Be-7 from water samples from the Arctic collected on RV Polarstern cruise ARK-XXVI/3 from Tromso, Norway to Bremerhaven, Germany in 2011 (Be-7 Tracer Method project)

Website: https://www.bco-dmo.org/dataset/564229
Version: 04 August 2015
Version Date: 2015-08-04

Project
» Sample Analysis to Test a Novel Method of Determining Atmospheric Deposition of Trace Elements to the Ocean/Ice System of the Arctic (Be-7 Tracer Method)

Contributors	Affiliation	Role
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Coverage

Spatial Extent: **N**:89.96 **E**:-164.2 **S**:79.15 **W**:166.41
Temporal Extent: 2011-08-13 - 2011-09-21

Dataset Description

Be-7 data from water column, meltpond, snow, and ice samples from the Arctic.

Methods & Sampling

During the occupation of ice stations, samples from the mixed layer were acquired approximately 150m from the ship to mitigate disruption of surface water properties. A hydrohole was cut through the ice, followed by the lowering of a portable conductivity, temperature, depth probe (CTD) to determine mixed layer depth. A weighted sampling hose was then deployed to the center of the observed mixed layer. Remotely operated vehicle (ROV) observations confirmed that the weighted hose attained accurate deployment-depth measurements from the ice surface. A gasoline generator powered a centrifugal pump which drew water through the sampling hose to the surface where it was passed through iron-oxide impregnated Acrylic fiber filters. A flow meter attached in-line to the filter compartment recorded the amount of seawater passed through each filter. To maximize 7Be collection, two fibers filtering approximately 600L of seawater apiece were collected from each ice station depth and later combined. The efficiency of the fiber for extraction of Be from seawater was determined by adding stable Be atomic absorption standards to a drum containing seawater, pumping the water through an iron fiber cartridge, and at every 100 L measuring the Be content of the cartridge effluent. Based on several trials, it was found that for sample volumes in the range 400-700L,

extraction efficiencies are respectively, 82 ± 3% to 76 ± 2%.

The same filtering apparatus was deployed over the side of the ship to collect 7Be from waters below the mixed layer, and from open-ocean mixed layers when not in the ice. At each ice station, a submersible in-line pump was deployed over the side of the ship to a depth of 40m for sampling below the mixed layer. This was used to fill two 1000L holding tanks, from which up to 700L of seawater was passed through one fiber filter each as was done with the mixed-layer samples. For open-water sampling, the ship's seawater system drew water from the mixed layer at a depth of 8m and filled two holding tanks for immediate filtration. All fibers were returned to the lab where they were dried, ashed, and placed in a Marinelli beaker, which in turn was placed over a low background germanium gamma detector. 7Be has a readily identifiable peak at 478keV. The detector is calibrated for these samples by adding a commercially prepared mixed solution of known gamma activities to an ashed fiber and counting it in the Marinelli geometry.

Melt pond water, ice, and snow samples were collected as well. Melt pond samples consisted of 50L of water from undisturbed ponds which were typically 50cm deep. Ice core samples were taken from the ice surface to seawater, producing a core 14cm in diameter and generally 2m in depth. When snow was present, it was removed from the surface of the ice prior to ice coring. All samples were melted and received 5mL of concentrated HCl, 5mL of FeCl in solution, and 0.5mL of a stable Be tracer. After 12 hours of equilibration, a concentrated NaOH solution was slowly added to coprecipitate the 7Be with Fe(OH)3. The precipitate was returned to the lab where it was dried, placed in Petrie dishes, and counted by gamma spectroscopy calibrated for this geometry. The precipitate was redissolved in dilute HCl, and analyzed for stable Be by atomic absorption to calculate recovery yields.

Data Processing Description

Please refer to:
Kadko, D. and D. Olson (1996) Be-7 as a tracer of surface water subduction and mixed layer history. Deep Sea Res. 43, 89-116. doi:10.1016/0967-0637(96)00011-8

BCO-DMO Processing Notes:
- formatted date to mm/dd/yyyy;
- modified parameter names to conform with BCO-DMO naming conventions;
- added column containing cruise_id;
- replaced blanks with 'nd' to indicate 'no data';
- 03 October 2017: made the dataset public per request of data contributor.

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Data Files

File
Be7_water_col.csv (Comma Separated Values (.csv), 2.96 KB) MD5:d9d3a86eb641d49e690f9ebb042a40eb Primary data file for dataset ID 564229

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Parameters

Parameter	Description	Units
date	Month, day, and year.	mm/dd/YYYY
cruise_id	Cruise identifier.	dimensionless

station	Station identifier.	dimensionless
lat	Latitude in decimal degrees North.	decimal degrees
lon	Longitude in decimal degrees East.	decimal degrees
sample_id	Sample identifier.	dimensionless
depth	Water column depth.	meters
platform	Water column platform (ship or ice-station).	dimensionless
sample_vol_water	Water column sample volume.	liters (L)
Be7_water	Water column 7Be concentration.	disintegrations per minute per 1000 liters (dpm/1000L)
Be7_water_se	Standard error of water column 7Be concentration.	disintegrations per minute per 1000 liters (dpm/1000L)
sample_vol_meltpond	Melt pond sample volume.	liters (L)
Be7_meltpond	Melt pond 7Be concentration.	disintegrations per minute per 1000 liters (dpm/1000L)
Be7_meltpond_se	Standard error of melt pond 7Be concentration.	disintegrations per minute per 1000 liters (dpm/1000L)
sample_vol_snow	Snow sample volume.	liters (L)
Be7_snow	Snow 7Be concentration.	disintegrations per minute per 1000 liters (dpm/1000L)
Be7_snow_se	Standard error of snow 7Be concentration.	disintegrations per minute per 1000 liters (dpm/1000L)
sample_vol_ice	Ice core sample volume.	liters (L)
Be7_ice	Ice core 7Be concentration.	disintegrations per minute per 1000 liters (dpm/1000L)
Be7_ice_se	Standard error of ice 7Be concentration.	disintegrations per minute per 1000 liters (dpm/1000L)

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Instruments

Dataset-specific Instrument Name	CTD
Generic Instrument Name	CTD - profiler
Dataset-specific Description	During the occupation of ice stations, a hydrohole was cut through the ice, followed by the lowering of a portable conductivity, temperature, depth probe (CTD) to determine mixed layer depth.
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	Ice Corer
Generic Instrument Name	Ice Corer
Dataset-specific Description	Ice core samples were taken from the ice surface to seawater, producing a core 14cm in diameter and generally 2m in depth.
Generic Instrument Description	An ice corer is used to drill into deep ice and remove long cylinders of ice from which information about the past and present can be inferred. Polar ice cores contain a record of the past atmosphere - temperature, precipitation, gas content, chemical composition, and other properties. This can reveal a broad spectrum of information on past environmental, and particularly climatic, changes. They can also be used to study bacteria and chlorophyll production in the waters from which the ice core was extracted.

Dataset-specific Instrument Name	ROV
Generic Instrument Name	Remotely Operated Vehicle
Dataset-specific Description	A hydrohole was cut through the ice, followed by the lowering of a portable conductivity, temperature, depth probe (CTD) to determine mixed layer depth. A weighted sampling hose was then deployed to the center of the observed mixed layer. Remotely operated vehicle (ROV) observations confirmed that the weighted hose attained accurate deployment-depth measurements from the ice surface.
Generic Instrument Description	Remotely operated underwater vehicles (ROVs) are unoccupied, highly maneuverable underwater robots operated by a person aboard a surface vessel. They are linked to the ship by a group of cables that carry electrical signals back and forth between the operator and the vehicle. Most are equipped with at least a video camera and lights. Additional equipment is commonly added to expand the vehicle's capabilities. These may include a still camera, a manipulator or cutting arm, water samplers, and instruments that measure water clarity, light penetration, and temperature.

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Deployments

ARK-XXVI-3

Website	https://www.bco-dmo.org/deployment/537987
Platform	R/V Polarstern
Report	http://dmoserv3.whoi.edu/data_docs/Be7_Tracer/649-2012_Schauer_ARK-26-3.pdf
Start Date	2011-08-05
End Date	2011-10-06
Description	The Polarstern expedition ARK-XXVI/3 "TransArc" (Trans-Arctic survey of the Arctic Ocean in transition) served the overarching goal to capture the physical, biological and chemical state of the Arctic Ocean in a changing climate. During TransArc, investigators sampled the ocean and ice properties and their ecosystems along gradients from the Eurasian shelf edge to the Canadian Basin. Polarstern left Tromso on August 5, 2011, with 54 scientists from 10 institutes of 7 countries and 43 crew members on board. A number of ice-tethered buoys and bottom-mounted moorings were deployed and recovered respectively. Ice thickness and optical measurements were made at stations, and an ROV was deployed for under ice observations. CTD casts, plankton net casts and sediment sampling were also conducted. The station work finished on September 26. After passing the ice-free Northern Sea Route to the western Barents Sea and the stormy Norwegian and North Seas, Polarstern returned to Bremerhaven on 6 October 2011.

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Project Information

Sample Analysis to Test a Novel Method of Determining Atmospheric Deposition of Trace Elements to the Ocean/Ice System of the Arctic (Be-7 Tracer Method)

Description from the NSF award abstract:
The investigators propose to use the naturally occurring isotope beryllium-7, which is produced in the

atmosphere by cosmic rays and has a 53.3-day half-life, as a tracer for estimating the atmospheric fluxes of a variety of trace elements to the surface of the Arctic Ocean. They have collected samples of snow, sea ice, surface waters, and atmospheric aerosols through an international collaboration concurrent with the preparation of this proposal. This project provides funding for the analysis of Be-7 and for trace elements including aluminum, manganese, iron, cupper, zinc, cadmium, and lead. The atmospheric input of numerous chemical species into the global ocean has been shown to equal or exceed that from river sources. In the Arctic, several contaminant elements in particular are dominated by atmospheric sources, with implications for the Arctic ecosystem and human health. The project will investigate several elements of interest to the international GEOTRACES program, which is currently formulating plans for coordinated Arctic work. The project will support a Ph.D. student who will incorporate these results into his dissertation.

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Funding

Funding Source	Award
NSF Arctic Sciences (NSF ARC)	PLR-1202990
NSF Arctic Sciences (NSF ARC)	PLR-1460290

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