# High Settling Process of Cd in Jiaozhou Bay

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

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

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

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

[a]dfyang_dfyang@126.com, [b]wangfy2001@yahoo.com.cn

[*] Corresponding author

## Abstract

Based on investigation data on Cd in bottom waters in Jiaozhou Bay in April and July 1986, we analyzed the horizontal distribution of Cd, and reveal the mechanism of high settling process of Cd. Results showed that Cd contents in April and July were 0.00-1.29 μg L-1, and were meeting Grade I to Grade II in Chinese Sea Water Quality Standard for Cd, indicating that bottom waters in this bay had been slightly polluted by means of vertical water's effect. There were high settling processes in waters outside the bay mouth. In case of Cd contents were relative high in surface waters, Cd contents in bottom waters would be also relative high. We proposed and defined that there were high settling process in waters in the outside of the bay mouth in different seasons.

## Keywords

Cd, Bottom water, Distribution, High settling process, Jiaozhou Bay.

## 1. Introduction

Cd was one of the widely used heavy metal elements in industry. Once Pb-containing wastes were generated and discharged from the factories, the migration and fate of Pb should be revealed. For instance, Pb-containing waste water could be discharged to streams, and transported to the ocean [1-2], and reached the sea bottom by means of vertical water's effect [3-7]. Therefore, understanding of the migration and fate of Cd in marine bay is essential to environmental protection.

Jiaozhou Bay is located in Shandong Province, China. Previous studies showed that this bay had been polluted by various pollutants including Cd [3-7]. This aim of this paper is to analyze the horizontal distribution features of Cd contents in bottom waters, to reveal the high value region and settling process of Cd, and to provide scientific basis for pollution control.

## 2. 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. This bay is a typical of semi-closed bay, and 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 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 Cd in Jiaozhou Bay was carried on in April and July 1986 in three investigation sites namely 2031, 2032 and 2033, respectively (Fig. 1). Pb in waters was sampled and monitored follow by National Specification for Marine Monitoring [10].

## 3. Results

### 3.1 Contents of Cd in bottom waters.

Cd contents in bottom waters in Jiaozhou Bay in April and July 1986 were 0.00-0.22μg $L^{-1}$ and 0.17-1.29 μg $L^{-1}$, respectively. In according to Grade I (1.00 μg $L^{-1}$) and Grade II (5.00 μg $L^{-1}$) in Chinese Sea Water Quality Standard for Cd, bottom waters in this bay was slightly polluted by Cd.

### 3.2 Horizontal distributions of Cd in bottom waters.

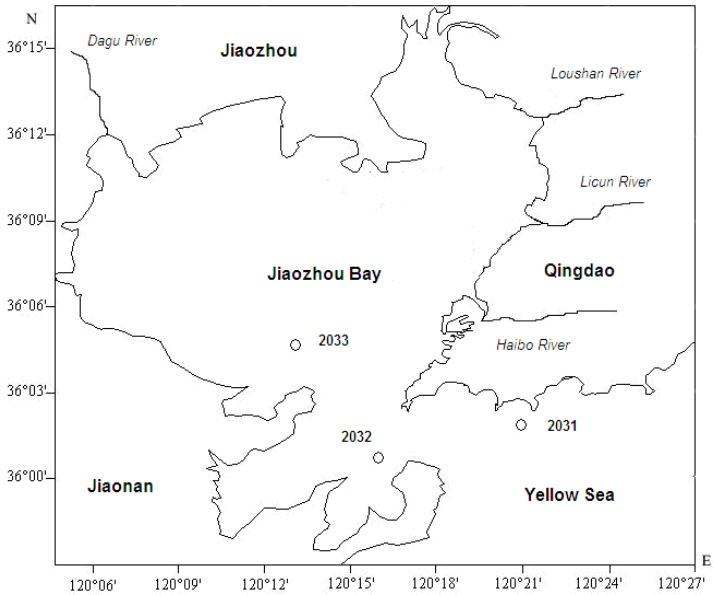


Fig. 1 Geographic location and sampling sites in Jiaozhou Bay

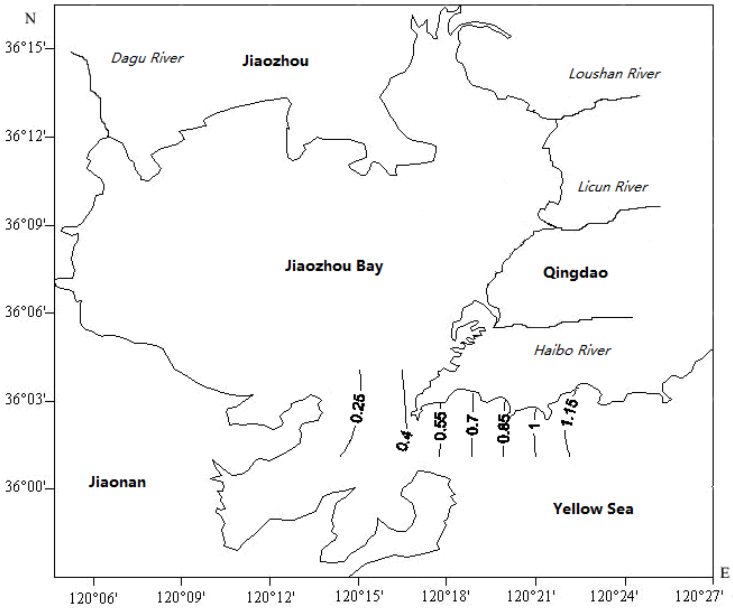


Fig. 2 Horizontal distribution of Cd in bottom waters in July 1986/μg $L_{-1}$

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). In April 1986, high value region was occurring in Site 2031 in the outside of the bay mouth, and the contour lines were parallel and decreasing from the high value center (0.22 μg $L^{-1}$) to the bay mouth ( 0.00 μg $L^{-1}$). In July 1986, high value region was also

occurring in Site 2031 in the outside of the bay mouth, and the contour lines were parallel and decreasing from the high value center (1.29 μg $L^{-1}$) to waters inside the bay mouth ( 0.17μg $L^{-1}$) (Fig. 2).

## 4. Discussion

### 4.1 Pollution level of Cd in bottom waters.

The major Cd source in April 1986 was stream flow. Cd was originally transported to surface waters, and then was settled to bottom waters. Hence, by means of vertical water's effect, Cd contents in bottom waters in April 1986 were 0.00-0.22 μg $L^{-1}$, and were meeting Grade I in Chinese Sea Water Quality Standard for Cd. In generally, bottom waters in April 1986 had not been polluted by Cd. The major Cd source in July 1986 was marine current. Similarly, by means of vertical water's effect, Cd contents in bottom waters in July 1986 were 0.17-1.29 μg $L^{-1}$, and were meeting Grade I and Grade II in Chinese Sea Water Quality Standard for Cd. In generally, bottom waters in July 1986 had been slightly polluted by Cd.

### 4.2 Migration process of Cd in waters.

By means of the water exchange between the open waters and the bay waters, the contents of the substances in Jiaozhou Bay were decreasing continuously [12]. In April 1986, Cd contents in bottom waters were 0.00-0.22 μg $L^{-1}$, and were decreasing from the open waters to the bay mouth and the bay, indicating that there were low and high settling process in waters inside and outside the bay mouth, respectively. In July 1986, Cd contents in bottom waters were 0.17-1.29 μg $L^{-1}$, and were also decreasing from the open waters to the bay mouth and the bay, indicating that there were low and high settling process in waters inside and outside the bay mouth, respectively. In generally, there were low and high settling process in waters inside and outside the bay mouth, respectively in both April and July.

### 4.3 Mechanism of settling process of Cd in waters.

In April 1986, Cd was originally arrived at surface waters with contents of 0.38 μg $L^{-1}$, and was transported through water body, and was decreased to 0.22 μg $L^{-1}$ in bottom waters. Similarly, in July 1986, Cd was originally arrived at surface waters with contents of 6.48 μg $L^{-1}$, and was transported through water body, and was decreased to 1.29 μg $L^{-1}$ in bottom waters. In generally, by means of the vertical water's effect, Cd was transported for a short distance by marine current, leading to the high settling process in waters outside the bay mouth. In case of Cd contents were relative high in surface waters, Cd contents in bottom waters would be also relative high. Hence, we proposed and defined that there were high settling process in waters in the outside of the bay mouth in different seasons.

## 5. Conclusion

Cd contents in bottom waters in Jiaozhou Bay in April and July 1986 were 0.00-0.22μg $L^{-1}$ and 0.17-1.29 μg $L^{-1}$, respectively, indicating that bottom waters in this bay was slightly polluted by Cd. There were low and high settling process in waters inside and outside the bay mouth, respectively in both April and July. In case of Cd contents were relative high in surface waters, Cd contents in bottom waters would be also relative high. We proposed and defined that there were high settling process in waters in the outside of the bay mouth in different seasons.

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