Background pollution level of Arsenic in Jiaozhou Bay

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Abstract

This paper researched on the background pollution level of As in Jiaozhou Bay in 1982. Results showed that As's contents in surface waters in April, June, July and October 1982 were 0.22-0.33 μg L^{-1}, 1.07-2.52 μg L^{-1}, 0.36-2.80 μg L^{-1}, and 0.58-1.62 μg L^{-1}, respectively. As's contents were much lower than the guide line of Grade I for As (20.00 μg L^{-1}) in Sea Water Quality Standard (GB 3097-1997). In according to the horizontal distributions of As's contents, it could be found that river runoff and overland runoff were the major source, and the source strength were 2.52 μg L^{-1} and 2.80 μg L^{-1}, respectively. The pollution level of As in 1982 was still very slight, and the background pollution level of As in Jiaozhou Bay could be roughly considered as 2.52-2.80 μg L^{-1}.

Keywords

Arsenic (As), Background pollution level, Distribution, Source, Jiaozhou Bay.

1. Introduction

Many marine bays have been polluted by As due to the rapid development of industrial economic and the increase of population size [1-2]. Understanding the background pollution level of As in marine bays is essential to pollution control [3-4]. Jiaozhou Bay is a semi-closed bay located in Shandong Province China, and has been polluted by various pollutants including As since China's Reform and Opening-up [1-2]. In order to provide basis for scientific research and environment remediation, this paper analyzed the background pollution level of As in Jiaozhou Bay in 1982. As a result, the background level, distribution and pollution source were defined. These results were important basis for scientific research and environment management decision-making.

2. Materials and method

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). The total area, average water depth and the width of the bay mouth are 446 km2, 7 m and 3km, respectively. The bay mouth is connecting to the Yellow Sea in the south, and is surrounded by Qingdao, Jiaozhou and Jiaonan in the east, north and west, respectively (Fig. 1). This bay has 12 major inflow rivers including Dagu River, Haibo Rriver, Licun Rriver, and Loushan Rriver etc., all of which are seasonal rivers [4-5].

The investigation on As in surface waters in Jiaozhou Bay was carried on in April, June, July and October 1982. There were five sampling sites in April, July and October 1982 (i.e., 083, 084, 121, 122 and 123), while in June 1982 there were four sampling sites (i.e., H37, H39, H40 and H41). As in waters was sampled and monitored follow by National Specification for Marine Monitoring [6].

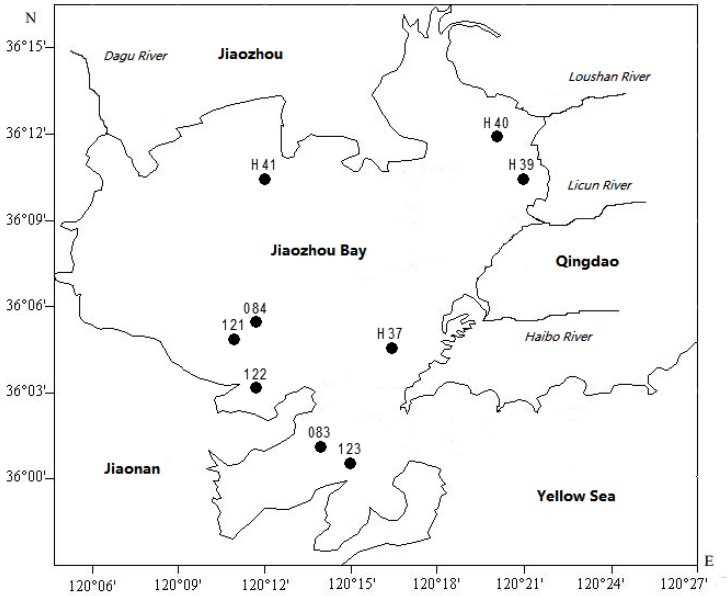

Fig. 1 Geographic location and monitoring sites in Jiaozhou Bay

3. Results and discussion

Contents and pollution level of As. As's contents in surface waters in April, June, July and October 1982 were 0.22-0.33 μg L-1, 1.07-2.52 μg L-1, 0.36-2.80 μg L-1, and 0.58-1.62 μg L-1, respectively. In April 1982, As's contents were 0.22-0.33 μg L-1, and the high value was in Sit 084 in the center waters in the southwest of the bay. In June 1982, As's contents were 1.07-2.52 μg L-1, and the high value was in Sit H40 in the estuary of Loushan River in the northeast of the bay. In July 1982, As's contents were 0.36-2.80 μg L-1, and the high value was in Sit 122 in coastal waters in the southwest of the bay. In October 1982, As's contents were 0.58-1.62 μg L-1, and the high value was in Sit 123 in the bay mouth. However, in according to Sea Water Quality Standard (GB 3097-1997) for As, As's contents were much lower than the guide line of Grade I for As (20.00 μg L-1), and therefore the pollution level of As in 1982 was still very slight (Table 1).

Table 1 Contents and pollution level of As in Jiaozhou Bay 1982

	April	June	July	October
Content/μg L^{-1}	0.22−0.33	1.07−2.52	0.36−2.80	0.58−1.62
Grade	I	I	I	I

Horizontal distributions of As. In April 1982, As's contents were very low, and there was a low value region between Site 084, 121 and 123, yet there was no significant distribution trends in study ares (Fig. 2). In June 1982, As's contents were relative high, and there was a high value region around Site H40 in the estuary of Loushan River in the northeast of the bay, and the contour lines of As's contents were forming a serious of semi-circles that decreasing from he northeast of the bay to the center of the bay (Fig. 3). In July 1982, As's contents were relative high, and there was a high value region between Site 083, 121 and 122 in coastal waters in the southwest of the bay, and As's contents were showing gradient descent from coastal waters to the center of the bay (Fig. 4). In October 1982, As's contents were relative low, and the contour lines of As's contents were forming different patches that showing no significant trends (Fig. 5). The horizontal distributions of substance's contents were important evidences to define the major sources [7].

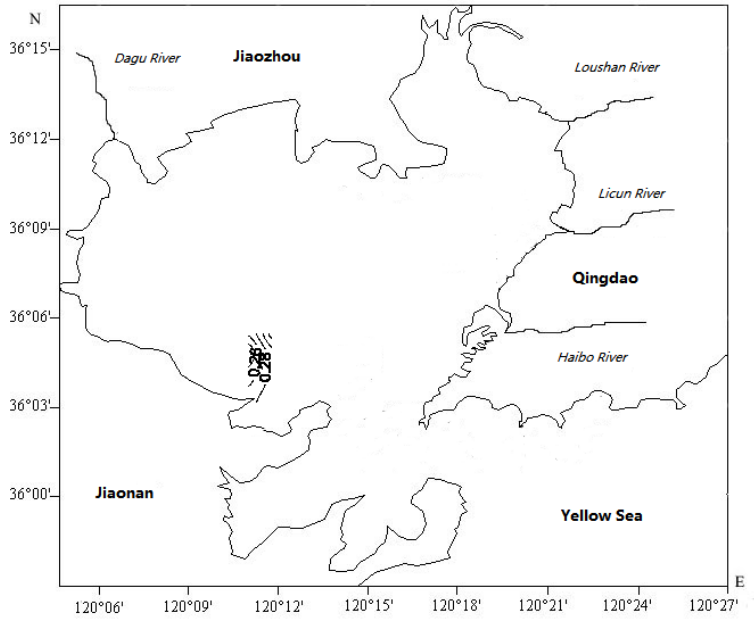

Fig. 2 Horizontal distribution of As in surface water in Jiaozhou Bay in April 1982/μg L-1

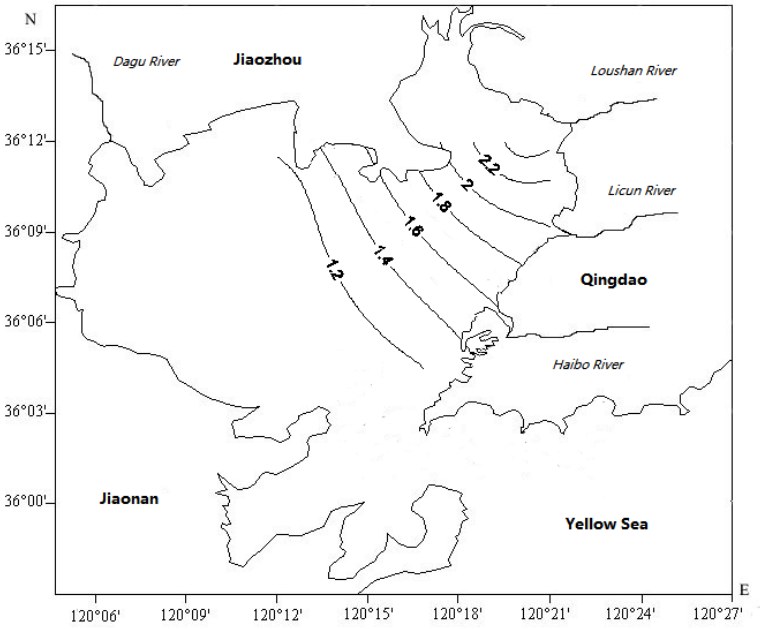

Fig. 3 Horizontal distribution of As in surface water in Jiaozhou Bay in June 1982/μg L-1

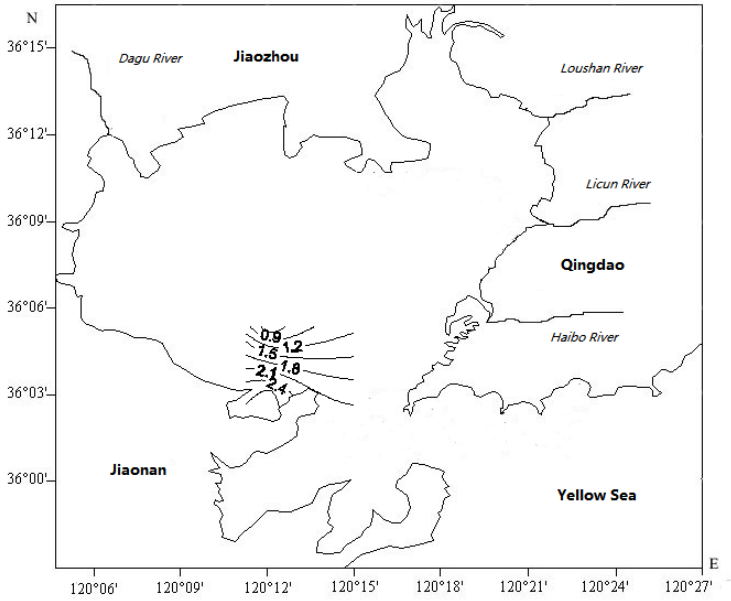

Fig. 4 Horizontal distribution of As in surface water in Jiaozhou Bay in July 1982/μg L-1

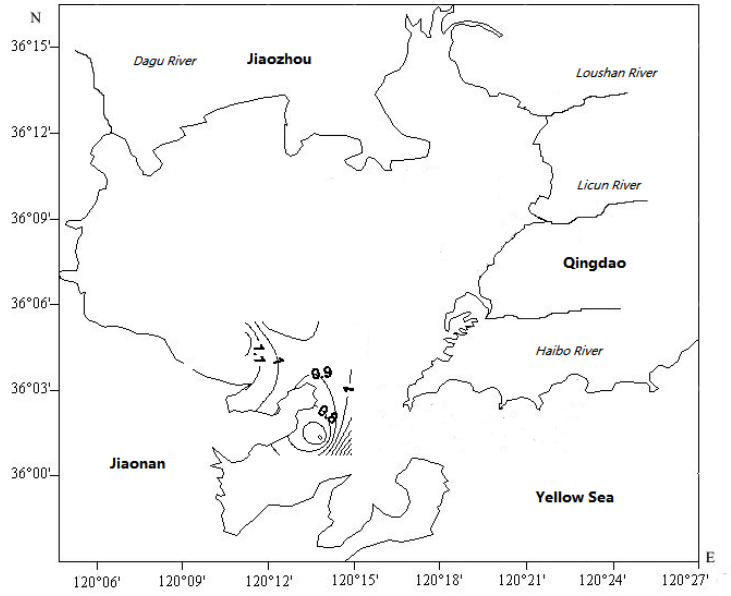

Fig. 5 Horizontal distribution of As in surface water in Jiaozhou Bay in October 1982/μg L-1

Sources and background pollution level of As. In April 1982, As's contents were very low, and there was a low In according to the horizontal distributions of As in April and October, it could be found that there was little source input, while the horizontal distribution of As in June and July indicated that river runoff was responsible [7]. The reason was that in study area, April and October were dry season, while June and July were wet season. The terrigenous As could be washed and transported to marine bay by means of rainfall-runoff. Hence, it could be found that the major source of As in Jiaozhou Bay 1982 were river runoff and overland runoff, and the source strengths were 2.52 μg L-1 and 2.80 μg L-1, respectively. This was consist with the analogous in this bay in 1981 [1]. 1982 was the beginning-early stage of China's Reform and Opening-up, and the pollution level of As in Jiaozhou Bay was very slight. From this point of view, the background pollution level of As in Jiaozhou Bay could be roughly considered as 2.52-2.80 μg L-1.

Influence of source input on horizontal distribution of As. The horizontal distributions of As's contents in marine bay were strongly impacted by source inputs of As to the bay. If there was no source input (Fig. 2 and 5), the horizontal distributions of As's contents would be no trends or

disorder patches (Fig. 3 and 4), if there was source input, the horizontal distributions of As's contents would show certain trends (Fig. 6). In case of river runoff was playing the major role, the contour lines of As's contents were showing parallel lines (Fig. 3); while in case of overland was playing the major role (Fig. 4), the contour lines As's contents were forming semi-circles (Fig. 6). As the source inputs of As were seasonal and temporal varying, the distributions of As's contents would be changing in season and space. Meanwhile, the major sources of As could be reversed from the horizontal distributions of As in waters. These were useful in cientific research and environment management decision-making.

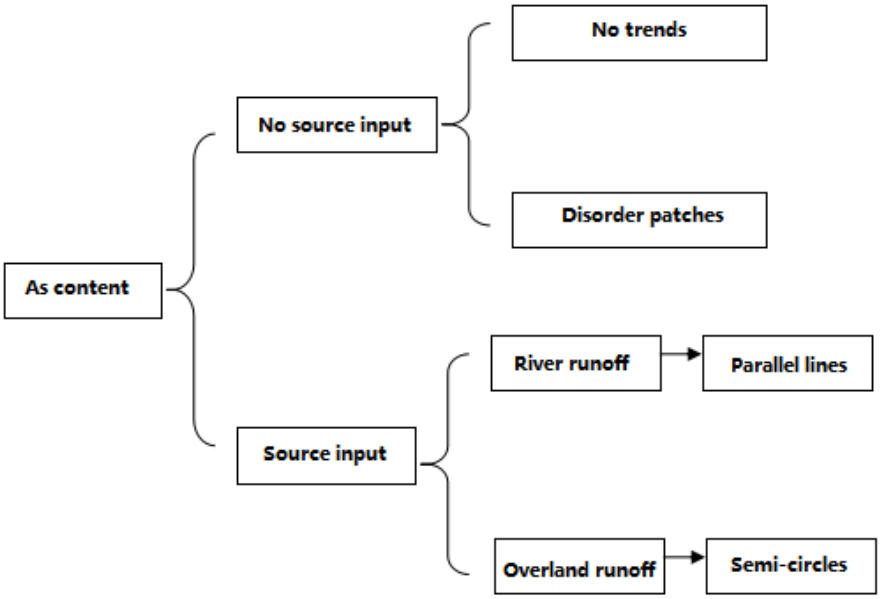

Fig. 6 Influence of source input on As's horizontal distribution in Jiaozhou Bay

4. Conclusion

As's contents in surface waters in Jiaozhou Bay in April, June, July and October 1982 were 0.22-0.33 μg L-1, 1.07-2.52 μg L-1, 0.36-2.80 μg L-1, and 0.58-1.62 μg L-1, respectively. In according to Sea Water Quality Standard (GB 3097-1997) for As, As's contents were much lower than the guide line of Grade I for As (20.00 μg L-1), and therefore the pollution level of As in 1982 was still very slight. The major source of As in Jiaozhou Bay 1982 were river runoff and overland runoff, and the source strengths were 2.52 μg L-1 and 2.80 μg L-1, respectively. In general, the background pollution level of As in Jiaozhou Bay could be roughly considered as 2.52-2.80 μg L-1.

Acknowledgments

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