Quantification of the sedimentation and accumulation of Cr in Jiaozhou Bay

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Abstract: Sedimentation and accumulation are important migration processes of pollutants in marine bay, and the quantification of these processes are essential to pollution control. Jiaozhou Bay is a semi-closed bay located in Shandong Province, China. Based on investigation data on Cr during 1979-1983, this paper analyzed the vertical variations of Cr, and quantified the sedimentation and accumulation of Cr in Jiaozhou Bay. Results showed that Cr contents in bottom waters were consist with which in surface waters, and the differences between surface and bottom waters were small. The absolute sedimentation amount, relative sedimentation amount, absolute accumulation amount and relative accumulation amount of Cr were 0.30-2.18 μg L^{-1}, 62.5%-92.8%, 0.37-1.84 μg L^{-1} and 681.4%-1336.3%, respectively. The sedimentation and of Cr and the accumulation of Cr in bottom waters were notable.

1. Introduction

Many marine bays in the whole word have been polluted by various pollutants due to the rapid increase of industry. Cr is one of the widely used heavy metal elements and Cr pollution is one of the critical environmental issues [1-4]. Sedimentation and accumulation are important migration processes of pollutants in marine bays, and the quantification of these processes are essential to pollution control. However, there were still few studies about the quantification of sedimentation and accumulation of pollutants in marine bays.

Jiaozhou Bay is a semi-closed bay located in Shandong Province, eastern China, and has been polluted by various pollutants include Cr [5-9]. Based on investigation data on Cr during 1979-1983, this paper analyzed the vertical variations of Cr, and quantified the sedimentation and accumulation of Cr in Jiaozhou Bay. Results found that the annual average relative sedimentation amount and relative accumulation amount were 84.2% and 1059.2%, respectively. The sedimentation and of Cr and the accumulation of Cr in bottom waters were notable. These results were essential to pollution control and environmental remediation.

2. Materials and method

Jiaozhou Bay (35°55′-36°18′ N, 120°04′-120°23′ E) is located in the south of Shandong Peninsula, eastern China. The area, bay mouth width and average water depth and average water depth are 390 km^2, 2.5 km and 7.0 m, respectively (Fig. 1). This bay is surrounding by cities of Qingdao, Jiaozhou and Jiaonan in the east, north and south, respectively. The bay mouth is located in the south of the bay, and is connected with the Yellow Sea. There are more than ten inflow rivers such as Loushan River, Licun River and Haibo River [10-11].

The investigation on Cr in surface waters in Jiaozhou Bay was conducted by North China Sea Environmental Monitoring Center. The investigation times were in August 1979, April and August 1981, April, July and October 1982, and May, September and October 1983, respectively [3-9], and the sampling sites were showed in Fig. 1. The investigation and measurement of Cr were following by National Specification for Marine Monitoring [12].

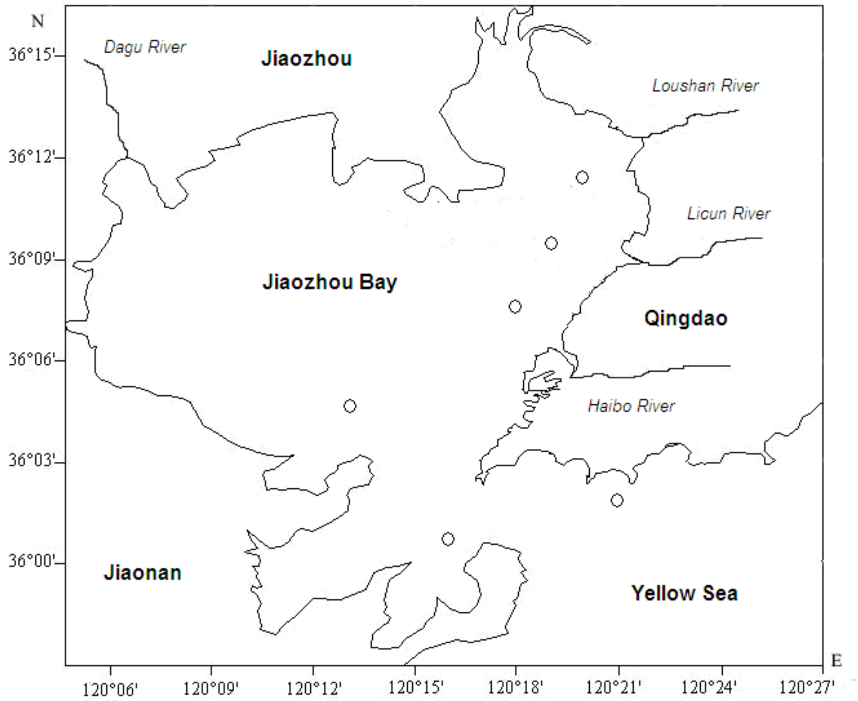

Fig.1 Geographic location and sampling sites of Jiaozhou Bay

3. Results and discussion

3.1 Vertical variations of Cr.

Based on the climate in study area, April, May and June are spring, July, August and September are summer, and October, November and December are autumn, respectively. In order to reveal the vertical variations of Cr, we calculated the ranges of Cr in surface and bottom waters, and the differences of Cr contents between surface and bottom waters (Table 1). As listed in Table 1, Cr contents in bottom waters were relative low in case of Cr contents in surface waters were relative low, and Cr contents in bottom waters were relative high in case of Cr contents in surface waters were relative high. In generally, Cr contents in bottom waters were consist with which in surface waters, and the differences between surface and bottom waters were small, never no matter in different years or seasons. Hence, it could be found that the sedimentation and of Cr and the accumulation of Cr in bottom waters were notable.

3.2 Sedimentation and accumulation of Cr.

In according to the Cr in surface and bottom waters and the differences between surface and bottom waters (Table 1), we could find that Cr contents in surface and bottom waters were tending to be consisting. The major reason was sedimentation and accumulation. The sedimentation amount of Cr was large in case of Cr contents in surface waters were high, yet would be small in case of Cr contents in surface waters were low, resulting in the consistency of Cr contents in surface and bottom waters. Based on Cr contents in surface and bottom waters, the absolute sedimentation amount, relative sedimentation amount, absolute accumulation amount and relative accumulation amount of Cr were calculated as 0.30-2.18 μg L^{-1}, 62.5%-92.8%, 0.37-1.84 μg L^{-1} and 681.4%-1336.3%, respectively (Table 2). It could be seen from Table 2 that the absolute and relative sedimentation and accumulation amounts of Cr in Jiaozhou Bay were different in different years. The annual average relative sedimentation amount and relative accumulation amount were 84.2%

and 1059.2%, respectively, indicated that the sedimentation and of Cr and the accumulation of Cr in bottom waters were notable.

Table 1 Cr in surface and bottom waters and the differences between surface and bottom waters

Year	Season	Cr content/μg L^{-1}		Difference/μg L^{-1}
		Surface waters	Bottom waters	
1979	Spring	0.10 to 1.40	0.03 to 0.40	-0.86 to 0.25
	Summer			
	Autumn			
1981	Spring			
	Summer	0.18 to 0.48	0.14 to 1.42	-0.86 to 0.25
	Autumn			
1982	Spring	0.81 to 2.11	0.81 to 0.95	-0.12 to 0.51
	Summer	1.02 to 2.42	1.20 to 2.11	-1.09 to 0.17
	Autumn	0.24 to 1.35	0.27 to 0.51	-0.07 to 0.28
1983	Spring	0.13 to 0.65	0.11 to 1.08	-0.86 to 0.25
	Summer	0.70 to 1.17	0.46 to 1.17	-0.42 to 0.44
	Autumn	0.44 to 1.56	0.63 to 1.58	-0.21 to 0.66

Table 2 Cr in surface and bottom waters and the differences between surface and bottom waters/μg L^{-1}

Year	1979	1981	1982	1983	Average
Absolute sedimentation amount/μg L^{-1}	1.30	0.30	2.18	1.43	1.30
Relative sedimentation amount/%	92.8	62.5	90.0	91.6	84.2
Absolute accumulation amount/μg L^{-1}	0.37	1.38	1.84	1.47	1.27
Relative accumulation amount/%	1233.3	985.7	681.4	1336.3	1059.2

4. Conclusions

Cr contents in bottom waters were consist with which in surface waters, and the differences between surface and bottom waters were small, never no matter in different years or seasons. The sedimentation amount of Cr was large in case of Cr contents in surface waters were high, yet would be small in case of Cr contents in surface waters were low, resulting in the consistency of Cr contents in surface and bottom waters. The absolute sedimentation amount, relative sedimentation amount, absolute accumulation amount and relative accumulation amount of Cr were calculated as 0.30-2.18 μg L^{-1}, 62.5%-92.8%, 0.37-1.84 μg L^{-1} and 681.4%-1336.3%, respectively, indicated that the sedimentation and of Cr and the accumulation of Cr in bottom waters were notable. The results were essential to pollution control and environmental remediation.

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