Carbonate chemistry data from water samples collected via CTD Niskin Bottles aboard Falkor (too) on cruises FKT230602 and FKT231202 in hydrothermally active areas off Costa Rica's Pacific margin from Jun and Dec 2023

Website: https://www.bco-dmo.org/dataset/997715
Data Type: Cruise Results
Version: 1
Version Date: 2026-04-29

Project
» Octopus Odyssey (OctoOdyssey)

Program
» Crustal Ocean Biosphere Research Accelerator (COBRA)

Contributors	Affiliation	Role
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Abstract
This dataset includes data from discrete water samples collected during two Octopus Odyssey expeditions aboard R/V Falkor (too) in June (FKT230602) and December (FKT231202) 2023. The data consists mainly of near-the-surface sampling events, with some take from the bottom at Dorado Outcrop and Pampa Submarina, hydrothermally active areas off Costa Rica's Pacific margin. The dataset includes information such as sampler, cruise number, station number, cast number, sampling date/time, depth, subsample/sample code, sampling coordinates, temperature (ºC), salinity (g/kg), oxygen (µmol/kg), dissolved inorganic carbon (µmol/kg), total alkalinity (µmol/kg), and inorganic nutrients (µmol/L), along with associated observational notes. The water samples were collected from 12 L Niskin bottles (24 Niskin bottles-CTD rosette) and in situ physicochemical parameters (temperature, salinity, oxygen) were measured with CTD. Water samples were analyzed at Centro de Investigación en Ciencias del Mar y Limnología (CIMAR-UCR). The research was conducted by an international team in collaboration with Costa Rican institutions, and the dataset is instrumental in oceanographic studies related to seamount ecosystems and carbonate chemistry.

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Coverage

Location: Pampa Submarina off-shore Costa Rica. 9N 87W, Costa Rica EEZ

Spatial Extent: **N**:9.2406 **E**:-85.643 **S**:8.6202 **W**:-87.3238
Temporal Extent: 2023-06-03 - 2023-12-10

Methods & Sampling

Water Sampling

Discrete water samples collected during two Octopus Odyssey expeditions aboard R/V Falkor (too) in June (FKT230602) and December (FKT231202) 2023. The data consists mainly of near-the-surface sampling events, with some take from the bottom at Dorado Outcrop and Pampa Submarina, hydrothermally active areas off Costa Rica's Pacific margin.

Discrete water samples were collected from 12 L Niskin bottles (24 Niskin bottles-CTD rosette) and in situ physicochemical parameters (temperature, salinity) were measured with CTD.

Laboratory analyses

Carbonate chemistry

Carbonate chemistry samples were collected first, as soon as the Niskin bottle was opened and before any other samples (e.g., phytoplankton, nutrients, microplastics, etc.) The sampling order was 1) dissolved inorganic carbon (DIC) and 2) total alkalinity (TA). DIC and TA samples were collected, poisoned and stored following procedures from SOP 3b (Dickson et al. 2007) and REMARCO-AO-P-01 (Sánchez-Noguera 2021). Water was collected from the Niskin bottle using a Tygon tubing. The water flow was constant during the process of rinsing the sample containers/syringes (x3) to remove bubbles from the draw Tygon tubing. Samples were stored in the dark at 4 ºC until analysis at Centro de Investigación en Ciencias del Mar y Limnología (CIMAR-UCR).

DIC: water was slowly drawn from the Niskin with a 60 mL syringe plugged into the Tygon tube. Sample from the syringe was filtered through a 0.45-micron filter and transferred with a smaller Tygon tube into a 40 mL amber borosilicate vial (acid-washed and combusted), rinsed three times with the sample. Sample was poisoned with 50 µL of saturated $HgCl_2$ and vial closed with PTFE septum.

TA: 250 mL borosilicate bottles with glass stopper were rinsed (3x) with flowing water and filled directly from the Niskin. Each bottle was allowed to overflow approximately 1.5 times the filling time. Headspace was adjusted with a plastic syringe (10 mL), sample was poisoned with 100 µL of saturated $HgCl_2$ and bottle sealed with a greased stopper (Apiezon-L).

Nutrients

Water was collected from the Niskin with a 60 mL syringe plugged into the Tygon tube. Sample from the syringe was filtered through a 0.45-micron filter and transferred with a smaller Tygon tube to a 60 mL plastic vial, rinsed three times with the filtered sample. Samples were frozen and stored at -20 ºC until analysis.

Data Processing Description

DIC data output from instrumentation was converted to units of µmol/kg from mg/kg. TA values were calculated from titration data, with a modified version of an R script developed by Comeau and Gazeau (Laboratoire d'Océanographie de Villefrance-sur-Mer) largely based on SOP 3b (Dickson et al. 2007). Final values of DIC and TA included in the dataset resulted from applying a daily correction factor (CF) to the measured values. The CF is determined by calibration of the system against a certified reference material (CRM) prepared at the Scripps Institution of Oceanography of the University of California, San Diego.

BCO-DMO Processing Description

- Loaded data from "DIC_fkt230602_fkt231202_Rosette_dm.csv" in CSV format, treating "nd" and empty strings as missing values, with headers from row 1

- Renamed fields: "Sal (g/kg)" to "Sal", "DIC (µmol/kg)" to "DIC", "Station #" to "Station_Number", "Cast #" to "Cast_Number", "Bottle No." to "Bottle_No", and "T (°C)" to "T"
- Applied find/replace on "Responsible" field using regex pattern "S[^a-zA-Z]nchez" to correct encoding corruption, replacing matches with "Sánchez"
- Combined "Date (mm-dd-yyyy)" and "TimeUTC (hh:mm:ss)" fields into a new "date_time_UTC" datetime field formatted as "%Y-%m-%dT%H:%M:%SZ" in UTC
- Deleted original date and time fields "Date (mm-dd-yyyy)" and "TimeUTC (hh:mm:ss)"
- Applied find/replace on "Long" field to prepend a negative sign to any longitude values not already negative
- Output written to "997114_v1_dic_fkt230602_fkt231202_rosette.csv"

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Related Publications

Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to Best Practices for Ocean CO2 Measurements. PICES Special Publication 3, 191 pp https://isbnsearch.org/isbn/1-897176-07-4
Methods

Sánchez-Noguera, C. (2021). Recolección y preservación de muestras para la medición de variables del sistema de CO2 en aguas marino - costeras. Red de Investigación de Estresores Marinos - Costeros en Latinoamérica y El Caribe – REMARCO. Santa Marta, Colombia. 17 pp. https://remarco.org/manual-ao/ https://remarco.org/wp-content/uploads/2021/10/Protocolo-Muestreo-REMARCO-completo-2.pdf
Methods

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Parameters

Parameter	Description	Units
Sampler	Type of sampler used (24 Niskin bottles-CTD Rosette)	unitless
Cruise_Number	ID for the research cruise or expedition	unitless
Station_Number	Specific station where the sample was collected, corresponding to a geographic location or a sampling point during the cruise	unitless
Cast_Number	Refers to the specific lowering and raising of the CTD-Rosette (Conductivity, Temperature, and Depth) instrument to gather data at different depths, known as a cast""	unitless
Depth	Sampling depth, corresponding units are included in the column heading	meters (m)
Subsample	ID for any subset or portion of the original sample collected with a specific Niskin bottle, which is taken to analyze a specific parameter (e.g. DIC, TA, nutrients)	unitless
Sample_code	Unique ID composed of (Cruise ID + Station Number + Cast Number + Depth + Subsample ID), used to identify the sample for tracking/cataloging purposes in the lab or database	unitless

Observations	Notes or remarks corresponding to sample collection or analysis, providing context or additional information relevant to the sample	unitless
Responsible	Person or group in charge of collecting and/or analyzing the sample	unitless
Bottle_No	Number associated with the specific Niskin bottle used to collect the sample	unitless
Lat	Latitude of sampling location, positive is North	decimal degrees
Long	Longitude of sampling location, negative is West	decimal degrees
T	Temperature of the sample in situ	degrees Celsius
Sal	Salinity of the sample in situ	g/kg
DIC	Dissolved inorganic carbon of the sample measured in the laboratory	µmol/kg
date_time_UTC	Sampling datetime in UTC	unitless

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Instruments

Dataset-specific Instrument Name	Altimeter
Generic Instrument Name	Altimeter
Dataset-specific Description	The system used was a Sea-Bird Electronics 911plus CTD system on a rosette carrying 24 Niskin bottles (12 L), equipped with two temperature sensors (SBE 4), two conductivity sensors (SBE 3+), two dissolved oxygen sensors (SBE 43), Fluorometer (chlorophyll a)/Turbidity Meter (WetLabs ECO FLNTUD), transmissometer (WetLabs C-star) and altimeter.
Generic Instrument Description	An instrument that measures height above a fixed surface. The data can be used to map ocean-surface topography and generate gridded surface height fields.

Dataset-specific Instrument Name	Two conductivity sensors (SBE 3+)
Generic Instrument Name	Conductivity Meter
Dataset-specific Description	The system used was a Sea-Bird Electronics 911plus CTD system on a rosette carrying 24 Niskin bottles (12 L), equipped with two temperature sensors (SBE 4), two conductivity sensors (SBE 3+), two dissolved oxygen sensors (SBE 43), Fluorometer (chlorophyll a)/Turbidity Meter (WetLabs ECO FLNTUD), transmissometer (WetLabs C-star) and altimeter.
Generic Instrument Description	Conductivity Meter - An electrical conductivity meter (EC meter) measures the electrical conductivity in a solution. Commonly used in hydroponics, aquaculture and freshwater systems to monitor the amount of nutrients, salts or impurities in the water.

Dataset-specific Instrument Name	Sea-Bird Electronics 911plus
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Dataset-specific Description	The system used was a Sea-Bird Electronics 911plus CTD system on a rosette carrying 24 Niskin bottles (12 L), equipped with two temperature sensors (SBE 4), two conductivity sensors (SBE 3+), two dissolved oxygen sensors (SBE 43), Fluorometer (chlorophyll a)/Turbidity Meter (WetLabs ECO FLNTUD), transmissometer (WetLabs C-star) and altimeter.
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Fluorometer (chlorophyll a)
Generic Instrument Name	Fluorometer
Dataset-specific Description	The system used was a Sea-Bird Electronics 911plus CTD system on a rosette carrying 24 Niskin bottles (12 L), equipped with two temperature sensors (SBE 4), two conductivity sensors (SBE 3+), two dissolved oxygen sensors (SBE 43), Fluorometer (chlorophyll a)/Turbidity Meter (WetLabs ECO FLNTUD), transmissometer (WetLabs C-star) and altimeter.
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Automated nondispersive infrared sensor (analyzer multi N/C UV HS, Analytik Jena)
Generic Instrument Name	Inorganic Carbon Analyzer
Dataset-specific Description	DIC samples were analyzed using an automated nondispersive infrared sensor (analyzer multi N/C UV HS, Analytik Jena). DIC was determined by acidifying the samples with 10% H3PO4 and quantifying the extracted CO2 gas by NDIR spectrometry.
Generic Instrument Description	Instruments measuring carbonate in sediments and inorganic carbon (including DIC) in the water column.

Dataset-specific Instrument Name	888 Titrando (Methrom)
Generic Instrument Name	Metrohm 888 Titrando pentiometric titrator
Dataset-specific Description	TA was determined by open-cell potentiometric titration with an 888 Titrando (Methrom) following procedures from SOP 3b (Dickson et al., 2007).
Generic Instrument Description	A modular pentiometric titrator for dynamic, monotonic and set endpoint titrations. The instrument consists of an intergrated buret, rod or magnetic stirrer and dosing system. Operation is carried out by means of a touch-sensitive display or with high-performance PC software. Temperature is measured by a Pt1000 or NTC. It has a measuring range of -13 to 20 pH, resolution of 0.001 pH and measuring accuracy of +/-0.003 pH.

Dataset-specific Instrument Name	24 Niskin bottles (12 L)
Generic Instrument Name	Niskin bottle
Dataset-specific Description	The system used was a Sea-Bird Electronics 911plus CTD system on a rosette carrying 24 Niskin bottles (12 L), equipped with two temperature sensors (SBE 4), two conductivity sensors (SBE 3+), two dissolved oxygen sensors (SBE 43), Fluorometer (chlorophyll a)/Turbidity Meter (WetLabs ECO FLNTUD), transmissometer (WetLabs C-star) and altimeter.
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Two dissolved oxygen sensors (SBE 43)
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Dataset-specific Description	The system used was a Sea-Bird Electronics 911plus CTD system on a rosette carrying 24 Niskin bottles (12 L), equipped with two temperature sensors (SBE 4), two conductivity sensors (SBE 3+), two dissolved oxygen sensors (SBE 43), Fluorometer (chlorophyll a)/Turbidity Meter (WetLabs ECO FLNTUD), transmissometer (WetLabs C-star) and altimeter.
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Transmissometer (WetLabs C-star)
Generic Instrument Name	Transmissometer
Dataset-specific Description	The system used was a Sea-Bird Electronics 911plus CTD system on a rosette carrying 24 Niskin bottles (12 L), equipped with two temperature sensors (SBE 4), two conductivity sensors (SBE 3+), two dissolved oxygen sensors (SBE 43), Fluorometer (chlorophyll a)/Turbidity Meter (WetLabs ECO FLNTUD), transmissometer (WetLabs C-star) and altimeter.
Generic Instrument Description	A transmissometer measures the beam attenuation coefficient of the lightsource over the instrument's path-length. This instrument designation is used when specific manufacturer, make and model are not known.

Dataset-specific Instrument Name	Turbidity Meter (WetLabs ECO FLNTUD)
Generic Instrument Name	Turbidity Meter
Dataset-specific Description	The system used was a Sea-Bird Electronics 911plus CTD system on a rosette carrying 24 Niskin bottles (12 L), equipped with two temperature sensors (SBE 4), two conductivity sensors (SBE 3+), two dissolved oxygen sensors (SBE 43), Fluorometer (chlorophyll a)/Turbidity Meter (WetLabs ECO FLNTUD), transmissometer (WetLabs C-star) and altimeter.
Generic Instrument Description	A turbidity meter measures the clarity of a water sample. A beam of light is shown through a water sample. The turbidity, or its converse clarity, is read on a numerical scale. Turbidity determined by this technique is referred to as the nephelometric method from the root meaning "cloudiness". This word is used to form the name of the unit of turbidity, the NTU (Nephelometric Turbidity Unit). The meter reading cannot be used to compare the turbidity of different water samples unless the instrument is calibrated. Description from: http://www.gvsu.edu/wri/education/instructor-s-manual-turbidity-10.htm (One example is the Orion AQ4500 Turbidimeter)

Dataset-specific Instrument Name	Two temperature sensors (SBE 4)
Generic Instrument Name	Water Temperature Sensor
Dataset-specific Description	The system used was a Sea-Bird Electronics 911plus CTD system on a rosette carrying 24 Niskin bottles (12 L), equipped with two temperature sensors (SBE 4), two conductivity sensors (SBE 3+), two dissolved oxygen sensors (SBE 43), Fluorometer (chlorophyll a)/Turbidity Meter (WetLabs ECO FLNTUD), transmissometer (WetLabs C-star) and altimeter.
Generic Instrument Description	General term for an instrument that measures the temperature of the water with which it is in contact (thermometer).

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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

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

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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 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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