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Are iron nanoparticles a potential source of bioavailable Fe to marine algae?

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Atmospheric Fe deposition has been suggested to affect biological productivity, not only in the Fe limited High Nutrient Low Chlorophyll (HNLC) regions, but also in the Tropical oligotrophic gyres. Therefore, it has direct and indirect impact on the climate. Atmospheric deposition provides soluble Fe as well as Fe nanoparticles. Our previous study confirmed the presence of Fe nanoparticles in rainwater, while another study by Aguilar-Islas et al. (2010) showed that Fe nanoparticles are the dominant fraction of aerosol derived dissolved Fe. It was generally accepted that soluble Fe is bioavailable. The question is: are Fe nanoparticles potential sources of bioavailable Fe to marine phytoplankton as well?

In this study, we synthesized Fe nanoparticles in the laboratory. The Fe nanoparticles were coated with citrate to avoid particle aggregation. The freshly prepared Fe nanoparticles were cultured with Fe depleted Thalassiosira pseudonana diatom cells at a concentration of 10nM to 1000nM Fe. We also cultured the diatom cells with soluble Fe at the same Fe concentration. We found that chlorophyll a content in the Thalassiosira pseudonana diatom cells increase by over 50% and 150% after 4 days of culture with 100 nM and 1000 nM Fe nanoparticles. Surprisingly, soluble Fe at the same concentration had a similar impact on the chlorophyll a content in the Thalassiosira pseudonana diatom cells. This may be due to the fact that soluble Fe precipitated as nanoparticles at a high pH of the culture media (similar to real sea water pH). Similar process may take place during atmospheric deposition of soluble Fe. Our results suggest that both soluble and nanoparticles Fe in atmospheric depositions are potential source of bioavailable Fe to the marine phytoplankton. Further investigations on the bioavailability of soluble and nanoparticle Fe in the rainwater are underway.