Elemental composition and potential toxicity of airborne particles at some urban schools

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Keywords: elemental composition, schools, vehicle emissions
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Although both the size and chemical composition of ambient particles are important parameters in determining their toxicities, their relative contributions are unclear (Heal et al., 2012). Children are particularly at risk to the detrimental health effects that have been linked to long term exposure to airborne particles (See e.g. Ruckerl et al., 2011). However, there is currently limited understanding of the health effects in children due to long term exposure to airborne particles. Schools are locations within an urban environment where children experience significant exposure to vehicle emissions, and to date there is limited information assessing children's exposure at school. This study is a part of a large project aimed at gaining a holistic picture of the exposure of children to traffic related pollutants. In the current paper, results from the investigation of the elemental composition of airborne particle at urban schools are presented.

Airborne Particulate Matter (PM) with aerodynamic diameters equal to or less than 1.0 (PM_1) and equal to or less than 2.5 micrometer ($PM_{2.5}$) were collected in 25 schools in Brisbane, Australia. $PM_{2.5}$ and PM_1 samples were both collected for 24 hours (8am to 8am) for one week at each school. Filters were subsequently analysed by Ion Beam Analysis (IBA) for their elemental compositions at ANSTO. Twenty-one elements (Na, Al, Si, P, S, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Br, Sr, Cd and Pb) were analyzed. Gravimetric analysis was performed on preconditioned filters on a 5 point balance.

The gravimetric results revealed that the on average the PM_1 fraction made up 82 ± 18% of the $PM_{2.5}$ fraction by mass at the schools. Therefore the majority of the sampled particles were in the PM_1 fraction. In Figure 1 the average concentrations across all the school are given. Overall, elements with crustal origins such as Al, Si, K, Ca, Ti, Mn and Fe were found predominantly in the $PM_{2.5}$ fraction. Whereas elements that are more associated with anthropogenic emissions, such as Cr, Pb, Ni, V, Cu and Zn were found predominantly in the PM_1 fraction. Comparison to previous work at roadside location in Brisbane (Friend et al., 2011) revealed that Cr, Ni, Br and Pb had statistically significantly higher $PM_{2.5}$ concentrations at the schools than the roadside indicating an influence from school traffic and other anthropogenic sources.

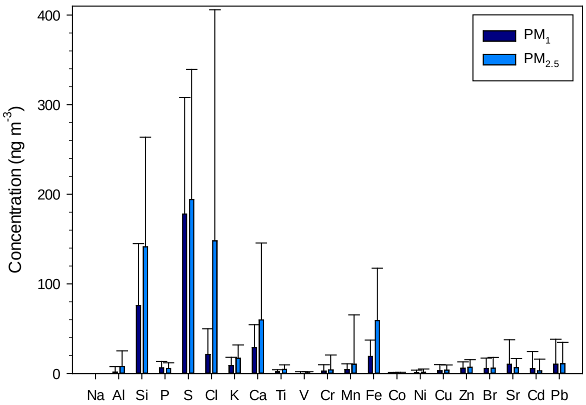

Figure 1: Average concentration of each element across all schools for the both size fractions. Error bars represent 1 standard deviation.

The more toxic heavy metals were found to be in the smaller particle sizes indicating that the PM_1 fraction may have greater detrimental health effects than the $PM_{2.5}$ fraction. Therefore, the results from this study point to PM_1 as a potentially better fraction to use when investigating the health effects of airborne particles. Further work is required to confirm this hypothesis.

Acknowledgements

This work was supported by the Australian Research Council, Department of Transport and Main Roads (DTMR) and Department of Education and Training (DET) through Linkage Grant LP0990134 while the elemental analysis was funded by AINSE grant 11097 . Our particular thanks go to Randall Fletcher (DTMR) and Andy Monk (DET) for their vision regarding the importance of this work. We would also like to thank all members of the UPTECH project, especially Dr Mandana Mazaheri.

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