Turk J Earth Sci
8 (1999) 125-135
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Biostratigraphic and Environmental Analysis of the Upper Jurassic-Lower Cretaceous Carbonate Sequence in the Başoba Yayla Area (Trabzon, NE Turkey)

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Received: 29.01.1999

Abstract: In the Başoba Yayla (Trabzon, NE Turkey) area, which is located in the Eastern Pontides northern zone, platform carbonates were deposited during the Late Jurassic-Early Cretaceous time in environments varying from intertidal/ supratidal to outer shelf. The carbonate sequence begins with a thick dolomite unit of the Late Jurassic to Early Cretaceous age. The following unit is rich in benthic foraminifers and pelecypoda shells. The foraminiferal assemblage comprising *Vercorsella laurentii/camposaurii* and *Pseudolituonella gavonensis* indicates a Late Hauterivian to Early Aptian age for this unit. The Late Aptian-Albian facies is characterized by bioclastic wackestones containing benthic foraminifers typical of outer platform environment, such as *Spirillinidae* and *Lenticulinidae*. Late Aptian transgression produced a deepening upward sequence, resulting in the deposition of a very fine-grained mudstone/wackestone with hemipelagic organisms: abundant *hedbergellids* and rare *calcispheres*.

Probably after the Late Albian time, sedimentation took place in slope environments, now represented by graded bioclastic calcarenites intercalated with *hedbergellid* and radiolaria-bearing marls and sandstones which fill up and level off the irregularities on the surface of the underlying outer platform limestone with *hedbergellids*. There is no evidence for emersion of the Eastern Pontides carbonate platform portion in the study area. In contrast to this, submarine erosive processes such as gravity-sliding and erosional reworking by currents caused this erosional unconformity.

Until the Albo-Cenomanian time, both zones of the Eastern Pontides were characterized by the same stratigraphic and tectonic features. Subsequently during the Late Cretaceous and the Early Cenozoic, in the northern zone a subduction-related magmatic arc complex developed while in the southern zone the deposition of siliciclastic turbidites took place. The appearance of such a change, following the breaking up of the platform, led to the subdividing of the Eastern Pontides into the northern and southern zones.

Key Words: Biostratigraphy, Depositional environment, Carbonate platform, Upper Jurassic-Lower Cretaceous, Eastern Pontides, Turkey.

Başoba Yayla (Trabzon) Yöresindeki Üst Jura-Alt Kretase Karbonat İstifinin Biyostratigrafik ve Ortamsal Analizi

Özet : Doğu Pontidler kuzey zonunda yeralan Başoba Yayla (Trabzon) yöresinde, Geç Jura-Erken Kretase sürecinde, gel-git içi/gel-git üstünden dış şelfe kadar değişen ortamlarda platform karbonatları çökelmiştir. Karbonat istifi kalın bir dolomit birimi ile başlar. Üzerleyen birim bentik foraminiferler ve pelespod kavkılarınca zengindir. *Vercorsella laurentii/camposaurii* ve *Pseudolituonella gavonensis* türlerini içeren bentik foraminifer topluluğu Geç Hotriviyen-Erken Apsiyen yaşını belgeler. Geç Apsiyen-Albiyen fasiyesi *Spirillinidae* ve *Lenticulinidae* gibi dış platform ortamının tipik bentik foraminiferlerini içeren biyoklastik vaketaşları ile karakterize edilir. Geç Apsiyen transgresyonu bol *hedbergellid* ve ender *kalsisfer* gibi yarı-pelajik organizmalar içeren çok ince taneli çamurtaşı/vaketaşı çökelmesini sonuçlayarak, üste doğru derinleşen bir istifin gelişmesini sağlamıştır.

Olasılı Geç Albiyen zamanından sonra tortulaşma olayları *hedbergellid* ve *radiolaria* içeren marn ve kumtaşı arakatkılı dereceli biyoklastik kalkarenitlerin çökeldiği yamaç ortamında gerçekleşmiştir. Bu yamaç çökelleri alttaki *hedbergellid* içeren dış platform kireçtaşlarının üzerindeki düzensizlikleri doldurur ve örter. Dolayısıyla, çalışma alanındaki Doğu Pontidler karbonat platformu kesiminin Orta Kretase döneminde yükselip, aşındığına ilişkin bir veri yoktur. Buna karşılık yerçekimi kaymaları ve akıntı kazımaları gibi denizaltı aşınma işlevleri bu aşınma uyumsuzluğuna neden olmuştur.

Albo-Senomaniyen zamanına kadar Doğu Pontidlerin kuzey ve güney zonları aynı stratigrafik ve tektonik özelliklerle karakterize edilmiştir. Sonraki Geç Kretase ve Erken Senozoyik süresince, güney zonunda silisiklastik türbiditler çökelirken, kuzey zonunda yitimle ilişkili bir magmatik yay gelişmiştir. Karbonat platformunun parçalanmasını izleyerek böyle bir değişimin ortaya çıkması, Doğu Pontidlerin kuzey ve güney zon halinde bölümlenmesine yol açmıştır.

Anahtar Sözcükler: Biyostratigrafi, Çökelme ortamı, Karbonat platformu, Üst Jura-Alt Kretase, Doğu Pontidler, Türkiye.

Introduction

The Eastern Pontides is subdivided into two zones (Özsayar et al., 1981), depending on their characteristic lithological assemblages and facies. The northern zone is characterized by the dominance of subduction-related volcanic and intrusive rocks of the Mesozoic and Cenozoic age (Bektaş et al., 1995) and in the southern zone sedimentary rocks are dominant (Fig. 1). In addition to these, Bektaş et al. (1995) recognized a third zone, called the "axial zone" in which ophiolitic rocks are widespread. In the northern zone Mesozoic platform carbonates are scarcely known because they are buried beneath the Upper Cretaceous to Tertiary volcano-sedimentary sequences.

The study area is located in the northern zone. Başoba Yayla, a small mountain village, is situated approximately 10 km northwest of Zigana Strait on the ancient road from Trabzon to Gümüşhane (Figure 1). In this area, an autochtonous carbonate sequence is well-exposed and well-bedded in spite of few acidic and basic magmatic dykes and faults that cut the sequence. In the Eastern Pontides northern zone further outcrops were found in Hamsiköy-Trabzon (Taslı, 1984), Dereli-Giresun (Boynukalın, 1991) and Düzköy-Trabzon (Bulguroğlu, 1991). In the Eastern Pontides magmatic arc, the recovery of outcrops of the platform carbonate sequences is important because all of them are regarded as exotic blocks in the Late Cretaceous magmatic arc complex (Gedik et al., 1996).

The main stratigraphic features of the northern zone have been discussed by Terlemez and Yılmaz (1980), Özsayar et al. (1981), Taslı (1984), Adamia et al. (1995), Korkmaz et al. (1995), Gedik et al. (1996) and Robinson et al. (1995). Nevertheless, many stratigraphic problems remain controversial or obscure. There is no standard lithostratigraphic nomenclature, different publications use different names in different localities for the same formation. Another difficulty is unavailable outcrops of formations due to intensive vegetation cover.

This paper primarily deals with the biostratigraphic and facies analysis of the platform carbonates and the overlying carbonate turbidites in the Başoba Yayla area. These rocks constitute a part of the Eastern Pontides platform carbonate sequence which accumulated during the Late Jurassic to Early Cretaceous. They record

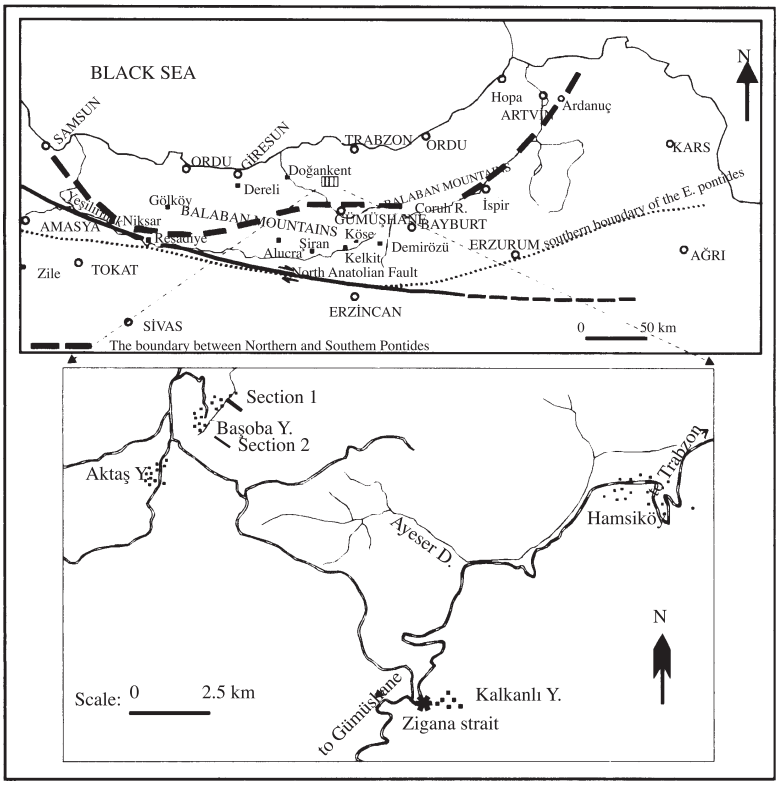


Figure 1. Schematic map showing the Eastern Pontides northern and southern zones (Özsayar et al., 1981) and the locations of the measured stratigraphic sections.

depositional and tectonic conditions in the development of the platform portion in a magmatic arc setting. Especially the calciclastic turbiditic sediments appear to be sensitive indicators of the breaking up of the Eastern Pontides carbonate platform. Biostratigraphy is provided by benthic foraminifers studied in thin sections.

Stratigraphic setting of the Eastern Pontides Northern Zone

A composite stratigraphic columnar section of the Eastern Pontides northern zone is given in Figure 2. The stratigraphic sequence was deposited on metamorphic basement rocks of Paleozoic age (Boynukalın, 1991). The places where metamorphic basement rocks crop out are near the town of Dereli (Giresun) and south of Araklı (Trabzon) (Korkmaz et al., 1995). They are similar to the pre-Upper Carboniferous metamorphic rocks of Bayburt Massif, which consists of garnet-bearing quartzo-feldispathic gneisses and metasediments (Robinson et al., 1995).

Mesozoic sediments lie unconformably on the basement. Rocks of undoubted Liassic age are only found near Dereli-Giresun and consist of volcanic-sedimentary rocks containing red limestone with ammonites (i.e., ammonitico-rosso facies) (Boynukalın, 1991). Upper parts of volcanic-sedimentary sequence may comprise the Dogger. As all of the Eastern Pontides, the Upper Jurassic-Lower Cretaceous consist of limestone which is named "Berdiga Formation" (Pelin, 1977) or "Berdiga Limestone" (Kırmacı et al., 1996). In the Gümüşhane and Trabzon areas, the Late Jurassic spilitized olivine-basalts,

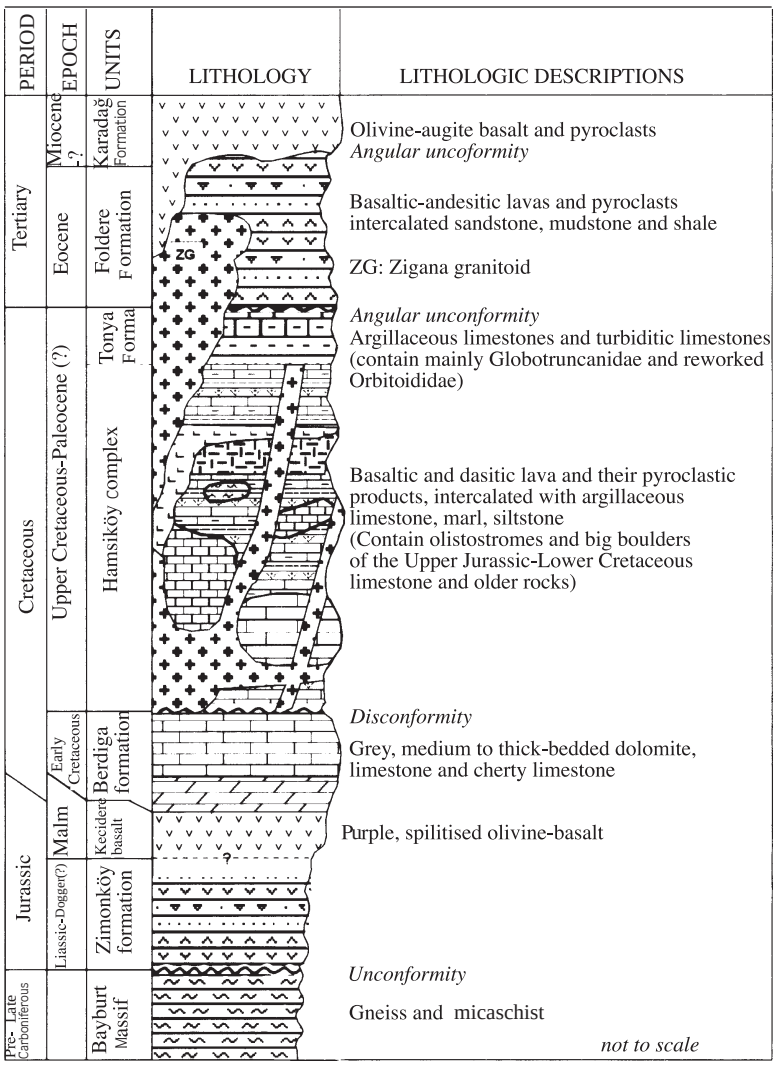


Figure 2. Generalized stratigraphic section of the Eastern Pontides northern zone (modified from Gedik et al., 1996).

named "Keçidere Basalt" (Taslı, 1997), underlie the Upper Jurassic-Lower Cretaceous platform carbonate sequence.

Until the Late Cretaceous time, the lithostratigraphic development of the Eastern Pontides northern zone was very similar to that of the Eastern Pontides southern zone. From that time onward the situation changed: while in the southern zone deposition of siliciclastic turbidites (Akdağ et al., 1994) took place, in the northern zone a magmatic arc sequence developed.

The platform carbonate sequence passes upward through a calciclastic turbiditic sequence (unnamed) into volcanic-sedimentary units of the Late Cretaceous age which developed heterogeneously with lateral and vertical changes, due to synsedimentary tectonism and arc magmatism. They have been called the "Hamsiköy Complex" (Gedik et al., 1996). This complex consists mainly of sedimentary and associated volcanic and volcaniclastic rocks which contain big boulders of Upper Jurassic-Lower Cretaceous limestone and Paleozoic crystalline basement rock. Senonian red pelagic marl-limestone underlies the siliciclastic turbidites, and it is a lithostratigraphic marker horizon in the Eastern Pontides southern zone. In the northern zone, these red beds intercalate with the Upper Cretaceous volcanic-sedimentary rocks. In the Campanian-Maastrichtian, pelagic grey limestone with *globotruncanids* and also *rudistid* limestone (Özsayar et al., 1981) occur sporadically but are never laterally extensive.

The Paleocene appears to be largely absent in the Eastern Pontides northern zone; only in the Ardanuç (Artvin) (Özsayar et al., 1982) and Gölköy (Ordu) (Terlemez and Yılmaz, 1980) areas are Paleocene limestones reported.

The Eocene comprises patches of nummulitic limestone and mafic volcanic rocks passing into turbiditic sandstone and tuffs.

Granitic rocks of the Late Eocene to younger age (Gattinger, 1962), called Rize Pluton (Çoğulu, 1970) or Zigana Granitoid (Gedik et al., 1996), are mainly exposed along the Zigana-Kalkanlı Mountains. Miocene and probably younger lavas and tuffs are present.

Location and field description of the sections analyzed

Two partial sections (Figure 1) were measured through the Berdiga Formation and overlying units. More than 80 rock samples were studied by thin sections. The outcropping lower part of the sequence is completely dolomitized and unfossiliferous whereas the upper parts are well-bedded limestones with pelecypod fragments. Thickness of individual beds ranges to 2.5 meters from 40 centimeters. The sequence is locally cut by acidic and basic magmatic dykes.

Lithostratigraphic and biostratigraphic subdivision of the Upper Jurassic-Lower Cretaceous carbonate sequence and its paleoenvironmental development

The four units presented here are recognized and described based on their microfacies analysis as well as macroscopic characteristics. Symbols are used for each unit described, not using lithostratigraphic terms. The descriptions are given from the bottom to the top of the sections studied (Figures 3 and 4).

Unit A

The basal part of the sequence consists of dark-gray, medium- to thick-bedded, locally laminated and brecciated dolomites. Maximum thickness of unit A is about 120 m. Fossils are lacking except for recrystallized shell remains and ghost structures.

Age: The underlying spilitized olivine-basalts, named Keçidere Basalt from the Kale (Gümüşhane) area, are of the Late Oxfordian-Early Kimmeridgian age (Taslı, 1997). Thus, Kimmeridgian to Valanginian age can be inferred for unit A.

Depositional Environment: Laminations and intensive dolomitization indicate that this unit was deposited on intertidal and peritidal flats.

Unit B

It is composed of gray, thick-to very thick-bedded limestone. This facies is characterized by peloidal and intraclastic packstones and grainstones containing abundant benthic foraminifers and *pelecypod* shell fragments, minor amounts of *echinoderm* debris, *ostracods* and *gastropods*. Unit B sporadically contains intercalations of oncoidal packstones with *ostracods* and only small foraminifers.

Fossils may comprise more than 50% of the rock volume. Among the total biofraction, benthic foraminifers and pelecypod shell fragments seem to be facies-diagnostic fossils of this facies type. The benthic foraminifers are diverse and abundant whereas *dasycladacean algae* are lacking, except for minor amounts of *Actinoporella* sp. fragments.

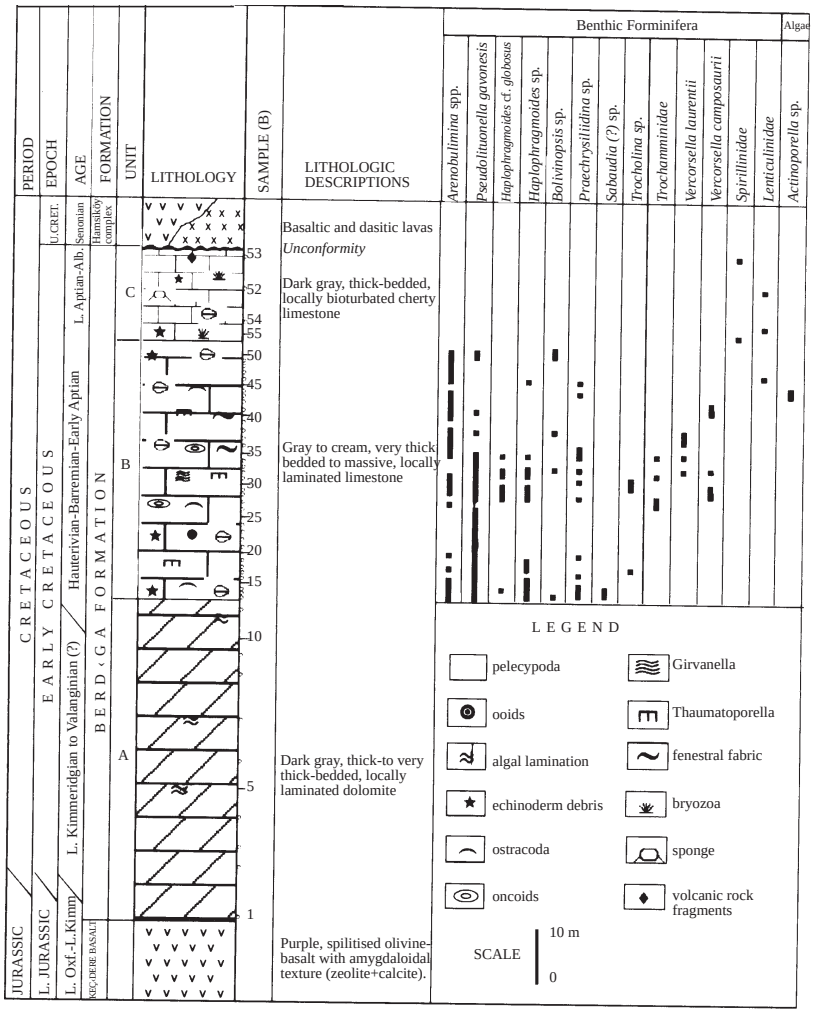


Figure 3. Başoba Yayla section-1 showing lithology and distributions of benthic foraminifers and algae of the Upper Jurassic-Lower Cretaceous platform carbonate sequence.

Thaumatoporella, Girvanella and *Cayeuxia* (?) sometimes associated with the benthic foraminifers.

Age: Unit B contains a benthic foraminiferal assemblage comprising *Haplophragmoides* sp. (Plate 1/1, 2), *Haplophragmoides* cf. *globosus* LOZO (Plate 1/3, 4), *Trochamminidae* (Plate 1/ 5-6), *Sabaudia* (?) sp. (Plate 1/11-13), *Vercorsella laurentii/camposaurii* (SARTONI and CRESCENTI) (Plate 1/ 14-17), *Pseudolituonella gavonensis* FOURY (Plate 1/10), *Praechrysalidina* sp. (Plate 1/8), *Arenobulimina* spp. (Plate 1/7), *Bolivinopsis* sp., (Plate 1/9), *Trocholina* sp., *Miliolidae* (*Pyrgo* and *Quinqueloculina*), and *Textulariidae*. Most of these foraminifers suggest a maximal time range from a Late Hauterivian to Aptian for most of unit B. *Vercorsella laurentii/camposaurii* (SARTONI and CRESCENTI) are described recently from the Barremian-Early Aptian of the Kale (Gümüşhane) area (Kırmacı et al., 1996).

Depositional Environment: These organisms and rock types indicate that the depositional environment of unit B was predominantly shallow subtidal in a moderately agitated environment with restricted conditions.

Unit C

It is composed of gray to dark-gray, thick-bedded, cherty, locally bioturbated limestone containing belemnites, sponges, bryozoans, terebratulid brachiopods and pelecypod fragments. The contact with the underlying unit marks a change of depositional pattern. The pre-existing biota and facies were completely drowned. The facies is characterized by bioclastic wackestones containing abundant echinoid debris, and fragments of pelecypods. Benthic foraminifers are represented by forms with hyaline calcareous walls such as *Spirillina* sp. A (Plate 2/3), *Lenticulinidae* and rarely by

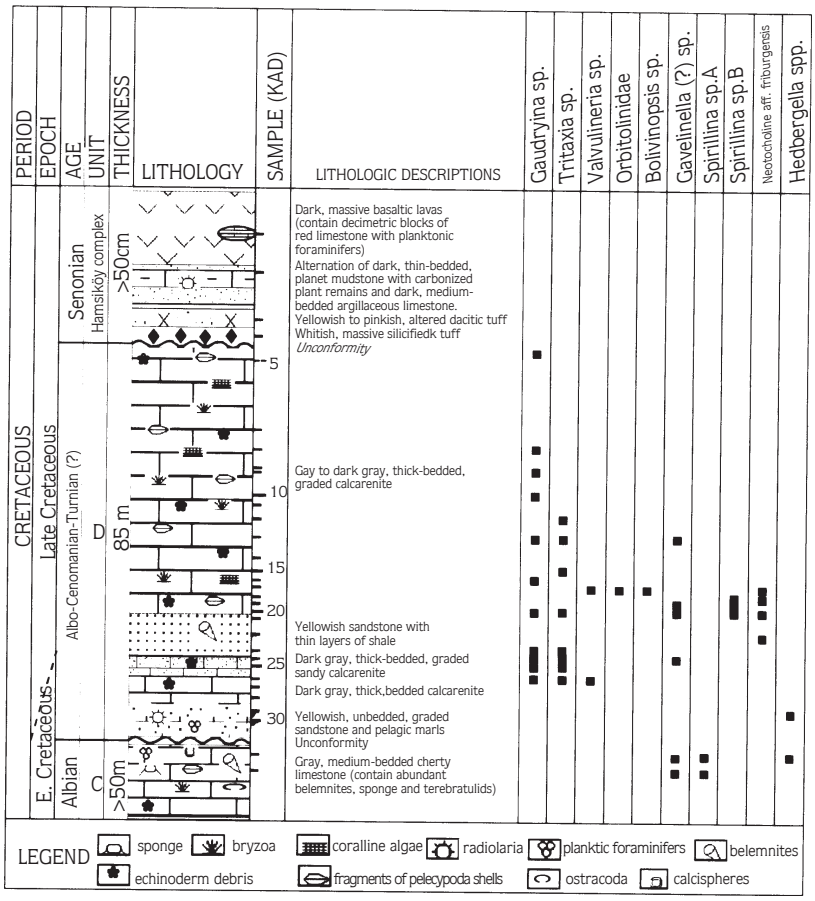


Figure 4. Başoba Yayla section-2 showing lithology and distributions of foraminifers and other microfossils in the redeposited carbonates overlying the platform carbonate sequence.

forms with microgranular calcareous walls such as small *Textulariidae*. In addition to these, the uppermost part of the unit contains abundant *Hedbergella* spp., *Gavelinella*(?) sp. (Plate 2/11), rarely *Valvulineria* sp. and *Calcisphaerula innominata* BONET.

Age: Without biomarkers, it is difficult to make precise age determination of unit C. However, an identical facies to that of unit C is also present in the Upper Aptian-Lower Albian sequence of the Torul (Gümüşhane) area, southeast of the study area (Taslı and Özsayar, 1997). For the uppermost part of the unit, an age not older than Late Albian can be inferred based on the presence of *hedbergellids* and *C. innominata* BONET.

Depositional Environment: Depositional environment gradually evolved into a shelf sea with open circulation as indicated by the predominance of *stenohaline* organisms and mud-rich lithologies. The platform gradually subsided and flooded, as indicated by the presence of planktonic organisms in uppermost parts of the unit.

Unit D

At the base, it consists of greenish to yellowish gray, non-bedded sandy marls with abundant *hedbergellids* and radiolarians. The sandy marls have, without a detectible angularity, a clear erosional contact with the underlying gray limestones with hedbergellids (unit C). Toward the top of the marls, lithic grains (including volcanic rock debris and plagioclase) decrease in abundance and completely missing. The marls pass upward into dark-gray, thick-bedded, graded calcarenites. The calcarenites are composed mainly of fragments of pelecypods, echinoderms, bryozoans, coralline algae, and lithoclasts which were derived from the underlying wackestones with *hedbergellids* (unit C). The calcarenites grade upward into green, non-bedded, graded sandstones with *belemnites*. The sandstones are dominantly fine-grained feldspathic litharenite and consist of angular to subrounded volcanic rock fragments, plagioclase, and very rarely echinoderm debris and lithoclasts. The matrix is composed of micrite with iron-oxide. The uppermost

60 m of this unit consists mainly of dark-gray, thick-to very thick-bedded, graded calcarenites. The majority of clasts are sub-rounded fragments of fossils (echinoderms, pelecypods, bryozoans, coralline and solenoporacean algae). Some horizons are rich in terigeneous material (fragments of volcanic rock, plagioclase and quartz). Pelecypoda and other skeletal debris within each bed are vertically graded in the muddy matrix. Granular calcitic cements fill intergranular pores. Syntaxial overgrowth on echinoderm debris is also observed. Depositional fabrics are variable, due to grading, grainstone/rudstone to wackestone/floatstone types. Fragments of pelecypods and echinoderms are partially silicified and bored by microboring organisms.

Age: Unit D contains a small benthic foraminiferal assemblage comprising *Gaudryina* sp. (Plate 2/4, 7), *Bolivinopsis* sp. (Plate 2/1), *Valvulineria* sp. (Plate 2/10), *Tritaxia* sp. (Plate 2/9), *Neotrocholina* aff. *friburgensis* GUILLAUME and REICHEL (Plate 2/13), *Spirillina* sp.B (Plate 2/6), *Gavelinella* (?) sp. (Plate 2/12), Lenticulinidae, and very rarely orbitolinids (Plate 2/8). These species have a large stratigraphic range, from Aptian to Cenomanian age. Thus, for unit D a probable Albo-Cenomanian or Turonian age is inferred.

In the Gümüşhane area, bioclast-dominated facies were developed at the beginning of the Turonian and they are intercalated with pelagic gray limestone which contains double-keeled planktonic foraminifers (*Marginotruncana* and *Dicarinella*) (Taslı and Özsayar, 1997).

Depositional Environment: Depositional environment of unit D is an open sea with pelagic sedimentation as indicated by the presence of planktonic organisms. Bioclastic grains of the calcarenites are transported shelf material. These require the nearby existence of some parts of the platform which have remained within the photic zone. The composition and texture of the calcarenites indicate that the depositional processes producing these displaced deposits originated by sediment gravity flow. Therefore, a slope environment can be inferred for unit D.

The Upper Cretaceous units of the Başoba Yayla area

Unit D seems to be patchily preserved along the contact between unit C and overlying Upper Cretaceous volcanic-sedimentary units. It is completely missing in the Aktaş section. When it is absent volcanic-sedimentary units of Late Cretaceous age unconformably overlie unit C.

The Upper Cretaceous units are made up of varying lithofacies in different localities. At the base a white, very thick (5 m) silicified tuff bed unconformably overlies unit D. It is followed by yellowish to cream porfiric dacites. The overlying sediments are composed of alternation of dark, medium-bedded argillaceous limestone and plated mudstones with carbonized plant remains. The argillaceous limestones contain abundant radiolaria. The following basaltic lavas contain red pelagic limestone blocks of decimetric scale which contain *Globotruncanidae* and *Heterohelicidae* indicating Early Senonian age.

Discussions and Results

The oldest exposed rocks in the Başoba Yayla area are spilitised olivine-basalts of the Late Oxfordian-Early Kimmeridgian age, named "Keçidere Basalt" from the Kale (Gümüşhane) area (Taslı, 1997). Its thickness reaches up to more than 200 meters and decreases from north to south toward the Kale (Gümüşhane) area. There, it interrupts limestone beds with *Alveosepta* (Taslı, 1993).

The platform carbonate sequence begins with a thick, monotonous dolomite unit which represents an intertidal-supratidal environment of deposition. Paralelling the evolution of the environment, a rich and diverse benthic foraminiferal assemblage, indicating a Late Hauterivian to Early Aptian age, developed. This assemblage comprising *Vercorsella laurentii/camposaurii* (SARTONI and CRESCENTI) was also found in the Kale (Gümüşhane) area (Kırmacı et al., 1996). The overlying bioclastic wackestones (unit C) mark a change of depositional pattern. Cherty wackestones having the same stratigraphic position with that of unit C are uniformly developed over the Eastern Pontides carbonate platform realm (Pelin, 1977; Taslı and Özsayar, 1997). Thus, we are inclined to relate the development of unit C to a relative rise in sea-level at the beginning of the probable Late Aptian. The uppermost part of unit C contains abundant *hedbergellids* and rare *calcispheres*. The Late Aptian transgression continued to probable Late Albian time, producing a deepening upward sequence.

From Late Albian time onward, the situation changed; autochtonous carbonate deposition on the platform was

completely masked by the arrival of calciclastic materials associated with pelagic sedimentation. Albo-Cenomanian or Turonian sequence (unit D) mostly consists of bioclastic facies with variable amounts of carbonate mud. These bioclastic sediments deposited on the subsiding platform margin, subjected to drowning. The contact between units C and D is uneven and sharp, indicating an erosional unconformity. There are no visible transgression phenomena on the disconformable surface covered by pelagic sandy marls with *hedbergellids* and radiolarians. Therefore, the erosional unconformity should be produced by submarine erosive processes such as gravity sliding and erosional reworking by currents. It is difficult to determine the precise duration of the hiatus because any significant biomarkers are lacking. Probably it spans Late Albian to Cenomanian.

In many areas of the Eastern Pontides platform, starting from the Albo-Cenomanian, bioclast-dominated facies associated with pelagic limestones replaces the outer platform facies of Early Cretaceous (Taslı and Özsayar, 1997). Following the breaking up of the platform, in the southern zone the deposition of siliciclastic turbidites took place, while in the northern zone a magmatic arc complex developed, due to the establishment of a southerly dipping subduction zone (Bektaş et al., 1995). According to Bektaş et al. (1995), drowning of the carbonate platform achieved by the progressive rifting or extensional tectonic regime during the Senonian in the northern zone. In the Rhodope-Pontide Fragment, the breaking up of the Middle Jurassic to Early Cretaceous carbonate platform is interpreted by Görür et al. (1993) as a result of the opening of the oceanic Black Sea back-arc basin accelerated during the Albian to Cenomanian. Gedik et al. (1996) suggested that during the Middle Cretaceous collisions of the oceanic plateaux along transpressive fault zones at the southern margin caused a northerly tilting in the Pontide block and development of many pull-apart basins.

Acknowledgement

We would like to thank T. Kemer (Mersin) who took the microphotographs and printed them.

PLATE 1. Benthic foraminifers of the Hauterivian-Early Aptian limestone section (Başoba Yayla area, NE Turkey).

Figure 1, 2. *Haplophragmoides* sp.
1. equatorial section, sample B 46, X100
2. axial section, sample B 12, X115

Figure 3, 4. *Haplophragmoides* cf. *globosus* LOZO
3. subequatorial section, sample B-14, X65
4. oblique subaxial section, sample B 14, X65

Figure 5, 6. Trochamminidae
5. subaxial section, sample B 28, X65
6. equatorial section, sample B 35, X75

Figure 7. *Arenobulimina* sp. transverse-oblique section, sample B 33, X65

Figure 8. *Praechrysalidina* sp. oblique subaxial section, sample B 13, X30

Figure 9. *Bolivinopsis* sp. longitudinal-axial section, sample B 51, X70

Figure 10. *Pseudolituonella gavonensis* FOURY axial section, sample B 13, X55

Figure 11-13. *Sabaudia* (?) sp.
11. longitudinal-tangential section, sample B 13, X90
12. transverse section, sample B 13, X60
13. longitudinal-axial section, sample B 13, X90

Figure 14. *Vercorsella camposaurii* (SARTONI and CRESCENTI) longitudinal-tangential section, sample B 13, X65

Figure 15-17. *Vercorsella laurentii* (SARTONI and CRESCENTI)
15. longitudinal-tangential section, sample B 33, X55
16. longitudinal-subaxial section, sample B 33, X55
17. transverse-oblique section, sample B 33, X60

PLATE 2. Foraminifers of the Middle Cretaceous slope deposits (Başoba Yayla area, NE Turkey)

Figure 1. *Bolivinopsis* sp. longitudinal axial section, sample KAD 17, X65

Figure 2, 5. *Hedbergella* sp.
2. equatorial section, sample KAD 31, X100
5. equatorial section, sample KAD 29, X130

Figure 3. *Spirillina* sp. A
axial section, sample KAD 32, X130

Figure 4, 7. *Gaudryina* sp. subaxial sections, sample KAD 17, X65

Figure 6. *Spirillina* sp. B, subaxial section, sample KAD 26, X65

Figure 8. Orbitolinidae, tangential section, sample KAD 17, X70

Figure 9. *Tritaxia* sp. transverse section, sample KAD 17, X65

Figure 10. *Valvulineria* sp. Axial-oblique section, sample KAD 17, X130

Figure 11, 12. *Gavelinella* (?) sp.
11. axial section, sample KAD 20, X100
12. equatorial section, sample KAD 31, X180

Figure 13. *Neotrocholina* aff. *friburgensis* GUILLAUME and REICHEL axial section, sample KAD 20, X60

PLATE 1

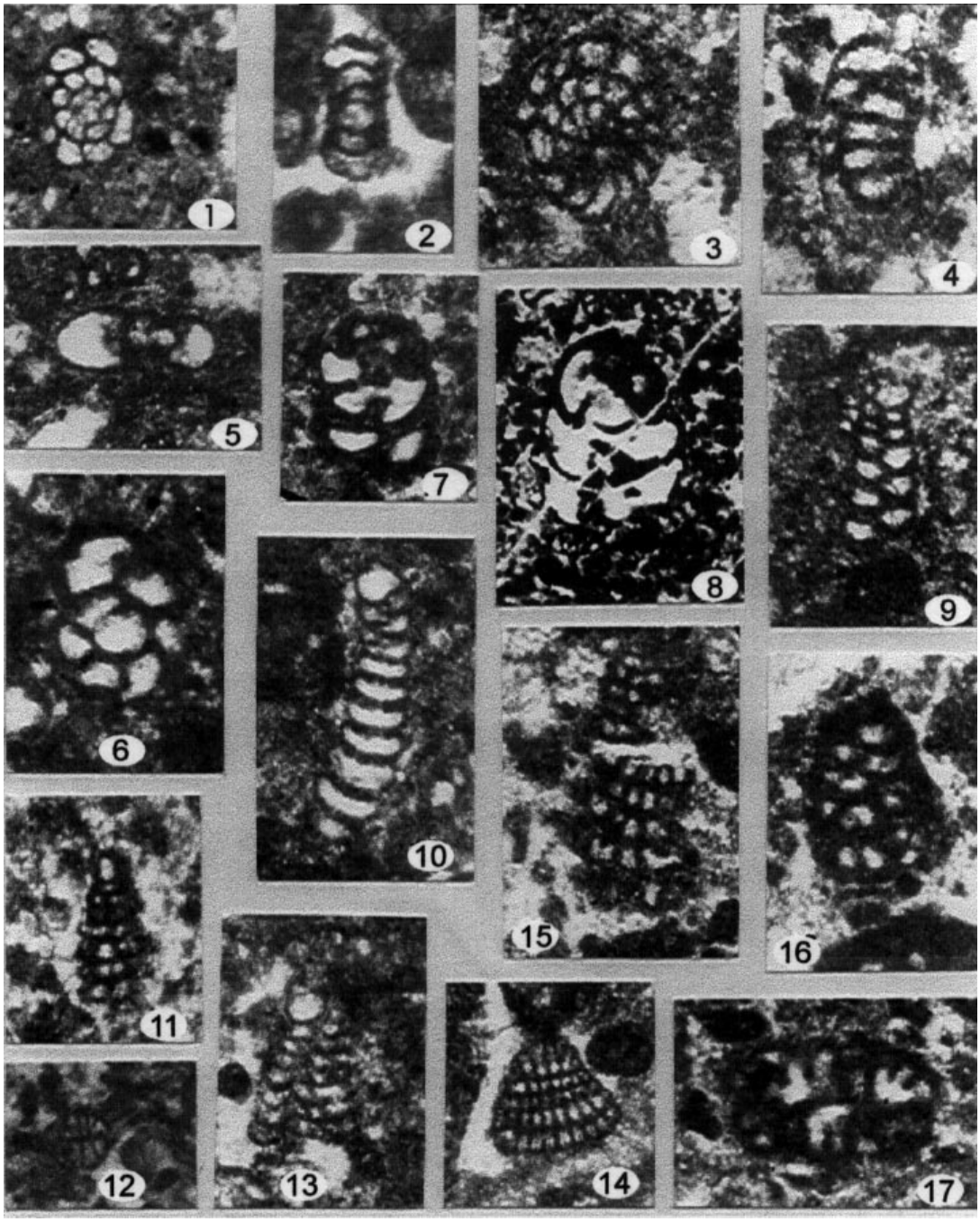
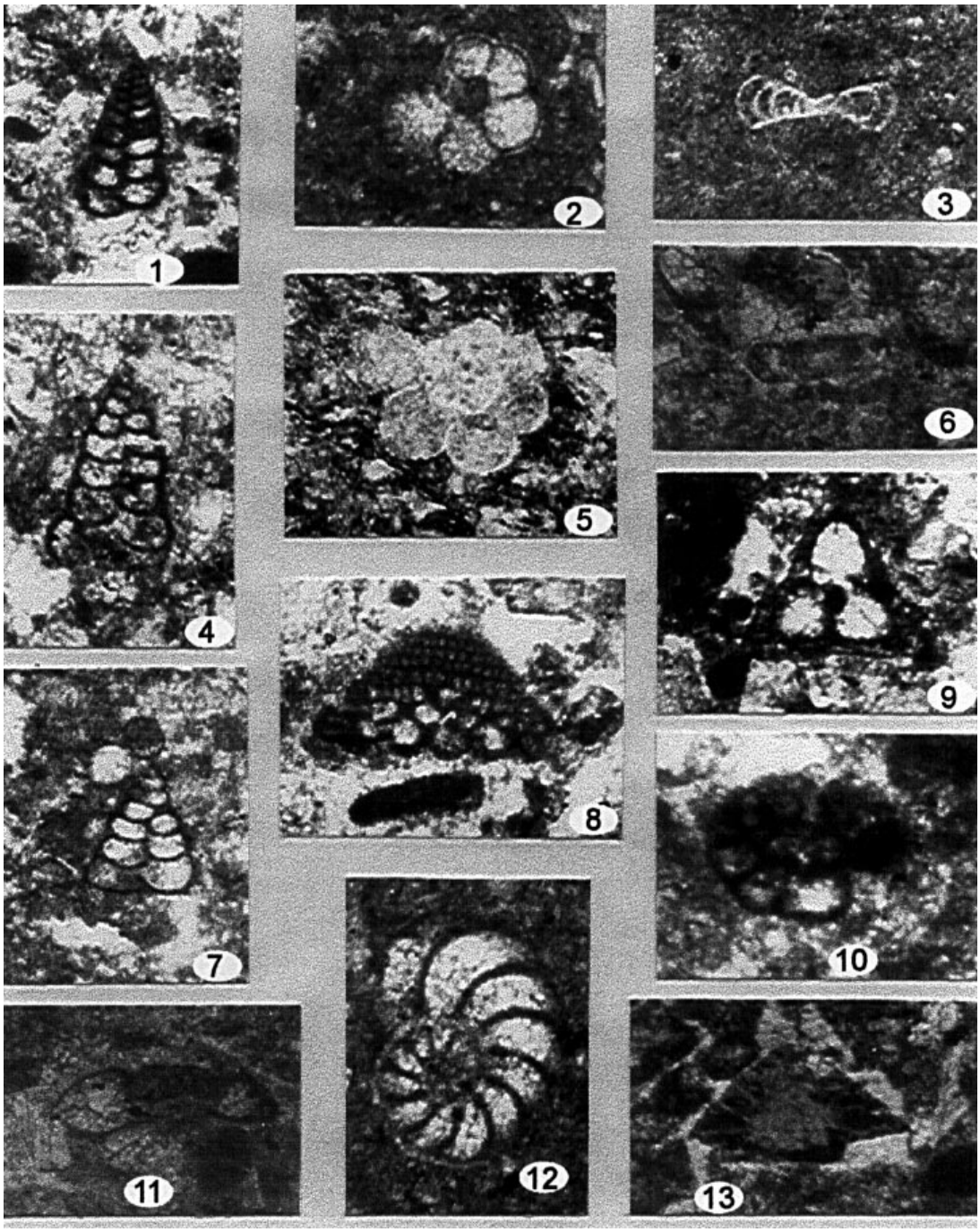


PLATE 2



References

Adamia, S., Bayraktutan, S. and Lordkipanidze, M., 1995. Structural correlation and Phanerozoic evolution of the Caucasus-Eastern Pontides. in: Erler, A., Ercan, T., Bingöl, E. and Örçen S. (eds.), Proceedings of the International Symposium on the Geology of the Black Sea Region 1992, 69-75, Ankara.

Akdağ, K., Özer, E., Kırmacı, M.Z., Çapkınoğlu, Ş. and Gedik, İ., 1994. Gümüşhane yöresindeki Üst Kretase istifinin gelişimi (Doğu Pontidler, KD Türkiye). Abstracts of the Geological Congress of Turkey, Chamber of Geol. Engineers of Turkey, p. 85, Ankara.

Bektaş, O., Yılmaz, C., Taslı, K., Akdağ, K. and Özgür, S., 1995. Cretaceous rifting of the Eastern Pontide carbonate platform (NE Turkey): the formation of carbonate breccias and turbidites as evidence of a drowned platform. Giornale di Geologia, 57, 1-2, 233-244.

Boynukalın, S., 1991. Dereli (Giresun) baraj yeri ve göl alanının mühendislik jeolojisi ve çevre kayaçların jeomekanik özellikleri. PhD Thesis Black Sea Technical University, 255 p., Trabzon (unpublished).

Bulguroğlu, N. 1991. Düzköy-Akçaabat yöresinin jeolojik incelemesi. MSc Thesis Black Sea Technical University, 86 p., Trabzon (unpublished).

Çoğulu, E., 1970. Gümüşhane ve Rize granitik plütonlarının petrolojik ve jeokronometrik etüdü. Thesis İstanbul Technical University (unpublished).

Gattinger, T.E. (Ed.), 1962. 1/500000 Ölçekli Türkiye Jeoloji Haritası Trabzon Paftası Açıklaması, Mineral Research and Exploration Institude of Turkey Publications.

Gedik, İ., Kırmacı, M.Z., Çapkınoğlu, Ş., Özer, E. and Eren, M., 1996. Geologic evolution of the Eastern Pontides. In: Korkmaz, S. and Akçay, M. (Eds.), Black Sea Technical University, Reports on 30th Year Symposium in Department of Geological Engineering, 654-677, Trabzon (in Turkish).

Görür, N., Tüysüz, O., Akyol, A., Sakınç, M., Yiğitbaş, E. and Akkök, R., 1993. Cretaceous red pelagic carbonates of northern Turkey: Their place in the opening history of the Black Sea. Eclogae Geologica Helvetiae, 86, 819-838.

Kırmacı, M.Z., Koch, R. And Bucur, J. I., 1996. An Early Cretaceous section in the Kırcaova area (Berdiga Limestone, NE Turkey) and its correlation with platform carbonates in W-Slovenia. Facies, 34, 1-22.

Korkmaz, S., Tüysüz, N., Er, M., Musaoğlu, A. and Keskin, İ., 1995. Stratigraphy of the Eastern Pontides, NE Turkey. in: Erler, A., Ercan, T., Bingöl, E. and Örçen S. (eds.), Proceedings of the International Symposium on the Geology of the Black Sea Region 1992, 59-68, Ankara.

Özsayar, T., Pelin, S. and Gedikoğlu, A., 1981. Cretaceous in the Eastern Pontides. Black Sea Technical University Earth Sciences Bulletin, Geology, 1/2, 65-114, Trabzon (in Turkish).

Özsayar, T., Pelin, S. and Gedikoğlu, A., 1982. Geological framework of the Ardanuç (Artvin) area. Black Sea Technical University Earth Sciences Bulletin, Geology, 2/1-2, 69-81, Trabzon (in Turkish).

Pelin, S., 1977. Geology of the southeastern Alucra (Giresun) region regarding the possibilities of oil. Black Sea Technical University Publications No. 87, Faculty of Earth Sciences Publication 13, 103 p., Trabzon (in Turkish).

Robinson, A. G., Banks, C. J., Rutherford, M. M. and Hirst, J. P. P., 1995. Stratigraphic and structural development of the Eastern Pontides, Turkey. Journal of Geological Society, London, 152, 861-872.

Taslı, K., 1984. Geology of the Hamsiköy (Trabzon) area. Black Sea Technical University Earth Sciences Bulletin, Geology, 1/2, 69-76, Trabzon (in Turkish).

Taslı, K., 1993. Micropaleontology, stratigraphy and depositional environment of the Jurassic platform carbonates in the Kale-Gümüşhane region (Eastern Pontides, NE Turkey). Revue de Micropaleont., 36/1, 45-65, Paris (in French).

Taslı, K., 1997. Stratigraphical and paleontological data on the Malm volcanism in the Eastern Pontides (NE Turkey). İstanbul University Earth Sciences Bulletin, 8/1-3, 95-101, İstanbul (in Turkish).

Taslı, K. and Özsayar, T., 1997. Stratigraphy and paleoenvironmental setting of the Albian-Campanian deposits within the Gümüşhane province (Eastern Pontides, NE Turkey). Bulletin of Turkish Association of Petroleum Geologists, 9, 1, 13-29, Ankara.

Terlemez, İ. and Yılmaz, A., 1980. Stratigraphy of the area between Ünye-Ordu-Koyulhisar-Reşadiye. Bulletin of Geological Society of Turkey of Turkey, 23, 179-191, Ankara (in Turkish).