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Assessing the Influnce of Diagenetic Processes at El-gedida Mine, El-bahariya Oasis, Egypt

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Abstract: This study is concerned with the lithostratigraphy, microfacies association, mineralogy, geochemistry, mossbauer analysis and diagenetic processes of the rock types: calcareous sandstone, iron ore, ferruginous sandstone, glauconitic sandstone, evaportic sandstone and fine sandstone forming the El-Gedida mine. These rock units include some microfacis as: Calcareous quartz wacke, Ironstone ore bed, Ferruginous quartz wake, Glauconitic Quartz arenite, Evaporetic quartz wake and Quartz arenite. The main minerals present are quartz, iron oxides as: hematite, goethite, glauconite, pyrite, calcite and halite which is present as cement. The argillaceous minerals include kaolinite, illite, and montomornite. Geochemically, El-Gedida is characterized by higher percentage of Fe_2O_3, Cao and MgO in iron ore beds, high content of SiO_2 as the main elements, while Fe_2O_3, SO_3, CaO, Al_2O_3 are minor elements. These elements are compound together and content the ferruginous sandstone and glauconitic sandstone microfacies, the high content of SiO_2, Na_2O and Cl as main elements and low content of CaO and SO_3 as minor elements compound together and content evaporatic sandstone microfacies. Mossbauer results confirmed and clarified the results obtained from the different techniques. So it through the light on the geochemical conditions under which the three different formations are deposited. The main diagenetic processes is the oxidation of pyrite and glauconite which is prduced the ferruginous sandstone and ironstone bed. Pyrite is oxidized and the released So_4^{2-} may react Ca^2 to form gypsum. The gypsum and halite which producing from sea water is contain evaportic sandstone.

Key word: Diagentic processes, Mossbauer, Iron ore, Bahariya Oasis

INTRODUCTION

El Gedida area is located in the Bahariya northern plateau, 15 km south 56° east of Gabel Ghorabi and 11 km north 22° east El–Harra triangulation point, (Fig.1 & 2). El Gedida area is divided topographically in to two main parts. The first one is high area in the center and the second is wadis surrounding the high area. High area is more or less leveled plateau dissected by numerous wadis. The beds which overlie the iron ore form scattered hillocks resting over the plateau surface. The average relief difference between the hillocks and the plateau level is about 40m., whereas that between the plateau surface and the surrounding wadis is about 30m. The low wadis surrounding the high area are mainly faulted wadis with this area as horsted block. These wadis surrounded the high area from the all directions and are bounded by limestone scarps from the east, west and south. The east, west and northern wadis join together and form major valley drainage its water inside the plateau.

El-Gedida area has been studied by many authors. Recently, Khalil (1995) and El-Aref *et al.* (1999) classified the iron ore of El Gedida mine area into six types, five of which are equivalent to the Lutenian ore (Naqb-Qazzun ore), whereas the uppermost type (the lateritic glauconitic ore) is related to alteration of the glaucony facies of the Bartonian Hamra Formation. However, Mesaed and Surour (1997) studied in detail the mineral chemistry and mechanism of formation of Bartonian glaucony of El-Gedida mine area, El-Gedida mine and associated glauconitic ironstones are sandwiched between two major unconformities occupied by Lowstand System Tract deposits(i.e. the Lutetian-Bartonian unconformity and associated laterritic iron ore are the base, and the upper Eocene – Oligocene unconformity and the associated continental deposits of the Qatrani Formation are the top). Mesaed (1999) also pointed out that the glucony facies within the siliciclastic- or carbonate-dominated cycles.

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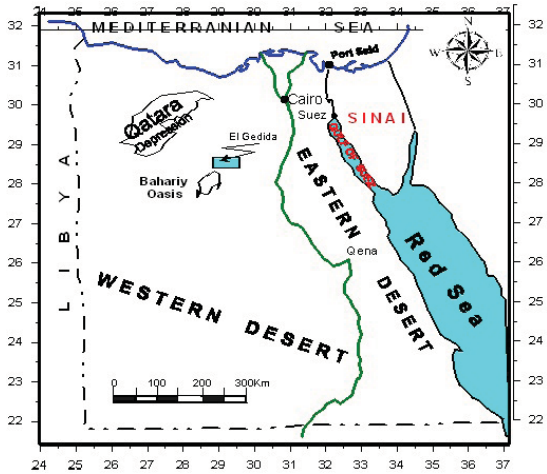


Fig. 1: Location map showing El Gedida study area.

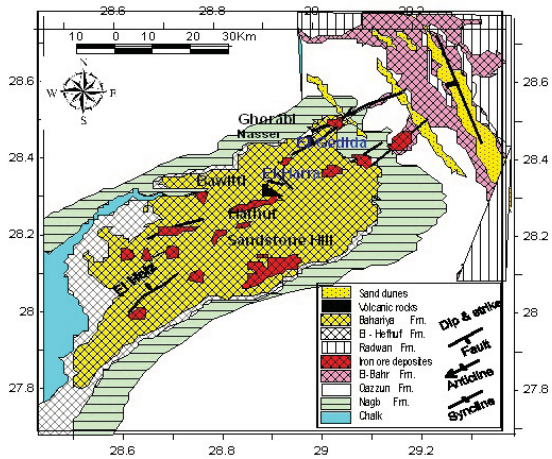


Fig. 2: Geological map of Bahariya Oases depression and locations of iron or deposites. Western Desert, Egypt. (After Amer, 1973).

Geological Setting of the Ore:

The iron ore is present mainly in the form of one bed varying in thickness from 1.0 m at the southern peripheries of the ore body to 24m; this is located near the fault plain which disturbs the western part of the high area. The average thickness of the iron ore in the study area is 7.90 m., the iron ore forms the top part at the center of the plateau surface and also covered by thin bed (average thickness 0.55m) consists of sand and gravels of iron which are binding together by salt.

At the area of the hillocks the iron ore is covered by greenish glauconitic sandy clay, quartzite and ferruginous grit, with an average thickness 42 m. The iron ore present in this high area is not interrupted; the iron ore is generally hard, heavy, massive red to dark reddish hematite. Hematite is occasionally finely oolitic porous and having metallic luster; it is also intercalated by Goethitic pockets. There is a sharp contact between the iron ore bed and the under laying sandstone bed.

At the wadis surrounding the high area, the iron ore is covered by a thick overburden of ferruginous sandstone about 4m. there is an intercalations of sandstone bands within the iron ore thickness about 4 m. the iron ore present in this area is a mixture of hematite and goethite, it is also rather fragmental than blocky and more cavernous. At the wadis to the west area, the iron ore bed is underlain by calcareous sandstone about 8 m.

Barite forms the main gang mineral associated with the ore bed, it is scattered and disseminated in the whole thickness of the iron ore bed in different shapes and quantities. Halite and gypsum are present in minor amounts, halite is present at the top of the ore body filling the cracks and gypsum is irregularly distributed.

MATERIALS AND METHODS

Methodology:

The present work aims to flash up at the petrographical, mineralogical, geochemical properties which are elucidated and confirmed through the hyperfine structure of the iron nuclei is detected from Mossbauer measurements of the El-Gedida mine area to evaluate the diagentic process which are effected on it. To achieve this target, a total twelve samples were collected to represent the different layers of the studied area. These samples were studied as follows:

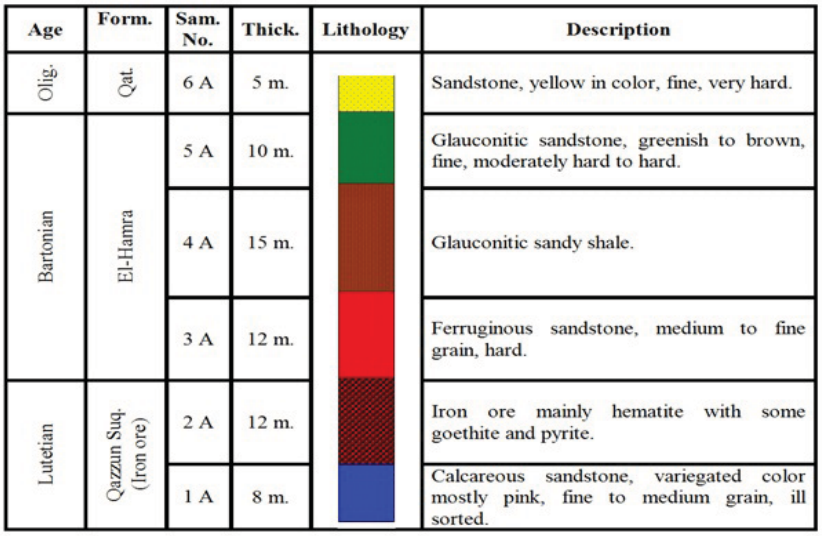
- Twelve thin sections were prepared for the petrographic study of the El-Gedida mine area to determine the mineralogical composition and microfacies association.

- Five samples were selected and analyzed by the X-ray diffraction. The analysis was carried out at the Egyptian Geological Survey and Mining Authority (Central Laboratories) , and using automated the automated powder diffractometer system of Philips PW 1710; with Ni – filter Cu radiation (λ = 1.542 A) at 40 KV, 30 mA and scanning speed 20 / min.
- Scanning electron microscope (SEM) for eight samples of different lithofacies was performed in order to diagnose and understand the micro-structures and diagenetic relationships among the pore space main constituents and matrix of the studied sequence. Identification of the different minerals through SEM was facilitated by comparing their morphologic characteristics with those shown in the SEM Petrology Atlas (Welton, 1984). SEM was also carried out at the Egyptian Geological Survey and Mining Authority (Central Laboratories) using a SEM Model Philips X30 attached with EDX unit , with acceleration Voltage of 30 KV , magnification 10X up to 400,000 and resolution for W. (3.5mm) . The samples were coated with gold.
- Six samples were selected for the geochemical study to determinate the major and trace elements. The detailed chemical analysis was carried out at the Egyptian Geological Survey and Mining Authority (Central laboratories sector). The analysis was made through automated powder diffractometter system of Philips PW 1710; with Ni-Filter, Cu radiation (=1.542 A) at 40 KV, 30mA and scanning speed 20/min.
- Four samples were selected for the Mossbauer measurements using a conventional constant acceleration driving spectrometer in the transmission geometry and (30 mci) Co^{57} radio-active source in Rh matrix. The spectra were recorded at room temperature. The Mossbauer parameters were determined by computer fitting using least-squar method. The relative amounts of iron in the various phases were estimated from the absorption area of the fitted Mossbauer spectra. The detail Mossbauer measurements were carried out at the Mossbauer Lab., Physics Department, Faculty of Science, Al-Azhar University.

Lithostratigraphy:

The studied area can be subdivided into three formations from base to top as follows: Qazzun sequence (iron ore), El-Hamra and Qatrani, Khalil (1995) Masaed and Surour (1997) and El-Aref *et al.* (1999).

The studied area is divided into two sections; the first one is located in hillocks which consist of six layers about 62 m. from base to top as follows**:** calcareous sandstone, iron ore, ferruginous sandstone, glauconitic sandy shale, glauconitic sandstone and fine sandstone, (Fig. 3). The second represented the wadies which consist of six layers about 30.5 m. from base to top as follows**:** calcareous sandstone, iron ore, ferruginous sandstone, glauconitic sandstone, evaportic sandstone and fine sandstone, (Fig. 4).



Age	Form.	Sam. No.	Thick.	Lithology	Description
Olig.	Qat.	6 A	5 m.		Sandstone, yellow in color, fine, very hard.
Bartonian	El-Hamra	5 A	10 m.		Glauconitic sandstone, greenish to brown, fine, moderately hard to hard.
		4 A	15 m.		Glauconitic sandy shale.
		3 A	12 m.		Ferruginous sandstone, medium to fine grain, hard.
Lutetian	Qazzun Suq. (Iron ore)	2 A	12 m.		Iron ore mainly hematite with some goethite and pyrite.
		1 A	8 m.		Calcareous sandstone, variegated color mostly pink, fine to medium grain, ill sorted.

Fig. 3: Lithologic description of the studied iron ore in the Hillocks area, section (A).

Age	Form.	Sam. No.	Thick.	Lithology	Description
Oligocene.	Qatrani	10 m.	6 B		Sandstone, variegated color mostly pink, fine to medium grain.
		0.5 m	5 B		Evaporetic sandstone medium to fine.
Bartonian	El-Hamra	4 m.	4 B		Glauconitic sandstone, greenish to brown, fine, moderately hard to hard.
		4 m.	3 B		Ferruginous sandy shale.
Lutetian	Qazzun Succ. (Iron ore)	4 m.	2 B		Iron ore patches of Barite. (Barite is massive grey to brown, fine to medium, transparent intersected
		8m.	1 B		Calcareous sandstone, fine to medium grain, pink to brown in color.

Fig. 4: Lithologic description of the studied iron ore in the Wadies area, section (B).

RESULTS AND DISCUSSION

Microfacies Associations of Studied Samples:

The microscopically study of the analyzed samples from El Gedida area, according to the classical classifications of Folk (1974), Pettijhon *et al.* (1973), Pettijhon (1975) and Tuker (1981), these led to the recognition of six microfacies associations as follows: Calcareous quartz wacke, Ironstone ore bed, Ferruginous quartz wake, Glauconitic Quartz arenite, Evaporetic quartz wake and Quartz arenite.

Calcareous Quartz Wacke:

The sandstones of this microfacies association are composed of medium to coarse quartz grains (average 75%) and about 25% non-quartz contents which represented by carbonate (about 15%) and (about 10%) are clay matrix, iron oxide and evaporates which present as cement, sub-rounded to rounded, occasionally well rounded. The grains are mostly monocrystalline and few are polycrystalline, this microfacies is represented by samples No. 1A & 1B (Plate 1, Fig. A). The Quartz grains are cemented by sparry calcite crystals in some places of the sample. Diagenetic processes such as cementation of silica and calcite have affected these sandstones. The probable depositional environment is shallow marine.

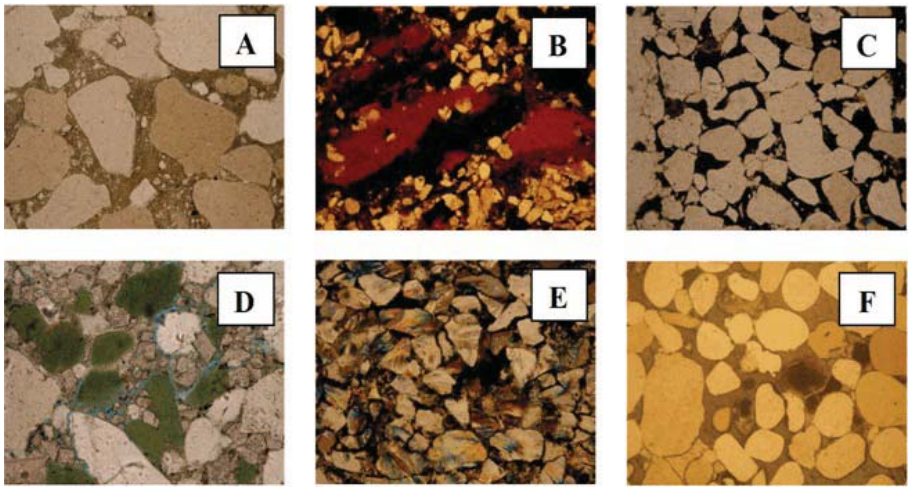


Plate 1:

Iron Ore Bed:

This microfacies is represented by two beds (each about 4 and 12m. in thickness), dark red in color, sandy, hard and resistant. The iron ore bed is composed mainly of iron oxides (Hematite and Goethite). The percentage of iron in the ore is ranging from 40 to 60%, quartz grains (about 10%) carbonate (about 10%) and evaporates (about 20%). These beds are represented by sample No's 2A & 2B (Pl. 1, Fig. B).

Ferruginous Quartz Wacke:

This microfacies is composed of 85% quartz grains, iron oxide content reached to 7% , 5% argillaceous matrix, and 3% calcareous & evaporitic cement. The quartz grains are sub-angular to subrounded, moderately to well sorted and most of the quartz grains are floated in iron oxides which cemented quartz and have not any porosity as shown in (Pl 1,Fig C) which represented by sample No's 3A & 3B.

Glauconitic Quartz Arenite:

Petrograpically, this microfacies is mainly composed of quartz grains are about 90 %, monocrystalline, medium grains, subrounded, moderately sorted. Glauconite is about 7 %, green in color, medium grain, oval shape and iron oxides as cement (about 3 %), this oxides is reddish hematitic in color which filling pores space. The probable depositional environment of this microfacies is reducing condition. This microfacies is represented by samples No's 4 A & 4B, (Pl. 1, Fig. D).

Evaporetic Quartz Wacke:

Petrogeaphically, this microfacies is composed of quartz grains (about 70 %), medium grains, subrounded to rounded, moderately sorted to well sorted. Evaporitic minerals are about 25%, mainly halite and gypsum. Carbonate and iron oxides cement filling the pore space between quartz grains (about 5 %). This microfacies is represented by sample No. 5B (Pl. 1 Fig E) with thickness about 0.5 m. The probable depositional environment of this microfacies is tidal flat.

Quartz Arenite:

The sandstones of this microfacies association are composed of fine to medium quartz grains (average 95%) and about 5% non-quartz contents which represented by clay matrix, carbonate, evaporites and iron oxide are present as cement, sub-rounded to rounded, occasionally well rounded. Quartz grains are texturally ranged from mature to super mature stage and well sorted grains. They are simple monocrystalline with some polycrystalline as shown in (Pl. 1, Fig. F). Contact between the quartz grains are point, concave, convex and straight occasionally sutured. Rock fragments are rarely presents and composed mainly of sedimentary rock fragments sample No's 6A & 6B. Cementation, grain-contact and pressure solution are the main diagenetic features which are recorded in such quartz arenite, these features may reflect that these sandstones are deposited in shallow marine environment.

Mineralogy:

The mineralogical analysis of the studied five samples was conducting via the X-ray diffraction analysis (XRD) and scanning electron microscopy (SEM).

Mineralogy of the Bulk Samples:

The minerals identified from the bulk samples of the studied sandstones are illustrated in (Fig. 5). From this Figure it can be seen that there are great consistence between the minerological analysis obtained from the XRD results and the microfacies associations of the six classified beds. These beds are characterized by calcareous quartz wacke, Ironstone ore bed, Ferruginous quartz wake, Glauconitic Quartz arenite, Evaporetic quartz wake and Quartz arenite.

The main constituting mineral present is quartz, sample No's 3A&6A, hematite goethite sample No's 2A&2B and sometimes halite (sample No. 5B). Calcite, dolomite, Kaolinite, illite, montomornite are present as minor minerals associated with iron minerals as hematite, goethite and pyrite, while the evaporate mineral are represented by halite and gypsum.

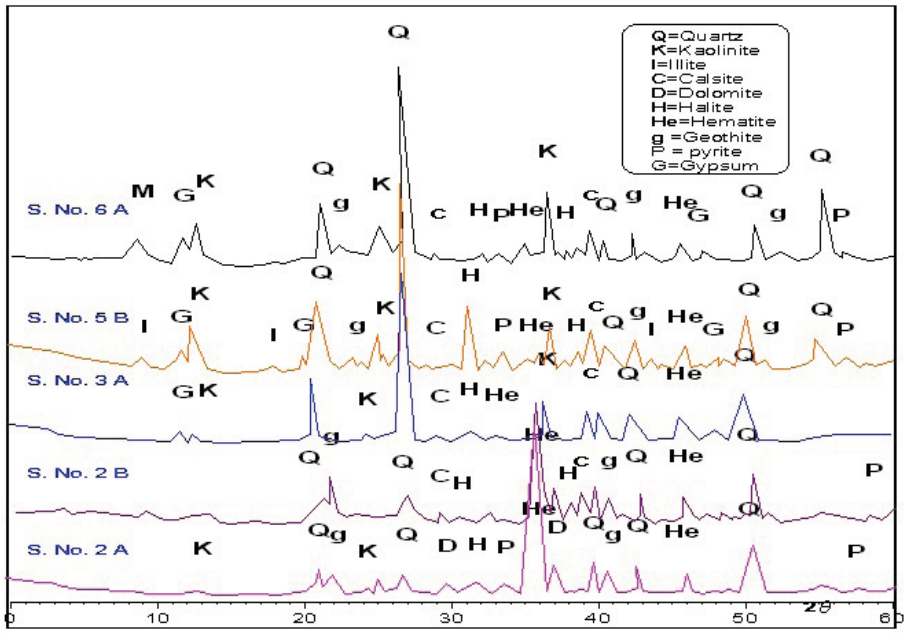


Fig. 5: X-ray diffraction of the studied bulk samples of the El-Gedida area, Baharaiya Oases, Egypt.

Mineralogy by the Scanning Electron Microscope:

The petrographic study, when combine with electron microscope investigations provides a good mean in identifying the minerlogical characteristics and the diagenetic process affecting the rock forming minerals. Khalil *et al.* (1999), El Sayed *et al.* (2000), Mousa (2007) and El-Hariri (2008).

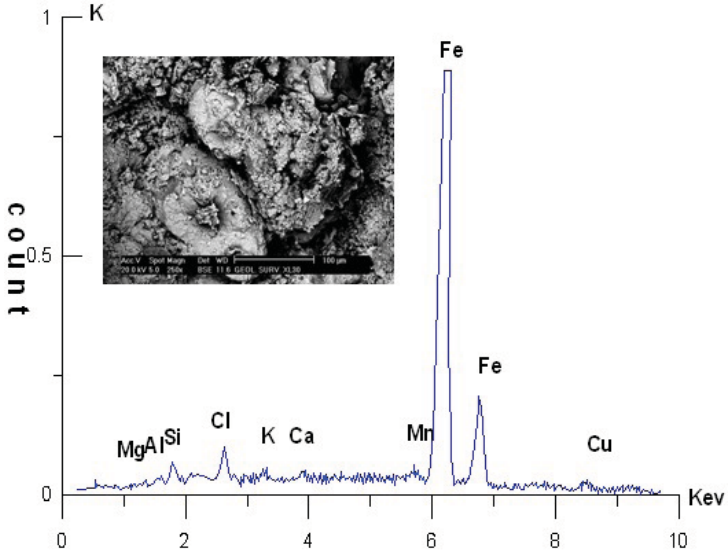


Fig. 6:

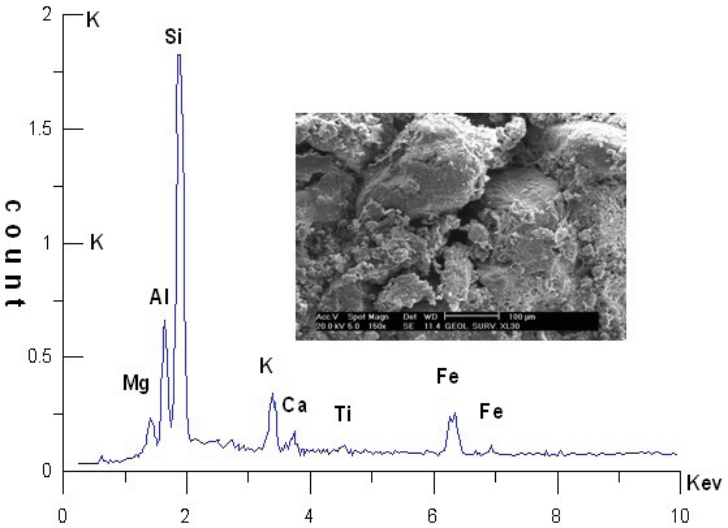


Fig. 7:

The following scanning electron micrograph is presented for illustrating the minerals morphology produced by various environments for the examined sandstone from El Gedida area.

- Hematite crystal which its morphology is only seen by higher magnification as shown in (Fig. 6, sample No.2A). Identification is based on crystal morphology and color (as observed under a binocular microscope). Red areas are hematite, in this case, Fe increased only in the EDX of the coated surface supporting the morphologic identification.
- Glauconite appears as nondescript, oval-shaped grains, which are difficult to identify without supplementary thin section or X-ray diffraction (XRD) information as shown in (Fig. 7, sample No. 4B). The composition of glauconite is highly variable, but EDX analysis here shows Si, Al, Mg, K, Ca, Fe and Ti all possible constituents of glauconite.
- The crystals of montomornite cannot be resolved in the SEM; instead, the clay appears as a thin, webby crust. This webby morphology a common crystal habit of montomornite, as shown in (Fig. 8, sample 3A).
- The prismatic gypsum which are arranged into a rosette. Identification of these crystals as gypsum is based correlating the morphology, as shown in (Fig. 9, sample 5B).
- Individual kaolinite books arranged face to face into elongate stacks called a "verm". This vermiform morphology, combined with the typical kaolinite, as shown in (Fig. 10, sample 4A).

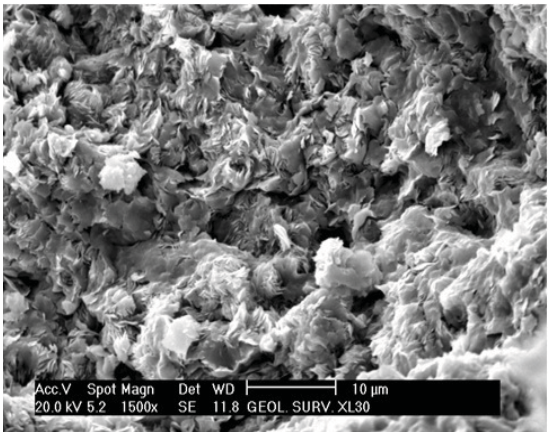


Fig. 8:

Fig. 9:

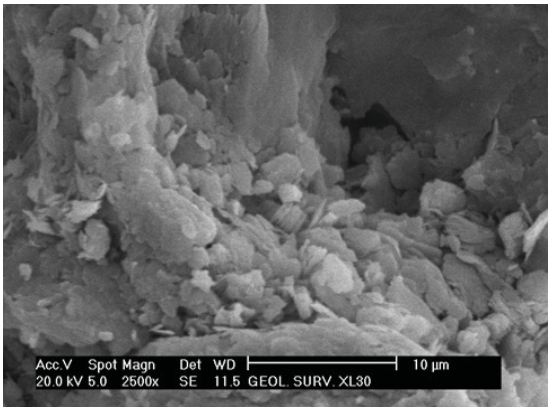


Fig. 10:

Geochemistry of Rocks:

In order to determine the major oxides (SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, Cl, SO_3 and L.O.I) in the studied two sections of the El-Gedida area to evaluate geochemical analysis, (Table 1).

Table 1: Chemical composition (Major oxides in wt %) of the studied samples of El-Gedida area, Bahariya Oasis, Egypt.

Age	Formation	Sample No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Cl	SO_3	L.O.I
Oligocene	Qatarani	6A	93.65	0.09	0.15	0.45	0.11	0.01	0.35	0.08	0.01	0.01	0.06	0.82	0.36
		5B	46.43	0.97	1.36	2.11	0.02	0.01	0.73	15.34	0.07	0.07	13.85	1.27	18.35
Bartonian	El-Hamra	4A	86.75	0.38	2.28	4.55	0.04	0.01	0.43	0.25	0.06	0.15	0.35	1.68	2.00
		3A	88.34	0.11	0.26	3.3	0.17	0.01	0.45	0.06	0.01	0.05	0.05	1.25	0.47
Lutetian	Qazzun Squancess	2A	1.75	0.01	0.11	60.15	1.66	0.92	3.65	5.1	0.37	0.45	4.85	4.17	16.08
		2B	3.155	0.07	0.52	39.04	0.14	0.01	0.45	0.85	0.01	0.27	0.44	18.27	3.63

The El-Gedida succession is characterized by different microfacies of rocks, such as calcareous sandstone, iron ore, ferruginous sandstone, glauconitic sandstone, evaportic sandstone and quartz arenite.

The Qazzun sequence formation is characterized by higher percentage of Fe_2O_3 which ranging from 39 to 60.15%, (Figs 11, 12, 13 & 14). The sample 2A is characterized by high content of calcium and manganese oxides as shown in (Fig. 15). The high content of gypsum & halite minerals as shown in (Figs 15 &16) . The sample No. 2B is characterized by high content of SO_3, which represented by the barite, (Fig. 15). The Hamera formation is represented by two samples No's 3A & 4A and characterized by high content of SiO_2 as the main elements, while Fe_2O_3, SO_3, CaO, Al_2O_3 are minor elements. These elements are compound together and content the ferruginous sandstone and glauconitic sandstone microfacies, as shown in (Figs. 11, 12, 13 & 14).

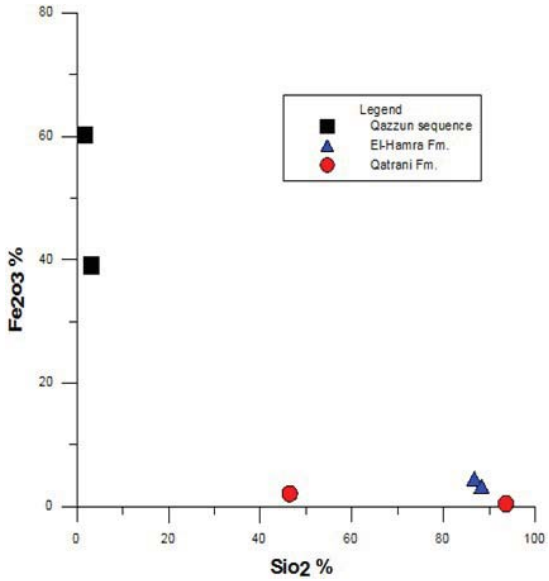


Fig. 11: Bivarite relationship between sllica and iron oxide in El-Gedida area.

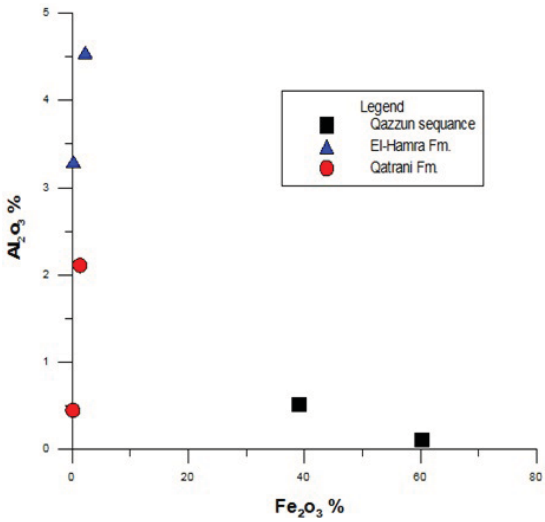


Fig. 12: Bivarite relationship between sllica and Alumina in El-Gedida area.

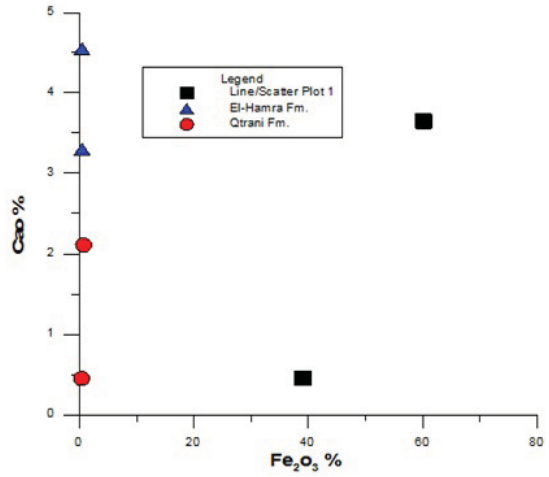


Fig. 13: Bivarite relationship between sllica and Calcium oxide in El-Gedida area.

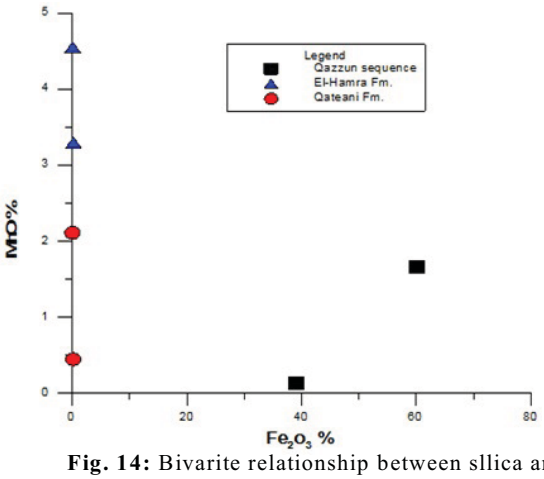


Fig. 14: Bivarite relationship between sllica and mangazine oxide in El-Gedida area.

The Qattrani Formation is represented by two samples No's 5B & 6A, the first sample which is represented the wadis area and characterized by high content of SiO_2, Na_2O and Cl as main elements and low content of CaO and SO_3 as minor elements. These elements are compound together and content evaporatic sandstone

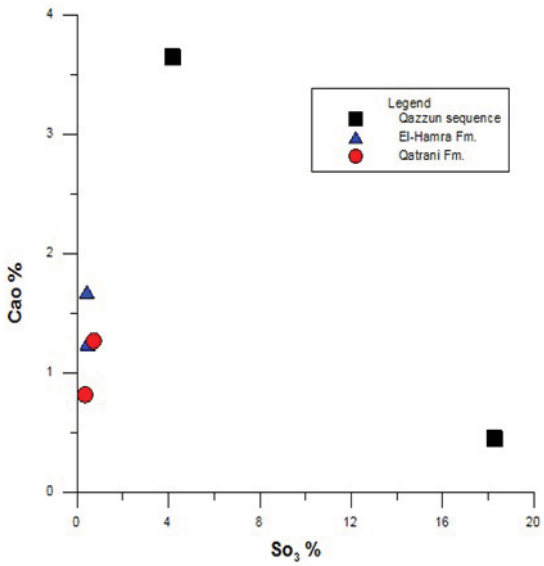


Fig. 15: Bivarite relationship between sllica and calcium oxide in El-Gedida area.

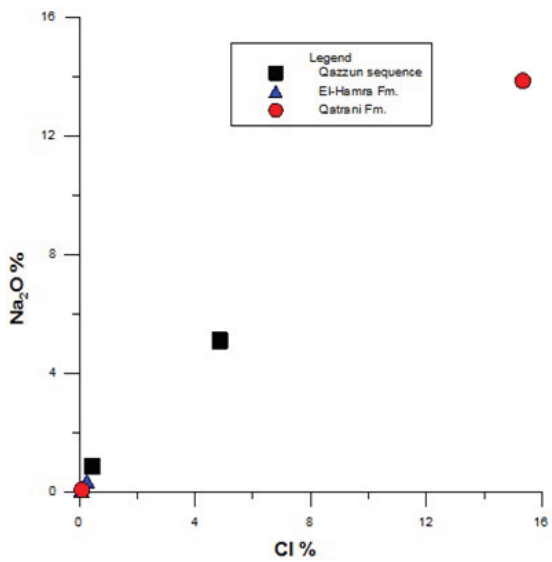


Fig. 16: Bivarite relationship between sllica and sodium oxide in El-Gedida area.

microfacies, (Figs 15&16). The second one is represented hillocks area and characterized by high content of SiO_2, which content the quartz arenite microfacies, (Fig. 11).

Mossbauer Effect Results and Discussion:

Room temperature Mossbauer spectra (MS) of some representative samples Fig. (17) and Table (2) showed the presence of more than one super imposed magnetic components and a paramagnetic one in some samples. The complicated magnetic patterns could be analyzed into two magnetic components (H_1 and H_2). The Mossbauer parameters of component H_1 of sample No. 2A which represent Qazzun sequence formation at hillocks, and which constitude 77% of the total iron present in this sample, are characterizing the well crystallized hematite (α-Fe_2O_3) specially it has an average line width (L.W) of 0.37 mm/s. The second magnetic component could be assigned as due to a well crystallized goethite (α-FeOOH) (Eissa *et al.,* 1974) and (Okada *et al.,* 2000) (On the other hand the doublet constitutes only 2% of the total iron present in the

Table 2: The Mossbauer parameter at R.T of Bulk samples from El-Gedida.

Sample No.	H KOe	I.S mm/s.	Q.S mm/s.	L.W mm/s.	Area %	Assignment
2A	516	0.41	-0.21	0.37	77	α-Fe_2O_3
	375	0.42	-0.23	0.56	21	α-FeOOH
	---	0.71	1.25	0.65	2	FeS_2
2B	517	0.37	-0.21	0.47	87	α-Fe_2O_3
	384	0.35	-0.34	0.47	13	α-FeOOH
3A	508	0.15	-0.22	0.37	83.4	α-Fe_2O_3
	----	0.24	0.62	0.67	16.6	Kaolinite
5B	346	0.1	0.01	0.6	22.2	α-Fe_2O_3
	287	0.21	-0.09	0.86	34.1	α-FeOOH
	----	0.71	1.17	0.65	23.7	FeS_2
	----	0.24	0.63	0.65	20	Kaolinite

sample No. 2A and has parameters characterizing pyrite (FeS_2). A representative room temperature MS of the sample No. 2B which represent the Qazzun sequence formation at the wadles (Fig. 17) showed the absence of the paramagnetic doublet characterizing pyrite.

The only two magnetic components H_1 and H_2 for hematite and goethite were present with an increase in the area ratio for (α-Fe_2O_3) on the expense of (α-FeOOH) and pyrite (Table2) Murad (1996) and Stevens (2006). These results are in agreement with the XRD results where the amount of pyrite in 2B is less than 2A. Analysis of MS of the sample 3A which represent El-Hamra formation showed the absence of magnetic

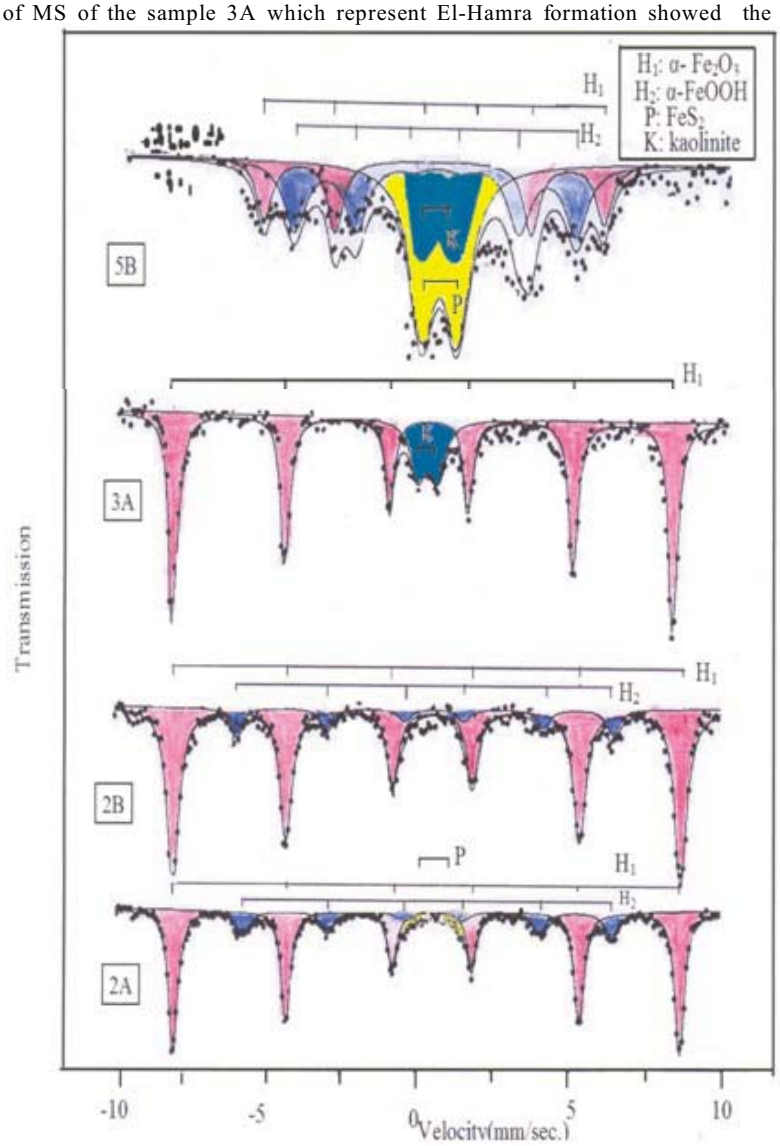


Fig. 17: Mossbauer Spectra of Bulk Samples Frm EL Gedida area, Bahariya Oasis, Egypt .

field characterizing goethite and the presence of ~ 83% of the total iron as well crystallized hematite indicated the formation under normal and oxidizing atmosphere and that hematite is preserved from weathering and corrosion effects. The remained doublet (16.6% of the total iron present) could be attributed to kaolinite or some clay minerals Eissa *et al.* (1994) and Berquo *et al.* (2007) in the ores. The appearance of the doublet characterizing kaolinite is consistent with the mineralogical analysis by XRD of this layer. The decrease of the value of the isomer shift of hematite in this sample than normal one (0.15 instead of ~ 0.4 mm/sec.) indicated that hematite in El-Hamra formation suffer from substitution by titanium or aluminium Ricsson

T.E *et al,* (1986), so increasing the s- electron charge density at the iron nuclius and hence decreasing the isomer shift. This result confirms the relative increase in the value of TiO_2 for sample No. A3 than A2, as obtained from the chemical composition (Table 2). It also interpret the shift of the main line characterizing hematite in the XRD toards low 2θ where this line is due to ($Fe_{2-x}O_3$, x= Ti or Al). In the fourth sample the two magnetic components H_1 and H_2 were present with relative small magnetic fields 346 and 287 KOe and very broad line width in addition to the paramagnetic doublet with relative area ratio 43.7%.

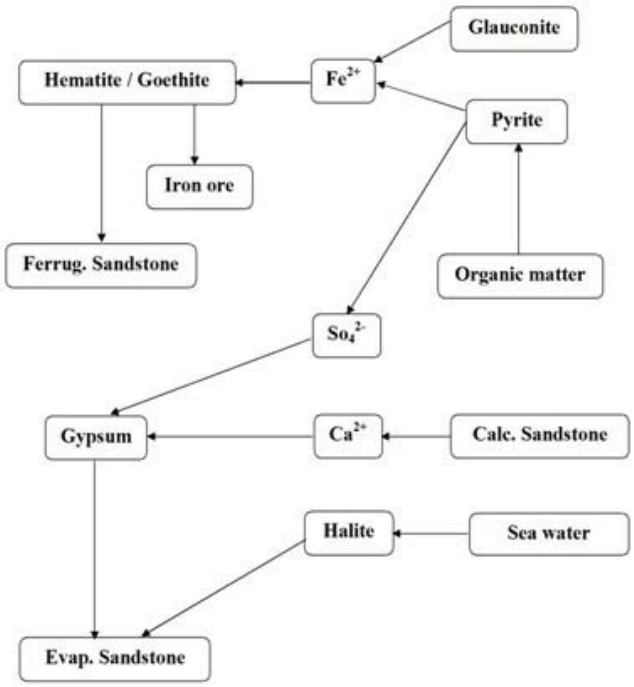


Fig. 18: The diagenetic processes of El-Gedida area, Bahariya Oasis, Egypt.

The relative small fields of H_1 and H_2 and very broad width is indicated that this doublet may be due to the presence of super paramagnetic particles of hematite and goethite which have a distribution of very small particle sizes and/or the minerals posses a wide range of particle size due to excess structural water i.e the minerals present in the form of $Fe_2O_3.nH_2O$ and $FeOOH.nH_2O$ with different values of n. The particle size is known to affect the electron spin relaxation time τ according to the equation:

$$\tau = \tau_o \exp^{(kV/KT)}$$

Where k is the anisotropy constant, V is the particle volume, the absolute temperature, K is Boltzman coIt may be also due to silicon substitution in hematite and goethite which causes a reduction in the magnetic field. It is known that every one mol% SiO_2 substitution reduces the hyperfine magnetic field of goethite by 0.52 KO_e since the studied iron ores contain more than 88% of Si as shown in table 2. In the investigated rock, particles with size close to the critical size (d_{cr} 170 Å) for goethite at room temperature Okada (2000) will have electron spin relaxation time in the order of the broadened and relaxed lines. The paramagnetic doublet resulted from the particles having sizes less than the critical size. On the other hand particles with sizes larger than the critical size are responsible for the normal magnetic patterns. According to the presence of hydro hematite and hydro goethite, and the disintegration in particle size of these hydro oxides may be due to erosion effect caused by weathering (differences in temperatures between day and night, summer and winter together with the very high humidity). The effect of substitutions by the elements Ti, Al ad/or Si is very pronounced on the Mossbauer parameters of each of hematite and goethite in this bed.

Diagentic Processes of El-Gideda Area:

The sediments of El-Gedida area characteristics by pyrite and glauconite which are commonly affected by oxidation processes, these represented the main cause of development of the ferruginous sandstone and

ironstone bed in Qazun and Homera formations. Pyrite is commonly associated with organic matter in the studied sediments. Pyrite forms under anoxic conditions in associated with organic matter decomposition and sulphate reduction by anaerobic bacteria. In the presence of iron oxidizing bacteria, pyrite is oxidized and the released So_4^{2-} may react Ca^2 to form gypsum. The gypsum and halite which producing from sea water is contain evaporatic sandstone in the Qattrani Formation.

Conclusion:

The study of microfacies associations indicates those six microfacies associations: Calcareous quartz wacke, Ironstone ore bed, Ferruginous quartz wake, Glauconitic Quartz arenite, Evaporetic quartz wake and Quartz arenite. Minerological study concluded that, the main constituting mineral present is quartz in Homra and Qattrani formations. Hematite and goethite are the main minerals in Qazun Formation. Calcite, dolomite, Kaolinite, illite, montomornite are present as minor minerals, associated with iron minerals as hematite, goethite and pyrite, while the evaporate mineral are represented by halite and gypsum in Qattrani Formation. The geochemical composition of el-Gedida area refer that, The Qazzun sequence Formation is characterized by higher percentage of Fe_2O_3, barite and calcium & manganese oxides. The Hamera Formation is characterized by high content of SiO_2 as the main elements, while Fe_2O_3, SO_3, CaO, Al_2O_3 are minor elements. The Qattrani Formation is characterized by high content of SiO_2, Na_2O, Cl, CaO and SO_3 as main elements in wadies and the hillocks area is characterized by SiO_2.

The Mossbauer results for the studied samples which represent different beds from the the three different formations in hillocks and in adies confirmed and clarified the other results obtained from the different used techniques as presented in the abave two paragraphs. These Mossbauer results through the light also on the geochemical conditions under hich the three different formations are sediment: Qazzun sequence formation as deposited under normal atmosphere and all crystallized hematite mainly with some all crystallized goethite and very small amount of pyrite in the iron ore bed. El-Hamra formation (represented by the sample No. 3A from the ferruginous sandstone bed) as deposited under highly oxidizing atmosphere, so all the iron oxide present, and which cemented quartz, is present as hematitee in whih some of the iron is substituted by Ti and/or Al, i.e it is in the form $Fe_{2-x}O_3$ (X = Ti or Al), together with some clay mineral (kaolinite). The Qatrani formation (reprented by the sample No. 5B from the evaporetic quartz take in wadies) as deposited under very high rate of formation and highly reducing medium, may be tidal condition, so the iron present as poorly crystalized goethite and less hematite which contained both excess structural ater and relatively high percentage of substituting elements such as Ti, Al and/or Si, together with moderate amounts of pyrite (FeS_2) and kaolinite.

The sediments of El-Gedida area characteristics by pyrite and glauconite which are commonly affected by oxidation processes, these represented the main cause of development of the ferruginous sandstone and ironstone bed in Qazun and Homera formations. Pyrite is oxidized and the released So_4^{2-} may react Ca^2 to form gypsum. The gypsum and halite which producing from sea water is contain evaportic sandstone in the Qattrani Formation.

REFERENCES

Amer, H.I., 1973. Geological and mineralogical studies on the Bahariya Oasis and their iron ore deposits, Western Desert, Egypt. Ph. D. Thesis, Fac. Sci., Cairo Univ.

Berquo, T.S., R.A.L Imbernon, A. Blot, D.R. Franco, M.C.M. Toledo and C.S.M. Partiti, 2007. Low temperature magnetism and Mossbauer spectroscopy study from natural goethite ,Journal Phucics and Chemistry of Minerals, 34(5): 287.

Eissa, N.A., H.A. Sallam, Gomaa, S.Sh, Saleh and Z. Miligy, 1974. Mossbauer Study of Egyptian goethite, J. Phys. D Appl. Phys., 7: 2121.

Eissa, N.A., N.H. Sheta, W.M. El-Meliegy and H.A. Sallam, 1994. Mossbauer Effect study of the effect of Gamma Irradiation and Heat Treatment on Mintmorillonite. J.Hyperfine Interactions, 91783.

El Aref, M.M., El M.A. Sharkawi and M.A. Khalil, 1999. The geology and genesis of the stratabound to stratiform Cretaceous – Eocene ore deposits of El Bahariya Region, Western Desert, Egypt.

El Sayed, M.I., M.A. Morsy and Y.S. Haroun, 2000. Field occurrence, Petrography and possible origin of surface uranium anomalies of the post-Oligocene deposits in Fayium depression, 5th Intern. Conf. Geol. of the Arab World, Cairo University, pp: 439-462.

El-Hariri, T.Y., 2008. Depositional environment and petrophysical studies on subsurface Devonian sediments from Faghur-1X well at north Western Desert. Jour. Appl. Sci. Res., 4(1): 65-75.

Folk, R.C., 1974. The natural history of crystalline calcium carbonates effect on magnesium content and salinity: Jour. Sed. Petrol., 44: 40-53.

Khalil, M.A., 1995. Geological and mineralogical studies on the northeastern part of EL Bahariya Oasis, Western Desert, Egypt. Ph.D. Thesis, El Azhar University, pp: 237.

Khalil, M.M., M.H. El-Baz and E.M. Abu-Assy, 1999. Petrography and diagenesis of Gabal El-Khashab "Red Sea" Egypt. J. Geo., 5: 119-133.

Mesaed, A.A. and A.A. Surour, 1997. Mineral chemistry and mechanism of formation of the Bartonian gulocony of El Gedida mine. El-Bahariya Oasis, Egypt.

Mesaed, A.A., 1999. Stratigraphic setting and paleoenvironment of the Bartonian – Priabonian glaucony facies of the northern part of Western Desert, Egypt. Egypt. J. Geol. in pree.

Mousa, A.S., 2007. Petrographical, geochemical and minerlogical studies of Raha Formation at Gabel Ekma area, southwestern Sinai, Egypt. Jour. Appl. Geophs., 6: 39-55.

Murad, E., 1996. Magnetic Properties of microcrystalline iron (III) oxides and related materials as reflected in their Mossbauer Spectra, J. Physics and Chemistry of Minerals, vol. 23, no.4-5 248.

Okada, T., Y. Ishii, T. Mizoguchi, I Tamura, Y. Kobayashi, Y. Takagi, S. Suzuki, H. Kihira, M. Itou, A Usami, K Tanabe and K. Masuda, 2000. Mossbauer studies on particle volume Distribution of α-FeOOh in Rust Formed on Weathering Steel, Jpn. J.Appl. Phys., 39: 3382.

Pettijhon, F.J., 1975. Sedimentary Rocks, Harper and Row, New York, pp: 630.

Pettijhon, F.J., P.E. Potter and R. Siever, 1973. Sand and Sandstone. Berlin, Heidelberg, New York., pp: 18.

Ricsson, T.E., A. Krisnhamurthy and B.K Srivastava, 1986. Morin-Transition in Ti-Substited Hematit ed: Phusica Scripta, 33: 66-90.

Steven, J.G., 2006. Mossbauer and x-ray Diffraction Investigations of a series of B-Doped Ferrihydites. Hyperfine Interactions, 161(1-4).

Tucker, N.E., 1981. Sedimentary petrology an introduction geosciences tests. England, pp: 252.

Welton, J.E., 1984. SEM petrology atlas. Am. Ass. Petrol. Geol. Bull. Methods in exploration series, (4): 237.