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# Middle–late Pleistocene marine molluscs from Izmit Bay area (eastern Marmara Sea, Turkey) and the nature of Marmara – Black Sea corridors



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## ABSTRACT

In this study, marine Pleistocene mollusc faunas from deposits along the southern shores of the Izmit Bay area (Marmara Sea, Turkey) are reviewed. Ten samples from five localities spanning middle and late Pleistocene intervals are assessed and compared to four samples of a Holocene age. For the Pleistocene fauna, a total of 59 mollusc species (33 bivalve and 26 gastropod species) are recorded, some of which are reported for the first time for this region. The middle Pleistocene fauna bears large resemblance to the late Pleistocene faunas, even though marine conditions were lacking during sea-level drops in the Marmara Sea Basin in intervening times. The middle Pleistocene mollusc fauna is dominated by species that typify the so-called Uzunlarian faunas while the late Pleistocene mollusc fauna is indistinguishable from Karangatian faunas of the Black Sea Basin.

Several common species (including *Bittium reticulatum*, *Rissoa* spp. and *Lucinella divaricata*) show that the both Uzunlarian and Karangatian assemblages of Yalova fauna mainly represent seagrass palaeo-environments. Palaeosalinities estimates for the Yalova area are uppermost mesohaline to polyhaline, typically around or above 20 psu, which is almost similar to the optimum salinity estimates for the middle Pleistocene Uzunlarian. However, it is slightly lower than the Upper Pleistocene Karangatian, representing the location of the Yalova area in an embayment with freshwater input at that time.

The Yalova sections are located in the southern flank of the North Anatolian fault system responsible for a strong local uplift of the study area. The sections contain evidence for three marine high stands, separated by terrestrial intervals. When regional uplift rates (approximately 0.2 mm/y) and oceanic sea-levels are considered it is likely that the three highstand intervals correspond to relative sea level high stands of MIS7, MIS5e and possibly MIS5d but further study is required to confirm such a suggestion.

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## 1. Introduction

The Marmara Sea is situated between the Black and Aegean/Mediterranean seas via narrow and shallow straits (Dardanelles and Bosphorus). The Marmara Sea Basin and its coastal region have played an important paleogeographic role in connecting the Mediterranean Sea and Black Sea during glacial and interglacial periods in Pleistocene times (Andrusov, 1903; Pfannenstiel, 1944; Stanley

and Blanpied, 1980; Meriç et al., 1995; Tchepalyga, 1995; Erol and Çetin, 1995; Görür et al., 1997; Emre et al., 1998; Aksu et al., 1999; Kerey et al., 2004; Yaltrak et al., 2012).

Episodic connections between Pontocaspian lakes of the Caspian and Black Sea Basin with the Mediterranean has been controlled by climatic changes and sea level fluctuations and occurred at least twelve times over the past 670 ka (Badertscher et al., 2011). The Marmara doorsteps between the Mediterranean and Pontocaspian systems have been shown by its Quaternary mollusc faunas (Taner, 1981, 1983; İslamoğlu, 2002, 2009; İslamoğlu and Tchepalyga, 1998 and references therein; Schneider et al., 2005; Taviani et al., 2014). The successive faunas show that the configuration of the Marmara Basin and adjacent basins has

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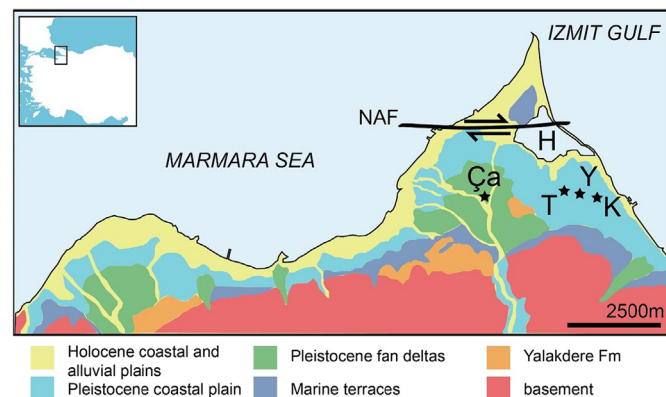
been dynamic and the exact locations of the connecting waterways may have shifted through the Quaternary (Yaltrak 2002 and references therein).

In order to understand the mollusc associations and their responses to environmental change during the Pleistocene, five marine Pleistocene fossiliferous successions in the southern Izmit Bay region located around Yalova were studied for sedimentology and faunal content. Çakaltepe is located at 60 m above sea level and represents a middle Pleistocene interval (bivalve faunas from that section were reported by Schneider et al. (2005) who named the locality “Subası”). The other four localities (Tofas, Hisar, Kaytazdere, Çavuşçiftliği) are of a late Pleistocene age. In previous works approximately 14 marine gastropod species and 24 bivalve species have been reported from Pleistocene deposits in the area (İslamoğlu et al., 2001; Schneider et al., 2005). However, major questions about the paleogeographic development of the region are still unresolved. In some works, Mediterranean “Tyrrhenian” or “Monastrian” age/signature were applied to these faunas (Göney, 1964; Taner, 1981; Sakiñç and Bargu, 1989; Erol, 1992; Erol and Çetin, 1995; Sakiñç and Yaltrak, 1997; Schneider et al., 2005). Others proposed a better correspondence to Karangatian faunas from the Black Sea Basin (İslamoğlu et al., 2001).

In this paper, we study and compare the faunal composition of middle and late Pleistocene localities (and also to local Holocene faunas) and reconstruct depositional environments. We compare the affiliation the Pleistocene fauna to that of the Tyrrhenian in the Mediterranean and the Uzunlarian and Karangatian in the Black Sea Basin, emphasizing their paleoecological, stratigraphical and paleogeographical significance. By combining uplift rate estimates and sea level history the present work aims to contribute to the discussion of the middle–late Pleistocene history of the threshold region between the Mediterranean and the Black Sea Basin.

## 2. Geological setting

The study area is located in the İzmit Bay, northeastern part of the Marmara Sea Basin (Fig. 1). Quaternary deposits overlie the Eocene sedimentary successions composed of siltstone, sandstone, marl, and limestones and Neogene units represented by Kılıç and Yalakdere ‘formations’ (Emre et al., 1998; Yiğitbaş et al., 1999;



**Fig. 1.** The locations of studied middle–late Pleistocene sections. The middle Pleistocene locality of Çakaltepe is located to the west of the map. NAF: North Anatolian fault, H: Hersek lagoon, Ç: Çavuşçiftliği, T: Tofas, Y: Yalova-Hisar, and K: Kaytazdere. Adapted from Emre et al. (1998).

Rückert-Ülkümen et al., 2006; Kılıç and Yalakdere members of Yalova formation). The Kılıç formation consists of fluvio-deltaic detritic sediments, while the Yalakdere formation consists of fine detritics and coal deposits representing lacustrine and (coastal) swamp palaeoenvironments (Rückert-Ülkümen et al., 2006). The units have a late Miocene – early Pliocene (late Khersonian/early Maeotian) age based on the presence of eastern paratethian fish taxa (Rückert-Ülkümen and Yiğitbaş, 2007), although some bivalve species appear to indicate an early Pliocene (Kimmerian) age (Emre et al., 1998).

The existence of late Pleistocene deposits in the Yalova area has been known since the 19th century (Tchihatchef, 1863–1867; Calvert and Neumayr, 1880; Andrusov, 1894). The fossiliferous deposits have been reported as “marine Pleistocene deposits” (Erinç, 1954, 1956), Altınova Formation (Sakiñç and Bargu, 1989) and “Qtr1 Marine terrace” (Gökten, 2001). Recently, all Pleistocene sequences surrounding the Marmara Sea and the Dardanelles have been attributed to the Marmara Formation (Sakiñç and Yaltrak, 1997). Middle Pleistocene deposits of the Marmara Formation contain sites with Pontocaspian type fauna that resulted from Caspian Sea overflows during the interglacial endothermal phases to the Black Sea and the Marmara Basin (Bardertscher et al., 2011; Yanina, 2014). The lowermost part of the Marmara Formation near Gelibolu in the southwestern Marmara region contains Chaudian (early middle Pleistocene) mollusc faunas (Andrusov, 1894; English, 1904; Taner, 1983; Tchepalyga, 1995). Early Khazarian (late middle Pleistocene) mollusc faunas were reported from the İznik lake basin terraces, also indicating Pontocaspian connections to that basin (İslamoğlu, 2009). Late Pleistocene occurrences of the Marmara Formation are known from the northern, northwestern, and southern coastal areas of the Marmara region, and Saroz bay of the Aegean sea, and located in altitudes between 0 and 40 m ASL (Erinç, 1954, 1956; Ardel, 1959; Göney, 1964; Akartuna, 1968; Bargu and Sakiñç, 1989; Sakiñç and Bargu, 1989; Sakiñç and Yaltrak, 1997; Emre et al., 1998; Meriç et al., 1999; Kazancı et al., 2000, 2003; Schneider et al., 2005). Furthermore, Pleistocene marine and Pontocaspian (Neoeuxinian) faunas are also known from submerged sites in the Marmara Sea (Taner, 1995; Meriç et al., 1995; İslamoğlu and Tchepalyga, 1998; Taviani et al., 2014 and references therein).

The NAF zone is located about 3 km north of the localities. The southern block that experiences strong uplift contains the Quaternary deposits (Dewey and Şengör, 1979; Barka and Kadinsky-Cade, 1988; Emre et al., 1998). Their occurrence has been interpreted as a result of single transgressive period (Erol, 1992; Sakiñç and Yaltrak, 1997) or two marine intervals (Erinç, 1954; Kazancı et al., 2000, 2003). Although they are termed “terraces” in earlier studies (Erinç, 1954, 1956; Gökten, 2001), uplift and tilting may have been more important in the genesis of these “terrace” like deposits.

## 3. Material and methods

The studied mollusc fossils were collected from the five localities in different altitudes (+18, +20, +23 m, +60 m) in Armutlu peninsula (SE Marmara region) during the fieldwork of the Tübitak project YDABCAG 100 Y 077 (Fig. 1, Table 1). The preliminary results from depositional characteristics and mollusc contents of the sections have been reported by İslamoğlu et al. (2001) and Kazancı et al. (2003). In this work, sedimentary facies and mollusc contents of the high-stand deposits are combined and documented (Fig. 2; Table 2).

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