Station data and nutrient profiles for analysis of microbial communities from R/V Thomas G. Thompson TN268 in the North Pacific from August to September 2011 (Sulfur Oxidizers project)

Website: https://www.bco-dmo.org/dataset/626572
Data Type: Cruise Results
Version: working
Version Date: 2015-11-17

Project
» Mixotrophic bacteria and the cryptic marine sulfur cycle: Mechanisms of carbon assimilation and sulfur oxidation in the Arctic96BD-19 GSO clade (Sulfur Oxidizers)

Contributors	Affiliation	Role
Morris, Robert	University of Washington (UW)	Principal Investigator, Contact
Allison, Dicky	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

Coordinates of sample locations, depths and analyses conducted during the biogeochemical hot spot study.

These data are reported and discussed in Mattes et al., 2013.

Methods & Sampling

All samples were collected onboard the R/V Thomas G. Thompson during a University of Washington led research cruise in support of the National Science Foundation's Ocean Observatory Initiative-Regional Scale Nodes cruise (August 19 – September 1, 2011) from Seattle, WA to Hydrate Ridge and Axial Seamount (Figure 1). Water samples for microbial and chemical analyses were collected using a Conductivity, Temperature, and Depth (CTD) rosette profiler equipped with 12 L Niskin bottles. Samples were collected from 5 different stations (CTD7 Cascadia Basin (lat: 45.8602/lon:-127.9353), CTD8 base of Axial Seamount (lat:45.8202/lon:-129.7567), CTD11 ASHES vent field (lat:45.9339/lon:-130.0136), CTD13 Coquille vent (lat:45.9264/lon:-129.9803), and CTD 17 ASHES vent field (lat: 45.9340/lon:-130.0138)).

Contextual data and site description

Partial and full water column profile measurements were conducted using a rosette-mounted instrument package that included a Seabird 9plus CTD with dual temperature and conductivity sensors, a Seabird 43 oxygen sensor (calibrated to onboard Winkler titrations), and a WET Labs C-Star transmissometer. Using the down-cast profile measurements, the position and extent of the hydrothermal plume was identified by large negative deflections in beam transmission (corresponding to the high particulate load generated from precipitating metal sulfides in the hydrothermal fluid), and subtle positive anomalies in temperature

(corresponding to the heat input from high-temperature fluids), following well established plume identification practices (Baker et al 1993). At the summit of Axial seamount, hydrothermal plumes were 30-100 meters thick, with the neutrally buoyant plume having a typical rise height of 75-200 meters above the seafloor.

During the profile up-cast, 12 L Niskin water sampling bottles (General Oceanics) were triggered at depths determined to be within the hydrothermal plume, and at regular intervals in the water column above the plume. Water samples were analyzed for methane (CH4) and hydrogen (H2) concentrations using shipboard gas chromatography. Samples were headspace extracted and inlet into a gas chromatograph (SRI Instruments) configured with a helium carrier, a 30 meter 5Å mol sieve column, a 50°C isothermal temperature program, and flame ionization (FID) and pulse discharge (PDD) detectors. This method provided the sensitivity to measure the low gas concentrations of background seawater (CH4 0.5-1 nM, H2 0.1-0.5 nM). Hydrothermal fluids are enriched in both CH4 and H2 (Lilley et al 1982, Proskurowski et al 2008).

Data Processing Description

Samples for nutrients, DOC and TDN analyses were stored frozen in 60 mL HDPE bottles until analysis within 2 months of the completion of the cruise. Nutrient concentrations were assessed by follow the protocols of the WOCE Hydrographic Program using a Technicon AAII system at the University of Washington. DOC and TDN concentrations were assessed by high temperature combustion using a Shimadzu TOC-csh with auto injection (Dickson et al 2007). Four point standard curves using KHP and KNO3 were run daily to calibrate the response of the high temperature combustion system. Measurements were quality controlled using Consensus Reference Materials (CRM's) distributed to the international community by the Hansell laboratory (Hansell 2005). The CRMs were analyzed at regular intervals during each analytical day. Low C reference water was employed to determine system blanks. DON was determined as the difference in concentrations of TDN and DIN. (See Supplementary Figure One (pdf))

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Data Files

File
nutrients.csv (Comma Separated Values (.csv), 4.65 KB) MD5:8bb34171027d05740e7c6c7c5165291e Primary data file for dataset ID 626572

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Parameters

Parameter	Description	Units
ctd_station	station number where CTD was deployed	number
site	descriptive term of sampling location	text
lat	Latitude	decimal degrees
lon	Longitude; West is negative	decimal degrees
depth	Sampling depth	meters
sample_no	sequential sampling identification number	number
PO4	nutrient phosphate	micromoles per kilogram
SiOH_4	silicate	micromoles per kilogram
NO3	nitrate	micromoles per kilogram
NO2	nitrite	micromoles per kilogram
NH4	ammonium	micromoles per kilogram
DON	Dissolved Organic Nitrogen; here the difference between Total Dissolved Nitrogen (TDN) and Dissolved Inorganic Nitrogen (DIN)	micromoles per kilogram
DOC	Dissolved Organic Carbon	micromoles C per kilogram
T_RFLP	terminal restriction fragment length polymorphism assessment done if 'X' is present	text
clone_library	16S rRNA gene clone library assessment done if 'X' is present	text
proteomics	an 'X' indicated that samples were used for proteomics work	text

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Instruments

Dataset-specific Instrument Name	CTD Seabird 911+
Generic Instrument Name	CTD Sea-Bird 911
Dataset-specific Description	Partial and full water column profile measurements were conducted using a rosette-mounted instrument package that included a Seabird 9plus CTD with dual temperature and conductivity sensors
Generic Instrument Description	The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a 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, fluorescence, light (PAR), light transmission, etc.). More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	Seabird 43 Oxygen Sensor
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Dataset-specific Description	Seabird 43 oxygen sensor (calibrated to onboard Winkler titrations)
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

Dataset-specific Instrument Name	Wet Labs C-Star transmissometer
Generic Instrument Name	WET Labs {Sea-Bird WETLabs} C-Star transmissometer
Generic Instrument Description	The C-Star transmissometer has a novel monolithic housing with a highly intgrated opto-electronic design to provide a low cost, compact solution for underwater measurements of beam transmittance. The C-Star is capable of free space measurements or flow-through sampling when used with a pump and optical flow tubes. The sensor can be used in profiling, moored, or underway applications. Available with a 6000 m depth rating. More information on Sea-Bird website: https://www.seabird.com/c-star-transmissometer/product?id=60762467717

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Deployments

TN268

Website	https://www.bco-dmo.org/deployment/626431
Platform	R/V Thomas G. Thompson
Start Date	2011-08-11
End Date	2011-09-01
Description	This was a two leg cruise. The National Science Foundation's Ocean Observatory Initiative-Regional Scale Nodes cruise (August 19 – September 1, 2011) from Seattle, WA to Hydrate Ridge and Axial Seamount. The cruise began August 11 when it left the port of Seattle.

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Project Information

Mixotrophic bacteria and the cryptic marine sulfur cycle: Mechanisms of carbon assimilation and sulfur oxidation in the Arctic96BD-19 GSO clade (Sulfur Oxidizers)

Website: http://morrislab.ocean.washington.edu/

Coverage: North Pacific Ocean

Description from NSF award abstract:

The ocean serves an immense reservoir of carbon, nitrogen, phosphorus, sulfur, and other elements required for all life. The active and diverse microbial populations that inhabit the oceans are responsible for mediating nutrient transformations that maintain the chemistry of seawater. A recent study identified a ubiquitous group of marine bacteria from the Arctic96BD-19 gamma-proteobacterial sulfur oxidizer (GSO) lineage that is closely related to known sulfur oxidizing species that fix inorganic carbon and oxidize sulfide in low-oxygen waters. The potential for GSOs to use reduced forms of sulfur in oxygenated waters suggests that they are a keystone species that link the marine carbon and sulfur cycles. The only known isolates from the Arctic96BD-19 lineage of GSOs are now in culture, allowing fundamental questions about their roles in carbon and sulfur cycling to be investigated. Preliminary data suggest that they use energy from the oxidation of sulfur to assimilate carbon. This project seek to address the overarching hypothesis that sulfur transformations provide the Arctic96BD- 19 lineage of GSOs with energy for organic and inorganic carbon cycling throughout the water column.

Three specific hypotheses will be tested.
1. Arctic96BD-19 cells assimilate either organic carbon or fixes inorganic carbon, depending on environmental conditions.
2. Arctic96BD-19 cells oxidize thiosulfate via formation of a tetrathionate intermediate, or using the branched thiosulfate oxidation pathway.
3. Arctic96BD-19 cells are ubiquitous sulfur oxidizers that assimilate organic and inorganic carbon through the Pacific Northwest.

A combination of laboratory growth studies of the investigator's pure cultures and comparative genomic analyses will be used. The genomic data will be used to determine whether the Arctic96BD-19 cultures possess the genetic potential to oxidize reduced sulfur to sulfate (based on possession of known core and ancillary sulfur oxidation genes), which potential oxidation pathways are used, and whether they can fix inorganic carbon. These data will help guide the physiology studies by determining the most likely forms of inorganic and organic compounds that can be utilized.

Marine bacteria are critical players in global nutrient cycles, but many of their individual and community functions in the ecosystem are not well understood. Future oceanographers will need to use cultivation-dependent and cultivation-independent methods to identify metabolic process that shape microbial communities and impact biogeochemical cycles. Student education, scientific advancement, and public awareness are all important components of this project.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1232840

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