

Horizontal distribution features of Pb in bottom waters in Jiaozhou Bay

Dongfang Yang^{1,2,3,a}, Sixi Zhu^{1,2}, Zhikang Wang^{1,2}, Xiuqin Yang^{1,2} and Ming Wang^{1,2}

¹Research Center for Karst Wetland Ecology, Guizhou Minzu University, Guiyang 550025, China;

²College of Chemistry and Environmental Science, Guizhou Minzu University, Guiyang 550025, China;

³North China Sea Environmental Monitoring Center, SOA, Qingdao 266033, China.

^adfyang_dfyang@126.com

Keywords: Pb; Bottom water; Horizontal distribution; Features; Jiaozhou Bay.

Abstract. Based on investigation data on Pb in bottom waters in Jiaozhou Bay during 1979-1982, we analyzed the horizontal distribution features of Pb. Results showed that there were high value regions in bottom waters in the center of the bay mouth, and there were three horizontal distribution features of Pb contents in bottom waters, i.e., 1) decreasing from the inside of the bay mouth to the outside of the bay mouth, 2) decreasing from the outside of the bay mouth to the inside of the bay mouth, and 3) decreasing from the bay mouth to the inside and outside of the bay mouth. In according to the horizontal distribution of Pb in bottom waters, it was found that the bay mouth and the inside of the bay mouth were undergoing relative long time of high sedimentation rate, yet the outside of the bay mouth was undergoing relative short time of high sedimentation rate. These founding were helpful to reveal the sedimentation mechanism of Pb in marine bay.

Introduction

Lead (Pb) has been widely used in industry and agriculture. However, the environment has been polluted by Pb since the waste treatment was lagging to the emission of Pb-containing waste. Ocean is the sink of pollutants, and the understanding of the distributions of Pb in bottom waters in marine bay is essential to environmental protection.

Jiaozhou Bay is located in Shandong Province, China, and is surrounded by economic and agricultural developed regions of Qingdao, Jiaozhou and Jiaonan. Previous studies showed that this bay had been polluted by various pollutants including Pb [1-6]. This aim of this paper is to analyze the horizontal distribution features of Pb contents in bottom waters during 1979-1982 in this bay, and to provide scientific basis for pollution control.

Study area and data collection

Jiaozhou Bay (35°55'-36°18' N, 120°04'-120°23' E) is located in the south of Shandong Province, eastern China (Fig. 1). It is a semi-closed bay with the total area and average water depth are 446 km² and 7 m, respectively. The bay mouth is located between Tuandao Island and Xuejiadao Island, and is connect to Yellow Sea in the south. The width of the bay mouth is only 3 km. Most of the rivers have seasonal features [7, 8].

The data was provided by North China Sea Environmental Monitoring Center. Pb contents in bottom waters were investigated in May, August and October 1979, June, July, September and October 1980, April, August and November 1981, and April, June, July and October 1982, respectively [1-6]. Bottom water samples were collected and measured followed by National Specification for Marine Monitoring [9].

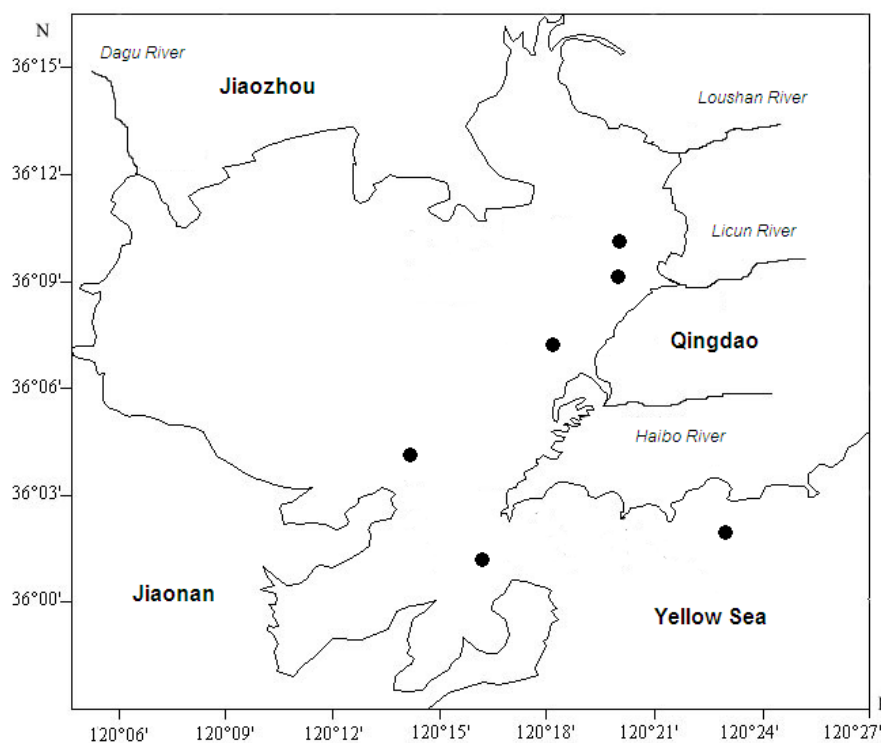


Fig.1 Geographic location and monitoring sites in Jiaozhou Bay

Results

In according to the location, the sampling sites were distribution from the inside of the bay, the bay mouth and the outside of the bay, respectively (Fig. 1). High value region of Pb was all occurring in the bay mouth in different months in 1979, yet there were two different horizontal distribution features. In May and October 1979, Pb contents were decreasing from the outside of the bay mouth to the bay mouth. While in August 1979, Pb contents were decreasing from the bay mouth to the inside and outside of the bay mouth. In 1980, high value region of Pb was all occurring in the outside of bay mouth in different months, and there was only one horizontal distribution feature. In different months in 1980, Pb contents in bottom waters were all decreasing from the outside of the bay mouth to the inside of the bay mouth. In 1981, high value region of Pb was all occurring in the bay mouth in different months, and there was only one horizontal distribution feature. In different months in 1981, Pb contents in bottom waters were decreasing from the bay mouth to the outside and inside of the bay mouth. High value region of Pb was all occurring in the bay mouth in different months in 1982, and there were two different horizontal distribution features. In April 1982, Pb contents were decreasing from the bay mouth to the bay mouth. While in July and October 1982, Pb contents were decreasing from the inside of the bay mouth to the bay mouth.

Discussion

Pb iron is low-soluble yet could be absorbed to suspended particulate matters. The growth and reproduction of marine organisms such as phytoplankton and zooplankton were increasing from May and reaching the climax in August, and there was a large amount of colloid in the surface of suspended particulate matters. Hence a lot of Pb irons were absorbed to the suspended particulate matters and were transferred to the bottom of the sea by means of gravity settling and biological settling. The horizontal distribution features of Pb in the bay were mainly determined by the gravity and biological settling, as well as the water exchange between the bay and the open waters. In according to the horizontal distribution of Pb in bottom waters, there were three horizontal distribution features of Pb contents in bottom waters, i.e., 1) decreasing from the inside of the bay

mouth to the outside of the bay mouth (Feature 1), 2) decreasing from the outside of the bay mouth to the inside of the bay mouth (Feature 2), and 3) decreasing from the bay mouth to the inside and outside of the bay mouth (Feature 3). The horizontal distribution features of Pb in bottom waters in different months during 1979-1982 were listed in Table 1. In 1980, high sedimentation regions were all occurring in the outside of the bay mouth. In 1981, high sedimentation regions were all occurring in the bay mouth. It was found that the bay mouth and the inside of the bay mouth were undergoing relative long time of high sedimentation rate, yet the outside of the bay mouth was undergoing relative short time of high sedimentation rate (Table 1). These findings were helpful to reveal the sedimentation mechanism of Pb in marine bay.

Table 1 The horizontal distribution features of Pb in the bottom waters in Jiaozhou Bay

| Year | Feature 1 | Feature 2 | Feature 3 |
|------|---------------|--------------------------------|-------------------------|
| 1979 | August | May, October | |
| 1980 | | June, July, September, October | |
| 1981 | | | April, August, November |
| 1982 | July, October | | April |

Conclusion

There were three horizontal distribution features of Pb contents in bottom waters, i.e., 1) decreasing from the inside of the bay mouth to the outside of the bay mouth, 2) decreasing from the outside of the bay mouth to the inside of the bay mouth, and 3) decreasing from the bay mouth to the inside and outside of the bay mouth.

The bay mouth and the inside of the bay mouth were undergoing relative long time of high sedimentation rate, yet the outside of the bay mouth was undergoing relative short time of high sedimentation rate. These findings were helpful to reveal the sedimentation mechanism of Pb in marine bay.

Acknowledgement

This research was sponsored by Doctoral Degree Construction Library of Guizhou Nationalities University, Education Ministry's New Century Excellent Talents Supporting Plan (NCET-12-0659), the China National Natural Science Foundation (31560107), Major Project of Science and Technology of Guizhou Provincial ([2004]6007-01), Guizhou R&D Program for Social Development ([2014] 3036) and Research Projects of Guizhou Nationalities University ([2014]02), Research Projects of Guizhou Province Ministry of Education (KY [2014] 266), Research Projects of Guizhou Province Ministry of Science and Technology (LH [2014] 7376).

References

- [1] Yang D F, Su C, Gao Z H, et al.: Chin. J. Oceanol. Limnol., Vol. 26(2008): 296-299.
- [2] Yang DF, Guo JH, Zhang YJ, et al.: Journal of Water Resource and Protection, Vol. 3(2011): 41-49.
- [3] Yang DF, Zhu SX, Wang FY, et al.: Applied Mechanics and Materials, Vol. 651-653(2014), p. 1419-1422.
- [4] Yang DF, Geng X, Chen ST, et al.: Applied Mechanics and Materials, Vol. 651-653 (2014), p. 1216-1219.
- [5] Yang DF, Ge HG, Song FM, et al.: Applied Mechanics and Materials, Vol. 651-653 (2014), p.

1492-1495.

[6] Yang DF, Zhu SX, Wang FY, et al.:Applied Mechanics and Materials, Vol.651-653 (2014), p. 1292-1294.

[7] Yang DF, Chen Y, Gao ZH, Zhang J, et al.:Chinese Journal of Oceanology and Limnology, Vol. 23(2005): 72-90.

[8] Yang DF, Wang F, Gao ZH, et al.: Marine Science, Vol. 28 (2004), p.71-74.

[9] State Ocean Administration. The specification for marine monitoring: Beijing, Ocean Precess, (1991).

[10]Yang DF, Wang FY, He HZ, et al.:Proceedings of the 2015 international symposium on computers and informatics, (2015), p. 2655-2660.