Source apportionment of $PM_{2.5}$ collected in a traffic site and in an urban background site in Athens, Greece: Comparison of the chemical profiles and the contributions

M. Manousakas[1], E. Diapouli[1], T. Maggos[1], D. Saraga[1], K. Bairachtari[1], F. Lucarelli[2], G. Calzolai[2], S. Nava[2], X. Querol[3], F. Amato[3], A. Karanasiou[3] and K. Eleftheriadis[1]

[1]Institute of Nuclear and Radiological Sciences & Technology, Energy & Safety, N.C.S.R. "Demokritos", Athens, 15310, Greece

[2] National Institute of Nuclear Physics, INFN – Florence, Via G. Sansone 1, 50019 Sesto Fiorentino (Florence), Italy

[3]Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, 08034, Spain

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Presenting author email: manosman@ipta.demokritos.gr

In the last years the efforts for implementing effective air pollution mitigation measures has been increased. PM (Particulate Matter) are one of the most important air pollutants with well documented adverse effects on human health. PM concentration levels often exceed the limit values of EU especially in Southern European Countries. The first step in order to formulate effective abatement strategies is the identification and quantification of the contributions of PM sources. That goal is not easily achieved because PM sources and their contribution to PM mass have significant spatial variation. Source apportionment techniques are a very useful tool in PM source characterization. Comparing source apportionment results from sites located close, but with different characteristics can help us to obtain a better perspective on the spatial variation of source contribution. This work compares results on PM2.5 source apportionment using EPA PMF 5.0 for two sites in Athens, Greece, one traffic site and one urban background site.

24-hr $PM_{2.5}$ samples were collected at an urban background site and a traffic site in Athens during 2013-2014. For the elemental analysis PIXE was used as one of the most effective techniques in PM analytical characterization. Altogether, the concentrations of 27 elements (Z=11-82) were determined. Elemental (EC) and organic carbon (OC) concentrations were quantified by means of an OC-EC Aerosol Analyser (Sunset Laboratory, Inc.). The concentrations of water soluble ions were determined by IC (Ion Chromatography), after extraction in 20mL of MilliQ water (with ultrasonic bath for 30 min) of 1/2 or 1/4 of filter.

In total 8 PM2.5 sources were identified in both the traffic and the urban background site. Seven of the sources were common for both sites and were namely heavy oil combustion (HOC), vehicle exhaust traffic emissions (VEX), vehicle non-exhaust traffic emissions (NEX), secondary sulfates and organics (SSO), mineral dust (MIN) and fresh sea salt (FSS). Aged sea salt (SEA) was unique for the urban background site and secondary nitrates (NIT) for the traffic site. All the other chemical source profiles were quite consistent between the two sites. Aged sea salt is not expected to highly affect a high pollution site because it is not emitted directly from a source but it is the product of a direct emission chemically altered in the atmosphere. Such sources can be identified in urban background sites which are affected mainly by aged air masses. On the other hand, even though nitrates are a secondary source, there are chemically unstable and it is more likely to be identified as an independent source in locations where the emissions of their precursors are high.

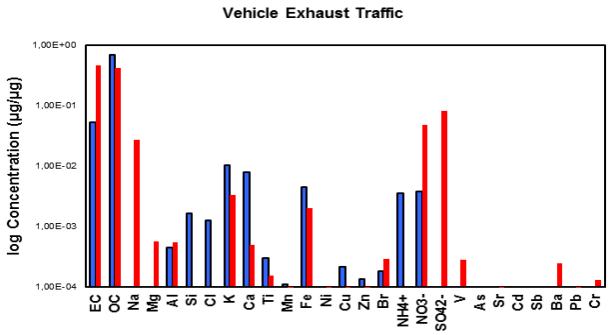

Figure 1. Comparison of chemical profiles of vehicle exhaust traffic emissions obtained for the two sites (blue background site, red traffic site)

The contributions of the sources were higher for the traffic site in every case except for MIN. The contributions of NEX and VEX were almost double on the traffic site in comparison to the urban background site.

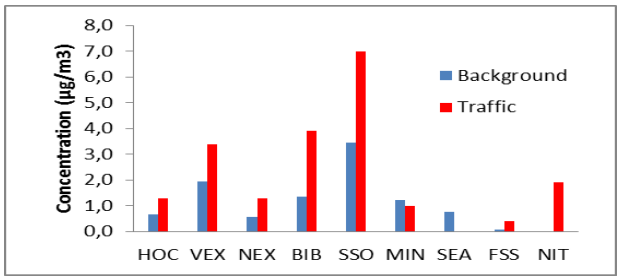

Figure 2. Comparison of source contributions for the two sites (blue background site, red traffic site)

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