NANNOFOSSILS' BIOZONES OF THE CONTACT BETWEEN KOMETAN AND SHIRANISH FORMATIONS, CHAQCHAQ VALLEY, SULAIMANIYAH, NE IRAQ

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Received: 30/ 03/ 2011, Accepted: 29/ 12/ 2011
Key words: Shiranish Formation, Kometan Formation, Gradational contact, Transitional zone, Nannofossils

ABSTRACT

Nineteen species of calcareous nannofossils were identified from the contact between Kometan and Shiranish formations that is exposed in Chaqchaq valley, northwest of Sulaimaniyah city, NE Iraq. The recorded calcareous nannofossils' assemblages permit recognition of two biozones:

1- *Aspidolithus parcus – Calculites ovalis* Interval Biozone (CC 18 – CC 19)
2- *Ceratolithoides aculeus* Interval Biozone (CC 20)

Based on nannofossils biozonation, the contact between Kometan and Shiranish formations is considered to be conformable. In the studied area, it was found that the age of the Shiranish Formation extends to Early Campanian.

الطباقية الحياتية لمتحجرات "النانو" في حد التماس بين تكويني كوميتان وشرانش، في وادي چقچق، السليمانية، شمال شرق العراق

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المستخلص

شخص تسعة عشر نوع من متحجرات "النانو" الكلسية من حد التماس بين تكويني كوميتان وشرانش المتكشفان في وادي چقچق شمال غرب مدينة السليمانية، شمال شرق العراق. خلال الانتشار الطباقي لحشود المتحجرات يمكن تمييز نطاقين حياتيين هما:

1- *Aspidolithus parcus – Calculites ovalis* Interval Biozone (CC 18 – CC 19)
2- *Ceratolithoides aculeus* Interval Biozone (CC 20)

اعتماداً على المتحجرات المتناهية الصغر وجد إن حد التماس بين تكويني كوميتان وشرانش هو توافقي. ويمتد عمر تكوين شرانش إلى الكامبانيان المبكر في منطقة الدراسة.

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INTRODUCTION

Kometan Formation was described by Dunnington (1953) in Bellen *et al*. (1959). It is exposed in the High Folded Zone and in subsurface sections in the Mesopotamian Zone (Dunnington, 1958; Buday, 1980, and Buday and Jassim, 1987). The type section is located 400 m west of Kometan village in the Naudasht valley in the foothills of Qandil Mountain, about 20 Km to the north of Ranyia town in the Imbricate Zone (Fig.1). According to the aforementioned authors, the formation is composed of well bedded, light grey or white limestone. It contains locally chert nodules or ribbons with rare pyrite concretions.

The thickness of the Kometan Formation, in the High Folded and Imbricate Zones, ranges from (100 – 120) m. The lower and upper contacts of the formation are unconformable (Dunnington, 1953; in Bellen *et al*., 1959; Buday, 1980, and Al-Khafaf, 2005). The first author added that faunal and intense glauconization indicate depositional hiatus and probable erosion. In this contact, he also found polygenetic micropebbles.

Recent sedimentological studies, such as Karim *et al*. (2008) and Taha (2008) analyzed what was called by Bellen *et al*. (1959) "polygenetic micropebbles". They proved that there are no such deposits in all studied six sections. In the contact, they found siliceous nodules and glauconite at one section. In the other section, they observed gradational contact as regular alternation of white limestone and bluish white marl.

The Shiranish Formation is the most wide spread rock unit throughout the Cretaceous of north Iraq. Its type section is first described by Henson (1940) (cited in Bellen *et al*., 1959) and lies at Shiranish Islam village near Zakho city, NW Iraq. It reaches about 228 m in thickness and consists mainly of marl and marly limestone representing off shore, open sea sediments of the Late Campanian – Maastrichtian age, on the basis of the foraminiferal assemblages' content.

LOCATION AND GEOMORPHOLOGY

The studied section is located 10 Km northwest of Sulaimaniyah city and about 3 Km south of Lower Hanaran village; in the middle part of the Chaqchaq valley. It is located in the intersection of latitude $35^{o}\ 39^{'}\ 46^{"}$ N and longitude $45^{o}\ 22^{'}\ 35^{"}$ E (Figs.1 and 2). The contact is exposed clearly along the right bank (when looking upstream) of the perennial Chaqchaq stream (Fig.3).

The Chaqchaq valley is flat bottomed at its mouth, to the east of Sulaimaniyah city, while it becomes V-shaped at its middle part and head. The valley is surrounded from southwest, north and northeast by Pira Magroon, Daban and Azmir Mountains, respectively (Fig.2). Structurally, it is occupied by wide syncline in which Tanjero, Shiranish and Kometan formations are exposed, near its axis and along the lower parts of the limbs. Along the upper part of the southwestern and northeastern limbs; Qamchuqa and Balambo formations are exposed, respectively.

MATERIAL AND METHODOLOGY

Forty one samples were collected from the Kometan and Shiranish formations across the contact between them. Two samples were collected from proper Kometan Formation; at the base of the sampled interval. Eight samples were collected from what seems to be the transitional zone (alternation between white pelagic limestone and bluish marl); at the middle part of the sampled intervals. The other samples were collected from the proper Shiranish Formation (bluish white marl); at the top of the sampled intervals. These samples are inspected under normal and polarized microscope with more than 1000 magnification. The samples are identified, the significant samples were photographed and then systematic paleontology and biozonation are achieved; as mentioned hereinafter.

For preparing smear slides, a small part of the sample was put on a glass slide and mixed thoroughly with distilled water. The slide was dried on a hot plate and covered with glass slide cover by using Canada balsam and examined with normal microscope.

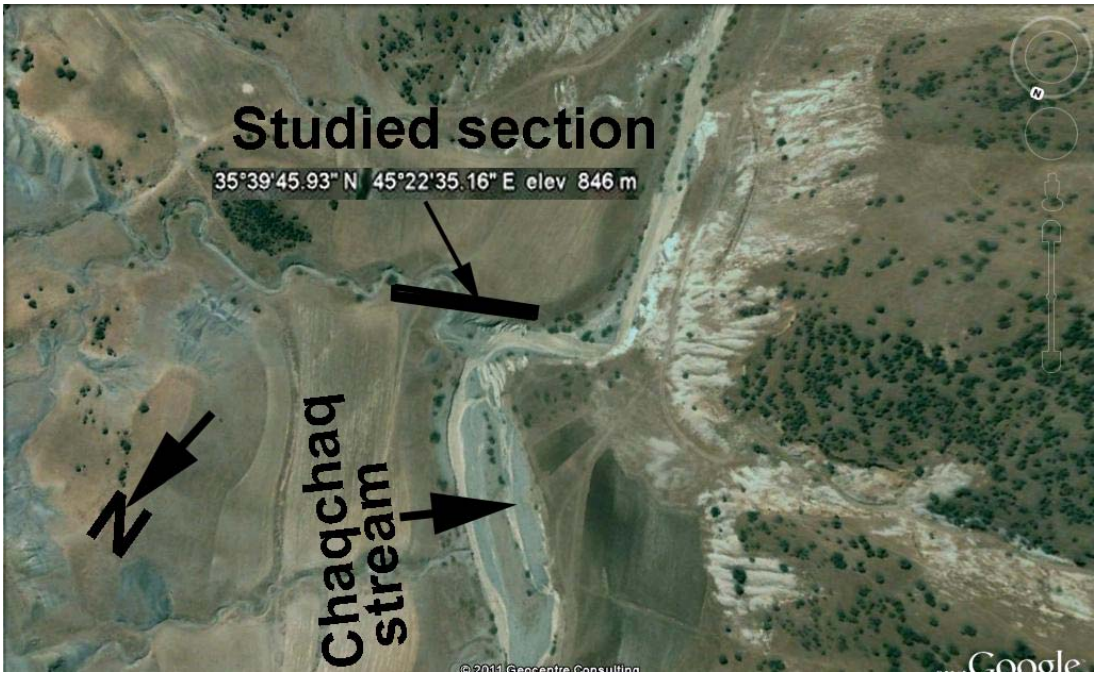

Fig.1: Google earth image of the studied area around the sampled section in Chaqchaq stream

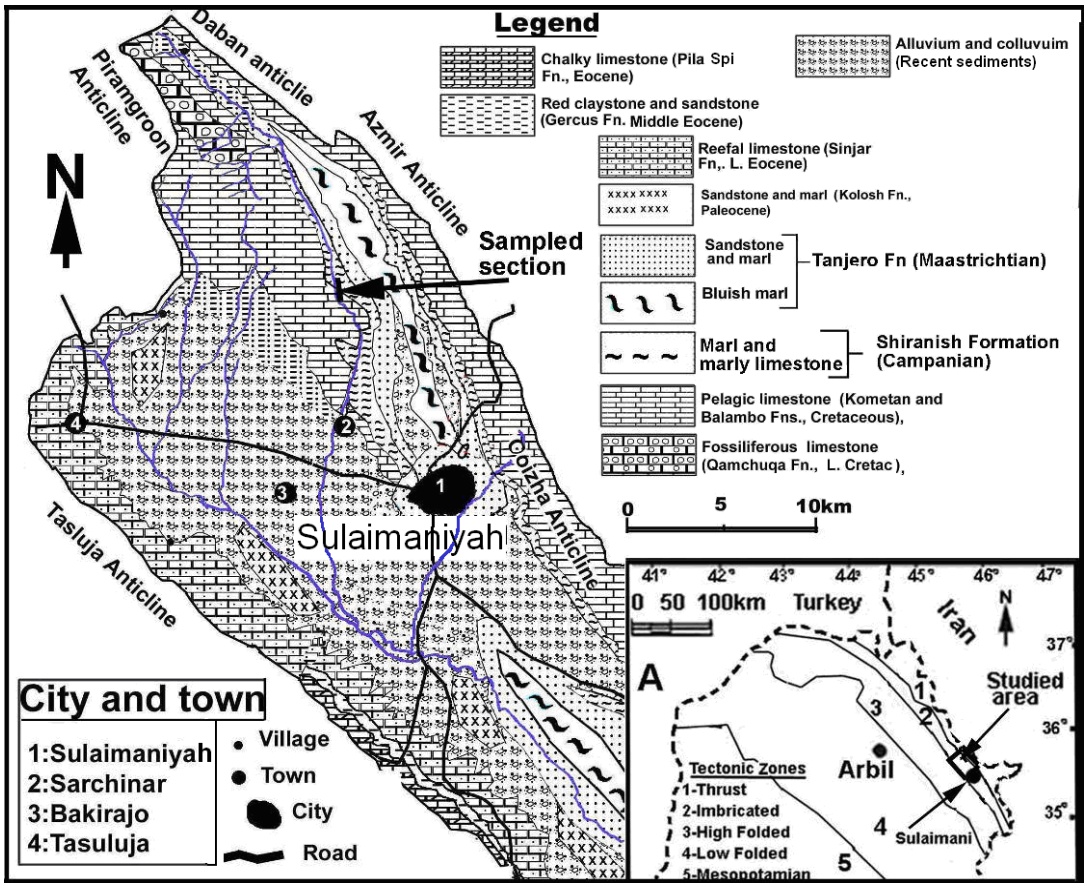

Fig.2: Geological map of the area around Sulaimaniyah city includes Chachaq stream (modified from Sissakian, 2000 and Ali, 2009)

Fig.3: Gradational contact between Kometan and Shiranish formations in Chaqchaq stream. The contact is represented by alternation of grey marl and fine crystalline limestone. The marl increases towards Shiranish Formation

SYSTEMATIC PALEONTOLOGY

The following species are identified and classified:

Kingdom Protista
Division Chrysophyta
Class Coccolithophyceae

Family Arkhangelskiellaceae Bukry, 1969
Genus *Aspidolithus* Noël, 1969
***Aspidolithus parcus* (Stradner, 1963)** Noël, 1969 (Figs.4.1and 4.2)
***Aspidolithus* sp.** (Fig.4.3)

Family Calyptrosphaeraceae Boudreaux and Hay, 1969
Genus *Lucianorhabdus* Deflandre, 1959
***Lucianorhabdus cayeuxii* Deflandre, 1959** (Fig.4.16)

Family Chiastozygaceae Rood, Hay and Barnard, 1973
Genus *Calculites* Prins and Sissingh, 1977
***Calculites obscurus* (Deflandre, 1959)** Prins and Sissingh, 1977 (Fig.4.5)
***Calculites ovalis* (Stradner, 1963)** Prins and Sissingh, 1977(Fig.4.6)

Family Chiastozygaceae Rood, Hay and Barnard, 1973
Genus *Chiastozygus* Gartner, 1968
***Chiastozygus platyrhethum* Hill, 1976** (Fig.4.10)
***Chiastozygus* sp.** (Fig.4.11)

Family Eiffellithaceae Reinhardt, 1965
Genus *Eiffellithus* Reinhardit, 1965
***Eiffellithus eximius* (Stover, 1966)** Perch-Nielsen, 1968 (Figs.4.12 and 4.13)
***Eiffellithus turriseffelii* (Deflandre, 1954)** Reinhardit, 1965 (Fig.4.14)

Family Ellipsagelosphaeraceae Noël, 1965
Genus *Watznaueria* Reinhardt, 1964
***Watznaueria barnesae* (Black, 1959)** Perch-Nielsen, 1968 (Fig.4.21)
***Watznaueria biporta* Bukry, 1969** (Fig.4.22)

Family Nannoconceae Deflandre, 1959
Genus *Nannoconus* Kamptner
***Nannoconus malticadus* Deflandre and Deflandre, 1959** (Fig.4.19)

Family Podrorhabdaceae Noel, 1965
Genus *Bipodorhabdus* Noël, 1970
***Bipodorhabdus tesselatus* Noël, 1970** (Fig.4.4)

Family Polycyclolithaceae Forchheimer, 1972
Genus *Micula* Vekshina, 1959
***Micula decussata* Vekshina, 1959** (Fig.4.17)
***Micula swastica* (**Fig. 4.18), Stradner and Steinmetz, 1984
Genus *Lithastrinus* Stradner, 1962
***Lithastrinus grillii* Stradner, 1962**(Fig.4.15)

Family Zygodiscaceae Hay and Mohler, 1967
Genus *Reinhardites* Perch-Nielsen, 1968
***Reinhardites anthrophorus* (Deflandre, 1959)** Perch-Nielsen, 1968 (Fig.4.20)
Incertae sedis
Genus *Ceratolithoides* Bramlette and Marini, 1964
***Ceratolithoides verbeekii* Perch-Nielsen, 1979** (Figs.4.8 and 4.9)
***Ceratolithoides aculeus* (Stradner, 1961)** Prins and Sissingh, 1977 (Fig.4.7)

NANNOBIOSTRATIGRAPHY

The boistratigraphic subdivision of the studied section is achieved, which resulted in identification of two main interval zones, as shown hereinafter and in Fig. (5).

1- *Aspidolithus parcus – Calculites ovalis* Interval Biozone (CC 18 – CC19)
Definition: First occurrence of *Aspidolithus parcus* to first occurrence of *Ceratolithoides aculeus*.

Thickness: 24.5 m of limestone, marly limestone and marl.

Boundaries and Discussion: Perch-Nielsen (1979) used the same definition for her Early Campanian *Eiffellithus eximius* Zone. Verbeek (1977), Roth (1978) and Doeven (1983) defined a *Broinsonia parca* Zone from the first occurrence of *Broinsonia parca* to first occurrence of *Ceratolithoides aculeus*, the event used by Sissingh (1977) to define the top of his Zone CC19 (Perch-Nielsen, 1985), therefore the age of this biozone is Early – Middle Campanian (Gradstein *et al*., 2004).

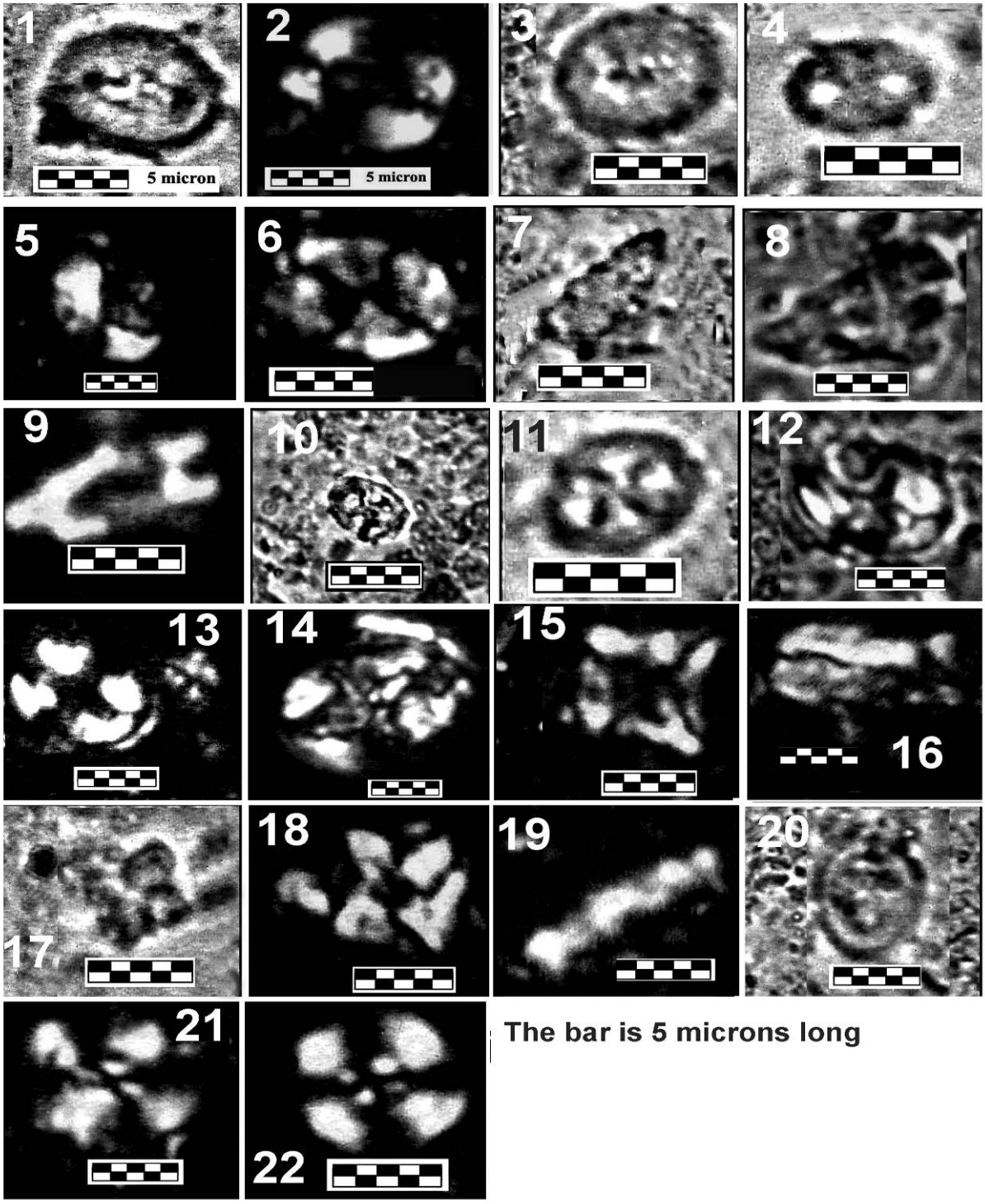

Fig.4: Nannofossils found in the sampled section across the contact between the Kometan and Shiranish formations
(The names of the species are listed in page 25)

1, **2)** Aspidolithus *parcus* (Stradner, 1963) Noël, 1969, sample no.2, normal and polarized transmitted light.
3) *Aspidolithus* sp. sample no.18, normal transmitted light.
4) *Bipodorhabdus tesselatus* Noël, 1970, sample no.2, normal transmitted light.
5) *Calculites obscurus*(Deflandre, 1959) Prins and Sissingh, 1977, sample no.6, polarized transmitted light.
6) *Calculites ovalis* (Stradner, 1963) Prins and Sissingh, 1977, sample no.2, polarized transmitted light.
7) *Ceratolithoides aculeus* (Stradner, 1961) Prins and Sissingh, 1977 sample no.18, normal transmitted light.
8, **9)** *Ceratolithoides verbeekii* Perch-Nielsen, 1979, sample no.6, normal and polarized transmitted light.
10) *Chiastozygus platyrhethum* Hill, 1976, sample no.23, normal transmitted light.
11) *Chiastozygus* sp. sample no.18, normal transmitted light.
12, **13)** *Eiffellithus eximius* (Stover, 1966) Perch-Nielsen, 1968, sample no.11, normal and polarized transmitted light.
14) *Eiffellithus turriseffelii* (Deflandre, 1954) Reinhardit, 1965, sample no.18, polarized transmitted light.
15) *Lithastrinus grillii* Stradner, 1962, sample no.11, polarized transmitted light.
16) *Lucianorhabdus cayeuxii* Deflandre, 1959, sample no.8, polarized transmitted light.
17) *Micula decussata* Vekshina, 1959, sample no.10, normal transmitted light.
18) *Micula swastica* Stradner and Steinmetz, 1984, sample no.6, polarized transmitted light.
19) *Nannoconus malticadus* Deflandre and Deflandre, 1959, sample no.9, polarized transmitted light.
20) *Reinhardites anthrophorus* (Deflandre, 1959) Perch-Nielsen, 1968, sample no.10, normal transmitted light.
21) *Watznaueria barnesae* (Black, 1959) Perch-Nielsen, 1968, sample no.9, polarized transmitted light.
22) *Watznaueria biporta* Bukry, 1969. Sample no.2, polarized transmitted light.

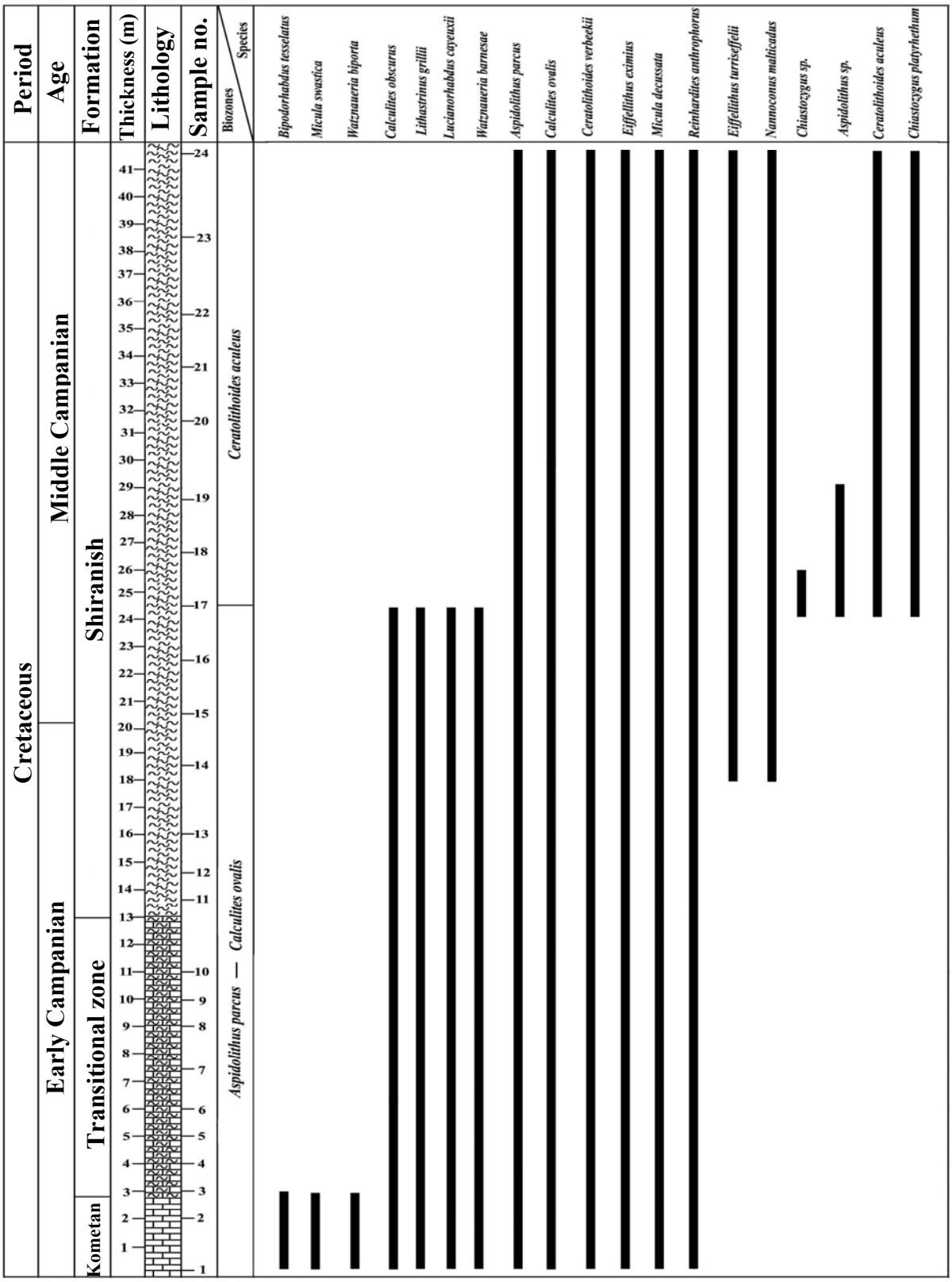

Fig.5: Range chart of the nannofossils found in the sampled section across the contact between Kometan and Shiranish formations

2- *Ceratolithoides aculeus* Interval Biozone (CC 20)
Definition: First occurrence of *Ceratolithoides aculeus* to first occurrence of *Quadrum sissinghi*.
Thickness: 16 m marl.

Boundaries and Discussion: Roth (1978) defined the *Tetralithus aculeus* Zone from the first occurrence of *Tetralithus aculeus* to the first occurrence of *Tetralithus trifidus* including CC20 and CC21 (Perch-Nielsen, 1985). In the present study, the *Quadrum sissinghi* was not signed, therefore the authors were unable to determine the upper contact of the biozone, but the age of this biozone is Middle Campanian (Gradstein *et al*., 2004).

DISCUSSION

Two significant results were achieved in this study: The first is the gradational contact, which has representative sediments, as indicated by the recorded nannofossils. The second is that the contact between the two formations is located in the Early Campanian instead of Middle Campanian (as mentioned previously).

The biostratigraphically proved gradational contact (conformable contact) is the first result. This proof has significant paleogeographic and tectonic importance, which changes the previous idea about the uplift and subsidence in the Middle Campanian. Conversely, the study shows calmer tectonics and different paleogeographic setting of the northeast Iraq, during Campanian and Maastrichtian.

Recent sedimentological study discussed nine sections in Sulaimaniyah and Erbil vicinities and in all those sections, it is inferred that there are submarine erosion or slow rate of sedimentation (represented by glauconitic bed), in two nearby sections at Dokan area (see Karim, *et al*., 2008 and Taha, 2008). The authors showed that the contact in other sections is gradational and without occurrence of conglomerate, erosional surface, paleosoil and glauconite beds. The only fulfillment lack of those papers was the paleontological proof, which is provided by the present study.

The occurrence of the contact in the Early Campanian is more or less abnormal, as the previous studies indicated that the Middle Campanian is missing due to uplift of the area and then starting of erosion by means of which polygenetic micropebbles were deposited (Bellen *et al*., 1959 and Buday, 1980). According to Al-Jassim *et al*. (1989) and Al-Khafaf (2005), and Jassim and Goff (2006) Kometan Formation extends from Turonian to Middle Campanian. The same authors assigned that the age of the Shiranish Formation is Late Campanian – Maastrichtian. This age of Kometan and Shiranish formations (in the studied area) is new. In the literature, there is one indirect pointing to the possibility of this age. This was proved in the sedimentological study of Taha (2008); who correlated the glauconite bed in Dokan area with the same bed in the north of the Sulaimaniyah city. He showed that the glauconite bed in Dokan area is located nearly at the contact between the two formations, while it is located inside the Shiranish Formation (30 m above the contact) (Fig.6); in a section; north of Sulaimaniyah city. As the glauconite beds have wide distribution (Galloway, 1989; Vail *et al*. 1977; Loutit *et al*., 1988; Haq, 1991 and Emery and Myers, 1996), therefore, the bed most possibly has the same age in both areas and thus both sedimentology and biozonation have more or less the same result, as concerned to the contact in Sulaimaniyah area.

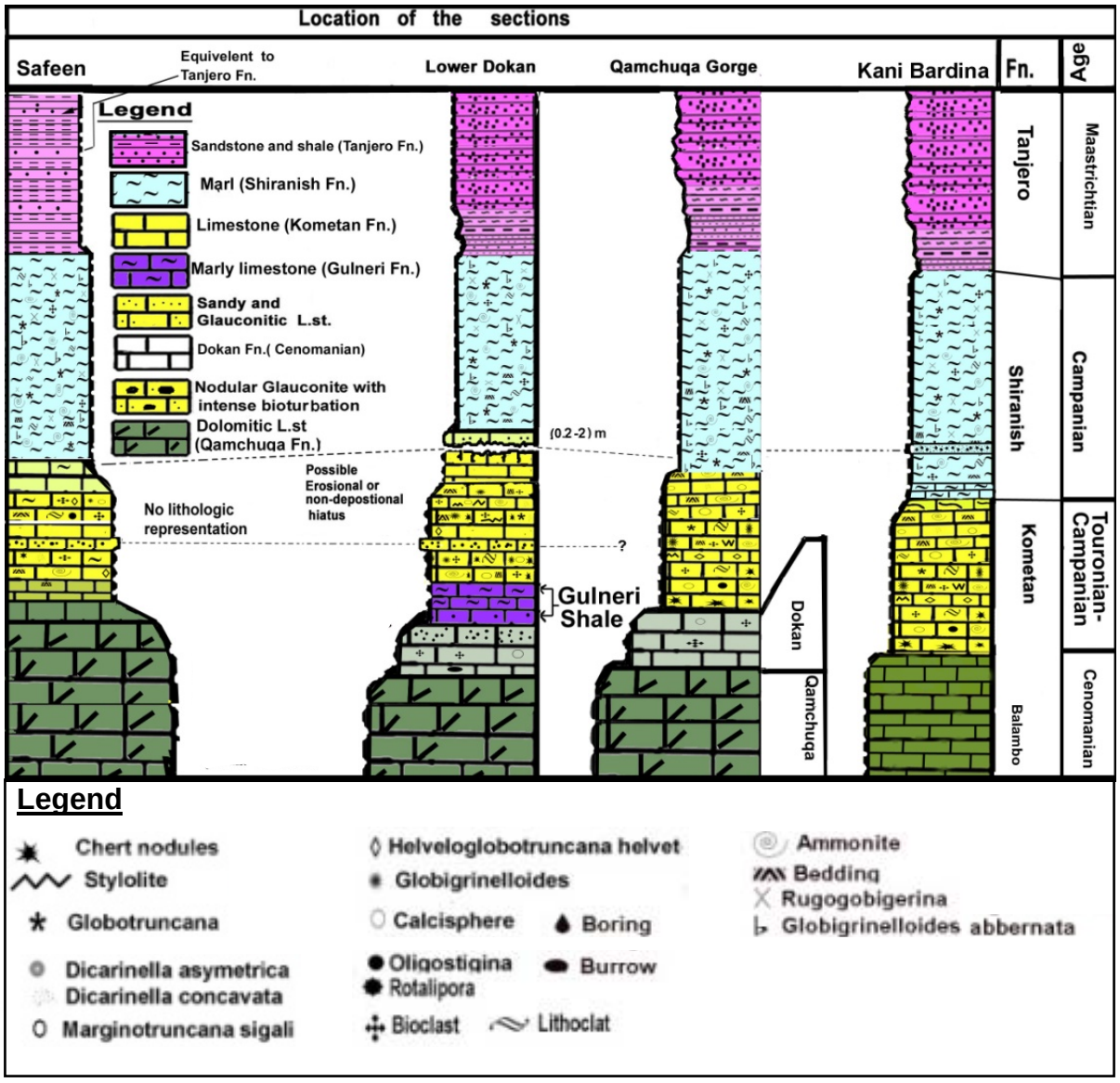

Fig.6: Sedimentological correlation between the glauconite beds near the contact between Kometan and Shiranish formations in the lower Dokan and Kani Bardina sections (7 Km northwest of Sulaimaniyah city)
It shows that in the latter section, the bed is located inside Shiranish Formation (Taha, 2008)

CONCLUSIONS

This study has the following conclusions:

- The recorded calcareous nannofossils' assemblages permit the recognition of two biozones:
  1- *Aspidolithus parcus – Calculites ovalis* Interval Biozone (CC 18 – CC 19)
  2- *Ceratolithoides aculeus* Interval Biozone (CC 20)
- This study inferred that the contact between Kometan and Shiranish formations is conformable with Early Campanian age.
- The age of the Shiranish Formation extends to Early Campanian.

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