17	3.06	0.91	0.05	0.08	0.12	0.10	0.11	0.70	0.40	0.51	0.91	0.89
K	0.08	0.01	0.01	0.01	0.04	1.71	1.92	1.95	1.83	1.60	0.01	0.01	0.01	0.01	0.02
An	1.25	16.10	20.21	22.44	75.73	-	-	-	-	-	-	-	-	-	-
Ab	90.0	81.73	68.55	63.97	21.77	-	-	-	-	-	-	-	-	-	-
Or	1.53	0.29	0.024	0.25	1.01	-	-	-	-	-	-	-	-	-	-

S. No Sample number

Magma type and tectonic setting

The ternary diagram Fe–Mg–Al2O3 (Gokhale 1968), indicates that the biotite is of magmatic origin (Fig. 6). Nachit et al. (1985) used the biotite chemistry to discriminate between peraluminous, calc-alkaline. Subalkaline and alkaline-peralkaline granites. The analyzed biotite crystals from Wadi Balli granites plot a within sub-alkaline field except one sample plot in calc-alkaline field (Fig.7).

Abdel-Rahman (1994) used successfully the composition of igneous biotites in reflecting the nature of their host magmas. He defined three compositionally distinct fields: Biotite in alkaline anorogenic suites are mostly iron-rich siliceous annites (FeO*/MgO = 7.40), biotites in peralumenous suites are siderophylliti in composition (FeO*/MgO = 3.48), whereas those in calc-alkaline mostly subduction – related orogenic suites are moderately enriched in MgO with a FeO*/MgO ratio of 1.756. The FeO*/MgO ratio of the analyzed biotite ranges between 1.36 and 2.20 with an average of 2.08. The obtained ratio is similar to calc-alkaline, subduction – related origin biotites. Moreover, the biotite of the calc-alkaline suites has the averages of 14.90%, 11.2% and 19.7% for their contents of Al_2O_3, MgO and FeO* respectively (Abdel – Rahman 1994).

The corresponding averages of the analyzed biotites are 15.99%, 11.60% and 23.39% nearly the same as those of calc-alkaline suites. On the biotite discrimination diagrams given by the same author, namely Al_2O_3 vs. MgO and FeO* (Figs. 8, 9) the studied biotites of Wadi Balli granites plot also in the field of calc-alkaline orogenic suites.

Conclusion

The Gabal Gattar area is bounded by latitudes 26o 52/ to 27o 08/ N and longitudes 33o 13/ to 33o 26/ E. It comprises the Gattar batholith which is very rugged, where the highest peaks are displayed by the pink Gattarian granites namely G. Gattar (1963m asl) and G. Umm Disi (1556 m), G. Abu El Hassan, G. Abu El Hassan El-Ahmar, G. Reddah, G. Theima and G. Abu Samyuk. The main wadis are W. Balli and W. El Ghozah southerly.

The G. Gattar area covered with Precambrian basement rocks represented by metavolcanics, diorites, granodiorites, hammamat sediments and the younger Gattar granites pluton. It is dissected by various faults mainly trending in the ENE-WSW, NNW-SSE, NW-SE and NNE-SSW.

Petrographicaly the studied Gattar granites are composite from quartz, perthite and plagioclase as essential minerals, together with biotite, hornblende, zircon, apatite, opaqus and sphene as accessory minerals, epidote, chlorite and sericite are secondary minerals. By study the different grains from the granites of Wadi Balli under the ESEM attached by EDX units found that, the plagioclase composition ranges from oligoclase (An10 to An76), and composite at temperature 850°C. The amphiboles of Wadi Balli are calcic in composition and are classified into ferropargasitic hornblende. Finally the analyzed biotite crystals in Wadi Balli gave that the biotites are of magmatic originated from calc-alkaline magma.

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دراسة بتروجرافية وكيميائية للمعادن المتواجدة فى الصخور الجرانيتية فى وادى بالى بمنطقة جبل جنار شمال الصحراء الشرقية المصرية

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هيئة الواد النووية صندوق بريد 530 المعادى القاهرة

يتكون جرانيت جبل جنار من معادن اساسية مثل الكوارتز و الفلسبارات و معادن مصاحبة مثل البيوتيت و الهورنبلد و الزيركون و الاسفين و الاباتيت و معادن ثانوية مثل الابيدوت و الكلوريت و السيريسيت. و جرانيت جنار من النوع الكلسى قلوى و تكون فى الجزر البركانية. و بعد فصل معادن الفلسبار و البيوتيت و الهورنبلند و دراستها بواسطة الميكروسكوب الماسح الالكترونى البيئى (ESEM) المتصل بوحدة دارسة الطاقة المنشرة بواسطة الاشعة السينية (EDX) و ذلك بمقر هيئة الواد النووية. وجد ان الفلسبار تكونت تحت درجة حرارة 850 درجة مئوية و ان البيوتيت من اصل مجمانى