

## The concentration and distribution of mercury species in aquatic ecosystems of Baihua reservoir

YAN H. Y.<sup>1,2</sup>, FENG X. B.<sup>1,\*</sup>, JIANG H. M.<sup>1,2</sup>, QIU G. L.<sup>1,2</sup>, SHANG L. H.<sup>1,2</sup>, ZHENG W.<sup>1,2</sup>,  
DAI Q. J.<sup>1,2</sup>, LI G. H.<sup>1,2</sup>, WANG S. F.<sup>1,2</sup>, HOU Y. M.<sup>1,2</sup>

<sup>1</sup>State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry Chinese Academy of Sciences, Guiyang 550002, PR China

<sup>2</sup>Graduate School of the Chinese Academy Sciences, Beijing 100039, P R China

\*Corresponding author; E-mail address: xinbin.feng@mail.gyig.ac.cn

**Abstract:** Mercury species in water columns, sediment and fish from the Hg-contaminated BaiHua reservoir were measured by trap pre-concentration and CVAFS detection method. The results show that the highest average total Hg concentration is up to 73.36 ngL<sup>-1</sup> in water columns, 186.7 ngL<sup>-1</sup> in pore water of surface sediment in BaiHua reservoir. The range of total mercury concentrations in surface sediment is from 0.87 to 33.74 mg/g. This suggests that the re-suspension of the sediment and Hg input from organic chemical plant that is located at upstream of the reservoir are the main mercury contamination sources of this reservoir. In addition, the probable reasons why mercury concentrations in fish are very low in this reservoir are that the low DOC concentrations and high pH of the water, which are not in favor of methylmercury formation and consequently bioaccumulation in food-chain.

**Key words:** Speciation, reservoir, aquatic ecosystem

### INTRODUCTION

The biogeochemical cycle of mercury in aqueous system is important to global dispersion of mercury and the health safety of fish consumers. Dissolved gaseous mercury (DGM) evasion is considered to be one of the most important mercury sources for the atmosphere. At the same time, this procedure reduces the Hg burden in the water column and may thus decrease the methylmercury production and accumulation in fish<sup>[1]</sup>. Baihua reservoir (106°27'-106°34'N, 26°35'-26°42'E) situated in Guizhou Province, has suffered from serious mercury contamination from Guizhou Organic Chemical

Plant (GOCP), which used metallic mercury as a catalyst to produce acetic acid and is located at the upper reaches of the reservoir. The water, sediment and fish samples from Baihua reservoir were collected using metal clean protocols in winter 2002. As shown in Figure 1, three sampling sites were selected at the upper, middle and down parts of the reservoir in this campaign, respectively. Dissolved gaseous mercury (DGM), dissolved reactive mercury (DRHg), dissolved total mercury (DTHg) concentration and particulate mercury, PHg, in water profiles and pore water of the sediments were measured by trap pre-concentration and CVAFS detection methods<sup>[2]</sup>. Mercury in sediment was mea-

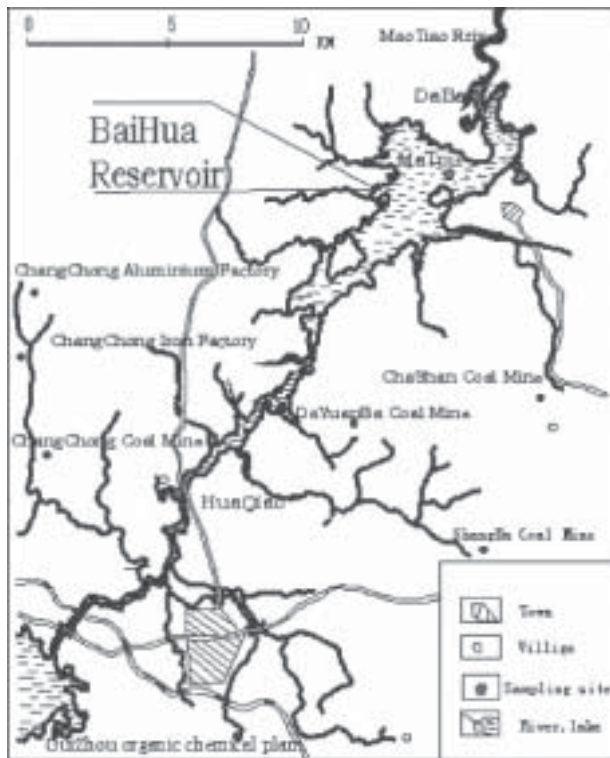


Figure 1. Sampling locations at BaiHua Reservoir

sured using acid digestion and cold vapor atomic absorption spectrometry (CVAAS) detection methods.

## RESULTS AND DISCUSSION

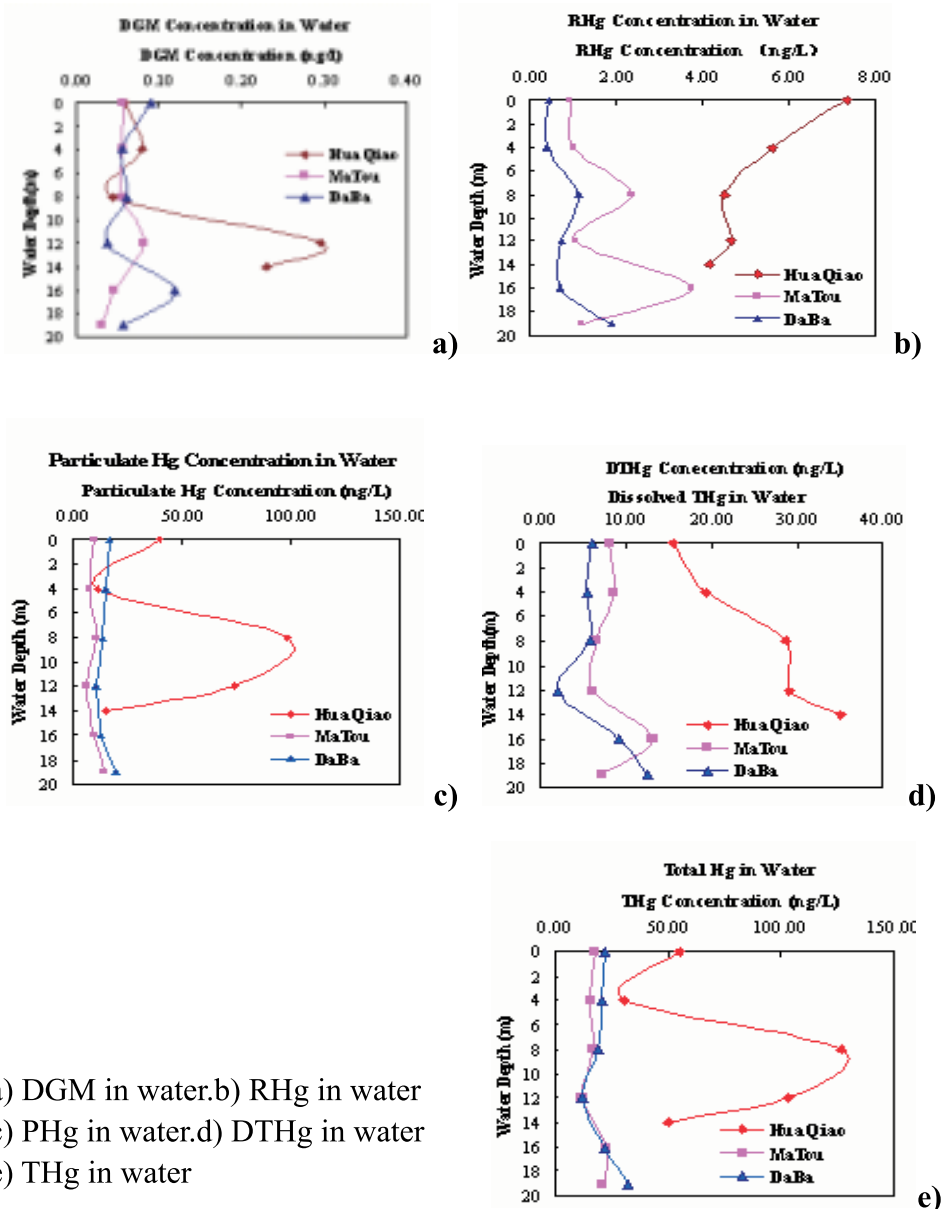
The concentration and distribution of mercury species in water profiles of BaiHua reservoir are shown in Fig 2.

The results indicate that there is no steady stratosphere in this reservoir, and the distribution trend of mercury species in water profiles, pore water and sediment showed that mercury concentration in three sites gradually reduces along the water flow, and the

highest concentration site presented in the upper stream (at Huaqiao) of the lake. The main reasons for this probably are that Huaqiao is close to Guizhou organic chemical plant, a mercury draining source and that the fast current velocity increased the number of particulate matters in water column, which are rich in mercury. For the similar reason, at Matou site, PHg concentration is lower than that at DaBa because draining in dam disturbed surface sediment, which increased the number of particulate matters with Hg high concentration in the water columns. It is also shown in Figure 2 that particulate mercury has a main effect on the concentration and distribution of total Hg in water column. Furthermore, there is a simi-

lar distribution trend between dissolved reactive mercury (RHg) and dissolved total mercury (DTHg) in water column. Particulate mercury concentration in upper stream is higher than that in down stream, and the highest average dissolved reactive, dissolved

total mercury, particulate mercury and total mercury concentrations are  $5.25 \text{ ngL}^{-1}$ ,  $25.58 \text{ ngL}^{-1}$ ,  $47.78 \text{ ngL}^{-1}$  and  $73.36 \text{ ngL}^{-1}$ , respectively. DGM concentrations in surface water at three sites are in the similar level, but there is all an increase trend of DGM from



a) DGM in water. b) RHg in water  
c) PHg in water. d) DTHg in water  
e) THg in water

Figure 2. The concentration and distribution of mercury species in water of BaiHua Reservoir

the surface water to the bottom, indicating some of chemical and/or biologic process produces DGM in the bottom part of the water column. Total mercury concentrations in surface sediment are from 0.87 to 33.74 mg/g, and the highest concentration of THg in pore water from surface sediments is 186.7 ngL<sup>-1</sup>. Mercury concentration in the down water layer is obviously higher than that in upper water layer.

Our study showed that even though the reservoir is seriously contaminated with mercury, mercury concentrations in fishes from the reservoir are very low in comparison to other similar lakes<sup>[3]</sup>. The total mercury concentration in fish is only 7-61 ngg<sup>-1</sup> (wet). We believe that high pH (average pH is 8.0) and low DOC (0.3 mgL<sup>-1</sup>) of the reservoir are not in favor of mercury methylation and subsequent bioaccumulation in food chain.

## REFERENCES

- [1] NRIAGU, J. O. (1994): Mechanistic steps in the photoreduction of mercury in natural waters. *Sci. Total. Env.* 154, pp. 1-8.
- [2] YAN HAI-YU, FENG XIN-BIN, SHANG LI-HAI (2003): Speciation analysis of ultra trace levels of mercury in natural waters; *Journal of instrumental analysis* 22(5), pp. 10-13
- [3] HECKY, R. E., RAMSEY, D. J., BODALY, R. A., STRANGE, N. E. (1991): Increased methylmercury contamination in fish in newly formatted freshwater reservoirs; In (SUZUKI, T. ET AL., Ed.) *Advances in Mercury Toxicology*, New York, Plenum Press, pp. 33 -52.

## CONCLUSION

BaiHua reservoir is seriously contaminated with mercury, but total Hg content in fish is lower than that in uncontaminated acid lakes in Europe and North America. Low DOC concentration and high pH of the reservoir water are responsible for the low methylation rate of mercury in the aquatic system. Particulate mercury is the major mercury species in the water of Baihua reservoir.

## Acknowledgements

This work was financially sponsored by Chinese Academy of Sciences through “Hundred Talent Plan” and through an innovation project (KZCX2-105), and by Chinese Natural Science Foundation (40173037).