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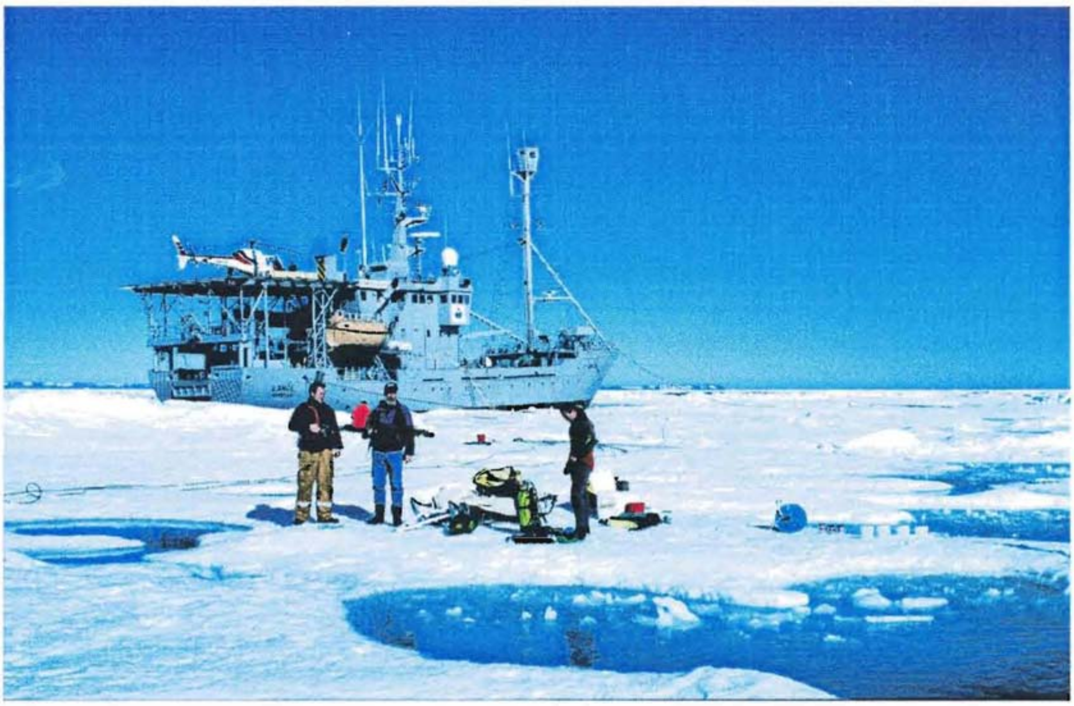
The ICE-BAR 1996 cruise in the northern Barents Sea



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Contents

1. Background

Haakon Hop and Stig Falk-Petersen

Marginal ice zones (MIZ), regions of major importance for biogenic production in high latitudes, are some of the most dynamic areas in the world's ocean. For example, the location of the ice edge during summer in the Barents Sea can vary by hundreds of kilometres from year to year. Another important factor in the dynamics of the MIZ is the strong seasonal variations in light, and thereby seasonal variation in biological production.

The marginal ice zone in the northern Barents Sea is ecologically important because it represents the most productive area in arctic water masses north of the Polar Front. The phytoplankton blooms sweep across the northern Barents Sea, following the receding ice edge as it melts, and intensive blooms also occur in leads as the MIZ opens up. The primary production consists of three components: (1) actively growing phytoplankton at the outer edge of the ice margin and in larger leads, (2) a thick layer of specialised sub-ice algae assemblage dominated by *Nitzshia frigida* in the dense pack ice, and (3) a sub-ice assemblage dominated by *Melosira arctica*, often associated with multi-year ice.

The onset of the primary production is directly related to the availability of light which is controlled by oscillation of the incident light in the northern hemisphere and melting of the ice. Hydrophysical factors, particularly wind and ice cover movements, may explain the presence and absence of blooms in spring, whereas increased grazing probably reduces the phytoplankton biomass in autumn. The summer situation is not well known far north in the Barents Sea, although theories predict a delayed "spring" bloom in summer during the short period of open water. During early spring ice algal production is predominant, being out-competed by the pelagic production sometime during the summer. The primary production is the sum of pelagic and ice algal production. On an annual basis this may account for 60 and 40 % of total production, respectively, but real data still lacks. This intense production is grazed by herbivorous zooplankton and ice-fauna.

The zooplankton stocks and species composition are key factors which directly affect the primary production as well as the vertical carbon flux. Copepod over-wintering success, the timing of their ascent from hibernation, population density and grazing pressure in the surface waters are factors that exert control on "successful" retention of the primary produced energy in the pelagic ecosystem or the loss of primary produced matter by sedimentation. Zooplankton, together with ice-fauna, is also the direct link between the primary producers and fish stocks.

On the underside of the ice there is a biological community of ice algae and ice-fauna. The ice-fauna consists of organisms living their whole life in the drifting sea-ice, the permanent or autochtonous ice fauna, but also stages of pelagic and benthic organisms finding the ice habitat favourable at certain times of year, the allochtonous fauna. The organisms feed on ice algae (e.g. *Melosira arctica, Nitzchia sp.* and *Navicula sp.*), detritus, or prey on other organisms such as copepods. Community composition may vary with the age of the ice (first year ice versus multi-year ice), the complexity of the habitat, the sediment load in the ice, and with the life cycle of organisms.

The interface between ice and sea water provides a habitat, which has been described as an upside-down benthic environment, although the habitat is more dynamic and may undergo radical changes in structure and composition in response to seasonal melting and freezing as well as physical forcing. The structural under-ice topography, which probably to a large extent determines the actual distribution and density of ice-fauna, includes both mesoscale structures, such as ridges, flat surfaces and edges, and small scale structures such as brine channels, protruding ice pieces, and other structures related to the melting process.

The extreme oscillations of abiotic factors is the critical factor structuring the Arctic marine biotic systems. Pelagic marine herbivores exposed to such marked variation in available food have responded, *inter alia*, by storing large amount of lipids as energy reserves. These high energy compounds are rapidly transferred through the food chain and provide the caloric needs for higher trophic levels. Lipid levels increase from 10-20% in phytoplankton to 50-70% in herbivorous zooplankton and ice-fauna. This increase in lipid level, combined with high transfer efficiency, is probably one of the most fundamental and key specialisations in Arctic bioproduction. The dramatic accumulation of oil provides the large stocks of Arctic fish, birds and mammals with energy-packed food to sustain large populations over the winter. This makes the MIZ an area of special interest for studies of arctic biodiversity and wildlife.

The determination of trophic pathways is a critical point in the understanding of the structure, interactions and energy transfers in marine ecosystems. Hietherto, studies of food web structures have mainly been based on stomach content analyses. As a result, resolution of both temporal and spatial patterns is low. Naturally occurring stable isotopes of carbon ($^{12}\delta C/ ^{13}\delta C$) and nitrogen ($^{14}\delta N/ ^{15}\delta N$) can provide useful information about trophic structure. These isotopes undergo a stepwise enrichment in the bodytissues of species of subsequent trophic levels (prey-consumer). This method is based on the actually assimilated material and allows the evaluation of trophic long-term relationships. Analyses of both lipids and stable isotopes in different marine organisms collected will result in a semi-quantitative description of trophic levels in marginal ice-zone food web. This will enhance the overall picture of the food web of the northern Barents Sea.

The ICE-BAR research program

The overall goal of the ICE-BAR program (administrated by the Norwegian Polar Institute) is to increase our understanding of the importance of the marginal ice-zone for the productivity and biodiversity in the northern Barents Sea. The program provides basic information about structures and processes of one of the most productive and variable ecosystems in the Arctic, and forms the scientific base for future management decisions concerning MIZ. This international, multidiciplinary research program, partly funded by mini-AOGC money (NFR) included studies of:

Climate: ocean- atmospheric CO_2 exchange, light spectrum and albedo, atmospheric boundary layer.
Ice physics: ice density packing, ice structures in cores, under-ice topography, melt processes.
Hydrography: meltwater formation, currents and transport, jets and eddies, energy balance.
Primary production: ice algae and phytoplankton, chlorophyll, biomass, biodiversity and taxonomy.
Secondary production: zooplankton distribution, ice fauna diversity, population dynamics, life strategies.
Benthic ecology: community diversity, pelago-benthic coupling, life strategies.
Birds and mammals: spatial distribution in relation to oceanographic fronts.
Trophic relationships: food web structures, energy transfers, lipids, isotopic signals, feeding ecology.
Ecotoxicology: persistent organic pollutants, heavy metals, radionuclides and bioaccumulation.

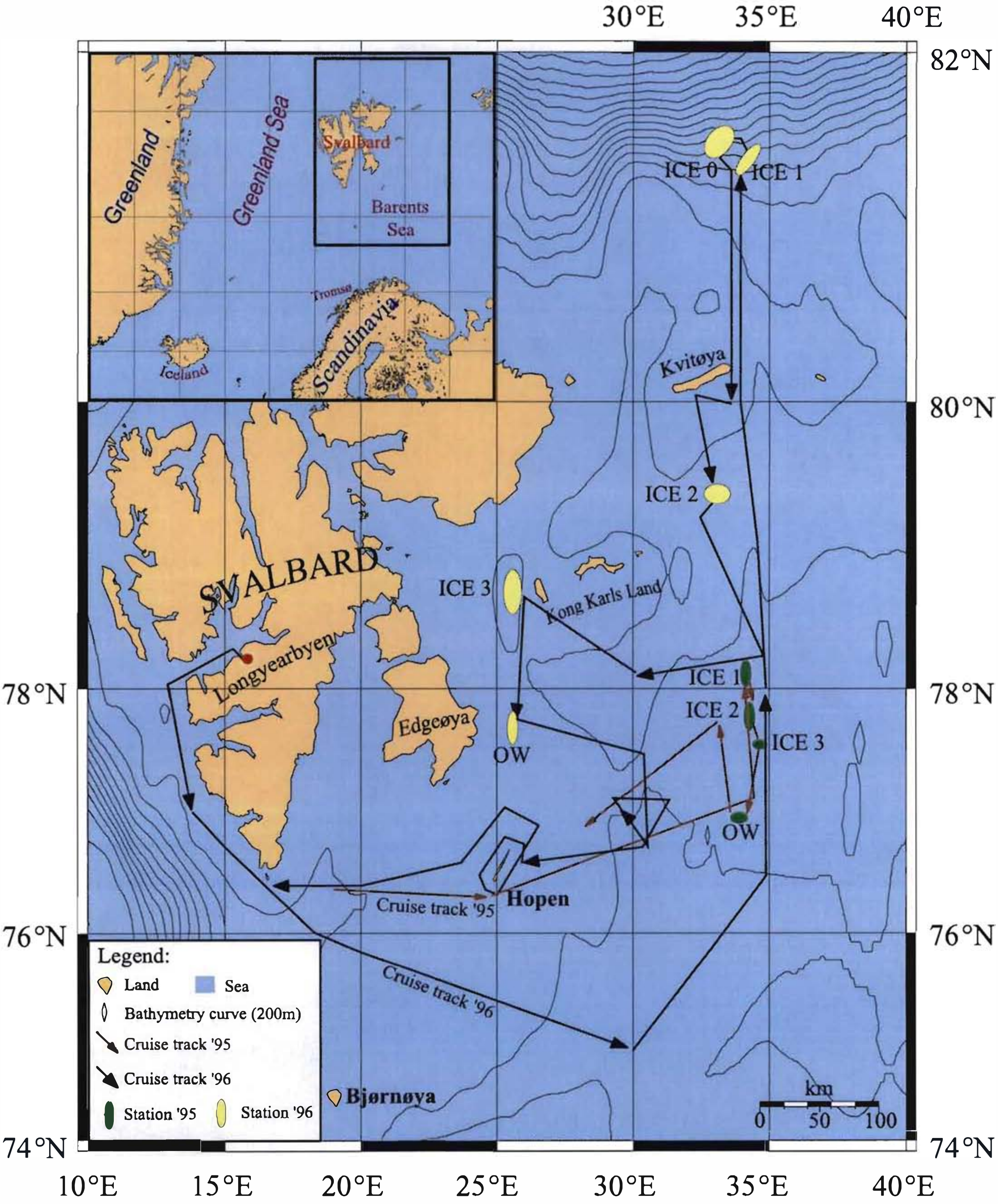
The ICE-BAR 1996 cruse with R/V 'Lance' was performed from 20 July to 16 August in the Norwegian Zone east of Svalbard, between 77 °N and 81 °N. There were four main stations in areas with different ice cover and conditions, and one open water station (Figure 1). In addition to this, CTD stations were performed between the main stations.

The ICE-BAR 1996 cruise was part of the "Pilot Arctic Ocean Project 1996", coordinated by the Nansen Environmental and Remote Sensing Center and funded by the Norwegian Research Council.

There once was an ICE-BAR cruise
Who wanted to find out and deduce
The biophysics of ice
We remember it nice
With the long lost ADCP blues!

JBØ-97

2. Map of the cruise track for ICE-BAR 1995 and 1996



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4. Scientific results

4.1 Physical Oceanography

W. Paul Budgell and Terje B. Løyning

Introduction
The physical oceanographic component of ICE-BAR 1996 was designed to:
1. Provide a general description of the water mass and circulation characteristics of the study area.
2. Characterise the influence of topography and ice cover on water mass distribution and circulation.
3. Supply information on some of the abiotic factors, such as oceanic mixing and vertical structure, which influence biomass distribution and primary productivity.

The northern Barents Sea is a region which is usually ice-covered, even in summer. The ICE-BAR 1996 cruise aboard a vessel with "icebreaking" capabilities, R/V 'Lance', afforded a unique opportunity to map the hydrography (TS) in a part of the worlds ocean where there are few observations. The ICE-BAR 1996 cruise was particularly noteworthy in that, due to favourable ice conditions, stations were occupied as far north as 81.6°N. It should, thus, be possible to trace water mass development and evolution all the way from the Arctic Ocean to the Hopen Trough.

The area of interest in the programme, from 76°N to 81.6°N and from 25°E to 35°E, is a shelf sea with depth less than 350 m. The topography in the area is highly variable, with order 1 depth variation. That is, the variation in the bottom topography is equal to the mean depth in the region. This means that one can expect a strong barotropic circulation (constant with depth). This part of the circulation can not be estimated from CTD surveys. Instead, one must measure the actual velocities in the water column. Because the R/V 'Lance' is an iceclass vessel equipped with an ADCP (Acoustic Doppler Current Profiler), it was possible for the first time to get direct measurements of the currents throughout this region.

Measurement programme
The measurement programme consisted of CTD profiles, continuous shipboard ADCP sampling, ADCP moorings and DOC (dissolved organic carbon) samples. The CTD sampling was conducted along transects and during time series stations. The station sampling was generally 10 nautical miles (18 km) in order to provide regional coverage of water mass variations. When mesoscale (5 km) structures, such as the Polar Front or ice edge regimes, were anticipated, station spacing was reduced to 2 nm (3.6 km) in an attempt to resolve them. For further details, see Løyning and Budgell (1996).

The shipboard ADCP was run continuously throughout the cruise. In addition to the velocity profiles mentioned previously, the ADCP system logged the intensity of backscatter through the water column. These backscatter intensities seem correlated with both biomass and zooplankton densities, as well as with video observations from the ROV. It is possible that the backscatter intensities, which were collected as a byproduct, may complement some of the other measures of biological activity in the water column.

Two self-contained ADCP instruments were moored around Kvitøya in an attempt to obtain indications of the strength of tidal currents suspected to provide the mixing necessary to produce the Kvitøya polynya observed during the programme. The ice concentration and strong drift speed made recovery difficult, and only one mooring was retrieved.

Water samples were collected at various locations for subsequent DOC analysis by colleagues at SINTEF in Trondheim and the Geophysical Institute, University of Bergen. It is anticipated that the DOC measurements will help characterise water mass origin and history.

List of DOC sampling
Sixty samples of Dissolved Organic Carbon (DOC) were taken. More than half of the samples were collected at the ice floe stations whereas the rest were sampled in open water. At the three ice floe stations, four samples from three depths were taken; at the bottom, in the mid depth and at the surface. Two of the samples at each depth

were filtered. All samples were frozen immediately and transported to the laboratory in Trondheim after the cruise.

DCM 12 deployments and recovery

Originally, the DCM 12 moorings were planned to be set out at 70 m depth in the Russian sector. The denial from Russian authorities of the 'Lance' cruise into the Russian sector led to a change of plans, and we had to look for deployment positions west of the 35°E longitude.

The pressure sensor in the instrument is constructed with a pressure range of 0-100 psi which equals 70 m. There are few locations were such depths could be found, but proper positions were found on the shallow banks around Kvitøya. The first mooring was deployed south of Kvitøya at 12:30 (local time) on the 25 of July in position N80°00.268 E32°21.3, at 69 m depth. The second mooring was deployed north of Kvitøya at 21:55 (local time) on the same day at position N80°30.136 E33° 15.206, at 50m depth. The weather and ice conditions were good: sunshine and ice free (open) waters. Because of the good weather conditions, we decided to put a line from the end of the ground line and up to the surface with surface floats.

We arrived at the northern DCM 12 mooring in the morning on 4 August, 11 days after deployment. After several days with northerly winds, the shallow banks were covered with multi-year ice floes and the sea ice concentration was 30%. The surface floats were not found. The ice concentration, in addition to strong drift, made dragging difficult and two dragging attempts were unsuccessful. We left the area to continue the research program, but came back to the northern position the same afternoon. The weather and ice conditions were now more favourable for dragging. However, this dragging was not successful either.

We then steamed south of Kvitøya, to retrieve the southernmost mooring. This bank was also covered with ice, although the waters around the bank were ice free. The surface floats were not to be found. We dragged twice, and the second attempt was successful, with the mooring on deck at 01:10 on 5 July. The DCM 12 tent had been broken and was filled with stones and gravel. The mooring had apparently been dragged along the bottom. A handle on the top of the instrument was broken off, but the external battery package and the instrument itself were OK. The mooring line was cut off close to the end; most of the line was recovered. The instrument recordings could probably reveal when dragging occurred, and thereby tell if the mooring was dragged by ice or by 'Lance'.

Possible explanations of the unsuccessful recovery of one DCM 12:

- The surface floats have probably been taken by the drifting ice.
- There are strong tidal currents around these shallow banks. The drift of the vessel was measured to be around 3 knots. (The ADCP onboard Lance will give a more accurate current velocity.) Due to the properties of the pressure sensor in the DCM 12's as mentioned above, the instruments had to be put on these shallow banks, if they were to be put out at all.
- It is possible that at wrong type of dragging anchor was used. We used another dragging anchor for the DCM 12 that was successfully recovered.

ULS recovery

The ULS in position N 77°54.56 E 28°21.45 with a ground line, RCM7 and an APL ULS, was recovered on the first dragging attempt. No new ULS mooring was deployed, because the instrument and buoyancy floats were missing when we left Longyearbyen on 20 July.

The ULS in position N77° 40.34 E26° 27.048, with an acoustic release, ULS and ARGOS transmitter, was not recovered. Two attempts were made, and the technique used was to go in a circle around the position with the dragging anchor at the bottom, in order to hook up the mooring. The diameters of the circles made, were 500-800 meters, and the length of the wire with the dragging anchor 1500-1800 meters.

Reference

Løyning, T. B. and Budgell, W. P. Physical Oceanography Data Report From the ICEBAR Cruise 1996. Norsk Polarinstitutt Rapportserie No. 95. 48 pp. ISBN 8276661149

4.2 Oceanic Carbon Dioxide

Gen Hashida

Introduction

The Marginal Ice Zone and the Polar Frontal Zone in the Barents Sea are the most productive areas in the Arctic seas. Preliminary data of the measurement of pCO_2 (partial pressure of carbon dioxide in the surface water) of such polar fronts (Greenland and Barents Sea, investigated during 'Lance' cruises of 1992, 1993 and 1995) suggested that active CO_2 sink areas seemed to be present at these zones, which are possible phytoplankton blooming areas. This information implies that the CO_2 sink was due to biological carbon uptake by phytoplankton production and biological and physiochemical transportation through arctic marine food web from surface water to the deep, also called "biological pump". These highly productive and highly CO_2 absorbed areas could play an important role as a sink of the CO_2 in the atmosphere.

Objectives

To obtain basic information on the distribution and abundance of inorganic carbon (e.g. pCO_2 and Dissolved Inorganic Carbon: DIC) and phyto and zooplankton in relation to the several water mass structures observed around the Marginal Ice Zone and the Polar Front Zone in the Barents Sea.

Experimental procedures

1. XBT observation for vertical temperature profiling along specific transects.
2. Surface water monitoring (salinity, temperature, chlorophyll fluorescence, and nitrate plus nitrite concentrations) along the cruise track.
3. Equilibrated air and sea water sampling for pCO_2, DIC, and $\delta^{13}C$ of DIC.

1. XBT - Expandable Bathy Thermograph

To determine the water mass structure, XBT temperature profilers (Tsurumi Seiki Co. Ltd.) were used. Detailed information on location, date, time, etc. is in the log of the cruise. Probes were launched along four transects; 18 probes for the transect along 35°E from 78°4' N to 79°11' N spacing every 2 nm, 12 XBT's for southeastward transect off the east of Hopen, spacings every 3.3 nm, 12 XBT's for westward transect off the east of Hopen, 18 XBT's for westward transect off the west of Hopen. These data are supplemented by CTD observations.

2. Surface water monitoring

Along the cruise track, salinity, temperature, chlorophyll fluorescence and nitrate plus nitrite concentrations in the surface water were analysed continuously (nitrate plus nitrite concentrations were partly observed). The surface water was collected and supplied continuously from the ship bottom (4.5 m depth) by a pump. The water was immediately flowed into water bath (ca. 20 l) which was installed Aquapack (Ci Co.), a CTD-Fluorescence analyser. At the same time a portion of the water was supplied to AutoAnalyzer II (Technicon), an automated nutrient analysing system. Data from Aquapack was stored on the hard disk of an PCpersonal computer every five seconds, and the data from AutoAnalyzer II was continuously recorded on charts by a pen recorder. Horizontal distributions of temperature, salinity and chlorophyll will be analysed.

3. Inorganic carbonate species

An equilibrator was used for air sampling. The same sea water as used in the surface water monitoring, was continuously sprayed into the airtight chamber. Given enough time (approximately 15 minutes), air in the equilibrator will reach equilibrium with dissolved CO_2 gases regarding partial pressure. The concentration or partial pressure of these samples will be analysed by gas chromatography equipped by a FID detector. The manometric methods will be used to measure DIC. A sample of sea water and phosphoric acid are introduced and mixed in glass cylinder which is connected to a vacuum pump. Mixed with phosphorous acid, all carbonate species (bicarbonate and carbonate) are converted to gaseous CO_2. While these CO_2 gases and other gases such as water vapour and nitrogen are pumped out of sea water, the cooled trap installed between the cylinder and the pump, fixes only CO_2 within the trap. Since the volume of the trap is known, CO_2 molecular numbers can be calculated, if temperature and pressure of CO_2 gases are measured. Dividing obtained CO_2 molecular numbers by the weight of the sample gives the concentration of dissolved inorganic carbon. The trapped CO_2 can be also analysed for stable isotopic ratio($\delta^{13}C/\delta^{12}C$) by mass spectrometer. During the cruise, samples for pCO_2 and DIC were taken at 20 stations in the north-eastern Barents Sea which will be many enough to draw a contour map of pCO_2 in the region. On 10 stations, sea water samples were taken at several depths by a CTD rosette sampler for vertical profiling of DIC and determination of its stable isotope ratio.

Summary

1. Activities

XBT observations have been done for vertical temperature profiling along four transects. These data will be formatted into the temperature contour maps, supplemented by CTD observations.

Along the cruise track, salinity, temperature, chlorophyll fluorescence and nitrate plus nitrite concentrations in the surface water were analysed continuously (nitrate plus nitrite concentrations were partly observed). Horizontal distributions of temperature, salinity and chlorophyll will be analysed.

Air which is equilibrated with the surface sea water, regarding dissolved gases and sea water, were sampled on 20 stations for pCO_2, DIC, and $\delta^{13}C$ for DIC analysis. On 10 stations sea water samples were taken at several depths by CTD rosette sampler for vertical profiling of DIC and its stable isotope ratio. NIPR and Tohoku University are in charge of the analysis.

On each ice station, sea-ice core samples were taken for analysis of ice crystallography, brine ratio, and other possible physical characteristics and qualitative analysis. These cores being kept under freezing condition will be delivered to Japan. NIPR and Hokkaido University are responsibile for seaice core analysis.

2. Proposed publications

From activities mentioned above, an idea of two possible publications is forwarded. First, having a good coverage of pCO_2, DIC, and $\delta^{13}C$ of DIC in the surface water in the western Barents Sea, from this cruise and other cruises, a publication is under planning on the distribution of these carbonate properties and their interpretation with regard to the oceanic condition such as the Polar Frontal Zone and the Marginal Ice Zone. The vertical profiles of DIC and $\delta^{13}C$ of DIC should also be discussed. Since inorganic carbon is the starting and ending point of the food web, some discussion about the relation between inorganic carbon and phytoplankton activity might be very interesting. Tentative title is "Distribution of Partial Pressure of Carbon Dioxide and Dissolved Inorganic Carbon in the Western Barents Sea". A second publication will be about sea ice cores. In addition to visual inspection during drilling, physical properties of the sea ice cores and characteristics of the ice floes from which sea ice cores were taken are subjects to discuss. The results from sea ice cores taken during ICE-BAR 1995 may be added. Ice physical characteristics are critical to the radiation transfer in the ice floe, so multidisciplinary publications in this sense should be planned.

4.3 Light physics

Jon Børre Ørbæk and Boris Ivanov

4.3.1 Radiation measurements (SM activity)

Background

The radiation program on the ICE-BAR 1996 cruise consisted of a marine and an icefloe part, both utilising advanced spectral radiometers for under-water radiation measurements and for measurements of surface spectral albedo and under ice irradiance at the ice floes. The main objective of the marine part was to investigate the optical properties of the Arctic water masses to the east and north of Svalbard by means of spectral UV/VIS radiation measurements in the euphotic zone, i.e. the upper 50 meters of the water column.

The ice floe part of the program studied the optical and reflective properties of Arctic sea ice and snow and their variability. Large changes in the reflective properties of the snow and ice take place during the melting period due to the formation of water, in the sea ice, development of melt ponds, crystal growth, all changing the surface albedo. The amount of solar radiation penetrating the snow and ice cover varies considerably with the different surfaces and ice structures, and is an important parameter determining the onset of biological production.

The overall objective of this work was to study the spectral characteristics of snow and sea ice with the use of advanced spectral radiometers in order to improve our understanding of the natural variability of the spectral reflective properties of the surface as well as the key factors controlling the penetration through snow and sea ice. This will give information about the spectral distribution of solar radiation that reaches the underlying biotopes, as well as integrated quantities such as PAR-radiation (Photosynthetic Active Radiation) which is an important parameter for the biological production. As part of the effort to characterise the different ice floes, ice cores where taken from each floe for later analysis both with regard to the detailed description of the biotopes studied and for studies of light penetration.

4.3.2 Underwater spectral irradiance, Underwater Photosynthetic Active Radiation (PAR), global shortwave and UVB radiation

Material and Methods

During the ICE-BAR 1996 cruise, a northward transect from 75°N to 82°N along the 35°E meridian was conducted to measure the changes in water properties from the Barents Sea into the Arctic Ocean. Regular CTD measurements where done approximately every 10 nautical miles, whereas underwater spectral radiation profiles where taken approximately every 20 miles. The spectral radiation profiles where done in the upper 50 meters of the water column, with additional measurements of Secchi disc depth. Underwater spectral radiation profiles were also performed during the 4 ice stations on the cruise, as well as at the single open water station. Measurements stations are given in table 4.3.2.1.

A Licor 1800UW underwater spectroradiometer was used for the measurements, preset to perform spectral radiometric scans from 300-850 nm with 1 nm resolution (with a standard band width of 8 nm). In order to reduce the shadow effects from the ship to a minimum, the measurements were carried out from a small rubber boat with the instrument connected at the end of a 4 m rod sticking out from the side of the boat.

Continuous measurements of global shortwave radiation where performed simultaneously from the mast head with a Kipp & Zonen pyranometer and a Campbell CR10 datalogger. These measurements were used for general monitoring of the atmospheric radiation conditions and for stability check of the incoming solar radiation during the underwater profile measurements in order to correct for variations if possible. A Solar Light Company SL501 UVBiometer was used for continuous measurements of solar UVB radiation, evaluated in MED/hr (Minimum Eurythemal Dose per hour).

Table 4.3.2.1 Underwater spectral measurements stations (UWS) during the ICE-BAR 1996 cruise.

Station No.	Lat. N	Long. E	Date	Time (LT)	Water depth (m)	Secchi depth (m)	Measurement depth (m)
SM01/1	76°28.00	34°48.40	96.07.23	01:20	222		00-15
SM02/2	76°48.70	34°49.40	96.07.23	04:30	129		00-15
SM03/3	77°09.17	34°49.36	96.07.23	07:25	142		00-50
SM04/4	77°29.10	34°46.70	96.07.23	11:14	197	11	00-50
SM05/5	77°18.10	34°48.50	96.07.23	17:08	152	16	00-50
SM06/6	77°24.10	34°49.40	96.07.23	18:37	188	13.5	00-50
SM07/7	77°28.00	34°50.20	96.07.23	19:45	193	14	00-50
SM08/8	77°32.10	34°50.60	96.07.23	21:57	100	12.5	00-40
SM09/9	77°44.40	34°49.60	96.07.24	02:20	174	13.5	00-50
SM10/10	78°04.00	34°44.30	96.07.24	09:20	155	11	00-50
SM11/11	78°22.90	34°32.40	96.07.24	14:30	108		00-50
SM12/12	78°43.00	34°13.20	96.07.24	18:00	300		00-50
SM13/13	79°03.40	34°21.20	96.07.24	21:30	239	20	00-50
SM14/14	79°30.40	33°40.20	96.07.25	02:45	285	17.	00-50
SM15/15	80°00.10	33°47.40	96.07.25	07:30.	209	11	00-50
SM16/16	79°59.96	34°00.54	96.07.25	15:55	206	11	00-50
SM17/17	80°29.90	34°00.20	96.07.25	20:05	164	21.5	00-50
SM18/18	80°50.10	34°18.50	96.07.25	03:35	171	17	00-50
SM19/19	81°20.20	33°28.90	96.07.26	09:00	194	20.5	00-50
SM20/20	81°30.70	34°13.00	96.07.26	15:20	235	23.5	00-50
SM21/21	81°30.70	34°13.00	96.07.26	15:55	235	12.5	00-50
SM29/22/I1A	81°30.00	34°37.50	96.07.29	16:30	252	15	00-50
SM29/23/I1A	81°30.00	34°37.50	96.07.29	17:00	252	16.5	00-50
SM29/24	81°30.00	34°37.50	96.07.29	17:30	252	18	00-50
SM38/25/I0A	81°29.90	33°25.30	96.08.02	17:30	180	8.5	00-50
SM38/26/I0A	81°29.90	33°25.30	96.08.02	18:00	180	9	00-50
SM40/27	80°09.50	33°38.70	96.08.04	13:00	161	15.5	00-50
SM43/28/I2A	79°28.70	32°37.90	96.08.05	20:00	294	24.5	00-50

SM43/29/I2A	79°28.70	32°37.90	96.08.05	21:00	294	26.5	00-50
SM50/30/I3A	78°32.60	25°46.40	96.08.08	17:00	156	16	00-30
SM51/31/I3A	78°39.40	25°48.30	96.08.09	10:00	85		00-50
SM55/32	77°43.80	25°25.70	96.08.10	13:30	153	5.5	00-50

4.3.3 Surface spectral irradiance, surface spectral albedo and under ice spectral irradiance

Material and Methods

During the ICE-BAR 1996 cruise, 4 ice stations were established in the Marginal Ice Zone (MIZ) for multidiciplinary investigations of Arctic ice flora and fauna as well as geophysical parameters connected to the ice environments. At these stations, measurements of the surface spectral albedo and the under ice irradiance were executed at different surfaces of the ice floe, i.e. at wet snow, dirty snow, bare ice and in melt ponds. The following measurements were carried out: angular distribution of incoming spectral radiance, bi-directional reflectance, spectral albedo at Nadir, melt pond bottom albedo and under ice spectral irradiance.

An advanced portable spectroradiometer of type FieldSpec FR 350-2500nm from Analytical Spectral Devices Inc. was used for the measurements. The instrument actually consists of three coupled spectrometers with three different detectors each covering independent wave length regions. The visible and near infrared part (VNIR) from 350-1000 nm was of the diode array type with 512 element (1.4 nm band width) silicon photodiode array and a spectral resolution of about 3 nm. The shortwave infrared radiation (SWIR) was measured be means of two scanning spectrometers with concave holographic gratings and thermoelectric cooled IndiumGalliumArsenide (InGAs) detectors. The SWIR1 spectrometer covered the wavelength region 900-1850 nm, whereas the second SWIR2 covered the region 1700-2500 nm, with 2 nm steps and approximately 10 nm wave length resolution.

The radiance measurements of spectral albedo and the angular distribution of incoming solar radiation were performed by means of the standard fibre optic cable having a 25° field of view. White reference measurements were done on a calibrated white reference plate placed at Nadir. The melt pond bottom albedo was determined by irradiance measurements utilising a 4 meter protected fibre optic extension cable with attached water tight remote cosine receptor. The same equipment was used for the under ice measurements attaching the remote cosine receptor to a 5-meter dedicated aluminium rod. The end 1-meter of the rod could remotely be lifted up 90° after being lowered under the ice so that the attached cosine receptor actually was located 1 meter to the side of the drillhole. Underwater spectral radiation profiles were also performed during the four ice stations on the cruise. Simultaneous measurements of global radiation were performed from the mast head of 'Lance' in order to check the stability of the incoming radiation conditions during spectral measurements. These data were logged with 1 minute resolution by means of Campbell CR10 datalogger together with the air temperature. Measurements of the reflected shortwave radiation were also performed during ice station 1 (I1A). Each melt pond under investigation was also examined by temperature and salinity profiles utilising a portable handheld CTD sonde.

Table 4.3.3.1. List of the measurements performed at the four ice stations. Hsn: -snow thickness, Hmp: melt pond depth, Hice: ice thickness, Dn: downward, Up: upward

Ice Station Date	Time (LT)	Type of measurements	Location	Description of surface/ice
I1A - 96.07.27- 96.07.30				
96.07.27	21:13-21:19	Angular distr. of downward radiance	Loc.1b	Wet snow (white), Hsn=4-6 cm
	21:24-21:26	Bidirectional reflectance	Loc.1b	Wet snow (white), Hsn=4-6 cm
	21:35-21:37	Global Dn and reflected irradiance	Loc.1b	
96.07.28	13:19-13:27	Spectral albedo	Loc.1b	Wet snow (white), Hsn=4-6 cm
	13:02-13:04	Angular distr. of Dn and refl. rad.	Loc.1 b	Wet snow (white), Hsn = 4-6 cm
	13:38-13:47	Spectral albedo	Loc.1c	Wet snow (white), Hsn=4-6cm
	14:42-14:59	Spectral albedo	Loc.MP1	Melt pond surface, Hmp=12cm
	15:19-15:38	Spectral albedo	Loc.MP2	Melt pond surface, Hmp=20cm
	20:02-20:52	Melt pond UW irradiance	Loc.MP2a	Melt pond bottom, Hmp=16cm
	x	Melt pond UW irradiance	Loc.MP2b	Melt pond bottom, Hmp=19cm

	x	Melt pond UW irradiance	Loc.MP2c	Melt pond bottom, Hmp=29cm
	21:20-21:33	Melt pond UW upward irradiance	Loc.MP2d	Melt pond bottom
	17:37-17:39	Intercomp. RCR - 4mFOP		
96.07.29	11:01-11:09	Angular distr. of downward radiance	Loc.1b	Wet snow (white), Hsn=4-6cm
	11:25-11:28	Spectral albedo	Loc.1b	Wet snow (white), Hsn=4-6cm
	11:43-11:46	Spectral albedo	Loc.1c	Wet snow (white), Hsn=4-6cm
		Intercomp. RCR - 4mFOP		
	14:19-14:28	Under ice irradiance	Loc.MP3a	Melt pond, Hmp=20-30cm, Hice=1.2m
	14:55-14:57	Melt pond UW irradiance	Loc.MP3b	Melt pond, Hmp=20-30cm
96.07.30	10:32-10:37	Angular distr. of Dn and refl. rad.	Loc.1b	Wet snow
	10:46-10:51	Spectral albedo	Loc.1b	Wet snow
	11:17-11:19	Intercomp. RCR - 4mFOP		
		Under ice irradiance	Loc.MP3a	Melt pond, Hmp=20-30cm, Hice=1.2m
	11:51,53, 12:00-01	Under ice irradiance	Loc.5	
	14:01,02, 14:08-09	(profile - 5 points)	Loc.1a	Hice=2.1-2.2 m
	14:28, 29, 14:32-33		Loc.2	Hice=1.65 m
	14:39, 44, 47		Loc.3	Hice=1.55 m
	15:00, 04, 10		Loc.4	Melt pond, Hmp=15cm, Hice=1.2m
I0A 96 08.01-96.08.02				
96.08.01	14:17-14:22	Angular distr. of Dn and refl. rad.	Loc.1a	Wet snow (white), Hsn=4-5cm
	14:40-14:42	Spectral albedo	Loc.1b	Wet snow (white)
	15:55-15:56	Spectral albedo	Loc.5	Wet snow (white)
	16:13-16:15	Spectral albedo	Loc.2a	Wet snow (grey), Hsn=4-5cm
	15:44-15:46	Spectral albedo	Loc.4a	Wet snow (grey), Hsn=4-5cm
	14:53-14:54	Spectral albedo	Loc.3a	Melt pond, Hmp=25cm, Hrind=1.2m
	15:03-15:05	Spectral albedo	Loc.3b	Melt pond, Hmp=25cm, Hrind=1.5m
	15:20-15:22	Spectral albedo	Loc.3c	Melt pond, Hmp=25cm, Hrind=0.7m
	11:17-11:18	Intercomp. RCR - 4mFOP		
96.08.02	11:32, 39, 41	Under ice irradiance	Loc.1c	Hice=2.5 m
	12:55, 59, 13:01	(profile - 5 points)	Loc.2b	Hice=1.75 m
	13:26, 29, 30		Loc.3d	Melt pond, Hmp=25cm, Hice=1.2m
	13:45, 47 ,49		Loc.4b	Hice=1.55m
	14:04, 06, 07			Hice=1.9m
	14:30	Angular distr. of Dn and refl. rad.	Loc.5c	Wet snow (white), Hsn=5cm
		Wavelength calibration		
I2A 96.08.05-96.08.06				
96.08.05	12:01-12:07	Spectral albedo	Loc.1a	Wet snow (white), Hsn=20cm
	x	Spectral albedo	Loc.1b	Wet snow (white), Hsn=25cm
	14:30-14:31	Spectral albedo	Loc.3	Wet snow (blue hue), Hsn=3cm
	14:41-14:42	Spectral albedo	Loc.4	Wet snow (white), Hsn=7-10cm
	15:34-15:35	Spectral albedo	Loc.6a	Wet snow (white), Hsn=15cm
	13:56-14:23	Spectral albedo	Loc.2a	Melt pond, Hmp=17cm, Hrind=1.3-1.8cm
	x	Spectral albedo	Loc.2b	Melt pond, Hmp=23-25cm, Hrind=1.0-1.2cm
	x	Spectral albedo	Loc.2c	Melt pond, Hmp=22-23cm, Hrind=0.8-1.2cm
	14:55-15:21	Spectral albedo	Loc.5a	Melt pond, Hmp=30-35cm
	x	Spectral albedo	Loc.5b	Melt pond, Hmp=15-20cm
	17:17-17:19	Under snow irradiance	Loc.6b	Snow covered melt pond
	17:40-17:41	Melt pond UW irradiance	Loc.5c	Melt pond bottom, Hmp=37cm, D=24cm
	17:59-18:01	Melt pond UW upward irradiance	Loc.5c	Melt pond bottom, Hmp=37cm, D=26cm
96.08.06	13:46-50, 13:55-58	Under ice irradiance	Loc.7	Hice=2.0 m
	14:00-19, 14:23-26	Under ice irradiance	Loc.5d	Melt pond, Hmp=25cm, Hice=1.55-1.65m
I3AK 96.08.08				
96.08.08	13:52-14:00	Angular distr. of Dn and refl. rad.	Loc.1b	Wet snow (white), Hsn=5cm
	14:14-14:15	Spectral albedo	Loc.1b	Wet snow (white)
	14:20-14:22	Spectral albedo	Loc.2b	Wet snow (Hidden MP?), Hsn=1-2cm

	14:36-14:37	Spectral albedo	Loc.3c	Melt pond, Hmp=15cm
	14:38-14:39	Bidirectional reflectance	Loc.3c	Melt pond
	14:56-00, 15:03-07	Under ice irradiance	Loc.3a	Melt pond, Hmp=27cm, Hice=83cm
	15:19-23, 15:25-28	Under ice irradiance	Loc.1a	Wet snow (white), Hsn=5cm, Hice=1.25m
		Intercomp. RCR - 4mFOP		
IS3AL 96.08.08				
96.08.08	20:09-20:11	Spectral albedo	Loc.1	Wet snow (dirty), Hsn=3-5cm
	20:25-20:26	Spectral albedo	Loc.4	Wet snow (dirty), Hsn=5cm
	20:16-20:17	Spectral albedo	Loc.2	Melt pond (sediments), Hmp=70cm
	20:22	Spectral albedo	Loc.3	Melt pond (sediments), Hmp=40-50cm
	20:28-20:29	Spectral albedo	Loc.5	Melt pond (sediments), Hmp=40-50cm
96.08.08	14:40-14:42	Spectral albedo	Loc.6	Wet snow (dirty), Hsn=3cm
	14:48-14:50	Spectral albedo	Loc.7	Wet snow (dirty), Hsn=1cm
	14:57-14:58	Spectral albedo	Loc.8	Wet snow (dirty), Hsn=0-1cm
	15:06-15:07	Spectral albedo	Loc.9	Melt pond (sediments), Hmp=20cm, brash ice
	15:12-15:12	Spectral albedo	Loc.10	Melt pond (sediments), Hmp=30-35cm
				Hrind=0.5cm, crumbly
	15:17-15:18	Spectral albedo	Loc.11	Melt pond (sediments), Hmp=18-20cm
				Hrind=0.7-0.9 cm, crumbly
I3AA 96.08.09				
96.08.09	17:21-24, 17:30-39	Under ice irradiance	Loc.1	Melt pond, Hmp=20-30cm, Hrind=0.5cm
	17:40-17:46	Under ice irradiance	Loc.2	Wet snow (white), Hsn=5cm, Hice=2.0m
	17:55-17:56	Spectral albedo	Loc.3	Wet snow (white), Hsn=2cm

4.4 Phytoplankton and Ice algae

Else Nøst Hegseth and Yuri Okolodkov

4.4.1 Phytoplankton and ice algae

Else Nøst Hegseth

Introduction

Marginal ice zones are recognised as sites of enhanced primary production, and in the Barents Sea extensive ice edge phytoplankton blooms are found in early spring, while enhanced biomass is usually reported until freezing starts in September. Hydrophysical factors, particularly wind and ice cover movements, may explain the presence and absence of blooms in spring, while increased grazing probably reduces the phytoplankton biomass in autumn. The summer situation is not well known far north in the Barents Sea, although theories predict a delayed "spring" bloom in summer during the short period of open water.

In early spring, ice algal production is predominant, being outcompeted by the pelagic production some time during summer. The primary production is the sum of pelagic and ice algal production. On an annual basis this may account for 60 and 40 % of total production, respectively, but real data still lacks.

The main objectives of this project were to describe the summer situation north of the Polar Front and to relate the phytoplankton biomass to hydrographic conditions. Is there a spring/summer bloom in the high north? What is the size of the primary production here? Are there different productive regions? If so, why? Is there still an ice algal production, or is the growth season for ice algae terminated due to melting?

Material and methods

Work was divided into a phytoplankton part and an ice algae part. Each part was supposed to cover biomass, primary production and chemical composition of the algae, and most of this program was carried out (Table 4.4.1.1).

Additionally, incoming visible light (as PAR = photosynthetic active radiation, 400-700 nm), including some wavelengths in the UV part of the spectrum were measured continuously during the cruise by a sensor on the front deck. At most stations, vertical profiles of underwater irradiance were measured one to several times by an underwater sensor (as PAR and UV radiation).

Phytoplankton

The phytoplankton sampling started on the first transect from the Polar Front to Kvitøya, covering vertical profiles from the surface to bottom of fluorescense, chlorophyll and cell numbers (at some stations) along the transect. Deck incubation measurements for testing of UV radiation effects on primary production were also performed. Some more stations were covered around Kvitøya and north to the first ice station, I1A. Here the distribution of the phytoplankton in the water masses was monitored during the five days at the station by vertical profiles of biomass (chlorophyll, cell numbers). Chemical composition of the algae was measured as POC, PON, POP, biogenic Si and lipid, and samples for nutrients (nitrate, phosphate, silicate) in the water column were collected from filtrates. Primary production was measured *in situ* at six different depths from surface to 30 m three times, using incubation bottles of different material (quarts, quarts with mylar film and quarts with pyrex cover) to include measurements of possible effects of UVA and UVB radiation on the photosynthesis at the respective depths. The bottles were submerged in a lead from a floating rig attached to the edge of a floe, and incubation time was 6 hours.

At the next two ice stations (I0A and I2A) the sampling program was repeated, but because of difficult ice conditions (small leads, lots of fast drifting floes) the *in situ* primary production experiments could not be carried out; the risk of loosing the rig was considered too high. Instead deck incubations (0 and 10 m) were carried out. At ice station 3 (I3A) successful production measurements were for the first time conducted in full sunlight. Previously there had been mostly foggy days.

The last station was situated in open water, and in addition to the biomass and chemical composition measurements, a freefloating *in situ* primary production experiment was carried out. The rig with the incubation bottles was left to drift around on the open ocean while the ship was performing other sampling programs. After 6 hours the rig was located and picked up again without any loss or damage to the sample bottles. The weather was sunny during the whole incubation period. In addition to the long stations, phytoplankton was also sampled along a transect between Kvitøya and the Victoria Island to study biomass distribution relative to the physical conditions across a trench.

Ice algae

The success of this part of the program would be highly dependent on the ice conditions and the degree of melting of the ice cover. Normally, the northern Barents Sea is ice covered south to 78-79°N in July, but this year melting/wind had caused open water far north, leaving an ice cover in a late melting stage. Consequently, virtually all of the ice algal layer had disappeared, also at the northernmost stations (I1A & I0A). Almost constant fog prevented us from using the helicopter to go further north. Collecting of samples was performed by divers, using a hand operated electrical suction sampler and sampling inside a frame to obtain quantitative samples. At the same time irradiance (PAR) was measured on each sampling site by a handheld underwater light meter. In some of the samples biomass was measured as chlorophyll, POC, PON, POP, biogenic silica and cell numbers.

Table 4.4.1.1. Sampling program for phytoplankton and ice algae

Date	Open water st.	Ice st.	Physical. parameter	Biological parameter; phytoplankton
96.07.23	16			Chl, cell no.
96.07.23	21			Chl, cell no., deck incubation
96.07.23	23		UW Irradiation	Chl, cell no., deck incubation
96.07.24	39		UW Irradiation	Chl, cell no.
96.07.96	49		UW Irradiation	Chl, cell no., deck incubation
96.07.24	51		UW Irradiation	Chl, cell no.
96.07.24	53			Chl, cell no.
96.07.25	61		UW Irradiation	Chl, cell no., deck incubation
96.07.25	62		UW Irradiation	Chl, cell no.
96.07.25	66		UW Irradiation	Chl, cell no.
96.07.26	69		UW Irradiation	

96.07.26	72		UW Irradiation	Chl, cell no., deck incubation
96.07.26	74		UW Irradiation	Chl, cell no.
96.07.27	77	I1A		Chl, cell no., POC,PON, POP,Si,nutrients,lipids
96.07.28	83	I1A	UW Irradiation	Chl, cell no., in situ inc., POC,PON,POP,Si
96.07.28		I1A		Chl, cell no., Si, POC, PON,POP
96.07.29	91	I1A	UW Irradiation	Chl, cell no., in situ inc.,nutrients
96.07.29	93	I1A	UW Irradiation	Chl, cell no., POC,PON; POP, Si, nutrients,lipids
96.07.30	103	I1A	UW Irradiation	Chl, cell no., lipids
96.07.30	111	I1A		Chl, cell no.
96.07.31		I1A	UW Irradiation	Chl, cell no., POC, PON,POP, Si, nutrients
96.08.01	119	I0A	UW Irradiation	Chl, cell no., nutrients
96.08.02	123	I0A	UW Irradiation	Chl, cell no., POC, PON;POP, Si, nutrients,lipids
96.08.04	126			Chl
96.08.04	130			Chl
96.08.04	134		UW Irradiation	Chl, cell no.
96.08.05	136	I2A	UW Irradiation	Chl, cell no.,
96.08.05	137	I2A	UW Irradiation	Chl, cell no., lipids
96.08.05	138	I2A		Chl
96.08.05	139	I2A	UW Irradiation	Fl
96.08.06	142	I2A		Chl, cell no., POC,PON,POP, Si,nutrients
96.08.08	153	I3A	UW Irradiation	Chl, in situ incubation
96.08.08	154	I3A	UW Irradiation	Chl, cell no., POP, PON, POP,Si, nutrients
96.08.08		I3A		Chl, cell no., POC,PON,POP, Si,lipids
96.08.09	160	I3A	UW Irradiation	Chl, cell no., nutrients,lipids
96.08.09	161	I3A	UW Irradiation	Chl
96.08.09		I3A	UW Irradiation	Chl, cell no., POC,PON,POP, Si,lipids
96.08.10	180		UW Irradiation	Chl, cell no., *in situ* inncubation.,POC,PON,POP,Si,nutrients

				Biological parameter; ice algae
96.07.28	86	I1A	Under ice irradi.	Chl, cell no., POC, PON, POP, Si
96.07.31	115	I1A	Under ice irradi.	Chl, cell no., POC, PON, POP Si, nutrient, lipids
96.08.08	154	I3A		Chl, cell no., POC, PON, POP, Si, lipid
96.08.09	160	I3A	Under ice irradi.	Chl, cell no., POC, PON, POP, Si, lipid

4.4.2 Biodiversity of planktonic and sea-ice algae

Yuri B. Okolodkov

Objectives
The main objectives were as follows:
1. To study biodiversity of planktonic and sea-ice algae with emphasis on dinoflagellates, important but unsatisfactorily known organisms.
2. To investigate temporal-spatial distribution of planktonic and sea-ice algae in the MIZ.

Material and Methods
A total of 69 samples at 30 stations were taken. Phytoplankton samples were taken with a stainless steel bucket (19 samples) from the surface and with plankton net, mesh 25 µm or 70 µm, from the depth of 20 m or 25 m to the surface. The algae collected with bucket (18 samples) were concentrated using the reverse-filtration device and Nuclepore filters 1 µm. The volume filtered varied from 1 to 5 l. The samples of ice algae from the lower ice surface were collected by electric suction sampler, and those floating on the surface were gathered manually. Lumps found on the bottom of melt ponds were taken by pipette. Samples were usually fixed with formaldehyde to a final concentration 1 to 2%, and in some cases with Lugol solution. Compound Leitz LABORLUX S microscope equipped with the objectives 10/0.25 Ph, 40/0.65 Ph and 100/1.25 Oil Ph, and photo-camera Wild MPS52 were used.

Results

Phytoplankton

In the area between 75 and 76°N with no ice, *Rhizosolenia hebetata f. semispina* and *Chaetoceros concavicornis* were dominant. The number of species per station was as low as 7 to 12. At three stations carried out at 77-78°N, with no ice or with ice concentration 3, *Gymnodinium spp.* and *Peridiniella danica* prevailed. The number of species per station was about 20. At two stations located at the same latitude, with no ice, performed 18-20 days later, *Chaetoceros wighamii, C. fragilis, Thalassiosira nordenskioeldii* and *Dinobryon balticum* dominated, the total number of species being 30. At station located at 78°43', with ice concentration 1, various unidentified flagellates of 5-12 µm in diameter and *Gymnodinium sp.* were dominant. At three stations located in a polynya, between 80°00' and 80°30'N, with no ice visible, a spring bloom was observed: *Thalassiosira antarctica, T. nordenskioeldii, Chaetoceros concavicornis, C. Fragilis, C. socialis, Fragilariopsis oceanica* and *Phaeocystis cf. pouchetii* prevailed in number. The species diversity increased substantially compared with that at the previous stations, the number of species reaching 55 per station.

At Ice station 1 a bloom was observed; *Thalassiosira antarctica, T. bioculata, T. nordenskioeldii, Chaetoceros socialis, C. wighamii* and *Fragilariopsis oceanica* were dominant. Some cells of *T. antarctica* and *F. oceanica* started to form resting spores. Mostly planktonic and some sympagic-planktonic as well as a few epiphytic species characteristic of sub-ice assemblages occurred. The number of species reached 40. At Ice station 0 the same diatom species, except *C. socialis*, were dominant. The number of species was about 25 (only a sample taken with plankton net was examined). At station located at 80°17'N, 34°30'E, a bloom was observed, with *Thalassiosira bioculata, T. nordenskioeldii* and *Fragilariopsis oceanica* being dominant. The number of species exceeded 50. At Ice station 2, with ice concentration 3, a chrysophyte *Dinobryon balticum* was dominant. The number of species reached 30. At Ice station 3, *Thalassiosira bioculata, T. antarctica* and *T. nordenskioeldii* were dominant. The number of species was about 40. In the surface layer, a number of nanoplanktonic flagellate species were observed.

The phytoplankton community was studied at its different stages of seasonal succession. The stage with prevalence of *Phaeocystis cf. pouchetii*, in a pronounced bloom occurring in the middle of polynya, at 80°01'N, 32°21'E, should be considered the earliest. In peripheral parts of the polynya, the state of phytoplankton community might be considered as that in an advanced stage. *P. cf. pouchetii* were in poor condition and in less number resulting in a less pronounced bloom. Among *Chaetoceros* species, mainly small-sized ones contribute to the spring bloom. O regard to the other dominant species, *Thalassiosira antarctica* is a typically planktonic species, whereas *Fragilariopsis oceanica* and *Thalassiosira nordenskioeldii* and *T. bioculata* are sympagic-planktonic.

Among the most interesting findings are dinoflagellates *Micracanthodinium claytonii, Dinophysis pulchella* and *Gyrodinium endofasciculum*. They have previously been known from southerly areas and probably indicate the intrusion of warmer Atlantic waters.

Sea-ice algae

At Ice station 1, in sub-ice assemblage collected from smooth under surface of multi-year ice floe, under melt pond, *Fragilariopsis oceanica, Thalassiosira nordenskioeldii* and *Chaetoceros wighamii* were dominant. *Melosira arctica* was a dominant species and epiphytic diatoms *Attheya septentrionalis* and *Pseudogomphonema arcticum* were frequent. In addition, small flagellates 6-13 µm long, presumably asigned to zooflagellate class Kinetoplastidea were very common. Another sample, a lump stuck to an amphipod (*Gammarus* sp.) collected from the lower surface of multi-year ice was composed mainly of a benthic filamentous seaweed *Ulothrix pseudoflacca*. It has been previously known from freshened areas in the coastal zone of the Arctic seas. Despite that, seaweed found at Ice station 1 may be considered an allochthonous species, it appears to continue vegetating in sub-ice assemblages.

At Ice station 0, in a lump floating on the surface, *Thalassiosira antarctica, Fragilariopsis oceanica* and *Chaetoceros wighamii* were dominant. Another sample taken from the lower surface of first-year ice floe was dominated by *Melosira arctica* with no auxospores or resting spores, *Synedropsis hyperborea* and *Attheya septentrionalis*, representing a typical *M. arctica* assemblage. Lumps found in the leads among ice floes and obviously detached from their lower surface were composed mainly of *M. arctica* and *S. hyperborea*. A sample collected from the lower surface of a multi-year ice floe at Ice station 2 included *Synedropsis hyperborea* as a dominant species. At Ice station 3, under 4-m ice in the zone of subhummocks, a small-sized diatôm provisionnaly ascribed to the genus *Amphora* prevailed, the cell length being 7.5-12 µm. The *Amphora* assemblage coloured rather fragile lower-ice layer light brown and covered the ice homogenously. *Synedropsis hyperborea* was subdominant.

The species composition in sea-ice samples were compared between the 1996 and 1995 cruises. Species characteristic of sea-ice flora as *Nitzschia frigida*, *Navicula kariana* and *N. septentrionalis* were not dominant, and *Nitzschia promare* was not encountered at all. In May 1996, *N. frigida* and *N. promare* were the most common dominant species in sub-ice assemblages in the MIZ of the Barents Sea.

The relationship of *Thalassiosira nordenskioeldii, T. antarctica* and *Chaetoceros wighamii* to their natural habitats must be re-considered. The data obtained in the cruise allow us to consider them sympagic-planktonic rather than purely planktonic species. The former two species are known to be able to produce endogenous resting spores and thus to survive unfavourable conditions. Heterotrophic flagellates of the class Kinetoplastidea seem to be characteristic of ageing or decaying assemblages.

Flora of melt ponds

Seven samples were taken from melt ponds at Ice station 0 and one at Ice station 2. Mostly white lumps, in some cases greenish or grey, were collected from depressions of up to 7 cm in diam. on the bottom of melt ponds. In all samples at Ice station 0, cells of 23-27 µm in diam. with green content provisionally ascribed to a chlorophycean Volvocales gen. sp. were found. Lumps, primarily consisting of diatoms, include more than 20 species, which are represented by empty frustules or decaying cells with remnants of chloroplasts. Thus, taking into account mainly dead cells found in melt ponds, the latter may be considered as thanatocoenosis rather than biocoenosis. Epiphytic diatom *Synedropsis hyperborea* was a dominant in all samples. The rest of the identified diatoms were typically sea-ice algal species. in addition to algae, zooflagellates of the class Kinetoplastidea were found.

At Ice station 2 only greenish lumps were found on the bottom of a freshwater melt pond. The lumps consisted of detritus. A sample taken from a melt pond at Ice station 3 contained much detritus, mineral particles, many empty diatom frustules and a few diatom cells with remnants of chloroplasts of mostly pennate species. Detritus with embedded frustules was represented with aggregations of globular shape, ca 2-5 mm in diameter.

Supplement 4.4.1

A list of algal taxa found in phytoplankton samples during the 'Lance' cruise, in July-August 1996

Cryptophyta:
Cryptophyta gen. sp.

Dinoflagellata:
Amphidinium sphenoides
Amphidinium spp.
Amylax triacantha
Ceratium arcticum var. arcticum
Cochlodinium spp.
Dinophysis acuminata
D. pulchella
D. rotundata
Gonyaulax spinifera
Gymnodinium cf. wulffii
Gymnodinium spp.
Gyrodinium endofasciculum
G. cf. calyptroglyphe
G. cf. fusus
G. cf. lachryma
G. pellucidum
G. spirale
Gyrodinium spp.
Heterocapsa rotundata
Katodinium glaucum
Micracanthodinium claytonii
Peridiniella catenata
P. danica
Prorocentrum balticum (thecae)
P. minimum
Protoperidinium cf. achromaticum
P. bipes
P. brevipes
P. cerasus
P. islandicum
P. cf. monovelum
P. cf. ovatum
P. pallidum
P. pellucidum
P. cf. pyriforme
Dinoflagellate cysts

Bacillariophyta: Centrophyceae:
Attheya septentrionalis
Bacterosira bathyomphala
Chaetoceros atlanticus
C. borealis
C. concavicornis
C. convolutus
C. decipiens
C. fragilis
C. gracile
C. socialis
C. wighamii
Melosira arctica

Porosira glacialis
Proboscia alata
Rhizosolenia hebetata f. semispina
R. setigera
Thalassiosira antarctica
T. bioculata
T. nordenskioeldii

Bacillariophyta: Pennatophyceae:
Cylindrotheca closterium
Entomoneis paludosa var. hyperborea
Fragilariopsis cylindrus
F. oceanica
Navicula kariana
N. pelagica
Nitzschia frigida
Pseudo-nitzschia cf. delicatissima
P. cf. seriata

Chrysophyta:
Dinobryon balticum
D. faculiferum
Distephanus speculum

Prymnesiophyta:
Phaeocystis cf. pouchetii

Prasinophyta:
Pyramimonas spp.

Euglenophyta:
Euglenophyta gen. sp.

Uncertain taxonomic position:
Leucocryptos marina

4.5 Zooplankton

Gunnar Pedersen and Stig Falk-Petersen

Background
The zooplankton stocks and species composition are key factors which directly affect the primary production as well as the vertical carbon flux. It is shown that during the spring bloom, copepod overwintering success, the timing of their ascent from hibernation, population density and grazing pressure in the surface waters are factors that exert control on "successful" retention of the primary produced energy in the pelagic ecosystem or the loss of primary produced matter by sedimentation. Zooplankton, together with icefauna, is also the direct link between the primary producers and fish stocks, marine mammals and sea birds.

The extreme oscillation of abiotic factors is the critical factor structuring Arctic marine biotic systems. Pelagic marine herbivores exposed to such marked variation in available food have responded, *inter alia*, by storing large amount of lipids as energy reserves. The lipid levels increase from 10-20% in phytoplankton to 50-70% in herbivorous zooplankton and icefauna. This increase in lipid levels is probably one of the most fundamental and key specialisations in Arctic bioproduction. The dramatic accumulation of oil provides higher trophic levels with energypacked food to sustain them over the winter.

The main objectives of this investigation were to study the community structure and the lipid chemistry of the zooplankton. This included:

1. Abundance and age/size distribution of different types of zooplankton at the north-south transect.
2. Ontogenetic and vertical migration of the copepods because of the utilisation of phytoplankton and avoidance of predators.
3. Production of herbivorous zooplankton in terms of egg production.
4. Analyses of lipid composition of important zooplankton species in relation to their life cycle strategies and trophic levels.

Methods
The MULTINET is a zooplankton sampling system with five nets which can be opened/closed from the ship at discrete depths. The opening is 0.5x0.5m (0.25m^2). During ICE-BAR 1996 the mounted nets had 180 μm mesh size and the MULTINET was only used in vertical tows. The depth strata sampled were chosen by the depth of the water column, the back scatter at the ADCP and physical stratification of the water column.

The Tucker trawl is a zooplankton sampling device with one net which can be opened and closed at discrete depths. The depth is calculated from the angle and the length of the towing wire. The opening is 1x1m (1m^2), and the nets used on the ICE-BAR 1996 were 1000 and 2000 µm mesh size. The Tucker trawl is towed after the ship with a speed of 2 knots.

The WP2 net is a single net used for vertically tows. The diameter is 0.6m ($0.28m^2$ opening), and the mesh size used was 200 µm. The speed of the net through the water column was 13 to 16 $m.sec^{-1}$.

All the samples were fixed in buffered 4% formaldehyde solution in seawater, together with a bactericide (1,2 propandiole).

4.6 Quantitative studies of ice fauna by diving, and sampling of food web components of the marginal ice zone for stable isotope analysis

Haakon Hop, Ole Jørgen Lønne, Michael Poltermann, Katrin Iken, Karen v. Juterzenka, Bo I. Bergström, and Jan-Otto Pettersson.

Background

The sympagic, or ice-associated, macrofauna community is predominately located on the underside of the ice where the organisms feed on ice algae (e.g., *Melosira arctica, Nitzchia sp. and Navicula sp.*), detritus, or prey on other organisms such as copepods. The sympagic community may vary with the age of the ice (first year ice versus multi-year ice), the complexity of the habitat, the sediment load in the ice, and with the life cycle of organisms. The ice fauna consists of organisms living their whole life in the drifting sea ice, the permanent or autochtonous ice fauna, but also stages of pelagic and benthic organisms finding the ice habitat favourable at certain times of year, the allochtonous fauna (e.g., Horner 1989; Lønne and Gulliksen 1991). The sympagic macrofauna in the northern Barents Sea generally comprises four species of amphipods: *Gammarus wilkitzkii, Apherusa glacialis, Onisimus nanseni* and *O. glacialis*. In addition, the polar cod (*Boreogadus saida*) is part of the ice-associated fauna, and this species is also a key component of the pelagic food web in the Arctic (Welch *et al.* 1992).

The interface between ice and sea water provides a habitat, which has been described as an upside-down benthic environment (Mohr and Tibbs 1963), although the habitat is more dynamic and may undergo radical changes in structure and composition in response to seasonal melting and freezing as well as physical forcing. The structural under-ice topography, which probably to a large extent determines the actual distribution and density of ice fauna includes both mesoscale structures (ridges, flat surfaces, edges) as well as small scale structures (e.g. brine channels, protruding ice pieces).

During the ICEBAR 1995 cruise, samples of ice fauna were collected successfully by diving, but it became readily apparent that it was difficult to describe the undersurface topography of the ice in an objective manner (FalkPetersen and Hop 1996). It also became apparent that a multidiciplinary effort was needed to resolve this problem, and we thus established a multidiciplinary research group consisting of biologists/divers and ice researchers. The mesoscale under-ice topography was interpreted as three-dimensional images based on side scanning sonar recordings (Korsnes and Smedsrud, ibid). In addition, the ROV group (Bergström/Pettersson) used a remote operated vehicle outfitted with a video camera to record more refined pictures of small scale under-ice structures. Divers were then able to collect organisms from different habitats which could be described in an objective manner.

The research questions of our investigations were:
1) What is the distribution and density of Arctic ice amphipods in relation to mesoscale under-ice topography?
2) How do small scale structures affect the distribution and behaviour of Arctic ice amphipods?
3) Does the variability in light penetration to lower sea ice surfaces have implications for the associated sympagic assemblages?

In addition, we wanted to conduct more specific studies on growth, age distribution, reproduction strategies, and feeding ecology of arctic ice amphipods as well as polar cod. The ice-associated food web was finally placed in a broader context by describing the entire food web of the marginal ice zone by means of the stable isotope ratio technique involving $^{13}\delta C$ and $^{15}\delta N$ (Hobson and Welch 1992; Hobson et al. 1995).

Sampling of ice fauna
Sampling was done during the ICE-BAR 1996 cruise to the northern Barents Sea during July/August 1996 on four large ice floes located between 81°N and 77°N.

Under-ice fauna was sampled by electrical suction samplers operated by scuba divers (Lønne 1989); the team of divers consisted of Haakon Hop (NP), Ole Jørgen Lønne (UNIS/Apn), Michael Poltermann and Katrin Iken (AWI). We sampled the ice fauna quantitatively by means of 50 x 50 cm standard frames which floated up against the underside of the ice. Selected types of structures were chosen and sampled randomly to remove the ice macrofauna. After some initial surveys and studies of images created by the sonar/ROV groups, we decided to sample a minimum of four identifiable structures under each selected ice floe:

1) **Flat areas:** horizontally smooth undersurface of the ice.
2) **Ridges:** keels protruding down from the ice undersurface, sometimes down to 10 meter depth.
3) **Domes:** light areas characterized by advanced snow melt often with melt ponds on top which increased light penetration. Often the ice in these areas was thinner and the area dome shaped.
4) **Edges:** the complex borders of the ice floes.

Each area was sampled with 10 x standard frames during the same dive. Sampling was conducted without disturbing the sampling area by air bubbles. Organisms were preserved in buffered formalin (4%).

The undersurface of the ice was described by the sonar group (Korsnes and Smedsrud), and the initial images were used as guiding maps for diving and collections. In addition, the top surfaces of the ice floes were mapped with measuring tape and theodolite for elevations of ridges (Lønne), and both top and bottom ice maps were constructed. On these maps we in most cases could identify the actual structures sampled.

The undersurface of the ice was also described by the ROV group (Bergström and Petterson) who used an unmanned teetered vehicle outfitted with a video camera. A video camera was also operated by one of the divers (Ole Jørgen Lønne). These images showed more detailed ice structures than what could be described by sonar. Two types of images of the undersurface of the ice are available:

1) Low resolution large spatial coverage maps showing the entire mesoscale under-ice topography of the sampling area (30-40 meter radius).
2) High resolution limited spatial coverage images of both mesoscale topography and small scale under-ice structures (< 1 m).

Ice fauna samples
The ice fauna in the northern Barents Sea consisted of four species of amphipods, *Gammarus wilkitzkii*, *Apherusa glacialis*, *Onisimus nanseni* and *O. glacialis*. The most abundant species were *A. glacialis* and *G. wilkitzkii*, whereas the other two species generally had low abundance. Many *G. wilkitzkii* were seen as mating pairs, the larger male being attached to the smaller female inside brine channels, on flat surfaces or even swimming in open water. Some samples consisted of a large portion of juveniles, age 0 individuals. Few of the females had attached juveniles as it has been observed earlier in the year in 1995 (June/July). Other organisms collected from smaller ice floes included a few polychaetes, which indicate that these floes most probably origin from shallow water.

Quantitative samples (n=114) distributed approximately equally between the four different ice stations are listed in Table 4.6.1. These samples were analysed (Michael Poltermann, AWI) for species composition, length/weight, sex ratio, and gut contents. In addition, mass samples of the abundant *G. wilkitzkii* and *Apherusa glacalis* were subjected to analysis on population dynamics and gut contents. Mass samples of ice organisms were also collected for analysis of stable isotope ratios (Haakon Hop) and lipid composition (Stig Falk-Petersen). Only few specimens of polar cod were found and sampled from caves and cavities in the ice.

Trophic levels
Samples were collected from the sympagic, pelagic and benthic communities for later analysis of stable isotope ratios to determine trophic levels (Hobson and Welch 1992; Hobson et al. 1995). Ice fauna samples were collected as previously described. Samples from the pelagic system were collected by Tucker Trawl and WP2 net, whereas samples from the benthic system were collected by bottom trawl and benthic dredge (see Benthic sampling report). The samples were identified and frozen, and will later be dried and prepared for analyses at the Institute for Energy Technology, Kjeller (Norway) and at the Alfred Wegener Institute (Germany).

Table 4.6.1. Quatitative samples of ice fauna collected during ICE-BAR 1996

Station	Date	Structure	Sampler	Station	Date	Structure	Sampler
ICE1 a	96.07.29	edge	OL	ICE0 d	96.08.02	ridge	KA
ICE1 a	96.07.29	edge	OL	ICE0 d	96.08.02	ridge	KA
ICE1 a	96.07.29	edge	OL	ICE0 d	96.08.02	ridge	KA
ICE1 a	96.07.29	edge	OL	ICE0 d	96.08.02	flat	MP
ICE1 a	96.07.29	flat	H2	ICE0 d	96.08.02	flat	MP
ICE1 a	96.07.29	flat	H2	ICE0 d	96.08.02	flat	MP
ICE1 a	96.07.29	flat	H2	ICE0 d	96.08.02	flat	MP
ICE1 a	96.07.29	flat	H2	ICE2	96.08.05	edge	KA
ICE1 a	96.07.29	ridge	MP	ICE2	96.08.05	edge	KA
ICE1 a	96.07.29	ridge	MP	ICE2	96.08.05	edge	MP
ICE1 a	96.07.29	ridge	MP	ICE2	96.08.05	edge	MP
ICE1 a	96.07.29	ridge	MP	ICE2	96.08.05	flat	MP
ICE1 a	96.07.29	light area	KA	ICE2	96.08.05	flat	MP
ICE1 a	96.07.29	light area	KA	ICE2	96.08.05	flat	MP
ICE1 a	96.07.29	light area	KA	ICE2	96.08.05	flat	MP
ICE1 a	96.07.29	light area	KA	ICE2	96.08.05	light area	KA
ICE1 b	96.07.30	flat	MP	ICE2	96.08.05	light area	KA
ICE1 b	96.07.30	flat	MP	ICE2	96.08.05	light area	KA
ICE1 b	96.07.30	flat	MP	ICE2	96.08.05	light area	KA
ICE1 b	96.07.30	flat	MP	ICE2	96.08.05	ridge	H2
ICE1 b	96.07.30	flat	H2	ICE2	96.08.05	ridge	H2
ICE1 b	96.07.30	light area	H2	ICE2	96.08.05	ridge	H2
ICE1 b	96.07.30	light area	H2	ICE2	96.08.05	ridge	H2
ICE1 b	96.07.30	light area	H2	ICE2	96.08.05	ridge	OL
ICE1 b	96.07.30	light area	H2	ICE2	96.08.05	ridge	OL
ICE1 b	96.07.30	ridge	KA	ICE2	96.08.05	ridge	OL
ICE1 b	96.07.30	ridge	KA	ICE2	96.08.05	ridge	OL
ICE1 b	96.07.30	ridge	KA	ICE2	96.08.06	flat	H2
ICE1 b	96.07.30	ridge	KA	ICE3 c	96.08.08	edge	MP
ICE1 b	96.07.30	ridge	OL	ICE3 c	96.08.08	edge	MP
ICE1 b	96.07.30	ridge	OL	ICE3 c	96.08.08	edge	MP
ICE1 b	96.07.30	ridge	OL	ICE3 c	96.08.08	edge	MP
ICE1 b	96.07.30	ridge	OL	ICE3 c	96.08.08	flat	MP
ICE0 c	96.08.01	edge	KA	ICE3 c	96.08.08	flat	MP
ICE0 c	96.08.01	edge	KA	ICE3 c	96.08.08	flat	MP
ICE0 c	96.08.01	edge	KA	ICE3 c	96.08.08	flat	MP
ICE0 c	96.08.01	edge	KA	ICE3 c	96.08.08	light area	KA
ICE0 c	96.08.01	flat	MP	ICE3 c	96.08.08	light area	KA
ICE0 c	96.08.01	flat	MP	ICE3 c	96.08.08	light area	KA
ICE0 c	96.08.01	flat	MP	ICE3 c	96.08.08	light area	KA
ICE0 c	96.08.01	flat	MP	ICE3 c	96.08.08	ridge	KA
ICE0 c	96.08.01	ridge	OL	ICE3 c	96.08.08	ridge	KA
ICE0 c	96.08.01	ridge	OL	ICE3 c	96.08.08	ridge	KA
ICE0 c	96.08.01	ridge	OL	ICE3 c	96.08.08	ridge	KA
ICE0 c	96.08.01	ridge	OL	ICE3 d	96.08.08	flat	H2
ICE0 c	96.08.01	ridge	H2	ICE3 d	96.08.08	flat	H2

ICE0 c	96.08.01	ridge	H2	ICE3 d	96.08.08	flat	H2
ICE0 c	96.08.01	ridge	H2	ICE3 d	96.08.08	flat	H2
ICE0 c	96.08.01	ridge	H2	ICE3 d	96.08.08	ridge	H2
ICE0 d	96.08.02	edge	OL	ICE3 d	96.08.08	ridge	H2
ICE0 d	96.08.02	edge	OL	ICE3 d	96.08.08	ridge	H2
ICE0 d	96.08.02	edge	OL	ICE3 d	96.08.08	ridge	H2
ICE0 d	96.08.02	edge	OL	ICE3 e	96.08.09	ridge	OL
ICE0 d	96.08.02	light area	H2	ICE3 e	96.08.09	ridge	OL
ICE0 d	96.08.02	light area	H2	ICE3 e	96.08.09	ridge	OL
ICE0 d	96.08.02	light area	KA	ICE3 e	96.08.09	ridge	OL
ICE0 d	96.08.02	light area	KA				
ICE0 d	96.08.02	ridge	KA				

a: diving from ice edge **b: diving from dive hole** **c: dive site away from 'Lance'** **d: dive site close to 'Lance'** **e: dirty ice floe**

Qualitative samples of ice fauna (ICE-BAR 1996)

Station	Date
ICE0	96.08.01
ICE0	96.08.01
ICE2	96.08.06
ICE3	96.08.09

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4.7 Under Ice topography measurements

Reinert Korsnes and Lars Henrik Smedsrud

Background
Large scale topography on the underside of selected ice floes was mapped by a side scanning sonar on the ice stations IA0-IA3. The purpose of these measurements was to provide information on ice characteristics to the biological sampling programme.

Materials and Methods
The measuring system included a Mesotech 971 side scanning sonar operating at 675 kHz on the tip of a vertical 20 m metal bar inserted through a hole in the ice (Fig. 4.7.1) The sonar has a conical beamwidth of 1.7° giving a resolution in the range 0.6-1.2 m for the ice surface 20-40 m from the sonar. We covered areas of size up to 22500 m^2 for each of these stations. Figures 4.7.2-4.7.5 illustrate the resulting maps given with a *xy* coordinate system common to the work on mapping features on the top surface of the ice floe. The sonar gave localised ice thickness data around the hole by scanning linear profiles below the ice for each 5° (horizontal). A 250 m cable linked the sonar to a computer controlled logging system on board 'Lance'.

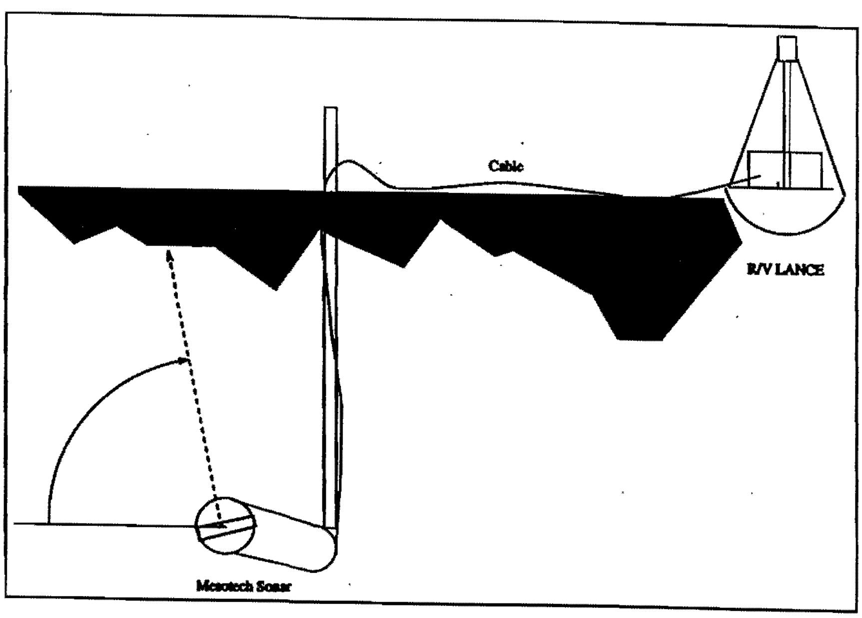
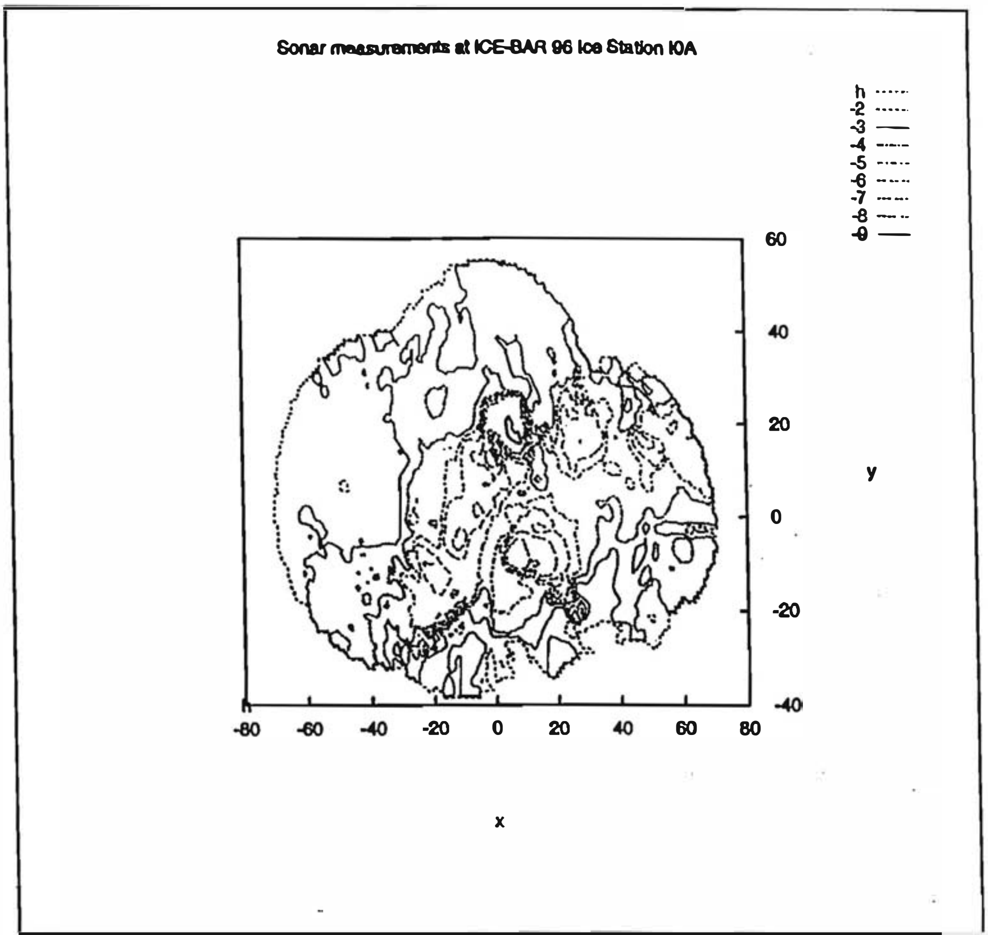


Figure 4.7.1. Ice topography sonar mapping system used on ICE-BAR 1996.



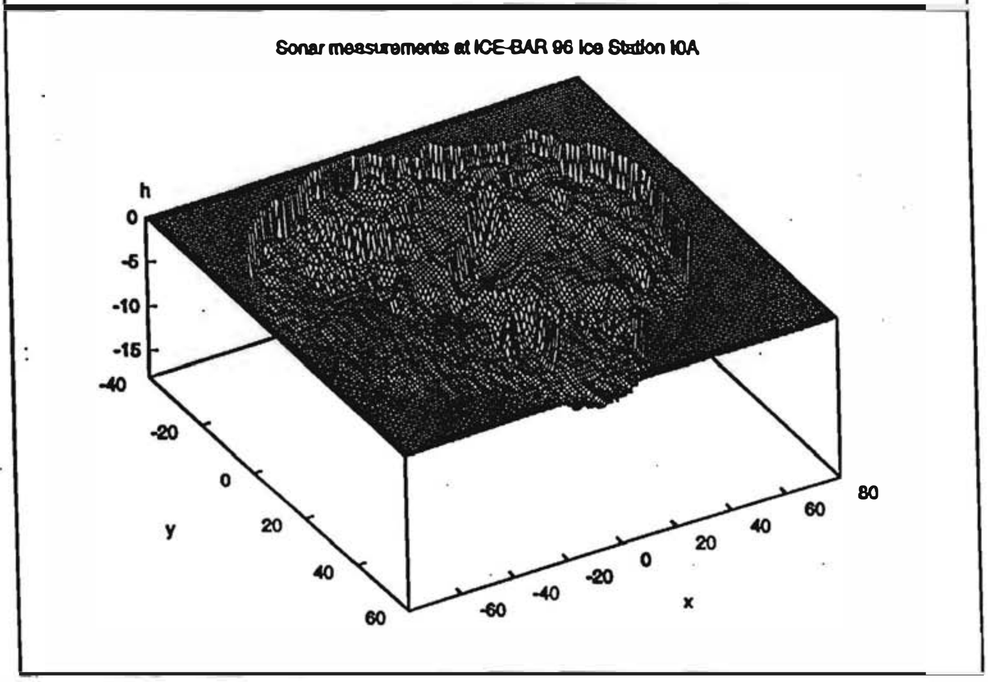


Figure 4.7.2. Ice bottom topography at ICEBAR Ice Station I0A.

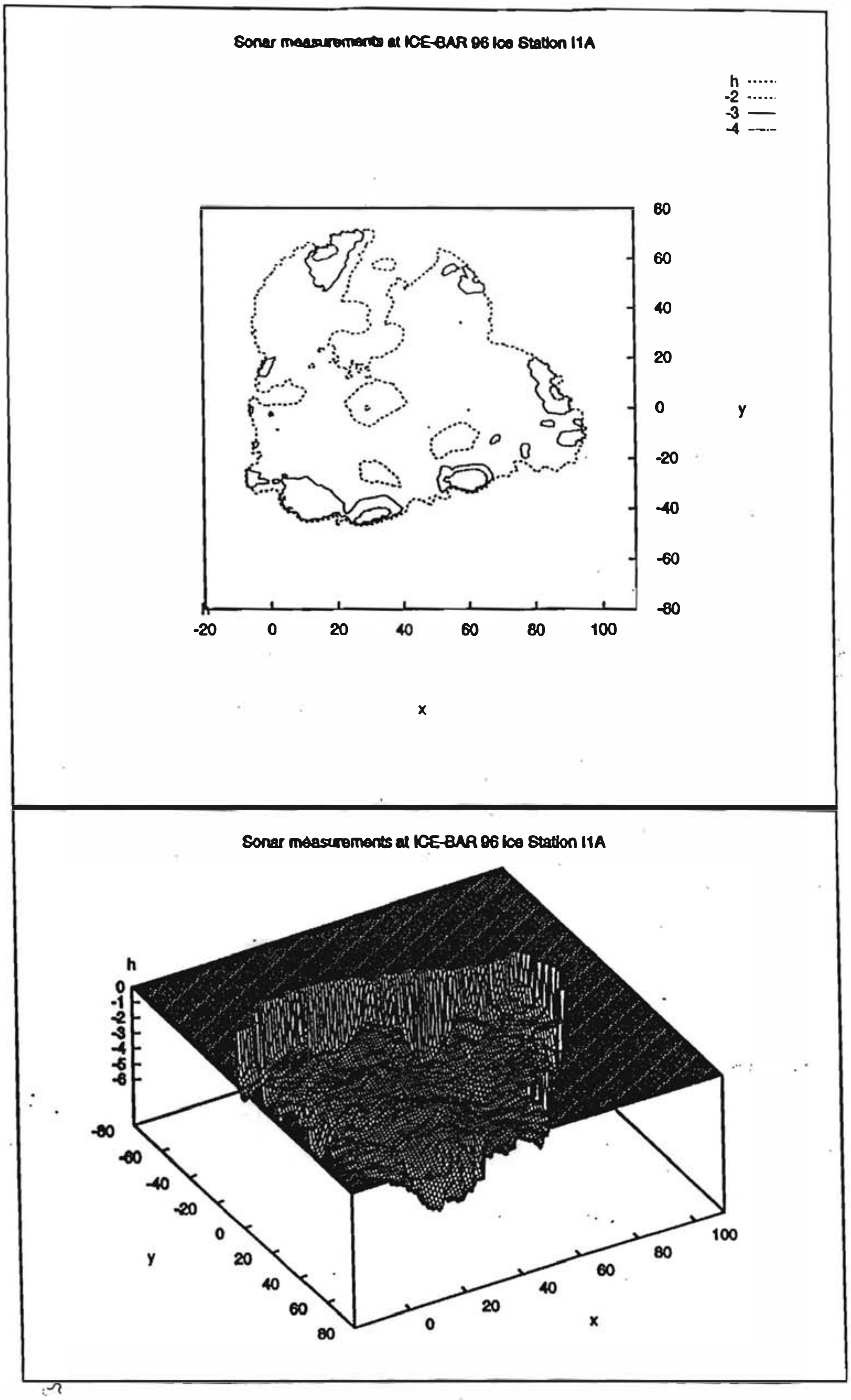
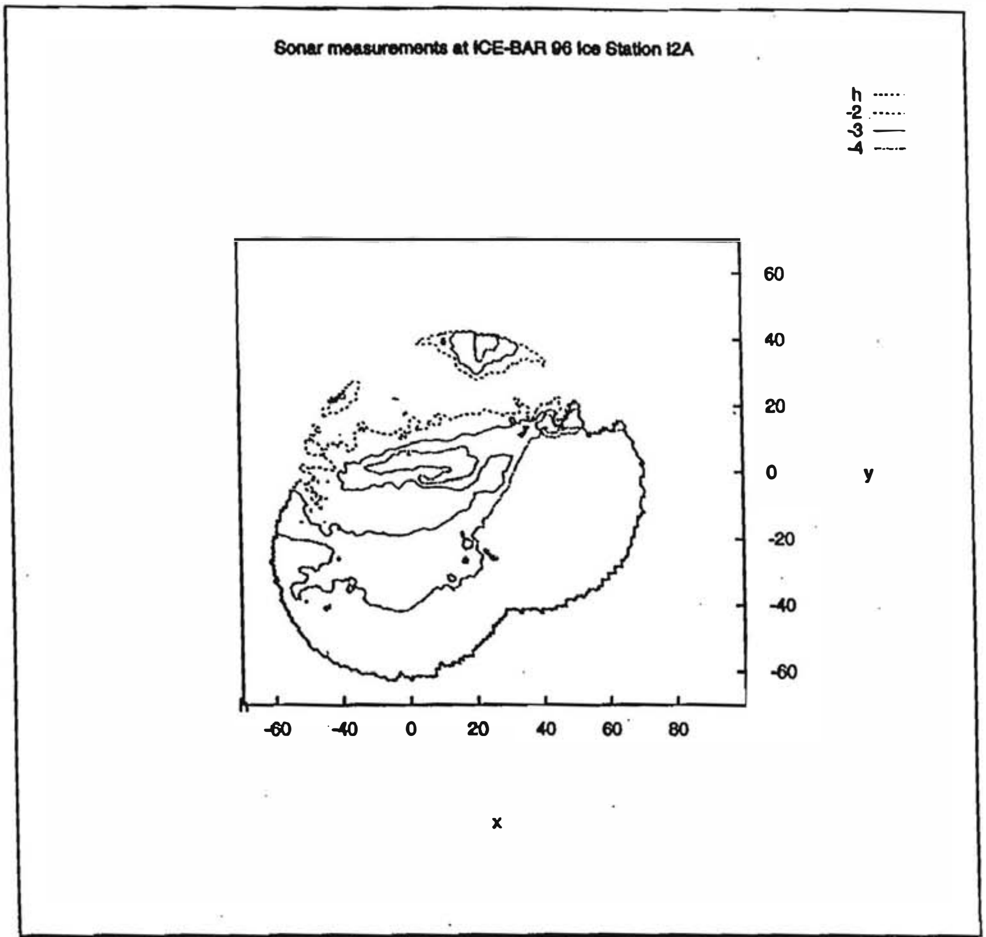


Figure 4.7.3. Ice bottom topography at ICEBAR Ice Station I1A.



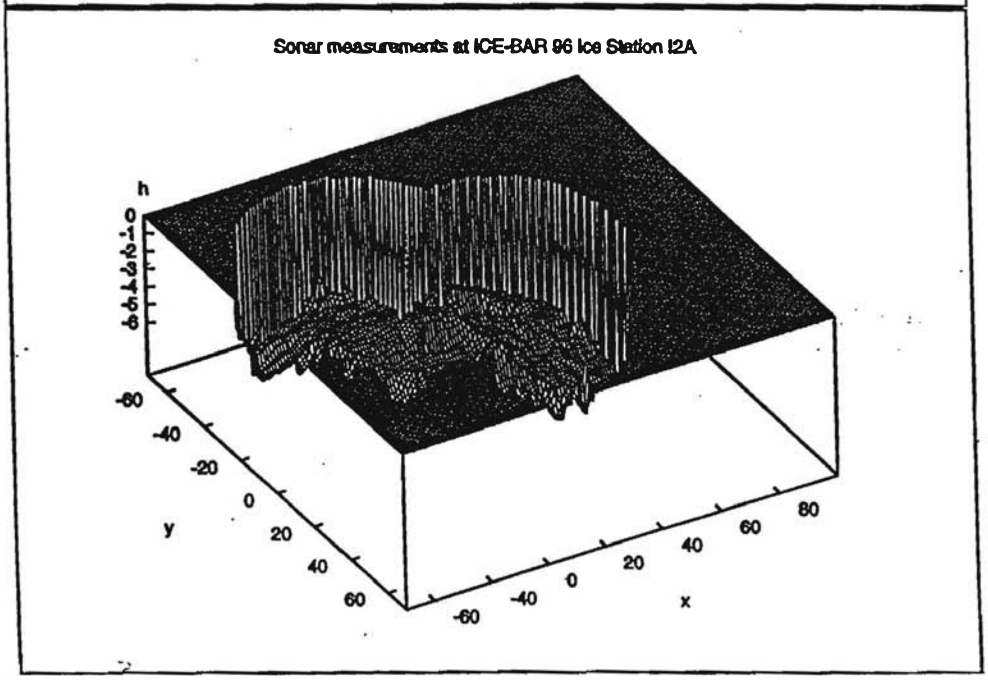
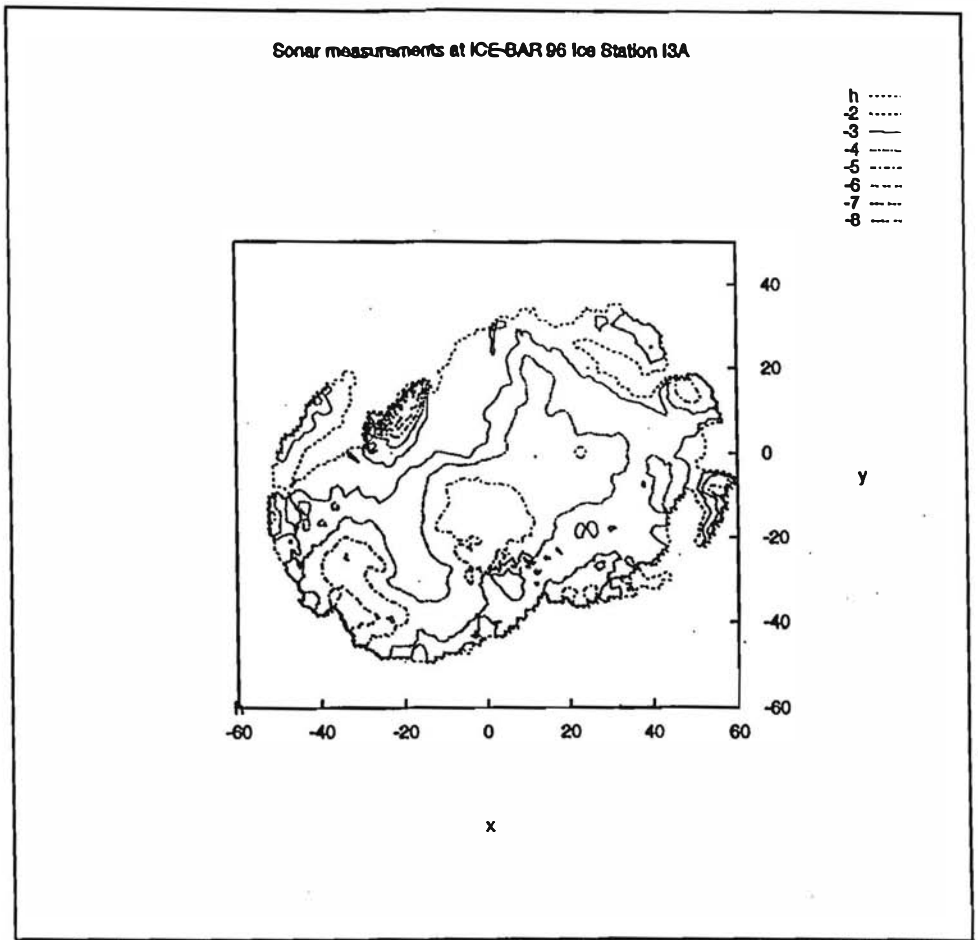


Figure 4.7.4. Ice bottom topography at ICEBAR Ice Station I2A.



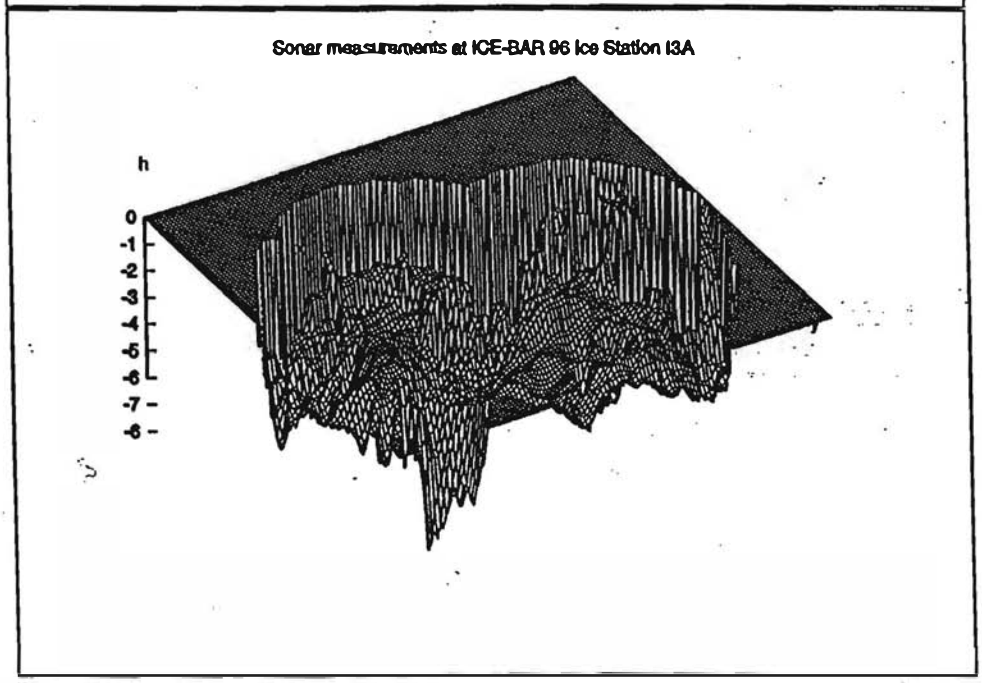


Figure 4.7.5. Ice bottom topography at ICEBAR Ice Station I3A.

4.8 Work with Remotely Operated Vehicle (ROV), Sea Owl MK II

Bo I. Bergström and Jan-Otto Pettersson

Introduction

The work performed during the ICE-BAR 1996 expedition mainly focused on using the ROV to obtain video images from defined positions under the icefloes in areas chosen for the multidisciplinary work carried out during the expedition. The reason for this was a need to "groundtruth" maps of the ice subsurface constructed by the "sonar group". Furthermore, we wanted to collect habitat information in the sites that were sampled for under ice biota by the "divegroup". More specifically, the objectives in this context were to describe and map the occurrence of different subsurface structures such as pressure ridges, melting structures, multi-year ice, new ice pockmarks etc. with the hope of correlating these structures with:

1. Top surface structures which may ultimately be mapped by some remote sensing technique, and;
2. "correlate" the distribution of subsurface structures (under-ice habitats) with sympagic fauna composition and abundance, for each of the chosen ice areas.

In addition to the under ice work, several vertical profiles in the water mass were performed to "groundtruth" and illustrate data obtained by Acoustic Doppler Current Profiler (ADCP), zooplankton net sampling and phytoplankton production estimates.

ROV deployment and field procedures.

The ROV was used both at ice stations and open water stations (Table 4.8.1).

Table 4.8.1. Data on ROV activities.

Op.#	Date	Station	Position start	Position end	Start	End	Duration	Operation	Tape#
1	96.07.27	Ice 1	81°33.00N 34°50.00E		13:05	16:54	03:49	Test run	1
2	96.07.27	Ice 1	81°33.30N 34°51.15E	81°32,4N 34°47,9E	19:34	21:50	02:16	Gtruthing ice underside	2
3	96.07.28	Ice 1	81°32.04N 34°47.09E	81°30,0N 34°31,7E	21:22	22:40	01:18	Gtruthing ice underside	2
4	96.07.28	Ice 1	81°32.04N 34°47.09E	81°30,0N 34°31,7E	22:41	23:20	00:39	Pelag. prof. 125m.	2
5	96.07.28	Ice 1	81°30.00N 34°31.07E	81°29,9N 34°31,8E	23:46	00:00	00:14	Gtruthing ice underside	2
6	96.07.29	Ice 1			14:00	15:29	01:29	Video doc of *in situ* phytopl.ankon rig	2/3
7	96.07.29	Ice 1			15:30	15:52	00:22	Video doc. sampling by divers	3
8	96.07.30	Ice 1	81°23.03N 34°20.00E	81°22,6N 34°20,6E	08:57	09:18	00:21	Pelag. prof. 75 m.	3
9	96.07.31	Ice 0	81°34.01N 33°02.60E	81°22,5N 33°05,9E	19:04	19:39	00:35	Gtruthing ice underside	4
11	96.08.01	Ice 0	81°31.00N 33°22.01E		16:32	16:59	00:27	Pelag. prof. 130 m.	5
12	96.08.04	Ice 2	79°28.36N 32°36.80E		16:49	17:17	00:28	Pelag. prof. 175 m.	5

13	96.08.04	Ice 2	79°28.36N 32°36.80E	79°30,0N 32°49,5E	19:12	21:16	02:04	Gtruthing ice underside	5/6
14	96.08.05	Ice 2	79°29.44N 33°22.26E	79°29,9N 33°23,0E	13:22	14:50	01:28	Gtruthing ice underside	6
15	96.08.07	Ice 3	78°31.97N 25°49.79E	78°31,9N 25°04,8E	14:57	15:59	01:02	Video doc.	7
16	96.08.07	Ice 3	78°32.00N 25°45.07E	78°34,5N 25°46,9E	17:15	20:39	03:24	Video doc.	7
17	96.08.08	Ice 3	78°40.15N 25°30.00E	78°39,9N 25°52,0E	10:37	10:53	00:16	Pelag. prof. 70 m.	7
						Total	20:12		

As shown in Table 4.8.1. two types of operations predominated, "groundtruthing" of the subsurface of the ice and pelagic profiles.

"Groundtruthing" of ice under side; procedures and experiences
This was done using the ROV in combination with the HPR positioning system. Subsequent to establishing a fixed point (the centre of the study area) and an "x axis" on the upper surface of ice by means of theodolite, the transducer, attached to a 8m long pole, was submerged through a hole in the ice, close to the ship. The position of the transducer was then determined from the fixed point with theodolite in order to get off-set values in x (longships) and y (athwards) directions. These off-sets were then set as constants in the HPR system. Through this operation, the position of the transducer was geometrically transported to the fixed point of the respective floes. Through submerging a transponder in a hole along the x axis of the floe coordinate system, the HPR "longships line" was aligned parallel to the floe coordinate system.

Several checks on the accuracy of the HPR system were done through submerging a transponder both in holes in the ice which were previously measured with the theodolite and by hanging off transponders from the bow and stern of the ship. In every case the accuracy of the obtained distances were less than 0.5 m of the distance measured conventionally on the surface.

The ROV with attached transponder was then launched and steered to the work area, and video recording of surfaces commenced while range, bearing, real time and brief comments were noted manually on a log sheet. These positions of the recorded video sequences were then plotted in order to provide a map of areas surveyed with the ROV. A work-saving procedure would of course be to use a Computer Aided Tracking system (CAT) to log and plot positions automatically. A variety of such systems are available through dealers supplying the offshore oil industry.

The HPR system was also used to get accurate positions of suction samples collected by the divers. A transponder was carried by the sampling diver and a log of real time, range and bearing was kept at station ICE 1 in order to allow subsequent plotting of the sampling areas.

Pelagic profiles
Several descents down through the water column were done to get immediate information on which organisms were present in the water column and some impressions of their relative abundance. These profiles were also motivated by a need to verify ADCP data, check zooplankton net sampling and identification of layers of intense primary production. The operational procedure was to descend below the ice floe as far down as safely possible while continuously recording. While descending, short stops at 5 meter depth intervals were done. From these profiles we were able to both identify layers of intense primary production and also identify "hydroacoustic scatters" recorded by the ship-board ADCP.

Miscellaneous work
In addition to the above mentioned main tasks for the ROV, several other minor tasks were performed, includeing video recordings of the *in situ* primary production rig, light measuring devices, and suction sampling by divers.

In addition, inspections of the ADCP acoustic window of R/V 'Lance' were done both before entering the ice and after leaving the ice.

4.9 Benthic investigations

Karen v. Juterzenka, Ole J. Lønne and Katrin Iken

Background

During the ICE-BAR 1996 cruise, benthic communities and sediments were sampled regarding different aspects. Grab samples were taken for community studies and analysis of contaminants in surface sediments (Ole J. Lønne, UNIS/Apn). The epibenthic macro- and megafauna were sampled by a bottom dredge to study the population dynamics and feeding behaviour of ophiuroids (Karen v. Juterzenka, IPOE) as well as for stable isotope analysis of conspicuous members of the benthic community (Katrin Iken, AWI).

The benthic grab sampling program was aimed to be an integral part of this years ICE-BAR program and to supplement those samples taken in 1995; the benthic sampling covers the same stations as the sympagic and pelagic program. It will further contribute to the "Polar Environmental Centre" program on "Taxonomic studies of the benthos of the Northern European Seas". The benthic program will also supplement Akvaplan-niva's baseline studies of pollutants and the biodiversity and community studies of the benthic fauna in the Barents Sea.

Sediment sampling

Surface sediments were taken from benthic grab samples (0-2 cm) and from top surface of dirty ice floes for studies of persistent organic compounds, metals and radionucleides, grain size distribution and content of organic carbon and nitrogen. The sieved samples were fixed in a 10-15% borax buffered, pH neutral formalin solution. Subsamples of surface sediment for analysis of contaminants, total organic carbon/nitrogen and grain size were taken from the upper 2 cm sediment layer, from separate grab hauls and frozen at -18°C.

Samples from the following "dirty" ice floes were taken for contaminant studies (Table 4.9.1).

Table 4.9.1. Data on "dirty" ice floes from which samples were taken for contaminant studies.

Station no	Lat. N	Long. E	Replicates	Date	Time
I3A	78°35.01	25°47.92	1	96.08.08	11:00
I3A	78°41.52	25°52.92	1	96.08.08	11:15
I3A	78°50.27	26°04.43	1	96.08.08	11:30

The following categories of samples were collected for the contaminant study. Separate grab samples were collected and the upper 2 cm of the sediment was used (Table 4.9.2).

Table 4.9.2. Categories of samples collected from sediment for the contaminant study.

Analysis	Container	Amount	Notes
PCB's/THC	Sterile glass jar	3/4 full	Collected with metal spoon
Metals	250 litre plastic bag	1/2 full	Collected with plastic spoon
Grain size/PAH's/ TOC/TN/Radionucleides	Plastic bag	Approx. 100 g	Collected with metal/plastic spoon
Community studies	in 3 litre plastic buckets, preserved in 4% buffered formalin	12 buckets depending on amount of material	

Soft bottom benthos sampling

Benthic macrofauna was collected by a 40 kg van Veen grab with a surface sampling area of 0.1 m^2 which was deployed from the main deck using a 10 mm wire and the ship's main hauling winch. The ship's meter wheel was used to determine the amount of wire paid out. The grab had hinged and lockable inspection flaps with a mesh diameter of 0.5 mm. These were covered by additional rubber flaps, allowing water to pass freely through the grab during descent, to minimize the pressure wave below the instrument which can "blow off" the top surface of the sediment during sampling. On ascent, the rubber flaps were closed to minimize the water turbulence inside the grab. As a further precaution against sediment loss during sampling, the winch speed was slowed for the last meters of descent.

The loaded grab was received onto the washing table (or into a plastic container for later washing on the table) and the condition of the sample was examined through the inspection flaps. Samples which appeared to have lost some of the surface sediment layer were rejected. The fine "fluffy" surface layer was gently washed into sieves immersed in running sea water, to minimize damage to small soft-bodied animals. The mesh consisted of round holes with a diameter of 1 mm. The material retained on the screen after washing was decanted into sample buckets.

Samples will be analysed for community structure and species composition. Data will add to the existing data base on distribution of benthic fauna in the Barents Sea.

Table 4.9.3. Benthic stations (5) sampled along the cruise track during ICE-BAR 1996.

Station no.	Lat. N	Long. E	Depth (m)	Replicates	Date	Time
I1A	81°30.40	34°37.00	245	5	96.07.29	15:00
IZA	81°29.80	33°16.10	183	5	96.08.02	13:20
-	80°22.40	34°05.50	198	5	96.08.03	16:50
I2A	79°29.40	32°32.90	288	5	96.08.06	13:20
I3A	78°40.40	25°50.00	92	5	96.08.09	15:45

Epibenthos: investigations of stable isotopes as markers in marine food chains

The determination of trophic pathways is a critical point in the understanding of the structure, interactions and energy transfers in marine ecosystems. Hitherto, studies of food web structures have mainly been based on stomach content analysis. As a result, resolution of both temporal and spatial patterns is low. Naturally occurring stable isotopes of carbon ($^{12}\delta C/^{13}\delta C$) and nitrogen ($^{14}\delta N/^{15}\delta N$) can provide useful information about trophic structure. These isotopes undergo a stepwise enrichment in the bodytissues of species of subsequent trophic levels (prey-consumer). This method is based on the actually assimilated material and allows the evaluation of trophic long-term relationships.

During ICE-BAR 1996, the macro- and megazoobenthos were sampled with a bottom dredge (opening 1m) at eight stations, between 81 °N and 77 °N, at water depths between 85 and 315 m (Table 4.9.4). The most conspicuous species of macro- and megazoobenthos were sampled for the analysis of stable isotope ratios (Table 4.9.5). The samples covered most of the main systematic groups and feeding types. On most stations, the epibenthic macro- and megafauna were dominated by ophiuroids. All material was immediately frozen at -30 °C and will be processed further at Alfred Wegener Institute (AWI) and Institute for Polar Ecology (IPOE).

Epibenthos: investigations of ophiuroids

Ophiuroids are conspicuous members of benthic communities in the Arctic seas and are often found to be among the dominant epibenthic species. To evaluate their role within the benthic food web as well as their contribution to benthic-pelagic coupling, information is needed about the population dynamics of abundant species as well as their nutrition and feeding behaviour in relation to their life cycles and seasonal food availability in the polar environment.

Samples of ophiuroids were taken from dredge samples for growth analysis as well as the determination of stable isotopes ($^{13}\delta C$ and $^{15}\delta N$) and lipid composition. Individuals of four species (*Ophiopholis aculeata, Ophiacantha bidentata, Ophiura sarsi* and *Ophiopleura borealis*) were kept alive for feeding experiments on board the ship and for later laboratory work. The feeding experiments were carried out in a recirculating flow tank which contained natural seawater from the capture site, using natural phytoplankton and artificial particles as food sources. With an identical setup, a marker substance (Calcein) was tested for further use in growth determination and aging of arctic ophiuroids. Dredge samples as well as experimental results will be analyzed at the IPOE lab.

Table 4.9.4. Dredge samples

St.no.	Date	Lat. N	Long. E	Depth (m)	Time at bottom (min)
BE001	96.07.26	81°30.80	34°16.40	228	6
BE002	96.07.31	81°21.80	34°03.20	170	5
BE003	96.08.02	81°28.20	34°45.01	184	2
BE004	96.08.03	80°24.70	33°47.80	216	5
BE005	96.08.06	79°32.60	33°09.40	315	5
BE006	96.08.07	78°31.20	33°27.00	144	5
BE007	96.08.10	77°49.08	25°31.09	85	5
BE008	96.08.11	77°51.85	25°05.03	90	5

Table 4.9.5. Dredge samples of benthos for stable isotope analysis.

St. no.	Sample no.	Species	No. of specimen	Reference
BE001	D1/1	*Ctenodiscus crispatus*	37	3
BE001	D1/2	*Molpadia* cf *arctica*	2	3
BE001	D1/3	*Sebastes* sp.	1	
BE001	D1/4	Bryozoa sp.1/netlike	pieces	1 piece
BE001	D1/5	Bryozoa sp.2/branched	pieces	1 piece
BE001	D1/6	Porifera: limp, bright	pieces	1 piece
BE001	D1/7	Polychaeta/Errantia	7	1
BE001	D1/8	*Astarte crenata*	13	1
BE001	D1/9	*Yoldiella intermedia*	16	1
BE001	D1/10	*Siphonodentalium lobatum*	7	1+shells
BE001	D1/11	*Ophiura sarsi*	8	Ophiuroidea
BE002	D2/1	Porifera: limp, bright		1 piece
BE002	D2/2	Ophiuroidea sp 1	9	Ophiuroidea
BE002	D2/3	Porifera: slimy, unreg. shaped		1 piece
BE002	D2/4	*Siphonodentalium lobatum*	4	3
BE002	D2/5	*Astarte crenata*	ca 10	2
BE002	D2/6	*Yoldiella intermedia*	9	1
BE002	D2/7	*Alcyonidium gelatinosum*		2
BE002	D2/8	Polychaeta: Errantia		
BE002	D2/9	*Sabinea sarsi*	4	1
BE002	D2/10	*Molpadia* cf *arctica*	5	1
BE002	D2/11	*Icasterias panopla*	6+9BT	1
BE002	D2/12	*Ctenodiscus crispatus*	4	sea stars
BE002	D2/13	*Urasterias lincki*	2	sea stars
BE002	D2/14	*Ophiacantha bidentata*	10	Ophiuroidea
BE002	D2/15	*Ophiura sarsi*	5	Ophiuroidea
BE002	D2/16	Ophiuroidea sp. 1	5	Ophiuroidea
BE003	D3/1	*Astarte crenata*	24	4
BE003	D3/2	*Yoldiella intermedia*	25	2
BE003	D3/3	*Tentorium semisuberites*	11	2
BE003	D3/4	*Siphonodentalium lobatum*	5	1
BE003	D3/5	*Alcyonidium gelatinosum*	60	3

BE003	D3/6	*Ophiacantha bidentata*	10	Ophiuroidea
BE003	D3/7	Bryozoa: rodlike, branched		2 colonies
BE003	D3/8	*Icasterias panopla*	14	1
BE003	D3/9	*Ctenodiscus crispatus*	2	1
BE004	D4/1	*Ctenodiscus crispatus*, large	10	Ctenodiscus
BE004	D4/2	*Ctenodiscus crispatus*, small	10	Ctenodiscus
BE004	D4/3	*Ctenodiscus crispatus*, medium	6	Ctenodiscus
BE004	D4/4	*Ctenodiscus crispatus*, small	21	Ctenodiscus
BE004	D4/5	*Astarte montagui*	77	3
BE004	D4/6	*Yoldiella intermedia*	21	2
BE004	D4/7	*Siphonodentalium lobatum*	4	1 + shells
BE004	D4/8	*Ophiacantha bidentata*	10	Ophiuroidea
BE004	D4/9	Polychaeta: Errantia large	7	Polychaeta
BE004	D4/10	Polychaeta: Errantia small	100	Polychaeta
BE004	D4/11	Alcyonaria	ca 40 colonies	1
BE004	D4/12	*Icasterias panopla*	1	see D2, D3
BE004	D4/13	*Molpadia* cf *arctica*	2	see D2, D3
BE004	D4/14	*Sabinea septemcarinata* (juv.)	22	2
BE004	D4/15	*Sabinea septemcarinata* (ad.)	5	3
BE004	D4/16	*Ampelisca eschrichtii*	16	2
BE004	D4/17	*Pandalus borealis*	6	2
BE005	D5/1	*Ctenodiscus crispatus*	21	5
BE005	D5/2	*Astarte crenata*	355	3
BE005	D5/3	*Saduria sabini*	7	1
BE005	D5/4	*Nucula tenuis*	ca 20	4
BE005	D5/5	*Yoldiella intermedia*	340	4
BE005	D5/6	*Ophiopleura borealis*	2	Ophiuridea
BE006	D6/1	Bryozoa: rodlike, branched		
BE006	D6/2	*Ophiopolis aculeata*	5	Ophiuroidea
BE006	D6/3	*Ophiacantha bidentata*	5	Ophiuroidea
BE006	D6/4	*Ophiacantha bidentata*	5	Ophiuroidea
BE006	D6/5	*Ophiopholis aculeata*, large	5	Ophiuroidea
BE007	D7/1	*Glandulactis spetzbergensis*	15	2
BE007	D7/2	*Hormatia nodosa*	25	3
BE007	D7/3	Alcyonaria	15	3
BE007	D7/4	*Ophiacantha bidentata*	10	sp.1
BE007	D7/5	*Ophiocten sericeum*	16	sp.2
BE007	D7/6	Ophiura sp.	23	sp.3
BE007	D7/7	Gorgonocephalus sp.	1	Gorgonoceph
BE007	D7/8	*Nymphon hirtipes*	81	5
BE007	D7/9	*Alcyonidium gelatinosum*		1
BE007	D7/10	*Eualus gaimardi*	28	2
BE007	D7/11	Bryozoa branched		5 pieces
BE007	D7/12	Bryozoa, Flustra-like		2 pieces
BE008	D8/1	*Ophiocten sericeum*	12	Ophiuroidea
BE008	D8/2	*Ophiocten sericeum*	11	Ophiuroidea

BE008	D8/3	*Ophiocten sericeum*	100	Ophiuroidea
BE008	D8/4	*Alcyonidium gelatinosum*		pieces
BE008	D8/5	Bryozoa Flustra-like		pieces
BE008	D8/6	*Nuculana pernula*	293	3
BE008	D8/7	*Astarte montagui*	6	3
BE008	D8/8	*Eualus gaimardi*	50	3

4.10 Seabirds and marine mammals

Kjell Isaksen and Endre Knudsen

The main purpose for the work on seabirds and marine mammals was to obtain an extensive data set of seabird distribution from different water masses in the northern Barents Sea (Atlantic water, the Polar Front region, Arctic water, and areas with different ice coverage). Seabirds and marine mammals were counted both from the ship during cruising and during helicopter flights. A standardised method using transects of a specific width was used to allow the results from different parts of the cruise to be compared with each other as well as with results from other cruises. Generally, densities of seabirds were low during the cruise. This especially applies to the Brünnich's Guillemot and the Little Auk, two of the most numerous seabirds in the Barents Sea. The low number of birds encountered may, at least partly, be explained by the long distances between the seabirds' breeding colonies and the position of the ship during most of the cruise. As expected, high numbers of birds were found in the areas around Hopen and in Storfjorden during the last part of the cruise. Extensive periods of thick fog with limited visibility reduced the quality of the transect counts, and also prohibited helicopter flights during large parts of the cruise.

Among the main findings from the work on birds and mammals as an observation of a pod of narwhals in the area north of Kvitøya, relatively high numbers of Ross's Gulls observed in the areas north of 80°N, and the mainly northerly direction of the massive swimming migration of juvenile and adult Brünnich's Guillemots from the large breeding colonies at Hopen.

5. Data log

Following abbreviations are used in the data log:

Signature

Bergersen, Bård	BM
Bergstrøm, Bo	BB
Budgell, Paul	PB
Falk-Petersen, Stig	SF
Fossan, Kristen	KF
Hashida, Gen	GH
Hop, Haakon	H2
Iken, Katrin	KA
Isaksen, Kjell	KI
Ivanov, Boris	BI
Juterzenka, Karen von	KJ
Knutsen, Endre	EK
Korsnes, Reinert	RK
Lønne, Ole Jørgen	OL
Løyning, Terje B.	TL
Nøst Hegseth, Else	EN
Okolodkov, Yuri	YO
Pedersen, Gunnar	GP
Pettersson, Jan-Otto	JP
Polterman, Michael	MP
Smedsrud, Lars Henrik	LS
Ørbæk, Jon Børre	JB

Main station code (St.):

Ice station	I
Floe	A,B ---
Open water	O

Activity code (Act.):

Ice physics	IP
Physical oceanography	HS
Radiation measurements	SM
Zooplankton	ZO
Ice biota	IB
Phytoplankton	PP
Benthos	BE
Diving	DI
ROV	RO
Bird transect ship	BS
Bird transect helicopter	BH
Carbon dioxide	CD

Gear

CTD	CTD
XBT	XBT
XCTD	XCT
ADCP moorings	ADM
Bottom trawl	BTR
Pelagic trawl	PTR
Tucker trawl	TTR
WP2	WP2
Multinet	MNT
Phytoplankton net	PPN
Okolodkov net	OKN
Okolodkov bucket	OKB
Hashida net	GHN
Benthic dredge	KBS
Benthic grab	OBG
ROV	ROV
Suction pump	SUP
Hand net	HAN
Light meter	LME
Video camera	VCA
Underwater camera	UWC
Frame	FRA
Dip net	DIP
UW-Spectrometer	UWS
Reflectans spectrometer	RFS
UV-Spectrometer	UVS
UV-Biometer	UVB
Pyronometer	CM1
Sonar mesotec	SSS
Time laps video	TLV
Theodolitt	THO
Equilibrator	EQB
S-T-Ch monitoring	STM
UV / PAR	PUV
Niskin	NIS

St	Act	DateTime	Depth	Ice	Latitude	Longitude	Gear	Sample	Comment	Sign
	PP20--	9607191920	12	0	7813.80N	1537.50E	OKN	049n		YO
	PP20--	9607191920	12	0	7813.80N	1537.50E	OKB	048f	11	YO
	PP21--	9607201300	81	0	7815.70N	1532.40E	OKB	050f	11	YO
	PP21--	9607201300	81	0	7815.70N	1532.40E	OKN	052n		YO
	HS0001	9607211235	253	0	7607.30N	1800.00E	CTD	TCSP		PB
	PP22--	9607211530	35	0	7546.20N	1959.50E	OKN	054n		YO
	PP22--	9607211530	35	0	7546.20N	1959.50E	OKB	053f	41	YO
	HS0002	9607211530	41	0	7546.25N	1959.50E	CTD	TCSP	Bird 1	PB
	BS001-	9607211603	-	0	7549.00N	1959.00E	-	-		KI
	HS001M	9607211625	31	-	7547.97N	2012.34E	STM	TSFN		GH
	CD001P	9607211625	31	-	7547.97N	2012.34E	EQB	pCO2	CTD002	GH
	CD001D	9607211625	31	-	7547.97N	2012.34E	CTD	DI13	CTD002	GH
	CDP02P	9607212345	141	-	7524.25N	2459.39E	EQB	pCO2	CTD003	GH
	CD002D	9607212345	141	-	7524.25N	2459.39E	CTD	DI13	CTD003	GH
	HS0003	9607212345	152	0	7524.37N	2459.46E	CTD	TCSP	Bird 1	PB
	BS002-	9607220725	-	0	7500.00N	3000.00E	-	-		KI
	CD003P	9607220745	370	-	7500.31N	2955.35E	EQB	pCO2	CTD004	GH
	CD003D	9607220745	370	-	7500.31N	2955.35E	CTD	DI13	CTD004	GH
	HS0004	9607220800	378	0	7459.79N	2958.60E	CTD	TCSP	Bird 1	PB
	PP23--	9607220830	372	0	7459.50N	2957.30E	OKB	055f	31	YO
	PP23--	9607220830	372	0	7459.50N	2957.30E	OKN	056n		YO
	HS0005	9607221030	370	0	7507.73N	3023.48E	CTD	TCSP	Bird 2	PB
	CD004P	9607221125	362	-	7513.02N	3040.43E	EQB	pCO2	CTD006	GH
	CD004D	9607221125	362	-	7513.02N	3040.43E	EQB	DI13	CTD006	GH
	HS0006	9607221150	372	0	7515.16N	3046.57E	CTD	TCSP	Bird 2	PB
	HS0007	9607221315	348	0	7522.25N	3111.08E	CTD	TCSP	Bird 2	PB
	SM001-	9607221410	350	0	7529.96N	3134.95E	PUV	SI		EN
	HS0008	9607221430	350	0	7529.96N	3134.95E	CTD	TCSP	Bird 2	PB
	HS0009	9607221550	331	0	7537.34N	3200.40E	CTD	TCSP	Bird 2	PB
	HS0010	9607221617	322	0	7545.08N	3226.33E	CTD	TCSP	Bird 2	PB
	HS0011	9607221830	286	0	7552.65N	3251.66E	CTD	TCSP	Bird 2	PB
	HS0012	9607222003	304	0	7600.16N	3316.49E	CTD	TCSP	Bird 2	PB
	PP24--	9607222015	297	0	7600.30N	3216.10E	OKB	057f	31	YO
	PP24--	9607222015	297	0	7600.30N	3216.10E	OKN	058n		YO
	HS0013	9607222130	291	0	7607.78N	3342.80E	CTD	TCSP	Bird 2	PB
	CD005P	9607222255	310	-	7615.99N	3410.91E	EQB	pCO2	CTD014	GH
	CD005D	9607222255	310	-	7615.99N	3410.91E	EQB	DI13	CTD014	GH
	HS0014	9607222255	316	0	7615.99N	3410.91E	CTD	TCSP	Bird 2	PB
	HS0015	9607230005	275	0	7621.92N	3430.06E	CTD	TCSP	Bird 2	PB
	HS0016	9607230111	241	0	7626.92N	3449.96E	CTD	TCSP	Bird 2	PB
	PP001-	9607230120	241	0	7626.92N	3449.18E	NIS	KC		EN
	SM01--	9607230120	222	-	7628.00N	3448.40E	UWS	0-15	Rubber boat	JB
	HS0017	9607230150	243	0	7627.56N	3448.39E	CTD	TCSP	Sect A	PB
	BS003-	9607230201	-	0	7628.00N	3448.00E	-	-	0-8/8ice	KI
	HS0018	9607230305	194	0	7638.34N	3449.81E	CTD	TCSP	Sect A	PB
	HS0019	9607230415	135	0	7648.67N	3449.37E	CTD	TCSP	Sect A	PB
	SM02--	9607230430	129	-	7648.70N	3449.40E	UWS	0-15	Rubber boat	JB
	CD006P	9607230607	113	-	7659.36N	3449.18E	EQB	pCO2	CTD020	GH
	CD006I	9607230607	113	-	7659.36N	3449.18E	EQB	DI13	CTD020	GH
	HS0020	9607230607	119	0	7659.36N	3449.18E	CTD	TCSP	Sect A	PB
	PP002-	9607230715	148	0	7709.17N	3449.36E	NIS	KCI		EN
	SM03--	9607230725	142	-	7709.17N	3449.36E	UWS	0-50	Rubber boat	JB
	HS0021	9607230730	148	0	7709.17N	3449.36E	CTD	TCSP	Sect A	PB
	PP25--	9607230805	140	0	7709.50N	3449.80E	OKB	059f	51	YO
	HS0022	9607230912	170	-	7719.07N	3448.95E	CTD	TCSP	Sect A	PB
	HS0023	9607230912	203	3	7729.07N	3446.70E	CTD	TCSP	Sect A	PB
	PP003-	9607231100	200	x	7729.07N	3446.70E	NIS	KCI		EN
	SM04--	9607231114	197	-	7729.10N	3446.70E	UWS	0-50	Rubber boat	JB
	SM002-	9607231235	200	x	7729.07N	3446.70E	PUV	UWI		EN
	HS0024	9607231337	203	1	7726.67N	3450.02E	CTD	TCSP	Sect A	PB
	HS0025	9607231438	196	-	7724.38N	3450.37E	CTD	TCSP	Sect A	PB
	SM	9607231440	-	0	78.50N	34.50E	SM	-		RK
	HS0026	9607231515	179	-	7722.40N	3449.25E	CTD	TCSP	Sect A	PB
	HS0027	9607231548	162	-	7720.23N	3450.35E	CTD	TCSP	Sect A	PB
	HS0028	9607231622	160	-	7715.12N	3450.03E	CTD	TCSP	Sect A	PB
	SM003-	9607231705	154	0	7717.7N	3448.3E	PUV	UWI		EN
	SM05--	9607231708	152	-	7718.10N	3448.50E	UWS	0-50	Rubber boat	JB
	SM	9607231709	-	0	77.50N	34.80E	SM	-		RK
	PP26--	9607231715	152	0	7717.70N	3438.60E	OKB	060f	41	YO
	HS0029	9607231820	194	-	7724.07N	3449.40E	CTD	TCSP	Sect A	PB
	SM06--	9607231837	188	-	7724.10N	3449.40E	UWS	0-50	Rubber boat	JB
	HS0030	9607231925	200	-	7726.07N	3449.80E	CTD	TCSP	Sect A	PB
	SM07--	9607231945	193	-	7728.00N	3450.20E	UWS	0-50	Rubber boat	JB
	CD007P	9607232000	193	-	7728.05N	3450.20E	EQB	pCO2	CTD031	GH
	CD007I	9607232000	193	-	7728.05N	3450.20E	EQB	DI13	CTD031	GH
	HS0031	9607232000	199	1	7728.05N	3450.20E	CTD	TCSP	Sect A	PB
	HS0032	9607232110	216	3	7730.06N	3447.55E	CTD	TCSP	Sect A	PB
	HS0033	9607232156	200	3	7732.10N	3450.63E	CTD	TCSP	Sect A	PB

SM08--	9607232157	100	-	7732.10N	3450.60E	UWS	0-40	Rubber boat	JB
HS0034	9607232235	203	3	7734.15N	3450.30E	CTD	TCSP	Sect A	PB
HS0035	9607232316	194	1	7736.08N	3450.73E	CTD	TCSP	Sect A	PB
HS0036	9607232353	188	1	7738.07N	3445.70E	CTD	TCSP	Sect A	PB
HS0037	9607240041	162	1	7739.99N	3449.92E	CTD	TCSP	Sect A	PB
HS0038	9607240130	177	1	7742.66N	3449.52E	CTD	TCSP	Sect A	PB
CD008P	9607240220	173	-	7744.21N	3450.06E	EQB	pCO2	CTD039	GH
CD008I	9607240220	173	-	7744.21N	3450.06E	CTD	DI13	CTD039	GH
SM09--	9607240220	174	-	7744.40N	3449.60E	UWS	0-50	Rubber boat	JB
PP004-	9607240223	176	x	7744.20N	340.07E	NIS	KC		EN
HS0039	9607240223	182	1	7744.20N	3450.07E	CTD	TCSP	Sect A	PB
SM004-	9607240305	176	x	7744.20N	3450.07E	PUV	UWI		EN
HS0040	9607240344	188	1	7746.58N	3450.61E	CTD	TCSP	Sect A/Q	PB
HS0041	9607240420	173	1	7748.84N	3450.39E	CTD	TCSP	Sect A/Q	PB
HS0042	9607240454	164	1	7751.09N	3450.23E	CTD	TCSP	Sect A/Q	PB
HS0043	9607240530	186	1	7752.92N	3449.79E	CTD	TCSP	Sect A/Q	PB
HS0044	9607240615	192	3	7755.04N	3449.41E	CTD	TCSP	Sect A	PB
HS0045	9607240640	173	3	7756.06N	3450.19E	CTD	TCSP	Sect A/Q	PB
HS0046	9607240715	148	3	7758.15N	3450.09E	CTD	TCSP	Sect A/Q	PB
HS0047	9607240750	147	3	7800.06N	3451.15E	CTD	TCSP	Sect A/Q	PB
PP27--	9607240755	148	3	7800.14N	3451.28E	OKB	061f	41	YO
PP27--	9607240755	148	3	7800.14N	3451.28E	OKN	062n		YO
HS0048	9607240820	135	5	7802.04N	3451.06E	CTD	TCSP	Sect A/Q	PB
PP005-	9607240915	155	x	7804.00N	3444.31E	NIS	KCI		EN
CD009P	9607240915	155	-	7804.01N	3444.13E	EQB	pCO2	CTD049	GH
CD009I	9607240915	155	-	7804.01N	3444.13E	CTD	DI13	CTD049	GH
HS0049	9607240915	161	5	7804.01N	3444.13E	CTD	TCSP	Sect A	PB
SM10--	9607240920	155	-	7804.00N	3444.30E	UWS	0-50	Rubber boat	JB
SM005-	9607240930	155	x	7804.00N	3444.31E	PUV	UWI		EN
HS001X	9607240955	155	-	7804.01N	3444.13E	XBT	----	CTD049	GH
HS002X	9607241030	189	-	7806.00N	3438.72E	XBT	----	CTD049	GH
HS003X	9607241055	214	-	7808.00N	3429.34E	XBT	----		GH
HS004X	9607241120	232	-	7810.09N	3426.48E	XBT	----		GH
HS005X	9607241138	241	-	7812.00N	3423.17E	XBT	----		GH
HS006X	9607241153	238	-	7812.89N	3424.15E	XBT	----	CTD050	GH
HS0050	9607241207	242	-	7812.57N	3424.21E	CTD	TCSP	Sect A	PB
HS007X	9607241300	230	-	7815.00N	3425.70E	XBT	----		GH
HS008X	9607241331	189	-	7817.13N	3420.15E	XBT	----		GH
HS009X	9607241351	120	-	7819.00N	3419.24E	XBT	----		GH
HS010X	9607241411	85	-	7821.46N	3425.37E	XBT	----		GH
HS011X	9607241429	103	-	7823.11N	3431.82E	XBT	----	CTD051	GH
SM11--	9607241430	108	-	7822.90N	3432.40E	UWS	0-50	Rubber boat	JB
PP006-	9607241433	108	x	7823.07N	3431.94E	NIS	KC		EN
CD010P	9607241433	109	-	7823.08N	3431.95E	EQB	pCO2	CTD051	GH
CD010I	9607241433	109	-	7823.08N	3431.95E	CTD	DI13	CTD051	GH
HS0051	9607241433	114	-	7823.08N	3431.95E	CTD	TCSP	Sect A	PB
SM006-	9607241445	108	x	7823.07N	3431.94E	PUV	UWI		EN
SM	9607241503	-	3	77.33N	34.82E	SM	-		RK
HS012X	9607241540	125	-	7825.27N	3428.75E	XBT	----		GH
HS013X	9607241606	116	-	7828.45N	3431.69E	XBT	----		GH
SM	9607241620	-	3	78.38N	34.53E	SM	-		RK
HS0052	9607241635	202	-	7832.53N	3428.65E	CTD	TCSP	Sect A	PB
HS014X	9607241639	190	-	7832.66N	3428.69E	XBT	----	CTD052	GH
HS015X	9607241713	191	-	7835.00N	3423.10E	XBT	----		GH
HS016X	9607241722	210	-	7837.00N	3421.75E	XBT	----		GH
HS017X	9607241734	233	-	7839.00N	3418.00E	XBT	----		GH
HS018X	9607241745	262	-	7841.00N	3415.30E	XBT	----		GH
PP007-	9607241800	300	0	7843.04N	3413.21E	NIS	KC		EN
SM12--	9607241800	300	-	7843.00N	3413.20E	UWS	0-50	Rubber boat	JB
HS0053	9607241800	306	-	7843.04N	3413.22E	CTD	TCSP	Sect A	PB
PP28--	9607241804	297	1	7843.10N	3413.00E	OKB	063f	31	YO
HS019X	9607241847	300	-	7843.04N	3413.22E	XBT	----	CTD053	GH
HS020X	9607241905	304	-	7846.00N	3414.98E	XBT	----		GH
HS021X	9607241912	314	-	7847.00N	3414.84E	XBT	----		GH
HS022X	9607241923	275	-	7849.00N	3415.60E	XBT	----		GH
HS023X	9607241934	285	-	7859.00N	3417.90E	XBT	----		GH
HS0054	9607241955	285	-	7853.09N	3420.57E	CTD	TCSP	Sect A	PB
HS024X	9607242023	276	-	7854.40N	3423.80E	XBT	----		GH
HS025X	9607242038	279	-	7857.00N	3425.60E	XBT	----		GH
HS026X	9607242051	297	-	7859.00N	3426.00E	XBT	----		GH
HS027X	9607242103	279	-	7901.00N	3423.60E	XBT	----		GH
HS028X	9607242115	239	-	7903.41N	3421.25E	XBT	----	CTD055	GH
CD011P	9607242125	239	-	7903.41N	3421.25E	EQB	pCO2	CTD055	GH
CD011I	9607242125	239	-	7903.41N	3421.25E	CTD	DI13	CTD055	GH
HS0055	9607242125	245	-	7903.41N	3421.25E	CTD	TCSP	Sect A	PB
SM13--	9607242130	239	-	7903.40N	3421.20E	UWS	0-50	Rubber boat	JB
HS029X	9607242222	217	-	7906.00N	3426.41E	XBT	----		GH
HS030X	9607242229	210	-	7907.01N	3426.63E	XBT	----		GH
HS031X	9607242245	211	-	7911.00N	3426.71E	XBT	----		GH

	HS032X	9607242308	201	-	7911.00N	3426.71E	XBT	----		GH
	HS0056	9607242330	213	-	7913.23N	3420.50E	CTD	TCSP	Sect A	PB
	HS0057	9607250115	253	-	7920.14N	3350.96E	CTD	TCSP	Sect A	PB
	SM14--	9607250245	285	-	7930.40N	3340.20E	UWS	0-50	Rubber boat	JB
	HS0058	9607250247	291	-	7930.39N	3340.21E	CTD	TCSP	Sect A	PB
	HS0059	9607250420	352	-	7940.19N	3344.73E	CTD	TCSP	Sect A	PB
	HS0060	9607250551	253	-	7950.24N	3348.17E	CTD	TCSP	Sect A	PB
	PP008-	9607250725	209	0	8000.11N	3347.45E	NIS	KCI		EN
	HS0061	9607250725	215	-	8000.11N	3347.45E	CTD	TCSP	Sect A	PB
	CD012P	9607250727	209	-	8000.11N	3347.45E	EQB	pCO2	CTD061	GH
	CD012I	9607250727	209	-	8000.11N	3347.45E	CTD	DI13	CTD061	GH
	SM15--	9607250730	209	-	8000.10N	3347.40E	UWS	0-50	Rubber boat	JB
	SM007-	9607250745	209	0	8000.11N	3347.45E	PUV	UWI		EN
	PP29--	9607250754	210	0	7959.80N	3347.60E	OKB	064f	41	YO
	PP29--	9607250754	210	0	7959.80N	3347.60E	OKN	065n	Bloom	YO
	SM	9607251111	-	0	78.59N	32.19E	SM	-		RK
	SM	9607251121	-	0	78.59N	32.19E	SM	-		RK
	SM	9607251124	-	0	78.59N	32.19E	SM	-		RK
	PP30--	9607251226	56	0	8000.40N	3221.12E	OKB	066f	41	YO
	PP30--	9607251226	56	0	8000.40N	3221.12E	OKN	067n	Bloom	YO
	HS0062	9607251232	70	-	8000.37N	3221.37E	ADM	UVTW	ADCP 1	PB
	PP009-	9607251305	87	0	7959.96N	3220.41E	NIS	KC		EN
	SM008-	9607251428	87	0	7959.96N	3220.41E	PUV	UWI		EN
	HS0063	9607251554	212	-	7959.97N	3400.54E	CTD	TCSP	Sect A	PB
	SM16--	9607251555	206	-	7959.96N	3400.54E	UWS	0-50	Rubber boat	JB
	HS0064	9607251731	222	-	8010.11N	3359.98E	CTD	TCSP	Sect A	PB
	HS0065	9607251850	242	-	8020.13N	3359.85E	CTD	TCSP	Sect A	PB
	PP010-	9607252000	164	x	8029.88N	3400.20E	NIS	KC		EN
	CD013P	9607252000	164	-	8029.88N	3300.20E	EQB	pCO2	CTD066	GH
	CD013I	9607252000	164	-	8029.88N	3300.20E	CTD	DI13	CTD066	GH
	HS0066	9607252000	170	-	8029.88N	3400.20E	CTD	TCSP	Sect A	PB
	SM17--	9607252005	164	-	8029.90N	3400.20E	UWS	0-50	Rubber boat	JB
	SM009-	9607252030	164	x	8029.88N	3400.20E	PUV	UWI		EN
	PP31--	9607252047	163	0	8030.01N	3400.95E	OKB	068f	41	YO
	PP31--	9607252047	163	0	8030.01N	3400.95E	OKN	069n	Bloom	YO
	HS0067	9607252155	50	-	8030.16N	3315.14E	ADM	UVTW	ADCP 2	PB
	HS0068	9607260059	167	-	8040.11N	3340.02E	CTD	TCSP	Sect A	PB
	Z0001-	9607260130	158	-	8040.01N	3349.75E	TTR	-		GP
	HS0069	9607260327	177	-	8050.13N	3418.54E	CTD	TCSP	Sect A	PB
	SM18--	9607260335	171	-	8050.10N	3418.50E	UWS	0-50	Poor	JB
	SM010-	9607260355	171	x	8050.60N	3419.56E	PUV	UWI		EN
	HS0070	9607260543	223	-	8100.12N	3412.71E	CTD	TCSP	Sect A	PB
	CD014P	9607260750	182	-	8110.45N	3405.74E	EQB	pCO2	CTD071	GH
	CD014I	9607260750	182	-	8110.45N	3405.74E	CTD	DI13	CTD071	GH
	HS0071	9607260750	188	-	8110.45N	3405.74E	CTD	TCSP	Sect A	PB
	SM19--	9607260900	194	-	8120.20N	3328.90E	UWS	0-50	Rubber boat	JB
	PP011-	9607260940	201	x	8120.00N	3328.00E	NIS	KCI		EN
	SM011-	9607260955	201	x	8120.00N	3328.00E	PUV	UWI		EN
	HS0072	9607261000	200	-	8120.17N	3328.88E	CTD	TCSP	Sect A	PB
	SM	9607261135	-	0	81.30N	34.08E	SM	-		RK
	SM	9607261140	-	0	81.30N	34.08E	SM	-		RK
	SM	9607261144	-	0	81.30N	34.08E	SM	-		RK
	HS0073	9607261150	194	-	8129.98N	3325.26E	CTD	TCSP	Sect A	PB
	Z0002-	9607261330	228	-	8131.06N	3406.37E	TTR	-		GP
	Z0003-	9607261404	222	-	8130.60N	3409.83E	TTR	-		GP
	PP012-	9607261425	220	x	8130.72N	3413.01E	NIS	KC		EN
	HS0074	9607261425	226	-	8130.72N	3413.01E	CTD	TCSP	Sect A	PB
	SM012-	9607261510	220	x	8130.72N	3413.01E	PUV	UWI		EN
	SM20--	9607261520	235	-	8130.70N	3413.00E	UWS	0-50	Open water	JB
	BE001-	9607261526	228	-	8130.80N	3416.44E	KBS	OGMI		KJ
	SM21--	9607261555	235	-	8130.70N	3413.00E	UWS	0-50	Near ice	JB
	PP32--	9607261944	255	3	8133.17N	3430.26E	OKB	070f		YO
	PP32--	9607261944	255	3	8133.17N	3430.26E	OKN	071n		YO
	HS0075	9607262030	261	-	8133.22N	3432.18E	CTD	TCSP	Sect A	PB
	SM	9607262037	-	0	81.31N	34.21E	SM	-		RK
	SM	9607262040	-	0	81.31N	34.21E	SM	-		RK
	HS0076	9607262330	263	-	8131.81N	3418.67E	CTD	TCSP	Sect A	PB
I1A	Z0004-	9607271251	265	-	8133.01N	3446.03E	MNT	-	I1a	GP
I1A	PP013a	9607271400	270	x	8133.02N	3445.67E	NIS	KCB	CTD077	EN
I1A	HS0077	9607271406	270	-	8133.02N	3445.67E	CTD	TCSP		PB
I1A	SM22--	9607271600	270	-	8133.00N	3445.70E	CM1	perm	On ice	JB
I1A	Z0005-	9607271615	263	-	8133.48N	3446.77E	PPN	-		GP
I1A	Z0006-	9607271810	269	-	8133.85N	3448.86E	MNT	-		GP
I1A	-	9607271947	-	-	81.34N	34.51E	SO	-		RK
I1A	-	9607272000	-	-	-	-	-	-	Mapping	OL
I1A	PP013b	9607272005	265	x	8134.06N	3452.22E	NIS	K	CTD078	EN
I1A	PP013c	9607272005	265	x	8134.06N	3452.22E	PPN	L	CTD078	EN
I1A	CD015P	9607272005	265	-	8134.06N	3452.22E	EQB	pCO2	CTD078	GH
I1A	CD015I	9607272005	265	-	8134.06N	3452.22E	CTD	DI13	CTD078	GH

I1A	HS0078	9607272005	271	-	8134.06N	3452.22E	CTD	TCSP		PB
I1A	SM23--	9607272030	270	-	8134.10N	3454.00E	RFS	2	HR+BR	JB
I1A	ZO007-	9607272110	270	-	8134.06N	3453.58E	WP2	-		GP
I1A	HS0079	9607272300	278	-	8133.88N	3454.08E	CTD	TCSP		PB
I1A	ZO008-	9607280019	271	-	8133.72N	3453.43E	MNT	-		GP
I1A	HS0080	9607280204	271	-	8133.72N	3451.68E	CTD	TCSP		PB
I1A	HS0081	9607280504	275	-	8134.10N	3451.05E	CTD	TCSP		PB
I1A	ZO009-	9607280613	271	-	8134.33N	3451.37E	MNT	-		GP
I1A	HS0082	9607280800	281	-	8134.23N	3452.68E	CTD	TCSP		PB
I1A	PP014a	9607281000	275	x	8134.22N	3452.65E	NIS	KCB	CTD083	EN
I1A	PP014b	9607281030	275	x	8134.22N	3452.65E	PPR	ISI	CTD083	EN
I1A	HS0083	9607281100	283	-	8134.26N	3453.14E	CTD	TCSP		PB
I1A	IBF---	9607281120	-	-	8134.40N	3452.90E	SUP	M	I	OL
I1A	IBA---	9607281120	-	-	8134.40N	3452.90E	SUP	Q	I	OL
I1A	SM013a	9607281205	277	x	8134.25N	3452.14E	PUV	UWI	CTD083a	EN
I1A	SM24--	9607281300	273	-	8133.80N	3457.70E	RFS	3	HR+2BR	JB
I1A	IB33--	9607281300	267	3	-	-	HAN	072i	Seaweed	YO
I1A	HS0084	9607281400	273	-	8133.81N	3457.78E	CTD	TCSP		PB
I1A	ZO010-	9607281415	271	-	8133.66N	3451.34E	MNT	-	I1a	GP
I1A	SM013b	9607281435	267	x	8133.81N	3451.78E	PUV	UWI	CTD084	EN
I1A	-	9607281533	-	-	81.33N	34.50E	SO	-		RK
I1A	SM25--	9607281600	266	-	8133.50N	3450.20E	RFS	2	2BRMP	JB
I1A	HS0085	9607281720	266	-	8133.54N	3450.27E	CTD	TCSP		PB
I1A	ZO011-	9607281820	269	-	8133.47N	3450.48E	MNT	-	I1a	GP
I1A	SM26--	9607281900	213	-	8133.30N	3450.60E	RFS	3	Int+2UW	JB
I1A	PP014c	9607282000	207	x	8133.25N	3450.70E	SUP	KCB	CTD086Ice algae	EN
I1A	IP----	9607282000	-	-	8133.20N	3450.70E	THO	Q	-	OL
I1A	HS0086	9607282000	213	-	8133.25N	3450.70E	CTD	TCSP		PB
I1A	IBA---	9607282020	-	-	8133.20N	3450.70E	LME	Q	I	OL
I1A	SM013c	9607282045	207	x	8133.25N	3450.70E	LME	UIL	CTD086Under ice	EN
I1A	-	9607282127	-	-	81.32N	34.51E	SO	-		RK
I1A	HS0087	9607282300	267	-	8132.68N	3449.54E	CTD	TCSP		PB
I1A	ZO012-	9607282330	258	-	8132.53N	3448.55E	MNT	-	I1a	GP
I1A	HS0088	9607290237	259	-	8137.95N	3445.28E	CTD	TCSP		PB
I1A	HS0089	9607290610	260	-	8131.51N	3442.50E	CTD	TCSP		PB
I1A	HS0090	9607290810	258	-	8131.41N	3440.67E	CTD	TCSP		PB
I1A	PP015a	9607290935	250	x	8131.43N	3440.53E	NIS	KC	CTD091	EN
I1A	HS0091	9607290940	256	-	8131.47N	3440.53E	CTD	TCSP		PB
I1A	IP----	9607291016	-	-	8131.20N	3439.10E	THO	Q	-	OL
I1A	PP015b	9607291050	250	x	8131.43N	3440.53E	PPR	ISI	CTD091	EN
I1A	SM27--	9607291100	257	-	8131.20N	3438.90E	RFS	3	HR+2BR	JB
I1A	HS0092	9607291100	257	-	8131.20N	3438.92E	CTD	TCSP		PB
I1A	IBF---	9607291115	-	-	8131.00N	3438.40E	SUP	Q	A	OL
I1A	SM014	9607291120	251	x	8131.20N	3438.91E	PUW	UWI	CTD092	EN
I1A	PP015c	9607291305	248	x	8130.92N	3437.87E	NIS	KCB	CTD093	EN
I1A	HS0093	9607291305	254	-	8130.92N	3437.88E	CTD	TCSP		PB
I1A	-	9607291315	-	-	81.30N	34.37E	SO	-		RK
I1A	SM28--	9607291400	263	-	8130.80N	3437.10E	RFS	3	UI+UW	JB
I1A	HS0094	9607291437	263	-	8130.81N	3437.11E	CTD	TCSP		PB
I1A	BE----	9607291500	-	-	8130.40N	3437.00E	OBG	Q	245m	OL
I1A	PP015d	9607291600	244	x	8150.53N	3437.43E	PPN	L	CTD095	EN
I1A	SM29--	9607291600	252	-	8130.00N	3437.50E	UWS	3	3UW	JB
I1A	ZO013-	9607291600	244	-	8130.53N	3437.43E	NIS	-	I1a	SF
I1A	HS0095	9607291600	250	-	8130.53N	3437.43E	CTD	TCSP		PB
I1A	ZO015-	9607291615	252	-	8930.08N	3433.55E	WP2	EGG	I1a	GP
I1A	IBF---	9607291620	-	-	8130.50N	3437.40E	SUP	Q	A	OL
I1A	IBF---	9607291620	-	-	8130.50N	3437.40E	SUP	M	A	OL
I1A	-	9607291659	-	-	81.30N	34.37E	SO	-		RK
I1A	ZO014-	9607291700	248	-	8130.30N	3437.27E	NIS	-	I1a	SF
I1A	HS0096	9607291705	250	-	8130.30N	3437.27E	CTD	TCSP		PB
I1A	HS0097	9607291800	240	-	8130.13N	3436.63E	CTD	TCSP		PB
I1A	ZO016-	9607291850	242	-	8930.01N	3434.07E	WP2	EGG	I1a	GP
I1A	ZO1NPN	9607291925	232	-	8130.01N	3434.36E	GHN	I1N1		GH
I1A	IP----	9607291932	-	-	8130.00N	3435.20E	THO	Q	-	OL
I1A	ZO017-	9607292000	235	-	8129.99N	3434.20E	WP2	FORM	I1a	GP
I1A	ZO018-	9607292020	228	-	8130.00N	3433.55E	WP2	FORM	I1a	GP
I1A	HS0098	9607292045	238	-	8130.00N	3433.51E	CTD	TCSP		PB
I1A	SM30--	9607292200	220	-	8128.20N	3432.90E	CTD	6	CTD m.p.	BI
I1A	HS0099	9607292305	233	-	8130.00N	3431.84E	CTD	TCSP		PB
I1A	HS0100	9607300204	234	-	8129.66N	3432.39E	CTD	TCSP		PB
I1A	HS0101	9607300500	226	-	8129.14N	3433.63E	CTD	TCSP		PB
I1A	HS0102	9607300600	226	-	8128.90N	3433.65E	CTD	TCSP		PB
I1A	PP016a	9607300800	217	x	8128.57N	3433.63E	NIS	KC	CTD103	EN
I1A	HS0103	9607300800	223	-	8128.58N	3433.63E	CTD	TCSP		PB
I1A	PP016b	9607300905	217	x	8128.57N	3433.63E	PPR	ISI	CTD103	EN
I1A	HS0104	9607301000	219	-	8128.24N	3432.97E	CTD	TCSP		PB
I1A	SM015a	9607301010	213	x	8126.23N	3432.97E	PUV	UWI	CTD104	EN
I1A	IBF---	9607301010	-	-	8128.30N	3433.20E	SUP	Q	A1	OL
I1A	SM31--	9607301030	213	-	8128.00N	3431.20E	RFS	2	HR+BR	JB

I1A	SM32--	9607301130	210	-	8128.00N	3431.20E	RFS	1	UIMP3	JB
I1A	HS0105	9607301130	213	-	8128.06N	3431.25E	CTD	TCSP		PB
I1A	SM33--	9607301200	213	-	8128.10N	3431.30E	RFS	2	UI Loc3	JB
I1A	SM34--	9607301330	213	-	8128.00N	3429.70E	RFS	13	UI 2,4,5,6	JB
I1A	SM015b	9607301340	207	x	8120.06N	3431.25E	PUV	UWI	CTD105	EN
I1A	HS0106	9607301410	213		8127.98N	3429.65E	CTD	TCSP		PB
I1A	IBF	9607301430			8127.90N	3429.60E	SUP	Q	A1	OL
I1A	ZO019	9607301450	207		8127.72N	3430.49E	PPN	LIP	I1a	GP
I1A	HS0107	9607301450	215		8127.86N	3429.91E	CTD	TCSP		PB
I1A	IB	9607301508			8127.80N	3429.90E	VCA	D	A1	OL
I1A	HS0108	9607301540	208		8127.74N	3430.36E	CTD	TCSP		PB
I1A	SM015c	9607301555	202	x	8127.73N	3430.36E	PUV	UWI	CTD108	EN
I1A	IBF	9607301600			8127.60N	3430.60E	SUP	M	A1	OL
I1A		9607301619			81.27N	34.30E	SO			RK
I1A	HS0109	9607301630	215		8127.70N	3430.54E	CTD	TCSP		PB
I1A	HS0110	9607301656	214		NOGPS	NOGPS	CTD	TCSP		PB
I1A	PP36	9607301658	200	3	8127.70N	3430.64E	PPN	078n	Bloom	YO
I1A	PP36	9607301658	200	3	8127.70N	3430.64E	OKB	079f	41	YO
I1A	PP016c	9607301700	208	x	8127.69N	3430.54E	PPN	L	CTD110	EN
I1A	ZO020	9607301700	207		8127.70N	3430.54E	PPN	LIP	I1a	GP
I1A	IB	9607301710			8126.90N	3432.60E	UWC	D	A1	OL
I1A	IBF	9607301730			8126.90N	3432.60E	SUP	M	A	OL
I1A	IP	9607301958			8126.10N	3431.70E	THO	Q		OL
I1A	PP016d	9607302000	194	x	8127.69N	3430.54E	NIS	KC	CTD111(GPSout)	EN
I1A	HS0111	9607302000	200		NOGPS	NOGPS	CTD	TCSP		PB
I1A	IB	9607302002			8126.10N	3431.70E		D	A	OL
I1A	HS0112	9607302300	190		8125.43N	3427.19E	CTD	TCSP		PB
I1A	HS0113	9607310200	197		8125.36N	3424.19E	CTD	TCSP		PB
I1A	HS0114	9607310500	185		8124.63N	3425.75E	CTD	TCSP		PB
I1A	HS0115	9607310800	178		8124.64N	3425.70E	CTD	TCSP		PB
I1A	PP017a	9607310900	172	x	8124.64N	3425.70E	SUP	KCB	CTD115 Ice algae	EN
I1A	PP017b	9607310900	172	x	8124.64N	3425.70E	SUP	L	CTD115 Ice algae	EN
I1A	SM35	9607310900	178		8124.60N	3425.70E	ICR	1	Ice core	JB
I1A	IBA	9607310900			8123.30N	3424.80E	SUP	Q	A	OL
I1A	IBA	9607310900			8123.30N	3424.80E	LME	Q	A	OL
I1A	IBF	9607310915			8123.30N	3424.80E	SUP	M	A	OL
I1A	SM016	9607310930	172	x	8124.64N	3425.70E	LME	UIL	CTD115 Under ice	EN
I1A	SM016	9607310930	172	x	8124.64N	3425.70E	LME	UIL	CTD115 Under ice	EN
	ZO021	9607311107	172		8121.44N	3400.25E	TTR			GP
	ZO022	9607311135	171		8121.02N	3347.81E	TTR			GP
	ZO023	9607311207	172		8121.97N	3403.28E	TTR			SF
	ZO024	9607311229	179		8122.04N	3405.10E	TTR			SF
	BE002	9607311415	170		8121.80N	3352.20E	KBS	05MI		KJ
	BH001	9607311654		1	8121.00N	3359.00E			18/8ice	KI
	BS004	9607312112		2	8123.00N	3249.00E			28/8ice	KI
I0A	SM36	9608010000	784		8134.10N	3450.10E	RFS	8	Spectral albedo	JB
I0A	HS0117	9608010500	706		8135.57N	3300.63E	CTD	TCSP		PB
I0A	HS0116	9608010740	818		8136.77N	3254.90E	CTD	TCSP		PB
IZA	IB	9608010915			8134.20	3257.70	SUP	D		OL
I0A	CD016P	9608011040	784		8134.05N	3450.06E	EQB	pCO2	CTD118	GH
I0A	HS0118	9608011128	790		8134.23N	3249.88E	CTD	TCSP		PB
I0A	ZO025	9608011247	801		8134.58N	3250.87E	MNT		I0a	GP
I0A	IBF	9608011405			8134.00	3250.20	SUP	Q	A	OL
I0A	IBF	9608011500			8134.00	3250.20	SUP	M	A	OL
I0A	PP018a	9608011550	672	x	8134.47N	3259.28E	NIS	KCN	CTD119	EN
I0A	HS0119	9608011550	678		8134.47N	3259.29E	CTD	TCSP		PB
I0A	SM017a	9608011703	672	x	8134.47N	3259.28E	PUV	UWI	CTD119	EN
I0A	ZO026	9608011730	582		8133.88N	3303.33E	MNT		I0a	SF
I0A	IBF	9608011915			8133.00	3305.90	SUP	Q	A	OL
I0A	PP018b	9608012000	434	x	8132.46N	3305.74E	NIS	F	CTD120	EN
I0A	SM017b	9608012000	434	x	8132.46N	3305.74E	PUV	UWI	CTD120	EN
I0A	IBF	9608012000			8132.50	3305.90	SUP	M	A	OL
I0A	CD016I	9608012020	428		8132.40N	3306.23E	CTD	DI13	CTD120	GH
I0A	IB39	9608012030	200	4	8132.50N	3305.90E	OKB	084i	Lead	YO
I0A	ZO027	9608012045	425		8132.29N	3305.26E	WP2	LOST	I0a	GP
I0A	HS0120	9608012250	434		8132.40N	3306.23E	CTD	TCSP		PB
I0A	PP018c	9608012300	482	x	8132.32N	3303.16E	NIS	F	CTD121	EN
I0A	HS0121	9608012300	488		8132.32N	3303.16E	CTD	TCSP		PB
I0A	ZO028	9608012330	491		8132.39N	3303.36E	MNT		I0a	GP
I0A	SM017c	9608012335	482	x	8132.32N	3303.16E	PUV	UWI	CTD121	EN
I0A	SM37	9608020000	182		8130.80N	3315.30E	RFS	20	Under Ice	JB
I0A	HS0122	9608020550	229		8131.08N	3314.80E	CTD	TCSP		PB
I0A	ZO029	9608020625	209		8130.71N	3315.35E	MNT		I0a	GP
I0A	ZO2NPN	9608020710	765		8130.89N	3315.30E	GHN	I0N2		GH
I0A	PP019a	9608020800	182	x	8130.88N	3315.33E	NIS	KCBI	CTD123	EN
I0A	HS0123	9608020800	188		8130.89N	3315.33E	CTD	TCSP		PB
I0A	SM018a	9608020818	182	x	8130.88N	3315.33E	PUV	UWI	CTD123	EN
I0A	ZO030	9608020901	186		8130.67N	3315.30E	WP2		I0a	SF
I0A	ZO031	9608020920	189		8130.67N	3315.30E	WP2		I0a	SF

I0A	IB40	9608020930	184	4	8129.69N	3314.34E	OKB	086p	Pond	YO
I0A	IB40	9608020930	184	4	8129.69N	3314.34E	OKB	087p	Pond	YO
I0A	IB40	9608020930	184	4	8129.69N	3314.34E	OKB	088p	Pond	YO
I0A	IB40	9608020930	184	4	8129.69N	3314.34E	OKB	089p	Pond	YO
I0A	IB40	9608020930	184	4	8129.69N	3314.34E	OKB	090p	Pond	YO
I0A	IB40	9608020930	184	4	8129.69N	3314.34E	OKB	091p	Pond	YO
I0A	SM39	9608021000			8130.90N	3315.30E	ICR	1	5.4m Ice core	GH
I0A	IBF	9608021018			8132.50	3305.90	SUP	Q	B	OL
I0A	PP019b	9608021100	180	x	8129.97N	3325.29E	PPN	L	CTD124	EN
I0A	IB40	9608021100	184	4	8129.95N	3317.43E	PPN	092n		YO
I0A	IBF	9608021100			8129.50	3315.10	SUP	Q	B	OL
I0A	SM018b	9608021108	180	x	8129.97N	3325.29E	PUV	UWI	CTD124	EN
I0A	Z0032	9608021130	189		8130.30N	3317.00E	PPN	LIP	I0a	SF
I0A	SM018c	9608021305					PUV	UWI		EN
I0A	BE	9608021320			8129.80	3316.10	OBG	Q	183m	OL
I0A	BH002	9608021334		0	8130.00N	3314.00E			08/8ice	KI
I0A	IB40	9608021400	184	4	8129.95N	3317.43E	OKB	093f	41	YO
I0A	Z0033	9608021455	190		8130.05N	3319.31E	WP2	LIP	I0a	GP
I0A	IBA	9608021520			8130.70	3322.40	SUP	Q	B	OL
I0A	IBA	9608021520			8130.70	3322.40	SUP	M	B	OL
I0A	Z0034	9608021600	192		8130.06N	3323.42E	PPN	STIS	I0a	GP
I0A	HS0124	9608021644	186		8129.98N	3225.30E	CTD	TCSP		PB
I0A	IB41	9608021700	184	4	8129.20N	3329.20E	OKB	094i	Lead	YO
I0A	IB41	9608021700	184	4	8129.20N	3329.20E	SUP	095i	Sub ice	YO
I0A	IB41	9608021700	184	4	8129.20N	3329.20E	OKB	096i	Lead	YO
I0A	IB41	9608021700	184	4	8129.20N	3329.20E	SUP	097i	Hammer	YO
I0A	IBA	9608021730			8130.70	3322.40	SUP	M	B	OL
I0A	SM38	9608021800	180		8129.90N	3325.30E	UWS	2	0-40m	JB
I0A	IBA	9608021840			8129.20	3329.20	SUP	Q	B	OL
I0A	IBF	9608022015			8128.70	3332.90		D	B	OL
	Z0035	9608022135	187		8128.35N	3343.67E	TTR			GP
	Z0036	9608022155	186		8128.29N	3348.69E	TTR			GP
	Z0037	9608022218	188		8128.79N	3344.79E	TTR			GP
	BE003	9608022315	184		8128.20N	3345.01E	KBS	02MI		KJ
	BS005	9608022349		0	8128.00N	3353.00E			08/8ice	KI
	Z0038	9608031228	268		8018.92N	3351.82E	TTR			GP
	Z0039	9608031304	282		8018.06N	3351.61E	TTR			GP
	Z0040	9608031344	241		8019.30N	3351.46E	WP2			GP
	Z0041	9608031405	247		8019.35N	3351.68E	WP2			GP
	Z0042	9608031435	247		8020.00N	3350.03E	PTR			SF
	BE004	9608031535	216		8024.70N	3347.80E	KBS	05MI		KJ
	HS0125	9608031635	215		8022.56N	3408.87E	CTD	TCSP	TuckerTrawl	PB
	BE	9608031650			8022.40	3405.5	OBG	Q	198m	OL
	PP42	9608040335	295	3	8017.00N	3429.96E	PPN	098n	Bloom	YO
	PP42	9608040335	295	3	8017.00N	3429.96E	OKB	099f	51	YO
	PP020	9608040845	120	x	8008.42N	3459.70E	NIS	K		EN
	HS0126	9608040845	126		8008.43N	3459.71E	CTD	TCSP	KvitSec	PB
	HS0127	9608040915	140		8008.38N	3447.44E	CTD	TCSP	KvitSec	PB
	HS0128	9608040942	234		8008.04N	3435.03E	CTD	TCSP	KvitSec	PB
	HS0129	9608040942	232		8008.04N	3435.03E	CTD	TCSP	KvitSec	PB
	PP021	9608041013	209	x	8008.51N	3422.58E	NIS	K		EN
	HS0130	9608041013	215		8008.52N	3422.59E	CTD	TCSP	KvitSec	PB
	HS0131	9608041046	221		8008.48N	3410.57E	CTD	TCSP	KvitSec	PB
	HS0132	9608041118	239		8008.63N	3358.96E	CTD	TCSP	KvitSec	PB
	HS0133	9608041154	217		8009.25N	3347.15E	CTD	TCSP	KvitSec	PB
	PP022	9608041225	161	x	8009.46N	3338.65E	NIS	KC		EN
	HS0134	9608041225	167		8009.49N	3338.65E	CTD	TCSP	KvitSec	PB
	SM019	9608041240	161	x	8009.46N	3338.65E	PUV	UWI		EN
	SM40	9608041300	161		8009.50N	3338.70E	UWS	1	0-50m	JB
	SM	9608041631		0	80.15N	34.00E	SM			RK
I2A	SM41	9608050000	310		7930.10N	3236.10E	RFS	9	Spectral albedo	JB
I2A	SM	9608050740		0	79.33N	32.21E	SM			RK
I2A	HS0135	9608050812	320		7928.76N	3215.41E	CTD	TCSP		PB
I2A	CD017P	9608050855	300		7930.05N	3236.09E	EQB	pCO2	CTD136	GH
I2A	CD017I	9608050855	300		7930.05N	3236.09E	CTD	DI13	CTD136	GH
I2A	Z0043	9608050900	313		7930.89N	3230.71E	WP2		I2a	GP
I2A	Z0044	9608050942	302		7930.59N	3232.64E	WP2		I2a	GP
I2A	IBF	9608051045			7930.00	3236.10	SUP	Q		OL
I2A	IBF	9608051045			7930.00	3236.10	SUP	M		OL
I2A	HS0136	9608051055	306		7930.05N	3236.09E	CTD	TCSP		PB
I2A	PP023a	9608051100	300	x	7930.05N	3206.09E	NIS	KC		EN
I2A	Z0045	9608051132	303		7929.73N	3237.02E	MNT		I2a	GP
I2A	SM020a	9608051235	300	x	7930.05N	3206.09E	PUV	UWI		EN
I2A	IP	9608051310			7930.00N	3236.10E	THO	Q		OL
I2A	BH003	9608051321		0	7928.00N	3237.00E			08/8ice	KI
I2A	IBF	9608051350			7930.00	3236.10	SUP	Q		OL
I2A	PP023b	9608051400	296	x	7928.66N	3237.90E	NIS	K		EN
I2A	HS0137	9608051405	312		7928.66N	3237.91E	CTD	TCSP		PB
I2A	Z0046	9608051420	301		7928.65N	3237.91E	PPN		I2a	GP

I2A	SM020b	9608051435	296	x	7928.66N	3237.90E	PUV	UWI		EN
I2A	IBF	9608051445			7928.50	3237.00	SUP	Q		OL
I2A	PP023c	9608051500	296	x	7928.66N	3237.90E	PPN	L		EN
I2A	SM42	9608051500			7928.70N	3237.90E	ICR	1	Ice core	GH
I2A	Z0047	9608051515	300		7928.37N	3236.81E	WP2		I2a	GP
I2A		9608051546			79.28N	32.38E	SO			RK
I2A	Z0048	9608051710	302		7928.40N	3236.51E	MNT		I2a	SF
I2A	PP023d	9608051715	292	x	7928.36N	3236.80E	NIS	KC		EN
I2A	HS0138	9608051720	298		7928.37N	3236.81E	CTD	TCSP		PB
I2A	IB	9608051937			7930.10	3240.40	VCA			OL
I2A	SM43	9608052000					UWS	2	0-50m	JB
I2A	IBF	9608052001			7930.10	3240.40		D		OL
I2A		9608052005			79.30N	32.44E	SO			RK
I2A	PP023e	9608052010	ccc	x	aaaa.aaN	bbbb.bbE	NIS	F		EN
I2A	HS0139	9608052011	303		7930.14N	3244.83E	CTD	TCSP		PB
I2A	PP020c	9608052040	ccc	x	aaaa.aaN	bbbb.bbE	PUV	UWI		EN
I2A	HS0140	9608052308	297		7929.28N	3255.53E	CTD	TCSP		PB
I2A	Z0049	9608052320	291		7929.15N	3256.38E	MNT		I2a	GP
I2A	SM44	9608060000	292		7930.10N	3320.10E	RFS	4	UI,MP+edge	JB
I2A	HS0141	9608060200	295		7927.72N	3258.29E	CTD	TCSP		PB
I2A	PP43	9608060645	291	3	7929.79N	3302.98E	PPN	100n		YO
I2A	PP43	9608060645	291	3	7929.79N	3302.98E	PPN	101f	41	YO
I2A	PP024a	9608061000	292	x	7930.05N	3320.10E	NIS	KCB		EN
I2A	HS0142	9608061000	298		7930.05N	3220.10E	CTD	TCSP		PB
I2A		9608061050			79.29N	33.22E	SO			RK
I2A	IBF	9608061107			7929.60	3323.50	SUP	M		OL
I2A	BE	9608061320			7929.40	3232.90	OBG	Q	288m	OL
I2A	BH004	9608061331		0	7929.00N	3318.00E			08/8ice	KI
I2A	PP45	9608061340	162	3	7832.10N	2550.62E	PPN	104n		YO
I2A	PP45	9608061340	162	3	7832.10N	2550.62E	OKB	105f		YO
I2A	IB45	9608061340	162	3	7832.10N	2550.62E	OKB	106i	Lead	YO
I2A	IB45	9608061340	162	3	7832.10N	2550.62E	OKB	107i		YO
I2A	IB45	9608061340	162	3	7832.10N	2550.62E	OKB	108i		YO
I2A	IB45	9608061340	162	3	7832.10N	2550.62E	OKB	109i	Snow	YO
I2A	SM45	9608061400	301		7929.60N	3321.30E	CTD	3	MP13	BI
I2A		9608061413			79.29N	33.21E	SO			RK
I2A		9608061413			79.29N	33.21E	SO			RK
I2A	IBF	9608061420			7929.90	3323.00	SUP	M		OL
I2A	IBF	9608061420			7929.90	3323.00	SUP	Q		OL
I2A	HS0143	9608061554	307		7930.00N	3321.29E	CTD	TCSP		PB
I2A	PP024b	9608061600	301	x	7929.59N	3321.29E	NIS	KCB		EN
I2A	IB44	9608061600	291	3	7930.40N	3324.40E	SUP	102i	Sub ice	YO
I2A	IB44	9608061600	291	3	7930.40N	3324.40E	OKB	103p	Pond	YO
I2A	ZO3NPN	9608061615	292		7929.60N	3321.29E	GHN	I0N2		GH
	Z0050	9608061820	305		7931.81N	3329.11E	TTR			GP
	Z0051	9608061845	301		7932.15N	3325.66E	TTR			GP
	Z0052	9608061920	311		7932.80N	3325.16E	WP2			GP
	Z0053	9608061950	310		7935.60N	3326.40E	TTR			SF
	Z0054	9608062010	306		7932.80N	3328.00E	TTR			SF
	IBF	9608062010			7937.70	3327.50	SUP	Q		OL
	Z0055	9608062100	305		7932.50N	3331.50E	PTR			SF
	Z0056	9608062210	300		7933.90N	3327.70E	PTR			SF
	BE005	9608062310	315		7932.60N	3309.40E	KBS	05MI		KJ
	BS006	9608062359		0	7932.00N	3328.00E			08/8ice	KI
	HS0144	9608070300	76		7911.08N	3200.64E	CTD	TCSP	SectB	PB
	CD018P	9608070306	69		7911.07N	3200.01E	EQB	pCO2	CTD144	GH
	CD018I	9608070306	69		7911.07N	3200.01E	CTD	DI13	CTD144	GH
	HS0145	9608070353	82		7905.17N	3217.05E	CTD	TCSP	Sect B	PB
	HS0146	9608070452	221		7859.59N	3236.62E	CTD	TCSP	Sect B	PB
	HS0147	9608070550	294		7853.52N	3253.27E	CTD	TCSP	Sect B	PB
	HS0148	9608070653	256		7847.35N	3310.91E	CTD	TCSP	Sect B	PB
	HS0149	9608070750	294		7841.54N	3329.08E	CTD	TCSP	Sect B	PB
	HS0150	9608070850	265		7835.80N	3347.24E	CTD	TCSP	Sect B	PB
	HS0151	9608070955	179		7829.53N	3403.99E	CTD	TCSP	Sect B	PB
	HS0152	9608071103	89		7822.25N	3425.64E	CTD	TCSP	Sect B	PB
	SM	9608071112		0	78.17N	33.07E	SM			RK
	SM	9608071117		0	78.17N	33.07E	SM			RK
	BE006	9608071245	144				KBS	05MI		KJ
	CD019P	9608071900	322		7806.14N	2919.74E	EQB	pCO2		GH
	CD019I	9608071900	322		7806.14N	2919.74E	CTD	DI13		GH
	BH005	9608080541		0	7831.00N	2607.00E			08/8ice	KI
	BH006	9608080840		0	7833.00N	2548.00E			08/8ice	KI
	COI	9608081100			7835.01	2547.92	HPC	Q	Floe 1	OL
	Z0057	9608081115	159		7832.57N	2549.18E	MNT		I3a	GP
	COI	9608081115			7841.52	2552.92	HPC	Q	Floe 2	OL
	COI	9608081130			7850.27	2604.43	HPC	Q	Floe 3	OL
I3A	HS0153	9608081208	161		7832.42N	2550.04E	CTD	TCSP		PB
I3A	CD020P	9608081208	155		7832.42N	2550.04E	EQB	pCO2	CTD153	GH
I3A	CD020I	9608081208	155		7832.42N	2550.04E	CTD	DI13	CTD153	GH

I3A	PP025a	9608081215	155	x	7832.41N	2550.04E	NIS	K		EN
I3A	PP025b	9608081340	155	x	7832.41N	2550.04E	PPR	ISI		EN
I3A	ZO058	9608081340	167		7832.10N	2250.62	WP2		I3a	GP
I3A	SM021	9608081355	155	x	7832.41N	2550.04E	PUV	UWI		EN
I3A	SM49	9608081400	156		7832.60N	2546.40E	ICR	1	Ice core	GH
I3A	SM46	9608081400	155		7832.10N	2547.90E	RFS	10	Albedo+under ice	JB
I3A	ZO059	9608081405	169		7832.04N	2550.45E	WP2		I3a	GP
I3A	IBF	9608081408			7831.90	2549.60	SUP	Q	Main floe	OL
I3A	PP026	9608081415	165	x	7831.99N	2550.33E	NIS	KCB		EN
I3A	BH007	9608081415		0	7832.00N	2548.00E			08/8ice	KI
I3A	HS0154	9608081419	171		7832.00N	2550.39E	CTD	TCSP		PB
I3A		9608081443			78.31N	25.49E	SO			RK
I3A		9608081705			78.32N	25.47E	SO			RK
I3A	SM022	9608081715	156	x	7832.58N	2546.42E	PUV	UWI		EN
I3A	HS0155	9608081808	160		7832.60N	2546.41E	CTD	TCSP		PB
I3A	ZO060	9608081814	161		7832.68N	2546.21E	MNT		I3a	GP
I3A		9608081945			78.33N	25.45E	SO			RK
I3A	SM47	9608082000			7843.30N	2545.90E	RFS	5	Albedo dirty ice	JB
I3A	SM48	9608082000			7843.30N	2545.90E	ICR	1	Ice core dirty ice	JB
I3A	IB46	9608082000	162	3	7843.30N	2545.90E	OKB	110i	Snow	YO
I3A	IB46	9608082000	162	3	7843.30N	2545.90E	OKB	111p	Pond	YO
I3A	IB46	9608082000	162	3	7843.30N	2545.90E	OKB	112i	Snow	YO
I3A	IB46	9608082000	162	3	7843.30N	2545.90E	OKB	113i	Snow	YO
I3A	IBF	9608082010			7833.80	2546.60	SUP	Q	Mainfloe	OL
I3A	ZO4NPN	9608082020	145		7833.75N	2546.10E	GHN	I3N4		GH
I3A	HS0156	9608082023	151		7833.72N	2545.93E	CTD	TCSP		PB
I3A	SM023	9608082030	145	x	7833.72N	2545.93E	PUV	UWI		EN
I3A	PP027a	9608082030	145	x	7833.72N	2545.93E	SUP	KCB	CTD156Ice algae	EN
I3A	PP027b	9608082030	145	x	7833.72N	2545.93E	SUP	L	CTD156Ice algae	EN
I3A	HS0157	9608082300	151		7833.75N	2546.10E	CTD	TCSP		PB
I3A	ZO061	9608082310	134		7834.55N	2547.21E	MNT		I3a	GP
I3A	ZO065	9608090000					PPN		I3a	SF
I3A	DI	9608090000					SUP		I3A	
I3A	DE	9608090000					SUP			
I3A	HS0158	9608090200	129		7834.93N	2546.85E	CTD	TCSP		PB
I3A	HS0159	9608090508	126		7835.55N	2545.90E	CTD	TCSP		PB
I3A	ZO062	9608090615	126		7836.90N	2543.70E	MNT		I3A	GP
I3A	SM	9608090858		0	78.40N	25.51E	SM			RK
I3A	PP028a	9608091000	85	x	7839.39N	2548.28E	NIS	KCN		EN
I3A	HS0160	9608091000	91		7839.90N	2548.28E	CTD	TCSP		PB
I3A	SM50	9608091000	85		7839.40N	2548.30E	UWS	2	0-50m	JB
I3A	SM024	9608091010	95	x	7839.39N	2548.28E	PUV	UWI		EN
I3A	IBF	9608091038			7840.20	2553.40	SUP	M	Dirty floe	OL
I3A	IBF	9608091038			7840.20	2553.40	SUP	Q	Dirty floe	OL
I3A	IBF	9608091038			7840.20	2553.40		D	Dirty floe	OL
I3A	IBF	9608091130			7840.20	2553.40	SUP	M	Rigid floe	OL
I3A	ZO064	9608091202	81		7839.98N	2554.23E	WP2		I3A	GP
I3A	ZO063	9608091255	83		7840.04N	2554.38E	WP2		I3A	GP
I3A	PP028b	9608091300	78	x	7839.98N	2554.24E	PPN	L		EN
I3A	PP47	9608091400	162	3	7840.00N	2549.20E	PPN	114n		YO
I3A	HS0161	9608091410	86		7839.90N	2553.58E	CTD	TCSP		PB
I3A	PP029a	9608091500	82	x	7840.00N	2551.70E	NIS	KC		EN
I3A	SM51	9608091500			7844.10N	2542.00E	RFS	6	Albedo dirty ice	JB
I3A1	SM52	9608091500			7844.10N	2542.00E	ICR	2	Ice core dirty ice	LS
I3A	SM025a	9608091510	82	x	7840.00N	2551.70E	PUV	UWI		EN
I3A	PP029b	9608091600	82	x	7840.00N	2551.70E	SUP	KCB	CTD161Ice algae	EN
I3A	PP029c	9608091600	82	x	7840.00N	2551.70E	SUP	L	CTD161Ice algae	EN
I3A	IBA	9608091600			7840.20	2549.20	SUP	Q	Mainfloe	OL
I3A	SM025b	9608091630	82	x	7840.00N	2551.70E	LME	UIR	CTD161Under ice	EN
I3A	BH008	9608091631		0	7837.00N	2530.00E			08/8ice	KI
I3Aa	SM53	9608091700			7840.00N	2554.30E	RFS	4	Alb.+Under ice rad	JB
	ZO066	9608091859	128		7840.24N	2534.64E	TTR			SF
	ZO067	9608091918	129		7840.52N	2531.70E	TTR			GP
	ZO068	9608091930	127		7840.62N	2529.68E	TTR			GP
	HS0162	9608092040	92		7841.61N	2549.50E	CTD	TCSP	Sect C	PB
	BS007	9608092049		0	7842.00N	2550.00E			08/8ice	KI
	HS0163	9608092115	96		7839.76N	2545.34E	CTD	TCSP	Sect C	PB
	HS0164	9608092151	122		7838.18N	2540.12E	CTD	TCSP	Sect C	PB
	HS0165	9608092223	139		7836.42N	2536.59E	CTD	TCSP	Sect C	PB
	HS0166	9608092302	149		7834.65N	2532.20E	CTD	TCSP	Sect C	PB
	HS0167	9608092328	178		7832.65N	2528.18E	CTD	TCSP	Sect C	PB
	HS0168	9608092355	181		7830.60N	2524.03E	CTD	TCSP	Sect C	PB
	HS0169	9608100028	186		7828.72N	2519.80E	CTD	TCSP	Sect C	PB
	HS0170	9608100050	186		7826.90N	2515.69E	CTD	TCSP	Sect C	PB
	HS0171	9608100118	202		7824.88N	2511.77E	CTD	TCSP	Sect C	PB
	HS0172	9608100147	196		7825.03N	2511.89E	CTD	TCSP	Sect C	PB
	HS0173	9608100210	143		7820.58N	2501.84E	CTD	TCSP	Sect C	PB
	HS0175	9608100240	141		7818.62N	2457.40E	CTD	TCSP	Sect C	PB
	HS0176	9608100318	116		7816.75N	2453.31E	CTD	TCSP	Sect C	PB

	HS0177	9608100329	97		7814.77N	2449.23E	CTD	TCSP	Sect C	PB
	HS0178	9608100350	82		7812.83N	2445.39E	CTD	TCSP	Sect C	PB
	HS0179	9608100410	76		7810.98N	2441.33E	CTD	TCSP	Sect C	PB
I4A	ZO069	9608100723	171		7746.60N	2524.62E	MNT		I4	GP
I4A	CD021P	9608100727	154		7745.52N	2525.35E	EQB	pCO2	CTD180	GH
I4A	CD021I	9608100727	154		7745.52N	2525.35E	CTD	DI13	CTD180	GH
I4A	ZO070	9608100822	164		7745.70N	2525.31E	WP2		I4	GP
I4A	ZO071	9608100840	163		7745.69N	2525.64E	WP2		I4	GP
I4A	ZO072	9608100850	163		7745.68N	2525.95E	WP2		I4	GP
I4A	HS0180	9608100927	160		7745.52N	2525.35E	CTD	TCSP		PB
I4A	PP030a	9608100930	154	0	7745.52N	2525.35E	NIS	KCB		EN
I4A	PP030b	9608101030	154	0	7745.52N	2525.35E	PPR	ISI		EN
I4A	ZO5NPN	9608101035	160		7746.19N	2528.28E	GHN	O1N5		GH
I4A	ZO073	9608101059	168		7746.26N	2528.12E	TTR		I4	GP
I4A	ZO074	9608101140	161		7745.68N	2527.91E	TTR		I4	SF
I4A	ZO075	9608101150	163		7745.87N	2527.91E	TTR		I4	SF
I4A	ZO076	9608101235	158		7743.89N	2525.64E	MNT		I4	GP
I4A	HS0181	9608101324	159		7743.77N	2525.69E	CTD	TCSP		PB
I4A	SM54	9608101330	153		7743.80N	2525.70E	UWS	32	0-50m	JB
I4A	SM026	9608101335	153	0	7743.76N	2525.69E	PUV	UWI		EN
I4A	ZO077	9608101852	167		7743.56N	2537.00E	MNT		I4	GP
I4A	HS0182	9608101910	167		7743.51N	2536.17E	CTD	TCSP		PB
I4A	BE007	9608102008	85		7749.08N	2531.09E	KBS	05MI		KJ
I4A	HS0183	9608102220	168		7743.99N	2535.68E	CTD	TCSP		PB
I4A	ZO078	9608102320	171		7742.60N	2533.90E	MNT		I4	GP
	BE	9608111005			7849.00	2503.00		D	Ryke yse	OL
	BE008	9608111120	90		7751.85N	2505.03E	KBS	05MI		KJ
	SM	9608111412		0	77.56N	25.11E	SM			RK
	SM	9608111413		0	77.56N	25.11E	SM			RK
	HS0184	9608120007	132		7804.35N	2527.76E	CTD	TCSP	Leg 1	PB
	BS008	9608120019		0	7804.00N	2525.00E				KI
	HS0185	9608120111	192		7800.92N	2605.43E	CTD	TCSP	Leg 1	PB
	HS0186	9608120220	160		7801.77N	2653.79E	CTD	TCSP	Leg 1	PB
	HS0189	9608120317	323		7805.52N	2913.53E	CTD	TCSP	Leg 2	PB
	HS0187	9608120330	245		7803.26N	2740.72E	CTD	TCSP	Leg 1	PB
	HS0188	9608120442	291		7804.34N	2829.04E	CTD	TCSP	Leg 1	PB
	HS0190	9608120705	292		7756.77N	2934.61E	CTD	TCSP	Leg 2	PB
	HS0191	9608120829	239		7747.91N	2957.35E	CTD	TCSP	Leg 2	PB
	HS0192	9608120950	217		7734.82N	3028.18E	CTD	TCSP	Leg 2	PB
	HS0193	9608121052	202		7726.83N	3029.08E	CTD	TCSP	Leg 3	PB
	HS0194	9608121135	192		7721.44N	3028.70E	CTD	TCSP	Leg 3	PB
	HS0195	9608121203	188		7719.58N	3028.54E	CTD	TCSP	Leg 3	PB
	SM	9608121223		0	77.07N	30.25E	SM			RK
	SM	9608121225		0	77.07N	30.25E	SM			RK
	HS0196	9608121228	188		7717.63N	3027.78E	CTD	TCSP	Leg 3	PB
	HS0197	9608121253	188		7715.79N	3026.79E	CTD	TCSP	Leg 3	PB
	HS0198	9608121319	195		7713.60N	3026.20E	CTD	TCSP	Leg 3	PB
	HS0199	9608121347	202		7711.44N	3026.18E	CTD	TCSP	Leg 3	PB
	HS0200	9608121429	206		7706.77N	3024.94E	CTD	TCSP	Leg 3	PB
	SM	9608121433		0	77.55N	25.10E	SM			RK
	SM	9608121436		0	77.55N	25.10E	SM			RK
	HS0201	9608121537	238		7657.18N	3021.80E	CTD	TCSP	Leg 3	PB
	HS0202	9608121654	252		7647.19N	3018.76E	CTD	TCSP	Leg 3	PB
	HS0203	9608121811	242		7656.16N	3038.18E	CTD	TCSP	Leg 4	PB
	CD022P	9608121811	237		7656.16N	3038.18E	EQB	pCO2	CTD203	GH
	CD022I	9608121811	237		7656.16N	3038.18E	CTD	DI13	CTD203	GH
	HS0204	9608121935	216		7706.34N	3101.98E	CTD	TCSP	Leg 4	PB
	ZO079	9608122005	211		7708.67N	3102.21E	WP2			SF
	ZO080	9608122013	207		7708.67N	3102.21E	TTR			SF
	HS0205	9608122150	150		7716.40N	3124.26E	CTD	TCSP	Leg 5	PB
	HS0206	9608122250	179		7716.51N	3043.07E	CTD	TCSP	Leg 5	PB
	HS0207	9608122352	184		7716.53N	3002.64E	CTD	TCSP	Leg 5	PB
	HS033X	9608130100	179		7716.50N	2914.40E	XBT		CTD208	GH
	HS0208	9608130105	178		7716.51N	2914.60E	CTD	TCSP	Leg 5	PB
	ZO081	9608130110	178		7716.51N	2914.48E	WP2			GP
	ZO082	9608130120	177		7716.57N	2914.07E	TTR			GP
	HS034X	9608130156	191		7713.60N	2921.40E	XBT			GH
	HS035X	9608130211	202		7711.10N	2926.00E	XBT			GH
	HS036X	9608130227	209		7708.30N	2931.70E	XBT			GH
	HS0209	9608130247	198		7707.20N	2934.36E	CTD	TCSP	Leg 6	PB
	HS037X	9608130257	202		7705.60N	2937.10E	XBT			GH
	HS038X	9608130313	225		7703.00N	2942.60E	XBT			GH
	HS039X	9608130328	231		7700.20N	2948.40E	XBT			GH
	HS040X	9608130347	240		7657.70N	2954.60E	XBT		CTD210	GH
	HS0210	9608130350	240		7657.69N	2954.84E	CTD	TCSP	Leg 6	PB
	HS041X	9608130417	245		7655.00N	3000.30E	XBT			GH
	HS042X	9608130433	258		7652.40N	3006.80E	XBT			GH
	HS043X	9608130449	252		7649.80N	3013.00E	XBT			GH
	HS044X	9608130508	254		7647.20N	3019.60E	XBT		CTD211	GH

	HS0211	9608130511	254		7647.22N	3019.69E	CTD	TCSP	Leg 6	PB
	Z0083	9608130520	251		7647.09N	3019.39E	WP2			GP
	Z0084	9608130532	251		7647.04N	3019.5E	TTR			GP
	HS045X	9608130605	247		7646.80N	3004.70E	XBT			GH
	HS046X	9608130621	259		7646.30N	2950.40E	XBT			GH
	HS0212	9608130644	258		7645.80N	2936.52E	CTD	TCSP	Leg 7	PB
	HS047X	9608130714	245		7645.30N	2920.90E	XBT			GH
	HS048X	9608130730	244		7644.90N	2907.80E	XBT			GH
	HS0213	9608130751	222		7644.61N	2853.84E	CTD	TCSP	Leg 7	PB
	HS049X	9608130820	171		7644.40N	2838.50E	XBT			GH
	HS050X	9608130836	140		7644.10N	2824.30E	XBT			GH
	HS0214	9608130858	152		7643.44N	2811.00E	CTD	TCSP	Leg 7	PB
	HS051X	9608130924	150		7643.00N	2755.00E	XBT			GH
	HS052X	9608130939	142		7642.60N	2741.80E	XBT			GH
	HS0215	9608131000	113		7642.09N	2718.63E	CTD	TCSP	Leg 7	PB
	HS053X	9608131027	110		7641.50N	2708.70E	XBT			GH
	HS054X	9608131039	107		7641.10N	2659.00E	XBT			GH
	CD023P	9608131058	81		7640.67N	2644.89E	EQB	pCO2	CTD216	GH
	CD023I	9608131058	81		7640.67N	2644.89E	CTD	DI13	CTD216	GH
	HS0216	9608131102	88		7640.16N	2644.53E	CTD	TCSP	Leg 7	PB
	HS055X	9608131132	73		7640.20N	2622.80E	XBT			GH
	HS056X	9608131156	45		7639.90N	2601.00E	XBT			GH
	HS0217	9608131230	26		7639.90N	2537.79E	CTD	TCSP	Leg 7	PB
	HS057X	9608140701	82		7633.90N	2342.80E	XBT			GH
	HS058X	9608140716	83		7633.00N	2330.10E	XBT			GH
	HS059X	9608140731	110		7632.10N	2317.40E	XBT			GH
	HS060X	9608140745	183		7631.20N	2305.30E	XBT			GH
	HS061X	9608140759	200		7630.20N	2253.00E	XBT			GH
	HS062X	9608140815	208		7629.30N	2240.20E	XBT			GH
	HS063X	9608140823	227		7628.40N	222.50E	XBT			GH
	HS064X	9608140844	235		7627.40N	2215.50E	XBT			GH
	HS065X	9608140858	235		7626.60N	2203.50E	XBT			GH
	HS066X	9608140912	245		7625.90N	2151.50E	XBT			GH
	HS067X	9608140925	239		7625.10N	2139.80E	XBT			GH
	HS068X	9608140940	250		7624.40N	2127.20E	XBT			GH
	CD024P	9608140950	226		7627.08N	2210.21E	EQB	pCO2		GH
	CD024I	9608140950	226		7627.08N	2210.21E	CTD	DI13		GH
	HS069X	9608140955	239		7623.50N	2131.70E	XBT			GH
	HS070X	9608141008	233		7622.70N	2102.20E	XBT			GH
	HS071X	9608141022	226		7622.00N	2049.50E	XBT			GH
	HS072X	9608141036	225		7621.30N	2037.70E	XBT			GH
	HS073X	9608141052	225		7621.50N	2023.10E	XBT			GH
	HS073X	9608141108	231		7622.20N	2209.00E	XBT			GH