Mercury stable isotope values for marine particles from R/V Kilo Moana cruises KM1418, KM1407 and KM1506 around station ALOHA in 2014 and 2015

Website: https://www.bco-dmo.org/dataset/788753
Data Type: Cruise Results
Version: 1
Version Date: 2020-02-21

Project
» Collaborative Research: Isotopic insights to mercury in marine food webs and how it varies with ocean biogeochemistry (Hg_Biogeochemistry)

Contributors	Affiliation	Role
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Abstract
This dataset contains the mercury stable isotope ratios collected in marine particles during R/V Kilo Moana cruises around Station ALOHA. These data were published in Motta et al., (2019) with supporting information.

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Coverage

Spatial Extent: **Lat**:22.75 **Lon**:-158
Temporal Extent: 2014-02-19 - 2015-05-02

Dataset Description

This dataset contains the mercury stable isotope ratios collected in marine particles during R/V Kilo Moana cruises around Station ALOHA. For more information about the ALOHA observatory see: http://aco-ssds.soest.hawaii.edu/. These data were published in Motta et al., (2019) with supporting information.

Methods & Sampling

Small (1-53 µm) and large (>53 µm) marine particles were sampled on all three cruises using in situ pumps (WTS-LV, standard, 8 L min^{-1}; McLane Research Laboratories, East Falmouth); water was passed sequentially through 53 µm pore-size nylon mesh and 1 µm pore-size quartz microfiber (QMA) filters with 142 mm diameter using a mini-MULVFS filter holder (Bishop et al., 2012). On the spring cruise, one pump was equipped with a pump head and motor with a maximum flow rate of 30 L min^{-1}, and high volume samples of particles >53 µm were collected. The large particles collected on the nylon mesh were sonicated and concentrated into a pre-combusted 47 mm QMA filter.

Marine particles were collected in two size fractions, small particles in combusted quartz filters (1-53 µm) and large particles in a nylon mesh (> 53 µm) using in situ McLane pumps during the three research cruises.

The marine particles were analyzed for total Hg concentrations by acid assisted microwave digestions and aliquots were analyzed by cold vapor atomic fluorescence spectrophotometry.

For THg isotope determination samples were combusted in a two-stage combustion furnace and Hg(0) g was trapped in a 1% KMnO4 solution. The 1% KMnO4 solution was analyzed for Hg stable isotope composition using a multiple collector inductively coupled plasma mass spectrometer.

All the methods are detailed in Motta et al., (2019).

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Data Files

File
hg_isotopes_particles.csv (Comma Separated Values (.csv), 741 bytes) MD5:c4b009517111fb923e1a7506f1df6ed4 Primary data file for dataset ID 788753

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Related Publications

Blum, J. D., Popp, B. N., Drazen, J. C., Anela Choy, C., & Johnson, M. W. (2013). Methylmercury production below the mixed layer in the North Pacific Ocean. Nature Geoscience, 6(10), 879–884. doi:10.1038/ngeo1918 *General*

Motta, L. C., Blum, J. D., Johnson, M. W., Umhau, B. P., Popp, B. N., Washburn, S. J., … Lamborg, C. H. (2019). Mercury Cycling in the North Pacific Subtropical Gyre as Revealed by Mercury Stable Isotope Ratios. Global Biogeochemical Cycles, 33(6), 777–794. doi:10.1029/2018gb006057 https://doi.org/10.1029/2018GB006057 *Results*

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Parameters

Parameter	Description	Units
Cruise_Number	Cruise ID number	unitless
Date	Sampling date (UTC); format: yyyymmdd	unitless
Mean_Depth	Mean depth of sample	meters (m)
Size_fraction	Size fraction	micrometers (um)
d202Hg	Stable isotope ratio; δ202Hg	per mil (‰)
D199Hg	Stable isotope ratio; Δ199Hg	per mil (‰)
D201Hg	Stable isotope ratio; Δ201Hg	per mil (‰)
D200Hg	Stable isotope ratio; Δ200Hg	per mil (‰)
D204Hg	Stable isotope ratio; D204Hg	per mil (‰)

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Instruments

Dataset-specific Instrument Name	cold vapor atomic fluorescence spectrophotometry
Generic Instrument Name	Cold Vapor Atomic Fluorescence Spectrophotometer
Generic Instrument Description	A Cold Vapor Atomic Fluorescent Spectrophotometer (CVAFS) is an instrument used for quantitative determination of volatile heavy metals, such as mercury. CVAFS make use of the characteristic of mercury that allows vapor measurement at room temperature. Mercury atoms in an inert carrier gas are excited by a collimated UV light source at a particular wavelength. As the atoms return to their non-excited state they re-radiate their absorbed energy at the same wavelength. The fluorescence may be detected using a photomultiplier tube or UV photodiode.

Dataset-specific Instrument Name	MC-ICP-MS
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	multicollector inductively coupled plasma mass spectrometer (MC-ICP-MS; Nu instruments)
Generic Instrument Description	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

Dataset-specific Instrument Name	WTS-LV
Generic Instrument Name	McLane Large Volume Pumping System WTS-LV
Dataset-specific Description	in situ pumps (WTS-LV, standard, McLane Research Laboratories)
Generic Instrument Description	The WTS-LV is a Water Transfer System (WTS) Large Volume (LV) pumping instrument designed and manufactured by McLane Research Labs (Falmouth, MA, USA). It is a large-volume, single-event sampler that collects suspended and dissolved particulate samples in situ. Ambient water is drawn through a modular filter holder onto a 142-millimeter (mm) membrane without passing through the pump. The standard two-tier filter holder provides prefiltering and size fractioning. Collection targets include chlorophyll maximum, particulate trace metals, and phytoplankton. It features different flow rates and filter porosity to support a range of specimen collection. Sampling can be programmed to start at a scheduled time or begin with a countdown delay. It also features a dynamic pump speed algorithm that adjusts flow to protect the sample as material accumulates on the filter. Several pump options range from 0.5 to 30 liters per minute, with a max volume of 2,500 to 36,000 liters depending on the pump and battery pack used. The standard model is depth rated to 5,500 meters, with a deeper 7,000-meter option available. The operating temperature is -4 to 35 degrees Celsius. The WTS-LV is available in four different configurations: Standard, Upright, Bore Hole, and Dual Filter Sampler. The high-capacity upright WTS-LV model provides three times the battery life of the standard model. The Bore-Hole WTS-LV is designed to fit through a narrow opening such as a 30-centimeter borehole. The dual filter WTS-LV features two vertical intake 142 mm filter holders to allow simultaneous filtering using two different porosities.

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Deployments

KM1418

Website	https://www.bco-dmo.org/deployment/636002
Platform	R/V Kilo Moana
Start Date	2014-08-29
End Date	2014-09-11
Description	Original cruise data are available from the NSF R2R data catalog

KM1407

Website	https://www.bco-dmo.org/deployment/635932
Platform	R/V Kilo Moana
Start Date	2014-02-19
End Date	2014-02-28
Description	Original cruise data are available from the NSF R2R data catalog

KM1506

Website	https://www.bco-dmo.org/deployment/636095
Platform	R/V Kilo Moana
Start Date	2015-05-03
End Date	2015-05-12
Description	Original cruise data are available from the NSF R2R data catalog

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Project Information

Collaborative Research: Isotopic insights to mercury in marine food webs and how it varies with ocean biogeochemistry (Hg_Biogeochemistry)

Coverage: Pacific Subtropical Gyre, Station ALOHA 22.75N 158W; equatorial Pacific (10N 155W, 5N 155W)

NSF award abstract:
Mercury is a pervasive trace element that exists in several states in the marine environment, including monomethylmercury (MMHg), a neurotoxin that bioaccumulates in marine organisms and poses a human health threat. Understanding the fate of mercury in the ocean and resulting impacts on ocean food webs requires understanding the mechanisms controlling the depths at which mercury chemical transformations occur. Preliminary mercury analyses on nine species of marine fish from the North Pacific Ocean indicated that intermediate waters are an important entry point for MMHg into open ocean food webs. To elucidate the process controlling this, researchers will examine mercury dynamics in regions with differing vertical dissolved oxygen profiles, which should influence depths of mercury transformation. Results of the study will aid in a better understanding of the pathways by which mercury enters the marine food chain and can ultimately impact humans. This project will provide training for graduate and undergraduate students, and spread awareness on oceanic mercury through public outreach and informal science programs.

Mercury isotopic variations can provide insight into a wide variety of environmental processes. Isotopic compositions of mercury display mass-dependent fractionation (MDF) during most biotic and abiotic chemical reactions and mass-independent fractionation (MIF) during photochemical radical pair reactions. The unusual combination of MDF and MIF can provide information on reaction pathways and the biogeochemical history of mercury. Results from preliminary research provide strong evidence that net MMHg formation occurred below the surface mixed layer in the pycnocline and suggested that MMHg in low oxygen intermediate waters is an important entry point for mercury into open ocean food webs. These findings highlight the critical need to understand how MMHg levels in marine biota will respond to changes in atmospheric mercury emissions, deposition of inorganic mercury to the surface ocean, and hypothesized future expansion of oxygen minimum zones. Using field collections across ecosystems with contrasting biogeochemistry and mercury isotope fractionation experiments researchers will fill key knowledge gaps in mercury biogeochemistry. Results of the proposed research will enable scientists to assess the biogeochemical controls on where in the water column mercury methylation and demethylation likely occur.

Related background publication with supplemental data section:
Joel D. Blum, Brian N. Popp, Jeffrey C. Drazen, C. Anela Choy & Marcus W. Johnson. 2013. Methylmercury production below the mixed layer in the North Pacific Ocean. Nature Geoscience 6, 879–884. doi:10.1038/ngeo1918

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1433846

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