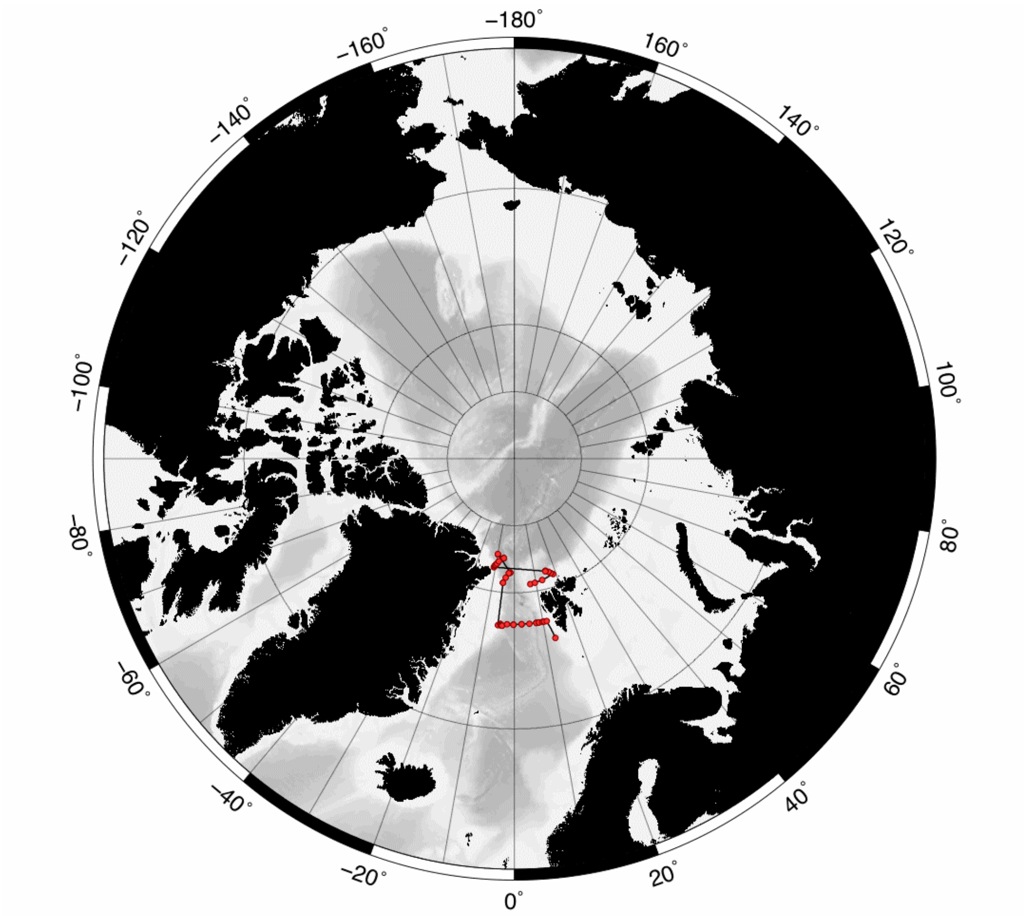
CRUISE REPORT: ARK-II_3

(Updated JAN 2013)



Highlights

Cruise Summary Information

WOCE Section Designation	**ARK-II_3**
Expedition designation (ExpoCodes)	**06AQ19840720**
Alias	**ARCHY, ARKTIS II/3, NFS**
Chief Scientists	**Gotthilf Hempel Ret. / AWI**
Dates	1984 Jul 19 - 1984 Aug 7
Ship	FS *Polarstern*
Ports of call	Longyearbyen, Norway - Tromsö, Norway
Geographic Boundaries	82° 46' N 10° 38.6' W 18° 35.3' E 76° 20' N
Stations	32
Floats and drifters deployed	0
Moorings deployed or recovered	0

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Links To Select Topics

Shaded sections are not relevant to this cruise or were not available when this report was compiled.

3. WASSERMASSEN IN DER FRAM–STRASSE UND IM NORDPOLARMEER

WATER MASSES IN FRAM STRAIT AND IN THE ARCTIC OCEAN

Dritter Fahrtabschnitt (Third Cruise Leg)
des FS *Polarstern*: Arktis 11/3

Fahrtleiter (Chief Scientist): Gotthilf Hempel (AWI)*

3.1. Aufgaben

Die Fraxn–Straße zwischen Grönland und Spitzbergen ist die einzige Tiefwasserverbindung zwischen dem Arktischen Ozean und dem übrigen Weltmeer. Ihre Schwellentiefe im Lena–Graben beträgt 2600 m. Bis vor wenigen Jahren nahm man an, daß der Arktische Ozean hinsichtlich der Wassermassen, die unterhalb dieser Schwellentiefe lagern, weitgehend abgeschlossen ist. Die Ergebnisse der Reisen von *Hudson* 1982, *Meteor* 1982 und *Polarstern* 1983 ergaben aber ein sehr kompliziertes Bild der vertikalen und horizontalen Zirkulation, das stark geprägt wird von der Bodentopographie und von verschiedenartigen Vermischungsprozessen. Diese Daten stammen allerdings überwiegend aus dem Gebiet südlich 80°N, wo auch 1984 während MIZEX hochgenaue CTD–und Nährstoftmessungen durchgeführt wurden. Aufgabe des 3. Fahrtabschnittes war es, das ozeanographische Beobachtungsprogramm möglichst weit in die verschiedenen Becken nördlich von Spitzbergen und nördlich der Fram–Straßen–Schwelle vorzutreiben. Die bisherigen aus diesem Gebiet vorliegenden Datensätze stammten meist von driftenden Eisschollen. Sie reichen nicht in große Tiefen. Die wenigen älteren Schiffsdaten sind nur bedingt brauchbar.

Die Entwicklung der Spurenstoff–Chemie und der Radiochemie eröffnete in den letzten Jahren eine wesentliche Ergänzung der auf Temperatur– und Salzgehaltsmessungen fußenden Identifizierung von Wassermassen und ihres Schicksals im Gefolge von Transport- und Vermischungsprozessen.

Bezogen auf unser Untersuchungsgebiet können natürliche und anthropogene Spurenstoffe und ihre radioaktiven Isotope sowohl das Alter des Arktischen Bodenwassers der internen Tiefenzirkulation als auch die Wechselwirkungen zwischen den Wassermassen nördlich und südlich der Fram–Straßen–Schwelle sowie den Austausch in mittleren Tiefen anzeigen. Ziel des Fahrtabschnittes ist u. a. eine neue Beschreibung der Rezirkulation des atlan–tischen Wassers, das der Westspitzbergenstrom in mehreren Ästen um das Yermak–Plateau herumführt und das hier auf arktische Wassermassen trifft, mit denen es im Ostgrönlandstrom teilweise wieder nach Süden gelenkt wird.

FS *Polarstern* als geräumiger Forschungseisbrecher bot sich als geeignete Plattform für eine breitangeleqte Kooperation zwischen starken, instrumentell gut ausgestatteten – vorwiegend amerikanischen – Gruppen von Meereschemikern, deutschen und norwegischen Ozeanographen und deutschen Planktoloqen an.

Das biologische Programm bezog sich auf die Erfassung der Zooplankton–Gemeinschaften in den verschiedenen Wassermassen. Das im Vorjahr nördlich von Spitzberaen gesammelte Material sollte durch weitere Fänge ergänzt werden. Vor allem aber war ein planktologischer Zonalschnitt quer durch die Fram–Straße geplant, auf dem die verschiedenen Zooplankton–Biozönosen nebeneinander erwartet werden konnten. Neben dem zoogeographischen Aspekt wurde der Frage nach der Vertikalverteilung und den Beziehungen zur Eisbedeckung nachgegangen. Dabei sollten die Untersuchungen des MIZEX–Abschnittes über den Einfluß von Wassertemperatur und Eisbedeckung auf Stoffwechsel und Fortpflanzung bei dominanten Copepoden in beschränktem Umfang fortgesetzt werden. Der geplante ozeanographisch–chemische Schnitt über die Ausflüsse von Amundsen– und Nansen–Becken in die nördliche Fram–Straße sollte genutzt werden, um die bisher nicht ausreichend

* Erläuterung der Institute unter "Beteiligte Institute"

bekannte Plankton–Fauna dieser hocharktischen Region mit tiefreichenden Vertikalfängen zu erfassen. Das norwegische Polar–Institut führt seit mehreren Jahren ein sehr intensives Programm zur Erfassung der Vogel– und Säugetierfauna der Seegebiete um Spitzbergen und Ostgrönland durch. Aufgrund der Eisverhältnisse sind die Beobachtungen, die meist von relativ kleinen Forschungsschiffen durchgeführt werden, ungleichmäßig verteilt. Die geplante Fahrtroute von *Polarstern* versprach, einige Lücken im Beobachtungsnetz zu schließen. Daher führten vier junge Biologen im Auftrag des norwegischen PolarInstituts rund um die Uhr Vogel– und Säugetierzählungen vom Peildeck aus durch.

Die Verteilung der Eisbedeckung und der Eisdicken in der Fram Straße sollte von einem weiteren Wissenschaftler des Norsk Polarinstitutts erfaßt werden.

Der Fahrtabschnitt diente – wie üblich – auch zur Prüfung und Eichung von Geräten, die für die Arbeiten des Alfred–Wegener–Instituts neu beschafft waren und auf der nächsten Antarktis–expedition routinemäßig eingesetzt werden sollten: Autoanalyzer, Multinetz, Pilkmaschine zum Fang von Tintenfischen.

In foiqenden Gebieten sollte *Polarstern* arbeiten:

- Gebiet des Yermak-Plateaus,
- Südrand des Nansen-Beckens nördlich von Nordostland (Spitzbergen),
- ein Zonaischnitt bei ca. 82°30'N durch die beiden Einlässe vom Amundsen-Becken und Nansen-Becken zum Lena-Graben vor NO-Grönland,
- in der Längsachse des ostqrönländischen Grabensystems von 82° N bis 78° N,
- auf ca. 78° N vom grönländischen Schelf quer durch die Fram-Straße bis auf den Spitzbergen-Schelf.

Das gewählte Arbeitsgebiet lag hinsichtlich der Eisbedeckung buchstäblich am Rande des für *Polarstern* Erreichbaren. Die Programmgestaltung mußte entsprechend flexibel gehalten werden.

3.2. Reiseverlauf Longyearbyen-Tromsö

19. Juli bis 8. August 1984

Nachdem FS *Polarstern* am 18. Juli nachruittags vor Longyearbyen (West-Spitzberqen) auf Reede vor Anker gegangen war, erfolgte der Personalaustausch in der Nacht des 18./19. Juli. Die Wissenschaftler und Techniker des 3. Fahrtabschnittes trafen auf dem Flugplatz Longyearbyen die Aussteiger nur zu einem kurzen Gespräch. Für die Fahrtleiter des 2. und 3. Fahrtabschnittes war am 19. Juli ausreichend Zeit für einen gründlichen Erfahrungsaustausch. Am 19. Juli vormittags waren Schiffsführung und Wissenschaftler des FS *Valdivia* an Bord der *Polarstern* und nachmittags fand ein kleiner Empfang für die Honoratioren von Longyearbyen statt. *Polarstern* ging 20.00 GMT Anker auf.

Bei ruhigem Wetter erreichte das Schiff am 20. Juli nachmittags seine erste Station auf dem Yermak-Plateau am Rande des Packeises. Zwei weitere Stationen am Ostrand des Plateaus folgten, sie lagen im mäßig dichten Packeis. Hier wurde physikalischozeanoqraphisch, chemisch und bioloqisch gearbeitet.

55 Seemeilen weiter ostwärts, auf dem Schelf des Nordostlandes begann ein Schnitt über dem Südosthang des Nansen-Beckens. Für die Chemiker und physikalischen Ozeanographen war die tiefste Station auf 2400 m Wassertiefe von besonderer Bedeutung. Hier hielt sich das Schiff im dichten Packeis bis zum 22. Juli abends auf. Bei anfangs günstigen Wetterbedinqunqen suchte

Polarstern anschließend den kürzesten Weg zur Packeisgrenze, um möglichst im freien Wasser bis zum Yerniak-Plateau zurückzukehren, wo am 23. Juli, bei meist dichtem Nebel, drei biologische Stationen erledigt wurden. Dann begann die 600 Seemeilen lange Fahrt zur Nordostecke Grönlands. Dabei wurde die Packeiszunge des Ostgröri-landstromes weit südlich auf 78°20'N gekreuzt, weil hier nach der detaillierten Hisheratung durch Herrn Strübing, Deutsches Hydrographisches Institut Hamburg, mit den geringsten Zeitverlusten zu rechnen war. Tatsachlich erfolgte die Passage unter Umgehung großer Eisschollen relativ schnell, so daß *Polarstern* bereits am 25. Juli im Treibeis, das nach Norden zu immer lockerer wurde, etwa entlang der 200 m-Linie unter der grönländlichen Küste nordwärts vordringen konnte. Am 26. Juli morgens wurde auf 81°46'N 10°41'W die Anfangsposition für den Südwest - Nordost Schnitt durch den Nordausqang des Lena-Grabens erreicht. 46 Stunden lang konnte auf sechs Stationen in freiem Wasser auf Tiefen zwischen 200 m und 4500 m ein intensives Programm aller beteiligten Disziplinen abgearbeitet werden. Für die Wahl der Stationspositionen erwies sich auch die neueste Tiefenkarte des Office of Naval Research als wenig hilfreich. So wurde für die Suche nach dem tiefsten Teil des Lena-Grabens ein Lotprofil gefahren, das Wassertiefen von 4500 m ergab, wo laut Karte bereits der Osthang des Grabens mit Wassertiefen um 3000 m lag. Dieser Osthang konnte wegen der massiven Barriere von mehrjährigem Packeis, die die Polynya östlich begrenzte, nicht erreicht werden. Am 28. Juli folgte ein kurzer Abstecher nach Nordwesten, etwa in der Achse des Lena-Grabens, wo auf 82°45'N 9°40'W die nördlichste Station der Reise mit vollem ozeanographischeni und biologischem Programm erreicht wurde. Die allgemein günstige Eislaqe dieses Jahres und die anhaltenden südlichen Winde, die das Treibeis weit nach Norden verdriftet hatten, erlaubten ein noch weiteres Vordringen nach Norden, wobei allerdings das Treibeis zunehmend großflächiger und massiver wurde. Auf 83°00'N 10°28'W drehte das Schiff nach Süden ab und begann einen Meridionalschnitt mit XBT zur Erfassung des Atlantikassers entlang des Lena-Grabens. Bei den Arbeiten im Eis und der Suche nach geeigneten Positionen für die Stationen wurden wir tagelang vom dichten Nebel behindert, der seit dem 22. Juli jegliche Aufklärungstätigkeit durch Hubschrauber verhinderte. Am 29. Juli konnte *Polarstern* im freien Wasser vor der im wesentlichen nord-südlich verlaufenden Pac1ceisgrenze auf drei Stationen am Osthang des Grabens arbeiten und anschließend den XBT-Schnitt nach Süden fortsetzen. Der Südkurs am 30. und 31. Juli führte bei Nebel meist durch schweres Packeis. Am Westhang des südlichen Lena-Grabens erfolgte eine biologisch-ozeanographische Station, bei der das Schiff für Eisdickenmessungen an einer großen Schollelängsseits ging.

Auf Wunsch des MIZEX-Koordinators bemühten wir uns, eine norwegische Driftboje von einer Eisscholle zu bergen. Dies gelang nach längerer Suche am 1. August morgens. Der Beginn des Zonalprofils über die Fram-Straße verzöqerte sich damit beträchtlich.

Der "Fram–Straßen–Schnitt" auf 77°40'N sollte die horizontale und vertikale Verteilung der Wassermassen vom Grönländischen Schelf über die Grönlandsee und den Mittelatlantischen Rücken zur Norwegischen See und dem West–Spitzberqenschelf erfassen. Alle Disziplinen von den Vogel– und Robben–Beobachtern über die Zoo- und Phytoplanktologen zu den Spurenstoff–Chemikern, physikalischen Ozeanographen und Glaziologen waren gleichermaßen an diesem Schnitt interessiert. Daraus ergab sich ein sehr komplexes Untersuchungsprogramm. Starker Strom am steilen Schelfrand bei schwierigen Packeis–Verhältnissen und meist dichtem Nebel machte die Einhaltung eines strikten Stationsprogrammes anfangs unmöglich. Aufdampfen auf Station, um die geforderte Position und Tiefe wieder zu erreichen, konnte Stunden kosten, da bis zu 5 sm lange Eisschollen im dicken Packeis zu umfahren waren. Auch kleine technische Ausfälle an den Geräten, Winden und Zählwerken verzögerten den Stationsablauf; sie konnten aber dank des Einsatzes und Geschickes der Elektroniker meist mit bordeigenen Mitteln behoben werden. Vom 1. – 5. August wurden anfangs bei Nebel, später bei starken südwestlichen Winden auf dem Fram-Straßen–Schnitt 13 ozeanographische Meßstationen und zwei Untersuchungen von Eisschollen durchgeführt. Stationen nahmen bis zu 13 Stunden in Anspruch, wenn große Prohennenqen aus Tiefen bis 3400 m genommen wurden. Dabei richtete sich das chemische und biologische Sammelprogramm z.T. nach den durch CTD–Messungen ermittelten hydrographischen Verhältnissen. So erübrigte sich z.B. im Becken der Norwegischen See die Entnahme von Tiefenwasser für Tritium und Caesium, da das Recken offenbar seit den Untersuchungen der *Hudson* im Frühjahr 1982 stark durchspült worden war.

Die bei den meereschemischen Arbeiten im Fram–Straßen–Schnitt eingesparten Stunden wurden am Sonntag, dem 5. August für einen Besuch im Hornsund (Spitzberqen) verwendet, wo im ruhigen Wasser eine zum Fang von Tintenfischen neu beschaffte Pilk–Maschine getestet wurde; diese Tests wurden auf der Fugloya–Bank am 7. August fortgesetzt. Vorher aber lief *Polarstern* auf dem Weg von Spitzbergen nach Tromsö eine Position auf 1500 m Wassertiefe westlich der Bäreninsel an, um ein neubeschafftes CTD–System zu erproben. Um einen Tiefenmesser des Multinetzes zu überprüfen, wurde am 6. August eine weitere Station gefahren. Am 7. August, 19:00 Uhr Ortszeit, machte *Polarstern* an der Breivika–Pier von Tromsö fest, wo am folgenden Morgen die Entladung schwerer Expeditionsgeräte begann. Die eingeschifften Wissenschaftler und Techniker verließen das Schiff im Laufe des Vormittags. Nachmittags hatte die Bevölkerung von Tromsö und besonders die Angehörigen der Universität Gelegenheit, *Polarstern* zu besichtigen. Norwegische Wissenschaftler, die an der Expedition teilgenommen hatten, unterstützten ihre deutschen Kollegen bei Gruppenführungen durch das Schiff. Am Abend fand ein offizieller Empfang für Honoratioren der Stadt und für mann interessierte Universitätsprofessoren statt. An diesem Empfang nahmen bereits Kapt. Zapff, der Kaot. Suhrmeyer in Tromsö ablöste, und Prof. Thiede als Fahrtleiter des folgenden Expeditionsabschnittes teil. Anschließend bunkerte *Polarstern* und die Teilnehmer von ARK 11/4 kamen an Bord. Am 9. August, 9:00 Uhr, verließ *Polarstern* Tromsö.

Polarstern hat sich auch auf diesem Fahrtabschnitt als eisbrechendes Forschungsschiff wieder bewährt. Es ist eine hervorragende Basis für multidisziplinäre Arbeit im Packeis. Dabei ist aber eine sehr enge Kooperation, ein gegenseitiges Mitdenken von wissenschaftlicher Fahrtleitung und Schiffsführung erforderlich, denn ein starres Festhalten an geplanten Kursen und Stations–Positionen ist im Eismeer technisch nicht möglich und in Seegebieten, deren Bodentopographie und Strömungsverhältnisse nur schlecht bekannt sind, wissenschaftlich nicht sinnvoll. Wir haben auf diesem Fahrtabschnitt hinsichtlich der Flexibilität der Programmdurchführung viel dazugelernt, qeqenseitiges Verstehen eingeübt. Geduld mußten auch die einzelnen Arbeitsqruppen beweisen, die oft stundenlang auf ihren Einsatz warten mußten, weil das Schiff nicht die geforderte Wassertiefe oder geographische Position erreichte oder dort nicht die gewünschte ozeanographische Situation, die erwartete Konfiguration der Wassermassen, antraf.

Die Operationen im Packeis vor Ostqrönland – meist bei Nebel – bedeuteten für Kapitän, Brückenoffiziere, Rudergänger und Windenfahrer eine starke Anspannung. Sie wurde besonders für den Kapitän zu einer sehr hohen Dauerbelastung. Die Sicherheit, mit der Schiffsführung und Besatzung die Anforderungen der Forschungsarbeiten im Eismeer bewältigten, fand hohe Anerkennung auch bei den mit der Arktisforschung vertrauten norwegischen und amerikanischen Kollegen. Die Stationen dieses Fahrtabschnittes sind in der Abbildung 3.1 dargestellt.

Water masses in Fram Strait and in the Arctic Ocean

3.1 a Objectives (Summary):

Fram Strait represents the only deep water connection between the Arctic Ocean and the Atlantic. Formerly, the deep water of the Arctic was considered as being cut off from regular exchange processes. Based on observations of recent cruises (*Hudson* 1982, *Meteor* 1982, *Polarstern* 1983), a new and complex pattern of vertical and horizontal exchange processes across the sill evolved. The circulation pattern is strongly influenced by the bottom topography and a variety of different mixing processes. While existing data were mainly collected south of 80°N, including MIZEX 1984, the objective of leg 3 was to extend the observations as far as possible into the basins north of Spitsbergen and to the north of the Pram Strait sill.

Recent advances in tracer and radionuclide chemistry have greatly improved the established methods of water mass indentification, especially, with respect to transport and mixing processes. Natural and anthropogenic tracers, including their radioactive isotopes, allow estimates of the age of the Arctic bottom water, and to quantify the exchange processes across the Fram Strait sill. A major objective of this cruise was the evaluation of the complicated flow pattern in Fram Strait. Water masses of Atlantic origin are transported around the Yermak Plateau, and are also recirculated in the southward flow of the East Greenland Current after mixing with Arctic Ocean water.

The biological programme focussed on the zooplankton communities associated with the different water masses, the vertical distribution of the species and their correlation with ice cover. Physiological experiments of the previous leg, MIZEX cruise, were to be continued. In addition, birds and mammals were registered along the cruise track, which covered areas not observed before. During the entire cruise new equipment was tested and calibrated: a fluorescence probe, an autoanalyzer, the Multi–net, and a jigging machine for squid fishing.

The extension of the pack ice and the thickness of the floes was measured in the Fram Strait area.

Proposed regions of research activities:

- Area of the Yermak Plateau,
- Southern part of the Nansen Basin north of Svalbard,
- Transect at 82°30'N through the entrance of the Lena Trough off the coast of northeast Greenland,
- Longitudinal transect through the East–Greenland trough system from 82°N to 78°N,
- Latitudinal transect along 78°N between the Greenland Shelf and the Svalbard Shelf.

3.2 a Cruise report: Longyearbyen – Tromsö
(July 19 to August 8, 1984)
(Summary)

After changing scientific and technical personnel in Longyearbyen, *Polarstern* set sail at 20:00 on July 19, 1984. The next day, the scientific programme started with three stations across the ice edge in the area of the Yermak Plateau.

55 nm to the east, a transect along the southeast slope of the Nansen Basin followed. *Polarstern* returned to the Yermak Plateau to complete three more biological stations. From here the ship progressed to the northeast tip of Greenland. During the 600 nm run, the ship's course was selected according to the pack ice situation. On July 26, *Polarstern* reached 81°46'N 10°41'W, the first station along the transect through the entrance of Lena Trough. A very involved 46 h scientific programme started. Some of the arising problems were due to the lack of charts in the still un–surveyed area, and the eastern slope of Lena Trough could not be reached because of a thick multi–year ice cover. On July 28, the northernmost station (82°45'N 9°40'W) was completed. A favourable ice situation allowed *Polarstern* to proceed as far north as 83°00'N 10°27'W.

During a southbound longitudinal transect through Lena Trough XBT measurements were done underway. Dense fog restricted any survey of the ice cover by helicopter. On July 29, *Polarstern* completed three stations on the eastern slope of the trough; then continued the southbound voyage in fog and heavy ice with XBT stations underway. Another multi–disciplinary station was located on the western slope of Lena Trough.

At the request of the MIZEX coordinator, a Norwegian drifting buoy was picked up on Aug 1. Thus, the Fram Strait transect along 77°40'N started with considerable delay. The complex multi-disciplinary programme was partially hampered by strong shelf currents, thick pack ice, heavy fog and equipment failures. In managing the latter, the ship's electronic personnel were most helpful. By August 5, a total of 13 stations in Fram Strait and two ice floe experiments were completed.

During a short visit in Horn Sound (Spitsbercien) and later near Fugloya Bank a new jigging machine for squid fishing was tested. *Polarstern* reached Tromsö by 19.00 LT on August 7, 1984.

During this leg, the icebreaking R.V. *Polarstern* proved to be a most suitable base for a multi-national cooperation of American chemical oceanographers, German and Norwegian physical oceanographers and German planktologists.

Of utmost importance for the execution of the scientific programme was the good cooperation between the captain of the vessel and the chief scientist. Flexibility with respect to the ship's course and the position of the stations was necessary when *Polarstern* operated in areas of unknown bottom topography and current movements particularly under conditions of heavy ice and fog. The positions of stations of this leg are portrayed on Figure 3.1.

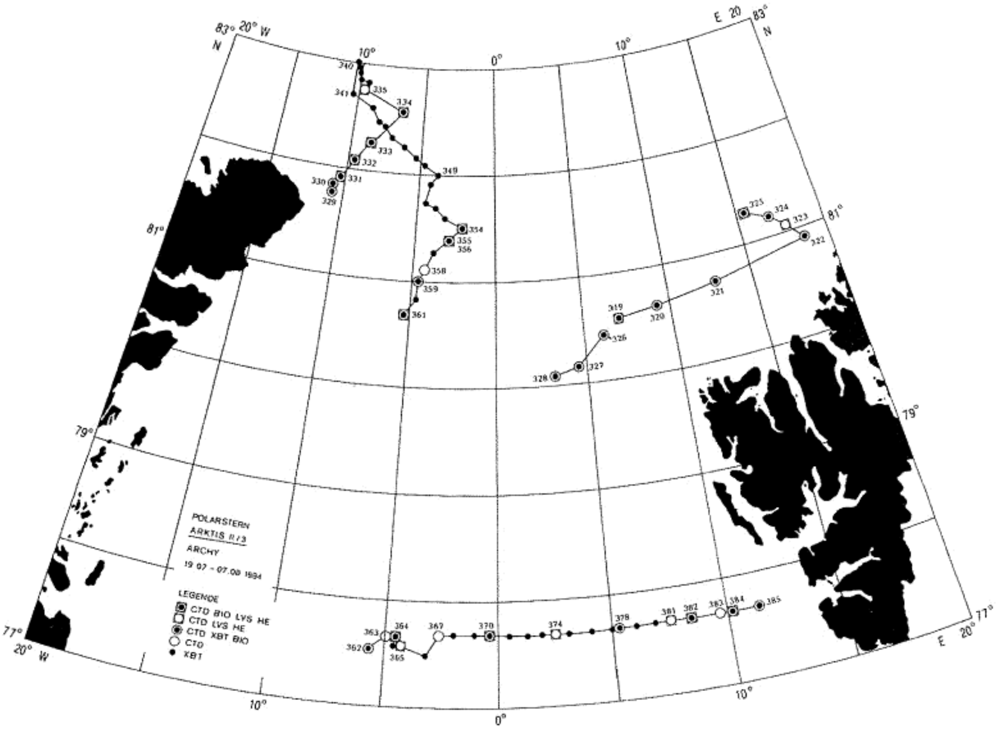

Figure 3.1: *Station map of cruise leg Arktis II/3*

3.3 Weather situation between 20.7. and 6.8.1984 (SWA)

At the beginning of the cruise the working area was influenced by high pressure centered over the Barents Sea. The anticyclonic flow changed to a cyclonic one very soon, due to a high level trough extending from Greenland to Central and Eastern Europe, acting as a steering flow. At its front side depressions were moving towards the northeastern edge of Greenland. Apart from short time intervals of high pressure due to a persistent Siberian high, cyclonic air flow was predominant. During this time easterly wind directions were prevailing. The air masses were of warm continental character modified by the long way across the Barents Sea where they took up moisture. At the beginning of August the large scale pattern changed significantly. A frontal zone was built up from New Fondland over

Iceland to Svalbard. Now strong southwesterly winds were prevailing, transporting maritime Atlantic air. Visibility conditions were moderate to poor during nearly the entire cruise.

We did 131 observations. At 47.3 % of these observations fog occurred (Vis. 1000 m or less); if expressed in days with prevailing fog, 11 days out of 16 were foqqy. For detailed information see Table 3.1. The wind statistics show the following picture: Force 1 - 4 (velocity in beaufort) occurred at ca. 64% of all observations, force 5 - 7 at 36%. For detailed information see Table 3.2.

Table 3.1: *Visibility in % related to 131 observations, done in 3 hours intervals*

Vis.	<1000 m	1 - 3 km	3 - 9 km	9 - 20 km
	47.3	15.3	19.1	1

Table 3.2: *Wind velocity in % related to 131 observations, done in 3 hours intervals*

Beaufort	1	2	3	4	5	6	7	8
	8.4	12.2	25.2	18.3	17.6	15.3	3.0	0

3.4 Chemical and physical oceanography (DHI, GPiB, SIO)

An interactive set of processes ties the Arctic Ocean, the Greenland/Norwegian Sea, and the peripheral shelf seas into a unique thermohaline system, with deep and bottom waters primarily forming and circulating internally, while various intermediate waters ventilate the deep North Atlantic. Programmes of measurements of geochemical tracers and routine hydrographic properties were carried out during the *Polarstern* cruise Arktis 11/3 to determine the characteristics of the water masses from the surface to bottom both north and south of Fram Strait. Special attention was given to the routine hydrographic measurements because geochemical tracer data have been previously collected from this domain without sufficient background information, especially for the properties needed to calculate density, to make comparisons with other regions. Density is closely tied to salinity at the extremely cold temperatures typical of these domains.

A team from the Scripps Institution of Oceanography brought a rosette water sampler with a capacity of 24 10–liter sample bottles plus laboratory equipment, calibration standards, and supplies to determine salinity, oxygen, and nutrient salts in the seawater samples from the rosette. They also brought low range deep sea reversing thermometers to measure in–situ temperatures at up to six depths per rosette cast. The rosette was, without problems, mated with a Neil Brown CTD from the Alfred Wegener Institut. The CTD was run mainly by the DHI group. Pressures and temperatures for the water samples were provided by the CTD measurements. The Scripps rosette provided water samples for several other programmes of measurements. These include freons (LDGO) and Cesium/strontium isotopes (WHOI) and carbon dioxide partial pressure (LDGO), oxygen–18 (CaTe and Geofysisk Institutt), tritium (Miami Tritium Lab,), helium–3 (Institut für Umweltphysik, Heidelberg), neodynium, lead and uranium (all CaTe),

The preliminary hydrographic data show previously unknown features important to our understanding of the circulation. The salinity measurements provide an example of data quality: the Scripps salinities, carefully collected and run within 48 hours of collection on a Guildline Auto–Sal salinometer, with a fresh vial of IAPSO Standard Seawater for each cast, are nominally accurate to ± 0.003 PSU. The *Polarstern* measurements in individual deepwater masses appear to have a standard deviation of less than ± 0.002 with respect to the calibration standard.

It is interesting to compare the deep Arctic Ocean salinity results - just north of Fran Strait - with those from the central Greenland and Norwegian seas, regions well sampled with similar standards on other recent expeditions. The Greenland and Norwegian seas are known to be nearly isohaline below 2000 m. But a deep salinity gradient plus several extrema, depending on the respective location, appear in the *Polarstern* Arctic Ocean results. A similar structure is also seen at the western boundary of the Fram Strait section. Later analysis and a comparison with tracer data may show if these extrema are interdependent. It is also not known as yet whether these deep salinity extrema arise from the proximity to an active boundary region (Fram Strait) or are ubiquitous throuhout the Eurasian sector of the Arctic Ocean. From the data it becomes quite evident that on the East Greenland side of Fram Strait the current system has a very much banded structure, with several cores well separated from each other on different density surfaces.

The Fram Strait sections clearly show the warm Atlantic water in the West Spitsbergen Current flowing north. This current provides the only heat input to the Arctic Ocean, but it is not known how much of the West Spitsbergen Current actually enters the Arctic Ocean and how much is recirculated in Fram Strait. Our section shows two cores of this recirculating high salinity water, the westmost of which is at the East Greenland Shelf break.

All the rosette sampling programmes appear to have met their goals. Because the new data form a northward and westward extension of the available high–quality data base near Fram Strait they shall be incorporated into many studies of the thermohaline circulation und exchange in this region.

3.5 Large volume seawater radiochemistry (UL, WHOI, DHI)

The broad objectives of this proramme are to use artificial radionuclides as tracers of water circulation in the Arctic and sub–Arctic oceanic reqions. These artificial radionuclides have been introduced to the region from nuclear weapon testing in the atmosphere and from discharges to the Irish Sea of radioactive waste from nuclear fuel reprocessing. A major benefit of these tracers is that they can provide some information on the rates of the various water transport processes. The area of Fram Strait is very important in that it is the location of exchanqe between the Arctic Ocean to the north – and the Norwegian/Greenland Sea to the south.

The large volume sampling programme on the cruise was divided between the Lund University programme and the Woods Hole programme. The Lund University programme concentrated on the collection of large volume surface water samples to be analyzed for ^{3}H, ^{90}Sr, ^{137}Cs, ^{134}Cs, $^{239+240}Pu$, ^{241}Am and ^{99}Tc. Sample sizes ranged from 50 to 1700 liters depending on the radionuclide to be analyzed. The stations or positions at which surface samples were collected are compiled in Table 3.3 together with the radionuclides to be measured.

Table 3.3: *Surface water samples (UL)*

Stn or position	Nuclide						
	^{3}H	^{90}Sr	^{137}Cs	^{134}Cs	$^{239+240}$Pu	^{241}Am	^{99}Tc
319	x	x	x	x	x	x	x
321	x	x	x	x	x	x	x
322	x	x	x				
325	x	x	x	x	x	x	x
327	x	x	x	x	x	x	x
329	x	x	x	x	x	x	x
331	x	x	x				
333	x	x	x	x	x	x	x
334	x	x	x				
335	x	x	x				
354	x	x	x	x	x	x	x
359	x	x	x				
363	x	x	x	x	x	x	x
365	x	x	x				
366	x	x	x	x	x	x	x
367	x	x	x				
371	x	x	x				
375	x	x	x				
381	x	x	x				
383	x	x	x				
384	x	x	x				
76°45'N 14°40'E	x	x	x				
76°58'N 14°36'E	x	x	x				
386	x	x	x				
74°44'N 15°05'E	x	x	x				
73°55'N 16°00'E	x	x	x				
73°27'N 16°29'E	x	x	x				
72°53'N 16°52'E	x	x	x				
72°24'N 17°28'E	x	x	x				
71°38'N 18°19'E	x	x	x				
71°11'N 18°38'E	x	x	x				
70°47'N 19°06'E	x	x	x				

Table 3.4: *Large volume samples collected for ^{137}Cs, ^{90}Sr and ^{3}H analysis*

Region		Station	Atlantic Water	Polar Water	Deepwater
Atlantic Inflow					
	S.Fram Strait	381-2	7	-	2
	NW Yerrnak Plateau	354-5	3	-	
	Nansen Basin	325	7	1	3
		319	1	-	-
		327	1	-	-
		361	2	-	-
Arctic Outflow					
	E.Greenland	362	1	-	-
	Slope	363	2	1	-
		364-5	5	1	5
	SW Nansen Basin	329	-	1	-
	81°46'N - 83°32'N	331	6	1	4
		332	1	-	1
		334	6	1	4
		335	1	-	-
Boreas Basin					
		310	4	3	

Table 3.5: *Large volume samples collected for ^{14}C and ^{85}Kr analysis*

	Station	Depth (m)
Nansen Basin		
	335	250
	332	600
	332	1000
	334	1500
	334	2500
	334	3566
	334	4266

The Woods Hole programme concentrated primarily on subsurface sampling. Large volume samples for ^{137}Cs, ^{90}Sr and ^{3}H analysis were collected using multiple tripping of bottles on a 24 x 10-liter rosette, 100 liter GOFLO bottles and 280 litre "Gerard" bottles (from DHI). The number of samples collected in the various regions are tabulated in Table 3.4 according to type of water mass. On the Atlantic inflow side of Fram Strait we collected samples along a section at 77°40'N, at locations to the northwest of the Yermak Plateau and in the southern portion of the Nansen Basin. The outflow samples were collected in the Lena Trough north of Fram Strait sill and south of the sill on the East Greenland slope at 77°40'N. In all cases the comparison of the tracer properties of the various water masses on either side of the Fram Strait sill should provide information about the nature of the circulation and exchange processes.

The complete profile of large volume samples was collected in the Nansen Basin for radiochemical analysis of ^{14}C by Dr. C. Ostlund of the University of Miami and for ^{85}Kr by Dr. W. Smethie of the Lamont-Doherty Geological Observatory, New York (Table 3.5). For the DHI radiochemistry group large volume samples were taken at 13 positions for the polar surface layer and at the main depth of the Atlantic inflow core. These samples are to be used for calculations of transfer rates between waters of Atlantic and polar origin to assess other surface data from this area.

One negative result of interest in the sampling programme was our failure to find high salinity water in the deep mid–ocean ridge trough just east of the Boreas Basin. In winter 1982, R.V. *Hudson* occupied a station there at which it was shown that the deep water carried both a huge ^{3}H and salt signal. On returning to this location no trace of this water was found. So it seems that the trough has been effectively flushed since 1982.

3.6 Radon daughters in Arctic air (UL)

A number of air filter samples were taken in order to measure the concentrations of the long–lived radon daughters, ^{210}Pb (T=22 y) and ^{210}Po (T=138 d), in arctic air.

These elements are known to adhere to aerosols to practically 100%. Since the radon (^{222}Rn, T=3.8 d) nearly exclusively originates from the decay of ^{226}Ra in the continents, such measurements yield information about the time elapsed since the air mass concerned left a continent, and, furthermore, on the mean residence time of arctic aerosols.

The project is a follow–up to the YMER–80 expedition, which encompassed extensive studies of radon and its daughters in Arctic air.

3.7 Freon studies (LDGO)

The overall objective of the study is to understand better the exchange of water between the Arctic Ocean and the Greenland and Norwegian seas, The specific objectives of the Freon field programme were to measure a vertical section of Freon–11 and Freon–12 across Fram Strait and to measure the vertical distribution of both Freons in the Arctic Ocean. Both of these objectives were met very successfully.

Freon samples were collected from all bottom rosette casts beginning with station 325. A total of about 550 samples were collected from 25 stations. These samples were analyzed on board for Freon–11 and Freon–12 using electron capture gas chromatography. Air samples were also collected and analyzed for Freon–11 and Freon–12. A comparison of inside air to outside air revealed that the ship's atmosphere had a variable freon content ranging from 1.3 to 3 times outside air for Freon–11 and 1.3 to 6 times outside air for Freon–12. These levels did not cause contamination problems.

Final data reduction will be carried out at Lamont Doherty Geological Observatory, but some preliminary calculations were made at sea. The highest and lowest freon concentration were observed at station 334 in the deepest part of northern Fram Strait, The surface water which had a temperature of –1.6°C had Freon–11 and Freon–12 concentrations of approximately 6.1 pmoles/kg and 2.4 pmoles/ka. The water below 3000 m at this station had a salinity of 34.936 to 34.938‰ and was presumably Arctic Ocean Deep Water. This water mass had the lowest freon concentration measured on this cruise, 0.14 pmoles/kq for Freon–11 and 0.08 pmoles/kq for Freon–12. These concentrations are similar to concentrations measured in Norweqian SeaDeep Water, 0.16 pmoles/kg for Freon–11 and 0.15 pmoles/kg for Freon–12, by Bullister and Weiss (1983) on the 1982 *Hudson* expedition.

The Fram Strait section revealed lobes of low freon water at about 2000 m on both the western and eastern slopes. The central part of the 77°40'N transect crossed the northern part of the Boreas Basin. The freon content of the bottom water in the Boreas Basin was 0.71 pmoles/kg for Freon–11 and 0.36 pmoles/kg for Freon–12. This is similar to values measured in the deep Greenland Sea, 0.76

pmoles/kq for Freon–11 and 0.31 pmoles/kg for Freon–12, on the 1982 *Hudson* expedition (Bullister and Weiss, 1983).

In the coming months the freon data will be reduced to its final form and we will work with the other scientists who participated in this cruise in the interpretation of the results.

Reference

Bullister, J.L. and R.F. Weiss. 1983. Anthropogene chlorofluoromethane in the Greenland and Norwegian seas, Science **221:265–268**

3.8 Sea ice measurements (NFl)

The oceanographic condition in the Arctic is dominated by a negative radiation balance which requires a heat transport from lower latitudes. The oceanographic part of this transport is composed of the transport of warm Atlantic water and export of ice through Fram Strait. The other passages to the Arctic Ocean are too small to be of importance in this connection.

The participation in this cruise by the Norwegian Polar Research Institute is part of a long term programme in which information on the ice fluxes in the area has been collected.

The objective of the work was to record the distribution of ice–types and to measure the ice thickness along cross–sections in Fram Strait. For this purpose ice observations (when there was ice) were made every three hours (total 73 ICEOBS), and ice drilling was done as often as possible (5 ice stations, 30 holes). The ice thickness is an extremely important and the least known variable in the dynamics of sea ice transport from the Arctic Ocean.

The ice programme was hampered by poor weather conditions, which prevented helicopter operations. It was impossible to operate on small ice floes (40–100 m in diameter) from the ship, and the drillings therefore had to be made somewhat inside the outer ice edge.

The shiptime was mainly spent on the eastern and western sides of the main core of the ice stream in Fram Strait and ice characteristics in these areas have been pretty well registered. A representation of the results is given in Figure 3.2. It shows that the multi–year ice is concentrated on the western side indicating an ice outflow of older ice, probably from the Beaufort Sea Gyre. The second–year ice increases towards the east, – the winter ice too, indicating that the Transpolar Drift Stream, bringing younger ice from the Siberian shelf, dominates the ice conditions on the eastern side of Fram Strait.

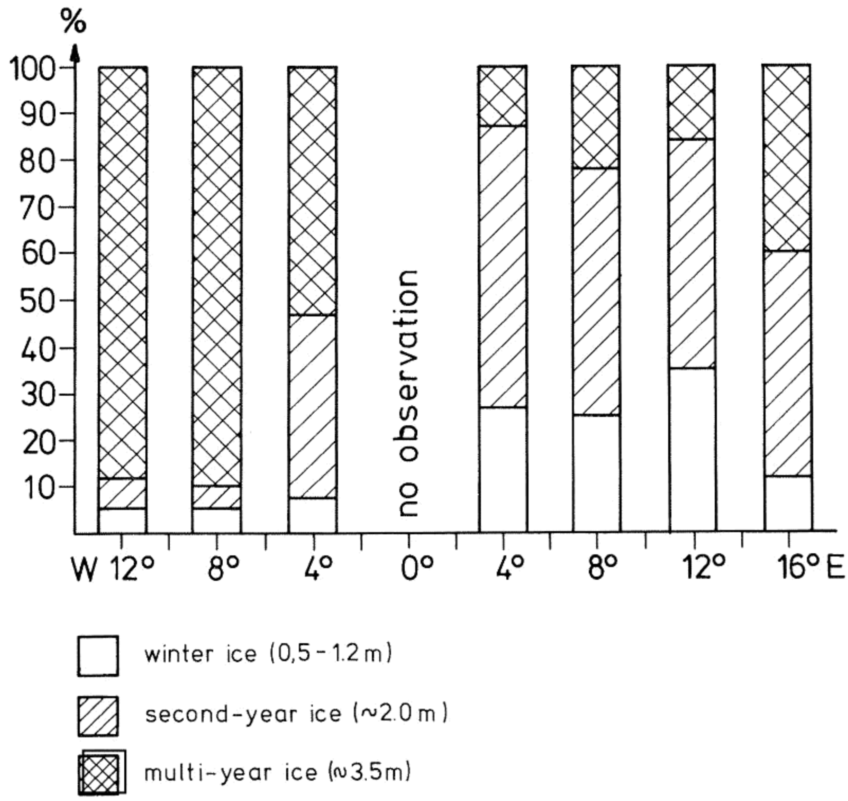

Figure 3.2: *Normalized ice distrubution across the Fram Strait,- proportion of area.*

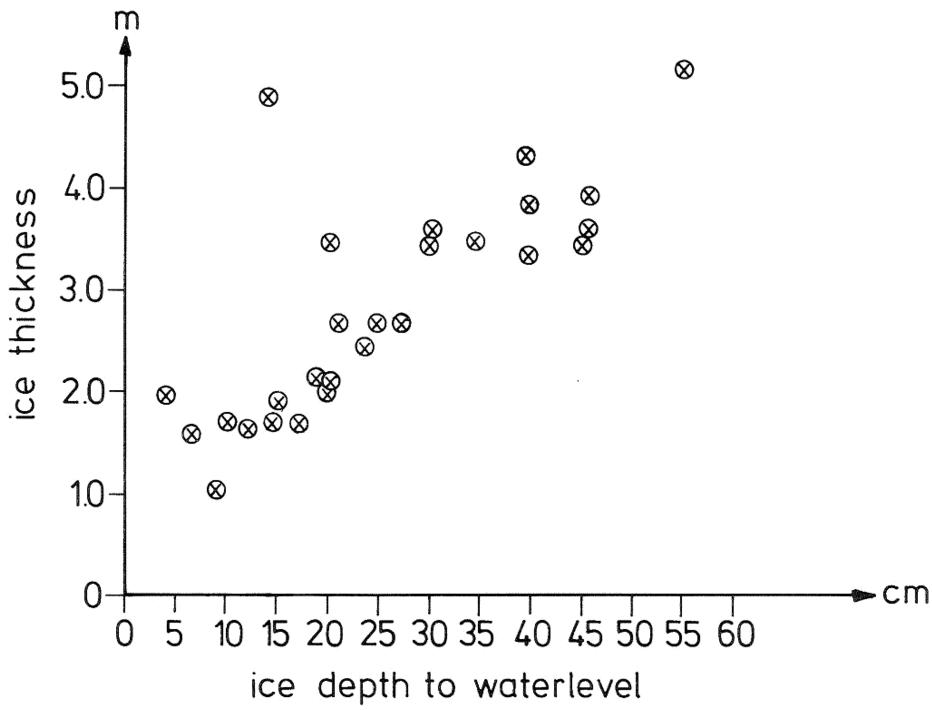

Figure 3.3*: Ice thickness versus ice depth*

Figure 3.3 shows a representation of the drilling data. The holes were drilled in 'flat' spots on the ice.

3.9 **Phytoplankton** (AWI)

a) Calibration of fluorescence probe

The fluorescence probe has been recently installed in the Neil–Brown rosette sampler. On 18 stations vertical profiles were registered. Fluorescence was measured durinq slackening and hieving. The two profiles at each station were identical. Dependinq on the fluorescence intensity, at least three samples (500 – 2000 ml) of different depths were filtered. For pigment analysis ashore, the filters were immediately frozen. The calibration should facilitate the correlation between fluorescence units and actual amounts of chlorophyll a. The fluorescence of a watermass will vary with different dominant phytoplankton species and will be influenced by chemical characteristics of the water. Thus, a calibration is needed at every station. Concurrently, with each chlorophyll a sample, 200 ml of seawater was preserved for the identification of the dominant alqal species.

b) Profiles of fluorescence

None of the profiles showed any fluorescence peak below 30 m depth. Between 40 m and the maximum depth of 150 m, the measured fluorescence hovered around the zero value. The three northernmost stations (333, 334, 335) at 82°N showed so little fluorescence that the proper functioning of the probe was in doubt. Chlorophyll a extraction of the filtered samples will provide an estimate of the phytoplankton biomass.

c) Fluorescence– and chlorophyll a profiles along the Fram Strait transect (77° 40' N)

Along the Fram Strait transect, vertical profiles of fluorescence were reqistered. Concurrently water samples were taken for chlorophyll a and phaeopiqment analysis as well as preserved samples for identification of phytoplankton species. An attempt will he made, to correlate the phytoplankton data with the results of the zooplankton study.

3.10 **The distribution and ecophysiology of Arctic zooplankton (AWI, IPÖ)**

The Framstrait Expedition 1984 had four major objectives:

- Extension of the descriptive zooplankton study that had been started during the previous summer in the area north of Spitsbergen.
- Zooplankton survey in the up to now scarcely examined pack ice region off north-eastern Greenland.
- Investigations concerning the correlation between zooplankton communities and certain hydroqraphically defined water masses along a transect through Fram Strait along 77°40'N, from the Greenland Shelf through the Greenland Sea and across the Mid-Atlantic-Ridge into the Norwegian Sea and to the Spitsbergen Shelf. By a sequence of closing net stations the large scale horizontal and the vertical distribution of zooplankton was studied.
- Experimental investigations on secondary productivity of three dominant copepod species of the sampled watermasses were carried out in order to round up the results of the preceeding cruise leg (MIZEX).

In the area north and northwest of Spitsbergen between 80°04'N - 81°18'N and 03°09'E - 16°45'E, eight stations, visited during the 1983 cruise, were repeated. This allows for a study of annual variation.

The Multi-net was opened and closed at five defined depths; it was equipped with 300 micron mesh netting. Hauls were done over standard depth ranges: 1000 m - 500 m - 200 m - 100 m - 50 m - surface.

In the pack ice northeast of Greenland, vertical hauls were done with the Bongo net; either with 300 and 500 micron mesh netting, or with 500 and 700 micron mesh netting. At each station the first haul sampled the entire water column, the second haul only the upper 100 m. First results of the distribution of high latitude zooplankton are given in Figure 3.4. The Bongo net was equipped with metal collectors, which kept the zooplankton in very good condition. In the deep hauls bathypelagic decapods, medusae and pteropods could be observed. The seven most northern Bongo hauls were made between 81°46'N and 82°45'N - 06°49'W and 09°40'W. Three additional hauls were located near 81°30'N 02°44'W.

Along the Fram Strait transect (77°40'N) the Multi–net was deployed at 7 stations: the first station on the Greenland Shelf, stations 2 and 3 in the Greenland Sea, station 4 at the Polar Front on the western slope of the Mid–Atlantic Ridge, stations 5 and 6 in the West–Spitsbergen Current, and the station 7 on the West–Spitshergen Shelf. At the above stations two hauls were made, one according to the standard depth ranges and one with variable depth intervals. In the latter hauls the depths for opening and closing of the five nets were selected with respect to the hydroqraphic CTD–data.

The experiments on secondary productivity were carried out on board with various developmental stages of the copepods *Calanus finmarchicus, Calanus glacialis and Calanus hyperboreus*. Egg production rates of the females should give an indication of the production of organic matter by the adult; in the earlier stages this production qoes into somatic growth. The freshly caught animals were kept for 24 h in 4 1 incubation vessels at 2°C.

Moulting rates of various copepodite staqes of the three species, taken in different water masses, were determined by calculation of the time required for the shift from one defined stage to the next.

Furthermore, five copepoclite stages were sampled for later laboratory analysis of digestive enzyme activities. Active Amylase, Trypsin and Larninarinase mean that the animals are feeding and will probably moult into adults within the same season. The preliminary results reveal that *Calanus finrnarchicus* seems to be able to reproduce in relatively warm waters only, while *Calanus glacialis* seems to be unaffected by in situ water temperatures below zero. The females of *Calanus hyperboreus* found mainly off East Greenland, never produced eggs in our experiments.

Within the period of observation of 18 days no animal incubated as fifth copepodite stage matured, while moulting from the fourth to the fifth stage of *Calanus finmarchicus* and *Calanus glacialis* took place. This could indicate that the copepods reached a resting stage for this year, allowing them to mature quickly the following season.

For the community studies, a total of 24 Multi–net and 10 Bongo net hauls were performed during the entire cruise. Further 20 Bongo hauls of the upper 150 in were taken for the eco–physiological studies. While the use of the Bongo net did not cause any trouble, certain technical difficulties were encountered with the Multi–net.

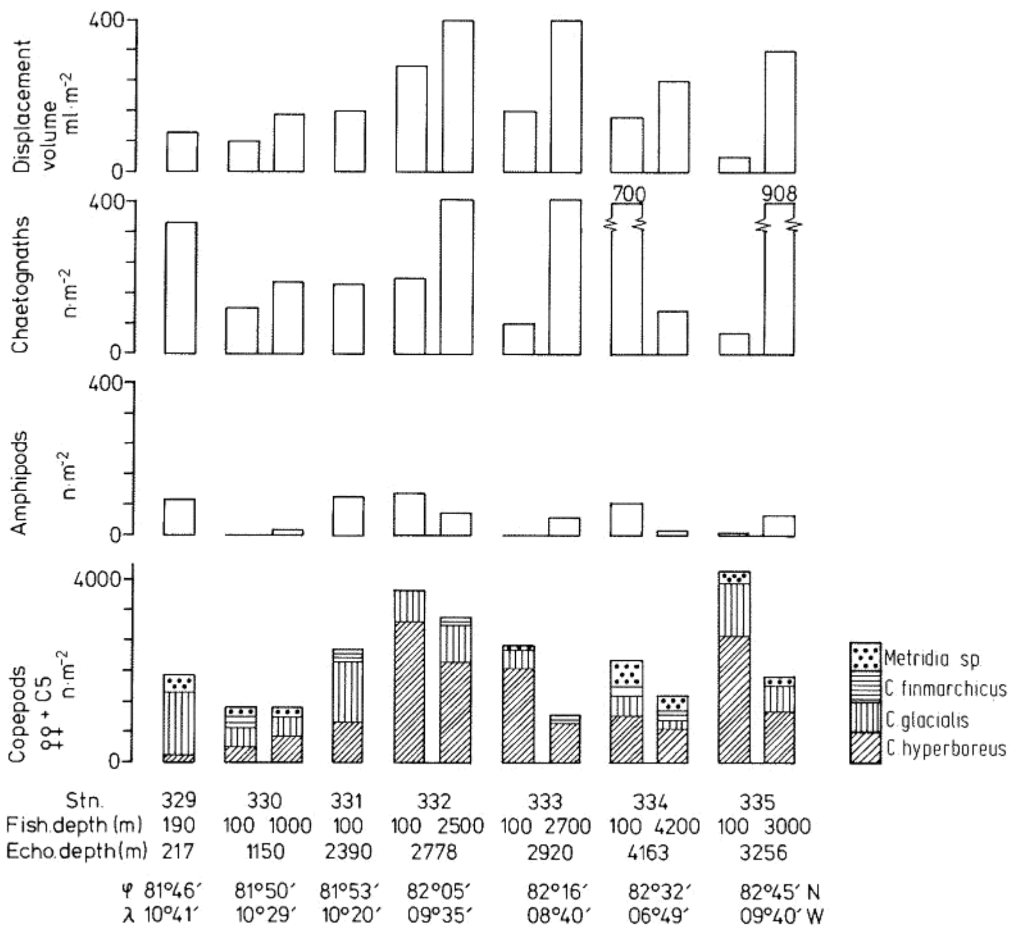

Figure 3.4: *Distribution of zooplankton along the section northeast of Greenland (stn. 329–335). One Bongo net 500 micron 0.26 m², vertical hauls of upper 100 m and total water column.*

3.11 Birds and mammals (NPI)

In recent years the Norwegian Polar Research Institute has conducted transect observations of bird arid marine mammal life in the high Arctic waters of Svalbard and adjacent areas. The long term goal of all the transects is to map important faunal areas through successive yearly observationss, to describe migrational patterns and the relative and absolute distribution of birds and mammals in Norwegian high Arctic areas and in the surrounding waters. The Fram Strait expedition of R.V. *Polarstern* provided an excellent chance to perform transect observations through areas with little or no previous observations.

While *Polarstern* was in motion observations were conducted from the top–deck. The observation crew consisted of two ornithologists and two marine zoologists, all with sufficient experience in both subjects to enable each observer to cover both bird and mammal spotting. A shift system was established with rotating shifts of 4 and 3 hours. This gave each observer the chance of working all the shifts. Observations were conducted with the aid of binoculars and a laser distance meter.

The transect observations from *Polarstern* rendered difficulties due to the many foggy days experienced on the cruise (11 out of 16 days were foggy). Especially the number of mammals, but also of birds, observed must have been negatively influenced by this. During the cruise all expected species were observed, but some special observations should be mentioned: The high number of

Pomarine Skuas counted was unexpected, This species is normally only observed east of Svalbard and is usually not numerous. Furthermore observations of two Leach's Storm–petrels were of interest because these may be the worlds northernmost observations of this species. A list of birds and mammals seen from *Polarstern* and the number of individuals of each species observed is enclosed.

Outside the observation area on the way home between Bear island and northern Norway the following whales were observed: at 73°45'N 16°09'E two large sperm whales swimming and diving, at 73°04'N 16°40'E a group of four large and possibly two small humpback whales were seen jumping and playing. Finally a group of approximately 30 white nosed dolphins were seen feeding at 71°34'N 18°22'E.

LIST OF BIRDS AND MAMMALS OBSERVED FROM "POLARSTERN 20.07.–04.08.1984

Polar Bear	5 (+1)
Fin Whale	3
Minke Whale	12
Ringed Seal	207
Bearded Seal	23
Harp Seal	7
Hooded Seal	39
Seal sp.	85
Walrus	2
Fulmar	4308
Leach's Storm-petrel	2
Glaucous Gull	76
Kittiwake	3013
Ivory Gull	319
Arctic Tern	8
Great Skua	4
Pomarine Skua	212
Arctic Skua	14
Long-tailed Skua	31
Skua sp.	5
Black Guillemot	105
BrLinnichs Guillemot	813
Little Auk	17362
Puffin	47
Purple Sandpiber	2
Ross's Gull	5

3.12 Squid fishing in the High Arctic (AWI)

At stations of <500 m depth a 'jigging machine' was tested; it is used in an attempt to catch live squid.

The 'jigging machine' was developed in Japan and has been used very successfully in coastal fisheries. After testing, German biologists plan to employ the device on future research cruises in the Arctic as well as in the Antarctic.

The two common squid species in the Arctic are *Gonatus fabricii* and *Todarodes sagittatus* While the latter species is intensively harvested by Norwegian fishermen in coastal waters between August and

January (C. 18 000 metric tons in 1983), not a single animal was caught during the cruise, not even in Horn Sound and on Fugloya Bank.

Bezeichnung der eingesetzten Geräte

AG	Airgun
BG	Backengreifer
BO	Ronqo
COB-OBS	Ozeanbodenseismoqraph
CTD	Temperatur-Leitfhikeitssoride
EG	Strommesserverankerunq, Univ. of Washington
EXPL	Explosion
ES	Strornmesserverankerunq, Univ. of Washington
GEG	Großkastenqreifer
LVS	Livingston-Gerät
MU	Multinetz
MX	Strommesserverankerung, Univ. of Washirioton
PLA	Planktonnetz
RAMSES	Mikro-Fernerkunc3unq
RO, Rosi	Kranz mit Wasserschöpfern
SL	Schwerelot
T-OBS	Ozeanhodenseisruograph
VN	Vertikalnetz
WG	Watergun
XRT	Bathy-Thermograph

BETEILIGTE INSTITUTE (PARTICIPATING INSTITUTIONS)

	Institutsadresse	Expeditions-teilnehmer (FS *Polarstern*)	Fahrta-schnitte
Bundesrepublik Deutschland			
AWI	Alfred-Wegener-Institut für Polarforschung Columbus-Center 2850 Bremerhaven	22	1,2,3,4
DFVLR	Deutsche Forschungs- und Versuchs- anstalt für Luft- und Raumfahrt e.V. 8031 Oberpfaffenhofen		
DHI	Deutsches Hydrographisches Institut Bernhard-Nocht-Straße 78 2000 Hamburg 4	4	1,2,3
GIB	Geologisches Institut Ruhr-Universität Bochum Universitätsstraße 150 4630 Bochum-Querenburg	1	4
GL	Germanischer Lloyd (GL) Vorsetzen 32 2000 Hamburg 11	5	1
GPI	Geologisch-Paläontologisches Institut und Museum, Christian- Albrechts-Universität Olshausenstraße 40 2300 Kiel	15	4,5
HDW	Howaldswerke Deutsche Werft AG Postfach 6309 2300 Kiel 14	1	1
HL	Hapag-Lloyd Transport & service GmbH Geo-Plate-Straße 2850 Bremerhaven-Kaiserhafen	2	1
HSVA	Hamburgische Schiffbau-Versuchs- anstalt GmbH Bramfelder Straße 164 2000 Hamburg 60	11	1
HSW	Helicopter-Service Claus Wassertha Ecätnerweg 43 2000 Hamburg 65	5	1,2,3
IAP	Institut für Angewandte Physik Christian-Albrechts-Universität Olshausenstraße 40 2300 Kiel	2	4
IEH	Institut für Erdvermessung Universität Hannover Astronomische Station Nienburger Straße 5 3000 Hannover 1	2	4

IfMH	Institut für Meeresforschung Universität Hamburg Heimhuder Straße 71 2000 Hamburg 13		
IfMK	Institut für Meereskunde der Christian-Albrechts-Universität Düsternbrooker weg 20 2300 Kiel 1	6	2,4,5
IGH	Institut für Geophysik Universität Hamburg Bundesstraße 55 2000 Hamburg 13	12	4,5
IGK	Institut für Geophysik Christian-Albrechts-Universität Olshausenstraße 40 2300 Kiel	4	4
IHF	Institut für Hydrobiologie und Fischereiwissenschaften Zeisseweg 9 2000 Hamburg 50		
IPÖ	Institut für Polarökologie Christian-Albrechts-Universität Qlshausenstraße 40 - 60 2300 Kiel	1	3
JAST	Jastram-Werke Billwerder Billdeich 2000 Hamburg-Bergedorf	1	1
LH	Deutsche Lufthansa AG Abteilung LMS Von-Gablenz-Straße 2 - 6 5000 Köln 21	2	4
MIH	Meteorologisches Institut der Universität Hamburg Bundesstraße 55 2000 Hamburg 13	3	2
MIM	Meteorologisches Institut der Universität Mainz Anselm-F.-von-Bentzel-Weg 6500 Mainz	2	1
MPIfM	Max-Planck-Institut für Meteorologie Bundesstraße 55 2000 Hamburg 13	1	2
NDR	Norddeutscher Rundfunk Kiel Postfach 34 80 2300 Kiel	5	1,3
PS	Prakla-Seismos GmbH Buchholzer Straße 100 3000 Hannover 51	1	4
RGE	Firma Ruhrgas Postfach 4300 Essen	1	1

SFB 94	Sonderforschungsbereich 94 der Universität Hamburg Bundesstraße 55 2000 Hamburg	3	2
SWA	Deutscher Wetterdienst Seewetteramt Bernhard-Nocht-Straße 76 2000 Hamburg 4	4	1,2,3,4,5
RWTH	Rheinische Westfälische Technische Hochschule Worringer Weg 5100 Aachen	2	2
THW	Technisches Hilfswerk Carl-Cohn-Straße 36-38 2000 Hamburg 60	1	5
TNSW	Thyssen-Nordsee-Werke GmbH Postfach 2900 Emden	2	1
TUHH	Technische Universität Hamburg-Harburg Harburger Schloß 20 2000 Hamburg 90	3	1
VTG	Vereinigte Tanklager und Transportmittel GmbH Postfach 10 06 60 2800 Bremen 1	1	1
Frankreich			
CNES	Centre Nationale d'Etudes Spatiales 18 Avenue Edouard Behn 31055 Toulouse	2	2
IFP	Institut Francais du Pétrohe Paris	1	5
IFRE	Institut Francais de Recherche et d' Exploitation Centre de Brest, Brest	1	5
IPG	Institut Physique du Globe Paris	1	5
LOP	Laboratoire d'Oceanographie Physique de Muse Naturelle d'Nistoire Naturelle, 43 Rue Cuiver 75231 Paris Cedex 05	1	2
Grobritannien			
NS	New Scientist Commonwealth House 1-19 New Oxford Street London WC1 1NG	1	3
SPRI	Scott Polar Research Institute Lensfield Road Cambridge CB2 1ER	4	2

Kanada			
AES	Atmospheric Environment Service Ice branch 365 Laurier Av.-N. Ottawa, Ontario K1A OH3	3	1
BIO	Bedford Institute of Oceanography P.O. Box 1006 Dartmouth, Nova Scotia Kanada B2Y 4A2	2	2
CCG	Canadian Coast Guard Canada	2	1
IAC	Indian Affairs Canada	1	1
NRC	National Research Council of Canada Division of Building Research Geotechnical Section Ottawa, Ontario MA 0R6	3	1
TDC	Transport & Development Center Canada 1000 Sherbrooke Street-W. P.O. Box 549, place de Ltavitation Montreal, Quebec H3A 2R3	1	1
Norwegen			
GPIB	Geophysical Institute University of Bergen 5014 Bergen	3	2,3
IGO	Institutt for geologi Universitetet i Oslo Postboks 1047, Blindern Oslo 3	1	4
NFI	Norsk Polar Institutt Rolfstangveien 12 1330 Oslo-Lufthavn	5	3
UBJ	Universitetet i Bergen Jordskjelvstasjonen 5014 Bergen-US	1	5
Schweden			
UG	University of Göteborg Göteborg	1	2
UL	University of Lund Dept. of Radiation Physics Lasarettet 22185 Lund	1	3
USt	University of Stockholm 10691 Stockholm		
Vereinigte Staaten von Amerika			
BLOS	Bigelow Laboratory for Ocean Sciences Boothbay, Maine	1	2
BNL	Brookhaven National Laboratory Building 318 Upton, NY 11973	1	2
CaTe	California Institute of Technology Pasadena, California 91125	1	3

CRREL	US Army Cold Regions Research and Engineering Laboratory 72 Lymne Road Hannover, NH 03755	5	1,2
ERIM	Environmental Research Institute of Michigan P.O. Box 8618 Ann Arbour, Michigan 48107	2	2
LDGO	Lamont-Doherty Geological observatory Palisades, NY 10964	3	2,3
NPS	Naval Postgraduate School Dept. of Oceanography, Code 680j Monterey, California 93940	1	2
ONR	Office of Naval Research Arctic Programs, Code 425 AR 800 N. Quincy Street Arlington, Virginia 22217	2	2,4
RSLUK	University of Kansas Remote Sensing Laboratory 22291 Irving Hill Drive Lawrence, Ks 66045	1	2
SIO	Scripps Institution of Oceanography La Jolla, California 92093	4	3
UW	University of Washington School of Oceanography Seattle, Washington 98195	2	2,3
WHOI	Woods Hole Oceanographic Institution Woods Hole, Massachussettes 02543	4	3,4

LISTE DER FAHRTTEILNEHMER (PARTICIPANTS) auf FS *POLARSTERN*

Name	Vorname (Surname)	Institut (Institution)	Fach (Discipline)
1. FAHRTABSCHNITT - FIRST LEG			
Asmus	Ken	AES	Meereis
Astheimer	Ulrike	AWI	Rechner
Barbour	William	-	Beobachtung
Beckmann	Hans-Jürgen	HL	Schiffstechnik
Blanke	Arend	TNSW	Beobachter
Brahms	Rolf-Hermann	VTG	Beobachter
Burkat	Dieter	MIM	Meteorologie
Burmeister	Karl-Heinz	NDR	Journalist
Csullion	John	IAC	Beobachter
Dentler	Frank-Ulrich	SWA	Bordwetterwarte
Dimmier	Werner	AWI	Elektronik
Edmunds	Sharon	-	Beobachtung
Evers	Karl-Ulrich	HSVA	Technik
Frederking	Robert	NRC	Technik
Göth	Rüdiger	GL	Technik
Götze	Hans-Jürgen	GL	Technik
Gow	Anthony J.	CRREL	Technik
Grabe	Günther	TUHH	Technik
Greuner	H. P.	RGE	Beobachter
Grinstead	John	CCG	Beobachter
Groth	Heiner	GL	Technik
Hackbarth	Günther	HSVA	Technik
Heilmann	Jens-Holger	HSVA	Technik
Henning	Klaus	HL	Schiffstechnik
Hiller	Wolfgang	AWI	Rechner
Hoffmann	Lutz	HSVA	Technik
Hosemann	Gert	NDR	Journalist
Isaac	Donald	AES	Meereis
Keating	Kathleen	HSVA	Dokumentation
Kirndörfer	Georg	NDR	Journalist
Kiehe	Hans-Jörg	HDW	Techn./Beobachter
Klimsa	Werner	HSVA	Technik
Kojak	Apa	-	Beobachter
Krause	Hans	AWI	Rechner
Lafraniboise	Jacques	TDC	Beobachter
Lemke	Dieter	HSVA	Technik
Lundström	Volker	HSW	Hubschr./Technik
Lydorf	Uwe	HSVA	Technik
Martinson	Carl	CRREL	Technik
Mockenhaupt	Rainer	HSW	Hubschr./Pilot
Müller	Lutz	GL	Technik
Murdy	Dave	NRC	Technik
Nash	William	CCG	Beobachter
Ohlendorf	Hans	SWA	Bordwetterwarte
Ramseier	René	AES	Meereis
Raue	Friedrich	TUEB	Vermessung
Sasse	Ingo	GL	Technik

Schüler	Oskar	TNSW	Techn./Beobachter
Schulze-Eishof	Hartmut	HSW	Hubschrauber/Pilot
Schütz	Lothar	MIM	Meteorologie
Schütz	Hans	HSW	HubSchr./Pilot
Schum	Günther	TUHH	Vermessung
Schwarz	Joachim	HSVA	Techn./Fahrtleiter
Sprunk	Bruno	HSVA	Technik
Strübing	Klaus	DHI	Meereis
Tattinclaux	Jean-Claude	CRREL	Technik
Timco	Garry	NRC	Technik
Weiß	Friedrich	JAST	Technik
Wolff	Karsten	HSVA	Technik

2. FAHRTABSCHNITT - SECOND LEG

Anderson	Leif	UG	Chemie
Augstein	Ernst	AWI	Koordin./Fahrtl.
Baranski	Beate	AWI	Meteorologie
Barthel	Klaus-Günther	IfMK	Biologie
Baumann	Marcus	RWPH	Biologie
Böhmer	Wolfgang	MIH	Meteorologie
Bohrer	Richard	AWI	Biologie
Brecht	Heinz.-H.	MIH	Meteorologie
Bröring	Joachim	AWI	Ozeanographie
Buens	Ilse	SFB 94	Biologie
Burns	Barbara	KRIM	Fernerkundung
Chapuis	Emile	CNES	Fernerkundung
Cowan	Andrew	SPRI	Photographie
Darnall	Clark H.	UW	Ozeanographie
Dentler	Frank Ulrich	SWA	Bordwetterwarte
Flenner	Gunnar	AWI	Meteorologie
Frey	Helmut	AWI	Ozeanographie
Gow	Anthony	CRREL	Meereis
Gradinger	Rolf	IfMK	Biologie
Hirche	Hans Jürgen	AWI	Biologie
Hoeber	Heinrich	MIH	Meteorologie
Horn	Dean A.	ONR	Koordination
Ito	Hajime	AWI	Meereis
Johannessen	Ola	GPIB	Koordination
Jones	Peter	BIO	Chemie
Kattner	Gerhard	SFB 94	Chemie
Kelley	Peter J.	BLOS	Biologie
Koltermann	Klaus Peter	DHI	Ozeanographie
Krause	Hans	AWI	Rechner
Lane	Peter V.	BNL	Biologie
Larson	R.	KRIM	Fernerkundung
Lenz	Jürgen	IfMK	Biologie
Lundström	Volker	HSW	Hubschrauber
Manley	Tom	LOGO	Ozeanographie
Menzel	Wolfgang	HSW	Hubschrauber
Mockenhaupt	Rainer	USW	Hubschrauber
Moore	S.	SPRI	Meereis
Ohlendorf	Hans	SWA	Bordwetterwarte
Onstott	Robert	RSLOK	Fernerkundung
Richez	Claude	LOP	Ozeanographie

Rick	Hans Josef	RWPH	Biologie
Schgounn	Catherine	CNES	Fernerkundung
Schriever	Dirk	MPIfM	Meteorologie
Schütt	Monika	SFB 94	Biologie
Schütz	Hans	HSW	Hubschrauber
Sellmann	Lutz	AWI	Meteorologie
Smith	Walker O.	NPS	Biologie
Squire	Vernon	SPRI	Meereis
Stribing	Klaus	DHI	Meereis
Tüg	Helmut	AWI	Elektronik
Tucker III	William B.	CRREL	Meereis
Wadhams	Peter	SPRI	Meereis
Wamser	Christian	AWI	Meteorologe
Weeks	Wilson	CRREL	Meereis
Zemlyak	Frank	BIO	Chemie

3. FAHRTABSCHNITT - THIRD LEG

Bassek	Dieter	SWA	Bordwetterwarte
Casso	Susan	WHOI	Chemie
Castello	Jim	SIO	Chemie
Chipman	David	LDGO	Chemie
Diehl	Sabine	AWI	Biologie
Erlingsson	Björn	NPI	Glaziologie
Field	Timothy	SIO	Chemie
Foldvik	Arne	GPIB	Ozeanographie
Frikke	John	NPI	Biologie
Gjertz	Ian	NPI	Biologie
Günther	Johanna	SWA	Bordwetterwarte
Haberstroh	Doris	AWI	Biologie
Hallstadius	Lars	UL	Chemie
Hempel	Gotthilf	AWI	Biologie
Hempel	Irmtraut	IPO	Biologie
Koltermann	Klaus Peter	DHI	Ozeanographie
Linnehol	Björn	NPI	Biologie
Livingston	Hugh	WHOI	Chemie
Lüthje	Herbert	DHI	Phys.Ozeanogr.
Lydersen	Christian	NPI	Biologie
Menzel	Wolfgang	HSW	Hubschrauber
Mills	Stephan	NS	Journalist
Muus	David	SIO	Chemie
Piatkowski	Uwe	AWI	Biologie
Schmidt-Walther	Peer	NDR	Journalist
Schutz	Hans	NSW	Hubschrauber
Smethie	William	LDGO	Chemie
Spies	Annette	AWI	Biol.Ozeanogr.
Stordall	Mary	CaTe	Chemie
Swift	James	SIO	Phys.Ozean./Chemie
Torresen	Tor	GPIB	Ozeanographie
Tripp	Richard	UW	Phys.Ozeanographie
Wirtz	Reinhardt	NDR	Journalist
Wöckel	Peter	DHI	Ozeanographie

4. FAHRTABSCHNITT - FOURTH LEG

Andresen	Olaf	IGH	Geophysik
Asper	Vernon	WHOI	Ozeanographie
Bassek	Dieter	SWA	Bordwetterwarte
Bleil	Ulrich	GIB	Geophysik
Bohrmann	Gerhard	GPI	Geologie
Cherkis	Norman	ONR	Geologie
Fiedler	Horst	OPI	Technik
Fischer	Gerhard	GPI	Geologie
Gehrmann	Thomas	IGK	Geophysik
Grahi	Wolf-U.	IGK	Technik
Grünig	Sigrun	AWI	Geologie
Günther	Johanna	SWA	Bordwetterwarte
Henrich	Rüdiger	GPI	Geologie
Hillermann	Elke	IGH	Techn.Ass.
Honjo	Suzumu	WHOI	Ozeanographie
Jedicke	Frank	IGK	Geophysik
Koeve	Wolfgang	IfMK	Biologie
Linke	Peter	IfMK	Biologie
Lutter	Ulrich	IAP	Ozeanographie
Meyer	Ulrich	IEH	Kartographie
Mülhan	Norbert	GPI	Geologie/Technik
Ostermann	Dorinda	WHOI	Ozeanogr./Technik
Phillips	Dennis	LH	Journalist
Reil	Werner	PS	Geodäsie
Sarnthein	Michael	GPI	Geologie
Schaible	Wolfram	LH	Photograph
Schenke	Hans-Werner	AWI	Geol./Seabeam
Schmidt	Michael	IAP	Ozeanographie
Schreiber	Reinhold	IGK	Geophysik
Schuchardt	A.	IEH	Geodäsie
Stabell	Björg	IGO/GPI	Paläontologie
Thiede	Jörn	GPI	Paläont./Fahrtl.
Wefer	Gerold	GPI	Geologie
Zahn	Rainer	GPI	Geologie

5. FAHRTABSCHNITT - FIFTH LEG

Altenbach	Alexander	GPI	Paläontologie
Andresen	Olaf	IGH	Geophysik
Avedik	Felix	IFRE	Geophysik
Bassek	Dieter	SWA	Bordwetterwarte
Birgisdottier	Lovina	GPI	Geologie
Dreves	Erno	IGH	Techniker
Gallart	Jose	IPG	Geophysik
Gebhardt	Volkmar	IGH	Geophysik
Grotkopp	Jan	IGH	Geophysik
Günther	Johanna	SWA	Bordwetterwarte
Herber	Rolf	IGH	Physik
Hillermann	Elke	IGH	Tech. Ass.
Klussmann	Jürgen	IGH	Geoph./Seismol.
Locker	Sigurd	GPI	Geologie
Lundbeck	Holger	THW	Technik
Lutze	Gerhard-F.	GPI	Geologe
Neuhaus-Steinmetz	Hermann	IGH	Physik

Niemann	Volkmar	IGH	Geophysik
Nuppenau	Volker	IGH	Elektronik
Pinet	Bertrand	IFP	Geophysik
Rahal	Mohamed	IGH	Geophysik
Reimers	Wolfgang	GPI	Tech.Ass.
Romero	Marina	IfMK	Biologie
Salomon	Brigitte	GPI	Tech.Ass.
Sandvoll	M.	UBJ	Geologie
Weigel	Wilfried	IGH	Geoph./Fahrtl.

CCHDO Data Processing Notes

Date	Person	Data Type	Action	Summary
2009-06-15	*Dave Muus*	BTL	Website Updated	data online

Detailed Notes

Notes on ARCHY cruise EXPOCODE 06AQ19840720 090610/dm

1. Data taken from ODF ARCHY cruise #262 file: ark23whprp050216, dated Feb 16, 2005.
2. Changed Station 358, Sample 13, 752.0 dbars, CTDTMP from 65.000 to 0.066 and CTDSAL from 64.639 to 34.923.
   New values taken from CTD 'Protokoll' form and corrected with offsets from adjacent levels at this station.
   Original Reversing Thermometer data indicates rack trip bad(~200db).

   #from sts: /cruise/ArktisII.3/archy/dbtfldata/aryhdd 090501/dm
   358 1 13 DELTA P = -513; CALC OK. EITHER UNP WB OR CHECKED H+00 & +01 OK
   KMS 13MAR86
   358 1 13 POSSIBLY RACK PT. CTD T AT 752 APPROX.
   358 1 13 CTD T AT 239. DELETE ALL HYDRO T IN H+01 &
   358 1 13 H+00. D. MUUS 26SEP84
3. Added SECTION ID "NFS" Northern Fram Strait.

Date	Person	Data Type	Action	Summary
2013-01-24	*Andrew Barna*	ExpoCode	Website Updated	ExpoCode Changed, files updated

ARK-II_3 1984 06AQ19840719 processing - BTL

2013.01.23
A Barna
.. contents:: :depth: 2
Process
=======
Changes
----
nfs_06AQ19840719hy.txt
~~~~~~~~~~~~~~~~~~~~~~
- Expocode changed from 06AQ19840720 to 06AQ19840719
- filename changed from nfs_06AQ19840720hy.txt to nfs_06AQ19840719hy.txt

nfs_06AQ19840719su.txt
~~~~~~~~~~~~~~~~~~~
- Expocode changed from 06AQ19840720 to 06AQ19840719
- filename changed from nfs_06AQ19840720su.txt to nfs_06AQ19840719su.txt

nfs_06AQ19840719_hy1.csv
~~~~~~~~~~~~~~~~~~~
- Expocode changed from 06AQ19840720 to 06AQ19840719
- filename changed from nfs_06AQ19840720_hy1.txt to nfs_06AQ19840719_hy1.txt

Directories
===========
:working directory:
/data/co2clivar/arctic/archy/origional/2013.01.23_FIX_EXPO_AMB
:cruise directory:
/data/co2clibar/arctic/archy/
Updated Files Manifest
======================
- nfs_06AQ19840719_hy1.csv
- nfs_06AQ19840719hy.txt
- nfs_06AQ19840719su.txt
~~~~~~~~~~~~~~~~~~~

2013-01-24	*Jerry Kappa*	CrsRpt	Website Updated	Final PDF file online

I've placed 1 new version of the cruise report:

nfs_06AQ19840720do.pdf

into the directory: co2clivar/arctic/archy/

It includes summary pages and CCHDO data processing notes as well as a linked Table of Contents and links to figures, tables and appendices.