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BURDIGALIAN–LANGHIAN (MIOCENE) OSTRACOD BIOSTRATIGRAPHY AND CHRONOSTRATIGRAPHY OF THE KASABA BASIN (KAŞ/ANTALYA), SW TURKEY

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Abstract: In this investigation, 205 samples were collected from five measured stratigraphic sections in the Kasaba Basin (Kaş/Antalya, SW Turkey) and 16 genera and 33 species of ostracods were identified. Three different biozones have been recognized on the basis of the stratigraphic and geographic distribution of ostracod fauna in the measured sections which are, from bottom to top, as follows: 1. Early–Middle Burdigalian age, Cytherella triestina Zone, 2. Late Burdigalian-Early Langhian age, Aurila soummamensis-Krithe papillosa Zone, 3. Langhian age, Cytherella vulgata-Xestoleberis reymenti Zone. These zones have been correlated with the well known and widespread Neomonoceratina helvetica and Aurila soummamensis Zones of other Turkish and Mediterranean Basins. The choronostratigraphic Burdigalian-Langhian correlation of the sequence has been established mainly by Ostracoda assemblages. The results are integrated with the other faunal and floral occurrences observed during the investigation, which include planktonic and benthonic foraminifers, nannoplankton, Bivalvia, Gastropoda and corals. Thus, the Burdigalian (early, middle, late) and Langhian stage boundary has been biostratigraphically identified.

Key words: Turkey, Kasaba Basin, Burdigalian–Langhian, biostratigraphy, chronostratigraphy, Ostracoda.

Introduction

Several connected and isolated basins occurred along the Mediterranean coast of Turkey from west to east during the Neogene period. One of them is the Kasaba Basin (Fig. 1).

Several geological investigations have been carried out in the Kasaba Basin (Colin 1962; Pisoni 1965; Önalan 1979; Günay et al. 1982; Igdir et al. 1972; Hayward 1982; Şenel et al. 1989, 1994; Bilen 1996; Bilen & Tunoglu 1996; Hayward et al. 1996). Numerous geological and paleontological works have also been carried out on the other similar and neighbouring Neogene basins along the Mediterranean Region of Turkey (Doruk 1975, 1979; Benda et. al. 1977; Bassiouni 1979; Freels 1980; Hayward 1982; Aranki 1987; Tanar 1989; Gökçen et al. 1991; Nazik 1993; Şafak & Ünlügenç 1992; Şafak 1993a,b; Flecker et al. 1995; Rögl 1998).

The purpose of this paper is to present the ostracod biostratigraphy and a choronostratigraphic correlation within the lithostratigraphic framework of the Kasaba Basin. Biostratigraphic correlations and comparisons between the Kasaba Basin and the other Neogene basins of Turkey and Mediterranean are also presented in Table 1.

Geological setting

Neogene units are separated from the Eocene (Lutetian–Priabonian) aged basement rocks by an angular unconformity. Miocene units are separated into two formations which are named the Sinekçi Formation (Burdigalian) and the Kasaba Formation (late Burdigalian–Langhian). The Sinekçi Formation consists of three different members which are named from bottom to top: the Gömüce Member, the Kibrisdere Member and the Çaybogazi Member (Fig. 2). Correlations of measured stratigraphic sections and sample numbers in the sections are presented in Fig. 3.

The Gömüce Member of the Sinekçi Formation, which was deposited during the Early Burdigalian Stage and comprised of thick layered algal limestones (see Fig. 3). These rocks contain algae and benthonic foraminifers. The Kibrisdere Member of the Sinekçi Formation contains light yellow clayey limestones that were deposited during the Early–Middle Burdigalian. This limestone unit contains ostracods, nannoplankton and planktonic foraminiferal assemblages. The Çaybogazi Member consists of light-grey, yellow and green sandstone and claystone with interbedded calcarenite and contains planktonic and benthonic foraminifers.

The Kasaba Formation of late Burdigalian–Langhian age overlies unconformably the Çaybogazi Formation. The Kasaba Formation is involved dark-green sandstone, claystone and conglomerate and includes abundant and rich ostracods, benthonic foraminifers, molluscs (bivalvia, gastropods) and corals.

Biostratigraphy and chronostratigraphy

The biostratigraphic investigations and the chronostratigraphic correlations of the Neogene sequences in the Kasaba Basin are based primarily on qualitative analysis of ostracod

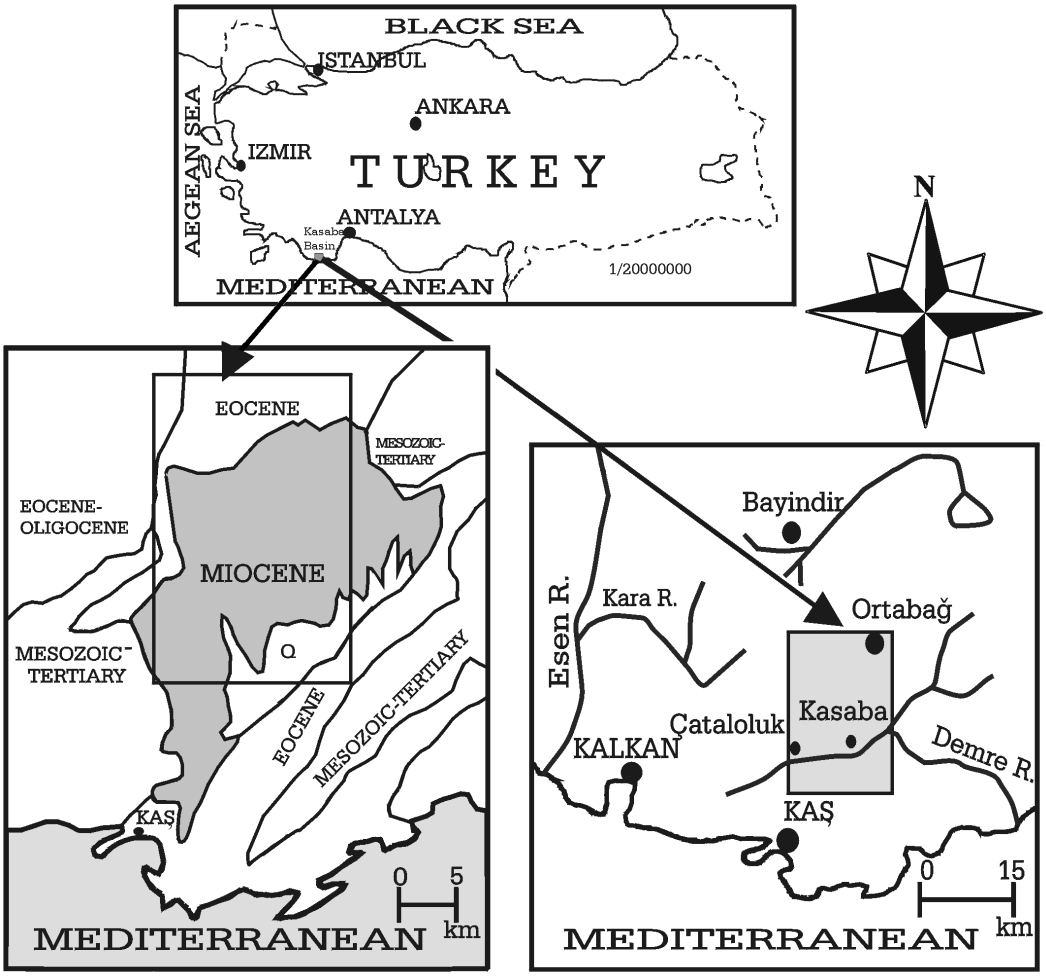


Fig. 1. Location map of the study area.

assemblages (Fig. 4). The ostracod biostratigraphy is integrated with that of calcareous nannoplankton, benthonic and planktonic foraminifers, gastropods, bivalves and corals. The entire ostracod assemblages and the other fauna and flora associations are endemic to the Neogene/Mediterranean bioprovince (Steininger et al. 198; Tunoglu & Gökçen 1997). Therefore, the Mediterranean Neogene stage concept has been used for this chronostratigraphic subdivision. A comparison of ostracod zones of the Kasaba Basin with zones of other basins of Turkey is presented in Table 2.

Suggested biozones have been described as a taxon range and an assemblage zone and these are characterized either by the predominance or presence of one or a few species or by a short ranged index species.

KBZ 1 (Kasaba Basin Zonation) — Cytherella triestina Zone

Category: Taxon Range Zone.

Age: Early–Middle Burdigalian.

Definition: This zone is characterized by first occurrences and last appearances of *Cytherella triestina* Kollmann, *Bairdia subdeltoidea* Munster, *Cyamocytheridea reversa* Egger and *Henryhowella asperrima* Reuss (Fig. 5).

Paleoenvironment: Infraneritic environment, according to ostracod assemblages (Table 3) and the other paleontological and lithological data. This zone correlates with the top of zones N5, N6, N7 and the lower part of zone N8 in the Mediterranean Neogene Basins of Steininger 1988. The Cytherella triestina Range Zone occurs in the clayey limestone of the Kibrisdere Member of the Sinekçi Formation in the Kasaba Basin. This Member contains few ostracods, a rich and abundant nannoplankton flora and planktonic foraminifers. The Kibrisdere Member was deposited in shallow marine conditions according to the rich and abundant pelagic fauna and flora associations.

Other paleontological data: The Cytherella triestina Zone occurs within the NN4 Helicosphaera ampliaperta Bramlette et Wilcoxon 1967 Nannoplankton Zone. The following nannofossil species were observed in this study: *Helicosphaera obliqua* Bramlette et Wilcoxon, *H. scissura* Miller, *H. euphratis* Haq, *Coccolithus pelagicus* Schiller, *C. miopelagicus* Bukry, *Dictyococcolites antarticus* Haq, *Cyclicargolithus floridanus* Bukry, *Discoaster deflandrei* Bramlette et Riedel, *D. perflexus* Bramlette et Riedel, *D. druggii* Bramlette et Wilcoxon, *Sphenolithus dissimilis* Bukry et Percival, *S. moriformis* Bramlette et Wilcoxon, *Braarudosphaera bigelowii* Deflandre, *Corono-*

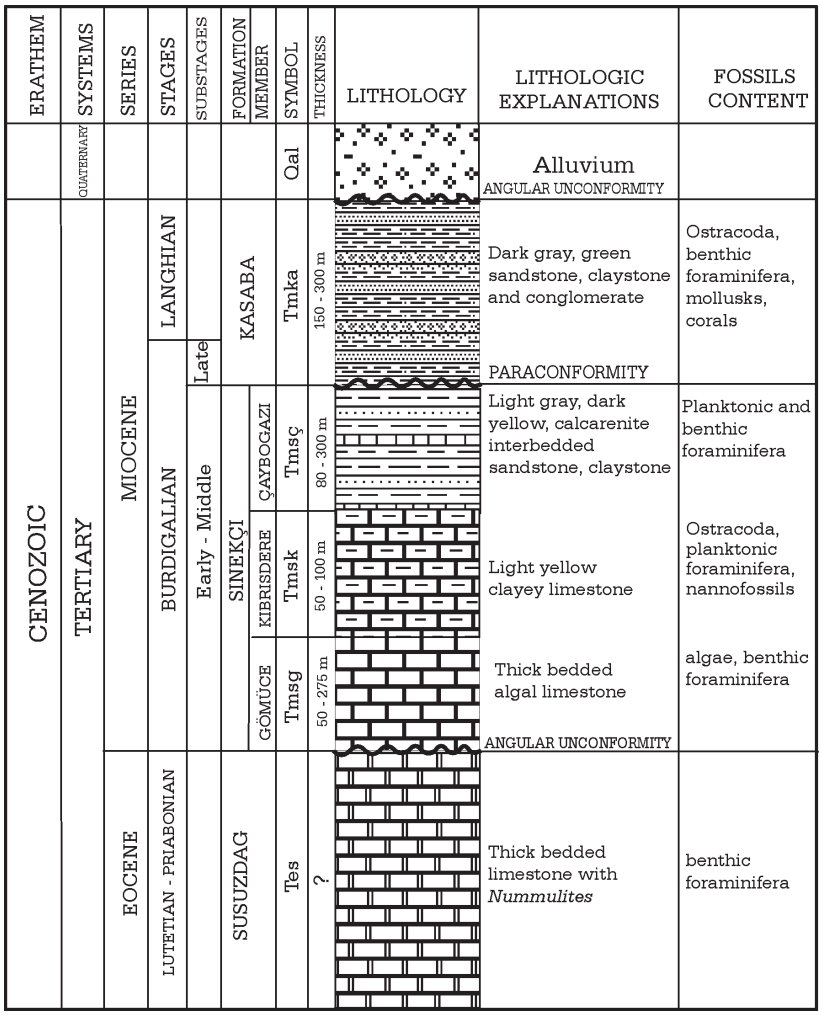


Fig. 2. Generalized stratigraphic section of the study area.

cyclus nitescens Bramlette et Wilcoxon and *Thoracosphaera saxea*.

The following species of planktonic foraminifers were observed: *Globigerinoides ruber* (d'Orbigny), *G. trilobus trilobus* (Reuss), *G. obliquus* Bolli, *G. trilobus immaturus* Le Roy, *G. trilobus sacculiferus* (Brady), *Orbulina bilobata* (d'Orbigny), *O.* cf. *suturalis* Brönniman, *Praeorbulina glomerosa glomerosa* (Blow), *Globoquadrina dehiscens* (Chapmann, Parr et Collins), *Bulimina alazanensis* Cushman, *Siphonogerina* cf. *senni* Cushman et Renz, *Osangularia mexicana* (Cole), *Oridorsalis umbonatus* (Reuss), *Globigerina praesiphonifera* Blow and species of *Anomalinoides* and *Nuttalites.* This planktonic foraminiferal association corresponds to the N7 Globigerinoides trilobus Interval Zone (Perch-Nielsen 1985).

Biostratigraphic correlation: This formation can be correlated with the Kemer Formation (Hayward 1982), the lower part of Sofular Formation in the Antakya Basin (Şafak 1993a) and the Derinçay Formation in the Adana-Mut Basin (Tanar 1989). Cytherella triestina Zone can be correlated with the lower part of the Neomonoceratina helvetica and Aurila soummamensis Superzone of Gökçen (1979, 1982, 1984); the Pronocypris sp. and Hemicyprideis helvetica Zone of Tanar (1989); and the Aurila soummamensis Zone of Şafak & Ünlügenç (1992), Nazik (1993) and Şafak (1993a,b) (Tables 1 and 2). *Cytherella triestina* was observed in the Bartonian in the Thrace/European part of Turkey (Sönmez-Gökçen 1973), Illerdian-Cuisian in Polatli/Ankara (Duru 1984), and the late Burdigalian–Langhian in the Mut Basin/Adana (Tanar 1989).

KBZ 2 — Aurila soummamensis and Krithe papillosa Zone

Category: Assemblage Zone.

Age: Late Burdigalian–Early Langhian.

Definition: This zone is characterized by rich and abundant occurrence of *Aurila soummamensis* and *Krithe papillosa*. Otherwise, this zone is placed between the first occurrences of *Pokornyella deformis minor, Aurila ducasse, Aurila convexa, Acanthocythereis hystrix, Loxoconcha punctatella* and the first occurrence of *Cytherella vulgata, Callistocythere discrepans, Cyamocytheridea meniscus, Ruggieria tetraptera tetraptera* and *Occultocythereis bituberculata.* Other ostracod species in this zone are *Hermanites haidingeri minor, Cytheretta ramosa sublaevis, Neomonoceratina helvetica, N. moulina, Loxoconcha stellifera, L. tumida, L.* cf. *variesculpta* and *L. cristatissima* (Figs. 5–7).

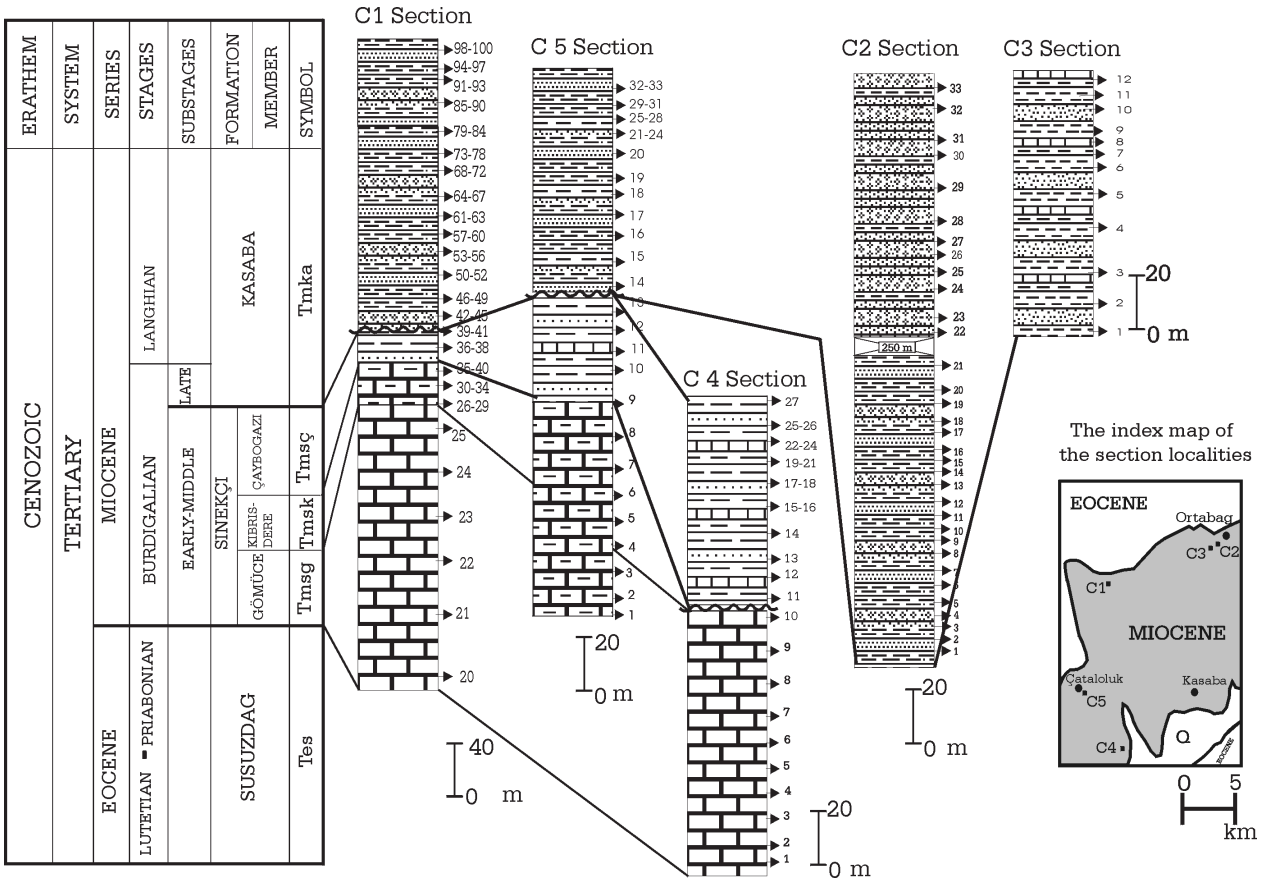


Fig. 3. Comparison of measured stratigraphic sections.

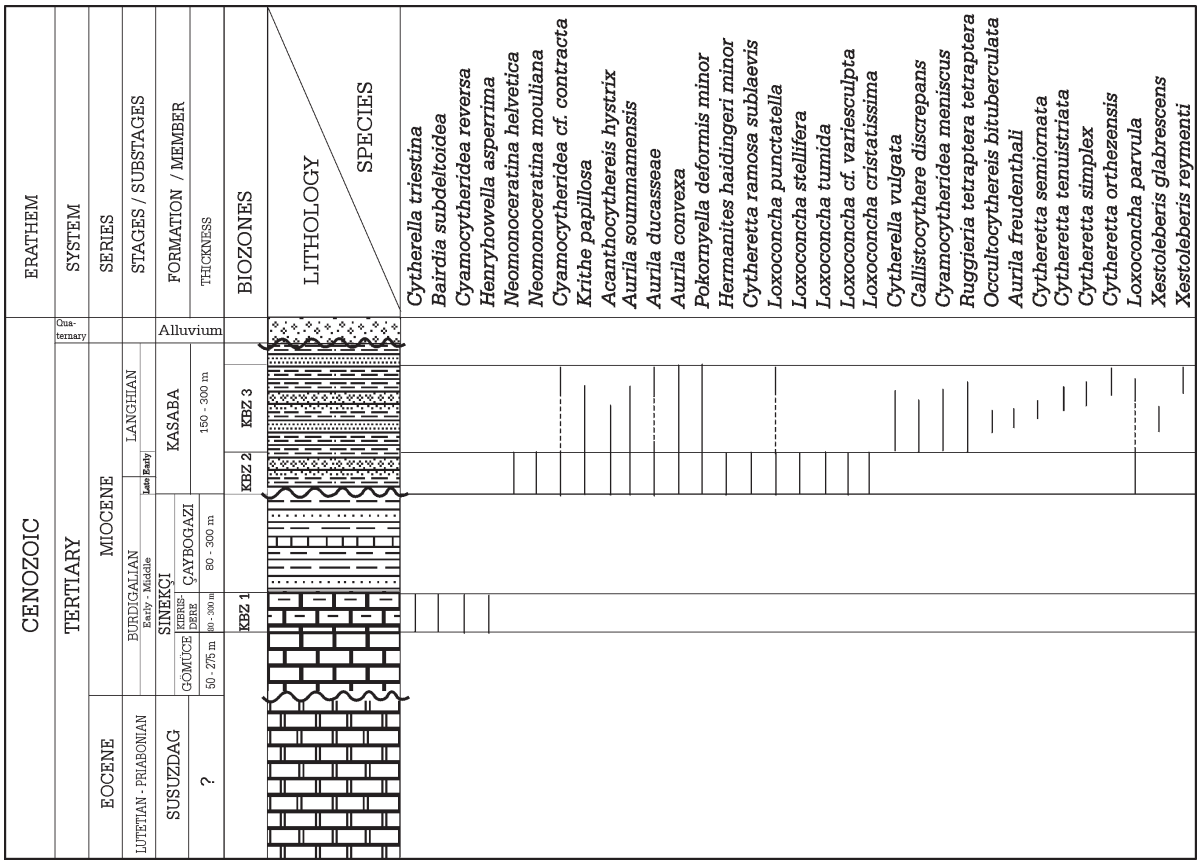
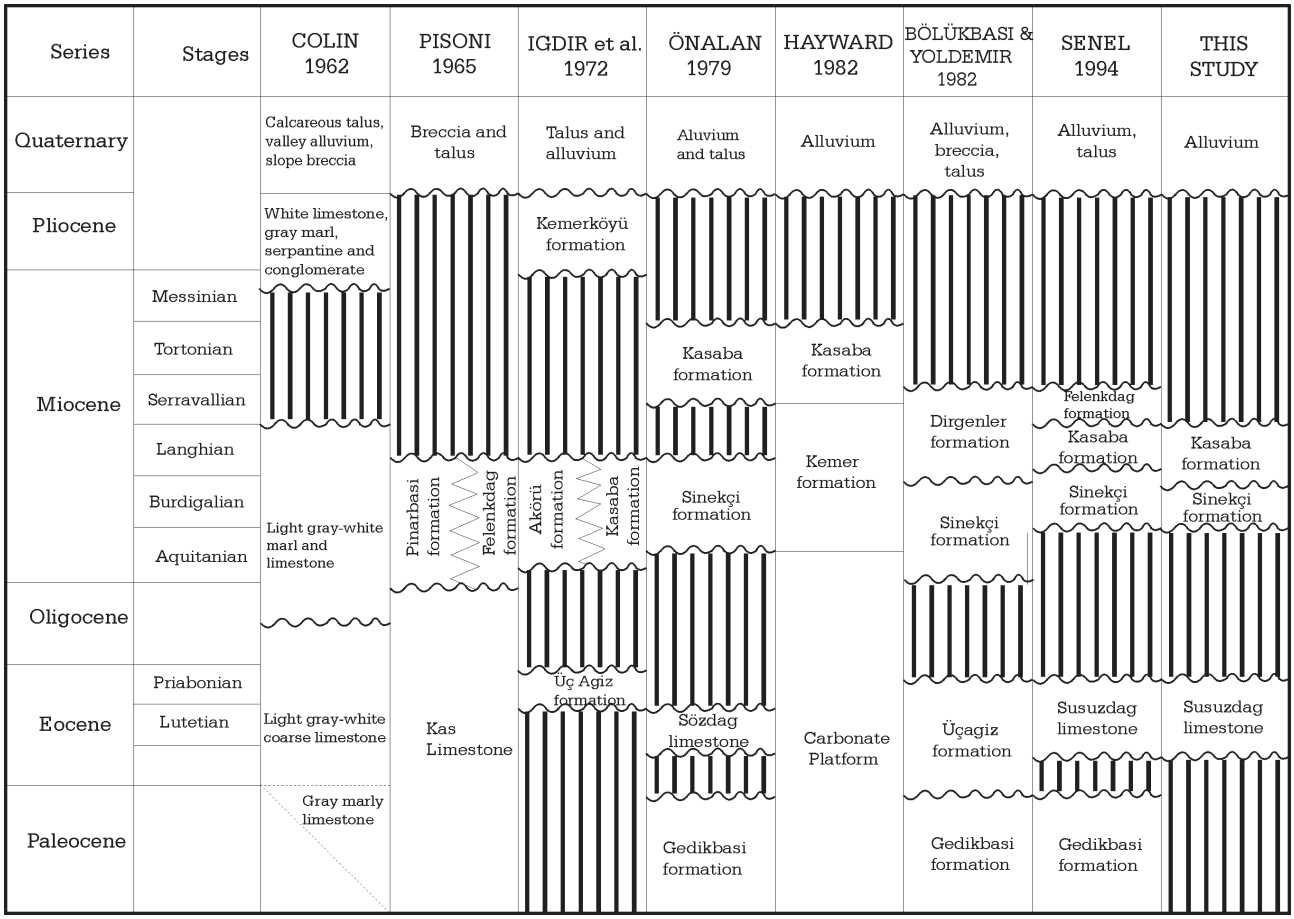


Fig. 4. Distribution of Ostracoda in the Kasaba Basin.

Table 1: Comparison of Tertiary lithostratigraphic units in study.



Paleoenvironment: The species that define this zone were deposited in shallow water (epineritic) conditions according to the ostracod fauna assemblage (see Table 3) and the other paleontological and lithological aspects. The benthonic foraminiferal associations support these environmental conclusions.

Other paleontological data: KBZ 2 (Aurila soummamensis and Krithe papillosa) and KBZ 3 (Cytherella vulgata and Ruggieria tetraptera tetraptera) assemblage zones have very rich and abundant nannoplankton floras, and benthonic foraminiferal, mollusc and coral faunas. Both ostracod zones occur within the calcareous nannoplankton Zone NN5 Sphenolithus heteromorphus. Other nannoplankton species in this zone include *Helicosphaera scissura* Miller, *Reticulofenestra pseudoumbilica* Gartner, *Coccolithus pelagicus* Schiller, *Coccolithus miopelagicus* Bukry, *Dictyococcites antarticus* Haq, *Cyclicargolithus floridanus* Bukry, *Sphenolithus heteromorphus* Deflandre, *Sphenolithus dissimilis* Bukry et Percival, *Sphenolithus moriformis* Bramlette et Wilcoxon, *Ericsonia cava* Perch et Nielsen, *Pontosphaera discopora* Schiller. This assamblage correlates to the Early–Middle Miocene age.

The benthonic foraminiferal species observed in this zone include *Spirolutilus carinatus* (d'Orbigny), *Lenticulina calcar* (Linne), *Lenticulina orbicularis* d'Orbigny, *Marginulina fragaria* Gumbel, *Marginulina hantkeni* Gumbel, *Siphonodosaria verneoulli* (d'Orbigny), *Siphonodosaria monilis* (Silvester), *Siphonodosaria nuttali* (Cushman-Jerv.), *Uvigerina barbatula* Macfad and are assigned an Early–Middle Miocene age.

Biostratigraphic correlation: *Aurila soummamensis* (see Fig. 6.2) is the dominant ostracod species in the investigated area. This zone was observed in the Denizli Neogene Basin by Gökçen (1979, 1982), and in Burdigalian-Early Langhian deposits in the Antakya Basin (Doruk 1975, 1979), Burdigalian-aged deposits in the Karsanti of Adana (Şafak 1993) and Mut Basin of Adana (Tanar 1989), Burdigalian aged deposits in the Gözne of Mersin (Nazik 1993) (Table 2). The same zone was also observed and determined in the Soummam Valley of Algeria (Coutelle & Yassini 1974), middle Oligocene–Miocene aged deposits in the Aquitaine Basin of France (Keij 1957; Moyes 1965; Bekaert et al. 1991, 1992), Aquitanian–Burdigalian aged deposits in the Rhône Basin of France (Carbonnel 1969; Carbonnel & Martini 1976; Carbonnel & Jiříček 1977). *Cytherella vulgata, Bairdia subdeltoidea, Neomonoceratina helvetica, Cyamocytheridea reversa, Krithe papillosa, Aurila soummamensis, Hermanites haidingeri minor, Cytheretta orthezensis, Cytheretta ramosa subleaveis, Loxoconcha punctatella, Xestoleberis glabrescens* species are also observed in the Burdigalian deposits of

Table 2: Comparison of Ostracoda zones of Kasaba Basin with the other zones in Turkey.

STAGES		Adana Basin		Antakya Basin		Denizli		Denizli Konya Mersin Sivas	Mut Basin	North of Adana Basin	Antakya Basin	Karsanti-Adana	Gözne-Mersin	Kasaba Basin
PARATETHYS	MEDITERRANEAN	DORUK 1979		DORUK 1979		GÖKÇEN 1979,1982		GÖKÇEN 1984	TANAR 1989	SAFAK & ÜNLÜGENÇ 1992	SAFAK 1993 b	SAFAK 1993 a	NAZIK 1993	THIS STUDY
Romanian	Piacenzian			J	*Bythocypris lucida B.bosquetina Cytherella vulgata*									
Dacian	Zanclean	G	*Mutilus skalae M.brochotus*	H	*Cytheridea voraginosa*									
		F	*Mutilus albicans*	F	*Mutilus albicans*									
Pontian	Messinian	E	*Cyrideis ruggieri*	E	*Cyrideis ruggieri*									
Pannonian	Tortonian	D	*Cnestocythere lamellicosta C.truncata*											
Sarmatian		C	*Cytheridea acuminata*	C	*Cytheridea acuminata*									
Badenian	Serravallian	B	*Bairdia subdeltoidea* *Macrocypris cf. cylindracea*	B	*Bairdia subdeltoidea* *Macrocypris cf. cylindracea*			*Carinocythereis* datum level	*Pokornyella deformis minor* -		*Cyprideis* datum level *Carinocythereis* datum level			*Cytherella vulgata Ruggieria tetraptera tetraptera* Zone
	Langhian	A	*Henryhowella ruggieri* *Krithe citae*						*Callistocythere ennensis* z.	*Neomonoceratina helvetica*		*Neomonoceratina helvetica*	*Neomonoceratina helvetica*	*Aurila soummamensis Krithe papillosa* Zone
Karpatian	Burdigalian					*Neomonoceratina helvetica - Cyamocytheridea reversa* S.	*Paracypris polita* zone	*Neomonoceratina helvetica*			*Neomonoceratina helvetica*			
Ottnangian							*Hermanites haidingeri minor* z.		*Pronocypris sp.* -	*Aurila soummamensis*	*Aurila soummamensis*	*Aurila soummamensis*	*Aurila soummamensis*	*Cytherella triestina* Zone
							Cytherella consueta Ctyheretta orthozensis z.	*Aurila soummamensis*		Zone	Zone	Zone	Zone	
Eggenburgian							*Costa yenipehirensis Cytheretta ramosa sublaevis*	Superzone	*Hemicyprideis helvetica* zone					
Egerian	Aquitanian					*Cyamocytheridea devexa Hemicyprideis rhenana* z.								

Table 3: The environments which are designated by Ostracoda fauna of the investigation area (according to Moore 1961; Morkhoven 1962, 1963; Aranki 1987; Bonaduce et al. 1975; Tunoglu 1999).

STAGES / SUBSTAGES	FORMATION / MEMBER	ENVIRONMENTS / OSTRACODA	CONTINENTAL	LITTORAL	EPINERITIC	INFRANERITIC	BATHYAL	ABYSSAL
					SHALLOW SEA		DEEP SEA	
Langhian	Kasaba Fm.	*Loxoconcha*						
		Acanthocythereis						
		Callistocythere						
		Xestoleberis						
		Cyamocytheridea						
		Occultocythereis						
		Pokornyella						
		Aurila						
		Ruggieria						
		Cytheretta						
		Krithe						
Late Burdigalian-Early Langhian		*Cytherella*						
		Loxoconcha						
		Acanthocythereis						
		Cyamocytheridea						
		Pokornyella						
		Aurila						
		Cytheretta						
		Hermanites						
		Neomonoceratina						
		Krithe						
Early-Middle Burdigalian	Sinekçi Fm. Kibrisdere M.	*Cyamocytheridea*						
		Bairdia						
		Henryhowella						
		Cytherella						

the Kula–Yenişehir areas (Denizli-SW of Turkey — Gökçen 1985). The ostracods also indicate sedimentation in the neritic environment, similar to the Kasaba Basin.

Burdigalian-aged units include the Sinekçi Formation and the lower part of the Kasaba Formation. The Gömüce Member of the Sinekçi Formation is the oldest Miocene unit of the investigated area. The following benthonic foraminiferal species of Gömüce Member were identified: *Miogypsina irregularis* (Michelotti), *Miogypsinoides dehaartii* (Van Der Klerk), *Amphistegina* sp., *Miogypsinoides* sp., *Operculina* sp., *Borelis* sp., *Gypsina sp., Heterostegina* sp., and some species of Rotaliidae and Textularidae. Bryozoa and Rhodophyta also indicate Burdigalian age. Gökçen (1984) suggested that *Neomonoceratina helvetica* Oertli, together with *A. soummamensis* Coutelle & Yassini' interval can be used to define a useful biozone in the Burdigalian–early Langhian. According to Gökçen 1984, the first occurrence of species of *Carinocythereis* is a fixed datum level within the Langhian Stage. But unfortunately this genus could not be discovered at this locality.

KBZ 3—Cytherella vulgata and Xestoleberis reymenti Zone

Category: Assemblage Zone.

Age: Langhian.

Definition: This zone is characterized by the first occurrence of *Cytherella vulgata* and last occurrence of *Xestoleberis reymenti* and these species are very rich and abundant in this zone. This zone is also characterized by the first occurrence of *Occultocythereis bituberculata* (Reuss), *Callistocythere discrepans* (G.W. Muller), *Cyamocytheridea meniscus* Doruk and *Ruggieria tetraptera tetraptera* (Sequenza). Other ostracod species of this zone include *Krithe papillosa* (Bosquet), *Acanthocythereis hystrix* (Reuss), *Aurila soummamensis* Coutelle et Yassini, *A. ducasseae* Moyes, *A. convexa* (Baird), *A. freudenthali* Sissingh, *Pokornyella deformis minor* Moyes, *Loxoconcha punctatella* (Reuss), *L. parvula* Moyes, *Cytheretta semiornata* Egger, *C. tenuistriata* Reuss, *Xestoleberis glabrescens* (Reuss), (Figs. 5–7).

Paleoenvironment: Epineritic environment, according to ostracod assemblages (see Table 3), but other paleontological and lithological aspects indicate shallower conditions than the Cytherella vulgata and Xestoleberis reymenti Zone.

Other paleontological data: NN5 Sphenolithus heteromorphus Zone. The following nannoplankton species were identified: *Dictyococcites antarticus* Haq, *Coccolithus pelagicus* Schiller, *Cyclicargolithus floridanus* Bukry, *Reticulofenestra pseudoumbilica* Gartner, *Sphenolithus moriformis* Bramlette et Wilcoxon, *Sphenolithus heteromorphus* Deflandre. This nannofossil assemblage indicates assignment to the NN5 nannoplankton zone of Middle Miocene age.

Heliastraea sp., *Tarbellastrea* sp., *Tarbellastrea* cf. *raulini* Milne-Edwards et Haime and *Tarbellastrea* cf. *T. eggenburgensis* Kuhn coral associations are observed in the same zone.

The following Mollusca species were identified: Gastropods: *Conus antiquus* Lamarck, *C. mercati* Brocchi, *C. betulinoides* Lamarck, *C. puschi* Michelotti, *C. fuscocingulatus* Bronn, *Turritella (Archimediella) bicarinata* Eichwaldi, *T. (Haustator) tricincta* (Borson), *Pirenella* cf. *P. picta* (Defrance in Basterot), *Natica millepunctata* Lamarck, *Cypraea (Bernayia) fabagina* Lamarck, *Mürex (Hexaplex) austriacus* Tournover, *Bursa (Ranella) marginata* (Brocchi), *Ancillaria* sp. Bivalvia include: *Cardium (Discors) spondloides* Von Haver, *Arca okeni* Mayer, *A. (Anadara) turoniensis* Dujardin, *Glycymeris (Glycymeris) cor* (Lamarck), *Pecten praebenedictus* Tournover, *P. benedictus* Lamarck, *Lucinopsis rupestris* Brocchi, *Venus multilamella* Lamarck, *V.* cf. *V. burdigaliensis* Mayer, *Flabellipecten ficheuri* Brives, *Flabellipecten* sp. and *Tapes* sp.

The benthonic foraminiferal assemblage indicates Early Miocene age. The species include *Spirolutilus carinatus* (d'Orbigny), *Lenticulina calcar* (Linné), *Lenticulina orbicularis* d'Orbigny, *Marginulina fragaria* Gumbel, *Siphonodosaria monilis* (Silvestri), *Siphonodosaria nuttali* (Cushman-Jerv), *Ammonia beccarii* (Linné), *Asterigerinata mammilla* (Williamson), *Operculina complata* Defrance, *Operculina ammonoides* Granovius, *Borelis* sp., *Lenticulina* sp., *Elphidium* sp., *Quinqueloculina* sp., *Spiroloculina* sp., *Miliolinella* sp., *Eponides* sp.

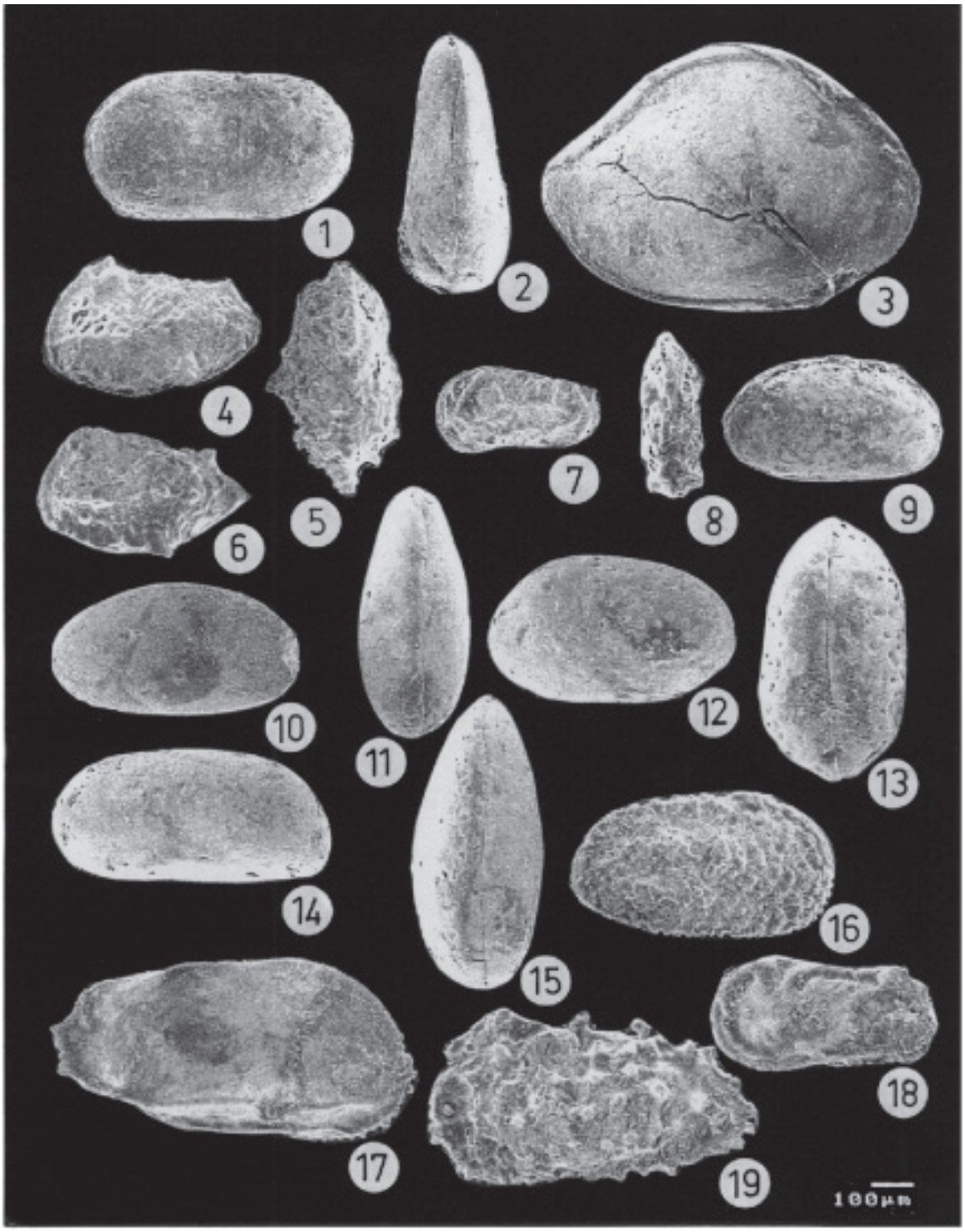


Fig. 5. 1, 2. ***Cytherella vulgata*** Ruggieri 1962. C3 Section, Karacayer Hill, C3-9, Langhian. 1 — Right valve, external. 2 — Carapace, dorsal. **3.** ***Bairdia subdeltoidea*** (Münster 1830). C1 Section, West of Feslegen Hill, C1-35, Early–Middle Burdigalian. Carapace, right valve, external. **4, 5.** ***Neomonoceratina helvetica*** Oertli 1958. C1 Section, SW of Feslegen Hill, C1-61, Late Burdigalian–Early Langhian. 4 — Left valve, external. 5 — Carapace, dorsal. **6.** ***Neomonoceratina mouliana*** Sissingh 1972. C1 Section, SW of Feslegen Hill, C1-61, Late Burdigalian–Early Langhian. Left valve, external. **7, 8.** ***Callistocythere discrepans*** (G.W. Muller 1894). C2 Section, S of Ortabag, C2-16, Langhian. 7 — Left valve, external. 8 — Carapace, dorsal. **9.** ***Cyamocytheridea meniscus*** Doruk 1975. C2 Section, S of Ortabag, C2-6, Langhian. Carapace, right valve, external. **10, 11.** ***Cyamocytheridea reversa*** (Egger 1858). C1 section, W of Çataltepe, C1-35, Early-Middle Burdigalian. 10 — Carapace, left valve, external. 11 — Carapace, dorsal. **12, 13.** ***Cyamocytheridea*** **cf.** ***contracta*** Doruk 1975. C2 Section, S of Ortabag, C2-24, Langhian. 12 — Left valve, external. 13 — Carapace, dorsal. **14, 15.** ***Krithe papillosa*** (Bosquet 1852). C-2 Section, S of Ortabag, C2-15, Langhian. 14 — Left valve, external. 15 — Carapace, dorsal. **16.** ***Henryhowella asperrima*** (Reuss 1850) C1 Section, W of Çataltepe, C1-35, Early–Middle Burdigalian. Right valve, external. **17.** ***Ruggieria tetraptera tetraptera*** (Sequenza 1879). C2 Section, S of Ortabag, C2-16, Langhian. Right valve,

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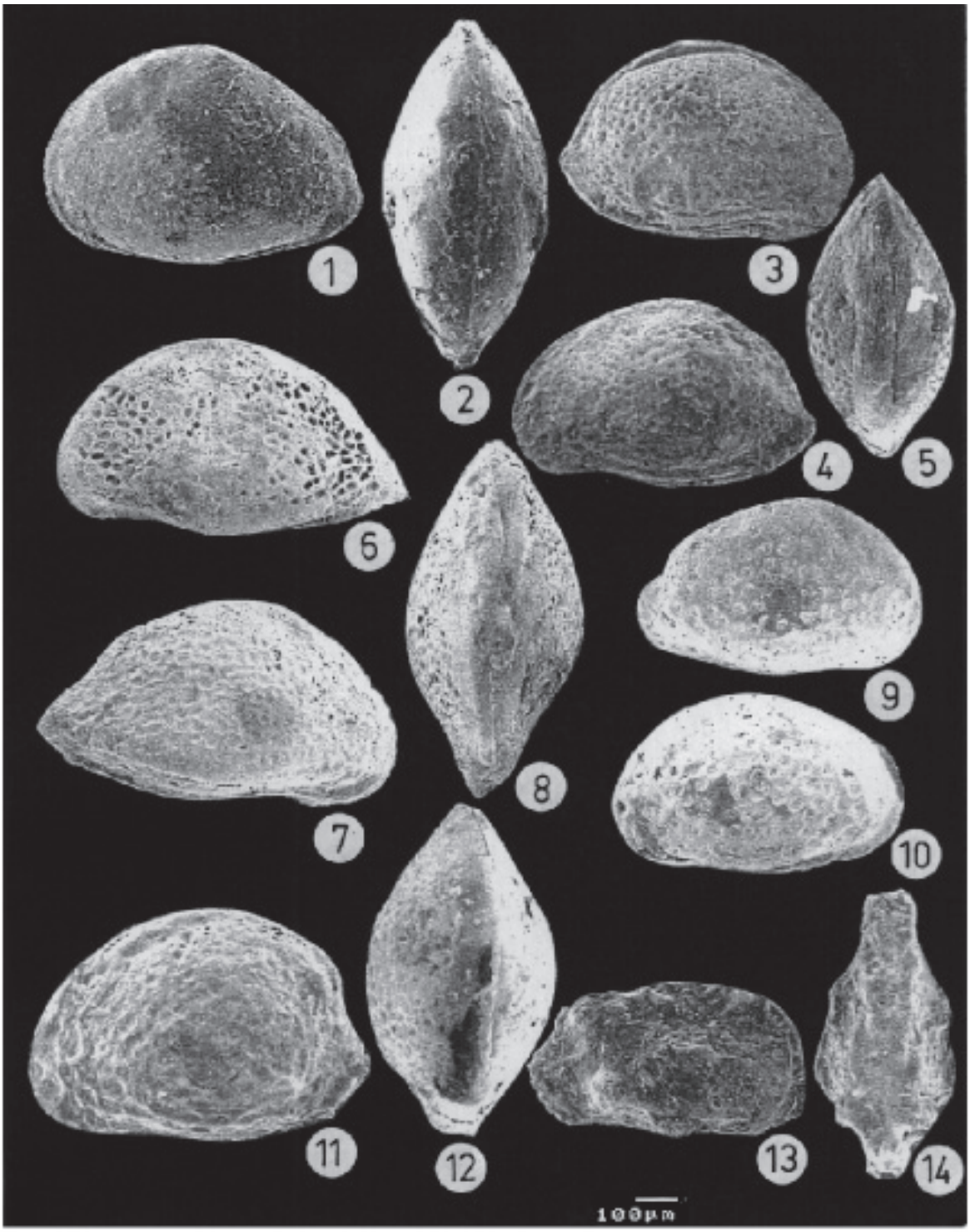

Fig. 6. 1, 2. ***Aurila soummamensis*** Coutelle et Yassini 1974. C2 Section, S of Ortabag, C2-14, Langhian. 1— Left valve, external. 2 — Carapace, dorsal. **3–5.** ***Aurila convexa*** (Baird 1850). C2 Section, S of Ortabag, C2-24, Langhian. 3 — Carapace, right valve, external. 4 — Left valve, external. 5 — Carapace, dorsal. **6–8.** ***Aurila freudenthali*** Sissingh 1972. C2 Section, S of Ortabag, C2-19, Langhian. 6 — Left valve, external. 7 — Right valve, external. 8 — Carapace, dorsal. **9, 10.** ***Aurila ducasseae*** Moyes 1961. C2 Section, S of Ortabag, C2-24, Langhian. 9 — Right valve, external. 10 — Left valve, external. **11, 12.** ***Pokornyella deformis minor*** Moyes 1965. C1 Section, SW of Feslegen Hill, C1-16, Late Burdigalian–Early Langhian. 11 — Left valve, external. 12 — Carapace, dorsal. **13, 14.** ***Hermanites haidingeri minor*** Ruggieri 1962. C1 Section, SW of Feslegen Hill, C-61, Late Burdigalian–Early Langhian. 13 — Right valve, external. 14 — Carapace, dorsal.

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external. **18.** ***Occultocythereis bituberculata*** (Reus 1850). C2 Section, S of Ortabag, C2-20, Langhian. Left valve, external. **19.** ***Acanthocythereis hystrix*** (Reuss 1850). C1 Section, SW of Feslegen Hill, C1-61, Late Burdigalian–Early Langhian. Left valve, external.

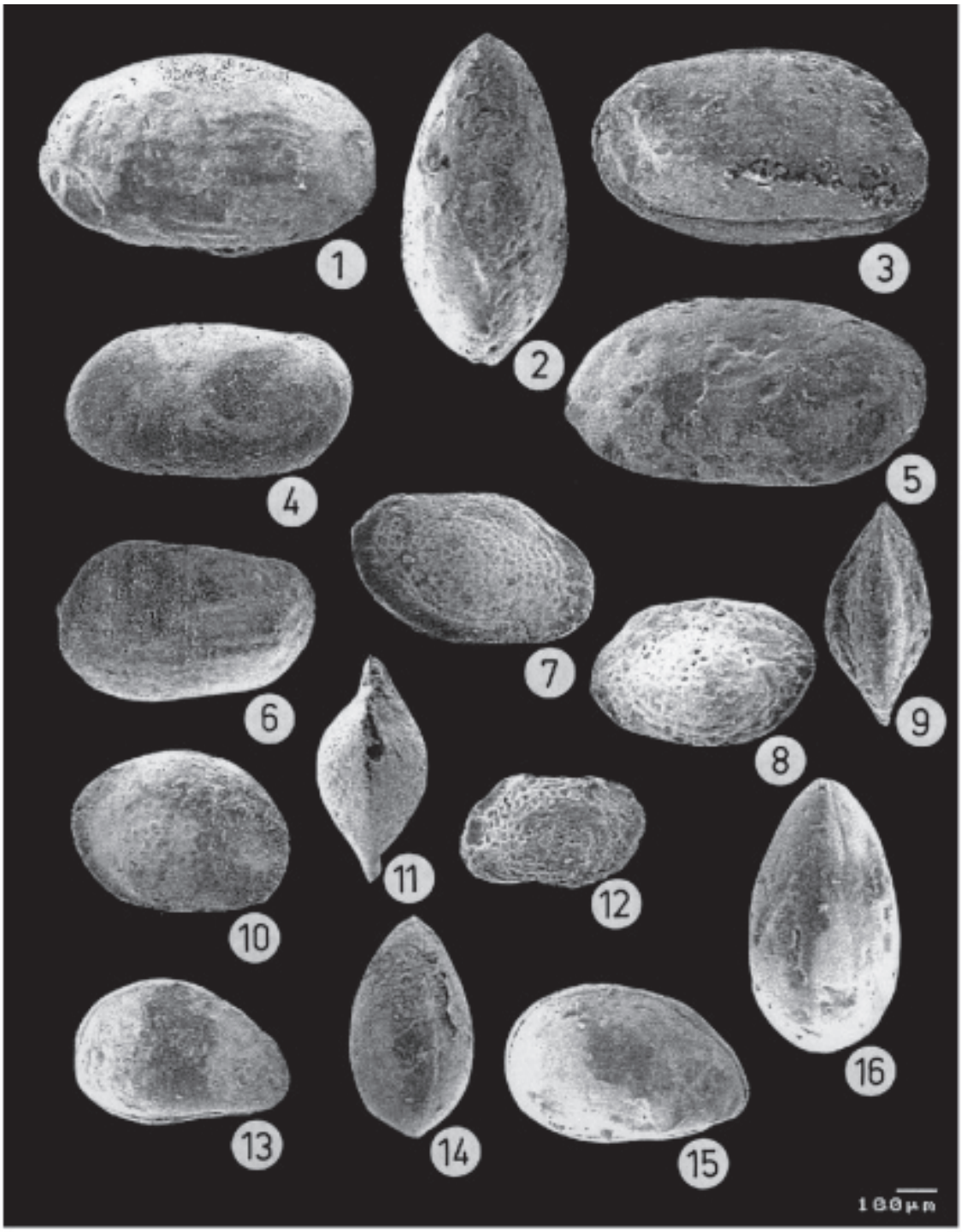

Fig. 7. 1, 2. ***Cytheretta orthezensis*** Moyes 1965. C2 Section, S of Ortabag, C2-24, Langhian. 1 — Carapace, left valve, external. 2 — Carapace, dorsal. **3.** ***Cytheretta ramosa subleaevis*** Triebel 1952. C1 Section, SW of Feslegen Hill, C1-61, Late Burdigalian–Early Langhian. Carapace, right valve, external. **4.** ***Cytheretta simplex*** Moyes 1965. C3 Section, Karacayer Hill, C3-6, Langhian. Left valve, external. **5.** ***Cytheretta semiornata*** Eggeri 1967. C3, S of Ortabag, C2-19, Langhian. Left valve, external. **6.** ***Cytheretta tenuistriata*** (Reuss 1853). C3 Section, Karacayer Hill, C3-6, Langhian. Left valve, external. **7.** ***Loxoconcha punctatella*** (Reuss 1850). C1 Section, SW of Feslegen Hill, C1-61, Late Burdigalian–Early Langhian. Right valve, external. **8, 9.** ***Loxoconcha tumida*** (Brady 1869). C1 Section, SW of Feslegen Hill, C1-61, Late Burdigalian–Early Langhian. 8 — Left valve, external. 9 — Carapace, dorsal. **10, 11.** ***Loxoconcha stellifera*** Muller 1894. C1 Section, SW of Feslegen Hill, C1-61, Late Burdigalian–Early Langhian. 10 — Right valve, external. 11 — Carapace, dorsal. **12.** ***Loxoconcha* cf. *variesculpta*** Ruggieri 1962. C1 Section, SW of Feslegen Hill, C1-61, Late Burdigalian–Early Langhian. Left valve, external. **13, 14.** ***Xestoleberis glabrescens*** (Reuss 1850). C2 Section, S of Ortabag, C2-5, Langhian. 13 —Carapace, right valve, external. 14 — Carapace, dorsal. **15, 16.** ***Xestoleberis reymenti*** Ruggieri 1967. C2 section, S of Ortabag, C2-24, Langhian. 15 — Carapace, right valve. 16 — Carapace, dorsal.

Biostratigraphic correlation: Deposits of Langhian age have been recognized only in the Kasaba Formation. The lower boundary of Kasaba Formation is compromised with the base of the late Burdigalian age and marked by the first appearances of Aurila soummamensis and Krithe papillosa assemblage Zone. Two ostracod assemblage zones have been identified in the Kasaba Formation, which coincide with the NN5 — Sphenolithus heteromorphus Nannoplankton Zone.

Deposits of the Langhian Stage have been identified in the Adana Basin by Doruk (1979); in the Denizli, Konya, Mersin and Sivas regions by Gökçen (1984); in the Mut Basin by Tanar (1989); in the northern Adana Basin by Şafak and Ünlügenç (1992); in the Antakya Basin by Şafak (1993a); in the Karsanti region by Şafak (1993b); and in the Gözne of Mersin area by Nazik (1993). In the Misis area, the Langhian has been recognized on the basis of the first appearances of the *Carinocythereis* datum level, but unfortunately *Carinocythereis* was not discovered in the Kasaba Basin. The Neomonoceratina helvetica Zone is known in the Rhône Basin (France) and this zone is considered to correlate with NN3–NN4 nannoplankton zones and N7–N8 planktonic foraminiferal zone (Carbonnel & Martini 1976).

Results

1. Correlation of the Kasaba Basin to the chronostratigraphy of the Neogene Mediterranean stage concept has been achieved using ostracod assemblages, thus facilitating recognition of the Early–Middle Burdigalian, Late Burdigalian–Early Langhian and Langhian.

2. Three ostracod biozones have been defined and proposed in this study. These are:

a) Cytherella triestina Taxon Range Zone (Early–Middle Burdigalian).

b) Aurila soummamensis-Krithe papillosa Assemblage Zone (Late Burdigalian–Early Langhian).

c) Cytherella vulgata-Xestoleberis reymenti Assemblage Zone (Langhian).

3. These zones can be correlated only between the Mediterranean Basins.

4. These biostratigraphic results have been integrated with the other fauna and flora groups (planktonic and benthonic foraminifers, nannoplankton, macro bivalvia, gastropods and corals) which were found in the study area and allow for an Early Burdigalian–Langhian assignment of these sections.

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