LEAD CONTENT IN A SEDIMENT CORE OFF RAB ISLAND (CROATIA)

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Abstract

Changes during sedimentation and recent anthropogenic pollution are recorded in marine sediment. Granulometric composition, carbonate, organic matter and lead content in the sediment sample collected near Rab Island were determinated. The sediment core recovered indicates that there were no dramatic changes during sedimentation, however, anthropogenic influences in the form of lead pollution have increased with time.

Key words: lead, organic matter, sediments, Adriatic Sea

Introduction

Numerous studies show that lead is a ubiquitous metal contaminant emitted into the atmosphere of the Northern Hemisphere. Lead, mainly transported and deposited via the atmosphere, has become a global issue. The strong increase in the environmental lead concentration in Europe coincides with the introduction of tetraethyl lead gasoline after World War II.

In surface sediments of the open Adriatic, lead content varies from 5 to 51 mg kg^{-1} dry weight (1), while in sediments in coastal regions of the Adriatic it varies from 10 (Stoncica, Island Vis – unpolluted area) to 300 mg kg^{-1} (Gruz harbor, Dubrovnik – heavily polluted area) (2, 3).

Transport, burial, and diagenesis play a key role in the preservation of historical records for metal contamination in sediments. These historical records may be disrupted by bioturbation, erosion, trawling and other sediment mixing processes.

Material and methods

A sediment core 88 cm long was collected at 89.5 m depth using a plastic gravity corer (6 cm diameter) in July 1996 at a station located off Rab Island (Lat. 44° 51' 23" N; Long.14° 35' 02"E). The sediment core was sliced into 1 (0-10 cm), 2 (10-50 cm) and 4 cm (50-88 cm) thick sub-samples. The granulometric composition of sediment was determined by sieving (>63 mm) and hydrometring according to Casagrande (<63 μm) of 4 cm thick sub-samples. Carbonate content was determined as weight loss after treatment with 4M HCl (4). The organic matter content was determined as a weight loss after H_2O_2 treatment and ignition at 450° C for 6 h.

Samples were digested with a mixture of HF, HNO_3 and $HClO_4$ (5). Lead concentrations were measured by GFAAS method using a Perkin-Elmer 1100 B instrument. The accuracy of the analytical procedure used was repeatedly checked by analyzing samples of reference sediment standards (IAEA marine sediments SD-M-2/TM and SRM 1646 estuarine sediments).

Results

The results of granulometric analysis are listed in Table 1, while the level and distribution of carbonates, organic matter and lead content along the sediment core are presented graphically in Figure 1. The organic matter varied from 3.7 to 8.1 %, carbonate from 26 to 51 % and the lead concentrations were in the range 6.52 – 26.35 mg kg-1 (Figure 1).

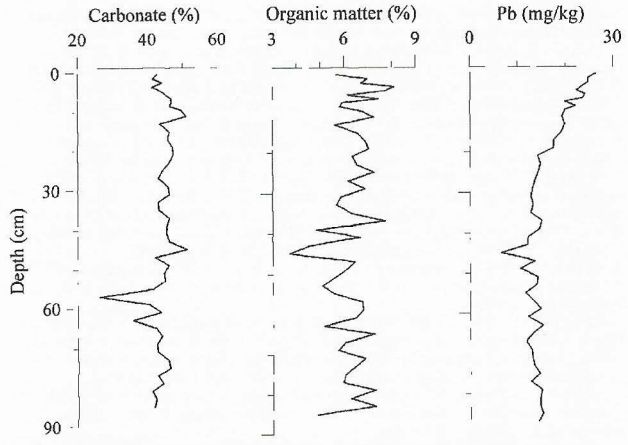

Figure 1. Carbonate, organic matter and lead content in the sediment core.

Discussion

The sediment in the core is clayey silt, except the first 4 cm in which it is silt. In the surface layer biogenous remnants (foraminifera) predominate. In all sub-samples (>63mm) observed under binocular microscope, biogenous material made up the predominant fraction (foraminifera and other remnants of benthic organisms). The sediment record indicates equal environment sedimentation along the core. A good correlation between organic matter and carbonate content along the core was found (0.72, $P<0.01$). That also indicates the autochthonous orgin of the organic matter and carbonate content. The relatively low concentrations of lead found in this study indicate a rather low level of lead pollution in the investigated area (1, 2, 3). If it is assumed that the topmost 20 cm (lead concentration >17 mg kg^{-1}) were sedimented over the last 50 years, the sedimentation rate could be of the order of 0.4 cm/year. According to this assumption the whole sediment core collected could have been formed during the last 220 year. However, if there was mixing of sediment due to the bioturbation or trawling and lead penetrated deeper in the sediment, the true sedimentation rate could be lower, and hence the sediment core might represent a longer time span. Geochronological dating techniques would help resolve this question.

Table 1. Granulometric characteristics of sediment samples (Mz- mean size), and sediment type (6)

Depth (cm)	sand (%)	silt(%)	clay(%)	Mz (mm)	Sediment type (6)
0-4	3	80	17	13.14	silt
4-8	3	71	26	8.57	clayey silt
8-12	4	66	30	7.9	clayey silt
12-16	3	69	28	8.18	clayey silt
16-20	3	67	30	7.21	clayey silt
20-24	3	64	33	6.2	clayey silt
24-28	2	65	33	6.72	clayey silt
28-32	3	64	33	6.06	clayey silt
32-36	3	65	32	7.9	clayey silt
36-40	3	63	34	5.59	clayey silt
40-44	2	65	33	6.65	clayey silt
44-48	2	67	31	6.96	clayey silt
48-52	2	69	29	7.72	clayey silt
52-56	3	66	31	6.96	clayey silt
56-60	3	67	30	7.46	clayey silt
60-64	2	69	29	7.72	clayey silt
64-68	2	69	29	7.37	clayey silt
68-72	3	64	33	5.92	clayey silt
72-76	2	66	32	6.06	clayey silt
76-80	3	64	33	5.92	clayey silt
80-84	2	62	36	5.15	clayey silt
84-88	2	63	35	5.15	clayey silt

Conclusions

The sediment record indicates that the changes in the sedimentation environment were not dramatic along the core. Furthermore, the lead concentration shows a gradual increase towards the surface, as a result of the effect of global pollution.

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