

CTD water profiles collected in the Yucatan Peninsula and Cozumel Island from 2022 to 2025

Website: <https://www.bco-dmo.org/dataset/1009304>

Data Type: Other Field Results

Version: 1

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Project

» [Collaborative Research: Illuminating Cave Benthos in Subterranean Estuaries- Biodiversity, Ecology, and Role in Coastal Ecosystem Functioning](#) (Karst Cave Benthos)

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Abstract

This dataset includes cave CTD water profiles from subterranean aquatic systems in the Yucatan Peninsula and Cozumel between 2022 – 2025. The study area consists of subterranean aquatic cave systems and associated groundwater habitats characterized by low-light conditions, stable temperatures, and limited nutrient input. These environments support diverse benthic invertebrate communities inhabiting cave substrates and sediments. Water profiles were collected directly by scientific cave divers with YSI EXO sondes calibrated in accordance with the manufacturer instructions. Metadata includes collection site, measurements taken, and CTD model used. This dataset was generated to document water quality during each of the field campaigns in order to better understand ecological processes of cave benthic communities. The work was conducted by the Borda Lab (A&M-SA), XibaLab (Stephen F. Austin State University; Dr. Calderón-Gutiérrez Lab), USGS (Dr. Pohlman), IRSA-CNR (Dr. Brankovits) in collaboration with Woods Hole Oceanographic Institution.

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Coverage

Location: Subterranean aquatic cave systems in the Yucatan Peninsula and Cozumel

Spatial Extent: N:20.7805 E:-86.9422 S:20.26667 W:-87.3917

Temporal Extent: 2022-09-23 - 2025-02-18

Methods & Sampling

Water profiles were conducted during each dive with a multi-parameter sonde (YSI EXO-1 or EXO-2; YSI Inc.) measuring depth (m), temperature (°C), salinity, dissolved oxygen (% saturation), pH, and turbidity (FNU) at 0.5 or 1 second intervals. EXO-2 deployments also included ORP, and Fluorescent Dissolved Organic Matter. The sonde was calibrated prior to deployment following the manufacturer's recommendations. To ensure an undisturbed water-column profile, the sonde was carried by the lead diver with the sensor array oriented forward.

Data Processing Description

Water profiles were cleaned on R 4.6.0 with the R package dplyr 1.2.1. Data cleanup was restricted to removal of data outside of the water and removal of outliers.

BCO-DMO Curation Notes

Curation actions performed on the data files

- Loaded `Cave\_Benthos\_Profiles\_DM.csv` as table `1009304\_v1\_cave\_ctd\_water\_profiles`, using row 1 as the header and treating blank values and `NA` as missing.
- Loaded `Profile\_Summary\_DM.csv` as table `1009304\_v1\_cave\_ctd\_water\_profiles\_summary`, using row 2 as the header and treating blank values and `nd` as missing.
- Renamed columns in `1009304\_v1\_cave\_ctd\_water\_profiles` to standardized names, including `Date`, `Time`, `Time\_Fract\_Sec`, `Site\_Name`, `Cond`, `nLF\_Cond`, `ODO\_sat`, `ODO\_local`, `ODO\_mgL`, `Pressure`, `Sal`, `SpCond`, `TDS`, `Turbidity`, `TSS`, `Temp`, `fDOM\_QSU`, `fDOM\_RFU`, and `ORP`.
- Renamed columns in `1009304\_v1\_cave\_ctd\_water\_profiles\_summary` to standardized names, including `Profile\_number`, `Sampling\_rate`, `Cond`, `Depth`, `fDOM\_QSU`, `fDOM\_RFU`, `nLF\_Cond`, `ODO\_sat`, `ODO\_local`, `ODO\_mgL`, `ORP`, `Pressure`, `Sal`, `SpCond`, `TDS`, `Turbidity`, `TSS`, `pH\_mV`, and `Temp`.
- Combined the `Date` and `Time` columns in `1009304\_v1\_cave\_ctd\_water\_profiles` into a new `ISO\_DateTime\_UTC` column, converting timestamps from `Etc/GMT-5` to UTC and formatting them as `%Y-%m-%dT%H:%M:%SZ`.
- Reordered the columns in `1009304\_v1\_cave\_ctd\_water\_profiles` as follows: `ISO\_DateTime\_UTC`, `Date`, `Time`, `Time\_Fract\_Sec`, `Site\_Name`, `Cond`, `Depth`, `nLF\_Cond`, `ODO\_sat`, `ODO\_local`, `ODO\_mgL`, `Pressure`, `Sal`, `SpCond`, `TDS`, `Turbidity`, `TSS`, `pH`, `Temp`, `fDOM\_QSU`, `fDOM\_RFU`, and `ORP`.
- Converted the `Date` column in `1009304\_v1\_cave\_ctd\_water\_profiles\_summary` from `%m/%d/%y` to a date type formatted as `%Y-%m-%d`.
- Set column types in `1009304\_v1\_cave\_ctd\_water\_profiles`: measurement fields were set as numeric, `TDS` as integer, `Date` and `Site\_Name` as strings, `ISO\_DateTime\_UTC` as UTC datetime, `Time` as time, and `Time\_Fract\_Sec` as numeric.
- Set column types in `1009304\_v1\_cave\_ctd\_water\_profiles\_summary`: `Date` as date, `Profile\_number` as integer, `Sampling\_rate` as numeric, and all remaining columns as strings.
- Updated column metadata for `1009304\_v1\_cave\_ctd\_water\_profiles`, including BCO-DMO standard name IDs, descriptions, and supplied units. `Depth` was designated as the primary parameter.
- Saved the final tables as `1009304\_v1\_cave\_ctd\_water\_profiles.csv` and `1009304\_v1\_cave\_ctd\_water\_profiles\_summary.csv`.

Problem Description

No problems or issues with this dataset have been reported by the dataset authors.

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Parameters

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Parameter	Description	Units
ISO_DateTime_UTC	Date time that measurement was collected by the CTD in UTC.	unitless
Date	Date measurement was collected by the CTD.	unitless
Time	Time measurement was collected by the CTD in local time (GMT-5).	unitless
Time_Fract_Sec	Time fraction.	unitless
Site_Name	Site name	unitless
Cond	Conductivity.	uS/cm
Depth	Depth	meters (m)
nLF_Conc	nLF Conductivity	uS/cm
ODO_sat	Dissolved oxygen saturation percentage.	unitless
ODO_local	Dissolved oxygen saturation - local - percentage.	unitless
ODO_mgL	Dissolved oxygen saturation	mg/L
Pressure	Pressure	PSI
Sal	Salinity	PSU
SpCond	Specific conductivity	uS/cm
TDS	description	units
Turbidity	Turbidity	FNU
TSS	Total Suspended Solids	mg/L
pH	pH	unitless
Temp	Temperature	degrees Celcius

fDOM_QSU	Dissolved Organic Matter	QSU
fDOM_RFU	Dissolved Organic matter	RFU
ORP	Oxidation-Reduction Potential	mV

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Instruments

Dataset-specific Instrument Name	YSI EXO 1 or EXO 2
Generic Instrument Name	YSI EXO multiparameter water quality sondes
Dataset-specific Description	Water profiles were conducted during each dive with a multi-parameter sonde (YSI EXO-1 or EXO-2; YSI Inc.) measuring depth (m), temperature (°C), salinity, dissolved oxygen (% saturation), pH, and turbidity (FNU) at 0.5 or 1 second intervals. EXO-2 deployments also included ORP, and Fluorescent Dissolved Organic Matter.
Generic Instrument Description	Comprehensive multi-parameter, water-quality monitoring sondes designed for long-term monitoring, profiling and spot sampling. The EXO sondes are split into several categories: EXO1 Sonde, EXO2 Sonde, EXO3 Sonde. Each category has a slightly different design purpose with the EXO2 and EXO3 containing more sensor ports than the EXO1. Data are collected using up to four user-replaceable sensors and an integral pressure transducer. Users communicate with the sonde via a field cable to an EXO Handheld, via Bluetooth wireless connection to a PC, or a USB connection to a PC. Typical parameter specifications for relevant sensors include dissolved oxygen with ranges of 0-50 mg/l, with a resolution of +/- 0.1 mg/l, an accuracy of 1 percent of reading for values between 0-20 mg/l and an accuracy of +/- 5 percent of reading for values 20-50 mg/l. Temp ranges are from -5 to +50 degC, with an accuracy of +/- 0.001 degC. Conductivity has a range of 0-200 mS/cm, with an accuracy of +/-0.5 percent of reading + 0.001 mS/cm and a resolution of 0.0001 - 0.01 mS/cm.

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Project Information

Collaborative Research: Illuminating Cave Benthos in Subterranean Estuaries- Biodiversity, Ecology, and Role in Coastal Ecosystem Functioning (Karst Cave Benthos)

Coverage: Yucatan and Cozumel, Mexico, aquifer/anchialine caves

NSF Award Abstract:

Karst subterranean estuaries (KSEs) occur worldwide where fresh and marine-derived waters mix within coastal aquifers, creating a chemical reaction zone that alters the composition of materials transported to the sea and sustains characteristic aquatic communities. Approximately one quarter of Earth's population depends on karst (eroded limestone) water supplies that – within coastal regions – are directly threatened by rising sea level, uncontrolled groundwater extraction, and rapid coastal development. Yet, the role of these ecosystems in coastal biogeochemical cycling and groundwater health remains unknown. While pelagic constituents of flooded caves in KSEs have been studied for decades, the living benthic (cave floor / seafloor-hosted) fauna of

these caves and caverns remains understudied. The overarching goal of this project is to better understand how benthic biodiversity affects ecosystem functioning across subsurface environmental gradients between freshwater aquifers and the marine environment. Flooded coastal caves allow the team to access the KSEs and make direct observations. Results of this work benefit marine benthic ecology and biology, biogeochemistry, paleoecology and biodiversity assessments. This interdisciplinary project establishes a multinational, multi-institutional collaboration, enhance research and scholarship opportunities at a predominantly undergraduate Hispanic-serving institution in Texas and support young investigators from under-represented groups in the sciences. For outreach, the project-associated PhD student, who is an African American female, is co-authoring a semi-autobiographical children's book about cave diving and the wonders of cave-associated organisms.

KSEs influence coastal carbon and nitrogen cycling because they buffer terrestrial material inputs with groundwater discharge into the oceans. While pelagic communities of flooded cave environments in KSEs have been studied for decades due to their adaptations, biogeography, and evolutionary origin, the living benthic fauna and their role in KSE elemental cycling remains understudied. The overall aim of this project is to establish the diversity and ecology of benthic eukaryotes across environmental gradients in extensive coastal caves flooded by the KSE in the Yucatan Peninsula and Cozumel Island (Mexico) and determine how they interact with benthic elemental cycles. This study provides a holistic characterization of KSE benthos using interdisciplinary field- and lab-based approaches including barcoding/meta-barcoding, meta-transcriptomics, ultrastructural analysis, and lab culturing that are being integrated with biogeochemical and hydrological measurements. Specifically, the investigators are characterizing (1) the drivers of spatial biodiversity patterns in coastal cave eukaryotic benthic communities across salinity/oxygen gradients, relative to organic inputs; (2) the role of benthic meiofauna (to nanobiota) communities, with emphasis on foraminifera, in ecosystem function relative to dominant biogeochemical processes that mediate organic matter transformations and nitrogen cycling; and (3) the temporal constraints of benthic meiofauna (to nanobiota) biodiversity and ecosystem resilience in response to seasonal hydrological variation associated with meteorological events.

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.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2136377
NSF Division of Ocean Sciences (NSF OCE)	OCE-2136322

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