Seawater Trace Metal Concentrations from China incubation experiment conducted in April 2011

Website: https://www.bco-dmo.org/dataset/855813
Data Type: Other Field Results, experimental
Version: 1
Version Date: 2021-07-16

Project
» Atmospheric Deposition Impacts on Marine Ecosystems (ADIMA)

Contributors	Affiliation	Role
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Abstract
This dataset reports trace metal concentrations in seawater from an incubation experiment carried out in China in April 2011.

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Coverage

Spatial Extent: **N**:30.7178 **E**:122.936 **S**:30.6367 **W**:122.666
Temporal Extent: 2011-04 - 2011-04

Methods & Sampling

Seawater for incubation experiments was collected at two sites located in and near the Yangtze River plume in April 2011 aboard a local fishing boat. Site 1 was within the plume, and site 2 was further away from the river discharge point. Site 1 was nearer to the mouth of the Yangtze River, between two islands in an area with visible suspended sediment (30° 43′ 04″N, 122° 39′ 58″E). Site 2 was east of the Zhoushan Archipelago in waters influenced by the Kuroshio Current outside the area of high sediment resuspension from the Yangtze River, and had a salinity of 31.7ppt (30° 38′ 12.2″N, 122° 56′ 8.51″ E). Site 1, being more heavily influenced by the river discharge, had a salinity of 28.7ppt. Assuming river water has a salinity of zero and ocean water has a salinity of 33, the water we collected at site 1 was a mixture of 87% seawater and 13% river water, while site 2 was 96% seawater and 4% river water. Both of these sites are clearly affected by the Yangtze River outflow, and this is reflected in their salinity levels and nutrient characteristics.

Trace metal clean techniques were used to collect incubation water and during all handling and sample processing steps. Acid cleaning included a 1 week Citranox soaking step, followed by a 1week 10% hydrochloric acid soaking step, followed by a thorough milliQ rinse. All containers and equipment were stored double bagged until use after acid cleaning. For each experiment, surface seawater was collected using a

peristaltic pump with acid cleaned C-Flex tubing, passed through 80 µm mesh into acid clean, sample rinsed 50L carboys, and transported to Shengsi Island in the dark. Transport took less than 2 h. In the lab, water was dispensed into 500 mL acid clean, sample rinsed, clear polycarbonate bottles. Nutrient additions included nitrogen (N, as 10 µM $NaNO_3$ + 0.5 µM $(NH_4)_2SO_4$), phosphorus (P, as 0.5 µM NaH_2PO_4), or N + P together, and these concentrations were designed to approximately double the background concentrations of these nutrients observed at site 1. Control bottles contained no nutrient additions.

Aerosol treatments included aerosols representing 5 different dates of collection (see below). To simulate 10 days of a moderately strong deposition event for this region (1 g m^{-2} d^{-1}) over a 10 m mixed layer, 1 mg aerosol on the filter was added per L of seawater. The aerosol filter was cut to the correct size to deliver the appropriate amount of aerosol and then added directly to the bottles. No prior leaching step was included to increase the solubility of the aerosols. The annual average deposition flux for the region is 4.6–98 g m^{-2} y^{-1}. The deposition rate assumed for the additions is thus an order of magnitude above average and represents strong wind or dust storm conditions. For aerosol NW37, concentrations of 0.2 mg L^{-1} (similar to average or typical loading at the site) and 5 mg L^{-1} (very high deposition, strong dust storm conditions) were also included to test phytoplankton responses to aerosol dosing. Bottles were incubated in a flowing seawater pool by pumping coastal seawater into the pool at a rate high enough to maintain ambient coastal seawater temperatures without allowing the pool to warm from sunlight. No attempt to artificially manipulate temperature was made. The pool was shaded with a neutral density shade cloth to attenuate sunlight 50% for both site 1 and site 2 experiments. Three bottles per treatment were sampled at “time zero” (collected immediately after nutrient or aerosol additions were made) and on the final day of the incubation 3 days later. The incubation time of 3 days was selected because it is long enough to observe changes in phytoplankton community structure based on prior studies, while avoiding major bottle effects that occur with longer-term incubation experiments.

Water samples for trace metal analyses from the incubation experiments were filtered (0.2µm PES) in a laminar flow hood following trace metal clean techniques. Sample bottles were stored in clean plastic bags and stored frozen.

To measure trace metals in the incubation seawater, samples from the incubation experiments and operational field blanks (MilliQ water, see below) were acidified to pH < 2 with concentrated trace metal grade nitric acid at least 48 h before processing. Trace metals were concentrated using Nobias Chelate-PA1 resin (HITACH, Japan) to remove the seawater matrix, and eluted in 5 mL nitric acid following (Sohrin et al., 2008). Concentrated samples were analyzed by ICP-MS using standards prepared in 5% nitric acid as described previously (Mackey et al., 2015). All sample preparation occurred within a class 1000 clean room in class 10 laminar flow hoods under HEPA filtration.

Operational field blanks of MilliQ water collected to determine if trace metal contamination was introduced during the course of the incubation. Incubation bottles were filled with 500 mL of MilliQ water and were incubated identically to the seawater samples. One bottle was collected every day of the experiment and these blanks were processed along with the seawater samples. The concentrations were 0.046 ± 0.028 nM Cd, 0.010 ± 0.0032 nM Pb, 3.2 ± 2.1 nM Al, 0.98 ± 0.28 nM Fe, 0.00024 ± 0.00 nM Co, 0.13 ± 0.088 nM Ni, 0.22 ± 0.12 nM Cu, and 1.8 ± 0.76 nM Zn (average ± standard deviation, n = 5). Separate MilliQ procedural blanks (including column chemistry through ICP analysis) were also performed. Reported values herein for seawater samples have been blank corrected using the procedural blank averages.

Data Processing Description

BCO-DMO Processing:
- split the original Location column into Site, Latitude, and Longitude;
- converted latitude and longitude to decimal degrees from degrees, minutes, seconds;
- renamed fields to comply with BCO-DMO naming conventions.

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Data Files

File
china_inc_tm.csv (Comma Separated Values (.csv), 4.92 KB) MD5:9b9818c244696459abd56aaffcc9826c Primary data file for dataset ID 855813

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Related Publications

Mackey, K. R. M., Chien, C.-T., Post, A. F., Saito, M. A., & Paytan, A. (2015). Rapid and gradual modes of aerosol trace metal dissolution in seawater. Frontiers in Microbiology, 5. doi:10.3389/fmicb.2014.00794
Methods

Mackey, K. R. M., Kavanaugh, M. T., Wang, F., Chen, Y., Liu, F., Glover, D. M., … Paytan, A. (2017). Atmospheric and Fluvial Nutrients Fuel Algal Blooms in the East China Sea. Frontiers in Marine Science, 4. doi:10.3389/fmars.2017.00002
Results

Sohrin, Y., Urushihara, S., Nakatsuka, S., Kono, T., Higo, E., Minami, T., … Umetani, S. (2008). Multielemental Determination of GEOTRACES Key Trace Metals in Seawater by ICPMS after Preconcentration Using an Ethylenediaminetriacetic Acid Chelating Resin. Analytical Chemistry, 80(16), 6267–6273. doi:10.1021/ac800500f
Methods

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Related Datasets

IsRelatedTo

Paytan, A., Mackey, K. R. (2021) **Major nutrient concentrations in seawater from an incubation experiment carried out in China in April 2011.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-07-16 doi:10.26008/1912/bco-dmo.855966.1 [view at BCO-DMO]
Relationship Description: Both datasets are the results of the same incubation experiment.

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Parameters

Parameter	Description	Units
Site	Location/site number	unitless
Latitude	Site latitude	decimal degrees Norh
Longitude	Site longitude	decimal degrees East

Treatment	treatment in the incubation experiment: **Control**: Control bottles contained no nutrient additions **N**: nitrogen addition (N, as 10 µM NaNO3 + 0.5 µM (NH4)2SO4) **P**: phosphorus addition (P, as 0.5 µM NaH2PO4) **N+P**: N+P addition together **NW32**: One of the aerosol treatments. 1 mg aerosol on the MW32 (collected 19 Nov 2010) filter was added per L of seawater. MW: northwestern (NW) back trajectories originating over mainland China **NW34**: One of the aerosol treatments. 1 mg aerosol on the MW34 filter (collected 23 Nov 2010) was added per L of seawater. MW: northwestern (NW) back trajectories originating over mainland China **NW37**: One of the aerosol treatments. 1 mg aerosol on the MW37 filter (collected 29 Nov 2010) was added per L of seawater. MW: northwestern (NW) back trajectories originating over mainland China **PO19**: One of the aerosol treatments. 1 mg aerosol on the PO19 filter (collected 16 Aug 2010) was added per L of seawater. PO: back trajectories originating over the Pacific Ocean **PO24**: One of the aerosol treatments. 1 mg aerosol on the PO24 filter (collected 26 Aug 2010) was added per L of seawater. PO: back trajectories originating over the Pacific Ocean **NW37 low**: Similar to NW37, but only 0.2 mg aerosol was added per L of seawater **NW37 med**: This is NW37, just added “med” **NW37 high**: Similar to NW37, but 5 mg aerosol was added per L of seawater	unitless
Concentration_Al_initial	Initial mean concentration of Aluminum (Al) of three replicate samples; initial = metal concentrations after nutrient or aerosol additions were made.	nanomolar (nM)
Concentration_Al_final	Final mean concentration of Aluminum (Al) of three replicate samples; final = metal concentrations on the final day of the 3-day incubation.	nanomolar (nM)
Concentration_Cd_initial	Initial mean concentration of Cadmium (Cd) of three replicate samples; initial = metal concentrations after nutrient or aerosol additions were made.	nanomolar (nM)
Concentration_Cd_final	Final mean concentration of Cadmium (Cd) of three replicate samples; final = metal concentrations on the final day of the 3-day incubation.	nanomolar (nM)
Concentration_Co_initial	Initial mean concentration of Cobalt (Co) of three replicate samples; initial = metal concentrations after nutrient or aerosol additions were made.	nanomolar (nM)

Concentration_Co_final	Final mean concentration of Cobalt (Co) of three replicate samples; final = metal concentrations on the final day of the 3-day incubation.	nanomolar (nM)
Concentration_Cu_initial	Initial mean concentration of Copper (Cu) of three replicate samples; initial = metal concentrations after nutrient or aerosol additions were made.	nanomolar (nM)
Concentration_Cu_final	Final mean concentration of Copper (Cu) of three replicate samples; final = metal concentrations on the final day of the 3-day incubation.	nanomolar (nM)
Concentration_Fe_initial	Initial mean concentration of Iron (Fe) of three replicate samples; initial = metal concentrations after nutrient or aerosol additions were made.	nanomolar (nM)
Concentration_Fe_final	Final mean concentration of Iron (Fe) of three replicate samples; final = metal concentrations on the final day of the 3-day incubation.	nanomolar (nM)
Concentration_Mn_initial	Initial mean concentration of Manganese (Mn) of three replicate samples; initial = metal concentrations after nutrient or aerosol additions were made.	nanomolar (nM)
Concentration_Mn_final	Final mean concentration of Manganese (Mn) of three replicate samples; final = metal concentrations on the final day of the 3-day incubation.	nanomolar (nM)
Concentration_Ni_initial	Initial mean concentration of Nickel (Ni) of three replicate samples; initial = metal concentrations after nutrient or aerosol additions were made.	nanomolar (nM)
Concentration_Ni_final	Final mean concentration of Nickel (Ni) of three replicate samples; final = metal concentrations on the final day of the 3-day incubation.	nanomolar (nM)
Concentration_Pb_initial	Initial mean concentration of Lead (Pb) of three replicate samples; initial = metal concentrations after nutrient or aerosol additions were made.	nanomolar (nM)
Concentration_Pb_final	Final mean concentration of Lead (Pb) of three replicate samples; final = metal concentrations on the final day of the 3-day incubation.	nanomolar (nM)
Concentration_Zn_initial	Initial mean concentration of Zinc (Zn) of three replicate samples; initial = metal concentrations after nutrient or aerosol additions were made.	nanomolar (nM)
Concentration_Zn_final	Final mean concentration of Zinc (Zn) of three replicate samples; final = metal concentrations on the final day of the 3-day incubation.	nanomolar (nM)
Standard_error_Al_initial	Standard error of Concentration_Al_initial	nanomolar (nM)

Standard_error_Al_final	Standard error of Concentration_Al_final	nanomolar (nM)
Standard_error_Cd_initial	Standard error of Concentration_Cd_initial	nanomolar (nM)
Standard_error_Cd_final	Standard error of Concentration_Cd_final	nanomolar (nM)
Standard_error_Co_initial	Standard error of Concentration_Co_initial	nanomolar (nM)
Standard_error_Co_final	Standard error of Concentration_Co_final	nanomolar (nM)
Standard_error_Cu_initial	Standard error of Concentration_Cu_initial	nanomolar (nM)
Standard_error_Cu_final	Standard error of Concentration_Cu_final	nanomolar (nM)
Standard_error_Fe_initial	Standard error of Concentration_Fe_initial	nanomolar (nM)
Standard_error_Fe_final	Standard error of Concentration_Fe_final	nanomolar (nM)
Standard_error_Mn_initial	Standard error of Concentration_Mn_initial	nanomolar (nM)
Standard_error_Mn_final	Standard error of Concentration_Mn_final	nanomolar (nM)
Standard_error_Ni_initial	Standard error of Concentration_Ni_initial	nanomolar (nM)
Standard_error_Ni_final	Standard error of Concentration_Ni_final	nanomolar (nM)
Standard_error_Pb_initial	Standard error of Concentration_Pb_initial	nanomolar (nM)
Standard_error_Pb_final	Standard error of Concentration_Pb_final	nanomolar (nM)
Standard_error_Zn_initial	Standard error of Concentration_Zn_initial	nanomolar (nM)
Standard_error_Zn_final	Standard error of Concentration_Zn_final	nanomolar (nM)

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Instruments

Dataset-specific Instrument Name	HR-ICP-MS Thermo Fisher Scientific
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
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.

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Project Information

Atmospheric Deposition Impacts on Marine Ecosystems (ADIMA)

Website: http://pmc.ucsc.edu/~apaytan/page_projects.html

Coverage: Gulf of Aqaba, Atlantic Ocean (Bermuda Time Series Station), Monterey Bay

Chemical components delivered to the surface ocean through atmospheric deposition influence ocean productivity and ecosystem structure thus are tightly related to the global carbon cycle and climate. Accordingly, the major aim of this project is to quantitatively estimate the variable impact of aerosols on marine phytoplankton and to determine the specific effects on various taxa. Such data could in the future be used to better understand the global impact of aerosols on the oceanic ecosystem. To accomplish this goal the PI will monitor aerosol dry deposition fluxes, determine aerosol sources, obtain the chemical composition and solubility of aerosols, and evaluate the contribution of aerosols to nutrient and trace metal budgets of seawater at two oceanographically different sites (Bermuda and Monterey Bay) representing open ocean and coastal setting. The effects of the different aerosol "types" (defined by source and chemical characteristics) on specific phytoplankton taxa will also be evaluated using pure culture and natural samples bioassays. This project is particularly important in light of the role atmospheric deposition can resume in oligotrophic and coastal settings and the predicted future global conditions of increased aridity and urbanization and associated changes in dust fluxes and composition.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0850467

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