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A multi disciplinary overview of factors controlling on meiofauna assemblages around Maden and Alibey islands in Ayvalik (Balikesir, Eastern Aegean Sea)

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ABSTRACT

In coastal parts of the study areas, heavy metals containing ground water flows along the faults and fractures and reaches at sea. In these contaminated waters, morphologically abnormal individuals of the affected meiofauna (benthic foraminifera, ostracod, mollusc) can be found. Three cores were taken from the seafloor in the four separate stations that are located in NW of Ayvalık village, around Alibey and Maden islands, and one core of each three core groups was studied in order to investigate the aforementioned morphological affects on the recent meiofauna, which have been inhibited in those contaminated waters. Lead, manganese, hematite and limonite deposits with small reserves were present in Alibey, Maden and Küçük (Small) Maden islands. Morphological changes and coloring were observed in tests of large number of *Peneroplis, Lobatula, Ammonia* and *Elphidium* samples collected from these areas. This observation vindicates impact of heavy metals onto the foraminifera assemblages. Heavy metals and other chemical and radioactive elements found in the surrounding country side have been naturally transported into the adjacent sea water during the past and present. The aim of this study is to figure out the effects of the chemical and radioactive elements, which were carried from the land on the meiofaunal (benthic foraminifera, ostracod and mollusc) assemblages.

1. Introduction

Even though trace level of heavy metals that have been disposed into the natural environment due to human activities, in time they accumulate in soil, water, sediments as well as in plants and animals. Inspired by a study done in the western part of Greenland (Elberling et al., 2003) a similar research was carried out in the present study basing upon the samples of the cores cut at the seafloor stations located around Alibey and Maden islands. Those islands are located along southern cost of the Gulf of Edremit which is northeastern extension of Aegean Sea (Fig. 1).

Part of the Recent sediments deposited in study area is red-brown in color. They contain plenty of benthic foraminifera tests with red-brown, yellow, orange and dark gray colors, or with mixture of those colors. *Peneroplis pertusus* (Forskal) and *P. planatus*

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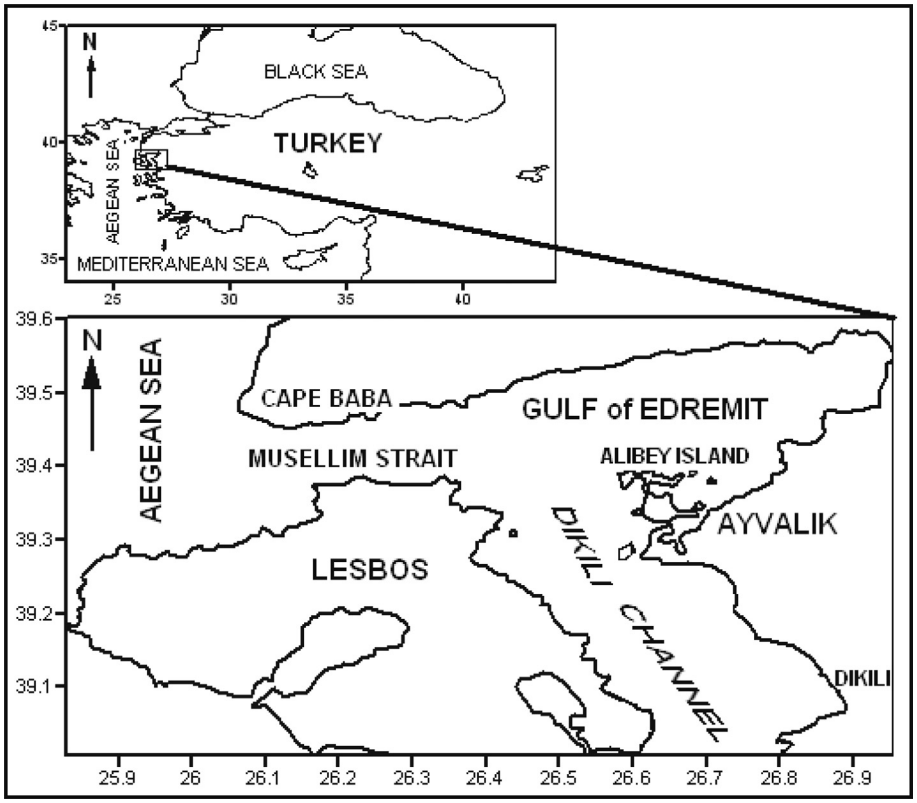

Fig. 1. Location map of the investigation area.

(Fichtel and Moll) are the abnormally abundant members of existing biota. In this assemblage, another noteworthy feature is abundance of benthic foraminifera especially *Peneroplis* tests displaying extreme morphological disorders. The recent sediments consist of light gray sands in the other studied areas, and a small number of partly colored or colorless benthic foraminifera are observed in the upper levels (Meriç et al., 2012a,b; Barut et al., 2013; Yümün et al., 2016). *Ammonia compacta* Hofker, *A. parkinsoniana* (d'Orbigny), *Challengerella bradyi* Billman, Hottinger and Oesterle, *Elphidium complanatum* (d'Orbigny) and *E. crispum* (Linné) are the dominant species in this assemblage. Although benthic foraminifera found in those studied locations also display interesting shape deformations, however these morphological features are less remarkable than the deformation displayed by the aforementioned benthic foraminifera.

Presence of ostracods in these Recent sediments reveals occurrence of different conditions in the site of deposition. Observed genera and species are small in number in the reddish-colored sands; hence the genera and species are diversified and abundant in the gray sands. These observed differences in both abundance and diversity of the foraminifera under consideration suggest that ecological conditions had locally and periodically changed in the studied area. The mollusc fauna exhibits a parallel tendency to the foraminifera and ostracod assemblage. Molluscs are rarely found in the red-brown sands while they are common to abundantly in the gray sands.

Rarity versus extreme abundance of the recent plant remains in the different layers is another feature that was observed in the studied sediments. For example, in a 0.45 m long 1c core; plant remains are rare in 0.00–0.16 m interval, extremely abundant in 0.16–0.32 m interval and they are reduced in numbers in 0.32–0.45 m interval. In both 2c and 3a cores; the plant remains are abundant in entire 0.00–0.45 m interval. However this throughout abundance is not observed in a 0.52 m long core 4b. Water depths (subsea elevations) measured at the coring stations is as follows: 4b (0.80 m), 1c (1.50 m), 3a (2.70 m) and 2c (8.00 m).

Presence of the economic mineral deposits with small reserves at various locations in both Maden and Alibey islands are reported in some of the previous studies. The volcano sedimentary sequence, which was deposited from Middle-Upper Miocene to younger period, is a typical depression fill. The topographic depression is the extension of a larger NW trending structural feature which is called the Dikili-Ayvalık Depression. In this area, polymetallic ore dykes are found along approximately NNE trending fault and fractures that had been developed in the alkaline basaltic volcanic rocks (Dora and Savaşçın, 1980). Among these ore minerals lead has a primary place, and limonite, hematite and manganese oxides are the minerals with lesser economic importance (Dora and Savaşçın, 1980; Akyürek, 1989).

Some aquatic plants and diatoms were used as biomarkers by Padinha et al. (2000) and Fisher et al. (1981) respectively, in order to identify marine contaminators. Benthic foraminifera abundantly present in marine environment, therefore they are very important group of organisms to be used studying changes occur in the environmental conditions. Their sensitivity to environmental changes has long been reported in relevant publications (*i.e.* Murray, 1991). To some extent, preservation of morphologic and textural properties of shells and tests deposited in sediments for a long time is a unique feature. Therefore, they have been reliable biomarkers up against both natural (Murray, 1991) and artificial (Nagy and Alve, 1987; Alve, 1995; Yanko et al., 1999) contaminators. Oil wastes, agricultural chemicals and heavy metals in waters had played active role in those reported morphological deformations (Ellisson et al., 1986; Nagy and Alve, 1987; Alve, 1995; Samir and El-