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

Website: https://www.bco-dmo.org/dataset/891941
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
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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 km past the shelf break. Surface samples were collected by underway pumping using Teflon-lined tubing, using a method modified from Vink et al. (2000). Filtered dissolved metal surface samples were collected using a 0.45 µm in-line Acropore filter under N_2 pressure. Water samples were processed in the shipboard clean lab within three hours of collection. Dissolved samples were filtered using acid-washed 0.45 µm 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 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 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.

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Coverage

Spatial Extent: **N**:60.1926 **E**:-144.926 **S**:59.0789 **W**:-145.172

Temporal Extent: 2010-04-08 - 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).

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. The towfish was suspended by a polyester line from a boom extending ~10 m from the starboard side of the ship to minimize contamination. Seawater was pumped using a shipboard air-operated Teflon-lined diaphragm pump to a shipboard clean lab, where both filtered and unfiltered samples were collected. Acropore cartridges (0.45 micrometers (µm)) were used to filter the surface water samples inline under N_2 pressure, without requiring any intermediate collection vessel, after flushing 10 liters (L) through each cartridge before first use. Surface water salinity, temperature, and sampling depth were logged once per minute using a YSI Sonde attached to the towfish.

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. Data from sub-surface samples are available as a related dataset (BCO-DMO dataset 891918).

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.

Data Processing Description

BCO-DMO Processing:

- converted date-time field to ISO 8601 format;
- renamed fields to comply with BCO-DMO naming conventions;
- removed the Notes field (empty).

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Data Files

File
2010_surface_samples.csv(Comma Separated Values (.csv), 5.53 KB) MD5:f77ca53658636546e117f90d51a66b0b Primary data file for dataset ID 891941.

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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

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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 subsurface 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.891918.1 [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

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Parameters

Parameter	Description	Units
Latitude_degN	Sample latitude	degrees North
Longitude_degE	Sample longitude	degrees East
ISO_DateTime_UTC	Station timestamp (UTC) in ISO 8601 format	unitless
YSI_Depth	depth of the sonde	meters (m)
Surface_Salinity	salinity at the surface	PSU
Distance_from_Shore	calculated distance from shore	kilometers (km)
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)

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Instruments

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	PVC towfish
Generic Instrument Name	GeoFish Towed near-Surface Sampler
Dataset-specific Description	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. The towfish was suspended by a polyester line from a boom extending ~10 m from the starboard side of the ship to minimize contamination. Seawater was pumped using a shipboard air-operated Teflon-lined diaphragm pump to a shipboard clean lab, where both filtered and unfiltered samples were collected. Acropore cartridges (0.45 micrometers (µm)) were used to filter the surface water samples inline under N2 pressure, without requiring any intermediate collection vessel, after flushing 10 liters (L) through each cartridge before first use. Surface water salinity, temperature, and sampling depth were logged once per minute using a YSI Sonde attached to the towfish.
Generic Instrument Description	The GeoFish towed sampler is a custom designed near surface (

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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

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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.

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Funding

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

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