THE PARTICULATE TRACE METAL (CU, ZN, CR, FE, MN, NI, PB AND HG) LOAD CARRIED BY GEDIZ RIVER INTO THE OUTER IZMIR BAY; THE AEGEAN SEA

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Abstract

In the surface water in the mouth of the Gediz river, the concentrations of particulate Cu, Zn, Cr, Fe, Mn, Ni, Pb and Hg measured for determining their loads to the outer section of the Izmir Bay. Excluding Mn and Hg, the temporal variations of the particle trace metals showed significant correlations with the river flow. With their independence from the flow, the transport patterns of Mn and Hg indicated that the Gediz River was a non-point source for these metals. There were also significant correlations between the suspended particulate matter (SPM) and the particulate metal concentrations except for Hg. The highest flow since 1999, had been recorded on February 18, 2005 exactly which one of the sampling surveys was carried out.

Keywords : Aegean Sea, Trace Elements, Particle Flux, River Input.

Introduction

Macro (N, P, Si and organic C) and micro (Fe, Mn, Co, Ni, Cu, Zn) nutrient inputs from the rivers influence the biogeochemical processes in the coastal seas and affect the quality and quantity of material accumulating in marine sediments. Changes in salinity brought about by fresh water and the introduction of river-derived nutrients have been found to promote the growth of siliceous plankton which increased the fluxes of biogenic opal and organic matter [1]. Among the micronutrients, Fe, Mn, Co, Ni, Cu and Zn are important metals. It is important to understand antagonist and synergic interactions between metals and the effects of these interactions on primary productivity in the coastal zone. These trace nutrients are required in metabolic processes for both marine and fresh water phytoplankton [2]. However, the some of these micronutrients are hazardous to aquatic life and human health when their concentrations are higher than the natural levels. For example, there is evidence that trace metals might also have been involved in the development of certain harmful species [3] in addition to the pollution in the sediment.

Material and Methods

Analysis of these metals in SPM (suspended particulate matter) was carried out by flame AAS (Varian Spectraa-300 plus). Prior to the determinations, the samples were microwave-digested (Milestone 1200 Mega) in Teflon bombs using a mixture of HNO_3-HF-$HClO_4$-HCl. Since this study was the first effort for taking the sample on particle flux of trace metals in the mouth of Gediz River, the very first data set were finally obtained and preented. There were four sampling surveys over a 1-year period for the particle trace metals, i.e., November 04, February, April and August 05. The main strategy in the determination of the sampling timing was the matching the periods of river's low and high flows. The relationships between metal concentrations, SPM, flow, dissolved oxygen, pH, and temperature were examined. Metal loadings were estimated by using the metal concentrations and river's flow.

Results and Discussion

The specific objectives of the research were the following: (i) Collect reliable analytical data on the concentrations of particle Cu, Zn, Cr, Fe, Mn, Ni, Pb and Hg in the mouth of the river entering to the outer Izmir Bay, (ii) Obtain particle metal data at both high and low stream flows, (iii)Use particle metal concentration and flow data to generate metal loading data for the Gediz River as a first step in understanding the effects of particle metal input on the water quality of the outer Izmir Bay.

Metals in the river is transported principally by suspended sediments. A large proportion of the suspended sediments are discharged to the outer Izmir bay during high flow events and are deposited into bottom sediments when the flow rate of water carrying them is decreased. The flux during the study period had seasonally changed in the range of 5 to 123 $m^3\ s^{-1}$ .The freshwater discharges to the outer Izmir bay are generally low, an overall mean annual freshwater contribution to the outer Izmir bay of approximately 33 $m^3\ s^{-1}$ when the monthly averaged values since 1962 were considered. The period of trace metal deployment in the plume coincided with the period of high water discharge of the river. Maximum fluxes of biogenic and lithogenic components coincided with maximum discharge of the Gediz River during February 05. Freshwater SPM was deposited near its source, and the small amount that is exported to the outer Izmir Bay is probably subject to successive resuspension. The river act as effective sediments traps. Then sediments are behaving as an important diffuse source, being reservoir of trace metals from continental discharges, which are released to the water column due to resuspension.

Large seasonal variations of fluxes were observed for Cu (about 300.000 times), Pb (about 300.000 times), Fe (about 2.000 times), Cr (about 500 times), Zn (about 500 times), Mn (about 350 times), Ni (about 300 times) and Hg (about 50 times) when the maximum particle metal flux values were compared with their minimum values.

At the end of the present study, the following recommendations are made: i)Metal concentrations should be studied at more stations and at all seasons even daily sampling to determine to what extent metals are transported and recirculated from sediment into overlying waters, ii)Organisms at all trophic levels should be examined over a period of several years for bioactive metals.

References

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