Helium isotope and neon data from seawater samples collected June 2018 during FS Alkor cruise AL510 in the Baltic Sea

Website: https://www.bco-dmo.org/dataset/915490
Data Type: Cruise Results
Version: 1
Version Date: 2023-12-05

Project
» Collaborative Research: Influence of Surfactants on Air-Sea Gas Exchange: 3He/SF6 Experiments in the Baltic Sea (Baltic GasEx)

Programs
» United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
Schlosser, Peter	Arizona State University (ASU)	Principal Investigator
Koffman, Tobias N.	Lamont-Doherty Earth Observatory (LDEO)	Scientist
Pasqualini, Angelica		Data Manager
Gerlach, Dana Stuart	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset encompasses 145 seawater samples collected from 23 hydrographic stations during the AL510 cruise in the Baltic Sea aboard the research vessel Alkor, from June 6 to June 11, 2018. Helium isotopes and neon measurements were conducted in the Noble Gas Laboratory of the Lamont-Doherty Earth Observatory on a dedicated, fully automated VG5400 mass spectrometer following the procedures described by Ludin et al. (1998). Helium and neon samples were collected from Niskin bottles in copper tubes (40 ml) sealed by stainless steel pinch-off clamps. Shipboard sampling, gas extraction, and isotopic analysis were done by Tobias (Toby) Koffman with data processing by Peter Schlosser.

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Coverage

Spatial Extent: **N**:54.71 **E**:10.13 **S**:54.52 **W**:10.07
Temporal Extent: 2018-06-03 - 2018-06-15

Methods & Sampling

Field sampling

A total of 145 seawater samples were collected from 23 hydrographic stations aboard the Alkor (AL510) cruise from June 6 to June 11, 2018. Samples were secured in 40 milliliter copper tubes sealed by stainless steel pinch-off clamps. The seawater samples were first degassed in a vacuum extraction unit with an efficiency of ca. 99.9% to extract the dissolved gases helium (He) and neon (Ne). He and Ne were then isolated by cold trapping on activated charcoal.

Laboratory measurements
Helium (He) and Neon (Ne) gas samples were analyzed at the Lamont-Doherty Earth Observatory (LDEO) Noble Gas Laboratory on a dedicated, fully automated VG5400 quadrupole mass spectrometer following the procedures described by Ludin et al. (1998). A fraction of the helium and neon was admitted into a quadrupole analyzer for helium and neon measurements. Separation of neon from helium was achieved using a cryogenic trap, and the separated helium was admitted into the isotope mass spectrometer for isotopic analysis. Air samples and blanks were used to calibrate and monitor the sensitivity changes of the instrument during operation. He and Ne are reported in units of cubic centimeters at standard temperature and pressure per gram (cm3 STP g-1) where standard temperature and pressure is 0 degrees, 101.325 kPa. The precision of the helium and neon concentrations is ±1% of the measured value. Helium isotope ratios were measured with precision of ca. 0.2% and reported as d3He or the percent deviation of the 3He/4He ratio of a measured sample from that of an air standard (Ratm = 1.386 x 106; Clarke et al., 1976).

Processing DRIs (directly responsible individuals):
Shipboard sampling was done by Tobias (Toby) Koffman.
Helium extraction work and isotopic analysis by Tobias (Toby) Koffman.
Data processing by Peter Schlosser.

Problems/Issues
Some samples (indicated in the data table) contained excess air trapped in the copper tube during sampling.
Station 31, AL510_CTD_043, 3100007
Station 31, AL510_CTD_042, 3100006
Station 44, AL510_CTD_107, 4400011
Station 52, AL510_CTD_135, 5200003
Station 54, AL510_CTD_155, 5400011
Station 68, AL510_CTD_227, 6800011
Station 70, AL510_CTD_233, 7000005

Data Processing Description

Standardization (air standards), linearity (measurement of multiple quantities of a standard amount), and stability (repeated standard measurements). Details are described in Ludin et al. (1988)

BCO-DMO Processing Description

* Imported data from source file "He_Ne_AL510_2018_120323.xlsx" into the BCO-DMO data system.
* Modified parameter (column) names to conform with BCO-DMO naming conventions.
* Formatted He and Ne concentrations as scientific notation

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Data Files

File	
915490_v1_helium_neon.csv	(Comma Separated Values (.csv), 30.92 KB) MD5:47f7197469cbedb2dc4f3a6881e17147
Primary data file for dataset ID 915490, version 1	

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Related Publications

Clarke, W. B., Jenkins, W. J., & Top, Z. (1976). Determination of tritium by mass spectrometric measurement of 3He. The International Journal of Applied Radiation and Isotopes, 27(9), 515–522. https://doi.org/10.1016/0020-708x(76)90082-x https://doi.org/10.1016/0020-708X(76)90082-X
Methods

Ludin, A., Weppernig, R., Boenisch, G., & Schlosser, P. (2017). *Mass Spectrometric Measurement of Helium Isotopes and Tritium in Water Samples* (Version 1.0) [Data set]. Interdisciplinary Earth Data Alliance (IEDA). https://doi.org/10.1594/IEDA/100661
Methods

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Related Datasets

IsRelatedTo

Ho, D. T., Schlosser, P., Dobashi, R. (2024) **SF6 and helium data from a tracer release experiment conducted June 2018 in the coastal Baltic Sea during FS Alkor cruise AL510.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-01-10 doi:10.26008/1912/bco-dmo.915772.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
St_ID	Station ID number	unitless
Sa_ID_LDEO	Lamont Doherty Earth Observatory Sample ID number	unitless
Sample_label	Sample ID label from cruise	unitless
Sa_ID	Sample ID is composed of the (station ID # 10^5) + (niskin #)	unitless
Sample_DateTime_UTC	Station timestamp (UTC) in ISO 8601 format yyyy-mm-ddTHH:MMZ	unitless
Lat	Station latitude	decimal degrees
Lon	Station longitude	decimal degrees
Bottom_depth	Sea bottom depth with respect to sea level	meters (m)
Niskin	Niskin bottle number	unitless
Depth_uncorr	Planned depth of sample	meters (m)
Depth	Actual depth of seawater sample	meters (m)
Temp	Temperature from CTD	degrees Celsius (°C)
Sal	Salinity from CTD	PSU
Dens_pot	Potential Density from CTD	kilogram per cubic meter (kg/m3)
d3He	Percent deviation of the 3He/4He ratio of a measured sample from that of an air standard, Ratm = 1.386 x 106 (Clarke et al., 1976)	percent (%)
d3HeEr	Error associated with d3He measurements	percent (%)

d3HeFlag	Quality control flag (2 = good; 3 = questionable; 4 = bad)	unitless
He4Conc	Concentration of helium-4 reported in cubic centimeters	cubic centimeters at standard temperature and pressure per gram (ccSTP/g)
He4ConcEr	Error associated with helium-4 concentration	cubic centimeters at standard temperature and pressure per gram (ccSTP/g)
He4Flag	Quality control flag (2 = good; 3 = questionable; 4 = bad)	unitless
He3Conc	Concentration of helium-3	cubic centimeters at standard temperature and pressure per gram (ccSTP/g)
He3ConcEr	Error associated with helium-3 concentration	cubic centimeters at standard temperature and pressure per gram (ccSTP/g)
He3He4Ratio	Ratio of helium-3 concentration and helium-4 concentration	unitless
He3He4Er	Error associated with helium-3/helium-4 ratio	cubic centimeters at standard temperature and pressure per gram (ccSTP/g)
He4	Helium-4 weight	grams
He4ErRelpercent	Percentage error in measurements of the weight of helium-4	percent (%)
NeConc	Total neon concentration	cubic centimeters at standard temperature and pressure per gram (ccSTP/g)
NeConcEr	Error associated with total neon concentration	cubic centimeters at standard temperature and pressure per gram (ccSTP/g)
NeFlag	Quality control flag (2 = good; 3 = questionable; 4 = bad)	unitless
MeasureDate	Date of mass spec analysis	unitless
Comment	Lab comments	unitless

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Instruments

Dataset-specific Instrument Name	VG-5400 noble gas mass spectrometer
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Helium analysis was performed on a VG-5400 (Micromass) noble gas mass spectrometer. The Micromass VG-5400 instrument is a sector field mass spectrometer designed for measurement of all noble gases (He, Ne, Ar, Kr, Xe) and their isotopes.
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Baltic Sea seawater was collected in Niskin bottles at 20+ stations
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	Submerged pump for continuous SF6 Analysis system
Generic Instrument Name	Pump - Surface Underway Ship Intake
Dataset-specific Description	SF6 was monitored continuously from the vessel by pumping water via a submerged pump
Generic Instrument Description	The 'Pump-underway ship intake' system indicates that samples are from the ship's clean water intake pump. This is essentially a surface water sample from a source of uncontaminated near-surface (commonly 3 to 7 m) seawater that can be pumped continuously to shipboard laboratories on research vessels. There is typically a temperature sensor near the intake (known as the hull temperature) to provide measurements that are as close as possible to the ambient water temperature. The flow from the supply is typically directed through continuously logged sensors such as a thermosalinograph and a fluorometer. Water samples are often collected from the underway supply that may also be referred to as the non-toxic supply. Ideally the data contributor has specified the depth in the ship's hull at which the pump is mounted.

Dataset-specific Instrument Name	QMG Pfeiffer PrismaPlus
Generic Instrument Name	Quadrupole Mass Spectrometer
Dataset-specific Description	Neon analysis was performed using a QMG Pfeiffer PrismaPlus compact mass spectrometer
Generic Instrument Description	A piece of apparatus that consists of an ion source, a mass-to-charge analyser, a detector and a vacuum system and is used to measure mass spectra. The detector is a quadrupole mass-to-charge analyser, which holds the ions in a stable orbit by an electric field generated by four parallel electrodes.

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Deployments

AL510

Website	https://www.bco-dmo.org/deployment/915500
Platform	FS Alkor
Report	https://oceanrep.geomar.de/id/eprint/46291/1/Cruise_report_AL510_final.pdf
Start Date	2018-06-03
End Date	2018-06-15
Description	Cruise name: Baltic GasEx Chief Scientist Dr. Dennis Booge Departure: 2018-06-03 (Kiel, Germany) Return: 2018-06-15 (Kiel, Germany)

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Project Information

Collaborative Research: Influence of Surfactants on Air-Sea Gas Exchange: 3He/SF6 Experiments in the Baltic Sea (Baltic GasEx)

Website: https://www.geomar.de/en/research/expeditionen/detail-view/exp/completed/346931/

Coverage: Baltic Sea

NSF Abstract:

Gas exchange, the movement of gases between the atmosphere and the surface ocean (in both directions), is an important process to understand in global biogeochemistry. A particular area of interest is the rate of exchange of gases such as carbon dioxide and dimethyl sulfide, which play important roles in Earth's climate. Understanding and modeling air-sea exchange on a global scale requires understanding of how gas exchange rates vary in response to a number of factors such as temperature, wind speed, and the presence of surface chemical films (known as surfactants) in the ocean. Over the past 25 years, major advances have been made in understanding air-sea gas exchange in the open ocean, mainly due to improvements in methodology and a number of successful process studies. However, some important questions remain, such as what happens near coastal areas (including inland seas), and how surfactants affect gas exchange. The Baltic Sea Gas Exchange Experiment (Baltic GasEx) is a collaboration between scientists from the US and Germany designed to address these questions. Participants in Baltic GasEx will measure the air-sea gas exchange rates with

different techniques in the Baltic Sea before and after the spring bloom, when concentrations and compositions of surfactants will be different. The expeditions will be conducted on a German ship (Alkor), with the ultimate goal of quantifying the relationship between wind speed and gas exchange in an inland sea, and understanding the impact of surfactants on air-sea gas exchange. The project will involve significant international collaboration, public education and outreach through both participating U.S. institutions, and substantial student training in partnership with the international collaborators.

NSF funding will support helium-3 and sulfur hexafluoride measurements during Baltic GasEx to determine the gas exchange rate. German colleagues are independently funded to quantify surfactants with AC voltammetry, surface tension, and sum frequency generation; to determine chemical characteristics of the micro layer; and to estimate the gas exchange rate using eddy covariance flux measurements of CO2 and DMS. The proposed experiment is designed to address the question of whether open ocean wind speed/gas exchange parameterizations can be applied to inland seas like the Baltic. Also, the effect of surfactants on gas exchange has been studied extensively in the laboratory, but there is little direct field evidence for the effect of surfactants on gas exchange. The proposed experiment, with expeditions at times with both high and low surfactant concentrations, should shed new light on the effect of natural surfactants on gas exchange. Finally, some wind speed/gas exchange parameterizations proposed for the Baltic Sea appear to be higher than typical open ocean parameterizations. These are typically based on eddy covariance flux measurements of CO2. However, in open ocean experiments where both the helium-3/sulfur hexafluoride approach and eddy covariance of CO2 have been deployed, there seems to be a discrepancy between gas transfer velocities measured with the two techniques. This experiment should show whether a similar difference in gas transfer velocities measured via these two techniques also exists in the Baltic Sea.

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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Program Information

United States Surface Ocean Lower Atmosphere Study (U.S. SOLAS)

Website: http://www.us-solas.org/

Coverage: Global

The Surface Ocean Lower Atmosphere Study (SOLAS) program is designed to enable researchers from different disciplines to interact and investigate the multitude of processes and interactions between the coupled ocean and atmosphere.

Oceanographers and atmospheric scientists are working together to improve understanding of the fate, transport, and feedbacks of climate relevant compounds, and also weather and hazards that are affected by processes at the surface ocean.

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Physical, chemical, and biological research near the ocean-atmosphere interface must be performed in synergy to extend our current knowledge to adequately understand and forecast changes on short and long time frames and over local and global spatial scales.

The findings obtained from SOLAS are used to improve knowledge at process scale that will lead to better quantification of fluxes of climate relevant compounds such as CO2, sulfur and nitrogen compounds, hydrocarbons and halocarbons, as well as dust, energy and momentum. This activity facilitates a fundamental understanding to assist the societal needs for climate change, environmental health, weather prediction, and national security.

The US SOLAS program is a component of the International SOLAS program where collaborations are forged with investigators around the world to examine SOLAS issues ubiquitous to the world's oceans and

atmosphere.

Â» International SOLAS Web site

Science Implementation Strategy Reports

US-SOLAS (4 MB PDF file)
Other SOLAS reports are available for download from the US SOLAS Web site

Ocean Carbon and Biogeochemistry (OCB)

Website: http://us-ocb.org/

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1756757

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