HEAVY METALS, PAHS AND PCBS IN THE SEDIMENT OF THE VENICE LAGOON

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Abstract

The sediment of the shallow water areas of the Venice Lagoon was investigated by collecting 50 cm-long cores from 380 sites. Samples were analysed for heavy metal, polycyclic aromatic hydrocarbon (PAHs) and polychlorinated biphenyls (PCBs) contents. Pollutant concentration shows a wide variability both spatially and along the vertical profile, but not evident situation of acute contamination are observed. However, the contamination level of mercury deserves attention, its value resulting quite often above the NOAA-ERM limit.

Keywords: Metals, Pcb, Pah, Sediments, Lagoons

Sediments are widely recognized as a suitable medium for assessing environmental quality, as they both reflect and integrate contaminant inputs to the marine environment, thereby allowing sources and sinks to be investigated [1]. The lagoon of Venice is a coastal shallow waterbody with a surface of 550 km^2 and an average depth of about 1 m. The impact of the human activities affects the various shallow water areas to a different extent, in response to local water renewal and position with respect to the pollution sources. This study focused on heavy metals (Al, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb and Zn), arsenic, polycyclic aromatic hydrocarbon (PAHs) and polychlorinated biphenyls (PCBs) distributions in the sediment of the whole lagoon. In 2008, fifty centimetres-long cores were collected in 380 sampling sites (Fig.1). Each core was sliced in five parts, obtaining 1900 samples corresponding to the following depth layers: 0-5 (named layer "A"), 5-10 ("B"), 10-20 ("C"), 20-30 ("D") and 30-50 ("E") cm. Metal concentrations were determined by inductively coupled plasma atomic emission spectrometry (ICP-AES) [2]. Concentrations of 14 PAHs (USEPA *priority pollutants*) and 7 PCB congeners (named *indicator*-PCBs) were analyzed in the 760 samples from layers "A" and "B" with high performance liquid chromatography (HPLC) and by capillary gas chromatography (GC), respectively [3]. Analyses of grain-size distribution and nutrient (C, N, P) contents were also performed. The obtained 3D dataset updates and upgrades the knowledge on the lagoon sediment characteristics, and permits to investigate their spatial and temporal variations as well as quality conditions with a great detail. Pollutant concentration shows a wide variability both spatially and along the vertical profile. Higher metal concentrations (particularly Cd, Cu, Hg, Pb and Zn) are found in the correspondence of knew sources (freshwater tributary inlets, industrial area, city of Venice), but also new situations of sediment contamination are evidenced in some areas. Mean concentration values calculated in the five sampling layers (Table 1) give a first picture of the contamination level of the whole lagoon sediment. For comparison, the table also shows the percentage distribution of concentration data measured in the 1900 samples with respect to the NOAA sediment quality guidelines (SQGs): effect range-low (ERL) and effect range-median (ERM) [4]. Arsenic, Cd and Ni concentration exceeds the ERL value in a significant number of samples (37%, 29%, and 16% respectively). However, the most relevant outcome is the high concentration of Hg, which exceeds the ERL and the ERM values in 76% and 27% of the samples, respectively. Concerning the two superficial layers, it is worth to observe that the mean concentration in "A" is lower by about the 10% with respect to "B", for all metals. Mean PAH and PCB concentrations, instead, do not show variation with the depth.

Fig. 1. Location of the 380 sampling sites

Tab. 1. Average concentration (mg/kg, dry weight) of contaminants in the five investigated sediment layers. The last three columns report the percentage distribution of the 1900 samples with respect to the NOAA-SQGs.

	Sediment layer					< ERL	ERL – ERM	> ERM
	A	B	C	D	E			
As	6,6	7,5	8,3	9,1	9,3	63	37	0
Cd	1,2	1,4	1,3	1,3	1,1	71	29	1
Cr	16	17	18	19	19	100	0	0
Cu	19	21	21	21	19	92	8	0
Hg	0,51	0,55	0,54	0,49	0,39	24	49	27
Mn	239	250	265	278	279	-	-	-
Ni	13	14	15	16	17	84	16	0
Pb	15	17	17	17	15	99	1	0
Zn	90	103	107	105	72	87	10	3
ΣPAH	0,36	0,35	-	-	-	99	1	0
ΣPCB	0,006	0,006	-	-	-	98	2	0

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