

THE DISTRIBUTION OF ZN IN SEAWATER AND SEDIMENTS OF A COASTAL MARINE AREA AFFECTED BY INDUSTRIAL ACTIVITIES (NW SARONIKOS GULF)

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Abstract

An oceanographic study of the coast of the North West Saronikos Gulf was carried out in the years 2006 and 2007. The area is affected by industrial and urban activities. Seawater and sediment samples were collected and various trace metals were determined. The present paper presents the results on the distributions and behaviour of Zn, which a metal of significant environmental importance, in this coastal marine environment.

Keywords: Aegean Sea, Coastal Waters, Zinc

INTRODUCTION

North West Saronikos Gulf is located 80 km west of Athens. This marine area is affected by industrial activities (oil refinery, cable manufacturer, soya mills, sulphur and fertilizers manufacturing), as well as touristic activity in the towns of Agioi Theodoroi and Isthmia. Furthermore the coastal zone of North West Saronikos is located on the Sousaki volcanic region therefore this area is characterized by a unique geological setting.

MATERIALS AND METHODS

The area was studied extensively from January 2006 to December 2007. There were 8 seasonal samplings in 9 coastal stations (MOT 1-MOT 9), in 7 off shore stations with depths ranging from 20 to 100m (MOT 10-16) and one off-shore station in the Megara Basin (UN6) with a depth of 200m. Dissolved and particulate Zn determinations were carried out using Chelex 100 pre-concentration and nitric acid digestion respectively. Total Zn in sediments was extracted with strong acids (including HF) digestion [1]. The non lattice fraction of Zn was extracted with 0,5M HCl and with the BCR protocol [2]. All extracts from the above procedures were measured with Flame Atomic Absorption Spectrometry.

RESULTS AND DISCUSSION

The water column in both near-shore and off-shore stations was fully oxygenated in all seasons due to adequate water circulation. The thermocline started forming in June and was fully developed between 30 and 40m depth in August and September. The water column below 150m (UN6) has been isolated since 1992, therefore almost anoxic conditions prevail. Dissolved Zn ranged from 0,41 to 39,2 µg/L, while particulate Zn ranged from 0,11 to 4,1 µg/L. The dissolved Zn fraction comprised of more than 75% of the total concentration in all samplings. The average total Zn concentrations of coastal and off-shore stations were 2,7 and 5,1 µg/L respectively and differed statistically (independent samples t-test). The off-shore stations exhibited a wider range of concentrations and some extreme values. The concentrations of total Zn below the depth of 20m were statistically higher than the corresponding concentrations at the surface and 20m. This was also depicted in the vertical profiles of total Zn in almost all sampling stations. The levels of total Zn in the off-shore stations of the study area were similar to the values of offshore East and South Saronikos Gulf but lower than the more polluted Elefsis Gulf which is characterised by more intensive industrial activity [3].

The total Zn concentrations in sediments ranged from 27,7 to 120 mg/kg.

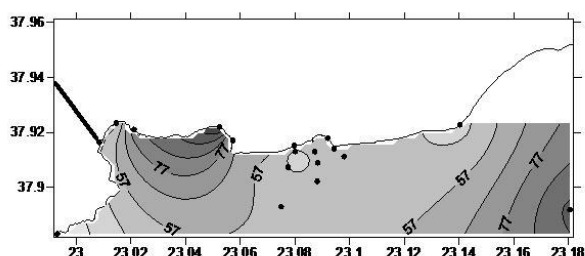


Fig. 1. Figure 1 Surface distribution of total Zn (mg/kg) in the sediments of the study area

The highest concentrations were determined in stations MOT5 (near a small shipyard) and UN6 (200m depth). The non lattice held (BCR1-3) concentrations of Zn ranged from 8,6 to 36,6 mg/kg and represented 17-53% of the total content. The highest percentages were determined near the main industries (stations MOT 2, 3 and 4). The non lattice held Zn was mostly found associated with Fe and Mn oxides (BCR2). The stations MOT5 and UN6 exhibited Sediment Enrichment Factors higher than 2 therefore the total Zn concentrations in these sediments could be attributed to anthropogenic pollution. The vertical distribution of total and non lattice held Zn in a small sediment core (10cm) of station UN6 also shows a marked increase in the surface layer which could be attributed to anthropogenic influence.

CONCLUSIONS

The study area of North West Saronikos Gulf is not a conventional hot spot due to increased depth and adequate water circulation and dilution. The levels of Zn in seawater and sediments were similar to other Greek marine areas and much lower than the most polluted part of the Gulf of Elefsis and East Saronikos. The significant pollution sources mentioned above and the neighbouring of populated and touristic towns suggest frequent monitoring of selected points to ensure that pollution levels remain fairly constant.

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