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CONTRAIBUTION TO MINERALOGY AND GEOCHEMISTRYOF THE LOWER CEOMANIAN CLASTICS, BAHARIA OASIS, EGYPT

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ABSTRACT

The petrography, mineralogy and geochemistry of clasitic sediments constitiuting the exposed section of Lower Cenomanian age and located at Naqb El-Baharia, Baharia Oasis, were studied. Three main rock types have been recognized: quartz arenite, argillaceous sandstone and shale.

The quartz arenites are the most common rocks. It is enriched in silica and relatively impoverished in the other constituents. X-ray diffractometry revealed that these samples are mostly composed of quartz with minor calcite, halite and Kaolinite.

The argillaceous sanstones and shales are distinguished by relatively less frquent silica content and an increase in Al_2O_3, *K2O and* Fe_2O_3 *contents. The minerals determined include quartz, Kaolinite and illite, Appreciable amounts of halite is detected particularly in the upper beds of the studied section.*

It is suggested that the investigated calstic sediments were essentially formed by intense weathering of quartz bearing pplutonic rocks. The pareoenvironmintal conditions of deposition as well as the diagenetic history of the sediments are discussed.

INTRODUCTION

The Baharia oasis is located in the central plateau of the Western Desert, about 380 Km southwest of Cairo. It lies betweev Latitudes 27° 48' and 28° 30'N and Longitudes 28K 35' and 29K 10' E. Its northern edge is located along the contact between the stable and unstable shelves (Said, 1962). The sedimentary succession ot area ranges in age between lower Cenomanian to Quaternary.

The four Cretaceous formations (Baharia, Heiz, Hefhuf and "Chalk" in the Baharia Oasis represent a varied sequence of lithotopes. Lateral and vertical changes in the tectonic framework of sedimentation accompanied with four successive tectonic cycles of uplifting and subsidence were reported by Soliman and El-Badry, (1980). According these authors, the oldest outcropping sediment in the area is the Baharia Formation which is of Lower Cenomanian age. It forms the floor of the Oasis and the base of the surrounding escarpment. Stratigraphically, the sediments were studied by Ball and Beadnell (1903), Stromer (1914), Lebling(1919), El.Akaad and Issawi (1963), Soliman *et al* . (1970) and others.

The Baharia Formation is a clastic section substantially composed of bedded claystones and argillaceous sandstones, intercalated by anhydrite, gypsum and calcareous bands. Carbonaceous matter and ferruginated bands also predominate at the lower part of this formation (El-Akaad and Issawi, 1963).

According to Soliman and El-Badry (1980), the Baharia Formation was mainly developed in a complex prodelta and delta platform environment. Its contributing provenance was a deeply weathered basement complex mass located to the SE and S of the Baharia area.

The present work is concerned with the petrography, mineralogy and geochemistry of sandstone and other clastic rocks representing a stratigraphic section in the Baharia Formation exposed at Naqb El-Baharia (Fig. 1) in order to decipher their conditions of sedimentation and diagenetic history.

METHODS OF STUDY

For the purpose of study, a lithostratigraphic section at Naqb El-Baharia was described, measured and sampled. The lithologic succession of Baharia Formation at this locality is illustrated in Fig. 2. From this section, 26 samples were collected representing 20 beds.

Mineralogical composition of the bulk rock samples was studied using petrographic microscope and X-ray diffractometry. The fabric and textural relationships were determined using microscopic point countes (20 thin sections from 26 rock samples). Examination by

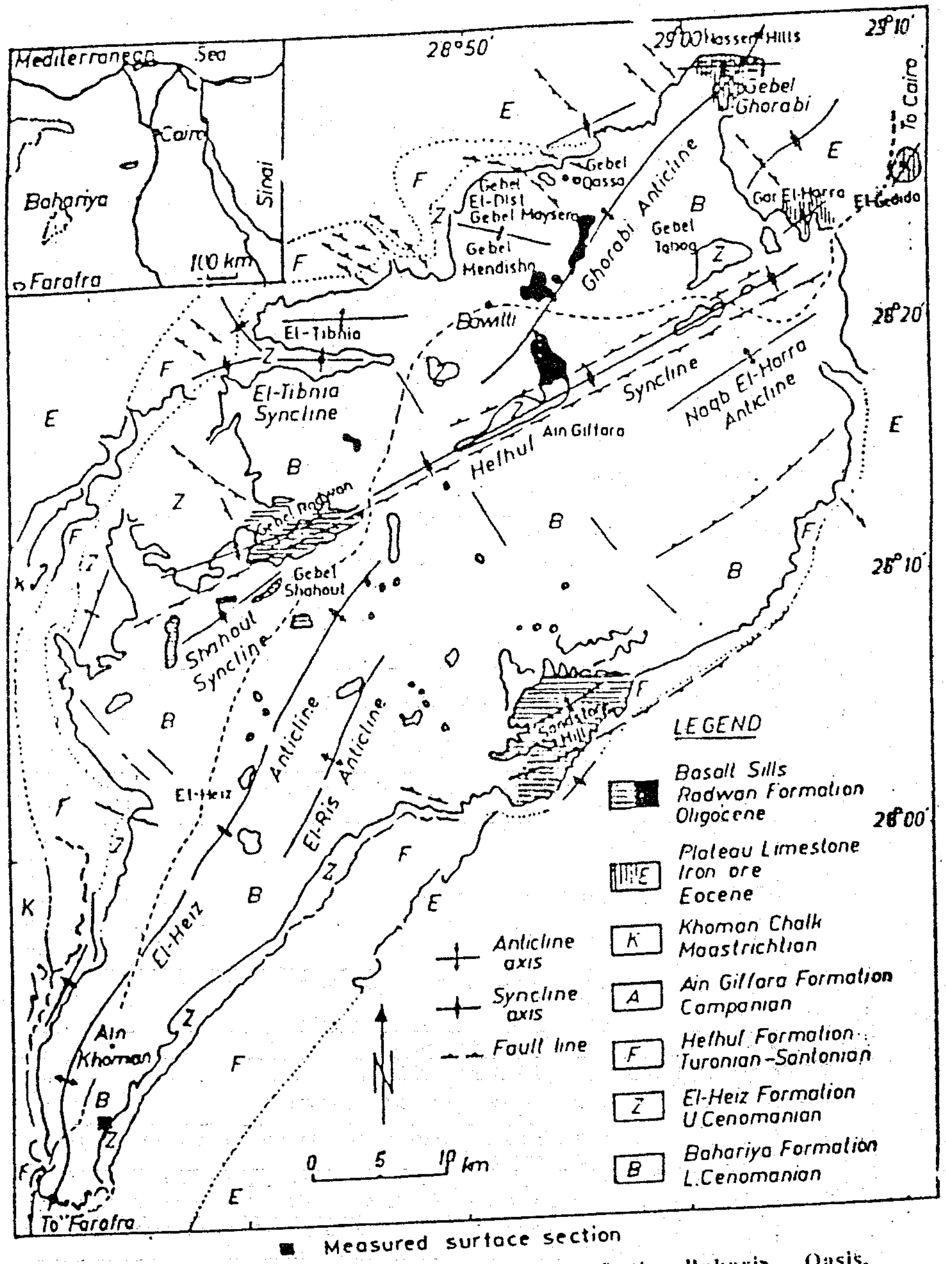


Fig. 1: Geological and structural map of the Baharia Oasis, Western Desert, Egypt. (After, Allam, 1986).

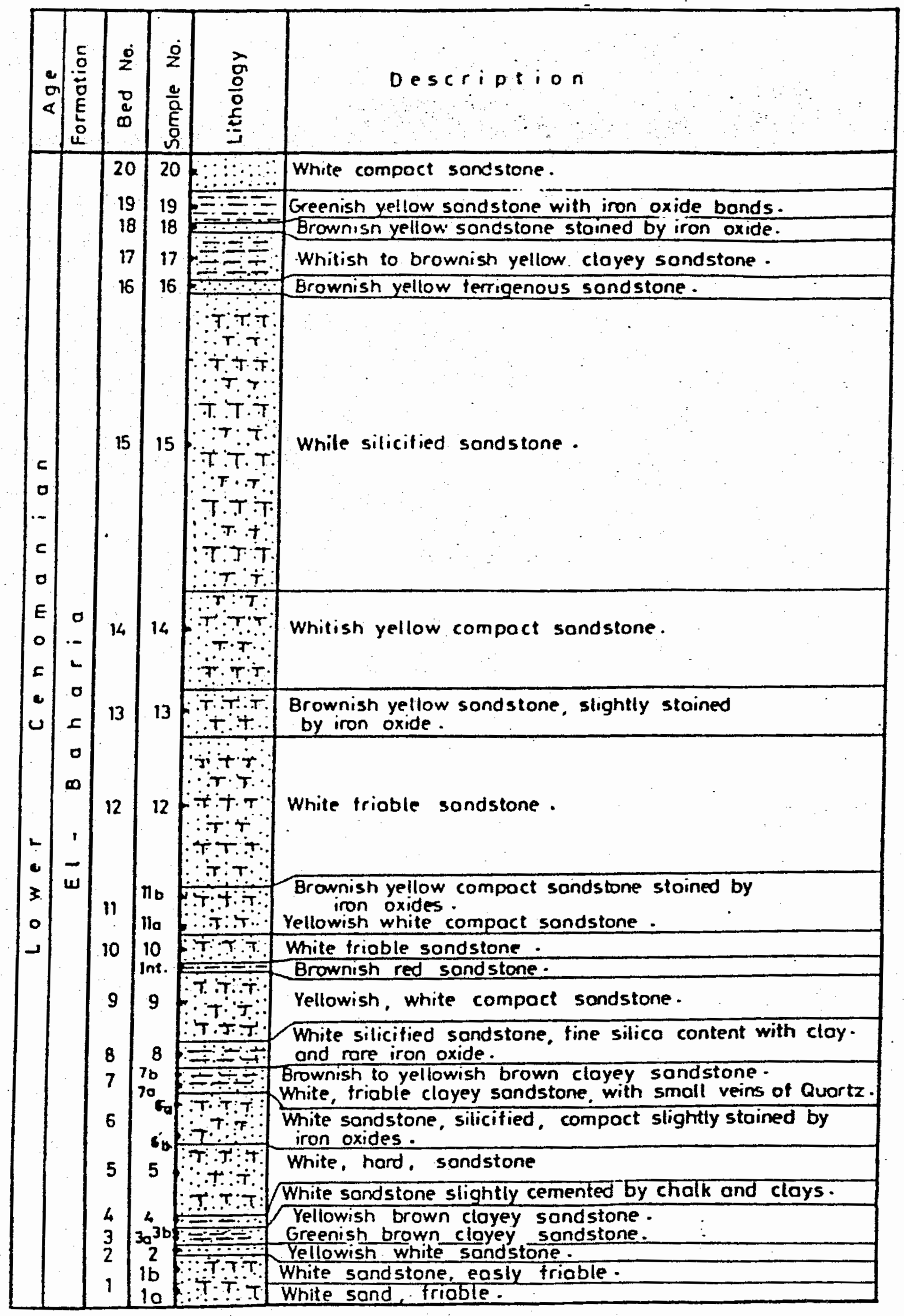
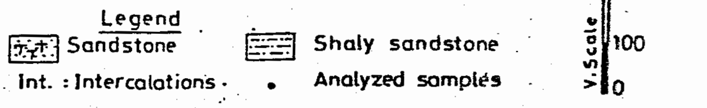


Fig. 2. Stratigraphic columnar section of El-Baharia Formation at Naqb El-Baharia, Baharia Oasis.



X-ray diffraction was done by using Schimadzo XD-3 diffractometer with Ni-filtered Cu radiation at 40 Kv and 20 mA. Scanning started from 2 $\theta = 2°$ to 2 $\theta = 70°$ in all samples. The clay fraction was also X-rayed after separation by the sedimentation technique and preparation of three slides for each (untreated, glycolated and heated).

Complete chemical analysis were carried out by the standard analytical methods of silicate rocks (Easton, 1972; Hutchuson, 1974). CaO, MgO, Al_2O_3 and total iron were determined by EDTA titration. Soluble chlorides were obtained by titration against standard $AgNO_3$ solution. SiO_2 and SO_3^{--} were estimated gravimetrically. Na_2O and K_2O were determined by flame photometry. Mn, Sr, Cu, Co and Ni were determined using atomic absorption spectrophotometer. P_2O_5 was estimated colorimetrically by the vanadomolybdate method. Precision and accuracy of the results were of the order 2 - 5 %.

X-ray and chemical analyses have been carried out in the Central Laboratory and in the laboratory of the Geology Department at El-Menoufia University respectively.

PETROGRAPHY

The main sedimentary rock types recorded within the succession in the studied area includes sandstone of arenaceous and argillaceous types and claystone (shaly rocks).

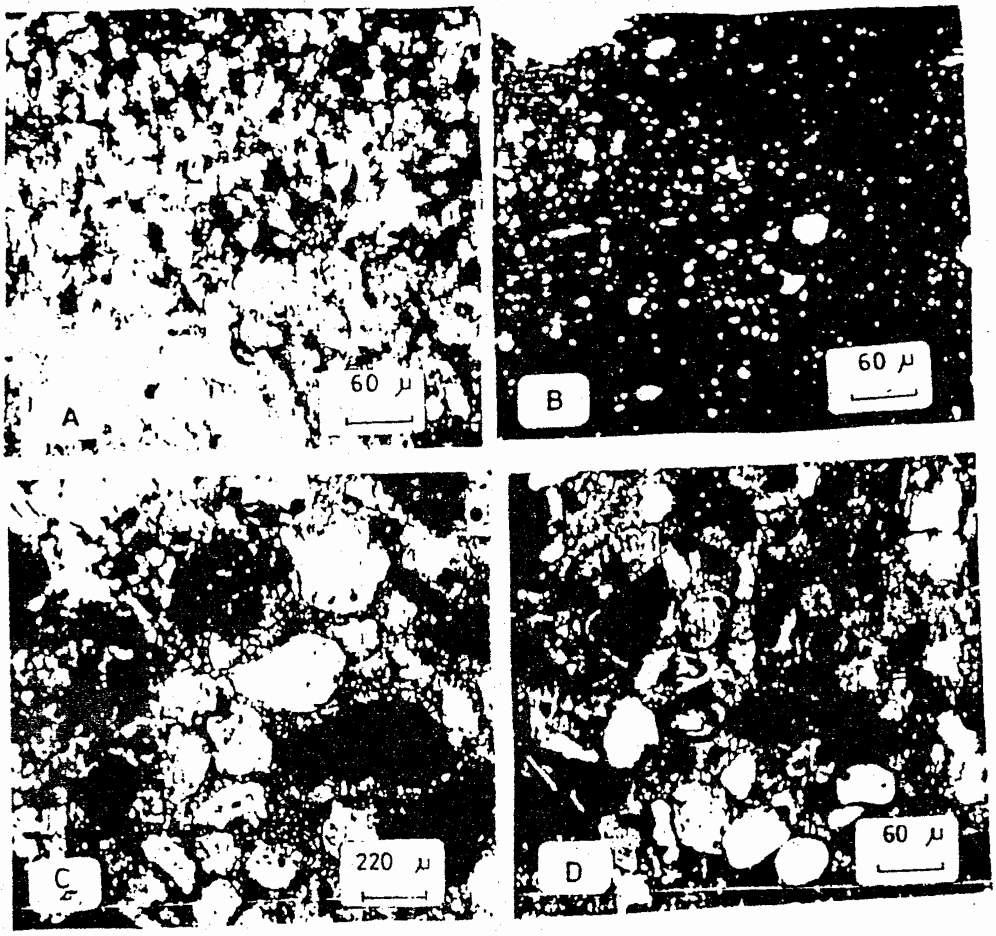
The sandstone facies of Naqb El-Baharia section is predominant and represented by most samples. It occurs as beds of variable thickness intercalated with argillaceous and shaly beds. They are white to brownish yellow in colour, fine to meduim grained, sometimes laminated, ferruginous and calcareous. In the lower part of the section as indicated by samples No. 3 a, b, 4 and 7 a, b the sandstone occurs intercalated the yellowish brown claystone and ferruginous to calcareous varieties.

The microscopic point counts of twenty thin sections representing the sandstone rock samples (Table 1) according to

Table (1) : Petrographic characteristics of the Baharia Formation at Naqb El-Baharia (Point counting)

Age	Formation	Sample No.	Framework components		Diagenetic components					Intergranular (minus cement) porosity	Percent of porosity destroyed by compaction	Percent of porosity destroyed by cementation
			Quartz	Feld-spars	Calcite	Clays	Halite	Anh-ydrite	iron oxides			
Lower Cenomanian	Bahariya Formation	19	51.78	0.60	-	20.0	21.9	-	4.00	23.70	33.05	66.95
		18	71.30	0.75	-	5.5	15.5	-	6.50	19.25	28.55	71.45
		17	60.80	0.70	-	15.0	24.0	-	-	28.30	22.48	77.52
		16	59.65	0.70	-	6.0	20.9	-	11.00	26.60	21.16	78.84
		8	67.85	0.65	7.5	2.0	18.9	-	1.5	28.90	23.55	76.45
		7a	55.62	0.55	-	42.5	-	-	-	30.60	33.40	66.60
		3a	33.85	1.70	3.50	45.8	5.80	-	7.50	41.50	22.16	77.84
		1a	32.92	1.65-	15.80	-	23.99	18.66	-	38.60	29.75	70.25

Figure : 3 .



Explanation of Figure

Fig. 3 a : Argillaceous and ferruginous sandstones, showing subangular to sub-rounded and corroded framework quartz grains; cemented by clays and iron oxides (samples 1 a and 9).

Fig. 3 b : Marly sandstone showing angular to subangular deterital quartz grains in microcrystalline iron stained. (samples 3 a, 7 a, and 8).

Fig. 3 c : Ferruginous and calcareous sandstone with subangular and subrounded quartz grains, cemented with both calcite and iron oxides (sample 16).

Fig. 3 d : Ferruginous sandstone showing iron oxide occasionally replacing the detrital framework quartz grains (sample 18).

Pettijohn (1975) revealed the presence of common detrital framework components formed of subangular and less common corroded, angular and rounded crystalline quartz grains. The grain size, as measured in thin section for their long axes, ranges from 0.12 to 0.15 mm with a mean of 0.13 mm for the lower beds of the section under study (samples No. 1 a, 3 a, 7a and 8) and from 0.15 to 0.19 mm with a mean of 0.18 mm for the middle and upper beds of the section (samples No. 16, 17, 18 and 19). These results denote that the fine-grained sandstone is most common in the lower part of the studied section (Figs 3 a, b) and it becomes less fine in the upper part (Figs. 3 c, d).

Quartz arenite thin sections indicate a mud supported and grain supported closely packed terrigenous fine to medium (average size 0.15 mm), subangular quartz grains. Few grains of feldspar group (average 0.90 %), in addition to some opaque grains and some resistate minerals such as zircon and tourmaline are randomly scattered throughout the sandstone matrices. The rock thin sections are devoid of any metamorphic minerals or any organic remains. This facies is constituting most the sediments of El-Baharia Formation.

The interparticle volume (including minus-cement porosity) ranges between 19.25 % and 41.50%. The minor corrosion of some of the detrital quartz grains as well as minor dissolution of the calcite cement resulted in the initation of minor secondary porosity and minor fracture that were observed in some of the sandstone thin sections (Figs. 3 b, d).

The diagenetic constituents recorded within the sandstones include halite, iron oxides, clays, calcite and anhydrite cementation, minor silica overgrowths as well as minor infilteration. The iron oxides were proved to be pigmenting most of the studied samples. They occur as coating on some of the calcite cement, occasionally replacing the detrital framework quartz grains and as a cement filling some of the pore spaces.

On the other hand, the clay constituents are the most abundant intergranular pore filling cement between detrital quartz framework grains or coating on some of the quartz and associated with halite in the argillaceous sandstone samples. The calcite is the less abundant, it occurs as poikilotopic network that is highly cementing the quartz framework grains.

The essential clay minerals constituting the bulk rock samples of the studied shaly rocks and also detected in the argillaceous sandstones (Samples No. 3 a, 4, 7a, 17 and 19) are koalinite and illite. It is also found that kaolinite and illite are the characteristic mineral assemblages determined in the clay fraction separated from samples No. 3 a, 17 and 19.

Mineralogy

The average thickness of the studied section at Naqb El Baharia is ~ 26 m. It is mostly composed of sandstone with occasional intercalation of clay. Semiquantitative data of the constituent minerals determined adopting the method of Carver (1971) for 9 selected rock samples as well as the results of identification of clay minerals in the clay fraction of 3 samples are given in Table 2. Fig. 4 shows part of the the corresponding X- ray diffraction charts for bulk rock samples and Fig. 5 for the separated clay fraction from the bulk samples. Generally, the minerals comprise quartz, halite, anhydrite, gypsum, dolomite calcite, kaolinite, illite, haematite, siderite and ilmenite. It is also found that kaolinite and illite are the characteristic mineral assemblages determined in the clay fraction separated from 3 samples with relatively higher content of Al_2O_3.

The X-ray diffraction data supported by petrographic studies show that the lowest part of the studied succession as represented by sample 1a is mainly composed of quartz, halite, anhydrite, dolomite with minor amounts of calcite, gypsum and illite. This is an indication that the deposition process of such sediments was complex to give chance for accumulation of nearly a possible source of sand and evaporites. Higher up in the investigated section as represented by sample 2,it is noted that quartz content increases, while the other minerals detected in the base of the section are nearly diminished with the exception of minor amounts of illite and calcite. In sample (3 a) the amount of kaolinite is nearly equal to the amount of quartz.

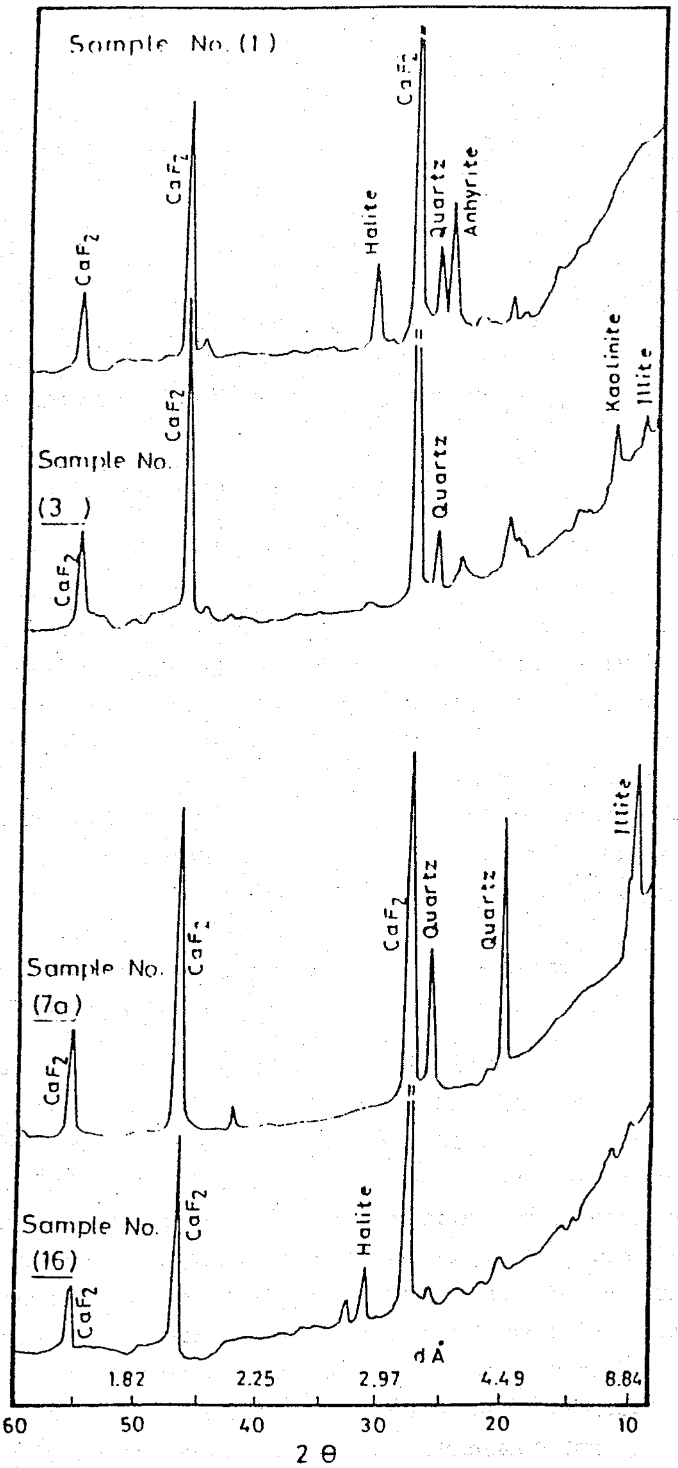


Fig.4. X-ray diffraction patterns of selected bulk samples from Naqb El-Baharia , Baharia Oasis .

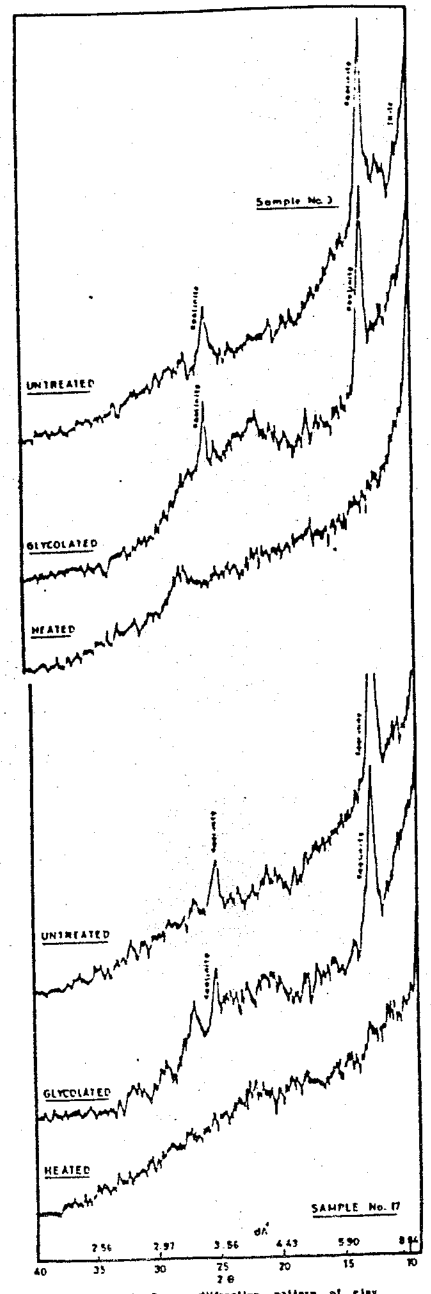


Fig.5 : Selected X-ray diffraction pattern of clay fraction of Bohorio Formation at Noqb EL-Bohorio.

Table (2) : Semi-quaintitative X-ray diffraction data of bluk samples analyzed from Naqb EL- Baharia Baharia Oasis.

Mineral / Sample No.	Quartz	Halite	Calcite	Anhydrite	Gypsum	Koalimite	Illite	Haematitie	Siderite	Iimenite
	%	%	%	%	%	%	%	%	%	%
1a	33	22	16	19	2	3	4	-	-	-
2	96	-	2	-	-	-	2	-	-	-
3a	34	6	1	-	-	35	4	-	-	-
7a	57	-	-	-	-	2	4	-	4.5	4
11b	93	-	-	-	-	7	-	-	-	-
14	94	-	-	-	-	4	-	-	-	-
16	60	21	-	-	4	2	2	-	-	-
17	61	24	-	-	-	10	5	3	2	4
19	52	22	-	-	-	17	3	-	4	-

Sample 7 a is mostly composed of quartz and illite with lesser amount of kaolinite.The predominance of illite over kaolinite might indicate alkaline, poorly drained normal marine environments. The main bulk of samples (11b) and (14) is formed of quartz with minor amount of kaolinite.

The upper part of the studied section as represented by samples 16, 17 and 19 is distinguished by its notable increase in halite and kaolinite content. Minor amounts of haematite, siderite and gypsum are also detected.

Geochemistry

The results of chemical analysis of 26 representatve samples of the studied succession of Baharia formation at Naqb El- Baharia are included in Table 3. From the obtained data, the following geochemical characteristics of the investigated rocks can be deduced.

(A) Major Constituents

The majority of sandstone samples from the studied succession are characterized by the considerably high enrichment in silica ranging between 90-99% SiO_2 and the distinct impoverishments in the other constituents. Plotting of the data obtained in the triangular diagram of Fig.6 indicates that quartz arenite (quartzose) is the most dominant rock type. This is confirmed by comparing the chemical composition of the analyzed samples with the average quartz arenite as given by Pettijohn(1963).

The low concentration of Al_2O_3, Fe_2O_3,CaO, K_2O,Na_2O,Cl^-, SO_3 and L.O.I as well as the deficiency in feldspars as revealed by X-ray diffraction analysis in the studied quartz arenite samples indicate that minerals such as clay, iron oxides, calcite, sulphates and halite occur in variable amounts and they are most probably acting as a cement to the arenites as detected by the microscopic studies.

Samples with lesser concentration of silica content ranging between 35-85 % SiO_2, show considerable diversity in composition :

Table (3): Major constituents % and trace element contents in ppm for the studied samples at Naqb El-Baharia, Baharia Oasis.

Sample No. / Constituents	1a	1b	2	3a	3b	4	5	6a	6b	7a	7b	8	9	Int.	10	11a	11b	12	13	14	15	16	17	18	19	20
SiO_2 %	38.43	94.01	95.91	35.12	46.95	54.12	97.55	90.29	94.47	70.89	85.29	68.03	99.08	94.76	94.55	96.73	96.77	99.11	97.06	94.63	92.59	59.79	58.22	70.89	61.12	94.98
Al_2O_3 %	1.28	1.15	0.72	17.39	12.17	15.06	1.05	1.12	1.32	23.05	6.27	4.26	1.15	2.05	2.18	0.85	n.d	1.35	1.85	2.15	2.18	2.05	11.15	3.45	5.08	0.48
TiO_2 %	0.19	0.17	0.21	0.56	0.58	0.43	0.22	0.21	0.23	0.63	0.54	0.20	0.19	0.36	0.18	0.20	0.18	0.16	0.19	0.68	0.23	0.25	0.65	0.18	0.59	0.21
Fe_2O_3 %	0.30	1.33	0.74	2.59	1.63	2.15	0.15	0.07	0.15	0.52	0.22	0.15	0.22	1.18	0.15	0.67	0.74	0.07	0.52	0.22	0.37	8.73	1.65	5.92	2.37	0.29
CaO %	18.76	0.32	0.62	16.24	15.77	7.01	0.21	0.29	0.21	0.29	2.05	4.01	0.08	0.28	0.36	0.17	0.27	0.19	0.26	0.41	1.48	0.52	5.13	1.22	1.61	0.26
MgO %	0.21	0.01	0.30	0.28	0.17	0.35	0.01	0.01	0.31	0.01	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.05	0.02	0.02	0.01	0.39	0.18	0.06	0.06	0.01
Na^+ %	4.99	0.09	0.10	1.56	1.21	0.23	0.10	1.39	0.55	0.13	0.29	3.29	0.04	0.09	0.09	0.197	0.07	0.09	0.015	1.141	0.148	4.52	2.73	2.24	5.02	0.55
K_2O %	0.26	0.47	0.91	2.24	2.16	0.58	0.71	0.52	0.61	0.91	0.85	0.18	0.06	0.81	0.26	0.71	0.52	0.51	0.91	0.82	0.63	0.07	2.05	0.93	0.82	0.05
H_2O %	0.85	0.36	0.09	0.92	0.90	0.53	0.16	0.29	0.51	0.86	0.92	0.08	0.05	0.11	0.31	0.25	0.21	0.14	0.10	0.86	0.09	0.35	0.79	0.64	0.91	0.14
L.O.I %	10.67	0.44	0.21	15.83	12.27	8.36	0.25	0.36	0.18	0.38	1.85	5.95	0.11	0.39	0.42	0.24	0.36	0.29	0.38	0.56	1.93	0.31	6.59	2.89	2.59	0.32
SO_3^{--} %	7.26	1.32	0.89	0.32	0.08	8.68	0.04	0.25	0.14	0.24	0.46	0.37	0.20	0.78	1.55	0.36	0.05	0.18	0.24	0.59	0.82	2.10	0.57	0.84	[illegible]	0.89
Cl %	14.79	0.25	0.30	4.64	3.59	0.69	0.27	4.19	1.67	0.41	0.88	9.82	0.14	0.25	0.27	0.60	0.19	0.25	0.47	0.41	0.47	15.53	8.80	7.25	15.45	2.28
MnO %	0.013	0.015	0.245	0.008	0.011	0.771	0.029	0.003	0.007	0.01	0.025	0.008	0.038	0.023	0.014	0.016	0.032	0.017	0.072	0.011	0.014	0.103	0.033	0.191	0.059	0.015
P_2O_5 %	0.12	0.03	0.09	0.18	0.16	0.14	0.04	0.05	0.05	0.14	0.08	0.09	0.09	0.05	0.06	0.08	0.05	0.05	0.08	0.11	0.05	0.09	0.03	0.08	0.09	0.02
Total	98.12	99.97	101.34	97.88	97.65	99.10	100.79	99.04	100.41	98.47	99.75	96.47	101.46	101.31	100.4	101.09	99.11	101.46	101.17	101.60	101	97.26	98.57	96.78	96.06	100.5
Sr (ppm)	512	136	110	418	275	294	112	134	138	258	114	205	110	132	148	142	153	106	142	138	212	242	189	182	112	124
Cu (ppm)	5	2	30	12	45	97	10	12	10	15	12	2	5	5	2	7	17	12	20	7	15	32	25	22	15	7
Co (ppm)	25	n.d	20	35	35	215	5	7	12	n.d	13	17	10	n.d	7	15	15	2	10	12	12	47	25	22	25	15
Ni (ppm)	60	42	45	125	150	382	20	92	10	37	n.d	75	12	n.d	n.d	65	90	57	127	77	32	135	92	45	100	67

(n.d) : not detected.
(L.O.I) : Loss on Ignition.
Int. : Intercalation.

Al_2O_3 spans the range 1.28-23.05%, Fe_2O_3 spans the range 0.18-0.63%,CaO spans the range 0.29-18.76 % MgO spans the range 0.01-0.39%, Na_2,O spans the range 0.62-13.52 % and K_2O spans the range 0.07- 2.24%. Accordingly these sediments vary between calc- shales-sandstones- assemblage, affected by post depositional activities (El- Kammar and Mansey, 1983). On the other hand, these samples mostly fall within the arkosic to subarkosic fields in the triangular diagram of Fig.6. Following Dott (1964) and Pettijohn *et al.* (1973) the term " wacke" is applied to substitute for quartz arenite when the sandstone has more than clay 15% matrix. Thus wacke is a synonym for argillaceous sandstone which is applied in this work for such a group of samples. Samples 3a,4 and 7a show the highest concentration of alumina among these samples and thus they are considered as shale rocks. This is confirmed by the X-ray data and the petrographic studies.

From the obtained data, the following geochemical characteristics of the investigated rocks can be deduced :

1. The wide variation in SiO_2 content indicates that the studied sediments are generally varied with respect to quartz content.

2. The content of Al_2O_3 which can be considered as a direct measure of the clay admixture of the sediments, tends to be concentrated in the lower beds rather than the upper ones.

3. CaO is correlated with L.O.I which reflects its presence mainly as calcite with a notable trend of being decreased in amount going from the base of the succession upwards. Samples containing more CaO than the requirements of calcite is mostly alloted with SO_3^{--} as gypsum

4. Dolomite is nearly absent since these samples analyzed are generally poor in MgO.

5. Cl^- is strongly correlated with Na_2O(Fig. 7) which points out to its occurrence as halite. With the exception of samples (8, 16, 17, 18 and 19) in which the content of halite shows a tendency to increase. The excessive amounts of halite were previously detected

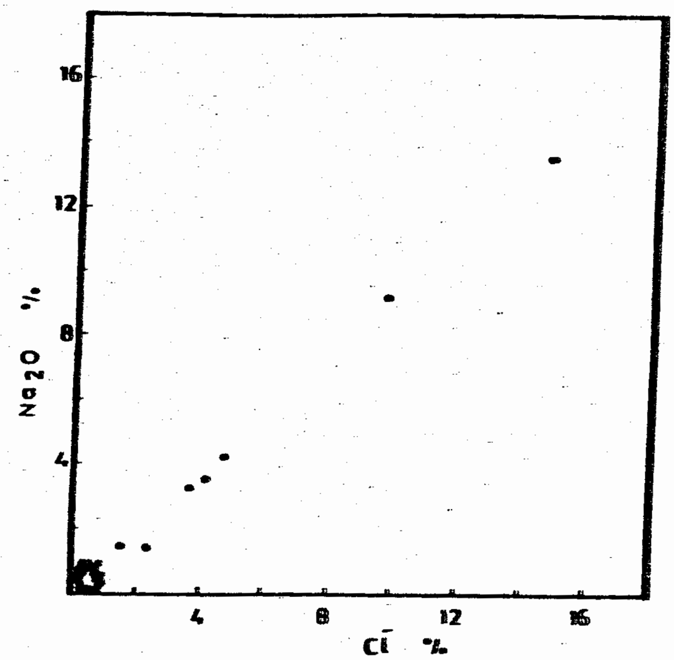


Fig. 7 . The relationship between Na_2O content and Cl^- content in the rock samples understudy.

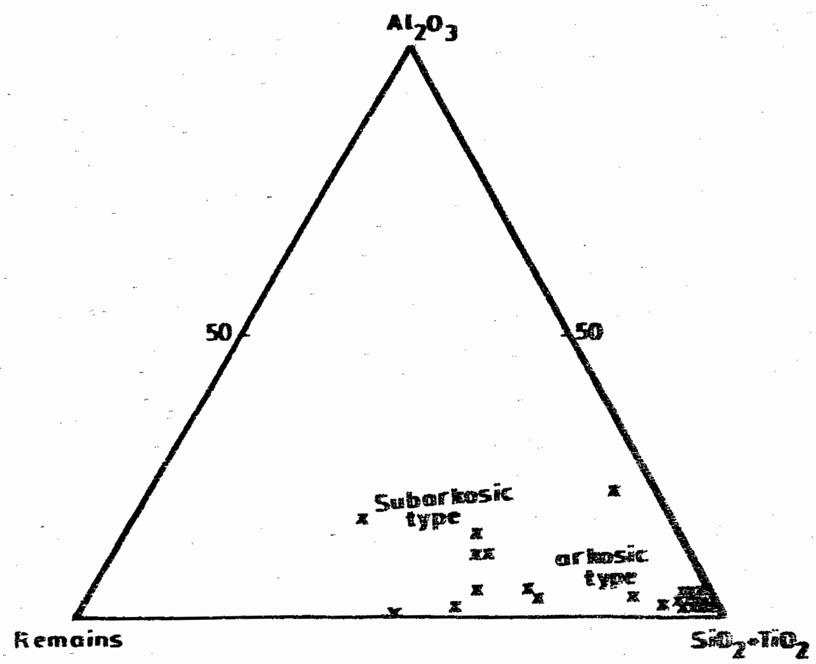


Fig. 6 . Chemical classification of the sandstone from El-Baharia Formation, Naqb El-Baharia, Baharia Oasis (According to Pettijohn, 1949).

in the clastics of Baharia Formation by El-Kammar and El-Mansy (1983) where its content may reach about 40 % of the whole rock. Halite is believed to be introduced into the sediments as superfacial encrustation during a late diagenetic stage. This argument was confirmed petrographically (El-Kammar and El-Mansy, 1983). Also, the upper beds are markedly enriched in Fe_2O_3. Such enrichment in halite and iron oxides appears to be at the expense of the clay minerals in these rocks.

6. It is noted that the highest concentratien of K_2O is present in samples with relatively high c ntents of alumina which is most probably attributed to clay minerals (e.g illite). This is supported by X- ray diffration data.

(B) Minor and Trace Elements

Generally, the concentration of Ti,Sr,Mn,Ni,Co and Cu are very low in quartz arenites.The argillaceous sandstone and shaly rocks are remarkably higher in concentration of these elements. This is because trace elements are largely accomodated in clay minerals due to their reactivity, variability of structure and very small grain size. A strong positive correlation has been observed between Ni versus Al_2O_3 and Fe_2O_3 suggesting that Ni is concentrated in clay minerals (Figs 8 and 9) Sr and Ti may also be adsorbed on the clay fraction of the sediments (Bareber,1974). Compared with average values for shale by Krauskoph (1967) (Sr-420, Ni-95, Co-20, Cu-57ppm), the studied argillaceous sandstone and shale rocks show normal values and thus these sediments may not be affected by late hydrothermal activity. However the hydrothermal activity of the Baharia Oasis have been discussed by several authors and seemed to have contributed in the formation of the iron deposits of the area (Basta and Amer, 1969).

DISCUSSION

The results of the present study throw more light on the paleoenvironmental conditions of sedimentation as well as the diagenetic alteration of the different facies constituting the

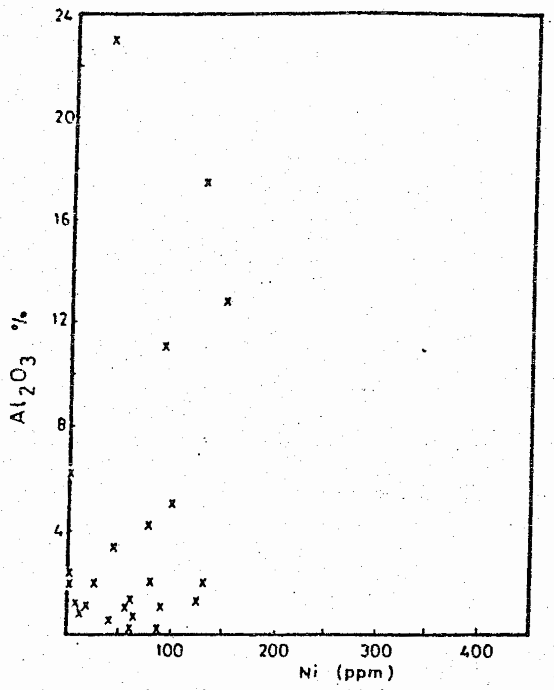


Fig. 8 . The relationship between Al_2O_3 content and Ni (ppm) in the rock samples understudy.

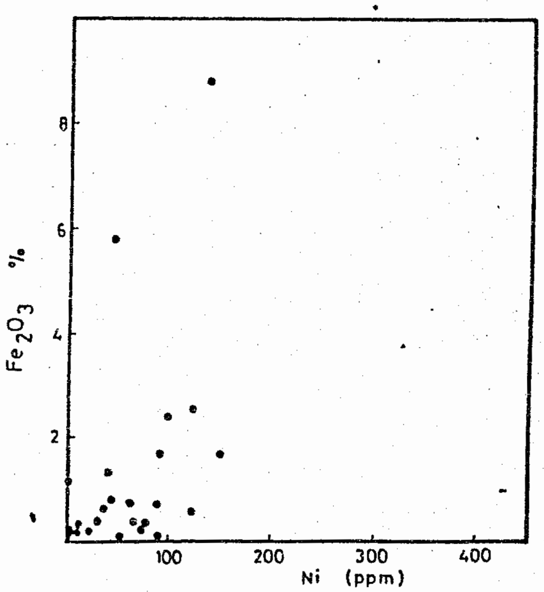


Fig. 9 . The relationship between Fe_2O_3 content and Ni (ppm) in the rock samples understudy.

succession of Naqb El-Baharia; Baharia Formation.

The main rock type represented in Baharia Formation at the studied locality are quartz arenite, intercalated with argillaceous sandstone and shaley rocks.

It is noted that the quartz arenites are the most differentiated and enriched in silica and the most impovirished in the other constituents. These rocks are mostly composed of quartz as revealed petrographically and by X- ray diffraction analysis. Normal quartz and undulose quartz related mainly to igneous and metamorphic sources respectively were recorded in the Nubian type sandstone of um Bogma area (Soliman and El-Fetouh, 1969). The general abundance of normal quartz over the undulose variety in the arenites of Baharia Formation indicates a general igneous provenance with subordinate metamorphic suite (Soliman and El-Badry,1980).

Zaghloul *et al.*, (1984) are inclined to consider the quartz arenite of the Gulf of Suez as first cyclic sandstones formed by decomposition of quartz bearing plutonic rocks under severe climatic conditions. The intensity of weathering is affected by the physicochemical condition in the source area directly or indirectly dependent on the climate (Ronov *et al.*, 1966). Extensive chemical weathering and leaching of source rocks took place under warm and humid climate that prevailed during Cretaceous time (Said *et al.*, 1976).

The petrographic characteristics and geochemical data of fine grained, unfossiliferous, sometimes laminated ferruginous and calcareous sandstones reflect their sedimentation under shallow tidal flat conditions, where continous reworking by waves and currents resulted in removal of most of the feldspar or clays.

Compaction, minor silica overgrowths, common carbonatization and ferrugination are the main diagenetic alterations reported within sandstone facies of El-Baharia Formation. This compaction destroyed an average of 26.76 % of the primary intergranular porosity (Table. 1) probably during low burial as estimated by the equations of Houseknecht (1987).

Cementation common by clays, sulphates and carbonate minerals, resulted in the destruction of 73.23 % of the primary intergranular porosity.

Ferrugination with iron oxides is also a common diagenetic alteration, which occurred, more likely, later to carbonatization as evidenced by iron coating and iron replacing the calcite cement. The ferruginous materials might have originated as siderite, and iron oxides crystallization from possible pre-existing weathered sources and / or reduction of iron component leached from soil and its precipitation under reducing diagenetic conditions.

The iron oxide component, pigmenting the claystone most probably originated from interstratal dissolution of Fe-cemented sources (Turner, 1980) and mixed with clay component during erosion and transportation. The absence of faunal remains (washed samples proved to be devoid of microfauna) and the above mentioned characteristics of major and trace elements of these clay components favour that the components of these claystones were transported by fresh water streams (fluvial) and that their sedimentation were occurred under fluviomarine conditions, precceding a next following shallow marine invasion.

On the other hand, the argillaceous sandstones and shales are second in abundance to quartz arenites in the investigated succession. Besides quartz, which is abundantly present, the clay minerals are predominantly identified.

X-ray analysis shows that kaolinite and illite are the most common clay minerals in these sediments. Kaolinite might have originated through erosion of preexisting nearly acidic sourees, under high rainfall and good drainage conditions (Grim, 1968). Millot (1970) mentioned that kaolinite develops through continental weathering under strong leaching acid conditions favoured by humid and warm climate. He also indicated that during Early Cretaceous, in Africa, areas that were emergent during the great regression were supplied with continental deposits reworked from laterites formed under tropical humid climate. Erosion distributes the products of lateritic weathered mantle rich in kaolinite into sedimentary basin. Illite is formed by leaching of micas and feldspars during weathering in almost any environment containing potassium (Schultz, 1963). Keller (1970) regarded that both potassuim and hydrogen are needed for illite formation. The presence of potassuim in the examined samples is in favour with such origin for illite.

Conclusion

The petrography, X- ray diffraction analysis and chemical studies on the Baharia Formation in Naqb El-Baharia section have revealed that there are three rock types; quartz arenite, argillaceous sandstone and shale.X-ray diffractometery has revealed that quartz, kaolinite, illite, halite, calcite and gypsum are the chief mineral constituents in the argillaceous sandstone and shale in contradistinction with quartz arenite which is mostly composed of quartz. The analyzed rocks are characteristically devoid in faunal content. The recorded difference in mineral contents leads to a notable difference in chemical composition. The distribution of the trace elements Sr, Ni, Co and Cu shows normal values of the same common rock types.

The examined sediments possibly deposited under continental, fluvial to fluvio-marine conditions.

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إضافة الى معدنية وجيوكيميائية الصخور الكلاستكية التابعة للعصر السينوجينى الأسفل، الواحات البحرية مصر

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يتناول هذا البحث دراسات بيتروجرافية ومعدنية لبعض الرواسب الكلاستيكية التى يتركب فيها القطاع الظاهر على السطح في منطقة نقب البحرية بالواحات البحرية والذى يتبع العصر السيتوميني الأسفل ولقد تم التعرف على ثلاثة أنواع رئيسية من الصخور هى الكوارتز مع كميات ثانوية من الكالسيت والهاليت والكاولينيتى من أكثر هذه الأنواع شيوعاً. أما بالنسبة للحجر الرملى الطفلى والطفل فتزداد بها معادن الطين مثل الكاولينيت والاليت بينما تقل نسبة الكوارتز ولذلك فهى تحتوى على نسبة عالية من أكسيد الألمونيوم وأكسيد البوتاسيوم وأكسيد الحديديك. ولقد وجد أن هذه الرواسب الفتاتية قد نتجت من تجوية الصخور النارية المجاورة وقد ناقش البحث ظروف بيئة الترسيب وعمليات مابعد الترسيب والتى تغير من طبيعة هذه الرواسب.