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Trace metals in the surface waters of Maxwell Bay, King George Island, Antarctica

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남극 킹조지섬 맥스웰만의 표층해수중의 미량금속

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Abstract : The Cd, Cu, Pb and Zn concentrations in the surface waters of Maxwell Bay, King George Island, Antarctica were measured during austral summer of 1989. The trace metal concentrations appeared to be generally low in the central Maxwell Bay and high in the Marian Cove. The trace metal levels in Maxwell Bay were considerably higher than those in the Southern Ocean near Antarctica or in the South Sea of Korea.
Key words : trace metals, Cd, Cu, Pb, Zn

요약 : 1988-89년 남극의 여름기간에 남극반도의 킹 죠지섬에 있는 맥스웰만에서 표층해수 중의 Cd, Cu, Pb, Zn등 4가지 미량금속 농도를 측정하였다. 중금속 농도는 전반적으로 맥스웰만 중앙 해역이 낮은 반면에 마리안 소만이 높게 나타났다. 본 조사결과는 남극에 근접한 남 아프리카의 남해나 우리나라 남해의 중금속 농도보다도 매우 높았다.
주요어 : 미량금속, Cd, Cu, Pb, Zn

Introduction

A unique feature of the Antarctic region is its remoteness from sources of man-made toxic pollutants. Unfortunately, however, the region is being contaminated by chemical pollutants caused by increased human activities. For instance, the DDT and PCBs occur in Antarctic fauna like seals and birds. Moreover, high levels of heavy metals are measured in these animals (Schneider et al., 1985). In spite of growing concern on the Antarctic pollution, few works have been done on the distribution of trace metals in the Antarctic Ocean, especially in the coastal waters. This paper reports the distribution of trace metals such as Cd, Cu, Pb and Zn in the surface waters of Maxwell Bay, King George Island, Antarctica.

Sampling and Analytical Methods

The locations of sampling stations in Maxwell Bay are shown in Fig. 1. Surface seawater samples were collected at 21 stations during January 27-28, 1989. Samples were taken from the bow of slowly moving ship(ca. 2 knots) using precleaned polyethylene bottles hung on a PVC pole(Boyle et al., 1981) and transferred to laboratory for analysis. In the laboratory, 4 ml of distilled hydrochloric acid were added to one

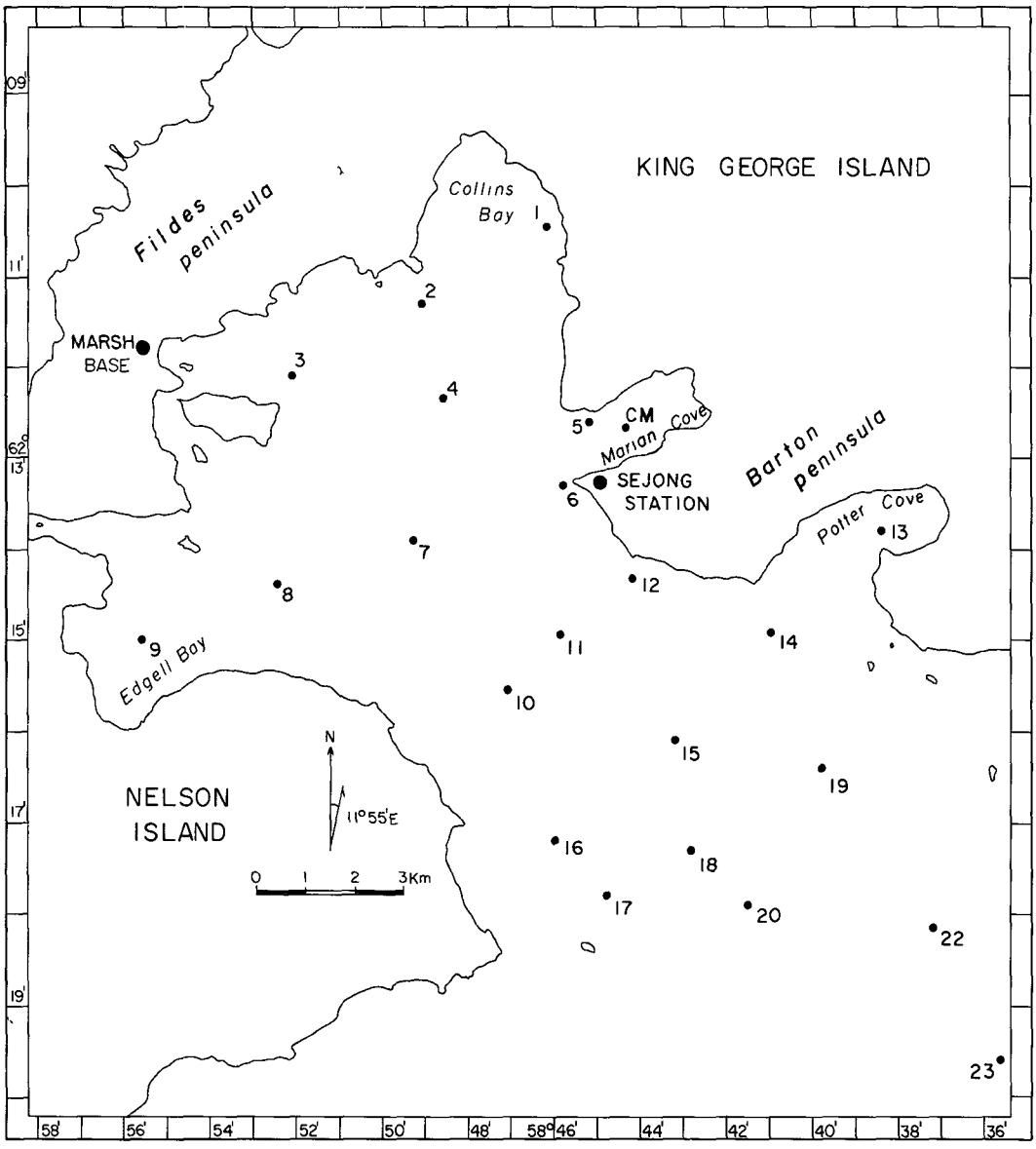

Fig. 1. Map showing the sampling stations.

liter of sample for preservation until analysis under a Class−100 laminar flow bench. The trace metal concentrations were determined by a graphite furnace atomic absorption spectrophotometer following 50 times preconcentration using a dithiocarbamate extraction method (Danielsson et al., 1978). Extractions were made with Teflon separatory funnels under the laminar flow bench in a clean room.

Results and Discussion

The distributions of Cd, Cu, Pb and Zn concentrations in the surface waters of Maxwell

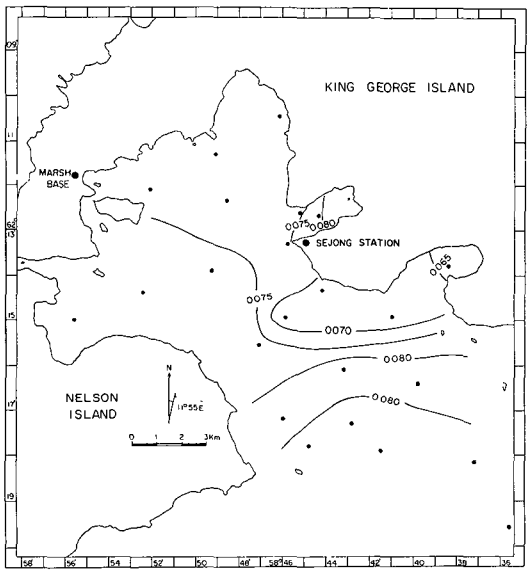

Fig. 2. Distribution of cadmium in the surface water of Maxwell Bay during January 27–28, 1989 ($\mu g/\ell$).

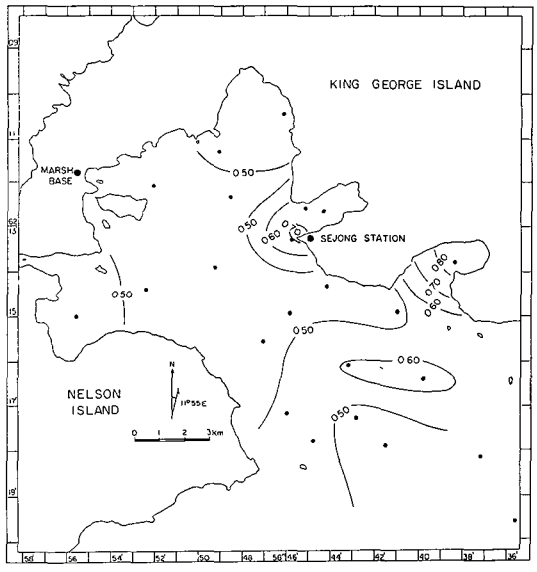

Fig. 3. Distribution of copper in the surface water of Maxwell Bay during January 27–28, 1989 ($\mu g/\ell$).

Bay are shown in Figs. 2 through 5. Relatively higher Cd concentrations appeared at the mouth of Maxwell Bay, while lower Cd level was found in the Potter Cove (Fig. 2). The Cd concentration in the central Maxwell Bay was ca. 0.075 $\mu g/\ell$. It is of interest to note that the Cd levels were observed comparatively high at the mouth of Maxwell Bay, but the reason is not clear due to lack of other chemical data. Cu concentrations were 0.50 $\mu g/\ell$ or less in the central Maxwell Bay and higher than 0.60 $\mu g/\ell$ in the Marian and Potter Coves (Fig. 3). In the vicinity of the King Sejong Station, relatively high level of Cu (0.70 $\mu g/\ell$) was observed. Extremely high Cu value (1.21 $\mu g/\ell$) was found at St. 1 in the Collins Bay and not included in the figure. The highest Pb concentration of 0.06 $\mu g/\ell$ was observed in the Marian Cove near the King Sejong Station (Fig. 4) The Potter Cove showed more than 0.02 $\mu g/\ell$ level of Pb. Except these two areas, the Pb levels were less than 0.02 $\mu g/\ell$ in the Maxwell Bay. The variations of Zn con-

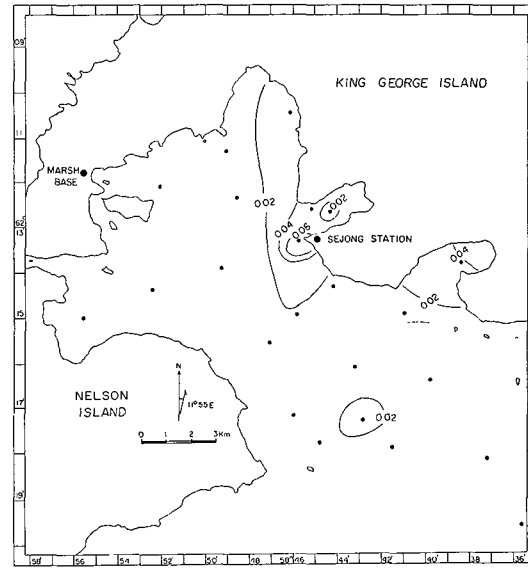

Fig. 4. Distribution of lead in the surface water of Maxwell Bay during January 27–28, 1989 ($\mu g/\ell$).

centrations were not significant (Fig. 5). In the central Maxwell Bay, less than 0.3 $\mu g/\ell$ level

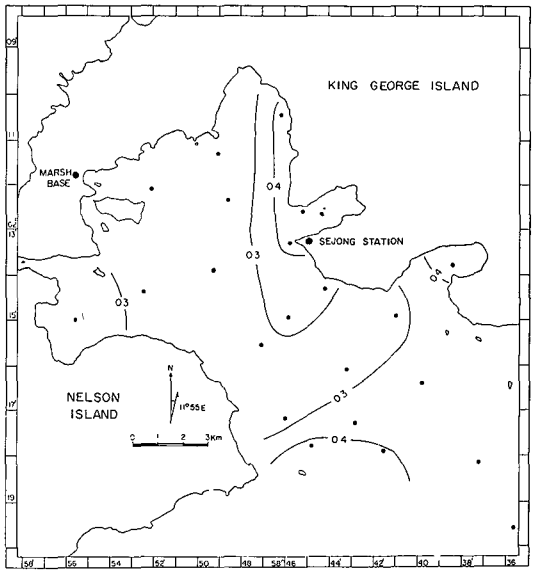

Fig. 5. Distribution of zinc in the surface water of Maxwell Bay during January 27−28, 1989 ($\mu g/\ell$).

of Zn was found. However, the Zn values that are higher than 0.4 $\mu g/\ell$ were also observed in the Marian Cove, Potter Cove and at the mouth of Maxwell Bay.

The trace metal levels in the surface waters of Maxwell Bay were generally high in the Marian Cove and the Potter Cove (except Cd). This may be largely due to human activities including increased scientific works and tourism around these areas. In part, this was ascribed to inputs of freshwater with suspended materials from the adjacent glaciers or land, because the salinities in the two areas were much lower than those in the central Maxwell Bay (KORDI, 1989a). Furthermore, limited water circulation could increase metal levels in these areas. In this respect, the Collins Bay would be also vulnerable to contamination from heavy metals.

The results of this study indicate that the trace metal levels (Cd, Cu, Pb, Zn) in Maxwell Bay are much elevated with respect to those in the Southern Ocean of South Africa, near Antarctica (Orren and Monteiro, 1985) or in the South Sea of Korea (Mean : Cd 0.016 $\mu g/\ell$, Cu 0.11 $\mu g/\ell$, Pb 0.018 $\mu g/\ell$, Zn 0.13 $\mu g/\ell$; KORDI, 1989b). However, the Cd, Cu and Pb levels of the present study are comparable with mean values reported for the European continental shelf (Cd 0.054 ± 0.015 $\mu g/\ell$, Cu 0.51 ± 0.16 $\mu g/\ell$; Kremling, 1985) or mean concentration of sea water (Pb 0.03 $\mu g/\ell$; Bowen, 1979).

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Appendix 1 Concentrations of trace metals in the surface waters of Maxwell Bay, King George Island, Antarctica during January 27－28, 1989($\mu g/\ell$)

Station No.	Cd	Cu	Pb	Zn
CM(Continuous Monitoring)	0.079	－	0.021	0.38
1	0.074	1.21	0.031	0.38
2	0.074	0.54	0.012	0.24
3	－	－	－	－
4	0.071	0.40	0.010	0.25
5	0.074	0.63	0.043	0.37
6	0.074	0.69	0.065	0.43
7	0.076	0.45	0.013	0.26
8	0.076	0.35	0.015	0.27
9	0.078	0.64	0.016	0.36
10	0.076	0.44	0.013	0.26
11	0.069	0.49	0.018	0.34
12	0.069	0.44	0.017	0.28
13	0.065	0.85	0.035	0.45
14	0.067	0.47	0.014	0.25
15	0.083	0.57	0.011	0.29
16	0.083	0.52	0.013	0.29
17	0.077	0.52	0.015	0.44
18	0.075	0.45	0.024	0.31
19	0.084	0.60	0.011	0.32
20	0.077	0.46	－	0.44
21	－	－	－	－
22	－	－	－	－
23	0.079	0.35	0.012	0.25
Mean	0.075	0.55	0.020	0.33