

## Calcareous Nannofossils Biostratigraphy of Aaliji Formation in Well (K- 116), Northern Iraq

Raghda Saad Al-Hyaly

Omar Ahmed Al-Badrani

Department of Geology

College of Science

University of Mosul

(Received 13/11/2018 , Accepted 27/1/2019)

### ABSTRACT

Thirteen samples of Aaliji Formation from the well (K-116), Kirkuk area, Northern Iraq, are studied on the basis of the stratigraphic ranges of the recorded calcareous nannofossils for sixty species, the studied section reveals five biozones arranged from oldest to youngest as follows:

1. *Fasciculithus tympaniformis* Interval Biozone (CP4)
2. *Heliolithus kleinpellii* Interval Biozone (CP5)
3. *Discoaster mohleri* Interval Biozone (CP6)
4. *Discoaster nobilis* Interval Biozone (CP7)
5. *Discoaster multiraditus* Interval Biozone (CP8)

These biozones are correlated with other calcareous nannofossils biozones from both local and regional sections leading to conclude the age of Middle Paleocene to Early Eocene.

**Key words:** Calcareous nannofossils, Biostratigraphy, Paleocene, Iraq.

الطباقية الحياتية لمتحجرات النانو الكلسية لتكوين عليجي في بئر (K-116)، شمالي العراق

عمر احمد البدراني

رغدة سعد الحياي

قسم علوم الأرض

كلية العلوم

جامعة الموصل

### المخلص

درست ثلاثة عشر نموذجا من تكوين عليجي في بئر (K-116)، منطقة كركوك، شمالي العراق، بالاعتماد على الامتدادات الطباقية لمتحجرات النانو الكلسية المسجلة لسنتين نوعا، ظهر في المقطع قيد الدراسة خمسة أنطقه حياتية هي من الاقدم الى الاحدث كالاتي:

1. *Fasciculithus tympaniformis* Interval Biozone (CP4)
2. *Heliolithus kleinpellii* Interval Biozone (CP5)
3. *Discoaster mohleri* Interval Biozone (CP6)

4. *Discoaster nobilis* Interval Biozone (CP7)

5. *Discoaster multiraditus* Interval Biozone (CP8)

تمت مضاهاة الانطقة الحالية مع الانطقة العالمية واستنتج عمر التكوين بالبالايوسين الاوسط الى الابوسين

المبكر.

الكلمات الدالة: تكوين عليجي، منطقة كركوك، الطباقية الحياتية، باليوسين، أنطقه حياتية.

## INTRODUCTION

Aaliji Formation was first described in northwest Syria (Meidanki, lat.  $36^{\circ} 29' 25''$  N, long.  $36^{\circ} 53' 32''$  E) A supplementary type locality has been chosen in Iraq is located at Well K-109 (lat.  $35^{\circ} 33' 08''$  N and long.  $44^{\circ} 18' 55''$  E), between drilled depths 2487 feet and 3035 feet, so the thickness is 548 feet (167 meters) (Bellen et. al., 1959).

The studied section that lies in Kirkuk area at (K-116) (lat.  $35^{\circ}47' 28''$ N and long.  $43^{\circ}59' 06''$  E) consists of marlstone and marly limestone between drilled depths 1441m. and 1375 m., so the thickness is about 64 m (Fig. 1).

Twenty-Three samples of marly limestone and marl are selected for the studying the calcareous nannofossils using the thin sections (under transmitted-light microscope). The calcareous nannofossils are extracted by using the method (H) (Armstrong and Brasier, 2005).

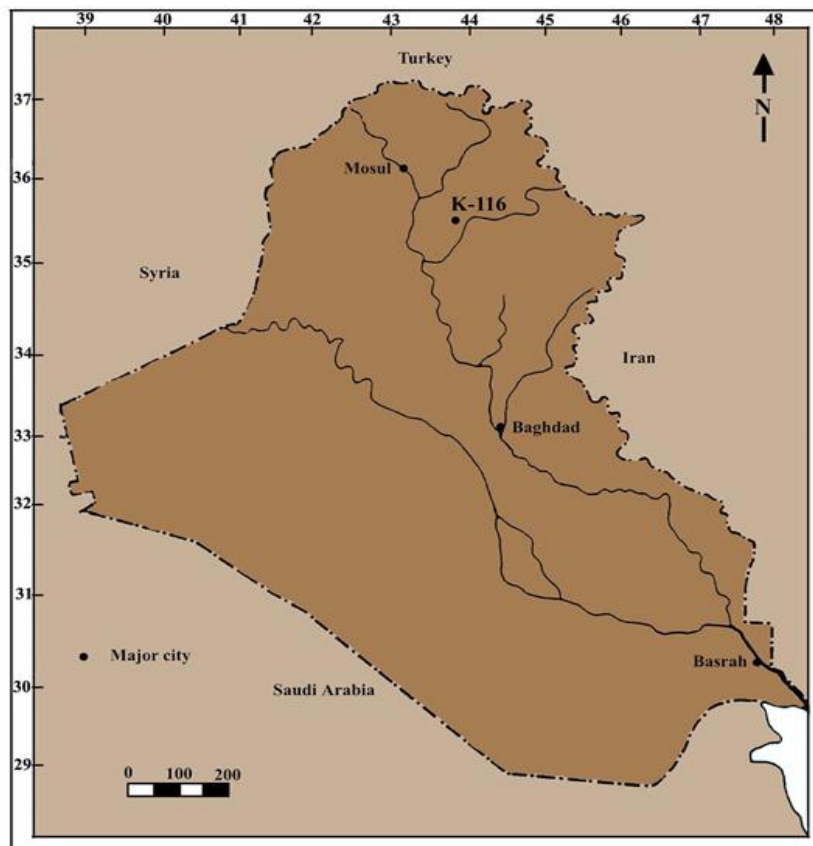


Fig. 1: Location map for the studied section at K-116 Materials and Methods

## NANNOBIOSTRATIGRAPHY

Depending on the stratigraphic distribution of the recorded species, five Biozones are identified (Fig.2):

### 1 - *Fasciculithus tympaniformis* Interval Biozone (CP4) (Part)

**Definition:** Interval biozone of *Fasciculithus tympaniformis* Hay and Mohler, 1967.

**Boundaries:** The biozone determinate by FO of *Fasciculithus tympaniformis* Hay and Mohler, 1967 to FO of *Heliolithus kleinpellii* Sullivan, 1964.

**Thickness:** (4750-4700) ft.

**Correlation and Discussion:** This biozone correlated with *Fasciculithus tympaniformis* biozone (CP4) by Okada and Bukry (1980) which aged Middle Paleocene (Selandian), and correlated with *Fasciculithus tympaniformis* biozone (NP5) by Martini (1971) which aged Middle Paleocene (Selandian) too. Therefore, depending on stratigraphic correlation above this biozone aged Middle Paleocene (Selandian) (Gradstein *et al.*, 2012).

### 2- *Heliolithus kleinpellii* Interval Biozone (CP5) (CP11)

**Definition:** Interval biozone of *Heliolithus kleinpellii* Sullivan, 1964.

**Boundaries:** The biozone determinate by FO of *Heliolithus kleinpellii* Sullivan, 1964 to FO *Discoaster mohleri* (Bukry and Perciavel, 1971).

**Thickness:** (4700-4670) ft.

**Correlation and Discussion:** This biozone correlated with *Heliolithus kleinpellii* biozone (CP5) by Okada and Bukry (1980) which aged Middle to late Paleocene (Selandianto Thanetian), and correlated with *Heliolithus klenpellii* biozone (NP6) by Martini (1971) which aged Middle to Late Paleocene (Selandian to Thanetian) too. Therefore, depending on stratigraphic correlation above this biozone aged Middle to Late Paleocene (Selandian to Thanetian) (Gradstein *et al.*, 2012).

### 3 - *Discoaster mohleri* Interval Biozone (CP6)

**Definition:** Interval biozone of *Discoaster mohleri* Bukry and Perciavel, 1971.

**Boundaries:** The biozone determinate by FO of *Discoaster mohleri* Bukry and Perciavel, 1971 to FO of *Discoaster nobilis* Martini, 1961

**Thickness:** (4670-4640) ft.

**Correlation and Discussion:** This biozone correlated with *Discoaster mohleri* biozone (CP6) by Okada and Bukry (1980) which aged Late Paleocene (Thanetian), and correlated with *Discoaster mohleri* biozone (NP7) by Martini (1971) which aged Late Paleocene (Thanetian) too. Therefore, depending on stratigraphic correlation above this biozone aged Late Paleocene (Thanetian) (Gradstein *et al.*, 2012).

#### 4 - *Discoaster nobilis* Interval Biozone (CP7)

**Definition:** Interval biozone of *Discoaster nobilis* Martini, 1961.

**Boundaries:** The biozone determinate by FO of *Discoaster nobilis* Martini, 1961 to FO *Discoaster multiradiatus* Bramlette and Riedel, 1954.

**Thickness:** (4640-4590) ft.

**Correlation and Discussion:** This biozone correlated with *Discoaster nobilis* biozone (CP7) by Okada and Bukry (1980) which aged Late Paleocene (Thanetian), and correlated with *Discoaster nobilis* biozone (NP8) by Martini (1971) which aged Late Paleocene (Thanetian) too. Therefore, depending on stratigraphic correlation above, this biozone aged Late Paleocene (Thanetian) (Gradstein *et al.*, 2012).

#### 5- *Discoaster multiradiatus* Interval Biozone (CP8) (part)

**Definition:** Interval biozone of *Discoaster multiradiatus* Bramlette and Riedel, 1954.

**Boundaries:** The biozone determinate by FO of *Discoaster multiradiatus* Bramlette and Riedel, 1954 to FO of *Discoaster diastypus* Bramlette and Sullivan, 1961.

**Thickness:** (4590-4540) ft.

**Correlation and Discussion:** This biozone correlated with *Discoaster multiradiatus* biozone (CP8) by Okada and Bukry (1980) which aged Late Paleocene to Early Eocene (Thanetian to Ypresian), and correlated with *Discoaster multiradiatus* biozone (NP9) by Martini (1971) which aged Late Paleocene to Early Eocene (Thanetian to Ypresian) too. Therefore, depending on stratigraphic correlation above this biozone aged Late Paleocene to Early Eocene (Thanetian to Ypresian) (Gradstein *et al.*, 2012).

### CONCLUSIONS

Aaliji Formation in (K-116) well consist of five biozones for calcareous nannofossils, these are from older to younger (Figs.2, 3):

1. *Fasciculithus tympaniformis* Interval Biozone (CP4)
2. *Heliolithus kleinpellii* Interval Biozone (CP5)
3. *Discoaster mohleri* Interval Biozone (CP6)
4. *Discoaster nobilis* Interval Biozone (CP7)
5. *Discoaster multiradiatus* Interval Biozone (CP8)

This biozones aged Middle Paleocene to Early Eocene for studied section (Fig.4).

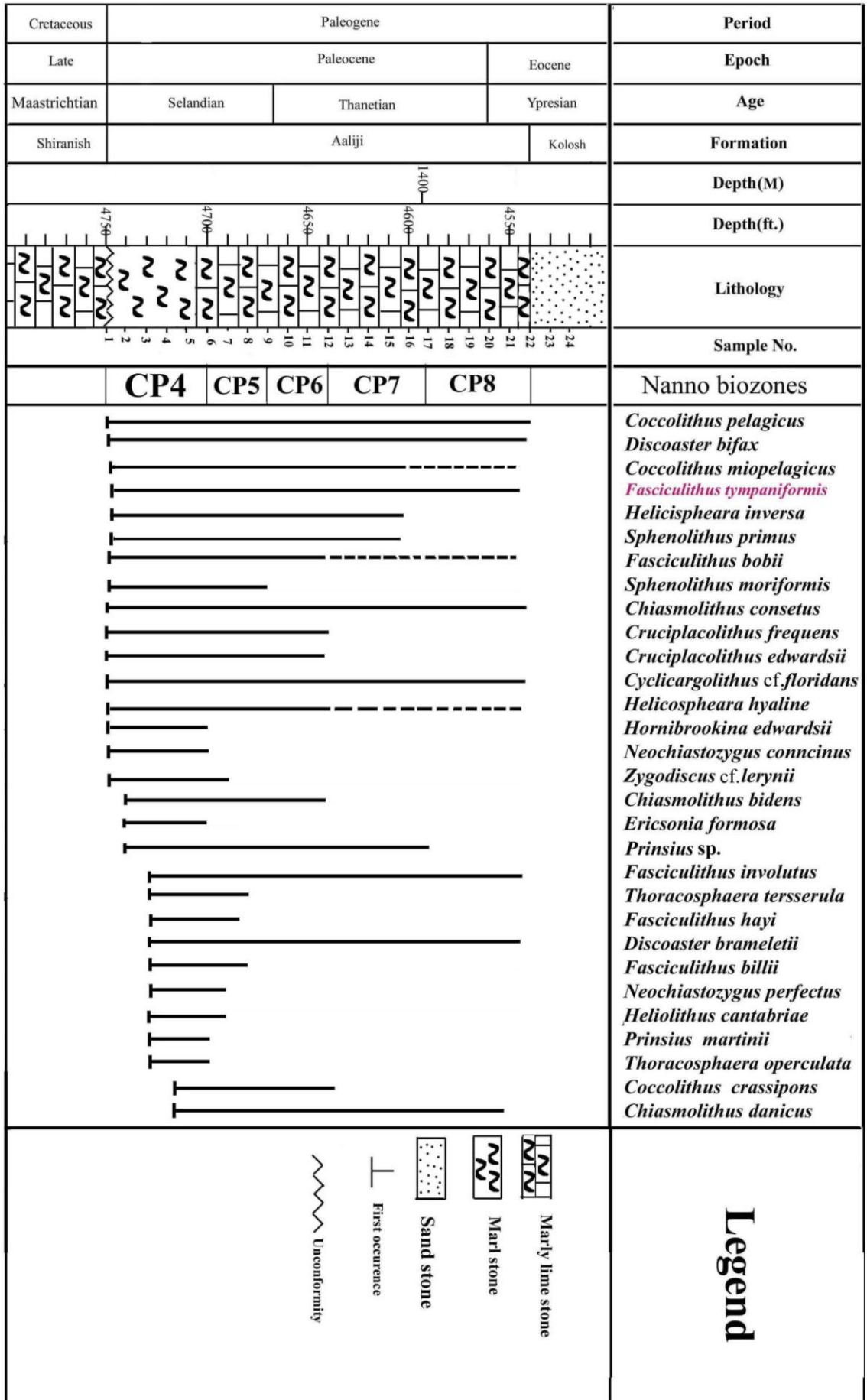


Fig. 2a: Biostratigraphic chart of studied section.

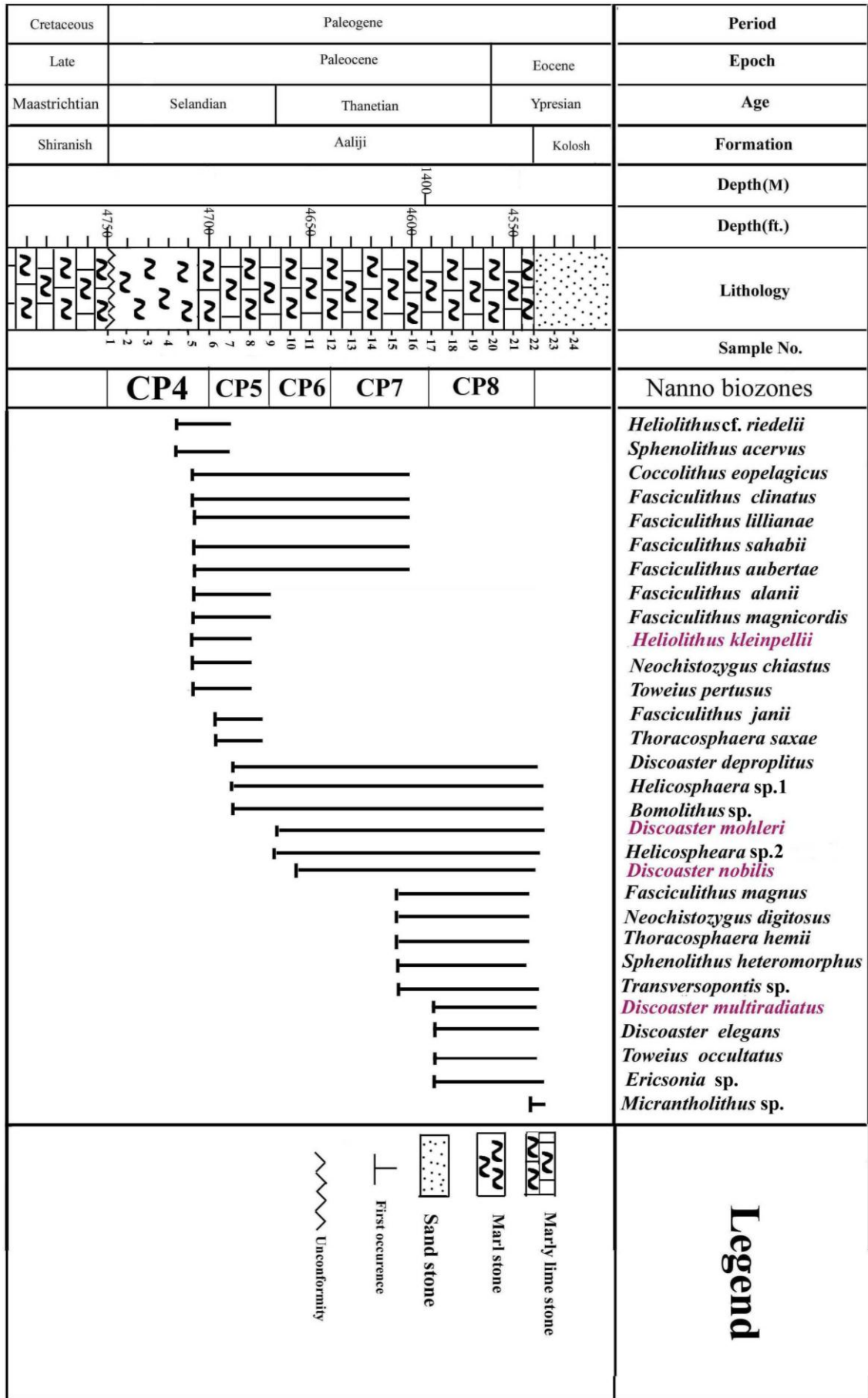


Fig. 2b: Biostratigraphic chart of studied section.

Gradstein et al., 2012						Present work	
Age (Ma.)	Epoch	Stage	Martini, 1971	Okada and Bukry 1980	Nannobiozones		
35 40 45 50 55 60 65	Eocene	Priabonian	NP21	CP16	a	Not studied	
			NP20 NP19	CP15	b		
			NP18		a		
		Bartonian	NP17	CP14	b		
			NP16		a		
		Lutetian	NP15	CP13	c		
					b		
			NP14		a		
		Ypresian	NP13	CP11			
			NP12	CP10			
			NP11		b		
			NP10	CP9	a		
		NP9	CP8	b			
				a			
Paleocene	Thanetian	NP8	CP7		<i>Discoaster multiradiatus</i>	<i>Discoaster multiradiatus</i>	
		NP7	CP6		<i>Discoaster nobilis</i>	<i>Discoaster nobilis</i>	
	Selandian	NP6	CP5		<i>Discoaster mohleri</i>	<i>Discoaster mohleri</i>	
		NP5	CP4		<i>Heliolithus kleinpellii</i>	<i>Heliolithus kleinpellii</i>	
		NP4	CP3		<i>Fasciculithus tympaniformis</i>	<i>Fasciculithus tympaniformis</i>	
	Danian	NP3	CP2				
NP2	CP1	b					
		a					
NP1							

Fig. 3: Index calcareous nannofossils species for studied section.

Age(Ma.)	Epoch	Stage	Gradstein et al., 2012		Hay and Mohler, 1967	Perch Nielsen, 1971	Edwards, 1971	Bukry, 1973	Varol, 1989	Present Study				
			Okada and Bukry, 1980	France							Denmark	New Zealand	Pacifics ocean	British
35-	Eocene	Priabonian	NP21	<i>Hirronites andersonii</i>	CP16									
			NP20	<i>Sphenolithus prestolatorius</i>	CP15									
			NP19	<i>Helioolithus recurvus</i>	a	<i>Discocaster</i>								
			NP18	<i>Discocaster subloboensis</i>	b	<i>Discocaster</i>								
			NP17	<i>Discocaster saipuanensis</i>	CP14									
			NP16	<i>Discocaster lamii nodifler</i>	a	<i>Reticulogenera umbilica</i>								
					b	<i>Discocaster saipuanensis</i>								
					c	<i>Coccolithus staurion</i>								
			NP15	<i>Nannoceratina fulgens</i>	a	<i>Nannoceratina quadrata</i>								
					b	<i>Chiasmolithus gigas</i>								
NP14	<i>Discocaster subloboensis</i>	CP12												
NP13	<i>Discocaster lodoensis</i>	a	<i>Discocaster subloboensis</i>											
		b	<i>Rubidolophura inflata</i>											
50-	Eocene	Lutetian	NP14	<i>Discocaster subloboensis</i>	CP12									
			NP13	<i>Discocaster lodoensis</i>	CP11									
			NP12	<i>Tribraclidium orthostylus</i>	a	<i>Discocaster</i>								
					b	<i>Discocaster binodosus</i>								
			NP11	<i>Discocaster binodosus</i>	CP9									
			NP10	<i>Tribraclidium comertus</i>	a	<i>Discocaster</i>								
			NP9	<i>Discocaster multiradiatus</i>	b	<i>Discocaster</i>								
					a	<i>Discocaster</i>								
			NP8	<i>Helioolithus reidii</i>	CP7									
			NP7	<i>Discocaster nobilis</i>	CP6									
NP6	<i>Helioolithus kleinpelli</i>	a	<i>Discocaster nobilis</i>											
		b	<i>Discocaster moelleri</i>											
		c	<i>Discocaster moelleri</i>											
NP5	<i>Helioolithus kleinpelli</i>	a	<i>Helioolithus kleinpelli</i>											
		b	<i>Helioolithus kleinpelli</i>											
NP4	<i>Fasciculithus pygmaeiformis</i>	a	<i>Fasciculithus pygmaeiformis</i>											
		b	<i>Fasciculithus pygmaeiformis</i>											
60-	Eocene	Selandian	NP4	<i>Ellipsolithus macellus</i>	CP3									
			NP3	<i>Chiasmolithus danicus</i>	CP2									
			NP2	<i>Chiasmolithus danicus</i>	a	<i>Chiasmolithus danicus</i>								
			NP1	<i>Chiasmolithus danicus</i>	b	<i>Chiasmolithus danicus</i>								
			NP1	<i>Chiasmolithus danicus</i>	a	<i>Chiasmolithus danicus</i>								
					b	<i>Chiasmolithus danicus</i>								
			NP1	<i>Chiasmolithus danicus</i>	a	<i>Chiasmolithus danicus</i>								
					b	<i>Chiasmolithus danicus</i>								
			65-	Paleocene	Danian	NP1	<i>Chiasmolithus danicus</i>	CP1						
						NP1	<i>Chiasmolithus danicus</i>	a	<i>Chiasmolithus danicus</i>					
NP1	<i>Chiasmolithus danicus</i>	b				<i>Chiasmolithus danicus</i>								
NP1	<i>Chiasmolithus danicus</i>	a				<i>Chiasmolithus danicus</i>								
NP1	<i>Chiasmolithus danicus</i>	b				<i>Chiasmolithus danicus</i>								
NP1	<i>Chiasmolithus danicus</i>	a				<i>Chiasmolithus danicus</i>								
NP1	<i>Chiasmolithus danicus</i>	b				<i>Chiasmolithus danicus</i>								
NP1	<i>Chiasmolithus danicus</i>	a				<i>Chiasmolithus danicus</i>								
NP1	<i>Chiasmolithus danicus</i>	b				<i>Chiasmolithus danicus</i>								
NP1	<i>Chiasmolithus danicus</i>	a				<i>Chiasmolithus danicus</i>								

Fig. 4: Comparisons between calcareous nannofossils biozones for studied section.



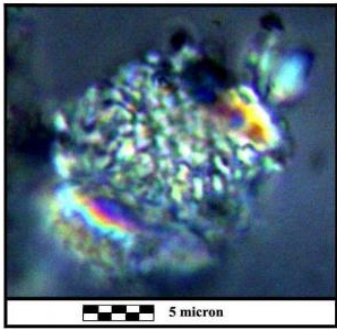
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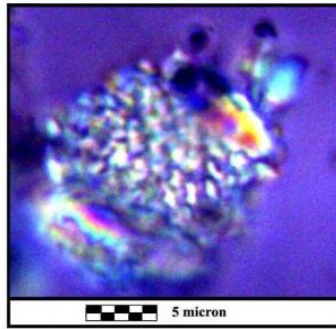
**PLATE EXPLANATIONS**

- 1, 2 *Thoracosphaera tersserula* Fütter, 1978, bar = 5 micron, (1) Polarized Light Photo  
(2) Gypsum Light Photo.
- 3, 4 *Heliolithus klenPELLII* Sullivan, 1964, bar = 5 micron, (1) Polarized Light Photo (2)  
Gypsum Light Photo.
- 5, 6 *Fasciculithus tympaniformis* Hay and Mohler, 1967 in Hay, Mohler and Roth,  
1967, bar = 5 micron, (1) Polarized Light Photo.
- 7, 8 *Sphenolithus acervus* Bown, 2005, bar = 5 micron, (1) Polarized Light Photo (2)  
Gypsum Light Photo.
- 9 *Discoaster mohleri* Bukry and Percival, 1971, bar = 5 micron, (1) Normal Light  
Photo.
- 10 *Discoaster multiradiatus* Bramlette and Riedel, 1954, bar = 5 micron, (1) Normal  
Light Photo.
- 11 *Discoaster nobilis* Martini, 1961, bar = 5 micron, (1) Normal Light Photo
- 12 *Discoaster deproplitus* Martini, 1961, bar = 5 micron, (1) Normal Light Photo.

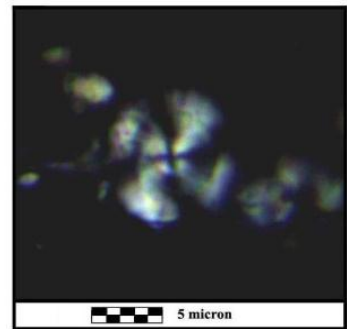
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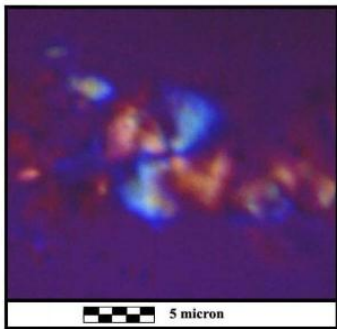
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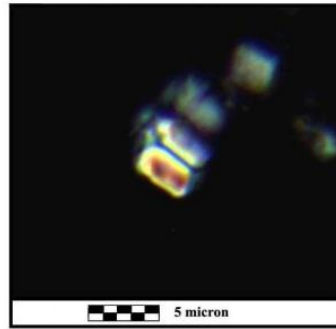
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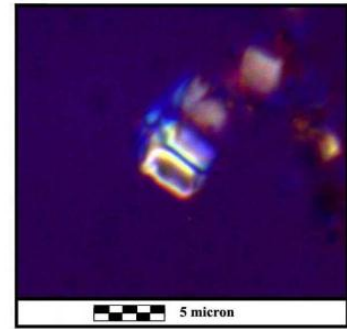
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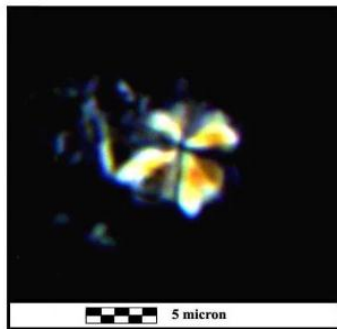
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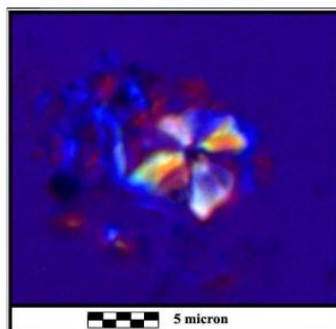
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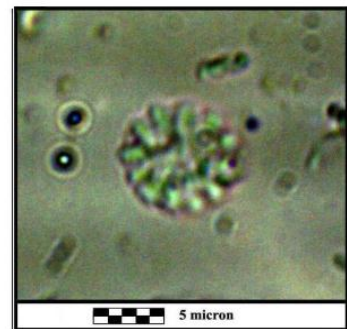
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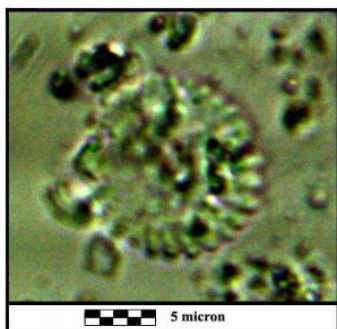
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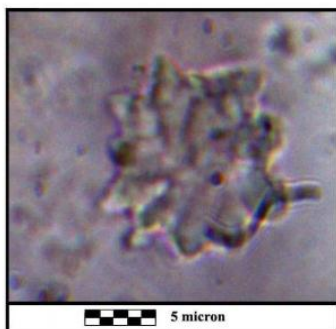
(8)



(9)



(10)



(11)



(12)