

What controls iron and phosphorus solubility in wet deposition?

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• Introduction and motivation

Iron and phosphorus are important nutrients for the marine ecosystems. A major source of iron and phosphorus in the open ocean is from atmospheric depositions. In order to evaluate the impact of atmospheric depositions of iron and phosphorus to the ocean ecosystems and thus the climate, global models need to be able to estimate the flux of bioavailable iron and phosphorus from the atmosphere to the ocean. Therefore, it is essential to know what controls the solubility of these elements, which are poorly understood.

• Scientific objectives

The aim of this work is to understand the factors controlling amount of the soluble (<3kDa; ~2nm) and dissolved (<200nm) Fe and/or P in rainwater deposited to the oceans. The specific objectives are:

- (1) To understand the fundamental parameters and processes controlling the concentration and partition of labile, soluble and dissolved Fe and P in dust from rainwater; the parameters to be examined include pH, mass of dust per litre of rainwater; concentrations of ionic species such as sulfate, nitrate, ammonium, Ca²⁺, K⁺ and water soluble organic carbon;
- (2) To clarify how Fe interact with P and trace metals in rainwater and affect their solubilities; and
- (3) To quantify the soluble, dissolved and total Fe and P deposition fluxes in Crete

• Reason for choosing station

Crete island is in the middle of eastern Mediterranean which is a phosphorus limited ocean. It is an ideal location to study iron and phosphorus from atmospheric deposition because it receives both Saharan dust from Africa and pollution from Europe. Therefore, it provides the unique opportunity to sample Saharan dust, anthropogenic particles, as well as their mixtures. This is essential to better understand the factors controlling iron and phosphorus solubility in atmospheric depositions.

• Method and experimental set-up

A commercial dry and wet deposition sampler will be used collect both dry and wet deposition samples over a year (Jan 2013 to Jan 2014). The dry deposition samples will be collected every two weeks. The wet deposition samples will be collected on event basis. The samples will be size separated to <3kDa and <200nm using vivaspin 20 or 6. The vivaspin filtration units and all tubes and sample bottles are thoroughly washed using trace metal clean methods. A separate fraction of the sample will be filtered and the particulate on the filter digested with concentrated acids. All the solution samples will be analyzed with ICP-MS. A separate rainwater sample will also be collected for IC analysis of anions, cations, P and selected water soluble organic carbon.

The soluble and dissolved Fe concentrations in the rainwater will be compared with pH dependent ferrihydrite solubility. The fractional solubility (dissolved to total; and soluble to total) of Fe and P will also be calculated and compared with each other. The data on trace elements and the solubility data will also be compared with dry and wet deposition ionic composition and water soluble organic carbon composition.

Eventually, we will calculate the deposition fluxes of different species of Fe, P, and trace metals in the dry and wet depositions.

• Preliminary results and conclusions

The dry/wet deposition sampler has been shipped from China to Crete. The sampler has been successfully modified (for trace metal analysis) and set up for sampling in the field. No scientific data are obtained yet. The actual analysis and sampling will take place latter in Jan 2013.

- **Outcome and future studies**

The sampler has been modified according to trace metal clean method. Blank samples have been taken and will be analyzed with ICP-MS. See also Method and Experimental set-up.

- **References**

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