Die Expedition ARKTIS XVII/1 des Forschungsschiffes POLARSTERN 2001

The Expedition ARKTIS XVII/1 of the Research Vessel POLARSTERN in 2001

Herausgegeben von / Edited by
Eberhard Fahrbach
unter Mitarbeit der Fahrtteilnehmer
with contributions of the participants

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FAHRTLEITER

Eberhard Fahrbach

KOORDINATOR

Eberhard Fahrbach

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1. ZUSAMMENFASSUNG UND FAHRTVERLAUF
E. Fahrbach

Am 19. Juni 2001 verließ POLARSTERN Bremerhaven zur Forschungsreise ARKXVII/1 in das Europäische Nordmeer (Abb. 1). An Bord waren 43 Besatzungsmitglieder und 34 Fahrtteilnehmer/innen. Die Reise dauerte 41 Tage. Während dieser Zeit legten wir 5 307 Seemeilen zurück, um im Europäischen Nordmeer mehrere Forschungsprogramme mit unterschiedlichen fachlichen und regionalen Schwerpunkten durchzuführen. Sie hatten die Untersuchung der physikalischen, biologischen, chemischen und geologischen Bedingungen dieses Seegebiets zum Inhalt. Um die Verteilung der Wassermassen zu erfassen, wurden 189 CTD-Stationen (Conductivity, Temperature, Depth) ausgeführt (Abb. 2).

Die Fahrt führte direkt in das Europäische Nordmeer, wo die Arbeiten am östlichen Ende eines hydrographischen Schnitts auf 75°N bei 15°50'E mit CTD-Messungen begannen. Durch jährliche Wiederholungsmessungen der Wassermasseneigenschaften sollen langfristige Veränderungen bei der Erneuerung der Tiefen- und Bodenwassermassen der Grönlandsee aufgedeckt werden. Die hydrographischen Daten haben gezeigt, dass die Temperaturzunahme im Bodenwasser um etwa 0,01K pro Jahr, die in den letzten Jahren beobachtet worden war, anhält. Im Gegensatz zu den früheren Jahren wurden drei Schlote mit homogener Vertikalverteilung von Temperatur und Salzgehalt bis auf 2300 m Tiefe angetroffen, die einen Einfluss auf den Verlauf der tiefen Konvektion im kommenden Winter haben können. Zur Erfassung der Bedingungen im Winter waren im vergangenen Jahr in der zentralen Grönlandsee 2 Verankerungen mit vertikalprofilierenden Messgeräten ausgelegt worden, die aufgenommen und zusammen mit einer dritten Verankerung neu ausgelegt wurden. Die Geräte haben während des gesamten Verankerungszeitraums in zweitägigem Abstand Temperatur- und Salzgehaltsprofile geliefert.

Verbunden mit den CTD-Messungen wurden Wasserproben für die planktologischen Arbeiten genommen. Die Untersuchungen umfassten die Verteilung des Phytoplanktons in Abhängigkeit von Wassermassen und Meereis. Dazu wurden Wasserproben zur Bestimmung der Artenverteilung und summarischer Parameter wie Konzentration von partikulärem Kohlenstoff und Stickstoff, biogenem Silikat und Chlorophyll a genommen. Um die Artenzusammensetzung der Mikrozooplankton-Gemeinschaft und ihre Bedeutung für die trophischen Verknüpfungen im aquatischen Nahrungsnetz abzuschätzen, wurden während der Reise 7 Experimente mit Wasserproben ausgeführt. Nach der Rückkehr ins AWI werden auf der Grundlage von eingefrorenen Filtern die Abundanz der Bakterien und anhand fixierter Wasserproben die Abundanz von Protisten und Algen vor und nach der Inkubation des Experimentsdurchlaufes bestimmt. Aus den gewonnen Daten lässt sich der Fraßdruck einzelner Gruppen der Mikrozooplankton-Gemeinschaft unter in-situ Bedingungen ermitteln und somit ihre Bedeutung im Kohlenstofffluss nachweisen. Zur Untersuchung der oberen Glieder der Nahrungskette wurden immer dann Seevögel, Wale, Delphine, Robben und Eisbären gezählt, wenn das Schiff nicht auf Station lag.

Am Kontinentalabhang von Ostgrönland bei etwa 74°30'N wurde im Rahmen des BMBF-Verbundprojektes ARKTIEF 2 ein Rinnensystem untersucht, um dessen Auswirkung auf die Wassermassenmodifikation, die Sedimentation und die Lebensbedingungen in der Tiefsee zu beurteilen. Transporte in Rinnen können energiereiche

Ströme in ansonsten ruhigen Regionen hervorrufen, die einen deutlichen Einfluss auf die Umweltbedingungen in der Tiefsee haben können. Die Rinne war bereits im vergangenen Jahr bearbeitet worden. Deshalb konnten wir auf Vorkenntnissen aufbauen und das Untersuchungsgebiet erweitern. Wiederholungsmessungen sollen Aufschluss über die zeitliche Veränderungen geben. Als Grundlage erfolgte die Aufnahme der Bodentopographie mit Hydrosweep. Allerdings erlaubten die Eisbedingungen nur eingeschränkt, den Verlauf der Rinne vom Kontinentalhang in die Tiefsee zu verfolgen. Daher konzentrierten sich die Arbeiten auf den Hangfuß und die Ausläufer in die Tiefsee. Allerdings deuten die Daten darauf hin, dass die Rinne nicht am oberen Hang sondern erst am Fuß beginnt. Mit einer Breite von wenigen Kilometern und einer Sprungtiefe von 50 bis 100 m, führt sie in Schlangenlinien über etwa 200 km in das Grönlandbecken. Dabei nehmen Eintiefung und Breite deutlich ab. Mit Multicorer, Großkastengreifer und Schwerelot wurden Proben innerhalb und außerhalb der Rinne gewonnen, um die Entstehung und die vorherrschenden Sedimentationsprozesse aufklären zu können. Die internen Strukturen des Rinnensystems wurden mit dem Echolot Parasound kontinuierlich aufgezeichnet. Das geschleppte Kamera-System OFOS (Ocean Floor Observation System) lieferte Fotos auf Querschnitten über die Rinne und von Vergleichsgebieten außerhalb der Rinne. Zur Beprobung der Rinnenfauna wurden zwei Hols mit dem Agassiz-Trawl sowie Multicorer-Probennahmen zur Bestimmung von Abundanz, Biomasse und Aktivität kleiner benthischer Organismen (Bakterien bis Meiofauna) ausgeführt. Mit diesen Daten sollen die Verteilungsmuster der benthischen Organismen in und um die Rinne erfasst werden, um die Bedeutung von benthischen Prozessen in Rinnen für das Ökosystem der arktischen Tiefsee beurteilen zu können. Benthische Verteilungsmuster, Aktivitäts- und Biomassendaten sollen Aufschluss geben, ob die Rinnen heute "aktive" oder "passive" Abflusssysteme darstellen. Messungen mit der CTD, die beim Fieren und Hieven über die Rinne geschleppt wurde, sollen dazu dienen, den potentiellen Beitrag von Strömungen in der Rinne zur Erneuerung der Wassermassen in der arktischen Tiefsee zu ermitteln. Ferner soll gezeigt werden, ob diese Strömungen die Ursache von sogenannten benthischen Stürmen sein können. Es hat sich allerdings herausgestellt, dass Verankerungen, mit denen von 1993 bis 1995 benthische Stürme gemessen wurden, 5 sm nördlich der Rinne lagen. Die Trübung des Wassers in der Rinne wich nicht wesentlich vom Hintergrund ab. Daraus lässt sich schließen, dass zumindest während des Messzeitraums keine Strömung vorhanden war, die zu erhöhter Suspension geführt hat. Weitere Aufschlüsse werden von den Daten aus verankerten Geräten erwartet, die wegen der Eisverhältnisse erst im September aufgenommen werden.

Nach Abschluss der Arbeiten vor Ostgrönland dampfte POLARSTERN in die Framstraße. Im Arbeitsgebiet „Hausgarten" wurden die Ursachen und Effekte physikalischer, chemischer und biologischer Gradienten in der Tiefsee untersucht, um die Dynamik benthischer Bakteriengemeinschaften und ihren Einfluss auf kleinskalige Heterogenitätsmuster sowie zwischenjährliche Variabilität in arktischen Tiefseesedimenten zu verstehen. Dazu wurden am Hang des Molloy Deep zwischen 1700 und 5500 m Tiefe Bodenproben mit dem Multicorer genommen. Sie werden zu molekulargenetischen Untersuchungen zur Ermittlung kleinskaliger Heterogenitätsmuster an Populationen von Tiefsee-Nematoden verwendet. Mit dem Einsatz eines freifallenden, mit Kamera, Scanning Sonar und beköderten Reusen bestückten Landers wurde die Fähigkeit von Amphipoden ermittelt, auf Nahrungsangebote, sogenannte "food falls" zu reagieren, die natürliche Störungen am Boden der Tiefsee darstellen.

Der vertikale Partikelfluss im Hausgarten wurde mit verankerten Sinkstofffallen gemessen, die aufgenommen und wieder neu ausgelegt wurden.

Als letztes Teilprogramm folgten CTD-Messungen in der Framstraße. Sie dienen dazu, im Zusammenhang mit Verankerungsmessungen, den Austausch von Wassermassen zwischen dem Europäischen Nordmeer und dem Nordpolarmeer zu bestimmen. In internationaler Kooperation mit dem Norsk Polar Institutt und der Universität Hamburg wird ein Feld von 14 Verankerungen aufrecht erhalten, das die Messung von Volumen-, Salz- und Wärmetransporten erlaubt. Drei dieser Verankerungen wurden ausgetauscht, um Bodendruckmesser auszubringen. Damit soll festgestellt werden, ob die Bodendruckfluktuationen nach ausreichender Kalibrierung als Maß für Transportschwankungen herangezogen werden können. Dann wäre es möglich, die Anzahl der Verankerungen nach einer ausreichenden Erprobungsphase zu verringern. Da die Verankerungen verhältnismäßig große Abstände haben und die Messgeräte nur mit eingeschränkter Genauigkeit messen, wurde zur hochauflösenden und genaueren Aufnahme der Verteilung von Temperatur und Salzgehalt ein zonaler Schnitt von der Küste Spitzbergens bis auf den ostgrönländischen Schelf ausgeführt. Mit einem weiteren Schnitt, der von der Nordwestecke Spitzbergens über den Rand des Sofia Deeps zum Meridian von Greenwich und dort bis auf 75°15' N führte, wurde die Aufspaltung des Atlantischen Wassers des Westspitzbergenstroms in drei Äste erfasst. Der erste führt entlang der Nordküste Spitzbergens, der zweite westlich des Yermakplateaus und der dritte speist die Rezirkulation südlich und innerhalb der Framstraße.

Durch die günstigen Wetterbedingungen konnten die Arbeiten während der ganzen Reise zügig abgewickelt werden. Dadurch stand mehr Stationszeit als erwartet zur Verfügung. Anhaltende äußerst ruhige Wetterlagen hatten zur Folge, dass nur während weniger Stunden Winde der Stärke 7 gemessen wurden. Allerdings war das ruhige Wetter mit häufigem Nebel verbunden, der zeitweise die Aufnahme von Verankerungen und des Landers sowie die Fahrt im Eis behinderte. Die Meereisverteilung entsprach der frühen Sommersituation mit Eiskonzentration von 7 bis 9/10 im Ostgrönlandstrom, allerdings mit einer deutlich abnehmenden Tendenz.

Auf dieser Reise begleitete uns der Maler Gerhard Rießbeck, dem es darum ging, den Gegenstand unserer Forschung, das eisbedeckte Nordmeer, aus seiner Sicht darzustellen. Er fertigte auf der Reise 41 Entwürfe und 500 Fotos an, die später dann die Vorlage zu Gemälden in Öl auf Holz bieten werden.

Die wissenschaftlichen Arbeiten wurden am 27. Juli beendet. Auf der Rückreise erhielten wir Kenntnis, dass ein Lander, den wir für die Dauer eines Jahres in der Framstraße verankert hatten, vorzeitig aufgetaucht war. Da wir bereits zu weit vom Arbeitsgebiet entfernt waren, nahmen wir die Unterstützung des Norsk Polar Institutts in Anspruch, um den an der Oberfläche treibenden Lander zügig aufzunehmen, was umgehend durch die norwegische Küstenwache erfolgte. Für diese unbürokratische Form der internationaler Zusammenarbeit sind wir überaus dankbar. POLARSTERN lief dem Plan gemäß am 29. Juli 2001 in Tromsø ein.

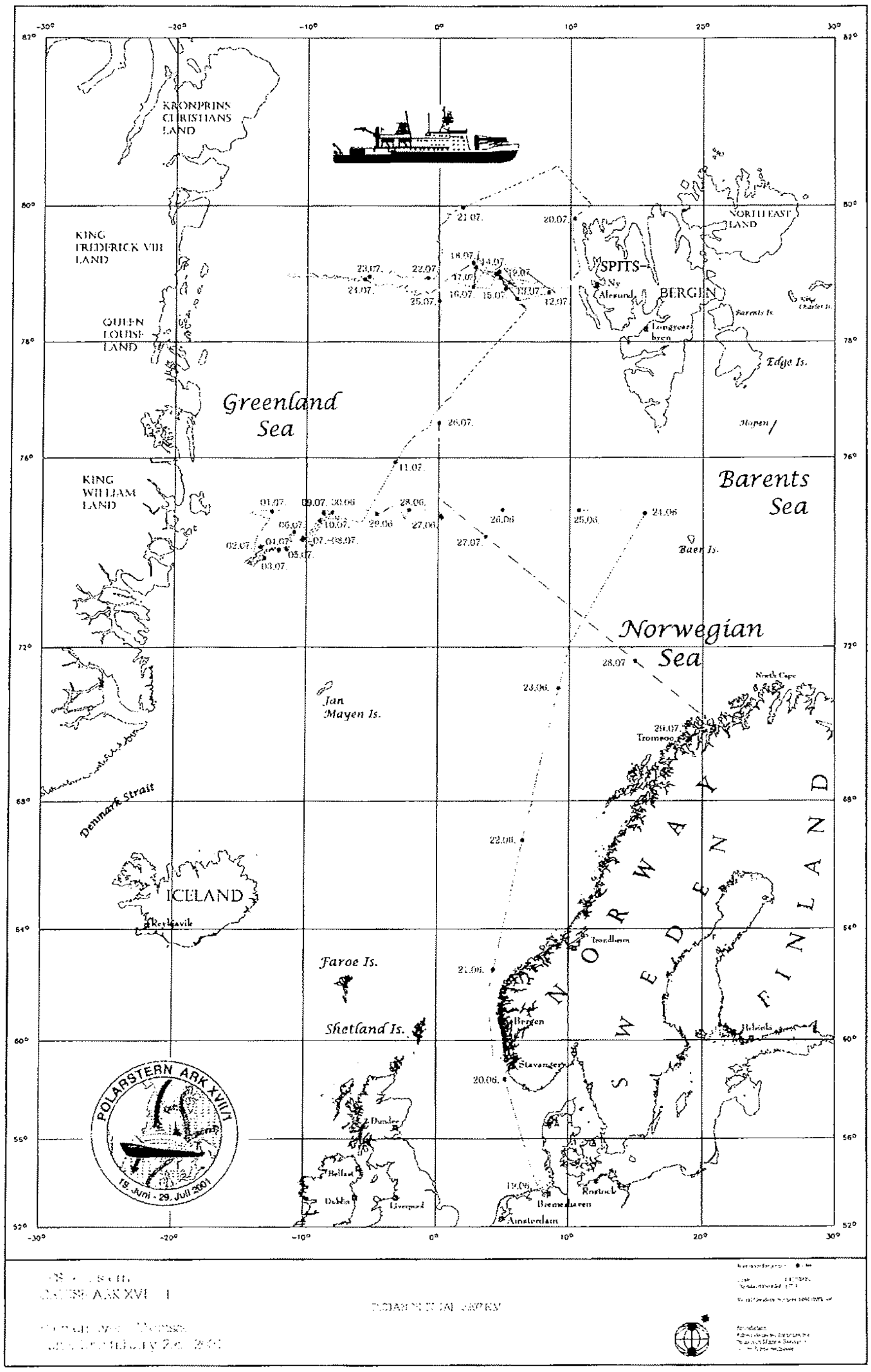


Abb. 1: Fahrtroute der POLARSTERN während der Forschungsreise ARK XVII/1.
Fig. 1: Cruise track of POLARSTERN during cruise ARK XVII/1.

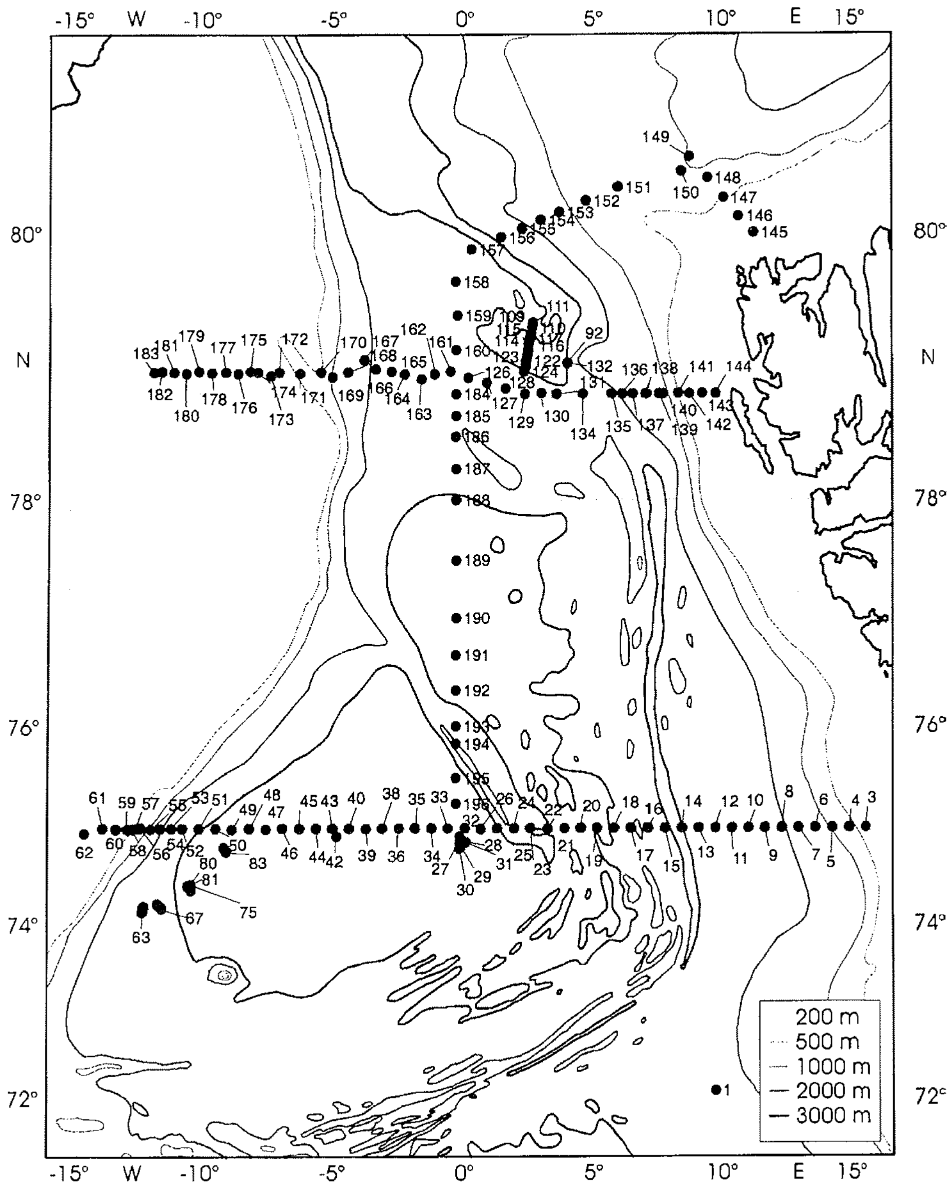


Abb. 2: CTD-Stationen, die während der POLARSTERN-Forschungsreise ARK XVII/1 ausgeführt wurden.
Fig. 2: CTD stations which were obtained during POLARSTERN cruise ARK XVII/1.

2. ITINERARY AND SUMMARY
E. Fahrbach

POLARSTERN left Bremerhaven on 19 June 2001 for the cruise ARKXVII/1 in the Nordic Seas. On board were 43 crew members and 34 cruise participants. The cruise lasted 41 days. During this time we travelled 5 307 nm to investigate the physical, chemical, biological and geological conditions at several regional and disciplinary foci in the Nordic Seas (Fig. 1). To measure the water mass distribution 189 CTD stations (Conductivity, Temperature, Depth) were obtained (Fig. 2).

POLARSTERN steamed on direct way to the eastern end at 15°50'E of a CTD transect along 75°N across the Greenland Sea. The annually repeated hydrographic observations along the transect are used to investigate the long period variability of the formation of deep and bottom water. The data from this year show that the temperature increase of 0.01 K per year, which was derived from data obtained during cruises in previous years, kept on. In contrast to previous years three eddy-like structures with homogenous temperature and salinity down to 2300 m were observed. They might serve as a preconditioning to a new phase of deep open ocean convection in the Greenland Sea. Two moorings with profiling instruments were recovered in the central Greenland Sea and three new moorings were deployed. The profilers had worked successfully for the whole deployment period.

Water samples from CTD stations were used to obtain the distribution and variability of phytoplankton species composition, biomass (chlorophyll a), particulate organic carbon and nitrogen and biogenic silica to understand the relation to sea ice cover and water column stability. The related vertical particle flux serves as food supply to the benthos. Furthermore water samples were used for experiments to study the role of the microzooplankton community for trophic interactions within the aquatic food web. Quantitative estimates of the at-sea distribution of seabirds and marine mammals were carried out from the bridge while the ship was moving.

On the East Greenland continental slope at approximately 74°30'N multidisciplinary investigations were carried out in the framework of the BMBF project ARKTIEF 2 to investigate the role of deep-sea channels for water mass formation, sedimentation and living conditions of benthos. The channel flow might stimulate energetic currents in otherwise quiet regions that might have a considerable impact on the deep-sea environment. The first phase of the project started in summer 2000. Based on these results, we extended the study area. Measurements were repeated to assess long term variability. A basic requirement for the investigations are high-quality bathymetric data obtained from Hydrosweep surveys. However, ice conditions did not allow to track the channel far up the slope. Consequently our work concentrated on the foot of the continental slope and the deep sea. Preliminary results, however, indicate that this channel originates on the continental foot. The channel is a few kilometres wide and 50 to 100 m deep. It was captured over 200 km from the foot into the deep sea. On its way, it becomes narrower and less deep. With multicorer, giant box corer and piston corer samples were taken in the channel and the adjacent deep sea to study the long-term development and the sedimentation processes. The internal structure of the channel system was studied by Parasound echosounder. The Ocean Floor Observation System (OFOS) was towed across the channel and along two transects at the adjacent deep-sea floor. Samples of benthic organisms were taken with two hauls with the Agassiz trawl and by means of the multicorer. The latter will be used to analyse abundance, biomass and activity of small benthic biota (bacteria to meiofauna). The data allow to determine the distribution patterns of benthic organisms in and around channel systems in order to estimate the relevance of benthic processes within the channels for the Arctic Ocean ecosystem. Based on activity and biomass data, it might be possible to determine whether a channel system is "active" or "fossil". To identify strong currents light attenuation in the water column was measured with a CTD towed across the channel while hoisted and lowered. The measured water mass properties, in particular the attenuation, showed weak indications to follow the channel profile. However, the signal is too weak to be indicative for intensive currents. On the other hand such weak signals have to be treated with special care when the data are still in a rather raw status and time variability might disguise the effect.

Causes and effects of physical, chemical and biological gradients in the deep sea were studied in Fram Strait on the eastern slope of Molloy Deep in water depth between 1700 m and 5500 m. The area includes a long-term station (AWI-"Hausgarten" at 79°04'N 4°10'E in 2500 m water depth), and was already sampled in summer 2000 to detect interannual variability in the benthos. Samples with the multicorer were taken to investigate the dynamics of benthic bacterial communities and their impact on small-scale heterogeneity patterns of Arctic deep-sea sediments. Molecular genetics will be applied as a tool to understand small-scale heterogeneity in populations of Arctic deep-sea nematodes. Of particular interest are food falls that represent natural disturbances at the seafloor of the deep sea. They were simulated and observed by 6 deployments of a lander that was equipped with bait fish, cameras and a scanning sonar system to take slides from the approaching amphipods and catch them in traps. Studies of phytoplankton ecology and related biogeochemical parameters occurred with water samples in the vicinity of a mooring with sediment traps which was replaced. The work aims to understand the seasonality as well as the interannual differences of phytoplankton distribution patterns and the vertical particle flux.

Fram Strait represents the only deep connection between the Arctic Ocean and the Nordic Seas. Just as the freshwater transport from the Arctic Ocean is thought to be of major influence on water mass formation in the Nordic Seas, the transport of warm and saline Atlantic water significantly affects the water mass characteristics in the Arctic Ocean. The inflow from the Arctic Ocean into the Nordic Seas influences the formation of water masses which are advected through Denmark Strait to the south and participate in the formation of the North Atlantic Deep Water. To determine the fluxes through Fram Strait a hydrographic section approximately along 79°N was repeated and 14 moorings are maintained. Three of them were exchanged to install bottom pressure recorders. It is expected that variations of the horizontal bottom pressure differences will yield sufficient information to derive transport fluctuations after careful calibration. The CTD survey was extended to capture the recirculation of the Atlantic Water flow in and south of Fram Strait by a section along the Greenwich Meridian and the spreading of the two branches east and west of Yermak Plateau.

Favourable weather conditions with only a few hours of winds with force 7 facilitated the work. However, the calm weather was connected to frequent fog which at times obstructed mooring or lander work as well as proceeding in ice. The sea ice conditions corresponded to the expected early summer situation with significant ice concentrations between 7 and 9/10 in the East Greenland Current with a strongly decreasing tendency.

One of the cruise participants was Gerhard Rießbeck, a painter. He intended to display the subject of our research, the ice covered ocean, through his view. For this purpose, he produced 41 sketches and 500 slides which are the basis of later paintings in oil on wood.

The station work ended on 27 July on the Greenwich Meridian at 75°N. On our way to Tromsø, we obtained the message that a lander which we had deployed in Fram Strait to be moored there for a year, had returned to the surface prematurely. It was too late to return to the position and we had to ask the Norwegian Polar Institute for assistance. In a very unbureaucratic way with no delay the Norwegian Coast Guard recovered the lander successfully for which we are very grateful.

POLARSTERN reached Tromsø on 29 July 2001 where the cruise ended.

3. WEATHER CONDITIONS
K. Buldt, H.-J. Möller

After leaving Bremerhaven the first part of the voyage in the North Sea was influenced by the frontal system of a low pressure field in the southern part of the Norwegian Sea with rain and visibility below 5 km for a time. Near the southern shores of Norway the southerly wind increased up to 6 Bft. Moving south-east the low pressure system crossed the course of POLARSTERN in the morning of the 21 June. Pressure rise at its backside built up a high pressure zone reaching from Barents Sea to western Europe which determined the weather for the rest of the transit. While sunshine prevailed at first, low clouds and fog came up later.

In the research area along 75°N high pressure influence prevailed until end of June. Dense fog or low stratus clouds covered the Nordic Seas for long time. The high pressure extended from north-eastern Canada to the Greenland Sea. It was flanked by a sequence of low pressure systems extending from Kara Sea via northern Scandinavia and the Northeast Atlantic to Newfoundland. In consequence of this pressure distribution only light and variable winds blew near the eastern coast of Greenland since 26 June.

At the end of the month, the center of high pressure moved to east and pressure fell at Greenland's coast. A flat low pressure trough merged with a low south-west of Iceland and another one near the North Pole. The wind shifted south-west to south and increased up to 6 Bft. Some days later, the Iceland low moved to the Norwegian Sea and the pressure gradient weakened. The wind abated at 3 July. While low stratus and fog dominated before, now sunshine and weak frost set in.

A new low pressure system formed near Cap Farvel and moved to Denmark Strait. Then it joined a low pressure trough extending from the Pole to East Greenland. With southerly wind humid air came up and dense fog dominated for longer periods. In the morning of 7 July the low pressure trough crossed our course eastward. Then, wind direction changed to north-west and a dry airflow caused good visibility.

In connection with pressure rise over Greenland and pressure fall near the Norwegian coast the northerly winds reached to 5 and 6 Bft for a time and occasionally snow was observed.

After the 10 July, a gale centre moved over the Norwegian Sea north-eastward. Its frontal system crossed Fram Strait at 14 July and the visibility rose up to more than 100 km rapidly.

At the middle of the month a large high pressure system developed over the Nordic Seas. Only weak winds mainly from north set in. The visibility changed from fog to 100 km or more within a few minutes. This conditions persisted until 22 July when the main wind direction changed to south, because the axis of high pressure crossed POLARSTERN. Pressure fall over the coast of East Greenland built up a strong gradient at the western and central part of the Fram Strait and the wind increased up to 7 Bft for a short time at 23 July.

At the end of the voyage the subpolar high moved to northeast followed by a North Atlantic low. In consequence the wind changed to easterly directions. Later on the wind veered to southwest because a high pressure system build up over Skandinavia.

Characteristics of weather conditions are summarized in Figs. 3 to 6.

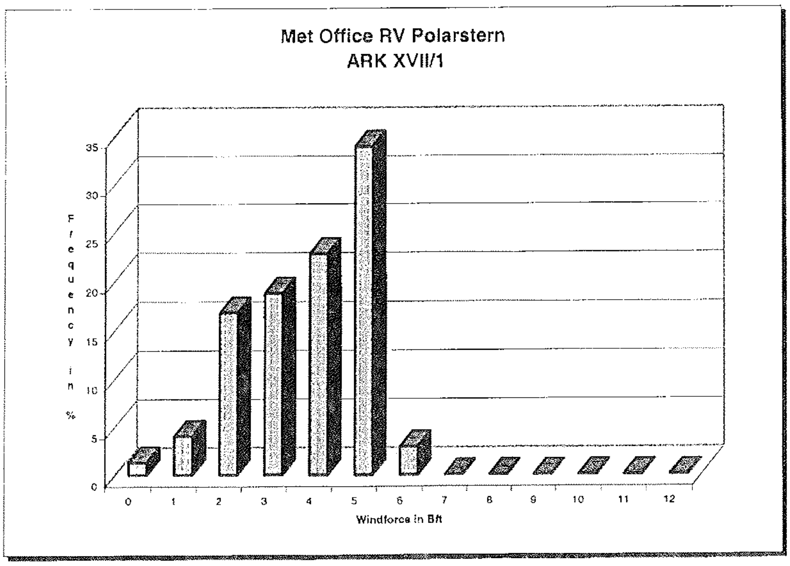


Fig. 3: Frequency distribution of windforce during ARK XVII/1.
Abb. 3: Häufigkeitsverteilung der Windstärke während ARK XVII/1.

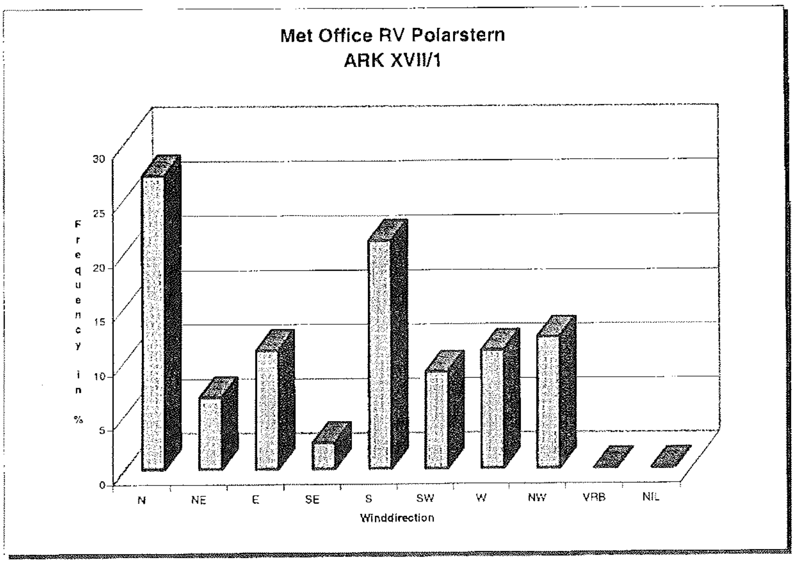


Fig. 4: Frequency distribution of wind direction during ARK XVII/1.
Abb. 4: Häufigkeitsverteilung der Windrichtung während ARK XVII/1.

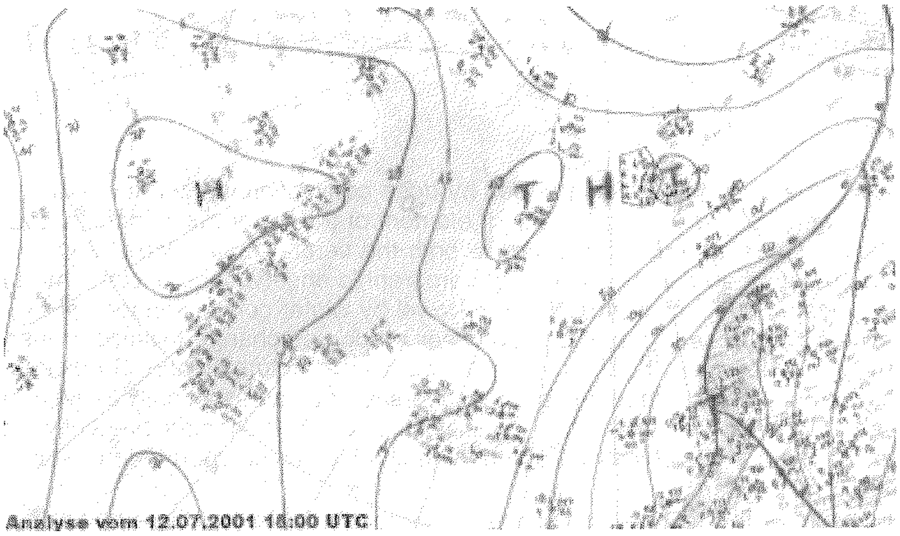


Fig. 5: Weather chart displaying conditions typical for ARK XVII/1.
Abb. 5: Wetterkarte mit für ARK XVII/1 typischen Wetterbedingungen.

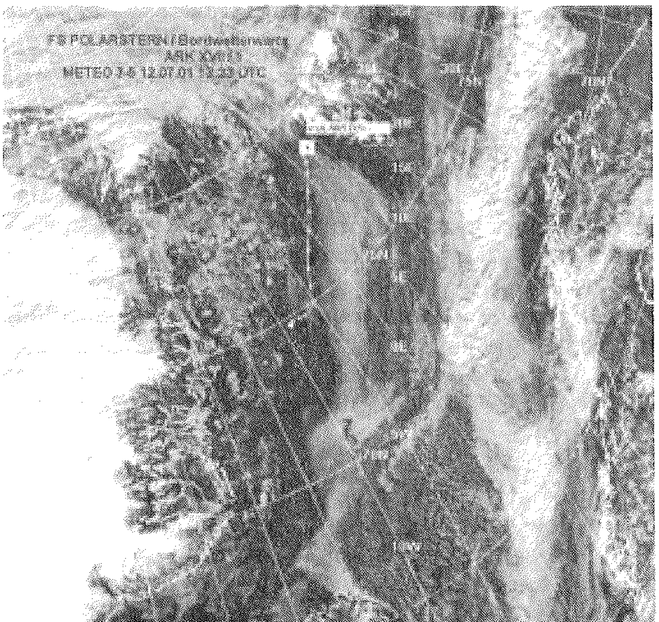


Fig. 6: Sea ice conditions typical for ARK XVII/1.
Abb. 6: Meereisverteilung während der für ARK XVII/1.

4. HYDROGRAPHIC CONDITIONS IN THE GREENLAND SEA

G. Budéus, V. Lüer, I. Meyer-Holste, S. Müller, B. Plüger, R. Plugge, S. Ronski

Objectives

Bottom water renewal in the Greenland Sea by deep convection in interplay with ice coverage and atmospheric forcing is a major element of the water mass modification in the Arctic Mediterranean. Effects influence both the central Arctic Ocean and the overflow waters into the Atlantic. Since the hydrographic observations became more frequent in the late 1980s, no bottom water renewal by winter convection took place, however. Under these conditions, the deep water properties change towards higher temperatures and salinities. Furthermore, the doming structure in the Greenland Gyre, as it was observed in the mid-80s, was superseded by an essentially 2-layered water mass distribution with a marked density step which is located presently at about 1500 m. The specific objectives of the project, which is incorporated in the EU funded CONVECTION, are

- to investigate the relative importance of atmospheric forcing parameters for winter convection,
- to clarify whether ice coverage inhibits or facilitates deep convection,
- to build a long term observational basis about deep water changes in the Greenland Gyre, and
- to contribute to the decision which deep water exchange mechanisms are at work under the absence of deep winter convection.

Work at sea

In the central Greenland Sea, a long term zonal CTD transect at 75°N has been performed with a regular station spacing of 10 nautical miles (Fig. 2 and 7). This distance has not been reduced at frontal zones in order to gain time for a couple of stations dedicated to the investigation of an convective eddy which had been detected earlier and had been marked with an APEX float to facilitate its identification.

Two in house developed EP/CC (externally powered/compressibility compensated) Jojo moorings have been exchanged during splendid weather conditions. One additional Jojo mooring has been deployed according to the EU contract of the project CONVECTION. Deployments and recoveries revealed no problems and all equipment worked faultlessly.

This is also true for the CTD work. It is not possible to describe the full details of calibration and data procedures here. A few hints may suffice to give an idea about the general procedure. We use the same sensors already for a number of years and checked for their performance with respect to unwanted cross dependencies. According to this, one of the temperature sensors shows a pressure sensitivity of roughly 1.5 mK/4000 dbar while no pressure or temperature dependence of the conductivity sensors could be found. To identify the latter is close to impossible in the field (within the polar oceans) because of the high gradients in the upper water column where temperature differences occur. The locations of in-situ comparisons have been chosen carefully by checking for each data point whether a comparison is allowed or inadmissible. As there is no suitable location in Fram Strait except the deep waters of Molloy Deep, the opportunity for an in-situ comparison there has been used. Duplicate sensors have been utilized throughout, with varying positions on the CTD. Time alignment has been optimised for each flow path separately (stations 54 and 75) and will be applied together with final post cruise calibration. The difference between pre-cruise and post-cruise calibration is normally in the range of a few mK and a few 1/1000 in salinity. Bottle sample salinities of triple samples are determined as a rough check on board, in the lab on land, and by Ocean Scientific.

In addition to the standard parameters, the following properties have also been measured: Chlorophyll fluorescence (Haardt), oxygen (SBE43, first test), and transmission (Seatech, 30 cm).

Preliminary results

The most outstanding single feature of the survey in the Greenland Sea was certainly the convective eddy, which was revisited for the second time after its detection in early spring. This feature represents the deepest convection level observed in recent years. It was found close to the Greenwich Meridian a few miles south of 75°N. The homogeneous water column extended to about 2300 dbar, with the ubiquitous temperature maximum (found usually at medium depth levels of some 1500 to 1700 m) displaced downwards to 2700 m. The feature has been covered with five stations which showed that at present the APEX drifter is not located exactly in the centre of the eddy. The eddy contains water which is denser than the surrounding at low pressure levels (about 600 m), but considerably less dense at higher pressures. This indicates that the water within the eddy is not likely to replace bottom water. There are indications that the eddy may not have been formed during the last winter but before and that its lifetime exceeds one year.

A second eddy with a similar structure was observed during on the regular transect at about 2°W. The temperature maximum was located at a slightly smaller depth level (2200 dbar). No attempt has been made to investigate its horizontal extent or identify its centre. The nearby Jojo mooring at 2°30' W captured the passing of such a structure which belongs presumably to the same eddy. The mooring data show that the vertical extent of the homogenized water column exceeds greatly the actual winter ventilation depth in mid winter.

The conditions within the two eddies differ from those in the surrounding waters where winter convection did not penetrate through the temperature maximum and is confined mostly to about 1000 m. Since the water properties in 2000 and 2001 are very similar, the Jojo moorings serve as the best indicators for winter ventilation depth. A generally valid estimate the depth level of the temperature maximum is not possible because of the distortions of the isotherms induced by the eddies. In the mid gyre a depth level of roughly 1700 dbar is observed. However it is beyond any doubt, that the warming of the bottom waters, observed during the last years, continued with at usual rate of about 10 mK/year. The temperatures in the bottom waters increased e.g. from -1.145°C (potential temperature) in 2000 to -1.131°C in 2001 at 1°W. Consequently, the isotherm of e.g. -1.10°C is found at a greater depth in 2001 than in 2000 (3250 m and 3100 m respectively) in the central basin.

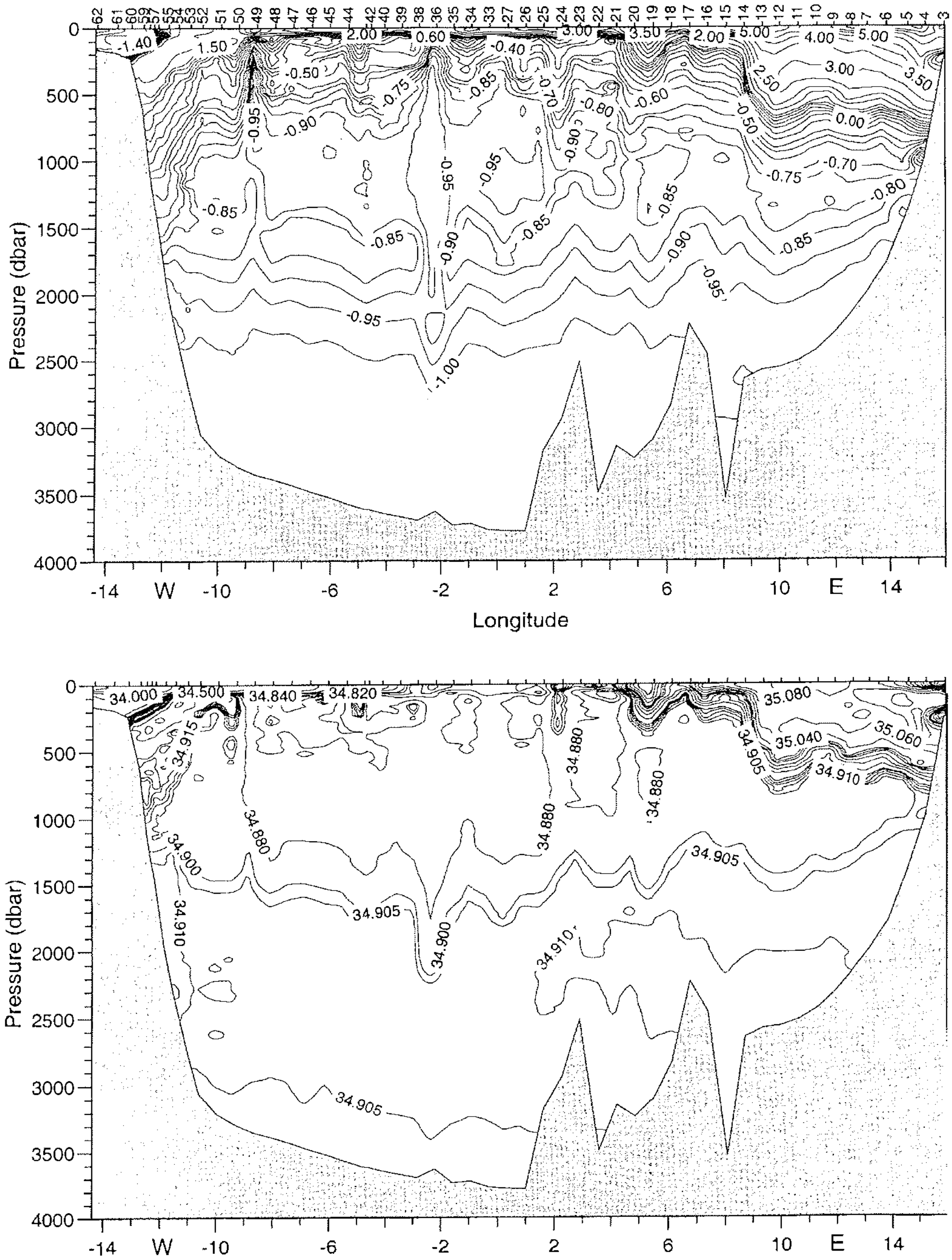


Fig. 7: Transect of potential temperature and salinity across the Greenland Sea along 75°00'N. For location see Fig. 2.

Abb. 7: Vertikalschnitt der potentiellen Temperatur und des Salzgehalts durch die Grönlandsee auf 75°00'N. Zur Lage des Schnitts, siehe Abb. 2.

5. PROCESSES IN CHANNEL SYSTEMS IN THE WESTERN GREENLAND SEA

5.1 Structure and geological processes

A. Aahke, C. Hohmann, C. Kierdorf, J. Matthiessen, J. Vernaleken

Objectives

In the frame work of the multi-disciplinary research programme ARKTIEF sedimentation processes are studied on geological time-scales (± 1000-2000 years) in a channel system at the East Greenland continental margin. The geological programme aims at

(1) characterizing the larger scale subsurface structure of the channel and the adjacent areas,
(2) mapping the various sedimentary facies, and
(3) sampling surface and near surface sediments for a detailed study of various sedimentological, organic geochemical and micropaleontological tracers which may reflect the various sedimentation processes, in particular gravitative mass transports. Additionally, the history of sediment transport in the channel will be elucidated by analysing sediment cores. These studies will contribute to a better understanding of the recent and past activity of the channel system.

Work at Sea

Bathymetrical survey

The swath sounding system HYDROSWEEP was used during expedition ARK XVII/1 for a bathymetric survey in the study area of ARKTIEF at the East Greenland continental margin. Based on the results of the survey during expedition ARK XVI/1 in 2000 (Krause and Schauer 2001), the adjacent lower continental slope and deep-sea areas were visited to continue the detailed mapping of the course of the channel. Furthermore, selected transects were conducted in the central portion of the system that was studied in 2000 to fill gaps in the bathymetric chart of this area.

Sediment echosouding

The ship-mounted PARASOUND echosounding system of POLARSTERN was in operation during the work in the Greenland Sea in order to characterize the acoustic behaviour of the uppermost sediment layers. The PARASOUND transects were conducted partly perpendicular to the axis of the channel in order to identify lateral variability of sedimentary facies. Furthermore, PARASOUND profiling was used to select coring locations and transects for the OFOS surveys. The data were digitised by two different systems:

(1) the PARASOUND system for simultaneous printing on a chart recorder (Atlas Deso 25), and
(2) by the PARADIGM system (Spiess 1992). For details of the method and standard settings used during the expedition see e.g. Niessen & Whittington (1994).

Bottom sediment sampling
Surface and near-surface sediments were collected in the study area on transects across the channel to sample the various sedimentary environments. A more detailed sampling was done along the OFOS transects in collaboration with the biology group. In order to get undisturbed surface and near-surface sediments, the giant box corer (GKG) with a size of 50x50x60 cm and the multi corer (MUC) with a tube diameter of 10 cm were used. The sampling was routinely done by MUC because of the better recovery of sediment surfaces. Gravity corers (SL) were used to obtain long sediment cores from the channel, the adjacent levees and the deep sea.

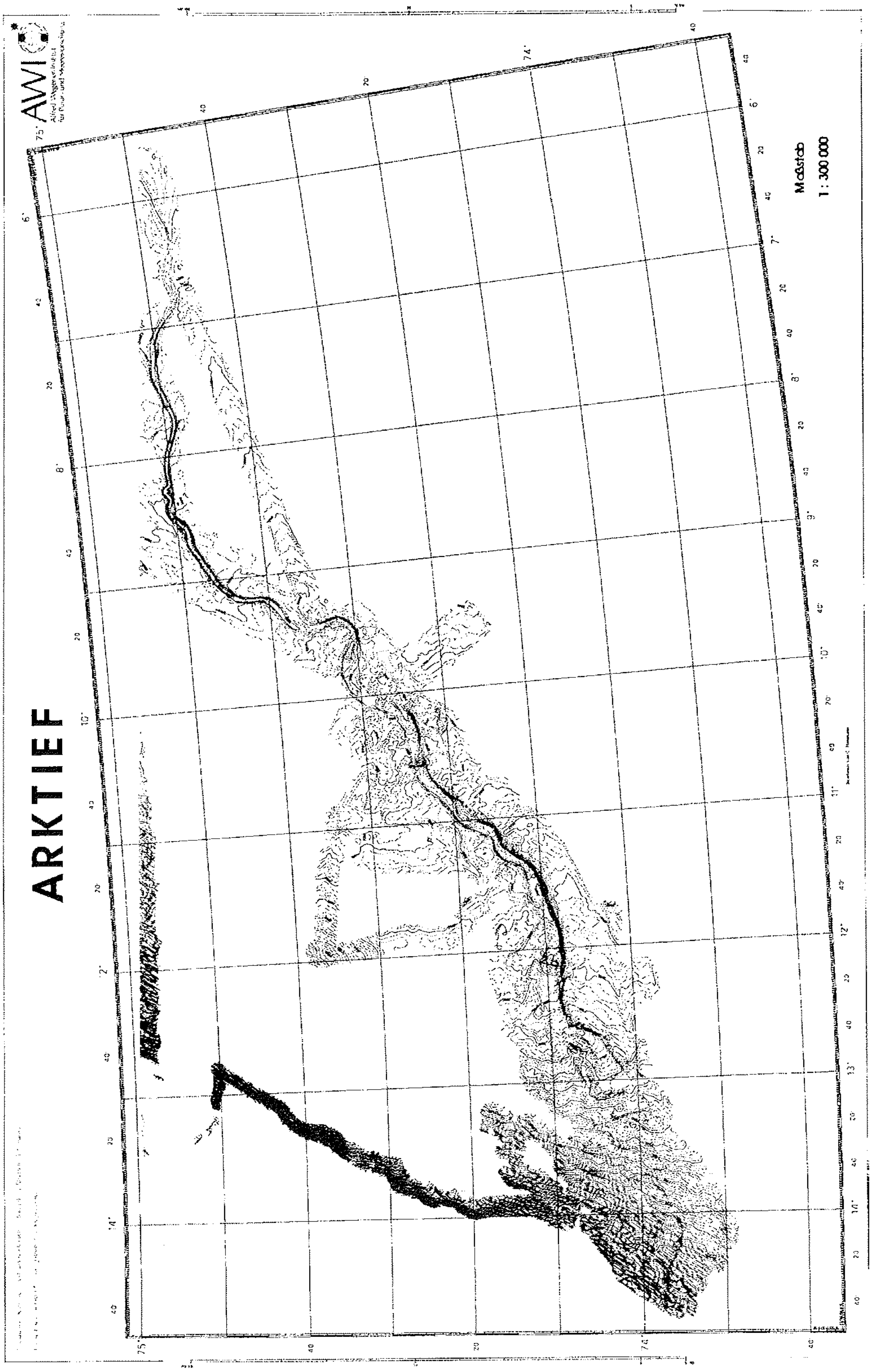
Preliminary Results

Bathymetry of the channel system
A large-scale mapping with the GLORIA long-range side-scan sonar revealed the general pattern of a system with three major channels in the western Greenland Basin (Mienert et al. 1993; Hollender 1996) but only single separate segments of the channel system that were selected for detailed studies in the ARKTIEF project could be mapped. The preliminary results of our bathymetric surveys in 2000 (Krause and Schauer 2001) and in 2001 show that a single channel meanders from the lower continental slope to the abyssal plain over a distance of about 200 km (Fig. 8). The channel was tracked back from the Greenland Basin in ca. 3500 m water depth at ca. 74°45'N and 6°30'W to the continental rise at ca. 74°N and 13°15'W in about 2600 m water depth. Although the severe ice conditions during ARK XVII/1 hampered the survey at the continental slope, the few profiles suggest that there is not a single distinct channel extending upslope. Smaller tributary channels may be found running down slope but further detailed processing of the data is needed to allow a definite interpretation. Along the entire course, this channel system is developed as a single channel that is clearly separated from the other channel systems. East of 6° 30'W distributary channels may have developed as indicated by the GLORIA data (Hollender 1996) but due to time constraints, the transition from the channel to the depositional area could only be studied along a single line when POLARSTERN left the area of operations to Fram Strait. Any larger depositional regions in the distal parts of the channel have not been observed.

Morphology of the channel system
The acoustic penetration was on the average down to a sediment depth of 25 to 40 m, except in the channel bottom and in the continental slope where penetration was usually less than 5 m. The channel system can be tentatively divided into 4 morphological divisions based on morphological and acoustic characteristics.

The upper channel system extends from the continental slope to about 12°W (Fig. 8). The structure of the channel is less distinct than in the middle and lower channel system. A levee extends along the southern margin of the channel but it is almost

Fig. 8: Preliminary bathymetric map of the channel at the East Greenland margin based on HDROSWEEP data obtained during expeditions ARK XVI/1 and ARK XVII/1. Depth contours are at 10 m intervals (Processing of data by C. Hohmann).
Abb. 8: Vorläufige bathymetrische Karte der untersuchten Rinne am ostgrönländischen Kontinentalhang, basierend auf den während der Expeditionen ARK XVI/1 und ARK XVII/1 erhobenen HYDROSWEEP-Daten. Abstand der Tiefenlinien ist 10 m (Datenprozessierung durch C. Hohmann).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indistinct at the northern margin. On the lower continental slope at the westernmost end of the mapped area, the channel is becoming much wider (ca. 10 km), probably ending at a slide headwall. Shallow depressions upslope (<10 m) of the possible headwall may indicate that tributary channels may originate on the upper continental slope. Although the acoustic penetration is low on the continental slope, debris flow deposits are clearly identified in most profiles.

The middle channel system consists of a leveed channel extending from the continental foot to about 9°30´W. Levees are usually well developed at both flanks, the southern one being consistently higher than the northern one giving the channel an asymmetric shape. Some levees stand out clearly by more than 20 m from the adjacent deep-sea plain. The U-shaped channel is incised into the sea floor up to 100 m, but mainly less than 50 m, and is relatively narrow with an average width of ca. 2000 m. The levee deposits usually show a number of distinct parallel acoustic reflectors whereas only one prominent reflector is seen in the channel sections. The channel bottom is relatively even.

The lower channel system is characterized by a symmetric to asymmetric V-shape and the absence of prominent levees. Single cross sections are about 600 to 1000 m wide and the channel is incised up to 50-70 m (max. 150 m) into the sea-floor. The channel floor is relatively rough. Apparently, the channel shallows east of 7°W being in general less than 30-50 m deep and having again a symmetric U-shape. The channel floor is more even than west of 7°W. These observations are only based on few oblique profiles across the channel and these interpretations must be considered as rather tentative. Further HYDROSWEEP and PARASOUND surveys are required because only one relatively narrow stripe of ca. 5000 m width was mapped along the channel.

In the Greenland Basin east of ca. 6°35´W PARASOUND profiles show that the channel widens considerably terminating possibly in larger depositional lobes that have been interpreted from the GLORIA profiles (Hollender 1996). Single lens-shaped bodies with a transparent internal structure comparable to debris flows are possibly indicating sediment deposition related to transport in the channel system. However, further studies in this area are needed to reveal morphological details of this deep-sea depositional environment.

Sedimentary environment along the channel system

Bottom sediment sampling was conducted along the whole channel focussing on the central part of the system. The initial macroscopic analysis of the surface sediments suggests that the composition of sediments in the channel, the adjacent levees and the deep-sea areas is similar. The lack of erosional surfaces and the comparable sediment composition along the course of the channel suggest continuous recent and sub-recent deposition. Only short sediment cores were recovered from the channel floor. Gravity cores did not penetrate into the acoustic transparent layer below the top reflector. The core recovery was usually less than 100 cm indicating that only a thin cover with soft (Holocene?) sediments overlies bedrock. Longer sediment cores were only retrieved from the adjacent levees and the deep sea. Further detailed land-based sedimentological, geochemical and micropaleontological studies as well as analysis of the HYDROSWEEP and PARASOUND records are required to evaluate the variability of sediments in the study area with respect to sedimentation and transport processes.

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5.2 Benthic distribution patterns and turn-over processes

S. Brückner, M. Dickmann, C. Hasemann, K. v. Juterzenka, T. Renneberg, I. Schewe, T. Schott, N. Queric

Objectives

Objectives of the planned biological and biochemical investigations within the ARKTIEF project are to assess large-scale distribution patterns of benthic organisms in and around channel systems crossing the eastern Greenland continental margin and the deep central Greenland Sea, and to estimate benthic processes within these areas and their relevance for the Arctic Ocean ecosystem. Based on activity and biomass data it might be possible to estimate the frequency and intensity of particle-loaded near-bottom currents within the channels, and to evaluate the quality of the suspended matter. The combination of results from optical surveys assessing distribution patterns of the larger epibenthic fauna with activity and biomass data for small sediment-inhabiting organisms from biochemical analyses will help to determine whether a channel system is "active" or "fossile".

Work at Sea

Small benthic organisms

We hypothesize that the distribution as well as the activity of small benthic organisms are corresponding to the topographic and biochemical features of channel systems in terms of depth and distance to the channel centre. Benthic microbial processes are suspected to be directly connected to the occurrence of meio- and macrofaunal organisms.

Sampling was performed by using a multicorer sampling system, allowing the investigation of an undisturbed sediment surface. A total of 11 stations were sampled in the vicinity of the channel system. Subsamples for abundance, diversity and activity of bacteria and meiofauna, as well as the biogenic sediment compostion were taken using 5 ml and 20 ml syringes with cut off ends (see also section 9). Subsamples were sectioned horizontally in 1 cm-layers and analysed separately to investigate gradients within the sediment column. Bacterial production was measured via labelled leucine incorporation. Sediment-bound chloroplastic pigment equivalents (CPE) were determined on board to quantify organic matter input from primary production. To evaluate microbial exoenzymatic activities, esterase turn over rates were determined with the fluorogenic substrate fluorescein-di-acetate (FDA). Analyses of phospolipids and proteins will contribute to the assessment of living organisms and the proportion of detrital organic matter in the sediments. To assess the presence of traces, tracks and other "Lebenspuren" of macrofauna, a photo of each core surface was taken before sampling.

Mega-/Epifauna

The Mega-/Epifauna in the vicinity of the channel system was observed by means of the Ocean Floor Observation System (OFOS), which is suitable for seafloor imaging in water depth down to 6000 m. The OFOS frame is equipped with a still camera (Benthos), a black and white video camera (Deep-Sea Power & Light), two floodlights with 250 W each, flashes (600 W/s) and three laser pointers in a fixed distance of 52 cm from each other as a size reference. The still camera was triggered on command or timer-controlled in 30 s intervals and was loaded with Kodak Ectachrome 100 ASA film, providing up to 800 shots per track. The whole system was towed across the seafloor in a distance of approx. 1.50 m with a drift velocity of approx. 0.5 kn. The distance to the bottom has to be controlled by the winch operator, by adjusting the cable length according to the video information. To sample the epibenthic fauna and obtain reference material for the analysis of OFOS images, a small Agassiz trawl (width 1 m) had been used.

During the cruise, 7 OFOS transects have been performed. At St. 04, a first survey was made at the continental slope off Bear Island and was used to optimise the distance to the seafloor, camera specifications and timer-controlled operation and check laser performance. Overall, six transects were obtained in the main investigation area off East Greenland and will provide approx. 3050 colour slides of the sea floor. Four transects were placed across the ARKTIEF channel according to HYDROSWEEP information and PARASOUND profiles (St. 65, 69, 78, 84). St. 78 represents a profile at the central section of the channel which had been studied in 1999 by the ROV VICTOR6000 and in 2001 by the OFOS system and therefore allows an evaluation of interannual variability. To get an idea about the colonization of the deep-sea floor outside the channel, two transects were placed north and south of the central area (St. 73, 82; see Fig. 9). In the course of the transects, multicorer samples were taken inside and outside the channel to analyse small biota.

Transects across the channel covered at least the bottom of the channel, slope and the adjacent seafloor (water depth about 3000 – 3200 m; transect length 1 to 2 nm). A first impression of the benthos fauna in the vicinity of the channel system is given by video information and short pieces of photo film, which were developed on board for quality control reasons. Seafloor images revealed two species of elpidiid holothurians, crinoids, traces and calcareous test of the irregular echinoid *Pourtalesia jeffreysi*, actinaria, gastropods and small pantopods as well as a variety of traces and tracks. Some ball-shaped sediment-coloured and bright structures are thought to represent several species of deep-sea sponges (e.g., *Thenea abyssorum)*. Small pieces of solid substrate (e.g dropstones) are colonized by anthozoans (Fig. 10).

Two trawl catches along the channel axis provided material of dominant epibenthic organisms (mainly elpidiid holothurians, at least three species of deep-sea sponges, pycnogonids). Image analysis and species determination will take place at the home institute.

The results of quantitative and qualitative evaluation of bacteria, meiofauna and epi-/megafaunal organisms will contribute to the knowledge on the habitat heterogenity, distribution patterns, as well as biomass and activity patterns of benthos communities in this channel system, which had become the focus of interest in 1999.

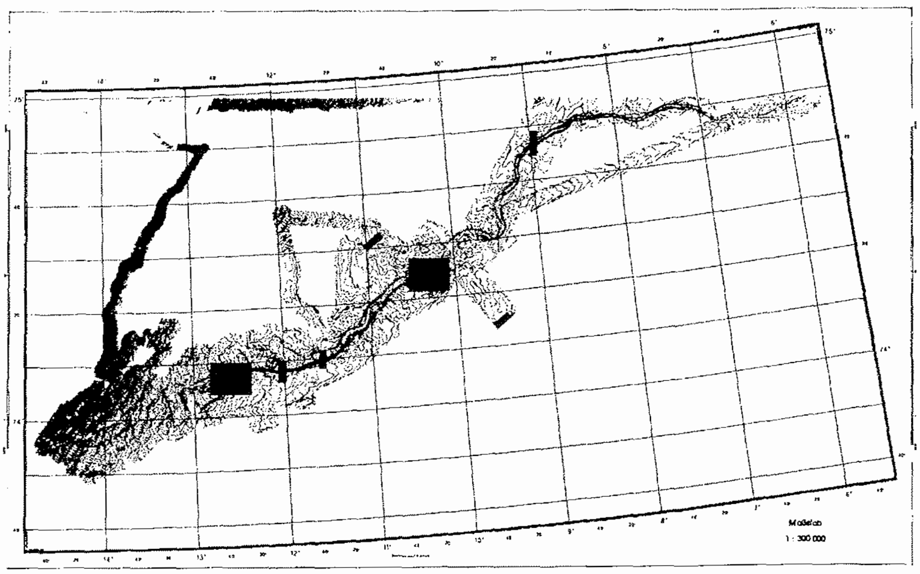


Fig. 9: Location of the sections in the ARKTIEF area where samples were taken and OFOS was deployed.
Abb. 9: Lage der Schnitte im ARKTIEF-Gebiet, auf denen Proben genommen und OFOS-Aufnahmen ausgeführt wurden.

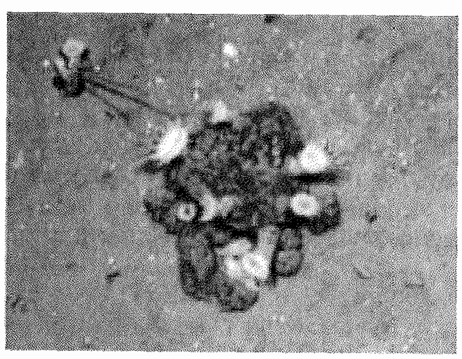


Fig. 10: Sea floor images taken with OFOS which show that solid substrate (e.g. drop stones) is colonized by anthozoans.
Abb. 10: Fotografische Aufnahmen mit OFOS, die zeigen, dass Hartsubstrate wie „drop stones" mit Anthozoen besiedelt sind.

5.3 Physical Processes

G. Budéus, E. Fahrbach, V. Lüer, I. Meyer-Holste, S. Müller, B. Plüger, R. Plugge, S. Ronski

Objectives

The aims of the ARKTIEF 2 project are to estimate the contribution of various processes to the modification of deep water masses in the Arctic, to understand the dynamics of these processes, and to assess their effect on the conditions for marine life. The acquired data and results should serve to improve the basis of physical and ecological modelling.

In the past, water mass modification in the Greenland Sea took place mainly through deep-reaching convection, which is presently absent. However, the changes presently observed in the deep and bottom waters of the Greenland Sea indicate that other processes play a role in deep water modification. Shelf drainage via channels that extend down the continental slope of east Greenland into the deep sea is a potential process of deep water formation. Currents trapped in narrow channels could stimulate energetic flows in otherwise quiet regions, which has considerable impact on the sedimentation and living conditions in the deep sea.

Work at sea

To measure bottom current events three moorings are presently deployed in the ARKTIEF channel and will be replaced by LANCE in autumn 2001. During the present cruise oblique CTD-profiles with an attenuation sensor were measured across the channel to detect, if an elevated load of suspended matter would indicate enhanced currents (Figs 2 and 11). To obtain sufficient horizontal resolution the CTD was towed with 1 kn when hoisted and lowered within 500 m from the bottom. By this procedure the foot points of the profiles are 600 m apart and the profiles were in an angle of 35° to the vertical. Due to the wire angle the CTD was about 2 km behind the ship.

Preliminary results

The measurements with the CTD towed across the channel while hoisted and lowered should provide information if the water mass properties reflect the flow conditions in the channel. It is of interest if currents in the channel transport water masses from shallower depths into the deep sea and if the flow in the channel could be the origin of benthic storms. Those current events were observed with moored instruments from 1993 to 1995. It appeared that the moorings in that time had been deployed 5 km north of the channel since it was not yet known. The water mass properties measured with the towed CTD, in particular the attenuation, showed weak indications to follow the channel bottom profile (Fig. 11). However the signal is too weak to be indicative for intensive currents. On the other hand such weak signals have to be treated with special care when the data are still in a rather raw status and time variability might disguise the effect.

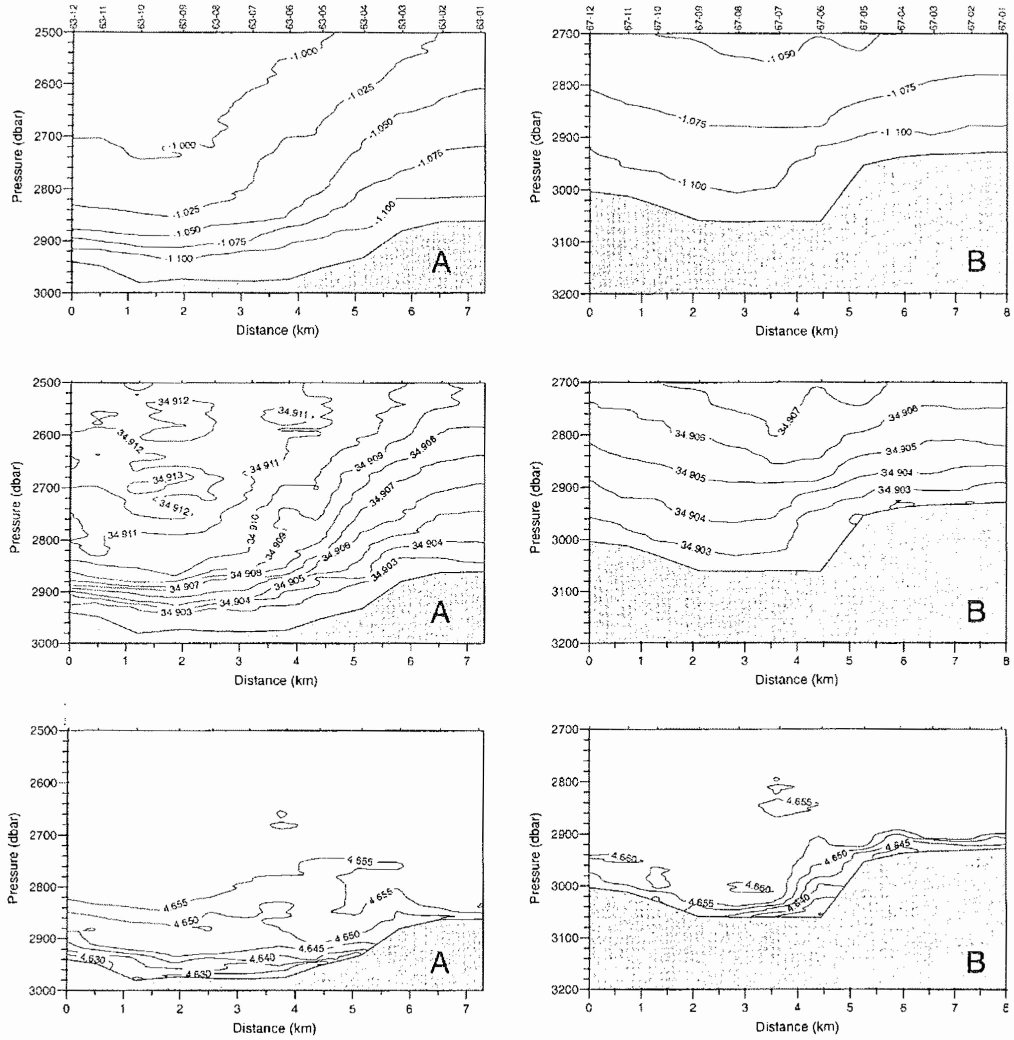


Fig. 11a: Transect of potential temperature, salinity and attenuation across the ARKTIEF channel obtained by towing the CTD when hoisted and lowered within 500 m from the bottom. A channel west 1 St. 63, B channel west 2 St. 67.

Abb. 11a: Vertikalschnitt der potentiellen Temperatur, des Salzgehalts und der Licht-Attenuation quer zur ARKTIEF-Rinne, gemessen in den unteren 500 m der Wassersäule mit einem beim Hieven und Fieren geschleppten CTD. A Rinne West 1 St. 63, B Rinne West 2 St. 67.

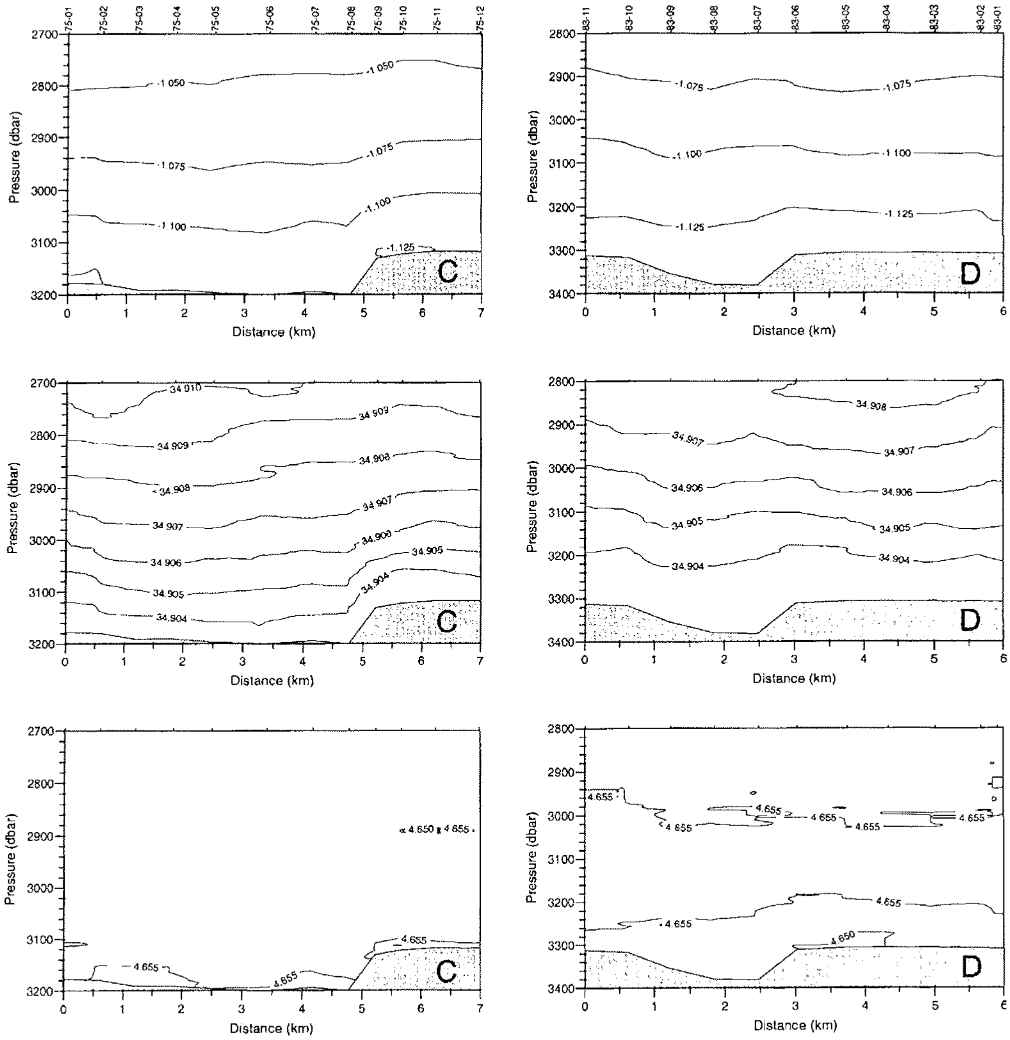


Fig. 11b: Transect of potential temperature, salinity and attenuation across the ARK-TIEF channel obtained by towing the CTD when hoisted and lowered within 500 m from the bottom. C central channel St. 75 and D channel east St 84.
Abb. 11b: Vertikalschnitt der potentiellen Temperatur, des Salzgehalts und der Licht-Attenuation quer zur ARKTIEF-Rinne, gemessen in den unteren 500 m der Wassersäule mit einem beim Hieven und Fieren geschleppten CTD. C Rinne Mitte St. 75 und D Rinne Ost St. 84.

6. OBSERVATION OF SEABIRDS AND MARINE MAMMALS

J. Tahon, B. Van Mol, B. Saveyn

Objectives

- To obtain a better knowledge of quantitative distribution of seabirds and marine mammals, based on the presence of different water masses and fronts, determined by water temperature and salinity. Basic aspects are abundance of preys.
- To increase the volume of data, collected by the same team, using the same methodology. In this ARK XVII 1, a total of 25 species of birds was identified, as well as 5 species of whales, 1 of dolphins, 4 of seals and the polar bear.
- To compare the data with earlier results collected in this region since 1974; since 1988 under icy conditions on board of POLARSTERN, METEOR 1985; POLARSTERN 1988 ARK V 1b and V 2, 1990 ARK VII2, 1991 ARK VIII 1 and 2, 1993 ARK IX 2 and 3; DALNIE ZELENTSY (Murmansk) 1991, 1992 and 1993.
- To estimate the importance of followers within the counting. Followers are birds following a vessel for some time. They cause serious problems of counting because they circle around the vessel and are likely to be counted several times. They may sometimes outnumber the valuable counting data by a factor of 100.
  Different categories of followers are to be taken into account:
  a) Birds attracted some moments, from 10 km or more, by the superstructures of POLARSTERN, e.g. *Uria aalge, Uria lomvia, Alle alle, Fratercula arctica, Cepphus grylle.*
  b) Birds staying at one stop station (CTD, multi-boxcorer, ...) and sitting close at sea for ½ hour or more, to feed actively in the turbulences caused by the motors, e.g. *Fulmarus glacialis, Rissa tridactyla,* some skuas, some gulls,... .
  c) Real followers, following during hours, sometimes individually identified, mainly *Fulmarus glacialis* and *Rissa tridactyla.* Also to be taken into consideration are *Morus bassanus, Stercorarius pomarinus, Stercorarius parasiticus, Stercorarius longicaudus, Larus fuscus, Larus argentatus, Larus marinus, Pagophila eburnea,...* .

  The aim on this trip is to produce a basic protocol of general application to evaluate and eliminate the drawbacks caused by these followers.
- Establish broad ecological comparison between European Arctic Seas and the Weddell Sea, Antarctica (POLARSTERN 1988 EPOS I leg 1).

Work at sea

A total of 5308 sea miles were travelled during the 40 days of navigation. For practical purposes, the cruise was divided into 7 legs or periods, totalling 680 counts of 30 minutes.

LEG		PERIOD	COUNTS
1)	The way North From Bremerhaven (53° N) to 75° N, 15° E	19/06-24/06	128
2)	The 75° N transect From 15° E to 15° W across the Greenland Sea	24/06-01/07	110
3)	ARKTIEF 2 Channel System of the Eastern Greenland Sea BOX 75° N – 12° W 75° N – 15° W 73° N – 13° W 73° N – 17° W	01/07-11/07	133
4)	Towards 79° N To Svalbard and Fram Strait	11/07-12/07	51
5)	AWI - Hausgarten BOX 80° N 07° E, 80° N 02° E 79° N 07° E 79° N 02° E	12/07-19/07	96
6)	The 79° N transect a) Towards 80° 30' N along Spitsbergen b) 79°N transect across Fram Strait and back 0°	19/07-22/07 22/07-25/07	71 56
7)	The way back* From 79° N-long.0° Greenwich to Tromsø (70° N)	25/07-28/07	35
Total for the 7 legs		19/06 - 28/07/2001	680 counts

An additional 58 uncompleted counts were discarded for several reasons: sudden dense fog, unpredicted stops of POLARSTERN, fruitfull discussions aboard, e-mail duties,... .

*the writing of the report was stopped at sea before the end of the trip at 75°15'N (27/07 at 05 h). While countings still went on.

Preliminary results

Level of presence per species

A species is present or not in each count. The positive data introduced in a specific list of birds. At the end of the period, a percentage is obtained, relative to the total number of counts of the period. The species is then attributed to one of the 4 categories A, B, C or D, in order to situate the level of presence of that species (see species table).

Species presence

A	> 50%	of the counts of the period:	very common
B	25% - 50%	of the counts of the period:	common
C	5% - 25%	of the counts of the period:	significant
D	< 5%	of the counts of the period:	occasional

For example:
For the first period, the way North, there are two species represented in more than 50% of the counts (categorie A), in 65 counts or more on a total of 128 counts, namely *Fulmarus glacialis* and *Rissa tridactyla*.

Level of presence per species

Period	dates	N of 30' counts	BIRDS A >50	B 25-50	C 5-25	D <5	Total N of species/ period	SEA MAMMALS species whales	dolphins	seals	p. bear
1. The way North	19/06-24/06	128	2	0	6	13	18	4	1	0	0
2. The 75° N transect	24/06-01/07	110	0	2	5	11	18	0	1	4	1
a) no ice	24/06-30/06	(83)	(0)	(2)	(5)	(9)	(16)	(0)	(1)	(4)	(0)
b) ice	30/06-01/07	(27)	(0)	(2)	(4)	(5)	(11)	(0)	(0)	(4)	(1)
3. ARKTIEF 2	01/07-11/07	133	0	2	4	7	13	0	0	4	1
4. Towards 79° N	11/07-12/07	51	0	4	2	3	9	1	1	1	0
5. AWI-Hausgarten	12/07-19/07	96	2	2	3	2	9	3	1	3	0
6. The 79°N transect	19/07-25/07	127	0	3	4	8	15	2	0	3	1
a) Towards 80°30'N	19/07-22/07	(71)	(3)	(3)	(1)	(5)	(12)	(2)	(0)	(3)	(1)
b) 79°N transect	22/07-2507	(56)	(0)	(0)	(5)	(5)	(10)	(2)	(0)	(2)	(1)
7. The way back	25/07-27/07	35	2	2	2	0	6	0	0	2	0
Total	40 days	680					25	5	1	4	1
							Total N of species				

All bird species are listed in the next table, devoted to a specific presentation for the 7 periods.

Comment: Few species are very common (categorie A) during one single period.
Birds belonging to categories B and C are also relevant (common and significant) for the given period.
Many species are only noted as D (occasional), sometimes during one single period.
They are anecdotic for the study of food webs.

Involved species
List of the 25 observed bird species and frequency during the 7 periods

	PERIODS								
	1	2a no ice	2b ice	3	4	5	6a	6b	7
	NUMBER OF COUNTS								
	128	83	27	133	51	96	71	56	35
PROCELLARIIDAE									
Fulmarus glacialis	A	B	B	B	C	C	B	C	B
Puffinus puffinus	D	-	-	-	-	-	-	-	-
ANATIDAE									
Somateria sp.	-	-	-	-	-		D	-	-
SULIDAE									
Morus bassanus	C	-	-	-	-	-	-	-	-
SCOLOPACIDAE									
Numenius phaeopus	D	-	-	-	-	-	-	-	-
STERCORARIIDAE									
Stercorarius skua	D	D	-	-	-	-	D	-	-
Stercorarius pomarinus	D	C	C	C	D	-	-	D	-
Stercorarius parasiticus	D	D	D	D	D	D	D	-	-
Stercorarius longicaudus	-	-	-	D	-	-	D	D	-
LARIDAE									
Larus ridibundus	-	D	-	-	-	-	-	-	-
Larus canus	D	-	-	-	-	-	-	-	-
Larus argentatus	D	D	-	-	-	-	-	-	-
Larus fuscus	C	D	D	-	-	-	-	-	-
Larus marinus	D	D	-	-	-	-	-	-	-
Rhodostethia rosea	-	-	-	-	-	-	-	D	-
Rissa tridactyla	A	B	B	C	B	A	A	C	B
Larus hyperboreus	D	D	D	C	D	C	C	D	-
Pagophila eburnea	-	-	D	D	-	-	-	C	-
STERNIDAE									
Sterna paradisaea	-	D	-	D	-	-	D	-	-
ALCIDAE									
Alle alle	D	D	C	B	B	B	A	C	A
Fratercula arctica	C	C	-	D	B	B	B	-	C
Cepphus grylle	-	C	-	D	-	C	B	D	C
Uria aalge	D	C	C	D	C	D	-	-	-
Uria lomvia	D	C	C	C	B	A	A	C	A
Alca torda	D	-	-	-	-	-	-	-	-
Number of species	18	18		13	9	9	15		6

*A= present in more than 50% of the counts; B= present in 25 to 50% of the counts;
C= present in 5 to 25 % of the counts; D= present in less than 5% of the counts.

Only 11 species, present as A, B or C, in at least one period, are of real interest in the area for the study of trophic levels and food webs, i.e.: *Fulmarus glacialis, Morus bassanus, Stercorarius pomarinus, Larus fuscus, Rissa tridactyla, Larus hyperboreus, Alle alle, Fratercula arctica, Cepphus grylle, Uria aalge* and *Uria lomvia.*

List of the observed sea mammals

Whales and dolphins are mostly observed in "warm" water masses, free of ice; in contrast seals and polar bears are mainly seen on ice floes, which serve as physical supports.

WHALES (Balaenopteridae)

- *Balaenoptera acutorostrata*

PERIOD	N	POSITION		PERIOD	N	POSITION	
1	1	66° 48' N	06° 27' E	6	1	79° 29' N	10° 13' E
5	1	79° 03' N	04° 25' E	6	3	74° 59' N	02° 03' E
5	1	78° 53' N	05° 18' E	6	1	79° 46' N	00° 14' E

- *Balaenoptera physalus*

PERIOD	N	POSITION		PERIOD	N	POSITION	
1	1	68° 46' N	07° 35' E	5	4	79° 07' N	05° 23' E
1	1	68° 51' N	07° 39' E	5	1	78° 58' N	04° 42' E
4	1	77° 07' N	00° 57' E	5	3	78° 54' N	01° 25' E

- ***Megaptera novaeangliae***

PERIOD	N	POSITION		PERIOD	N	POSITION	
5	1	78° 59' N	04° 40' E	6	1	80° 03' N	02° 47' E

- ***Physeter macrocephalus***

PERIOD	N	POSITION		PERIOD	N	POSITION	
1	1	65° 50' N	05° 56' E	1	1	73° 10' N	12° 03' E
1	1	69° 03' N	07° 47' E				

- ***Orcinus orca***

PERIOD	N	POSITION		PERIOD	N	POSITION	
1	11	66° 53' N	06° 30' E	1	5	72° 08' N	10° 05' E
1	3	71° 15' N	09° 22' E				

DOLPHINS

- *Lagenorhynchus albirostris*

Period 1 = 2 dolphins in 1 count at 74° 22' N – 14° 30' E.
Period 2 = 25 dolphins in 5 counts from 75° 00' N – 14° 46' E to 75° 00' N – 07° 15' E.
Period 4 = 19 dolphins in 2 counts from 77° 58' N – 04° 21' E to 78° 45' N – 08° 15' E.
Period 5 = 6 dolphins in 1 count at 78° 58' N – 04° 42' E.

SEALS

- *Pusa hispida or Phoca hispida*

Period 2: 9 seals in 4 counts from 75° 00' N – 12° 23' W to 74° 57' N – 14° 12'W.
Period 3: 322 seals in 32 counts from 75° 50' N – 13° 03' W to 74° 11' N – 12° 35'W with concentrations of 16,21,29,21,16,15,27,54,34 and 23 *Pusa hispida*.
Period 6: 2 seals in 2 counts at 79° 53' N – 00° 46' E and 79° 00 N – 02° 20' W.

- *Erignathus barbatus*

Period 2: 1 seal in 1 count at 74° 58' N – 08° 08' W in a group of *P. groenlandicus*.
Period 3: 3 seals in 3 counts from 73° 58' N – 13° 56' W to 74° 12' N – 12° 19' W.
Period 4: probably some 60 bearded seals in concentrations of *Pagophilus groenlandicus* (see *P.gr.*).
Period 5: 2 seals in 2 counts at 79° 04' N – 03° 37' E and at 78° 58' N – 00° 38' E.
Period 7: 1 seal in 1 count at 78° 32' N – 00° 01 E.

- *Pagophilus groenlandicus or Phoca groenlandica*

Period 2: 293 seals in 8 counts from 74° 49' N – 00° 10' E to 75° 00' N – 14° 00' W with concentrations of 83 and 200 *Pagophilus groenlandicus*.

Period 3: 146 seals in 6 counts from 73° 56' N – 14° 45' W to 74° 24' N – 09° 44' W
with a concentration of 140 *Pagophilus groenlandicus.*

Period 4: 4170 seals in 3 counts from 75° 52' N – 03° 21' W to 76° 29' N – 01° 15' W
with concentrations of 200, 2400 and 1570 *Pagophilus groenlandicus*.
Each time lying on a succession of +/- 10 middle sized ice-floes. The two main groups at respectively 75° 57' N – 03° 11' W and 76° 29' N – 01° 15' W.

Period 5: 17 seals in 9 counts from 78° 00' N – 07° 00' W to 78° 58' N – 02° 48' E.

Period 6: 31 seals in 13 counts along the 79° N from 10° 40' E to 01° 55 W and back.

Period 7: 354 seals in 3 counts with a concentration of 350 probably *Pagophilus groenlandicus* at 77° 42' N – 00° 01' E.

- *Cystophora cristata*

Period 2: some 10 seals in 1 count at 74° 58' N – 08° 08' W in a group of *Pagophilus groenlandicus*.

Period 3: 5 seals in 4 counts from 74° 06' N – 13° 47' W to 74° 11' N – 12° 19' W.

Period 4: probably some 60 hooded seals in a concentration of *Pagophilus groenlandicus* (see *P.gr.*).

Period 5: 1 seal in 1 count at 78° 58' N – 00° 38 E.

Period 6: 2 seals in 2 counts at 79° 52' N – 00° 38' E and 79° 18' N – 00°03' W

POLAR BEAR (*Ursus maritimus)*

10 polar bears from 73° 58' N – 14° 10 W to 75° 00' N – 13° 50' W.

Period 2	3	1 female with 2 young	at 75° 00' N – 13° 29' W
	1	second year	at 75° 00' N – 13° 50' W
Period 3	1	eating at carcass	at 74° 05' N – 14° 11' W
	1	middle sized one	at 73° 58' N – 14° 25' W
	1	-	at 74° 11' N – 13° 48' W
	2	1 female with 1 young	at 74° 14' N – 13° 41' W
	1	a big one	at 73° 58' N – 14° 10' W
This is an important concentration of 10 polar bears at rather low latitude.			
Period 6	1	bloodily eating	at 80° 00' N – 00° 58' E
	1	-	at 78° 58' N – 05° 50' W

Preliminary results

- Almost all *Fulmarus glacialis* individuals, at 79° N, belong to the dark form of the *Fulmarus glacialis* species. They are scarcely distributed in the area, being a little bit more numerous above ice floes than at sea.
- As a family, *Laridae* are "southern" birds. *Rissa tridactyla* and sometimes *Larus hyperboreus* are the ones to be seen at 79° N.
- At 79° N, *Rissa tridactyla* is regularly present, most of the birds being adult individuals, probably breeding. Non-adult birds are found more to the south.
- During periods 1 to 4, *Stercorarius pomarinus* was exceptionally frequent, from an ornithological point of view. It could mean that such a continental nesting bird stayed longer in the North Eastern Atlantic waters. Along the coast of Norway, migration normally occurs at the end of April and during May. That land species nests throughout northern Siberian, during May, mostly eating small rodents. Lemmings constitute a major part of their diet. Supposed absence of lemmings this year could have turned pomarine skuas to piracy at sea.
- *Alcidae* is the best represented family in the North Eastern Atlantic and Arctic waters, namely with *Uria lomvia* (3.10^6 breeding pairs), *Fratercula arctica* (3.10^6 b.p.) and *Alle alle* ($1,5.10^6$ b.p.) For these three species, Spitsbergen, Eastern Greenland, Iceland and Norway are major haunts. Very high numbers

of "crossers" coming from or going to colonies. (POLARSTERN was less than 10 km from Spitsbergen).

The first two are fish eaters. The diet of the third is zooplankton. All of them play an important role in the trophic chains of the North Eastern Atlantic and Arctic seas.

- *Cepphus grylle* is known to be a very coastal bird. Presence far at sea has been frequently observed. Nevertheless these observations are mostly involving 1st summer individuals, therefore not in charge of breeding duties.
- As huge sea mammals that play a considerable role in trophic webs, whales were evidently to be involved in the counts. In agreement with literature concerning weight, 1 *Physeter macrocephalus* (sperm whale, Pottwal) (30 tons) is equivalent to 200.000 *Alle alle* (Little Auk, Krabbentaucher) (150 g). To no surprise they were mostly present in the "warm" waters of the West Spitsbergen Current, and were represented by 43 animals belonging to 5 species.
- Living in family pods, *Lagenorhynchus albirostris,* small cetaceans of 200 kg, were observed mainly in West Spitsbergen Current, West of the Barents Sea, with a total of 52 individuals. Dolphins are very active fish eaters. They are easily observed from the vessel and in some way their importance is often overestimated.
- Large concentrations of *Pagophilus groenlandicus* (4170 individuals in 3 groups) were observed between 75° 52' N – 03° 21' W and 76° 29' N – 01° 15' W. With a mean weight of about 100 kg, these fish eaters represent a very important web in the food chain.
- Polar bears are super predators, standing at the top of the trophic chain, like man. The study of the behaviour of the mythic "Micha" is therefore of prime interest. A total of 10 *Ursus maritimus* (polar bears) were encountered in a relatively restricted area (between 75° 00' N – 13° 50' W and 73° 58' N – 14° 25' W), which is unusually south for that species. Reasons for that are to be discussed later (global increasing population? change in environmental conditions? prey occasionally concentrated more to the south? south eastern Greenland population? (See also Polar Bear studies, ARK IX 2 and 3, pp. 116-125).
- Many warm-blooded animals (whales, dolphins, seals, walruses, etc.), just like cold-blooded ones (fish...) do not occupy large areas at random. They are concentrated in clusters where the food is accessible or where they nest (*Alcidae* on ice floes and cliffs) or where they moult (Anatidae). To be instantly ready to identify them at sea is a question of good knowledge of systematics and habits, but above all it requires an aggressive determination to perform long-term counting.

Followers

Because followers cause serious problems while counting, we tried to make an estimation of their impact.

Therefore the number of birds of a species during a normal count (N) is compared with the number of followers of that species after the counting (N') and after 1 hour on CTD-station (N"). These data registered with or without ice and with or without fog are entered separately in the table. This has been done during the 75°N and the 79°

N transects. The following tables show the results for *Fulmaris glacialis* and *Rissa tridactyla*, the two most frequent followers.

Fulmarus glacialis — 75° N transect — 22 counts

	NO ICE				ICE				GLOBAL	
	NO FOG		FOG		NO FOG		FOG			
	A	r	A	r	A	r	A	r	A	R
N	2/10	0,20	0/4	0,00	3/7	0,71	0/1 *	0,00 *	5/22	**0,32**
N'	5/7	4,86	1/1*	4,00*	1/2 *	2,50*	0/1*	0,00*	7/11	**3,91**
N"	10/10	54,50	4/4	38,00	7/7	24,43	0/1*	0,00*	21/22	**39,45**

A = X/C = Number of counts where the species is present/ total number of counts
r = N/C = Number of birds counted/ total number of counts

N: number of birds counted during a count
N': flying followers (counted at the end of a count)
N": sitting followers (during CTD-stations), after +/- 1 hour during which POLARSTERN is on stop position.

*: non significant

Fulmarus glacialis — 79° N transect — 16 counts

	NO ICE				ICE				GLOBAL	
	NO FOG		FOG		NO FOG		FOG			
	A	r	A	r	A	r	A	r	A	r
N	1/5	0,40	0/2*	0,00*	4/9	0,78	0/0*	0,00*	5/16	**0,57**
N'	4/4	2,25	0/2*	0,00*	6/7	6,29	0/0*	0,00*	10/13	**4,08**
N"	4/5	7,40	1/2*	2,00*	8/9	11,56	0/0*	0,00*	13/16	**9,06**

Rissa tridactyla: — 75°N transect: — 22 counts

	NO ICE				ICE				GLOBAL	
	NO FOG		FOG		NO FOG		FOG			
	A	r	A	r	A	r	A	r	A	r
N	1/10	0,10	0/4	0,00	3/6	0,83	1/1*	4,00 *	5/21	**0,48**
N'	3/7	2,28	1/1*	2,00*	0/2*	0,00*	0/1*	0,00*	4/11	**1,64**
N"	8/10	6,10	0/3*	0,00*	5/7	2,14	0/1*	0,00*	13/21	**3,62**

Rissa tridactyla: — 79° N transect — 16 counts

	NO ICE				ICE				GLOBAL	
	NO FOG		FOG		NO FOG		FOG			
	A	r	A	r	A	r	A	r	A	r
N	3/5	2,0	0/2*	0,00*	3/9	0,56	0/0*	0,00 *	6/16	**0,94**
N'	2/4	0,75	0/2*	0,00*	6/7	13,43	0/0*	0,00*	8/13	**7,46**
N"	2/5	1,60	0/2*	0,00*	5/9	4,89	0/0*	0,00*	7/16	**3,25**

For the *Fulmarus glacialis* there are, at 75° N, 10 times more flying followers (N') and 100 times more sitting followers (N") than on normal counts (N). The data from all species need to be accurately analysed in order to present a protocol involving all followers. In order to better understand the behaviour of the followers, waves and wind are also factors to take into consideration.

7. PHYTOPLANKTON ECOLOGY AND VERTICAL PARTICLE FLUX

O. Haupt, S. Haase

The distribution of phytoplankton and the vertical particle flux were the research interests of the phytoplankton working group during ARK XVII-1. The stability of the water column due to sea ice melting and freezing as well as hydrographic conditions of the different water masses in the Nordic Seas and Fram Strait can be correlated with the occurrence of blooms of different phytoplankton species. Also the annual succession of phytoplankton species can be found in the material that sinks down to the sea floor. In order to understand the seasonality as well as the interannual differences of phytoplankton distribution patterns and vertical particle flux, we have collected samples of phytoplankton and related biogeochemical parameters, and deployed sediment traps.

A total of 29 stations were sampled on a transect along 75°N, in the ARKTIEF investigation area off East Greenland and in the „Hausgarten" area off Svalbard. At 17 stations on the transect we collected only water from 6 depths between the surface and 75 m for the analysis of chlorophyll to get information about the species succession across the Nordic Seas. At 12 stations on the transect and in the other investigation areas we took samples from the surface down to the sea floor with a water sampler rosette (Niskin bottles) to get data on the vertical distribution of nutrients as well as for the chlorophyll, organic carbon and nitrogen and silicate contents of the particulate material of the water column. Samples for microscopic analyses of the plankton community were also taken with the water sampler and a net on selected stations.

We further changed a mooring with two sediment traps and a current meter (Fevi-1 / Fevi-2) at 79° 01,8' N, 04° 20,3' E. The traps were deployed right below the euphotic zone at about 260 m and close to the bottom at about 2310 m.

Only investigations by microscope and chlorophyll measurements could be made on board to get first information about the phytoplankton distribution along the transect at 75°N. The data show that chlorophyll concentrations reaches up to 5 $\mu g\ dm^{-3}$ in the centre of the Greenland Sea gyre. Comparing the eastern and the western part of the transect we found that the chlorophyll maximum sinks down from the surface to a depth of about 30 m close to the shelf of East Greenland. Microscopic investigations show that the phytoplankton was dominated by dinoflagelates in the eastern part of the transect which is typical for a summer situation. However, in the western part diatoms played the leading role and the phytoplankton compositions shows typical characteristics for a spring system. More detailed analyses of nutrients and water masses have to be made in Bremerhaven to get a clear picture of the state of the ecosystems in the Greenland Sea.

The long term mooring Fevi-1 could have been recovered successfully but results are not available yet.

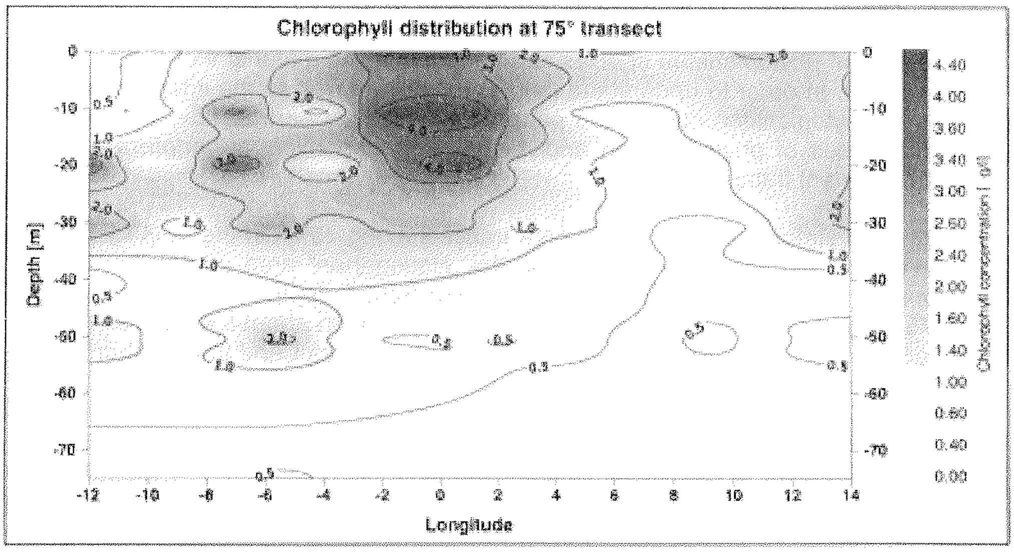


Fig. 12: Chlorophyll distribution at 75°N transect.
Abb. 12: Chlorophyllverteilung auf dem 75°N-Schnitt.

8. THE ROLE OF PROTISTS IN THE FOOD WEB OF THE ARCTIC OCEAN

M. Wengert, S. Zitzmann

Objectives

Despite of intensive investigations of the abundances and seasonality of pelagic protists in the Arctic Ocean, the functioning and the role of protists in this ecosystem is poorly understood. As we know from studies in other aquatic systems the impact of heterotrophic protists to the carbon cycling is large. Furthermore protists are highly species-specific within their trophic relationship. The aim of our investigation is to estimate the role of heterotrophic protists as herbivores (ciliates) and bacterivores (flagellates) in the aquatic food web of the Arctic Ocean.

Work at Sea

We conducted two types of experiments, a "dilution experiment" and a "tracer experiment", to investigate the role of protists in the arctic ecosystem. The "dilution experiment" should show the grazing pressure from heterotrophic protists on algae, hetero- and autotrophic protists. Therefore natural unfractionated seawater was diluted with particle-free seawater in several steps to reduce the encounter probability between predator and prey. The bacterivory is given by the "tracer experiment". Labelled bacteria (fluorescently-labelled, FLB) were offered as food source for heterotrophic protists. The magnitude of bacterivory will be deduced from the difference in the abundance of the tracer between initial to the end samples. Both types of experiments were incubated under in-situ conditions in two seawater through-flow on-deck incubators for 48 h. The two types of experiments were performed seven times with different water masses from 20 to 35 m depth. To investigate the abundance of bacteria and the bacterivory, filters were made and frozen.

Preliminary results

Only test-counting took place on board. It resulted, that the bacterial abundance of natural seawater was between 0,2-0,89 $*10^6$ bacteria/ml. This abundances correlate with bacteria concentrations found in the literature. To estimate the abundance of ciliates and algae fixed water samples are taken. The main evaluation will occur at the AWI and include:

- Determination of abundances of autotrophic and heterotrophic protists and bacteria
- Taxonomic description of the organisms
- Determination of concentration of chlorophyll a
- Determination of concentration of nutrients
- Determination of community growth rates
- Determination of community grazing rates
- Determination of species-specific growth rates
- Determination of species-specific grazing rates
- Direct quantification of bacterivory.

9. DEEP-SEA BIOLOGY

S. Brückner, C. Hasemann, K. v. Juterzenka, K. Premke, N. Queric, I. Schewe, J. Wegner

The aim of this project is to investigate depth related distribution patterns of benthic bacteria and meiofauna. Various biotic parameters are investigated on the background of interannual variability. Sediment samples were taken at a long term depth-transect (1000-5000 m) on the continental margin west off Spitsbergen, crossing the "AWI-Hausgarten" to the Arctic deepest point, the Molloy Deep (Fig. 13).

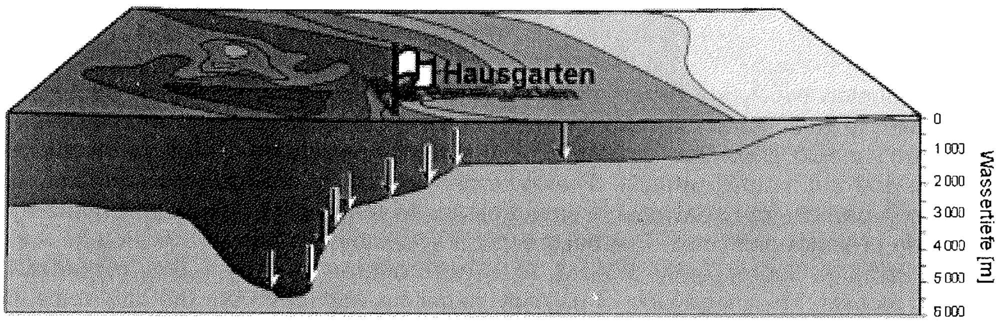


Fig. 13: Schematic representation Molloy Deep and the "Hausgarten" sampling distribution.
Abb. 13: Schematische Darstellung von Molloy Deep und die Verteilung der Probennahme im „Hausgarten".

Sampling was performed using a multicorer sampling system, allowing the investigation of an undisturbed sediment surface. A total of 10 stations were sampled along this transect. Subsamples for faunistic investigations and for biochemical analyses were taken using 1ml, 5 ml and 20 ml syringes with cut off anterior ends. Subsamples were sectioned horizontally in 1 cm-layers and analysed separately to investigate gradients within the sediment column.

9.1 Causes and effects of physical, chemical and biological gradients in the deep sea

The parameters which are suspected to follow a gradient are mainly abundance, diversity and activity of bacteria and meiofauna, as well as the biogenic sediment composition. To evaluate microbial exoenzymatic activities, esterase turn-over rates were determined with the fluorogenic substrates fluorescein-di-acetate (FDA). Sediment-bound chloroplastic pigment equivalents (CPE) also were determined to quantify organic matter input from primary production. Additional sediment samples were preserved for later investigations in the home laboratory - analysis of phospholipids and proteins will contribute to the assessment of the total microbial biomass and the proportion of sediment bound detrital organic matter.

Preliminary results show a distinct depth-gradient for sediment bound plant pigments (Fig. 14) and exoencymatic bacterial activities (Fig. 15). An exception of this gradient are the two stations sampled in the Molloy Deep. In relation to water depth the values for FDA and CPE are increased. A possible explanation for this result might be the special water mass regime above the deep (Fig. 16). A gyre circulation in the deep might keep the products of an increased primary production within the Molloy Deep area.

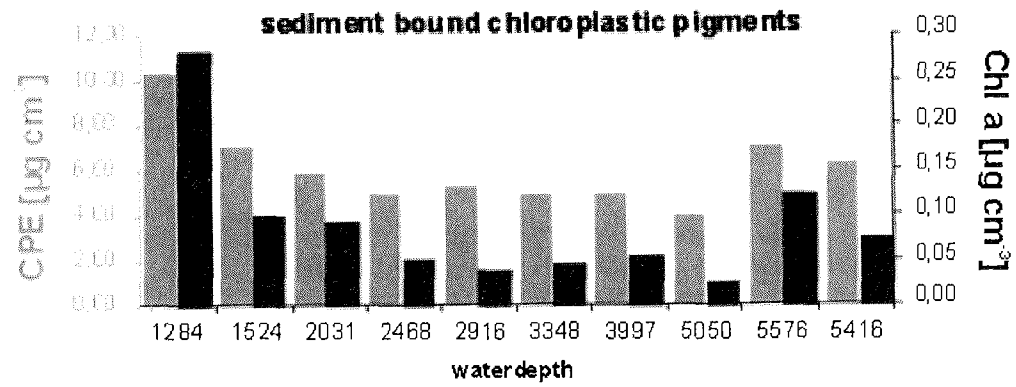


Fig. 14: Concentrations of plant pigments in the sediment-water-interface (0 - 1 cm) along the "Hausgarten" depth-transect.
Abb. 14: Konzentrationen der pflanzlichen Pigmente in der Sediment-Wasser-Übergangsschicht (0 - 1 cm) auf dem Schnitt durch den Hausgarten.

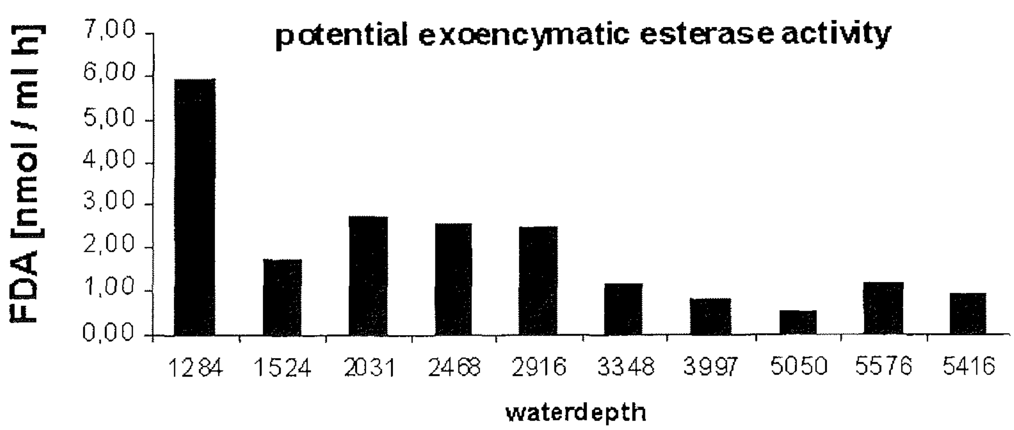


Fig. 15: Potential exoenzymatic activity of ester-cleaving bacteria in the sediment-water-interface (0-1cm) along the "Hausgarten" depth-transect.
Abb. 15: Potentielle exoenzymatische Aktivität von ester-aufspaltenden Bakterien Pigmente in der Sediment-Wasser-Übergangsschicht (0 - 1 cm) auf dem Schnitt durch den Hausgarten.

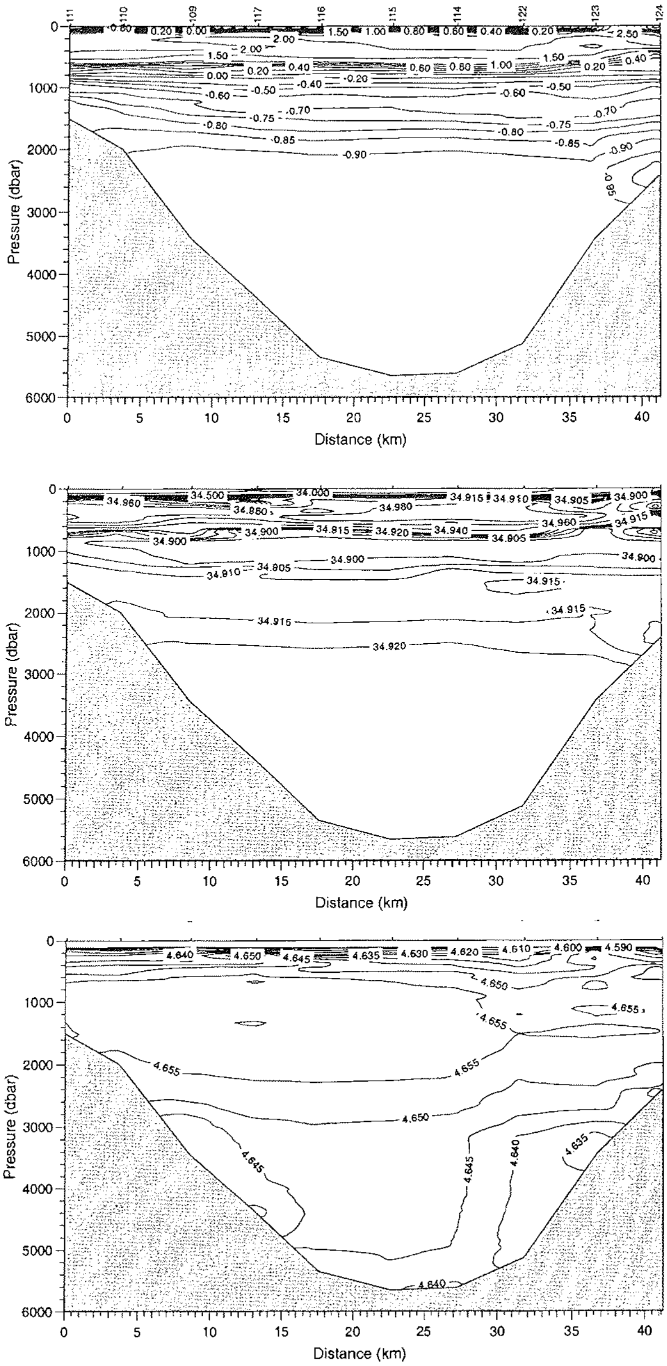


Fig. 16: Transect of potential temperature, salinity and attenuation across Molloy Deep.

Abb. 16: Vertikalschnitt der potentiellen Temperatur, des Salzgehalts und der Licht-Attenuation quer zu Molloy Deep.

9.2 Investigations on the dynamics of benthic bacterial communities and their impact on small-scale heterogeneity patterns of Arctic deep-sea sediments

Topographic-geochemical features are connected with the varying occurrence of megafaunal populations, which in turn play an important role for the distribution and for the activity of benthic bacteria. To get an idea about bacterial dynamics in deep-sea sediments, large-scale samples implying the decreasing effects with increasing water depth were compared with small-scale samples with regard to biologically produced habitat structures in terms of bacterial activity, diversity and abundance.

The benthos of the Molloy Deep is dominated by holothurians producing tracks, feeding traces and faeces. The sediment there is characterized by small grain sizes. In the sample aera of the "Hausgarten" we can find a wide range of bioturbating species creating tubes, burrows sea mounds and other biogenic structures.

Bacterial production was measured via dual labelling by means of ^{14}C leucine and ^{3}H thymidine incorporation. A direct counting, dual staining method was applied to evaluate the proportion of active and inactive bacteria. We found a trend of decreasing microbial activity in sediment surface layer in dependence of an increasing sediment depth as well as water depth. Samples for different molecular analysis were prepared on board for further processing at the institute.

9.3 "Food falls" – natural disturbances at the seafloor of the deep sea

The food supply hence energy flow to the benthic deep-sea ecosystem is partly driven by sinking carcasses (food falls). Although of natural origin food falls create small scaled disturbances because they are discrete events with significant implications for the influenced area. Scavenging demersal fishes and invertebrates are attracted in large numbers by food falls. The impact of any food fall is unpredictable both in space and time for benthic or bentho-pelagic scavengers.

However, preliminary results of baited time-lapse camera experiments and baited traps carried out in 2000 (ARK XVI/2) and 2001 (ARK XVII/1) indicate that thousands of individuals of the cosmopolitic necrophagous deep-sea amphipod *Eurythenes gryllus* appear shortly after bait deployment (Fig. 17).

A free-falling lander system was used equipped with a pre-programmed time-lapse camera, flow meter, autonomous scanning sonar system and traps. Five lander deployments each lasting for about 20 hours were scheduled for the centre and vicinity of the deep-sea long-term station (AWI-"Hausgarten"). The scanning sonar system recorded signals, which could in combination with the photos of the time laps camera use to find out a prefered direction in the appearance of the amphipods (Fig. 18).

The bait in the traps with a weight of about 4 kg (on average) was totally consumed in 20 hours by 800 amphipods per lander deployment. About 3900 amphipods were caught by the traps. 200 organisms were kept alive in a cooled laboratory container on board POLARSTERN and later at the institute for further experiments under controlled conditions. The other 3700 cached amphipods of all deployments will be used for analysing lipid contents, estimate the genetic differences, and for information about the distribution of female and male amphipods.

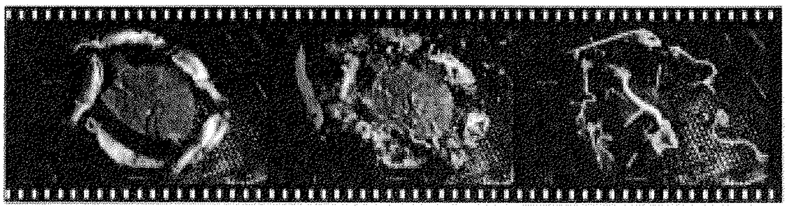


Fig. 17: Time-lapse photograph sequences of bait deployment at 2600 m water depth indicating the rapid consumption of about 3 kg (wet weight) of fish bait by a single amphipod species (*Eurythenes gryllus*).
Abb. 17: Fotosequenz während der Köderausbringung in 2600 m Wassertiefe, die den schnellen Verzehr von etwa 3 kg (Nassgewicht) Fischköder durch eine Amphipodenart (*Eurythenes gryllus*) zeigt.

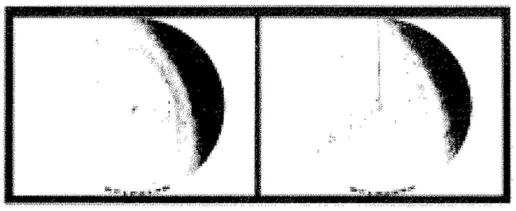


Fig. 18: Recorded signals of scanning sonar system on the lander, plotted in polar version (01:12 hours in between); the right picture show the incoming individuals to the bait.
Abb. 18: Mit dem scannenden Sonar auf dem Lander im Zeitabstand von 1:12 Stunden aufgezeichnete Signale in polarer Projektion. Auf der rechten Abbildung sind die sich dem Köder nähernden Tiere zu erkennen.

10. WATER MASS EXCHANGES BETWEEN THE ARCTIC OCEAN AND THE NORDIC SEAS

G. Budéus, E. Fahrbach, V. Lüer, I. Meyer-Holste, S. Müller, B. Plüger, R. Plugge, S. Ronski, E. Schütt

Objectives

Exchanges between the North Atlantic and the Arctic Ocean result in the most dramatic water mass conversions in the World Ocean: warm and saline Atlantic waters, flowing through the Nordic Seas into the Arctic Ocean, are modified by cooling and freezing into shallow fresh waters (and ice) and saline deep waters. The outflow from the Nordic Seas to the south provides the initial driving of the global thermohaline circulation cell. The outflow to the north has a major impact on the large scale circulation of the Arctic Ocean. Measurement of these fluxes is a major prerequisite for the quantification of the rate of overturning within the large circulation cells of the Arctic and the Atlantic Oceans, and is also a basic requirement for understanding the role of these ocean areas play in climate variability on interannual to decadal time scales.

Fram Strait represents the only deep connection between the Arctic Ocean and the Nordic Seas. Just as the freshwater transport from the Arctic Ocean is thought to be of major influence on water mass formation in the Nordic Seas, the transport of warm and saline Atlantic water significantly affects the water mass characteristics in the Arctic Ocean. The inflow from the Arctic Ocean into the Nordic Seas determines to a large extent the formation of water masses which are advected through Denmark Strait to the south and participate in the formation of the North Atlantic Deep Water. The obtained data will be used, in combination with a regional model, to investigate the nature and origin of the transport fluctuations as well as the modification of signals during their propagation through the strait.

The specific objectives are:

- to measure the current, temperature and salinity fields on sections across Fram Strait
- to determine the characteristic time scales of the fluctuations, in particular, the contribution of the seasonal cycle
- to calculate seasonal and annual mean transports of mass, heat and salt
- to understand the origin of the fluctuations
- to detect the influences of low frequency fluctuations of the transports through Fram Strait on remote variations further south
- to detect interannual variability of the described processes.

Polar oceans are generally weakly stratified and hence oceanic currents are primarily determined by the barotropic flow component. Thus, geostrophic calculations based on hydrographic sections are not sufficient to determine the current field to the required accuracy. In these ice-covered areas, the barotropic component can only be determined from direct current measurements, since satellite altimetry is not yet able to supply appropriate measurements of sea level fluctuations under ice. Due to relatively large contributions of boundary and frontal areas and the small Rossby radius of deformation, relatively high horizontal resolution is required for the measurements.

However, measurements with bottom pressure recorders might allow to obtain transport estimates, if they are properly calibrated against a current meter array.

The net transport through Fram Strait is the difference between the northward flowing West Spitsbergen Current in the east and the southward flowing East Greenland Current in the west. A significant recirculation from of water from Atlantic origin occurs in several current branches south, in and north of Fram Strait. To estimate the intensity of the recirculation on the zonal transect across the strait a meridional transect is needed at the Greenwich Meridian.

Work at Sea

To measure the current field between East Greenland and West Spitsbergen, actually 14 mooring arrays are deployed across Fram Strait at 79°N, in water depths between 200 m and 2600 m water depth. For a sufficient vertical resolution, 3 to 4 instruments per mooring are required. Temperatures and salinities are measured together with the currents, to allow derivation of the heat and salt transports. Three of the moorings on the eastern side of the mooring array were recovered and redeployed with bottom pressure recorders (see tables).

Salinity sensors on moored instruments still suffer from uncertainties and are too expensive to be deployed in a large number. Therefore CTD stations (Fig. 2) are conducted across Fram Strait from the Spitsbergen shelf to the East Greenland shelf to ensure calibration of the moored instruments and to supply much higher spatial resolution. The transect did not reach the Greenland coast, but ended at 79°N 11°47'W due to the ice conditions which would have required more time to reach the fast ice edge than available.

To determine the different branches of the Atlantic Water entering the Arctic Ocean a transect was made from the northwestern corner of Spitsbergen to the northwest across the southern part of Sofia Deep. At the western slope of Sofia Deep the transect veered to the southwest and reached the Greenwich Meridian at 79°40'N. From there, it went approximately south, but was adapted to the ice conditions. The measurements ended on the way south to Tromsø at 75°15'N 00°00'. However the horizontal station distance had to be increased up to 30 nm in the deep basins.

Preliminary Results

The CTD section (Figs. 2 and 19) across Fram Strait from the Spitsbergen shelf to the East Greenland shelf did show the expected water mass distribution with warm saline water of Atlantic origin on the eastern side in the West Spitsbergen Current and colder and less saline in the southward return flow on the western side. Cold and low saline Polar Water was observed on the western side and over the east Greenland shelf. Since the transect did not reach the Greenland coast, the recirculation on the shelf could not be determined.

The different branches of the Atlantic Water entering the Arctic Ocean were detected an a transect from the northwestern corner of Spitsbergen to the northwest across the southern part of Sofia Deep (Figs. 2 and 20) and on the western slope of Sofia Deep (Figs. 2 and 21). On the Greenwich Meridian the recirculation front was encountered at 79°'N.

The long term development of the water mass properties is shown in Fig. 22. Mean temperatures and salinities are given for two depth levels (5 to 30 m and 50 to 500 m). Horizontally three areas are distinguished: the West Spitsbergen Current (WSC), between the shelf edge and 5° E, the Return Atlantic Current (RAC) between 3°W and 5°E and Polar Water in the East Greenland Current (EGC) between 3°W and the Greenland shelf. It has to be noted that the data from Fram Strait are scattered from spring to autumn and consequently affected by the annual cycle which is most pronounced in the upper layers. Therefore, the observation time indicated in the figure has to be taken into account.

11. ACKNOWLEDGEMENT

The achievements during the cruise were only possible because of an effective and heartful cooperation between the ship's crew and the scientific party. We are grateful to Master Dr. Boche and his crew for another example of the traditionally good cooperation on board. We want to thank as well to all those, even if we are not able to call them all by name, who contributed to the success of the cruise by their support on shore during planning, preparation and while we have been at sea.

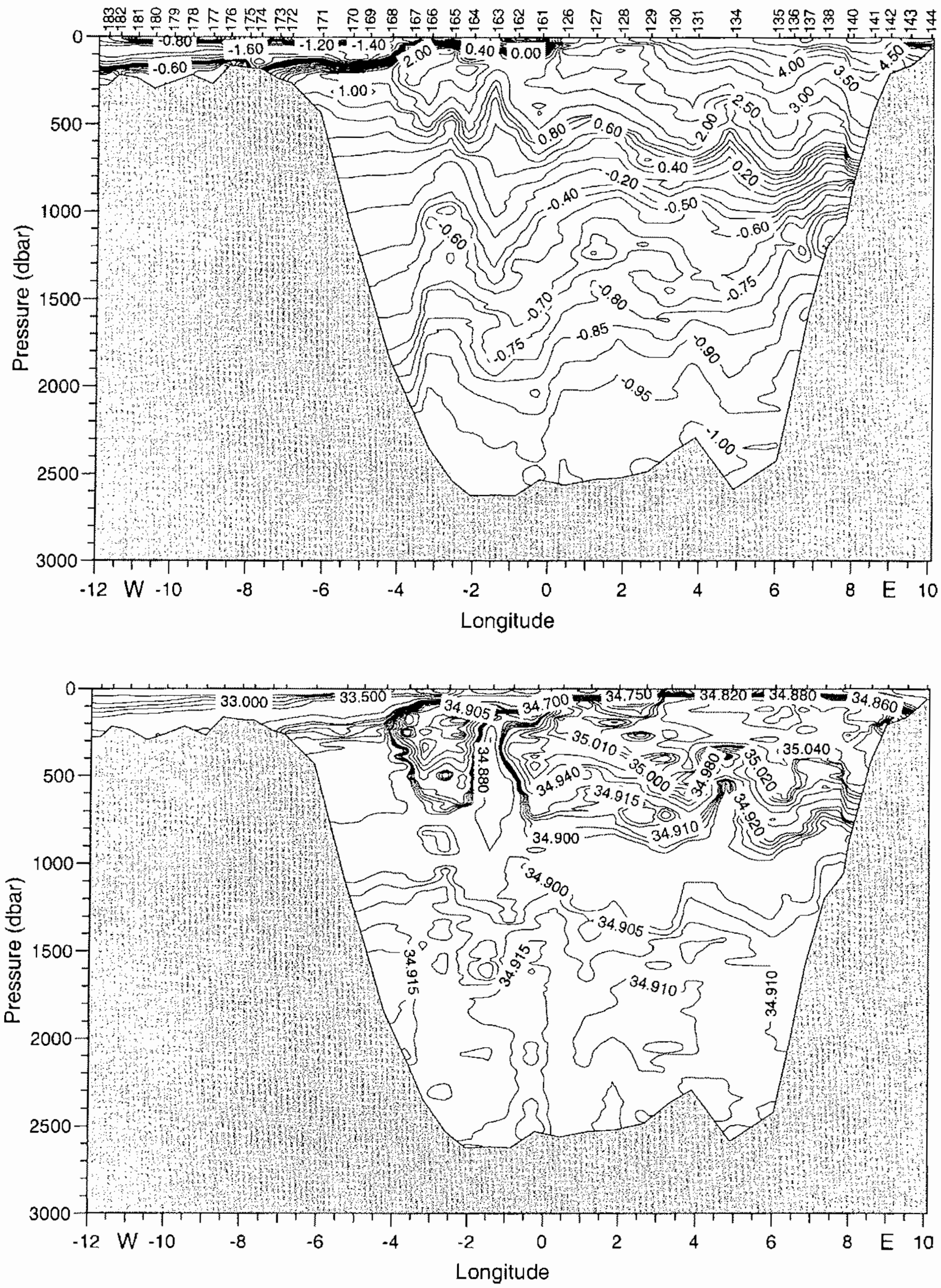


Fig. 19: Transect of potential temperature and salinity across Fram Strait along 79°00'N in the west and 78°50'N in the east. For locations of stations see Fig. 2.
Abb. 19: Vertikalschnitt der potentiellen Temperatur und des Salzgehalts durch die Framstraße auf 79°00'N im Westen und auf 78°50'N im Osten. Zur Lage des Schnitts, siehe Abb. 2.

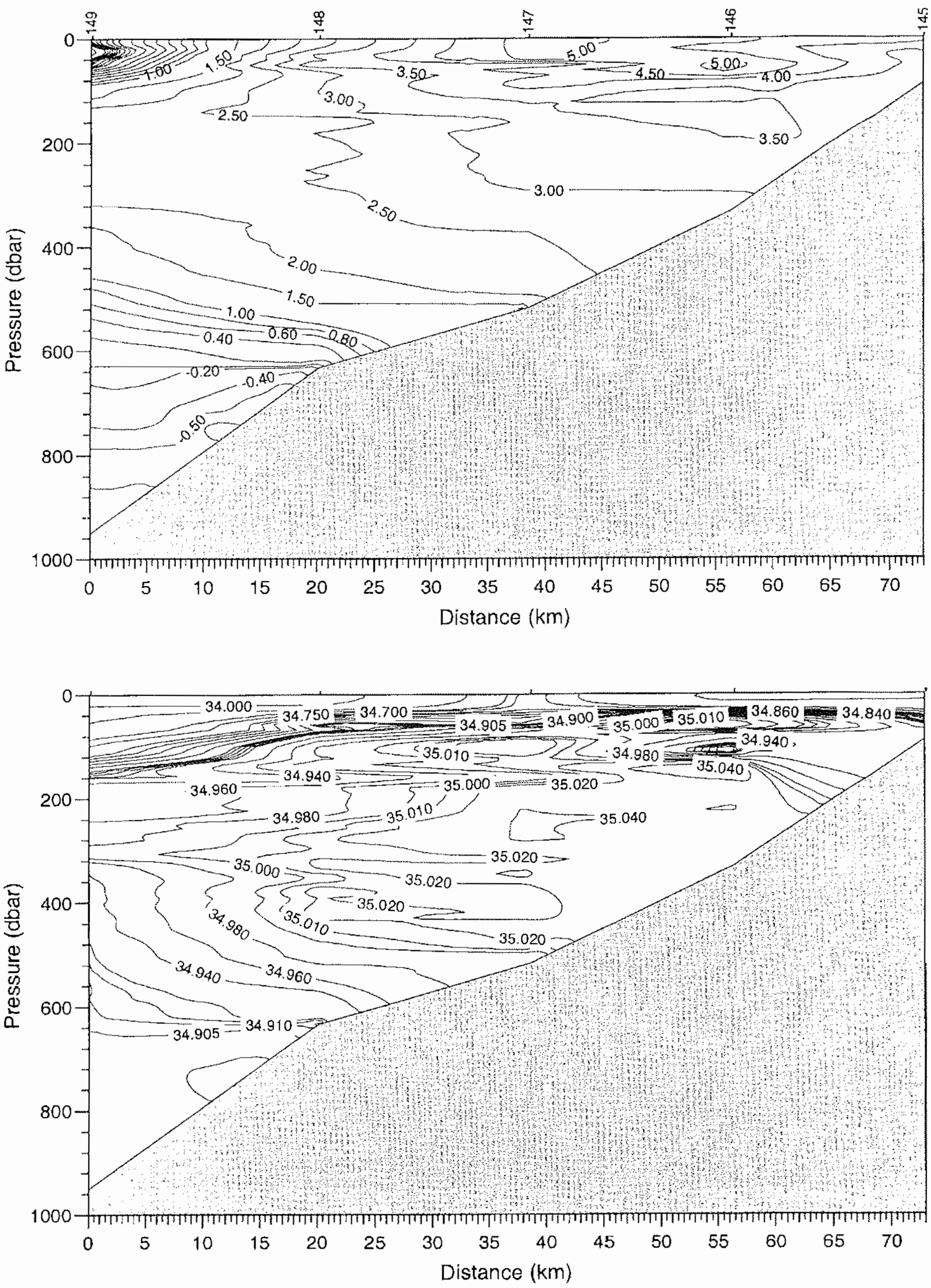
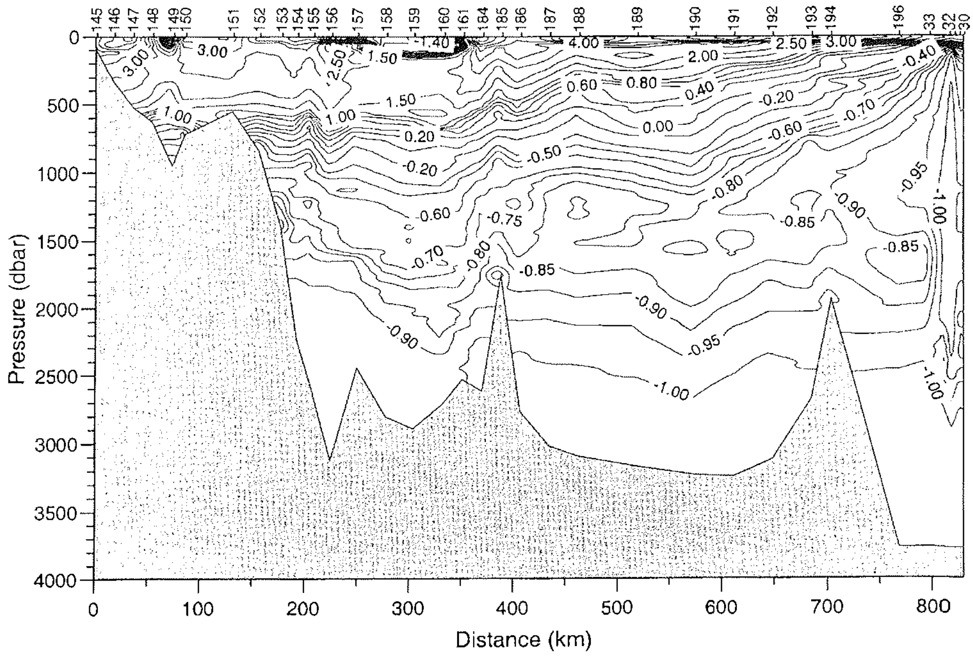


Fig. 20: Transect of potential temperature and salinity north of Fram Strait crossing the flow of Atlantic Water north of Spitsbergen. For locations of stations see Fig. 2.
Abb. 20: Vertikalschnitt der potentiellen Temperatur und des Salzgehalts nördlich der Framstraße, um den Strom von Atlantischem Wasser nördlich von Spitzbergen zu erfassen. Zur Lage des Schnitts, siehe Abb. 2.



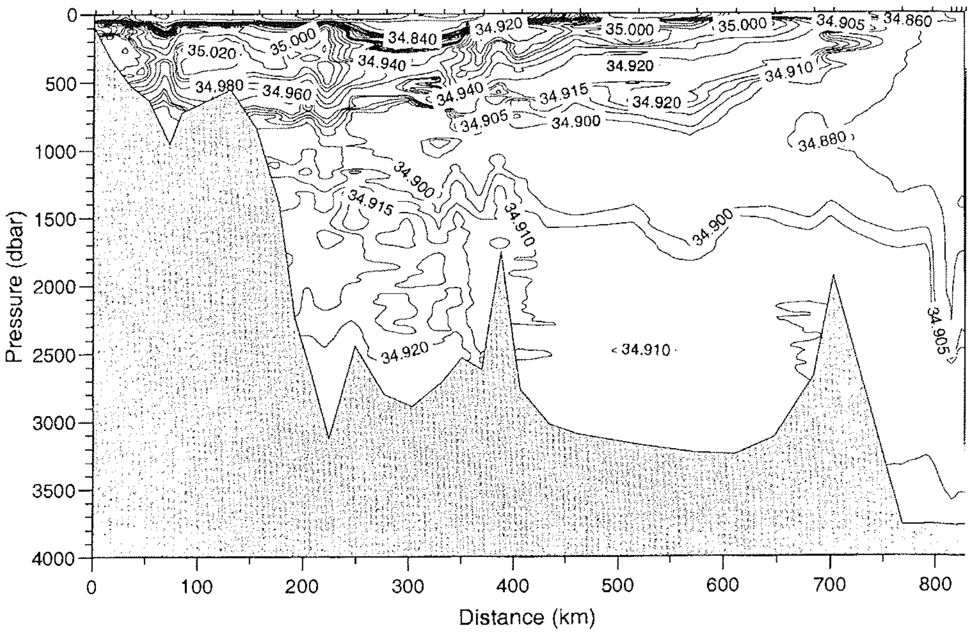
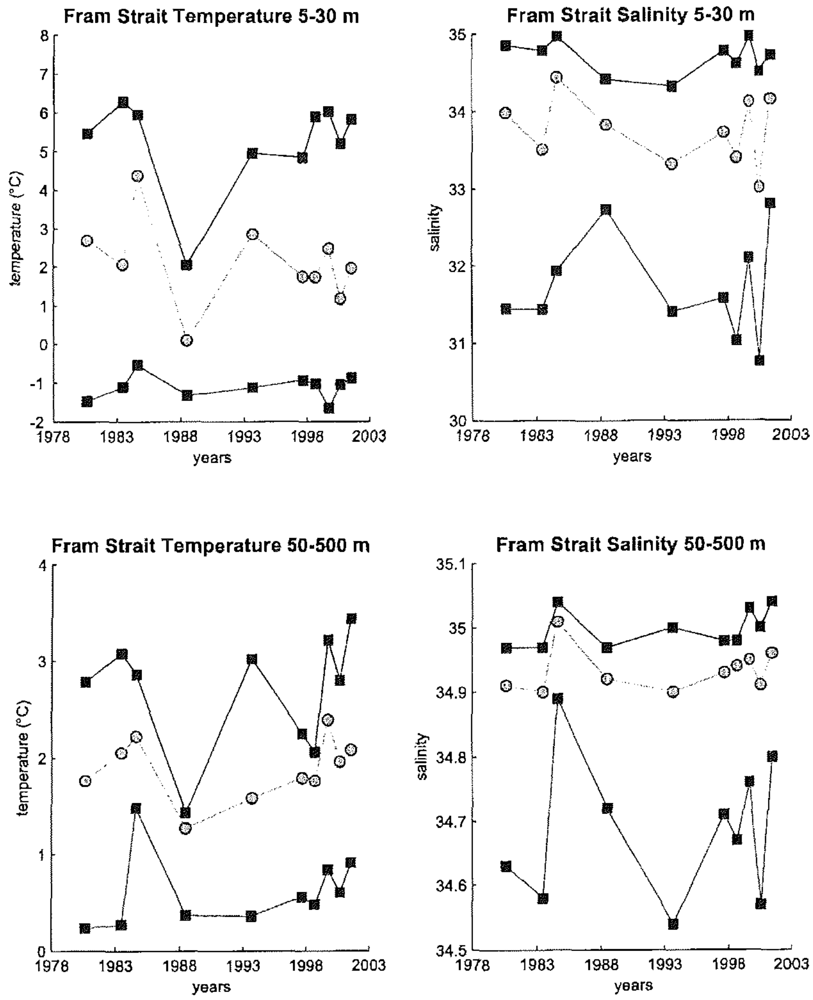


Fig. 21: Transect of potential temperature and salinity across Fram Strait from the southern end of Yermak Plateau to the Greenwich Meridian and along it up to 75°00'N. For locations of stations see Fig. 2.

Abb. 21: Vertikalschnitt der potentiellen Temperatur und des Salzgehalts durch die Framstraße vom südlichen Rand des Yermakplateaus zum Meridian von Greenwich und entlang ihm bis 75°00'N. Zur Lage des Schnitts, siehe Abb. 2.



1980: Ymer (22.08 - 27.08)
1983: Lance (24.06 - 27.06)
1984: Lance (26.08 - 29.08)
1988: Polarstern (24.06 - 29.06)
1993: Lance (16.08 - 27.08)
1997: Lance (23.08 - 17.09)
1998: Polarstern (01.09 - 09.09)
1999: Polarstern (13.09 - 24.09)
2000: Lance (29.08 - 02.09)
2001: Polarstern (18.07 - 23.07)

■ West Spitsbergen Current (**WSC**): mean temperature and salinity between 5°E and eastern shelf edge.

⊙ Return Atlantic Current (**RAC**): mean temperature and salinity between 3°W and 5°E.

■ East Greenland Current (**EGC**): mean temperature and salinity between western shelf edge and 3°W.

Fig. 22: Mean potential temperature and salinity of the Atlantic Water in Fram Strait on transect from 1984 to 2001.
Abb. 22: Mittlere potentiellen Temperatur und des Salzgehalts des Atlantikwassers in der Framstraße bestimmt mit hydrographischen Schnitten von 1984 bis 2001.

Moorings recovered in Fram Strait during ARKXVII/1.
Verankerungen, die während ARKXVII/1 in der Framstraße aufgenommen wurden.

Recovered moorings							
Mooring-name	Latitude Longitude	Date&Time(UTC) of first record	Water-depth	Instrument Type	Instrument Ser. No.	Instrument Depth	Record-length(days)
F 2-4	78°50.37 N	18 Aug. 2000, 12:48	794 m	FSI ACM	1557	56 m	348
	08°18.35 E			SBE 37	212	57 m	348
				AVTC	9402	259 m	348
				AVT	9767	785 m	188
				SBE 16	1253	786 m	348
F 6-4	78°50.01 N	04 Aug. 2000, 15.21	2637 m	FSI ACM	1562	59 m	362
	05°02.53 E			SBE 37	217	60 m	362
				AVTPC	10872	262 m	362
				AVT	9187	1518 m	362
				AVT	9185	2634 m	362
				SBE 26	258	2637 m	362
F 8-3	78°50.00 N	06 Aug. 2000, 08:22	2470 m	FSI ACM	1564	60 m	360
	02°33.70 E			SBE 37	221	61 m	360
				AVTP	8417	143 m	360
				AVTP	11888	249 m	360
				AVTPC	11613	750 m	360
				AVTP	9786	1506 m	360
				AVT	9782	2462 m	360
FEVI 1	79°01.70 N	19 Aug. 2000, 22:05	2456 m	Sed. trap		256 m	320
	04°20.86 E			Sed. trap		2286 m	0
				AVT	10873	2441m	347

Abkürzungen/ Abbreviations:

FSI-ACM	Falmouth Scientific 3-dimension acoustic current meter with temperature and pressure sensor
AVTPC	Aanderaa current meter with temperature, pressure, and conductivity sensor
AVTC	Aanderaa current meter with temperature and conductivity sensor
AVTP	Aanderaa current meter with temperature and pressure sensor
AVT	Aanderaa current meter with temperature sensor
SBE 16	SeaBird Electronics self contained CTD, type: SeaCat
SBE 26	SeaBird Electronics high resolution water level recorder
SBE 37	SeaBird Electronics MicroCat CT recorder
Sed. Trap	Salzgitter Electronics SZE Sediment trap

Moorings deployed in Fram Strait during ARKXVII/1.
Verankerungen, die während ARKXVII/1 in der Framstraße ausgelegt wurden.

Deployed moorings						
Mooring-name	Latitude Longitude	Date&Time(UTC) of deployment	Water-depth	Instrument Type	Instrument Ser. No.	Instrument Depth
F 2-5	78°50.35 N	12 July 2001, 15:54	794 m	ACM/CTD	1471	57 m
	08°18.30 E			SBE 37	449	58 m
				AVTP	8418	262 m
				SBE 37	219	782 m
				AVT	10495	788 m
				SBE 26	226	794 m
F 6-5	78°49.95 N	15 July 2001, 17:15	2626 m	ACM/CTD	1449	52 m
	05°02.55 E			SBE 37	445	53 m
				AVTPC	8400	248 m
				AVTPC	12326	1504 m
				AVTPC	12330	2620 m
				SBE 26	259	2626 m
F 8-4	78°50.05 N	17 July 2001, 18:11	2470 m	AVTP	10005	59 m
	02°33.83 E			SBE 37	446	61 m
				AVTPC	8401	145 m
				AVTP	8402	251 m
				AVTPC	8396	752 m
				AVTPC	12328	1508 m
				AVT	10532	2464 m
				SBE 26	261	2470 m
FEVI 2	79°01.80 N	14 July 2001, 11:46	2482 m	Sed. trap		259 m
	04°20.30 E			Sed. trap		2310 m
				AVT	10496	2466 m

Abkürzungen/ Abbreviations:

ACM-CTD	Falmouth Scientific 3-dimension acoustic current meter with CTD sensor head (CTD=Conductivity, Temperature, Depth)
AVTPC	Aanderaa current meter with temperature, pressure, and conductivity sensor
AVTP	Aanderaa current meter with temperature and pressure sensor
AVT	Aanderaa current meter with temperature sensor
SBE 26	SeaBird Electronics high resolution water level recorder
SBE 37	SeaBird Electronics MicroCat CT recorder
Sed. Trap	Salzgitter Electronics SZE Sediment trap

12. BETEILIGTE INSTITUTIONEN/PARTICIPATING INSTITUTIONS

Stiftung Alfred-Wegener- Institut für Polar- und Meeresforschung Columbusstraße D-27568 Bremerhaven	AWI
Deutscher Wetterdienst Geschäftsfeld Seeschiffahrt Jenfelder Allee 70 A D-22043 Hamburg	DWD
Motoren- und Turbinen-Union Friedrichshafen GmbH Stützpunkt Hamburg Försterkamp 9 21149 Hamburg	MTU
OKTOPUS Wischhofstr. 1-3 D-24148 Kiel	OKTOPUS
Free University of Brussels Pleinlaan 2 B-1050 Brussels Belgium	VUB

13. FAHRTTEILNEHMER/PARTICIPANTS

Ahke, Astrid	AWI
Brückner, Sarah	AWI
Budeus, Gereon	AWI
Buldt, Klaus	DWD
Dickmann, Miriam	AWI
Fahrbach, Eberhard	AWI
Haase, Susann	AWI
Hasemann, Christiane	AWI
Haupt, Olaf	AWI
Höft, Lars	MTU
Hohmann, Constanze	AWI
Kierdorf, Christoph	AWI
Lüer, Vanessa	AWI
Matthießen, Jens	AWI
Meyer-Holste, Ina	AWI
Möller, Hans-Joachim	DWD
Müller, Sebastian	AWI
Pflüger, Börge	AWI
Plugge, Rainer	AWI
Premke, Katrin	AWI
Quéric, Nadja-Valérie	AWI
Renneberg, Tom	AWI
Rießbeck, Gerhard	
Ronski, Stephanie	AWI
Saveyn, Bert	VUB
Schewe, Ingo	AWI
Schott, Thorsten	OKTOPUS
Schütt, Ekkehard	AWI
Tahon, Jacques	VUB
Van Mol, Barbara	VUB
Vernaleken, Jutta	AWI
Von Juterzenka, Karen	AWI
Wegner, Jan	AWI
Wengert, Melanie	AWI
Zitzmann, Sybille	AWI

14. SCHIFFSPERSONAL/SHIP'S CREW

Master	Boche, Martin
1. Offc.	Grundmann, Uwe
Ch. Eng.	Schulz, Volker
1. Offc.	Rodewald, Martin
2. Offc.	Fallei, Holger
2. Offc.	Peine, Lutz G.
Doctor	Kohlberg, Eberhard
R. Offic.	Hecht, Andreas
1. Eng.	Delff, Wolfgang
2. Eng.	Krüger, Michael
2. Eng.	Simon, Wolfgang
Electron.	Baier, Ulrich
Electron.	Bohlmann, Harald
Electron.	Fröb, Martin
Electron.	Holtz, Hartmut
Electron.	Piskorzynski, Andreas
Boatsw.	Loidl, Reiner
Carpenter	Neisner, Winfried
A. B.	Bäcker, Andreas
A. B.	Bastigkeit, Kai
A. B.	Guse, Hartmut
A. B.	Hagemann, Manfred
A. B.	Hartwig Andreas
A. B.	Moser, Siegfried
A. B.	Schmidt, Uwe
A. B.	Winkler, Michael
Storek.	Beth, Detlef
Mot-man	Arias Iglesias, Enr.
Mot-man	Dinse, Horst
Mot-man	Emmrich, Andreas
Mot-man	Fritz, Günter
Mot-man	Krösche, Eckhard
Cook	Fischer, Matthias
Cooksmate	Martens, Michael
Cooksmate	Tupy, Mario
1. Stwdess	Dinse, Petra
1. Stwdess	Streit, Christina
Stwdess/Kr	Brendel, Christina
2. Stwdess	Deuß, Stefanie
2. Stwdess	Schmidt, Maria
2. Steward	Tu, Jian-Min
2. Steward	Wu, Chi Lung
Laundrym.	Yu, Chung Leung

15. STATIONSLISTE/STATION LIST

Date	Station Nr.	Time (UTC)	Latitude	Longitude	Depth (m)	Operation
23.06.01	PS59/001	17:44	72°05.0'N	10°00.0'E	2365	CTD
		19:20	72°04.7'N	09°59.8'E	2369	
24.06.01	PS59/002	12:08	74°57.3'N	15°43.0'E	500	MUC
		12:38	74°57.3'N	15°42.9'E	514	
	PS59/003	14:25	75°00.0'N	15°49.8'E	268	CTD
		14:38	75°00.0'N	15°50.0'E	264	
	PS59/004-1	16:10	75°00.0'N	15°10.0'E	1021	CTD
		16:48	75°00.1'N	15°10.2'E	1014	
	PS59/004-2	16:55	75°00.2'N	15°10.6'E	1007	OFOS
		18:47	75°00.4'N	15°08.9'E	1006	
	PS59/005	20:05	75°00.0'N	14°31.3'E	1423	CTD
		20:55	75°00.0'N	14°31.3'E	1421	
	PS59/006	22:17	75°00.0'N	13°52.4'E	1803	CTD
		23:20	74°54,7'N	13°52.3'E	1814	
25.06.01	PS59/007	00:43	75°00.0'N	13°12.2'E	2020	CTD
		01:51	74°59,8'N	13°12.0'E	2024	
	PS59/008	03:05	75°00.0'N	12°34.9'E	2183	CTD
		04:19	75°00.2'N	12°34.7'E	2181	
	PS59/009	05:43	75°00.0'N	11°56.0'E	2335	CTD
		07:02	75°00.1'N	11°56.4'E	2334	
	PS59/010	08:25	75°00.0'N	11°19.0'E	2455	CTD
		09:44	74°59.4'N	11°20.8'E	2457	
	PS59/011	11:13	74°59.9'N	10°39.4'E	2455	CTD
		12:31	75°00.0'N	10°39.4'E	2537	
	PS59/012	13:39	75°00.0'N	10°00.1'E	2580	CTD
		15:01	74°59.6'N	10°00.4'E	2587	
	PS59/013	16:18	75°00.0'N	09°22.0'E	2601	CTD
		17:41	75°00.2'N	09°20.7'E	2606	
	PS59/014	18:50	75°00.0'N	08°43.8'E	2673	CTD
		20:15	75°00.5'N	08°43.2'E	2673	
	PS59/015	21:30	75°00.0'N	08°05.1'E	3544	CTD
		23:20	75°00.0'N	08°04.8'E	3545	
26.06.01	PS59/016	00:37	75°00.0'N	07°25.7'E	2487	CTD
		01:55	75°00.1'N	07°25.2'E	2489	
	PS59/017	03:11	75°00.0'N	06°47.4'E	2259	CTD
		04:21	75°00.1'N	06°47.4'E	2251	
	PS59/018	05:39	75°00.0'N	06°08.2'E	2846	CTD
		07:17	74°59.9'N	06°07.2'E	2886	
	PS59/019	08:30	74°59.9'N	05°29.7'E	3118	CTD
		10:15	74°59.9'N	05°29.0'E	3109	
	PS59/020	11:30	75°00.0'N	04°52.2'E	3241	CTD
		13:12	75°00.4'N	04°52.5'E	3245	
	PS59/021	14:31	75°00.0'N	04°13.9'E	3112	CTD
		16:07	74°59.7'N	04°15.2'E	3276	
	PS59/022	17:30	74°59.9'N	03°35.4'E	3496	CTD
		19:20	75°00.2'N	03°07.2'E	3524	
	PS59/023	20:42	74°59.9'N	02°55.4'E	2533	CTD
		22:00	75°00.0'N	02°54.2'E	2531	
	PS59/024	23:15	74°59.9'N	02°17.2'E	2956	CTD
27.06.01		00:51	74°59.8'N	02°17.7'E	2959	
	PS59/025	02:14	75°00.0'N	01°37.8'E	3189	CTD
		03:50	75°00.0'N	01°37.6'E	3222	
	PS59/026	05:05	74°59.9'N	00°59.5'E	3790	CTD
		07:01	74°59.7'N	00°58.9'E	3785	
	PS59/027	08:16	75°00.0'N	00°21.6'E	3778	CTD

		10:10	75°00.0'N	00°23.2'E	3779	
	PS59/028-1	11:16	74°52.6'N	00°10.8'E	3777	CTD
		13:10	74°52.9'N	00°11.2'E	3779	
	PS59/028-2	12:32	74°52.9'N	00°10.9'E	3780	HN
		12:56	74°52.9'N	00°10.9'E	3780	
	PS59/029	13:39	74°50.1'N	00°10.0'E	3779	CTD
		15:36	74°50.4'N	00°9.2'E	3780	
	PS59/030	16:00	74°47.6'N	00°10.1'E	3776	CTD
		18:04	74°48.0'N	00°8.9'E	3782	
	PS59/031	18:46	74°51.4'N	00°24,6'E	3791	CTD
		20:48	74°51.0'N	00°23.7'E	3782	
	PS59/032	21:32	74°55.0'N	00°10,5'E	3782	CTD
		23:33	74°55.4'N	00°12.7'E	3782	
28.06.01	PS59/033	00:44	75°00.1'N	00°18,1'W	3771	CTD
		02:59	75°00.3'N	00°17.6'W	3769	
	PS59/034	04:20	75°00.0'N	00°56.4'W	3728	CTD
		06:16	75°00.0'N	00°55,9'W	3728	
	PS59/035	07:31	75°00.0'N	01°35.1'W	3740	CTD
		09:35	74°59.2'N	01°35.3'W	3736	
	PS59/036	10:45	74°59.9'N	02°12.8'W	3653	CTD
		12:46	75°00.8'N	02°12.6'W	3568	
	PS59/037-1	14:25	74°49.9'N	02°30.9'W	3700	J010 Aufnahme
		16:32	74°50.2'N	02°31.4'W	3706	
	PS59/037-2	16:55	74°50.3'N	02°29.6'W	3707	J013 Auslegung
		18:50	74°50.0'N	02°30,1'W	3703	
	PS59/038	20:19	75°00.0'N	02°51.2'W	3700	CTD
		22:23	75°00.0'N	02°50.7'W	3705	
	PS59/039	23:41	75°00.0'N	03°29.6'W	3672	CTD
29.06.01		01:35	75°00.1'N	03°29.0'W	3674	
	PS59/040	02:52	75°00.0'N	04°07.9'W	3646	CTD
		04:50	74°59.3'N	04°08.2'W	3651	
	PS59/041	06:23	75°05.0'N	03°27.0'W	3677	J012 Ausbringung
		07:56	75°05.0'N	03°27.0'W	3683	
	PS59/042-1	09:51	74°54.9'N	04°37.7'W	3624	J009 Aufnahme
		11:23	74°55.2'N	04°37.3'W	3625	
	PS59/042-2	11:29	74°55.2'N	04°37.4'W	3623	CTD
		13:23	74°55.7'N	04°39.5'W	3624	
	PS59/042-3	13:43	74°55.1'N	04°36.9'W	3619	J011 Auslegung
		15:27	74°55.0'N	04°38.1'W	3624	
	PS59/043	16:14	74°59.9'N	04°47.1'W	3620	CTD
		18:07	75°00.1'N	04°47.9'W	3620	
	PS59/044	19:16	75°00.0'N	05°25.1'W	3585	CTD
		21:11	75°00.3'N	05°28.8'W	3585	
	PS59/045	22:23	75°00.0'N	06°04.0'W	3534	CTD
30.06.01		00:24	75°00.7'N	06°04.1'W	3539	
	PS59/046	01:42	75°00.0'N	06°43.0'W	3496	CTD
		03:38	74°59.9'N	06°43.7'W	3497	
	PS59/047	04:53	74°59.9'N	07°21.9'W	3447	CTD
		06:43	75°00.0'N	07°22.7'W	3447	
	PS59/048	07:55	75°00.0'N	08°00.9'W	3404	CTD
		09:47	74°59.6'N	08°01.5'W	3404	
	PS59/049	13:07	74°59.9'N	08°40.0'W	3366	CTD
		14:56	74°59.6'N	08°38.9'W	3368	
	PS59/050	16:02	75°00.0'N	09°18.8'W	3301	CTD
		17:45	74°59.6'N	09°17.8'W	3311	
	PS59/051	19:02	75°00.0'N	09°57.0'W	3226	CTD
		20:44	75°00.0'N	09°56.4'W	3224	
	PS59/052	22:03	75°00.0'N	10°36.2'W	3078	CTD
		23:39	74°59.8'N	10°34.9'W	3085	
1.07.01	PS59/053	0:38	75°00.0'N	11°02.1'W	2742	CTD
		2:03	74°59.8'N	11°01.7'W	2764	

	PS59/054	03:02	75°00.0'N	11°27.9'W	2346	CTD
		04:19	74°59.8'N	11°26.8'W	2378	
	PS59/055	05:23	74°59.8'N	11°49.2'W	1972	CTD
		06:25	74°59.2'N	11°48.4'W	2015	
	PS59/056	07:35	75°00.5'N	12°11.4'W	1453	CTD
		08:23	75°00.2'N	12°11.0'W	1486	
	PS59/057	09:20	74°59.9'N	12°20.0'W	1298	CTD
		09:53	74°59.7'N	12°19.0'W	1338	
	PS59/058	10:43	74°59.8'N	12°30.4'W	1051	CTD
		11:17	74°59.5'N	12°29.9'W	1085	
	PS59/059	12:08	74°59.9'N	12°43.8'W	636	CTD
		12:29	74°59.8'N	12°43.6'W	670	
	PS59/060	13:33	74°59.7'N	13°09.5'W	249	CTD
		13:46	74°59.6'N	13°09.1'W	255	
	PS59/061	15:08	74°59.9'N	13°39.9'W	201	CTD
		15:17	74°59.9'N	13°39.7'W	201	
	PS59/062	17:13	74°57.3'N	14°21.8'W	178	CTD
		17:24	74°57.3'N	14°21.7'W	178	
3.07.01	PS59/063	16:35	74°07.7'N	12°08.1'W	2883	CTD Jo-Jo
		22:02	74°11.5'N	12°09.2'W	2989	
	PS59/064	22:50	74°07.1'N	12°08.1'W	2885	MUC
4.07.01		00:43	74°07.1'N	12°08.5'W	2883	
	PS59/065	02:24	74°07.0'N	12°08.8'W	2882	OFOS
		08:58	74°10.5'N	12°06.1'W	2980	
	PS59/066	09:29	74°09.6'N	12°06.1'W	2995	MUC
		11:24	74°09.5'N	12°06.0'W	2996	
	PS59/067	20:45	74°09.9'N	11°22.9'W	2951	CTD
5.07.01		02:40	74°13.1'N	11°33.5'W	3009	
	PS59/068	03:10	74°11.2'N	11°27.0'W	3076	MUC
		05:10	74°11.0'N	11°26.8'W	3079	
	PS59/069	05:35	74°09.8'N	11°22.5'W	2951	OFOS
		10:37	74°11.5'N	11°26.8'W	3081	
	PS59/070-1	11:05	74°13.3'N	11°33.8'W	3010	MUC
		12:59	74°13.1'N	11°33.0'W	3012	
	PS59/070-2	13:20	74°13.1'N	11°32.9'W	3012	GKG
		14:39	74°13.3'N	11°30.5'W	3017	
	PS59/070-3	15:09	74°13.0'N	11°34.5'W	3008	SL
		16:23	74°13.1'N	11°32.7'W	3014	
	PS59/071-1	17:00	74°11.1'N	11°27.2'W	3077	SL
		18:10	74°11.1'N	11°27.1'W	3078	
	PS59/071-2	18:47	74°11.7'N	11°26.2'W	3067	AGT
		22:57	74°10.1'N	11°33.9'W	3063	
6.07.01	PS59/072	08:27	74°30.1'N	10°58.5'W	3130	MUC
		10:26	74°29.7'N	10°58.0'W	3133	
	PS59/073	11:24	74°34.0'N	10°55.8'W	3155	OFOS
		16:13	74°31.3'N	10°57.2'W	3137	
	PS59/074-1	16:35	74°30.1'N	10°58.4'W	3132	GKG
		18:05	74°29.5'N	10°56.1'W	3137	
	PS59/074-2	18:32	74°30.3'N	10°59.7'W	3130	SL
		19:48	74°29.7'N	10°58.4'W	3133	
	PS59/075	22:32	74°25.3'N	10°15.5'W	3198	CTD
7.07.01		04:12	74°21.4'N	10°14.3'W	3145	
	PS59/076-1	04:58	74°24.5'N	10°15.7'W	3217	MUC
		07:00	74°24.5'N	10°16.1'W	3215	
	PS59/076-2	07:11	74°24.5'N	10°15.7'W	3217	GKG
		08:30	74°84.2'N	10°16.3'W	3200	
	PS59/076-3	09:05	74°24.5'N	10°15.9'W	3217	SL
		10:17	74°24.3'N	10°15.1'W	3224	
	PS59/076-4	10:39	74°24.5'N	10°16.1'W	3218	SL
		11:53	74°24.4'N	10°15.5'W	3218	
	PS59/077-1	12:50	74°21.8'N	10°16.0'W	3139	SL
		14:07	74°21.7'N	10°16.1'W	3138	

	PS59/077-2	14:24	74°21.7'N	10°15.8'W	3138	GKG
		15:49	74°21.6'N	10°15.4'W	3139	
	PS59/078	16:30	74°22.1'N	10°15.5'W	3141	OFOS
		23:37	74°25.5'N	10°15.8'W	3189	
	PS59/079	23:57	74°25.3'N	10°15.6'W	3193	MUC
8.07.01		01:44	74°24.8'N	10°13.7'W	3214	
	PS59/080	02:08	74°24.5'N	10°16.0'W	3217	CTD
		03:54	74°24.2'N	10°14.2'W	3218	
	PS59/081-1	04:38	74°24.3'N	10°23.3'W	3202	AGT
		08:40	74°24.0'N	10°32.2'W	3192	
	PS59 081-2	09:30	74°24.4'N	10°23.6'W	3205	CTD
		11:25	74°24.0'N	10°20.4'W	3207	
	PS59/082-1	18:04	74°15.0'N	09°33.8'W	3235	MUC
		20:05	74°15.0'N	09°34.0'W	3234	
	PS59/082-2	20:22	74°15.0'N	09°34.1'W	3236	GKG
		21:50	74°15.0'N	09°34.2'W	3235	
	PS59/082-3	22:14	74°15.0'N	09°34.1'W	3235	SL
		23:37	74°15.0'N	09°33.4'W	3237	
9/7/01	PS59/082-4	00:17	74°15.1'N	09°33.0'W	3236	OFOS
		05:53	74°16.8'N	09°33.1'W	3236	
	PS59/083	18:50	74°45.6'N	08°53.7'W	3321	CTD
10.07.01		00:20	74°48.6'N	08°59.7'W	3325	
	PS59/084-1	01:03	74°45.7'N	08°53.9'W	3325	MUC
		03:14	74°45.7'N	08°54.3'W	3324	
	PS59/084-2	03:29	74°45.7'N	08°54.4'W	3322	OFOS
		08:23	74°47.4'N	08°57.7'W	3328	
	PS59/085-1	09:09	74°47.9'N	08°57.6'W	3325	MUC
		11:14	74°47.9'N	08°57.9'W	3324	
	PS59/085-2	11:29	74°47.9'N	08°57.9'W	3324	GKG
		13:00	74°48.0'N	08°57.9'W	3325	
	PS59/085-3	13:22	74°47.9'N	08°57.9'W	3325	SL
		14:47	74°47.8'N	08°58.0'W	3325	
	PS59/086-1	15:26	74°46.6'N	08°55.5'W	3373	GKG
		17:04	74°46.7'N	08°55.8'W	3395	
	PS59/086-2	17:18	74°46.7'N	08°55.6'W	3390	MUC
		19:27	74°46.7'N	08°55.8'W	3395	
12.07.01	PS59/087	06:15	78°30.0'N	06°36.2'E	2644	LANDER
	PS59/088	10:50	78°45.0'N	08°20.3'E	818	AGT
		13:09	78°46.4'N	08°20.9'E	782	
	PS59/089	13:53	78°50.2'N	08°18.3'E	816	Verankerung F2-4
		14:48	78°50.2'N	08°18.5'E	812	
		15:06	78°50.4'N	08°18.4'E	816	Verankerung F2-5
		15:54	78°50.4'N	08°18.3'E	819	
	PS59/090	17:04	78°45.2'N	08°49.0'E	422	AGT
		18:18	78°46.5'N	08°44.6'E	398	
	PS59/91	22:45	79°08.0'N	06°05.0'E	1283	MUC
		23:42	79°08.0'N	06°04.0'E	1283	
13.07.01	PS59/92	02:11	79°04.1'N	04°19.9'E	2356	CTD
		03:29	79°04.3'N	04°19.1'E	2350	
	PS59/93	08:34	78°30.3'N	06°36.1'E	2630	LANDER Aufnahme
		10:20	78°31.1'N	06°34.9'E	2511	
	PS59/94	15:23	79°04.0'N	04°10.9'E	2465	MUC
		16:58	79°04.4'N	04°09.9'E	2468	
	PS59/95	19:53	78°50.5'N	05°52.0'E	2524	LANDER B Auslegung
	PS59/96	22:15	79°08.1'N	04°54.5'E	1518	MUC
		23:16	79°08.2'N	04°54.2'W	1520	
	PS59/97	23:46	79°10.1'N	04°43.8'E	1494	ECHO PINGER
14.07.01	PS59/98	00:33	79°06.1'N	04°14.5'E	2268	ECHO PINGER
	PS59/99	00:52	79°06.0'N	04°09.3'E	2389	ECHO PINGER
	PS59/100	04:10	79°07.4'N	04°35.7'E	1701	MUC
		05:29	79°07.6'N	04°35.5'E	1978	
	PS59/100-1	05:36	79°07.7'N	04°35.4'E	2023	MUC

		06:59	79°08.0'N	04°35.5'E	2017	
	PS59/101	08:00	79°01.8'N	04°20.5'E	2549	FEVI-1 Aufnahme
		09:50	79°02.5'N	04°16.4'E	2532	
	PS59/101-1	10:20	79°01.5'N	04°21.3'E	2547	FEVI-2 Auslegung
		11:46	79°01.8'N	04°20.3'E	2499	
	PS59/102	14:25	78°50.6'N	05°53.0'E	2521	LANDER B Aufnahme
		15:49	78°50.5'N	05°52.9'E	2523	
	PS59/103	20:08	79°04.1'N	03°43.1'E	2903	MUC
		21:58	79°04.0'N	03°41.7'E	2989	
	PS59/104	23:00	79°04.0'N	04°19.9'E	2368	LANDER C Auslegung
15.07.01	PS59/105	00:07	79°05.0'N	03°36.6'E	3276	MUC
		02:11	79°05.0'N	03°35.4'E	3383	
	PS59/106	11:22	78°49.9'N	05°02.9'E	2694	VERANKERUNG Aufnahme F6-4
		15:08	78°48.9'N	05°00.0'E	2678	
	PS59/106-1	15:53	78°50.0'N	05°02.5'E	2699	VERANKERUNG Auslegung F6-5
		17:15	78°50.0'N	05°02.6'E	2700	
	PS59/107	19:21	79°04.5'N	04°19.1'E	2377	LANDER C Aufnahme
		20:35	79°04.3'N	04°16.4'E	2394	
	PS59/108	21:53	79°04.0'N	03°29.7'E	3963	MUC
16.07.01		00:23	79°04.0'N	03°28.7'E	4004	
	PS59/109	02:33	79°17.5'N	02°55.4'E	3391	CTD
		04:12	79°17.6'N	02°53.8'E	3489	
	PS59/110	04:41	79°20.0'N	02°58.2'E	2021	CTD
		05:49	79°20.0'N	02°57.7'E	2071	
	PS59/111	06:15	79°22.0'N	03°00.0'E	1531	CTD
		07:09	79°22.1'N	02°59.8'E	1505	
	PS59/111-1	07:42	79°21.8'N	02°59.2'E	1478	LANDER D Auslegung
	PS59/112	12:11	78°50.0'N	02°33.5'E	2529	MUC
		14:20	78°50.0'N	02°33.5'E	2533	
	PS59/113	16:24	79°04.1'N	03°21.4'E	4981	CTD
		19:30	79°04.2'N	03°19.8'E	5210	
	PS59/114	20:24	79°07.5'N	02°47.1'E	5506	CTD
		22:48	79°07.5'N	02°47.2'E	5510	
	PS59/115	23:22	79°10.0'N	02°48.9'W	5571	CTD
17.07.01		02:03	79°10.2'N	02°45.1'E	5513	
	PS59/116	02:33	79°12.7'N	02°50.6'E	5258	CTD
		05:11	79°13.0'N	02°49.1'E	5260	
	PS59/117	06:00	79°15.0'N	02°53.4'E	4360	CTD
		08:00	79°15.0'N	02°53.5'E	4365	
	PS59/118	08:59	79°22.0'N	02°59.7'E	1505	LANDER D Aufnahme
		10:18	79°21.7'N	02°58.2'E	1510	
	PS59/119	13:58	78°49.9'N	02°34.1'E	2528	VERANKERUNG Aufnahme F8-3
		16:34	78°50.0'N	02°34.1'E	2517	VERANKERUNG Auslegung F8-4
		18:11	78°50.1'N	02°33.8'E	2524	
	PS59/120	18:42	78°50.1'N	02°41.9'E	2504	LANDER E Auslegung
	PS59/121	21:06	79°08.1'N	02°54.4'E	5576	MUC
18.07.01		00:38	79°08.5'N	02°54.3'E	5576	
	PS59/122	01:20	79°05.1'N	02°44.4'E	5018	CTD
		03:32	79°05.3'N	02°45.0'E	5179	
	PS59/123	04:08	79°02.4'N	02°41.8'E	3591	CTD
		05:50	79°01.8'N	02°41.4'E	3152	
	PS59/124	06:16	79°00.0'N	02°39.2'E	2450	CTD
		07:26	78°59.8'N	02°37.9'E	2445	
	PS59/125	08:55	79°11.9'N	02°35.2'E	5401	MUC
		12:10	79°12.0'N	02°32.8'E	5397	
	PS59/126	15:27	78°57.4'N	00°27.2'E	2589	CTD

		17:09	78°56.6'N	00°24.0'E	2582	
	PS59/127	18:46	78°55.0'N	01°12.0'E	2560	CTD
		20:06	78°55.1'N	01°12.4'E	2559	
	PS59/128	21:20	78°52.5'N	01°57.0'W	2546	CTD
		22:33	78°52.5'N	01°56.9'E	2545	
	PS59/129-1	23:50	78°50.1'N	02°42.2'E	2508	LANDER
19.07.01		01:32	78°50.5'N	02°41.9'E	2506	
	PS59/129-2	01:52	78°50.1'N	02°41.1'E	2510	CTD
		03:05	78°50.5'N	02°40.9'W	2510	
	PS59/130	04:06	78°50.1'N	03°19.0'E	2399	CTD
		05:23	78°50.4'N	03°19.0'E	2394	
	PS59/131	06:22	78°49.9'N	03°54.9'E	2321	CTD
		07:33	78°49.9'N	03°54.8'E	2320	
	PS59/132	09:27	79°04.0'N	04°20.0'E	2379	CTD
		10:47	79°04.1'N	04°17.1'E	2401	
	PS59/133	11:20	79°06.0'N	04°33.6'E	2092	LANDER F geslipt
	PS59/134	13:34	78°50.0'N	04°54.9'E	2619	CTD
		14:59	78°50.0'N	04°55.1'E	2614	
	PS59/135	16:33	78°50.0'N	06°02.7'E	2451	CTD
		17:51	78°50.0'N	06°03.1'E	2445	
	PS59/136	18:28	78°50.0'N	06°26.7'E	2054	CTD
		19:32	78°49.9'N	06°26.8'E	2056	
	PS59/137	20:16	78°49.9'N	06°51.3'E	1602	CTD
		21:09	78°49.8'N	06°50.1'E	1634	
	PS59/138	22:00	78°50.0'N	07°21.7'E	1231	CTD
		22:39	78°49.9'N	07°21.2'E	1234	
	PS59/139	23:27	78°50.0'N	07°51.4'E	1086	CTD
20.07.01		00:03	78°50.4'N	07°52.8'E	1085	
	PS59/140	00:40	78°50.0'N	08°13.7'E	893	CTD
		01:12	78°50.4'N	08°13.6'E	896	
	PS59/141	01:55	78°50.1'N	08°35.2'E	430	CTD
		02:13	78°50.2'N	08°35.0'E	441	
	PS59/142	02:54	78°49.9'N	09°00.2'E	217	CTD
		03:04	78°49.9'N	09°00.2'E	215	
	PS59/143	03:52	78°50.0'N	09°30.1'E	172	CTD
		04:01	78°50.0'N	09°30.0'E	173	
	PS59/144	04:58	78°50.0'N	10°00.3'E	69	CTD
		05:05	78°50.0'N	10°00.3'E	69	
	PS59/145	13:38	80°00.0'N	11°31.2'E	126	CTD
		13:48	80°00.1'N	11°31.8'E	102	
	PS59/146	14:59	80°06.6'N	10°56.5'E	347	CTD
		15:15	80°06.7'N	10°57.2'E	346	
	PS59/147	16:32	80°14.0'N	10°19.9'E	531	CTD
		16:56	80°14.2'N	10°20.9'E	535	
	PS59/148	18:04	80°21.7'N	09°42.3'E	653	CTD
		18:28	80°21.8'N	09°42.3'E	655	
	PS59/149	19:56	80°30.0'N	08°59.8'E	972	CTD
		20:27	80°29.4'N	08°52.2'E	984	
	PS59/150	22:09	80°24.4'N	07°41.4'E	743	CTD
		22:34	80°24.5'N	07°41.1'E	745	
21.07.01	PS59/151	00:30	80°18.4'N	06°17.1'E	573	CTD
		00:50	80°18.5'N	06°18.0'E	570	
	PS59/152	02:37	80°13.0'N	05°03.3'E	860	CTD
		03:06	80°13.0'N	05°04.5'E	857	
	PS59/153	04:31	80°08.4'N	04°01.4'E	1427	CTD
		05:17	80°08.3'N	04°01.0'E	1434	
	PS59/154	06:16	80°05.3'N	03°17.3'E	2275	CTD
		07:29	80°05.5'N	03°14.0'E	2250	
	PS59/155	08:24	80°01.9'N	02°33.8'E	2647	CTD
		09:48	80°01.6'N	02°31.0'E	2665	
	PS59/156	10:55	79°58.3'N	01°45.5'E	3100	CTD
		12:32	79°58.1'N	01°44.6'E	3233	

	PS59/157	14:37	79°53.2'N	00°35.0'E	2484	CTD
		15:57	79°53.2'N	00°36.4'E	2463	
	PS59/158	18:41	79°39.6'N	00°01.4'W	2828	CTD
		20:10	79°39.8'N	00°00.7'W	2828	
22.07.01	PS59/159	00:42	79°25.4'N	00°02.0'E	2916	CTD
		02:12	79°25.3'N	00°02.8'E	2921	
	PS59/160	05:19	79°09.8'N	00°00.4'E	2729	CTD
		06:43	79°09.9'N	00°02.2'E	2730	
	PS59/161	08:16	79°00.1'N	00°12.8'W	2559	CTD
		09:42	78°59.6'N	00°10.1'W	2557	
	PS59/162	11:12	78°59.0'N	00°50.7'W	2648	CTD
		12:31	78°58.7'N	00°49.9'W	2648	
	PS59/163	14:04	78°56.8'N	01°23.3'W	2644	CTD
		15:24	78°56.8'N	01°23.3'W	2637	
	PS59/164	17:21	78°59.1'N	02°02.0'W	2651	CTD
		18:52	79°00.0'N	01°55.8'W	2651	
	PS59/165	20:46	79°00.1'N	02°32.8'W	2556	CTD
		22:07	79°00.4'N	02°28.6'W	2564	
	PS59/166	23:37	79°01.3'N	03°04.0'W	2373	CTD
23.07.01		00:51	79°01.2'N	03°09.2'W	2380	
	PS59/167	04:25	79°05.6'N	03°37.1'W	2156	CTD
		05:33	79°05.7'N	03°37.1'W	2160	
	PS59/168	07:32	78°59.9'N	04°13.6'W	1862	CTD
		08:32	78°59.6'N	04°12.1'W	1878	
	PS59/169	09:33	78°58.0'N	04°48.8'W	1436	CTD
		10:20	78°57.8'N	04°48.4'W	1448	
	PS59/170	11:13	78°59.9'N	05°16.7'W	1129	CTD
		11:48	78°59.9'N	05°17.3'W	1117	
	PS59/171	13:01	78°59.4'N	06°05.5'W	451	CTD
		13:19	78°59.3'N	06°05.3'W	454	
	PS59/172	14:58	78°59.9'N	06°53.5'W	280	CTD
		15:11	79°00.0'N	06°52.9'W	273	
	PS59/173	15:48	78°58.4'N	07°13.1'W	251	CTD
		16:01	78°58.5'N	07°12.7'W	254	
	PS59/174	16:55	78°59.9'N	07°42.4'W	192	CTD
		17:07	78°59.9'N	07°42.0'W	189	
	PS59/175	17:44	79°00.5'N	08°00.8'W	185	CTD
		17:56	79°00.5'N	08°00.3'W	186	
	PS59/176	18:45	78°59.4'N	08°29.9'W	176	CTD
		18:55	78°59.4'N	08°29.6'W	177	
	PS59/177	19:48	78°59.9'N	08°57.5'W	283	CTD
		20:04	78°59.8'N	08°57.2'W	286	
	PS59/178	21:26	78°59.7'N	09°30.5'W	230	CTD
		21:38	78°59.8'N	09°30.4'W	224	
	PS59/179	22:38	79°00.4'N	10°00.4'W	275	CTD
		22:52	79°00.4'N	10°00.4'W	273	
	PS59/180	23:34	78°59.5'N	10°30.4'W	311	CTD
		23:49	78°59.5'N	10°30.2'W	311	
24.07.01	PS59/181	00:36	79°00.1'N	10°79.7'W	246	CTD
		00:44	79°00.7'N	10°59.9'W	246	
	PS59/182	01:35	79°00.4'N	11°27.9'W	235	CTD
		01:47	79°00.4'N	11°27.9'W	235	
	PS59/183	02:51	79°00.0'N	11°46.0'W	300	CTD
		03:05	79°00.1'N	11°45.9'W	292	
25.07.01	PS59/184	08:05	78°49.9'N	00°00.6'W	2643	CTD
		09:30	78°49.8'N	00°02.8'W	2636	
	PS59/185	10:40	78°40.0'N	00°00.3'E	1820	CTD
		11:36	78°39.5'N	00°00.9'E	1787	
	PS59/186	12:50	78°30.3'N	00°01.0'W	2782	CTD
		14:10	78°30.2'N	00°00.7'W	2782	
	PS59/187	16:16	78°15.0'N	00°00.2'W	3039	CTD
		17:43	78°15.0'N	00°00.4'E	3039	

	PS59/188	19:29	78°00.1'N	00°00.3'W	3119	CTD
		21:03	78°00.0'N	00°00.8'W	3110	
26.07.01	PS59/189	00:33	77°30.0'N	00°00.4'E	3183	CTD
		02:01	77°30.0'N	00°00.7'E	3184	
	PS59/190	05:35	77°00.0'N	00°00.0'	3250	CTD
		07:08	77°00.7'N	00°00.5'E	3247	
	PS59/191	09:54	76°39.8'N	00°00.1E	3260	CTD
		11:29	76°40.2'N	00°00.4'E	3258	
	PS59/192	13:53	76°19.9'N	00°00.1'W	3131	CTD
		15:22	76°20.4'N	00°01.2'W	3151	
	PS59/193	17:53	76°00.0'N	00°00.0'	2697	CTD
		19:09	76°00.2'N	00°00.8'E	2718	
	PS59/194	20:27	75°49.9'N	00°00.4'W	1970	CTD
		21:26	75°49.9'N	00°00.3'W	1968	
	PS59/195	23:51	75°30.0'N	00°00.2'W	3766	CTD
27.07.01		01:37	75°30.6'N	00°02.2'E	3774	
	PS59/196	03:30	75°15.0'N	00°00.3'W	3773	CTD
		05:21	75°15.4'N	00°00.6'W	3772	

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