Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20175

# Acquisition of Fe and P from Natural and Anthropogenic Aerosols by Marine Phytoplankton

**PROF. YEALA SHAKED, PHD**[1], YITZHAK JACOBSON[2], DIRK DE BEER[3], SIYUAN WANG[1], FUTING ZHANG[1], ANNA-NEVA VISSER[1], MERI EICHNER[4], DR. NAVOT MORAG[5], ALON ANGERT[6] AND SUBHAJIT BASU[7]

[1]Interuniversity Institute for Marine Sciences
[2]Israel Limnological and Oceanographic Research
[3]Max-Planck-Institute for Marine Microbiology
[4]Institute of Microbiology of the Czech Academy of Sciences
[5]Geological Survey of Israel
[6]The Hebrew University of Jerusalem
[7]University of Petroleum and Energy Studies

Presenting Author: yeala.shaked@mail.huji.ac.il

Iron (Fe) and Phosphorous (P), essential nutrients for marine phytoplankton, are supplied to the ocean surface through atmospheric deposition of natural and anthropogenic aerosols. However, the utilization of these nutrients is often restricted by the low aerosol solubility in seawater. Colonies of the globally important marine cyanobacterium *Trichodesmium* were found to collect dust and mine it for Fe through ligand and reductive dissolution. Because P is often associated with Fe minerals in aerosols, we hypothesize that these pathways may also enhance the bioavailability of P. The talk will cover geochemical and physiological studies investigating the coupling between P and Fe dissolution and acquisition from aerosols in marine systems.

We developed a sensitive assay to determine P uptake from particles, utilizing $^{33}$P-labeled Ferrihydrite. To validate the method, we examined single natural *Trichodesmium thiebautii* colonies in a high-resolution radiotracer ß-imager, identifying strong colony-mineral interactions, efficient removal of external mineral-phase $^{33}$P, and elevated $^{33}$P uptake in the colony core. Next, we determined bulk phosphate uptake rates from $^{33}$P labelled Ferrihydrite, which were comparable between natural Red Sea colonies and P-limited cultures of *Trichodesmium erythraeum*. Uptake rates were similar to P release rate from the mineral, suggesting tight coupling between dissolution and uptake. Synthesizing P-Ferrihydrite labeled with either $^{33}$P or $^{55}$Fe we tested if ligands and reducing agents, which are commonly used for microbial mineral solubilization of Fe, can also effect P release and uptake. Addition of a strong Fe-chelator and superoxide to cell-free minerals enhanced Ferrihydrite dissolution and subsequently accelerated $^{33}$P and $^{55}$Fe release. Repeating these experiments with *Trichodesmium,* we documented elevated $^{33}$P and $^{55}$Fe release and uptake, indicative of Fe/P co-extraction from particles. We also examined whether Fe-chelators and reductants lead to co-release Fe and P from natural (desert dust) and anthropogenic (coal-fly ash) aerosols. In these multi-mineral systems results were more complex, but some co-release was observed for ash. Further research, benefiting from our tools, is required to explore the prevalence of Fe and P co-release from aerosols and particles in aquatic environments.