All measurements used in the gross oxygen production estimates; from samples collected on R/V Yellowfin cruises to the San Pedro Ocean Time-series (SPOT) station in 2013 and 2014

Website: https://www.bco-dmo.org/dataset/685427
Data Type: Other Field Results
Version: 22 March 2017
Version Date: 2017-03-22

Project
» Collaborative Research: Use of Triple Oxygen Isotopes and O2/Ar to constrain Net/Gross Oxygen Production during upwelling and non-upwelling periods in a Coastal Setting (UpRISEE O2 upwelling)

Contributors	Affiliation	Role
Haskell, William	University of California-Santa Barbara (UCSB-MSI)	Principal Investigator
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Coverage

Spatial Extent: **Lat**:33.55 **Lon**:-118.4
Temporal Extent: 2013-01-16 - 2014-06-19

Dataset Description

All measurements used in the gross oxygen production estimates. Measurements were made at the San Pedro Ocean Time-series (SPOT) station (33 33'N, 118 24'W). Data are also published in Table 3 in the following publication:
Haskell, W. Z.,et al. 2017. Annual cyclicity in export efficiency in the inner Southern California Bight. Global Biogeochemical Cycles, 31. doi:10.1002/2016GB005561

Methods & Sampling

See complete methodology in Haskell et al. (2017). In summary:
This study is part of an effort aimed at characterizing the biological response to upwelling at SPOT on 21 cruises between January 2013 and June 2014; the Upwelling Regime In-Situ Ecosystem Efficiency (Up.R.I.S.E.E.) study.

O2/Ar and Triple Oxygen Isotopes (TOI): Samples for O2/Ar and TOI analysis were collected from Niskin bottles in 300 or 500 mL glass flasks equipped with airtight Louwers-Hapert valves (with three high-vacuum greased Viton O-rings in valve stem) and sidearms. Each bottle was poisoned with 150 uL saturated HgCl2, dried in an oven at 50 degrees C, preevacuated on a rotary vane vacuum pump (Pfeiffer Duo 2.5) for at least 5 min before evacuation on a stainless steel gas line using a turbo drag dry high vacuum pump (Alcatel Drytel 31). A vacuum of <1 mtorr was reached and held for at least 5 min, then the bottle was weighed. After sampling, the samples were equilibrated with the headspace for ~12–24 h on a shaking table at University of Southern California (USC), weighed, and drained. The headspace was analyzed in the laboratory of R. Stanley (Woods Hole Oceanographic Institution) for O2 and Ar by peak jumping and for 18O16O (m/z 34) and 17O16O (m/z 33) using a Thermofisher MAT 253 multicollector isotope ratio mass spectrometry. The TOI values are reported relative to atmospheric air as a standard, for which clean Woods Hole air stored in an electropolished 2 L stainless steel cylinder was used.

Gross Oxygen Production (GOP) Rates: Using estimates of vertical advection, diffusion, and gas exchange, we calculated the rates of GOP during each cruise. This dataset contains the calculated GOP rates, δ17O, δ18O, and 17Δ. Total euphotic zone GOP rates ranged from 161 +/- 44 mmol m-2 d-1 to 256 +/- 41 mmol m-2 d-1 in fall/winter,
and 175 ± 58 mmol m-2 d-1 to 477 ± 155 mmol m-2 d-1 in spring.

Oxygen mixed layer depths were determined as the depth at which the oxygen concentration was 0.5% different from the surface concentration. Oxygen was measured by using a Seabird SBE 43 oxygen sensor mounted on an SBE 9plus conductivity-temperature-depth (CTD) and calibrated by using Winkler titrations collected in duplicate at five depths on every CTD cast. For nine cruises (Up-13 to Up-21), the base of the euphotic zone was determined as the depth at which 1% of the surface photosynthetically available radiation (PAR) was measured. Prior to Up-13, there was no PAR sensor on the CTD unit. Since the deep chlorophyll a maximum (DCM, determined via CTD fluorescence) is almost always above the euphotic depth in the Southern California Bight, for the remainder of the cruises, the euphotic depth was defined as 10m below the DCM, except during Up-2, Up-3, and Up-4 because the DCM was within the mixed layer. For these three cruises, the euphotic depth is defined as 15m below the MLD.

Data Processing Description

BCO-DMO Processing:
-created separate columns for MLD and EuphD;
-modified parameter names to conform with BCO-DMO naming conventions;
-formatted date to yyyy-mm-dd;
-added site name, lat, and lon from information on metadata form.

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Data Files

File	
gross_O2_production.csv	(Comma Separated Values (.csv), 9.89 KB) MD5:6f518249a660449de9bd842163cd05c3
Primary data file for dataset ID 685427	

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Parameters

Parameter	Description	Units
site	Name of the site	unitless
lat	Latitude of the site	decimal degrees
lon	Longitude of the site	decimal degrees
cruise_id	Cruise identifier	unitless
MLD	Mixed layer depth; Oxygen mixed layer depths were determined as the depth at which the oxygen concentration was 0.5% different from the surface concentration.	meters (m)
EuphD	Euphotic depth; see "Acquisition Description" for methodology.	meters (m)
date	Date of sampling formatted as yyyy-mm-dd	unitless
year	4-digit year	unitless
month	2-digit month	unitless
day	2-digit day	unitless
yrday	Year day (sequential day of year, eg. Jan 1 = 1)	unitless
depth	Sample depth	meters (m)
O2_sat	Oxygen saturation concentration calculated in mmol kg-1 using temperature and salinity measured by Seabird CTD (Garcia and Gordon, 1992), then converted to uM assuming a density of 1.0255 kg L-1.	micromolar (uM)
O2	O2 concentration	micromolar (uM)
delta_17O	delta 17O. dO and 17D values calculated using atm O2 as reference material.	per mil
delta_18O	detla 18O	per mil
D17	dO and 17D values calculated using atm O2 as reference material.	per microgram (ug)

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Instruments

Dataset-specific Instrument Name	SBE 9plus CTD
Generic Instrument Name	CTD Sea-Bird 9
Dataset-specific Description	Oxygen was measured by using a Seabird SBE 43 oxygen sensor mounted on an SBE 9plus conductivity-temperature-depth (CTD).
Generic Instrument Description	The Sea-Bird SBE 9 is a type of CTD instrument package. The SBE 9 is the Underwater Unit and is most often combined with the SBE 11 Deck Unit (for real-time readout using conductive wire) when deployed from a research vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorometer, altimeter, etc.). Note that in most cases, it is more accurate to specify SBE 911 than SBE 9 since it is likely a SBE 11 deck unit was used. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Thermofisher MAT 253 multicollector isotope ratio mass spectrometry
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	O2 and Ar isotope ratios were measured on a Thermofisher MAT 253 multicollector isotope ratio mass spectrometry at Woods Hole Oceanographic Institution.
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
Dataset-specific Description	Samples for O2/Ar and TOI analysis were collected from Niskin bottles.
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

UpRISEE_SPOT_13-14

Website	https://www.bco-dmo.org/deployment/684011
Platform	R/V Yellowfin
Start Date	2013-01-16
End Date	2014-06-19
Description	A series of cruises were conducted from January 2013 to June 2014 to the San Pedro Ocean Time-Series (SPOT) station. These cruises were part of a study aimed at characterizing the biological response to upwelling at SPOT: the Upwelling Regime In-Situ Ecosystem Efficiency (Up.R.I.S.E.E.) study.

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Project Information

Collaborative Research: Use of Triple Oxygen Isotopes and O2/Ar to constrain Net/Gross Oxygen Production during upwelling and non-upwelling periods in a Coastal Setting (UpRISEE O2 upwelling)

Coverage: Northeast Pacific Ocean

The marine biological pump is one of the primary pathways via which anthropogenic carbon dioxide may be sequestered from the atmosphere and exported to the deep ocean as organic carbon. While the link between nutrient supply and high primary productivity in upwelling regions is well established, factors controlling the organic carbon export efficiency of upwelling ecosystems are not well known. Scientists from the University of Southern California and Pomona College plan to determine the factors that control the rates and magnitudes of two components of biological production, Net Community Production (NCP) and Gross Primary Production (GPP), as well as particulate organic carbon export efficiency, at the San Pedro Ocean Time Series, a coastal site in the California Borderland during periods of minimal and high upwelling velocity over a 2-year span. At this site, past and ongoing observations of hydrography and carbon rain will provide an historical context for interpreting results and mechanisms at work.

Rates of NCP and GPP will be quantified at different upwelling intensity, using dissolved oxygen to argon (O2/Ar) ratios and the oxygen triple isotope composition of dissolved oxygen (O2). The export of organic carbon will be established using 234Th (thorium) profiles in the water column, coupled with floating sediment trap deployments, and the development of a carbon isotope balance for the water column. Upwelling will be characterized using non-steady state budgets for atmospheric 7Be (beryllium) input and its depth-integrated decay, as well as estimating rates based on remote measurements of wind stress curl and budgets for dissolved inorganic carbon and silicon. Application of the O2/Ar ratio and the oxygen triple isotope approach will require depth-integrated profiles of these tracers to evaluate the impact of upwelling on mixed layer inputs and use of non-steady state models during seasonal transitions in upwelling. The comprehensive data set to be obtained should provide insights into the organic carbon export efficiency under variable upwelling regimes and help to relate the satellite-based measurements of chlorophyll to the organic carbon export of these highly productive ecosystems.

Broader Impacts: One graduate and one undergraduate student from the University of Southern California and two undergraduate students from Pomona College would be supported and trained as part of this project.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1260296
NSF Division of Ocean Sciences (NSF OCE)	OCE-1260692

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