

Horizontal distributions of Pb in surface and bottom waters and the block diagram model in Jiaozhou Bay

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Abstract

This paper analyzed the horizontal distributions of Pb in surface and bottom waters in Jiaozhou Bay based on investigation of Pb in surface and waters in different seasons during 1979-1983. Results showed that Pb's horizontal distribution trends in surface and bottom waters were consist at some times, yet were reverse at some times. The horizontal distributions of of Pb contents in surface waters were mainly determined by the inputs of Pb by these sources and the water exchange between the bay and the open waters. However, the horizontal distributions of of Pb contents in bottom waters were determined by which in surface waters, as well as the sedimentation and accumulation of Pb in bottom waters. A block diagram model was provided to reveal the three stages of the transferring process of Pb in this bay, i.e., 1) Pb was input to the bay by various pollution sources, 2) Pb was dispersed to surface waters, and 3) Pb was transferred to bottom waters.

Keywords

Pb, Horizontal distribution, surface waters, bottom waters, Block diagram model, Jiaozhou Bay.

1. Introduction

A large amount of Pb had been used in industries along with the rapid development of economic and population, and the Pb-containing waste was also increasing rapidly. However, the waste treatment was always lagging to waste emission, leading to the excessive emission of Pb to the environment. Nowadays, Pb pollution has been one of the critical environmental issues on a worldwide scale. Many marine bays were always surrounding by developed/developing cities, and were suffering from Pb pollutions for long time. Hence, understanding the distribution and transferring process was essential to marine environmental protection [1-6].

Jiaozhou Bay is a semi-closed bay located in south of Shandong Peninsula, eastern Chin. The aim of this paper was to analyze the horizontal distributions of Pb in surface and bottom waters in Jiaozhou Bay based on investigation data in surface waters in different seasons during 1979-1983, and to reveal the stages of the transferring process of Pb in this bay, and to provide scientific basis for environmental protection and the sustainable development of study area.

2. Study area and data collection

Jiaozhou Bay (120°04'-120°23' E, 35°55'-36°18' N) is located in the south of Shandong Province, eastern China (Fig. 1). It is a semi-closed bay with the total area, average water depth and bay mouth width of 446 km², 7 m and 3 km, respectively. There are more than ten inflow rivers (i.e., Haibo Rriver, Licun Rriver, Dagu Rriver, and Loushan Rriver), most of which have seasonal features [7-8].

The data was provided by North China Sea Environmental Monitoring Center. The survey was conducted in different months during 1979-1983 [1-6]. Surface and bottom water samples were collected and measured followed by National Specification for Marine Monitoring [9].

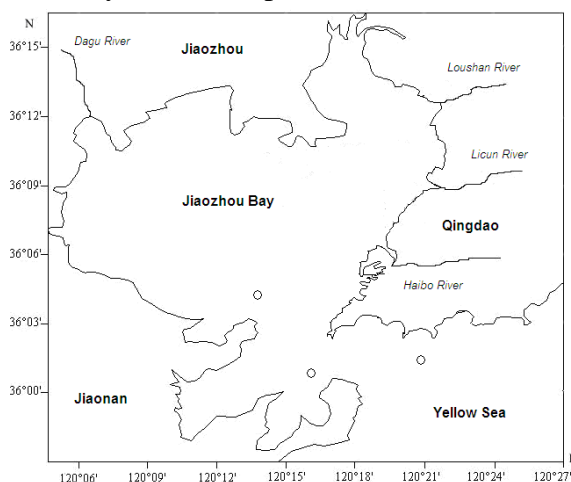


Fig.1 Geographic location and monitoring sites in Jiaozhou Bay

3. Results

In according to the geographical locations, the monitoring sites in Jiaozhou Bay were located in the inner bay and the bay mouth, respectively. Hence, the horizontal distribution trends of Pb in surface and bottom waters could be decreasing from the inner bay to the bay mouth or increasing from the inner bay to the bay mouth.

The horizontal distribution trends of Pb in surface and bottom waters in 1979 were list in Table 1. In May, August and October 1979, Pb contents in surface waters were all decreasing from the inner bay to the bay mouth, yet in bottom waters were all increasing from the inner bay to the bay mouth (Table 1).

Table 1 Horizontal distribution trends of Pb in surface and bottom waters in 1979

Month	Surface waters	Bottom waters	Same or reverse
May	Decreasing	Increasing	Reverse
August	Decreasing	Increasing	Reverse
October	Decreasing	Increasing	Reverse

The horizontal distribution trends of Pb in surface and bottom waters in 1980 were list in Table 2. In April, July and September 1980, Pb contents in surface waters were all increasing from the inner bay to the bay mouth, as well as in bottom waters. In October 1980, Pb contents in surface waters were also increasing from the inner bay to the bay mouth, yet in bottom waters were all decreasing from the inner bay to the bay mouth (Table 2).

The horizontal distribution trends of Pb in surface and bottom waters in 1981 were list in Table 3. In August and November 1981, Pb contents in surface waters were increasing from the inner bay to the bay mouth, as well as in bottom waters. In April 1981, Pb contents in surface waters were also decreasing from the inner bay to the bay mouth, yet in bottom waters were all increasing from the inner bay to the bay mouth (Table 3).

Table 2 Horizontal distribution trends of Pb in surface and bottom waters in 1980

Month	Surface waters	Bottom waters	Same or reverse
April	Increasing	Increasing	Same
July	Increasing	Increasing	Same
September	Increasing	Increasing	Same
October	Increasing	Decreasing	Reverse

Table 3 Horizontal distribution trends of Pb in surface and bottom waters in 1981

Month	Surface waters	Bottom waters	Same or reverse
April	Decreasing	Increasing	Reverse
August	Increasing	Increasing	Same
November	Increasing	Increasing	Same

The horizontal distribution trends of Pb in surface and bottom waters in 1982 were list in Table 4. In July and October 1982, Pb contents in surface waters were decreasing from the inner bay to the bay mouth, yet in bottom waters were increasing. In April 1982, Pb contents in surface waters were increasing from the inner bay to the bay mouth, yet in bottom waters were decreasing (Table 4).

Table 4 Horizontal distribution trends of Pb in surface and bottom waters in 1982

Month	Surface waters	Bottom waters	Same or reverse
April	Increasing	Decreasing	Reverse
July	Decreasing	Increasing	Reverse
October	Decreasing	Increasing	Reverse

The horizontal distribution trends of Pb in surface and bottom waters in 1983 were list in Table 5. In May, September and October 1983, Pb contents in surface waters were decreasing, increasing and decreasing from the inner bay to the bay mouth, yet in bottom waters were decreasing, decreasing and increasing from the inner bay to the bay mouth, respectively (Table 5).

Table 5 Horizontal distribution trends of Pb in surface and bottom waters in 1983

Month	Surface waters	Bottom waters	Same or reverse
May	Decreasing	Decreasing	Same
September	Increasing	Decreasing	Reverse
October	Decreasing	Increasing	Reverse

4. Discussion

During 1979-1983, the major sources of Pb in Jiaozhou Bay were stream flow, atmosphere deposition, marine current and marine traffic. Pb's horizontal distribution trends in surface and bottom waters were consist at some times, yet were reverse at some times (Table 1-Table 5). It could be found that the horizontal distribution trends of Pb in surface and bottom waters in 1979 were reverse; the horizontal distribution trends of Pb in surface and bottom waters in April, July and September 1980 were same, yet in October were reverse; the horizontal distribution trends of Pb in surface and bottom waters in August and November 1981 were same, yet in April 1981 were reverse; the horizontal distribution trends of Pb in surface and bottom waters in different months in 1982 were reverse; the horizontal distribution trends of Pb in surface and bottom waters in different months in April 1983 were same, yet in July and October were reverse.

In generally, the horizontal distributions of of Pb contents in surface waters were mainly determined by the inputs of Pb by these sources and the water exchange between the bay and the open waters, and the horizontal distributions of of Pb contents in bottom waters were determined by which in surface waters, as well as the sedimentation and accumulation of Pb in bottom waters. There were three stages of the transferring process of Pb in this bay (Fig. 2). Firstly, Pb was input to the bay by various pollution sources. Secondly, Pb was dispersed to surface waters. Thirdly, Pb was transferred to bottom waters. As showing in Fig. 2, the horizontal distribution trends of Pb in surface and bottom waters were revealing the input-output processes of Pb in this bay, and the sedimentation and accumulation of Pb in bottom waters. Due to the variations of the source strengths of the Pb sources, Pb's horizontal distribution trends in surface and bottom waters were consist at some times, yet were reverse at some times.

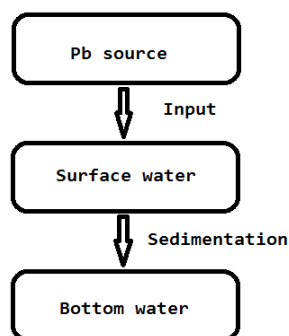


Fig.2 The block diagram model of the horizontal distributions of Pb in surface and bottom waters

5. Conclusion

Pb's horizontal distribution trends in surface and bottom waters were consist at some times, yet were reverse at some times. The horizontal distributions of of Pb contents in surface waters were mainly determined by the inputs of Pb by these sources and the water exchange between the bay and the open waters. The horizontal distributions of of Pb contents in bottom waters were determined by which in surface waters, as well as the sedimentation and accumulation of Pb in bottom waters. There were three stages of the transferring process of Pb in this bay, i.e., 1) Pb was input to the bay by various pollution sources, 2) Pb was dispersed to surface waters, and 3) Pb was transferred to bottom waters.

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