

aerosol *n.* a colloidal dispersion of solid or liquid particles in a gas (air).

New Fine Particle Characterisation and Source Apportionment

ANSTO has been involved in fine particle characterisation for many years, sampling every Sunday and Wednesday at a number of typical urban sites in the Sydney basin, nationally and internationally. Filters have been analysed for a range of elements including, H, Na, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Br and Pb and elemental carbon using simultaneous accelerator-based IBA techniques of PIXE, PIGE, RBS and PESA see previous Newsletters N°17 to 25 for example or the ANSTO Web Site (<http://www.ansto.gov.au/nugeo/iba/> for more information).

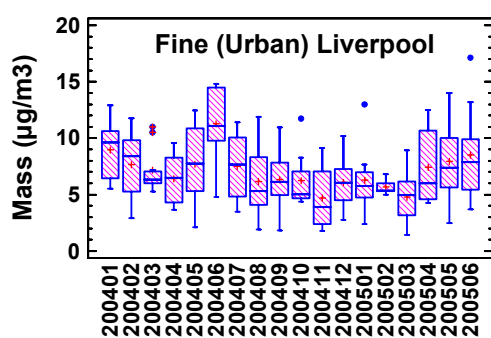


Fig. 1 Average monthly PM_{2.5} mass concentrations at Liverpool, Sydney

PM _{2.5} Species	Liverpool 2004-05 (µg/m ³)
Mass	7.1±3
Sulfate	1.12±0.8
Soil	0.66±0.42
BC	2.1±2
Sea salt	0.90±0.6
Potassium	0.045±0.04
Iron	0.072±0.05
Zinc	0.014±0.02
Lead	0.004±0.004

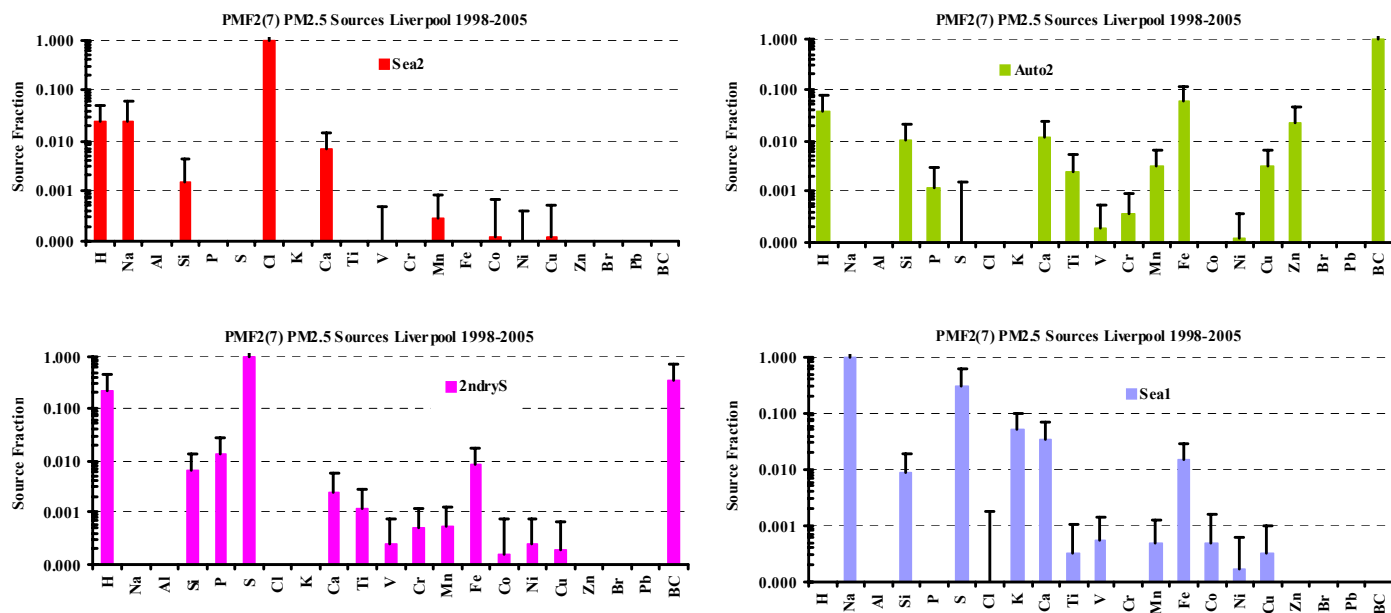
Table 1. Average PM_{2.5} composition for January 2004 to June 2005 at Liverpool.

Fig. 1 shows a box and whisker plot for the average monthly fine particle mass measured at Liverpool site during 2004-2005. **Table 1** is the average PM_{2.5} composition at the Liverpool site. The large standard deviations of the results reflect the large daily and seasonal variations. Black carbon (BC) and sulfate are usually associated with combustion products and generally dominate the fine aerosol. Sulfate is associated with industry, coal burning and lead with petrol combustion by motor vehicles.

Multi-elemental accelerator analyses can now be used to characterise and source fine particle pollution in detail through determination of source fingerprints and apportionment of source contributions to the measured fine particle mass. We now use the novel receptor-modelling statistical technique of positive matrix factorisation (PMF) to achieve this. The advantage of the PMF is that both the source fingerprints as well as their relative contributions on a daily basis can be estimated at the same time from the same extensive data set.

Fig. 2 shows seven such typical source fingerprints obtained for the Liverpool site using these new PMF techniques.

PMF Average Source Fingerprints for the Liverpool Site



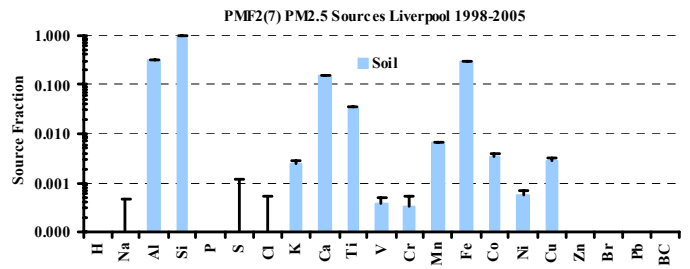
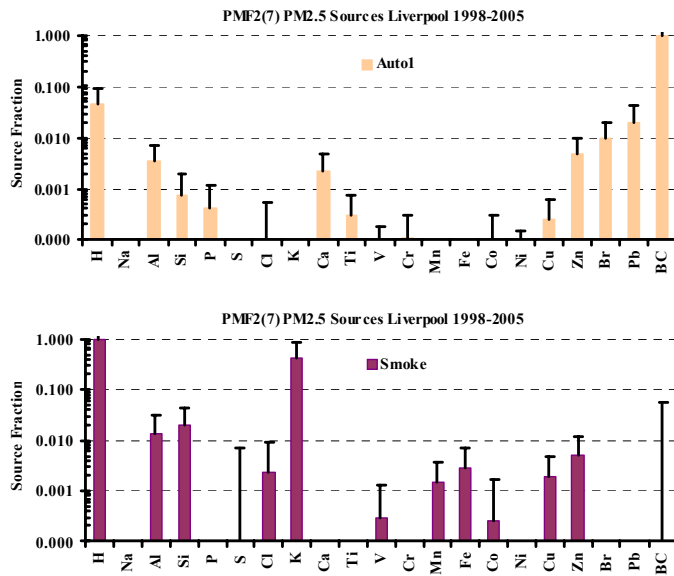
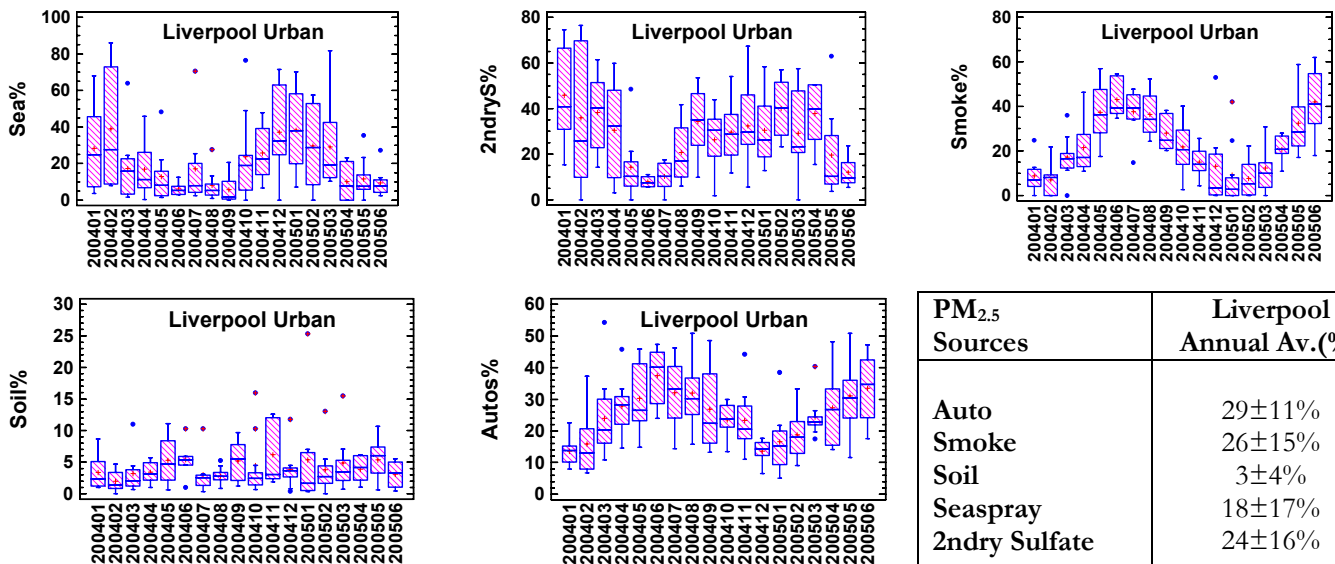


Fig. 2. PMF average source fingerprints obtained using PMF analysis on all Liverpool PM_{2.5} data from 1998-05.

The percentage average monthly contributions for 5 of the major sources for the sampling period from January 2004 to June 2005 are shown in **Fig. 3** below. All sources except Soil have significant seasonal variations, Smoke and Autos are higher in the winter as expected. Smoke can contribute as much as 60 % to PM_{2.5} levels during winter. Secondary sulfate and sea spray are higher in the summer when there is significantly more sunlight and the NE sea breezes predominate in the Sydney region. The annual average source contributions obtained by this PMF analysis for the Liverpool site are given in **Table 2** below.

PM_{2.5} Percentage Source Contributions at Liverpool Site 2004-05



PM _{2.5} Sources	Liverpool Annual Av.(%)
Auto	29±11%
Smoke	26±15%
Soil	3±4%
Seaspray	18±17%
2ndry Sulfate	24±16%

Fig. 3. Average monthly percentage source contributions for January 2004 to June 2005 at the urban site of Liverpool for PM_{2.5} particles using PMF analyses.

Table 2. Annual Average percentage source contributions for PM_{2.5} for the Liverpool site for 2004-05.

This Newsletter demonstrates that given enough high quality fine particle data, covering a sufficient timeframe we now have the ability at ANSTO to provide quantitative PM_{2.5} characterisation and source contribution estimates from the total measured fine mass. If you need more information please contact us through any of the contact addresses below.

Short Term US EPA NAAQS Standards for Airborne Particulate Matter

Index (NAAQS)	TSP (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	Air Quality
0 to 50	0 - 75	0 - 50	0 - 15	Good
51 to 100	76 - 260	51 - 150	16 - 65	Moderate
101 to 200	261 - 375	151 - 350	66 - 150	Unhealthy
201 to 300	376 - 625	351 - 420	151 - 250	V/Unhealthy
> 300	> 626	> 421	> 251	Hazardous

Source : US EPA July 1997 Documents.

Australian NEPM for PM_{2.5}

8 µg/m³ annual and 25 µg/m³ 24-hr average

Further information can be obtained from our WEB site or by contacting David Cohen at the addresses given in the header or ad in this ASP Newsletter.



Want more information on how ANSTO can help you with your Fine Particle air sampling and characterisation?

Contact: **Dr. David Cohen**

+61 2 9717 3042

fax: +61 2 9717 3257

e-mail: dcz@ansto.gov.au

sto.gov.au/ansto/environment1/iba/index.html