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HEAVY METAL CONCENTRATIONS IN A MARINE AREA INFLUENCED BY RIVER DISCHARGES

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SUMMARY.

A study was carried out for the determination of several toxic heavy metal concentrations (Cd, Cr, Hg, Pb and Zn) in the marine area affected by the Guadalhorce river mouth (Málaga. Spain). Spatial and temporal distribution of the concentrations suggest that those heavy metal levels are stable and characteristic of the studied area, and they are not caused solely by the river discharges.

TEXT.

The heavy metal levels detected in the marine environment come from natural geochemical processes, and from the movilization of these metals by the mining and industrial activities of man, whose residues are discharged into the sea. Some metals such as manganese, iron and copper, are essential micronutrients for many organisms. However, all the metals, including the micronutrients, are toxic in sufficiently high concentrations (1,2).

We studied several toxic heavy metal concentrations: cadmium (Cd), chromium (Cr), mercury (Hg), lead (Pb) and zinc (Zn), present in the marine area near Guadalhorce river mouth (Málaga. Spain).

The sampling was made over a year in a semicircular area with a radius of 1 Km, and centred in the river mouth, where 16 sampling stations were established. All the samples were fixed with concentrated nitric acid for the preservation until the analysis.

The Cd, Cr, Pb and Zn concentrations were determined by the Flame Atomic Absorption Spectrophotometry technique (3). Mercury concentrations were obtained by the cold vapor technique (3). All the determinations were carried out using and Atomic Absorption Spectrophotometer (Instrumentation Laboratory, Model IL 451) with a vapor generator systém (Model IL 440).

The results are summarised in table 1, where it is shown that dangerous levels of metals were never detected in comparison with those specified by Bryan (1). However, the studied heavy metal concentrations were higher, in one order of magnitude than those obtained by Aubert et al. (4) in samples taken 5 miles from the Málaga coast, and exced in 2 or 3 orders of magnitude the average concentrations given for clean seawater (5).

There is a direct and positive relationship between the concentrations obtained for Cd, Cr, Pb and Zn and the distance from the river mouth. On the other hand, mercury concentratios are very homogeneous and a variation between different sample stations is not observed.

The spatial distribution of concentrations suggests that river outfall is not the major or sole source of heavy metals into the sea. Their presence in these waters could be caused by sediment resuspension and element recirculation.

Temporal distribution is very uniform for the studied metals. So, these metal levels are considered as stable and characteristic of this area, and probably caused by an ancient and persistent contamination associated with the typical resuspension process of coastal areas.

TABLE 1. Heavy metal concentrations obtained over the sampling period.

Distance to river mouth (m)	Number of samples	Average concentrations of metals (µg/ml)				
		Cd	Cr	Hg	Pb	Zn
0	7	0.143	0.439	0.008	0.642	0.038
250	35	0.273	0.704	0.007	1.336	0.073
500	35	0.270	0.743	0.008	1.306	0.071
1000	35	0.267	0.775	0.008	1.289	0.058

This work was supported by C.A.I.C.Y.T. grant number 1158/81 from Ministerio de Educación y Ciencia of the Spanish Government.

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PRELIMINARY RESULTS ON TOTAL MERCURY AND METHYLMERCURY CONTENT IN DIFFERENT TISSUES OF TWO BENTHIC SPECIES COLLECTED IN THE NORTHERN TYRRHENIAN SEA

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Mercury originating from the weathering of the cinnabar deposits on Mt.Amiata, and from the mining and processing of ore in the past, affects the sediments of the northern Tyrrhenian continental shelf (1). On the contrary, the metal content in sea water does not seem affected (2). Benthic organisms, even from the outer shelf where sediments are unpolluted, show high Hg concentrations (3,4). This induced us to determine total Hg and methylmercury (MeHg) in the tissues of several benthic organisms.

During 1984 samples of superficial sediments, of the flat fish Citharus linguatula (L.) and of the crustacean Medorippe lanata (L.) were collected in three zones (A,B, C) of the Tyrrhenian continental shelf (Fig.1). Samples were digested with conc. HNO_3 at 120° C for 6 h in teflon vessels under pressure. Total Hg was determined with cold vapour atomic absorption spectrophotometry; the organic forms of Hg (referred as MeHg) were analyzed following the procedure described by Capelli et al.(5).

Total Hg concentrations in sediments were high at the outlet of the river Albegna (zone A), much lower in front of the Ombrone and approached background levels in zone C (TAB.1). Concentrations in organisms did not reflect the Hg content in the sediment and were generally higher in the larger specimens. While in the muscle of the two species the metal content was in the same range, the viscera of M.lanata (which included the digestive gland) showed higher values than the viscera or liver of C.linguatula. The different physiology and breeding behavior in these organisms probably contribute to this result.

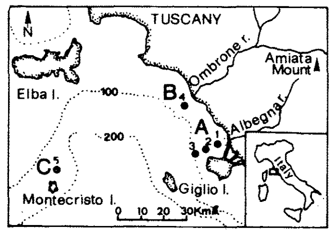

Fig. 1

TAB. 1
Mean mercury concentration ($\mu g\ g^{-1}$ d.w.) in sediments, C. linguatula and M. lanata

Zone	St.	Sediments	C. linguatula, Range of length: 6-8 cm: Muscle	liver	viscera	n	C. linguatula, Range of length: 10-11 cm: Muscle	liver	viscera	n	M. lanata, Range of weight: 12.0-21.2 g: Muscle	gills	viscera	carapace	n
A	1	2.00	0.77	0.67	0.66	4	2.00	1.68	1.40	3	1.60	5.20	2.80	0.14	3
	2	1.45	2.81	2.38	0.80	5	-	-	-	-	2.47	2.08	2.70	0.21	3
	3	1.25	1.05	0.80	0.90	3	2.00	1.75	1.52	3	1.10	2.80	1.05	0.13	3
B	4	0.60	1.15	0.77	1.00	2	0.98	0.60	0.68	2	1.17	2.10	1.47	0.10	3
C	5	0.20	0.95	0.81	0.76	3	3.20	2.49	2.27	1	-	-	-	-	-

Standard deviations are 31.12-48.16% of their mean value for muscle, 49.15-71.68% for liver, 35.01-97.15% for viscera 22.13-57.01% for gills and 37.11-47.35% for carapace; n: number of samples

Although in literature there is evidence of Hg uptake from water (6), this aspec is often neglected. The highest concentrations of Hg have been found in crustacean gills and this fact seems to indicate their involvement in the uptake of the metal.

Results of MeHg determinations in C.linguatula and M.lanata are summarized in TAB.2. Data on sediments are not reported as they were always less than 1% of the total Hg.

TAB. 2
Mean methylmercury content (as % of total mercury ± SD) in C.linguatula and M.lanata

C.linguatula: Muscle	Liver	Viscera	n° of samples	M.lanata: Muscle	Viscera	Gills	n° of samples
81.4+3.3	62.1±4.6	36.4±12.4	16	80.1±4.3	30.5±12.6	26.8±7.9	10

The percentages of MeHg in the muscle of the two organisms are similar and correspond to those found in several species of fish (7).

Research is in progress on other organisms of the benthic food-chain and on ecological factors involved in Hg bioaccumulation.

Acknowledgements

This research was supported by funds from the Italian National Research Council, project "Climate and Environment of the Mediterranean Area".

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