C-III7

Vertical Distribution of Heavy Metals in Sediments from Rivers in Northern Greece

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Data obtained by vertical distribution studies may,generally,cover the last two hundred years or greater time span of industrial development.

The vertical distribution of Cu,Cd,Cr,Mn,Zn,Fe, and Pb was studied in sediment cores from two rivers in Northern Greece,Axios and Aliakmon ,which had been previously(SAMANIDOU et al 1987) examined for the metal partitioning into selective fractions in surface(0-10 cm)sediments.Both rivers flow into the Thermaikos Gulf.

Axios is affected by domestic effluents and industrial wastes mainly from the Yugoslavian region,since in the Greek area only domestic and agricultural effluents are discharged into its waters. Aliakmon is affected by domestic effluents and wastes of textile and food industries(FYTIANOS et al, 1986).

Four samplings were performed in three month intervals during a period of one year. A plexiglass corer of 1 m length and 8.0 cm diameter with a latex stopper for the upper side,was manually driven into the sediment. Samples were subsequently subdivided in 10 cm fractions. Due to technical difficulties the subdivision of the core in shorter sections,in order to obtain more detailed information ,was not possible. Only at one sampling was it possible to take a core of a length greater than 30 cm, due to the sandy texture of the sediments beneath this depth. All sediment samples were wet sieved using nylon sieve,and the fraction <0.063 mm,was selected for study. The sieved material was then dried at 105°C. Metal analysis was performed by wet acid digestion under pressure using a mixture of HNO_3-$HClO_4$ 4:1 v/v , at 150°C (AGEMIAN et al, 1976). The acid extracts were analysed for the above mentioned metal ions,by flame AAS (Pye-Unicam SP 192) or flameless AAS (Perkin-Elmer HGA 400) when needed. The standard addition method was followed for each metal separately. The precision of sediment metal analysis was checked by five replicate samples of SD-N-1/2 IAEA reference river sediment material and coefficients of variation ranged between 1 and 8 %.

Table 1 presents the metal core correlation coefficients for the examined metals at the four sampling stations (AX1 ,AX2 ,AL1 ,AL2),obtained from one sampling, for core depth >30 cm. As shown , a negative correlation (significant though only for Pb,Zn and Cu in AX1 station) ,is observed ,between metal concentration in sediments and depth in the core. Except for Cd ,all other metals exhibit a peak concentration at 10-20 cm depth in core, probably due to resuspension of surface sediments. The fact that most of the metals show the peak concentration at the same depth implies, that these metals have a common origin. Cadmium which has its maximum concentration at the surface layer has probably a different origin. The enrichment of Cd at the top

Table 1. Correlation coefficients between metal concentrations and depth in core.

	AX1	AX2	AL1	AL2
Pb	-0.786*	-0.823	-0.576	-0.772
Zn	-0.883	-0.636	-0.401	-0.439
Cu	-0.855	-0.368	-0.517	-0.764
Mn	-0.735	-0.620	-0.754	-0.876
Fe	-0.410	-0.727	-0.162	0.493
Cr	-0.641	-0.525	-0.941	-0.642
Cd	-0.641	-0.705	-0.771	-0.659
d.f. (n-2)	5	3	2	4

***The underlined values are significant at the 5% level.**

of the core is due to the high anthropogenic flux during the last decades (ETCHEBER et al ,1977).

Surface layers (0-10 cm) are directly affected by human activities. Suspended materials after a certain period of transportation are deposited on the river bottom, enriching consequently the upper layers of sediments with heavy metals. On the other hand, surface layers are mostly exposed to the pH-Eh changes in aquatic environment, which lead to a heavy metal release(HILTON et al,1985). As acid mine effluents are discharged into Axios river, a decrease of pH value can lead to a release of heavy metals bound to carbonates and hydroxides. A change of redox conditions can cause the reduction of hydrous Fe-Mn oxides yielding the scavenged or sorbed heavy metals (SALOMONS et al ,1984).

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C-III8

Etude des Métaux Lourds (Zn, Cu, Pb, Cd, Cr) dans les Sédiments de la Pêcherie d'Homa - Izmir

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La Pêcherie d'Homa située entre la rivière Gediz et la Saline de Camaltu, dans la baie extérieure d'Izmir, a une superficie de 1800 ha. et une profondeur moyenne d'1m. (Fig. 1) qui est régulièrement diminuée par les apports d'alluvions de cette rivière et par l'étranglement de la passe qui assure la circulation entre la mer et la Pêcherie (YARAMAZ & ALPBAZ, 1988).

Les prélèvements ont été réalisés, mensuellement, à l'aide d'un benne "Orange-Peel" en novembre, décembre 1989 et en janvier 1990 à partir de 5 stations (Fig.1)

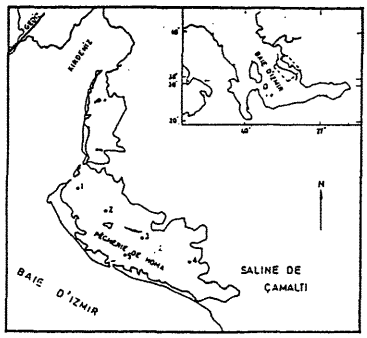

Fig. 1 : Localisation des Stations

Les échantillons de sédiments ont été transportés au laboratoire dans un sac en plastique puis séchés à 60°C pendant 24 heures. On pèse 1g. de sédiment préalablement broyé afin d'obtenir une poudre (<160 µm) que l'on met dans un ballon. On ajoute 10 ml d'eau régale [HC1:HNO_3 (3:1 v/v Merck)] qui est chauffée durant deux heures à 120°C. On filtre la solution additionnée d'environ 25 ml d'eau permutée à l'aide d'un filtre Whatman, puis on ajoute encore jusqu'à 50 ml. dans une fiole jaugée. La solution est prête pour l'absorption atomique modèle 2280 Perkin-Elmer (ARNOUX *et coll.*, 1981).

Le tableau 1 révèle les concentrations en métaux lourds dans la Pêcherie d'Homa à travers des prélèvements réalisés aux mois de novembre, décembre 1989 et janvier 1990.

St.		1	2	3	4	5
Zn	Nov.	40.5	47.5	57.0	41.5	68.0
	Dec.	49.0	50.5	59.0	36.0	61.0
	Jan.	47.5	60.0	65.0	32.0	59.0
Cu	Nov.	21.0	20.0	24.0	21.5	26.5
	Dec.	21.0	19.5	27.0	22.2	22.0
	Jan.	19.0	25.5	24.5	19.0	19.5
Pb	Nov.	10.0	40.0	95.0	25.0	25.0
	Dec.	10.0	25.0	20.0	24.0	20.0
	Jan.	33.5	38.5	34.3	18.5	28.0
Cd	Nov.	3.0	5.5	3.5	3.0	3.0
	Dec.	4.0	2.5	3.0	3.0	2.0
	Jan.	5.5	4.0	3.6	2.5	4.0
Cr	Nov.	60.0	44.5	72.0	57.0	69.0
	Dec.	66.0	59.0	73.0	60.6	68.5
	Jan.	44.0	43.0	78.0	50.0	43.0
Mat.col. %	Nov.	9.09	9.17	11.89	11.91	15.44
	Dec.	8.38	8.63	13.67	14.27	13.07
	Jan.	7.65	14.08	8.52	2.64	6.30
% C	Nov.	1.65	1.86	2.21	2.14	3.00
	Dec.	1.53	1.43	2.53	2.45	2.29
	Jan.	1.45	2.35	1.70	1.39	1.27

Tab. 1 : Concentrations des métaux lourds dans les sédiments de Pêcherie d'Homa (µg/g poids sec)

Comme le montre le Tableau 2, les concentrations relevées dans la Pêcherie d'Homa sont inférieures à celles de la Baie d'Izmir et il n'existe pas actuellement de risques de pollution par les métaux lourds.

	Zn	Cu	Pb	Cd	Cr	Ref.
Baie d'Izmir	53 - 8660	33 - 866	40 - 280	0.2 - 40	-	(UYSAL,TUNCER 1984)
Baie d'Izmir	61 - 899	16 - 213	13 - 305	1.3 - 6.6	21 - 237	(GEY, MORDOĞAN 1988)
Baie de Gülbahçe	16 - 135	12 - 56	35 - 183	1.4 - 14	-	(UYSAL, TUNCER 1984)
Pêcherie de Homa	32 - 68	19 - 27	10 - 95	2 - 5.5	43 - 78	(Ce travail)

Tab. 2 : Comparaison des teneurs en métaux lourds entre la Pêche d'Homa, la Baie d'Izmir et celle de Gülbahçe (µg/g poids sec)

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