7 BIO-GEOCHEMISTRY (BGC)

E.Damm[1], P. Simões Pereira[2], A. Dumitrascu[2], M. Stephens[3]

[1] AWI, [2] UGOT, [3] FIU

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A comprehensive summary of the bio-geochemical measurements during all 5 cruise legs will be published in the *Special Feature: The Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAiC)* of the scientific journal *Elementa: Science of the Anthropocene* (https://online.ucpress.edu/elementa/collection/269/Special-Feature-The-Multidisciplinary-Drifting)

Objectives

During the Leg 2 phase of the MOSAiC Transpolar drift expedition we continued the year-round observations of climate relevant trace gases (CRTG) to study their complex pathways and feedback mechanisms at the ocean-sea ice-air interfaces. These CRTG exert a large control on atmospheric chemistry and climate. Quantifying seasonally varying fluxes of these compounds to the atmosphere is therefore essential to improve existing climate models. The biogeochemical cycle of the CRTG in the Arctic is largely promoted by numerous physical, chemical and biological processes within the sea ice, for instance through fluid and gas exchanges at the sea ice interface or through the influence of the biology within or beneath the sea ice. This holistic configuration results in CRTG being exchanged with both the overlying atmospheric boundary layer and the underlying ocean down to the halocline. The collected data from Leg 2 links to the atmosphere, snow, sea ice, ocean, and ecosystem domains, and will therefore help improving our understanding on the biogeochemical cycles of CRTG in the Arctic during polar winter.

Work at sea

During the two months on the MOSAiC floe, we retrieved a total of 119 ice cores, 123 snow profiles, 42 frost flower samples and 39 brine samples collected from sackholes. Most of the snow and ice cores were taken from the three BGC sites (i.e. BGC1, BGC 2, and BGC 3), as well as from the FYI and SYI position at the Dark Site. Additionally, we sampled snow and ice from seven newly formed leads and cracks that opened up on various locations around our floe (Table 1 and 2).
Once collected from the field, the samples were then taken back on board of Polarstern for further investigations. Material from the field was processed in discrete samples and analyzed for their concentration in several dissolved gases (i.e. volatile halogenated organic compounds, or VHOC, and CH_4), as well as for the isotopic composition of beryllium (^7Be) and methane ($\delta_{13}C$-CH_4). Additional sub-samples were taken from the corresponding discrete layers for later measurements of N_2O concentration and stable oxygen and hydrogen isotopes in water ($\delta_{18}O/\delta D$).
Continuous atmospheric and/or surface water measurement were further undertaken for CH_4, CO_2 and VHOC concentrations, as well as the $\delta_{13}C$-CH_4, and ^{222}Rn. Refer to the Expedition Program for principal investigators and their scientific objective.
In Ocean City, we sampled seawater up to 250m water depth from the rosette samplers on 41 CTD casts. Our sampling comprised dissolved gases, several isotope systems, nutrients and

further compounds (Table 3). In addition, water samples were also collected from eight deep casts from the ship CTD. This activity included temporally sampling for Iodide and Nd isotopes.

Table 1: Ice coring events with sampled parameters

Date	Action log ID	Site	VHOC	CH_4	$\delta^{13}C$-CH_4	N_2O	^{18}O	Be-7
15.12.2019	PS122-2_15-12	BGC1	x					
23.12.2019	PS122-2_17-3	DS FYI	x	x	x		x	
25.12.2019	PS122-2_17-29	BGC2	x	x	x		x	
28.12.2019	PS122-2_17-124	BGC3	x	x	x		x	
02.01.2020	PS122-2_18-118	BGC2		x				x
03.01.2020	PS122-2_18-62	RS	*x*					
04.01.2020	PS122-2_18-113	BGC1	x					
06.01.2020	PS122-2_19-7	DS FYI	x	x	x		x	
06.01.2020	PS122-2_19-7	DS lead	x					
09.01.2020	PS122-2_19-152	BGC3	x		x		x	
10.01.2020	PS122-2_19-180	BGC2			x		x	
13.01.2020	PS122-2_20-5	DS SYI	x	x	x	x	x	x
15.01.2020	PS122-2_20-28	DS	x	x	x		x	x
16.01.2020	PS122-2_20-65	DN L2	x	x	x		x	
18.01.2020	PS122-2_20-92	BGC1	x					
18.01.2020	PS122-2_20-134	BGC1						x
20.01.2020	PS122-2_21-13	DS FYI	x	x	x	x	x	
22.01.2020	PS122-2_21-49	DS lead	x	x	x		x	
26.01.2020	PS122-2_21-127	BGC2		x	x		x	
27.01.2020	PS122-2_22-7	DS SYI	x	x	x	x	x	
29.01.2020	PS122-2_22-29	DS lead	x	x	x		x	
31.01.2020	PS122-2_22-77	BGC1	x					x
03.02.2020	PS122-2_23-3	DS FYI	x	x	x	x	x	
05.02.2020	PS122-2_23-128	DS lead	x					
05.02.2020	PS122-2_23-127	Crack near DS lead	x	x	x		x	
07.02.2020	PS122-2_23-65	BGC2	x					x
10.02.2020	PS122/2_24-8	DS FYI	x			x		
12.02.2020	PS122-2_24-34	DN L1	x	x	x		x	
17.02.2020	PS122/2_25-15	DS SYI	x			x		
18.02.2020	PS122/2_25-47	BGC3	x					x

Table 2: Snow sampling events with sampled parameters

Date	Action log ID	Site	VHOC	N_2O	^{18}O	Be-7	For Lei
23.12.2019	PS122/2_17-131	DS FYI	x		x		
25.12.2019	PS122-2_17-122	BGC2	x		x		
25.12.2019	PS122/2_17-128	BGC2				x	
28.12.2019	PS122-2_17-123	BGC3	x		x		
28.12.2019	PS122/2_17-130	BGC3				x	
02.01.2020	PS122/2_18-117	BGC2		x	x	x	
03.01.2020	PS122-2_18-111	RS	x				
03.01.2020	PS122/2_18-64	RS				x	
04.01.2020	PS122-2_18-112	BGC1	x			x	
06.01.2020	PS122-2_19-149	DS FYI	x	x	x		
09.01.2020	PS122-2_19-153	BGC3	x			x	
10.01.2020	PS122/2_19-157	BGC2				x	
10.01.2020	PS122/2_19-154	DS lead				x	
13.01.2020	PS122-2_20-128	DS SYI	x	x	x		
15.01.2020	PS122/2_20-148	DS lead	x	x	x	x	
16.01.2020	PS122/2_20-64	DN L2	x				
16.01.2020	PS122/2_20-63	DN L2				x	
18.01.2020	PS122/2_20-90	BGC2					x
18.01.2020	PS122/2_20-90	BGC1	x			x	
20.01.2020	PS122-2_21-144	DS FYI	x	x	x		
20.01.2020	PS122-2_21-6	Egon's lead				x	x
22.01.2020	PS122-2_21-46	DS lead	x	x	x	x	
27.01.2020	PS122/2_22-113	DS SYI	x	x	x		
29.01.2020	PS122/2_22-25	DS lead	x	x	x	x	
31.01.2020	PS122/2_22-76	BGC1	x			x	
03.02.2020	PS122/2_23-122	DS FYI	x	x	x		
05.02.2020	PS122/2_23-100	DS lead	x	x	x	x	
07.02.2020	PS122/2_23-96	BGC2	x			x	
10.02.2020	PS122/2_24-6	DS FYI	x				x

12.02.2020	PS122/2_24-32	DN L1	x	x	x	x	
15.02.2020	PS122/2_24-73	BGC3				x	
15.02.2020	PS122/2_24-74	BGC1				x	
17.02.2020	PS122/2_25-14	DS SYI	x				
18.02.2020	PS122/2_25-45	BGC3	x	x		x	

Table 3: Ocean city water sampling with collected parameters

Date	Action log ID	VHOC	CH_4	$\delta^{13}C$-CH_4	N_2O	$\delta^{18}O$	Nutrients	I^-	For Lai	Bact
21.12.2019	PS122/2_16-54	x	x	x		x	x			
24.12.2019	PS122/2_17-18	x	x			x				
30.12.2019	PS122/2_18-5		x		x	x				
31.12.2019	PS122/2_18-16		x	x	x	x	x			
06.01.2020	PS122/2_19-4	x	x	x	x	x	x			
07.01.2020	PS122/2_19-18		x			x				x
13.01.2020	PS122/2_20-2	x	x	x		x				
14.01.2020	PS122/2_20-17		x	x	x	x	x	x	x	x
20.01.2020	PS122/2_21-1		x			x				
21.01.2020	PS122/2_21-26		x	x	x	x	x		x	x
24.01.2020	PS122/2_21-101		x	x		x		x		
25.01.2020	PS122/2_21-114		x	x		x	x			
26.01.2020	PS122/2_21-128		x	x	x	x	x			x
27.01.2020	PS122/2_22-3		x	x	x	x	x			
28.01.2020	PS122/2_22-18	x	x	x	x	x	x		x	x
31.01.2020	PS122/2_22-71		x	x	x	x	x			
03.02.2020	PS122/2_23-4		x	x	x	x	x			
04.02.2020	PS122/2_23-17		x	x		x				
08.02.2020	PS122/2_23-97		x		x	x	x		x	x
14.02.2020	PS122/2_24-47	x	x	x	x	x	x	x		
17.02.2020	PS122/2_25-4		x	x	x	x	x			x

7.1. Fate and pathways of methane in sea ice and surface water

E. Damm, AWI

The coupling of ice and snow physics on one side with the ecosystem on the other side induces numerous biogeochemical reactions during freezing and melt cycles of sea ice, which finally results in methane exchange with both the overlaying Arctic atmospheric boundary layer and the underlying, sea ice influenced, ocean down to the halocline. By combining year-round observations, we will be able to evaluate how seasonal variability in physical and biogeochemical regimes affect the methane distribution, isotopic fractionation and sea/ice air fluxes. We consider direct interactions, i.e. from ice and snow to surface water and indirect interactions, where methane circulate through more than one environment before leaving to the atmosphere. During the freeze period, we focus on potential alterations in the isotopic

composition of methane along these pathways, mainly induced by kinetic isotopic fractionation. Fractionation initiates modifications in the isotopic signature of sea-ice related methane, which when unconsidered, encourages a misleading source identification of Arctic emissions. The collected data links to most of the measurements in the atmosphere, snow, sea ice, ocean, and ecosystem domains. The enhanced process understanding contributes to future improvements of climate models.

Work at sea

Seawater sampling occurred up to 250 m water depth from the Ocean City rosette mainly two times per week. At the end of January, a daily sampling occurred before and after a 24h event of turbulence measurements. Selected sampling depths varied over time related to gradients in temperature, salinity and former measured methane profiles.
Ice cores from all three BGC sites and both locations at the Dark Site, i.e. FYI and SYI were taken and analyzed (Tab. 1 and 2).
After coring with a standard Kovacs 9 cm ice corer, ice cores were divided into 10 cm sections and thawed in gas-tight Tedlar™ bags. The melted ice were filled in 160 ml and 500 ml glass bottles for the analysis of methane concentration and stable carbon isotopic signature of methane, respectively.
The concentration and stable carbon isotopic signature of methane were analysed directly on board. Methane concentration was measured with the headspace method, i.e. , 1.5 mL gas sample was taken from the headspace of a 160 ml water bottle and injected into a gas chromatograph (Agilent GC 7890B) with a flame ionization detector (FID). For gas chromatographic separation a packed column (Porapac Q 80/100 mesh) was used. The GC operated isothermally (60°C) with a detector temperature of 200°C.
For the analysis of the stable carbon isotopic signature a 25 ml headspace with methane free air was created. After shaking, a 20 ml gas sample was taken and injected into the SSIM mounted on a PICARRO 2132.

Preliminary results

<u>Seawater - Winter mixed layer</u>

The surface water show a persistent well mixed layer deepening from shallow 10-20m at the end of December to about 50-60 m at the end of February. Within this Winter Mixed Layer (WML) methane concentration was up to 30 % enhanced related to the atmospheric background. The highest super-saturation was detected on the beginning on the drift, i.e. in the southernmost part of the drift area. Over the course of the drift, super-saturation slightly decreased within the WML while reaching pronounced under-saturation underneath the WML. The stable carbon isotopic signature of dissolved methane deviated slightly from the background value in December. In comparison, values more in enriched in ^{13}C clearly show the ongoing temporal shift later in winter (Fig. 1).

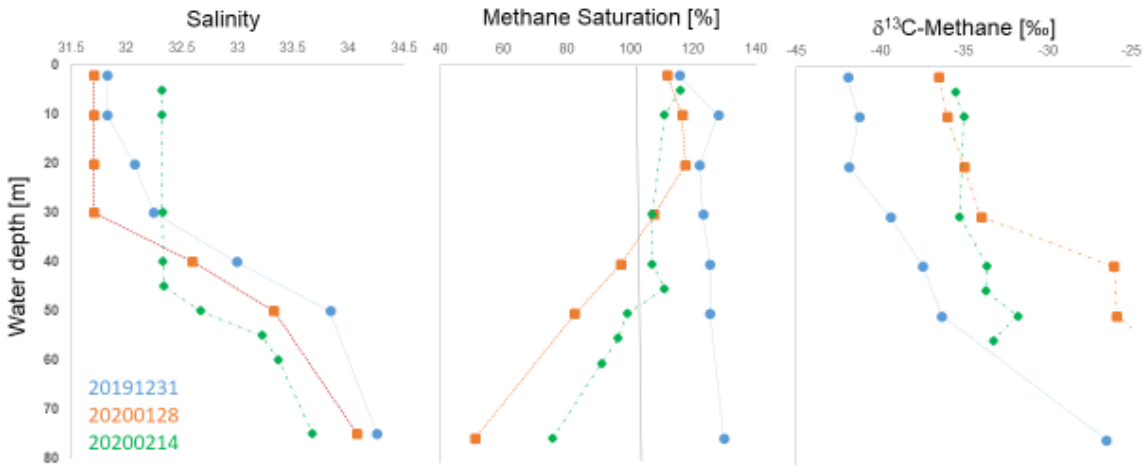

Fig 1. Salinity, saturation (100% corresponds to an equilibrium with the atmosphere) and the stable carbon isotopic signature of methane in seawater underneath sea ice on three chosen days during leg 2

Sea ice

As well as the spatial and temporal variability of sea ice was considered. The former was taken into account by coring of different types of sea ice, i.e. first and second year ice: (FYI, SYI) but also rafted ice and fresh formed ice on leads. The later by repeated coring/analysis of ice of the chosen coring sites, BGC1, BGC 2, BGC 3, FYI and SYI at the dark site and leads over the course of the whole leg 2 (Tab. 1). Methane concentration in FYI and lead ice corresponded to the range of magnitude as the seawater underneath sea ice, i.e. the WML. While in comparison, SYI and rafted ice showed slightly enhanced values (raw data). Furthermore, the temporal variability of concentrations remained rather small over the course of leg 2.
In all types of sea ice, the stable isotopic signature of methane shifted towards values depleted in ^{13}C compared to those in seawater. By comparison, SYI showed with up to -70 ‰ the most pronounced depletion in 13C.

Data management

All data are handled, documented, archived and published following the MOSAiC data policy (see APPENDIX). The raw data are available according to the data policy of the MOSAiC expedition.

7.2 Seasonal sea ice – a new source of bromine during polar night

P. Simões Pereira[1], A. Dumitrascu[1], K. Abrahamsson[1] (not onboard), and A. Saiz Lopez[2] (not onboard)

[1]UGOT, Sweden
[2]CSIC, Spain

Objectives

The aim of this project is to study emissions of naturally occurring halogenated trace gases, i.e. volatile halogenated organic compounds (vHOC), or halocarbons. These compounds exert

a large control on atmospheric chemistry and are hence an important element of the Arctic. Halocarbons have ozone-depleting properties, and are therefore subject to present and future regulation under international agreements (e.g., the Montreal Protocol). While significant effort were made over the last decades to generate global budgets of halogenated compounds, observational data from the Central Arctic is still very limited, hindering accurate prediction of future ozone levels in the years to come. Sea ice and snow surface were shown to provide major controls on halogen chemistry in the atmospheric boundary layer, either through changes in sea ice distribution, concentrations, and age, especially in the Arctic where the extent of multi-year ice has declined substantially compared to seasonal ice. During the Antarctic winter, for instance, estimates of ozone-depleting halogen fluxes from seasonal ice are 100 to 1000 times higher than during to summer. The numerous biogeochemical processes that occur at the sea ice-air interface continue, however, to be poorly understood or quantified, especially for the polar winter.

One of the main focus of Leg 2 is to study halocarbon distribution in the Central Arctic during polar winter, which is characterized by continuous night time, cold temperatures (Leg 2 average temperatures was -25°C) and persistent ice growth. During our drift, we will measure halocarbon concentrations in ocean, snow, ice and air to further our understanding on the biogeochemical processes that occur within the sea ice cover. We will monitor halocarbons in the atmosphere, and relate them to the tropospheric, sea ice and ocean water chemistry. We also investigate the role of ice, especially first-year or saline ice, as a reaction surface for chemical conversion processes, and therefore as a source for halogens to the air. Finally, we will estimate the contribution of seasonal sea ice to the load of halogens to the atmospheric boundary layer. Overall, our result will improve improving existing uncertainties in global flux models of halocarbons through air-ice-sea measurements.

Work at sea

Measurements of brominated, iodinated and chlorinated halocarbon compounds were conducted on air, sea ice, snow and ocean water in order to estimate their fluxes, and therefore assess the importance of Arctic sea ice as a source for ozone-depleting halogen compounds to the atmosphere during winter. An important aspect of the sampling strategy for sea ice and snow was to continue with the time-series of trace gases established during Leg 1. To this end, the main BGC study sites from Leg 1 (BGC1, BGC2, BGC3, DS FYI & SYI) were periodically resampled, with ice cores and snow profiles being repeatedly taken from each location. For the halocarbon project, two (and occasionally three) cores were taken during each field campaign and processed separately. Ice cores were then taken from the field to the ship, cut into 5 to 10 cm sections and thawed in gas-tight Tedlar™ bags. Samples were filtered before analysis in case they presented significant amounts of particular algaes and sediments. Depending on sea ice type and snow thickness, two snow depth-profiles were taken at the same location of the coring event. Computer tomography (CT) profiles and high-resolution snow and surface sea ice sampling (1-2 cm sections) were performed on occasions at BGC 1 in collaboration with the ICE Team as part of the snow-salinity project, which we initiated halfway through Leg 2. For this experiment, we removed the saline snow cover from a first-year ice field (BGC 1) and let fresh, non-saline snow fall on it. Regular snow and ice sampling of this site was conducted to investigate and quantify the brine transport and halocarbon flux from ice to snow. To assess the importance of winter sea ice formation and growth on halocarbon fluxes, several leads and cracks events around the flow were further sampled for their newly formed ice and snow. Since the very beginning of Leg 2, a new site was established at the “old” Dark Site Lead, a lead that opened end of December and on which we established a continues time-series in fast ice formation. Frost flowers and brine were also collected from the field to better understand the fluxes of halocarbons during the initial stage of winter sea ice growth. Sea ice brine was collected by drilling boreholes at BGC 1 at different depth to enable the drainage of brine from the surrounding ice. Seawater from shallow and deep ocean depth was collected from the ship’s and Ocean City CTD casts.

We measured a suite of halocarbon compounds, especially $CHBr_3$, CH_2Br_2, $CHCl_2Br$, $CHClBr_2$, CH_3I, CH_2ClI and CH_2I_2. All discrete samples were analyzed with a purge-and-trap system connected to a gas chromatograph with electron capture detector (GC-ECD). In addition to the discrete sample analysis, continuous measurements of surface seawater and air were performed by a custom-made purge-and-trap instrument attached to a GC-ECD. Air was continuously drawn from ca. 25m altitude through a ~100m long Teflon tube with a diameter of 4 mm through the means of an air pump downstream of the tubing. The instrument was also fed by a continuous stream of water from the ship´s underway surface water inlet.

A MAXDoas instrument was also set up during Leg 1 to measure atmospheric concentrations of BrO and IO, but the lack of sunlight and radiation during Leg 2 did not allow for any collection of data.

Preliminary results

During polar springtime, active bromine drives ozone, a greenhouse gas, to near-zero levels. Bromine production and emission in the polar regions have so far been assumed to require sunlight. We have earlier reported measurements of bromocarbons in sea ice, snow and air during the Antarctic winter that revealed an unexpected new source of organic bromine to the atmosphere during periods of no sunlight. The findings were based on measurements in air, sea ice, and snow. During our drift, we will test the hypothesis that these findings are also applicable to the Arctic.

Sea ice and snow

Similar to Leg 1, the first-year ice sites (i.e. DS, BGC1, BGC3) shower the highest concentration in halocarbons compared to any other type of sea ice (lead, SYI). Halocarbon concentration is particularly high in the uppermost 20 cm of the ice cores, as well as at the bottom of the snow profiles that were deposited on FYI. Time-series on FYI show a 10 to 100-fold increase in bromoform ($CHBr_3$) concentrations over the course of the whole Leg 2. Bromoform in FYI snow samples display an increase with a similar order of magnitude. These findings suggest that the snow-ice interface of FYI is of paramount important for the biogeochemical cycle and flux of halocarbons in the Arctic. In contrast, halocarbon concentrations in SYI snow and cores are low and do not exhibit any specific trends. The inherent saline character of FYI will be investigated in further detail during the postcruise work.

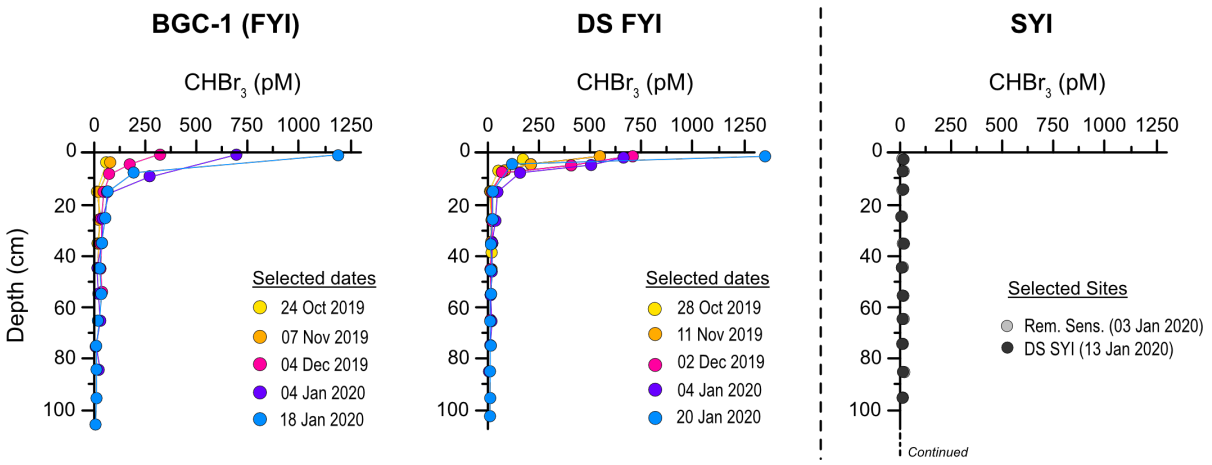

Fig 7.2.1. *Bromoform ($CHBr_3$) concentrations in first-year (BGC-1 and DS FYI) and second-year (DS SYI) profiles. Note the striking difference between FYI and SYI (right panel: grey circle is behind the black circle), as well as a pronounced decrease in bromoform concentrations over time at the surface of the ice core.*

Frost Flowers and Brine

During Leg 2, a total of seven leads and cracks were sampled, providing further opportunities for frost flower sampling, in addition to newly formed ice, slush, surface seawater and freshly deposited snow. Frost flowers are vapour-deposited ice crystals that can take up brine from the newly formed sea ice possibly through capillary action. Frost flowers were characterized by very high bromoform concentrations compared to any other ice type, and are therefore of particular interest for halocarbon fluxes.

Several sackholes (or brinepits) were created towards the end of Leg 2 at BGC 1 and one at BGC 2 to extract brine which drains through the surrounding ice wall of the pit. These sackholes successfully accumulated brine, which was periodically sampled for halocarbon analysis. All brine samples show higher bromoform concentrations compared to frost flowers and FYI, and are therefore an important element for the biogeochemical cycle of halocarbon in sea ice. A brine experiment consisting of four brinepits with different depths was launched at BGC1 to better understand the brine transport and fluxes in the ice.

Ocean water

Preliminary results of halocarbon concentrations in seawater taken from the Ocean City and Polarstern CTD casts show a persistent well mixed ocean surface layer, with little variation in most of the halocarbon concentrations. This “winter mixed layer” extends from the surface down to the halocline. Over the course of Leg 2, we observed a thickening of this mixed layer, which correlates with a deepening of the halocline. The process behind this thickening will be studied during the postcruise work with all team members. Beneath the halocline, several halocarbon tracer show drastic changes in several components that can be related to the inflow of different water masses at the deep levels of the ocean column. This set of halocarbons can be therefore used as water mass tracers, and can help identifying sources of the water masses in the Arctic.

Continuous air and seawater analysis

Approximately 1600 lower atmospheric and surface seawater samples were analyzed for halocarbon concentrations with our semi-automatic purge-and-trap system and GC-ECD. Data will be processed postcruise.

Data management

All data are handled, documented, archived and published following the MOSAiC data policy (see APPENDIX). All data from Leg 2 will be processed back on land during the participants postcruise phase of the expedition. Quality control of the data will be based on standard calibrations and reproducibility of the instruments, as well as on an inter-calibration between the two independent instruments as soon as the participants are back on land. The data will be made available according to the data policy of the MOSAiC expedition.

7.3. Cosmogenic ^{7}Be as a tracer of atmospheric fluxes of trace elements.

Mark Stephens[1] [1]FIU
David Kadko[1] (not on board), William Landing[2] (not on board), Clifton Buck[3] (not on board), Chris Marsay[3] (not on board) [2]FSU [3]SkIO

Objectives

The radionuclide ^{7}Be (half-life 53 days) is produced in the atmosphere by cosmic radiation and deposited onto the ocean and ice surface via precipitation. Its known half-life and source enable us to quantitatively determine the fluxes of airborne particles that deliver trace elements to the Arctic Ocean ecosystem. However, no winter data from the Arctic are available so far. Our objective is to combine measurements of ^{7}Be in snow, ice and seawater with trace metal data from a continuous time-series of aerosol collection, establishing the first winter time-series of atmospheric trace metal fluxes in the Arctic.

Work at sea

By measuring the inventory of 7Be in snow, ice and seawater, we can determine the flux of ^{7}Be at the MOSAIC study area. Trace element fluxes will then be calculated using the ^{7}Be fluxes and concentrations of trace elements and ^{7}Be in aerosol particles.

Snow Sampling

18 bulk snow samples were collected. An area of 25x25cm was marked off and the entire snow column within that square was scooped into a clean bucket. Sites sampled included BGC1, BGC2, BGC3, Remote Sensing, and near leads at the Dark Site and the runway. Snow depths varied from 6.5cm to 30.25cm.

Snow profiles, in which three to five different depth intervals of the column are sampled separately, were collected at BGC1, BGC2, BGC3, Fort Ridge, Snow2, and near the Dark Site lead. Sites were chosen to represent different depositional environments (e.g. flat area, drifting snow accumulation near ridges, etc.). Nine profiles were sampled, with snow depths ranging from 7 to 34cm.

A time series of snow and 7Be deposition was established at the Dark Site lead within 5 days after the surface iced over. Here, frost flowers were sampled on January 10, 2020. On January 15, 2020, the lead was covered with snow to a depth of 5cm and two bulk snow samples were collected. Over the following six weeks, the site was revisited and sampled four more times (bulk snow and snow profiles).

Frost flowers were also sampled at a new Dark Site lead on February 5, 2020 with the intention to establish a second time series. Both time series will be continued through MOSAIC legs 3 and 4.

Fresh, falling snow was sampled by deploying a bucket attached to a rail on the p-deck of Polarstern during one snowfall event with light winds (February 4-8, 2020).

Ice Sampling

Ice cores were collected using a Kovacs 9cm corer at five sites (BGC1, BGC2, BGC3, the Dark Site lead, and Dark Site SYI). Generally, three cores were collected and combined for one sample. On one occasion, six cores were collected from BGC1 in order to measure the ^{7}Be

within three different ice depths. Except for the Dark Site lead cores, which measured 40cm, core lengths ranged from 110cm to 126cm.

Sample Preparation

Snow and ice samples were prepared for gamma counting on board Polarstern according to the following steps:

1. Samples were melted and acidified with 5ml of 6N HCl.
2. Iron chloride solution and stable beryllium spike were added to the sample.
3. After an equilibration period, the sample was precipitated using sodium carbonate.
4. The precipitate was centrifuged, washed, collected, dried and placed in a gamma counting vial.

Seawater Sampling

Mixed layer ^{7}Be concentrations will be determined from samples obtained in the Polarstern fish lab. Two 700 liter plastic tanks were filled from the seawater intake. The water was then pumped through an iron impregnated acrylic fiber filter, which absorbs beryllium. This procedure was carried out eight times during leg 2 (every 7-10 days).

Seawater from ten meters below the mixed layer was sampled at Ocean City on December 26, 2019, and from the Polarstern ctd hole on January 25, 2020 and February 11, 2020. For each of these samples, 1700 liters of water was filtered using a centrifugal pump and a pvc hose with an attached Seabird SBE19 ctd.

Aerosol Sampling

Our aerosol equipment consists of a Tisch high volume sampler fitted with twelve Whatman W41 filters, a heated sonic anemometer, and a rain and snow sensor. The device is programmed to sample only when there is no precipitation and the wind direction is within 60 degrees of the bow (clean air, free of stack exhaust).

The equipment was installed on Polarstern's p-deck at the beginning of leg 2, and seven deployment periods of 2-10 days duration were sampled.

Preliminary results

Gamma spectra were obtained for 37 samples (snow and ice) on board Polarstern using a Canberra germanium gamma detector provided by Walter Geibert (AWI). Determination of chemical yield and ^{7}Be activity will be performed following leg 2 at Florida International University.

All trace elements analysis will be performed after leg 3 at Florida State University and Skidaway Institute of Oceanography.

Data management

All data are handled, documented, archived and published following the MOSAiC data policy (see APPENDIX). The raw data is available according to the data policy of the MOSAiC expedition.