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**FACIES AND DEPOSITIONAL ENVIRONMENT OF THE PHOSPHATE DEPOSITS AT EL-RASHDA, EL-MAWHOOB AREA, DAKHLA OASIS, WESTERN DESERT, EGYPT.**

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**Abstract**

This work which is based on the field and laboratory investigations represents to throw light on the geological, mineralogical, geochemical and environmental deposition of the phosphorite deposits at El-Rashda, El-Mawhoob area, Dakhla, Western Desert, Egypt.

fifty stratigraphic sections, 19 borholes representing the study area, are measured, sampled and studied.

The laboratory work comprises 69 samples for studying physical properties, 11 samples for XRD analyses, 27 thin sections and 133 samples for chemical analyses using XRF method to detect the major oxides, as well as trace element.

The studies revealed that fluorapatite, carbonate fluorapatite, carbonate hydroxylapatite, fluorellstadite, ankerite, dolomite, are the main constituents of the studied phosphorite deposits. While the associated minerals are, halite, quartz, anhydrite, montmorillonite, calcite. (table.1).

Chemically; the average contents of  $Al_2O_3$ ,  $SiO_2$  are comparatively low in the study area, while the average content of  $MgO$ ,  $Fe_2O_3$  and  $SO_3$  are relatively high.

The low contents of  $Al_2O_3$ ,  $SiO_2$  may be attributed to locate them outside the apatite lattice. While the high content of  $MgO$  may be due to derivation of  $MgO$  from dolomite by the oxidation processes, or resulted from the negative relationship of  $MgO$ ,  $CaO$  where  $Ca^{2+}$  substitute by  $Mg^{2+}$  (McConnell 1980).

The iron content in phosphorites deposits is valueless for any postdepositional indications, as iron may enter the site of deposition at any stage, whether syngenetic or epigenetic.

Field observations and petrographic, mineralogical, chemical studies revealed that the origin of the phosphorite deposits at the study area points to shallow marine environment and controlled by various physico-chemical conditions.

**Introduction**

The study area is located at the central part of the Western Desert. The study area lies between Latitudes;  $25^{\circ} 30' 00'' - 25^{\circ} 45' 00''$  N and Longitude ;  $28^{\circ} 30' 00'' - 29^{\circ} 00' 00''$  E (Fig. 1).

Covering about  $303.8 \text{ km}^2$ , where the phosphorite deposits cover an area about  $265.5 \text{ km}^2$ . It is easily accessible through high way of kharga-Dakhla and Farafra Town.

The present work is devoted to study geological, geochemical, mineralogical and environmental studies of the phosphorite deposits at the study area.

**Geologic Setting**

As mentioned before the sedimentary sequence ranges in age from Campanian to Upper Paleocene. The lithostratigraphic investigation allowed to subdividing the succession into four rock units from (oldest to youngest) as follow, Qusseir

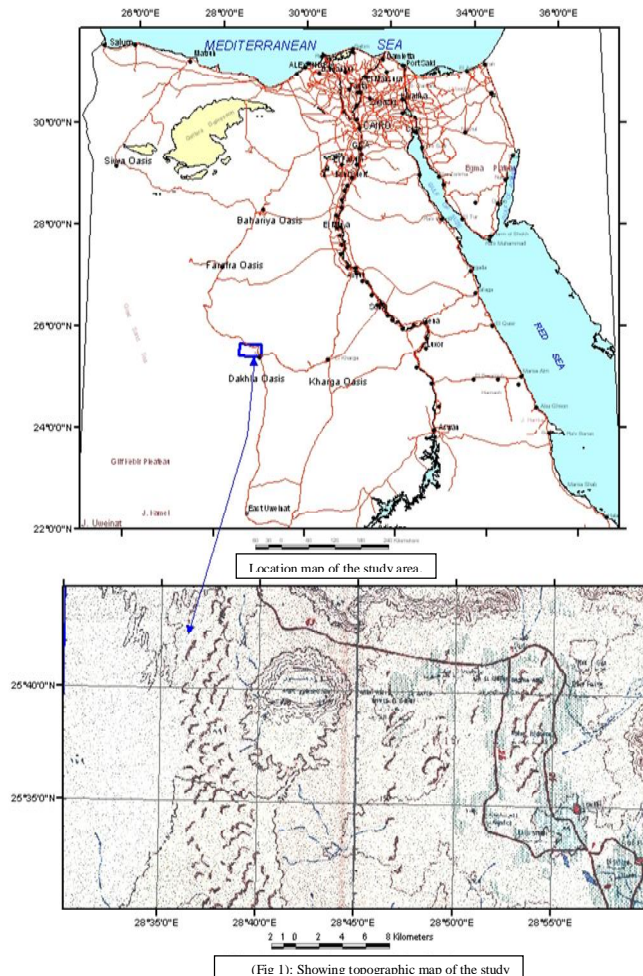
Formation, Duwi Formation, Dakhla shale, Tarawan Chalk as shown in geologic map (fig.2).

### **Qusseir Formation;-**

The Qusseir Formation was first recognized as a distinct unit from the Qusseir area by Youssef(1957), who assigned it "Qusseir Variegated Shales ". Stratigraphically, the Qusseir Formation unconformably overlies the basement rocks and unconformably underlies the Duwi Formation.

Lithologically; this formation consists of black to green and reddish brown, varies in thickness from 1.00m for to 6.00m at reddish Clay, that observed in the enithal road of Dakhla area and El-Rashda, El-Dhose Villages.

The age of this formation may be Senonian by (Hume 1912), or may be Campanian age by (said 1962).



**Duwi Formation;**- (Ghorab 1956), recognized this formation and named it Duwi Formation.

Hermina et. al.(1961). The base of this formation is marked and limited by distinguishable bed named the Neara bed at the Dakhla Oasis.

The Neara bed is pale yellow to yellowish brown in colour, it is hard to moderately hard, fossiliferous, mudstone.

El –Kelany, et. al., (1992), recorded that the Duwi Formation Campanian in age directly overlies the Variegated Shale at the Dakhla area, and it is. Honein, (1993) reported the Duwi Formation to be conformably overlies the Qusier Formation and underlies the Dakhla Shale .

El-Bakry (2005), recorded that the upper part of Qussier Formation West of Dakhla Oasis shows unconformity surface with Duwi Formation, this is demonstrated by the sharp facies changes between coastal to swampy, unfossiliferous facies of the Qusseir Formation, and the fossiliferous, marine facies of the Duwi Formation.

The author supports and agree with El-Bakry view, where the contact between the upper part of Qussier Formation and the lower part of the Duwi Formation shown in (fig.3). The Duwi Formation is mainly composed of phosphorite beds interclated with shale and siltstone beds (fig.4) , The number of phosphorite beds ranges from two to four but mainly the beds are two.

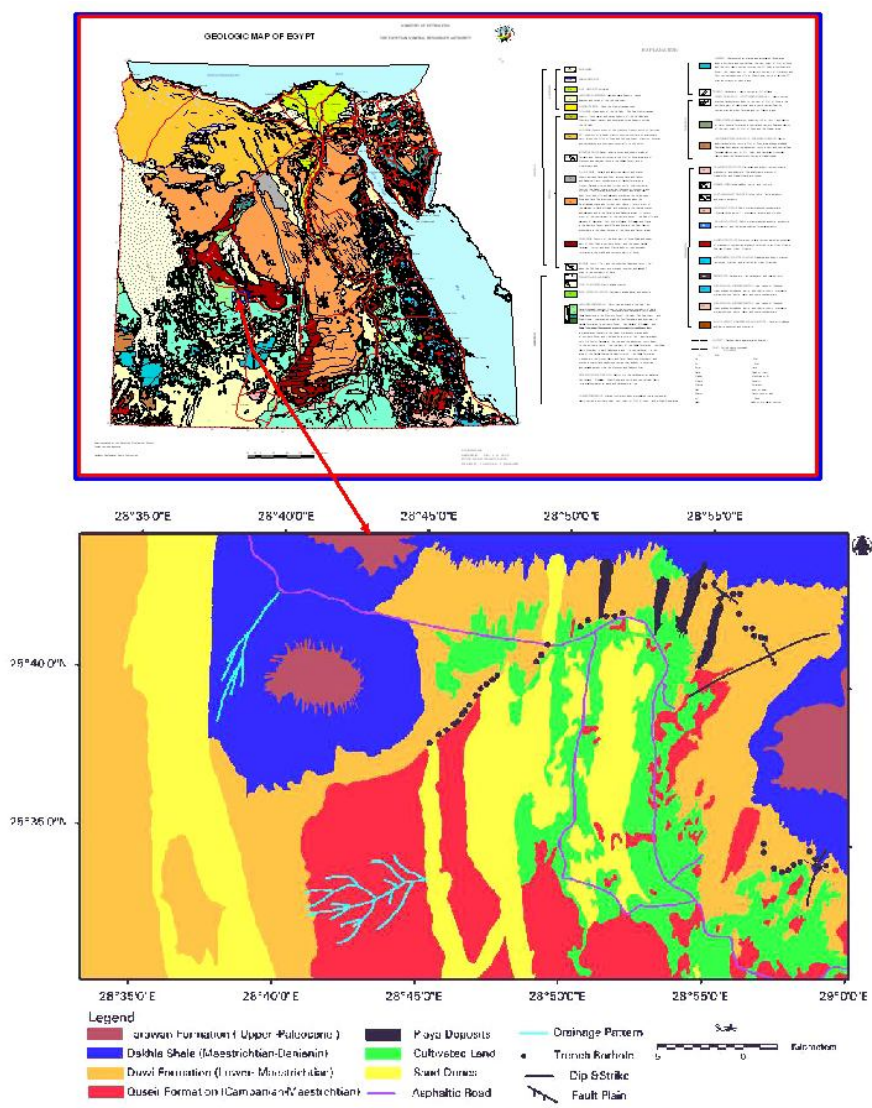
Most of the phosphate beds in the study area are pale yellow to yellowish brown in colour, medium to coarse grained, moderately hard with bone fragments and contain some shark teeth (fig.5), the phosphorites beds vary in thickness with an average from 0.25m to 2.10m. The phosphorite beds are based by bioturbation activity (fig.6).

The thickness of phosphate beds observed, are well developed in, El Dohose, El Rashda, and El Qaser Villages. The detailed field study allows classifying the Duwi Formation into four large sedimentary cycles shown in upward the follow;

**-The first cycle;** represents the lower part of the Duwi Formation that overlies the Qusseir Formation with a sharp contact, lithologically; this cycle consists of shale, black, blackish grey, to greenish grey, moderately compacted and intercalated with claystone, yellow to yellowish brown, silty clay, yellow to pale yellow, low to moderately hard, gypsiferous, occasionally interbedded with bands of phosphatic clay, yellow to yellowish brown, underlies the mudstone, yellowish brown, hard to moderately hard, fossiliferous, "**Neara bed**", and topped by yellowish brown, pale brown to blackish grey, moderately hard, bone fragments of phosphate beds.

The type section of this cycle is well developed at El-Rashda, El-Dohose, and El Qaser Villages.

**-The second cycle;** composed mainly of claystone, silty clay, brown to pale yellow, moderately hard, changing laterally at Mawhoob Village into shale, greenish grey to black, fissile, with pockets of iron hydroxides, phosphatic at the base and topped by pale brown to yellow, moderately hard, shark teeth, phosphate bed (fig.7).



**Fig.2; Geological map of the studied area.**

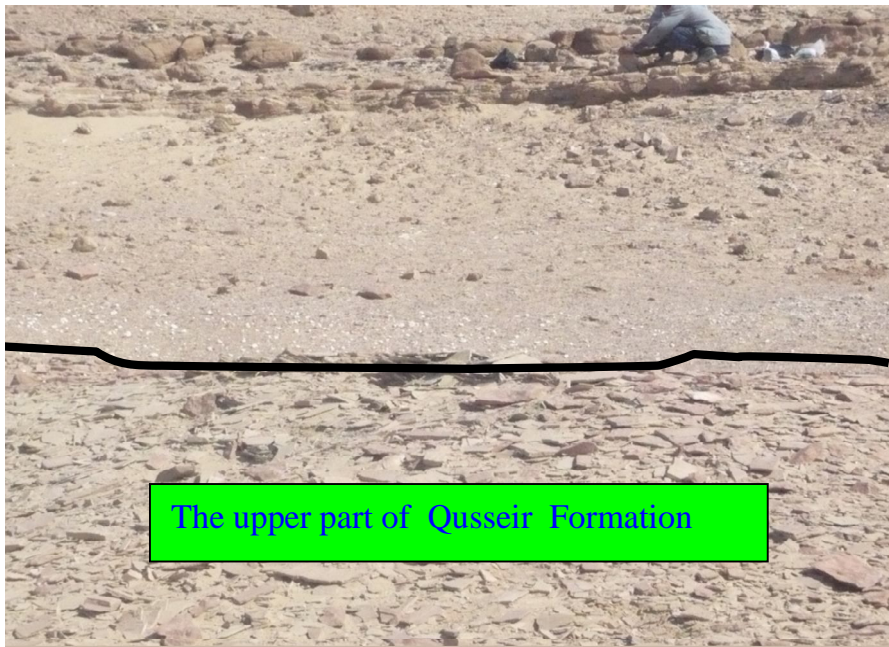


Fig.3; Photograph showing the contact between the Qusseir Formation and the Duwi Formation at El- Rashda area.

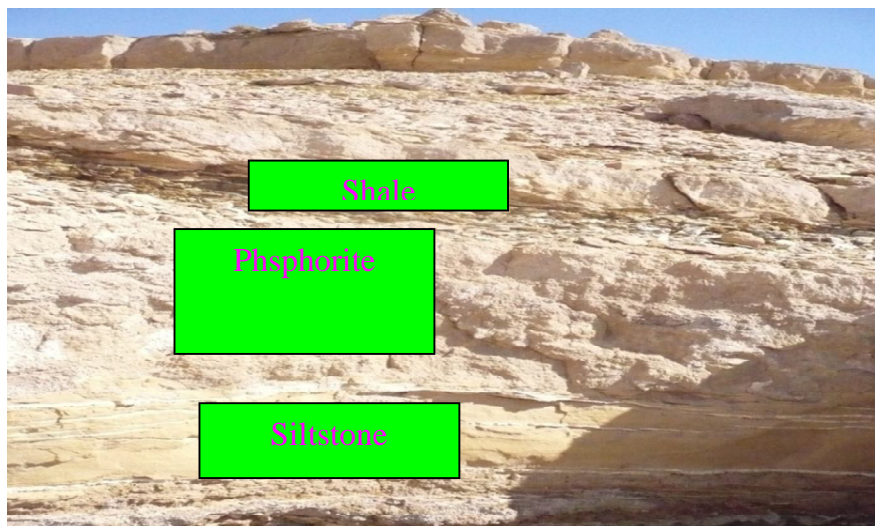


Fig.4; Photograph showing the phosphorite beds intercalated with Shale and based by Siltstone at El- Rashda area.

**-The third cycle;** composed of a thick bed of shale ,grey to yellowish brown, gypsiferous, moderately hard, changes laterally into claystone. It is yellow in colour, moderately hard at the western side of El-Mawhoob Village and topped by dark brown to yellowish brown, moderately hard, phosphate bed.

**-The fourth cycle;** consists of shale, grey to greenish grey, fissile claystone, yellow to light yellow, gypsiferous, with concoidal fracture, represented in most of the study area, the phosphate beds are absent (fig.8).



**Fig.5;** Photograph showing the granular and coars grained of phosphorite ore at El-Qaser area.



**Fig.6;**Photograph showing the bioturbation activity at the base of phosphorite beds. Dakhla shale;-

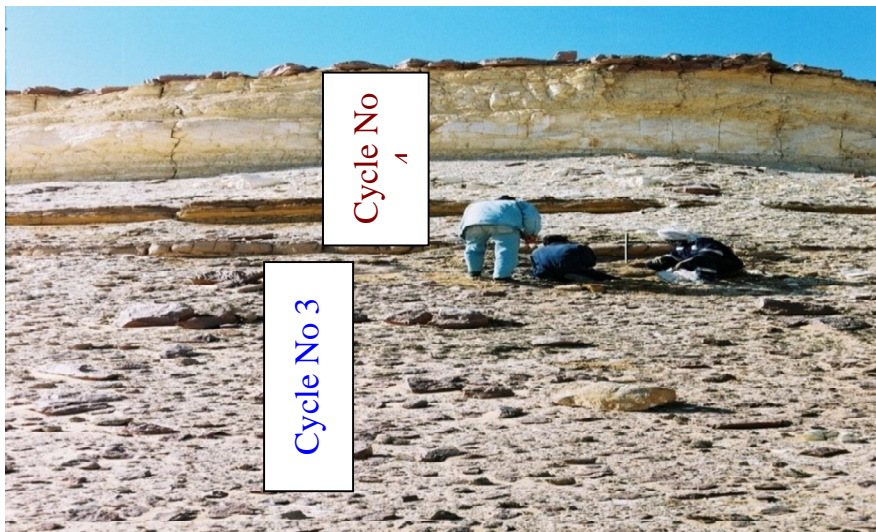
Said (1961), described the shale's which overlain the phosphate sediments and below the chalk of the northern scarp of Dakhla Oasis under the term Dakhla Shale.

In the study area, the Dakhla Shale underlies the Tarawan Chalk and overlies the Duwi Formation. It is composed of shale, mudstone, claystone, argillaceous, limestone and siltstone.

Shale is pale yellow to dark grey in colour, fissile, the mudstone is violet and ferruginous and the claystone is pale grey with conchoidal fracture, while argillaceous limestone is yellowish white and the siltstone is pale yellow and fractured, jointed. It attains a thickness of about 255m, The Dakhla Shale characterized by exogyra overwegi.

#### **Tarawan Chalk;-**

The term Tarawan Chalk was introduced (Awad and Ghobrial, 1965) to describe a well known rock unit that separates the Dakhla Shale from the Esna Shale. This formation is widely represented in the eastern part of the western desert. In Dakhla Oasis, the chalk facies change laterally to limestone that overlies the Dakhla Shale and that contains a fossil assemblage which is quite different from that found in the type of locality in the Kharga Oasis. It is composed of highly fossiliferous reefal limestone, it is yellow in colour, highly compacted, with pockets of calcite. It attains a thickness of about 30m, and forms a cliff overlying the Dakhla Shale in the main scarp.



**Fig.8; Photograph showing the third and fourth cycles.**



**Fig.7; Photograph showing the first, and the second cycles.**

### **Petrographical And Mineralogical Study**

1-The phosphatic components;

-Peloids; occur either ovule or oolitic grains (P.3D, 4B), and it is advantages with two types of cracks 1) deformational crack (P.3A) 2) dehydration crack (P.4C).

-Skeletal materials; a containing the bone fragments, shark teeth, advantages with internal structures (P.1A) and highly cracked.

2-Non phosphatic constituents;

-Detrital quartz; angular to subrounded, and occasionally shapeless (P.1D), colourless under ordinary light.

-Ferruginous materials; occur either 1) as patches or 2) as coatings surrounding the grains (P.3A,C).

-Pyrite; is present admixed with the phosphate pellets, bone fragments and clay matrix.

-Gypsum; common in the weathered phosphorites, occurs as cementing aggregates of flaky and fibrous crystals (P.4A).

3-Cementing materials;

-Silica cement: represented at (P.4C).

-Carbonate cement; containing calcite, dolomite cement, where it is represented in most of the thin sections studied.

-Sulphate cement: represented by gypsum (P.4A).

The mineralogical studies including XRay diffraction analysis revealed that the investigated phosphorite is composed of the following constituents;

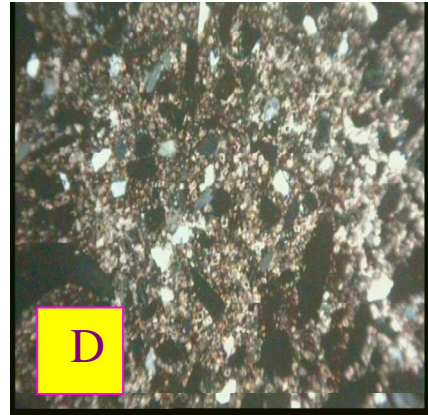
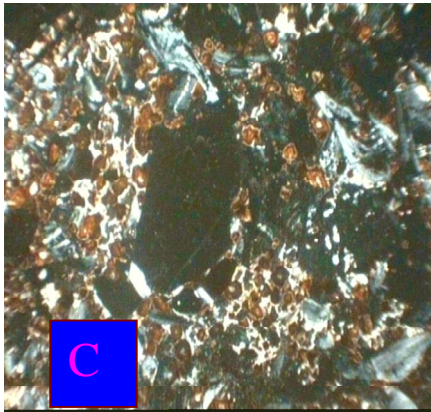
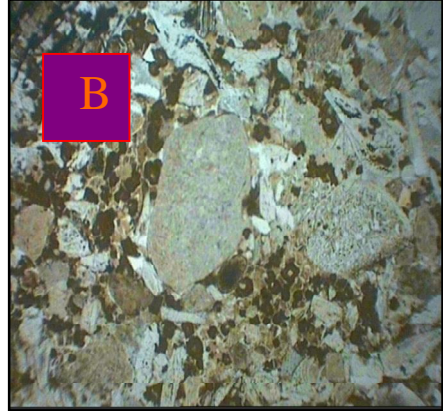
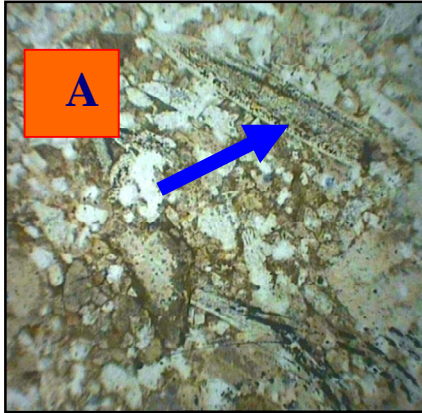
### **Mineralogy;-**

In the present study X-ray diffraction analysis was carried out 11 representative phosphorite samples to identify the different clay minerals;



**Technique used;**

Philips XRay Diffraction equipment model pw/1710 with monochromatic Cu-radiation ( $\lambda=1.542\text{\AA}$ ) at 40K.V. 35m. A. and scanning speed  $0.02^\circ/\text{sec}$ . were used.

**Plate; 1**

(A)-Photomicrograph showing shark teeth, X25.

(B)-Photomicrograph showing subrounded apatite peloid surrounded by skeletal material and quartz grains, X25

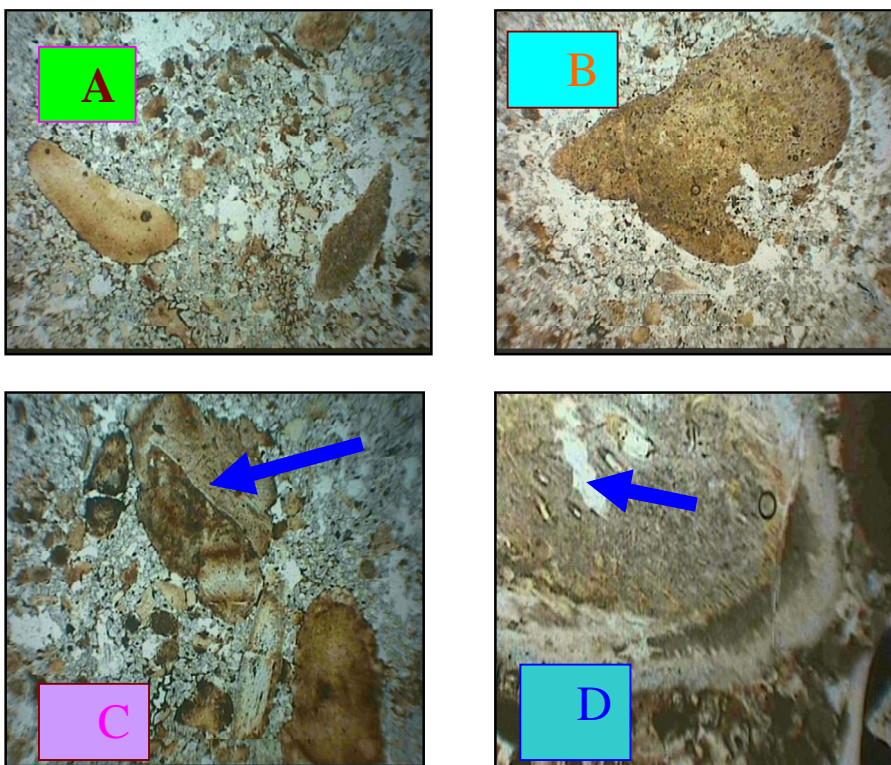
(C)-Photomicrograph showing the peloids and skeletal material embedded in calcite cement, X25.

(D)-Photomicrograph showing angular to subrounded, moderately sorting of quartz grains, X25.

The reflection peaks between  $2\theta=2^\circ$  and  $60^\circ$ , Corresponding spacing ( $d_1 \text{ \AA}$ ) and relative intensities ( $1/I^\circ$ ) were obtained. The diffraction charts and relative intensities are obtained and compared with ICDD files.

**The results;**

XRay Diffraction analyses revealed that the studied samples are composed of the following minerals in a decreasing order of their abundance as shown in (table.1).

**Plate 2**

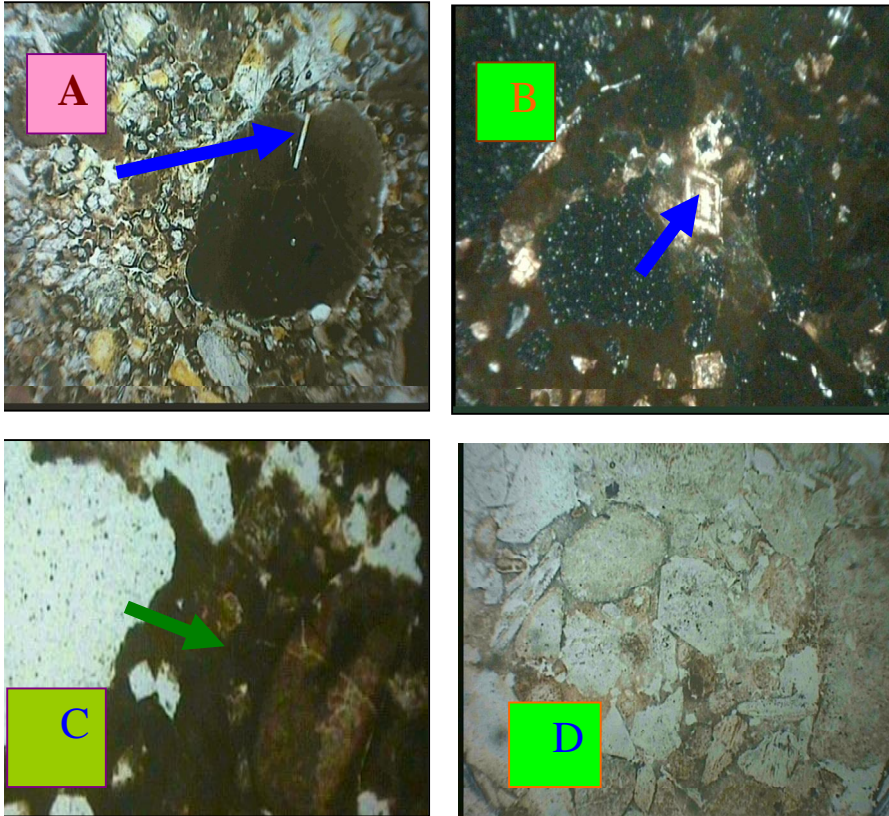
(A)-Photomicrograph showing angular to subrounded, poorly sorting peloids, X25.

(B)-Photomicrograph showing low sphericity-subrounded peloid, surrounded by skeletal materials, X25.

(C)-Photomicrograph showing detailed view of composite peloid, X25.

(D)-Photomicrograph showing the detailed view of bone fragment and its inclusions of quartz grains and other skeletal materials, X25.

## Plate; 3

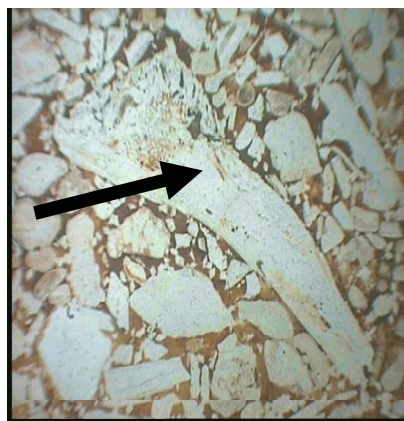
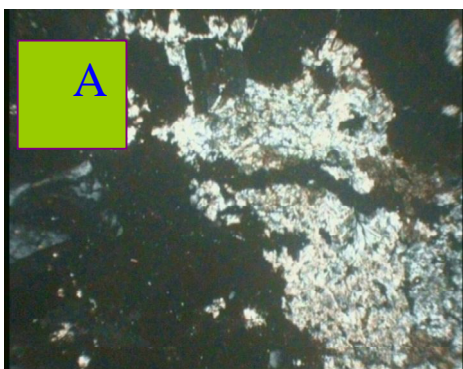


(A)-Photomicrograph showing detail view of peloidal crack (deformational crack) surrounded by skeletal materials, X25.

(B)-Photomicrograph showing euhedral dolomite crystals as cement material, X25.

(C)-Photomicrograph showing the irregular shapes of peloids coated with ferruginous materials, X25.

(D)-Photomicrograph showing ovule peloidal grain, X25

**Plate; 4**

- (A)-Photomicrograph showing detailed view of gypsum as cementing material, X25.  
(B)-Photomicrograph showing the composite peloidal grain and concentric layering as oolite, X25.  
(C)-Photomicrograph showing detailed view of peloidal crack (dehydration crack), X25.  
(D)-Photomicrograph showing detailed view of elongated bone fragments, surrounded by apatite peloids, X25.

**Table.1; The Mineralogical Composition of El-Rashda, El-Mawhoob phosphorites.**

Tr .No	S . No	Major Const.	Minor Const.	Trace Const.
2	4	Carbonate fluoroapatite	Quartz	Dolomite, Calcite and Montmorillonite
	5	Carbonate fluoroapatite and Fluorapatite	Ankerite	Quartz
	6	Carbonate fluoroapatite	Dolomite and Quartz	Calcite
4	9	Ankerite	Quartz and Anhydrite	Fluorapatite
	10	Fluorellestadite	Ankerite and Quartz	-----
7	17	Fluorapatite	Quartz	Calcite
	18	Fluorapatite	Dolomite, Halite and Quartz	Calcite
	19	Carbonate hydroxylapatite and Dolomite	Halite	Quartz and Calcite
12	28	Fluorapatite	Halite	Quartz
	29	Fluorapatite	Ankerite and Quartz	-----
	30	Carbonate fluoroapatite and Dolomite	Halite	Quartz

### Mineralogy of El-Rashda, El-Mawhoob area

#### Phosphatic minerals;

Awad and Ghobrial (1965), identified francolite in the phosphorites of Kharga Oasis, El-Tablawi (1966) identified Francolite and Wilkeite as the most common phosphate minerals forming The phosphorites of Kharga and Dakhla Oasis. Mansour (1973) reported francolite, wilkeite, carbonate apatite, mangan apatite, lewistonite, whitlockite, dahllite, and dehrnites as the possible minerals constituting the phosphorites of Dakhla Oasis.

#### -Fluorapatite; $\text{Ca}_3(\text{PO}_4)_2\text{F}$ ;

It is rarely found as  $\text{Ca}_5(\text{PO}_4)_3\text{F}$  but containing traces of chlorine (Bianchi, 1919). The F content is 2.64 - 4.24% (Jacob and Reynolds, 1928). Fluorapatite is detected in most of the X-ray line spectra of the studied samples.

#### -Francolite{carbonate fluorapatite}; $(\text{Ca}_3\text{F})_2(\text{P},\text{C})_6$

#### (O, OH, F) $24(\text{Ca},\text{C})_4$ ;

Gruner and McConnell (1937); carried out a detailed study on francolite (3.36%  $\text{CO}_2$ ) and concluded that some carbon occupies Ca positions, forming carbonate groups with the three oxygen ions already present, and that most of the carbon substitutes for phosphorus in tetrahedral positions to the extent of 1 carbon to 9 phosphorus and that this decrease in positive charge allows OH and F to replace O. They gave francolite the formula  $[\text{Ca}(\text{F},\text{Cl},\text{OH})] (\text{Ca},\text{C})_4[(\text{P},\text{C})(\text{O},\text{OH},\text{F})]$ . Francolite is detected in most of the X-ray line spectra of the studied samples.

**Dahllite{carbonatehydroxyapatite};  $\text{Ca}_6(\text{OH})_2(\text{P,C})_6\text{O}_{24}(\text{Ca,C})_4$ ;**

This mineral was first recorded by Washington (1929) as occurring in crevices in the dolomite rock. It is pale dull yellow in color with thin black bands. He stated that the diffraction pattern appeared to be identical with that of fluorapatite and gave the formula  $3\text{Ca}_3(\text{P}_2\text{O}_8)\text{Ca}[(\text{CO}_2), (\text{OH})_2]$  for dahllite. The X-ray diffraction lines of dahllite were detected in one sample (19) at the studied area.

**-Fluorellestadite;**

The ellestadites are nesosilicates, which are minerals with isolated  $\text{SiO}_4$  tetrahedral. They are members of the apatite group, but whereas phosphorus is one of the chief constituents of apatite, in ellestadite it is almost completely replaced by sulfur and silicon, without appreciably altering the structure (McConnell 1973). The X-ray diffraction lines of fluorellestadite were detected in one sample (10) at the studied area.

**Non phosphatic minerals;**

**-Quartz ;( $\text{SiO}_2$ );**

X-ray diffraction lines of quartz are common in the studied phosphorite samples. Availability; Quartz forms 35-50% of the terrigenous fraction of sedimentary rock. Most quartz comes from reworking of older sandstones or sandy limestone.

**Ankerite;  $\text{Ca}(\text{MgFe})(\text{CO}_3)_2$ ;**

Ankerite is one of the important minerals of carbonate rocks. It may like dolomite form as a replacement, or directly precipitate ooze or as concretions. Ankerite is detected in four samples (3), (9), (29), (5) of the studied samples.

**-Dolomite;  $\text{CaMg}(\text{CO}_3)_2$ ;**

Dolomite may occur as directly-precipitated ooze in crystals 2-20 microns in diameter. It is distinguished from calcite by the fact that it nearly always shows some evidence of rhombic crystal form. Most definite replacement dolomite is coarser than 0.015mm. Dolomites finer than 0.010mm is believed to be of primary origin, accumulated directly on the sea floor as dolomite ooze (dolomicrite). Dolomite is detected in most of the X-ray line spectra of the studied samples.

**Halite ( $\text{NaCl}$ );**

Halite or rock salt is a massive, coarsely crystalline material without joints. In some deposits it is laminated. Halite is detected at only three samples (19), (18), (17), (28) of the X-ray line spectra of the studied samples.

**Calcite ;( $\text{CaCO}_3$ );**

Probably; calcite forms over half by volume of the carbonates, occurring as directly-precipitated microcrystalline ooze (forming irregularly rounded grains 1-4 microns in diameter), as mosaic, xenomorphic crystals which are clear and often twinned. Calcite is detected in most of the X-ray line spectra of the studied samples.

**-Anhydrite ;( $\text{CaSO}_4$ );**

Anhydrite like rock gypsum occurs in beds which in some places are thick and extensive. Anhydrite beds are commonly finely granular, although fibrous and

coarsely crystalline masses are also known. Anhydrite is detected in one sample (9) of the X-ray line spectra of the studied samples.

**-Montmorillonite;**

Montmorillonite formed in a Mg-rich environment, mostly by a leaching of volcanic ash. Some by temperate weathering especially of basic rocks. On incipient metamorphism, montmorillonite may convert to Illite or chlorite. Marine diagenesis has a little effect on volcanic montmorillonite except to change adsorbed Cations. Montmorillonite is detected in one sample (4) of the X-ray line spectra of the studied samples.

**- Origin and environmental deposits of El-Rashda, El-Mawhoob phosphorites;**

-The studied area contains different lithological units as Qusseir Formation at base, Duwi Formation at middle, Dakhla Shale and Tarawan Chalk at top.

Phosphorite deposits are mainly composed of three to four phosphorite beds with irregular thickness from (few centimeter to 2.10 meter). It is alternated with, shale, claystone and capped with limestone and dolomite.

-The Duwi Formation contains highly fossiliferous horizons, where gastropods, shark teeth, bone fragments are recorded.

-Occasionally, the phosphorite beds are based and capped by bioturbant in different localities at the studied area.

-The upper series of the phosphorite beds are subjected to rapid lateral variation, where the argillaceous mudstone cap the Duwi Formation at east and dolomite at west.

-Veins of gypsum and Anhydrite are recorded underlying the phosphorite beds.

**-From the field work allows concluding the following remarks;**

-The presence of the variable lithological units and the alternation of the phosphorite beds with shale and mudstone indicate that the sea must have gave rise to littoral, supra-and infra-neritic conditions resulting in the deposition of different rock types.

-The predominance of siliceous, anhydrite, gypsumiferous coarse grained, light colored at El-Rashda-El-Mawhoob phosphorite is taken as an evidence of their deposition in shallow aerated water, this may be due to relatively shallower conditions of their deposition.

-The rapid lateral variation of El-Rashda, El-Mawhoob phosphorite attributed to physicochemical conditions.

-The recording of bioturbant at the phosphorite beds indicated that the Calm current and the deposition of shallow marine condition.

The petrographic investigations revealed that the phosphate minerals are present in the form of grains of various sizes, colours and shapes, these grains were deposited chemically as a gel from colloidal solutions, while the other part of phosphate bearing fragments (fossil bones and teeth fragments) are the result of the decay of nektonic vertebrates.

-Grains of phosphate minerals of small sizes and lath shapes have been deposited in place, so that no reworking, due to transportation has taken place, the

coarser and more rounded grains are believed to have been transported for short distances, their shape is due to rolling and reworking of waves.

-The different types of minor constituents and cementing material are more reflections of the physicochemical conditions prevailing during the deposition of calcium phosphate or slightly after it due to changes in the environmental conditions.

-Bones and teeth fragments, included in the large grains of phosphate, seem to have been deposited together with the host phosphate.

-Other inclusions such as, carbonaceous matter, iron oxides, detrital quartz seems to be chemically Co-precipitated with phosphate host grains.

-The climate prevailing during the formation of phosphates is a warm one.

-The dolomite one of non phosphatic minerals that obtained in the mineralogical composition and according to many authors (Strakhov, 1962; Friedman and Sanders, 1967; Pettijohn, 1975; Riggs, 1979a; and others) the dolomite can form in shallow evaporate basins within the intertidal zone of carbonate environment and seems to be more related to the deposition of phosphorites.

-The presence of montmorillonite as minor mineral constituent of phosphate rocks in the area that indicates to the deposition of the shallow water equivalent facies.

-The composite grains seem to have been formed in two steps; 1-the enclosed grains were chemically deposited as pellets or ovules, 2-new peloid was deposited forming a primary cement for these grains.

-The reducing and oxidizing conditions alternated in the environment where different phosphorite rocks were formed.

#### **-Observations from X-ray mineralogical studies;**

The studies of X-ray mineralogical refers to the common phosphate minerals represented in apatite minerals as fluorapatite, carbonate-fluorapatite, carbonate-hydroxyl-apatite, that reverses to the deposition of phosphate minerals at pH range from 7 to 7.8, where the concentration of Ca- and P- ions in the sea water depending on the physicochemical conditions and the supply of the phosphate-bearing solutions. That means two factors controlled in the precipitation of calcium phosphate;

-The pH value should lie between 7 and 7.8.

-P- and Ca-ions must be present in sufficient amounts.

The changes in the pH value controlled by the CO<sub>2</sub> partial pressure, where the increase in the partial pressure of CO<sub>2</sub> cause a decrease in the pH value of the sea water, while the decrease of this pressure that lead to increasing of the pH value of the sea water, organisms, whether plants or animals also play an important role in producing variation in the pH value of sea water, the concentration of P-ions is measured by the amount of decayed organisms.

From the non phosphatic minerals that represents by dolomite, gypsum, anhydrite, pyrite and montmorillonite, where dolomite is considered of primary origin, formed by pencontemporaneous dolomitization of calcite, according to (Teodorovich 1958). This dolomitization most probably occurs at pH values between 7.2 – 9.



Also, gypsum is considered to be the result of two processes ;(a)-hydration of anhydrite, and(b)-oxidation of pyrite, formed after the deposition of Ca-phosphate.

While anhydrite, is considered as an antigenic mineral formed after the deposition of Ca-phosphate, Anhydrite may be deposited in saline lagoons or in seas and lakes at ph values ranging from 7.2 – 8, (Teodorovich 1958).

From all above and from X-ray mineralogical studies the author believed that the area was characterized by the present of sufficient amounts of P-and Ca-ions and the increase in the partial pressure of CO<sub>2</sub>.

### Conculation

The present work based on the field and laboratory works, studying the phosphorite deposits at El-Rashda, El-Mawhoob area. These targets depended on the preparation of a map for the phosphorite sites chosen for the study, preparation of thin sections for microscopic investigation and determination of mineralogical constituents and the stratigraphic sections. The studied area contains the following rock units;

Top

Tarawan Chalk	(Upper Paleocene)
Dakhla Shale	(Maestrichtian—Danian)
Duwi Formation	(Lower--Maestrichtian)
Qussier Formation	(Campanian—Maestrichtian)

Base

The petrographic studies that phosphorite of El-Rashda; El-Mawhoob contains of three basiccomponents:-

- 1) The phosphatic components are Peloids; and keletal material.
- 2) Non phosphatic constituents Is Detrital quartz;-Ferruginous matter, Pyrite; and Gypsum.
- 3) The cementing materials is Silica cement, Carbonate cement and sulphate cement the investigated phosphorite is composed of the following constituents.

1-Phosphatic minerals contains of as follow:-

Fluorapatite; $Ca_3(PO_4)F$ ; Francolite {Carbonate Fluorapatite};  $(Ca_3F)_2(P,C)_6$  and  $(O,OH,F)_{24} (Ca,C)_4$  Dahllite {Carbone Hydroxyapatite};  $Ca_6(OH)_2(P,C)_6O_{24} (Ca,C)_4$ ; Fluorelleste;

2-Non phosphatic minerals;is Quartz ;( SiO<sub>2</sub> , Ankerite;  $Ca(MgFe)(CO_3)_2$ , Dolomite;  $CaMg (CO_3)_2$ ; -Halite (NaCl, Calcite;  $(CaCO_3)$ ; Anhydrite;  $(CaSO_4)$ , Montmorillonite.

From all the field observation and detection of the petrographic, mineralogical at the study area revealed that the origin of the phosphorite deposits is shallow marine deposits and controlled with varies physco-chemical conditions.

### Reference

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