FIRST INVESTIGATIONS OF METAL CONTENTS AND PB ISOTOPES IN PROTECTED SALT MARSH SEDIMENTS (NORTH SEA COAST OF FRANCE)

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Introduction

Salt marshes are dynamic coastal regions of environmental and economic importance. The salt marshes of Platier d'Oye located in a heavily industrialized zone (including Calais and Dunkerque, northern France) are currently part of an ecological restoration project (by EDEN62) and belong to a national sanctuary created in 1987. Despite past and current activities related to industry, hunting and WW2 in and around the studied area, no data on metal contents are available for this zone. Therefore, the aim of the present study is to establish a first inventory of metal contents associated with physico-chemical parameters and isotopic Pb measurements in salt marsh sediments from the Platier d'Oye.

Methods

Unvegetated sediment cores of 15-25 cm length were collected from five sites inside the sanctuary in September 2014 for isotopic and metal analyses. Sediments were also characterized for organic matter content, grain size distribution and mineralogy. After concentrated acid digestion, total concentrations of Al, Cd, Cr, Cu, Fe, Mn, Ni, Pb, V and Zn were determined by ICP-AES. The extent of sediment contamination was determined using the enrichment factor (EF)[1]. In selected levels with different EF, the reactive fraction of lead was obtained using 1 M HCl leaching (Leventhal and Taylor, 1990) for isotopic composition determination by TIMS.

Results

Figure 1 reports the enrichment factors of 4 representative metals (Cr, Ni, Pb and Zn) in 5 sediment cores. For all stations, Ni shows either no or minor enrichment (the same tendency was obtained for Cd, Cu, Fe, Mn and V). In contrast, Pb enrichment is considered as moderately severe in one site and below 10 cm for another site. For Zn and Cr, enrichments are estimated as moderate in three and two sites, respectively.

[1] $EF = (X/Al)_{sample}/(X/Al)_{background}$ where X/Al is the ratio of metal (X) to aluminium. The used background values were the average concentrations of upper crust reported by Taylor and McLennan (1995).

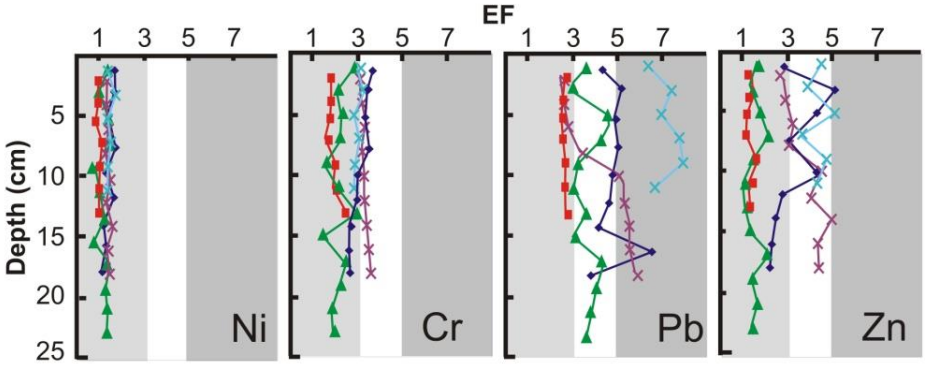

Figure 1. Enrichment factor (EF) values for Ni, Cr, Pb and Zn in five core samples from the Platier d'Oye. EF < 3 indicates minor enrichment, EF = 3-5 moderate enrichment, EF = 5-10 moderately severe enrichment.

$^{207}Pb/^{206}Pb$ versus $^{208}Pb/^{206}Pb$ diagram (Fig. 2) presents data obtained on selected core levels. Whereas Pb samples with low EF have a more geogenic character, those with higher EF exhibit a more anthropogenic signature. This is confirmed by comparison with northern France intertidal sediments from the (1) "near-pristine" Authie bay and the (2) strongly contaminated Seine bay.

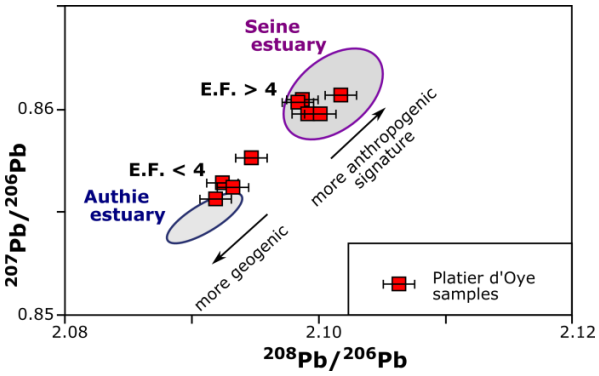

Figure 2. Pb-Pb diagram for reactive Pb from the Platier d'Oye salt marsh sediments (red squares) with data from sediments of the Authie and Seine estuaries (Philippe et al., 2008).

Conclusion

The salt marshes of the Platier d'Oye present various contamination levels ranging from uncontaminated to moderately severe contaminated. These variations will be interpreted with respect to the involved metals, their sources and the physical-chemical parameters of the sediments. Special attention will also be paid to the history of this area and its environmental management. Considering the important role of halophytic plants on metal dynamics in salt marshes (Almeida et al., 2008), further investigations will be conducted on this zone to characterize metal mobilization processes under different vegetated covers.

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