Academic Journal of Engineering and Technology Science
ISSN 2616-5767 Vol. 2, Issue 3: 36-43, DOI: 10.25236/AJETS.020053

Hg Content Accumulated in Seafloor Decided by the Time of Transporting Hg Content

Dongfang Yang[1,2,3,a], Ye Li[4], Bailing Fan[1,2], Chunhua Su[1,2], Sixi Zhu[1,2]

[1]*Research Center for Karst Wetland Ecology, Guizhou Minzu University, Guizhou Guiyang, Guizhou Guiyang, China*
[2]*College of Chemistry and Environmental Science, Guizhou Minzu University, Shanghai, 550025, China*
[3]*North China Sea Environmental Monitoring Center, SOA, Qingdao 266033, China*
[4]*School of Computer Science, Fudan University, 201203, China.*
[a]*dfyang_dfyang@126.com*

Abstract. *Based on the investigation data of Hg in Jiaozhou Bay in May, August and October of 1991, according to the horizontal and vertical distribution of Hg content, the difference of Hg at surface and bottom disclosed that the Hg content and transport time influenced the variation of Hg content at surface and bottom and the sedimentation area. The results showed that in bay center, there was no source to transport Hg content in May and 0.081μg/L of Hg content was transported from atmospheric sedimentation in August. In eastern nearshore waters, 0.041μg/L of Hg content was transported from ships and wharfs in May and there was no source in August. Spatially, different sources presented the spatial variation of Hg content. Specifically, in May, in eastern nearshore waters, Hg content at surface was less than that at bottom, decreasing to the bay center along with the gradients. In August, in bay center, Hg content at surface was less than that at bottom, decreasing to eastern nearshore waters along with the gradients. Temporally, at different time, the sources changed. From May to August, in bay center, from no source to atmospheric sedimentation, there was no Hg content at seafloor, so Hg content at surface was more than that at bottom. Whereas, in nearshore waters, Hg content was transported by ships and wharfs all the time, causing a great number of Hg content at seafloor, so Hg content at surface was less than that at bottom. Therefore, the spatial and temporal variation of Hg content disclosed that the Hg content accumulated in seafloor was decided by the time of transporting Hg content, not contrary.*

Keywords: *Hg content; transport amount and time; spatial and temporal variation at surface and bottom; Hg content accumulated in seafloor; Jiaozhou Bay*

Hg was discharged by human activities to the waters, atmosphere, soil and ocean,

ISSN 2616-5767 Vol. 2, Issue 3: 36-43, DOI: 10.25236/AJETS.020053

and sedimented to seafloor by the waters effect. Hence, it is necessary to study the transport of Hg content in waters, from surface to bottom [1-11]. Based on the investigation data of Hg in Jiaozhou Bay in May, August and October of 1991, according to the horizontal and vertical distribution of Hg content, the difference of Hg at surface and bottom disclosed the source of Hg content, spatial and temporal variation of Hg content, to provide scientific reference for the study on vertical sedimentation and horizontal transport of Hg content at surface and bottom.

1. Investigation Waters, Materials and Methods

1.1 Natural environment of Jiaozhou Bay

Jiaozhou Bay, located in southern Shandong Peninsula, is a typical semi-closed bay. The geographical location is 120°04′-120°23′E, 35°58′-36°18′N. Bounded by the line connecting Tuandao Cape and Xuejiadao Island, it connects with Yellow Sea, covering an area of about 446km^2, with the average depth of about 7m. There are dozens of rivers reaching the ocean in Jiaozhou Bay, among of which, the rivers with a larger volume of runoff and sand content include Dagu River, Yang River, Haibo River in Qingdao, Licun River, Loushan River and so on. These rivers are seasonal streams, and hydrological characteristics vary seasonally [12, 13].

1.2 Materials and methods

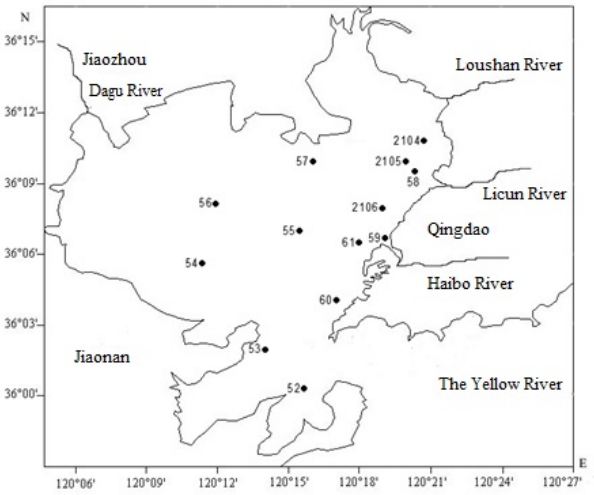

Fig.1 Investigation sites in Jiaozhou Bay

The materials about Hg in Jiaozhou Bay waters in May and August of 1990 was

ISSN 2616-5767 Vol. 2, Issue 3: 36-43, DOI: 10.25236/AJETS.020053

provided by North China Sea Environment Monitoring Center, State Oceanic Administration. In May and August, site 55 and 61 were established, which are shown in Figure 1. Samplings were performed for three times in May and August in 1990, respectively. According to the depth of water, sampling and survey were conducted (surface and bottom layers were sampled when the depth of water is more than 10m, but just surface layer when less than 10m). The survey on Hg of Jiaozhou Bay waters was in accordance with national standard method, which was included in The Specification for Marine Monitoring (1991) [14].

2. Results

2.1 The horizontal distribution at surface

In May, Hg content was low in site 55, but reached high as 0.041μg/L in site 61, forming a series of semi-concentric circles with different gradients. Hg content decreased from 0.041μg/L in the center to 0.020μg/L in bay center, shown in Figure 2.

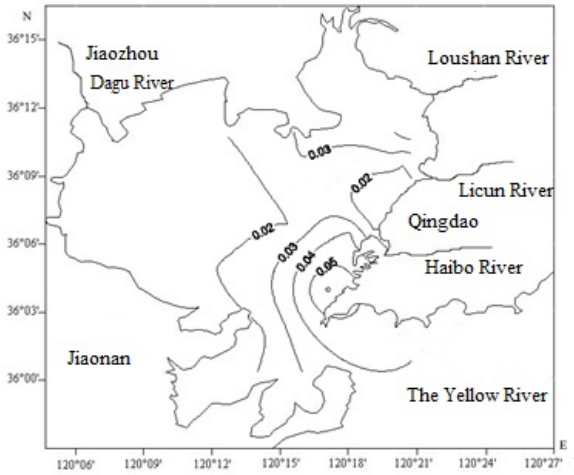

Fig.2 Hg content distribution at surface in Jiaozhou Bay in May(μg/L)

In August, Hg content was low in site 61, but reached high as 0.081μg/L in sit 55, forming a series of concentric circles with different gradients. Hg content decreased from 0.081μg/L in the center to 0.021μg/L in eastern nearshore waters, shown in Figure 3.

ISSN 2616-5767 Vol. 2, Issue 3: 36-43, DOI: 10.25236/AJETS.020053

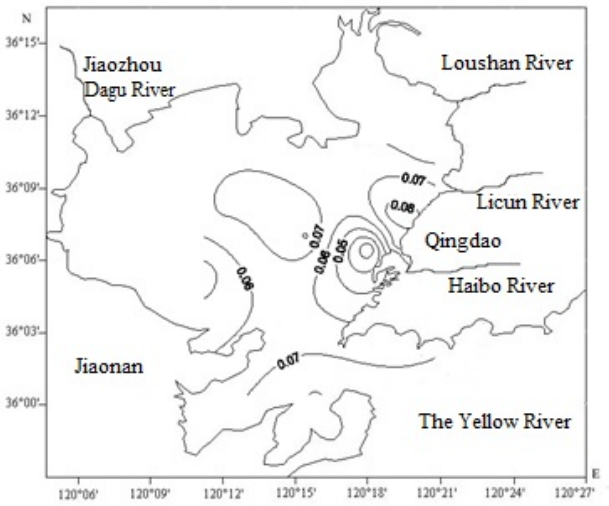

Fig.3 Hg content distribution at surface in Jiaozhou Bay in August(μg/L)

2.2 The vertical variation at surface and bottom

In May and August, the minus of Hg contents at surface and bottom in site 55 and 61 was -0.033-0.049μg/L, showing that Hg contents at surface and bottom were similar.

It was -0.010-0.004μg/L in May and -0.033-0.049μg/L in August, positive in site 55 and negative in site 61, shown in Table 1.

Tab.1 The minus of Hg contents between the surface and bottom layers in Jiaozhou Bay center and eastern nearshore waters

site / Month	55	61
May	positive	negative
August	positive	negative

3. Discussion

3.1 The variation of matter content

In the transfer process, matter content varied. According to vertical and horizontal waters effect and waters effect proposed by the author [15-18], in surface waters from bay center to eastern nearshore, Hg particles were absorbed in the

ISSN 2616-5767 Vol. 2, Issue 3: 36-43, DOI: 10.25236/AJETS.020053

surface of a great number of suspended particulate matters, and sedimented to the seafloor due to the impact of gravity and water current. By the vertical waters effect, the variation of Hg content at surface decided the variation of that at bottom.

3.2 The source

In May, Hg content was low in bay center and high in eastern nearshore waters, and the high content of 0.041μg/L was from ships and wharfs. In August, Hg content was low in eastern nearshore waters and high in bay center, and the high content of 0.081μg/L was from atmospheric sedimentation.

Thus, the high content of 0.041μg/L in eastern nearshore waters in May was transported by ships and wharfs, and the high content of 0.081μg/L in bay center in August was transported by atmospheric sedimentation.

3.3 The regional sedimentation

Regionally, from bay center to eastern nearshore waters, the minus of Hg contents between surface and bottom layers varied along with the change of time, shown in Table 1. When Hg content was transported to Jiaozhou Bay, it reached the surface first, and rapidly and constantly sedimented to seafloor, presenting the variation of Hg content at surface and bottom in Table 1.

3.4 The spatial sedimentation

Spatially, the different sources of Hg content presented its spatial variation.

The Hg content of 0.041μg/L in eastern nearshore waters in May was transported by ships and wharfs, presenting the higher Hg content at bottom than surface. From eastern nearshore waters to bay center, it decreased to bay center.

It was high when transported by ships and wharfs. In spring, ships and wharfs began to increase, so that Hg content transported constantly reached the ocean and sedimented in seafloor. So it was higher at bottom than surface. At the same time, with the sedimentation, it decreased to the bay center from eastern nearshore waters to bay center.

The high content of 0.081μg/L in bay center in August was transported by atmospheric sedimentation, presenting the lower Hg content at bottom than surface. From bay center to eastern nearshore waters, it decreased.

It was high when transported by atmospheric sedimentation to reach the surface in bay center and even the surrounding waters. Without the long-term sedimentation, Hg content was not sedimented in seafloor. In this way, it was lower at bottom than surface.

ISSN 2616-5767 Vol. 2, Issue 3: 36-43, DOI: 10.25236/AJETS.020053

3.5 The temporal sedimentation

Temporally, the sources of Hg content varied decided the variation of Hg content. From May to August, the sources of Hg content varied.

In bay center, there was no source to transport Hg content, so it was higher at surface than bottom. From May to August, there was no sedimentation of Hg content in seafloor. It was high when transported by atmospheric sedimentation to reach the surface in bay center, presenting the higher content at surface than bottom.

In eastern nearshore waters, it was high when transported by ships and wharfs in May. So it was higher at bottom than surface. From May to August, with the sedimentation in three months, Hg content was sedimented in seafloor. In August, there was no source to transport Hg content, however, there was a great number of Hg content in seafloor. In this way, it was higher at bottom than surface.

It showed the sources for Hg content varied along with the time.

In bay center, Hg content was transported by atmospheric sedimentation in May and there was no source in August, without accumulation of Hg content in seafloor, showing the higher content at surface than bottom. Whereas, Hg content was transported by ships and wharfs from May to August, with accumulation of Hg content in seafloor, showing the higher content at bottom than surface.

The high content of 0.041μg/L in eastern nearshore waters in May was transported by ships and wharfs, and the high content of 0.081μg/L in bay center in August was transported by atmospheric sedimentation. The former was lower than the latter, however, it was higher at bottom than surface in eastern nearshore waters, and higher at surface than bottom in bay center. It indicated that the time of transporting Hg content decided the Hg content in seafloor, not the amount of Hg content.

4. Conclusion

The high content of 0.041μg/L in eastern nearshore waters in May was transported by ships and wharfs, and the high content of 0.081μg/L in bay center in August was transported by atmospheric sedimentation.

Spatially, the different sources of Hg content presented its spatial variation.

The Hg content of 0.041μg/L in eastern nearshore waters in May was transported by ships and wharfs, presenting the higher Hg content at bottom than surface. From eastern nearshore waters to bay center, it decreased to bay center. The high content of 0.081μg/L in bay center in August was transported by atmospheric sedimentation, presenting the lower Hg content at bottom than surface. From bay center to eastern nearshore waters, it decreased.

Temporally, the sources of Hg content varied decided the variation of Hg content. From May to August, the sources of Hg content varied.

ISSN 2616-5767 Vol. 2, Issue 3: 36-43, DOI: 10.25236/AJETS.020053

In bay center, Hg content was transported by atmospheric sedimentation in May and there was no source in August, without accumulation of Hg content in seafloor, showing the higher content at surface than bottom. Whereas, Hg content was transported by ships and wharfs from May to August, with accumulation of Hg content in seafloor, showing the higher content at bottom than surface.

The high content of 0.041μg/L in eastern nearshore waters in May was transported by ships and wharfs, and the high content of 0.081μg/L in bay center in August was transported by atmospheric sedimentation. The former was lower than the latter, however, it was higher at bottom than surface in eastern nearshore waters, and higher at surface than bottom in bay center. It indicated that the time of transporting Hg content decided the Hg content in seafloor, not the amount of Hg content.

Acknowledgement

This research was sponsored by Doctoral Degree Construction Library of Guizhou Nationalities University and Research Projects of Guizhou Nationalities University ([2014]02), Research Projects of Guizhou Province Ministry of Education (KY [2017]138), Research Projects of Guizhou Province Ministry of Science and Technology (LH [2018]1075)，National Natural Science Foundation of China in 2018 (31860178).

References

[1] Yu Chen, Zhenhui Gao, Yanheng Qu, Dongfang Yang and Hongxia Tang. Mercury distribution in the Jiaozhou Bay[J]. Chin. J. Oceanol. Limnol. 2007, 25(4): 455-458.

[2] Dongfang Yang, Hairong Cao, Zhenhui Gao, Qing Lu, Yanfeng Qu. The Distribution and Transport of Hg in Jiaozhou Bay [J]. Marine Environmental Science, 2008, 27(1): 37-39.

[3] Dongfang Yang, Leilei Wang, Zhenhui Gao, Lian Ju, Jiping Zeng. The Distribution and Pollution Source of Hg in Jiaozhou Bay [J]. Marine Environmental Science, 2009, 28(5): 501-505.

[4] Yu Chen, Yinjiang Zhang, Junhui Guo, Qiang Shi, Dongfang Yang. The Distribution and Seasonal Variation of Hg in Jiaozhou Bay [J]. Ocean Development and Management, 2013, 30(6): 81-83.

[5] Dongfang Yang, Peiyan Sun, Lian Ju, Yuhui Zhao, Yanfeng Qu. The Quality Concentration and Distribution of Hg in Jiaozhou Bay [J]. Coastal Engineering, 2013, 32(4): 65- 76.

[6] Dongfang Yang, Zijun Xu, Yanfeng Qu, Yanrong Zhou, Fei Teng. The Distribution and Input Path of Hg in Jiaozhou Bay [J]. Coastal Engineering, 2014, 33(1):67-78.

[7] Yu Chen, Yanfeng Qu, Renlin Pei and Dongfang Yang. Effect of Hg in Jiaozhou Bay waters- The aquatic transfer process[J]. Advanced Materials Research

ISSN 2616-5767 Vol. 2, Issue 3: 36-43, DOI: 10.25236/AJETS.020053

Vols.955-959. 2014, 2491-2495.
[8] Dongfang Yang, Sixi Zhu, Fengyou Wang, XiuqinYang and Yunjie Wu. Effect of Hg in Jiaozhou Bay waters- The land transfer process[J]. Advanced Materials Research Vols.955-959. 2014, 2496-2500.
[9] Dongfang Yang, Sixi. Zhu, Fengyou Wang, Huazhoung He and Yunjie Wu. Effect of Hg in Jiaozhou Bay waters- The Temporal variation of the Hg content[J]. Applied Mechanics and Materials Vols.556-562. 2014, 633-636.
[10] Dongfang Yang, Fengyou Wang, Huazhong He, Youfu Wu and Sixi Zhu. Effect of Hg in Jiaozhou Bay waters- The change process of the Hg pollution sources[J]. Advanced Materials Research Vols.955-959. 2014, 1443-1447.
[11] Dongfang Yang, Xiao Geng, Yanfeng Qu, Hongyan Bai, Zijun Xu. The Distribution and Gravity Features of Hg in Jiaozhou Bay [J]. Ocean Development and Management, 2014, 31(12): 71- 77.
[12] D F YANG, Y CHEN, Z H GAO, et al. SiLicon Limitation on primary production and its destiny in Jiaozhou Bay, China IV transect offshore the coast with estuaries [J]. Chin. J. OceanoL. LimnoL. 2005, 23(1): 72-90.
[13] Dongfang Yang, Fan Wang, Zhenhui Gao et al. Ecological phenomena of phytoplankton in Jiaozhou Bay [J]. Marine Sciences, 2004, 28(6): 71-74.
[14] State Oceanic Administration. The Specification for Marine Monitoring [Z]. Beijing: China Ocean Press, 1991.
[15] Dongfang Yang, Zhenqing Miao, Huanzhi Xu, Yu Chen, Jingya Sun. The Time for the Exchange of Sea Water in Jiaozhou Bay [J]. Marine Environmental Science, 2013, 32(3): 373-380.
[16] Dongfang Yang, Fengyou Wang, Huozhong He, Sixi Zhu and Yunjie Wu. Vertical water body effect of benzene hexachloride[J]. Proceedings of the 2015 international symposium on computers and informatics. 2015, 2655-2660.
[17] Dongfang Yang, Fengyou Wang, Xiaoli Zhao, Yunjie Wu, Sixi Zhu. Horizontal waterbody effect of hexachlorocyclohexane [J]. Sustainable Energy and Enviroment Protection. 2015, 191-195.
[18] Dongfang Yang, Fengyou Wang, Xiuqin Yang, Yunjie Wu and Sixi Zhu. Water's effect of benzene hexachloride [J]. Advances in Computer Science Research. 2015, 2352: 198-204.