

## **Geochemical Rate/RNA Integration Study (GRIST): A Pilot Field Experiment for Inter-Calibration of Biogeochemical Flux and Nucleic Acid Measurements**

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### **Abstract**

The BI-OMP program promotes a more thorough understanding of the links and feedback mechanisms between solar irradiance, primary productivity, marine microbial activity, carbon and nitrogen cycles, and remotely-sensed ocean color data. Our recent awareness of carbon/nitrogen cycling in the marine environment and various members of the biota has been dominated by the concept of new and regenerated primary production in the euphotic zone (Dugdale and Goering, 1967; Eppley and Peterson, 1979). In the ocean, the new (export) production is commonly equated with diatom production because of their dominance under high nitrate conditions and their enhanced sinking rates due either to aggregation (Scharek et al. 1999) and/or packaging into fecal pellets, (e.g., Dugdale and Wilkerson 1998). It appears that at times, however, this diatom export pump can become short-circuited – as phytoplankton can release significant amounts of low molecular weight inorganic and organic carbon and nitrogen compounds in the absence of grazing (e.g., Bronk and Ward 1999; Lomas and Glibert 1999). Additionally, bacteria have been shown to compete with phytoplankton for inorganic N uptake (review by Kirchman, 1994; Kirchman and Wheeler, 1998), complicating our perception of the controls to primary production and nutrient recycling in marine systems.

Although the role of nitrogen in modulating carbon fixation has been known for some time, the complex interaction between uptake, exudation, and re-mineralization among the various members of the planktonic community is only now being discerned. A new paradigm of these various processes is emerging using tools for analyzing gene expression and enzyme activity for many of the pathways involved in carbon, nitrogen, and sulfur cycling in the environment (Fig. 1). In an effort to link the molecular and global scales, the BIOMP program supports research to increase our knowledge of the genes responsible for the C and N cycling.

In this pilot study, we propose to monitor several important biogeochemical processes (e.g. primary production, bacterial production, DOM production/uptake, N-assimilation, and N redox cycling) in water column and sediment samples concurrently with the molecular approaches to assess how the flux measurements and conventional approaches can be enhanced using gene-based methodologies. Although the simultaneous measurement of carbon and nitrogen cycling processes has occurred infrequently, the concurrent measurement of the expression of carbon and nitrogen cycling genes has never before been attempted. Furthermore, a coordinated field experiment with simultaneous monitoring of the processes and gene products listed in Figure 1 has never been tried. Here, we plan an integrated field experiment to assess the different biogeochemical measurements and molecular based approaches to focus on how the combination of the flux determinations and the knowledge of the active players will help us better understand regulation and response in overall system performance to different environmental parameters.