Trace elements in aerosols, rain, and the sea-surface microlayer of the South Pacific Ocean under low wind conditions

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The sea-surface microlayer (SML) is the largest phase boundary on Earth, and is characterised by sharp gradients in its physical, chemical, and biological composition relative to the underlying water. The SML is the interfacial boundary layer between the atmosphere and the ocean, through which all matter and gases must exchange. Consequently, processes occurring in this boundary layer have the potential to influence biogeochemical cycles on a global scale.

Aerosol, rain, SML, and underlying bulk water (~ 0.3 m depth) samples were collected twice daily for determination of bioactive trace elements during the mulitdisciplinary #airtosea cruise from Darwin, Australia to Guam in Oct/Nov 2016. Here, we present data from three stations from different hydrographic regimes and/or under different environmental conditions. All SML samples were collected using a tube of pure silica quartz in low wind speeds (< 5 m s^{-1}).

Using the example of dissolved zinc (Zn), the highest concentrations were observed at Station 5 (SML = 9.7±0.06 nM, bulk = 0.17±0.02 nM; biomass burning aerosols, high UV, *Trichodesmium* bloom), and the lowest at Station 17 (SML = 1.2±0.02 nM, bulk = 0.10±0.007 nM; low aerosol regime, high UV). All SML samples were enriched compared to the underlying bulk water. Enrichment factors ranged from 6.1±0.3 at Station 17, to 63±8.1 at Station 5, to 315±104 at Station 11 (low aerosol regime, during rain). This data suggests that atmospheric deposition is an important source of dissolved Zn to the SML, but that wet deposition has a greater impact than dry deposition, at least in terms of enrichment. Despite higher concentrations and enrichment factors in the SML, all underlying bulk water samples had uniformly low dissolved Zn concentrations (0.1-0.26 nM) compared to the SML (1.2-9.7 nM). Explanations for this apparent decoupling between trace elements in the SML and underlying water will be examined in the context of ecological stoichiometry.