HEAVY METAL CONTAMINATION IN SEDIMENTS OF THE SHALLOW WATER AREAS SURROUNDING THE CITY OF VENICE (ITALY)

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Abstract
Part of the pollutant load generated by the Venice urban system can be transferred to the sediment of the shallow water areas surrounding the city. These areas were studied in order to assess metals level and distribution in the sediment, and to highlight possible contributions due to the city. A moderate pollution was found in the surface sediments (0-30 cm), with concentration of the main contaminants ranging between 6% (Cd) and 29% (Hg) of the mean value measured in the canal network. The comparison of metal concentrations with SQGs revealed a low ecotoxicological risk for the surveyed areas, excepting for Hg, which values exceed the ERM guideline (0,71 mg/kg d.w.) in 75% of samples. Concentration trends along the vertical profile pointed out a diminution of both metal contamination and the finer particle content with time.
Keywords: Sediments, Metals

The City of Venice, located in the middle of the lagoon, has a population of about 60000 inhabitants and an average additional daily presence of about 75000 units (tourists and commuters). Its 40 km long canal network receives inputs of particulate matter and pollutants from the urban sewage system and point and non-point sources, such as atmospheric deposition and urban runoff, building erosion and corrosion of metal structures, boat traffic [1]. Even though the canal network has a high capability in retaining particles and associated contaminants, a fraction of the total load is transferred to the lagoon [2] by tidal currents. The export is enhanced by particle resuspension due to the boat traffic. Contaminants can therefore accumulate in the sediment of the shallow water areas surrounding the city, which are characterized by a low hydrodynamics. Aim of this study was the assessment of the pollution level in the sediment of these areas, also to evidence possible contributions due to the city. Thirty centimetres-long cores where collected in 2003 and 2004 from 69 sampling sites; cores were sliced into 10 cm layers and analyzed for grain-size distribution and metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn) concentration. A further sediment characterization survey was made in 2008, collecting 26 new cores. Surface sediment samples are mainly constituted of silt (mean content = 55.1 %, σ = 14.7 %), but display a high variability in grain-size characteristics. A positive gradient of the mud (d<63 mm) content is observed towards the West. Table 1 shows metal mean concentration in each analysed sediment layer; for comparison, mean values determined in the whole canal network are reported [1]. The table also shows the percentage distribution of concentration data with respect to the three concentration ranges which are discriminated by the NOAA Sediment Quality Guidelines (SQGs): effect range-low (ERL) and effect range-median (ERM). Concerning the spatial distribution, Cd (0,1-6,9 mg/kg d.w.), Cu (5-144), Pb (4-126), and Zn (27-327) show the greater variability among the shallow water areas. On the average, these metals have a concentration of about 10% with respect to values measured in the canal network. Arsenic, Cr, and Ni concentrations are relatively low in the investigated areas, as well as in the canal system. An effective fingerprint due to the city is observed for Hg (Figure 1). Its concentration is always higher than the ERL value (0,15 mg/kg d.w.), and higher than the ERM value (0,71 mg/kg d.w.) in 75 % of samples. As the other metal concentrations never exceed the ERM, the ecotoxicological risk of the sediment is enhanced by mercury. Concerning the surface layer (0-10 cm), a comparison between data from sediments collected in 2003-04 and in 2008 was made. Lower values characterize almost all samples analysed in 2008, pointing out a diminution of concentrations with time. This is accompanied by a greater presence of finer particles with depth, as resulting by the examination of grain-size along the vertical profile.

Tab. 1. Metal mean concentrations (mg/kg, dry weight) in the investigated areas and in the Venice canal network. In the last three rows, the percentage distribution of concentration data with respect to the NOAA SQGs is reported.

		As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
mean	layer 0-10 cm	6,9	0,71	10	28	1,06	7	23	99
	layer 10-20 cm	8,0	0,57	13	29	1,10	8	27	90
	layer 20-30 cm	8,2	0,40	15	28	1,09	9	29	74
	Venice canals network	16,6	6,60	31	245	3,70	36	222	889
percentage	< ERL	59	91	100	80	0	100	96	88
	ERL - ERM	41	9	0	20	25	0	4	12
	> ERM	0	0	0	0	75	0	0	0

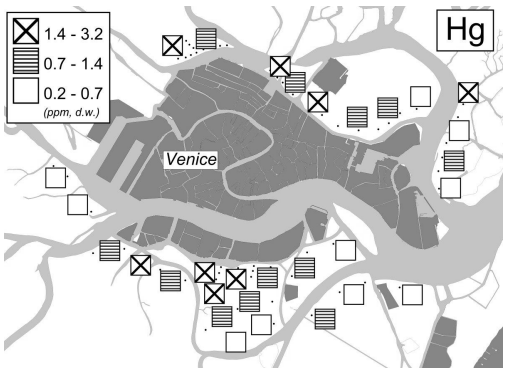

Fig. 1. Mercury concentration distribution in the surface sediment layer (0-10 cm) of the shallow water areas surrounding Venice

References
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