Hydrographic data and noble gas concentrations from CTD bottle samples collected during the a R/V Adolph Jensen in Sermilik Fjord, Greenland in 2015

Website: https://www.bco-dmo.org/dataset/734967
Data Type: Cruise Results
Version: 1
Version Date: 2018-05-08

Project
» Tracking Greenland Melt in the Ocean Using Noble Gas Fingerprints (Greenland Melt Noble Gases)

Contributors	Affiliation	Role
Straneo, Fiamma	University of California-San Diego (UCSD-SIO)	Principal Investigator, Contact
Beaird, Nicholas	University of California-San Diego (UCSD-SIO)	Co-Principal Investigator
York, Amber D.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Noble gas (helium, neon, argon, krypton, xenon) concentrations were measured from CTD bottle samples collected during the a R/V Adolph Jensen in Sermilik Fjord, Greenland in 2015. Temperature, salinity, and pressure were collected from the CTD rosette.

Table of Contents

Coverage

Spatial Extent: **N**:66.2681 **E**:-37.6321833 **S**:65.56145 **W**:-38.3505167
Temporal Extent: 2015-08-03 - 2015-08-11

Methods & Sampling

Temperature and salinity data were collected using a SBE 25plus Sealogger CTD (Sea-Bird Scientific, Bellevue, Washington). Water samples were collected from twelve 5 L Niskin bottles (Ocean Test Equipment, Fort Lauderdale, Florida) equipped with silicone o-rings and coated springs, mounted on a Sea-Bird rosette.

Noble gas and helium isotope samples were acquired by gravity-feeding from NISKIN bottle into lengths of 5/8" OD copper tubing which were cold-welded to form replicate ~45 g, helium-leak-tight samples (Young and Lupton 1983) and returned for shore-based sample extraction and mass-spectrometric analysis.

The extracted gases are purified, separated and measured mass spectrometrically using a third generation, WHOI-constructed, statically operated, helium isotope mass spectrometer of branch tube design for fully simultaneous collection of 3He and 4He with improved ion optics. It employs a high emission Nier type ion source. The 4He branch has a Faraday Cup detector with a low-noise FET-input electrometer and precision high-frequency VFC for digital signal integration. The 3He branch uses a Galileo Channeltron operating in pulse counting mode, with high-speed preamplifier and discriminator electronics. The fully automated sample processing line is optimized for processing extracted water samples, and combines a three-stage cryogenics system [Lott 1984, Lott et al. 2001, Stanley et al. 2009] with a Pd-catalyst and dual SAES-707 getters for the removal of water vapor, the purification of reactive gases, and the quantitatively reproducible separation of the 5 noble gases (He, Ne, Ar, Kr, and Xe). Helium isotopes (3He, 4He) are measured using the magnetic sector dual-collecting mass spectrometer to a reproducibility of 0.1%, and the other noble gases using a quadrupole mass spectrometer (QMS) with a triple mass filter and an electron multiplier operated in pulse counting mode. The lighter noble gases (He, Ne, and Ar) are determined using peak-height manometry while the heavier noble gases (Kr and Xe) are measured using a newly developed, modified ratiometric multi-isotope dilution method. The system achieves reproducibility of gas standards of 0.1% for He, Ne, Ar, Kr, and Xe, and approximately 0.15% reproducibility based on the average standard deviation of 11 replicate pairs of water samples. The mass spectrometer gas standards are tied to an atmospheric standard assuming ``canonical" atmospheric abundances for the noble gases of 5.24, 18.18, 9340, 1.14, and 0.087 ppm by volume for He, Ne, Ar, Kr, and Xe (Unnumbered table, Section 3.0, page 33 of COESA 1976 to +/- 0.05%. Saturation values were computed using solubilities determined assuming the same standardization.

BCO-DMO Processing Description

* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions
* added negative symbol to the longitude value
* rounded pressure to two decimal places
* rounded Del3HeC to two decimal places
* rounded lat/lon to five decimal places

[table of contents | back to top]

Data Files

File
beaird_sermilik_2015_hydro.csv (Comma Separated Values (.csv), 11.11 KB) MD5:5ebae1591535140a67947ffe36bf189d Primary data file for dataset ID 734967

[table of contents | back to top]

Related Publications

COESA (1976) U.S. Standard Atmosphere, U.S. Government Printing Office, Washington, D.C.
Methods

Lott, D. E. (2001). Improvements in noble gas separation methodology: A nude cryogenic trap. Geochemistry, Geophysics, Geosystems, 2(12), n/a–n/a. doi:10.1029/2001gc000202 https://doi.org/10.1029/2001GC000202
Methods

Lott, D. E., & Jenkins, W. J. (1984). An automated cryogenic charcoal trap system for helium isotope mass spectrometry. Review of Scientific Instruments, 55(12), 1982–1988. doi:10.1063/1.1137692
Methods

Stanley, R. H. R., Baschek, B., Lott, D. E., & Jenkins, W. J. (2009). A new automated method for measuring noble gases and their isotopic ratios in water samples. Geochemistry, Geophysics, Geosystems, 10(5), n/a–n/a. doi:10.1029/2009GC002429
Methods

Young, C. and J. E. Lupton (1983). "An ultratight fluid sampling system using cold-welded copper tubing." EOS Transactions AGU 64: 735.
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
station	station number	unitless
Lat	latitude of cast	decimal degrees
Lon	longitude of cast	decimal degrees
Time	time (UTC) of cast in format HH:MM:SS	unitless
Date	date (UTC) of cast in format yyyy-mm-dd	unitless
bottle	bottle number	unitless
pressure	sample pressure	decibar
temperature	temperature (in-situ)	degrees Celsius
salinity	salinity	Practical Salinity Units (PSU)
Del3HeC	helium isotope ratio anomaly	percent (%)
C_He	helium concentration	mols per kilogram (mols/kg)
C_Ne	neon concentration	mols per kilogram (mols/kg)
C_Ar	argon concentration	mols per kilogram (mols/kg)
C_Kr	krypton concentration	mols per kilogram (mols/kg)
C_Xe	xenon concentration	mols per kilogram (mols/kg)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	CTD Sea-Bird 25+
Generic Instrument Name	CTD Sea-Bird 25
Generic Instrument Description	The Sea-Bird SBE 25 SEALOGGER CTD is battery powered and is typically used to record data in memory, eliminating the need for a large vessel, electrical sea cable, and on-board computer. All SBE 25s can also operate in real-time, transmitting data via an opto-isolated RS-232 serial port. Temperature and conductivity are measured by the SBE 3F Temperature sensor and SBE 4 Conductivity sensor (same as those used on the premium SBE 9plus CTD). The SBE 25 also includes the SBE 5P (plastic) or 5T (titanium) Submersible Pump and TC Duct. The pump-controlled, TC-ducted flow configuration significantly reduces salinity spiking caused by ship heave, and in calm waters allows slower descent rates for improved resolution of water column features. Pressure is measured by the modular SBE 29 Temperature Compensated Strain-Gauge Pressure sensor (available in eight depth ranges to suit the operating depth requirement). The SBE 25's modular design makes it easy to configure in the field for a wide range of auxiliary sensors, including optional dissolved oxygen (SBE 43), pH (SBE 18 or SBE 27), fluorescence, transmissivity, PAR, and optical backscatter sensors. More information from Sea-Bird Electronics: http:www.seabird.com.

[table of contents | back to top]

Deployments

SERM2015

Website	https://www.bco-dmo.org/deployment/734971
Platform	R/V Adolf Jensen
Start Date	2015-08-02
End Date	2015-08-11
Description	start and end port Tasiilaq, Greenland

[table of contents | back to top]

Project Information

Tracking Greenland Melt in the Ocean Using Noble Gas Fingerprints (Greenland Melt Noble Gases)

Coverage: Sermilik Fjord, East Greenland

NSF Award Abstract:
Rapid land-ice loss from the Greenland Ice Sheet is resulting in increased fresh water discharge into the ocean. One consequence is a rise in global sea level. Another consequence, that has attracted less attention, is the freshening of ocean waters at Greenland's coastal margins. Locally, this impacts sea-ice formation, air-sea exchange, the marine ecosystems and local communities. On larger scales, it can impact dense water formation and hence the global circulation. Beyond bulk estimates based on ice sheet-wide assessments, however, the limited knowledge of where, when and how fresh water enters the ocean makes it difficult to assess its present and future impact. One consequence of this uncertainty is the large discrepancy in the formulation of the fresh water forcing used in model studies to investigate the oceanic impact of Greenland melt. Greenland's fresh water discharge occurs at the head of fjords in the form of icebergs, submarine melt and discharge of surface melt at base of glaciers often hundreds of meters beneath sea level. This discharge drives a non-trivial transformation of the fjords' waters and forms a new water class, glacially modified waters. It is through the export of these glacially modified waters, much of it occurring below the surface, that Greenland's fresh water reaches the large-scale ocean circulation. Traditional measurements do not provide an unambiguous means of tracking glacially modified waters nor can they be used to quantify the relative fraction of surface and submarine melt. Yet knowing how Greenland's fresh water is exported, and differentiating pathways and rates for submarine or surface melt, which may vary at different rates, is key to the ability to assess present and future local and large-scale impacts. By providing the first measurements of how different melt components spread into Greenland's fjords and onto the continental shelves, this project will contribute to ensuring appropriate representation of the relevant dynamics in climate models, which do not resolve ice-ocean exchanges or fjord dynamics. The cross-disciplinary nature of this project will benefit the training of a post-doc. As part of this project, the scientists have interested a media science program (NOVA) in the largely neglected impact of Greenland's increasing fresh water discharge on the ocean. Pending obtaining separate funding, NOVA will be sending a professional producer in the field with the scientists and use material for this project to produce several media pieces on the problem of melting glaciers. In addition, the material from this research will used to raise public awareness on changes occurring in the oceans near Greenland.

Land-ice loss at both poles is predicted to increase in a warming climate and will further increase the fresh water discharge into the oceans. Understanding the mechanisms that govern the fate of this fresh water is key to the ability to predict both its local and global impacts. This project utilizes the unique signature of noble gases, and other tracers (tritium, oxygen and helium isotopes), in each type of glacial meltwater to identify and track different kinds of Greenland fresh water in a major glacier-fjord system and on the continental shelves. The method builds on work in Antarctica and, more recently, on a pilot study conducted by the project's scientists in a small glacier-fjord system in West Greenland. The field observations will take advantage of two existing cruises, one to a large glacial fjord system in Southeast Greenland and the other to the continental shelves at the southern tip of Greenland, to collect geochemical tracer data in regions influenced by Greenland's meltwater. Synoptic and moored measurements, collected as part of these cruises, will provide context to the geochemical tracer analysis. The first goal of the project is to develop a method that can be used to track glacial melt water both in Greenland and Antarctica and at the margins of other ice caps and glaciers. A second objective is to provide an ocean-based assessment of the glacial melt water transport out of a major fjord, and along Greenland's continental shelves, at the peak of the melt season.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1536856

[table of contents | back to top]