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Organic contamination in the Great Wall bay, Antarctica in austral summer

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Abstract——During 1992/1993 austral summer, oil, BHCs, DDTs, PCBs etc. were determined in the sea water, sediments and organisms samples of the Great Wall bay, Antarctica. In surface sea water, the mean concentrations of oil were 0.26－0.93 μg/L. DDTs were all lower than the DL of the method, that was <0.04 ng/L. BHCs mean concentrations were <0.69－<1.94 ng/L. In other samples, oil, BHCs, DDTs, and PCBs were all relatively higher in patella than that in sediments and seaweed. PAHs could not be detected in all samples. By comparison, the concentrations level of organic contaminants in the Great Wall bay was low yet.

Keywords: Antarctica; the Great Wall bay; organic contamination.

1 Introduction

In the middle years of 1960s, scientists discovered the evidence of man-made organic pollutants existed in the marine organisms in Antarctica, for example, DDTs, and BHCs (William, 1966; Tatton, 1967). It made a leap in the cognition of people on the globalism of environmental pollution. After that, scientists made wide-ranging researches and surveys on the organic pollutants in every environmental sample from Antarctica, including ice-core, sea water, sediment, atmospheric aerosol, marine organism, terrestrial plant and so on. Along with the progressing of modern analytical and testing methods, the quality of data information on organic pollutants obtained nowadays is much more better than the previousness. And it is already becoming possible to monitor the changing trend of the concentrations of man-made pollutants in all mediums of Antarctic environment, widespreadly and continuously. Many researchers have undertaken fruitful studies on the originating, distribution state and the changes to the marine ecological environment of organic pollutants in Antarctic environmental samples (Robert, 1990; Shinsuke, 1983; Per, 1992).

The Great Walls bay (62°13′S, 58°57′W) is located to the east of the Chinese Great Wall Base in King George Island, Antarctica. It is a semi-closed bay with about 3 km^2 areas. In austral summer, thawed snow water from Fields Peninsula imported into the bay passing through two lakes and two brooks. There were no formal reports on the organic contamination state of the Great Wall bay. During austral summer of 1992/1993, to understand the ba-

sic state of organic contaminants in the bay at present, we collected samples of sea water, sediments and organisms from the Great Wall bay and analyzed them.

2 Materials and methods

Surface sea water from 14 stations, sediments from 2 stations, patella and seaweed from the tideland of the bay were collected. The locations of sampling stations are presented in Fig. 1.

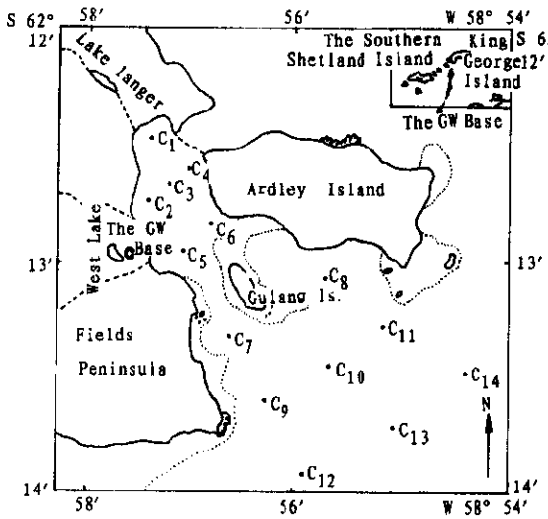

Fig. 1 Locations of sampling stations

With a cleaned 5L bottle the surface sea water was directly collected. In which 2L water was extracted with 15 ml petroleum ether for determining the oil, and another 2L water was extracted with 20 ml hexane for determining the pesticides. The extracts were sealed up in glass bottles and refrigerated. Sediments were collected with a grab sampler. Only at C_1, C_4 stations the surface sediments could be collected. There were gravel and powder sand in other stations. The sediments samples were sealed up in cleaned aluminum boxes and frozen. Patella and seaweed samples were collected on the tideland to the southeast of the Great Wall base, and sealed up in a polythene bag and a paper bag respectively and frozen.

Oil in all samples was determined with a Hitachi 650 — 60 Fluorescence Spectrophotometer. Pesticides and PCBs were determined with a Shimadzu GC-7AG Gas Chromatograph equipped with a ECD. PAHs were with a Hitachi 655 Liquid Chromatograph. For all samples the treatment and analysis processes were according to the "Specifications of Oceanographic Surveys" (State Oceanic Administration, 1992).

3 Results and discussion

The concentrations of organic contaminants in surface sea water, sediments and organisms of the Great Wall bay are presented in Table 1 and Table 2. Gas chromatograms from several samples analyzing are presented in Fig. 2.

Table 1 Organic contaminants concentration in surface sea water of the Great Wall bay

Stations	Oil, μg/L	BHCs, ng/L	DDTs, ng/L
C_1	0.75	ND*	ND
C_2	0.48	ND	ND
C_3	0.91	ND	ND
C_4		1.21	ND
C_5	1.05	ND	ND
C_6	1.47	0.17	ND
C_7	0.29	0.07	ND
C_8	0.54	3.20	ND
C_9	0.29	2.32	ND
C_{10}	0.34	2.31	ND
C_{11}	0.24	ND	ND
C_{12}	0.27	0.91	ND
C_{13}	0.22	2.21	ND
C_{14}	0.22	ND	ND
Outside sea water	0.57	1.54	ND

* : no detected

Table 2 Organic contaminants concentrations in other samples of the Great Wall bay Unit: g/L

Samples	Oil, $\times10^{-8}$	BHCs, $\times10^{-9}$	DDTs, $\times10^{-9}$	PCBs, $\times10^{-9}$	PAHs, $\times10^{-9}$
Sediments					
C_1	1.76	0.441	<0.05	0.30	ND*
C_4	1.78	0.412	0.762	1.22	ND
Patella	47.1	0.586	1.049	1.76	ND
Seaweed	0.214	<0.05	0.46	ND	

* : no detected

3.1 Oil

As shown in Fig. 1, the bay can be divided into two parts for discussion. That is to take C_1—C_6 stations as in inlet, C_9—C_{14} stations as in outlet. Equally the oil concentrations, 0.93 μg/L and 0.26 μg/L respectively, were higher in inlet than in outlet. The current characteristics in the bay was going towards outlet at the surface and towards inlet at the bottom. At the top of the bay fresh water from Lake Langer imported. This lake had ever been a dumping site, with water heavily polluted. The oil in its surface water we determined was 7.6μg/L. So the imported contaminated fresh water was contributive to the oil level in sea

Fig. 2 Selected chromatograms of several samples extracts from the Great Wall bay
a. BHCs, DDTs in water;
b. BHCs, DDTs in sediment;
c. PCBs in sediment;
d. PCBs in patella

water of the bay. From inlet to outlet, the progressive decreasing trend of oil concentrations tallied with the surface current direction. Oil concentrations were not much different in two sediments, but was high up to 47.1×10^{-6} in patella. May be it was the result of biological enrichment of patella to oil.

By comparison, the oil concentrations level in the Great Wall bay was low (Kennicutt II, 1992; Hunter, 1990).

3.2 BHCs

In surface sea water of about one third stations, BHCs were undetectable. In general, BHCs were higher in outlet (<1.94 ng/L) than in inlet (<0.69 ng/L). The general level was similar to that in Syowa Station (Shinsuke, 1983). The outside sea water was collected at the west of the Southern Shetland Islands about one day's voyaging distance. BHCs were 1.54 ng/L in it and a little high. Accordingly we can infer that BHCs concentrations in surface sea water of the bay were lower than that in the outside sea. That is to say BHCs contamination in the Great Wall bay at present is just to a small extent. At all stations BHCs detected, there were all β-BHCs, γ-BHCs existed at few stations, α-BHC and δ-BHC could not be detected. It indicated that the environmental stability of β-BHC was relatively high in the bay environment, or β-BHC was the principal composition in BHCs transported to the bay environment. In two sediments there were similar BHCs concentrations. In patella it was a little high, but lower than the other researchers' result (Yao, 1990).

3.3 DDTs

DDTs could not be detected in all surface sea water samples, that was <0.04 ng/L, showing no difference with the other researchers' conclusion (Yao, 1990). In other samples, DDTs concentrations were much higher in patella (1.049×10^{-9}), and took second place in sediment of C_4 station. Generally speaking, in all samples of the bay DDTs concentrations were at low level (Scott, 1990).

3.4 PCBs

Only PCB_3+ PCB_5 concentrations were determined in sediments and organisms samples. PCBs concentrations were also much higher in patella, and took second place in sediment of C_4 station. There are two explanations. First, for oil, BHCs, DDTs, and PCBs the patella possesses a strong enriching ability, so their concentration were high in it comparing with other samples. Second, the C_4 station was relatively heavily contaminated. It was near the

southwest of the Ardley Island. Penguins and seals were gathered there. In sediment there was much biological metabolite. The DDTs and PCBs in sediment might mainly come from it. By comparison, PCBs concentrations were also at low level in sediments and organisms of the Great Wall bay (Scott, 1990).

3.5 PAHs

In sediments and organisms samples there were no PAHs detected at present.

Generally speaking, the organic contamination in the Great Wall bay was still low at present. The concentrations of BHCs, DDTs, PCBs and oil were lower than that in other Antarctic environment, for example, Ross sea, Weddell sea, Palmer station, McMurdo bay, and so on (Scott, 1990; Kennicutt II, 1992; Hunter, 1990).

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