4Hz data from 8 Wire Flyer deployments conducted on R/V Atlantis cruise AT42-03 in the Costa Rica Margin from October to November 2018

Website: https://www.bco-dmo.org/dataset/879389
Data Type: Cruise Results
Version: 1
Version Date: 2022-08-31

Project
» Collaborative research: Quantifying the biological, chemical, and physical linkages between chemosynthetic communities and the surrounding deep sea (Costa Rica Seeps)

Contributors	Affiliation	Role
Roman, Christopher Neil	University of Rhode Island (URI)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset includes 4Hz data from 8 Wire Flyer deployments conducted on R/V Atlantis cruise AT42-03 in the Costa Rica Margin from October to November 2018.

Table of Contents

Coverage

Spatial Extent: **N**:9.08166 **E**:-84.1795 **S**:8.54076 **W**:-85.14475
Temporal Extent: 2018-10-20 - 2018-11-03

Methods & Sampling

Data were collected from Wire Flyer deployments on R/V Atlantis cruise AT42-03 in the Costa Rica Margin from October to November 201. These data are reported directly from the sensors or were calculated using the seawater toolbox. The data have not been corrected for any time lags. Refer to the Supplemental Files for more information on the Wire Flyer.

Known Problems/Issues:
There is some difference in the fluorometer data between the up and down casts. We are not sure what is causing this just yet. This can be seen as an obvious striping pattern in the profile plots. The oxygen sensor has a time lag of 5-7 seconds. Applying this amount of lag helps align the up and down casts well. The data here are not time shifted.

Data Processing Description

These data have not been processed to any significant extent. The latitude and longitude positions reported are for the Wire Flyer vehicle, and not the ship. This position was calculated using measurements of the clump weight depth and the wire payout.

BCO-DMO Processing:
- concatenated data from 8 separate files into one dataset;
- created new column "deployment_id" (based on original file name);
- removed the CDOM column (not used);
- converted date/time field to ISO8601 format.

[table of contents | back to top]

Supplemental Files

File
AT42-03 Wire Flyer Summary Plots filename: summary_plots.zip (ZIP Archive (ZIP), 8.85 MB) MD5:eb9054e1925496bf6f0522326dc96fa5 Summary plots of data from 8 Wire Flyer deployments conducted on R/V Atlantis cruise AT42-05. There is one PDF for each deployment. The file naming convention is YYYYMMDD_HHMMSS, set at the start of the deployment, e.g. 20170125_151748. The times are all in GMT, not local time.
Wire Flyer Launch and Recover Document filename: flyer_launch_and_recover_document.pdf (Portable Document Format (.pdf), 7.26 MB) MD5:f9274b8c8b003b9a39083191e4f2c76b Document describing the Wire Flyer launch and recovery procedures.
Wire Flyer Overview 2019 filename: Wire_flyer_overview_2019.pdf (Portable Document Format (.pdf), 15.84 MB) MD5:7c3c14f839142f115c5aa467894395d7 Slides from a presentation by Christopher Roman titled "The Wire Flyer vehicle system and high resolution hydrographic sections".

[table of contents | back to top]

Related Publications

Roman, C., Ullman, D. S., Hebert, D., & Licht, S. (2019). The Wire Flyer Towed Profiling System. Journal of Atmospheric and Oceanic Technology, 36(2), 161–182. doi:10.1175/jtech-d-17-0180.1
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
deployment_id	identifier for the deployment; indicates the start date and time of deployment in format: YYYYMMDD_hhmmss (time zone is GMT)	unitless
Time_string	date-time string (GMT) in format where xxx represent milliseconds: YYYY-MM-DD hh:mm:ss.xxx	unitless

ISO_DateTime_UTC	date-time string converted to ISO8601 format: YYYY-MM-DDThh:mm:ss.xxxxxxZ. Note that data are accurate to milliseconds (not microseconds)	unitless
Julian_day	Julian day	unitless
Unix_time_sec	Unix time	seconds
Lat	latitude of the Wire Flyer	degrees North
Lon	longitude of the Wire Flyer	degrees East
Depth_m	depth calculated using seawater toolbox	meters (m)
Vertical_velocity_m_per_sec_pos_down	vertical velocity	meters per second (m/s)
Temperature_C	temperature	degrees Celsius
Pot_temperature_C	potential temperature calculated using seawater toolbox	degrees Celsius
Pot_density	potential density calculated using seawater toolbox	kilograms per cubic meter (kg/m^3)
Pressure_db	pressure	decibars (db)
Conductivity_sm	conductivity	siemens-meter (sm)
Salinity_PSU	salinity calculated using seawater toolbox	PSU
Sound_velocity_m_per_sec	sound velocity calculated using seawater toolbox	meters per second (m/s)
O2_con_umol	oxygen concentration	micromoles (umol)
optode_temp_C	optode temperature	degrees Celsius
Air_sat_percent	air percent saturation	unitless (percent)
Chlorophyll_ug_per_L	chlorophyll	micrograms per liter (ug/L)

Turbidity_NTU	turbidity	NTU

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Aanderaa Optode 4831F
Generic Instrument Name	Aanderaa 4831F (fast-response) oxygen optode
Dataset-specific Description	Oxygen data is from an Aanderaa Optode 4831F.
Generic Instrument Description	A stand-alone oxygen optode with integrated temperature sensor, manufactured by Aanderaa. This instrument exploits the physio-chemical principle of dynamic fluorescence quenching to measure absolute oxygen concentration and percent saturation. Depth rating: 300 m, 3000 m or 6000 m; oxygen concentration accuracy of < 8 uM or 5 %, and resolution of < 1 uM; air saturation accuracy of < 5 %, and resolution of 0.4 %; response time (63 %): < 8 s.

Dataset-specific Instrument Name	Seabird 49 Fast-CAT CTD
Generic Instrument Name	Sea-Bird SBE 49 FastCAT CTD Sensor
Dataset-specific Description	Temperature, salinity and depth are from a Seabird 49 Fast-CAT CTD.
Generic Instrument Description	The SBE 49 FastCAT is a CTD sensor for use in autonomous platforms. It contains a SBE 3P temperature sensor, a SBE 4C conductivity sensor and a strain-gauge pressure sensor as standard. It can operate in autonomus (16 Hz per sec) or polled mode (transmits each sample). The sensor is depth-rated to 350 m (plastic housing) or 7000 m (titanium housing). Accuracy: +/- 0.002 deg C (temperature), +/- 0.0003 S/m (conductivity), 0.1% of full scale range (pressure).

Dataset-specific Instrument Name	Wet Labs Flbb-2k
Generic Instrument Name	WETLabs ECO FLBB scattering fluorescence sensor
Dataset-specific Description	The Chl and turbidity are from a Wet Labs Flbb-2k, 470/695 nm Chl-a and 700nm turbidity.
Generic Instrument Description	A dual-optical-sensor that carries a single-wavelength chlorophyll fluorometer (470nm ex/695nm em) and backscattering sensor (700 nm) that measures phytoplankton and particle concentration. It operates by using blue (470nm) and red (700 nm) LEDs that alternately flash. The blue LED stimulates chlorophyll fluorescence in plants while the red light illuminates the total particle field. The backscattering sensor has an in-water centroid angle of 142 degrees and can be calibrated to measure turbidity. The fluorometer can typically measure phytoplankton concentrations in the range 0-30 ug/l, with a sensitivity of 0.015 ug/l. The backscattering sensor can measure within the range 0-3 m-1, with a sensitivity of 0.0015 m-1. The instrument output in the standard version is digital and uses a low power mode and stores data. Other variants are used. The instrument is rated to a depth of 600m as standard, with the options of deeper instruments rated up to 6000m and instruments with bio-wipers, rated to 300 m. This instrument comes in the following optional models: FLbb(RT), FLbb(RT)D, FLbbB, FLbbS, FLbbBS, FLbb2k. Refer to the datasheet from the manufacturer: https://www.seabird.com/asset-get.download.jsa?id=55460873804

Dataset-specific Instrument Name	Wire Flyer
Generic Instrument Name	Wire Flyer Towed Profiling System
Generic Instrument Description	Description from Roman et al. (2019): The Wire Flyer towed vehicle is a platform able to collect high-resolution water column sections. The vehicle is motivated by a desire to effectively capture spatial structures at the submesoscale. The Wire Flyer profiles up and down along a ship-towed cable autonomously using controllable wings for propulsion. At ship speeds between 2 and 5 kt (1.02–2.55 m s−1), the vehicle is able to profile over prescribed depth bands down to 1000 m. The vehicle carries sensors for conductivity, temperature, depth, oxygen, turbidity, chlorophyll, pH, and oxidation reduction potential. During normal operations, the vehicle is typically commanded to cover vertical regions between 300 and 400 m in height with profiles that repeat at kilometer spacing. The vertical profiling speed can be user-specified up to 150 m min−1. During operations, an acoustic modem is used to communicate with the vehicle to provide status information, data samples, and the ability to modify the sampling pattern. Detailed information can be found in the following publication: Roman, C., Ullman, D. S., Hebert, D., & Licht, S. (2019). The Wire Flyer Towed Profiling System. Journal of Atmospheric and Oceanic Technology, 36(2), 161–182. doi:10.1175/jtech-d-17-0180.1

[table of contents | back to top]

Deployments

AT42-03

Website	https://www.bco-dmo.org/deployment/777903
Platform	R/V Atlantis
Start Date	2018-10-17
End Date	2018-11-06
Description	More cruise information is available from Rolling Deck to Repository (R2R): * https://www.rvdata.us/search/cruise/AT42-03 * https://doi.org/10.7284/908473

[table of contents | back to top]

Project Information

Collaborative research: Quantifying the biological, chemical, and physical linkages between chemosynthetic communities and the surrounding deep sea (Costa Rica Seeps)

Coverage: Costa Rica Pacific Margin

NSF abstract:
If life were to disappear from the deep sea, would we notice? We only have a cursory understanding of this vast region and the connectivity among its communities and the rest of the oceans, and yet the ecosystems of the deep sea have been implicated in the larger function of the global marine ecosystems. We now rely on the deep ocean for food, energy, novel drugs and materials, and for its role in the global cycling of carbon, as well as for supporting services such as habitat creation, nutrient replenishment for shallow waters, and the maintenance of biodiversity. Cold seeps, active areas of the seafloor where methane and other chemicals are released, are key features along the continental margins worldwide. To characterize how methane seep communities interact with the surrounding ecosystems and vice versa, we will study methane seeps off the Pacific coast of Costa Rica in 2017 and 2018. It is the sphere of influence around the seep, both along the seafloor and up into the water column, that we seek to better understand. We will map the structure and the chemistry surrounding these habitats using a novel 3-dimensional framework, combining typical transects with vertical characterizations of the water column just above the seafloor. This will include measurements of methane flux into the water column and changes in the overlying carbonate chemistry and oxygen levels that are critical to our understanding of the effect of warming, oxygen loss and ocean acidification in this region. Within this framework, we will collect seep organisms in sediments and on rocks (including all sizes from microbes to large animals), and transplant some of these from within the area of seep influence to the background deep sea, and vice-versa. Together, these studies will help us to measure the size of the seep sphere of influence, and also demonstrate the role of these seeps within the deep sea and the greater, global, marine ecosystem. We will share this information with a group of teachers during a series of workshops in the San Diego area, at an exhibit at the Birch Aquarium, and through the work of an artist who has worked extensively with marine organisms in extreme environments.

Chemosynthetic ecosystems are inextricably linked to the broader world-ocean biome and global biogeochemical cycles in ways that we are just beginning to understand. This research will identify the form, extent, and nature of the physical, chemical, and biological linkages between methane seeps and the surrounding deep-sea ecosystem. The proposed research builds critical understanding of the structural and functional processes that underpin the ecosystem services provided by chemosynthetic ecosystems. We target a critical continental margin, Costa Rica, where methane fates and dynamics loom large and play out in an setting that reflects many oceanographic stressors. We will use quantitative sampling and manipulative studies within a 3-dimensional oceanographic framework. We will ask what are the shapes of the diversity and density functions for organisms of different size classes and trophic position over the transition from the seep habitat through the ecotone to the background deep sea? Further, we will ask how do depth, dissolved oxygen concentrations, pH and carbonate ion availability, relative rates of fluid flux, and substrate (biogenic, authigenic carbonate, sediments) alter these linkages and interactions with the surrounding deep sea? Evidence for distinct transitional communities and biotic patterns in density and alpha and beta diversity will be quantified and placed in a global biogeographic context. All of these investigations will occur across biological size spectra: for microorganisms (archaea, bacteria, microeukaryotes), the macrofauna, and the megafauna that form biogenic habitats. Our research results will be interpreted in the context of potential effects of global ocean change in the equatorial Pacific to determine how the linkages with the surrounding deep sea will be altered as anthropogenic impacts proceed in the future.

Related publications:

Levin, L.A., V.J. Orphan, G.W. Rouse, W. Ussler, A. E. Rathburn, G. S. Cook, S. Goffredi, E. Perez, A. Waren, B. Grupe, G. Chadwick, B. Strickrott. (2012). A hydrothermal seep on the Costa Rica margin: Middle ground in a continuum of reducing ecosystems. *Proc. Royal Soc. B.* 279: 2580-88 doi: 10.1098/rspb.2012.0205

Sahling, H., Masson, D. G., Ranero, C. R., Hühnerbach, V., Weinrebe, W., Klaucke, I., & Suess, E. (2008). Fluid seepage at the continental margin offshore Costa Rica and southern Nicaragua. *Geochemistry, Geophysics, Geosystems* 9: doi: 10.1029/2008GC001978

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1634559

[table of contents | back to top]