TRANSFER AND DISTRIBUTION OF SILVER IN SEAWATER AND SEDIMENT CORES FROM NORTHERN SARONIKOS GULF, GREECE

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Silver was determined in seawater and sediment cores from northern Saronikos Gulf, Greece by Instrumental Neutron Activation Analysis (INAA). Increased levels of total and dissolved Ag in seawaters and total and 0.5N HCl extractable Ag in sediment cores were found from stations near the Athens Sewage Outfall (ASO) and close to a fertilizer Plant (F.P.) outside Piraeus Harbor as compared with those found from stations 5 km offshore. The predominant Ag form in seawaters was dissolved Ag (90% of total). A transfer of Ag towards southwest from pollution sources was observed, both in seawater and sediment core samples, due to the predominant cyclonic circulation in the N. Saronikos Gulf.

INTRODUCTION

Northern Saronikos Gulf receives combined domestic and industrial wastes through the Athens Sewage Outfall (ASO). The Gulf also receives waste water from a Fertilizer Plant (F.P.) and other industries outside Piraeus harbor. All these wastes contain trace and other trace elements including silver. Silver salts are expectionally toxic toward freshwater fish (Förstner & Wittmann 1983). Details of the distribution of Ag in seawater are not very well known (Bruland 1983). Increased concentrations of silver in surface sediments near the ASO of the Northern Saronikos Gulf have been previously found (Papakostidis et al., 1975).

The objective of this study was to investigate the transfer and distribution of siver in seawater column (total, dissolved and particulate Ag) and in sediment core samples (total, 0.5N HCl-extractable and particulate Ag) from the northern Saronikos Gulf.

MATERIALS & METHODS

Sampling: Seawater samples were collected from 15 stations (Fig. 1) during two cruises (July and October 1984). Sediment core samples were collected during the October cruise (Fig. 1). Details about sampling and pretreatment of samples for analyses are given elsewhere (Grimanis et al. 1985).

Methodology: Silver was determined in seawater and sediment samples by INAA (Grimanis et al. 1985).

RESULTS & DISCUSSION

Silver concentrations in seawaters: During both cruises maximum concentrations of Ag in surface waters were found near the F.P. outside Piraeus harbor (1.0-1.4 µg/l for total Ag, 0.97-1.3 µg/l for dissolved Ag). Elevated concentrations of Ag in surface waters were also observed in the vicinity of the ASO (0.7-1.1 µg/l for total Ag, 0.67-1.1 µg/l for dissolved Ag as compared with those found in surface waters from stations 5 km offshore (0.15-0.30 µg/l) both for total and dissolved Ag).

Concentrations of total, dissolved and particulate Ag in the water column ranged as follows: 0.1-1.4 µg/l for total Ag, 0.10-1.3 µg/l for dissolved Ag and 0.006-0.10 µg/l for particulate Ag. The predominant Ag form in seawater samples from all stations was dissolved Ag (>90% of total).

Chromium concentrations in sediment cores: Maximum concentrations of total, 0.5N HCl extractable and residual Ag (µg/g dry weight) in the silt-clay fraction (particle diameter <55 µm) of sediment core samples from stations C_7, C_6 and C_1 are presented graphically in Fig. 2. Station 7 was situated close to the

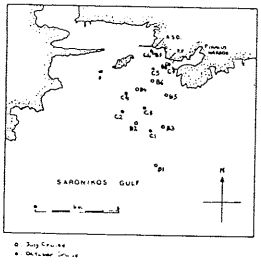

Fig. 1 Sampling Stations

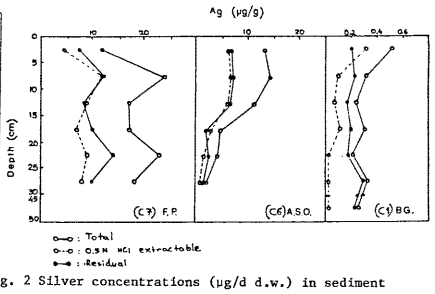

Fig. 2 Silver concentrations (µg/d d.w.) in sediment cores

F.P. and C_6 close to ASO. Station 1 was situated ∿5 km away from ASO.

Maximum concentrations of total, 0.5N HCl extractable and residual Ag were found in the core C_7 with an abnormal distribution with depth (Fig. 2) probably due to periodic dumping of solid and liquid wastes. Elevated concentrations of total, 0.5N HCl extractable and residual Ag were found at C_6 station close to the ASO as compared with those found a few km offshore. A sharp decrease of Ag concentrations with depth was observed at Station C_6 which seems to reflect the changes of the quality of wastes during the last years. The lowest total, 0.5N HCl exctractable and residual Ag concentrations were found in the core of station C_1, which were relatively constant with depth and can be used to define the geochemical background values for Ag in the area studied.

Silver transfer: Higher concentrations of Ag were found both in seawater and sediment samples collected from stations located SW of the pollution sources when compared with those found in seawater and sediment samples from stations SE of these sources (Tab.1).

TABLE 1. Comparison of Ag levels in seawater and sediments from the SW and SE stations of the North Saronikos Gulf

Stations	Surface sea water total Ag (µg/l)				Sediment cores total Ag (µg/g)			
	July Cruise		October Cruise		October Cruise 0-10 cm		10-30 cm	
SW stations (B_4,B_2,C_4,C_2)*	0.67 (B4)	0.43 (B2)	0.41 (C4)	0.45 (C2)	0.24 (C4)	0.82 (C2)	0.74 (C4)	0.79 (C2)
SE stations (B_5,B_3,C_3,C_1)*	0.49 (B5)	0.41 (B3)	0.31 (C3)	0.18 (C1)	0.67 (C3)	0.41 (C1)	0.55 (C3)	0.27 (C1)

*Letters in parenthesis indicate the sampling stations (Fig. 1).

This distribution proves that there is a southwestern transfer of Ag probably due to the predominant cyclonic circulation of the Northern Saronikos Gulf.

BRULAND K.W. (1983) In Chemical Oceanography (Riley S.P. and Chester R. eds.) Academic Press, Vol. 8, pp. 172-173.

FORSTNER U., WITTMANN G.T.W. (1983) Metal Pollution in the Aquatic Environment, Second edition, Springer-Verlag, Berlin.

GRIMANIS, A.P., KALOGEROPOULOS, N., ZAFIROPOULOS D., VASSILAKI-GRIMANI M. (1985) Proc. of the Intern. Conf. Heavy Metals in the Environment, Athens, Sept. 1985, Vol. 2, 427-429 (Ed. T.D. Lekkas) CEP Consultants Ltd., 26 Albany St., Edinburgh EM1,3QH

PAPAKOSTIDIS G., GRIMANIS A.P., ZAFIROPOULOS D., GRIGGS G.B., HOPKINS T.S. (1975) Pollut. Bull. 6, 136-138.

ÉTUDE COMPARATIVE DES PARTICULARITÉS PHYSICO-CHIMIQUES ET BIOLOGIQUES DANS DEUX BAIES, POLLUÉE ET NON-POLLUÉE DU GOLFE D'IZMIR

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SUMMARY

In this investigation undertaken in the polluted (iner bay) and unpolluted (Gülbançe Bay) waters of Izmir Bay, the physico-chemical parameters and biological characteristics have been determinated. It has been observed that the above stated characteristics show variation due to pollution in the inner bay.

INTRODUCTION

La pollution a débuté en 1960 dans le Golfe d'Izmir, mais ses effets ne sont apparus qu'à partir de 1970. Pour cette raison, les conséquences de la pollution sur les paramètres physico-chimiques et biologiques ont été étudiés depuis 1970 (Kocatas et Gelday, 1980, Kocatas et al., 1984).

DEFINITION DES ZONES ETUDIES ET DES POLLUANTS

Dans la partie la plus orientale du Golfe d'Izmir, une baie intérieure relativement fermée et peu profonde (mx. 20 m) occupe une superficie de 65.5 km^2. Au sud est du Golfe, la baie de Gülbahçe est plus profonde (max. 30 m) et plus vaste (120 km^2). La baie de Gülbahçe reçoit seulement les déchets domestiques de quelques villages alors que dans la baie intérieure se déversent 245 000 m^3 d'eaux usées par jour et les déchets industriels non traités de 1250 usines, ceci correspondant à 93 000 m^3/jour.

METHODE DE TRAVAIL

Dans chaque baie, six stations ont été choisies et la recherche s'est faite entre 1983 et 1985. Les paramètres physico-chimiques tels la température, la transparence, le seston, la salinité, l'oxygène dissous, le pH et la teneur en sels nutritifs ont été mesurés selon les méthodes classiques. Les prélèvements de plancton ont été effectués à l'aide de l'Hydrobios universal serie water sampler (5 l) et les prélèvements benthiques avec une benne type "orange-peel" qui permet de récolter 4 à 5 litres de sédiment. Les poissons ont été capturés avec des filets. La richesse spécifique (indice de diversité) a été calculée par la formule de Shannon-Weaver (1963).

RESULTATS ET DISCUSSION

1-Comparaison des paramètres physico-chimiques

Dans les deux baies, les températures, salinités et pH présentent des valeurs moyennes assez homogènes, les taux d'oxygène dissous sont très variables et les quantités de seston et de sels nutritifs sont très supérieurs dans la baie intérieure où la transparence est considérablement diminuée par rapport aux valeurs obtenus dans la baie de Gülbhaçe.

2-Plancton

Les recherches réalisées dans les deux baies, ont mis en évidence des différences au niveau de la composition spécifique tant du phytoplancton que du zooplancton.Au point de vie quantitatif, la baie intérieure est plus riche que la baie de Gülbhaçe. L'indice de diversité de Shannon permet de mettre en évidence des différences au niveau des Communautés planctonniques des deux baies (Fig. 1).

3-Peuplements benthiques

Les prélèvements effectués dans la baie intérieure totalisent 75 espèces et 3814 individus, en baie de Gülbahçe, 179 espèces et 9113 individus ont été dénombrés. En raison de la forte pollution de la baie intérieure, les cinq stations internes sont très pauvres en espèces. Par contre, la station 6, située dans une zone intermédiaire est très proche des résultats obtenus dans la baie de Gülbahçe, ainsi que le confirme l'indice de diversité (Fig. 1).

4- Populations de poissons

On a observé des données quantitatives plus élevées dan la baie intérieure, mais un nombre d'espèces plus élevé dans la baie de Gülbahçe.

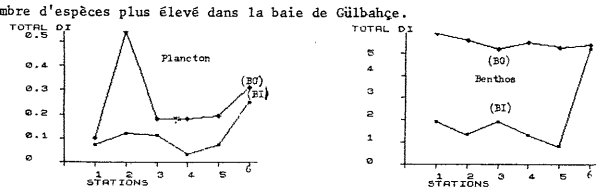

Fig. 1: Indices de diversité des peuplements planctonniques et benthiques dans les deux baies (BG: baie de Gülbahçe; BI: baie intérieure)

REFERENCES

Kocatas et Gelday, 1980: *Helgol. Meeresf.*, 33: 393-400

Kocatas et al., 1984. *5èmes Journ. Et. Poll. mar., C.I.E.S.M.*,Lucerne, octobre 1984

Shannon C.E. and Weaver W., 1963. The mathematical theory of communication, Illinois Univ. Press, Urban, Ill., 117 p.