Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31507

Drivers of lipid remodeling in marine microbial communities - A mesocosm approach

JULIO SEPÚLVEDA[1], EDGART FLORES[1], SEBASTIAN I CANTARERO[2], HARRY ALLBROOK[1], PEIAHNG XU[3], CHRISTIAN FURBO REEDER[4], CAROLIN LÖSCHER[3], CRISTIAN A VARGAS[5], PAULINA AGUAYO[6], LENNART T. BACH[7] AND ULF RIEBESELL[8]

[1]University of Colorado Boulder
[2]University of Colorado, Boulder
[3]University of Southern Denmark
[4]Linnaeus University
[5]Universidad de Concepción
[6]University of Concepción
[7]University of Tasmania
[8]GEOMAR Helmholtz Centre for Ocean Research Kiel

It is known that microbes can remodel their lipidome in response to environmental stress (lipid remodeling). Yet, the application of lipids in oceanography has been limited by the number of known chemical structures and biological sources, as well as by bioinformatic limitations for the processing of large environmental data sets. However, the improved accessibility to high-resolution mass spectrometers, a growing database of lipid classes, new open-source software packages for the processing of targeted and untargeted lipid analysis, and the identification of genomic sequences that encode the enzymes responsible for lipid biosynthesis are quickly advancing the field of environmental lipidomics. These advances now allow the use of lipids as indicators of microbial adaptation to environmental change.

This presentation will examine lipid remodeling in natural microbial communities exposed to multiple environmental stressors in a mesocosm experiment. We test the overarching hypothesis that we can distinguish between changes in the lipidome caused by varying biological sources (phylogeny) and physiological adaptation (lipid remodeling) of source organisms exposed to changing environmental conditions. We study changes in the pool of intact polar lipids (IPLs) and the composition of a microbial community exposed to multi-environmental stressors during a 2-month-long mesocosm experiment off the coast of Callao, Peru. We investigate lipid remodeling in response to changing community composition, nutrient stoichiometries, temperature, pH, and light availability in surface and subsurface water masses with contrasting redox potentials, using multiple linear regressions, classification and regression trees, and random forest analyses. We will show how the observed statistical relationships between IPL distributions, physical-chemical parameters, and the composition of the microbial community suggest evidence of lipid remodeling in response to environmental stressors, and we will discuss how these results have implications for ocean biogeochemistry under future scenarios of climate change.