

Dissolved gas O₂/Ar and triple oxygen isotope discrete samples collected from 16 basin-wide transects of the North Pacific, Hong Kong - Long Beach, CA from the M/V OOCL Tianjin and M/V OOCL Tokyo, 2008-2012 (NPac Cont Ship project)

Website: <https://www.bco-dmo.org/dataset/626855>

Version: 2016-02-03

Project

» [North Pacific Surface Carbon, Oxygen and Isotope Measurements from Container Ships \(2008-\)](#) (NPac Cont Ship)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: N:49.67 E:-120 S:22.133 W:120

Temporal Extent: 2008-10-06 - 2012-12-11

Dataset Description

This dataset includes triple oxygen isotopes ($\delta^{17}\text{O}$ and $\delta^{18}\text{O}$), a tracer of gross primary production; oxygen/argon dissolved gas ratios, a tracer of net community production or carbon export; temperature and salinity. Samples were collected during transects across the Pacific Ocean from Hong Kong to Long Beach, CA on commercial container ships starting in 2008.

Related Dataset: [Carbonate chemistry and isotopes](#)

Methods & Sampling

Samples for TOI and O₂/Ar analysis were collected from shipboard seawater intake (10 m depth) on basin-wide transects of the North Pacific between Hong Kong and Long Beach, California onboard the M/V OOCL Tianjin and the M/V OOCL Tokyo (each individual transect has a unique Cruise ID) starting in 2008. Samples were collected into pre-evacuated 500-ml flasks every ~2.5° longitude across the basin following the procedures of Emerson et al. [1999]. Sea surface temperature and salinity at the time of sample collection were determined using a Sea-Bird Electronics SBE45 thermosalinograph installed in the ship's seawater intake. To prevent

biofouling that could cause respiration in the ship's seawater lines and contaminate O₂/Ar measurements [Juranek et al., 2010], intake lines between the anticorrosive sea chest and the sampling port were purged with bleach and freshwater between every cruise.

In the laboratory, dissolved gas samples were equilibrated at room temperature for 24 hours and then drained under vacuum to remove seawater. Oxygen and argon were cryogenically extracted and separated from the remainder of the dissolved gas mixture following the procedures of Juranek and Quay [2005]. Samples were subsequently analyzed on a Finnegan MAT 253 isotope ratio mass spectrometer using 75 paired measurements of masses 32, 33, and 34 alternating with measurements of an internal standard to determine $\delta^{17}\text{O}$ and $\delta^{18}\text{O}$, followed by measurements of masses 32 and 40 on a single collector to determine O₂/Ar. Reported values for $\delta^{17}\text{O}$ and $\delta^{18}\text{O}$ are corrected for the experimentally-determined dependence on both the sample size, as described by Stanley et al., [2010], and the sample O₂/Ar ratio. Measurement uncertainty for each sample batch was determined based on daily air standards, and is reported along with all sample values.

Measurement errors for $\delta^{17}\text{O}$ and $\delta^{18}\text{O}$ are correlated ($r^2 = 0.90$, $n = 489$), resulting from mass-dependent fractionation in the sample extraction and measurement process initially reported by Hendricks et al. [2004]. To enable the correlation in these errors to be accounted for in propagating error in calculations made direction from $\delta^{17}\text{O}$ and $\delta^{18}\text{O}$ (i.e. gross oxygen production), we report the slope of the linear relationship between $\delta^{17}\text{O}$ and $\delta^{18}\text{O}$ error for each sample batch as well as the slope uncertainty.

Data Processing Description

Data is only reported for samples that meet quality control standards (any with problems in the laboratory extraction and measurement process have been replaced with NaN in the data spreadsheet). NB. NaN's were changed to nd's in the served dataset.

BCO-DMO Processing:

- added conventional header with dataset name, PI name, version date, reference information
- renamed parameters to BCO-DMO standard
- split date/time into two columns
- reformatted date from m/d/yyyy to yyyy-mm-dd
- changed NaN to nd
- changed number of significant digits to 2 (lat, lon, lon360) or 3 (sal, temp)

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Data Files

File
O_Ar.csv (Comma Separated Values (.csv), 111.41 KB) MD5:813f69468d91fc239f13e75f93288d22
Primary data file for dataset ID 626855

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Related Publications

Emerson, S., Stump, C., Wilbur, D., & Quay, P. (1999). Accurate measurement of O₂, N₂, and Ar gases in water and the solubility of N₂. *Marine Chemistry*, 64(4), 337–347. doi:10.1016/s0304-4203(98)00090-5
[https://doi.org/10.1016/S0304-4203\(98\)00090-5](https://doi.org/10.1016/S0304-4203(98)00090-5)
Methods

Hendricks, M. B., Bender, M. L., & Barnett, B. A. (2004). Net and gross O₂ production in the southern ocean from measurements of biological O₂ saturation and its triple isotope composition. *Deep Sea Research Part I: Oceanographic Research Papers*, 51(11), 1541–1561. <https://doi.org/10.1016/j.dsr.2004.06.006>

Related Research

Juranek, L. W., & Quay, P. D. (2005). In vitro and in situ gross primary and net community production in the North Pacific Subtropical Gyre using labeled and natural abundance isotopes of dissolved O₂. *Global Biogeochemical Cycles*, 19(3). doi:10.1029/2004gb002384 <https://doi.org/doi:10.1029/2004GB002384>
Related Research

Juranek, L. W., Hamme, R. C., Kaiser, J., Wanninkhof, R., & Quay, P. D. (2010). Evidence of O₂ consumption in underway seawater lines: Implications for air-sea O₂ and CO₂ fluxes. *Geophysical Research Letters*, 37(1), n/a-n/a. doi:10.1029/2009gl040423 <https://doi.org/10.1029/2009GL040423>
Methods

Palevsky, H. I., Quay, P. D., & Nicholson, D. P. (2016). Discrepant estimates of primary and export production from satellite algorithms, a biogeochemical model, and geochemical tracer measurements in the North Pacific Ocean. *Geophysical Research Letters*, 43(16), 8645–8653. <https://doi.org/10.1002/2016gl070226>
<https://doi.org/doi:10.1002/2016GL070226>
Results

Palevsky, H. I., Quay, P. D., Lockwood, D. E., & Nicholson, D. P. (2016). The annual cycle of gross primary production, net community production, and export efficiency across the North Pacific Ocean. *Global Biogeochemical Cycles*, 30(2), 361–380. doi:10.1002/2015gb005318
<https://doi.org/doi:10.1002/2015GB005318>
Results

Quay, P., Stutsman, J., and Steinhoff, T. (2012). Primary production and carbon export rates across the subpolar N. Atlantic Ocean basin based on triple oxygen isotope and dissolved O₂ and Ar gas measurements. *Global Biogeochemical Cycles*, 26, GB2003, doi:10.1029/2010GB004003
Related Research

Stanley, R. H. R., Kirkpatrick, J. B., Cassar, N., Barnett, B. A., & Bender, M. L. (2010). Net community production and gross primary production rates in the western equatorial Pacific. *Global Biogeochemical Cycles*, 24(4), n/a-n/a. <https://doi.org/10.1029/2009gb003651> <https://doi.org/10.1029/2009GB003651>
Related Research

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Related Datasets

IsReferencedBy

Palevsky, H. I., Quay, P. (2021) **Temperature, salinity, fluorescence, and dissolved O₂/Ar ratios measured continuously underway onboard basin-wide transects of the North Pacific from Hong Kong to Long Beach, CA.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2020-11-20 doi:10.26008/1912/bco-dmo.831046.1 [[view at BCO-DMO](#)]
Relationship Description: This dataset (O₂/Ar and triple oxygen isotopes) has been used to calibrate TrueO₂Ar measurements for dataset 831046 (Continuous underway data)

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Parameters

Parameter	Description	Units
cruise_id	cruise identification	unitless
vessel	vessel name	unitless
station	station number	unitless
date	date; UTC	yyyy-mm-dd
time	time; UTC	HH:MM
sal	sea surface salinity	PSU
temp	sea surface temperature	degrees Celsius
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
lon_360	longitude based on 360 degrees	decimal degrees
O2_Ar	oxygen/argon dissolved gas ratio in seawater sample	unitless
del18O	ratio of 18Oxygen to 16Oxygen: $\text{del18O} = 1000 * [(\text{18O}/\text{16O})_{\text{sample}} - (\text{18O}/\text{16O})_{\text{air standard}}] / (\text{18O}/\text{16O})_{\text{air standard}}$	per mil
del17O	ratio of 17Oxygen to 16Oxygen: $\text{del17O} = 1000 * [(\text{17O}/\text{16O})_{\text{sample}} - (\text{17O}/\text{16O})_{\text{air standard}}] / (\text{17O}/\text{16O})_{\text{air standard}}$	per mil
D17O	Excess of dissolved 17O (as compared to air). $\text{D17O} = 10^6 [\log(1 + \text{del17O}/10^3) - 0.518 * \log(1 + \text{del18O}/10^3)]$	per meg
O2_Ar_uncert	sample batch specific measurement uncertainty (1 standard deviation) in O2/Ar	unitless
del18O_uncert	sample batch specific measurement uncertainty (1 standard deviation) in del18O	per mil
del17O_uncert	sample batch specific measurement uncertainty (1 standard deviation) in del17O	per mil
D17O_uncert	sample batch specific measurement uncertainty (1 standard deviation) in D17O	per meg
TOI_uncert_slope	sample batch specific slope of the linear relationship between deviations from mean values in del17O and del18O; determined from air standards	unitless
TOI_uncert_slope_err	standard error (1 standard deviation) of the slope of the del17O vs. del18O error linear relationship	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Finnegan MAT 253 isotope ratio mass spectrometer
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

Dataset-specific Instrument Name	
Generic Instrument Name	Sea-Bird SBE 45 MicroTSG Thermosalinograph
Generic Instrument Description	A small externally powered, high-accuracy instrument, designed for shipboard determination of sea surface (pumped-water) conductivity and temperature. It is constructed of plastic and titanium to ensure long life with minimum maintenance. It may optionally be interfaced to an external SBE 38 hull temperature sensor. Sea Bird SBE 45 MicroTSG (Thermosalinograph)

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Deployments

TJ1

Website	https://www.bco-dmo.org/deployment/626889
Platform	OOCL Tianjin
Start Date	2008-10-06
End Date	2008-10-17
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

TJ2

Website	https://www.bco-dmo.org/deployment/626891
Platform	OOCL Tianjin
Start Date	2008-11-13
End Date	2008-11-21
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

TJ3

Website	https://www.bco-dmo.org/deployment/626893
Platform	OOCL Tianjin
Start Date	2008-11-27
End Date	2008-12-11
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

TJ4

Website	https://www.bco-dmo.org/deployment/626896
Platform	OOCL Tianjin
Start Date	2009-01-20
End Date	2009-01-30
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

TJ5

Website	https://www.bco-dmo.org/deployment/626897
Platform	OOCL Tianjin
Start Date	2009-04-01
End Date	2009-04-10
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

TJ6

Website	https://www.bco-dmo.org/deployment/626898
Platform	OOCL Tianjin
Start Date	2009-09-24
End Date	2009-09-27
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

TJ7

Website	https://www.bco-dmo.org/deployment/626900
Platform	OOCL Tianjin
Start Date	2009-10-28
End Date	2009-11-07
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

TJ9

Website	https://www.bco-dmo.org/deployment/626904
Platform	OOCL Tianjin
Start Date	2010-02-13
End Date	2012-02-21
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

Tianjin_1

Website	https://www.bco-dmo.org/deployment/626918
Platform	OOCL Tianjin
Start Date	2012-04-30
End Date	2012-05-13
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

Tianjin_2

Website	https://www.bco-dmo.org/deployment/626920
Platform	OOCL Tianjin
Start Date	2012-07-24
End Date	2012-08-06
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

Tianjin_3

Website	https://www.bco-dmo.org/deployment/626922
Platform	OOCL Tianjin
Start Date	2012-11-28
End Date	2012-12-11
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

Tokyo_0

Website	https://www.bco-dmo.org/deployment/626906
Platform	OOCL Tokyo
Start Date	2011-02-23
End Date	2011-03-07
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

Tokyo_1

Website	https://www.bco-dmo.org/deployment/626908
Platform	OOCL Tokyo
Start Date	2011-05-16
End Date	2011-05-29
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

Tokyo_2

Website	https://www.bco-dmo.org/deployment/626910
Platform	OOCL Tokyo
Start Date	2011-06-27
End Date	2011-07-10
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

Tokyo_3

Website	https://www.bco-dmo.org/deployment/626912
Platform	OOCL Tokyo
Start Date	2011-09-20
End Date	2011-10-02
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

Tokyo_4

Website	https://www.bco-dmo.org/deployment/626914
Platform	OOCL Tokyo
Start Date	2012-01-25
End Date	2012-02-06
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

TJ8

Website	https://www.bco-dmo.org/deployment/626902
Platform	OOCL Tianjin
Start Date	2009-12-03
End Date	2009-12-12
Description	Container ship collected surface salinity, temperature and water samples for carbon and oxygen isotopes measurements.

Project Information

North Pacific Surface Carbon, Oxygen and Isotope Measurements from Container Ships (2008-) (NPac Cont Ship)

Coverage: Transects across the North Pacific from Hong Kong to Long Beach, California, USA; ~25-50N, 115E-120W

This project is an ongoing time-series beginning in 2008 of measurements relevant to ocean carbon cycling and productivity on basin-wide container ship transects across the North Pacific from Hong Kong to Long Beach, California, with transects made throughout the seasonal cycle beginning in October 2008. The goal of this project is to improve our understanding of the rates and mechanisms of ocean carbon uptake from the atmosphere throughout the seasonal cycle and across spatial gradients across the basin. Sampling includes both discrete samples and continuous underway measurements. Tracers sampled in this program include triple oxygen isotopes ($\delta^{17}\text{O}$ and $\delta^{18}\text{O}$), a tracer of gross primary production, oxygen/argon dissolved gas ratios, a tracer of net community production or carbon export, and carbonate system parameters (pCO_2 , total alkalinity, DIC, and ^{13}C -DIC) as tracers of ocean carbon uptake and carbon cycling.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0628663
NSF Division of Ocean Sciences (NSF OCE)	OCE-1259055
NOAA Oceanic and Atmospheric Research (OAR) Climate Program Office (NOAA OAR Climate Program)	A10OAR4310088

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