CTD profiles collected from R/V Sally Ride cruise SR2508 off the coast of California from April 8 to 21, 2025

Website: https://www.bco-dmo.org/dataset/1004720
Data Type: Cruise Results
Version: 1
Version Date: 2026-08-12

Project
» Microbial Activity and Chemoautotrophy in the Deep Sea: Who, How, and How Much? (DARC Microbes)

Contributors	Affiliation	Role
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Abstract
This dataset consists of CTD sensor data collected during the DARC Microbes Cruise on R/V Sally Ride (SR2508) from April 8 to April 21, 2025, off the coast of California.

Table of Contents

Coverage

Location: Pacific Ocean, off San Francisco, CA, USA
Spatial Extent: **N**:37.1338 **E**:-122.545 **S**:34.4352 **W**:-126.743
Temporal Extent: 2025-04-08 - 2025-04-20

Methods & Sampling

During deployments, the CTD/Rosette with 24 10-liter (L) Niskin bottles was controlled from the console on a Windows PC, using the Sea-Bird SeaSave software (version 7.26.7.121). The CTD/Rosette was first lowered to 10 meters wire out for a 'soak' to let the oxygen and other sensors acclimate. Once the oxygen reading was stable and temperature and salinity differences of the dual sensors were minimal (usually 1-2 minutes), the CTD/Rosette was brought back to the surface and then sent down to the deepest sampling depth. The Niskin bottles were closed during the upcast. Once the CTD/Rosette reached a target depth, bottles were closed after waiting for 2-3 ship rolls or about 20-25 seconds. This resulted in the water that was being dragged up by the CTD/rosette to dissipate and ensured that the water collected in the bottle was representative of the undisturbed water at that depth. On casts where samples were collected 10 meters above the seafloor, the altimeter was used to determine the distance of the CTD/Rosette to the bottom. The altimeter normally kicked in at around 100 meters from the bottom.

Data Processing Description

After the cast was completed, the raw data was processed using the SBE Data Processing SeaSoft software (version 7.26.7). The following processing modules were used in sequence:

1. DatCnv – converts raw binary data to engineering units using the sensor calibrations and outputs data in text format (.cnv files).

2. Filter – applies a low pass filter to smooth rapidly changing data. The filter was applied to the following parameters: pressure (depth), oxygen and transmission.

3. AlignCTD – aligns slower responding sensors with pressure. A 3 second offset was used for the oxygen sensor.

4. CellTM – removes conductivity cell thermal mass effects.

5. LoopEdit – removes effects of pressure reversals due to ship roll. It was also used to remove the surface soak from the downcast.

6. Derive – uses pressure, temperature and conductivity from the sensors to derive parameters like salinity, density, potential temperature, etc.

7. BinAvg – bins the data. Data was binned in 1 db pressure increments.

8. DataCnv for bottles – see above.

9. BottleSum – creates a bottle summary file that includes all sensor data around time of bottle closure.

BCO-DMO Curation Notes

- Imported the 32 original CTD cast files ("SR2508_S1_CTD01" through "SR2508_S4_CTD17") into the BCO-DMO data processing system.
- Parsed header row from row 12, with commas as delimiter.
- Skipped rows matching "END_DATA" and "DBAR" (units row) strings.
- Captured metadata values from skipped comment rows using regex patterns, creating new columns: STNNBR, CASTNO, DATE, TIME, LATITUDE, LONGITUDE, and DEPTH_BOTTOM.
- Flagged "-9.990e-29" as a missing data value (note that missing data values are empty/blank in the final CSV file).
- Concatenated all 32 files into a single table, adding a new "file_name" column capturing the source filename for each row.
- Renamed columns to comply with BCO-DMO naming conventions.
- Combined DATE (parsed as %Y%m%d) and TIME (parsed as %H%M) columns, both interpreted in UTC, into a new datetime column, ISO_DateTime_UTC, formatted as %Y-%m-%dT%H:%MZ.
- Saved the final file as "1004720_v1_sr2508_ctd_profiles.csv".

Problem Description

The CTD/Rosette performed well during the whole cruise, with the following exceptions:

- On the first cast the oxygen sensor went sometimes negative during the upcast. It was replaced before S2_CTD01. Negative data was flagged as bad (‘4’ instead of ‘2’) in the WHP files.

- Bottle 24 did not always close. The carousel was changed out before S2_CTD03.

- Bottle 19 did not always close with the new carousel. The lever on the carousel was not as easy to move as the others. Before S4_CTD01, the lever was lubricated, and the bottle was placed a bit higher on the frame to change the angle of the pulley relative to the carousel. This fixed it.

- As described above, during S2_CTD13 the primary conductivity sensor started having a big offset from the secondary. During S2_CTD14, the two salinities differed by ~0.6 PSU. The primary conductivity sensor was

changed out before S4_CTD01. It was noted later that on a previous cast (S2_CTD10) the offset between the 2 conductivity sensors increased with depth. During casts S4_CTD06 through S4_CTD13, the differences between the two sensors was also large (due to the secondary conductivity sensor). These data were marked as bad in the WHP files.

- The Mast PAR sensor failed at around 22:00 on April 16 (local time), before S4_CTD05. Although this is not a sensor mounted on the CTD/Rosette, it does get included with the CTD files, so that CTD PAR can be converted to percent of surface (mast) PAR. All Mast PAR (SPAR) data starting with cast S4_CTD05 has been marked as bad in the WHP files. As a workaround, we found that there is a good correlation with Mast PAR and Mast SWR, where PAR = 3.33 * SWR.

[table of contents | back to top]

Data Files

File
1004720_v1_sr2508_ctd_profiles.csv (Comma Separated Values (.csv), 8.54 MB) MD5:704d1896d55f99db549649595b846232 Primary data file for dataset ID 1004720, version 1

[table of contents | back to top]

Parameters

Parameter	Description	Units
file_name	name of the original csv file	unitless
STNNBR	Station number	unitless
CASTNO	Cast number	unitless
DEPTH_BOTTOM	Depth of the water column at the sampling station	meters (m)
ISO_DateTime_UTC	Date and time (UTC) at start of cast in ISO 8601 format	unitless
DATE	Date at start of cast	unitless
TIME	Time (UTC) at start of cast	unitless
LATITUDE	Latitude at start of cast	decimal degrees
LONGITUDE	Longitude at start of cast	decimal degrees
CTDPRS	Pressure	decibars (dbar)

CTDPRS_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
CTDDEPTH	Depth	meters (m)
CTDDEPTH_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
CTDTMP	Temperature, sensor 1	degrees Celsius, ITS-90
CTDTMP_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
CTDTMP2	Temperature, sensor 2	degrees Celsius, ITS-90
CTDTMP2_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
CTDSAL	Salinity, sensor 1	PSU
CTDSAL_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
CTDSAL2	Salinity, sensor 2	PSU
CTDSAL2_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
CTDOXY	Oxygen	micromoles per liter (umol/L)
CTDOXY_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
CTDFLUOR	Fluorescence	milligrams per cubic meter (mg/m^3)
CTDFLUOR_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
CTDXMISS	Transmission	percent transmission
CTDXMISS_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless

PAR	PAR (Photosynthetically Active Radiation)	micromoles per square meter per second (umol/m^2/sec)
PAR_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
SPAR	Surface PAR	micromoles per square meter per second (umol/m^2/sec)
SPAR_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
SIGMA_THETA	Potential density anomaly, sensor 1	kilograms per cubic meter (kg/m^3)
SIGMA_THETA_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
SIGMA_THETA2	Potential density anomaly, sensor 2	kilograms per cubic meter (kg/m^3)
SIGMA_THETA2_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
SIGMA_T	Density , sensor 1	kilograms per cubic meter (kg/m^3)
SIGMA_T_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
SIGMA_T2	Density, sensor 2	kilograms per cubic meter (kg/m^3)
SIGMA_T2_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
POTENTIAL_TMP	Potential temperature, sensor 1	degrees Celsius
POTENTIAL_TMP_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
POTENTIAL_TMP2	Potential temperature, sensor 2	degrees Celsius
POTENTIAL_TMP2_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless
ALTIMETER	Altimeter	meters (m)

ALTIMETER_FLAG_W	WOCE CTD Quality Code (see https://exchange-format.readthedocs.io/en/latest/quality.html)	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Biospherical QSP2350
Generic Instrument Name	Biospherical Instruments QSP-2350 underwater PAR sensor
Generic Instrument Description	Quantum Scalar Irradiance PAR Sensor. Developed for data loggers with limited dynamic range. It uses a scalar irradiance collector to obtain a uniform directional response over 3.6-pi steradians. A stainless steel encased optical light pipe guides flux from the collector to a filtered silicon photodetector, resulting in a flat quantum response over the PAR spectral region (400 - 700 nm). The sensor produces a logarithmically compressed analog voltage output and BH-4-MP connector. It operates in water depths up to 2000 m.

Dataset-specific Instrument Name	Biospherical QSR2200
Generic Instrument Name	Biospherical Instruments QSR 2200 surface reference radiometer
Generic Instrument Description	A surface reference radiometer to measure scalar irradiance from sunlight with a PAR response. These sensors are often used on ships during on-deck incubations, or while a QSP sensor is vertically profiling, for example, when mounted on a CTD. The QSR-2200 outputs a linear analog signal and is compatible with data loggers that can accept a wide range of signal voltages. QSR sensors are equipped with a detachable field-of-view cutoff shield to limit its response to light from the upper hemisphere (2 Pi steradians).

Dataset-specific Instrument Name	Sea-Bird SBE 43
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
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 the manufacturer: https://www.seabird.com/products/sbe-43-dissolved-oxygen-sensor

Dataset-specific Instrument Name	Sea-Bird SBE9plus CTD
Generic Instrument Name	Sea-Bird SBE 9plus CTD
Generic Instrument Description	High precision and accuracy CTD comprising an SBE 9plus underwater unit (SBE 3plus temperature, SBE 4C conductivity, and Paroscientific Digiquartz pressure sensors, and an SBE 5T submersible pump). Can be used for either real-time data acquisition or for autonomous operations at a sampling speed of up to 24 Hz. The instrument package also includes a TC duct, to reduce salinity spiking caused by ship heave for improved resolution of water column features, and to ensure that temperature and conductivity measurements are made on the same parcel of water. Supplied with both an aluminium and titanium main housing, allowing for use up to 6800 and 10,500 metre depths respectively. Also capable of measuring from eight auxiliary sensors.

Dataset-specific Instrument Name	Sea-Bird SBE 03
Generic Instrument Name	Sea-Bird SBE-3 Temperature Sensor
Generic Instrument Description	The SBE-3 is a slow response, frequency output temperature sensor manufactured by Sea-Bird Electronics, Inc. (Bellevue, Washington, USA). It has an initial accuracy of +/- 0.001 degrees Celsius with a stability of +/- 0.002 degrees Celsius per year and measures seawater temperature in the range of -5.0 to +35 degrees Celsius. More information from Sea-Bird Electronics: https://www.seabird.com/products/sbe-3-oceanographic-temperature-sensor

Dataset-specific Instrument Name	Sea-Bird SBE 4
Generic Instrument Name	Sea-Bird SBE-4 Conductivity Sensor
Generic Instrument Description	The Sea-Bird SBE-4 conductivity sensor is a modular, self-contained instrument that measures conductivity from 0 to 7 Siemens/meter. The sensors (Version 2; S/N 2000 and higher) have electrically isolated power circuits and optically coupled outputs to eliminate any possibility of noise and corrosion caused by ground loops. The sensing element is a cylindrical, flow-through, borosilicate glass cell with three internal platinum electrodes. Because the outer electrodes are connected together, electric fields are confined inside the cell, making the measured resistance (and instrument calibration) independent of calibration bath size or proximity to protective cages or other objects.

Dataset-specific Instrument Name	Seapoint Chlorophyll Fluorometer
Generic Instrument Name	Seapoint chlorophyll fluorometer
Generic Instrument Description	A high-performance, low power fluorometer for in-situ measurements of chlorophyll-a able to operate at depths of up to 6000 metres. May be used open in-situ or with a pump through sample volume. Internal circuitry gives an output voltage that is proportional to chlorophyll-a concentration.

Dataset-specific Instrument Name	Valeport VA500
Generic Instrument Name	Valeport VA500 altimeter
Generic Instrument Description	A titanium-housed acoustic altimeter used for underwater positioning to determine distance to or height above the seabed. Can be mounted and used on ROVs, AUVs, and other such platforms for various underwater construction and hydrographic applications. The VA500 features a 500kHz broadband transducer offering a range of 0.1m to 100m, a resolution of 1mm and a beam angle +/- 3 degrees. It features RS232 and RS485 digital output as standard, and is supplied with free DataLog X2 software for instrument setup and data display. An optional Valeport miniIPS pressure sensor can be added. The pressure sensor is a temperature compensated piezo-resistive sensor with various ranges available, an accuracy +/- 0.01 percent FS, and a resolution of 0.001 percent FS. The VA500 is depth-rated to 6000m.

Dataset-specific Instrument Name	Sea-Bird C-Star 25cm
Generic Instrument Name	WET Labs {Sea-Bird WETLabs} C-Star transmissometer
Generic Instrument Description	The C-Star transmissometer has a novel monolithic housing with a highly integrated opto-electronic design to provide a low cost, compact solution for underwater measurements of beam transmittance. The C-Star is capable of free space measurements or flow-through sampling when used with a pump and optical flow tubes. The sensor can be used in profiling, moored, or underway applications. Available with a 6000 m depth rating. More information on Sea-Bird website: https://www.seabird.com/c-star-transmissometer/product?id=60762467717

[table of contents | back to top]

Deployments

SR2508

Website	https://www.bco-dmo.org/deployment/1004726
Platform	R/V Sally Ride
Start Date	2025-04-08
End Date	2025-04-21
Description	See additional information at R2R: https://www.rvdata.us/search/cruise/SR2508

[table of contents | back to top]

Project Information

Microbial Activity and Chemoautotrophy in the Deep Sea: Who, How, and How Much? (DARC Microbes)

Coverage: Northeast Pacific Ocean and the Mediterranean Sea

*NSF Award Abstract:*The deep sea, defined as deeper than 200 m, is the largest and least explored habitat on the surface of our planet. It covers nearly two-thirds of the Earth's surface, contains approximately 75% of marine water by volume, and is home to about 55% of all marine microorganisms. Deep-sea microorganisms can play important roles in shaping global chemistry and climate, for example producing and consuming greenhouse gases (e.g., carbon dioxide and nitrous oxide). However, the microbiology of deep-sea waters is understudied relative to that of the surface ocean. Recent data suggests a much more diverse and active microbial community at depth than previously thought, but much remains to be known. For instance, recent estimates suggest that approximately 60% of the microbial species in the deep sea are novel. This project investigates the metabolic activity of deep-sea microorganisms, focusing on chemoautotrophy and the carbon cycle. Chemoautotrophy is a microbial metabolism in which inorganic carbon (e.g., carbon dioxide) is converted to sugar and biomass using chemical energy. This project uses several state-of-the-art sampling and analyses techniques to determine which species conduct chemoautotrophy (who?), what types of chemical energy support it (how?), and at what rate it occurs (how much?) throughout the deep sea. Answering these questions provides insight into deep-sea microbial ecology and quantitative data on the sources and sinks of carbon in deep waters. Results will advance our understanding of the ability of our oceans to sequester carbon over long timescales. This work benefits society through the implications of its findings for our ability to predict and mitigate climate change, as well as its educational mission, which includes training high school, undergraduate, and graduate students in interdisciplinary, climate-relevant science through one-on-one mentorship, hands-on coursework, and the initiation of an annual regional symposium featuring student research.

This project investigates uncultured microorganisms' genetic potential and activity in the mesopelagic and bathypelagic oceanographic layers (200 to 4000 m water depth) to characterize deep-sea microbiology and address a discrepancy in the marine carbon cycle, namely, that respiration rates consistently exceed estimates of vertical inputs of carbon to the dark ocean. Chemoautotrophy may explain at least part of this discrepancy, but known types of chemoautotrophy (e.g., coupled to ammonia and nitrite oxidation) are insufficient to bridge the gap, suggesting novel chemoautotrophs and diverse coupled catabolisms. The overarching hypotheses are that (1) deep-sea microorganisms are more active than currently appreciated, (2) the organic carbon required to support this activity is provided, at least in part, by higher rates of endogenous inorganic carbon fixation, and (3) carbon fixation is performed by more phylogenetically and metabolically diverse chemoautotrophs/mixotrophs than currently known. This study uses high-pressure sampling containers during two deep-sea oceanographic expeditions, metagenomics, metatranscriptomics, and stable-isotope experiments coupled to single-cell isotope analyses via nanoSIMS to (1) quantify microbial anabolic activity in general and chemoautotrophy, mixotrophy, and heterotrophy specifically at bulk and single-cell levels, (2) characterize the diversity and distribution of genes and transcripts involved in chemoautotrophy and heterotrophy, (3) identify novel chemoautotrophs and mixotrophs and quantify their contribution to carbon cycling, and (4) investigate the ability of a major chemoautotrophic deep-sea lineage, the Marine Group I Thaumarchaeota, to utilize organic matter. The results have the potential to reveal novel functions in uncultured microbes and change our understanding of marine carbon cycling.

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2143035

[table of contents | back to top]