Macrofaunal diversity and abundance characteristics of sediment push cores collected by HOV Alvin during R/V Atlantis cruise AT37-13 and AT42-03 in the Pacific margin of Costa Rica in 2017 and 2018

Website: https://www.bco-dmo.org/dataset/842061
Data Type: Cruise Results
Version: 1
Version Date: 2021-02-25

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
Macrofaunal diversity and abundance characteristics of sediment push cores collected by HOV Alvin during R/V Atlantis cruise AT37-13 and AT42-03 in the Pacific margin of Costa Rica from May to June 2017, and October to November 2018 respectively.

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Coverage

Temporal Extent: 2017-05-21 - 2018-11-05

Methods & Sampling

Sampling of sediment macrofauna took place on the Pacific margin of Costa Rica aboard the RV Atlantis using the submersible Alvin over May-June 2017 (AT37-13) and October-November 2018 (AT42-03), covering a depth range of 377-1908 m. Push cores were used to collect sediment samples from five methane seep sites (Jaco Scar, Mound 12, Mound 11, Parrita Seep, and Quepos Landslide) and surrounding non-seep sites. Samples were obtained under license of a collecting permit issued by the Ministerio de Ambiente y Energía of Costa Rica.

In total, 76 cores (6.4 cm internal diameter, 10 cm depth) representing 38 distinct sampling points (two cores per sampling point) were collected and analysed.

Data Processing Description

Annelid, peracarid crustacean and mollusc macrofauna (>300 µm; 95.7% of macrofaunal individuals) were identified to species or morpho-species level.

Samples were classified as being collected from ‘active’ chemosynthetically-fuelled (13 samples), ‘transition’ (13 samples) or ‘background’ photosynthetically-fuelled (12 samples) environments based on visual indicators of seep. Visual indicators of high seep chemosynthetic activity included high seafloor cover of microbial mats and non-sedimented authigenic carbonates, and high densities of seep-associated megafauna.

Taxonomic and functional biodiversity were quantified using richness (number of species/functional categories), diversity (Shannon Index), and evenness (Pielou’s Index) metrics in R 3.4.2 using the package ‘vegan’. Functional diversity was quantified based on the scoring of taxa for 32 traits in 7 trait groupings. Taxon-specific scores for traits were weighted by taxon abundance and totaled across all taxa present per sample, producing a sample (rows) by trait abundance (columns) matrix.

Standing stock (macrofaunal wet biomass per sample) was measured to 0.00001 g using an electronic balance (A&D GR-202). Excess liquid was wicked from specimens using paper tissue, and sample weights were recorded following a standardised two-minute period after removal from preservative. Faunal density was calculated as the total number of polychaete, peracarid crustacean and mollusc individuals per 64.3 cm2 sample (two cores, each with a surface area of 32.17 cm2), multiplied by 155.42 to express this as number of individuals per m2. Average individual body size (biomass) per sample was calculated by dividing sample biomass by macrofaunal abundance.

Values stated are for combined sample consisting of two push cores collected adjacent to each other.

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Data Files

File
faunal.csv (Comma Separated Values (.csv), 3.57 KB) MD5:9b53a27c11a0496f5594fe57831b6a53 Primary data file for dataset ID 842061

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Related Datasets

References

Levin, L. A., Rouse, G. (2021) **Sampling locations of hard substrates and push cores collected during R/V Atlantis cruise AT37-13 and AT42-03 in the Pacific Ocean off Costa Rica in 2017 and 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-02-19 doi:10.26008/1912/bco-dmo.840955.1 [view at BCO-DMO]
Relationship Description: For more information on the sampling locations see the dataset "Hard Substrates and Push Core Sampling Locations".

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Parameters

Parameter	Description	Units
Alvin_dive_and_push_cores	Alvin dive and pushcore	units
Cruise	Cruise ID	units
Methane_seep_site	description	units
Activity_category	Overall habitat sample collected from - 'active' seep habitat, inactive 'background' habitat, or 'transition' habitat between the two.	unitless
Species_richness	Number of species in sample.	unitless
Taxonomic_diversity_Shannon	Species diversity of sample, Shannon Index metric.	unitless
Taxonomic_evenness_Pielou	Species evenness of sample, Pielou metric.	unitless
Functional_richness	Number of functional trait categories in sample.	unitless
Functional_diversity_Shannon	Functional trait diversity of sample, Shannon Index metric.	unitless
Functional_evenness_Pielou	Functional trait evenness of sample, Pielou metric.	unitless
Faunal_density	Density of individuals in sample.	individuals/m2
Faunal_biomass	Biomass of individuals in sample.	gram per square meter (gr/m2)
Average_body_size	Average mass of an individual per sample.	total biomass/total density

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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

AT37-06_Alvin_Dives

Website	https://www.bco-dmo.org/deployment/782870
Platform	Alvin
Report	https://datadocs.bco-dmo.org/d3/data_docs/GuaymasBasin_Interactions/AT37-06_CruiseReport.pdf
Start Date	2016-12-09
End Date	2016-12-27
Description	Alvin dives conducted at Guyamas Basin on R/V Atlantis cruise AT37-06.

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

AT42-03_Alvin_Dives

Website	https://www.bco-dmo.org/deployment/777904
Platform	Alvin
Start Date	2018-10-17
End Date	2018-11-04

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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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