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Microfacies and depositional environment of Bajawan and Baba Formations in Kirkuk Oil fields north Iraq

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Abstract
The study of six selected wells from Kirkuk oil field petrographic and physical properties ; investigation while leads to interpret the microfacies and environment for Bajawan and Baba Formations. Five carbonate microfacies distingished from Bajawan Formation (Lime Mudstone Microfacies, Fossiliferous Lime Wackstone Microfacies, Miliolid Packstone Microfacies, Miliolid Grainstone Microfacies and Coral, Boundstone microfacies), while Two microfacies described from Baba Formation (Limestone bearing Larger foraminifera (*Lepidocylina- Nummulites*) packstone-wackstone microfacies and Fossiliferous Floatstone bearing Larger Foraminifera microfacies).
According to different types of microfacies that described from Bajwan and Baba Formations , the depositional environment of Bajawan Formation is backreef/reef or restricted lagoon (inner ramp), but for Baba Formation is shallow water forereef (middle ramp). The facies model were constructed on basis of stratigraphy, lateral and vertical facies change and depositional environment of Oligocene succession.

Introduction
The Oligocene is less represented than the Eocene age. It occupied limited area, located mainly within the Mesopotamian (1). The formations of Oligocene are separated by break and unconformity from both underlying Eocene and Paleocene and overlying Miocene. The sequence of Oligocene carbonate is called Kirkuk group comprises of nine formations (Anah, Azkand, Ibrahim, Bajawan, Baba, Tarjil, Shurau, Sheikh Alas and Palani) which distributed within lower, middle and upper Oligocene. The description of carbonate rocks of Bajawan and Baba Formations is according to the carbonate rocks classification by (2) modified by (3), Microfacies determination from Bajawan and Baba Formations based on sedimentologycal features and skeletal and non-skeletal components.Six carbonate microfacies distingished from Bajawan Formation and two microfacies described from Baba Formation,these Facies associations are compared with the models of standard microfacies and depositional environment belts of carbonates proposed by (4) , (5).
Depositional environment are natural geographic in which sediment accumulates. They are characterized by sets of biological, physical and chemical parameters. The interaction of these parameter produces different sediment types or facies representative of different environment condition . A study of sedimentary facies in the rock record allows some interpretation of the conditions present in ancient depositional setting, (6). many parameters characterize depositional environment, and these can be recognized through their effect on accumulating sediment. Environmental reconstruction is based on a knowledge of environmental processes and their products, which build up the sedimentary sequence. Facies models are used as basis for understanding depositional environment and are constructed from real and theoretical studies, both of the rock record and modern environment, (6).
The basis for the study of sedimentary rocks and the best starting point for paleoenvironmental interpretation is a knowledge of modern paleoenvironmental models (7). Certain biological factor have changed with time, such as extinction and domination of Certain genera and the environmental niche inhabited by certain genera; many factor have remained unchanged , however. The development of "ancient" models based onthe rock record takes into account these factors and helps greatly in understanding the sedimentology of carbonate.
The Kirkuk oil field is located to the North-northwest of Kirkuk city Figure (1). the length of field (100) km and the width is (4.5) km
The oil wells of the present study is concerned with Baba Dome which represent a part of Kirkuk oil field structure. the wells are as follow (K-229, K-218, K-160, K-181, K-242, K-289, K-152) table (1) The thickness of Bajawan and Baba Formations in Kirkuk oil field ranges from (60-100m)(North Oil Company).

Table (1) Coordinates of studied wells

Well no.		K-218	K-160	K-229	K-181	K-242	K-289	K-152
Coordinates (UTM)	E	437086.83	436396.39	440793.337	435681.19	436072.189	442750.491	448468.085
	N	3933712.53	3935501.00	3930429.944	3933838.76	3934827.355	3930062.508	3923198.60447

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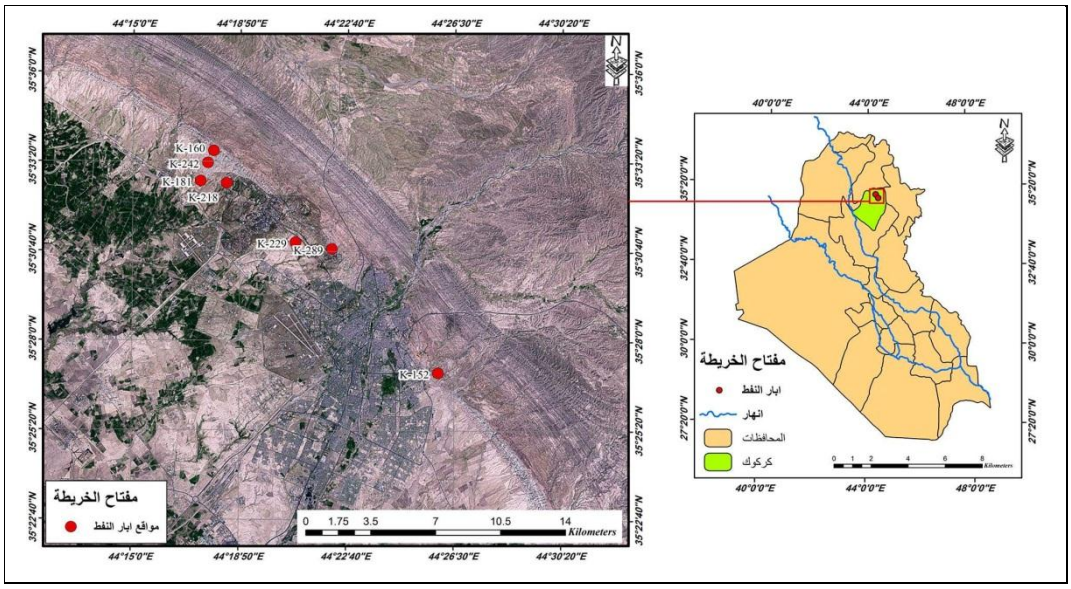

Figure (1):Location of studied area

The study area is located in northeastern part of the Arabian plate and on the unstable shelf . the selected boreholes are distributed on the foothill zone (Low folded zone) within the chemchemal –Arbil subzone (8)

The aims of current study are to interpret and to interpretation of Bajawan and Baba Formations within the studied wells to explain the environment of deposition by construct a model of sedimentation.

Previous studies

(9) He described the Kirkuk productive limestone as a reef-complex. The term "reef-complex" is applied to anaggregate of reef limestone with associated calcareous rocks, in which theback-reef, reef and forereef (basinward) can be differentiated by petrographic and micro paleontologic criteria. He also considered the integration zone between the reef-complex and basin ward sediments are favorable for the generation, migration and accumulation of oil, where the features of primary and secondary porosity and cementation in fore-reef limestone, if porous, may act as carrier beds and reservoirs.

(10) He presumed that the Main Limestone consisted of Paleocene, Lower, Middleand Upper Eocene and Lower, Middle and Upper Oligocene strata, the Oligocene successions were controlled by fringing reefs. He distinguished eight formations, with one unknown, which together form the'Kirkuk Group'. This group can be defined as a sequence of reef-controlled sediments of the Oligocene age, within which three separate reef 'cycles' canbe identified as Lower (Shurau, Sheikh Alas and Palani formations), Middle (Bajawan, Baba and Tarjil formations) and Upper (Anah, Azkand and "not known" formations) cycles; based on their relative stratigraphic positions, these sequences show lateral facies variations with backreef, reef and basinal facies. The "un known" was named "Ibrahim Formation, a basinal facies equivalent of the Anah and Azkand Formations for the upper Oligocene cycle.

(11) They classified the Oligocene strata as Early and Middle Oligocene. The Early Oligocene strata include a backreef-reef Shurau Formation, a forereef Sheikh Alas formation and a basinal Palani Formation, whereas the Middle Oligocene strata include a backreef-reef Bajawan Formation, a forereef Baba Formation and a basinal Tarjil formation.

(8) They rearranged the Oligocene deposits based on asequence of stratigraphic principles into two main sequences: the Lower and Upper Sequences. The Lower sequence comprises the reefal Sheikh Alas and Shurau formations with basinal Palani and Tarjil Formations, while the Upper Sequence comprises the reef complex of the Bajawan, Baba, Anah , Azkand and the basinal Ibrahim Formation

Practical work

The selected thin sections of Bajawan and Baba formations rocks has been studied in North Oil Company laboratories by using polarized microscope and it has been described petrographically and for the purpose of facies interpretation and classification and also to indicate the important digenetic processes which leads to determine the depositional environments and construcation the model of sedimentation. where the numbers of slides for the wells(k-160=129, k-180=88, k-229=48, k-218=59, k-242=40 , k-152=55 and k-289=8).

Results and discussion

Microfacies of Bajawan Formation

Bajawan Formation consists basically of Five microfacies easily recognizable throughout in the thin section . The lithofacies are:

1- Lime Mudstone Microfacies
2- Fossiliferous Lime Wackstone Microfacies
3- Miliolid Packstone Microfacies

4- Miliolid Grainstone Microfacies
5- Coral, Bound stone microfacies

1- Lime Mudstone Microfacies

This facies composed mainly of micrit and shells of fossils less than 10% according to (2), The thickness of this facies ranged (10-19 m.) it is found in upper and lower part of Bajawan Formation in wells K-152, K-160, K-180 and K-242. This microfacies divide to the following submicrofacies:

a. Non Fossiliferous dolomiticLime Mudstone Submicrofacies

The main characteristic of this microfacies is not contain any fossils, which is composed of dense lime mudstones and dolomitic Lime Mudstone, occurs in upper part of Bajawan Formation in contact with Fatha Formation ,also present in middle part and their apparent thickness about (10-20 m.) in upper part and about (7 m.) in middle part and only found in well K-152 (pl,1/A).This facies was deposited in nearshore, very shallow, low-energy restricted settings seaward of tidal flat. This facies refer to hypersaline situations within a shelf lagoon (11; 13).

This microfacies is similar to standard microfacies (SMF-23) that deposited in the facies zone (FZ-9) and represent very restricted bays & ponds and Restricted platform

b. Fossiliferous Lime Mudstone Submicrofacies

This Submicrofacies occured in the upper and lower part of the Bajawan Formation, it appeared in thickness about (3 m.). This facies present in wells K-152, K-160, K-181and K-242, and consist of Miliolids (pl,1/B).

This microfacies is similar to standard microfacies (SMF19) that deposited in the facies zone (FZ-8)., and represent very restricted bays & ponds and Restricted platform (4; 5).

2- Fossiliferous Lime Wackstone Microfacies:

This facies characterized by the grains with percentage >10% (4-10), and the skeletal grains of this facies include some of benthic foraminifera like *Rotallids ,Ostracod & Pelecypod* shells). This facies has been divided in to the following sub microfacis :

a. Pelecypod- Ostracod Wackstone submicrofacies

This submicrofacies is composed of dense limestone, essential faunas include mainly pelecypod and ostracod shells. This facies occurs in upper parts of the Bajawan Formation in a thickness about (5-7 m.) (pl,1/C&D). This facies comprised of echinoid, mollusca, bryozoans and corallinacean. Additional components are Miliolids, and Dendritina. Due to predominance of mud-rich texture with miliolids and the presence of a low-diversity foraminiferal arrangement A restricted platform, very shallow lagoon with quiet water conditions is suggested for deposition of this microfacies (14).

The microfacies is similar to standard microfacies (SMF19) that deposited in the facies zone Fz-7 or 8 (4; 5).

These facies appeared in all wells except well K-152. this facies represents the upper part of Bajawan Formation and in contact between Bajawan and Fatha Formation,

b. Miliolid Wackstone Submicrofacies

This facies is composed of imperforate foraminifera (miliolids, peneroplids) and other benthic foraminiferas, and composed of dense lime wackstone. This facies occurs in middle parts of the Bajawan Formation in three wells (k-152, k-218 and k-242) at thickness about (3m., 5m. and 20m.) respectively. The main facies in the Bajwan Formation is *miliolid* wackestone. They are associated with benthic foraminifera and echinoid fragment (pl,1/E&F). This facies appeared in all studied wells.

It was deposited in semi restricted marine environment (back-reef facies), the precence of a large number of imperforate benthic foraminifer tests suggests that this facies was deposited in(shallow sub-tidal ramp) by (15),also an inner ramp setting and points to nutrient-rich with slightly hypersaline and warm euphotic condition (16).

c. Miliolid, Rotalia Wackstone Submicrofacies

This microfacies is predominantly composed of Rotalia, Miliolids and others benthonic foraminiferas. In addition, large fragments of bryozoan, coral, austrotrillina, archaias, and peneroplis, occurs in minor amounts and distributed regularly among the other components (pl,2/A),. This facies is composed of dolomitic or lime wackstone and occurs in lower parts of the Bajawan Formation, in another hand,in the contact between Bajawan and Baba Formation, it appeared in a variety thickness in all the wells, (k-152,k-181, k-242, k-218, k-229 and k-160) at a thickness about (21m., 19m., 16m., 14m., 9m. and 1.5m.) respectively . It was deposited in restricted marine environment (4; 5). and according to (15) are deposited in shallow sub-tidal ramp to deeper ramp

3- Miliolid Packstone Microfacies

This microfacies, is mostly composed of benthic foraminifera, miliolids; *Peneroplis*; *Austrotrillina*; *Praerhapydionina*, *Dendritina* and other of type of miliolids, (pl,2/B), This facies occurs in middle parts of the Bajawan Formation in wells (k-160 and k-218) at a thickness about (7m.) while it appeared at thick (18m.) in well k-229. It was deposited in shallow water setting, The occurrence of large numbers of imperforate foraminifera in packstone represents restricted shallow sub-tidal environments with relatively low current energy (14; 17). The dominant packstone texture suggests depositionin a low energy environment and interpreted as microfacies 4, protected embayment in a shallow subtidal ramp by (15). This microfacies is similar to standard microfacies SMF-12 of (5), that deposited in the facies zone FZ-5

4- Miliolid Grainstone Microfacies

This facies is composed skeletal graine precentage >60% of imperforate foraminifera (miliolids). Other common constituents include benthic foraminiferas

such as *Peneroplis, Dendritina rengi* and *Meandropsina anahensi* (pl,2/C),

This microfacies is composed of dense lime grainstone .This facies was deposited in restricted circulation condition in a protected lagoon environment (open lagoon) and backreef (4; 5). grainstone texture is occur in the depositional environment of suggested a relatively moderate to high energy regime, may be influenced by waves and currents.

This facies appeared in all wells studied except the well K-229, the thickness of this facies is about (21m., 16m., 12m., 10m. and 8m.)from wells (k-152, k-242, k-160, k-181 and k-218)) respectively.

This microfacies is similar to standard microfacies SMF18 of Flügel (2004) that deposited in the facies zone FZ-8 .

5- Coral, Boundstone microfacies

It is present as a patch reefs which are common in open (non-restricted) lagoons and/or barrier reef which separated the open marine from a restricted lagoon (18) This microfacies is predominantly composed of coral and echinoid fragments, coral are abundant (pl,2/D),

This facies occurs in lower parts of the Bajawan Formation where it is contact with Baba Formation, and this facies appeared in two wells just of K-160 and K-152, the thickness about (2m. and 19m.) respectively.

The most abundant microfacies in reef environment (coral build up reef facies) are Coralline Boundstone. The presence of coral refer to upper part of a carbonate slope environment in oligotrophic situation (4;5). This microfacies is similar to standard microfacies SMF-7 of (5) that was deposited in the facies zone FZ-5.

Microfacies of Baba Formation:

Baba Formation comprise of two lithofacies where diagnosed by study of the thin section; The lithofacies are:

1- Limestone bearing Larger foraminifera (*Lepidocylina - Nummulites*) packstone - wackstone microfacies

2- Fossiliferous Floatstone bearing Larger Foraminifera microfacies

1- Limestone bearing larger foraminifera (Lepidocylina- Nummulites) packstone -wackstone microfacies

This microfacies is predominantly composed lime packstone-wackstone, where represent the upper and middle part of Baba Formation. The predominant grain types are large perforate foraminifera consists of *Lepidocyclina, Nummulites, Heterostegina, Rotalia, amphistegina* and *operculin)* (pl,2/E),

This facies appeared, in all wells, where consider main facies fore Baba Formation and occur in middle and lower part in different thickness about (10-50m.) in all studied wells .

Larger foraminifera are typically associated with tropical and subtropical shallow-water carbonate sediments (19). They can form a considerable portion of the skeletal debris of reef and platform environments. It was deposited in reef to an open marine environment The high diversity of plentiful hyaline, large and flat foraminifera such as *Nummulite* and *Lepidocyclina* and presence of typical open marine, normal salinity and oligophotic zone in a shallow open marine setting (17; 20). This flattened test shapes suggest that this microfacies was deposited in the lower photic zone in the distal middle ramp (19, 21; 22; 20) This microfacies is similar to standard microfacies zone 7 by (15).

2- Fossiliferous Floatstone bearing large Foraminifera microfacies

This facies occur in Baba formation in upper part of Baba Formation, so it was observed in wells K-160 and K-181 only (pl,2/F), The predominant grain types are corallinacean and larg perforate foraminifera (hayaline) consists of *Lepidocyclina* and *Heterostegina*. The minor constituents are echinoid, mollusca, bryozoan, dasyclacean alga and other large foraminifera such as *rotalia, amphistegina, operculina*. with some massive coral and platy algal (*Archeolithothamnian, Lithothamnian*) where large fossils are abundant. For coarse fossiliferous bioclastic limestones, the terms floatstone where the bioclasts (>2mm diameter), the bioclasts are supported by finer sediment.This facies are deposited in forereef position, and reef slopes, or in. middle ramps. The microfacies is similar to standard microfacies MSF-5 that deposited in the facies zone FZ-3 or 4 (4; 5).

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PLATE−1-

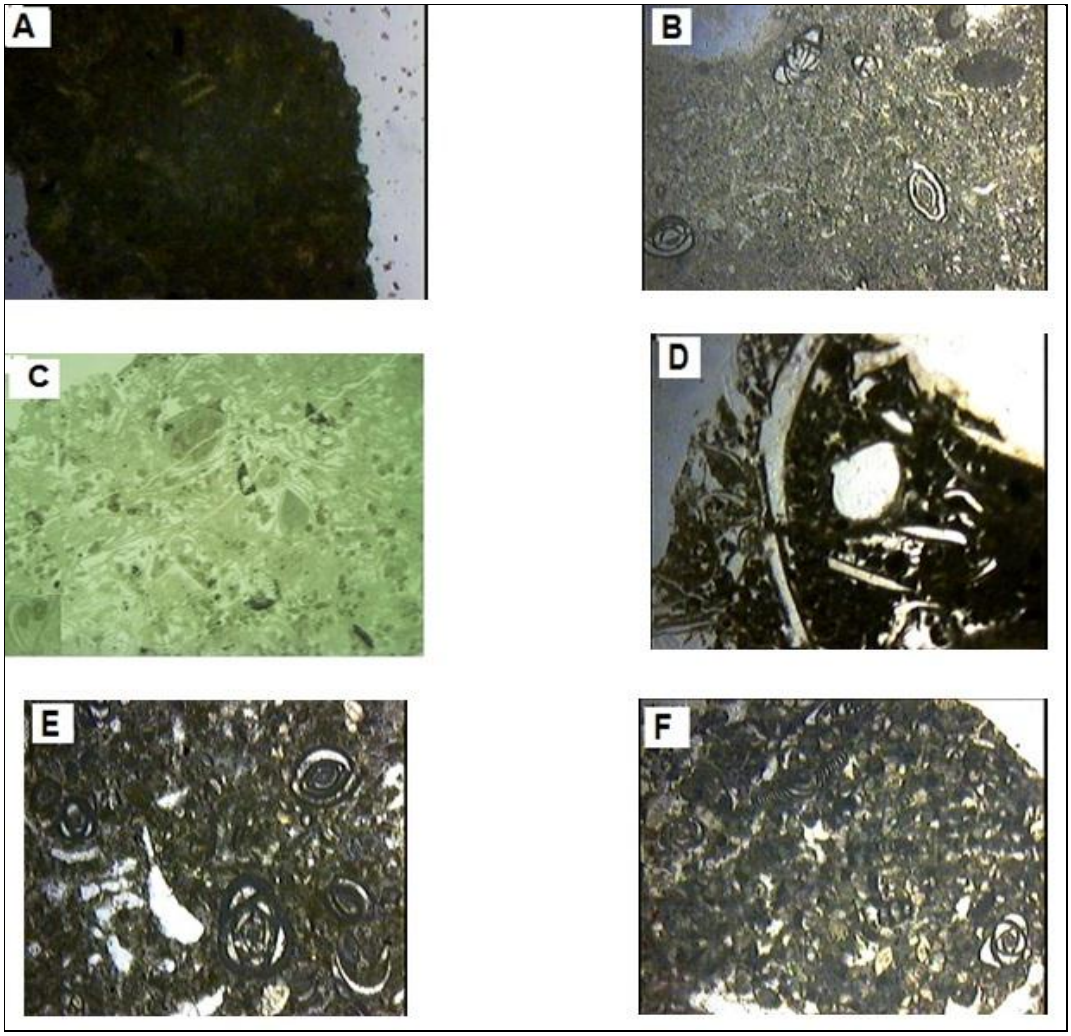

Plate -1- : A- Non Fossiliferous dolomiticLime Mudstone Sub Microfacies in Bajawan Formation in well k-152 with depth 641.7m., sample of catting,. microscope polarizer X- 0.7
B- Fossiliferous Lime Mudstone Sub Microfacies, in Bajawan Formation in well k-181 with depth 616m., sample of core/7,. microscope polarizer X- 1.5
C- pelecypod- ostracod wackstone sub Microfacies, in Bajawan Formation in well k-181 with depth 581m., sample of core/1,. Lightcure microscope X- 1
D- pelecypod- ostracod wackstone sub Microfacies, in Bajawan Formation in well k-229 with depth 420m., sample of catting,. microscope polarizer X- 0.7
E- Miliolid Wackstone Sub Microfacies in Bajawan Formation in well k-152 with depth 637m., sample of catting, . microscope polarizer X- 1.5
F- Miliolid Wackstone Sub Microfacies in Bajawan Formation in well k-242 with depth 382m., sample of catting,. microscope polarizer X- 1.5

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PLATE -2-

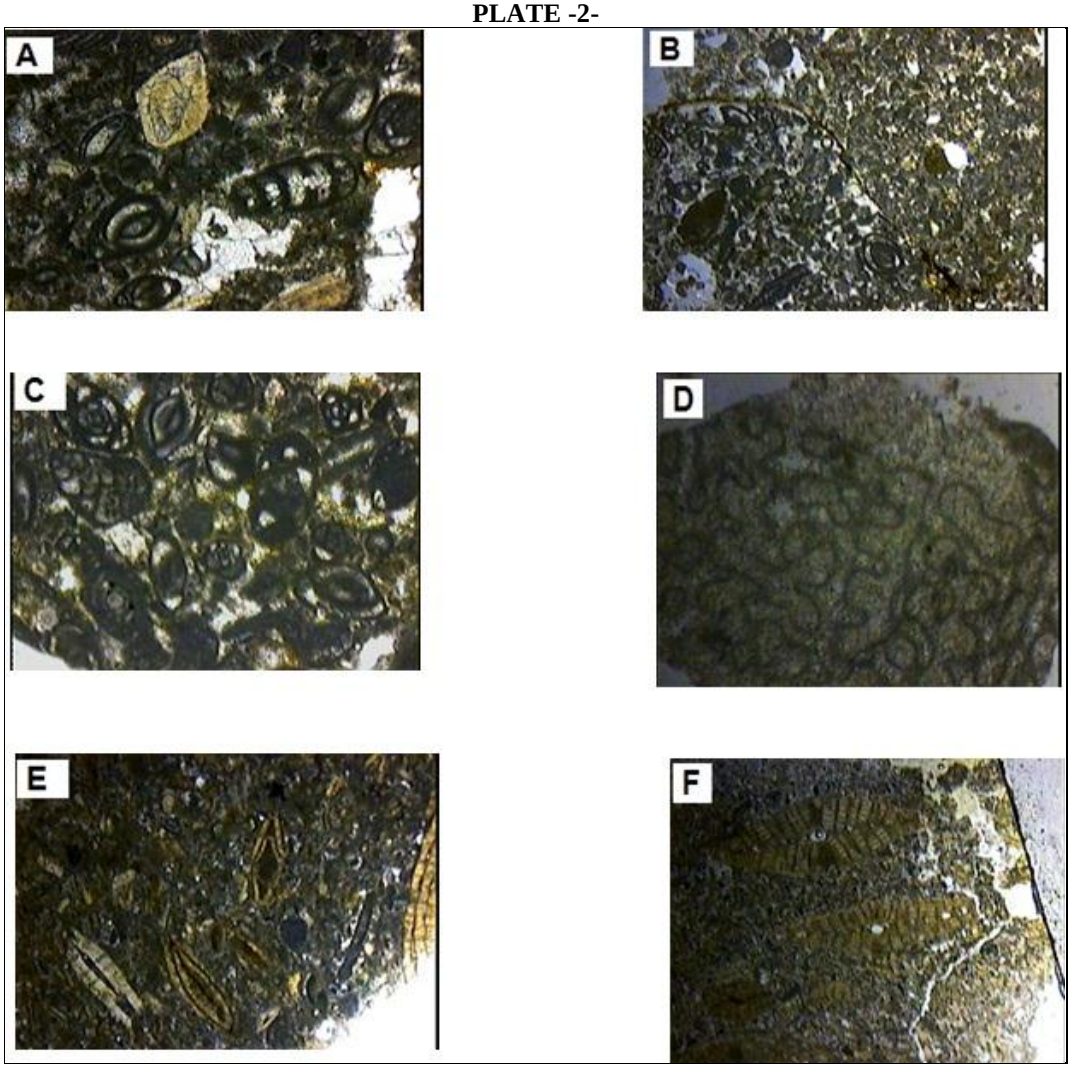

Plate -2-: A- Miliolid, Rotalia Wackstone Sub Microfacies, in Bajawan Formation in well k-181 with depth 607m., sample of core/5, . microscope polarizer X- 1.5
B- Miliolid Packstone Microfacies, in Bajawan Formation in well k-160 with depth 397m., sample of core/2, . microscope polarizer X- 0.7
C- Miliolid Grainstone Microfacies, in Bajawan Formation in well k-160 with depth 391m., sample of core/1, . microscope polarizer X- 1.5
D- Coral, Bound stone microfacies, in Bajawan Formation in well k-152 with depth 651m., sample of cutting, . microscope polarizer X- 0.7
E-Limestone bearing Larger foraminifera (Lepidocylina- Nummulites) packstone -wackstone microfacies, in Baba Formation in well k-160 with depth 427m., sample of core/6,. microscope polarizer X- 1.5
F- Fossiliferous Floatstone bearing Larger Foraminifera microfacies, in Baba Formation in well k-160 with depth 431m., sample of core/7, . microscope polarizer X- 1.5

Depositional Environment of Bajwan Formation:
According to different type of microfacies that identified from Bajwan Formation , their comparison with the similar standard microfacies and It is equlivent depositional environment by (4;5), as well as the existence imperforate (porcaleneous) larger Foraminifera like *Archaias kirkukensis* and *Praerhapydionina delicata*, with the *Milliolides Austrotrillina asmariensis* and *Heterotrillina hensoni* together with *Peneroplis evolutus*, *Peneroplis thomasi*, *Archaias kirkukensis* that give indication that the depositional environment according to(14) deposil in the back reef environment; In addition, *Miliolids* are indications of very shallow, hyposaline to hypersaline and restricted environments and reflect decreased circulation and likely reduced oxygen contents or euryhaline conditions figures (2, 3, 4, 5, 6, 7) .
The dominant packstone texture suggests deposition in a low energy environment and interpreted as microfacies 4, protected embayment in a shallow subtidal ramp by (15), also an inner ramp setting and

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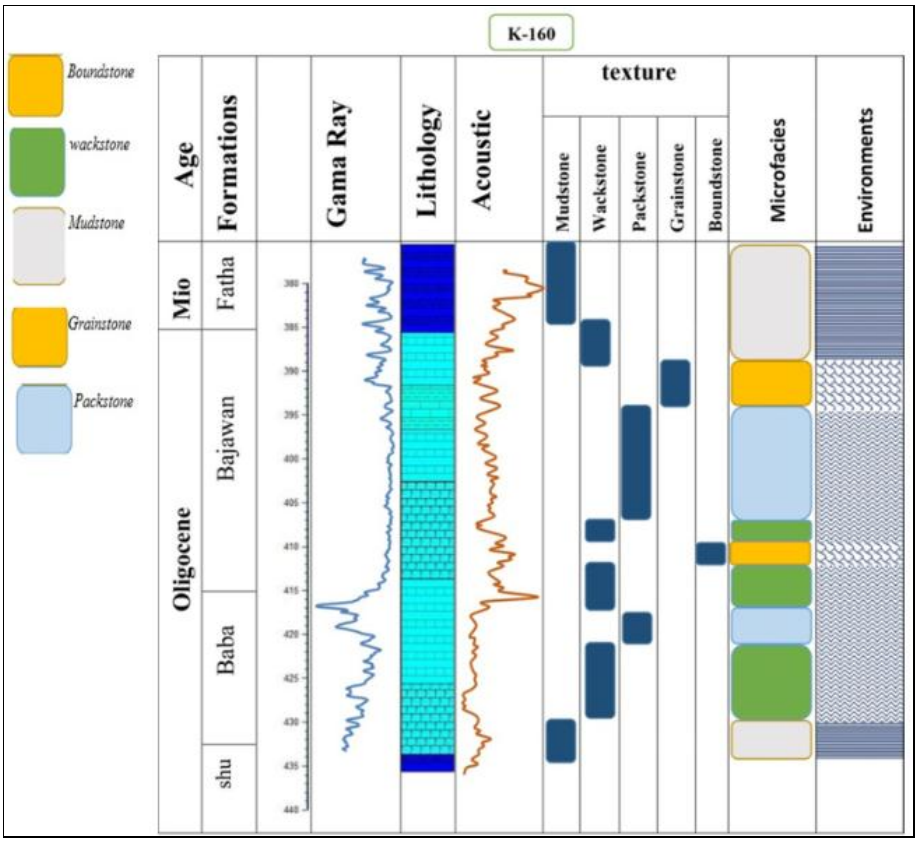
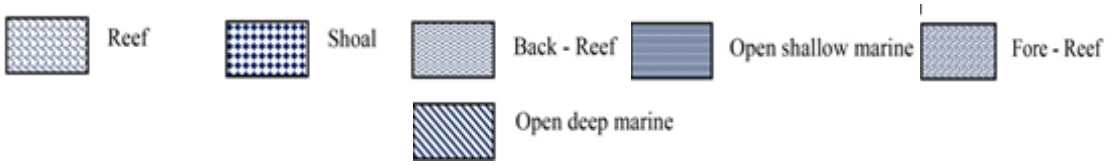
points to nutrient-rich with slightly hypersaline and warm euphotic condition (16).

Depositional Environment of Baba Formation:

The existence of Limestone bearing Larger foraminifera (*Lepidocylina- Nummulites*) packstone -wackstone microfacies espically in the middle and Lower part of Baba Formation . The predominant grain types are large perforate foraminifera consists of *Lepidocyclina, Nummulites, Heterostegina, .,rotalia, amphistegina* and *operculin* are typically associated with tropical and subtropical shallow-water carbonate sediments (Hottinger 1983). They can form a considerable portion of the skeletal debris of reef and platform environments, The flattened test shapes of large perforate foraminifera suggest that this microfacies was deposited in the lower photic zone in the distal middle ramp (19; 20; 21; 22; 23) This microfacies is similar to standard microfacies zone 7 by (16).



(Fig. 2): Stratigraphic column of the Oligocene succession at k-160 showing texture and environment



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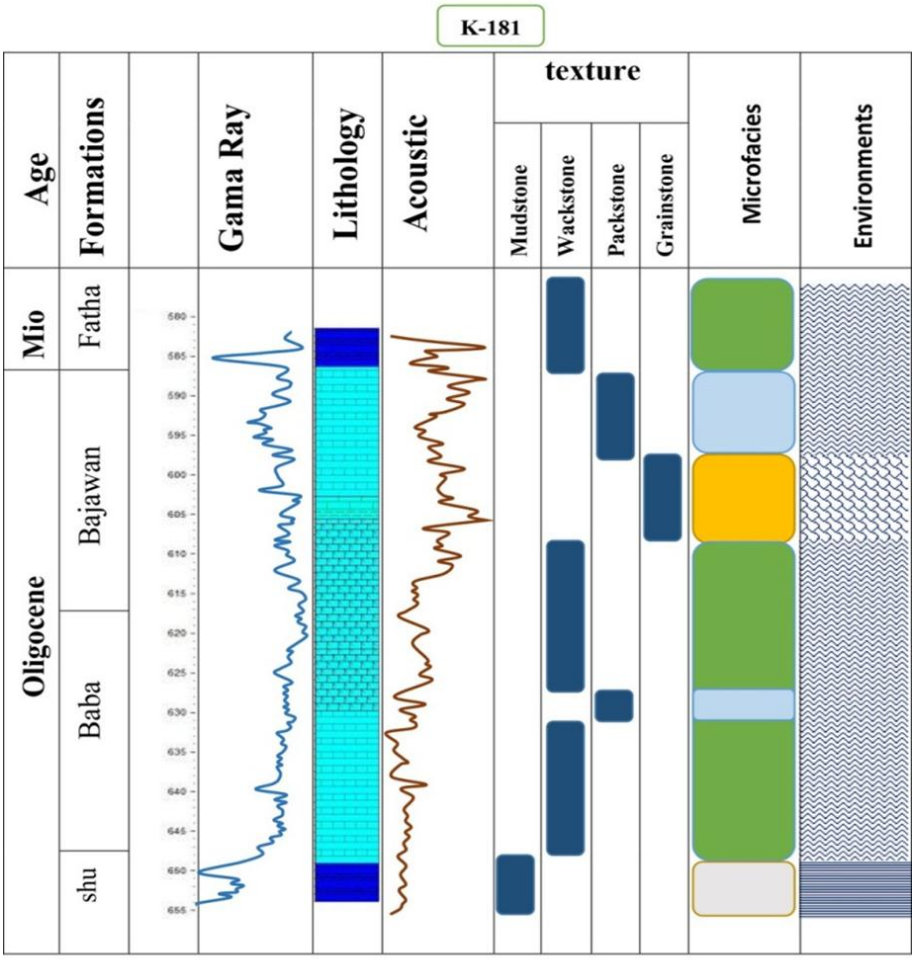

(Fig. 3): Stratigraphic column of the Oligocene succession at k-181 showing texture and environment

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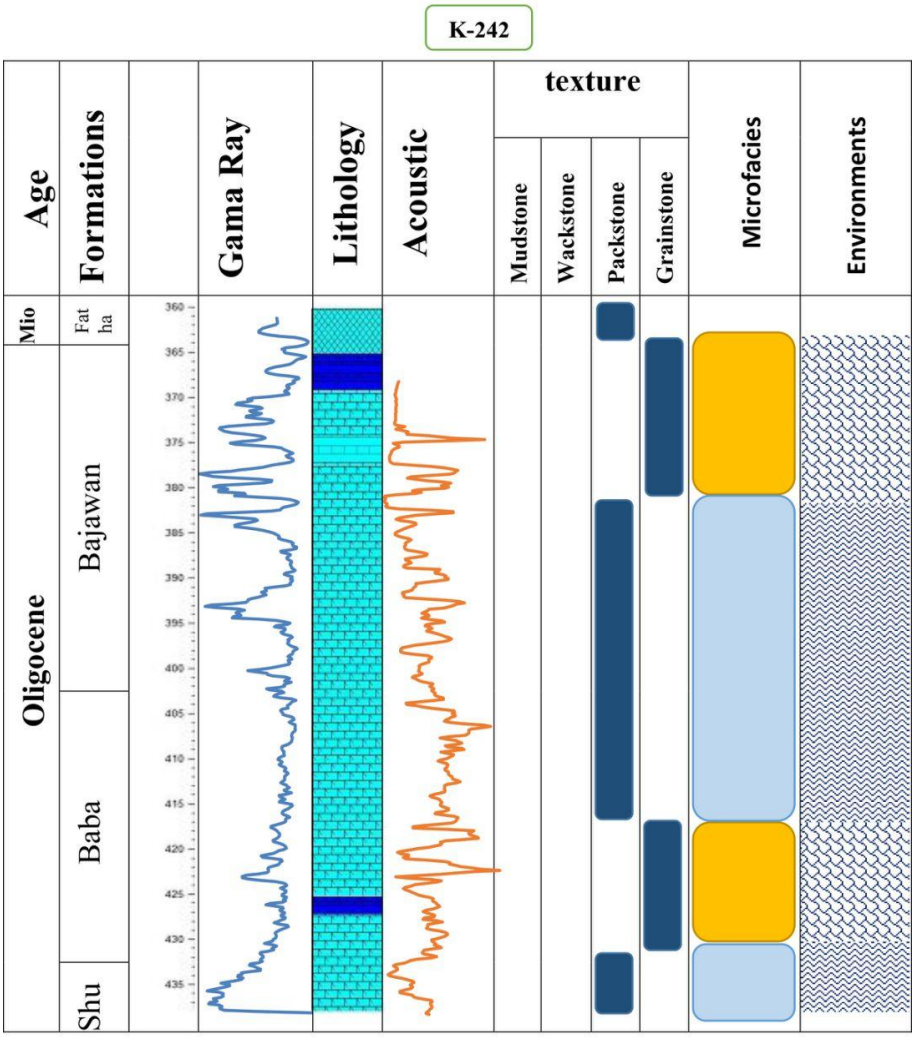

(Fig.4): Stratigraphic column of the Oligocene succession at k-242 showing texture and environment

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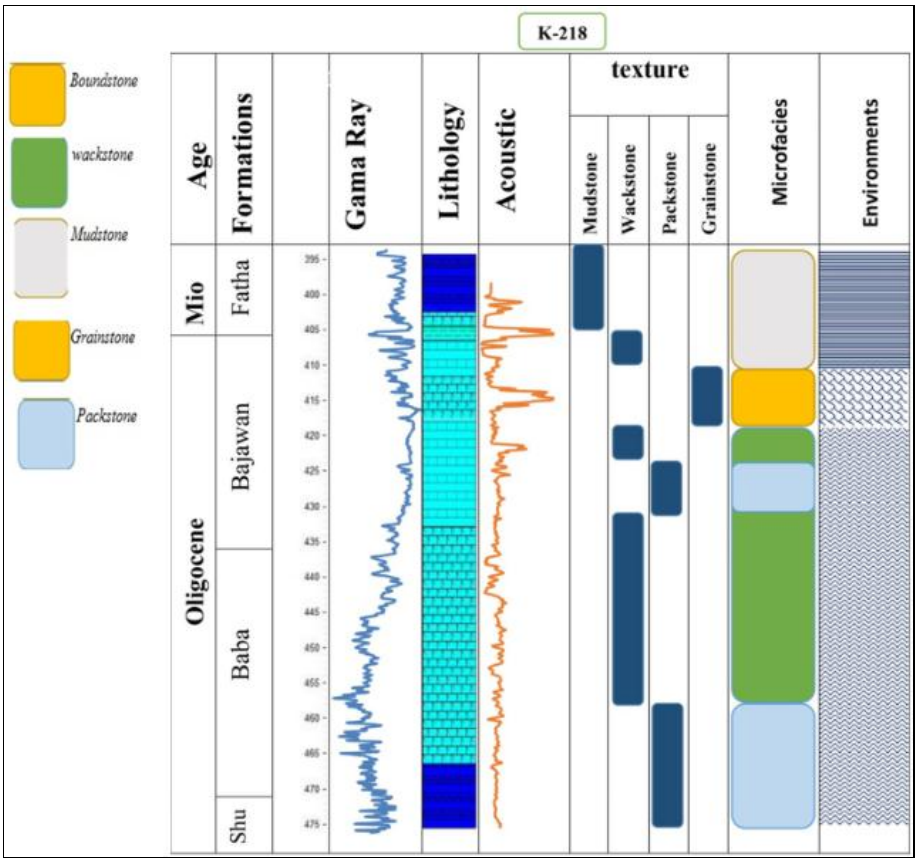
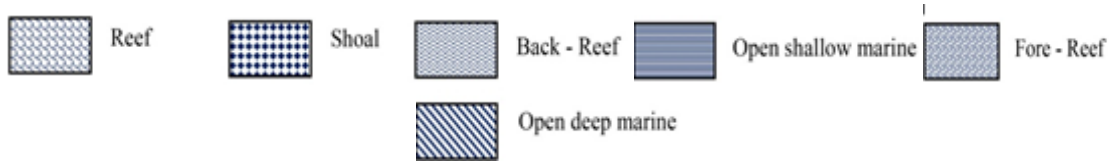


(Fig. 5): Stratigraphic column of the Oligocene succession at k-218 showing texture and environment



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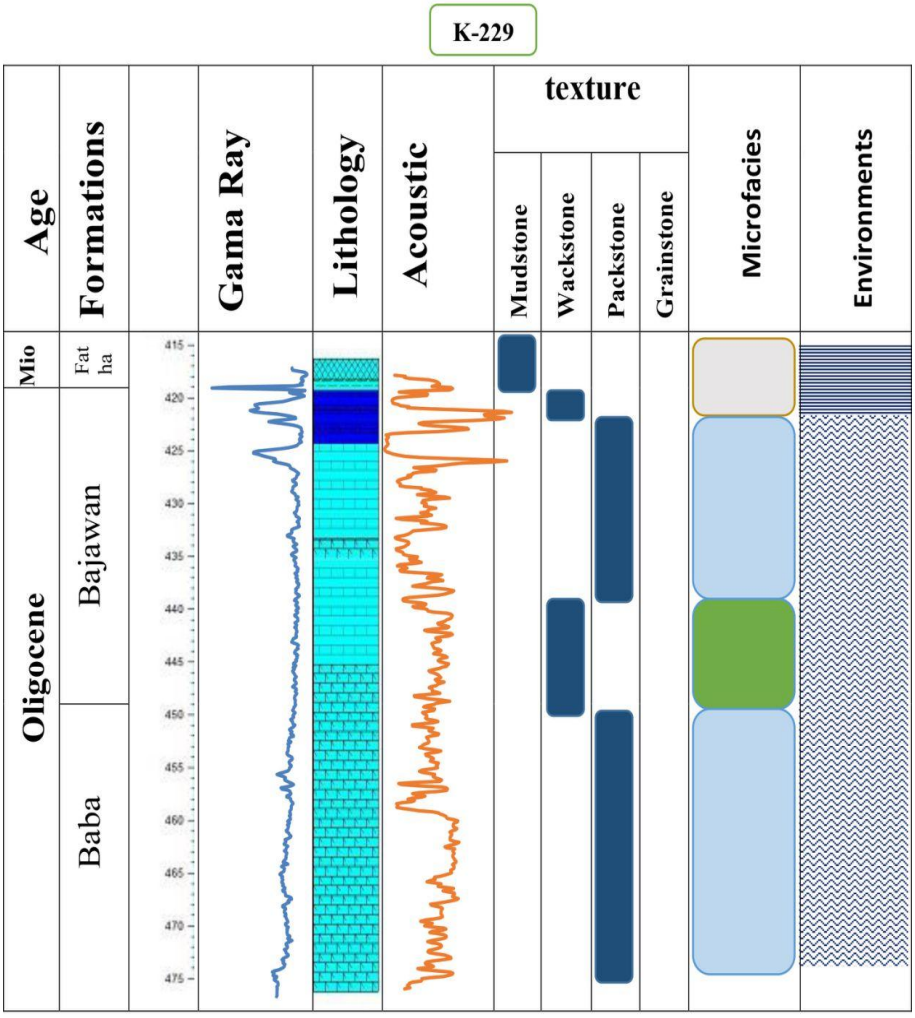
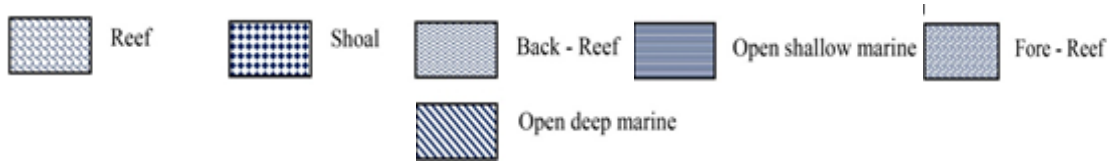


(Fig. 6): Stratigraphic column of the Oligocene succession at k-229 showing texture and environment



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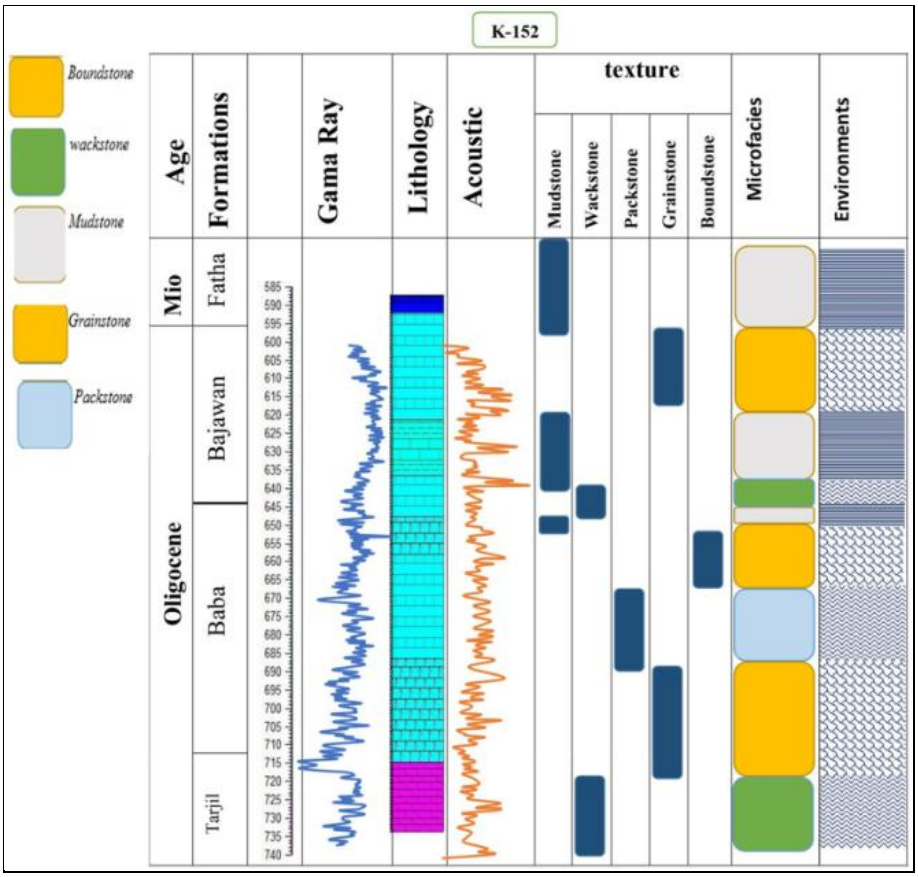
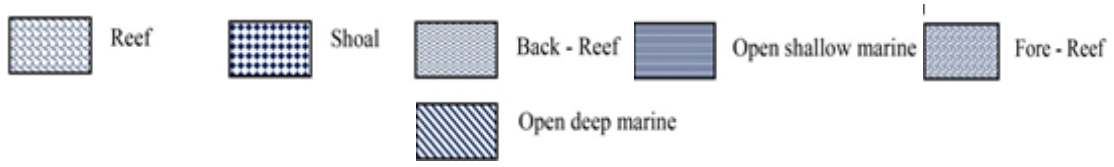
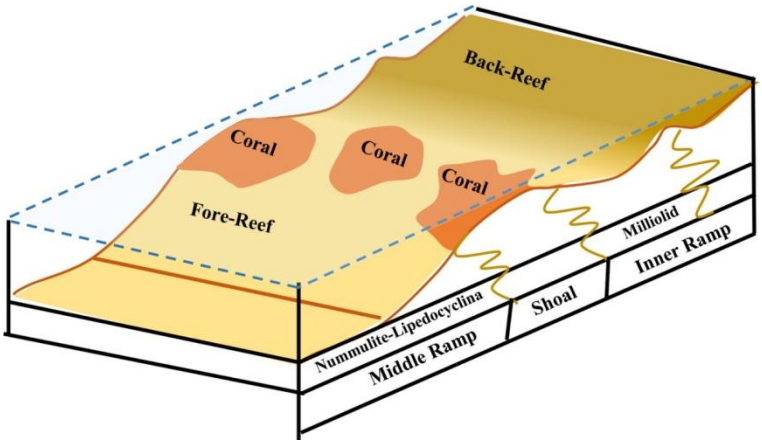


(Fig. 7): Stratigraphic column of the Oligocene succession at k-152 showing texture and environment



Depositional Environment model :

Oligocene cycle; second reef The sequences of Late Oligocene seem to be like Early body originated in which reef-fore reef facies (Baba Formation) and reef- back reef and reef-lagoon facies Bajawan Formation) were deposited .The second cycle of Late Oligocene is developed almost similarly with relatively extensive reef association which indicates longer high stand (interval as compared to the lower cycle (24). During Late Oligocene period, the createdreef-back reef facies (represented by Bajawan Formation) and reef-basin is occupied by forereef facies Baba Formation). Both of them have unconformabely set on the previous Lower Oligocene sequence which included Shurau and Sheikh Alas Formations; A transgressive reef building shoreward over its earlier back reef lagoonal facies is seen in Kirkuk oil field where Late Oligocene reef and fore reef deposits have built shoreward over the earlier Lower Oligocene reef (Edgell, 1997) The back reef-reef facies of the Bajwan Formation started prograding over the forereef Baba Formation and overlies it conformably The facies model of Bajawan and Baba Formation were deposited on a carbonate shelf, dominated by large bentic foraminifera, coralline algae and subordinately, echinoids, bryozoans, colonial corals Depending on stratigraphy, sedimentology, distribution of foraminifera, vertical and lateral facies relationships, two depositional environments are identified in the Oligocene succession in the study section, These include inner shelf/ lagoon, middle shelf (ramp) (Fig.8). The construction paleoclimate anddistribution certain skeletal grains suggest that carbonate sedimentation of these formations took place in tropical waters under oligotrophic to slightly mesotrophic conditions.



(Fig.8): Depositional model for the platform carbonates of the Bajawan and Baba Formations

References

1 Jassim, S. Z., Karim, S. A., Basi, M., Al-Mubarak, M. A., Munir, J.,1984. Final report on the regional geological survey of Iraq, Volume 3,Stratigraphy. Manuscript report, Geological Survey of Iraq.

2 Dunham, R. J., (1962). Classification of carbonate rocks according to depositional texture. In: Ham, W. E., (eds.), Classification of carbonate rocks, , AAPG., Mem.1, PP. 108-121.

3 Embry, A.F., and Klovan, E.J., 1972. A Late Devonian reef tract in North Eastern Banks Island. North West Territories. Can Petrol. Geology Bull.vol.19, pp. 730-781 .,

4 Wilson JL (1975). Carbonate Facies in Geological History. Berlin-Heidelberg. New york: Springer. Pp471. Flügel E (1982). Microfacies analysis of limestones. Berlin - Heidelberg New York, Springer. 633p

5 Flügel, E. 2004. Microfacies of carbonate rocks: analysis, interpretation
and application, Springer Verlag. 984p.

6 Elf-Aquitaine., 1982. Paleoecological conditions andmorphological variation in monospecific banks of Nummulites: anexample. Bulletin des Centres de Recherches Exploration Production Memoire, 6, 557-563.

7 Heckle, P.H., 1983. Diagenetic Models Pennsylvania, Custatic Cyclo-thems, Jou. of Sed.. Pet.V.53,No.3,PP.733-789.

8 Jassim, S. Z., Goff, J. C., 2006. Geology of Iraq. Dolin. 341pp

9 Henson, F. R. S., 1950a. Cretaceous and Tertiary reef formations and associated sediments in Middle East. American Association of Petroleum Geology Bulletin, 34, 215–238.

10 Bellen, R. C. Van., (1956): the stratigraphy of the main limestone of Kirkuk, Bai-Hassan and Qarah Chauq Dagh structures in northern Iraq. Inst. Petroleum found. Vol. 42, London.

11 Majid, A. H., Veizer, J. A. N., 1986. Deposition and Chemical Diagenesis of Tertiary Carbonates, Kirkuk Oil Field, Iraq. AAPG Bulletin, 70, 898-913.

12 Amirshahkarami, M., Vaziri-Moghaddam, H., Taheri, A. 2007.Sedimentary facies and sequence stratigraphy of the Asmari Formationat Chaman-Bolbol, Zagros Basin, Iran. Journal of Asian EarthSciences, 29, 947-959.

13 Amirshahkarami M, Ghabeishavi A, Rahmani A (2010). Biostratigraphy and paleoenvironment of the larger benthic foraminifera in wells sections of the Asmari Formation from the Rag-e-Safid oil field (Zagros Basin, southwest Iran). Stratigraphy and Sedimentology Researches. 40(3): 63-84

14 Geel T (2000). Recognition of stratigraphic sequence in carbonate platform and slope: empirical models based on microfacies analysis of Paloogene deposits in southeastern Spain.
Palaeogeog. Palaeoclimatol. Palaeoecol. 155: 211–238.

15 Buxton MWN, Pedley HM (1989). A standardized model for Tethyan
tertiary carbonate ramps. J Geol Soc. Lond. 146: 746–748.

16 Yazdani R. (2014). Biostratigraphy and Facies Distribution of The Asmari Formation in Aghajari Well # 66, Zagros Basin, SW Iran. Int. Res. J. Geo. Min. 4(4): 101-115

17 Romero J, Caus E, Rossel J (2002). A model for the paleoenvironmental distribution of larger foraminifera based on late Middle Eocene deposits on the margin of the south Pyrenean basin (NE Spain). Palaeogeogr. Palaeoclimatol. Palaeoecol. 179: 43–56.

18 Tucker, M. E., Wright, V. P., Dickson, J., 1990. Carbonate sedimentology. An introduction, Vol. 3, Black well scientific publ.Oxford, 252p.

19 Hottinger, L., 1983, Processes determining the distribution of larger foraminifera in space and time: Utrecht Micropaleont. Bull. 30, p. 239-253.

20 Leutenegger, S., 1984, Symbiosis in benthic foraminifera, specificity and host adaptations:Journal of Foraminifera Research, no.14, p.16-35.

21 Hallock, P., and E.C., Glenn, 1999, Larger foraminifera: A Tool for Paleoenvironmental Analysis of Cenozoic carbonate depositional facies: Palaios, no.1, p. 55-64.

22 Reiss, Z., and L., Hottinger, 1984, The Gulf of Aqaba: Ecological Micropaleontology: Berlin – Springer. 354p.
23 Randazzo, A.G. and Zachos, L.G., 1984. classification and description of dolomitic fabric of rock from the Florida Aquifer, U.S.A.: Jour. Sed. Geii., vol. 37, No.3, pp.151-162.
24 Al-Qayim, B., 2006. Sag-Interior Oligocene Basin of North-central Iraq:Sequence Stratigraphy and Basin Overview (abstract), Middle EastConference and Exhibition; Manama, Bahrain.

دراسة السحنات الدقيقة والبيئة الرسوبية لتكويني باجوان وبابا في حقل كركوك شمال العراق

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الملخص

شملت الدراسة الحالية دراسة بتروغرافية وبتروفيزياية لستة ابار في حقل كركوك لتكويني باجوان وبابا في حقل كركوك. شخصت عدد السحنات في تكوين باجوان هي (سحنة الحجر الطيني الرئيسية, سحنة الحجر الجيري الواكي, سحنة الحجر الجيري المرصوص الحاوي على المليوليد, سحنة الحجر الجيري الحبيبي الحاوي على المليوليد, و سحنة الحجر الجيري الحاوي على الطحالب) , وفي تكوين بابا تم تشخيص سحنتين هما (سحنة الحجر الجيري الحاملة للفورامنفيرا كبيرة الحجم *(Lepidocylina- Nummulites)* الواكي–المرصوصة و سحنة الحجر الجيري الحاملة للفورامنفيرا كبيرة الحجم float stone) ,اعتمادا على السحنات الدقيقة تم تحديد البيئات الرسوبية وتبين بان بيئة تكوين الباجوان هي بيئة الحيد الريف وخلف الريف او بيئة اللاكون الممحصورة او شبه محصورة اما بيئة تكوين بابا فتمثلت ببيئة امام الحيد . وبالتالي تم رسم الموديل البيئي الذي يمثل بيئات كلا التكوينين.