

Heavy Metals in Some Parts of Antarctica and the Southern Indian Ocean

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Though remote in its geographical location Antarctica is known to be indirectly affected by industrial and agricultural activities on other continents. This is evident in the concentrations of synthetic chemicals such as the organochlorine pesticides which are present in the Antarctic environment (Risebrough *et al.*, 1968; Brewerton, 1969). There is a need to investigate heavy metal levels in the Antarctic continent, as these contaminants may also be subject to aerial transport. Baseline studies such as those of Anderlini *et al.* (1972) suggest that metals may be of significance as marine pollutants in some part of the Antarctic continent.

During the 7th Indian scientific expedition to Antarctica, the concentrations of certain trace metals were determined in various samples. Zooplankton and krill were collected from 30°S to the Southern ocean. Lichens and moss were collected from the shores of glacial lakes around the Indian station *Maitri* in the Schirmacher Oasis.

Sediments from three different lakes were also collected. Penguin feathers, providing a measure of metal accumulation over two years, were also sampled. All samples were collected taking particular care to avoid contamination. Biological samples were digested in triplicate with a mixture of nitric acid and perchloric acid. Sediment samples were digested using hydrofluoric acid, perchloric acid and nitric acid. Blanks and standards were digested with each sample set, to provide

TABLE 1

Comparison of analytical values obtained with certified concentrations of metals for three reference materials. All data as $\mu\text{g g}^{-1}$ dry wt.

	TORT		MESS	
	Certified values	Values obtained	Certified values	Values obtained
Cd	26.3 ± 2.1	26.37 ± 0.50	0.59 ± 0.10	0.55 ± 0.003
Cu	439 ± 22	376 ± 10.0	25.10 ± 3.80	23.54 ± 0.87
Pb	10.4 ± 2.0	9.98 ± 0.05	34.00 ± 6.10	33.20 ± 0.05
Ni	2.3 ± 0.3	2.5 ± 0.25	29.50 ± 2.70	26.32 ± 1.10
Marine sediment reference materials				
	BCSS		MESS	
	Certified values	Values obtained	Certified values	Values obtained
Cd	0.25 ± 0.04	0.23 ± 0.002	0.59 ± 0.10	0.55 ± 0.003
Cu	18.5 ± 2.7	17.88 ± 0.06	25.10 ± 3.80	23.54 ± 0.87
Pb	22.7 ± 3.4	23.01 ± 0.05	34.00 ± 6.10	33.20 ± 0.05
Ni	55.3 ± 3.6	51.16 ± 1.03	29.50 ± 2.70	26.32 ± 1.10
Co	11.4 ± 2.1	13.50 ± 0.08	10.80 ± 1.90	13.15 ± 0.75

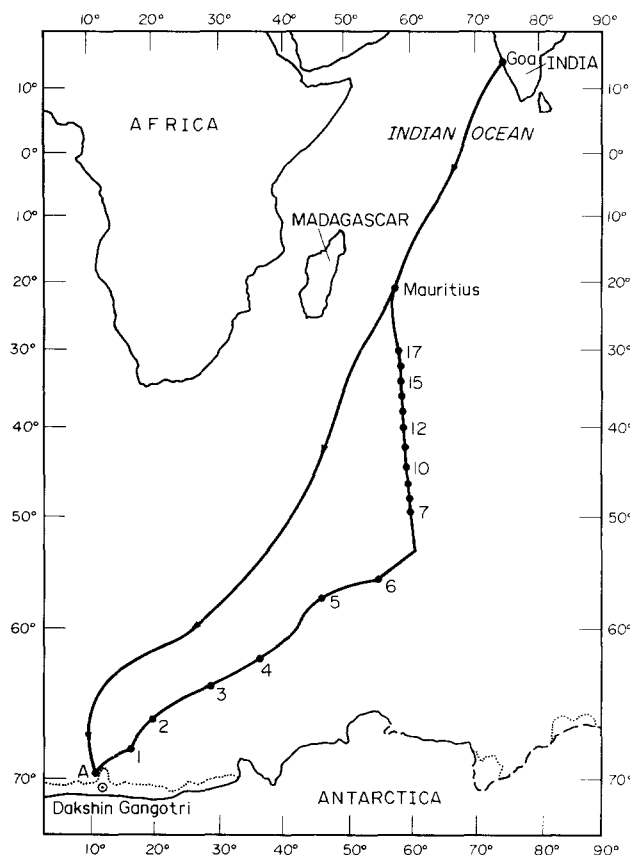


Fig. 1 Cruise track and number of stations: 7th Indian Antarctic expedition. A indicates station in Polynya.

quality control. The accuracy of the results was checked by analysing the reference materials TORT, (lobster hepatopancreas marine reference material for trace metals) MESS, and BCSS (marine sediment reference materials for trace metals) supplied by NERC, Canada, in triplicate with each batch of samples. The results (Table 1) are in good agreement with the certified values.

Samples were analysed on a GBC flame atomic absorption spectrophotometer equipped with a background corrector and an automatic zero function to compensate for the blank values. The results obtained are detailed in Table 2. The station positions in the southern Indian Ocean are given in Fig. 1, while Fig. 2 shows the location of the three lakes sampled. Penguin feathers were hand-picked from Emperor penguins in a

TABLE 2

Concentration of heavy metals in zooplankton and krill ($\mu\text{g g}^{-1}$ wet wt).

Material	Pb	Cu	Co	Ni	Cd	Type of sample
Krill stn. 8	<0.05	160.0	<0.05	<0.04	<0.04	-
Zooplankton stn. 2	8.0	11.9	<0.05	<0.04	<0.04	Mixed
Zooplankton stn. 5	5.4	23.4	<0.05	<0.04	<0.04	Mixed
Zooplankton stn. 8	2.2	31.0	<0.05	<0.04	<0.04	Mixed
Zooplankton stn. 13	6.0	6.0	<0.05	<0.04	<0.04	Mixed
Zooplankton stn. 15	3.3	43.6	<0.05	<0.04	<0.04	Mainly euphausiids
Krill stn. 10	1.2	79.0	<0.05	<0.04	<0.04	-

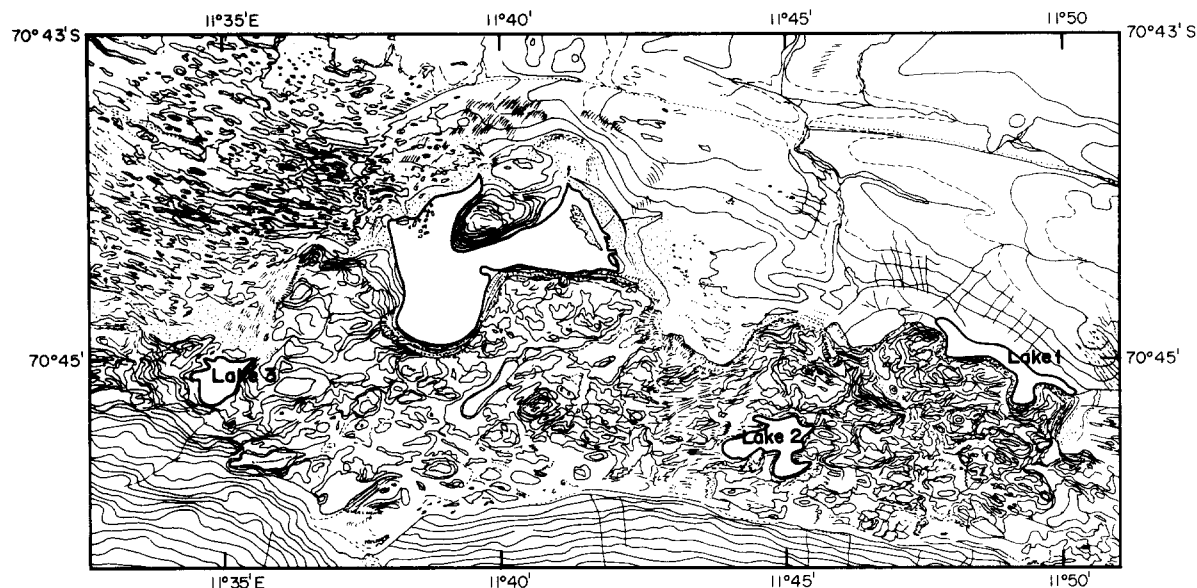


Fig. 2 Location of the three glacial lakes in the Schirmacher Oasis.

rookery. Of the five metals, Cd, Co and Ni were not detected in any of the zooplankton or krill samples. Pb ranged from below $0.05 \mu\text{g g}^{-1}$ wet wt to $8.0 \mu\text{g g}^{-1}$ wet wt, and Cu from $6.0\text{--}160.0 \mu\text{g g}^{-1}$. No consistent geographical variation was observed in the concentrations. However, krill exhibited the highest values of Cu. Hennig *et al.* (1985) found that zooplankton accumulate metals to a degree which is dependent on the water masses in which they live, and speculated that accumulation may be associated with the nutrient cycle (Boyle *et al.*, 1981).

The three glacial lakes in the Schirmacher Oasis exhibited high concentrations of most of the trace metals in sediments, with Cu concentrations being generally greatest, but Cd, Co and Ni levels also being appreciable (Table 3). The mosses and lichens growing on the shores of these lakes exhibited high Cu concentrations, but levels of Cd, Co and Ni were below detection limits in these samples. Feathers collected from moulting Emperor penguins could be useful indicators of contaminants accumulated over time. It is believed that penguins moult every two years and hence their feathers provide an indication of levels of contaminants over this period. The only metal detected in these feathers was Cu, present at a concentration of $15.3 \mu\text{g g}^{-1}$ wet wt. This may reflect the exposure of Emperor penguins to copper in their diet of krill (see Table 2). These results provide baseline information on the levels of trace metals in two essentially pristine environments, the Southern Indian Ocean and the Antarctic continent.

TABLE 3

Concentrations of heavy metals in lichens and mosses, lake sediments, and feathers of Emperor penguins.

Material	Pb	Cu	Co	Ni	Cd
Lichen*	<0.05	14.0	<0.05	<0.04	<0.04
Moss*	2.3	59.4	<0.05	<0.04	<0.04
Sediment†	13.9	50.0	23.0	29.0	1.1
Lake 1					
Sediment†	13.9	67.0	23.3	91.0	1.6
Lake 2					
Sediment†	13.9	75.0	30.0	31.3	1.4
Lake 3					
Penguin* feathers	<0.05	15.3	<0.05	<0.04	<0.04

*Wet weight.

†Dry weight.

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