Aerosol Nitrate (NO3) from samples collected on the US GEOTRACES Arctic cruise (HLY1502) from August to October 2015

Website: https://www.bco-dmo.org/dataset/753147
Data Type: Cruise Results
Version: 1
Version Date: 2019-01-17

Project
» U.S. Arctic GEOTRACES Study (GN01) (U.S. GEOTRACES Arctic)
» Collaborative Research: GEOTRACES Arctic Ocean section-Constraining Nitrogen Cycling in the western Arctic Ocean. (US GEOTRACES Arctic Nitrogen Flux)

Program
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **N**:89.9413 **E**:171.6882 **S**:56.0743 **W**:-104.19
Temporal Extent: 2015-08-10 - 2015-10-09

Dataset Description

This dataset contains concentration and nitrogen and oxygen isotopic composition of aerosol nitrate collected during the U.S. GEOTRACES ARCTIC research cruise in 2015.

Methods & Sampling

Samples were collected using Florida State University's high volume aerosol sampler (Tisch Environmental TSP TE5170V), during the US GEOTRACES Arctic cruise, USCG Healy (HLY1502), which took place from August 9, 2015 - October 12, 2015. Samples were collected at the rate of 1 cubic meter per minute on Whatman 47 mm discs (glass fiber; GF) or quartz microfiber; QMA) and were pre-combusted before deployment.

Methods for collection of filter and extraction of nitrate are described in Morton et al. (Limnology and Oceanography: Methods; 2013). Filters were stored frozen until processing. Filters were soaked in 30 mL ultrapure (18 Megaohm) water, sonicated, and then filtered via syringe filters.

Concentration analysis of samples was completed using an automated colorimetric system (WestCo SmartChem 200); the pooled standard deviation of control standards run within each sample set run was 0.3 micromoles per Liter (6.2 ppb nitrate); detection limit was 0.09 micromoles per Liter. Based upon nitrate concentration, 20 nmol of N were injected into vials containing denitrifying bacteria to convert nitrate to nitrous oxide for isotopic analysis on a ThermoFisher Delta V isotope ratio mass spectrometer. Analysis for d15N and d18O of nitrate are described in Sigman et al. (Analytical Chemistry; 2001), Casciotti et al. (Analytical Chemistry; 2002), McIlvin and Casciotti (Analytical Chemistry; 2011). Kaiser et al. (Analytical Chemistry; 2007) describes similar methodology for the determination of D17O of nitrate. D17O analyses require 50 nmol of N for complete analysis.

Data Processing Description

NOTE: Not enough nitrate for D17O analysis for aerosol samples. No NH4 or H2O isotope analyses were conducted for these samples.

As described in Kaiser et al. (2007), isotopic data is corrected and standardized to international reference materials IAEA-N3, USGS34, and USGS35, which are run 3-9 times with each sample run. For d15N, samples are corrected for isobaric interferences and a blank associated with the bacteria. For d18O, samples are corrected for isobaric interferences, blank, and exchange between sample nitrate and background water that takes place during denitrification to nitrous oxide. The pooled standard deviation for the reference materials are (n=88): 0.2 per mil for d15N and 0.7 per mil for d18O of IAEA-N3; 0.3 per mil for d15N and 0.7 per mil for d18O of USGS34; and 0.7 per mil for d18O of USGS35 (sample d15N is not corrected for d15N of USGS35, this is used as an internal quality check and pooled standard deviation across all runs in 0.2 per mil). 10 samples were run in duplicate or triplicate and the paired pooled standard deviation (n=10) is 0.2 per mil for d15N and 0.4 per mil for d18O. Pooled standard deviation for USGS34 and USGS35 run for D17O is 0.6 and 0.9 per mil each (n=14 and 15, respectively), and replicate samples were 0.9 per mil (n=4).

Due to contamination during sample processing with syringe filters, only a subset of aerosols collected could be analyzed for isotopic characterization (n = 8 reported out of 12).

BCO-DMO Processing:
- modified parameter names (replaced spaces with underscores);
- formatted times as hh:mm;
- separated Dates_of_collection field into Date_Start and Date_End (yyyy-mm-dd).

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Data Files

File
Aerosols_NO3.csv (Comma Separated Values (.csv), 2.62 KB) MD5:ee9d077009ec4eedb5c83a726538563c Primary data file for dataset ID 753147

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Related Publications

Casciotti, K. L., Sigman, D. M., Hastings, M. G., Böhlke, J. K., & Hilkert, A. (2002). Measurement of the Oxygen Isotopic Composition of Nitrate in Seawater and Freshwater Using the Denitrifier Method. Analytical Chemistry, 74(19), 4905–4912. doi:10.1021/ac020113w
Methods

Kaiser, J., Hastings, M. G., Houlton, B. Z., Röckmann, T., & Sigman, D. M. (2007). Triple Oxygen Isotope

Analysis of Nitrate Using the Denitrifier Method and Thermal Decomposition of N2O. Analytical Chemistry, 79(2), 599–607. doi:10.1021/ac061022s
Methods

McIlvin, M. R., & Casciotti, K. L. (2011). Technical Updates to the Bacterial Method for Nitrate Isotopic Analyses. Analytical Chemistry, 83(5), 1850–1856. doi:10.1021/ac1028984
Methods

Morton, P. L., Landing, W. M., Hsu, S.-C., Milne, A., Aguilar-Islas, A. M., Baker, A. R., … Zamora, L. M. (2013). Methods for the sampling and analysis of marine aerosols: results from the 2008 GEOTRACES aerosol intercalibration experiment. Limnology and Oceanography: Methods, 11(2), 62–78. doi:10.4319/lom.2013.11.62
Methods

Sigman, D. M., Casciotti, K. L., Andreani, M., Barford, C., Galanter, M., & Böhlke, J. K. (2001). A Bacterial Method for the Nitrogen Isotopic Analysis of Nitrate in Seawater and Freshwater. Analytical Chemistry, 73(17), 4145–4153. doi:10.1021/ac010088e
Methods

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Parameters

Parameter	Description	Units
deployment_number	Deployment set number (designated by FSU filter collection team)	unitless
filter_type	Filter type (GFF = glass fiber; QMA = quartz microfiber)	unitless
GEOTRC_EVENTNO	Cruise event number	unitless
GEOTRC_SAMPNO	Log number for sample set (GEOTRACES sample number)	unitless
Dates_of_collection	Cruise collection dates in 2015. Format: m/dd - m/dd	unitless
Date_Start	Date at start of collection period. Format: yyyy-mm-dd	unitless
Date_End	Date at end of collection period. Format: yyyy-mm-dd	unitless
UTC_Start	Start time (UTC). Format: hh:mm	unitless
Latitude_Start	Latitude at start of air collection through filter; positive is North	decimal degrees
Longitude_Start	Longitude at start of air collection through filter; negative is West	decimal degrees

UTC_End	End time (UTC). Format: hh:mm	unitless
Latitude_End	Latitude at end of air collection through filter; positive is North	decimal degrees
Longitude_End	Longitude at end of air collection through filter; negative is West	decimal degrees
Collection_Time	Total time of air collection through filter, in hours	hours
Total_air_filtered	Total volume of air filtered through each filter	cubic meters of air
Extraction_Volume	Volume of ultra pure water used to extract filter nitrate	millilters (mL)
NITRATE_A_SML_CONC_HIVOL	Concentration of aerosol nitrate after accounting for volume air filtered, in micromoles per liter of air; this conversion allowed for comparable units with non-aerosol data in micromoles per liter of water	micromoles per liter of air (umol/L)
NITRATE_15_14_A_SML_DELTA_HIVOL	delta 15N of aerosol nitrate	permil vs. atmospheric N2
NITRATE_18_16_A_SML_DELTA_HIVOL	delta 18O of aerosol nitrate	permil vs. VSMOW
Comments	Comments regarding aerosol collection	unitless

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Instruments

Dataset-specific Instrument Name	Tisch TE-5170V-BL high volume aerosol sampler
Generic Instrument Name	Aerosol Sampler
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

Dataset-specific Instrument Name	WestCo SmartChem 200 discrete chemistry analyzer
Generic Instrument Name	Discrete Analyzer
Generic Instrument Description	Discrete analyzers utilize discrete reaction wells to mix and develop the colorimetric reaction, allowing for a wide variety of assays to be performed from one sample. These instruments are ideal for drinking water, wastewater, soil testing, environmental and university or research applications where multiple assays and high throughput are required.

Dataset-specific Instrument Name	ThermoFisher Delta V isotope ratio mass spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

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Deployments

HLY1502

Website	https://www.bco-dmo.org/deployment/638807
Platform	USCGC Healy
Report	https://datadocs.bco-dmo.org/docs/302/geotraces/GEOTRACES_ARCTIC/data_docs/cruise_reports/healy1502.pdf
Start Date	2015-08-09
End Date	2015-10-12
Description	Arctic transect encompassing Bering and Chukchi Shelves and the Canadian, Makarov and Amundsen sub-basins of the Arctic Ocean. The transect started in the Bering Sea (60°N) and traveled northward across the Bering Shelf, through the Bering Strait and across the Chukchi shelf, then traversing along 170-180°W across the Alpha-Mendeleev and Lomonosov Ridges to the North Pole (Amundsen basin, 90°N), and then back southward along ~150°W to terminate on the Chukchi Shelf (72°N). Additional cruise information is available in the GO-SHIP Cruise Report (PDF) and from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/HLY1502

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Project Information

U.S. Arctic GEOTRACES Study (GN01) (U.S. GEOTRACES Arctic)

Website: https://www.geotraces.org/

Coverage: Arctic Ocean; Sailing from Dutch Harbor to Dutch Harbor (GN01)

Description from NSF award abstract:
In pursuit of its goal "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions", in 2015 the International GEOTRACES Program will embark on several years of research in the Arctic Ocean. In a region where climate warming and general environmental change are occurring at amazing speed, research such as this is important for understanding the current state of Arctic Ocean geochemistry and for developing predictive capability as the regional ecosystem continues to warm and influence global oceanic and climatic conditions. The three investigators funded on this award, will manage a large team of U.S.scientists who will compete through the regular NSF proposal process to contribute their own unique expertise in marine trace metal, isotopic, and carbon cycle geochemistry to the U.S. effort. The three managers will be responsible for arranging and overseeing at-sea technical services such as hydrographic measurements, nutrient analyses, and around-the-clock management of on-deck sampling activites upon which all participants depend, and for organizing all pre- and post-cruise technical support and scientific meetings. The management team will also lead educational outreach activities for the general public in Nome and Barrow, Alaska, to explain the significance of the study to these communities and to learn from residents' insights on observed changes in the marine system. The project itself will provide for the support and training of a number of pre-doctoral students and post-doctoral researchers. Inasmuch as the Arctic Ocean is an epicenter of global climate change, findings of this study are expected to advance present capability to forecast changes in regional and globlal ecosystem and climate system functioning.

As the United States' contribution to the International GEOTRACES Arctic Ocean initiative, this project will be part of an ongoing multi-national effort to further scientific knowledge about trace elements and isotopes in the world ocean. This U.S. expedition will focus on the western Arctic Ocean in the boreal summer of 2015. The scientific team will consist of the management team funded through this award plus a team of scientists from U.S. academic institutions who will have successfully competed for and received NSF funds for specific science projects in time to participate in the final stages of cruise planning. The cruise track segments will include the Bering Strait, Chukchi shelf, and the deep Canada Basin. Several stations will be designated as so-called super stations for intense study of atmospheric aerosols, sea ice, and sediment chemistry as well as water-column processes. In total, the set of coordinated international expeditions will involve the deployment of ice-capable research ships from 6 nations (US, Canada, Germany, Sweden, UK, and Russia) across different parts of the Arctic Ocean, and application of state-of-the-art methods to unravel the complex dynamics of trace metals and isotopes that are important as oceanographic and biogeochemical tracers in the sea.

Collaborative Research: GEOTRACES Arctic Ocean section-Constraining Nitrogen Cycling in the western Arctic Ocean. (US GEOTRACES Arctic Nitrogen Flux)

Coverage: Chukchi shelf and western Arctic Ocean basins

In this project, a group of investigators from the University of Connecticut, the University of Massachusetts-Dartmouth, and Brown University will participate in the 2015 U.S. GEOTRACES Arctic expedition to determine the biogeochemistry of nitrogen in the region. In common with other multinational initiatives in the International GEOTRACES Program, the goals of the U.S. Arctic expedition are to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions. Some trace elements are essential to life, others are known biological toxins, and still others are important because they can be used as tracers of a variety of physical, chemical, and biological processes in the sea. Nitrogen is one of the two major nutrients required universally by plankton in the ocean, and this study in the Arctic Ocean will increase our understanding of the ocean?s ecology, productivity, and carbon cycle. This study will also provide training for graduate and undergraduate students, and results will be shared through public outreach events.

The state of knowledge of Arctic nitrogen (N) biogeochemistry remains cursory as compared to that in other ocean basins despite the fact that understanding Arctic Ocean nitrogen cycling is central to understanding its global biogeochemistry. For one, benthic nitrogen loss on Arctic continental shelves may represent a globally significant sink of oceanic fixed nitrogen. Second, benthic nitrogen loss on the Arctic continental shelf and slope reduces the ratio of nitrate to phosphate substantially below the mean requirements of phytoplankton nitrogen, consequently limiting primary production at the ice-free surface of the western Arctic Ocean. In light of the rapid changes in Arctic climatology, the characterization of its biogeochemistry and establishment of a

baseline from which to monitor future changes is critical. Researchers will use the stable N isotope (15N/14N) ratio in nitrate, nitrite, ammonium, and nitrogen gas determined for a suite of dissolved, particulate, atmospheric, snow, and sea-ice samples to better constrain the spatial and temporal variability of biological nitrogen transformations in the Arctic. Results from this study will provide a first order understanding of the contribution of water masses to the regional nitrogen budget, identify regional nitrogen sources and sinks, and diagnose important biological nitrogen transformations that occur on the Chukchi shelf, and in the central basins.

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Program Information

U.S. GEOTRACES (U.S. GEOTRACES)

Website: http://www.geotraces.org/

Coverage: Global

GEOTRACES is a SCOR sponsored program; and funding for program infrastructure development is provided by the U.S. National Science Foundation.

GEOTRACES gained momentum following a special symposium, S02: Biogeochemical cycling of trace elements and isotopes in the ocean and applications to constrain contemporary marine processes (GEOSECS II), at a 2003 Goldschmidt meeting convened in Japan. The GEOSECS II acronym referred to the Geochemical Ocean Section Studies To determine full water column distributions of selected trace elements and isotopes, including their concentration, chemical speciation, and physical form, along a sufficient number of sections in each ocean basin to establish the principal relationships between these distributions and with more traditional hydrographic parameters;

* To evaluate the sources, sinks, and internal cycling of these species and thereby characterize more completely the physical, chemical and biological processes regulating their distributions, and the sensitivity of these processes to global change; and

* To understand the processes that control the concentrations of geochemical species used for proxies of the past environment, both in the water column and in the substrates that reflect the water column.

GEOTRACES will be global in scope, consisting of ocean sections complemented by regional process studies. Sections and process studies will combine fieldwork, laboratory experiments and modelling. Beyond realizing the scientific objectives identified above, a natural outcome of this work will be to build a community of marine scientists who understand the processes regulating trace element cycles sufficiently well to exploit this knowledge reliably in future interdisciplinary studies.

Expand "Projects" below for information about and data resulting from individual US GEOTRACES research projects.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1435002
NSF Division of Ocean Sciences (NSF OCE)	OCE-1433989

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