

CHARACTERISING NANOPARTICLES IN SUB-OXIC ENVIRONMENTS

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Characterising nanoparticles in sub-oxic environments is important for understanding pollution transport and attenuation within a range of situations, e.g. in waste water treatment plants, hyporheic zones and within groundwater. It has been shown that multi-method approaches are essential in an environmental context for adequate characterisation [1]. In the last decade there has been a focus on the use of manufactured nanoparticles for contaminant attenuation and remediation of groundwater e.g. Elliot and Zhang [2], Reinsch et al. [3]. Obtaining a representative sample and maintaining the environmental redox status throughout the field and laboratory work is a real challenge when working in these environments. To date, very few studies have successfully sampled and characterised nanoparticles in sub-oxic environments, e.g. anaerobic groundwaters, using a range of state-of-the-art techniques.

The focus of our research was to develop a robust methodology to sample and characterise nanoparticles in sub-oxic environments using a range of techniques. To test and develop this method a shallow sub-oxic alluvial groundwater system within the floodplain of the River Thames, locally impacted by a landfill plume, was selected as the field site. Iron-rich and organic nanoparticles were sampled and characterised in sub-oxic four groundwater samples, under oxygen-free conditions, by atomic force microscopy (AFM), transmission electron microscopy (TEM), scanning electron microscopy with energy-dispersive X-ray diffraction (SEM-EDX) and field-flow fractionation (FFF) with UV absorbance detection. Figure 1 shows an example of AFM images and particle size ranges obtained from groundwater before and after aeration. Dramatic changes in nanoparticle sizes and morphology were observed following mild aeration under controlled laboratory conditions.

This study has shown that detailed characterisation of environmental nanoparticles in sub-oxic environmental waters is possible using a range of complimentary techniques. This has important implications for field and laboratory based studies focused on understanding the fate, transport and toxicity of trace elements and engineered nanoscale materials such as zerovalent iron and silver oxide in the environment.

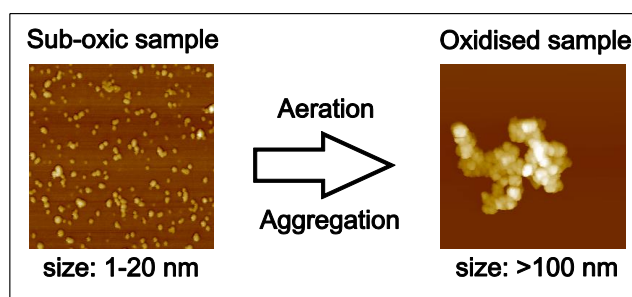


Figure 1. AFM images (2x2 μm) for sub-oxic and aerated groundwater

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