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To cite this article: Dongfang Yang *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **295** 012045

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Influencing factors of the horizontal distributions of Pb in surface and bottom waters

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Abstract. By the investigation dataset on Plumbum (Pb) in surface and bottom waters in waters from the bay center to the bay mouth in Jiaozhou Bay 1990, the analysis in this paper unveiled the seasonal variation and horizontal distribution of Pb. the results would determine that In May and August 1990, Pb contents in surface waters in Jiaozhou Bay were 4.64-13.39 $\mu\text{g L}^{-1}$ and 3.84-11.01 $\mu\text{g L}^{-1}$ respectively, compared to 4.64-9.41 $\mu\text{g L}^{-1}$ and 2.96-8.86 $\mu\text{g L}^{-1}$ respectively in bottom water. In according to the high values, Pb contents could be considered as moderate polluted, while in according to the low values the pollution level was slightly polluted. Pb contents were in order of spring > summer in both surface and bottom waters. The source inputs of Pb to this bay were different in different seasons and locations, resulting in different seasonal variations of Pb contents in surface waters. By means of vertical water's effect, Pb in surface waters were migrating to bottom waters continuously, resulting in the horizontal distributions of Pb in surface and bottom waters were consistent. Pb contents in bottom waters were relatively high/low in case of Pb contents in surface waters were relatively high/low. The seasonal variations of Pb contents in surface waters were mainly influencing by the source inputs, while in bottom waters were mainly influencing by the source input and the sediment process. The horizontal distributions of Pb in surface and bottom waters were consistent in different seasons. In any seasons, or under influences of different major sources, the horizontal distributions of Pb contents in surface and bottom waters were consistent.

1. Introduction

Under the rapid increasing of economic and industry many marine bays have showed the pollution, in which the pollutants expressed the spatial-temporal changes. During the past several decades, a large amount of Pb-containing wastes was generated and discharged to the air, land, and ocean, leading to Pb pollution in the coastal waters and in many marine bays, and further resulting in our attention being paid for the human health risk.

Jiaozhou Bay would show a beautifully semi-closed bay. our previous studies determined that this bay had Pb's pollution since 1980s through the development. By the investigation dataset on Pb in surface and bottom waters in waters from the bay center to the bay mouth in Jiaozhou Bay 1990, which would present the seasonal variation and horizontal distribution of Pb, and unveil the influencing factors of the horizontal distributions of Pb in surface and bottom waters, whose results would bring scientific basis to better understand the existence and migration of Pb in marine bay.

2. Study area and data collection



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2.1. Study area. Jiaozhou Bay in the south of Shandong Province, eastern China ($35^{\circ}55'-36^{\circ}18' \text{ N}$, $120^{\circ}04'-120^{\circ}23' \text{ E}$) has the total area 446 km^2 (Fig. 1). There are many rivers, for example, Dagu River, Haibo River, Licun River, and Loushan River etc..

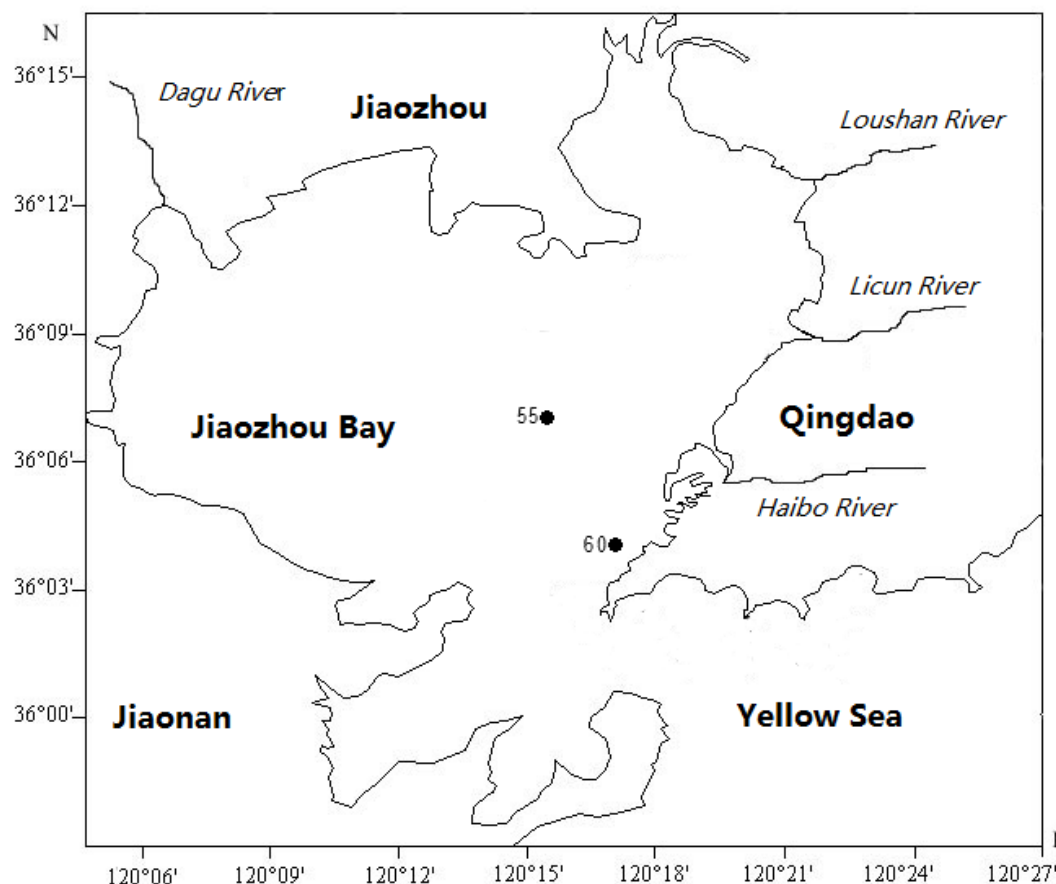


Fig. 1 Geographic location and sampling sites of Jiaozhou Bay

2.2. Data collection. The investigations of the dataset on Pb in Jiaozhou Bay from North China Sea Environmental Monitoring Center in May and August 1990 showed that there were 2 sampling sites of Site 55 and Site 60 locating in the bay center and the north of the bay mouth, respectively (Fig. 1). The monitoring of Pb in surface waters was originating from National Specification for Marine Monitoring [1].

3. Results

3.1. Contents of Pb. In May and August 1990, Pb contents in surface waters in Jiaozhou Bay were $4.64\text{--}13.39 \mu\text{g L}^{-1}$ and $3.84\text{--}11.01 \mu\text{g L}^{-1}$ respectively, compared to $4.64\text{--}9.41 \mu\text{g L}^{-1}$ and $2.96\text{--}8.86 \mu\text{g L}^{-1}$ respectively in bottom water. In according to the Sea Water Quality standard GB 3097-1997 for Pb (Table 1). In according to the high values, Pb contents could be considered as moderate polluted, while in according to the low values the pollution level was slightly polluted.

3.2. Seasonal variations of Pb. May and August belong to spring and summer in study area. The seasonal variations of Pb contents were in order of spring > summer in both surface and bottom waters.

Meanwhile, Pb contents in bottom waters were relatively high/low in case of Pb contents in surface waters were relatively high/low.

3.3. Horizontal distributions of Pb. In May 1990, Pb contents in both surface and bottom waters were decreasing from the north of the bay mouth to the bay center, while in August Pb contents in both surface and bottom waters were decreasing from the bay center to north of the bay mouth. It could be found that the horizontal distributions of Pb in surface and bottom waters were consistent in different seasons.

4. Discussion

4.1. Sedimentation process. By means of vertical water's effect [7-9], Pb contents are changing so much during the migration process from surface waters to bottom waters. The growth and reproduction of marine plankton are increasing rapidly from spring, and reaching the climax in summer, and then decreasing after summer. The colloids generated by marine plankton are changing along with the seasonal variations of the growth and reproduction of marine plankton, resulting in the absorption capacity of suspended particulate matters are enhancing from spring to summer, and decreasing after. Therefore, the sedimentation process of Pb from surface waters is showing such a seasonal variation style [1-6].

4.2. Seasonal variation process. In the bay center, the major Pb sources in spring and summer were port wharf and marine current, whose source strengths were relatively high and relatively low, respectively, resulting in the seasonal variations of Pb contents in surface waters in the bay centers were order of spring > summer. In the bay mouth, there was little source input in spring, while in summer atmosphere deposition was responsible, resulting in the seasonal variations of Pb contents in surface waters in the bay centers were also order of spring > summer. In general, the seasonal variations of Pb contents in surface waters were mainly influencing by the source inputs. By means of the sedimentation process, Pb contents in surface waters were migrating to bottom waters continuously with a same seasonal variation style, resulting in the seasonal variations of Pb contents in bottom waters were also in order of spring > summer.

4.3. Spatial variation process. In according to the Pb contents in surface and bottom waters, it could be found that Pb contents in bottom waters were relatively high/low in case of Pb contents in surface waters were relatively high/low. Meanwhile, the horizontal distributions of Pb in surface and bottom waters were consistent in different seasons. The major driving forces are gravity and marine current, whose influences on spatial distributions of Pb contents had been summarized as horizontal and vertical water's effects [7-9]. By this way, in any seasons, or under influences of different major sources, the horizontal distributions of Pb contents in surface and bottom waters were consistent.

5. Conclusion

In May and August 1990, Pb contents in surface waters in Jiaozhou Bay were 4.64-13.39 $\mu\text{g L}^{-1}$ and 3.84-11.01 $\mu\text{g L}^{-1}$ respectively, compared to 4.64-9.41 $\mu\text{g L}^{-1}$ and 2.96-8.86 $\mu\text{g L}^{-1}$ respectively in bottom water. In according to the high values, Pb contents were moderate polluted, while in according to the low values the pollution level was slight polluted.

The seasonal variations of Pb contents were in order of spring > summer in both surface and bottom waters. Pb contents in bottom waters were relatively high/low in case of Pb contents in surface waters were relatively high/low. The seasonal variations of Pb contents in surface waters were mainly influencing by the source inputs, while in bottom waters were mainly influencing by the source input and the sediment process.

The horizontal distributions of Pb in surface and bottom waters were consistent in different seasons. In any seasons, or under influences of different major sources, the horizontal distributions of Pb

contents in surface and bottom waters were consistent. In general, the spatial-temporal changes of pollutants in marine bay were the common product of anthropogenic activities and natural factors.

References

- [1] China's State Oceanic Administration: The specification for marine monitoring (Ocean Press, Beijing 1991), p.1-300.