Comparison of elemental quantity by PIXE and ICP-MS for atmospheric aerosol sample

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Abstract

Since PIXE allows detection of minute samples smaller than a milligram without any complex chemical manipulation and since it not only simultaneously detects elements from Na to U in a short time but also detects major-to-ultratrace elements at the ppb level, it is being used in a variety of fields, including environmental research, medicine, geology and archeology, and PIXE analysis is fast becoming a universal method for highly sensitive analysis of multiple elements. Meanwhile, multi-element analysis by means of ICP-MS is being performed on a daily basis by many research and analysis institutions. In the field of environmental research, ICP-MS have become synonymous with multi-element analysis. Comparison of values determined by PIXE with those determined by ICP-MS is important in the field of environmental research in terms of evaluating values determined by PIXE. As such, we compared values determined by PIXE with those determined by ICP-MS using atmospheric aerosol sample.

PIXE analysis of the samples was carried out using PIXE system at Nishina Memorial Cyclotron Center, Japan Radioisotope Association. Quantitative analysis of elemental concentrations was performed based on the Nuclepore-Br method. For preparation of the samples for ICP-MS (Agilent Technologies 7000x), these samples were decomposed with 1% nitric acid using the ultrasonic/heating-block method. The number of elements determined by ICP-MS was 28: Be, Na, Mg, Al, Si, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Sr, Mo, Ag, Cd, Sb, Ba, Tl, Pb, Th and U. Elemental values were determined based on response factors generated from analysis of the continuing calibration standard.

The comparison results of elemental quantitative value by PIXE and ICP-MS, was a linear relationship of the quantitative value of the elements except Cr. In the Mg, Al, Si, Ti, and Fe of major elements, quantitative values by ICP-MS are lower than quantitative values by P IXE. Quantitative values of Na, K, Ca, and Zn by ICP-MS are higher than the quantitative values by P IXE. For trace elements, quantitative values of Sr and Ni by ICP-MS are lower than the quantitative value by P IXE. In the V, Mn, Cu, and Pb, quantitative values of ICP-MS and PIXE are almost the same.