Input and transfer processes of Cu in bay waters

Dongfang Yang[1, 2, 3, a], Zhenqing Miao [2], Wenlin Cui [1], Lin Zheng[1] and Shengtao Chen[1]

[1] North China Sea Environmental Monitoring Center, SOA, Qingdao 266033, China;

[2] School of Fishery, Zhejiang Ocean University, Zhoushan, 31600, China;

[3] College of Life, Shanghai Ocean University, Shanghai, 201306, China.

[a]dfyang_dfyang@126.com

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Abstract. This paper analyzed the input and transfer processes of Cu in waters of Jiaozhou Bay, Shandong Province, eastern China. Results showed that the input of Cu was stream flow discharge and atmospheric deposition; while the major transfer processes of Cu was vertical sedimentation and horizontal diffusion. For seasonal variations, the Cu contents in Jiaozhou Bay were higher in wet season than in dry season. For spatial variation, the Cu contents were higher in surface water than in bottom waters, and were decreasing from the pollution sources to the around areas.

Introduction

Cu has been widely used in many industries such as metallurgy, pharmaceutical, alloying etc. The excess of Cu contents in the environment could be toxic to organisms such as fish, algae etc [1]. Nowadays, Cu pollution has been one of the critical environmental pollution issues in many countries and regions. Understanding the input processes as well as the transfer processes of Cu in the environment were essential to pollution control and treating.

Jiaozhou Bay is a semi-closed bay located in Shandong Province, eastern China. Around the bay there are many economic regions such as Qingdao, Jiaonan etc. The discharge of industrial and municipal waste water was increasing along with the rapid increasing of industrialization and urbanization. Hence, Jiaozhu Bay has been polluted by various pollutants during the past thirty years.

The main object of this paper was to reveal the major input and transfer process of Cu in Jiaozhou Bay, based on the analysis of the Cu contents in both surface and bottom waters, as well as the analysis of the spatial and temporal distribution of Cu.

Material and method

Jiaozhou Bay (35°55′-36°18′ N, 120°04′-120°23′ E) is located in the south of Shandong Province, China (Fig. 1). The total water area was 390 km^2, yet the width of the bay mouth was only 3 km. Hence, this bay was typically a semi-closed bay [2]. The investigation of Cu contents in Jiaozhou Bay was conducted in July and October 1982. Five monitoring sites were set up in southwest of the bay, and both surface and bottom water samples were collected and measured for Cu.

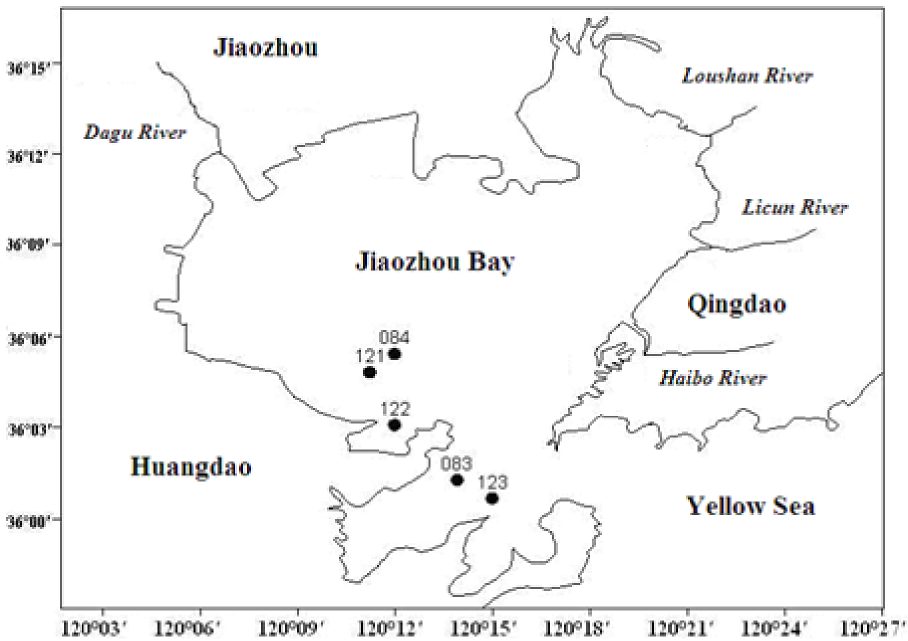

Fig.1 Sampling sites of Cu in Jiaozhou Bay

Results and discussion

Seasonal distributions of Cu. The Cu contents in July and October in surface waters were 0.15-0.23 $\mu g.L^{-1}$ and 2.22-5.36 $\mu g.L^{-1}$, while for bottom waters were 0.23-1.46 $\mu g.L^{-1}$ and 1.56-3.22 $\mu g.L^{-}$, respectively (Fig. 2). It was clearly that Cu contents in both surface and bottom waters were higher in October than in July. October was the wet season in study area, and therefore the rainfall runoff was more plenty in October than in July. Therefore, Cu from both point and non-point sources were transferred into Jiaozhou Bay by processes of overland runoff, stream flow discharge and wet deposition. In generally, the seasonal distributions of Cu in Jiaozhou Bay were that relative high in wet season yet relative low in dry season.

Vertical distributions of Cu. It could be seen from Fig. 2 that Cu contents in surface waters were higher than in bottom waters in both July and October. The Cu contents in surface waters in October were higher than in July; the Cu contents in bottom waters in October were higher than in July as well. The vertical distributions of Cu indicated that Cu contents in bottom waters were mainly determined by which in surface waters. Cu in sea waters could be easily absorbed to suspended particles and phytoplankton [3]. In summer and autumn, the growth and reproduction of phytoplankton were higher than winter and spring [4-6]. Hence, the absorption of Cu in sea waters was increasing from spring and autumn, leading to the increasing of Cu contents in October than in July bottom waters by means of vertical sedimentation to and accumulation in bottom waters.

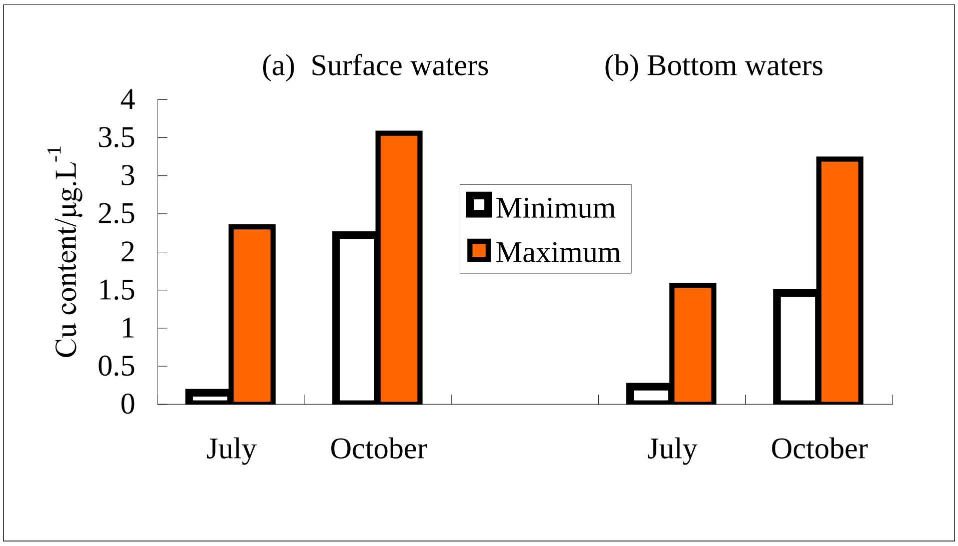

Fig. 2 The minimum and maximum of Cu contents in a) surface waters and b) bottom waters in July and October in Jiaozhou Bay

Horizontal diffusion of Cu. The horizontal distributions of Cu in bottom waters in July and October were showing inverse trends (Fig. 3). In July, the Cu contents were decreasing from the inshore waters to the center of the bay. While in October, the Cu contents were decreasing from the center of the bay to the inshore water. It could be explained that the inputs of Cu to Jiaozhou Bay was mainly from stream flow discharge from the continent, while in October atmospheric deposition especially wet deposition were the major source. Hence, high values of Cu contents in July and October were occurred in inshore waters and the center of the bay, respectively. By means of water exchange, Cu contents were decreasing from the higher value center to the around areas.

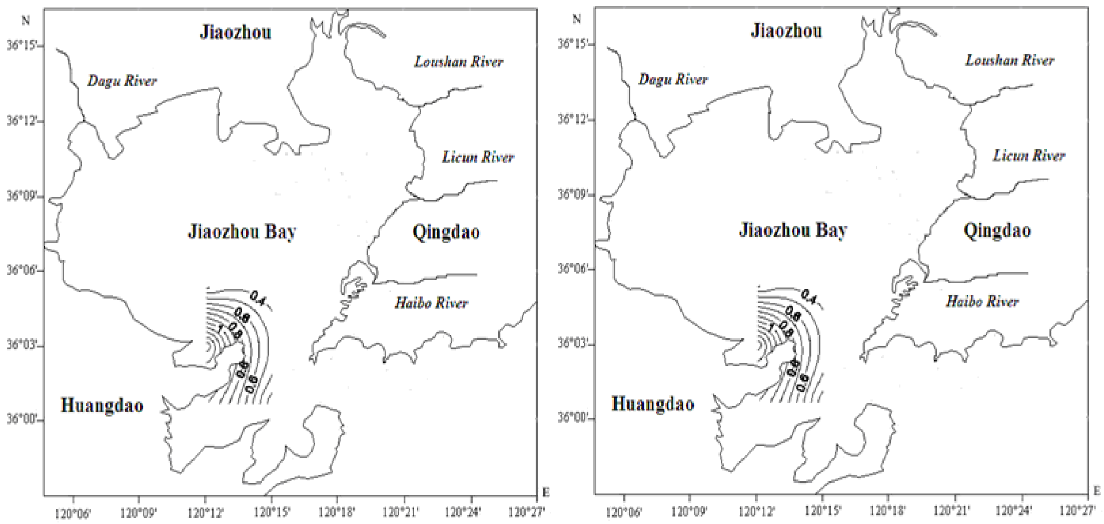

Fig. 3 Distributions of Cu in bottom waters in Jiaozhou Bay in a) July and b) October /$\mu g.L^{-1}$

Conclusion

The major input processes of Cu to Jiaozhou Bay were stream flow discharge and wet deposition. The major transfer processes of Cu in Jiaozhou Bay were vertical sedimentation and horizontal diffusion. For seasonal variations, the Cu contents in Jiaozhou Bay were higher in wet season than in dry season. For spatial variation, the Cu contents were higher in surface water than in bottom waters, and were decreasing from the pollution sources to the around areas.

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