

# TRACE ELEMENTS CONCENTRATIONS IN THE SURFACE SEDIMENTS AND THE WATER COLUMN OF KAVALA GULF (NORTHERN GREECE)

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## Abstract

The total metal content for Cd, Cr, Cu, Ni, Pb and Zn, in surface sediments (0-5 cm, 24 samples) and in bottom suspended particulate matter (27 samples), from the coastal zone of the Kavala Gulf (northern Aegean) was investigated. Sediment analysis showed maximum values for Cu, Cd and Zn at the industrial zone while Ni, Pb and Cr at the deeper parts. For bottom SPM trace elements distributions showed almost equal values of Ni, Zn and Cu at all areas, increased Cd at the deeper parts, Pb at the fish-farming and industrial areas and Cr at the industrial and tourist areas.

*Keywords: metal pollution, sediment, suspended particulate matter, Kavala Gulf*

## Introduction

A series of land-based activities take place along gulf's coastline, such as tourism at the western part of the gulf, urban and industrial activities (including phosphoric fertilizer plant, waste water treatment works, oil refineries and a commercial harbor) at the central and eastern part, and fish-farming activities (including extensive aquaculture in four coastal lagoons and mussel-culture farms) at the eastern gulf. The scope of this study was to determine the spatial distribution of six trace elements (Cd, Cr, Cu, Ni, Pb and Zn), in the surface sediments and the water column (suspended particulate matter) at a semi-enclosed coastal water body (Kavala Gulf, northern Greece).

## Materials and methods

A total number of 24 surface sediment samples (0-5 cm) were collected from the Gulf of Kavala, using a Van Veen sampler. Pretreatment of samples was performed according to [1]. Sediment samples were digested in a mixture of 1 ml HF and 4 ml of aqua regia in microwave oven. During the same cruise, seawater samples (2 l each) were collected from 27 stations (at the surface and bottom of the water column). Samples pretreatment and cleaning procedures were performed according to [2]. Filters were digested using a hot plate in a mixture of 8 ml HNO<sub>3</sub> and 1ml HF. Sediment and loaded filters were analyzed using a Perkin Elmer Analyst 800 atomic absorption spectrophotometer with Zeeman background correction. Precision and accuracy were checked using the MESS-3 (N.R.C. of Canada) marine sediment as reference material.

## Results and discussion

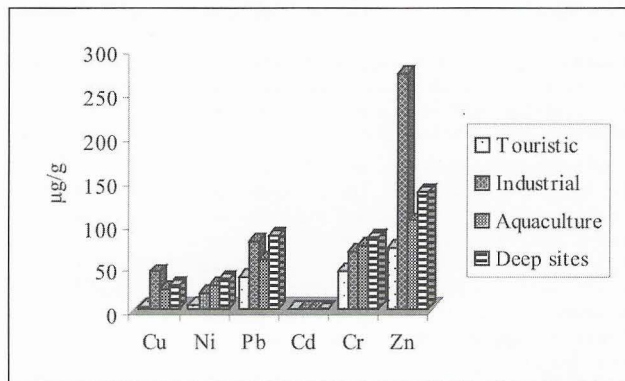
Summary statistics of the heavy metal concentrations in the sediment and water of Kavala Gulf are shown in Table 1. Figure 1 presents the mean sediment metal concentrations of stations in the vicinity of each land-based activity. Maximum values for Cu, Cd and Zn were found at the industrial zone, lower concentrations were observed at the deeper stations and the fish-farming area, while the lowest values at the western tourist part. The deeper stations (where fine sediments are deposited) showed increased Ni, Pb and Cr values.

**Table 1. Mean concentrations (standard deviations), minimum and maximum values (in µg/g) for all trace elements in sediments and suspended particulate matter at the bottom of the Kavala Gulf.**

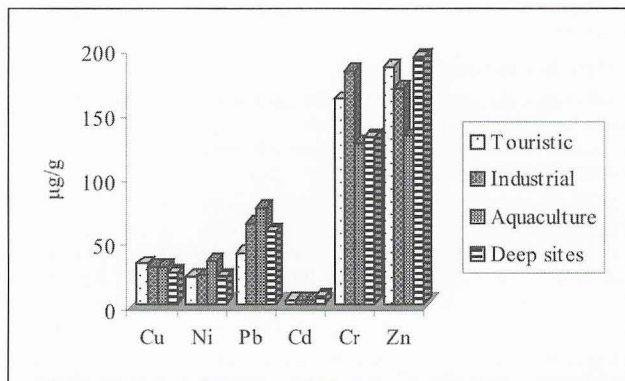
	Cu	Ni	Pb	Cd	Cr	Zn
Sediment values	25.1 (21.3)	19.5 (15.7)	64.7 (40.4)	0.3 (0.3)	64.9 (23.2)	157.4 (258)
min-max	0.5-75	0.4-47.3	24.9-209.1	0.01-0.9	36.9-113.8	41.8-1,353
Bottom SPM values	29 (10.5)	23.9 (11.4)	57.6 (30.2)	4.4 (1.9)	155.3 (60.4)	173.9 (64.6)
min-max	11.2-45.7	4.6-60.4	9.7-108.5	1.7-8.5	77.4-304.2	51.5-307

The distribution of trace metals at the suspended particulate matter of the water column is shown in Figure 2. Ni, Zn and Cu were distributed almost equally inside the gulf while increased Cd was found at the deeper parts of the gulf. High particulate Cr values were

observed at the industrial and tourist areas. Particulate Cr and Zn showed very high values compared to the surface sediment concentrations at all stations and increased Pb values at the fish-farming and industrial areas.



**Fig. 1. Heavy metal distribution for the sediment in the four areas of Kavala Gulf.**



**Fig. 2. Heavy metal distribution for the SPM in the four areas of Kavala Gulf.**

## References

- 1 - Aloupi M., and Angelidis M.O., 2001. Geochemistry of natural and anthropogenic metals in the coastal sediments of the island of Lesbos, Aegean Sea. *Environ. Pollut.*, 113: 211-219.
- 2 - Pohl C., 1997. Trace metals in marine suspended particulate matter: an international ICES intercomparison exercise. *Accredit. Qual. Assur.*, 2: 2-10.