MICROFACIES AND BIOSTRATIGRAPHY OF BABA FORMATION (LATE OLIGOCENE) IN BAI HASSAN, OIL WELL-25, KIRKUK AREA, CENTRAL NORTH IRAQ

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Received: 15/ 08/ 2010, Accepted: 16/ 06/ 2011
Key words: Larger Foraminifera, Baba Formation, Late Oligocene, Chattian, Kirkuk, Iraq

ABSTRACT

Larger Foraminifera in the Baba Formation (Middle Oligocene) are discussed. The investigation is based on a well sequence of limestone in Bai Hassan oil well -25, Kirkuk area central northern part of Iraq. Baba Formation is subdivided into three microfacies, which are: Fine to very coarse larger Foraminifera packstone, Fine bioclastic smaller Foraminiferal packstone and Fine bioclastic smaller Foraminiferal wackestone. The depositional environment of Oligocene Carbonate may be a part of an attached platform area, where more or less open marine prevailed through out.

دراسة السحنات الطباقية الحياتية لتكوين بابا (الأوليگوسين المتأخر) في بئر باي حسن-25، منطقة كركوك، وسط شمال العراق

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المستخلص

تمت دراسة الفورامينفرا الكبيرة في تكوين بابا (الأوليگوسين الأوسط)، حقل نفط باي حسن في بئر-25. تمت الدراسة الحالية بالاعتماد على التتابع للحجر الجيري (فتات حياتي). تم تقسيم تكوين بابا إلى ثلاثة سحنات رئيسية: السحنة الأولى تشمل باكستون محتوى على بايوكلاستيك دقيق إلى خشن للفورامنيفيرا الكبيرة، السحنة الثانية تشمل باكستون محتوى على الفورامنيفيرا الصغيرة، السحنة الثالثة تشمل واكستون إلى دولستون محتوي على بايوكلاستيك دقيق للفورامنيفيرا الصغيرة. تمت دراسة البيئة الترسيبية للاوليگوسين الكاربوناتي، وبينت الدراسة بأنها جزء من منطقة الرف المثبت وترسبت في بيئة بحرية مفتوحة.

INTRODUCTION

The studied area is located within Kirkuk Governorate in central northern part of Iraq, which is located at latitude 36º 19' 12" and 36º 18' 30" and longitude 45º 10' 15" and 45º 09' 44" (Fig.1) (Buday, 1980). The Oligocene sediments in Iraq have relatively restricted area of distribution, and are reduced in thickness too (Bellen, 1956).

Baba Formation was first defined by Bellen in 1956 from Kirkuk oil well-109, lithologically consists of porous dolomitized limestones, in surface outcrops the limestone has a chalky appearance, which is mostly massive, with some bedded parts (Bellen *et al*., 1959). The formation was deposited in fore-reef area of both northeastern and southeastern margins of Oligocene Basin. Ditmar *et al*. (1971, p.97) claimed that the Baba Formation is representative for northeastern area (Present studied area) only. Ctyroky and Karim (1971) proved the existence of the formation along the southeastern shore area, around Anah too, where; the thickness of the formation is even bigger than in the northeast, fossils are abundant. According to Hay and Hart (1959) the thickness of the formation is even bigger

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than in the northeast. In the type area Bellen *et al*. (1959, p.47), recorded the presence of rare *Lepidocyclina* s.l. spp., *Nummulities fichteli*, *Operculina* sp., *Rotalia viennoti*, and *Heterostegina* cf. *assilinoides*. The age of the formation according to Bellen *et al*. (1959, p.47) is Middle Oligocene. The Formation overlies in the type area the Lower Oligocene Shurau Formation conformably. In Anah area (Fig.1), the underlying formation is Sheikh Alas Formation, an unconformable contact might be supposed their too. While the upper contact in the type area is conformable, the Bajwan Formation is the overlying unit (Buday, 1980). In Anah area, the overlying unit is Anah Formation, the contact is, gradational and conformable. This however, strongly supports the idea of Ditmar *et al*. (1971, p.96) concerning the rough identity of the Anah – Azkand and Bajwan – Baba duplets. In central part of Iraq, the formation occurs widespread in all oil wells, southwest of the Lesser Zab River, in Kirkuk structure. It also occurs in the northeastern flank of the Bai Hassan structure, and outcrops in the northern dome of Qarah Chough Dagh. Northwards, the Baba Formation is formed in Gusiar oil well No.1 and wells in Ain Zala structure (Bellen *et al*., 1959). The formation occurs along both the northeastern and southwestern shore areas of the Oligocene sea. On the surface, it croups-out in Qarah Chough Dagh along the northeastern shore region, and along the Euphrates valley to the west of Anah, along the southwestern shore area. In subsurface sections, the formation occurs between Ain Zala, Bai Hassan, and Kirkuk in the northeast and in Anah, Hit, Faluja, Dujaila and ? Afag. In the southwest, the formations of Oligocene are separated by breaks and unconformities from both underlying and overlying units (Buday, 1980).

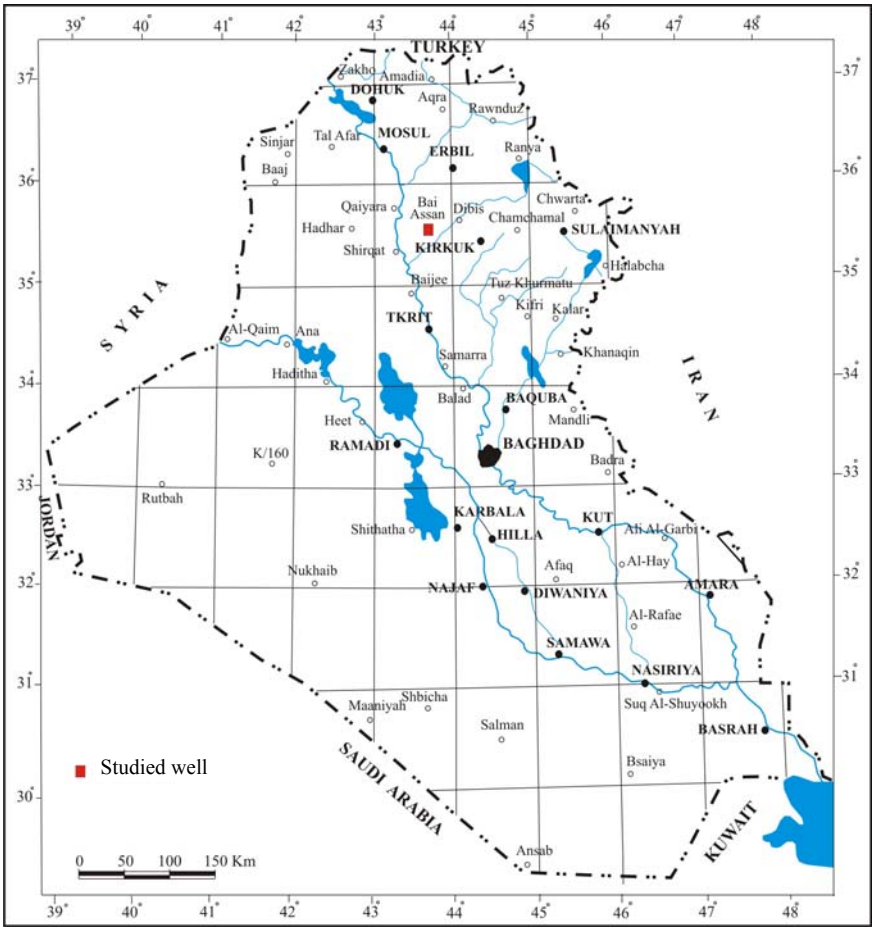

Fig.1: Location map of the studied well

In Azkand and Baba formations, larger foraminifera are typically associated with shallow water carbonate sediments; the facies change continuously in this environment. Many studies referred to the occurrence of Miocene Azkand Formation, which directly overly Oligocene Baba Formation (Fig.2) in the same section. In the present study only Baba Formation is involved, which is overlain by Bajwan Formation and underlain by Shurau Formation.

Age \ Facies		Reef/ Back reef	Fore-reef	Off-shore
Miocene	Aquitanian	Anah	Azkand	Ibrahim
Oligocene	Chattian	Bajwan	Baba	Tarjil
	Rupelian	Shurau	Sheikh Alas	Palani

Fig.2: Lithostratigraphic units of Kirkuk Group. Subdivisions are based on age, facies and the relationships between reef, back-reef, fore-reef and off-shore facies (Modified from Bellen, 1956)

Although the Baba Formation has been studied sedimentologically and paleontologically from different oil fields in Iraq, Late Oligocene age is suggested according to the prevalence of faunal content (Mohammed, 1983; El-Eisa, 1992; Bakkal and Al-Ghreri, 1993; Abid, 1997; Al-Guburi, and El-Eisa, 2002 and Ghafor, 2004). Recently in the world, Late Oligocene was studied paleontologically by Baumgartner-Mora *et al*. (2008), from Nosara (Nicoya Peninsula, Costa Rica) and Windward (Camacou, Grenada, Lesser Antillies), and (Gedik, 2008) from Denizli region, SW Turkey.

MICROFACIES

Oligocene Baba Formation in Bai Hassan oil well-25, is subdivided into three microfacies (Fig.3), they are from the lower part to the upper part of the section, as follows.

- **Microfacies I**

It consists of larger Foraminiferal packstone. The lowermost interval of this section is characterized by presence of larger foraminifera with Mollusc and Algae bioclastic facies of about 26 m thick, which shows general fining upwards, and deepening. The relative frequency of the planktonic foraminifera in association with smaller foraminifera, is variable with a peak values of 55 percent. The coarse fraction of the packstone is dominated by larger foraminifera, echinoid and algal bioclasts, especially the later, which in most cases are of the Melobesioid type; it generally has a subrounded shape. The ratio of P (P + B) is high, which indicates that the sediments were deposited on a relatively shallow, open marine slope or platform.

- **Microfacies II**

It consists of smaller foraminiferal packstone. The thickness of this facies is about 25 m, which consists of vaguely bedded, fine and medium grained packstone, in which larger bioclasts are very rare. Bioturbation is the most frequently observable sedimentary structure, with small scale burrows. The previous facies is marked by an increase of the grain size above this facies and generally fining upwards coarse to medium packstone.

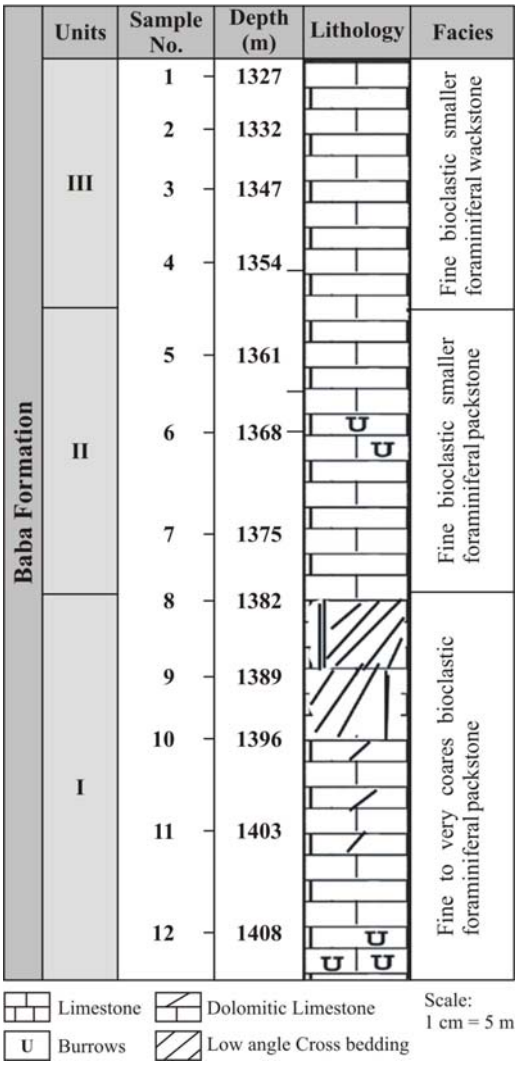

Fig.3: Lithostratigraphic column of the section in Bai Hassan oil well-25

- **Microfacies III**

It consists of fine bioclasts with smaller foraminiferal wackestone. The thickness of this facies is a bout 30 m, in which it's lower part, is dolomitized and associated with high frequency of badly preserved *Lepidocyclina*. The lower part is dolomitized too.

BIOSTRATIGRAPHY

The following microfauna are identified in limestones of the Baba Formation (Fig.4). *Nummulites vascus* Leymerie; *Lepidocyclina(Eulepidina)dilatata* Michelotti; *Lepidocyclina (Eulepidina)* sp., *Lepidocyclina (Nephrolepidina) praemarginata* Douville, *Lepidocyclina (Nephrolepidina) morgani* Lemoine and Douville, *Nummulites fichteli* Michelotti *Spiroclypeus* spp. *Heterostegina costata* d'Archiac*Ethellia alba* Van Bosse; *Planoorbulina* sp.; *Operculina complanata* Defrance; *Corallaria* sp.; *Archaias asmaricus* Smout and Eames, *Rotalia viennotti* Grieg; *Valvulina* sp.; *Austrotrillina asmariensis* Schlumberger; *Peneroplis thomasi* Henson; *Bigenerina* sp.; *Amphehistegina* sp. *Pararotalia* sp. *Heliastia defrancei* Mill, Edwar and Haime, Encrusting Foraminifera, based on these microfauna, the Baba Formation in Bai Hassan oil well-25, Kirkuk area are divided into *Lepidocyclina – Nummulites* Assemblages Zone, with Late Oligocene age (Fig.5).

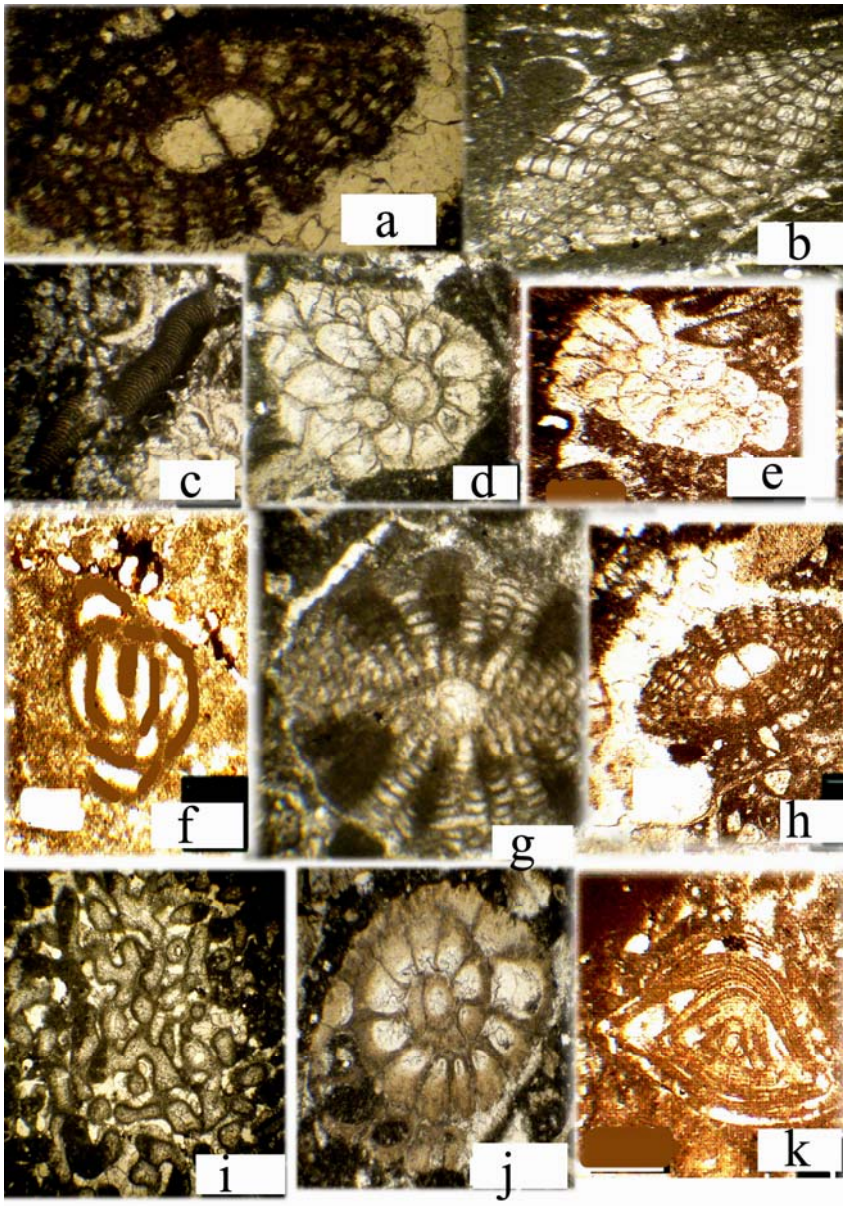

Fig.4: **a – b)** *Lepidocyclina (Nephrolepidina) morgani* Lemoine and Douville, 100X, sample No.7, Foraminiferal packstone, Baba Formation, Late Oligocene, Bai Hassan oil well-25, 1375 m depth. **c)** *Peneroplis thomasi* Henson, 100X, sample No.4, Foraminiferal wackestone, Baba Formation, Late Oligocene, Bai Hassan oil well-25, 1354 m depth. **d)** *Miogypsina tani* Drogger, 100X, sample No.10, Foraminiferal packstone, Baba Formation, Late Oligocene, Bai Hassan oil well-25, 1396 m depth. **e)** *Miogypsina gunteri* Cole, 100X sample No.11, Foraminiferal packstone, Baba Formation, Late Oligocene, Bai Hassan oil well-25, 1403 m depth. **f)** *Austrotrillina asmariensis*, Schlumberger, 100X, sample No.6, Foraminiferal packstone, Baba Formation, Late Oligocene, Bai Hassan oil well-25, 1368 m depth. **g – h)** *Lepidocyclina (Nephrolepidina) morgani* Lemoine and Douville, 100X, sample No.2, Foraminiferal wackestone, Baba Formation, Late Oligocene, Bai Hassan oil well-25, 1332 m depth. **i)** Coralline Limestone, 100X. **j)** *Dentrina rangi*, Michelotti, 100X, sample No.3, Foraminiferal wackestone, Baba Formation, Late Oligocene, Bai Hassan oil well-25, 1347 m depth. **k)** *Amphistegina* sp. 100X, sample No.12, Foraminiferal packstone, Baba Formation, Late Oligocene, Bai Hassan oil well-25, 1408 m depth.

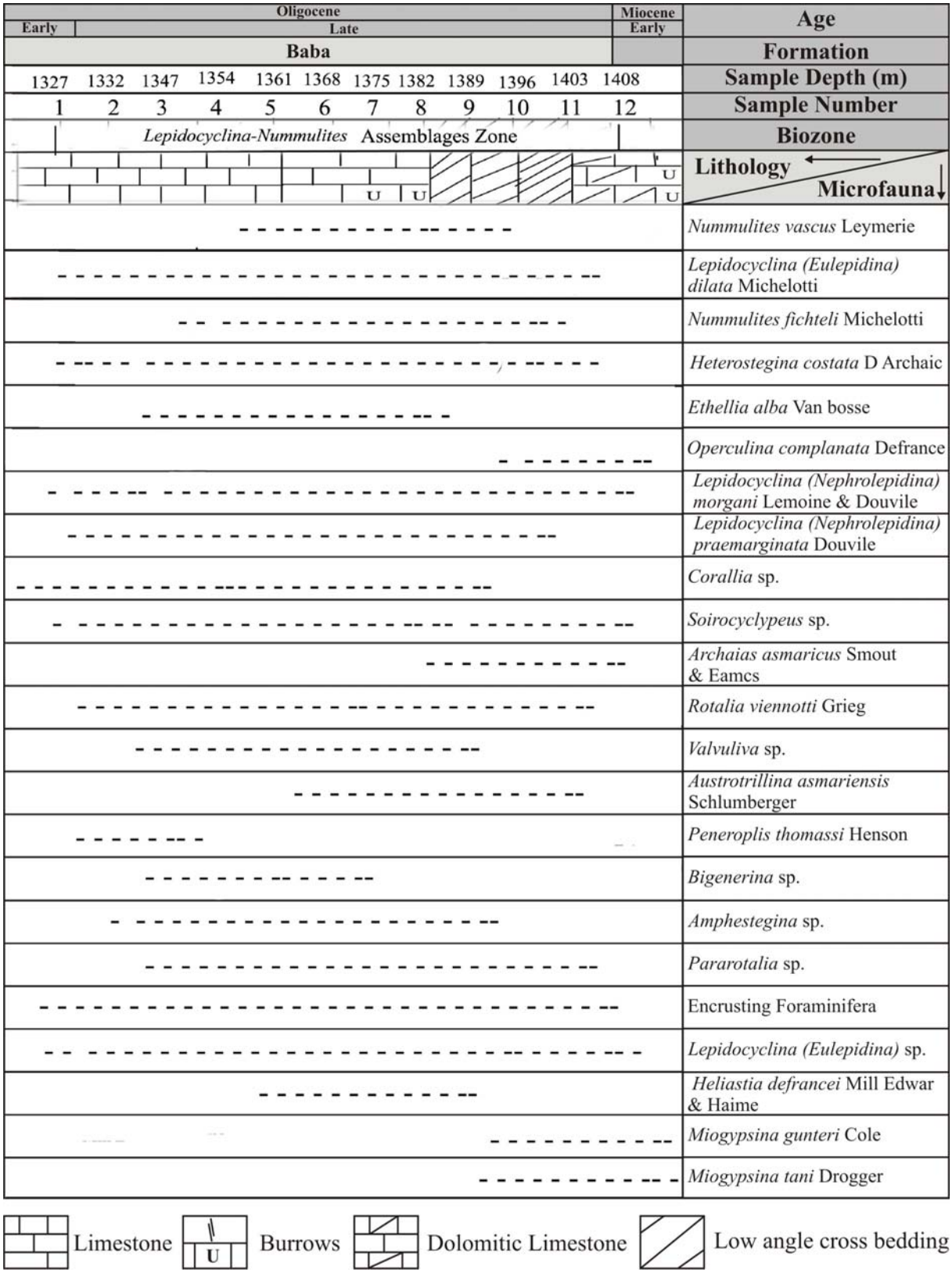

Fig.5: Biostratigraphic range chart of Bai Hassan oil well-25

DEPOSITIONAL ENVIRONMENT

The presence of coarse grained packstone and cross bedding in the lower part of the studied section, point to an increase of the hydrodynamic energy and probably to a slight deepening or more opened condition platform during the deposition of this part of the section and the positive percentage of planktonic foraminifera in this facies (part). The occurrence of *Lepidocyclina (Nephrolepidina)*, *Nummulites intermedius*, *Operculina* sp., *Heterosttegina* sp., indicate the shallow marine realm. The upward decrease of the depositional depth is uncertain for the uppermost part of the microfacies II, in which the increase of the average grain size does not continue. The hard ground at the boundary between the microfacies may represent the final expression of the shallowing trend during the deposition of the carbonate platform, because of the appearance of small size *Lepidocyclina (Nephrolepidina)*, and coral patches. In the lower part of the microfacies III, the depositional environment of the Oligocene carbonate (Baba Formation) can be characterized as a part of an attached area, where open marine conditions prevailed throughout.

CONCLUSIONS

The study acquired the following conclusions.

- Baba Formation in Bai Hassan oil well-25 is characterized by abundant larger Foraminifera.
- The age of the recorded fossil assemblages indicate Late Oligocene age for the formation.
- Three microfacies are distinguished as follows:
  - a- Fine to very coarse bioclastic larger Foraminiferal packstone
  - b- Fine bioclastic smaller Foraminiferal packstone
  - c- Fine bioclastic smaller Foraminiferal wackestone
- The depositional environment of Baba Formation may be a part of an attached platform area, where open marine condition prevailed through out.

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