CTD profile data from R/V Atlantis cruise AT50-08 in the ETNP oxygen minimum zone

Website: https://www.bco-dmo.org/dataset/995462
Data Type: Cruise Results
Version: 1
Version Date: 2026-03-24

Project
» EAGER: Mechanistic Study of Extracellular Vesicle Production by Marine Microalgae using Advanced Imaging Technologies (Marine Microbial Extracellular Vesicles)

Contributors	Affiliation	Role
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Abstract
These data describe CTD-rosette water collections carried out during R/V Atlantis cruise AT50-08 in February 2023 in the Eastern Tropical North Pacific oxygen minimum zone (OMZ). Seawater was collected from Niskin bottles mounted on a CTD rosette at selected depths between ~50 and 600 m and was used as starting material for extracellular vesicle (EV) and viral particle purification workflows, as well as other microbial and biogeochemical measurements. These water-collection records provide the physical and sampling context needed to interpret downstream EV, virus, and microbial datasets and to relate them to the structure of the water column in a low-oxygen, strongly stratified environment.

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Coverage

Location: Eastern Tropical Pacific, Minimum Oxygen Zone (OMZ)
Spatial Extent: **Lat**:0 **Lon**:0
Temporal Extent: 2023-02-10 - 2023-03-15

Methods & Sampling

Seawater samples (10 × 100 L) were collected during R/V *Atlantis* cruise AT50-08 (Feb–Mar 2023) at two stations in the Oxygen Minimum Zone of the Eastern Tropical North Pacific (10–600 m depth). Samples were collected by CTD rosette, pre-filtered through 0.22 µm filters to remove cells and debris, and concentrated ~500× by tangential flow filtration (100 kDa cutoff).

The resulting concentrates contained both viruses and extracellular vesicles (EVs). EVs were enriched on board using a lectin-based binding column. Transmission electron microscopy (JEOL JEM 1400, Stony Brook University CryoEM facility) confirmed EV enrichment after column purification.

Subsequent EV analyses were performed at the University of Pennsylvania School of Veterinary Medicine EV

Core Facility. Methods included size-based separation (SEC-HPLC, gravity-driven iZon column, density-gradient ultracentrifugation), particle quantification (resistive pulse sensing, nCS1; nanoparticle tracking analysis, NTA), and immunophenotyping (nanoscale flow cytometry; ExoView™ chip array). See related datasets.

Data Processing Description

CTD data were processed following standard Sea-Bird CTD procedures. Raw measurements were converted to engineering units using manufacturer calibration coefficients, then time-aligned across sensors (e.g., conductivity and oxygen aligned to pressure/temperature) and corrected for conductivity cell thermal mass.

Data were screened to remove periods of unstable flow and package motion (surface soak, pump start-up, winch stops/pressure reversals/loops), and automated despiking (“wild edit”) was applied to remove dropouts and isolated spikes.

Final profiles were generated from the downcast and used to compute derived variables including practical salinity, depth (from pressure using latitude), density, sound velocity (Chen–Millero), and dissolved oxygen products (µmol/kg, mL/L, % saturation); some oxygen fields include a smoothed/windowed version indicated in the headers (e.g., “WS=2”).

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	Sea-Bird SBE 911plus CTD System
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Dataset-specific Description	Sea-Bird SBE 911plus CTD system (SBE 9plus underwater unit with an SBE 11+ deck unit) mounted on a rosette frame with an SBE 32, 24-position carousel carrying 10-L Niskin bottles (Atlantis typically sails with 23 bottles installed, but it can be configured to 24).
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	10-L Niskin Bottles
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Sea-Bird SBE 911plus CTD system (SBE 9plus underwater unit with an SBE 11+ deck unit) mounted on a rosette frame with an SBE 32, 24-position carousel carrying 10-L Niskin bottles (Atlantis typically sails with 23 bottles installed, but it can be configured to 24).
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.

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Deployments

AT50-08A

Website	https://www.bco-dmo.org/deployment/995482
Platform	R/V Atlantis
Start Date	2023-02-07
End Date	2023-02-10
Description	Project: Collaborative Research: Key Microbial Processes in Oxygen Minimum Zones: From In Situ Community Rate Measurements to Single Cells Chief: Pachiadaki, Maria G Start port: Putarenas, Costa Rica End port: Puntarenas, Costa Rica

AT50-08B

Website	https://www.bco-dmo.org/deployment/995472
Platform	R/V Atlantis
Start Date	2023-02-10
End Date	2023-03-16
Description	Project: Collaborative Research: Key Microbial Processes in Oxygen Minimum Zones: From In Situ Community Rate Measurements to Single Cells Chief: Pachiadaki, Maria G Start port: Putarenas, Costa Rica End port: Puntarenas, Costa Rica

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Project Information

EAGER: Mechanistic Study of Extracellular Vesicle Production by Marine Microalgae using Advanced Imaging Technologies (Marine Microbial Extracellular Vesicles)

Coverage: Coastal Western Atlantic waters and Eastern Tropical North Pacific OMZ

NSF Award Abstract:
This EAGER project is a proof-of-concept study on the composition, origins, and dynamics of extracellular vesicles (EVs) produced by marine microalgae in response to various environmental and biotic stressors. EVs are microscopic lipid-encased particles that are released naturally from almost all cell types and are vehicles for a variety of cargo, including genetic material (RNA, DNA), proteins, and lipids. EVs have been variously postulated to serve as a defense against viral attack, a waste disposal mechanism, a stress response, or a means of cell-to-cell communication. Marine microalgae are pivotal players in the global carbon cycle. By better understanding processes that govern their population dynamics and responses to environmental changes, we can develop better predictive models of responses to global climate change. The need to understand these mechanisms is becoming increasingly urgent as climate change becomes more manifest. Very recent findings suggest that EVs play a key role in marine phytoplankton population regulation, but our understanding of their function(s) in planktonic systems is severely limited and fragmentary. This project addresses significant knowledge gaps and explores the potential complexities of marine planktonic EV production. This project provides support and training to a female graduate and undergraduate marine sciences students, who are receiving unique opportunities to master new experimental approaches and state-of-the-art research tools that are extremely rare in marine sciences programs. The project supports high school students in marine sciences studies as a part of the summer science camp (www.sigmacamp.org). A female postdoc is also being trained on the project.

Using the cosmopolitan and geochemically-important microalga E. huxleyi as a model system, this project tests three major hypotheses to enhance our understanding of the purpose(s) of microalgal EV production. (1) Microalgae produce distinctive types of EVs (ectosomes or exosomes) in response to different environmental conditions, and EV types have definitive functions (stress response, viral defense, intercellular communication, waste disposal). (2) EVs' cargo is diverse, so their production and release reflect a complex intercellular communication mechanism. (3) Exosome genesis is a multistage process, and its stages are separated in time. Therefore, algal cells may contain a pool of pre-formed EVs loaded with different cargo that are stored internally, and when induced by a sudden change in external conditions are released through the outer membrane. To adequately test these hypotheses requires using single particle analytical methods in addition to ensemble measurements. The investigators are using an assortment of recently developed methods and original experimental approaches developed by our group to investigate EV compositional variability under selected stress conditions. They use single particle Raman microspectroscopy, pulse-chase Stable Isotope Probing, and LC-MSMS for compositional analysis of EVs, and Cryo-EM and AFM for morphological analyses. If experimental data confirm our suspicions, then phytoplankton EVs represent a novel and essentially overlooked mechanism of extracellular interactions that potentially govern a wide range of globally-important processes.

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-2202723

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