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Concentration level of heavy metals in the Great Wall Bay, Antarctica in austral summer

Pu Jiabin, Fu Yunna, Li Zhongping

Institute of Marine Environmental Protection, SOA, Dalian 116023, China

Abstract—Heavy metals in different marine environmental mediums from the Great Wall Bay, Antarctica were determined. Sea water samples from 14 stations, surface sediments from 2 stations and marine organisms from 1 station were analyzed for Cu, Pb, Zn, Cd, Cr, Hg concentrations. The results showed that the terrestrial input characteristics of Cu, Pb and Cr in sea water was evident. Zn concentration in the outlet water was high. The difference of each heavy metal concentration in two sediments was low. The enriching ability of seaweed to Zn was relatively high. Generally speaking, the concentration level of heavy metals in the Great Wall Bay was low.

Keywords: Antarctica; Great Wall Bay; heavy metals.

A bay environment receives input of the terrestrial matter. Meanwhile, it also participates the exchanging and transmitting processes with the outer sea. It is important to understand the concentration level and the distribution characteristics of heavy metals in a bay environment, especially in realizing the changing trends of heavy metals, monitoring the influence extent of human's activities and preventing the deterioration of environment. It is much more necessary when the bay is in Antarctica which is far from the densely populated areas and possesses a fragile ecological environment.

The Great Wall Bay (62° 13′ S, 58° 57′ W) is located to the east of the Great Wall Base of China in King George Island, Antarctica. It is a funnel-shaped and semi-closed bay with about 3 km^2 areas. Under the effect of the invaded Bransfield Current and the perennial wind direction, the surface current of the bay goes towards out the inlet, and the bottom current goes towards into the inlet. In the Fields Peninsula the thawing snow water flows into the bay by going through two lakes and two brooks. In this study, we determined the concentrations and distribution difference of heavy metals in different environmental samples. All the samples were collected in December 1992.

1 Materials and methods

The sampling stations are shown in Fig. 1. A total of 19 sea water samples from 14 stations, 2 sediments from 2 stations and a patella, a seaweed, and a fresh snow sample were

collected.

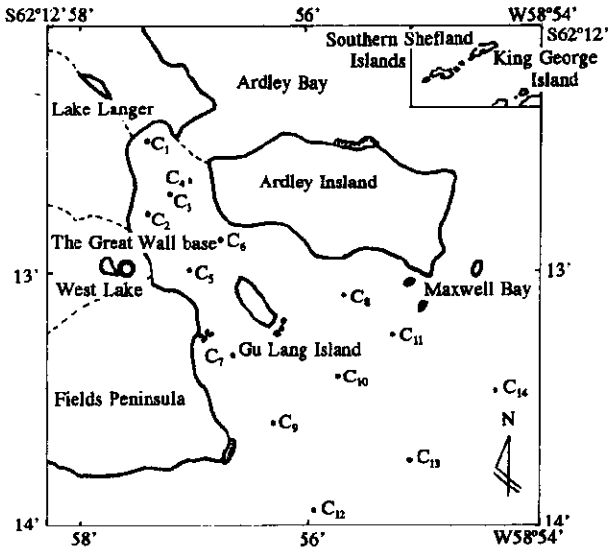

Fig. 1 Locations of sampling stations

The surface sea water was directly sampled with clean polythene bottle. The bottom water was sampled with a 5L Goflon Water Sampler. All water samples were fixed with high purity reagent HNO_3 or H_2SO_4 and then refrigerated without filtering. The surface sediments were collected by a 0.05 m^2 grab sampler, then sealed up in clean polythene boxes and froze. Only in C_1, C_4 stations the sediments can be collected. There are gravels and powder sand in other stations. The patella and seaweed samples were collected on the tideland to the south of the Great Wall Base, then sealed up in polythene bags and froze. The fresh snow was collected in the outside of the base, stored in a clean polythene bag and was frozen without fixing and filtering.

For all samples analyzing was carried out by the Central Lab of the Institute of Marine Environmental Protection, SOA, China. This Lab had taken part in the Intercomparison Exercises organized by the IOC-GMESI many times, and won excellent results. The determination of Cu, Pb, Zn, Cd concentrations in sea water was performed with a ZVA-2 polarograph; Cr in water and Cu, Pb, Cd, Cr in other samples were determined with a PE-Z3030 atomic absorption spectrophotometer (AAS). Zn and Hg were determined respectively with a AA-875 AAS and a Rigaku SP-II Mercury Detector. The determination methods were all referred to the "Specifications of Oceanographic Survey" (SOA, 1992).

2 Results and discussion

The concentration of heavy metals in sea water, sediment and organism from the Great Wall Bay are presented in Table 1 and Table 2.

Table 1 Heavy metals concentrations in sea water from the Great Wall Bay Unit: μg/L

Station	Cu	Pb	Zn	Cd	Cr
C_1	1.25	3.86	8.67	ND	2.38
C_2	0.68	1.38	6.67	≤0.09	1.31
C_3	2.58	ND	4.67	ND	2.74
C_4	0.83	1.22	4.08	ND	4.74
C_5	0.87	ND	5.54	≤0.09	2.19
C_6	0.87	ND	3.56	≤0.09	2.03
C_7	0.87	0.74	9.05	≤0.09	2.43
C_8	0.87	ND	2.14	≤0.09	1.79
C_9	0.57	ND	5.90	0.10	1.62
C_{10}	0.57	1.10	8.70	0.10	0.81
C_{11}	0.56	ND	13.00	0.10	1.41
C_{12}	ND	ND	7.26	≤0.09	1.70
C_{13}	ND	ND	10.22	ND	0.61
C_{14}	ND	0.45	11.25	ND	1.74
C_3*	0.50	0.37	7.86	≤0.09	2.18
C_{10}*	0.71	0.50	8.33	0.10	0.64
C_{12}*	0.71	ND	20.83	≤0.09	0.96
C_{13}*	1.00	0.36	34.29	0.10	0.56
C_{14}*	ND	0.63	17.69	0.10	0.51
Fresh snow	1.30	2.58	5.00	ND	0.26

*: bottom water ND: no detected Limit of detection: Cu: 0.5 μg/L; Pb: 0.33 μg/L; Zn: 1.60 μg/L; Cd: 0.09 μg/L; Cr: 0.20μg/L

Table 2 Heavy metals concentrations in other samples Unit: mg/kg DW

Sample	Cu	Pb	Zn	Cd	Cr	Hg
C_1	34.06	2.16	86.96	0.41	10.76	0.028
C_4	27.46	2.40	78.26	0.36	9.96	0.024
Patella	10.40	0.83	34.33	4.95	2.00	0.005
Seaweed	3.22	0.098	55.73	<0.004	<0.038	0.005

In the stations of sea water in which heavy metals could be detected, all the heavy metals concentrations were higher than the mean background levels of the world ocean. The highest background contents of heavy metals in sea water of the world ocean were: Cu: 0.50μg/L, Pb: 0.05 μg/L; Zn: 5.0 μg/L, Cd: 0.12 μg/L, Cr: 0.5μg/L.

In surface sea water of the Great Wall Bay, the concentration difference of Cu, Cd was low among all stations, and the change from inlet to outlet was slow. Comparatively speaking, Pb concentration was higher in inlet surface water than that in outlot surface water, and

the situation was more distinct for Cr. The result from fresh snow determining showed that the concentrations of Pb, Zn were high. An another determination of two surface sea water samples far from the King George Island showed that Pb and Zn were also high in concentration. In which the mean value of Pb was 1.08 μg/L, Zn was 13.26 μg/L. According to Zhao's studies (Zhao, 1991), in fine particles of the atmospheric aerosol in the area of Great Wall Base, the contents of Cu, Zn, Pb, Cr were more than 50% of the total aerosol composition. They came from the long-distance transport of the atmosphere. So that the high level of Pb, Zn in this bay, especially in the outlet area, had something to do with the outside importing. Zn concentration in bottom water of the outlet was high. It might showed that Zn was high in the outside sea water importing into the bay. To this there was no other researcher's data for comparing now.

C_1 station was located at the top of the bay, closed to the estuary of Lake Langer. Being ever a rubbish dumping site, this lake was polluted heavily. So the concentrations of all heavy metals except Cd were high in C_1 station. Cu, Pb and Cr concentrations were all high in surface sea water of the inlet. It indicated that the characteristics of terrestrial input of Cu, Pb and Cr was evident. But the concentration change of Pb in the bay was not well-distributed.

Generally speaking, except Cd, the characteristics of terrestrial input of Cu, Pb, Zn and Cr at the top of the bay was evident. They were all diffused and diluted along with the outward flowing of the surface sea water. Meanwhile, in bottom water of the outlet, Cu, Pb, Zn and Cd also showed the characteristics of importing from the outside sea, especially to Zn. The fresh snow also brought in some Cu and Pb. The distribution diagrams of Cu, Cr in surface sea water of the bay are represented in Fig. 2.

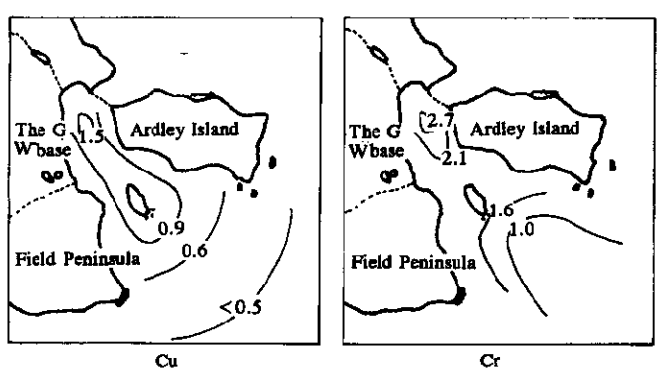

Fig. 2 Distribution diagrams of Cu, Cr in surface sea water of the GW Bay

The surface sediments were collected at C_1, C_4 stations, near the top of the bay and the northeastern side of Ardley Island. Penguins *et al.* were gathering activities in this area. Being black and stinking, the content of organic matter in sediments was high. The concentrations of Pb, Cd, Hg and Cr were very approximate in two sediments, Zn and Cr were of a little difference and for Cd and Pb, the results in this study were some differents from that of

other researchers (Alam, 1990; Zhang, 1989).

Generally speaking, the results in this study showed that the concentrations of heavy metals in surface sediments of the Great Wall Bay were lower or not exceeded that in other bay environment in the world (Subramarian, 1990; Scott, 1990; Li, 1989).

Except Zn, Hg, in patella sample the concentrations of Cu, Pb, Cd, Cr were all higher than that in seaweed. It showed that the biological enriching ability of patella to Cu, Pb, Cd, Cr was high, but that of seaweed to Zn was high. These two organisms were collected on the tideland near the lower reaches of the surface water of the bay. So it might reflect the contaminated level of organisms in this bay. Compared with that in other areas in the world (Richardo, 1990; Li, 1989), the heavy metals in the organisms from the Great Wall Bay were also at low level.

References

Alam IA, Sadiq M. Marine Pollution Bulletin, 1993; 26:523

Li J, Zheng CJ. Handbook of the environmental background data. Beijing: Chinese Environmental Science Publishing Service. 1990

Rickardo EW. Marine Pollution Bulletin, 1990; 21:237

Scott WF. Marine Environmental Research, 1990; 29:1

State Oceanic Administration. Specifications of Oceanographic Survey. Beijing. 1992

Subramanian V, Mohanachandran G. Marine Pollution Bulletin, 1990; 21:324

Zhang PR, Wang JX, Ma JR, Zhu JS, Lu XQ. Journal of Dalian Fisheries College, 1989; 4:33

Zhao JL. The characteristics of the morden environmental geochemistry and natural environmental evolution in the region of antarctic Great Wall Station. Beijing: Science Press. 1991

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