Depth profiles of N2O concentrations and site preference from R/V Kilo Moana KM1314 in the The North Pacific Ocean (Seattle to Honolulu, including Line P, Station ALOHA), Aug - Sept 2013

Website: https://www.bco-dmo.org/dataset/997809
Data Type: Other Field Results
Version: 1
Version Date: 2026-07-23

Project
» Significance of nitrification in shaping planktonic biodiversity in the ocean (Nitrification and Marine Planktonic Biodiversity)

Program
» Dimensions of Biodiversity (Dimensions of Biodiversity)

Contributors	Affiliation	Role
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Abstract
Nitrous oxide (N2O) is an important greenhouse gas, and the ocean represents a significant source to the atmosphere. However, in situ measurements of N2O concentrations in the northeastern Pacific Ocean are scarce, and the processes controlling its production and consumption remain poorly constrained. During the R/V Kilo Moana cruise KM1314 (August 2013), vertical profiles were collected at Stations 1, 5, 8, and 13 from the surface to 300 m depth. The dataset includes dissolved N2O concentrations and isotopic measurements, including site preference and related isotope parameters. These observations provide constraints on the pathways and dynamics of N2O cycling in the upper water column and support investigation of nitrification and other microbial processes regulating marine N2O production in this region.

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Coverage

Spatial Extent: **N**:50 **E**:-126 **S**:30 **W**:-150
Temporal Extent: 2013-08-08 - 2013-08-29

Methods & Sampling

N2O samples were collected using Niskin bottles attached at CTD, through silicone tubing directly into Wheaton 160 mL glass serum bottles and overflowed twice before filling. The tubing was removed, and a 1 mL

headspace was introduced into each bottle before capping with a gray butyl septum. After collection, 100 µL of saturated mercuric chloride was added to each bottle and then resealed with the gray butyl septum and an aluminum crimp seal. Samples were stored in the dark at room temperature until analysis.

Data Processing Description

Raw isotope measurements of N2O were obtained using an automated purge-and-trap inlet coupled to isotope ratio mass spectrometry and normalized to injections of calibrated N2O reference gas. Measured ion ratios (31R, 45R, 46R relative to reference gas) were first converted to ratio-of-ratios values and corrected for peak size using a calibrated 20 V-second peak area at m/z 44. Isotopomer scrambling corrections were applied to obtain corrected 15Ra and 15Rb values following published procedures. Nitrogen and oxygen isotope ratios were then reported in delta notation (δ15Na, δ15Nb, δ15Nbulk, δ17O, δ18O, and site preference) relative to atmospheric N2 and VSMOW standards.

Dissolved N2O concentrations were calculated from the m/z 44 peak area using a calibrated conversion factor and a fixed extracted seawater volume of 153.8 mL. Analytical precision was determined from replicate measurements.

BCO-DMO Curation Notes

* converted latitude and longitude notation from decimal, minutes, seconds to decimal degrees
* Rounded Latitude and Longitude to maximum 5 decimal places, preserving trailing zeros only where precision exceeded 5 digits
* Adjusted parameter names to comply with database requirements

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Data Files

File
997809_v1_isotopes.csv (Comma Separated Values (.csv), 3.26 KB) MD5:585f8c6dc6a909c8f9eb195e7e75ca4d Primary data file for dataset ID 997809, version 1

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Related Publications

Frame, C. H., & Casciotti, K. L. (2010). Biogeochemical controls and isotopic signatures of nitrous oxide production by a marine ammonia-oxidizing bacterium. Biogeosciences, 7(9), 2695–2709. https://doi.org/10.5194/bg-7-2695-2010
Methods

Gluschankoff, N., Santoro, A. E., Buchwald, C., & Casciotti, K. L. (2023). Shifts in the Isotopic Composition of Nitrous Oxide Between El Niño and La Niña in the Eastern Tropical South Pacific. Global Biogeochemical Cycles, 37(10). Portico. https://doi.org/10.1029/2023gb007959 https://doi.org/10.1029/2023GB007959
Methods

McIlvin, M. R., & Casciotti, K. L. (2010). Fully automated system for stable isotopic analyses of dissolved nitrous oxide at natural abundance levels. Limnology and Oceanography: Methods, 8(2), 54–66. doi:10.4319/lom.2010.8.54
Methods

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Parameters

Parameter	Description	Units
Datetime_of_sampling	Date and time of sampling in UTC time zone	unitless
Latitude	Latitude of sampling location	decimal degrees
Longitude	Longitude of sampling location	decimal degrees
Station_ID	Station identification	unitless
Depth	Depth in meters of sampling	meters (m)
N2O_Concentration	N2O gas concentration	nmol per milliliter (nmol/L)
d15Na	Enrichment of the central 15N atom in N_2O relative to the natural abundance of nitrogen isotopes.	permille (‰)
d15Nb	Enrichment of the outer 15N atom in N_2O relative to the natural abundance of nitrogen isotopes.	permille (‰)
Sp	Difference in δ15N between the central (a) and outer (b) N atoms in the linear N2O molecule (NNO).Sp (‰)=d15Na (‰) - d15 Nb(‰)	permille (‰)
d15Nbulk	Enrichment of the 15N atoms in N_2O relative to the natural abundance of nitrogen isotopes.	permille (‰)
d17O	Enrichment of the 17O atoms in N_2O relative to the natural abundance of oxygen isotopes.	permille (‰)
d18O	Enrichment of the 18O atoms in N_2O relative to the natural abundance of oxygen isotopes.	permille (‰)

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD - profiler
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	Thermo Fisher Scientific DeltaPLUS XP 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).

Dataset-specific Instrument Name	
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.

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Deployments

KM1314

Website	https://www.bco-dmo.org/deployment/536050
Platform	R/V Kilo Moana
Start Date	2013-08-07
End Date	2013-09-05

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Project Information

Significance of nitrification in shaping planktonic biodiversity in the ocean (Nitrification and Marine Planktonic Biodiversity)

Microorganisms sustain the biogeochemical cycling of nitrogen, one of the most important nutrient cycles on earth. A key step in this cycle, the oxidation of ammonia to nitrite by autotrophic microorganisms, was for a century thought mediated by a few restricted bacterial genera. Significant ammonia oxidation, perhaps most, is now attributed to a previously enigmatic group of Archaea - the ammonia-oxidizing archaea (AOA) - of high abundance in both marine and terrestrial environments. The investigators prior physiological and environmental analyses, the foundation for this proposal, have shown that AOA are active within the marine photic zone and that their competitive fitness in the marine environment is at least in part attributable to an extremely high affinity for ammonia, growing at near maximum growth rates at concentrations of ammonia that would not sustain known bacterial ammonia oxidizers, and an unusual copper-based respiratory system that may render them more competitive in iron limited environments. The compelling inference from these prior analyses is that AOA alter and possibly control the forms of fixed nitrogen available to other microbial assemblages within the photic zone by converting ammonia, a nearly universally available form of nitrogen, into nitrite, a form only available to nitrite oxidizing bacteria and some phytoplankton. If correct, this has a significant impact on biodiversity.

The PIs will use the most recent technological advances in protein and high throughput sequencing to evaluate the significance of nitrification in shaping biodiversity (genomic and metagenomics), activity (transcriptome, proteome and stable isotope probing), and in controlling availability of an important trace element (copper). In turn, by resolving the environmental and biotic variables that influence the diversity, distribution and activity of AOA, they will advance general understanding of their taxonomy. More directly, functional knowledge of the contribution of AOA to regenerated nitrate will improve estimates of new ocean production ("biological pump") based on nitrate assimilation, which in the past has mostly neglected the importance of nitrification as a major source of nitrate. Together these studies will transform understanding of the marine nitrogen cycle, estimates of new production, and will ultimately provide a better understanding of the impact of human activity on this critical nutrient cycle.

The nitrogen cycle has been profoundly affected by anthropogenic inputs of reactive nitrogen into terrestrial, marine, and atmospheric systems having, or predicted to have, major impacts on marine biological production, increased N20 emissions, nitrogen pollution, and eutrophication. Likewise, there is a poor understanding of the relationship between nitrogen cycling and productivity in marine ecosystems. Marine systems are increasingly affected by ocean acidification and by atmospheric inputs of reactive nitrogen. Since both changes greatly alter nitrogen available to microorganisms, the characterization of the response of these environmentally relevant AOA is of tremendous relevance to understanding the affect of acidification and anthropogenic nitrogen inputs on major ocean processes.

The proposed project encompasses and integrates the three dimensions (functional genetic, and taxonomic) of biodiversity. First, the project is framed by function: microbial control of one of the most important nutrient cycles on earth, the nitrogen-cycle. Second, it is motivated by recent genetic analyses that associate activities of a novel clade of Archaea (provisionally assigned to a new kingdom within the Archaea, the Thaumarchaeota) with control of ammonia oxidation in the ocean. Third, it is built upon a compelling synthesis of physiological and environmental data that lead to its central hypothesis that by altering and possibly controlling the form of nitrogen, the AOA also alter biodiversity and ecological function in one of the most productive environments on earth. It identifies a specific taxonomic imperative. The tremendous genetic diversity among the globally abundant AOA catalogued almost exclusively by gene sequencing surveys and therefore lacking formal description makes it essential to resolve membership into ecologically relevant groups or clades as a prelude to developing a formal taxonomy. The investigators have assembled a group of researchers with specific expertise in each of dimension and uniquely qualified to address the research objectives outlined in an integrative way.

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Program Information

Dimensions of Biodiversity (Dimensions of Biodiversity)

Website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446

Coverage: global

(adapted from the NSF Synopsis of Program)
Dimensions of Biodiversity is a program solicitation from the NSF Directorate for Biological Sciences. FY 2010 was year one of the program. [MORE from NSF]

The NSF Dimensions of Biodiversity program seeks to characterize biodiversity on Earth by using integrative, innovative approaches to fill rapidly the most substantial gaps in our understanding. The program will take a broad view of biodiversity, and in its initial phase will focus on the integration of genetic, taxonomic, and functional dimensions of biodiversity. Project investigators are encouraged to integrate these three dimensions to understand the interactions and feedbacks among them. While this focus complements several core NSF programs, it differs by requiring that multiple dimensions of biodiversity be addressed simultaneously, to understand the roles of biodiversity in critical ecological and evolutionary processes.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1046017

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