Total organic carbon and total nitrogen content; and nitrogen and oxygen isotope composition of precipitation collected at Qindao, Yantai and Changdao Island, China from May 17, 2019 to August 31, 2020.

Website: https://www.bco-dmo.org/dataset/948560
Data Type: Other Field Results
Version: 1
Version Date: 2025-02-13

Project
» Collaborative Research: Characterization of Reactive Nitrogen in The North Pacific Atmosphere (North Pacific Atmos)

Contributors	Affiliation	Role
Hastings, Meredith	Brown University	Principal Investigator
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Abstract
These data include the content of total organic carbon content and total nitrogen, and nitrogen (15N) and oxygen (17O and 18O) isotope composition of precipitation collected at three fixed locations: Qindao (121°28'15" E, 31°37'21" N), Yantai (121°27'40" E, 37°31'20" N), and Changdao Island (120°45'20" E, 38°10'23" N) in China. the rainwater samples collected on the Changdao Island were via an automatic rainwater collector (Model XHARS30C, Jinshui Huayu Scientific Inc. Weifang, China), and all other rainwaters collected in Yantai and Qindao were via stainless buckets from May 17, 2019 to August 31, 2020. Recognizing the deposition from precipitation has the potential to understanding the important role of atmospheric deposition to the nitrogen cycle and biogeochemistry in the ocean. These data assess the contribution of atmospheric deposition to organic carbon and were collected by Dr. Ren Pen (pren@qnlm.ac) at the Ocean University of China.

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Coverage

Location: North Pacific Ocean
Spatial Extent: **N**:38.1731 **E**:149.5972 **S**:30.3331 **W**:120.3867
Temporal Extent: 2019-05-17 - 2020-08-31

Methods & Sampling

Precipitation samples were collected at three fixed points (Qindao (121°28'15" E, 31°37'21" N), Yantai (121°27'40" E, 37°31'20" N), and Changdao Island (120°45'20" E, 38°10'23" N)) in China from May 17, 2019 to August 31, 2020 using an automatic rainwater collector (Model XHARS30C, Jinshui Huayu Scientific Inc. Weifang, China) on Changdao and stainless buckets on Yantai and Qindao.

Data Processing Description

For these samples, we measured the concentrations of dissolved inorganic nitrogen (DIN), total dissolved nitrogen (TDN), dissolved organic nitrogen (DON), dissolved organic carbon (DOC), phosphate, dissolved silica, ammonium, nitrate, and nitrite. Additionally, nitrogen (15N) and oxygen (17O and 18O) isotopes were measured. DIN, TDN, DON, DOC, phosphate, and dissolved silica measurements were conducted at the Center for Isotope Geochemistry and Geochronology (CIGG) at the Qingdao National Laboratory for Marine Science and Technology (QNLM) in Qingdao, China. Ammonium, nitrate, and nitrite concentrations, and isotope measurements were conducted at the Department of Earth, Environmental, and Planetary Sciences at Brown University in Providence, RI (USA).

Concentrations of nutrients (DIN, PO43- , DSi) were analyzed using an autoanalyzer (Quaatro plus system). DIN concentration was the sum of NO3- , NO2- and NH4+. DON was the difference between TDN and DIN. Duplicate measurements were done for some samples.

The concentration of ammonium, nitrate, and nitrite were determined colorimetrically (indophenol blue) using a discrete UV–Vis analyzer (Westco Smartchem 200). U.S. EPA Compliant Methods 350.1 (O'Dell, 1993), 353.2 (Revision 2.0), and 354.1 were followed for ammonium, nitrate, and nitrite, respectively. Standard lab protocols were followed, including calibration to standards as well as blanks and in-house quality control measurements.

The denitrifier method (Casciotti et al., 2002; Sigman et al., 2001) was used to complete nitrate (15N/14N) and oxygen (18O/16O) isotope analyses on a continuous flow isotope ratio mass spectrometer. Values were reported in ‰ relative to standards.

Instruments:

Autoanalyzer (Quaatro plus system) – DIN, phosphate, dissolved silica

Discrete UV–Vis analyzer (Westco Smartchem 200): for ammonium, nitrate, and nitrite concentrations.

Continuous Flow Isotope Ratio Mass Spectrometer: for ammonium, nitrate, and oxygen isotope values.

BCO-DMO Processing Description

* Adjusted parameter names to comply with database requirements
* Converted sampling latitude and longitude notation from decimal, minute, seconds to decimal degrees. Rounded these fields to 4 decimals
* Converted date to ISO notation (Y-m-d)

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Data Files

File	
948560_v1_precipitation.csv	(Comma Separated Values (.csv), 6.16 KB) MD5:60fcec0bcf191bff6093d00953baf156
Primary data file for dataset ID 948560, version 1	

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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

O'Dell, J.W., 1993a. In: Method 350.1, Revision 2.0: Determination of Ammonia Nitrogen by Semi-automated Colorimetry. US EPA. https://www.epa.gov/sites/default/files/2015-08/documents/method_350-1_1993.pdf
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

U.S. EPA. (1993) In: Method 353.2, Revision 2.0 (August 1993): Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry. US EPA. Retrieved from https://www.epa.gov/sites/default/files/2015-08/documents/method_353-2_1993.pdf
Methods

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Parameters

Parameter	Description	Units
Date	Sampling date in ISO format (yyyy-mm-dd)	unitless
Site	Location name of sampling site: Qingdao, Yantai, Changdao Island or Cruise	unitless
longitude	Sampling longitude, west is negative	decimal degrees
latitude	Sampling latitude, south is negative	decimal degrees
Duplicate	Duplicate number: 1 or 2	unitless
AmmoniumConcentration_umolperL	Ammonium concentration	micromoles per lieter (umol / L)
NitrateConcentration_umolperL	Nitrate concentration	micromoles per lieter (umol / L)
NitriteConcentration_umolperL	Nitrite concentration	micromoles per lieter (umol / L)
PhosphateConcentration_umolperL	Phosphate concentration	micromoles per lieter (umol / L)
DissolvedSilicaConcentration_umolperL	Dissolved silica concentration	micromoles per lieter (umol / L)
DINConcentration_umolperL	Total dissolved inorganic nitrogen (DIN) concentration	micromoles per lieter (umol / L)

TDNConcentration_umolperL	Total dissolved nitrogen (TDN) concentration	micromoles per lieter (umol / L)
DONConcentration_umolperL	Total dissolved organic nitrogen (DON) concentration	micromoles per lieter (umol / L)
DOCConcentration_umolperL	Total dissolved organic carbon (DOC) concentration	micromoles per lieter (umol / L)
Delta15N_Nitrate	Nitrogen isotope ratio (15N/14N) of atmospheric nitrate (NO3-).	parts per thousand (permil) (‰)
Delta15N_Ammonium	Nitrogen isotope ratio (15N/14N) of atmospheric ammonium (NH4+).	parts per thousand (permil) (‰)
Delta18Oxygen_Nitrate	Oxygen isotopic ratio (18O/16O) of atmospheric nitrate (NO3-)	parts per thousand (permil) (‰)
Delta17Oxygen_Nitrate	Measured isotope value of atmospheric nitrate (NO3-)	parts per thousand (permil) (‰)

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Instruments

Dataset-specific Instrument Name	Quaatro plus system
Generic Instrument Name	Continuous Flow Analyzer
Dataset-specific Description	Autoanalyzer (Quaatro plus system) – DIN, phosphate, dissolved silica
Generic Instrument Description	A sample is injected into a flowing carrier solution passing rapidly through small-bore tubing.

Dataset-specific Instrument Name	
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Continuous Flow Isotope Ratio Mass Spectrometer: for ammonium, nitrate, and oxygen isotope values.
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).

Dataset-specific Instrument Name	Westco Smartchem 200
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	Discrete UV–Vis analyzer (Westco Smartchem 200): for ammonium, nitrate, and nitrite concentrations.
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

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Project Information

Collaborative Research: Characterization of Reactive Nitrogen in The North Pacific Atmosphere (North Pacific Atmos)

Coverage: coastal China atmosphere, Northwestern Pacific waters and atmos, Hawaii atmosphere

NSF Award Abstract:
Nitrogen is an essential element for life, and its availability can limit the growth of phytoplankton in the surface waters of the oceans. One source of nitrogen to surface waters is deposition from the atmosphere, which is the result of reactive nitrogen emissions from both human (anthropogenic) activities and natural processes. Anthropogenic nitrogen emissions to the atmosphere and nitrogen deposition to the oceans have increased exponentially since preindustrial times. In fact, global modeling studies have suggested that as much as 80% of total nitrogen deposition to the oceans is anthropogenic in origin, and that the magnitude of input to the global oceans rivals estimates of biological nitrogen fixation. The impacts associated with this increased nitrogen deposition are clear in both terrestrial and coastal systems, but the implications for open ocean biogeochemistry are less well studied. Recent work in the North Pacific Ocean (NPO) has suggested that increased nitrogen due to anthropogenic atmospheric deposition is detectable even in the open ocean, while other work can explain nutrient dynamics based upon natural biological and physical processes. The investigators propose to study the influence of both anthropogenic and natural sources on the deposition of nitrogen (as nitrate, ammonium, and organic nitrogen) in the NPO. This will be based on collection of aerosol and rainwater samples year-round at two sites: (1) Chang-Dao Island, China where they expect high anthropogenic nitrogen inputs; and (2) Oahu, Hawaii where they expect marine sources to dominate. They will also collect ship-based samples in the marine boundary layer via already planned short-term research cruises in each season. In addition to the scientific outcomes, this project will provide for human resources and professional development of the team members (faculty members, a graduate student, undergraduate student, and technicians), advance international collaborations, and contribute to education and public outreach. Identifying the sources of nitrogen deposition to the open ocean is crucial for understanding anthropogenic impacts on biogeochemical cycles. A primary question is, is nitrogen deposition the result of external, anthropogenic processes or does it represent recycled nitrogen from the ocean's point of view? The specific objectives of this project are to: characterize the atmospheric composition and sources of inorganic (ammonium and nitrate) and organic nitrogen with an emphasis on seasonality; diagnose the influence of air-sea exchange versus anthropogenic sources of nitrogen on atmospheric deposition; and determine the isotopic composition of gaseous and particulate inorganic nitrogen in the marine boundary layer via ship-based sample collections in the NPO. Using concentration and isotopic measurements of reactive nitrogen species, in addition to transport and chemical box modeling, the study aims to characterize nitrogen deposition in two locations with very different source influences. This study will provide the first comprehensive, seasonal analysis of the isotopic values of reactive nitrogen species in the NPO atmosphere where nitrogen deposition is considered intense. Ultimately this project will lead to a better understanding of how anthropogenic changes in the atmospheric nitrogen cycle may influence the biogeochemistry of the surface ocean as well as the composition of the marine atmosphere.This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851318
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851343

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