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Annual changes and seasonal variations of Cd in Jiaozhou Bay 1979-1983

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Keywords: Cd; Annual change; Seasonal variation; Jiaozhou Bay.

Abstract: This paper analyzed the annual change and seasonal variation of Cd in Jiaozhou Bay during 1979-1983. Results showed that the highest values of Cd contents in 1979-1982 were confirm to Grade I (1.00 μg L^{-1}) of National Sea Water Quality Standard (GB 3097-1997), yet in 1983 were Grade II. For temporal changes, Cd contents were showing increasing trends during 1979-1983, indicating the increasing of Cd input to the bay from human activities. For seasonal variation, Cr contents in spring during 1979-1983 were relative low and were confirm to Grade I, while in summer and autumn were relative high and the highest values of Cd contents were confirm to Grade II. These indicated that the input of Cr to the bay was different in different season. In general, the pollution level of Cd were increasing after reform and opening-up due to the rapid increase of industry.

1. Introduction

After the reform and opening-up, the industry is increasing rapidly, and a large amount of pollutants are generating and discharging to the environment. Cd is one of the critical heavy metal widely used in industry and agriculture. The ocean has been polluted by various pollutants including Cd since ocean is the sink of pollutant [1-10]. Understanding the pollution level, seasonal variation and change trend of Cd is essential to marine environment protection and the maintaining of ecological sustainable development. This paper analyzed the annual change and seasonal variation of Cd in Jiaozhou Bay during 1979-1983, provided information for scientific research and pollution control and environmental remediation.

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 bay mouth width are 446 km^2, 7 m and 3 km, respectively. This bay is a typical of semi-closed bay which is connected to the Yellow Sea in the south. 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 [11-12]. The investigation on Cd in Jiaozhou Bay was carried on in different seasons in during 1979-1983 (Fig. 1 and Table 1). Cd in waters was sampled and monitored follow by National Specification for Marine Monitoring [13].

Table 1 Sampling time of Cd in Jiaozhou bay

Month	April	May	June	July	August	September	October	November
1979		√			√			√
1980			√	√		√	√	
1981	√				√			√
1982	√		√	√			√	
1983		√				√	√	

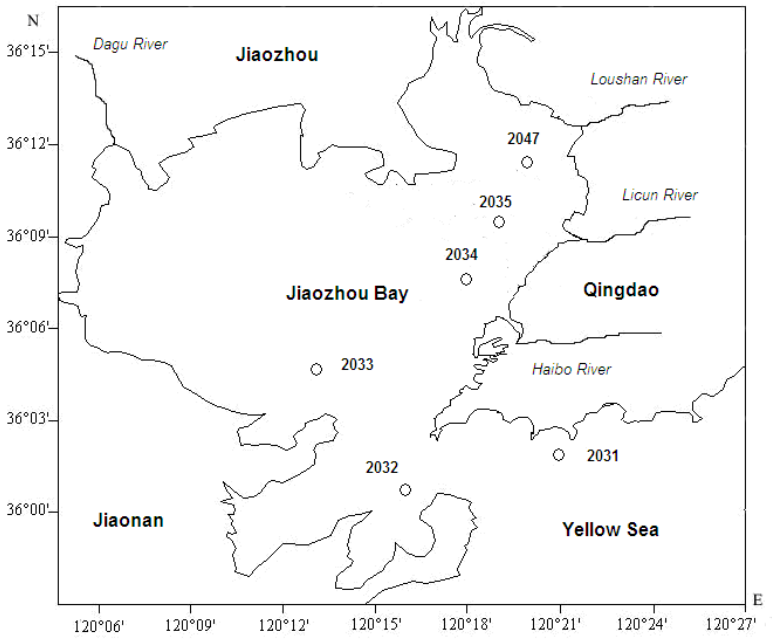

Fig. 1 Geographic location and sampling sites in Jiaozhou Bay

3. Results and discussion

3.1 Seasonal variation of Cd.

The contents of Cd in different months during 1979-1983 were listed in Table 2. In according to the guide line of Cd in Grade I (1.00 μg L^{-1}) of National Sea Water Quality Standard (GB 3097-1997), the contents of Cd in Jiaozhou Bay during 1979-1983 were still very low, and were confirm with Grade I in generally. In study area, April, May and June are spring, July, August and September are summer, while October, November and December are autumn. The seasonal variations of pollution level of Cd in Jiaozhou Bay were listed in Table 3. For seasonal variation, Cd contents in spring during 1979-1983 were relative low and were confirm to Grade I, while in summer and autumn 1983 were relative high and the highest values of Cd contents were confirm to Grade II. These indicated that the input of Cd to the bay was different in different season.

Table 2 Cd contents in surface water in different months in Jiaozhou Bay during 1979-1983/μg L^{-1}

Month	April	May	June	July	August	September	October	November
1979		0.04-0.07			0.01-0. 85			0.02-0.25
1980			0.05-0.16	0.00-0.48		0.00-0.24	0.00-0.00	
1981	0.00-0.55				0.00-0.40			0.00-0.00
1982	0.11-0.38		0.11-0.21	0.12-0.52			0.32-0.53	
1983		0.09-0.41				0.40-3.33	0.10-1.50	

Table 3 Pollution levels of Cd in surface water in different months in Jiaozhou Bay during 1979-1983/μg L^{-1}

Season	Spring	Summer	Autumn
1979	I	I	I
1980	I	I	I
1981	I	I	I
1982	I	I	I
1983	I	I, II	I, II

3.2 Annual change of Cd.

The highest values of Cd contents in each year during 1979-1983 were showed in Fig. 2. It could

be seen from Fig. 2 that the highest value of Cd contents during 1979-1982 were still low, yet in 1983 were increasing rapidly. For annual changes, Cd contents were showing increasing trends during 1979-1983, indicating the increasing of Cd input to the bay from human activities. In general, the pollution level of Cd were still slight before 1982, and could be considered as background pollution level of Cd (about 0.55 μg L^{-1}) in this bay. However, after the continuous generation and discharging of Cd-containing waste, this bay was polluted and Cd was accumulated in water body of this bay, and the waste treatment and pollution control were always delay from the development of economic. Therefore, the annual change trend of Cd was increasing after reform and opening-up due to the rapid increase of industry.

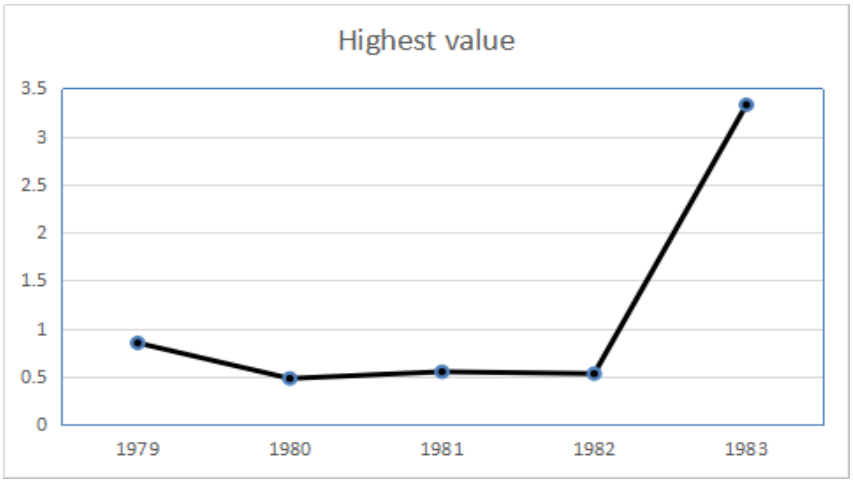

Fig. 2 The highest values of Cd contents in Jiaozhou Bay in each year during 1979-1983.

4. Conclusion

The pollution Cd contents during 1979-1982 were still low, yet in 1983 were increasing rapidly. The highest values of Cd contents in 1979-1982 were confirm to Grade I , while in 1983 were Grade II. For temporal changes, Cd contents were showing increasing trends during 1979-1983. For seasonal variation, Cd contents in spring during 1979-1983 were relative low and were confirm to Grade I, while in summer and autumn were relative high and the highest values of Cd contents were confirm to Grade II. In general, the pollution level of Cd were increasing after reform and opening-up due to the rapid increase of industry.

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References

[1] Yang DF, Chen Y, Wang H, et al.: Coastal Engineering, Vol. 29 (2010), p. 73-82.

[2] Yang DF, Chen Y, Liu CX, et al.: Coastal Engineering, Vol. 32(2013), p. 68-78.

[3] Yang DF, Zhu SX, Wu YF, et al.: Applied Mechanics and Materials, Vol.644-650 (2014), p. 5325-5328.

[4] Yang DF, Wang FY, Wu YF, et al.: Applied Mechanics and Materials, Vol.644-650 (2014), p. 5329-5312.

[5] Yang DF. Chen Y, Gao ZH, et al.: Proceedings of the 2015 international symposium on computers and informatics. Vol.(2015), p. 2667-2674.

[6] Yang DF, Zhu SX, Yang XQ, et al.: Materials Engineering and Information Technology Apllication, Vol. (2015), p.558-561.

[7] Yang DF, Zhu SX, Wang FY, et al.: Advances in Computer Science Research, Vol. 2352(2015), p.194-197.

[8] Yang DF, Wang FY, Sun ZH, et al.:Advances in Engineering Research, Vol. 40(2015), p.776-781.

[9] Yang DF, Yang DF, Zhu SX, et al.:Advances in Engineering Research, Vol. Part B (2016), p. 403-407.

[10] Yang DF, Yang XQ, Wang M, et al.:Advances in Engineering Research. Vol. Part B(2016), p. 412-415.

[11] Yang DF, Chen Y, Gao ZH, et al.: Chinese Journal of Oceanology and Limnology, Vol. 23(2005), p. 72-90. (in Chinese)

[12] Yang DF, Wang FY, Gao ZH, et al. Marine Science, Vol. 28 (2004), p. 71-74. (in Chinese)

[13] China's State Oceanic Administration: The specification for marine monitoring (Ocean Press, Beijiang 1991), p.1-300. (in Chinese)