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**NON-FILTERABLE METALS (NFM)
IN THE ATMOSPHERE**

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ABSTRACT

A new air sampler, the Mist-UV sampling system, has been developed to trap and detect metals and metal compounds present in atmospheric samples, as non-filterable metal (NFM). The Mist-UV system is based on the combination of two ideas, mixing the filtrated air sample with nitric acid mist and simultaneous ultraviolet irradiation of the mist. Atmospheric NFM in the introduced air samples, which were first passed through a 0.2 μm filter, were oxidised by UV irradiation and dissolved in the nitric acid mist. The trapped metals resulting from the NFM in nitric acid were quantitatively determined using ICP-MS.

Using the Mist-UV system, measurements of atmospheric NFM concentrations were carried out to obtain their temporal and spatial trends in Auckland, New Zealand. Five metals (Mg, Al, Cu, Ba and Sr) were detected as NFM in ambient air.

Elevated atmospheric concentrations of Mg, Cu, and Ba were detected in midsummer and in daytime samples. The UV oxidisable fraction dominated the NFM and high enrichment factors (EF_{crust}) were found for these metals. This suggested that natural emissions of organometals or reduced metals were responsible for the elevated atmospheric concentrations. Meteorological factors, particularly air temperature, light irradiation and rainfall, promoted biogenic activity and resultant NFM emissions.

Remarkably high concentrations of Al and Sr as NFM were discovered in several air samples and were dominated by the non-oxidisable compounds. This implies that the sources of Al and Sr were mainly from inorganic or oxidised metals associated with fine particulates.

Wet and dry soils appeared to be the sources of Mg+Ba and Al+Sr, respectively. Plant emissions are recognised as important sources of Mg, Cu and Ba as NFM in ambient air, whereas the suspension of fine particulates derived from road dust and soil enriched

with non-oxidisable compounds are seen as the major sources of Al and Sr. The emissions from automobiles and seawater samples were found to be unimportant NFM sources.

The NFM concentrations were found to be significantly higher than concentrations of particulate metals, therefore the atmospheric importance and role of NFM cannot be ignored in the estimation of global metal circulation and budgets.

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ABBREVIATIONS

AAS	Atomic absorption spectrometry
AEE	Anomalously enriched metals
EF	Enrichment factor
EF _{crust}	Enrichment factor for crust materials
EF _{sea}	Enrichment factor for seawater/sea salts
FPM	Fine particulate metals
GC	Gas chromatography
HDPE	High-density polypropylene
HNO ₃	Nitric acid
ICP-AES	Inductively coupled plasma – atomic emission spectrometry
ICP-MS	Inductively coupled plasma – mass spectrometry
LDPE	Low-density polypropylene
LOQ	Limit of quantitation
MDA	Metals dissolved in nitric acid
MMT	Methylcyclopentadiethyl manganese tricarbonyl
MOUDI	Micro-orifice uniform deposit impactor
NFM	Non-filterable metals
NMHC	Non-methane hydrocarbons
PM _{2.5}	Particulate matters of less than 2.5 µm diameter
PM ₁₀	Particulate matters of less than 10 µm diameter
PP	Polypropylene
PVC	Polyvinyl chloride
Tedlar [®] PVF	Polyvinyl fluoride
Teflon [®] PTFE	Polytetrafluoroethylene
Teflon [®] PFA	Perfluoroalkoxy
Teflon [®] FEP	Fluorinated ethylene propylene
UVox	UV oxidised (fraction)
VMC	Volatile metal compounds
VOC	Volatile organic compounds