

CR AND NI CONTENT IN SEDIMENTS FROM KASTELA BAY, ADRIATIC SEA, CROATIA

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Abstract

Six sediment samples from the Kastela Bay and 6 samples of land rocks east of the bay were taken in order to evaluate the possible contamination of the sediments by Cr and Ni. The level of these metals in both the marine sediments and land (flysch) rocks indicate that they are, in large part, of lithogenous origin. The elevated concentrations are associated more with fine-grained sediments.

Key-words: metals, Adriatic Sea

Introduction

Some studies on the concentration of Cr and Ni in marine sediments have demonstrated their geological origin, but in some polluted areas they may have anthropogenic origin as well (1). Measurement of trace metal concentrations in parent rock can substantially help to determine the anthropogenic influence on concentrations of these metals in sediments (2). The work presented here was undertaken to assess the possible contamination of the Kastela bay by Cr and Ni.

The Kastela Bay is a semi-enclosed basin located on the eastern Adriatic coast (Fig.1). The wider area of bay is densely populated and industrially developed. The bay is also heavily contaminated by untreated domestic and partially treated industrial waste waters (3). Therefore, distributions of organic matter and carbonates in the bay sediment samples were also determined in this survey.

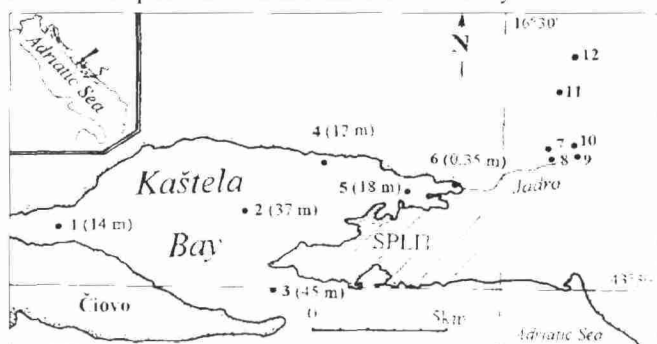


Fig. 1. Map of the study area and sampling locations. Depth in meters are given in parantheses next of each station.

Material and methods

The sediment samples were collected using a plastic gravity corer in March 1994 at 5 stations in the Kastela Bay (Fig. 1). At the station 6, in shallow water, a sediment sample was taken by a manually operated corer in May 1995. On land and in the drainage area, samples of parent rocks were collected in March 1995 at 6 locations (locations 7-12 shown in Fig. 1).

Immediately after sampling, sediment samples were frozen. Before analysis the sediments were defrosted at room temperature, sliced into 1 cm thick subsamples, dried at 60°C, and left to cool at room temperature. The granulometric composition of sediment was determined by sieving (> 63 µm) and areometry (Casagrande < 63 µm) of 4 cm (2 cm for Station 6) thick subsamples. Samples of the dry sediments and parent rocks were digested with a mixture of HF, HNO₃ and HClO₄ (4). The organic matter content was determined as a weight loss on ignition after H₂O₂ treatment and ignition at 450°C for 6 h (5). Carbonate content was determined as weight loss after treatment with 4M HCl (6). Cr and Ni concentrations were measured by the graphite-furnace atomic-absorption spectrophotometry (GFAAS) method using a Perkin-Elmer 1100 B instrument. The accuracy of the analytical procedure used was repeatedly checked by analysing samples of reference sediment standards (marine sediments SD-M-2/TM and SRM 1646 estuarine sediments) (Table 1).

Results

The results of granulometric analysis, carbonates and organic matter content of the sediment samples are listed in Table 2, while the level and distribution of Cr and Ni along the sediment cores are presented graphically in Figures 2 and 3, respectively. The characteristics of the parent rock are presented in Table 3. At the shallower stations (1, 4 and 6), the sediment was composed mainly of fine sand and silt.

Table 1. Cr and Ni concentration (mean ± standard deviation) for U.S. Natural Bureau of Standards (NBS) estuarine sediment (SRM 1646) and (median) for marine sediments (SD-M-2/TM).

Metal	Certified values (mg/kg)	This study (mg/kg)
Cr (SRM 1646)	73±3	88
Cr (SD-M-2/TM)	72.2	98.5
Ni (SD-M-2/TM)	56.1	51.6

Table 2. Granulometric characteristics of sediment samples (stations 1-6) and organic matter content.

Station	Core /depth length (cm)	Carbonates %	Organic matter %	Clay %	Mz (µm)	Sediment type Shepard (7)
1/14 m	0-4	54.3	5.3	1	113	silty sand
	4-8	59.2	4.9	4	123.8	sandy silt
	8-12	55.3	4.4	5	121.7	sandy silt
2/37 m	0-4	45	8.8	16	22.8	silt
	4-8	44.5	8.2	16	21.4	silt
	8-12	39.6	8.4	29	11.3	clayey silt
	12-16	37.4	7.6	15	24	silt
	16-20	39.9	7.7	10	29.7	silt
	20-24	44.5	7.2	9	25.8	silt
	24-27	42.1	6.9	6	24.3	silt
3/45 m	0-4	45.7	6	17	20.5	silt
	4-8	48.6	6.2	17	18.1	silt
	8-12	45.4	5.2	19	16.5	silt
	12-16	47.2	5	16	20.6	silt
	16-20	46.7	5.3	16	17.3	silt
4/12 m	0-4	46.5	9.2		93.1	sandy silt
	4-8	46.6	6.6		75.9	silty sand
	8-12	48.5	5.7	9	30.8	silt
	12-16	47.9	5.7	8	32.3	silt
	16-20	49.6	5.6	3	37.8	silt
5/18 m	0-4	50	8.8	3	37.3	silt
	4-8	49.2	8.1	7	30.9	silt
	8-12	51.8	8.0	10	28	silt
	12-16	50.4	7.4	6	24.6	silt
6/0.35 m	0-2	61.7	2.7		78.1	silty sand
	2-4	63	2.6		75.3	silty sand
	4-6	59.4	2.2		74.4	silty sand
	6-8	60	2.1		71.2	silty sand
	8-12	59.1	2.1		74.7	silty sand

The average particle size (Mz = 30.8 - 123.8 µm) corresponded to silt-fine sand. On the other hand, the sediment samples taken from the deeper stations (2, 3 and 5) were mainly silt (Mz = 11.3 - 37.3 µm).

The organic matter varied from 2.1 to 9.2% (Table 2). The lowest content was in the sandy sediment from station 6 facing the river Jadro (Figure 1), while the highest amount was found at stations 2 and 5 area with the highest phytoplankton density (10). Station 5 is located nearby outlets discharging urban and industrial waste waters containing high organic matter concentrations (3). The carbonate content was very high, both in the parent rocks and marine sediments particularly those at stations 1 and 6. It varied from 39% in marl to 99.9% in limestone, while in marine sediments it ranged from 37.4 to 63% (Table 2).

Chromium and Ni in marine sediments (Figs. 2 and 3) were considerably higher than in the parent rocks samples taken at the locations 9, 11 and 12 (limestones), while the other parent rocks samples taken at the locations 7, 8 and 10 (marl) had similar Cr and Ni concentrations