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SEDIMENTOLOGICAL- STRATIGRAPHICAL EVALUATION OF TERTIARY CARBONATES (SOĞUCAK FORMATION) OF THRACE BASIN (BOZCAADA - KIYIKÖY)

Baki VAROL*, Meltem BAYKAL** and Turhan AYYILDIZ*

ABSTRACT.- Soğucak formation which crops out in Thrace Basin has characteristics of reefal limestones and is one of the target levels in oil exploration studies in the basin. While this unit directly and unconformably overlies the basement rocks in some areas, it is transitive to siliciclastic-dominated units (Koyunbaba formation) in other areas. The Soğucak formation is comprised of carbonates of reefal-shore complex which was deposited in a shelf environment as a consequence of a transgression which lasted between Early-Middle Eocene and Early Oligocene. The rocks of the lower limit of the age interval of the formation, the Lower Eocene, crops out in Bozcaada only and is transitive to Fiçitepe formation. In general, the unit was deposited in SE of the basin between Middle-Late Eocene, and between Late Eocene and Early Oligocene in NE of the basin. Sedimentological features and age data indicate that Soğucak formation was deposited under the control of antecedent topography and it is the product of a time-transitive transgression together with coastal morphology and sea level changes.

Key words: Thrace Basin, Soğucak formation, sedimentology, stratigraphy

INTRODUCTION

Because of its rich coal, natural gas and quartz sand resources, the Thrace Basin has been studied in detail by various oil companies, MTA and University researchers for long years. The Tertiary units of Thrace are in general comprised of clastics and include carbonates in shelf areas (Figure 1). TPAO conducts detailed surface and subsurface (seismics, well log and test-development wells) studies because of the natural gas explored in the region. Among the researches conducted in the area, mainly Kopp et al., (1969) and Turgut et al., (1983, 1991) can be cited. The most significant documents for the stratigraphic definition of the Thrace basin are the 1:100 000 scale geological maps published by the MTA (İmrik, 1998; Çağlayan and Yurtsever, 1998; Şentürk and Karaköse, 1998). The Tertiary sequence which begins to cropping out at the southern foothills of the Strandja Mountains and covers almost the whole Thrace basin, reaches up to a thickness of 900 m (Kopp et al., 1969; Turgut et al., 1983, 1991; Görür and Okay, 1996; Turgut and Eseller, 2000; Siyako, 2006). The Eocene-Oligocene units are covered by Miocene and younger units in the Central and Northern Thrace. İslamoğlu et al., (2008) revealed the Oligocene paleogeography of the northern part of the Thrace basin.

Detailed description and various age data of the Soğucak and Ceylan formations of the Thrace Basin was studied by Siyako (2006). Researches conducted until today indicate that Soğucak formation is comprised of carbonates deposited in shelf environment. Besides, it was deposited in patchy reefal facies around Pınarhisar while the subsurface data show that it has characteristic features of pelagic clayey limestone (Siyako, 2006). Although different ages were attributed to the formation in different researches conducted in the basin, the generally accepted age for the Soğucak formation is the Middle Eocene – Early Oligocene (Siyako, 2006).

During this research, facies characteristics and age of the formation, based on fossil content, were studied in detail. According to the data acquired, the age of the carbonates of the Soğucak formation was revised; consequently the position and the place of the formation in the basin chronostratigraphy were reevaluated.

MATERIAL AND METHOD

Carbonates from the Soğucak formation are the materials used in this research. The samples from carbonates were collected along 15 measured stratigraphic sections where the Soğucak

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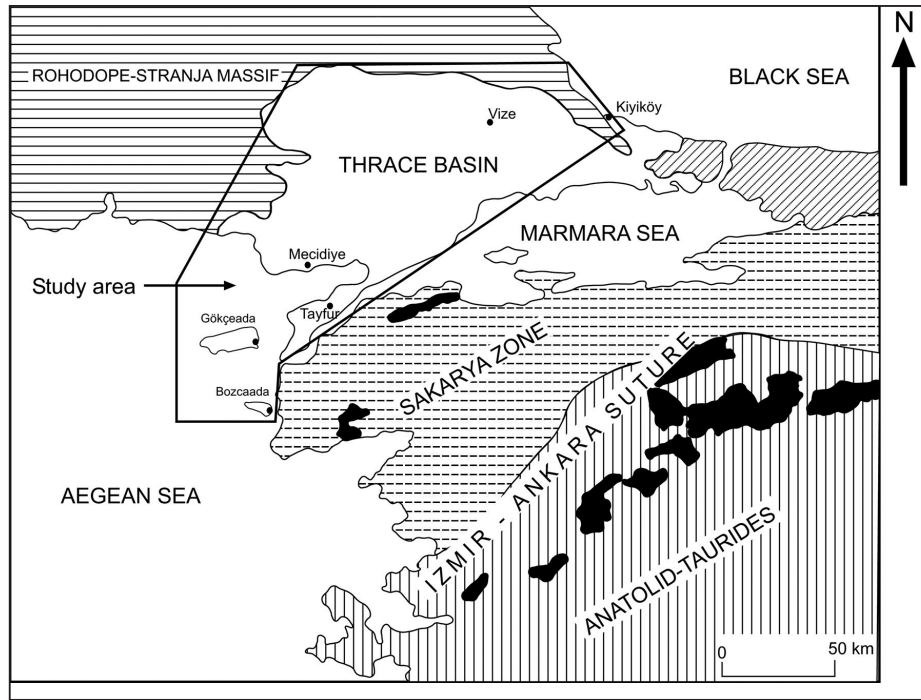


Figure 1- Location map of the study area (modified from Okay and Tansel, 1992).

cak formation is observed typically. These are Gökçeada, Bozcaada, Mecidiye, Süloğlu, Dolhan, Tekedere, Erenler, Soğucak, Poyralı, Okçular, Akören-Pınarhisar, Manastırdere, north of Vize, Kiyıköy1, Kiyıköy 1a, Kiyıköy 2 and Kiyıköy 2a sections. Besides where no good outcrops were observed, point samples were collected. From these limestone samples collected along the sections and the points, 350 thin sections were prepared in TPAO Research Center. Petrographic and paleontological study of the thin sections were conducted both in Petrography Laboratory of the Ankara University Department of Geological Engineering and Department of Geological Research of MTA. Leica DMEP Polarising microscope and Nikon E5400 Coolpix (5.1 MG pixel) were used to study and to take photographs of the thin sections, respectively.

STRATIGRAPHY

Stratigraphy of the Thrace Basin was studied in detail during many researches until today (Keskin, 1974; Siyako, 2006; Siyako and Huvaz, 2007). Previous studies, in general, indicate that

Middle Eocene-Early Miocene units unconformably overlie the Paleozoic-Mesozoic basement in the northern parts of the basin (Esso Standart, 1960; Holmes, 1961; Keskin, 1974; Kasar et al., 1983). The clastic sequence overlying the basement rocks were defined as the Koyunbaba Member in these studies, and the age attributed to this member is Middle Eocene (Siyako et al., 1989). Later on Keskin (1974) defined this member as Koyunbaba formation. Soğucak formation which overlies the Koyunbaba formation is of Middle-Late Eocene age in southern Thrace, namely in the Gelibolu peninsula, Bozcaada, Gökçeada and Biga peninsula (Kasar et al., 1983; Sümengen et al., 1987; Temel and Çiftçi, 2002; Siyako et al., 1989). The age of the outcrops of the formation, at the foothills of the Strandja Mountains and in the northern Thrace, was in general determined as Late Eocene (Erenler, 1985; Batı et al., 1993). Besides, Önal (1985, 2002) differentiated the Early Eocene carbonates below the Karaağaç formation in the Gelibolu Peninsula as Başoğlu member. On contrary, in Kuleli-Baebeski paleo-rise area located in the northwest of Thrace, the age of this formation was determined as Early Oligocene based on the well data (Kes-

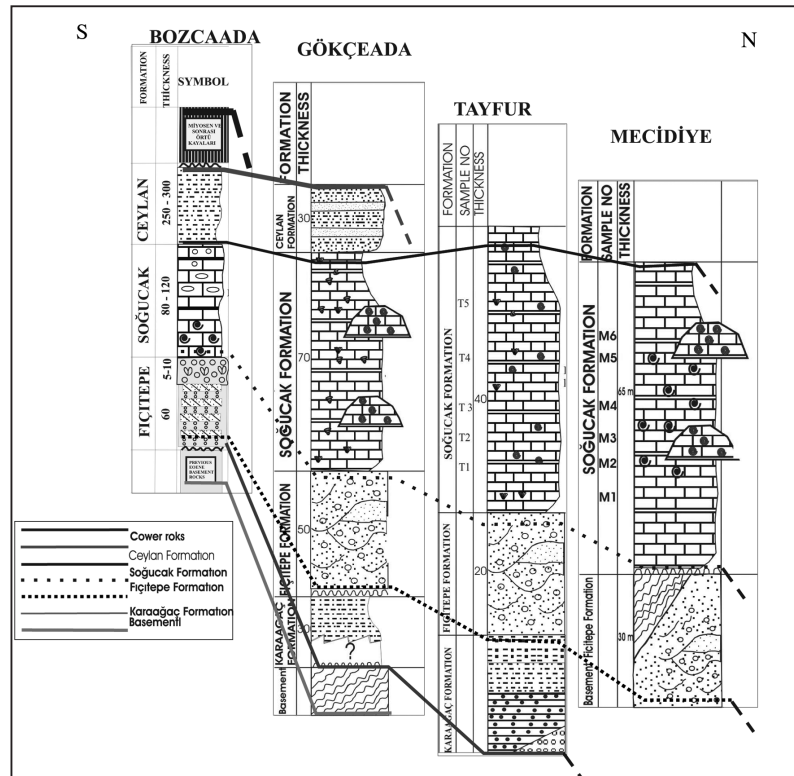
kin, 1974; Siyako, 2006). Ceylan formation which is observed to overlies these units is assumed to be conformable in general on the Soğucak formation. However, in the south, in Bozcaada, the Soğucak and Ceylan formations (Kesgin and Varol, 2003) and in the north, around Karaburun, Soğucak and Karaburun formations (Early Oligocene) were observed to have unconformable relations (Sakinç, 1994). On these rocks, Late Eocene-Early Miocene Mezaridere, Osmancık, Danişmen (Taşlısekban, Pınarhisar and Armutburnu members) and Çantaköy formations of Yenimuhacir Group take place. These units also are covered by Pliocene unconformably.

Soğucak formation which is the subject of this research is quite widespread in the northern parts of the Thrace Basin, and in general, the age of the unit is accepted as Middle-Late Eocene as cited above. Besides, the upper section of the Soğucak formation in the north of the basin (around Dolhan village) was dated as Oligocene (Sirel and Gündüz, 1976).

In this study, based on descriptions made along the measured stratigraphic sections which are given below in detail, the age of the Soğucak formation is determined to be as Early (?) - Late Eocene – Early Oligocene.

MEASURED STRATIGRAPHIC SECTIONS

The limestones of the Soğucak formation crop out as blocks (their size varying between a few m and a 100 m) along approximately east-west lying lines in the north of the basin. The measured stratigraphic sections (MSS) are located in the north of the basin, beginning in the west from Süloğlu village to Dolhan, Tekederesi, Kaynarca, Pınarhisar, Erenler, Soğucak, Vize, Okçular and around Kıyıköy in the easternmost. In the south, stratigraphic sections were measured on the outcrops in Bozcaada, Gökçeada; Tayfur and Mecidiye. The rock samples and fossils collected along these sections were used to evaluate the age data of the formation (Figures 2, 3, 4 and 5).



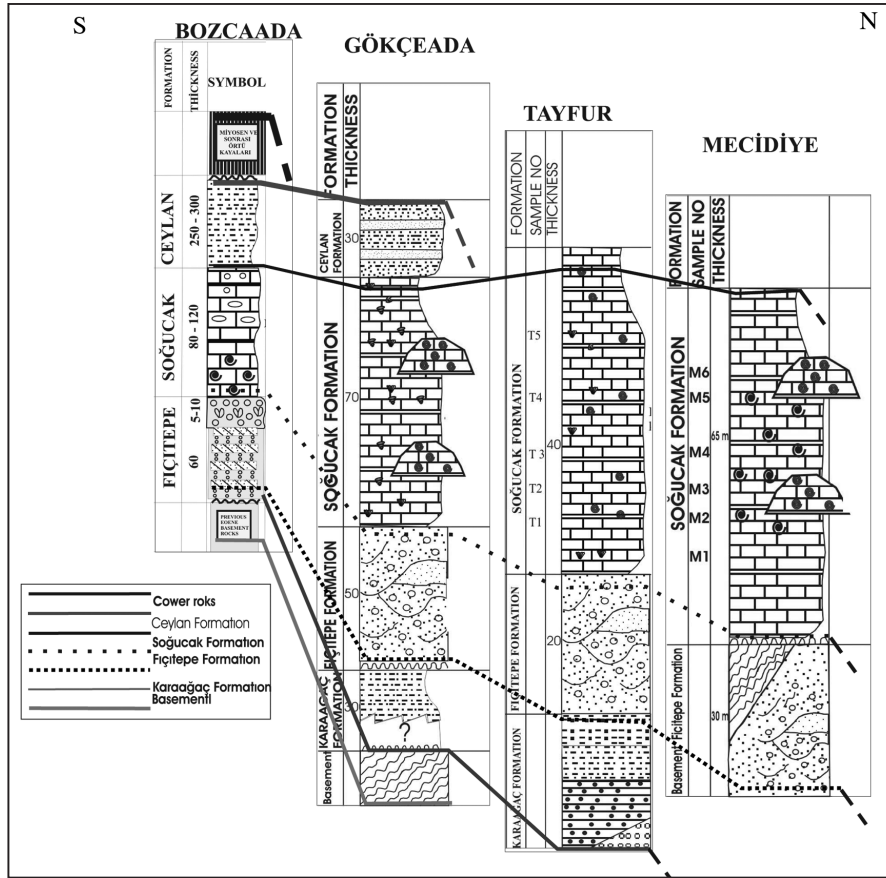


Figure 3- Chronostratigraphic correlation of the measured stratigraphic sections in south of the Thrace Basin.

Southern Sector of the Thrace Basin(Bozcaada, Gökçeada, Mecidiye, Tayfur)

The previous studies in the Bozcaada point out that Soğucak formation unconformably overlies the terrestrial Fıçıtepe formation and the age of the of the formation is Middle Eocene (Temel and Çiftçi, 2002; Kesgin and Varol, 2003). During this study, in pebblestone units of the Fıçıtepe Formation small scale individual reef developments were observed; this levels were observed to transite to Soğucak formation by sandstones, algae spreads and limestones with ostrea (Figure 6). Paleontological data acquired from this transitive levels indicate Early Eocene (Varol et al., 2007). However, the relation of these two units are reported to be unconformable in Mecidiye and Tayfur regions (Siyako, 2006). Besides, Önal (1985) differentiated the levels as Başoğlu Member which could assumed to be equivalents of the Early Eocene limestones. In this situation, it was found necessary to study the this unit which crops out in the Bozcaada in detail.

In Gökçeada-Kolbaşı hill the Soğucak formation is represented by typical patchy reefs and the surrounding reefs. As seen in paleontological evaluations in table 1, Late Eocene-Early oligocene age is attributed and its upper contact is transitive to the Ceylan formation (Figure 2).

Another section was measured around Mecidiye in the south of the basin. Here, Soğucak formation begins with algae oncoïd bearing banks and passes into coral reefs upwards. The

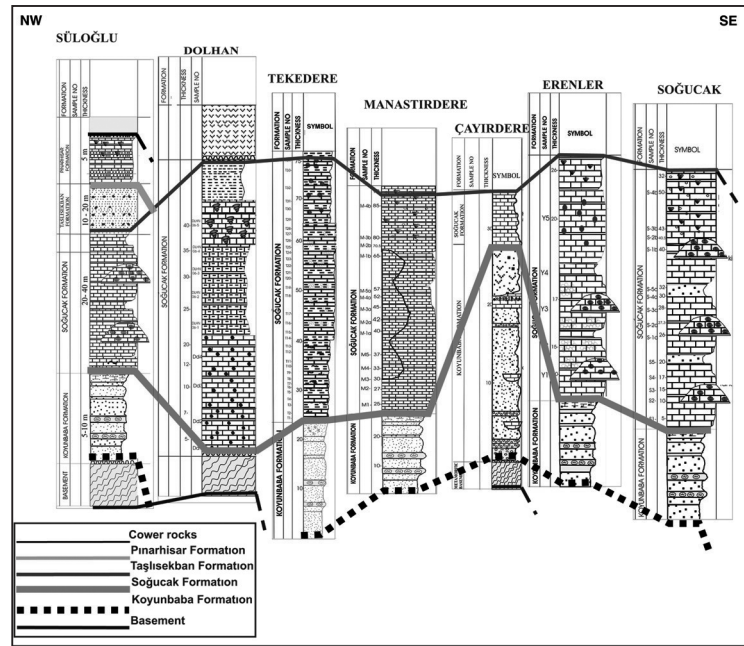


Figure 4a- Formations correlation of the measured stratigraphic sections within the northern part of the Thrace Basin

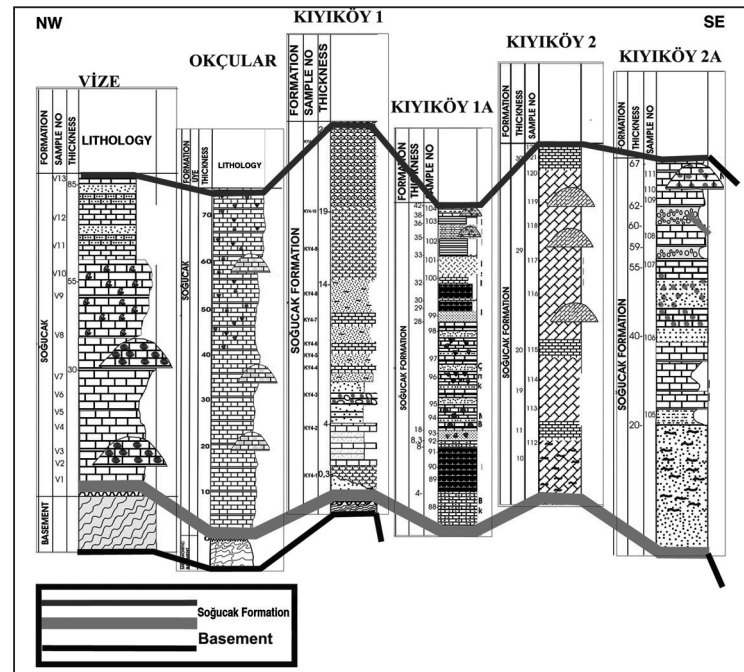


Figure 4b- Correlation graphic of the measured stratigraphic sections belonging to the Soğucak formation within the northern part of the Thrace Basin

facies surroundings of the reef is represented by bioclastic limestones. Here, Soğucak limestone unconformably overlies the basement rocks in the Fiçitepe formation in some places (Siyako and Huvaz, 2007).

The last section representing the Gelibolu Peninsula was measured in the north of the Tayfur village. The approximately 10-15 m thick limestones are comprised of lenticular *Nummulites* banks and the age of the unit is Late Middle-late Eocene (Figure 3). At the basement, it has unconformable relation with the Fiçitepe formation.

Northern Sector of the Thrace Basin (between Suloğlu – Kiyıköy)

During the study conducted in Thrace Basin, the places where the Soğucak formation is directly time-transgressive onto the basement are Suloğlu, Dolhan, Vize and Okçular sections. On contrary, in Tekedere, Manastırdere, Erenler, Soğucak and Poyralı sections it is transitive to Koyunbaba formation at the basement. The age determined in these sections is Late Eocene-Early Oligocene (Table 1) (Figure 5).

Along the Suloğlu section, Soğucak formation is unconformable on the metamorphic basement, along some other sections it is transitive to a very thin (3-4 m, comprised of quartz sandstones) Koyunbaba formation. The lower levels are transitive to *Nummulites* banks from back-reef environment; at the top this carbonate assemblage passes to coastal sandstones with 10-20 m thin mudstone bands. This unit was defined and mapped as Taşlısekban member in previous studies (Siyako and Kasar, 1985). Later on, the sequence ends up with a few metres thick *Congerina*-bearing limestone levels (Figure 7). These limestones crop out at some distinct regions of the Thrace Basin (Kaynarca – Erenler) and are differentiated as Pınarhisar formation (Keskin, 1966; Umut et al., 1983; Umut et al., 1984). Along Dolhan section carbonates of the Soğucak formation directly and unconformably rest on the basement. The lower levels of the sequence begin with bank type limestones bearing

abundant *Nummulites* and continues with mudstone dominated, cross bedded sandstone which deposited in lagoon-beach environment. It ends up with gastropoda bearing limestones which represent brackish water at the top. The samples collected here which include abundant *Nummulites* yield Late Eocene-Early Oligocene age which harmonize with the dating in Sirel and Gündüz (1976) (Figure 4, 5).

The Tekederesi section begins with the clastics which unconformably rest on the basement. The sandy limestones of the Soğucak formation with abundant bioturbation and ostrea are transitive to the clastic levels of the Koyunbaba formation (Figure 8). The levels, in general represent the lagoonal environment, are followed by *Nummulites* banks. In this period, based on the fast sea level changes, back-bank and fore-bank facies were developed very well. This bank-type deposition passes upwards into patchy reefs where the coral assemblages are dominant. In this section, the age of the *Nummulites* banks which form the lower-middle parts was given as Middle Eocene in previous studies (Baykal et al., 2007), however, according to latest paleontological data, age of this reefal assemblage is revised as Late Eocene-Early Oligocene (Figure 4). This indicates a relative sea level increase in this area by the end of the Eocene and beginning of Early Oligocene (Figures 4, 5).

Along the Manastırdere section, Soğucak formation rests on the Koyunbaba formation transitively. The first levels of the section is comprised of reef-backreef (lagoon) assemblages. The reef assemblage that developed in later stages around Kaynarca village form the massive reefal core of 50-60 m thick where the corals are dominant. In the SW direction thin bedded fore-reef facies with pelagic intercalations take place. This reefal assemblage ends up with limestones bearing *Congerina* near the junction of Kaynarca-Manastır road (Figure 9).

The section measured in Soğucak village which is reported as the typical section of the Soğucak formation in the Thrace Basin (Holmes, 1961) massive limestone deposition developed

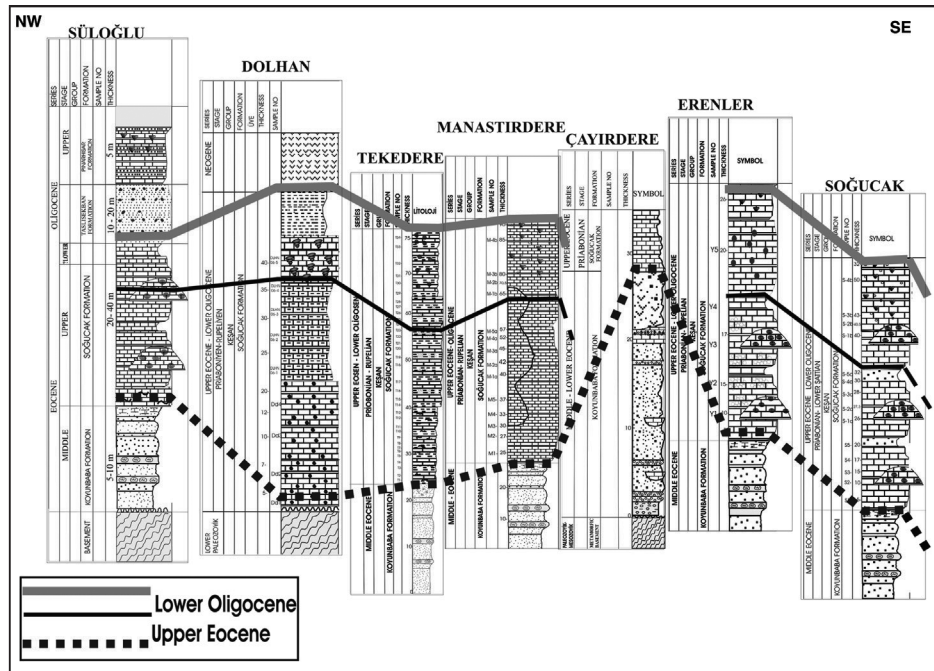


Figure 5a-Chronostratigraphic correlation graphic of the measured stratigraphic sections within the northern part of the Thrace Basin

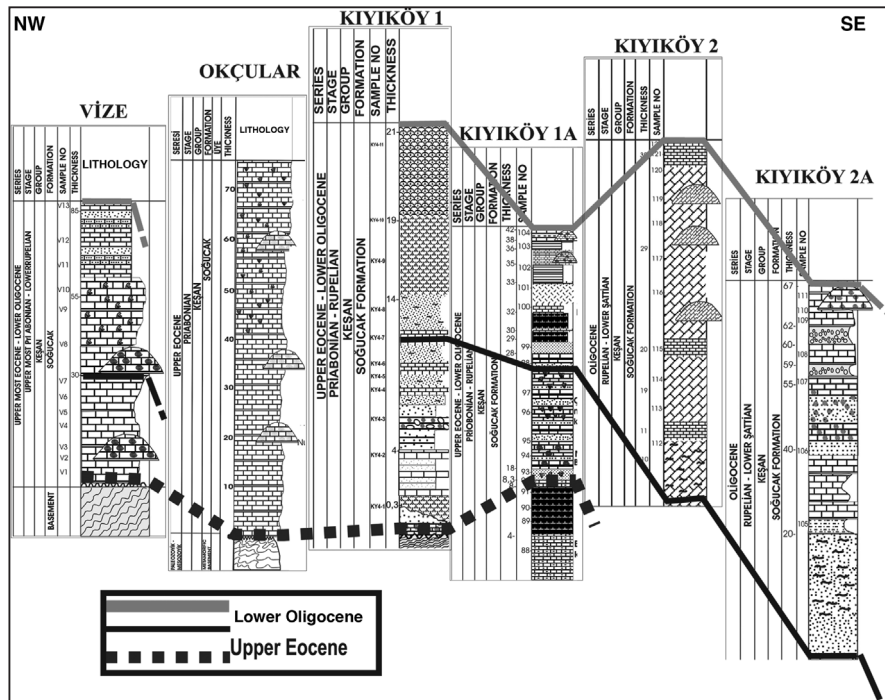


Figure 5b-Chronostratigraphic correlation graphic of the measured stratigraphic sections belonging to the Soğucak formation within the northern part of the Thrace Basin

Table 1- The age intervals of the Soğucak formation determined in measured stratigraphic sections in the investigated region.

MEASURED SECTION LOCATION	FOSSIL CONTENT	AGE INTERVAL IN THIS STUDY
BOZCAADA	<i>Bryozoa</i> , <i>Alveolina</i> sp., <i>Nummulites</i> sp., <i>Miliolidae</i> , <i>Cuvvillerina</i> sp., <i>Discocyclina</i> sp., <i>Assilina</i> sp., <i>Opertorbitolites douvillei</i> , <i>Alveolina</i> aff. <i>cemali</i> (n.s.p).	EARLY EOCENE
GÖKÇEADA	<i>Spharegypsina</i> , <i>Gypsina</i> , <i>Famiania cassis</i> / <i>Gyroidinella</i> sp., <i>Rotalidae</i> , <i>Asterocyclina</i> sp., <i>Discocyclina</i> sp., <i>Globigerapsis</i> sp., <i>Alveolina</i> sp., <i>Asterigerina</i> sp., <i>Nummulites pertatus</i> , <i>Nummulites ptukhiani</i> , <i>Nummulites cf. incrassatus</i> , <i>Assilina</i> sp.,	MOST EOCENE - OLIGOCENE
MECİDİYE	<i>Fabiania</i> , <i>Spiroclypeus</i> sp., <i>Discocyclina</i> sp., <i>Nummulites</i> sp., <i>Gyroidinella magna</i>	LATE EOCENE
TAYFUR	<i>Gyroidinella maga</i> , <i>Fabiania cassis</i> , <i>Heterostegina</i> sp., <i>Halksyardia minima</i> , <i>Discocyclina</i> sp., <i>Nummulites</i> sp., <i>Alveolina</i> sp., <i>Orbitolites</i> sp., <i>Acervulina</i> sp.,	LATE MIDDLE - LATA EOCENE
SÜLOĞLU	<i>Congerina</i> sp., <i>Gastropoda</i> , <i>Coral</i> , <i>Red alg</i> <i>Bryozoa</i> , <i>Nummulites</i> sp.,	LATE EOCENE - EARLY OLIGOCENE
DOLHAN	<i>Nummulites intermedius</i> , <i>Nummulites fichteli</i> , <i>Nummulites vascus</i> , <i>Asterigerina</i> sp., <i>Operculina</i> sp., <i>Rotalia</i> sp., <i>Nummulites fabianii</i> , <i>Fabiania cassis</i> ,	LATE EOCENE - EARLY OLIGOCENE
TEKEDERE	<i>Fabiania cassis</i> , <i>Gyroidinella cf. magna</i> , <i>Acervulina</i> sp., <i>Miliolidae</i> , <i>Spiroclypeus</i> sp., <i>Nummulites cf. vascus</i> <i>Planispira</i> sp., <i>Textularia</i> sp., <i>Bryozoa</i> , <i>Kırmızı alg</i>	LATE EOCENE - EARLY OLIGOCENE
MANASTIRDERE	<i>Red alga</i> , <i>Nummulites</i> sp., <i>Miliolidae</i> , <i>Pelecypoda</i> <i>Asterigerina</i> cf. <i>rotula</i> <i>Textularidae</i> , <i>Nummulites vascus</i> <i>Rotalia</i> cf. <i>armata</i> <i>Ostrakoda</i> , <i>Pelecypoda</i>	LATE EOCENE - EARLY OLIGOCENE
ERENLER	<i>Nummulites</i> sp., <i>Nummulites cf. vascus</i> <i>Nummulites cf. fichteli</i> , <i>Red alga</i> , <i>Bryozoa</i> <i>Nummulites</i> sp.	LATE EOCENE - EARLY OLIGOCENE
SOĞUCAK	<i>Red alga</i> , <i>Ekinit</i> , <i>Nummulites</i> sp., <i>Miliolidae</i> , <i>Pelecypoda</i> , <i>Mercan</i> <i>Amhisteginid</i> , <i>Rotalidae</i> , <i>Sphaerogypsina</i> sp., <i>Nummulites cf. vascus</i> , <i>Nummulites</i> sp.,	LATE EOCENE - EARLY OLIGOCENE
VİZE	<i>Gyroidinella magna</i> , <i>Acervulina</i> , <i>Miliolidae</i> , <i>Orbitolites</i> sp., <i>Asterigerina</i> sp., <i>Rotalia</i> sp., <i>Nummulites cf. vascus</i> <i>Gyroidinella</i> sp., <i>Asterigerina rotula</i> , <i>Spiroclypeus</i> <i>Chapmanina gassinensis</i> , <i>Alveolinidae</i> , <i>Fabiania</i> sp.,	LATE MOST EOCENE - EARLY OLIGOCENE
OKÇULAR	<i>Nummulites</i> cf. <i>fabiani</i> , <i>Asterigerina</i> sp., <i>Discocyclina</i> sp., <i>Orbitolites</i> sp., <i>Heterostegina</i> sp., <i>Rotalidae</i> , <i>Miliolidae</i> , <i>Ostracoda</i> , <i>Nummulites</i> sp.,	LATE EOCENE
BALKAYA	<i>Red alga</i> , <i>Nummulites</i> sp., <i>Amphisteginid</i> , <i>Miliolidae</i> ,	LATE EOCENE
KIYIKÖY 1	<i>Red alga</i> , <i>Nummulites</i> sp., <i>Coral</i> , <i>Bryozoa</i> , <i>Pelecypoda</i> , <i>Nummulites</i> cf. <i>Vascus</i> <i>Cytheridae</i> cf. <i>pernota</i> , <i>Costa tricostrata</i> <i>Paijenborchella</i> sp.,	LATE EOCENE - EARLY OLIGOCENE
KIYIKÖY 2	<i>Nummulites</i> sp., <i>vascus</i> <i>Operculina</i> ? sp., <i>Operculina</i> cf. <i>Complanata</i> <i>Amphisteginid</i> , <i>Krithe</i> cf., <i>bartonensis</i> , <i>Cytheretta tenuistriata</i> <i>Costa tricostrata</i> , <i>Ruggieria</i> sp., <i>Cytheridae</i>	OLIGOCENE
KIYIKÖY 3	<i>Neorotalia lithothamnica</i> , <i>Nummulites fichteli</i> , <i>Nummulites vascus</i> , <i>Nummulites</i> sp., <i>Ekinit</i> , <i>Pelecypoda</i> , <i>Red alga</i>	OLIGOCENE
KIYIKÖY 4	<i>Neorotalia lithothamnica</i> , <i>Nummulites</i> cf. <i>vascus</i> <i>Operculina</i> ? sp., <i>Operculina</i> cf. <i>complanata</i> , <i>Amphisteginid</i> <i>Krithe</i> cf. <i>bartonensis</i> , <i>Cytheretta tenuistriata</i> , <i>Cytheridae</i> <i>Cytheretta tenuipunctata</i> , <i>Costa tricostrata</i> , <i>Ruggieria</i> sp.	LATE EOCENE - EARLY OLIGOCENE

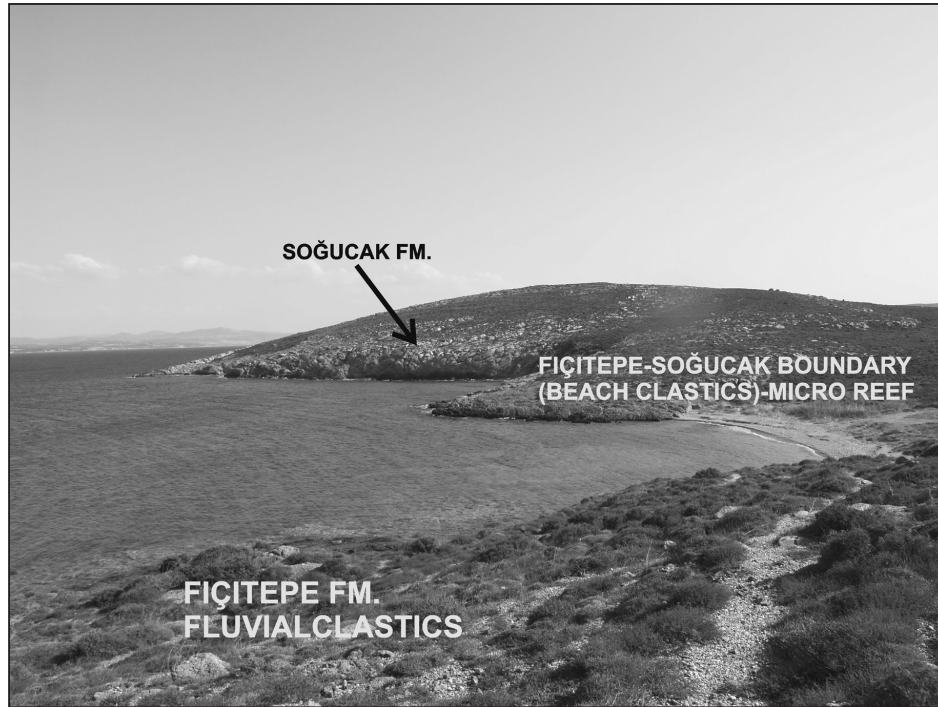


Figure 6- Transition of Fiçitepe – Soğucak formations in south of Bozcaada – Poyraz port.

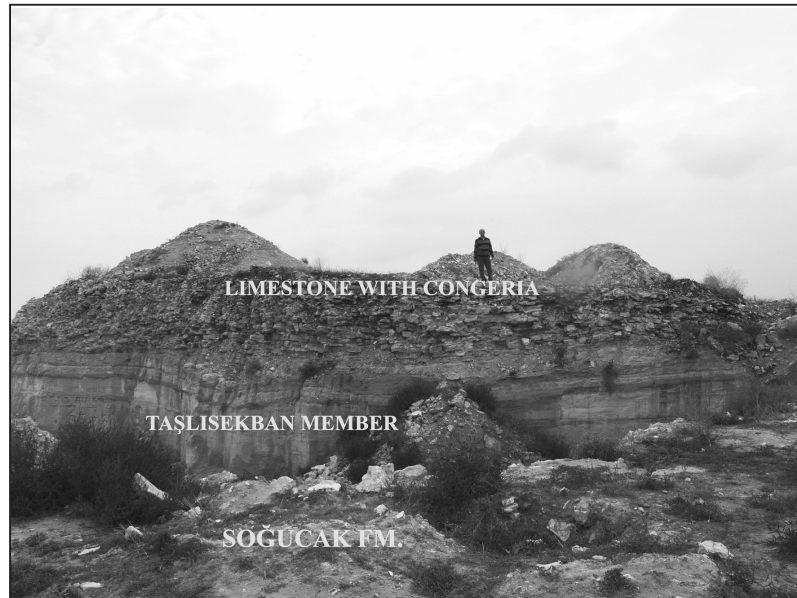


Figure 7- Transition of Soğucak formation – Taşlısekban Member in (north of) Süloğlu.

in form of bank-reef complex is observed. Around this assemblage, back-reef and fore-reef facies spread out in wide areas. In this area, onlaps and offlap sets which indicate fast sea level changes overlie each other angularly. Dating from the samples collected from the entire sequence indicate Late Eocene-Early Oligocene (Table 1). Along the Erenler section which is located at the southeastern extension of this section, this reefal assemblage is covered by 5-7 m thick cross bedded oolitic limestones. The transgressive layering observed in oolites which represent the carbonate shoal indicate the changes in the coast line based on the sea level changes. The *Congerina* sp. bearing limestones which form the uppermost level of the section represent a brackish water facies that developed in the platform where the Soğucak formation was de-

posited; its stratigraphical position is interpreted as the upper section of the formation.

Paleontological determinations indicate that age of the unit is Late Eocene-Early Oligocene (Figure 5, Table 1).

In the north of Vize, the Soğucak formation unconformably overlies the basement rocks. In this section which displays examples of a typical bank formation, the E-W trending massive bank and the surrounding facies represented by thin to medium limestones are observed (Figure 8). The back-bank facies deposited during the regressional periods are in general thin bedded and include carbonaceous mudstone intercalations and abundant bioturbations (Figure 10). The age interval of the formation, different from the previous studies (Baykal et al., 2007: Middle Eo-

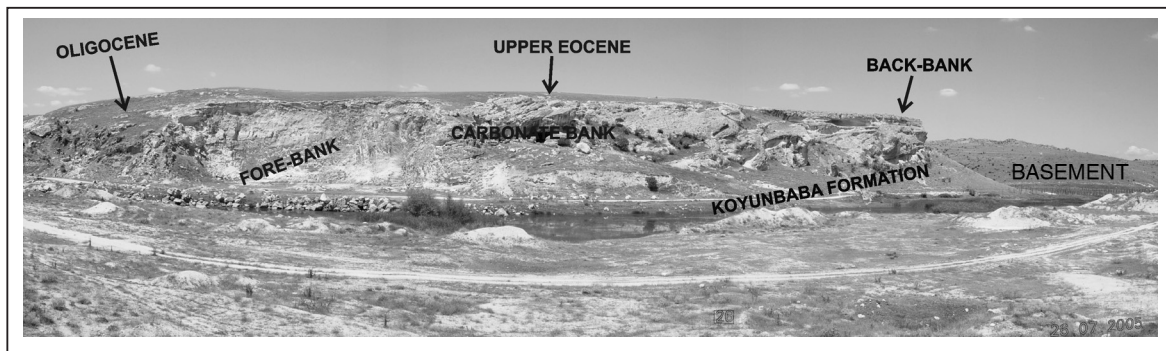


Figure 8- The facies and stratigraphic relation of the Soğucak formation with the other units in the Tekederesi section.



Figure 9- Transition from reefal Soğucak limestone to *Congerina* bearing limestone in the Manastır section (north of the Kaynarca village).

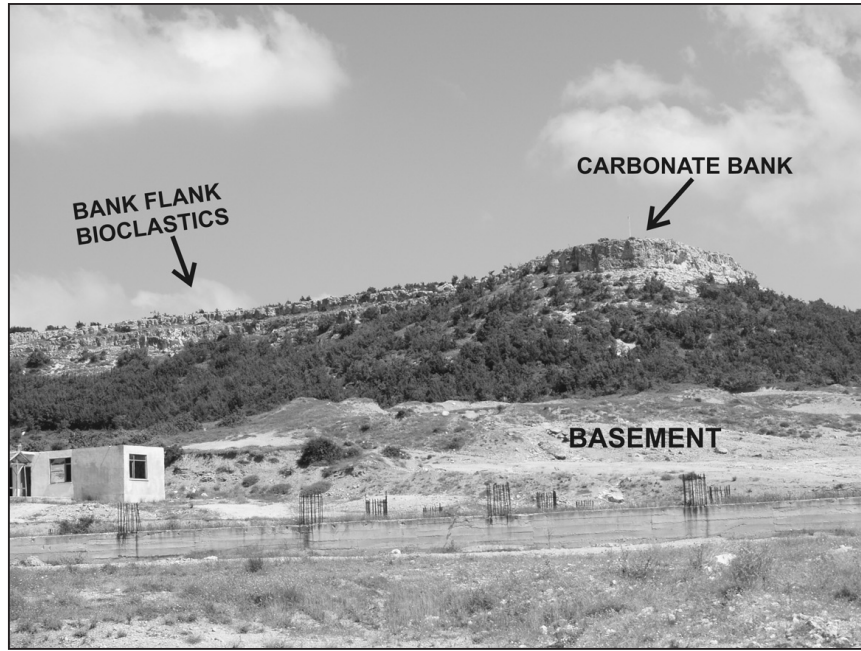


Figure 10- Facies assamblages of the Soğucak formation in the north of the Vize

cene) but conformable with the other sections, was determined as Late Eocene – Early Oligocene (Figures 4, 5) (Table 1).

The Soğucak formation which can be observed in the easternmost part of the study area crops out around the Kiyıköy and was investigated by sections measured on both flanks of an anticline observed on the coast. The sequence unconformably rests on the basement rocks and there is a thin siliciclastic-dominant level at the base of the formation. In the overlying coast sandstones (5-10 m thick) with bioturbation, mudstones including mud intraclasts and flame structures representing tide conditions take place. This level passes upwards into cross bedded clastic limestones (Figure 4). This clastic section is 10-15 m thick and includes a few meter thick individual coral reefs. The sequence ends up with levels bearing *Ostrea* and gastropoda deposited along a retreading coast line. This way, the levels including mudstone intercalations pass into the Ceylan formation through a tuffaceous level (Figure 11).

Section (2, 2a) represents the southern flank of the syncline. Sandy limestone with bioturbation is located at the base similarly (10 - 15 m). This level passes upwards massive bioclastic sand and sandstone with coral fragments. At these levels many soft deformation structures and brecciation and nodules are observed. In this section which is about 50 m thick channels fills with pebbles, cross bedding and local interbands with echinoid lineaments can be observed. The sequence in general is of set sand complex nature. In the back-set abundant pelecypod, *Ostrea* and gastropoda bearing bioturbated sandy limestone and carbonate mudstones were deposited. The most typical examples of bioclastic dominated Soğucak formation is revealed in this section. Along the coast, NW-SE trending limestones with huge cross beds most probably mark the megaripples active along the coast line (Figure 4).

The age interval which is valid for the whole Kiyıköy section is determined as Late Eocene (Priabonian) – Oligocene (Rupelian – Early Chattian) (Baykal et al., 2009) (Table 1) (Figure 5).

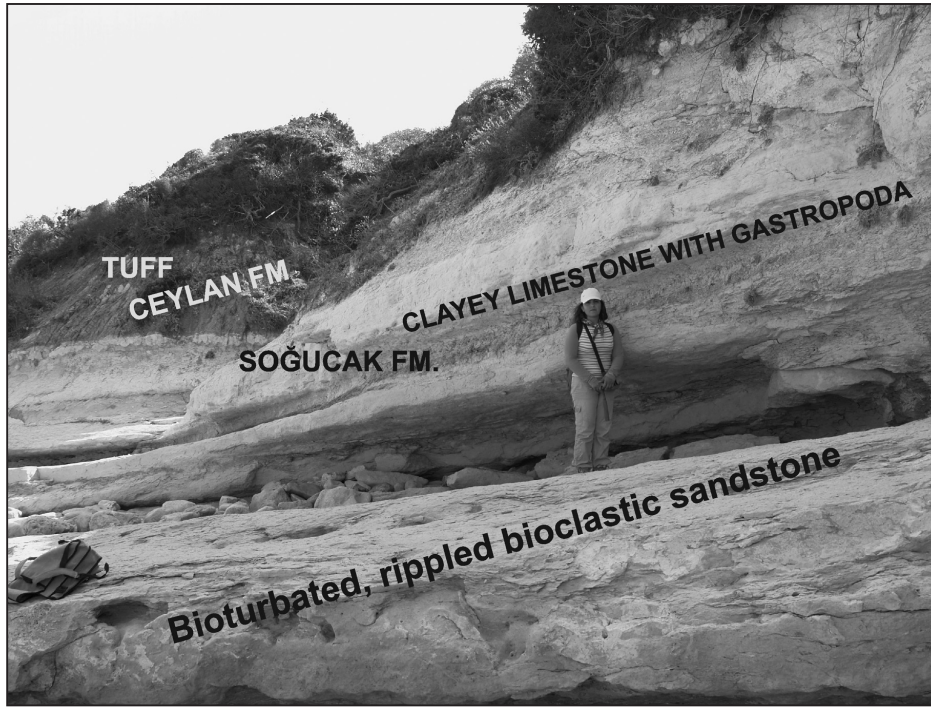


Figure 11- Facies assemblages representing the transition of the Soğucak – Ceylan formations in the Kiyıköy.

COMPARISON OF THE MEASURED STRATIGRAPHIC SECTIONS

Southern Sector: In this sector, the Bozcaada, Gökçeada, Tayfur (in Gelibolu Beninsula) sections and Mecidiye section (Gulf of Saros) were measured. The most different section here is the Bozcaada section; abundant *Alveolina canavari*, *Alveolina pasticillate*, *Alveolina aff. pisi-formis*, *Alveolina avellena*, *Alveolina cemali*, *Alveolina sp.*, and *Nummulites sp.*, (Table1) fossils are dominant throughout the bank-type limestones in the unit which was determined to be Middle Eocene Soğucak formation previously. However the above mentioned fossils indicate Early Eocene (Figure 3). Another different point is about the lower boundary of the Soğucak formation. In previous studies, Fiçitepe formation is defined as a terrestrial formation in the region. In this study, it was observed that the upper boundary of the formation is composed of beach

pebblestones-micro reefal assemblage, and it is transitive with the Soğucak formation (Varol et al., 2007). Although in the Gökçeada, Mecidiye and Tayfur sections Fiçitepe formation is unconformably located at the lower boundary of the Soğucak formation, especially in the Mecidiye section, it can directly overlie the basement rocks as a result of time transgression. Age of the unit defined in these sections is Middle-Late Eocene. In all the sections, Ceylan formation conformably take place at the upper boundaries of these sections (Table 1) (Figures 2-3).

Northern Sector: When a west to east ordering was made here, the first group is represented by the Suloğlu, Dolhan and Tekedere sections. The age interval determined as Late Eocene – Early Oligocene (Figure 5). In these sections the Early Oligocene (?) Soğucak formation (Late Eocene in Dolhan stream) unconformably overlies the basement. However, along the other

sections, clastics of the Koyunbaba formation are transitively located at the base. The upper contact of the formation is variable in this region. In the Süloğlu, in a limited area, quartz sandstone and mudstone which are the products of a siliciclastic coastal development overlie the platform limestone (Taşlısekban formation) and this is overlain by *Congerina* bearing limestones (Pınarhisar formation). Extensions of these two formations which overlie the Soğucak formation are not observed in this position along the other sections. Only in the Dolhan stream a formation similar to the Pınarhisar is observed to overlie the Soğucak formation (Table 1). In the Tekedere stream this upper section is missing (Figure 4).

Northeastward, along the Manastırdere, Çayırdere, Erenler and Soğucak sections the Koyunbaba formation is observed at the base. Along Okçular section, Soğucak formation is observed to overlap the basement. Age of the Soğucak formation determined here is in general Late Eocene – Early Oligocene, however, along the Okçular section it is Late Eocene. Erenler section has a difference in this group (Figure 4). The oolitic facies and the *Congerina* bearing limestone in the section are not observed along the other sections. In previous studies these facies assemblage is mapped as the Pınarhisar (Keskin, 1966).

Along the Vize and Kırıkköy sections which are located at the easternmost part of the study area Soğucak formation is unconformable on the basement, however, along the section Kırıkköy 1a, a thin (3-5 m) siliciclastic level behind the Soğucak formation can be correlated to the Koyunbaba formation with its stratigraphic position. The age interval obtained from these sections is Late Eocene – Early Oligocene (Table 1, Figure 5). A significant matter that should be mentioned here is that Kırıkköy facies is quite different than the other facies assemblages in the areas of the other section with respect to the facies types and environments (shore, back-shore, beach, lagoon). The upper limit of the Soğucak formation passes by a thin tuffaceous level

in lagoon facies to the Ceylan formation in Kırıkköy (Figure 11).

DISCUSSIONS AND RESULTS

Soğucak formation which crops out in the Thrace was deposited as reefal facies in general between Middle Eocene – Early Oligocene. The *Nummulites* banks, from the point of facies development, dominantly characterizes the Middle – Late Eocene. The dominant coral patchy reefs were deposited during Late Eocene – Early Oligocene. The facies around reefs have formed different deposition environments based on the sea level changes. These can be differentiated as back-reef – lagoon, tidal flat, oolite shoals and fore-reefs.

Soğucak formation was deposited in Early Eocene in the Bozcaada section. If this time interval is taken as a beginning point, it can be said that the Eocene transgression in the Thrace basin has advanced on an irregular topography time transgressively from south to north. For this reason, in the Kırıkköy which is the distant point of the transgression, a thick Oligocene sequence was deposited. The depositional features and age limits of the Soğucak formation pointed out in this study emphasize the necessity to deal with the following subjects:

1- The Early Eocene limestones cropping out in the Bozcaada were included in Soğucak formation, however, this unit must be studied in detail and its position in the Eocene must be clarified.

2- Interpretation of oolite and *Congerina* bearing limestones which were assumed to be a distinct facies group in the Soğucak formation in the Kaynarca-Erenler section as a different facies assemblage deposited in the platform where the Soğucak formation was deposited, and consequently its redefinition as a single formation (Soğucak Fm); this redefinition shall facilitate the correlation of Early Oligocene units which crop out widely in the Soğucak formation.

3- The units which rest on the basement in the Kıyıköy are quite different than the facies defined in the Soğucak formation. In the region which is represented by high energy clastic carbonate depocenters (set island – beach complex, megaripples, etc.) detailed sedimentological studies are required.

ACKNOWLEDGEMENT

The authors thank TÜBİTAK for its contribution in realizing this study (Project no. 104Y333) and Dr. Ercüment Sirel (Ankara University) who carried out the paleontological determinations and Mr. Muzafer Siyako (TPAO) for his remarks on the study.

Manuscript received February 2, 2009

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