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DINOFLAGELLATE CYSTS AND MIOSPORES FROM THE ALBIAN - CENOMANIAN SEQUENCE OF THE QARUN 2 - 1 BOREHOLE, WESTERN DESERT, EGYPT

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الطحالب البحرية السوطية وأبواغ وحبوب لقاح العصر الألبي – السينوماني في بئر قارون ٢-١ بالصحراء الغربية – مصر

صلاح يوسف البيلي

يعالج هذا البحث دراسة التجمعات الأحفورية للطحالب البحرية السوطية والأبواغ وحبوب اللقاح في سبع عينات تم الحصول عليها من بئر قارون ٢-١ بالصحراء الغربية بمصر وتتراوح في عمقها من ٢٧١٨ – ٢٨٥٤م . وأمكن تحديد عمر هذا التتابع الطبقي بدءاً من العصر الألبي الأوسط / المتأخر وحتى باكورة العصر السينوماني وقد ترسب ذلك القطاع في بيئة بحرية شاطئية محصورة . بالإضافة إلى ذلك فقد تم التعرف على أحد الطحالب البحرية وبعض الأبواغ السرخسية والتي تميز الجزء السفلي من صخور حقب الحياة القديمة ويفسر ذلك على أن أحافير حقب الحياة القديمة قد نقلت واختلطت مع صخور العصر الألبي – السينوماني مما يشير بوضوح إلى أن تواجد صخور حقب الحياة القديمة في هذا التتابع أمر مشكوك فيه .

Key Words: Albian, Cenomanian, Dinoflagellates, Egypt, Miospores, Qarun, Western Desert

ABSTRACT

Rich distinctive dinoflagellate cyst assemblages together with significant numbers of miospores were recovered from seven cuttings samples in the Qarun 2 - 1 borehole between 2718 - 2854 m. This association represents a ? Middle / Late Albian to Early Cenomanian microflora deposited in a nearshore restricted marine or brackish water lagoonal environment.

Paleozoic palynomorphs have been isolated from samples dominated by forms of Albian - Cenomanian age. The low abundance, clearly different colour and mixed ages (pre-Early Ordovician acritarchs assigned to *Vulcanisphaera* sp. at 2738-2740 m and post - Late Ordovician spores) indicate that ? Paleozoic reworking can be easily identified in the mid Cretaceous deposits. The significance of this apparent mixing of assemblages is discussed.

INTRODUCTION

This report presents the results of the palynological analysis of seven cuttings samples from the interval 2718 m to 2854 m of the Qarun 2 - 1 borehole, drilled by Shell Winning NV in 1986 in the eastern part of the Egyptian Western Desert (Lat. 29° 21' 04" N; Long 30° 41' 03" E, Fig. 1). The majority of previous palynological investigations carried out on mid Cretaceous deposits of this area have mainly concentrated on miospores (e.g. Saad, 1978; Sultan and Ali, 1986; Schrank, 1982, 1983, 1987; El Beialy, 1993). Occurrences of Lower Cretaceous dinocysts from the same area have been studied recently (Omran *et al.*, 1990).

The dating of the sequence in the Qarun 2 - 1 borehole has presented problems due to the paucity of planktonic foraminifera as independent control. Thus the suggested chronology of the sequence is based entirely on observations of the dinocysts and miospores which are present.

PALYNOLOGICAL ANALYSIS

All samples were processed employing the standard preparation procedure adopted by El Beialy (1990). 20% HCl and 50% HF acids were used to remove carbonates and silicates respectively. The organic residues were concentrated

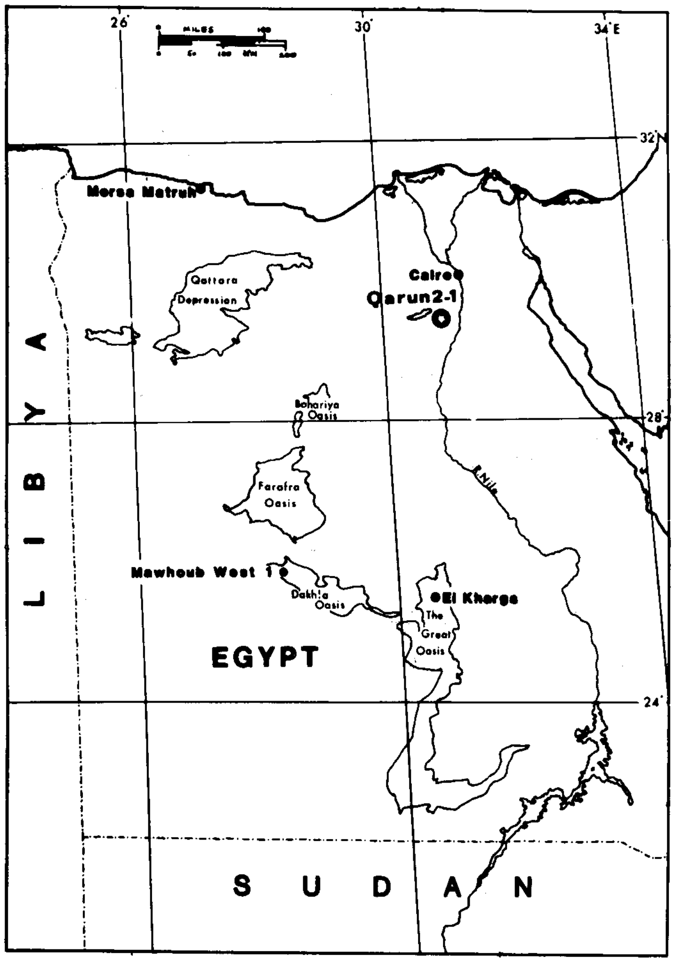

Fig. 1: Map showing the location of the Qarun 2 - 1 borehole.

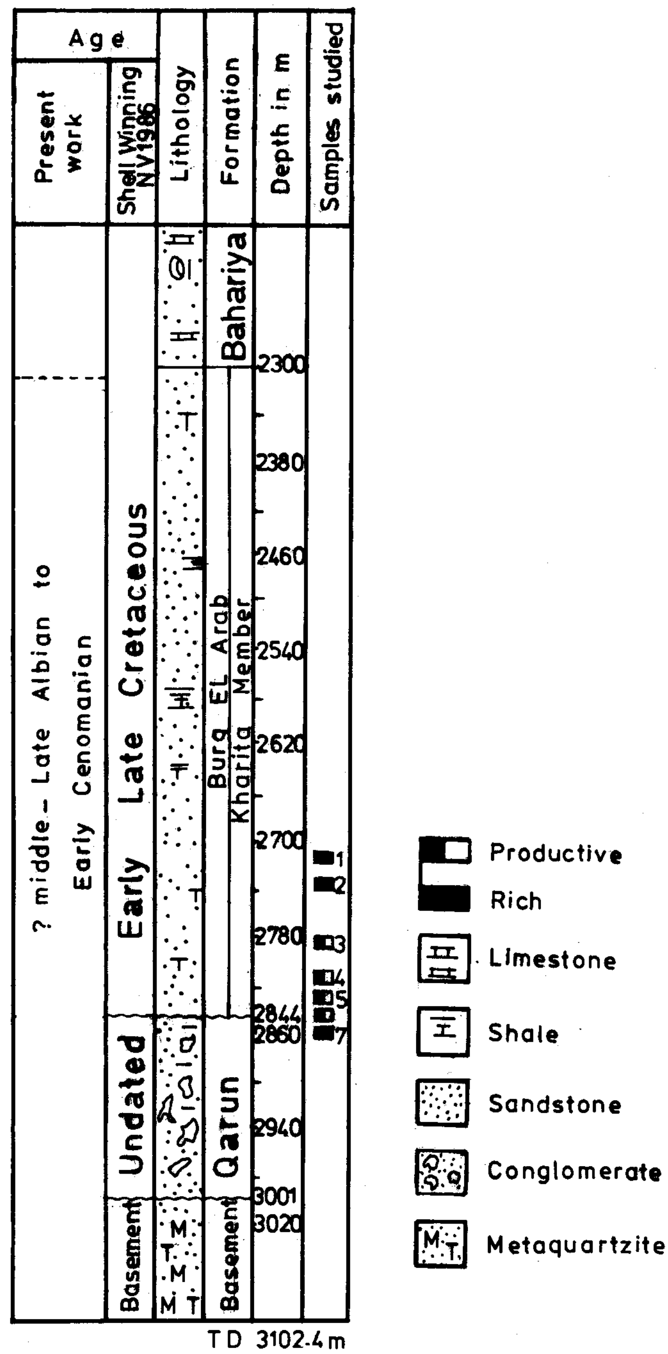

Fig. 2: Stratigraphic column of the Qarun 2 - 1 borehole showing the lithology of the formations, based on data from the Shell Winning NV (1986). Age assignments are based on data obtained from the Shell Winning NV biostratigraphic summary log and on miospores and dinocyst evidence (this study).

by sieving and the organic fraction between 10 and 125 µm, was prepared as a permanent scatter mount. Few drops of polyvinyl alcohol (PVA) were added to the residue for dispersion and Canada Balsam was the mounting medium. Counts of 200 specimens per sample were made from each productive sample. Biostratigraphically significant dinocysts and miospores are illustrated on figures 3 and 4. The slides containing the figured specimens, located by England Finder references are held in the author's collections at the Department of Geology, Faculty of Science, University of Qatar, Doha, Qatar.

STRATIGRAPHIC SETTING

The lithostratigraphic sequence of the Qarun 2 - 1 borehole includes successions from the pre-Cambrian basement complex to ? Neogene (Shell Winning NV, 1986). The samples studied, together with their locations within the borehole are indicated in Figure 2. The samples investigated were collected from the Kharita Member of the Burg El Arab Formation and the underlying Qarun Formation. Partially or entirely black rectangles represent productive or rich samples.

The litho - biostratigraphy of the Kharita Member and its environment of deposition was briefly documented by El Beialy (1993) in the first part of this contribution which dealt with the palynological dating of the Cretaceous Kharita Member in the same well, based mainly on miospores.

The Qarun unit is made up of conglomerates and sandstone. It rests unconformably over the basement rocks and under the sandy Kharita Member. The Shell Winning NV (1986) did not assign an age to this unit. It was possibly or questionably deposited as an alluvial fan.

PALYNOLOGICAL RESULTS

All discussion is based entirely on the analysis of seven samples. The depths from which each sample comes is indicated on the log (Fig. 2). Analysis of the stratigraphic distribution of dinocysts and miospores in this well has been hampered by the generally poor sample coverage and the limited number of cuttings available. Abundance data of taxa reported in this study is presented in terms of absolute figures, rather than percentages. In this way readers can develop some idea of the productivity of the samples and gauge the quality of the database used (Table 1).

The following palynomorphs have been identified in this preliminary study and short discussions are given to the forms marked by an asterisk.

Dinoflagellate cysts:

1. *Coronifera albertii* Millioud, 1969
2. *Cleistosphaeridium* sp.
3. *Cribroperidinium edwardsii* (Cookson & Eisenack) Davey, 1969
4. *Cribroperidinium* sp.
5. *Diconodinium* sp.
6. *Dinopterygium cladoides* Deflandre, 1935
7. *Escharisphaeridia* sp.
8. *Florentinia laciniata* Davey & Verdier, 1973
9. *F. mantelli* (Davey & Williams) Davey & Verdier, 1973
10. *Spiniferites* sp.
11. *Subtilisphaera perlucida* (Alberti) Jain & Millepied, 1973
12. *Subtilisphaera* sp.
13. *Xenascus ceratioides* (Deflandre) Lentin & Williams, 1973

*14. *Cassiculosphaeridia* cf. *reticulata* Davey, 1969

Miospores:

1. *Cyathidites australis* Couper, 1953
2. *Cyathidites minor* Couper, 1953
3. *Concavisporites* spp.
4. *? Biretisporites* sp.
5. *Gleicheniidites senonicus* Ross, 1949
6. *Triplanosporites* sp.
7. *Perotrilites pannuceus* Brenner, 1963
8. *Pelletieria minutaestriata* Bolkhovitina, 1961
9. *Classopollis* sp.
10. *Ephedripites* sp.
11. *Araucariacites australis* Cookson, 1947
12. *Stellatopollis* sp.
13. *Elaterosporites klaszi* (Jardiné & Magloire) Jardiné, 1967
14. *Elaterocolpites castelaini* Jardiné & Magloire, 1965
15. *Afropollis jardinus* (Brenner) Doerenkamp *et al.*, 1982
16. *Monocolpopollenites* sp.
17. *Retitricolpites* sp.

*18. *Cretacaeiporites* cf. *scabratus* Herngreen, 1973

Other Algae:

1. *Pediastrum*
2. *Botryococcus*

Others:

Foraminiferal test linings

TAXONOMY AND SYSTEMATICS

Dinocysts:

Cassiculosphaeridia cf. *reticulata* Davey, 1969 (Fig. 3, 10)

Remarks: The size of the reticulation is smaller than found in typical Lower Cretaceous specimens of *C. reticulata* described from the North Sea.

Miospores:

Cretacaeiporites cf. *scabratus* Herngreen, 1973 (Fig. 3, 7)

Remarks: This taxon is identical to *C. scabratus* in general morphology and exinal structure. It differs in being larger, thicker walled and having only 6, large, symmetrically arranged pores.

Table 1

Quantitative or semi-quantitative distribution of dinocysts and miospores in the Qarun 2 -1 borehole. Data presented in terms of actual numbers of specimens counted.

Distribution	Kharita Member					Qarun Fm	
Taxa	1	2	3	4	5	6	7
Dinocysts:							
1. *Cassiculosphaeridia* cf. *reticulata*	1						
2. *Canninginopsis* sp.	1	1					1
3. *Coronifera albertii*	1	1					
4. *Cleistosphaeridium* sp.		1		1			
5. *Cribroperidinium edwardsii*	2						
6. *Cribroperidinium* sp.	1						1
7. *Diconodinium* sp.	1						
8. *Cyclonephelium distinctum*	1						
9. *Dinopterygium cladoides*	1		1				
10. *Escharisphaeridia* sp.							1
11. *Florentinia laciniata*	5						
12. *F. mantelli*	2						3
13. Spiniferites sp.	2	2					
14. *Subtilisphaera perlucida*	1	2					
15. *Subtilisphaera* sp.	2						
16. *Xenascus ceratioides*	3						6
17. *Xenascus* spp.	2	3					
Miospores:							
1. *Cyathidites australis*	30	35	2	26		16	2
2. *C. minor*	2	3	1	2		1	1
3. *Concavisporites* spp.	4	15			15	17	2
4. *Triplanosporites* sp.	30	2		1	2	2	2
5. *Perotrilites pannuceus*	2				2		3
6. *Pelletieria minutaestriata*	1	1			3		
7. *Araucariacites australis*	2				3	1	1
8. *Elaterosporites klaszi*	67	6	3	1		6	21
9. *Elaterocolpites castelaini*	6						
10. *Afropollis jardinus*	3					1	1
11. *Monocolpopollenites* sp.	2			1			
12. *Retitricolpites* sp.			1	1			
13. *Cretacaeiporites* cf. *scabratus*		1					
14. *Classopollis* sp.					1		
15. *Ephedripites* sp.	2						

BIOSTRATIGRAPHIC INTERPRETATIONS

In the following section, a selection of the most distinctive and common dinocysts and miospores of the studied samples is briefly discussed. In evaluating the biostratigraphic significance of the Qarun 2 -1 borehole microflora, the palynomorphs are compared with other African palynomorphs rather than with those from other continents.

The Albian - Cenomanian microflora in all samples studied between 2718 m and 2854 m is dominated by *Cyathidites* spp. together with the gymnosperm pollen *Araucariacites* and *Classopollis*. The latter ones are usually long ranging and they tend to become rare or to disappear in the post-Cenomanian strata (Schrank, 1990). The presence of the key forms *Afropollis jardinus, Elaterosporites klaszi* and *Elaterocolpites castelaini* is notable, and a ? Middle / Late Albian to Early Cenomanian age was suggested for the majority of forms encountered in this section (Jardiné, 1967; Herngreen, 1973; Schrank, 1990). According to the new data available from the Wara and Safaniya members of the Wasia Formation in the northernmost Arabian Gulf (in Herngreen and Duenas

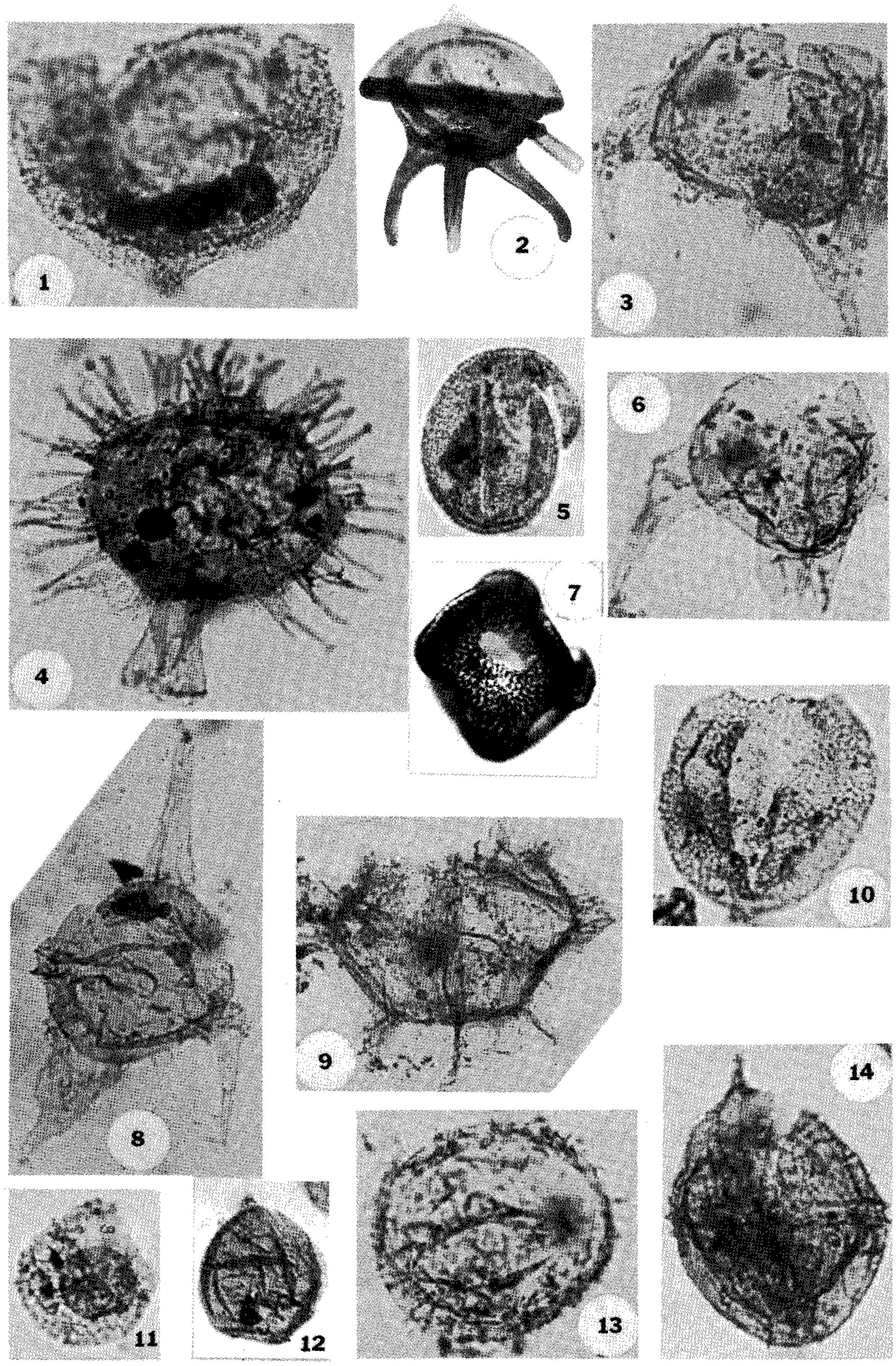

Fig. 3:
1. *Canniginopsis* sp., sample 2, depth 2738 - 2740 m, X 19, X 750.
2. *Elaterosporites klaszi* (Jardiné & Magloire) Jardiné, 1967. sample 1, depth 2718 - 2720 m, Y46, X750.
3, 6. *Xenascus ceratioides* (Deflandre) Lentin & Williams, 1973, 3. sample 7, depth 2852 - 2854 m, P 38, X750; 6. sample 1, 2718 - 2720 m, X 37, X750.
4. *Florentinia laciniata* Davey & Verdier, 1973, sample 1, depth 2718 - 2720 m, D28, X 1000.
5. *Foveotricolpites* sp., sample 1, depth 2718 - 2720 m, X 34, X 750.
7. *Cretacaeiporites* cf. *scabratus* Herngreen, 1973, sample 2, depth 2738 - 2740 m, 023, X 750.
8. *Xenascus* sp., sample 1, depth 2718 - 2720 m, X 42, X 1000.
9. *Dinopterygium cladoides* Deflandre, 1935, sample 7, depth 2852 - 2854 m, S 42, X 750.
10. *Cassiculosphaeridia* cf. *reticulata* Davey, 1969, sample 1, depth 2718 - 2720 m, S34, X 750.
11. *Afropollis jardinus* (Brenner) Doyle *et al.*, 1982, sample 1, depth 2718 - 2720 m, R43, X 750.
12. *Subtilisphaera* sp., sample 1, depth 2718 - 2720 m, H 34, X 500.
13. ? *Cyclonephelium distinctum* Deflandre and Cookson, 1955, sample 1, depth 2718 - 2720 m, V43, X 750.
14. *Cribroperidinium edwardsii* (Cookson & Eisenack) Davey, 1969, sample 1, depth 2718 - 2720 m, R35, X 750.

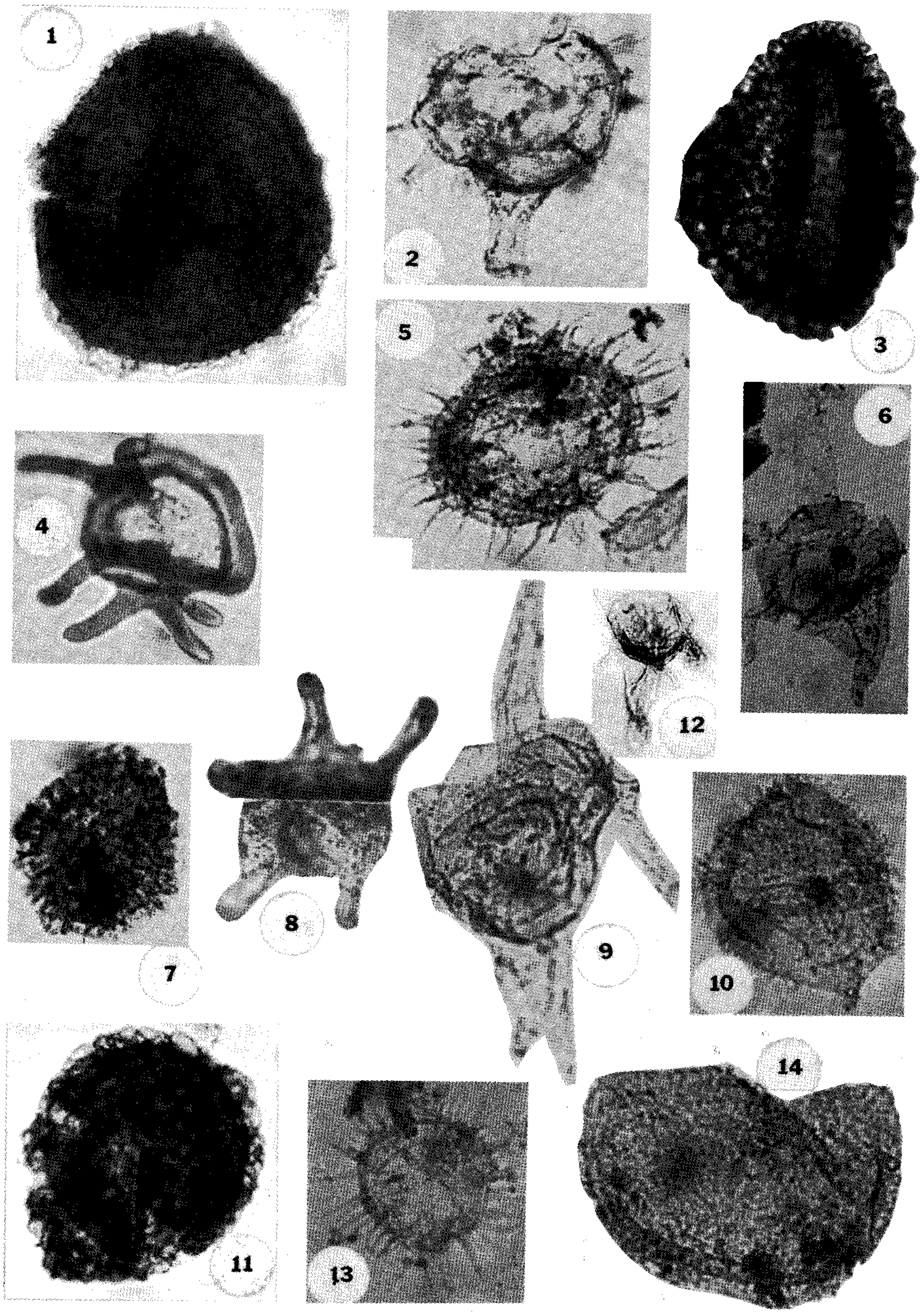

Fig. 4:
1. dark Paleozoic spores, sample 6, depth 2846 - 2848 m, L35, X 1000.
2. *Florentinia* cf. *mantelli* (Davey & Williams) Davey & Verdier, 1973, sample 1, depth 2718 - 2720 m, 045, X 750.
3, 7. *Retitricolpites* sp. sensu Herngreen and Duenas Jimenez, 1990. 3. sample 3, depth 2784 - 2786 m, X 19, X 1000; 7. sample 4, depth 2812 - 2814 m, M20, X 750.
4. *Elaterosporites klaszi* (Jardiné & Magloire) Jardiné, 1967, sample 1, depth 2718 - 2720 m, V41, X 750.
5. *Cleistosphaeridium* sp., sample 4, depth 2812 - 2814 m, V41, X 750.
6, 9. *Xenascus* spp., samples 2, 1, N 15, M25, X 500, X 750.
8. *Elaterocolpites castelaini* Jardiné & Magloire, 1965, sample 1, depth 2718 - 2720 m, P30, X 750.
10. *Diconodinium* sp., sample 1, depth 2718 - 2720 m, M28, X 750.
11. *Perotrilites pannuceus* Brenner, 1963, sample 4, depth 2812 - 2814 m, M33, X 750.
12. *Xenascus ceratioides* (Deflandre) Lentin and Williams, 1973, sample 7, depth 2852 - 2854 m, 034, X 350.
13. Acanthomorphic acritarch, sample 7, depth 2852 - 2854 m, N39, X 750.
14. *Escharisphaeridia* sp., sample 7, depth 2852 - 2854 m, X37, X 750.

Jimenez, 1990), it is evident that the elaterate species are common in the Albian - Cenomanian of this area and occur also in central Sudan (Kaska, 1989). These observations, together with *Elateroplicites africaensis* Herngreen, were confirmed from northern Sudan (Schrank, 1990). Findings of these elaterate taxa were not reported from the Omdurman Formation, Khartoum area, Sudan (Schrank and Awad, 1990). Data from southern Iraq (Venkatachala and Rawat, 1981) suggest that these assemblages are transitional between the African - South American (ASA) and Boreal provinces. The elaterate species have their widest distribution in the Late Albian and earliest Cenomanian (Herngreen and Duenas Jimenez, 1990). The *C.* cf. *scabratus* from depth 2738 m has vertical range similar to those of the elaterate pollen, namely Albian - Cenomanian. *A. jardinus* has its main distribution in the Upper Albian but ranges into Lower Cenomanian as evidenced by El Beialy *et al.* (1990); Omran *et al.* (1990) from Egypt and by Batten and Uwins (1985) and Uwins and Batten (1988) from northeast Libya. Other miospores which also show a stratigraphic overlap in the Albian - Cenomanian include *P. pannuceus, P. minutaestriata, Stellatopollis* sp., *Monocolpites* and *Retitricolpites* pollen.

Significant numbers of dinocysts are also present in the samples. These are mainly long ranging forms typically encountered in Albian - Cenomanian assemblages. The presence of *D. cladoides and X. ceratioides* is consistent with an age no older than a level within the Middle / Late Albian (Thusu and van der Eem, 1985) and also in the open marine, environmentally controlled playnomorph association IVA, Vraconian to Early Cenomanian of northeast Libya (Uwins and Batten, 1988).

On these grounds the vertical range of the miospores and dinocysts discussed above, must be taken as evidence pointing to a ? Middle / Late Albian to earliest Cenomanian age for samples studied between 2718 - 2854 m containing the elaterate - *Afropollis* - *Cretacaeiporites* association.

Pre - Early Ordovician acritarchs assigned to *Vulcanisphaera* sp. at 2738 - 2740 m are recorded. Other forms present at 2718 - 2720 m, 2812 - 2814m and 2852 - 2854 m may be also Paleozoic acritarchs. Post - Late Ordovician spores seen at 2812 - 2814 m, 2846 - 2848 m and 2852 - 2854 m may also represent a Paleozoic element. One thus can conclude that some reworked Paleozoic elements at or near the base of the Albian - Cenomanian succession of strata in the Qarun 2 -1 borehole, cannot be excluded.

PALEOENVIRONMENTAL INTERPRETATIONS

Inertinite dominates the kerogen content of the samples studied except at 2718 - 2720 m and 2784 - 2786 m where amorphous material, probably degraded vitrinite, is the primary kerogen type. On the whole the palynomorph and in particular the dinocyst *Xenascus* spp. / kerogen content suggests that deposition took place in restricted marine or brackish water lagoonal environment. A nearby freshwater source is also suggested by the presence of *Pediastrum* and *Botryococcus.*

CONCLUSIONS

Seven cuttings samples collected from the Qarun 2 - 1 borehole have been investigated palynologically. The biostratigraphic data from this borehole provides tentative evidence for the age of strata penetrated in the overlying Kharita Member and the underlying Qarun Formation. The following factors are significant in determining the age of the section studied:

a. Albian - Cenomanian forms totally dominate the microflora.

b. The full development of Albian - Cenomanian sediments is unknown and therefore the extent of possible caving cannot be fully determined.

c. From the evidence provided in the paper, all the ? Paleozoic palynomorphs have been isolated from samples dominated by forms of Albian - Cenomanian age. ? Paleozoic material indicates that some reworking at or near the base of the Albian - Cenomanian succession of strata in the studied borehole, cannot be excluded.

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