Background pollution and anthropogenic impact of Cr in Jiaozhou Bay 1989

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Abstract. Chromium (Cr) pollution in marine environmental is one of the critical environmental issues in the whole world. Understanding the background pollution and source of Cr in marine bay is essential to pollution control and environmental remediation. Jiaozhou Bay is a semi-closed bay located in Shandong Province, China. This paper analyzed the background pollution and source of Cr in surface waters in Jiaozhou Bay in April and July 1989. Results showed that Cr contents in April and July were 1.01-3.29 μg L^{-1} and 0.63-2.36 μg L^{-1}, respectively. These contents were much lower than the Grade I (50 μg L^{-1}) for Cr in Sea Water Quality Standard (GB 3097-1997). The pollution level of Cr in Jiaozhou Bay in 1989 was very slight, and the background pollution level of Cr could be considered as 0.63-3.29 μg L^{-1}. The major anthropogenic sources of Cr were atmosphere deposition and river discharge, whose source strengths were 3.29 μg L^{-1} and 2.36 μg L^{-1}, respectively. In general, the background pollution of Cr was very slight in Jiaozhou Bay in 1989 and the influence of human activities was still light.

1. Introduction

Cr has been widely used in various industries of metallurgy, electroplating, chemical industry, aviation industry, etc. [1-2]. A large amount of Cr-containing waste gas, water and slag, or flames and smoke were discharged along with the rapid development of industry in the past several decades [3-5]. Marine is the sink of pollutants, and Cr pollution in marine environmental is one of the critical environmental issues in the whole world [4-7]. Understanding the background pollution and source of Cr in marine bay is essential to pollution control and environmental remediation [8-9]. Jiaozhou Bay is a semi-closed bay located in Shandong Province, China. This paper analyzed the background pollution and source of Cr in surface waters in Jiaozhou Bay in April and July 1989. The aim of the paper is to provide scientific basis for pollution control of Cr.

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 km2, 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].

The investigation on Cr in surface waters in Jiaozhou Bay was conducted by North China Sea Environmental Monitoring Center in April and July 1989, and the sampling sites were showed in Fig.

1. The investigation and measurement of Cr were following by National Specification for Marine Monitoring [11].

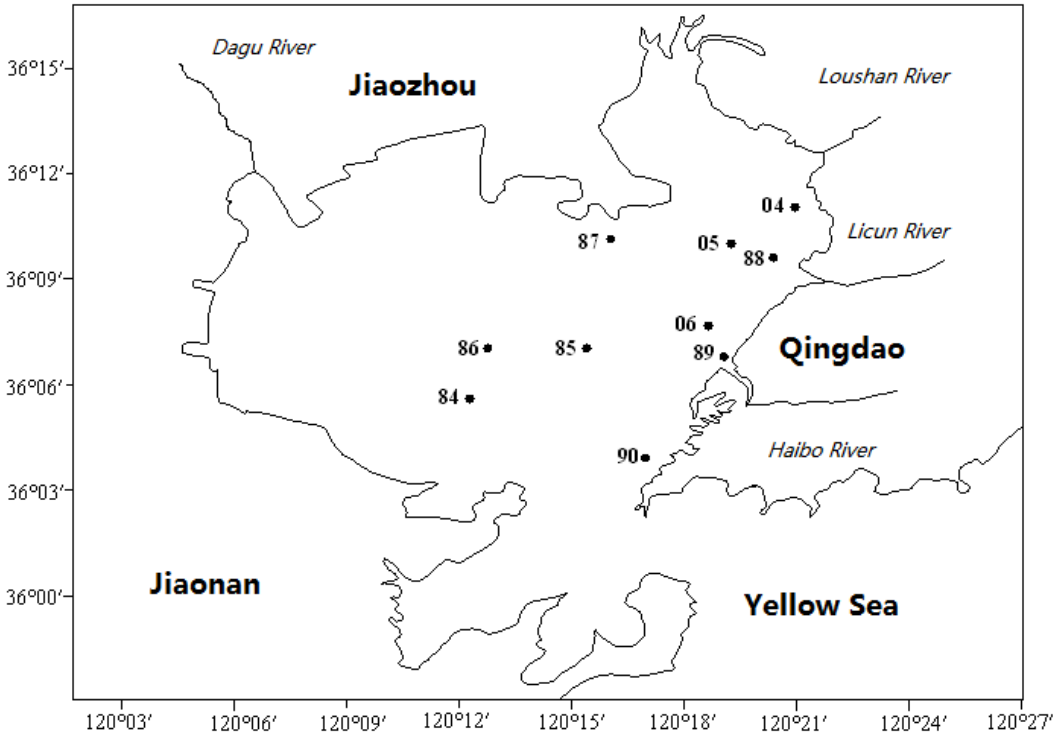

Fig.1 Geographic location and sampling sites of Jiaozhou Bay

3. Results and discussion

*3.1.Content and horizontal distribution of Cr***.** Cr contents in April and July were 1.01-3.29 μg L^{-1} and 0.63-2.36 μg L^{-1}, respectively. In April 1989, high value of Cr contents (3.29 μg L^{-1}) was in Site 06 in coastal waters in the east of the bay, and the contour lines of Cr contents were forming a serious concentric circles that were decreasing from the east of the bay to the bay center (1.90 μg L^{-1}) and to the southwest of the bay (1.66 μg L^{-1}) (Fig. 2). In July 1989, high value of Cr contents (2.36 μg L^{-1}) was in Site 87 in coastal waters in the north of the bay, and the contour lines of Cr contents were forming a serious parallel lines that were decreasing from the north of the bay to the bay mouth (1.64 μg L^{-1}) (Fig. 3).

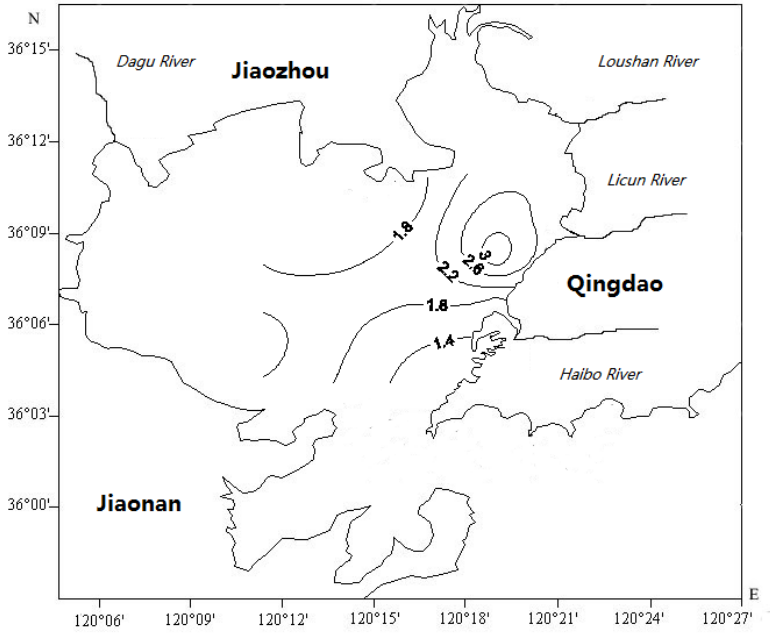

Fig. 2 Horizontal distributions of Cr in surface waters in Jiaozhou Bay in April 1989/μg L^{-1}

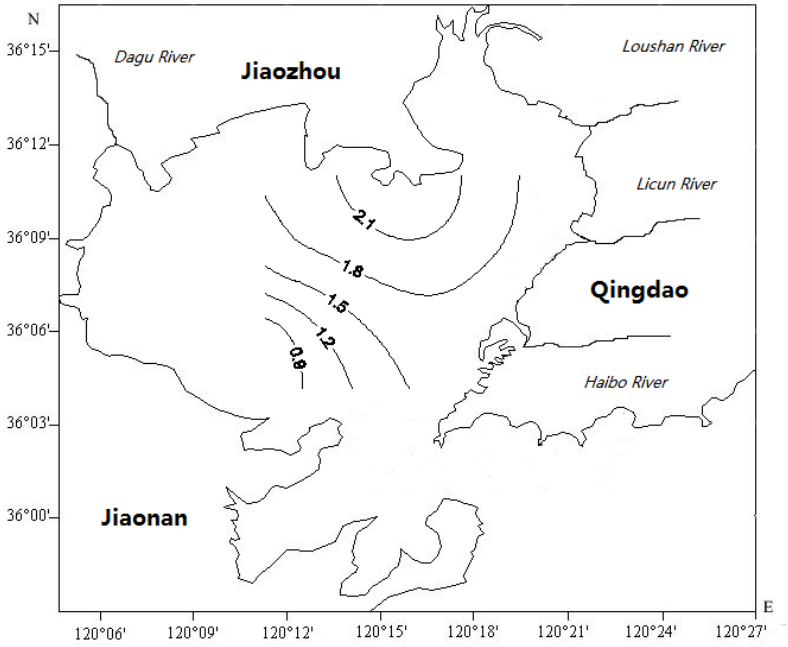

Fig. 3 Horizontal distributions of Cr in surface waters in Jiaozhou Bay in July 1989/μg L^{-1}

3.2. Pollution level and background pollution of Cr. In April 1989, Cr contents were 1.01-3.29 μg L^{-1}, and the high value regions was forming a triangle between Site 06, 05 and 08 in where Cr contents were 2.47-3.29 μg L^{-1} (Fig. 4), while in other regions were much lower than 2.47 μg L^{-1} . In July 1989, Cr contents were 0.63-2.36 μg L^{-1}, and the high value regions was in waters around Site 87 in where Cr contents were around 3.29 μg L^{-1}, while in other regions were much lower than 3.29 μg L^{-1} . In according to the guideline of Cr in National Standard of China for Seawater Quality (GB3097-1997) for Grade I (50 μg L^{-1}), Cr contents in bottom waters in different seasons in Jiaozhou Bay in 1989 were very low, and the pollution level of Cr in Jiaozhou Bay was still very slight in the early stage of

China's Reform and Opening-up, and the background pollution level of Cr could be considered as 0.63-3.29 μg L^{-1}.

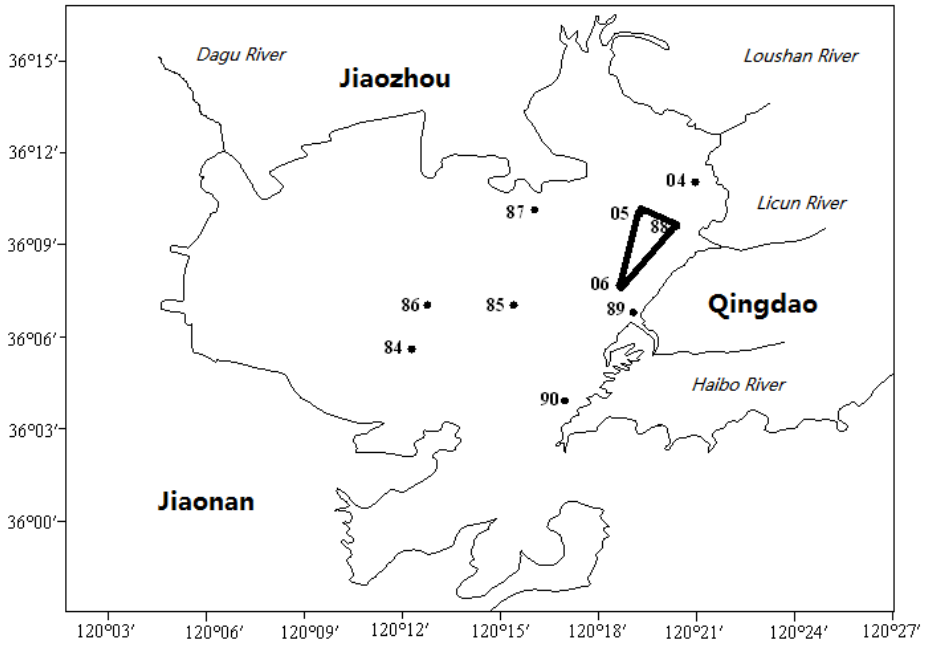

Fig. 4 High value region of Cr in surface waters in Jiaozhou Bay in July 1989/μg L^{-1}

3.3. Major source of Cr. Cr contents in surface waters could be impacted by anthropogenic inputs directly and immediately. Hence, the major sources of Cr could be defined in according to the horizontal distributions of Cr in surface waters since. In April 1989, Cr contents were forming a serious concentric circles that were decreasing from the east of the bay to the bay center and to the southwest of the bay (Fig. 2). This indicated that river discharge was the major source in April 1989, and the source strength was 3.29 μg L^{-1}. In July 1989, Cr contents were forming a serious parallel lines that were decreasing from the north of the bay to the bay mouth (Fig. 3). This indicated that atmosphere deposition was the major source in July 1989, and the source strength was 2.36 μg L^{-1}.

3.4. Anthropogenic influence on Cr. The anthropogenic influence on Cr in Jiaozhou Bay was mainly from two paths of river discharge and atmosphere deposition. In general, the source strengths of the major Cr sources were very slight in Jiaozhou Bay in 1989 and the influence of human activities was still light. By comparison, the source strength of river discharge was higher than atmosphere deposition. However, the sea area is vast, and the influence of atmosphere deposition could be potentially huge. Meanwhile, the influence of atmosphere deposition on sea water is direct. Hence, in addition to source control in industrial sewage, it is essential to promote air pollution treatment.

4. Conclusions

Cr contents in April and July were 1.01-3.29 μg L^{-1} and 0.63-2.36 μg L^{-1}, respectively. These contents were much lower than the Grade I (50 μg L^{-1}) for Cr in Sea Water Quality Standard (GB 3097-1997). The pollution level of Cr in Jiaozhou Bay in 1989 was very slight, and the background pollution level of Cr could be considered as 0.63-3.29 μg L^{-1}.

The major anthropogenic sources of Cr were atmosphere deposition and river discharge, whose source strengths were 3.29 μg L^{-1} and 2.36 μg L^{-1}, respectively. In general, the background pollution of Cr was very slight in Jiaozhou Bay in 1989 and the influence of human activities was still light.

The anthropogenic influence on Cr in Jiaozhou Bay was mainly from two paths of river discharge and atmosphere deposition. The sea area is vast, and the influence of atmosphere deposition could be

potential huge. In addition to source control in industrial sewage, it is essential to promote air pollution treatment.

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