Annual change of Pb contents in Jiaozhou Bay during 1979-1983

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Abstract. Based on investigation data on Pb in surface waters in Jiaozhou Bay during 1979 to 1983, this paper analyzed the annual change of both contents and pollution levels of Pb. Results showed that Pb contents in surface waters in Jiaozhou Bay in 1979, 1980, 1981, 1982 and 1983 were 0.25-1.52 μg L^{-1}, 0.07-2.71 μg L^{-1}, 0.00-3.34 μg L^{-1}, 0.30-3.35 μg L^{-1} and 0.58-2.34 μg L^{-1}, respectively, indicated that his bay had been slightly of moderated polluted by Pb in 1979 to 1983, and the pollution level of Pb in Jiaozhou Bay was increasing since the reform and opening-up. The promotion of waste treatment and environmental protection was essential. The investigation data of this study would be basic information to the relevant scientific research on this bay.

Introduction

Pb has been widely used industry and agriculture. A large amount of Pb-containing waste water, gas and residue were generated and discharged to the environment along with the rapid increasing of economic and population since the reform and opening-up. Pb is one of the critical strong pollutants due to the high toxicity and persistence in the environment. The marine environment had been polluted by Pb via stream flow, atmosphere deposition etc., and could be harmful to the health of ecologic system, and human beings via food chain [1-6]. Hence, understanding the changes of Pb contents in marine waters is essential to marine environmental protection.

Jiaozhou Bay is located in Shandong Province, China, and is surrounded by economic and agricultural developed regions of Qingdao, Jiaozhou and Jiaonan. The waters in this bay had been polluted by Pb since the reform and opening-up [1-6]. This aim of this paper is to analyze the changes of Pb contents in the early stage of the reform and opening-up during 1979-1983, and to provide basic information to both scientific research and pollution control protection in this bay.

Material and method

Jiaozhou Bay (35°55′-36°18′ N, 120°04′-120°23′ E) is located in the south of Shandong Province, eastern China (Fig. 1). It is a semi-closed bay with the total area, average water depth and bay mouth width of 446 km^2, 7 m and 3 km, respectively. The bay mouth is located between Tuandao Island and Xuejiadao Island, and is connect to Yellow Sea in the south. There are more than ten inflow rivers (e.g., Haibo Rriver, Licun Rriver, Dagu Rriver, and Loushan Rriver), most of which have seasonal features [7, 9].

The data was provided by North China Sea Environmental Monitoring Center. The investigations of Pb contents in surface waters were conducted in May, August and October 1979, June, July, September and October 1980, April, August and November 1981, April, June, July and October 1982, and May, September and October 1983, respectively [1-6]. Surface water samples were collected and measured followed by National Specification for Marine Monitoring [9].

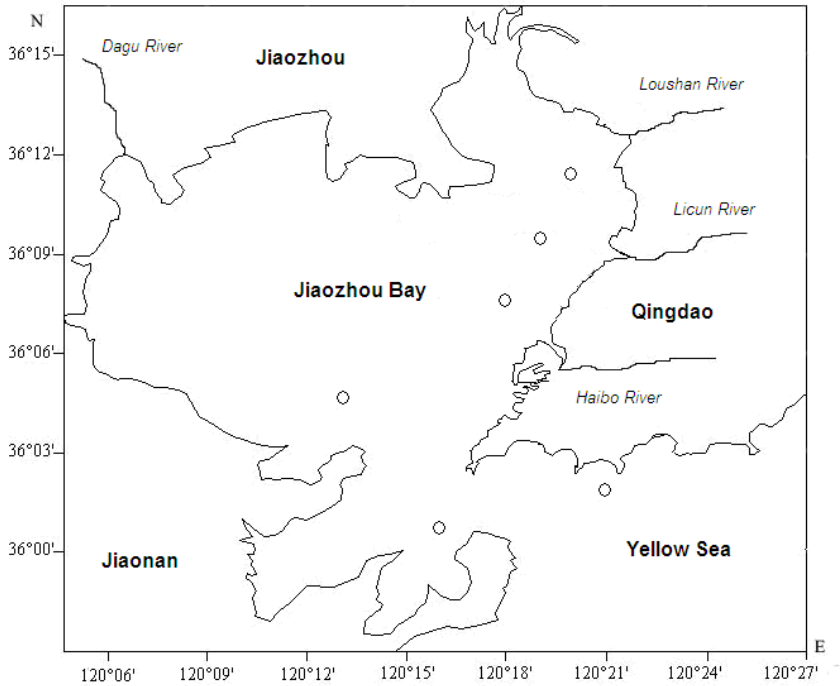

Fig. 1 Geographic location and sampling sites in Jiaozhou Bay

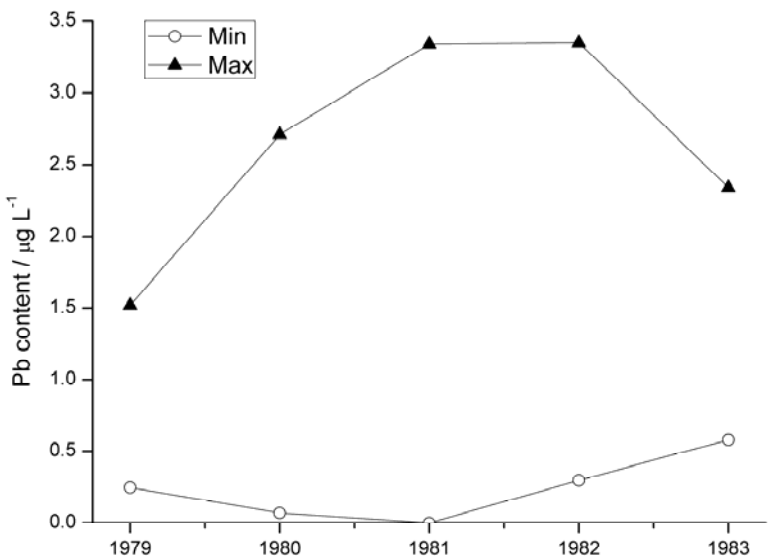

Fig. 2 Pb contents in surface waters in Jiaozhou Bay during 1979-1983

Contents of Pb during 1979-1983

Pb contents in surface waters in Jiaozhou Bay in 1979, 1980, 1981, 1982 and 1983 were 0.25-1.52 μg L^{-1}, 0.07-2.71 μg L^{-1}, 0.00-3.34 μg L^{-1}, 0.30-3.35 μg L^{-1} and 0.58-2.34 μg L^{-1}, respectively (Fig. 2). The maximum values of Pb contents were increasing from 1979 to 1981, and were decreasing from 1981 to 1983, yet the changing trend of minimum values of Pb contents were reverse. Pb contents in marine bay waters were determined by source strengths of Pb, the marine water exchange, and the migrations of Pb in waters, hence there were annual variations of Pb contents in Jiaozhou Bay surface waters. However, in according to the generally trend of Pb contents showed in Fig. 2, it could be found that both maximum values and minimum values of Pb

contents in surface waters were increasing from 1979-1983. Obviously, since the reform and opening-up, the pollution level of Pb in Jiaozhou Bay was increasing. The reason was that the development of waste treatment and environmental protection was lagging behind the increasing of the generation and emission of Pb-containing waste water, gas and residue.

Pollution levels of Pb during 1979-1983

The pollution levels of Pb in marine waters could be assessed in according to National Sea Water Quality Standard (GB 3097-1997) for Pb (Table 1). During 1979-1983, the pollution levels of Pb in surface waters in Jiaozhou Bay were listed in Table 2. It could be seen from Table 2 that for individual years, the pollution levels of Pb in surface waters in Jiaozhou Bay were all Grade I and II. All of the minimum values of Pb contents in the five years were lower than 1.0 μg L^{-1}, and were confirmed to Grade I, yet the maximum values of Pb contents in the five years were between 1.0 μg L^{-1} and 5.0 μg L^{-1}, and were confirmed to Grade II. In generally, this bay had been slightly of moderated polluted by Pb in 1979 to 1983. It should be noticed that the maximum value of Pb contents in 1982 was 3.35 μg L^{-1}, which were closed to 5.0 μg L^{-1}, i.e., Grade III. In consideration that there was increasing trend of annual Pb contents (Fig. 2), the pollution levels of Pb in Jiaozhou Bay were increasing.

Table 1 Guideline of Pb contents in National Sea Water Quality Standard (GB 3097-1997)

Grade	I	II	III	IV
Guideline/μg L^{-1}	1.0	2.0	5.0	50.0

Table 2 Pollution levels of Pb in surface waters in Jiaozhou Bay during 1979-1983

Year	1979	1980	1981	1982	1983
Grade	I, II	I, II	I, II	I, II	I, II

Conclusion

Pb contents in surface waters in Jiaozhou Bay in 1979, 1980, 1981, 1982 and 1983 were 0.25-1.52 μg L^{-1}, 0.07-2.71 μg L^{-1}, 0.00-3.34 μg L^{-1}, 0.30-3.35 μg L^{-1} and 0.58-2.34 μg L^{-1}, respectively, and were increasing from 1979-1983.

All of the minimum values of Pb contents in the five years were lower than 1.0 μg L^{-1}, and were confirmed to Grade I, yet the maximum values of Pb contents in the five years were between 1.0 μg L^{-1} and 5.0 μg L^{-1}, and were confirmed to Grade II, indicated that his bay had been slightly of moderated polluted by Pb in 1979 to 1983.

Since the development of waste treatment and environmental protection was lagging behind the increasing of the generation and emission of Pb-containing waste water, gas and residue, the pollution level of Pb in Jiaozhou Bay was increasing since the reform and opening-up, and the promotion of waste treatment and environmental protection was essential.

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