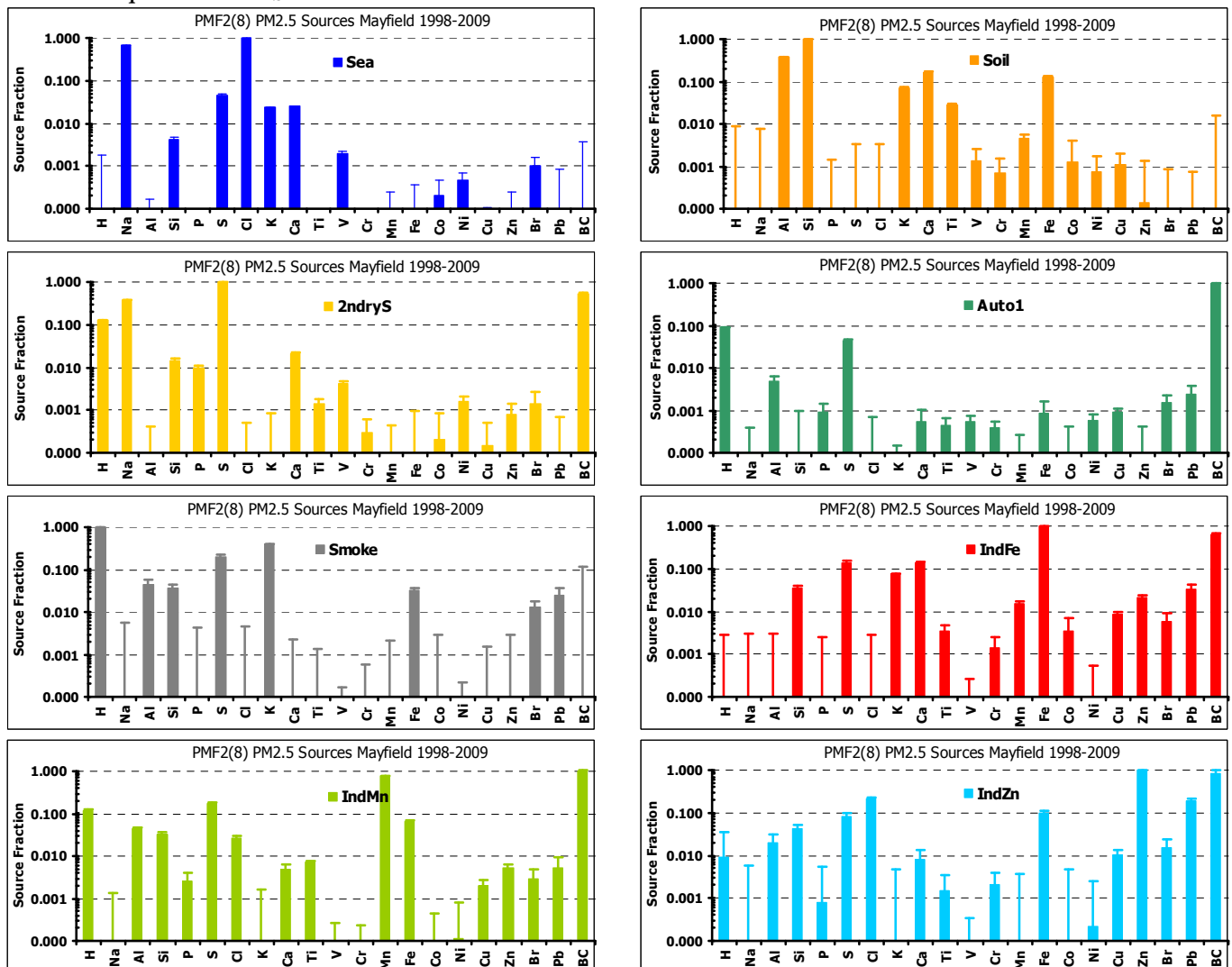


aerosol *n.* a colloidal dispersion of solid or liquid particles in a gas (air).

Long Term Trends in Newcastle (Mayfield) - a 12 Year Study (1998-2009)

ANSTO has been involved in air borne fine particles (PM_{2.5}) research since 1991. During this time fine particles have been routinely collected at selected urban, rural and industrial sites in NSW, Australia and Asia on stretched Teflon filters over a 24-hour period every Wednesday and Sunday. This long term aerosol sampling study is the only one of its kind taking place in Australia, and as a result has established a significantly large and unique data set for each sampling site. The collected samples have been analysed at ANSTO using accelerator based Ion Beam nuclear Analytical methods (IBA) together with microbalance and laser absorption techniques. The unique combination of these techniques providing a powerful method of quantitatively determining the concentration of 21 elements in the aerosols, from hydrogen to lead, as well as determining the gravimetric mass and black carbon. This newsletter highlights the use of these uniquely large data sets generated over the past 12 years (July 1998 – December 2009) in examining the long term chemical composition and source apportionment trends at the Mayfield (Newcastle) site. Mayfield is not only a highly populated urban region, but also a major industrial hub for NSW.

Fig. 1 (below) presents typical source fingerprints obtained for the Mayfield site using the positive matrix factorisation, PMF technique on all PM_{2.5} data obtained from 1998-2009



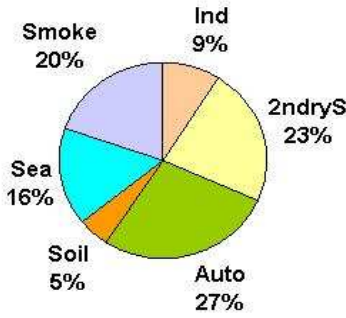


Fig. 2. Percentage source contribution in Mayfield based on all PM_{2.5} data obtained from 1998-2009

Positive matrix factorisation, PMF is a powerful receptor modelling technique used for determining specific source fingerprints through elemental ratios and their contribution to the total measured mass at a site. The names given to the sources fingerprints in Fig. 1 & 2, such as, soil; sea; smoke etc, are assigned based on the major elemental contributors that comprise the elemental mix for each source. Most of the major elemental contributors show significant seasonal (summer & winter) variations as expected. However, changes to these routine variations can also highlight more specific pollution events. For example, both manganese (Mn) and iron (Fe) are dominant elements found within the “industry” source fingerprint. In Mayfield, the observed Mn levels (fig. 3) clearly show a significant deviation from typical seasonal variation; with the measured concentration decreasing dramatically in 2008. This decrease coincides with the closure of a significant industry source of manganese in Mayfield which also occurred in 2008. This known industrial operation previously manufactured and supplied approximately 15% of the worlds manganese dioxide, MnO₂ requirements for applications such as alkaline dry cell batteries.

Similarly, it can also be seen in fig. 3 that the Fe levels measured at the Mayfield site showed a marked decrease at the end of 1999. It is known that industrial operations associated with the production of steel are one of the major source contributors of Fe in Newcastle. Therefore, the dramatic reduction in Fe emission observed at the Mayfield site from 1999 onwards can be correlated with the October 1999 closure of a major industrial steel works plant in Newcastle.

These examples not only demonstrate the aerosol sampling and elemental analysis capabilities at ANSTO, but also the possible correlation between large scale industrial processes and the resulting local air quality (i.e. pollution). As fine particle pollution (PM_{2.5}) has been linked to human health issues, its measurement and monitoring have particular importance in locations such as Mayfield that are both heavily industrialised and densely populated.

ANSTO has established an extensive fine particle database for its sampling site at Mayfield in Newcastle spanning the period of 1998 to 2009.

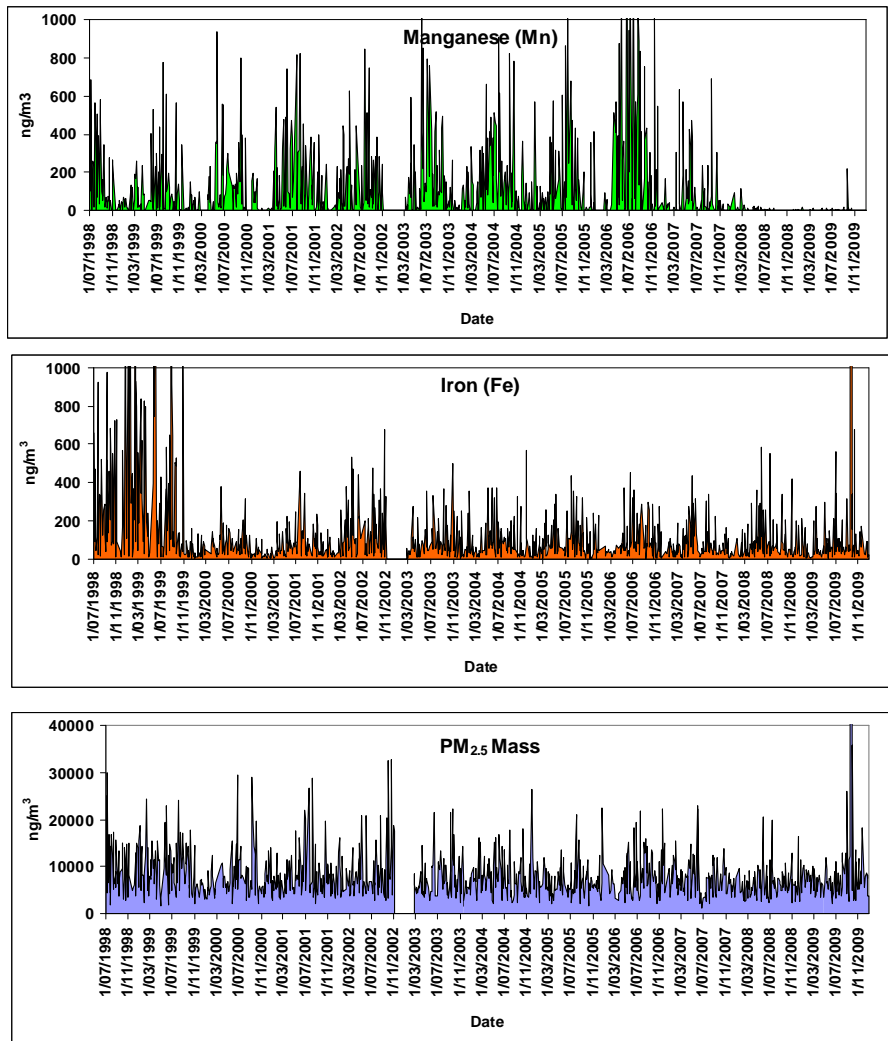


Fig. 3. Concentration (ng/m³) measured at Mayfield from 1998 – 2009 (top) Mn, (middle) Fe, and (bottom) PM_{2.5} mass

We not only have the ability to analyse chemical species from H to Pb using IBA techniques, but can also provide quantitative PM_{2.5} characterisation and source contribution estimates from the total measured fine mass using PMF techniques. This aerosol data is currently being utilised by local councils, research organisations, pollution management agencies and industry bodies to assess air pollution in Australia.

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

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

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