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Through the Princeton Environmental Institute Outreach program I participated in The Center for Environmental Bioinorganic Chemistry undergraduate summer fellowship 2004 at the Department of geosciences, Princeton University. I worked in Prof. François M. M. Morel lab, under the supervision of Dr. Adam B. Kustka studying Trace Metal Reduction by Phytoplankton: (Non enzymatic versus Enzymatic processes in cell surface Copper reduction).

Phytoplankton are found near the surface of Marine and Fresh water. The Greek phrase phytoplanktons means wandering plants, so they are known as the microscopic plants that drift in the ocean. Known as wandering plants, and are the base of all aquatic food chain. We looked at the Diatoms (Bacillariophyceae), they are a significant group of eukaryotic marine phytoplankton, they are important for the biogeochemical cycling of minerals (Silica) and for global carbon fixation. They contribute as much as 20 – 25 % of the earth’s global primary productivity. A unique feature of the group is their frustules (silicified cell wall). So they require silica to grow and make their frustules. From previous studies the phytoplankton cell surface reduces external copper (II) and Iron (III) (Jones et al., 1987). In the previous study with copper reduction in the Diatom Thalassiosira wiesflogiiit was observed that here is non-enzymatic reduction (which is non renewable during the time course of the experiment) and enzymatic reduction. The non-enzymatic reduction is only observed in the diatoms and other species of Phytoplanktons that are not diatoms do not. We used a specie of diatom Phaeodactylum tricornutum (P.t) that can grow with or without Silica, further more the cells are believed to produce Super oxide which might play a part in the Non enzymatic reduction. Copper was used in this study, because we believe that the cell reductase enzyme that reduce Copper also reduce Iron (Fe). So we can relate the Cu reduction to that of Fe.

Hypothesis
The Frustules play a role in the non-enzymatic reduction
Fe (iron) limited Phaeodactylum tricornutum has a higher copper “enzymatic” rates of reduction.
Super oxide reduces Fe (III)/Cu (II) reduction directly via enzymatic activity.

Methods
We grew P.t (phaeodactylum tricornutum) with and without Silica (Si) in the culture media, because without Si in the media they can’t make frustules (this represents other species of phytoplankton). We also used variable Fe concentrations (High and low Fe Concentrations, 450nM, 20 nM) to Fe limit the cells. By using the Spectrophotometer (Cary WIN UV VIS 100) we measured reduction, both non-enzymatic and enzymatic, using different concentrations of copper. The cells were used in the experiments during the exponential phase of growth. We later tested with SOD (super oxide dismutase), which gets rid of Super oxide, we used one cell condition +/- SOD with rigorous celloaired comparison (same cult cond, same actual bottle of SOD)
Results

Preliminary results show that the Fe limited cells have a higher enzymatic rate of copper reduction, and with the silica less cells there is little or no non-enzymatic reduction observed, while the cells with Silica have. The test with SOD showed a surprising result that the non-enzymatic capacity is super oxide dependent.

Discussion

The non-enzymatic capacity is super oxide dependent, not the enzymatic rate, and also the intermediate is slowly by super oxide, but at 5uM Cu it can’t recharge fast enough.

The knowledge received during the time of this study is unparallel. Learning data analysis, computer skills, experimental design, various lab techniques and most of all working under one of the worlds best scientist and studying in one of the best schools in the world all at once, is a dream that most people might achieve in a life time but CEBIC and PEI have made this possible for me this summer. I can basically use the computer more proficiently; I have learnt so much that will take me so far in life over a short period of time. Further more working in a lab with Post doc. and postgraduate students is as inspiring as it can get.

This opportunity given has enabled me to think critically, and has also broadened my perspective both in life and in the science field, in general the knowledge I have gained “cannot” be taught in a classroom. It is an opportunity of a lifetime. I would further my studies at a four-year college studying Chemistry, and later on apply to a medical school in the U.S.