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Size and time-resolved roadside enrichment of atmospheric particulate pollutants

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Size and time-resolved roadside enrichments of atmospheric particulate pollutants in PM10 were detected and quantified in a Mediterranean urban environment (Barcelona, Spain). Simultaneous data from one urban background (UB), one traffic (T) and one heavy traffic (HT) location were analysed, and roadside PM10 enrichments (RE) in a number of elements arising from vehicular emissions were calculated. Tracers of primary traffic emissions (EC, Fe, Ba, Cu, Sb, Cr, Sn) showed the largest REs (>70%). Other traffic tracers (Zr, Cd) showed lower but still consistent REs (25-40%), similar to those obtained for mineral matter resulting from road dust resuspension (Ca, La, Ce, Ti, Ga, Sr, 30-40%). The sum of primary and secondary organic carbon showed a RE of 41%, with contributions of secondary OC (SOC) to total OC ranging from 46% at the HT site, 63% at the T site, and 78% in the UB. Finally, other trace elements (As, Co, Bi) showed unexpected but consistent roadside enrichments (23% up to 69%), suggesting a link to traffic emissions even though the emission process is unclear. Hourly-resolved PM speciation data proved to be a highly resourceful tool to determine the source origin of atmospheric pollutants in urban environments. At the HT site, up to 62% of fine Mn was attributable to industrial plumes, whereas coarse Mn levels were mainly attributed to traffic. Similarly, even though Zn showed on average no roadside enrichment and thus was classified as industrial, the hourly-resolved data proved that at least 15% of coarse Zn may be attributed to road traffic emissions. In addition, our results indicate that secondary nitrate formation occurs within the city-scale, even in the absence of long atmospheric residence times or long-range atmospheric transport processes.

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