

Uniformity changing process of Cr in waters in marine bay

Dongfang Yang^{1, 2, 3, a}, Sixi Zhu^{1, 2}, Fengyou Wang^{1, 2, b, c}, Zhikang Wang^{1, 2} and Xiuqin Yang^{1, 2}

¹Research Center for Karst Wetland Ecology, Guizhou Minzu University, Guiyang 550025, China;

²College of Chemistry and Environmental Science, Guizhou Minzu University, Guiyang 550025, China;

³North China Sea Environmental Monitoring Center, SOA, Qingdao 266033, China.

^adfyang_dfyang@126.com, ^bcorresponding author, ^cfywang@163.com.cn.

Keywords: Cr, Distribution, Homogeneity, Changing process, Jiaozhou Bay.

Abstract. Based on the investigation data on Cr in waters in Jiaozhou Bay in May and August, we analyzed the spatial and temporal distributions of Cr. Results showed that the horizontal distribution of Cr in May was inhomogeneous, yet in August was homogeneous. Cr contents in marine bay were undergoing a process from inhomogeneous to homogeneous. In case of the import of Cr to the bay was lasting, Cr contents in waters were tending to be inhomogeneous horizontal distribution. In case of the import of Cr to the bay was stopping, Cr contents in waters were tending to be homogeneous horizontal distribution. The horizontal distributions of Cr revealed the effects of tide and marine current that leading substances in waters being homogeneous. Therefore, we proposed 'homogeneous law of substances in waters', and believed that the ocean could make all of the substances being homogeneous, and force all of the substances to be homogeneous by diffuse movement.

Introduction

The rapid increasing or industrialization and urbanization are generating a large amount of environmental pollutants and have caused many environmental issues. Marine is the sink of various pollutants; particularly many marine bays have been heavy polluted. Since the pollution of marine bays would cause harms and various diseases to human beings, understanding the environmental behavior and migration process of the pollutants in marine bay are essential to marine environment protection and the maintaining of ecological sustainable development.

We have found the 'homogeneous law of substances in waters', and we believed that the ocean could make all of the substances being homogeneous. Cr is one of the critical pollutant in marine environment [1-2]. In this paper, we took Cr in Jiaozhou Bay as a case study, and reveal the uniformity changing process of substance in waters in marine bay. The aim of this paper was to provide information for research and 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 km², 7 m and 3 km, respectively. There are a dozen of rivers, and the majors are Dagu River, Haibo River, Licun River, and Loushan River etc., all of which are seasonal rivers [3-4].

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 [5].

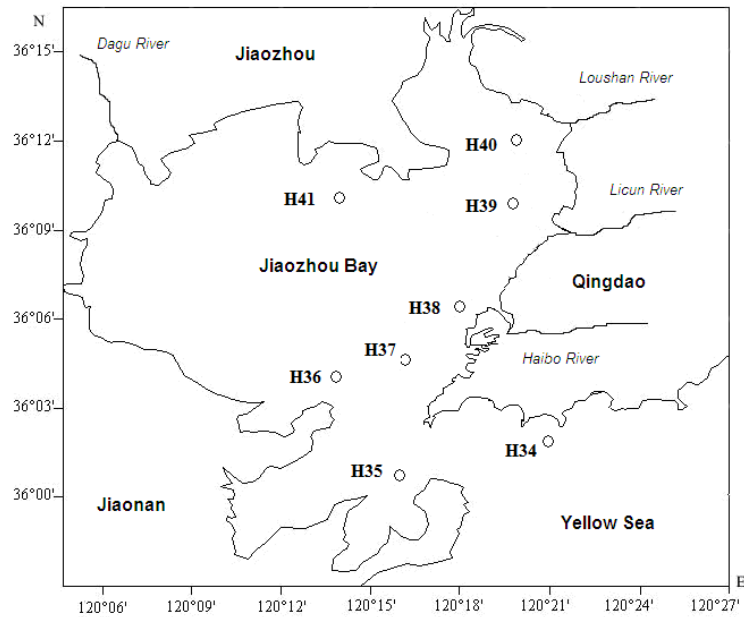


Fig.1 Investigation sites in Jiaozhou Bay

Results

Horizontal distributions of Cr. In May 1979, Cr contents were decreasing from the estuaries of Loushan River and Licun River in the northeast of the bay to the bay mouth in the south of the bay ($0.20\mu\text{g L}^{-1}$) (Fig. 2). In August 1979, Cr contents were decreasing from the estuaries of the major river in the east of the bay to the costal waters in the west the bay (Fig. 3).

High values of Cr. In May 1979, there was a high value ($112.30\mu\text{g L}^{-1}$) in Site H39 and a high value region between the estuaries of Loushan River and Licun River in the northeast of the bay (Fig. 2). In August 1979, there was a high value ($1.40\mu\text{g L}^{-1}$) in Site H34, H37 and H38 closed the estuaries of the major river in the east of the bay (Fig. 3). It should be noticed that Site H34, H37 and H38 were far away, yet in where the high value of Cr contents in August were all $1.40\mu\text{g L}^{-1}$.

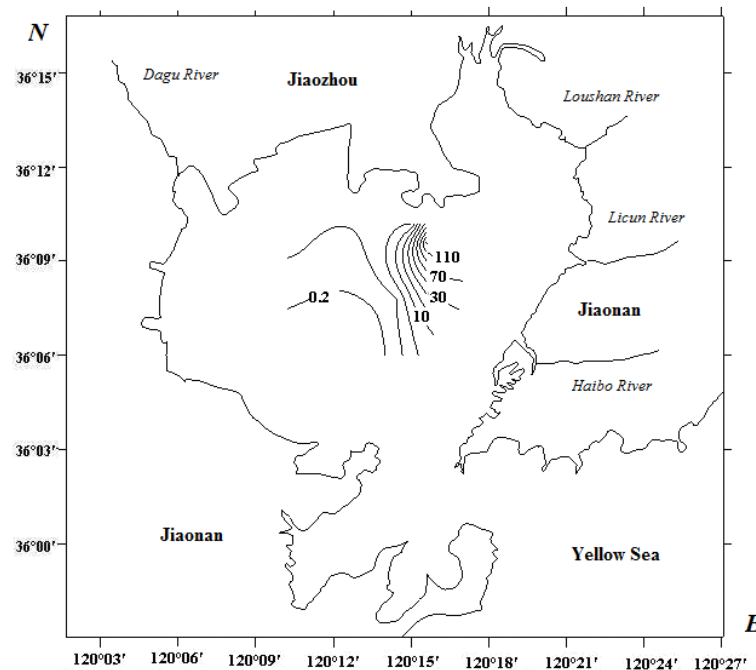


Fig. 2 Horizontal distributions of Cr in surface waters of Jiaozhou Bay in May 1979/ $\mu\text{g L}^{-1}$

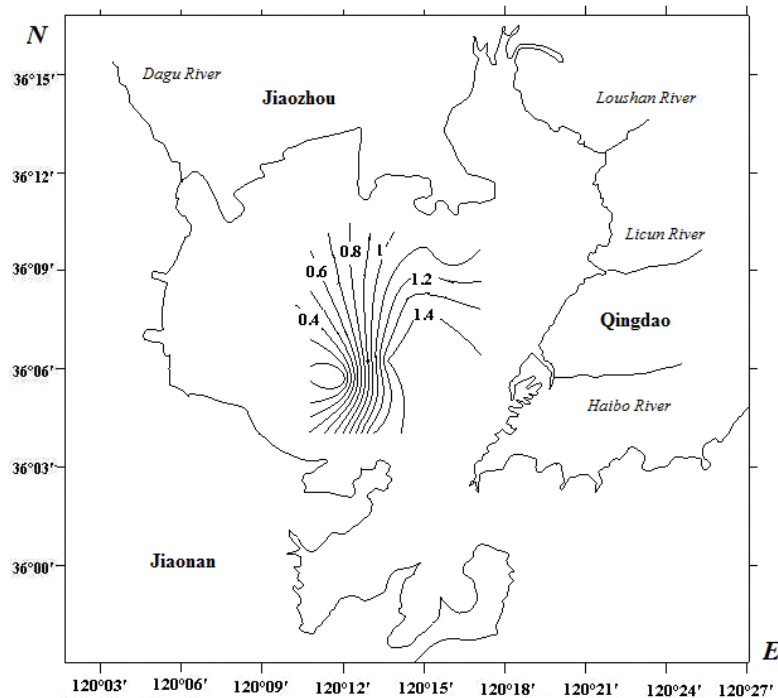


Fig. 3 Horizontal distributions of Cr in surface waters of Jiaozhou Bay in August 1979/ $\mu\text{g L}^{-1}$

Discussion

Spatial homogeneity. Cr contents in August 1979 were $0.10\text{--}1.40 \mu\text{g L}^{-1}$, and were indicating that the contents were relative low and the horizontal variations were very small. Meanwhile, Site H34, H37 and H38 were far away, yet in where the high value of Cr contents in August 1979 were all $1.40 \mu\text{g L}^{-1}$ (Fig. 3). Hence, it could be found that Cr contents in waters were inhomogenous in August 1979.

Temporal homogeneity. There was only one major Cr source in Jiaozhou Bay in May 1979, and the source strength was as high as $112.30 \mu\text{g L}^{-1}$, and the horizontal distribution of Cr in May 1979 was very inhomogenous (Fig. 2). By contrast, there was little Cr import to Jiaozhou Bay in August 1979, and the horizontal distribution of Cr in August 1979 was very homogenous (Fig. 3). Cr contents were ranging greatly from $0.20\text{--}112.30 \mu\text{g L}^{-1}$ in May 1979, yet were only ranging from $0.10\text{--}1.40 \mu\text{g L}^{-1}$ in August 1979. In generally, as time going by, the substances in the ocean were tending to be homogenous.

Homogeneity of ocean. We found that all of the substances in the ocean were stirring and transporting by tide and current, and were tending to be homogenous in waters [6]. Tide was playing the major role in coastal waters, while marine is responsible in open waters, as well as storm and earth quake. Therefore, all of the substances in the ocean were just as substances in the container, and were going to be homogenous, and the ocean had homogeneity. In case of the import of Cr to the bay was lasting, Cr contents in waters were tending to be inhomogeneous horizontal distribution. In case of the import of Cr to the bay was stopping, Cr contents in waters were tending to be homogeneous horizontal distribution. The findings were confirmed by the distributions of PHC and Cu in Jiaozhou Bay 1983 [7-8], as well as Cd and Pb in Jiaozhou Bay in 1985 [9].

Conclusion

All of the substances in the ocean were stirring and transporting by tide and current, and were tending to be homogenous in waters. The spatial-temporal distributions of the substances were fully indicating that the ocean could make all of the substances being homogeneous, and force all of the substances to be homogeneous by diffuse movement.

In case of the import of substances to the bay was lasting, substances in waters were tending to

be inhomogeneous horizontal distribution. In case of the import of substances to the bay was stopping, substances in waters were tending to be homogeneous horizontal distribution.

Acknowledgement

This research was sponsored by Doctoral Degree Construction Library of Guizhou Nationalities University, Education Ministry's New Century Excellent Talents Supporting Plan (NCET-12-0659), the China National Natural Science Foundation (31560107), Major Project of Science and Technology of Guizhou Provincial ([2004]6007-01), Guizhou R&D Program for Social Development ([2014] 3036) and Research Projects of Guizhou Nationalities University ([2014]02), Research Projects of Guizhou Province Ministry of Education (KY [2014] 266), Research Projects of Guizhou Province Ministry of Science and Technology (LH [2014] 7376).

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