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BIOSTRATIGRAPHY OF DAMMAM FORMATION SUCCESSION IN BOREHOLES N3 AND N15 IN AL-NAJAF AREA, IRAQ

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ABSTRACT

The Dammam Formation in S and SW of Iraq is an Eocene carbonate succession consisting of limestone and dolostone. Two boreholes are selected in Al-Najaf area to investigate its biostratigraphy. The biostratigraphy of Dammam Formation consists of 22 species belonging to 13 foraminiferal genera.

Two biozones are distinguished in Dammam Formation depending on the benthonic foraminiferal genus *Nummulites*. Those biozones are *Nummulites gizehensis* range zone and *Alveolina* sp. – *Coskinolina* sp. assemblage zone. According to those biozones the age of Dammam Formation is considered to be of Middle Eocene, whereas the absence of those biozones represents Lower and Upper Eocene.

الطباقية الحياتية لتتابع تكوين الدمام في آبار N3 و N15 في منطقة النجف، العراق

سلام اسماعيل الدليمي و محمد كريم عبد الحسين الوائلي

المستخلص

تكوين الدمام في جنوب وجنوب غرب العراق يمثل تتابع الايوسين الجيري ويتكون من الحجر الكلسي والحجرالدولومايتي، تمت دراسة الطباقية الحياتية للتكوين في بئرين في منطقة النجف. الطباقية الحياتية لتكوين الدمام تتكون من 22 نوع تعود الى 13 جنس من متحجرات الفورامنيفرا. وتم تمييز نطاقين حياتيين اعتماداً على الفورامنيفرا القاعية (*Nummulites*) وهذين النطاقين الحياتيين هما نطاق المدى *Nummulites gizehensis* وانطاق التجمعي *Alveolina* sp. – *Coskinolina* sp. وبموجب هذين النطاقين الحياتيين يكون عمر تكوين الدمام الايوسين الاوسط، بينما غياب هذين النطاقين الحياتيين يمثل الايوسين المبكر والمتأخر.

INTRODUCTION

The Dammam Formation is exposed in most parts of the studied area. It is composed mainly of *Nummulites* recrystallized and cavernous limestone. The Dammam Formation was first described by Bramkamp in 1941 from the Dammam dome in E Saudi Arabia (Van Bellen *et al*., 1959). It was divided into five informal members in the supplementary type section in well Zubair-3 of the Mesopotamia Zone (Owen and Nasr, 1958), Al-Mubark and Amin (1983) mapped the area regionally and divided the Dammam Formation into three informal members in study area as follows:

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- Lower Member, which has been subdivided into three units; Wagsa, Sharaf and Shbicha – Lower Huweimi Units.
- Middle Member, which has been subdivided into four units; Upper Huweimi, Shawiya, Ghabd and Radhuma – Barbak Units.
- Upper Member, which includes Ghanimi unit.

According to Al-Sharhan, and Narin, (1995), The Dammam Formation in Iraq is equivalent to the Dammam Formation in neighboring countries such as Saudi Arabia, Kuwait, Jordan (Ma'an Formation) and Iran (Juhram Formation).

The main aim of the present study includes the following: biostratigraphic analysis of the Dammam Formation based on the occurrence of *Nummulites* and other associated fossils and obtain an idea as to the age of the formation.

The studied area is located in the Southwestern Desert, within Al-Najaf Governorates, (Figure 1). Two boreholes are studied: N15 (31° 58' 53.5" N, 43° 50' 49.5" E) and N3 (31° 57' 26.0" N, 44° 03' 53.6" E). They are about 21 Km a part.

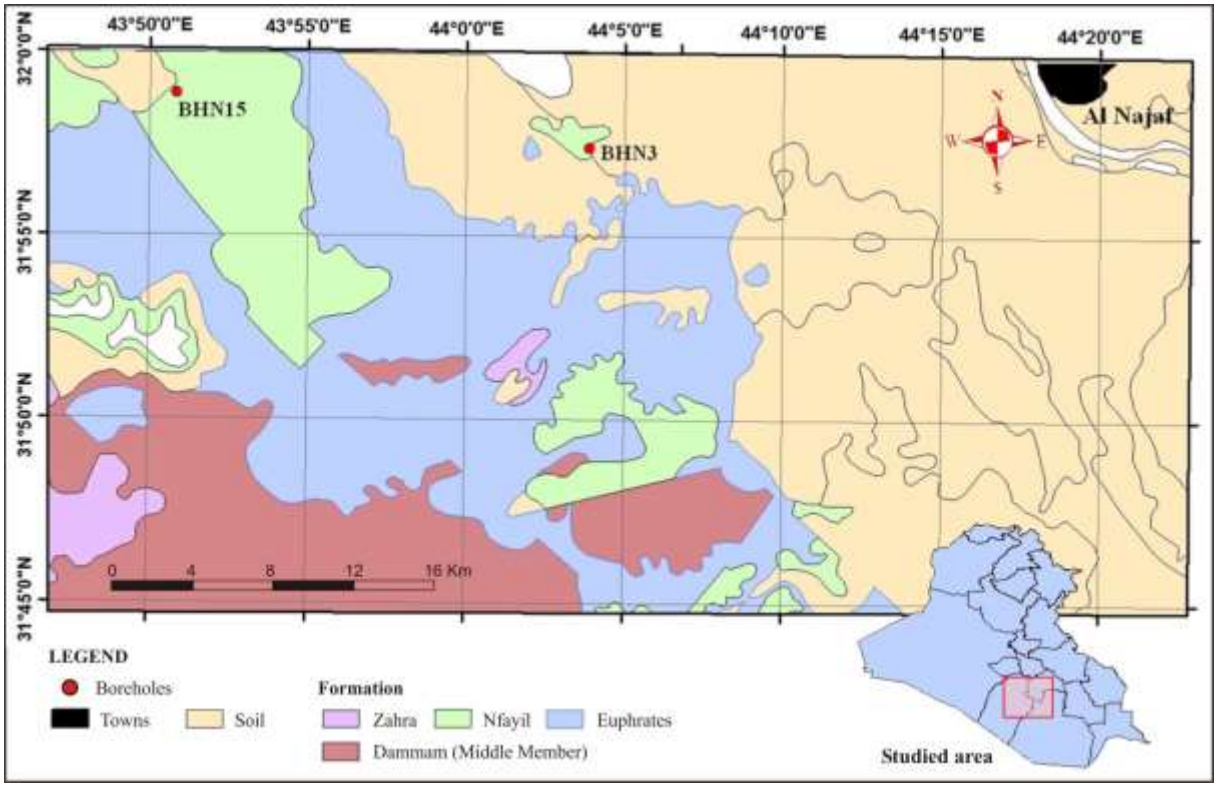

Fig.1: Location map of the study area

The Dammam Formation has been studied previously by authors such as:

– Al-Hashimi (1973) studied the stratigraphy and paleontology of Eocene succession in Western Desert and in Samawa area, He recorded the Dammam Formation in the former area and Rus and Dammam Formations in the subsurface of Samawa area.
– Amer (1980) studied the biostratigraphy and micropaleontology of Dammam Formation (Lower – Middle Eocene), from West Najaf – Nukhaib area and recorded fossils of Middle Eocene age.

– Al-Mutter (1983) studied the biostratigraphy of the formation (Lower – Middle Eocene) from South Najaf area. He found index fossil and characteristic four biozones of the Formation equivalent of Wagsa, Upper Huwiemi, Shawiya and Chabad units.
– Al-Mubark and Amin (1983) mapped regionally the Western and the Southern Desert areas. They divided the Dammam Formation into three informal members, Lower, Middle, and Upper part based on index fossils.
– Al-Mutter (1985) studied the biostratigraphy of the formation (Middle – Upper Eocene) in K.H.5, Salhubiya.
– Al-Jibouri (2003) studied the sequence stratigraphy of the Paleocene – Eocene Succession in Western and Southern Iraq. In addition, she studied different facies deposited during the different environment of Dammam Formation.

BIOSTRATIGRAPHY OF DAMMAM FORMATION SUCCESSION

The study of biostratigraphy of the Dammam Formation depends on benthonic foraminifera and other associated fossils. Some of these fossils have a short distribution, while others have long distribution.

▪ Biostratigraphy of Borehole (N15)

The following benthonic fauna are identified from the sediments of Dammam Formation (Figures 2 and 3): *Nummulites gizehensis* FORESKAL (Figure 4), *Nummulites gizehensis zeitteli* DE LA HARPE, *Nummulites bayhariensis* CHECCHIA-RISPOLT, *Nummulites elevata* AL-HASHIMI AND AMER (Figure 5), *Nummulites planulatus* LAMARCK, *Nummulites murchisoni* RUTIMEYER, *Nummulites* sp. (Figure 6), *Nummulites discorbinus* SCHLUBMERGER, *Nummulites millicopeta* BOUBEE, *Nummulites perforate* MONTFORT, *Nummulites atacicus* LEYMERIE, *Lockhartia* sp., *Spiroloclina depressa*, *Alveolina ellipica* SWOERBY, *Dictyocunoides cooks* CARTAR, *Linderina bruges* SCHLUMBERGER (Figure 7), *Rotalia* sp., *Coskinolina* sp. (Figure 8), Miliolids (Figure 9), algae, echinoid, Bryozoa (Figure 10), Pelecypoda, Gastropoda and Shell fragments.

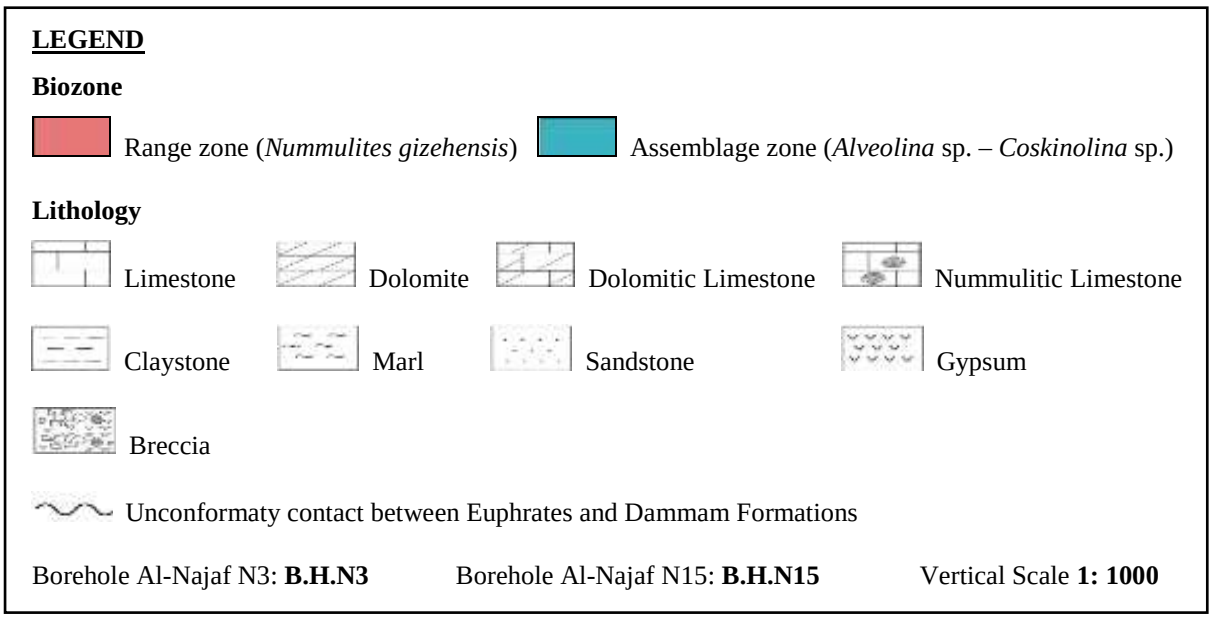

Fig.2: Legend of lithology and biozone of boreholes of the study area

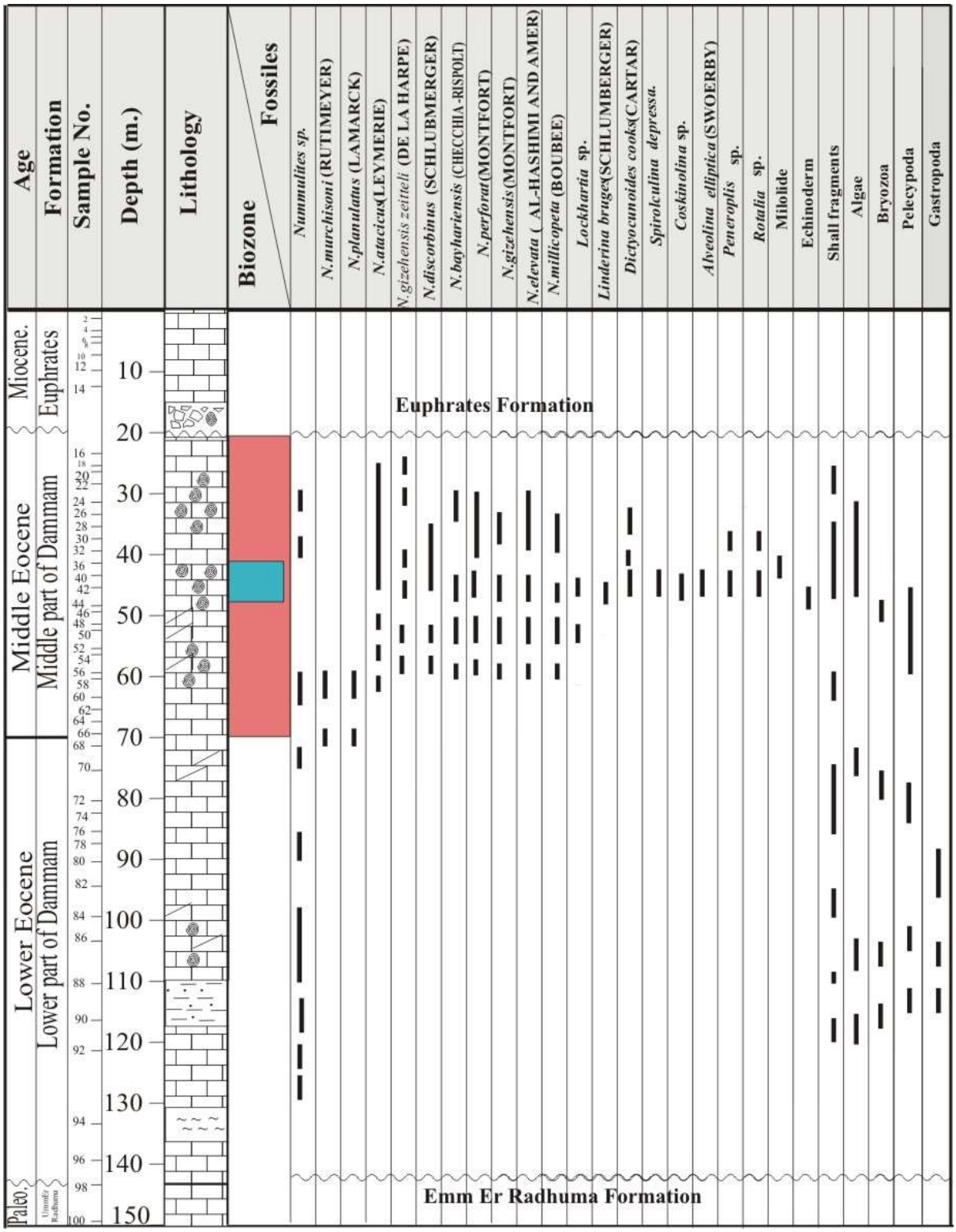

Fig.3: Biostratigraphy of borehole N15

Fig.4: *Nummulites gizehensis*

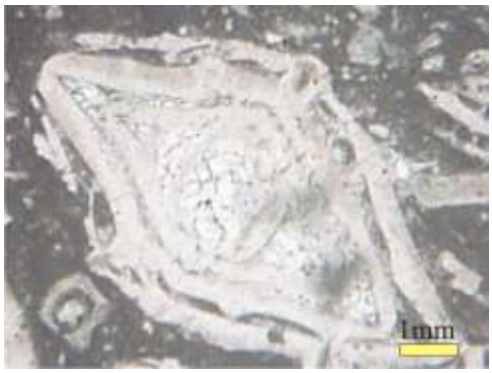

Fig.5: *Nummulites elevata*

Fig.6: *Nummulites* sp.

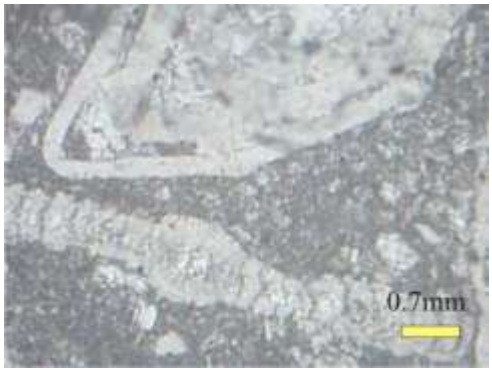

Fig.7: *Linderina bruges*

Fig.8: *Coskinolina* sp.

Fig.9: Miliolids

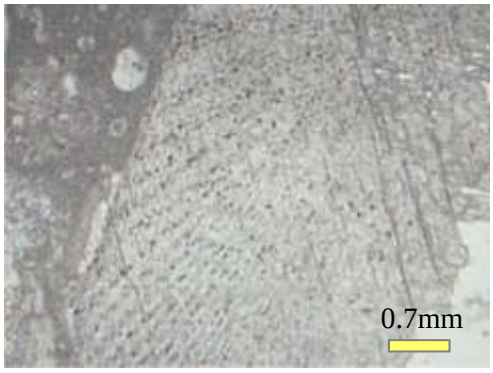

Fig.10: Bryozoa

- **Biostratigraphy of Borehole (N3)**

The following benthonic fauna identified from the sediments of Dammam Formation are (Figures 2 and 11): *Nummulites gizehensis* Foreskal, *Nummulites gizehensis zeitteli* De La Harpe, *Nummulites bayhariensis* Checchia-Rispolt, *Nummulites elevata* Al-Hashimi and Amer, *Nummulites planulatus* Lamarck, *Nummulites murchisoni* Rutimeyer, *Nummulites* sp., *Nummulites discorbinus* Schlubmerger, *Nummulites millicopeta* Boubee, *Nummulites perforate* Montfort, *Lockhartia* sp., *Spiroloclina* sp. (Figure 12), *Orbitolina* sp., *Lockhartia aleveolata*, *Alveolina* sp. (Figure 13), *Textularia* sp., *Linderina* sp., Peneroplis, *Robulus* sp., *Cyclammina* sp., *Rotalia* sp., Miliolids, Algae, Echinoid (Figure 14), Bryozoa, Large Foraminifera.

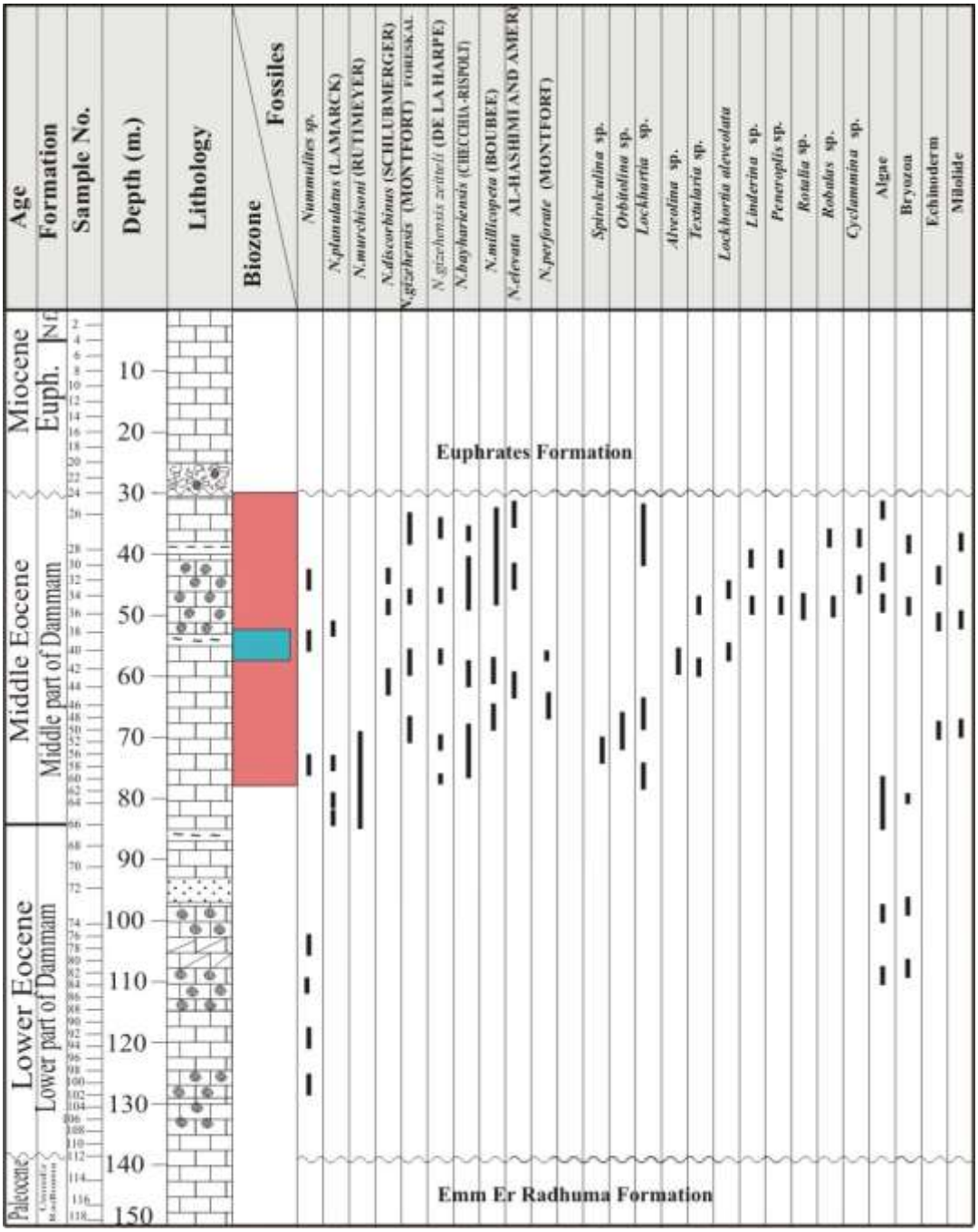

Fig.11: Biostratigraphy of borehole N3

Fig.12: *Spiroloclina* sp.

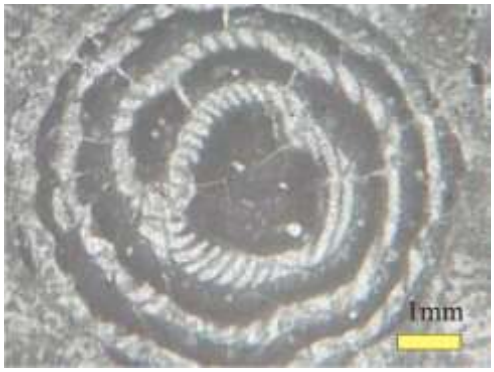

Fig.13: *Alveolina* sp.

Fig.14: Echinoid

- **Biozones of Dammam Formation**

By the detailed biostratigraphic study of Dammam Formation depending on benthonic Foraminifera, two Biozones are identified, the description of which are manifested in Figures (3 and 11).

– ***Nummulites gizehensis*** **Range zone:** This zone was determined according to the first appearance of this species as the lower limit and its disappearance as the upper limit.

It is recognized by its wide distribution, its distinct and large size (more than 2 mm). It indicates Middle Eocene. The thickness of this zone in this study is as follows: (50 m) in borehole (N15), (48 m) in borehole (N3). The fossils associated with this zone are: *Nummulites gizehensis* Foreskal, *Nummulites discorbinus* Schlothien, *N. perforatus* Montfort, *Nummulites bayhariensis* Checchia-Rispolt, *Nummulites elevata* Al-Hashimi and Amer, *Nummulites murchisoni* Rutimeyer, *Nummulites millicopeta* Boubee, *Nummulites planulatus* Lamarck, *Nummulites* sp., *Linderina* sp., *Lockhartia alveolata* Silvestri, *Coskinolina balsilliei* Daves, *Linderina brugesi* Schlumberger, *Alveolina elliptica* Sowerby, *Alveolina lepidula* Schwager, *Dictyoconoides cooki* Carter, *Coskinolina* sp., *Orbitolites* sp., miliolids, gastropods, pelecypods, ostracods, algae and echinoid spines.

Age of *Nummulites gizehensis* Range zone was determined depending on its occurrence among Eocene deposits as located worldwide; some of these occurrences were recorded by number of researchers as: *Nummulites gizehensis* Foreskal represented by the Middle part of the Dammam Formation (Middle Eocene) according to Van Bellen *et al*. (1959); Antonets and Passikove (1965); Al-Hashimi (1974); Karim (1977); Al-Mutter (1983); Amer (1980);

Buday (1980); Abdul Muniam (1983); Al-Hashimi and Amer (1985). According to Jassim *et al*. (1984) many assemblages of the fossils mentioned above exist within this zone. The *Nummulites gizehensis* Zone exist in many countries, such as Iran as mentioned by Bozergani and Banfti (1964) and Sampo (1969); Syria by Ejel (1969); Egypt by Fahmy *et al*. (1969) and Said (1961); Pakistan by Kureshy, (1969).

– ***Alveolina*** **sp. –** ***Coskinolina*** **sp. Assemblage zone:** This zone was determined according to the first appearance of these species as lower limit and their disappearance as the upper limit.

It is recognized by the wide distribution and distinction. The thickness of this zone determined in this study as follow: (7 m) in borehole (N15), (6 m) in borehole (N3). The fossils associated with this zone are: *Nummulites gizehensis* Foreskal, *N. discorbinus* Schlothien, *N. bayhariensis* Cheshea-Rispoll, *Nummulites* sp., *Linderina brugesi* Schlumberger, *Coskinolina* sp., *Alveolina* sp., *Dictyoconoides cooki* Carter, *Lockhartia* sp., *Linderina* sp., miliolids, gastropods, pelecypods, ostracods, algae and echinoid spines. This Assemblage zone indicates Middle part of Dammam Formation, which represents Middle Eocene age.

Age of this zone was determined depending on its occurrence among middle part of Dammam Formation (Middle Eocene) deposit. It is found worldwide. However, some of these occurrences were recorded by number of researchers e.g. Al-Hashimi (1973); Amer (1980); Al-Mutter (1983); Al-Jibouri (2003) and Al-Kubaysi (2013).

- **Discussion on the Biostratigraphy of Dammam Formation**

Al-Hashimi (1973) divided the Dammam Formation into 11 biostratigraphic units, comprising five larger foraminiferal assemblage zones, three planktonic foraminiferal concurrent range zones and three benthonic foraminiferal local zones.

Based on Al-Hashimi and Amer (1985), the index foraminiferal fossils of the Lower part of the Dammam Formation (Lower Eocene) are: *Nummulites deserti*, De La Harpe, *N. globulus* Leymeri, *N. akashensis* Al-Hashimi, *N. exilis* Douville, *N. planulatus* Lamarck, *N.* sp., *Operculina libyca* Schwager, *Assilina spira* Deroissy and the Lower Eocene is characterized by two types of facies: **A)** Shoal *Nummulites* facies at the base of the Formation. **B)** Restricted marine platform facies (semi closed lagoon) is dominated by miliolids and molluscas fauna; the age of the Lower Eocene is (Lower – Upper) Ypresian.

In the study area, Lower Dammam could be characterized by small size *Nummulites* sp., in addition to the availability of other associated fauna like: Echinoderm, Shell fragment, Algae, Bryozoa, Pelecypoda, Gastropod, and Miliolid. However, these fauna can be recognized in boreholes (N15).

The middle part of the Dammam Formation represents a new cycle of transgression marked by the first appearance of excellent index *Nummulites* fossils, which is represented by its large size (more than 2 mm) as mentioned by Raji (1984); Al-Mutter (1983); Amer (1980); Buday (1980); and Al-Hashimi and Amer (1985).

In the present study, the middle part of the Dammam Formation could be characterized by presence of large *Nummulites* with other macrofossils of Gastropod and Pelecypod. The biostratigraphy of the middle part of the Dammam Formation shows that this part is composed of two biozones:

A. *Nummulites gizehensis* Range zone which is characterized by large size of *Nummulites gizehensis* species (about 2 – 10 mm), in addition to the availability of other associated fauna. It represents the middle part of the Dammam Formation marked by the first appearance of the excellent index *Nummulites gizehensis* range zone. This range zone appears within the study area in the middle part of the Dammam Formation at depth intervals of (20 – 70 m) in borehole (N15), and (30 – 78 m) in borehole (N3).

B. *Alveolina* sp. – *Coskinolina* sp. Assemblage zone and other associated fauna, which represent the middle part of the Dammam Formation within the study area at depth intervals (41 – 48 m) in borehole (N15), and (52 – 58 m) in borehole (N3).

CONCLUSIONS

This study involves comprehensive biostratigraphy of Dammam Formation in two boreholes (N3) and (N15) in SW of Iraq. The main conclusions of the study can be listed as follows:

- The biostratigraphy of Dammam Formation consists of 22 species which belong to 13 genera of foraminifera.
- Two biozones were distinguished in Dammam Formation depending on benthonic foraminifera (*Nummulites*); these biozone are:
  - **a)** *Nummulites gizehensis* range zone.
  - **b)** *Alveolina* sp. – *Coskinolina* sp. As semblage zone.
- The age of Dammam Formation is determined as lower Eocene to Upper Eocene according to previous work, but the presence of the above mentioned biozones of foraminifera indicate a Middle Eocene, whereas their absence represent Lower and Upper Eocene.

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