

The Calcareous Nannofossils Biostratigraphy of the Cretaceous Red Bed the in Shiranish Formation, Hiran in Erbil Governorate and Smaqoli Area in Sulaimaniya Governorate, Northern Iraq

Alaa S. Al-Zubaidi and Omar¹ A. Al-Badrani^{1,*}

- ¹ Department of Geology, College of Science, Mosul University, Mosul, Iraq.
- * Correspondence: <u>omarbadrani@uomosul.edu.iq</u>

Abstract

Received: On the basis of the stratigraphic ranges of the reported calcareous nannfossils for several 20 December 2022 species, two sections of the Shiranish Formation from the Hiran in the Erbil Governorate and the Smaqoli area in Sulaimaniya Governorate, Northern Iraq, are analyzed. Four biozones are Accepted: visible in the examined region, grouped as follows from oldest to youngest: Uniplanarius 8 March 2023 gothicus Interval zone; Tranolithus phacelosus Interval zone; Rienhardtites lives Interval zone; Micula murus Interval zone. The relationship between these biozones and those of other Published: 31 July 2023 calcareous nannofossil biozones from local and regional sections allows scientists to determine that these fossils are from the Late Campanian to Early Maastrichtian period. **Keywords:** Calcareous nannofossils; Biostratigraphy; Campanian; Maastrichtian; Iraq.

1. Introduction

The Shiranish Formation is regarded as one of the common and widely spread late Cretaceous successions in northern Iraq. The formation has an economic importance and considered as one of the most important oil reservoirs in several oilfields of Iraq due to presence of secondary fracture porosity and could be regarded as potential hydrocarbon source rocks as well. The Shiranish Formation has been described in numerous research papers and academic. Many studies were made on it that discussed the depositional paleoenvironment of formation in terms of foraminiferal biostratigraphy, geochemistry and microfacies.

The Shiranish Formation was first described by Henson (1940) in Bellen et al. (1959) from the High Folded Zone of Northern Iraq, near the village of Shiranish Islam, Northeast of Zakho. It is one of the most wide spread units of the Upper Campanian- Maastrichtian cycle in North Iraq. The stratigraphy of this formation has been studied previously by many researchers (e.g., Al-Badrani and Al-Assaf, 2011; Al-Shareefi et al., 2014; Al-Maamari and Al-Badrani 2019). The previous work was accomplished within different disciplines and by using different tools, such as foraminifera, ostracode as well as calcareous nano-fossils, in addition to numerous sedimentological and geochemical studies. Perhaps the reason for this interest is the importance of the Shiranish Formation as a cap rock of oil reservoirs in many oil-producing formations in southern Iraq. It is also considered as a reservoir rock unit in the areas of northern and central Iraq, including the area of the current study, due to the tiny joints and the micro fractures in its rock structure.

DOI: 10.46717/igj.56.2A.15ms-2023-7-24

In the recent study, an outcropped sections was chosen at Hiran area in Erbil Governorate and Smaqoli area in Sulaimaniya Governorate, Northern Iraq, and detailed field description was conducted including description of the stratigraphic units of the Shiranish Formation and the lithological characteristics. Additionally, biostratigraphy of the Shiranish Formation based on calcareous nannofossils was achieved.

The study aims to describe the biostratigraphy of the Shiranish Formation by determining the nannofossils and their ages and matching them globally and locally to determine the exact age of this formation.

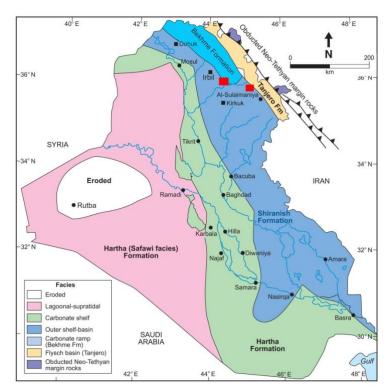


Fig. 1. Location map showing the sections at Hiran area in Erbil Governorate and Smaqoli area in Sulaimaniya Governorate, Northern Iraq

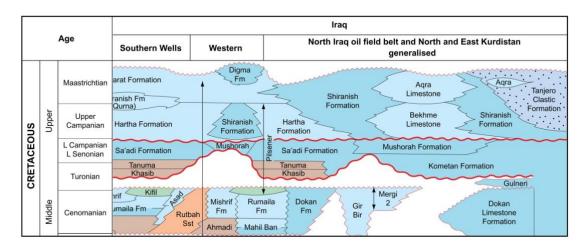


Fig. 2. Schematic regional rock unit correlation (After Haddad and Amin, 2007)

2. Methodology

2.1 Materials

Data for this study was generated from many samples of outcrouped samples from Shiranish Formation. Samples were collected at different interval which was obtained from northern Iraq, with Lithologic mainly from Limestone and marly limestone.

2.2 Laboratory Analysis

• (A) Nannofossil Slides preparation making by using the method (H) (Armstrong and Brasier, 2005), the procedure is as follows:

A sieve used to separate each rock sample, which weighs around 5 grams. To serve as a dispersant, a tiny drop is introduced. A direct, low-heat source (hotplate) is used to completely dry the slide and residue, however contamination must always be avoided. A thin, uncontaminated cover slip has been coated with an amorphous oleoresin called as (Canada balsam). A dry drop of previously dried and hardened sample solution is poured over it, and the sample is then set up for observation under a transmitted microscope.

• (B) Observation Techniques

Using a light microscope, cross-polarized transmitted lights, and gypsum plate, the slides were examined for the presence of calcareous nannofossils. The assemblages were thoroughly analyzed at x1000 magnification. Species were identified by utilizing a catalog that other authors have published online and in libraries.

3. Results and discussions

To identify numerous species of calcareous nannofossils, nannopaleontologists used a variety of paleontological sources, including Bown and Young (1997) and Perch-Nielsen (1985). The materials are kept in the Geology Department at the University of Mosul, Iraq.

3.1. Nannobiostratigraphy

1. Uniplanarius gothicus Interval zone

Definition: Interval Zone for Uniplanarius gothicus (Deflandre, 1959) Hattner & Wise, in Wind & Wise. The zone determinate from the FA for the Uniplanarius gothicus (Deflandre, 1959) Hattner & Wise, in Wind & Wise, and to the LA for Eiffilithus eximus (Stover, 1966; Perch-Nielsen, 1968).

Author: Sisingh (1977).

Age: Late Cmpanian

Thickness: Hiran 50 m and Smaqoli 15 m.

Remarks: This zone is comported with zone CC22 (Uniplanarius trifidus Zone) of Sisingh (1977) in the upper Campanian. and comported UC15 zone which is determined by Bown (1998), that aged upper Campanian age (Gradstein et al., 2012) (Figs. 3-11).

2. Tranolithus phaclosus Interval zone

Definition: Interval zone of Tranolithus phaclosus Stover, 1966. The zone studied by the LA for the Eiffilithus eximus (Stover, 1966; Perch- Nielsen, 1968) to the LA for Tranolithus phaclosus Stover (1966).

Author: Bukry and Bramlette (1970). Age: late Campanian to early Maastrichtian Thickness: Hiran 90 m and Smaqoli 65 m. Remarks: This zone is comported with CC23 (Tranolithus phaclosus zone) which studied by the Sisingh (1977) which aged of the upper Campanian to lower Maastrichtian. and comported UC16, UC17 zone, which is studied by Bown (1998) that aged Campanian to lower Maastrichtian, age. (Gradstein et al., 2012) (Figs.3-11).

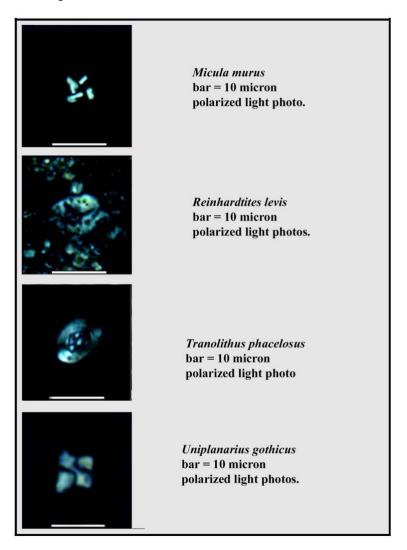


Fig. 3. Index calcareous nannofossils for The Shiranish Formation, Northern Iraq

3. Reinhardtites levis Interval zone

Definition: Interval zone of Reinhardtites levis Prins and Sisingh in Sisingh (1977). The zone determinate by the LA for Tranolithus phaclosus Stover, (1966) to the LA for Reinhardtites levis Sisingh (1977) or Micula murus (Martini, 1961; Bukry, 1973).

Author: Sisingh (1977).

Age: lower Maastrichtian

Thickness: Hiran 60 m and Smaqoli 50 m.

Remarks: This zone is comported with CC24 (Reinhardtites levis zone) which studied by the Sisingh (1977) at the age of the upper Campnian to lower Maastrichtian. and comported UC18 zone that is studied by Bown (1998) that aged Maastrichtian age (Gradstein et al., 2012) (Figs. 3-11).

4. Micula murus Interval zone

Definition: Interval zone for Micula murus (Martini, 1961; Bukry, 1973). The zone determinate by the LA for Reinhardtites levis Prins and Sisingh in Sisingh (1977) or Micula murus (Martini, 1961; Bukry, 1973) to the FA of Nepholithus frequens Górka (1957).

Author: Perch-Nielsen (1972).

Age: Late Maastrichtian

Thickness: Hiran 10 m and Smaqoli 15 m.

Remarks: This zone is comported with (CC25) (Arkhngelskiella cymbiformis zone) Sisingh (1977) is divided into three subdivisions by the FA for the species Arkhngelskiella cymbiformis and the FA for species Lithraphidites quadratus at Maastrichtian age, and comported UC19 zone that is studied by Bown (1998) that aged upper Maastrichtian age (Gradstein et al., 2012) (Figs. 3-11).

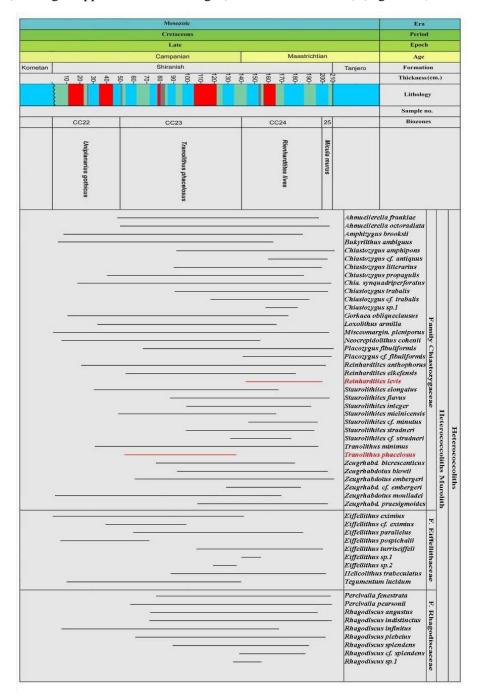


Fig. 4. Range chart for calcareous nannofossils for Hiran section (Part 1)

		Mesozoic			E	177		
		Cretaceous			Per			
		Campanian	Maastrich	tion	Aş			-
ometan		Shiranish		T	Tanjero Form			-
oniotan [40 20 10		190 180 160 140	200	Thickne			-
					Litho			-
5					Sampl	е по.	s	-
	CC22	CC23	CC24	25	Biozo	nes	-	-
		N						
	Uniplanarius gothicus	Tranolithus phacelosus	Rienhardtites lives	Micula murus				
					Corollithion completum Cylindralithus coronatus Cylindralithus cf. nieliae Cylindralithus serratus Rotelapillus msakyae Rotelapillus munitus			
					Biscutum constans Biscutum melaniae Biscutum sp. 1	Biscut.		
Petrarhabdus Petrarhabdus Petrarhabdus Petrarhabdus Petrarhabdus Petrarhabdus Petrarhabdus Prediscospha Prediscospha Prediscospha Prediscospha							H. Plac	
			 		Grantar. coronadventis Grantar. cf. coronadventis Retecapsa angustiforata Retecapsa ficula Retecapsa cf. ficula Retecapsa schizbrachiat Retecapsa schizbrachiat Retecapsa schizbrachiat Retecapsa sp.1 Retecapsa sp.2	F. Cretarhab		
					Cyclagelosph. margerelli Cyclagelosph. reinhardli Cyclagelosphaera sp.1 Cyclagelosphaera sp.3 Watynauerla barnesiae Watynauerla biporta Watynauerla optata Watynauerla optata Watynauerla quadrizadia Watynauerla sp.1 Watynauerla sp.3	F. Watznaue		

Fig. 5. Range chart for calcareous nannofossils for Hiran section (Part 2)

	Era Period				Mesozoic Cretaceous
	Epoch				Late
	Age		an	Maastrichti	Campanian
	Formatio	Tanjero			Shiranish
:m.)	Thickness		210	190- 180- 170- 150-	1110 1110 1110 1110 1110 1110 1110 111
	Litholog				
	Sample n				
	Biozone		25	CC24	CC22 CC23
			Mic	Rie	Tre Un
			Micula murus	Rienhardtites lives	Tranolithus phacelosus Uniplanarius gothicus
- 21	naastrichtiensis enormis sub constricta sub expansa sub parca sp.1	Broinsonia Broi. parca	_		CLIS
hs Placolith	o coxalliae o diversum us magnificus inversus pperum caistorensis	Markalins i Senilatus zi	 		
E Columbus has a T	s mchanae s sp. 1 diditus vvalis vvalis vvalis vvalis p. 2 ubdus cayeuxii cchiterminalis cf. maleformis bidus sp. 1 keadyi nuilfplus terrazctus ukryi hus bicornus	Lucianorh, Lucianorh, Lucianorha Munarinus Octolithus i Ottavianus Russellia bi Semiholoilt			
	si. asymmetrica sis glans sis cf. glans sis mariae sis cf. fricornus sis sp. 2 sis sp. 3 sis sp. 5	Lapideacas Lapideacas Lapideacas			
Minanakakaka	ites acutus niolensis ssopectinatus ites quadratus dulus decoratus dulus undosus capus	Lithraphidi Microrhaba			
Deleverabelishe	floralis s quadricuspis s sp. 1 peata cava iformis	Eprolithus			

Fig. 6. Range chart for calcareous nannofossils for Hiran section (Part 3)

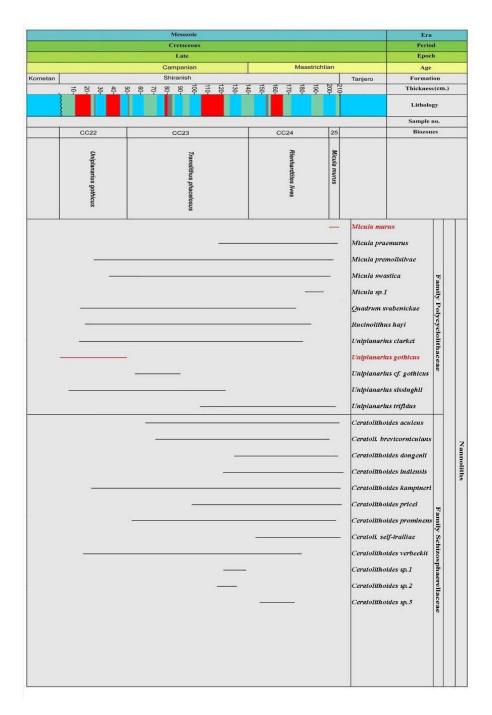


Fig. 7. Range chart for calcareous nannofossils for Hiran section (Part 4)

			Mesozoic Cretaceous						ra		
			Late						och		,
			Campanian	Maa	strichtian				ge		
Kometan			Shiranish				Tanjero	Form	_	1	
	10	40	50-50-	-08	110-	130-	140	Thickn	ess(c	:m.)	
								Lithe	ology		
	}							Samp	le no		-
	CC22	CC23			CC24			Bioz	-		-
	5		7		70						Ī
	Jniplanarius gothicus		Tranolithus phacelosus		Rienhardtites lives	Micula murus					
							Ahmueller, J Ahmueller, J Ahmueller, J Amphiz, Cf. J Bukyrlithus Chi, gartiso Chi, gartiso Chi, quadrij Chiastozygu G, pseudant Hieteromary, Loxolithus a Mono, quad Placozygus Mono, quad Placozygus Mono, quad Placozygus Mono, quad Placozygus Mono, quad Sta, dibrach Sta, scf. mie Tranolithus Zeugrhabdo Zeugr, diplo Zeugr, sigm	egularis minimus ambiguus nii perforatus s traballs hophorus bugensi traulla ernarius ernarius ernarius ernarius ernarius ernarius traulia si tevis si tevis hacelosus orionatus tus blowii grammus	Family Chias	Heterococcoliths Murolith	
	-			_	-		Eiffelli, cf. e Fiffellithus y Fiffelli, cf. p Fiffellithus y Tegumentun Tegument, so	gorkae oarallelus sp.1 1 lucidum	Eiffellithaceae	urolith	
						·	Percivalia fa Rhagodiscu Rhagodis sp	s infinitus	Rhago.		
							Cylindrali. I Cylindrali. s Rhombol. rh Rotelapillus Stradner. ge	culptus tombicum munitus	Stephano.		
							Axopodorha Cribrocoron Cribrosph. c Cribrosph. a Nephrolithu Octocyclu. r Tetrapodo. c Tetrapodo. s Tetrapodo. s Tetrapodo. s	a gallica f. circula laniae s corystus einhardtil coptensis f. decorus p.1	bd	Heterococcoliths	
							Biscutum co Biscutum m Biscutum sp Discorhabda	etaniae .1	F. Biscutaceae	Placolith	

Fig. 8. Range chart for calcareous nannofossils for Smaqoli section (Part 1)

							15	Cretaceou	1			_	_			
								Late								
			chtian	Maastric	1			npanian	Corres.							
Tanjer								hiranish								tan
140	120-	- P	110-	100	99	, 8	70-	8	5	40 -	8 .	5	20-	10		- 2
																-
						-	-					-	-	-	8 1	
			CC24		_				23	CC		_		2	CC2	T
			70						3					2		
Micula murus			Rienhardtites lives						Tranolithus phacelosus						Omplanarius youncus	
Petrark											-		-	2		
- Cretari Pickelh Reteca. Reteca Reteca Reteca Reteca Reteca Reteca			-	-								-	-		-	-
Cyclag Cyclag Cyclag Cyclag Cyclag Percha Watzna Watzna Watzna Watzna																
Arkhan Broinse Broinse B, cf, e B, cf, e B, cf, p B, cf, p B, vere B, vere			-										_			
Angula Garine – Marka Repag. Senilat Tortolh	_													-		
Acutur Calcult — Cal m Calcult Calcult Calcult Lucian Munar Octolit Orastr. Russell Semiho														-		

Fig. 9. Range chart for calcareous nannofossils for Smaqoli section (Part 2)

		Mesozoic					ra	
		Cretaceous					iod	
		Late					och	
ometan		Campanian Shiranish	Maastrichtian		Tania	A: Form	10.00	
orneran	10 20		120 110 90	130	Tanjero 14	Thickn		n.)
-								
	{					Litho	logy.	
						Samp		
	CC22	CC23	CC24		-	Bioz	ones	
	ş	78	2					
	Uniplanarius gothicus	Tranolifius phacelosus	Renhardites lives	Micula murus				
					Lapide. asymm	and and a sec	F	_
		3 			Lapideacassis.	mariae	api	
					Lapideacassis Lapideacassis Lapideacassis Lapideacassis	sp. б sp. 7	Lapideacass.	
				-	· Lithr. carniole	-	2	
			<u></u>		Lithr. cf. carni	olensis	fier	
					Mlcrorha. deci Mlcrorhabduli Mlcrorhabduli	is sp. 1	Microrhab.	
					Eprolithus flor Lithastrinas ge Micula cipeau Micula cubito Micula autorito Micula nurus Micula sinnog Micula Sinn	tilli ta peata mis phora ta ayi othicus othicus ghii ssinghii	Polycyclolithaceae	
					Cera. indiensis		5	
					Cera. cf. ohall Cera. sagittatu	8		
		_=			Cera, verbeeki Ceratolithoide Ceratolithoide Ceratolithoide Ceratolithoide	s sp. 1 s sp. 3 s sp. 4 s sp. 5	Family	
							Schizosphaerellaceae	

Fig. 10. Range chart for calcareous nannofossils for Smaqoli section (Part 3)

Ma	Period	Epoch	Age	Ogg et al., 2012	Age	Sissingh, 1977	Perch-Nielsen, 1985	Bown, 1998	Age	Present study				
66-					_									
67- 68-				CC26		CC26	CC26	UC20		\geq				
69-							0005			CC25				
69- 70-				CC25		CC25	CC25	UC19		CC25				
70-				CC 24		CC 24	CC 24	UC18]	CC24				
72-				CC 24		CC 24	CC 24	UC17		CC24				
73- 74- 75-			L	CC23	t.	CC23	CC23	UC16	-	CC23				
76-				CC22		CC22	CC22		1	CC22				
77-		sn	a	CC21	u.	CC21	CC21		H					
78-	cous	taceo	Campanian M	CC20	Campanian M	CC20	CC20	UC15		UC15	UC15	Campanian		
79- 80-	Cretaceous	Late Cretaceous	Cam	Cam	Can	Can	Can	CC19	Cam	CC19	CC19		Can	\backslash
81-				CC18		CC18	CC18	UC14						
82- 83-			ш	CC17	Е	CC17	CC17	UC13	-					
84- 85-			Sant.	CC16	Sant.	CC16	CC16	UC12 UC11	Sant.	/				

Fig. 11. Age correlation chart of calcareous nannofossils for The Shiranish Formation, Northern Iraq

4. Conclusion

From this study the followings are concluded:

1. many spcies of calacreous nanaofosssil recored from Shiranish Formation from Kurdistan region, Northern Iraq.

2. The species categorized into four biozones as follow:

Uniplanarius gothicus Interval zone Tranolithus phacelosus Interval zone Rienhardtites lives Interval zone Micula murus Interval zone

3. The biozones corellted to other calcareous nannofossil biozones from both anothers sections and aged the Late Campanian to Early Maastrichtian.

Acknowledgments: The University of Mosul/College of Science's facilities, which aided in raising the caliber of this study, are greatly appreciated by the authors.

References

- Abdallah, F.T., Al-Dulaimi, S.I., 2019. Biostratigraphy of the Upper Cretaceous for selected sections in northern Iraq. Iraqi Journal of Science, 60 (3), 545-553.
- Al-Badrani, O.A. 2012. Nannobiostratiraphy of the Lower part of Shiranish Formation, Sinjar Anticline, NW Iraq. Iraqi National Journal of Earth Sciences, 12 (1), 1-16.
- Al-Badrani, O.A., Al-Assaf, E.N., 2011. Nannobiostratigraphy of Shiranish Formation in Balad Well No. 8, Northern Baghdad, Iraq. Iraqi National Journal of Earth Sciences, 11 (2), 65 80.
- Al-Haidary, L.Y., 2009. Stratigraphy and Depositional Environment of Bekhme Formation and the Natural of its Contact with Shiranish Formation in Dohuk Area, North of Iraq. Unpublished. M.Sc. Thesis, Mosul University, Iraq.
- Al-Maamari, A.M., Al-Badrani, O.A., 2019. Calcareous nannofossils biostratigraphy of Shiranish Formation (K-306) well, Northern Iraq. Iraqi National Journal of Earth Sciences, 19 (2), 1 – 10.

- Al-Mutwali, M.M., Al-Banna, N.Y. and Al-Ghrear, J.S., 2008. Microfacies and Sequence Stratigraphy of the Late Campanian Bekhme Formation in the Dohuk Area, N. Iraq. Journal of GeoArabia, 13(1), 39 54.
- Al-Sulivani, R. F., Al-Badrani, O.A., 2021. Calcareous nannofossils biostratigraphy of Tanjero Formation at Azmer Anticline, Sulimaniya, Northern Iraq. Iraqi Journal of Science, 62 (5), 1605-1621.
- Armstrong, H., and Brasier, M., 2005. Microfossils Black well publishing.
- Bellen, R.C. van, Dunnington, H.V., Wetzel, R., Morton, D., 1959. Lexique Stratigraphique International. Asie, Iraq, Fasc. 10a, Paris.
- Bown, P.R., Young, J.R., 1997. Mesozoic calcareous nannoplankton classification. Journal of Nannoplankton Research, 19(1), 21-36.
- Bown, P.R., 1998. Calcareous Nannofossil Biostratigraphy. British Micropalaeontological Society Publications Series. Chapman and Hall, London.
- Jassim, S.Z., Buday, T., 2006. Units of the Unstable Shelf and the Zagros Suture. In: Jassim, S. Z. and Goff, J.C. (Eds.) Geology of Iraq, Published by Dolin Prague and Moravian Museum, Brno, 71 – 83.
- Ogg, J.G., Ogg, G., Gradstein, F.M., 2016. A Concise Geologic Time Scale: Amsterdam, Elsevier.
- Perch-Nielsen, K., 1985. Mesozoic calcareous nannofossils. In: H.M., Bolli, J.B., Saunders, and K., Perch-Nielsen, (Eds.), Plankton stratigraphy. Cambridge University Press, Cambridge, 329-426.
- Sissingh , W., 1977. Biostratigraphy of Cretaceous Calcareous Nannoplankton. In: H.M., Bolli, J.B., Saunders, and K., Perch-Nielsen, (Eds.), 1985. Plankton Stratigraphy. Cambridge University Press, Cambridge, 329 426.