

TRACE ELEMENT DETERMINATION IN AEROSOLS FROM THE ANTARCTIC PENINSULA BY NEUTRON ACTIVATION ANALYSIS*

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Recently interest has grown in the determination of the composition of atmospheric aerosols in remote areas, like the South Pole and the Antarctic Peninsula [1,2]. This knowledge is of great importance for the study of long-range transport of atmospheric contaminants and from the climatological point of view also.

Due to the very low elemental concentrations found in remote areas, only very sensitive analytical techniques, like neutron activation analysis [3,4], PIXE, AAS, ICP-AS, can be applied.

The present work is a joint project carried out by the Institute of Spatial Research (INPE) and the Nuclear and Energy Research Institute (IPEN-CNEN/SP) for the analysis of several trace elements in the atmosphere of the Antarctic Peninsula. The Brazilian Antarctic Station "Comandante Ferraz" (62°S, 58°W) where the samples were collected is located on the King George Island in the Antarctic Peninsula and is maintained by the Brazilian Antarctic Program since 1984.

Aerosol samples were collected from a 5 meter tower at the external part of the Laboratory of Atmospheric Sciences of the Station. The collecting system is very simple and consists of a membrane pump surrounded by a PVC protector, to avoid the penetration of snow or ice. Air is aspirated through a Millipore filter, of 0,45 µm pore size and 18 mm diameter. The filter is placed on a screen in a plastic holder. The flow rate of the pump is of 0,25 m³/h and air is collected for a period of one week. The filters were first analyzed for their alpha radioactivity and then irradiated for instrumental neutron activation analysis.

Irradiations were carried out at the IEA-R1 research reactor, under a thermal neutron flux of about 10¹² n.cm⁻².s⁻¹. Filters and synthetic standards were encapsulated in polyethylene envelopes and placed in polyethylene or aluminum irradiation containers. Irradiations of five minutes allow the determination of Al, V, Mn, Na and Cl and of

24 hours allow the determination of Ca, Au, Br, Sb, Sc, Fe, Zn, K and La. Blanks consisting of clean Millipore filters and plastic envelopes were analyzed and the concentrations of the elements found in the blanks were subtracted from the real samples.

Radioactivity measurements were carried out by using an ORTEC Ge(Li) detector with a resolution of 2.7 keV for the 1332 keV peak of ^{60}Co coupled to an ORTEC Model 6240B, 4096-channel analyzer. Calculations were performed with a PDP 11/04 computer by means of the GELIGAM software of ORTEC.

The accuracy of the analytical technique was tested by analyzing the elements of interest in the reference materials W-1 (USGS) and Bowen's Kale. Good agreement was found with the literature values.

The aerosol elemental concentrations were determined in 86 samples collected at the Brazilian Station, during 1986 and 1987.

Concentrations found, after subtracting the blank, were of the order of ng/m^3 for V, Al, Mn, Na, Cl, Ca, Br, Fe, Zn and K, and of the order of pg/m^3 for Au, Sb, Sc and La.

The data obtained are being processed by Principal Factor Analysis, using IBM/PC compatible software. Correlations with other measurements performed at Ferraz such as radon, ozone, CO, and meteorological data are also being made by use of this software.

The concentrations found for V, Al, Mn, Na and Cl allowed to draw the following preliminary conclusions:

- The elemental concentrations present a seasonal variation.
- The marine aerosol is predominant. The Na/Cl of 1,8 found is consistent with the ratio found in seawater.
- Principal factor analysis points to two factors to explain the origin of these elements, which are the ocean and soil.

The data for Ca, Br, Fe, Zn, K, Au, Sb, Sc and La are being processed.

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