

Rock and sediment samples collected by ROV SuBastian during the Octopus Odyssey expeditions Fkt230602 and Fkt231202 aboard R/V Falkor (too) in Costa Rica (2023)

Website: <https://www.bco-dmo.org/dataset/1001800>

Data Type: Cruise Results

Version: 1

Version Date: 2026-07-02

Project

» [Octopus Odyssey](#) (OctoOdyssey)

Program

» [Crustal Ocean Biosphere Research Accelerator](#) (COBRA)

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Abstract

This dataset includes metadata of geological samples collected during the Octopus Odyssey expeditions (Fkt230602 and Fkt231202) aboard the R/V Falkor (too) in the Pampa Submarina region off the Pacific coast of Costa Rica. Sampling was conducted from 3-20 June and 3-14 December 2023 using the ROV SuBastian across six geologic features at depths between 500 and 3180 meters. Push core sediment samples were collected and used for various analyses. Most rock samples are curated at the Escuela Centroamericana de Geología at the Universidad de Costa Rica (Central American School of Geology, University of Costa Rica) and at the U.S. Geological Survey Pacific Coastal and Marine Science Center, United States of America. Sampling was carried out under national research permits. The data file includes geological descriptions of sediment and rock samples.

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Coverage

Location: Pampa Submarina, Costa Rica, Eastern Tropical Pacific

Spatial Extent: N:9.13611 E:-86.40155 S:8.61649 W:-87.346229

Temporal Extent: 2023-06-03 - 2023-12-14

Methods & Sampling

Sampling was conducted across six main geological features in the Pampa Submarina region off the Pacific coast of Costa Rica, including several hills, knolls, a seamount, and the surrounding abyssal plain.

Push core sediment samples were collected in the abyssal plain where sufficient sediment thickness allowed coring. Rock samples were collected during ROV SuBastian dives when suitable outcrops were encountered. Both push core and rock samples were collected using the ROV's manipulator arms.

Rock samples were labelled using the standard code used in the expedition (Cruise ID, followed by a sequential sample code used for each expedition, and then the type of sample (S for sediments, R for rocks); e.g. FKt230602-006-S). Samples were photographed on board following the standards methods used for rocks.

Samples from these collections were allocated to various biological, physical, geochemical, and ecotoxicological analyses. These included characterization of sediment, fungi, worms, protists, and meiofauna, physical sediment descriptions using smear slides, geochemistry, 'omics-based taxonomic and functional assessment of microbiomes, Cd exposure ecotoxicological experiments and background metal concentration of the 0-10 cm layer, namely by quantifying Cu, Fe, Mn, Zn, Ni, Cr, Pb, Cd.

Data Processing Description

Sample metadata were compiled and verified using the cruise data log maintained during both cruises. After each cruise, the dataset was reviewed to ensure consistency in sample codes, description, and location details. The information from both expeditions was then integrated into a single dataset.

BCO-DMO Processing Description

- Loaded original file "OctopusOdyssey_GeologicalSamples.csv" into the BCO-DMO system.
- Combined columns "eventDate" (time, format "%H:%M:%S") and "eventDate2" (date, format "%Y-%m-%d") into new datetime column "ISO_DateTime.UTC" formatted as "%Y-%m-%dT%H:%M:%SZ" in UTC.
- Applied find/replace on an erroneous "decimalLongitude" value, replacing "-87277339.0" with "-87.277339".
- Saved the file as "1001800_v1_rov_rock_sediment_samples.csv" and requested submitter approval.
- Loaded the submitter-modified version of this file, "1001800_v1_rov_rock_sediment_samples_MS.csv" into the BCO-DMO system.
- Converted eventDate2 from format %d/%m/%Y to date type with output format %Y-%m-%d.
- Saved the final file as "1001800_v1_rov_rock_sediment_samples.csv".

Problem Description

A few samples were lost during the ROV ascent; however, because these events were recorded in the sample logs, they remain part of the dataset. Each case is clearly noted in the corresponding occurrenceRemarks field associated with those samples, ensuring transparency and completeness of the sampling record.

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Data Files

File
1001800_v1_rov_rock_sediment_samples.csv (Comma Separated Values (.csv), 40.40 KB) MD5:e21f4fa5c2a1fa31ae69ccce7e8a9f
Primary data file for dataset ID 1001800, version 1

Related Datasets

IsRelatedTo

(2024) **SuBastian ROV Sample Log**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-08-13 <http://lod.bco-dmo.org/id/dataset/935534> [[view at BCO-DMO](#)]
Relationship Description: Octopus Odyssey Project - ROV SuBastian Sample Log

Parameters

Parameter	Description	Units
cruiseNumber	Unique identifier for the research cruise or expedition during which the sample was collected. Identifier for the Schmidt Ocean Institute expedition Fkt230602 or Fkt231202.	unitless
sampleNumber	Unique identifier assigned to an individual sample collected during a cruise expedition. A sequential number corresponding to the master log of the expedition, where all sampling events were recorded (e.g., 005).	unitless
sampleType	General category of the sample (e.g., sediment, rock). The code abbreviates with a “S” when it is a sediment sample and adds a “R” when it is a rock.	unitless
sampleCode	Short standardized code used internally to identify or classify the sample. (e.g., FKt230602-116-S)	unitless
description	General descriptive notes about the sample including appearance composition or relevant observations.	unitless
geologicalDescription	Detailed description of the geological characteristics of the sample such as lithology grain size or mineral/ biogenic composition.	unitless
typeofgeologicalDescription	Classification or method used for the geological description such as macroscopic or microscopic.	unitless
dive	Identifier of the dive or ROV operation during which the sample was collected.	unitless
diveSite	Name of the specific site or location where the dive took place. (e.g., Tengosed Seamount)	unitless

ISO_DateTime_UTC	Date and time (UTC) when the sampling event occurred in ISO 8601 format.	unitless
eventDate	Time when the sampling event occurred (UTC).	unitless
eventDate2	Date when the sampling event occurred.	unitless
decimalLatitude	Latitude coordinate of the sampling location	decimal degrees
decimalLongitude	Longitude coordinate of the sampling location	decimal degrees
depth_m	Depth at which the sample was collected	meters
sampleFinalLocation	Current repository or storage location of the sample such as laboratory/ museum collection.	unitless
occurrenceRemarks	Additional remarks or comments about the sampling occurrence including contextual information.	unitless

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Instruments

Dataset-specific Instrument Name	sediment push cores
Generic Instrument Name	Push Corer
Dataset-specific Description	All geological samples were collected using the remotely operated vehicle (ROV) SuBastian, operated by the Schmidt Ocean Institute aboard the R/V Falkor (too). The ROV is equipped with manipulator arms, it has a fore portside sliding, 8 core, locked basket with bungee holders in each core holster. Each dive is equipped to carry a total of 8 sediment push cores. Environmental parameters such as depth, temperature, and location were recorded through the ROV's integrated sensor suite and navigation system, maintained and calibrated by Schmidt Ocean Institute's technical team.
Generic Instrument Description	Capable of being performed in numerous environments, push coring is just as it sounds. Push coring is simply pushing the core barrel (often an aluminum or polycarbonate tube) into the sediment by hand. A push core is useful in that it causes very little disturbance to the more delicate upper layers of a sub-aqueous sediment. Description obtained from: http://web.whoi.edu/coastal-group/about/how-we-work/field-methods/coring/

Dataset-specific Instrument Name	remotely operated vehicle (ROV) SuBastian
Generic Instrument Name	ROV SuBastian
Dataset-specific Description	All geological samples were collected using the remotely operated vehicle (ROV) SuBastian, operated by the Schmidt Ocean Institute aboard the R/V Falkor (too). The ROV is equipped with manipulator arms, it has a fore portside sliding, 8 core, locked basket with bungee holders in each core holster. Each dive is equipped to carry a total of 8 sediment push cores. Environmental parameters such as depth, temperature, and location were recorded through the ROV's integrated sensor suite and navigation system, maintained and calibrated by Schmidt Ocean Institute's technical team.
Generic Instrument Description	ROV SuBastian is operated from the research vessel Falkor and the R/V Falkor(too). The ROV is outfitted with a suite of sensors and scientific equipment to support scientific data and sample collection, as well as interactive research, experimentation, and technology development. More information available at https://schmidtoccean.org/technology/robotic-platforms/4500-m-remotely-op...

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Deployments

FKt230602

Website	https://www.bco-dmo.org/deployment/935537
Platform	R/V Falkor (too)
Start Date	2023-06-01
End Date	2023-06-22
Description	Operator: Schmidt Ocean Institute Project: Octopus Odyssey Start Port: Puntarenas, Costa Rica End Port: Puntarenas, Costa Rica See additional information at R2R: https://www.rvdata.us/search/cruise/FKt230602 Cruise website: https://schmidtoccean.org/cruise/octopus-odyssey/

FKt231202

Website	https://www.bco-dmo.org/deployment/935539
Platform	R/V Falkor (too)
Start Date	2023-12-02
End Date	2023-12-15
Description	Operator: Schmidt Ocean Institute Project: Octopus Odyssey (Too) Start Port: Balboa, Panama End Port: Golfito, Costa Rica See additional information at R2R: https://www.rvdata.us/search/cruise/FKt231202 Cruise website: https://schmidtoccean.org/cruise/octopus-odyssey-too/

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Project Information

Octopus Odyssey (OctoOdyssey)

Website: <https://schmidtocean.org/cruise/octopus-odyssey/>

Coverage: Central Eastern Pacific offshore Costa Rica

Brief Overview:

The first Octopus Odyssey expedition took place from June 2 to June 21, 2023 on R/V Falkor (too). The second expedition, Octopus Odyssey (too) took place from December 2 to December 15, 2023. Both expeditions explored The Dorado Outcrop, one of Costa Rica's "Off-Axis seamounts on the complex Cocos Plate. These two cruises featured early career training activities and international capacity-sharing elements that were integrated into the NSF-funded COBRA program. In addition to the NSF award, this project was also supported by Schmidt Ocean Institute, Blue Nature Alliance, and Bigelow Laboratory for Ocean Sciences.

More information is available from Schmidt Ocean Institute at:

<https://schmidtocean.org/cruise/octopus-odyssey/>

and

<https://schmidtocean.org/cruise/octopus-odyssey-too/>

Detailed Description:

Seamount ecosystems support highly diverse animal communities on the seafloor and the surrounding ocean, yet the diversity, connectivity and ecosystem services of these environments is poorly understood. The Pacific Ocean margin of Costa Rica contains a range of seamount habitats, from the rough terrain of the southwestern margin to the sparser terrain of the northwestern margin. While the southwestern terrain has previously been surveyed (including by R/V Falkor in 2019) and some seamount areas are already protected, far less is known about the ecosystems of the northwestern terrain. In 2013/2014 unique animal behaviors and hydrothermal venting were discovered using ROV Jason and HOV Alvin on a small feature in the northwestern terrain. Namely, extensive aggregations of octopus were observed at a place called the Dorado Outcrop, located in areas of diffuse venting of slightly warmed hydrothermal fluids. At the time of discovery, it was unclear if these aggregations could be considered nurseries, since no viable eggs were observed with brooding mothers.

Two expeditions of the RV Falkor (too) were planned for 2023 to return to this region to ask new questions about the connection of life, rocks, and fluids around these seafloor features. The team wanted to answer questions, such as:

- Are there viable octopus nurseries hosted on seamounts offshore Costa Rica?
- If yes, are the octopus nurseries active at a different time of year?
- Do octopus brooding in hydrothermal springs have different microbiomes as compared to other octopus, and are those microbiomes connected to the microbes in the hydrothermal springs or surrounding rocks?
- Are the hydrothermal spring fluids unique, representing different trends in fluid-rock-life reactions, or do they represent a single altered fluid?
- Are there seasonal trends in biodiversity on the seafloor or in the water above?

In June of 2023, an international team traveled to this region aboard R/V Falkor (too) for the Octopus Odyssey Leg 1 expedition Fkt230602 with a major goal to determine if the eggs at the nursery were viable, as past expeditions to the outcrop had never seen evidence of developing embryos. From 2-21 June 2023, we conducted 14 dives with ROV SuBastian to explore six seafloor features (only one of which had ever been explored before), augmented by 13 full-water-column CTD Niskin Rosette casts and six multibeam surveys. We had roughly 229 hours of ROV operations in the water (172 hours on the seafloor + 57 hours of ascent/descent), resulting in 208 hours of video. The longest ROV dive was approximately 35 hours and the deepest depth of ROV exploration was 3178 m. We had 285 sampling events during the ROV dives: 150 primary biological specimens (plus associates), 66 sediment push cores, 28 ROV Niskin samples of bottom water, 13 squeezer fluid samples, 30 rock samples. This also included deployments of 22 different experiments planned for recovery in December 2023, and recovery of 2 experiments from the Dorado Outcrop deployed in 2014. We also conducted 31 video transects. Operations went very smoothly, although some transit between sites had to be diverted due to long line fishing in the area, and one medical evacuation required transit to port before returning to site. On the first ROV dive at the nursery in June, we witnessed baby octopus hatching, confirming our primary hypothesis that there are viable octopus nurseries in this region. We also found the fifth known octopus nursery in the world on a different seafloor feature 30 nautical miles away. Exploration of the six seafloor features on the expedition revealed an incredibly rich biodiversity and biogeography of life on ancient volcanoes offshore Costa Rica. We also documented additional evidence of the hydrogeology of the region – how water moves in, out, and through oceanic crust. This data can inform why volcanoes and

earthquakes in Costa Rica vary as different types of seamounts and oceanic crust subducts beneath overriding plates.

In December 2023, the Octopus Odyssey (too) Leg 2 team returned to this region on RV Falkor (too) on expedition Fkt231202 to ask new questions about biodiversity in the region and to recover experiments to track the hydrogeology of the area. From 1-15 December 2023, Octopus Odyssey (too) conducted twelve full-ocean depth ROV dives with ROV SuBastian, augmented by five full-ocean depth CTD Niskin Rosette casts, and multibeam operations resulting in 7416 km² of coverage in Costa Rican waters. We had roughly 104 hours of ROV operations (55 hours on the seafloor + 49 hours of ascent/descent). This has resulted in approximately 141 hours of video. The longest ROV dive was a little over 16 hours and the deepest depth of ROV exploration was 3179 mbsl. We had 241 sampling events with the ROV in the water: 93 primary biological specimens, 14 sediment push cores, 21 ROV Niskin samples, 20 rock samples, and 51 fluid samples collected with a third-party SUPR sampler. On the ship, we collected an additional 66 secondary associate biological samples from primary specimens, bringing the total number of samples to 307 (this does not include subsamples). We also conducted 23 video transects. For the most part, our operations went according to schedule. No ROV operations were ended early due to operational issues, although one dive was aborted on launch due to a ground fault in a third-party instrument; this was quickly resolved and the dive restarted. One dive ended early due to a fishing long-line drifting towards the vessel; we recovered early then re-dove on the site after the long-line passed by. Communications with fishing boats and the fisheries ministry, enabled by the Berth-of-Opportunity Observer from Instituto Costarricense de Pesca y Acuacultura (INCOPESCA), helped prevent further issues in the area. The biggest finding of the return expedition was confirmation that the octopus nurseries offshore Costa Rica support baby octopus throughout the year, not just in the summer rainy season. Scientists onboard witnessed spectacular scenes of the first moments of life, as baby octopus emerged from their eggs, including traveling with one hatchling for an epic journey over 150 m up into the water. Immature eggs were also observed to have tiny octopus embryos inside. Having two expeditions to the same region in one year was essential for confirming this finding. Moreover, the seamounts offshore Costa Rica support at least four new species of deep-sea octopuses, based on the collection of specimens from both Octopus Odyssey expeditions in June and December 2023. This is an unprecedented biodiversity of octopus in this small area especially at these depths.

Equally as important as achieving the scientific objectives was the objective to continue the theme of capacity sharing, early career development, and raising awareness of deep-sea heritage in Latin America. The international Octopus Odyssey and Octopus Odyssey (too) teams gathered to achieve collaborative co-production of knowledge and training with Costa Ricans, honoring the work in Costa Rica's waters. Spanish-speaking scientists were given priority for dive lead watches to enable livestream narration in Spanish, and priority for leadership experience. Ship-to-shore engagements were also prioritized for Spanish-speaking audiences, particularly in Costa Rica. These efforts were intended to raise the profile of the deep-sea heritage in Costa Rica ahead of the 2024 UN Ocean Conference meeting taking place in Costa Rica in June 2024. Over 300 biological specimens collected on the two expeditions are archived at the Museum of Zoology at the University of Costa Rica, enabling current and future generations of students and researchers to develop expertise in regional deep-sea animals. It is likely that many of the specimens collected represent new species and new records of known species for the region. Rock and sediment samples collected on the expeditions are revolutionizing the understanding of the complex geological origins and processes occurring on this part of the seafloor. Surprisingly, initial analysis of microfossils in sediments reveals that seafloor sediments are millions-of-years old, indicating strong currents, dissolution and scouring. In addition, fossils of beaked whales were found on numerous outcrops. All microfossils and macrofossils are archived in the Paleontology collection at the Central American School of Geology at the University of Costa Rica for continued study, with additional mineralogical samples shared with the Global Marine Minerals Program at the U.S. Geological Society. Finally, bathymetric and subbottom profile mapping data conducted on the OctoOdyssey expeditions was used to define the diverse seafloor features in this region to then propose official names to GEBCO. This naming effort is being led by Costa Rican scientists in consultation with the Costa Rican Committee on Nomenclature; the new proposed names were unanimously approved by the committee and will now be included on Costa Rican maps.

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Program Information

Crustal Ocean Biosphere Research Accelerator (COBRA)

Coverage: global

NSF Abstract:

The deep seafloor covers two-thirds of Earth's surface area, but there is limited understanding of the deep-ocean ecosystems and resources and the ability of these ecosystems to withstand human impacts. Human uses such as deep-sea mining and carbon sequestration are poised to fundamentally alter physical, chemical, and biological conditions of the seafloor and surrounding environments. These activities have the potential to rival negative effects from bottom fishing and other human impacts to the deep sea, yet the science to inform and evaluate the impacts of these new industries is lacking. The Crustal Ocean Biosphere Research Accelerator (COBRA) project connects diverse stakeholders and experts – interdisciplinary academic and government scientists, private institutions, policy makers, industry experts and other stakeholders – through virtual meetings to coordinate efforts. The goal is to generate new knowledge and inform decision-making relating to emergent industrial uses of the deep ocean and decrease the likelihood of serious harm to the environment while maintaining the broad benefits that society currently enjoys.

The COBRA network of networks has nine key partners that bring access to international science and crustal ocean exploration assets (Ocean Exploration Trust, Schmidt Ocean Institute, Ocean Networks Canada, Cluster Ocean Floor at MARUM, and C-DeepSea), to experts that provide science-based recommendations to policy makers (Deep Ocean Stewardship Initiative working groups, including the Challenger 150 program), to governmental groups responsible for assessing crustal ocean resources (USGS Global Marine Minerals Group), and to experts in team science (CREDITS program). COBRA unites these partners in a common mission to accelerate research on the structure, function, resilience, and ecosystem services of the crustal ocean biosphere to inform decision making. COBRA will help to close knowledge gaps by facilitating dedicated and coordinated expedition and observatory efforts combined with emergent characterization approaches. In parallel, COBRA will train at least 50 globally distributed early-career researchers in ocean exploration, science, and policy through innovative virtual expedition leadership training and support two dozen international research exchanges that promote team science collaboration, diversity, equity, and inclusivity. COBRA will also establish a web-based search portal that points to all data types deposited in appropriate internationally accessible data repositories to promote data discovery and accelerate knowledge transfer and collaboration.

The Accelerating Research through International Network-to-Network Collaborations (AccelNet) program is designed to accelerate the process of scientific discovery and prepare the next generation of U.S. researchers for multiteam international collaborations. The AccelNet program supports strategic linkages among U.S. research networks and complementary networks abroad that will leverage research and educational resources to tackle grand scientific challenges that require significant coordinated international efforts.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

Description:

The mission of the Crustal Ocean Biosphere Research Accelerator (COBRA) is to accelerate research on the structure, function, resilience, and ecosystem services of the crustal ocean biosphere to inform decision making. The goal is to generate new knowledge and inform decision-making relating to emergent industrial uses of the deep ocean, such as deep-sea mining and subseafloor carbon sequestration, and decrease the likelihood of serious harm to the environment while maintaining the broad benefits that society currently enjoys. COBRA will help to close knowledge gaps by facilitating dedicated and coordinated expedition and observatory efforts combined with emergent characterization approaches. In parallel, COBRA will train at least 50 globally distributed early-career researchers in ocean exploration, science, and policy through innovative virtual expedition leadership training and support two dozen international research exchanges that promote team science collaboration, diversity, equity, and inclusivity. COBRA will also establish a web-based search portal that points to all data types deposited in appropriate internationally accessible data repositories to promote data discovery and accelerate knowledge transfer and collaboration.

Affiliated Programs:

C-DEBI, IODP, OOI, DOSI, Schmidt Ocean Institute, Ocean Exploration Trust, Ocean Networks Trust

Funding

Funding Source	Award
NSF Office of International Science and Engineering (NSF OISE)	OISE-2114593

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