Wintertime nitrate delta 15N and delta 18O from hydrocasts from R/V S. A. Agulhas II cruise VOY03 in the Southern Ocean south of Africa in 2012 (Diatom-bound_N_Isotopes project)

Website: https://www.bco-dmo.org/dataset/557616
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Project
» High-resolution, Assemblage-specific Records of Diatom-bound N Isotopes from the Indian Sector of the Antarctic Ocean (Diatom-bound_N_Isotopes)

Contributors	Affiliation	Role
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Table of Contents

Dataset Description

Wintertime nitrate delta 15N and delta 18O from the Southern Ocean south of Africa from hydrocasts taken on the July 2012 R/V *S.A. Agulhas II* VOY03 expedition. The dataset includes hydrocast (depth-profile) data along with the hydrographic data accompanying each CTD.

Note: In addition to the awards identified below, the dataset was also supported by funding from the South African National Research Foundation (NRF), Applied Centre for Climate and Earth Systems Science (ACCESS), University of Cape Town (UCT), and the Grand Challenges Program of Princeton University.

Methods & Sampling

Samples were collected aboard the R/V *S.A. Agulhas II* and analyzed in the Sigman lab at Princeton University using the "denitrifier method" to convert sample nitrate to N2O gas. The isotopic composition of N2O was measured by GC-IRMS using a Thermo MAT 253 mass spectrometer with a purpose-built on-line N2O extraction and purification system. For the nitrate+nitrite data, the pooled sample standard deviation is 0.05‰ for delta 15N (n = 3-7) and 0.17‰ for delta 18O (n = 3-5). For the 'nitrate-only' data, the pooled sample standard deviation is 0.05‰ for delta 15N (n = 3-7) and 0.13‰ for delta 18O (n = 3-7). See methods section of Smart et al. (2015) for details of sample collection, isotope analysis and data quality.

Related Publications:
Smart, S.M., S.E. Fawcett, S.J. Thomalla, M.A. Weigand, C.J.C. Reason, and D.M. Sigman. 2015. Isotopic evidence for nitrification in the Antarctic winter mixed layer, *Global Biogeochem. Cycles*, *29*, doi: 10.1002/2014GB005013.

Data Processing Description

Individual sample analyses were referenced against automated injections of N2O from a gas cylinder; however, the N2O cylinder is not used as the absolute reference. Rather, each sample run included replicates of two international reference materials, IAEA-N3 and USGS-34 that were used to calibrate isotope ratios to that of N2 in air (for delta 15N) and VSMOW (for delta 18O). An in-house N2O standard was also run with each batch of samples to monitor mass spectrometry. See methods section of Smart et al. (2015) for a description of the procedures followed.

BCO-DMO Processing Notes:
- Modified parameter names to conform with BCO-DMO naming conventions.
- Replaced blanks (missing data) with 'nd', meaning 'no data'.

[table of contents | back to top]

Data Files

File
hydrocast.csv (Comma Separated Values (.csv), 36.65 KB) MD5:4df4d76bfc615a85ffd1bc3ae7fd35b5 Primary data file for dataset ID 557616

[table of contents | back to top]

Parameters

Parameter	Description	Units
station	Station number.	dimensionless
date	Month, day, and year of sampling.	mm/dd/yy
time	Time, in hours and minutes, of sampling.	HHMM
lat	Latitude in decimal degrees North. (Negative values = South).	decimal degrees
lon	Longitude in decimal degrees East.	decimal degrees
depth_mixed_layer	Mixed layer calculated from sigma-t using ref depth = 32 m. Mixed layer depth at each station is defined as the closest depth to the surface at which sigma theta is greater by >= 0.03 kg m-3 than the value at a reference depth of 32 m (the shallowest depth common to every CTD station) (based on the criterion of de Boyer Montégut et al. (2004)).	meters
sample	Sample ID number.	dimensionless
depth	Sample depth.	meters
temp	Water temperature.	degrees Celsius (C)
sal	Salinity.	practical salinity units (psu)
oxygen_corr	Oxygen (corrected).	milliliters per liter (ml/l)
sigma_t	Potential density (sigma-theta); calculated from temperature and salinity.	kilograms per cubic meter (kg/m^3)

NO3_NO2_mean	Mean nitrate (NO3) plus nitrite (NO2) concentration of a sample in micromolar units.	micromolar (uM)
NO3_NO2_stdev	Standard deviation of the nitrate (NO3) plus nitrite (NO2) concentration of a sample in micromolar units.	micromolar (uM)
d15N_NO3_NO2_mean	delta 15N of NO3+NO2. d15N (‰ vs. AIR) is the nitrogen isotopic composition of a sample expressed in delta notation (in units of per mil) relative to atmospheric N2, where delta 15N = {[(15N/14N)sample / (15N/14N)atmN2] – 1} × 1000.	per mil
d15N_NO3_NO2_stdev	Standard deviation of d15N_NO3_NO2_mean.	per mil
d18Ocorr_NO3_NO2_mean	delta 18O of NO3+NO2. d18O (‰ vs. VSMOW) is the oxygen isotopic composition of a sample expressed in delta notation (in units of per mil) relative to Vienna Standard Mean Ocean Water (VSMOW), where delta 18O = {[(18O/16O)sample / (18O/16O)VSMOW] – 1} × 1000.	per mil
d18O_NO3_NO2_stdev	Standard deviation of d18O_NO3_NO2_mean.	per mil
NO3_mean	Mean nitrate (NO3) concentration of a sample in micromolar units, measured after nitrite (NO2) had been removed (using the protocol of Granger and Sigman (2009)).	micromolar (uM)
NO3_stdev	Standard deviation of the nitrate (NO3) concentration of a sample in micromolar units, measured after nitrite (NO2) had been removed (using the protocol of Granger and Sigman (2009)).	micromolar (uM)
d15N_NO3_mean	delta 15N of NO3. d15N (‰ vs. AIR) is the nitrogen isotopic composition of a sample expressed in delta notation (in units of per mil) relative to atmospheric N2, where delta 15N = {[(15N/14N)sample / (15N/14N)atmN2] – 1} × 1000.	per mil
d15N_NO3_stdev	Standard deviation of d15N_NO3_mean.	per mil
d18O_NO3_mean	delta 18O of NO3. d18O (‰ vs. VSMOW) is the oxygen isotopic composition of a sample expressed in delta notation (in units of per mil) relative to Vienna Standard Mean Ocean Water (VSMOW), where delta 18O = {[(18O/16O)sample / (18O/16O)VSMOW] – 1} × 1000.	per mil
d18O_NO3_stdev	Standard deviation of d18O_NO3_mean.	per mil
month	2-digit month of year.	mm (01 to 12)
day	2-digit day of month.	dd (01 to 31)
year	4-digit year.	YYYY
ISO_DateTime_UTC	Date and time (UTC) formatted to ISO 8601 standard, where T indicates the start of the time string and Z indicates UTC.	YYYY-mm-ddTHH:MM:SS.xxZ

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	CTD
Generic Instrument Name	CTD Sea-Bird
Dataset-specific Description	Circumpolar fronts were identified from surface and subsurface (200m) temperature and salinity properties using data obtained from a Sea-Bird conductivity-temperature-depth (CTD) sensor mounted on the Niskin bottle rosette, as well as from 28 underway-CTD and 88 expendable bathythermograph deployments.
Generic Instrument Description	Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics, no specific unit identified. This instrument designation is used when specific make and model are not known. See also other SeaBird instruments listed under CTD. More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	Niskin bottle
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.

Dataset-specific Instrument Name	Sea-Bird SBE 43
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Dataset-specific Description	Dissolved oxygen profiles (obtained for every CTD cast from a mounted Sea-Bird SBE 43 sensor) were used together with potential density, salinity, and nitrate profiles to identify key water masses.
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. more information from Sea-Bird Electronics

[table of contents | back to top]

Deployments

VOY03

Website	https://www.bco-dmo.org/deployment/557788
Platform	R/V S.A. Agulhas II
Start Date	2012-07-10
End Date	2012-08-06
Description	R/V S.A. Agulhas II, VOY03 (July 2012): The winter "shake-down" cruise, part of the GoodHope monitoring programme. Transect extends from the subtropics (offshore of Cape Town, South Africa; 33.9°S, 18.4°E) to just beyond the winter sea-ice edge (encountered at 56.7°S, 0.0°E), covering a 0-2000 m depth range.

[table of contents | back to top]

Project Information

High-resolution, Assemblage-specific Records of Diatom-bound N Isotopes from the Indian Sector of the Antarctic Ocean (Diatom-bound_N_Isotopes)

Coverage: Kerguelen Plateau

Description from NSF award abstract:
The high concentration of the major nutrients nitrate and phosphate is a fundamental characteristic of the Antarctic Zone in the Southern Ocean and is central to its role in global ocean fertility and the global carbon cycle. The isotopic composition of diatom-bound organic nitrogen is one of the best hopes for reconstructing the nutrient status of polar surface waters over glacial cycles, which in turn may hold the explanation for the decline in atmospheric carbon dioxide during ice ages. The PIs propose to generate detailed diatom-bound nitrogen isotope (δ15Ndb) records from high sedimentation rate cores from the Kerguelen Plateau. Because the cores were collected at relatively shallow seafloor depths, they have adequate planktonic and benthic foraminifera to develop accurate age models. The resulting data could be compared with climate records from Antarctic ice cores and other archives to investigate climate-related changes, including the major steps into and out of ice ages and the millennial-scale events that occur during ice ages and at their ends. The records generated in this project will provide a critical test of hypotheses for the cause of lower ice age CO2.

This study will contribute to the goal of understanding ice ages and past CO2 changes, which both have broad implications for future climate. Undergraduates will undertake summer internships, with the possibility of extending their work into junior year projects and senior theses. In addition, the PI will lead modules for two Princeton programs for middle school teachers and will host a teacher for a six-week summer research project.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1136345
NSF Division of Polar Programs (NSF PLR)	PLR-1401489
NSF Division of Polar Programs (NSF PLR)	PLR-0612198
NSF Division of Ocean Sciences (NSF OCE)	OCE-1060947
European Commission Seventh Framework Programme (FP7-ENV-2010)	FP7 265294

[table of contents | back to top]