

Ice core Be7 concentrations from the MOSAIC expedition on the R/V Polarstern in the Central Arctic Ocean from October 2019 to May 2020

Website: <https://www.bco-dmo.org/dataset/875885>

Data Type: Cruise Results

Version: 1

Version Date: 2022-06-21

Project

» [Collaborative Research: Defining the Atmospheric Deposition of Trace Elements Into The Arctic Ocean-Ice Ecosystem During The Year-Long MOSAIC Ice Drift](#) (MOSAIC)

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|---------------------------------|---|---------------------------------|
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Abstract

This is a dataset of ice core Be7 concentrations from the MOSAIC expedition (R/V Polarstern PS122) in the Central Arctic Ocean from October 2019 to May 2020.

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Coverage

Spatial Extent: N:88.1124 E:126.145 S:83.9063 W:14.312

Temporal Extent: 2019-10-28 - 2020-05-04

Acquisition Description

Ice cores were collected using a Kovacs Mark II 9 cm diameter corer (area = 63.62 cm²). Snow was swept away from the ice surface before drilling through the ice column. Once recovered, cores were laid out on a cradle to measure length (ice thickness) and then put in a plastic sleeve before being transported to Polarstern where they were placed in buckets for melting.

We generally took three ice cores (total sample area = 190.85 cm², 11 samples) from a site and combined them into one sample, but for some samples we took 4 cores (area = 254.5 cm², 5 samples) or 6 cores (area = 381.7 cm², 3 samples).

For two samples (Core11 and Core13), cores were cut into segments before melting. For example, Core11 consists of 6 cores, each of which was cut into three segments (Core11a = 0-40cm, Core11b = 40-80cm, and Core11c = 80-123cm, where depth = 0cm at the snow-ice surface). For all other samples, the full length of

each core was melted without segmenting.

Shipboard Laboratory Procedure: After placing the cores in buckets, we added the following solutions: 5 ml hydrochloric acid, 2 ml iron chloride solution, and 1 ml of 1000 ppm stable beryllium AA standard (chemical yield tracer). After melting at room temperature, the water volume was measured using a graduated cylinder. Next, the sample was precipitated using ammonium hydroxide. After allowing the precipitate to settle, excess water was removed by decanting and centrifugation. Finally, the samples were transferred to petri dishes and placed in an oven for drying.

Gamma Analysis: Dried samples in petri dishes were counted by gamma spectroscopy. Be-7 has a readily identifiable gamma peak at 478 keV. The counting system was calibrated for all samples by preparing a commercial standard in a geometry identical to the samples.

Chemical Yield Determination: After gamma counting, samples were brought up to 1 liter in 1% nitric acid solution. The beryllium concentrations were then determined using a Perkin Elmer Optima 7300 DV ICP-OES. Our chemical yields averaged over 80% (Kadko et al., 2019).

Processing Description

BCO-DMO Processing

- Converted dates to ISO8601 format (YYYY-MM-DD)
- Adjusted field/parameter names to comply with BCO-DMO naming conventions
- Added a conventional header with dataset name, PI names, version date

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Related Publications

Kadko, D., Aguilar-Islas, A., Bolt, C., Buck, C. S., Fitzsimmons, J. N., Jensen, L. T., Landing, W. M., Marsay, C. M., Rember, R., Shiller, A. M., Whitmore, L. M., & Anderson, R. F. (2019). The residence times of trace elements determined in the surface Arctic Ocean during the 2015 US Arctic GEOTRACES expedition. *Marine Chemistry*, 208, 56-69. <https://doi.org/10.1016/j.marchem.2018.10.011>
Methods

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Parameters

| Parameter | Description | Units |
|------------------|--|------------------------------------|
| SAMPLE_ID | Sample Identifier | unitless |
| Collection_Date | Sample collection date in format YYYY-MM-DD | unitless |
| MOSAIC_EVENTNO | Event Numer | unitless |
| MOSAIC_Site_Name | Site name on the ice floe | unitless |
| LATITUDE | Latitude North of sample site | decimal degrees |
| LONGITUDE | Longitude East (West is negative) of sample site | decimal degrees |
| ICE_THICKNESS | Thickness of the ice | meters (m) |
| SAMPLE_DEPTH | Depth from top of the ice | meters (m) |
| AREA_SAMPLED | Horizontal sample area | square meters (m2) |
| SAMPLE_VOLUME | Volume of melted sample | cubic meters (m3) |
| Be_7_CONC | Be-7 concentration | Becquerels per cubic meter (Bq/m3) |
| Be_7_ERR | Error associated w Be-7 concentration | Becquerels per cubic meter (Bq/m3) |

Instruments

| | |
|---|---|
| Dataset-specific Instrument Name | Kovacs Mark II 9 cm diameter ice corer |
| Generic Instrument Name | Ice Corer |
| 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 | Perkin Elmer Optima 7300 DV ICP-OES |
| Generic Instrument Name | Mass Spectrometer |
| 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 | high purity germanium (HPGe) gamma detectors |
| Generic Instrument Name | Gamma Ray Spectrometer |
| Generic Instrument Description | Instruments measuring the relative levels of electromagnetic radiation of different wavelengths in the gamma-ray waveband. |

Deployments

PS122

| | |
|--------------------|--|
| Website | https://www.bco-dmo.org/deployment/861601 |
| Platform | R/V Polarstern |
| Report | https://datadocs.bco-dmo.org/docs/305/MOSAIC/data_docs/Expeditionsprogramm_PS122_leg2.pdf |
| Start Date | 2019-09-20 |
| End Date | 2020-10-14 |
| Description | MOSAIC (Multidisciplinary Drifting Observatory of the Study of Arctic Climate) was Polarstern expedition PS122, which started on September 20th 2019 in Tromsø (Norwegian). PS122 was a year-around expedition in the central Arctic Ocean and was divided into six legs (PS122/1 - PS122/6). The expedition finished on October 14th 2020 in Bremerhaven. Additional information can be found at: https://mosaic-expedition.org / https://epic.awi.de/id/eprint/50082/ |

Project Information

Collaborative Research: Defining the Atmospheric Deposition of Trace Elements Into The Arctic Ocean-Ice Ecosystem During The Year-Long MOSAiC Ice Drift (MOSAIC)

Coverage: Central Arctic Ocean

NSF Award Abstract:

This project will use a Beryllium 7 (7-Be) method in a year-long expedition as part of the international Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAIC) expedition to assess the seasonal variability of aerosol deposition. This is the first modern opportunity for such a comprehensive study of the yearly depositional flux of trace elements (TEs) into the Arctic ocean/ice ecosystem. The combination of 7-Be and aerosol TE measurements has been shown to be an effective tool for estimating the atmospheric input of TEs in remote ocean regions where nearby land-based collection sites do not exist. The data generated in this work will be available to allow ground-truthing of models of aerosol deposition and atmospheric input of TEs. Atmospheric deposition is the dominant pathway by which anthropogenically-derived trace elements, especially mercury (Hg), enter the Arctic Ocean, and recent literature suggests that atmospheric deposition of biologically-essential trace elements such as iron (Fe) could play a major role in controlling biological productivity in the Arctic.

Atmospheric transport and deposition of aerosols is an important delivery mechanism of natural and contaminant trace elements (TEs) to the Arctic. Existing data show that atmospheric deposition of contaminant elements like Hg, Pb, and Se may be a major input of these elements to the Arctic, with likely sources being anthropogenic - industrial or power plant emissions associated with fossil fuel combustion in Europe, Russia, and Asia. The atmospheric input of biologically-essential trace elements (e.g. Mn, Fe, Co, Ni, Cu, Zn) plays a key role in controlling biogeochemical processes in the ocean, and recent work suggests this might be true in the Arctic as well. These inputs have strong implications for the ecosystem, and even human health. Assessment of this input is difficult because measurements of deposition rates in remote ocean regions are scarce, and are particularly daunting to take in the Arctic because harsh conditions and limited research platforms make it difficult to obtain quality-controlled precipitation and aerosol chemistry measurements on a routine basis. This research will provide estimates of the yearly atmospheric deposition flux of aerosol TEs (total and soluble), including those of biogeochemical importance as well as pollutant species. The seasonal evolution of partitioning of trace element deposition among the various catchments (ice, water, snow, melt ponds) will also be assessed. The work will involve measurements of 7-Be inventories, 7-Be aerosol activities, and aerosol concentrations of TEs. Field work will be during a year-long ice drift of the MOSAiC expedition through the central Arctic Ocean.

This project will be a component of the MOSAiC expedition, an international initiative motivated by the rapidly evolving Arctic climate system, with thinning sea ice, warming ocean and atmosphere temperatures, strong climate feedbacks, and dramatic implications for society. MOSAiC has broad international support and has been endorsed by international and US institutions as a project that is critically needed to provide foundational information on the changing central Arctic system required to support coupled model development. The ability to provide estimates of the atmospheric input of relevant TEs to the Arctic Ocean will contribute widely to the field of chemical oceanography, including understanding anthropogenic impacts on the region and the role atmospheric input of TEs plays in Arctic Ocean ecology. The lead institution is one of the country's leading minority serving universities, and the lead researcher has undertaken a mentoring program for students involved in its research activities. The team will record short lectures and video logs that can be used in future iterations of his courses to introduce important oceanographic concepts and give his students a first-hand account of life aboard an oceanographic vessel. Other scientists will be asked to grant interviews to add to the breadth of perspectives, and the outreach will emphasize the role of basic scientific research in improving our understanding of natural phenomena and the planet's response to anthropogenic stressors.

Funding

| Funding Source | Award |
|---|-----------------------------|
| NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP) | OPP-1753408 |
| NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP) | OPP-1753423 |
| NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP) | OPP-1753418 |

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