Vertical settlement results in homogeneous of Hg between surface and bottom waters in Jiaozhou Bay

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Abstract. Using investigation data on Mercury (Hg) in waters between the bay center and the bay mouth in Jiaozhou Bay in May and August 1990, this paper analyzed the vertical settlement process and the influence on the vertical variation of Hg contents. Results showed that Hg contents in surface waters in May and August 1990 were 0.189-0.204 μg L^{-1} and 0.053-0.063 μg L^{-1}, compared to 0.194-0.208 μg L^{-1} and 0.055-0.055 μg L^{-1} in bottom waters. The pollution level in May was moderate, compared to slight polluted in August. There were high settlement processes in the bay center in May and August 1990. Hg contents in bottom waters would be high/low in case that Hg contents in surface waters were high/low. By means of vertical water's effect, the settlement processes of Hg in waters were rapid in different space and time, resulting in the homogeneous of Hg contents between surface and bottom waters.

1. Introduction

Hg is widely used in various industries. However, Hg is high toxic, and the excess existence of Hg in the environmental could result in health risk [1-2]. Jiaozhou Bay is a semi-closed bay located in Shandong Province, China. This bay is surrounding by cities of Jiaozhou, Jiaonan and Qingdao (Fig. 1). This bay has been polluted by various pollutants since the rapid development of industry and the lagging of waste treatment in mang countries in regions [3-10]. Understanding the migration process in marine bay is essential to environmental protection and remediation [11-14]. Using investigation on Hg in May and August 1990, this paper analyzed the vertical migration process of Hg, and the influence on the changes of Hg contents. The aim of this paper is to provide basis for research on the migration of Hg in marine bay.

2. Study area and data source

2.1 Study area. 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 km^2, 7 m and 3 km, respectively. There are more than ten inflow rivers such as Haibo Rriver, Licun Rriver, and Loushan Rriver [15-16].

2.2 Data source. The data was provided by North China Sea Environmental Monitoring Center. The investigations were conducted in May and August 1990, respectively. Surface and bottom water samples in 2 sampling sites (i.e., 55 and 60) were collected and measured followed by National Specification for Marine Monitoring (Fig. 1) [17].

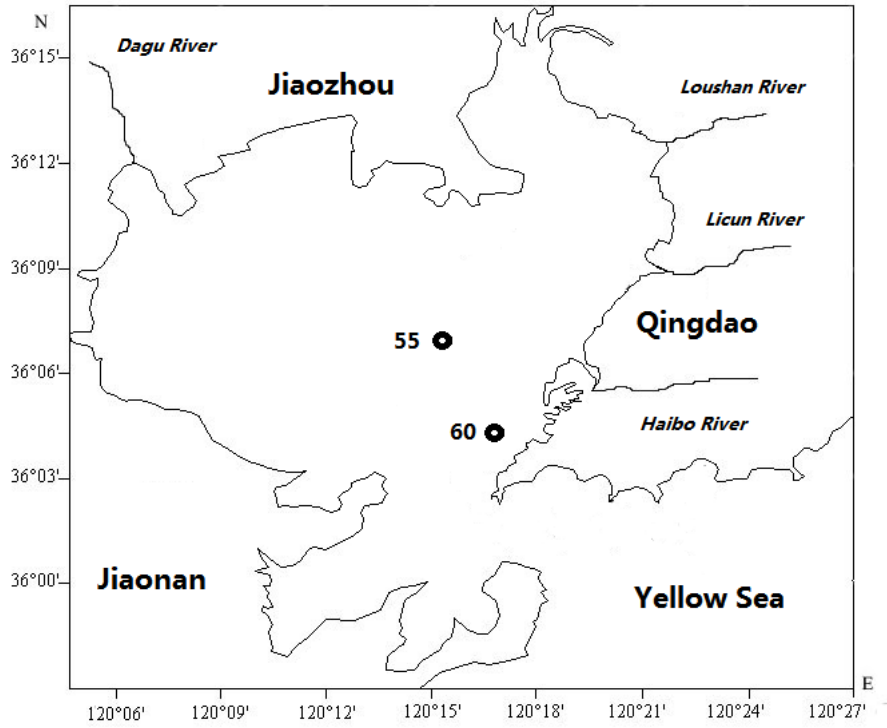

Fig. 1 Geographic location and monitoring sites in Jiaozhou Bay

3. Results and discussion

3.1 Pollution level of Hg. Hg contents in surface waters in May and August 1990 were 0.189-0.204 μg L^{-1} and 0.053-0.063 μg L^{-1}, compared to 0.194-0.208 μg L^{-1} and 0.055-0.055 μg L^{-1} in bottom waters. The China Sea Water Quality Standard (GB 3097-1997) establishes guide lines for Hg (Table 1). The Hg contents in Site 55 in the center of the bay in May were higher than 0.20 μg L^{-1} and lower than 0.50 μg L^{-1}, indicating that the pollution levels were Grade III and V. For Site 60 in the north of bay mouth in May, Hg contents were were higher than 0.05 μg L^{-1} but closed to 0.20 μg L^{-1}, indicating that the pollution levels were Grade II but closed to Grade III and V. In August, Hg contents in Site 55 and Site 60 were lower than 0.20 μg L^{-1} but closed to 0.05 μg L^{-1}, indicating that the pollution levels were Grade I. The pollution level in May was moderate, compared to slight polluted in August.

Table 1 China Sea Water Quality Standard (GB 3097-1997) guide lines for Hg

Grade	I	II	III and V[b]
Content/μg L^{-1}	0.05	0.20	0.50

[b]Guide lines for Hg of Grade III and V are same.

Table 2 Hg contents and pollution levels of Hg in Jiaozhou Bay 1990

Month	Site	Water layer	Content/μg L^{-1}	Pollution level
May	55	Surface water	0.208	III and V
		Bottom water	0.204	III and V
	60	Surface water	0.194	II
		Bottom water	0.189	II
August	55	Surface water	0.055	I
		Bottom water	0.063	I
	60	Surface water	0.053	I
		Bottom water	0.053	I

3.2 Vertical settlement of Hg. In May 1990, Hg contents in bottom waters were relative high in Site 55 in the center of the bay, and the contour lines were forming a series of parallel lines that decreasing from the center to the bay to the bay mouth. This indicated that there was a high sediment process in the bay center in May 1990. In August 1990, Hg contents in bottom waters were also relative high in Site 55 in the center of the bay, and the contour lines were also forming a series of parallel lines that decreasing from the center to the bay to the bay mouth. This indicated that there was also a high sediment process in the bay center in August 1990. In general, there were high settlement processes in the bay center in both May and August 1990.

3.3 Influence of the vertical settlement of Hg. In May 1990, Hg contents in surface waters were relative high in Site 55 in the center of the bay (0.208 μg L^{-1}), and in bottom waters were also relative high (0.204 μg L^{-1}). Meanwhile, Hg contents in surface waters were also relative low in Site 60 in the north of the bay mouth (0.194 μg L^{-1}), and in bottom waters were also relative low (0.189 μg L^{-1}). In August 1990, Hg contents in surface waters were relative high in Site 55 in the center of the bay (0.055 μg L^{-1}), and in bottom waters were also relative high (0.063 μg L^{-1}). Meanwhile, Hg contents in surface waters were also relative low in Site 60 in the north of the bay mouth (0.053 μg L^{-1}), and in bottom waters were also relative low (0.053 μg L^{-1}). Hg contents in bottom waters would be high/low in case of Hg contents in surface waters were high/low. By means of vertical water's effect [12-14], the settlement process of Hg in waters were rapid in different space and time, resulting in the homogeneous of Hg contents between surface and bottom waters.

4. Conclusion

Hg contents in surface waters in May and August 1990 were 0.189-0.204 μg L^{-1} and 0.053-0.063 μg L^{-1}, compared to 0.194-0.208 μg L^{-1} and 0.055-0.055 μg L^{-1} in bottom waters. The pollution level in May was moderate, compared to slight polluted in August. There were high settlement processes in the bay center in May and August 1990. Hg contents in bottom waters would be high/low in case that Hg contents in surface waters were high/low. By means of vertical water's effect, the settlement processes of Hg in waters were rapid in different space and time, resulting in the homogeneous of Hg contents between surface and bottom waters.

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