SuBastian ROV Sample Log

Website: https://www.bco-dmo.org/dataset/935534
Version: 1
Version Date: 2024-08-13

Project
» Octopus Odyssey (OctoOdyssey)

Program
» Crustal Ocean Biosphere Research Accelerator (COBRA)

Abstract
This dataset describes the samples collected with the ROV SuBastian during R/V Falkor (too) cruises Fkt231202 and Fkt230602. For each sample, descriptive information is included, as well as the coordinates and date of the sample collection.

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Coverage

Location: Central Eastern Pacific Ocean, offshore Costa Rica

Methods & Sampling

Cruise Fkt231202 ROV SuBastian Dive Operation Details

From 1-15 December 2023, we conducted 12 dives with ROV SuBastian to explore six seafloor features in the Pacific Ocean offshore Costa Rica. We had roughly 104 hours of ROV operations in the water (55 hours on the seafloor + 49 hours of ascent/descent) resulting in 141 hours of video. The longest ROV dive was approximately 16 hours and the deepest depth of ROV exploration was 3179m.

Cruise Fkt231202 ROV SuBastian Sampling Details

We had 241 sampling events during the ROV dives: 159 biological specimens, 14 sediment push cores, 21 ROV Niskin samples of bottom water, 51 fluid samples collected with a third-party SUPR sampler, and 20 rock samples. The sample total also included deployments and recoveries of 42 different experiments. We also conduct 23 video transects. Biological specimens were photographed and subsampled, with specimens archived at the Museum of Zoology at the University of Costa Rica. Rock and sediment samples were photographed and subsampled, with archives split between the School of Geology at the University of Costa Rica and the Global Marine Minerals Project at the US Geological Survey. Video data are archived on YouTube.

Cruise Fkt230602 ROV SuBastian Dive Operation Details

From 2-21 June 2023, we conducted 14 dives with ROV SuBastian to explore six seafloor features in the Pacific Ocean offshore costa Rica. 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 3178m.

Cruise Fkt230602 ROV SuBastian Sampling Details

We had 285 sampling events during the ROV dives: 150 primary biological specimens (plus associated), 66 sediment push cores, 28 ROV Niaskin samples of bottom water, 13 squeezer fluid samples, and 30 rock samples. The sample total also included deployments of 22 different experiments planned for recovery in December 2023, and recovery of two experiments from the Dorado Outcrop deployed in 2014. We also conduct 31 video transects. Biological specimens were photographed and subsampled, with specimens archived at the Museum of Zoology at the University of Costa Rica. Rock and sediment samples were photographed and subsampled, with archives split between the School of Geology at the University of Costa Rica and the Global Marine Minerals Project at the US Geological Survey. Video data are archived on YouTube.

Data Processing Description

Coordinate and timestamp data derived from ROV SuBastian.

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Octopus Odyssey (OctoOdyssey)

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 northwest 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

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Funding

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

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