MOBILITY OF Zn IN SEDIMENTS FROM SEPETIBA BAY, RIO DE JANEIRO

1. INTRODUCTION

Sepetiba Bay, located about 60 km south of the city of Rio de Janeiro, Brazil, is one of the most important fishery areas in the State of Rio de Janeiro. Since the early 70's, the construction of a large harbor brought up a considerable investments and the region has undergone fast industrial expansion, leading to high levels of pollution by metals (*Pellegatti et al., 2001*). For the last two decades, an industrial park composed of about 400 industrial plants, basically metallurgical, was established in the Sepetiba Bay basin, releasing its wastes either straight into the bay or through local rivers. Metal contamination in the bay for some metals, especially zinc and cadmium (*Barcellos et al., 1991; Barcellos et al., 1998*), has already exceeded acceptable levels. In this work, Instrumental Neutron Activation Analysis (INAA) was applied to the determination of the Zn in bottom sediment samples from Sepetiba Bay. The results obtained were analyzed in the light of a geoestatistic model (attetuation model) which evaluate the mobility of the metal in the studied region (*Wasserman e Queiroz, 2004*).

2. MATERIAL AND METHODS

1. Sampling, sample preparation and analytical procedures

For INAA, samples were dried at 40°C in a ventilated oven for three days, were carefully ground in agate mortars and stored in polyethylene bags until analysis.

One hundred to one hundred and fifty mg of the samples (bottom sediments) were accurately weighted in polyethylene bags. Elemental synthetic standards of the analyzed elements were prepared by pipetting convenient aliquots of standard solutions (SPEX) onto 1 cm^2 pieces of Whatman 40 filter paper. The standards were then sealed in polyethylene bags. Samples and standards were irradiated for 16 hours at a thermal neutron flux of 10^{13} n cm^{-2} s^{-1} at the IEA-R1 nuclear reactor of IPEN. The measurements of the induced gamma-ray activity were carried out in a GMX20190 hyperpure Ge detector about 15 days after irradiation.

With the measured values, a model of the attenuation of concentrations of zinc was constructed following (*Wasserman e Queiroz, 2004*). The model output is a map of the attenuations, which represent the steepness of the gradient of concentration. The faster the concentrations fall from a hot spot the highest is the attenuation, meaning that in that direction the metal has a low mobility.

3. RESULTS AND DISCUSSION

Table I shows the concentrations obtained for Zn and Figure 01 shows the attenuation map obtained from the results.

Table I- Concentration of Zn in the sediments samples of Sepetiba Bay (mg Kg^{-1}).

Elemento	Sp1	Sp2	Sp3	Sp4	Sp5	Sp6	Sp9	Sp10
	703	651	564	713	159	269	45	85
	Sp11	Sp12	Sp13	Sp14	Sp15	Sp16	Sp17	Sp18
	59	36	91	421	71	24	74	419
	Sp19	Sp20	Sp 21	Sp22	Sp23	Sp24	Sp25	Sp28
Zn	114	960	631	91	488	144	60	382
	Sp29	Sp30	Sp31	Sp32	Sp34	Sp39	Sp41	Sp43
	324	385	346	747	326	1746	1097	647
	Sp47	Sp51	Sp55	Sp61				
	1472	1200	1095	950				

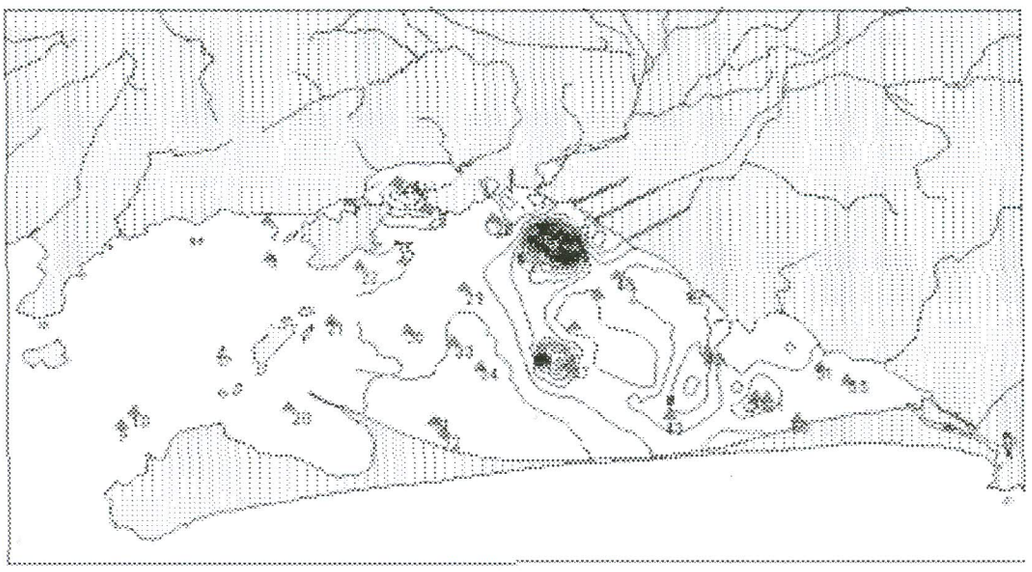

Figure 1. Attenuation of Zn concentration in Sepetiba Bay.

According to Figure 1, it is possible to observe that there are two points where the attenuation of Zn is significant, one near the input of the riverine water to the bay and the other in the central area of the bay: The presence of elevated values of attenuation indicate low mobility that are probably associated with geochemical barriers. The northern elevated attenuation spot was expected and is associated with the pollution sources that enter the bay by the northern rivers. On the other hand, the central spot was unexpected but may be associated with the chemical characteristics of the sediments. None of the hydrodynamic features described by (*Signorini, 1980*) explain this behaviour. This barrier may be related to the elevated phytoplankton production, causing an increase in pH, that should reduce Zn mobility in the environment.

4. CONCLUSIONS

The attenuation model used to study the mobility of Zn can be helpful to understand the mobility process of Zn and other elements in Sepetiba Bay. It can be observed that the Zn distribution pattern is homogeneous, showing low attenuation at the western part of the bay, indicating higher mobility of Zn in this region. The high attenuation observed near the input of the rivers into the bay indicates that Zn has little mobility in this area constituting a geochemical barrier.

5. REFERENCES

BARCELLOS, C., LACERDA, L. D., CERADINi, S. Metal scavenging and cycling in a tropical coastal region. In: J. C. WASSERMAN, E. V. SILVA-FILHO, R. VILLAS-BOAS (Eds.), Environmental Geochemistry in the Tropics, 1st ed., Vol. 72, p. 157-169. Heidelberg: Springer-Verlag.1998.

BARCELLOS, C., REZENDE, C. E., PFEIFFER, W. C. Zinc and cadmium production and pollution in a Brazilian coastal region. Mar. Poll. Bull., v. 22, n. 11, p. 558-561, 1991.

PELLEGATTI, F., FIGUEIREDO, A. M. G.E WASSERMAN, J. C. Neutron activation analysis applied to the determination of heavy metals and other trace elements in sediments from Sepetiba bay (RJ), Brazil. Geostand. Newslett., v. 25, n. 2, p. 163-171, 2001.

SIGNORINI, S. R. A study of the circulation in bay of the Ilha Grande and Bay of Sepetiba. Part II. A assesment to the tidally and wind-driven circulation using a finite element numerical model. Bolm. Inst. Oceanogr., v. 29, n. 1, p. 57-68, 1980.

WASSERMAN, J. C. e QUEIROZ, E. L. The attenuation of concentrations model: A new method for assessing mercury mobility in sediments. Quim. Nova, v. 27, n. 1, p. 17-21, 2004.

Authors Contact

RIBEIRO, ANDREZA P.[1], FIGUEIREDO, ANA M. G[1]; WASSERMAN JULIO C.[2],
SANTOS, JOSÉ O.[1], CORTEZ, VINICIUS D.[1]

[1]NEUTRON ACTIVATION ANALYSIS LABORATORY
LAN/CRPQ – IPEN/CNEN - SP, BRASIL
E-MAIL:ANDREZPR@USP.BR

[2]DEPARTAMENTO DE ANÁLISE GEO-AMBIENTAL
INSTITUTO DE GEOCIÊNCIAS
UNIVERSIDADE FEDERAL FLUMINENSE RJ, BRASIL