

Surface and profile concentrations of trace metals and radionuclides near Station ALOHA

Website: <https://www.bco-dmo.org/dataset/792817>

Data Type: Cruise Results

Version: 1

Version Date: 2020-02-11

Project

» [Center for Microbial Oceanography: Research and Education](#) (C-MORE)

Contributors	Affiliation	Role
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Abstract

Trace element water samples from KM1513 were collected with the MIT Automated Trace Element (ATE) sampler, deployed with a teflon-coated wire from the ship's deck for surface water samples (collected at roughly 10 m depth), and with the ATEs attached to PVC "Vanes" designed to prevent contamination from the ship's steel wire for samples collected at greater depth. Samples were filtered at 0.4 μm immediately after collection through polycarbonate track etched filters (Nucleopore) into 250 mL HDPE bottles and acidified to 0.012 M hydrochloric acid (ultrapure by quadruple distillation in a Vycor still; $\sim\text{pH } 2$) at sea. Sampling and filtration followed published protocols used previously at Station ALOHA, for direct comparison (Fitzsimmons et al., 2015). These casts mostly aligned with Niskin cast station locations, but in some cases did not.

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Coverage

Spatial Extent: N:24.60302 E:-156.2798 S:22.75 W:-158

Temporal Extent: 2014-12-11 - 2015-08-03

Dataset Description

Trace element water samples from KM1513 were collected with the MIT Automated Trace Element (ATE) sampler, deployed with a teflon-coated wire from the ship's deck for surface water samples (collected at roughly 10 m depth), and with the ATEs attached to PVC "Vanes" designed to prevent contamination from the ship's steel wire for samples collected at greater depth. Samples were filtered at 0.4 μm immediately after collection through polycarbonate track etched filters (Nucleopore) into 250 mL HDPE bottles and acidified to 0.012 M hydrochloric acid (ultrapure by quadruple distillation in a Vycor still; $\sim\text{pH } 2$) at sea. Sampling and filtration followed published protocols used previously at Station ALOHA, for direct comparison (Fitzsimmons et al., 2015). These casts mostly aligned with Niskin cast station locations, but in some cases did not.

Acquisition Description

Thorium isotope samples were collected from the ship's Niskin bottle rosette, and in some cases, surface water (from roughly 15 m depth) was also collected using a Teflon diaphragm pump (Cole Palmer) operated from the ship's deck. Water was filtered at 0.45 μm using Acropak filter cartridges and acidified to 0.024 M HCl ($\sim\text{pH } 1.5$) at sea.

Surface samples for both trace elements and thorium isotopes were taken every 12 hours between July 25 and August 3, roughly at sunrise and sunset (Hawaii Standard Time). This timing was motivated to observe the maximum possible change in dissolved elemental concentrations since it coincides with the highest contrast in surface water biomass (maximum at sunset, minimum at sunrise). Depth profile samples for trace elements were collected on July 30 at 10:00 AM, except for the sample from 180 m, which was collected on August 2 at 4:00 PM, due to a misfiring of the original 180 m Vanes deployment. Thorium depth profile samples were collected on July 31 at 2:00 AM (station 43 of KM1513).

On KM1427 (December 2014), thorium isotope samples were collected as on KM1513.

The elements Sc, Mn, Fe, Co, Ni, Cu, Zn, Cd, and Pb from the Lagrangian sampling (KM1513) were analyzed at Texas A&M University using an offline SeaFAST-pico preconcentration system (ESI, Omaha, NE) and a Thermo Finnigan Element XR high-resolution inductively-coupled mass spectrometer (HR-ICP-MS) housed at the R. Ken Williams Radiogenic Isotope Facility. Notably, samples were not UV oxidized, and thus cobalt concentrations must be considered to be operationally defined ICP-labile cobalt (ICo). Accuracy was assessed by analyzing aliquots of the SAFe D1 seawater consensus standard. Precision is reported as error bars for each analysis and

was assessed using the standard deviation of duplicate or triplicate analyses of all samples.

Note trace metal data that did not meet the principal of oceanographic consistency were marked in parentheses in the worksheet. These data could not be determined specifically to have been contaminated but we treat them with caution and they were not considered in the publication.

Thorium isotopes (^{232}Th and ^{230}Th) were analyzed at MIT by Fe co-precipitation from 4 L samples, acid digestion, anion exchange chromatography, and a Nu Plasma II ICP-MS. Accuracy was assessed by analysis of the SWS2010-1 standard (Anderson et al., 2012) (Table 2) as well as an in-house thorium isotope standard (MITh-1). Reported uncertainty for thorium isotopes represents the uncertainty in isotope ratios measured on the ICP-MS.

Select samples were also analyzed for dissolved aluminum (dAl) concentrations. These samples were sub-sampled from the water filtered from the ATE sampler, filtered directly into 125 mL acid washed PMP bottles and acidified to 0.006 M HCl and microwaved for 58 seconds/125mL of sample. These samples were then acidified to 0.012 M HCl (~pH 2) and stored for shipboard analysis on a later cruise (R/V Revelle cruise RR1815 in November 2018) for dAl using flow injection analyses. Replicate standards were used to assess precision and accuracy of this method, and reported errors are the relative standard deviation of standard analyses.

Processing Description

No data processing were necessary.

BCO-DMO Processing Notes:

- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- Converted available date time combinations to ISO 8601 formatted date and time.
- Converted Longitude values from degrees West to degrees East.

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Related Publications

Bell, J., Betts, J., & Boyle, E. (2002). MITESS: a moored in situ trace element serial sampler for deep-sea moorings. *Deep Sea Research Part I: Oceanographic Research Papers*, 49(11), 2103–2118. doi:10.1016/S0967-0637(02)00126-7 [https://doi.org/10.1016/S0967-0637\(02\)00126-7](https://doi.org/10.1016/S0967-0637(02)00126-7)
[\[details\]](#)

Fitzsimmons, J. N., Hayes, C. T., Al-Subiai, S. N., Zhang, R., Morton, P. L., Weisend, R. E., ...

Boyle, E. A. (2015). Daily to decadal variability of size-fractionated iron and iron-binding ligands at the Hawaii Ocean Time-series Station ALOHA. *Geochimica et Cosmochimica Acta*, 171, 303–324. doi:[10.1016/j.gca.2015.08.012](https://doi.org/10.1016/j.gca.2015.08.012) [[details](#)]

Hayes, C. T., J. N. Fitzsimmons, L. T. Jensen, N. T. Lanning, M. Hatta, D. McGee, E. A. Boyle (2020), A Lagrangian view of trace elements and isotopes in the North Pacific, *Journal of Geophysical Research: Oceans*. [[details](#)]

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Parameters

Parameter	Description	Units
Cruise	ship and cruise number	unitless
Sample_Time	date and time of sample in HST	unitless
Depth	water depth	meters (m)
Unit_Cast_Niskin	Sampling Unit or Cast/Niskin number	unitless
Latitude	latitude with positive North	decimal degrees
Longitude	longitude with positive East	decimal degrees
Mn_D_CONC	concentration of dissolved Manganese	nanomole per kilogram (nmole/kg)
Mn_D_CONC_ERROR	concentration of dissolved Manganese error	nanomole per kilogram (nmole/kg)
Fe_D_CONC	concentration of dissolved Iron	nanomole per kilogram (nmole/kg)
Fe_D_CONC_ERROR	concentration of dissolved Iron error	nanomole per kilogram (nmole/kg)

Co_L_CONC	concentration of labile Cobalt	picomole per kilogram (pmole/kg)
Co_L_CONC_ERROR	concentration of labile Cobalt error	picomole per kilogram (pmole/kg)
Ni_D_CONC	concentration of dissolved Nickle	nanomole per kilogram (nmole/kg)
Ni_D_CONC_ERROR	concentration of dissolved Nickle error	nanomole per kilogram (nmole/kg)
Cu_D_CONC	concentration of dissolved Copper	nanomole per kilogram (nmole/kg)
Cu_D_CONC_ERROR	concentration of dissolved Copper error	nanomole per kilogram (nmole/kg)
Zn_D_CONC	concentration of dissolved Zinc	nanomole per kilogram (nmole/kg)
Zn_D_CONC_ERROR	concentration of dissolved Zinc error	nanomole per kilogram (nmole/kg)
Cd_D_CONC	concentration of dissolved Cadmium	picomole per kilogram (pmole/kg)

Cd_D_CONC_ERROR	concentration of dissolved Cadmium error	picomole per kilogram (pmole/kg)
Pb_D_CONC	concentration of dissolved Lead	picomole per kilogram (pmole/kg)
Pb_D_CONC_ERROR	concentration of dissolved Lead error	picomole per kilogram (pmole/kg)
Sc_D_CONC	concentration of dissolved Scandium	picomole per kilogram (pmole/kg)
Sc_D_CONC_ERROR	concentration of dissolved Scandium error	picomole per kilogram (pmole/kg)
Th_232_D_CONC	concentration of dissolved Thorium-232	femtomole per kilogram (fmole/kg)
Th_232_D_CONC_ERROR	concentration of dissolved Thorium-232 error	femtomole per kilogram (fmole/kg)
Th_230_D_CONC	concentration of dissolved Thorium-230	micro-Bq/kg
Th_230_D_CONC_ERROR	concentration of dissolved Thorium-230 error	micro-Bq/kg
Al_D_CONC	concentration of dissolved Aluminum	nanomole per kilogram (nmole/kg)

PHSPHT_INT	Phosphate values based on interpolation of the nearest available station (45) on the same cruise for the purposes of calculating metal:nutrient ratios (original nutrient data available here: http://hahana.soest.hawaii.edu/hoelegacy/data/data.html)	micromole per kilogram (umole/kg)
NO2_NO3_INT	Nitrate values based on interpolation of the nearest available station (45) on the same cruise for the purposes of calculating metal:nutrient ratios (original nutrient data available here: http://hahana.soest.hawaii.edu/hoelegacy/data/data.html)	micromole per kilogram (umole/kg)
SILCAT_INT	Silicate values based on interpolation of the nearest available station (45) on the same cruise for the purposes of calculating metal:nutrient ratios (original nutrient data available here: http://hahana.soest.hawaii.edu/hoelegacy/data/data.html)	micromole per kilogram (umole/kg)
ISO_DateTime.UTC	date and time formatted following ISO8601 conventions	unitless

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Instruments

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Standard Niskin bottle rosettes were used for thorium sampling.
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24 or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	MIT Automated Trace Element (ATE) sampler
Generic Instrument Name	Trace element sampler
Dataset-specific Description	The MIT Automated Trace Element (ATE) sampler (Bell et al., 2002) was used for trace metal sampling.
Generic Instrument Description	Automated trace element sampler (MITESS or ATE unit). Bell, J., J. Betts, and E. Boyle (2002) MITESS: A Moored In-situ Trace Element Serial Sampler for Deep-Sea Moorings, Deep-Sea Research I: 49:2103-2118 (pdf) More description: http://boyle.mit.edu/~ed/MITESS/MITESShomepage.html

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Deployments

KM1513

Website	https://www.bco-dmo.org/deployment/640720
Platform	R/V Kilo Moana
Start Date	2015-07-24
End Date	2015-08-05
Description	The objective of the cruise is deploy free-drifting surface drifters in the vicinity of the Hawaii Ocean Time-series (HOT) station (Station ALOHA), which is defined as a circle with a 6 nautical mile radius centered at 22° 45'N, 158°W. The surface drifters will be monitored for the duration of the cruise and the Kilo Moana will conduct water-column sampling using the CTD-rosette alongside one of the drifters for the duration of the cruise. Cruise Plan Cruise Binder

KM1427

Website	https://www.bco-dmo.org/deployment/734731
Platform	R/V Kilo Moana
Start Date	2014-12-08
End Date	2014-12-12

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Project Information

Center for Microbial Oceanography: Research and Education (C-MORE)

Website: <http://cmore.soest.hawaii.edu/>

Coverage: North Pacific Subtropical Gyre (large region around 22 45 N, 158 W)

Project summary The Center for Microbial Oceanography: Research and Education (C-MORE) is a recently established (August 2006; NSF award: EF-0424599) NSF-sponsored Science and Technology Center designed to facilitate a more comprehensive understanding of the diverse assemblages of microorganisms in the sea, ranging from the genetic basis of marine microbial biogeochemistry including the metabolic regulation and environmental controls of gene expression, to the processes that underpin the fluxes of carbon, related bioelements and energy in the marine environment. Stated holistically, C-MORE's primary mission is: Linking Genomes to Biomes. We believe that the time is right to address several major, long-standing questions in microbial oceanography. Recent advances in the application of molecular techniques have provided an unprecedented view of the structure, diversity and possible function of sea microbes. By combining these and other novel approaches with more well-established techniques in microbiology, oceanography and ecology, it may be possible to develop a meaningful predictive understanding of the ocean with respect to energy transduction, carbon sequestration, bioelement cycling and the probable response of marine ecosystems to global environmental variability and climate change. The strength of C-MORE resides in the synergy created by bringing together experts who traditionally have not worked together and this, in turn, will facilitate the creation and dissemination of new knowledge on the role of marine microbes in global habitability. The new Center will design and conduct novel research, broker partnerships, increase diversity of human resources, implement education and outreach programs, and utilize comprehensive information about microbial life in the sea. The Center will bring together teams of scientists, educators and community members who otherwise do not have an opportunity to communicate, collaborate or design creative solutions to long-term ecosystem scale problems. The Center's research will be organized around four interconnected themes: (Theme I) microbial biodiversity, (Theme II)

metabolism and C-N-P-energy flow, (Theme III) remote and continuous sensing and links to climate variability, and (Theme IV) ecosystem modeling, simulation and prediction. Each theme will have a leader to help coordinate the research programs and to facilitate interactions among the other related themes. The education programs will focus on pre-college curriculum enhancements, in service teacher training and formal undergraduate/graduate and post-doctoral programs to prepare the next generation of microbial oceanographers. The Center will establish and maintain creative outreach programs to help diffuse the new knowledge gained into society at large including policymakers. The Center's activities will be dispersed among five partner institutions: Massachusetts Institute of Technology, Woods Hole Oceanographic Institution, Monterey Bay Aquarium Research Institute, University of California at Santa Cruz and Oregon State University and will be coordinated at the University of Hawaii at Manoa. Related Files: Strategic plan (PDF file)

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Funding

Funding Source	Award
NSF Emerging Frontiers Division (NSF EF)	EF-0424599

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