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Calcareous Nannofossils from the Shiranish Formation at Bekhaer anticline, Dhouk area, Northern Iraq

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ABSTRACT

Calcareous nannofossils are examined up on the Shiranish Formation from the Bekhaer anticline in Northern Iraq. The study area includes about 55 meters to find calcareous nannofossils assemblages, from which (36) species have identified.

Three biozones are postulated based on the above studied assemblages, in order of biozones: *Tranolithus phacelosus* biozone; *Reinhardites levis* biozone; *Arkhangelskiella cymbiformis* biozone. From a regional perspective, these biozones were connected with other calcareous nannofossils biozones, leading to the conclusion that the section is Late Campanian-Maastrichtian in age.

1. Introduction

Henson in (1940) was firstly described the Shiranish Formation in an unpublished report, near the type section that is located near the village of Shiranish Islam near Zakho in northern Iraq [1]. It is represented by a section exposed on the surface with a thickness approximately 227.8 m. It was divided into two rock units, the upper unit is 99 m thick, which is consisted of blue marl, and the lower unit is 128.8 m thick, which is consisted of dark-blue and black marly limestone. Henson (1940) in [1] explained that the age of the formation is the Maastrichtian at the top of the section, while the lower part of it represents the late Campanian age.

After the marine regression that occurred at the end of the Cenomanian - Campanian cycle, a wide transgression occurred in most parts of Iraq and continued until the end of the Maastrichtian age. The reason for this was attributed to the diminishing or ending of the Sub-Hercynian tectonic movement within the inner parts of the Eugeosyncline [2]. This transgression led to the flooding of the whole of Kurdistan region, northern Iraq, as well as other neighboring regions such as southern Turkey and eastern parts of Syria, in addition to western Iran. This inundation with water led to the result of diverse sediments and their distribution over most of the area of the sedimentary basin, forming a sedimentary form that differs greatly from the previous stages. [3] mentioned that Laramide Orogeny is responsible for these events and that as a result of it, three environments have developed in this cycle, the deep sedimentary basin environment and the neritic environment on the shelf, and these two environments overlap and add to them the deeper environment affected by flesh deposits.

This formation has been studied by many researchers with different specializations, where [4, 5] studied it with other formations based on fossils of Ostracoda, foraminifera, and some other groups. The formation was studied by relying on foraminifera fossils, such as [6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19]. The formation based on calcareous nannofossils has also been studied by [20, 21, 22].

The study section is located within the Bekhaer anticline, in the Dohuk governorate, northern Iraq, (Fig.1). It is represented by an outcrop section exposed to the surface with a thickness of 55 meters that was studied through 29 rock samples elicited from this section (Fig. 2). The lithology of the section from the bottom is limestone with intercalation marls separating it from the hard limestone detritus rocks below it, which represented by the Bekhme Formation. An unconformity is clear between them. Then the lithology of the formation starts with rock

sample no. 15, which is represented by marl with intercalation chalky limestone until it reaches the shale and sandstone beds that are representative of the Kolosh Formation. The contact between both formations is unconformable.

The aim of the current study is to identify the calcareous nannofossils assemblages that are distributed within this formation, and then determine the biozones that represent the formation based on these fossils genera/species and compare them with previous studies from different regions. Also, the research aims to conclude the age of the formation accurately.

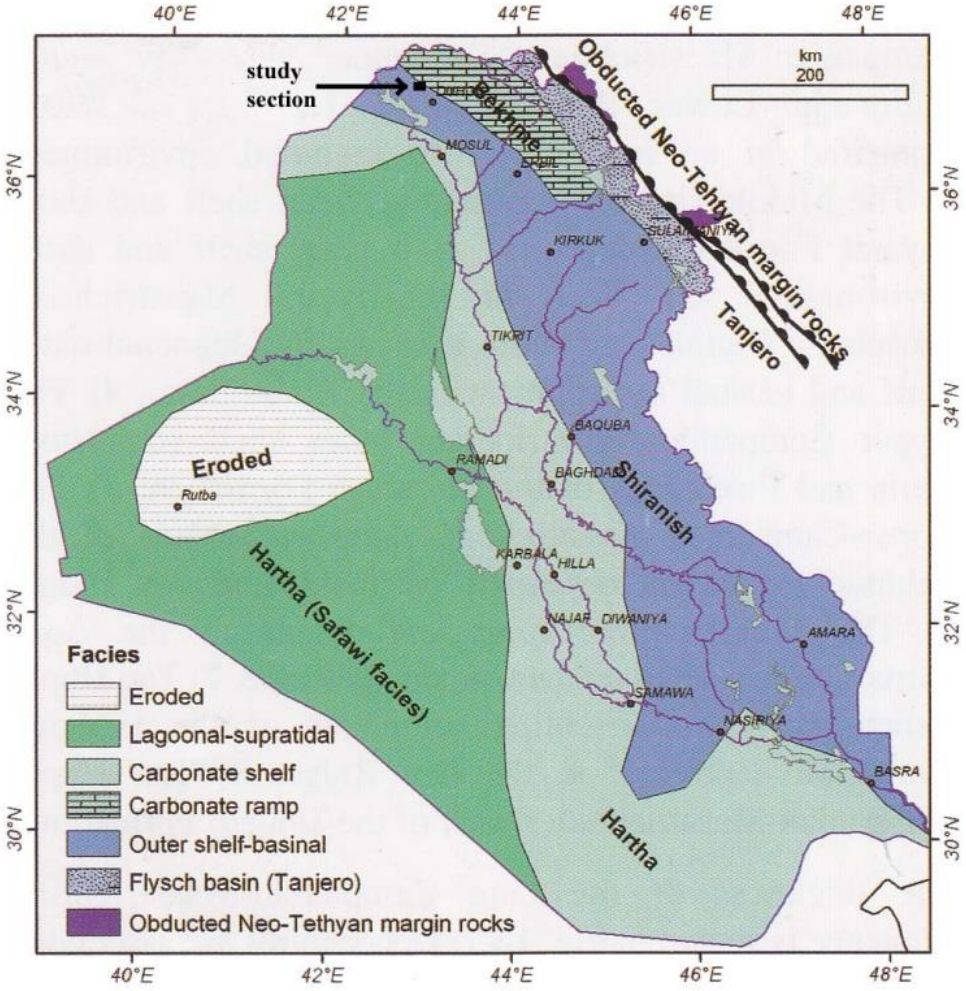

Fig.1: Paleogeographic map of Iraq; it shows the location of the study section. From [23]

2. Materials and methods

We have collected twenty nine samples of stratigraphic successions from the marls and the marly limestone, to studying the calcareous nannofossils taxon using transmitted- light microscope, the specimens are extracted using the method-H [24].

It is an extraction method for microfossils that can be properly examined, when it is extracted from the rocks, each paleontologist tends to have favorite methods for these procedures. The sample preparation is decanting and smears slides that provide method for producing slides of calcareous nannofossils by small amount of the disaggregated sample is placed in distilled water and a drop of cello size added to act as a dispersant. The cover slip is left to dry on a warm hotplate. To make permanent mounts allow the slide and residue to dry at a low temperature away from possible sources of contamination. Place a drop of mounting medium (e.g. Canada balsam) on a clean cover slip and drop this over the residue. Allow to dry before examining with transmitted light.

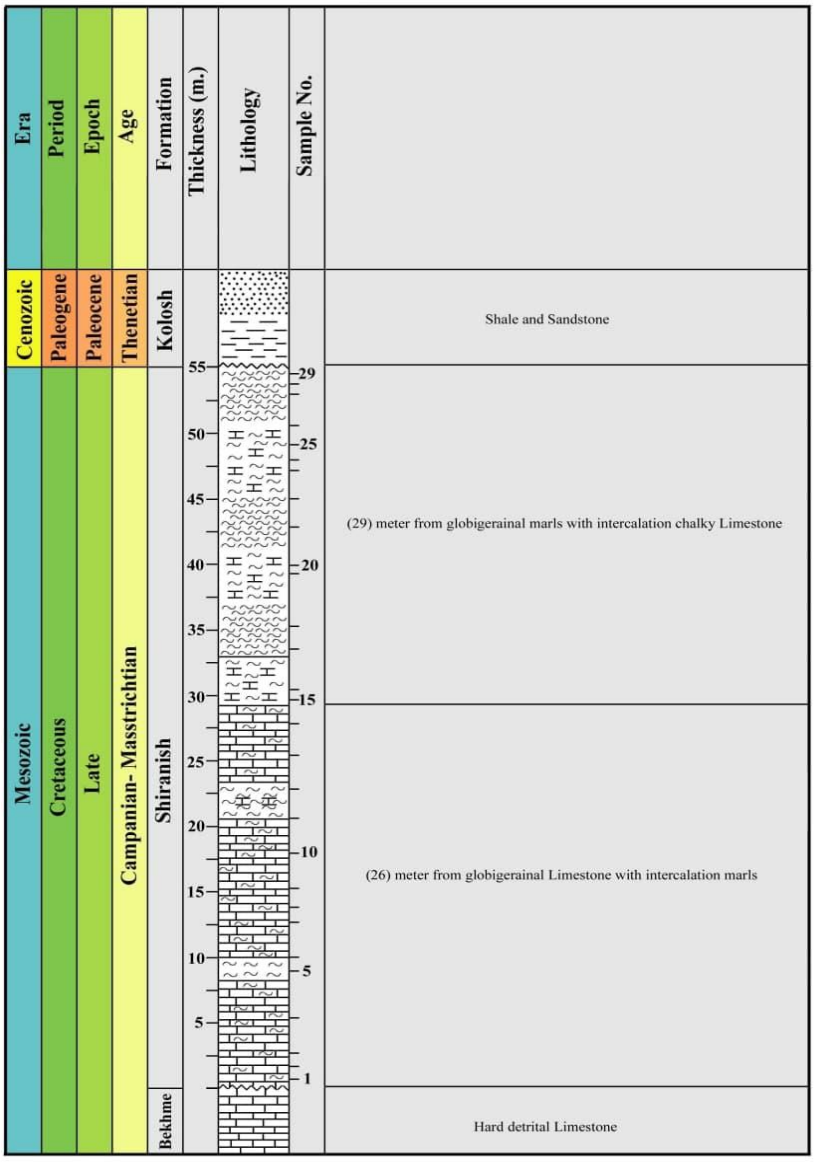

Fig. 2: Lithostratigraphic column of the Shiranish Formation from Bekhaer anticline, Northern Iraq.

3. Results

A Detailed systematic study of calcareous nannofossils has been carried out for the Shiranish Formation, Thirty six genera/species has determinated as following (Figs. 3, 4 and 5):

1 - Heterococcoliths

Family Chiastozygaceae [25]
Genus Bukyrlithus [26]
Bukyrlithus ambiguus [26] (Fig.3a)
Genus *Chiastozygus* [27]
Chiastozygus platyrhethus [28] (Fig.3b)
Genus *Placozygus* [29]
Placozygus fibuliformis ([30]) [29] (Fig.3c)
Genus *Reinhardtites* [31]
Reinhardtitus anthophorus ([32]) [31] (Fig.3d)
Reinhardtitus levis Prins and Sissingh, in [33] (Fig.3e)
Genus *Tranolithus* [34]
Tranolithus phacelosus [35] (Fig.3f)
Family Eiffellithaceae [36]
Genus *Eiffellithus* [36]
Eiffellithus gorkae [36] (Fig.3g)
Family Stephanolithiaceae [37]
Genus *Cylindralithus* [38]
Cylindralithus nudus [39] (Fig.3h)
Family Axopodorhabdaceae [40]
Genus *Cribrosphaerella* Deflandre in [41]
Cribrosphaerella ehrenbergii (Arkhangelsky) Deflandre in [41] (Fig.3i)
Genus *Nephrolithus* [42]
Nephrolithus sp. (Fig.3j)
Family Prediscosphaeraceae [43]
Genus *Prediscosphaera* [44]
Prediscosphaera grandis [45] (Fig.3k)
Prediscosphaera sp. (Fig.3l)
Family Cretarhabdaceae [46]
Genus *Retecapsa* [26]
Retecapsa angustiforata [26] (Fig.4a)
Retecapsa crenulata [38] Grün in: [47] (Fig.4b)
Family Watznaueriaceae [25]
Genus *Watznauria* [30]

Watznaueria barnesae ([48]) [31] (Fig.4c)
Watznauria biporta [39] (Fig.4d)
Family Arkhangelskiellaceae [39]
Genus *Arkhangelskiella* [44]
Arkhangelskiella cymbiformis [44] (Fig.4e)
Arkhangelskiella specillata [44] (Fig.4f)
Genus *Broinsonia* [39]
Broinsonia parca ([49]) [39] (Fig.4g)
Broinsonia signata ([50]) [51] (Fig.4h)
2 - Holococcoliths
Family Calyptrosphaeraceae [52]
Genus *Calculites* [33]
Calculites ovalis ([49]) Prins and Sissingh in: [33] (Fig.4i)
Calculites obscurus ([32]) Prins and Sissingh in: [33] (Fig.4j)
3 -Nannoliths
Family Microrhabdulaceae [53]
Genus *Lithraphidites* [53]
Lithraphidites praequadratus [54] (Fig.4k)
Lithraphidites quadratus [38] (Fig.4l)
Genus *Microrhabdulus* [32]
Microrhadulus decoratus [32] (Fig.5a)
Microrhabdulus undosus [55] (Fig.5b)
Family Polycyclolithaceae [56]
Genus *Eprolithus* [34]
Eprolithus floralis ([57]) [34] (Fig.5c)
Eprolithus sp. (Fig.5d)
Genus *Lithastrinus* [58]
Lithastrinus sp. (Fig.5e)
Genus *Micula* [44]
Micula staurophora ([59]) [49] (Fig.5f)
Micula swastica [60] (Fig.5j)
Genus *Radiolithus* [34]
Radiolithus planus [34] (Fig.5h)
Genus *Uniplanarius* [61]
Uniplanarius trifidus (Stradner In [58]) Prins and Perch-Nielsen in [62] (Fig.5i)
Uniplanarius sp. (Fig.5j)
Genus *Ceratolithoides* [38]
Ceratolithoides aculeus ([58]) Prins and Sissingh in [33] (Fig.5k)
Ceratolithoides sesquipedalis [63] (Fig.5l)

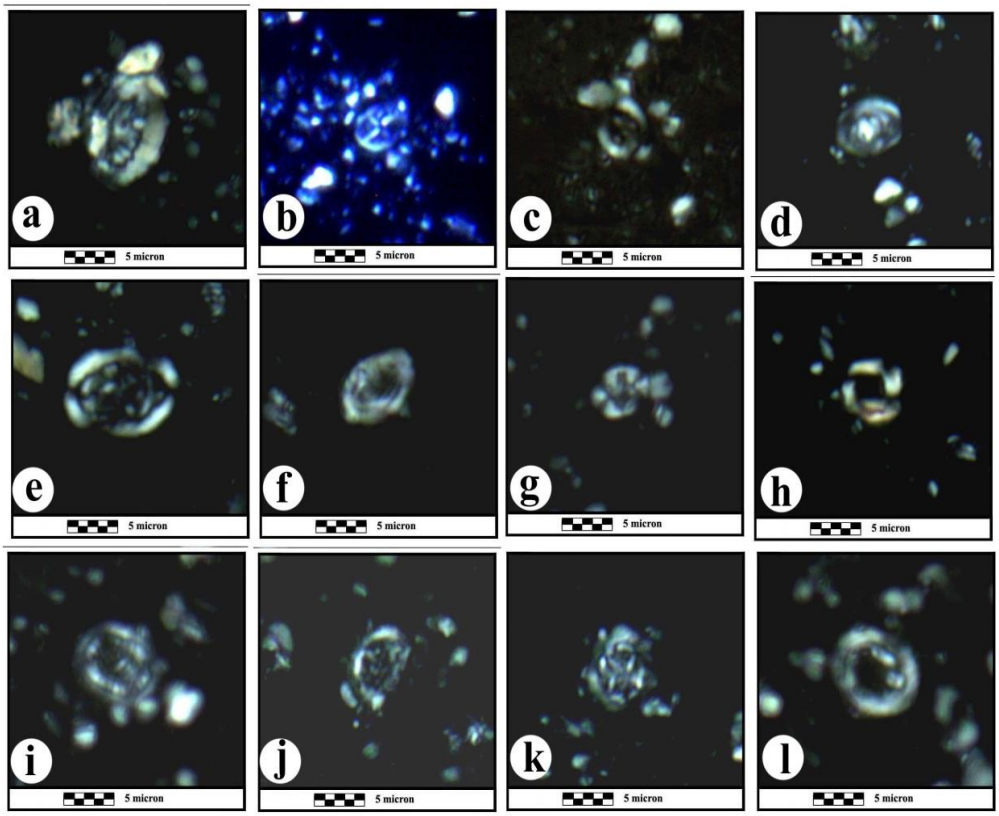

Fig.3: Cross-polarized micrograph of significant calcareous nannofossil taxon from the Shiranish Formation. (a) *Bukyrlithus ambiguus*; (b) *Chiastozygus platyrhethus*; (c) *Placozygus fibuliformis*; (d) *Reinhardtitus anthophorus*; (e) *Reinhardtitus levis*; (f) *Tranolithus phacelosus*; (g) *Eiffellithus gorkae*; (h) *Cylindralithus nudus*; (i) *Cribrosphaerella ehrenbergii*; (j) *Nephrolithus* sp.; (k) *Prediscosphaera grandis*; (l) *Prediscosphaera* sp.

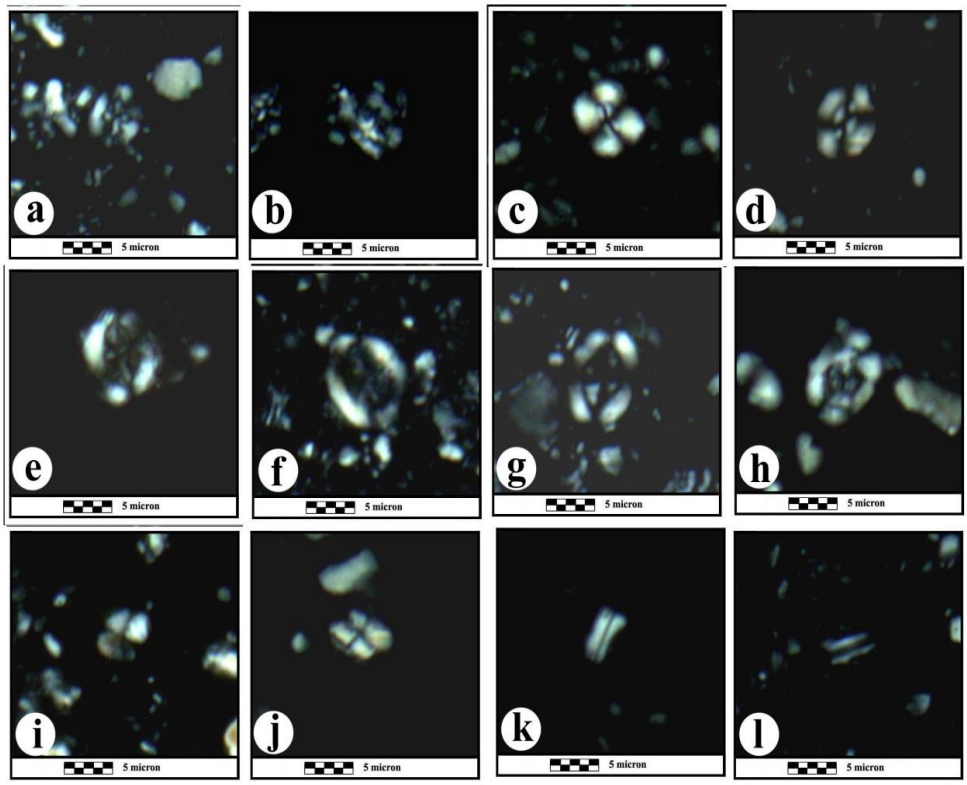

Fig. 4: Cross-polarized micrograph of significant calcareous nannofossil taxon from the ShiranishFormation. (a) *Retecapsa angustiforata;* (b)*Retecapsa crenulata;* (c) *Watznaueria barnesae;* (d) *Watznauria biporta;* (e) *Arkhangelskiella cymbiformis;* (f) *Arkhangelskiella specillata;* (g) *Broinsonia parca;* (h) *Broinsonia signata;* (i) *Calculites ovalis;* (j) *Calculites obscurus ;* (k) *Lithraphidites praequadratus;* (l) *Lithraphidites quadratus.*

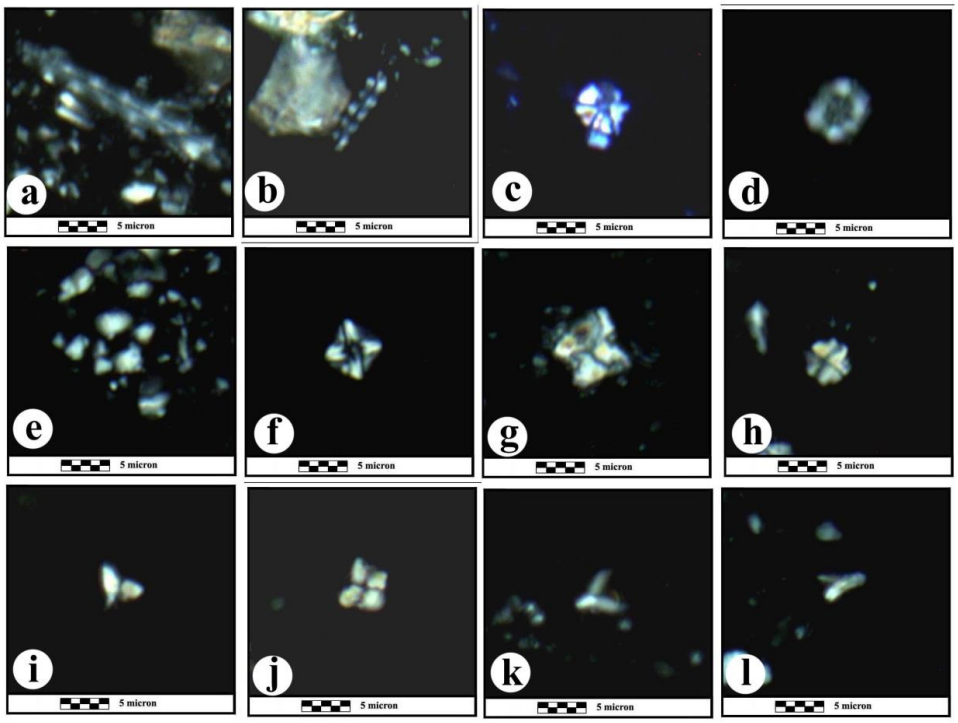

Fig. 5: Cross-polarized micrograph of significant calcareous nannofossil taxon from the ShiranishFormation. (a) *Microrhabdulus decoratus*; (b) *Microrhabdulus undosus*; (c) *Eprolithus floralis*; (d) *Eprolithus* sp.; (e) *Lithastrinus* sp.; (f) *Micula staurophora*; (g) *Micula swastica*; (h) *Radiolithus planus*; (i) *Uniplanarius trifidus*; (j) *Uniplanarius* sp.; (k) *Ceratolithoides aculeus*; (l) *Ceratolithoides sesquipedalis*.

4. Discussions

Stratigraphic distribution of the recorded genera/species reveals three biozones (Fig. 6) and correlated with local and regional previous studies (Figs. 7 and 8), These biozones are :

1 - *Tranolithus phacelosus* [35] Interval Biozone (CC 23)

Identification: It is Interval biozone for *Tranolithus phacelosus* [35], recorded by the Last Appearance Datum (LAD) of the species *Eiffilithus eximus* Reinhardt (1965), and extends to the Last Appearance Datum (LAD) of the species *Tranolithus phacelosus* [35], and the thickness of this biozone is about (18 meters), within the lower part of the Shiranish Formation

Correlation: This zone is compared with CC23 (*Tranolithus phacelosus*) zone which studied by the [33] that aged of the late Campanian to early Maastrichtian, and compared with UC16, UC17 zone that is studied by [40], that aged Campanian to early Maastrichtian age. On local scale its compared with *Tranolithus phacelosus* zone that is recorded by the [22, 65, 66, 67], that is also extends un age from Campanian to early Maastrichtian. Its also recorded as index of zone CC23 from the lower part of the Tanjero Formation, Sulaimani area by [68]. Accordingly, the suggested age for this zone extends late Campanian to early Maastrichtian based on geological time scale by [69].

2– *Reinhardtites levis* [33] **Interval Biozone (CC24)**

Identification: It is Interval biozone of the species *Reinhardtites levis* [33], recorded by Last Appearance Datum (LAD) of the species *Tranolithus phacelosus* [35], to the Last appearance Datum(LAD) of *Reinhardtites levis* [33]. The thickness of this biozone is about (12 meters). Within the middle part of the studied section of the Shiranish Formation

Correlation: This zone is compared with CC24 (*Reinhardtites levis*) zone that studied by the [33] which is indicating an age extends from the late Campanian to early Maastrichtian, and compared with the UC18 zone that is studied by [40] that aged Maastrichtian age; and compared with *Reinhardtites levis* zone that studied by the [22, 65, 66], that aged of the early Maastrichtian. Its alo recoreded by [68] from the lower part of Tanjero Formation in sulaimnai area. Based on this correlation, this interval biozone assigned to be as early Maastrichtian in age [69].

3– *Arkhangelskiella cymbiformis* [44] **Interval Biozone (CC25)**

Identification: It is Interval biozone of the species *Arkhangelskiella cymbiformis* [44], recorded by Last Appearance Datum (LAD) *Reinhardtites levis* [33] to the First Appearance Datum (FAD) *Nephrolithus frequens* [42]. The thickness of this biozone IS about (25 meters) and recorded from the upper part of Shiranish formation in the studied section

Correlation: This biozone is compared with (CC25) (*Arkhangelskiella cymbiformis*) zone by [33] , which is subdivided into three subzones namely (CC25a, CC25b, CC25c), that is based on the the first appearance of the species *Arkhangelskiella cymbiformis* and the first appearance of species *Lithraphidites quadratus* at Maastrichtian age, and compared with the UC19 zone that is studied by [40] that aged Late Maastrichtian age. IN Kurdistan region this zone also compared with *Arkhangelskiella cymbiformis* zone by the [65] which is assigned to be Maastrichtian in age ; therefore we suggested the Maastrichtian [69].

Its worthy to mention neither late Maastrichtian (CC26) nor Danian calcareous nannofossils (CP.1) biozones are recognized in the studied section of Beakher anticline, Dhouk area, Kurdistan region, (N. Iraq)

5. Conclusions

The study of the Shiranish Formation at Bekhair anticline, Dhouk area, Kurdistan region, Northern Iraq suggested that:

1 - Presence of three calcareous nannofossils, these are from oldest to youngest;

a. *Tranolithus phacelosus* Interval zone (CC23)

b. *Rienhardtites lives* Interval zone (CC24)

c. *Arkhangelskilla cymbiformis* Interval zone (CC25).

2 - The recorded three biozone are point to Campanian to late Maastrchtain age, but with remarkable disappearance of the latest Maastrichtian calcareous nannofossils *Nephrolithus frequens* (CC26), as well as the Danian calcareous nannofossils zone (CP1).

3 – The disappearances mostly point to a gap and unconformity between the Shiranish Formation and overlying Kolosh Formation (Paleocene), which is mostly, indicates the terminations of the Tectonic Megasequence AP9 by the influence of the tectonic activity at that time.

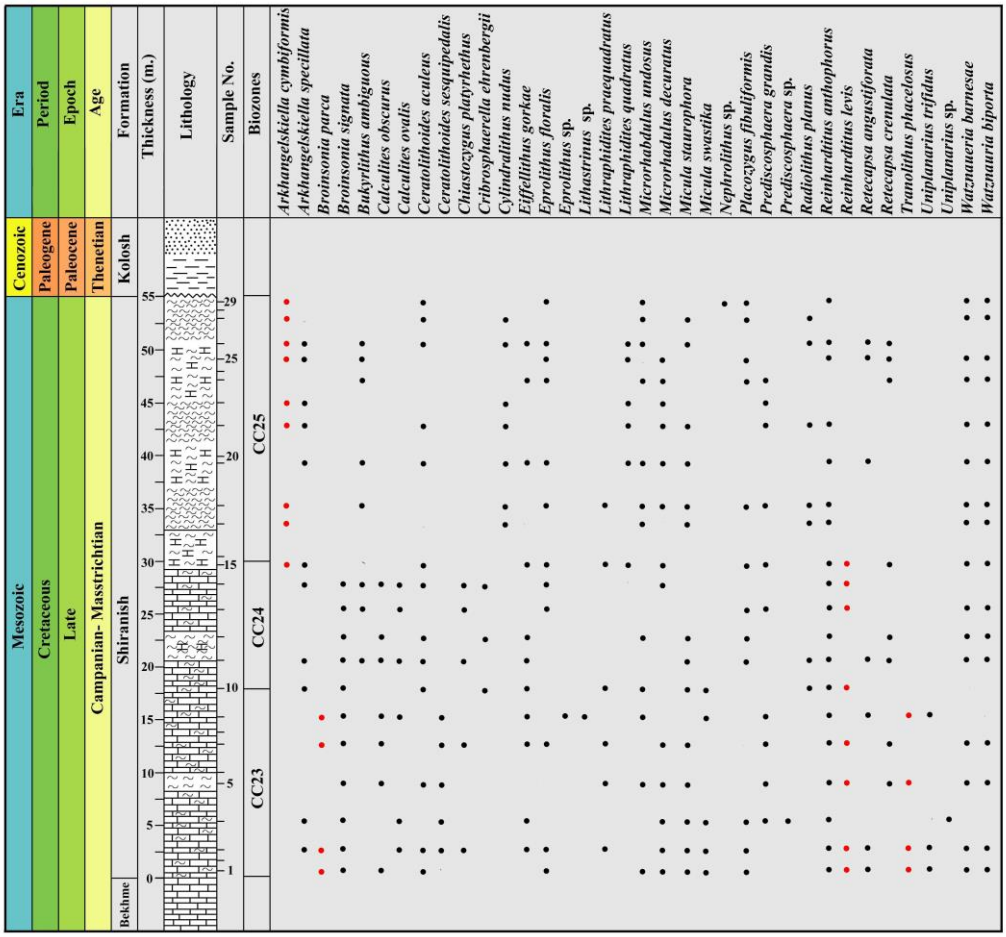

Fig.6: Calcareous nannofossils range chart for the Shiranish Formation from the studied area.

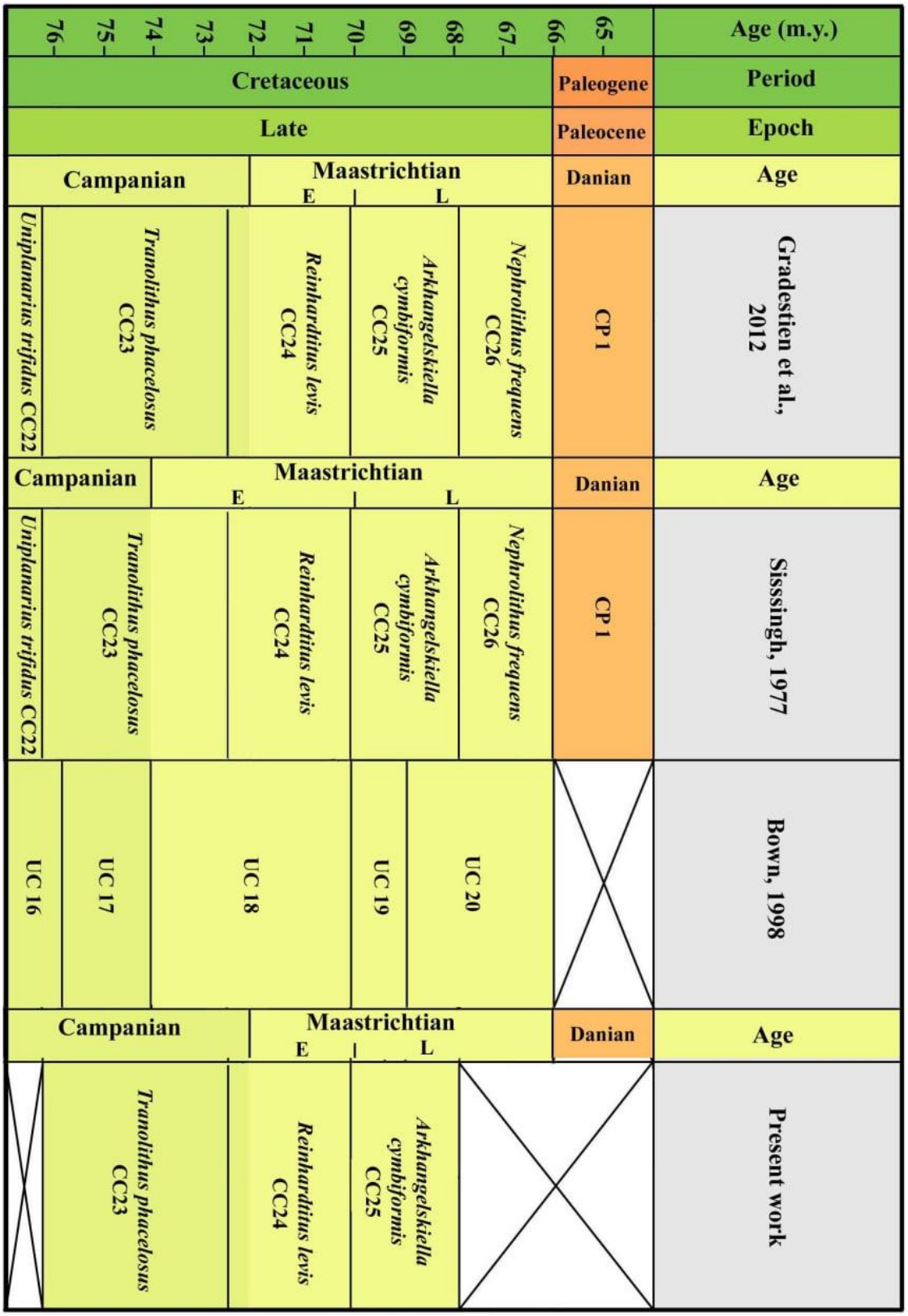

Fig .7: Regional correlation chart for the Cretaceous calcareous nannofossils biozones

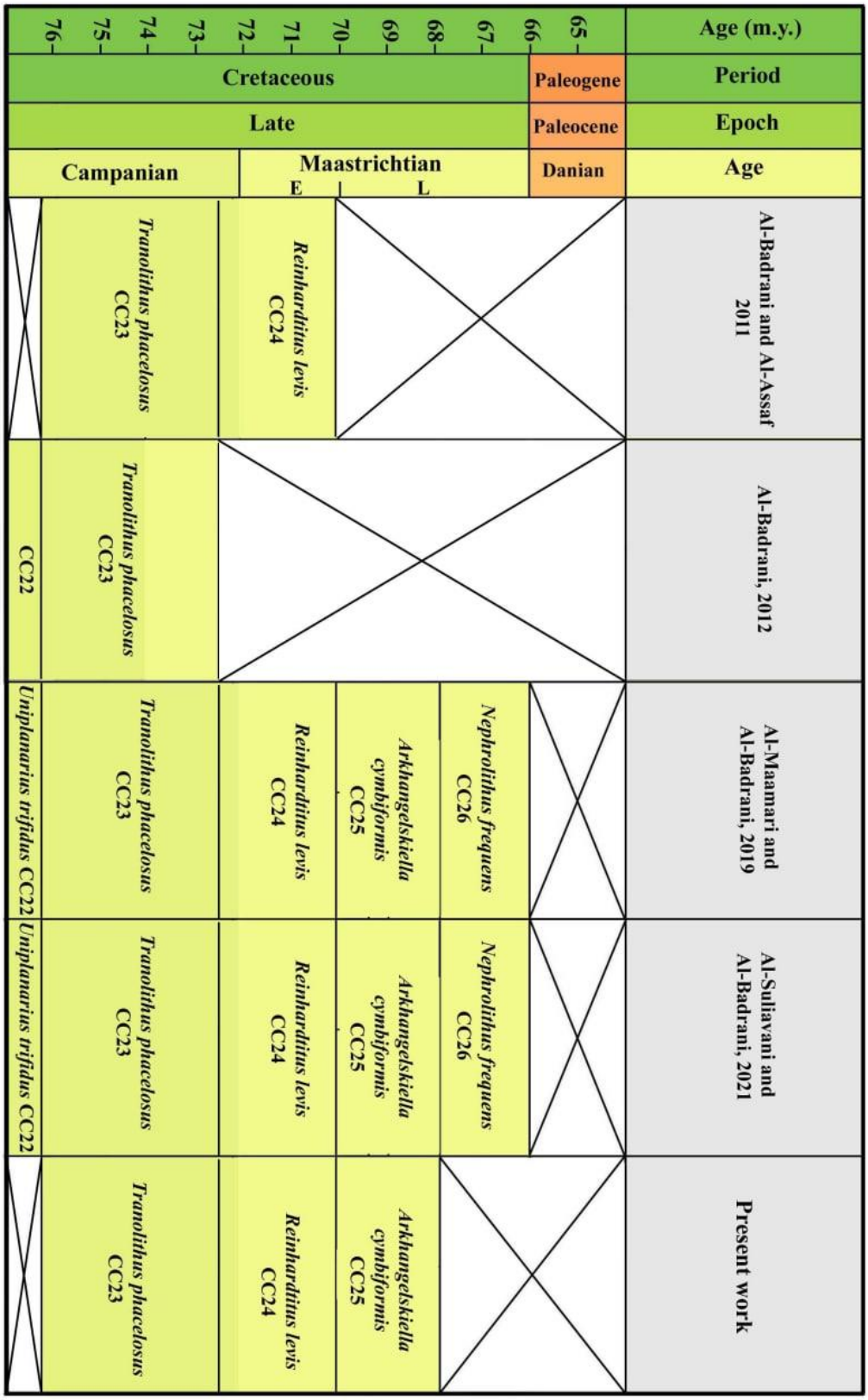

Fig. 8: Local correlation chart for the Cretaceous calcareous nannofossils biozones

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متحجرات النانو الكلسية من تكوين شرانش في طية بيخير المحدبة، منطقة دهوك، شمال العراق

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الملخص

تم دراسة متحجرات النانو الجيرية في تكوين شرانش من طية بخير المحدبة في منطقة دهوك في شمال العراق. بلغ سمك المقطع المدروس حوالي 55 مترًا , حيث تم ملاحظة تجمعات لمتحجرات النانو الجيرية وامكن تحديد 36 نوعًا.

تم تحديد ثلاثة انطقة حياتية بناءً على التجمعات المدروسة أعلاه وهي مرتبة من الاقدم الى الاحدث كالتالي:

Tranolithus phacelosus biozone**,** ***Rienhardtites lives*** biozone**,** ***Arkhangelskilla cymbiformis*** biozone**.**

من منظور المقارنة إلاقليمية ، تم ربط هذه الانطقة الحياتية مع انطقة حياتية أخرى لمتحجرات النانو الجيرية ، مما أدى إلى استنتاج أن المقطع المدروس هو بعمر الكامبانيان– الماسترختيان المتأخر.