Total organic carbon content, total nitrogen content, and carbon isotope (13C and 14C) composition of atmospheric particulates from aerosol samples collected on the R/V Dong Fang Hong-3 in the western North Pacific from October to December 2019

Website: https://www.bco-dmo.org/dataset/917642
Data Type: Cruise Results
Version: 1
Version Date: 2023-12-28

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

Contributors	Affiliation	Role
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Abstract
These data include the content of total organic carbon and total nitrogen, and carbon isotope (13C and 14C) composition of atmospheric particulates collected in the western North Pacific. On-ship aerosol sampling was conducted on the R/V Dong Fang Hong-3 during a cruise to the western North Pacific from October 31 to December 1, 2019. Sampling was conducted using two portable aerosol particle samplers (model 2030, Qingdao Laoying Environmental Technology Co.) with a filter size of 9 cm O.D. Recognizing the deposition of atmospheric particulates has the potential to further understanding of the role of atmospheric deposition in the carbon cycle and biogeochemistry in the ocean. These data assess the contribution of atmospheric deposition to organic carbon and were conducted by Prof. XuChen Wang of the Key Laboratory of Marine Chemistry Theory, Ocean University of China, Qingdao 266100, China.

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Coverage

Spatial Extent: **N**:37.0003 **E**:153.333 **S**:14.0006 **W**:120.232
Temporal Extent: 2019-10-31 - 2019-11-29

Methods & Sampling

On-ship aerosol sampling was conducted on the R/V Dong Fang Hong-3 during a cruise to the western North Pacific from October 31 to December 1, 2019 (Chief Scientist Zaohui, Chen of the Ocean University of China,

(chenzhaohui@ouc.edu.cn)). The ship sailed from Qingdao, China (36°1'56"N, 120°13'56"E) to the western North Pacific (14°0'2"N, 149°35'56"E). Two portable aerosol particle samplers (model 2030, Qingdao Laoying Environmental Technology Co.) were used with a filter size of 9 centimeters (cm) O.D. (outer diameter). The GF/F filters were precombusted (550 degrees Celsius (°C), 4 hours) before use, and the sampling period was 18 to 72 hours for each filter with an air flow rate of 100 liters pers minute (L/min) based on the cruise track. A total of 16 samples were collected during the cruise.

For the aerosol samples, measurements were made of the concentrations of aerosol particulate organic carbon (POC), total nitrogen (TN), and carbon isotope (^{13}C and ^{14}C) compositions of aerosol OC. All measurements were conducted at the Center for Isotope Geochemistry and Geochronology (CIGG) at the Qingdao National Laboratory for Marine Science andTechnology (QNLM) in Qingdao, China. For atmospheric POC measurements, a cut piece of filter containing particles was acidifed first with 10% high-purity HCl to remove inorganic carbon and then dried at 50°C. Concentrations of POC and TN were measured using an elemental analyzer (Elementar vario Isotope select) with analytical standard deviations of ±0.03% for OC, and ±0.04% for TN (n = 6). The $\delta^{13}C$ values of POC were measured using a Thermal Delta V Advantage isotope ratio mass spectrometer coupled with an Elemental Analyzer-IsoLink CN. Values of $\delta^{13}C$ were reported in ‰ relative to ^{13}C standards (IAEA-CH-3, cellulose, and IAEA-600 caffeine), and the analytic precision was ≤0.2‰ (n = 10). For POC ^{14}C measurements, the pretreated filters were placed separately in double quartz tubes (precombusted at 850°C for 2 hours) with CuO and Ag wires added. The tubes were then evacuated on a vacuum line, flame sealed, and combusted at 850°C for 2 hours (Druffel et al., 1992). CO_2 resulting from POC oxidation was collected cryogenically and quantified monometrically on a vacuum line. The purified CO_2 was converted to graphite using the closed tube iron reduction method (Xu et al., 2007; Walker et al., 2019) and ^{14}C was measured by accelerator mass spectrometry (AMS, NEC 0.5MV XCAMS). $\Delta^{14}C$ results were reported, and conventional radiocarbon ages [years before present (BP)] were calculated based on the study by Stuiver and Polach (1977).

BCO-DMO Processing Description

- Imported the original file "Western Pacific Cruise datas.xlsx" into the BCO-DMO system.
- Marked "n.d." as a missing data value (missing data are blank/empty in the final CSV file).
- Renamed fields (column headers) to comply with BCO-DMO naming conventions.
- Converted latitude and longitude values from degrees, minutes, and seconds to decimal degrees.
- Rounded the latitude and longitude values to 5 decimal places.
- Converted the Date column to YYYY-MM-DD format.
- Created a date-time column in ISO 8601 format (UTC).
- Saved the final file as "917642_v1_north_pacific_atmospheric_particulates.csv".

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Data Files

File	
917642_v1_north_pacific_atmospheric_particulates.csv	(Comma Separated Values (.csv), 1.85 KB) MD5:8ddfcb4cd044b043e66ee0ed1b5fa1ce
Primary data file for dataset ID 917642, version 1	

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Related Publications

Druffel, E. R. M., Williams, P. M., Bauer, J. E., & Ertel, J. R. (1992). Cycling of dissolved and particulate organic matter in the open ocean. Journal of Geophysical Research: Oceans, 97(C10), 15639–15659. Portico. https://doi.org/10.1029/92jc01511 https://doi.org/10.1029/92JC01511
Methods

Ren, P., Luo, C., Zhang, H., Schiebel, H., Hastings, M. G., & Wang, X. (2022). Atmospheric Particles Are Major Sources of Aged Anthropogenic Organic Carbon in Marginal Seas. Environmental Science & Technology,

56(19), 14198–14207. https://doi.org/10.1021/acs.est.2c06321
Results

Stuiver, M., & Polach, H. A. (1977). Discussion Reporting of 14C Data. Radiocarbon, 19(3), 355–363. doi:10.1017/s0033822200003672 https://doi.org/10.1017/S0033822200003672
Methods

Walker, B. D., & Xu, X. (2019). An improved method for the sealed-tube zinc graphitization of microgram carbon samples and 14C AMS measurement. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 438, 58–65. https://doi.org/10.1016/j.nimb.2018.08.004
Methods

Xu, X., Trumbore, S. E., Zheng, S., Southon, J. R., McDuffee, K. E., Luttgen, M., & Liu, J. C. (2007). Modifying a sealed tube zinc reduction method for preparation of AMS graphite targets: Reducing background and attaining high precision. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 259(1), 320–329. https://doi.org/10.1016/j.nimb.2007.01.175
Methods

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Parameters

Parameter	Description	Units
Sample_number	Sample number. The atmospheric particulates samplers were labeled from 1 to 16.	unitless
Date	The sampling date	unitless
Start_time	Time when sampling started (in UTC)	unitless
Start_ISO_DateTime_UTC	Date and time (UTC) when sampling started in ISO 8601 format	unitless
Sampling_period	Duration of the sampling event	hours (h)
Latitude	Latitude of the sampling location (positive values = North)	decimal degrees
Longitude	Longitude of the sampling location (positive values = East)	decimal degrees
Total_air_volume	Total air volume during the sampling	liters (L)
Particle_weight	Atmospheric particulates weight of each sample	milligrams (mg)
Total_particulates_concentration	Concentration of total particulate matter	micrograms per cubic meter (ug/m3)
POC	Content of particulate organic carbon	percent (%)
TN	Content of total nitrogen	percent (%)
POC_d13C	d13C value of POC	per mil (‰)
d14C	d14C value of POC	per mil (‰)
d14C_stdev	Standard deviation for d14C value of POC	per mil (‰)
Age_14C	14C ages of POC	Year BP
Age_14C_stdev	Standard deviation for 14C-age of POC	Year BP

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Instruments

Dataset-specific Instrument Name	accelerator mass spectrometry
Generic Instrument Name	Accelerator Mass Spectrometer
Dataset-specific Description	The Δ14C values of POC were measured by accelerator mass spectrometry (AMS, NEC 0.5MV XCAMS).
Generic Instrument Description	An AMS measures "long-lived radionuclides that occur naturally in our environment. AMS uses a particle accelerator in conjunction with ion sources, large magnets, and detectors to separate out interferences and count single atoms in the presence of 1x1015 (a thousand million million) stable atoms, measuring the mass-to-charge ratio of the products of sample molecule disassociation, atom ionization and ion acceleration." AMS permits ultra low-level measurement of compound concentrations and isotope ratios that traditional alpha-spectrometry cannot provide. More from Purdue University: http://www.physics.purdue.edu/primelab/introduction/ams.html

Dataset-specific Instrument Name	portable aerosol particle samplers
Generic Instrument Name	Aerosol Sampler
Dataset-specific Description	Aerosol samples were collected with portable aerosol particle samplers (model 2030, Qingdao LaoyingE nvironmental Technology Co.) with a filter size of 9 cm O.D.
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

Dataset-specific Instrument Name	Elementar vario Isotope select
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	The concentrations of POC and TN were measured using an elemental analyzer (Elementar vario Isotope select).
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Thermal Delta V advantage
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	The δ13C values of POC were measured using a Thermal Delta V advantage isotope ratio mass spectrometer coupled with an Elemental Analyzer-IsoLink CN.
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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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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