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The Biostratigraphy of Calcareous Nannofossils of the Hartha Formation from Qasab (11) Well, Southern Mosul Area in Nineveh Governorate, Northern Iraq

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ABSTRACT

The calcareous nannofossils biozones are analyzed that have been reported for a number of species at one section of the Hartha Formation from Qasab (11) well, southern Mosul area in Nineveh Governorate, Northern Iraq. The region under examination displays a total of four biozones arranged chronologically from oldest to youngest: *Uniplanarius sissingh* biozone CC21; *Uniplanarius gothicus* biozone CC22; *Tranolithus phacelosus* biozone CC23; Rienhardtites *lives* biozone CC24.
Researchers have determined that these taxa date from the Late Campanian to the Early Maastrichtian based on the relationships between these biozones and those of the other calcareous nannofossil biozones from both local and regional areas.

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الطباقية الحياتية لمتحجرات النانو الكلسية لتكوين هارثة من بئر قصب (11) في منطقة جنوبي الموصل في محافظة نينوى، شمالي العراق

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الملخص

تم تسجيل الانطقة الحياتية لعدد من الانواع التابعة لمتحجرات النانو الكلسية باستخدام الانواع المشخصة لمقطع واحد من تكوين هارثة من بئر القصب (11) جنوبي منطقة الموصل في محافظة نينوى، شمالي العراق. تم تحديد اربعة انطقة حياتية لمتحجرات النانو الكلسية مرتبة ترتيبًا زمنيًا من الأقدم إلى الأحدث:

Uniplanarius sissingh bioone C.C.21; *Uniplanarius gothicus* bioone C.C.22; *Tranolithus phacelosus* bioone C.C.23; Rienhardtites *lives* bioone C.C.24.

استنتج الباحثون أن هذه المتحجرات تعود إلى عمر الكامبانيان المتاخر إلى الماسترختيان المبكر بناءً على المقارنات بين هذه المناطق الحياتية وتلك الموجودة في المناطق المجاورة المحلية والإقليمية.

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Introduction

One of the most significant Late Campanian to Maastrichtian cycle formations in Central and South of Iraq is the Hartha Formation. Carbonates make up the primary lithotype in this cycle's successions, which are significant hydrocarbon-producing formations (Aqrawi *et al*. 2010). According to Sadooni (1996), oil has been produced in western Iraq from the shelf marine carbonates of the Hartha Formation, and there are also indications of good economic oil in the Ahdab and East Baghdad oil fields.

The Hartha Formation was described first by Bellen *et al*. (1959) as a partly dolomitized limestone with irregular intercalations of marlstone and shale stone. The whole regions of Iraq are covered by the formation. Previous research has concentrated on the central and southern regions of Iraq. The goal of this investigation is to close the knowledge gap regarding this significant formation in the northern and northwestern regions of Iraq (Fig. 1).

Except for the western portion of the country (the Ga'ara uplift), which is the result of subsequent tectonic events, Cretaceous strata may be found throughout Iraq (Buday, 1980). According to Chatton and Hart (1961), the effect of these movements is evident in the Late Campanian to Maastrichtian successions, which include the Hartha Formation. The transgression had covered the study area and resulted in the deposition of a different lithology in different depositional paleoenvironments in the northern part of Iraq.

The research region is located in Iraq's foothill zone, which is a part of the tectonically unstable shelf (Jassim and Goff, 2006). The Tayarat, Digma, Aqra, Bekhme, Shiranish, Tanjero, and Hadiena Formations are all part of the late Turonian to Danian megasequence

AP9, which is represented by the Hartha Formation. The Tanjero Formation is of deep (flysch) facies; the Shiranish Formation is of deep basinal facies; and the Hartha, Aqra, and Bekhme Formations are of shallow platform facies, which are the three primary categories of late Cretaceous lithofacies (Dunnington, 1958; Ditmar et al., 1971).

The Hartha Formation is present throughout the majority of Iraq, with the exception in the west as indicated previously. It is absent in the northeast, where the Shiranish Formation entirely replaces it; nevertheless, in northern and middle Iraq, it forms a tongue-like intertwinement with the Shiranish Formation. To the west, the Tayarat Formation dominates the Hartha Formation (Fig. 2). To the southeast, the Bahrah Formation correlates with the Hartha Formation, which correlates with the Aruma Formation of Saudi Arabia and with the Tayarat Formation in northwestern Kuwait.

The recent study was conducted on selected borehole samples from Qasab (11) well in the southern Mosul area, Nineveh Governorate, Northern Iraq. Additionally, calcareous nannofossils are used to create a biostratigraphy of the Hartha Formation. The thickness of the Hartha Formation varies greatly in the studied Qasab-11 well, reaching 133 meters thick.

Unconformable contacts exist between the Hartha Formation and the underlying and overlying formations. The gamma log data show an abrupt transition from the shallow marine facies of the Hartha Formation upward to the deep marine basinal facies with the Shiranish Formation, which is shown by the latter's predominance of glauconite. The shallow marine Hartha Formation and the underlying deep marine Saadi Formation include no conformable connections. Similar types of interactions are also noted in southern and central Iraq (Buday, 1980).

The study aims are to identify the nannofossils and their ages, and to compare them both locally and internationally. Moreover, the study seeks to characterize the biostratigraphy of the Hartha Formation.

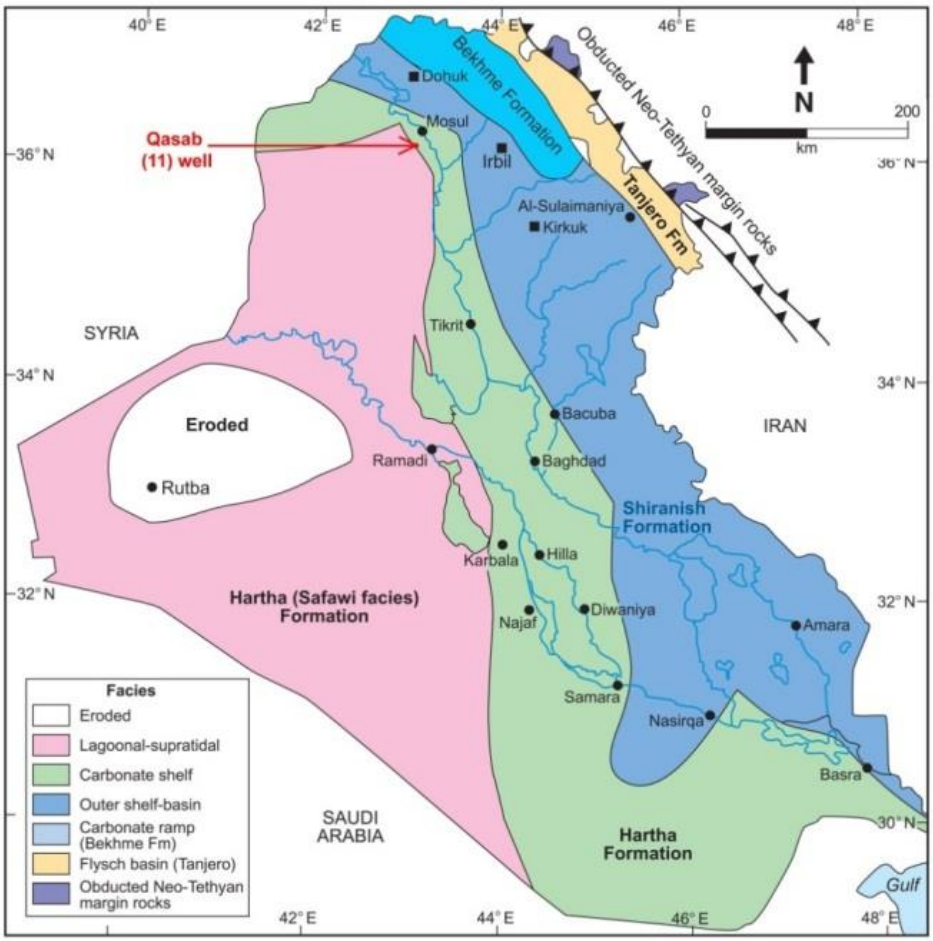

Fig.1. Location map showing the Hartha Formation from Qasab (11) well in the southern Mosul area, Nineveh Governorate, Northern Iraq.

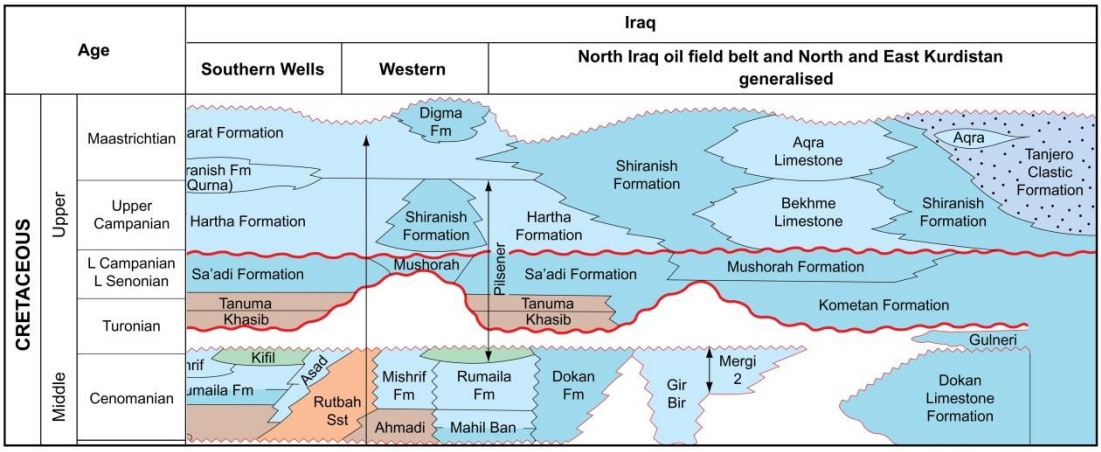

Fig. 2. Diagram illustrating the link between regional rock units (After Haddad and Amin, 2007).

Methodology

Numerous outcrop samples from the Hartha Formation provided the data for this investigation. Samples were taken from northern Iraq at various intervals, primarily from limestone and marly limestone, with lithologic descriptions. The preparation of the nanofossil slides is utilized by following the method (H) of the laboratory analysis (Armstrong and Brasier, 2005), and the photo techniques by light microscope, cross-polarized transmitted lights, and a gypsum plate are used to look for calcareous nannofossils on the slides. The collections are carefully examined under a 1000x magnification.

Results and discussions

Nannopaleontology

Nannopaleontologists employed a number of paleontological sources, such as Bown and Young (1997) and Perch-Nielsen (1985), to identify various species of calcareous nannofossils. The resources are housed at the Geology Department, University of Mosul, Mosul, Iraq.

- Heterococcoliths
- Muroliths

⊕ Order EIFFELLITHALES

Family CHIASTOZYGACEAE

Genus *Chiastozygus* (*Chiastozygus garrisonii* and *Chiastozygus synquadriperforatus*)

Genus *Gorkaea* (*Gorkaea obliqueclausus*)

Genus *Heteromarginatus* (*Heteromarginatus bugensis*)

Genus *Loxolithus* (*Loxolithus bicyclus*)

Genus *Reinhardtites* (*Reinhardtites anthophorus* and *Reinhardtites levis*)

Genus *Staurolithites* (*Staurolithites dibrachiatus*)

Genus *Tranolithus* (*Tranolithus phacelosus* and *Tranolithus* sp.)

Genus *Zeugrhabdotus* (*Zeugrhabdotus embergeri* and *Zeugrhabdotus* sp.)

Family EIFFELLITHACEAE

Genus *Eiffellithus* (*Eiffellithus eximius, Eiffellithus lindiensis, Eiffellithus pospichalii,* and *Eiffellithus turriseiffelii*)

⊛ Order STEPHANOLITHIALES

Family STEPHANOLITHIACEAE

Genus *Cylindralithus* (*Cylindralithus sculptus* and *Cylindralithus serratus*)

Genus *Rotelapillus* (*Rotelapillus munitus*)

- Placoliths

◉ Order PODORHABDALES

Family AXOPODORHABDACEAE

Genus *Cribrosphaerella* (*Cribrosphaerella ehrenbergii*)

Genus *Tetrapodorhabdus* (*Tetrapodorhabdus decorus*)

Family BISCUTACEAE
Genus *Biscutum* (*Biscutum dekaenelii*)
Family CRETARHABDACEAE
Genus *Retecapsa* (*Retecapsa octofenestrata* and *Retecapsa schizobrachiata*)

- Order WATZNAUERIALES

Family WATZNAUERIACEAE
Genus *Cyclagelosphaera* (*Cyclagelosphaera margerelii* and *Cyclagelosphaera* sp.)
Genus *Watznaueria* (*Watznaueria barnesiae, Watznaueria bayackii*, *Watznaueria biporta, Watznaueria fossacincta,* and *Watznaueria ovata*)

- Order ARKHANGELSKIALES

Family ARKHANGELSKIELLACEAE
Genus *Arkhangelskiella* (Arkhangelskiella cymbiformis and *Arkhangelskiella specillata*)
Genus *Broinsonia* (*Broinsonia enormis*)
Family KAMPTNERIACEAE
Genus *Gartnerago* (*Gartnerago coxalliae)*

- Holococcoliths

Family CALYPTROSPHAERACEAE
Genus *Calculites* (*Calculites obscurus* and *Calculites ovalis)*
Genus *Okkolithus* (*Okkolithus* sp.)

- Nannoliths

Family MICRORHABDULACEAE
Genus *Lithraphidites* (*Lithraphidites quadratus, Lithraphidites* cf. *carniolensis,* and *Lithraphidites* sp.*)*
Family POLYCYCLOLITHACEAE
Genus *Eprolithus* (*Eprolithus floralis)*
Genus *Lithastrinus* (*Lithastrinus quadricuspis*)
Genus *Micula* (*Micula clypeata* and *Micula staurophora*)
Genus *Uniplanarius* (*Uniplanarius gothicus* and *Uniplanarius sissingh)*
Family SCHIZOSPHAERELLACEAE
Genus *Ceratolithoides* (*Ceratolithoides kamptneri)*

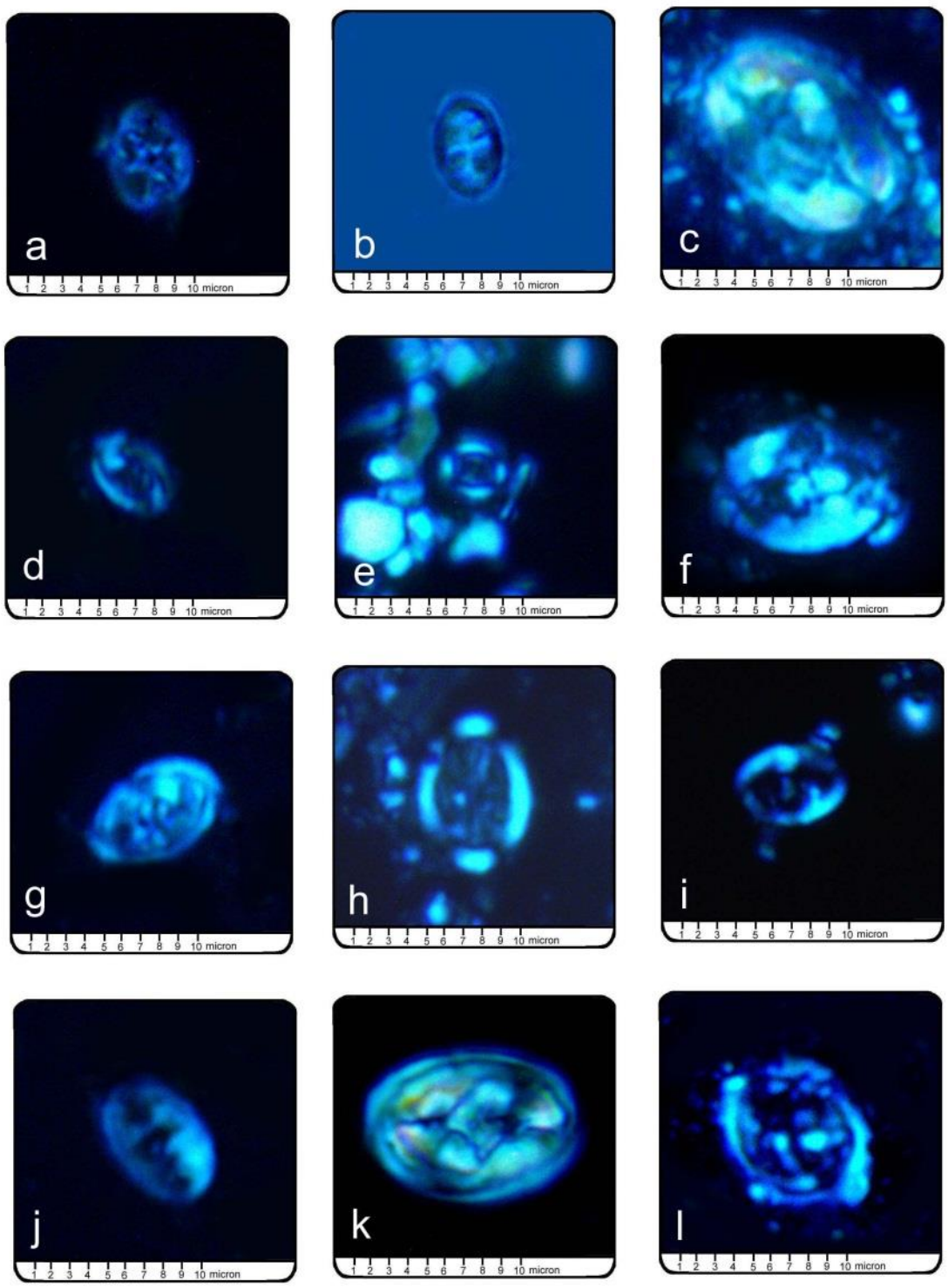

Fig. 3. Polarized photos of calcareous nannofossil from Hartha Formation. (a) Chiastozygus garrisonii; (b) Chiastozygus synquadriperforatus; (c) Gorkaea obliqueclausus; (d) Heteromarginatus bugensis; (e) Loxolithus bicyclus; (f) Reinhardtites anthophorus; (g) Reinhardtites levis; (h) Staurolithites dibrachiatus; (i) Tranolithus phacelosus; (j) Tranolithus sp.; (k) Zeugrhabdotus embergeri; (l) Zeugrhabdotus sp.

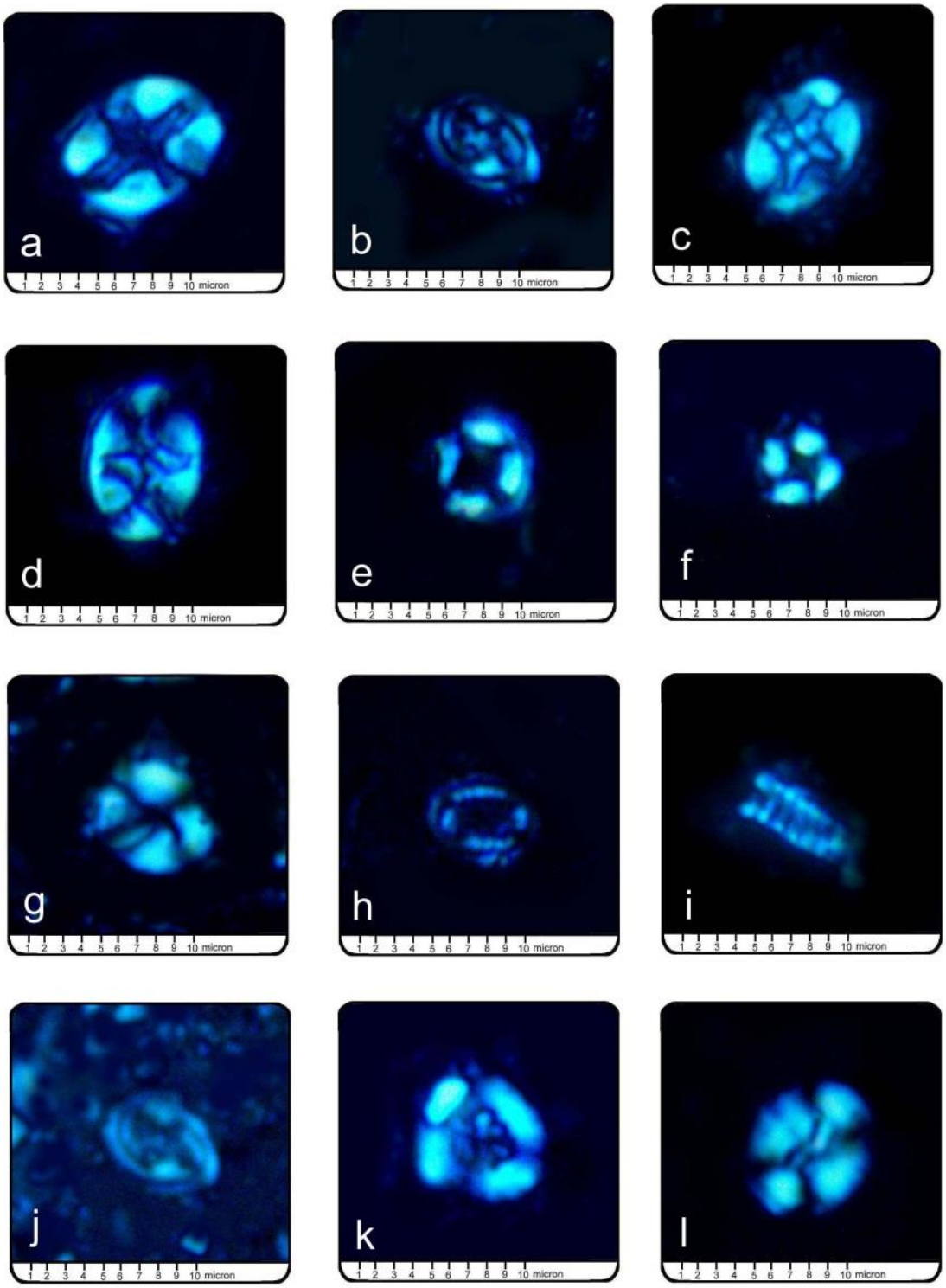

Fig.4. Polarized photos of calcareous nannofossil from Hartha Formation. (a) Eiffellithus eximius; (b) Eiffellithus lindiensis; (c) Eiffellithus pospichalii; (d) Eiffellithus turriseiffelii; (e) Cylindralithus sculptus; (f) Cylindralithus serratus; (g) Rotelapillus munitus; (h) Cribrosphaerella ehrenbergii ; (i) Tetrapodorhabdus decorus; (j) Biscutum dekaenelii; (k) Retecapsa octofenestrata; (l) Retecapsa schizobrachiata.

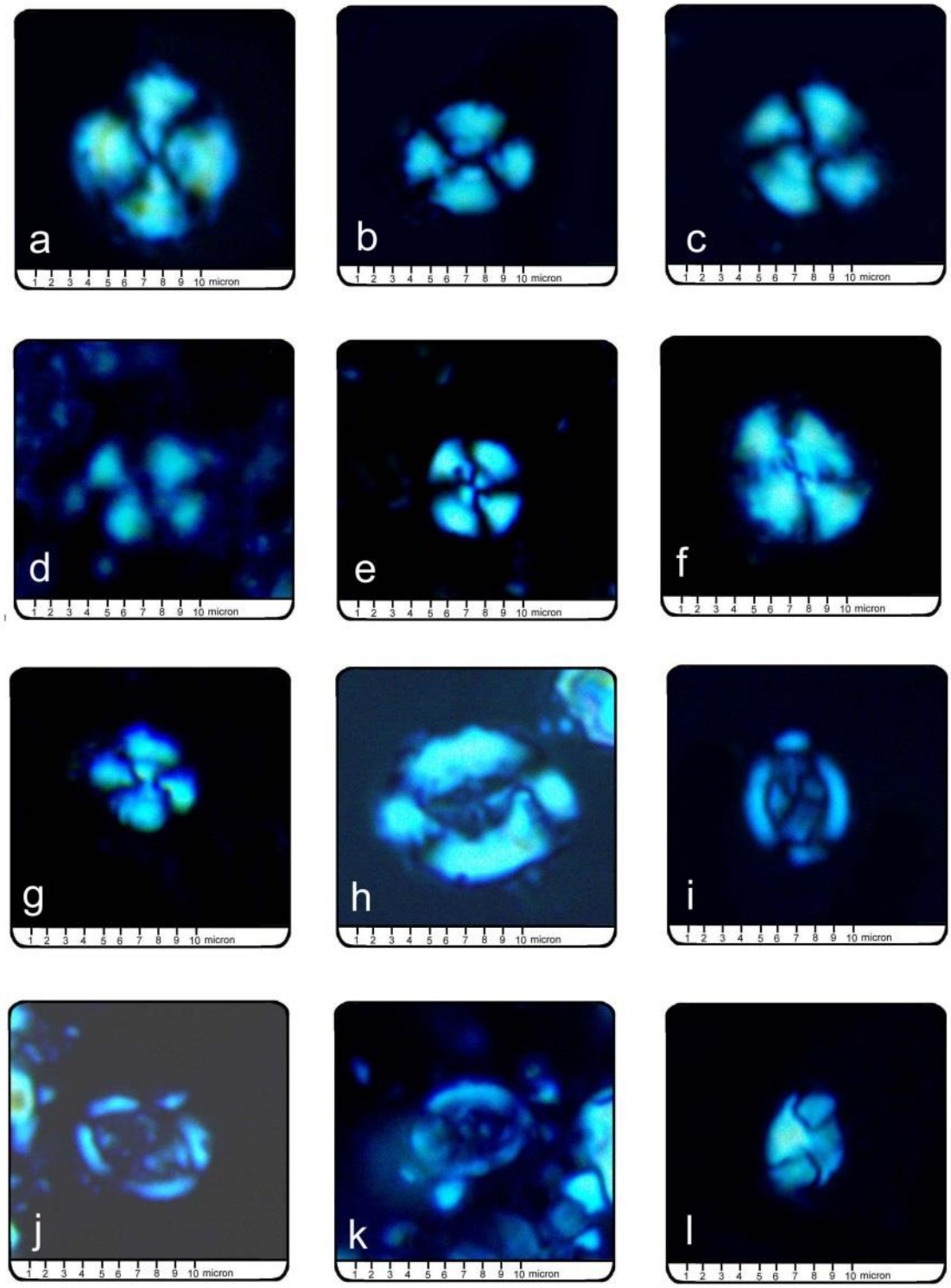

Fig.5. Polarized photos of calcareous nannofossil from Hartha Formation. (a) Cyclagelosphaera margerelii; (b) Cyclagelosphaera sp.; (c) Watznaueria barnesiae; (d) Watznaueria bayackii; (e) Watznaueria biporta; (f) Watznaueria fossacincta; (g) Watznaueria ovate; (h) Arkhangelskiella cymbiformis; (i) Arkhangelskiella specillata; (j) Broinsonia enormis; (k) Gartnerago coxalliae; (l) Calculites obscurus.

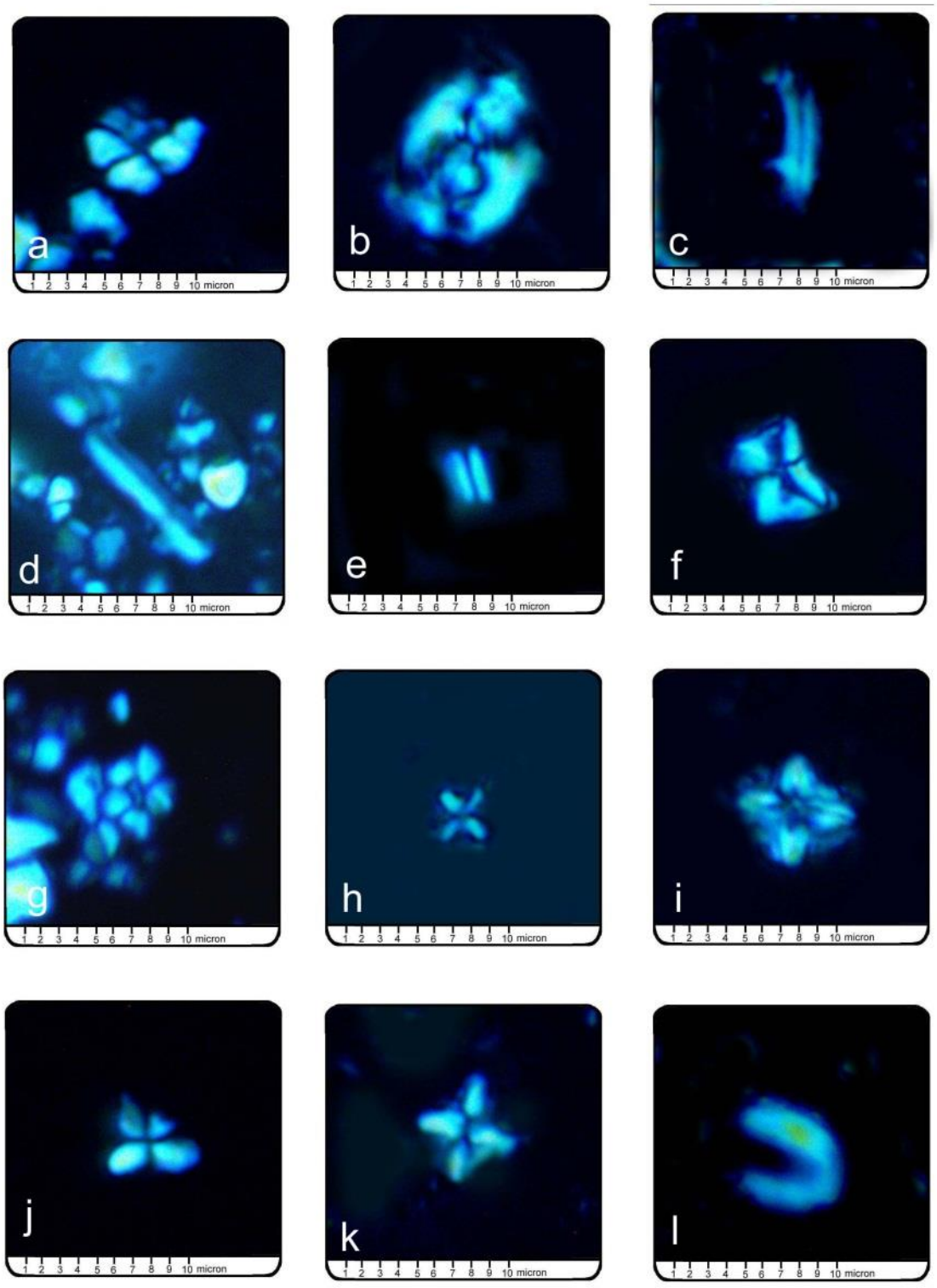

Fig.6. Polarized photos of calcareous nannofossil from Hartha Formation. (a) Calculites ovalis; (b) Okkolithus sp.; (c) Lithraphidites quadratus; (d) Lithraphidites cf. carniolensis; (e) Lithraphidites sp.; (f) Eprolithus floralis; (g) Lithastrinus quadricuspis; (h) Micula clypeata; (i) Micula staurophora; (j) Uniplanarius gothicus; (k) Uniplanarius sissinghi; (l) Ceratolithoides kamptneri.

Nannobiostratigraphy

1- *Uniplanarius sissingh* Interval biozone (CC21)

U. sissingh inhabits the Interval biozone in this biozone. The zone that is determined by the first appearance of *U. gothicus* and *U. sissinghi*. This zone is reported as belonging to the Late Campanian zone CC21 (*U. sissingh* biozone) of Sissingh (1977) and the Late Campanian biozone UC14, as identified by Bown (1998) and Gradstein *et al*. (2012).

2 - *Uniplanarius gothicus* Interval zone (CC22)

The U. *gothicus* (Deflandre, 1959). Hattner and Wise, in Wind and Wise, refer to this biozone as the Interval biozone. The biozone definitely extends to the last appearance of *E. eximus* (Stover, 1966), Perch-Nielsen, 1968, and from the first appearance of the *U. gothicus* (Deflandre, 1959), Hattner & Wise, in Wind and Wise. This biozone is reported to be in the L. Campanian, zone CC22 (*U. trifidus* Zone) of Sisingh (1977), and the Late Campanian, zone UC15, as defined by Bown (1998), Gradstein *et al*. (2012).

3 - *Tranolithus phaclosus* Interval zone (CC23)

This biozone is known as the *T. phaclosus* Interval biozone (Stover, 1966). The region that was investigated by the last appearance of *T. phaclosus* Stover, 1966, and the last appearance of *E. eximus* (Stover, 1966) Perch-Nielsen, 1968, or the last appearance of *R. anthophorus* (Deflandre, 1959) Perch-Nielsen, 1968. This biozone is comported with CC23 (*T. phaclosus* zone), which was studied by Sisingh (1977), which aged from the L. Campanian to lower Maastrichtian, and comported UC16, UC17 biozone, which is studied by Bown (1998) that aged Campanian to Early Maastrichtian age (Figs. 3–11) from Gradstein *et al*., 2012.

4 - *Reinhardtites levis* Interval zone (CC24)

R. levis Prins and Sisingh classified this biozone as an interval biozone in Sisingh's (1977) study. The zone defined by the last appearance of *T. phaclosus* Stover (1966) to the last appearance of *R. levis* Sisingh (1977). This zone is comported with CC24 (*R. levis* zone), which was studied by Sisingh (1977) at the age of the Last Campanian to Early Maastrichtian, and is comported UC18 zone, that is studied by Bown (1998) that aged Maastrichtian. (Figs. 3–11) from Gradstein *et al*., 2012.

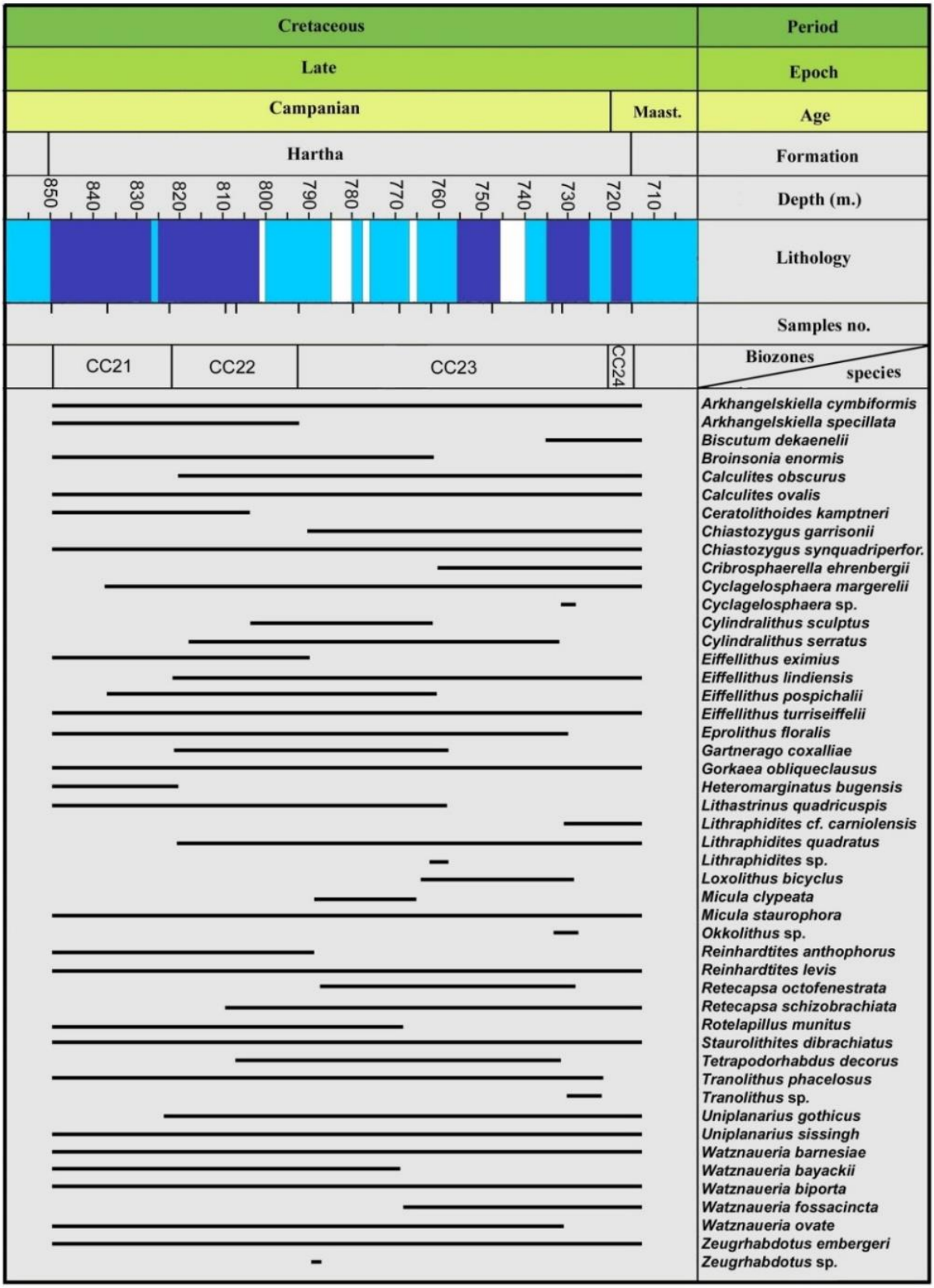

Fig.7. Distribution chart of calcareous nannofossils in Hartha Formation.

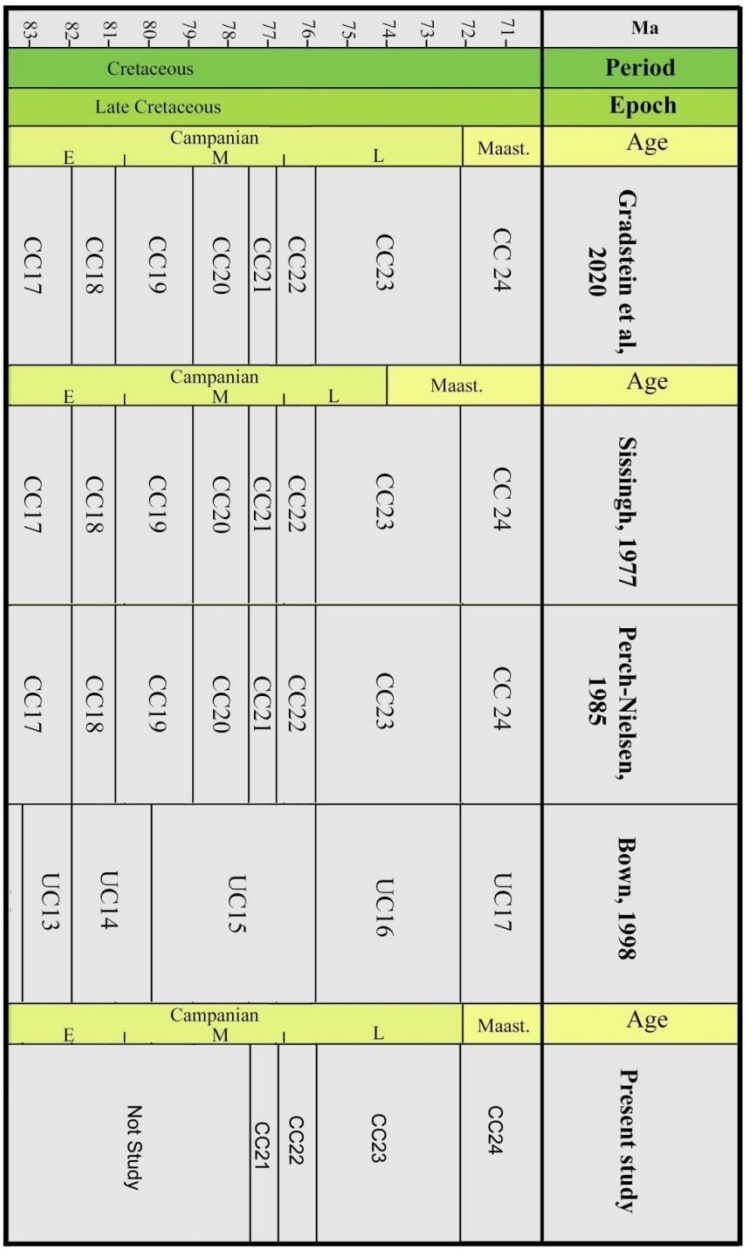

Fig.8. Age correlation chart of calcareous nannofossils in Hartha Formation.

Conclusion

Fourthy eight spcies of calacreous nanaofosssil are recored from Hartha Formation from northern Iraq; these families are: Chiastozygaceae (12 species); Eiffellithaceae (4 species); Stephanolithaceae (3 species); Axopodorhabdaceae (2 species); Biscutaceae(1 species); Cretarhabdaceae (2 species); Watznaueriaceae (7 species); Arkhangelskillaceae (3 species); Kampatneriaceae (1 species); Calyptrospharaceae (3 species); Microrhabdulaceae (3 species); Polycyclolithaceae (6 species); Schizospherellaceae (1 species).

The region under examination displays a total of four biozones arranged chronologically from oldest to youngest: *U. sissinghi* Interval biozone (CC21); *U. gothicus* Interval biozone (CC22); *T. phacelosus* Interval biozone (CC23); *R. lives* Interval biozone (CC24). The relationships between these biozones and those of other calcareous nannofossil biozones from locally and regionally sections have led us to conclude that these nannofossils date from the L. Campanian to the E. Maastrichtian.

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