CoBOP: Microbial Biofilms: A Parameter Altering the Apparent Optical Properties of Sediments, Seagrasses and Surfaces.

Alan W. Decho
Department of Environmental Health Sciences & Marine Sciences Program
University of South Carolina
Columbia, SC. 29208
Tel: (803) 777-6584. Fax: (803) 777-3391 Email: adecho@sph.sc.edu
Award #: N000149710024

LONG-TERM GOAL

The long-term goal of my research is to understand the optical properties of microbial biofilms, which form coatings on sediments and other surfaces in coastal oceans. The specific project goals are to determine how biofilm coatings may influence (i.e., alter) optical spectra of surfaces through reflection, refractance and fluorescence. This project is a part of the CoBOP (Coastal Ocean Benthic Optical Properties) initiative in the Environmental Optics Program.

OBJECTIVES

The objective of year two was to perform the first component of our field-study" at Lee Stocking Island, in association with the CoBOP "Sediment Group. Our specific objectives were: 1) to survey and sample a range of sediment field sites having different sediment and seagrass characteristics; 2) quantify exopolymer concentrations in these sediments; 3) conduct initial laboratory manipulative experiments geared toward characterizing specific chemical properties of exopolymers, which may potentially alter optical spectra.

APPROACH

Five sediment sites were intensively sampled by the sediment group in an effort to coordinate a range of chemical, biological and geological properties of sediments with their optical properties. Optical measurements of these different "sediment types" were conducted using BDRF, and Hand-held Fluorometers. Our specific approach was to extract biofilm exopolymers from these sediment types, quantify their abundances, and then using laboratory studies, begin to characterize their optical properties using spectrophotometry and fluorometry.

WORK COMPLETED

Our field campaign to Lee Stocking Island during year-two was highly successful. All objectives were accomplished. Five different sediment sites were intensively sampled.
Each site had several "subsites" which constituted several different sediment textures within that site. These included:

1) North Perry Reef Site: [Film and No-Film sediments]
2) Twin-Beaches Site: [Diatom-Film, Non-Vegetated, and Vegetated]
3) Rainbow Gardens Site: [Coral, Seagrass, Bare-Sand]
4) Grapstone Site: [Yellow-Film, White-Sand]
5) Ooid Shoals Site:

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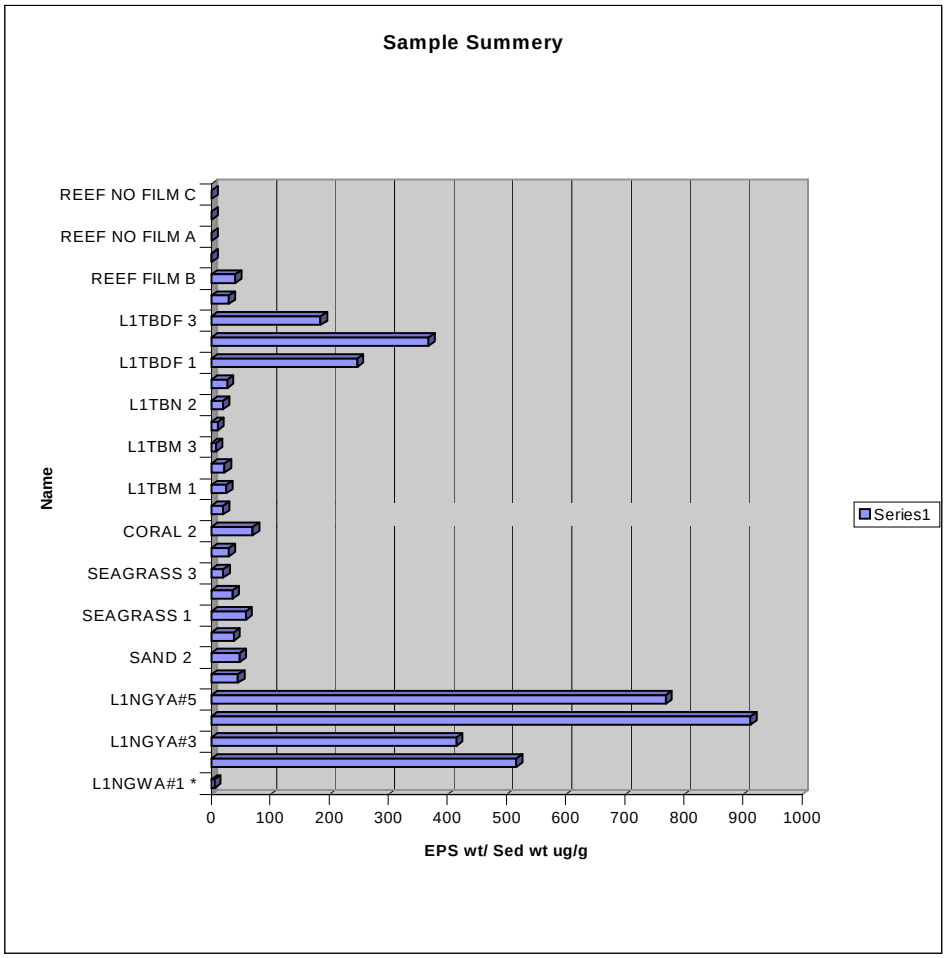
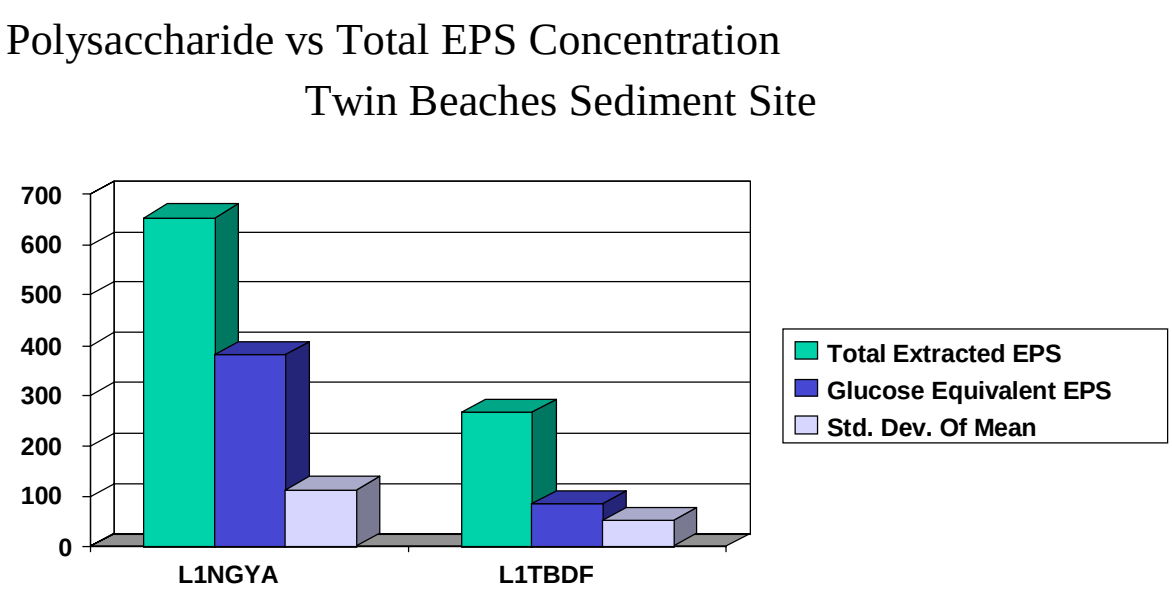
A great deal of time was spent in quantifying exopolymer samples, and in the initial chemical characterization of the exopolymers.



RESULTS

Results show a wide variation in exopolymer (EPS) concentrations exist among the five sediment sites. Highest EPS abundances were found at the “Grapestone site”, while lowest EPS concentrations occurred at the “North Perry” sediment sites. Within each site, variations in concentrations were low (statistical analyses not yet completed).

Characterization of EPS showed a wide variation in the composition of EPS among sites. We found that the Rainbow Gardens site were composed of EPS which was very low in polysaccharidic components (i.e. less than 20% by wt), and very high in other (as yet to be determined) components (> 80%). This contrasts to our “Grapestone” site where polysaccharides comprised 50 – 80 % of the EPS components.



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IMPACT/APPLICATION

The results of exopolymer sediment sampling, shows that biofilm exopolymers are common at all sediment sites. Their abundances vary in a predictable manner with other microbial parameters (determined by other members of Sediment group) and depending on the site. This suggests that alterations in optical spectra resulting from biofilm coatings may occur to different extents, depending on the exopolymer compositions associated with each sediment sites. We are currently examining the optical properties of EPS from the five different sites to determine their effects on altering optical properties

TRANSITIONS

The close coordination of "Sediment group" CoBOP personnel has provided a strong and unique dimension to our work. We are planning co-ordinated field experiments which will empirically test ideas derived from our first field study.

RELATED PROJECTS

Below I list ongoing work in conjunction with CoBOP Biofilm project.

1 – Contract Collaborations with Dr. Brad Bebout (NASA-Ames Laboratory, Moffet Field, CA.). Ongoing work with Drs. Bebout and R. Pamela Reid (CoBOP- Univ. Miami) is examining the effects of microbial EPS spacing and alignment of sediment grains. Our hypothesis is that high concentrations of EPS will increase the spacing of grains and permit a greater abundance of light to penetration sediment, thus reducing scattering off of the sediment surface. Optical probes, developed by Dr. Bebout will be used in these studies.

REFERENCES

None