Investigation of metals in $PM_{2.5}$ and coarse PM at in typical urban environment in Hong Kong

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Keywords: Metals, Size fractionated PM, Water solubility, Crustal enrichment factor.
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An investigation of elemental characteristics abundance, bioavailability and size-segregated aerosol with temporal variability was conducted at one traffic site on urban background during winter in 2011 to 2012 in Hong Kong. Fourteen elements including Al, Ca, Cd, Cr, Co, Cu, Fe, K, Pb, Mg, Mn, Mo, Na, Ni, V and Zn in both aquatic extraction and strong acidic extraction were analyzed using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) and Inductively coupled plasma mass spectrometry (ICP-MS).

Dominant wind from North and North-East directions was observed during the sampling period showing the contribution of regional transport to local air pollution in Hong Kong in winter time. Fe, Zn, Ca, Al and Pb are the most abundant metals in $PM_{2.5}$ while Ca, Fe, Al and Mg in coarse PM. The distribution of metals in $PM_{2.5}$ and coarse PM are similar in pattern but different in magnitudes with Cd, Cr, Cu, Pb, Mn, Ni, V, Zn claiming much higher portion in $PM_{2.5.}$

Metals in urban PM showed distinct types of particle size-fractionated behavior depending on the discrimination of different emission sources. A common practice when using CEFs is to expect a CEF of 1 as the background value and CEFs >10 as the indicative of PM sources different from crustal material, e.g., from anthropogenic sources (Birmili, 2006). Distinguish of crustal enrichment factors (CEFs) of elements for two size particles between fine and coarse PM showed that CEFs for nine of fourteen species were higher than 10 in which Cd, Pb, Zn, Mn and Cu were far above 100 in fine particles; whereas in coarse particles, the CEFs of most elements were lower than 10 except Cd was higher than 100.

In bioavailability study, extractable and residual fractions of the elements were present in different size distributions. The extractable fraction was mainly distributed in fine particles, while the residual fraction was in general predominant in the coarse size range. Coarse PM and $PM_{2.5}$ also showed different solubility profiles for the measured metals as a result of their different chemical forms either due to different source emissions or atmospheric processes altering its chemical states. The results from this study demonstrated large variation of water solubility of metals in urban aerosols in different size fractions and highlighted solubility as an important metric for considering the relation between metals and adverse human health effects in epidemiological and toxicological studies.

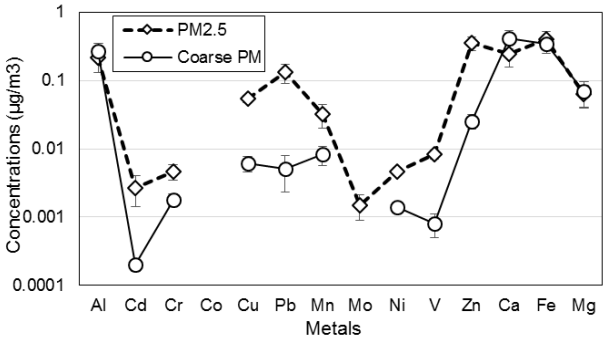

Figure 1. Concentration of metals in $PM_{2.5}$ and coarse PM.

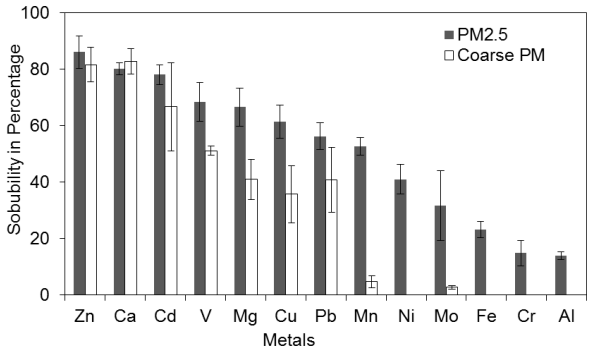

Figure 2. Water solubility ratios of metals in $PM_{2.5}$ and coarse PM in Hong Kong.

Reference:
Birmili, W., Allen, A.G., Bary, F., Harrison, R.M. (2006). *Environ Sci Technol.* 40, 1144-1153.