GEOCHEMICAL INVESTIGATIONS IN SEDIMENT CORES FROM THE ELEFSIS GULF, GREECE

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ABSTRACT
The Elefsis gulf is an area with a significant metal enrichment. Eight cores were collected and analyzed for the determination of the total metal content and the metal partitioning among the geochemical phases. Metals concentrations were measured by Atomic Absorption Spectrophotometry. It is suggested that it is rather necessary to remove and clean the surface sediment from various parts of the seabed in order to prevent their contribution to the pollution of the Saronic gulf, even after (and if) the Elefsis gulf industrial and transportation activity reduction, in volume and importance as a pollution source.

Keywords: Elefsis gulf, geochemical fraction, secondary pollution source, sediment core, total metal.

ΓΕΩΧΗΜΙΚΕΣ ΜΕΛΕΤΕΣ ΣΕ ΠΥΡΗΝΕΣ ΑΠΟ ΤΟΝ ΚΟΛΠΟ ΤΗΣ ΕΛΕΥΣΙΝΑΣ

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ΠΕΡΙΛΗΨΗ
Ο κόλπος της Ελευσίνας είναι μια περιοχή που εμφανίζεται εμπλουτισμένη σε βαρέα μέταλλα. Οκτώ πυρήνες συλλέχθηκαν και αναλύθηκαν για τον προσδιορισμό της ολικής συγκέντρωσης μετάλλων και την κατανομή τους στα διάφορα γεωχημικά κλάσματα. Οι συγκεντρώσεις των μετάλλων μετρήθηκαν με Φασματοσκοπία Ατομικής Απορρόφησης. Προτείνεται η απομάκρυνση και ο καθαρισμός των ιζημάτων από διάφορες περιοχές του θαλάσσιου πυθμένα σε μια προσπάθεια περιορισμού της συμβολής τους στη ρύπανση του Σαρωνικού κόλπου.

Λέξεις-κλειδιά: γεωχημικό κλάσμα, δευτερογενής πηγή ρύπανσης, ιζήματα, κόλπος Ελευσίνας, ολικό μέταλλο.

INTRODUCTION

The Elefsis gulf is characterized by a significant metal enrichment due to the presence of: (a) large scale important industries, located at its northern coasts; (b) the Elefsis port with an annual passenger movement of 660.000 and an annual commerce movement of 2.666.000 metric tons; (c) the presence of individual loading points for some industries, and (e) the rather enclosed type of the gulf.

MATERIALS AND METHODS

Eight cores were collected from the gulf (Fig. 1) in 2001, and analyzed for the total metal (Fe, Mn, Ni, Cr, Pb, Zn, Cu) content using a mineral acid (HNO_3, $HClO_4$, HF) attack ((Haralambides, 2005, UNEP, 1985). Metal concentrations were measured by Atomic Absorption Spectrophotometry. The relative standard deviation of the measurements was <5%.

Then, the samples were analyzed for the metal partitioning among the geochemical phases, following the Tessier et al (1979) procedure with some modifications (Sakellariadou, 1987), in an attempt not only to get some information concerning the metal biological and physicochemical availability but also to get some valuable indications concerning the metal sources. The geo-chemical phases are the exchangeable, carbonate hosted, reducible, organic matter-sulphide bound, and residual. Metal concentrations were measured by Atomic Absorption Spectrophotometry. The relative standard deviation of the measurements was <5%.

RESULTS AND DISCUSSION

The upper parts of the cores collected from the central and northern areas of the gulf show a metal enrichment, mainly in Pb (max.>510 ppm), Zn (max.>970 ppm), Cu (max.>210 ppm), Cr (max.>180 ppm) and Fe (max.>26000 ppm). Taking into consideration the sedimentation rate, the pollution sources position and the metal content distribution, the metal enrichment could be attributed to man made pollution, namely the heavy industrial and transportation activity in the area.

Fig. 1. Map showing the sampling sites, cores collected from 1, 3, 4, 5, 6, 7, 8 and 9 sites.

Some cores from the central and the northern part of the gulf, show a slight metal content decrease (mainly Fe) in their top in comparison with their bottom. This decrease is even more pronounced in the exchangeable geochemical fraction. It could be attributed to the sediment role, at these parts of the gulf, acting as periodically metal trap (Scoullos, 1973) and consequently as secondary metal sources, leading to metal re-entrance into the water column. The cores from the deepest part of the gulf (cores 4 and 9) show an increase in metals bound to the sulfide and organic matter due to the corresponding anoxic environment. Also, they show a total metal concentrations decrease in their top in comparison with their bottom, that could be attributed to the sediment role as metal trap (Scoullos, 1973), resulting to metal re-entrance in the water column .

CONCLUSIONS AND SUGGESTIONS

It is suggested that it is rather necessary to remove and clean sediment of various parts of the seabed characterized as highly metal polluted. This suggestion is made even stronger by the fact that due to water circulation (mainly clockwise) (Scoullos, 1981), the polluted sediments acting as secondary pollution sources will continue to contribute to the pollution of the Saronic gulf, even after (and if) the industrial and transportation activity in the Elefsis gulf is reduced in volume and importance as a pollution source.

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