Dissolved aluminum (Al) and manganese (Mn) and total dissolvable Al and Mn from subsurface water samples collected during three cruises in 2010 in the northern Gulf of Alaska

Website: https://www.bco-dmo.org/dataset/891918
Data Type: Cruise Results
Version: 1
Version Date: 2023-03-14

Project
» US GEOTRACES Pacific Section-Shipboard Al, Mn and Fe (EPZT Shipboard Al Mn Fe)

Contributors	Affiliation	Role
Crusius, John	USGS Alaska Science Center at University of Washington, School of Oceanography	Co-Principal Investigator
Resing, Joseph A.	UW-NOAA Joint Institute for the Study of the Atmosphere and Ocean (JISAO)	Co-Principal Investigator
Campbell, Robert William	Prince William Sound Science Center (PWSSC)	Scientist
Michael, Susanna	University of Washington (UW)	Scientist
Schroth, Andrew	University of Vermont (UVM)	Scientist
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Water samples were collected along a transect during three cruises in 2010 (7-9 April, 5-7 May, and 27-29 July) in the northern Gulf of Alaska, from the mouth of the Copper River to about 50 kilometers past the shelf break. Vertical profiles were collected using Teflon-lined Niskin bottles attached to a Spectra™ (Dyneema) line and triggered using Teflon-lined messengers. Additionally, profiles of salinity, temperature, fluorescence, and turbidity were measured with a Seabird SBE16 CTD, deployed at the same time as the collection of the subsurface water samples. Water samples were processed in the shipboard clean lab within three hours of collection. Dissolved samples were filtered using acid-washed 0.45-micrometer Pall-Supor filters. All samples were acidified to pH 1.8 using Seastar grade HCl within 3 days and stored for 5 years before analysis. Filtered samples were analyzed for dissolved aluminum (Al) and unfiltered samples were analyzed for total dissolvable Al using Flow Injection Analysis (Resing and Measures 1994) using fluorescent detection of lumogallion. Filtered samples were analyzed for dissolved manganese (Mn) and unfiltered samples were analyzed for total dissolvable Mn according to the method of Resing and Mottl (1992), which uses spectroscopic detection of leuchomalachite green.

Table of Contents

Coverage

Spatial Extent: **N**:60.1914 **E**:-144.916 **S**:59.0767 **W**:-145.2
Temporal Extent: 2010-04-07 - 2010-07-29

Dataset Description

These data were funded through the following: NSF OCE-1237011; NOAA-PMEL Earth Ocean Interactions Program, NOAA Cooperative Agreement NA15OAR4320063, Contribution No. 2022-1176; and by the Cooperative Institute for Climate, Ocean, & Ecosystem Studies (CIOCES) under NOAA Cooperative Agreement NA20OAR4320271, Contribution No. 2022-1176, and PMEL Contribution No. 5345.

Methods & Sampling

Data were collected from the Northern Gulf of Alaska, along the shelf and slope from the mouth of the Copper River to about 50 kilometers (km) past the shelf break. This was roughly along a N/S transect along ~145º West, between 59º North and 60.2º North and a few samples collected along an E/W transect between ~146º West and 145º West. Sample collection occurred during three research cruises in 2010 (7-9 April (CR2010-01), 5-7 May (CR2010-02), and 27-29 July (CR2010-04).

Samples below the surface were collected using 8 L externally closed Niskin bottles whose inner face was Teflon-coated, attached to Spectra (Dyneema) line, and triggered at depth using Teflon-lined messengers. Additionally, profiles of salinity, temperature, fluorescence, and turbidity were measured with a Seabird SBE16 CTD, deployed at the same time as the collection of the subsurface water samples. All water column profiles were carried out to within roughly 5 m of the maximum water depth, except at station 5, where the water depth was ~4000 m. Niskin bottles were processed in the shipboard clean lab within 3 hours or less of sample collection. Acid-washed 0.45 µm Pall Supor filters were used in the clean lab to filter the seawater samples collected using Niskin bottles, also under N_2 pressure. All trace metal samples were stored double-bagged in acid-cleaned low-density polyethylene bottles and acidified to pH 1.8 in the shipboard clean lab with Seastar™ concentrated HCl within 3 days of collection, then stored for >6 months prior to analysis.

Surface waters were sampled by underway pumping of seawater through Teflon-lined tubing using a technique adapted from that of Vink et al. (2000), with the intake positioned a few centimeters forward from, and mounted to, a PVC towfish towed ~2 meters (m) below the surface. Data from surface samples are available as a related dataset (BCO-DMO dataset 891941).

Filtered samples were analyzed for dissolved aluminum (Al) and unfiltered samples were analyzed for total dissolvable Al using Flow Injection Analysis (Resing and Measures 1994) using fluorescent detection of lumogallion. Samples exceeding 100 nanomolar (nM) were diluted with low-aluminum, low-manganese seawater to ensure linear response of the standard curve. Samples were assigned to a low, medium, or high standard curve depending on concentration. Low concentration samples were considered to be 0-20 nM, medium: 10-100, and high 100-2000 nM. Standards of 0, 1, 5, and 15 nM (low curve); 10, 50, 100 nM (medium curve); and 750 nM and 2000 nM (high curve) were analyzed in replicate. For the low curve, the detection limit was 0.79 nM, and 1 nM standards had a relative standard deviation (RSD) of 33% (n = 8). The minimum concentration of all samples analyzed was 3.7 nM; there were only four samples with concentrations less than 5 nM. The 5 nM standard had an RSD of 6% (n = 10), and the 15 nM standard had an RSD of 3% (n = 10). For the medium curve, the 10 nM standard had an RSD of 4% (n = 10), and the 50 nM and 100 nM standards had RSDs of 1%. The 750 nM and 2000 nM standards were measured to have a relative standard deviation <1%.

Filtered samples were analyzed for dissolved manganese (Mn) and unfiltered samples were analyzed for total dissolvable Mn according to the method of Resing and Mottl (1992), which uses spectroscopic detection of leuchomalachite green. A similar method to that described above was used to determine the accuracy of the wide spread of the data. Standards were run 10 times in succession to determine the daily precision. The 5 nM standard had a relative standard deviation of 3%, the 20 nM and 50 nM standards had RSDs of 1%. A sample collected during the campaign was used as an internal standard and analyzed at least daily, with a concentration determined to be 25.2 nM ± 0.7 (1 SD, n = 20). The limit of detection was determined by analyzing the lowest standard (0.52 nM) in replicate (SD = 0.86 nM). This value is 12% of the lowest sample analyzed.

Known Issues/Problems:
CTD data for April Station 5 does not extend to depth, and the CTD profile for April Station 3 was not collected.

Data Processing Description

BCO-DMO Processing:
- converted date-time field to ISO 8601 format;
- renamed fields to comply with BCO-DMO naming conventions.

[table of contents | back to top]

Data Files

File
2010_vertical_casts.csv (Comma Separated Values (.csv), 9.49 KB) MD5:f9821b965005ebc6e6b35a80a42ab303 Primary data file for dataset ID 891918.

[table of contents | back to top]

Related Publications

Crusius, J., Schroth, A. W., Resing, J. A., Cullen, J., & Campbell, R. W. (2017). Seasonal and spatial variabilities in northern Gulf of Alaska surface water iron concentrations driven by shelf sediment resuspension, glacial meltwater, a Yakutat eddy, and dust. Global Biogeochemical Cycles, 31(6), 942–960. Portico. https://doi.org/10.1002/2016gb005493
Related Research

Michael, S. M., Crusius, J., Schroth, A. W., Campbell, R., & Resing, J. A. (2023). Glacial meltwater and sediment resuspension can be important sources of dissolved and total dissolvable aluminum and manganese to coastal ocean surface waters. Limnology and Oceanography, 68(6), 1201–1215. Portico. https://doi.org/10.1002/lno.12339
Results

Resing, J. A., & Measures, C. I. (1994). Fluorometric Determination of Al in Seawater by Flow Injection Analysis with In-Line Preconcentration. Analytical Chemistry, 66(22), 4105–4111. doi:10.1021/ac00094a039
Methods

Resing, J. A., & Mottl, M. J. (1992). Determination of manganese in seawater using flow injection analysis with on-line preconcentration and spectrophotometric detection. Analytical Chemistry, 64(22), 2682–2687. doi:10.1021/ac00046a006
Methods

Vink, S., Boyle, E. A., Measures, C. I., & Yuan, J. (2000). Automated high resolution determination of the trace elements iron and aluminium in the surface ocean using a towed Fish coupled to flow injection analysis. Deep Sea Research Part I: Oceanographic Research Papers, 47(6), 1141–1156. https://doi.org/10.1016/s0967-0637(99)00074-6 https://doi.org/10.1016/S0967-0637(99)00074-6
Methods

[table of contents | back to top]

Related Datasets

IsRelatedTo

Crusius, J., Resing, J. A., Campbell, R. W., Michael, S., Schroth, A. (2023) **Dissolved aluminum (Al) and manganese (Mn) and total dissolvable Al and Mn from surface water samples collected during three cruises in 2010 in the northern Gulf of Alaska.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-03-14 doi:10.26008/1912/bco-dmo.891941.1 [view at BCO-DMO]
Relationship Description: Both datasets were collected and analyzed together. 891918 contains data from the sub-surface (vertical profiling) samples and 891941 contains data from the surface samples.

Crusius, J., Schroth, A. W., Resing, J. A., Cullen, J., & Campbell, R. W. (2017). Gulf of Alaska Shelf and Slope Iron and Nitrate data, Copper River Region, 2010 [Data set]. U.S. Geological Survey. https://doi.org/10.5066/F7222S06

[table of contents | back to top]

Parameters

Parameter	Description	Units
Cruise	Cruise number	unitless
Station	Station number (1-5)	unitless
Depth	water depth	meters (m)
ISO_DateTime_UTC	Station timestamp (UTC) in ISO 8601 format	unitless
Latitude_degN	Sample latitude	degrees North
Longitude_degE	Sample longitude	degrees East
DAl	Dissolved Aluminum	nanomolar concentration (nM)
TDAl	Total Dissolvable Aluminum	nanomolar concentration (nM)
DMn	Dissolved Manganese	nanomolar concentration (nM)
TDMn	Total Dissolvable Manganese	nanomolar concentration (nM)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Seabird SBE16 CTD
Generic Instrument Name	CTD Sea-Bird
Generic Instrument Description	Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics, no specific unit identified. This instrument designation is used when specific make and model are not known. See also other SeaBird instruments listed under CTD. More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	Flow Injection Analysis
Generic Instrument Name	Flow Injection Analyzer
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	8 L externally closed Niskin bottles
Generic Instrument Name	Niskin bottle
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.

[table of contents | back to top]

Deployments

CR2010-01

Website	https://www.bco-dmo.org/deployment/914018
Platform	R/V Montague
Start Date	2010-04-07
End Date	2010-04-09

CR2010-02

Website	https://www.bco-dmo.org/deployment/914019
Platform	R/V Montague
Start Date	2010-05-05
End Date	2010-05-07

CR2010-04

Website	https://www.bco-dmo.org/deployment/914020
Platform	R/V Montague
Start Date	2010-07-27
End Date	2010-07-29

[table of contents | back to top]

Project Information

US GEOTRACES Pacific Section-Shipboard Al, Mn and Fe (EPZT Shipboard Al Mn Fe)

Coverage: Eastern South Pacific Ocean

Description from NSF award abstract:
The 2013 GEOTRACES Eastern Pacific Zonal transect cruise will transit from the highly productive coastal upwelling region off Peru to the stratified oligotrophic waters of the South Pacific subtropical gyre on its way to

Tahiti. A range of subsurface oxygen depleted water and sedimentary inputs from the Peru margin will be encountered, as well as hydrothermal vents at 15°S on the East Pacific Rise (EPR). Scientists from the University of Washington and Old Dominion University plan to analyze seawater samples for dissolved and total-dissolvable aluminum (Al), manganese (Mn), and iron (Fe) in water column samples. The dissolved Al, Mn, and Fe in samples from the upper water column (<1000 m depth) will be analyzed onboard to ensure samples being collected are uncontaminated, as well as samples from west of the EPR at hydrothermal plume depths. The shipboard analyses will be augmented by shore-based analyses of water column samples from all depths, as well as analyses of total-dissolvable Al, Mn, and Fe, which will complement the direct analyses of particulate metals undertaken by other GEOTRACES investigators. Results will be used to test the following hypotheses concerning the sources and cycling of Al, Mn and Fe in the ocean: (1) when Aeolian inputs are relatively constant, dissolved Al concentrations in surface waters vary as a function of biological production; (2) concentration maxima of dissolved Al, Mn, and Fe in subsurface waters of the Eastern Pacific oxygen minimum zone are the result of lateral transport from the continental margin by means of resuspension and remobilization; and (3) values about ambient levels with conservative behavior will be encountered in the neutrally buoyant plume about the East Pacific Rise ridge crest for dissolved Fe and Al.

As regards broader impacts, results from the study would be disseminated to the public via lectures, the internet, and press releases. One graduate and one undergraduate student from the University of Washington would be supported and trained as part of this project.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1237011

[table of contents | back to top]