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Evaluating the factors controlling the dissolution of aerosol iron in seawater

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The nanonutrient Fe is known to play an important role in phytoplankton metabolism. It can limit primary production and also influence phytoplankton community structures in certain regions of the world's oceans and indirectly influences C and S cycles and climate change. The main source of iron to the euphotic zone of the oceans is from the atmosphere, by wet and dry deposition. The solubility, and hence bioavailability of iron in the oceans is constrained and will vary both on spatial and temporal scales.

This current work therefore investigates the influence of a complex array of physical and chemical processes on the extent and kinetic of the aerosol seawater solubility of Fe at realistic seawater dust concentrations.

The study is based on two contrasting end-members: urban and crustal: CRM NIST 1648 and Saharan dust from Erdemli, Turkey. Dusts have been introduced into low DOC (dissolved organic carbon) low Fe seawater, UV irradiated and at a low stirring rate.

Several factors potentially influencing the dissolution process were investigated at two temperatures, 5oC and 25°C, representing high and equatorial latitudes, these include (i) chemical influences i.e. end-member aerosols having contrasting solid state speciation; with/without additions of siderophores (e.g. Desferrioxamine B - DFOB) (ii) physical influences i.e. dark and light conditions (the controlled commercially available light source was a Xenon lamp, with a similar spectrum to that of natural daylight).

The aims of the study were achieved by interfacing a trace metal aerosol dissolved/particulate incubation system with a sensitive flow injection chemiluminescence (FI-CL) detection system.

The knowledge gained will enhance our understanding of the environmental factors impacting on Fe aerosol seawater dissolution, which will assist in the development of more refined models of atmospheric dry deposition fluxes of soluble Fe to open ocean systems.