Vertical Distribution and Sedimentation of Cr in Jiaozhou Bay

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Abstract

Many marine bays have been polluted by various pollutants, among which Cr is one of the critical heavy metal. Based on the investigation on Cr in 1979, this paper analyzed the distributions of Cr in Jiaozhou Bay, a semi-closed bay in Shandong Province, China. Results showed that in waters around the bay mouth of Jiaozhou Bay, Cr contents were consisting in spatial, varying and vertical scales. In spatial scale, the gradient distributions of Cr contents in surface and bottom waters were consisting. In varying scale, the variation ranges of Cr contents in surface and bottom waters were closed. In vertical scale, Cr contents in surface and bottom waters were closed. By means of vertical water's effect, and in according to the vertical distributions of Cr, it was identified that the sedimentation of Cr were relative low in waters in the middle and the outside of the bay mouth, yet were relative high in waters in the inside of the bay mouth.

Keywords

Cr; Vertical distribution; Consistency; Sedimentation; Jiaozhou Bay.

1. Introduction

Cr is one of the widely used heavy metal in industries of metallurgy, chemical engineering, electroplate, leatherworking and so on, as well as one of the most critical environmental pollutants due to the high toxicity. Many marine bays have been polluted by Cr since a large amount of Cr-containing waste water is generating along with the rapid increasing of industries, yet the waste waters treatment is always lagging. Ocean is the sink of various pollutants that most of the pollutants would be settling to sea bottoms by means of gravitational force and current [1-11].

Jiaozhou Bay is a semi-closed bay located in Shandong Province, eastern China, and has been polluted by various pollutants including Cr [1-11]. In order to provide scientific basis for the research on the migration and exist of Cr in Jiaozhou Bay, this paper analyzed the horizontal and vertical distributions of Cr based on investigation data in bottom waters in 1979, and revealed the transferring and sedimentation processes of Cr.

2. Materials and method

Jiaozhou Bay (35°55′-36°18′ N, 120°04′-120°23′ E) is located in the south of Shandong Peninsula, eastern China. The area, bay mouth width and average water depth and average twater depth are 390 km^2, 2.5 km and 7.0 m, respectively (Fig. 1). This bay is surrounding by cities of Qingdao, Jiaozhou and Jiaonan in the east, north and south, respectively. The bay mouth is located in the south of the bay, and is connected with the Yellow Sea. There are more than ten inflow rivers such as Loushan River, Licun River and Haibo River, all of which are seasonal rivers [12-13]. The investigation on Cr in three sampling sites (H34, H35 and H36) in Jiaozhou Bay waters was conducted by North China Sea Environmental Monitoring Center in August 1979 (Fig. 1). The investigation and measurement of Cr were following by National Specification for Marine Monitoring [14].

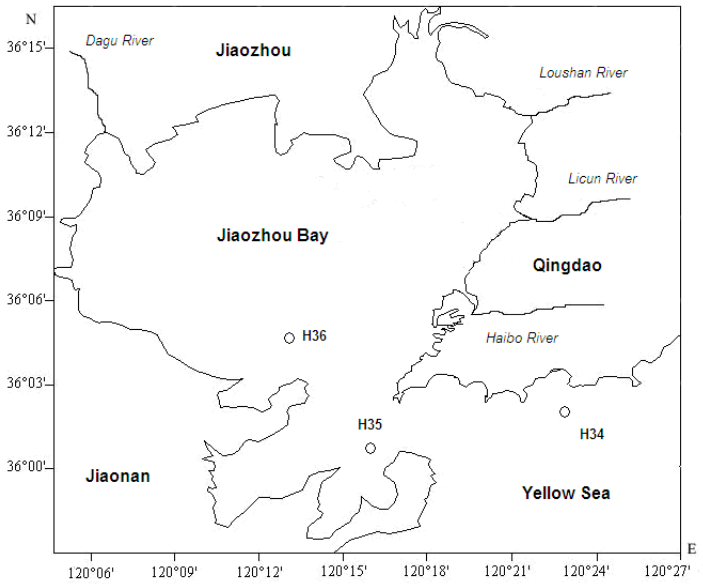

Fig.1 Geographic location and sampling sites of Jiaozhou Bay

3. Results

3.1 Horizontal distributions of Cr.

In according to the location of the sampling sites, H34, H35 and H36 were in the outside of the bay mouth, the middle of the bay mouth and the inside of the bay mouth, respectively. In surface waters, Cr contents were decreasing from 1.40 μg L^{-1} to 1.30 μg L^{-1} gradiently. In bottom waters, Cr contents were decreasing from 0.10 μg L^{-1} to 0.03μg L^{-1} gradiently. In generally, the gradient distributions of Cr in both surface and bottom waters were same.

3.2 Horizontal distributions of Cr.

Cr contents in surface waters were relative low (0.10-1.40 μg L^{-1}), and Cr contents in bottom waters were also relative low (0.03-0.40 μg L^{-1}). The variation range of Cr contents in surface waters were high than which in bottom waters. In generally, the higher Cr contents in surface waters, the higher Cr contents in bottom waters, yet the variation ranges were basically closed. For the three sampling sites of H34, H35 and H36, Cr contents in surface waters were subtracted by which in bottom waters, respectively, and the minus were -0.30 to 1.30 μg L^{-1}(Table 1).

Table 1. Subtractions of Cr contents between surface waters and bottom waters in Jiaozhou Bay

Sampling site	H36	H35	H34
Result	Negative	Positive	Positive

4. Discussion

4.1 Sedimentation process of Cr.

Cr contents were changing a lot once were transferring through water body by means of vertical water's effect [15]. Cr could be absorbed to plankton and suspended particulates easily, and this feature was infecting the vertical transferring process of Cr in waters. The growth and production of marine plankton were increasing in summer, and were generating a large amount of colloids which were absorbed to the suspended particulates. Therefore, the absorption of Cr to suspended particulates was enhancing and the sedimentation of Cr to bottom waters was increasing by means of gravitational force and current [4-6]. That was the sedimentation process of Cr.

4.2 Consistency of Cr.

In spatial scale, the horizontal distributions of Cr in surface waters and bottom waters in August were consist, because a large amount of Cr in waters were settling to bottom waters continuously, leading to the same distribution trends of Cr contents in surface waters and bottom waters. In temporal scale, the variation ranges were basically closed, and the higher Cr contents in surface waters, the higher Pb contents in bottom waters, indicated that the variations of Cr contents were consist. In vertical scale, Cr contents in surface and bottom waters were small, indicated Cr could be transported to bottom waters by means of vertical water's effect [8], and the loss of Cr contents was little. Therefore, Cr contents in surface waters and bottom waters were consisting.

4.3 High sedimentation region of Cr.

In regional scale, the differences of Cr contents between surface and bottom waters in the sampling sites were indicating the changing of Cr contents in surface and bottom waters. There was little Cr source and input in the bay mouth in August, and Cr contents in bottom waters were which in the waters itself. Therefore, by means of rapid sedimentation of Cr, Cr contents were changing in surface and bottom waters. In waters in the middle and the outside the bay mouth, Cr contents were higher than which in bottom waters, yet in waters inside the bay mouth were lower than which in bottom waters. It could be found that the sedimentation of Cr were relative low in waters in the middle and the outside of the bay mouth, yet were relative high in the inside of the bay mouth.

5. Conclusion

In waters around the bay mouth of Jiaozhou Bay, Cr contents were consisting in spatial, varying and vertical scales. In spatial scale, the gradient distributions of Cr contents in surface and bottom waters were consisting. In varying scale, the variation ranges of Cr contents in surface and bottom waters were closed. In vertical scale, Cr contents in surface and bottom waters were closed. The sedimentation of Cr were relative low in waters in the middle and the outside of the bay mouth, yet were relative high in waters in the inside of the bay mouth.

Acknowledgements

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).

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