Journal of Environmental Sciences (China) Vol. 4, No. 3, pp. 88–90, 1992 ISSN 1001-0742

Heavy metal pollution of aquatic sediments in the Le An River-Poyang Lake area

Schmitz, W. and Ramezani, N.

Institute of Sedimentology, University of Heidelberg, Germany

Mao Meizhou and Wang Zhihai

Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085, China

Abstract — The sediment quality mapping of Cu, Zn, Pb and Cd in the < 20 μm fraction of surface sediments of the Le An River-Poyang Lake area clearly proves that the mining activities of Dexing Copper Mine and nearby smaller Pb-Zn mines have already polluted the aquatic system to some extent. Although pollution indices of the Poyang Lake sediments are still close to background values, first results from sediment cores point to a definite trend of gradually increasing contamination.
Keywords: heavy metal; aquatic sediments; copper mine.

INTRODUCTION

The Poyang Lake area comprises the Poyang Lake and its five major tributaries including the Rao River-Le An River system, located in the Southeast of China. Lake Poyang is one of the largest freshwater resources in China, discharges finally into the Yangtze River. It is known that acid waters containing heavy metals had already entered the aquatic system before the mines were opened. However, no data are available on the pre-mine situation with regard to heavy metal contamination. To evaluate inventory ("pool"), pollution history and "forecast" of the heavy metals' impact, sediment cores were taken both in rivers and the lake. To get essential information on carrier particles and transformation processes, we apply sequential chemical extraction.

MATERIALS AND METHODS

Sediments were collected, using a Van Veen grab sampler, at 40 stations along 279 km of Le An River from Dexing Copper Mine entering Poyang Lake up to 15 km. Vertical core profiles were taken, using a Phleger valve corer, at 20 stations along the river and on three rays in Poyang Lake.

We based the heavy metal analysis on a standardized procedure with regard to particle size by separating fraction < 20 μm with nylon sieves (Förstner, 1980; Ackermann, 1983). Applying sequential leaching technique after Tessier *et al.* (Tessier, 1979) and Salmons and Förstner (1980), we used bulk wet surface sediments. Material of fraction < 20 μm of surface sediments (top 10–15 cm) and core profiles (1 cm slices) were digested by HNO_3. The copper, zinc, lead and cadmium contents of total digests and leachates were determined by AAS. Pb–210 and Cs–137 techniques were used for dating the sediment cores (Dominik, 1981).

RESULTS AND DISCUSSION

Comparison of the average metal concentrations for unpolluted sediments (fraction < 2 μm) from recent lakes (Förstner, 1983). We used a quantitative measure of metal pollution in aquatic sediments introduced by Müller (Müller, 1979), which is called the " Index of Geoaccumulation".

Upstream of Le An River at San Guang Qiao, a site remote from the mining area, we observe concentrations of Cu, Zn and Pb within the range found for recent lakes. For Cd it is noticeable that the sediments are already moderately polluted (I_{geo}–class 2). Upstream of the mining area the pollution status is quite similar with the exception of Zn (I_{geo}–class 2) and Cd (I_{geo}–class 3) at Haikou caused by discharges of an activated carbon factory. The first impact of Cu occurs at Pan Long An, where alkaline wastewaters from the tailings reservoir enter Le An River. The inflow of floatation agents should be very high at this site.

Starting at the converging point of the Dawu River, Gukou which is affected mostly by acid mine drainage and alkaline wastewaters, down to Futiancun, Cu reaches the highest grade, which indicates a very strong pollution. The indices for Zn and Cd increase by one grade compared to the upstream background values. Nearly 30% of Cu is partitioned in the sulphidic / organic fraction, suggesting again the influence of floatation agents as carrier modifiers. In contrast 40–50% of the Zn has been found in the reducible fraction, indicating that oxyhydroxides are the main carrier for Zn. About 40 km downstream of Dawu River mouth the Jishui River is also strongly polluted by Zn, Cd (both I_{geo}–class 4) and Pb (I_{geo}–class 3) due to a number of small Pb-Zn mines.

Further downstream the pollution indices for Cu, Zn and Cd remain between I_{geo}–class 3–4; the sediments are strongly polluted.

Entering the Poyang Lake at Longkou the situation becomes less serious. Up to 5 km from Longkou the sediments clearly indicate the heavy metal contamination caused by the mining operations in the upper reaches (Chen, 1989). Sites remote from this tributary in a range of 10–15 km are comparable to the background values in the upstream of Le An River.

These findings clearly characterize the Rao River-Le An River system as a point source for the southeastern part of Lake Poyang. This is also proved by sediment cores for example from Caijiawan and 2 km northwest of Longkou in Poyang Lake. Both Cu profiles show strong evidence for gradually increasing pollution on both sites. Particularly the last named Cu profile indicates the beginning contamination in the early sixteen (Cs–137), which is incidentally at the

same time when Dexing Copper Mine starts operation.

REFERENCES

Ackermann, F., Bergmann, H. and Schleichert, U., Environ. Sci. Technol., 1983, 4 : 317

Chen, J., Dong, L. and Deng, B., Hydrobiologia, 1989, 176/ 177:159

Dominik, J., Mangini, A. and Müller, G., Sedimentology, 1981, 28 :653

Förstner, U. and Salomons, W., Environ. Sci. Technol., 1980, 1:494

Förstner, U. and Wittmann, G., Metal Pollution in the aquatic environment, Berlin, Heidelberg, New York: Springer Verlag, 1983:486

Müller, G., Umschau, 1979, 79 : 778

Tessier, A., Cambell, P. G. C. and Bisson, M., Anal. Chem., 1979, 51 (7):844

(Received October 9, 1991)