

# PHOSPHORUS CONCENTRATION IN THE MIDDLE ADRIATIC SURFACE SEDIMENT LAYER

S. Matijevic\*, G. Kuspilic and A. Baric

Institute of Oceanography and Fisheries, Split, Croatia - dosen@izor.hr

## Abstract

Organic and inorganic sediment phosphorus concentrations, organic matter content, and the granulometric composition of sediments were investigated in sediment samples from 15 middle Adriatic stations. Cluster analysis of the results obtained has confirmed differences in phosphorus concentrations in sediment at different stations depending on hydrographic properties, sediment type and sediment organic matter content. Statistically-significant correlations between the investigated parameters indicate that phosphorus in the middle Adriatic sediments is a result of sedimentation of organic matter produced in the water column.

*Keywords: Adriatic Sea, sediments, phosphorus, organic matter*

## Introduction

The primary input of dissolved phosphorus (P) into the sea is from continental weathering carried by the rivers (1), but certain anthropogenic influences have also become important. P concentrations in the middle Adriatic waters are relatively low (2) and there are a relatively small number of freshwater inputs from the eastern coast to these waters (compared to northern Adriatic waters). These facts indicate that marine sediments could be an important source of P in this area. To determine the role of sediment in the phosphorus regeneration cycle it is necessary, firstly, to investigate phosphorus regeneration, organic matter content and granulometric composition of the sediments at different stations. The aim of this paper is to determine the distribution of organic and inorganic phosphorus in sediments at different stations, as well as to estimate possible correlations between organic and inorganic phosphorus in the superficial sediment layer (0-2 cm), and chl a in the water column, sediment organic matter and P concentration in the water column.

## Materials and methods

Sediment sampling was performed during 1997/98 and in June 1999 at 15 different stations in the middle Adriatic: 3 stations in semi-enclosed bays and estuary (EBS) (areas with the highest nutrient concentrations and primary productivity with a high urban nutrient loading), 2 channel stations (CWS), and 8 open sea stations (OSS).

The surface sediment layer (0-10 cm) was sampled with a plastic gravity corer ( $\phi$  3.5 cm). Analyse of phosphorus content in sediment samples were done according to Aspila (3). Phosphorus concentrations were determined colorimetrically using an AutoAnalyzer (4). The accuracy of analytical method was tested using standard reference material PACS - 2 (INMS - CNRC). Organic matter content was measured gravimetrically after oxidation with 30 %  $H_2O_2$ , and granulometric composition of the sediment was determined according to Shepard (5).

## Results and discussion

The sediment organic phosphorus concentrations (OP) were from 0.54 to 25.85 mmol P  $kg^{-1}$  (dry sediment), and for inorganic phosphorus (IP) from 2.94 to 38.62 mmol P  $kg^{-1}$ . The obtained results showed very important differences in phosphorus concentrations in sediment at different stations depending of hydrographic properties and sediment type (from silty to clayey or sandy sediments) and sediment organic matter content (from 1.1 % to 10.9 %). The concentration of total phosphorus, (OP + IP), at EBS1 station in the Krka river estuary (exposed to long term contamination by phosphate ores and fertilizers) was 1.6 times higher than at the stations in semienclosed bays (EBS2, EBS3), 2 times higher concentration than at the open sea stations (OSS) and 3.5 times higher than at the channel stations (CWS1, CWS2). Cluster analysis of investigated parameters (sediment OP concentrations, chl a concentration in the water column, granulometric composition of the sediments) has confirmed the grouping of stations on the basis of hydrographic properties (Figure 1).

A statistically significant correlation has been estimated between the chl a concentration in the water column and OP concentration in the superficial sediment layer (0-2 cm) ( $R = 0.59$ ,  $p < 0.01$ ), as well as the correlation between OP concentrations and organic matter content in the same sediment layer ( $R = 0.357$ ,  $p < 0.05$ ). There has also been estimated a statistically significant correlation between the flux of phosphate ( $J_{PO_4}$ ) at the sediment / water interface and the concentration gradient of IP in the superficial layer of sediment (Figure 2). Jensen (6) also found a significant correlation between phosphate flux and one inorganic phosphorus form (Fe-bound P).

## Conclusion

The differences in phosphorus sediment concentrations between the investigated stations (estuary, bays, channel and open sea stations) indicated a strong anthropogenic influence on the estuary and bay stations. Estimated correlations of investigated parameters (OP concentrations, sediment organic matter content and chl a concentration in the water column) indicate that the phosphorus in the middle Adriatic sediments is a result of sedimentation of organic matter produced in the water column.

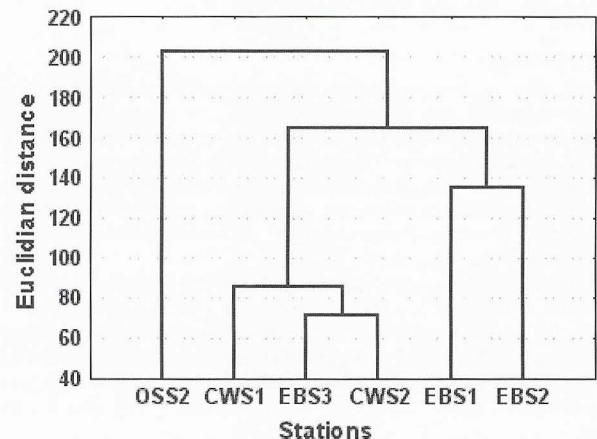


Figure 1. Cluster analysis of investigated parameters at the middle Adriatic stations

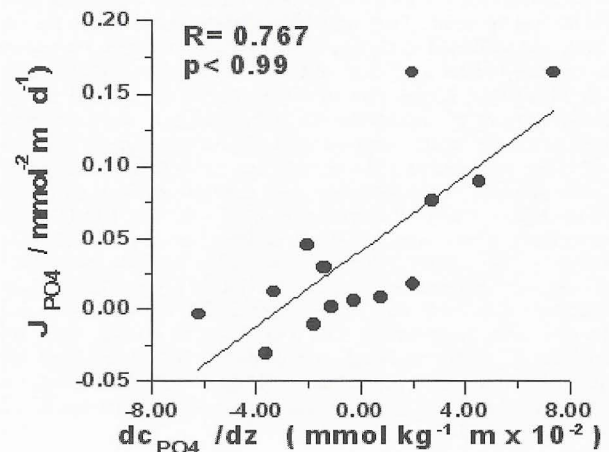


Figure 2. Correlations between phosphate flux ( $J_{PO_4}$ ) and the IP concentration gradient in the surface sediment layer (0-2 cm)

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