Current speed and direction determined by tilt meters deployed at Costa Rica Seeps during R/V Atlantis cruises AT37-13 and AT42-03 during 2017 and 2018

Website: https://www.bco-dmo.org/dataset/815486
Data Type: Cruise Results
Version: 1
Version Date: 2020-06-17

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

Contributors	Affiliation	Role
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Abstract
Current speed and direction determined by tilt current meters deployed at Costa Rica Seeps during R/V Atlantis cruises AT37-13 and AT42-03 during 2017 and 2018.

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Coverage

Spatial Extent: **N**:9.11751 **E**:-84.21817 **S**:8.853146 **W**:-85.122235
Temporal Extent: 2017-05-25 - 2018-09-13

Methods & Sampling

Current measurements were made every 1 minute by Lowell Instruments TCM-3 tilt current meters deployed at 4 locations.

Data Processing Description

BCO-DMO Processing:
- concatenated separate ;files into one dataset;
- renamed fields;
- added site name, lat, lon, and depth from metadata;
- sorted data by site name then date/time.

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Parameters

Parameter	Description	Units
site	Name of the deployment site	unitless
Latitude	Latitude of the deployment	decimal degrees North
Longitude	Longitude of the deployment	decimal degrees East
Depth	Depth of deployment	meters (m)
ISO8601_Time	Date and time; format: YYYY-MM-DDThh:mm:ss	unitless
Speed	Speed	centimeters per second (cm/s)
Bearing	Bearing	degrees
Velocity_N	Velocity North	centimeters per second (cm/s)
Velocity_E	Velocity East	centimeters per second (cm/s)

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Instruments

Dataset-specific Instrument Name	Lowell Instruments TCM-3 tilt current meters
Generic Instrument Name	Tilt Current Meter
Dataset-specific Description	Lowell Instruments TCM-3 tilt current meters were deployed. Current: Range 0-80 cm/s, accuracy 3 cm/s + 3% of reading, resolution 0.1 cm/s Direction: Range 0-360°, accuracy 5° (for speed >5 cm/s), resolution 0.1° Temperature: Range -5 to 30 °C, accuracy 0.1 °C, resolution
Generic Instrument Description	Tilt current meters are based upon the property that a tethered object will experience drag inside a current flow. If a restoring force perpendicular to the drag is introduced, the tethered object will tilt until the system of forces is balanced. Therefore, measuring the tilt allows calculation of drag force, from which current speed can be obtained. Measuring the direction of tilt gives current heading. Tilt current meters operate under the drag-tilt principle and are designed to either float or sink depending on the type. A floating tilt current meter typically consists of a sub-surface buoyant housing that is anchored to the sea floor with a flexible line or tether. A sinking tilt current is similar, but the housing is designed such that the meter hangs from the attachment point. In either case, the housing tilts as a function of its shape, buoyancy (negative or positive) and the water velocity. Once the characteristics of a housing is known, the velocity can be determined by measuring the angle of the housing and direction of tilt.

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Deployments

AT37-13

Website	https://www.bco-dmo.org/deployment/714567
Platform	R/V Atlantis
Start Date	2017-05-20
End Date	2017-06-11
Description	More cruise information is available from Rolling Deck to Repository (R2R): * https://www.rvdata.us/search/cruise/AT37-13 * https://doi.org/10.7284/907684

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

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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

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Funding

Funding Source	Award
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