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SHORT COMMUNICATION

RECONNAISSANCE OF ELEMENTAL COMPOSITION IN AEROSOLS OF THE ANTARCTIC PENINSULA

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Abstract—The composition of sub-antarctic aerosols collected during 1986/1987 in the Brazilian coastal station Ferraz (62°S, 58°W), is presented in this paper. The soil dust components Al and Mn were about 30 times larger than at the South Pole. Yearly averages of Al, Mn, Na, Cl and trace gas radon presented higher values during 1986 when higher winds prevailed. The trace metals Zn and Sb exhibited a clear seasonal trend with a minimum during winter.

Key word index: Aerosols, Antarctic Peninsula, Neutron Activation Analysis, trace elements.

EXPERIMENTAL SET-UP

Brazil's Ferraz Antarctic Station is located on King George Island, in the South Shetland Islands of the Antarctic Peninsula (62°05'S, 58°23.5'W). In 1986 a routine base aerosol survey was added to an on-going program of gaseous trace element measurements. The preliminary results of the first 2 years of operation are reported in this work.

The station was erected over a beach area composed mainly of coarse Mesozoic volcanic debris. The island is heavily glaciate and ice cliffs form much of its coastline. Heavy melting occurs during summer creating an ice-free area around the station which reaches its maximum during February and March.

The aerosols were collected on 0.45 μm Millipore membrane filters at a flow rate of 5 ℓ min^{-1} from a laboratory located 300 m upwind from the main buildings, 31 m above sea level. Due to the low flow rate, the sampling period was set to one week, providing a total air sample volume of about 40 m^3. After conclusion of the 1-week sampling period, the filters were carefully sealed in plastic bags for later analysis in Brazil. Blank filters from the same allotment were analysed for background corrections.

The Neutron Activation Analysis (NAA) was employed for the trace element determinations. This technique provided a good limit of detection and the details of all the experimental procedures, including the preparation of the spikes, is given by Loureiro (1989).

EXPERIMENTAL RESULTS AND DISCUSSION

Table 1 shows the averages and standard deviations of the sea-salt-derived Na and Cl, and the soil-dust-derived Al and Mn obtained for 1986 and 1987. Concentrations of the trace elements are also shown but are only available for 1986. Table 1 also gives the results of local atmospheric radon and the atmospheric temperature, and wind speed data. Radon is used as a tracer for continental air masses.

Compared to aerosols collected in other Antarctic stations, the 2-year averages of the terrigenous elements (Al = 17.7 ng m^{-3} and Mn = 0.33 ng m^{-3}) were consistently higher than values found by Zoller *et al.* (1974) for the South Pole (Al = 0.57 ng m^{-3} and Mn = 0.010 ng m^{-3}) and by Wagenbach *et al.* (1988) for the Georg von Neumayer Station, in the Ekström ice shelf at 70°S (Mn = 0.011 ng m^{-3}).

Yearly averages for the terrigenous elements Al and Mn decreased by more than 60% in 1987 with respect to 1986. Surface wind intensity and atmospheric radon also exhibited this same tendency. Sodium and Cl presented a smaller 22% decrease. Mean surface air temperatures were virtually the same for these two periods. Apparently, aerosols were more efficiently transported from South America to Ferraz during 1986 as a result of the higher winds. The lower average radon in 1987 is in accordance with this observation (Pereira, 1990).

Maximum Na and Cl concentrations were found during January to April contrasting with results obtained by Wagenbach *et al.* at the Ekström ice shelf, which places a sharper maximum between November and December. Sodium and Cl occurred in aerosols with the same ratios of sea water. The same did not occur to the other sea-salt-derived inorganic components, K, Ca and Br (Table 2). With the noteworthy exception of Br all other elements were enriched in the aerosols by factors proportional to their atomic weights. Comparable results have been obtained by other authors for several coastal stations, including Antarctica (Komabayasi, 1962) and were attributed to sea–air fractionation.

The trace metals Sb and Zn exhibit the same general trend shown by soil-dust- and sea-salt-derived elements, with lower concentrations occurring in winter. Concentrations of Br and

Table 1. Average elemental composition of aerosols in Ferraz for 1986 and 1987 (ng g^{-1}). Results for mean atmospheric radon (Bq m^{-3}), wind velocity (m s^{-1}) and temperature (°C) are also shown for comparison. The number of samples is indicated in parentheses

	1986	1987
Na	1111 ± 486 (34)	866 ± 537 (33)
Cl	2048 ± 902 (34)	1614 ± 980 (33)
Al	26.0 ± 12.7 (34)	9.5 ± 5.6 (33)
Mn	0.41 ± 0.44 (34)	0.15 ± 0.07 (26)
V	0.30 ± 0.14 (34)	
Ca	224.5 ± 174.4 (31)	
K	116.9 ± 151.6 (17)	
Fe	24.81 ± 7.36 (34)	
Zn	5.17 ± 7.22 (34)	
Br	4.07 ± 2.20 (34)	
La	$(30.01 \pm 18.67) \times 10^{-3}$ (27)	
Sb	$(15.79 \pm 14.57) \times 10^{-3}$ (33)	
Au	$(3.44 \pm 2.75) \times 10^{-3}$ (34)	
Sc	$(3.39 \pm 1.32) \times 10^{-3}$ (33)	
Radon	0.026 ± 0.018	0.014 ± 0.008
Wind	7.2 ± 6.0	5.0 ± 4.1
Temp.	−5.0 ± 6.0	−4.7 ± 5.9

Table 2. Enrichment factors of sea-spray-derived elements in the aerosols with respect to the sea water composition. Sodium was used as the reference ion in the calculations

Element	Enrichment factor
Na	1.00
Cl	1.02
K	3.87
Ca	6.00
Br	0.65

V exhibited a decreasing tendency during the year. Calcium, Fe, Au, La and Sc did not present a definite trend, showing a more or less constant concentration level throughout the year.

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