Multiple sources and unique high sedimentation location of Hg in Jiaozhou Bay

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Abstract: This paper analyzed the contents and distributions of Hg in bottom waters Jiaozhou Bay in 1988, and tried to reveal the vertical migration processes. Results showed that Hg contents in bottom waters were 0.024-0.128 μg L^{-1}, and were conformed with Grade I to II, indicated that the pollution level of Pb was still slight in 1988. There were multiple Hg sources around the bay, yet was only one high sedimentation location in the center of the bay. The reason was that the terrestrial P sources discharged into the coastal waters of the bay could be transferred to the center of the bay by means of falling tide. Furthermore,Hg contents would be decreasing while passing through the bay mouth, no matter from the inner of the bay to the open waters or from the open waters to the inner of the bay. In general, there may be unique high sedimentation location of substance even if in case of multiple sources, and substance contents would be decreasing gradiently during transferring process through the bay mouth.

1. Introduction

Hg has been widely exploited and used in human society, particularly after the industrial revolution. However, Hg is one of the toxic heavy metals, and the excessive of Hg in the environment is harmful to ecosystem and human beings [1-4]. Many marine bays have been polluted by Hg since ocean is the sink of pollutants [5-8], and therefore understanding the migration process of Hg in essential to pollution control and environmental remediation [9-11]. The terrestrial Hg was firstly delivered and discharged to surface waters the coastal waters of marine bay, and were finally arriving at sea bottom after transporting through water body by means of vertical waters effect [12-14], resulting in the changing of Hg contents in bay waters. Jiaozhou Bay is a semi-closed bay located in Shandong Province, China. This paper analyzed the contents and distributions of Hg in bottom waters in Jiaozhou Bay in 1988, and tried to reveal the vertical migration processes.

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 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 Rriver, Licun Rriver, and Loushan Rriver etc., all of which are seasonal rivers [15-16]. The investigation on Hg in bottom waters in Jiaozhou Bay was carried on in

April and July 1988 in six monitoring sites (Fig. 1). Hg in bottom waters was sampled and monitored follow by National Specification for Marine Monitoring [17].

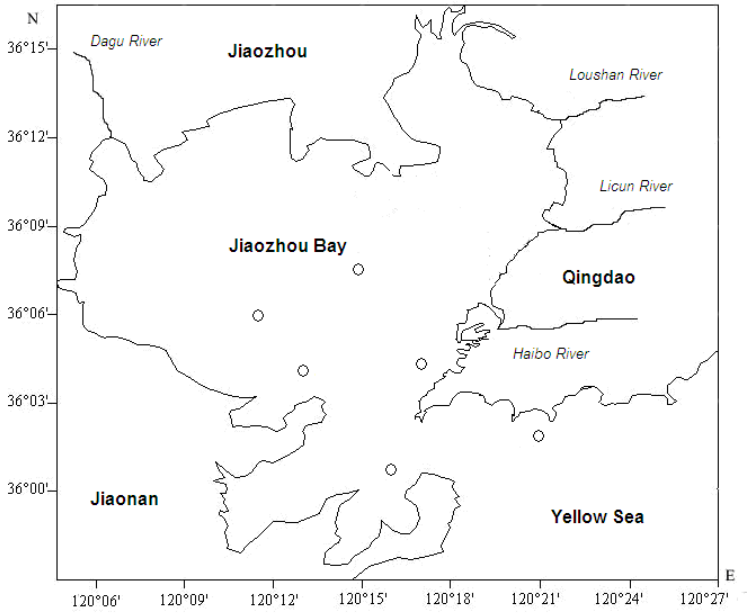

Fig.1 Geographic location and monitoring sites in Jiaozhou Bay

3. Results and discussion

3.1 Contents and pollution levels of Hg in bottom waters

Hg contents in bottom waters in Jiaozhou Bay in April and July 1988 were 0.041-0.128 μg L^{-1} and 0.024-0.075 μg L^{-1}, respectively. In according to Guidelines for Hg in Sea Water Quality Standard (GB3097-1997) , the pollution level of Hg in bottom waters in April and July 1988 were ranging from Grade I to Grade II. In general, the pollution levels of Hg in bottom waters in 1988 was still slight.

3.2 Horizontal distributions of Hg in bottom waters

In April 1988, the high value of Hg contents in bottom waters were existing in the center of the bay, and Hg contents were decreasing from the center of the bay (0.128 μg L^{-1}) to the bay mouth (0.121 μg L^{-1}), and to the open waters (0.048 μg L^{-1}) (Fig. 2). In July 1988, the high value of Hg contents in bottom waters were existing in the coastal waters in the east of the bay (0.075 μg L^{-1}), and Hg contents were decreasing from the high value region in the east of the bay to the bay mouth (0.038 μg L^{-1}), and to the center of the bay (0.033 μg L^{-1}) (Fig. 3). In according to the horizontal distribution Hg contents, it could be found that there were high sedimentation locations in the center of the bay and the bay mouth in April and July 1988, respectively.

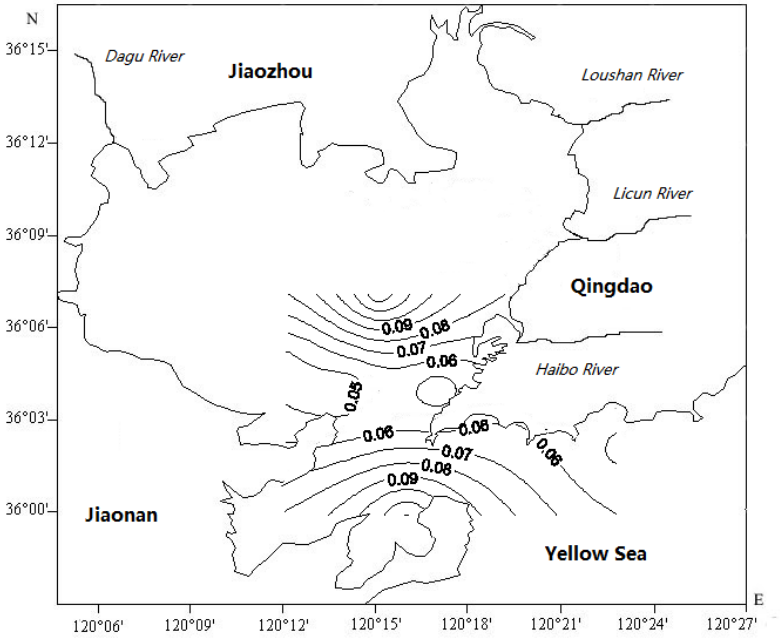

Fig. 2 Horizontal distribution of Hg in bottom waters in Jiaozhou Bay in April 1988/μg L^{-1}

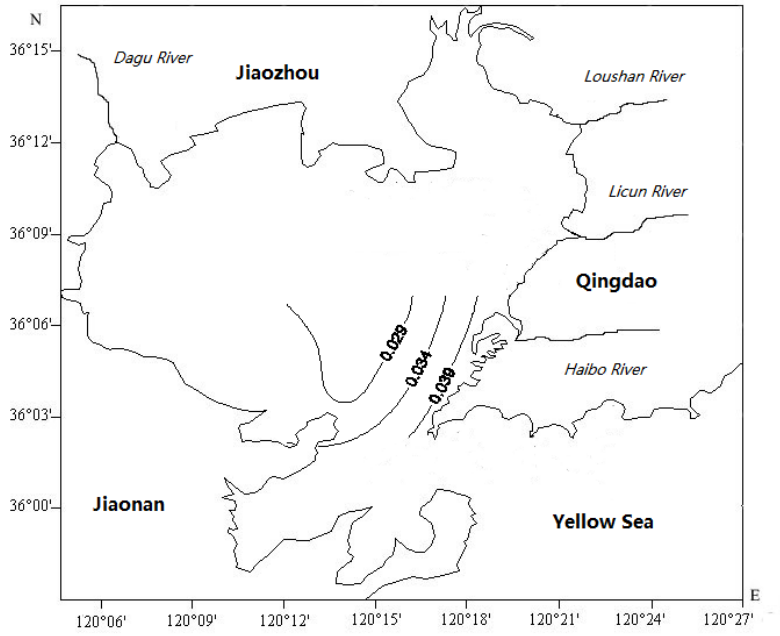

Fig. 3 Horizontal distribution of Hg in bottom waters in Jiaozhou Bay in July 1988/μg L^{-1}

3.3 Migration process of Hg in the bay

In April, the major terrestrial Hg sources in Jiaozhou Bay were overland runoff and river flow. The major overland Hg source was from the north of the bay, with the source strength of 0.080 μg L^{-1}. The major river flow Hg source was from Haibo River in the east of the bay, with the source strength of 0.061μg L^{-1}. The terrestrial Hg was firstly delivered and discharged to surface waters the coastal waters of marine bay, and high Hg content locations in surface waters were closed to the Hg sources.

Hg contents were transporting through water body by means of vertical waters effect [12-14], and were intensively settling in the center of the bay with a drifting (i.e., from the coastal waters to the bay center) by means of marine current (Fig. 4). In general, there may be different high sedimentation locations due to the multiple different Hg sources and different source strengths, yet there was unique high sedimentation location of Hg in Jiaozhou Bay. The reason was that the terrestrial sourced Hg was transported from the coastal waters along with the path of falling tide, and was settled to bottom waters in the center of the bay (Fig. 5).

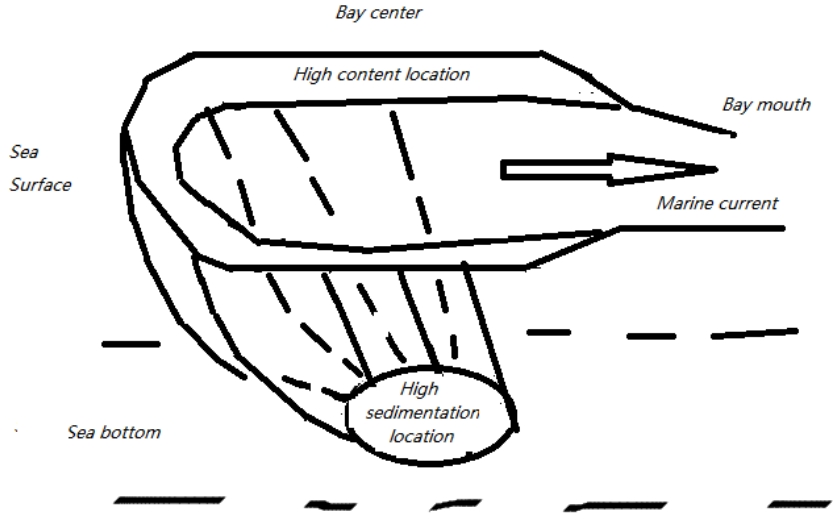

Fig. 4 Sedimentation process of terrestrial P in waters in the center of Jiaozhou Bay/μg L^{-1}

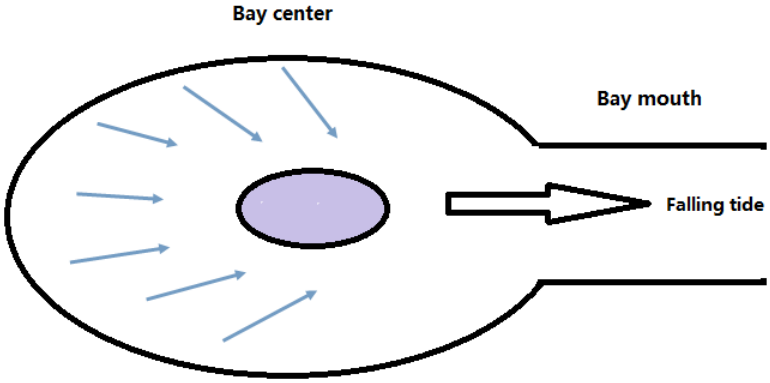

Fig. 5 Migration direction and path of Hg during falling tide in Jiaozhou Bay/μg L^{-1}

3.4 Changes of Hg in the bay mouth

It could be found that in April 1988 Hg contents in bottom waters were decreasing gradiently from the center of the bay to the bay mouth, and to the open waters (Fig. 2). This indicated that Hg contents were decreasing while transporting through the bay mouth from the narrow bay mouth. In general, the narrow bay mouth was playing a role of a filter, and substance contents would be decreasing while passing through the bay mouth [18], no matter from the inner of the bay to the open waters or from the open waters to the inner of the bay.

4. Conclusion

Hg contents in bottom waters in Jiaozhou Bay in April and July 1988 were 0.041-0.128 μg L^{-1} and

0.024-0.075 μg L^{-1}, respectively, and the pollution levels of Hg in bottom waters in 1988 was still slight. There may be unique high sedimentation location of substance even if in case of multiple sources. The reason was that the terrestrial sourced Hg was transported from the coastal waters along with the path of falling tide, and was settled to bottom waters in the center of the bay. The substance contents in marine bay would be decreasing gradiently during transferring process through the bay mouth.

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