APPLICATIONS OF PARTICLE INDUCED X-RAY EMISSION ANALYSIS FOR ATMOSPHERIC AEROSOL

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Abstract

Applications of Particle Induced X-Ray Emission(PIXE) Analysis were shown for the monitoring of atmospheric aerosol. Time variation of concentrations of 10 elements was observed using a sequence sampler.

Introduction

Owing to its high sensitivity, PIXE method is especially useful for the analysis of very small amount of elements in such as environmental, biological and archaeological samples. In this presentation, an application of PIXE method of analysis for atmospheric aerosol is given by the field experiments at Tsukuba Research Center.

Using, PIXE, the sampling time was made short enough to get 2-hour time resolution in the analysis of Al, S, Cl and Pb in the samples collected by using a sequential sampler in a period of week. The analysis of data disclosed a possibility of a very simple monitoring system of emission sources of aerosol, in the combination of these data with meteorological data.

Experimental

Samplings were made at two obserbation stages, 10 m and 200 m over ground, of a meteorological observation tower, Tsukuba. A streaker sampler which draws air at 3 L/min from a moving nozzle that pressed to a strip of Nuclepore filter, was used as a sequential sampler of atmospheric aerosol. The nozzle, 2 mm x 10 mm, moves 1 mm per 1 hour, so that a 168 mm strip of particles filtered on the filter is obtained in the sampling of one week.

Samples were irradiated with a beam of proton(2.5MeV) in a chamber at 10^{-5} torr. The induced X-Ray was measured by a Si(Li) semi-conductor detector having a resolution of 180 eV FWHM at 5.9 KeV.

Results and Discussion

At both altitudes, 10 elements, Al, Si, S, Cl, K, Ca, Mn, Fe, Zn and Pb, were determined every other hour. Elemental concentration data are shown in Table 1. Data at 200 m were lower than those at 10 m by factors of 0.7 to 0.9 except Al, Cl and Fe.

On the other hand, time sequential data ofelemental concentrations of Al, S, Cl and Pb are shown in relations with the wind direction in circle graphs.

Directional characteristics were not observed for Al concentratios, but high concentrations were found for Cl and Pb in the southwest wind, toward Tokyo. And S had a weak tendency to distribute in southeastern wind, toward Kashima, a nearby industrial complex.

In this investigation, data from single sampling site gave elemental concentrations varying with wind directions. This was only possible with time sequential data of elemental concentrations obtainable by PIXE. This technique must be useful for monitoring emission sources such as stacks at power stations.

Table 1 Elemental Concentrations and Concentration Ratios in the Atmospheric Aerosol at Tsukuba

Element	Average conc., A (ng/m^3)	Average conc., B (ng/m^3)	Concentration ratio B/A
Al	550 ± 260 (n=30)	530 ± 240 (n=30)	0.96
Si	1880 ± 1250 (n=30)	1270 ± 920 (n=31)	0.68
S	2350 ± 1110 (n=30)	1750 ± 820 (n=31)	0.74
Cl	880 ± 940 (n=30)	870 ± 810 (n=23)	0.99
K	430 ± 240 (n=30)	320 ± 330 (n=31)	0.74
Ca	2790 ± 1640 (n=30)	2260 ± 1600 (n=31)	0.81
Mn	110 ± 65 (n=30)	99 ± 56 (n=31)	0.90
Fe	1320 ± 670 (n=30)	1340 ± 810 (n=31)	1.0
Zn	250 ± 120 (n=30)	200 ± 140 (n=31)	0.80
Pb	110 ± 72 (n=30)	88 ± 65 (n=31)	0.80

A : 10 m height, B : 200 m height
Sampling period : Aug. 27 - Sep. 3, 1981

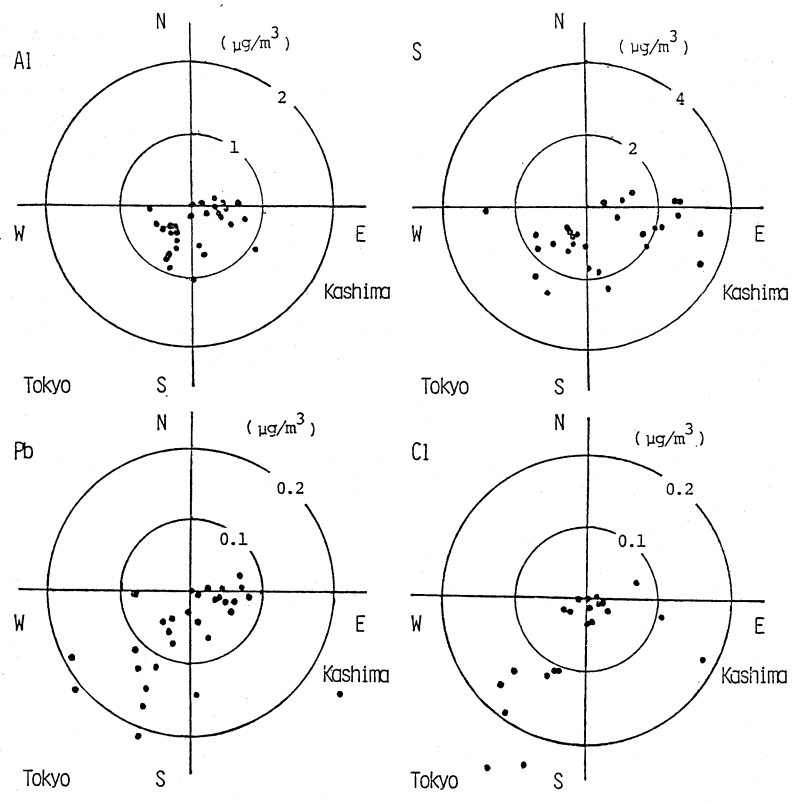

Fig. 1 Relations of Wind Direction with Concentrations of Al, S, Pb and Cl in the Atmospheric Air at Tsukuba(Aug.27-Sept.3, 1981)