BIOGEOCHEMISTRY OF LEAD IN A COASTAL BAY OFF ALEXANDRIA

M. A. R. ABDEL-MOATI

Marine Science Department, Faculty of Science, University of Qatar, Doha P.O.Box 2713, Qatar

In addition to industrial discharge, the coastal waters of Alexandria receives huge amounts of agricultural runoff from the Nile delta lagoons as well as untreated sewage discharge from main metropolitan stations. As a consequence of the growing industrialization and human activities in recent years, the task of lead pollution in the coastal waters of Alexandria arise to be a major problem. The ultimate sink of most of metals derived through land-based sources is the semi-enclosed basins like harbors and bays surrounding the city. The present work is an attempt for evaluating the sources, behavior and fate of lead in a coastal ecosystem, to understand the degree of the metal impact on its environment. Mex bay, located west of Alexandria city, have a surface area of 19.4 km^2 and a mean depth of 10 m. The bay receives 2.2 x 10^9 m^3 y^{-1} of agricultural drainage water through Umum drain (bearing industrial wastes discharging into Lake Mariut), 0.12 x 10^9 m^3 y^{-1} of industrial water discharge from a Chlor-alkali plant as well as 1.13 x 10^9 m^3 y^{-1} from the Western harbor of Alexandria. Three factories (cement, petrochemicals and petroleum refinery) are located in the vicinity of the bay.

During 1992-1993, subsurface and near bottom sea water from 10 stations were sampled by pumping during low and high discharge periods from Umum drain. Water samples were collected in pre-acid cleaned, DDW washed and filtered sea water rinsed teflon bottles.

After filtration, Adsorptive Cathodic Stripping Voltammetry in the differential pulse mode was used for determination of labile (untreated) and total dissolved lead (acidified + UV irradiated) at pH 7.7 using 0.01 M HEPES as a buffer and 8 x 10^{-6} M oxine as chelator (VAN DEN BERG, 1986).

Labile lead values ranged from 8.6 nM Kg^{-1} near discharge points and 1.5 nM kg^{-1} seaward, constituting between 60-80% of total dissolved metal. With respect to salinity, lead behaved nonconservatively during transport from discharge points seaward showing 43-72% and 28-52% removal during high and low discharges from Umum drain. Suspended and bottom sediments were digested using the sequential method of TESSIER *et al.* (1979) followed by measurement on GFAAS. Due to the huge suspended matter discharged from landbased sources, suspended lead dominated the total metal in water constituting between 59 and 81% during low and high flow periods, respectively. Lead was enriched in Mex bay sediments sampled opposite to Alexandria Petroleum Company outfall reaching 171.2 μg g^{-1} while opposite to Umum drain, Chlor-alkali plant and Western harbor/Mex bay connection area levels were: 89.6, 34.7 and 48.2 μg g^{-1}, respectively, compared with offshore levels of 18.7 μg g^{-1}. Most of lead in sediments appeared in the organic and Fe/Mn hydroxides fractions.

Atmospheric transport is of major consideration in lead cycling. Wet and dry depositions contributed to about 2.1 ± 0.7 T y^{-1} and 0.8 ± 0.4 T y^{-1} of lead to Mex bay. However, this amount accounts for no more than 24% of total lead input to the bay through landbased sources. Sedimentation rates data (corrected for organic matter decomposition but not for resuspension) using sediment traps, deployed in the bay for two weeks, were 21.7 ± 6.3 g m^{-2} d^{-1} and 9.5 ± 1.8 g m^{-2} d^{-1} for Mex bay inshore and offshore waters, leading to an average total sedimentary flux of about 1.3 T y^{-1}.

An imbalance between the in/out fluxes of lead in Mex bay accounting to about 2.24 T y^{-1} indicate its accumulation in the water column. The standing stock of lead in the bay is 1.3 T. Phyto- and zooplankton contributed to about 0.16 ± 0.07 T and 0.3 ± 0.2 T of the lead present in the bay. Representatives of the food web showed lead accumulation in different parts of demersal rather than pelagic living organisms. Bivalves (*Donax trunculus*) and the macroalgae (*Ulva rigida*) recorded elevated accumulation factors (range 1200-4000) indicating high accumulation rates. Although the lead contents of the flesh for most common commercial fish species sampled in the bay was consistently low (< 0.3 μg g^{-1}) accumulation in liver and kidney is much higher i.e. range 10-22 and 6-13 μg g^{-1},respectively. Assessing the quantitative contribution of fish, bivalves and algae to the biogeochemical cycle of lead in the bay needs further investigations concerning their stocks and periodicity.

REFERENCES

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