



## Sedimentological study of the Lower-Middle Miocene Sequences at Selected Wells in Jambur and Khabaz oilfields, NE Iraq

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### Abstract

The study includes petrographic and stratigraphical characteristics of the lower-middle Miocene sequence at selected wells from Jambur and Khabaz oilfields. Four hundred and sixty thin sections from Jeribe, Serikagni, Euphrates, Dhiban, Anah and Azkand formations in four wells from Jambur and Khabaz oilfields are studied. The stratigraphic study indicates that contact between Jeribe and Fa'tha formations, Jeribe and Dhiban formations are unconformable in all wells under study, while the contact between Jeribe and Anah, Anah and Azkand, Euphrates and Serikagni formations are conformable.

The petrographic study reveals that most of the studied formations are limestone rich in benthonic foraminifera especially in Jeribe and Anah formations, with low percentage of planktonic foraminifera such as *Globigerina* species in Serikagni and Azkand formations. Additionally, echinoids, coral algae, ostracoda and intraclast remains are present. Non-skeletal component such as pellets and ooids are rare in Euphrates Formation. Microfacies analysis shows the presence of several microfacies distributed in the studied formations.

The environments of lower-Middle Miocene formations have been concluded from petrography and microfacies studies. Jeribe Formation was deposited in lagoonal or semi lagoonal environment, while Serikagni and Euphrates formations were deposited in deep marine environment and shallow open lagoon environment respectively. Closed lagoonal environment is assigned for deposition of Dhiban Formation, while slope and reef environment is recognized for the Azkand Formation and tidal and supratidal with reef marine tropical environment for the Anah Formation.

### Introduction

The lower to middle Miocene sequence at Jambur and Khabaz oilfields are represented by many formations such as Jeribe Formation, which was deposited in the Langhian cycle [1] as a cycle of shallowing-upward and composite of carbonates including foraminifera, remains of mollusca shells, echinoderm, and ostracoda. The Burdigalian cycle is represented by Euphrates, Serikagni and Dhiban formations in shallowing-upward cycle while Anah and Azkand formations were deposited in the Aquitanian cycle [2].

In the current study, four wells were selected in the Khabaz and Jambur oilfields within the Kirkuk area of northern Iraq. The (KZ-9) well is located at the

NW limb of the Khabaz oilfield and the (KZ-35) well is located at the SE limb of oilfield. The (Ja-46) well is located at the NW end of the Jambur oilfield and the well (Ja-55) is located at the far NW of the same field (Figure 1) and Table (1). The Jambur oilfield is located in northern Iraq and SE of the Kirkuk city about 20 km to the SE of the oilfields of Khabaz and Bai Hassan.

Tectonically, the area of study is located within the low folded zone within the Hemrin-Makhul zone at the unstable area of Iraq [1]. The oilfield of Khabaz is located in the SW of the Kirkuk oilfield.

The Euphrates and Jeribe formations are considered previously as one unit [3], the author also considered

that Dhiban Formation is a member of this unit. [4] studied the sedimentology of that the Sreikagni, Euphrates and Dhiban formations and divided these formations into two sub-cycles related to the early Miocene age.[5] studied the sedimentary environment of the Serikagni, Euphrates, Dhiban, Jeribe and Fa'tha formations and pointed out that the environment of the Serikagni was deep marine to open shallow marine environment, while it was shallow marine environment for the Euphrates Formation, He also mentioned that Dhiban Formation

represents a shallow semi closed marine environment. [6] studied the microfacies of Jaddala, Palani, Tarjel, Baba, Bajwan, Ibrahim, Azkand and Anah formations at Kirkuk oilfield and mentioned that these formations were deposited in tidal and basinal environments.

The aim of the study is to point out the development of lower Miocene basin of at Khabaz and Jambur oilfields by means of the petrography and microfacies of four wells in these two oilfields.

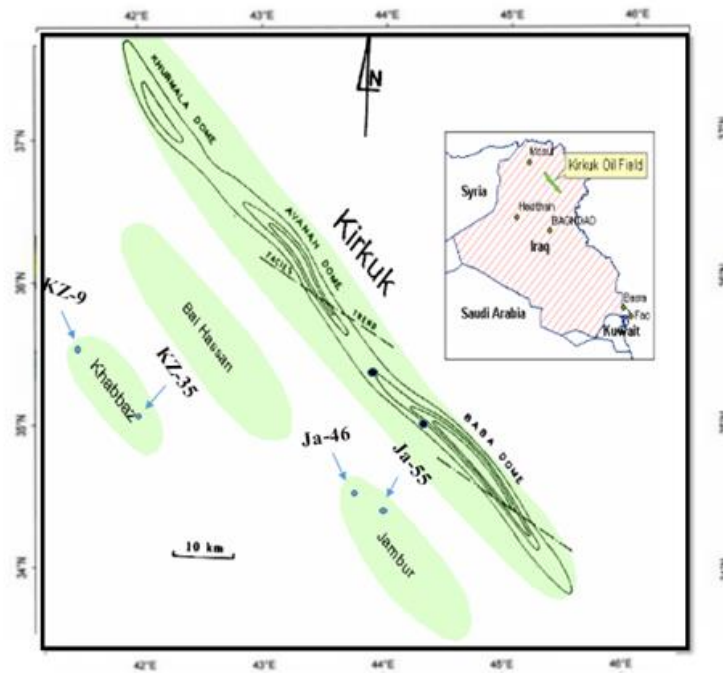


Figure (1) Map showing the location of the oilfields Jambur and Khabaz the studied wells [7]

Table (1) Formations and their thickness in the wells under study

Wells	Formation	Thickness (m)	slide	Top of Formation (m)	Bottom of Formation (m)	Location (UTM)
KZ-9	Jeribe TH (m)	25	20	2180	2205	E: 449060.2 N: 3931971.26
	Anah	25	17	2205	2230	
	Azkand	55	21	2230	2255	
KZ-35	Jeribe TH (m)	25	26	2130	2155	E: 3930498.1 N: 419385.9
	Anah	20	19	2155	2175	
	Azkand	45	12	2175	2220	
Ja-46	Jeribe	44	35	1520	1565	E:35 0946.814 N: 44 32:18.644
	Dhiban	65	49	1565	1630	
	Euphalates	35	30	1630	1665	
	Serikagni	65	20	1665	1730	
Ja-55	Jeribe	48	37	1860	1905	E: 3902 072.05 N: 446 457.43
	Dhiban	50	26	1905	1955	
	Euphrates	35	35	1955	1990	
	Serikagni	30	30	1990	2020	

## Materials and Methods

Samples are collected from the four wells under study, Ja-46, Ja-55, KZ-9 and KZ-35 (Figure 1). Four hundred and sixty thin sections were made and studied under traditional polarized microscope to identify the mineralogical composition and textures of the rocks of different formations under study. Microfacies analysis done and several microfacies have been recognized based on the classification proposed by [8] and by [9] (Figures 2-5). These microfacies were compared with the standard microfacies zones modified by [10, 11] to determine of the environmental zones.

### Microfacies

From the petrographic study, several microfacies have been recognized in the formations under study Figures (2-5), these are:

#### 1-Microfacies of Azkand Formation

The facies of this formation is characterized by limestone and dolomite and is affected by dissolution and micritization and saturated with hydrocarbons in some parts. Three microfacies are recognized:

##### A- Lime Mudstone Microfacies

Skeletal grains form less than 10% of the total components and mainly are planktonic foraminifera and organic detritus. This microfacies may indicate deposition in slope environment Plate (A-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:4) that refer to deposition in restricted platform environment [11].

##### B- Coralline Algae Lime Boundstone Microfacies

This microfacies mainly formed of coralline algae and is an indication for deposition in reefal environment Plate (F-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:4) that refer to deposition in slope than restricted platform environment [11].

#### 2- Microfacies of the Anah Formation

Microfacies of this formation are characterized by high dolomitization with association of anhydrite microfacies. The following microfacies are identified:

##### A- non-fossiliferous Lime Mudstone Microfacies

No any type of skeletal grains are recognized, but evaporates are common with severe affection by dolomitization plate (A-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:9) This is an indication for deposition in supratidal evaporative environment [11].

##### B- Miliolid Lime Wackstone Microfacies

Skeletal grains form more than 10% of the component in this microfacies and are represented mainly by miliolids with few of fecal pellets Plate (H-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:8). The microfacies is affected with various proportions with dolomitization and micritization. Deposition was in restricted lagoon environment [11].

##### C- Coralline Algae Lime Boundstone Microfacies

Coralline algae is the main component of this microfacies even it was affected by severe dolomitization in some locations Plate (F-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:5). This microfacies represents deposition in platform marine deep environment [11].

#### 3-Microfacies of the Serikagni Formation

Serikagni Formation includes three microfacies, which are affected by dissolution and dolomitization in varied proportions. These are:

##### A- Foraminifera Lime Mudstone Microfacies

Planktonic and benthonic foraminifera form the main component of this microfacies although they never exceeds 10% of the components Plate (A-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:3). The microfacies represents deposition in slope to top of slope settings [11].

##### B- Planktonic Foraminifera Lime Wackstone Microfacies

Planktonic foraminifera forms the main component in this microfacies, they are dominated by *Globigerina*, *Globorotalia* with few of benthonic foraminifera like *Textularia* Plate (C-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:3). This microfacies indicates deposition in shelf margin setting [11].

##### C- Planktonic Foraminifera Lime Packstone Microfacies

Planktonic foraminifera are dominated by *Globigerina*, *Globorotalia* and form the principal component of this microfacies with few amounts of other grains Plate (D-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:4). These foraminifera indicate deposition in deep shelf settings [11].

#### 4-Microfacies of the Euphrates Formation

Three microfacies have been recognized in the Euphrates Formation, which are affected, by dissolution and dolomitization in varied proportions. These are:

##### A- Foraminifera Lime Mudstone Microfacies

Skeletal components not exceed 10% of the components. Miliolids and *Textularia* with less of organic detritus are the main components Plate (A-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:8). The microfacies represents open lagoon environment [11].

##### B-Benthonic Foraminifera Lime Wackstone Microfacies

Skeletal components exceed 10% of the components. The main skeletal grains are miliolids and some gastropods and few of organic detritus Plate (C-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:8). It also represents open lagoon environment [11].

##### C- Oolitic Lime Packstone Microfacies

Oolite as non-skeletal grains forms more than 50-80% of the components. This microfacies is saturated

by hydrocarbons so it has dark grey color Plate (E-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:7). This microfacies represents the shoal part of the open marine environment [11].

**5-Microfacies of the Dhiban Formation**

Two microfacies have been identified in the Dhiban Formation. These are highly affected by dolomitization.

**A- Lime Anhydrite microfacies**

Anhydrite is the main composition of this microfacies with few percentage of limestone. No other skeletal grains plate (G-1). This microfacies indicate for deposition in evaporative restricted lakes [11].

**B- Miliolidal Lime Wackstone Microfacies**

Miliolids represent the most common component Plate (C-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ:9). This microfacies is affected by dissolution in varied

proportions. It indicates deposition in restricted lagoon [11].

**6-Microfacies of the Jeribe Formation**

Two microfacies have been recognized:

**A- Lime mudstone Microfacies**

Micrite forms the main component of this microfacies while the grains form less than 10% of the composition of this microfacies, most of grains are skeletal and represented by benthic foraminifera, such as miliolids, few mollusca and organic detritus, Plate (A-1). The abovementioned components refer to deposition of this microfacies facies zones (FZ-8) that refer to deposition in restricted platform environment [11].

**B- Miliolidal Lime Wackstone Microfacies**

This microfacies is common in the Jeribe Formation. Miliolid forms the dominant component with some ostracods and gastropods and fecal pellets, Plate (H-1). This microfacies is regarded as index for deposition in restricted lagoon setting[11].

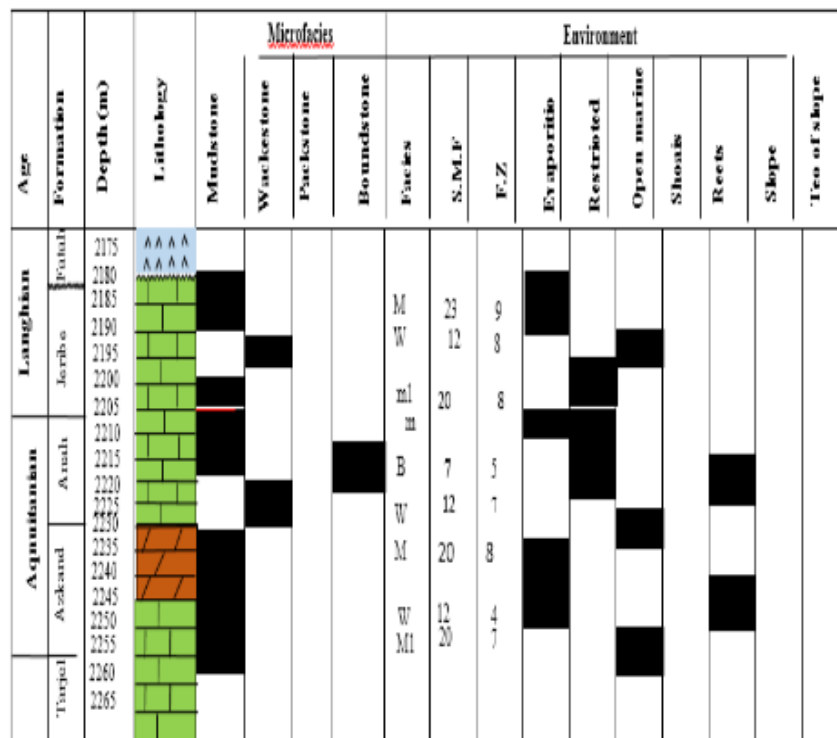


Figure (2) Shows the distribution of microfacies at well KZ-9

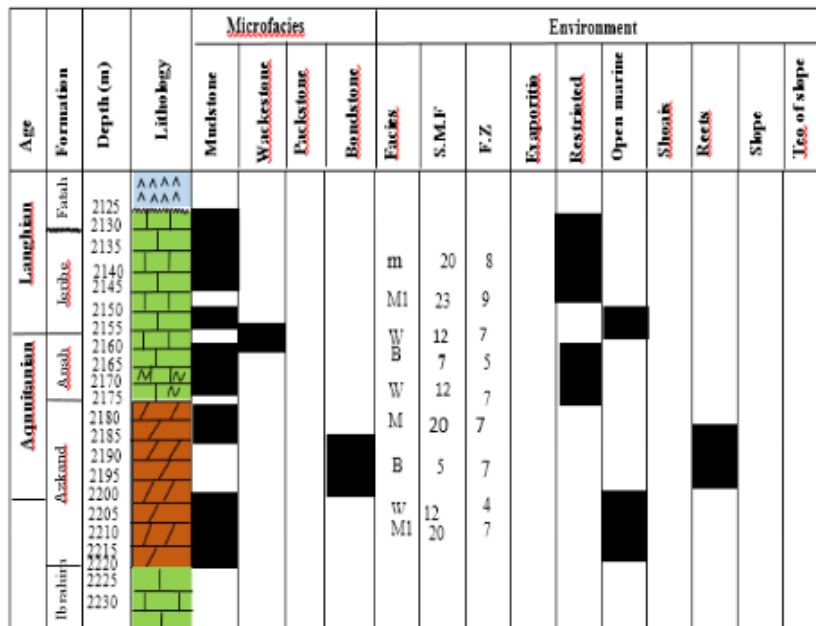


Figure (3) Shows the distribution of microfacies at well KZ-35

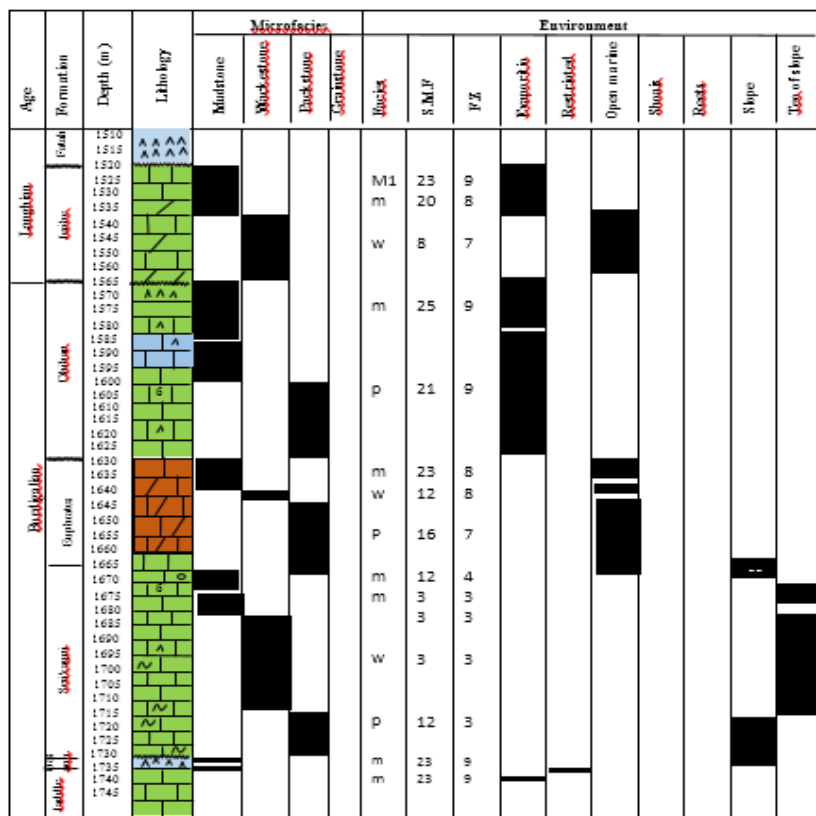


Figure (4) Shows the distribution of microfacies at well Ja-46

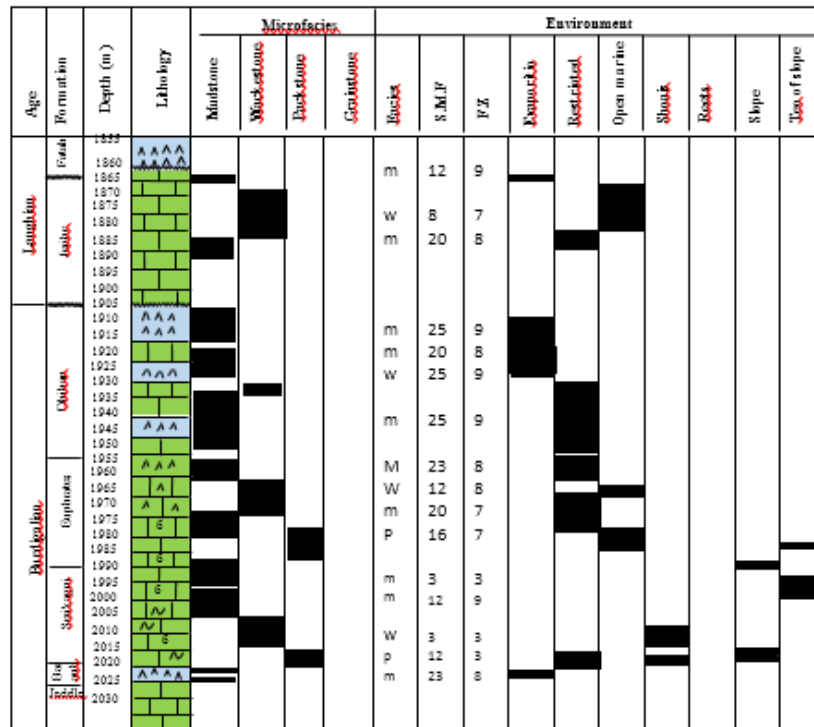
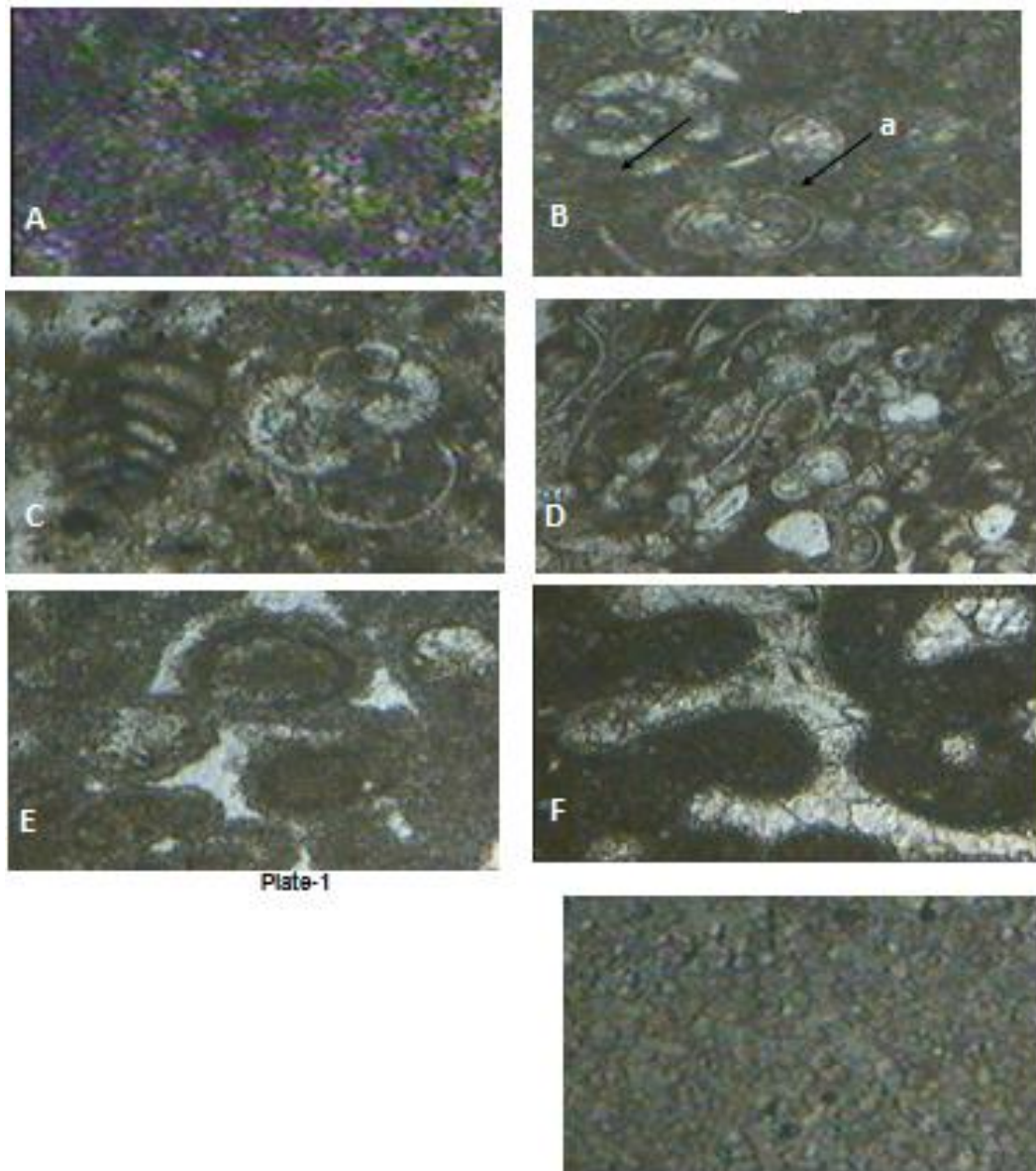


Figure (5) Shows the distribution of microfacies at well Ja-55

**Plate-1**

- A- Non-fossiliferous lime mudstone microfacies, Jeribe Formation KZ-9 well at depth 2185 m, X10 magnification.
- B- Planktonic foraminifera lime wackstone microfacies containing *Globigerina* (a) and *Globorotalia* (b), Sreikagni Formation Ja-46 well at depth (1720), X10 magnification.
- C- Planktonic and benthonic foraminifera lime wackstone microfacies, Serikagni Formation, Ja-46 well at depth 1672m, X10 magnification.
- D- Planktonic foraminifera lime packstone microfacies with the presence of the anhydrite deposited in the micrite matrix. This facies is affected

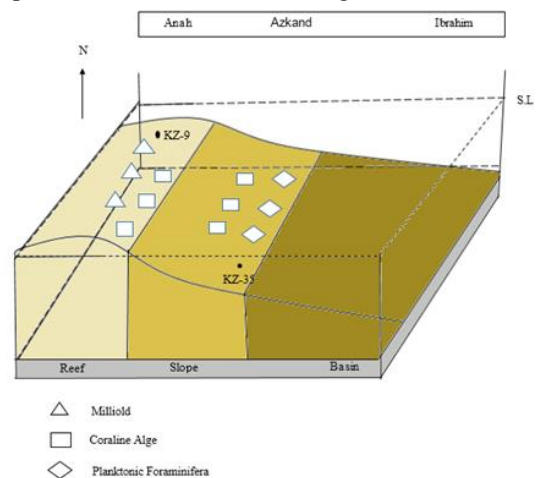
- process. Serikagni Formation, Ja-46 well at depth 1678m, X10 magnification.
- E- Oolitic lime packstone microfacies, Euphrates Formation, Ja-55 well at depth 1978 m, X10 magnification.
- F- Coralline algae lime boundstone microfacies, Anah Formation KZ-9 well at depth 2216 m, X10 magnification.
- G- Anhydrite microfacies, Dhiban Formation, Ja-55 at depth 1914 m, X10 magnification.
- H- Miliolidal Lime Wackstone Microfacies, Euphrates Formation, Ja-46 well at depth 1968m, X10 magnification.



**Depositional environment**

Petrographic description and microfacies analysis of the formations of lower-middle Miocene succession at four studied wells from Khabaz and Jambur oilfields have revealed that Azkand Formation was deposited in the two range facies (FZ. 4, 7) of the slope and the reef environment. Anah Formation was deposited in two environmental facies (FZ.5, 8), represented by tidal environment (Figure 1). Serikagni Formation was deposited in two facies (FZ 3, 4), with deep marine environment confined between the toe of the slope and the edge of the Slope margins. While the Euphrates Formation was deposited in the standard facies (FZ- 7, 8) with open lagoon environment. Dhiban Formation is deposited within the standard facies (FZ. 9) represented by closed shallow environment with a high salinity closed lagoon (Figure 2). The presence of the anhydrite is one of the most important evidences of evaporatic conditions and high salinity. Finally, Jeribe Formation deposited within standard facies

(FZ. 7,8,9). Facies zone 8 represents the lagoonal environment mostly closed from open sea with high evaporation condition [10, 11] (Figure 3).



**Figure (1) Sedimentary model for the of Aquitanian cycle (Ibrahim, Azkand, Anah)**

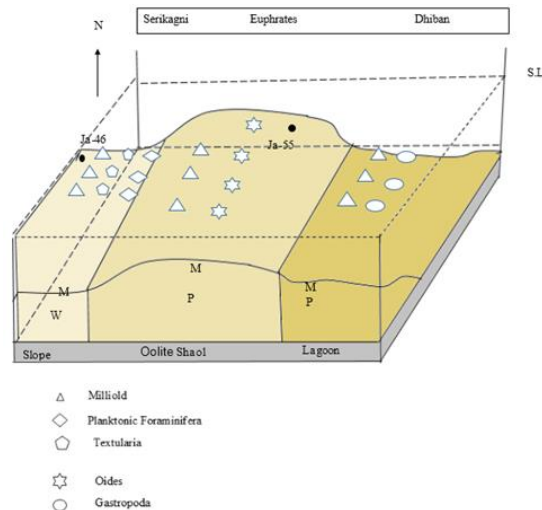


Figure (2) Sedimentary model for the of Burdigalian cycle (Serikagni, Euphrates, Dhiban)

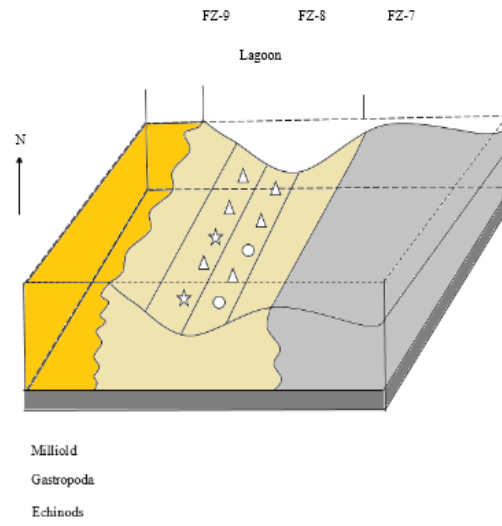


Figure (3) Sedimentary model for the of Langhian cycle (Jeribe)

## Conclusions

The Aquitanian cycle which appeared in the Khabaz oilfield is a regressive cycle involving a deep marine environment that was represented by Ibrahim Formation and shallow environments of Azkand Formation and tidal environments of Anah Formation. This cycle not extended to the areas of Jambur and the base layer of anhydrite is appeared because most of Jambur areas are high at that time.

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After the Aquitanian cycle, the Burdigalian cycle which is represented by Serikagni Formation deposited with deep marine environment. Then, depositing of the Euphrates Formation in a shallow marine environment and finally the Dhiban Formation deposited in a supratidal environment, this cycle also is a regressive shallowing upward cycle.

The third cycle is a Langhian consisting of a Jeribe and Fatha formations that appeared in the entire area of lagoonal facies.

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## دراسة رسوبية لتتابعات المايوسين الأسفل – الأوسط لأبار مختارة في حقلي جمبور و خباز في شمال شرق العراق

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### الملخص

تضمنت الدراسة النواحي الطباقية والبتروغرافية لتعاقب المايوسين الأسفل-الأوسط لأبار مختارة من حقلي جمبور وخباز النفطيين، تمت دراسة 460 شريحة صخرية للتكاوين جريبي سريكاكي الفرات ذيبان عانه وازقند في أربعة ابار من حقلي جمبور وخباز. بينت الدراسة الطباقية ان حدود التماس ما بين التكاوين جريبي والفتحة وجريبي والذيبان هي غير متوافقة لجميع ابار الدراسة. بينما تكون حدود التماس ما بين التكاوين جريبي وعانه، عانه وازقند، والفرات وسريكاكي تكون متوافقة. أظهرت الدراسة البتروغرافية ان اغلب التكاوين هي من الحجر الجيري الغني بالفورامنيفيرا القاعية وخاصة لتكاوين جريبي وعانه، مع القليل من الفورامنيفيرا الطافية مثل الكلويجيرينا في تكاوين سريكاكي وازقند، بالإضافة الى وجود الزنبيقيات والطحالب والمرجان والايوستراكودا وبقايا الفتات الداخلي. المكونات الغير هيكلية تشمل الدمالق والسرثيات وبشكل نادر في تكوين الفرات. أظهر التحليل السحني الدقيق وجود عدة سحنات دقيقة في التكاوين قيد الدراسة. بيئة تكاوين المايوسين الأسفل-الأوسط والمستنتجة من الدراسة البتروغرافية والسحنات الدقيقة هي، تكوين الجريبي مترسب في بيئة لاغونية-شبه لاغونية. بينما ترسبت تكاوين سريكاكي والفرات في بيئات بحرية عميقة وبحرية ضحلة لاغونية على التوالي. البيئة اللاغونية المغلقة هي بيئة ترسيب تكوين الذيبان، بينما الشعاب المرجانية والمنزلق هي بيئة تكوين ازقند وبيئة المدية وفوق المدية مع شعاب مرجانية مدارية هي بيئة ترسيب تكوين عانه.