MeHg photoreduction rates and stable isotope enrichment from mercury reduction experiments conducted on marine phytoplankton from 2012-2013.

Website: https://www.bco-dmo.org/dataset/826633
Data Type: experimental
Version: 1
Version Date: 2020-10-14

Project
» Collaborative Research: Transformations and mercury isotopic fractionation of methylmercury by marine phytoplankton (Phytoplankton MeHg)

Contributors	Affiliation	Role
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Fisher, Nicholas S.	Stony Brook University - SoMAS (SUNY-SB SoMAS)	Co-Principal Investigator
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Blum, Joel D.	University of Michigan	Scientist
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Abstract
MeHg photoreduction rates and stable isotope enrichment from mercury reduction experiments conducted on marine phytoplankton from 2012-2013.

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Coverage

Temporal Extent: 2012-12-12 - 2013-08-27

Methods & Sampling

For detailed methods, see Kritee, et al. (2017).

Rates and Hg stable isotope signatures of photomicrobial transformations of Hg(II) and MeHg in marine phytoplankton exposed to visible light and varying levels of UV radiation were examined in experiments with (1) sterile-filtered spent growth media containing extracellular exudates from cultures of *Isochrysis galbana*, a eukaryotic marine microalga of the globally important Prymnesiophyceae class; (2) actively growing monospecific cultures of *I. galbana*; and (3) cysteine or ocean water washed (nongrowing) *I. galbana* cells.

These data were published in Supplementary Table 2 of Kritee, et al. (2017).

Data Processing Description

BCO-DMO Processing:
- changed date format to YYYY-MM-DD

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Data Files

File
ISOMeHg_rates.csv (Comma Separated Values (.csv), 989 bytes) MD5:10513f9f1dd972f067ccb40da7617c3c Primary data file for dataset ID 826633

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Related Publications

Kritee, K., Motta, L. C., Blum, J. D., Tsui, M. T.-K., & Reinfelder, J. R. (2017). Photomicrobial Visible Light-Induced Magnetic Mass Independent Fractionation of Mercury in a Marine Microalga. ACS Earth and Space Chemistry, 2(5), 432–440. doi:10.1021/acsearthspacechem.7b00056
Results

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Parameters

Parameter	Description	Units
Treatment	Experimental conditions	unitless
Date	Date of experiment; MM/DD/YYYY	unitless
Reactor_type	Experimental vessel	unitless
Init_cell_density	Cell density at start of experiment	cells per milliliter (cells/mL)
Init_MeHg_conc_mass	MeHg concentration at start of experiment	nanograms per milliliter (ng/mL)
Init_MeHg_conc_molar	MeHg concentration at start of experiment	nanomolar (nM)
Init_intracell_MeHg_conc	Intracellular MeHg concentration at start of experiment	nanomoles Hg per microgram chlorophyll a (nmol/ug chla)
Duration	Length of experiment	days
Rate_const	First order rate constant of reaction	1/h
Rate_const24	First order rate constant of reaction extrapolated to 24 h of daylight	1/d
Hg_reduced	Total Hg reduced at end of experiment	percent (%)
epsilon_202	mass-dependent 202Hg enrichment factor	per mil (‰)
epsilon_199	mass-independent 199Hg enrichment factor	per mil (‰)
D199_D201_ratio	D199Hg/D201 ratio	unitless
D199_d202_ratio	D199Hg/d202 ratio	unitless

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Project Information

Collaborative Research: Transformations and mercury isotopic fractionation of methylmercury by marine phytoplankton (Phytoplankton MeHg)

Coverage: Antarctic Peninsula

NSF Award Abstract:
The accumulation of mercury (Hg) in seafood is a public health concern. The presence of Hg in seafood depends to a large degree on the air-sea exchange of Hg, with atmospheric deposition leading to accumulation of Hg in the ocean. The pathways to seafood start with the uptake of Hg by phytoplankton from seawater where is has always been assumed to accumulate to be eaten by grazers and passed on to larger organisms. This project challenges this assumption with preliminary data that suggests certain phytoplankton species can transform Hg to volatile forms (mercury vapor & dimethylmercury) that are lost to the atmosphere, a processes that removes Hg from the ocean rather than simply concentrating it into the ecosystem and seafood. This process, which has not been studied before, could dramatically alter our view of the Hg cycle in the ocean. The researchers funded by this project will look for the specific phytoplankton species that are capable of volatilizing Hg and quantify the rates at which they do so. They will also examine the suspected role of associated sulfur and selenium compounds in the process, as well as quantifying the changes in the Hg isotopic values for potential use as chemical tracers of the source of Hg in the ecosystem and food supply. These results should allow oceanographers to better quantify and refine our knowledge of Hg cycling in the ocean. The project will support participation of graduate students, a postdoctoral scientist, and incorporation of new information directly into courses taught by the researchers. Funding will also support continuing activities by the participants in activities that disseminate information on mercury and its effect on public and environmental health.

Biogeochemical cycling of mercury (Hg) in the ocean may be more complex than previously assumed. New evidence has challenged the idea that methylmercury (MeHg) merely accumulates in phytoplankton and undergoes little to no transformation before being passed into the food web. This project aims to more fully elucidate the mechanisms behind the intracellular transformation of MeHg to volatile Hg and dimethylmercury (Me2Hg) that can be lost to the atmosphere, as well as to evaluate the range of algal taxa that can perform this transformation using directed culture work. Additionally, the PIs will investigate evidence that thiols, organic selenium (Se) compounds, and sulfides are required to facilitate these reactions within the phytoplankton, and specific pathways will be investigated and quantified through this research. Stable Hg isotopic data has been used to track Hg sources and pathways in marine systems and its fractionation during these MeHg transformations will also be quantified for future field study of marine Hg. The investigators hypothesize that coccolithophorids and other haptophytes capable of these intracellular reactions may account for a significant portion of the production of volatile Hg in the ocean. If this turns out to be the case, understanding and quantifying these volatilization processes may significantly alter our current understanding of the overall biogeochemical cycling of Hg in the ocean.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1634154

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