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Biostratigraphy of Yamama Formation in Faihaa Oil Field, Southern Iraq

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Abstract

The Yamama Formation was studied in three wells (Fh-1, Fh-2, and Fh-3) within Faihaa oil field, south Iraq. Thin sections were studied by using the polarizing microscope examination in order to determine microfossils and biozone. Thirty-five species of benthic foraminifera were recognized, including four index species. In addition, twelve species of calcareous green algae were recognized, including two index species. Other fossils that were recognized in Yamama Formation include Gastropoda, Bryozoa, Coral, Rudist, and Pelecypoda.

Six biozones were observed, which are ***Charentia cuvillieri* sp.** (Range Zone of Berriasian age), ***Psudochryalidina infracretacea* sp.** (Range Zone of Berriasian age)**,** ***Pseudocyclammina Lituus* sp.** (Range Zone of Valanginian age), ***Nezzazata Perforate sp.*****and*****Choffatella* sp.(**Assemblage Zoneof Berriasian-Valanginian age), **Desycladales Green Algae-** ***Cylindroporella* sp. (**Range Zone of Early Cretaceous-Berriasian age), and **Desycladales Green Algae-** ***Salpingoporella cf. circassa* sp. (Range Zone** of Valanginian age). According to these biozones, the age of Yamama Formation was distinguished to be the Berriasian-Valanginian.

Keywords:- Yamama Formation, Biostratigraphy, Foraminifera, Calcareous green algae, Faihaa oil field.

الطباقي الحياتي لتكوين اليمامة في حقل الفيحاء النفطي, جنوب العراق.

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الخلاصة

تكوين اليمامة هو احد التكاوين التي ترسبت خلال العصر الطباشيري في العراق. حيث تم دراسة التكوين في(بئر فيحاء-1 , فيحاء -2 و فيحاء-3) الواقعة ضمن حقل الفيحاء النفطي في محافظة البصرة جنوب العراق. تم دراسة مائه وتسعة شريحة لتحديد المتحجرات و الانطقة الحياتية .تم تحديد خمسة وثلاثون نوع من اجناس الفورامنيفرا القاعية واثنى عشر من الطحالب الكلسية الخضراء بالإضافة الى قطع من الرودست والبليسيبودا والنواعم و الكاستروبودا والمرجان والاصداف وشوكيات الجلد. تم تحديد ستة انطقة حياتية والتي من خلالها تم تحديد عمر التكوين الذي يعود الى (برياسين-فالانجينيان).

Introduction

Yamama Formation is one of the most important oil production reservoirs in the southern Mesopotamian Zone, which belongs to the Early Cretaceous (Berriasian-Valanginian) sequence. The Early Cretaceous succession (late Berriasian- Aptian) extends, from the shore to deep basin, by the Zubair, Ratawi, Yamama, Shuiaba, and Sulaiy formations. It includes important carbonate reservoirs in southern Iraq, namely in the West Qurna, North Rumaila, and Majnoon fields [1]. The lower and upper contacts of Yamama Formation are conformable with Sulaiy and Ratawi formations,

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respectively. The formation is a subsurface unit, which consists of different limestone units, such as fossiliferous limestone, vuggy limestone, chalky limestone, and argillaceous limestone [2]. The present study includes biostratigraphic investigation of Yamama Formation in the wells of Faihaa-1 (Fh-1), Faihaa-2 (Fh-2), and Faihaa (Fh-3) (Table 1), at Faihaa oil field (Figure.1).

The previous studies of Yamama Formation subdivided the formation into different units based on lithological variations and cyclicity. An earlier study [3] divided the Yamama Formation into six units and combined Yamama/Sulaiy Formation as a peloidal limestone overlain by the Ratawi Formation. Another work [4] divided the Yamama Formation into six depositional cycles representing a general regressive sequence. In the southern part of Iraq, Yamama Formation was subdivided into two upper and lower members or reservoir units separated by barriers [5]. Biostratigraphy and microfacies of Yamama Formation in the selected wells, southern Iraq, were also investigated [6]. The biostratigraphic studies of Yamama Formation were mainly based on benthic foraminifera fossils. The current study used both benthic foraminifera and green calcareous algae in the biostratigraphic zonation and age determination.

Location of the study area

The Faihaa oil field is located in Basrah Governorate, 20km south-east Basrah city, and extends across the border with Iran (Figure-1). The distance between wells Fh-1 and Fh-2 is 6.606 Km, while that between wells Fh-1- and Fh-3 is 6.075km (Figure.2).

Table 1-Geographic coordinates of Faihaa wells (UTM system WGS84) and thickness of Yamama Formation.

Well No.	Geographic coordinate of well		Thickness of Yamama Formation (m)
	E	N	
Fh-1	215343	3426021	324m
Fh-2	215502	3432609	297.9m
Fh-3	215503	3419884	126m

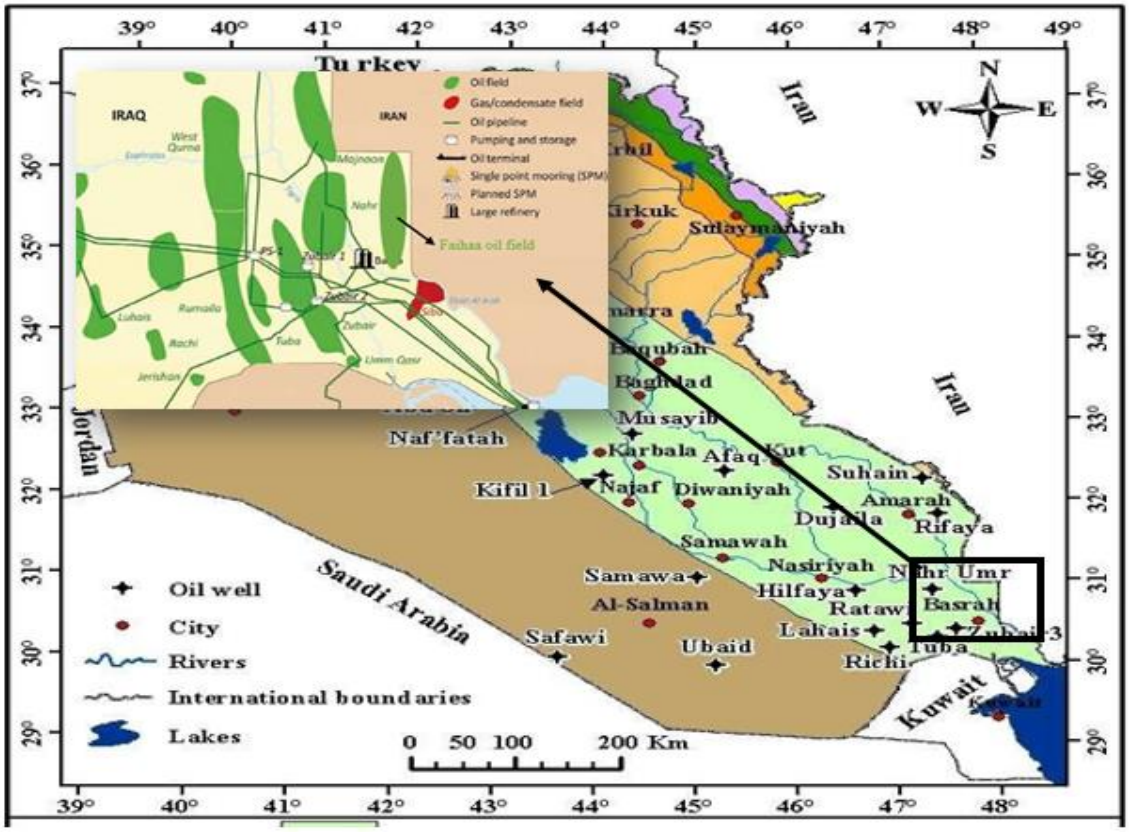
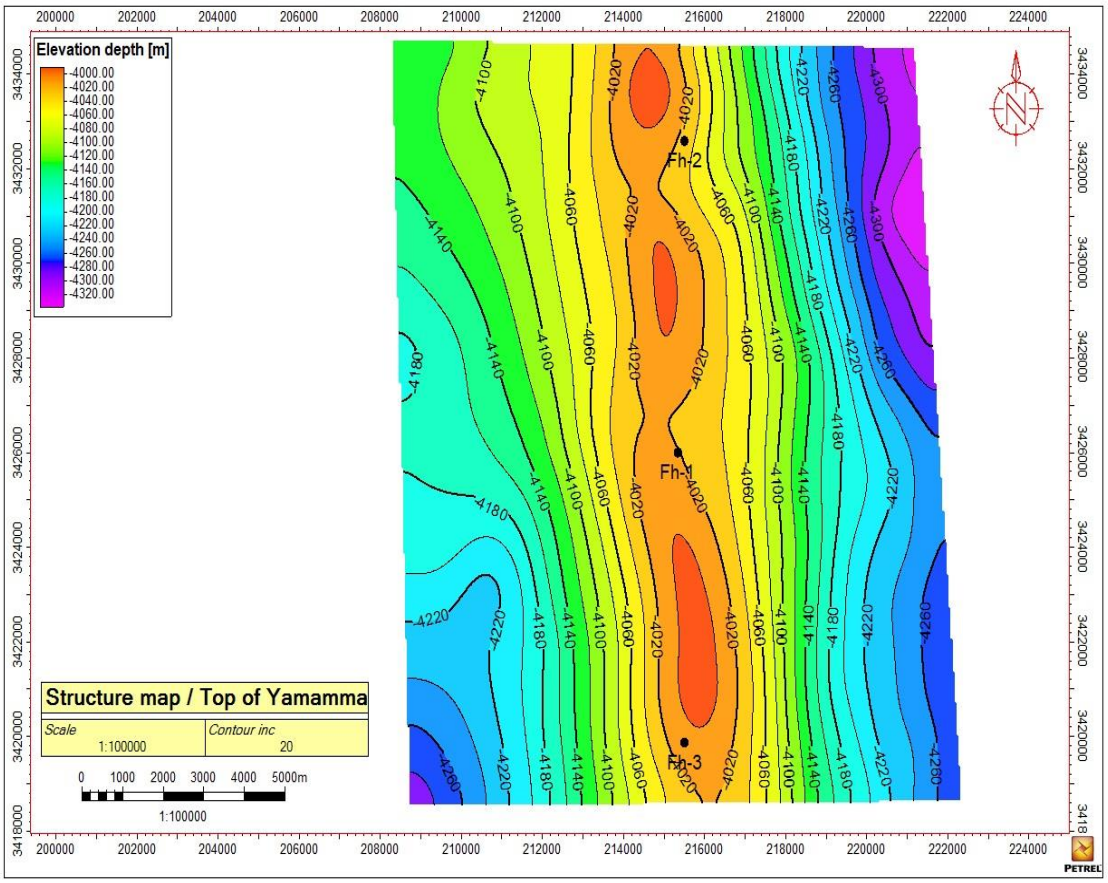


Figure1-Location map of the study area [1]



Stratigraphy and Geological Setting

Faihaa oilfield is located in the east of the Mesopotamian Basin in the Zubair subzone that is characterized by a subsurface geologic structure covered by sediments from the Quaternary. This zone is bounded by two faults, the first belongs to Al-Batin fault zone, whereas the second belongs to the Najd fault system between Ramadi-Musaiyib fault zone in the SW and Tikrit-Amara fault zone in the NE [7]. The collision of the Arabian-Iranian plates generated regional compression effect that produced NW-SE trending fold structures. The effect of folding extends along the NW-SE regional trend of the Zagros fold –Thrust Belt. The

Figure.2 Structural contour map at the top of Yamama Formation in Faihaa oil field with the locations of the selected wells [8].

structure of Faihaa oil field belongs to this trend, which represents an approximately N-S anticline with three structural closures (Figure.2).

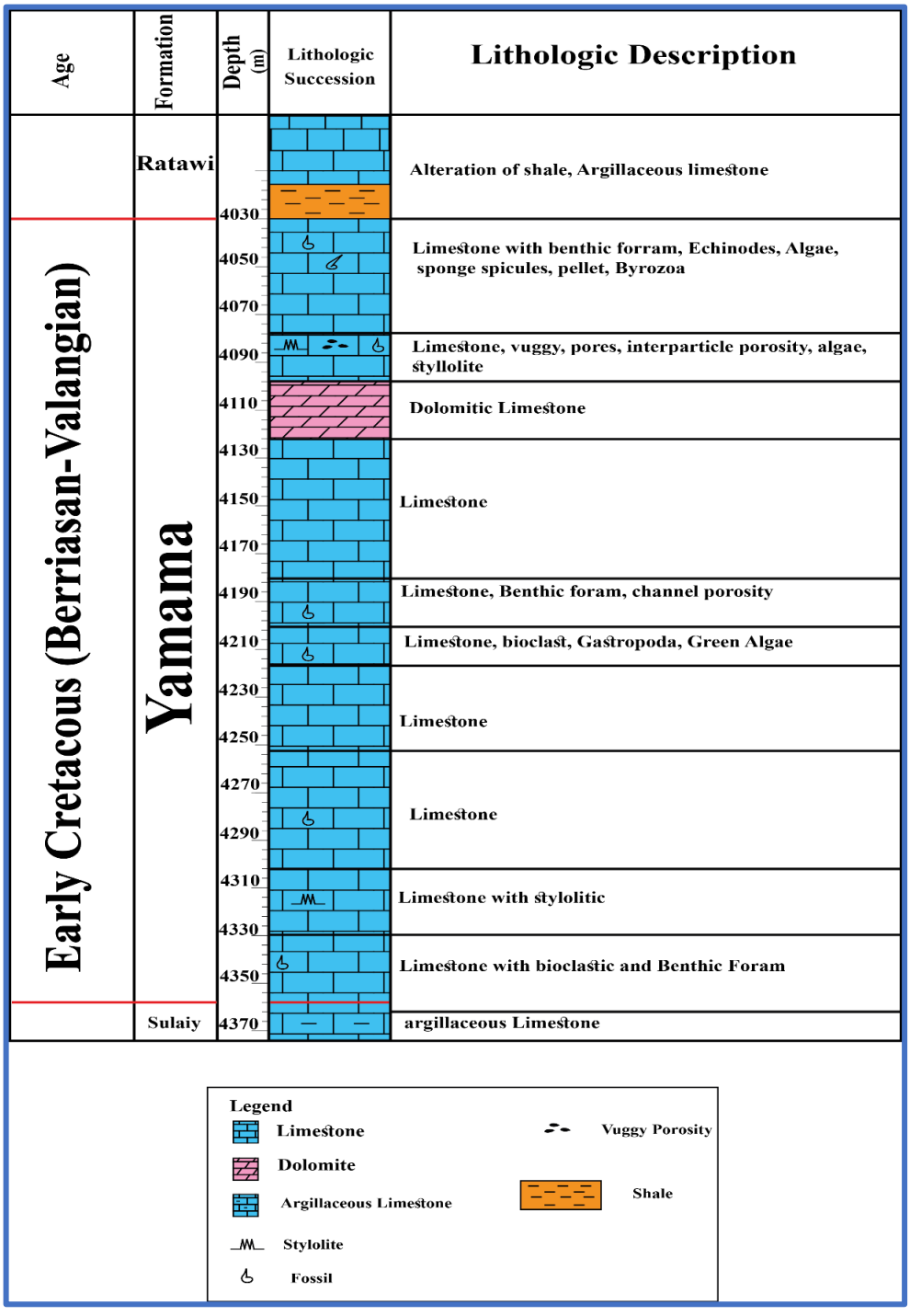


Figure 3-Stratigraphic succession of Yamama Formation in well Fh-1.

The Yamama Formation was deposited during the Lower Cretaceous period within the main retrogressive depositional cycle [1] The shallow water carbonates of Yamama Formation covered large areas in the eastern shelf platform of the Arabian plate, and their depositions were affected by a moderately high, but falling, eustatic sea level [9]. The formation is assigned to the Berriasian-Valanginian age [3]. The Thickness of the Formation is up to 400m [2], while its maximum thickness in the study area reaches 324m at well Fh-1 (Figure.3).

Biostratigraphy of Yamama Formation at Well Fh-1

The following microfossils are identified in the core samples of Yamama Formation at Fh-1 (Figure.4); benthic foraminifera species: *Choffatella* sp. (d'orbigeny, 1904), Pl.A (Fig.1), *Nezzazata perforate* sp. (Omara, 1956), Pl.A (Fig.2), PL, *Charentia cuvillieri* sp. .(d'orbigny, 1904), Pl.A (Fig.3), *Pseudocyclammina lituus* sp. (Yokoyama, 1890), Pl.A (Fig.4), Suborder Miliolina: *Spirologulina* sp. Pl.A (Fig.5), and *Quinqueloclina* sp. Pl.A (Fig.6). Also, the identified calcareous green algae include *Salpingoporella* sp. (Deecke), Pl.A (Fig.7) along with the associated fossils of Gastropoda Pl.A (Fig.8).

Biostratigraphy of Yamama Formation at Well Fh-2

The following microfossils are identified in the core samples of Yamama Formation at Fh-1 (Figure. 5); Benthic foraminifera species include *Korkyrella texana* sp. Pl.B (Fig.1), *Nezzazata simplex* sp. Pl.B (Fig.2), *Textulirina* sp. Pl.B (Fig.3), and *Praechrysalidina infracretacea* sp. (Luperto sinni, 1979), Pl.B (Fig.4). Calcareous green Algae include *Clylindroporella* sp. (Elliott, 1957), Pl.B (Fig.5) and *Bakalovaella Bakalova* sp. (Elliott, 1957), Pl.B (Fig.6), whereas the associated fossils are Pelecypoda Pl.B (Fig.7) and Coral Pl.B (Fig.8).

Biostratigraphy of Yamama Formation at Well Fh-3

The following microfossils are identified in the core samples of Yamama Formation at Fh-1 (Figure.6); Benthic foraminifera species include *Trocholina Sagittaria* sp. Pl.C (Fig.1)**,** *Nummofallotia apula* sp. (Sleinmann, 1881), Pl.C (Fig.2)**, and** *Nautiloculina* sp. Pl.C (Fig.3). Calcareous green Algae include *Arabicodium* sp. (Elliot, 1957), Pl.C (Fig.4)**,** *Salpingoporella* cf. *circassa* sp. Pl.C (Fig.5)**,** *Terquemella* sp. Pl.C (Fig.6), and *Noemeris* sp. (d'archiac), Pl.C (Fig.7). Associated fossils include Rudist Pl.C (Fig.8)**.**

Biozones of Yamama Formation at Well Fh-1

The Biostratigraphy zones of the current study depend on benthic foraminifera and calcareous green algae**.** The definitions of these biozones were achieved based on the stratigraphic distribution of these many types of fauna (Figs. 4, 5, and 6), with the following six biozones being distinguished.

1. *Charentia cuvillieri* sp. Range Zone

This biozone was identified depending on the range of extension of the species. The zone was determined based on the first and last occurrence of the species *Charentia Cuvillieri* in well Fh-1. This species is found in Yamama Formation (Figure. 4) and the thickness of this Biozone is 72m at Fh-1.

-Age of *Charentia cuvillieri* sp. Range zone

The age of this biozone is the Eerly Cretaceous (Berriasian) ([10, 11, 12, 13], as can be shown in table-2 below.

Table 2-The age of the index fossil specie (*Charentia Cuvillieri*) as indicated by studies in other countries.

Researcher	Country	Index fossil	Geological Time				
			Late Jurassic	Early Cretaceous			
			Tithonian	Be.	Va.	Ha.	Ba.
Neumann, 1965	Spain	*Charentia cuvillieri* sp.					
Tappan,1966	Syria						
Gorbachik, 1968	France						
Daria & Iranova, 2010	Europe						

Maryam& Mohammad,2011	Iran		
Present study,2019	Iraq		

2. *Psudochryalidina infracretacea* sp. Range Zone

This biozone was identified depending on the range of extension of the species. The zone was determined based on the first and last occurrence of the species *Psudochryalidina infracretacea* in well Fh-2. This species is found in Yamama Formation (Figure.5), with the thickness of this Biozone being 197.2m at Fh-2.

- Age of *Psudochryalidina infracretacea* sp. Range zone

The age of this biozone is the Eerly Cretaceous (Berriasian) [12, 13, 14, 15], as shown in table-3 below.

Table 3-The age of the index fossil species (*Psudochryalidina infracretacea* sp.), as indicated by studies in other countries.

Researcher	Country	Index fossil	Geological Time						
			Late Jurassic	Early Cretaceous					
			Tithonian	Be.	Va.	Ha.	Ba.	Ap.	Al.
Luperto, 1979	Spain	*Psudochryalidina infracretacea* sp.							
Michal& Barbara, 2005	France								
Seyed &Conrad, 2008	Iran								
Ivovelic& Branko, 2009	USA								
Maryam & mohammad, 2011	Iran								
Leila & Ahmad, 2018	Iran								
Present study, 2019	Iraq								

3. *Pseudocyclammina Lituus* sp. Range Zone

This zone was determined based on the first and last occurrence of the species *Pseudocyclammina Lituus* in wells Fh-1and 2. The distinguished species are shown in Figures 4 and 5, while the thickness of this Biozone is 72m at well Fh-1.

- Age of *Pseudocyclammina Lituus* sp. Range zone

The age of this biozone is the Eerly Cretaceous (Valanginian) [10, 12, 15, 16], as shown in table-4 below.

Table 4-The age of the index fossil species (*Pseudocyclammina Lituus)*, as indicated by studies in other countries.

Researcher	Country	Index fossil	Geological Time				
			Late Jurassic	Early Cretaceous			
			Tithonian	Be.	Va.	Ha.	Ba.
Yokoyama, 1890.	Japan	*Pseudocyclammina Lituus* sp.					
Hart, 1962.	Iraq						
Fourcadann & Neamann,1966.	Croatia						
Hottinger, 1967.	Morocco						
Fourcade, 1971.	Spain						
Sartorio& Venturini, 1988	Italy						
Ornelas& Alzaga, 1994.	Mexico						
Krajewski& Olszewska, 2007.	Crimea						
Iranova,2008.	Bulgaria						
Ceila& Morteza, 2018.	Iran						
PrePresent study,2019	Iraq						

4. *Nezzazata Perforate sp.-Choffatella* sp. Assemblage Zone

This biozone is defined by three or more different taxa, which may, or may not, be related to each other. The boundaries of the assemblage zone were defined by the occurrence of the typical specified fossil assemblage. This can include the appearance, but also the disappearance, of certain taxa [16]. The occurrence of *Nezzazata perforate* sp. and *Choffatella* sp. was recorded. The assemblage zone have the same trend of appearing and disappearing taxa in almost the same depth in well Fh-1 (Figure.4).

- Age of *Nezzazata Perforate sp.*and *Choffatella* sp. Assemblage Zone

The age of this biozone is the Cretaceous (Berriasian- Valanginian) [10, 12, 13, 18], as shown in table-5 below**.**

Table 5-The age of fossils *(Nezzazata Perforate sp.-Choffatella* sp.*)*, as indicated by studies in **other countries.**

Researcher	Country	fossils	Geological Time						
			Late Jurassic	Early Cretaceous					
			Tithonian	Be.	Va.	Ha.	Ba.	Ap.	Al.
Ivo Velic, 1983	Yugoslavia	*Nezzazata Perforate sp.- Choffatella* sp.				N.P.			
Neumann, 1965	Spain					Ch.			
Barbara O., 2005	France					Ch.			

Ivovelic, 2007	SE Europe		N.P.
Maryam& mohammad, 2011	Iran		Ch.
Mahin R. & Mohsen A., 2012	SE Iran		N.P.
Present study,2019	Iraq		N.P. Ch.

5. Desycladales Green Algae- *Cylindroporella* sp. Range Zone

This biozone was identified depending on the range of extension of the species. The zone was determined based on the first and last occurrence of the species *Cylindroporella* in well Fh- 2 (Figure. 5). The thickness of this Biozone is 121.8m at well Fh-1**.**

- Age of *Cylindroporella* sp. Range Zone

The age of this biozone is the Eerly Cretaceous (Berriasian) [14, 15, 20, 21], as shown in table-6 below**.**

Table 6-The age of the index fossil (*Cylindroporella sp.)*, as indicated by studies in other **countries.**

Researcher	Country	Index fossil	Geological Time				
			Late Jurassic	Early Cretaceous			
			Tithonian	Be.	Va.	Ha.	Ba.
Elliott,1968	Peninsula	*Cylindroporella* sp.					
Granier,1990	Portugal						
Mahuel &Elene,1993	Cuban						
Masse & Dalmasso, 1999	France						
Granier,2000	Abu Dhabi						
Seyed&Marc,2008	Iran						
Ahtun &Branko, 2009	Croatia						
Bruno&Alexandre, 2017	Oman						
Leila, Ali &Ahmad, 2018	Persian Gulf						
Present study,2019	Iraq						

6. Desycladales Green Algae- *Salpingoporella cf. circassa* sp. Range Zone

This zone was determined based on the first and last occurrence of the species *Salpingoporella cf. circassa* in well Fh- 3. This species was found in Yamama Formation (Figure. 6), while the thickness of this Biozone is 123m at Fh-3.

- Age of *Salpingoporella cf. circassa* sp. Range BioZone

The age of this biozene is the Eerly Cretaceous (Valanginian) [13, 15, 20, 22], as be show in table-7 blew**.**

Table 7-The age of the index fossil (*Salpingoporella cf. circassa* sp), as indicated by studies in other countries.

Researcher	Countries	Index fossil	Geological Time				
			Late Jurassic	Early Cretaceous			
			Tithonian	Be.	Va.	Ha.	Ba.
Elliott, 1957	Qatar	*Salpingoporella cf. circassa* sp.					
Elliot,1968	France						
Mahuel & Elene, 1993	Cuban						
Aziz & El-Sattar,1997	Abu Dhabi						
Branko,2004	Croatia						
Maryam &Mohammad 2011	Iran						
Gristian & Bruno, 2016	Romania						
Leila &Ahmed, 2018	Persian Gulf						
Present study,2019	Iraq						

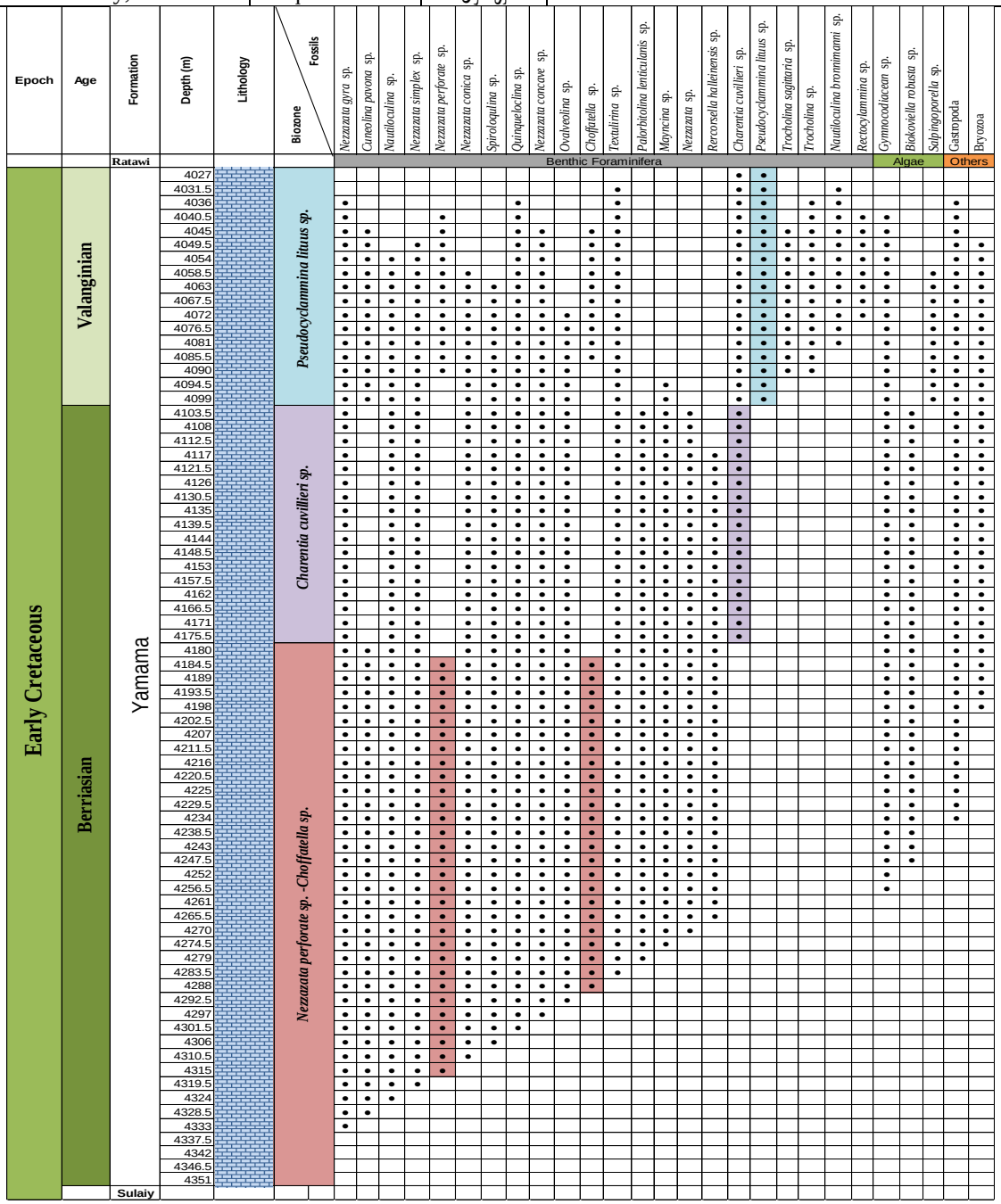


Figure 4- The biostratigraphy of Yamama Formation at well Fh-1

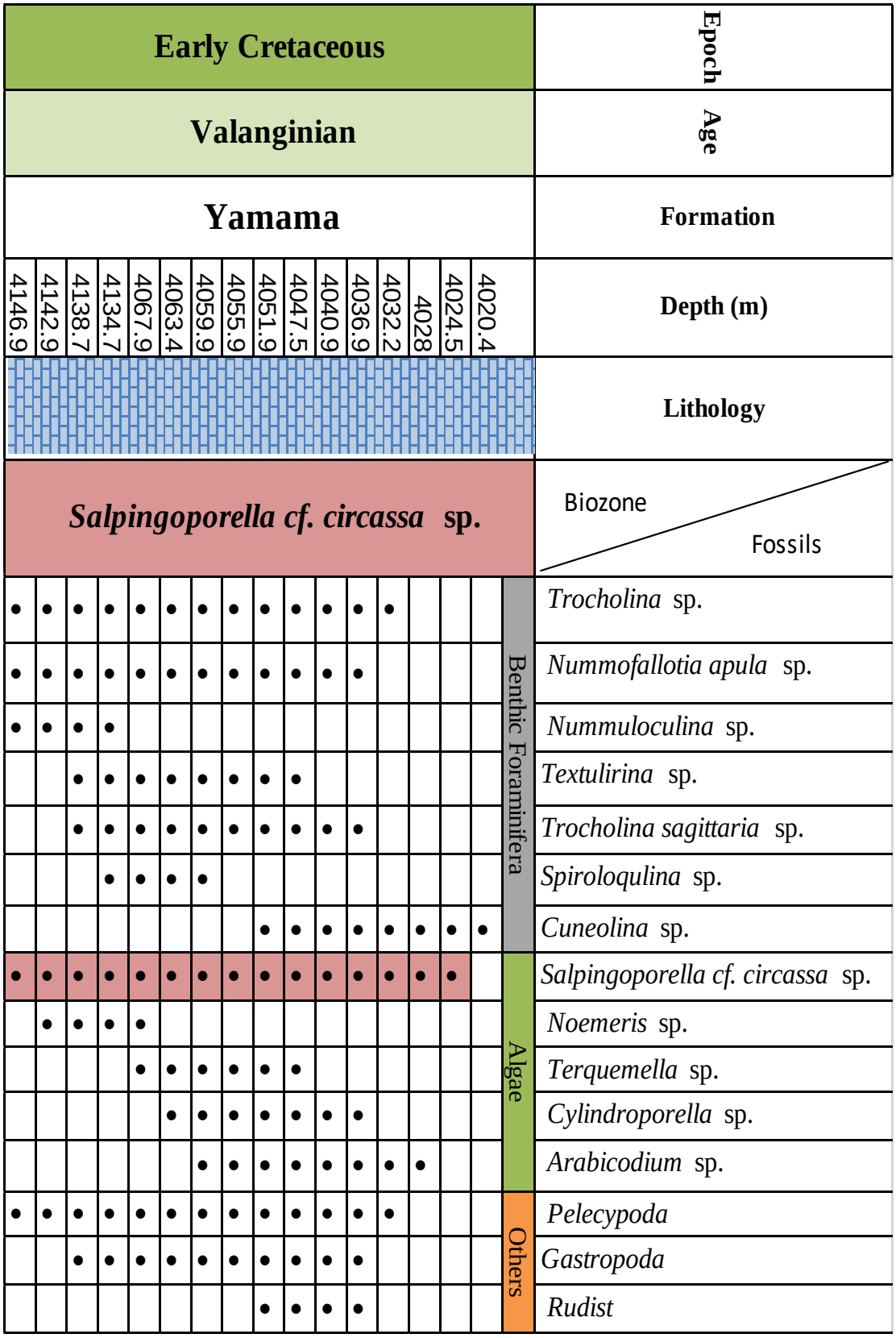


Figure 5-The biostratigraphy of Yamama Formation at well Fh-2.

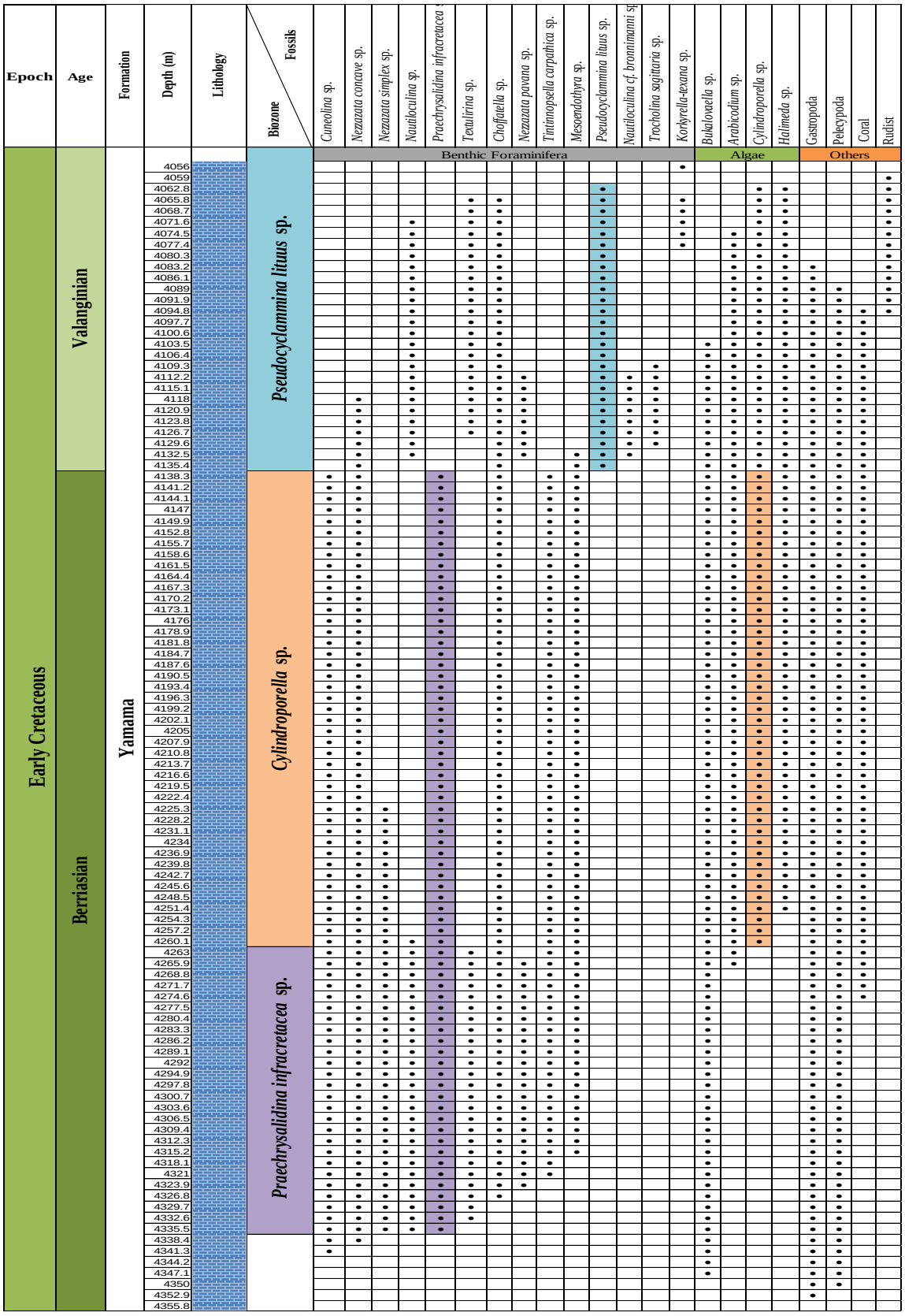


Figure 6-The biostratigraphy of Yamama Formation at well Fh-3.

Plate - A -

Fig.1*:* *Choffatella* sp. Foraminifera, Yamama Formation, axial section, Fh-1 at depth (4211.5m). Age: Early Cretaceous to Recent.

Fig.2*:* *Nezzazata perforate* sp. Foraminifera, Yamama Formation, subequatoriale section, Fh-1 at depth (4177m), Age: Early Cretaceous.

Fig,3: *Charentia cuvillieri* sp. Foraminifera, Yamama Formation, axial section, Fh-1 at depth (4027m). Age: Berriasian.

Fig.4: *Pseudocyclammina Lituus* sp. Foraminifera, Yamama Formation, axial section, Fh-1 at depth (4031.5 m). Age: Valanginian.

Fig.5: *Spiroloculina* . Miliolidae, Yamama Formation, oblique section, Fh-1 at depth (4186m), Age: Jurassic - Early Cretaceous.

Fig.6: *Quinqueloclina* SP. Miliolidae Yamama Formation, oblique section, Fh-1 at depth (4193.5m). Age: Jurassic - Early Cretaceous.

Fig.7: *Salpingoporella* sp. Algae Dasyclaies , Yamama Formation, transverse section, Fh-1 at depth (4094.5m), Age: Valanginian.

Fig.8: Gastropoda sp. ,Yamama Formation, oblique section, Fh-1 at depth (4270.5m), Age: Cambrian –Holocene.

Plate - B -

Fig.1: *Korkyrella texana* sp. Foraminifera, Yamama Formation, axial section, Fh-2 at depth (4062.80m), Age: Early Cretaceous.

Fig.2*:* *Nezzazata simplex* sp. Foraminifera (Omara, 1956), Yamama Formation, oblique axial section, Fh-1 at depth (4177m), Age: Early Cretaceous.

Fig,3: *Textulirina* sp. Foraminifera, Yamama Formation, axiale section, Fh-2 at depth (4126.7 m), Age: Early Cretaceous.

Fig.4: *Praechrysalidina infracretacea* sp. Foraminifera (Luperto Sinni,1979), Yamama Formation, transversal section, Fh-2 at depth (4278.3m).Age: Valanginian-Aptian.

Fig.5: *Cylindroporella* sp. Algae Dasyclaies (Elliott,1957), Yamama Formation, oblique section, Fh-2 at depth (4062.80m). Age: Early Cretaceous (Berriasian).

Fig.6: *Bakalovaella Bakalova* sp. Algae Dasyclaies (Elliott,1957), Yamama Formation, oblique section, Fh-2 at depth (4101.90m). Age: Early Cretaceous.

Fig.7: Pelecepoda, Yamama Formation, axial section, Fh-2 at depth (4098.80m). Age: Paleozoic – Recent.

Fig.8: Coral fragment, Yamama Formation, longitudinal section, Fh-2 at depth (4095.90m). Age: Paleozoic – Recent.

Plate - c –

Fig.1: *Trocholina* Sagittaria sp.Foraminifera, Yamama Formation, axiale section, Fh-3 at depth (4139m).Age: Valanginian.

Fig.2: *Nummofallotia apula* sp. Foraminifera (Luperto sinni, 1968), Yamama Formation, oblique section, Fh-3 at depth (4146.75m), Age: Early Aptian.

Fig.3: Nautiloculina sp. Yamama Formation, axial section, Fh-3 at depth (4040.90m), Age: Valanginian.

Fig.4: *Arabicodium* sp. Algae Silphonales (Elliott,1957), Yamama Formation, axial section, Fh-3 at depth (4063.40m), Age: Eerly Cretaceous.

Fig.5: *Salpingoporella* cf. *circassa* sp. Algae Dasyclaies (Deecke), Yamama Formation, tangential section, Fh-3 at depth (4146.75m).Age: Valanginian.

Fig.6: Terquemella sp. Algae Dasyclaies (D'archiac),Yamama Formation, tangential section, Fh-3 at depth (4068m), Age: Early Cretaceous.

Fig.7: *Noemeris* sp. Algae Dasyclaies (D'archiac),Yamama Formation, tangential section, Fh-3 at depth (4146.75m), Age: Cretaceous to Recent.

Fig.8: Rudest, Yamama Formation, axial section, Fh-3 at depth (4048.80m), Age: Paleozoic – Recent.

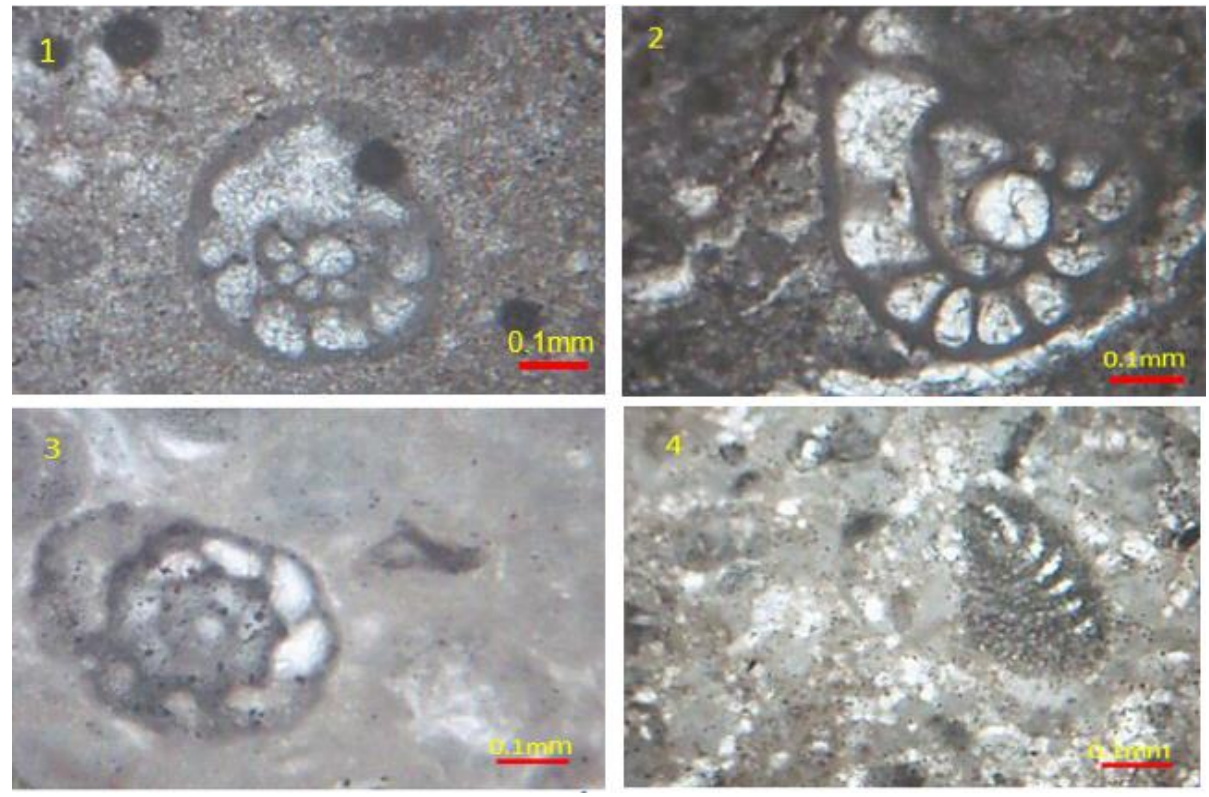
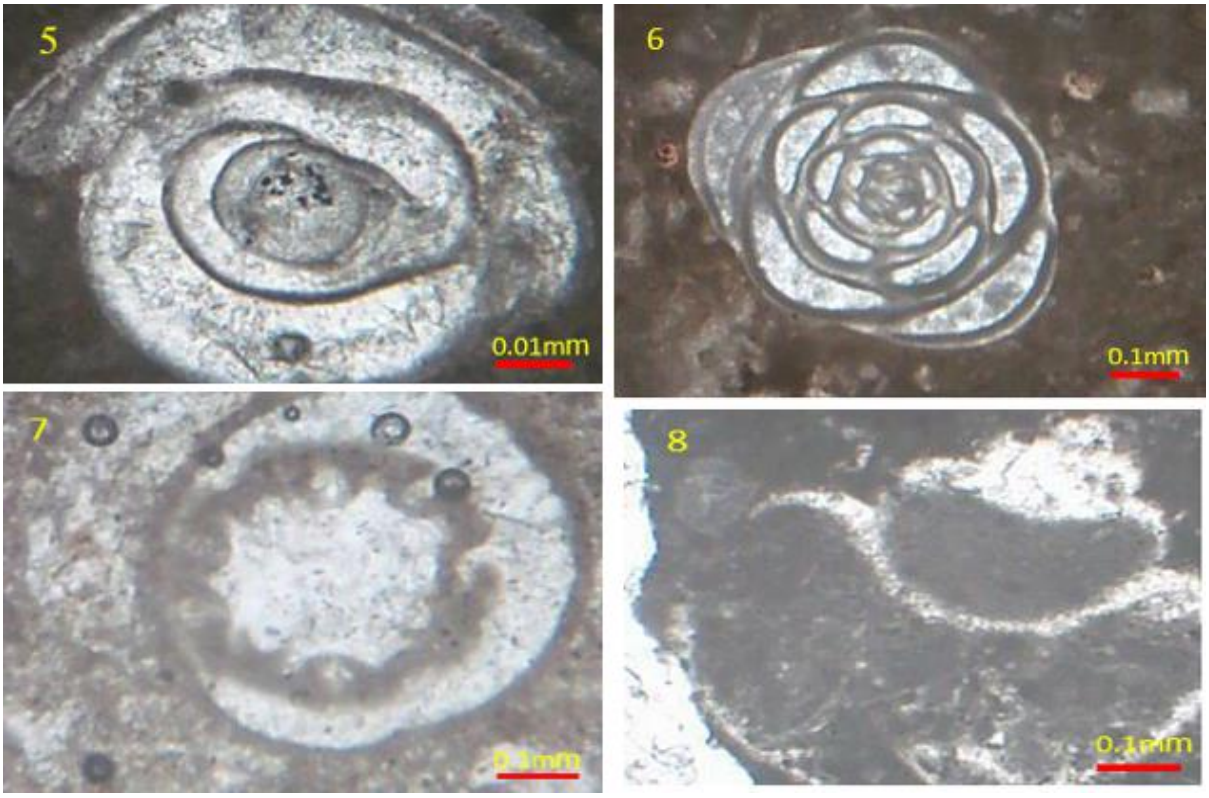


Plate - A -



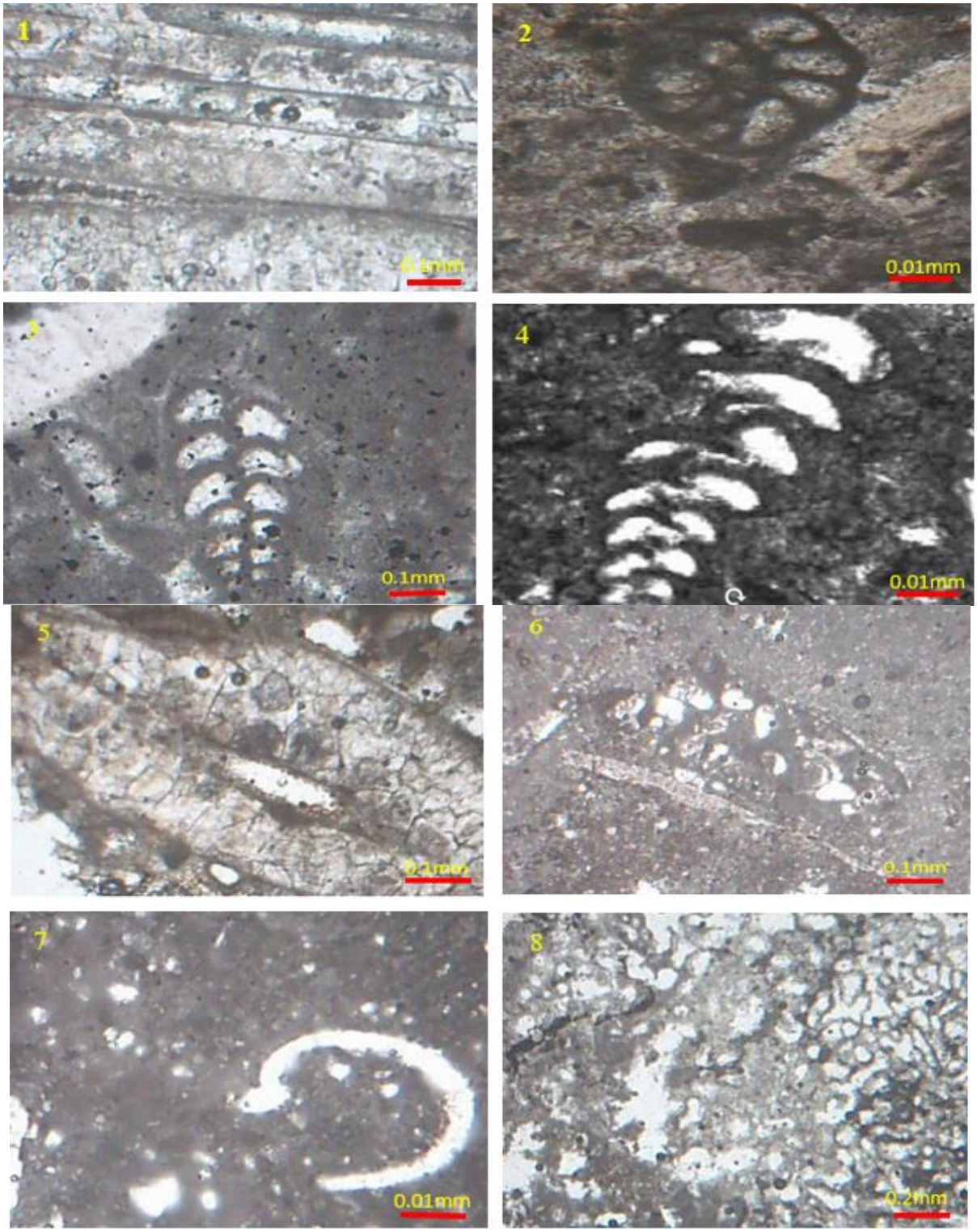


Plate - B –

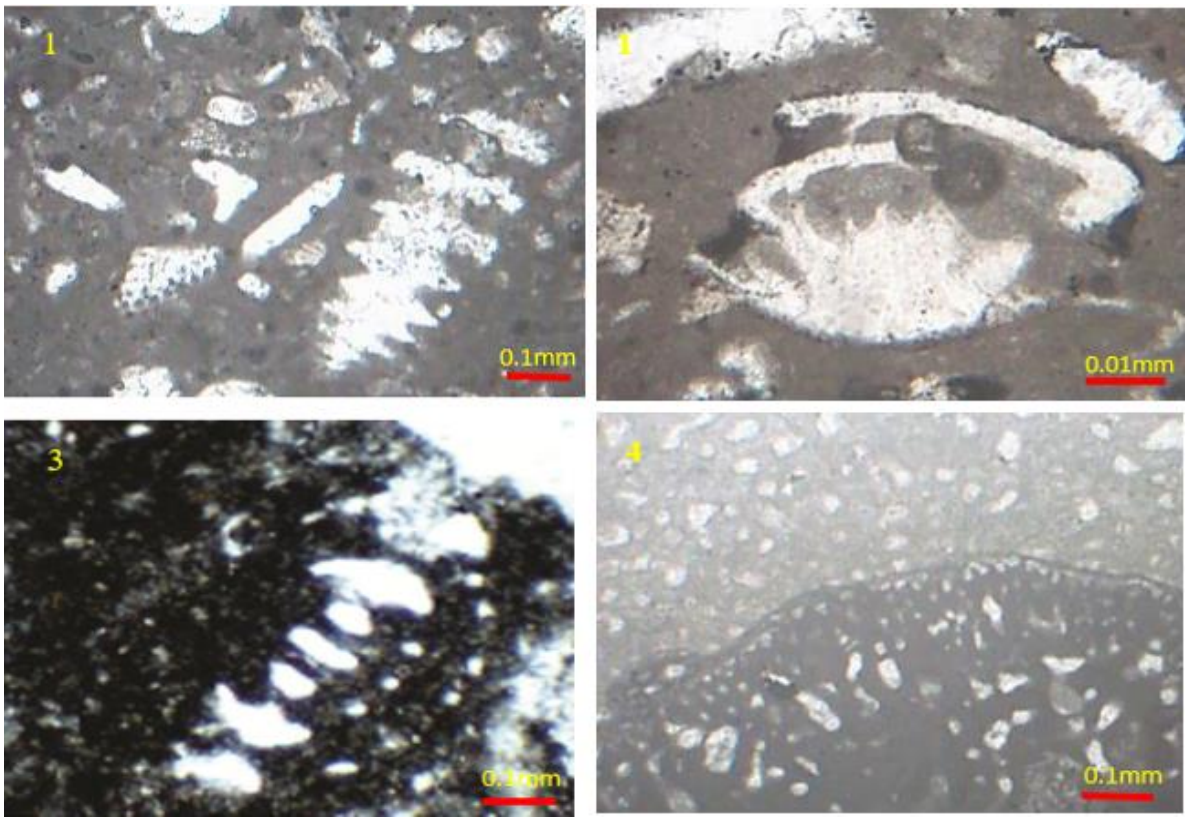
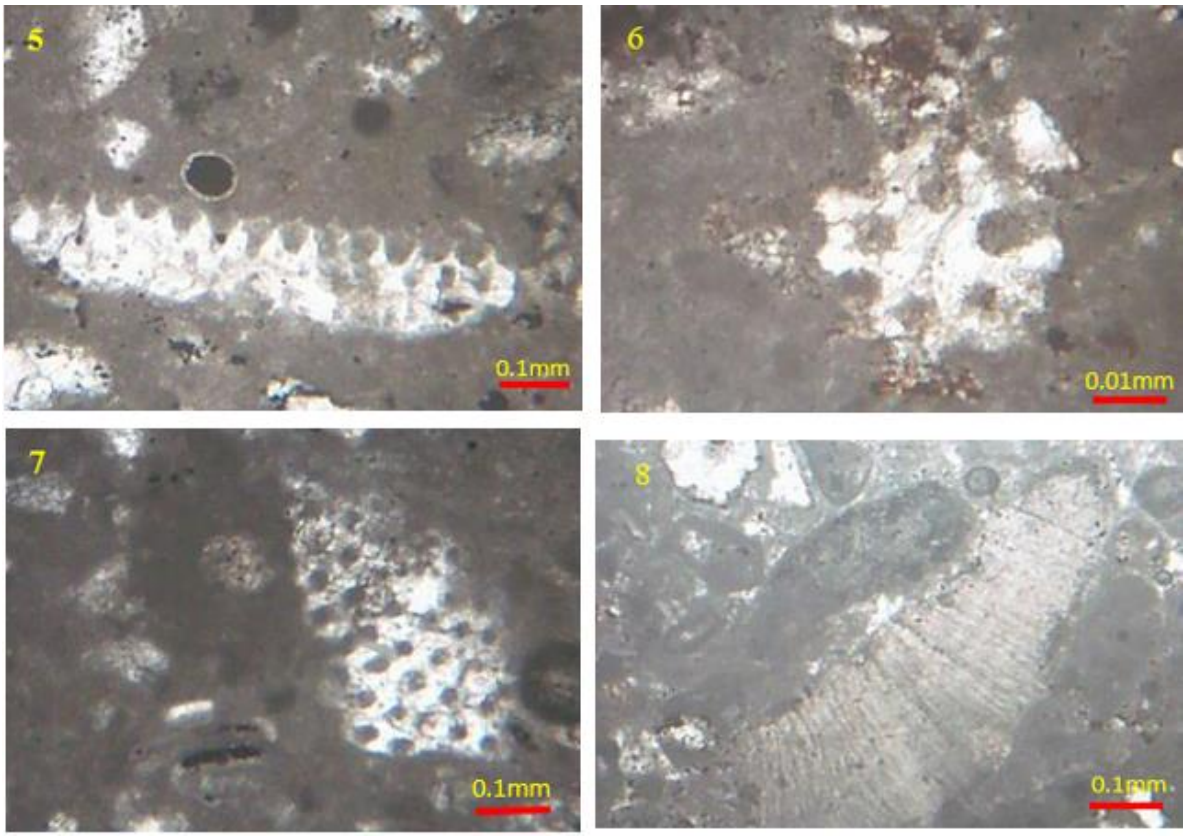


Plate - C -



Conclusions

This study involves the biostratigraphy of three wells belonging to Yamama Formation, Faihaa oilfield, Southern Iraq.

Thirty three species of benthic Foraminifera and ten species of calcareous green algae were distinguished, which are :

Charentia cuvillieri sp., *Pseudocyclammina Lituus* sp., *Nezzazata gyra* sp., *Trocholina* Sagittaria sp., *Rectocylammina* sp., *Nautiloculina* cf *broennimanni* sp., *Trocholina* sp., *Palorbitolina Lenticularis* sp., *Mayncina* sp., *Nezzazata concava* sp., Rercorsella halleinensis sp., *Nezzazata Conica* sp., *Nautiloculina* sp., *Nezzazata simplex* sp., *Nezzazata perforate* sp., *Spiroloqulina* sp., *Quinqueloclina* sp., *Ovalveolina* sp., *Choffatella* sp., *Textulirina* sp., *Pyrgo* sp., *Alveolinidae* sp., *Cuneolina* sp., *Praeaiveolina* sp., *Cuneolinapavonia* sp., *Triluculina* sp., *Orbitolina* sp., *Glompospira* sp., *Korkyrella texana* sp., *Tintinnopsella carpathica* sp., *Praechrysalidina infracretacea* sp., *Nummofallotia apula* sp. and *Nummuloculina* sp., **calcareous green algae:** *Salpingoporella* sp., *Biokoviella robusta* sp., *Gymnocodiacean* sp., *Halimeda* sp., *Arabicodium* sp., *Cylindroporella* sp., *Bakalovaella Bakalova* sp., Terquemella sp., *Salpingoporella* cf. *circassa* sp., and *Noemeris* sp., with other fossils like Pelecypods, Gastropods, Rudest, Coral. and Pryozoan.

Six biozones were distinguished in Yamama Formation, depending on the index fossil species These zones are:

1. ***Charentia cuvillieri* sp.** Range Zone of Eerly Cretaceous (Berriasian).
2. ***Psudochryalidina infracretacea* sp.** Range Zone of Eerly Cretaceous (Berriasian).
3. ***Pseudocyclammina Lituus* sp.** Range Zone of Eerly Cretaceous (Valanginian).
4. ***Nezzazata Perforate sp.-Choffatella* sp.** Assemblage Zone of Eerly Cretaceous (Berriasian-Valanginian).
5. **Desycladales Green Algae-*Cylindroporella* sp.** Range Zone of Eerly Cretaceous (Berriasian)**.**
6. **Desycladales Green Algae-*Salpingoporella cf. circassa* sp.** Range Zone of Eerly Cretaceous (Valanginian).

The age of the Yamama Formation was determined as the Berriasian- Valanginian, depending on the identified biozones of benthic Foraminifera and calcareous green algae.

References

1. **Buday, T., 1980**. The regional geology of Iraq. Stratigraphy and Paleogeography, Kassab, I. I. and Jassim, S.Z., (eds), Dar Al-Kutib Publ. House, Mosul, Iraq, 445p.
2. **Jassim, S.Z. and J.C. Goff, 2006**. Geology of Iraq. Dolin, Prague and Moravian Museum, Brno, 341 p.
3. **Bellen, R. C. Van., Dunnington, H. V., Wetzel, R., and Morton, D. M.,1959**. Lexique Stratigraphique International, Asia, Iraq. Int. Geol.Congr. Comm. Stratig. V.3, 10a, pp.1-333.
4. **Dhihny, G. A. 1993.**Yamama Formation in Southern Iraq. The depositionalmodel and diagenetic history, regional study. Internal report, INOC, Baghdad.
5. **Rozarian, A.1995**.Sedimentological and depositional history of the Yamama Formation, Southern Iraq.Internal report, INOC, Basra.
6. **Al-Shahwan, M., F. 1993**. Biostratigraphy and microfacies of Yamama Formation in selected wells, southern Iraq, Unpublished MSc. Thesis, University of Baghdad, 122p.
7. **Buday, T., and Jassim, S.Z,1987**. Geology of Iraq. Dolin, Prague and Moravian Museum, Brno, 341 p.
8. **International oil companies: Kuwait energy final well report of Faihaa oilfilde,2019**.
9. **Ziegler M.A., 2001**.Late Permian to Holocene Paleofacies Evolution of the Arabian Plate and its Hydrocarbon Occurrences, GeoArabia, No. 3, GulfPetroLink, Bahrain, p.445-504.
10. - Neumann, M.,& Schroeder, R. (eds), 1985. Les Grands Foraminifères du Crétacé Moyen de la Région Méditerranéenne. Geobios, Mémoire Spécial, 7: 1–140
11. **Loeblich, A. R. and Tappan, H., 1985;** Foraminiferal genera and their classification. Van Nostrand Reinhold, New York, Two volume 2047p.
12. **Ivanova, D. and Kolodziej, B., 2010.** Late Jurassic-Early Creyaceous Foraminifera from stramberk-type limestones, polish outer carpathians. Studia Universitatis Babes-Bolyai, Geological, Vol.55,No.2,pp:3-31.
13. **Jamalian, M., Adabi, M., H., Moussavi, M., R., Sadegh, A., Baghbani, D., Ariyafar, B., 2011.** Facies characteristic and Paleoenvironmental veconstruction of the Fahliyan Formation, Lower Cretaceous in the Kuh-e Siah area, Zagros Basin, Southern Iran.Facies. Vol.57,pp:101-122.
14. **Hosseini, S., A. and Conrad, M., A.,2008**. Calcareous algae, foraminifera and sequence stratigraphy of the Fahliyan Formation at Kun-e-Surmeh (Zagros Basin, SW of Iran). Geologia Croatica, Vol. 61. No. 3, pp:215-237.

15. **Rostami, L., Vaziri, S., H., Jahani, D., Solgi, A., Abad, M., T., Carevic, I., Yahyaei, A.,2018.** Benthic Foraminiferal and calcareous algal biostratigrphy of the Fahliyan Formation in oil well XI, Dorood oilfield, Persian Gulf. Geopersica, Vol.8, No.2, pp: 319-329.
16. **Yokoyamo, M., 1890.** Foraminiferen aus dem Kalksteine von Torinosu und Kompira: Wien, Denkschriften der Kaiserlichen Akademie der Wissenschaften: Mathematisch-Naturwissenschaftliche Classe, 57, 26-27.
17. **Flügel E. 2004**. Microfacies of Carbonate Rocks. Analysis, Interpretationand Application.Springer Berlin Heidelberg New York.976 p.
18. **Ivana, D.,1999.** Middle Callovian to Valanginan Microfossil Biostratigraphy in the west Balkan Mountain, Bulgavia (se Europe). Act palaeontologica Romanian, Vol.2,pp: 231-236.
19. **Rami, M., Vaziri, M., R., Abad, M., T., K., Hasseini, S., A., Carevic, I., Allamh, M., 2012**. Revista Mexicanade Ciencias Geologicas, Vol. 29, No. 1, pp: 63-75.
20. **Elliott, G. F., 1968,** Permian to Paleocene calcareous algae (Dasycladacea) of the Middle East. Bull. British Mus. (Nat. Hist), Geology Supplement. 4, 111p, 24 pls., 16 Text-figs. London.
21. **Krobicki, M. and Olszewska, B., 2005.** Urgonian- type microfossils in exotic pebbles of the Late Cretaceous and Palaeogene gravelstones from the Sromowce and Jarmuta Formation (Pieniny Klippen Belt, Polish Carpathians).studia Geologica Polonica, Vol. 124, pp:215-235.
22. **Velic, I., 2007**. Stratigraphy and Palaeobiogeog raphy of Mesozoic Benthic Foraminifera of the Karst Dinarides (SE Europe). Geologia croatica, Vol. 26,pp:1-60.