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THE PALEOGEOGRAPHIC AND PALEOECOLOGIC CHARACTERISTICS OF THE MIOCENE AGED MOLLUSCAN FAUNA IN ANTALYA AND KASABA BASINS (WEST-CENTRAL TAURUS, SW TURKEY)

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ABSTRACT.- Throughout this study, the paleogeographical and paleoecological characteristics of the samples of the Miocene aged molluscan fauna have been described which identified in Antalya and Kasaba basins, in west and central Taurus. In addition to the presence of the species belonging to Tethys realm such as *Cingula ventricosella* Cerulli-Irelli, *Cerithium appenninicum dertosulcata Sacco,* and *Xenophora infundibulum* (Brocchi), the *Hydrobia (Hydrobia) frauenfeldi (Hoernes), Pirenella gamlitzensis gamlitzensis* (Hilber), *Irus (Paphirus) gregarius* Partsch and *Glossus (Cytherocardia)* cf. *deshayesi* (Kutassy) type species known in marinal stages of Central Paratethys are also found. Similarly, in Kasaba basin; together with the presence of the *Turritella terebralis turritissima* Sacco, *Conus antiquus* Lamarck, *Conus clavatulus* d'Orbigny, *Pecten benedictus* Lamarck and *Pecten fuschi* Fontannes known only in the Tethys province, the *Cerithium zejsneri* Putsch, *Divaricella ornata subornata* Hilber, *Pitar (Paradione) lilacinoides* Schaffer and *Venus (Antigona) burdigalensis producta* Schaffer type species restricted to Central Paratethys are found. Besides, it is known that, in the investigated basins, the rest of the fauna as a whole is widespread in both provinces. In order to make contribution to the environmental interpretations, the geochemical analyses have been carried out on 14 and 16 fossil casts from Antalya and Kasaba basins respectively. In this way, the fossil casts with aragonite composition have low Mg content. The 1000 Sr/Ca ratios are propotional to salinity. Consequently, the salinity of seawater in Miocene aged Antalya basin is lower than that of Kasaba basin during Upper Burdigalian (Karpatian- Ottnangian). This result is completely in agreement with the known paleoecological characteristics of the fauna. The Antalya and Kasaba basins are similar to intermontane molasse basins in the Alps and situated in the same orogenic belt. The all paleogeographic and paleoecological results indicate that, during the evolution of the Tethys, the similar events and Paratethys like environmental conditions were developed. For this reason, the stage names have been used mutually for the investigated basins. The determination of regional stages seems to be a need for the region as having its own special conditions.

INTRODUCTION

The examined samples have been obtained from the Miocene Antalya and Kasaba basins located in the east of Western Taurus and west of Central Taurus respectively (Fig. 1). This study aims to discuss the previously identified and determined age intervals of Molluscan species (İslamoğlu, 2001-2002; İslamoğlu and Taner, 2002) together with their paleogeographic distributions and stratigraphical levels.

THE PALEOGEOGRAPHIC AND PALEOECOLOGICAL CHARACTERISTICS OF THE IDENTIFIED MOLLUSCAN FAUNA IN INVESTIGATED AREAS

Antalya Miocene basin

In this basin, 84 molluscan species were identified and detailed stratigraphy of the basin has been established (İslamoğlu 2001-2002). In this way, the paleogeographical and paleoecological characteristics of the species belonging to class Bivalvia and Gastropoda identified in the Sevinç conglomerate, Oymapınar limestone, Altınkaya formation and Aksu formation of the basin are as following:

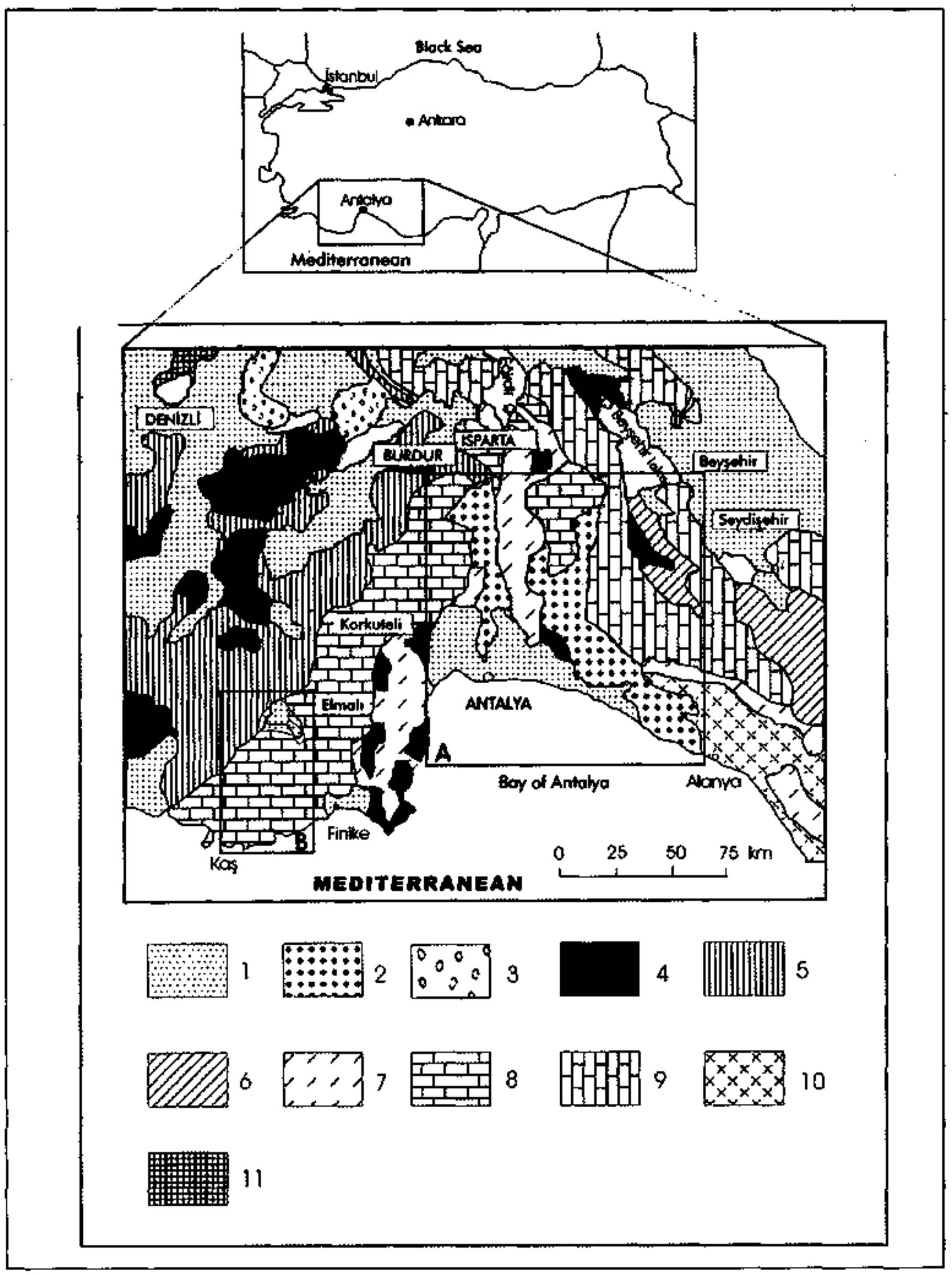

Fig. 1- Structural units in Antalya and Kasaba basins and in surrounding areas. A: Antalya Miocene basin, B: Kasaba Miocene basin, 1- Plio-Quaternary, 2- Miocene aged molasse basin, 3- Tavas- Burdur post-tectonic molasse basin, 4- Ophiolite nappes, 5- Lycian nappes, 6- Beyşehir -Hoyran - Hadim nappes, 7- Antalya nappes, 8- Beydağları autochthon, 9- Anamas- Akseki autochthon, 10- Alanya nappe, 11- Menderes massive (from Şenel, 1997).

The *Pecten (Aequipecten) scabrella bollenensis* (Mayer) yielding Upper Burdigalian age has been identified in Sevinç conglomerate and reflects the Tethys province and normal sea water salinity.

The *Pecten fuschi* Fontannes, *Anadara (Anadara) diluvii pertransversa* Sacco, *Carditamera (Lazariella) striatellata* (Sacco), *Cardiocardita* cf. *monilifera* (Dujardin), *Cardium kunstleri* Cossmann ve Peyrot, *Venus (Ventricoloidea) multilamella* (Lamarck), *Codakia leonina* (Basterot), *Athleta ficulina* (Lamarck), *Tellina (Peronaea) planata* Linne are found in Upper Burdigalian stage in Oymapınar limestone and they are also known to be present in Ottnangian and Karpatian stages of Central Paratethys. However, the *Pecten fuchsi* Fontannes, *Chlamys (Aequipecten) scabrella bollenensis* (Mayer) are only present in Tethys (Table 1a-b, 2 a-b and 4 a-b). The all identified fossil samples in this formation represent the environment having the normal sea water salinity.

The abundant molluscan fauna yielding Upper Burdigalian - Langhian (Ottnangian - Karpatian - Lower Badenian) age and refleo ting brackish water - marine environment has been found in Antalya Basin within the units of Altmkaya formation, the class Gastropoda including *Pirenella gamlitzensis gamlitzensis* (Hilber), *Terebralia bidentata cingulatior* Sacco, *Terebralia lignitara* (Eichwald), *Cerithium (Tiaracerithium) pseudotiarella* (d'Orbigny), *Nehtina picta* (Ferussac), *Hydrobia (Hydrobia) frauenfeldi* (Homes) and *Gastrana fragilis* (Linne), *Pelecyora (Cordiopsis) islandicoides* (Lamarck), *Irus (Paphirus) gregarius* Partscji of Bivalvia class have been found (Table 2 a b and 3 a-b). These species adapted an environment with relatively lower salinity than that of normal sea water. Of these fossils, *Pirenella gamlitzensis gamlitzensis* (Hilber), *Irus (Paphirus) gregarius* Partsch, *Hydrobia (Hydrobia) frauenfeldi* (Homes) like species are belonging to Central Paratethys (Table 3 a-b). The samples indicating normal sea water salinity are *Turritella (Turritella) turris* Basterot, *Turritella (Archimediella) bicarinata* Eichwald, *Triphora adversa miocenica* Cossmann ve Peyrot, *Conus conoponderosus* (Sacco), *Polinices (Polinices) redemptus* (Michelotti) which are wellknown both in Tethys and Central Paratethys facies (Table 3 a-b and 4 a-b). Most of the mollusc species in Altınkaya formation are present in both Lower - Middle Miocene stages of Tethys and marinal Ottnangian, Karpatian and Badenian stages of Central Paratehys. These are *Turritella (Turritella) turris* Basterot, *Tinostoma woodi* (Homes), *Nehtina picta* Ferussac, *Alvania (Alvania) venus* (d'Orbigny), *Terebralia bidentata cingulatior* Sacco, *Terebralia lignitara* (Eichwald), *Polinices (Polinices) redemptus* (Michelotti), *Natica millepunctata* Lamarck of class Gastropoda and *Pelecyora (Cordiopsis) islandicoides* Lamarck, *Gastrana fragilis* Linne, *Sanguinolaria (Soletellina) labordei* (Basterot), *Crassostrea gryphoides* (Schlotheim) of class Bivalvia (Table 1 a-b, 2 a-b, 3 a-b and 4 a-b). Except these species, the *Cerithium (Tiaracerithium) pseudotiarella* (d'Orbigny) and *Terebralia subcorrugata* d'Orbigny are only found in Lower Miocene in Tethys; whereas *Hydrobia (Hydrobia) frauenfeldi frauenfeldi* (Homes), *Irus (Paphirus) gregarius* Partsch, *Pirenella gamlitzensis gamlitzensis* (Hilber), *Glossus (Cytherocardia)* cf. *deshayesi* (Kutassy) are the species present in Ottnangian - Sarmatian epochs of Central Paratethys (Table 2 a-b and 3 a-b). Based on this, it is accepted that, it is better to use Upper Burdigalian together with Ottnangian - Karpatian stages for the age of the Altınkaya formation.

Table 1 a- The paleogeographic and stratigraphical distributions of the species of Class Bivalvia identified in Antalya and Kasaba Miocene basins. 1: Hoernes (1870), Schaffer (1910), Steininger (1963), Steininger et al. (1971); 2: Csepreghy- Meznerics (1954), Dulai (1996); 3: Kojumdgieva and Strachimirov (1960), Kojumdgieva (1969); 4: Moisescu (1955-1994), Hinculov (1968), Ionesi and Nicorici (1994); 5: Studencka (1986-1994), Studencka and Studencki (1988); 6: Hölzl (1958); 7: Tejkal et al. (1967), Ondrejickova (1972), Ctyroky et al. (1973); 8: Korobkov (1954), Nevesskaya (1993).

BIVALVIA	CENTRAL PARATETHYS							EASTERN PARATETHYS				
	Austria	Hungary	Bulgaria	Romania	Polonia	Germany	Slovakia	Ukrania	Georgia	Moldavia	Caucasia	Old S.S.S.R.
	1	2	3	4	5	6	7	8				
Barbatia (B.) cf. *barbata* (Linne)	Egb., K., Bd.	K.,Ott., Bd.	Bd.	Bd.	Bd.			G.Bd.		G.Bd.	Kon.	
Anadara (A.) diluvii (Lamarck)	Eg.- Bd.	E.Bd.	Bd.	Bd.	Bd.		Egb.	Tr.,Çk.	Sak.	G.Bd.		
Anadara (A.) diluvii pertransversa Sacco	Bd.	Ott.		G.Bd.								
Anadara (A.) fichteli (Deshayes)	Egb.	K.				Egb.	Egb.					
Anadara (A.) turonica (Dujardin)	Egb.-Bd.		Bd.	Bd.	Egb. -Bd.		Bd.	G.Bd.	Kon.	G.Bd.	Kon.	Sak.,Tr., Çk., Kon.
Glycymeris pilosa deshayesi (Mayer)	Bd.	Bd.	Bd.	Bd.	Bd.			Tr.,G.Bd.	Sak.			
Glycymeris (G.) bimaculatus (Poli)	Bd.			Bd.								
Glycymeris (G.) cor (Lamarck)	Egb.	Egb.				Egb.	Egb.					Sak.
Glycymeris (G.) inflatus (Brocchi)												
Amusium cristatum (Bronn)	K.- Bd.				Bd.							
Chlamys (A.) scabrella bollenensis (Mayer)												
Chlamys (M.) latissima praecedens (Sacco)												
Pecten benedictus Lamarck												
Pecten fuschi Fontannes												
Pecten zizinae Blanckenhorn												
Pecten (Flabellipecten) solarium Lamarck	Bd.	Bd.	Bd.	Bd.	Bd.							
Spondylus crassicosta ornatulina Sacco		Bd.										
Anomia (A.) ephippium rugulosostriata (Bronn)	Egb.- Bd.	Bd.	Bd.	Bd.	Bd.							
Pycnodonta germanitala (De Gregorio)												
Ostrea lamellosa Brocchi	Egb.	Egb., Bd.		Bd.								Tr.
Crassostrea gryphoides (Schafler)	Egb., Bd.	Egb., Ott.,Bd.		Bd.	Bd.			Bd.- E.Sr.	Tr.			Tr., Kon.
Codakia leonina (Basterot)	Bd.	Bd.	Bd.				Bd.					
Linga (L.) columbella strictula Sacco				Bd.								
Loripes (L.) dujardini (Deshayes)	K.- Bd.		Bd.	Bd.	Bd.- Sr.		Bd.					Tr.- Çk.
Parvilucina (Microloripes) dentatus (Defrance)	Eg.- Bd.		Bd.- E.Sr.				Bd.	G.Bd.- E.Sr.		G.Bd.- E.Sr.	Tr., Çk., Kon.	
Megaxinus bellardianus (Mayer)		K., Bd.										
Megaxinus transversus rotundula Sacco												
Megaxinus (M.) ellipticus (Borson)					Bd.							

Table 1 b- Continue 1 a- 9: Dollfuss and Dautzenberg (1902), Deperet and Roman (1902-12), Cossmann and Peyrot (1914-1919), Roger (1939); 10: Sacco (1897-1898-1899-1901), Venzo and Pelosio (1963), Tavani and Tongiorgi (1963), Robba (1968), Sırna and Masullo (1978); 11 and 12: Malatesta (1960-1974); 13: Erünal-Erentöz (1958), 14: İslamoğlu (2001-2002) and 15: İslamoğlu and Taner (2002).

BIVALVIA	TETHYS								
	France	Italy	Portugal	Medit.	TURKEY				
					Karaman	Adana	Hatay	Antalya	Kasaba
	9	10	11	12	13			14	15
Barbatia (B.) cf. *barbata* (Linne)	B-O.M	G B T Pl							L (E.Bd)
Anadara (A.) diluvii (Lamarck)	G B	T	O M . T	Pl -Gun	G B			G B =Ott-K E T	G B-L (G Egb-E Bd)
Anadara (A.) diluvii pertransversa Sacco	O M	T - P	Pl		G B		Pl	G B (Ott-K)	
Anadara (A.) fichteli (Deshayes)	B	G B S T			G B				G B (G.Egb-K)
Anadara (A.) turonica (Dujardin)	A . B	G B	B		G B	T			L (E Bd)
Glycymeris pilosa deshayesi (Mayer)	G B.O M	G B	O M.						G B-L (G Egb-E Bd)
Glycymeris (G.) bimaculatus (Poli)	B	B T . Pl	T						G B (G Egb-K)
Glycymeris (G.) cor (Lamarck)		B - Pl	T Pl			T			G.B-L (G Egb-E Bd)
Glycymeris (G.) inflatus (Brocchi)	O M	B . Pl		Pl - Gun	G B				L (E Bd)
Amusium cristatum (Bronn)		G B -Pl			G B		Pl		L (E Bd)
Chlamys (A.) scabrella bollenensis (Mayer)	B . T . Pl.							G B (Ott-K), E.T	
Chlamys (M.) latissima praecedens (Sacco)		G B							G B. (G Egb-K)
Pecten benedictus Lamarck	B								G B (G Egb-K)
Pecten fuschi Fontannes	B -O M	B						G B (Ott-K)	L (E Bd)
Pecten zizinae Blanckenhorn	B								G B. (G Egb-K)
Pecten (Flabellipecten) solarium Lamarck	B -O M				G B				L (E Bd)
Spondylus crassicosta ornatulina Sacco		Pl			G B			L (E Bd)	
Anomia (A.) ephippium rugulosostriata (Bronn)	A - Pl	A B S T	O M -Pl						L (E Bd)
Pycnodonta germanitala (De Gregorio)		T Pl			G B			L (E Bd)	L (E Bd)
Ostrea lamellosa Brocchi	G B - O M	Pl	O M -T	Pl				G B -L (Ott-E Bd)	
Crassostrea gryphoides (Schaffer)	A - B	B T Ms Pl			G B	T		L (E Bd)	
Codakia leonina (Basterot)	A . E B	B Pl	O M	Pl - Gun					L (E Bd)
Linga (L.) columbella strictula Sacco	G B -O M	T Pl						E T	
Loripes (L.) dujardini (Deshayes)	A - B	T Pl						E T	
Parvilucina (Microloripes) dentatus (Defrance)	B	G B T Pl						E T	
Megaxinus bellardianus (Mayer)	A O M	Ol A B S T Pl						G B (Ott-K) E T	
Megaxinus transversus rotundula Sacco		Pl	A					E T	
Megaxinus (M.) ellipticus (Borson)	Pl	T - Pl						E T	

Table 2 a- The paleogeographic and stratigraphical distributions of the species of Class Bivalvia identified in Antalya and Kasaba Miocene basins. 1: Hoernes (1870), Schaffer (1910), Steininger (1963), Steininger et al. (1971); 2: Csepreghy-Meznerics (1954), Dulai (1996); 3: Kojumdgieva and Strachimirov (1960); 4 : Hinculov (1968), Ionesi and Nicorici (1994); 5: Studecka and Studencki (1988), 6: Hölzl (1958), 7: Pfister and Wegmüller (1998); 8: Nevesskaya (1993).

BIVALVIA	CENTRAL PARATETHYS							EASTERN PARATETHYS				
	Austria	Hungary	Bulgaria	Romania	Polonia	Germany	Switzerland	Ukrania	Georgia	Moldavia	Caucasia	Old S.S.S.R.
	1	2	3	4	5	6	7	8				
Divaricella ornata subornata Hilber		Bd.										
Pseudochama gryphina taurolunata Sacco												
Carditamera (L.) striatellata (Sacco)	Bd.	K., Bd.	Bd.									
Cardiocardita cf. *monilifera* (Dujardin)												Sak.
Cardum kunstleri Cossman ve Peyrol					Bd.		Egb.					
Cardium praeaculeatum Hölzl						Egb.						
Acanthocardia (A.) turonica Mayer	Bd.											
Nemocardium spondyloides (Hauer)	Egb.	Bd.		Bd.	Bd.		Egb.		Sak.			
Nemocardium spondyloides herculeum D.C.G.	Ott.- Bd.											Sak.
Laevicardium (L.) oblongum (Chemnitz)												Sak.
Lutraria (P.) oblonga Chemnitz	Bd.	E. Bd.		Bd.	Bd.							
Tellina (Peronaea) planata Linne	Egb.- Bd.	Egb.	Bd.	Bd.	Bd.			Bd.	Sak.	Bd.	Kon.	
Gastrana fragilis (Linne)	Bd.	Bd.		Bd.	Bd.							Kon.-E.Sr.
Sanguinolaria (Soletellina) labordei (Basterot)		Ott,K,Bd										Kon.-E.Sr.
Glossus (C.) cf. *deshayesi perlongata* (Kulassy)					Bd.							
Venus (V.) excentrica Agassiz												
Venus (A.) burdigalensis producta Schaffer	Egb.											
Venus (Ventricoloidea) multilamella (Lamarck)	Eg. -Bd.	Eg.- Bd.		Bd.								Sak.
Pitar (P.) rudis (Poli)	K.-Bd.	Bd.	Bd.									Tr.- Çk.
Pitar (Paradione) lilacinoides (Schaffer)	Egb.					Egb.						
Callista (Callista) chione (Linne)		Bd.		Bd.	Bd.							Sak,Tr, Kon
Pelecyora (C.) islandicoides (Lamarck)	Egb.- Bd	E.Bd.	Bd.	Bd.	Bd.			Sak,Bd.	Sak.	Bd.		Kon.
Pelecyora (C.) polytropa suborbicularis (Goldfuss)						Ol.-E.M.						
Dosinia lupinus (Linne)	Egb.- Bd.							Bd.	Sak., Çk.	Bd.	Kon.	
Irus (P.) gregarius gregarius Partsch	K.-E.Sr.	O.Sr.		E.Sr.	E.Sr.							O.Sr.
Corbula (Varicorbula) gibba (Olivi)	Eg.- Bd.											Ol., M.
Panopea (P.) menardi (Deshayes)	Egb.	Eg.			Bd.							Sak.- Tr.

Table 2 b- Continue 2 a- 9: Dollfuss and Dautzenberg (1902), Cossmann-Peyrot (1909-1912); 10: Sacco (1899, 1900-1901), Venzo and Pelosio (1963), Sırna and Masullo (1978); 11 and 12: Malatesta (1960 - 1974), 13: Erünal-Erentöz (1958), 14: İslamoğlu (2001-2002) and 15: İslamoğlu and Taner (2002).

BIVALVIA	TETHYS								
	France	Italy	Portugal	Meditt.	TURKEY				
					Karaman	Adana	Hatay	Antalya	Kasaba
	9	10	11	12	13			14	15
Divaricella ornata subornata Hilber									L (E.Bd)
Pseudochama gryphina taurolunata Sacco		B.,T.,Pl.							L (E.Bd)
Carditamera (L.) striatellata (Sacco)	A., E.B.	B.						G.B. (Ott-K)	
Cardiocardita cf. *monilifera* (Dujardin)	G.B.							G.B. (Ott-K)	
Cardum kunstleri Cossman ve Peyrot	G.B.	T.						G.B. (Ott-K)	
Cardium praeaculeatum Hölzl									G.B. (G.Egb.-E.Bd)
Acanthocardia (A.) turonica Mayer	G.B.	T., Pl.						G.B. (Ott-K)	
Nemocardium spondyloides (Hauer)	G.B., O.M.	G.B.	T.						G.B. (G.Egb.-E.Bd)
Nemocardium spondyloides herculeum D.Ç.G.	G.B.								L (E.Bd)
Laevicardium (L.) oblongum (Chemnitz)		T., Pl.	O.M.-T.					E.T.	
Lutraria (P.) oblonga Chemnitz	G.B.-O.M.	B.,T.,Pl.			G.B.	T.			G.B. (G.Egb.-E.Bd)
Tellina (Peronaea) planata Linne	B.- O.M.	T.- Pl.					Pl.	G.B=Ott-K; E.T.	
Gastrana fragilis (Linne)	B.- O.M.	Pl.						G.B. (Ott-K)	
Sanguinolaria (Soletellina) labordei (Basterot)	B.	Pl.						G.B. (Ott-K)	
Glossus (C.) cf. *deshayesi perlongata* (Kutassy)								G.B. (Ott-K)	
Venus (V.) excentrica Agassız	G.B., Pl.	T., Pl.						L. (E. Bd.)	
Venus (A.) burdigalensis producta Schaffer									G.B.(G.Egb.- K.)
Venus (Ventricoloidea) multilamella (Lamarck)	G.B.-O.M.	T., Pl.	T., Pl.	P.-Gün	G.B.		Pl.	G.B. (Ott-K)	G.B.-L. (G. Egb.-K)
Pitar (P.) rudis (Poli)	G.B.-O.M.	B., T., Pl.					Pl.	G.B. (Ott-K)	
Pitar (Paradione) lilacinoides (Schaffer)									G.B.-L. (G. Egb.-K)
Callista (Callista) chione (Linne)	G.B., O.M.	B., Pl.	Pl., P.						G.B.-L. (G. Egb.-K)
Pelecyora (C.) islandicoides (Lamarck)	O.M.	T., Pl.			G.B.			G.B. (Ott-K)	
Pelecyora (C.) polytropa suborbicularis (Goldfuss)								G.B. (Ott-K)	
Dosinia lupinus (Linne)	G.B.	Ol.-Pl.			G.B.			G.B. (Ott-K)	
Irus (P.) gregarius gregarius Partsch								G.B. (Ott-K)	
Corbula (Varicorbula) gibba (Olivi)	G.Eosen			Pl.-Gün					L (E.Bd)
Panopea (P.) menardi (Deshayes)		G.Ol.-T.							G.B. (G. Egb-K.)

Table 3 a- The paleogeographic and stratigraphical distributions of the species of Class Gastropoda identified in Antalya and Kasaba Miocene basins. 1: Hoernes (1856), Papp (1952), Steininger et al. (1978); 2: Strausz (1966), 3: Friedberg (1914 1954-55), 4: Moisescu (1955), Hinculov (1968); 5: Kojumdgieva and Strachimirov (1960); 6: Iliana (1993).

GASTROPODA	CENTRAL RARATETHYS					EASTERN PARATETHYS
	AUSTRİA	HUNGARY	POLONIA	ROMANIA	BULGARIA	Old S.S.S.R.
	1	2	3	4	5	6
Gibbula (G) maga Linne						
Tinostoma woodi (Hoernes)	Ott -Bd		Bd .			
Astraea (Bolma) rugosa (Linne)						
Neritina picta (Ferussac)			Bd..	Bd..- O. Sr.		Kr., Kon , Sr
Hydrobia (H) frauenfeldi (Hoernes)	Ott.-O.Sr	O Sr	Bd. -Sr	O. Sr.	Sr.	Kr , Kon , Sr.
Cingula (P.) ventricosella (Cerulli-Irelli)						
Alvania ispartaensis n sp						
Alvania (Alvania) curta (Dujardin)						
Alvania (A) venus (d'Orbigny)	Egb - Bd	Egb.-Bd				
Alvania tanerae n sp						
Turritella terebralis turritissima Sacco						
Turritella terebralis subagibbosa Sacco						
Turritella (T) tricarinata (Brocchi)						
Turritella (T) turris Basterot			K -Bd			
Turritella (Haustator) striatellatus Sacco						
Turritella (H) tricincta Borson	Bd		Bd.			
Turritella (Zaria) spirata (Brocchi)	Egb.- Bd.	Bd	Bd			Tr - Çk - Kon
Turritella (Z.) subangulata (Brocchi)	Bd.					
Turritella (A) bicarinata Eichwald	E. Bd.	E Bd.	E. Bd		Egb., Pl.	Tr., Çk., Kon
Turritella (Peyrotia) desmarestina Basterot						
Pirenella gamlitzensis gamlitzensis (Hilber)	K	Bd.-O. Sr		Bd..-O Sr		Kr., Kon., Sr
Terebralia bidentata cingulatior Sacco						
Terebralia lignitara (Eichwald)	K , Bd., Sr	Bd.	Bd..-Sr		Bd	Kon. Sr
Terebralia lignitara lignitara (Eichwald)			Bd., Sr.	Bd , Sr		
Terebralia subcorrugata d'Orbigny						
Cerithium appenninicum dertosulcata Sacco						
Cerithium zejsneri Pustch	Bd		Bd.			
Cerithium (P) turritoplicatum Sacco		Bd				
Cerithium (T) pseudotiarella d'Orbigny						
Cerithium (T) europaeum graciliornata Sacco	K.-Bd.	Bd..	Bd..			
Cerithium (T) vulgatum miocenicum Vignal						
Triphora adversa miocenica Coss. ve Pey.						
Chrysallida (Parthenina) interstincta (Mayer)		Bd .	Bd .			Tr . Çk. . Kon
Odostomia (Megastomia) conoidea (Brocchi)						
Turbonilla (Mormula) aturensis (Coss ve Pey)						
Xenophora deshayesi (Michelotti)	Eg.- Bd.	Bd..	Bd..	E Bd..		
Xenophora infundibulum (Brocchi)						

Table 3 b- Continue 3 a- 7: Cossmann-Peyrot (1919 -1924), Vignal (1910); 8: Sacco (1895 -1896), Venzo and Pelosio (1963), Greco (1970); 9: Wenz (1938-44), Malatesta (1960-1974); 10: Erünal-Erentöz (1958); 11: İslamoğlu (2001-2002) and 12: İslamoğlu and Taner (2002).

GASTROPODA	TETHYS							
	FRANCE	ITALY	MEDİTERR.	TURKEY				
				Karaman	Adana	Hatay	Antalya	Kasaba
	7	8	9	10			11	12
Gibbula (G.) maga Linne		T.-P.	Gun.					
Tinostoma woodi (Hoernes)		G. B.-T.					G.B. (Ott.- K.)	
Astraea (Bolma) rugosa (Linne)		T., Pl.		G. B.			E. T	
Neritina picta (Ferussac)	G.B	G. B					G B. (Ott.- K.)	
Hydrobia (H.) frauenfeldi (Hoernes)							G.B. (Ott - K.)	
Cingula (P.) ventricosella (Cerulli-Irelli)			Gün				E. T.	
Alvania ispartaensis n. sp							G.B. (Ott.- K.)	
Alvania (Alvania) curta (Dujardin)	B	T.-E. Ms					G.B. (Ott.-K), E T	
Alvania (A.) venus (d'Orbigny)	A.-B						G.B (Ott.-K), E T	
Alvania tanerae n. sp.							E. T.	
Turritella terebralis turritissima Sacco	E. B.							G B. (G.Egb-K)
Turritella terebralis subagibbosa Sacco		G. B						G.B. (G.Egb-K).
Turritella (T.) incarinata (Brocchi)		G B.- P	Gün				G.B. (Ott - K.)	G.B. (G.Egb-K)
Turritella (T.) turris Basterot	A.-E. B							G.B.-L (G. Egb.-E. Bd)
Turritella (Haustator) striatellatus Sacco		G. B.						G.B (G.Egb-K)
Turritella (H.) tricincta Borson		T., Pl.		G. B.				G.B.-L (G. Egb.-E Bd)
Turritella (Zaria) spirata (Brocchi)		G. B.- P					G.B. (Ott.-K), E.T.	L. (E. Bd.)
Turritella (Z.) subangulata (Brocchi)	G B	G. B., Pl.			T.	Pl.		G B (G.Egb-K)
Turritella (A.) bicarinata Eichwald	G B	T		G. B			G B. (Ott.-K), E.T	L (E. Bd.)
Turritella (Peyrotia) desmarestina Basterot	A.	G. B						G.B. (G Egb-K)
Pirenella gamlitzensis gamlitzensis (Hilber)							G.B. (Ott.- K.)	
Terebralia bidentata cingulatior Sacco		G B			G B		G B. (Ott.- K.)	
Terebralia lignitara (Eichwald)	A.- T				O M.		G B. (Ott.- K.)	
Terebralia lignitara lignitara (Eichwald)							G B. (Ott.- K.)	
Terebralia subcorrugata d'Orbigny	A.-B						G.B. (Ott.- K.)	
Cerithium appenninicum dertosulcata Sacco		T.					E. T.	
Cerithium zejsneri Pusch								L (E. Bd.)
Cerithium (P.) turritoplicatum Sacco		G B					G.B. (Ott.- K.)	L. (E. Bd.)
Cerithium (T.) pseudotiarella d'Orbigny	A.- B.	G. B					G.B (Ott.- K.)	
Cerithium (T.) europaeum graciliornata Sacco		T., Pl.					G.B. (Ott.- K.)	
Cerithium (T.) vulgatum miocenicum Vignal	A.-B						G.B. (Ott.- K.)	
Triphora adversa miocenica Coss. ve Pey	B						G. B. (Ott. - K.)	
Chrysallida (Parthenina) interstincta (Mayer)	G.B	T., Ms., P.	Gün.				G B. (Ott.-K), E T	
Odostomia (Megastomia) conoidea (Brocchi)		T., Pl.					E. T.	
Turbonilla (Mormula) aturensis (Coss. ve Pey.)	A							G B. (G.Egb-K)
Xenophora deshayesi (Michelotti)	G. B.	Ol., B., Pl.		G. B				G.B.-L (G. Egb.-E Bd)
Xenophora infundibulum (Brocchi)		T., Pl					E. T.	

Table 4 a- The paleogeographic and stratigraphical distributions of the species of Class Gastropoda identified in Antalya and Kasaba Miocene basins. 1: Hoernes (1856), Steininger et al. (1971); 2: Csepreghy-Meznerics (1954), Strausz (1966"), 3: Kojumdgieva and Strachimirov (1960); 4: Hinculov (1968); 5: Friedberg (1911-28, 1954), 6: Iliana (1993).

GASTROPODA	CENTRAL PARATETHYS					EASTERN PARATETHYS
	Austria	Hungary	Bulgaria	Romania	Polonia	Old S.S.S.R.
	1	2	3	4	5	6
Aporrhais pespelecani (Linne)	Bd.	Bd.	Bd.		Bd.	Tr.
Strombus coronatus Defrance	Eg., K., Bd.			E.Bd.		
Strombus coronatus compressonana Sacco						
Strombus bonelli Brongniart	Bd.	K.- Bd.	Bd.		Bd.	
Erato (E.) laevis elongata Sacco		K.- Bd.	Bd.		Bd.	
Cypraea (B.) fabagina Lamarck	Bd.	Bd.	Bd.		Bd.	
Cypraea (B.) fabagina mioporcellus Sacco						
Cypraea (A.) subamygdalum d'Orbigny						
Polinices (Polinices) redemptus (Michelotti)	Bd.	Bd.		Bd.	Bd.	
Natica millepunctata Lamarck	K.- Bd.	Bd.	Bd.	Bd.	Bd.	Tr., Çk., Kr., Kon.
Cassidaria tauropomum (Sacco)						
Cassis (C.) mamillaris postmammilaris S.						
Distorsio (Rhysema) tortuosa (Borson)			Bd.			
Charonia stefaninii (Monterosato)						
Ficus geometra (Borson)	Egb.				Bd.	
Murex (Bolinus) subtorularius Hoernes-Auinger	K.- Bd.	Bd.	Bd.	Bd.	Bd.	
Hadriana becki (Michelotti)						
Mitrella (M.) liguloides (Doderlein)						
Mitrella (M.) nassoides grateloupi Peyrot						
Galeodes cornutus (Agassiz)	K., Bd.		Bd.			
Arcularia (A.) ringicula (Bellardi)						
Hinia (Uzita) porrecta (Bellardi)						
Latirus (Dolichalatirus) dispar (Peyrot)	Ott.-Bd.	Ott.-Bd.	Ott.-Bd.		Ott.-Bd.	
Ancilla (B.) glandiformis (Lamarck)	Bd.	Bd.	Bd.	Bd.	Bd.	
Ancilla (B.) obsoleta (Brocchi)	Ott.-Bd.	Bd.			Bd.	
Vexillum (U.) pluricostata percostulata (Sacco)						
Mitra (M.) fusiformis (Brocchi)						
Athleta ficulina (Lamarck)						
Athleta (A.) rarispina (Lamarck)	Eg.- Bd.	Bd.	Bd.	Bd.	Bd.	
Voluta erentoezae n. sp.						
Gibberulina (G.) philippi (B.D.D.)	Bd.	Bd.			Bd.	
Clavatula asperulata (Lamarck)	Bd.	Bd.			K.	
Clavatula (C.) calcarata francisci (Toula)						
Mangelia cf. brachystoma (Philippi)						
Conus antiquus Lamarck						
Conus clavatulus d'Orbigny						
Conus conoponderosus (Sacco)						
Conus mercati Brocchi						
Conus striatulus Brocchi						
Conus (Chelyconus) fuscocingulatus Bronn		Bd.		Bd.		
Conus (Chelyconus) puschi Michelotti	K.- Bd.					
Conus (Conolithus) dujardini Deshayes	K. - Bd.	K. - Bd.	K. - Bd.	K. - Bd.		
Subula (Oxymeris) plicaria (Basterot)	Bd.	Bd.			Bd.	

Table 4 b- Continue 4 a- 7: Cossmann-Peyrot (1924), Peyrot (1928,1931,1932); 8: Malatesta (1960,1974); 9: Sacco (1891,1893,1904), Moroni (1953), Venzo and Pelosio (1966), Hall (1964), Robba (1968), Davoli (1972-1990); 10 and 11: Malatesta (1960,1974); 12: Erünal-Erentöz (1958); 13: İslamoğlu (2001-2002) and 14: İslamoğlu and Taner (2002).

GASTROPODA	TETHYS								
	France	Algeria	Italy	Portugal	Medit.	TURKEY			
						Karaman	Hatay	Antalya	Kasaba
	7	8	9	10	11	12		13	14
Aporrhais pespelecani (Linne)	G.B.-O.M.	Pl	O.M.-G.M						L. (E.Bd)
Strombus coronatus Defrance	G.B.	Pl	Pl			G.B		E.T	
Strombus coronatus compressonana Sacco			Pl					E.T	
Strombus bonelli Brongniart	A.. E.B.		G.B.					E.T	L (E.Bd)
Erato (E.) laevis elongata Sacco			G.B., T.. Pl.					E.T.	
Cypraea (B.) fabagina Lamarck	E.B.		G.B.			G.B.		E.T.	G.B-L (G.Egb.-E.Bd)
Cypraea (B.) fabagina mioporcellus Sacco			T.					E.T.	
Cypraea (A.) subamygdalum d'Orbigny	B.- O.M.		G.B.. T.					E.T.	
Polinices (Polinices) redemptus (Michelotti)	G.B		T			G.B		G.B (Ott-K)	L. (E.Bd)
Natica millepunctata Lamarck			G.B.. T.. Pl.		Gun	G.B	Pl.	E.T	G.B-L (G.Egb.-E.Bd)
Cassidaria tauropomum (Sacco)			Ot - B						G.B. (G.Egb-K)
Cassis (C.) mamillaris postmammilaris S									
Distorsio (Rhysema) tortuosa (Borson)	A. - O.M		G.B. - Pl.						L. (E.Bd)
Charonia stefaninii (Monterosato)			T.					E.T.	
Ficus geometra (Borson)		Pl	G.B.,T.,Pl.						G.B-L (G.Egb.-E.Bd)
Murex (Bolinus) sublorularius Hoernes-Auinger						G.B			L (E.Bd)
Hadriana becki (Michelotti)			T.. Pl					E.T.	
Mitrella (M.) ligutoides (Doderlein)			T					E.T	
Mitrella (M.) nassoides grateloupi Peyrot	B. - O.M								L (E.Bd)
Galeodes cornutus (Agassiz)	B. - O.M.		G.B. - T			G.B.		E.T	G.B-L (G.Egb.-E.Bd)
Arcularia (A.) ringicula (Bellardi)			T.					E.T.	
Hinia (Uzita) porrecta (Bellardi)			T.					E.T	
Latirus (Dolichalatirus) dispar (Peyrot)	G.B.		T.					E.T.	L. (E.Bd)
Ancilla (B.) glandiformis (Lamarck)	B.- O.M.		G.B.- Ms.	O.M. - T.					G.B-L (G.Egb.-E.Bd)
Ancilla (B.) obsoleta (Brocchi)	G.B.-O.M		T.. Ms.						G.B. (G.Egb-K)
Vexillum (U.) pluricostata percostulata (Sacco)			G.B.						G.B (G.Egb-K)
Mitra (M.) fusiformis (Brocchi)	Pl.		Pl			G.B.		E.T	
Athleta ficulina (Lamarck)	E.B.		G.B.			G.B		G.B.(Ott-K). E.T.	G.B (G.Egb-K)
Athleta (A.) rarispina (Lamarck)	B.-O.M		T.	T.			Pl.	E.T	G.B (G.Egb-K)
Voluta erentoezae n. sp								E.T	
Gibberulina (G.) philippi (B.D.D.)			T.- Gün.					E.T.	
Clavatula asperulata (Lamarck)	A.- B.		G.B.						G.B-L (G.Egb.-E.Bd)
Clavatula (C.) calcarata francisci (Toula)						G.B.	Pl.		L. (E.Bd)
Mangelia cf. brachystoma (Philippi)			T.- Pl.		Gun			E.T.	
Conus antiquus Lamarck	B. - O.M		B.. S.. T.						L (E.Bd)
Conus clavatulus d'Orbigny	B.- Pl		G.B						L. (E.Bd)
Conus conoponderosus (Sacco)			G.B.. T					G.B.(Ott-K). E.T	L. (E.Bd)
Conus mercati Brocchi	G.B.							E.T	L. (E.Bd)
Conus striatulus Brocchi			G.B.. T.. Pl.					G.B.(Ott-K). E.T.	
Conus (Chelyconus) fuscocingulatus Bronn			T.					E.T.	
Conus (Chelyconus) puschi Michelotti	G.B		G.B.. S.. T.						G.B-L (G.Egb.-E.Bd)
Conus (Conolithus) dujardini Deshayes	G.B.- O.M.		G.B.. T.. Pl.			G.B.		E.T.	G.B. (G.Egb-K)
Subula (Oxymeris) plicaria (Basterot)	A. - B.		Pl.			G.B			

In Aksu formation, the *Gibbula (Gibbula) maga* Linne, *Hadriani becki* (Michelotti), *Mitrella (Mitrella) liguloides* (Doderlein), *Mangelia* cf. *brachystoma* (Philippi), *Cerithium appenninicum dertosulcata* Sacco, *Odostomia (Megastomia) conoidea* (Brocchi), *Xenophora infundibulum* (Brocchi), *Arcularia (Arcularia) ringicula* (Bellardi), *Charonia stefaninii* (Montarano), *Hinia (Uzita) porrecta* (Bellardi), *Cypraea (Bernaya) fabagina mioporcellus* Sacco, *Conus conoponderosus* (Sacco) of class Gastropoda and *Megaxinus transversus rotundula* Sacco of class Bivalvia are the species appeared at the beginning of the Tortonian only in Tethys (Table 1 a-b, 3 a-b and 4 a-b).

Apart from these, the species like *Alvania (Alvania) curta* (Dujardin), *Mitra (Mitra) fusiformis* Brocchi, *Conus mercati* Brocchi, *Astraea (Bolma) rugosa* (Linne), *Chrysallida (Parthenina) interstincta* (Montagu), *Linga (Linga) columbella strictula* (Sacco) have been appeared since Burdigalian. Of these *Astraea (Bolma) rugosa* (Linne), *Chrysallida (Parthenina) interstincta* (Montagu), *Linga (Linga) columbella strictula* (Sacco) are also identified in marinal Lower Badenian stage of Central Paratethys (Table 1 a-b and 3 a-b). Although some of the species identified in this formation have distribution in Lower and Middle Miocene of Central Paratethy, they can be totally correlated with Tethys in Upper Miocene. For this reason, the Lower Tortonian stage has only been used for the Aksu formation.

In fauna identified in Aksu formation, the presence of the species like *Strombus (Strombus) bonellii* Brongniart, *Strombus coronatus* Defrance, *Erato (Erato) laevis elongata* Sacco, *Cypraea (Bernaya) fabagina mioporcellus* Sacco, *Odostomia (Megastomia) conbidea* (Brocchi), *Gibberulina (Gibberulina) philippi* (Monterosato), *Gibbula (Gibbula) maga* (Linne) and *Alvania vehus* (d'Orbigny) indicate high sea water salinity and subtropical climatic conditions. Consequently, it can be deduced that, the climatic conditions were better and warmer in Antalya Miocene basin relative to Lower and Middle Miocene.

Kasaba Miocene basin

The total 68 mollusc species have been identified in Kasaba Miocene basin and the detailed stratigraphy of the basin has been established (İslamoğlu and Taner, 2002). The Upper Burdigalian - Langhian (Upper Eggenburgian - Karpatian) aged whole mollusc fauna identifed in Kasaba basin reflects normal sea water salinity in subtropical climate belt and shallow marine environmental conditions being different from Antalya Miocene basin. The stratigraphic and paleogeographic characteristics of the fauna are as follows:

In stratigraphic sections measured within Ucarsu formation the identified species which are *Turritella terebralis turritissima* Sacco, *Turritella terebralis subagibbosa* Sacco, *Turritella (Peyrotia) desmarestina* Basterot, *Cassidaria tauropomum* (Sacco), *Turbonilla (Mormula) aturensis* (Cossmann ve Peyrot), *Vexillum (Uromitra) pluricostata percostulata* (Sacco) of class Gastropoda and *Pecten zizinae* Blanckenhorn, *Cardium praeaculeatum* (Holzl) and *Pitar (Paradione) lilacinoides* (Schaffer) of class Bivalvia became totally extinct at the end of Burdigalian (Table 2 a-b, 3 a-b and 4 a-b). These species are absent in Langhian (Lower Badenian) aged Kasaba formation.

In Ugarsu formation, mostly, the *Turritella terebralis turritissima* Sacco, *Turritella terebralis subagibbosa* Sacco, *Clavatula (Clavatula) calcarata francisci* (Toula) and *Conus mercati* Brocchi of class Gastropoda and *Pecten zizinae* Blanckenhorn, *Glycymeris (Glycymeris) inflatus* (Brocchi) of class Bivalvia are found only Tethys (Table 1 a-b, 3 a-b and 4 a-b). However, the *Conus (Chelyconus) puschi* Michelotti, *Ancilla (Baryspira) glandiformis* (Lamarck), *Turritella (Haustator) tricincta* (Borson), *Cypraea (Bernaya) fabagina* Lamarck, *Natica millepunctata* Lamarck, *Turritella (Turritella) turns* Baste rot, *Cypraea (Bernaya) fabagina* (Lamarck) and *Athleta ficulina* (Lamarck) of class Gastropoda and *Anadara (Anadara) diluvii* (Lamarck), *Glycymeris (Glycymeris) cor* (Lamarck), *Glycymeris pilosa desh*ayes/ (Mayer), *Callista (Callista) chione* (Linne) and *Nemocardium spondyloides* (Hauer) of class Bivalvia type species are found in some or all marinal stages Eggenburgian, Karpatian and Badenian of both Tethys and Central Paratethys (Table 1 a-b, 2 a-b, 3 a-b and 4 a-b). In addition, a few species belonging to only the Eggenburgian stage of Central Paratethys such as, *Pitar (Paradione) lilacinoides* (Schaffer) and *Venus (Antigona) burdigalensis producta* Schaffer have been also found (Table 1 a-b). As far as the paleogeographical characteristics of the molluscan fauna are considered, it is necessary to use the Upper Burdigalian stage with Upper Eggenburgian- Karpatian stages.

In Kasaba formatipn, the species appeared firstly at the beginning of Middle Miocene are *Cerithium zejsneri* Pusch and *Divaricella ornata subornata* Hilber of class Gastropoda. These are the species which belonging to marinal Lower Badenian stage of Central Paratethys (Table 2 a-b and 3 a-b). The *Turritella (Turritella) turns* Baste rot, *Cypraea (Bernaya) fabagina* Lamarck, *Clavatula asperulata* (Lamarck) of class Gastropoda and *Nemocardium spondyloides herculeum* Dollfuss-Cotter-Gomez, of class Bivalvia became extinct at the end of Middle Miocene (Table 2 a-b, 3 a-b and 4 a-b).

The most of the species identified in Kasaba formation are present in marinal stages of Central Paratethys with Tethys fauna similar in Ugarsu formation. As mentioned above, except these, the only *Cerithium zejsneri* (Pusch) and *Divaricella ornata subornata* Hilber type species are found in lower Badenian stage of Central Paratethys (Table 2 a-b and 3 a-b). Based upon these data, the age of the Kasaba formation has been accepted as Langhian (Lower Badenian). Additionally, this fauna is typically in marine character and indicates the presence of a stable marine environment with normal salinity.

THE DISCUSSION OF THE CHRONOSTRATIGRAPHIC LEVELS AND PALEOGEOGRAPHICAL DISTRIBUTIONS OF THE USED STAGES

In order to discuss and understand better the paleogeographic interpretations of the mollusc fauna present in the basins, it is necessary to give some knowledge mentioned below.

Regional changes in terrain have been developed in Tethys realm and surrounding areas since the beginning of Cenozoic due to effect of neotectonism (Steininger et al., 1985). These changements have caused the seperation of the Tethys since Paleocene; as a result of this event, the new marine realms and gateways were developed (Steininger et al., 1985). The continuation of this event has been increased since the beginning of Neogene; consequently, the newly formed marine realms evolved differently and each of them became a distinct isolated small basin. At the same time, the connection of the marine realm, existed at the south, with (Tethys) Atlantic, Indo-Pasific and northern inland seas (Central and Eastern Paratethys) was continued by limited sea ways and later, disconnected firstly with Paratethys and the other oceans (Steininger et al., 1985; Rögl, 1998).

This geodinamic evolution in the region caused the development of paleobiogeographic and paleogeographic differences in three different regions within the Alpine - Caucasus orogenic belt. These regions are named as; Tethys in the south, Central Paratethys for Central Europe and Eastern Paratethys between eastern Europe and Caucasia (Nevesskaya et al., 1975; Papp, 1981; Steininger and Rogl, 1984; Steininger et al., 1985; Rogl, 1998).

It is necessary to research the causes of facies and faunal changes, their relationships and evolution developed in different regions. For this purpose, the detailed biostratigraphic and chronostratigraphical studies have been carried out in Tethys, Central Paratethys and Eastern Paratethys and the best stratotypes representing the regions were identified. The new stratotypes have also been suggested whenever the problems come to existence correlation. By using the biostratigraphy and magnetostratigraphy together with radiometric age methods, the correlation tables among regions were worked out and the time equivalents of stages and their relations were established (Cicha et al., 1969; Carloni et al., 1971; Nevesskaya, et al., 1979; Papp, 1981; Steininger and Rögl, 1984; Steininger et al., 1985).

The regional stage names used in preparation of correlation charts have allowed investigators to have different opinions and make discussions. Some of the stage names were left to use and instead the new stage names were suggested. Especially, before the Central Paratethys concept is established, The Tethys stages were used and later, it was understood that not only the facies and faunal content but also the stratigraphic levels and ages were inconsistent, for this reason, the regional new stages have been identified. The stage names previously used in the old literature and correlative regional new stage names are shown in Fig. 2.

For example, the new idea and discussions are suggested that the widely used and known Aquitanian and Burdigalian stages of Lower Miocene are not consistent for Tethys. The Carloni et al., (1971) claimed that, the Aquitanian and Burdigalian are local facies and not to have being a stratotype, also, Gelati and Robba (1975) pointed out that, the stratotypes in which these stages identified are not belonging to the Mediterranean, instead, related to the Atlantic and no marine gateway existed between two oceans during Early Miocene. They also claimed that, the type sections of the Oligocene - Miocene is somewhat problematic. Based on these, Gelati and Robba (1975) identified a new stratotype including the whole Lower Miocene in Piedmonte basin located at north of Italy in Tethys realm and suggested a new stage name as "Cortemilian".

The Helvetian stage stratotype is in Switzerland in Central Paratethys, known also western Paratethys. The Helvetian is known to represented typical mollusc species depicting brackish- marine facies (Rutsch, 1971). The Helvetian stage including endemic fauna and developed different facies, was widely used both in Tethys and Central Paratethys; however, due to correlation problems, it was decided not to be used for both realms and which stages could be used instead, was the subject of discussion (Steininger and Rögl, 1979).

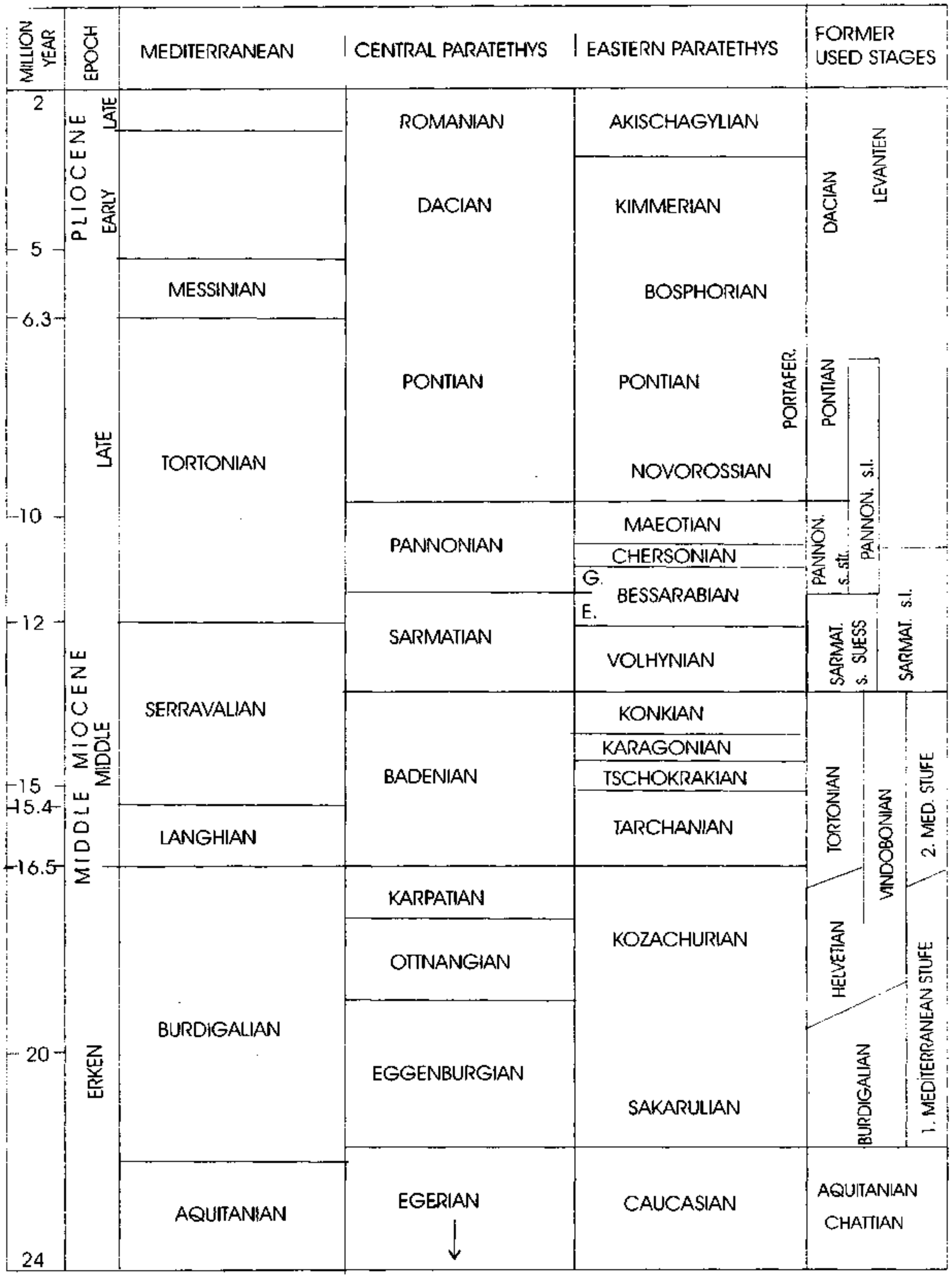

Fig. 2- The previously used stage names and theis new equivalants (Steininger and Rögl, 1979).

Before the establishment of Central Paratethys concept, the Tethyian stages or local stages were used. Throughout the progressive studies, it was deduced that, the most of the stage names were not consistent with paleogeographic and paleoecological characteristics of the region, and for each stage names the suitable stages were selected. Consequently, it has been decided that, the "Ottnangian" stage is suggested to be used for old Lower Helvetian which was transgressive and marinal character at the beginning, later became regressive and endemic brackish fauna in Central Paratethys. For the transgressive and marine fauna in old Upper Helvetian, the "Karpatian" stage is used (Steininger et al., 1976; Steininger and Rögl, 1979 and 1984; Nagymarosy and Müller, 1988; Steininger et al., 1988).

In previous studies in Tethys realm, the Helvetian stage of Western Paratethys was used for Italy and France countries. However, when given up the usage of this stage, the Langhian and Serravalian stages (Middle Miocene) were instead thought (Cita and Blow, 1969; Carloni et al., 1971; Later, it has been decided that, based on the developments in biostratigraphic correlations and changements in biozones, the Helvetian is corresponding to the Upper Burdigalian (Steininger et al., 1976; Steininger and Rögl, 1979; Harzhauzer, 1999, written communication; Robba, 2000, written communication; see Fig. 6.2).

The Badenian and Sarmatian stage names are used for Middle Miocene in Central Paratethys (Fig. 3). The Tortonian of Tethys was previously used in both regions for the Middle Miocene; later, it is concluded that, the true Tortonian is correlative of Upper Miocene and is suitable for Tethys (Nagymarosy and Müller, 1988; Steininger et al., 1988).

In the investigated basins, the most of the identified mollusc fauna has wide distribution both in Tethys and Central Paratethys. Furthermore, the specie's appeared only in Tethys or Central Paratethys and the newly identified a few species peculiar to the region are also present.

In Turkey, apart from the studied areas, the similar findings have been obtained by other investigators. Especially, in West Anatolia and Taurus, the faunal assemblages were detected reflecting the same environmental conditions similar to Central Paratethys. In contest, in northern Anatolia, the Eastern Paratethys fauna is found. Based upon this:

Bukowski (1983), in Rhodos Island, identified *Vivipara clathrala* Deshayes, *Melania tournouari* Fuch, *Planorbis trassylvanicus* Neumayr, *Bythinia meridionalis* Freundf. and *Hydrobia ventrosa* Montagu like mollusc samples and established the Levantine (Romanian) stage.

Oppenheim (1918) referred to Sarmatian - Pontian stages based on the *Bithynia pisidica* Oppenheim, *Vivipara bukowski* Oppenheim, *Valvata pisidica* Oppenheim and *Limnaeus meparensis* identified around Eflatun - Bunar (Yenice) at the east of Beyşehir lake.

A great number of samples of class Bivalvia and Gastropoda identified by Erünal - Erentöz (1958) in Karaman, Adana and Hatay were also detected in Antalya and Kasaba basins. The stage names used by Erünal - Erentöz (1958) especially the Helvetian was identified in Switzerland falls into the effective area of Central Paratethys as mentioned previously. When she interpreted the paleogeographic distribution of identified mollusc fauna in her study area, she also indicated that, they were widely distibuted in Vienna basin in

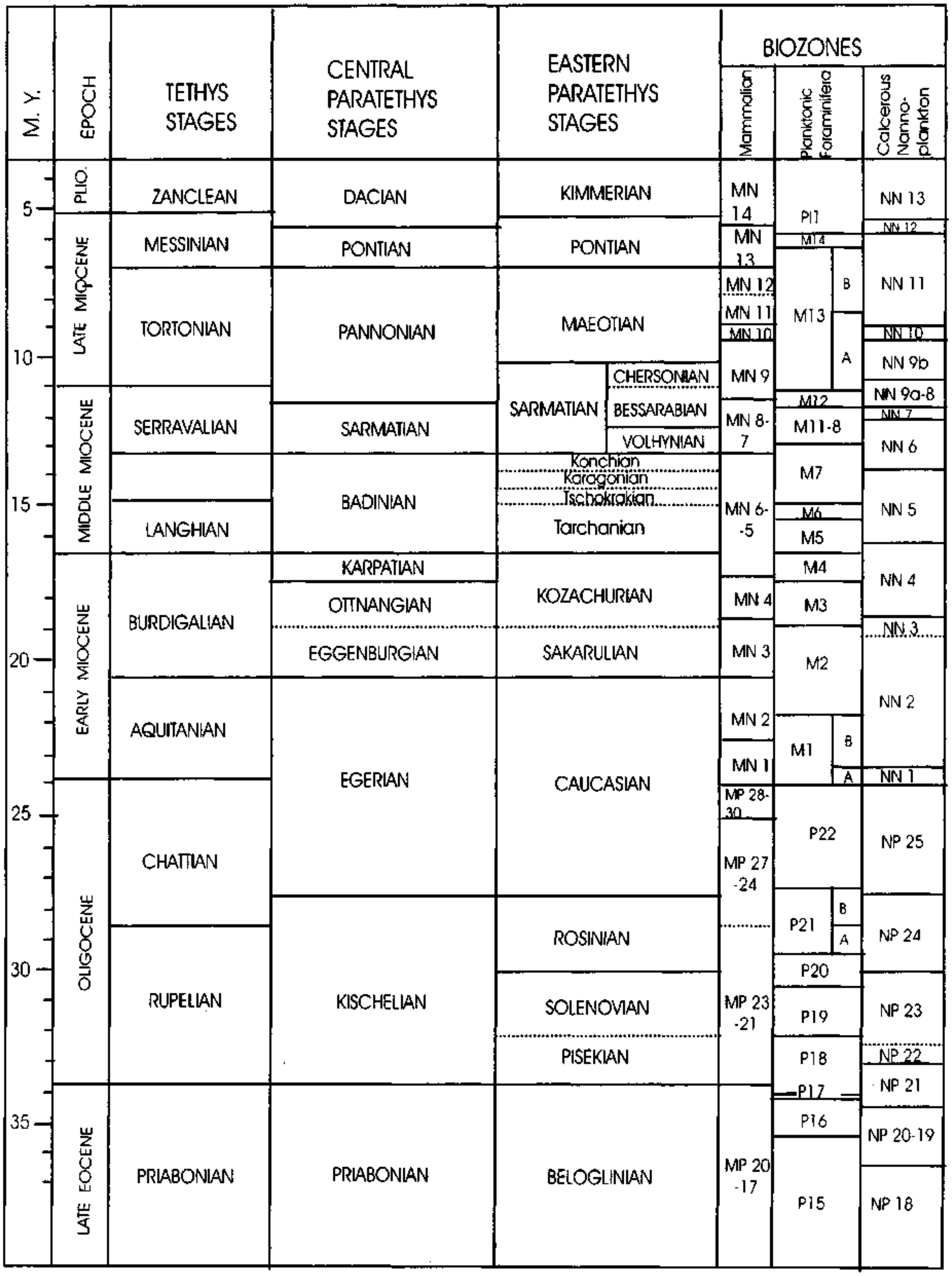

Fig. 3- Correlation of regional stages in Tethys, Central Paratethys and Eastern Paratethys (Rögl, 1998).

Central Europe and Polonia. Of the mollusc fauna, the important species are *Turritella (Haustator) tricincta* (Borson), *Turritella (Archimediella) bicarinata* Eichwald, *Terebralia lignitara* Eichwald, *Xenophora deshayesi* (MichelottL), *Cypraea (Bernaya) fabagina* (Lamarck), *Natica millepunctata* Lamarck, *Galeodes cornutus* (Agassız), *Ancilla (Baryspira) glandiformis* (Lamarck), *Mitra (Mitra) fusiformis* (Brocchi), *Volutilithes (Athleta) ficulina* (Lamarck), *Conus (Chelyconus) puschi* Michelotti, *Anadara (Anadara) fichteli* (Deshayes), *Anadara (Anadara) turonica* (Dujardin), *Amusium cristatum* (Bronn), *Pecten (Flabellipecten) solarium* Lamarck, *Crassostrea gryphoides* (Schlotheim), *Tellina (Peronaea) planata* Linne, *Venus (Ventricoloidea) multilamella* (Lamarck) and *Pelecyora (Cordiopsis) isladicoides* (Lamarck).

Taner (1975, 2001), established the Maeotian - Pontian stages in Denizli region based on the identified mollusc samples which are *Radix (A.) phrygica* Oppenheim, *Pseudocardita phrygica* Oppenheim, *Dreissena phrygica* Oppenheim, *Pseudocardita bukowskii* Oppenheim, *Paradacna denizliuense* Taner, *Prososthenia phrygica phrygica* Oppenheim, *Pyrgula conica conica* Taner and *Theodoxus (C.) karakovensis karakovensis* Taner.

Özsayar (1977) identified the mollusc fauna peculiar to Eastern Paratethys along Black Sea coast and based on this, the used Tarchanian, Tschokrakian, Karagonian and Bessarabian in Sinop area and Pontian stage in Bafra and Trabzon provinces. In addition, the author detected the presence of genus *Velapertina* sp., identified by Prof. Dr. Papp and special to Upper Badenian stage planktonic foraminiferas of Central Paratethys, and he also claimed that this genus was reached Jo the region by marine gateways.

Gökçen (1979) studied the ostracod fauna in the south of Denizli and north of Muğla, and based on this, she defined the Lower Aquitanian - Burdigalian stages between Kale - Yenişehir and Sarmatian, Pannonian and Pontian stages in Göktepe and Yatağan areas. She also pointed out that, the *Neomonceratina helvetica* Oertli and *Cyamocytheridea reversa* (Egger) detected especially around Kale area are together with Burdigalian consistent also with Eggenburgian and Ottnangian.

These data show us that, the Tethys and Paratethys stages have been detected in different parts of Anatolia. The mollusc samples that obtained from study area were correlated by detail examination of stratigraphic levels in Tethys, Central and Eastern Paratethys. As a result of this, it can be thought that, the Antalya and Kasaba basins depicted the evolutionary style similar to that of Tethys, since they are located in Taurids which is situated in the same orogenic belt with Alpine intermontane basins. Consequently, it is concluded that, the similar environmental conditions in the study areas could be developed as that of Central Paratehys. For this reason, it is decided that, the time-equivalent stage names of Tethys and Central Paratethys must be used together whenever the correlation is possible. The difficulties and geographic differences encountered during correlation of stratotypes in Europe have been also referred by Becker-Platen (1970) who studied in West Taurus. For this reason, a need appeared to define the regional stages peculiar to Turkey in the future.

THE MINERALOGICAL COMPOSITION, MAJOR AND TRACE ELEMENT VALUES OF THE MOLLUSC SHELLS

Material and method

In this study, the mineralogical and element compositions of the shells obtained from different locations are defined and it is tried to carry out the environmental interpretations on the shells with less effect of diagenesis. For environmental interpretations, the known paleoecological characteristics of the fauna are considered.

The analyses were carried out on 30 mollusc shells in total. These shells are belonging to species identifed in Kasaba and Antalya basins. The Kasaba basin includes *Turritella (Haustator) tricincta* (Borson), *Turritella terebralis turritissima* Sacco, *Turritella terebralis subagibbosa* Sacco, *Turritella (Turritella) turns* Basterot, *Turritella (Peyrotia) desmarejstina* Basterot, *Turritella (Archimediella) bicarinata* Eichwald, *Ancilla (Baryspira) glandiformis* (Lamarck), *Conus antiquus Lamarck and Conus conoponderosus* (Sacco) of class Gastropoda and *Pecten (Flabellipecten) solarium* Lamarck and *Nemocardium spondyloides* (Hauer) of class Bivalvia. The *Terebralia lignitara* (Eichwald), *Terebralia lignitara lignitara* (Eichwald), *Strombus coronatus* Defrance, *Cehthium appenninicum dertosulcata* Sacco, *Cerithium (Thericium) europaeum graciliornata* (Sacco), *Conus mercati* Brocchi and *Conus conoponderosus* (Sacco) of class Gastropoda and *Crassostrea gryphoides* (Schlotheim) and recent shell from Side beach *Glycymeris (Glcymeris) bimaculatus* (Poli) of class Bivalvia are obtained from Antalya basin.

Prior to applying analyses the shells are cleaned up, later they are grinded in agate mortar and prepared to powder. Each sample is cut into halves, one half for detected of mineralogical composition by X-Ray (X-Ray differaction) and the other for identification of major and trace elements by XRF Analyses and Technology Department of MTA.

The samples for X-Ray differaction analyses were induced between 2.5-60° where scanning speed is 8. The obtained mineral to the lesser one. The calcite coexis tence with aragonite is unclear whether it is Mg-Calcite or not. Hence, the values are considered only as calcite.

The major element analyses by XRF method have been carried out on the samples dried at 105°.

Antalya Miocene basin

By evaluating the mineralogical composition of the shells in the basin, while the Upper Burdigalian (Ottnangian -Karpatian) aged marinal shells in Altınkaya formation are in calcite or calcite-aragonite composition, the Lower Tortonian marine molluscs in Aksu formation are in aragonite composition (Table 5 a-b).

The *Crassostrea gryphoides* (Schlotheim) species of Langihian (Lower Badenian) Altınkaya formation adapted to brackish water environment are calcite in composition with lesser amount of quartz in their body. Due to the effect of burial conditions, the silicification can be developed in genus and species of order Ostreina and it takes place as SiO_2 quartz mineral within body of crust (Ozhigova, 1992).

When the major and trace element values of mollusc shells of Antalya basin are examined; it is shown that the Ca takes the values ranging between %35.02 and %38.95 as being the main component of the all shells in the region.

In Altınkaya formation, the species representing Upper Burdigalian (Ottnangian-Karpatian) yield 222 ppm Na, whereas the Langhian (Lower Badenian) aged *Crassostrea gryphoides* (Schlotheim) type species point a lower value of Na (74-148 ppm).

The Na content of the samples in Lower Tortonian age Aksu formation is at higher values relative to the others and changes between 222 and 296 ppm. By comparing these values with the recent shells, the Na content of *Glycymeris (Glycymeris) bimaculatus* (Poli) taken from Side beach depicts a 445 ppm value of Na (Table 5 a-b and 6 a-b). Consequently, the sea water salinity is proportional to Na content and it is concluded that the Na content of the Miocene sea was lower than that of the recent in the region.

In the case of Mg content of the shells (Table 5 a-b); the *Cerithium (Thericium) europaeum graciliornata* Sacco has Mg value of 362 ppm in Aşağıyaylabel section and between 301 and 603 ppm in Hocalarsırtı section, which both of them are Upper Burdigalian (Ottangian - Karpatian) in age in Altınkaya formation. The *Ostrea lamellosa* Brocchi yields a 241 ppm value of Mg in the Alarahan section of Upper Burdigalian Oymapınar limestone. The Mg values of Langhian (Lower Badenian) aged *Crassostrea gryphoides* (Schlotheim) species are between 301 and 422 ppm in Altınkaya formation. The samples in Lower Tortonian aged Aksu formation indicate the values ranging between 6 and 241 ppm of Mg. A 60 ppm value of Mg has been found in recent *Glycymeris (Glycymeris) bimaculata* (Poli) from Side beach. This last value is much lower than that of Miocene aged mollusc shells. The anomalous increase in Mg content is known to be related to the diagenesis (Kim et al., 1999). Based on this, it can be interpreted that, the samples with high value of Mg are more diagenetic and those with low value mean less diagenetic.

The Al and Si values are randomly distributed in the whole region. For the Sr, the all Langhian (Lower Badenian) aged *Crassostrea gryphoides* (Schlotheim) species from different localities of Altınkaya formation contain lower and constant values which is 84 ppm. The whole formation of this species from calcitic shells reveals that the original shell compositon has not changed (Ozhigova, 1992). The upper Burdigalian (Ottnangian- Karpatian) aged aragonitic gastropod shells, taken from under the *Crassostrea gryphoides* (Schlotheim) level have Sr contents ranging between 253 and 338 ppm in Altınkaya formation. It is known that, the Sr in sea water is proportional to the salinity (Turekian, 1955). Consequently, it can be interpreted that, the sea water salinity during Langhian (Lower Badenian) was much lower in the region.

When the 1000 Mg/Ca and 1000 Sr/Ca ratios of the shells are considered; firstly, the recent *Glycymeris (Glycymeris) bimaculata* (Poli) found in Side beach processed and the 1000 Sr/Ca= 6.60 and 1000 Mg/Ca= 1.60 ratios have been obtained. Later, the other data are correlated with this result.

Table 5 a- The stratigraphical levels and mineralogical compositions of mollusc fauna identified in Antalya Miocene basin**

FAUNA	Formation	MSS locality	Sample No	Stratigraphical level	Mineralogical comp.
Strombus coronatus Defrance	Aksu	Kargı	K17	Tortonian	Aragonite, Calcite
Cerithium appenninicum dertosulcata Sacco	Aksu	Kargı	K16	Tortonian	Aragonite, Calcite
Conus mercati Brocchi	Aksu	Kargı	K17	Tortonian	Aragonite,Calcite, Dolomite
Conus conoponderosus (Sacco)	Aksu	Kargı	K17	Tortonian	Aragonite, Calcite
Crassostrea gryphoides (Schlotheim)	Altınkaya	Altınkaya	S5	Langhian (Lower Badenian)	Calcite, rare Quartz
Crassostrea gryphoides (Schlotheim)	Altınkaya	Aşağıyaylabel	A15	Langhian (Lower Badenian)	Calcite, rare Quartz
Crassostrea gryphoides (Schlotheim)	Altınkaya	Aşağıyaylabel	A15	Langhian (Lower Badenian)	Calcite, rare Quartz
Crassostrea gryphoides (Schlotheim)	Altınkaya	Hocalarsırtı	H2	Langhian (Lower Badenian)	Calcite, Quartz, Illite
Crassostrea gryphoides (Schlotheim)	Altınkaya	Kesme yolu		Langhian (Lower Badenian)	Calcite, Quartz
Crassostrea gryphoides (Schlotheim)	Altınkaya	Kesme yolu		Langhian (Lower Badenian)	Calcite, Quartz
Terebralia lignitara (Eichwald)	Altınkaya	Hocalarsırtı	H1	Upp. Burd. (Ott Egg.-Karp.)	Calcite, Aragonite
Terebralia lignitara lignitara (Eich.)	Altınkaya	Hocalarsırtı	H1	Upp. Burd. (Ott. Egg.-Karp.)	Calcite, Aragonite
Cerithium (T.) europaeum graciliornata (S.)	Altınkaya	Aşağıyaylabel	A10	Upp. Burd. (Ott. Egg.-Karp.)	Calcite, Aragonite
Ostrea lamellosa Brocchi	Oymapınar	Alarahan	A4	Upp. Burd. (Ott. Egg.-Karp.)	Calcite

** For explanations of formations, MSS localities and sample numbers, See: İslamoğlu 2001 - 2002

Table 5 b- Continue 5 a-

FAUNA	Ca %	Na (ppm)	Mg (ppm)	Al (ppm)	Si (ppm)	Fe (ppm)	Sr (ppm)	1000Sr/Ca	1000Mg/Ca
Strombus coronatus Defrance	38,23	222	60	53	93	69	338	9;07	9,72
Cerithium appenninicum dertosulcata Sacco	38,23	296	180	53	373	139	253	2,19	7,87
Conus mercati Brocchi	37,59	296	180	105	607	139	338	2,28	8,17
Conus conoponderosus (Sacco)	37,73	222	241	105	513	139	338	4,82	17,21
Crassostrea gryphoides (Schlotheim)	38,45	74	301	53	420	69	84	6,9	8,21
Crassostrea gryphoides (Schlotheim)	37,3	74	422	158	513	209	84	2,39	17,18
Crassostrea gryphoides (Schlotheim)	38,23	74	301	105	420	139	84	8,84	1,56
Crassostrea gryphoides (Schlotheim)	35,09	148	603	529	1915	839	84	6,61	4,7
Crassostrea gryphoides (Schlotheim)	37,45	74	422	211	1027	209	84	8,99	4,78
Crassostrea gryphoides (Schlotheim)	36,8	74	301	211	1401	279	84	8,95	6,38
Terebralia lignitara (Eichwald)	35,02	222	603	529	2569	909	169	2,16	6,18
Terebralia lignitara lignitara (Eich.)	36,66	222	301	317	1401	559	253	2,16	7,82
Cerithium (T.) europaeum graciliornata (S.)	37,23	222	362	158	747	419	338	2,25	11,31
Ostrea lamellosa Brocchi	38,95	74	241	53	607	69	84	2,24	11,26

Table 6 a- The stratigraphical levels and mineralogical compositions of mollusc fauna identified in Kasaba Miocene basin.**

FAUNA	Formation	MSS locality	Sample No	Stratigraphical level	Mineralogical comp.
Turritella (A.) bicarinata Eichwald	Kasaba	Ortabağ	Çb2	Langhian (Lower Badenian)	Calcite, Aragonite
Pecten (F.) solarium Lamarck	Kasaba	Ortabağ	Çb2	Langhian (Lower Badenian)	Calcite, Aragonite
Ancilla (B.) glandiformis (Lamarck)	Kasaba	Ortabağ	Çb2	Langhian (Lower Badenian)	Aragonite, Calcite
Turritella (T.) turris Basterot	Kasaba	Ortabağ	Çb2	Langhian (Lower Badenian)	Aragonite, Calcite
Conus antiquus Lamarck	Kasaba	Ortabağ	Çb2	Langhian (Lower Badenian)	Aragonite, Calcite
Nemocardium spondyloides (Hauer)	Kasaba	Ortabağ	Çb2	Langhian (Lower Badenian)	Aragonite, Calcitet
Conus conponderosus (Sacco)	Kasaba	Boyacıpınarı	Fd9	Langhian (Lower Badenian)	Calcite, Aragonite
Turritella (A.) bicarinata Eichwald	Kasaba	Boyacıpınarı	Fd9	Langhian (Lower Badenian)	Calcite, Aragonite
Turritella (H.) tricincta (Borson)	Kasaba	Boyacıpınarı	Fd8	Langhian (Lower Badenian)	Aragonite, Calcite
Ancilla (B.) glandiformis (Lamarck)	Kasaba	Boyacıpınarı	Fd2	Langhian (Lower Badenian)	Aragonite, Calcite
Turritella (T.) turritissima Sacco	Uçarsu	Uçarsupınarı	Uç1	Upp. Burd (Upp Egg.-Karp.)	Aragonite, Calcite
Turritella (T.) turritissima Sacco	Uçarsu	Sıradona	S1	Upp. Burd.(Upp Egg.-Karp.)	Aragonite, Calcite
Ancilla (B.) glandiformis (Lamarck)	Uçarsu	Bozgediktepe	Bgt2	Upp. Burd.(Upp. Egg.-Karp.)	Aragonite, Calcite
Turritella (T.) terebralis subagibbosa Sacco	Uçarsu	Bozgediktepe	Bgt4	Upp. Burd.(Upp. Egg.-Karp.)	Aragonite, Calcite
Turritella (T.) terebralis terebralis Lam.		Akçasupınarı	Ak1		Aragonit, Kalsit
Turritella (P.) desmarestina Basterot	Uçarsu	Akçasupınarı	Ak1	Upp. Burd.(Upp Egg.-Karp.)	Calcite, Aragonite
Glycymeris (G.) bimaculata (Poli)		Side Beach		Recent	Aragonite, rare Calcite

** For explanations of formations. MSS localities and sample numbers, See: İslamoğlu and Taner, 2002.

Table 6 b- Continue 6 a-

FAUNA	Ca %	Na (ppm)	Mg (ppm)	Al (ppm)	Si (ppm)	Fe (ppm)	Sr (ppm)	1000Sr/Ca	1000Mg/Ca
Turritella (A.) bicarinata Eichwald	36,6	148	784	105	1027	349	169	4,6	2,14
Pecten (F.) solarium Lamarck	37,37	296	603	53	654	209	169	4,5	16,1
Ancilla (B.) glandiformis (Lamarck)	37,73	222	241	53	373	139	338	8,95	6,38
Turritella (T.) turris Basterot	36,8	222	723	105	1027	349	253	6,87	19,6
Conus antiquus Lamarck	38,23	222	120	53	93	69	253	6,61	3,13
Nemocardium spondyloides (Hauer)	37,73	222	241	53	420	139	253	6,7	3,38
Conus conponderosus (Sacco)	38,02	222	241	53	233	139	338	8,89	6,33
Turritella (A.) bicarinata Eichwald	37,87	148	482	53	373	209	422	11,14	1,27
Turritella (H.) tricincta (Borson)	37,73	148	362	105	467	209	338	8,95	9,59
Ancilla (B.) glandiformis (Lamarck)	38,59	222	120	53	373	69	338	8,75	3,1
Turritella (T.) turritissima Sacco	37,87	222	301	53	373	69	338	8,92	7,94
Turritella (T.) turritissima Sacco	38,02	148	362	53	607	139	338	8,89	9,52
Ancilla (B.) glandiformis (Lamarck)	37,52	222	422	53	654	209	338	9	11,2
Turritella (T.) terebralis subagibbosa Sacco	37,52	222	241	53	607	139	338	9	6,42
Turritella (P.) desmarestina Basterot	37,16	222	482	158	887	279	253	6,8	12,9
Glycymeris (G.) bimaculata (Poli)	38,23	445	60	53	140	69	253	6,61	1,56

A general evaluation has been carried out on the comparison between mineralogical compositions and element ratios of the shells obtained from Antalya Miocene basin. As the following;

For aragonitic shells:

1000 Sr/Ca =2.16-9.07

1000 Mg/Ca = 7.87-17.21

Mg=60-241ppm

Sr=169-338ppm

For calcitic shells:

1000 Sr/Ca =2.39-8.99

1000 Mg/Ca= 1.56-17.18

Mg=301-603ppm

Sr = 84 ppm values have been determined.

Based on the results obtained from the basin, the all calcitic shells are pelecypods and the shells with aragonite+ calcitic composition are gastropods. Hence, the aragonitic shells have lower Mg content. This conclusion is also consistent with the studies Yalçın and Bozkaya (1995) on recent mollusc shells in Bay of İzmit (SE Marmara sea). The 1000 Sr/Ca ratio is much lower than 1000 Mg/Ca ratio in aragonitic shells. However, in calcitic shells, the 1000 Mg/Ca ratio may be the same . or a little bit more or less than 1000 Sr/Ca ratio. If an evaluation is fullfilled with respect to - the ages and localities of the shells;

For the shells of Upper Burdigalian (Ottnangian- Karpatian) age:

1000 Sr/Ca =2.16-2.25

1000 Mg/Ca = 6.18-11.31

For the shells of Langhian (Lower Badenian) age:

1000 Sr/Ca =2.39- 8.99

1000 Mg/Ca = 1.56- 17.18

For of Lower Tortonian shells:

1000 Sr/Ca =21.9- 9.07

1000 Mg/Ca = 7.87 - 17.21 ratios have been found.

Based on this, the 1000 Sr/Ca ratio was much lower than that of the recent, during Upper Burdigalian (Ottnangian- Karpatian) period. However, the 1000 Mg/Ca ratio is higher than the recent. By comparing the locations, *Cerithium (Thericium) europaeum graciliornata* (Sacco) in point A10 of Aşağıyaylabel section (Altınkaya formation) and *Ostrea lamellosa* Brocchi in point A4 of Alarahan section (Oymapınar limestone) have close values which are 224 and 225 ppm respectively. In Hocalarsırtı section, the two different samples *(Terebralia lignitara* Eichwald *and Terebralia lignitara lignitara* Eichwald) indicate the same 1000 Sr/Ca value (2.16). Although the 1000 Mg/Ca ratios of the same samples are nearly proportional to 1000 Sr/Ca, they are not very reliable.

The 1000 Sr/Ca ratio in Langhian (Lower Badenian) is lower than the recent in same samples and is close on much more in other samples. The all of the 1000 Mg/Ca ratios are much more than recent. A striking result is that, in all localities, the shells of *Crassostrea gryphoides* (Schlotheim) have 8.4 ppm Sr and 74 ppm Na which are very low. The Lower Tortonian 1000 Sr/Ca ratio is much lower than that of recent (2.19-4.82 ppm). The *Crassostrea gryphoides* (Schlotheim) species having only calcitic shell has the same Sr value, in the same age, but in different localities. The previous studies carried out on ostreas indicate that this group yields reliable results in paleoecological interpretations (Ozhigova, 1992). The data obtained from *Crassostrea gryphoides* (Schlotheim) depicts the environment with low salinity and is well consistent with its paleoecological characteristics itself.

Kasaba Miocene basin

By considering the mineralogical composition of the shells; in Ortabağ section of the Kasaba formation, the Langhian (Lower Badenian) aged *Ancilla (Baryspira) glandiformis* (Lamarck), *Conus antiquus* Lamarck, *Turritella (Turritella) turn's* Baste rot and *Nemocardium spondyloides* (Hauer) are aragonite- calcite in composition, whereas in the same level, the *Turritella (Archimediella) bicarinata* Eichwald and *Pecten (Flabellipecten) solarium* Lamarck are calcite- aragonite in composition. Similarly, in Boyacıpınar, the Langhian (Lower Badenian) aged *Turritella (Haustator) tricincta* (Borson) is in the composition of aragonite - calcite, while the *Turritella (Archimediella) bicarinata* Eichwald and *Conus conoponderosus* (Sacco) are in calcite-aragonite composition (Table 6 a-b).

The all Upper Burdigalian (Upper Eggenburgian - Karpatian) aged shells in Uçarsu formation are composed of two minerals aragonite calcite or calcite aragonite. The, changements in aragonite - calcite ratios of the shells reflect the diagenetic effects after deposition (Kim et al., 1999). It can also be thought that, in Kasaba basin, the shells partly undergone diagenetic effects.

The major and trace element ratios of the shells are evaluated as; the Ca ratio changes between % 36.6 and % 38.59. The Na ratio withi no difference in Kasaba and Uçarsu formations is between 148-222 ppm values. The Mg ratios in the samples of the Kasaba basin are a little bit high relative to those of recent and in the values of 241-482 ppm in Upper Burdigalian (Upper Eggenburgian - Karpatian).

The Langhian (Lower Badenian) aged shells, although they are in the same locations, they indicate different compositions. For example, in the Çb2 sample point of Ortabağ section, as the *Turritella (Turritella) turris* Basterot is 723 ppm and *Turritella (Archimediella) bicarinata* Eichwald is 784 ppm in Mg values, the *Conus antiquus* Lamarck has 200 ppm and-the *Ancilla (Baryspira) glandiformis* (Lamarck) has 241 ppm values. The similar values are also present in Boyacıpınar section of the same period. The *Ancilla (Baryspira) glandiformis* (Lamarck) and *Turritella (Archimediella) bicarinata* Eichwald yield the 120 and 482 ppm values respectively. By comparison of the mineralogical compositions of the shells, it is seen that, the *Ancilla (Baryspira) glandiformis* (Lamarck) with low Mg ratio content has higher aragonite ratio (Table 6 a-b). This also confirms that, the Mg content in aragonitic shells is low as mentioned before.

There has been no consistency among the Si, Al and Fe ratios, mineralogical compositions and localities of the shells, similar to those in Antalya Miocene basin. However, the Al content of the all shells is nearly equal to the recent, while the Si and Fe contents are a little bit high in values.

When a comparison is full filled between the mineralogical composition and element ratios of the shells obtained from Kasaba Miocene basin;

For the shells with aragonite+ calcite composition:

1000 Sr/Ca =6.7-9.0

1000 Mg/Ca = 3.1 -11.2

Mg = 120-723 ppm

Sr = 253 - 338 ppm

For the shells having calcite+aragonite composition:

1000 Sr/Ca =4.5-11.1

1000 Mg/Ca = 2.1 -12.9

Mg=241-784ppm

Sr = 169 - 422 ppm values have been determined.

Based on this, in the shells of aragonite+calcite composition, the 1000 Mg/Ca ratio is lower than the 1000 Sr/Ca ratio. The same occurence is also valid for the shells having calcite+aragonite composition. Except this, there has not been any clear difference among the all ratios.

The shell of the recent pelecypod taken from Side beach (Antalya), indicates 6.61 value for 1000 Sr/Ca ratio and 1.56 for 1000 Mg/Ca ratio. The 1000 Mg/Ca ratio of this aragonitic shells is lower than 1000 Sr/Ca ratio. This conclusion also implies that, the aragonitic shells have low Mg content (Yalçın and Bozkaya, 1995). If the geochemical values of aragonitic pelecypoql in Side beach and the" shells with the same composition in İzmit Bay (SE Marmara sea) are compared, it is found that, the 1000 Sr/Ca ratio in sample of Side is 6.6 and that in İzmit. Bay is 3.60-5.72. The 1000 Mg/Ca ratios are 1.6 and 0.86-1.69 for Side and İzmit Bay respectively (Yalçın and Bozkaya, 1995; Yalçın and Taner, 1998). Since it is known that, the Mediterranean has a high salinity relative to the Marmara sea, it can be concluded that, the 1000 Sr/Ca ratios is propositional to the salinity.

Evaluating the shell localities and ages;

For the Upper Burdigalian (Upper Eggenburgian -Karpatian) aged shells:

1000 Sr/Ca =6.8- 9

1000 Mg/Ca = 6.4-12.9

For Langhian (Lower Badenian) aged shells:

1000 Sr/Ca = 4.5-11.1

1000 Mg/Ca = 2.1-19.6 values have been found. Based on this, the 1000 Sr/Ca ratio in Upper Burdigalian (Upper Eggenburgian -Karpatian) and Langhian (Lower Badenian) periods is nearly equal or a little bit high (Table 6 a-b).

CONCLUSIONS

Paleogeographic results

1. The paleogeographic distribution of mollusc fauna puts in evidence that, the Lower- Middle Miocene age formations in Antalya and Kasaba basins have correlative characteristics both with Tethys and Central Paratethys stages. Hence, the time equivalent stage names of these two provinces are used together.
2. Although some of the samples from studied regions are widely distributed in Eastern Paratethys, it is not advisable to use the time equivalent stages of this region.

3. In both regions, for the Lower- Middle Miocene, the *Hydrobia (Hydrobia) frauenfeldi* (Homes), *Pirenella gamlitzensis gamlitzensis* (Hilber), *Irus (Paphirus) gregarius* Partsch and *Glossus (Cytherocardia)* cf. *deshayesi* (Kutassy) type species peculiar to the only Central Paratethys were identified.

4. The Antalya and Kasaba Miocene basins are in the same character of the intermontane molasse basins in the Alps and located in the same orogenic belt. Consequently, the similar events during Tethyan evolution must have been occured in the study areas. The faunal development also reveals the environmental conditions similar to Paratethys, besides the Tethys. For this reason, it is normal that, the special bioprovinces similar to Central Paratethys could be developed in Turkey. In this study, although the stage names for the basins are used together, it is a need in the future to define the regional stages.

Paleoecological results

1. The Mg contents of aragonitic shells yield lower values relative to those of calcitic ones.

2. As a result of geochemical analyses of shells, it is concluded that, the Na and Sr trace element concentrations and 1000 Sr/Ca ratios are proportional to the salinity either increase or decrease.

3. Based on the biochemical values obtained from mollusc fauna, during Upper Burdigalian (Ottnangian- Karpatian) the Sr/Ca ratio in Antalya Miocene basin (2.16-2.25) is lower than that (6.8-9.0) of Kasaba Miocene basin. Since the Sr in sea water is proportional to the salinity either increase or decrease (Turekian, 1955), it is concluded that, Antalya Miocene basin in this period has a marine realm with lower salinity with respect to that of Kasaba Miocene basin. The widely distributed brackish water - marine samples in Antalya Miocene basin also confirm this result.

4. The 1000 Sr/Ca ratios increased a little big (2.39-8.99) in Antalya Miocene basin during Langhian (Lower Badenian). However, it is the same in Kasaba Miocene basin (4.5-11.1). Consequently, although the salinity increased a bit, it is lower than Kasaba Miocene basin.

5. During Lower Tortonian, the 1000 Sr/Ca values in Antalya basin ranged between 2.19-9.07. In Kasaba basin, there is no only marine deposit in this period. Hence, any comparison can not be carried out.

6. The Sr trace element concentration of *Crassostrea gryphoides* (Schlotheim) which is widely distributed in Antalya Miocene basin is very low. Its originally crust composition (calcite) has not been also changed. The shells of this species in different localities indicate the same values.

Table captions: E: Early, O: Middle, G: Late, Ol: Oligocene, A: Aquitanian, B: Burdigalian, L: Langhian, S: Serravalian, T: Tortonian, Mes: Messinian, Pl: Pliocene, P: Pleistocene, Gun: Recent, Eg: Egerian, Egb: Eggenburgian, Ott: Ottnangian, K: Karpatian, Bd: Badenian, Sr: Sarmatian, Kr: Karagonian, Sak: Sakarulian, Tr: Tarchanian, Çk: Tschokrakian, Kon: Konkian.

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