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14. ABSTRACT
This project is a collaborationbetween Dr. Robert Byrne, University of South Florida, and the PI (Perry). Our long-term objective is to better understand the mechanisms involved in the development, maintenance, and transformation of optically-active, thin layers. Because nutrients play an important role in regulating phytoplankton growth and in maintaining phytoplankton thin layers, our specific goals are to determine how phytoplankton photosynthetic physiology responds to small changes in nutrient flux and how nutrient flux regulates thin layer dynamics.

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The Role of Nutrients in the Formation, Maintenance, and Transformation of Phytoplankton Thin Layers

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LONG-TERM GOALS

This project is a collaborationbetween Dr. Robert Byrne, University of South Florida, and the PI (Perry). Our long-term objective is to better understand the mechanisms involved in the development, maintenance, and transformation of optically-active, thin layers. Because nutrients play an important role in regulating phytoplankton growth and in maintaining phytoplankton thin layers, our specific goals are to determine how phytoplankton photosynthetic physiology responds to small changes in nutrient flux and how nutrient flux regulates thin layer dynamics.

OBJECTIVES

Our research seeks to address how the combination of nutrient concentrations, pH, irradiance, and fluorescence can be used to study the physiology of the planktonic community in a specific layer. The objective is to better understand how the physiology changes as thin layers grow and dissipate. Initially, we will test our methods and ideas in a controlled environment using laboratory phytoplankton cultures and freshly collected natural populations. We will then move to the field to study the role of nutrients on the growth and physiology of phytoplankton living in vertically heterogeneous environments. Ultimately we plan to incorporate this suite of sensors into the autonomous Bottom Stationed Ocean Profiler, developed at the University of South Florida, to study thin layers and nutrient fluxes in the field.

APPROACH

Our approach is to combine new, miniaturized optical and chemical sensors that are capable of sampling on the critical space and time scales relevant to the formation and maintenance of optical thin layers. The laboratory at the University of South Florida has the capability to measure phytoplankton nitrogenous nutrient concentrations with nanomolar resolution (Byrne et al., 2000) and pH with 4 ten thousandths of a pH unit resolution (Clayton and Byrne, 1993). The laboratory at the University of Maine has the capability to measure fluorescence and other optical changes associated with photosynthetic physiology and cell growth as well as the capability to measure 14C-carbon incorporation at 5 dpm above background. Our initial approach will be to combine the suite of chemical and optical sensors in controlled environmental chambers using axenic cultures. In the second phase of our project we will progress to using large volumes of freshly collected seawater in temperature-controlled chambers, and repeating measurements made in pure phytoplankton cultures.

WORK COMPLETED

The project only began recently and the principal investigators are currently in the phase of designing collaborative experiments and testing methodologies.

RESULTS

The expected outcomes of the proposed work will be better understanding of phytoplankton physiology at low nutrient concentrations, better tools to study the dynamics of phytoplankton thin layers, and finer scale observations of optical and chemical changes in thin layers.

IMPACT/APPLICATIONS

Two major impediments to modeling the formation, maintenance, and demise of phytoplankton thin layers have been a lack of nutrient measurement in thin layers and a poor understanding of the short-term physiological responses of phytoplankton to nutrient fluxes. New sensors that provide high-resolution measurement of nutrient concentrations *in situ*, as well as recent improvements in optical approaches for determining phytoplankton physiological responses, will both aid in removing those impediments. By applying new chemical and optical sensors to the study of thin layer dynamics, we can substantially improve our understanding of phytoplankton growth in thin layers as nutrients become exhausted.

TRANSITIONS

The results of this work will help to improve the understanding of optical and biological variability.

RELATED PROJECTS

This project is coordinated with Award N00014-02-1-0823 under the direction of Dr. Robert Byrne at the University of South Florida.

REFERENCES

Byrne, R.H., Yao, W., Kaltenbacher, E. and Waterbury, R.D. (2000) Construction of a Compact Spectrophotometer/Spectrofluorometer Using a Flexible Liquid Core Waveguide. *Talanta*, 50:1307-1312.

Clayton, T.D. and R.H. Byrne, 1993. Spectrophotometric seawater pH measurements: Total Hydrogen Ion Concentration Scale Calibration of m-cresol purple and At-Sea Results. *Deep-Sea Research 40*:2115-2129.

PUBLICATIONS

No publications are directly attributable to this project at this time, due to the very recent start date.