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Palynological Studies on the Upper Cretaceous Wata and Matulla Formations in Bakr Oil Field, Gulf of Suez, Egypt

Somia Said[1,2], Mahmoud Faris[2], Abdel Fattah Zalat[2], Ali Soliman[2]

1 General Petroleum Company, Exploration Department, Nasr City, 11759, Egypt
2 Geology Department, Faculty of Science, Tanta University, Tanta 31527, Egypt

Corresponding author: Somia Said e-mail:somia_sayed@science.tanta.edu..eg

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ABSTRACT

Palynological investigation of the subsurface Upper Cretaceous (Turonian-Santonian) Wata and Matulla formations in three wells drilled in the Bakr oilfield, Gulf of Suez area is presented. 147 species of palynomorphs (spores, pollen dinoflagellate cysts and prasinophytes green algae) are identified. A Turonian-Santonian age is suggested based on the occurrences of many diagnostic taxa such as *Liliacidites farafraensis, Droseridites senonicus, Ephedripites ambiguus, Isabelidinium cooksoniae, Isabelidinium glabrum, Odontochitina porifera, Odontochitina costata, Canningia reticulata* and *Trichodinium castanea*. The paleoenvironmental reconstruction of the studied interval indicates the carbonate-dominated Wata Formation was deposited during the Turonian transgressive condition and the Matulla Formation which is consist of clastic-dominate deposited during the Coniacian-Santonian regressive phase. The presence of Palm Province pollen such as *Arecipites*, *Retimonocolpites* and Longapertites associated with the pteridophytes spores refer to a tropical humid climate in the area of deposition. The abundance of green algae *Pediastrum* and occurrences of *Crybelosporites* water fern indicate discharge of freshwater into the basin.

1. Introduction

Gulf of Suez is one of the most intensively faulted areas, that is approximately 19-32 Km wide and 319 Km long from its head at city of Suez to its south at Ras Mohammed near its junction with the Red Sea, with average water depth 55-100 m **(Young *et al*., 2000)**.

Bakr oil field is located on the western side of the Gulf of Suez, about 10 Kms north of Gharib oil field, and about 40 Kms north of Ras Shukher Field **(Fig.1)**. Bakr oil field is pre-Miocene fault block that has northwest-southeast trend that is dissected by transverse cross faulting into two blocks Bakr north and Bakr south. Since the discovery of Ras Gharib oil field in 1938, which is based on gravity data, that drawn the attention to Bakr area. Successive wells were drilled on the basis of seismic, magnetic, and gravity data (GPC internal report). The Upper Cretaceous sections which consist of chalk, marls, limestone, clay and sandstone are overlying the Paleozoic Nubia section.

Several micropalaeontological and stratigraphical studies of the Upper Cretaceous (including surface and subsurface) based upon foraminiferal and nannofossils have been done in the Gulf of Suez area (e. g. **Said and Kenawy, 1957; Bold, 1964; Hataba and Ammar, 1990; Mandur and Baioumi, 2009; Mousa *et al*., 2011; Boukhary *et al*., 2014; Farouk, 2015)**. Few studies dealt with the Upper Cretaceous palynology, mainly palynofacies and organic geochemistry analysis have been published **(El Diasty *et al*., 2014; El Diasty *et al*., 2017; Sultan *et al*., 1986)**.

The current work focuses on the palynological characteristics of the Upper Cretaceous (Turonian-Santonian) deposits in the Gulf of Suez aims to:

(1) Reconstruct palynostratigraphic framework and age assignment and

(2) Throw some light on the depositional environment of the studied formations based on terrestrial and marine palynomorphs.

2. Geological setting and ithostratigraphy

In the Gulf of Suez area, Lower Cretaceous sediments hosts more than one reservoir such as Cenomanian clastic deposits (Raha Formation) and Upper Cretaceous clastics deposits (Wata and Matulla formations). In our study we concerned with two important reservoirs; the Turonian sand and limestones of the Wata Formation and the Santonian sands of the Matulla Formation.

Matulla Formation is introduced by **Ghorab (1961)** for the Coniacian-Santonian section that ranges between 100 and 159 m in the studied area. It is conformably overlies the Wata Formation and underlies the Campanian Brown Limestone. It is a sandstone-dominated stratigraphic unit, interbedded with limestone and shale beds. The sandstones are brown to grey, moderately hard, very-fine to fine-grained and calcareous. The Matulla Formation is subdivided based on lithological and electrical characters into five subunits (M1-M6). The Wata Formation **(Ghorab, 1961)** overlies the Raha and underlies the Matulla formations respectively, covers the interval between 90 and 120 m thick in the study area. This term describes the carbonate section of a transgressive phase prevailed at the end of the Turonian age. It is mostly built up of white to light brown, moderately hard, glauconitic and pyritic limestone beds. These limestone beds are characterized by low gamma-ray, and neutron readings, while they show high resistivity and density readings, and it can be subdivided into four units (W-1 to W-4) according to lithological and electric characters **(Figs. 2-4)**.

3. Material and methods

The ditch cutting samples recovered from Bakr-12, Bakr-13, and Bakr-17 wells were processed using standard palynological technique of **(Wood *et al.*, 1996; Soliman, 2012)**. 10-15 gm of each sample were treated using a porcelain mortar to facilitate subsequent chemical reaction. Firstly, carbonates were removed by reaction with HCl (10%) for approximately 24 hours until effervescence stopped. Samples were washed several times with distilled water and then added 30-50 ml Conc. HF (40%) for silicate removal, then residue was washed by distilled water. The neutralized residue was passed through a 125 µm brass sieve and 10 µm nylon mesh to separate the organic matter from any remaining unwanted inorganic material. No oxidation was carried out in order to avoid damage to the palynomorphs. At least one slide from each sample is scanned. The miospores, pollen grains and dinoflagellate cysts are identified to species level whenever possible. Some diagnostic taxa are photographed with Leica Microscope equipped with HD camera, housed in Geology Department, Faculty of Science, Tanta University in the collection of the Botanical microfossils and Paleoecology Lab.

4. Palynological results

147 species of palynomorphs are identified from the Wata and Matulla successions encountered in the studied wells. The identified taxa in the present study are divided into spores, pollen grains, dinoflagellate cysts and prasinophytes green algae according to their affinities. The identified diagnostic taxa are presented in range charts **(Figs. 2-4)** and some stratigraphically important forms are illustrated in **(Figs 5-8)**. For taxa authorship references see **(Ravn, 1998)** for miospores and (http://dinoflaj.smu.ca/dinoflaj3/index.php/Main_Page) for dinoflagellate cysts.

The encountered spores are mostly characteristic of the Upper Cretaceous, however some of them are of long stratigraphic ranges. Among the identified spores we can list the widely known taxa such as *Biretisporites boltenhagenii; B. potoniaei; Crybelosporites aegypticus*; *C. pannuceus*; *Foveotriletes subtriangularis; Gabonisporis vigourouxii*; *Microreticulatisporites sacalii; M. uniformis* and *Zlivisporis blanensis.* Some megaspores are also identified such as *Ariadnaesporites caperatus*; *A. longiprocessum*; *A. rugulatus* and *A. spinocaperatus*.

The diagnostic gymnosperm pollen taxa are represented by *Classopollis brasiliensis C. jardinei; Ephedripites ambiguus*; *E. brasiliensis; E. multicostatus; Inaperturopollenites undulates* and *Steevesipollenites binodosus*. While the angiosperm pollens are represented by *Arecipites microfoveolatus; A. microreticulatus; A. punctatus*; *Droseridites baculatus*; *D. senonicus*; *Foveotricolpites gigantoreticulatus*; *F. giganteus*; *Liliacidites farafraensis* and *Tricolpites crassimurus*.

The dinoflagellate cysts are more diversified and of good preservation state. Many Upper Cretaceous taxa are identified from the studied successions and many of them have a stratigraphic value such as *Canningia senonica*; *Chatangiella chetiensis*; *C. ditissima; Circulodinium distinctum*; *Cometodinium obscurum*; *Coronifera oceanica*; *Cyclonephelium filoreticulatum; C. membraniphorum; Dinogymnium acuminatum; D. denticulatum; D. vozzhennikovae; Isabelidinium; I. belfastense; I. cooksoniae; I. glabrum; Odontochitina costata*; *O. porifera*; *Palaeohystrichophora infusorioides*; *Senoniasphaera rotundata rotundata*; *Spinidinium echinoideum* and *Trichodinium castanea*.

5. Age assignment

The three studied sedimentary successions in Bakr oil field are attributed to the Late Cretaceous according to their identified palynomorphs. The findings are correlated with previous studies in both Gulf of Suez and Western Desert of Egypt in addition to other studies in Africa, Europe, South and North America.

5.1 Santonian

It comprises the intervals extending from 2560 to 2657 ft in Bakr-13, from 2460 to 2520 ft in Bakr-17, and it is missed in Bakr-12 for probably structure/tectonic activity. These intervals are dated as Santonian age according to first downhole occurrence (FDO) of *Odontochitina porifera*/*O. costata* **Cookson (1956)**. According to **Helby *et al*., (1987)** *O. porifera* exists in post- Coniacian sediments based on the age of the assemblage. Cookson (1956) described *O. porifera* from the "Senonian" of Australia. It is recorded from eastern Greenland (Nøhr-Hansen, 2012) to East Antarctica (Macphail and Truswell, 2004). The first downhole occurrences of *O. porifera* indicate the start of mid Santonian that supposed by many authors (e.g. Williams and Brideaux, 1975; Bujak and Williams, 1978; Williams and Bujak, 1985; Williams et al. 1993; Schrank and Ibrahim, 1995). According to Williams et al., (2004) the first appearance datum (FAD) of O. *porifera* is dated at 84.12 Ma (Santonin) in the Northern Hemisphere. **Nøhr-Hansen *et al.*, (2019)** put the first occurrence of *O. porifera* at the base of the Santonian in their zone *Chatangiella spinosa* (middle Coniacian to middle Santonian). **Pearce *et al*., (2020)** assumed the first occurrence of *O. porifera* is the early Santonian and the last occurrence lies in the Campanian.

In Egypt, *O. porifera* is considered as a characteristic Coniacian-Santonian marker **(Schrank and Ibrahim, 1995; Abdel-Kireem *et al*., 1996;El-Soughier *et al*., 2013 and El Diasty *et al*., 2014)**. **Deaf *et al*., (2014)** supposed a Coniacian-early Campanian age including Tethys ranges.

The FDO of *Canningia reticulata* and *C. senonica* is encountered within this zone at B-13 and B-17. *C. reticulata* has a stratigraphic range from the Late Jurassic **(Berthou and Leereveld, 1990)** through the Santonian **(Robaszynski *et al*., 1980)**. *C. senonica* is first described by **Clarke and Verdier (1967)** from the Santonian of the Isle of Wight, UK and it has a stratigraphic range from the Cenomanian **(Srivastava, 1992)** to the lower Campanian **(Foucher, 1979)**. The total range of *C. senonica* defined the early Santonian- (PZ-5) zone of **Deaf *et al*., (2014)** at the Abu Tunis-1x borehole, North Western Desert Egypt.

The co-occurrences of *Liliacidites, Arecipites* spp., *F. giganteus* or *F. gigantoreticulatus* are common Coniacian-Santonian angiosperm pollen grains worldwide. In Egypt, they indicate a relatively similar age. *Liliacidites* *farafraensis* was described from the El-Hefhuf Formation (Late Turonian – Santonian) by **Ibrahim and Abdel-Kireem (1997)**. It is recorded from Turonian- lower Santonian of Abu Roash Formation as *Liliacidites* sp. **(Schrank and Ibrahim, 1995)**, and Coniacian-Santonian **(Mahmoud, 2003)** of north Western Desert. *L. farafraensis* is dated as of Santonian age as indicated by **(Ibrahim et al., 2009)**. They defined the "*Liliacidites* spp.– *Zilivisporis blanensis – Ariadnaesporites longiprocessum*" Assemblage Zone. The *Liliacidites* sp. (cf. *farafraensis*) is recorded from the Matulla Formation in the Belayim oilfield (central Gulf of Suez) and in the West Esh El Mellaha area (SW Gulf of Suez) and this species belongs to Coniacian-Santonian age **(El Diasty *et al*., 2014)**.

5.2 Coniacian

It comprises the intervals extending from 2561 to 2763 ft in Bakr-12, from 2657 to 2866 ft in Bakr-13, and from 2520 to 2700 ft in Bakr- 17. These intervals are dated as Coniacian age according to first downhole occurrence (FDO) of *Isabelidinium* complex *(I. glabrum*, *I. cooksonia* and *I. belfastense* and the lower boundary is defined by the FDO of *T. castanea.*

I. glabrum is a Turonian-Coniacian marker species in the uppermost part of the *P. infusorioides* Zone and the lowermost part of the *Conosphaeridium striatoconus* Zone of the Australian Mesozoic Palynological Scheme of **Helby *et al.*, (1987). Riding and Crame (2002)** suggested a Coniacian age for a single sample from Hidden Lake Formation of the Gustav Group, James Ross Basin, Antarctica based on the occurrence of *I. glabrum*. *I. acuminatum* was recorded from the foraminiferal constrained Coniacian–Santonian of Algeria **(Foucher *et al*., 1994)**.

Nøhr-Hansen (1996) defined *S. echinoideum* interval zone of late Coniacian age according to its first occurrence in West Greenland. **Schioler and Wilson (1998)** defined an acme of *S. echinoideum* in the middle part of late Coniacian – early Santonian *C. abbreviatum* interval zone from Ben More and Kekerengu sections, New Zealand. In the northern Hemisphere, **Williams *et al*., (2004)** reported that the age of the last appearance of *S. echinoideum* to be late Coniacian, also recorded from upper Coniacian lower Berezovo subformation in northern Siberia (Lebedeva, 2006). **Prince *et al*. (2008)** defined *Spinidinium echinoideum* from upper Coniacian Chalk in the Kingsdown Cliffs of east Dover.

D. senonicus is a global diagnostic species in the Late Cretaceous. In Egypt it was recorded from the Turonian-lower Santonian of Gulf of Suez **(Sultan *et al.*, 1986)**; Turonian-lower Santonian **(Schrank & Ibrahim, 1995)**; Coniacian **(Ibrahim, 1996)**; late Turonian-Santonian of Farafra Oasis **(Ibrahim & Abdel Kireem, 1997)**; late Turonian- Coniacian **(Ibrahim *et al*., 2009; El Beialy *et al*., 2010; El Diasty *et al*., 2014)** and Coniacian-Santonian (**Ied and Tahoun, 2018)**.

5.3 Turonian

It comprises the intervals extending from 2763 to 3200 ft in Bakr-12, from 2866 to 3200 ft in Bakr-13, and from 2700 to 3060 ft in Bakr- 17. This interval is defined by FDO of *E. ambiguus* and *E. multicostatus* and FDO of *T. castanea* to the end of the studied interval.

In Egypt, *E. ambiguus* (*Equisetosporites ambiguus*) was recorded from the late Cenomanian-Turonian

(Ibrahim, 1996; Aboul Ela *et al*., 2019) and from early- late Turonian of Eastern Desert **(Tahoun *et al*., 2017)**. It is also encountered from the Cenomanian – Turonian of Gabon **(Boltenhagen, 1980)**, and the late Turonian of Canada **(Sweet and McIntyre, 1988)**. On the other hand, *E. multicostatus* is recorded from the early Turonian of Eastern Desert (**Tahoun *et al*., 2017)**; middle Albian – early Turonian of north Western Desert **(Aboul Ela *et al*., 2019)**. In Nigeria, it is recorded from the Turonian through the Maastrichtian by **(Lawal and Moullade, 1986)**.

In Egypt, *T. castanea* is a Turonian diagnostic taxon. It was recorded from Turonian **(Schrank and Ibrahim, 1995)**; middle late Turonian **(Aboul Ela *et al*., 2019)**, late Cenomanian – Santonian **(Ibrahim *et al*., 2009)**, late Albian – early Santonian **(Deaf *et al*., 2014)**, Turonian **(Aboul Ela *et al*., 2013)**, early Cenomanian – Santonian **(Ibrahim et al., 2020)** of north Western Desert, and from the early Turonian –Coniacian of Eastern Desert **(Tahoun *et al*., 2017)**.

6. Depositional environment

Our studied stratigraphic succession in Bakr -12, 13 and 17 wells, Gulf of Suez area, begins with carbonate-dominated Wata Formation that deposited during Turonian transgressive marine condition which prevailed over a larger part of north Egypt **(Kerdany and Cherif, 1990)**. Limestone beds dominated the lower and upper subunits (Wata 1 and Wata 4 subunits), while sandstone interbedded with shale and mudstone beds are common in Wata 2 and Wata 3 subunits. The palynomorphs that recovered from Turonian Wata Formation are dominated by dinoflagellate cysts, where high dinoflagellate cyst concentrations have been found to show offshore increase to the continental slope, where with increased water depth they begin to decline **(Balch *et al*., 1983; De Vernal and Giroux, 1991)**. Occurrences of fresh water green algae especially *Scenedesmus bifidus* with *Pediastrum boryanum* in marine strata occur as part of an allochthonous association that brought by rivers and streams from freshwater catchment area **(Brenac and Richards, 1996)**.

The Coniacian-Santonian Matulla Formation was deposited during Conicain – Santonian regressive phase **(G.P.C, 2014)**. It is composed of sandstone, shale and limestone intercalations. The identified palynological assemblage from Matulla Formation includes an alternated spores, pollen grains and dinoflagellate cysts, may suggest shallow marine environment and may confirm deposition under marginal conditions.

7. Conclusions

The present study challenge is to provide a unifying subdivision of the Upper Cretaceous Wata and Matulla formations units in the Gulf of Suez based palynological results. The palynological examination of the studied samples from three wells (Bakr- 12, Bakr- 13, Bakr- 17 wells), led to identify 147 species of spores, pollen grains, and dinoflagellate cysts. These allowed recognition of many marker taxa such as O. *porifera / O. costata, Droseridites senonicus, L. farafraensis* and *Arecipites* spp. (Santonian); *Isabelidinium* spp. (Coniacian); *E. ambiguus C. jardinei T. castanea* (Turonian). The identified assemblages may suggest shallow marine environment and may confirm deposition under marginal conditions. A fresh-water inputs to area of deposition is indicated by the abundance of the green algae *Pediastrum*.

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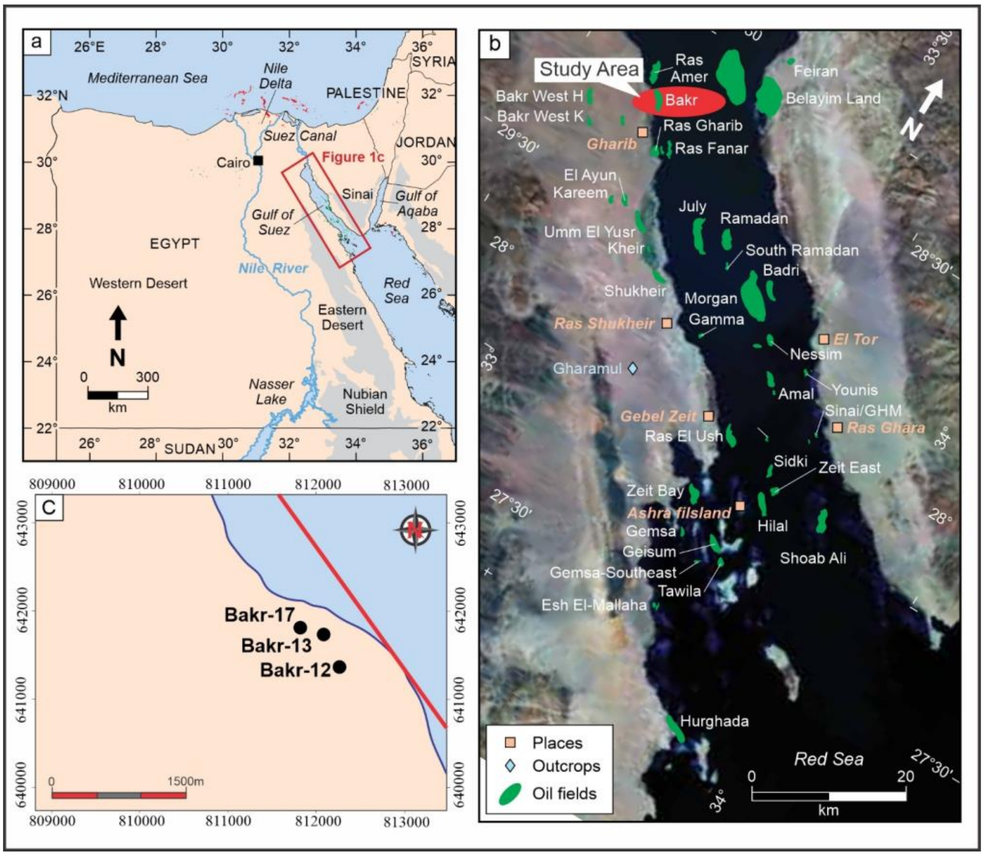


Fig. (1a, 1b): Generalized Concession map of different oil fields in the area of Gulf of Suez) and locations of the studied three wells Bakr 12, 13, and 17 (c).

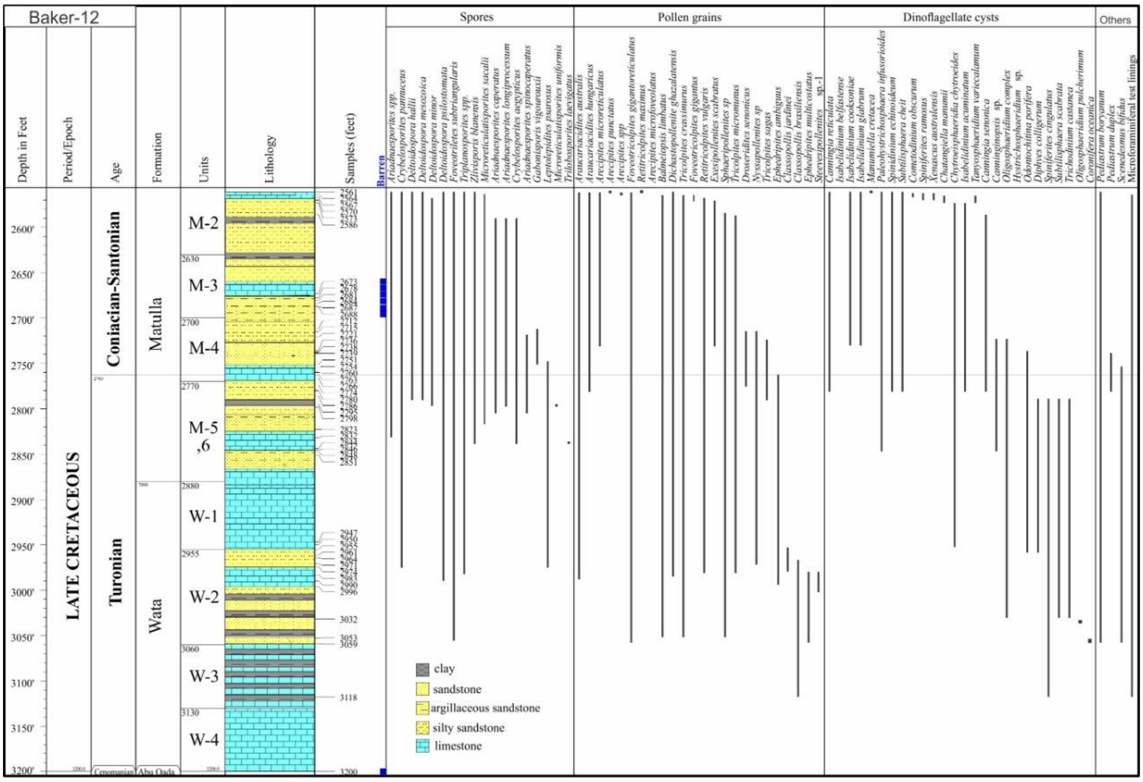


Fig. (2): Palynostratigraphic range chart (spores, pollen, and dinoflagellate), Well Bakr- 12.

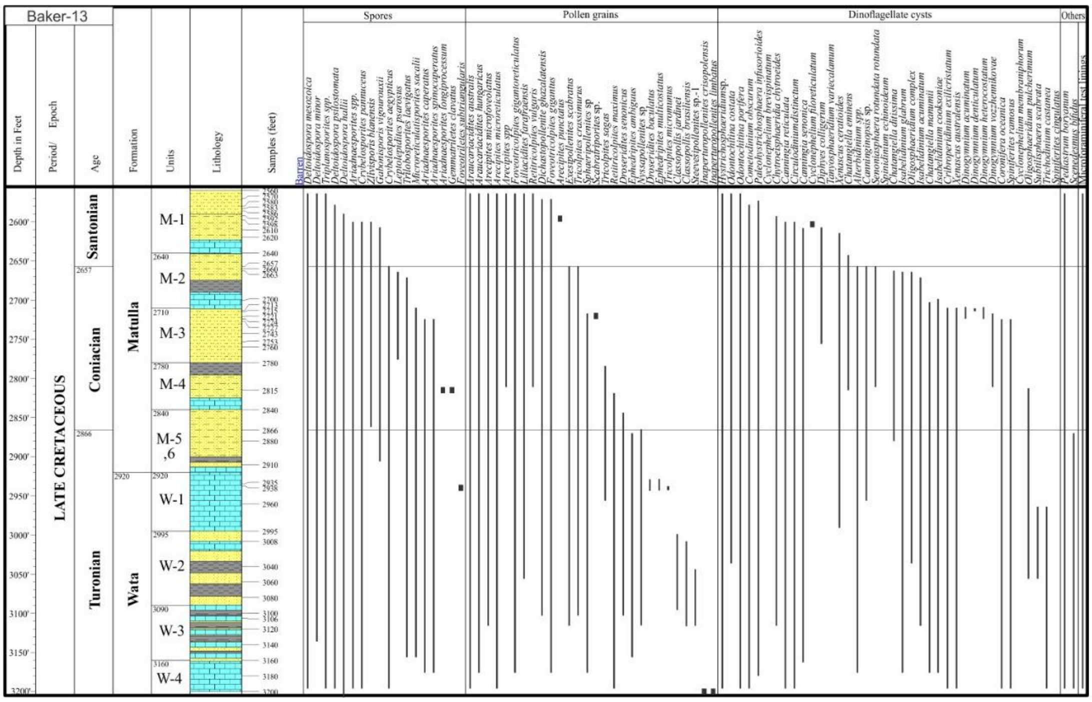


Fig. (3): Palynostratigraphic range chart (spores, pollen, and dinoflagellate), Well Bakr- 13.

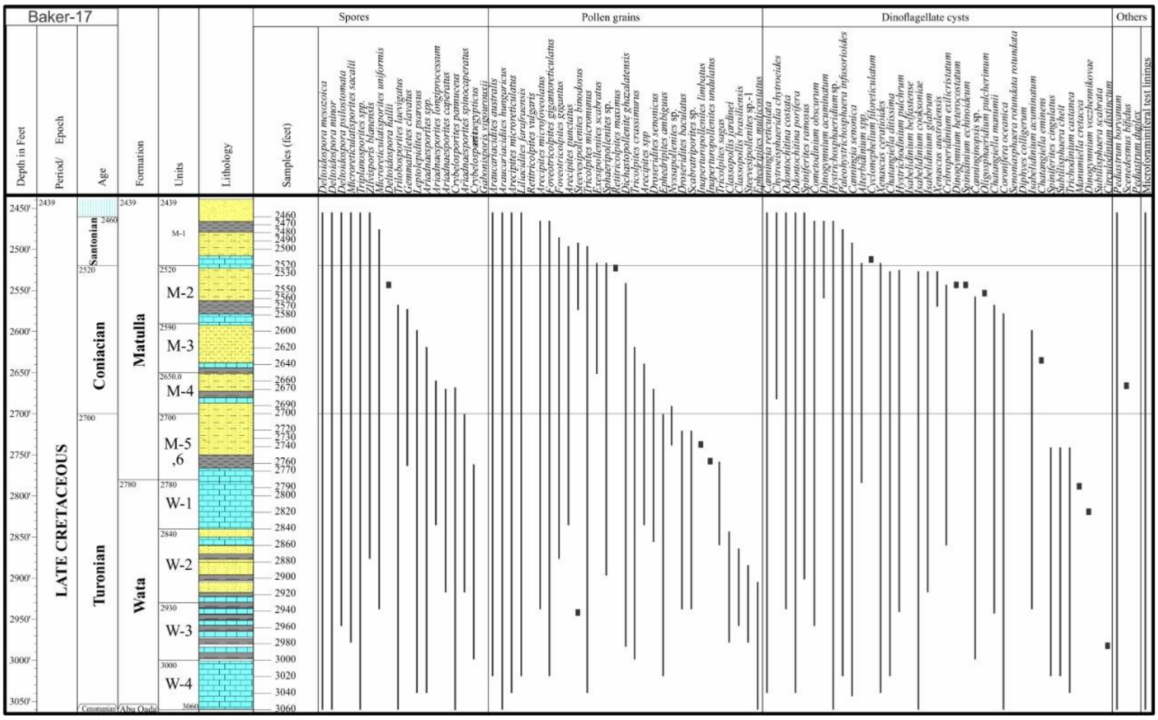
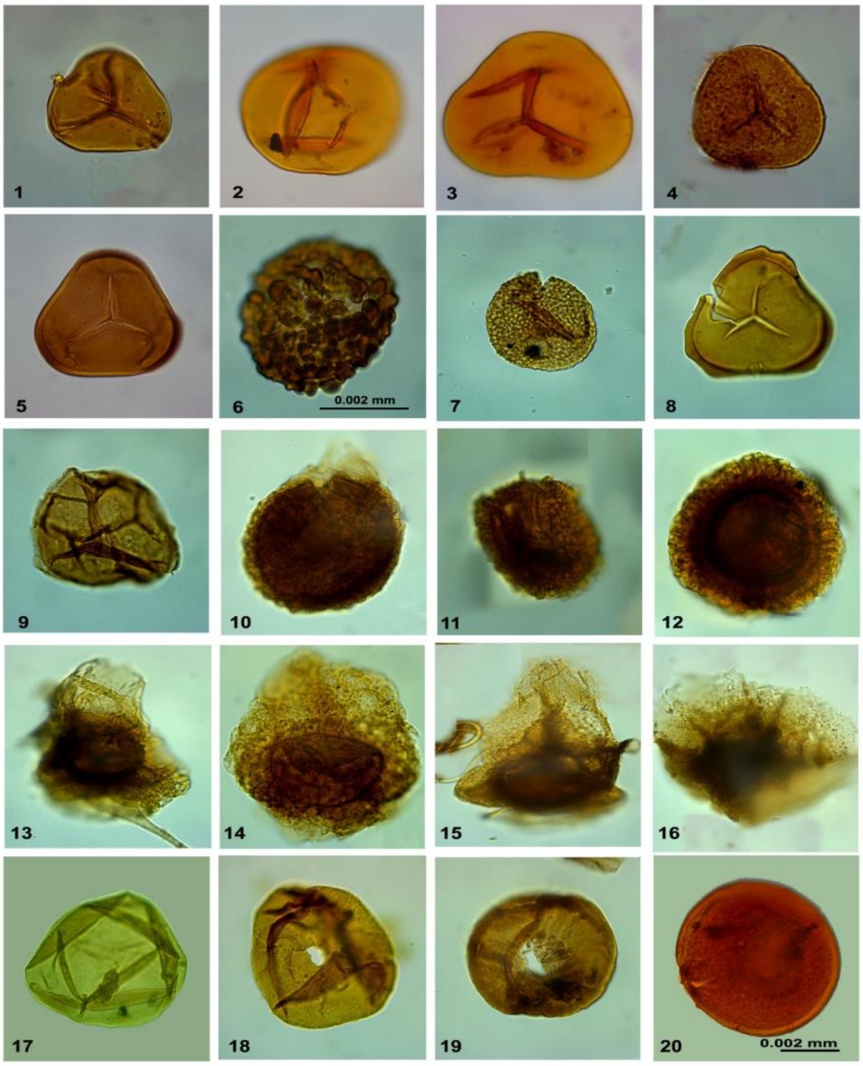


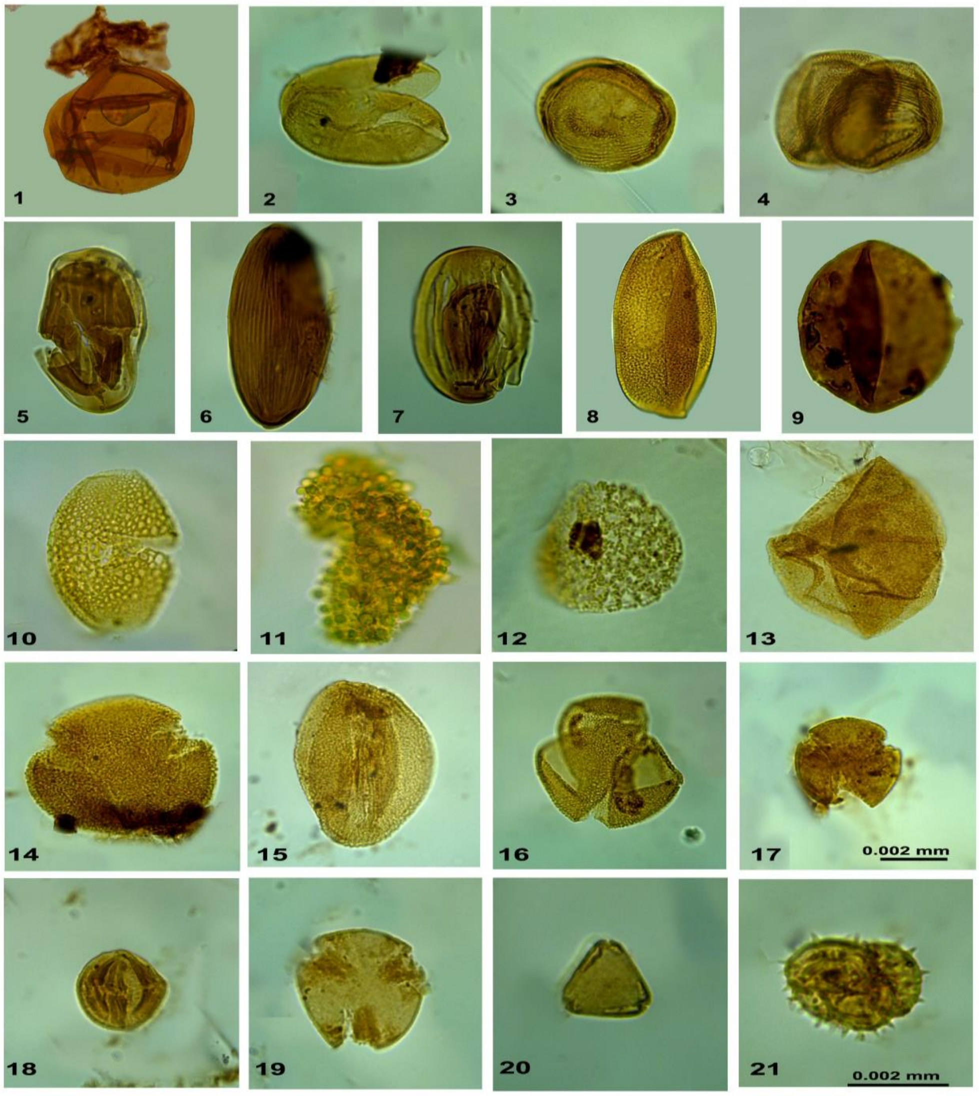
Fig. (4): Palynostratigraphic range chart (spores, pollen, and dinoflagellate), Well Bakr- 17.

Plate-1



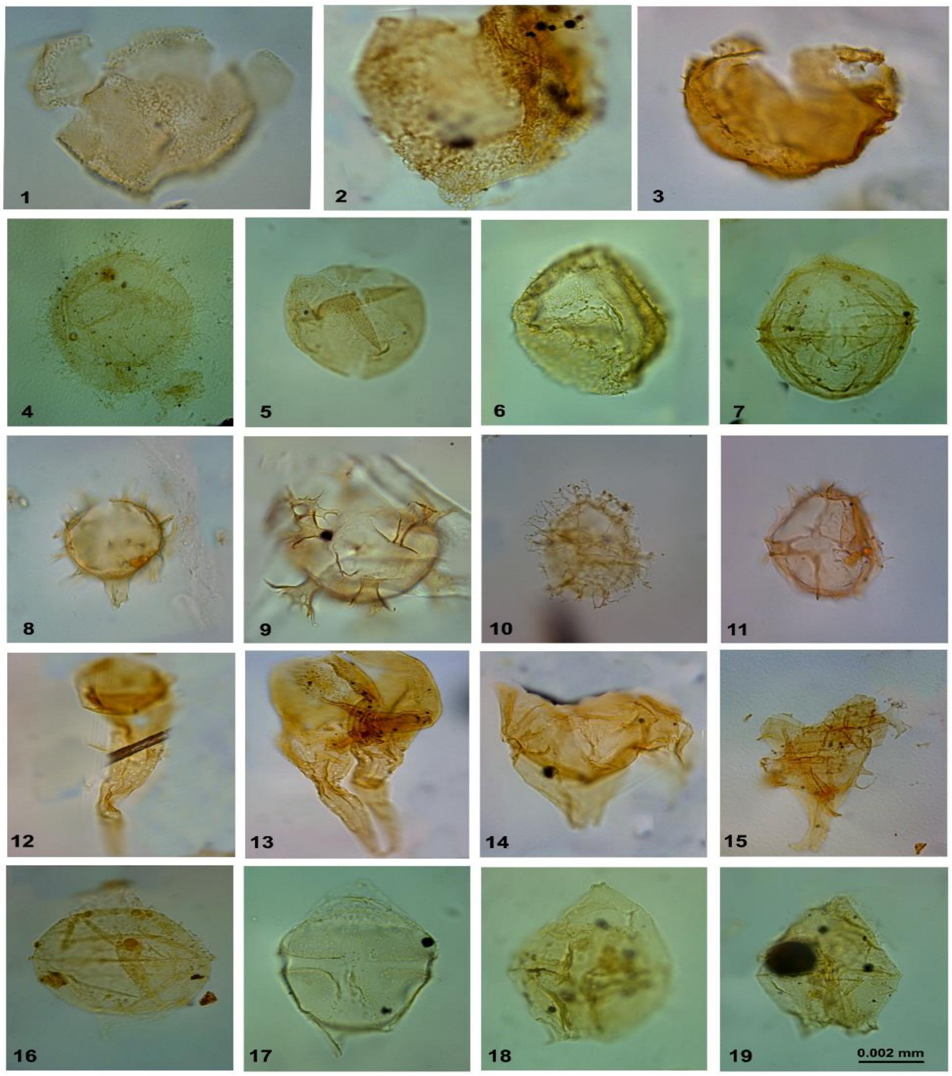
1. *Biretisporites potoniaei* Delcourt & Sprumont 1955, B-12, depth 2971- 2974, V 28/4.
2. *Deltoidospora hallii Miner*, 1935, B-12, depth 2766-2786, A23/4.
3. *Deltoidospora mesozoica* (Thiergart) Schuurman, 1977, B-12, depth 2766-2786, R12/3.
4. *Deltoidospora psilostoma;* Rouse 1959, B-12, depth 2980-2983, E 26/1.
5. *Dictyophyllidites* sp., B-12, depth 2718-2721, T43/4.
6. *Leptolepidites psarosus* Norris 1969, B-12, depth 2841-2844, J28.
7. *Foveotriletes subtriangularis* Kedves. 1997, B-12, depth 2980-2983, G15/1.
8. *Trilobosporites laevigatus*, El Beialy 1994a, B-17, depth 2570-2580, V40/3.
9. *Zlivisporis blanensis* Pacltova, 1961, B-12, depth 2841-2844, W 33/3.
10. *Crybelosporites pannuceus* (Brenner) Srivastava,1977, B-12, depth 2718-2721, T12/2.
11. *Crybelosporites aegypticus*, Kedves 1995, B-12, depth 2841-2844, Y28/2.
12. *Gabonisporis vigourouxii* Boltenhagen 1967, B-12, depth 2751-2754, D27/1.
13. *Ariadnaesporites longiprocessum* (Hills & Jensen) Hills 1967, B-12, depth 2718-2721, B13.
14. *Ariadnaesporites caperatus* Singh, 1983, B-12; depth 2570-2573; U48.
15. *Ariadnaesporites spinocaperatus* Phillips & Felix 1971, B-12, depth 2718-2721, W14.
16. *Ariadnaesporites* spp., B-17, depth 2710-2720, F8/4.
17. *Araucariacites australis* Cookson ex Couper 1953, B-12, depth 2570-2573, V32
18. *Araucariacites hungaricus* Deak, 1964, B-12, depth 2558-2561, J28/1.
19. *Balmeiopsis limbata (Balme) Archangelsky 1979, B-12, depth 2570-2573, Q44/1.*
20. *Exesipollenites scabratus*, Balme 1957, B-12, depth 2567-2570, Q21/3.

Plate- 2



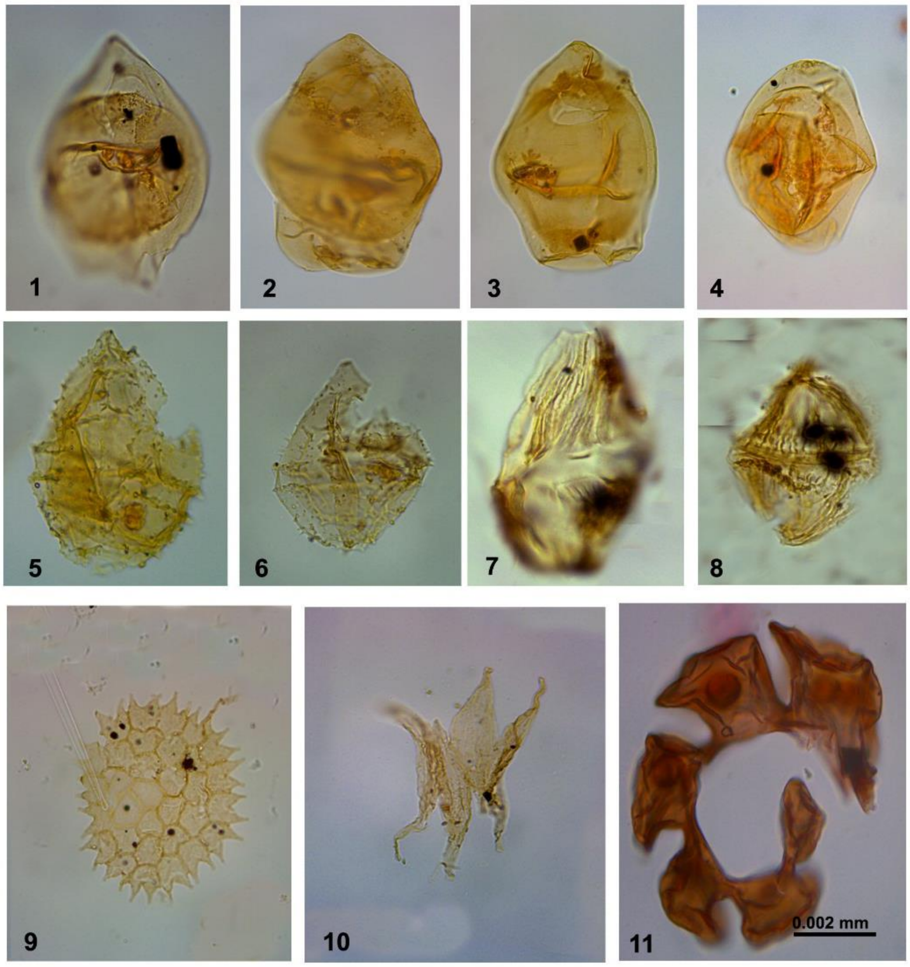
1. ***Sphaeropollenites sp.*, B-17, depth 2570-2580-G48/2.**
2. ***Classopollis brasiliensis* Herngreen 1975, B-17, depth 2850-2860, R10.**
3. ***Classopollis jardinei Herngreen* 1973, B-17, depth 2850-2860, U23.**
4. **Diod of *Classopollis jardinei,* Herngreen 1973, B-17, depth 2930-2940, Y32.**
5. ***Ephedripites ambiguus* Hedlund 1966, B-12, depth 2980-2983, D52/4.**
6. ***Ephedripites multicostatus* Brenner 1963, B-12, depth 2971-2974, W8/1.**
7. ***Steevisipollenites* sp- 1, B-12, depth 2980-2983, C22.**
8. ***Arecipites microfoveolatus* Ibrahim, 2002, B-12, depth 2570-2573, L27/2.**
9. ***Retimonocolpites spp.*, B-13, depth 2813-2815, D-19.**
10. ***Liliacidites farafraensis,* Ibrahim & Abdel El Kireem, 1997, B-17, depth 2470-2480, F31/1.**
11. ***Stellatopollis* sp., B-13, depth 2718-2721, Q15/2.**
12. ***Dichastopollenites ghazalatensis* Ibrahim 1996, B-13, depth 2813-2815, M43/1.**
13. ***Foveotricolpites gigantus* (Jardiné & Magloire) Jan du Chêne et al. 1978, B-13, depth 2813-2815, W49/2.**
14. ***Foveotricolpites gigantoreticulatus* (Jardiné & Magloire) Schrank 1987b, B-17, depth 2760-2770, G27/3.**
15. ***Retitricolpites Vulgaris* (Pierce) Srivastava, 1969, B-17, depth 2690-2700, D26.**
16. ***Tricolpites crassimurus* (Groot and penny), Singh, 1971, B-17, depth 2930-2940, G34/4.**
17. ***Tricolpites sagas* Norris, 1967, B-17, depth 2750-2760, J39/2.**
18. ***Retitricolporites* sp., B-17, depth 2690-2700, W38/2.**
19. ***Nyssapollenites* sp., Thiergart 1937, B-17, depth 2760-2770, R44.**
20. ***Scabratriporites* sp., B-17, depth 2710-2720, O29/2.**
21. ***Droseridites senonicus* Jardiné & Magloire 1965, B-17, depth 2690-2700, S46/2**

Plate-3



1. ***Canningia reticulata*** **Cookson and Eisenack, 1960; emend. Below, 1981; emend. Helby, 1987, B-12, depth 2766-2786, D27.**
2. ***Canningia senonica*** **Clarke & Verdier 1967, B-13, depth 2813-2815, W30/2.**
3. ***Canninginopsis*** **sp. Cookson and Eisenack, 1962, B-12, depth 2850-2851, E35/1.**
4. ***Cometodinium obscurum*** **Deflandre and Courteville, 1939 emend. Monteil, 1991, B-13, depth 2813-2815, Q40.**
5. ***Sentusidinium*** **spp., B-17, depth 2657-2670, N42/2.**
6. ***Trichodinium castanea*****; Deflandre 1935 ex Clark and Verdier 1967, B-12, depth 2969-2971, N19/1.**
7. ***Cribroperidinium exilicristatum*** **(Davey, 1969) Stover and Evitt, 1978, B-17, depth 2850-2860, Q13/4.**
8. ***Diphyes colligerum*** **(Deflandre and Cookson, 1955) emend. Goodman and Witmer, 1985, B-12, depth 2766-2786, Z16.**
9. ***Oligosphaeridium pulcherrimum*** **(Deflandre and Cookson, 1955) Davey and Williams, 1966, B-12, depth 3029-3032, L47.**
10. ***Spiniferites ramosus*** **(Ehrenberg) Loeblich & Loeblich 1966, B-12, depth 2567-2570, B20.**
11. ***Spiniferites cingulate*****, B-12, depth 2766-2786, D47.**
12. ***Odontochitina porifera*** **Cookson 1956, B-17, depth 2470-2480, S33/4.**
13. ***Odontochitina costata*** **Clarke and Verdier, 1967, B-17, depth 2450-2460, J9/3.**
14. ***Xenascus australensis*** **Cookson and Eisenack, 1969, B-13, 3190-3200, J31-2.**
15. ***Xenascus ceratioides*** **(Deflandre, 1937) Lentin and Williams, 1973, B-13, depth 3718-2721, E45/3.**
16. ***Palaeohystrichophora infusorioides*** **Deflandre 1935, B-12, 2567-2570, Y24/3.**
17. ***Subtilisphaera scabrata*** **Jain and Millepied, 1973, B-12; 3029-3032; F44/3.**
18. ***Alterbidinium*** **spp., B-13, 2813-2815, J51/1.**
19. ***Chatangiella ditissima*** **Lentin and Williams, 1976, B-17, 2657-2670, C8/3.**

Plate- 4



1. ***Isabelidinium acuminatum*** **(Cookson and Eisenack, 1958) Stover and Evitt, 1978, B-12, 2570-2573, J8.**

2. *Isabelidinium cooksoniae* (Alberti, 1959) Lentin and Williams, 1977, B12, 2567-2570, E20.

3. *Isabelidinium glabrum*; (Cookson and Eisenack 1969) Lentin and Williams 1977, B-12, 2558-2561, A49.

4. *Manumiella cretacea* (Cookson, 1956) Bujak and Davies, 1983, B-12, 2558-2561, P32.

5, 6. *Spinidinium echinodeum* (Cookson and Eisenack, 1960; emend. Sverdlove and Habib, 1974) Lentin and Williams, 1976.

5. B-12, depth 2564-2567, L7. 6. B-12, depth 2564-2567, L27/1.

7. *Dinogymnium heterocostatum* subsp. Kolpaschevii (Vozzhennikova) emend. Lentin & Williams 1973, B-13, depth 2713-2715, K32/2.

8. *Dinogymnium vozzhennikovae*, Lentin and Williams, 1973 emend. Lentin and Vozzhennikova, 1990, B-13, depth 2713-2715, G31/3.

9. *Pediastrum boryanum* (Turpin) Meneghini 1840, B-17, depth 2510-2520, U38/4.

10. *Scenedesmus bifidus* Batten & lister 1988, B-12, depth 2795-2798, F61.

11. Microforaminiferal inner test lining, B12, depth 2766-2786- G23

دراسات بالينولوجية على العصر الطباشيرى العلوى لمتكونى الواطة والمطلة فى حقل بكر - بمنطقة خليج السويس، مصر

سمية جمال ابراهيم [١،٢]- محمود فارس محمد[٢] - عبدالفتاح زلط[٢] - على سليمان على[٢]

(١) الشركة العامة للبترول – مدينة نصر- القاهرة - مصر
(٢) قسم الجيولوجيا – كلية العلوم – جامعة طنطا – طنطا – مصر

تم اجراء دراسة للاحافير النباتية للعصر الطباشيرى التحت سطحى لمتكونى المطلة والواطة فى حقل بكر بمنطقة خليج السويس وتم تعريف مائه وسبعه واربعين نوعا من الاحافير النباتية (الجراثيم، وحبوب اللقاح، والسوطيات، والطحالب الخضراء).

تم تحديد عمر تلك الصخور بناءا على تواجد أنواع هامة من الناحية الاستراتيجرافية مثل:

Liliacidites farafraensis, Droseridites senonicus, Ephedripites ambiguus, Isabelidinium cooksoniae, Isabelidinium glabrum, Odontochitina porifera, Odontochitina costata, **and** ***Trichodinium castanea***

والتى تدل على العمر الترونى والسانتونى.

تم القاء الضوء على البيئات الترسيبية لمتكون الواطة بمنطقة الدراسة والذى تم ترسيبه اثناء تقدم البحر الترونى وان متكون المطلة قد ترسب اثناء التقهقر البحرى اثناء عصرى الكونيسي والسانتونيان.

ان تواجد بعض مجموعات حبوب اللقاح مصاحبة لبعض انواع من الجراثيم تشير الى اجواء استوائية رطبة. كما ان تواجد الطحالب الخضراء بوفرة تدل على تداخل المياه العذبه فى حوض الترسيب اثناء تلك الفترة الزمنية.