

Biostratigraphy of Bluish Marl Succession (Maastrichtian) in Sulaimanyia, Area, Kurdistan Region NE- Iraq

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ABSTRACT

Recently a new lithology is found at the middle part of Tanjero Formation (Maastrichtian) and consists of a bluish marl succession about 100m thick in Sulaimanyia area. This succession is lithologically similar to Shiranish Formation and has nearly same color and stacking pattern which didn't described in the original description in the type section of Tanjero Formation. Geographically it can be seen in PiraMagroon and Sharazoor plains, Chaqchaq valley (to the northwest of Sulaimani City) and Dokan area. The biostratigraphy of this succession indicates Early Maastrichtian to Early Late Maastrichtian which includes four interval zones of:

Racemiguembelina fructicosa Interval Zone (CF4) (Early late Maastrichtian),

Pseudotextularia intermedia Interval Zone (CF5) (Early Maastrichtian)

Contusotruncana contusa Interval Zone (CF6) (Early Maastrichtian)

Gansserina gansseri Interval Zone (CF7) (Early Maastrichtian)

As concerned to the affinity of this succession two possibilities can be assigned:

1-Middle part of Tanjero Formation.

2-lentils of Shiranish Formation inside Tanjero Formation.

This study prefers the first assignation as the foraminiferal assemblages show that the marly succession is not belonging to Shiranish which has, in the studied area, the age of Campanian. Another reason for this assignation is that the environment and sequence stratigraphy, tectonics of Tanjero Formation is more understandable than the first assignation (If it is included in the Shiranish Formation). The record of this new lithology and submergence of the type section of the formation under the water of Darbandikhan (dam) impose selection of a new type section or a supplementary type section for the formation either in Dokan or Chwarta areas where there are representatives of the new lithology inside the Tanjero Formation and the sections are well exposed.

الطباقية الحياتية لتتابعات الطفل المزرق (الماسترختيان) في منطقة السليمانية، شمال شرق العراق

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الملخص

أظهرت الدراسة الحالية تواجد تتابعات صخرية للطفل المزرق والتي تقع داخل تكوين تانجرو بسمك 100م وتشبه تكوين شرانش من حيث المكونات الصخرية واللون والتتابع، حيث لم يتم التطرق الي هذه التتابعات في الوصف الاصلي للمقطع المثالي لتكوين تانجرو. يمكن ملاحظة هذه التتابعات في سهلي شهرزور و بيره مكروون و وادي جق جق ومنطقة الدوكان. اجريت لها دراسة طباقية حياتية للفورامنفيرا الطافية حيث تم تحديد الانطقة الحياتية الآتية وأظهرت عمر الماسترختيان المبكر.

Racemiguembelina fruticosa Interval Zone (CF4) (Early late Maastrichtian)

Pseudotextularia intermedia Interval Zone (CF5) (Early Maastrichtian)

Contusotruncana contusa Interval Zone (CF6) (Early Maastrichtian)

Gansserina gansseri Interval Zone (CF7) (Early Maastrichtian)

1- أن تكون هذه التتابعات الجزء الوسط من تكوين تانجرو.

2- أو تمثل عدسة من تكوين شرانش داخل تكوين تانجرو.

والدراسة الحالية تفضل الاختيار الاول حيث ان تجمعات الفورامنفيرا الموجودة لا تعود لتكوين شرانش (هو الكامباني في منطقة الدراسة) اما السبب الثاني هوأن وجود التتابعات داخل تكوين التانجرو يتوافق بشكل أفضل مع تكتونية والبيئة الترسيبية لتكوين تانجرو من تكوين شرانش. بسبب تسجيل هذه الوحدة الصخرية داخل تكوين تانجرو و تغطية المقطع المثالي للتكوين تحت مياه سدة درينديخان، نقترح اختيار مقطع مثالي جديد آخر لتكوين تانجرو في منطقة دوكان أو جوارتا والتي تشكل هذه التتابعات جزءا منه.

INTRODUCTION

The studied area is located in Sulaimanyia Governorate, northeastern Iraq (Fig. 1). Dunnington (1952 in Bellen *et al.* 1959) divided the Tanjero Formation, on the basis of lithology, in the type section, into two parts, i.e. lower and upper

parts. He cited that the upper part consists of silty marls, siltstone, sandstone, conglomerate and sandy biogenic detrital limestone; this part is 1532 meters thick. The lower part is 484 meters thick and composed of pelagic marl with some siltstone and rare marly limestone.

The above division is based only on the lithologic variation of the type section in the Sirwan valley and had not taken into consideration in the other areas. This division is later, followed by all other researchers such as (Buday, 1980), (Al-Rawi, 1981), (Abdel-Kireem 1986a), (Jaza, 1992), (Saaddlla and Hassan, 1987).

A marly succession, about 100m thick, is located at the middle part of Tanjero Formation and in many places it is, lithologically, very similar to Shiranish Formation as concerned to constituent, color and stacking pattern (Fig. 2). It can be seen in Piraagroon and Sharazoor plains, Dokan area (Qashqulley), Chaqchaq valley (Fig. 3).

In this study, this succession is called Chaqchaq Marl as it is well exposed in Chachaq valley.

This succession is wide spread in Tanjero-Balambo Subzone but as it is very soft so it is mostly covered by soil and alluvium. In these places, it is composed of light bluish white marl with occasional intercalation of thin beds of marly limestone. This succession not exist in the type section (in Sirwan valley) but its equivalent exists which consists of olive green calcareous shale.

In Chwarta area, the equivalent of the succession consists of dark green calcareous shale with thin inter beds of bluish marls which is located between sandstone succession of Tanjero Formation and limestone of Aqra lens. Most of the previous studies are conducted on those areas that are very similar to the type section; therefore they didn't deal with the succession.

The exceptions are studies of (Karim, 2004), Karim and Surdashy, (2005a and 2005b) which are assigned the succession as a middle part of Tanjero Formation. According to (Karim, 2004). occurrence of this succession, in some place and its absence in other ones is due to two reasons.

The first is that the Tanjero Formation is deposited as several fans (Jaza, 1991 and Karim, 2004), therefore the calcareous shale and sandstone are deposited in front of submarine fans and secondly, the marl and marly limestone is deposited in the areas that are located between the fans (inter-fan areas) where there are calmness and less energy of turbidity currents.

The aim of this study is to investigate the biostratigraphy to indicate the age of the Chachaq marl and to indicate the stratigraphic relation with both Tanjero and Shiranish Formation in addition to the possibility of the repetition of the succession by faulting. For this purpose 12 samples were selected for planktonic foraminiferal zonation in one outcrop section (Fig. 2).

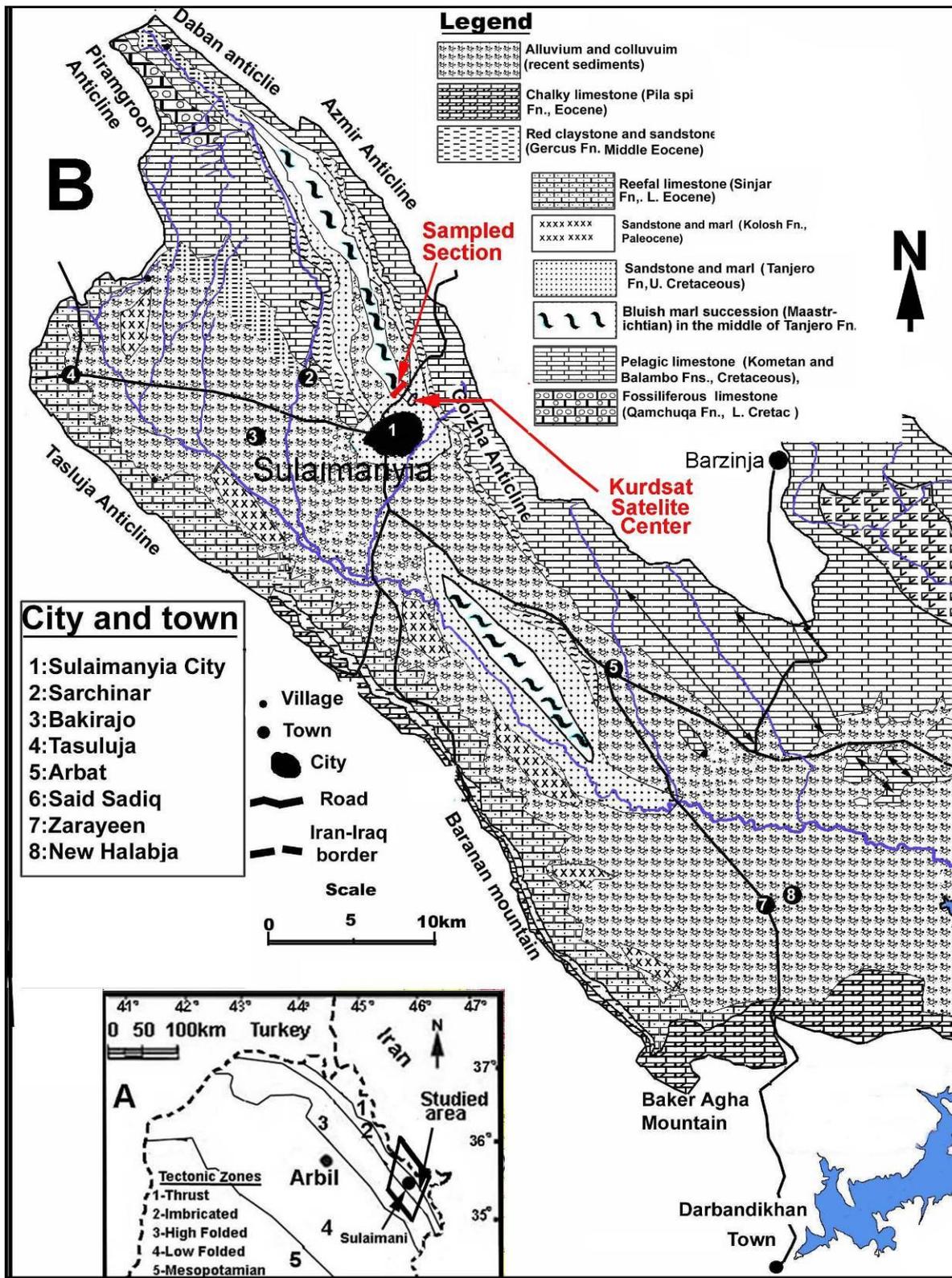


Fig. 1: Location map (A) and geological map (B) of the area around Sulaimanyia area (modified from Ali, 2008) on which the sampled section and outcrops of the new lithologies (Chaqchaq marl) of Tanjero Formation are shown.

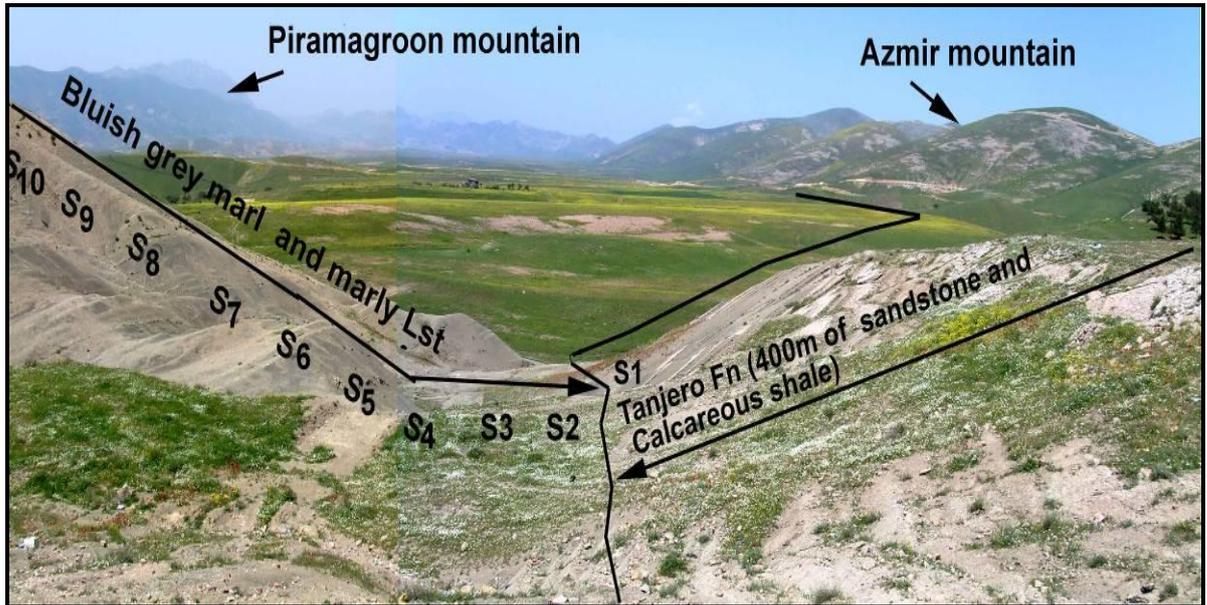


Fig. 2: The sampled section directly to the north of Kurdsat Satellite Center (North of Sulaimanyia).



Fig. 3: Typical lithology and stacking pattern of the relatively competent and incompetent bluish marl successions (Chaqchaq Marl) which is located directly to the southwest of Qulqula village.

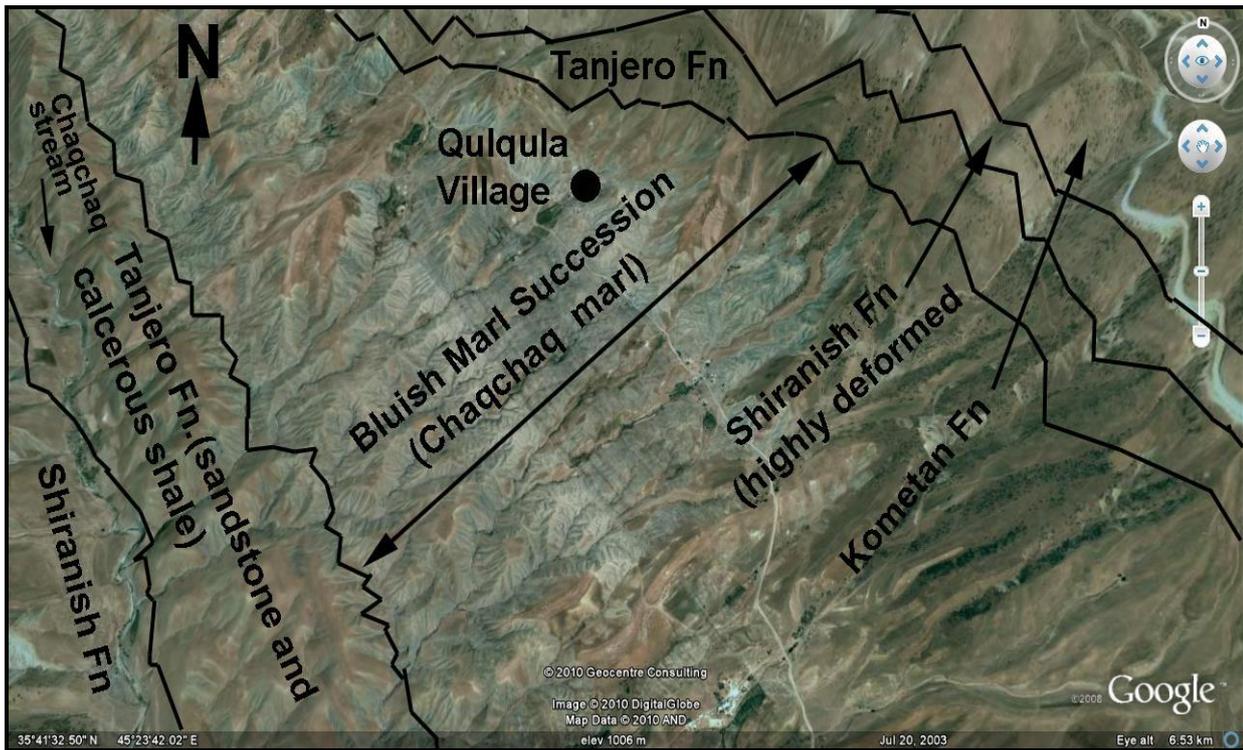


Fig. 4: Chachaq valley (directly to the northeast of Sulaimaniya city) in which the succession is well exposed.

BIOSTRATIGRAPHY

The samples are taken from an outcrop section which provided abundant well preserved foraminifera. These include high diversity of Globotruncanids, Rugoglobigerinids, Globigerinelloids and Heterohelicids planktonic foraminifera with moderate calcareous and rare agglutinated benthonic foraminifera (Fig. 4).

The foraminifera occur continuously in the studied succession generally shows continuous sedimentary sequence without any interruptions. Fifty seven planktonic foraminiferal species belonging to nineteen genera were recorded (Fig. 5).

The planktonic foraminifera show the best indication for typical Tethyan fauna type. They are used for biozonation of the sediments in tropical/subtropical regions by (Li and Keller, 1998a), (Keller, 2004), (Abramovich *et al.*, 2002), (Abramovich and Keller, 2003), (Samir 2002), (Obaidalla, 2005) and (Sharbazheri 2007, 2008, 2010). These studies are used exclusively as the biostratigraphic framework in this study. (Li and Keller, 1998a) subdivided the Maastrichtian zonal scheme into nine Cretaceous Foraminiferal (CF) zones labeled CF9 to CF1, from the base to the top. They calibrated their ranges to the paleomagnetic time scale in the DSDP Site 525A and on Tunisian sections by (Li and Keller, 1998b).

The Diagnosis and biozonation that are used in this study follow that of (Georgescu, 1996, 2002), and (BouDagher- Fadel, *et al.*,1997).

The biostratigraphic correlation of the studied section is based on planktonic foraminiferal zonations (Figs.6, 7) which shows a comparison between the biostratigraphic zones established in this study with other equivalent of the commonly used planktonic zonal scheme. The biostratigraphic zones are described from the bottom to the top of the section as follows:

***Gansserina gansseri* Interval Zone (CF7)**

The *Gansserina gansseri* (or CF7 zone) was introduced by (Bronnimann, 1952) in (Samir, 2002) as *Globotruncana gansseri* Zone and placed in the Early Maastrichtian of Trinidad. In present study, the base of this biozone is not recorded and the top of the zone is marked by the FAD of *Contusotruncana contusa* (Cushman), (Plate 1, Figs. a, b). Most of the workers in the zonal scheme placed *Gansserina gansseri* zone informally at the middle- lower Maastrichtian (Abramovich, *et al.*, 2002, Samir, 2002, Maestas *et al.*, 2003, Al-Mutwali and Al-Jubouri 2005, Chacon and Martin 2005, Sharbazheri, 2007, 2008, 2010) (Figs.7,6). (Obaidalla, 2005) placed this zone at the base of Late Maastrichtian and (Maestas *et al.*, 2003) placed this zone at Late Campanian- Early Maastrichtian. This zone cover abundant occurrence of the nominate species for 7m.in Tanjero Formation and 10m of bluish marl succession. In addition to the index species, the planktonic assemblages of this zone recorded in the (Fig. 5) and its age is Middle Early Maastrichtian.

***Contusotruncana contusa* Interval Zone (CF6)**

Dalbeiz (1955) in (Samir, 2002) proposed the *Globotruncana contusa* Zone for the Late Maastrichtian of Tunisia. Biostratigraphically it is located at the interval between the FAD of *Contusotruncana contusa* (Cushman), at the base and last appearance (LAD) of *Globotruncana linneiana* (d'Orbigny) at the top (Plate 1, Figs. f). In present study this Zone (CF6) covers an interval of 50m and provided an assemblage of planktonic foraminifera which totally resembles that of the underlying *Gansserina gansseri* Zone (CF7), except for the first appearance of *Contusotruncana contusa* (Cushman), *Globotruncanita angulata* Tilev, *Globotruncana dupeblei* Caron *et al.*, *Rugotruncana subcircumnodifer* (Gandolfi), *Contusotruncana plicata* White, *Contusotruncana walfishensis* Todd, *Globotruncanella pschadae* (Keller), *Pseudotextularia deformis* (Kikoine), *Pseudotextularia intermedia* (De Klasz), *Gublerina cuvillieri* Kikoine, *Hedbergella holmdelensis* Olsson.

As defined herein, the present biozone (CF6) is correlatable with the zone recorded by (Li and Keller, 1998 b), (Abramovich *et al.*, 2002), (Samir, 2002). (Sharbazheri, 2008, 2010), (Abawi *et al.*, 1982) and (Abdel-Kareem, 1986 a and b) correlated the zone to the lower part of *Rosita contusa* Zone in the Northeast of Iraq. (Premoli-Silva and Sliter, 1995, 1999), (Premoli-Silva *et al.*, 1998) in Italy. (Abdel-Kareem and Samir, 1995) in Egypt. It is correlated with middle part of *Gansserina gansseri* Zone of (Al-Mutwali, 1996), (Hammoudi, 2000),

(Al-Mutwali and Al-Jubouri, 2005), (Chacon and Martin, 2005). Iraq and other different localities of the world (Robaszynski *et al.*, 1984), (Caron, 1985), (Hont and Keller, 1991), (Maestas *et al.*, 2003), (Obaidalla, 2005), (Figs. 7, 6). Magnetochron records by (Li and Keller, 1998 a) of this biozone shows the age estimation of the time span from (69.56 - 69.06) Ma with estimated absolute time span of 500 Ky/50m ages based on magnetochron ages with 10 Ky/m with moderate rate of deposition (Fig. 6). Age: Late Early Maastrichtian.

***Pseudotextularia intermedia* partial range Zone (CF5)**

In the present study *Pseudotextularia intermedia* Zone or (CF5) is defined by the LAD of the *Globotruncana linneiana* (d'Orbigny) at the base and the FAD of *Racemiguembelina fructicosa* (Egger) at the top. (Nederbragt, 1991) originally introduced this biozone as the interval from the FAD of *Planoglobulina acervulinoides* at the base and the FAD *Racemiguembelina fructicosa* at the top.

In the present study, the application agreed with the definition of (Li and Keller, 1998b). The interval of this zone is 28 m thick, besides the planktonic foraminiferal species enduring from the underlying biozones, some species shows their first appearance, e.g. *Pseudotextularia intermedia* (De Klasz), *Globigerinelloides subcarinata* Bronnimann, *Globigerinelloides bolli pessango*, *Abathomphalous mayaroensis* Bolli, and *Hedbergella deleroiensis* Carsey.

Due to high similarities of foraminiferal occurrence, the present zone (CF5) is equivalent to that of (Li and Keller, 1998 a,b), (Abramovich *et al.*, 2002), (Samir, 2002), (Sharbazheri, 2008, 2010) it is mostly equivalent to the upper part of *Gansserina gansseri* Zone recorded in the North, Northeast of Iraq and different regions of the world (Al-Mutwali and Al-Jubouri, 2005), (Al-Mutwali, 1996), (Hammoudi, 2000), (Caron, 1985), (Ubaidalla, 2005), (Robaszynski, *et al.*, 1984) and (Hont and Keller, 1991) and it is equivalent to the upper part of *Glt.contusa* Zone of (Abawi, *et al.*, 1982) and (Abdel-Kareem, 1986), and *Glt .contusa-R . fructicosa* Zone of Premoli (Silva and Sliter, 1995, 1999), (Abdel-Kareem and Samir, 1995) (Figs. 7, 6).

The *Pseudotextularia intermedia* Zone spans about 0.73Myr (69.06 - 68.33), 730Ky/28m estimating absolute ages based on magnetochron ages with 26 Ky/meter of moderate rate of deposition (Fig. 6). Age: Late Early Maastrichtian.

***Racemiguembelina fructicosa* Interval Zone (CF4) part**

Racemiguembelina fructicosa Zone or (CF4) is introduced by (Li and Keller, 1998 a, b) as a biostratigraphic interval between FAD of *Racemiguembelina fructicosa* (Egger) at the base and the FAD of *Pseudoguembelina hariaensis* at the top. Only the lower part of this zone is recorded in the upper part (10m thick) of the marly succession and continued to the Tanjero Formation (sample No.12) to the FAD of *Pseudoguembelina hariaensis* Nederbragt (not studied).

Most of the workers in the zonal scheme placed *Racemiguemblina fructicosa* Zone at the Early Late Maastrichtian, (Keller *et al.*, 1995), (Li and Keller, 1998b), (Premoli Silva, 1999), (Abramovich, *et al.*, 2002), (Samir, 2002) and (Obaidalla, 2005) (Sharbazheri, 2007, 2008 and 2010)).

As defined above, the present biozone (CF4) is correlatable with the lower part of *A. mayaroensis* of (Abawi, *et al.*, 1982), (Robaszynski, *et al.*, 1984), (Caron, 1985), (Abdel-Kareem, 1986) and (Premoli- Silva and Sliter, 1995-1999) (Figs. 5, 6). This zone covers abundant occurrence of the nominate species along 35m thick In addition to the index species, *Racemiguemblina fructicosa* (Egger), the planktonic foraminiferal assemblages of this zone include well preserved of 40 species which shown in stratigraphic range chart of the studied section (Fig. 5).

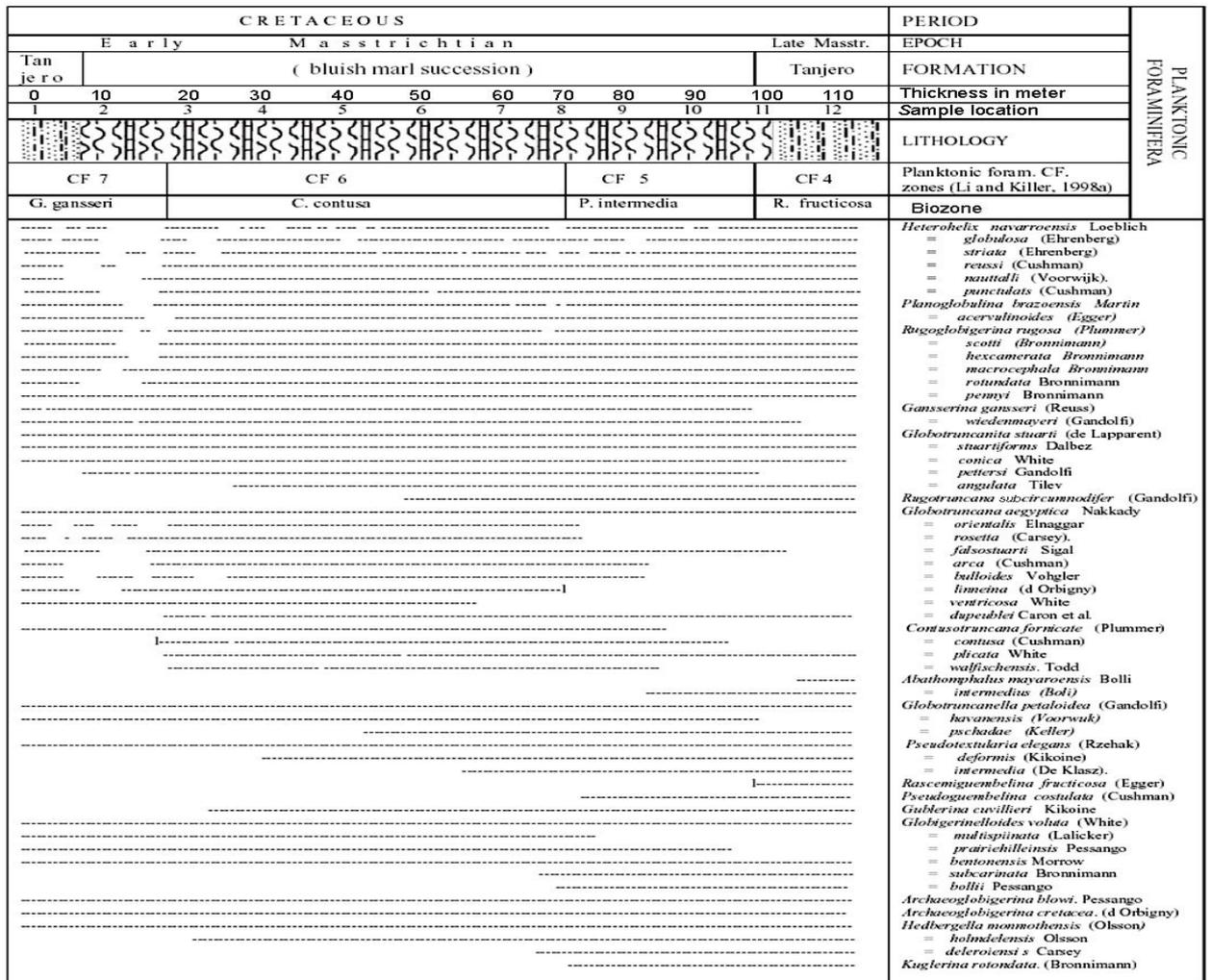


Fig. 5: Stratigraphic range chart of planktonic foraminifera of the bluish Chaqchaq Marl of the Kurdsat section, Sulaimanyia area.

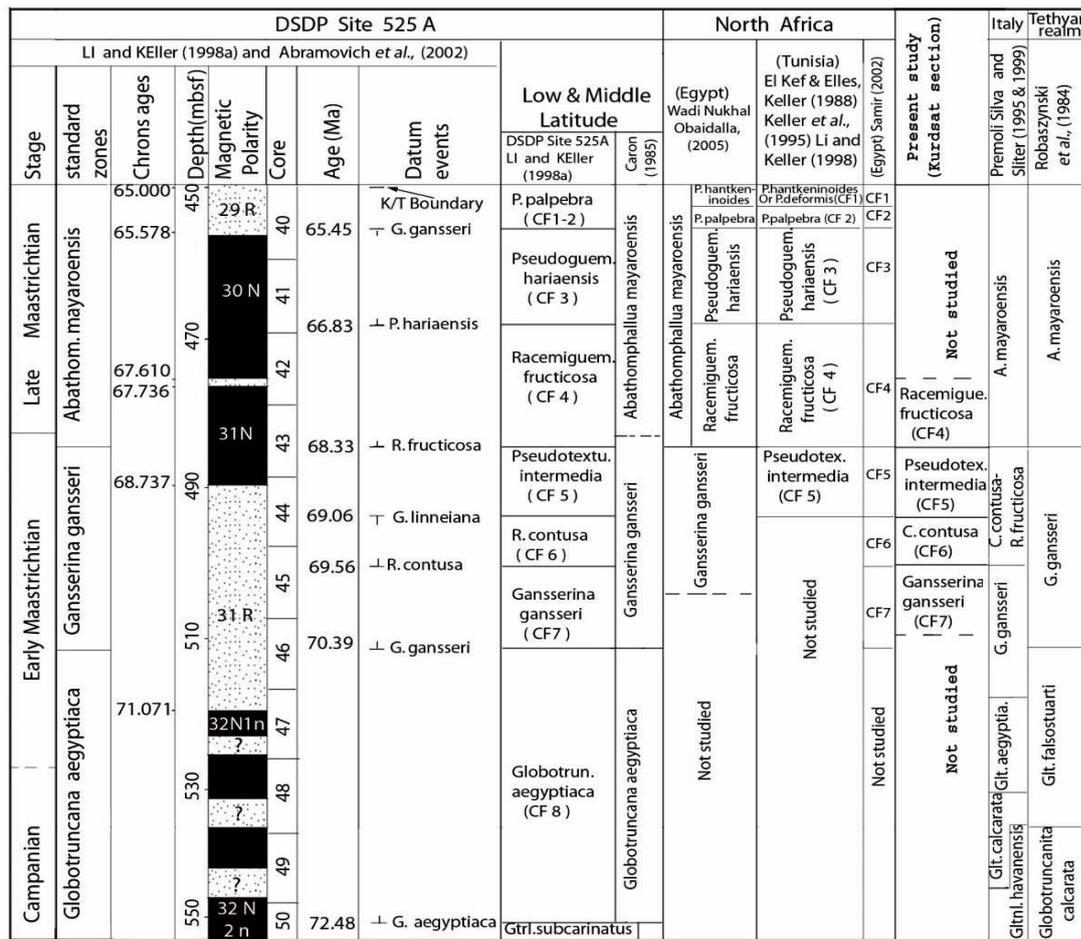


Fig. 6: Correlation chart showing the proposed biostratigraphic zones of Kurdsat with the Planktonic foraminiferal zonation commonly used in low, middle latitudes. The present proposed zonation based on DSDP Site 525A, (by Li and Keller, 1998 a) and (Abramovich, *et al.*, 2002) in the new zonal scheme. The age of planktonic foraminiferal datum events is shown. (Modified from different authors).

Requirement of introduction a new type section and a supplementary reference section of the formation

According to North American Commission on Stratigraphic Nomenclature (1983), reference section is very valuable in definition and revision of geologic units. It is convenient to indicate and define new type section for Tanjero Formation for the following reasons:

First: the water of Darbandikhan reservoir covers the original type section, especially its contact with Shiranish Formation. The type section runs along the northwestern bank of the Sirwan River (upstream of Diala River). In this connection the North American Commission on Stratigraphic Nomenclature (1983) is permitted to assign neostatotype when the stratotype is covered.

Second: the lithology of the type section is not the representative of the formation (as proved by the authors) and only representative of Sirwan Valley. Even in the Tanjero valley, from which the name came, the formation has very different lithology as includes the bluish marl succession in the middle part.

Third: the Tanjero valley (from which the name is derived) is about 20km far from the Sirwan valley. Therefore, according to the above-mentioned Commission, the Sirwan valley section (type section) does not demonstrate regional validity as concerned to lithology and naming. Moreover, the supplementary reference sections, according to the commission, are often designated to illustrate the diversity or heterogeneity of a defined unit or some critical feature not evident or exposed in the stratotype. When a new type section is selected in the Chuarta area or around Sulaimaniya City its lithology will stand for at least 80% of the outcrops of the formation. This new section will show the different parts of the formation and the environment in addition to sequence stratigraphy can be deduced easily. According to sequence stratigraphy, the new sections will give clear subdivision of the formation into its system tract.

Stage	Sharbazheri (2010) (Awajird section)	present study (Kurdaat section)	Sharbazheri (2008) Gali section	Sharbazheri (2007) Kato area NE Iraq	Al-Mutwali and Al Juboury (2005)	Hammoudi (2000) Jambur Well No (13)	Al- Mutwali (1996) Khashab Well No.(1)	Abawi et al., (1982) and Abdel-Kireem and Abdel-Kireem (1986) NE Iraq	Kassab (1972, 1974, 1975, 1976 and 1979) and Kassab et al., (1986) N. and NE Iraq
Maastrichtian	Not studied	Not studied	<i>P. hantkeninoides</i> (CF1)	Not studied					Glt. falsocalcarata
	Pseudoguem. hariaensis (CF3)		<i>P. palpebra</i> (CF2)						
Late Maastrichtian	Racemiguem. fructicosa (CF4)	Racemiguem. fructicosa (CF4)	Racemiguem. fructicosa (CF4)	Racemiguem. fructicosa (CF4)	Late			A. mayaroensis	A. mayaroensis
Early Maastrichtian	Pseudotex. intermedia (CF5)	Pseudotex. intermedia (CF5)	Pseudotex. intermedia (CF5)	Pseudotex. intermedia (CF5)	Middle		Glt. aegyptiaca - lapparenti - stuarti	Glt. contusa	Glt. contusa esnehenensis duwi
	C. contusa (CF6)	C. contusa (CF6)	C. contusa (CF6)	C. contusa (CF6)					
	Gansserina gansseri (CF7)	Gansserina gansseri (CF7)	Gansserina gansseri (CF7)	Gansserina gansseri (CF7)					
	Glt. aegyptiaca (CF8)	Glt. aegyptiaca (CF8)	Glt. aegyptiaca (CF8)	Glt. aegyptiaca (CF8)					
Campanian	Not studied	Not studied	Not studied	Not studied	Early				
	Glt. calcarata								
	Glt. roseta								
	Ros. fornicata								
	Glt. fornicata								
	Glt. calcarata								
	Glt. calcarata								
	elevata								
	aegyptiaca								

Fig.7: Correlation chart showing the proposed biostratigraphic zones of Kurdaat section with the Planktonic foraminiferal zonation commonly used in Iraq.

CONCLUSIONS AND RECOMMENDATION

- 1- Fifty eight planktonic foraminiferal species belonging to nineteen genera have been recorded from the bluish marl succession.
- 2- Four Planktonic Foraminiferal biostratigraphic zones have been detected in the studied section represent *Gansserina gansseri* Interval Zone (CF7), *Contusotruncana contusa* Interval Zone (CF6), *Pseudotextularia intermedia* Partial Range Zone (CF5), *Racemiguembelina fructicosa* Interval Zone (CF4), and they display Early Maastrichtian-Early Late Maastrichtian age.
- 3- The planktonic foraminifera occur continuously in the sedimentary succession of the studied section shows continual in deposition without any interruptions.
- 4- The exposed bluish marl succession (Chaqchaq Marl) has special monotonous, conventional lithologic character differs from Tanjero Formation which extends geographically for more than 80 km and it has mapable extend and thickness which reaches about 100ms in Kurdsat section, with relevant feasible geologic age of Early Maastrichtian about 1.5My duration.
- 5- Consequently the authors recommend the supplementary type section of Tanjero Formation in the studied area as a new formal lithologic description to display all lithologic components and characters according to international stratigraphic code.

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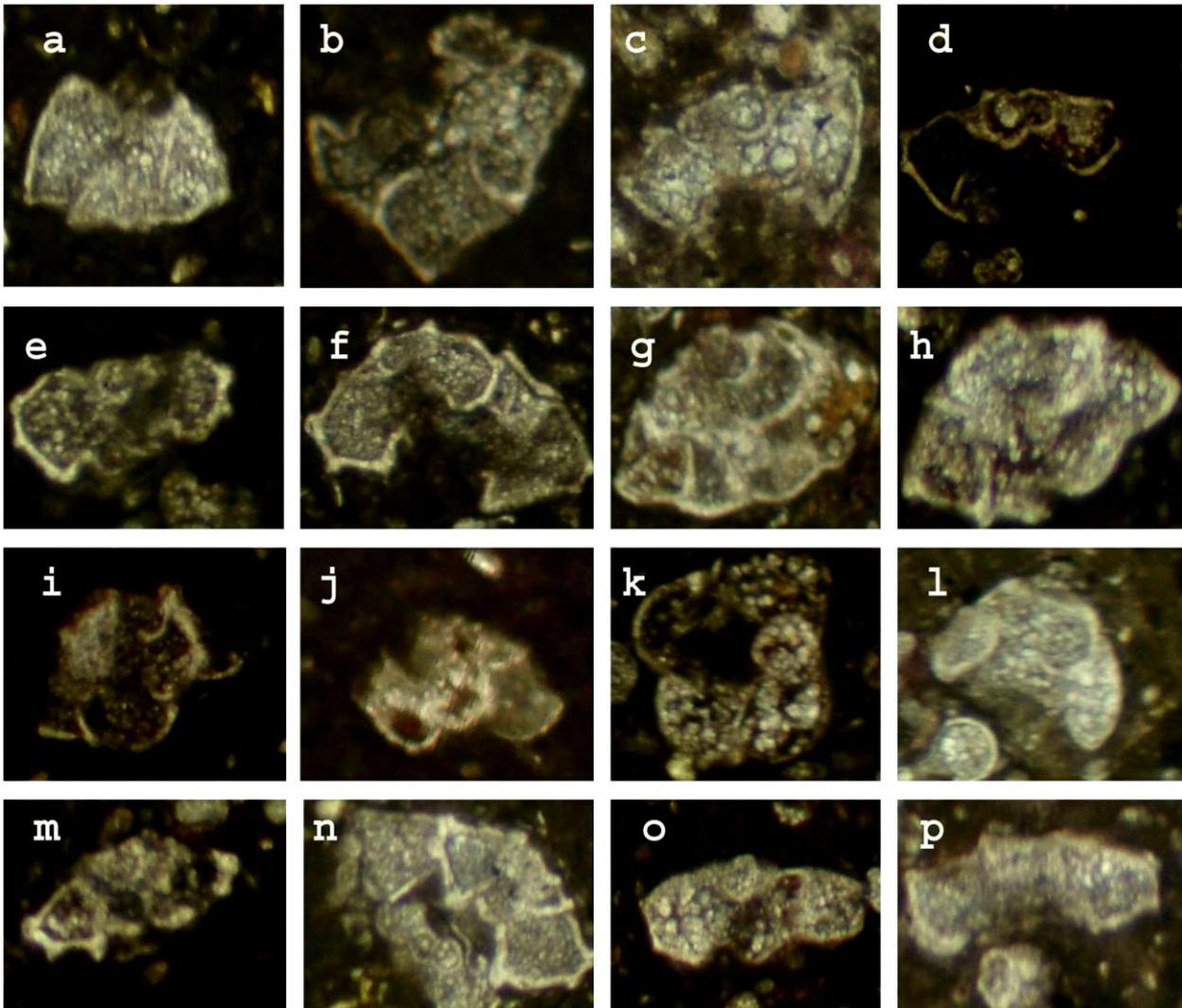
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PLATE – 1



Figs. a, b *Gansserina gansseri* (Bolli), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *G. gansseri* Zone.

Figs. c *Gansserina wiedenmayeri* (Gandolfi), bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *G. gansseri* Zone.

Figs. d ,e *Globotruncana aegyptiaca* Nakkady, 100X, bluish marl succession Early Maastrichtian, Kurdsat, Specimen from *G. gansseri* Zone.

Fig. f *Contusotruncana contusa* (Cushman), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *Contusotruncana contusa* Zone.

Figs. g ,h *Globotruncanita conica* White, 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *Contusotruncana contusa* Zone.

Figs. I, j *Contusotruncana walfischensis*. Todd, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *Contusotruncana contusa* Zone.

Figs. k, l *Contusotruncana* sp. 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *Contusotruncana contusa* Zone.

Figs. m, n *Globotruncana orientalis*. El-Naggar, 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *Contusotruncana contusa* Zone.

Figs. o, p *Globotruncana linneiana* (d Orbigny), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *Contusotruncana contusa* Zone.

PLATE – 2

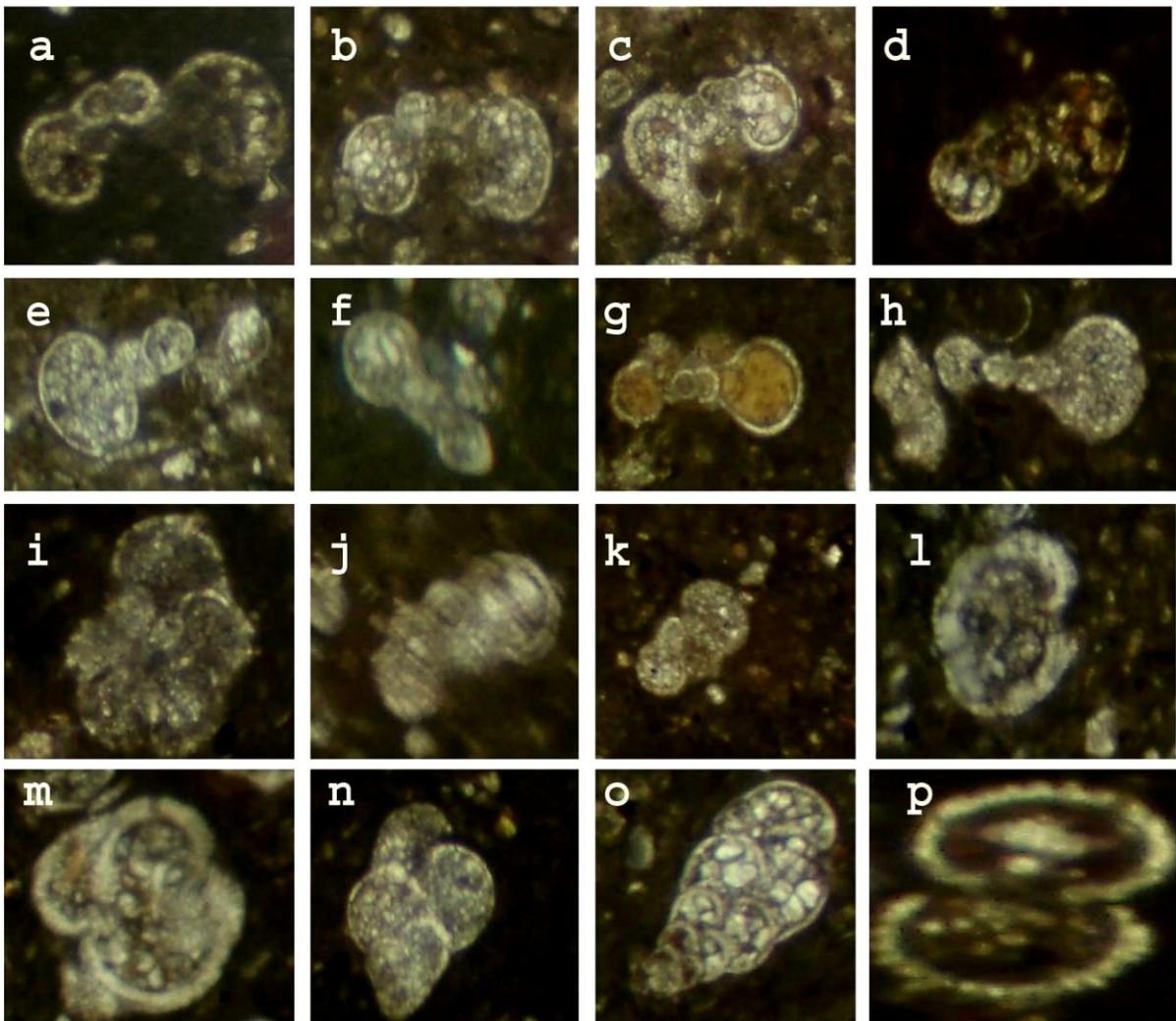


Fig. a *Hedbergella deleroiensis* Carsey 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *C. contusa* Zone.

Fig. b *Hedbergella monmuthensis* (Olsson), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *C. contusa* Zone.

Figs. c, d *Hedbergella holmdelensis* Olsson, 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *C. contusa* Zone.

Fig. e *Globigerinelloides bentonensis* Morrow 100X, bluish marl succession, Early

Maastrichtian, Kurdsat, Specimen from *C. contusa* Zone.

Fig. f *Globigerinelloides subcarinata*.(Bronnimann), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *C. contusa* Zone.

Figs. g, h *Globigerinelloides bollii* Pessango 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *G. gansseri* Zone.

Figs. i, j *Rugoglobigerina rugosa*. (Plummer), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *P.intermedia* Zone.

Fig.k *Rugoglobigerina macrocephala*. Bronnimann. 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *P. intermedia* Zone

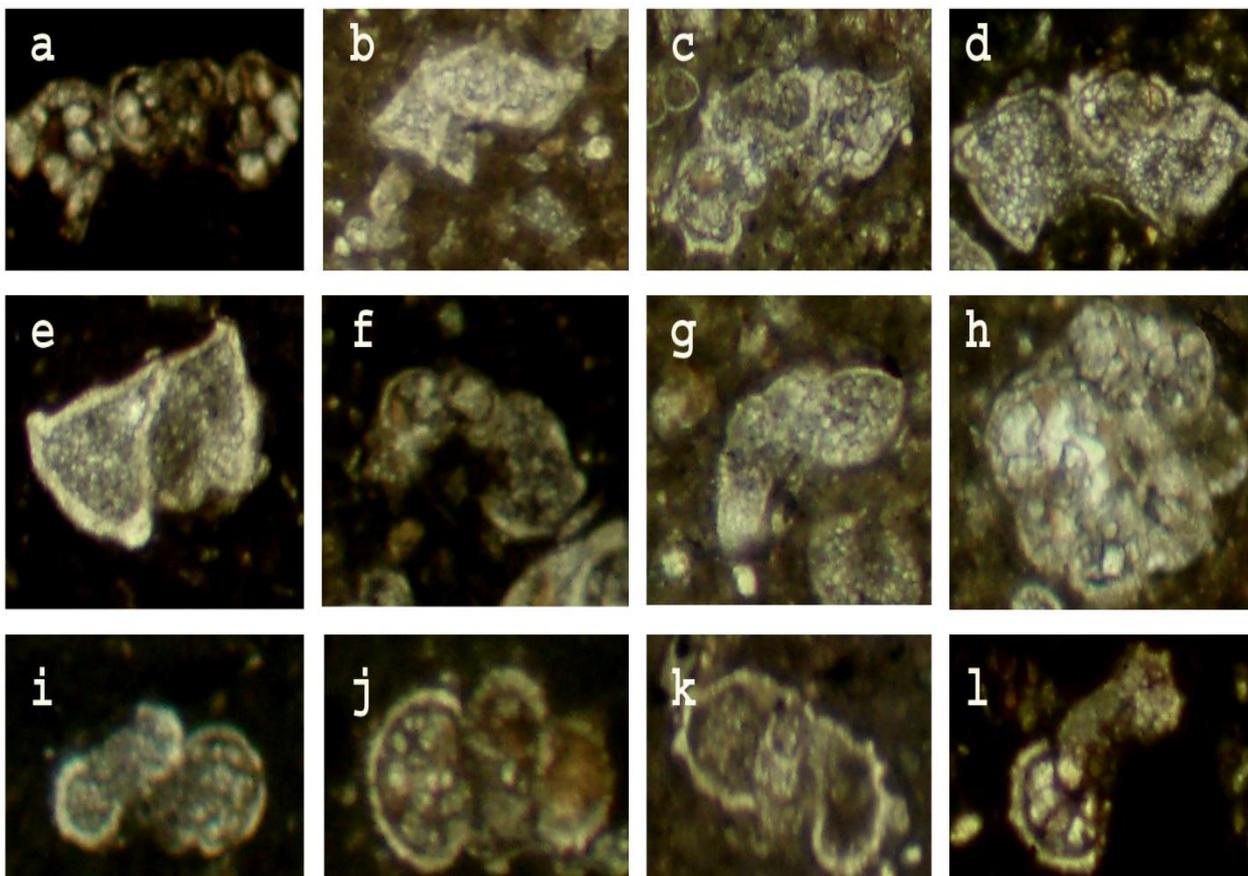
Figs. l, m *Kuglerina rotondata*. (Bronnimann). 100X, bluish marl succession, Early Maastrichtian, Kurdsat, specimen from *G. gansseri* Zone.

Fig. n *Heterohelix globulosa*.(Ehrenberg), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, specimen from *G. gansseri* Zone.

Fig. o *Heterohelix punctulata*. Cushman, 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *R. fructcosa* Zone.

Fig. p *Pseudotextularia elegans*. (Rzehak), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *C. contusa* Zone.

PLATE – 3



- Fig. a *Globo truncana bulloides*, Vohgler, 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *C. contusa* Zone.
- Fig. b *Globo truncana falsostuarti*. Sigal, 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *G. gansseri* Zone.
- Figs. c, d *Globo truncana arca*. (Cushman). 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *C. contusa* Zone.
- Fig. e *Globo truncanita angulata*, Tilev. 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *G. gansseri* Zone.
- Fig. f *Globo truncanella havanensis* (Voorwijk), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *P. intermedia* Zone.
- Fig. g *Globo truncanella petaloidea* (Gandolfi). 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *P. intermedia* Zone.
- Fig. h *Racemiguembelina fructicosa* (Egger) 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *R. fructicosa* Zone.
- Figs. i, j *Archaeoglobigerina blowi*. Pessango, 100X, bluish marl succession, Early Maastrichtian, Kurdsat, Specimen from *G. gansseri* Zone.
- Figs. k, l *Archaeoglobigerina cretacea*. (d Orbigny), 100X, bluish marl succession, Early Maastrichtian, Kurdsat, specimen from *G. gansseri* Zone.