Vanishment of Hg's sedimentation in Jiaozhou Bay

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Abstract

Ocean is the sink of various pollutants since a big part of pollutants would be transported to sea bottom by means of sedimentation. Understanding the sedimentation processes of pollutants in marine bay is essential to pollution control. Based on investigation on Hg in Jiaozhou Bay in 1987, this paper analyzed the spatial-temporal variations of the vertical variations of Hg, and revealed the status and mechanisms. Results showed that the sedimentation processes of Hg within year in Jiaozhou Bay included four stages of 1) the source input of Hg was beginning, 2) the source input of Hg was increasing, 3) the source input of Hg was decreasing, and 4) the source input of Hg was stopping. Furthermore, the mechanism of spatial-temporal changes of sedimentation process of Hg was revealed that, the variations of Hg contents in surface and bottom waters were determined by the source strengths of the major sources and the distances of the transporting process.

Keywords

Hg; Sedimentation process; Spatial-temporal; Status; Jiaozhou Bay.

1. Introduction

Hg has been widely used in industries, and a large amount of Hg-containing waste water, sludge and solid waste were generated rapidly along with the rapid increase of economic [1-2]. However, the development of waste treatment was always lagging, resulted in Hg pollution in the environment. The excessive content of Hg in the environment is harmful to organism and ecosystem since Hg is high toxic. Many marine bays have been polluted by Hg nowadays, and understanding the environment behavior of of Hg in marine bays is essential to pollution control [3-8].

Jiaozhou Bay is a semi-closed bay located in Shandong Province, eastern China, and had been polluted by various pollutants including Hg in the past three decades [9-13]. Based on investigation on Hg in Jiaozhou Bay in May, July and November 1987, this paper analyzed the spatial-temporal changes of the vertical variations of Hg, and revealed the status and mechanisms of Hg's sedimentation processes. The aim of this paper was to provide basis information to scientific research and pollution control practice.

2. Study area and data collection

Jiaozhou Bay is located in the south of Shandong Province, eastern China (35°55′-36°18′ N, 120°04′-120°23′ E). The total area, average water depth and the wide of the bay mouth are 446 km2, 7 m and 3 km, respectively (Fig. 1). This bay is connected to the Yellow Sea in the south, and cities of

Qingdao, Jiaozhou and Jiaonan are located in the east, north and west of the bay, respectivey (Fig. 1). 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 [14-15].

The investigation on Hg in surface and bottom waters in Jiaozhou Bay was conducted in May, July and November 1987, respectively. Hg in surface and bottom waters was sampled and monitored follow by National Specification for Marine Monitoring (Fig. 1)[16]. For seasonal division, May, July and November in study area are belong to spring, summer and autumn, respectively.

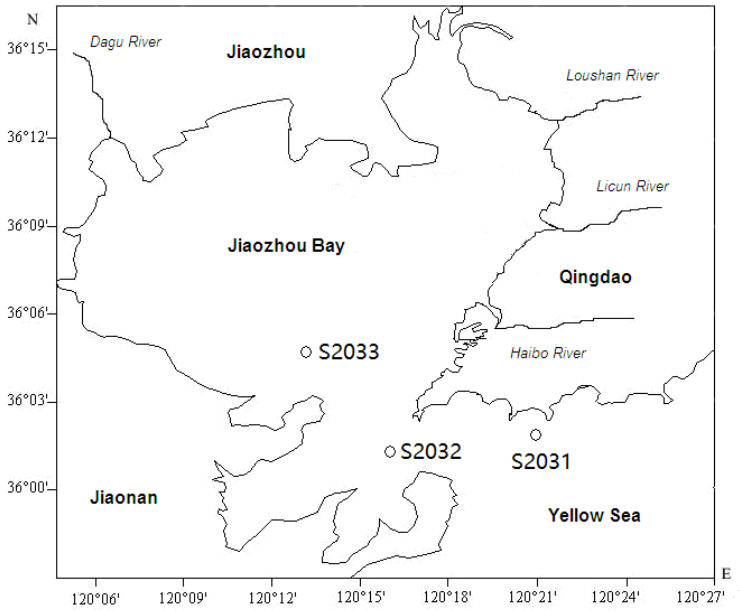

Fig. 1 Geographic location and sampling sites in Jiaozhou Bay

3. Results and discussion

Vertical variations of Hg in waters. In according to the geographic locations, the sampling sites of S2033, S2032 and S2031 were located in the inside of the bay, the bay mouth and the outside of the bay, respectively. In order to reveal the vertical variations of Hg contents, Hg content in surface waters in each sampling site in each survey were subtracting which in bottom waters, and the minus in May, July and November 1987 were ranging from -0.013 to 0.080 μg L-1, -0.028 to 0.008 μg L-1, and 0.004 to 0.050 μg L-1, respectively. The minus of Hg contents between surface and bottom waters in each sampling site represented the vertical variations of Hg contents, and positive or negative represented Hg content in surface waters was higher or lower than in bottom water. It could be seen from Table 1 that the vertical variations of Hg contents were showing significant spatial and temporal variations.

Table 1 The minus of Hg contents between surface and bottom waters in each sampling site in 1987

Month	S2033	S2032	S2031
May	Positive	Negative	Positive
July	Negative	Positive	Negative
November	Positive	Positive	Positive

Spatial and temporal variations of vertical variations of Hg in waters. Once Hg was transported to Jiaozhou Bay from the major sources, Hg was firstly arrived at surface waters, and then was transported to sea bottom rapidly and continuously by means of sedimentation, and was resulting in the spatial and temporal variations of the vertical variations (Table 1). In May, the major Hg source was

river flow, and the source strength was relative high. Hg was transporting from the inside of the bay mouth to the outside of the bay mouth along with the flow direction of river flow, resulting in Hg contents in surface waters were higher than in bottom waters in the inside of the bay mouth. In the middle of the bay mouth, Hg contents in surface waters were lower than in bottom waters since a big part of Hg was transported to bottom waters. However, Hg contents sourced from river flow had not been arrived at the outside of the bay mouth in May, and the sedimentation of Hg was still limit, resulted in Hg contents in surface waters were higher than in bottom waters. In July, the major Hg sources were river flow and marine current, and the source strengths were highest within year. Meanwhile, more and more Hg had been transported to sea bottom in the past two months, resulted in Hg contents in surface waters were lower than in bottom waters in the inside of the bay mouth and the outside of the bay mouth. However, the source strengths of Hg in the middle of the bay mouth were weak, and the sedimentation of Hg was also limit, resulted in Hg contents in surface waters were higher than in bottom waters. In November, the major Hg source was marine current, and the source strength was relative weak. However, the sedimentation of Hg was going on, and more and more of Hg in bottom waters was fixed to the sediment and removed from waters. Hence, Hg contents in surface waters were higher than in bottom waters in the study area in November.

Mechanisms spatial and temporal variations of vertical variations of Hg in waters. In according to the spatial and temporal variations of vertical variations of Hg in waters (Table 1), it could be found that for temporal variations, Hg contents in surface waters were higher than in bottom waters in the early and the middle of the year, yet were lower in the late of year. For spatial variations, Hg contents in surface waters were higher than in bottom waters in locations closed to strong source, yet were lower in locations far away from strong source. The source input of Hg could be considered as the external cause of the vertical variations of Hg, while the sedimentation process could be considered as the internal cause. In general, the sedimentation processes of Hg within year in Jiaozhou Bay included four stages of 1) the source input of Hg was beginning, 2) the source input of Hg was increasing, 3) the source input of Hg was decreasing, and 4) the source input of Hg was stopping. The variations of Hg contents in surface and bottom waters were determined by the source strengths of the major sources and the distances of the transporting process, that was the mechanism of spatial-temporal variations of sedimentation process of Hg.

4. Conclusion

The spatial-temporal variations of the vertical variations of Hg in Jiaozhou Bay were analyzed, and the status and mechanisms were revealed. The vertical variations of Hg contents were showing significant spatial and temporal variations. The source input of Hg was the external cause of the vertical variations of Hg, while the sedimentation process was the internal cause.

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