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OSTRACOD FAUNA AND ENVIRONMENTAL FEATURES OF TERTIARY (PALEOGENE-NEOGENE) DEPOSITS IN YEDİKULE- İSTANBUL REGION

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Research Article

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ABSTRACT

This study consists of micro paleontological assessments of samples taken from drills carried out around Yedikule area for the micro zonation study made by the Istanbul Municipality in European side of Istanbul province. The investigation was performed on core samples in three drill wells excavated within Yedikule settlement area. Very well preserved ostracod fauna and micro mollusks at some levels were obtained from claystone, clayey limestone, limestone, fossilliferous sandstone, blackish-green and organic clays and marl layers. With these three drill core samples in which the microfauna occurs, the age of the succession was determined as Tertiary (Late Miocene-Early Oligocene) with microfauna.

1. Introduction

The study area is the Yedikule vicinity located at the southern part of the European side in İstanbul (Figure 1). The investigators such as; Akartuna (1953), Erentöz (1953), Pamir (1954), Ozansoy (1962, 1964), Sönmez (1963), Sönmez and Gökçen (1964, 1973), Rückert and Ülkümen (1964, 1965), Kemper (1966), Aslaner (1966), Keskin (1974), Sayar (1992), Şafak (1997), Nazik (1998), Şafak et al. (1999) have carried out geological and paleontological studies in the study area and its surround.

The purpose of this study is mineralogically to assess successions in cores excavated around Yedikule, during micro zonation study carried out by the Istanbul Municipality in the southern part of the European side in Istanbul province. In May 2015, the data from the same drill samples were added to micropaleontological sampling collected in years 2016-2017. Thus; new samples in upper layers of drill cores of the investigation carried out by Şafak (2014) were micropaleontologically handled in this study. Few fossilliferous sections of the Bakırköy Formation, which form the upper parts of the succession, were reassessed with this study and a rich ostracod fauna belonging to this unit was obtained. For this reason, the total of 85 core samples related to Bakırköy and Danişmen/Gürpınar Formations were collected from three excavated and classified drill wells, the washing method was applied in laboratory to obtain the ostracod fauna, which is the main subject of the investigation, then ostracod genera and species were determined. In the study; 16 ostracod genera, 25 ostracod species and 3 micro mollusc genera were described. Described genera and species were counted, both vertical and lateral distributions of ostracods were estimated and their quantitative abundances were determined. In this distribution table, the symbols explaining the frequency of ostracods were used.

In classifying the ostracods, the systematic of Hartmann and Puri (1974) was used.

Based on these data, which are assessed statistically and relatively, the paleoevironmental interpretation of the study area was made using environmental and salinity criteria of Van Morkhoven (1963), Witt (2011), Rückert-Ülkümen (2009), Freels (1980), Athersuch et al. (1989) and Remane (1958). In interpreting

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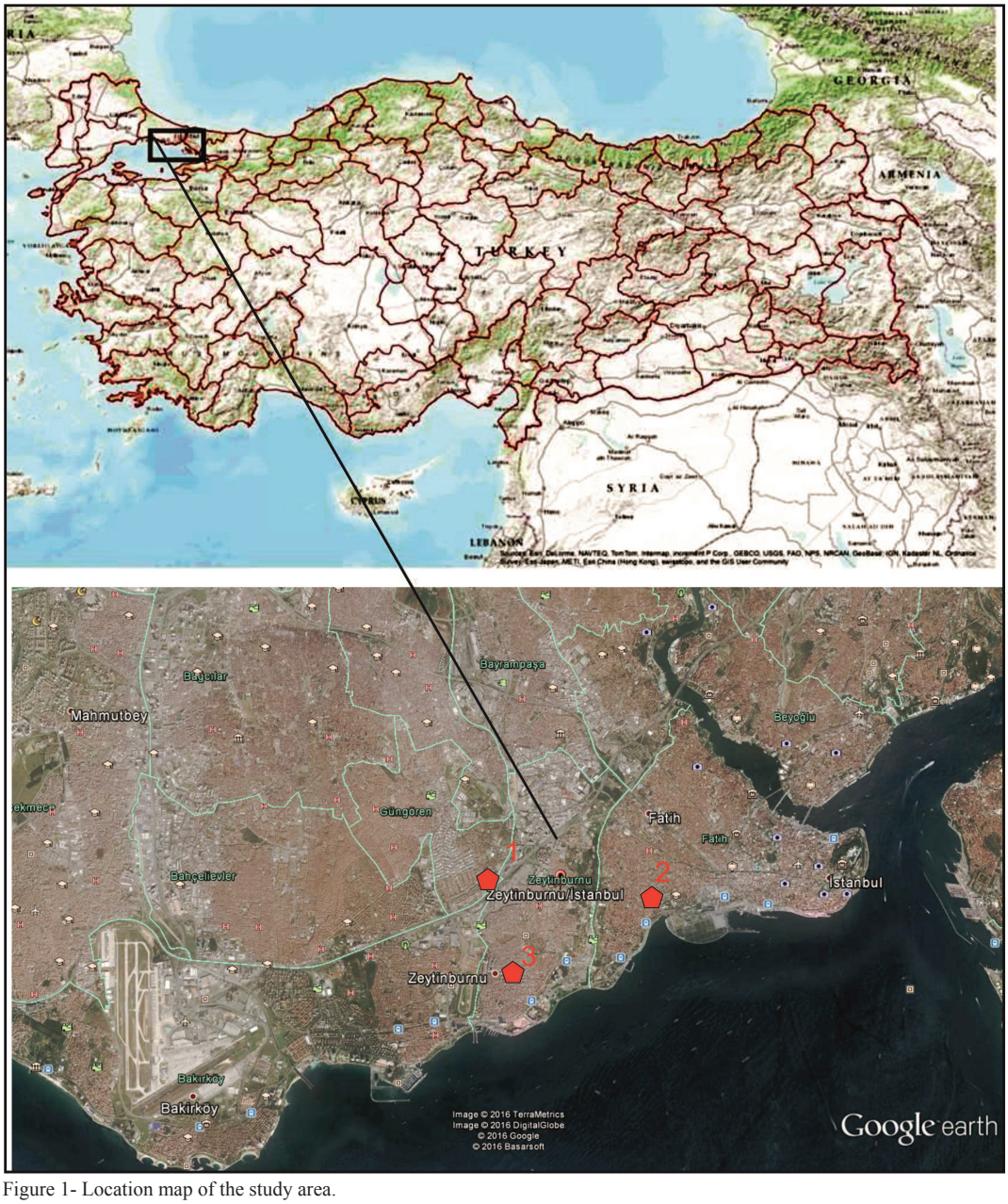

Figure 1- Location map of the study area.

especially the mollusk genera and species, which are compatible to limnic conditions, the studies of Wenz (1922), Bremer (1978), Taner (1980) and Sayar (1991) were used as basis.

SEM images of some ostracod genera and species described in this study were presented in plates 1-3.

2. Stratigraphy

In the study area, the Ceylan/Yenimuhacir formation is observed at the bottom and these units are conformably overlain by Danişmen formation. The Bakırköy Formation and infilling material cover the Danişmen Formation (http://www.ibb.gov.tr). The units in drillings investigated in the study area from bottom to top are Danişmen and Bakırköy formations and the infilling material. These materials crop out in southwest of Istanbul and around Yedikule.

2.1. Danişmen Formation (Gürpınar Formation) (old)

The formation was defined by Ternek (1949) and Lebküchner (1974) as lignified sandstone; by Bear and Wright (1960) as one formation of Malkara clastic group; by Boer (1954), Gökçen (1967),

Kellog (1973), Sümengen and Terlemez(1991) as the Danişmen Formation; and as the Gürpınar formation by Sayar (1977) around Istanbul. The formation was also used under the same name in studies carried out by the Istanbul Municipality (http://www.ibb.gov.tr). It widely crops out in northern Thrace, on the slopes of Strandzha (Edirne), in vicinities of Süloğlu, Pınarhisar, Vize and Binkılıç and in open coal mines in southern Thrace.

The Danişmen Formation occasionally consists of varved shales, limestone, sandstone, pebble stone and coal, fish fossils in northern Thrace and silicified wooden fossils in southern Thrace (Siyako, 2002; MTA, 2006). Looking at the drillings in this study, the Danişmen Formation is formed by claystone, clayey limestone, siltstone, fossilliferous sandstone, blackish-green clay, organic clay, marl, sandy clay layers.

Ostracod genera and species such as; *Cytheromorpha zinndorfi* (Lienenklaus), *Cytheromorpha* sp., *Neocyprideis apostolescui* (Keij), *N. williamsoniana* (Bosquet), *Cytheridea pernota* (Oertli and Keij), *Cyamocytheridea punctatella* (Bosquet), *C. inflata* (Deltel), *Cyamocytheridea* sp., *Hemicyprideis montosa* (Jones and Sherborn), *H. elongata* (Keen), *H. helvetica* (Lienenklaus), *Cladarocythere apostolescui* (Margerie), *Loxoconcha delemontensis* (Oertli), *Xestoleberis subglobosa* (Bosquet), *Candona (Pseudocandona) fertilis* (Triebel), *Eucypris pechelbronnensis* (Stchepinsky), *Ilyocypris boehli* (Triebel), and micro mollusc genera such as; *Viviparus*sp., *Avimactra* sp. were described in Danişmen/Gürpınar formation (Figure 2). The age of the formation was determined as Early Oligocene due to this fossil content.

2.2. Bakırköy Formation (mib)

Bakırköy Formation was first described by Sayar (1977, 1989, 1992). The formation was defined as; limestone with *mactra* by Sayar (Arınç) (1955), *Melanopsis* and limestone bands with *mactra* by Ternek (1987) and as Bakırköy limestone by Sayar (1989). It outcrops in Beylikdüzü-Avcılar, Yeşilköy-Halkalı, Bağcılar-Bahçelievler, Bakırköy, Yenibosna-Mahmutbey, Merter-Esenler, Zeytinburnu-Topkapı-Kocamustafapaşa (MTA, 2006).

The formation is formed by white to dirty white, fine layered clay intercalated limestones with *mactra* and its lower section consists of clay-limestone alternation. The Bakırköy Formation consists of limestone, fossilliferous clayey limestone, fossilliferous marl, clayey sand and clay layers in succession in this study.

The formation is gradually transitional with the underlying Güngören Formation, and it is overlain by Quaternary units. It is gradually transitional with Güngören formation, which underlies in sections discriminated and observed in Yedikule, Kazlıçeşme, Osmaniye, Rami, between Atışalanı-Esenler areas and in east of Güngören. The maximum thickness of the unit is 30 m in these regions (Arınç, 1955; http://www.ibb.gov.tr). The thickness of the unit was detected as 40 m by Sayar (1977, 1989, 1992). The average thickness of the unit was found as 24 m in this study. Ostracod and gastropod genera and species within Bakırköy formation such as; *Cyprideis seminulum* (Reuss), *C. torosa* (Jones), *C. anatolica* (Bassiouni), *C. pannonica* (Mehes), *C. sohni* (Bassiouni), *Miocyprideis sarmatica* (Zalanyi), *Darwinula cylindrica* (Straub), *Heterocypris salina* (Brady), *Ilyocypris bradyi* (Sars), *I. gibba* (Ramdohr), *Ilyocypris* sp., *Candona (Caspiocypris) alta* (Zalanyi), *Candona (C) parallela pannonica* (Zalanyi), *Valvata* sp. were described in this study. Its age was found as Late Miocene based on vertebrate fossils and ostracods (Sayar-Arınç, 1955; Şafak, 1997; Nazik, 1998).

The environment of the unit is lake and lagoon according to its fossil content and lithology.

3. Drilling Findings

Lithological observations, fossil findings and environmental interpretations of drills 1-3 in Yedikule-Istanbul are as follows;

3.1. Yedikule-Istanbul Drill Log No 1

This drilling is located in coordinates of X: 28.74°, Y: 41.09° and Z: 113 m, in 1/25000 scaled İstanbul F23c3 sheet.

The drilling depth is 30 m. Below the infilling material at 1.90 m the carbonated clay; at 2.60 m the clay; at 3.00, 4.30 and 5.65 meters the contact between clay-disintegrated sand; at 7.00 m the yellowish-beige fossilliferous limestone; at 7.30 m the claystone and at 7.50, 9.00 and 9.00-10.50 meters limestones with *mactra*; between 10.50-11.00 meters and at 12.00 m the green clay (formation transition); at 12.80, 13.50, 14.00 meters the pale brown-dark yellow fossilliferous claystone layers take place.

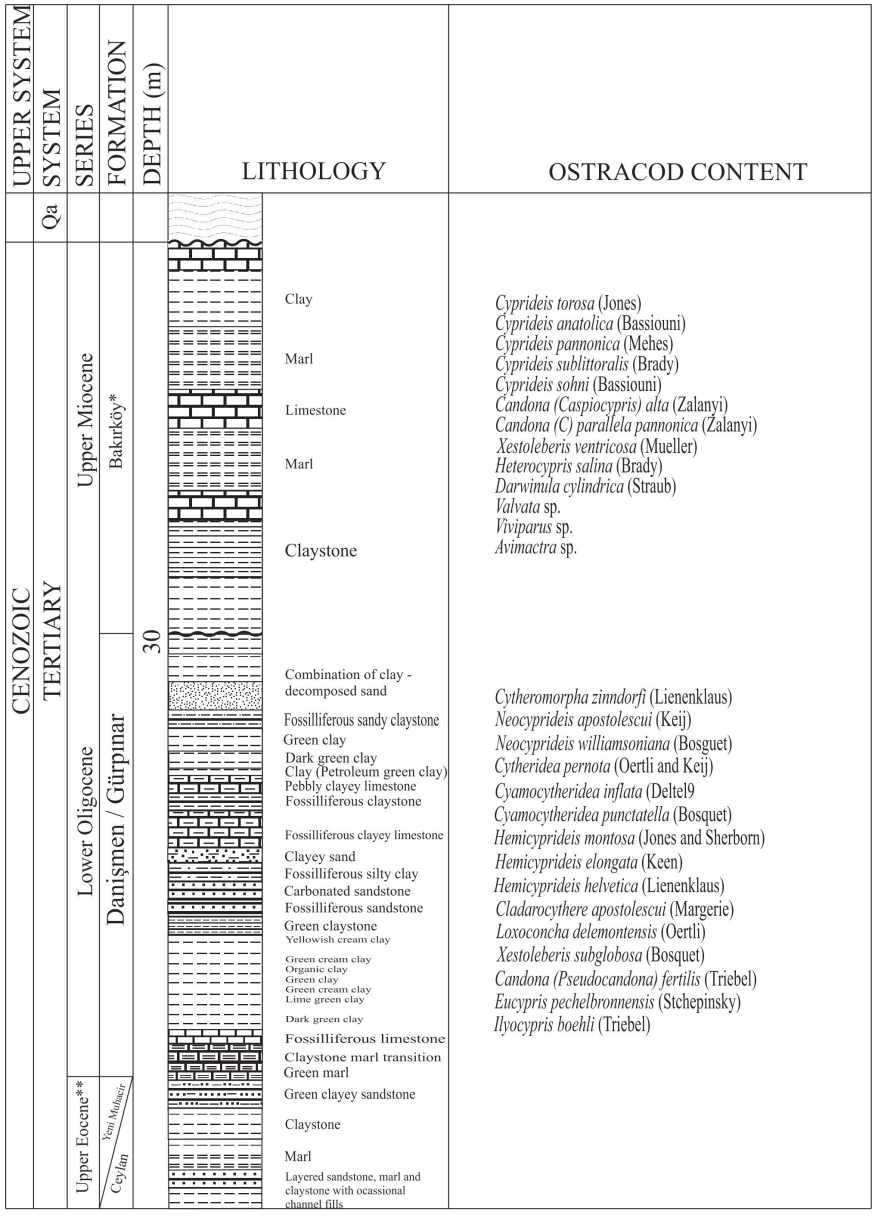

Figure 2- Generalized stratigraphical section of the study area (*Sayar, 1977; 1992; **Sümengen and Terlemez,1991; Keskin, 1974).

At 14.04 and 14.90 m clayey sand; at 15.00 m carbonated sandstone and pebble; at 16.25 and 16.90 m the fossilliferous limestone; at 17.10, 18.00 and 18.50 m the green claystone; at 18.80 m yellowish clay, at 19.00 and 19.70 m green clay, at 20.00 and 20.90 m blackish green organic clay, at 21.50-22.00-22.50 meters grayish green, fossilliferous claystone, at 24.00 and 24.50 meters cream colored and at 27.90 m petroleum green colored, foliated, micro fossilliferous clay, and at 28.00, 29.00 and 29.90 m fossilliferous, pale petroleum colored, sandy clay were cut. Total of 27 wash samples were taken from this drill and wash samples numbered as; 5, 6, 9, 10, 11, 12, 14, 17, 18 and 20 of the Bakırköy Formation and wash samples numbered as; 24, 25, 26, and 27 of the Danişmen/Gürpınar Formation were assessed micropaleontologically.

Among the ostracod species distinguished in this drill in the Bakırköy Formation the following distirbution was obtained; *Ilyocypris bradyi* as

very frequent*; C. seminulum*, *C. pannonica*, *C. anatolica, Heterocypris salina* frequent and very frequent*; Ilyocypris gibba* frequent*; Cyprideis torosa* widespread and frequent; *Darwinula cylindrica, Candona* sp. frequent; *C. sohni* as widespread.

The ostracod species belonging to the Danişmen/ Gürpınar Formation, the following distribution was obtained; *Cytheromorpha zinndorfi, Neocyprideis williamsoniana, C. inflata*, *Hemicyprideis montosa*, *H. helvetica, Xestoleberis subglobosa, Candona (Pseudocandona) fertilis, Eucypris pechelbronnensis* as generally widespread and frequent; *Cytheridea pernota, Cyamocytheridea punctatella, Hemicyprideis montosa* as frequent and *Neocyprideis apostolescui*, *Cyamocytheridea inflata, Hemicyprideis elongata* as rare.

Ostracod species described in this drill characterizes the neritic environment (Figure 3).

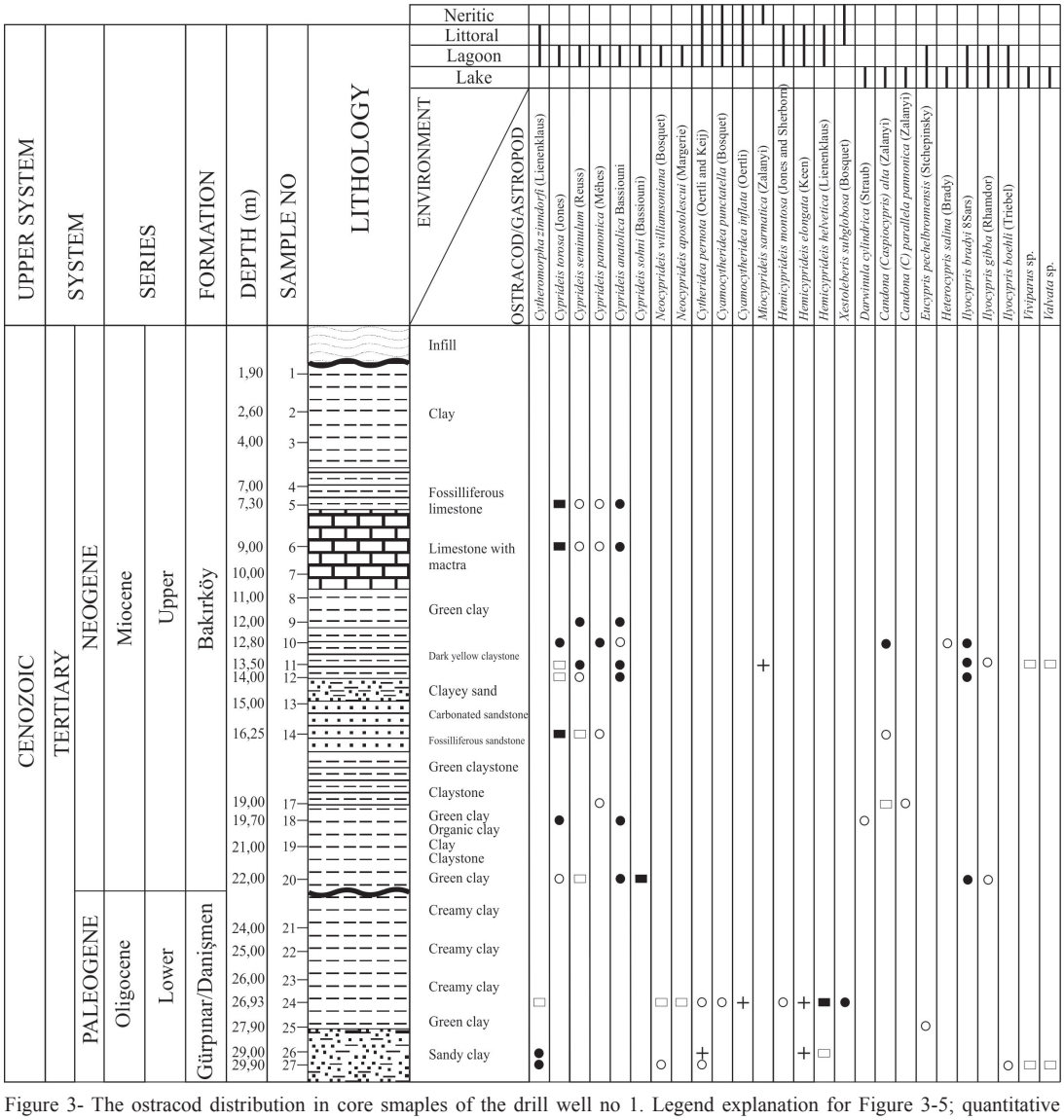

Figure 3- The ostracod distribution in core smaples of the drill well no 1. Legend explanation for Figure 3-5; quantitative abundances of ostracods (+) 1-2 very rare, (□) 3-5 rare, (■) widespread 6-15, (○) frequent 16-25, (●) very frequent >25, from Sissingh (1972).

3.2. Yedikule-Istanbul Drill Log No 2

This drilling is located in coordinates of X: 28.91°, Y: 41.01° and Z: 49 m, in 1/25.000 scaled Istanbul F23c3 sheet.

The depth of the drill is 30 meters and the following lithologies were cut below the infilling material; at 3.50–4.50-5.90-6.00 meters cream colored, altered marl; between 6.00-7.50 meters the limestone; at 10.50 m the marl; at 11.00 m the clay; at 11.20 m the petroleum green clay; at 11.50 the limestone with avimactra; at 12.70-13.50 m the petroleum green clay; at 13.55 m limy pebble; at 14.70 fossilliferous silty clay; at 14.85 m green-cream colored silt-limestone transition; at 15.10 m the limestone; at 16.50 m limestone transition; at 17.80, 19.50-21.00 and 22.10 m the limestone with mactra; at 23.10 limestone with mactra; at 26.00 m the transition between limestone-green marl; at 28.20 m green claystone and sandstone; at 30.00 m cream colored siltstone were cut. Total of 28 wash samples were collected in this drilling and rich ostracod assemblages were observed in samples 7, 11, 13, 14, 15, 16, 20 and 25 in Bakırköy Formation and in wash sample 28 of the Danişmen/Gürpınar Formation.

Among the ostracod species distinguished in this drill in the Bakırköy Formation the following distribution was obtained; *Ilyocypris bradyi* as very frequent*; C. seminulum*, *C. anatolica, Cyprideis torosa* as widespread, frequent and very frequent*; Miocyprideis sarmatica* as widespread and rare; *C. pannonica* as widespread; *Cyprideis sublittoralis, Cyprideis sohni* as rare.

The following genera and environments were detected in this drilling; micro pelecypod genus *Avimactra* and ostracod genus *Ilyocypris* lake-lagoon; *Cyprideis, Neocyprideis* lagoon, *Cytheromorpha*, *Cytheridea*, *Cyamocytheridea*, *Hemicyprideis*, Loxo-concha, *Xestoleberis* lagoon-littoral, *Miocyprideis* neritic environments (Figure 4).

3.3. Yedikule-Istanbul Drill Log No 3

This drilling is located in coordinates of X: 28.82°, Y: 41.07° and Z: 102 m, in 1/25.000 scaled Istanbul F23c3 sheet.

The depth of the drilling is 30 meters and the following lithologies were cut; at 1.50-4.50 m infilling material; at 5.00 m pebbly-sandy fossilliferous claystone; at 7.00 m the fossilliferous claystone-limestone; at 11.50 m the limestone with *mactra*; at 13.50-16.00-19.00 hard, fossilliferous limestone; at 21.80 m sandy clay and clay; at 22.10 m fossilliferous, cream colored clay; at 22.50 m fossilliferous, cream-dark green clay transition; at 23.50 m fossilliferous, dark green clayey sand; at 23.80 m the fossilliferous, foliated clay; at 24.50 m the limestone with *mactra*; at 25.50 m dark green claystone-marl transition; at 26.80 m the green marl; at 28.00 m the limestone with *mactra*; at 29.80 m the sandstone; at 30.60 m the claystone. Total of 30 wash samples were taken in this drill and very well preserved, several ostracod assemblages were observed in wash samples numbered 4, 19, 20 and 21 belonging to the Bakırköy formation, and wash samples numbered as; 29 and 30 belonging to Danişmen/Gürpınar Formation.

From ostracod species distinguished in this drilling *Cyprideis torosa*, *C. anatolica*, *C. pannonica*, *C. sohni* are generally frequent and very frequent; *Cyprideis seminulum* are rare and widespread; and *Cladarocythere apostolescui, Neocyprideis williamsoniana, N. apostolescui, Cytheridea pernota, Hemicyprideis elongata, Eucypris pechelbronnensis, Ilyocypris boehli* the number of valves are frequent and widespread*, Hemicyprideis montosa* the number of valves are very frequent; *Cyamocytheridea punctatella*, *Cyamocytheridea* sp. have rare valves among ostracod species belonging to Danişmen/ Gürpınar Formation.

From the ostracod species described in this drilling the following environments were characterized; *Candona*, *Eucypris*, *Ilyocypris* lake-lagoon, *Cyprideis*, *Neocyprideis*, *Cladarocythere* lagoon, *Cytheridea*, *Cyamocytheridea*, *Hemicyprideis* lagoon-littoral (Figure 5).

4. Distribution of Ostracod Types in Time

In this study, the findings of ostracod types defined within Bakırköy and Danişmen formations through geological time are significant in dating. Therefore; the distributions of important ostracod types defined in different locations on the world through time can be summarized as below.

Cyprideis seminulum; Upper Pontian in Yugoslavia (Republic of Monte Negro) (Krstic; 1963, 1970); and Upper Miocene and Pliocene in Austria, Bulgaria, and Turkey (Kollmann, 1960; Bassiouni, 1979; Şafak, 1997; Nazik, 1998; Şafak et al., 1999 *a,b*).

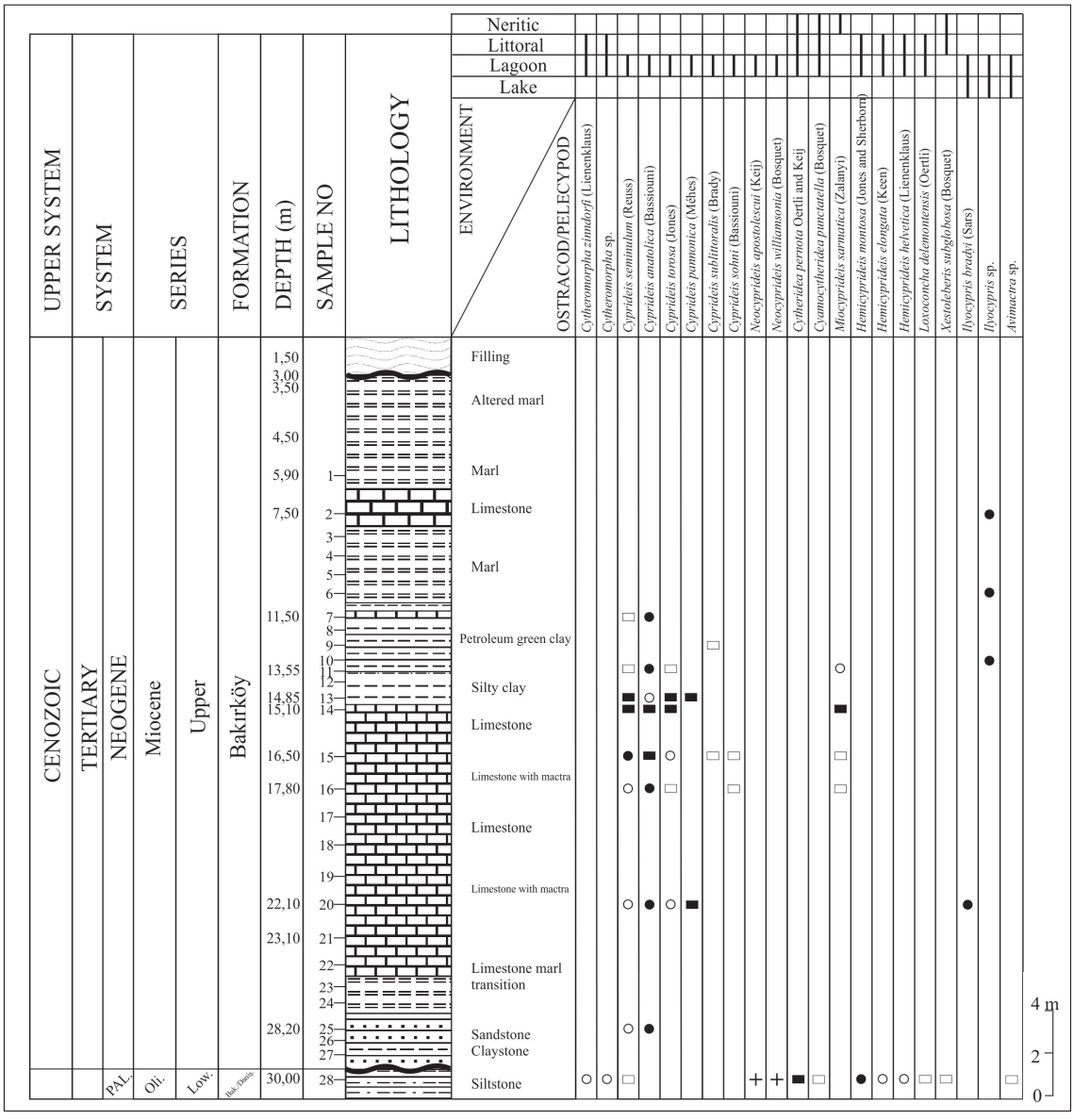

Figure 4- Ostracod distribution in core samples of the drill well no 2.

Cyprideis torosa; Messinian in Italy (Decima, 1962), Late Miocene in France (Carbonnel, 1969) and Pannonian-Pontian in Turkey (Ünal and Tunoğlu, 1996; Ünal, 1996; Nazik et al., 2008), Plio-Pleistocene (Bassiouni, 1979); Pliocene (Nazik and Gökçen, 1995; Tunoğlu et al., 1995). Species is observed also as actual.

Cyprideis pannonica; Lower Pannonian in Austria, Hungary, Czech Republic and Yugoslavia (Kollmann, 1960; Mehes, 1908; Pokorny, 1944; Krstic, 1970), Upper Miocene in Italy (Decima, 1964); Upper Miocene in Bursa, Denizli, Ankara, Kayseri, Erzurum (Bassiouni, 1979) and Upper Miocene-Pliocene in İstanbul (Turkey) (Şafak, 1997; Nazik, 1998; Şafak et al., 1999 *a,b*; Nazik et al., 2008).

Cyprideis anatolica; Late Pliocene in Hatay, Late Pliocene in North of Eastern Mediterranean (Bassiouni, 1979); Late Miocene and Pliocene in Bakırköy basin, western Istanbul and in west Bakırköy (Şafak, 1993, 1997; Şafak et al., 1999*a*, Şafak et al., 1999*b*; Nazik et al., 2008);

Cyprideis sublittoralis; Pannonian in Italy, Austria and Yugoslavia (Decima, 1962; Krstic, 1971; Jiricek, 1983;

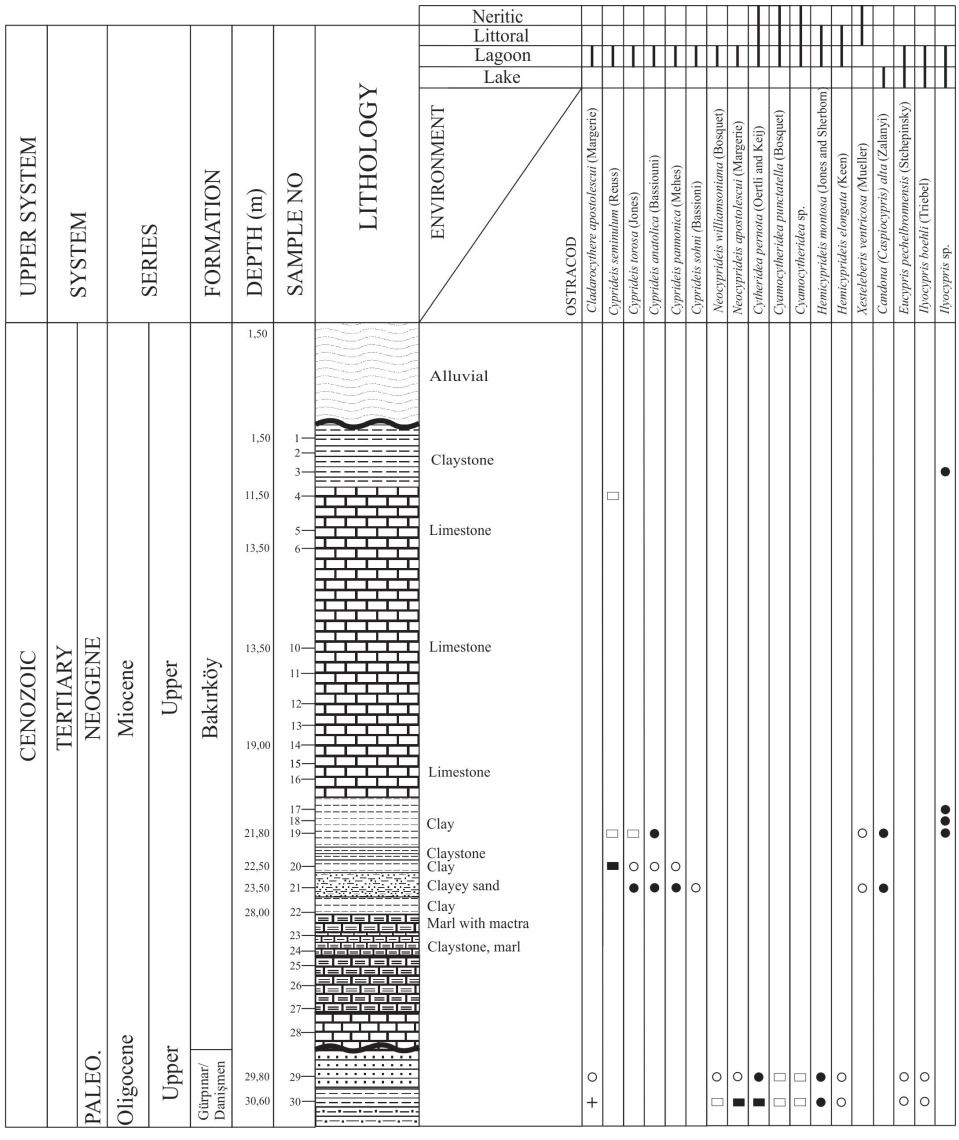

Figure 5- Ostracod distribution in core samples of the drill core no 3.

Jiricek and Riha, 1990); Late Pannonian-Pontian in Turkey (Ünal, 1996; Ünal and Tunoğlu, 1996), Pontian-Messinian (Şafak, 1997), Pontian (Nazik, 1998);

Cyprideis sohni; Late Pleistocene in Hatay (Turkey), north of Eastern Mediterranean and in Northern Anatolia (Bassiouni, 1979); Late Miocene and Pliocene in Bakırköy basin, West of Istanbul, Late Miocene and Pliocene in western Bakırköy (Şafak, 1993*b,* 1997 and Şafak et al., 1999*a*);

Miocyprideis sarmatica; Early-Middle Sarmatian in north of Bulgaria (Stancheva, 1965); Tortonian in Yugoslavia (Krstic, 1973), Sarmatian in Vienna Basin and Czech Republic (Jiricek, 1974); Sarmatian in Hungary (Töth, 2008); Lower-Upper Miocene in Malatya, Adana-Karsantı Basin and in Thrace (Turkey) (Bassiouni, 1979; Şafak, 1993*a*; Rückert-Ülkümen et al., 2009);

Darwinula cylindrica; Late Miocene in Bursa-Orhangazi and Çengiler, NW Anatolia (Freels, 1980) and Late Miocene in Ulukışla Basin in the Central Anatolia (Nazik, 1988);

Ilyocypris bradyi; Pontian (Nazik, 1988), Pliocene (Agalarova, 1956; Stancheva, 1966; Guernet et al., 1977; Şafak et al., 1992; Nazik et al., 1992); Miocene-Pliocene (Şafak, 1997; Şafak et al., 1999*b*); Upper Miocene (Nazik et al., 2008); Holocene (Şafak and Taner, 1998, Nazik et al., 1999, Şafak, 2003); Miocene-Recent in Europe, North Africa, Middle East, Central Asia and in South America (Meisch, 2000);

Ilyocypris gibba; Pleistocene in North America (Delorme, 1971), Pleistocene in England (Sıddıqui, 1971; Whatley et al., 1971); Helvetian-Tortonian in Germany (Straub, 1952), Pleistocene (Triebel, 1941; Lüttig, 1955); Pliocene in France (Carbonnel, 1969); Holocene in Netherlands, Turkey (Wagner, 1957, Nazik et al., 1999); Pleistocene in Italy (Devoto, 1965); Upper Oligocene-Quaternary in Yugoslavia (Malez and Sokac, 1968), Pleistocene (Gagic and Sokac, 1970); Pliocene in Former Soviet Union (Agalarova, 1956); Pontian in Turkey (Gökçen, 1979; Nazik, 1988), Pliocene (Şafak, 1993b, Şafak et al., 1992; Nazik et al., 1992); Messinian (Şafak, 1993*b*; Şafak et al., 2009); Late Miocene (Nazik et al., 2008; Şafak, 2010*a*);

Heterocypris salina; Upper Miocene in Konya, Elbistan, İstanbul, Malatya (Turkey) (Freels, 1980; Şafak, 1997; Nazik, 1998; Nazik et al., 2008; Şafak, 2010*a*); Pliocene in Tufanbeyli, Burdur, Istanbul (Nazik et al., 1992; Tunoğlu and Bayhan, 1996; Şafak et al., 1999*a,b*); Plio-Pleistocene in Yalova, Konya-Karapınar, Elbistan (Witt, 2003; Beker et al., 2008; Tunoğlu et al., 2012), Holocene (Nazik et al.,1999); Late Miocene-Recent in North and Baltic Sea (Meisch, 2000); Middle Miocene in Serbia (Krstic, 1972); Upper Miocene in Slovakia (Pipik, 2001); Quaternary-Neogene in Middle East, North Africa and Europe (Meisch and Broodbakker, 1993; Gliozzi and Mazzini, 1998; Matzke-Karazs and Witt, 2005), Miocene-Recent in Europe, North Africa, Middle East, Central Asia and South America (Meisch, 2000);

Candona (Caspiocypris) alta; Sarmatian in Caspian Basin (Zalanyi, 1929); Romania (Hanganu, 1974); Mio-Pliocene in South Carpathians (Vasiliev et al., 2005); Upper Miocene in Sivas and Şebinkarahisar (Turkey) (Freels, 1980), Pliocene in Sarız and Tufanbeyli (Turkey) (Şafak et al., 1992; Nazik et al., 1992); Pliocene-Pleistocene in Erzurum (Şafak, 2013);

Cladarocythere apostolescui; Early Oligocene and Late Eocene in England and Turkey (Keen, 1972; Şafak, 2008; Şafak et al., 2013; Şafak and Güldürek, 2014, Şafak et al., 2015);

Cytheromorpha zinndorfi; Early Oligocene in France and Turkey (Estéoulle et al., 1986; Sönmez-Gökçen, 1973; Şafak, 1997; Şafak, 2010*a*; Şafak et al., 2013; Şafak and Güldürek, 2014; Şafak et al., 2015);

Neocyprideis apostolescui; Middle-Late Eocene and Early Oligocene in studies made in England, France and Turkey (Haskins, 1969; Oertli, 1985; Şafak, 1990; Şafak, 2008, 2010*a,b*; Şafak et al., 2013; Şafak and Güldürek, 2014; Şafak et al., 2015);

Neocyprideis williamsoniana; Early Oligocene in England and France (Haskins, 1969; Keen, 1972; Oertli, 1985); Late Eocene and Early Oligocene in Turkey (Şafak, 2008, 2010*a,b*; Şafak et al., 2013; Şafak and Güldürek, 2014; Şafak et al., 2015);

Hemicyprideis montosa, *Hemicyprideis elongata;* Lower Oligocene in England and France (Keen, 1972; Oertli, 1985); Lower Oligocene and Late Eocene in Turkey (Tanar and Gökçen, 1990; Şafak, 2008, 2010*a,b*; Şafak et al., 2005, 2013; Şafak and Güldürek, 2014; Şafak et al., 2015)

Hemicyprideis helvetica; Lower Oligocene in England, Paris and Turkey (Keen, 1972; Oertli, 1985, Şafak, 2008; 2010*a*; Şafak and Güldürek, 2014 Şafak et al., 2015); Upper Oligocene in Romania (Jiricek, 1983);

Cytheridea pernota; Upper Eocene and Lower Oligocene in England, France, Hungary, Romania and Turkey (Keen, 1972; Oertli, 1985; Monostori, 1983; Jiricek, 1983, Şafak, 2008; Şafak and Güldürek, 2014; Şafak et al., 2015);

Cyamocytheridea punctatella; Upper Eocene in Hungary and Romania and Lower Oligocene in NW Europe and Turkey (Monostori, 1983; Jiricek, 1983; Keen, 1972; Şafak, 2008; Şafak and Güldürek, 2014);

Cyamocytheridea inflata; Late Eocene- Early Oligocene (Deltel, 1963), Lower Oligocene (Oertli, 1985) in France- Akiten Basin.

Loxoconcha delemontensis; Oligocene in Germany (Lienenklaus, 1894); Lutetian-Rupelian in France-Akiten Basin (Deltel, 1961); Rupelian in Switzerland (Oertli, 1956); Sannoisian in NW Europe (Keen, 1972); Early Oligocene in Turkey (Sönmez-Gökçen, 1973);

Xestoleberis subglobosa; Lutetian-Bartonian in France-Paris Basin (Apostolescu, 1964; Bosquet, 1852); Late Eocene in Akiten Basin (Ducasse, 1959); Lutetian-Bartonian in Netherlands (Keij, 1957); Middle-Late Eocene – Oligocene in Turkey (Şafak, 1999; Şafak et al., 1999*a,b*; Şafak and Güldürek, 2014);

Candona (Pseudocandona) fertilis; Oligocene in Europe (Triebel, 1963), Early-Late Oligocen in Germany (Carbonel and Ritzkovski, 1969), Early-Late Oligocene in Switzerland and France (Carbonel, Weidmann and Berger; 1985, Keen, 1972) and Karsantı Basin/Adana (Ünlügenç et al., 1991; Şafak, 1993*b*; Şafak, 2010*a,b,* Şafak and Güldürek, 2014; Şafak et al., 2015);

Eucypris pechelbronnensis; Sannoisian in France (Pechelbronn) (Keen, 1972);

Ilyocypris boehl; Lower Oligocene in England (Keen, 1972); Lower and Upper Oligocene in Turkey (Sönmez-Gökçen, 1973; Tanar and Gökçen, 1990; Şafak, 1993*a*; Şafak et al., 2015).

5. Results

This study was carried out to micropaleontologically assess the successions in cores excavated around Yedikule during micro zonation study performed by the Istanbul Municipality in the southern part of European side in Istanbul province. For this reason, total of 85 core samples were collected from 3 drills excavated and classified wells. In succession, where limestone, marl, silty sandstone, sandstone, organic clay, claystone, clayey limestone and fossilliferous limestones are dense, 16 genera and 25 species of ostracods and 3 micro mollusc genera were described from samples belonging to Bakırköy and Danişmen/Gürpınar Formation.

Ostracod and gastropod genera and species such as; *Cyprideis seminulum* (Reuss), *C. torosa* (Jones), *C. anatolica* (Bassiouni), *C. pannonica* (Mehes), *C. sohni* Bassiouni, *Miocyprideis sarmatica* (Zalanyi), *Darwinula cylindrica* Straub, *Heterocypris salina* (Brady), *Ilyocypris bradyi* Sars, *I. gibba* (Ramdohr), *Ilyocypris* sp.,*Candona (Caspiocypris) alta* (Zalanyi), *Candona (C) parallela pannonica* (Zalanyi), *Valvata* sp. were determined in Bakırköy Formation.

Ostracod genera and species such as; *Cytheromorpha zinndorfi* (Lienenklaus), *Cytheromorpha* sp., *Neocyprideis apostolescui* (Keij), *N. williamsoniana* (Bosquet), *Cytheridea pernota* (Oertli and Keij), *Cyamocytheridea punctatella* (Bosquet), *C. inflata* (Deltel), *Cyamocytheridea* sp., *Hemicyprideis montosa* (Jones and Sherborn), *H. elongata* (Keen), *H. helvetica* (Lienenklaus), *Cladarocythere apostolescui* (Margerie), *Loxoconcha delemontensis* (Oertli), *Xestoleberis subglobosa* (Bosquet), *Candona (Pseudocandona) fertilis* (Triebel), *Eucypris pechelbronnensis* (Stchepinsky), *Ilyocypris boehli* (Triebel), and micro molluscs genera such as; *Viviparus* sp.*, Avimactra* sp. were described in Danişmen/Gürpınar Formation.

Described ostracod species were correlated with studies carried out in Central Europe (Keen, 1972; Oertli, 1985; Monostori, 1983), Italy, France, Monte Negro, Romania, Austria, Hungary, Czech Republic (Mehes, 1908; Decima, 1964; Stancheva, 1965; Krstic, 1973) and in Turkey (Nazik, 1993; Tanar and Gökçen, 1990; Sönmez-Gökçen, 1973; Şafak, 2008, 2010; Şafak and Güldürek, 2014), and Bakırköy and Danişmen/Gürpınar formations were dated as Late Miocene and Early Oligocene, respectively.

Candona, *Candona (Pseudocandona), Candona (Caspiocypris)*, *Eucypris, Heterocypris, Darwinula* from ostracoda genera described in drill cores and *Viviparus*, *Valvata* from micro gastropods present lake environment, micro pelecypod genera *Avimactra* and *Ilyocypris* lake-lagoon, *Cyprideis*, *Neocyprideis* lagoon, *Cytheromorpha*, *Cytheridea*, *Cyamocytheridea*, *Hemicyprideis*, *Xestoleberis* lagoon-littoral and *Miocyprideis* characterizes neritic environment.

Considering data of this and previous studies, the marl, silty sandstone, claystone, clayey limestones and fossilliferous limestones deposited especially in lower and upper layers of organic clay and claystone indicate that they contain generally lagoonal ostracods in both formations.

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PLATE

PLATE I

Figure 1. *Cladarocythere apostolescui* (Margerie)

1. Carapace, right lateral view, drill log no 3, sample no 29

Figure 2-3. *Cytheromorpha zinndorfi* (Lienenklaus)

2. Right valve, external view, drill log no 2, sample no 28

3. Carapace, right lateral view, drill log no 1, sample no 26

Figure 4-5. *Cytheridea pernota* (Oertli and Keij)

4. Carapace, left lateral view, drill log no 1, sample no 24

5. Carapace, right lateral view drill log no 1, sample no 24

Figure 6-7. *Neocyprideis williamsoniana* (Bosquet)

6. Left valve, external view, drill log no 1, sample no 25

7. Carapace, right lateral view, drill log no 3, sample no 30

Figure 8. *Cyprideis anatolica* Bassiouni

8. Left valve, external view, drill log no 1, sample no 9

Figure 9. *Cyprideis torosa* (Jones)

9. Right valve, external view, drill log no 3, sample no 19

PLATE I

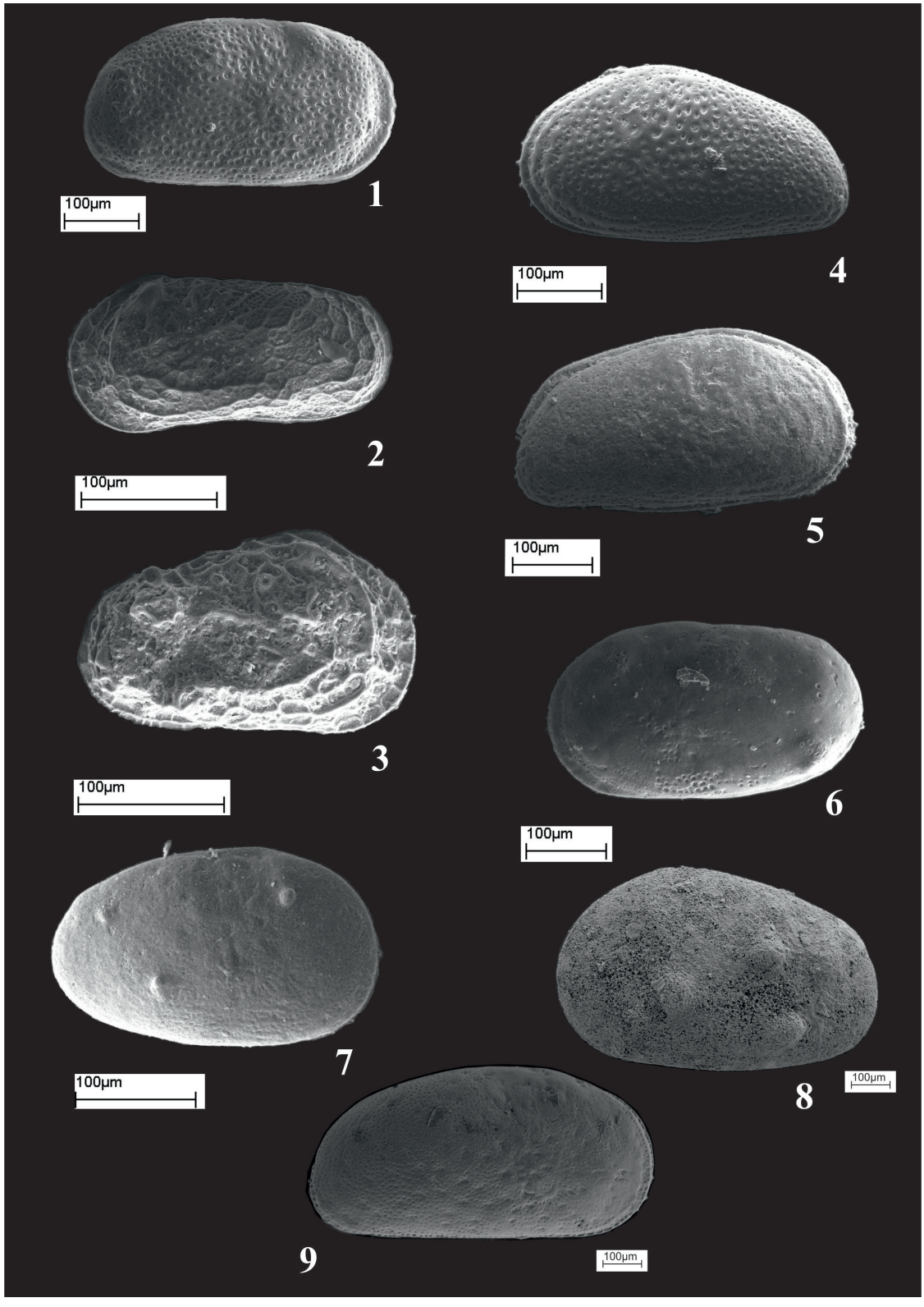
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PLATE II

Figure 1-2. *Cyprideis torosa* (Jones)

1. Carapace, right lateral view, drill log no 1, sample no 10

2. Carapace, left lateral view, drill log no 3, sample no 2

Figure 3-5. *Cyprideis pannonica* (Mehes)

3. Left valve, external view, drill log no 3, sample no 21

4. Left valve, external view, drill log no 1, sample no 10

5. Carapace, left lateral view, drill log no 2, sample no 13

6. Miocyprideis sarmatica (Zalanyi)

6. Carapace, left lateral view, drill log no 2, sample no 11

Figure 7-8. *Cyprideis seminulum* (Reuss)

7. Carapace, left lateral view, drill log no 3, sample no 20

8. Left valve, external view, drill log no 2, sample no 11

Figure 9-10. *Cyprideis sublittoralis* Pokorny

9. Carapace, right lateral view, drill log no 2, sample no 15

10. Carapace, left lateral view, drill log no 2, sample no 15

PLATE II

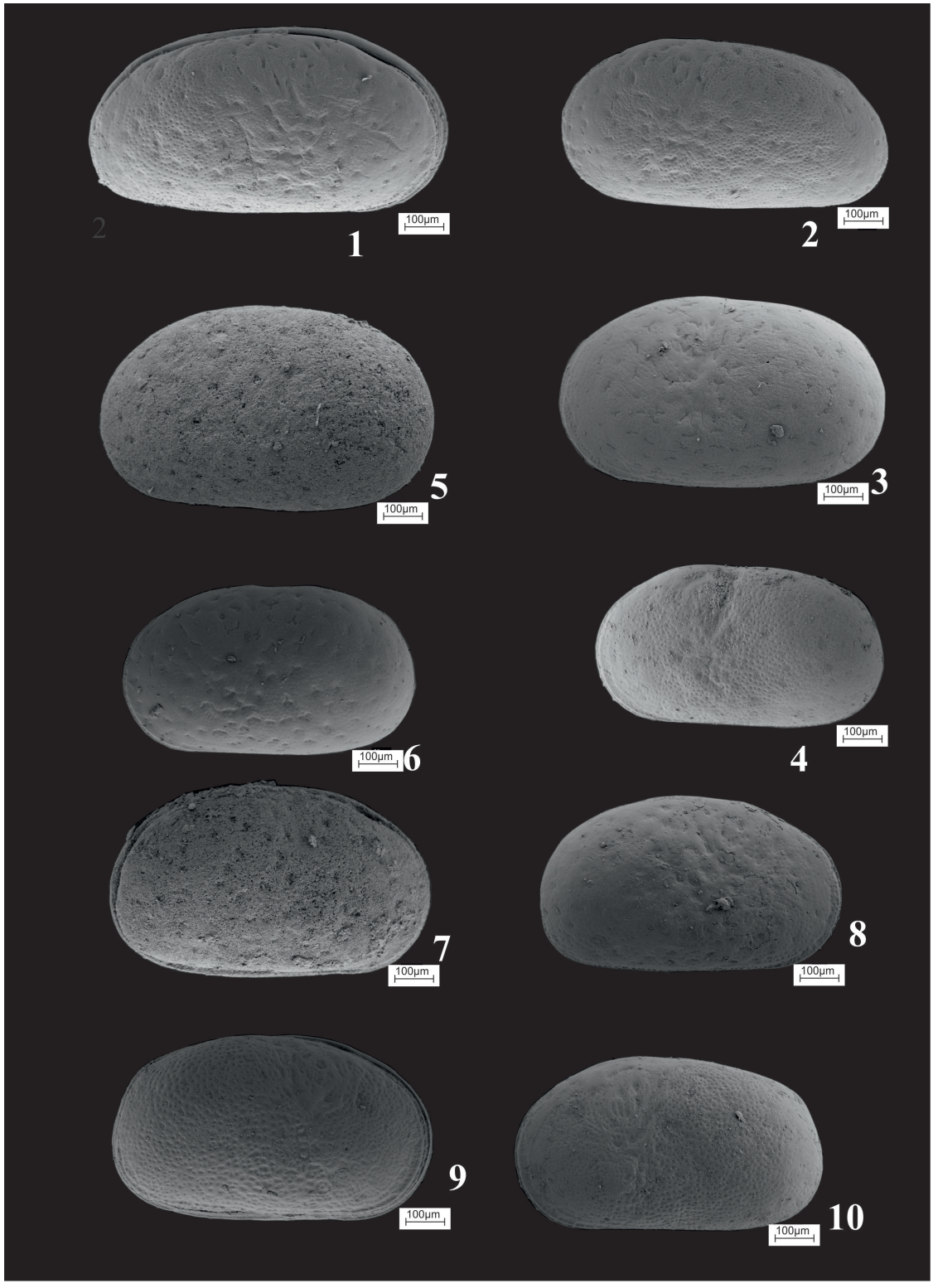
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PLATE III

Figure 1-2. *Heterocypris salina* (Brady)

1. Carapace, left lateral view, drill log no 3, sample no 25

2. Carapace, right lateral view, drill log no 3, sample no 1

Figure 3. *Xestoleberis ventricosa* Mueller

3. Carapace, left lateral view, drill log no 3, sample no 21

Figure 4. *Xestoleberis subglobosa* (Bosquet)

4. Carapace, left lateral view, drill log no 1, sample no 24

Figure 5. *Darwinula cylindrica*Straub

5. Carapace, left lateral view, drill log no 1, sample no 18

Figure 6. *Candona (Caspiocypris) alta* (Zalanyi)

6. Right valve, external view, drill log no 1, sample no 10

PLATE III