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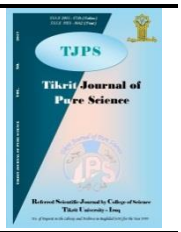

Palynological Study of Kolosh Formation (Paleocene–Early Eocene), in Dokan area, Sulaimani, Kurdistan Region- Iraq

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Abstract

The Kolosh Formation is belongs to Paleocene –Early Eocene cycle, this cycle is characterize by a complete development in the basin of deposition in all parts of Iraq.

This study assessed to find the age of Kolosh Formation, dinoflagellate cysts as a main tool were used for this purpose through analyzing twelve (12) samples taken from Dokan area Sulaimani Governorate, the samples were treated by normal palynological analyses used in the world, the results showed presence of 15 genera and 19 species of dinoflagellate cysts in the formation, the determined plynomorphes were used to draw a rang chart, which used to subdivide the section to many biozones, named shortly as (P.Z1, P.Z2, and P.Z3), and to show the distribution of palynomorohes, in addition to the age of the formation.

The assigned biozones were correlated with other studies done before for the same age in Iraq at Shaqlawa area, and outside of Iraq with those of Germav Formation located in SE Anatolia, Turkey.

Introduction

The Kolosh Formation is comprised of flysch deposit of sandstones, shales, marls, intraformational conglomerates, in addition to thin beds of arenaceous limestone, deposited in subducted trench, parallel to the suture zone, which formed by closing of the southern Neotethyan ocean and finally collision between the Arabian, Anatolian and Iranian plates, extended NW-SE, from Mushorah (NW) to Kashti (SW) [1].

The Kolosh Formation was First described by [2] from Kolosh Village, north of Koi Sinjak district-Erbil Governorate.

The description of the Formation detailed from top to bottom by [3] as followings.

The top 144m is of composed limestone and marlstone with Miscellanea miscella, ostracods and miliolids.

Then thirty meters of limestones with *Dictyokathina simplex, Lockhartia sp., valvulinids*, miliolids, ostracods.

The next 113.5m is limestone and shales, red shales and sandstones with the same fossils but without Dictyokathina simplex, then six m. of limestone with *Saudia lbyrinthica*, miliolids and rotalids, the last 410m is composed of blue shale and green sand.

Most of the researchers think that the lower part of Paleocene (Danian) age is missing, even it was found by others like [4]. The presence of Danian sediments is confirmed locally in Syria and in north Iraq, in wells Ain Zalah and Butmah, [1].

Danian strata was also confirmed in west of Iraq (in the lower part of the Palaeocene Akashat Formation exposed west and northwest of Rutba Town).

[5] Had earlier considered that Danian sediments were absent in Iraq. The lack of evidence of basin Danian sediments in central Iraq may be due to insufficient sampling of the Cretaceous / Tertiary boundary sections in wells and / or to condensed sedimentation in Danian time.

Regarding to the paleoclimate, the Cretaceous-Tertiary boundary is characterized by rapid cooling trend in climate and regression [6]. They thought that the cooling trend in the latest Cretaceous climate destroyed most of the flora in the south America ,North Africa, and Middle East. Though In our study only *Areoligera senonensis, Exochosphaeridium bifidum, Hystrichosphaeridium sp., Hystrichosphaeridium tubiferum, Liptodinium sp.,* and *Palaeocystadinium benjamini* species were observed representing Late-Cretaceous and reached Paleocene.

The above mentioned species both *Exochosphaeridium bifidum and Hystrichosphaeridium tubiferum* were studied in Krappfeld, Carinthia, and Austria as a Late Cretaceous dinocycts [7], while the others returned to Paleocene .The rapid cooling trend and regression are believed to have caused the extinction of some taxa at the end of the Maastrichtian, and some resistant forms such as *Spiniferites ramosus* survived in the Tertiary and seen in the current study.

Though the fossils evidences indicates that the Formation should be of Paleocene age. The Early Eocene might be represented in the section by the limestone inter beds.

In the current study the identified 15 genera and 19 species of dinoflagellate cysts were used to draw a palynozonation chart, in order to determine the exact age of the Formation in the studied area.

The studied area

The Kolosh Formation section in the present study is locates in Dokan area, the location is shown by a black square in both, location and geologic map (Fig.1).

Previous studies

The Kolosh Formation was first described by [2] from Kolosh village, north of Koi Sanjak, in the High Folded Zone. According to [8], the type section of the formation includes part of the Sinjar Limestone Formation.

Many studies were performed previously, began with [3].

[9] Considered that the Formation has the characteristics of molasses.

[4] studied the depositional environment of Kolosh Formation, he found it as marginal marine depositional environment and narrow rapidly subsiding trough, then he found that the Kolosh clastics were flysch deposits, [10] studied the formation in Derbendikhan area.

[11] studied the Palynology of the Cretaceous - Tertiary boundary in Hijran Area, Northeastern Iraq.

[12] studied the lateral and vertical facies changes of the formation in Sulaimani and Duhok Governorate.

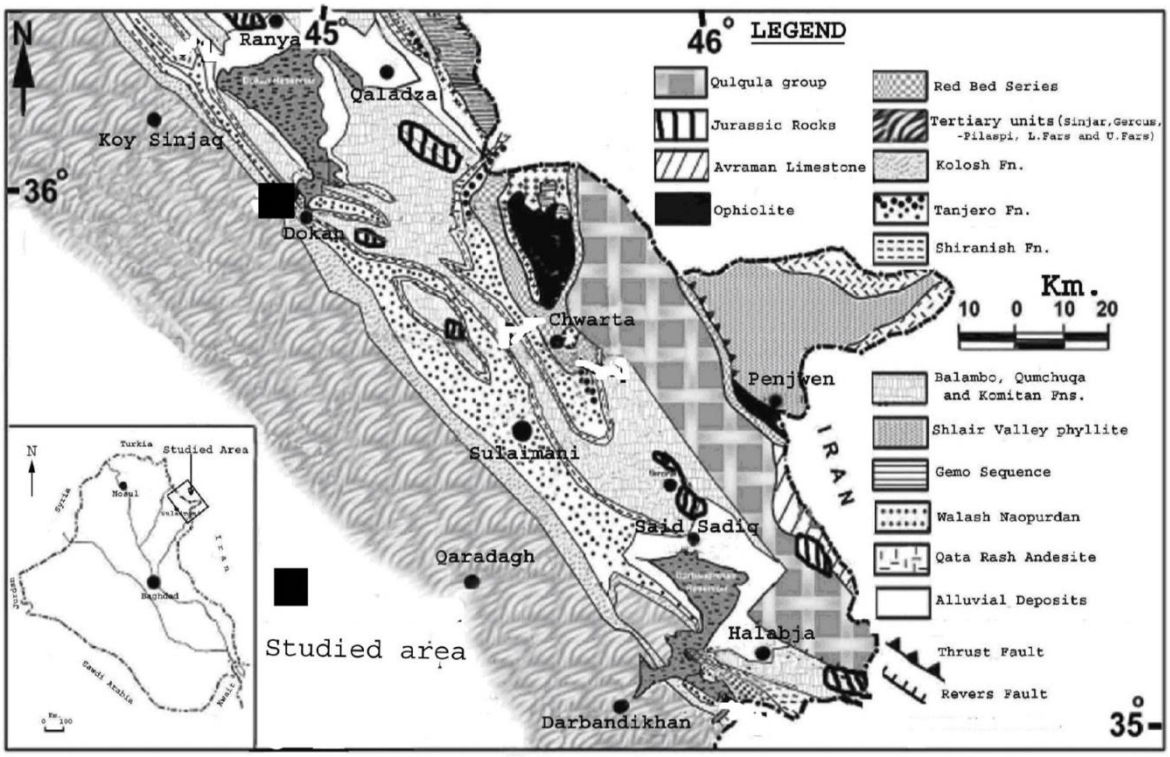

Figure (1): Geological map of the studied area After [13].

Stratigraphy

The Lower boundary of the Kolosh Formation is uncomfortably overlies Upper Cretaceous beds. In the type locality it overlies the Tanjero Formation; in other places it overlies the Shiranish Formation or Upper Cretaceous limestones.

The clastics of the Kolosh were derived from erosion of the Tanjero, Qulqula and other Cretaceous-Jurassic formations [1].

The upper boundary is characterized by gradational conformable contact with Khurmala (Sinjar) Formation [1].

[3] suggested that the upper boundary of the Kolosh Formation is unconformable.

However, where the Kolosh is overlain by Palaeocene-Lower Eocene limestones (as in the type section) the upper boundary is conformable and gradational.

The Kolosh Formation is about 400 m thick in the type section; it reaches to 1000 m thick in the Derbendikhan area [10], while in the north of Iraq the thickness is about 230 m in well Jabal Kand-l and reaches to 318 m in well Kirkuk-117.

The Formation extends to Turkey, where it is represented by clastic facies of Kermav Formation., while in Iran in SE they found that the upper part of Amiran Formation, and the purple shale of lower Pabdeh Formations are equivalent to Kolosh Formation of Iraq [14].

Kolosh Formation is equivalent with several other formations in other parts of Iraq. These formations define according to lithology, it is diachronous, in north Iraq, pass to or inter-tongue with algal reef limestone (Sinjar Formation) and reef - back reef deposit (Khurmala Formation) [3], moreover, a different set of paleocene formations are used in central, western and southern Iraq like Aaliji, Akashat and Umm Er Radhumma Formations. The complex lithostratigraphy relationships between these units are not suitable for correlation and best resolved by other ways like biostratigraphy and sequence stratigraphy.

Aim of Study

The main aim for the current study is to recognize the palynomorphs in the samples taken from Kolosh Formation in Dokan area, that had not been studied before palynologically, then to use the palynomorphes to determine the age of the Formation, even it is determined before by many authors, but not in Dokan area, then to compare the results with the some previous studies in and outside of Iraq.

Palynozonation

Twelve samples were studied palynologically for both Kolosh and Tanjero Formations, one sample for Tanjero, and eleven samples for Kolosh Formation. Dinoflagellate cysts seen in most samples of Kolosh Formation, while in the sample of Tanjero Formation no criteria were found unfortunately, so this sample doesn't involved in the palynozones chart.

A total of (19) dinoflagellate cysts species belong to (15) genera were identified or recognized by using many references for, like [15], [16], [17], [18], [19].

Then, a range chart was drawn depending on the distribution of dinoflagellate cysts, by drawing a stratigraphic range of the important species Fig. (2).

Palynozonation:

The studied section was subdivided into many palynozones named shortly as (P.Z), without using or depending on a certain taxon, as index, for nomination, the description of the zones are as followings:

1-Palynozone -1 (P.Z $_1$):

This assemblage zone is represented in the present study by samples (K_2,K_3), as bellow:

A-The lower contact is pointed by the appearance of an association species in the bottom such as *Amphorosphaeridium fenestratum, Areoligera senonensis, Ericania dynamica, Fibradinium annetorpence, Spiniferites cf. lenzii, Spiniferites ramosus var. gracilis, Thalassiphora sp.*

B-The upper contact is shown by the first appearance of *Hystrichosphaeridiu miniralosum* and *Hystrichosphaera tertiaria*, and the end of. *Ericania dynamica.*

C-The determined age of this zone is Late Danian-Early Selandian (Figure 2)

2-Palynozone -2 (P.Z $_2$):

This zone is represented by samples (K_4,K_7), as bellow:

A-The base of this palynozone is characterized by last appearance of *Ericania dynamica* and first appearance of, *Hystrichosphaeridium mineralosum* and *Hystrichosphaeridium tubiferm.*

B- The top is represented by the first appearance of *Exochosphaeridium bifidum, Heterosphaeridium heteracanthum, Hystrichosphaeridium sp., Liptodinium sp.*,and *Spiniferites cornutus* species with last appearance of *Fibradinium annetorpence* and *Spiniferites ramosus var. gracilis* species.

C- *Hystrichosphaera tertiaria* and *Spiniferites cf. lenzii* are also present partially in this zone.

D-The determined age is Selandian- Early Thanetian (Figure-2)

3-Palynozone -3 (P.Z $_3$):

This biozone is represented by samples (K_8,K_9), as bellow:

A-The lower contact is determined by the first appearance of *Exochosphaeridium brium, Heterosphaeridium heterocanthum, Hystrichosphaeridiu sp., paleocystadinium benjamini, Spiniferites cornatus.*

B- The upper contact is characterized by the last appearance of *Amphorosphaeridium fenestratum, Hystrichosphaera tertiaria, Palaeocystadinium benjamini, Spiniferites cf. lenzii, , Spiniferites cornutus*, and first appearance of *Diphyes monstruosum, Liptodinium sp, Pareodinia prolongata*.

C-The determined age is Middle to Late Selandian (Figure-2).

Comparison with other dinoflagelate cyst zones:

By comparing the result of the current study with previous studies in and outside Iraq, the following results were found:

Most of the species in the present study are belong to Paleocene (Upper most Danian, Selandian, and Thanetian) (Figure 2) ,while the ranges of some dinoflagellate cysts species will reach to the Cretaceous or more, for example *Areoligera senonensis, Exochosphaeridium bifidum, Hystrichosphaeridium sp., Hystrichosphaeridium tubiferum, Liptodinium sp.*, and *Palaeocystadinium benjamini*.

By comparing some species in the current study like *Fibradinium annetorpence, Spiniferites cornutus, and Thalassiphora sp.* with those of Germav Formation done by [6] in SE Anatolia, Turkey, we found that all are represent Danian age, even a part of it seen in Dokan area.

Then the palynomorphs of present study were compared with those of Hijran area in Northeastern Iraq studied by [11], the comparison indicated that *Exochosphaeridium bifidum, Liptodinium sp., Areoligera senonensis, Spiniferites cornutus* species are belong to Danian age, but a part of it was seen here also, figure (3).

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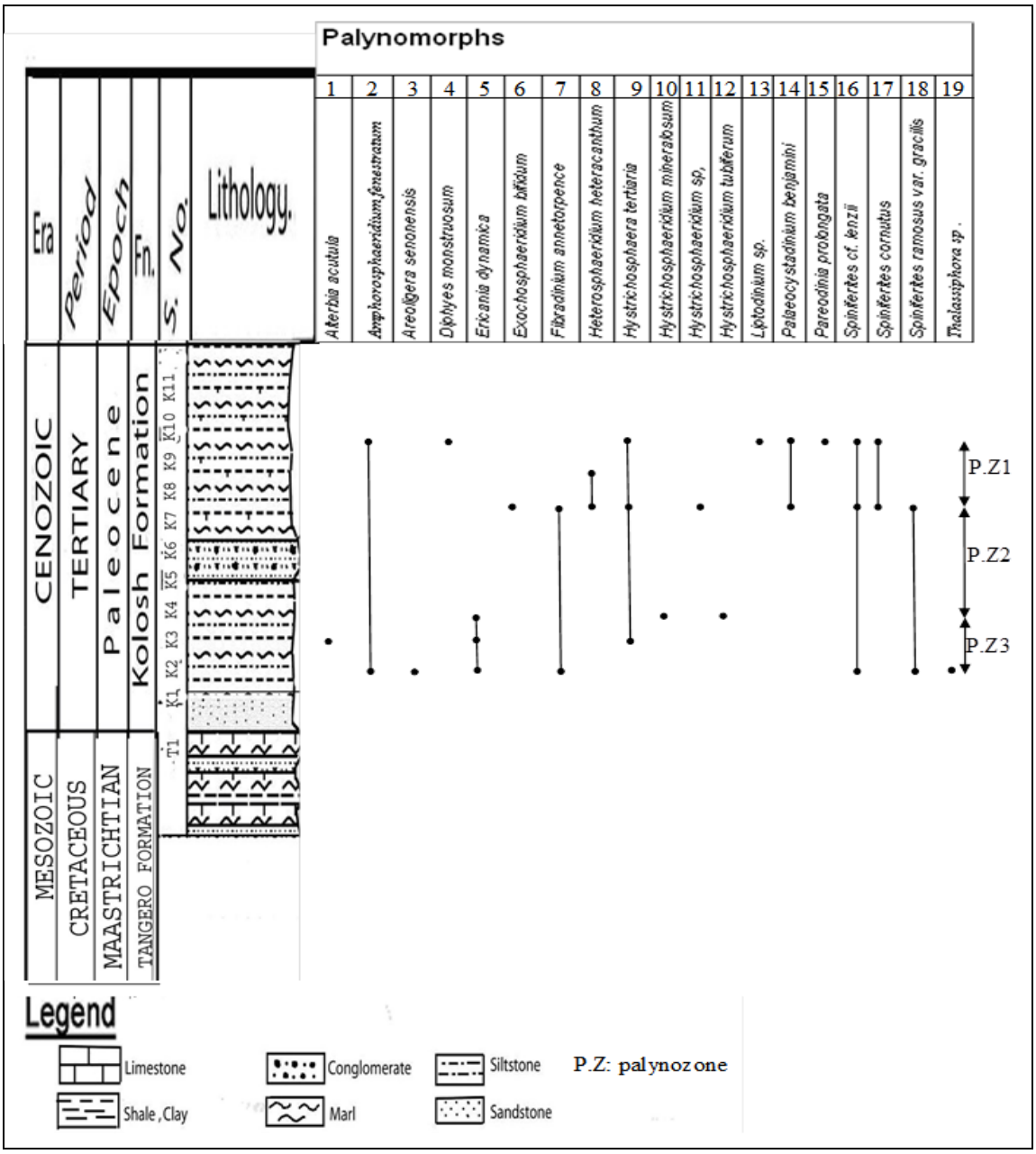

Figure (2): Range chart of selected dinoflagelate cysts species of Kolosh formation in Dokan area
Note: the columnar section is not to scale.

Current Study

Epoch	Age	Palynozones	Formation	Hijran area NE of Iraqi Kurdistan Region Hanna, 1993 Kolosh Fn.		SE Anatolia, Turkey Ertug et.al., 1990 Germav Fn.
				Palynozone		Palynozone
Paleocene	Middle to Late Thanetian	P.Z3	Kolosh	*Danea californica* Zone	*Cerodinium striatum* Subzone	P.Z5
	Selandian/Early Thanetian	P.Z2			*Spiniferites Cryptovesculatus* Subzone	P.Z4
	Late Danian/ Selandian	P.Z1			*Senoniasphaer*	

Figure (3) Correlation of the current study palynozones scheme with previous zonations in Iraq and Turkey, P.Z.= Palynozone

Conclusion

Many studies were done for Kolosh Formation in different parts of Iraq, the current study is one of them, but in different area, located in Dokan District, Sulaimani Governorate, Kurdistan Region /Iraq.

Kolosh Formation was deposited in the same basin with similar properties in many parts of Iraq, this basin had a good extension, with a few lateral and vertical variations from place to another.

In the current study 12 samples were analyzed, for both Kolosh and Tanjero Formations (one sample from Tanjero and eleven samples from Kolosh Formation respectively), by using normal palynological analyses, 15 genera and 19 species of dinflagellate cysts were determined, these species were used to build a palynozone chart, which used to find the age of the formation.

Accordingly the formation was subdivided in to three palynozones, named shortly as (P.Z.1, P.Z.2, and P.Z.3) without using certain species for nomination.

All the palynozones in the current study are represent Paleocene age, the (P.Z-1) represents Late Danian-selandian, then (P.Z-2, Selandian-Early Thanetian), and the upper most one (P-Z-3) was found as Middle-Late Thanetian.

Later the biozones of the current study were compared with two studies done before for the same age, one in Turkey for Termove Formation by [6], and the second comparison done with a local study done by [11] in Hijran area Shaqlawa district- Erbil-Iraq.

The comparison showed some similarities, most of the genera are found in all studies, even a complete Danian was not found in the current study, may the barren sample in the base is represents the rest of Danian, but no palynomorphes was seen to confirm it.

The Plates

Plates-1

A-*Alterbia acutula*, [18], width 33µm ,p rocesses, 10 µm, K3, 125/2.

B-*Amphorosphaeridium fenestratum*, Davey 1969, 28 µm, processes 7µm, K2, 143.2/11.2.

C- *Amphorosphaeridium fenestratum*, Davey 1969, 30 µm, processes 6µm, K9, 143.2/11.2.

D-*Areoligera senonenses* ,Wison and Clowes 1980, width 46 µm, processes13µm, K2,153.8/12.7.

E-*Diphyes monstruosum*, Tasch1964, length 34µm processes 9 µm, K9,131/14.9.

F-*Erikania dynamica*, Morgenroth 1966,width 30µm, K2 ,136.2/12.8.

Plate-2

A-*Exochosphaeridium bifidum*,Clarke & Verdier 1967, width 53 µm , processes 14 µm, K7, 11.9/7.

B-*Fibradinium annetorpence*, Morgenroth 1968, width 35 µm ,K7,113/5.2.

C-*Heterosphaeridium heteracanthum sub sp. sparsiprocessum*, [15], width 20 µm, processes 9 µm, K8,123/14.9.

D-*Heterosphaeridium heteracanthum sub sp. sparsiprocessum*, [15], width 20 µm, processes 9 µm, K7,128/7.6.

ISSN: 1813 – 1662 (Print)
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E-*Hystrichosphaera tertiaria*, Eisenack & Gocht 1960, width 25 µm, processes 7µm , K9, 153.2/1.
F- *Hystrichosphaera tertiaria* , Eisenack & Gocht 1960, width 24 µm, processes 7µm , K3, 119/8.2

Plate- 3

A-*Hystrichosphaeridium mineralosum*, [15],width 30 µm, processes 10 µm, K4, 121.2/8.2.
B- *Hystrichosphaeridium sp.* Samoilovich 1961 ex Norris & Sarjeant 1965,width 30 µm, processes 6µm, K7, 125.1/15.1.
C-*Hystrichosphaeridium tubiferum*, (Ehrenberg) Deflandre 1937, width 42 µm processes15 µm, K4, 112/7.5.
D-*Leptodinium sp.*, Samoilovich 1961 ex Norris & Sarjeant 1965, width 32 µm, K9, 120.2/20.
E-*Palaeocystadinium benjamini*, Drugg 1967, width 49 µm, processes24 µm, K7, 148.2/9.
F-*Pareodinia prolongata* , Sarjeant 1959,width 26.5 µm ,processes19µm, K9, 125/13.

Plate- 4

A-*Spiniferites cf. lenzii*, Below 1982, length 45 µm, processes 9 µm, K2, 130/20.
B- *Spiniferites cf. lenzii*, Below 1982, length 42 µm, processes 10 µm, K7, 107/4.5
C- *Spiniferites cornutus* , (Gerlach 1961) Sarjeant 1970, width 25 µm, processes 5 µm, K7, 121/4.
D-Spiniferites ramosus var. gracilis, (Davey & Williams) Sarjeant 1970, width 20 µm, processes 8 µm, K7, 111/20.
E-Spiniferites ramosus var. gracilis, (Davey & Williams) Sarjeant1970, width 24 µm, processes 4 µm, K2,148.6/8.2.
F- *Thalassiphora sp.*, Davey & Williams 1966, width 34 µm.

Plate- 1

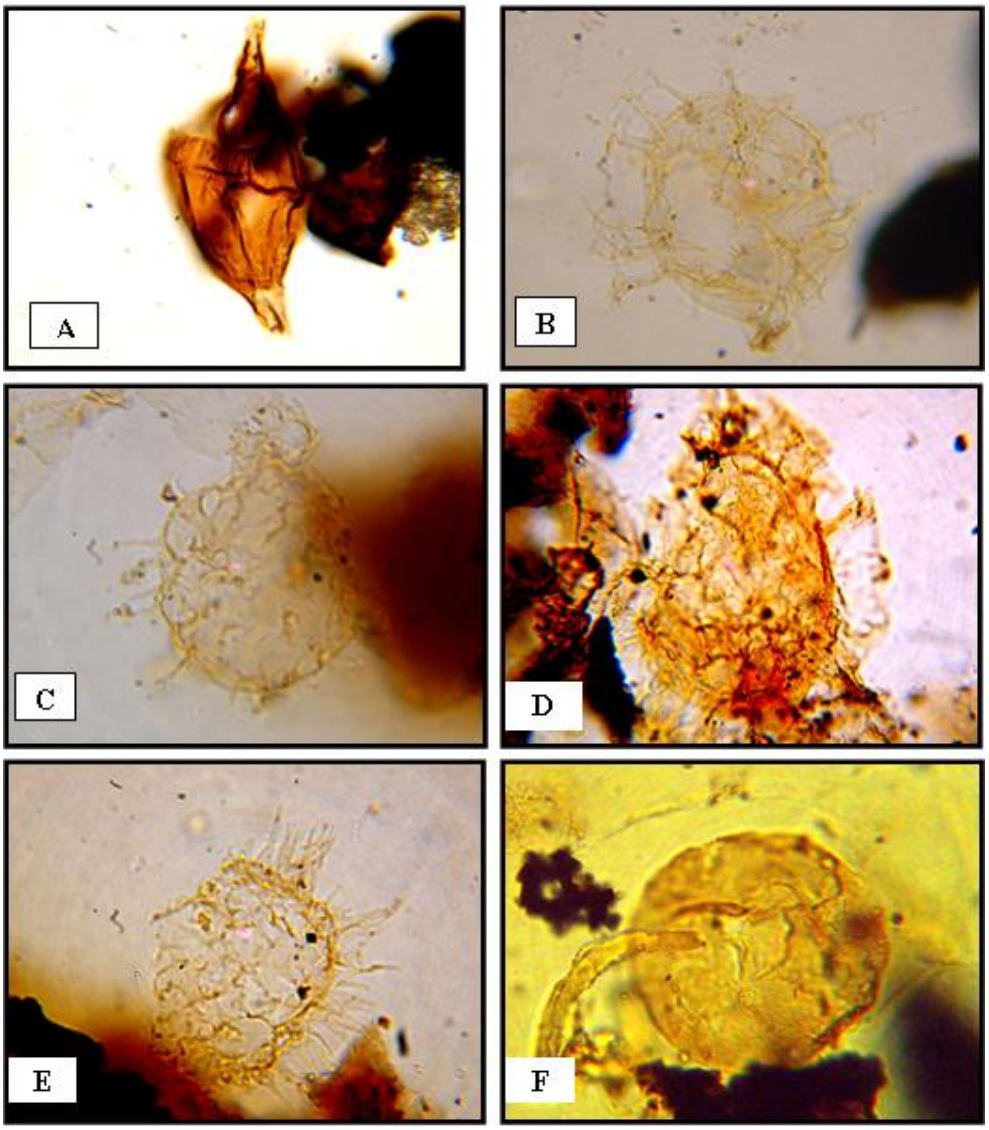

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Plate-2

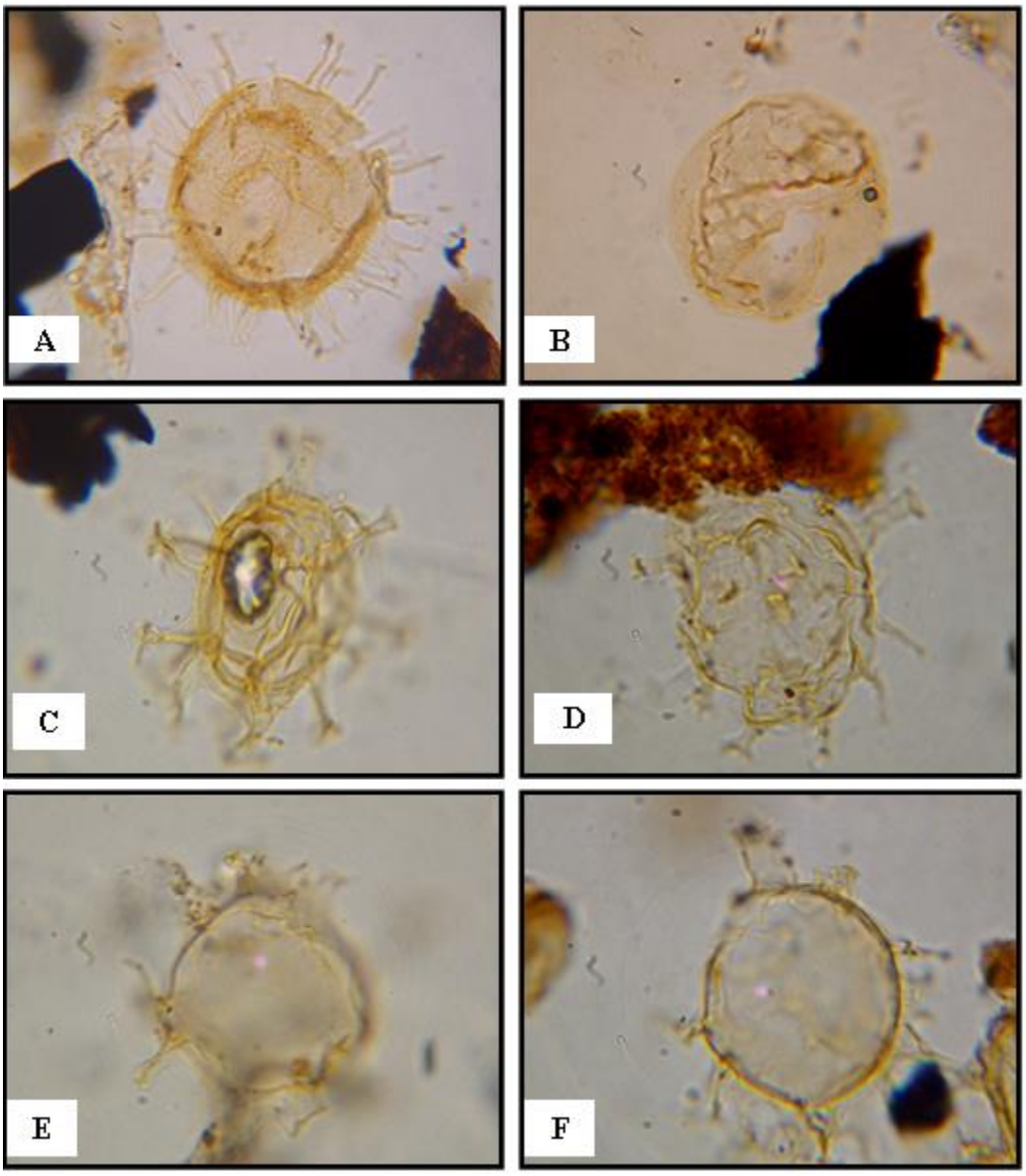

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Plate-3

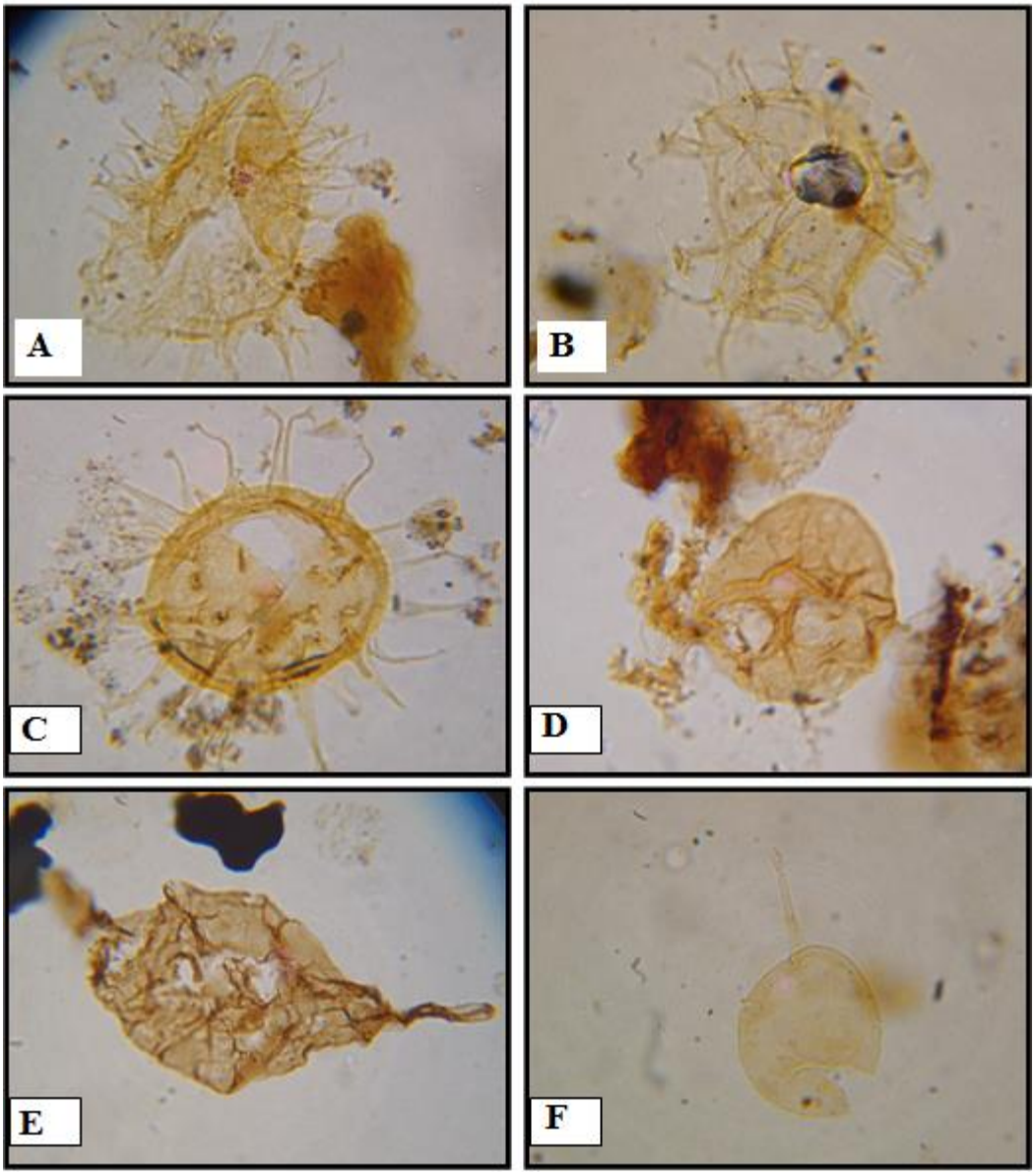

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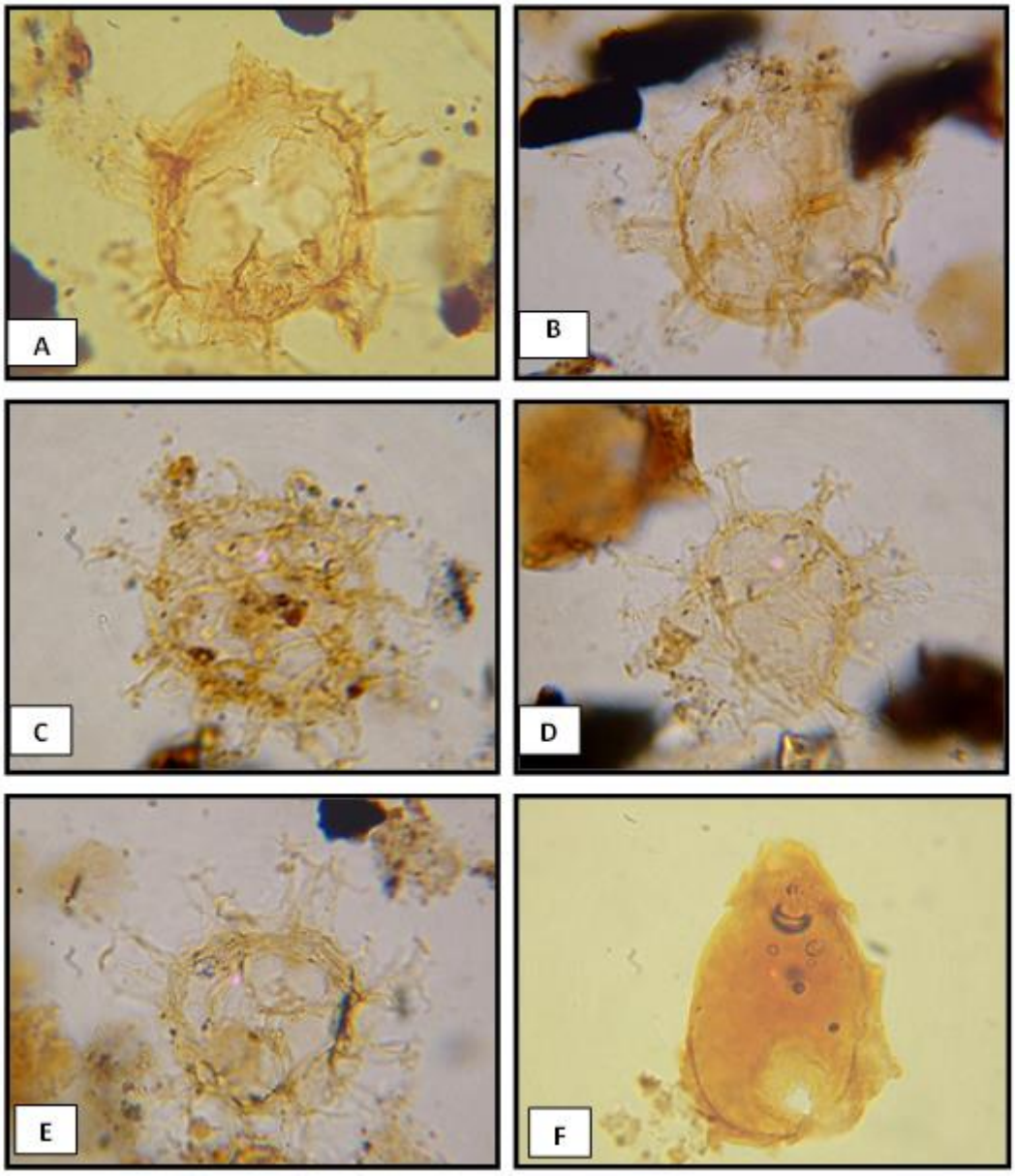
Plate- 4



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دراسة بالينولوجية لتحديد الانطقة الحياتية لتكوين كولوش (باليوسين–الايوسين المبكر)، في منطقة، دوكان، محافظة السليمانية، اقليم كردستان العراق

سرود فاروق النقشبندي

قسم علوم الارض، كلية العلوم ، جامعة صلاح الدين ، اربيل ، العراق

الملخص

تم تحليل 12 نموذجا صخريا بالطرق العالمية المعروفة لاجل فصل المواد العضوية الرسوبية (الباليونولات) عن النمذج الصخرية لتنوين كولوش قيد الدراسة و الماخوذة من منطقة دوكان، محافظة السليمانية، وقد اظهرت نتائج التحليل تواجدا جيداللمواد العضوية بحيث تم فصل 15 جنسا و 19 نوعا مختلفا من اكياس ذوات السوطين، ومن ثم استعملت الباليونولات في تحديد عمر تكوين كولوش من خلال عمل جدول لامتداد الانواع المدروسة، والخطوة اتي تلتها هي مقارنة الانطقة مع بعض الدراسات المحلية و العالمية.

الكلمات المفتاحية: تكوين كولوش، الباليونولات، الانطقة الحياتية.