PAH DISTRIBUTION IN WATER COLUMN AND SURFACE SEDIMENTS OF THERMAIKOS GULF, GREECE

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Abstract

The distribution of polycyclic aromatic compounds (PAH), was studied in the water column and surface sediments collected from Thermaikos gulf, in order to investigate the effects of resuspension events on the cycling and impact of these organic pollutants. The PAH compositional patterns and the application of various diagnostic criteria suggested that in February 2002 the increased values of their concentrations measured in the water column were clearly related to resuspended material from sediments.

Keywords: Thermaikos Gulf, resuspension, PAH

Introduction

PAHs show a high affinity to aquatic particles, especially to the organic carbon or lipid component. Because the sediments are the main repositories for such particle reactive contaminants, it is important to understand the processes that control chemical fluxes. Two major processes can move chemicals from the sediments to the overlying water column [1]: a) diffusive flux of dissolved species and 2) resuspension of in-place sediments with potential for redistribution of organic contaminants from the sediment to the water column. The aim of this work was to study the effects of natural resuspension occurred during stormy conditions and of anthropogenic resuspension induced by the intense trawling activities in the area of Thermaikos Gulf on the cycling and impact of PAHs.

Materials and methods

Surface sediment samples (0-2 cm) and seawater samples (20 L) were collected from 10 stations in Thermaikos Gulf during September 2001 (before the trawling activity), October 2001 (during trawling activity) and February 2002 (during natural/stormy induced resuspension events) (Fig. 1). Polycyclic aromatic hydrocarbon concentrations were determined by gas chromatography / mass spectrometry after extraction, cleanup and fractionation [2]. PAHs determined included the parent compounds with 2 – 6 aromatic rings, dibenzothiophene, retene and the methylated derivatives of dibenzothiophene and phenanthrene

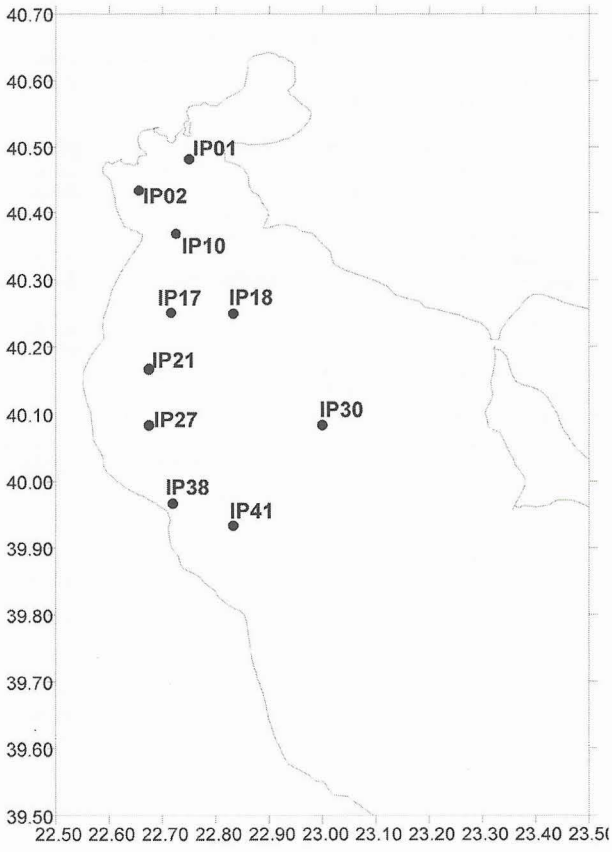

Fig. 1. The sampling locations in Thermaikos Gulf.

Results and discussion

Concentrations of total polycyclic aromatic hydrocarbons in surface sediments ranged from 27.2 to 280.5 ng/g (mean value 164.3 ng/g) in September, from 59.6 to 261.9 ng/g (mean value 160.7 ng/g) in October and from 62.7 to 285.9 ng/g (mean value 165.8 ng/g) in February. These values can be generally characterized as low and are similar to those found in relatively unpolluted marine areas. Slightly elevated concentrations were found in station 1, whereas considerably low values were recorded in station 18. No differences in PAH concentrations were observed among the three sampling periods. PAH with 4 or 5 aromatic rings originating from pyrolytic sources dominated the PAH composition in all cases, whereas petroleum related compounds accounted for less than 15% of the total PAHs.

Concentrations of total polycyclic aromatic hydrocarbons in the water column ranged between 0.8 and 13.4 ng/L (mean value 5.8 ng/L) in September, between 1.5 and 16.9 ng/L (mean value 7.0 ng/L) in October and between 4.4 and 16.8 ng/L (mean value 8.9 ng/L) in February. No important spatial variation was observed, whereas increased values were measured in the whole water column during October and February. These higher values are probably related with increased inputs of riverine or atmospheric inputs of land derived PAHs. In most cases and in all sampling periods PAH values in bottom water were slightly higher than those in the overlaying water masses. PAH compositional patterns can be used in order to examine their sources and pathways. It is known that low MW PAHs are more water soluble and usually predominate in the water column, whereas the high MW pyrolytic PAHs with negligible water solubility but high stability towards physicochemical or biological degradation are easily accumulated in sediments. In the water samples of Thermaikos gulf combustion PAHs accounted for the 0.1-7.6% of the total PAHs in September (mean value 3.3%), whereas in October and especially in February these percentages were clearly higher (1.9-17.6%, mean value 6.1% and 4.6-14.2%, mean value 7.6% respectively). This increase, which was more pronounced in the bottom water samples (Fig. 2), is a strong indication that there was a contribution from sedimentary PAHs in the water column in October and February, probably related to the resuspension events occurred during these periods.

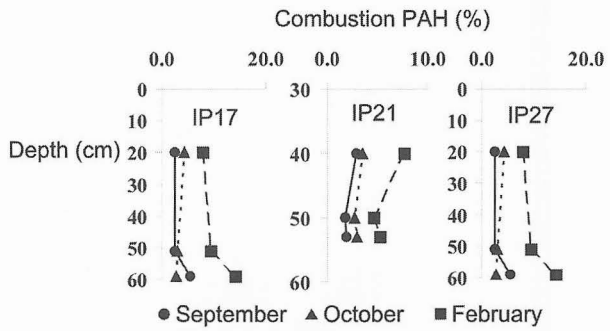

Fig. 2. Combustion PAH percentages in the water column.

References

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