

Factors that Influence the Rate and Extent of the Seawater Solubility of Aerosol Associated Trace Metals (Cu, Pb And Zn); Impact on their Seawater Speciation

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Recent recognition of the importance of micronutrient trace metals inputs in oceanic biogeochemical cycling, and of the importance of atmospheric trace metal inputs to marine waters, highlights the need to assess potentially bioavailable trace metal inputs from atmospheric sources. No study has extensively investigated the factors that influence the seawater solubility of aerosol associated trace metals (particle concentrations, temperature, seawater dissolved organic ligands, light intensity and aerosol type). Therefore a novel experimental system has been developed to determine fast resolution kinetics of the dissolution of trace metals (Cu, Pb and Zn) from aerosol material in seawater. These experiments were continued upto a 2h period, at environmentally realistic concentrations (50 and 300 mg · l⁻¹), under controlled experimental conditions. Labile and total dissolved Cu were determined by adsorptive cathodic stripping voltammetry (square wave, 200Hz scanning frequency), with a flow cell every 30s. The speciation of Pb and Zn were simultaneously measured every 70s by anodic stripping voltammetry during the experimental run.

Samples were filtered on-line through a 0.45_μm cellulose acetate membrane filter from a 1L Teflon vessel, at a flow rate of 1 ml · min⁻¹. Prior to the determination of total dissolved trace metals, the sample was acidified and UV irradiated on-line, through a silica coil. No more than 20% of the original sample volume was taken by the end of the experiment.

Adsorption and contamination in the experimental system has been carefully assessed. The total Zn, Pb and Cu concentrations from spiked filtered seawater were the same before and after equilibration in Teflon vessels (n=3) for 24 h. Contamination from the filtration unit and tubing was assessed in MilliQ by the flow cell method before each experimental run, after cleaning the system with 0.5% HCl. The accuracy of the technique was validated with certified reference material.

End member aerosols used in the experiments (urban and Saharan) were physically and chemically characterised (total trace metal concentration, particle size distribution, morphology and surface area). Known particle concentrations (50 and 300 mg · l⁻¹) were added to UV and non UV irradiated seawater. Constant seawater temperature was maintained either at 10 or 25°C. The reaction vessel was either kept in dark conditions or subjected to simulated sunlight.

The fast resolution kinetic studies provide data on the rate constants under different experimental conditions, hence the mechanisms of the dissolution of trace metals from end member aerosols in seawater. A conceptual model will be presented to aid the understanding of the effects of different factors on the extent and rate of the dissolution of trace metals from aerosol material in seawater. In future work, this model will be verified and modified using 'real' environmental samples collected from Eastern Mediterranean and UK coastal sites. Also there will be an investigation of the influence of factors on the extent and rate of the dissolution of different Fe species, associated with end member aerosols in seawater.