Unearthing Histories of Atmospheric Pollution in Industrial Landscapes using Urban Sediment Archives

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The release of atmospheric pollution throughout the Anthropocene is a major challenge driving climate change and damaging human health. A complexity of pollutants have been released to air since the Industrial Revolution (e.g., UK post-1800), with unprecedented industrialisation and urbanisation experienced during the 20th and early 21st century. Present day pollution levels and legacies of contamination inevitably vary from place to place, dependent on industrial activities, fuel consumption trends and urban infrastructure. Of global concern to human health is the release of fine particulate matter (PM): PM10 and PM2.5, especially in densely populated cities, from industry, power generation and road and air travel due to their short and long-term health implications. Current air quality monitoring programmes within urban environments are however, spatially and temporally limited.

We show how suitable urban sediment archives located within industrial landscapes can provide long-term, site-specific histories of PM deposition, extending our knowledge of PM10 and PM2.5 beyond conventional monitoring (pre-1990). Down-core variations in geomagnetism, geochemistry and spheroidal carbonaceous particles (SCPs), unambiguous stratigraphic markers of PM from fossil fuel combustion, were complimented by radiometric chronologies to reconstruct high-resolution temporal pollution records from urban ponds.

Set within heavily industrialised landscapes including NW England, UK, and the Chinese megacity of Chongqing, these urban air pollution histories reveal the changing characteristics of atmospheric PM pollution since the 20th century. Unique to their locality, these records correspond to key phases in local urban and industrial developments and increased road and air travel. The novel application of high-throughput imaging flow cytometry to urban sediments, accurately resolves the quantification and morphological characteristics of SCPs, indicative of their source and toxicity.

These records provide a detailed understanding of the long-term release of harmful particulates within different urban landscapes, allowing us to assess air quality impacts of urbanisation and industrialisation, as well as the efficacy of pollution controls. This work is critical to determine life-time exposures to environmental toxins over generational timescales in densely populated urban regions.