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Developing novel optical chemical measurements of particulate iron

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Iron (Fe) is an essential micronutrient and its availability relative to other nutrients impacts phytoplankton growth in the ocean. Hence, extensive research has been devoted to better understanding Fe cycling and accurately determining the most bioavailable dissolved phase (dFe, <0.2 µm). A gap in our knowledge exists with regards to how particulate Fe (pFe, >0.2 µm) contributes to the 'Fe pool', despite results indicating this pool is significant and can often exceed dFe concentrations. Fe is readily cycled between dissolved and particulate phases and although marine particles are often chemically characterised as lithogenic, authigenic or biogenic in origin, little is known of the oceanic pFe composition and distribution relative to dFe. A lack of marine pFe data is largely due to the lengthy processing time and intensive analytical demands required of discrete samples. Optical sensors on autonomous marine monitoring systems potentially offer a tractable alternative proxy method for pFe determination.

In this presentation we present the feasibility of using optical technologies to infer pFe concentrations using a bottom-up and top-down approach. Firstly, a physico-chemical characterisation of 10 sediments was conducted, samples were collected from contrasting natural environments including: shelf seas, coastal, estuarine and riverine waters. A suite of analytical techniques (FT-IR, Coulter Counter PSA, SEM microscopy, UV-Vis-NIR spectrophotometry and fluorimetry) was used to provide complimentary data to the trace metal concentrations obtained by single- and triple- quadrupole ICP-MS. Secondly, relationships between concurrent optical *in-situ* measurements and trace metal concentrations were explored in archival oceanographic datasets.

Preliminary analyses indicate environment-specific relationships between optical signatures and particulate trace metal concentrations. Notably, strong linear correlations between pFe and sensor-derived beam attenuation measurements were identified across multiple shelf sea environments at depth-specific locations within the water column. This research suggests a new type of pFe observation to enhance spatio-temporal estimates and improve our understanding of the role of pFe and other trace metals in marine biogeochemical cycles.