High sedimentation rate of Pb in the bay mouth of Jiaozhou Bay

Dongfang Yang[1,2,3,a] , Sixi Zhu[1,2] , Ming Wang[1,2] , Xiuqin Yang[1,2] and Fengyou Wang [1,2,b,c]

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

[2]College of Chemistry and Environmental Science, Guizhou Minzu University, Shanghai, 550025, China;

[3]North China Sea Environmental Monitoring Center, SOA, Qingdao 266033, China;

[a]dfyang_dfyang@126.com; [b]Corresponding author; [c]wangfy2001@yahoo.com.cn.

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Abstract. Based on investigation data on Pb in bottom waters in 1985, we analyzed the content, pollution and horizontal distribution of Pb in bottom waters in the bay mouth of Jiaozhou Bay, eastern China. Results showed that Pb contents were 8.57-36.35 μg L^{-1}, and were confirmed with Grade III to IV in according to Chinese Sea Water Quality Standard (GB 3097-1997), indicated that the pollution level of Pb was heavy. The pollution sources in different seasons were different, and the Pb sedimentation rate of were occurring in different regions. In April, July and October, Pb high sedimentation rate regions were in the bay mouth, the outside of the bay mouth and the bay mouth, respectively. The differences were determined by vertical water's effect.

Introduction

Ocean is the sink of pollutants. Once Pb-containing waste gas and waste water was discharged to the environmental, the marine water quality could be degraded by atmosphere deposition, stream flow discharge, etc [1-6]. By means of vertical water's effect [7], Pb was transferring from surface waters to bottom waters, resulting in the changing of Pb content in waters. Pb is not only toxic, but is also persistent in the environment, and the excessive remaining of Pb in the environmental is harmful to the health of both ecosystem and human. Based on investigation data on Pb in bottom waters in 1985, we analyzed the content, pollution and horizontal distribution of Pb in bottom waters in the bay mouth of Jiaozhou Bay, eastern China, and to provide scientific basis for researching on the existence and transfer of Pb in marine bay.

Materials and method

Jiaozhou Bay is located in the south of Shandong Province, eastern China (35°55′-36°18′ N, 120°04′-120°23′ E), which is connected to the Yellow Sea in the south. The total area, average water depth and bay mouth width are 446 km^2, 7 m and 3 km, respectively. This bay is a typical of semi-closed bay. There are a dozen of inflow rivers, and the majors are Dagu River, Haibo Rriver, Licun Rriver, and Loushan Rriver etc., all of which are seasonal rivers [8-9].

The investigation on Pb in bottom waters in Jiaozhou Bay was carried on in April, July and October 1985 in three investigation sites namely 2031, 2032 and 2033, respectively (Fig. 1). Pb in bottom waters were sampled and monitored follow by National Specification for Marine Monitoring [10].

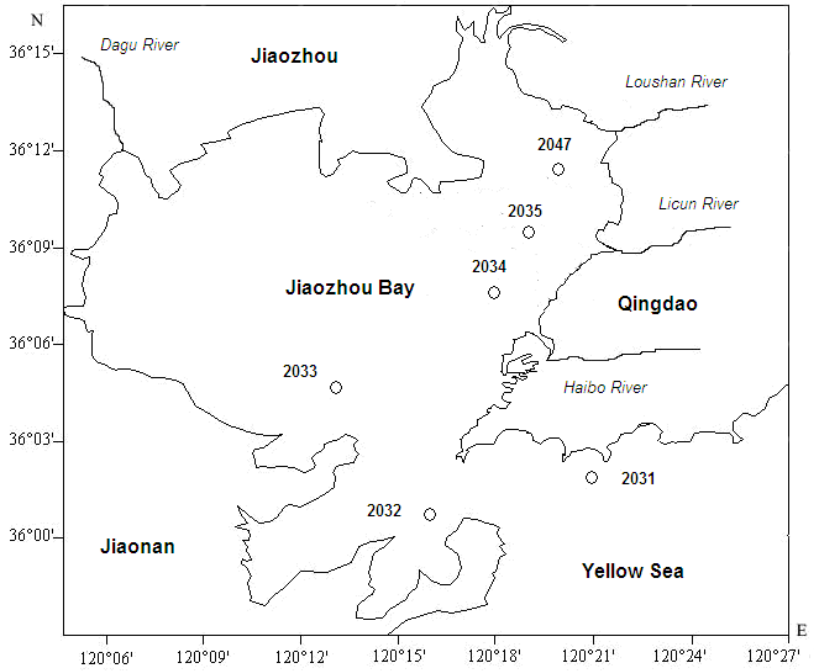

Fig. 1 Geographic location and sampling sites in Jiaozhou Bay

Results and discussion

Contents of Pb in bottom waters. The guide line of Pb contents of Grand I, Ⅱ, III and IV in Chinese Sea Water Quality Standard (GB 3097-1997) are 1.00 μg L^{-1}, 5.00 μg L^{-1}, 10.00 μg L^{-1} and 40.00 μg L^{-1}, respectively. Pb contents in bottom waters in April, July and October 1985 were 12.89-15.48 μg L^{-1}, 16.03-36.35 μg L^{-1} and 8.57-15.10 μg L^{-1}, respectively (Table 1). In according to Chinese Sea Water Quality Standard (GB 3097-1997), Pb contents in April and July and were Grade IV, while in October were Grade III to IV. In generally, Pb pollution in bottom water in Jiaozhou Bay in 1985 were very heavy, and were in order of summer>autumn>spring.

Table 1 Pb contents in bottom water in Jiaozhou Bay in April, July and October 1985

Time	April	July	October
Content/μg L^{-1}	12.89-15.48	16.03-36.35	8.57-15.10
Grade	IV	IV	III to IV

Horizontal distributions of Pb. The three sampling Sites of 2031, 2032 and 2033 were located in the outside of the bay mouth, the bay mouth and the inside of the bay mouth, respectively. In April, there was a high value zone in the coastal waters in the outside of the bay mouth, and the highest value (15.48 μg L^{-1}) was occurring in Site 2031 (Fig. 2). The contour lines were forming a series of parallel lines, which were decreasing from the open waters to the west of bay mouth (12.89 μg L^{-1}). In July, there was a high value zone in the bay mouth, and the highest value (36.35 μg L^{-1}) was occurring in Site 2032 (Fig. 3). The contour lines were forming a series of parallel lines, which were decreasing from the bay mouth to the open waters (16.03 μg L^{-1}). In October, there was a high value zone in the coastal waters in the outside of the bay mouth, and the highest value (15.10 μg L^{-1}) was occurring in Site 2031 (Fig. 4). The contour lines were forming a series of parallel lines, which were decreasing from the open waters to the west of bay mouth (8.57 μg L^{-1}).

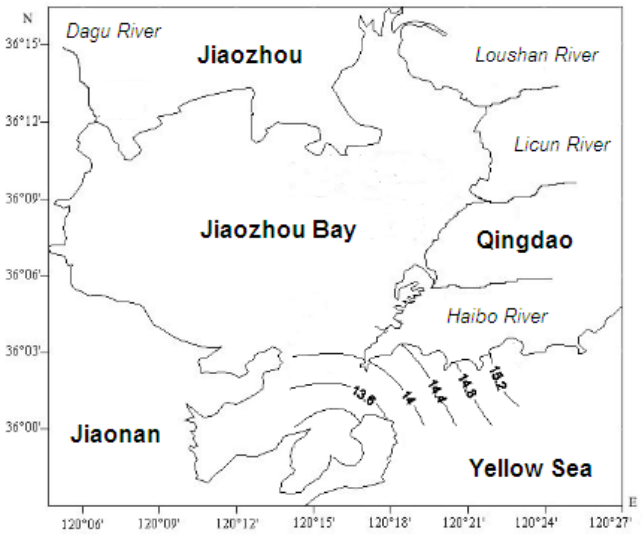

Fig. 2 Horizontal distribution of Pb contents in bottom waters in April 1985 in the bay mouth of Jiaozhou Bay/μg L^{-1}

Fig. 3 Horizontal distribution of Pb contents in bottom waters in July 1985 in the bay mouth of Jiaozhou Bay/μg L^{-1}

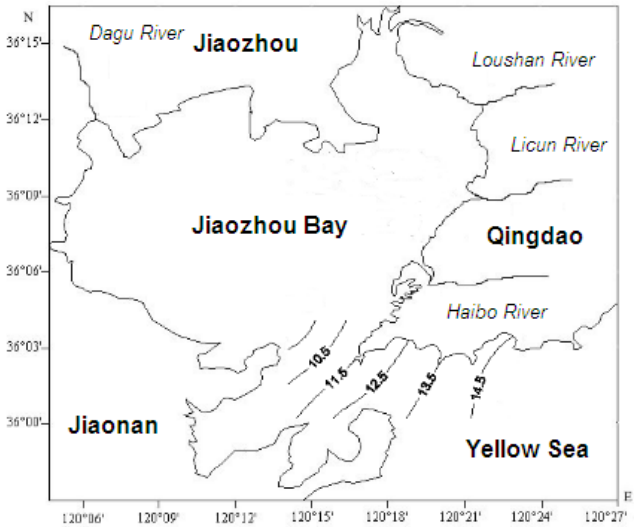

Fig. 4 Horizontal distribution of Pb contents in bottom waters in October 1985 in the bay mouth of Jiaozhou Bay/μg L^{-1}

Transfer process of Pb. The contents of the substances were decreasing contentiously by means of water exchange [11]. Pb contents in April were 12.89-15.48 μg L^{-1}, and were increasing from the bay mouth to the open waters. Hence, in April, low sedimentation rate region was in the bay mouth, yet high sedimentation rate region was in the outside of the bay mouth. Pb contents in July were 16.03-36.35 μg L^{-1}, and were increasing from the bay mouth to the open waters and the center of the bay. Hence, in July, low sedimentation rate region was in the inside and outside of the bay mouth, yet high sedimentation rate region was in the bay mouth. Pb contents in October were 8.57-15.10 μg L^{-1}, and were increasing from the bay mouth to the open waters. Hence, in October, low sedimentation rate region was in the bay mouth, yet high sedimentation rate region was in the outside of the bay mouth. It could be found that the high sedimentation rate region were occurring in different regions in different seasons due to the sources and Pb contents in surface waters were different. Pb contents were relative low in bottom waters in April and October, and the high sedimentation rate regions were in the outside of the bay mouth. Pb contents were relative high in bottom waters in July, and the high sedimentation rate region was in the bay mouth.

Conclusions

Pb contents in April and July and were Grade IV, while in October were Grade III to IV in Jiaozhou Bay in 1985, and the contents were in order of summer>autumn>spring. High sedimentation rate region were occurring in different regions in different seasons due to the sources and Pb contents in surface waters were different. Pb contents were relative low in bottom waters in April and October, and the high sedimentation rate regions were in the outside of the bay mouth. Pb contents were relative high in bottom waters in July, and the high sedimentation rate region was in the bay mouth.

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