MAGNETICALLY QUANTIFYING URBAN DYNAMIC EXPOSURE TO NANOPARTICULATE

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Background

High-levels of urban particulate pollution are known to affect human health. In ultra-urban environments like London, iron oxides typically make up 10-70% of the bulk iron content of particulate matter, and are usually primarily anthropogenic in origin. Much of this iron-bearing particulate matter derived from friction- and combustion-derived urban sources is nanometric, i.e., ≤ 100 nm (Fig. 1). Nanometric iron-oxide particulate is thought to be particularly toxic and has recently been linked to both neurodegenerative diseases including Alzheimer's and Parkinson's disease, and cardiovascular disease (Maher et al., 2016; 2019). In addition to the intrinsic toxicity of iron-rich PM, such nanoparticulate matter is often co-associated with other potentially toxic components, including various metals (Al, Ca, Ce, Co, Cr, Cu, Mn, Ni, Pt, Ti, Sn and Zn) and carcinogenic organic species (Hofman et al., 2016).

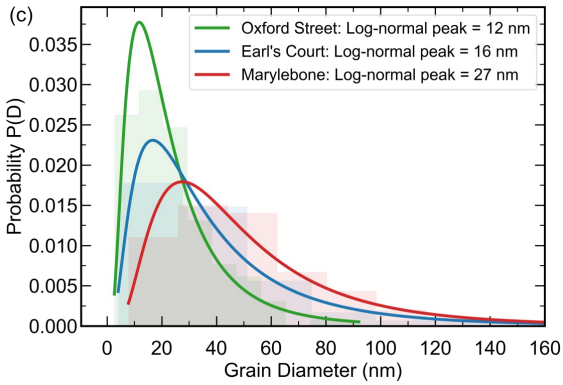

Figure 1. Characterization of grain-size distributions of particulate matter (mostly iron oxides) from various localities in London. From Muxworthy et al. (2022).

Recent studies by us (e.g., Muxworthy et al., 2022) have shown that very fine iron-oxide particulate matter (< 30 nm in size, Fig. 1), is likely more abundant than previously thought. This is important, as toxicity increases with surface to volume ratio. Identifying very fine particles is challenging as electron microscopy analysis, required to directly determine grain-size distributions at this scale, is time consuming. Another way to determine the grain-size is through magnetic measurements. Magnetic measurements allow for the rapid identification and quantification of fine iron-oxide particles, i.e., < 30 nm, in bulk samples, as such grain-sizes display a strong temperature dependency in their magnetic behaviour.

It has been commonly assumed in pollution studies that people's exposure to particulate matter is based on pollution levels at their home residence address, however, efforts are now being made to quantify peoples' dynamicexposure to pollution, i.e., including how exposure may vary throughout a persons day. For example, levels of pollution are far higher on the London's Underground than in London's suburban areas; does a daily one-hour Underground ride affect human health greater than living on moderately busy suburban street?

Our knowledge of the various types of particulate matter that people are exposed to during their daily lives is poor; most studies simply involve particulate matter collected kerbside. What is the make up of all the particulate matter people are exposed to daily? The aim of this PhD project is to quantify this through a combination of various analytical methods: magnetic, electron microscopy, spectroscopy and geochemical.

This is laboratory project and would suit a candidate with an interest environmental science. Candidates should have a good degree in any area of science. Good laboratory skills also desirable, as are the ability to communicate.

References

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