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River as the major source of Cr in Jiaozhou Bay

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Abstract. Based on investigation dada on Cr in May and August 1979 in Jiaozhou Bay, we analyzed the content, distribution of Cr. Results showed that Cr contents in 1984 in surface waters were 0.10-112.30 μg L^{-1} and were meeting Grade I (50 μg L^{-1}), II (100 μg L^{-1}) and III (200 μg L^{-1}) in National Sea Water Quality Standard (GB 3097-1997). We found that river was the major source of Cr, and the source strength could be as high as 112.30 μg L^{-1}. In April, Cr contents were relative high in coastal waters in the northeast of the bay yet were relative low in coastal waters in the south of the bay. In August, Cr contents were relative low inside and outside the bay. In generally, this bay had been moderately polluted by Cr, and the source-control/reduction of Cr was necessary.

Introduction

Cr is one of the necessary elements for mammal, yet chromium compound would be high toxicity once the concentration was too high. In generally, Cr irons are mainly trivalent chromium and hexavalent chromium, and the toxicity of the later is 100 times to the former. If the concentration of hexavalent chromium in drinking waters for animal is 5 μg L^{-1}, chromium poisoning may be caused [1-3]. A large amount of Cr-containing waste waters were generated and discharged rivers and marine bays along with the rapid increase of industry [4], and the marine bays were polluted by Cr, and the pollution in the marine bays could be harmful to human being itself finally.

Hence, the research on the contents, pollution levels and sources of Cr in marine bays were essential to protect the marine environment and to maintain the harmonious development of society economy and ecological environment. This paper analyzed the contents, pollution levels and sources of Cr in 1979 in Jiaozhou Bay. The Major purpose of this paper was to provide scientific background and basis for provide basis for pollution control and environmental remediation in marine Bay.

Material and method

Jiaozhou Bay is located in the south of Shandong Province, eastern China (35°55′-36°18′ N, 120°04′-120°23′ E), which is connected to the Yellow Sea in the south. This bay is a typical of semi-closed bay, and the total area, average water depth and bay mouth width are 446 km^2, 7 m and 3 km, respectively. 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 [5].

The investigation on Cd in Jiaozhou Bay was carried on in May and August 1979 in eight investigation sites namely H34, H35, H36, H37, H38, H39, H40 and H41, respectively (Fig. 1). Cr in surface waters was sampled and monitored follow by National Specification for Marine Monitoring [6].

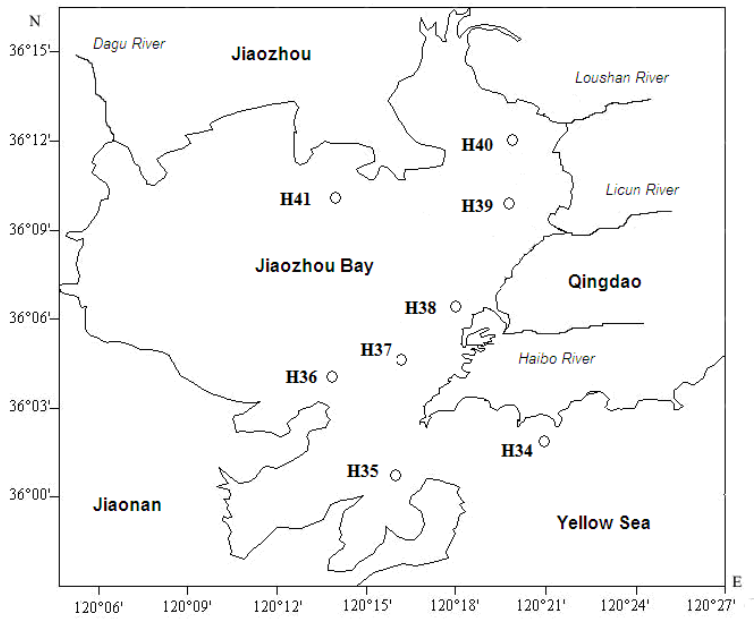

Fig.1 Investigation sites in Jiaozhou Bay

Results

Contents of Cr. The contents of Cr in May and August 1979 were 0.20-112.30 μg L^{-1} and 0.10-1.40 μg L^{-1}, respectively. In According to National Sea Water Quality Standard (GB 3097-1997), Cr contents in July 1979 were meeting Grade I to III, yet in August were meet Grade I (Table 1). The pollution level of Cr in July 1979 was moderate, yet in August was slight, and this bay had been moderate polluted by Cr since 1979 as a whole.

Table1 Pollution level of Cr in May and August 1979 in surface waters in Jiaozhou Bay

Month	July	August
Content/μg L^{-1}	0.20-112.30	0.10-1.40
Water quality grade	I to III	I

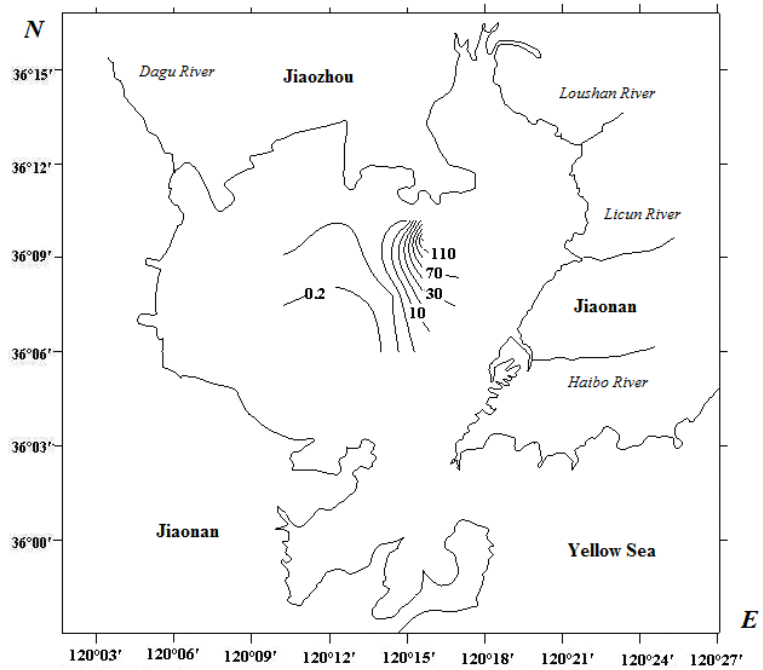

Fig. 2 Horizontal distributions of Cr in surface waters of Jiaozhou Bay in May 1979/μg L^{-1}

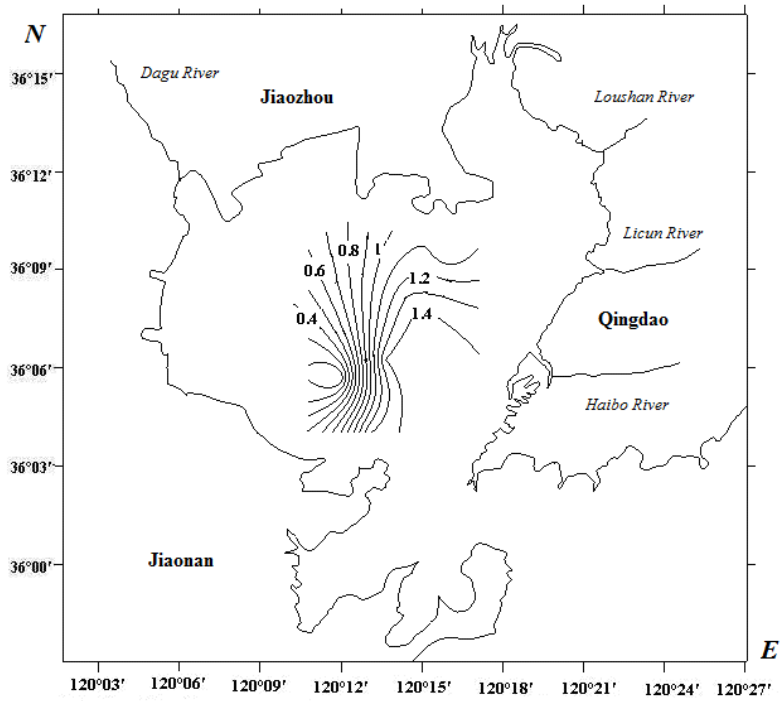

Fig. 3 Horizontal distributions of Cr in surface waters of Jiaozhou Bay in August 1979/μg L^{-1}

Horizontal distributions of Cr. In May 1979, there was a high value (112.30 μg L^{-1}) in Site H39 and a high value region between the estuaries of Loushan River and Licun River in the northeast of the bay, and there were a series of parallel lines decreasing from the high value center to the bay mouth in the south of the bay (0.20μg L^{-1}) (Fig. 2). In August 1979, there was a high value (1.40 μg L^{-1}) in Site H34, H37 and H38 closed the estuaries of the major river in the east of the bay, and there were a series of semi-concentric circles decreasing from the high value center to the costal waters in the west the bay (0.20μg L^{-1}) (Fig. 3).

Discussion

Water quality of Cr. In according to the horizontal distribution of Cr in May and August 1979, the water quality of Cr was showing significant spatial-temporal variations. Cr contents in the whole bay in May 1979 was 0.20-112.30 μg L^{-1}, yet in August were as low as 0.10-1.40 μg L^{-1}. In May 1979, Cr contents could be as high as 112.30 μg L^{-1} in waters closed to estuaries of Loushan River and Licun River in the northeast of the bay, yet could be as low as 0.20 μg L^{-1} in waters closed to the bay mouth, while Cr contents were moderate (19.00-112.30 μg L^{-1}) between estuaries of Loushan River to Haibo River.

Sources of Cr. In May 1979, there was a high value region between the estuaries of Loushan River and Licun River in the northeast of the bay, and Cr contents were decreasing from the high value center to the bay mouth in the south of the bay (Fig. 2). In August 1979, there was a high value region closed the estuaries of the major river in the east of the bay, and Cr contents were decreasing from the high value center to the costal waters in the west the bay (Fig. 3). Hence, it could be concluded that river flow was the major source of Cr in Jiaozhou Bay in 1979. It should be noticed that the source strength of river could be as high as 112.30 μg L^{-1}, which is a moderate pollution level in according to National Sea Water Quality Standard (GB 3097-1997).

Conclusion

The contents of Cr in May and August 1979 were 0.20-112.30 μg L^{-1} and 0.10-1.40 μg L^{-1}, respectively. In according to the horizontal distribution of Cr in May and August 1979, the water quality of Cr was showing significant spatial-temporal variations. The pollution level of Cr in July

1979 was moderate, yet in August was slight, and this bay had been moderate polluted by Cr since 1979 as a whole.

River flow was the major source of Cr in Jiaozhou Bay in 1979, and the source strength of river could be as high as 112.30 μg L^{-1}, which is a moderate pollution level in according to National Sea Water Quality Standard (GB 3097-1997), and the source-control/reduction of Cr was necessary.

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