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CALCAREOUS NANNOFOSSILS BIOSTRATIGRAPHY OF THE SHIRANISH FORMATION FROM AJEEL-10 WELL, NORTH IRAQ

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ABSTRACT

Calcareous Nannofossils are studied from the Shiranish Formation in Ajeel well No. (10), 30 Km North East of Tikrit City, the study covers the depth interval (1350 – 1500) m, which is investigated to identify calcareous nannofossils species. Based on twenty-five identified calacareous nannofossils belonging to eleven genera, three biozones are identified which reflect outer shelf and basinal environments in the studied section. These are from older to younger: *Uniplanarius trifidus* Range Zone (CC22) (Part), *Tranolithus phacelosus* Interval Biozone (CC23) and *Reinhardites levis* Interval Biozone (CC24) (Part). These biozones are correlated with other calcareous nannofossils biozones from regional view which led to conclude that the age of the studied section is Late Campanian to Early Maastrichtian.

الطباقية الحياتية لمتحجرات النانو الكلسية لتكوين شرانش في بئر (عجيل -10)، شمال العراق

عمر احمد البدراني و ابراهيم يونس الشريفي

المستخلص

درست متحجرات النانو الكلسيية في تكوين شرانش في بئر(عجيل-10)، 30 كلم شمال شرق مدينة تكريت وشملت الدراسة الاعماق مابين (1350 – 1500) متر لتشخيص متحجرات النانو الكلسية في هذا المقطع والتي تبين انها تعكس بيئة الرف الخارجي والبيئة العميقة. تمت دراسة متحجرات النانو الكلسية بواسطة تحضير شرائح لفحصها بالمجهر المستقطب باستخراجها من خلال سحق حوالي بضع غرامات من كل عينة صخرية وتمريرها خلال غربال (45 ميكرون) و نقعها في الماء المقطر و تترك على غطاء زجاجي حتى تجف على لوح تسخين دافئ حيث. يُسمح للشريحة والبقايا أن تجف عند درجة حرارة منخفضة بعيدًا عن مصادر التلوث المحتملة ثم توضع قطرة منها وباستخدام مادة الكندا بلسم على شريحة نظيفة ويتم إسقاط هذا الغطاء على البقايا ويترك ليجف قبل الفحص باستخدام المجهر المستقطب. بالاعتماد على المتحجرات المشخصة والمؤلفة من 25 نوع تعود الى 11 جنس، أمكن تسجيل ثلاثة أنطقة حياتية والتي تمثل الهدف الرئيسي للدراسة وهي من الأقدم الى الأحدث:

Uniplanarius trifidus Range Zone (CC22) (Part), *Tranolithus phacelosus* Interval Biozone(CC23), *Reinhardites levis* Interval Biozone(CC24) (Part).

تمت مضاهاة هذه الأنطقة مع الأنطقة الحياتية لمتحجرات النانو الكلسية من المناطق المجاورة مما قاد الى إعطاء عمر الكامبانيان المتأخر الى الماسترختيان المبكر للمقطع المدروس.

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INTRODUCTION

The Shiranish Formation was first described by Henson (1940) in Bellen *et al*. (1959) from the High Folded Zone of Northern Iraq, near the village of Shiranish Islam, Northeast of Zakho. It is one of the most wide spread units of the Upper Campanian- Maastrichtian cycle in North Iraq. The stratigraphy of this formation has been studied previously by many researchers (e.g., Al-Badrani and Al-Assaf, 2011; Al-Shareefi *et al.*, 2014; and Al-Maamari and Al-Badrani 2019). The previous work was accomplished within different disciplines and by using different tools, such as foraminifera, ostracode as well as calcareous nano-fossils, in addition to numerous sedimentological and geochemical studies. Perhaps the reason for this interest is the importance of the Shiranish Formation as a cap rock of oil reservoirs in many oil-producing formations in southern Iraq. It is also considered as a reservoir rock unit in the areas of northern and central Iraq, including the area of the current study, due to the tiny joints and the micro fractures in its rock structure.

According to (Jassim and Buday, 2006), the Shiranish Formation belongs to the Late Campanian – Early Maastrichtian cycle, This cycle attests a peak in the rush of Ophiolite abduction due to the occurrence of a collision between the Arabian and Iranian plate tectonics that led to the continued gradual closure of the southern part of the Neo Tethys, with widespread transgression that led to the full immersion of most of Iraq's regions (Jassim and Buday, 2006). The paleogeographic map of this cycle (Fig.1) shows five facies belts that extends towards the northwest – southeast, one of them is Shiranish Formation facies which deposited and extend toward the southwest within the outer shelf and basinal environments.

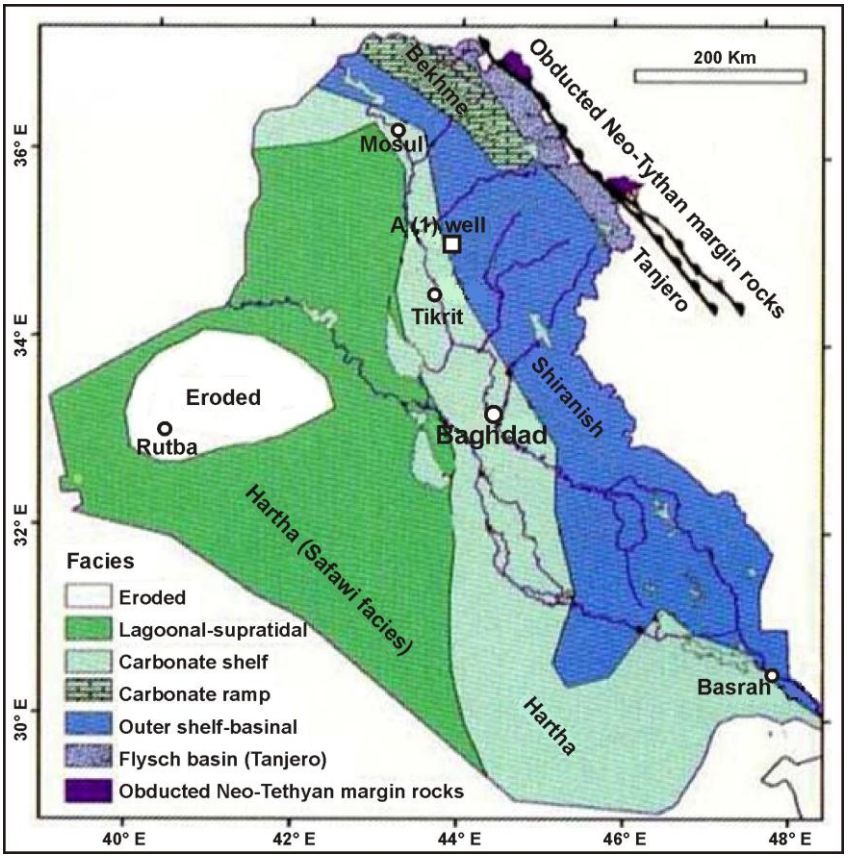

Fig.1: Paleogeographic and sedimentary facies map of the Late Campanian – Early Maastrichtian cycle in Iraq (Jassim and Buday, 2006) showing location of the studied section

THE STUDIED SECTION

The studied section from Ajeel well No. (10) is located North East of Tikrit City, Central Iraq (Fig.1), within the Foothill Zone of the Unstable Shelf of the Nubio-Arabian platform (Buday and Jassim, 1987). The sampled stratigraphic succession of the Shiranish Formation in this well (15 samples), consists of marl and marly limestone (Fig.2).

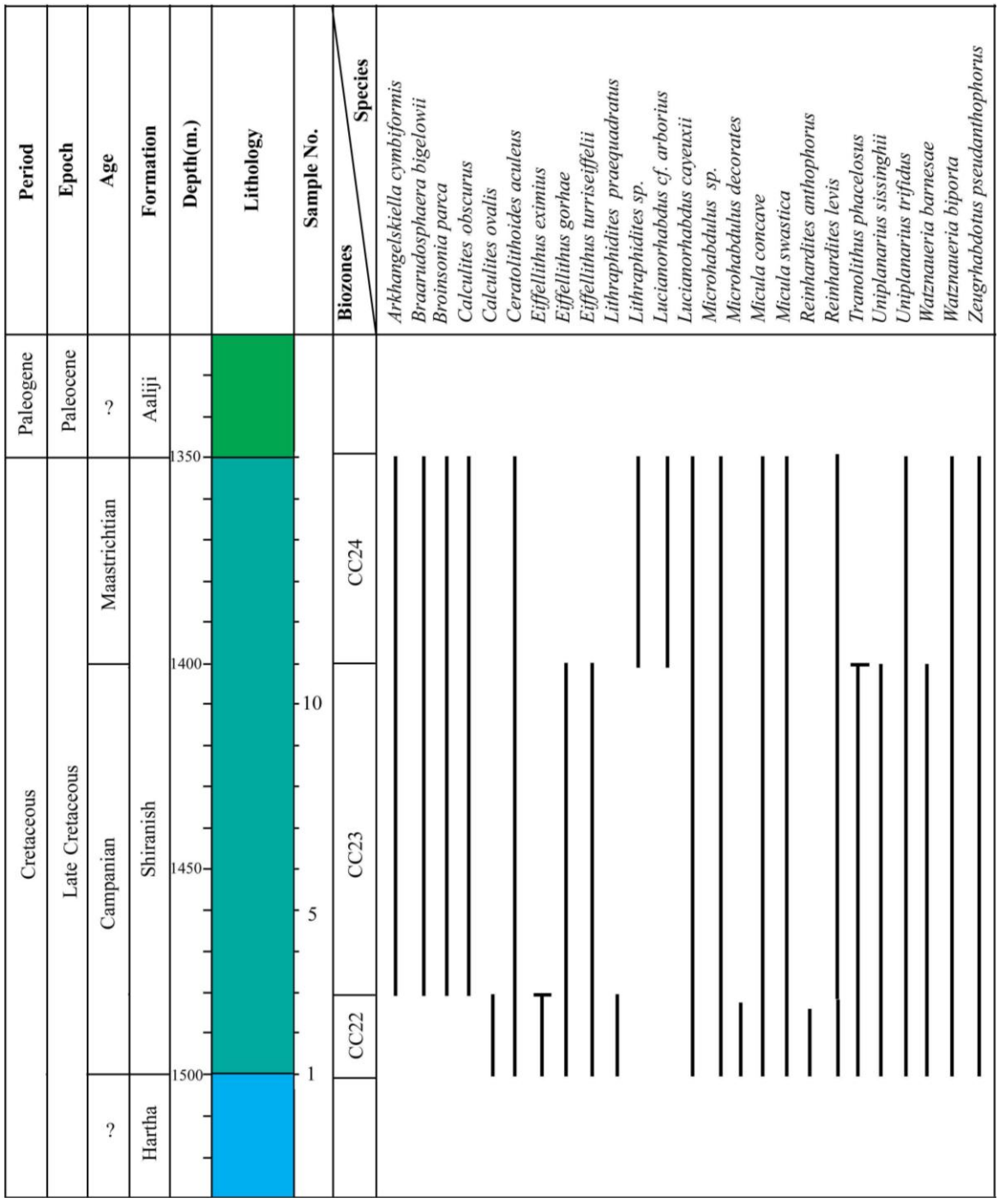

Fig.2: Range chart of the studied section

METHODOLOGY

15 cutting samples were obtained from well (Ajeel-10) within the interval depths (1350 – 1500 m) from Shiranish Formation, representing 150 m thickness of the marl and marly limestone succession. Thin sections are prepared for the polarized microscope examination. The extraction of the calcareous nannofossils is carried out using the method of Armstrong and Brasier, (2005) as follow:

1. About 5 grams of each sample is crushed to pass through a sieve of 45 μm and then soaked in distilled water. A drop of cello size is added to act as a dispersant.
2. The cover slip is left to dry on a warm hotplate. To make permanent mounts the slide and residue are allowed to dry at a low temperature away from possible sources of contamination.
3. A drop of mounting medium (Canada Balsam) is placed on a clean cover slip and this cover is then dropped on the residue and allowed to dry before examining with transmitted light microscope.

RESULTS AND DISCUSSION

- **Systematic paleontology**

The taxonomic study of calcareous nannofossils in this study is based on the classification proposed by (Perch-Nielsen, 1985). The following species are identified in the samples:

Kingdom Protista
Division Chrysophyta
Class Coccolithophyceae
Family Arkhangelskiellaceae Bukry, 1969
Genus *Arkhangelskiella* Vekshina, 1959
Arkhangelskiella cymbiformis Vekshina, 1959 (Fig.3a)

Genus *Broinsonia* Bukry, 1969
Broinsonia parca (Stradner, 1963) Bukry, 1969 (Fig.3c)

Family Braarudsphaeraceae Deflandre, 1947
Genus *Braarudosphaera* Deflandre, 1947
Braarudosphaera bigelowii (Gran and Braarud, 1935) Deflandre, 1947 (Fig.3b)

Family Calyptrosphaeraceae Boudreaux and Hay, 1969
Genus *Calculites* Sissingh, 1977
Calculites obscurus (Deflandre, 1959) Prins and Sissingh in Sissingh, 1977 (Fig.3d)
Calculites ovalis (Stradner, 1963) Prins and Sissingh in Sissingh, 1977 (Fig.3e)

Genus *Lucianorhabdus* Deflandre, 1959
Lucianorhabdus cayeuxii Deflandre, 1959 (Fig.3l)
Lucianorhabdus cf. arborius Wise and Wind, 1977 (Fig.3m)

Family Chiastozygaceae Rood, Rood *et al*., 1973
Genus *Reinhardtites* Perch-Nielsen, 1968
Reinhardites anthophorus (Deflandre, 1959) Perch-Nielsen, 1968 (Fig.3r)

Reinhardtitus levis Prins and Sissingh, in Sissingh 1977 (Fig.3s)

Genus *Tranolithus* Stover, 1966
Tranolithus phacelosus Stover, 1966 (Fig.3t)

Genus *Zeugrhabdotus* Reinhardt, 1965
Zeugrhabdotus pseudanthophorus (Bramlette and Martini, 1964) Perch-Nielsen, 1984 (Fig.3y)

Family Eiffellithaceae Reinhardt, 1965
Genus *Eiffellithus* Reinhardt, 1965
Eiffellithus eximius (Stover, 1966) Perch-Nielsen, 1968 (Fig.3g)
Eiffellithus gorkae Reinhardt, 1965 (Fig.3h)
Eiffellithus turriseiffelli (Deflander and Fert, 1954) Reinhardt, 1965 (Fig.3i)

Family Microrhabdulaceae Deflandre, 1963
Genus *Lithraphidites* Deflandre, 1963
Lithraphidites praequadratus Roth, 1978 (Fig.3j)
Lithraphidites sp. (Fig.3k)

Genus *Microrhabdulus* Deflandre, 1959
Microrhadulus decuratus Deflandre, 1959 (Fig.3o)
Microhabdulus sp. (Fig.3n)

Family Polycyclolithaceae Varol, 1992
Genus *Ceratolithoides* Bramlette and Martini, 1964
Ceratolithoides aculeus (Stradner, 1961) Prins and Sissingh in Sissingh, 1977 (Fig.3f)

Genus *Micula* Vekshina, 1959
Micula concava (Martini and Stradner, 1960) Verbeek, 1976 (Fig.3p)
Micula swastika Stradner and Steinmetz, 1984 (Fig.3q)

Genus *Uniplanarius* Hattner and Wise, 1980
Uniplanarius sissinghii Perch-Nielsen, 1984 (Fig.3u)
Uniplanarius trifidus (Stradner in Stradner and Papp 1961) Prins and Perch-Nielsen in Manivit *et al*., 1977 (Fig.3v)

Family Watznaueriaceae Rood *et al*., 1971
Genus *Watznauria* Reinhardt, 1964
Watznaueria barnesae (Black and Barnes, 1959) Perch-Nielsen, 1968

- **Biostratigraphy**

Based on the stratigraphic distribution of the 25 recorded species (Figs.2 and 3), three biozones are identified from the lower to the upper part of the sampled section (Figs.4 and 5):

– ***Uniplanarius trifidus*** **Interval Zone (Part) (CC22):** Interval from first appearance of *Uniplanarius trifidus* {=*Quadrun trifidum* Vekshina (1959)} to last appearance of *Reinhardites anthophorus* (Deflandre, 1959). The Thickness of this zone is about (20) meters.

The lower boundary of this biozone is not found in the studied section which is marked by the first appearance of *Quadrun trifidum* (Vekshina, 1959). The upper boundary is marked by the last appearance of *Reinhardites anthophorus* (Deflandre, 1959). The last appearance of *Eiffelithius eximius*, determined by Stover (1966), coincides with the last appearance of *Reinhardites anthophorus* (Deflandre, 1959). The zone is correlated with *Quadrun trifidum* Biozone of Bukry and Bramlette (1970) which is emended by Sissingh (1977) of Late Campanian age (Ogg *et al*., 2016). This zone corresponds to the studies of (Al-Badrani and Al-Assaf, 2011) and (Al-Maamari and Al-Badrani, 2019).

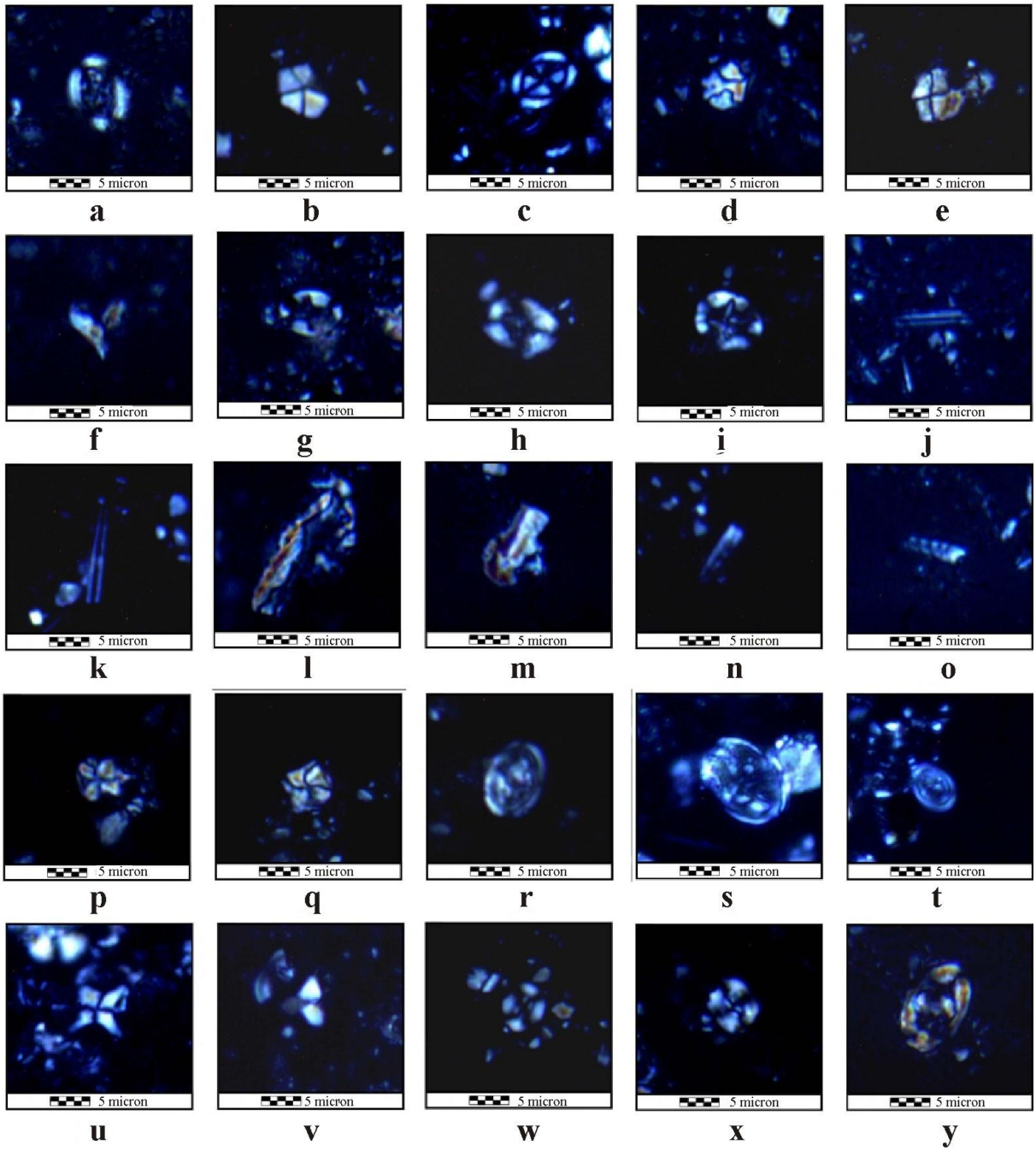

Fig.3: cross-polarized light photos of receded calcareous nannofossil from Shiranish Formation.

a) *Arkhangelskiella cymbiformis*, **b)** *Braarudosphaera bigelowii*, **c)** *Broinsonia parka*, **d)** *Calculites obscurus*, **e)** *Calculites ovalis*, **f)** *Ceratolithoides aculeus*, **g)** *Eiffellithus eximius*, **h)** *Eiffellithus gorhae*, **i)** *Eiffellithus turriseiffelii*, **j)** *Lithraphidites praequadratus*, **k)** *Lithraphidites* sp., **l)** *Lucianorhabdus cayeuxii*, **m)** *Lucianorhabdus* cf. *arborius*, **n)** *Microhabdulus* sp., **o)** *Microhabdulus decorates*, **p)** *Micula concave*, **q**) *Micula swastika*, **r)** *Reinhardites anthophorus*, **s)** *Reinhardites levis*, **t)** *Tranolithus phacelosus*, **u)** *Uniplanarius sissinghii*, **v)** *Uniplanarius trifidus*, **w)** *Watznaueria barnesae*, **x)** *Watznaueria biporta*, **y)** *Zeugrhabdotus pseudanthophorus*

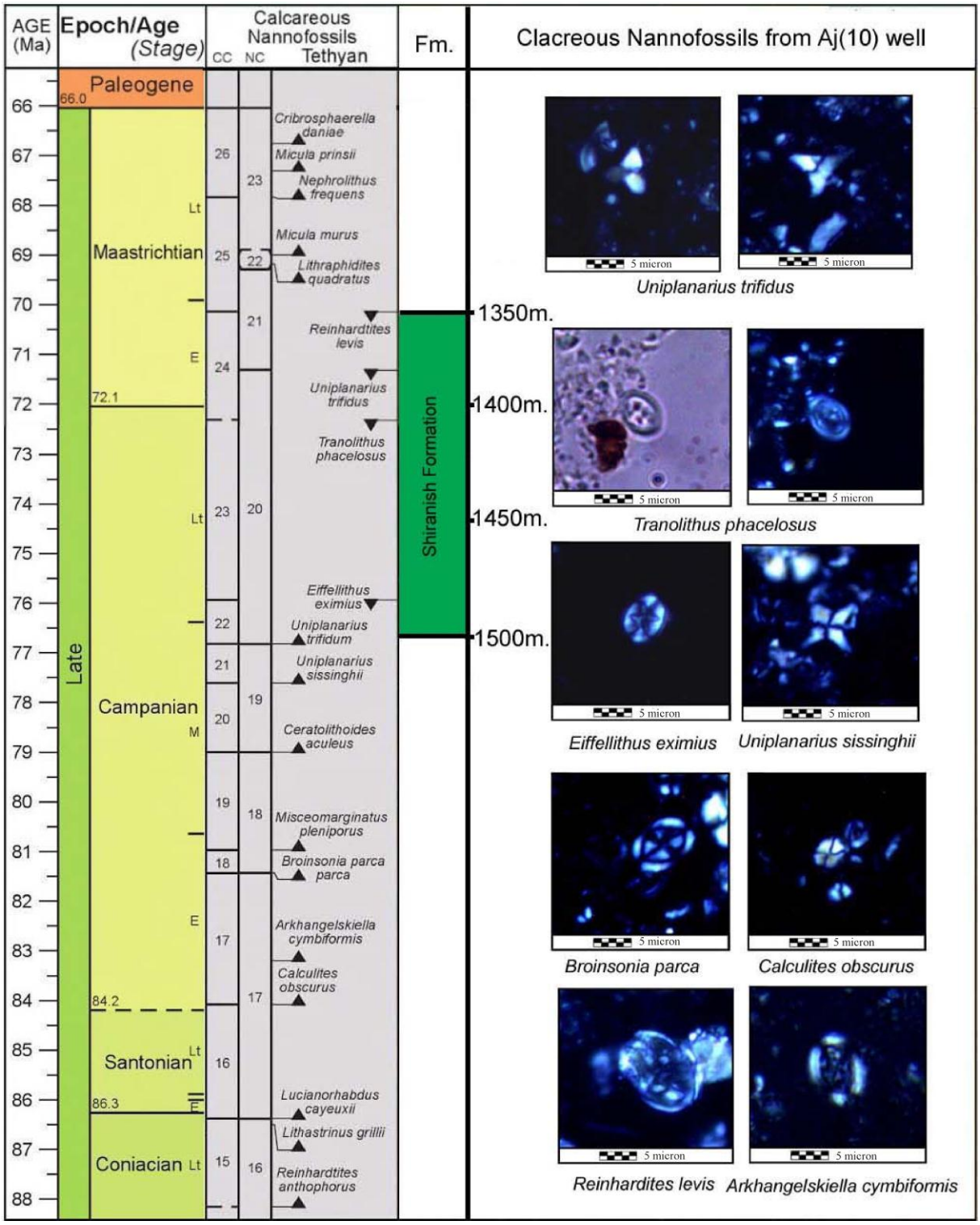

Fig.4: Age determination chart of the studied section

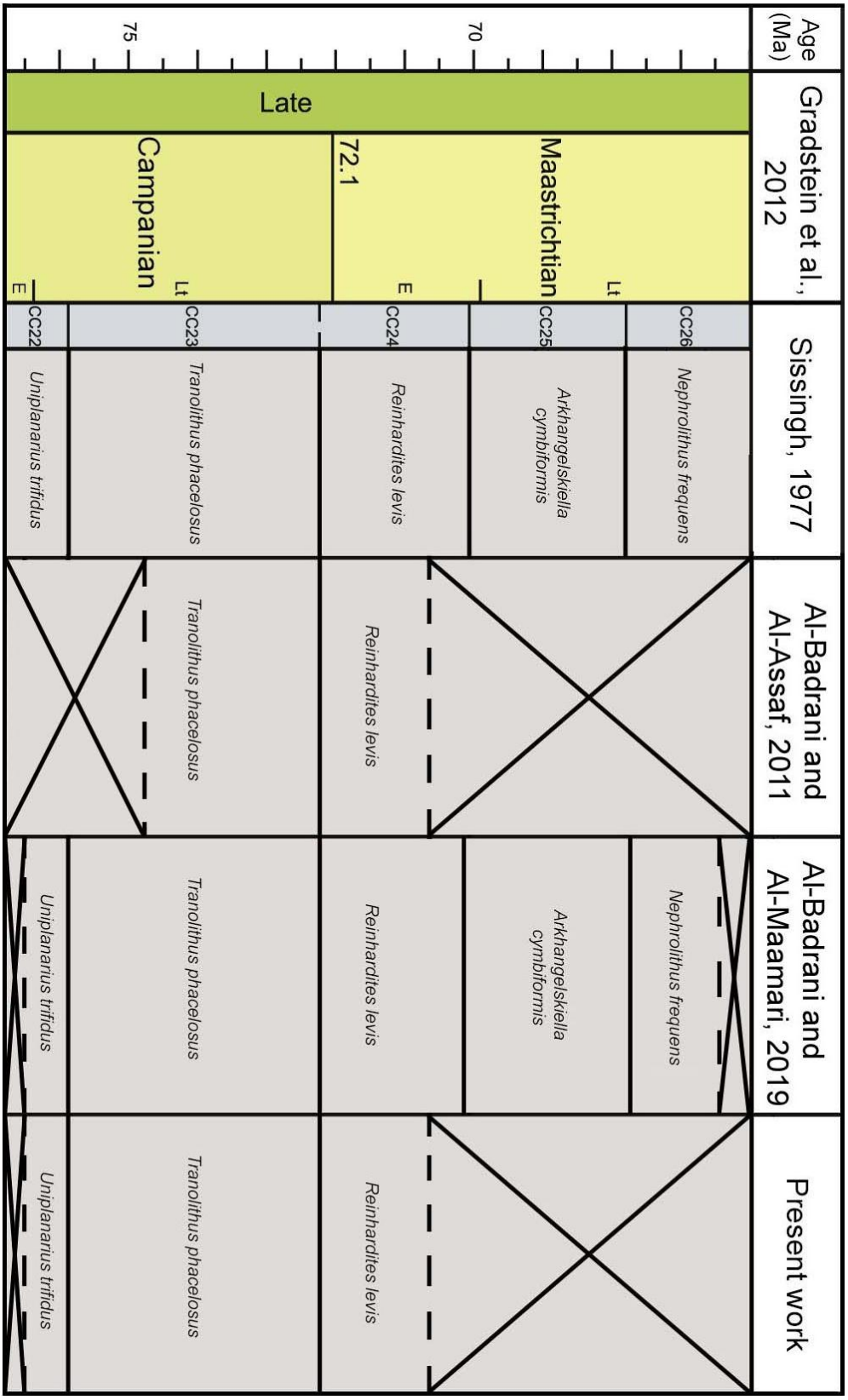

Fig.5: Comparison between previous and present work on the calcareous nannofossils biozones in the studied section

– ***Tranolithus phacelosus* Interval Zone (Part) (CC23):** Interval from last appearance of *Reinhardites anthophorus* (Deflandre, 1959) to the last appearance of *Tranolithus phacelosus* Stover (1966). The Thickness of this zone is about: (80) meters.

The lower boundary is marked by the last appearance of *Lithraphidites praequadratus* (Roth, 1978). The upper boundary, which isnot determined in this study, is marked by the last appearance of *Tranolithus phacelosus* Stover (1966). This zone is correlated with *Tranolithus phacelosus* zone of Sissingh (1977) which is assigned to latest Campanian age (Ogg *et al*., 2016). This zone corresponds to the studies of (Al-Badrani and Al-Assaf, 2011) and (Al-Maamari and Al-Badrani 2019).

– ***Reinhardites levis* Interval Biozone (CC24) part:** Interval from Last appearance of *Tranolithus phacelosus* Stover (1966) to Last appearance of *Renhardites levis* (Sissingh, 1977). The thickness of this zone is about (50) meters and consist of marly limestone.

The lower Boundary is marked by the last appearance of *Tranolithus phacelosus* Stover (1966), and the upper boundary is not included in the studied section.

This biozone is correlated with *Renhardites levis* (CC24) by Perch-Nielsen (1979) and Sissingh (1977) as Early Maastrichtian, and correlated with *Arkhangeskilla cymbiformis* by Doeven (1983) as Early Maastrichtian, and correlated with *Lithraphidites praequardatus* by Roth (1978). Therefore, the age of this biozone is Early Maastrichtian (Ogg *et al*., 2016). This result corresponds to the study of (Al-Maamari and Al-Badrani, 2019).

According to the results obtained in this study, the age of the Shiranish Formation in the sampled sequence is Late-Campanian-Early Maastrichtian, which corresponds to some previous studies dealt with the biostratigraphy of this formation in nearby areas to Ajeel-1 section by using other groups of fossils (Foraminifera and Ostracoda) such as the study of Al-Shareefi *et al.* (2014).

CONCLUSIONS

This study has the following conclusions:

- 25 species belonging to 11 genera of nannofossil assemblage are recorded from the sampled sequence of the Shiranish Formation.
- The studied depth interval is subdivided into three biozones which are from the lower to the upper part of the section:
  1. *Uniplanarius trifidus* Interval Range Zone (CC22) (Part)
  2. *Tranolithus phacelosus* Interval Biozone (CC23)
  3. *Reinhardites levis* Interval Biozone (CC24) (Part)
- Based on the recorded biozones, the age of the Shiranish formation in the sampled interval is Late Campanian to Early Maastrichtian.
- The studied biozones can be correlated with other regional studies.

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