

15N₂-based N₂ fixation rates from the Eastern Tropical South Pacific collected on the R/V Atlantis (AT15-61) and R/V Melville (MV1104) in 2010-2011 (N₂ fixation ETSP project)

Website: <https://www.bco-dmo.org/dataset/555666>

Data Type: Cruise Results

Version: 2016-02-29

Project

» [Collaborative Research: Documenting N₂ fixation in N deficient waters of the Eastern Tropical South Pacific](#) (N₂ fixation ETSP)

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Abstract

15N₂ incubation-based N₂ fixation rates, nitrate plus nitrite concentration and d15N, sediment trap PN mass flux and isotopic composition from the Eastern Tropical South Pacific, 2010 and 2011.

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Coverage

Spatial Extent: N:-15 E:-80 S:-20 W:-100

Temporal Extent: 2010-02-01 - 2011-04-19

Dataset Description

15N₂ incubation-based N₂ fixation rates, nitrate plus nitrite concentration and d15N, sediment trap PN mass flux and isotopic composition from the Eastern Tropical South Pacific, 2010 and 2011.

Methods & Sampling

Water column sample collection: Samples were collected on the R/V Atlantis in January through February 2010, and the R/V Melville in March through April 2011 on a zonal transect along 20° S between 80° W and 100° W, with exact station locations and sample depths, nutrient concentrations and isotopic compositions reported below. Water column samples were collected by Niskin bottles deployed on a rosette equipped with conductivity-temperature-depth (CTD) sensors. All samples were collected into acid-washed, sample-rinsed HDPE bottles, and samples from the upper 400 m passed a 0.2 µm filter before collection. All samples were stored at -20° C until analysis on land.

15N2 fixation rate measurements: Short-term N2 fixation rate measurements incubated with 15N2 gas from Sigma Aldrich (lot #s SZ1670V and MBBB0968V) were carried out in acid-washed, sample-rinsed light transparent 4 L polycarbonate bottles amended with 1.5 mL of 99% 15N2 and 1.5 mL of 0.5M NaH13CO3. Incubations were performed under simulated in situ conditions of temperature and light and run for staggered periods (e.g. 0, 12, 24 and 48 hrs). Incubations were terminated by filtration of the 4 L sample onto a precombusted 25 mm Whatman GF/F, which was then analyzed by mass spectrometry at the University of Southern California for d15N and d13C. During ESTP 1, periodic time zero incubations were measured, with samples filtered within 5 to 10 minutes of injection of 15N2. Zero time enrichments were typically near natural abundance levels with the greatest observed enrichment in 8 experiments at 23‰, essentially at natural abundance level for our tracer experiments. We assumed natural abundance (0.3663 atom %) for calculations. Limits of detection are about 10-14 µg for N and 6-10 µg for C. Reproducibility as the standard deviation for isotopic analysis is about ±0.3‰ for d15N and ±0.2‰ for d13C, and about ±0.1-0.2 µg for mass determinations.

Data Processing Description

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date
- renamed parameters to BCO-DMO standard
- added cruise id column

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Data Files

File
Nfix.csv (Comma Separated Values (.csv), 308 bytes) MD5:58ff632e413b759cd7575e87a37c4f4f Primary data file for dataset ID 555666

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Related Publications

Montoya, J. P., M. Voss, P. Kahler, and D. G. Capone. 1996. A Simple, High-Precision, High-Sensitivity Tracer Assay for N (inf2) Fixation. Applied and Environmental Microbiology 62: 986-993.

<https://aem.asm.org/content/62/3/986>

Methods

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Parameters

Parameter	Description	Units
date	sample collection date (local). Format: yyyy-mm-dd	unitless
station	station	unitless
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
depth	sample depth	meters
Nfix_umol_N_m2_d	24 hr 15N2 fixation rate	umol N m-2 d-1
Nfix_stdev	24 hr 15N2 fixation rate standard deviation	umol N m-2 d-1
cruise_id	cruise_id	unitless

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Instruments

Dataset-specific Instrument Name	CTD
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	Gas Chromatograph
Generic Instrument Name	Gas Chromatograph
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

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Deployments

AT15-61

Website	https://www.bco-dmo.org/deployment/58785
Platform	R/V Atlantis
Start Date	2010-01-29
End Date	2010-03-03
Description	See more information at R2R: https://www.rvdata.us/search/cruise/AT15-61

MV1104

Website	https://www.bco-dmo.org/deployment/555585
Platform	R/V Melville
Start Date	2011-03-23
End Date	2011-04-23
Description	See more information at R2R: https://www.rvdata.us/search/cruise/MV1104

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Project Information

Collaborative Research: Documenting N₂ fixation in N deficient waters of the Eastern Tropical South Pacific (N₂ fixation ETSP)

Coverage: Eastern Tropical South Pacific

Description from NSF award abstract:

Several independent lines of geochemical and remote sensing evidence suggest that dinitrogen (N₂) fixation may be associated with surface waters downstream of major oxygen minimum zones (OMZs) and in particular in the Eastern Tropical South Pacific (ETSP). However, little direct evidence supports these inferences. Besides substantiating these indirect assessments, documenting significant N₂ fixation in the ETSP would provide insight into two longstanding controversies: Is the marine N budget balanced, as implied by modeling and paleoceanographic data, and if so, how are the processes that add and remove N spatially, and thus temporally coupled?

In this project researchers at the University of Southern California and the University of Miami will test the hypothesis that fixation occurs in the ETSP at areal rates that equal or exceed those previously documented in more well-studied regions such as the oligotrophic waters of the sub/tropical North Atlantic. If scaled to the surface area of ETSP waters, this could add an additional 10-50 Tg N per year of inputs to the global marine N budget. They will undertake two cruises in the ETSP during early and late summer in two consecutive years to assess the quantitative significance of N₂ fixation as a source of new N to surface waters using complementary biological and geochemical tools. N₂ fixation rates will be evaluated on two temporal/spatial scales: daily/local (bottle ¹⁵N₂ incubations and floating sediment traps); and seasonal/regional (d¹⁵N budget using moored sediment traps and water column TDN d¹⁵N). These estimates provide detailed observations of potential N₂ fixation during station occupation in two summer seasons, when rates are expected to be greatest, as well as prolonged observation over lower expected N₂ fixation periods. A combination of these different estimates will aim to determine if N₂ fixation in this region can help balance the marine N budget. If all goes as planned, this study will determine the quantitative importance of N₂ fixation in the ETSP, and whether these previously undocumented rates can help resolve the marine N budget. Implications include the ability of the marine N cycle to maintain homeostasis, and thus the global C cycle on glacial/interglacial time scales.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0850801
NSF Division of Ocean Sciences (NSF OCE)	OCE-0850905

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