Berichte
zur Polar- und Meeresforschung

674
2014

Reports on Polar and Marine Research

The Expedition of the Research Vessel "Polarstern" to the Antarctic in 2013 (ANT-XXIX/7)

Edited by
Bettina Meyer and Lutz Auerswald
with contributions of the participants

HELMHOLTZ
GEMEINSCHAFT

Alfred-Wegener-Institut
Helmholtz-Zentrum für Polar-
und Meeresforschung
D-27570 BREMERHAVEN
Bundesrepublik Deutschland

ISSN 1866-3192

Hinweis

Die Berichte zur Polar- und Meeresforschung werden vom Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung in Bremerhaven* in unregelmäßiger Abfolge herausgegeben.

Sie enthalten Beschreibungen und Ergebnisse der vom Institut (AWI) oder mit seiner Unterstützung durchgeführten Forschungsarbeiten in den Polargebieten und in den Meeren.

Es werden veröffentlicht:

— Expeditionsberichte (inkl. Stationslisten und Routenkarten)
— Expeditions- und Forschungsergebnisse (inkl. Dissertationen)
— wissenschaftliche Berichte der Forschungsstationen des AWI
— Berichte wissenschaftlicher Tagungen

Die Beiträge geben nicht notwendigerweise die Auffassung des Instituts wieder.

Notice

The Reports on Polar and Marine Research are issued by the Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung in Bremerhaven*, Federal Republic of Germany. They are published in irregular intervals.

They contain descriptions and results of investigations in polar regions and in the seas either conducted by the Institute (AWI) or with its support.

The following items are published:

— expedition reports (incl. station lists and route maps)
— expedition and research results (incl. Ph.D. theses)
— scientific reports of research stations operated by the AWI
— reports on scientific meetings

The papers contained in the Reports do not necessarily reflect the opinion of the Institute.

The „Berichte zur Polar- und Meeresforschung”
continue the former „Berichte zur Polarforschung”

* Anschrift / Address
Alfred-Wegener-Institut
Helmholtz-Zentrum für Polar-
und Meeresforschung
D-27570 Bremerhaven
Germany
www.awi.de

Editor:
Dr. Horst Bornemann

Assistant editor:
Birgit Chiaventone

Die "Berichte zur Polar- und Meeresforschung" (ISSN 1866-3192) werden ab 2008 als Open-Access-Publikation herausgegeben (URL: http://epic.awi.de).

Since 2008 the "Reports on Polar and Marine Research" (ISSN 1866-3192) are available as open-access publications (URL: http://epic.awi.de)

The Expedition of the Research Vessel "Polarstern" to the Antarctic in 2013 (ANT-XXIX/7)

Edited by
Bettina Meyer and Lutz Auerswald
with contributions of the participants

Please cite or link this publication using the identifier
hdl:10013/epic.43441 or http://hdl.handle.net/10013/epic.43441

ISSN 1866-3192

ANT-XXIX/7

14 August - 16 October 2013

Punta Arenas – Cape Town

Chief scientist
Bettina Meyer

Coordinator
Rainer Knust

Contents

1. ZUSAMMENFASSUNG UND FAHRTVERLAUF

Bettina Meyer AWI

Am 14. August 2013 lief *Polarstern* von der Bunkerstation Cabo Negro, nördlich von Punta Arenas, Chile, zur Antarktisexpedition ANT-XXIX/7 aus. Ziel dieser Expedition war es, die Bedeutung der winterlichen Meereisbedeckung für die Entwicklung des Schlüsselorganismus Krill, *Euphausia superba*, im Südpolarmeer, und speziell seiner Larvenstadien, zu untersuchen.

In diesem Zusammenhang fand neben den Untersuchungen am Krill eine detaillierte physikalische und biologische Charakterisierung des Meereishabitats sowie der Wassersäule statt. Die Untersuchungen erfolgten in internationaler und interdisziplinärer Zusammenarbeit von Krillbiologen, Zoo- und Phytoplanktologen sowie Meereisphysikern, Geochemikern und Ozeanographen aus neun verschiedenen Nationen. Die Expedition stellt einen wichtigen Beitrag zum Forschungsprogramm PACES II des Alfred-Wegener-Instituts Helmholtz-Zentrum für Polar- und Meeresforschung (AWI) dar, das im Januar 2014 startete, und es ist auch ein Beitrag zum Forschungsschwerpunkt des Helmholtz Virtuell Institute PolarTime (Biological Timing in a Changing Marine Environment), mit Start im Januar 2013.

Zunächst führte die Expedition auf einem West-Ost Schnitt von Patagonien in Richtung South Georgia (Abb. 1). Am Ende des Abschnitts stand die Bergung einer Sedimentfalle an, die auf der Expedition ANT-XXVIII/3 im Jahr 2012 ausgesetzt wurde. Im geschützten Sunset Fjord/South Georgia konnte sodann die Kalibrierung des Fischereiecholots EK6 erfolgreich durchgeführt werden. Von hier aus führte die Expedition auf einem Nord-Süd Schnitt in Richtung der South Orkney Inseln. Südöstlich dieser Inselgruppe wurde im Packeis das erste Tauchcamp auf einer Meereisscholle errichtet. Nach neun Tagen setzten wir die Expedition nach Osten in Richtung südlich der South Sandwich Inseln fort. An einer geeigneten, stabilen Eisscholle wurde hier das zweite, 14 Tage währende, Tauchcamp errichtet. Anschließend führte die Expedition weiter in nördlicher Richtung entlang der South Sandwich Inseln. Nordwestlich dieser Inselgruppe wurde eine neue Verankerung, bestückt mit zwei Sedimentfallen und einem Akustiksensor, zur akustischen Aufnahme von Wal- und Robbenmigrationen ausgesetzt. Östlich der South Sandwich Inseln, im Übergangsbereich zwischen einjährigem Packeis und der Eisrandzone wurden erneut Tauchuntersuchungen, diesmal vom Schlauchboot aus, in einem veränderten Eishabitat durchgeführt. Der Fahrtverlauf führte weiter in nordöstlicher Richtung und schloss mit einem Süd-Nord Transekt auf dem Greenwich Meridian ab. Die Expedition endete mit der Ankunft in Kapstadt am 16. Oktober 2013.

Das Hauptziel der Expedition bestand darin, die Bedeutung der Meereisbedeckung für die Entwicklung des Krill im Winter besser zu verstehen. Dazu wurden zwei Tauchcamps über die Dauer von 9 und 14 Tagen auf einer Meereisscholle im einjährigen Packeis errichtet. Weiterhin fanden Tauchuntersuchungen vom Schlauchboot aus im einjährigen Packeis sowie in der Übergangszone vom Packeis zur Eisrandzone statt. Die Tauchuntersuchungen dienten zum Einen der Beprobung des Krills unter dem Meereis, zum Anderen jedoch auch der Bestimmung des Verhaltens, der Verteilungsmuster und Abundanz des Krill unter dem Eis. Die Tauchstudien wurden ergänzt durch Untersuchungen zur physikalischen und biologischen Beschaffenheit des Meereishabitats. In diesem Zusammenhang kamen neueste Techniken wie der EM-Bird und ein ROV zum Einsatz. Darüber hinaus wurde die Zusammensetzung der Zoo- und Phytoplanktongemeinschaften mit verschiedenen vertikalen und horizontalen Netzsystemen mit unterschiedlichen Netzmaschenweiten (RMT, SUIT, Multinetz, Bongo, Handnetz) und CTD, sowohl auf den Transekten als auch an den Tauchstationen erfasst (Abb.1).

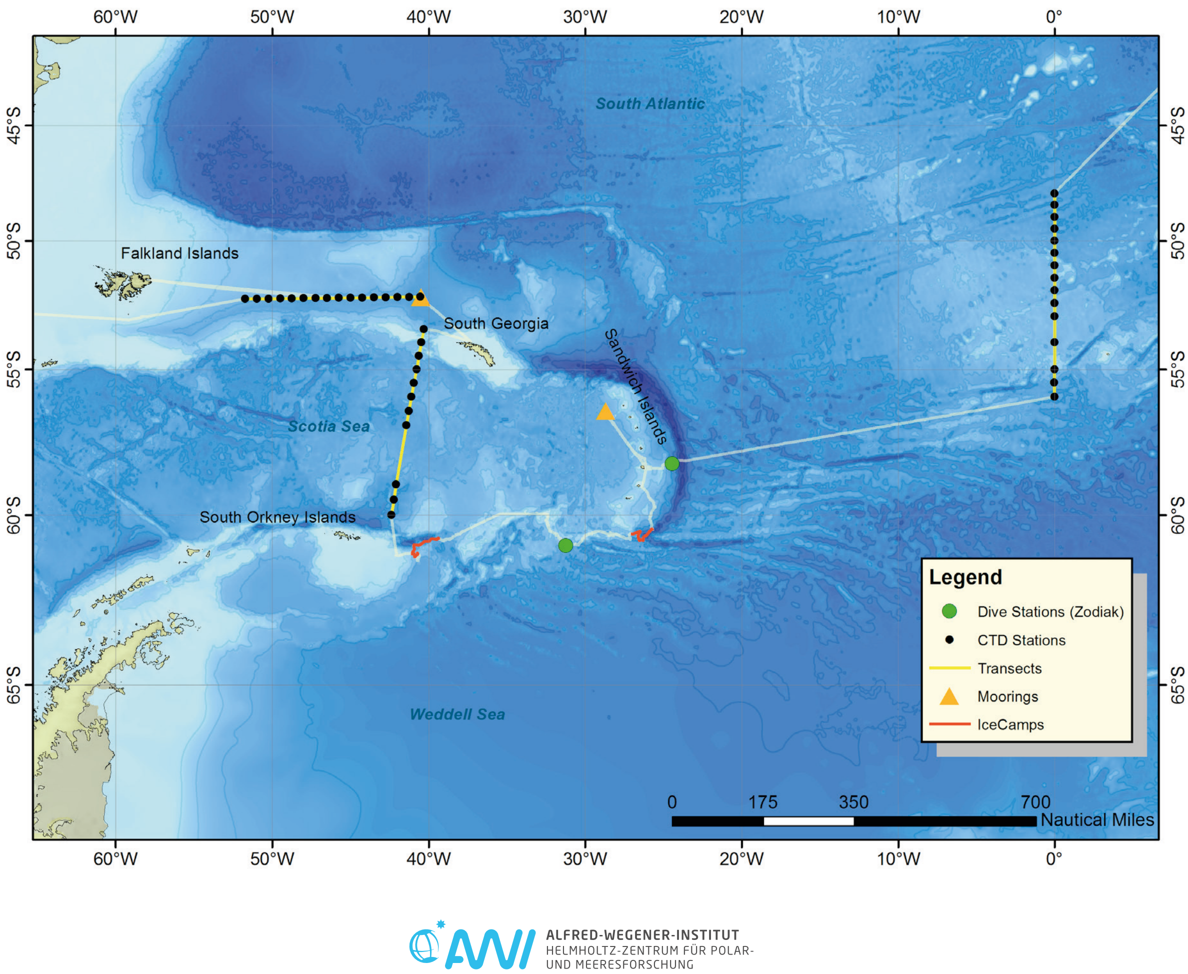


Abb. 1: Kurs der Polarsternreise ANT-XXIX/7
Fig. 1: Cruise track of Polarstern expedition ANT-XXIX/7

SUMMARY AND ITINERARY

Polarstern left the bunker station Cabo Negro, north of Punta Arena, Chile, on 14th August 2013 for Antarctic expedition ANT-XXIX/7. The aim of this cruise was to investigate the importance of winter sea ice coverage for the development of the key organism Krill, *Euphasia superba*, especially its larval stages, in the Southern Ocean.

In this regard, intensive research on the physical and biological characterisation of the sea ice habitat took place in parallel with the actual krill study. All investigations were carried out in international and inter-disciplinary collaboration of krill biologists, zoo- and phyto-planktologists as well as sea ice physicists, geo chemists and oceanographers from nine nations. The expedition significantly contributed towards the programme PACES II of the AWI, which started in January 2014, and is also a contribution to the research focus of the Virtual Institute PolarTime (Biological Timing in a Changing Marine Environment) funded by the Helmholtz Centre that started in January 2013.

The expedition first headed east on a transect from Patagonia to South Georgia (Fig. 1.1). At the end of this section, a sediment trap was recovered that had been deployed during expedition ANT-XXVIII/3 in 2012. The calibration of the fish eco-sounder EK6 was then carried out successfully in the shelter of the Sunset Fjord of South Georgia. From here, the cruise followed a North-South transect towards the South Orkney Islands. Southeast of the islands, the first dive camp was erected on an ice floe of the pack ice. Nine days later, we continued our expedition eastwards in the direction of the South Sandwich Islands. Here, we erected the second, two-week long dive camp on a suitable, stable ice floe. Subsequently, we cruised in a northerly direction along the South Sandwich Islands. Northwest of these islands, in the transition zone from one-year pack ice to the Marginal Ice Zone, another set of dive investigations from Zodiacs followed, this time in a changing ice habitat. From there, the cruise headed in north-easterly direction and was concluded with a transect on the Greenwich Meridian. The expedition ended in Cape Town, South Africa on 16th October 2013.

With the aim to better understand the importance of sea ice coverage for krill development in winter, two dive camps of nine and 14 days duration, respectively, were erected on sea ice floes in the one-year pack ice. Moreover, dive investigations from the Zodiak took place in the one-year pack ice as well as in the transition zone from pack ice to Marginal Ice Zone. On the one hand, the dive studies served the sampling of krill from under the sea ice and, on the other hand, provided information on behaviour, distribution patterns and abundance of krill under the ice. The dive operations were supplemented by research on the physical and biological composition of the sea ice habitat. For the latter, latest technology was used such as the EM-Bird and an ROV. Furthermore, during transects and dive stations, the composition of zoo- and phytoplankton communities was investigated using various vertical and horizontal net systems with different mesh sizes (RMT, SUIT, multi net, bongo, hand net) and CTD (Fig. 1.1).

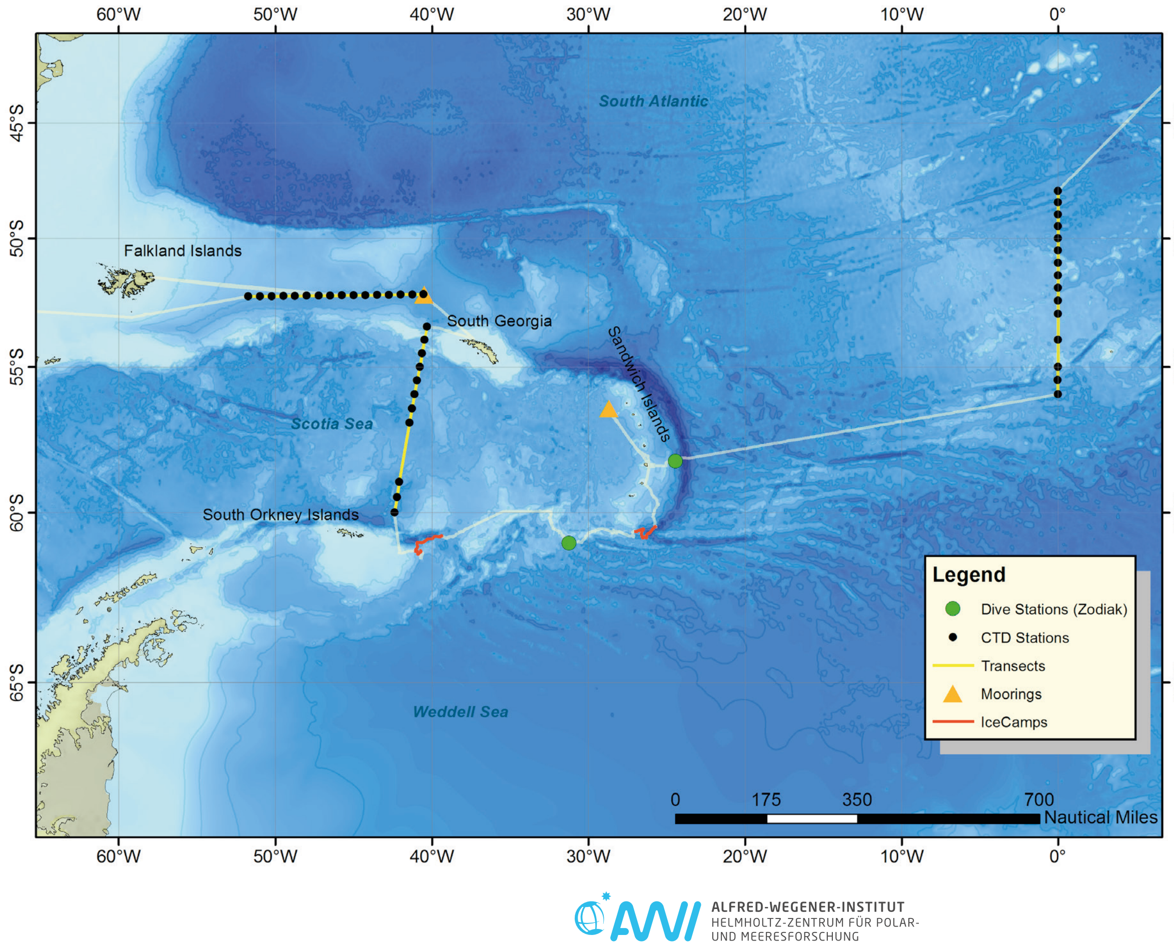


Abb. 1.1: Kurs der Polarsternreise ANT-XXIX/7

Fig. 1.1: Cruise track of Polarstern expedition ANT-XXIX/7

2. WEATHER CONDITIONS DURING ANT-XXIX/7

Max Miller, Juliane Hempelt DWD

A violent storm west of the Drake Passage caused heavy winds at Punta Arenas on Wednesday, 14th August 2013 (21:00 pm), when *Polarstern* left Punta Arenas for the campaign ANT-XXIX/7. North-westerly winds at Bft 7 and gusts of up to Bft 9, snow showers and a temperature of only 1°C were registered.

The storm moved towards the Drake Passage and weakened gradually. On our way, east-westerly to north-westerly winds persisted at Bft 6 to 8.

A ridge approached on Sunday (18th Aug.), the wind abated and veered north. Due to an emergency, *Polarstern* had to turn around and headed for the Falkland Islands. In the evening, winds from north increased again and on Monday, we observed Bft 8 which caused a swell of up to 4 m.

On Tuesday (20th Aug.), we had reached Berkeley Sound (north of Port Stanley) and experienced westerly winds of Bft 6 to 7, gusts of up to Bft 9 and some showers. In the late afternoon, we steamed back east at the north side of a storm which had crossed the Drake Passage. During the night to Wednesday (21st Aug.), winds from west to southwest increased up to Bft 9 and caused a swell of 6 to 7 m. The winds abated only slightly the next day but clearly during the night to Thursday while veering south.

Another low formed off Bahia Blanca on Thursday (22nd Aug.), intensified and moved southeast and caused stormy winds at Bft 8 from southeast on Friday, it. On Sunday morning (25th Aug.), we entered Sunset Fjord at South Georgia. Calibration works had to be finished at calm conditions. According to the synoptic situation, south-westerly winds at Bft 4 could be expected but due to jet-like effects, we observed winds of up to Bft 8 at some spots of the inner fjord.

On Tuesday (27th Aug.), a storm formed south of Falkland Islands and moved towards Weddell Sea. *Polarstern* sailed at its northeast side. Northerly winds increased continuously and reached a maximum at Bft 9 during the night to Wednesday. On Thursday, winds veered west to southwest and abated to 6 to 7 Bft. We had entered the ice by then and swell was no longer a problem.

The coldest day so far was registered on Friday (30th Aug.)with -23° C. Together with still strong south-westerly winds, a wind chill of -54° C resulted. Winds abated on Saturday and veered north and therefore temperature rose to -8° C.

From Sunday (01st Sep.) on, the first dive camp was set up on an ice floe at 61°S 41°W. During the following days, several lows moved east via Antarctic Peninsula and Weddell Sea. Most of the time, we observed westerly winds and the maximum of Bft 8 was reached on Thursday (05th Sep.). The stormy winds pushed *Polarstern* east, together with the ice floe, at a speed of almost 1 knot.

On Sunday (08th Sep.), the dive camp ended suddenly – the ice floe broke into pieces. Fortunately, a ridge was the dominant feature on this day. North-westerly winds of only Bft 4 allowed transport of equipment by helicopter. On the other hand, fog patches were present and hampered the flight operations. Until afternoon, the whole camp could finally be transported back to the vessel. Thereafter, *Polarstern* steamed east.

During the night to Tuesday (10th Sep.), a cold front crossed our area. Winds increased temporarily and veered south and caused a sudden drop of temperature (15 degrees). This was followed by a ridge on Tuesday. At sunny skies, the whole day could be used for helicopter flights.

During the following days, we searched for a suitable ice floe to build the second dive camp. Near South Georgia, a small storm formed and moved east via South Thule. From the night to Saturday (14th Sep.) on, it affected the progress of *Polarstern* with easterly winds at Bft 8. Additional snow fall prevented reconnaissance flights by helicopter. Winds abated later but persistent low stratus caused "whiteouts" and prevented flights again.

On Tuesday (17th Sep.), *Polarstern* docked at a suitable ice floe (60.6°S 21.1°W) and the dive equipment could be flown to the planned spot the following day. The weather of the next days was dominated by several lows. But often, we were located near their centres and therefore wind force didn't exceed Bft 6. Periods of only light and variable winds were observed occasionally. Moist air masses were present frequently and hampered flight operations. But on Saturday (28th Sep.), weather conditions allowed the backhaul of dive equipment by helicopter. Saturday evening, we headed for the east side of the South Sandwich Islands. We steamed between a high at the Falkland Islands and a trough along the Greenwich Meridian which caused southerly winds at Bft 5 to 7.

A storm formed near the Antarctic Peninsula on Tuesday (01st Oct.), intensified and moved east. At this time, *Polarstern* operated east of Montagu Island. According to the synoptic situation, we could expect westerly to south-westerly winds at Bft 8 to 9. But again, local features came into effect. Within short distances, wind force varied between Bft 4 and 10. After the cold front had crossed our area, the weather cleared up and the responsible topography could be seen.

The storm moved away on Friday (04th Oct.). During the following days, we observed only light and variable winds, but moist air caused mist and low stratus clouds.

On Wednesday (09th Oct.), a new low formed near Larsen Ice Shelf and moved east. Together with the subtropical anticyclone, it produced strong westerly winds at our final research area along Greenwich Meridian and we registered the maximum wind force at Bft 7 to 8 and a swell of 4 m on Saturday (12th Oct.). At this time we already steamed towards Cape Town. Approaching the subtropical, high winds abated on Sunday and on Monday, a secondary low caused a temporary increase of north-westerly winds around Bft 6.

In the late evening of Tuesday, 15th October 2013, *Polarstern* reached Cape Town at moderate winds from southwest.

For further statistics see Figs. 2.1 – Fig. 2.3.

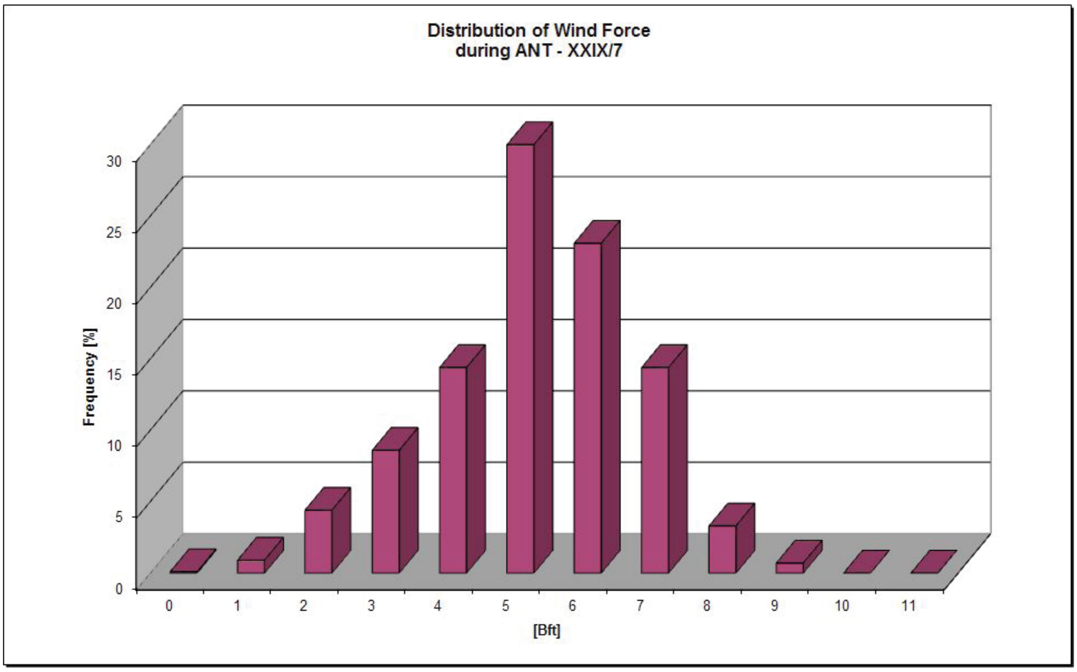


Fig. 2.1: Distribution of wind force

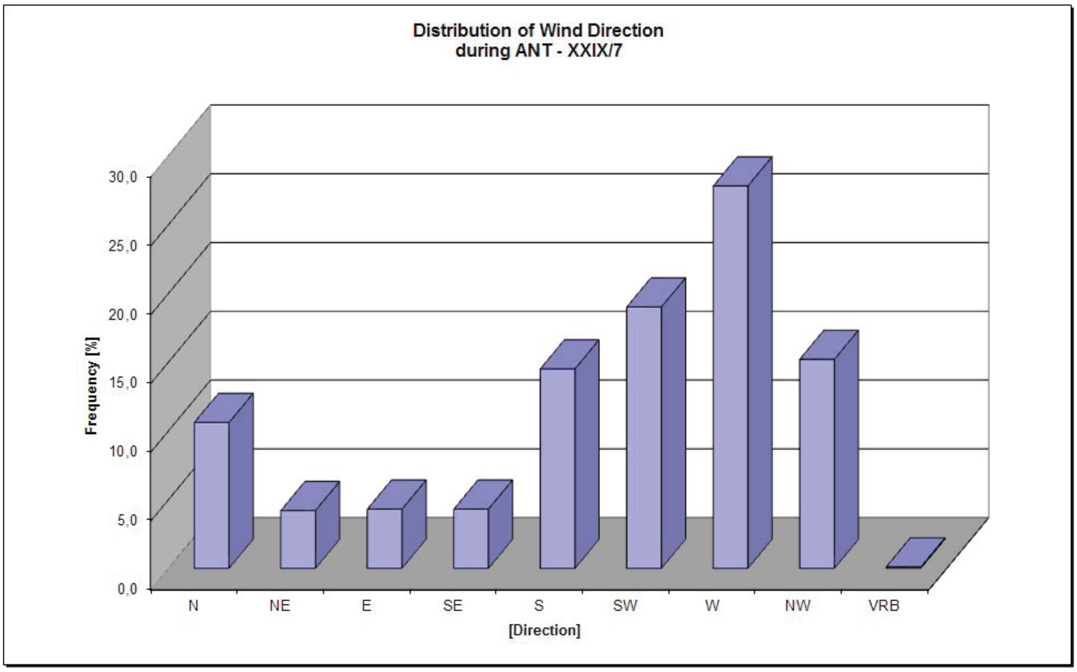


Fig. 2.2: Distribution of wind direction

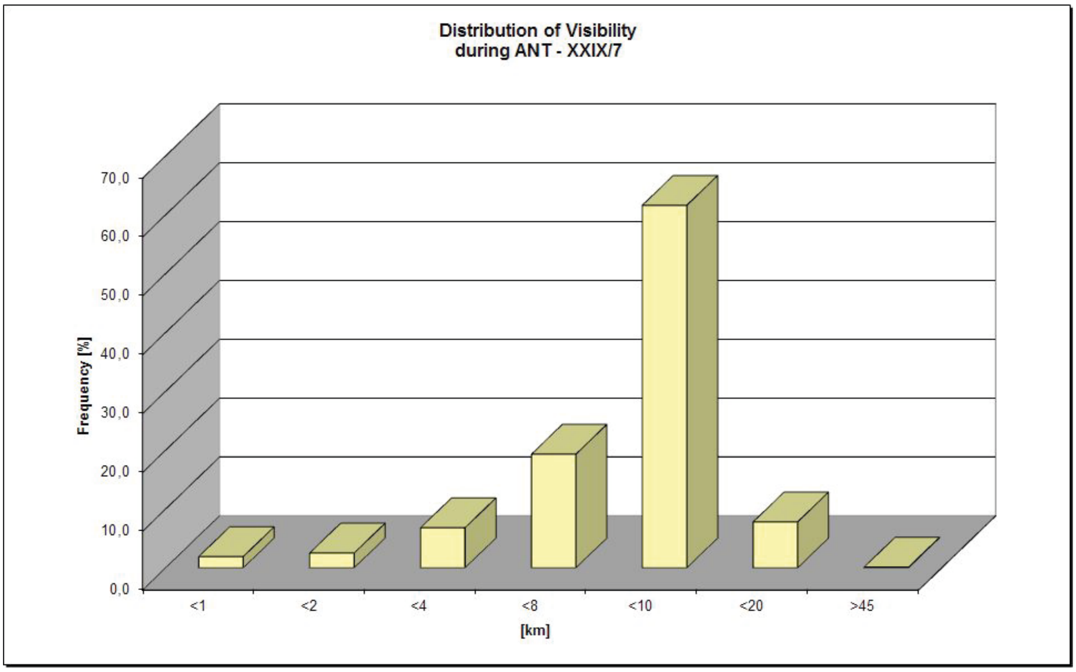


Fig. 2.3: Distribution of visibility

3. SCIENTIFIC DIVING UNDER ANTARCTIC WINTER CONDITIONS

Ulrich Freier[1], Gernot Nehrke[1], Mathias Teschke[1], Noyan Yilmaz[2], Albrecht Götz[3], Sven Kerwath[4], Borwin Schulze[1], Lutz Auerswald[4]

[1]AWI
[2]UNI-IST
[3]SAEON
[4]DAFF

Objectives

Our knowledge and understanding on how pelagic organisms survive the austral winter season is still very scarce. At this time of the year, daylight is much reduced and most of the Southern Ocean is covered by sea ice, reducing phytoplankton production in the water column to a minimum. The sea ice- and weather conditions limit accessibility of the area and also cause problems for sampling of pelagic organisms by the usual types of nets. Sampling by net in Antarctic winter is not only harsh on the gear but also puts strain on the sampled animals. In the cod end of the net, they are exposed to temperatures of far below freezing point and mechanical damage due to ice pieces, resulting in weak conditions that are not suitable for on-board physiological experiments. Diving is therefore the best way to collect pelagic organisms from under the sea ice in good condition.

Diving operations provide additional benefits: Important information can be accumulated about the exact location and distribution of the animals, their behaviour, and, of course, the under-ice habitat itself (e.g. under-ice topography, colouration of sea ice, currents etc). Such information is essential for data interpretation and for the understanding of survival strategies of pelagic organisms associated with the sea ice. Moreover, the importance of the winter sea ice coverage for the animals' development and survival can be evaluated.

The main aims of the scientific dive team on ANT-XXIX/7 were the following:

- Collection of larval krill (*Euphausia superba*) and other planktonic organisms from under the sea ice for ecophysiologial experiments.
- Estimation of distribution and abundance of larvae krill under the sea ice.
- Study of the behaviour of krill larvae under the sea ice.
- Characterisation of the under ice habitat.

Work at sea

Dive operations took place during two ice camps located on sea ice floes – the first with a duration of 10 days and the second of 14 days. Additionally, some dives took place from inflatable rubber boads (IRBs) in the open water between ice floes and in the marginal ice zone (MIZ).

Preliminary results

Ice stations

Before establishing a long-term ice station, a combination of different requirements has to be checked:

- the occurrence of krill, especially larval krill
- ice thickness and stability
- control of the presence of leopard seals

First and Second Aid

A mobile cabin sled served as a field-hospital for first aid and transportation in the case of emergency. Oxygen and first aid kits were provided in the dome tent as well as on the sled. The hospital at *Polarstern* was on „stand-by" during dive operations.

Leopard seals

According to AWI safety regulations, special attention was given to the potential appearance of leopard seals. From the bridge of *Polarstern*, the area around the ship and the ice camp was continuously observed using binoculars. Depending on the weather conditions, helicopter flights were carried out in a radius of 5 km from the ship. At the dive hole, a continuous underwater observation (laptop-based 24 hour survey) was carried out with a special infrared DigiCam.

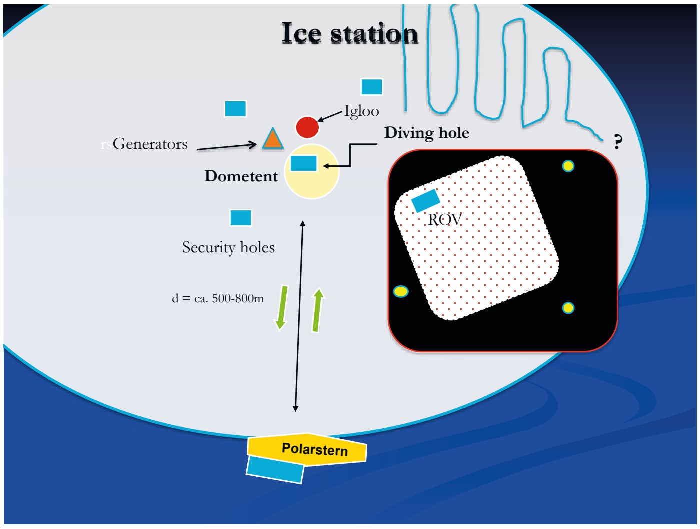


Fig. 3.1: Overview of an ice camp

Diving at the ice station

In response to the observed changing current conditions, the dive area was secured under the ice by safety lines that spanned from the dive hole to the security holes (blue rectangles, Fig. 3.1). A 15 m vertical line with a weight of 10 kg was used to help the divers with orientation and adjustment of their buoyancy.

Diving from the IRBs

Larger leads, polynias and open water areas in the MIZ were used for diving operations from the IR. The IRBs were motorised with 35 hp Diesel outboard motors. Technical assistance and transportation capacity was provided by a second IRB. At the edge of the ice floe, the boats were secured to the ice by ice screws.

Sampling of larval krill and other organisms

Animals were caught with the plankton pump MASMA (MAnguera SubMArina). The system consisted of a motor-driven centrifugal pump (0.40 m^3 min^{-1}) connected to a plankton filtration system. Filtration was carried out through a zooplankton net (200 - 1,000 µm mesh size) with a 2 litre cod end located inside an air-tight container and placed upstream of the pump. High volumes of water were transported to the container through a tube (2 inch diameter, up to 50 m length). In this way, the animals were concentrated in the cod end before the water reached the pump. The animals sampled were in very good condition, and thus suitable for physiological experiments. Underwater handling was comfortable for the diver due to the near-weightless plastic tube. This tube could be used by the diver as a modified vacuum cleaner to catch large amounts of larvae but also allowed for catching distinct individuals if required. The MASMA was the standard sampling gear during ice camps of this cruise.

Observations of abundance, distribution and behaviour of krill larvae and their under-ice habitat

Pictures of the under-ice habitat were taken by an Olympus C 8080 WZ with an Ikelite underwater housing and an Ikelite flash. Videos and stills were recorded with a Sony Digital Handycam with Ikelite housing, whereas abundance and distribution of krill larvae were determined with distinct random photo-quadrats and repeated video transects. The safety lines under the ice (see above) were subdivided into 5 m sections by marker tape and used as observation transects by the divers.

Characterisation of the under ice habitat

In addition to the video observations, ice pieces from the deeper dents and hollows, where the larvae occurred (1.50 - 2.50 m under the ice surface), were collected and processed for microscopic observation of the autotrophic and heterotrophic community as well as for the concentration of chlorophyll a (Chl *a*).

Conclusions

Diving was carried out under extreme winter conditions. The equipment was sufficient and suitable for the described conditions. The dome tent provided good protection against wind and freezing temperatures and was essential for our dive operations in Antarctic winter conditions. The two IRBs of *Polarstern* served as good diving platforms, but dive operations from the IRBs were limited by the exposure of the divers and the equipment to cold temperatures and wind. A boat of similar size with an aluminium keel and an integrated Diesel engine as well as a heated cabin could significantly enhance the diving conditions and extend the range of diving operations. This second winter dive operation of the AWI has clearly shown again that diving and under-ice work is possible even under extreme Antarctic winter conditions. No accidents and no dangerous situations occurred at any time. A summary of dives during the voyage is given in Table 3.1.

Tab. 3.1: Summary of dives during the expedition ANT-XXIX/7

Dives ANT-XXIX/7	No	Min
South Georgia	2	
Divecamp 1	20	
MIZ 1	1	
Divecamp 2	42	
MIZ 2	5	
Total	**70**	**1530**

Data management

Processed data will be uploaded to the PANGAEA Data Publisher for Earth & Environmental Science.

4. ANTARCTIC KRILL ECOPHYSIOLOGY AND BIOLOGY

4.1. Physiological condition of krill, with emphasis on the larval stages, in relation to biological and physical open water and sea ice condition

Bettina Meyer[1], Hannelore Cantzler[2], Laura Halbach[3], Malte Krieger[2], Mathias Teschke[1], Tobias Mattfeldt[1], Scientific dive team (see chapter 3.)

[1]AWI
[2]UOL
[3]UMR

Objectives

A vital step in successful krill recruitment is larval krill survival through the first winter. The various ontogenetic stages of krill (larvae, juveniles, sub-adults and adults) have different dependencies on ice biota, with larvae coupled to the underside of sea ice and adults mainly away from it (e.g. Quetin *et al.* 1996, Meyer *et al.* 2009, 2010; Meyer 2012). Unlike adults, larvae have to find food continuously to meet their energetic needs.

However, our understanding of larval krill in winter stems from a small number of studies, mainly performed in the West Antarctic Peninsula region and the Lazarev Sea, which make it difficult to generalise the observations that winter sea ice might be essential for a successful development of larval krill and consequently the recruitment success of krill.

It is not clear yet which sea ice conditions are essential for a successful development of larvae during winter (e.g. abundance of heterotroph or autotroph microbial community, rafted sea ice refuges). To overcome these uncertainties we investigated the condition of larval krill in open water and under sea ice in terms of their metabolic and feeding activity, growth rate, elemental and biochemical composition in relation to biological and physical environmental properties.

Work at sea

Sampling of larval krill to determine their condition

Larval krill were sampled with an Rectangular Midwater trawl 8+1 in open water regions with an closed 10L cod end and by scientific divers under the sea ice (see chapter 3.). One sub-sample of freshly caught larvae was staged and measured under the stereomicroscope before being frozen at -80°C for analysis of dry weight (DW), elemental- (carbon, nitrogen) and biochemical composition (total body lipid and protein) as well as stomach and gut contents. Another sub sample was used to measure growth rates (see chapter 4.3).

Ice core sampling from sea ice to identify potential food sources during ice camp work

Ice cores were taken along transects to describe the constitution and thickness of the sea ice and the incorporated biomass for correlation with data from the under-ice research such as krill distribution and abundance as well as stomach analyses.

During both ice camps, along the three 30 m diving transects two ice cores were taken every two meters and melted onboard *Polarstern*. Sub-samples were taken to determine Chl *a*, particulate carbon -, nitrogen concentration, phytoplankton, proto- and mikrozooplankton abundance, fatty acid composition as well as the concentration of macro nutrients such as nitrogen, phosphor and silicate.

Preliminary (expected) results

The samples will be analysed within the frame of two Bachelor- and one Master thesis in the first half of 2014 and within one PhD thesis, which will start in Spring 2014.

Data management

Processed data will be uploaded to the database PANGAEA Data Publisher for Earth & Environmental Science. It is envisaged that all samples will be analysed within three years after the voyage.

References

Meyer B (2012) Te overwintering of Antractic krill, *Euphausia superba*, from an ecophysiological perspective, – a review –, Polar Biol (2012) 35:15–37.

Meyer B, Fuentes V, Guerra C, Schmidt K, Atkinson A, Spahic S, Cisewski B, Freier U, Olariaga A, Bathmann U (2009) Physiology, growth and development of larval krill *Euphausia superba* in autumn and winter in the Lazarev Sea, Antarctica. Limnol Oceanogr 54:1595–1614.

Meyer B, Auerswald L, Siegel V, SpahiT S, Pape C, Fach B, Teschke M, Lopata A, Fuentes V (2010) Seasonal variation in body composition, metabolic activity, feeding, and growth of adult krill *Euphausia superba* in the Lazarev Sea. Mar Ecol Prog Ser 398:1–18.

Quetin LB, Ross RM, Frazer TK, Habermann KL (1996) Factors affecting distribution and abundance of zooplankton, with an emphasis on Antarctic krill, *Euphausia superba*. Ant Res Ser 70:357–371.

4.2. Mechanisms of temporal synchronization in Antarctic krill: Endogenous clocks and biological rhythms at the daily and annual scale

Mathias Teschke, Bettina Meyer, Tobias Mattfeldt AWI

Objectives

Investigations on adults, field based and in the laboratory, indicate that synchronization between Antarctic krill (*Euphausia superba*) and its environment depend upon an endogenous timing system (i.e. circadian clock, Teschke *et al.* 2011), which facilitates synchronization of its physiology and behaviour to daily environmental cycles but may also play a role for the control of seasonal events during its annual life cycle. The seasonal course of photoperiod in the environment seems to act as an essential *Zeitgeber* that links the endogenous clock with the outside world (Teschke *et al.* 2007).

In contrast to adult krill, physiological functions in larvae seem to be directly linked to the available food supply rather than representing endogenous rhythms (Meyer *et al.* 2011). It is not clear yet whether larval krill possess a functional endogenous clock and at which developmental stage (e.g. 1 year old krill) the endogenous clock in krill will be initiated.

We now need an improved understanding of biological timing in Antarctic krill, its underlying mechanisms, and its functional interaction with the external environment. In this sense, two main topics have been the focus of this expedition:

- Firstly, we wanted to study the gene expression profiling in adult krill around the clock at the vernal equinox.
- Secondly, we wanted to test whether larval krill possess a functional circadian clock at all.

Work at sea

To address the first goal, samples of freshly caught adult krill were taken at regular intervals (4 h) over a 24 h sampling campaign (see Tab. 4.2.1). The sampling of adult krill was based on a rectangular midwater trawl type RMT 8+1 harnessed with 4.5 and 0.3 mm mesh nets to sample adult krill in open water areas.

Tab. 4.2.1: 24 h sampling campaign with the RMT 1+8 in the upper 200 m of the water column

Date	Shiptime	Station	Net	Latitude	Longitude
9/30/2013	07:00 am	*PS 81/571-1*	RMT 200	58.26.00 S	26.05.40 W
9/30/2013	11:00 am	*PS 81/571-3*	RMT 200	58.23.92 S	26.09.63 W
9/30/2013	15:00 pm	*PS 81/572-1*	RMT 200	58.08.77 S	26.12.47 W
9/30/2013	19:00 pm	*PS 81/573-1*	RMT 200	57.56.67 S	26.57.42 W
9/30/2013	23:00 pm	*PS 81/574-1*	RMT 200	57.40.02 S	27.15.38 W
10/1/2013	03:00 am	*PS 81/575-1*	RMT 200	57.80.40 S	27.45.84 W

Freshly caught animals were flash frozen in liquid nitrogen for later molecular analyses at the AWI.

In addition, freshly caught healthy adults were collected from the RMT nets and were maintained in a cooling container under different light-dark cycles to study the phase response characteristics of the circadian clock (e.g. changes in period length or amplitude of oscillating clock genes). Therefore, 250 animals were maintained in three 60 litre containers with filtered chilled sea water (1.2 °C). An artificial light regime was installed mimicking the *in-situ* photoperiod (LD 12:12) at that time. After three days of adaptation samples were taken at regular intervals (every 3 h) over a 24 h cycle. After that the photoperiod was shifted to a "long day" simulating

16 h of light and 8 hours of darkness (LD 16:8). After two days of adaptation a second 24 h time series was sampled with the same set of intervals. All samples were flash frozen for molecular analyses at the AWI.

In parallel, we determined oscillatory rhythms at the organismic physiological level in krill by measuring temporal profiles of oxygen consumption. Respiration rates were measured by monitoring the decrease in oxygen concentration in Schott flasks (2 l volume) with two 4-channel OXY devices in conjunction with 2 mm polymer optical fiber (Presens, Germany). The principle of the sensor's operation is based on the quenching of luminescence caused by collision between molecular oxygen and luminescent dye molecules in the excited state. In the presence of oxygen the signal decreases and can be related to the oxygen content. This non-invasive method allows continuous monitoring of oxygen concentration over long periods of time without disturbing the organism.

To achieve the second goal, freshly caught krill larvae (Furcilia IV-VI) were continuously sampled over a period of ten days by an Aqualife Products BP40 fish pump (for details see 4.3). This pump was installed on *Polarstern* in order to pump water through the moon pool from directly under the ship's keel, 15 m under the surface. In this way, seawater was continuously running over a fine-meshed sieve, filtering out the krill larvae with a rate of 900 m^3 per hour (for details see 4.3). To study in detail the molecular mechanisms of diurnal activity patterns and physiology in larval krill, freshly caught larvae were taken at regular intervals (every hour) over a 24 h sampling campaign from the fish pump and flash frozen for molecular analyses at the AWI.

To test for the existence of a functional circadian clock in larval krill, freshly caught larvae were collected from the fish pump and were maintained in a cooling container under different light-dark cycles. A total of 250 animals were maintained in three 60 litre containers with filtered chilled sea water (1.2 °C). An artificial light regime was installed mimicking the *in-situ* photoperiod (LD 12:12) at that time. After three days of adaptation, samples were taken at regular intervals (every 3 h) over a 24 h cycle. After that the photoperiod was shifted to continuous darkness (DD) and a second 24 h time series was sampled with the same set of intervals. All samples were shock frozen for molecular analyses at the AWI. In parallel, we determined oscillatory rhythms at the organismic physiological level in krill larvae by measuring temporal profiles of oxygen consumption (see above).

Preliminary (expected) results

Gene expression profiling in adult krill around the clock

Samples of adult krill captured around the clock during the vernal equinox will be used to identify *in-situ* diurnal expression levels of clock and clock controlled physiological target genes by quantitative Polymerase Chain Reaction (qPCR) according to Teschke *et al.* (2011). Comparing expression levels of these genes between krill sampled under different simulated photoperiods (LD 12:12 vs. LD 16:8) will help us to understand the phase response characteristics of the circadian clock in adult krill. Respiration measurements, known to be a proxy for metabolic activity, will help us to test the effect of photoperiod on metabolic functions in krill. Considering both, patterns of differential expression of target genes and of overall metabolic activity, will potentially demonstrate a link between the effect of photoperiod on clock gene expression and downstream transcriptional effects, and hence an

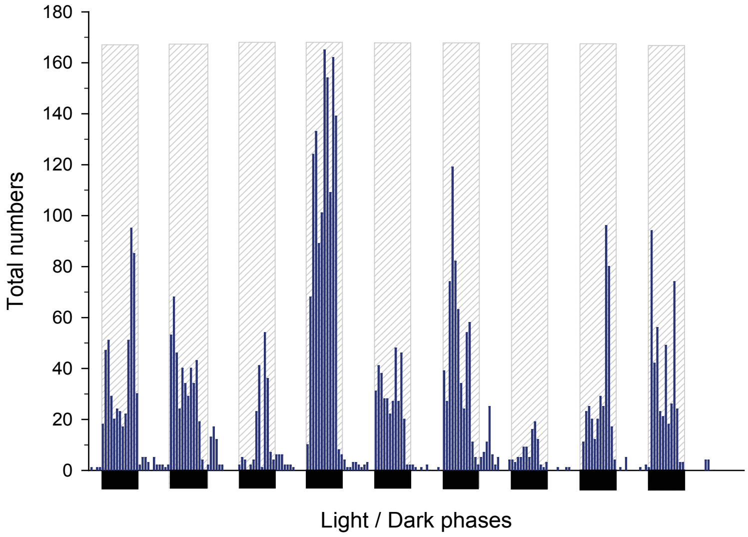


Fig. 4.2.1: A diurnal pattern of krill larvae caught by the fish pump. Blue bars indicate the number of krill caught every hour. White color is indicating daylight hours. Black color and shaded bars indicate nighttime.

involvement of the circadian system in photoperiodic time measurement.

In general, comparisons of molecular data from this cruise with those of different geographical locations and under different photoperiodic scenarios will foster our insights into the mechanisms of temporal synchronisation of this key species. This is crucial to predict the response of krill to the on-going environmental changes and, due to its central position, to predict alterations in biodiversity, composition and productivity in the Southern Ocean ecosystem.

Do larval krill possess a functional circadian clock?

The continuous, multi/day sample collection revealed a reoccurring diurnal pattern in krill distribution (see Fig. 4.2.1). Immediately after dusk, the numbers of larvae caught under the ship increased dramatically and remained at high levels for the entire night before dropping close to zero at dawn. Together with the observations from our diving operations (see chapter 3), this pattern is likely to be the result of a small scale daily vertical migration of krill larvae between the under Ice surface, where the larvae resided during the day, and deeper layers of the open water column (< 20 m), where the larvae were migrating to during the early night. The strong correlation with the day/night cycle indicates that the photoperiodic signal (i.e. duration of daylight or night length) is a very important environmental Zeitgeber for this behavioural pattern. Although it cannot be excluded that this is driven by the direct effect of light, it is very likely that this behavioural cycle is controlled by an endogenous circadian clock, as it was already shown for adult krill (Teschke *et al.* 2011).

Samples of larval krill collected around the clock during entrainment experiments will help us to finally prove the existence of a circadian clock and of clock-controlled physiological processes. Therefore, expression levels of clock and clock controlled physiological target genes during a 24 h cycle will be compared by quantitative Polymerase Chain Reaction (qPCR) between the simulated natural photoperiod (LD 12:12) and free running conditions (DD). Primers will be used according to known gene sequences for adult krill. Respiration measurements, known to be a proxy for metabolic activity, will help us to test whether metabolic functions in krill are under circadian regulation.

Data management

Most data will be obtained through laboratory analyses after the cruise. Processed data will be uploaded to the database PANGAEA Data Publisher for Earth & Environmental Science.

References

Meyer B (2012) The overwintering of Antarctic krill, *Euphausia superba*, from an ecophysiological perspective, – a review, Polar Biology 35:15-37

Teschke M, Wendt S, Kawaguchi S, Kramer A, Meyer B (2011) A circadian clock in Antarctic krill: An endogenous timing system governs metabolic output rhythms in the Euphausid species *Euphausia superba*. PlosOne (DOI:10.1371/journal.pone.0026090)

Teschke M, Kawagushi S, Meyer B (2007) Simulated light regimes affect feeding and metabolism of Antarctic krill, *Euphausia superba*. Limnol Oceanogr 52(3): 1046-1054

4.3 Adult krill growth and benthic feeding

Rob King[1], Simon Jarman[1], Roland Proud[1],[2], So Kawaguchi[1] (not on board), Hannelore Cantzler,[4] Laura Halbach[5], Malte Krieger[4], Tobias Mattfeldt[3], Bettina Meyer[3]

[1]AAD
[2]UTAS
[3]AWI
[4]UOL
[5]UMR

Objectives

Antarctic krill’s life history and annual physiological cycles are evolutionally finely tuned to synchronize the dramatic Antarctic environment. These environments are also known to be spatially and temporary dynamic and these patterns further vary along with climate change.

At the same time krill, especially in their post-larval stages, are known for their plasticity of their growth and life style, which is suggested to be the important strategy for the population survival.

Krill growth is one of the most important parameters required for ecosystem management under the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) regime, and emerging priority agenda for the future CCAMLR management is the potential effects of climate change. Data on distribution and condition of krill during the winter period is still scarce.

By improving our understanding on how environmental conditions, such as quantity and quality of the food as well as photoperiod and temperature, affect krill growth and their condition, we will be able to better model krill growth according to their habitat condition. We especially lack data on the details of feeding and growth from winter/early spring as well as krill from sea floor. The latter was recently suggested to be one of the common habitats for krill.

Our main aims during the voyage were:

- To describe krill demography and large-scale distribution patterns of size groups and maturity stages.
- To collect information on krill growth and condition and relate that to habitat environment, especially quality and quantity of food from open sea, MIZ, ice area, and sea floor.
- To describe the diet of krill from analysis of DNA in stomach contents. Dietary information generated from samples collected during ANT-XXIX/7 will be compared to samples collected in other locations and at different times of year.
- To compare gene allele frequencies of krill from the Weddell Sea with allele frequencies of krill collected in a variety of other locations.

Work at sea

Instantaneous Growth Rate (IGR) experiments

IGR-experiments were conducted on 15 occasions during the voyage (see Tab. 4.3.1). Experiments 1-6 and 14 were conducted in the IGR supplied with a continuous flow of uncontaminated sea water from the ocean. All other experiments were conducted in closed volume jars as they were for larval krill, which could otherwise have escaped from the larger apparatus. The water in the closed volume jars was replaced on day 4 and day 6 for experiments running past day 3. Animals were checked for moults up to twice each day and animals were measured on ship using a Leica MZ 7.5 stereomicroscope running LAS image analysis software. All moulted animals were then snap frozen in liquid nitrogen before being transferred to -80°C freezer for later biochemical analysis at AWI.

It is recommended that a Leica MZ 9.5 stereomicroscope be used for such work in the future as the magnification of the 7.5 was at its limit for determining the uropod lengths of F4 and F5 krill larvae. A specifically designed apparatus to maintain water flow through larval IGR's would be a significant improvement on future winter voyages. Whilst the fish hold adult IGR apparatus worked very well, it was of limited use as most catches from under the ice were larvae and adults were rarely encountered.

Tab. 4.3.1: Summary of all IGR-experiments performed on ANT-XXIX/7

IGR Exp	Caught (UTC)	Latitude	Longitude	Source
1	27/08/2013	54°30.000'S	40°37.620'W	Fish pump (open ocean)
2	04/09/2013	60°57.002'S	40°43.780'W	Bongo Nets
3	05/09/2013	60°51.632'S	40°20.934'W	Bongo Nets
4	06/09/2013	60°45.850'S	39°37.170'W	Dive hole Ice station 1
5	07/09/2013	60°46.460' S	39°29.460'W	Dive hole ice station 1
6	11/09/2013	59°56.827'S	33°08.927'W	Suit Net
7	17/09/2013	60°38.966'S	27°09.592'W	Bongo Nets

IGR Exp	Caught (UTC)	Latitude	Longitude	Source
8	18/09/2013	60°35.991'S	26°56.737'W	Fish pump Ice station 2
9	20/09/2013	60°34.965'S	26°35.297'W	Dive hole Ice station 2
10	21/09/2013	60°43.403'S	26°35.318'W	Dive hole Ice station 2
11	21/09/2013	60°43.870'S	26°35.297'W	MASMA Dive Hole Ice Station 2
12	25/09/2013	60°40.339'S	26°13.925 ,W	Dive hole Ice station 2
13	28/09/2013	60°26.861'S	25°44.658'W	Fish pump Ice station 2
14	04/10/2013	58°29.000'S	25°49.020'W	RMT Target MIZ
15	04/10/2013	58°18.700'S	24°21.740'W	RMT Target MIZ

Note: Position data for some experiments was estimated based on approx. time of capture

Krill Pump

Krill were pumped from the well shaft utilising an Aqualife Products BP40 fish pump. The variable speed drive on this unit failed and was bypassed and the unit was run from 3 phase directly and achieved a flow rate of approximately 900 litres per minute. Water was filtered through a 100 micron stainless steel mesh screen which was cleaned daily with hot water to remove algae. The krill pump was only able to pump sea water from below the ship's hull when the vessel was clear of sea ice or stationary. This was because a large barrier is inserted into the well shaft during ice breaking to prevent the ingress of ice and this effectively blocked the aperture to the ocean below the vessel. However krill juveniles and larvae were successfully pumped prior to entering the ice and at ice station two. This was not possible at ice station one as the means of correctly inserting the suction tube had not yet been successfully accomplished. However at ice station two, over four and a half thousand *Euphausia superba* larvae were caught by the pump in good physiological condition. They were utilised for gut fluorescence, light entrainment, IGR and frozen in time series for later biochemical analysis. The pump ran continuously at ice station two for ten days with only brief breaks for maintenance and cleaning.

The efficiency of the pump was limited by the fact that there was no practical alternate discharge point for filtered water. As such filtered water was returned to the well shaft and it is estimated that 25 % of the water sucked in by the pump was previous filtrate. The efficiency of this system could therefore be improved in the future by providing an alternate discharge point that is capable of receiving a 4 inch tube. Ideally this point should be at the same height as *Polarstern's* E deck such that no head losses are incurred in attempting to pump discharge water higher prior to discharge.

Deep water CTD

CTD casts were made to the sea floor on eighteen occasions (see Tab. 4.3.2). On three occasions the camera failed to operate correctly. On one occasion the light trap failed to operate correctly.

Tab. 4.3.2: Summary of deep CTDs to observe and catch adult krill at or near the sea floor

Deep CTD #	Latitude	Longitude	Depth (m)	Date (UTC)	Comments	Trap Open (UTC)	Trap Shut (UTC)
1	52° 14.910‘ S	40° 32.750‘ W	3,700	23/8/13	no video	05:02	05:17
2	53° 32.660‘ S	39° 34.840‘ W	3,100	26/8/13	no video	06:29	06:44
3	61° 13.420‘ S	40° 43.570‘ W	2,534	31/8/13		03:45	04:00
4	61° 11.070‘ S	41° 03.850‘ W	1,994	01/09/13		16:20	16:35
5	60° 56.943‘ S	40° 48.116‘ W	3,516	03/09/13		23:30	23:45
6	60° 45.878‘ S	39° 37.451‘ W	3,810	06/09/13	no trap	20:32	20:40
7	60° 45.041‘ S	39° 27.677‘ W	2,846	07/09/13		21:50	22:05
8	60° 44.744‘ S	39° 19.077‘ W	3,002	08/09/13		17:55	18:10
9	59° 57.429‘ S	33° 51.115‘ W	1,600	10/09/13		16:08	16:18
10	59° 56.746‘ S	33° 09.215‘ W	3,547	11/09/13		02:12	02:27
11	60° 37.676‘ S	31° 49.250‘ W	1,884	12/09/13		01:39	01:54
12	60° 58.171‘ S	31° 14.729‘ W	2,288	12/09/13		15:31	16:15
13	60° 42.771‘ S	27° 09.663‘ W	3,552	16/09/13	no video	14:58	15:13
14	60° 25.728‘ S	25° 42.385‘ W	5,850	28/09/13		16:13	16:30
15	59° 05.585‘ S	26° 20.713‘ W	990	29/09/13		21:06	21:21
16	56° 31.276‘ S	28° 37.470‘ W	3,108	01/10/13		17:31	17:46
17	58° 29.569‘ S	26° 03.755‘ W	1,075	03/10/13		20:50	21:05
18	58° 17.064‘ S	24° 25.776‘ W	3,786	05/10/13		11:38	11:53

DNA Sampling

Samples of krill were collected for future molecular analysis of krill diet, age and gene expression. Late-stage larval krill were collected from under an ice floe and from the water column along with the microbial biofilm forming on the ice surface. These samples will be valuable for investigating differences in krill feeding. Samples of krill collected at several different fucilial stages and as sub-adults will be used in experiments for developing a molecular age assay for krill. Samples of krill collected with the modified fish pump were collected hourly over several days and provide a valuable resource for studies of circadian regulation of expression of any genes.

Ship-based Active Acoustics

Data was collected between 15th August and 12th October 2013. However, due to technical issues, no data was recorded by the 120 kHz echosounder on 17th August from 01:00 to 14:03 and also by any sounders from 23:30 on 19th September to 20:30 on 20th. Large sources of noise were experienced from ship thrusters and winch operations, especially during stations, which resulted in major disruptions to the data. Furthermore, interference from the on board deep-water sonar and Doppler log caused intermittent data quality loss.

On 20th August, offshore of the Falkland Islands, the first calibration attempt was made. Due to severe weather conditions, the operation was unsuccessful. A second attempt was therefore carried out on the 25th August at the more suitable Sunset Fjord, South Georgia. The operation was successful and carried out over an 8-hour period using the on-board ISI-TECH automated system. All of the five frequencies, namely the 18, 38, 70, 120 and 200 kHz echosounders, were calibrated by employing the standard target method using a tungsten carbide sphere. The measurements were recorded separately and are available for post-processing.

Three separate krill targets were identified using known frequency relationships of target strength and trawled with the RMT in the South Sandwich Island region. Comparisons of biological samples with acoustic data will enable target density estimations to be inferred and in effect ground-truth further quantification of acoustically recorded targets. This in turn will allow the spatial resolution or ‚patchiness' of krill to be determined and regional inferences to be made.

Preliminary (expected) results

Deep CTDs to observe and catch adult krill at or near the sea floor

In one of the 18 CTDs only ones was a single Antarctic krill *Euphausia superba* videoed swimming horizontally towards the camera at the sea floor on deep CTD cast 10 at 3,547 metres depth. No krill were caught in the traps other than a *Thysanoessa macrura* larvae on Deep CTD 2 which was thought to have most likely entered the trap through the air escape holes during the CTD's return to the surface and was therefore discounted. The data suggests sea floor feeding by Antarctic krill is not occurring at the times and locations of sampling.

Ship-based Active Acoustics with the EK 60 Fish-Echo-Sounder

At the first ice camp, diel vertical migration (DVM) was observed from the data recorded by the high frequency echosounders, the intensity of which reduced linearly during our stay - shown below in Fig. 4.3.1.a.

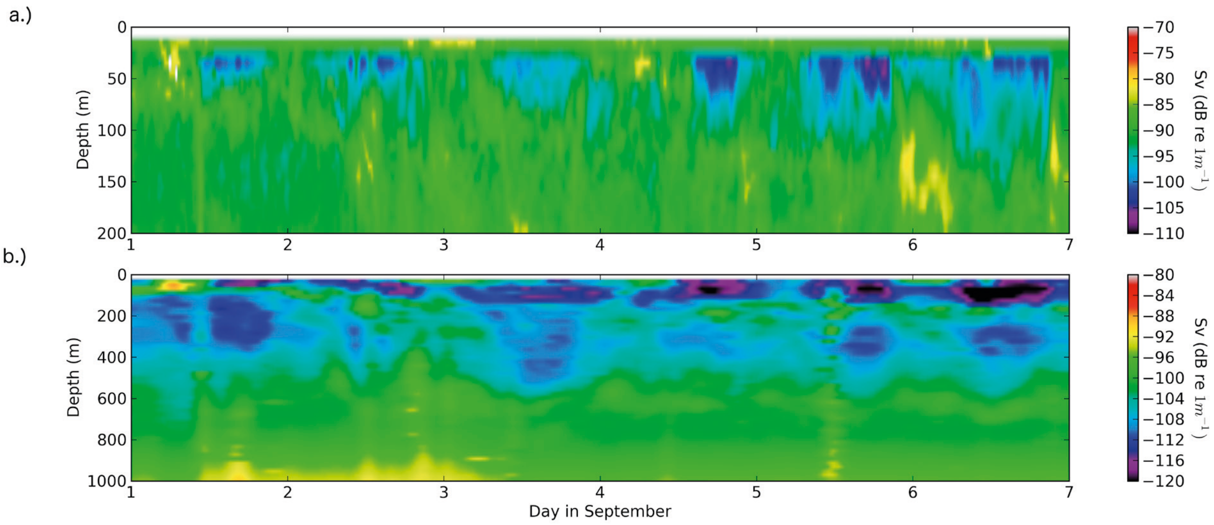


Fig. 4.3.1: Water column observed acoustically during the first ice camp: a) Echogram produced from data output from the 120 kHz echosounder down to a depth of 200 m; b) Echogram produced from data output from the 38 kHz echosounder down to a depth of 1,000 m.

Interestingly, this DVM signal seemed only to be sourced from the epi-pelagic region (0 - 200 m) as no deep scattering layers (DSL) were observed - see Fig. 4.3.1.b. Conversely at the second ice camp towards the end of the 23rd September, an intense DSL appeared centred at around 500 m as shown in Fig. 4.3.2.b.

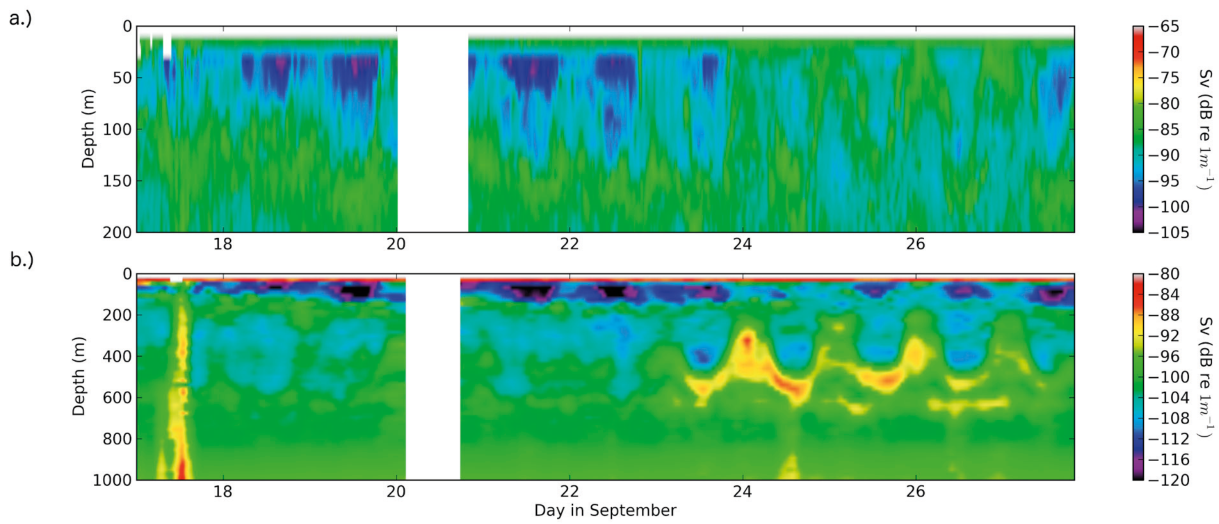


Fig. 4.3.2: Water column observed acoustically during the second ice camp: a) Echogram produced from data output from the 120 kHz echosounder down to a depth of 200 m; b) Echogram produced from data output from the 38 kHz echosounder down to a depth of 1,000 m.

This layer is expected to be formed of deep living organisms such as myctophids, squid and jellyfish. Coincidently this event coincided with both a minimum in krill abundance caught by the fish pump and also surface current velocity recorded by the ship based Acoustic Doppler Current Profiler (ADCP). Further analysis of this data coupled with the 24-hour multi-net station data will reveal whether this occurrence was simply down to a shift in water mass, or a result of large-scale patchiness.

Targets that were fished will be analysed by their acoustic frequency components and then compared to the length-frequency data recorded from the RMT samples. This will enable a more accurate quantification of krill abundance and density to be estimated for both targeted and non-targeted aggregates. Also, a comparison will then be made between the different forms of the aggregates displayed by the species of krill in order to gain a better insight into their behaviour.

Data management

Processed data will be registered and will be available through the Australian Antarctic Division.

5. PELAGIC FOOD WEBS

5.1. Sea ice associated macro-fauna and mega-fauna (*Iceflux*)

Jan Andries van Franeker[1], Hauke Flores[2] (not on board), Carmen David[2], Fokje Schaafsma[1], Michiel van Dorssen[1]

[1]IMARES
[2]AWI

Objectives

Pelagic food webs in the Antarctic sea ice zone can depend significantly on carbon produced by ice-associated microalgae. Future changes in Antarctic sea ice habitats will affect sea ice primary production and habitat structure, with unknown consequences for Antarctic ecosystems. Antarctic krill *Euphausia superba* and other species feeding in the ice-water interface layer may play a key role in transferring carbon from sea ice into the pelagic food web, up to the trophic level of birds and mammals (Flores *et al.* 2011, 2012). To better understand potential impacts of changing sea ice habitats for Antarctic ecosystems, the HGF Young Investigators Group *Iceflux* in co-operation with IMARES, Texel *(Iceflux NL)* aims to quantify the trophic carbon flux from sea ice into the under-ice community. This will be achieved by 1) quantitative sampling of the under-ice community and environmental parameters; 2) using molecular and isotopic biomarkers to trace sea ice-derived carbon in pelagic food webs; and 3) applying sea ice-ocean models to project the flux of sea ice-derived carbon into the under-ice community in space and time. ANT-XXIX/7 will provide the first Antarctic bio-environmental dataset for the modelling incentive of *Iceflux*, as well as biological samples for the biomarker approach.

In the Southern Ocean, the exploitation of marine living resources and the conservation of ecosystem health are tightly linked to each other in the management framework of the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). Antarctic krill is important in this context, both as a major fisheries resource, and as a key carbon source for Antarctic fishes, birds, and mammals. Similar to Antarctic krill, several abundant top predators have been shown to concentrate in pack-ice habitats in spite of low water column productivity (van Franeker *et al.* 1997). Investigations on the association of krill and other key species with under-ice habitats will be complemented by systematic top predator censuses in order to develop robust statements on the impact of sea ice decline on polar marine resources and conservation objectives.

Work at sea

SUIT sampling

Under-ice fauna was sampled at 13 stations with a Surface and Under-Ice Trawl (SUIT; van Franeker *et al.*, 2009). Complementary, eight qualitative stations were performed during the two ice camps. The net was deployed in the open water behind the stationary ship, in order to collect extra samples for biomarker and diet studies. The SUIT was equipped with two parallel nets attached next to each other in the mouth opening which has a height of 2.01 m: a shrimp net (7 mm half-mesh) covering 1.54 m of the opening, and a zooplankton net (0.3 mm mesh) covering 0.42 m of the opening. A bio-environmental sensor array was mounted in the SUIT frame, consisting of an Acoustic Doppler Current Profiler, a CTD probe with built-in fluorometer and altimeter, two spectral radiometers, and a video camera. After retrieval of the net, several abundant species were immediately preserved for (a) Compound-Specific Stable Isotope Analysis (CSIA) at -80°C, (b) gut content analysis in 4 % formaldehyde, (c) C/N ratio and calorific measurements at -20°C. The remaining catch was preserved in 4 % formaldehyde for further species identification, counting and length measurements.

Pelagic sampling

In collaboration with the AWI krill group, the group of E. Pakhomov (UBC) and others, we sampled deeper-dwelling key species of the pelagic food web, such as euphausiids, amphipods, cnidarians and myctophids caught by Rectangular Midwater Trawl (RMT) in parallel with SUIT, as well as multinets during ice stations. Intended testing of a new type of dip-net to sample zooplankton surface swarms from a helicopter, was not conducted as sparse flying moments were best dedicated to the predator surveys.

Stationary sea ice research

At the two ice camps, ice cores were taken for additional CSIA of phytoplankton and sea biota and for additional analysis of sea ice properties. For the former the cores were melted and filtrated, after which the filters were stored in -80°C. Additional samples for CSIA were taken with the CTD rosette, which were also filtered and stored at -80°C.

Top predator censuses

Whenever possible during steaming of the ship, surveys of top predator densities were made from open observation posts installed on the monkey-deck. Standard band transect methods are used, with snapshot methodology for birds in flight, and additional line-transect methods for marine mammals. Overall 540 standard 10-minute counts were completed. Bandwidth surveyed is usually 300 m, that is 150 m to both sides, but this may vary with conditions. At standard bandwidth and ship speed of around 10 knots, a 10 minute count covers a surface area of close to one km^2. More than half of the ship based counts were made after departure from the second dive station, moving east along the ice edge to the zero meridian at 56°S and then north to 48°S. In addition to the ship-based surveys overall 9 helicopter flights were dedicated to top predator surveys from the stationary ship at dive camps. Flying time was about 2 hours per flight, but because 2 flights had to be stopped early due to weather conditions, overall flying time was 16 hrs. Flights are conducted at standard seal survey altitude of 300 ft and speed of 60 to 80 knots. For unbiased sampling, surveys followed pre-determined straight transect lines to a maximum of 50 nautical miles away from the ship. Counts are made by units of approximately 2 minutes identified by waypoints made on GPS, using bandwidths between 200 and 300 m depending on conditions. During the 9 flights, 298 waypoint counts were completed. Surface area covered between two waypoints is usually in the range of one and half to two km^2.

Preliminary results

Some preliminary results may be shown for the SUIT sampling and for the top predator censuses. For results on other elements, samples need to be analysed in home laboratories.

SUIT results

From the 13 quantitative SUIT hauls completed, one was conducted in open water, and 12 were conducted under various types of sea ice, including new forming ice, one year flat ice to highly rafted ice (Fig. 5.1.1). The ice coverage of the under-ice hauls ranged between 45 % in the Marginal Ice Zone to 100 % in the pack ice. The under ice mean temperature was -1.8 ºC with a mean salinity of 33.7 ppt.

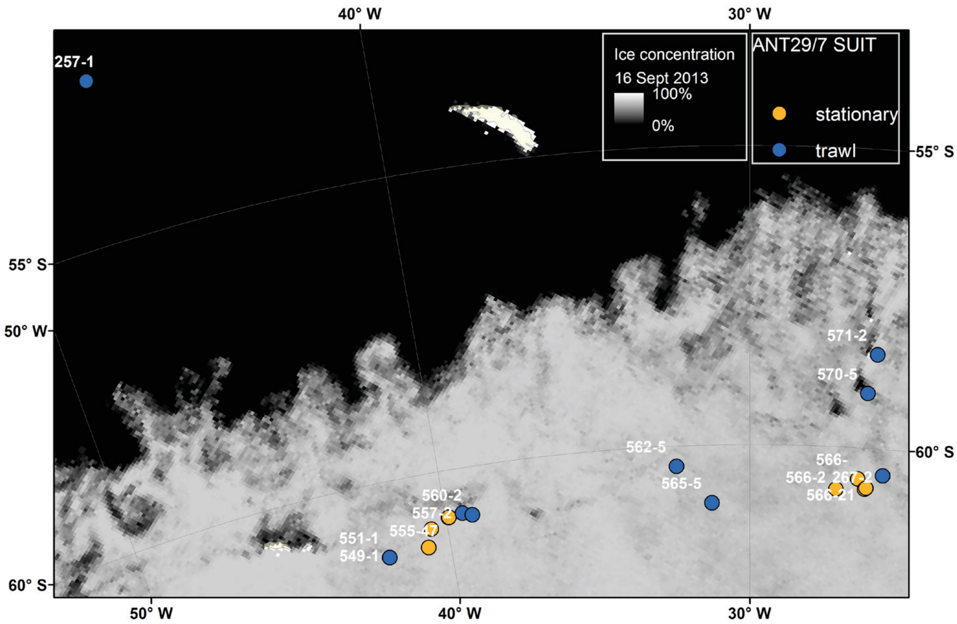


Fig. 5.1.1: Geographical positions of SUIT hauls during ANT-XXIX/7, projected on a map showing the sea ice concentration on 16th September 2013

The species composition in the SUIT samples showed a distinction between open water and under-ice habitats. Under sea ice, samples were dominated in density by the ice-associated euphausid *E. superba,* or Antarctic krill. In the one open water station, the pelagic euphausid *Thysanoesa* sp. was most abundant. Four under-ice stations were analysed, namely station 557_2, 560_2, 562_5 and 565_5. At these stations, besides the euphausid *E. superba* (82 % contribution), the amphipods were the second dominating group contributing to the community composition with 10 %, followed by chaetognatha (mainly *Sagitta* sp.) with 3.5 %. Different relative contribution to the under ice community was found during the winter 2006 when siphonophora was the second dominating group with 1 % (Flores *et al.* 2012). In addition to the four stations, krill from two other stations were measured, namely stations 551 and 555_47. Before the ice camp early adult stages were most frequent, while at the other stations there were mainly juveniles and furcilia VI. At the 11th trawl even earlier larval stages were found, namely furcilia IV and V. The krill at haul 10 seem to have a widely distributed length but the numbers are very low (Fig. 5.1.2). In 2006 mainly adult krill was caught underneath the ice while this year there was lot of late furcilia stages and juveniles (Flores *et al.* 2012).

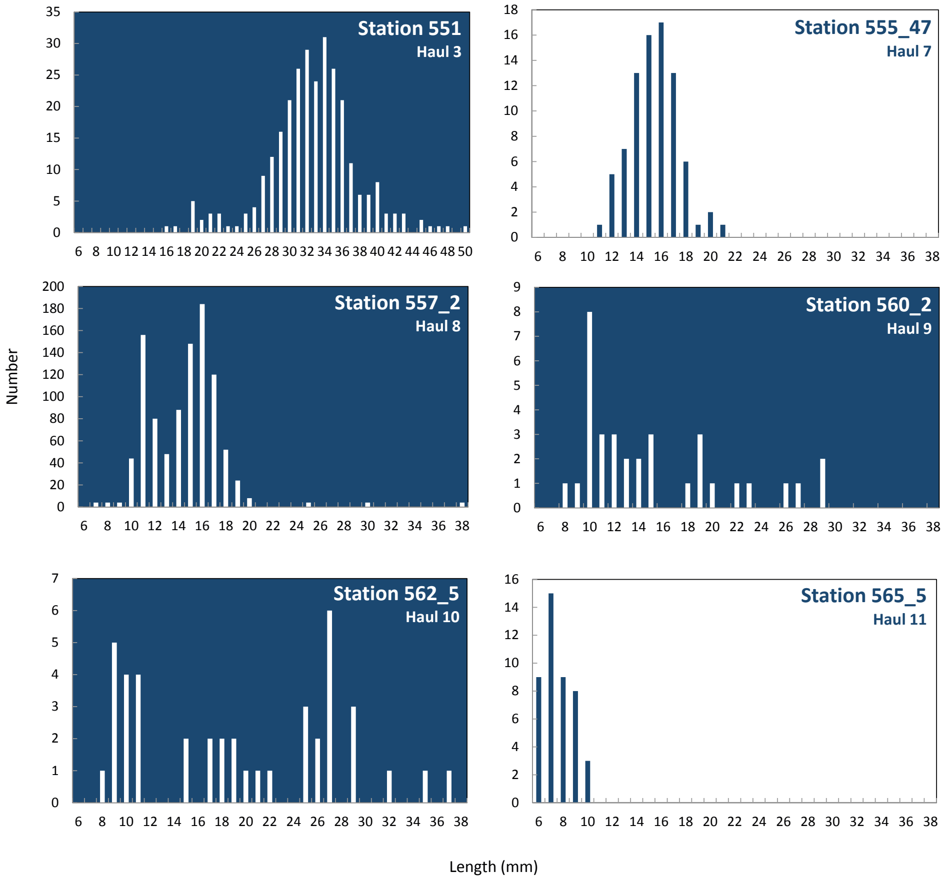


Fig. 5.1.2: Length/frequency of Euphausia superba per station. Dark blue graphs indicate night hauls, white graphs indicate day hauls.

Top predator results

The aim of collecting data on distribution and abundance of top predators in the *Iceflux* study is to estimate how much of the biological production in sea ice and open water ultimately reaches the top of the food chain and assign these requirements to different habitats, primarily open water compared to sea-ice, but also in more detail. Numerical data on densities of birds, seals and whales assessed during surveys, are therefore translated into food requirements using well established allometric formulas on daily energy requirements of predators of different groups and sizes. Energy requirements are translated to fresh food requirements using an energetic value of 4.5 KJ per gram fresh weight of food, being the approximate energy content of one gram of 'average' krill. For further methodological details see Van Franeker *et al.* 1997. Data, that is data collected before and during the second ice dive camp, were entered into Oracle data tables and analysed. The analysis includes 466 counts, being 213 10-minute counts for ship based observations and 8 flights with 253 waypoint counts for the helicopter surveys. Later data cannot be discussed in this preliminary analysis.

Figure 5.1.3 provides an overview of the daily food requirements of the top predator community in open water and sea ice during two winter cruises. As observed in all earlier north-south transects (e.g. Van Franeker *et al.* 1997), food requirements in the sea ice areas were much higher than in open water: during ANT-XXIX/7 at least an order of magnitude higher. In an earlier winter cruise in 2006, open water requirements were calculated at 0.40±0.17 kg food per day per km^2 (avg±se; n=214) and those in 2013 at a nearly identical 0.40±0.023 (n=93). The general impression that higher predators were not very abundant in the sea ice during ANT-XXIX/7, proved not to be true in this data analysis. The 2006 average food requirement of 6.3±1.3 $kg.km^{-2}.day^{-1}$ in the Lazarev Sea was doubled to 13.2±3.3 $kg.km^{-2}.day^{-1}$ observed in the 2013 survey. Penguins, that is emperor and Adélie penguins, and crabeater seals were relatively more important in the recent study.

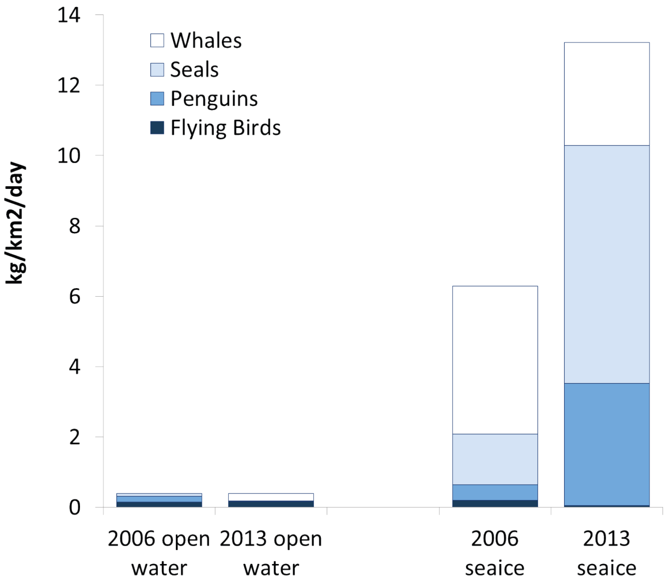


Fig. 5.1.3: Average food requirements of Antarctic top predators in open water and sea-ice during two winter studies: ANT-XXIII/6 in the Lazarev Sea 2006 (n=732 ship counts) and the current ANT-XXIX/7 in the western Weddell Sea 2013 (n=466 ship and helicopter counts).

The apparently erroneous impression of low predator abundance during ANT-XXIX/7 may have a background in the fact that in the vicinity of the two long dive camps, low predator densities were present (Fig. 5.1.4). Patchy high density of predators was observed during helicopter surveys to the south of dive camp 1. Consistent high seal and penguin densities of seals and penguins were observed from both ship and helicopter between 35°W and 30°W during the fast passage between the two stations. At this stage there is no evident explanation for the very strong spatial differences in top predator abundances in the study area. SUIT catches as well as deeper nets within this area all showed low biomass of organisms that could serve as food and do not provide an link to the observed patterns in food requirements of higher predators. Also ice characteristics, oceanographic data and bio-acoustical data do not provide immediately obvious links, but need to be further analysed in relation to the top predator distribution pattern.

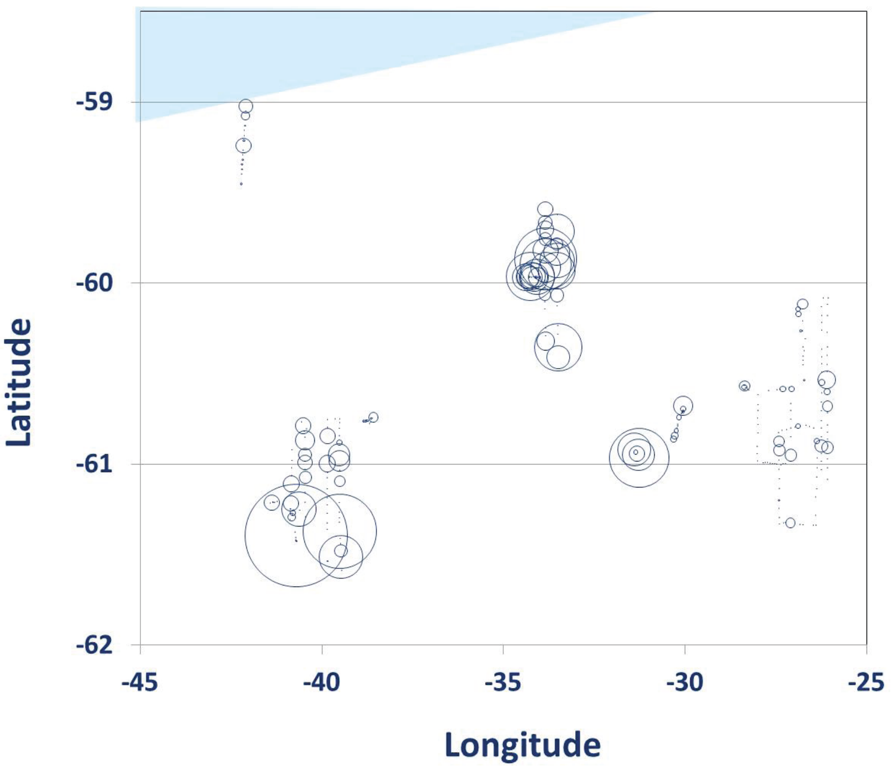


Fig. 5.1.4: Spatial pattern in abundance of top predators in sea ice during ANT-XXIX/7 in terms of combined daily food requirements. Dive camp 1 (PS81/0555 was situated around 61°S-39°W and Dive camp 2 (PS81/0566) around 60°30'S-27°W. The shaded area in the top left indicates approximate extent of open water.

Data management

Almost all sample processing will be carried out in the home laboratories at AWI and IMARES. This may take up to three years depending on the parameter as well as analysis methods (chemical measurements and species identifications and quantifications). As soon as the data are available they will be accessible to other cruise participants and research partners on request. Depending on the finalization of PhD theses and publications, data will be submitted to PANGAEA Data Publisher for Earth & Environmental Science and SCAR-MarBIN, and will be open for external use.

References

Flores H, Van Franeker JA, Siegel V, Haraldsson M, Strass V, Meesters EHWG, Bathmann U, Wolff WJ (2012) The association of Antarctic krill Euphausia superba with the under-ice habitat. PloS one 7, e31775.

Flores H, Van Franeker JA, Cisewski B, Leach H, Van de Putte AP, Meesters EHWG, Bathmann, U., Wolff, W.J. (2011) Macrofauna under sea ice and in the open surface layer of the Lazarev Sea, Southern Ocean. Deep Sea Research Part II: Topical Studies in Oceanography 58, 1948–1961.

van Franeker JA, Bathmann U, Mathot S, (1997) Carbon fluxes to Antarctic top predators. Deep-Sea Research II 44, 435–455.

van Franeker JA, Flores H, Van Dorssen M (2009). The Surface and Under Ice Trawl (SUIT), in: Flores H. (Ed.), Frozen Desert Alive - The Role of Sea Ice for Pelagic Macrofauna and its Predators. PhD thesis. University of Groningen, pp. 181–188.

5.2 Macrozooplankton and micronekton dynamics during the Antarctic winter

Evgeny Pakhomov[1], Brian Hunt[2]
[1]UBC
[2]MIO

Objectives

Characterize zooplankton and micronekton community structure within the open waters of the Antarctic Convergence, marginal ice zone and in the sea ice covered region during the late Austral winter;

Study the population biology of major species, including pelagic tunicates (*Salpa thompsoni*) and Antarctic krill *Euphausia superba*

Work at sea

Sampling of the macrozooplankton and micronekton have been carried out:

1. along the transect from South Georgia to the marginal ice zone (MIZ) (22th-28th August)
2. at the sea ice zone (SIZ), focussing on two ice camps and near the South Sandwich Islands (29th August to 8th October)
3. at the Antarctic Polar Front on the North Transect along the Greenwich meridian (11th October)

For the community structure, a total of 19 double oblique tows using RMT 1+8 were completed in the top 500 m of the water column (Fig. 5.2.1). When possible samples were processed on board. For salp biology, salps from every gear were collected immediately after the catch, counted, measured, sexed and staged. In addition, salp guts were removed and pigments were extracted from them in 90 % acetone to study the feeding activity of this tunicate. Here, the preliminary findings are presented and detailed sample analysis will be completed in the home laboratory.

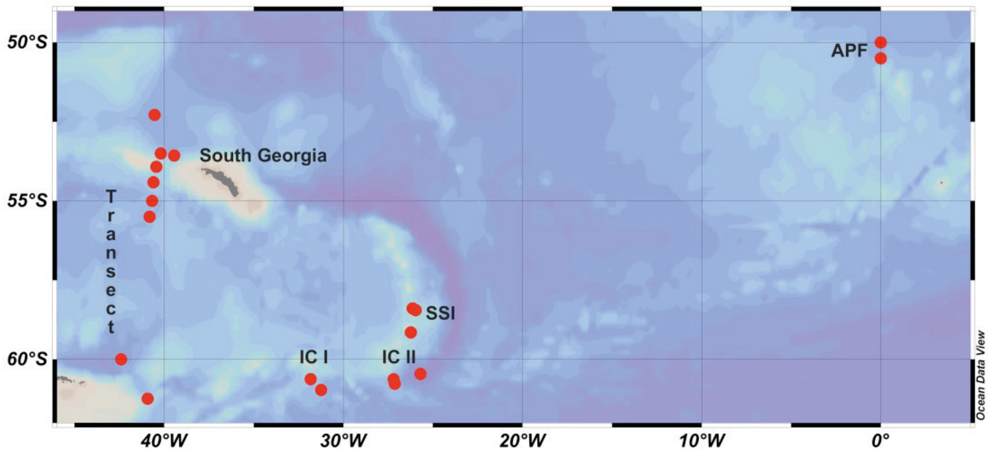


Fig. 5.2.1: Station positions of double oblique RMT 1+8 tows during Austral winter 2013. Transect: stations during the transect from South Georgia to the marginal ice zone; IC I: ice camp I; IC II: ice camp II; SSI: South Sandwich Islands; APF: Antarctic Polar Front Stations.

Preliminary Results

Macrozooplankton/micronekton community structure

RMT-8 net abundance levels ranged from 20 to 120 ind.1,000 m^{-3} with overall mean of 43 ind.1,000 m^{-3} and were less variable than the biomass estimates. Biomass levels varied substantially between ice free and ice covered regions. Total biomass ranged from 0.2 to 14.8 gDW.1,000 m^{-3}, with a mean of 2.1 g.DW.1,000 m^{-3} (Fig. 5.2.2). Lowest biomass were recorded in the ice free region (generally < 2 g. DW.1,000 m^{-3}). The highest biomass was observed at the Station 567-1 due to catch of the large jellyfish *Periphylla periphylla* (Fig. 5.2.2). In the ice free waters, euphausiids (mostly *Euphausia triacantha* and *E. vallentini*) and myctophids (mostly *Protomyctophum bolini* and *Gymnoscopelus braueri*) accounted for >70 % of total biomass with siphonophores (*Melophysa melo*) and amphipods (*Themisto gaudichaudii*, *Cyphocaris richardi* and *Parandania boecki*) occasionally being the second and third most important taxa. With a few exceptions, ice covered stations biomass levels were on average two fold higher than in the ice free waters (Fig. 5.2.2). The community at the ice covered stations was overwhelmingly dominated by carnivorous gelatinous organisms (jellyfish *P. periphylla*, siphonophores *Diphyes antarctica* and ctenophores *Callianira* sp.) which collectively accounted for >50 % of total biomass (Fig. 5.2.2).

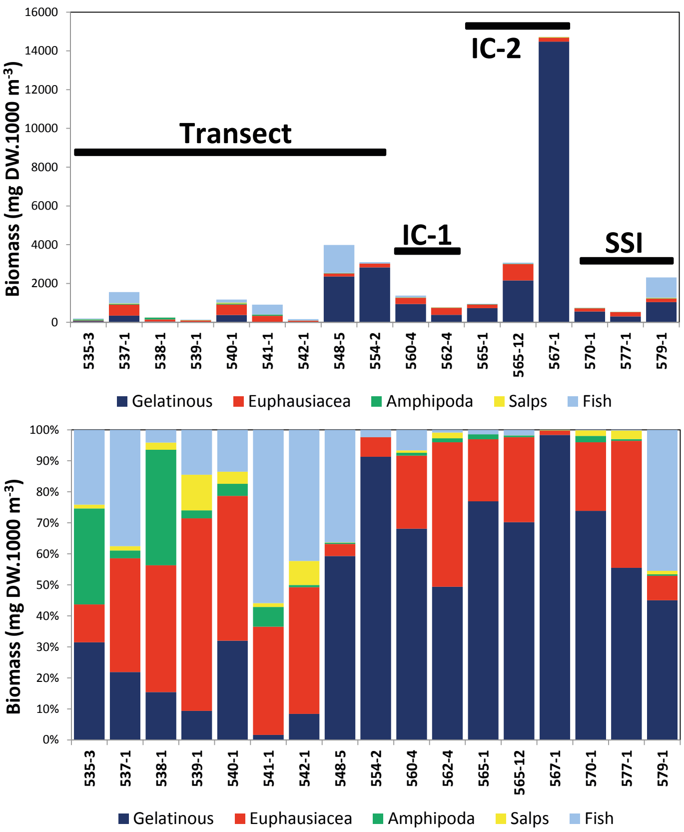


Fig. 5.2.2: Total biomass distribution of main taxonomic groups of macrozooplankton and micronekton along the transect, in the ice zone (IC I and IC II) and near South Sandwich Islands (SSI).

Euphausiids were the second most prominent taxonomic group and comprised five species (Fig. 5.2.3). The euphausiid community differed markedly between ice free and ice covered waters, with the warmer water species *E. triacantha* and cold water *Thysanoessa macrura* strongly dominating in ice free and ice covered regions, respectively (Fig. 5.2.3). Antarctic krill *E. superba* was sampled in all but one station. However, this species only twice made up between 40 and 50 % of euphausiid biomass (Fig. 5.2.3).

In summary, the biomass and abundance levels of macrozooplankton and micronekton during Austral winter 2013 were comparable to summer, fall and winter values recorded in the adjacent Lazarev Sea (range 0.9 – 2.7 gDW.1,000 m^{-3}, Hunt *et al.*, 2011) and about four fold lower than summer values reported at the APF zone (Pakhomov & Hunt, unpublished data). A strong separation between ice free and ice covered regions was visible in the level of macroplankton/micronekton densities as well as in the community structure. It should be noted that ice covered waters harboured a significant carnivorous gelatinous component.

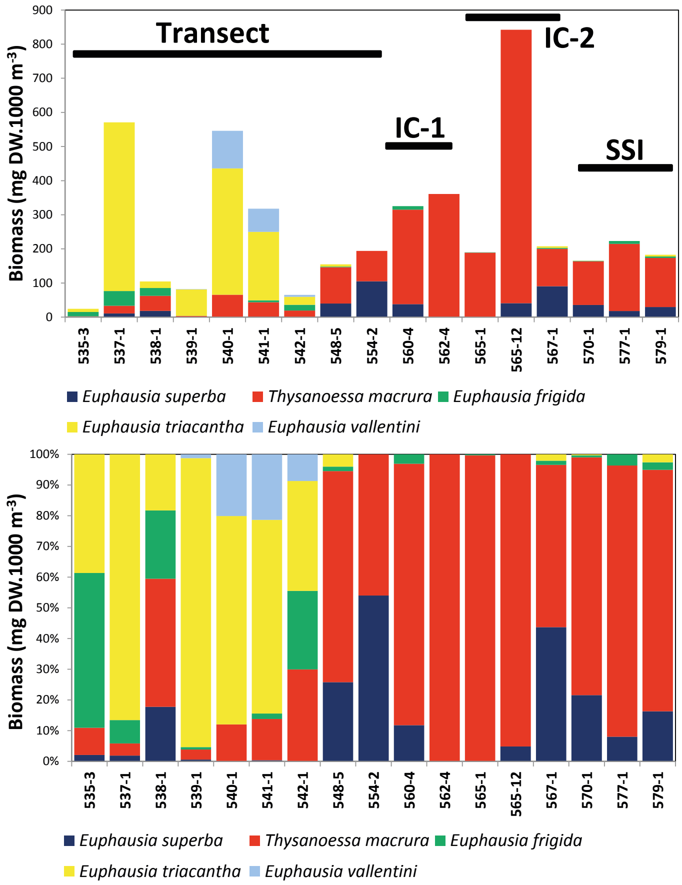


Fig. 5.2.3: Total biomass distribution of five euphausiid species along the transect, in the ice zone (IC I and IC II) and near South Sandwich Islands (SSI).

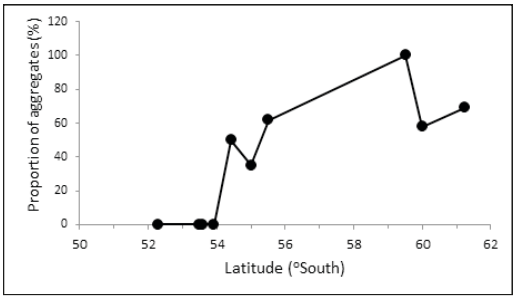
Biology of pelagic tunicate Salpa thompsoni

Two species of salps, *Salpa thompsoni* and *Ihlea racovitzai*, were sampled in the area investigated. *S. thompsoni* was recorded at all but one station in relatively small numbers with densities ranging from 0.1 to 5.4 (mean 0.9) ind.1,000 m^{-3}. In terms of biomass, salps generally accounted for <5 % of total RMT-8 catches (Fig. 5.2.2). Their biomass varied between 0.1 and 45 mgDW.1000 m^{-3} with an across region mean of 12 mgDW.1,000.m^{-3}. The *I. racovitzai* collection at two stations near IC II is likely the first record of this species in this area.

Along the transect from South Georgia to the MIZ, only solitary forms of *S. thompsoni* were found north of 54°S, while aggregates accounted for >50 % of the salp numbers further south (Fig. 5.2.4). It was rather surprising that the population in the northern part of the transect displayed the typical overwintering biology in

S. thompsoni life cycle, while in the southern part, including ice covered region, salps were in more advanced stage (spring) of development. This can be clearly observed in the length frequency distribution as well as in the developmental stage composition of *S. thompsoni* (Fig. 5.2.5).

Fig. 5.2.4: Proportion of aggregates along the transect from South Georgia to MIZ during Austral winter 2013.



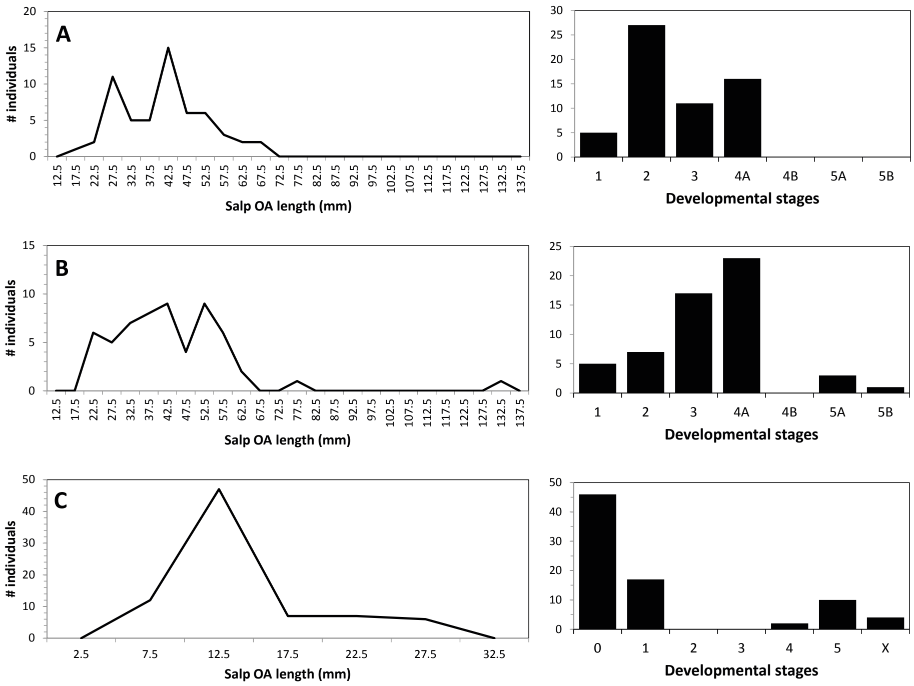


Fig. 5.2.5: Length frequency distribution and developmental stage composition of Salpa thompsoni solitaries north of 54°S (A), solitaries south of 54°S (B) and aggregates south of 54°S (C) during Austral winter 2013.

North of 54°S, salps were represented by medium sized solitaries at early stages of development (Fig. 5.2.5A). Nevertheless, there were a notable number of individuals that had already started developing their stolon (stage 4A, Fig. 5.2.5A). Further south, solitaries were slightly larger but significantly more developed with some specimens having already released their first chain of aggregates (Fig. 5.2.5B). Remarkably, aggregates south of 54°S , although small in size (modal OAL = 12.5 mm) and mostly comprising early developmental stages (0 and 1), had relatively high numbers of individuals that had already developed the embryo or even released it (~10 % of aggregates) (Fig. 5.2.5C).

The length and developmental stage of *S. thompsoni* solitaries at the Ice Camp stations (IC I & IC II) were similar to the southern transect individuals (Fig. 5.2.6A). Nevertheless, stages 1-3 dominated in this region. Solitaries near the SSI were generally larger and at more advanced developmental stages representing more of a spring situation, with chain release already actively ongoing (Fig. 5.2.6B).

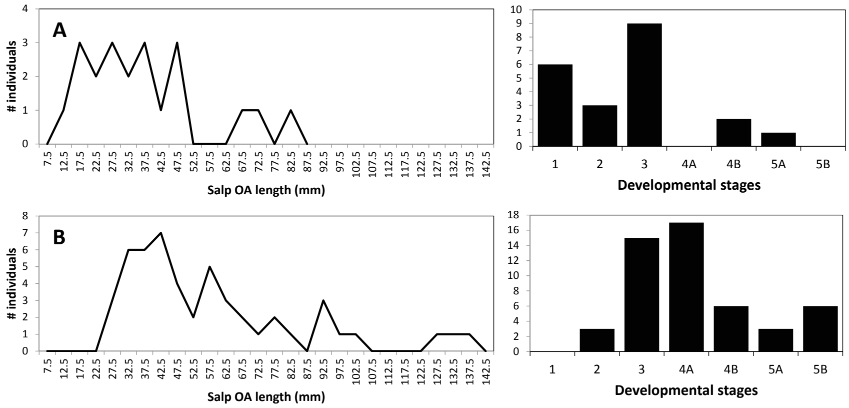


Fig. 5.2.6: Length frequency distribution and developmental stage composition of Salpa thompsoni solitaries at the ice camp stations (A) and in the vicinty of the South Sandwich Islands (B) during Austral winter 2013.

Both aggregate length distribution and stage composition were very similar at ice camp stations and in the vicinity of SSI, reflecting a spring situation with stages 1 and 2 dominating total aggregate counts, and with a modest amount of specimens having already reached full maturity (Fig. 5.2.7).

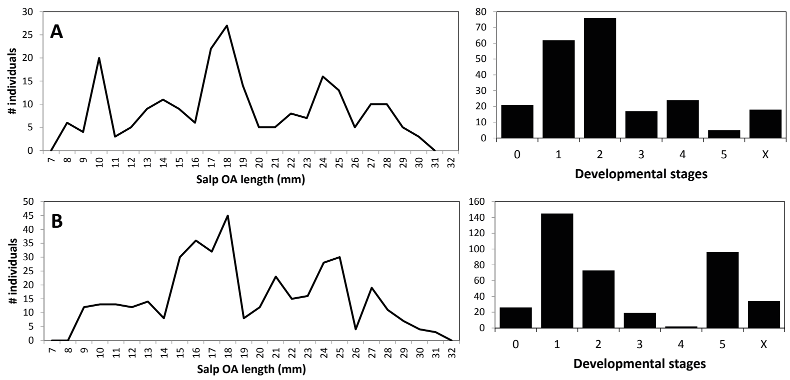


*Fig. 5.2.7**:** Length frequency distribution and developmental stage composition of Salpa thompsoni solitaries at the Ice Camp stations (A) and in the vicinty of the South Sandwich Islands (B) during Austral winter 2013.*

Winter feeding intensity of *S. thompsoni* aggregates measured as pigment content was similar to the summer values measured in the Lazarev Sea (von Harbou *et al.*, 2011) and at the APF (Pakhomov & Hunt, unpublished data) (Fig. 5.2.8). Solitaries showed a different pattern as there were specimens that had not commenced active feeding yet (winter overwintering situation) with their values well below the summer values recorded in other regions (Fig. 5.2.8). At the same time actively developing solitaries exhibited very high level of pigments in their stomachs well above published literature summer values (Fig. 5.2.8).

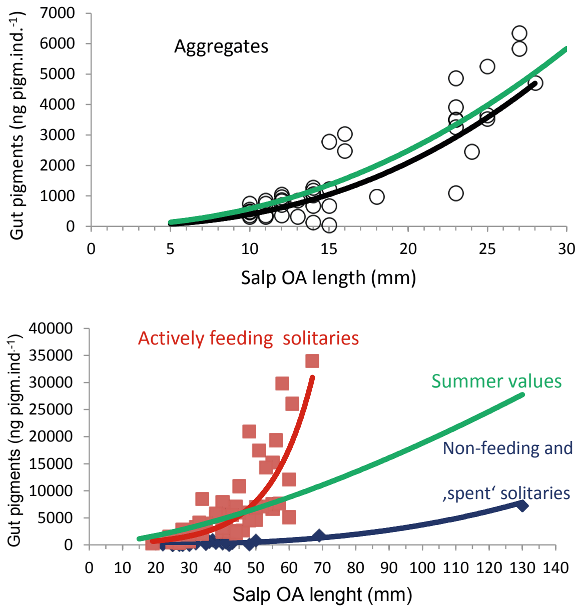


Fig. 5.2.8: Gut pigment content of aggregate and solitary forms of Salpa thompsoni solitaries during Austral winter 2013

Some preliminary conclusions

- Population development of *Salpa thompsoni* appeared to be different regionally. It was more advanced in the southern part of survey including ice covered regions. To explain this pattern a further investigation is required;
- physiological rates (gut pigments, ingestion) of *S. thompsoni* appeared to be within the range of or even higher than previously measured rates in different parts of the Southern Ocean during summer.

Data management

Data will be made available to PANGAEA Data Publisher for Earth & Environmental Science within 1-2 years after the return to the home laboratory.

References

Hunt, B.P.V., Pakhomov, E.A., Siegel, V., Strass, V., Cisewski, B. and Bathmann, U. (2011) The seasonal cycle of the Lazarev Sea macrozooplankton community and a potential shift to top down trophic control in winter. Deep-Sea Research II, 58(13-16): 1662-1676.

Von Harbou, L., Dubischar, C.D., Pakhomov, E.A., Hunt, B.P.V., Hagen, W. and Bathmann, U. (2011) Salps in the Lazarev Sea, Southern Ocean: I. Feeding dynamics. Marine Biology, 158: 2009-2026.

5.2.1 Pelagic food web structure in the Antarctic winter

Evgeny Pakhomov[1], Brian Hunt[2]
[1]UBC
[2]MIO

Objectives

1. Composition of the pelagic food web from phytoplankton to micronekton
2. Size structured dynamics of the pelagic food web

The first step in this research program is at sea data collection. Following this is compositional analysis, of the taxonomic make up, abundance, biomass and size structure of community components. Finally, stable isotope analysis of community components will be used to determine trophic linkages and food web interactions.

Work at sea

Sampling of the pelagic food web occurred in three stages:

1. North to South Transect from South Georgia to the marginal ice zone (MIZ) (22nd - 28th August)
2. Sea Ice Zone (SIZ), focussing on three ice camps (29th August to 8th October).
3. South to North Transect along the Greenwich meridian (8th October to 12th October)

Sampling therefore provided winter and early spring coverage of the Permanently Open Ocean Zone (1 & 2) and later winter SIZ. A summary of regions and all stations sampled is provided in Fig. 5.2.9.

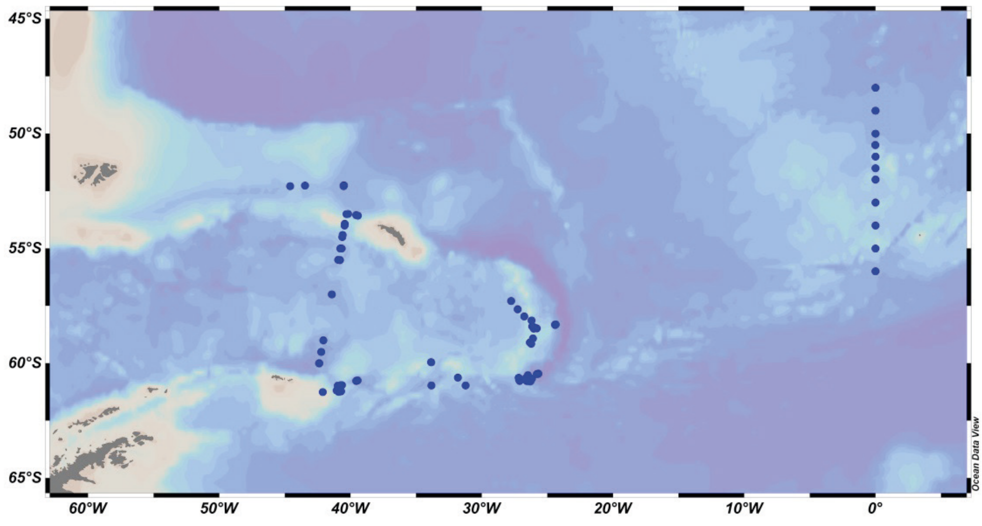


Fig. 5.2.9: Distribution of all sample points during the ANT XXIX/7 food web study

Data collection aimed to provide complete coverage of the pelagic food web for all organisms between phytoplankton and micronekton. To achieve this a range of gears were used. These and the food web components sampled are outlined in Tab. 5.2.1.

Tab. 5.2.1: Food web parameters sampled during ANT-XXIX/7

Food web component	**Region**	**Sampling gear**	**Depth**	**Size fractions**	**Measures**	**Number of stations / Status**
Phytoplankton / microzooplankton (POM)	POOZ-W; POOZ-ES; SIZ	Niskin bottles; Ice cores	Mixed layer; Sea ice	0.7 - 2µm 2-20µm > 20µm	Biomass, $\delta^{13}C$ & $\delta^{15}N$	30 / Dried
Dissolved Organic Carbon	POOZ-W; POOZ-ES; SIZ	Niskin bottles	9 depths between 0 & 250 m		DOC	25 / Frozen
Pico & nanoplankton	POOZ-W; POOZ-ES; SIZ	Niskin bottles	10 depths between 0 & 250 m	> 2µm	Flow Cytometry	25 / Frozen
Micro-mesozooplankton	POOZ-W; POOZ-ES; SIZ	Handnet (64µm mesh; 0.2m^2)	50 m vertical haul	64-125µm 125-250µm 250-500µm 500-1000µm 1000-2000µm	Biomass, $\delta^{13}C$ & $\delta^{15}N$, community composition	30 / Formalin & dried samples
Mesozooplankton	POOZ-W; POOZ-ES; SIZ	Bongo (100 & 250µm mesh, 0.28m^2) RMT1 (250µm mesh; 1m^2)	100-200 m vertical haul	125-250µm 250-500µm 500-1000µm 1000-2000µm 2000-4000µm	Biomass, $\delta^{13}C$ & $\delta^{15}N$, community composition	30 / Formalin & dried samples
Macrozooplankton	POOZ-W; POOZ-ES; SIZ	RMT8 (4.5mm mesh; 8m^2)	500-200 m oblique hauls	2-20 mm	Biomass, $\delta^{13}C$ & $\delta^{15}N$, community composition	30 / Formalin & dried samples
Micronekton	POOZ-W; POOZ-ES; SIZ	RMT8 (4.5mm mesh; 8m^2)	500-200 m oblique hauls	> 20 mm	Biomass, $\delta^{13}C$ & $\delta^{15}N$, community composition	30 / Formalin & dried samples

NB: POOZ-W, POOZ-ES, SIZ

Preliminary results

The majority of the samples collected at sea cannot be analysed on board. However, the taxonomy and abundance of all RMT8 and 20 of 30 hand net samples were processed on board. The RMT8 data are presented in this issue by Pakhomov & Hunt. Here we report on the micro- and mesozooplankton data collected with the 64 µm, 50c m diameter hand net.

Hand net abundance levels varied substantially between regions (Fig. 5.2.10). Lowest densities were recorded at Station 556 (353 ind.m^{-3}), between Ice Camps I and II. Values at the MIZ and Ice Camp I, averaged 1015 ind.m^{-3}, substantially lower than the vicinity of South Georgia (3,214 ind.m^{-3}) and Ice Camp II (3197 ind.m^{-3}). Ice Camp III (St 587) had densities of 4,500 ind.m^{-3}, and the highest densities were recorded at Montagu Island (St 583), 36,958 ind.m^{-3}.

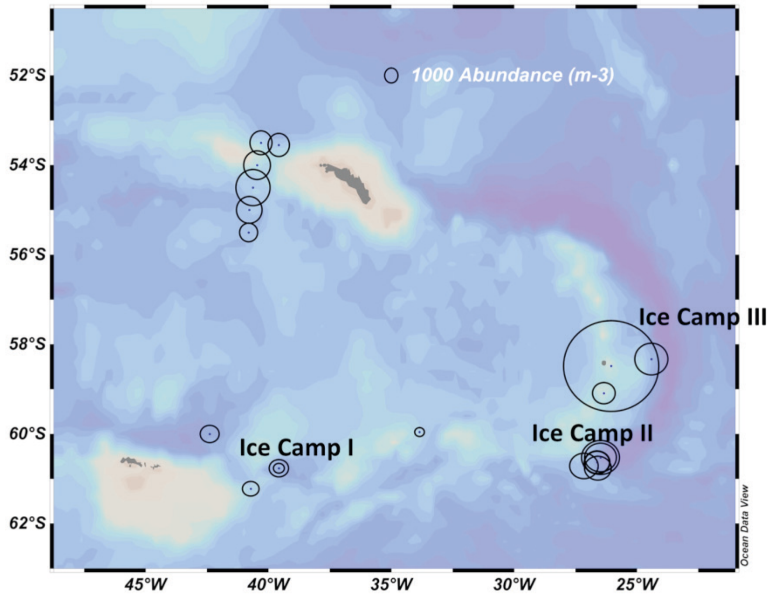


Fig. 5.2.10: Map of hand net stations plotted as open circles, with circle size relative to abundance (individuals.m^{-3})

Biomass was estimated by multiplying size class specific densities by mean individual animal weights values for the size classes analysed (Table 1), measured during a summer voyage in 2012. Biomass levels reflected the pattern shown by the abundance data (Fig. 5.2.11).

Zooplankton abundance was dominated by the 64-125 µm size class in the MIZ and SIZ (Fig. 5.2.12). Stations on the South Georgia transect had a larger contribution of the 125-250 and 250-500 µm size class, the former being the dominant size class at stations 537 and 541-2.

Cyclopoid copepod nauplii were the largest contributor to total hand net abundance (Fig. 5.2.13). Cylopoid copepodites and adult stages were important contributors in the South Georgia, the MIZ, and Ice Camp's I and II, but not at Ice Camp III. Cyclopoids were entirely represented by *Oithona similis* and it is therefore expected that this species was the major contributor to the cyclopoid nauplii category. Ice Camp I had a large contribution of Tintinnids, while Appendicularians were well represented at Ice Camp III.

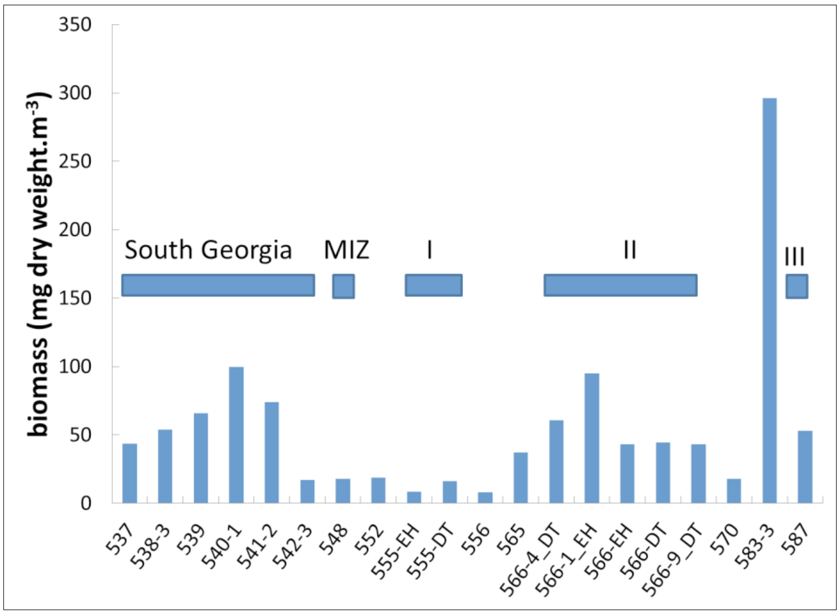


Fig. 5.2.11: Total zooplankton biomass estimated from hand net hauls. Roman numerals indicate Dive Camp number. DT = dive tent; EH = emergency hole.

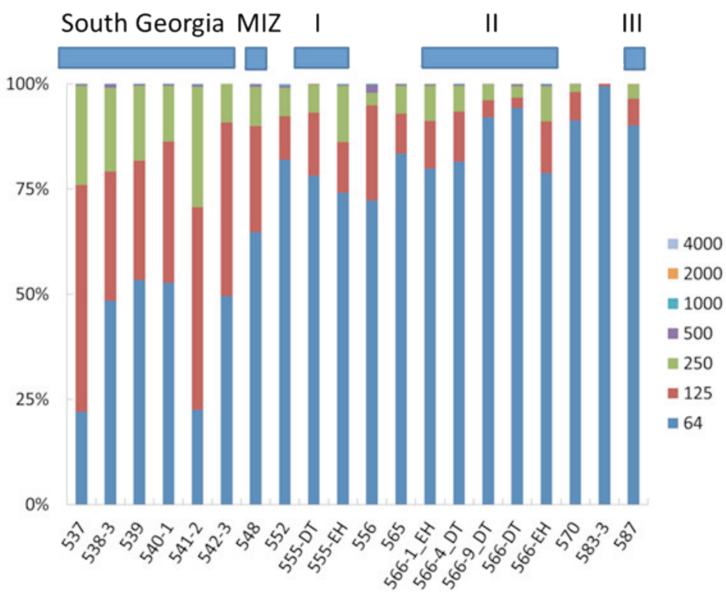


Fig. 5.2.12: Percentage contribution of zooplankton size classes to total abundance measured from hand net hauls. Key to size classes in µm. Roman numerals indicate Dive Camp number. DT = dive tent; EH = emergency hole.

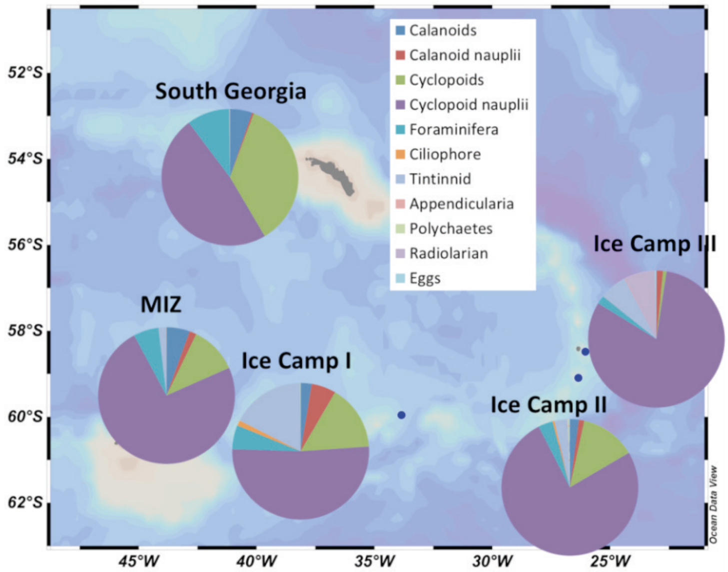


Fig. 5.2.13: Percentage contribution of major micro- and mesozooplankton groups to total hand net abundance. Fourteen taxonomic classes were omitted from these pie charts for ease of data representation.

Winter copepod densities were an order of magnitude lower than those measured in late summer 2012, in the vicinity of the Polar Front (Atlantic) (Fig. 5.2.14), and winter zooplankton egg densities were up to five orders of magnitude lower (Fig. 5.2.15). However, the large percentage contribution of nauplii to the copepod population indicated that copepods were reproductively active during the winter months (Fig. 5.2.16). *Oithona similis* was the most prevalent copepod species, and it is possible that their eggs were undersampled with the 64 µm mesh hand net.

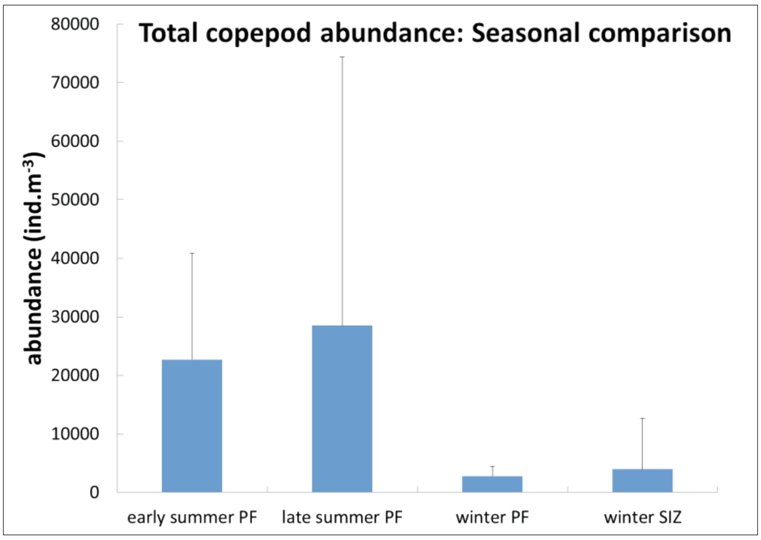


Fig. 5.2.14: Total copepod densities from the vicinity of the Polar Front (PF) and Sea Ice Zone (SIZ), Atlantic Sector of the Southern Ocean, measured in summer 2012 and winter 2013.

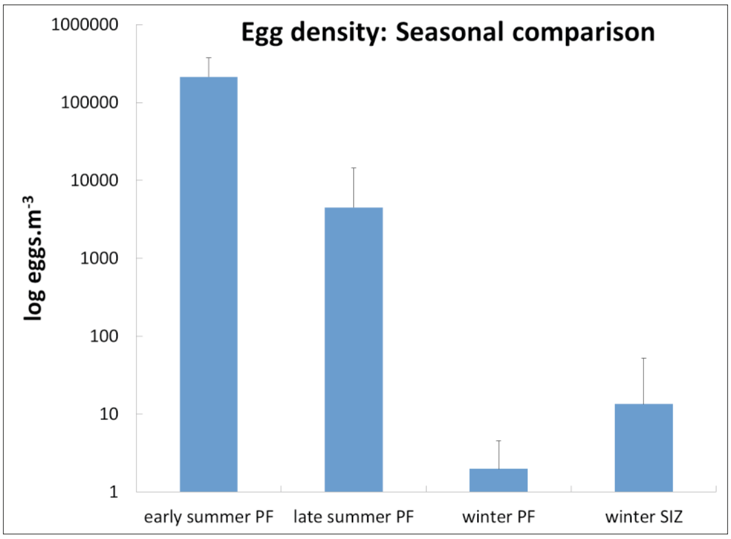


Fig. 5.2.15: Zooplankton egg densities from the vicinity of the Polar Front (PF) and Sea Ice Zone (SIZ), Atlantic Sector of the Southern Ocean, measured in summer 2012 and winter 2013.

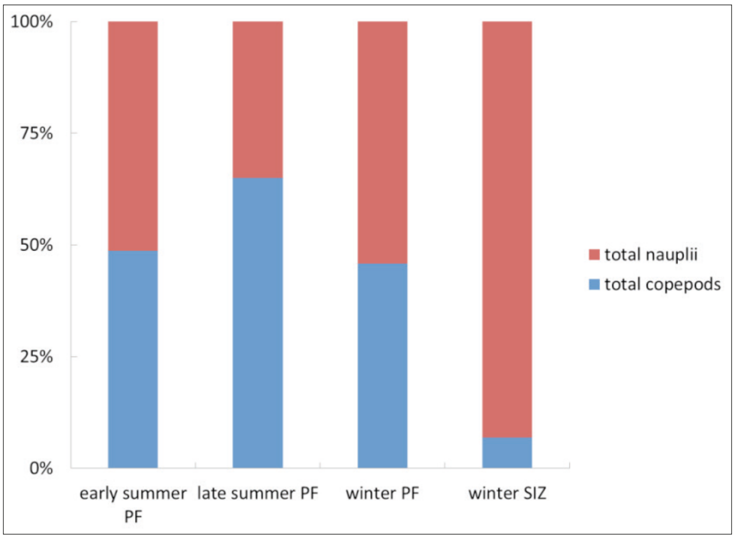


Fig. 5.2.16: Relative contribution of copepod nauplii to copepodite/adult stages in the vicinity of the Polar Front (PF) and Sea Ice Zone (SIZ), Atlantic Sector of the Southern Ocean, measured in summer 2012 and winter 2013.

Data management

Data will be made available to PANGAEA Data Publisher for Earth & Environmental Science within 1-2 years of returning to the home laboratory.

5.2.2. Multi-net 24 hour stations

Brian Hunt[1], Evgeny Pakhomov[2], Mathias Teschke[3], Rob King[4], Hannelore Cantzler[5], Laura Halbach[6], Aneesh Bose[7], Malte Krieger[5]

[1]MIO
[2]UBC
[3]AWI
[4]AAD
[5]UOL
[6]UMR
[7]UNI-ONT

Objectives

Determine the vertical distribution of *Euphausia superba* larvae/juveniles in the water column over a complete diel cycle.

Work at sea

Three 24 hour stations were completed, two at Ice Camp II (Station 566) and one at Ice Camp III (Station 587). At each station samples were collected at intervals of 2-6 hours. At Ice Camp II, 24 hour station #1 was undertaken with a 0.5 m^2 maxi multi-net harnessed with 100 µm mesh. A total of 9 depth strata were sampled: 0-10, 10-20, 20-30, 30-40, 40-50, 50-75, 75-100, 100-150, 150-200 m. Station #2 was conducted with a 0.25 m^2 mini multi-net harnessed with a 55 µm mesh. Five depth strata were sampled: 0-10, 10-20, 20-30, 30-40, 40-50 m. At Ice Camp III sampling was conducted with the maxi multi-net according to the same depth strata as Ice Camp II Station #1. *Euphausia superba* larvae/juveniles were enumerated from each depth stratum before formalin preservation of samples. At Ice Camp II the large winter active copepod *Calanus propinquus* was also enumerated. For Ice Camp II the multi-net data from Station #I were compared directly with those from krill pump samples collected continuously over the sampling period. The krill pump operated through the well shaft in the ship's hull at a flow rate of approximately 900 litres per minute. Water was pumped from directly beneath the ship's hull, a depth of ~ 7 m. *Euphausia superba* larvae/juveniles collected from the pump were also used for observations of gut fluorescence during one full 24 hour cycle at Ice Camp II (23/24 September). Additional samples for gut fluorescence were taken for both *Euphausia superba* larvae/juveniles and *C. propinquus* from zooplankton nets between 23 and 25 September.

Preliminary Results

At Ice Camp II (Station #1, 23/24 September) *Euphausia superba* larvae/juveniles were captured in the upper 10 m of the water column over the entire night period, apart from the 01:04 sample (Fig. 5.2.17). The highest densities recorded at Station #1 were 10 ind.m^{-2}. During the day they were almost completely absent from the water column. No *E. superba* larvae/juveniles were collected at depths > 10 m at any time. The multi-net data corresponded well with *E. superba* larvae/juvenile densities recorded from the krill pump, including almost complete water column absence during the day and the peak in densities observed at ~ 04:00.

Calanus propinquus at Station #1 exhibited a strong diel vertical migration pattern (Fig. 5.2.18). During the day this copepod species was largely absent from the upper 50 m of the water column. The centre of their distribution was ~ 75 m, and they were present to depths of ~ 150 m. No *C. propinquus* were observed below 175 m depth. After sunset *C. propinquus* migrated into the upper 25 m of the water column, thus occupying an overlapping depth zone as *E. superba* larvae/ juveniles. The numbers of *C. propinquus* at Station #1 declined dramatically after midnight, perhaps indicating a change of water masses. Nonetheless, a clear downward migration of the *C. propinquus* population was observed after sunrise.

A similar diel pattern was observed for both *E. superba* larvae/juveniles and *C. propinquus* at Station #2 (25/26 September) of Ice Camp II (Fig. 5.2.19). The highest densities of *E. superba* larvae /juveniles recorded at Station #2 were 80 ind.m^{-2}. Apart from one specimen collected from 30-40 m, all *E. superba* larvae/ juveniles were observed in the 0-10 m depth zone. In the case of *C. propinquus* the full vertical extent of the diel migration was not observed as sampling was only in the upper 50 m of the water column.

Ice Camp III (Station #3, 4/5th October) again confirmed a diel pattern of *E. superba* larvae/juveniles being present in the upper water column during the night, and absent during the day. At Station #3 they were predominantly located in the upper 10 m of the water column but were also present to depths of 30 - 40 m. Station #3 recorded the highest densities of all sites at 177 ind.m^{-2}. The daytime absence of *E. superba* larvae/juveniles from the depth strata sampled, combined with diving and ROV observations, clearly demonstrate a diel cycle of daytime occupation of the sea-ice interface, and night time movement from the sea-ice surface into the water column.

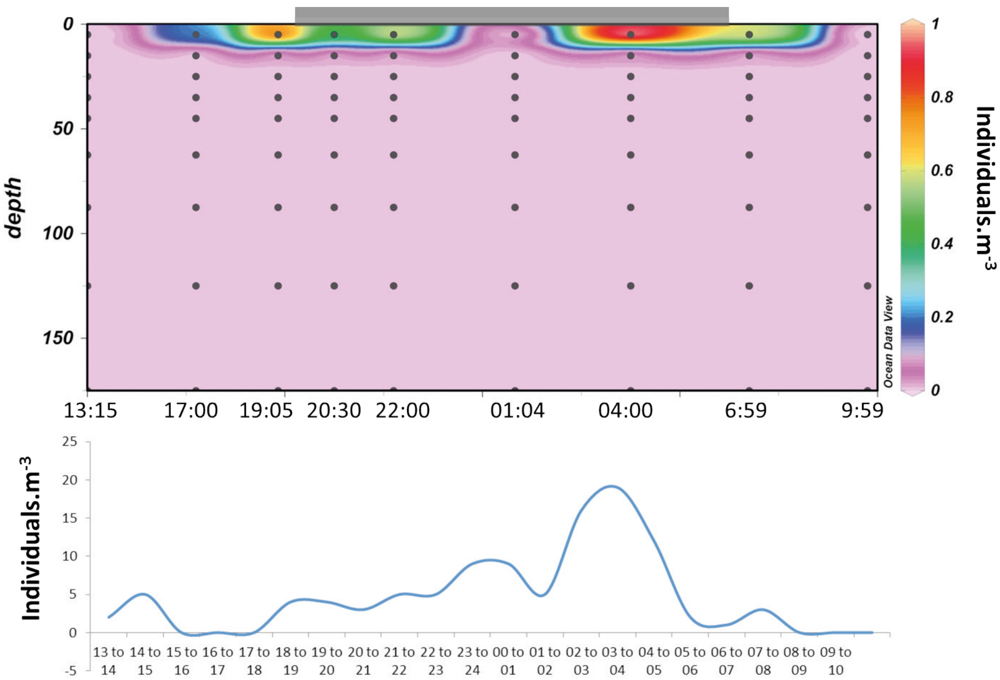


Fig. 5.2.17: Upper panel: Vertical distributions of Euphausia superba larvae/juveniles in the upper 200 m of the water column at Ice Camp II, 24 hour station #1 (23/24th September 2013). Grey bar indicates night time. Lower panel: Densities of E. superba larvae/juveniles in the water, pumped from ~ 7 m depth over the time period of the 24 hour multi-net station.

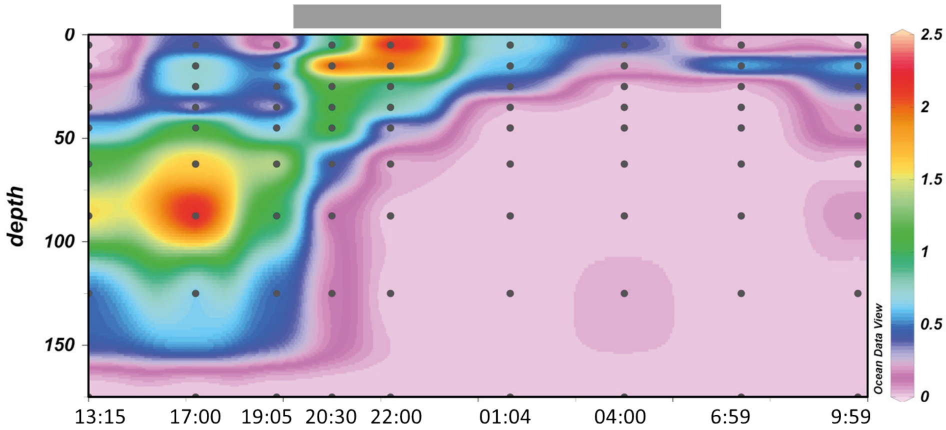


Fig 5.2.18: Vertical distributions of Calanus propinquus in the upper 200 m of the water column at Ice Camp II, 24 hour station #1 (23/24th September 2013). Grey bar indicates night time.

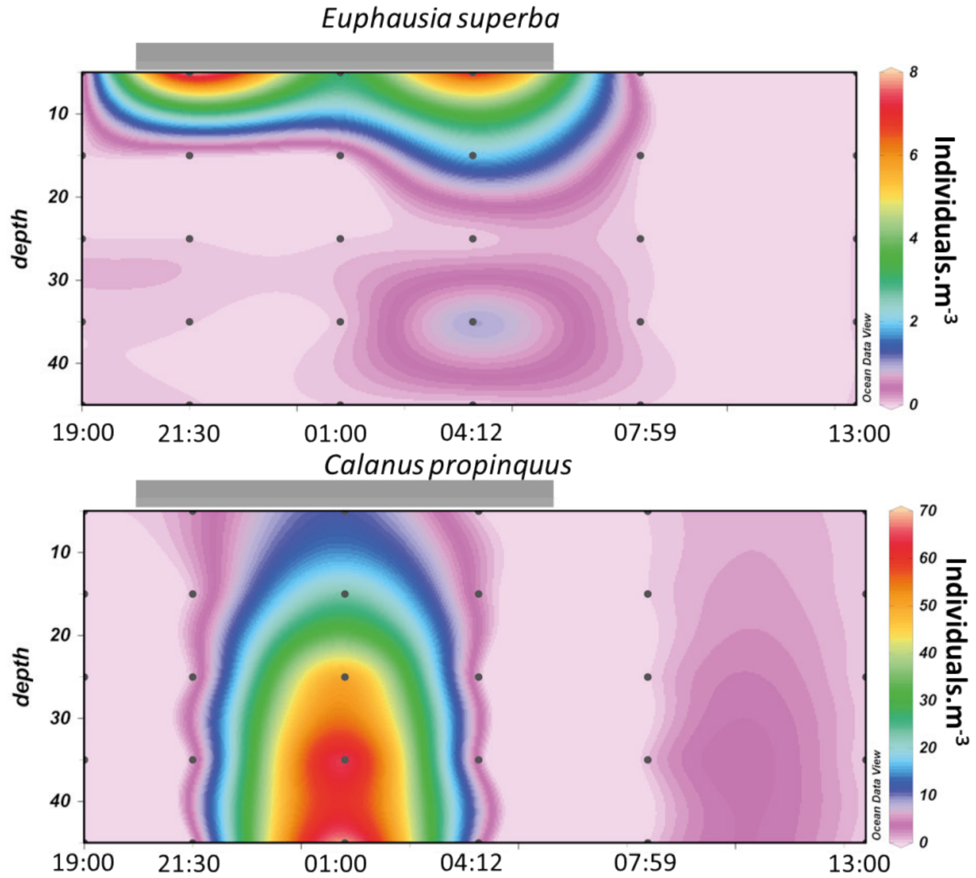


Fig. 5.2.19: Vertical distributions of Euphausia superba larvae/juveniles and Calanus propinquus in the upper 50 m of the water column at Ice Camp II, 24 hour Station #2 (25/26th September 2013). Grey bar indicates night time.

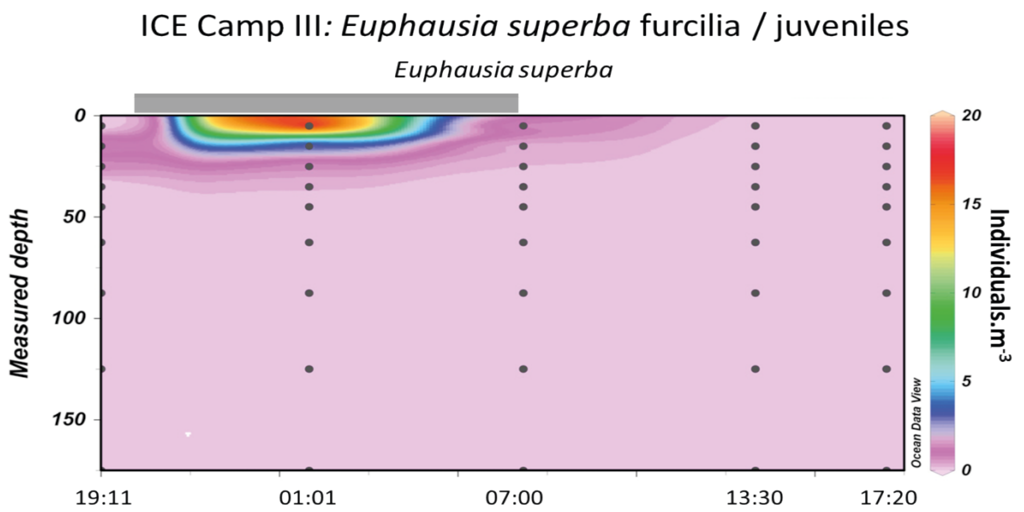


Fig. 5.2.20: Vertical distributions of Euphausia superba larvae/juveniles in the upper 200 m of the water column at Ice Camp III, 24 hour station #3 (4/5th October 2013). Grey bar indicates night time.

Gut fluorescence

At Ice Camp II, the autotrophic feeding intensity of *Euphausia superba* larvae/juveniles was relatively low, mainly ranging from 1 to 7 ng(pigm).ind.$^{-1}$ with elevated values of up to 25 ng(pigm).ind.$^{-1}$ during the evening and night time hours (Fig. 5.2.21). The results of two observational episods showed slightly different diel pattern, with larvae/juveniles collected during the continuous krill pump sampling showing almost no diel variability with occasional 3-fold pigment content increases during the afternoon (Fig. 5.2.21). The gut evacuation rate of *Euphausia superba* larvae/juveniles was estimated to be 0.836h^{-1} with gut passage time equal to 1.2 hours (Fig. 5.2.22).

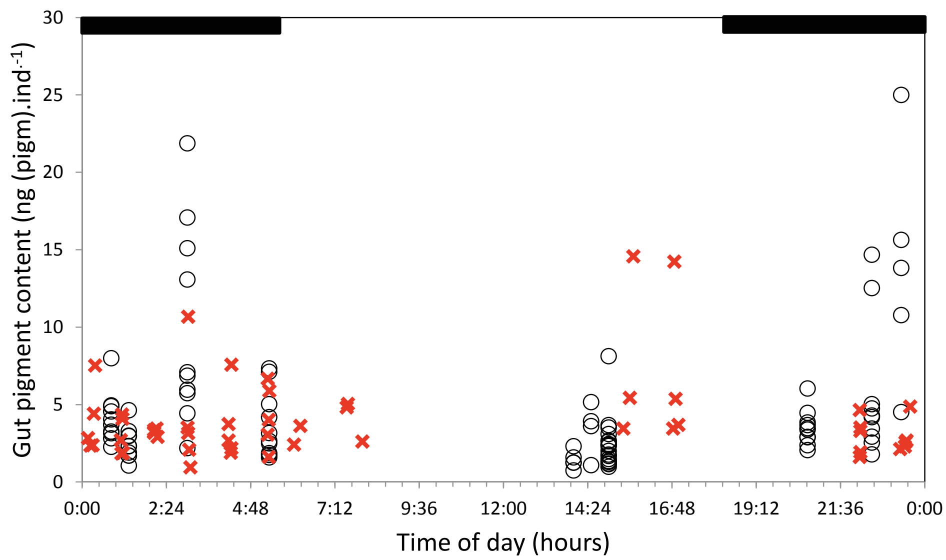


Fig. 5.2.21: Diel dynamics of gut pigment content of Euphausia superba larvae/juveniles during Ice Camp II: Open circles represent data collected between September 21st and 23rd; red crosses show samples collected 24 hour krill pump sampling during September 23rd/24th. Black bar indicates period of darkness.

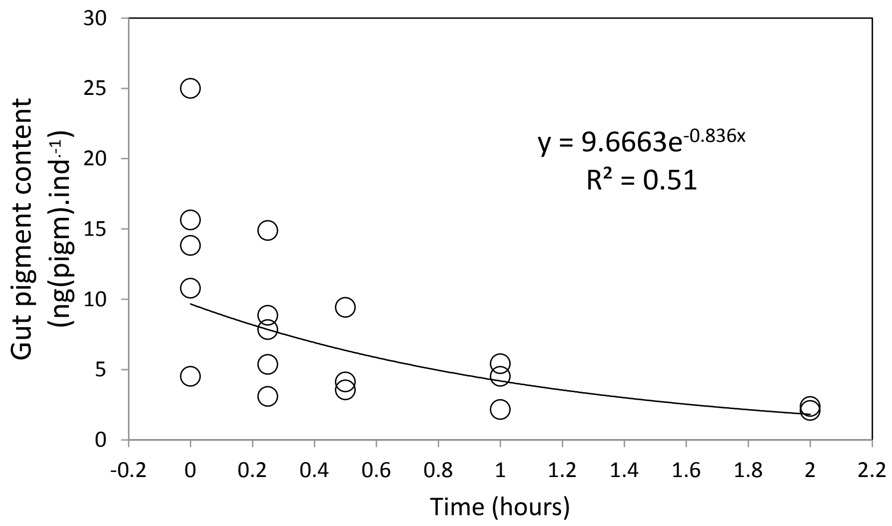


Fig. 5.2.22: Results of the gut evacuation rate experiment for Euphausia superba larvae/juveniles completed during Ice Camp II

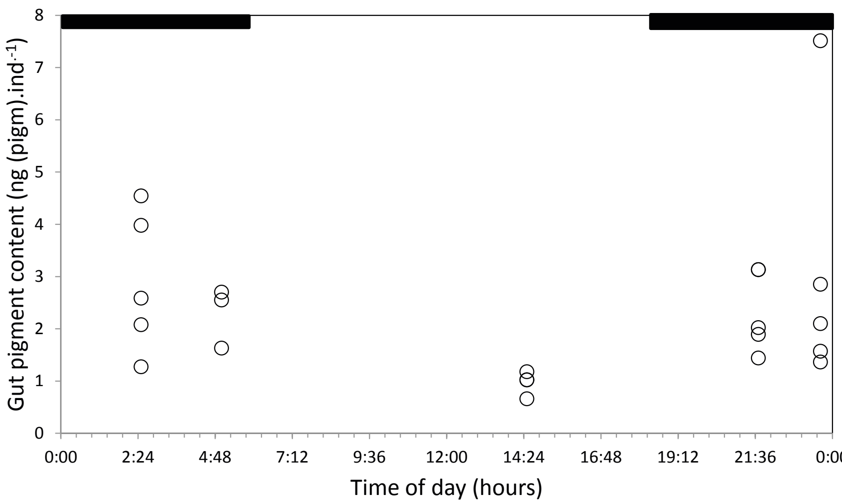


Fig. 5.2.23: Diel dynamics of Calanus propinquus adult's pigment contents during the Ice Camp II station collected between September 21st and 23rd, 2013. Black bar indicates period of darkness.

A preliminary daily ingestion rate of *E. superba* larvae/juveniles can be calculated using the following equation: IR = k * (GPC*24)/(1-PD), where *k* is gut evacuation rate, GPC is gut pigment content and PD is pigment destruction. The PD was assumed to be 0.73 after Pakhomov *et al.* (2004). The ingestion rates of *Euphausia superba* larvae/juveniles ranged from 298 to 343 ng(pigm).ind.$^{-1}$day^{-1}. Assuming a Chl*a*/C ratio of 50 (for fresh phytoplankton), this would be equivalent to 15 - 17 µmC.ind.$^{-1}$day^{-1}. Applying literature values of the mean carbon weight of the krill larvae from Pakhomov *et al.* (2004), the autotrophic carbon consumption would account for 8.1 - 9.4 % of body carbon per day. This is a meaningful consumption rate but it remains to be cross-checked with the respiration demands and growth rates estimated simultaneously during this station. These values are however about 3 fold lower than similar measurements from the Bellinghausen Sea during fall 2001 (Pakhomov *et al.*, 2004).

The feeding activity of *C. propinquus* demonstrated clear diel variability, with highest gut pigment content levels (up to 7.5 ng(pigm).ind.$^{-1}$) measured during the night time and the lowest (~1ng(pigm).ind.$^{-1}$) during the daytime (Fig. 5.2.23). In comparison to previous studies, the feeding activity of *C. propinquus* was only about 1/5 of the summer values reported from the similar system of the Lazarev Sea (Pakhomov and Froneman, 2004).

In summary, both species showed diel variability in their feeding activity, feeding mostly during the night time in the upper water column. This despite their contrasting ay time strategies, ascending to the se-ice surface in the case of *E. superba* larvae/juveniles, and descending to the deeper layers in the case of *C. propinquus*. Notably, the feeding intensity of both species was several fold lower than summer-fall levels measured in similar Antarctic systems.

Data management

Data will be made available to PANGAEA Data Publisher for Earth & Environmental Science within 1-2 years of returning to the home laboratory.

References

Pakhomov, E.A. and Froneman, P.W. (2004) Zooplankton dynamics in the eastern Atlantic sector of the Southern Ocean during the austral summer 1997/1998. Part 2. Grazing impact. Deep-Sea Research II, 51(22-24): 2617-2631.

Pakhomov, E.A., Atkinson, A., Meyer, B., Oettl, B. and Bathmann, U. (2004) Daily rations and growth of larval *Euphausia superba* in the Eastern Bellingshausen Sea during austral autumn. Deep-Sea Research II, 51(17-19): 2185-2198.

6. SEA ICE STUDIES

6.1. Sea ice bio-optics, floe-scale, ice algal, and under-ice krill observations using an instrumented Remotely Operated Vehicle (ROV)

Klaus Meiners[1,3], Mark Milnes[1], Peter Mantel[1], Rob King[1], Simon Jarman[1], Roland Proud[1,2], So Kawaguchi[1] (not on board)

[1]AAD
[2]UTAS
[3]ACE-CRC

Objectives

Sea ice is an important factor in determining the structure of the Southern Ocean and plays a pivotal role in the biogeochemical cycles of Antarctic marine ecosystems. The sea ice cover greatly affects the exchange of energy and material between the ocean and the atmosphere, and provides a vast habitat for diverse assemblages of organisms. Sea ice algal production is considered to contribute significantly to ecosystem primary production, accounting for up to 25 % of overall primary production in ice-covered waters (Arrigo and Thomas, 2004). Sea ice algal distribution is highly patchy and classical sampling methods, e.g. ice coring, are insufficient to properly quantify ice algal biomass on the sea ice floe-scale (Mundy *et al.* 2007). Sea ice communities provide an important food source for pelagic herbivores during winter and early spring, when food supply in the water column is scarce. There is a close relationship between the extent of winter sea ice and the subsequent recruitment and abundance of Antarctic krill (*Euphausia superba*) in certain areas of the Southern Ocean (Atkinson *et al.,* 2004). The mechanism proposed for this relationship hinges on the reliance of krill, particularly krill larvae and juveniles, on the algal communities which grow at the subsurface of ice. Krill have been observed feeding on sea ice microbial communities, particularly in late winter, but whether this community is a major food source over the entire range of krill and throughout the winter is uncertain. To study the relationships between sea ice physical properties, ice algae and krill, the objectives of this work-package were:

- to develop algorithms to estimate sea ice algal biomass (as chlorophyll *a*) from under-ice hyperspectral irradiance measurements, and
- to simultaneously measure ice thickness/under-ice roughness, ice algal biomass and under-ice krill distribution on the sea ice floe-scale using an instrumented Remotely Operated Vehicle (ROV).

Work at sea

Algorithm development

During both multi-day ice stations (PS81/555 (# Ice1) and P81/566 (# Ice2)) we have carried out transmitted under-ice irradiance measurements using a L-arm mounted hyperspectral radiometer (TriOS Ramses ACC-VIS) and collected several ice cores at each radiometer measurement site (Table 6.1.1). Ice cores were collected with a Kovacs Mark II ice coring system and used for determination of vertical profiles of ice temperature and other physical and biological parameters. Sea ice bulk salinities were measured with a YSI-100 conductivity probe and chlorophyll *a* concentrations were determined according to standard protocols after filtration of melted ice samples onto glass-fibre (Whatman GFF) filters. Subsamples for determination of particulate organic carbon and nitrogen (POC/PON), algal pigment composition (via High Performance Liquid Chromatography (HPLC)) as well as for filter-pad absorption measurements to determine spectral absorption coefficients for sea ice algal and detrital material will be analysed in our home laboratories. Additional ice core samples were collected for determination of sea ice texture and sea ice sediment concentrations (by C. David and B. Lange as well as B. Meyer group (AWI); for methods see Meiners *et al.*, 2011).

Tab. 6.1.1: Radiometer sampling sites and overview of ice parameters including snow thickness, sea ice freeboard, ice thickness and integrated chlorophyll a (Chl *a*) concentration.

Station	**Snow thickness (m)**	**Freeboard (m)**	**Ice thickness (m)**	**Chl *a* (mg m^{-2})**
P81/555, Ice # 1 Site A, (W1HA)	0.20	0.04	0.51	3.57
P81/555, Ice # 1 Site B, (W1HB)	0.20	0.08	0.56	16.01
P81/566, Ice # 2 Site A, (W2HA)	0.28	-0.15	0.60	2.15
P81/566, Ice # 2 Site B, (W2HB)	0.30	-0.01	0.53	1.65
P81/566, Ice # 2 Site C, (W2HC)	0.18	0.00	0.46	3.22
P81/566, Ice # 2 Site D, (W2HD)	0.19	0.01	0.44	3.24
P81/566, Ice # 2 Site E, (W2HE)	0.26	0.02	0.94	11.42

ROV deployments

The ROV sensor payload consisted of an acoustic modem for interrogation of a triangular transponder array to support positioning, an accurate depth sensor and up-ward looking sonar to determine sea ice draft, a hyperspectral radiometer to measure under-ice transmitted irradiance and estimate ice algal biomass, an up-ward looking digital stills camera to quantify krill larval abundance and several video-camera systems to support navigation and obtain under-ice footage. An additional surface hyperspectral radiometer was installed on the ice surface during each deployment. Sensor data streams from the ROV, except for the stills camera and some of the video cameras, were transferred via a fibre-optic tether to the surface and logged and time-stamped using a surface computer system. Stills camera images and video were time-stamped using the relevant device settings.

The transponder array was set up in a triangular pattern with a side length of approximately 250 m. Each transponder deployment site was equipped with a surface GPS and two additional GPS stations were used to mark the "origin" and a y-axis direction for 100 m x 100 m ROV survey grids. This set-up allows to tie in the under-ice ROV measurements with surface measurements of other groups, e.g. snow and ice thickness surveys carried out by the AWI sea ice physics team (Krumpen, Ricker, Schiller, this report). The ROV was also piloted under the dive-area of the AWI dive team to support ice algal biomass estimates along three 20 m transects named "little hole", "iceberg" and "ROV hole" at station # Ice2. In addition the ROV was used to measure several "long transects" in order to estimate the patchiness of ice algal biomass and krill abundance on >100 m length scales.

Preliminary results

Algorithm development

Both ice stations were characterised by moderate snow cover as well as relatively high ice temperatures and bulk salinities resulting in high brine volumes (calculated according to Cox and Weeks 1983) and thus a porous and permeable ice cover (Fig. 6.1.1, Table 6.1.1). Sea ice chlorophyll *a* concentrations from ice core measurements ranged between 1.4 µg l^{-1} and 53.7 µg l^{-1} with integrated values ranging between 1.7 mg m^{-2} and 16.0 mg m^{-2} (Fig. 6.1.1, Table 6.1.1). Fig. 6.1.2 shows transmitted under-ice irradiance spectra normalised to 550 nm. Changes in the 440 nm – 500 nm range of the spectra can be attributed to ice algal absorption. Fig. 6.1.3a shows relationships between a normalised difference index (NDI) (calculated after Mundy *et al.* 2007) and integrated ice algal biomass. Fig. 6.1.3b shows the relationship between the ratio of under-ice transmitted irradiances at 440 nm and 550 nm and integrated ice algal biomass. This ratio has been used to estimate integrated chlorophyll *a* concentrations in optical mooring studies (e.g. Honda *et al.* 2009). Both the NDI and the ratio approach provide apparent relationships with the integrated biomass measurements. However, further work is required and we will apply various spectral analysis methods to a larger combined dataset (with data from the Winter Weddell Outflow Study (WWOS, 2006) and the Sea Ice Physics and Ecosystems Experiments (SIPEX and SIPEX-2, 2007 and 2012) voyages).

ROV deployments

The instrumented ROV was deployed during both station # Ice1 (2 missions) and # Ice2 (19 missions) operating for a total of >24 hours and >15 km of under-ice travel distance. A plot showing the various ROV survey tracks carried out during # Ice2 is shown in Fig. 6.1.4. Further work on the ROV data will be carried out after the voyage. This will include the estimation of ice algal biomass (patchiness) on the sea ice floe-scale, the estimation of patchiness of juvenile krill on >100 m scales, the analysis of ROV data along dive transects and the calculation of gridded data sets that allow comparison of ROV data with surface-based measurements of snow and ice thickness carried out by the AWI sea ice physics group.

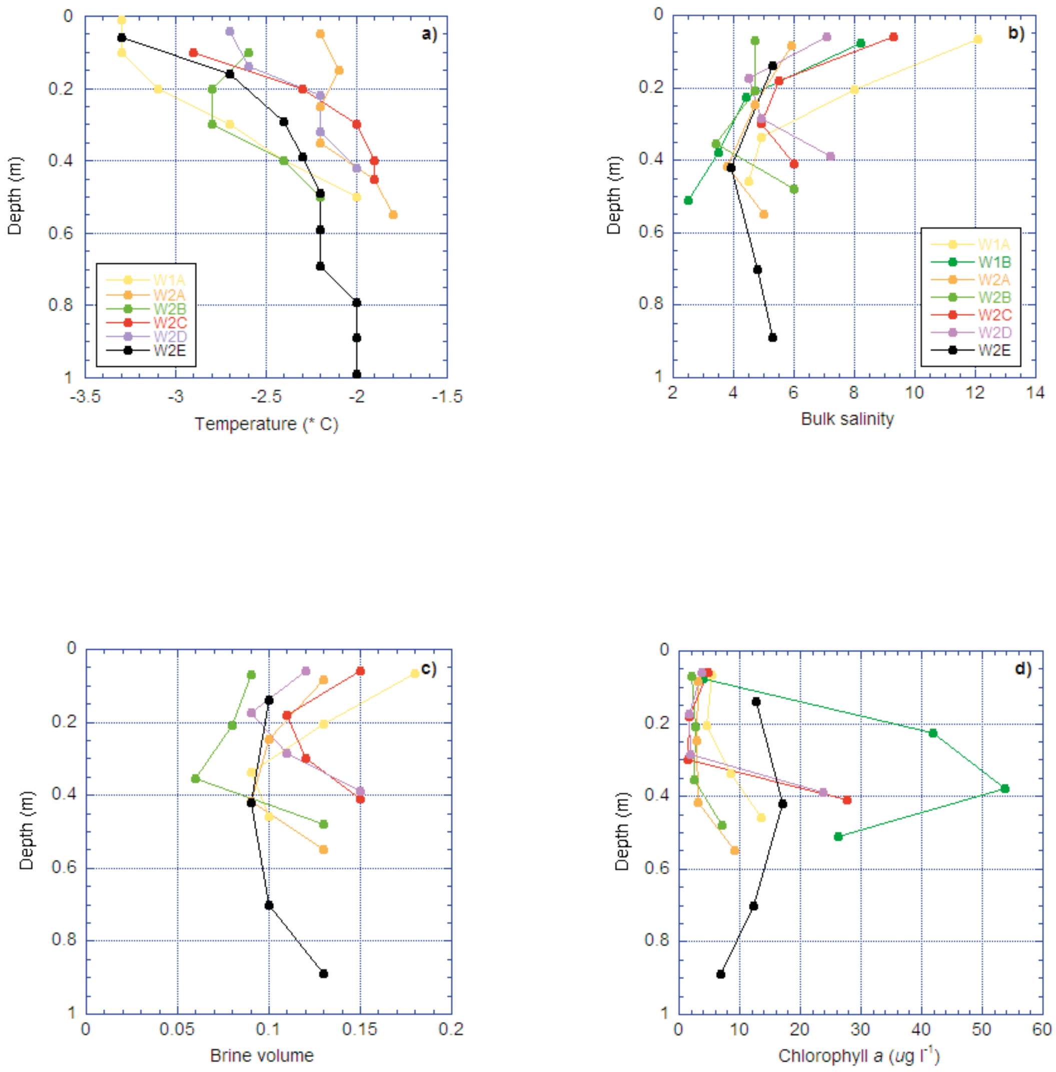


Fig. 6.1.1: Vertical profiles of a) sea ice temperature, b) bulk salinity, c) brine volume fraction (calculated according to Cox and Weeks (1983) and d) chlorophyll a concentration at the radiometer sampling sites.

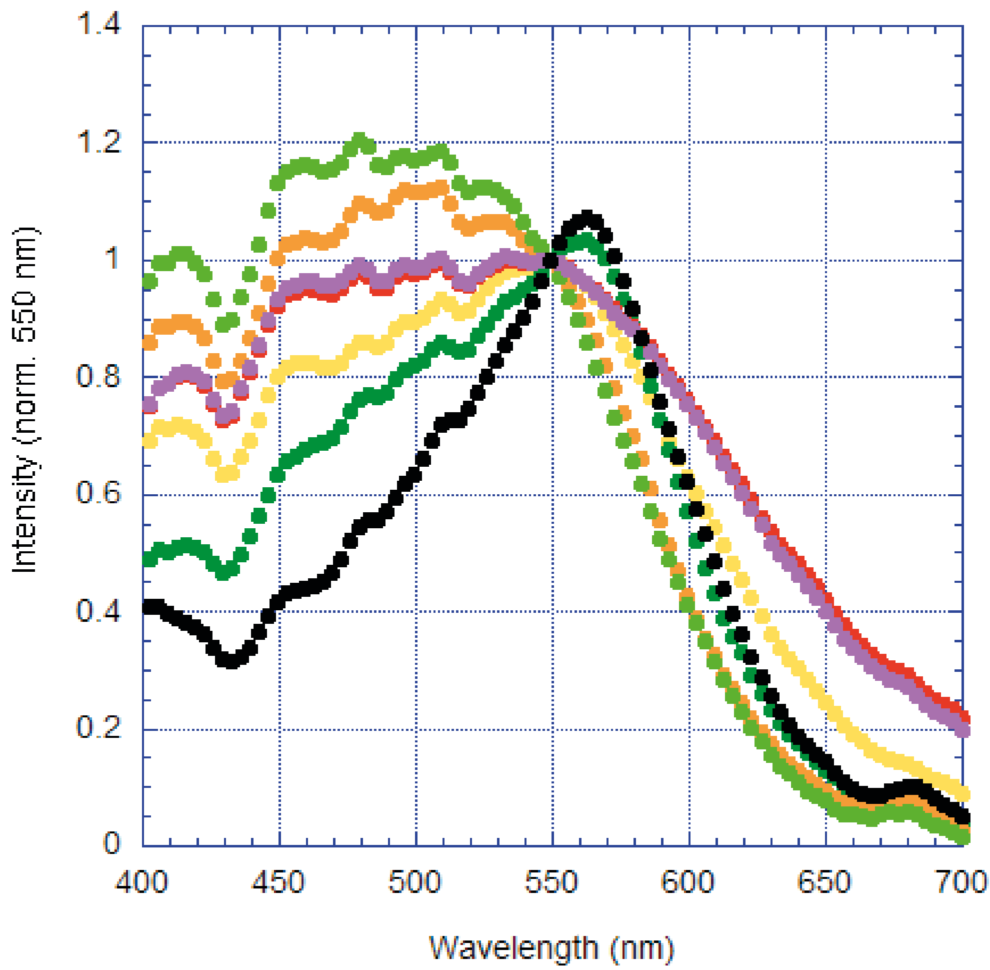


Fig. 6.1.2: Transmitted under-ice irradiance spectra (normalised to 550) nm. Colour code as given in Fig. 6.1.1.

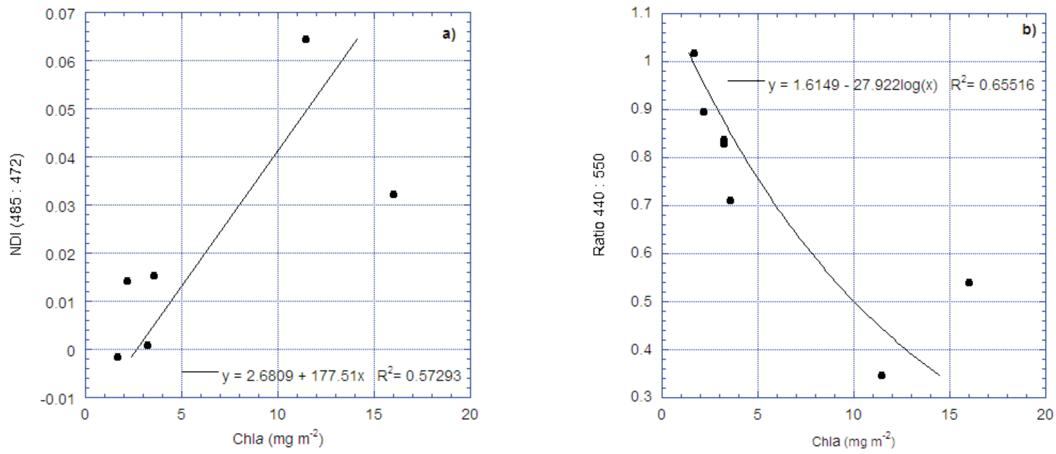


Fig. 6.1.3: Relationships between the integrated sea ice algal chlorophyll a concentration and a) Normalised Difference Index (calculated as: NDI = $(I_{485nm} - I_{472nm}) / (I_{485nm} + I_{472nm})$ and b) the ratio of the under-ice irradinance intensities at 440 nm and 550 nm.

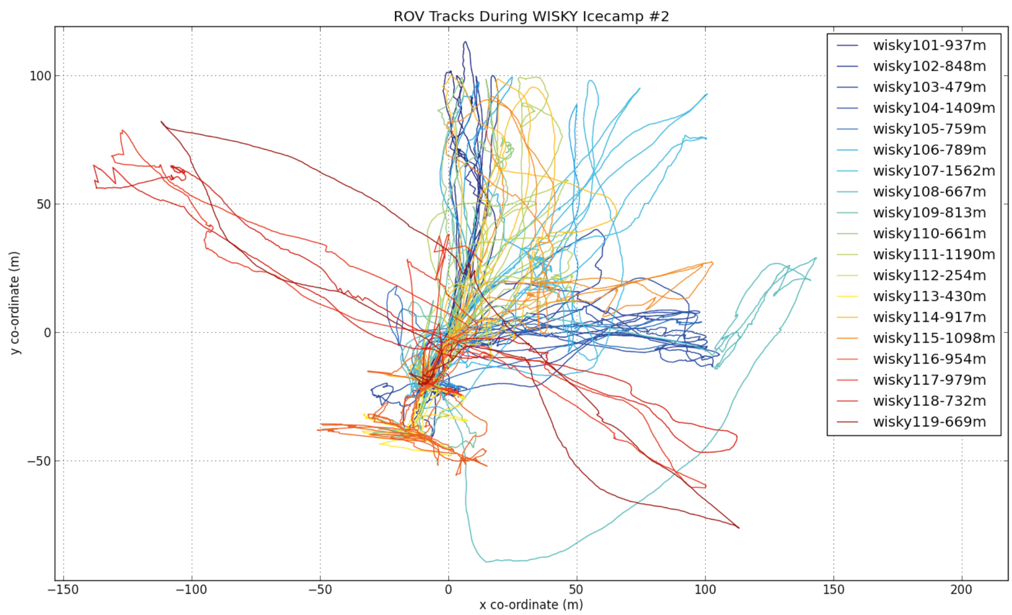


Fig. 6.1.4: Tracks surveyed with the Remotely Operated Vehicle during station (# Ice2)

Data management

Most of the data analyses will be carried out after the cruise. Raw and processed data will be registered and will be made publicly available through the Australian Antarctic Data Centre and/or PANGAEA Data Publisher for Earth & Environmental Science.

References

Arrigo K, Thomas DN (2004) Large-scale implications of sea ice biology in the Southern Ocean. Antarctic Science 16: 471-586

Atkinson A, Siegel V, Pakhomov E, Rothery P (2004) Long-term decline in krill stock and increase in salps within the Southern Ocean. Nature 432: 100-104

Cox GFN, Weeks WF (1983) Equations for determining the gas and brine volume in sea ice samples. Journal of Glaciology 29: 306–316

Honda MC, Sasaoka K, Kawakami H, Matsumoto K, Watanabe S, Dickey T (2009)Application of underwater optical data to estimation of primary productivity. Deep-Sea Research I 56: 2281-2292

Meiners KM, Norman L, Granskog MA, Krell A, Heil P, Thomas DN (2011) Physico-ecobiogeochemistry of East Antarctic pack ice during the winter–spring transition. Deep-Sea Research II 58: 1172-1181

Mundy CJ, Ehn JK, Barber DG, Michel C (2007) Influence of snow cover and algae on the spectral dependence of transmitted irradiance through Arctic landfast first-year sea ice. Journal of Geophysical Research 112: C03007, doi:10.1029/2006JC003683

6.2 Activities of the sea ice physics group during ANT-XXIX/7

Thomas Krumpen, Robert Ricker, Martin Schiller | AWI

6.2.1 AEM Bird ice thickness measurements

Objectives

The winter sea ice thickness in the Weddell Sea is poorly constrained by observational data. Data exists from upward-looking sonars and few *Polarstern* cruises. Satellite data of ice thickness is currently limited to the ICESat period, however a program exists to evaluate ice thickness retrievals from CryoSat-2 and thin ice thickness by SMOS.

One scope of airborne surveys during ANT-XXIX/7 was to obtain validation data for satellite retrieval algorithms of Antarctic winter sea ice thickness and to complement ice thickness measurements and sea ice surveys made during ANT-XXIX/6.

Work at sea

We used airborne electromagnetic (AEM) induction sounding to measure sea ice thickness by helicopter surveys. The instrumentation consists of a 4 m long sensor which is towed on a 20 m long cable at an altitude between 10 and 15 m above the ice surface. The method utilizes the difference of electrical conductivity between sea ice and sea water to estimate the thickness of sea ice including the snow layer if present. Two AEM Systems were applied: "Orphan" which was used during the first half of the cruise, and "MAiSIE" which was applied in the second half. The "MAiSIE" system is equipped with an aerial nadir camera (Canon EOS 5D Mk II) and an Inertial Navigation System.

Preliminary results

The flight operations were significantly hampered by weather conditions with low clouds and low contrast during the entire cruise. Therefore, only 5 flights were successfully performed in the vicinity of *Polarstern*, covering predominantly older first-year sea ice (first half of the cruise) and younger first-year sea ice (second half of the cruise). Fig. 6.2.1 and Table 6.2.1 provides an overview of AEM flights made during ANT-XXIX/7. Ice thickness data based on the "Orphan" sensor has been fully processed during the cruise and are available upon request as point data with an average spacing of 3 to 4 meters and a footprint of approximately 40 m. The data obtained by the "MAiSIE" sensor requires further processing and will be made available shortly after the cruise. In addition to ice thickness information, aerial images were acquired on the last flight with an aerial camera mounted inside the EM-Bird. Aerial images will be post-processed and geo-referenced based on Bird internal GPS and INS information. Depending on altitude, the images cover an area from below to several hundreds of meters.

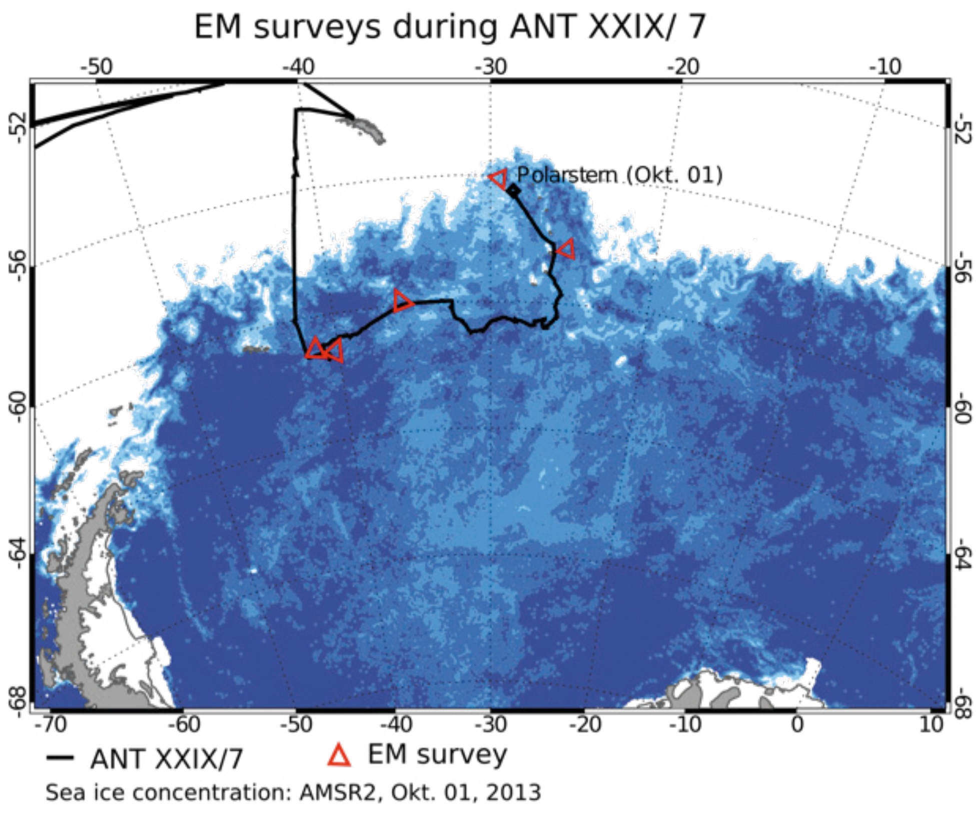


Fig. 6.2.1: Map of airborne electromagnetic induction sounding (AEM) surveys of sea ice thickness during ANT-XXIX/7.

Tab. 6.2.1: List of airborne sea ice thickness surveys during *Polarstern* cruise ANT-XXIX/7

Platform/ Device	Date	Lat/Lon	Label	Flight pattern	Comment
EM-Bird ‚Orphan'	20130829	-61.107/-41.0468	20130829_ allfinal	Triangle	*Flight covers homogenous level ice and deformed ice zones that are visible on the TSX1 scenes.*
EM-Bird ‚Orphan'	20130831	-61.288/-40.863	20130831_ allfinal	Triangle	*Partially covering ice floe of ice station 1* (PS81/555)
EM-Bird ‚Orphan'	20130910	-59.970/-34.076	20130910_ allfinal	Triangle	
EM-Bird ‚MAiSIE'	20130930	-58.015/-25.299	*Data requires post-processing in Bhv.*	Triangle	*Flight covers mostly thin ice near the ice edge.*
EM-Bird ‚MAiSIE'	20131001	-28,505/-56,665	*Data requires post-processing in Bhv.*e	Triangle	*Thin ice only (high percentage of cake ice).*

Data management

The sea ice thickness data will be released following final processing after the cruise in the PANGAEA Data Publisher for Earth & Environmental Science and international databases like the Sea Ice Thickness Climate Data Record (Sea Ice CDR).

6.2.2. Ground-based ice thickness and snow measurements

Objectives

Characterization of the state of the sea ice cover is of great importance for the evaluation of the polar climate system. Sea ice thickness datasets are sparse and rarely combine high resolution thickness information and high spatial coverage. Furthermore instrument design and processing techniques are usually based on a simple 1D representation of the sea ice layer and the ice cover is interpreted as level ice. This mostly affects thickness measurements of sea ice pressure ridges, whose thickness can be underestimated by as much as 50 percent.

For further development of EM sea ice thickness retrieval and high resolution thickness information a multi-frequency device (GEM-2) was used during this expedition. Similar to the AEM measurements, GEM-2 surveys made during ANT-XXIX/7 are a continuation of measurements made during ANT-XXIX/6. Main goal is to resolve with different sounding depths complex and small-scale sea ice thickness and conductivity structures. In addition, snow and sea ice thickness were measured to resolve the thickness distributions on individual floes. Data from the small footprint instrument GEM-2 will be compared to the larger footprint device EM-Bird. Furthermore, the GEM-2 data will be compared to winter Weddell Sea sea ice thickness time series, especially to 1989/1992.

Work at sea

We used the ground-based electromagnetic device GEM-2 to measure sea ice plus snow thickness. The method is based on the contrast of electrical conductivity between ocean water and sea ice (including snow). The instrumentation consists of two coils with separation of 1.67 m. The device was used either by putting the instrument down onto the snow or by pulling it over the sea ice mounted in a plastic sled. For calibration purpose a wooden ladder was used. The snow thickness during GEM-2 surveys was measured with a magnaprobe with a 2 m spacing. The device measures the snow depth and records it on a data logger for later downloading to a computer. The measurement is made by means of a sliding basket and magneto-strictive device.

Preliminary results

GEM-2 and magnaprobe surveys were made during both ice stations. A detailed list of performed GEM-2 and magna probe surveys is given in Table 6.2.2. The data was used to make assumptions on the stability of the floe, as well as to get insight into the ice and snow thickness distribution at the ROV and dive sides (Fig. 6.2.2). For further development of the method of EM sea ice thickness retrieval, GEM-2 data were acquired on 2 deformed sea ice structures along 40 meter transects. Round about 260 bore holes were drilled in order to measure freeboard and sea ice thickness and validate the GEM-2 data. Snow thickness information were obtained with the magnaprobe (Fig. 6.2.3 RIDGE_FIG).

Tab. 6.2.2: List of ground-based EM sea ice-thickness measurements and Magna Probe snow thickness measurements

Event	Location	Label	Magna probe invest.	Device	Date	Comment 1
PS81/555 GEM-1	Ice station 1	20130831_ Survey_001_gem	NO	GEM2	20130831	Ice thickness survey near ship for unloading operations and security
PS81/555 GEM-2	Ice station 1	20130901_ Survey_001_gem	YES	GEM2/Magne probe	20130901	Survey around ice station including ROV and dive side
PS81/555 GEM-3	Ice station 1	20130902_ Survey_001_gem	YES	GEM2/Magne probe	20130902	Survey around ice station including ROV and dive side
PS81/555 GEM-4	Ice station 1	20130903_ Ridge_001_gem	YES	GEM2/Magne probe	20130903	Ridge Survey 1
PS81/555 GEM-5	Ice station 1	20130904_ Ridge_001_gem	YES	GEM2/Magne probe	20130904	Ridge Survey 1
PS81/555 GEM-6	Ice station 1	20130907_ Survey_001_gem	YES	GEM2/Magne probe	20130907	Survey around ice station and above a ROV transect for validation

Event	Location	Label	Magna probe invest.	Device	Date	Comment 1
PS81/566 GEM-7	Ice station 2	20130918_ Survey_001_gem 20130918_ Survey_002_gem	YES	GEM2/Magne probe	20130918	Survey around dive and ROV camp and in between safety dive holes.
PS81/566 GEM-8	Ice station 2	20130919_ Ridge_001_gem	YES	GEM2/Magne probe	20130919	Ridge Survey 2
PS81/566 GEM-9	Ice station 2	20130923_ ROV_001_gem 20130923_ ROV_003_gem	YES	GEM2/Magne probe	20130923	Grid over ROV survey area (separate GPS file for reference frame available)
PS81/566 GEM-10	Ice station 2	20130925_ Survey_001_gem	YES	GEM2/Magne probe	20130925	Survey around ice station
PS81/566 GEM-11	Ice station 2	20130927_ Survey_001_ modgem 20130927_ Survey_002_ modgem	YES	GEM2/Magne probe	20130927	Survey near ship for TSX1 validation and around ice station
PS81/566 GEM-12	Ice station 2	20130928_ Survey_001_gem	NO	GEM2	20130928	Survey near ship for TSX1 validation and around ice station

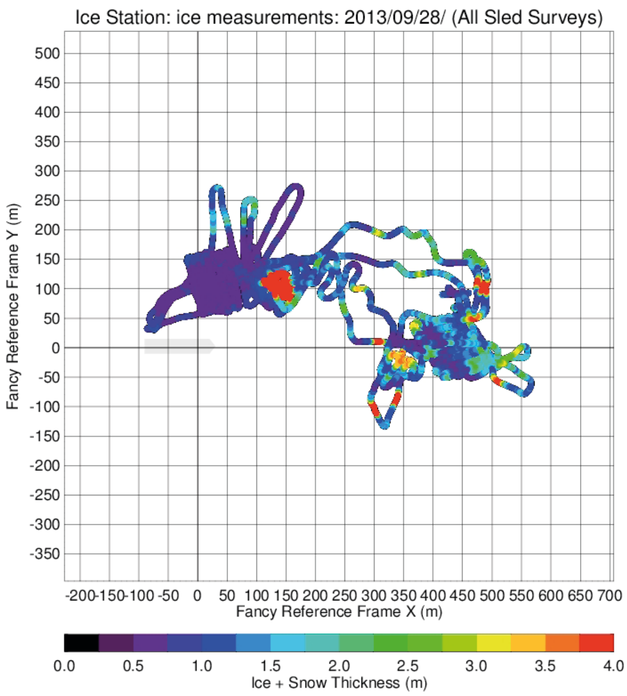


Fig. 6.2.2: GEM-2 ice thickness surveys performed between Sept. 09 and Sept. 18 (ice station 2, PS81/566). The color coding corresponds with the ice plus snow thickness. Data is projected to a reference frame relative to the ship position (grey box).

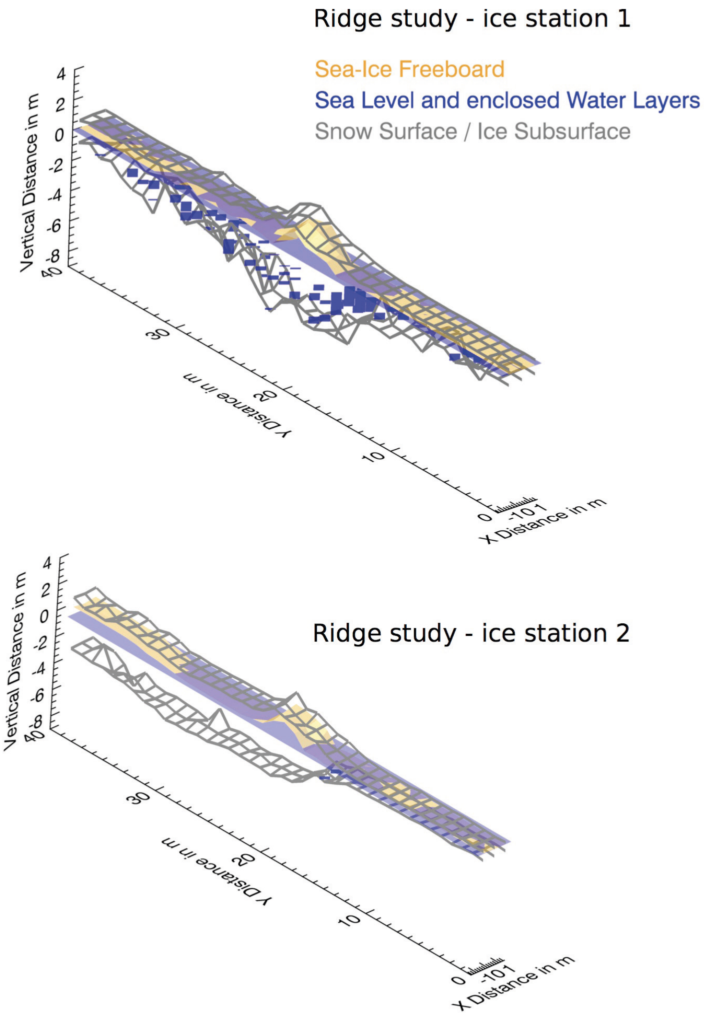


Fig. 6.2.3: Snow thickness, freeboard, and ice thickness measurements made along two ridges investigated during ice station 1 (PS81/555) and ice station 2 (PS81/566). Data was obtained through bore hole and magnaprobe measurements and will be used to validate and improve GEM-2 retrievals.

Data management

The magnaprobe and GEM-2 data will be released following final processing after the cruise in the PANGAEA Data Publisher for Earth & Environmental Science.

6.2.3. TerraSAR-X image acquisitions

Objectives

The aim of the TerraSAR-X image acquisitions is to extract information on sea ice deformation, drift patterns, the occurrence of leads, as well as the state of short-term seasonal variations in the snow cover. The information was used in the field to detect potential ice floes for ice station setups (Fig. 6.2.4) and to aid navigation (Fig. 6.2.5). Furthermore, TerraSAR-X derived sea ice information will be combined with *in-situ*, air- and ship-borne observations to investigate the role of sea ice and snow properties on Antarctic krill distribution in winter/spring. For a detailed description of the project objectives we refer to Busche *et al.* (2013, DLR proposal for scientific TerraSAR-X image acquisitions).

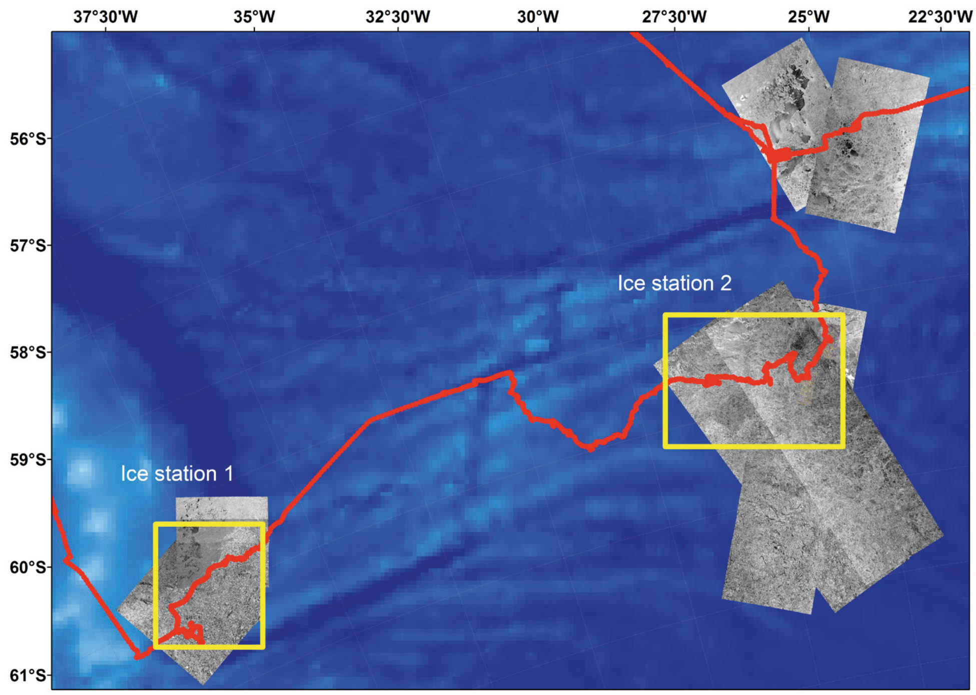


Fig. 6.2.4: TerraSAR-X scenes covering the ship's position and ice stations, obtained during ANT-XXIX/7 (Copyright: DLR)

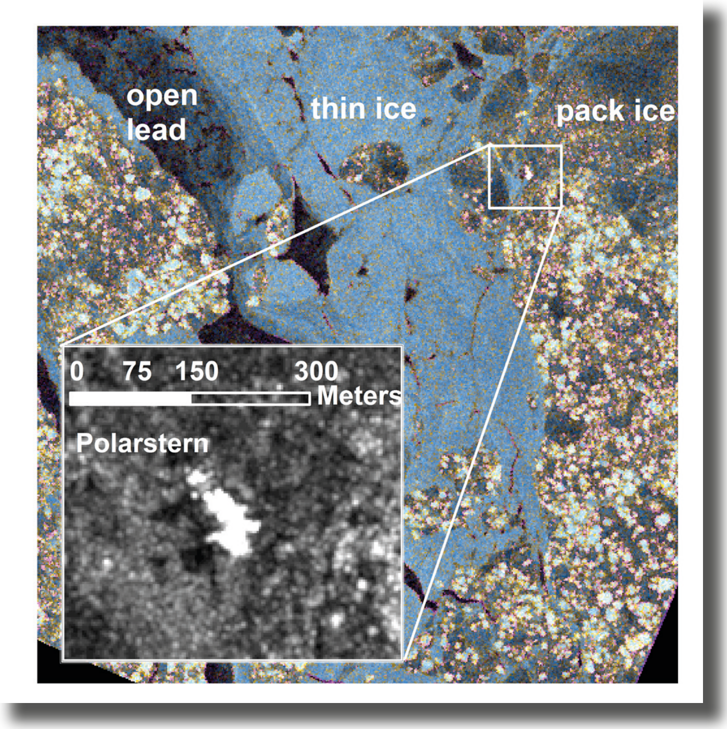


Fig. 6.2.5: TerraSAR-X scene acquired during the first ice station on September 03, 2103. On the enlargement Polarstern appears as a bright spot in the centre of the scene (Copyright: DLR)

Work at sea

TerraSAR-X acquisitions were placed on board based on the estimated ship position during time of planned image retrieval. After successful image acquisition and downlink, data were processed at the Realtime Data Centre in Neustrelitz and send to *Polarstern*. An automatic ship and iceberg detection algorithm is part of the processing chain. On average, images were retrieved on board approximately 3-4 hours after acquisition. Finally, data was post-processed for visualization in a geographical information system and provided to the cruise leader and bridge to aid in decision making in the field. Table 3 gives an overview of the acquired TerraSAR-X scenes during ANT-XXIX/7.

Tab. 6.2.3: List of acquired TerraSAR-X scenes during ANT-XXIX/7

Platform	**Product**	**Predicted acquisition time**	**Polar-stern match**	**Polari-zation**	**NRT delivery**	**Comment**
TerraSAR-X	ScanSAR	20130828_2159	NO	HH	NO	
TerraSAR-X	ScanSAR	20130829_2114	NO	HH	NO	
TerraSAR-X	ScanSAR	20130901_2224	NO	HH	YES	
TerraSAR-X	ScanSAR	20130902_2207	YES	HH	YES	*Scene covers ice station 1 (*PS81/555)
TerraSAR-X	Spotlight	20130903_0722	YES	HH	YES	*Not freely available, scene covers ice station 1 (*PS81/555)
TerraSAR-X	ScanSAR	20130905_0648	YES	HH	YES	*Scene covers ice station 1 (*PS81/555)
TerraSAR-X	Stripmap	20130908_0730	YES	HH/VV (dual)	YES	*Scene covers ice station 1 (*PS81/555)
TerraSAR-X	ScanSAR	20130908_2159	YES	HH	YES	*Scene covers ice station 1 (*PS81/555)
TerraSAR-X	ScanSAR	20130909_0713	YES	HH	YES	*Scene covers ice station 1 (*PS81/555)
TerraSAR-X	ScanSAR	20130911_0638	NO	HH	YES	
TerraSAR-X	ScanSAR	20130911_2107	NO	HH	YES	
TerraSAR-X	ScanSAR	20130912_0621	NO	HH	YES	
TerraSAR-X	ScanSAR	20130912_2049	NO	HH	YES	
TerraSAR-X	ScanSAR	20130914_2148	NO	HH	YES	
TerraSAR-X	ScanSAR	20130916_2115	YES	HH	YES	*Scene covers ice station 2 (*PS81/566)
TerraSAR-X	ScanSAR	20130917_0630	YES	HH	YES	*Scene covers ice station 2 (*PS81/566)
TerraSAR-X	ScanSAR	20130917_2057	YES	HH	YES	*Scene covers ice station 2 (*PS81/566)
TerraSAR-X	Stripmap	20130922_0638	NO	HH/VV (dual)	YES	
TerraSAR-X	Stripmap	20130922_2106	NO	HH/VV (dual)	YES	
TerraSAR-X	Stripmap	20130823_0621	YES	HH/VV (dual)	YES	*Scene covers ice station 2 (*PS81/566)

Platform	Product	Predicted acquisition time	Polar-stern match	Polari-zation	NRT delivery	Comment
TerraSAR-X	Stripmap	20130928_0630	YES	HH/VV (dual)	YES	*Scene covers ice station 2* (PS81/566)
TerraSAR-X	ScanSAR	20131004_0621	NO	HH	YES	
TerraSAR-X	ScanSAR	20131004_2050	NO	HH	YES	
TerraSAR-X	ScanSAR	20131005_0603	NO	HH	YES	
TerraSAR-X	ScanSAR	20131005_2033	NO	HH	YES	
TerraSAR-X	ScanSAR	20131007_1959	YES	HH	YES	*Ice edge zone*
TerraSAR-X	ScanSAR	20131008_0511	YES	HH	YES	*Ice edge zone*
TerraSAR-X	ScanSAR	20131010_2030	NO	HH	NO	*Open water*
TerraSAR-X	ScanSAR	20131011_1850	NO	HV	YES	*Open water*

Preliminary results

To aid image interpretation, information obtained from GEM-2 and magnaprobe surveys were linked to brightness values. Through this it could be shown that areas of generally darker appearance correspond with thinner pack ice with negative freeboard, whereas brighter areas coincide with thicker floes with a positive freeboard.

Data management

The project leader (PI) Thomas Busche (DLR), of the project "Investigation of the role of sea ice and snow properties on Antarctic krill distribution and condition in winter/spring" is the responsible person for the exclusively scientific use of the TerraSAR-X data. Because data remains property of the DLR, it will not be released in the PANGAEA Data Publisher for Earth & Environmental Science and is available upon request only. For data access, please contact Thomas Busche (DLR, Thomas.Busche@dlr.de), Egbert Schwarz (Egbert.Schwarz@dlr.de) or Thomas Krumpen (AWI, Thomas.Krumpen@awi.de).

References

Busche, T., Krumpen, T., Meyer, B., Meiners, K. (2013) Investigation of the role of sea ice and snow properties on Antarctic krill distribution in winter/spring, DLR Proposal for the scientific use of TerraSAR-X Data, accepted Aug., 2013.

6.3 DMSP (dimethylsulfoniopropionate) degradation and DMS (dimethylsulfide) production under sea ice as well as during zooplankton grazing

E. Damm AWI

Objectives

Air - sea ice - ocean interactions in the Polar Regions have a substantial impact on the oceanographic regime, natural biogeochemical cycles and global climate. However, our understanding of the fundamentals of the associated surface chemical, physical, and biological exchange processes that occur at relevant interfaces, particularly those associated with sea ice, is very limited. Changes in brine salinity and salt precipitation/dissolution cycles affect the solubility of gases (minor direct relationships for most gases, but quite dramatic, indirect relationships for carbon and sulphur dioxides) and organic solutes. These relationships dictate the physical controls on mass, gas and energy fluxes operating within the ocean-sea ice-atmosphere system and hence play an important role in chemical exchange across the sea ice interface.

DMSP is an abundant methylated substrate in the surface ocean and large amounts are produced annually by marine phytoplankton and in sea ice by ice algae, respectively. Hence, the DMSP turnover plays a significant role in carbon and sulphur cycling in the surface ocean and in sea ice. Especially, an understanding of the role of these methylated substrates in sea ice is still lacking. Demethylation dominates dissolved DMSP consumption and leads to formation of MMPA (3-mercaptopropionate) and subsequently methanethiol (MT). Cleavage of DMSP can be carried out by bacteria or by phytoplankton, and leads to formation of DMS (dimethylsulfide). DMS partly escapes to the atmosphere where it is oxidized to sulphuric acid and methanesulfonic acid. These sulfur-containing aerosols serve as cloud condensation nuclei altering the global radiation budget. Thus DMS may exert a cooling (negative) effect on earth's climate. The cycling of DMS and DMSP in the marine environment is controlled by bacterial activities and phytoplanktonic enzymes but also by zooplankton grazing. Under ice zooplankton grazing may also act as a sink for DMSP produced in sea ice. Experiments with grazing krill are planned to test the DMS/P acquiring from their phytoplanktonic food. As DMSP cleavage produces also acrylic acid, a broad spectrum antibiotic, its potential concentrating in their cells as a means to photo-protect delicate cells will be tested just as DMS that may act as an antioxidant neutralising oxygen radicals and therefore may also contribute to protect cells.

Work at sea

DMS and DMSP particulate and dissolved have been measured in sea water, sea ice and in zooplankton. Along the N-S transect DMS and DMSPt have been measured on water samples collected in Niskin bottles mounted on a rosette sampler at discrete depths throughout the water column up to 200 m water depth. Ice cores have been taken on the first and second ice station. Sea ice cores have been returned to the vessel and sectioned frozen in 5 to 10 cm slides. DMS has been immediately measured by gas chromatography equipped with a pulsed flame photometer (PFPD) and a purge and trap system. Measurements of DMSP total were conducted after alkaline cleavage as DMS. DMSP dissolved has been measured after melting in sea water at 4°C, filtering and cleavage. DMSP particulate results then from the difference of total and dissolved DMSP.

Slush and snow sampling have been carried out on the second ice station during 10 days twice a day. Further, during a freezing experiment 10 ice cores from new frozen sea ice, i.e. 2 up to 8 days old have been sampled. On the second ice station DMSPt and DMSPd have been measured on 28 ice cores sampled along three transects near the dive hole.

DMSPt have been analysed on zooplankton as well as on whole animals and compartments. Krill, pteropods, copepods and ice copepods have been investigated. Table 6.3.1 shows the overview of sampling during ice stations.

Tab. 6.3.1: DMS/DMSPt/DMSPd measurements during ANT XXIX-7

Location	Activities	Sampling
N-S transect	6 stations/up to 200 m	CTD, sea water
station 553	1 ice core	level sea ice
	zooplankton	ice copepods
station 555	7 ice cores	level/ridge sea ice
	zooplankton	ice copepods
		copepods
		krill
station 566	3 ice cores	level/ridge sea ice
	3 ice transects	transect EB
		8 cores
		transect ROV
		9 cores
		transect POL
		11 cores
	freezing experiment	10 ice cores
		2-8 days frozen sea ice
	slush/snow sampling	18.9 .- 28.9.2013
		twice a day
	zooplankton	krill
		pteropods

Preliminary results

At both ice stations, in level sea ice clearly higher DMSPt concentration have been detected than in ridge ice. Also the vertical DMSP distribution is quite different. The former shows a pronounced gradient in DMSP from the bottom to the top while the latter DMSP varies less along the whole core. Despite the different DMSP concentrations, it is noticeable that the DMS concentration is comparatively low in both ice types. In level sea ice DMS is correlated with DMSPt (Fig. 6.3.1).

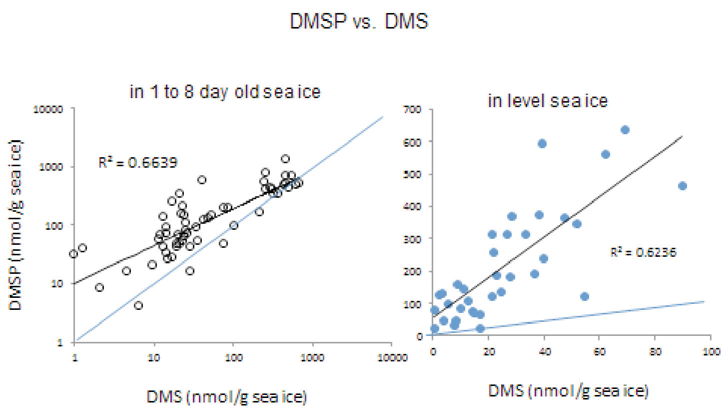
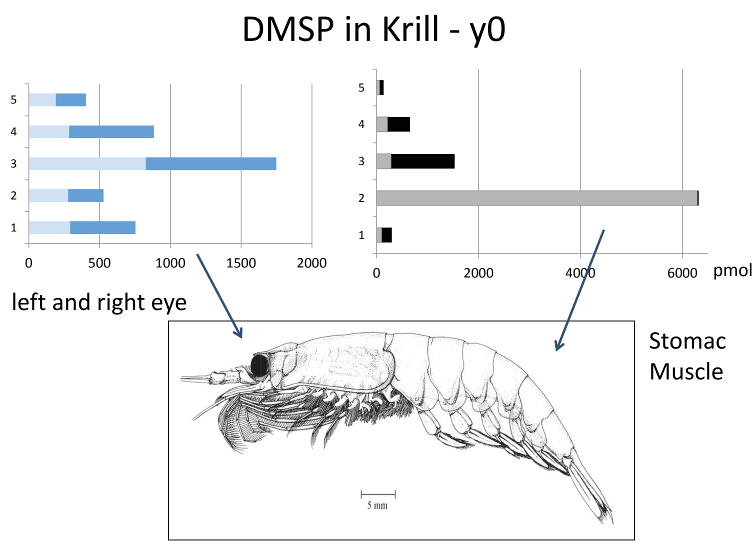


Fig. 6.3.1: DMSP versus DMS, DMSP concentrations are similar in level sea ice and fresh frozen sea ice, while the DMS content is clearly higher in young sea ice.

The freezing experiment highlights the development of DMSP distribution in sea ice over the duration of 8 days. DMSP enrichment starts in two distinct zones i.e. the top and the bottom. In freshly formed sea ice, distinctly less DMSPt and DMS concentrations have been detected in the middle part of sea ice while their DMSP concentration increases during ongoing sea ice aging. DMS concentration follows the DMSP pattern shown by the correlation between both. The freezing experiment reveals that in freshly frozen sea ice the DMS content is much higher compared to that in level sea ice (Fig. 6.3.1).

Measurements in zooplankton (Copepods, sea ice copepods, pteropods and krill) revealed high amounts of DMSP in animals living in or near the sea ice environment. Measurements in body compartments of krill clearly demonstrated that DMSP is enriched outside the stomach in muscles and especially in the eyes (Fig. 6.3.2).

Fig. 6.3.2: DMSP concentration in compartments of 5 krill larvae



Data management

All data obtained from this cruise will be uploaded to PANGAEA Data Publisher for Earth & Environmental Science.

6.4 Biogeochemistry of calcium carbonates from sea ice

Gernot Nehrke[1], Jörg Göttlicher[2], Gerhard Dieckmann[1] (not on board), Nikolaus Gussone[3](not on board)

[1]AWI
[2]KIT
[3]IMM

Objectives

The aim of the Biogeochemsitry group is to contribute to the understanding on how the geochemical signatures of the calcium carbonate mineral ikaite and the calcium carbonate test of the foraminifera pachyderma are related to their physicochemical environment, the brine within the Antarctic sea ice.

We propose a scientific program to determine the distribution of ikaite, especially the real distribution under the sea ice. The latter will allow investigating the possibility of ikaite entering the underlying water column. The comparison with data obtained from sea ice cores will allow to determine the spatial distribution of ikaite in sea ice, which will enable quantifying the effect of ikaite formation and dissolution on the carbon cycle. The geochemistry of the pachyderma will be analysed to determine to what extend their intermittent presence in the brine channels effect their shell geochemistry. The shell geochemistry of pachyderma represents an important proxy archive for paleo-climate reconstruction in the Antarctic realm.

During the formation of sea ice the main part of the ions dissolved in sea water can not enter the structure of solid water, and are enriched in residual solutions (brine) that fill channels and cavities in the ice. Recently, biological research focussed on the planktonic life in the system sea ice – brine. But also from a geochemical and mineralogical point of view brines are of interest because their high ionic strength may reach super-saturation at temperatures below 4 °C for the water containing calcium carbonate mineral ikaite ($CaCO_3$ x 6 H_2O) that has been described in antarctic and arctic sea ice (Dieckmann *et al.* 2008, 2010). Ikaite bounds CO_3-ions, and hence, may have an impact on the CO_2 exchange between ocean water and atmosphere. Since ikaite precipitation in brines changes their ionic composition with respect to Ca and carbonate brine biology could also be affected. In an approach of estimating the ikaite contents of Antarctic sea ice Fischer *et al.* (2013) mentioned an inhomogeneous occurrence of ikaite. This gave rise to further investigations during the 7th leg of the ANT-XXIX cruise of the *Polarstern* into the winter sea ice of the northern Weddell sea of intensifying the search for locations and conditions of ikaite formation.

Work at sea

At two ice stations (floes) samples from different depths of the sea ice and snow coverage were taken. Sampling includes frost flowers as well because of high salinities in their local environment and their low formation temperatures. The snow – ice interface might be of importance because snow coverage pushes the ice surface below the sea water level (negative freeboard) and snow can be infiltrated with water of high salinity. In total about 190 samples from different parts of the sea ice system were taken: about 60 cores and pieces of ice, about 60 samples from the interface ice – snow, about 50 snow samples, and 20 connected to frost flowers.

For depth dependent ice sampling a corer developed for drilling in such type of material was used (Fig. 6.4.1, Fig 6.4.2). Snow and samples from the snow ice interface can be taken just with a scratcher or scooper. Frost flowers having formed after cold and wet nights on new and hence thin ice are difficult to reach, but can be harvested from an opening in a crane basket ('Mummy Chair') that can be moved via the ship crane to the ice (Fig. 6.4.3, Fig. 6.4.4; frost flowers Fig. 6.4.5, 1.6). Samples were kept for an interim period at about -3 °C or were processed (melted, filtered and the filter residue spiked with Ethanol solution) below 4 °C in a cold laboratory on board ship of the *Polarstern*. Without this treatment ikaite decomposes within minutes to the calcium carbonate modification calcite ($CaCO_3$) and water (H_2O), and cannot be analyzed in the home laboratories any more. A preliminary determination of crystals detected in the filtration residue as ikaite is possible in the cold laboratory on board ship via light microscopy by its crystal shape. From previous expeditions crystals with that characteristic shape have been identified as ikaite with synchrotron X-ray diffraction at the Karlsruhe Institute of Technology (KIT, ANKA) and with Raman spectroscopy at the AWI.

Under ice sampling with a newly developed scratcher was tested, but the underwater ice topography made it difficult to collect sufficient material for further processing. Stalactite like structures under the ice where brine solutions flow alongside have been sampled together with seawater in its vicinity by using a small plastic container. After processing the sample in the cold laboratory and inspection with a light microscope no ikaite crystals were detected.

Ice and interface ice/snow Samples that could not be processed on board ship will be transported to the AWI for further processing.

Only a few out of several attempts were successful to extract brine solution by cryo-centrifugation of slices from ice cores because the semi-transparent separation plate of one centrifugation tubes broke and could not be replaced. And moreover centrifugation tubes had different net weights, and it was almost impossible to balance the masses because the centrifuge is also very sensitive to the mass distribution (liquids at the bottom of the tube, ice above the separation plate). A few gramme of deviation and the centrifuge stopped with an imbalance error and could not reach the required frequency of rotation.

Preliminary (expected) results

As one preliminary result of this cruise we can confirm an inhomogeneous distribution of ikaite in the ice. At the ice – snow interface accumulations of ikaite have been observed that contain several hundreds of ikaite crystals per litre molten sample whereas in similar sample locations in close vicinity the results were negative. By direct observation of the melting process in the cold laboratory on-board ship with a light microscope it has been shown that the ikaites originally were grown as nearly perfect crystals with sharp edges and faces (Fig. 6.4.7). Until now shapes of ikaite crystals with rounded edges were known (Fig. 6.4.8). The rounded shape might be a consequence of the melting in the laboratory where crystals are exposed for about 1 to 3 days in their own melt solutions of decreasing salinity with time. Alternatively, it may result when crystals are re-deposited in an environment of lower salinity. In a laboratory experiment with 'sharp-edged' ikaite rounding occurs after a couple of hours in a solution of salinity of 5 which is a common value for molten sea ice of medium depth.

In the few attempts of getting access to the brine solution by cryo-centrifugation, brines of salinities between about 40 and 50 have been determined, but ikaites did not move out with the brine. Hence, cryo-centrifugation seems to be a method suitable for extracting the brines from ice core sections but not for extracting the ikaites themselves. It is planned to repeat cryo-centrifugation on frozen ice cores and on ikaite synthesis at the AWI. Therefore, the determination of the salinity on-board ship was restricted to measurements of the bulk salinity in the melting solution, as it is shown in Fig. 6.4.9 for the so far processed samples. The different compartments snow, ice core, interface ice-snow, and frost flowers are characterized by increasing mean salinities in the given order.

Fig. 6.4.1: Drilling of ice cores (photo Jörg Göttlicher)

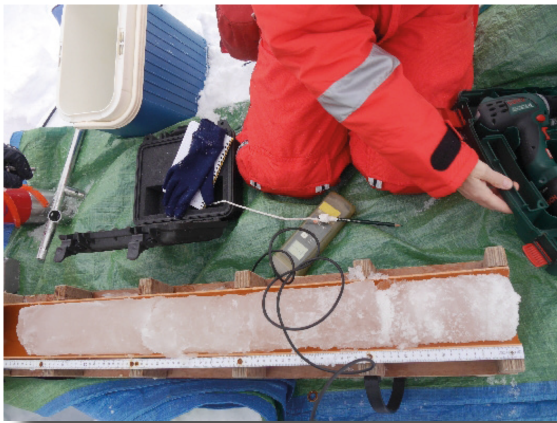


Fig. 6.4.2: Ice drilling core; directly after sampling the temperature profile is being measured (photo Jörg Göttlicher).

Fig. 6.4.3: Trip to the frost flower ‘harvesting’ with the crane basket (‚Mummy Chair’), (photo Michelle Nerentorp)

Fig. 6.4.4: Sampling through the bottom opening of the crane basket (photo Jörg Göttlicher)

Fig. 6.4.5: Frost flowers on young sea ice; long edge of the image about 15 cm (photo Jörg Göttlicher)

Fig. 6.4.6: Frost flowers of different appearance. Here ikaites have been detected; long edge of the image about 50 cm (photo Jörg Göttlicher).

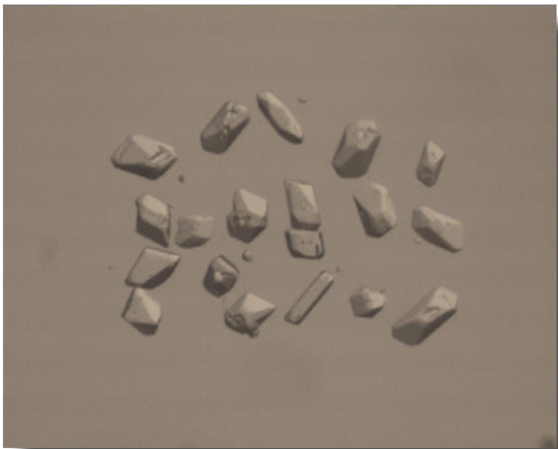


Fig. 6.4.7: Nearly perfect crystals of ikaite; long edge of the image about 3 mm (photo Jörg Göttlicher)

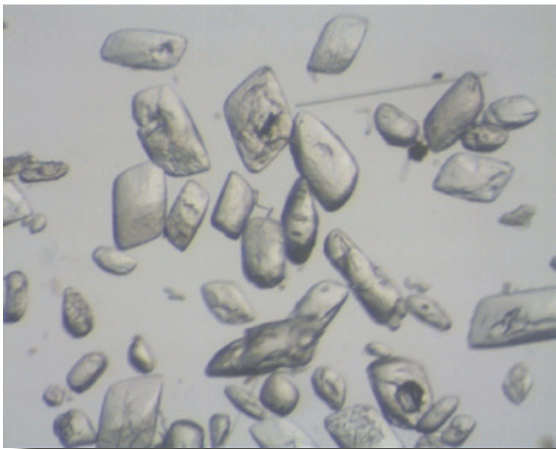


Fig. 6.4.8: Ikaites with rounded edges, most probably as a consequence of staying in solutions of low salinity; long edge of the image about 2 mm (photo Jörg Göttlicher).

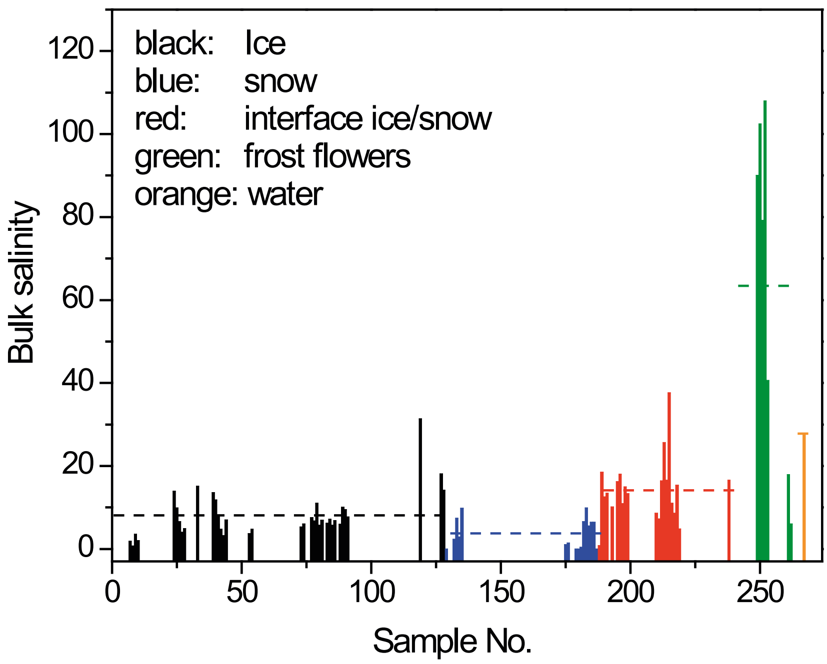


Fig. 6.4.9: Bulk salinity vs. sample No. Samples from different compartments of the system sea ice are ice (black), snow (blue), interface (red), frost flowers (green) and water (orange). Gaps are meaning that data will be later available. Dashed lines represent the mean values of salinities for the compartments: ice (8.1), snow (3.4), interface ice/snow (11.1), frost flowers (63.4), water from borehole (27.8). Not all data from the samples are included yet in this figure

Ikaites have also been found in connection with some frost flowers in an environment of extreme high salinity of 90 to 100 as nearly perfect crystals. Besides ikaite another crystalline phase has been observed: Crystals that were present during the melting process and rapidly dissolved when the melting process is finished. Because of the high sulfate and sodium contents of the frostflower brine the crystals are assumed to be mirabilite, a water containing sodium sulfate (Na_2SO_4 x 10 H_2O). The crystals are difficult to preserve. The dissolution could be stopped, when incompletely melted sample has been filtrated with 75 % ethanol water solution. Concerning the ikaites from the frost flower samples one half of one sample has been stored in 75 % Ethanol – water solution after filtration and the other half in their own filtrate of high salinity in order to check if solutions of high salinity can be used as storage medium for ikaites. So far ikaites have been about 20 days in ethanol or high salinity brine solution. For the latter the quality of the crystals was checked, and no rounding of edges has been found after 20 days. In the case of frost flowers the salinity of the molten frost flower solution is most probably very close to the salinity of its brine because the ice fraction in such a system is very small. For the other samples with high ice fraction this procedure will not work because salinity after melting is too low to be used as storage medium for ikaites after extraction. Here, solutions of high salinity have to be prepared separately when storage in such media is considered. Exposure of ikaites to solutions with, e.g. salinity of about 5 causes a rapid attack of the solution to ikaites and results within a few hours in ikaites where edges are rounded. Keeping ikaites in their own melting solutions before filtration for several hours, results in an underestimation of their mass due to substance loss by dissolution. In principle, dissolution of ikaite starts with the ice melting because the salinity of the molten fraction is decreasing from the time when ice is melting and mixing with the effluent brine. A method for correcting this loss or a modified processing technique should be developed. A technology where melting solution and ikaite are being continuously removed by filtration and by cleaning of the filter, respectively, is suggested. Such an ikaite 'extractor' might be constructed and tested under laboratory conditions at AWI and later on board ship during polar expeditions. If this concept turns out to operate routinely, a further step towards an ikaite 'harvester' shall be considered. Its construction may contain elements of the micrometeorite harvester, recently developed and described by Duprat *et al.* (2013). Whereas the micrometeorite harvester is designed to work at higher temperatures the challenge for an ikaite 'harvester' will be its restriction to a processing temperature below 4 °C.

More than 100 of filtrate solutions have been kept and were frozen at -20 °C in order to check their potential of ikaite precipitation. Filtrates have also been transported at 4 °C to the AWI for chemical analyses. Solutions shall be checked for their Ca contents mainly.

This study will deliver additional results about the formation and distribution of ikaite, and hence, will contribute to the knowledge about the role of ikaite in the sea ice system with relation to CO_2 exchange and sea ice biology.

Sampling of the foraminifera has been finished during the 6th leg of ANT-XXIX. Because sample transport from Punta Arenas to AWI were not possible, samples remained on board ship in the cold lab at about +4 °C in darkness during the 7th leg, and will be shipped from Cape Town to AWI in a +4 °C container. Foraminifera samples will be investigated in the home laboratories.

Data management

Data on the samples will be completed in the home laboratories at AWI and KIT and delivered to PANGAEA Data Publisher for Earth & Environmental Science within two years after the cruise. Ice cores that have been not processed on board will be stored in the cold storage facilities of the AWI until further processing.

References

Dieckmann GS, Nehrke G, Papadimitriou S, Gottlicher J, Steininger R, Kennedy H, Wolf-Gladrow D, Thomas DN (2008). Calcium carbonate as ikaite crystals in Antarctic sea ice, Geophysical Research Letters, 35 (8), L08501, doi:10.1029/2008GL033540.

Dieckmann GS, Nehrke G, Uhlig C, Goettlicher J, Gerland S, Granskog MA, Thomas DN (2010) Brief Communication: Ikaite ($CaCO_3$ x $6H_2O$) discovered in Arctic sea ice, Cryosphere, 4 (2), 227-230.

Duprat J, Dachwald B, Hilchenbach M, Engrand C, Espe C, Feldmann M, Francke G, Görög M, Lüsing N, Langenhorst F (2013). The MARVIN project: a Micrometeorite hARVester IN antarctic snow. 44th Lunar and Planetary Science Conference, The Woodlands, Texas, USA, March 18-22, 2013.

Fischer M. Thomas DN, Krell A, Nehrke G, Göttlicher J, Norman L, Meiners KM, Riaux-Gobin C, Dieckmann GS (2013) Quantification of ikaite in Antarctic sea ice, Antarctic Science 25(3), 421–432.

7. PLANKTON ASSEMBLAGE COMPOSITION, CHLOROPHYLL, NUTRIENTS, PARTICULATE AND DISSOLVED ORGANIC CARBON, BIOGENIC SILICA, STABLE SILICON ISOTOPES, HYDROGRAPHY (CTD)

Christine Klaas[1], Jana Hölscher[1],	[1]AWI
Sebastian Rössler[2], Aneesh	[2]FIELAX
Bose[3], Dieter Wolf-Gladrow[1]	[3]UNI-ONT

Objectives

Expeditions to the Southern Ocean during winter are challenging to undertake, and thus *in-situ* investigations of conditions during this period of the year are scarce. Our work will provide important information as to the nutrient conditions and plankton standing stocks at the beginning of the growth season, in the Southern Antarctic Circumpolar Current and the Weddell Gyre. The data collected will, among others, be used to make budget estimates of productivity and nutrient uptake for the Atlantic sector of the Southern Ocean. Furthermore, the collected dataset will provide the basic information required to validate certain coupled general ocean circulation-biogeochemistry models. Finally, we hope to improve our understanding of the distribution patterns and population dynamics of key plankton species, and elucidate their contribution to particulate matter sedimentation in the water column in this important region of the World's Oceans.

Work at sea

During ANT-XXIX/7 65 CTD profiles were performed at 57 stations (Fig. 7.1). The operated CTD (conductivity-temperature-depth) system was a Sea-Bird Electronics Inc. SBE 911+ system. The unit was equipped with duplicate sensors for temperature (SBE3+, S/N 2929 and S/N 5027) and conductivity (SBE4C, S/N 2470 and S/N 3585) and a pressure sensor (Digiquartz, S/N 0321) and was connected to a SBE 32 carousel water sampler (S/N 718) with 24 12-liter Niskin bottles. Additionally, a Benthos altimeter (S/N 47768), a Wetlabs C-Star Transmissiometer (S/N 1220), a Wetlabs FLRTD Flourometer (S/N 1670) and a SBE43 dissolved oxygen sensor (S/N 1605) were mounted. The computation of oxygen concentration requires temperature, salinity and pressure, which are measured by the CTD system. Most casts were made to a depth of 1,000 m.

For the validation of the conductivity sensors, 64 water samples were taken from rosette bottles of 22 casts. The salinity was measured using an Optimare Precision Salinometer (Optimare Sensorsystems AG Bremerhaven, Germany), which was standardized with Standard Water Batch p152. Due to a measured increasing offset, the conductivity sensor of the first sensor pair was replaced (09/09/2013) during the cruise with a spare sensor (S/N 3173). Also the oxygen sensor was replaced (17/10/2013) by a spare sensor (S/N 1834) due to high deviations at temperatures around 0°C.

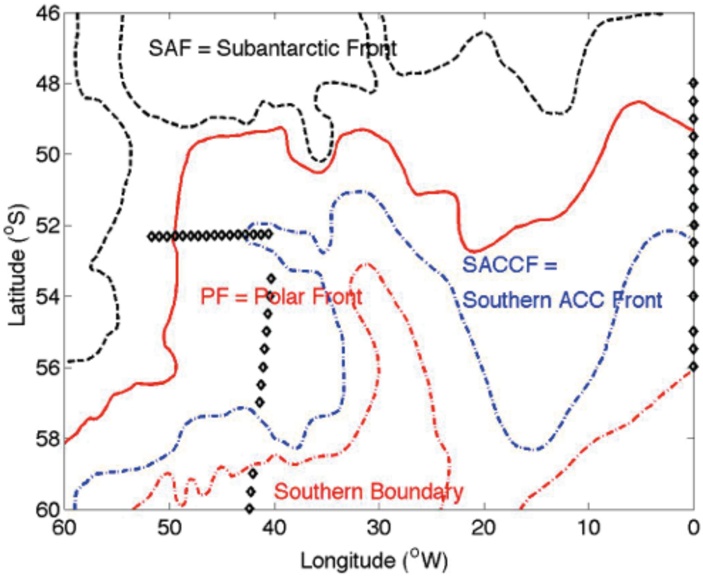


Fig. 7.1: Stations (black diamonds) of the three CTD transects and positions of oceanic fronts according to Orsi et al. (1995).

The collected data from each cast was processed using SBE Data Processing 7.22 (Sea-Bird) software. The results are available as data tables in 1 dbar intervals, graphical plots and bottle files containing averaged sensor values for each water sample taken. For the three sections, the processed tables were imported to the software OceanDataView (by Reiner Schlitzer, AWI), which allows the interpolation to 2-dimensional section plots of the measured parameters.

200 and 100 mL water samples for microscopic analyses of protist assemblage (phyto- and protozooplankton) were obtained from Niskin bottles attached to a Conductivity Temperature Depth (CTD) rosette from 10 discrete depths between 10 and 250 m at each station. One set of samples (200 mL) was preserved with hexamine-buffered formalin solution, and the other (100 mL) with acidic Lugol's iodine at a final concentration of 2 % and 10 %, respectively. Additionally, samples for nano- and picoplankton assemblages were collected at the same depths, fixed with 0.1 % glutaraldehyde and kept frozen at -80°C for further analysis in the home lab.

Water samples for determination of Chlorophyll a (Chl *a*), biogenic silica (BSi), particulate and dissolved organic carbon (POC and DOC), and particulate and dissolved organic nitrogen (PON and DON) were obtained from the same bottles and depths as for the microscopic and flow cytometry analyses. Chl *a* samples were filtered onto 25 mm diameter GF/F filters at pressures not exceeding 200 mbar. Filters were immediately transferred to centrifuge tubes with 6 ml 90 % acetone and 1 cm^3 of glass beads. The tubes were sealed and stored at –20°C for at least 30 min and up to 24 hours. Chl *a* was extracted by placing the centrifuge tubes in a grinder for 25 seconds followed by centrifugation at -10°C for 5 min at 4,000 rpm. The supernatant was poured into quartz tubes and measured for Chl *a* content in a Turner 10-AU fluorometer. Calibration of the fluorometer was carried out at the beginning and at the end of the cruise. Chl *a* content was calculated using the equation given in Knap *et al.* (1996).

2L seawater samples for BSi were filtered onto 25 mm diameter 0.65 µm pore size polycarbonate filters and stored in Eppendorf tubes for later BSi analysis A similar volume was filtered onto pre-combusted GF/F filters and stored in pre-combusted glass petri dishes for later POC and PON analysis. After filtration, all filters were dried overnight at 50°C and stored at (-20°C) for transport back to lab.

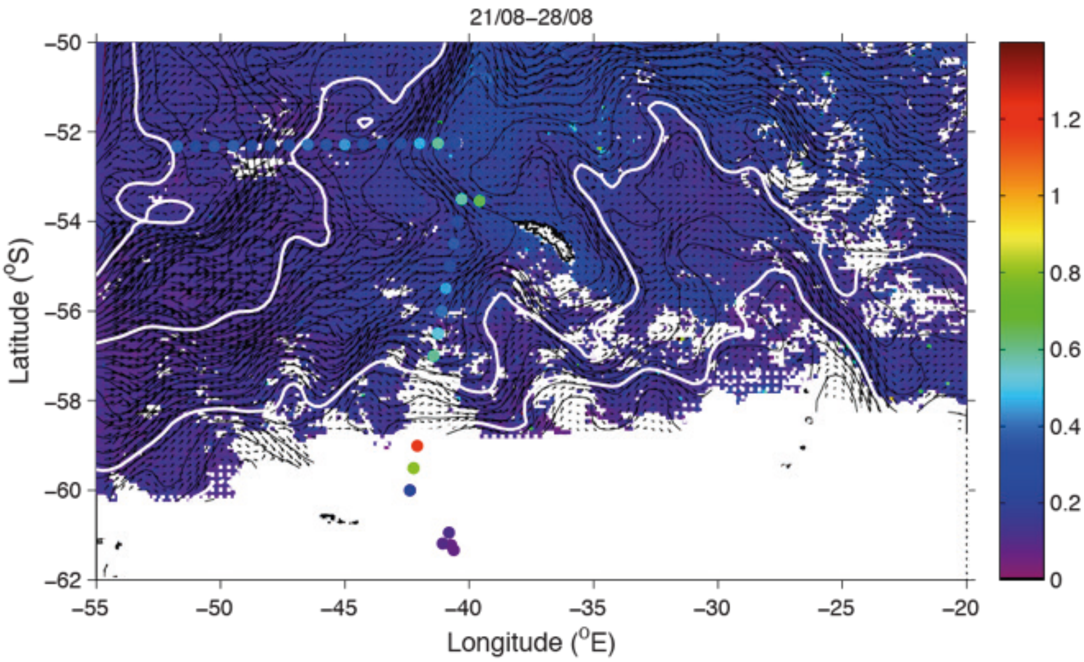


Fig. 7.2: Surface Chlorophyll a concentrations in mg m^{-3} (coloured dots) measured during the first 2 transects. Background colour represents, on the same colour scale, the SeaWIFS Chlorophyll a climatology calculated for the study period based on 9 km resolution / 8 days composite data obtained from http://oceancolor.gsfc.nasa.gov. White lines indicate average positions of the Subantarctic, Polar, Southern ACC fronts and the Southern Boundary based on Venables et al. (2012) and absolute dynamic height data from Aviso (Rio and Hernandez, 2004).

Samples (~60 mL) for DOC and DON analysis were filtered through pre-combusted GF/F filters using an HCl-cleaned glass filtration unit. The procedure was repeated 3 times for each sample in order to rinse the vials and the filtration unit, keeping the last filtrate for analysis. The final filtrate was collected directly into HCl-rinsed plastic (HDPE) bottles and frozen (-20°C) for further analysis on land.

Additional 50 ml water samples were obtained from the rosette sampler from all depths for nutrient analyses. After collection, nutrient samples were transferred into 15 mL polyethylene vials, and placed in the sampler after rinsing twice. All analyses were performed with an auto-analyser QuAAtro in combination with AA3-Analyzer from Seal Analytical. Calibration standards were diluted from stock solutions of the different nutrients in artificial seawater containing sodium chloride and sodium-hydrogen-carbonate. The artificial seawater was also used as baseline water for the analysis between samples. Each run of the system had a correlation coefficient of at least 0.9999 for 8 calibration points, but typical 1.0000 for linear chemistry. Nutrients were measured from all sampled depths along each CTD profile. On both manifolds of the QuAAtro, all samples and standards were brought to ~40°C with the exception of ammonia, where a water bath was used to heat the samples and standards to 75°C for the formation of the colour complex. Concentrations were recorded in µmol per litre (mmol m^{-3}). During each run a mixed nutrient standard, containing silicate, phosphate, nitrate and ammonia (a so-called "nutrient cocktail"), was measured four times. The QuAAtro was calibrated with calibration standards every second week. From nearly every station a duplicate sub-sampled for nutrients analysis was stored in the dark at -20°C, and transported back to the Alfred Wegener Institute. In total, more than 1,500 samples were analysed for phosphate, silicate, nitrate and ammonia.

Sampling for stable silicon isotopes was performed at 12 stations in the Scotia Sea. 10 to 20 L from a depth of 40 m were filtered (polycarbonate, 0.6 mm). Filters were then dried overnight at 50°C and stored frozen (-80°C) for further analysis on land. Two 0.5 L samples of the filtered seawater were stored at +4°C for further analysis on land.

In order to study seasonality in the composition and magnitude of fluxes to the deep ocean in areas that are naturally fertilized by iron supply from the continental shelves, a long-term (1 year) mooring equipped with sediment traps was recovered in the Georgia Basin and another deployed near the South Sandwich Islands.

Preliminary (expected) results

In order to study winter conditions in the Southern ACC, three main CTD transects were carried out crossing the main frontal structures, namely, the Polar Front, the Southern ACC front and the Southern Boundary. The position of the CTD casts with respect to the fronts' positions based on Orsi *et al.* (1995) is given in Fig. 7.1. Results from the Chlorophyll *a* surveys (Figs. 7.2 and 7.3) shows surprisingly high accumulation of phytoplankton biomass early in the growth season. Consistent with previous observations (Smetacek *et al.*, 2012), high Chlorophyll *a* concentrations (almost 1 mg m^{-3}) could be observed near the Polar Front despite deep mixed layers (100 m or more; Figs. 7.3 and 7.4).

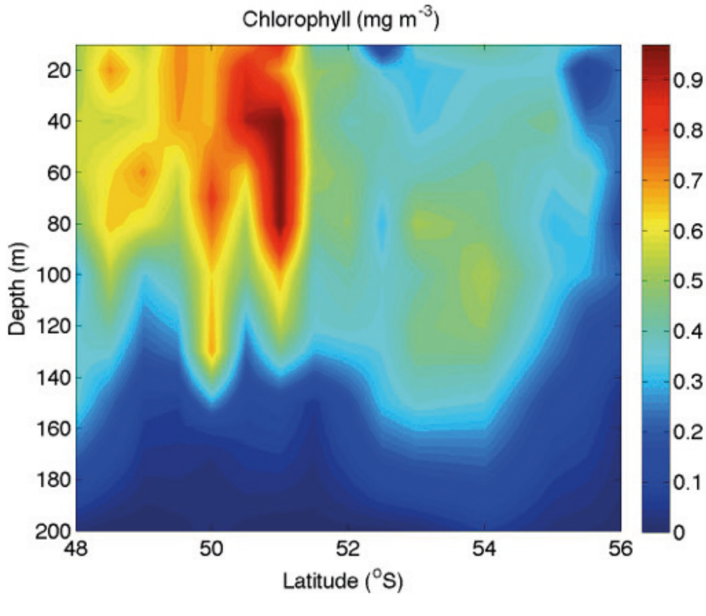


Fig. 7.3: The chlorophyll concentrations along the Greenwich meridian transect. High concentrations (almost 1 mg m^{-3}) are observed in deep mixed layers (100 m or more) near the Antarctic Polar Front.

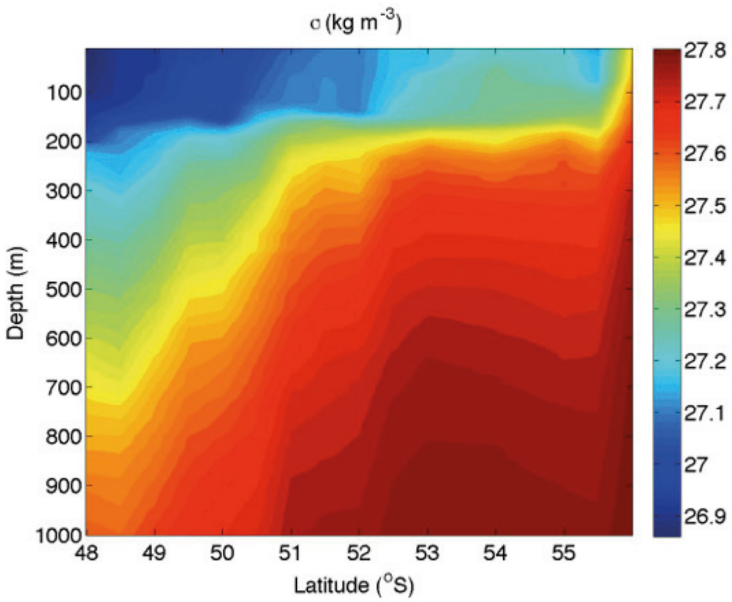


Fig. 7.4: Potential density s_q (kg L^{-1}), along the transect on the Greenwich meridian. The following fronts are clearly visible: (1) Antarctic Polar Front (50 to 51°S), (2) Southern ACC Front (52 to 52.5°S), (3) Southern Boundary (55.5 to 56°S).

At the Greenwich meridian (Fig. 7.4), the Antarctic Polar Front (50 to 51°S) is further south than expected from the analysis of Orsi *et al.* (1995), whereas the Southern ACC Front (52 to 52.5°S) and the Southern Boundary (55.5 to 56°S) occur at positions consistent with Orsi *et al.* (1995).

Data management

All data obtained from this cruise will be uploaded to PANGAEA Data Publisher for Earth & Environmental Science.

References

Knap, A., Michaels, A., Close, ., Ducklow H. & Dickson, A. (eds.) (1996) Protocols for the Joint Global Ocean Flux Study (JGOFS) Core Measurements. hdl:10013/epic.27912.d001.

Global Ocean Flux Study (JGOFS) Core Measurements (1994) JGOFS Report Nr. 19, vi+170 pp. Reprint of the IOC Manuals and Guides No. 29, UNESCO 1994.

Orsi, A., Whitworth, H.T., & Nowlin, W. D. (1995) On the meridional extent and fronts of the Antarctic Circumpolar Current. Deep Sea Research Part I: Oceanographic Research Papers, 42(5), 641-673.

Rio, M.-H. & Hernandez, F., (2004) A mean dynamic topography computed over the world ocean from altimetry, in-situ measurements, and a geoid model. J. Geophys. Res. 109 (C12032). doi:10.1029/2003JC002226.

Smetacek V, et al. (2012) Deep carbon export from a Southern Ocean iron-fertilized diatom bloom. Nature, 487, 313-319.

Venables, H., Meredith, M. P., Atkinson, A. & Ward, P. (2012) Fronts and habitat zones in the Scotia Sea. Deep-Sea Research II, 59-60, 14-24.

8. ATMOSPHERIC CHEMISTRY

Hans-Werner Jacobi[1], Jan-Marcus Nasse[2], Michelle Nerentorp[3], Johannes Zielcke[2], Martin Schneebeli[4] (not on board)

[1]LGGE
[2]UHD
[3]CHALMERS
[4]SLF

Objectives

Periods with depletion of atmospheric ozone and mercury are recurrent events in both Polar Regions, which have been observed during springtime for more than 20 years. These events are initiated and driven by reactive halogen species (RHS) that are generated from the ubiquitous sea salt in the marine environment. Major species are bromine-containing compounds like BrO, Br, and HOBr, but similar chlorine and iodine compounds may also contribute. While ozone reacts to molecular oxygen, the elemental mercury is transformed into oxidized and more soluble species. As a result, the reactive mercury compounds generated during the depletion events are quickly removed from the atmosphere either by dry deposition or after transfer to particles in the form of particulate mercury. By this pathway, mercury can efficiently enter the cryospheric or marine system with a potentially harmful impact on the ecosystems in these compartments. Moreover, iodine can contribute to new particle formation and chlorine radicals reduce the lifetime of potent greenhouse gases like methane. Therefore, RHS may influence the polar (and potentially global) climate system.

While the chemical mechanisms in the atmosphere driving the depletion of ozone and mercury are relatively well understood, the compartment in which the non-reactive sea salt is transformed into RHS is still not well identified. The largest amounts of RHS are released over sea ice-covered regions in both Polar Regions as well documented by satellite data of BrO. However, in these environments several different sea salt-containing compartments exist ranging from sea water, sea salt aerosols, different types of newly formed sea ice, frost flowers, and older snow-covered sea ice. The salinities in these compartments can range from higher than 100 in frost flowers and brine on new ice to zero in surface snow, where sea salt concentrations depend mostly on the deposition of sea salt aerosols. In contrast, reactive iodine species do most likely not originate from sea salt, but from biogenic iodine compounds released to the atmosphere and undergoing subsequent photolysis.

The direct and simultaneous detection of ozone, mercury, and mercury species and halogen oxides will help to address the following questions:

- What is the extent of ozone and mercury depletions in Antarctica?
- What is the source of reactive bromine in polar spring? It is still unknown on which kind of surfaces (e.g. first-year sea ice, open leads, frost flower fields, brine) the heterogeneous release of bromine actually occurs.

- To what extent is BrO released from blowing snow and the snowpack?
- What is the vertical distribution of reactive halogens in Polar Regions?
- How do huge amounts of iodine radials accumulate in the Antarctic snowpack, how can these be sustained, and why is reactive iodine found in Antarctica, but not in the Arctic?
- What is the influence of photo reduction of divalent mercury in sea ice, water and snow in comparison to previous data obtained during Antarctic summer?
- How is the evasion of mercury from Polar Regions influenced by sea ice?
- What processes govern mercury cycling between atmosphere/sea ice/ seawater and can we quantify the associated fluxes?
- Does the lack of sunlight influence concentrations of DGM in sea ice and water?

The direct detection of halogen oxides by differential optical absorption spectroscopy (DOAS) performed by the University of Heidelberg is part of the Extended Experimental Studies of Reactive Halogen Chemistry in the Polar Troposphere - HALOPOLE II. The participation on this cruise for mercury measurements is within the European project GMOS (Global Mercury Observation System) aiming to map mercury concentrations in air and water at land based stations and in marine regions all over the world.

Work at sea

The measurements included atmospheric measurements of specific species relevant to the formation of RHS, such as halogen oxides, gaseous elemental mercury, oxidized mercury, organic and particulate fractions of mercury, and ozone. A summary of the measurements is given in Table 8.1.

Tab. 8.1: Summary of measurements and sampling

Atmospheric sampling

Parameter	Technique	Resolution	Dates	Involved staff
Ozone	UV abs	1 min	14-08-2013 to 13-10-2013	H.-W. Jacobi
Particulate NO_3^- N and O isotopic composition	High Volume sampler	Weakly samplings	14-08-2013 to 13-10-2013	H.-W. Jacobi
BrO, IO, NO_2, O_3, H_2O,OClO, O_4, HCHO	Ship based MAX-DOAS	3 minutes	14-08-2013 to 15-10-2013	J. Zielcke, J.Nasse

Parameter	Technique	Resolution	Dates	Involved staff
BrO, IO, NO_2, O_3, H_2O,OClO, O_4, HCHO	Air borne MAX-DOAS	1 min	During Helicopter flights [1, 2]	J. Nasse, J. Zielcke
IO, NO_2, OClO	Cavity enhanced DOAS	30 s	During ice stations 14-08-2013 to 08-10-2013	J. Zielcke, J. Nasse
Ozone	UV abs.	1 min	14-08-2013 to 13-10-2013	J. Zielcke
Mercury speciation Hg^0(g), Hg(II)(g), Hg(II)(particulate phase)	Tekran 1135 CVAFS	5 min	14-08-2013 to 13-10-2013	M. Nerentorp

Sea-ice / snow sampling

Parameter	Technique	Resolution	Dates	Involved staff
Snow chemical composition, salinity	Manual sampling, ion chromatography	During ice station and with mummy chair	30-08-2013 to 01-10-2013	H.-W. Jacobi
Snow, mercury species Dissolved Hg^0 Hg-total Methyl-Hg^+	Purge and trap CVAFS Derivatisation Gas chromatography	Daily during ice stations, 10 cm	14-08-2013 to 28-09-2013	M. Nerentorp
Sea ice, mercury species Dissolved Hg^0 Hg-total Methyl-Hg^+	Purge and trap CVAFS Derivatisation Gas chromatography	Dissolved Hg^0 Daily during ice stations, 5-10 cm. Hg-total Methyl-Hg^+ Selected samples	14-08-2013 to 28-09-2013	M. Nerentorp

Sea-water sampling

Parameter	Technique	Resolution	Dates	Involved staff
Surface water, chemical composition	Ion chromatography	Irregular	30-08-2013 to 13-10-2013	H.-W. Jacobi
Water column, Dissolved Hg^0 Hg-total Methyl-Hg^+	Purge and trap CVAFS Derivatization Gas chromatography	CTD stations	14-08-2013 to 11-10-2013	M. Nerentorp

[1] Helicopter flights with MAX-DOAS measurements were performed on the following days: 28-08-2013, 30-08-2013, 03-09-2013, 04-09-2013, 07-09-2013, 10-09-2013 (2x), 12-09-2013, 13-09-2013 (3x), 15-09-2013 (2x), 18-09-2013, 23-09-2013 (2x), 26-09-2013, 30-09-2013, 01-10-2013 (2x), 04-10-2013

[2] Helicopter flights with MAX-DOAS profile measurements were performed on the following days: 10-09-2013, 13-09-2013, 23-09-2013, 25-09-2013, 28-09-2013, 29-09-2013, 30-09-2013, 01-10-2013, 06-10-2013, 08-10-2013, 09-10-2013 (2x)

A multi axis (MAX)-DOAS instrument, which is installed on board of *Polarstern* since May 2009, performed automatic measurements during the entire cruise. The telescope is mounted in a small heated box on top of the vessel and measures the incoming solar radiation at a series of elevation angles. If necessary, ice layers and snow on the telescope were removed daily during the cruise. Nevertheless, residual or not immediately removed ice/snow may have influenced the actual field of view during individual observations.

A similar, yet more compact MAX-DOAS instrument was installed on the helicopters. The instrument was active during 33 helicopter flights. Two types of flights were performed. On some occasions, the instrument was mounted on the helicopter during flights by other groups, e.g. sea ice physics or top predator survey flights. During more interesting periods such as ozone depletion events (ODEs) so-called profile flights were performed to sound the vertical extent of the involved chemistry up to heights of approximately 2,300 m. 13 of the 33 flights were such profile flights. Although all arising opportunities were exploited, the number of helicopter flights was limited due to bad weather conditions and maximum heights of the profiles were chosen according to the ceiling height. The helicopter flights addressed two main purposes: a) to cover a wide area of different ice conditions including first-year sea ice, newly-formed sea ice, frost flower fields, and open leads and b) to gain information on the vertical distribution of BrO. All flights were documented using a compact camera. During five flights the sea ice physics group performed sea ice thickness and sea ice condition measurements at the same time.

Measurements of iodine monoxide (IO) were performed using Cavity Enhanced (CE)-(DOAS) instruments in open cavity mode. These instruments are most suited for the in-situ measurement of IO since CE-DOAS measurements are very sensitive (limit of detection ~0.5 ppt) and provide point-like measurements of IO.

Their low power consumption as well as the compact design allows for portable instrumentation. Owing to its short photochemical lifetime, IO is expected to be present only very close to the snowpack surface. Therefore, measurements were conducted directly above the sea ice during the second ice camp. Also, experiments with the instrument in different heights above the surface were performed, including a placement directly on slush and sea ice after removing surface snow. In addition, the CE-DOAS was installed on the signals deck during cruise times.

Furthermore, a Long Path-DOAS system was set up on the ship for measurements during the two ice camp stations. This made it possible to study the diurnal variation of several trace gas species, including BrO, IO, ClO, OClO, O_3, NO_2. For this a telescope was set up on the signals deck and a reflector was brought out 1-5 km to the sea ice by helicopter. Due to the ship movement and unstable sea ice conditions, measurements were only conducted during the second ice station.

Onboard *Polarstern* the goal was to measure mercury species in air and dissolved gaseous mercury (DGM) in seawater, snow, and ice. The mercury measurements started already during ANT-XXIX/6 and continued during ANT-XXIX/7. All instruments were already installed and the continuous measurements were running when ANT-XXIX/7 started. One member of the mercury group at Chalmers University of Technology in Gothenburg, Sweden participated in both cruise legs and similar sampling procedures and measurements were performed during both cruise legs. All air and DGM measurements were performed onboard. Samples for total mercury and methyl mercury were collected and stored for further shipment to partners within the GMOS project. All mercury analyses onboard are made using a cold vapor atomic fluorescence spectrometer (Tekran 2537A instrument).

Measurements of mercury species in air were performed using a Tekran 1130/35 denuder system. The measured species were gaseous elemental mercury (GEM), gaseous oxidized mercury (GOM), and particulate mercury (HgP). DGM concentrations in surface water were continuously measured using the principle of opposite flow, where a constant flow of mercury-free air is purged via a glass frit through the continuous inflow of sea water from the ship's bow water system with an intake at a depth of 8 m. The principle of the opposite flow extractor is described in Andersson *et al.* (2008). The measurements started in the afternoon of 15th August and ended on 13th October. With an impinger system, discrete sea water samples (0.4 L) from the CTD were manually analyzed for DGM concentrations. The efficiency and reproducibility of this method was reported by Gårdfeldt *et al.* (2002). Two CTDs were sampled also for future analyses for methyl mercury. During the first CTD-transect, 13 CTDs were measured. During the last transect samples from ten CTDs were analyzed.

During both long-term ice stations, ice cores, snow samples, and under ice water were sampled and analyzed for DGM concentrations. Samples for methyl mercury and total mercury analysis were also collected. During ice station *Alpha*, a total of 22 ice cores were sampled and analyzed. To study the influence of light, ice cores were sampled during different times of the day. A freezing experiment was also made by drilling six holes in the ice during the first day and then drilling in these old holes again once per day. At ice station *Beta*, similar experiments were done and 33 ice cores were sampled. Here, a freezing experiment lasting eight days was performed in collaboration with Ellen Damm and Jana Hölscher, who measured DMS/DMSP and nutrient concentrations. Samples for methyl mercury from these ice cores were also taken and will be analyzed by colleagues within the GMOS project. Some snow samples and frost flowers were sampled using the mummy chair.

To determine the chemical composition of the different components of the ocean and cryosphere snow, sea ice, frost flowers, and sea water samples were collected throughout the cruise to investigate the role of these different compartments on the exchange of RHS and mercury compounds between the atmosphere and the underlying surface. More than 700 samples were collected and will be shipped to the home and partner institutes for further chemical analysis regarding major and minor sea salt components.

Finally, physical properties of the snowpack and the underlying sea ice surface like snow type, grain size, density, temperature, and salinity were recorded during both long-term ice stations *Alpha* and *Beta*. These manual observations were complemented by regular measurements of resistance profiles of the snowpack using a snow micro-penetrometer.

Preliminary (expected) results

Although satellite measurements as well as ground based MAX-DOAS measurements indicated high levels of IO in Antarctica (Frieß *et al.* 2010), so far surprisingly low IO concentrations were found after a preliminary evaluation of the obtained data. IO was below the detection limit (<0.5 ppt) of the active DOAS instruments, the CE-DOAS, and the LP-DOAS. This confirms the findings of two measurement campaigns conducted at the German Research Station *Neumayer* (70°S, 8°W) in austral summer 2011 and the New Zealand Station *Scott Base* (177°E, 78°S) in winter/spring 2013. A comprehensive analysis of the results for detection of IO of the whole cruise from the active and passive instruments will help to address the question to what extent IO is of importance for the chemistry of the springtime Antarctic marine boundary layer. Moreover, a comparison of conditions when IO was detected and when it remained below the detection limit may give a hint about differences between Antarctica and the Arctic.

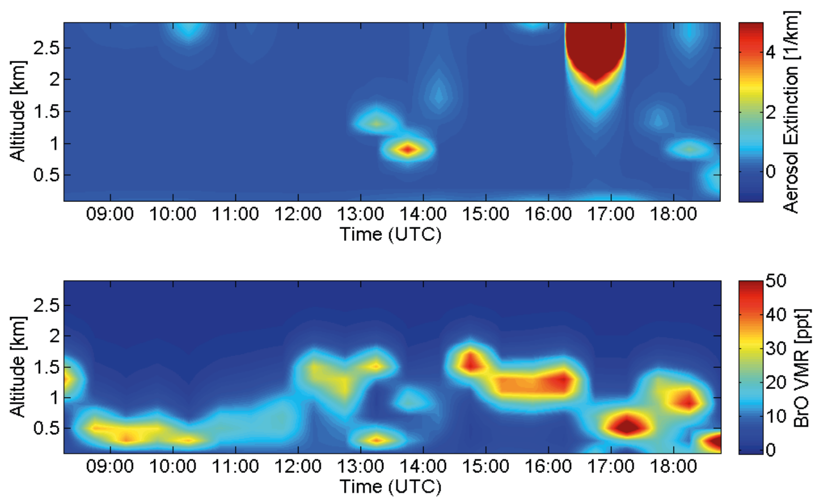


Fig. 8.1: Example of the aerosol extinction and BrO vertical profile after applying a radiative transfer inversion to the MAX-DOAS data of 15 September 2013

From the spectral analysis of the MAX-DOAS measurements the so-called slant column density (SCD) was retrieved. The SCD is the integrated trace gas concentration along the light path through the atmosphere. Extensive radiative transfer modelling after the cruise will give detailed knowledge about the actual light path and concentrations will be retrieved. In Fig. 8.1, an example of this profile retrieval is shown for 15th September 2013. The helicopter based measurements will be critical for the validation of these inverse-modeled profiles.

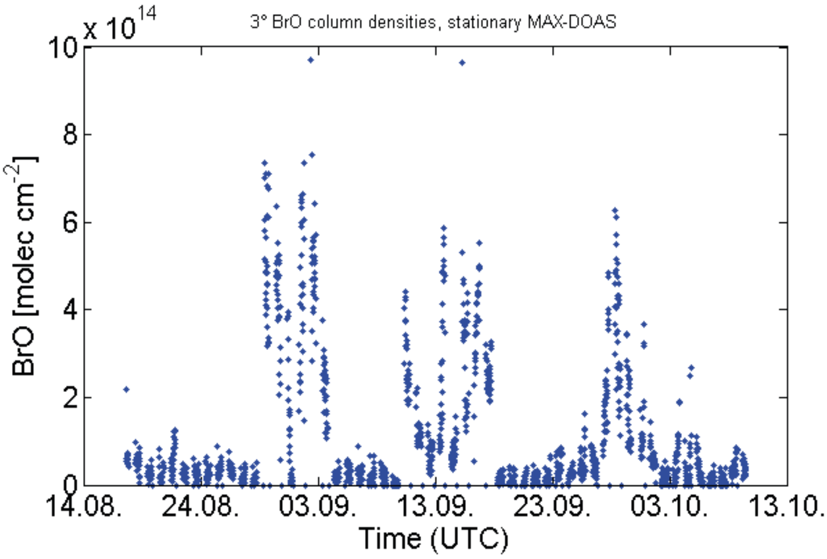


Fig. 8.2: Time series of slant column densities of the stationary MAX-DOAS instrument obtained at an elevation angle of 3°

Both MAX-DOAS instruments indicated elevated differential slant column densities of BrO during long periods of the cruise under different sea ice and snow conditions. A time series obtained at an elevation angle of 3° is shown in Fig. 8.2. Three periods of enhanced BrO are evident, each lasting for several days. How the different conditions and the transport of the air masses influenced the extent of bromine explosion events will be addressed by further evaluation using air mass trajectories and satellite observations. In addition, different conditions observed during flights and the cruise will be compared. The information about the vertical and spatial distribution of the detected BrO will help to address which role sea ice plays in the generation of sea salt aerosols and reactive halogens. Consequences on atmospheric chemistry will be examined after further evaluation. In particular, the collaboration with the DMS and sea ice physics groups might be a big step forward.

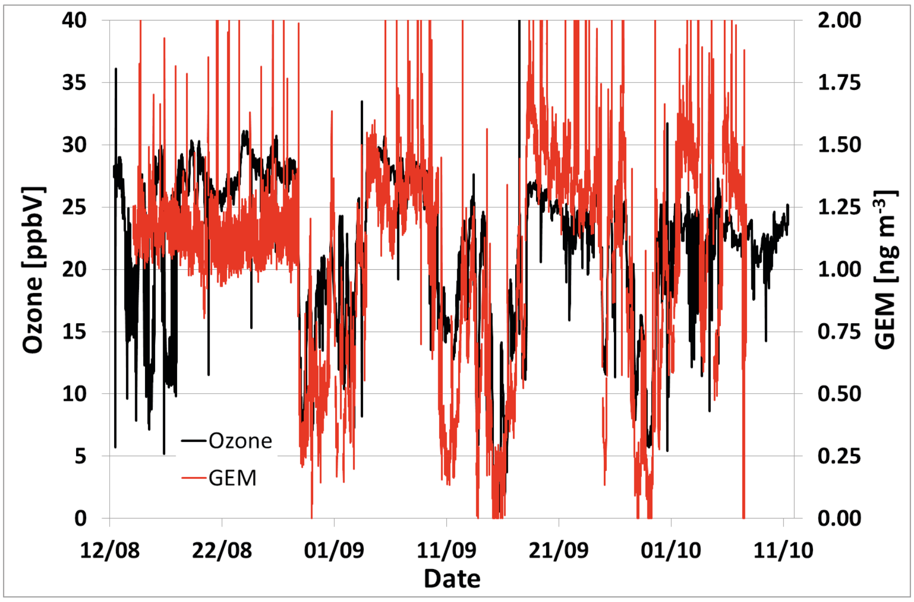


Fig. 8.3: Raw time series of atmospheric ozone and GEM measured on board. The raw data still include periods during regular calibration of the instruments as well as periods when ozone was impacted by the ship's exhaust, which can be identified by highly variable and low ozone values with GEM close to background values around 1.3 ng m^{-3}.

The results of the atmospheric measurements of ozone and mercury species are shown in Fig. 8.3. Three extended periods with depleted GEM and ozone were recorded. In some cases, GEM dropped below the limit of detection. The smallest recorded ozone mixing ratio was below 1 ppbV. The periods with depleted ozone and GEM coincided with elevated concentrations of BrO (Fig. 8.2) and HgP and GOM (Fig. 8.4). Local events were further confirmed by elevated DGM concentrations in surface snow, probably as a consequence of subsequent deposition of fractions of oxidized mercury.

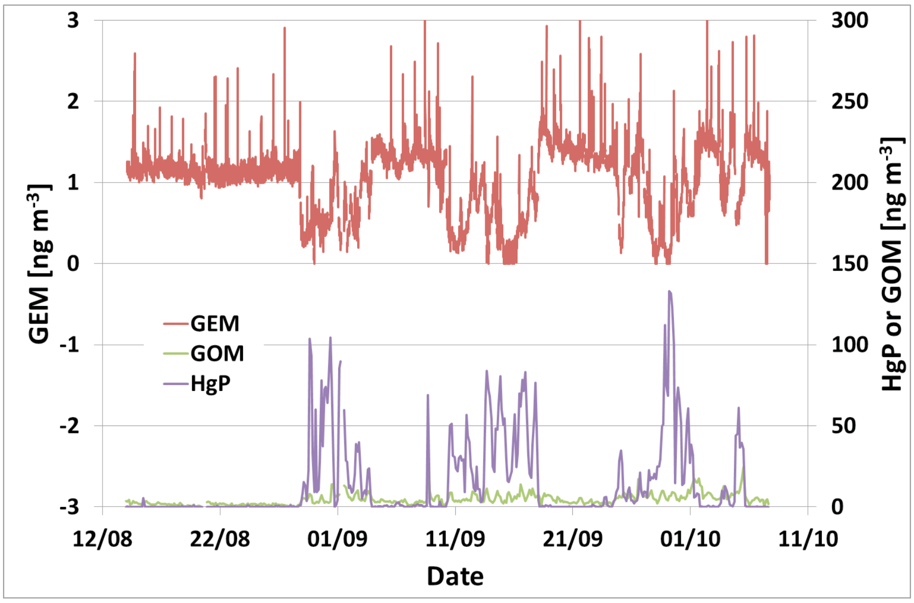


Fig. 8.4: Raw time series of atmospheric GEM, GOM, and HgP measured on board

Preliminary results of the continuous measurements of DGM in surface water can be found in Fig. 8.5. The most remarkable result was that the surface DGM concentration was much higher when entering the sea ice-covered area, which may indicate that the sea ice limits the fluxes of mercury from the ocean to the atmosphere. Furthermore, preliminary results from two selected CTDs are presented in Fig. 8.6. The results from the CTDs show similar surface DGM concentrations in open water and sea ice-covered regions as obtained with the continuous system.

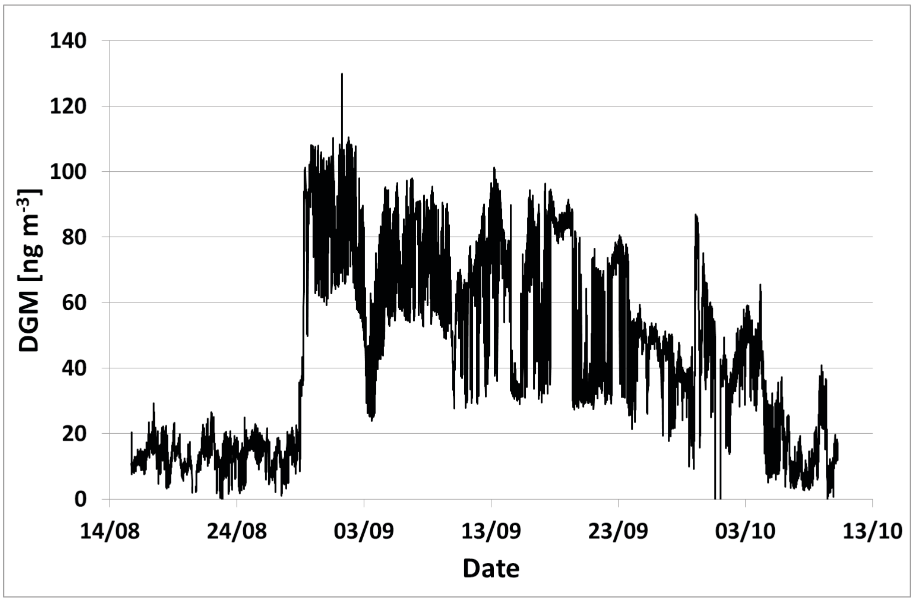


Fig. 8.5: Raw time series of DGM continuously measured in surface water at a depth of approximately 8 m.

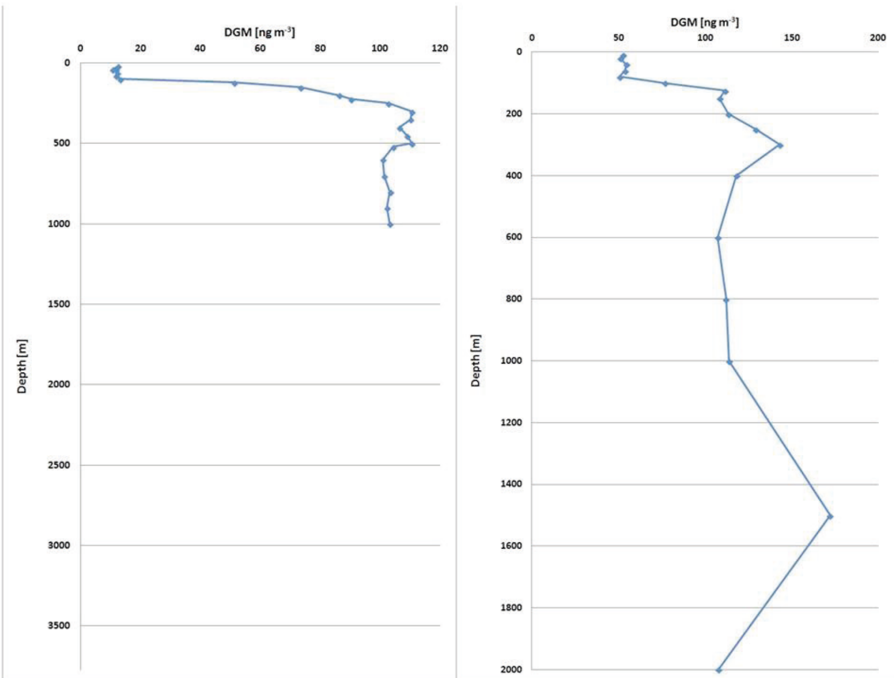


Fig. 8.6: DGM concentrations observed in two CTD profiles. The left figure is a profile from before reaching the ice.

One ice core profile determined at station *Alpha* together with under ice water and snow concentrations is presented in Fig. 8.7. The surface snow concentrations varied with time and location. Generally, they were around 200 to 1,000 ng m^{-3}. On Wednesday (12/09), the surface snow concentration was around 100 ng m^{-3}, while the concentration in frost flowers harvested at the same time was 300 ng m^{-3}.

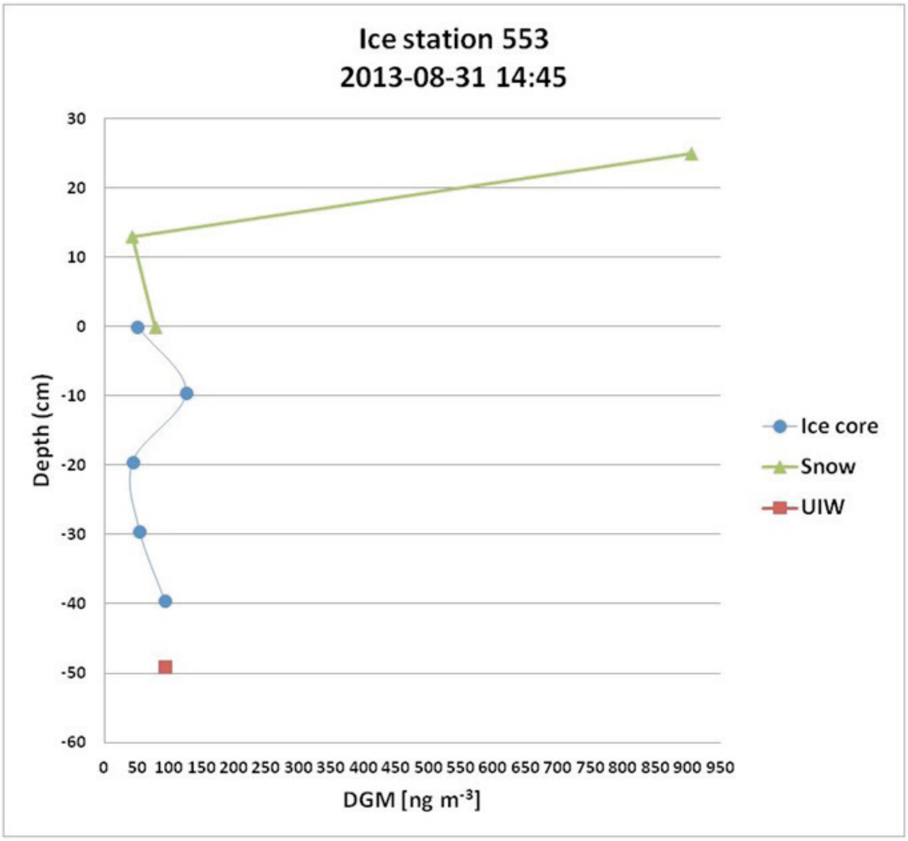


Fig. 8.7: DGM profile in snow, ice, and under ice water (UIW) from ice station 553

Detailed results on major and minor sea salt components of the collected snow samples will become available only after chemical analysis in the home and partner institutes. The results will be used to assemble a time series of the composition of the different compartments to examine if the identified atmospheric processes caused specific chemical signatures that can for example be related to high RHS concentrations. Furthermore, the samples may allow determining which compartment contributed to the transformation of sea salt into RHS.

The chemical composition of the snow will also be related to physical parameters and snow properties. At all stations the snowpack was characterized by approximately two thirds of depth hoar crystals at the bottom covered by smaller facetted crystals. Depending on the meteorological conditions the surface of the snowpack changed rapidly between fresh snow, soft and still mobile blown snow, and softer and harder wind crusts. Surface snow temperatures were also variable and dropped for example at ice station *Beta* from -1°C at the day of arrival to almost -18°C during the cold spell towards the end of the station (Fig. 8.8). The surface temperatures of the sea ice varied much less and showed a slow overall increase until 23 September, before the values dropped again. The lowest observed sea ice surface temperature was around -6°C. The collected snow micro-penetrometer data will be used to examine the metamorphism of the snow and how the transformation of the snow was related to these unique environmental conditions with strong temperature gradients inside the snowpack.

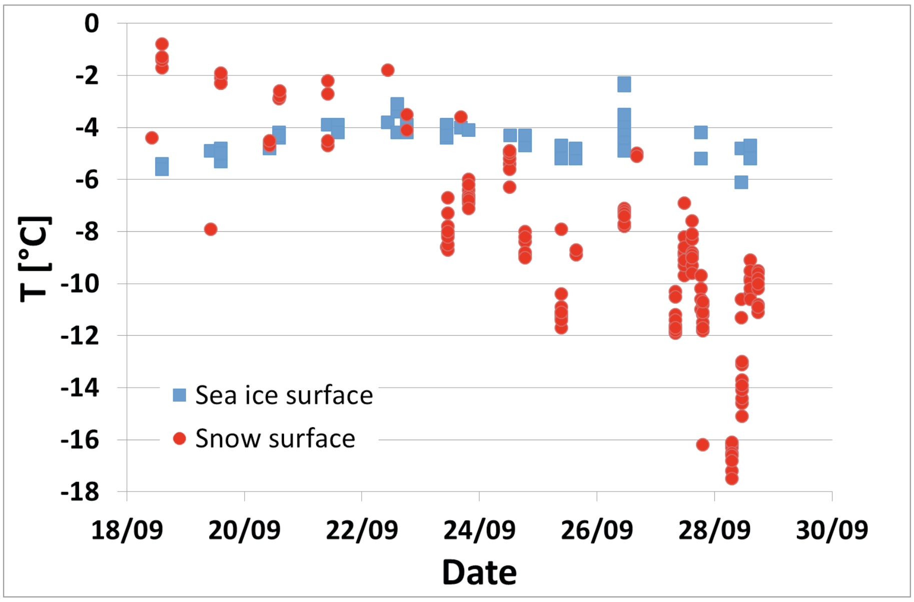


Fig. 8.8: Time series of measured temperatures of the snow surface and the sea ice surface during ice station Beta

Data management

Quality-controlled data of the continuous atmospheric and seawater measurements will be made available in public data bases (e.g. PANGAEA Data Publisher for Earth & Environmental Science.) in the form of time series with the maximum available temporal resolution after publication in peer-reviewed literature. Similarly, published results regarding the analysis of snow, sea ice, and seawater samples will also be made available. All data will be shared with other cruise participants upon request.

References

Andersson, ME, Gårdfeldt, K, Wängberg, I (2008) A description of an automatic continuous equilibrium system for measurement of dissolved gaseous mercury. Analytical and Bioanalytical Chemistry, 391, 2277-2282.

Frieß, U, Deutschmann, T, Gilfedder, BS, Weller, R, Platt, U (2010) Iodine monoxide in the Antarctic snowpack. Atmospheric Chemistry and Physics, 10, 2439–2456.

Gårdfeldt, K, Horvat, M, Sommar, J, Kotnik, J, Fajon, V, Wängberg, I, Lindqvist, O (2002) Comparison of procedures for measurements of dissolved gaseous mercury in seawater performed on a Mediterranean cruise. Analytical Bioanalytical Chemistry, 374, 1002-1008.

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTIONS

	Address
AAD	Australian Antarctic Division 203 Channel Highway Kingston Tasmania 7050 Australia
ACE-CRC	Antarctic Climate & Ecosystems Cooperative Research Centre Castray Esplanade Hobart Tasmania, 7000 Australia
AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung Postfach 120161 27515 Bremerhaven Germany
Chalmers	Chalmers University of Technology 41296 Gothenburg Sweden
DAFF	Department of Agriculture, Forestry and Fisheries Branch: Fisheries Management Private Bag X2 Rogge Bay 8012, Cape Town South Africa
DOX	DOX PRODUCTIONS 84, Addison Gardens W14 0DR, London Great Britain
DWD	Deutscher Wetterdienst Geschäftsbereich Wettervorhersage Seeschifffahrtsberatung Bernhard-Nocht Str. 76 20359 Hamburg Germany
FIELAX	FIELAX Gesellschaft für wissenschaftliche Datenverarbeitung mbH Schleusenstraße 14 27568 Bremerhaven Germany
HELISERVICE	HeliService international GmbH Am Luneort 15 27572 Bremerhaven Germany

	Address
IMARES	Wageningen IMARES Haringkade 1 1976 CP Ijmuiden Netherlands
IMM	Institut für Mineralogie Münster Corrensstraße 24 48149 Münster Germany
INIDEP	Instituto Nacional de Investigación y Desarollo Pesquero Paseo Victoria Ocampo No. 1 Escollera Norte (7602) Mar del Plata - Buenos Aires Argentina
IUPH	Institut für Umweltphysik Heidelberg Im Neuenheimer Feld 229 69120 Heidelberg Germany
KIT	Karlsruher Institut für Technologie (KIT) Institut für Synchrotronstrahlung (ISS) Hermann-von-Helmholtz-Platz 1 76344 Eggenstein-Leopoldshafen Germany
LGGE	Laboratoire de Glaciologie et Géophysique de l'Environnement 54, rue Molière 38402 Saint Martin d'Hères cedex France
MIO	M.I.O. Institut Méditérranéen d'Océanologie Campus de Luminy Case 901 13288 Marseille cedex 09 France
SAEON	South African Environmental Observation Network Elwandle Node 18 Somerset Street Private Bag 1015 Grahamstown 6140 South Africa
SLF	WSL-Institut für Schnee- und Lawinenforschung SLF Flüelastraße 11 7260 Davos Dorf Switzerland

	Address
UBC	University of British Columbia Vancouver Campus 2329 West Mall Vancouver, BC Canada V6T 1Z4 Canada
UHD	Universität Heidelberg Grabengasse 1 6911 Heidelberg Germany
UMR	Philipps-Universität Marburg Biegenstraße 10 35032 Marburg Germany
UNI-IST	Istanbul University, Institute of Marine Sciences and Management Muskule Sok, No: 1, Vefa, 34116 Istanbul Turkey
UOL	Carl-von-Ossietzky Universität Oldenburg Ammerländer Heerstraße 114-118 26129 Oldenburg Germany
UNI-ONT	McMaster University Ontario 1280 Main St. West Hamilton, Ontario L8S 4K1 Canada
UTAS	University of Tasmania Private Bag 49 Hobart, TAS 7001 Australia

A.2 FAHRTTEILNEHMER / CRUISE PARTICIPANTS

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession
Auerswald	Lutz	DAFF	Biologist
Bose	Aneesh	UNI-ONT	Student, biology
Brauer	Jens	HELISERVICE	Pilot
Cantzler	Hannelore	UOL	Student, biology
Damm	Ellen	AWI	Geo-Chemist
David	Carmen	AWI	PhD student, biology
Dorssen van	Michiel	IMARES	Technician
Franeker van	Jan Andries	IMARES	Biologist
Freier	Ulrich	AWI	Biologist
Gall	Fabian	HELISERVICE	Technician
Gischler	Michael	HELISERVICE	Pilot
Göttlicher	Jörg	KIT	Mineralogist
Götz	Albrecht	SAEON	Biologist
Halbach	Laura	UMR	Student, biology
Heckmann	Hans	HELISERVICE	Pilot
Hempelt	Juliane	DWD	Technician, meteorology
Hölscher	Jana	AWI	Technician, biology
Hunt	Brian	UBC	Biologist
Jacobi	Hans-Werner	LGGE	Chemist
Jarman	Simon	AAD	Biologist
Kerwath	Sven	DAFF	Biologist
King	Rob	AAD	Biologist
Klaas	Christine	AWI	Biologist
Krieger	Malte	UOL	Student, biology
Krumpen	Thomas	AWI	Physicist
Leonarduzzi	Ezequiel		Observer
Maison	Jerome	DOX	Cameraman
Mantel	Peter	AAD	Technician, biology
Mattfeldt	Tobias	AWI	PhD student, biology
Meiners	Klaus	AAD	Biologist

Name/ Last name	**Vorname/ First name**	**Institut/ Institute**	**Beruf/ Profession**
Meyer	Bettina	AWI	Biologist, Chief Scientist
Miller	Max	DWD	Meteorologist
Milnes	Mark	AAD	Technician
Nasse	Jan-Marcus	IUPH	Physicist
Nehrke	Gernot	AWI	Mineralogist
Nerentorp	Michelle	Chalmers	PhD student, chemistry
Nitsch	Torsten	AWI	Biologist
Pakhomov	Evgeny	UBC	Biologist
Proud	Roland	UTAS	PhD student, physics
Ricker	Robert	AWI	Physicist
Rössler	Sebastian	FIELAX	Technician
Schaafsma	Fokje	IMARES	Student, biology
Schiller	Martin	AWI	Physicist
Schulze	Borwin	AWI	Technician
Sington	David	DOX	Documentary filmmaker
Tardec	Frederic	FIELAX	Geoinformaticist
Teschke	Mathias	AWI	Biologist
Walsh	Heather	DOX	Documentary filmmaker
Wolf-Gladrow	Dieter	AWI	Biologist
Yilmaz	Noyan	UNI-IST	Biologist
Zielcke	Johannes	IUPH	Physicist

A.3 SCHIFFSBESATZUNG / SHIP'S CREW

Name	First Name	Rank
Schwarze	Stefan	Master
Grundmann	Uwe	1.0ffc.
Farysch	Bernd	Ch. Eng.
Fallei	Holger	2. Offc.
Langhinrichs	Moritz	2.0ffc.
Peine	Lutz	3.0ffc.
Pohl	Claus	Doctor
Hecht	Andreas	R.Offc.
Grafe	Jens	2.Eng.
Minzlaff	Hans-Uirich	2.Eng.
Holst	Wolfgang	3. Eng.
Scholz	Manfred	Elec.Tech.
Riess	Felix	Electron.
Hüttebräucker	Olaf	Electron.
Nasis	llias	Electron.
Himmei	Frank	Electron
Loidl	Reiner	Boatsw.
Reise	Lutz	Carpenter
Scheel	Sebastian	A.B.
Brickmann	Peter	A.B.
Winkler	Michael	A.B.
Hagemann	Manfred	A.B.
Schmidt	Uwe	A. B.
NN		A.B.
Wende	Uwe	A.B.
Bäcker	Andreas	A.B.
Preußner	Jörg	Storek.
Teichert	Uwe	Mot-man
Schütt	Norbert	Mot-man
Elsner	Klaus	Mot-man
Voy	Bernd	Mot-man
Pinske	Lutz	Mot-man
Müller-Homburg	Ralf-Dieter	Cook

Name	First Name	Rank
Silinski	Frank	Cooksmate
Martens	Michael	Cooksmate
Czyborra	Bärbel	1.Stwdess
Wöckener	Martina	Stwdss/KS
Gaude	Hans-Jürgen	2.Steward
Silinski	Carmen	2.Stwdess
Arendt	Rene	2.Steward
Möller	Wolfgang	2.Steward
Sun	Yong Shen	2.Steward
Yu	Kwok Yuen	Laundrym.

A.4 STATIONSLISTE / STATION LIST PS 81

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0519-1	17.08.13	12:04:00	CTD/RO	in the water	52° 19.58‘ S	51° 44.27‘ W	2759.1
PS81/0519-1	17.08.13	12:34:00	CTD/RO	on ground/ max depth	52° 19.34‘ S	51° 44.08‘ W	2757.1
PS81/0519-1	17.08.13	12:37:00	CTD/RO	hoisting	52° 19.35‘ S	51° 44.04‘ W	2757.1
PS81/0519-1	17.08.13	13:15:59	CTD/RO	on deck	52° 19.25‘ S	51° 44.16‘ W	2759
PS81/0520-1	17.08.13	15:49:00	CTD/RO	in the water	52° 19.42‘ S	50° 59.98‘ W	2909.5
PS81/0520-1	17.08.13	16:19:00	CTD/RO	on ground/ max depth	52° 19.38‘ S	50° 59.65‘ W	2911.6
PS81/0520-1	17.08.13	16:21:00	CTD/RO	hoisting	52° 19.36‘ S	50° 59.67‘ W	2910.6
PS81/0520-1	17.08.13	16:56:59	CTD/RO	on deck	52° 19.31‘ S	50° 59.60‘ W	2907.8
PS81/0521-1	17.08.13	19:38:00	CTD/RO	in the water	52° 19.32‘ S	50° 14.97‘ W	2993.2
PS81/0521-1	17.08.13	20:09:00	CTD/RO	on ground/ max depth	52° 19.80‘ S	50° 14.56‘ W	3005.4
PS81/0521-1	17.08.13	20:45:59	CTD/RO	on deck	52° 20.25‘ S	50° 13.89‘ W	3031.8
PS81/0522-1	17.08.13	23:14:00	CTD/RO	in the water	52° 18.68‘ S	49° 29.80‘ W	3101.7
PS81/0522-1	17.08.13	23:44:00	CTD/RO	on ground/ max depth	52° 18.50‘ S	49° 29.20‘ W	3076.5
PS81/0522-1	18.08.13	00:21:59	CTD/RO	on deck	52° 18.30‘ S	49° 28.76‘ W	3057.4
PS81/0523-1	18.08.13	03:00:00	CTD/RO	in the water	52° 18.54‘ S	48° 45.15‘ W	3003.8
PS81/0523-1	18.08.13	03:31:00	CTD/RO	on ground/ max depth	52° 18.65‘ S	48° 44.86‘ W	3009
PS81/0523-1	18.08.13	03:33:00	CTD/RO	hoisting	52° 18.66‘ S	48° 44.87‘ W	3008.9
PS81/0523-1	18.08.13	04:07:59	CTD/RO	on deck	52° 18.74‘ S	48° 44.96‘ W	3006.5
PS81/0524-1	18.08.13	06:52:00	CTD/RO	in the water	52° 18.29‘ S	47° 59.99‘ W	3441.6
PS81/0524-1	18.08.13	07:20:00	CTD/RO	on ground/ max depth	52° 18.28‘ S	47° 59.94‘ W	3440.1
PS81/0524-1	18.08.13	07:21:00	CTD/RO	hoisting	52° 18.27‘ S	47° 59.94‘ W	3439.8
PS81/0524-1	18.08.13	07:55:59	CTD/RO	on deck	52° 18.20‘ S	47° 59.88‘ W	3430.4
PS81/0525-1	18.08.13	10:32:00	CTD/RO	in the water	52° 18.00‘ S	47° 15.03‘ W	3510.9
PS81/0525-1	18.08.13	11:01:00	CTD/RO	on ground/ max depth	52° 17.72‘ S	47° 14.51‘ W	3523.6
PS81/0525-1	18.08.13	11:35:59	CTD/RO	on deck	52° 17.39‘ S	47° 13.85‘ W	3513.2
PS81/0526-1	18.08.13	14:08:00	CTD/RO	in the water	52° 17.65‘ S	46° 30.03‘ W	3268.6
PS81/0526-1	18.08.13	14:37:00	CTD/RO	on ground/ max depth	52° 17.67‘ S	46° 30.03‘ W	3268.4
PS81/0526-1	18.08.13	14:38:00	CTD/RO	hoisting	52° 17.67‘ S	46° 30.03‘ W	3268.8
PS81/0526-1	18.08.13	15:15:59	CTD/RO	on deck	52° 17.70‘ S	46° 30.10‘ W	3268.5
PS81/0527-1	22.08.13	09:33:00	CTD/RO	in the water	52° 17.47‘ S	45° 45.18‘ W	3464
PS81/0527-1	22.08.13	10:04:00	CTD/RO	on ground/ max depth	52° 17.52‘ S	45° 45.00‘ W	3467.5
PS81/0527-1	22.08.13	10:37:59	CTD/RO	on deck	52° 17.51‘ S	45° 44.77‘ W	3468
PS81/0527-2	22.08.13	13:15:00	SUIT	in the water	52° 17.56‘ S	45° 4.24‘ W	3348.4
PS81/0527-2	22.08.13	13:23:00	SUIT	profile start	52° 17.69‘ S	45° 4.15‘ W	3360.4

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0527-2	22.08.13	13:24:00	SUIT	on ground/ max depth	52° 17.71' S	45° 4.13' W	3361.9
PS81/0527-2	22.08.13	13:54:00	SUIT	profile end	52° 19.61' S	45° 2.80' W	3490.9
PS81/0527-2	22.08.13	14:18:59	SUIT	on deck	52° 20.53' S	45° 2.17' W	3537.9
PS81/0528-1	22.08.13	15:18:00	CTD/RO	in the water	52° 17.16' S	45° 0.02' W	3308
PS81/0528-1	22.08.13	15:49:00	CTD/RO	on ground/ max depth	52° 17.20' S	45° 0.03' W	3309.8
PS81/0528-1	22.08.13	15:50:00	CTD/RO	hoisting	52° 17.20' S	45° 0.03' W	3310.2
PS81/0528-1	22.08.13	16:25:59	CTD/RO	on deck	52° 17.28' S	44° 59.98' W	3310.5
PS81/0528-2	22.08.13	18:16:00	RMT	in the water	52° 16.93' S	44° 36.13' W	0
PS81/0528-2	22.08.13	19:09:00	RMT	on ground/ max depth	52° 16.88' S	44° 31.64' W	3110.1
PS81/0528-2	22.08.13	19:10:00	RMT	profile start	52° 16.88' S	44° 31.56' W	3111.1
PS81/0528-2	22.08.13	19:13:00	RMT	hoisting	52° 16.88' S	44° 31.31' W	3120.2
PS81/0528-2	22.08.13	19:15:00	RMT	lowering	52° 16.88' S	44° 31.14' W	3120.6
PS81/0528-2	22.08.13	19:35:00	RMT	on ground/ max depth	52° 16.88' S	44° 29.35' W	3125.4
PS81/0528-2	22.08.13	19:44:00	RMT	hoisting	52° 16.87' S	44° 28.63' W	3093.9
PS81/0528-2	22.08.13	19:44:01	RMT	profile end	52° 16.87' S	44° 28.63' W	3093.9
PS81/0528-2	22.08.13	21:26:59	RMT	on deck	52° 16.86' S	44° 20.62' W	3137.4
PS81/0529-1	22.08.13	22:03:00	CTD/RO	in the water	52° 16.96' S	44° 15.18' W	3184.1
PS81/0529-1	22.08.13	22:31:00	CTD/RO	on ground/ max depth	52° 16.95' S	44° 15.17' W	3183.4
PS81/0529-1	22.08.13	23:07:59	CTD/RO	on deck	52° 17.00' S	44° 14.85' W	3196.2
PS81/0530-1	23.08.13	02:41:00	CTD/RO	in the water	52° 16.40' S	43° 29.94' W	0
PS81/0530-1	23.08.13	03:12:00	CTD/RO	on ground/ max depth	52° 16.05' S	43° 29.52' W	0
PS81/0530-1	23.08.13	03:13:00	CTD/RO	hoisting	52° 16.04' S	43° 29.51' W	0
PS81/0530-1	23.08.13	03:48:59	CTD/RO	on deck	52° 15.78' S	43° 29.05' W	0
PS81/0530-2	23.08.13	04:10:00	BONGO	in the water	52° 15.64' S	43° 28.86' W	0
PS81/0530-2	23.08.13	04:24:00	BONGO	on ground/ max depth	52° 15.57' S	43° 28.74' W	0
PS81/0530-2	23.08.13	04:25:00	BONGO	hoisting	52° 15.56' S	43° 28.72' W	0
PS81/0530-2	23.08.13	04:31:59	BONGO	on deck	52° 15.54' S	43° 28.64' W	0
PS81/0531-1	23.08.13	08:31:00	CTD/RO	in the water	52° 16.07' S	42° 45.06' W	3439
PS81/0531-1	23.08.13	09:00:00	CTD/RO	on ground/ max depth	52° 15.97' S	42° 44.98' W	3440
PS81/0531-1	23.08.13	09:34:59	CTD/RO	on deck	52° 15.82' S	42° 44.65' W	3441
PS81/0532-1	23.08.13	13:43:00	CTD/RO	in the water	52° 15.84' S	42° 0.12' W	0
PS81/0532-1	23.08.13	14:13:00	CTD/RO	on ground/ max depth	52° 15.58' S	41° 59.66' W	3513.3
PS81/0532-1	23.08.13	14:45:59	CTD/RO	on deck	52° 15.00' S	41° 59.58' W	3487.6
PS81/0533-1	23.08.13	20:30:00	CTD/RO	in the water	52° 15.68' S	41° 15.29' W	3773.9
PS81/0533-1	23.08.13	20:57:00	CTD/RO	on ground/ max depth	52° 15.62' S	41° 15.49' W	3772.3

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0533-1	23.08.13	21:33:59	CTD/RO	on deck	52° 14.98‘ S	41° 15.55‘ W	0
PS81/0534-1	24.08.13	03:41:00	CTD/RO	in the water	52° 15.04‘ S	40° 32.15‘ W	3797.6
PS81/0534-1	24.08.13	05:02:00	CTD/RO	on ground/ max depth	52° 14.91‘ S	40° 32.73‘ W	3797
PS81/0534-1	24.08.13	05:18:00	CTD/RO	hoisting	52° 15.05‘ S	40° 32.93‘ W	3797.6
PS81/0534-1	24.08.13	06:40:59	CTD/RO	on deck	52° 14.80‘ S	40° 33.24‘ W	3796.9
PS81/0535-1	24.08.13	12:58:00	MOR	in the water	52° 15.21‘ S	40° 29.68‘ W	0
PS81/0535-1	24.08.13	12:58:01	MOR	on ground/ max depth	52° 15.21‘ S	40° 29.68‘ W	0
PS81/0535-1	24.08.13	12:59:00	MOR	information	52° 15.18‘ S	40° 29.67‘ W	0
PS81/0535-1	24.08.13	13:10:00	MOR	on deck	52° 14.86‘ S	40° 29.70‘ W	0
PS81/0535-1	24.08.13	13:17:00	MOR	information	52° 15.10‘ S	40° 29.77‘ W	0
PS81/0535-1	24.08.13	13:30:00	MOR	at surface	52° 15.05‘ S	40° 29.71‘ W	0
PS81/0535-1	24.08.13	13:47:00	MOR	at surface	52° 15.01‘ S	40° 30.17‘ W	3796.7
PS81/0535-1	24.08.13	14:05:00	MOR	information	52° 15.04‘ S	40° 30.55‘ W	3797.1
PS81/0535-1	24.08.13	14:17:00	MOR	on deck	52° 15.07‘ S	40° 30.34‘ W	3796.4
PS81/0535-1	24.08.13	14:25:00	MOR	on deck	52° 15.09‘ S	40° 30.28‘ W	3796.9
PS81/0535-1	24.08.13	14:45:00	MOR	on deck	52° 14.86‘ S	40° 30.41‘ W	3796.1
PS81/0535-1	24.08.13	15:01:00	MOR	on deck	52° 14.81‘ S	40° 30.59‘ W	3796.4
PS81/0535-1	24.08.13	15:10:00	MOR	on deck	52° 14.62‘ S	40° 30.58‘ W	3795.7
PS81/0535-1	24.08.13	15:18:59	MOR	on deck	52° 14.55‘ S	40° 30.54‘ W	3795.2
PS81/0535-2	24.08.13	15:45:00	BONGO	in the water	52° 15.30‘ S	40° 30.00‘ W	3797
PS81/0535-2	24.08.13	15:55:00	BONGO	on ground/ max depth	52° 15.32‘ S	40° 30.07‘ W	3796.4
PS81/0535-2	24.08.13	15:55:01	BONGO	hoisting	52° 15.32‘ S	40° 30.07‘ W	3796.4
PS81/0535-2	24.08.13	16:02:59	BONGO	on deck	52° 15.32‘ S	40° 30.05‘ W	3796.8
PS81/0535-3	24.08.13	17:15:00	RMT	in the water	52° 16.75‘ S	40° 31.28‘ W	3798.6
PS81/0535-3	24.08.13	18:06:00	RMT	on ground/ max depth	52° 19.29‘ S	40° 33.44‘ W	3800.2
PS81/0535-3	24.08.13	18:06:01	RMT	hoisting	52° 19.29‘ S	40° 33.44‘ W	3800.2
PS81/0535-3	24.08.13	18:07:00	RMT	profile start	52° 19.33‘ S	40° 33.47‘ W	3800.7
PS81/0535-3	24.08.13	18:55:00	RMT	at surface	52° 21.64‘ S	40° 34.88‘ W	3801.8
PS81/0535-3	24.08.13	18:56:00	RMT	profile end	52° 21.68‘ S	40° 34.89‘ W	3802.9
PS81/0535-3	24.08.13	19:03:59	RMT	on deck	52° 21.89‘ S	40° 34.95‘ W	3802.6
PS81/0536-1	25.08.13	13:30:00	CAL	profile start	54° 0.42‘ S	37° 19.89‘ W	0
PS81/0536-1	25.08.13	19:35:00	CAL	on ground/ max depth	54° 0.17‘ S	37° 20.86‘ W	0
PS81/0536-1	25.08.13	19:35:02	CAL	profile end	54° 0.17‘ S	37° 20.86‘ W	0
PS81/0536-1	25.08.13	19:35:59	CAL	on deck	54° 0.17‘ S	37° 20.86‘ W	0
PS81/0537-1	26.08.13	03:28:00	RMT	in the water	53° 34.28‘ S	39° 26.07‘ W	3314.3
PS81/0537-1	26.08.13	04:03:00	RMT	on ground/ max depth	53° 33.77‘ S	39° 28.84‘ W	3174.7
PS81/0537-1	26.08.13	04:04:00	RMT	profile start	53° 33.75‘ S	39° 28.91‘ W	3174.1
PS81/0537-1	26.08.13	04:50:00	RMT	profile end	53° 33.13‘ S	39° 32.54‘ W	3209.2

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0537-1	26.08.13	04:55:59	RMT	on deck	53° 33.07' S	39° 32.92' W	3193
PS81/0537-2	26.08.13	05:18:00	CTD/RO	in the water	53° 32.48' S	39° 35.12' W	3156.6
PS81/0537-3	26.08.13	05:36:00	APSN	in the water	53° 32.55' S	39° 35.06' W	3155.8
PS81/0537-3	26.08.13	05:42:00	APSN	on ground/ max depth	53° 32.60' S	39° 35.07' W	3156.2
PS81/0537-3	26.08.13	05:55:59	APSN	on deck	53° 32.63' S	39° 35.04' W	3155.8
PS81/0537-2	26.08.13	06:29:00	CTD/RO	on ground/ max depth	53° 32.70' S	39° 34.89' W	3154
PS81/0537-4	26.08.13	06:38:00	HN	in the water	53° 32.67' S	39° 34.85' W	3153.6
PS81/0537-4	26.08.13	06:39:00	HN	on ground/ max depth	53° 32.67' S	39° 34.85' W	3153.6
PS81/0537-4	26.08.13	06:40:59	HN	on deck	53° 32.66' S	39° 34.85' W	3153.6
PS81/0537-2	26.08.13	06:45:00	CTD/RO	hoisting	53° 32.66' S	39° 34.84' W	3153.3
PS81/0537-2	26.08.13	07:55:59	CTD/RO	on deck	53° 32.58' S	39° 34.56' W	3150.8
PS81/0538-1	26.08.13	10:09:00	RMT	in the water	53° 29.81' S	40° 10.59' W	2627.9
PS81/0538-1	26.08.13	10:36:00	RMT	on ground/ max depth	53° 30.00' S	40° 12.31' W	2361.4
PS81/0538-1	26.08.13	10:37:00	RMT	profile start	53° 30.00' S	40° 12.39' W	2331.1
PS81/0538-1	26.08.13	10:37:01	RMT	hoisting	53° 30.00' S	40° 12.39' W	2331.1
PS81/0538-1	26.08.13	11:20:00	RMT	profile end	53° 30.72' S	40° 15.05' W	2137.2
PS81/0538-1	26.08.13	11:26:59	RMT	on deck	53° 30.85' S	40° 15.39' W	2039.6
PS81/0538-2	26.08.13	12:12:00	CTD/RO	in the water	53° 30.01' S	40° 18.32' W	2127.2
PS81/0538-3	26.08.13	12:18:00	HN	in the water	53° 30.02' S	40° 18.34' W	2118.2
PS81/0538-3	26.08.13	12:22:00	HN	on ground/ max depth	53° 30.03' S	40° 18.35' W	2111.4
PS81/0538-3	26.08.13	12:24:59	HN	on deck	53° 30.04' S	40° 18.35' W	2108.6
PS81/0538-2	26.08.13	12:41:00	CTD/RO	on ground/ max depth	53° 30.07' S	40° 18.40' W	2120.5
PS81/0538-2	26.08.13	13:13:59	CTD/RO	on deck	53° 29.99' S	40° 18.52' W	2121.3
PS81/0539-1	26.08.13	16:03:00	RMT	in the water	53° 55.30' S	40° 26.44' W	585.7
PS81/0539-1	26.08.13	16:47:00	RMT	on ground/ max depth	53° 57.07' S	40° 27.03' W	1457.8
PS81/0539-1	26.08.13	16:47:01	RMT	profile start	53° 57.07' S	40° 27.03' W	1457.8
PS81/0539-1	26.08.13	17:37:00	RMT	profile end	53° 58.94' S	40° 27.63' W	2277
PS81/0539-1	26.08.13	17:43:59	RMT	on deck	53° 59.14' S	40° 27.69' W	2293.5
PS81/0539-2	26.08.13	17:59:00	CTD/RO	in the water	53° 59.96' S	40° 27.89' W	2583.4
PS81/0539-3	26.08.13	18:09:00	HN	in the water	53° 59.99' S	40° 27.92' W	2589.4
PS81/0539-3	26.08.13	18:10:00	HN	on ground/ max depth	53° 59.99' S	40° 27.92' W	2590.1
PS81/0539-3	26.08.13	18:13:59	HN	on deck	54° 0.00' S	40° 27.94' W	2591.9
PS81/0539-2	26.08.13	18:29:00	CTD/RO	on ground/ max depth	54° 0.05' S	40° 27.99' W	2596.1
PS81/0539-2	26.08.13	18:29:01	CTD/RO	hoisting	54° 0.05' S	40° 27.99' W	2596.1
PS81/0539-4	26.08.13	18:51:00	HN	in the water	54° 0.09' S	40° 27.92' W	2611.3

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0539-4	26.08.13	18:54:00	HN	on ground/ max depth	54° 0.10‘ S	40° 27.92‘ W	2612.8
PS81/0539-4	26.08.13	18:54:59	HN	on deck	54° 0.10‘ S	40° 27.92‘ W	2612.8
PS81/0539-2	26.08.13	19:02:59	CTD/RO	on deck	54° 0.12‘ S	40° 27.96‘ W	2613.1
PS81/0540-1	26.08.13	21:50:00	RMT	in the water	54° 24.79‘ S	40° 35.99‘ W	1714.5
PS81/0540-1	26.08.13	22:28:00	RMT	on ground/ max depth	54° 26.18‘ S	40° 36.84‘ W	1743.3
PS81/0540-1	26.08.13	22:29:00	RMT	hoisting	54° 26.22‘ S	40° 36.87‘ W	1737.3
PS81/0540-1	26.08.13	22:29:01	RMT	profile start	54° 26.22‘ S	40° 36.87‘ W	1737.3
PS81/0540-1	26.08.13	22:50:00	RMT	information	54° 26.92‘ S	40° 37.34‘ W	1563.5
PS81/0540-1	26.08.13	22:57:00	RMT	profile end	54° 27.16‘ S	40° 37.51‘ W	1414.8
PS81/0540-1	26.08.13	22:58:00	RMT	hoisting	54° 27.20‘ S	40° 37.53‘ W	1409.8
PS81/0540-1	26.08.13	23:30:59	RMT	on deck	54° 28.19‘ S	40° 38.14‘ W	1717.2
PS81/0540-2	26.08.13	23:55:00	CTD/RO	in the water	54° 30.04‘ S	40° 37.80‘ W	2012.9
PS81/0540-3	27.08.13	00:00:00	HN	in the water	54° 30.04‘ S	40° 37.87‘ W	2022.7
PS81/0540-3	27.08.13	00:01:00	HN	on ground/ max depth	54° 30.04‘ S	40° 37.90‘ W	2003.1
PS81/0540-3	27.08.13	00:02:59	HN	on deck	54° 30.04‘ S	40° 37.91‘ W	2020.7
PS81/0540-2	27.08.13	00:25:00	CTD/RO	on ground/ max depth	54° 29.91‘ S	40° 37.90‘ W	1880
PS81/0540-4	27.08.13	00:32:00	HN	in the water	54° 29.87‘ S	40° 37.86‘ W	1854
PS81/0540-4	27.08.13	00:33:00	HN	on ground/ max depth	54° 29.86‘ S	40° 37.85‘ W	1855.6
PS81/0540-4	27.08.13	00:37:59	HN	on deck	54° 29.84‘ S	40° 37.83‘ W	1848.4
PS81/0540-2	27.08.13	01:00:59	CTD/RO	on deck	54° 29.72‘ S	40° 37.83‘ W	1809.3
PS81/0541-1	27.08.13	04:02:00	RMT	in the water	54° 59.97‘ S	40° 40.47‘ W	3406.5
PS81/0541-1	27.08.13	04:40:00	RMT	on ground/ max depth	55° 0.18‘ S	40° 42.76‘ W	3053.2
PS81/0541-1	27.08.13	04:40:01	RMT	profile start	55° 0.18‘ S	40° 42.76‘ W	3053.2
PS81/0541-1	27.08.13	05:27:00	RMT	profile end	55° 0.38‘ S	40° 45.40‘ W	3181.9
PS81/0541-1	27.08.13	05:30:59	RMT	on deck	55° 0.40‘ S	40° 45.54‘ W	3178.9
PS81/0541-2	27.08.13	05:46:00	CTD/RO	in the water	54° 60.00‘ S	40° 47.09‘ W	3108.2
PS81/0541-3	27.08.13	05:58:00	HN	in the water	54° 59.96‘ S	40° 47.02‘ W	3113.9
PS81/0541-3	27.08.13	06:00:00	HN	on ground/ max depth	54° 59.95‘ S	40° 47.00‘ W	3114.1
PS81/0541-3	27.08.13	06:01:59	HN	on deck	54° 59.95‘ S	40° 46.99‘ W	3114.9
PS81/0541-4	27.08.13	06:07:00	HN	in the water	54° 59.94‘ S	40° 46.95‘ W	3116.9
PS81/0541-4	27.08.13	06:09:00	HN	on ground/ max depth	54° 59.93‘ S	40° 46.94‘ W	3118
PS81/0541-4	27.08.13	06:12:59	HN	on deck	54° 59.92‘ S	40° 46.92‘ W	3120
PS81/0541-2	27.08.13	06:15:00	CTD/RO	on ground/ max depth	54° 59.91‘ S	40° 46.91‘ W	3122.6
PS81/0541-2	27.08.13	06:16:00	CTD/RO	hoisting	54° 59.90‘ S	40° 46.90‘ W	3123.4
PS81/0541-2	27.08.13	06:48:59	CTD/RO	on deck	54° 59.74‘ S	40° 46.68‘ W	3158.2
PS81/0542-1	27.08.13	10:00:00	RMT	in the water	55° 30.22‘ S	40° 48.35‘ W	3377.1

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0542-1	27.08.13	10:41:00	RMT	on ground/ max depth	55° 29.50‘ S	40° 51.00‘ W	3289.8
PS81/0542-1	27.08.13	10:41:01	RMT	profile start	55° 29.50‘ S	40° 51.00‘ W	3289.8
PS81/0542-1	27.08.13	10:41:02	RMT	hoisting	55° 29.50‘ S	40° 51.00‘ W	3289.8
PS81/0542-1	27.08.13	11:30:00	RMT	profile end	55° 28.79‘ S	40° 54.09‘ W	3271
PS81/0542-1	27.08.13	11:34:59	RMT	on deck	55° 28.74‘ S	40° 54.35‘ W	3267
PS81/0542-2	27.08.13	12:02:00	CTD/RO	in the water	55° 29.93‘ S	40° 57.09‘ W	3307.9
PS81/0542-3	27.08.13	12:07:00	HN	in the water	55° 29.90‘ S	40° 57.04‘ W	3310.4
PS81/0542-3	27.08.13	12:09:00	HN	on ground/ max depth	55° 29.90‘ S	40° 57.03‘ W	3310.2
PS81/0542-3	27.08.13	12:10:59	HN	on deck	55° 29.89‘ S	40° 57.03‘ W	3310.7
PS81/0542-4	27.08.13	12:11:00	HN	in the water	55° 29.89‘ S	40° 57.02‘ W	3310.8
PS81/0542-4	27.08.13	12:13:00	HN	on ground/ max depth	55° 29.88‘ S	40° 57.01‘ W	3310.8
PS81/0542-4	27.08.13	12:15:59	HN	on deck	55° 29.87‘ S	40° 57.00‘ W	3311.4
PS81/0542-2	27.08.13	12:30:00	CTD/RO	on ground/ max depth	55° 29.81‘ S	40° 56.95‘ W	3311.7
PS81/0542-2	27.08.13	13:02:59	CTD/RO	on deck	55° 29.78‘ S	40° 56.73‘ W	3325.3
PS81/0543-1	27.08.13	16:09:00	CTD/RO	in the water	55° 59.99‘ S	41° 6.60‘ W	3149.2
PS81/0543-1	27.08.13	16:40:00	CTD/RO	on ground/ max depth	56° 0.10‘ S	41° 6.60‘ W	3141.8
PS81/0543-1	27.08.13	16:41:00	CTD/RO	hoisting	56° 0.09‘ S	41° 6.61‘ W	3143.3
PS81/0543-2	27.08.13	16:42:00	HN	in the water	56° 0.09‘ S	41° 6.61‘ W	3142.7
PS81/0543-2	27.08.13	16:43:00	HN	on ground/ max depth	56° 0.10‘ S	41° 6.61‘ W	3142.9
PS81/0543-2	27.08.13	16:45:59	HN	on deck	56° 0.11‘ S	41° 6.61‘ W	3141.9
PS81/0543-1	27.08.13	17:18:59	CTD/RO	on deck	56° 0.14‘ S	41° 6.65‘ W	3139.9
PS81/0544-1	27.08.13	20:29:00	CTD/RO	in the water	56° 30.01‘ S	41° 15.91‘ W	3545.9
PS81/0544-2	27.08.13	20:35:00	HN	in the water	56° 30.05‘ S	41° 15.85‘ W	3556.3
PS81/0544-2	27.08.13	20:39:00	HN	on ground/ max depth	56° 30.06‘ S	41° 15.81‘ W	3559.5
PS81/0544-2	27.08.13	20:39:59	HN	on deck	56° 30.06‘ S	41° 15.81‘ W	3559.5
PS81/0544-3	27.08.13	20:54:00	HN	in the water	56° 30.03‘ S	41° 15.70‘ W	3554.2
PS81/0544-3	27.08.13	20:54:01	HN	on ground/ max depth	56° 30.03‘ S	41° 15.70‘ W	3554.2
PS81/0544-3	27.08.13	20:55:59	HN	on deck	56° 30.03‘ S	41° 15.69‘ W	3556.4
PS81/0544-1	27.08.13	20:58:00	CTD/RO	on ground/ max depth	56° 30.02‘ S	41° 15.70‘ W	3554.7
PS81/0544-1	27.08.13	20:58:01	CTD/RO	hoisting	56° 30.02‘ S	41° 15.70‘ W	3554.7
PS81/0544-1	27.08.13	21:31:59	CTD/RO	on deck	56° 29.85‘ S	41° 15.61‘ W	3537.8
PS81/0545-1	28.08.13	00:47:00	CTD/RO	in the water	57° 0.03‘ S	41° 26.13‘ W	3607.1
PS81/0545-1	28.08.13	01:12:00	CTD/RO	on ground/ max depth	57° 0.19‘ S	41° 26.24‘ W	3604
PS81/0545-1	28.08.13	01:40:59	CTD/RO	on deck	57° 0.17‘ S	41° 26.47‘ W	3610.1
PS81/0546-1	28.08.13	12:53:00	CTD/RO	in the water	59° 0.05‘ S	42° 4.73‘ W	3736.7

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0546-2	28.08.13	13:13:00	HN	in the water	59° 0.21' S	42° 4.86' W	3740.4
PS81/0546-2	28.08.13	13:14:00	HN	on ground/ max depth	59° 0.21' S	42° 4.88' W	3741.4
PS81/0546-2	28.08.13	13:16:59	HN	on deck	59° 0.22' S	42° 4.91' W	3741.7
PS81/0546-1	28.08.13	13:21:00	CTD/RO	on ground/ max depth	59° 0.24' S	42° 4.97' W	3741.6
PS81/0546-1	28.08.13	13:54:59	CTD/RO	on deck	59° 0.46' S	42° 5.34' W	3747.8
PS81/0547-1	28.08.13	17:20:00	CTD/RO	in the water	59° 30.04' S	42° 14.33' W	3854.4
PS81/0547-2	28.08.13	17:20:00	HN	in the water	59° 30.04' S	42° 14.33' W	3854.4
PS81/0547-2	28.08.13	17:21:00	HN	on ground/ max depth	59° 30.05' S	42° 14.32' W	3854.8
PS81/0547-2	28.08.13	17:24:59	HN	on deck	59° 30.08' S	42° 14.29' W	3855.4
PS81/0547-1	28.08.13	17:49:00	CTD/RO	on ground/ max depth	59° 30.34' S	42° 13.95' W	3860
PS81/0547-1	28.08.13	18:20:59	CTD/RO	on deck	59° 30.55' S	42° 13.50' W	3866.4
PS81/0547-3	28.08.13	18:38:00	RMT	in the water	59° 30.41' S	42° 14.36' W	3859.1
PS81/0547-3	28.08.13	18:41:00	RMT	on ground/ max depth	59° 30.39' S	42° 14.55' W	3858.4
PS81/0547-3	28.08.13	18:41:01	RMT	profile start	59° 30.39' S	42° 14.55' W	3858.4
PS81/0547-3	28.08.13	19:00:00	RMT	profile end	59° 30.17' S	42° 15.74' W	3850.9
PS81/0547-3	28.08.13	19:00:01	RMT	hoisting	59° 30.17' S	42° 15.74' W	3850.9
PS81/0547-3	28.08.13	19:10:59	RMT	on deck	59° 29.98' S	42° 16.50' W	3846.2
PS81/0548-1	28.08.13	22:26:00	CTD/RO	in the water	59° 59.78' S	42° 23.62' W	4282.2
PS81/0548-1	28.08.13	22:56:00	CTD/RO	on ground/ max depth	59° 59.85' S	42° 23.52' W	4282.8
PS81/0548-1	28.08.13	22:57:00	CTD/RO	hoisting	59° 59.85' S	42° 23.51' W	4283
PS81/0548-1	28.08.13	23:28:59	CTD/RO	on deck	59° 59.99' S	42° 23.63' W	4285.3
PS81/0548-2	28.08.13	23:33:00	HN	in the water	59° 59.99' S	42° 23.62' W	4285.1
PS81/0548-2	28.08.13	23:35:00	HN	on ground/ max depth	59° 59.99' S	42° 23.62' W	4285.6
PS81/0548-3	28.08.13	23:36:00	HN	in the water	59° 59.99' S	42° 23.61' W	4285.4
PS81/0548-2	28.08.13	23:36:59	HN	on deck	59° 59.99' S	42° 23.61' W	4285.4
PS81/0548-3	28.08.13	23:37:00	HN	on ground/ max depth	59° 59.99' S	42° 23.61' W	4285.3
PS81/0548-3	28.08.13	23:40:59	HN	on deck	59° 59.99' S	42° 23.60' W	4285.1
PS81/0548-4	28.08.13	23:42:00	HN	in the water	59° 59.99' S	42° 23.59' W	4285.3
PS81/0548-4	28.08.13	23:45:00	HN	on ground/ max depth	59° 59.97' S	42° 23.52' W	4284.4
PS81/0548-4	28.08.13	23:48:59	HN	on deck	59° 59.97' S	42° 23.51' W	4285.2
PS81/0548-5	29.08.13	00:06:00	RMT	in the water	59° 59.93' S	42° 24.15' W	4286
PS81/0548-5	29.08.13	00:08:00	RMT	lowering	59° 59.90' S	42° 24.26' W	4286.7
PS81/0548-5	29.08.13	00:09:00	RMT	profile start	59° 59.89' S	42° 24.33' W	4286.6
PS81/0548-5	29.08.13	00:35:00	RMT	on ground/ max depth	60° 0.00' S	42° 26.09' W	4306.9
PS81/0548-5	29.08.13	00:36:00	RMT	hoisting	60° 0.01' S	42° 26.16' W	4307.7

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0548-5	29.08.13	01:28:00	RMT	profile end	60° 0.53' S	42° 29.98' W	4359.1
PS81/0548-5	29.08.13	01:30:59	RMT	on deck	60° 0.56' S	42° 30.13' W	4360.3
PS81/0549-1	29.08.13	11:42:00	SUIT	in the water	61° 14.73' S	42° 3.69' W	595
PS81/0549-1	29.08.13	11:55:00	SUIT	profile start	61° 15.08' S	42° 3.89' W	594.3
PS81/0549-1	29.08.13	12:28:00	SUIT	profile end	61° 15.17' S	42° 5.14' W	593.7
PS81/0549-1	29.08.13	12:52:59	SUIT	on deck	61° 15.00' S	42° 5.03' W	593.1
PS81/0549-2	29.08.13	13:33:00	BONGO	in the water	61° 15.36' S	42° 7.32' W	581.4
PS81/0549-2	29.08.13	13:40:00	BONGO	on ground/ max depth	61° 15.36' S	42° 7.28' W	581.5
PS81/0549-2	29.08.13	13:40:01	BONGO	hoisting	61° 15.36' S	42° 7.28' W	581.5
PS81/0549-2	29.08.13	13:47:59	BONGO	on deck	61° 15.35' S	42° 7.24' W	581.5
PS81/0550-1	30.08.13	11:25:00	CTD/RO	in the water	61° 20.04' S	40° 38.14' W	2546.4
PS81/0550-1	30.08.13	11:53:00	CTD/RO	on ground/ max depth	61° 19.80' S	40° 37.93' W	2526.5
PS81/0550-1	30.08.13	11:55:00	CTD/RO	hoisting	61° 19.78' S	40° 37.91' W	2525.4
PS81/0550-1	30.08.13	12:30:59	CTD/RO	on deck	61° 19.48' S	40° 37.65' W	2487.5
PS81/0550-2	30.08.13	12:36:00	HN	in the water	61° 19.43' S	40° 37.60' W	2481.9
PS81/0550-2	30.08.13	12:37:00	HN	on ground/ max depth	61° 19.42' S	40° 37.60' W	2481.1
PS81/0550-2	30.08.13	12:40:59	HN	on deck	61° 19.39' S	40° 37.57' W	2479.4
PS81/0550-3	30.08.13	12:43:00	BONGO	in the water	61° 19.37' S	40° 37.55' W	2476.4
PS81/0550-3	30.08.13	12:50:00	BONGO	on ground/ max depth	61° 19.31' S	40° 37.50' W	2470.6
PS81/0550-3	30.08.13	13:02:59	BONGO	on deck	61° 19.21' S	40° 37.41' W	2458.1
PS81/0550-4	30.08.13	13:53:00	ICE	in the water	61° 18.88' S	40° 37.26' W	2420.1
PS81/0550-4	30.08.13	14:10:00	ICE	in the water	61° 18.73' S	40° 37.12' W	2410.7
PS81/0550-4	30.08.13	14:17:00	ICE	information	61° 18.66' S	40° 37.06' W	2405.2
PS81/0550-4	30.08.13	14:23:00	ICE	on ground/ max depth	61° 18.59' S	40° 36.99' W	2403.9
PS81/0550-4	30.08.13	14:27:59	ICE	on deck	61° 18.55' S	40° 36.88' W	2403.5
PS81/0550-5	30.08.13	15:43:00	ICE	in the water	61° 17.73' S	40° 36.57' W	2389.4
PS81/0550-5	30.08.13	15:47:00	ICE	on ground/ max depth	61° 17.70' S	40° 36.53' W	2390.5
PS81/0550-5	30.08.13	15:49:59	ICE	on deck	61° 17.68' S	40° 36.51' W	2391.1
PS81/0551-1	31.08.13	00:38:00	SUIT	in the water	61° 13.49' S	40° 43.17' W	2537
PS81/0551-1	31.08.13	00:47:00	SUIT	profile start	61° 13.33' S	40° 43.57' W	2525.6
PS81/0551-1	31.08.13	01:21:00	SUIT	profile end	61° 12.66' S	40° 44.46' W	2470.4
PS81/0551-1	31.08.13	01:34:00	SUIT	on ground/ max depth	61° 12.61' S	40° 44.37' W	2470.8
PS81/0551-1	31.08.13	01:34:59	SUIT	on deck	61° 12.61' S	40° 44.37' W	2470.8
PS81/0552-1	31.08.13	02:31:00	CTD/RO	in the water	61° 13.54' S	40° 44.05' W	2511.6
PS81/0552-2	31.08.13	03:31:00	HN	in the water	61° 13.42' S	40° 43.64' W	2522.9
PS81/0552-2	31.08.13	03:33:00	HN	on ground/ max depth	61° 13.43' S	40° 43.63' W	2523.1
PS81/0552-2	31.08.13	03:36:59	HN	on deck	61° 13.43' S	40° 43.62' W	2523.4

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0552-1	31.08.13	03:55:00	CTD/RO	on ground/ max depth	61° 13.38' S	40° 43.41' W	2528.8
PS81/0552-1	31.08.13	04:01:00	CTD/RO	hoisting	61° 13.37' S	40° 43.38' W	2529.4
PS81/0552-3	31.08.13	04:35:00	HN	in the water	61° 13.26' S	40° 43.17' W	2519.1
PS81/0552-3	31.08.13	04:36:00	HN	on ground/ max depth	61° 13.26' S	40° 43.17' W	2518.7
PS81/0552-3	31.08.13	04:40:59	HN	on deck	61° 13.25' S	40° 43.11' W	2517.9
PS81/0552-1	31.08.13	05:05:59	CTD/RO	on deck	61° 13.18' S	40° 42.91' W	2509.8
PS81/0553-1	31.08.13	15:00:00	ICE	on ground/ max depth	61° 17.62' S	40° 56.01' W	2243.6
PS81/0553-1	31.08.13	15:15:00	ICE	information	61° 17.66' S	40° 56.01' W	2245.6
PS81/0553-1	31.08.13	15:54:00	ICE	information	61° 17.78' S	40° 55.99' W	2252
PS81/0553-1	31.08.13	23:58:00	ICE	information	61° 17.37' S	40° 54.87' W	2292.8
PS81/0553-1	01.09.13	00:28:59	ICE	on deck	61° 17.26' S	40° 55.04' W	2278.9
PS81/0554-1	01.09.13	01:11:00	RMT	in the water	61° 15.09' S	40° 54.09' W	2293.8
PS81/0554-1	01.09.13	01:13:00	RMT	profile start	61° 15.12' S	40° 54.13' W	2293.5
PS81/0554-1	01.09.13	01:13:01	RMT	on ground/ max depth	61° 15.12' S	40° 54.13' W	2293.5
PS81/0554-1	01.09.13	01:28:00	RMT	profile end	61° 15.45' S	40° 54.41' W	2296.3
PS81/0554-1	01.09.13	01:32:59	RMT	on deck	61° 15.55' S	40° 54.45' W	2297.8
PS81/0554-2	01.09.13	02:05:00	RMT	in the water	61° 14.53' S	40° 54.33' W	2264.6
PS81/0554-2	01.09.13	02:29:00	RMT	on ground/ max depth	61° 15.11' S	40° 54.78' W	2290.3
PS81/0554-2	01.09.13	02:30:00	RMT	profile start	61° 15.13' S	40° 54.81' W	2290.3
PS81/0554-2	01.09.13	02:53:00	RMT	profile end	61° 15.68' S	40° 55.31' W	2280.3
PS81/0554-2	01.09.13	02:56:59	RMT	on deck	61° 15.78' S	40° 55.38' W	2266.6
PS81/0554-3	01.09.13	03:24:00	RMT	in the water	61° 14.22' S	40° 55.48' W	2177
PS81/0554-3	01.09.13	03:27:00	RMT	on ground/ max depth	61° 14.29' S	40° 55.43' W	2173.5
PS81/0554-3	01.09.13	03:27:01	RMT	profile start	61° 14.29' S	40° 55.43' W	2173.5
PS81/0554-3	01.09.13	03:42:00	RMT	profile end	61° 14.69' S	40° 55.29' W	2191.9
PS81/0554-3	01.09.13	03:46:59	RMT	on deck	61° 14.80' S	40° 55.30' W	2202.4
PS81/0555-1	01.09.13	12:00:00	ICE	on ground/ max depth	61° 12.66' S	41° 3.53' W	1894.3
PS81/0555-1	01.09.13	13:03:00	ICE	information	61° 12.21' S	41° 3.58' W	1927.8
PS81/0555-2	01.09.13	15:16:00	CTD/RO	in the water	61° 11.38' S	41° 3.81' W	1963.2
PS81/0555-2	01.09.13	16:04:00	CTD/RO	on ground/ max depth	61° 11.15' S	41° 3.85' W	1975.8
PS81/0555-2	01.09.13	16:34:00	CTD/RO	hoisting	61° 11.02' S	41° 3.84' W	1988.9
PS81/0555-2	01.09.13	17:20:59	CTD/RO	on deck	61° 10.82' S	41° 3.77' W	1995.1
PS81/0555-1	01.09.13	20:30:00	ICE	information	61° 9.90' S	41° 2.58' W	2099
PS81/0555-3	01.09.13	20:47:00	MN	in the water	61° 9.80' S	41° 2.45' W	2120.3
PS81/0555-3	01.09.13	21:49:00	MN	on ground/ max depth	61° 9.44' S	41° 1.97' W	2171.5
PS81/0555-3	01.09.13	22:32:59	MN	on deck	61° 9.18' S	41° 1.64' W	2202.2

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0555-4	02.09.13	00:00:00	MN	in the water	61° 8.67‘ S	41° 0.89‘ W	2278.8
PS81/0555-4	02.09.13	00:32:00	MN	on ground/ max depth	61° 8.48‘ S	41° 0.61‘ W	2307.7
PS81/0555-4	02.09.13	00:58:59	MN	on deck	61° 8.32‘ S	41° 0.40‘ W	2318.7
PS81/0555-5	02.09.13	04:04:00	MN	in the water	61° 7.28‘ S	40° 58.71‘ W	2302.7
PS81/0555-5	02.09.13	04:37:00	MN	on ground/ max depth	61° 7.09‘ S	40° 58.45‘ W	2269.8
PS81/0555-5	02.09.13	04:38:00	MN	hoisting	61° 7.08‘ S	40° 58.44‘ W	2269.7
PS81/0555-5	02.09.13	05:08:59	MN	on deck	61° 6.91‘ S	40° 58.19‘ W	2288
PS81/0555-6	02.09.13	08:04:00	MN	in the water	61° 5.66‘ S	40° 56.81‘ W	2210.1
PS81/0555-6	02.09.13	08:38:00	MN	on ground/ max depth	61° 5.38‘ S	40° 56.61‘ W	2232.4
PS81/0555-1	02.09.13	08:52:00	ICE	information	61° 5.26‘ S	40° 56.54‘ W	2255
PS81/0555-6	02.09.13	09:05:59	MN	on deck	61° 5.15‘ S	40° 56.49‘ W	2283.6
PS81/0555-1	02.09.13	09:07:00	ICE	information	61° 5.13‘ S	40° 56.48‘ W	2287.7
PS81/0555-1	02.09.13	10:32:00	ICE	information	61° 4.41‘ S	40° 56.29‘ W	2454.2
PS81/0555-7	02.09.13	12:05:00	MN	in the water	61° 3.69‘ S	40° 56.26‘ W	2483.4
PS81/0555-7	02.09.13	12:38:00	MN	on ground/ max depth	61° 3.43‘ S	40° 56.31‘ W	2495.6
PS81/0555-7	02.09.13	13:06:59	MN	on deck	61° 3.22‘ S	40° 56.38‘ W	2599.1
PS81/0555-8	02.09.13	16:00:00	MN	in the water	61° 2.11‘ S	40° 56.66‘ W	2627.6
PS81/0555-9	02.09.13	16:20:00	HN	in the water	61° 1.97‘ S	40° 56.67‘ W	2623.3
PS81/0555-9	02.09.13	16:22:00	HN	on ground/ max depth	61° 1.96‘ S	40° 56.67‘ W	2622.4
PS81/0555-9	02.09.13	16:25:59	HN	on deck	61° 1.94‘ S	40° 56.68‘ W	2622.1
PS81/0555-10	02.09.13	16:26:00	HN	in the water	61° 1.93‘ S	40° 56.68‘ W	2619.5
PS81/0555-10	02.09.13	16:27:00	HN	on ground/ max depth	61° 1.92‘ S	40° 56.68‘ W	2619.5
PS81/0555-10	02.09.13	16:28:59	HN	on deck	61° 1.91‘ S	40° 56.68‘ W	2621.1
PS81/0555-8	02.09.13	16:31:00	MN	on ground/ max depth	61° 1.89‘ S	40° 56.68‘ W	2615.9
PS81/0555-8	02.09.13	16:31:01	MN	hoisting	61° 1.89‘ S	40° 56.68‘ W	2615.9
PS81/0555-8	02.09.13	16:59:59	MN	on deck	61° 1.69‘ S	40° 56.72‘ W	2618.5
PS81/0555-11	02.09.13	18:16:00	CTD/RO	in the water	61° 1.09‘ S	40° 56.92‘ W	2740.9
PS81/0555-11	02.09.13	18:45:00	CTD/RO	on ground/ max depth	61° 0.86‘ S	40° 57.08‘ W	2796.4
PS81/0555-11	02.09.13	19:01:59	CTD/RO	on deck	61° 0.74‘ S	40° 57.18‘ W	2823.8
PS81/0555-12	02.09.13	20:04:00	MN	in the water	61° 0.30‘ S	40° 57.50‘ W	2843.5
PS81/0555-12	02.09.13	20:38:00	MN	on ground/ max depth	61° 0.07‘ S	40° 57.66‘ W	2991
PS81/0555-12	02.09.13	21:07:59	MN	on deck	60° 59.87‘ S	40° 57.79‘ W	3176.2

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0555-1	02.09.13	22:30:00	ICE	information	60° 59.32‘ S	40° 58.08‘ W	3481.6
PS81/0555-13	03.09.13	00:01:00	MN	in the water	60° 58.77‘ S	40° 58.29‘ W	3643.4
PS81/0555-13	03.09.13	00:32:00	MN	on ground/ max depth	60° 58.61‘ S	40° 58.35‘ W	3715.4
PS81/0555-13	03.09.13	01:01:59	MN	on deck	60° 58.46‘ S	40° 58.39‘ W	3812.5
PS81/0555-14	03.09.13	01:22:00	BONGO	in the water	60° 58.36‘ S	40° 58.41‘ W	3899.6
PS81/0555-14	03.09.13	01:31:00	BONGO	on ground/ max depth	60° 58.32‘ S	40° 58.42‘ W	3890.5
PS81/0555-14	03.09.13	01:38:59	BONGO	on deck	60° 58.29‘ S	40° 58.42‘ W	3959.9
PS81/0555-15	03.09.13	01:40:00	BONGO	in the water	60° 58.28‘ S	40° 58.42‘ W	3938.5
PS81/0555-15	03.09.13	01:49:00	BONGO	on ground/ max depth	60° 58.24‘ S	40° 58.43‘ W	3963.1
PS81/0555-15	03.09.13	01:56:59	BONGO	on deck	60° 58.21‘ S	40° 58.44‘ W	3946.1
PS81/0555-1	03.09.13	02:37:00	ICE	information	60° 58.03‘ S	40° 58.45‘ W	4079.6
PS81/0555-1	03.09.13	03:15:00	ICE	information	60° 57.89‘ S	40° 58.45‘ W	4093.6
PS81/0555-1	03.09.13	10:23:00	ICE	information	60° 56.51‘ S	40° 57.49‘ W	4797.3
PS81/0555-1	03.09.13	20:15:00	ICE	information	60° 56.78‘ S	40° 51.96‘ W	4547.5
PS81/0555-16	03.09.13	20:23:00	CTD/RO	in the water	60° 56.79‘ S	40° 51.82‘ W	4447.3
PS81/0555-16	03.09.13	20:38:00	CTD/RO	on ground/ max depth	60° 56.80‘ S	40° 51.54‘ W	4321.3
PS81/0555-16	03.09.13	20:43:00	CTD/RO	on deck	60° 56.80‘ S	40° 51.45‘ W	4321.9
PS81/0555-16	03.09.13	21:17:00	CTD/RO	in the water	60° 56.83‘ S	40° 50.81‘ W	3978.4
PS81/0555-16	03.09.13	21:20:00	CTD/RO	on deck	60° 56.84‘ S	40° 50.75‘ W	3892.4
PS81/0555-16	03.09.13	21:58:00	CTD/RO	in the water	60° 56.88‘ S	40° 50.01‘ W	3774.3
PS81/0555-1	03.09.13	22:30:00	ICE	information	60° 56.91‘ S	40° 49.35‘ W	3541.6
PS81/0555-16	03.09.13	23:15:00	CTD/RO	on ground/ max depth	60° 56.93‘ S	40° 48.41‘ W	3426.9
PS81/0555-1	03.09.13	23:20:00	ICE	information	60° 56.94‘ S	40° 48.31‘ W	3421.3
PS81/0555-16	03.09.13	23:45:00	CTD/RO	hoisting	60° 56.95‘ S	40° 47.78‘ W	3515.8
PS81/0555-16	04.09.13	00:56:59	CTD/RO	on deck	60° 56.98‘ S	40° 46.24‘ W	3284.8
PS81/0555-17	04.09.13	01:14:00	BONGO	in the water	60° 56.98‘ S	40° 45.85‘ W	3237.6
PS81/0555-17	04.09.13	01:19:00	BONGO	on ground/ max depth	60° 56.98‘ S	40° 45.74‘ W	3229.6

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0555-17	04.09.13	01:24:59	BONGO	on deck	60° 56.99‘ S	40° 45.63‘ W	3224.3
PS81/0555-18	04.09.13	01:27:00	BONGO	in the water	60° 56.99‘ S	40° 45.56‘ W	3221.6
PS81/0555-18	04.09.13	01:31:00	BONGO	on ground/ max depth	60° 56.99‘ S	40° 45.48‘ W	3217.9
PS81/0555-18	04.09.13	01:35:59	BONGO	on deck	60° 56.99‘ S	40° 45.39‘ W	3213.9
PS81/0555-19	04.09.13	01:36:00	BONGO	in the water	60° 56.99‘ S	40° 45.37‘ W	3213.3
PS81/0555-19	04.09.13	01:45:00	BONGO	on ground/ max depth	60° 56.99‘ S	40° 45.17‘ W	3209.3
PS81/0555-19	04.09.13	01:51:59	BONGO	on deck	60° 56.99‘ S	40° 45.04‘ W	3211.5
PS81/0555-20	04.09.13	01:52:00	BONGO	in the water	60° 56.99‘ S	40° 45.02‘ W	3211.9
PS81/0555-20	04.09.13	01:58:00	BONGO	on ground/ max depth	60° 56.99‘ S	40° 44.89‘ W	3217.5
PS81/0555-20	04.09.13	01:59:00	BONGO	hoisting	60° 56.99‘ S	40° 44.87‘ W	3229.9
PS81/0555-20	04.09.13	02:02:59	BONGO	on deck	60° 56.99‘ S	40° 44.80‘ W	3223.2
PS81/0555-21	04.09.13	02:03:00	BONGO	in the water	60° 56.99‘ S	40° 44.78‘ W	3222.9
PS81/0555-21	04.09.13	02:08:00	BONGO	on ground/ max depth	60° 56.99‘ S	40° 44.67‘ W	3245.4
PS81/0555-21	04.09.13	02:08:01	BONGO	hoisting	60° 56.99‘ S	40° 44.67‘ W	3245.4
PS81/0555-21	04.09.13	02:11:59	BONGO	on deck	60° 56.99‘ S	40° 44.60‘ W	3251.4
PS81/0555-22	04.09.13	02:13:00	BONGO	in the water	60° 56.99‘ S	40° 44.56‘ W	3254.7
PS81/0555-22	04.09.13	02:16:00	BONGO	on ground/ max depth	60° 56.99‘ S	40° 44.49‘ W	3261.3
PS81/0555-22	04.09.13	02:16:01	BONGO	hoisting	60° 56.99‘ S	40° 44.49‘ W	3261.3
PS81/0555-23	04.09.13	02:19:00	BONGO	in the water	60° 56.99‘ S	40° 44.43‘ W	3269.1
PS81/0555-22	04.09.13	02:19:59	BONGO	on deck	60° 56.99‘ S	40° 44.43‘ W	3269.1
PS81/0555-23	04.09.13	02:24:00	BONGO	on ground/ max depth	60° 57.00‘ S	40° 44.32‘ W	3281.8
PS81/0555-23	04.09.13	02:24:01	BONGO	hoisting	60° 57.00‘ S	40° 44.32‘ W	3281.8
PS81/0555-23	04.09.13	02:28:59	BONGO	on deck	60° 57.00‘ S	40° 44.23‘ W	3314
PS81/0555-1	04.09.13	10:48:00	ICE	information	60° 55.89‘ S	40° 33.55‘ W	2677.6
PS81/0555-44	04.09.13	11:47:00	SUIT	in the water	60° 55.58‘ S	40° 32.48‘ W	2712

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0555-44	04.09.13	11:50:00	SUIT	on ground/ max depth	60° 55.56' S	40° 32.43' W	2717
PS81/0555-44	04.09.13	11:50:01	SUIT	profile start	60° 55.56' S	40° 32.43' W	2717.3
PS81/0555-44	04.09.13	12:53:00	SUIT	profile end	60° 55.25' S	40° 31.37' W	2817.7
PS81/0555-44	04.09.13	12:56:59	SUIT	on deck	60° 55.24' S	40° 31.33' W	2818.5
PS81/0555-24	04.09.13	17:16:00	CTD/RO	in the water	60° 53.91' S	40° 26.89' W	2873.3
PS81/0555-24	04.09.13	17:33:00	CTD/RO	on ground/ max depth	60° 53.81' S	40° 26.61' W	2903.9
PS81/0555-24	04.09.13	17:33:01	CTD/RO	hoisting	60° 53.81' S	40° 26.61' W	2903.9
PS81/0555-24	04.09.13	17:47:59	CTD/RO	on deck	60° 53.73' S	40° 26.38' W	2923.3
PS81/0555-1	04.09.13	22:50:00	ICE	information	60° 52.08' S	40° 22.39' W	3769.4
PS81/0555-25	04.09.13	23:06:00	BONGO	in the water	60° 52.03' S	40° 22.28' W	3787
PS81/0555-25	04.09.13	23:10:00	BONGO	on ground/ max depth	60° 52.02' S	40° 22.25' W	3787.9
PS81/0555-25	04.09.13	23:13:59	BONGO	on deck	60° 52.01' S	40° 22.23' W	3790.8
PS81/0555-26	04.09.13	23:15:00	BONGO	in the water	60° 52.00' S	40° 22.21' W	3791.2
PS81/0555-26	04.09.13	23:19:00	BONGO	on ground/ max depth	60° 51.99' S	40° 22.18' W	3792.8
PS81/0555-1	04.09.13	23:20:00	ICE	information	60° 51.99' S	40° 22.17' W	3793.6
PS81/0555-26	04.09.13	23:23:59	BONGO	on deck	60° 51.98' S	40° 22.14' W	3795.5
PS81/0555-27	04.09.13	23:24:00	BONGO	in the water	60° 51.97' S	40° 22.13' W	3795.6
PS81/0555-27	04.09.13	23:34:00	BONGO	on ground/ max depth	60° 51.94' S	40° 22.05' W	3802.6
PS81/0555-27	04.09.13	23:40:59	BONGO	on deck	60° 51.93' S	40° 21.99' W	3807.1
PS81/0555-28	04.09.13	23:41:00	BONGO	in the water	60° 51.92' S	40° 21.99' W	3806.9
PS81/0555-28	04.09.13	23:46:00	BONGO	on ground/ max depth	60° 51.91' S	40° 21.94' W	3811.5
PS81/0555-28	04.09.13	23:50:59	BONGO	on deck	60° 51.90' S	40° 21.91' W	3814.9
PS81/0555-29	04.09.13	23:51:00	BONGO	in the water	60° 51.89' S	40° 21.90' W	3815.3
PS81/0555-29	04.09.13	23:56:00	BONGO	on ground/ max depth	60° 51.88' S	40° 21.86' W	3824.2
PS81/0555-29	05.09.13	00:00:59	BONGO	on deck	60° 51.87' S	40° 21.82' W	3826.1

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0555-30	05.09.13	00:01:00	BONGO	in the water	60° 51.87' S	40° 21.82' W	3857.1
PS81/0555-30	05.09.13	00:06:00	BONGO	on ground/ max depth	60° 51.85' S	40° 21.77' W	3859.6
PS81/0555-30	05.09.13	00:09:59	BONGO	on deck	60° 51.85' S	40° 21.75' W	3861.6
PS81/0555-31	05.09.13	00:10:00	BONGO	in the water	60° 51.84' S	40° 21.74' W	3861.9
PS81/0555-31	05.09.13	00:15:00	BONGO	on ground/ max depth	60° 51.83' S	40° 21.70' W	3865.1
PS81/0555-31	05.09.13	00:18:59	BONGO	on deck	60° 51.82' S	40° 21.67' W	3845.6
PS81/0555-32	05.09.13	00:19:00	BONGO	in the water	60° 51.82' S	40° 21.66' W	3868.5
PS81/0555-32	05.09.13	00:24:00	BONGO	on ground/ max depth	60° 51.81' S	40° 21.61' W	3872.4
PS81/0555-32	05.09.13	00:28:59	BONGO	on deck	60° 51.80' S	40° 21.57' W	3877.1
PS81/0555-33	05.09.13	00:29:00	BONGO	in the water	60° 51.80' S	40° 21.56' W	3874.4
PS81/0555-33	05.09.13	00:34:00	BONGO	on ground/ max depth	60° 51.78' S	40° 21.51' W	3899.6
PS81/0555-33	05.09.13	00:37:59	BONGO	on deck	60° 51.77' S	40° 21.47' W	3884.2
PS81/0555-34	05.09.13	00:51:00	RN	in the water	60° 51.73' S	40° 21.29' W	3992.1
PS81/0555-34	05.09.13	00:55:00	RN	on ground/ max depth	60° 51.72' S	40° 21.24' W	3929.9
PS81/0555-34	05.09.13	00:55:59	RN	on deck	60° 51.72' S	40° 21.24' W	3929.9
PS81/0555-35	05.09.13	00:57:00	RN	in the water	60° 51.71' S	40° 21.21' W	3927.3
PS81/0555-35	05.09.13	01:30:00	RN	on ground/ max depth	60° 51.56' S	40° 20.72' W	3966.1
PS81/0555-35	05.09.13	01:35:59	RN	on deck	60° 51.53' S	40° 20.64' W	4003.4
PS81/0555-1	05.09.13	02:52:00	ICE	information	60° 51.19' S	40° 19.70' W	4275.3
PS81/0555-1	05.09.13	03:20:00	ICE	information	60° 51.07' S	40° 19.33' W	4285.1
PS81/0555-1	05.09.13	11:00:00	ICE	information	60° 49.90' S	40° 13.30' W	0
PS81/0555-1	05.09.13	21:05:00	ICE	information	60° 48.80' S	39° 57.35' W	4840.7
PS81/0555-36	05.09.13	23:49:00	SUIT	in the water	60° 47.06' S	39° 54.71' W	0
PS81/0555-36	05.09.13	23:55:00	SUIT	on ground/ max depth	60° 47.01' S	39° 54.63' W	0
PS81/0555-36	06.09.13	00:00:00	SUIT	profile start	60° 46.97' S	39° 54.56' W	0
PS81/0555-36	06.09.13	01:00:00	SUIT	profile end	60° 46.50' S	39° 53.79' W	0

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0555-36	06.09.13	01:00:01	SUIT	hoisting	60° 46.50‘ S	39° 53.79‘ W	0
PS81/0555-36	06.09.13	01:13:59	SUIT	on deck	60° 46.41‘ S	39° 53.63‘ W	3243.5
PS81/0555-1	06.09.13	11:57:00	ICE	information	60° 45.17‘ S	39° 45.20‘ W	5104.7
PS81/0555-37	06.09.13	18:48:00	CTD/RO	in the water	60° 45.68‘ S	39° 39.35‘ W	4315.6
PS81/0555-37	06.09.13	20:17:00	CTD/RO	on ground/ max depth	60° 45.88‘ S	39° 37.48‘ W	3823.2
PS81/0555-1	06.09.13	20:33:00	ICE	information	60° 45.89‘ S	39° 37.17‘ W	3745.4
PS81/0555-37	06.09.13	20:41:00	CTD/RO	hoisting	60° 45.90‘ S	39° 37.01‘ W	3690.1
PS81/0555-37	06.09.13	21:55:59	CTD/RO	on deck	60° 45.92‘ S	39° 35.68‘ W	3542.2
PS81/0555-38	06.09.13	23:02:00	BONGO	in the water	60° 45.88‘ S	39° 34.62‘ W	3380.6
PS81/0555-38	06.09.13	23:12:00	BONGO	on ground/ max depth	60° 45.86‘ S	39° 34.48‘ W	3325
PS81/0555-38	06.09.13	23:19:59	BONGO	on deck	60° 45.86‘ S	39° 34.39‘ W	3279.1
PS81/0555-39	06.09.13	23:38:00	MN	in the water	60° 45.83‘ S	39° 34.14‘ W	3187.6
PS81/0555-39	06.09.13	23:42:00	MN	on ground/ max depth	60° 45.82‘ S	39° 34.09‘ W	3169
PS81/0555-39	06.09.13	23:45:59	MN	on deck	60° 45.81‘ S	39° 34.05‘ W	3163.9
PS81/0555-40	06.09.13	23:56:00	MN	in the water	60° 45.79‘ S	39° 33.93‘ W	3126.9
PS81/0555-40	07.09.13	01:25:00	MN	on ground/ max depth	60° 45.62‘ S	39° 33.14‘ W	2915.6
PS81/0555-40	07.09.13	02:35:59	MN	on deck	60° 45.56‘ S	39° 32.87‘ W	2820.8
PS81/0555-41	07.09.13	11:27:00	HN	in the water	60° 46.63‘ S	39° 29.84‘ W	2587.7
PS81/0555-41	07.09.13	11:35:00	HN	on ground/ max depth	60° 46.59‘ S	39° 29.74‘ W	2586.1
PS81/0555-41	07.09.13	11:40:59	HN	on deck	60° 46.57‘ S	39° 29.68‘ W	2584.4
PS81/0555-1	07.09.13	12:00:00	ICE	information	60° 46.46‘ S	39° 29.46‘ W	2572.2
PS81/0555-42	07.09.13	20:32:00	CTD/RO	in the water	60° 44.96‘ S	39° 28.06‘ W	2775.2
PS81/0555-42	07.09.13	21:57:00	CTD/RO	on ground/ max depth	60° 45.06‘ S	39° 27.49‘ W	2832.7
PS81/0555-42	07.09.13	22:05:00	CTD/RO	hoisting	60° 45.07‘ S	39° 27.41‘ W	2845.2
PS81/0555-42	07.09.13	22:51:59	CTD/RO	on deck	60° 45.05‘ S	39° 26.91‘ W	3105
PS81/0555-43	07.09.13	23:05:00	SUIT	in the water	60° 45.03‘ S	39° 26.75‘ W	3116.9

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0555-43	07.09.13	23:07:00	SUIT	on ground/ max depth	60° 45.02' S	39° 26.72' W	3104.1
PS81/0555-43	07.09.13	23:07:01	SUIT	profile start	60° 45.02' S	39° 26.72' W	3104.1
PS81/0555-43	08.09.13	00:05:00	SUIT	profile end	60° 44.87' S	39° 25.98' W	3109.2
PS81/0555-43	08.09.13	00:05:01	SUIT	hoisting	60° 44.87' S	39° 25.98' W	3109.2
PS81/0555-43	08.09.13	00:14:59	SUIT	on deck	60° 44.85' S	39° 25.86' W	3101.8
PS81/0555-1	08.09.13	02:32:00	ICE	information	60° 44.18' S	39° 24.23' W	2934.8
PS81/0555-1	08.09.13	10:00:00	ICE	information	60° 43.84' S	39° 23.89' W	2926.1
PS81/0555-1	08.09.13	14:00:00	ICE	information	60° 44.59' S	39° 21.37' W	2944.1
PS81/0555-1	08.09.13	16:00:00	ICE	information	60° 44.73' S	39° 19.67' W	2983.3
PS81/0555-45	08.09.13	16:30:00	CTD/RO	in the water	60° 44.70' S	39° 19.53' W	2986.2
PS81/0555-1	08.09.13	16:47:00	ICE	action	60° 44.71' S	39° 19.39' W	2992.3
PS81/0555-1	08.09.13	16:52:00	ICE	information	60° 44.71' S	39° 19.35' W	2993.8
PS81/0555-45	08.09.13	17:41:00	CTD/RO	on ground/ max depth	60° 44.74' S	39° 19.08' W	3001.4
PS81/0555-45	08.09.13	18:11:00	CTD/RO	hoisting	60° 44.78' S	39° 18.97' W	3005.7
PS81/0555-45	08.09.13	19:03:59	CTD/RO	on deck	60° 44.87' S	39° 18.86' W	3015.3
PS81/0555-46	08.09.13	19:30:00	MN	in the water	60° 44.93' S	39° 18.79' W	3021.2
PS81/0555-46	08.09.13	20:02:00	MN	on ground/ max depth	60° 45.03' S	39° 18.74' W	3030.1
PS81/0555-46	08.09.13	20:28:59	MN	on deck	60° 45.11' S	39° 18.68' W	3037.7
PS81/0555-47	09.09.13	13:39:00	SUIT	in the water	60° 48.08' S	39° 8.82' W	3317.3
PS81/0555-47	09.09.13	13:48:00	SUIT	on ground/ max depth	60° 48.13' S	39° 8.79' W	3308.3
PS81/0555-47	09.09.13	13:48:01	SUIT	profile start	60° 48.13' S	39° 8.79' W	3308.3
PS81/0555-47	09.09.13	14:30:00	SUIT	profile end	60° 48.08' S	39° 6.15' W	3178.1
PS81/0555-47	09.09.13	14:46:59	SUIT	on deck	60° 48.23' S	39° 5.95' W	3228.8
PS81/0556-1	10.09.13	15:16:00	CTD/RO	in the water	59° 57.89' S	33° 50.58' W	1588.8
PS81/0556-2	10.09.13	15:50:00	HN	in the water	59° 57.53' S	33° 50.97' W	1603.1
PS81/0556-2	10.09.13	15:52:00	HN	on ground/ max depth	59° 57.51' S	33° 50.99' W	1604.5
PS81/0556-2	10.09.13	15:54:59	HN	on deck	59° 57.49' S	33° 51.01' W	1605.2
PS81/0556-1	10.09.13	16:00:00	CTD/RO	on ground/ max depth	59° 57.44' S	33° 51.09' W	1605.1
PS81/0556-1	10.09.13	16:18:00	CTD/RO	hoisting	59° 57.32' S	33° 51.32' W	1584

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0556-1	10.09.13	17:09:59	CTD/RO	on deck	59° 57.13' S	33° 52.01' W	1488.3
PS81/0556-3	10.09.13	17:17:00	BONGO	in the water	59° 57.12' S	33° 52.11' W	1485.4
PS81/0556-3	10.09.13	17:24:00	BONGO	on ground/ max depth	59° 57.11' S	33° 52.20' W	1481.4
PS81/0556-3	10.09.13	17:25:00	BONGO	hoisting	59° 57.11' S	33° 52.21' W	1478.8
PS81/0556-3	10.09.13	17:37:59	BONGO	on deck	59° 57.11' S	33° 52.36' W	1452.6
PS81/0556-4	10.09.13	17:51:00	EF	on ground/ max depth	59° 57.12' S	33° 52.51' W	1442.3
PS81/0556-4	10.09.13	17:52:00	EF	profile start	59° 57.12' S	33° 52.52' W	1442
PS81/0556-4	10.09.13	18:05:00	EF	profile end	59° 57.13' S	33° 52.67' W	1443.8
PS81/0556-4	10.09.13	18:09:59	EF	on deck	59° 57.15' S	33° 52.74' W	1448.9
PS81/0557-1	10.09.13	22:19:00	EF	on ground/ max depth	59° 58.16' S	33° 9.71' W	3285.1
PS81/0557-1	10.09.13	22:19:01	EF	profile start	59° 58.16' S	33° 9.71' W	3285.1
PS81/0557-1	10.09.13	22:42:00	EF	profile end	59° 58.20' S	33° 9.72' W	3256.6
PS81/0557-1	10.09.13	22:44:59	EF	on deck	59° 58.21' S	33° 9.72' W	3261.2
PS81/0557-2	10.09.13	23:07:00	SUIT	in the water	59° 57.76' S	33° 9.98' W	3426.6
PS81/0557-2	10.09.13	23:13:00	SUIT	on ground/ max depth	59° 57.77' S	33° 9.99' W	3430.4
PS81/0557-2	10.09.13	23:15:00	SUIT	profile start	59° 57.74' S	33° 10.00' W	3427.2
PS81/0557-2	10.09.13	23:46:00	SUIT	profile end	59° 56.89' S	33° 8.63' W	3326.4
PS81/0557-2	11.09.13	00:10:59	SUIT	on deck	59° 56.88' S	33° 8.51' W	3245.6
PS81/0557-3	11.09.13	00:39:00	CTD/RO	in the water	59° 56.88' S	33° 8.68' W	3323.1
PS81/0557-3	11.09.13	01:55:00	CTD/RO	on ground/ max depth	59° 56.75' S	33° 9.18' W	3499.9
PS81/0557-3	11.09.13	02:28:00	CTD/RO	hoisting	59° 56.64' S	33° 9.47' W	3472.5
PS81/0557-3	11.09.13	03:38:59	CTD/RO	on deck	59° 56.35' S	33° 10.49' W	3527
PS81/0558-1	11.09.13	08:35:00	EF	profile start	59° 58.16' S	32° 25.07' W	538.2
PS81/0558-1	11.09.13	08:50:00	EF	profile end	59° 58.10' S	32° 25.41' W	538.9
PS81/0558-1	11.09.13	08:53:00	EF	on ground/ max depth	59° 58.09' S	32° 25.48' W	539.8
PS81/0558-1	11.09.13	08:53:59	EF	on deck	59° 58.09' S	32° 25.48' W	539.8
PS81/0559-1	11.09.13	11:03:00	EF	on ground/ max depth	60° 6.30' S	32° 24.66' W	976.4
PS81/0559-1	11.09.13	11:05:00	EF	profile start	60° 6.30' S	32° 24.68' W	976.8
PS81/0559-1	11.09.13	11:31:00	EF	profile end	60° 6.18' S	32° 24.95' W	986.9
PS81/0559-1	11.09.13	11:33:59	EF	on deck	60° 6.18' S	32° 24.96' W	987.1
PS81/0560-1	11.09.13	20:55:00	EF	profile start	60° 37.80' S	31° 46.80' W	1868.2
PS81/0560-1	11.09.13	20:56:00	EF	on ground/ max depth	60° 37.79' S	31° 46.80' W	1854.7
PS81/0560-1	11.09.13	21:09:00	EF	profile end	60° 37.68' S	31° 46.81' W	1839.1
PS81/0560-1	11.09.13	21:27:59	EF	on deck	60° 37.54' S	31° 46.83' W	1838.4
PS81/0560-2	11.09.13	21:42:00	SUIT	in the water	60° 37.43' S	31° 46.83' W	1839.1
PS81/0560-2	11.09.13	21:51:00	SUIT	on ground/ max depth	60° 37.50' S	31° 46.83' W	1841.1

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0560-2	11.09.13	21:51:01	SUIT	profile start	60° 37.50' S	31° 46.83' W	1841.1
PS81/0560-2	11.09.13	22:17:00	SUIT	profile end	60° 37.23' S	31° 48.47' W	1789.9
PS81/0560-2	11.09.13	22:35:59	SUIT	on deck	60° 37.15' S	31° 48.46' W	1775.1
PS81/0560-3	12.09.13	00:32:00	CTD/RO	in the water	60° 37.81' S	31° 49.92' W	1945.3
PS81/0560-3	12.09.13	01:25:00	CTD/RO	on ground/ max depth	60° 37.74' S	31° 49.55' W	1862.4
PS81/0560-3	12.09.13	01:55:00	CTD/RO	hoisting	60° 37.68' S	31° 49.26' W	1789.2
PS81/0560-3	12.09.13	02:32:59	CTD/RO	on deck	60° 37.61' S	31° 48.83' W	1794.4
PS81/0560-4	12.09.13	02:54:00	RMT	in the water	60° 37.50' S	31° 48.73' W	1767.9
PS81/0560-4	12.09.13	03:16:00	RMT	on ground/ max depth	60° 37.19' S	31° 49.65' W	1791.2
PS81/0560-4	12.09.13	03:16:01	RMT	profile start	60° 37.19' S	31° 49.65' W	1791.2
PS81/0560-4	12.09.13	03:38:00	RMT	profile end	60° 37.01' S	31° 50.76' W	1830.2
PS81/0560-4	12.09.13	03:42:59	RMT	on deck	60° 37.00' S	31° 50.87' W	1845.9
PS81/0561-1	12.09.13	10:59:00	EF	profile start	60° 57.50' S	31° 13.33' W	2726
PS81/0561-1	12.09.13	11:07:00	EF	on ground/ max depth	60° 57.51' S	31° 13.38' W	2732.6
PS81/0561-1	12.09.13	11:46:00	EF	profile end	60° 57.59' S	31° 13.61' W	2604.9
PS81/0561-1	12.09.13	11:46:59	EF	on deck	60° 57.59' S	31° 13.61' W	2604.9
PS81/0562-1	12.09.13	14:16:00	CTD/RO	in the water	60° 58.06' S	31° 14.59' W	2310.1
PS81/0562-1	12.09.13	15:16:00	CTD/RO	on ground/ max depth	60° 58.17' S	31° 14.73' W	2244.5
PS81/0562-2	12.09.13	15:22:00	ICE	in the water	60° 58.18' S	31° 14.69' W	2213.1
PS81/0562-2	12.09.13	15:27:00	ICE	in the water	60° 58.18' S	31° 14.70' W	2212.9
PS81/0562-2	12.09.13	15:37:00	ICE	on ground/ max depth	60° 58.19' S	31° 14.71' W	2212.5
PS81/0562-1	12.09.13	16:16:00	CTD/RO	hoisting	60° 58.21' S	31° 14.64' W	2194.3
PS81/0562-2	12.09.13	16:41:00	ICE	on deck	60° 58.22' S	31° 14.64' W	2184.9
PS81/0562-2	12.09.13	16:51:59	ICE	on deck	60° 58.23' S	31° 14.60' W	2183.4
PS81/0562-1	12.09.13	16:56:59	CTD/RO	on deck	60° 58.24' S	31° 14.57' W	2173.9
PS81/0562-3	12.09.13	17:17:00	EF	profile start	60° 58.20' S	31° 14.65' W	2205.1
PS81/0562-3	12.09.13	17:20:00	EF	profile start	60° 58.21' S	31° 14.65' W	2196.4
PS81/0562-3	12.09.13	17:20:01	EF	on ground/ max depth	60° 58.21' S	31° 14.65' W	2196.4
PS81/0562-3	12.09.13	17:20:02	EF	profile end	60° 58.21' S	31° 14.65' W	2196.4
PS81/0562-3	12.09.13	17:23:00	EF	on deck	60° 58.22' S	31° 14.64' W	2191.9
PS81/0562-3	12.09.13	17:30:00	EF	profile start	60° 58.24' S	31° 14.69' W	2173.4
PS81/0562-3	12.09.13	17:32:00	EF	on ground/ max depth	60° 58.24' S	31° 14.69' W	2175.9
PS81/0562-3	12.09.13	17:44:00	EF	profile end	60° 58.23' S	31° 14.67' W	2181.7
PS81/0562-3	12.09.13	17:47:00	EF	on deck	60° 58.22' S	31° 14.67' W	2198.6
PS81/0562-3	12.09.13	17:57:00	EF	profile start	60° 58.34' S	31° 14.48' W	2079.8
PS81/0562-3	12.09.13	18:00:00	EF	on ground/ max depth	60° 58.32' S	31° 14.52' W	2097.3
PS81/0562-3	12.09.13	18:10:00	EF	profile end	60° 58.29' S	31° 14.63' W	2161.8

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0562-3	12.09.13	18:12:59	EF	on deck	60° 58.27‘ S	31° 14.62‘ W	2154.1
PS81/0562-4	12.09.13	19:05:00	RMT	in the water	60° 57.95‘ S	31° 14.71‘ W	2362.3
PS81/0562-4	12.09.13	19:17:00	RMT	on ground/ max depth	60° 58.25‘ S	31° 14.20‘ W	2164
PS81/0562-4	12.09.13	19:18:00	RMT	profile start	60° 58.27‘ S	31° 14.16‘ W	2153
PS81/0562-4	12.09.13	19:49:00	RMT	at surface	60° 58.93‘ S	31° 11.94‘ W	1950.7
PS81/0562-4	12.09.13	19:49:01	RMT	profile end	60° 58.93‘ S	31° 11.94‘ W	1950.7
PS81/0562-4	12.09.13	19:56:59	RMT	on deck	60° 58.98‘ S	31° 11.77‘ W	2003
PS81/0562-5	12.09.13	20:39:00	SUIT	in the water	60° 57.99‘ S	31° 14.13‘ W	2352.9
PS81/0562-5	12.09.13	20:48:00	SUIT	profile start	60° 57.99‘ S	31° 14.36‘ W	2409.4
PS81/0562-5	12.09.13	20:48:01	SUIT	on ground/ max depth	60° 57.99‘ S	31° 14.36‘ W	2409.4
PS81/0562-5	12.09.13	21:13:00	SUIT	profile end	60° 57.89‘ S	31° 15.97‘ W	2425.6
PS81/0562-5	12.09.13	21:31:59	SUIT	on deck	60° 57.80‘ S	31° 16.12‘ W	2446.9
PS81/0563-1	15.09.13	11:19:00	EF	on ground/ max depth	60° 34.77‘ S	28° 25.25‘ W	1830.7
PS81/0563-1	15.09.13	11:20:00	EF	profile start	60° 34.76‘ S	28° 25.26‘ W	1829.9
PS81/0563-1	15.09.13	11:51:00	EF	profile end	60° 34.65‘ S	28° 25.41‘ W	1822.3
PS81/0563-1	15.09.13	11:52:59	EF	on deck	60° 34.65‘ S	28° 25.41‘ W	1822.3
PS81/0564-1	15.09.13	19:26:00	EF	on ground/ max depth	60° 36.41‘ S	28° 2.71‘ W	1699.8
PS81/0564-1	15.09.13	19:27:00	EF	profile start	60° 36.40‘ S	28° 2.71‘ W	1700.1
PS81/0564-1	15.09.13	19:52:00	EF	profile end	60° 36.16‘ S	28° 2.64‘ W	1686.5
PS81/0564-1	15.09.13	19:58:59	EF	on deck	60° 36.10‘ S	28° 2.63‘ W	1684.9
PS81/0565-1	16.09.13	09:15:00	RMT	in the water	60° 46.21‘ S	27° 7.31‘ W	3431.5
PS81/0565-1	16.09.13	09:15:02	RMT	profile start	60° 46.21‘ S	27° 7.31‘ W	3431.5
PS81/0565-1	16.09.13	09:38:00	RMT	on ground/ max depth	60° 45.60‘ S	27° 7.81‘ W	3324.9
PS81/0565-1	16.09.13	09:38:01	RMT	hoisting	60° 45.60‘ S	27° 7.81‘ W	3324.9
PS81/0565-1	16.09.13	10:15:00	RMT	profile end	60° 44.42‘ S	27° 7.95‘ W	3658.9
PS81/0565-1	16.09.13	10:18:59	RMT	on deck	60° 44.37‘ S	27° 7.91‘ W	3663.5
PS81/0565-2	16.09.13	10:36:00	EF	on ground/ max depth	60° 44.31‘ S	27° 8.03‘ W	3656.2
PS81/0565-2	16.09.13	10:39:00	EF	profile start	60° 44.29‘ S	27° 8.04‘ W	3653.6
PS81/0565-2	16.09.13	11:12:00	EF	profile end	60° 44.05‘ S	27° 8.11‘ W	3646.4
PS81/0565-2	16.09.13	11:16:59	EF	on deck	60° 44.03‘ S	27° 8.12‘ W	3658.2
PS81/0565-3	16.09.13	13:25:00	CTD/RO	in the water	60° 43.22‘ S	27° 9.07‘ W	3414.9
PS81/0565-4	16.09.13	14:27:00	HN	in the water	60° 42.88‘ S	27° 9.50‘ W	3490.3
PS81/0565-4	16.09.13	14:29:00	HN	on ground/ max depth	60° 42.87‘ S	27° 9.51‘ W	3474.9
PS81/0565-4	16.09.13	14:31:59	HN	on deck	60° 42.86‘ S	27° 9.53‘ W	3467.5
PS81/0565-3	16.09.13	14:49:00	CTD/RO	on ground/ max depth	60° 42.77‘ S	27° 9.66‘ W	3495.5
PS81/0565-3	16.09.13	15:14:00	CTD/RO	hoisting	60° 42.65‘ S	27° 9.82‘ W	3503.8
PS81/0565-3	16.09.13	16:22:59	CTD/RO	on deck	60° 42.37‘ S	27° 10.12‘ W	3456.6

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0565-5	16.09.13	16:46:00	SUIT	in the water	60° 42.28' S	27° 10.16' W	3446.1
PS81/0565-5	16.09.13	16:51:00	SUIT	on ground/ max depth	60° 42.30' S	27° 10.22' W	3433.7
PS81/0565-5	16.09.13	16:54:00	SUIT	profile start	60° 42.40' S	27° 10.37' W	3399.8
PS81/0565-5	16.09.13	17:19:00	SUIT	profile end	60° 42.48' S	27° 11.97' W	3322.9
PS81/0565-5	16.09.13	17:39:59	SUIT	on deck	60° 42.41' S	27° 11.95' W	3348.9
PS81/0565-6	16.09.13	19:29:00	EF	on ground/ max depth	60° 41.47' S	27° 10.08' W	3389.8
PS81/0565-6	16.09.13	19:30:00	EF	profile start	60° 41.47' S	27° 10.08' W	3391.9
PS81/0565-6	16.09.13	19:57:00	EF	profile end	60° 41.31' S	27° 10.00' W	3303.9
PS81/0565-6	16.09.13	19:57:01	EF	profile start	60° 41.31' S	27° 10.00' W	3303.9
PS81/0565-6	16.09.13	20:10:00	EF	profile end	60° 41.23' S	27° 9.96' W	3263
PS81/0565-6	16.09.13	20:10:59	EF	on deck	60° 41.23' S	27° 9.96' W	3263
PS81/0565-7	16.09.13	20:16:00	HN	in the water	60° 41.20' S	27° 9.95' W	3253.5
PS81/0565-7	16.09.13	20:19:00	HN	on ground/ max depth	60° 41.19' S	27° 9.94' W	3253.3
PS81/0565-7	16.09.13	20:21:00	HN	in the water	60° 41.18' S	27° 9.93' W	3251.4
PS81/0565-7	16.09.13	20:22:00	HN	on ground/ max depth	60° 41.17' S	27° 9.93' W	3256.5
PS81/0565-7	16.09.13	20:25:59	HN	on deck	60° 41.15' S	27° 9.92' W	3245
PS81/0565-8	16.09.13	23:12:00	BONGO	in the water	60° 39.81' S	27° 9.50' W	2570.8
PS81/0565-8	16.09.13	23:22:00	BONGO	on ground/ max depth	60° 39.72' S	27° 9.49' W	2473.7
PS81/0565-8	16.09.13	23:28:59	BONGO	on deck	60° 39.66' S	27° 9.49' W	2476.4
PS81/0565-9	16.09.13	23:35:00	BONGO	in the water	60° 39.60' S	27° 9.49' W	2513.3
PS81/0565-9	16.09.13	23:45:00	BONGO	on ground/ max depth	60° 39.50' S	27° 9.49' W	2539.7
PS81/0565-9	16.09.13	23:51:59	BONGO	on deck	60° 39.45' S	27° 9.50' W	2529.8
PS81/0565-10	16.09.13	23:54:00	BONGO	in the water	60° 39.42' S	27° 9.50' W	2522.2
PS81/0565-10	16.09.13	23:59:00	BONGO	on ground/ max depth	60° 39.37' S	27° 9.51' W	2491.5
PS81/0565-10	17.09.13	00:03:59	BONGO	on deck	60° 39.33' S	27° 9.51' W	2469.8
PS81/0565-11	17.09.13	00:05:00	BONGO	in the water	60° 39.31' S	27° 9.51' W	2471.5
PS81/0565-11	17.09.13	00:10:00	BONGO	on ground/ max depth	60° 39.26' S	27° 9.52' W	2422.7
PS81/0565-11	17.09.13	00:13:59	BONGO	on deck	60° 39.24' S	27° 9.53' W	2414.6
PS81/0565-12	17.09.13	05:11:00	RMT	in the water	60° 37.83' S	27° 11.84' W	2044.7
PS81/0565-12	17.09.13	05:32:00	RMT	on ground/ max depth	60° 37.33' S	27° 11.03' W	1927.9
PS81/0565-12	17.09.13	05:32:01	RMT	profile start	60° 37.33' S	27° 11.03' W	1927.9

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0565-12	17.09.13	06:11:00	RMT	profile end	60° 36.22‘ S	27° 9.46‘ W	1998.7
PS81/0565-12	17.09.13	06:16:59	RMT	on deck	60° 36.08‘ S	27° 9.23‘ W	2027.1
PS81/0565-13	17.09.13	10:05:00	EF	on ground/ max depth	60° 36.15‘ S	27° 8.97‘ W	2043.4
PS81/0565-13	17.09.13	10:06:00	EF	profile start	60° 36.15‘ S	27° 8.96‘ W	2044
PS81/0565-13	17.09.13	10:29:00	EF	profile end	60° 36.08‘ S	27° 8.79‘ W	2059.1
PS81/0565-13	17.09.13	10:29:59	EF	on deck	60° 36.08‘ S	27° 8.79‘ W	2059.1
PS81/0566-1	17.09.13	15:20:00	ICE	information	60° 36.11‘ S	27° 6.15‘ W	2379.8
PS81/0566-1	17.09.13	15:37:00	ICE	on ground/ max depth	60° 36.07‘ S	27° 6.03‘ W	2386.4
PS81/0566-1	17.09.13	16:06:00	ICE	information	60° 36.00‘ S	27° 5.89‘ W	2367
PS81/0566-1	17.09.13	19:20:00	ICE	information	60° 35.87‘ S	27° 4.10‘ W	2538
PS81/0566-1	18.09.13	10:01:00	ICE	information	60° 34.46‘ S	26° 50.42‘ W	3046.4
PS81/0566-1	18.09.13	19:40:00	ICE	information	60° 32.74‘ S	26° 40.30‘ W	3515.7
PS81/0566-1	19.09.13	01:45:00	ICE	information	60° 31.76‘ S	26° 36.07‘ W	0
PS81/0566-1	19.09.13	02:08:00	ICE	information	60° 31.73‘ S	26° 35.82‘ W	0
PS81/0566-1	19.09.13	09:40:00	ICE	information	60° 31.13‘ S	26° 31.66‘ W	4093.4
PS81/0566-2	19.09.13	11:40:00	SUIT	in the water	60° 30.94‘ S	26° 31.26‘ W	4088.7
PS81/0566-2	19.09.13	11:50:00	SUIT	on ground/ max depth	60° 30.94‘ S	26° 31.23‘ W	4089.3
PS81/0566-2	19.09.13	11:50:01	SUIT	profile start	60° 30.94‘ S	26° 31.23‘ W	4089.3
PS81/0566-3	19.09.13	12:06:00	CTD-KEV	in the water	60° 30.93‘ S	26° 31.18‘ W	4087.6
PS81/0566-3	19.09.13	12:10:00	CTD-KEV	on ground/ max depth	60° 30.93‘ S	26° 31.17‘ W	4086.6
PS81/0566-3	19.09.13	12:15:59	CTD-KEV	on deck	60° 30.93‘ S	26° 31.15‘ W	4086.6
PS81/0566-2	19.09.13	13:46:00	SUIT	profile end	60° 30.99‘ S	26° 30.90‘ W	4075.7
PS81/0566-2	19.09.13	13:46:01	SUIT	hoisting	60° 30.99‘ S	26° 30.90‘ W	4075.7
PS81/0566-2	19.09.13	13:56:59	SUIT	on deck	60° 31.00‘ S	26° 30.87‘ W	4076.3
PS81/0566-1	19.09.13	18:40:00	ICE	information	60° 31.56‘ S	26° 29.42‘ W	4132.9
PS81/0566-1	19.09.13	19:15:00	ICE	information	60° 31.58‘ S	26° 29.31‘ W	4134.2
PS81/0566-4	19.09.13	20:57:00	SUIT	in the water	60° 31.56‘ S	26° 29.07‘ W	4123.7
PS81/0566-4	19.09.13	21:01:00	SUIT	on ground/ max depth	60° 31.55‘ S	26° 29.06‘ W	4128.5
PS81/0566-4	19.09.13	21:01:01	SUIT	profile start	60° 31.55‘ S	26° 29.06‘ W	4128.5
PS81/0566-1	19.09.13	22:45:00	ICE	information	60° 31.49‘ S	26° 28.97‘ W	4136.8
PS81/0566-4	19.09.13	23:00:00	SUIT	profile end	60° 31.48‘ S	26° 28.98‘ W	4119.4
PS81/0566-4	19.09.13	23:00:01	SUIT	hoisting	60° 31.48‘ S	26° 28.98‘ W	4119.4
PS81/0566-4	19.09.13	23:09:59	SUIT	on deck	60° 31.47‘ S	26° 28.99‘ W	4135.9
PS81/0566-1	20.09.13	01:49:00	ICE	information	60° 31.59‘ S	26° 29.63‘ W	0

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0566-1	20.09.13	02:03:00	ICE	information	60° 31.62‘ S	26° 29.72‘ W	0
PS81/0566-1	20.09.13	10:00:00	ICE	information	60° 33.82‘ S	26° 32.43‘ W	0
PS81/0566-1	20.09.13	22:30:00	ICE	information	60° 37.65‘ S	26° 37.44‘ W	3846.5
PS81/0566-1	21.09.13	01:53:00	ICE	information	60° 38.54‘ S	26° 37.37‘ W	3920.4
PS81/0566-1	21.09.13	02:09:00	ICE	information	60° 38.62‘ S	26° 37.40‘ W	3924.9
PS81/0566-1	21.09.13	10:04:00	ICE	information	60° 42.02‘ S	26° 37.23‘ W	3441.7
PS81/0566-1	21.09.13	22:21:00	ICE	information	60° 45.85‘ S	26° 35.34‘ W	4221
PS81/0566-1	22.09.13	10:14:00	ICE	information	60° 47.86‘ S	26° 33.45‘ W	4055
PS81/0566-5	22.09.13	11:09:00	CTD/RO	in the water	60° 48.04‘ S	26° 33.26‘ W	4019.1
PS81/0566-5	22.09.13	12:35:00	CTD/RO	on ground/ max depth	60° 48.17‘ S	26° 32.59‘ W	3952.6
PS81/0566-5	22.09.13	12:36:00	CTD/RO	hoisting	60° 48.17‘ S	26° 32.58‘ W	3952.6
PS81/0566-6	22.09.13	13:22:00	HN	in the water	60° 48.16‘ S	26° 32.08‘ W	3940.8
PS81/0566-6	22.09.13	13:24:00	HN	on ground/ max depth	60° 48.16‘ S	26° 32.06‘ W	3953.6
PS81/0566-6	22.09.13	13:24:59	HN	on deck	60° 48.16‘ S	26° 32.06‘ W	3953.6
PS81/0566-5	22.09.13	13:49:59	CTD/RO	on deck	60° 48.13‘ S	26° 31.78‘ W	3942.6
PS81/0566-1	22.09.13	23:10:00	ICE	information	60° 46.32‘ S	26° 26.46‘ W	3275.6
PS81/0566-1	23.09.13	09:58:00	ICE	information	60° 46.64‘ S	26° 22.60‘ W	3568.4
PS81/0566-7	23.09.13	14:08:00	MN	in the water	60° 46.75‘ S	26° 22.53‘ W	3577
PS81/0566-7	23.09.13	14:16:00	MN	on ground/ max depth	60° 46.76‘ S	26° 22.48‘ W	3577.5
PS81/0566-7	23.09.13	14:16:01	MN	hoisting	60° 46.76‘ S	26° 22.48‘ W	3577.5
PS81/0566-7	23.09.13	14:24:59	MN	on deck	60° 46.78‘ S	26° 22.44‘ W	3578.8
PS81/0566-8	23.09.13	16:58:00	MN	in the water	60° 47.06‘ S	26° 21.10‘ W	3699.8
PS81/0566-8	23.09.13	17:09:00	MN	on ground/ max depth	60° 47.07‘ S	26° 20.99‘ W	3700.9
PS81/0566-8	23.09.13	17:17:59	MN	on deck	60° 47.08‘ S	26° 20.92‘ W	3709.3
PS81/0566-1	23.09.13	18:25:00	ICE	information	60° 47.16‘ S	26° 20.36‘ W	3685.2
PS81/0566-9	23.09.13	18:57:00	MN	in the water	60° 47.18‘ S	26° 20.12‘ W	3644.4
PS81/0566-9	23.09.13	19:12:00	MN	on ground/ max depth	60° 47.19‘ S	26° 20.02‘ W	3645.8
PS81/0566-9	23.09.13	19:17:59	MN	on deck	60° 47.19‘ S	26° 19.99‘ W	3646.5
PS81/0566-10	23.09.13	20:30:00	MN	in the water	60° 47.17‘ S	26° 19.60‘ W	3683.7
PS81/0566-10	23.09.13	20:38:00	MN	on ground/ max depth	60° 47.16‘ S	26° 19.57‘ W	3689.8
PS81/0566-10	23.09.13	20:45:59	MN	on deck	60° 47.16‘ S	26° 19.55‘ W	3685.1
PS81/0566-11	23.09.13	21:57:00	MN	in the water	60° 47.13‘ S	26° 19.39‘ W	3700
PS81/0566-1	23.09.13	22:05:00	ICE	information	60° 47.12‘ S	26° 19.37‘ W	3699.7
PS81/0566-11	23.09.13	22:05:00	MN	on ground/ max depth	60° 47.12‘ S	26° 19.37‘ W	3699.7
PS81/0566-11	23.09.13	22:09:59	MN	on deck	60° 47.12‘ S	26° 19.37‘ W	3689.8

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0566-12	24.09.13	01:02:00	MN	in the water	60° 47.29' S	26° 19.53' W	3704.1
PS81/0566-12	24.09.13	01:11:00	MN	on ground/ max depth	60° 47.30' S	26° 19.55' W	3710.6
PS81/0566-12	24.09.13	01:11:01	MN	hoisting	60° 47.30' S	26° 19.55' W	3710.6
PS81/0566-12	24.09.13	01:18:59	MN	on deck	60° 47.31' S	26° 19.56' W	3720.4
PS81/0566-1	24.09.13	01:55:00	ICE	information	60° 47.40' S	26° 19.66' W	3744.9
PS81/0566-1	24.09.13	02:01:00	ICE	information	60° 47.42' S	26° 19.67' W	3732.8
PS81/0566-13	24.09.13	03:58:00	MN	in the water	60° 47.75' S	26° 19.76' W	3808.1
PS81/0566-13	24.09.13	04:06:00	MN	on ground/ max depth	60° 47.76' S	26° 19.73' W	3790.4
PS81/0566-13	24.09.13	04:06:01	MN	hoisting	60° 47.76' S	26° 19.73' W	3790.4
PS81/0566-13	24.09.13	04:13:59	MN	on deck	60° 47.78' S	26° 19.70' W	3816.4
PS81/0566-14	24.09.13	06:58:00	MN	in the water	60° 47.94' S	26° 18.82' W	3820.3
PS81/0566-14	24.09.13	07:06:00	MN	on ground/ max depth	60° 47.95' S	26° 18.78' W	3820.4
PS81/0566-14	24.09.13	07:14:59	MN	on deck	60° 47.95' S	26° 18.74' W	3822.4
PS81/0566-15	24.09.13	09:55:00	MN	in the water	60° 47.78' S	26° 18.00' W	3802.9
PS81/0566-15	24.09.13	10:04:00	MN	on ground/ max depth	60° 47.75' S	26° 17.97' W	3807.4
PS81/0566-15	24.09.13	10:09:59	MN	on deck	60° 47.74' S	26° 17.96' W	3807.8
PS81/0566-1	24.09.13	10:21:00	ICE	information	60° 47.69' S	26° 17.92' W	3814.1
PS81/0566-16	24.09.13	10:35:00	CTD/RO	in the water	60° 47.64' S	26° 17.89' W	3813.2
PS81/0566-16	24.09.13	12:02:00	CTD/RO	on ground/ max depth	60° 47.24' S	26° 17.87' W	3841
PS81/0566-16	24.09.13	12:02:01	CTD/RO	hoisting	60° 47.24' S	26° 17.87' W	3841
PS81/0566-16	24.09.13	13:25:59	CTD/RO	on deck	60° 46.80' S	26° 18.05' W	3834.4
PS81/0566-17	24.09.13	13:36:00	MN	in the water	60° 46.74' S	26° 18.09' W	3844.7
PS81/0566-17	24.09.13	14:08:00	MN	on ground/ max depth	60° 46.56' S	26° 18.19' W	3882.2
PS81/0566-17	24.09.13	14:08:01	MN	hoisting	60° 46.56' S	26° 18.19' W	3882.2
PS81/0566-17	24.09.13	14:58:59	MN	on deck	60° 46.32' S	26° 18.34' W	3936.5
PS81/0566-1	24.09.13	22:28:00	ICE	information	60° 44.55' S	26° 17.78' W	4176.9
PS81/0566-1	25.09.13	10:15:00	ICE	information	60° 41.99' S	26° 17.06' W	5524.1

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0566-18	25.09.13	11:53:00	SUIT	in the water	60° 41.53' S	26° 16.05' W	5888.6
PS81/0566-18	25.09.13	11:58:00	SUIT	on ground/ max depth	60° 41.50' S	26° 16.00' W	5891.6
PS81/0566-18	25.09.13	11:58:01	SUIT	profile start	60° 41.50' S	26° 16.00' W	5891.6
PS81/0566-19	25.09.13	12:07:00	CTD-KEV	in the water	60° 41.46' S	26° 15.91' W	5911.1
PS81/0566-19	25.09.13	12:12:00	CTD-KEV	on ground/ max depth	60° 41.43' S	26° 15.86' W	5960.6
PS81/0566-19	25.09.13	12:19:59	CTD-KEV	on deck	60° 41.39' S	26° 15.79' W	5966.6
PS81/0566-18	25.09.13	13:57:00	SUIT	profile end	60° 40.82' S	26° 14.70' W	6181.2
PS81/0566-18	25.09.13	13:58:00	SUIT	hoisting	60° 40.82' S	26° 14.69' W	6182.7
PS81/0566-18	25.09.13	14:03:59	SUIT	on deck	60° 40.78' S	26° 14.63' W	6182.7
PS81/0566-20	25.09.13	19:02:00	MN	in the water	60° 39.66' S	26° 13.12' W	6545.7
PS81/0566-20	25.09.13	19:05:00	MN	on ground/ max depth	60° 39.66' S	26° 13.12' W	6572.2
PS81/0566-20	25.09.13	19:07:00	MN	hoisting	60° 39.66' S	26° 13.12' W	6572.6
PS81/0566-20	25.09.13	19:08:59	MN	on deck	60° 39.66' S	26° 13.12' W	6572.6
PS81/0566-1	25.09.13	19:43:00	ICE	information	60° 39.65' S	26° 13.12' W	6574.1
PS81/0566-21	25.09.13	20:54:00	SUIT	in the water	60° 39.72' S	26° 13.08' W	6530.7
PS81/0566-21	25.09.13	21:08:00	SUIT	on ground/ max depth	60° 39.75' S	26° 13.05' W	6521.7
PS81/0566-21	25.09.13	21:09:00	SUIT	profile start	60° 39.75' S	26° 13.05' W	6530.7
PS81/0566-22	25.09.13	21:15:00	CTD-KEV	in the water	60° 39.77' S	26° 13.03' W	6570.3
PS81/0566-22	25.09.13	21:22:00	CTD-KEV	on ground/ max depth	60° 39.78' S	26° 13.01' W	6523.2
PS81/0566-23	25.09.13	21:27:00	MN	in the water	60° 39.80' S	26° 12.99' W	6518.7
PS81/0566-22	25.09.13	21:27:59	CTD-KEV	on deck	60° 39.80' S	26° 12.99' W	6518.7
PS81/0566-23	25.09.13	21:31:00	MN	on ground/ max depth	60° 39.81' S	26° 12.98' W	6514.2
PS81/0566-23	25.09.13	21:35:59	MN	on deck	60° 39.83' S	26° 12.96' W	6500.7
PS81/0566-21	25.09.13	23:00:00	SUIT	profile end	60° 40.12' S	26° 12.45' W	6499.2
PS81/0566-21	25.09.13	23:00:01	SUIT	hoisting	60° 40.12' S	26° 12.45' W	6499.2

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0566-21	25.09.13	23:09:59	SUIT	on deck	60° 40.15' S	26° 12.36' W	6521.7
PS81/0566-24	26.09.13	00:59:00	MN	in the water	60° 40.32' S	26° 10.75' W	6245.7
PS81/0566-1	26.09.13	01:03:00	ICE	information	60° 40.31' S	26° 10.66' W	6217.2
PS81/0566-24	26.09.13	01:03:00	MN	on ground/ max depth	60° 40.31' S	26° 10.66' W	6217.2
PS81/0566-24	26.09.13	01:06:59	MN	on deck	60° 40.31' S	26° 10.60' W	6232.2
PS81/0566-1	26.09.13	01:18:00	ICE	information	60° 40.28' S	26° 10.33' W	6172.2
PS81/0566-25	26.09.13	03:59:00	MN	in the water	60° 39.26' S	26° 6.90' W	0
PS81/0566-25	26.09.13	04:02:00	MN	on ground/ max depth	60° 39.24' S	26° 6.85' W	6514.9
PS81/0566-25	26.09.13	04:05:59	MN	on deck	60° 39.21' S	26° 6.79' W	0
PS81/0566-26	26.09.13	04:11:00	MN	in the water	60° 39.16' S	26° 6.69' W	6503.5
PS81/0566-26	26.09.13	04:14:00	MN	on ground/ max depth	60° 39.13' S	26° 6.64' W	0
PS81/0566-26	26.09.13	04:17:59	MN	on deck	60° 39.11' S	26° 6.59' W	6509.9
PS81/0566-1	26.09.13	06:15:00	ICE	information	60° 38.21' S	26° 5.34' W	6580.2
PS81/0566-1	26.09.13	07:49:00	ICE	information	60° 37.61' S	26° 5.05' W	6894.3
PS81/0566-27	26.09.13	07:57:00	MN	in the water	60° 37.57' S	26° 5.05' W	6917.1
PS81/0566-27	26.09.13	08:01:00	MN	on ground/ max depth	60° 37.55' S	26° 5.05' W	6878.7
PS81/0566-27	26.09.13	08:05:59	MN	on deck	60° 37.53' S	26° 5.05' W	6902.6
PS81/0566-28	26.09.13	09:13:00	CTD/RO	in the water	60° 37.26' S	26° 5.12' W	6935.7
PS81/0566-1	26.09.13	10:03:00	ICE	information	60° 37.13' S	26° 5.18' W	7065.8
PS81/0566-28	26.09.13	10:56:00	CTD/RO	on ground/ max depth	60° 37.06' S	26° 5.19' W	7065.8
PS81/0566-28	26.09.13	10:57:00	CTD/RO	hoisting	60° 37.06' S	26° 5.19' W	7065.6
PS81/0566-28	26.09.13	12:23:59	CTD/RO	on deck	60° 37.04' S	26° 4.88' W	0
PS81/0566-29	26.09.13	12:58:00	MN	in the water	60° 37.05' S	26° 4.63' W	0
PS81/0566-29	26.09.13	13:01:00	MN	on ground/ max depth	60° 37.05' S	26° 4.61' W	7030.2
PS81/0566-29	26.09.13	13:05:59	MN	on deck	60° 37.05' S	26° 4.58' W	7045
PS81/0566-30	26.09.13	19:15:00	VIDEO	in the water	60° 36.77' S	26° 2.09' W	6837
PS81/0566-30	26.09.13	19:24:00	VIDEO	profile start	60° 36.75' S	26° 2.07' W	6837

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0566-30	26.09.13	19:31:00	VIDEO	on ground/ max depth	60° 36.73' S	26° 2.06' W	6837
PS81/0566-30	26.09.13	19:40:00	VIDEO	profile end	60° 36.71' S	26° 2.05' W	6837
PS81/0566-30	26.09.13	19:43:59	VIDEO	on deck	60° 36.71' S	26° 2.05' W	6837
PS81/0566-1	26.09.13	22:45:00	ICE	information	60° 36.37' S	26° 2.25' W	6852.1
PS81/0566-1	27.09.13	01:16:00	ICE	information	60° 35.85' S	26° 1.72' W	6838.2
PS81/0566-1	27.09.13	01:29:00	ICE	information	60° 35.79' S	26° 1.63' W	6852.5
PS81/0566-1	27.09.13	10:48:00	ICE	information	60° 32.29' S	25° 56.05' W	5843.6
PS81/0566-1	27.09.13	22:20:00	ICE	information	60° 28.58' S	25° 49.07' W	5233.1
PS81/0566-31	27.09.13	22:58:00	BONGO	in the water	60° 28.37' S	25° 48.83' W	5240.6
PS81/0566-31	27.09.13	23:07:00	BONGO	on ground/ max depth	60° 28.33' S	25° 48.78' W	5229.9
PS81/0566-31	27.09.13	23:13:59	BONGO	on deck	60° 28.29' S	25° 48.75' W	5227.1
PS81/0566-1	28.09.13	01:50:00	ICE	information	60° 27.63' S	25° 47.95' W	5219.6
PS81/0566-1	28.09.13	02:05:00	ICE	information	60° 27.57' S	25° 47.86' W	5218.1
PS81/0566-1	28.09.13	06:30:00	ICE	information	60° 27.02' S	25° 45.76' W	5444.6
PS81/0566-1	28.09.13	08:14:00	ICE	information	60° 26.86' S	25° 44.64' W	5585.6
PS81/0566-1	28.09.13	10:08:00	ICE	information	60° 26.63' S	25° 43.53' W	5723.6
PS81/0566-32	28.09.13	14:12:00	CTD/RO	in the water	60° 25.98' S	25° 42.41' W	5750.6
PS81/0566-32	28.09.13	16:12:00	CTD/RO	on ground/ max depth	60° 25.74' S	25° 42.39' W	5675.6
PS81/0566-32	28.09.13	16:30:00	CTD/RO	hoisting	60° 25.72' S	25° 42.38' W	5668.1
PS81/0566-1	28.09.13	18:04:59	ICE	on deck	60° 25.61' S	25° 42.36' W	5635.1
PS81/0566-32	28.09.13	18:06:59	CTD/RO	on deck	60° 25.60' S	25° 42.35' W	5633.6
PS81/0567-1	28.09.13	20:16:00	RMT	in the water	60° 27.66' S	25° 41.28' W	6436.2
PS81/0567-1	28.09.13	20:40:00	RMT	action	60° 26.85' S	25° 41.81' W	6205.1
PS81/0567-1	28.09.13	20:46:00	RMT	profile start	60° 26.82' S	25° 41.85' W	6182.7
PS81/0567-1	28.09.13	20:46:01	RMT	information	60° 26.82' S	25° 41.85' W	6182.7
PS81/0567-1	28.09.13	20:46:02	RMT	profile end	60° 26.82' S	25° 41.85' W	6182.7
PS81/0567-1	28.09.13	21:01:00	RMT	hoisting	60° 26.92' S	25° 41.79' W	6217.2
PS81/0567-1	28.09.13	22:01:59	RMT	on deck	60° 26.98' S	25° 41.85' W	5876.4
PS81/0567-2	28.09.13	23:00:00	SUIT	in the water	60° 26.85' S	25° 42.03' W	6182.7
PS81/0567-2	28.09.13	23:11:00	SUIT	on ground/ max depth	60° 26.75' S	25° 42.10' W	6158.7
PS81/0567-2	28.09.13	23:11:01	SUIT	profile start	60° 26.75' S	25° 42.10' W	6158.7
PS81/0567-2	28.09.13	23:25:00	SUIT	profile end	60° 26.32' S	25° 42.14' W	5884.1
PS81/0567-2	28.09.13	23:29:00	SUIT	hoisting	60° 26.32' S	25° 42.16' W	5879.6
PS81/0567-2	28.09.13	23:50:59	SUIT	on deck	60° 26.28' S	25° 42.24' W	5914.1
PS81/0568-1	29.09.13	09:57:00	EF	in the water	59° 44.19' S	25° 32.15' W	2580.6

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0568-1	29.09.13	09:58:00	EF	on ground/ max depth	59° 44.19‘ S	25° 32.16‘ W	2581.2
PS81/0568-1	29.09.13	09:58:01	EF	profile start	59° 44.19‘ S	25° 32.16‘ W	2581.2
PS81/0568-1	29.09.13	10:23:00	EF	profile end	59° 44.03‘ S	25° 32.21‘ W	2588
PS81/0568-1	29.09.13	10:25:59	EF	on deck	59° 44.01‘ S	25° 32.22‘ W	2588
PS81/0569-1	29.09.13	15:22:00	EF	in the water	59° 22.75‘ S	25° 57.91‘ W	2640.5
PS81/0569-1	29.09.13	15:23:00	EF	on ground/ max depth	59° 22.74‘ S	25° 57.92‘ W	2640.3
PS81/0569-1	29.09.13	15:24:00	EF	profile start	59° 22.72‘ S	25° 57.93‘ W	2640.6
PS81/0569-1	29.09.13	15:38:00	EF	profile end	59° 22.53‘ S	25° 58.00‘ W	2647.9
PS81/0569-1	29.09.13	15:39:59	EF	on deck	59° 22.51‘ S	25° 58.01‘ W	2648.6
PS81/0570-1	29.09.13	18:06:00	RMT	in the water	59° 9.25‘ S	26° 13.80‘ W	1805.4
PS81/0570-1	29.09.13	18:36:00	RMT	on ground/ max depth	59° 8.55‘ S	26° 15.57‘ W	1668.5
PS81/0570-1	29.09.13	18:41:00	RMT	profile start	59° 8.49‘ S	26° 15.65‘ W	1657.6
PS81/0570-1	29.09.13	19:40:00	RMT	profile end	59° 7.46‘ S	26° 18.31‘ W	1350.6
PS81/0570-1	29.09.13	19:44:59	RMT	on deck	59° 7.43‘ S	26° 18.35‘ W	1344.3
PS81/0570-2	29.09.13	20:22:00	CTD/RO	in the water	59° 5.82‘ S	26° 20.53‘ W	1023.3
PS81/0570-3	29.09.13	20:27:00	EF	profile start	59° 5.78‘ S	26° 20.56‘ W	1018.6
PS81/0570-3	29.09.13	20:28:00	EF	on ground/ max depth	59° 5.77‘ S	26° 20.56‘ W	1018.1
PS81/0570-3	29.09.13	20:28:01	EF	profile end	59° 5.77‘ S	26° 20.56‘ W	1018.1
PS81/0570-4	29.09.13	20:43:00	HN	in the water	59° 5.65‘ S	26° 20.66‘ W	997.7
PS81/0570-4	29.09.13	20:45:00	HN	on ground/ max depth	59° 5.64‘ S	26° 20.68‘ W	994.6
PS81/0570-3	29.09.13	20:49:59	EF	on deck	59° 5.61‘ S	26° 20.70‘ W	987.1
PS81/0570-4	29.09.13	20:49:59	HN	on deck	59° 5.61‘ S	26° 20.70‘ W	987.1
PS81/0570-2	29.09.13	20:51:00	CTD/RO	on ground/ max depth	59° 5.59‘ S	26° 20.71‘ W	984.9
PS81/0570-2	29.09.13	21:21:00	CTD/RO	hoisting	59° 5.32‘ S	26° 20.89‘ W	939.5
PS81/0570-2	29.09.13	21:51:59	CTD/RO	on deck	59° 5.05‘ S	26° 21.00‘ W	865.2
PS81/0570-5	29.09.13	22:10:00	SUIT	in the water	59° 5.01‘ S	26° 20.26‘ W	946.5
PS81/0570-5	29.09.13	22:19:00	SUIT	on ground/ max depth	59° 5.01‘ S	26° 20.31‘ W	940.3
PS81/0570-5	29.09.13	22:19:01	SUIT	profile start	59° 5.01‘ S	26° 20.31‘ W	940.3
PS81/0570-5	29.09.13	22:50:00	SUIT	profile end	59° 5.71‘ S	26° 21.95‘ W	849.5
PS81/0570-5	29.09.13	23:12:59	SUIT	on deck	59° 5.55‘ S	26° 22.10‘ W	810.6
PS81/0571-1	30.09.13	07:40:00	RMT	in the water	58° 26.04‘ S	26° 5.40‘ W	1088.9
PS81/0571-1	30.09.13	07:54:00	RMT	on ground/ max depth	58° 26.00‘ S	26° 6.32‘ W	1015.1
PS81/0571-1	30.09.13	07:54:01	RMT	profile start	58° 26.00‘ S	26° 6.32‘ W	1015.1
PS81/0571-1	30.09.13	08:21:00	RMT	information	58° 26.50‘ S	26° 8.16‘ W	864.2
PS81/0571-1	30.09.13	08:33:00	RMT	profile end	58° 26.49‘ S	26° 9.22‘ W	762.4
PS81/0571-1	30.09.13	08:34:00	RMT	at surface	58° 26.50‘ S	26° 9.31‘ W	753.8
PS81/0571-1	30.09.13	08:39:59	RMT	on deck	58° 26.47‘ S	26° 9.49‘ W	728.3

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0571-2	30.09.13	09:41:00	SUIT	in the water	58° 25.22‘ S	26° 6.53‘ W	1032.1
PS81/0571-2	30.09.13	09:48:00	SUIT	on ground/ max depth	58° 25.17‘ S	26° 6.63‘ W	1030.7
PS81/0571-2	30.09.13	09:51:00	SUIT	profile start	58° 25.21‘ S	26° 6.79‘ W	1024.8
PS81/0571-2	30.09.13	10:20:00	SUIT	profile end	58° 26.00‘ S	26° 8.35‘ W	780.6
PS81/0571-2	30.09.13	10:20:01	SUIT	hoisting	58° 26.00‘ S	26° 8.35‘ W	780.6
PS81/0571-2	30.09.13	10:35:59	SUIT	on deck	58° 25.91‘ S	26° 8.40‘ W	761.3
PS81/0571-3	30.09.13	11:56:00	RMT	in the water	58° 23.92‘ S	26° 9.63‘ W	934
PS81/0571-3	30.09.13	11:58:01	RMT	profile start	58° 23.94‘ S	26° 9.61‘ W	928.1
PS81/0571-3	30.09.13	12:05:00	RMT	on ground/ max depth	58° 24.17‘ S	26° 9.49‘ W	833.2
PS81/0571-3	30.09.13	12:05:01	RMT	hoisting	58° 24.17‘ S	26° 9.49‘ W	833.2
PS81/0571-3	30.09.13	12:18:00	RMT	profile end	58° 24.60‘ S	26° 9.33‘ W	642.4
PS81/0571-3	30.09.13	12:23:59	RMT	on deck	58° 24.70‘ S	26° 9.31‘ W	724.2
PS81/0572-1	30.09.13	15:55:00	RMT	in the water	58° 7.96‘ S	26° 12.28‘ W	2478.7
PS81/0572-1	30.09.13	16:01:00	RMT	on ground/ max depth	58° 8.11‘ S	26° 12.28‘ W	2471.1
PS81/0572-1	30.09.13	16:01:01	RMT	profile start	58° 8.11‘ S	26° 12.28‘ W	2471.1
PS81/0572-1	30.09.13	16:10:00	RMT	hoisting	58° 8.43‘ S	26° 12.34‘ W	2461.8
PS81/0572-1	30.09.13	16:17:00	RMT	profile end	58° 8.71‘ S	26° 12.39‘ W	2450.3
PS81/0572-1	30.09.13	16:23:59	RMT	on deck	58° 8.77‘ S	26° 12.47‘ W	2446.7
PS81/0573-1	30.09.13	19:54:00	RMT	in the water	57° 57.94‘ S	26° 45.58‘ W	965.6
PS81/0573-1	30.09.13	20:11:00	RMT	on ground/ max depth	57° 57.43‘ S	26° 46.49‘ W	1187
PS81/0573-1	30.09.13	20:11:01	RMT	profile start	57° 57.43‘ S	26° 46.49‘ W	1187
PS81/0573-1	30.09.13	20:31:00	RMT	profile end	57° 56.77‘ S	26° 47.36‘ W	1538.6
PS81/0573-1	30.09.13	20:31:01	RMT	at surface	57° 56.77‘ S	26° 47.36‘ W	1538.6
PS81/0573-1	30.09.13	20:35:59	RMT	on deck	57° 56.67‘ S	26° 47.52‘ W	1587.1
PS81/0574-1	01.10.13	00:00:00	RMT	in the water	57° 38.86‘ S	27° 15.98‘ W	2417.1
PS81/0574-1	01.10.13	00:01:00	RMT	profile start	57° 38.87‘ S	27° 15.97‘ W	2414.9
PS81/0574-1	01.10.13	00:06:00	RMT	on ground/ max depth	57° 38.93‘ S	27° 15.87‘ W	2408.6
PS81/0574-1	01.10.13	00:06:01	RMT	hoisting	57° 38.93‘ S	27° 15.87‘ W	2408.6
PS81/0574-1	01.10.13	00:10:00	RMT	lowering	57° 39.08‘ S	27° 15.81‘ W	2393.4
PS81/0574-1	01.10.13	00:16:00	RMT	on ground/ max depth	57° 39.34‘ S	27° 15.73‘ W	2388.5
PS81/0574-1	01.10.13	00:16:01	RMT	hoisting	57° 39.34‘ S	27° 15.73‘ W	2388.5
PS81/0574-1	01.10.13	00:30:00	RMT	profile end	57° 39.91‘ S	27° 15.43‘ W	2367.6
PS81/0574-1	01.10.13	00:38:59	RMT	on deck	57° 40.02‘ S	27° 15.38‘ W	2362.6
PS81/0575-1	01.10.13	04:00:00	RMT	in the water	57° 17.04‘ S	27° 45.99‘ W	3236.1
PS81/0575-1	01.10.13	04:08:00	RMT	on ground/ max depth	57° 17.37‘ S	27° 45.91‘ W	3236.9
PS81/0575-1	01.10.13	04:08:01	RMT	profile start	57° 17.37‘ S	27° 45.91‘ W	3236.9
PS81/0575-1	01.10.13	04:32:00	RMT	profile end	57° 18.41‘ S	27° 45.83‘ W	3237.6
PS81/0575-1	01.10.13	04:36:59	RMT	on deck	57° 18.40‘ S	27° 45.84‘ W	3237.3

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0576-1	01.10.13	11:00:00	REL	in the water	56° 30.84‘ S	28° 42.88‘ W	3086.8
PS81/0576-1	01.10.13	11:19:00	REL	on ground/ max depth	56° 30.76‘ S	28° 42.90‘ W	3076.4
PS81/0576-1	01.10.13	12:00:00	REL	hoisting	56° 30.62‘ S	28° 42.96‘ W	3077.2
PS81/0576-1	01.10.13	12:09:59	REL	on deck	56° 30.59‘ S	28° 42.97‘ W	3080.1
PS81/0576-2	01.10.13	13:04:00	MOR	in the water	56° 30.49‘ S	28° 42.94‘ W	3083
PS81/0576-2	01.10.13	13:12:00	MOR	in the water	56° 30.48‘ S	28° 42.91‘ W	3083.7
PS81/0576-2	01.10.13	13:37:00	MOR	in the water	56° 30.44‘ S	28° 42.79‘ W	3084.6
PS81/0576-2	01.10.13	13:43:00	MOR	in the water	56° 30.43‘ S	28° 42.75‘ W	3085.4
PS81/0576-2	01.10.13	14:16:00	MOR	in the water	56° 30.36‘ S	28° 42.47‘ W	3088.2
PS81/0576-2	01.10.13	14:39:00	MOR	in the water	56° 30.30‘ S	28° 42.23‘ W	3088.7
PS81/0576-2	01.10.13	14:46:00	MOR	in the water	56° 30.28‘ S	28° 42.14‘ W	3089.2
PS81/0576-2	01.10.13	14:48:00	MOR	action	56° 30.27‘ S	28° 42.12‘ W	3090
PS81/0576-2	01.10.13	15:00:59	MOR	on ground/ max depth	56° 30.17‘ S	28° 41.95‘ W	3092
PS81/0576-3	01.10.13	16:09:00	CTD/RO	in the water	56° 31.52‘ S	28° 38.70‘ W	3095.1
PS81/0576-4	01.10.13	16:18:00	EF	in the water	56° 31.49‘ S	28° 38.55‘ W	3093.4
PS81/0576-4	01.10.13	16:19:00	EF	on ground/ max depth	56° 31.49‘ S	28° 38.54‘ W	3093.3
PS81/0576-4	01.10.13	16:19:01	EF	profile start	56° 31.49‘ S	28° 38.54‘ W	3093.3
PS81/0576-4	01.10.13	16:42:00	EF	profile end	56° 31.40‘ S	28° 38.14‘ W	3090.3
PS81/0576-4	01.10.13	16:43:59	EF	on deck	56° 31.40‘ S	28° 38.13‘ W	3090.4
PS81/0576-3	01.10.13	17:16:00	CTD/RO	on ground/ max depth	56° 31.27‘ S	28° 37.45‘ W	3090.5
PS81/0576-3	01.10.13	17:46:00	CTD/RO	hoisting	56° 31.13‘ S	28° 36.80‘ W	3100.7
PS81/0576-3	01.10.13	18:46:59	CTD/RO	on deck	56° 30.88‘ S	28° 35.56‘ W	3065.5
PS81/0577-1	02.10.13	10:58:00	RMT	in the water	58° 23.46‘ S	26° 8.06‘ W	1095.7
PS81/0577-1	02.10.13	10:58:01	RMT	profile start	58° 23.46‘ S	26° 8.06‘ W	1095.7
PS81/0577-1	02.10.13	11:21:00	RMT	on ground/ max depth	58° 24.02‘ S	26° 8.39‘ W	876.3
PS81/0577-1	02.10.13	11:21:01	RMT	hoisting	58° 24.02‘ S	26° 8.39‘ W	876.3
PS81/0577-1	02.10.13	11:56:00	RMT	profile end	58° 25.20‘ S	26° 9.44‘ W	811
PS81/0577-1	02.10.13	12:03:59	RMT	on deck	58° 25.35‘ S	26° 9.58‘ W	774
PS81/0577-2	02.10.13	13:05:00	SUIT	in the water	58° 26.28‘ S	26° 5.68‘ W	1067.8
PS81/0577-2	02.10.13	13:08:00	SUIT	in the water	58° 26.31‘ S	26° 5.76‘ W	1062.6
PS81/0577-2	02.10.13	13:13:00	SUIT	on ground/ max depth	58° 26.47‘ S	26° 6.11‘ W	1006.6
PS81/0577-2	02.10.13	13:13:01	SUIT	profile start	58° 26.47‘ S	26° 6.11‘ W	1006.6
PS81/0577-2	02.10.13	13:47:00	SUIT	profile end	58° 27.59‘ S	26° 8.41‘ W	488
PS81/0577-2	02.10.13	13:47:01	SUIT	hoisting	58° 27.59‘ S	26° 8.41‘ W	488
PS81/0577-2	02.10.13	13:50:00	SUIT	on deck	58° 27.61‘ S	26° 8.68‘ W	466
PS81/0577-2	02.10.13	13:58:59	SUIT	on deck	58° 27.66‘ S	26° 9.01‘ W	457.2
PS81/0578-1	02.10.13	16:08:00	RMT	in the water	58° 28.76‘ S	26° 8.11‘ W	667.4
PS81/0578-1	02.10.13	16:21:00	RMT	on ground/ max depth	58° 28.17‘ S	26° 8.16‘ W	631.9

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0578-1	02.10.13	16:21:01	RMT	profile start	58° 28.17' S	26° 8.16' W	631.9
PS81/0578-1	02.10.13	16:22:00	RMT	hoisting	58° 28.13' S	26° 8.16' W	621.2
PS81/0578-1	02.10.13	16:40:00	RMT	profile end	58° 27.31' S	26° 8.17' W	718.5
PS81/0578-1	02.10.13	16:47:59	RMT	on deck	58° 26.93' S	26° 8.25' W	831.2
PS81/0579-1	02.10.13	21:04:00	RMT	in the water	58° 26.55' S	25° 57.44' W	1446.1
PS81/0579-1	02.10.13	21:04:01	RMT	profile start	58° 26.55' S	25° 57.44' W	1446.1
PS81/0579-1	02.10.13	21:44:00	RMT	on ground/ max depth	58° 27.24' S	25° 59.76' W	1405.3
PS81/0579-1	02.10.13	21:44:01	RMT	hoisting	58° 27.24' S	25° 59.76' W	1405.3
PS81/0579-1	02.10.13	22:40:00	RMT	profile end	58° 27.63' S	26° 3.44' W	1189.6
PS81/0579-1	02.10.13	22:50:59	RMT	on deck	58° 27.64' S	26° 3.80' W	1154
PS81/0579-2	02.10.13	23:27:00	SUIT	in the water	58° 27.45' S	26° 3.03' W	1218.4
PS81/0579-2	02.10.13	23:36:00	SUIT	on ground/ max depth	58° 27.36' S	26° 3.20' W	1195.2
PS81/0579-2	02.10.13	23:36:01	SUIT	profile start	58° 27.36' S	26° 3.20' W	1195.2
PS81/0579-2	03.10.13	00:06:00	SUIT	profile end	58° 27.25' S	26° 5.98' W	793.7
PS81/0579-2	03.10.13	00:06:01	SUIT	hoisting	58° 27.25' S	26° 5.98' W	793.7
PS81/0579-2	03.10.13	00:23:59	SUIT	on deck	58° 27.25' S	26° 5.99' W	807.5
PS81/0580-1	03.10.13	09:51:00	RMT	in the water	58° 26.37' S	25° 58.39' W	1374.2
PS81/0580-1	03.10.13	09:55:00	RMT	profile start	58° 26.31' S	25° 58.44' W	1371
PS81/0580-1	03.10.13	10:41:00	RMT	on ground/ max depth	58° 26.86' S	26° 0.22' W	1358.7
PS81/0580-1	03.10.13	10:44:00	RMT	action	58° 26.94' S	26° 0.38' W	1364
PS81/0580-1	03.10.13	11:15:00	RMT	profile end	58° 27.56' S	26° 1.95' W	1299.1
PS81/0580-1	03.10.13	11:25:59	RMT	on deck	58° 27.54' S	26° 2.52' W	1266.1
PS81/0580-2	03.10.13	12:49:00	RMT	in the water	58° 25.54' S	25° 56.86' W	1475.9
PS81/0580-2	03.10.13	12:50:00	RMT	profile start	58° 25.56' S	25° 56.89' W	1478.4
PS81/0580-2	03.10.13	13:21:00	RMT	on ground/ max depth	58° 26.53' S	25° 58.26' W	1405.6
PS81/0580-2	03.10.13	13:22:00	RMT	hoisting	58° 26.55' S	25° 58.31' W	1403.7
PS81/0580-2	03.10.13	13:30:00	RMT	profile end	58° 26.62' S	25° 58.73' W	1371.5
PS81/0580-2	03.10.13	13:36:59	RMT	on deck	58° 26.59' S	25° 58.89' W	1351.8
PS81/0581-1	03.10.13	15:48:00	MN	in the water	58° 27.40' S	26° 11.81' W	447
PS81/0581-1	03.10.13	15:50:00	MN	on ground/ max depth	58° 27.37' S	26° 11.78' W	453.8
PS81/0581-1	03.10.13	15:51:00	MN	hoisting	58° 27.35' S	26° 11.76' W	459.1
PS81/0581-1	03.10.13	15:54:59	MN	on deck	58° 27.29' S	26° 11.68' W	475.8
PS81/0582-1	03.10.13	16:18:00	RMT	in the water	58° 27.90' S	26° 11.20' W	260.3
PS81/0582-1	03.10.13	16:27:00	RMT	profile start	58° 28.22' S	26° 11.52' W	185
PS81/0582-1	03.10.13	16:39:00	RMT	on ground/ max depth	58° 28.65' S	26° 11.56' W	356.9
PS81/0582-1	03.10.13	16:40:00	RMT	hoisting	58° 28.69' S	26° 11.54' W	354
PS81/0582-1	03.10.13	16:52:00	RMT	profile end	58° 29.20' S	26° 11.36' W	414.3
PS81/0582-1	03.10.13	16:59:59	RMT	on deck	58° 29.26' S	26° 11.22' W	453

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0583-1	03.10.13	20:19:00	CTD/RO	in the water	58° 29.90' S	26° 4.43' W	1026.8
PS81/0583-1	03.10.13	20:47:00	CTD/RO	on ground/ max depth	58° 29.62' S	26° 3.83' W	1080.2
PS81/0583-1	03.10.13	21:05:00	CTD/RO	hoisting	58° 29.43' S	26° 3.54' W	1089.9
PS81/0583-1	03.10.13	21:26:59	CTD/RO	on deck	58° 29.19' S	26° 3.18' W	1130
PS81/0583-2	03.10.13	21:37:00	MN	in the water	58° 29.04' S	26° 2.96' W	1133
PS81/0583-2	03.10.13	21:40:00	MN	on ground/ max depth	58° 29.01' S	26° 2.93' W	1134.5
PS81/0583-2	03.10.13	21:40:01	MN	hoisting	58° 29.01' S	26° 2.93' W	1134.5
PS81/0583-2	03.10.13	21:43:59	MN	on deck	58° 28.98' S	26° 2.90' W	1136.1
PS81/0583-3	03.10.13	21:48:00	HN	in the water	58° 28.94' S	26° 2.86' W	1140
PS81/0583-3	03.10.13	21:49:00	HN	on ground/ max depth	58° 28.93' S	26° 2.86' W	1142.4
PS81/0583-3	03.10.13	21:51:59	HN	on deck	58° 28.91' S	26° 2.83' W	1144.1
PS81/0584-1	04.10.13	00:51:00	RMT	in the water	58° 28.76' S	25° 48.13' W	1873.2
PS81/0584-1	04.10.13	00:59:00	RMT	profile start	58° 28.80' S	25° 48.60' W	1857.4
PS81/0584-1	04.10.13	01:09:00	RMT	on ground/ max depth	58° 28.87' S	25° 49.19' W	1869.3
PS81/0584-1	04.10.13	01:11:00	RMT	profile end	58° 28.87' S	25° 49.20' W	1869.4
PS81/0584-1	04.10.13	01:18:59	RMT	on deck	58° 28.83' S	25° 49.16' W	1870.8
PS81/0585-1	04.10.13	12:35:00	RMT	in the water	58° 19.70' S	24° 31.80' W	3524.2
PS81/0585-1	04.10.13	12:50:00	RMT	on deck	58° 19.68' S	24° 32.34' W	3514.8
PS81/0585-1	04.10.13	13:15:00	RMT	in the water	58° 19.52' S	24° 30.98' W	3509.4
PS81/0585-1	04.10.13	13:20:00	RMT	profile start	58° 19.52' S	24° 31.53' W	3534.9
PS81/0585-1	04.10.13	13:30:00	RMT	on ground/ max depth	58° 19.61' S	24° 32.18' W	3523.9
PS81/0585-1	04.10.13	13:50:00	RMT	profile end	58° 19.66' S	24° 32.30' W	3515.2
PS81/0585-1	04.10.13	13:53:59	RMT	on deck	58° 19.64' S	24° 32.24' W	3519.2
PS81/0586-1	04.10.13	15:22:00	RMT	in the water	58° 18.64' S	24° 21.88' W	3669.4
PS81/0586-1	04.10.13	15:32:00	RMT	profile start	58° 18.74' S	24° 21.91' W	3675.6
PS81/0586-1	04.10.13	15:40:00	RMT	on ground/ max depth	58° 18.99' S	24° 22.10' W	3640.6
PS81/0586-1	04.10.13	15:45:00	RMT	profile end	58° 19.14' S	24° 22.24' W	3642
PS81/0586-1	04.10.13	15:54:59	RMT	on deck	58° 19.15' S	24° 22.14' W	3644.3
PS81/0587-1	04.10.13	19:08:00	MN	in the water	58° 17.13' S	24° 20.61' W	3763.5
PS81/0587-1	04.10.13	19:17:00	MN	on ground/ max depth	58° 17.09' S	24° 20.71' W	3763.6
PS81/0587-1	04.10.13	19:22:59	MN	on deck	58° 17.09' S	24° 20.78' W	3759
PS81/0587-2	04.10.13	20:19:00	ZODIAK	in the water	58° 16.39' S	24° 21.53' W	3794.7
PS81/0587-2	04.10.13	20:28:00	ZODIAK	in the water	58° 16.39' S	24° 21.76' W	3800.5
PS81/0587-2	04.10.13	22:02:00	ZODIAK	on ground/ max depth	58° 16.01' S	24° 23.41' W	3795.5
PS81/0587-2	04.10.13	22:03:00	ZODIAK	on deck	58° 16.00' S	24° 23.42' W	3796.6
PS81/0587-2	04.10.13	22:08:59	ZODIAK	on deck	58° 15.96' S	24° 23.45' W	3801.3
PS81/0587-3	05.10.13	01:00:00	MN	in the water	58° 16.54' S	24° 24.94' W	3770.6

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0587-3	05.10.13	01:08:00	MN	on ground/ max depth	58° 16.59‘ S	24° 24.96‘ W	3771.8
PS81/0587-3	05.10.13	01:09:00	MN	hoisting	58° 16.59‘ S	24° 24.96‘ W	3771.3
PS81/0587-3	05.10.13	01:15:59	MN	on deck	58° 16.61‘ S	24° 24.97‘ W	3770.2
PS81/0587-4	05.10.13	07:05:00	MN	in the water	58° 17.15‘ S	24° 23.04‘ W	3769.1
PS81/0587-4	05.10.13	07:13:00	MN	on ground/ max depth	58° 17.13‘ S	24° 23.01‘ W	3768.5
PS81/0587-4	05.10.13	07:18:59	MN	on deck	58° 17.12‘ S	24° 23.01‘ W	3768.3
PS81/0587-5	05.10.13	09:50:00	CTD/RO	in the water	58° 16.81‘ S	24° 24.30‘ W	3733.9
PS81/0587-5	05.10.13	11:23:00	CTD/RO	on ground/ max depth	58° 17.06‘ S	24° 25.76‘ W	3726.5
PS81/0587-5	05.10.13	11:55:00	CTD/RO	hoisting	58° 17.23‘ S	24° 26.21‘ W	3691.2
PS81/0587-5	05.10.13	13:20:59	CTD/RO	on deck	58° 17.80‘ S	24° 27.03‘ W	3620
PS81/0587-6	05.10.13	13:32:00	MN	in the water	58° 17.89‘ S	24° 27.07‘ W	3605.4
PS81/0587-6	05.10.13	13:38:00	MN	on ground/ max depth	58° 17.94‘ S	24° 27.08‘ W	3599.7
PS81/0587-6	05.10.13	13:39:00	MN	hoisting	58° 17.95‘ S	24° 27.08‘ W	3599.1
PS81/0587-6	05.10.13	13:46:59	MN	on deck	58° 18.00‘ S	24° 27.08‘ W	3593.1
PS81/0587-7	05.10.13	14:12:00	ZODIAK	in the water	58° 18.25‘ S	24° 27.00‘ W	3560.4
PS81/0587-7	05.10.13	14:16:00	ZODIAK	in the water	58° 18.29‘ S	24° 26.95‘ W	3557.1
PS81/0587-7	05.10.13	14:16:01	ZODIAK	on ground/ max depth	58° 18.29‘ S	24° 26.95‘ W	3557.1
PS81/0587-7	05.10.13	15:33:59	ZODIAK	on deck	58° 18.91‘ S	24° 26.46‘ W	3533.9
PS81/0587-8	05.10.13	16:02:00	BONGO	in the water	58° 19.11‘ S	24° 26.24‘ W	3561.1
PS81/0587-9	05.10.13	16:36:00	ZODIAK	in the water	58° 19.33‘ S	24° 25.86‘ W	3548.6
PS81/0587-9	05.10.13	16:40:00	ZODIAK	in the water	58° 19.35‘ S	24° 25.82‘ W	3526.4
PS81/0587-9	05.10.13	16:40:01	ZODIAK	on ground/ max depth	58° 19.35‘ S	24° 25.82‘ W	3526.4
PS81/0587-8	05.10.13	16:41:00	BONGO	on ground/ max depth	58° 19.36‘ S	24° 25.81‘ W	3525.7
PS81/0587-8	05.10.13	16:42:00	BONGO	hoisting	58° 19.36‘ S	24° 25.80‘ W	3522.6
PS81/0587-8	05.10.13	17:10:59	BONGO	on deck	58° 19.52‘ S	24° 25.50‘ W	3498.8
PS81/0587-10	05.10.13	17:15:00	MN	in the water	58° 19.54‘ S	24° 25.46‘ W	3498.8
PS81/0587-10	05.10.13	17:26:00	MN	on ground/ max depth	58° 19.58‘ S	24° 25.36‘ W	3501.6
PS81/0587-10	05.10.13	17:33:59	MN	on deck	58° 19.61‘ S	24° 25.27‘ W	3500.2
PS81/0587-11	05.10.13	17:54:00	HN	in the water	58° 19.67‘ S	24° 25.03‘ W	3515.5
PS81/0587-11	05.10.13	17:56:01	HN	on ground/ max depth	58° 19.67‘ S	24° 25.00‘ W	3510.2
PS81/0587-11	05.10.13	17:57:59	HN	on deck	58° 19.67‘ S	24° 24.99‘ W	3514.8
PS81/0587-9	05.10.13	18:50:00	ZODIAK	on deck	58° 19.70‘ S	24° 24.32‘ W	3524
PS81/0587-9	05.10.13	18:52:59	ZODIAK	on deck	58° 19.70‘ S	24° 24.30‘ W	3524.4

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0588-1	09.10.13	06:40:00	CTD/RO	in the water	55° 59.89' S	0° 0.00' E	3626
PS81/0588-2	09.10.13	06:51:00	HN	on ground/ max depth	55° 59.75' S	0° 0.17' E	3682.7
PS81/0588-2	09.10.13	06:51:01	HN	in the water	55° 59.75' S	0° 0.17' E	3682.7
PS81/0588-2	09.10.13	06:54:59	HN	on deck	55° 59.73' S	0° 0.23' E	3667.4
PS81/0588-1	09.10.13	07:03:00	CTD/RO	on ground/ max depth	55° 59.63' S	0° 0.38' E	3654.5
PS81/0588-1	09.10.13	07:04:00	CTD/RO	hoisting	55° 59.62' S	0° 0.40' E	3650.4
PS81/0588-1	09.10.13	07:26:59	CTD/RO	on deck	55° 59.39' S	0° 0.75' E	3644.4
PS81/0589-1	09.10.13	10:53:00	CTD	in the water	55° 29.63' S	0° 0.59' E	3600.7
PS81/0589-1	09.10.13	11:19:00	CTD	on ground/ max depth	55° 29.34' S	0° 1.09' E	3585
PS81/0589-1	09.10.13	11:20:00	CTD	hoisting	55° 29.33' S	0° 1.11' E	3587
PS81/0589-1	09.10.13	11:39:59	CTD	on deck	55° 29.16' S	0° 1.45' E	3600.8
PS81/0590-1	09.10.13	14:51:00	CTD/RO	in the water	54° 59.96' S	0° 0.05' W	1662.4
PS81/0590-2	09.10.13	14:54:00	HN	in the water	54° 59.97' S	0° 0.06' W	1664.6
PS81/0590-2	09.10.13	14:55:00	HN	on ground/ max depth	54° 59.97' S	0° 0.06' W	1670.2
PS81/0590-2	09.10.13	14:57:59	HN	on deck	54° 59.97' S	0° 0.06' W	1666
PS81/0590-1	09.10.13	15:16:00	CTD/RO	on ground/ max depth	54° 59.84' S	0° 0.09' W	1665.1
PS81/0590-1	09.10.13	15:16:01	CTD/RO	hoisting	54° 59.84' S	0° 0.09' W	1665.1
PS81/0590-1	09.10.13	15:34:59	CTD/RO	on deck	54° 59.70' S	0° 0.13' W	1669.7
PS81/0591-1	09.10.13	21:35:00	CTD/RO	in the water	53° 59.97' S	0° 0.08' E	2455.2
PS81/0591-2	09.10.13	21:39:00	HN	in the water	53° 59.98' S	0° 0.08' E	2458.5
PS81/0591-2	09.10.13	21:41:00	HN	on ground/ max depth	53° 59.98' S	0° 0.09' E	2458.8
PS81/0591-2	09.10.13	21:42:59	HN	on deck	53° 59.98' S	0° 0.09' E	2459.9
PS81/0591-1	09.10.13	22:00:00	CTD/RO	on ground/ max depth	53° 59.99' S	0° 0.09' E	2460.6
PS81/0591-1	09.10.13	22:01:00	CTD/RO	hoisting	53° 60.00' S	0° 0.09' E	2461.3
PS81/0591-1	09.10.13	22:20:59	CTD/RO	on deck	54° 0.07' S	0° 0.10' E	2473.4
PS81/0592-1	10.10.13	03:36:00	CTD/RO	in the water	52° 59.94' S	0° 0.02' E	2490.4
PS81/0592-2	10.10.13	03:51:00	HN	in the water	53° 0.00' S	0° 0.11' E	2481.5
PS81/0592-2	10.10.13	03:52:00	HN	on ground/ max depth	53° 0.01' S	0° 0.12' E	2480
PS81/0592-2	10.10.13	03:54:59	HN	on deck	53° 0.02' S	0° 0.14' E	2478.4
PS81/0592-1	10.10.13	04:01:00	CTD/RO	on ground/ max depth	53° 0.09' S	0° 0.20' E	2471.5
PS81/0592-1	10.10.13	04:19:59	CTD/RO	on deck	53° 0.20' S	0° 0.32' E	2463.5
PS81/0593-1	10.10.13	07:03:00	CTD/RO	in the water	52° 29.80' S	0° 0.19' E	2572.1
PS81/0593-1	10.10.13	07:27:00	CTD/RO	on ground/ max depth	52° 29.82' S	0° 0.27' E	2570.2
PS81/0593-1	10.10.13	07:44:59	CTD/RO	on deck	52° 29.79' S	0° 0.61' E	2548.8
PS81/0594-1	10.10.13	10:25:00	CTD/RO	in the water	51° 59.98' S	0° 0.04' E	2910.7

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0594-1	10.10.13	10:49:00	CTD/RO	on ground/ max depth	51° 59.89‘ S	0° 0.00‘ W	2904.7
PS81/0594-1	10.10.13	10:50:00	CTD/RO	hoisting	51° 59.89‘ S	0° 0.01‘ W	2904.7
PS81/0594-1	10.10.13	11:10:59	CTD/RO	on deck	51° 59.86‘ S	0° 0.14‘ W	2905.8
PS81/0595-1	10.10.13	13:53:00	CTD/RO	in the water	51° 29.96‘ S	0° 0.04‘ E	2718.2
PS81/0595-2	10.10.13	13:55:00	HN	in the water	51° 29.96‘ S	0° 0.03‘ E	2719.8
PS81/0595-2	10.10.13	13:57:00	HN	on ground/ max depth	51° 29.96‘ S	0° 0.03‘ E	2719.8
PS81/0595-2	10.10.13	14:01:59	HN	on deck	51° 29.97‘ S	0° 0.00‘ E	2721.4
PS81/0595-1	10.10.13	14:18:00	CTD/RO	on ground/ max depth	51° 29.99‘ S	0° 0.07‘ W	2726.9
PS81/0595-1	10.10.13	14:19:00	CTD/RO	hoisting	51° 29.99‘ S	0° 0.06‘ W	2726
PS81/0595-1	10.10.13	14:39:59	CTD/RO	on deck	51° 30.07‘ S	0° 0.12‘ W	2731.9
PS81/0596-1	10.10.13	17:27:00	CTD/RO	in the water	50° 59.74‘ S	0° 0.10‘ E	2226.2
PS81/0596-2	10.10.13	17:32:01	HN	in the water	50° 59.76‘ S	0° 0.13‘ E	2227.7
PS81/0596-2	10.10.13	17:33:00	HN	on ground/ max depth	50° 59.76‘ S	0° 0.14‘ E	2227.8
PS81/0596-2	10.10.13	17:35:59	HN	on deck	50° 59.77‘ S	0° 0.16‘ E	2227.7
PS81/0596-3	10.10.13	17:38:00	HN	in the water	50° 59.78‘ S	0° 0.20‘ E	2229.5
PS81/0596-3	10.10.13	17:39:00	HN	on ground/ max depth	50° 59.78‘ S	0° 0.21‘ E	2230.3
PS81/0596-3	10.10.13	17:40:59	HN	on deck	50° 59.79‘ S	0° 0.23‘ E	2231
PS81/0596-1	10.10.13	17:42:00	CTD/RO	on ground/ max depth	50° 59.79‘ S	0° 0.26‘ E	2231.9
PS81/0596-1	10.10.13	18:11:59	CTD/RO	on deck	50° 59.94‘ S	0° 0.46‘ E	2229.3
PS81/0597-1	10.10.13	20:59:00	CTD/RO	in the water	50° 30.03‘ S	0° 0.05‘ E	3405.1
PS81/0597-1	10.10.13	21:23:00	CTD/RO	on ground/ max depth	50° 30.00‘ S	0° 0.31‘ E	3410.1
PS81/0597-1	10.10.13	21:23:01	CTD/RO	hoisting	50° 30.00‘ S	0° 0.31‘ E	3410.1
PS81/0597-1	10.10.13	21:42:59	CTD/RO	on deck	50° 29.98‘ S	0° 0.57‘ E	3416
PS81/0597-2	10.10.13	21:53:00	RMT	in the water	50° 29.95‘ S	0° 0.57‘ E	3416.3
PS81/0597-2	10.10.13	21:54:00	RMT	profile start	50° 29.95‘ S	0° 0.55‘ E	3416.1
PS81/0597-2	10.10.13	22:27:00	RMT	on ground/ max depth	50° 30.10‘ S	0° 1.20‘ W	3405.1
PS81/0597-2	10.10.13	22:27:01	RMT	hoisting	50° 30.10‘ S	0° 1.20‘ W	3405.1
PS81/0597-2	10.10.13	23:16:00	RMT	profile end	50° 30.09‘ S	0° 3.85‘ W	3195
PS81/0597-2	10.10.13	23:20:59	RMT	on deck	50° 30.07‘ S	0° 4.03‘ W	3170.9
PS81/0598-1	11.10.13	02:12:00	CTD/RO	in the water	50° 0.03‘ S	0° 0.03‘ E	3518.2
PS81/0598-2	11.10.13	02:20:00	HN	in the water	50° 0.08‘ S	0° 0.09‘ E	3518.6
PS81/0598-2	11.10.13	02:22:00	HN	on ground/ max depth	50° 0.10‘ S	0° 0.11‘ E	3519.1
PS81/0598-2	11.10.13	02:24:59	HN	on deck	50° 0.12‘ S	0° 0.13‘ E	3519.3
PS81/0598-1	11.10.13	02:37:00	CTD/RO	on ground/ max depth	50° 0.15‘ S	0° 0.16‘ E	3519.5
PS81/0598-1	11.10.13	02:38:00	CTD/RO	hoisting	50° 0.15‘ S	0° 0.15‘ E	3519.5

Station	Date	Time	Gear	Action	Position Lat	Position Lon	Water depth [m]
PS81/0598-1	11.10.13	02:57:59	CTD/RO	on deck	50° 0.10‘ S	0° 0.17‘ E	3521.1
PS81/0598-3	11.10.13	03:08:00	RMT	in the water	50° 0.09‘ S	0° 0.10‘ W	3515.1
PS81/0598-3	11.10.13	03:25:00	RMT	on ground/ max depth	49° 59.97‘ S	0° 1.11‘ W	3527.1
PS81/0598-3	11.10.13	03:25:01	RMT	profile start	49° 59.97‘ S	0° 1.11‘ W	3527.1
PS81/0598-3	11.10.13	03:26:00	RMT	hoisting	49° 59.96‘ S	0° 1.16‘ W	3528.3
PS81/0598-3	11.10.13	03:45:00	RMT	profile end	49° 59.87‘ S	0° 2.24‘ W	3581.3
PS81/0598-3	11.10.13	03:45:01	RMT	at surface	49° 59.87‘ S	0° 2.24‘ W	3581.3
PS81/0598-3	11.10.13	03:50:59	RMT	on deck	49° 59.88‘ S	0° 2.25‘ W	3582.1
PS81/0599-1	11.10.13	06:36:00	CTD/RO	in the water	49° 30.03‘ S	0° 0.21‘ E	4119.6
PS81/0599-1	11.10.13	06:59:00	CTD/RO	on ground/ max depth	49° 30.20‘ S	0° 0.45‘ E	4158.1
PS81/0599-1	11.10.13	07:00:00	CTD/RO	hoisting	49° 30.20‘ S	0° 0.45‘ E	4158.5
PS81/0599-1	11.10.13	07:19:59	CTD/RO	on deck	49° 30.17‘ S	0° 0.54‘ E	4160.1
PS81/0600-1	11.10.13	10:34:00	CTD/RO	in the water	48° 59.98‘ S	0° 0.12‘ W	3840.7
PS81/0600-2	11.10.13	10:57:00	HN	in the water	49° 0.08‘ S	0° 0.40‘ E	3850.8
PS81/0600-2	11.10.13	11:00:00	HN	on ground/ max depth	49° 0.08‘ S	0° 0.36‘ E	3850.7
PS81/0600-1	11.10.13	11:01:00	CTD/RO	on ground/ max depth	49° 0.08‘ S	0° 0.33‘ E	3849.8
PS81/0600-1	11.10.13	11:01:01	CTD/RO	hoisting	49° 0.08‘ S	0° 0.33‘ E	3849.8
PS81/0600-2	11.10.13	11:01:59	HN	on deck	49° 0.08‘ S	0° 0.33‘ E	3849.8
PS81/0600-1	11.10.13	11:22:59	CTD/RO	on deck	49° 0.13‘ S	0° 0.49‘ E	3854.2
PS81/0601-1	11.10.13	14:20:00	CTD/RO	in the water	48° 29.92‘ S	0° 0.19‘ E	3782.1
PS81/0601-1	11.10.13	14:47:00	CTD/RO	on ground/ max depth	48° 29.97‘ S	0° 0.16‘ E	3779.4
PS81/0601-1	11.10.13	15:05:59	CTD/RO	on deck	48° 29.98‘ S	0° 0.24‘ E	3778.6
PS81/0601-2	11.10.13	15:08:00	HN	in the water	48° 29.98‘ S	0° 0.24‘ E	3778.6
PS81/0601-2	11.10.13	15:18:00	HN	on ground/ max depth	48° 30.01‘ S	0° 0.43‘ E	3777.6
PS81/0601-2	11.10.13	15:18:59	HN	on deck	48° 30.01‘ S	0° 0.43‘ E	3777.6
PS81/0602-1	11.10.13	18:31:00	CTD/RO	in the water	48° 0.03‘ S	0° 0.02‘ E	3864.3
PS81/0602-2	11.10.13	18:32:00	HN	in the water	48° 0.04‘ S	0° 0.04‘ E	3863.4
PS81/0602-2	11.10.13	18:35:00	HN	on ground/ max depth	48° 0.08‘ S	0° 0.12‘ E	3860.1
PS81/0602-2	11.10.13	18:36:59	HN	on deck	48° 0.09‘ S	0° 0.13‘ E	3860.4
PS81/0602-1	11.10.13	18:56:00	CTD/RO	on ground/ max depth	47° 59.98‘ S	0° 0.11‘ E	3865.9
PS81/0602-1	11.10.13	18:56:01	CTD/RO	hoisting	47° 59.98‘ S	0° 0.11‘ E	3865.9
PS81/0602-1	11.10.13	19:16:59	CTD/RO	on deck	48° 0.02‘ S	0° 0.02‘ E	3865.1

Die "Berichte zur Polar- und Meeresforschung" (ISSN 1866-3192) werden beginnend mit dem Heft Nr. 569 (2008) als Open-Access-Publikation herausgegeben. Ein Verzeichnis aller Hefte einschließlich der Druckausgaben (Heft 377-568) sowie der früheren **"Berichte zur Polarforschung"** (Heft 1-376, von 1981 bis 2000) befindet sich im open access institutional repository for publications and presentations (**ePIC**) des AWI unter der URL http://epic.awi.de. Durch Auswahl "Reports on Polar- and Marine Research" (via "browse"/"type") wird eine Liste der Publikationen sortiert nach Heftnummer innerhalb der absteigenden chronologischen Reihenfolge der Jahrgänge erzeugt.

To generate a list of all Reports past issues, use the following URL: http://epic.awi.de and select "browse"/"type" to browse "Reports on Polar and Marine Research". A chronological list in declining order, issues chronological, will be produced, and pdf-icons shown for open access download.

Verzeichnis der zuletzt erschienenen Hefte:

Heft-Nr. 662/2013 — "Climate Change in the Marine Realm: An international summer school in the framework of the European Campus of Excellence", edited by Angelika Dummermuth and Klaus Grosfeld

Heft-Nr. 663/2013 — "The Expedition of the Research Vessel 'Polarstern' to the Arctic in 2012 (ARK-XXVII/3)", edited by Antje Boetius

Heft-Nr. 664/2013 — "Russian-German Cooperation SYSTEM LAPTEV SEA: The Expeditions Laptev Sea - Mamontov Klyk 2011 & Buor Khaya 2012", edited by Frank Günther, Pier Paul Overduin, Aleksandr S. Makarov, and Mikhail N. Grigoriev

Heft-Nr. 665/2013 — "The Expedition of the Research Vessel 'Polarstern' to the Antarctic in 2013 (ANT-XXIX/3)", edited by Julian Gutt

Heft-Nr. 666/2013 — "The Expedition of the Research Vessel 'Polarstern' to the Antarctic in 2013 (ANT-XXIX/5)", edited by Wilfried Jokat

Heft-Nr. 667/2013 — "The Sea Ice Thickness in the Atlantic Sector of the Southern Ocean", by Axel Behrendt

Heft-Nr. 668/2013 — "The Expedition of the Research Vessel 'Polarstern' to the Antarctic in 2013 (ANT-XXIX/4)", edited by Gerhard Bohrmann

Heft-Nr. 669/2013 — "Processes in the Southern Ocean carbon cycle: Dissolution of carbonate sediments and inter-annual variability of carbon fluxes", by Judith Hauck

Heft-Nr. 670/2013 — "The Expedition of the Research Vessel 'Polarstern' to the Antarctic in 2012 (ANT-XXIX/1)", edited by Holger Auel

Heft-Nr. 671/2013 — "The Expedition of the Research Vessel 'Polarstern' to the Antarctic in 2012/2013 (ANT-XXIX/2)", edited by Olaf Boebel

Heft-Nr. 672/2014 — "The Expedition of the Research Vessel 'Polarstern' to the Antarctic in 2013 (ANT-XXIX/8)", edited by Vera Schlindwein

Heft-Nr. 673/2014 — "Airborne Measurements of Methane Fluxes in Alaskan and Canadian Tundra with the Research Aircraft 'Polar 5'", by Katrin Kohnert, Andrei Serafimovich, Jörg Hartmann, and Torsten Sachs

Heft-Nr. 674/2014 — "The Expedition of the Research Vessel 'Polarstern' to the Antarctic in 2013 (ANT-XXIX/7)", edited by Bettina Meyer and Lutz Auerswald