High sedimentation rate region of Pb in Jiaozhou Bay

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Abstract. Based on investigation dada on lead (Pb) in July and October 1984 in bottom waters in Jiaozhou Bay, we analyzed the content, pollution level and distribution of Pb. Results showed that Pb contents in 1984 in bottom waters were 1.33-17.34 μg L^{-1} and were meeting Grade II, III and IV in National Sea Water Quality Standard (GB 3097-1997). There were high sedimentation regions in different positions by means of vertical water's effect. There was high sedimentation region in the outside of the bay mouth in July, while in October there was high sedimentation region in the bay mouth. Pb contents in waters and the vertical water's effect was the major reason for the distributions of the water quality and sedimentation rates of Pb in Jiaozhou Bay.

Introduction

Pb has been widely used in industry and agriculture, and a large amount of Pb-containing waste waters were generated and discharged to rivers and marine bays along with the rapid increase of industry and agriculture [1-6]. The Pb pollution in the environment could be harmful to human via food chain due to the high toxicity of Pb. The research on the contents, pollution levels and migration process of Pb in marine bay was essential to reveal the exist and tranfer of Pb in marine bay [1-6].

Jiaozhou Bay is a semi-closed bay located in Shandong province, eastern China, and had been polluted by various pollutants including Pb [1-6]. This paper analyzed the contents, pollution levels and migration process of Pb based on investigation dada on Pb in July and October 1984 in bottom waters in Jiaozhou Bay, and tried to provide scientific basis for provide basis for understanding the contents and migration process of Pb.

Material and method

Jiaozhou Bay (35°55′-36°18′ N, 120°04′-120°23′ E) is a semi-closed bay located in the south of Shandong Province, eastern China (Fig. 1). The total area, average water depth and bay mouth depth 446 km^2, 7m and 3 km, respectively. This bay was arounded by Qingdao City, Jiaozhou City and Jiaonan City in the east, north and west, respecitively, and was connected to Yellow Sea in the south. The bay has more than ten inflow rivers, including Haibo Rriver, Licun Rriver and Loushan Rriver etc., all of which have seasonal features [7-8]. The data was provided by North China Sea Environmental Monitoring Center. The survey was conducted in July August and October 1984. Pb in surface waters in six sampling sties (Site 2031, Site 2032 and Site 2033) (Fig. 1) were sampled and monitored follow by National Specification for Marine Monitoring [9].

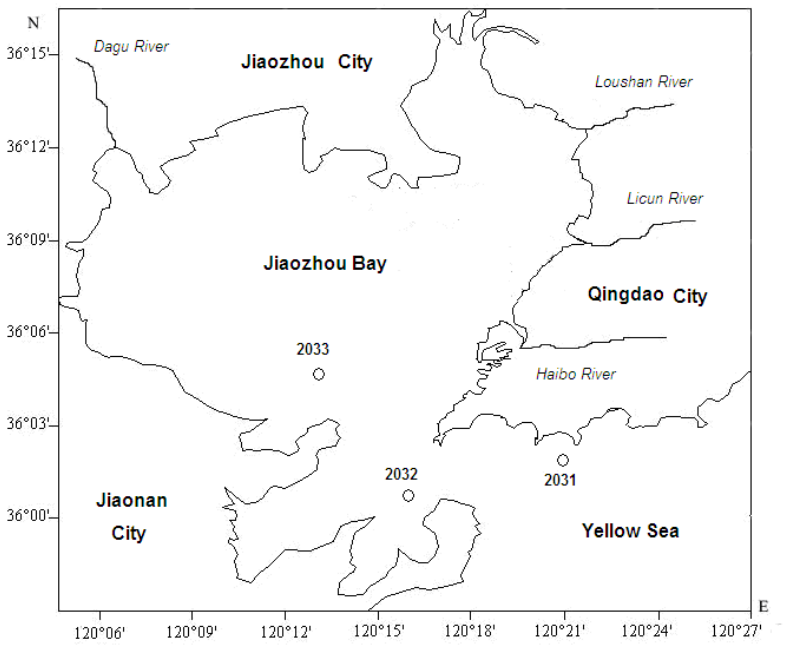

Fig.1 Investigation sites in Jiaozhou Bay

Results and discussion

Contents of Pb in bottom waters. Pb contents in bottom waters in July and October 1984 in Jiaozhou Bay were 1.33-17.34 μg L^{-1} (Table 1), and were meeting Grade II, III and IV in National Sea Water Quality Standard (GB 3097-1997) (Table 2). In July, Pb contents in bottom waters were ranging from 7.14-17.34 μg L^{-1}, and were meeting Grade III to Grade IV (Table 1), indicated that the pollution level of Pb was heavy in July. In October, Pb contents in bottom waters were ranging from 1.33-2.25 μg L^{-1} (Table 1), and were meeting Grade II, indicated that the pollution level of Pb was moderate in October. For the whole year in 1984, this bay could be considered as heavy Pb pollution.

Table1 Pollution level of Pb in bottom waters in Jiaozhou Bay in Julyand October 1984

Month	July	October
Content/μg L^{-1}	7.14-17.34	1.33-2.25
Water quality grade	III and IV	II

Table 2 Guideline of Pb in National Sea Water Quality Standard (GB 3097-1997)

Grade	I	II	III	IV
Content/μg L^{-1}	1.00	5.00	10.00	50.00

Horizontal distributions of Pb in bottom waters. As showed in Fig. 1, Site 2033, Site 2023 and Site 2031 were located in the inside of the bay mouth, the middle of the bay mouth and the outside of the bay mouth, respectively. In July, there was a high value (17.34μg L^{-1}) in Site 2031 and a high value region in the outside of the bay mouth, and there were a series of parallel lines, which were decreasing from the high value center in the east to coastal regions in the west of the bay mouth (7.15 μg L^{-1}) (Fig. 2). In October, there was a high value (2.25 μg L^{-1}) in Site 2032 in the middle of the bay mouth, and there were a series of parallel lines, which were decreasing from the middle of the bay mouth to he east in the outside of the bay mouth (1.33 μg L^{-1}). The distributions of Pb in bottom waters indicated that there were different migration processes.

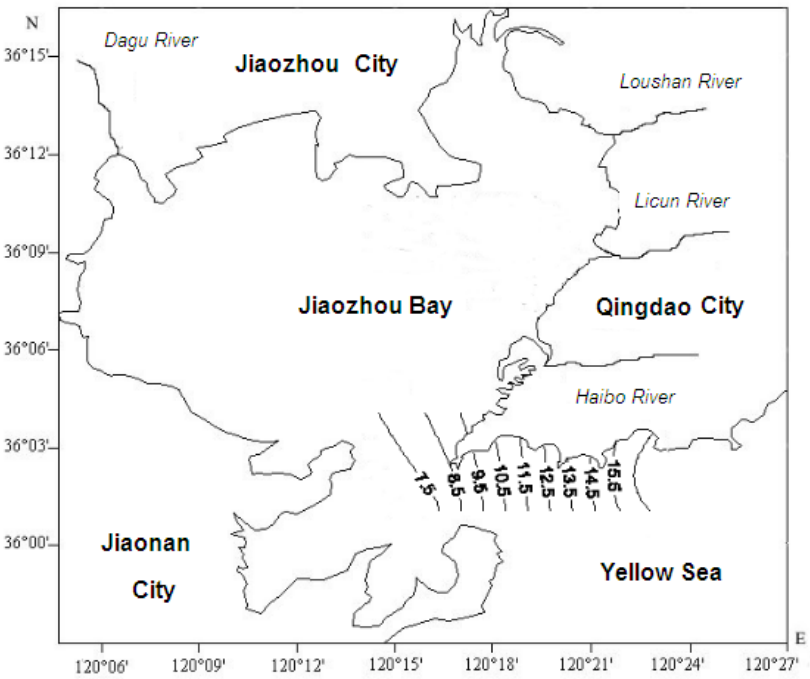

Fig. 2 Horizontal distributions of Pb in bottom waters of Jiaozhou Bay in July 1984/μg L^{-1}

Migration processes of Pb in bottom waters. The distributions of Pb in bottom waters showed that Pb contents were increasing from the middle of the bay mouth to the outside of the bay mouth in July, yet in October were reverse. In July, there were low sedimentaion rate region and high sedimentaion rate region in the middle of the bay mouth and the outside of the bay mouth, respectively. In October, here were high sedimentaion rate region and low sedimentaion rate region in the middle of the bay mouth and the outside of the bay mouth, respectively. The contents of the substants in marine bay were continously decreasing along with the water exchange of the bay and the open sea [11]. Pb contents in the bay mouth was mataining in a relative high level in July because Pb contents in the bay were relative high in July, yet was relative low in October due to Pb contents were relative low in October (Table 1). By means of the contents of Pb in waters and the vetical water's effect, there were high sedimentaion rate regions in the outside of the bay mouth in July and in the outside of the bay mouth in October.

Conclusion

Pb contents in bottom waters in July and October 1984 in Jiaozhou Bay were 1.33-17.34 μg L^{-1}, and were meeting Grade II, III and IV in National Sea Water Quality Standard (GB 3097-1997), indicated that this bay was heavy polluted by Pb in 1984. By means of the contents of Pb in waters and the vetical water's effect, there was high sedimentaion rate regions in the outside of the bay mouth in July and in the outside of the bay mouth in October.

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References

[1] Yang D F, Su C, Gao Z H, et al.: Chinese Journal of Oceanology Limnology, Vol. 26(2008), p. 296-299.

[2] Yang DF, Guo JH, Zhang YJ, et al.: Journal of Water Resource and Protection. Vol. 3(2011), p. 41-49.

[3] Yang DF, Zhu SX, Wang FY, et al.: Applied Mechanics and Materials, Vols. 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, et al.: Chinese Journal of OceanoLogy and LimnoLogy, Vol. 23(2005), p. 72-90.

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

[9] China's State Oceanic Administration: The specification for marine monitoring (Ocean Press, Beijiang 1991), p.1-300. (in Chinese)

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

[11] Yang DF, Miao ZQ, Xu HZ, et al.: Marine Science, Vol. 32 (2013), p. 373-380.