METAL POLLUTION IN SPERCHIOS ESTUARY, GREECE

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Abstract

Sperchios is a small river in eastern central Greece having a catchment area of 1,640Km^2, length of about 80km and water flow 5-50m^3/sec. It is polluted from agricultural, domestic and industrial effluents, both from point and non point sources. Sperchios River carries a significant load of pollutants to the sea, which has to be minimised by the proper environmental management in order to avoid ecological damages. The chemical study of trace metals in the estuary indicates an intermediate level of metal pollution and the significant role of suspended particulate matter of small size in the transport of metals to the sea.

Keywords : estuaries, pollution, trace elements, zinc

Introduction

The understanding of the chemical processes taking place in estuaries polluted by a variety of sources is of great importance because these processes are strongly responsive to changes in major physico-chemical variables and to hydrodynamic processes that affect particle/solution interactions. Changes in these parameters can be significant in small rivers that are systems in danger of environmental deterioration [1].

The studied area

Sperchios is a small river in eastern central Greece. Its catchment area is 1,640Km^2, its length about 80Km , and its flow ranges between 5 and 50 m^3/sec. The wetlands at the estuary form a unique and extensive ecosystem which is a wintering place for large bird populations and a nesting area in summer for rare species. The area is included in the European network "NATURA 2000" according to 92/43 E.U. directive .

The population of the region reaches 90,000 inhabitants. The main city is Lamia having about 45,000 inhabitants. The wastewater treatment plant of Lamia is located by the estuary and its load is about 700kg BOD_5/day. The treated effluents are disposed into the river. The main cultures in the catchment basin are cotton, cereals, olives, and pistachio trees, since large areas near the delta are planted with rice. The area is drained through an extensive network of channels. Some industrial and small manufacturing enterprises like olive oil refineries, wheat mills, abattoirs, dying works etc, discharge their waste directly or indirectly into the river. Our team has carried out environmental research studies in this area since 1984 [2].

Methodology

The studied area is shown in Figure 1.An extensive sampling was carried out during April 2000 (high flow period) when riverine, estuarine and marine samples were collected by Hydro-Bios sampling bottles. Dissolved O_2, temperature, conductivity, salinity and pH were measured in situ. The water samples were filtered in succession through 8 and 0.45 μm Millipore filters [3]. The filters were treated with concentrated HNO_3 in PTFE beakers. The water samples were preconcentrated by using Chelex-100 resin [4]. Trace metals were measured by Flameless Atomic Absorption Spectrophotometry (VARIAN SpectrAA 640Z).

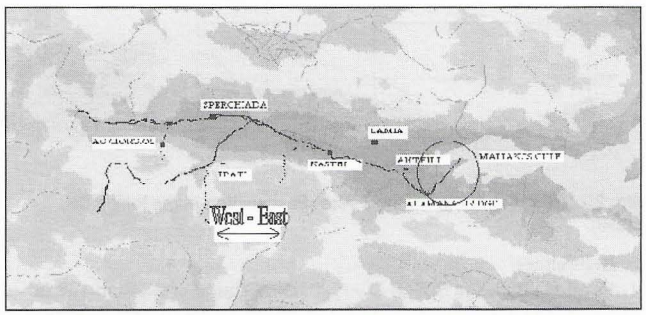

Figure 1 : The Sperchios river and the studied area.

Results and discussion

The water temperature was 15-16°C, the concentrations of dissolved O_2 were very close to the saturation values and the pH was 7.2-7.8 in river and estuary and about 8.1 in seawater. The conductivity in the upper part of the river was lower than the one in the estuary due to partial mixing of fresh and marine water there. The general picture of the river was rather normal for a small Mediterranean river. The whole system is divided to three parts. Upper river includes the area up to Alamana Bridge, whereas the estuary includes six stations in the mixing zone. The salinity in the neighboring marine area and in seawater samples was higher than 33‰

Table 1.

	Cu					Ni				
	D	P1	P2	Kds	Kdt	D	P1	P2	Kds	Kdt
Riverine	0.42	0.18	0.16	12.8	1.7	0.41	2.22	0.16	11.8	18.5
Estuarine	0.23	0.40	0.07	23.9	1.4	0.65	5.49	0.11	14.8	7.0
Marine	0.25	0.46	0.06	1.2	1.0	0.25	1.98	0.66	0.1	2.4
	Pb					Zn				
	D	P1	P2	Kds	Kdt	D	P1	P2	Kds	Kdt
Riverine	0.37	0.54	0.35	21.0	1.5	2.46	2.85	2.21	22.2	3.5
Estuarine	0.33	1.75	0.25	92.2	3.8	2.63	3.64	2.04	61.1	1.6
Marine	0.62	0.54	0.16	0.5	1.1	2.77	1.54	1.8	1.5	1.2

In Table 1 are presented the results of our study. It contains the mean metal concentrations (w/v) in ppb-μg/l (D: dissolved, P1: particulate retained on the filter of 8μm, P2: particulate retained on the filter of 0.45μm). It contains also the mean values of partition coefficient Kd : Cp/Cd where Cp the metal content of the particles and Cd the concentration of dissolved metals [5]. Kds are referred to the particles that are smaller than 8μm, and Kdt to the total particulate matter. (The values of Kd are *10^5). The main conclusions are the following :

➜ Trace metals concentrations lie in an intermediate range in comparison to rivers slightly and heavily affected by polluting activities [3].

➜ The P1 values are higher than the P2 values, due to the higher quantity of particles having diameters >8μm, although the elevated metal content of small particles .

➜ The high Kd values reveal the significance of small (<0.45μm) particles in the transport of metals, coming from polluting activities, from the river to the sea. The difference is lower in the case of Ni due to the geological origin of this element. The elevated estuarine values indicate the existence of increased adsorption in the intermixing zone whereas the significant decrease in marine zone indicates both desorption, dilution and influence by marine particles.

➜ In the case of dissolved Cu and Ni the dilution phenomenon prevails and the concentrations are lower in the marine zone. In the cases of Pb and Zn the influence of desorption of metal from the particles lead to increased values in marine waters.

➜ Similar phenomena were observed in our previous studies although there were variances in the ratios between dissolved and particulate metals due to various hydrological conditions [2].

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