

HEAVY METALS DISTRIBUTION IN SURFACE SEDIMENTS OF MALIAKOS GULF AND SPERCHIOS RIVER, CENTRAL GREECE

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Abstract

Surface sediments were collected during July 2005, from Maliakos Gulf and the estuary of Sperchios River. The total concentrations of zinc, copper, manganese, aluminium, iron and lead were determined. Grain size seems to be determinative for the metal load, in combination with the environmental pressures that the area receives. Metal concentrations were higher in the gulf samples.

Keywords : Coastal Systems, Estuaries, Metals, Sediments.

Introduction

Marine sediments provide a long-term record of the anthropogenic rural, industrial and domestic discharges in coastal areas. In contrast to the strong temporal and spatial variability in the aqueous concentrations of pollutants, sediments integrate pollutant concentrations over time. (1)

Study area

The area is located in the eastern part of central Greece; it is an area of ecological significance included in the Natura 2000 network. Three different parts can be distinguished in the site: a) Maliakos Bay, b) the estuary of Sperchios River and its surrounding area and c) Sperchios River valley and its springs. Maliakos Bay covers an area of 9,000 ha. It is a small enclosed embayment connected to the Aegean Sea and N. Evoikos Gulf through two small openings to the east. Its depth does not exceed 25 m and its bottom is covered mostly by soft sediments. Sperchios River meets the sea in the SW corner of the bay. The part of the bay close to the mouth of the river is the shallowest one. (2)

Methodology

Surface sediments were collected with the use of a grab sampler from five stations in Maliakos Gulf (M1, M2, M3) and the estuary of Sperchios River (S1, S1p), as shown in figure 1. The concentrations of heavy metal were determined in the total fraction after digestion of 0.5 g of the freeze dried samples with HNO₃/HClO₄/HF. Metal concentrations were determined by flame (Fe, Mn, Al, Cu, Zn) or flameless (Pb) atomic absorption spectrometry. Each sample was analyzed in triplicates. (3)



Fig. 1. Area map.

Results and discussion

All samples from the inner gulf were fine - grained, while samples from the estuary of Sperchios were coarse - grained, with the fraction <0.63 um amounting to less than 10%. The samples from the gulf were mainly composed of grains with diameter <0.63 um.

Each sample was analyzed in triplicate. The rsd% for each sample was; Zn <5.9, Cu <3.2, Pb <12.8, Al <4.6, Mn <2.6, Fe <4.2. A reference material was also digested and the percent recoveries for each metal were; Zn 105.3, Cu 103.2, Pb 75.4, Mn 104.5, Fe 98.8, Al 95.4.

Concentrations of heavy metals are shown in figure 2. Concentrations of Fe, Al, Pb, Zn, Cu increased in the west - east direction (from the estuary to the center of the gulf). This trend occurs due to the sample grain size nature that affects metal concentrations.

Atmospheric deposition of enriched in Pb particles of urban or industrial origin may contribute to the increase of Pb values in the gulf samples. The values of ratio C_{Pb}/C_{Al} also presented increase from the estuary to the center of the gulf.

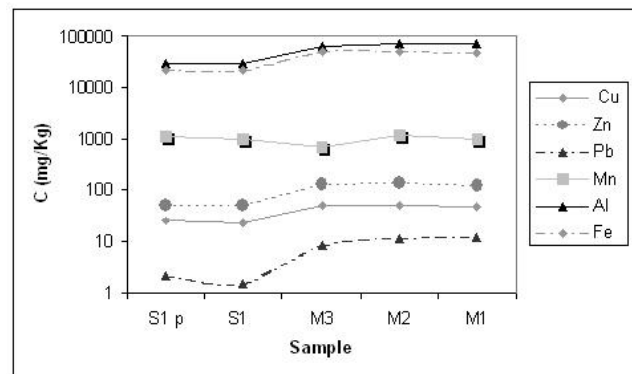


Fig. 2. Heavy metal concentrations.

Values of Mn showed a minimum at the station M3, that may be caused by dissolution of manganese oxides in the intermittently anoxic conditions that probably occur into the enriched in organic matter fine grained sediments of the area.

High Fe and Al values in all sediments indicate the terrigenous origin of sediments. The correlation of the values was determined very high ($R^2 = 0.98$ for linear equation). Moreover, Cu, Zn and Pb presented the same trend in their distribution in the samples. Correlations (R^2) of Cu-Zn, Cu-Pb, Zn-Pb are 0.99, 0.87, 0.89.

The values of C_{Fe}/C_{Al} ratio show a decrease from 0.77 to 0.66 for S1p, S1, M3, M2, M1 samples, revealing that the mineral structure of the samples is not the same but it is closely linked to the grain size of sample. Comparing our measurements to those of previous studies (4), (5) Zn and Fe values presented an increase in Maliakos Gulf while they show a decrease in the river. Concentrations of Mn are higher both in the River and the Gulf, while Pb values have the opposite trend.

References

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