

Identification of the Rapid Sedimentation Processes of Hg in Marine Bay

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Abstract. Jiaozhou Bay is a semi-closed bay located in Shandong Province, China. Using investigation data on Hg in bottom waters in April and July 1989, this paper analyzed the contents and distributions, and identified the rapid sedimentation processes of Hg. Results showed that Hg contents in bottom waters April and July were 0.064-0.109 $\mu\text{g L}^{-1}$ and 0.012-0.017 $\mu\text{g L}^{-1}$, respectively. These contents were up to Grade I and II for Hg in Sea Water Quality Standard (GB 3097-1997). The pollution level of Hg in bottom waters in Jiaozhou Bay in 1989 was slight. By means of vertical water's effect, there was a rapid sedimentation process in the bay mouth in April 1989, while in July 1989 a rapid sedimentation process was in the bay center. In general, Hg contents in bottom waters would be relatively high/low in case Hg contents in surface waters were high/low. By means of vertical water's effect, the sedimentation processes of Hg were rapid, and a big part of Hg could be migrated to sea bottom.

1. Introduction

A large amount of Hg-containing wastes were generated and discharged to the environment along with the rapid development of industries [1-2]. However, the lagging of industrial waste treatment always exists objectively in many countries and regions. The excessive existence of Hg in the environment is harmful to organism and ecosystem since Hg is high toxic [3-4]. Many marine bays have been polluted by Hg since ocean is the sink of pollutants [5-6]. Quantitative understanding the migration processes of Hg in marine bays is essential to pollution control [7-9].

Jiaozhou Bay is a semi-closed bay located in Shandong Province China, and has been polluted by various pollutants including Hg after the rapid increasing of industry the past three decades [10-14]. Using investigation data on Hg in April and July in Jiaozhou Bay, this paper analyzed the contents and horizontal distribution trends, and identified the rapid sedimentation processes of Hg. The aim of this paper was to better understand the transporting processes of Hg in marine bay, and provide basis for scientific research and environment remediation.



2. Materials and method

Jiaozhou Bay is located in the south of Shandong Province, eastern China ($35^{\circ}55'-36^{\circ}18' N$, $120^{\circ}04'-120^{\circ}23' E$). The total area and average water depth are 446 km^2 and 7 m , respectively. The bay mouth is very narrow (3 km), and is connected to the Yellow Sea in the south. There are a dozen of rivers including Dagu River, Haibo River, Licun River, and Loushan River etc., all of which are seasonal rivers [15-16].

The investigation on Hg in bottom waters in Jiaozhou Bay was carried on by North China Sea Environmental Monitoring Center. In April and July 1989, Hg contents in bottom waters were measured in Site 85 and Site 90 in the bay center and the bay mouth, respectively (Fig. 1). Hg in waters was sampled and monitored follow by National Specification for Marine Monitoring [17].

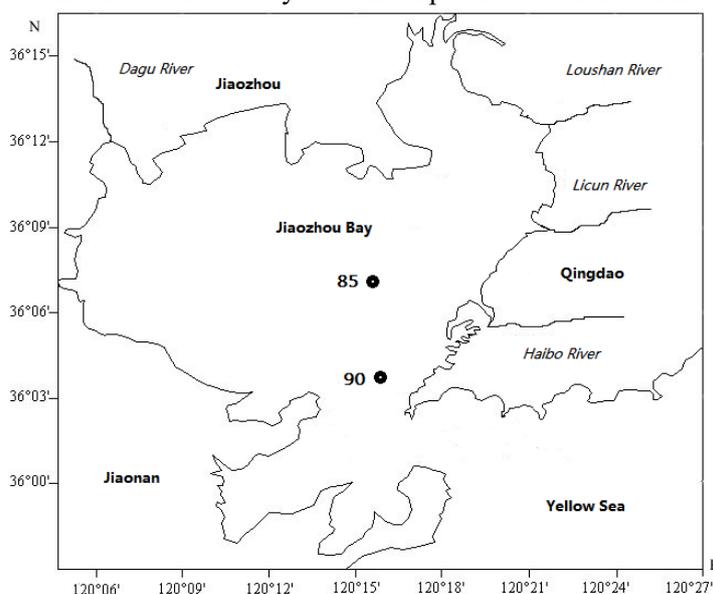


Fig. 1 Geographic location and monitoring sites in Jiaozhou Bay

3. Results

3.1 Contents of Hg. Hg contents in bottom waters April and July were $0.064\text{-}0.109 \mu\text{g L}^{-1}$ and $0.012\text{-}0.017 \mu\text{g L}^{-1}$, respectively (Table 1). These contents were up to Grade I ($0.05 \mu\text{g L}^{-1}$) and II ($0.20 \mu\text{g L}^{-1}$) for Hg in Sea Water Quality Standard (GB 3097-1997).

Table 1 Hg contents in bottom waters Jiaozhou Bay 1989

	April	July
Content/ $\mu\text{g L}^{-1}$	0.064-0.109	0.012-0.017
Grade	II	I

3.2 Horizontal distributions of Hg. In April 1989, Hg contents were relatively high in Site 90 in the bay mouth, and the contour lines of Hg contents were forming a series of parallel lines decreasing from the bay mouth ($0.109 \mu\text{g L}^{-1}$) to the bay center ($0.064 \mu\text{g L}^{-1}$). In July 1989, Hg contents were relative high in Site 85 in the bay center, and the contour lines of Hg contents were forming a series of parallel lines decreasing from the bay center ($0.017 \mu\text{g L}^{-1}$) to the bay mouth ($0.012 \mu\text{g L}^{-1}$).

4. Discussion

4.1 Pollution level of Hg. Hg in Jiaozhou Bay was mainly sourced from river discharge. The contents and distributions of Hg in bottom waters were forming by means of vertical water's effect [12-14]. In

general, the pollution level of Hg in bottom waters in Jiaozhou Bay in 1989 was slight (Table 1). In April 1989, Hg contents in the study area were all higher than $0.05 \mu\text{g L}^{-1}$, yet were all lower than $0.20 \mu\text{g L}^{-1}$, indicated that the pollution level was Grade II. In July 1989, Hg contents in the study area were all lower than $0.05 \mu\text{g L}^{-1}$, indicated that the pollution level was Grade I. In general, the pollution level of Hg in April was higher than in July, yet was still slight in study area.

4.2 Rapid sedimentation process of Hg. In April 1989, Hg contents were decreasing from the bay mouth ($0.109 \mu\text{g L}^{-1}$) to the bay center ($0.064 \mu\text{g L}^{-1}$), indicating that there was a rapid sedimentation process in the bay mouth. In July 1989, Hg contents were decreasing from the bay center ($0.017 \mu\text{g L}^{-1}$) to the bay mouth ($0.012 \mu\text{g L}^{-1}$), indicating that there was a rapid sedimentation process in the bay center. During the migration process, Hg was firstly arriving at surface waters, and then was transporting through water body, and was finally arriving sea bottom. These rapid sedimentation processes of Hg were determined by the source input, as well as the vertical water's effect [12-14].

4.3 Vertical migration process of Hg. In April 1989, Hg contents were relatively high ($0.164 \mu\text{g L}^{-1}$) in surface waters in the bay mouth, and Hg contents were also relatively high ($0.109 \mu\text{g L}^{-1}$) in bottom waters in the bay mouth. Meanwhile, in April 1989, Hg contents were relatively low ($0.066 \mu\text{g L}^{-1}$) in surface waters in the bay center, and Hg contents were also relatively high ($0.064 \mu\text{g L}^{-1}$) in bottom waters in the bay center. In July 1989, Hg contents were relatively high ($0.046 \mu\text{g L}^{-1}$) in surface waters in the bay center, and Hg contents were also relatively high ($0.017 \mu\text{g L}^{-1}$) in bottom waters in the bay center. Meanwhile, in July 1989, Hg contents were relatively low ($0.005 \mu\text{g L}^{-1}$) in surface waters in the bay mouth, and Hg contents were also relatively high ($0.012 \mu\text{g L}^{-1}$) in bottom waters in the bay mouth. By means of the vertical water's effect [12-14], Hg contents in bottom waters would be relatively high/low in case of Hg contents in surface waters were high/low.

5. Conclusions

Hg contents in bottom waters April and July were $0.064\text{-}0.109 \mu\text{g L}^{-1}$ and $0.012\text{-}0.017 \mu\text{g L}^{-1}$, respectively (Table 1). These contents were up to Grade I ($0.05 \mu\text{g L}^{-1}$) and II ($0.20 \mu\text{g L}^{-1}$) for Hg in Sea Water Quality Standard (GB 3097-1997).

There was a rapid sedimentation process in the bay mouth in April 1989, while in July 1989 a rapid sedimentation process was in the bay center. These rapid sedimentation processes of Hg were determined by the source input, as well as the vertical water's effect. By means of the vertical water's effect, Hg contents in bottom waters would be relatively high/low in case Hg contents in surface waters were high/low.

During the migration process, Hg was firstly arriving at surface waters, and then was transporting through water body, and was finally arriving sea bottom. That was the vertical migration mechanism of Hg in marine bay.

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