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The environmental dynamic value and model of Cr in marine bay

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Abstract: We applied the definition and structural model of environmental dynamic value of substance in marine bay and the variables including basic background value, environmental background value, input value and environmental dynamic value in analyzing the change process and change trend of Cd in Jiaozhou Bay, eastern China based on investigation data on Cd in May, August and November 1979. Results showed that the basic background value of Cd was 0.02-0.04 μg L^{-1}, the environmental background value of Cd was 0.01-0.04 μg L^{-1}, the input of Cd from river flow was 0.07-0.85 μg L^{-1}, the input of Cd from marine current was 0.25 μg L^{-1}, and the environmental dynamic value of Cd was 0.01-0.85 μg L^{-1}. The identification of change process and the change trend of Cd provided scientific basis for division of grade standards of Cd in marine bay.

1. Introduction

The existence of Cd in the environment is impacted by both natural factors and human activities. The mining and applying of Cd is increasing rapidly along with the development of economic and population, and many marine bays in the world have been polluted by Cd [1-2].Understanding the change process and trend of Cd is essential to environmental conservation practice and scientific research. Jiaozhou Bay is a semi-closed bay in Shandong Province, eastern China. This paper applied the definition and structural model of environmental dynamic value of substance in marine bay in analyzing the change process and change trend of Cd in Jiaozhou Bay based on investigation data on Cd in May, August and November 1979. The change process and the change trend of Cd was identified and was providing scientific basis for division of grade standards of Cd in marine bay.

2. Material and method

2.1. 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), with the total area, average water depth and bay mouth width of 446 km^2, 7 m and 3 km, respectively. This bay is a typical of semi-closed bay connected to the Yellow Sea in the south. There are a dozen of rivers including Dagu River, Haibo Rriver, Licun Rriver, and Loushan

Rriver etc., all of which are seasonal rivers [3-4]. The investigation on Cd in Jiaozhou Bay was carried on in May, August and November 1979 in eight investigation sites (i.e., H34, H35, H36, H37, H38, H39, H40, H41) (Fig. 1). Pb in waters was sampled and monitored follow by National Specification for Marine Monitoring [5].

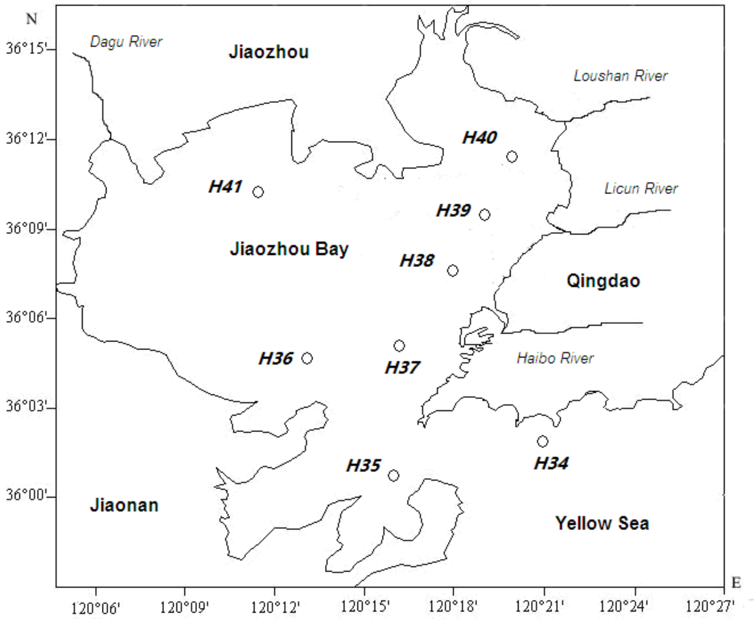

Fig. 1 Geographic location and sampling sites in Jiaozhou Bay

2.2. Definitions and structural model

In according to the environmental background structure proposed bay Yang [6-9], the structural model of environmental background value of substances was described as:

$$H = B + L + M \tag{1}$$

Where, B is the basic background value, represents the substance in waters. L is the input amount of runoff, represents the substance input from river runoff. M is the input amount of marine current, represent the substance input from marine current. H is the environmental background value of substance.

The structural model of environmental dynamic value of substances was further improved and established as:

$$D = B \cup H \cup \sum M_i \qquad (i=1, 2, \cdots, N) \tag{2}$$

Where, B is the basic background value, represents the substance in waters in case of no external input. H is the environmental background value, represents the smallest substance in case of there are external inputs. M_i is the input of the ith source. N is the number of the sources. D is the environmental dynamic value, represents the dynamic value in this waters. $\cup$ represents the union set.

3. Results

3.1. Contents and sources of Cd

The contents of Cd in May, August and November 1979 were 0.04-0.07μg L^{-1}, 0.01-0.85μg L^{-1} and 0.02-0.04μg L^{-1}, respectively. River runoff was the major source of Cd. River runoff was the major source in May 1979, and the source strength was 0.07μg L^{-1}. River runoff was also the major source in August 1979, and the source strength was 0.85 μg L^{-1}. However, the input from river runoff was stopped in November 1979, and the major source is marine current, whose source strength was 0.25 μg L^{-1}.

3.2. Homogeneity of distributions of Cd

The source strength of Cd from stream flow was very small in May 1979, and Cd contents were very low and well-distributed, indicating that the distribution of Cd in May had feature of homogeneity in generally. The input of Cd from stream flow was big in August 1979, and there was a relative high value region in estuary of Licun River, indicating that the distributions of Cd were just locally nonuniform distributed yet were well-distributed in generally. The input from river runoff was stopped in November 1979, and the distributions of Cd were well-distributed in generally.

4. Discussion

4.1. Basic background values of Cd

There was little input of Cd in Jiaozhou Bay in November since the input from river runoff was stopped. The distance from coastal waters in the northeast to the southwest was long yet Cd content in this waters was well-distributed (≈0.02 μg L^{-1}). The distance from coastal waters in the northwest to the southeast was also long yet Cd content in this waters was also well-distributed(≈0.04 μg L^{-1}). Hence, it could be found that the basic background value of Cd in Jiaozhou Bay was 0.02-0.04 μg L^{-1}.

4.2. Environmental background values of Cd

The source strength of river runoff in May 1979 was 0.07 μg L^{-1}, and the lowest value of Cd contents was 0.04 μg L^{-1} in the inner waters inside the bay mouth, indicating that the environmental background value of Cd was 0.04 μg L^{-1} in May 1979. The source strength of river runoff in August 1979 was 0.85 μg L^{-1}, and the lowest value of Cd contents was 0.01 μg L^{-1} in the south of the bay, indicating that the environmental background value of Cd was 0.01 μg L^{-1} in August 1979. The source strength of marine current in November 1979 was 0.25 μg L^{-1}, and the lowest value of Cd contents was 0.02 μg L^{-1} in the inner waters inside the bay mouth, indicating that the environmental background value of Cd was 0.02 μg L^{-1} in November 1979. Hence, the environmental background value of Cd was 0.01-0.04 μg L^{-1}.

4.3. Environmental dynamic values and structural model of Cd

Based on the structural model of environmental dynamic value (Eq. 2), The environmental dynamic structure of Cd in Jiaozhou Bay was:

$D=B \cup H \cup \sum \cup Mi$

=0.01～0. 85

=0.02～0.04∪0.01～0.04∪0.07～0.85∪0.25

Hence, the environmental structure and numerical values were defined and calculated (Table 1). Based on the environmental structure and numerical values, the change process and trend of Cd in Jiaozhou Bay could be identified, providing basis for environmental conservation and scientific research.

Table 1 Environmental dynamic structure of Cd in Jiaozhou Bay/μg L^{-1}

Environmental dynamic value (D)	Basic background value (B)	Environmental background value (H)	Input from river runoff (M_1)	Input from marine current (M_2)
0.01-0.85	0.02-0.04	0.01-0.04	0.07-0.85	0.25

5. Conclusions

The basic background value, environmental background value, input from river flow, input from river flow of Cd were 0.02-0.04 μg L^{-1}, 0.01-0.04 μg L^{-1}, 0.07-0.85 μg $L^{-1}$and 0.25 μg L^{-1}, respectively. The environmental dynamic value of Cd was 0.01-0.85 μg L^{-1}. The identification of change process and the change trend of Cd provided basis for environmental conservation and scientific research.

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