

Tracing of aerosol sources in an urban environment using carbonaceous, major ions, Sr isotope, and mineralogical compositional data

ANDREIA PAULA¹, SÓNIA LOPES¹, SARA RIBEIRO², JOSÉ FRANCISCO SANTOS², CARLA PATINHA², EDUARDO ANSELMO², ROSÁRIO SOARES³, REGINA DUARTE^{1,3}, ARMANDO DUARTE¹

¹ Department of Chemistry & CESAM &, University of Aveiro, 3810-193 Aveiro, Portugal, andrea.paula@ua.pt, sonialopes@ua.pt, regina.duarte@ua.pt, aduarte@ua.pt

² Department of Geosciences & GeoBioTec, University of Aveiro, 3810-193 Aveiro, Portugal, sararibeiro@ua.pt, jfsantos@ua.pt, cpatinha@ua.pt, eafsilva@ua.pt

³ Department of Chemistry & CICECO, University of Aveiro, 3810-193 Aveiro, Portugal, rosarios@ua.pt, regina.duarte@ua.pt

Understanding the chemical composition of atmospheric particulate matter (PM), particularly with a diameter less than 2.5 μm ($\text{PM}_{2.5}$), has become an emergent topic in atmospheric research due to its relation to climate change and serious health issues. In this study, a comprehensive assessment of the carbonaceous (organic carbon, water-soluble organic carbon, elemental carbon), major water-soluble inorganic ions (SO_4^{2-} , NO_3^- , NH_4^+ , Cl^- , K^+ , Na^+), $^{86}\text{Sr}/^{87}\text{Sr}$ isotope ratios, and mineralogical composition of $\text{PM}_{2.5}$ samples has been performed for a one-year period in an urban environment at the Western European Coast (Aveiro, Portugal). The concentration of each component was found to be highly dependent on the seasonal events, with the carbonaceous component being the major constituent of the $\text{PM}_{2.5}$ in almost all seasons. The concentration of SO_4^{2-} is higher in samples collected during warm seasons than in those of colder seasons, which is indicative of secondary formation (mediated by sunlight) in the atmosphere [F. Zhang *et al.*, 2014]. On the other hand, the concentration of the more volatile NO_3^- ion is highest for samples collected in colder seasons, which can be explained by the combined effects of lower air temperature and an increase of biomass burning and vehicles emissions during these seasons [F. Zhang *et al.*, 2014]. The equivalent molar ratio of cations to anions was also computed, indicating that the $\text{PM}_{2.5}$ is more acidic during high air temperature periods probably due to the highest accumulation of acidic components (e.g., SO_4^{2-}) during this period [J. Zhang *et al.*, 2014].

For the $^{86}\text{Sr}/^{87}\text{Sr}$ isotope ratios, it was possible to distinguish the labile (acid-leached) from the natural (remaining residue) Sr components (Fig.1). The highest $^{86}\text{Sr}/^{87}\text{Sr}$ ratios were observed for the residues embedded in the collection medium, being this indicative of a natural crustal dust source. The $^{86}\text{Sr}/^{87}\text{Sr}$ isotope ratios verified for the leachates are of the same order of magnitude of the reference value for seawater, thus suggesting that the urban $\text{PM}_{2.5}$ samples have also a predominant marine influence. These findings are also in agreement with the mineralogical composition data, which shows the presence of gypsum with a clear marine origin on almost all samples, besides feldspar with an anthropogenic origin, and aluminosilicates from soil dust.

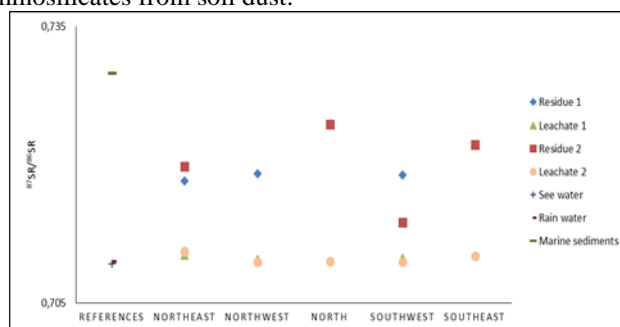


Fig. 1: $^{87}\text{Sr}/^{86}\text{Sr}$ isotope ratios in residues and leachates of $\text{PM}_{2.5}$ samples collected in the city of Aveiro (Portugal) during one-year period and under different air mass trajectories.

Acknowledgements: Centre for Environmental and Marine Studies (UID/AMB/50017/2013) and the Portuguese Science and Technology Foundation (FCT), through the European Social Fund and “Programa Operacional Potencial Humano – POPH”, are acknowledged for financial support. FCT is also acknowledge for a Post-doctoral grant (Regina Duarte, SFRH/BPD/102882/2014). This work was also funded by FEDER under the Operational Program for Competitiveness Factors – COMPETE and by National funds via FCT within the framework of research projects CN-linkAIR (PTDC/AAG-MAA/2584/2012) and ORGANOSOL (PTDC/CTE-ATM/118551/2010).

Zhang, F., Cheng, H., Wang, Z., Lv, X., Zhu, Z., Zhang, G., Wang, X. *Atmos. Environ.* **2014**, 86, 193-202

Zhang, J., Cheng, J., Yang, L., Sui, X., Lan, Y., Zheng, L., Wen, L., Xu, C., Wang, W. *Atmos. Environ.* **2014**, 99, 641-649.