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NANNOPLANKTON BIOSTRATIGRAPHY OF THE SELANDIAN-YPRESIAN GÜNEY FORMATION (ULUKIŞLA BASIN) AND SEA-WATER TEMPERATURE CHANGES IN THIS PERIOD

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ABSTRACT.- In this research, nannoplankton flora of Selandian-Ypresian Güney formation which is comprised of sandstone-shale intercalation and cropping out in Ereğli – Ulukışla basin was studied. 44 species of 16 nannoplankton taxons were determined in 50 samples collected from Güney measured stratigraphic section. Flora of five nannoplancton zone [*(Fasciculithus tympaniformis* Zone (late Selandian), *Heliolithus kleinpellii* Zone (late Selandian – early Thanetian, *Heliolithus ridelii* Zone (Thanetian), *Discoaster multiradiatus* Zone (Thanetian), Tribrachiatus contortus Zone (Ypresian)] were determined. Of the nannoplancton species which are sensitive to temperature changes, *Coccolithus eopelagicus* indicate mild – cool water and *Discoaster* and *Sphenolith* indicate mild-warm water environments; based on this information, we suggest that the sea water during the Selandian was mild to warm, during the Thanetian, the sea water was mild to cool and during the Ypresian, again the mild to warm sea water conditions prevailed.

Key words: Nannoplankton, Güney formation, Ereğli-Ulukışla Basin, Selandian, Ypresian.

INTRODUCTION

Ereğli-Ulukışla Basin is located 100 km NW of the Adana city (Figure 1). Güney formation which forms part of the basin spreads out in Ulukışla (Niğde), Çamardı, Pozantı and Ereğli (Konya) (Figure 1).

The basin is delimited by Aladağlar mountains and Ecemiş fault in the east, by Niğde massif in the west and by Bolkar mountains in the south (Demirtaşlı et al., 1973) (Figure 1).

Geological studies for different purposes were carried out in the study area and surroundings (Ketin and Akarsu (1965), Demirtaşlı et al.,1973; Oktay, 1982; Dellaloğlu and Aksu, 1986; Pampal and Meriç; 1990; Sonel and Sarı, 2004; Dursun, 2006). This study aims to reveal the *nannoplankton* biostratigraphy of the study area in detail.

In study area and its surroundings an ophiolitic emplacement is observed in Late Cretaceous; following this a sedimentary sequence were deposited in Late Cretaceous – Miocene time interval. The units filling the basin are clastic deposits, volcanosedimentary units, carbonates and evaporites. There are vertical and horizontal transitions and lithofacies changes among the Ulukışla, Halkapınar, Hasangazi and Güney formations (Figure 2). These units are shown in flysch character and they include many channel filling structures (Sonel and Sarı, 2004). By the end of the Middle Eocene, as a result of tectonic movements, the region has gained its structural position as shown today.

In this study, nannoplanktons in 50 samples collected from a measured stratigraphic section in Güney formation were studied and taxons of 5 biozone were determined (Figure 3). These data indicate that age of the formation is Selandian – Ypresian (Paleocene – early Eocene).

MATERIAL AND METHOD

50 samples collected from the Güney formation along a measured stratigraphic section are the materials used in this study. Slides were prepared from the samples by stripping method. Abundance of zone fossils from the samples collected were counted in 200 areas (Wei, 1988) and revealed. Accordingly, following evaluation

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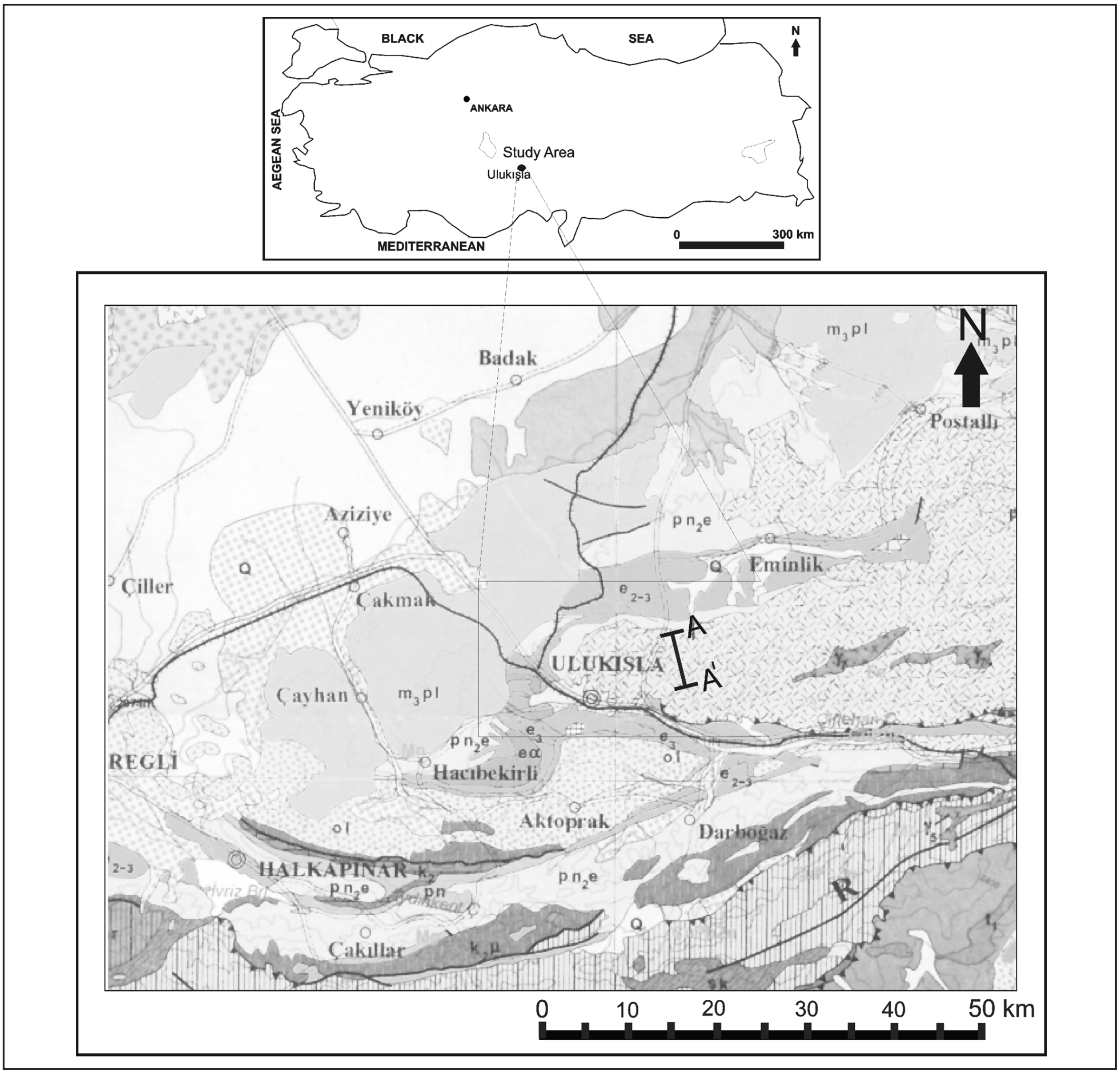

Figure 1- Location map of the study area (MTA, 2002)

was made for the species: one or many species in an area as “Abundant = B”; one species in 2 - 10 areas as “Widespread = Y”, and one species in 11 – 50 areas as “ Few (Little) = A” and one from each species in 51 – 200 areas as “Rare = N” (Table 1).

LITHOSTRATIGRAPHY

Güney formation which crops out in study area is comprised of an intercalation of sandstone and shale, however, red lenticular mudstones and thin to medium bedded lenticular sandstones and mudstones are also included. Pillow lavas of 1 – 15.5 m thick are also observed in the

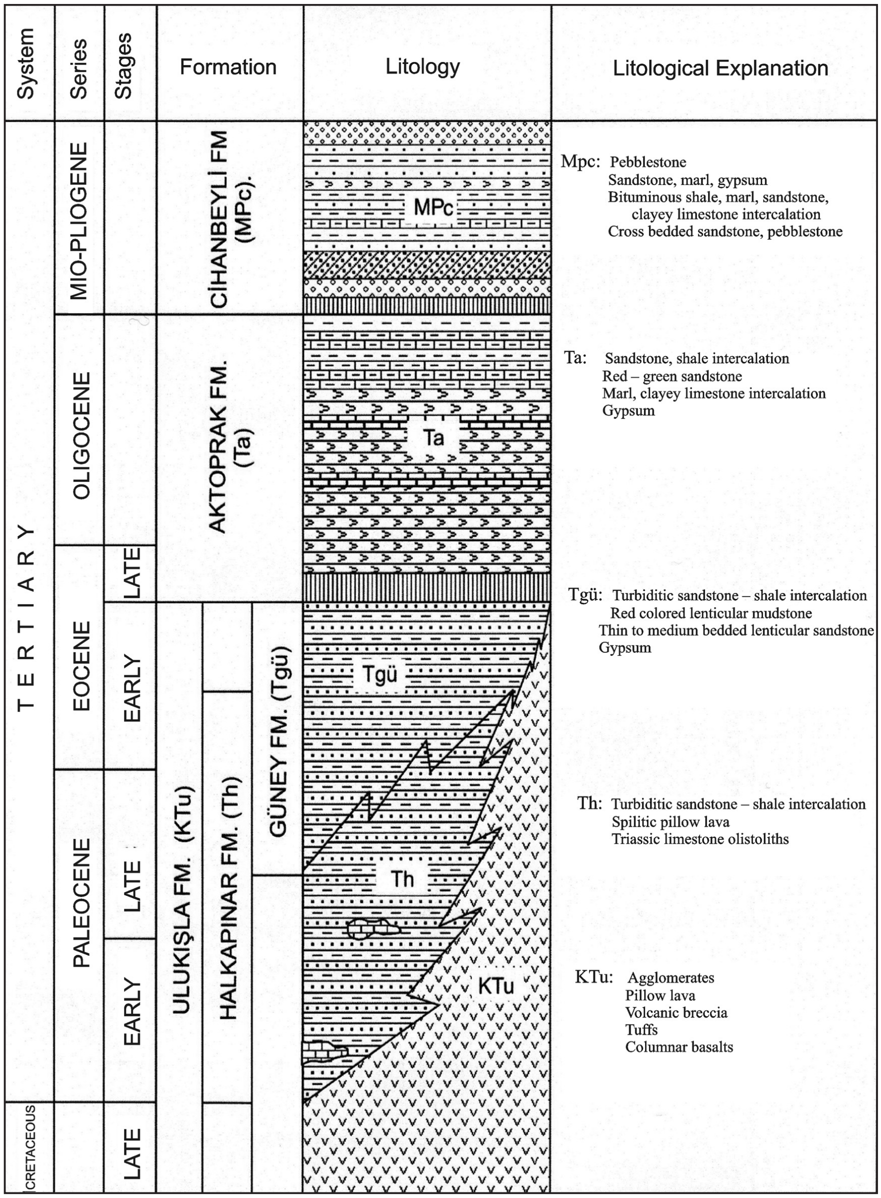

Figure 2- Generalized stratigraphic columnar section of the Ereğli-Ulukışla Basin(Dursun, 2006).

unit. At the top of the unit widespread lenticular channel fills displaying graded bedding, slump deposits and intercalations of turbiditic sandstone are observed.

Güney formation is represented very well around Ulukışla – Güney village. It was developed time regressive from north to south; therefore it has different facies and ages around its typical locality and southwest of Ulukışla (Oktay, 1982).

Güney formation was deposited in general below the wave base and by turbiditic currents.

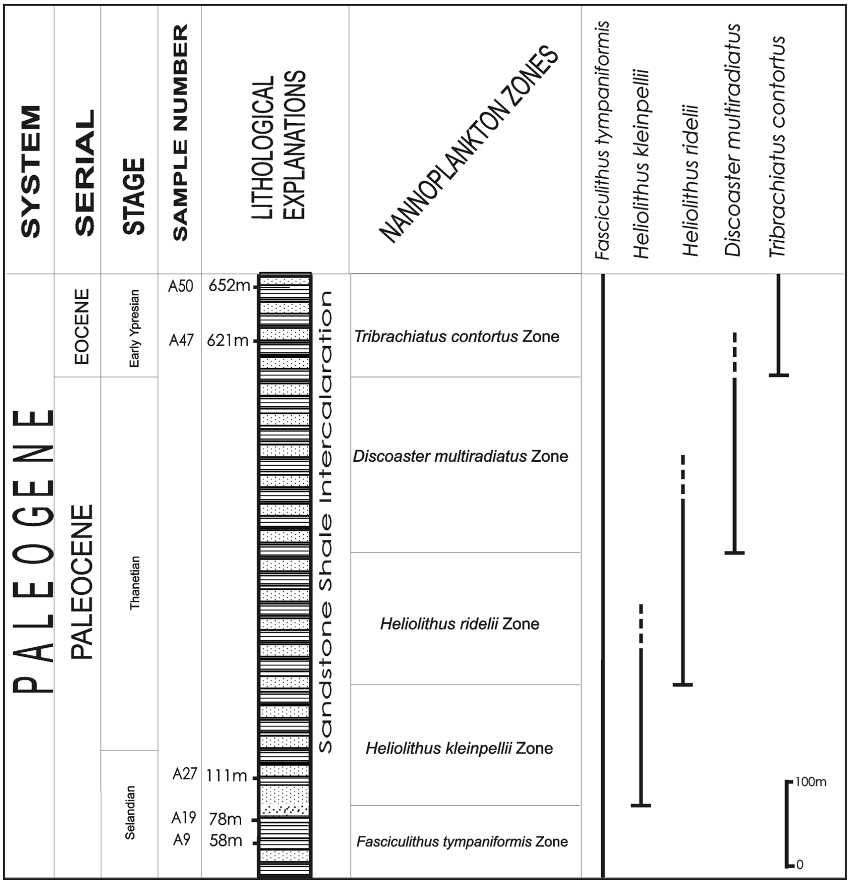

Figure 3- Generalized view ıof Güney formation (north of Bekçitepe).

The lower levels of the sequence include channel fills and sandstones are dominant in these levels, therefore they display characteristics of proximal turbidites. Northward in the study area, the shale and sandstone dominance become equal; in these regions channel fills are observed at the upper sections and sandstones become dominant with coarse grains while the dominance of the shales decrease. For this reason, the upper levels are observed in proximal turbiditic character.

The unit was developed in general as grey, coarse sandstone and shale intercalation. It is 800 m thick.

Güney formation is vertically and horizontally transitive to Ulukuşla and Halkapınar formations in the study area. It is not observed south of Ulukışla, but here Hasangazi formation which has the same age with the Ululışla formation was deposited. Aktoprak formation is vertically and horizontally transitive to Hasangazi and Güney formations and overlies these two formations. Miocene – Pliocene Cihanbeyli formation unconformably overlies the Aktoprak formation in south, and Güney formation in the north of the study area.

Along the 652 m thick Güney stratigraphic section which is comprised of sandstone – shale intercalation, between 58 – 78 m the amount

Table1- Abundance of Güney formation nannoplankton zone species

ZONES	SAMP. NUM. / SPECIES	F.tympaniformis	S.spiniger	S.anarrhopus	F.involotus	E.robusta	E.ovalis	E.cava	Thracosphaera sp.	T.tovae	C.eopelagicus	Z.bijugatus	D.barbadiensis	S.radians	S.editus	D.elegans	C.tenuis	D.bifax	H.kleinpellii	T.eminens	D.diastypus	D.binodosus	C.solithus	N.junctus	P.plana	C.danicus	B.sparsus	M.crenulatus	S.primus	D.saipanensis	H.ridelii	S.conspicuus	D.multiradiatus	E.formousa	D.aster	T.orthostylus	D.lodoensis	C.reticulatum	D.tani nodifer	D.tani	D.salisburgensis	B.bigelowi	S.conspicuus	N.eoseapes	D.pacificus	D.deflandrei	D.gemmeus	M.inversus	T.contortus
T.CONTORTUS ZONE	50	R				R					R																		R	R			R		R												R		
	49																																															R
	48	R					R	R	R	R	R			R	R														R					R	R	R													R
D.MULTIRADIATUS ZONE	47	F		R				R	R		F			F	R														R				R	R	R	R													
	46	F		R			R	R	R	R	F	R		F	R										R				R	R			R	R		R												R	
	45	R					R	R	R		F			R	R	R	R										R			R			R	F	R	R	R	R	R		R			R	R	R	R		
	44	R								R	F	R	R	F	R										R					R			R	F	R	F	R			R	R	R	R						
	43	F		R			F			F				R	R															R				R		R													
	42	F		R				R	R	R	F			F	R														R	R	R			F	R	R	R	R	R										
	41	F		R		R		R	R	R	R			F	R														R																				
	40	F		R		R		R		R	R			R	R														R																				
	39	F		R							R			F	R									R					R																				
	38	F								R	R	R		F	R														R																				
	37	F				R				F	R	R		F	R														R																				
	36																																														
	35	F		R		R	R	R		R	R			F	R																																		
	34	F		R		R		R	R	F	F	R		F	F														R																				
	33	R		R		R				R	R	R		R	R														R			R	R																
	32	F		R		R				R	R	R		F	R														R																				
	31	F		F						F	F	R		R	R																																		
	30	F		F		R		R		F	F			R	F														R				R																
	29	F		R						F	F	R		R	R																																		
	28	F		R		R		R	R	R	R			R	R														R				R																
H.RİDELII ZONE	27	R		R			R		R	R	R				R																																		
	26	R									R				R																																		
	25																																														
	24	F		F		R	R	R		F	F	R		R	R														R																				
	23	C		R		R	R			F	F	R		F																		R																	
	22	F		R		R	F		R	F	F	R		R										R					R																				
	21	F		F		R	R	R		F	F	R		R									R						R																				
	20	A		F		R	R	R		F	A	R		R	R											R			R		R																		
H.KLEINPELLII ZONE	19	F		R		R	R			R	F	R	R	R													R																						
	18	C		R			F	R		F	A	F		F	R			R										R	R	R																			
	17	F		R		R			R	F	F	R																																					
	16	A		R		R		R	R	F	F	R																																					
	15	F		R		R	R		R	F	F																																						
	14	A		F		R	F	R	R	C	A	R	R	R	R							R	R		R	R	R																						
	13	F		R		R		R	R	F	R																																						
	12	A		F		R	F	F		C	A	R	R						R	R	R	R	R	R																									
	11	F		R		R	R			R	R		R																																				
	10	F					R	R		R	R		R		R				R																														
F.TYMPANIFORMIS ZONE	9	C	R			R		R		F	F	R	R	R																																			
	8	F				R	R	R		R	R							R																															
	7																																														
	6	R					R			R	R		R																																				
	5	F		R		R	R	R		R	F																																						
	4	A		R		R	R	R	R	C	C	R																																					
	3	A		R	R	R	F	R		F	C	R		R		R	R																																
	2	F	R	R		R		R	R	F	R	R	R																																				
	1	F	R	F	R	R	F	R	R	F	F	R	R																																				

A: Abundant C: Common F: Few R: Rare

of sandstone decreases while the shales increase. Between 78 – 111 m, the thickness of sandstones is more than that of the shale (Figure 3).

BIOSTRATIGRAPHY

16 genus and 44 species were determined along 652 m thick stratigraphic section in Güney formation, and 5 biozones were defined (Figure 3). In the first 58 m, *Fasciculithus tympaniformis* Zone ranging between the first appearance of *Fasciculithus tympaniformis* Hay and Mohler and the first appearance of *Heliolithus kleinpellii* Sullivan; between 58-78 m *Heliolithus kleinpellii* Zone ranging between the first appearance of *Heliolithus kleinpellii* Sullivan and Discoaster gemmeus Stradner; and between 78-111 m *Heliolithus rideli* Zone ranging between the first appearance of *Heliolithus ridelii* Bramlette and Sullivan or *Dicoaster nobilis* Martini and *Discoaster multiradiatus Bramlette* and Riedel; between 111-621 m *Discoaster multiradiatus* Zone ranging between the first appearance of *Discoaster multiradiatus* Bramlette and Riedel and *Tribrachiatus contortus* Stradner, between 621-652 m *Tribrachiatus contortus* Zone ranging between the first and last appearance of *Tribrachiatus contortus* Stradner were determined (Figure 4, Table 1.2). As for the previous studies related to the biostratigraphic zoning of nannoplanktons we can cite Hay and Mohler (1967), Bukry (1969), Martini (1971), Okada and Bukry (1980) and, Perch and Nielsen (1985 a, b). This study is based on the standard zoning of Perch and Nielsen (1985 a, b) (Table 1,2).

Fasciculithus Tympaniformis Zone

Description: Zone was formed during the interval between the first appearance *Fasciculithus tympaniformis* Hay and Mohler and the first appearance of *Heliolithus kleinpellii* Sullivan of (Plate I, Figure 6).

Author: Hay and Mohler (1967)

Category: Concurrent range zone

Stratigraphic level: Selandian

Fossil Assemblage: *Biantolithus sparsus* (Bramlette and Martini), *Coccolithus eopelagicus* (Bramlette and Riedel), *Discoaster barbadiensis* (Tan Sin Hok), *Ericsonia cava* (Hay and Mohler), *Ericsonia ovalis* (Black), *Ericsonia robusta* (Bramlette and Sullivan), *Fasciculithus tympaniformis* (Hay and Mohler), *Fasciculithus involotus* (Bramlette and Sullivan), *Sphanolithus radians* (Deflandre), *Sphenolithus anarrhopus* (Burky and Bramlette), *Toweius tovae* (Perch and Nielsen), *Thracosphaera* sp. (Kamptner) and *Zygrhablithus bijugatus* (Deflandre).

Comparison and Interpretations: Hay and Mohler (1967), Martini (1971), Perch and Nielsen (1972,1985a), Toker (1977), Okada and Bukry (1980), Aköz (1981), Meriç et al. (1987), Lang and Wise (1987), Wise and Pospichal (1990), Aydın (2005) defined this zone at the same stratigraphic level during their studies. During this study, *Fasciculithus tympaniformis* Zone is determined in Selandian (Table 2).

Heliolithus Kleinpellii Zone

Description: *Heliolithus kleinpellii* Zone was formed during the first appearance of Sullivan and *Discoaster gemmeus* Stradner (Plate I, Figure 2).

Author: Hay and Mohler (1967)

Category: Concurrent range zone

Stratigraphic level: Upper level of late Selandian – lower level of early Thanetian

Fossil Assemblage: *Coccolithus eopelagicus* (Bramlette and Riedel), *Discoaster barbadiensis* (Tan Sin Hok), *Ericsonia cava* (Hay and Mohler), *Ericsonia ovalis* (Black), *Ericsonia robusta* (Bramlette and Sullivan), *Fasciculithus tympaniformis* (Hay and Mohler), *Heliolithus kleinpellii* (Sullivan), *Sphenolithus anarrhopus* (Burky and Bramlette), *Toweius tovae* (Perch and Nielsen).

Comparison and interpretation: Hay and Mohler (1967), Bukry (1969), Martini (1971), Perch and Nielsen (1972,1985a), Toker (1977), Okada and Bukry (1980), Aköz (1981), Lang and Wise (1987), Wise and Pospichal (1990), Aydın (2005) defined this zone during their studies. On the other hand, Decima et al. (1975) defined this zone as *Markalius inversus* Zone. Meriç et al. (1987) could not determine this zone during their study. In this study *Heliolithus kleinpellii* Zone was determined in late Selandian-early Thanetian based on the findings and the study of Bukry (1969) (Table 2).

Heliolithus Ridelii Zone

Description: *Heliolithus ridelii* Zone was formed between the first appearance of *Heliolithus ridelii* Bramlette and Sullivan or *Dicoaster nobilis* Martini and the first appearance of *Discoaster multiradiatus* Bramlette and Riedel (Plate I, Figure 3).

Author: Bramlette and Sullivan (1961), Perch-Nielsen (1972)

Category: Concurrent range zone

Stratigraphic level: Thanetian

Fossil Assemblage: *Coccolithus eopelagicus* (Bramlette and Riedel), *Cribrocentum reticulatum* (Gartner and Smith) Perch and Nielsen, *Discoaster aster* (Bramlette and Riedel), *Ericsonia formousa* (Kamptner), *Ericsonia ovalis* (Black), *Fasciculithus tympaniformis* (Hay and Mohler), *Heliolithus ridelii* (Bramlette and Sullivan), *Sphenolithus anarrhopus* (Burky and Bramlette), *Sphenolithus editus* (Perch-Nielsen), *Sphenolithus primus* (Perch and Nielsen), *Sphenolithus radians* (Deflandre), *Toweius tovae* (Perch and Nielsen), *Tribrachiatus orthostylus* (Shamrai) and *Thracosphaera* sp.

Comparison and interpretation: Hay and Mohler (1967), Bukry (1969), Martini (1971), Decima et al. (1975), Perch and Nielsen (1985a), Wise-Pospichal (1990), Aydın (2005) defined this zone during their studies. On the other hand, this zone was defined as *Discoaster gemmeus* Zone by Toker (1977) and Aköz (1981). Perch and Nielsen (1972), Okada and Bukry (1980), Lang and Wise (1987) defined this zone as *Discoaster nobilis* Zone. Meriç et al. (1987) determined the fosil assemblage of this zone durng their study. In this study, *Heliolithus ridelii* Zone is determined as Thanetian based on the findings and the study of Bukry (1969) (Table 2).

Discoaster Multiradiatus Zone

Description: Zone was formed between the first appearance of *Discoaster multiradiatus* Bramlette and Riedel and first appearance of *Tribrachiatus contortus* (Stradner) (Plate, Figure D).

Author: Bramlette and Sullivan (1961), Martini (1971)

Category: Concurrent range zone

Stratigraphic level: Upper level of Late Thanetian

Fossil Assemblage: *Biantolithus sparsus* (Bramlette and Martini), *Braarudosphaera bigelowi* (Gran and Braarud), *Coccolithus eopelagicus* (Bramlette and Riedel), *Chiasmolithus danicus* (Brotzen), *Chiasmolithus solithus* (Bramlette and Sullivan), *Cribrocentum reticulatum* (Gartner, 1967), *Cruciplacolithus tenius* (Stradner) Hay and Mohler, *Discoaster aster* (Bramlette and Riedel), *Discoaster barbadiensis* (Tan Sin Hok), *Discoaster deflandrei* (Bramlette and Riedel), *Discoaster diastypus* (Bramlette and Sullivan), *Discoaster elegans* (Bramlette and Sullivan), *Discoaster gemmeus* (Stradner), *Discoaster multiradiatus* (Bramlette and Riedel), *Discoaster pacificus* (Haq), *Discoaster salisburgensis* (Stradner), *Ericsonia cava* (Hay and Mohler), *Ericsonia formosa* (Kamptner), *Ericsonia robusta* (Bramlette and Sullivan), *Ericsonia ovalis* (Black), *Fasciculithus involotus* (Bramlette and Sullivan), *Fasciculithus tympaniformis* (Hay and Mohler), *Heliolithus kleinpelli* (Sullivan), *Heliolithus ridelii* (Bramlette and Sullivan), *Micrantolithus crenulatus* (Bramlette and Sullivan), *Markalius inversus* (Deflandre), *Neochiastozygus eoseapes* (Perch and Nielsen), *Neochiastozygus*

Table 2- General comparison of Paleocene – Early Eocene nannoplankton zones.

Series	Stages	Hay and Mohler 1967 France	Bukry 1969 NW Pacific Ocean	Martini 1971 Genel Zonlar	Perch and Nielsen 1972 Atlantic	Decima et al. 1975 Italy	Toker 1977 Haymana	Okada and Bukry 1980 General Zones	Aköz 1981 SE Turkey	Perch and Nielsen 1985 General Zones	Meriç et al. 1987 Adiyaman	Lang and Wise 1987 Atlas Ocean	Wise and Pospichal 1990 Antartica	Aydin 2005 Izmit	This Study 2006
EARLY EOCENE	YPRESIAN		*Discoaster lodoensis & Marthasterites contortus*	*Discoaster binodosus*		*Discoaster binodosus*	*Discoaster binodosus*	*Discoaster diastypus*	*Marthasterites tribrachiatus*	*Discoaster binodosus*	?	*Discoaster diastypus*	*Tribrachiatus bramlettei*	*Discoaster binodosus*	
			Marthasterites contortus & Discoaster diastypus	*Marthasterites contortus*		*Tribrachiatus contortus*	*Marthasterites contortus*			*Marthasterites contortus*	*Tribrachiatus contortus*			*Tribrachiatus contortus*	*Tribrachiatus contortus*
PALEOCENE	THANETIAN	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*	*Discoaster multiradiatus*
		Heliolithus ridelii	*Heliolithus ridelii*	*Heliolithus ridelii*	*Discoaster nobilis*	*Heliolithus ridelii*	*Discoaster gemmeus*	*Discoaster nobilis*	*Discoaster gemmeus*	*Heliolithus ridelii*	?	*Discoaster nobilis*	*Heliolithus ridelii*	*Heliolithus ridelii*	*Heliolithus ridelii*
		Discoaster gemmeus		*Discoaster gemmeus*	*Discoaster gemmeus*	*Cruciplacolithus tenuis*		*Discoaster mohleri*		*Discoaster mohleri*		*Discoaster mohleri*	*Discoaster mohleri*	*Discoaster gemmeus*	
		Heliolithus kleinpellii	*Heliolithus kleinpellii*	*Heliolithus kleinpellii*	*Heliolithus kleinpellii*	*Markalius inversus*	*Heliolithus kleinpellii*	*Heliolithus kleinpellii*	*Heliolithus kleinpellii*	*Heliolithus kleinpellii*	*Fascicolithus tympaniformis*	*Heliolithus kleinpellii*	*Heliolithus kleinpellii*	*Heliolithus kleinpellii*	*Heliolithus kleinpellii*
	SELANDIAN	*Fascicolithus tympaniformis*		*Fascicolithus tympaniformis*	*Fascicolithus tympaniformis*		*Fascicolithus tympaniformis*	*Fascicolithus tympaniformis*	*Fascicolithus tympaniformis*	*Fascicolithus tympaniformis*		*Fascicolithus tympaniformis*	*Fascicolithus tympaniformis*	*Fascicolithus tympaniformis*	*Fascicolithus tympaniformis*

junctus (Bramlette and Sullivan), *Pontosphaera plana* (Bramlette and Sullivan), *Sphenolithus anarrhopus* (Burky and Bramlette), *Sphenolithus conspicuus* (Martini), *Sphenolithus editus* (Perch and Nielsen), *Sphenolithus primus* (Perch and Nielsen), *Sphenolithus radians* (Deflandre), *Toweius tovae* (Perch and Nielsen), *Thracosphaera* sp., *Toweius eminens* (Bramlette and Sullivan), *Tribrachiatus orthostylus* (Shamrai) and Zygrhablithus bijugatus (Deflandre).

Comparison and interpretation: Hay and Mohler (1967), Bukry (1969), Martini (1971), Perch and Nielsen (1972,1985*a*), Decima et al. (1975), Toker (1977), Okada and Bukry (1980), Aköz (1981), Meriç et al. (1987), Lang and Wise (1987), Wise and Pospichal (1990), Aydın (2005) defined this zone at the same stratigraphic level during their studies. In this study, *Discoaster multiradiatus* Zone is defined in the upper level of Thanetian (Table 2).

Tribrachiatus Contortus Zone

Description: *Tribrachiatus contortus* Zone was formed between the first and last appearance of *Tribrachiatus contortus* (Stradner) (Plate, Figure A).

Author: Hay (1964) and Bukry (1973)

Category: Range zone

Stratigraphic level: Early Ypresian

Fossil Assemblage: *Coccolithus eopelagicus* (Bramlette and Riedel), *Discoaster barbadiensis* (Tan Sin Hok), *Ericsonia ovalis* (Black), *Fasciculithus tympaniformis* (Hay and Mohler), *Toweius tovae* (Perch-Nielsen) and *Tribrachiatus contortus* (Stradner).

Comparison and interpretation: Meriç et al. (1987), Decima et al. (1975), Aydın (2005) defined this zone during their studies. Martini (1971), Toker (1977), Perch and Nielsen (1985a) defined this zone as *Marthasterites contortus* Zone, on the other hand, Okada and Bukry (1980) and Lang and Wise (1987) defined it as *Discoaster diastypus* Zone, Aköz (1981) as Marthasterites tribrachiatus Zone, Wise-Pospichal (1990) as *Tribrachiatus bramlettei* Zone, and Bukry (1969) as *Marthasterites contortus* and *Discoaster diastypus* Zone. Perch and Nielsen (1972) did not encounter this zone during their study. In this study *Tribrachiatus contortus* Zone is defined in early Ypresian (Table 2).

TEMPERATURE CHANGE OF SEA WATER

In the graphical evaluations based on the nannoplankton species, changes in temperature of sea water were determined depending on the amount of the nannoplankton species which indicate the environments of hot and cold water. According to previous researchers, the number of *Coccolithus eopelagicus* is much in moderate sea water (Hay et al., 1967; McIntre et al., 1967,1970; Wei and Wise, 1989; Tantawy, 2003; Villa et al., 2005). *Discoaster* ve *Sphenolithus* species are represented abundant in moderate-warm water areas (Wei and Wise, 1989; Wise and Pospichal, 1990; Edwards and Perch-Nielsen,1975).

As a result of the study, it was determined that abundance of *Discoaster* and *Sphenolith* is inversely proportional to abundance of *Coccolithus* eoplelagicus.

While the individual number of *Coccolithus* eopelagicus in the samples in Selandian is 40, that of *Sphenolith* ve *Discoaster* is only 3. Towards the end of Selandian the number of Coccolithus eoplelagicus decreases, while the number of *Sphenolith* and *Discoaster* increases, depending on the increasing temperature of the sea water. The number of *Coccolithus eoplelagicus* increases first to 100 and then to 140 towards the middle Thanetian while the number of *Sphenolith* and *Discoaster* decreased to 3 and then 2. These data show that the temperature of the sea level decreased. Towards the end of Thanetian the individual number of Coccolithus eoplelagicus decreased again to 45 and the number of *Sphenolith* and *Discoaster* increased to 38; suggesting that the temperature of the sea water increased again. Individual number of *Coccolithus eopelagicus* decreased during Ypresian and became 30 in middle Ypresian and 5 at the end of the Ypresian. On the other hand, the number of *Sphenolith* and *Discoaster* increased and became 42 in middle Ypresian and 43 at the end of the Ypresian. This indicates that the temperature of the sea water increased (Figure 4).

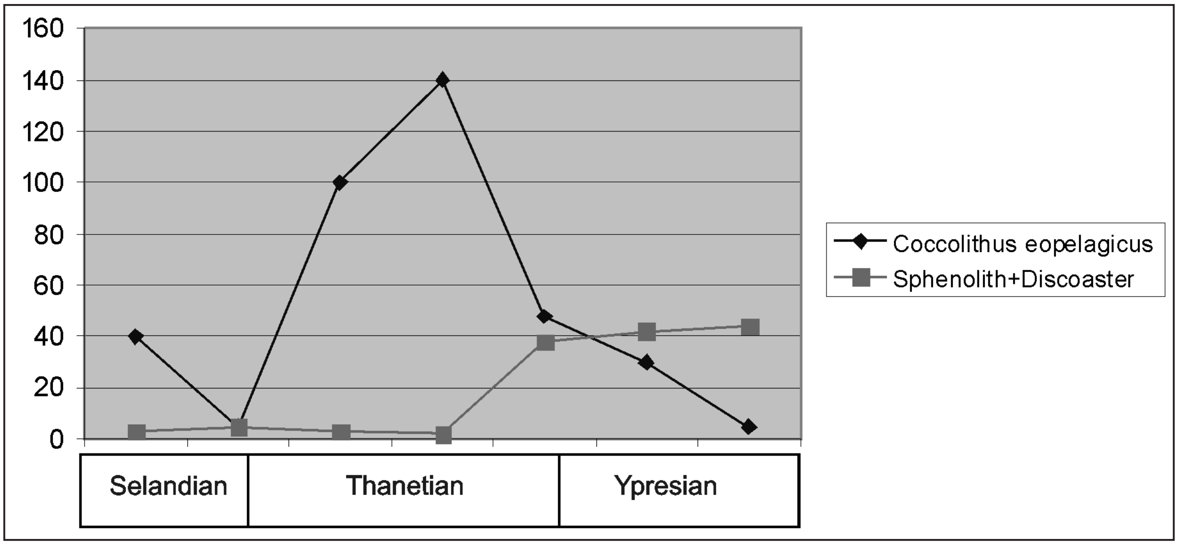

Figure 4- Nannoplankton zones determined along the Güney stratigraphic section in the study area.

RESULTS

As a result of the nannoplankton biostratigraphy research on Güney stratigraphic section in Ereğli-Ulukışla Basin, five zones, such as *Fasciculithus tympaniformis* Zone, *Heliolithus kleinpellii* Zone, *Heliolithus ridelii* Zone, *Discoaster multiradiatus* Zone ve *Tribrachiatus contortus* Zone were determined. Accordingly, it was also determined that the deep sea deposition represented by turbiditic sequence in the basin occurred between Selandian-Ypresian.

According to the analyses based on the individual numbers of the nannofossils, it was determined that temperature of the sea level decreased from moderate to warm in Selandian and became cooler in early – middle Thanetian. Between late Thanetian to Ypresian the temperature again increased and changed from moderate to warm.

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REFERENCES

Aköz, Ö., 1981. Karababa Tip Stratigrafi Kesiti' nin (GB Adıyaman) Nannoplankton' arla Biyostratigrafik İncelenmesi. Ankara Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi 81p. (unpublished).

Aydın, A., 2005. İzmit Kuzeybatısı Geç Kratese Paleojen Nannoplankton Biyostratigrafisi. Ankara Üniversitesi Fen Bilimleri

Enstitüsü Yüksek Lisans Tezi, 237 p. (unpublished).

Bramlette, M. N. and Sullivan, F., 1961. Coccolithophorids and related nannoplankton of the Early Tertiary in California. Micropaleontology 7, 129-188.

Bukry, D., 1969. Planktonic Microfossil Biostratigraphy of the NW Pasific Ocean. Initial Reports of the Deep Sea Drilling Project 6.79 p.

______, 1973. Low-latitude coccolith biostratigraphic zonation. Initial Reports of the Deep Sea Drilling Project, 15; 685-703.

Decima, F. R., Roth, P.H and Todesco, L., 1975. Nannoplankton calcareo del Paleocene e dell' Eocene della Sezione di possagno: Schweiz. Palaont. Abh., v. 97, 35-161.

Dellaloğlu, A. A., and Aksu, R., 1986. Ereğli (Konya)-Ulukışla-Çiftehan-Çamardı (Niğde) dolayının jeolojisi ve petrol olanakları. TPAO. Rapor No.2205 220s. (unpublished).

Demirtaşlı, E., Bilgin, A. Z., Erenler, F., Işılar, S., Sanlı, D., Selim, N. and Turhan, N., 1973. Bolkardağlarının Jeolojisi: Cumhuriyetin 50. yılı Yerbilimleri Kongresi, Tebliğler, MTA Yayını, Ankara, 608 p.

Dursun, A.İ., 2006. Ereğli-Ulukışla Havzası Ulukışla Formasyonunun (Ulukışla ve Çevresi) Petrol Hazne Kaya Özellikleri. Ankara Üniversitesi Fen Bilimleri Enstitüsü Yüksek Lisans Tezi, 68? (unpublished).

Edwards, A.R., Perch and Nielsen, K., 1975. Calcareous nannofossils from the Southern SW Pacific, Deep Sea Drilling Project Leg 29. Initial Reports of the DSDP, 29, 469-539.

Gartner, S. Jr. 1967. Calcareous nannofossils from Neogene of Trinidat, Jamaica and Gulf of Mexico. Paleont. Contr. Univ. Kansas. 29, 1-7.

Hay, W.W., 1964. The use of the electron microsroscope in the study of fossils. Annual Rep. Smithsonian Inst. (1963); 409-415.

Hay, W.W., Mohler, H.P., Roth, P.H., Schmidt, R.R. and Boudreaux, J.E., 1967. Calcareous nannoplankton zonation of the Cenozoic of the Gulf Coast and Caribbean-Antillean area, and transoceanic correlation. Transactions of the Gulf Coast Association of Geological Societies, 17, 428-480.

Hay, W.W. and Mohler, H. P., 1967. Calcareous nannoplankton from early Tertiary rocks at Pont Labau, France, and Paleocene-Early Eocene correlations. Journ. Pal., 41,6, 1505-1541.

Ketin, İ. and Akarsu, I., 1965. Ulukışla Tersiyer Havzasının jeolojik etüdü hakkında Rapor TPAO Rapor, 339 (unpublished).

Lang T.H. and Wise S. W., 1987. Neogene and Paleocene-Maestrichtian Calcareous nannofossil stratigraphy, Deep Sea Drilling Project Sites 604 and 605, Upper continental Rise off New Jersey: Sedimentation Rates, Hiatuses, and correlations with seismic stratigraphy, 661-683.

Martini, E., 1971. Standart Tertiary and Quaternary calcareous nannoplanktonzonation. Proceedings of the 2 nd. Planktonic Conference, 1970, Roma, Edizioni Tacnoscienza,2, 739-785.

McIntre, A.,B, A.W.H and Roche, B., 1967. Modern Coccolithophoridae of the Atlantic Ocean. I. Pacoliths and cyrtoliths. Deep Sea Res. Oceanogr. 14, 561-597.

______ and Roche, B., 1970. Modern Pacific Coccolithophoridae: a paleontological thermometer. N. Y. Acad. Sci. Trans. Sre. II 32,6, 720-731.

Meriç, E., Oktay, F. Y., Toker, V., Tansel, İ. and Duru, M., 1987. Adıyaman yöresi Üst MTA, 2002. 1/500 000 ölçekli jeoloji haritaları, No: 15 (Adana Paftası). Kretase-Eosen istifinin sedimanter jeolojisi ve biyostratigrafisi. Türkiye Jeoloji Bülteni 30, 19-32.

Okada H. and Bukry D., 1980. Supplementary modification and introduction of code numbers to the low-latitude coccolith biostratigraphic zonation (Bukry 1973, 1975) Mar. Micropaleont., 5, 321-325.

Oktay, F. Y., 1982. Ulukışla ve çevresinin stratigrafisi ve jeolojik evrimi: Türkiye Jeoloji Kurultayı Bülteni, 25, 15-23.

Pampal, S. and Meriç, E., 1990. Ereğli (Konya) güneybatısındaki Tersiyer yaşlı tortulların stratigrafisi: Türkiye Jeoloji Kurultayı Bülteni 33,39-45.

Perch-Nielsen, K., 1972. Remarks on late Cretaceous to Pleistocene coccoliths from the North Atlantic: Init. Repts. Deep-Sea Drilling Project, v. 12, Washington, U. S. Government Printing Office, 1003-1069.

______, 1985*a*. Mesozoic calcareous nannofossils, Eds In Plankton Stratigraphy. Bolli, J. B. Saunders ve K. Perch-Nielsen, Cambridge University Press, 329-426.

______, 1985*b*. Cenozoic calcareous nannofossils, Eds In Plankton Stratigraphy Bolli, J. B. Saunders ve K. Perch-Nielsen, Cambridge University Pres, 472-554.

Sonel, N. and Sarı, A., 2004. Ereğli- Ulukışla (Konya-Niğde) Havzasının Hidrokarbon potansiyelinin incelenmesi. Gazi Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi 19/4, 393-403.

Tantawy, A.A.A.M., 2003. Calcareous nannofossil biostratigraphy and paleoecology of the Cretaceous-Tertiary transition in the central eastern desert of Egypt. Marine Micropaleontology, 47, 323-356.

Toker, V., 1977. Haymana yöresinin (GB Ankara), planktonik foraminifera ve nannoplanktonlarla biyostratigrafik incelenmesi. Ankara Üniversitesi Fen Fakültesi, Doçentlik tezi, 155 p.

Villa, G., Palandri, S. and Wise S.W., 2005. Quaternary calcareous nannofossils from Periantartic implications. Marine Paleontology, 56/ 3-4, 103-121.

Wei, W., 1988. A new tecnique for preparing quantitive nannofossil slides. Journal of Paleontology, 62, 472-473.

______ and Wise, S.W., 1989. Paleogene calcareous nannofossil magnetobiochronology: Results from South Atlantic DSDP site 516. Marine Micropaleontology, 14, 119-152.

Wise, S. W. and Pospichal, J. J., 1990. 37. Paleocene to Middle Eocene calcareous nannofossils of ODP sites 689 and 690, Maud Rise, Weddell Sea, 613-638.

PLATE

PLATE - I

Figure 1- Fasciculithus tympaniformis Hay and Mohler; Sample Number: A 3

Figure 2- *Heliolithus kleinpellii* Sullivan; Sample Number: A 10

Figure 3*a-b-* *Heliolithus ridelii* Bramlette and Sullivan; Sample Number: A 20

Figure 4- *Discoaster multiradiatus* Bramlette and Riedel; Sample Number: A 33

Figure 5- *Tribrachiatus contortus* Stradner; Sample Number: A 48

Figure 6- *Discoaster saipanensis* Bramlette and Riedel; Sample Number: A 46

Figure 7- *Tribrachiatus orthostylus* Bramlette ve Riedel; Sample Number: A 42

PLATE - I