



Ostracoda Biostratigraphy and Chronostratigraphy of Pannonian-Pontian Sequence of Gelibolu Peninsula, NW Turkey

Gelibolu Yarımadası Pannoniyen-Ponsiyen İstifinin Ostracoda Biyostratigrafisi ve Kronostratigrafisi, KB Türkiye

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Abstract

In this study, a total of 300 samples either collected from 13 measured sections or as spot sample from 7 stratigraphic horizons have been investigated for their ostracoda assemblages. 22 species, 11 of which already known, eight yet unnamed, 2 new species and 1 new subspecies belonging to 8 brackish and freshwater genera have been identified.

Five different ostracoda biozones have been recognized considering the stratigraphic and geographic distribution of ostracoda fauna in the measured sections. These are from bottom to top: Zone AI- *Cyprideis pannonica*-*Cyprideis torosa* Zone, Zone All- *Limnocythere sp.1*-*Paralimnocythere sp. 2* Zone, Zone Alll-*Cyprideis sp.1* Zone, Zone AIV-*Cyprideis tuberculata*-*Cyprinotus salinus* Zone and Zone AV-*Xestoleberis sp.*-*Cyprideis sublittoralis* Zone. Zones AI, All, Alll and AIV are characterized in the Pannonian stage but Zone V in the Pontian stage.

The results are both correlated and supported with the other fauna and flora groups (benthic foraminifera, microvertebrate, microgastropoda, spores and pollens) which confirm the identification and separation of Pannonian (Early, Middle, Late) and Pontian stages in the studied material.

Key Words: Ostracoda, Pannonian-Pontian, biostratigraphy, chronostratigraphy, gelibolu peninsula, Turkey

Öz

Bu çalışma ile, 13 ölçülü stratigrafi kesiti ile 7 nokta lokaliteden alınan toplam 300 örnekte, 8 adet acı ve tatlısu ostrakod cinsine ait, 11'si bilinen, 8 adedi isimlendirilememiş, ikisi yeni tür ve biri de yeni alttür olmak üzere toplam 22 tür tanımlanmıştır.

*Ölçülü ve genelleştirilmiş stratigrafi kesitlerine bağlı olarak beş ayrı ostrakod biyozonunun varlığı ortaya konulmuştur. Bunlar alttan üste doğru: Zone AI- *Cyprideis pannonica*-*Cyprideis torosa* Zonu, Zon AU-*Limnocythere sp.1*-*Paralimnocythere sp. 2* Zonu, Zon Alll-*Cyprideis sp. 1* Zonu, Zon AIV-*Cyprideis tuberculata*-*Cyprinotus salinus* Zonu and Zon AV-*Xestoleberis sp.*-*Cyprideis sublittoralis* Zonu. AI, All, Alll ve AIV zonları Pannoniyen katı içerisinde, Zon V ise Ponsiyen katı içerisinde yer almaktadır.*

Pannoniyen katının alt kronostratigrafik bölünmesi başlıca ostrakod faunasına bağlı olarak gerçekleştirilmiştir. Sonuçlar, saptanmış diğer fauna ve flora grupları (bentik foraminifera, mikroomurgali, gastropoda, spor ve pollen) ile de denetlenmiştir ve Pannoniyen (Erken, Orta, Geç) ve Ponsiyen katları ayırtlanmıştır.

Anahtar Kelimeler: Ostrakoda, Pannoniyen-Ponsiyen, biyostratigrafi, kronostratigrafî, gelibolu yarımadası, Türkiye

INTRODUCTION

Along the coasts of Black Sea and Sea of Marmara (Turkey), some isolated or connected basins lie from west to east. One of them is located in Gelibolu Peninsula which is oriented in NE-SW direction. These basins were related to Tethys or

Paratethys bioprovince from Middle Miocene to Recent (Figure 1). The investigation area is a part of region indicated as 50a-f, according to "Neogene of the Mediterranean Tethys and Paratethys stratigraphic correlation tables, sediment distribution maps" (Steininger et al., 1985).

Previous investigations focusing on different geological aspects of the investigation area were carried out by İlhan (1964), Şentürk (1971), Saltık and Saka (1971 and 1972), Kellog (1973), Önem (1974), Ünal and Yılmaz (1984), Ünal (1984), Erol (1985), Sümengen et al. (1987), Şentürk and Karaköse (1987), Siyako et al. (1989), Okay et al. (1990) and Erol (1992). On the other hand, paleontologic studies were carried out by Hoernos (1876), Penck (1917 and 1919), Pfannenstiel (1944), Ternek (1949), Erguvan (1954 and 1957), Ülkümen (1960), Erol (1969), Erol and Nuttal (1973), Ozansoy (1973), Önem (1974), Saltık (1974), Taner (1977, 1981 and 1983), Tokar and Erkan (1983), Sümengen et al. (1987), Şentürk and Karaköse (1987), Taner (1994), Ünal (1996), Ünal and Tunoğlu (1996), Tunoğlu and Ünal (in press).

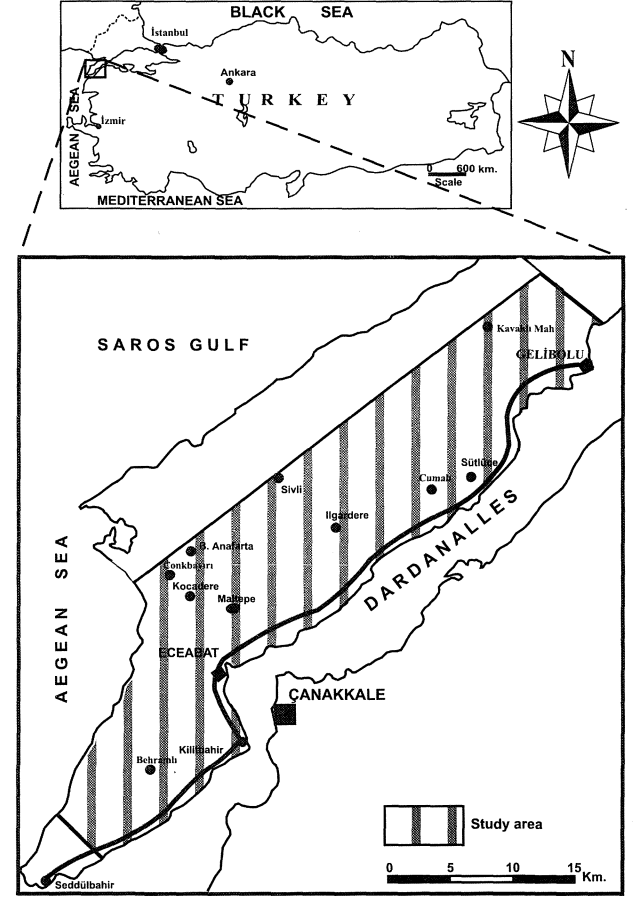
The aim of this paper is to determine the Neogene Ostracoda biostratigraphy and chronostratigraphy of Gelibolu Peninsula, correlate and compare the data with that of other Neogene basins of Turkey and other Paratethys basins developed during the same time interval.

GEOLOGIC SETTING

In the region, Neogene units rest on the Oligocene basement units by an angular unconformity (Figure 2). Middle-Upper Miocene units comprise two different units, namely the Çanakkale Formation (Pannonian) and the Conkbayın Formation (Pontian). The stratigraphic names of Sümengen (1987) and Şentürk and Karaköse (1987) are accepted and used in this investigation.

Çanakkale Formation consists of four members; from bottom to top, the Gazhanedere, Anafarta, Çamrakdere and Bayraktepe Member.

The Gazhanedere member deposited during the Early Pannonian, consists of claystone, sandstone, mudstone, marl, clayey limestone and limestone. This unit contains ostracoda and micro vertebrate fossils. Anafarta member, conformably lying on the Gazhanedere member, is represented by marl, sand-



Şekil I: Çalışma bölgesinin yer bulduru haritası.
Figure I: Location map of the study area.

stone, claystone, conglomerate and tabular sandstone. This unit was deposited during the Middle Pannonian and contains ostracoda and microvertebrate fossils. The Çamrakdere member was deposited conformably on the Anafarta member during the Middle-Late Pannonian and consists of claystone, marl, conglomerate, thick bedded clayey limestone and mudstone. This member contains ostracoda and microvertebrate fossils too. The last member of Çanakkale Formation, the Bayraktepe member, consists of fossiliferous limestone, sandstone, conglomerate, claystone and sandy limestone. The Bayraktepe member was deposited during Late Pannonian. This unit contains a rich association of ostracoda, gastropoda and spore and pollen. The Conkbayın Formation was deposited conformably on the Bayraktepe member of Çanakkale Formation during Pontian. This formation contains thick marl, sandstone, mudstone, claystone, conglomerate and consists of abundant ostracoda and microvertebrate fossils.

BIOSTRATIGRAPHY AND CHRONOSTRATIGRAPHY

The biostratigraphic and chronostratigraphic subdivision of the Neogene sequence in the Gelibolu Peninsula is based primarily on quantitative analysis of ostracoda assemblages integrated with data derived from microvertebrates, gastropoda, spore and pollen fossils. Comparison of the Neogene lithostratigraphic units of the investigation area with the neighboring regions is given in Table 1.

Five different ostracoda biozones have been identified based on the distribution of ostracoda species in the measured sections (Table 2). Four of them (AI, All, AIII and AIV) are placed in the Çanakkale Formation and the other one is confined to the Conkbayın Formation.

AGE	STAGE	SUBSTAGE	FORMATION	MEMBER	THICKNESS (m)	LITHOLOGICAL SYMBOL	EXPLANATIONS (LITHOLOGY)	
QUATERNARY				Qa	80 m		conglomerate	
				Qds			ANGULAR UNCONFORMITY conglomerate-sandstone ANGULAR UNCONFORMITY	
MIDDLE - UPPER MIOCENE	PONTIAN		CONKBAYIRI		300 m		marl mudstone claystone sandstone conglomerate	
							marl sandstone	
							sandy limestone claystone conglomerate	
							fossiliferous limestone mudstone	
							claystone marl	
	PANNONIAN	Middle-Upper	Upper	ÇANAKKALE (Teş)	Bayrak Tepe	110 m		claystone conglomerate fossiliferous limestone mudstone
					Çamrak Dere			80 m
		Lower		ÇANAKKALE (Teş)	Anafarta	200 m		clayey limestone claystone conglomerate cross bedded limestone marl sandstone
								sandstone
								sandstone clayey limestone mudstone marl sandstone sandstone limestone sandstone marl
			Gazhanedere	350 m		ANGULAR UNCONFORMITY		
OLIGOCENE						Basement		

Şekil 2: Çalışma bölgesinin genelleştirilmiş stratigrafik istifi.

Figure 2: Stratigraphic columnar section of the study area.

The following brackish water micro gastropoda association in the Çanakkale formation were determined by Yeşim İslamoğlu (MTA/General Directorate of Mineral Research and Exploration of Turkey): *Odostomia pallida minima* L. Iljina, *Odostomia insculpta* (Mtg) *Odontostomia unidentata pseudoturrita* Sacco, *Turricaspia aberrans* (Aandrus), *Odostomia* sp., *Caspiohydrobia tamanensis* L. Iljina, *Pseudamnicola maetica* (Staja) L. Iljina, *Brocchinia* sp., *Acteocina lajonkaireana* Basterot. This faunal association indicates Late Miocene age for the unit. Palynologic investigation, performed by Dr. Zühtü Batı (TPAO/Petroleum Cooperation of Turkey) revealed the following assemblage: *Pityosporites* spp., *Inaperturopollenites emmaensis* Murriger & Pflug, *I. dubius* (R. Potonie & Venitz) Thomson & Pflug, *I. magnus* (R. Potonie) Thomson & Pflug, *Compasitae*, *Monoporopollenites gramineoides* Meyer, *Periporopollenites stigmus* (R. Potonie) Thomson & Pflug, *Subtriporopollenites simplex* (R. Potonie) Thomson & Pflug, *Tricolporopollenites kruschi* (R. Potonie) Thomson & Pflug, *Tricolporopollenites henrici* (R. Potonie) Thomson & Pflug, *T. microhenrici* (R. Potonie) Thomson & Pflug, *Pediastrum* spp. and green algae. This association indicates Late Miocene age and continental-lacustrine conditions for the depositional environment. In the same unit, the following benthic foraminifera were observed and identified by Mehmet Sakmç (Istanbul Technical University): *Ammonia beccarii* Clarck and *Ammonia beccarii tevida* Clarck which are reported from Middle-Late Miocene.

The following ostracoda biozones are assemblage or abundance zones and characterized either by predominance or presence of one or few species or by a short ranged index species. Systematic descriptions of new species, new subspecies and the other ostracoda associations are given in Tunoğlu and Ünal (in press).

Zone A I- *Cyprideis pannonica* and *Cyprideis torosa* Zone:

Category: Assemblage Zone

Age: Early Pannonian

Definition: This zone is characterized by the first occurrence of *Cyprideis pannonica* Mehes and *Cyprideis torosa*, meanwhile, *Paralimnocythere* sp. 1, *Candona neglecta* Sars and *Candona Candida* O.F. Müller are the other species of this ostracoda assemblage.

Other paleontologic and chronostratigraphic data: Sümengen et al. (1987) observed and identified following microvertebrate fossils in the claystone levels of this member: Schizogalerix sp., Chiroptera sp., Democricetodon sp., Miodyronys sp., lagomopha sp. and Dakkamys sp. and have attained Aragonian age to the unit (Upper Orleanian-Astarasian). This stage can be correlated with Sarmatian-Pannonian stage of Paratethys bioprovince.

Paleoecology: Transitional-littoral environment by ostracoda (Table 3) and the other paleontologic and sedimentologic data.

AH Zone: Limnocythere sp.1 and Paralimnocythere sp. 2 Zone:

Category: Assemblage Zone

Age: Middle Pannonian

Definition: This zone is characterized by the first occurrence and the last appearance of Limnocythere sp.1 and Paralimnocythere sp.2 species respectively. Other ostracoda species are Limnocythere sp.2, Çizelge I: Çalışma bölgesi ile çevresindeki Neojen yaşlı litostratigrafik birimlerin denştirilmesi.

Paralimnocythere sp. 2, Candona neglecta Sars, Candona Candida O. F. Muller, Candona parallela pannonica Zalanyi, Candona sp., Ilyocypris sp., Ilyocypris bradyi Sars, Ilyocypris pontica Tunoğlu and Ünal, Loxoconcha sp. 1., Cyprideis cf. seminulum Reuss, Cyprideis quadrituberculata Krstic, Cyprideis trituberculata Krstic.

Other paleontologic and chronostratigraphic data: Sümengen et al. (1978) determined the following microvertebrate fossils in the same zone: Byzantinia bayraktepenis Ünay, Gürbüz, Atalay, Byzantinia sp., Megacricetodon sp., Miodyromys sp., Dakkamys sp., Pliospalax sp., Keramidomys sp., Dinosorex sp. and have considered the unit in Late Aragonian (Astrogonian) -Vallasian age. This stage can be correlated and compared with Tortonian in the Tethys bioprovince and Pannonian in the Paratethys bioprovince.

Paleoecology: Transitional (shallow marine, Lagoonal and lacustrine) environment according to all of the sedimentologic and palaeontologic data (see Table 3).

Table 1: Comparison of Neogene lithostratigraphic units of the investigation area

STAGE		TANER (1977)	ÖNAL (1984)	EROL (1985)	SANER (1985)	SÜMENGEN et al. (1987)	ŞENTÜRK and KARAKÖSE (1987)	SİYAKO et al. (1989)	ÜNAL (1996)
PARATETHYS	TETHYS	Gelibolu Frm.	Akyar Frm.	D III erosion-accretion surface	Conkbayırı Frm.			Ergene Frm.	
Dacian	Zanclean	Eceabat Frm.						Alçıtepe Frm.	
	Messinian								
Pontian		Kilitbahir Frm.			Alçıtepe Member	Conkbayırı Frm.	Conkbayırı Frm.(Tec)	Kirazlı Frm.	Conkbayırı Frm.(Tec)
Pannonian	Tortonian		Eceabat Frm.	D II erosion surface	ECEABAT FORMATION	Ergene Group Çanakkale Frm.	Çanakkale Frm.(Tec) -Teb -Teg -Teç -Teg	Gazhanedere Frm.	Çanakkale Frm.(Tec) -Teb -Teg -Teç -Teg
Sarmatian									
Badenian	Serravalian	Miocene units:							
	Langhian	conglomerate claystone siltstone sandstone							
Karpatian						Kilitbahir Member			
Otnangian	Burdigalian			D I erosion surface					
Eggenburgian									
	Aquitanian								
Egerian						Pınallı Member			

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AIII Zone: *Cyprideis* sp.1 Zone:

Category: Abundance Zone

Age: Middle-Late Pannonian

Definition: This zone is characterized mainly by the abundance of *Cyprideis* sp.1 and the other ostracoda species in this zone: *Cyprideis torosa tuberculata* Tunoğlu and Ünal, *Cyprideis pannonica* Mehes, *Cyprideis trituberculata* Krstic, *Cyprideis torosa* Jones, *Cyprideis* cf. *seminulum* Reuss, *Candona parallela pannonica* Zalanyi, *Limnocythere* sp. 2, *Ilyocypris bradyi* Sars, *Ilyocypris pontica* Tunoğlu and Ünal.

Other palaeontologic and chronostratigraphic data: Sümengen et al. (1978) observed and determined the following microvertebrate fossil associations: *Byzantinia* sp., *Cricetulodon* sp., *Dakkamys* sp., *Progonomys* sp., *Miodyromys* sp. and attained Late Vallasian (Early-Middle Miocene) age to the unit.

Paleoecology: Sediments of this zone were deposited in lagoonal environment with temporary fresh water and marine influence (see Table 3).

Çizelge 2: Gelibolu Yarımadası Neojen birimlerinde ostrakod faunasının ve biyozonların dağılımı.

AIV Zone/*Cyprideis tuberculata* and *Cyprinotus salinus* Zone:

Category: Assemblage Zone

Age: Late Pannonian

Definition: This zone is characterized mainly by the abundance and first occurrence and last appearance of *Cyprideis tuberculata* and *Cyprinotus salinus* respectively. Other ostracoda species of this zone are *Cyprinotus salinus* Brady, *Loxoconcha* sp.1, *Loxoconcha* sp. 2, *Xestoleberis* sp., *Cyprideis tuberculata* Mehes, *Cyprideis quadrituberculata* Krstic, *Cyprideis hegzatuberculata* Tunoğlu and Ünal, *Cyprideis pannonica tuberculata* Tunoğlu and Ünal, *Cyprideis pannonica* Mehes, *Cyprideis trituberculata* Krstic, *Cyprideis torosa* Jones, *Cyprideis* cf. *seminulum* Reuss, *Cyprideis sublittoralis* Pokorny, *Cyprideis* sp. 2, *Candona parallela pannonica* Zalanyi, *Candona neglecta* Sars, *Ilyocypris bradyi* Sars.

Other paleontologic and chronostratigraphic data: The following brackish gastropoda species were observed in this study and determined by Yeşim İslamoğlu (MTA-General Directorate of

Table 2: Distribution of ostracoda and biozones in the Neogene units of Gelibolu Peninsula.

QUAT.	AGE	STAGE	SUBSTAGE	FORMATION	MEMBER	SYMBOL	THICKNESS (m)	LITHOLOGICAL SYMBOL	EXPLANATIONS	OSTRACODA SPECIES			
										Qa	Qd5		
MIDDLE - UPPER MIOCENE	PONTIAN			CONKBAYIRI		T ec	80 m.		conglomerate	A V	<i>Cyprideis pannonica</i> <i>Cyprideis torosa</i> <i>Paralimnocythere</i> sp.1 <i>Candona neglecta</i> <i>Candona caritida</i> <i>Limnocythere</i> sp.1 <i>Paralimnocythere</i> sp.2 <i>Candona</i> sp. <i>Ilyocypris</i> sp. <i>Loxoconcha</i> sp.1 <i>Limnocythere</i> sp.2 <i>Ilyocypris bradyi</i> <i>Cyprideis</i> cf. <i>seminulum</i> <i>Cyprideis quadrituberculata</i> <i>Ilyocypris pontica</i> nsp. <i>Candona parallela pannonica</i> <i>Cyprideis trituberculata</i> <i>Cyprideis</i> sp.1 <i>C. torosa tuberculata</i> n.ssp. <i>Cyprideis tuberculata</i> <i>C. hegzatuberculata</i> nsp. <i>Cyprideis</i> sp.2 <i>Loxoconcha</i> sp.2 <i>Cyprinotus salinus</i> <i>Xestoleberis</i> sp. <i>C. pannonica tuberculata</i> n.ssp. <i>Cyprideis sublittoralis</i>		
							300 m.		marl mudstone claystone sandstone conglomerate				
							110 m.		marl sandstone sandy limestone claystone conglomerate fossiliferous limestone mudstone				
							80 m.		claystone marl clayey limestone				
	PANNONIAN	Upper			ÇANKAYA (Tep)	Bayrak Tepesi	T ec b	200 m.		conglomerate cross bedded limestone marl sandstone	A II		
								80 m.		claystone marl clayey limestone			
		Middle-Late				ANAFARTA	Dere	T ec c	350 m.		conglomerate cross bedded limestone marl sandstone clayey limestone mudstone marl sandstone limestone sandstone	A I	
									200 m.		sandstone clayey limestone		
									80 m.		marl sandstone limestone sandstone		
									80 m.		marl sandstone limestone sandstone		
OLIGOCENE								Basement					

Mineral Research and Exploration): *Odostomia pal-lida minima* L. *Ijina*, *Emmericia maeotica* L. *Ijina* and *Odontostomia unidentata pseudoturrita* Sacco. These horizons are considered Late Miocene (Meotian). The following palynomorph genera and species were determined by Kaya Ertuğ (TPAO): *Pediastrum* spp., *Botryococcus* spp. and *Pityosporites* spp. sporomorphs. A lacustrine paleo-environment is interpreted for these sediments, as indicated by palynomorph assemblages.

Palaeoecology: Sediments of this zone were deposited in brackish water (lagoonal) and occasional lacustrine environmental conditions (see Table 3).

AV Zone/*Xestoleberis* sp. and *Cyprideis sublittoralis* Zone:

Category: Assemblage Zone

Age: Pontian

Definition: This zone starts mainly by the last appearance of *Cyprideis tuberculata* and *Cyprinotus salinus* species. Other ostracoda species of this zone are: *Candona neglecta* Sars, *Candona Candida* O. F. Müller, *Candona paralella pannonica* Zalanyi, *Ilyocypris pontica* n.sp., *Xestoleberis* sp., *Cyprideis pannonica* Mehes, *Cyprideis torosa* Jones, *Cyprideis*

Çizelge 3: Çalışma bölgesinin ostrakod faunasına bağlı ortamsal özellikleri (Moore, 1961 ve Morkhoven, 1962, 1963).

Table 3: The environments designated by ostracoda fauna of the investigation area (Moore, 1961 and Morkhoven, 1962, 1963).

ENVIRONMENT OSTRACODA GENUS	CONTINENTAL	LITTORAL	EPINERITIC	INFRANERITIC	BATHYAL	ABYSSAL
			SHALLOW SEA		DEEP SEA	
CANDONA	—	—				
ILYOCYPRIS	—	—				
CYPRINOTUS	—	—				
LIMNOCYTHERE	—	—				
PARALIMNOCYTHERE	—	—				
CYPRIDEIS	—	—	—	—		
XESTOLEBERIS	—	—	—	—	—	
LOXOCONCHA	—	—	—	—	—	

quadrifidulata Krstic, *Cyprideis trituberculata* Krstic, *Cyprideis torosa tuberculata* Tunoğlu and Ünal, *Cyprideis pannonica tuberculata* Tunoğlu and Ünal, *Cyprideis sublittoralis* Pokorny.

Other palaeontologic and chronostratigraphic data: Sümengen et al. (1987) has observed and determined in the following microvertebrate fossils in the same zone: *Hipparion* sp., *Miyomimus* cf. *dehmi*, *Occitanomys* sp., *Chilotherium habereri* (Schlosser) and assigned Turolian age to the unit by this fossil assemblage.

Palaeoecology: Sediments of this zone were deposited in the very shallow transitional zone with little fresh water influence (see Table 3).

INTERPRETATION

The biostratigraphic and chronostratigraphic subdivision of the Pannonian (Early, Middle, Late) and Pontian transitional and non-marine sediments has been established mainly by ostracoda. Microvertebrate and gastropoda fauna were also integrated to the biostratigraphic zones.

The Late Miocene of Paratethys has been divided into several zones based on the first appearances of the ostracoda genera *Aurila* and *Cyprideis* (Carbonnel and Jiricek, 1977; Jiricek and Riha, 1990). The first appearance of the genera *Cyprideis* and *Hipparion* in the Upper Volhynian and Middle Tortonian stages are very important for correlation and comparison among the Tethys and Paratethys basins (Jiricek and Riha, 1990).

The Pannonian sequence of the Central Paratethys has been divided into five ostracoda zones by Jiricek (1983) and Jiricek and Riha (1990). The lowermost zone of Pannonian stage is *Hungarocypris auriculata*-*Hemicytheria loerentheyi* zone. This zone has been observed and determined in the Sitrimon Basin in Austria, Hungary, Yugoslavia, Bulgaria, Romania, Ukraine (Jiricek, 1983; Jiricek and Riha, 1990) and Turkey (Gökçen, 1979).

The biozone A-1 (*Cyprideis pannonica*-*Cyprideis torosa* Zone) is defined in the lower Pannonian levels of the Gelibolu Peninsula. This zone is identified in the Gazhanedere member of Çanakkale Formation. *Candona Candida*, *C. neglecta*, *Cyprideis*

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pannonica, *C. torosa* and *Paralimnocythere* sp. 1 are the other members of the ostracoda assemblage of these levels. *Cyprideis pannonica* is observed in the zone NO-15 and zone NO-16 too (Jiricek and Riha, 1990). The A-1 zone does not contain the ostracoda genera *Hemicytheria*, *Amplocypris*, *Loxoconcha*, *Xestoleberis*, *Hungarocypris*, *Leptocythere* and *Amnicythere* and related species. This can be explained by pleoecologic and paleogeographic influences; that is, our investigation area is located at the southern border of central Paratethys and between Tethys and Paratethys area.

The Middle Pannonian is represented by the *Hungarocypris hieroglyphica*-*Amplocypris recta* Zone in the Central Paratethys (Styrian Basin). This zone is represented by zone NO-17 in Jiricek (1983) and Jiricek and Riha (1990). The same zone is recognized in the Vienna Basin, in Hungary, Yugoslavia, but in the Eastern Paratethys. This level can be correlated with the *Xestoleberis guretskyi* - *X. vidua* zone of the Chersonian beds in Bulgaria (Stancheva, 1965, 1972), Austria (Vienne Basin), Hungary and Yugoslavia. The Middle Pannonian is characterized by the first appearance and last occurrence of *Paralimnocythere* sp.1 and *Paralimnocythere* sp. 2 in the Gelibolu Peninsula. This zone contains 14 ostracoda species, three of them are observed and known only in this zone.

The Late Pannonian (Upper Meotian) corresponds to zone NO-18 (*Cyprideis sublittoralis*-*Lineocypris reticulata* Zone, Jiricek, 1983; Jiricek and Riha, 1990). This zone is also described in the Strian Basin, Vienna Basin, Hungary, Yugoslavia (Sokac, 1967). This zone corresponds to *Xestoleberis lubria*- *X. kristafovichii* zone at the Upper Meotian in Romania, Bulgaria, Ukraine (Jiricek, 1983), and in Turkey (Gökçen, 1979; Tunoğlu, 1984; Tunoğlu and Gökçen, 1985, 1991, 1995, 1997; Ünal; 1996; Ünal and Tunoğlu, 1996). The uppermost level of Pannonian stage in the Central Paratethys is characterized by the first appearance of the subgenus *Candona* (*Caspiolla*) (Jiricek and Riha, 1990).

Zone AIII (Çomrakdere member) is transitional between zone AI (Anafarta member) and Zone AIV (Bayraktepe member). This zone is characterized mainly by *Cyprideis* sp. 1 and contain ten ostracoda species. Zone AIV contains nineteen ostracoda species and is characterized by (first appearance and

last occurrence) *Cyprideis tuberculata* and *Cyprinotus salinus*. This zone is more diverse and rich than the other zones.

The Pontian stage of Paratethys (especially Central and Eastern Paratethys) has been divided into three ostracoda zones. The first occurrence of *Candona* (*Bakunella*) *dorsoarcuata* was recorded in the *Candona* (*Candona*) *balcanica*-*Candona* (*Candona*) *lobata* Zone (Jiricek, 1983; Jiricek and Riha, 1990). This zone has been identified in Turkey, (Tunoğlu, 1984, Tunoğlu and Gökçen, 1985, 1991, 1997). This zone corresponds to Lower Pontian (Novorossian) in Hungary, Yugoslavia, Czechoslovakia, Romania, Bulgaria, Ukraine, Azerbaidzhan and Turkey (Tunoğlu, 1984; Tunoğlu and Gökçen, 1985, 1991, 1997). Similar faunas have been observed in the Strimon Basin (Greece) at the Late Tortonian. These levels correspond with fresh water Lower Pontian of the Vienna and Late Tortonian of Rhone Basin (France), Upper Messinian of Italy, Messinian of Crete in Greece (Jiricek and Riha, 1990).

Candona (*Candona*) *acronasuta*-*Candona* (*Bakunella*) *dorsoarcuata* Zone corresponds to the Middle Pontian (Portaferrian) (Jiricek and Riha, 1990; Jiricek, 1983). Middle Pontian Zone is known as the "Upper Pannonian s.1" in Hungary, as Portaferrian in Yugoslavia, Romania, Bulgaria and Ukraine. This zone is known as the NO-21 code numbered and general ostracoda fauna assemblage have been given by Jiricek (1983) and Jiricek and Riha (1990). This faunal assemblage has also been observed in the Late Mesinian in Italy and Crete (Greece). This zone has been accepted choronostratigraphically in Upper Tortonian in Greece and Crete (Jiricek and Riha, 1990).

The Upper Pontian (Bosphorian) is represented by the *Candona* (*Candona*) *gracilis* and *Tyrrhenocythere filipescui* species and this zone is given NO-22 code numbered by Jiricek (1983) and Jiricek and Riha (1990). Zone NO-22 was observed only in the Eastern Paratethys of Romania. Jiricek and Riha (1990) mentioned that Upper Pontian beds were defined on the basis of the first appearance of *Tyrrhenocythere filipescui* and *Candona* (*Candona*) *gracilis* species in the Eastern Paratethys of Romania, Bulgaria, Ukraine, Greece and Italy .

Twelve ostracoda species are observed and deter-

mined in the Conkbaym formation of Gelibolu Peninsula at the Pontian stage. These are: *Cyprideis pannonica*, *C. torosa*, *C. quadrituberculata*, *C. trituberculata*, *C. torosa tuberculata* Tunoğlu and Ünal, *C. pannonica tuberculata* Tunoğlu and Ünal, *C. sublitorallis*, *Xestoleberis* sp., *Ilyocypris pontica* Tunoğlu and Ünal, *Candona neglecta*, *C. Candida*, *C. parallela pannonica*. Brackish *Cyprideis* genus and related species are dominant at the Pontian stage in the Conkbaym formation. Unfortunately, substages of Pontian of Çonkbaym formation could not be identified with above ostracoda fauna assemblages.

RESULTS

1. The chronostratigraphic subdivisions of Neogene sequence of Gelibolu Peninsula can be defined by ostracoda assemblage. Thus, Pannonian (Early, Middle, Late) and Pontian stage and substages are identified.

2. Five ostracoda biozones have been suggested by this investigation. These are: AI Zone-*Cyprideis pannonica* and *Cyprideis torosa* Zone, (Early Pannonian) AII Zone-*Limnocythere* sp.1 and *Paralimnocythere* sp.2 Zone, (Middle Pannonian), AIII Zone-*Cyprideis* sp. Zone, (Middle-Late Pannonian), AIV Zone-*Cyprideis tuberculata* and *Cyprinotus salinus* Zone, (Late Pannonian), AV Zone-*Xestoleberis* sp. and *Cyprideis sublittoralis* Zone (Pontian)

3. These results have been correlated with the other fauna and flora associations (especially microvertebrate fauna).

4. The study area was related to only Central Paratethys bioprovince during the Pannonian-Pontian stages, and especially Pannonic Basin (Serbia, Croatia, Macedonia, Bosnia).

5. Five ostracoda zones of this investigation can be correlated with NO-17, NO-18, NO-19 ostracoda zones of Pannonian substages and NO-20, NO-21, NO-22 ostracoda zones of Pontian substages of Jiricek (1982) and Jiricek & Riha (1990).

GENİŞLETİLMİŞ ÖZET

Gelibolu Yarımadasının güney yarısı boyunca geniş bir alanda yüzeylenen, Neojen yaşlı birimlerin ostrakod biyostratigrafisi ve kronostratigrafisi konulu bu çalışma, Tunoğlu ve Ünal (baskıda) ayrıntılı taksonomisi verilmiş olan ostrakod topluluğuna bağlı olarak gerçekleştirilmiştir.

Arazi çalışmaları ile toplam 300 örnek, 13 ayrı ölçülü kesit boyunca ve 7 nokta lokaliteden alınmıştır. Ostrakodlara yönelik mikropaleontolojik laboratuvar çalışmaları neticesinde, 8 ayrı acı ve tatlısu ostrakod cinsine ait, 12'si bilinen, ikisi yeni tür, ikisi yeni alttür ve 11 adedi isimlendirilememiş toplam 25 tür ayırtlanmış ve taksonomik olarak tanımlanmıştır (Ünal, 1996; Tunoğlu ve Ünal, baskıda).

Bu çalışma ile belirenen *Cyprideis pannonica* Mehes, *C. sublitorallis* (Pokorny), *C. tuberculata* (Meheş), *C. torosa tuberculata* Tunoğlu & Ünal, *C. cf. Seminulum* (Reuss), *C. trituberculata* Krstić, *C. quadrituberculata* Krstić, *C. hegzatuberculata* Tunoğlu & Ünal, *C. sp.1*, *Candona neglecta* (Sars), *C. Candida* (O. F. Muller), *C. parallela pannonica* (Zalanyi), *C. sp.*, *Ilyocypris bradyi* (Sars), *I. pontica* Tunoğlu & Ünal, *I. sp.*, *Limnocythere* sp.1, *Limnocythere* sp.2, *Paralimnocythere* sp.1, *Paralimnocythere* sp.2, *Loxoconcha* sp. 1 ve *Cyprinotus salinus* (Brady) ostrakod türleri ile buldukları kayalara kronostratigrafik olarak Pannoniyen (Erken, Orta, Geç) ve Ponsiyen yaşları verilmiştir. Ostrakod faunası ile elde edilen yaş verileri, örneklerde saptanmış diğer faunanın (gastropoda, mikroomurgalı, foraminifera, spor ve pollen) kronostratigrafik verileri ile karşılaştırılmış ve desteklenmiştir (Sümengen ve diğ., 1987).

Ostrakod faunasının ölçülü ve genelleştirilmiş stratigrafi kesitlerine bağlı olarak gösterdikleri dikey yayılım beş ayrı ostrakod biyozonunun varlığını ortaya koymuştur. Bunlar: Zone AI- *Cyprideis pannonica*-*Cyprideis torosa* Zonu, Zon AII-*Limnocythere* sp.1-*Paralimnocythere* sp. 2 Zonu, Zon AIII-*Cyprideis* sp.1 Zonu, Zon AIV-*Cyprideis tuberculata*-*Cyprinotus salinus* Zonu and Zon AV-*Xestoleberis* sp.-*Cyprideis sublittoralis* Zonu. AI, AII, AIII ve AIV zonları Pannoniyen katı kapsamında yer alırken, Zon V ise Ponsiyen katı içerisinde gözlenmektedir.

OSTRACODA BIOSTRATIGRAPHY AND CHRONOSTRATIGRAPHY

Tüm paleontolojik, biyostratigrafik ve kronostratigrafik veriler, ortamın oldukça sığ denizel koşullar çerçevesinde gelişmiş ve karadan tatlısu beslenmesinin de dönem dönem etkin olduğu bir lagüner, gösel ve deltaik unsurları barındıran bir geçiş ortamına ait olabileceğini göstermektedir.

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