SOLARIS superoxide and standard CTD profiles from the EMB276 cruise on R/V Elisabeth Mann Borgese in the Baltic Sea from September 20-27, 2021

Website: https://www.bco-dmo.org/dataset/935118
Data Type: Cruise Results
Version: 1
Version Date: 2024-10-09

Project
» Collaborative Research: Manganese Cycling and Coupling Across Redox Boundaries within Stratified Basins of the Baltic Sea (MnIONS)

Contributors	Affiliation	Role
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Abstract
SOLARIS superoxide profiles and standard CTD profiles including oxygen, turbidity, fluorescence, temperature, and PAR data from seven stations in the Baltic Sea collected between September 20 - 27, 2021. Data was collected from the R/V Elisabeth Mann Borgese.

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Coverage

Spatial Extent: **N**:56.63332 **E**:20.65052 **S**:56.0002 **W**:19.18302
Temporal Extent: 2021-09-20 - 2021-09-27

Methods & Sampling

In situ measurements of superoxide were made with a superoxide sensor, SOLARIS, which has been previously described in detail in Taenzer et al., 2022. Superoxide is quantified using a chemiluminescent method where seawater is drawn in and combines with the chemiluminescent probe methyl *Cypridina* luciferin analog (MCLA) in a mixing cell. MCLA reacts specifically with superoxide, and the light that is produced is quantified by a photomultiplier. Data are collected at the frequency of 2 Hz, as raw counts.

Temperature, oxygen, salinity, photosynthetically active radiation (PAR), fluorescence, and turbidity were measured by a standard CTD package and associated rosette mounted sensors (Seabird 9/11+).

Data Processing Description

Superoxide data was depth-corrected using the descent speed of the CTD to account for the lag between when the water originally is drawn into the sampling wand and when it reaches the flow cell.

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Data Files

File
935118_v1_solaris_.csv (Comma Separated Values (.csv), 135.02 KB) MD5:8b95e97222d7787f109815104ea21696 Primary data file for dataset ID 935118, version 1

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Parameters

Parameter	Description	Units
cruise_name	Name of the cruise	unitless
station_name	Station name	unitless
cast_number	Profile number	unitless
latitude	Latitude of cast, south is negative	decimal degrees
longitude	Longitude of cast, west is negative	decimal degrees
Date	Date	unitless
Time_Start_UTC	Start time if profile	unitless
ISO_DateTime_UTC	Datetime of start of profile in ISO notation (UTC, timezone)	unitless
depth_m	Water column depth	meters (m)
Superoxide_nM	Superoxide concentrations	nanomolar (nm)
Oxygen_uM	Oxygen concentrations	micromolar (um)
PAR	photosynthetically active radiation	mol?m ?2 ?s ?1.
Fluorescence	fluorescence measurements	mg/m^3
Turbidity_NTU	turbidity measurements	NTU (Nephelometric Turbidity Unit)
Temp_C	temperature	degrees Celsius (°C)
Salinity_PSU	salinity	PSU

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Dataset-specific Description	CTD package and associated rosette mounted sensors (Seabird 9/11+).
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	
Generic Instrument Name	SOLARIS
Generic Instrument Description	SOLARIS (Submersible Oceanic Luminescent Analyzer of Reactive Intermediate Species) is a superoxide detector that can be used at deeper depths (up to 4000 meters) and could be incorporated into a deep-sea sampling platform such as WHOI's submersible, Alvin. See: https://doi.org/10.3390/s22051709

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Deployments

EMB276

Website	https://www.bco-dmo.org/deployment/934931
Platform	R/V Elisabeth Mann Borgese
Start Date	2021-09-17
End Date	2021-09-29

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Project Information

Collaborative Research: Manganese Cycling and Coupling Across Redox Boundaries within Stratified Basins of the Baltic Sea (MnIONS)

Coverage: Baltic Sea

NSF Award Abstract:
The trace element manganese (Mn) is distributed widely throughout the global ocean where it cycles among

three dominant oxidation states. Manganese in the higher oxidation states is highly reactive and thereby influences the cycling of nearly all other elemental cycles, including those of oxygen and nitrogen. The intermediate Mn species has only recently become recognized as an abundant component of the Mn pool, presenting now a previously unrecognized factor that may control the chemistry of the ocean. The Baltic Sea contains high Mn concentrations and preliminary investigations have pointed to the presence of an operationally defined "reactive" form of Mn but the composition and consequence of this Mn pool are unknown. This research will explore the cycling of Mn within the Baltic Sea enabled by an established collaboration with the Leibniz Institute for Baltic Sea Research in Warnemunde, Germany. By coupling field measurements and targeted shipboard incubations, this study will shed light on the processes controlling the Mn cycle and its link to the oxygen, iodine, and nitrogen cycles. This project will educate several undergraduate and graduate students and promote scientific exchange between research groups within the United States and Germany. Further, outreach efforts associated with this research will continue an existing collaboration between the PIs and the Boston Green Academy in South Boston to introduce high school students to chemical oceanography, and in particular biogeochemistry.

Manganese (Mn) is intricately linked to nearly all elemental cycles, and yet we know little about the processes governing its redox cycling within natural systems. Over the past decade a number of key scientific discoveries have provided greater insight into the diversity of processes and mechanisms involved in Mn redox cycling and introduced Mn(III) ligand complexes as important components of the dissolved Mn pool. The Baltic Sea is one of the most well studied stratified marine systems and reactive Mn has been implicated as a key factor in the formation and maintenance of suboxic zones. Thus, the goal of this research is to explore the cycling and elemental coupling of Mn within stratified basins of the Baltic Sea. The PIs predict that reactive Mn, as Mn(III) ligand complexes and Mn oxide particles, is a primary control on the redox landscape of stratified marine waters, particularly at redox boundaries and within the suboxic zone. The PIs propose fieldwork in a local permanently stratified brackish pond to refine experimental procedures followed by two cruises to suboxic basins in the Baltic Sea enabled by an established collaboration with the Leibniz Institute for Baltic Sea Research in Warnemunde. Field measurements will be obtained using a combination of in situ sensors and ship/lab-based instrumentation at several Baltic Sea sites to define the distribution of Mn species and the rates of Mn redox transformations spanning the redoxcline along with a suite of chemical information. Further, a matrix of shipboard incubations will be conducted to constrain the underlying (a)biotic processes responsible for the observed Mn profiles. Specifically, across oxygen and Mn gradients spanning the redoxcline, the PIs will interrogate the link between the Mn cycle and iodine and nitrogen species, which will ultimately help constrain current gaps in the mass balance of these elements in Baltic Sea models.

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-1924236

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