METAL GEOCHEMISTRY IN SEDIMENTS OF A SEMI-ENCLOSED BAY IN THE ISLAND OF LESVOS, GREECE

Apostolos M. Gavriil and Michael O. Angelidis *

Department of Environmental Studies, University of the Aegean, Greece
University Hill, 81100 Mytilene, Lesvos, Greece - magel@aegean.gr

Abstract

The concentrations of Al, Li, Fe, Mn and Ni were determined in sediment cores from the semi-enclosed Kalloni Bay, in the island of Lesvos, Greece. The mineralogical variations in the different drainage basins and especially the ultramafic minerals in the drainage basin of the stream Vouvaris, appear to be the main reason for the Mn, Fe and Ni enrichments in the sediments of the eastern part of the Bay. Diagenetic processes also influenced the concentrations of Mn in the sediments of the central part of the Bay.

Keywords: metals, marine sediments, geochemistry, Kalloni Bay.

Introduction

Coastal marine sediments are the major depositories for persistent substances such as heavy metals and their mineralogy is greatly affected by of the geological background of the neighboring landmasses. A detailed knowledge of the parameters that may affect the natural metal variability is necessary in order to evaluate the possible anthropogenic impact from pollution sources. In the present study natural fluctuations in metal concentrations were studied in sediment cores from a semi-enclosed shallow marine system, Kalloni Bay, in the island of Lesvos, Greece (Fig.1).

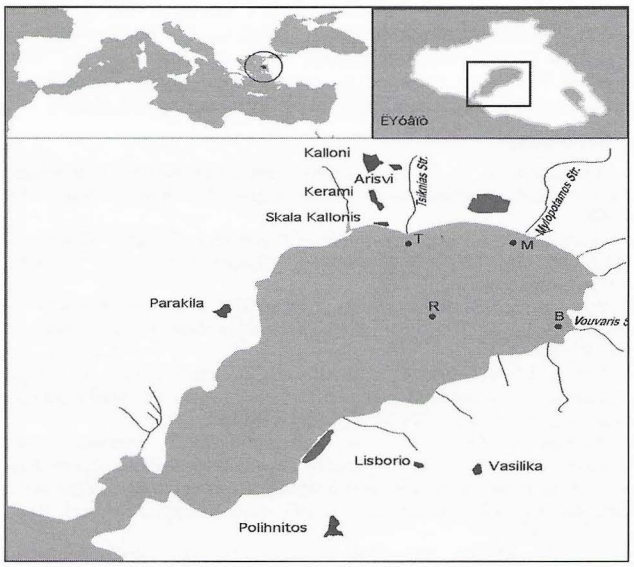

Fig. 1. Sampling stations

Materials and methods

Sediment cores were collected at four stations in the Bay during March 2000. Three cores (stations B, M and T) were collected near the mouths of the major streams of the area and a core was collected from the inner part of the Bay (station R). The cores were sliced and analyses were performed in the <1mm fraction using AAS [1].

Results and discussion

The concentrations of Al and Li in core B (3.80 ± 0.22% and 10.7±2.4 µg/g respectively) were aproximately half in comparison to the corresponding values in the other cores. Higher values were found in the finer aluminosilicate material, which escapes from the coastal zone and is deposited to the central parts of the Bay (Station R). Both elements did not present significant fluctuations along the cores depth.

Manganese concentrations in cores R and B were about three times higher compared to cores M and T. The high concentrations of Mn in core B were attributed to the geological background of stream Vouvaris watershed, which consists of ultrabasic rocks [2]. In the core R, at the centre of the Bay, Mn enhancement could be attributed to Mn remobilization from other parts of the Bay. Manganese, because of its redox sensitivitie, may be removed from the solid phase of the sediment, transported through water and re-deposited elsewhere, when oxic conditions occur [3]. The mobilization of Mn from the sediments and its diffusion through pore water to the water column, is supported by the high concentrations of the element near the surface in all cores (Fig.2).

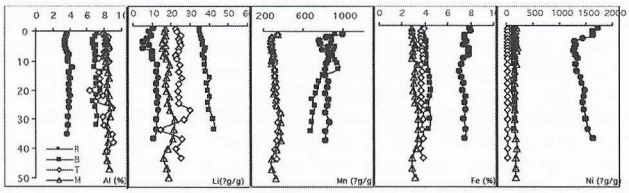

Fig. 2. Profiles of metal concentrations in the sediments of the Bay of Kalloni.

Iron concentrations were much higher in station B (7.5±0.2 %) than in the other stations (3.1±0.2% - 4.2±0.2%). The weathering of ultrabasic rocks rich in Fe in the drainage basin of the stream Vouvaris [2] is again the reason for Fe enhancement. No significant variations were found along the cores probably because of the relatively restricted remobilization of Fe. In contrast to the oxidation of Mn (II) to Mn (IV), the oxidation of Fe is very rapid [4]. As a consequence, when ions Fe^{2+} were diffused through pore water into oxygenated water column, they are immediately oxidized and precipitated before being transported.

The concentrations of Ni in core B were one to two orders of magnitude higher than the other cores (1438±134 µg/g in core B and 158±7, 165±18 and 15±3 µg/g respectively in cores R, M and T). The high Ni values were also attributed to the geological background of Vouvaris watershed, exclusively consisting of ultrabasic rocks (peridotites) and nickeliferous minerals rich in Ni [2].

Conclusions

The ultrabasic minerals of the drainage basin of Vouvaris appears to be the main reason for the marked enhancement of Fe, Mn and Ni in the coastal sediments at the eastern part of the Bay of Kalloni. The natural distribution of metals in the Bay of Kalloni is greatly influenced by the local geology on a relatively small scale. On the other hand, the redox sensitive Mn, which is also deposited on the coastal zone near the stream Vouvaris, is more easily remobilized and transported to greater distance, influencing the Mn distribution in the central part of the Bay.

References

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