AIR QUALITY MONITORING WITH ROUTINE UTILIZATION OF ION BEAM ANALYSIS

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Information on source contributions to ambient air particulate concentrations is a vital tool for air quality management. Traditional gravimetric analysis of airborne particulate matter is unable to provide information on the sources contributing to air particulate concentrations. Ion beam analysis is used to identify the elemental composition of air particulates for source apportionment and determining the relative contribution of biogenic and anthropogenic sources to air particulate pollution. The elemental composition is obtained by proton induced X-ray emission technique (PIXE), which is an ion beam analysis (IBA) technique. The element concentrations are deduced from the X ray spectra produced when the particulate collected on a filter is bombarded with a high-energy proton beam.

As part of the UNDP/IAEA/RCA Project RAS/8/082 'Better Management of the Environment, Natural Resources and Industrial Growth through Isotope and Radiation Technology,' a collaborative alliance was formed between the Institute of Geological and Nuclear Sciences Limited and the Wellington Regional Council, New Zeland [1]. The purpose of the project was to examine the elemental composition of air particulate matter and determine the origins through source apportionment techniques. In New Zealand PM 10 and PM 2.5 fractions have been collected at the industrial area of Seaview, Wellington over two years using a GENT stacked filter unit sampler. Concentrations of elements with atomic mass above neon were determined using ion beam analysis and elemental carbon concentrations were determined using a reflectometer. Specific ambient source elemental 'fingerprints' were then determined by factor analysis and the relative contributions of various local and regional sources were assessed. The significant factors (sources) were determined to be sea salt, soil, industry, and combustion sources. Local industry was found to contribute to ambient lead concentrations.

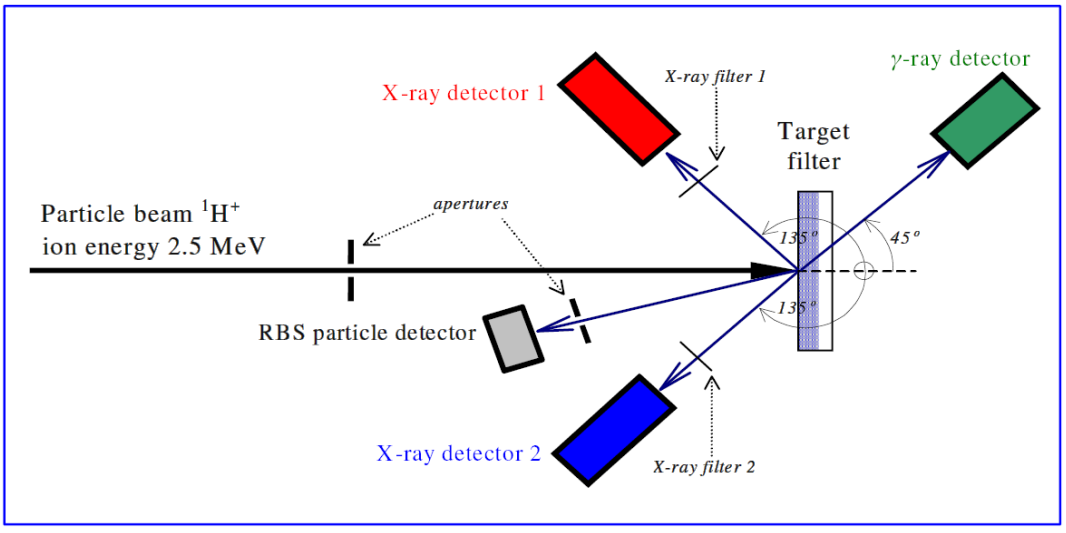

Fig. 1. Typical PIXE set-up.

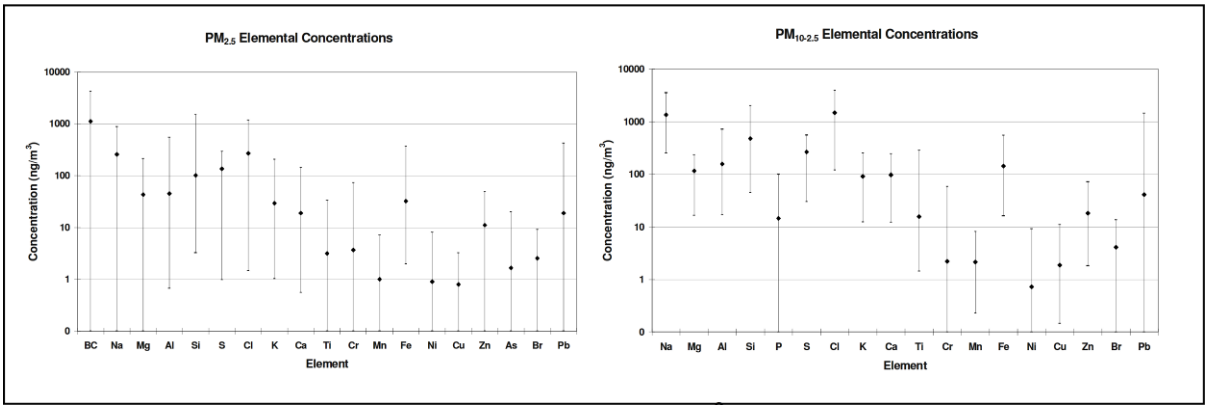

Fig. 2. Range of elemental concentrations (ng/m^3) for PM2.5 and PM10-2.5 respectively.

TABLE 3. THE FINGERPRINTS OR FACTORS IDENTIFIED FOR THE PM 10–2.5 FRACTION

Element	Factor 1 (soil)	Factor 2 (sea salt)	Factor 3 (lead)
Fe	0.98	-0.02	0.08
Si	0.98	-0.03	0.12
Al	0.97	-0.05	0.10
Ti	0.96	0.03	0.13
K	0.89	0.41	0.04
Ca	0.86	0.46	0.08
Zn	0.72	0.16	-0.13
Cl	-0.08	0.96	-0.08
Br	-0.02	0.90	0.20
Na	0.04	0.87	-0.09
Mg	0.52	0.78	0.11
S	0.32	0.77	0.27
Pb	0.10	0.13	0.97

REFERENCES

[1] UNITED NATIONS DEVELOPMENT PROGRAMME, Better Management of the Environment, Natural Resources and Industrial Growth through Isotope and Radiation Technology, UNDP/IAEA/RCA Project RAS/8/082 Report, UNDP, New York (2004).