



## Introduction of Calcareous Nannofossils (Santonian-Maastrichtian) From South East Isfahan in Central Iran

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### Abstract

This research studied the biostratigraphy of Upper Cretaceous deposits (Santonian - Maastrichtian) regarding to Coccolithophorids South east Isfahan, Central Iran. Nannofossils out of two sections from south and south-east Isfahan had good preservation and high variety. Lithostratigraphic unit have different thicknesses that, include marly limestone, shale, and limestone. Fine grained sediments, normally consisting of shale and marly limestone, have the best chance to contain nannofossils with respect to their content in calcareous nannofossils. The following genera and species were identified from deposits:

*Arkhangelskiella cymbiformis*, *Biscutum magnum*, *Braarudosphaera sp.*, *Calculites obscurus*, *Ceratholithoides self-trailiae*, *Ceratolithoides aculeus*, *Ceratolithoides amplector*, *Ceratolithoides brevicornicalans*, *Ceratolithoides kamptneri*, *Ceratolithoides pricei*, *Ceratolithoides sp.*, *Cyclagelosphaera margerelii*, *Lithraphidites carniolensis*, *Lithraphidites quadratus*, *Lucianorhabdus cayeuxii*, *Lucianorhabdus maleformis*, *Micula murus*, *Micula praemurus*, *Micula prinsii*, *Nannoconus dauvillieri*, *Quadrum gartneri*, *Quadrum trifidus*, *Thoracosphaera opercula*, *Watznaueria barnesae*.

Most of them have good preservation and high variety. Totally 16 genera, 26 species related to the calcareous nannofossils have been identified.

**Key words:** Coccolithophorids, nannofossil, south east Isfahan, Upper Cretaceous

## معرفی نانوفسیل های کرتاسه (سانتونی - ماستریشتین) جنوب شرق اصفهان در ایران مرکزی

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### چکیده

این پژوهش درباره بیواستراتیگرافی نهشته های کرتاسه ی فوقانی (رسوبات سانتونین - ماستریشتین) بحث می نماید. در این مقاله تعداد ۲۶ گونه و ۱۶ جنس مختلف نانوفسیل های آهکی کولیتوفورید برای اولین بار شناسایی شده اند. کولیتوفوریدهای جنوب شرقی اصفهان تنوع زیاد و حفظ شدگی خوب

دارند. اندازه‌ی بسیار کوچک و گسترش جغرافیایی زیاد نانوفسیل‌های آهکی، آن‌ها را به عنوان شاخصی کارآمد و مفید در مطالعات بیواستراتیگرافی مطرح ساخته است. واحدهای لیتواستراتیگرافی شامل ضخامت‌های مختلفی از رسوبات شیلی و ماری و تناوب آهک و مارن و همچنین آهک می‌باشند. رسوبات دانه‌ریز از قبیل شیل و آهک ماری بهترین شرایط را برای حفظ نانوفسیل‌ها دارند. جنس‌ها و گونه‌های متنوع نانوفسیلی از قبیل:

*Arkhangelskiella cymbiformis*, *Biscutum magnum*, *Braarudospheara* sp., *Calculites obscurus*, *Ceratholithoides self-trailiae*, *Ceratolithoides aculeus*, *Ceratolithoides amplexor*, *Ceratolithoides brevicornicalans*, *Ceratolithoides kamptneri*, *Ceratolithoides pricei*, *Ceratolithoides* sp., *Cyclagelosphaera margerelii*, *Lithraphidites carniolensis*, *Lithraphidites quadratus*, *Lucianorhabdus cayeuxii*, *Lucianorhabdus maleformis*, *Micula murus*, *Micula praemurus*, *Micula prinsii*, *Nannoconus dauvillieri*, *Quadrum gartneri*, *Quadrum trifidus*, *Thoracosphaera opercula*, *Watznaueria barnesae*.

شناسایی گردید. بیشتر آن‌ها از حفظ شدگی خوبی برخوردارند.

**واژه‌های کلیدی:** جنوب شرق اصفهان، کرتاسه‌ی فوقانی، کوکولیتوفوریدها، نانوفسیل‌ها

### 1. Introduction

In this investigation, some nannofossils zones in the vicinity of south and south east Isfahan (Central Iran) have been studied and introduced for first time. Tiny size and geographical distribution of calcareous nannofossils are some of the useful characteristics that, suggest them as substantial topics in biostratigraphy studies.

Studied regions are temperate to semi-dry areas, located near Kabuterabad and Shaydan villages which can be reached through two pathways:

1. Isfahan - Shareza road: departing Isfahan for Lashotor curve, and keeping on the same direction toward Gharneh and Shaydan villages.

2. North road: Isfahan to Mohammad Abad of Jarghoye.

Location of studied sections as follow as (fig. 1):

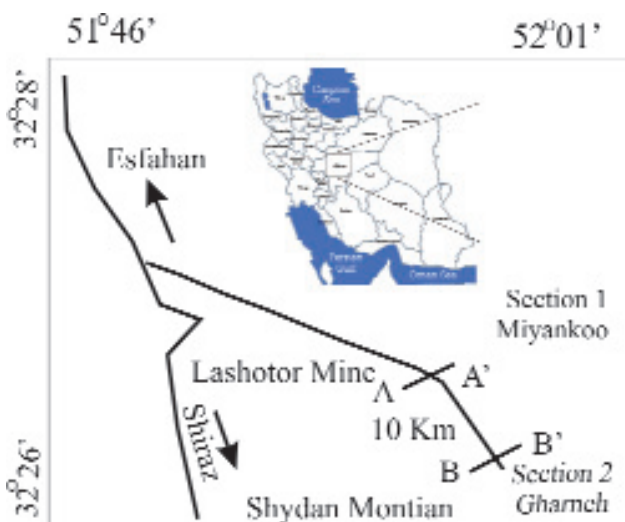


Fig. 1. Location of studied sections

### 2. Stratigraphy

#### Alternation of marl with limestone (Miyankoo and Gharneh Mountain):

These sediments are located in south east Isfahan. Departing Isfahan for Lashotor curve, and keeping on the same direction toward Gharneh and Shaydan villages, you will reach this area. Total thickness of sediments is about 320 meters. The youngest parts of studied sequence sediments can be traced in Shydan Mountain (near Gharneh). Lithologically, they consist of 250 meters marl and limestone alternation. Fine grained sediments, consisting of shale and marly limestone, have the best chance to contain nannofossils. Nevertheless, nannofossil frequency decrease in hard-rock sediments.

### 3. Calcareous Nanoplanktons

Coccolithophorids (Triassic to recent) are planktonic alge which have low Mg calcite skeleton consisting of a spherical coccosphere (10-100  $\mu$ m diameter) composed of numerous calcareous plate, called coccolithes are chiefly disco-shaped, commonly with radial arrangement of crystal calcium carbonate. Coccolithes occupied open-ocean and marine plagic environments from deep-water through to shallow subial and lagoon. Studied Nanofossils from south and south east Isfahan have good reservation and high variety (Fig. 3). In the investigation Nanofossils species such as: *Watznaueria biporta*, *Watznaueria barnesae*, *Lucianorhabdus maleformis*, *Micula murus*, *Ceratolithoides aculeus*, *Ceratolithoides amplexor*, *Calculites obscurus*, *Quadrum gartneri*, *Quadrum trifidus*, *Ceratolithoides* sp., *Ceratolithoides ultimus*, *Eiffellithus turriseiffelii*, *Lithraphidites carniolensis*, *Lucianorhabdus cayeuxii*, *Cyclagelosphaera margerelii*, *Ceratolithoides kamptneri*, *Ceratholithoides self-trailiae*, *Lithraphidites quadratus*, *Ceratolithoides brevicor-*

*nicalans*, *Arkhangelskiella cymbiformis*, *Biscutum magnum*, *Braarudospheara* sp., *Ceratolithoides pricei*, *Micula praemurus*, *Micula prinsii*, *Nannoconus dauvillieri*, *Thoracosphaera operculata* have been identified in research. Species such as: *Micula prinsii*, *Micula murus* are demonstrably related to the Uppermost of Maastrichtian age.

A diverse assemblage zone of *Ceratolithoides* taxa that was encountered during a study of Indian Ocean by Burnet (1977) and Perch-Nielsen (1985). *Ceratolithoides* species can be traced in this region, as well. *Ceratolithoides* Horseshoe-shaped, arrowhead shaped and blocky, squarish forms (Fig. 2). *Ceratolithoides* as well illustrated terminology used

to describe ceratolithoides. This research studied some genera related to ceratolithoides from south east Isfahan for the first time. (Plates 1-5)

#### 4. Biostratigraphy

Till now so many researches from around the world related to calcareous nannofossils of cretaceous are been published, such as: Sissingh (1977), Perch Nielsen (1985), Roth (1978), Hadavi (2008) biostratigraphy of Kopet Dagh cretaceous and Central Iran reported. Until now there is not study on Nannofossils zones South and South East Isfahan in Central Iran. According to this research we can enact some zonation (CC17-CC26 from Sissingh zonation) which is as follow as:

- Calculites obscurus* Zone (CC17)  
Age: Late Santonian/Early Campanian
- Aspidolithus parvus* Zone (CC18)  
Age: Early Campanian
- Culculites ovalis* Zone (CC19)  
Age: Early Campanian
- Ceratolithoides aculeus* Zone (CC20)  
Age: Late Early Campanian
- Quadrum Sissingh* Zone (CC21)  
Age: early Late Campanian
- Quadrum trifidum* (CC22)  
Age: late Late Campanian
- Tranolithus phacelosus* Zone (CC23)  
Age: Latest Campanian to Early Maastrichtian
- Reinhardites levis* Zone (CC24)  
Age: Early Maastrichtian
- Arkhangelskiella cymbiformis* Zone (CC25)  
Age: Late Maastrichtian
- Nephrolithus phrolithus frequens* Zone (CC26)  
Age: late Late Maastrichtian

#### 5. Conclusion

Twenty-six species and sixteen genera related to the nannofossils have been recognized.

Santonian to Maastrichtian sediments according to this study specifies the zonation of CC17-CC26 from sissingh zonation.

Maastrichtian sediments based on the assemblage of fossils include of, *Micula prinsii*, *Micula murus* and some other species is obvious and these sediments are recognized by overthrow of index forms of Cretaceous.

Based on exact studies of paleontology, the abundance and variety of different species at this time could be found in warm climate. The presence of species like *Watznaueria biporta*, *Watznaueria barnesae*, *Micula prinsii*, *Micula murus* which all are to low latitudes and are useful indexes of Upper Maastrichtian help us

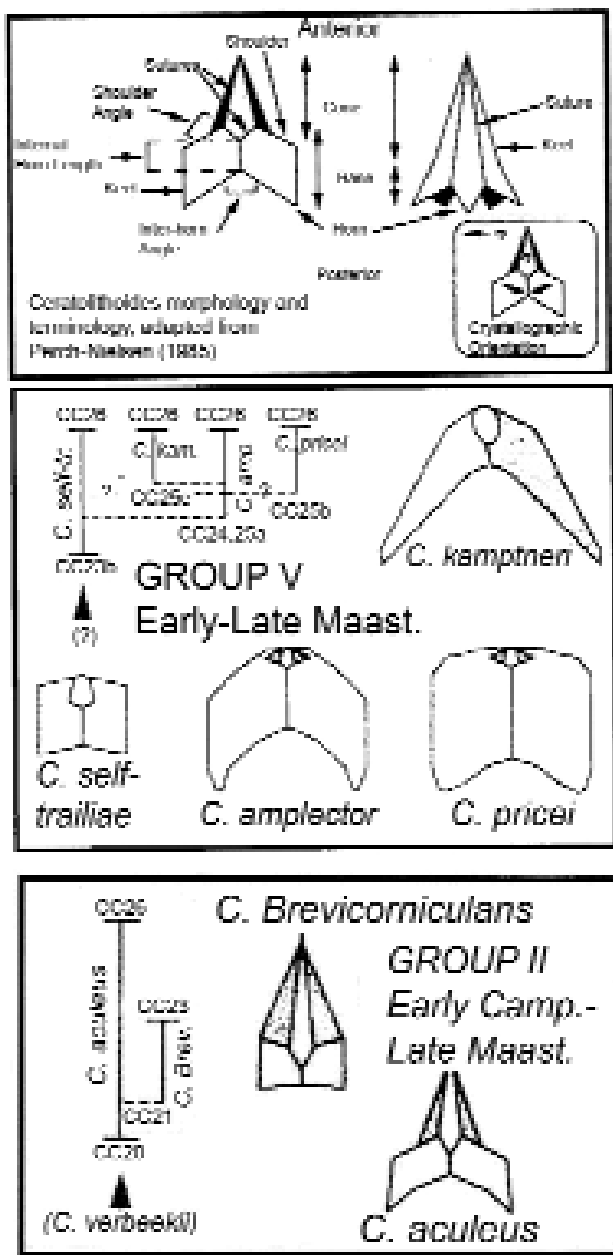


Fig. 2. Thoides morphology and terminology of *Ceratolithoides*, adapted from Perch-Nielsen (1985)

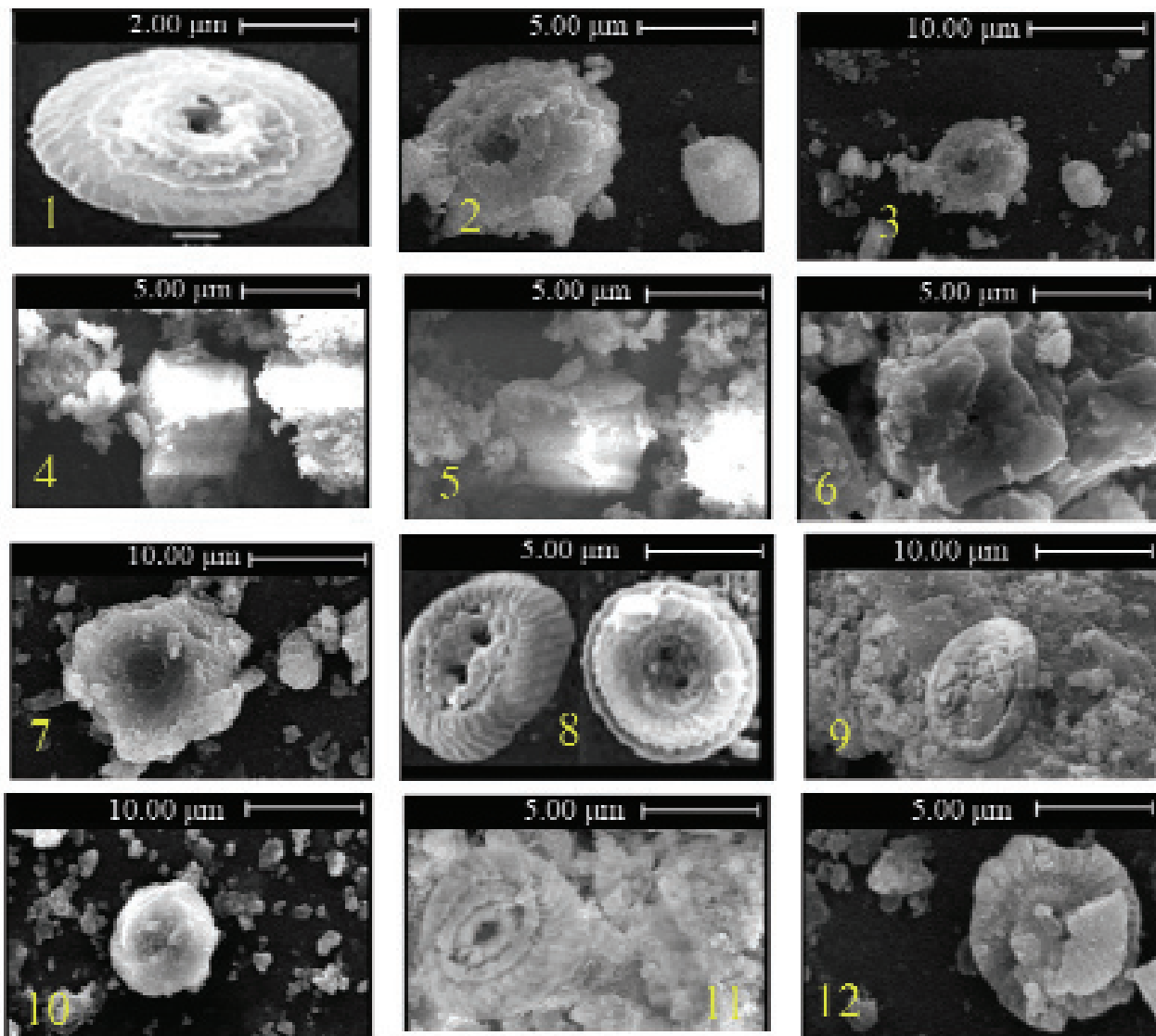


Fig 1-3. *Cycagelosphaera margerelii* (Bukry 1969)

Fig 4-7. *Micula* sp (Perch-Nielsen 1983)

Fig 8. *Watznaueria biporta* (Bukry 1969)

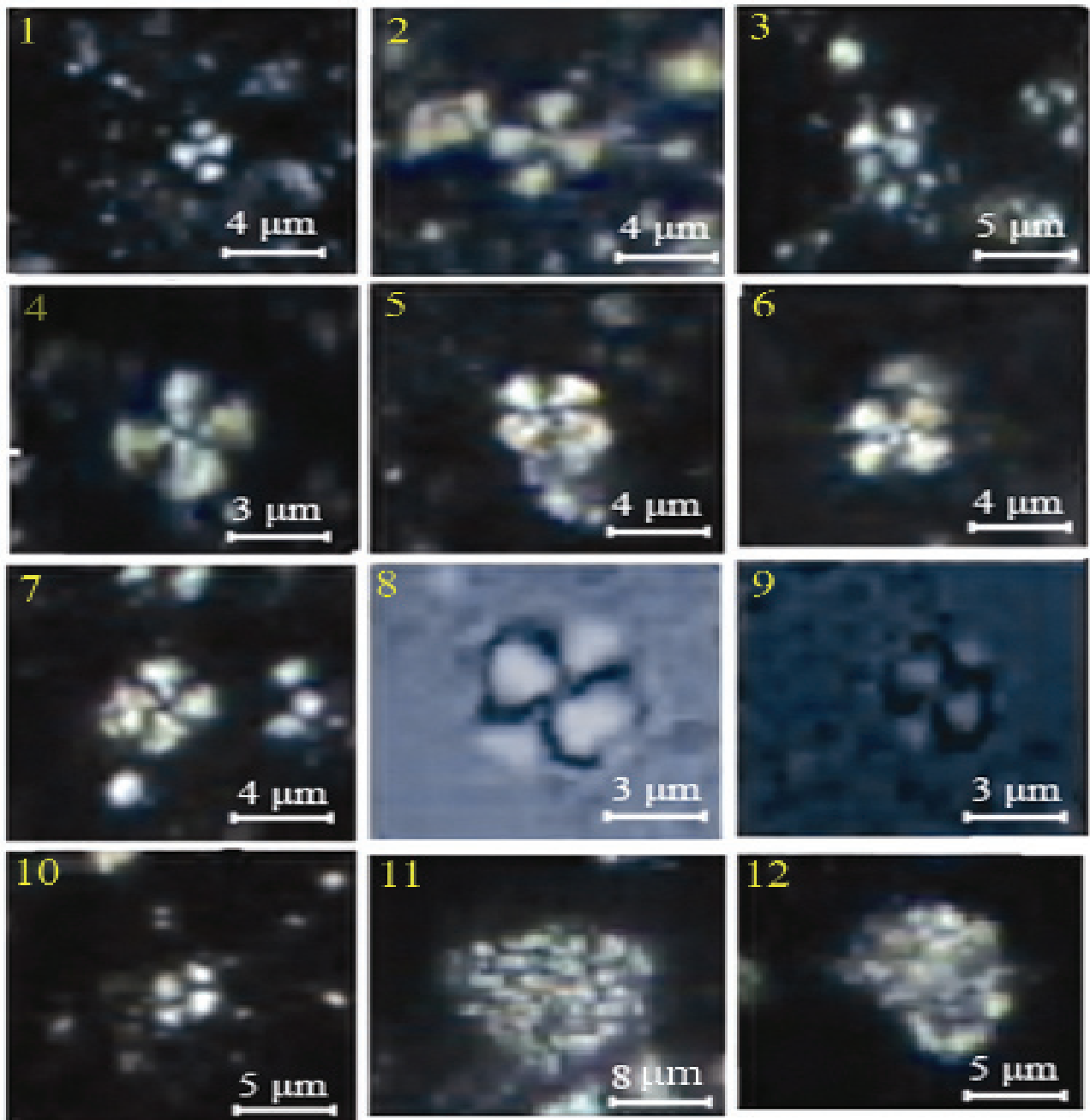
Fig 9. *Arkhangelskiella cymbiformis* (Burnett 1977)

Fig 10. *Coccolithes* sp (Noel 1959)

Fig 11. *Watznaueria barnesae* (Perch-Nielsen 1983)

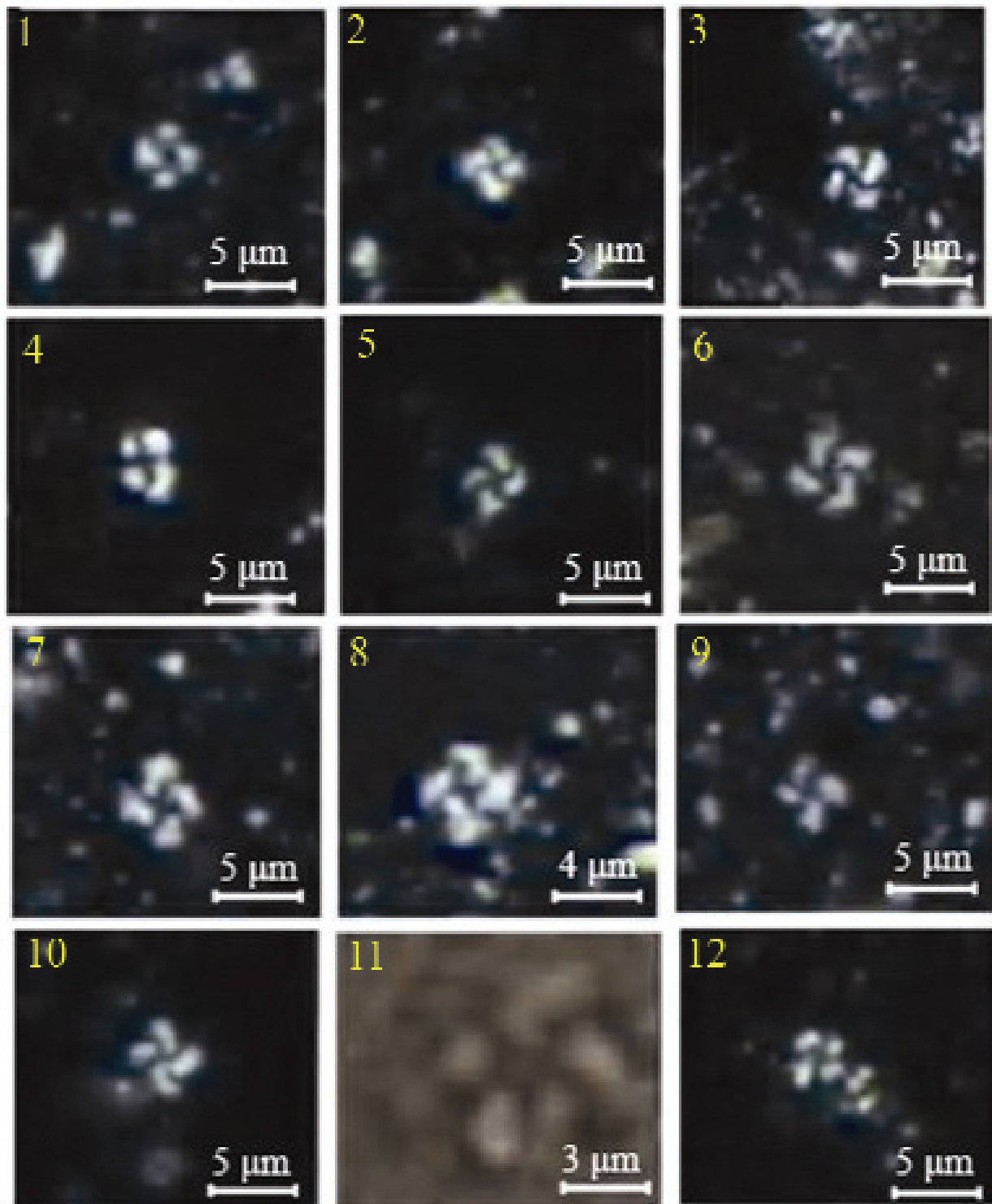
Fig 12. *Biscutum* sp. (Deflandre 1963)

Plate 1. Calcareous Nannofossils (Santonian-Maastrichtian) from south east Isfahan  
(Captured by SEM Microscope)



Figs 1 - 3. *Calculatus obscurus* (Sissingh 1977), XPL  
Figs 4 - 7. *Watznaueria biporta* (Bukry 1969), XPL  
Figs 8 - 10. *Watznaueria barnesae* (Black & Barnes 1959), XPL & PPL  
Figs 10 - 12. *Thoracosphaera operculata* (Perch-Nielsen 1985), XPL

Plate 2. Calcareous Nannofossils (Santonian -Maastrichtian) from south east Isfahan



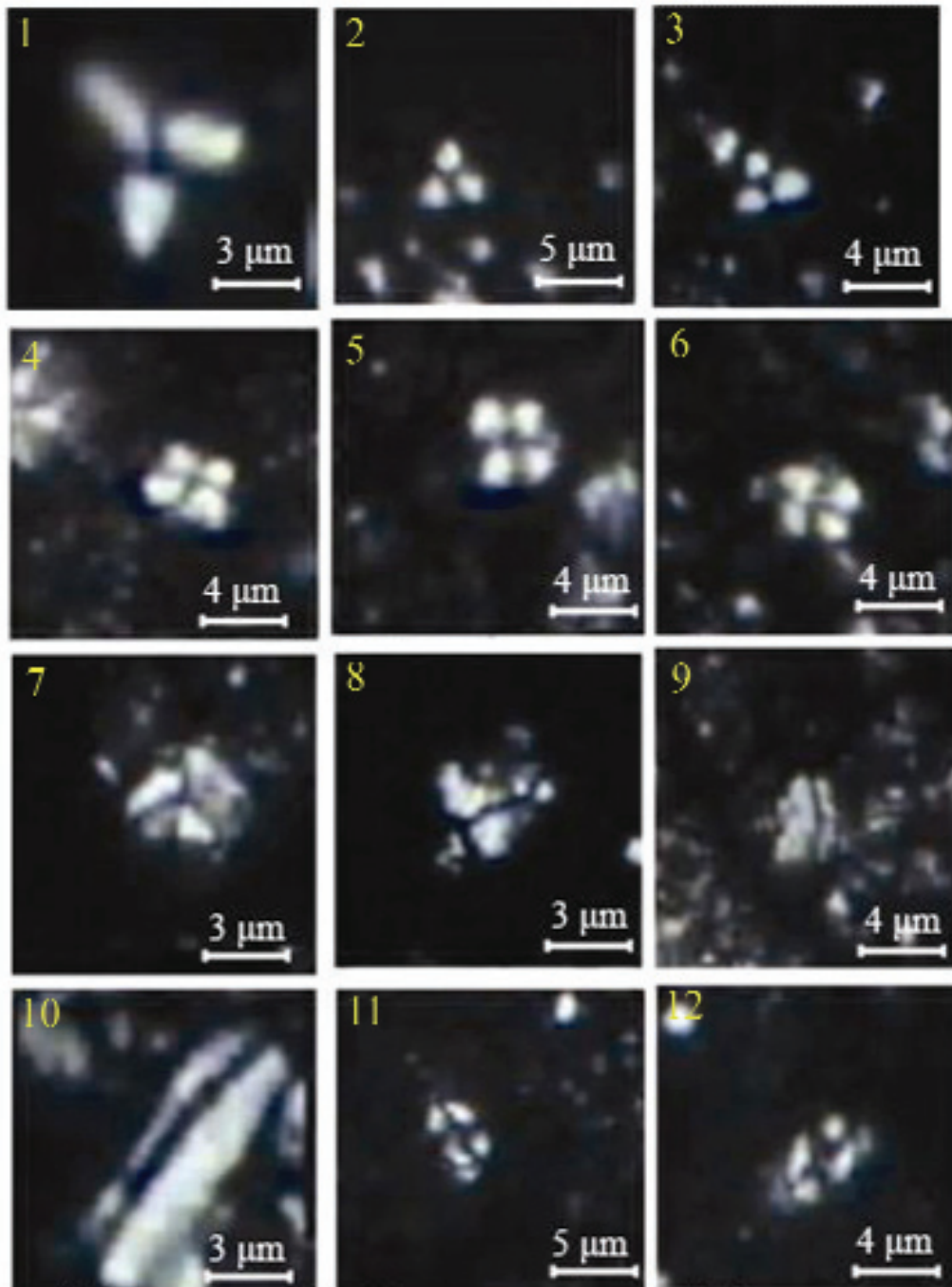
Figs 1 - 3. *Calculites obscurus* (Sissingh 1977), XPL

Figs 4 - 7. *Watznaueria biporta* (Bukry 1969), XPL

Figs 8 - 10. *Watznaueria barnesae* (Black & Barnes 1959), XPL

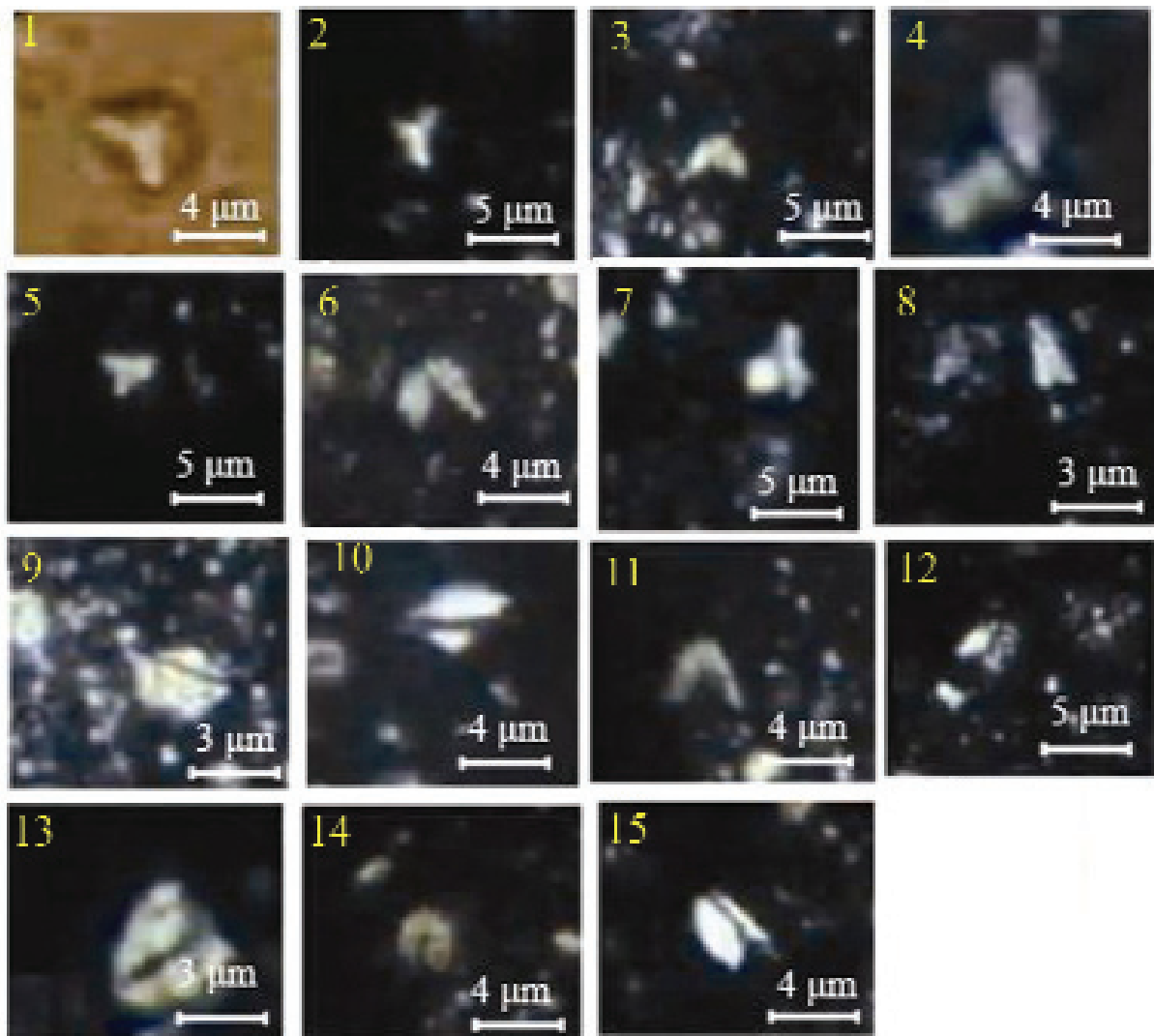
Figs 10 - 12. *Thoracosphaera operculata* (Perch-Nielsen 1985), XPL

Plate 3. Calcareous Nannofossils (Santonian -Maastrichtian) from south east Isfahan



Figs 1 – 3. *Quadrum trifidum* (PerchNielsen 1979), XPL  
Figs 4 – 6. *Quadrum gartneri* (Perch-Nielsen 1979), XPL  
Figs 7. *Braarudosphaera* sp. (Perch-Nielsen 1985), XPL  
Fig 8. *Lucianorhabdus maleformis* (Reinhardt 1966), XPL  
Fig 9 - 10. *Lucianorhabdus cayeuxii* (Reinhardt 1966), XPL  
Figs 11 , 12. *Eiffellithus turriseiffelii* (Deflandre in Deflandre & Fert 1954). XPL.

Plate 4. Calcareous Nannofossils (Santonian -Maastrichtian) from south east Isfahan



Figs 1 – 5. *Ceratolithoides aculeus* (Burnett 1977), XPL & PPL

Fig 6. *Ceratolithoides amplector* (Burnett 1977), XPL

Fig 7. *Ceratolithoides* sp. (Perch-Nielsen 1979), XPL

Fig 8. *Ceratolithoides brevicorniculans* (Perch-Nielsen 1979), XPL

Figs 9 - 10. *Ceratolithoides quadratus* (Perch-Nielsen 1985), XPL

Fig 11. *Ceratolithoides kamptneri* (Perch-Nielsen 1985), XPL

Fig 12. *Ceratolithoides pricei* (Perch-Nielsen 1985), XPL

Figs 13 – 15. *Ceratolithoides ulimns* (Burnett 1977), XPL

Plate 5. Calcareous Nannofossils (Santonian -Maastrichtian) from south east Isfahan



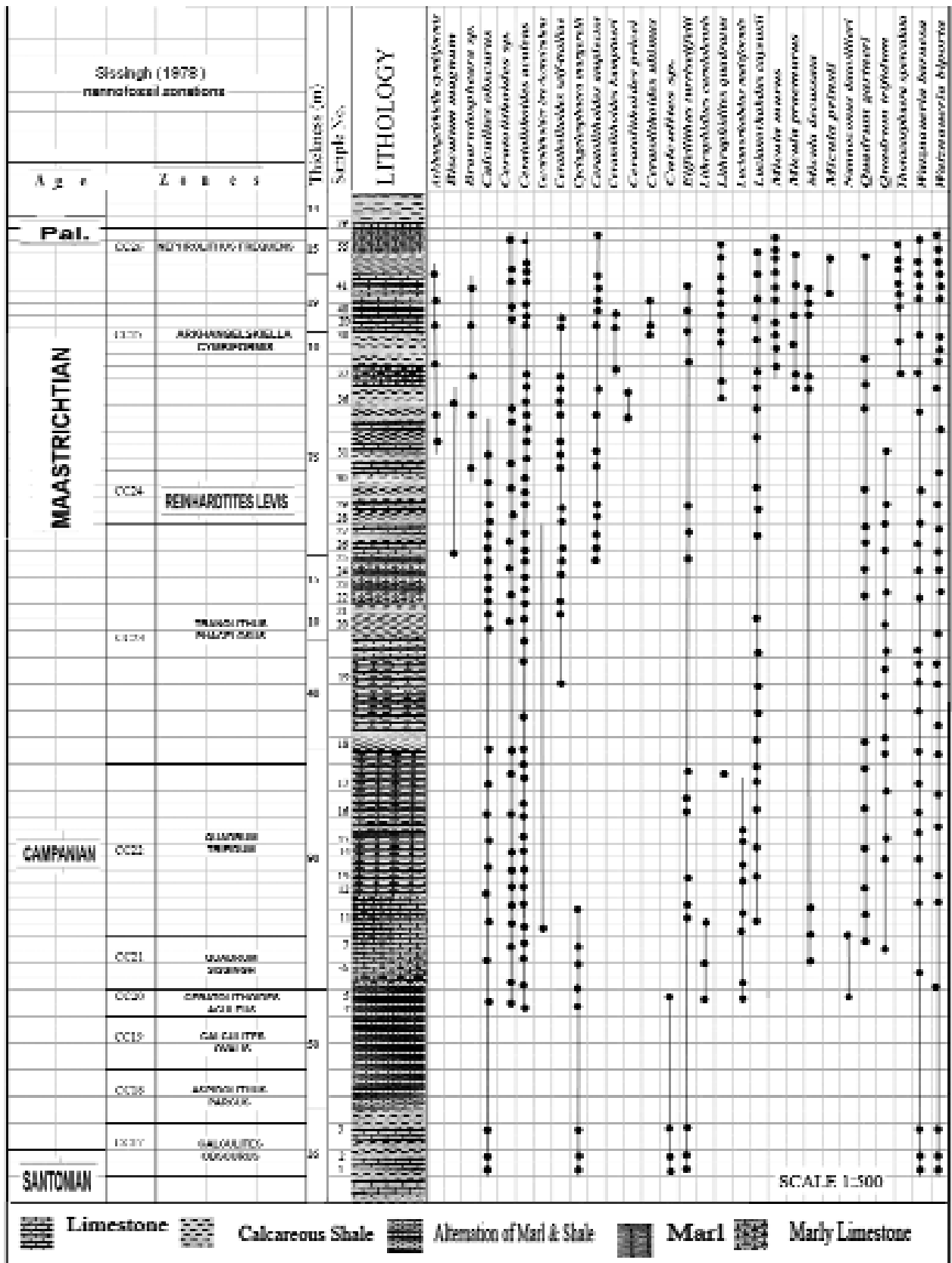


Fig. 3. Range-chart and biozonation of Calcareous Nannofossils (Santonian-Maastrichtian) from south east Isfahan

conclude that south east Isfahan basin have been located low to middle latitudes.

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