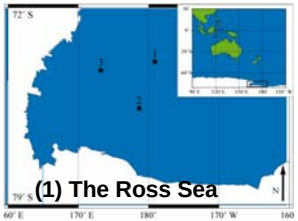
Erin M. Bertrand
WHOI/MIT Joint Program, Woods Hole, MA

2006 EPA Graduate Fellowship Conference *From Discovery to Solutions: Generation Y Scientist Lead The Way*

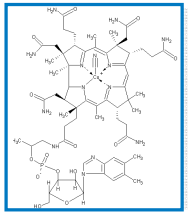
Vitamin B_{12} and iron co-limitation of phytoplankton growth in the Ross Sea

Erin M. Bertrand[†], Mak A. Saito[†], Julie M. Rose*, Christina R. Riesselman[#], Maeve C. Lohan[Θ], Abigail E. Noble [†], Giacomo R. DiTullio[&]

[†] Marine Chemistry and Geochemistry Department, Woods Hole Oceanographic Institution, Woods Hole Massachusetts 02543, USA *Department of Biological Sciences, University of Southern California, Los Angeles, California 90089, USA
[#]Department of Geological and Environmental Sciences, Stanford University, Stanford, California 94305, USA [Θ]School of Earth, Ocean and Environmental Sciences, University of Plymouth, Drake Circus, Plymouth, PL4 8AA United Kingdom
[&]Grice Marine Laboratory, College of Charleston, Charleston, South Carolina 29412, USA



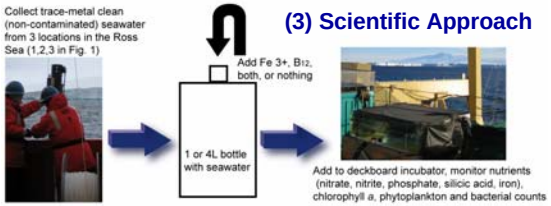
(1) The Ross Sea
A highly productive and seasonally iron-limited area of the Southern Ocean



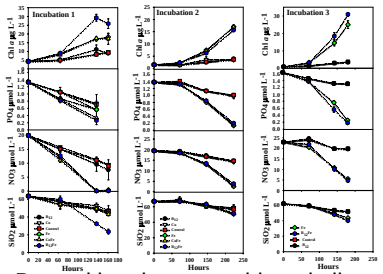
(2) Vitamin B_{12}-
a cobalt-containing micronutrient synthesized by select prokaryotes only– required by some phytoplankton; present in ocean at very low levels

Abstract This work investigates how vitamin B_{12} affects phytoplankton population dynamics in the ocean. Here we report the co-limitation of phytoplankton growth in the **Ross Sea of the Southern Ocean (1)** by iron and **vitamin B_{12} (2)** in the austral summer. In two of **three bottle incubation experiments (3)** from this region, significantly **higher chlorophyll *a* concentrations (4)** were measured upon the addition of iron and B_{12}, relative to iron additions alone. Initial **bacterial abundances (5)** were significantly lower in the two experiments that showed phytoplankton stimulation upon addition of B_{12} and iron relative to the experiment that did not show this stimulation. This supports the hypothesis that prokaryotic microbes of the upper water column ecosystem (heterotrophic bacteria in the Ross Sea), are an important **source of B_{12} to marine phytoplankton (6)**. The addition of iron alone increased the growth of *Phaeocystis antarctica* relative to diatoms. Where iron and B_{12} stimulated total phytoplankton growth, the diatom *Pseudonitzschia subcurvata* increased in relative abundance. These results demonstrate the importance of a vitamin to phytoplankton growth and **community composition (7)** in the marine environment, and have implications for our understanding of the global biogeochemical cycles of carbon and cobalt.

(3) Scientific Approach

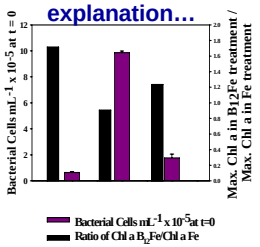


(4) Chlorophyll a and nutrient concentrations



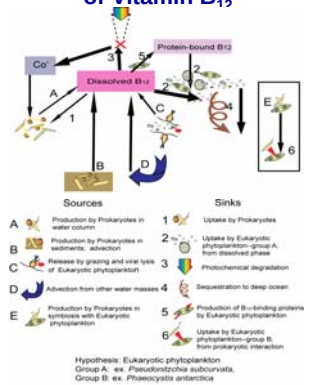
B_{12} and iron increase chlorophyll *a* production, ie. phytoplankton growth

(5) A bacterial explanation…

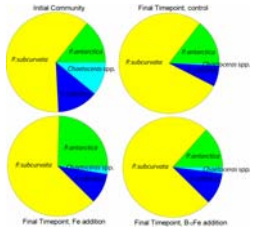


More bacteria, less B_{12} stimulation—importance of bacteria in C-fixation

(6) Hypothesized cycling and sources of Vitamin B_{12}



(7) Changes in Phytoplankton Community Composition



Microscopically-determined community composition in incubation 3's various treatments

Research Highlights

Primary Finding: The Ross Sea, one of the most productive areas of the ocean, is secondarily limited by vitamin B_{12}.

- Implicates the vitamin and its bacterial producers in marine carbon fixation and thus a major portion of the carbon cycle
- Variability in B_{12} uptake may drive phytoplankton community changes in the Ross Sea thereby affecting rates of carbon fixation and sequestration

This fellow is sponsored by EPA's STAR or Greater Research Opportunities (GRO) Program.