



Pliocene-Lower Pleistocene Ostracoda Fauna from İnsuyu Limestone (Karapınar-Konya/Central Turkey) and its Paleoenvironmental Implications

Pliyosen-Pleyistosen Yaşlı İnsuyu Kireçtaşı'nın Ostrakod Faunası (Karapınar-Konya/İç Anadolu, Türkiye) ve Eski Ortamsal Yorumu,

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ABSTRACT

The study area is located in the southern part of the Central Anatolia Neogene Basin (north of Karapınar Town and Acı Göl, Konya). The İnsuyu Limestone Unit, which has a total thickness of 100-400 m, is composed of claystone, sandstone, conglomerate and chert. There are also andezite and pyroclastic interclations within İnsuyu limestone. The claystone layers of this unit are white to pink in color and contain abundant Ostracoda and a few fresh water Gastropoda. In this study, 160 samples from 8 stratigraphic sections were collected but only samples having limestone lithology contained ostracods. A total of 16 ostracods taxa (11 previously known and five belonging to open nomenclature) are systematically described as *Cyprideis pannonica*, *C. torosa*, *Ilyocypris gibba*, *I. bradyi*, *Candona neglecta*, *C. candida*, *C. altoides*, *C. decimai*, *Pseudocandona compressa*, *Heterocypris salina*, *Zonocypris membranea*, *Ilyocypris* sp. *Candona* sp.1, *Candona* sp.2, *Pseudocandona* sp. and *Cypridopsis* sp. Based on this Ostracoda fauna, the age of this unit is assigned as Pliocene-Early Pleistocene. This fauna indicates a few brackish but dominantly fresh water conditions in a lacustrine environment.

Key words: Fresh water Ostracoda, İnsuyu Limestone Unit, Pliocene-Early Pleistocene, systematics, Turkey.

ÖZ

*Çalışma alanı "Orta Anadolu Neojen Baseni" nin güney kesiminde yer almaktadır (Karapınar Kasabası kuzeyi ve Acı göl, Konya). İnsuyu Kireçtaşı birimi 100-400 m toplam kalınlığa sahip olup, kiltası, kumtaşı, konglomera ve çört tabakalarından oluşmaktadır. İnsuyu Kireçtaşı biriminde andezitler ve piroklastik seviyeleri de vardır. Kiltaları beyaz ve pembe renklere olup bol miktarda ostrakod ve daha az oranda tatlı su gastrapod fosilleri içermektedir. Bu çalışmada, 8 stratigrafik kesit ölçülmüş ve bu kesitlerden 160 örnek toplanmıştır. Ancak sadece kireçtaşları ostrakod fosili içermektedir. Sonuç olarak, toplam 16 ostrakod taksonu (11 bilinen ve 5 isimlendirmeye açık) ayırtlanmıştır. Bunlar: *Cyprideis pannonica*, *C. torosa*, *Ilyocypris gibba*, *I. bradyi*, *Candona neglecta*, *C. candida*, *C. altoides*, *C. decimai*, *Pseudocandona compressa*, *Heterocypris salina*, *Zonocypris membranea*, *Ilyocypris* sp. *Candona* sp.1, *Candona* sp.2, *Pseudocandona* sp. and *Cypridopsis* sp. taksonlarıdır. Ostrakod topluluğuna göre birimin yaşı Pliyosen-Erken Pleyistosen olarak belirlenmiştir. Bu fauna topluluğu tatlı su (laküstrin) ortamına özgüdür.*

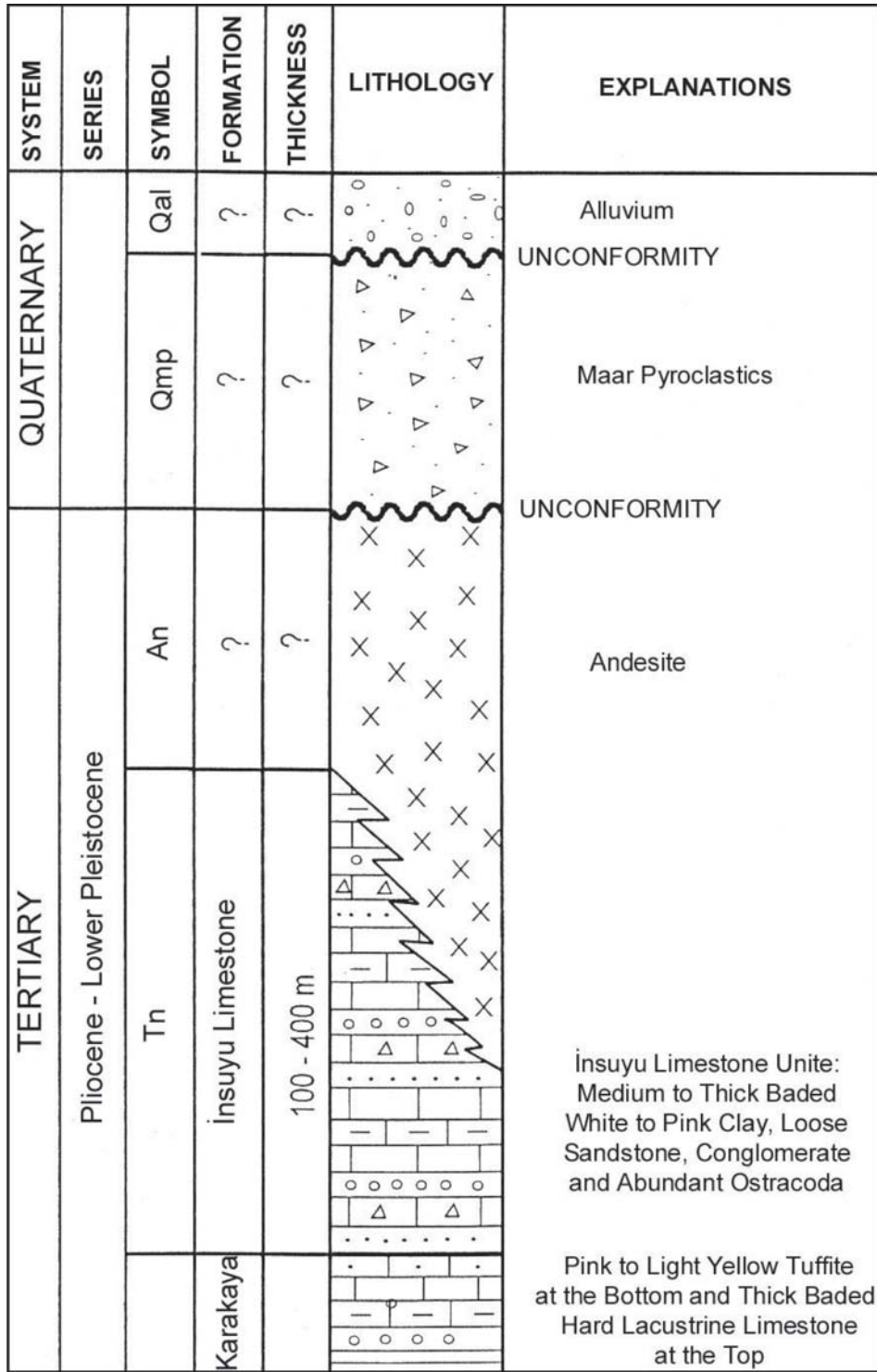


Figure 2. Generalized stratigraphic section of the study area

Şekil 2. Çalışma bölgesinin genelleştirilmiş stratigraphic kesiti

METHODOLOGY

This research includes both field and laboratory studies of the samples taken from İnsuyu Limestone Unit. All of the samples were collected from 8 different stratigraphic sections during field studies (Figure 3) and they were prepared for micropaleontologic study to determine the ostracod assemblage under a binocular microscope. Ostracods are present only in 50 of the 160 samples. Especially marl and limestone samples from the study area were processed using dilute 10% H₂O₂. During the study, an Olympus binocular stereo microscope was used, and a Scanning Electron Microscope (SEM-Jeol-JSM-6400) was also used for more precise determinations and photomicrography.

LITHOSTRATIGRAPHY AND OSTRACODA DISTRIBUTION ALONG THE SECTIONS

The lithological variations based on ostracod biostratigraphy and chronostratigraphy of the Pliocene-Early Pleistocene sequence in the Karapınar Region were investigated and are presented in this study. The systematic description of the Ostracoda taxa are also given. The study was carried out on 160 samples of eight measured stratigraphic sections (Figure 3). The lithological characteristics of these sections and distribution of ostracods throughout these sections are given in the following paragraphs. An explanation of abundance, frequency symbols and of the lithological symbols used in the Figures 4-11 are given in Figure 3.

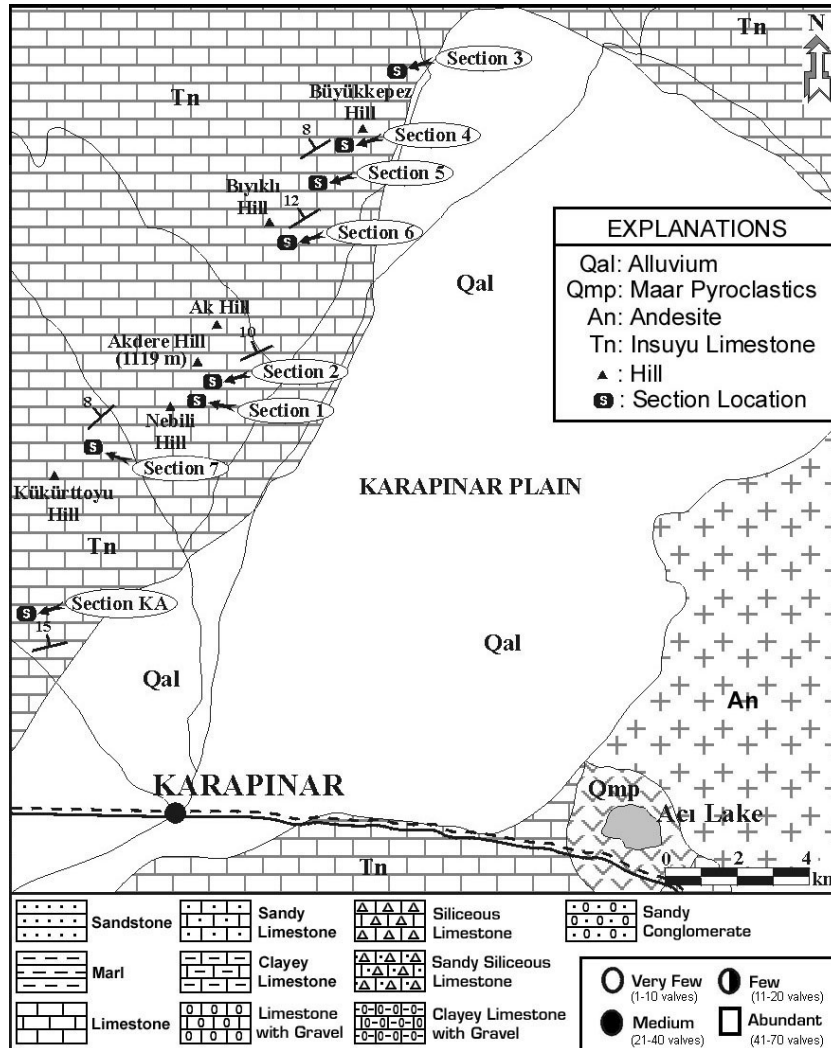


Figure 3. Geological map of the study area and locations of the Measured Stratigraphic Sections (frequency and lithological symbols used in the Figures 4-11 are given under this figure).

Şekil 3. Çalışma bölgesinin jeolojik haritası ve ölçülü stratigrafi kesitlerinin yerleri (Şekil 4-11 de kullanılan frekans aralık sembolleri ve litoloji sembolleri bu şekil altında verilmiştir)

KA stratigraphic section is 100 m thick (Figure 4). The basal part of this section is represented by clayey limestone with gravel and limestone. The overlying beds are characterized by mainly claystone, clayey limestone, clayey limestone with gravel and limestone.

Twenty one samples were collected from this section and 14 ostracod taxa identified. Two unfossiliferous zones were determined in this section. *Candona* is the dominant genus but *Cyprideis* is also reported in this section

Stratigraphic section 1 has a total thickness of 120 m (Figure 5). At the basal part of the section, it mainly includes clayey limestone, limestone, siliceous limestone and marl alternation. 13 ostracod taxa were determined from 38 samples in this section. *Candona* is dominant and *Ilyocypris*, *Heterocypris*, *Cypridopsis*, *Zonocypris* species are also present.

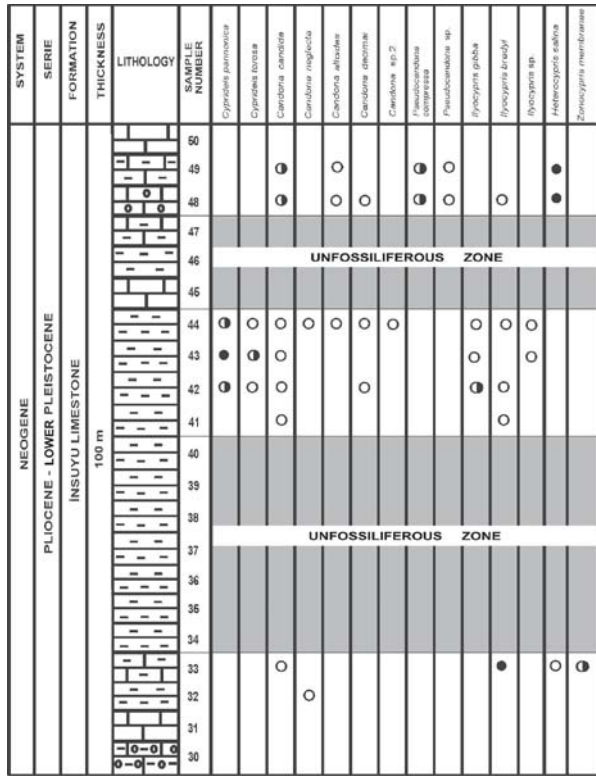


Figure 4. Ostracoda association and distribution along the KA Measured Stratigraphic Section

Şekil 4. KA Ölçülü Stratigrafi Kesiti boyunca ostrakod topluluğu ve dağılımı.

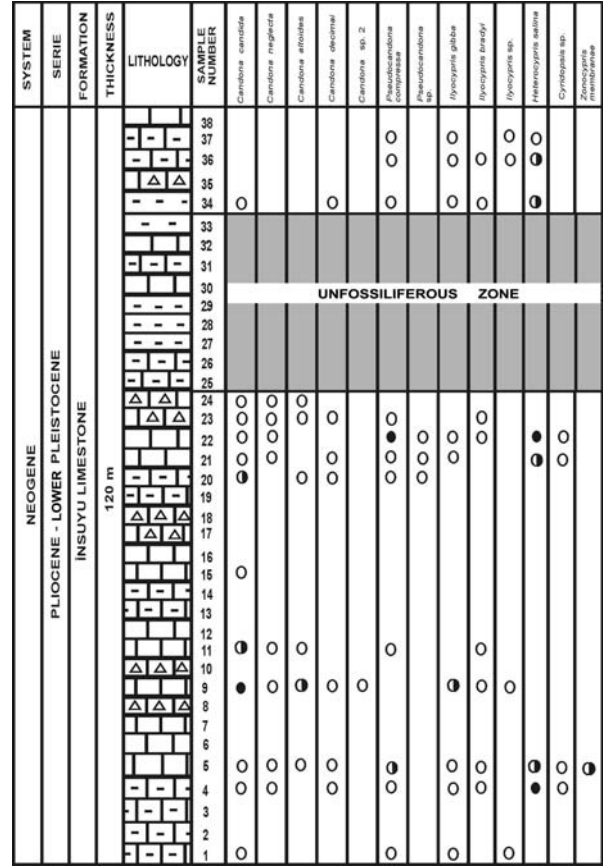


Figure 5. Ostracoda association and distribution along Measured Stratigraphic Section 1.

Şekil 5. 1 numaralı Ölçülü Stratigrafi Kesiti boyunca ostrakod topluluğu ve dağılımı

The thickness of the stratigraphic section 2 was measured as 105 meters (Figure 6). It includes clayey limestone and limestone at the bottom and siliceous limestone, clayey limestone and limestone alternation towards the top.

Two main unfossiliferous zones were identified at the mid and upper levels of this section. 12 ostracod taxa from 34 samples were determined, and *Candona* is the dominant genus in this section.

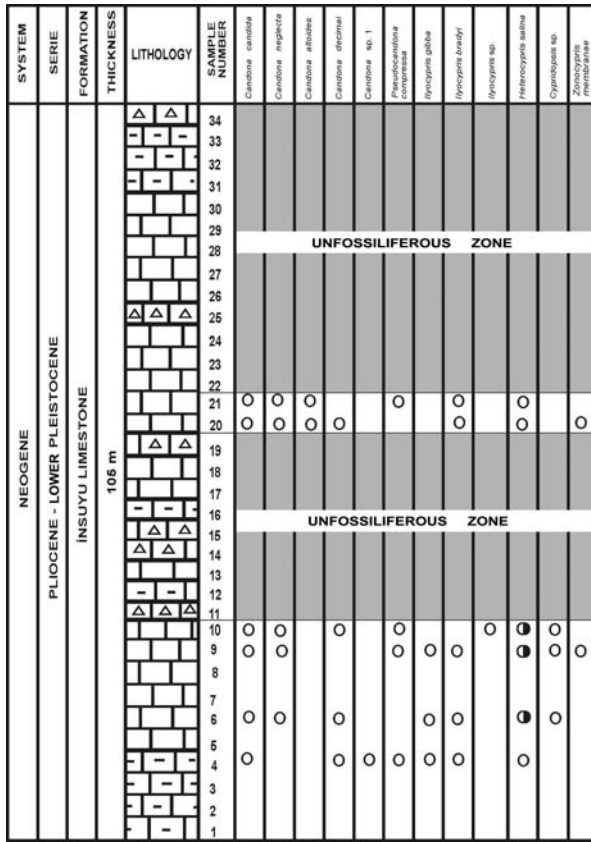


Figure 6. Ostracoda association and distribution along Measured Stratigraphic Section 2.

Şekil 6. 2 numaralı Ölçülü Stratigrafi Kesiti boyunca ostrakod topluluğu ve dağılımı

Stratigraphic section 3 is 80 m in total thickness (Figure 7). The basal part of this section is represented by sandy limestone, limestone and siliceous limestone. There is a 10 m thick conglomerate-sandstone in the middle part of the section. The upper part of this section is composed of thick siliceous limestone, limestone and sandy-siliceous limestone. Thirteen samples were collected from this section and only four samples representing basal levels contained ostracods. The mid and upper parts of this section did not contain ostracods (30-80 m). Nine ostracod species were reported, of which a species of *Candona* is dominant, especially at the basal levels of this section.

Stratigraphic section 4 is 80 meters in thickness (Figure 8). It contains siliceous limestone,

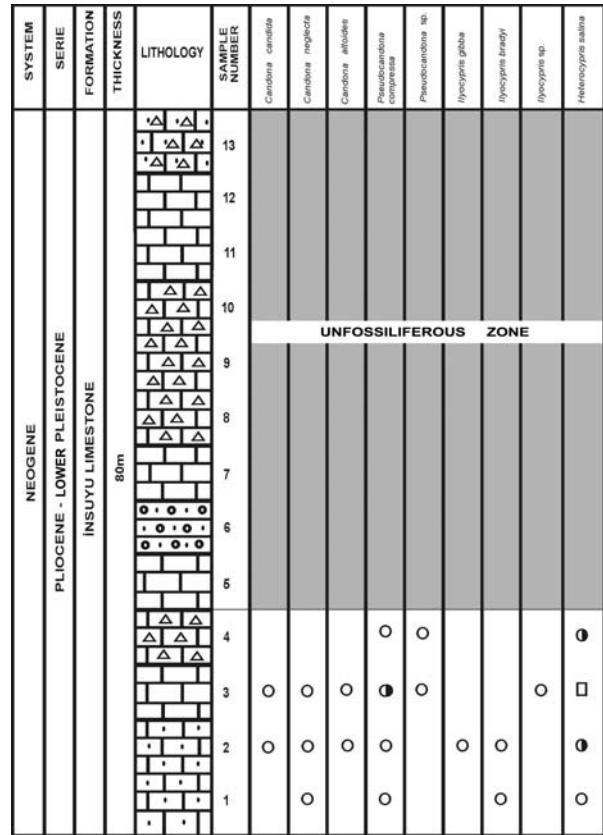


Figure 7. Ostracoda association and distribution along Measured Stratigraphic Section 3

Şekil 7. 3 numaralı Ölçülü Stratigrafi Kesiti boyunca ostrakod topluluğu ve dağılımı.

sandy limestone and marl alternations at the bottom and sandstone, sandy limestone, limestone and sandy, siliceous limestone towards the top. 16 samples were collected along the section and 5 of them, belonging to the upper levels, are fossiliferous. *Candona* is the dominant genus. Only nine ostracod species were determined but the number of individual examples is very low in this section.

The thickness of stratigraphic section 5 was 60 meters (Figure 9). The units of this section consist of only sandy, siliceous limestone and sandy limestone, 12 samples were collected but only two of them contain ostracod. Only three ostracod taxon are determined. The number of species and number of individuals are very few and *Candona* is the only genus found in this section.

Figure 8. Ostracoda association and distribution along Measured Stratigraphic Section 4.

Şekil 8. 4 numaralı Ölçülü Stratigrafi Kesiti boyunca ostrakod topluluğu ve dağılımı

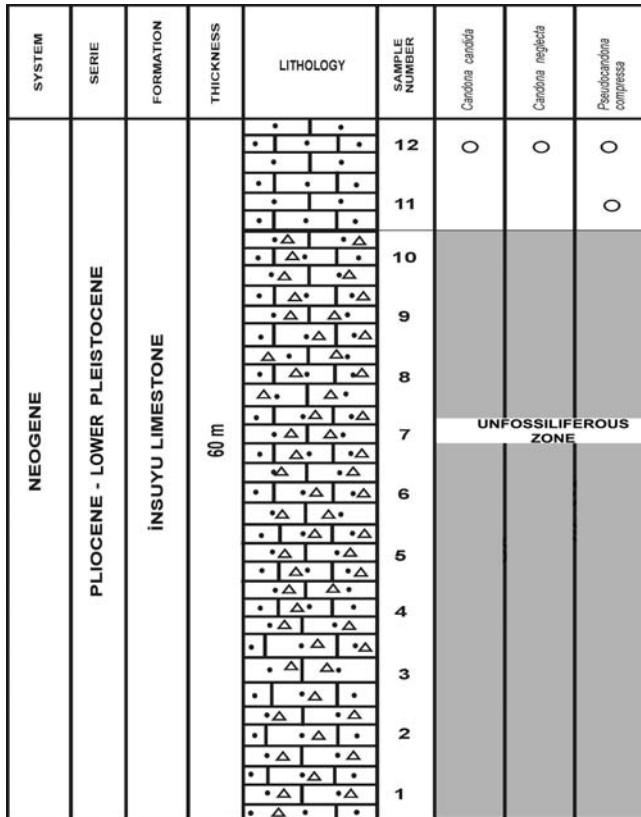
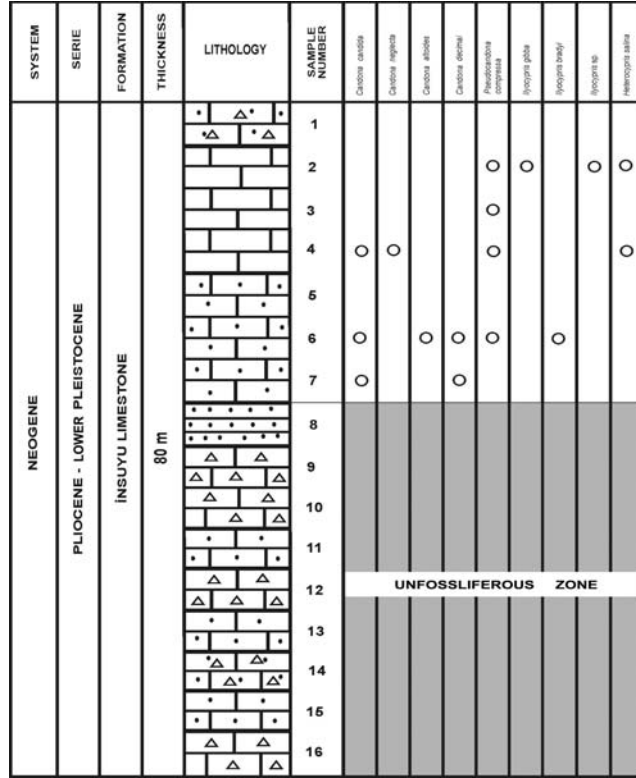


Figure 9. Ostracoda association and distribution along Measured Stratigraphic Section 5.

Şekil 9. 5 numaralı Ölçülü Stratigrafi Kesiti boyunca ostrakod topluluğu ve dağılımı

Stratigraphic section 6 is 75 m in thickness. (Figure 10). It contains sandy, siliceous limestone, limestone and siliceous limestone levels from bottom to top. 16 samples were collected along this section. Nine ostracod species were identified from only ten samples.

The uppermost 20 meters of this section are an unfossiliferous zone. *Candona* is the dominant genus.

SYSTEM	SERIE	FORMATION	THICKNESS	LITHOLOGY	SAMPLE NUMBER	<i>Candona caradida</i>	<i>Candona neglecta</i>	<i>Candona albidus</i>	<i>Candona dikornai</i>	<i>Phacelostrecha compressa</i>	<i>Ilyocypris gibba</i>	<i>Ilyocypris bradyi</i>	<i>Ilyocypris sp.</i>	<i>Heterocypris salina</i>			
NEOGENE	PLIOCENE - LOWER PLEISTOCENE	INSUYU LIMESTONE	75m		1												
					2	UNFOSSILIFEROUS ZONE											
					3												
					4												
					5												
					6												
					7												
					8												
					9												
					10												
					11												
					12												
					13												
					14												
					16												
					16												

Figure 10. Ostracoda association and distribution along Measured Stratigraphic Section 6.

Şekil 10. 6 numaralı Ölçülü Stratigrafi Kesiti boyunca ostrakod topluluğu ve dağılımı

SYSTEM	SERIE	FORMATION	THICKNESS	LITHOLOGY	SAMPLE NUMBER	<i>Ilyocypris gibba</i>	<i>Ilyocypris bradyi</i>	<i>Zonocypris membranæ</i>			
NEOGENE	PLIOCENE - LOWER PLEISTOCENE	INSUYU LIMESTONE	50 m		10						
					9						
					8						
					7						
					6						
					5	UNFOSSILIFEROUS ZONE					
					4						
					3						
					2						
					1						

Figure 11. Ostracoda association and distribution along Measured Stratigraphic Section 7.

Şekil 11. 7 numaralı Ölçülü Stratigrafi Kesiti boyunca ostrakod topluluğu ve dağılımı

Stratigraphic section 7 is 50 meters thick (Figure 11). Its lithology is similar to stratigraphic section 5. Siliceous limestone and sandy siliceous limestone lithology were dominant from bottom to top in this section. 10 samples were collected and only one sample from the top level contained ostracod. The other samples were unfossiliferous. Three Ostracoda species were determined. The number of individuals are very few and similar to stratigraphic section 5. Species of *Ilyocypris* and *Zonocypris* are only found in this section.

SYSTEMATIC PALEONTOLOGY

Phylum: Arthropoda
Subylum: Crustacea Pennant, 1777
Class: Ostracoda Latreille, 1806
Order: Podocopida Sars, 1866
Suborder: Podocopina Sars, 1866
Family: Cytherideidae Sars, 1925

Genus: *Cyprideis* Jones, 1857
Type species: *Candona torosa* Jones, 1850

Stratigraphic range: Sarmatian-Recent (Van Morkhoven, 1963)

Environment: Mostly brackish (meso-polyhaline), very few in the high saline (80 ‰) lakes (Van Morkhoven, 1963).

Cyprideis pannonica Mehes, 1908
Pl.1 , Figs.1-3

1908 *Cypridea pannonica* Mehes; Polizan Ostracoden, p. 553, pl. 11, figs. 6-14.

1958 *Cyprideis pannonica* (Mehes), Kollmann; p.163, pl. 13, figs. 1-4.

1962 *Cyprideis pannonica pannonica* (Mehes), Decima; pl. 26, figs. 5a-10b.

1968 *Cyprideis (Cyprideis) cf. pannonica* (Mehes), Krstic; p.111, pl. 1, figs. 2-3.

1974 *Cyprideis pannonica* (Mehes), Benson and Ruggieri, p. 238, fig. 1-A.

1978 *Cyprideis pannonica* (Mehes), Carbonnel; p. 81, pl. 1, figs.11-13.

1979 *Cyprideis (Cyprideis) pannonica* (Mehes), Bassiouni; p. 84, pl. 1, figs. 1-6.

1983 *Cyprideis pannonica* (Mehes), Jiricek; p. 216, pl. VI, fig. 32.

1990 *Cyprideis pannonica* (Mehes), Jiricek and Riha; p. 438, pl. 4, fig. 8.

1996 *Cyprideis pannonica* (Mehes), Ünal; p. 92, pl. 1, fig. 9-11.

1997 *Cyprideis (Cyprideis) pannonica* (Mehes), Şafak, pl. I, fig. 5.

1998 *Cyprideis pannonica* (Mehes), Kovac, Barath, Slamkova, Pipik, Hlavaty and Hudackova; p. 453, pl. 4, fig. 5.

1999 *Cyprideis pannonica* (Mehes), Şafak, Avşar and Meriç; pl. 1, figs.12-14.

2000 *Cyprideis pannonica* (Mehes), Atay; p. 48, pl.1, figs. 7-11.

2001 *Cyprideis pannonica* (Mehes), Tunoğlu and Ünal; p.171, pl. 1, fig.8.

2002 *Cyprideis pannonica* (Mehes), Beker; p. 48, 49, pl. 1, figs. 1-4.

Material: 67 valves.

Dimensions: Length:0.85 0.95 mm

Height: 0.50 0.55 mm

Width: 0.30 0.40 mm

Stratigraphic range and geographic distribution: Turkey: Kilitbahir (Çanakkale): Middle-Late Pannonian (Atay, 2000); Western Bakırköy (İstanbul): Pliocene (Şafak et al., 1999); Karaman: Late Miocene (Şafak, 1997); Malatya, Bala: Late Miocene (Bassiouni, 1979); Gelibolu Peninsula: Early-Late Pannonian-Pontian (Ünal, 1996; Tunoğlu and Ünal, 2001), Karapınar/Konya, Pliocene-Early Pleistocene (Beker, 2002). Yugoslavia: Belgrade: Late Pannonian (Krstic, 1968). France, Lyon: Messinian (Carbonnel,1978). Austria: Vienna Basin: Early Pannonian, Chersonian (Jiricek and Riha, 1990); Vienna Basin: Late Miocene (Kovac et al.,1998). Italy: Late Miocene (Decima,1962).

Locality and stratigraphic range in this study: Section KA: sample numbers: 41, 42, 43, 44;

***Cyprideis torosa* Jones, 1850**

Pl. 1, Figs. 4, 5

- 1850 *Candona torosa* Jones, p. 27.
1956 *Cyprideis torosa* (Jones), Agalarova, p.170, pl. 12, fig. 34.
1958 *Cyprideis torosa* (Jones), Kollmann; p.159, pl. 12, figs. 1-5, 9-11.
1962 *Cyprideis torosa* (Jones), Decima, p.117-120, pl. 11, figs. 3-8; pl. 12, figs.1-8, pl. 15, figs. 11-15.
1968 *Cyprideis torosa* (Jones), Krstic, p. 140, pl. 7, figs. 6-9.
1969 *Cyprideis torosa* (Jones), Carbonnel, p. 78, pl. 12, figs. 14-15.
1979 *Cyprideis torosa* (Jones), Bassiouni, p.100-101, pl. 5, figs. 14-15.
1979 *Cyprideis torosa* (Jones), Carbonnel and Peypouquet, p. 176, pl. 2, figs.1-6.
1990 *Cyprideis torosa* (Jones), Fuhrmann and Pietrzeniuk; p. 224, pl. 4, fig. 3.
1994 *Cyprideis* cf. *torosa* Fernandez, Frydas, Guernet and Mathieu; p.104, pl. 1, figs. 12-14.
1995 *Cyprideis torosa* (Jones), Nazik and Gökçen; p. 256, pl. 1, fig. 13.
1995 *Cyprideis torosa* (Jones), Tunoğlu, Temel and Gençoğlu; p. 273, pl.1, figs.1-5.
1996 *Cyprideis torosa* (Jones), Ünal; p. 95, pl. 2, figs. 5-7.
1998 *Cyprideis torosa* (Jones), Gliozzi and Mazzini; p. 79, pl. 1, fig. c.
1998 *Cyprideis* gr. *torosa* (Jones), Keen and Stromberg; p. 162, pl. 1.
1999 *Cyprideis torosa* (Jones), Nazik, Evans and Gürbüz; p. 142, pl. 2, figs. 5-8.
1999 *Cyprideis torosa* (Jones), Şafak, Avşar and Meriç; pl. 1, fig.15.
1999 *Cyprideis torosa* (Jones),Tunoğlu; p.83, pl.3, figs.15,16.
2000 *Cyprideis torosa* (Jones), Atay; p. 49, pl. 1, figs.12-15.
2000 *Cyprideis torosa* (Jones), Ruiz, Gonzales-Regalado, Baceta, Menegazzo-Vitturi, Pistolato, Rampazzo and Molinaroli; p. 450, fig. 5, (1-2).
2000 *Cyprideis torosa* (Jones), Meisch; p. 459, figs. 188-189.
2005 *Cyprideis torosa* (Jones), Matzke-Karasz and Witt, p. 128, pl. 3, figs.8-11.

Material: 23 valves.

Dimensions: Length: 0.95 1.00 mm
Height: 0.45 0.50 mm
Width: 0.40 0.45 mm

Stratigraphic range and geographic distribution: Austria: Recent (Kollmann, 1958); Turkey: Kilitbahir (Çanakkale): Middle-Late Pannonian (Atay, 2000); Gelibolu Peninsula: Early-Late Pannonian; Pontian (Ünal,1996); Sea of Marmara: Recent (Tunoğlu,1999); Eskişehir: Pliocene-Pleistocene (Bassiouni,1979); Eskişehir: Pliocene (Tunoğlu et al.,1995); Adana: Pliocene (Nazik and Gökçen,1995); Western Bakırköy (İstanbul): Pliocene (Şafak et al., 1999); Karapınar/Konya, Pliocene-Early Pleistocene (Beker, 2002); Italy: Messinian (Decima,1962); Quaternary (Gliozzi and Mazzini, 1998); Spain: Guadalquivir Basin (Southern Spain): Messinian (Keen and Stromberg, 1998); former Yugoslavia: Pleistocene (Krstic, 1968); European Coasts, West and Central Asia, Mediterranean Coast of Northern Africa, Middle East, Northern America and Lakes of Central Africa: Miocene, Pliocene and Pleistocene-Recent (Meisch, 2000), Yalova/Turkey, Neogene (Matzke-Karasz and Witt, 2005).

Locality and stratigraphic range in this study: Section KA: sample numbers: 42, 43, 44.

Super Family: Cyprioidea Baird,1845
Family: Ilyocyprididae Kaufmann,1900
Sub Family: Ilyocypridinae Kaufmann,1900

Genus: *Ilyocypris* Brady and Norman, 1889

Stratigraphic range: Portlandian-Recent (Van Morkhoven, 1963)

Environment: Different aquatic environments from fresh water to oligohaline conditions, generally live in muddy substrate (Van Morkhoven, 1963).

***Ilyocypris bradyi* Sars, 1890**

Pl. 1, Figs. 6-9

1890 *Ilyocypris bradyi* Sars, p. 59.

1928 *Ilyocypris bradyi* Sars; p.109, pl. 4, fig. 2.

1956 *Ilyocypris bradyi* Sars, Agalarova; p. 159, pl. 6, figs. 5a-5b.

1966 *Ilyocypris bradyi* Sars, Stancheva; p. 212, pl. 3, fig. 2.

1970 *Ilyocypris bradyi* Sars, Gagic and Sokac; p. 138.

1975 *Ilyocypris bradyi* Sars, Diebel and Pietrzeniuk, p. 31, 32, pl. 1, figs. 1-6; pl. 6, figs. 1-11.

1977 *Ilyocypris bradyi* Sars, Guernet, Sauvage, Marsche; p. 308, pl. 1, fig. 15.

1978b *Ilyocypris bradyi* Sars, Diebel and Pietrzeniuk, pl. 25, figs. 1,2.

1979 *Ilyocypris bradyi* Sars, De Decker, p. 298, pl. 33, fig. 14.

1979 *Ilyocypris bradyi* Sars, Van Harten, p. 77, pl. 1, figs. 1b-2c-2d, pl. 2; figs. 1b-2b.

1980 *Ilyocypris bradyi* Sars, Kkrstic and Obradovic; p. 94.

1985 *Ilyocypris bradyi* Sars, Gülen; p. 68.

1988 *Ilyocypris bradyi* Sars, Nazik, p. 78, pl. 4, figs. 1-3.

1990a, *Ilyocypris bradyi* Sars, Fuhrmann and Pietrzeniuk; p. 186, taf.2, figs. 1-4.

1990b, *Ilyocypris bradyi* Sars, Fuhrmann and Pietrzeniuk; p. 222, taf. 2, fig. 2.

1992 *Ilyocypris bradyi* Sars, Nazik, Şafak and Şenol; p.299, pl. 1, fig. 6.

1992 *Ilyocypris bradyi* Sars, Şafak; p. 25, pl. 5, fig. 5.

1992 *Ilyocypris bradyi* Sars, Şafak, Nazik and Şenol; p. 176, pl. 1, fig. 1.

1993 *Ilyocypris bradyi* Sars, Scharf, p. 462, figs. 7, 8-10.

1995 *Ilyocypris bradyi* Sars, Tunoğlu and Çelik, p. 234, pl.1, figs. 4,5.

1996 *Ilyocypris bradyi* Sars, Ünal, p.143, pl. 6, figs. 1,2.

1998 *Ilyocypris bradyi* Sars, Gliozzi and Mazini, p. 80, pl. 2, fig. c.

1999 *Ilyocypris bradyi* Sars, Mezquita, Hernandez, Rueda, p. 70, pl. 1, figs. O-Q.

1999 *Ilyocypris* cf. *bradyi* (Norman), Şafak, Avşar and Meriç; pl. IV, fig. 11.

2000 *Ilyocypris bradyi* Sars, Meisch, p. 253, fig. 107.

2000 *Ilyocypris bradyi* Sars, Atay, p. 63, pl. 4, figs. 4-7.

2001 *Ilyocypris bradyi* Sars, Tunoğlu and Ünal, p.175, pl. 2, figs. 15,16.

2001 *Ilyocypris bradyi* Sars, Altınsaçlı and Griffiths, p. 217-225.

Material: 73 valves.

Dimensions: Length: 0.85 0.98 mm

Height: 0.44 0.50 mm

Width: 0.35 0.40 mm

Stratigraphic and geographic distribution: Germany: Holocene (Scharf, 1993), Burgtonna, Pleistocene and Holocene (Diebel and Pietrzeniuk, 1975, 1978a, b). England: Middle Pleistocene (De Decker, 1979), Former Yugoslavia: Recent (Harten, 1979); Turkey: Gelibolu Peninsula: Middle-Late Pannonian (Ünal, 1996); Konya: Early Miocene (Tunoğlu and Çelik, 1995); Western Bakırköy/İstanbul: Pliocene (Şafak, Avşar and Meriç, 1999); Kilitbahir/Gelibolu: Middle-Late Pannonian (Atay, 2000); Gelibolu Peninsula: Pannonian (Tunoğlu and Ünal, 2001); Manyas Lake: Recent (Altınsaçlı and Griffiths, 2001); Spain: Recent (Mezquita et al., 1999); Italy: Quaternary (Gliozzi and Mazzini, 1998).

Locality and stratigraphic range in this study: Section KA: sample numbers: 33, 41, 42, 44, 48; Section 1: sample

numbers 4, 5, 9, 11, 22, 23, 34, 36; Section 2: sample numbers 4, 6, 9, 20, 21; Section 3: sample numbers 1, 2; Section 4: sample number: 6; Section 6: sample numbers: 6, 9, 16; Section 7: sample number: 10.

Ilyocypris gibba (Ramdohr, 1808)

Pl. 1, Figs.10, 11

- 1808 *Ilyocypris gibba* Ramdohr; p. 91, pl. 3, figs: 13,14,17.
 1955 *Ilyocypris gibba* (Ramdohr), Luttwig; pl. 17, fig. 6.
 1959 *Ilyocypris gibba* (Ramdohr), Luttwig; p. 193.
 1979 *Ilyocypris gibba* (Ramdohr), Van Harten; p. 77, pl.1, figs. 1 (1a), figs. 2 (2a-2b), pl.II, figs. 1 (1a), fig.2 (2a).
 1978b *Ilyocypris gibba* (Ramdohr), Diebel and Pietrzejnuk, p. 212-213, pl. 52, figs. 1, 2; pl. 53, figs. 1, 2.
 1979 *Ilyocypris gibba* (Ramdohr), Van Harten; p. 77, pl.1, figs. 1 (1a), figs. 2 (2a-2b), pl.II, figs. 1 (1a), fig.2 (2a).
 1979 *Ilyocypris gibba* (Ramdohr), De Decker; p. 298, pl. 33, fig. 15.
 1979 *Ilyocypris gibba* (Ramdohr), Carbonnel and Peypoquet; p.195, pl.1., fig. 2.
 1981 *Ilyocypris gibba* (Ramdohr), Cronin; p. 395, pl.1, fig. 6.
 1984 *Ilyocypris cf. gibba* (Ramdohr), Riha; p. 71, pl. III, figs. 18-21.
 1990b *Ilyocypris gibba* (Ramdohr), Fuhrmann and Pietrzeniuk; p. 222, taf.2, figs.5-6.
 1992 *Ilyocypris gibba* (Ramdohr), Nazik, Şafak and Şenol; p.300, pl.I, figs. 4-5.
 1992 *Ilyocypris gibba* (Ramdohr), Şafak, Nazik and Şenol; p. 177, pl. 1, fig. 2.
 1992 *Ilyocypris cf. gibba* (Ramdohr), Martens, Ortal and Meisch; p. 106, figs. 5, J-M.
 1995 *Ilyocypris gibba* (Ramdohr), Tunoğlu and Çelik; p. 234, pl. 1, figs.1-3.
 1995 *Ilyocypris gibba* (Ramdohr), Nazik and Gökçen; p.258, pl.3, fig.16.
 1997 *Ilyocypris gibba* (Ramdohr), Şafak; pl. IV, fig. 6.
 1998 *Ilyocypris gibba* (Ramdohr), Gliozzi & Mazzini; p. 80, pl. 2, fig. A.
 1998 *Ilyocypris gibba* (Ramdohr), Pipik; p. 172, pl. 1, fig. 8.
 1998 *Ilyocypris gibba* (Ramdohr), Mourguiart and Correge; p. 112, pl. 1, figs.J-K.
 1999 *Ilyocypris gibba* (Ramdohr), Nazik, Evans and Gürbüz; p. 142, pl. 2, fig. 1.
 1999 *Ilyocypris gibba* (Ramdohr), Tunoğlu; p. 82, pl. 2, fig.19.
 1999 *Ilyocypris cf. gibba* (Ramdohr), Şafak, Avşar and Meriç; pl. IV, fig.12.
 1999 *Ilyocypris gibba* (Ramdohr), Mezquita, Tapia and Roca; p. 70, pl.1, figs. (K-N).
 2000 *Ilyocypris gibba* (Ramdohr), Atay; p. 65, pl. 4, figs. 8-10.
 2000 *Ilyocypris gibba* (Ramdohr), Meisch; p. 245, fig. 104.

Material: 96 valves.

Dimensions: Length: 0.90 0.95 mm
 Height: 0.48 0.60 mm
 Width: 0.40 0.45 mm

Stratigraphic and geographic distribution: Azerbaijan-Turkmenistan: Pliocene (Agalarova, 1956); America: Late Pleistocene (Cronin, 1981); Bolivia: Holocene-Recent (Mourguiart and Correge, 1998); Eastern Africa: Recent (Carbonnel and Peypoquet, 1979); England: Middle Pleistocene (De Decker, 1979); Spain: Recent (Mezquita et al., 1999); Israel: Recent (Martens et al., 1992); Italy: Quaternary (Gliozzi and Mazzini, 1998); Germany: Burgtonna, Pleistocene-Holocene (Diebel and Pietrzejnuk, 1975, 1978b). Turkey: Sarız (Kayseri): Pliocene (Şafak et al., 1992); Konya (Tunoğlu and Çelik, 1995); Adana: Pliocene (Nazik and Gökçen, 1995); Sea of Marmara: Holocene-Recent (Tunoğlu, 1999); Adana (Akyatan Lagune): Holocene (Nazik et al., 1999); West Bakırköy: Tortonian (Şafak et al., 1999); Kilitbahir/Gelibolu Peninsula: Middle-Late Pannonian (Atay, 2000; Atay and Tunoğlu, 2002, 2005); Slovakia: Pannonian (Pipik, 1998).

Locality and stratigraphic range in this study: Section KA: sample numbers: 42, 43, 44 ; Section 1: sample

numbers: 1, 4, 5, 9, 21, 22, 34, 36, 37; Section 2: sample numbers: 4, 6, 9; Section 3: sample number: 2; Section 4: sample number: 2; Section: 6: sample numbers: 9, 10, 15, 16; Section 7: sample number: 10, Late Pliocene-Pleistocene.

Ilyocypris sp.

Pl. 1, Figs. 12, 13

Description: Rectangular in lateral view. Dorsal margin nearly straight. Ventral margin strongly concave at the right valve, but convex at the left valve. Anterior margin well and broadly rounded and depressed towards the ventral part, posterior margin well rounded at the left valve but postero-dorsal area angular at the right valve. There are two tubercles near the antero-dorsal and postero-dorsal areas. Another small one at the center. There is a sulcus from the middorsal area towards the center. Maximum height present at the anterior, maximum width present at the center.

Material: 24 valves.

Dimensions: Length: 0.85 0.95 mm

Height: 0.40 0.60 mm

Width: 0.35 0.40 mm

Remarks: *Ilyocypris* sp. is differentiated from *I. bradyi* by having one tubercle near the ventral area and the ventral margin is slightly concave.

Locality and stratigraphic range in this study: Section KA: sample numbers: 43, 44; Section 1: sample numbers 1, 9, 36, 37; Section 2: sample number: 10; Section 3: sample number: 3; Section 4: sample number: 2; Section 6: sample numbers: 5, 6, 15, 16, Late Pliocene-Pleistocene.

Family: Candonidae Kaufmann, 1900

Subfamily: Candoninae Kaufmann, 1900

Genus: *Candona* Baird, 1845

Type species: *Cypris candida* O.F. Müller 1776

Stratigraphic range: (?Eosen) Oligocene-Recent (Van Morkhoven, 1963).

Environment: Generally lake, rivers and deltaic environments, rarely brackish water (Van Morkhoven, 1963).

Candona neglecta Sars, 1887

Pl. 2, Figs. 1

1887 *Candona neglecta* Sars, p. 279, pl. 15, 5-7; pl. 19.

1966 *Candona neglecta* Sars, Stancheva, p. 227, pl. 2, fig. 1.

1975 *Candona neglecta* Sars, Diebel and Pietrzejnuk, p. 33, pl. 2, figs. 6-8.

1978a *Candona* cf. *neglecta* Sars, Diebel and Pietrzejnuk, p. 213, pl. 49, figs. 3-5, 7, 8.

1979 *Candona neglecta* Sars, De Deckker, p. 296, pl. 32, figs. 13-14.

1979 *Candona* cf. *neglecta* Sars, Guernet, p. 34, pl. 3, fig. 3-4.

1980 *Candona neglecta* Sars, Freels, p. 94, Taf. 16, figs. 8-11.

1988 *Candona (Candona) neglecta* Sars, Nazik, p. 80-81, pl. 4, figs. 4-6.

1989 *Candona neglecta* Sars, Nazik and Gökçen, p. 94, pl. 1, figs. 6-7.

1991 *Candona neglecta* Sars, Pietrzejnuk, p. 106, Taf. 2, figs. 1-4.

1992 *Candona (Candona) neglecta* Sars, Şafak, Nazik and Şenol, p. 178, pl. III, figs. 3-4.

1995 *Candona (Candona) neglecta* Sars, Tunoğlu, Temel and Gençoğlu; p. 273, pl. 1, figs. 19-23.

1996 *Candona neglecta* Sars, Ünal, p. 112, pl. 12, fig. 5.

1997 *Candona (Candona) neglecta* Sars, Şafak, pl. IV, fig. 7.

- 1998 *Candona (Candona) neglecta* Sars, Gliozzi and Mazini, p. 78, pl. 1, fig. e.
 1999 *Candona (Candona) neglecta* Sars, Şafak, Avşar and Meriç; pl. V, fig. 1.
 2000 *Candona (Candona) neglecta* Sars, Atay, p. 102, pl. 4, fig. 14.
 2000 *Candona neglecta* Sars, Meisch, p. 77, fig. 26.
 2001 *Candona neglecta* Sars, Tunoğlu and Ünal, p. 176, pl. 3, fig. 1.
 2005 *Candona (Neglecandona) aff. neglecta* Sars, Matzke-Karasz and Witt, p. 120,121, pl. 1, figs. 6,7.

Material: 43 valves.

Dimensions: Length: 1.05 1.20 mm
 Height: 0.66 0.80 mm
 Width: 0.60 0.70 mm

Environment: They generally prefer cold waters but can also live for a short time in 20C water. *Candona neglecta* can live in small running water which is connected to a spring, small lakes and rivers (Meisch, 2000).

Stratigraphic and geographic distribution: Germany: Holocene (Luttig, 1959), Burgtonna, Holocene (Diebel and Pietrzeniuk, 1975, 1978a); Italy (Liri Island): Quaternary (Devoto, 1965; Gliozzi and Mazzini, 1998); Bulgaria: Levantin (Stancheva, 1966); India (Kasmin): Pleistocene (Bhatia, 1968); England: Middle Pleistocene (De Decker, 1979); France (Ron Basin): Late Miocene-Pliocene (Carbonnel, 1969); former Yugoslavia (Dinaric karst): Plio-Quaternary (Sokac, 1975); Greece: Late Senozoic (Guernet, 1979); Late Pliocene (Nasser, 1994); Turkey: Denizli, Muğla: Sarmatian-Pannonian (Gökçen, 1979); Burdur: Pleistocene (Freels, 1980); Ulukışla: Pontian (Nazik, 1988); Kayseri, Sarız: Pliocene (Şafak et al., 1992); Eskişehir: Pliocene (Tunoğlu et al., 1995); Gelibolu Peninsula: Early-Late Pannonian; Pontian (Ünal, 1996); Karaman: Pliocene (Şafak, 1997); West Bakırköy: Pliocene (Şafak et al., 1999); Gelibolu Peninsula: Middle-Late Pannonian (Atay, 2000, 2002, 2005); Gelibolu Peninsula: Pannonian, Pontian (Tunoğlu and Ünal, 2001), Yalova, Neogene (Matzke-Karasz and Witt, 2005) Europe-North Africa, Asia, North America: Pleistocene-Recent (Meisch, 2000),

Locality and stratigraphic range in this study: Section KA: sample numbers: 32, 44; Section 1: sample numbers: 4, 5, 9, 11, 21, 22, 23, 24; Section 2: sample numbers: 6, 9, 10, 20, 21; Section 3: sample numbers: 1, 2, 3; Section 4: sample number: 4; Section 5: sample number: 12; Section 6: sample numbers: 6, 9, 10, 12, 15, Late Pliocene-Pleistocene.

Candona candida (O.F. Müller, 1776)

Pl. 2, Figs. 2, 3

1776 *Candona candida* O. F. Müller.

1965 *Candona candida* (O. F. Müller), Devoto; p. 337, fig. 36.

1956 *Candona candida* (O. F. Müller), Agalarova; p. 157, pl. 5, fig. 3.

1973 *Candona (Candona) candida pliocenica* (O. F. Müller), Krstić; p. 151-173, pl. 1, figs. 1-2.

1975 *Candona candida* (O. F. Müller), Diebel and Pietrzeniuk, p. 33, pl. 2, figs. 1, 2.

1978 *Candona candida* (O. F. Müller), Sokac; p. 24-25, pl. 9, figs. 1-4.

1979 *Candona candida* (O. F. Müller), De Deckker; p. 300, pl. 32, fig. 6.

1980 *Candona (Candona) aff. candida* (O. F. Müller), Freels; p. 80-82, pl. 13, figs. 6-8.

1984 *Candona (Candona) cf. candida* (O. F. Müller), Tunoğlu; p. 118-119, pl. 9, figs. 1-3.

1990a *Candona candida* (O. F. Müller), Fuhrmann and Pietrzeniuk; p. 185, pl. 3, figs. 1-4.

1990b *Candona candida* (O. F. Müller), Fuhrmann and Pietrzeniuk; p. 223, pl. 3, figs. 5-6.

1991 *Candona candida* (O. F. Müller), Pietrzeniuk; p. 106, pl. 2, figs. 5-7.

1993 *Candona candida* (O. F. Müller), Scharf; p. 462, figs. 7, (5).

1996 *Candona candida* (O. F. Müller), Ünal; p. 115, pl. 7, figs. 3, 4 pl. 13, fig. 1.

1997 *Candona (Candona) candida* (O. F. Müller), Tunoğlu, Ünal and Bilen; p. 92, pl. 9, figs. 6, 7; pl. 15, figs. 13-17.

1997 *Candona (Candona) candida* (O. F. Müller), Şafak; pl. IV, fig. 8.

- 1998 *Candona candida* (O. F. Müller), Gliozzi and Mazzini; p. 78, pl. 1, fig. f.
1999 *Candona (Candona) candida* (O. F. Müller), Şafak, Avşar and Meriç; pl. IV, fig. 17.
2000 *Candona (Candona) candida* (O. F. Müller), Atay; p. 70, pl. 5, figs. 6-8.
2000 *Candona candida* (O. F. Müller), Meisch; p. 65, fig. 20.
2001 *Candona candida* (O. F. Müller), Tunoğlu and Ünal; p. 177, pl. 3, fig. 7.

Material: 89 valves.

Dimensions: Length: 0.95 1.15 mm
Height: 0.50 0.55 mm
Width: 0.45 0.50 mm

Stratigraphic and geographic distribution: England: Middle Pleistocene (De Deckker, 1979); Italy (Liri Valley): Pleistocene (Devoto, 1965); Quaternary (Gliozzi and Mazzini, 1998); former Yugoslavia: Pontian (Krstic, 1973); Pannonian Basin: Pontian (Sokac, 1978); Germany: Burgtonna, Holocene (Diebel and Pietrzeniuk), Miocene (Pietrzeniuk, 1991), Holocene (Scharf, 1993); Turkey: Aydın: Late Miocene (Freels, 1980); Sinop: Pontian (Tunoğlu, 1984); Gelibolu Peninsula: Early-Middle Pannonian, Pontian (Ünal, 1996); Bafra (Samsun): Pontian (Tunoğlu et al., 1997); Karaman: Pliocene (Şafak, 1997); West Bakırköy: Pliocene (Şafak et al., 1999); Kilitbahir (Eceabat/Çanakkale): Middle-Late Pannonian (Atay, 2000; Atay and Tunoğlu, 2002, 2005); Gelibolu Peninsula: Early-Late Pannonian-Pontian (Tunoğlu and Ünal, 2001).

Locality and stratigraphic range in this study: Section KA: sample numbers: 33, 41-44, 48, 49; Section: sample numbers: 1, 4, 5, 9, 11, 15, 20-24, 34; Section 2: sample numbers: 4, 6, 9, 10, 20, 21; Section 3: sample numbers: 2, 3; Section 4: sample numbers: 4, 6, 7; Section 5: sample number: 12; Section 6: sample numbers: 5, 7, 10, 12, 15, 16; Pliocene-Early Pleistocene.

Candona altoides Petkovski, 1961
Pl. 2, Figs. 4, 5

- 1961 *Candona altoides* Petkovski, p. 41.
1975 *Candona (Candona) aff. altoides* Petkovski, Krstic, p. 193, fig. 5.
1980 *Candona (Candona) cf. altoides* Petkovski, Freels, p. 89, taf. 15, figs. 1-12.
1992 *Candona (Candona) altoides* Petkovski, Nazik, Şafak and Şenol; p. 303, pl. 3, figs. 1-2.
1995 *Candona (Candona) altoides* Petkovski, Tunoğlu, Temel and Gençoğlu; p. 274, pl. 2, fig. 1-6.
1999 *Candona (Candona) altoides* Petkovski, Şafak, Avşar and Meriç, pl. 5, fig. 3.

Material: 52 valves.

Dimensions: Length: 1.00 1.25 mm
Height: 0.60 0.75 mm
Width: 0.55 0.60 mm

Stratigraphic and geographic distribution: Turkey: Konya-Beyşehir-Seydişehir- Akçalar: Pliocene-Early Pleistocene (Freels, 1980); Tufanbeyli (Adana) Pliocene (Nazik et al., 1992), Sivrihisar (Eskişehir): Pliocene (Tunoğlu et al., 1995); Bakırköy (İstanbul): Pliocene (Şafak et al., 1999).

Locality and stratigraphic range in this study: Section KA: sample numbers: 44, 48, 49; Sample 1: sample numbers: 5, 9, 11, 20, 23, 24; Section 2: sample numbers: 20, 21; Section 3: sample numbers: 2, 3; Section 4: sample number: 6; Section 6: sample numbers: 7, 10; Pliocene-Early Pleistocene.

Candona decimai Freels, 1980

Pl. 2 Fig. 6

1963 *Candona angulata* Müller, Decima, p. 94, pl. 3, figs. 1-8.

1980 *Candona (Candona) decimai*, Freels, p. 94, taf. 16, figs. 12-19

1992 *Candona (Candona) decimai* Freels, Nazik, Şafak and Şenol, p. 301, pl. 2, figs. 6-7.

1992 *Candona (Candona) decimai* Freels, Şafak, Nazik and Şenol, p. 178, pl. 2, figs. 3, 4, pl. 3, fig. 1.

1999 *Candona (Candona) decimai* Freels, Şafak, Avşar and Meriç, pl. 5, fig. 2.

2005 *Candona (Candona) decimai* Freels, Matzke-Karasz and Witt, p. 120, pl. 1, figs. 4, 5.

Material: 46 valves.

Dimensions: Length: 0.95 1.15 mm

Height: 0.50 0.65 mm

Width: 0.40 0.50 mm

Stratigraphic and geographic distribution: Turkey: Afyon-Dinar-Acıgöl: Middle Miocene (Freels, 1980); Tufanbeyli (Adana): Pliocene (Nazik et al., 1992); Sarız (Kayseri): Pliocene (Şafak et al., 1992); Bakırköy (İstanbul): Pliocene (Şafak et al., 1999), Yalova, Neogene (Matzke-Karasz and Witt, 2005).

Locality and stratigraphic range in this study: Section KA: sample numbers: 42, 44, 48; Section 1: sample numbers: 4, 5, 9, 20, 21, 23, 34; Section 2: sample numbers: 4, 6, 10, 20; Section 4: sample numbers: 6, 7; Section 6: sample numbers: 7, 10, 15, 16; Pliocene-Early Pleistocene.

***Candona* sp.1**

Pl. 2, Fig. 7

Description: Dorsal margin straight, antero-dorsal and postero-dorsal margins angular. Ventral margin strongly concave at the center, anterior margin well rounded and depressed towards the ventral. Posterior margin broadly rounded. Maximum height and width at the posterior, length at the center. Valve surface smooth. Posterior area and margin broad at the dorsal view.

Material: 3 valves.

Dimensions: Length: 1.10 1.30 mm

Height: 0.55 0.90 mm

Width: 0.45 0.55 mm

Remarks: This species is similar to *Candona neglecta* but *Candona neglecta* has a wider dorsal margin and it is more elongated. It differs from *Candona neglecta* by possessing the longest posterior and anterior margins.

Locality and stratigraphic range in this study: Section 2: sample number: 4; Pliocene-Early Pleistocene.

***Candona* sp.2**

Pl. 2, Fig. 8

Description: Valves have a trapezoidal outline in lateral view, dorsal margin straight and narrow, postero-dorsal corner angular and high, ventral margin broadly concave, anterior margin well rounded and depressed towards ventral, posterior margin oblique toward the ventral margin and slightly tapering. Carapace long and ovate at the dorsal view. Maximum height and width near the center, length at the center, valve surface smooth.

Material: 7 valves.

Dimensions: Length: 0.90 0.95 mm
Height: 0.50 0.55 mm
Width: 0.40 0.45 mm

Remarks: *Candona altoides* is closely similar to *Candona (Candona) sp. 2* in general valve shape, but *Candona (Candona) sp. 2* can be differentiated from *C. altoides* by having a more tapering posterior margin at the dorsal view.

Locality and stratigraphic range in this study: Section KA: sample number: 44; Section 1: sample number: 9.; Pliocene-Early Pleistocene.

***Pseudocandona compressa* Koch, 1838**

Pl. 2, Fig. 9

1838 *Cypris compressa* Koch, p. 21, Art. 17.

1975 *Candona compressa* Koch, Diebel and Pietrzeniuk, p. 33, pl. 2, figs. 9, 10.

1977 *Candona compressa* Koch, Pietrzeniuk, p. 342, pl. 9, figs. 5-8.

1980 *Candona (Pseudocandona) compressa* Koch, Freels; p. 64, pl. 10, figs. 11-18.

1990a *Candona compressa* Koch, Fuhrmann and Pietrzeniuk, p. 188, pl. 4, figs. 3-4.

1991 *Candona compressa* Koch, Pietrzeniuk, taf. 3, figs. 1-2.

1995 *Candona (Pseudocandona) compressa* Koch, Tunoğlu et al., p. 274, pl. 2, figs. 7-9.

1998 *Pseudocandona compressa* Koch, Gliozzi and Mazzini, p. 80, pl. 2, fig. f.

2000 *Pseudocandona compressa* Koch, Meisch; s. 179, fig. 76.

2005 *Pseudocandona cf. compressa* Koch, Matzke-Karasz and Witt, p. 121, 122, pl. 1, fig. 11

Material: 153 valves.

Dimensions: Length: 0.70 0.95 mm
Height: 0.42 0.54 mm
Width: 0.35 0.40 mm

Stratigraphic and geographic distribution: Turkey: Beyşehir, Karapınar-Beşkuyu (Konya): Pliocene-Early Pleistocene (Freels, 1980); Sivrihisar (Eskişehir): Pliocene (Tunoğlu et al., 1995), Yalova, Neogene (Matzke-Karasz and Witt, 2005). Germany: Burgtonna, Holocene (Diebel and Pietrzeniuk, 1975), Jakutia/Lena river area, Pleistocene (Pietrzeniuk, 1977).

Locality and stratigraphic range in this study: Section KA: sample numbers: 48, 49; Section 1: sample numbers: 1, 4, 5, 11, 20-23, 34, 36, 37; Section 2: sample numbers: 4, 9, 10, 21; Section 3: sample numbers: 1-4; Section 4: sample numbers: 2-4, 6; Section 5: sample numbers: 11, 12; Section 6: sample numbers: 6, 7, 9, 10, 13, 16; Pliocene-Early Pleistocene.

***Pseudocandona* sp.**

Pl. 3, Figs. 1, 2.

Description: Dorsal margin diagonal and straight, ventral margin slightly convex. Posterior margin more broad than the anterior and both margins well-rounded. Maximum width and height between posterior margin and central part of carapace. Maximum length at the ventral half. Valve surface smooth. Marginal zone and selvage are wider and broad at the anterior half.

Material: 14 valves.

Dimensions: Length: 0.70 0.80 mm
Height: 0.45 0.60 mm
Width: 0.35 0.45 mm

Remarks: *Pseudocandona* sp. is similar to *Pseudocandona compressa*, but it differs by not having a compressed and angular antero-dorsal margin. *Pseudocandon* sp. is differentiated from *C. compressa* by having a rounded and relatively short posterior margin.

Locality and stratigraphic range in this study: Section KA: sample numbers: 48, 49; Section 1: sample numbers: 20-22 Section 3: sample numbers: 3, 4; Pliocene-Early Pleistocene.

Family: Cyprididae Baird, 1845
Sub Family: Cypridinae Baird, 1845
Genus: *Zonocypris* Müller, 1898

Stratigraphic distribution: Miocene-Recent.

Environment: Fresh water (Moore, 1961).

Zonocypris membranae (Livental, 1929)
Pl. 3, Figs. 3-5.

- 1956 *Eucypris membranae* (Livental), Agalarova, pl. 7, figs. 14a-b.
1966 *Zonocypris membranae membranae* (Livental), Stancheva, p. 216, pl.3, fig.8.
1983 *Zonocypris* aff. *membrana* (Livental), Jiricek, p. 227, pl. 9, fig.51.
1997 *Zonocypris membranae* (Livental), Tunoğlu, Ünal and Bilen, p.102,
pl.10, figs. 4-6; pl.17, figs. 7-12.
2003 *Zonocypris membranae* (Livental), Witt, p. 101, pl. 1, figs.9-13.

Material: 5 carapaces, 40 valves.

Dimensions: Length: 0.55 0.59 mm
Height: 0.30 0.33 mm
Width: 0.42 0.45 mm

Stratigraphic and geographic distribution: Turkey: Bafra/Samsun: Pontian (Tunoğlu et al., 1997); Develiköy/Manisa, Early Pliocene (Witt, 2003; Azerbaijan, Crime: Pliocene-Recent (Agalarova, 1956).

Locality and stratigraphic range in this study: Section KA: sample number: 33; Section 1: sample number: 5; Section 2: sample numbers: 9, 20; Section 7: sample number: 10.

Family: CYPRIDIDAE Baird, 1845
Sub Family: CYPRINOTINAE Bronshtein, 1947

Genus: *Heterocypris* Claus, 1892

Stratigraphic distribution: Paleocene-Recent (Moore, 1961).

Environment: Fresh water (Moore, 1961).

Heterocypris salina (Brady, 1868)
Pl. 3, Figs. 6-8

- 1868 *Cypris salina* Brady, p. 368, pl.28: figs. 8-13.
1955 *Cyprinotus salinus barneri* Lüttig, p.157, t. 18:2.

- 1980 *Heterocypris salina barneri* Lüttig, Freels, p. 29, pl. 3, figs. 7-8.
1980 *Heterocypris salina salina* Brady, Freels, p. 28, taf. 3, figs. 1-6.
1990a *Heterocypris salina* Brady, Fuhrmann and Pietrzeniuk, p. 225, pl. 4, figs. 4-5.
1992 *Heterocypris salina salina* Brady, Nazik, Şafak and Şenol, p. 303, pl. III, fig. 4.
1993 *Heterocypris salina* Brady, Meisch and Broodbakker, p. 10, figs. 2-5.
1995 *Heterocypris salina salina* Brady, Tunoğlu and Çelik, p. 234, pl. 1, figs. 17-20.
1999 *Heterocypris salina* Brady, Mezquita, Hernandez and Rueda, p. 93, pl. I, figs. F-G.
2000 *Heterocypris salina* Brady, Meisch, p. 354, fig. 148.
2003 *Heterocypris salina* Brady, Witt, p. 100-101, pl. 1, figs. 14-16.
2005 *Heterocypris salina* Brady, Matzke-Karasz and Witt, p. 126, pl. 3, fig. 4.

Material: 2 carapaces, 117 valves.

Dimensions: Length: 1.05 1.45 mm
Height: 0.75 0.90 mm
Width: 0.40 0.55 mm

Stratigraphic and geographic distribution: Turkey: Konya-Beyşehir-Gölkaşı: Pliocene-Early Pleistocene; Afyon-Acıgöl-Hırkaköy: Middle Miocene (Freels, 1980); Iğın (Konya): Early (Tunoğlu and Çelik, 1995); Tufanbeyli (Adana): Pliocene (Nazik et al., 1992); Develiköy/Manisa, Early Pliocene (Witt, 2003), Yalova, Neogene (Matzke-Karasz and Witt, 2005); Spain, Azor, Kanarya, Cape Verde Islands: Recent (Meisch and Broodbakker, 1993); Magre River: Recent (Mezquita et al., 1999)

Locality and stratigraphic range in this study: Section KA: sample numbers: 33, 48, 49; Section 1: sample numbers: 4, 5, 21, 22, 34, 36, 37; Section 2: sample numbers: 4, 6, 9, 10, 20, 21; Section 3: sample numbers: 1-4; Section 4: sample numbers: 2, 4; Section 6: sample numbers: 6, 7, 9, 15; Pliocene-Early Pleistocene.

Family: Cyprididae Baird, 1845
Subfamily: Cypridopsinae Kaufmann, 1900

Genus: *Cypridopsis* Brady, 1867

Stratigraphic distribution: Oligocene-Recent (Van Morkhoven, 1963)

Environment: Fresh water, they prefer oligo-mesohaline salinity conditions (Van Morkhoven, 1963).

Cypridopsis sp.

Pl. 3, Figs. 9, 10.

Description: The center of the dorsal margin slightly tapers at the lateral view. Anterior and posterior margin well-rounded, but posterior margin slightly tapering, ventral margin slightly concave. Antero-dorsal and postero-dorsal margins compressed. Maximum length, height and width are at the center. Valve surface covered by numerous normal pore canals. Width of marginal zone is almost equal at ventral and dorsal margins. Central muscle scar is characteristic for the genus.

Material: 22 valves.

Dimensions: Length: 0.85 1.00 mm
Height: 0.55 0.70 mm
Width: 0.40 0.55 mm

Remarks: *C.* sp. differs from *Cypridopsis vidua* O.F. Müller by having more compressed antero-dorsal and postero-dorsal margins and the anterior marginal area of *Cypridopsis vidua* is very broadly rounded.

Locality and stratigraphic range in this study: Section 1: sample numbers: 4, 5, 21, 22; Section 2: sample numbers: 6, 9, 10; Pliocene-Early Pleistocene.

ENVIRONMENTAL INTERPRETATION AND PALEOGEOGRAPHY

Based on the above ostracod assemblage, the age of this unit is assigned as Pliocene-Lower Pleistocene (Figure 12). This fauna also indicates that fresh water (lacustrine) dominated environment (Figure 13). Especially *Ilyocypris*, *Cypridopsis* and *Zonocypris* genera are known only in fresh water environments (Moore, 1961; Van Morkhoven, 1962, 1963; Meisch, 2000). *Cyprideis*, *Candona*, *Pseudocandona* and *Heterocypris* genera can adapt themselves to a brackish environment as well as to fresh water. The *Candona* genus is observed as the dominant taxon.

The ostracod species in this study have been correlated with other research studies in European Countries, Caucasian and Turkey in Figure 14. Generally, most of the species (*Ilyocypris bradyi*, *I. gibba*, *Cyprideis torosa*, *C. pannonica*, *Heterocypris salina*, *Z. membranae*, *Candona candida*, *C. altoides*, *C. neglecta*) in this study have been found in different localities of Anatolia and the Thrace Peninsula, from Miocene to Recent. Some of them (*Cyprideis torosa*, *Heterocypris salina*, *Candona candida*, *Candona neglecta*, *Ilyocypris bradyi*, *I. gibba*) have been determined in European Countries (England, Italy, Serbia, Austria, Spain, France, Germany, Bulgaria, Hungary), Caucasia (Azerbaijan) and Israel, by different researchers (Meisch, 2000).

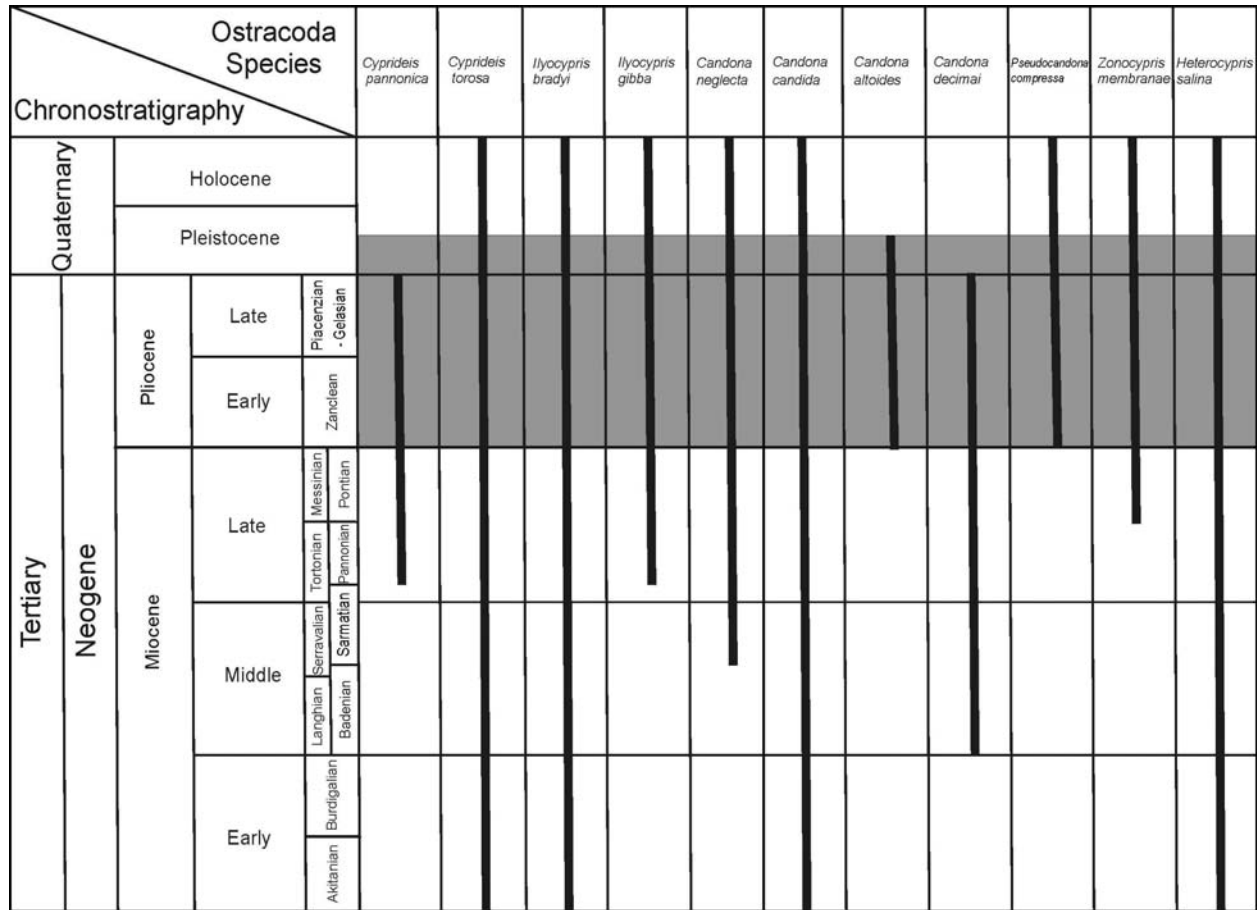


Figure 12 . Chronostratigraphic distribution of some known ostracoda species which were determined in this study (Bassiouni, 1979; Jiricek & Riha, 1991; Nazik & Gökçen, 1995; Meisch, 2000; Şafak et al., 1992; Nazik et al., 1992).

Şekil 12. Bu çalışmada tanımlanmış bilinen ostrakod türlerinden bazılarının kronostratigrafik dağılımları (Bassiouni, 1979; Jiricek and Riha, 1991; Nazik and Gökçen, 1995; Meisch, 2000; Şafak et al., 1992; Nazik et al., 1992).

OSTRACODA	ENVIRONMENTS (Remane, 1971)		
	FRESH WATER ($< \text{‰} 5$)	BRACKISH WATER ($\text{‰} 5-18$)	MARINE ($\text{‰} 18-30$)
CYPRIDEIS			----
ILYOCYPRIS			
CANDONA		----	
PSEUDOCANDONA		----	
CYRIDOPSIS			
HETEROCYPRIS		----	
ZONOCYPRIS			

Figure 13 . Habitat of known ostracoda genus which were determined in this study (according to salinity conditions Remane, 1971; Moore, 1961; Van Morkhoven, 1962, 1963; Meisch, 2000).

Şekil 13. Bu çalışmada tanımlanmış ostrakod cinslerinin yaşam ortamları ve tuzluluk değerleri (Remane, 1971; Moore, 1961; Van Morkhoven, 1962, 1963; Meisch, 2000).

Heterocypris salina prefers both small and slightly salty coastal and inland water. *Cyprideis torosa* occurs mainly in brackish waters with fluctuating salinity and prefers a mud or sandy mud substrate. This specimen is found in a wide range of salinity conditions from almost freshwater to fully marine and even hypersaline -water (over 60 ‰)- (Remane, 1971) in coastal ponds, lakes, lagoons, salt marshes, delta and estuaries, down to a depth of around 30 m (Meisch, 2000). *Ilyocypris gibba* and *I. bradyi* prefer small and shallow water bodies with clayey, fine-mudded or sandy substrate (Meisch, 2000). The general ecological environment of *Candona neglecta* is fresh water. But it prefers slightly

brackish water (Meisch, 2000).

All of the ostracod taxa generally indicate fresh water conditions and a lacustrine environment in the study area. But KA section also has brackish ostracod fauna (*Cyprideis pannonica*, *Cyprideis torosa*) besides fresh water ostracods, and Section 7 has only fresh water ostracod fauna (*Ilyocypris gibba*, *Ilyocypris bradyi*, *Ilyocypris* sp. and *Zonocypris membranea*). This situation indicates that the locality of Section 7 must be a connection point of a fluvial system in the lake, and the locality of Section KA must be a more saline and restricted area of the depositional basin.

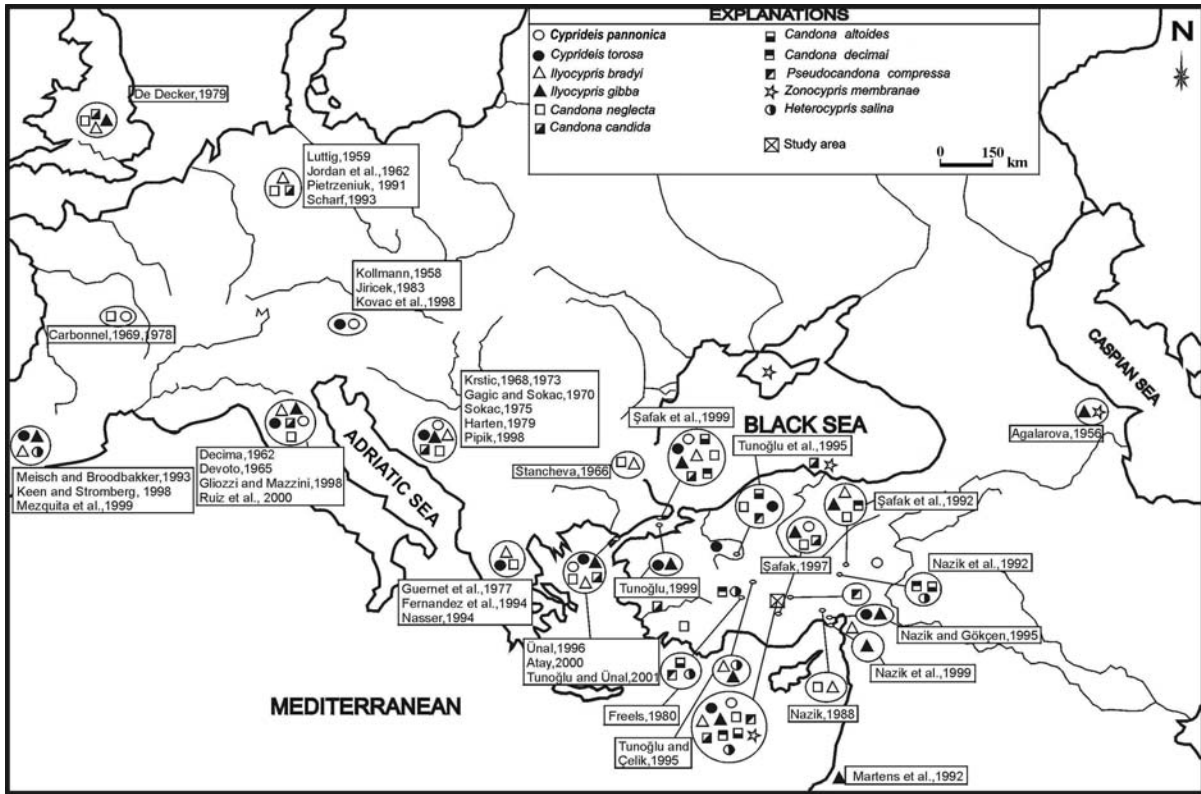


Figure 14 . Geographic distribution of known ostracoda species which were determined in this study.

Şekil 14. Bu çalışmada tanımlanmış bilinen ostrakod türlerinin Coğrafik dağılımı.

RESULTS

As a result, 16 ostracod species belonging to six genera and two subgenera, of which 11 are known, and 5 yet unidentified (open to nomenclature) have been determined: *Cyprideis pannonica*, *Cyprideis torosa*, *Ilyocypris gibba*, *Ilyocypris bradyi*, *Candona neglecta*, *Candona candida*, *Candona altoides*, *Candona decimai*, *Pseudocandona compressa*, *Heterocypris salina*, *Zonocypris membranæ*, *Ilyocypris* sp. *Candona* sp.1, *Candona* sp. 2, *Pseudocandona* sp. and *Cypridopsis* sp.

Generally, Upper Miocene-Pliocene and Pleistocene series in all of the Central Anatolia Neogene Basins are composed of lacustrine and fluvial deposits (limestone, claystone, sandstone and volcanoclastics in some localities). In this lacustrine environment, which generally shows an alkaline character (pH=8-9), besides detritic deposits generally dolomite and calcite, aragonite types of

carbonates have been locally formed (Tunoğlu et al, 1995). Some of them have brackish conditions (Tunoğlu and Çelik, 1995).

Based on the above ostracod assemblage, the age of this unit is assigned as Pliocene-Early Pleistocene. This fauna also dominantly indicates fresh water conditions in a lacustrine environment. Especially *Ilyocypris*, *Cypridopsis* and *Zonocypris* genera are known only in fresh water environments (Moore, 1961; Van Morkhoven, 1962, 1963; Meisch, 2000). *Candona*, *Pseudocandona* and *Heterocypris* genera can adapt themselves to a brackish environment as well as to fresh water. *Cyprideis pannonica* and *C. torosa* are known brackish water species and both of them have been found only in the KA measured stratigraphic section. This situation indicates that the southwestern part of the deposition area had brackish water conditions.

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GENİŞLETİLMİŞ ÖZET

Çalışma alanı "Orta Anadolu Neojen Baseni" nin güney kesiminde, Karapınar Kasabası ve Acı göl (Konya) kuzeyinde yer almaktadır. İnsuyu Kireçtaşı birimi 100-400 m toplam kalınlığa sahip olup, başlıca kilitaşı, kumtaşı, konglomera ve çört tabakalarından oluşmaktadır ve yer yer andezit ve piroklastik seviyeler de vardır. Kilitaşı beyaz ve pembe renklerde olup, bol miktarda ostrakod ve daha az oranda tatlı su gastropod fosilleri içermektedir. Bu çalışmada, 8 ayrı stratigrafik kesit ölçülmüş ve bu kesitlerden toplam 160 örnek derlenmiştir. Ancak sadece kireçtaşları ostrakod fosili içermektedir. Laboratuar çalışmaları sonucu, 12 bilinen ve 5 isimlendirmeye açık olmak üzere toplam 17 ostrakod taksonu ayırtlanmıştır. Bunlar: *Cyprideis pannonica*, *C. torosa*, *Ilyocypris gibba*, *I. bradyi*, *Candona neglecta*, *C. candida*, *C. altoides*, *C. decimai*, *Pseudocandona compressa*, *Heterocypris salina*, *Zonocypris membranea*, *Ilyocypris sp.*, *Candona sp.1*, *Candona sp.2*, *Pseudocandona sp.* ve *Cypridopsis sp.* taksonlarıdır.

Genel olarak, Üst Miyosen-Pliyosen ve Pleyistosen serileri tüm Anadolu'da göl ve akarsu çökellerinden (kireçtaşı, kilitaşı, kumtaşı ve bazı lokalitelerde volkanoklastikler) oluşmaktadır. Bu göl ortamları genellikle alkalin bir karakter gösterirler (pH=8-9), bu birimler kırıntılı çökellerin yanısıra, genellikle dolomit ve kalsit, lokal olarak ise aragonit tipte karbonatlar ile temsil edilirler (Tunoğlu et al, 1995). Bu sucul ortamların bazıları ise acı su karakterindedir (Tunoğlu and Çelik, 1995).

Yukarıdaki ostrakod topluluğuna göre birimin yaşı Pliyosen-Erken Pleyistosen olarak belirlenmiştir. Bu fauna tatlı su (laküstrin) bir ortamı işaret etmektedir. Özellikle, *Ilyocypris*, *Cypridopsis* ve *Zonocypris* cinsleri sadece tatlı su ortamlarını karakterize ederlerken (Moore, 1961; Van Morkhoven, 1962, 1963; Meisch, 2000). *Cyprideis*, *Candona*, *Pseudocandona* ve *Heterocypris* cinsleri ise tatlı su ortamlarının yanı sıra acı su ortamlarına da uyum sağlayabilmektedirler.

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PLATE 1

- Figures 1-3.** *Cyprideis pannonica* Mehes, 1908
Section KA, sample no: 44.
Collection no: H.Ü. JMB.O 2001 KB 001
1. Right valve, external view (X50).
2. Right valve, internal view (X50).
3. Left valve, dorsal view (X50).
- Figures 4-5.** *Cyprideis torosa* Jones, 1850
Section KA, sample no: 43.
Collection no: H.Ü. JMB.O 2001 KB 002
4. Right valve, external view (X50).
5. Right valve, internal view (X50).
- Figures 6-9.** *Ilyocypris bradyi* Sars, 1890
Section 2, sample no: 20.
Collection no: H.Ü. JMB.O 2001 KB 003
6. Right valve, external view, section KA, sample no: 33, (X50).
7. Left valve, external view, section 1, sample no: 5, (X50).
8. Right valve, internal view, section 2, sample no: 20, (X50).
9. Left valve, internal view, section 2, sample no: 20, (X50).
- Figures 10-11.** *Ilyocypris gibba* (Ramdohr, 1808)
Collection no: H.Ü. JMB.O 2001 KB 004
10. Right valve, external view, section KA, sample no: 42, (X50).
11. Left valve, external view, section 6, sample no: 9 (X50).
- Figures 12-13.** *Ilyocypris* sp.
Section 6, sample no: 15.
Collection no: H.Ü. JMB.O 2001 KB 005
12. Right valve, external view (X50).
13. Left valve, external view (X50).

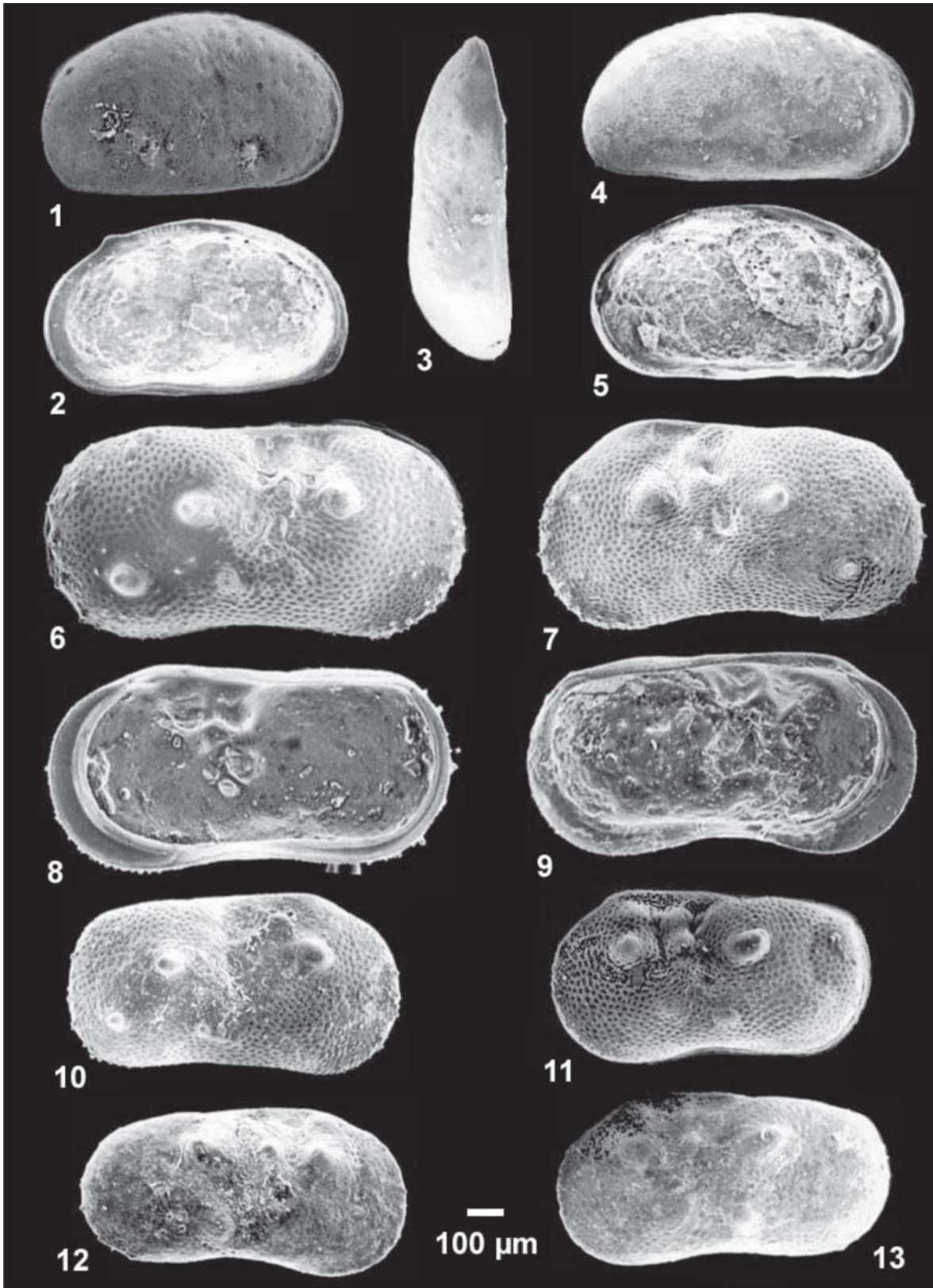


PLATE 2

- Figure 1.** *Candona neglecta* Sars, 1887
Section 1, sample no: 22.
Collection no: H.Ü. JMB.O 2001 KB 006
1. Left valve, external view (X50).
- Figures 2, 3.** *Candona candida* (O. F. Müller, 1776)
Collection no: H.Ü. JMB.O 2001 KB 008
2. Right valve, external view, Section 1, sample no: 9, (X50).
3. Left valve, internal view, Section 1, sample no: 11, (X50).
- Figures 4, 5.** *Candona altoides* Petkovski, 1961
Section 1, sample no: 9.
Collection no: H.Ü. JMB.O 2001 KB 009
4. Left valve, external view (X50).
5. Right valve, internal view (X50).
- Figure 6.** *Candona decimai* Freels, 1980
Section 2, sample no: 4.
Collection no: H.Ü. JMB.O 2001 KB 010
6. Right valve, external view (X50).
- Figure 7.** *Candona sp. 1*
Section 2, sample no: 4
Collection no: H.Ü. JMB.O 2001 KB 011
7. Right valve, external view (X50).
- Figure 8.** *Candona sp. 2*
Section KA, sample no: 44.
Collection no: H.Ü. JMB.O 2001 KB 012
8. Left valve, external view (X50).
- Figure 9.** *Pseudocandona compressa* Koch, 1838
Section KA, sample no: 49.
Collection no: H.Ü. JMB.O 2001 KB 013
9. Left valve, external view (X50).

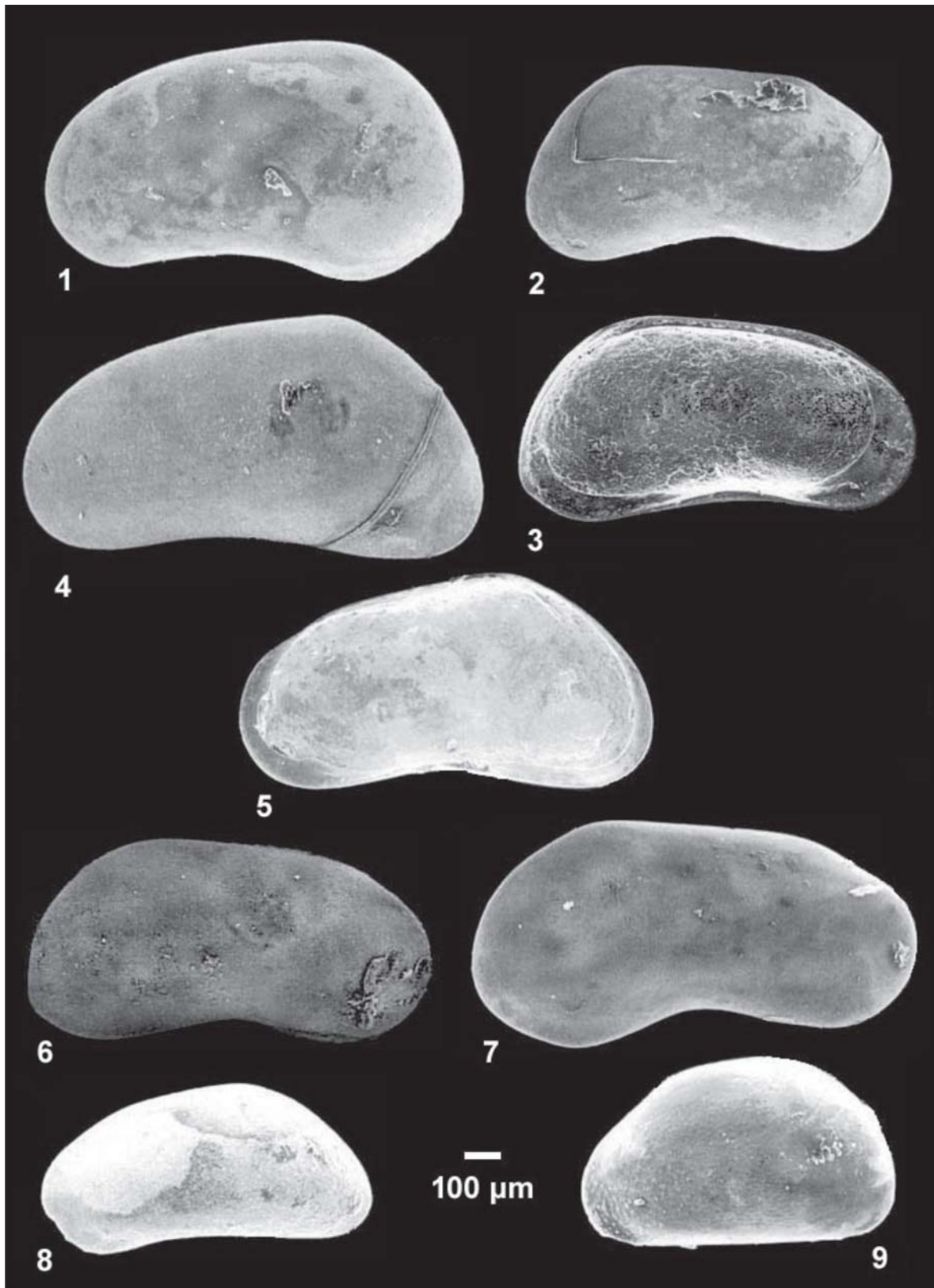


PLATE 3

- Figures 1-2.** *Pseudocandona* sp.
Section 1, sample no: 20.,
Collection no: H.Ü. JMB.O 2001 KB 014
1. Left valve, external view (X50).
2. Left valve, internal view (X50).
- Figures 3-5.** *Zonocypris membranae* Livental, 1929
Section 1, sample no: 5.
Collection no: H.Ü. JMB.O 2001 KB 015
3. Right valve, external view (X50).
4. Right valve, internal view (X50).
5. Carapace, dorsal view (X50)
- Figures 6-8.** *Heterocypris salina* Brady, 1868
Section 3, sample no: 3; Section 2, sample no: 9
Collection no: H.Ü. JMB.O 2001 KB 016
6. Right valve, external view (X50).
7. Right valve, internal view (X50).
8. Right valve, external view (X50).
- Figures 9-10.** *Cypridopsis* sp.
Section 1, sample no: 4.
Collection no: H.Ü. JMB.O 2001 KB 018
9. Right valve, external view (X50).
10. Left valve, internal view (X50).

