Effect of dissolved organic carbon on the iron solubility in seawater

N. MESKHIDZE[1*], D. HURLEY[1,2], T. ROYALTY[1] AND M. S. JOHNSON[3]

[1] North Carolina State University, Raleigh, NC, USA (*correspondence: nmeskhidze@ncsu.edu)
[2] University of British Columbia, Vancouver, BC, CA
[3] NASA Ames Research Center, Moffett Field, California 94035, USA

Atmospheric aerosols are an important source of soluble iron (sol-Fe) to the global oceans. After deposition to seawater, sol-Fe will either complex with marine organic ligands and enter the ocean dissolved Fe (DFe) pool, or form oxyhydroxide particles (PFe) and precipitate out. The importance of atmospheric sol-Fe is determined by the fluxes of sol-Fe and the fraction of sol-Fe that is converted to DFe in the ocean. Currently atmosphere and ocean biogeochemistry models do not consider the processes that govern the physicochemical speciation of sol-Fe at the ocean-atmosphere interface.

This study examines some previously unrecognized processes and elucidates the mechanisms that may affect aerosol sol-Fe on the timescale of minutes to days after deposition to the surface ocean. Laboratory studies show that in 20 min from the time of mixing with seawater, nearly all sol-Fe gets oxidized and converted to PFe. The addition of dicarboxylic acids had minor influence on the conversion rate of sol-Fe to PFe. While the addition of hydroxy-carboxylic acids greately increased the fraction of sol-Fe converted to seawater DFe. Surface ocean numerical simulations for sol-Fe laden dust deposition events show that if hydroxy acids were present in aerosol solution upon deposition to the ocean, over 95% of sol-Fe can bind with marine organic ligands (see Fig. 1A); this fraction reduces to ~15% in the absence of atmospheric organics (see Fig. 1B). A possible mechanism is provided to explain the differences in binding strength between aerosol sol-Fe and atmospheric dissolved organic carbon species commonly found in maritime aerosols.

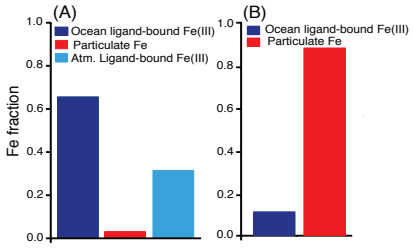

Figure 1: Five-day cumulative fraction for different forms of Fe(III) in the ocean A) in the presence and B) in the absence of atmospheric organic ligands mixed with the aerosol solution.