A Comprehensive Research on the Transporting Processes and Laws of Cu in Jiaozhou Bay

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Abstract: Cu pollution in marine bays has been one of the critical environmental issues in the world, and understanding the transporting laws in marine bay is essential to environmental protection. This paper provided a comprehensive research on the transporting processes and laws in Jiaozhou Bay, Shandong Province of China, during 1982-1986. According to the results, the transporting processes of Cu contents in bay waters along with the changing of space and time could be defined. These findings provided solid theory basis for better understanding the transporting processes and laws of pollutants in marine bay waters.

1. Introduction

Cu has been widely exploited and used for thousands of years. After the industrial revolution, the economic and population were increasing rapidly, and a large amount of Cu-containing wastes were discharged to the environment [1-3]. The excessive Cu contents were harmful to the organism and ecosystem, and to human beings finally by food chain [4-7]. Many marine bays had been polluted by Cu since ocean was the sink of pollutants [8-16], understanding the transporting laws in marine bays is essential to environmental protection.

Jiaozhou Bay is a semi-closed bay located in Shandong Province, eastern China. This bay is surrounded by cities of Jiaonan, Qingdao and Jiaozhou, and had been polluted along with the rapid development of industry and economic [1-8]. This paper provided a comprehensive research on the transporting processes and laws in Jiaozhou Bay [3-16], Shandong Province of China during 1982-1986. The aim of this paper was to provided basis information to scientific research and pollution control practice in marine bay.

2. Study area and data collection

Fig. 1 Geographic location of Jiaozhou Bay

Jiaozhou Bay is located in the south of Shandong Province, eastern China (35°55′-36°18′ N, 120°04′-120°23′ E). The total area, average water depth and bay mouth width are 446 km2, 7 m and 3 km, respectively. This bay is a typical of semi-closed bay which is connected to the Yellow Sea in the south. 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 [17-18].

The investigation on Cu in Jiaozhou Bay was carried on in July and October 1982, May, September and October 1983, July and October 1984, and April, July and October 1985 [3-16] (Fig. 1). Cu in waters was sampled and monitored follow by National Specification for Marine Monitoring [19].

3. Laws of spatial-temporal transporting processes of Cu

Based on the investigation data on Cu in waters in Jiaozhou bay during time periods of 1982 to 1986 [3-16], the laws of spatial and temporal transporting processed of Cu in bay waters were summarized. The major laws of spatial transporting processed were as follows:

1) The major sources of Cu in this bay were marine current, river flow, island top, overland runoff and marine traffic.

2) Within a year, Cu contents went through a process from homogeneous to heterogeneous, and then a process from heterogeneous to homogeneous.

3) Cu contents in land and oceans were jointly determined by natural factors and human activities.

4) Cu contents in the environment could be decreasing along with time in case of the cease of human input.

5) The variation ranges of Cu contents in surface waters and bottom waters were basic same, and variation ranges of Cu contents in surface and bottom waters were tending to be consistent.

6) Cu content in surface waters and bottom waters were closed, and Cu contents in surface and bottom waters were tending to be consistent.

7) During the spatial-temporal changing processes, Cu contents from the sources were always firstly arrived at surface waters, and then transported to sea bottom through water body.

8) The sources of Cu were varying at spatial scale, and by means of vertical water's effect, resulted in high sedimentation processes in different positions.

9) Cu contents in surface waters decreased along with the distance from the sources, so did Cu contents in bottom waters.

10) The seasonal variations of Cu contents were jointly determined by terrestrial transporting process and oceanic transporting process.

11) The ocean had features of homogeneous, Cu contents could be transported to anywhere in the bay.

12) Once the source input of Cu was decreasing along with time, the area of high sedimentation regions was decreasing, and Cu contents in the high sedimentation regions were also decreasing.

13) There was rapid sedimentation process of Cu content, and the sedimentation amount was consistent with the level of Cu contents in waters.

14) There was accumulation process in sea bottom along with the continuous sedimentation process of Cu content.

15) Cu content in waters were showing overturn and cyclic processes of appear-disappear-appear-disappear.

16) During the changing processes of Cu contents from the start and stop of sedimentation, there were sedimentation and accumulation processes, once Cu contents were disappearing in surface waters, Cu contents in bottom waters would also be disappear.

17) The relative sedimentation amount and absolute sedimentation amount of Cu contents were stable and high along with the change of time.

18) The sedimentation of Cu contents was rapid and thorough, with feature of easy to be settled.

19) The accumulation of Cu contents was stable and complete, with feature of easy to be accumulated and fixed.

20) The changes of Cu contents in surface and bottom waters were determined by the source strengths of Cu and the transporting distances from the sources.

21) Cu contents in the whole waters would be disappear completely once the source input of Cu was cut off.

22) Cu contents in marine waters was inherent.

23) During 1982-1986, the pollution level of Cu in spring in the early stage was moderate yet was slight in the later stage, while in summer and autumn the pollution level was slight in the whole time period.

24) Cu contents in this bay during 1982-1986 were in order of spring > summer > autumn.

25) The source input of Cu during 1982-1986 were decreasing, and the pollution levels were changed from moderate to slight.

26) The anthropogenic source input of Cu during 1982-1986 was decreasing, the natural source input of Cu was increasing and was the dominant source.

27) The impact of human activity on Cu content in this bay during 1982-1986 was decreasing, and the number and paths of anthropogenic sources of Cu was decreasing.

4. Conclusions

The transporting processes and laws of Cu in Jiaozhou Bay were analyzed based on investigation data during 1982-1986. More than twenty laws of spatial-temporal transporting processes of Cu contents were summarized. The transporting processes of Cu contents in bay waters along with the changing of space and time could be defined by means of these laws.

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