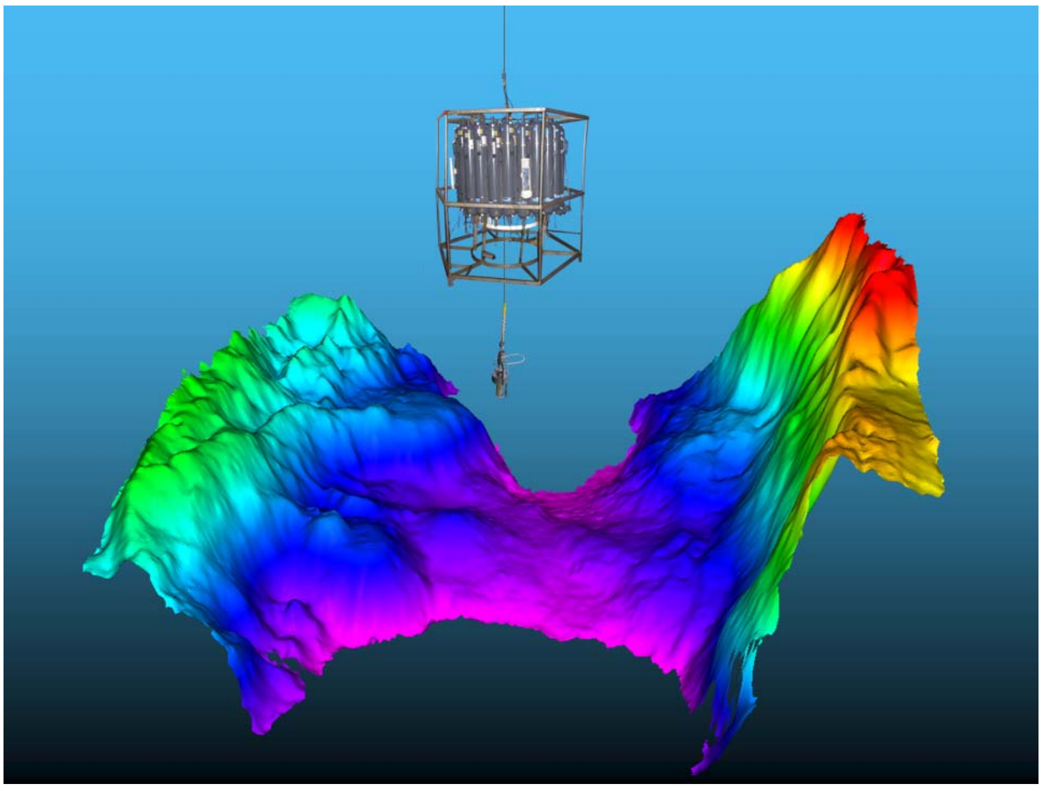
# RV Pelagia Shipboard Report

# Cruise 64PE275

**Geert-Jan A. Brummer, Hendrik M. van Aken, Steven van Heuven and shipboard party**



**BSIK Climate changes Spatial Planning, project CS1**
**CAMP (Clivarnet Atlantic Monitoring Programme)**
**LOCO (Long-term Ocean Climate Observations)**
**VAMOC (Variability of Atlantic Meridional Overturning Circulation)**
**CARBOOCEAN**

Royal NIOZ, 2007

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# Aims of RV Pelagia cruise 64PE275

Ocean-climate change is the common interest of a diverse group of marine scientists to undertake a joint research cruise in the North Atlantic from August 30 to September 27. As part of several national and international programs, the Dutch research vessel "Pelagia" will sail from the island of Texel in The Netherlands to the southern tip of Greenland, and back to Galway in Ireland. Their journey includes a number of operations (see map):

1. Salvaging a drifting, 1 km long array of instruments from a broken ocean mooring within the ANIMATE program run by our British colleagues, of which the whereabouts can be followed on the internet (http://www.noc.soton.ac.uk/animate/data/pap/papdata.php)
2. Deploying a deep ocean bed observatory for a year, to record how bottom sediments form under varying current velocities near the Mid Atlantic Ridge at 2600 meters depth. At that site an extremely detailed sediment record has been recovered of ocean-climate change over the past ca. 10,000 years, i.e. since the last ice age.
3. Recovering and redeploying 3 large arrays of instruments moored off the southern tip of Greenland. Two arrays include a package of temperature and salt sensors that move up and down the mooring line between 2500m depth and the near surface, every day for a full year. Both arrays also determine the changing current strength and direction, whereas the third array measures seasonal changes in particles that settle out from the surface to the deep ocean, and how they are transported by bottom currents.
4. Profiling the North Atlantic from southern Greenland to northern Ireland, from the surface to the deep ocean floor, to establish the year-to-year changes in ocean properties that include temperature and the invasion of man-induced $CO_2$.
5. Coring shelf sediments off northeastern Ireland to determine the impact of sea level change on sediment accumulation since the last ice age and the generation of natural gas, following a request by the Irish Geological Survey.

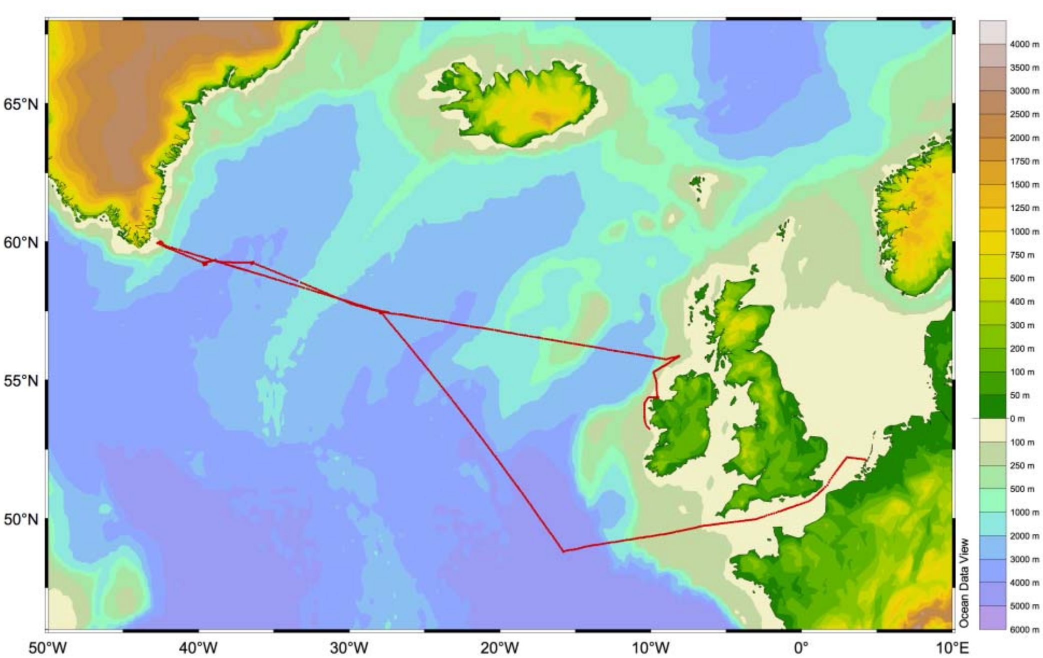



*Figure 1. The cruise track of RV Pelagia during cruise 64PE275.*

# Participating research programmes

**BSIK Climate changes Spatial Planning, project CS1**

The BSIK programme aims at the reinforcement of the knowledge infrastructure of science and technology in the Netherlands. Within the theme Climate changes Spatial Planning (CcSP), research is carried out to improve the climatologic information, required to carry out large investments in spatial planning, e.g. the design and building of overflow regions for high river level events in order to prevent uncontrolled flooding. One project within CcSP, CS1, aims to improve our fundamental understanding of the ocean and climate, and climate variability. Within CcSP CS1, NIOZ receives support to carry out monitoring activities in the northern North Atlantic. Data are collected during the CAMP surveys of a hydrographic section between Ireland and Greenland, and by profiling CTD moorings in the Irminger Sea, acquired with support from the LOCO investment programme.

**CAMP (Clivarnet Atlantic Monitoring Programme)**

During the World Ocean Circulation Experiment (WOCE) a few cross ocean  hydrographic sections were surveyed repeatedly to establish the representativeness of the hydrographic data, collected from 1990 to 1997 during the WOCE Hydrographic Program. It appeared that considerable climatic changes of the hydrography occurred on time scales of years to decades. The WOCE AR7E section between Ireland and Greenland was already surveyed in 1990 by NIOZ. As part of the Clivarnet programme, the Dutch contribution to the international Climate Variability and Predictability (CLIVAR) programme NIOZ contributes to the maintenance of annual hydrographic surveys of the AR7E section, in cooperation with Hamburg University. The results of these annual surveys are also reported in the annual assessment of the North Atlantic oceanic climate in the ICES Report on Climate (IROC). During the Pelagia 275 cruise (PE275) in September 2007, the AR7E section is resurveyed again. Similar to the surveys in 1991 and 2000, additionally parameters of the oceanic carbon dioxide system are also measured.

**LOCO (Long-term Ocean Climate Observations)**

Satellite altimetry shows strong inter-annual changes in the sea surface level (SSL). These changes seem to be correlated with the large-scale wind forcing over the North Atlantic, expressed as the NAO (North Atlantic Oscillation) index. The near-annual survey of the AR7E section (see CAMP project) has shown that these changes are correlated with water mass properties in the Irminger Sea. This survey, however, does not resolve the mechanism behind the changes in the water masses from year to year. In order to obtain a better resolution of the underlying processes, such as convection caused by strong surface cooling in winter or by changes in the advection caused by wind driven currents, measurements are done during the whole year. Within the framework of the Dutch Long-term Ocean Climate Observations (LOCO) investment programme two profiling CTD moorings were purchased. They have been deployed in 2003 in the Irminger Sea for a period of 5 years at least. During the 64PE275 cruise these moorings will be recovered, serviced and re-deployed. The moorings contain ADCP's to determine water velocity profiles, a CTD-profiler that moves up and down along a cable yielding one profile of physical parameters per day.

**VAMOC (Variability of Atlantic Meridional Overturning Circulation)**

This is a programme within the framework of RAPID (together with Norwegian and British colleagues). The Dutch contribution comes from the Royal NIOZ and Free University of Amsterdam (VU).The main question is: How did the Atlantic Meridional Overturning Circulation (AMOC) change on glacial-interglacial timescales and did the change take place in the same way every time? These changes can be derived from the bottom sediments. Within this project the Royal NIOZ is mainly studying the present on-going sedimentation in relation to the present water circulation. Others base their research on sediment cores from the area and the modeling of the underlying processes. An important aspect of the VAMOC project is the study of drift deposits. These are deposits with extremely high sedimentation rates of sediments that arrive more or less horizontally. On this cruise a mooring with two sediment traps will be recovered, serviced and re-deployed. The sediment traps contain 24 bottles that collect settling particles in intervals of two weeks over a period of one year. Thus seasonal cycles and short-lasting pulses of sediment resuspension can be observed. Having started in 2003, the mooring is planned for 5 years with refreshing every year. The traps are near the bottom (at about 3000 m) and 250 m above the bottom. Next year additional measurements will be done with a bottom lander with sensors to determine how drift deposits are actually formed. Detailed high-resolution information will be obtained to study the rapid change between the last glacial to the present interglacial. This period is very accurately dated by two well-known ash layers from Icelandic volcanic eruptions.

**CARBOOCEAN**

The European Union funded CARBOOCEAN project consists of a huge number of subprojects, with the overarching goal of gaining a better understanding of the oceanic contribution to the global carbon cycle, with an emphasis on the Atlantic Ocean. One of the main aims of the project is to better quantify the ocean's uptake of atmospheric carbon dioxide (CO2), the most important manageable driving agent for climate change. The ocean is a highly significant sink for man-made (‘anthropogenic’) CO2. The correct quantification of this sink is a fundamental necessary condition for all realistic prognostic climate modelling. During this cruise a study is made of how much of the atmospheric CO2 that enters the ocean surface finds its way to deeper layers in the ocean. This is done through highly accurate analyses of the several hundreds of water samples that will be brought on board during the cruise. Sample collection is carried out with a CTD-rosette, across the entire water column (generally from 8 to 24 depths between 0 and 3500 meters), at approximately 40 locations along a transect between southern Greenland and Northern Ireland. Analysis takes place in a dedicated laboratory on board. Therefore, data will be available for further analysis almost directly upon finishing the transect. Complicated calculations combining fundamental biogeochemical knowledge with extensive real-world datasets, as well as conceptually straightforward comparisons of the recent CO2-system data with data from earlier coverage of the same ocean region (e.g. TTO-NAS, 1981), or indeed the exact same transect (e.g. NIOZ cruises in 1991, 2005), will yield improved and important understanding of the increase in ocean CO2 content through the recent decades. This knowledge will prove highly valuable in predicting the ocean’s potential for further uptake of anthropogenic CO2, and its attenuating effect on global climate change.

# 1 Cruise summary

## 1.1 Cruise information

a: Expedition Designation (EXPOCODE): 64PE275

b: Chief Scientist: Dr. G.-J.A. Brummer
Royal Netherlands Institute for Sea Research (NIOZ)
P.O.Box 59
1790AB Den Burg/Texel
The Netherlands
Telephone: 31(0)222-369442
Telefax: 31(0)222-319674
e-mail: brummer@nioz.nl

c: Ship: RV Pelagia, Call Sign: PGRQ, Captain: Mr. John Ellen
length 66 m.
beam 12.8 m
draft 4 m
maximum speed 11 knots

d: Ports of Call: Texel, Scheveningen, Galway (Ireland)

e: Cruise dates: August 30, 2007 to September 27, 2007

## 1.2 Cruise track and station operations

The cruise was carried out in the North Atlantic Ocean (fig. 1)

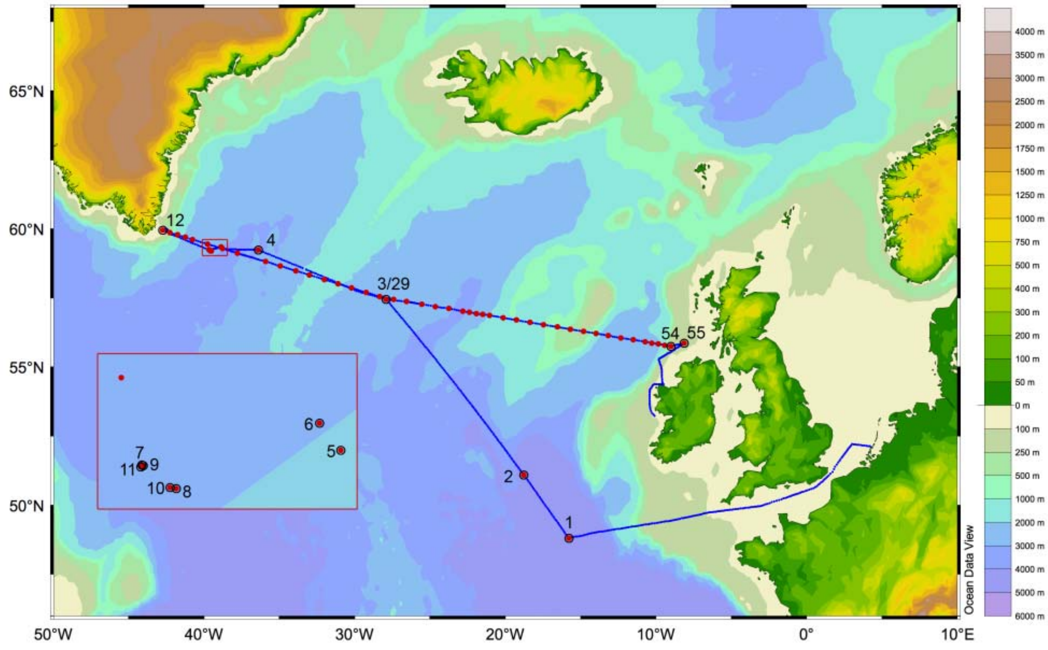



*Figure 2. The cruise track of RV Pelagia during cruise 64PE275 with stations of operation:*

*1. Salvaged mooring PAP2007*

*2. CTD- test cast*

*3/29. Multicorer, Pistoncorer, BOBO lander deployment*

*4. Multicorer on site previously occupied by mooring IRM-1*

*5. LOCO-02-4 mooring recovery*

*6. LOCO-02-5 mooring deployment*

*7. IRM-4 mooring recovery*

*8. LOCO-03-4 mooring recovery*

*9. Multicorer*

*10. LOCO-03-5 mooring deployment*

*11. IRM-5 mooring deployment*

*12-55. CTD-rosette/monocorer transect*

*55. attempted pistoncoring site*

**Mooring Deployments**

At three positions a mooring was recovered and later re-deployed (see table 1 and figure 3). Moorings LOCO 02-4/5 and LOCO 03-4/5 were profiling moorings, fitted with a McLane/FSI CTD profiler, two RDI Long Ranger ADCPs and an SBE Seacat CTD. They were deployed at a depth of about 3000 m. Mooring IRM-4/5 was fitted with two Technicap-PPS5 time-series sediment traps, one in a bottom frame and another at ~250 mab, NBA current meters, and tilt/temperature/OBS sensors, and deployed in conjunction with mooring LOCO 02-4/5. BOBO

| MOORING | Action | DATE & TIME | LAT | | | LON | | | Echo depth |
|---|---|---|---|---|---|---|---|---|---|
| LOCO2-4 | recovery | Sep 15 2005 10:18:46 | 59 | 12.32 | N | 39 | 29.947 | W | 3042 |
| LOCO2-5 | deployment | Sep 15 2005 16:44:10 | 59 | 16.21 | N | 39 | 29.798 | W | 3018 |
| LOCO3-4 | recovery | Sep 14 2005 08:32:16 | 59 | 14.64 | N | 36 | 23.655 | W | 3048 |
| LOCO3-5 | deployment | Sep 14 2005 14:39:41 | 59 | 11.59 | N | 36 | 26.742 | W | 2896 |
| IRM-4 | recovery | Sep 15 2005 08:16:31 | 59 | 15.05 | N | 39 | 38.461 | W | 3038 |
| IRM-5 | deployment | Sep 19 2005 19:07:11 | 59 | 15.05 | N | 39 | 38.461 | W | 3038 |
| BOBO | deployment | Sep 16 2007 08:49:28 | 57 | 43.33 | N | 27 | 25.208 | W | 2630 |

*Table1. Positions of the moorings, serviced during Pelagia Cruise 64PE275. Further details are given in Appendix B.*

**Hydrographic Stations**

A total of 43 CTD-rosette/monocorer casts were performed along the zonal area of the former WOCE A1E section (figure 1). During the up-cast of the CTD/rosette water samples were taken. These were analysed shipboard for the determination of salinity, dissolved nutrients (phosphate, NOx and silica) and oxygen, DIC and alkalinity, whereas samples were taken for CFCs. Additionally calibration control measurements of pressure and temperature were made for each closed bottle. Further information on the time, location and samples taken during these casts can be found in the Cruise Summary File (Appendix A).

## 1.3 Cruise Participants

**Scientific crew**

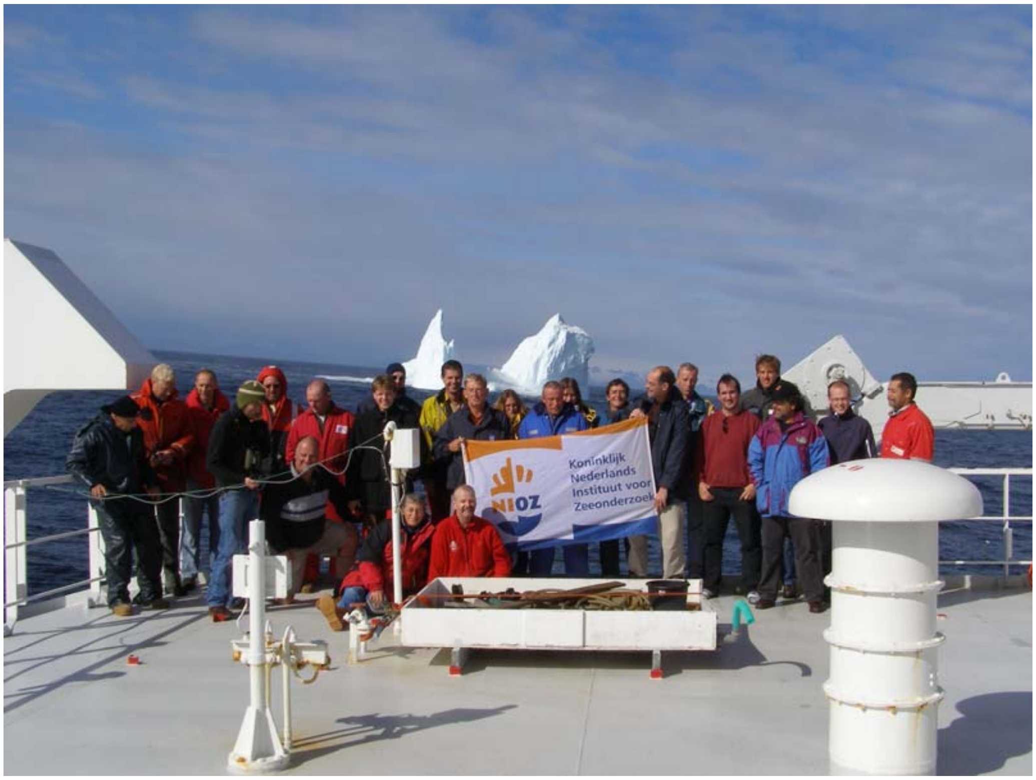
| **person** | **responsibility** | **Institute** |
|---|---|---|
| G.-J. A Brummer | Chief Scientist | NIOZ |
| H. van Aken | co-chief scientist | NIOZ |
| M.F. de Jong | CTD, data management, hydrowatch | NIOZ |
| M. Hiehle | CTD, data management, hydrowatch, Multibeam | NIOZ |
| S. Asjes | Electronic engineering, hydrowatch, moorings | NIOZ |
| M. Bakker | Mooring construction & engineering | NIOZ |
| L. Wuis | Mooring construction & engineering | NIOZ |
| E. van Weerlee | Nutrient analysis | NIOZ |
| S.R. Gonzales | Oxygen analysis, sediment traps, Multibeam | NIOZ |
| L.P. Jonkers | sediment traps, BOBO-lander, coring | NIOZ |
| H.J. Zemmelink | Carbonate system, CFCs | NIOZ |
| S. van Heuven | Carbonate system, CFCs | RUG |
| A. van Hoogstraten | Carbonate system, CFCs | RUG |
| S. Boing | student oceanography, hydrowatch | IMAU |
| M. Kroon | student oceanography, hydrowatch | IMAU |

*NIOZ:* *Royal Netherlands Institute for Sea Research, Texel*
*IMAU* *Institute for Marine and Atmospheric Research, Utrecht University.*
*RUG* *State University of Groningen*

**Ship's crew**

| | |
|---|---|
| J.C. Ellen | Captain |
| J. van Kralingen | First Mate |
| E. v.d. Weele | Second Mate |
| J. Seepma | Chief Engineer |
| M. Kleine | Second Engineer |
| S. Maas | Ships Technician |

| | |
|---|---|
| J.A. Israel Vitoria | Ships Technician |
| G. Vermeulen | Ships Technician |
| R. v.d. Heide | Ships Technician |
| G. Mik | Cook |




# 2 Measurements and Sampling

## 2.1 Continuous underway measurements (H.M. van Aken)

Continuous underway measurements were measured and recorded continuously. Recorded underway data deal with navigation (latitude, longitude, speed over ground, course over ground and heading), water depth (uncorrected echo sounder depth), thermosalinograph (sea surface temperature and salinity), and meteorology (surface air temperature and humidity, relative wind speed and direction, and global radiation.

The navigational data were collected from the ship's navigation system. The depth was determined with a 3.5 kHz echosounder.

For the calibration of the sea surface salinity water samples were taken and their salinity was determined. For the calibration of the sea surface temperature and additional calibration of the sea surface salinity the 3 m CTD temperature and salinity from the downcast was used. The meteorological instruments were calibrated by the Royal Netherlands Meteorological Institute (KNMI) in De Bilt. At NIOZ the data will be processed further to produce a well calibrated data set of underway measurements.

Vessel Mounted Acoustic Doppler Current Profiler (VMADCP) data were collected with a dedicated service computer, together with the appropriate navigational data. Regularly these data were transferred to the appropriate directory of the ship's computer network. For the determination of the alignment of the

VMADCP relative to dual GPS antennas, bottom tracking data were collected over the continental shelves of the Channel, Ireland and Greenland. Final data processing will take place at NIOZ after the cruise.

## 2.2 CTD measurements and rosette sampling (H.M. van Aken)

A Seabird Electronics (SBE) 9/11+ CTD (SN 0790) was used to measure hydrographic profiles. The CTD was mounted in the centre of a rack, fitted with a rosette sampler and sampler bottles. A 24 position rosette sampler (SBE) was used, fitted with 10 litre Niskin sampler bottles (Ocean Test Equipment, Inc.).

For the data collection the new Seasave software for Windows (V 5.28c), produced by SBE, was used. The CTD data were recorded with a frequency of 24 data cycles per second. After each CTD cast the data were copied to a hard disk of the ship's computer network, and a daily back-up copy was made.

On board the up-cast data files were sub-sampled to produce files with CTD data corresponding to each water sample, taken with the rosette sampler. The CTD data were processed with the preliminary calibration data, and reduced to 1 dbar average ASCII files. These were used for the preliminary analysis of the data. Full data processing with the final calibration values will be completed at NIOZ, Texel.

Mounted on the CTD-rack was a high precision SBE35 reference temperature sensor, SN 0019, which recorded the temperature every time a sampler was closed. These date will be used for the control and/or the calibration of the CTD temperature sensor, SN 4778.

On sampler bottles 3 and 9 thermometer racks were mounted, fitted with Sensore Instrumente Systeme GmbH (SIS) reversing electronic 6000X pressure sensors. On deck, prior to the CTD cast, these pressure sensors corrected internally for zero pressure. The readings of the SIS sensors are used to control, and if necessary to correct the calibration of the CTD pressure sensor.

Water samples for the salinity determination were collected in vertically homogeneous parts of the water column. After 3 times rinsing water was drawn from the samplers into a 0.25 litre glass sample bottle for the salinity determination. The sample bottles had a stopper as well as a screw lid. The salinity of water samples was determined on board by means of a Guildline Autosal 8400B salinometer. The salinometer was installed in a laboratory container, fitted with an air conditioning system. This kept the surrounding air temperature constant within 1°C. The salinity data will be used to check the calibration of the CTD conductivity sensor (SN 043263).

Additional to the CTD sensors, sensors for the determination of optical backscatter (Seapoint, SN 1728), fluorescence (Chelsea, SN 88026) and oxygen (SBE, SN 0431141) were mounted in the CTD rack. The data of these sensors were relayed, via the CTD, tot the CTD computer, and were stored synchronous with the CTD data.

A preliminary analysis of the SIS pressure sensors suggested that on average the CTD-pressure was 1 dbar (±1 dbar st. dev) too low. (N=79). Since this is well below the specifications no pressure correction is proposed.

A preliminary comparison of the CTD temperature with the temperature measured with the SBE35 reference thermometer revealed that on average the CTD temperature was only 0.0006 (±0.0014)°C to high. Since this is a very small deviation, well below the specifications of the CTD, no temperature correction is proposed.

A preliminary comparison of the CTD salinity with the salinity of only water samples, measured with the Guildline 8400B salinometer, suggested that the CTD salinity is about 0.0003 (±0.0009) too low (N=17).

Given the manufacturers specifications and the accuracy of the standard water, no salinity correction will therefore be applied to the CTD salinity.

Comparison of the water sample oxygen concentration with the CTD oxygen concentration indicated that with a linear correction of the CTD oxygen concentration will result in accurate CTD oxygen concentrations with a standard deviation below 2.2 μmol/kg.

## 2.3 Dissolved oxygen measurements (S. Gonzalez)

For the determination of dissolved oxygen concentration, water samples were drawn into pre-calibrated 120 ml pyrex glass bottles. Before drawing the sample, each bottle was flushed with at least 3 times its volume. The determination of the volumetric dissolved oxygen concentration of water samples was carried out by measuring the formed Iodine colour at 460nm on a Traacs 800 continuous flow spectro-photometer, combined with a stand-alone NIOZ-made sampler, based on the Winkler technique (see Su-Chen Pai et al., Marine Chemistry 41 (1993), 343-351). Immediately after acidification, all bottles were covered with parafilm against evaporation and shielded with PVC caps to prevent light-induced Iodine formation. A stock solution of $KIO_3$ was used in the analysis spiked to seawater blanks (reversed order addition of the Winkler chemicals) to obtain a calibration line, with an $R^2$=1.0000 for 4 calibrants in each run, for calibrating the spectrophotometer. The stock solution was stored in an airtight water-saturated box (100% humidity) to prevent evaporation.

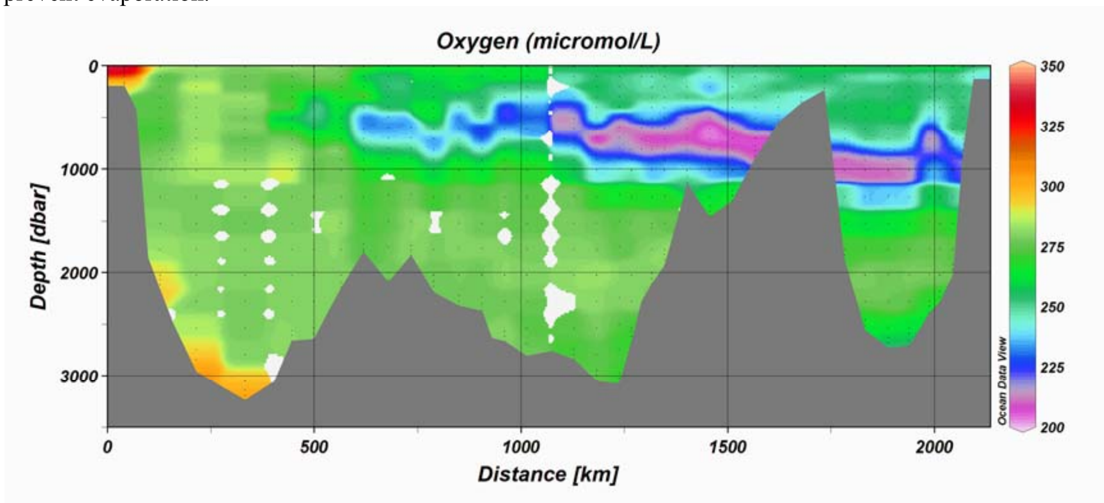



*Figure 4. Dissolved oxygen concentration*

At some cast duplicate samples were taken from the shallowest Rosette-bottle, in order to determine the inter variability between the daily runs. Gain-drift of the spectrophotometer was corrected by the used software. To obtain accuracy in between the runs a reference sample was measured, drawn from a large volume of saturated ocean water (50 l container) bottled according to Winkler. The reference yielded a narrow band signal of ± 1 μMol on a level of 234 μMol $O_2$ between the runs and better than 0.20 μMol within a run. From the volumetric oxygen concentration in μMol/dm$^3$ the densimetric oxygen concentration in μMol/kg was determined by dividing the sample density at sample temperature and salinity.

## 2.4 DIC and Total Alkalinity (S. van Heuven, A. Hoogstraten and H. Zemmelink)

Seawater subsamples of 0.6 L were collected from the Niskin bottles at different depths and analyzed (unpoisoned) within 1-12 hours for total dissolved inorganic carbon and alkalinity using a VINDTA-3C system (designed and built by Dr. L. Mintrop, Marine Analytics and Data, Germany).

Dissolved inorganic carbon ($TCO_2$) was determined by coulometry from a 20 ml subsample, following the method developed by Kenneth Johnson (Marine Chemistry, 1981). An automated extraction line takes a volumetrical subsample which is acidified with 8.5% phosphoric acid ($H_3PO_4$) to decrease the pH and convert all DIC to $CO_{2,aq}$. The gaseous $CO_2$ is stripped from solution using nitrogen gas and the carrier gas is led into a coulometric titration cell. This cell contains a solution of dimethylsulfoxide, ethanolamine and the colourimetric indicator thymolphtalein. The irreversible reaction of the $CO_2$ gas with the ethanolamine generates hydroxyethylcarbamic acid which in turn gives a color change of the dark blue indicator. The fading of the color is detected photometrically. During the electrochemical titration the hydroxyethylcarbamic acid is neutralized by $OH^-$ ions. The titration current is integrated over the duration of the titration and from that the concentration of DIC is calculated.

Total alkalinity (or titration alkalinity) was determined by potentiometric titration of 100 ml samples with 0.1 M HCl. From the titration curve the total alkalinity (TA) was calculated using a curve fit function, quite analogous to the modified Gran procedure.

The precision of both TA and $TCO_2$ was determined from duplicate analysis on a number of samples. The accuracy was set several times per day by running certified standards made available by Dr. A. Dickson of the Scripps Institution of Oceanography (USA).

## 2.5 Chlorofluorocarbon sampling (S. van Heuven, A. Hoogstraten and H. Zemmelink)

For the CFC-tracer group of the Insitut Fur Umweltphysik in Bremen, Germany, several hundreds of chlorofluorocarbon (CFC) samples were collected. Samples of ~100 ml were flame sealed in glass ampoules, without any contact with the atmosphere, using an simple but ingenious sample collection and storage system. Sampling grid is nearly identical to that of samples for DIC/TAlk samples, however with a reduced resolution in the upper 1000 meters.

Analysis of these samples in Bremen later this year will likely result in an accurate, high spatial resolution dataset of CFC-11 and CFC-12 as anthropogenic tracers.

## 2.6 Nutrient measurements (E. van Weerlee)

From all Rosette bottles samples were drawn for the shipboard determination of the 3 nutrients silica, nitrite+nitrate and phosphate. The samples were collected in polyethylene sample bottles after three times rinsing. The samples were stored dark and cool at 4°C. All samples were analysed within 18 hours with an autoanalyzer based on colorimetry using a BRAN&LUEBBE QUAATRO autoanalyzer. The samples, taken from the refrigerator, were directly poured in open polyethylene vials (6ml) and put in the auto sampler-trays. A maximum of 60 samples in each run was analysed. The different nutrients were measured colorimetrically as described by Grashoff (1983).

- Silicate reacts with ammoniummolybdate to a yellow complex, which, after reduction with ascorbic acid forms a blue silica-molybdenum complex that was measured at 800nm (oxalic acid was used to prevent formation of the blue phosphate-molybdenum).
- Phosphate reacts with ammoniummolybdate at pH 1.0, and potassiumantimonyltartrate was used as an inhibitor. The yellow phosphate-molybdenum complex was reduced by ascorbic acid to a blue complex and measured at 880nm.
- NO3+NO2: Nitrate was mixed with the buffer imidazole at pH 7.5 and reduced to nitrite by a copper-coated cadmium coil (efficiency > 98%), and measured as nitrite. Nitrite was diazotated with sulphanilamide and naftylethylenediamine to a pink coloured complex and measured at 550nm. The reduction efficiency of the cadmium column was measured in each run.

Calibration standards were prepared by diluting stock solutions of each nutrient in the same nutrient depleted surface ocean water as used for the baseline water. The standards were kept dark and cool in the same refrigerator as the samples. Standards were prepared fresh every day. Each run of the system had a correlation coefficient for the standards of at least 0.999. The samples were measured from the surface to the bottom to obtain the smallest possible carry-over-effects. In every run a mixed control nutrient standard containing silicate, phosphate and nitrate in a constant and well known ratio, the so-called nutrient-cocktail, was measured, as well as control standards sterilised in an autoclave or gamma radiation. These standards were used to check the performance of the analysis and the gain factor of the autoanalyzer channels (see table below). The results of analysis of the nutrient-cocktail during the cruise is:

| **nutrient-cocktail** | PO4 | NOx | Si |
|---|---|---|---|
| Average | 0.859 | 13.87 | 13.92 |
| Standard deviation | 0.008 | 0.098 | 0.11 |
| range in uM | 0-1.61 | 0-25.01 | 44.01 |

The autoanalyzer determined the volumetric concentration (μMol/dm$^3$) at a temperature of 24°C. In order to obtain the densimetric concentration in μMol/kg, the volumetric concentrations were divided by the density of sea water at 24°C, at sample salinity and zero sea level pressure.

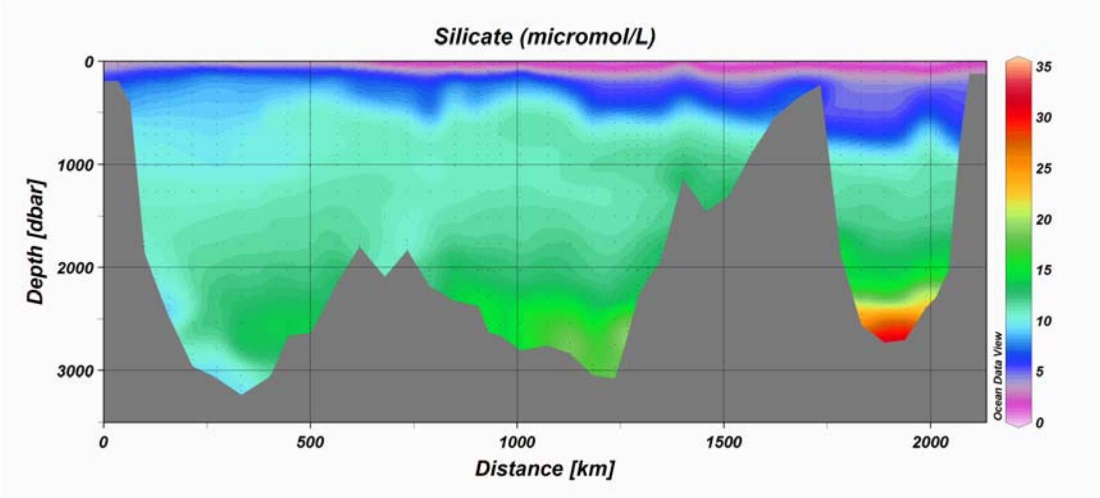



*Figure 5. Dissolved silicate*

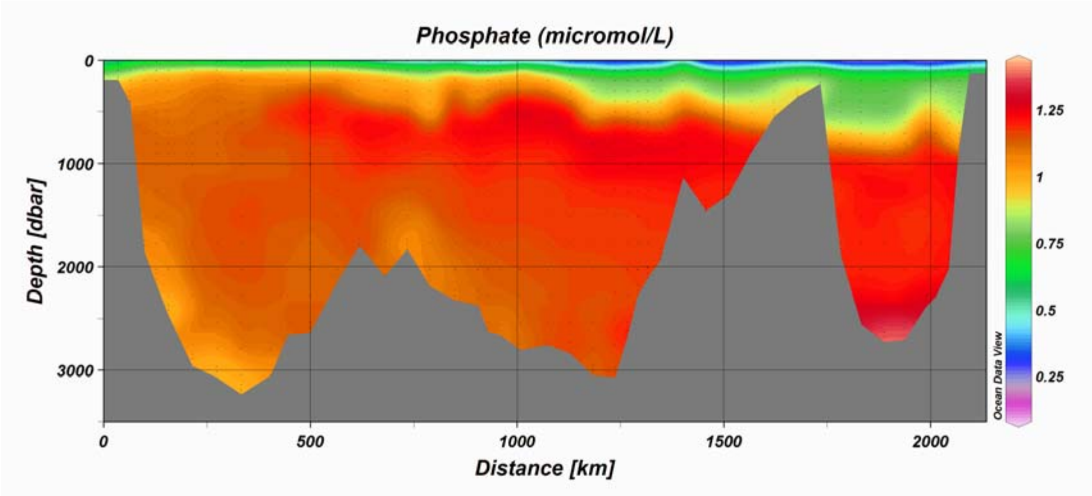



*Figure 6. Dissoved phosphate*

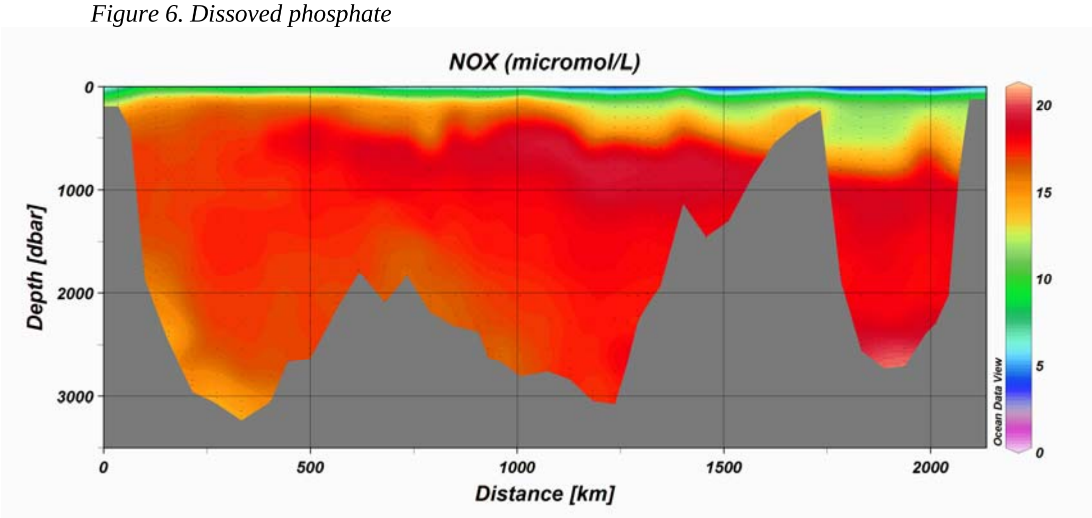



*Figure 7. Dissolved nitrate*

# 3 Moored instrumentation for time-series measurement

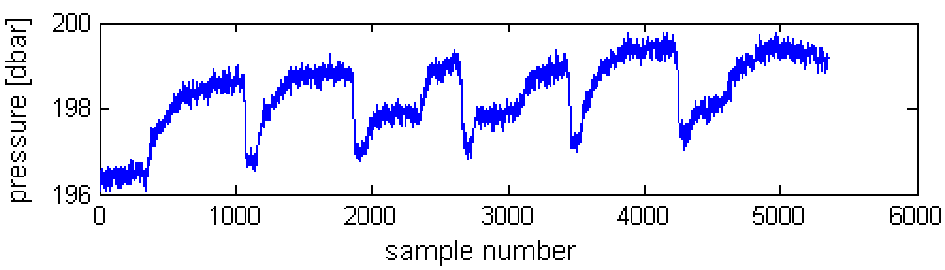
## 3.1 LOCO profiler/ADCP moorings (M.F. de Jong, H.M. van Aken)

Two LOCO moorings, which are part of the dutch Long-term OCean Observations program, were recovered and re-deployed in the Irminger Basin. The moorings are positioned at approximately 36 and 39 degrees West on the 3000 m isobath (precise recovery and deployment positions can be found in the cruise summary). The moorings sample the local hydrography and its day-to-day variability in the center of the Subpolar Gyre (39°W) and near the front of the Irminger Current (36°W).

The 3D velocity fields 100m below the surface and 500m above the bottom are observed with Long Ranger Acoustic Doppler Current Profilers (ADCPs). These instruments send out 75 kHz signals through its four “ears” (see photo). These signals are reflected by particles in the water, which move along with the local currents. The time delay between sending and receiving the signal is an indication of the distance of the reflecting particle from the instrument, while the phase change of the sound pulse cause by the Doppler shift is related to the speed of the particle. The slight angle between the four ears and recorded instrument tilt and orientation allows for a decomposition of the measured velocity in x, y and z coordinates relative to (the magnetic) North.

The four deployed ADCPs are set to record sample averages in 20 min intervals with 12 measurements per sample. The vertical resolution of the instruments is set at 74 bins of 8m thickness, resolving the velocity profile for a maximum of 592m of the water column.

McLane Moored Profilers (MMPs) record daily hydrographic profiles between approximately 150 and 2400m. One MMP, ballasted to the density at mid-profile, is attached to each mooring between two physical stops (bumbers). Each day the MMP moves either up or down the mooring propelled by an electric egine driving a wheel held tightly to the cable by a strong spring. While moving at a maximum speed of 25 cm/s the MMP records temperature, conductivity and pressure at 1.83 Hz. The observed pressure is regularly checked agains its programmed stop levels, shutting the instrument down when the intended end depth of the profile is reached. When the MMP encounters an obstruction on the cable outside of its intended stop depth it tries to overcome the obstacle by moving slightly back and hitting the obstacle. When a maximum of 6 such attempt has been reached the intruments shuts down and starts a profile from this depth the next day. The figure below shows the pressure record of the MMP of LOCO 3-2 trying to overcome an obstacle at 200 dbar depth.




## 3.2 Sediment trap moorings (L.P. Jonkers, G.J.A. Brummer)

During cruise 64PE275 sediment trap mooring IRM-4 at 59°14.85N 39°39.47W was successfully recovered on September 11, 2007. The mooring was deployed next to CTD-profiler/ADCP-mooring LOCO 02-4 during RV Discovery's cruise D309/10 on October 2, 2004. It consisted of two Technicap PPS-5/2 sediment traps (24 cups), one mounted in a bottom frame at 2989 m depth, the other at 238 m above the bottom, both with a collecting area of 1.0 $m^2$ and provided with a 1.5 cm honeycomb baffle. In addition, each sediment trap was provided with a sensor package for recording trap tilt, ambient pressure, temperature, and optical back scattering (OBS), a measure of turbidity, logging the data every 6 minutes. Both traps completed their pre-programmed sampling programme, which started on September 5, 2006 at 01:00 UCT with 17 intervals of 16 days intervals followed by 6 intervals of 8 days and a final interval of 16 days, thus ending on August 7, 2007. Both sensor packages performed flawlessly. Immediately after recovery and in set intervals, subsamples were taken of the supernate solution from the collecting cups and filtered for shipboard analysis of dissolved silica and phosphate in order to determine chemical dissolution and physical diffusion fluxes.

Following servicing of the traps, sensors and releases, the mooring was redeployed as IRM-5 at 59.2457°N 39.66322°W, water depth 3038 m alongside the LOCO 02-5 mooring on September 11 2007. Configuration of the mooring was the same as for IRM-4. Rotation schemes of both traps are given in the appendix. Sample cups of the bottom trap were filled with seawater collected near the deployment depth of the traps and near the actual deployment site, to which a biocide ($HgCl_2$; end-concentration 1.9 g $l^{-1}$) and a pH-buffer ($Na_2B_4O_7{\cdot}10H_2O$; end concentration 1.9 g $l^{-1}$) were added, supplemented by milliQ-water. A blank sample was taken for later comparison with the actual collecting cups to determine chemical dissolution fluxes. As for IRM-4, each sediment trap was provided with a sensor package for recording trap tilt, ambient pressure, temperature and turbidity by optical back scattering (OBS), logging the data every 6 minutes. Furthermore, two current meters were fitted to the mooring line, one 2 m below the topmost trap, the other 10 m above the bottom trap, that were set to 30 minutes measuring intervals.

## 3.3 BOBO-lander deployment (L.P. Jonkers, G.J.A. Brummer)

As part of the VAMOC-programme, a BOBO-type seabed observatory was deployed on Gardar Drift (Fig. xxx). At the specific site present sedimentation rates amount up to 2.3 mm/yr (Boessenkool et al., 2007). Sediments consist dominantly of resuspended lithogenous matter that is transported within the Iceland-Scotland Overflow waters. The results of this lander deployment are expected to provide new insights into the development of drift deposits and will be used for proxy calibration. The deployment is scheduled to last a full year.

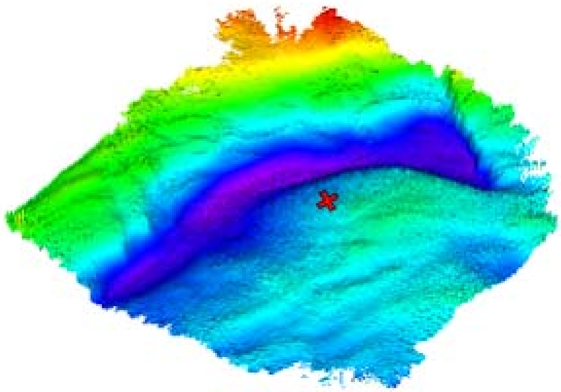


*Figure XXX. Multibeam image of bottom topography at deployment site of BOBO seabed observatory.*

The BOBO-lander was modified for this study. To prevent the lander from sinking into the very soft sediments the weights were not attached directly to the frame, but with a 1 metre rope. In this way the weight are hoped to sit on the top of the more consolidated sediments, while the lander is at the sediment water interface. An ADCP, in the original design downward-looking, was placed on top of the lander to monitor current speeds and directions in an approximately 20 metres thick layer above the lander. Measurements are programmed to be carried out every 15 minutes. The lander is fitted with three Technicap PPS xxx sediment traps, providing a one-year long record of sediment fluxes at 11-day resolution.

Additionally, two turbidity sensors are mounted on the frame at 1.0 and 3.0 meters from its base. A CT sensor is placed in the upper part of the lander. Conductivity, temperature and turbidity measurements will be made every 15 minutes. A passive sampler for organic contaminants (# 28) was mounted in the upper frame of the BOBO-lander. It contains three different plastic membranes with a high affinity for organic contaminants that are typically in the low pg/L range, which are rapidly taken up as a function of temperature and flow, i.e. silicone, double layered LDPE and trioleine coated SPMD. These are used to determine the background concentrations in the Iceland-Scotland overflow bottom water in relation to adsorption on near-bottom sediment (re)suspensions and possibly sediment accumulation through anthropogenic times. The sampler cage was kept covered in aluminium foil at -20°C, as the membranes are very efficient air samplers as well, which was removed after mounting, immediately prior to deployment.

The lander was lowered to the sea floor using a cable to ensure exact positioning. Deployment on September 9 failed due to malfunction of one of the acoustic releases, fortunately the lander could be recovered immediately and it was subsequently successfully deployed on September 16.

# 4 Sediment coring (L.P. Jonkers, G.-J.A. Brummer)

A novel element on the monitoring transect was the coring of bottom sediments carried out within the VAMOC-programme. Three coring techniques were applied.

1. Monocoring uses a completely new experimental device designed at NIOZ to take small 5.4 cm diameter cores of up to 30 cm in length from muddy sediments (fig. XX). It weighs about 15 kg and replaces the bottom switch weight on the CTD on an extended 12 m rope, penetrating the sediment as a gravity corer enhanced by the about 30 m/min lowering speed of the CTD as it approaches the ocean floor. It was derived from the Multicorer, in that two lids are closed upon tripping, one at the bottom to keep the core inside the liner, the other at the top to seal off the bottom water and thus to prevent flushing of the core during the upcast of the CTD and preserve the sediment-water interface. After a first successful test of the Monocorer at ocean depth in the LOCO-mooring area (Irminger Sea), it was standardly fitted to the CTD to assess the variability in sediment accumulation and composition along the entire transect. Upon recovery, the bottom water on top of the sediment was sampled for nutrients (syringe, 0.2um Acrodisc-filtered) for comparison with the CTD's bottom water. The upper 10 cm of sediment was subsampled in 0.5 cm thick slices, and in 1.0 cm slices further down.

2. Multi-coring uses the conventional Multicorer-technique employed for years now by NIOZ to collect sediment cores with an intact sediment-water interface for biogeochemical studies. The Multicorer was fitted with 2*4 polycarbonate coring cylinders of 6.3 cm in diameter, opposite of 2*2 of 9.0 cm in diameter, all 62 cm in length. Up to 4 of the smaller diameter cores were transferred into PE-tubes of the same inner diameter for subsequent XRF-corescanning at NIOZ, the others were subsampled in 0.5 cm thick slices, either entirely or only the upper 10 cm and in 1.0 cm slices further down.

3. Gravity-coring used the piston-corer set-up with a 1500 kg weight on top but without the trip-corer, exchanging the piston for a back-flushing valve fitted inside the liner, and with a modified core-catcher in order to not disturb the stratigraphy in the water saturated sediment in the Gardar Drift sediment where it was

used. The core liners (2 segments of 6 meters in length, 11 cm in diameter) were cut into 1 meter sections, and measured for magnetic susceptibility.

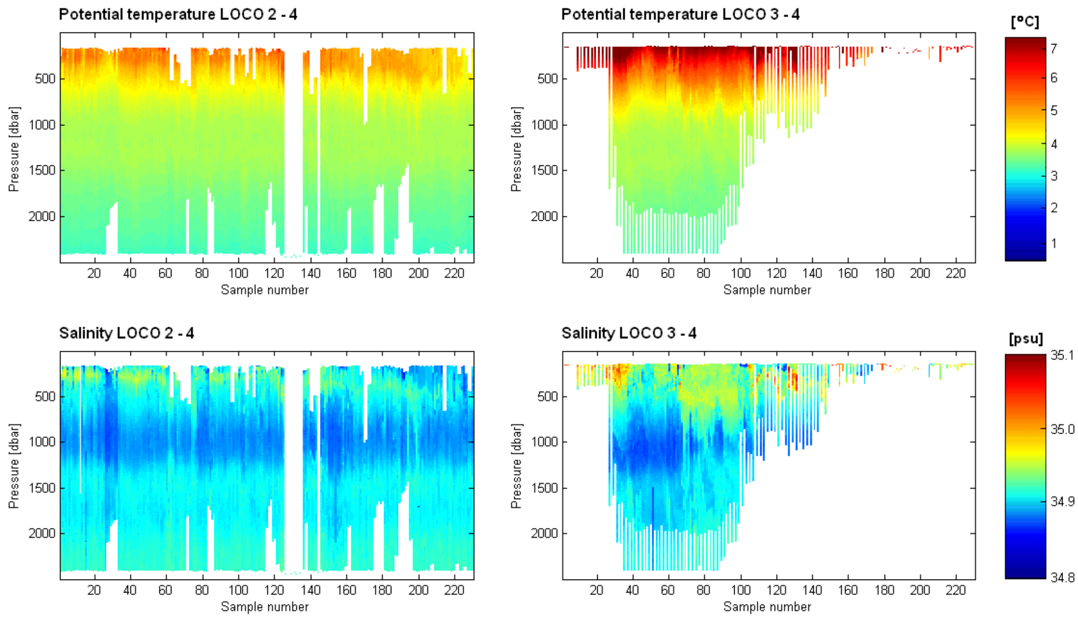
## 5 Data Management (M. Hiehle, H.M. van Aken)

All raw data were copied to a cruise directory on the network computer in different groups of sub-directories. Hydrographic and mooring data were already partly processed on board. Subsequent processed data, final products, documents and figures were copied to separate sub-directories within the cruise directory. Back ups of the network disks were made on a daily basis. At the end of the cruise copies of the whole cruise directory have been made on a portable hard-disk, which is brought to the NIOZ data management group for archiving directly after the cruise. By help of paper measurement forms and computerized data inventory files all activities and data were tracked. A final overview of the mooring activities, sediment sampling, hydrographic stations, water samples, and the available raw data and samples was made in a cruise summary file (Appendix A).

## 6. Preliminary results

### 6.1 The McLane Moored Profilers

The MMP attached to the LOCO 2-4 mooring functioned properly for 230 consecutive days after which its batteries were depleted. After some initial problems in the first month of its deployment the MMP attached to the LOCO 3-4 mooring started to record hydrographic profiles down to 2400 dbar depth. However, it did not remain at this depth while the MMP was turned off, but floated several hundreds meters upward while it waited for the upward profile start on the next day. After recording reasonably deep profiles for two months the MMP encountered obstacles on the cable at increasingly shallower depths, which it could not overcome. The MMP continuously tried to overcome the obstacle recording very short profiles until day 372 and recorded profile 373 on board the night after recovery. Possibly the remnants of a fishing line were causing the permanent obstruction, but no such line was encountered during the recovery of the mooring.




The preliminary data of both profilers are depicted in the figure above. The left column shows the potential temperature and salinity profiles from the LOCO 2-4 mooring located in the center of the Subpolar Gyre. The right column shows the first 230 profiles from the LOCO 3-4 mooring located near the front of the Irminger Current. The figure is an illustration of variability at various time scales. At the LOCO 2-4 location at about 1700 dbar the last remnants of the 1994 vintage of relatively fresh Labrador Sea Water are subject to salinification by mixing along isopycnals of more saline ambient waters. Around 1000 dbar the Labrador Sea Water formed in the Labrador Sea in 2000 is slowly increasing in salinity, but also shows a significant seasonal cycle with the minimum in salinity observed around day 150 (24 January) at mid winter. Such a seasonal cycle was also observed during the three previous deployments at this location. Mesoscale variability, on time scales of several day to weeks, can be seen at both locations but most strongly near the Irminger Front. Shifting of the location of the front and shedding of eddies are causes of such variability. Day-to-day thermohaline variability is important at both locations, most likely caused by advection along isopycnals.

**Hydrography**

At the end of the cruise the data were available in raw form and in partially processed form, but without final calibrations applied. From these data preliminary sections of potential temperature and salinity were plotted (Figures 10 and 11). The potential temperature and salinity at a pressure of 500 dbar can be compared with the results for the CAMP survey in the summer of 2000 (Figure 12).

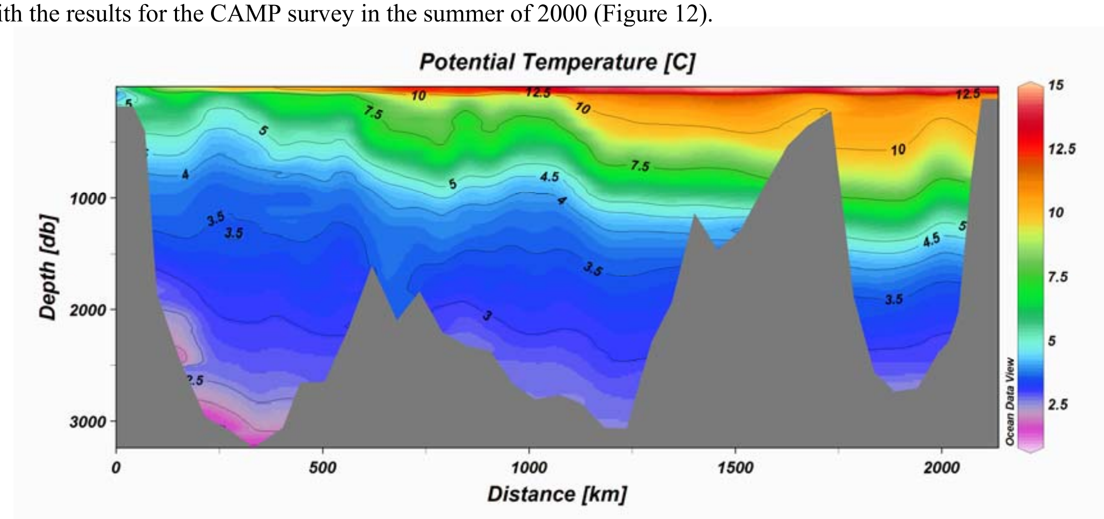



*Figure 10. The vertical distribution of the potential temperature along the former WOCE A1E section observed during the CAMP survey in 2007.*

The distribution of the potential temperature along the A1E section (Figure 10) shows the customary picture with the main mass of warm water in the eastern half of the Atlantic ocean. At ~35ºW a front is encountered in the upper 1000 dbar, which separates the water of the Irminger Current from the colder waters in the centre of the Irminger Basin. An eddy like structure seems to be visible between 35ºW and 32ºW. At approximately 27ºW the Sub-Arctic front is encountered which forms the western boundary of the North Atlantic Current in the Iceland Basin. In the deep layers the cold overflow water from Denmark Strait is found over the continental slope off Greenland ($\theta < 1.5$ºC). In the Iceland Basin the overflow water originating from the sills between Iceland and Scotland can be observed over the eastern slope of the Reykjanes Ridge ($\theta < 2.5$ºC).

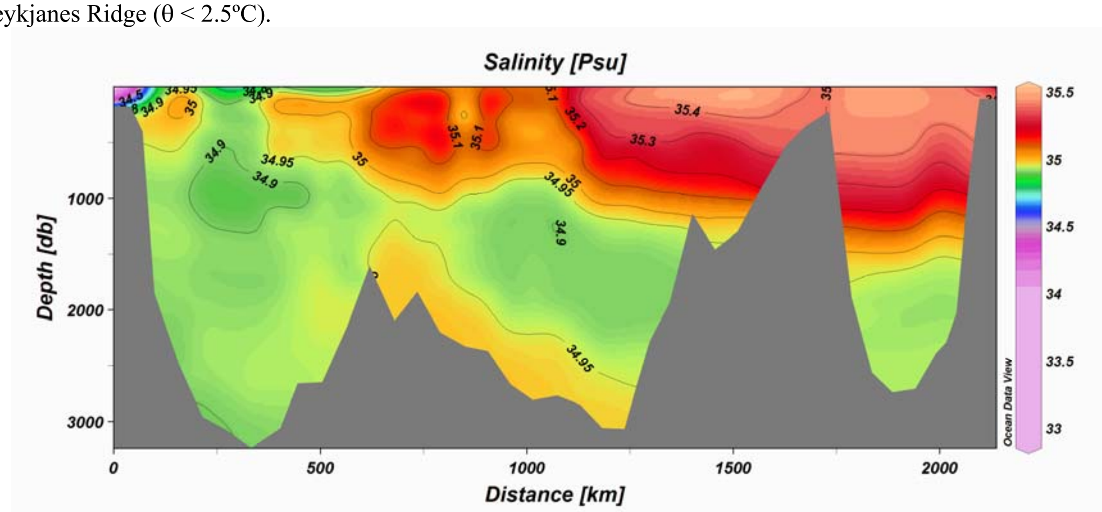


*Figure 11. The vertical distribution of the salinity along the former WOCE A1E section as observed during the CAMP survey in 2007.*

The distribution of the salinity along the A1E section (Figure 11) shows that in the upper 1000 dbar the temperature fronts, mentioned above, coincide with salinity fronts. In the Irminger Basin at intermediate levels the two low salinity cores of "Labrador Sea Water" near 800 and 1600 dbar, also encountered in 2000 are still present. Their salinity seems to have not significantly increased since then, but in contrast to 2003. There is a weak indication of an isolated body of saline water (S > 34.90) probably originating from a meso-scale eddy, is found in the centre of the Basin, like in 2003. The Labrador Sea water in the Iceland Basin and the Rockall Channel still show a single low salinity core near respectively 1800 and 2000 dbar.

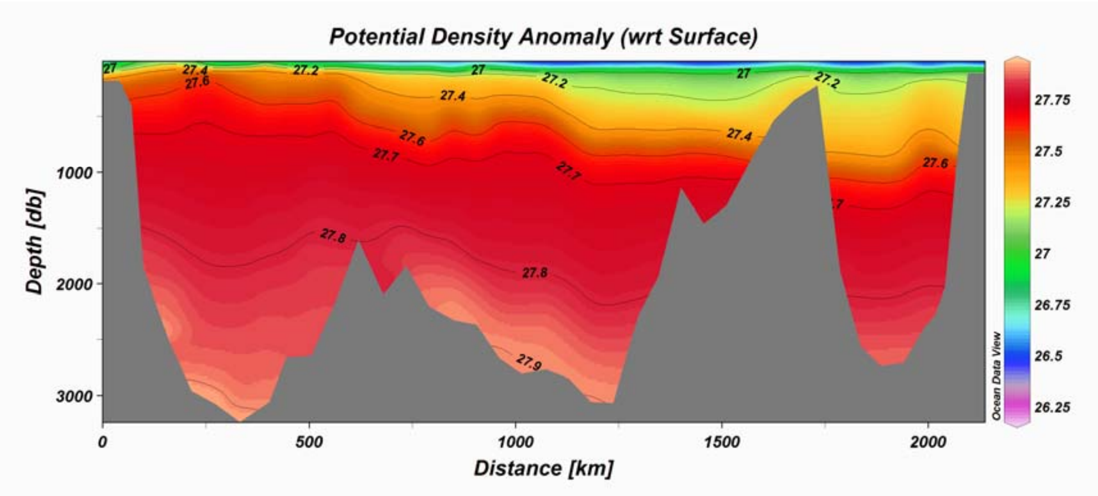



*Figure 11. The vertical distribution of the potential density anomaly along the former WOCE A1E section as observed during the CAMP survey in 2007.*

## **DIC and Total Alkalinity** (S. van Heuven, A. Hoogstraten and H. Zemmelink)

The concentrations of dissolved inorganic carbon (CT, Fig.8a) vary slightly with depth in the water column. Lowest values, around 2070 μmol $kg^{-1}$, are found in the surface waters. The Irminger Sea, characterized by Labrador Seawater reveals a homogeneous distribution of around 2160 μmol $kg^{-1}$ with similar values in Denmark Strait Overflow Water at the bottom. CT values increase towards the Rockall Plateau and in the Rockall Through, with highest values in North East Atlantic Deep Water at the bottom and in the North Atlantic Current Water around 1000 m depth.

Total alkalinity (AT, Fig.8b) shows low values (~ 2270μmol $kg^{-1}$) in the relative fresh water close to Greenland. Alkalinity concentrations in the Irminger Sea are homogeneously distributed, while towards the East concentrations increase, with highest values in North Atlantic Current Water between 1000 m and the surface.

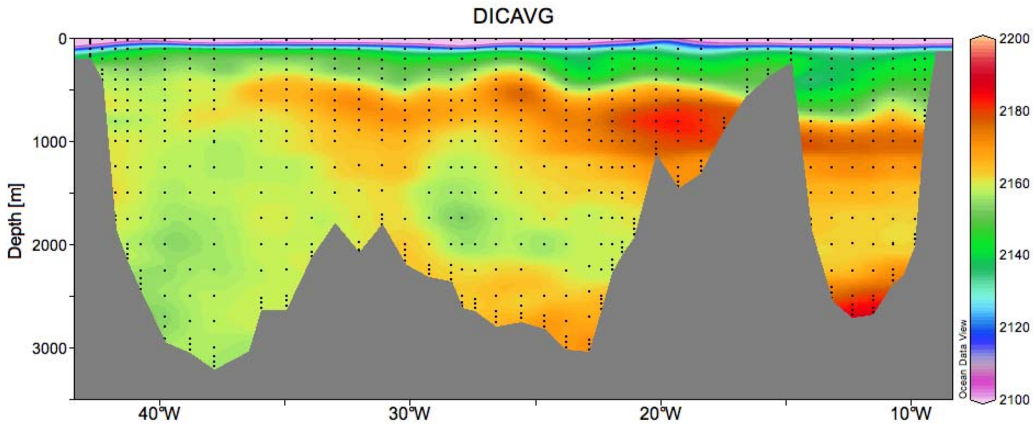



*Figure 8-. Preliminary figures of the distribution of (**a**) dissolved inorganic carbon (CT) and (**b**) total or titration alkalinity (AT) along the former WOCE AE1 section, using the data collected during this cruise.*

## Particle fluxes

Contrary to previous years both traps functioned properly. Intercepted amounts of sediment were extraordinary low, in contrast to the years before. The preliminary sediment fluxes in shallow IRM-4 A trap (Fig. x1) show a clear period of increased fluxes, starting early in June 2007 and lasting until July 2007. This period coincides roughly with the North Atlantic (diatom)bloom. Otherwise fluxes are low and more or less constant. In the bottom sediment trap intercepted amounts were too small to reliably determine a flux estimate. Only during the first collecting interval fluxes were higher, reaching values in excess of the maximum bloom fluxes in the upper trap.

Macroscopic swimmers of up to a few cm were detected in the shallow trap. The ammonium and pH data of the sample solution in both traps suggest that biocide concentrations were sufficient to prevent biological decay of organic matter.

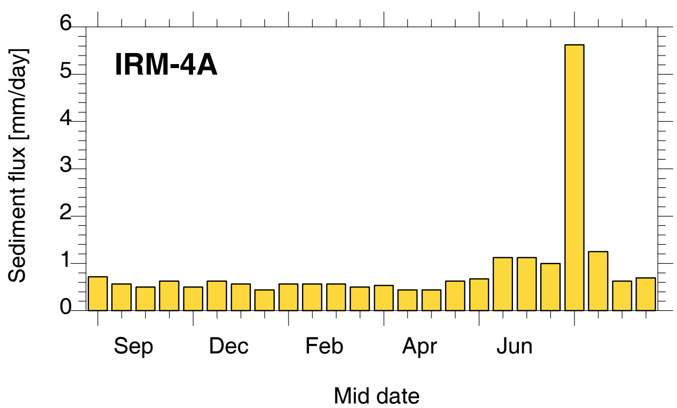



Figure x1: approximate sediment fluxes in trap IRM-4 A.

Dissolved $PO_4$, $NH_4$ and Si concentrations of the sample solution were measured within 2 hours after release of the mooring. Phosphate concentrations in IRM-4 A (Fig. x2a) generally vary between ~1 and ~40 µmol/L, with one peak (~140 µmol/L) in November. Apparently no clear trend is present in the phosphate concentrations, although it seems to be depleted just prior to the maximum sediment flux during bloom. Dissolved silica shows an irregular pattern with four peaks, the last one coinciding with the bloom period.

Values range from ~50 to ~650 µmol/L. Except for the first interval, phosphate and silica concentrations in IRM-4 B (Fig. x2b) are very low, approaching background concentrations. Sample 17 (May-June) was probably measured incorrectly and need to be repeated. To determine the dissolution of silica due to pressure release all solutions were re-sampled after 2, 4, 8, 16 etc. hours. No coherent change was observed in the samples from IRM-4 B that contained only little material. Of the other samples no change in the concentrations was observed after ~6 hours.

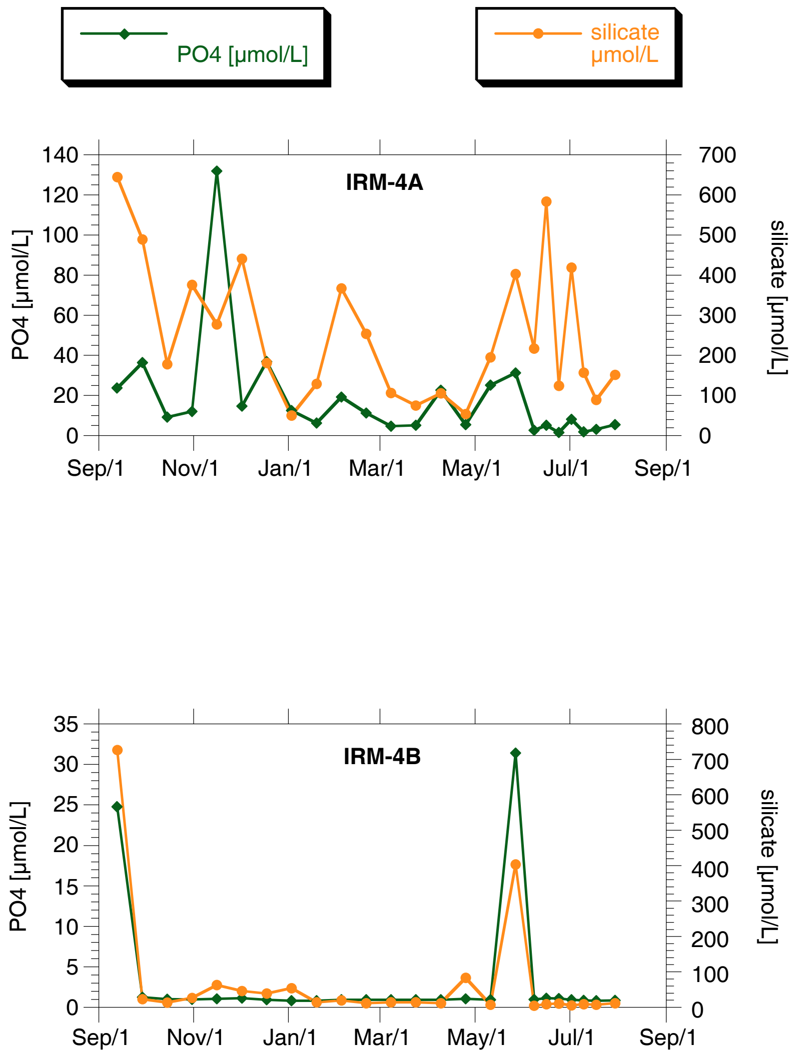



Figure x2: temporal patterns of dissolved silica and phosphate in the sample solution of traps IRM-4 A and B.

No current meter data are available yet as the recorder could not be read on board. As the data logger on IRM-4 A was mounted on the trap with an angle of ~6 º the tilt base line is shifted (Fig. x3a left panel), however no major changes in the tilt were observed during the deployment period. Variations in tilt angle show some cyclic variability, probably related to tidal movements, especially in the second half of the deployment period. OBS values (Fig. x3a left panel) show considerable variation, but do not seem to co vary with the sediment flux (Fig. x1). The extreme increase in OBS values end of July is probably caused by biofouling of the sensor. The trap sank vertically within 1 dbar during the deployment (Fig. x3a right panel). The temperature varied between ~2.5 and ~3 º C (Fig. x3a right panel). Visual inspection reveals no clear trend or cyclicity in this record.

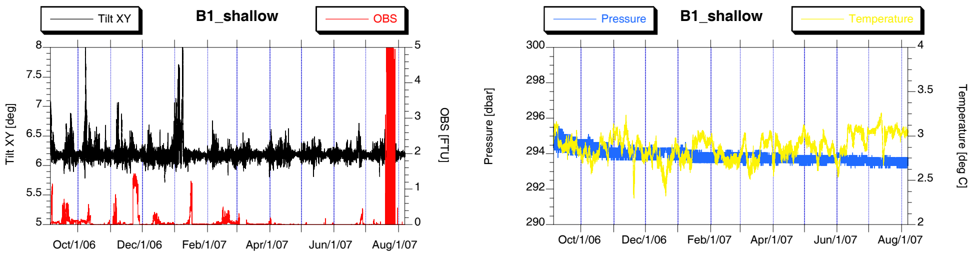



Figure x3a: sensor data IRM-4 A.

Tilt values of IRM-4 B (Fig. x4a left panel) are almost constant at 1 º, there is one short period with increased tilt angles (~2 º) in the beginning of January 2007. OBS values are low (Fig. x4a left panel), in accordance with the sediment fluxes. Pressure remains constant at ~326.5 dbar (Fig. x4a right panel), indicating that the trap remained at the ocean floor. Temperature at this depth is ~ 1.5 º C lower and variability is smaller (Fig. x4a right panel) than at 2750 m depth. The data suggest a small warming of bottom water temperature during deployment.

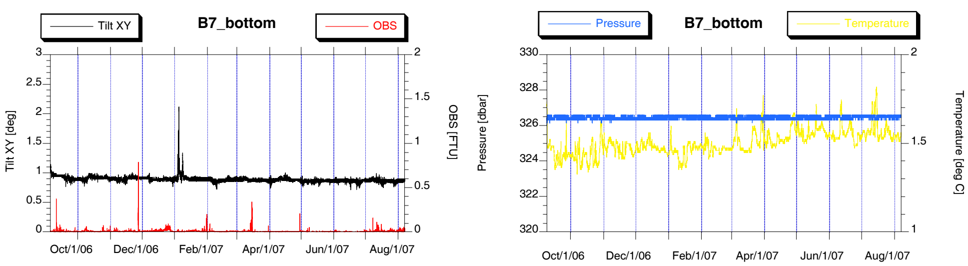



Figure x4: sensor data IRM-4 A.

For the first time in two years we have a synchronous record of both bottom and shallow sediment fluxes. Additionally we have obtained in situ sediments with the multicore. This opens new perspectives to better understand sedimentation processes and to link these to the actual geological record.

Samples will be analysed for dry bulk mass, organic matter (Corg, N), carbonate ($CaCO_3$), biogenic silica and lithogenic matter at Royal NIOZ, as well as for dissolved phases sampled shipboard. These will be followed by more specific analyses of bulk molecular, element and isotope composition, grain size distribution as well as analysis of specific particle groups and sizes, such as foraminiferal species and their element and isotope composition. The small amount of material however poses some limitations on the actual (number of) analyses that can be performed. The analyses are expected to inform on the provenance and magnitude of the intercepted fluxes, and be interpreted using the physical forcing conditions as measured by the instrumentation on the nearby LOCO 02-2 mooring alongside (current direction and strength, stratification and mixing, temperature, etc.).

## Sediment coring results

The Monocorer was used along the whole transect, which resulted in a total of 40 short cores (appendix x), a very encouraging result since the corer is an entirely new design. The device failed only in three cases; twice due to suspected coarseness of the sediments and in one case sediment was taken but flushed out on its way to the surface. The combined sediment and long-term hydrographic data will present a unique possibility for proxy calibration. Therefore future analyses will focus on the top few centimetres.

Figure xxx: multicore tubes from BOBO site.

Four multicores were taken (Table xxx). None of the cores showed signs of disturbance at the sediment-water interface. In some cores of 64PE275-30 cracks were visible at several depths, these were not stored.

Sediments of MC3 (Fig. xxx) will be used to complement the future BOBO dataset, the gravity core as well as to extend the ISOW flow intensity record of core RAPID-21-12B (Boessenkool et al., 2007). The cores taken at the sediment trap sites will (or will probably not) provide a link between the sediment fluxes as recorded by the traps and the actual geological record. Core 30 will be used to asses the performance of the newly designed monocorer.

| Station | Recovery (cm) | Short description | Remarks |
|---|---|---|---|
| 3 | 51 | Silty clay, very soft | BOBO site |
| 6 | 21 | Sandy clay, stiff | IRM-1 site |
| 9 | 28 | Sandy clay, stiff | IRM-2/5 site |
| 30 | 38 | Foram ooze | Monocore calib. |

Table xxx: multicores taken

Gravity coring at the Gardar drift site (64PE275-3) yielded one 9.2 m long core (excluding the barrel head). The sediments were only visually inspected during cutting of the liner in one-metre pieces, but the whole section appeared to consist of homogenous grey silty clay. The sediments in the top 2 sections are very soft due to the extremely high water content.

Variations in magnetic susceptibility (Fig. xxx) are small, but an overall decrease is clearly present in the data. Such a trend is not uncommon in cores from this region, but whether it reflects a true change in composition or is due to changes in the water content is not known.

Depth-to-depth correlation with core MD-xxxx (Ellison et al., 2006) at the same site suggests that the nine metres recovered span the last 5000 years.

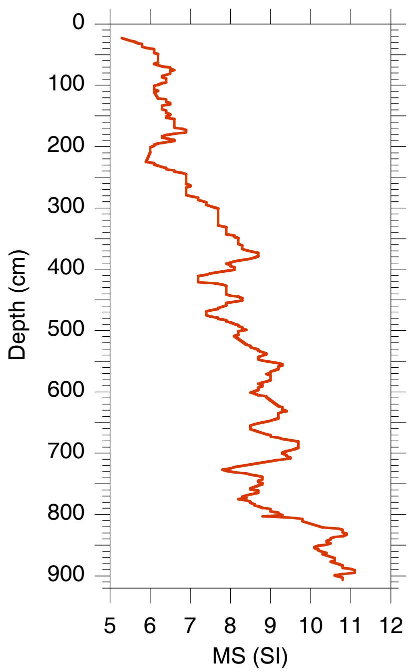



Figure xxx: magnetic susceptibility of gravity core 64PE275-3

## 5. Bird Observations (L. Jonkers)

A total of 20 bird species (see table below) were identified during the cruise. Observations were made irregularly and most time was spent on the open ocean.

| BIRD OBSERVATIONS | |
|---|---|
| 1: Lesser Black-backed Gull | 11: Great Shearwater |
| 2: Arctic Tern | 12: Sooty Shearwater |
| 3: Gannet | 13: Leach's Storm-petrel |
| 4: Great Skua | 14: Chiffchaff |
| 5: Pomarine Skua | 15: Cory's Shearwater |
| 6: Sabine's Gull | 16: Kittiwake |
| 7: Sand Martin | 17: Northern Wheatear |
| 8: Grey Pharalope | 18: Arctic Skua |
| 9: Northern Fulmar | 19: Iceland Gull |
| 10: Manx' Shearwater | 20: Glaucous Gull |

*Fig. XXX. Great Shearwater, southwest of Ireland. The azure blue colour of the ocean water is caused by a bloom of the calcifying alga Emiliania huxleyi*

## 6. Acknowledgements

The hydrographic research reported here is part of the Royal NIOZ contribution to the Dutch CLIVAR programme (CLIVARNET). The LOCO moorings were funded by NWO via the large investments funding programme. The sediment trap mooring and associated biogeochemical flux research were carried out within VAMOC as part of RAPID, a collaborative framework funded by NWO-ALW, NERC (UK) and the Norwegian Science Foundation.

I thank the ships captain and crew as well as NIOZ technicians for their professional support and active participation in the preparation and execution of the research programme during this cruise. The contributions of the colleagues from the NIOZ science departments and from the supporting engineering and administrative departments are highly acknowledged.

27 September 2007

Geert-Jan Brummer

Chief Scientist

| | Date UTC | Collecting interval |
|---|---|---|
| start sample #1 | 5/Sep/06 01:00 | |
| start sample #2 | 21/Sep/06 01:00 | 16.0 |
| start sample #3 | 7/Oct/06 01:00 | 16.0 |
| start sample #4 | 23/Oct/06 01:00 | 16.0 |
| start sample #5 | 8/Nov/06 01:00 | 16.0 |
| start sample #6 | 24/Nov/06 01:00 | 16.0 |
| start sample #7 | 10/Dec/06 01:00 | 16.0 |
| start sample #8 | 26/Dec/06 01:00 | 16.0 |
| start sample #9 | 11/Jan/07 01:00 | 16.0 |
| start sample #10 | 27/Jan/07 01:00 | 16.0 |
| start sample #11 | 12/Feb/07 01:00 | 16.0 |
| start sample #12 | 28/Feb/07 01:00 | 16.0 |
| start sample #13 | 16/Mar/07 01:00 | 16.0 |
| start sample #14 | 1/Apr/07 01:00 | 16.0 |
| start sample #15 | 17/Apr/07 01:00 | 16.0 |
| start sample #16 | 3/May/07 01:00 | 16.0 |
| start sample #17 | 19/May/07 01:00 | 16.0 |
| start sample #18 | 4/Jun/07 01:00 | 16.0 |
| start sample #19 | 12/Jun/07 01:00 | 8.0 |
| start sample #20 | 20/Jun/07 01:00 | 8.0 |
| start sample #21 | 28/Jun/07 01:00 | 8.0 |
| start sample #22 | 6/Jul/07 01:00 | 8.0 |
| start sample #23 | 14/Jul/07 01:00 | 8.0 |
| start sample #24 | 22/Jul/07 01:00 | 8.0 |
| end sample #24 | 7/Aug/07 01:00 | 16.0 |

Table x1: rotation scheme for moored sediment traps IRM-4 A and B

| IRM-5 TRAP ROTATION SCHEME | Time UTC | Collecting interval |
|---|---|---|
| start sample #1 | 13/Sep/07 01:00 | |
| start sample #2 | 21/Sep/07 01:00 | 8.0 |
| start sample #3 | 7/Oct/07 01:00 | 16.0 |
| start sample #4 | 23/Oct/07 01:00 | 16.0 |
| start sample #5 | 8/Nov/07 01:00 | 16.0 |
| start sample #6 | 24/Nov/07 01:00 | 16.0 |
| start sample #7 | 10/Dec/07 01:00 | 16.0 |
| start sample #8 | 26/Dec/07 01:00 | 16.0 |
| start sample #9 | 11/Jan/08 01:00 | 16.0 |
| start sample #10 | 27/Jan/08 01:00 | 16.0 |
| start sample #11 | 12/Feb/08 01:00 | 16.0 |
| start sample #12 | 28/Feb/08 01:00 | 16.0 |
| start sample #13 | 15/Mar/08 01:00 | 16.0 |
| start sample #14 | 31/Mar/08 01:00 | 16.0 |
| start sample #15 | 16/Apr/08 01:00 | 16.0 |
| start sample #16 | 2/May/08 01:00 | 16.0 |
| start sample #17 | 18/May/08 01:00 | 16.0 |
| start sample #18 | 3/Jun/08 01:00 | 16.0 |
| start sample #19 | 19/Jun/08 01:00 | 16.0 |
| start sample #20 | 5/Jul/08 01:00 | 16.0 |
| start sample #21 | 21/Jul/08 01:00 | 16.0 |
| start sample #22 | 6/Aug/08 01:00 | 16.0 |
| start sample #23 | 22/Aug/08 01:00 | 16.0 |
| start sample #24 | 30/Aug/08 01:00 | 8.0 |
| end sample #24 | 7/Sep/08 01:00 | 8.0 |

Rotation schemes for the time-series sediment traps on mooring IRM5; bottom and shallow trap are identical (Table x1).

## Appendix A Cruise Summary File

## Appendix B Mooring Summary File

| Cast Types | | Events | |
|---|---|---|---|
| CTD | CTD | BE | Begin |
| ROS | CTD with Rosette | BO | Bottom |
| MOR | Mooring | EN | End |
| LA | Lander | DE | Deployment |
| BC | Box Core | RE | Recovery |
| PC | Piston Core | | |
| MC | Multi Core | | |
| MB | Multi -Beam Track | | |

| STN NBR | CAST NO | CAST TYPE | DATE dd-mmm-yyyy | TIME UTC | EVENT CODE | LATITUDE Deg. | Min. | H | LONGITUDE Deg. | Min. | H | Depth Uncor. | Raw CTD File | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 01 | MOR | 04-Sep-2007 | 14:22 | RE | 48 | 48.10 | N | 15 | 47.00 | W | 4798 | | PAP 2007 mooring |
| 002 | 01 | ROS | 05-Sep-2007 | 10:37 | BE | 51 | 05.64 | N | 18 | 46.51 | W | 4707 | | |
| 002 | 01 | ROS | 05-Sep-2007 | 10:42 | BO | 51 | 05.66 | N | 18 | 46.48 | W | 4707 | 64PE275s02c1 | Test to 250 m |
| 002 | 01 | ROS | 05-Sep-2007 | 10:53 | EN | 51 | 05.75 | N | 18 | 46.47 | W | 4707 | | |
| 003 | 01 | MB | 07-Sep-2007 | 16:52 | BE | 57 | 25.09 | N | 27 | 54.15 | W | 2622 | | |
| 003 | 02 | MB | 07-Sep-2007 | 17:19 | EN | 57 | 26.81 | N | 27 | 50.52 | W | 2622 | | |
| 003 | 03 | MB | 07-Sep-2007 | 17:24 | BE | 57 | 27.16 | N | 27 | 50.58 | W | 2622 | | |
| 003 | 04 | MB | 07-Sep-2007 | 17:58 | EN | 57 | 29.56 | N | 27 | 54.33 | W | 2622 | | |
| 003 | 05 | MB | 07-Sep-2007 | 18:06 | BE | 57 | 29.57 | N | 27 | 55.12 | W | 2622 | | |
| 003 | 06 | MB | 07-Sep-2007 | 18:40 | EN | 57 | 26.48 | N | 27 | 54.38 | W | 2622 | | |
| 003 | 07 | ROS | 07-Sep-2007 | 18:55 | BE | 57 | 27.09 | N | 27 | 54.54 | W | 2622 | | |
| 003 | 07 | ROS | 07-Sep-2007 | 19:35 | BO | 57 | 27.09 | N | 27 | 54.53 | W | 2622 | 64PE275s03c7 | |
| 003 | 07 | ROS | 07-Sep-2007 | 21:05 | EN | 57 | 27.10 | N | 27 | 54.53 | W | 2622 | | |
| 003 | 08 | PC | 07-Sep-2007 | 21:55 | BE | 57 | 27.14 | N | 27 | 54.49 | W | 2622 | | |
| 003 | 08 | PC | 07-Sep-2007 | 22:34 | BO | 57 | 27.09 | N | 27 | 54.53 | W | 2622 | | |
| 003 | 08 | PC | 07-Sep-2007 | 23:14 | EN | 57 | 27.10 | N | 27 | 54.55 | W | 2622 | | |
| 003 | 09 | BC | 07-Sep-2007 | 23:33 | BE | 57 | 27.10 | N | 27 | 54.52 | W | 2622 | | |
| 003 | 09 | BC | 08-Sep-2007 | 00:05 | BO | 57 | 27.10 | N | 27 | 54.52 | W | 2622 | | |
| 003 | 09 | BC | 08-Sep-2007 | 00:43 | EN | 57 | 27.10 | N | 27 | 54.53 | W | 2622 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 003 | 10 | MC | 08-Sep-2007 | 01:19 | BE | 57 | 27.14 | N | 27 | 54.51 | W | 2622 | | |
| 003 | 10 | MC | 08-Sep-2007 | 02:02 | BO | 57 | 27.07 | N | 27 | 54.54 | W | 2689 | | |
| 003 | 10 | MC | 08-Sep-2007 | 02:43 | EN | 57 | 27.09 | N | 27 | 54.53 | W | 2689 | | |
| 003 | 11 | LA | 08-Sep-2007 | 05:44 | DE | 57 | 27.09 | N | 27 | 54.52 | W | 2689 | | BOBO deployment |
| 003 | 12 | LA | 08-Sep-2007 | 06:28 | RE | 57 | 27.42 | N | 27 | 54.89 | W | 2689 | | BOBO auto release |
| 003 | 13 | MB | 08-Sep-2007 | 07:12 | BE | 57 | 27.24 | N | 27 | 54.69 | W | 2689 | | |
| 003 | 14 | MB | 08-Sep-2007 | 07:35 | EN | 57 | 25.20 | N | 27 | 53.76 | W | 2689 | | |
| 003 | 15 | MB | 08-Sep-2007 | 08:02 | BE | 57 | 24.32 | N | 27 | 56.74 | W | 2689 | | |
| 003 | 16 | MB | 08-Sep-2007 | 08:53 | EN | 57 | 28.35 | N | 28 | 02.49 | W | 2689 | | |
| 004 | 01 | MB | 09-Sep-2007 | 15:36 | BE | 59 | 13.45 | N | 36 | 20.46 | W | 2993 | | |
| 004 | 01 | MB | 09-Sep-2007 | 15:58 | EN | 59 | 14.23 | N | 36 | 23.97 | W | 3036 | | |
| 004 | 02 | MOR | 09-Sep-2007 | 16:19 | RE | 59 | 14.31 | N | 36 | 23.99 | W | 3018 | | LOCO3-4 |
| 004 | 03 | ROS | 09-Sep-2007 | 19:17 | BE | 59 | 14.23 | N | 36 | 23.95 | W | 3024 | | |
| 004 | 03 | ROS | 09-Sep-2007 | 20:00 | BO | 59 | 14.22 | N | 36 | 23.98 | W | 3036 | 64PE275s04c3 | |
| 004 | 03 | ROS | 09-Sep-2007 | 21:02 | EN | 59 | 14.21 | N | 36 | 23.79 | W | 3036 | | |
| 004 | 04 | MB | 09-Sep-2007 | 21:51 | BE | 59 | 13.25 | N | 36 | 26.06 | W | 2987 | | missed10 minutes |
| 004 | 05 | MB | 09-Sep-2007 | 22:26 | EN | 59 | 11.39 | N | 36 | 29.27 | W | 2908 | | |
| 004 | 06 | MOR | 10-Sep-2007 | 01:03 | DE | 59 | 14.67 | N | 36 | 22.20 | W | 2878 | | LOCO3-5 |
| 004 | 07 | MB | 10-Sep-2007 | 01:19 | BE | 59 | 14.50 | N | 36 | 22.43 | W | 3048 | | |
| 004 | 07 | MB | 10-Sep-2007 | 01:41 | EN | 59 | 14.58 | N | 36 | 26.37 | W | 4103 | | |
| 005 | 01 | ROS | 10-Sep-2007 | 14:40 | BE | 59 | 17.01 | N | 38 | 46.02 | W | 3060 | | |
| 005 | 01 | ROS | 10-Sep-2007 | 15:21 | BO | 59 | 17.01 | N | 38 | 45.97 | W | 3060 | 64PE275s05c01 | |
| 005 | 01 | ROS | 10-Sep-2007 | 17:01 | EN | 59 | 17.01 | N | 38 | 46.02 | W | 3060 | | |
| 006 | 01 | MC | 10-Sep-2007 | 18:52 | BE | 59 | 20.74 | N | 38 | 51.86 | W | 3036 | | |
| 006 | 01 | MC | 10-Sep-2007 | 19:38 | BO | 59 | 20.76 | N | 38 | 51.81 | W | 3036 | | |
| 006 | 01 | MC | 10-Sep-2007 | 20:21 | EN | 59 | 20.74 | N | 38 | 51.77 | W | 3036 | | |
| 006 | 02 | MB | 10-Sep-2007 | 20:46 | BE | 59 | 20.87 | N | 38 | 51.58 | W | 3036 | | |
| 006 | 03 | MB | 10-Sep-2007 | 21:01 | EN | 59 | 20.55 | N | 38 | 53.38 | W | 3036 | | |
| 007 | 01 | MB | 11-Sep-2007 | 01:45 | BE | 59 | 14.97 | N | 39 | 39.96 | W | 3036 | | |
| 007 | 02 | MB | 11-Sep-2007 | 06:09 | EN | 59 | 11.07 | N | 39 | 27.46 | W | 3036 | | |
| 007 | 03 | MOR | 11-Sep-2007 | 07:06 | RE | 59 | 14.90 | N | 39 | 39.40 | W | 3036 | | IRM-4 |
| 008 | 01 | MOR | 11-Sep-2007 | 09:57 | RE | 59 | 11.82 | N | 39 | 30.51 | W | 3036 | | LOCO2-4 |
| 009 | 01 | MC | 11-Sep-2007 | 13:14 | BE | 59 | 14.85 | N | 39 | 39.34 | W | 3036 | | |
| 009 | 01 | MC | 11-Sep-2007 | 14:00 | BO | 59 | 14.88 | N | 39 | 39.46 | W | 3036 | | |
| 009 | 01 | MC | 11-Sep-2007 | 14:43 | BE | 59 | 14.84 | N | 39 | 39.49 | W | 3036 | | |
| 010 | 01 | MOR | 11-Sep-2007 | 18:14 | DE | 59 | 11.91 | N | 39 | 31.87 | W | 3036 | | LOCO2-5 |
| 011 | 01 | MOR | 11-Sep-2007 | 21:50 | DE | 59 | 14.75 | N | 39 | 39.79 | W | 3036 | | IRM-5 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 012 | 01 | ROS | 12-Sep-2007 | 11:18 | BE | 59 | 57.01 | N | 42 | 45.00 | W | 193 | | |
| 012 | 01 | ROS | 12-Sep-2007 | 11:22 | BO | 59 | 56.97 | N | 42 | 45.01 | W | 195 | 64PE275s12c1 | |
| 012 | 01 | ROS | 12-Sep-2007 | 11:34 | EN | 59 | 56.96 | N | 42 | 44.99 | W | 197 | | |
| 012 | 02 | MB | 12-Sep-2007 | 11:40 | BE | 59 | 56.96 | N | 42 | 44.97 | W | 194 | | |
| 012 | 03 | MB | 12-Sep-2007 | 11:47 | EN | 59 | 57.15 | N | 42 | 44.16 | W | 192 | | |
| 013 | 01 | MB | 12-Sep-2007 | 15:01 | BE | 59 | 52.69 | N | 42 | 16.22 | W | 389 | | |
| 013 | 01 | ROS | 12-Sep-2007 | 15:22 | BE | 59 | 52.01 | N | 42 | 14.88 | W | 423 | | |
| 013 | 01 | ROS | 12-Sep-2007 | 15:31 | BO | 59 | 52.03 | N | 42 | 14.93 | W | 422 | 64PE275s14c1 | deviating CTD file |
| 013 | 01 | ROS | 12-Sep-2007 | 15:51 | EN | 59 | 52.00 | N | 42 | 14.99 | W | 422 | | |
| 013 | 02 | MB | 12-Sep-2007 | 16:09 | BE | 59 | 51.61 | N | 42 | 12.84 | W | 499 | | |
| 014 | 01 | MB | 12-Sep-2007 | 17:39 | EN | 59 | 47.23 | N | 41 | 46.94 | W | 1856 | | named stat 15 |
| 014 | 02 | ROS | 12-Sep-2007 | 18:02 | BE | 59 | 47.01 | N | 41 | 45.02 | W | 1862 | | |
| 014 | 02 | ROS | 12-Sep-2007 | 18:36 | BO | 59 | 47.00 | N | 41 | 45.01 | W | 1862 | 64PE275s14bc1 | deviating CTD file |
| 014 | 02 | ROS | 12-Sep-2007 | 19:44 | EN | 59 | 47.01 | N | 41 | 45.00 | W | 1862 | | |
| 014 | 03 | MB | 12-Sep-2007 | 20:02 | EN | 59 | 46.63 | N | 41 | 43.04 | W | 1874 | | |
| 015 | 01 | MB | 12-Sep-2007 | 21:31 | BE | 59 | 42.27 | N | 41 | 17.40 | W | 2148 | | |
| 015 | 02 | MB | 12-Sep-2007 | 21:44 | EN | 59 | 42.00 | N | 41 | 15.12 | W | 2179 | | |
| 015 | 03 | ROS | 12-Sep-2007 | 21:53 | BE | 59 | 42.00 | N | 41 | 14.97 | W | 2173 | | |
| 015 | 03 | ROS | 12-Sep-2007 | 22:22 | BO | 59 | 41.99 | N | 41 | 14.97 | W | 2179 | 64PE275s15c3 | |
| 015 | 03 | ROS | 12-Sep-2007 | 23:34 | EN | 59 | 41.98 | N | 41 | 15.01 | W | 2179 | | |
| 015 | 04 | MB | 12-Sep-2007 | 23:48 | BE | 59 | 42.06 | N | 41 | 15.43 | W | 2173 | | |
| 015 | 05 | MB | 12-Sep-2007 | 23:55 | EN | 59 | 41.77 | N | 41 | 14.33 | W | 2185 | | |
| 016 | 01 | MB | 13-Sep-2007 | 01:30 | BE | 59 | 37.19 | N | 40 | 47.01 | W | 2459 | | |
| 016 | 01 | ROS | 13-Sep-2007 | 01:53 | BE | 59 | 37.01 | N | 40 | 45.02 | W | 2471 | | |
| 016 | 01 | ROS | 13-Sep-2007 | 02:27 | BO | 59 | 37.00 | N | 40 | 45.01 | W | 2471 | 54PE275s16c2 | |
| 016 | 01 | ROS | 13-Sep-2007 | 03:52 | EN | 59 | 37.01 | N | 40 | 44.95 | W | 2471 | | |
| 016 | 01 | MB | 13-Sep-2007 | 04:03 | BE | 59 | 37.00 | N | 40 | 45.05 | W | 2471 | | |
| 016 | 02 | MB | 13-Sep-2007 | 04:14 | EN | 59 | 36.64 | N | 40 | 43.06 | W | 2490 | | |
| 017 | 01 | MB | 13-Sep-2007 | 07:36 | BE | 59 | 27.25 | N | 39 | 47.00 | W | 2953 | | |
| 017 | 02 | MB | 13-Sep-2007 | 07:47 | EN | 59 | 26.97 | N | 39 | 45.00 | W | 2953 | | |
| 017 | 03 | ROS | 13-Sep-2007 | 07:56 | BE | 59 | 27.04 | N | 39 | 45.02 | W | 2953 | | |
| 017 | 03 | ROS | 13-Sep-2007 | 08:45 | BO | 59 | 27.01 | N | 39 | 45.10 | W | 2953 | 64PE275s17c3 | |
| 017 | 03 | ROS | 13-Sep-2007 | 10:12 | EN | 59 | 27.14 | N | 39 | 45.10 | W | 2947 | | |
| 017 | 04 | MB | 13-Sep-2007 | 10:19 | BE | 59 | 27.17 | N | 39 | 45.28 | W | 2953 | | |
| 017 | 05 | MB | 13-Sep-2007 | 10:32 | EN | 59 | 26.73 | N | 39 | 43.19 | W | 2953 | | |
| 018 | 01 | MB | 13-Sep-2007 | 18:20 | BE | 59 | 07.31 | N | 37 | 48.71 | W | 3221 | | |
| 018 | 02 | MB | 13-Sep-2007 | 18:31 | EN | 59 | 06.96 | N | 37 | 46.99 | W | 3215 | | |
| 018 | 03 | ROS | 13-Sep-2007 | 18:46 | BE | 59 | 07.07 | N | 37 | 47.14 | W | 3215 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 018 | 03 | ROS | 13-Sep-2007 | 19:31 | BO | 59 | 07.04 | N | 37 | 47.18 | W | 3219 | 64PE275s18c03 | |
| 018 | 03 | ROS | 13-Sep-2007 | 21:09 | EN | 59 | 07.02 | N | 37 | 47.07 | W | 4347 | | |
| 018 | 04 | MB | 13-Sep-2007 | 21:19 | BE | 59 | 07.05 | N | 37 | 47.12 | W | 3213 | | |
| 018 | 05 | MB | 13-Sep-2007 | 21:35 | EN | 59 | 06.70 | N | 37 | 44.96 | W | 3219 | | |
| 019 | 01 | MB | 14-Sep-2007 | 11:20 | BE | 58 | 49.24 | N | 35 | 56.10 | W | 3646 | | |
| 019 | 02 | MB | 14-Sep-2007 | 11:31 | EN | 58 | 48.98 | N | 35 | 54.04 | W | 2634 | | |
| 019 | 03 | ROS | 14-Sep-2007 | 11:44 | BE | 58 | 49.00 | N | 35 | 53.94 | W | 2646 | | |
| 019 | 03 | ROS | 14-Sep-2007 | 12:21 | BO | 58 | 49.00 | N | 35 | 54.00 | W | 2646 | 64PE275s19c3 | |
| 019 | 03 | ROS | 14-Sep-2007 | 13:43 | EN | 58 | 48.99 | N | 35 | 54.00 | W | 2646 | | |
| 019 | 04 | MB | 14-Sep-2007 | 13:56 | BE | 58 | 49.18 | N | 35 | 54.90 | W | 2621 | | |
| 019 | 05 | MB | 14-Sep-2007 | 14:13 | EN | 58 | 48.69 | N | 35 | 52.12 | W | 1195 | | |
| 020 | 01 | MB | 14-Sep-2007 | 17:38 | BE | 58 | 39.44 | N | 34 | 57.77 | W | 2475 | | |
| 020 | 02 | MB | 14-Sep-2007 | 17:49 | EN | 58 | 39.13 | N | 34 | 55.87 | W | 2640 | | |
| 020 | 03 | ROS | 14-Sep-2007 | 18:02 | BE | 58 | 39.00 | N | 34 | 55.99 | W | 2640 | | |
| 020 | 03 | ROS | 14-Sep-2007 | 18:37 | BO | 58 | 39.01 | N | 34 | 56.00 | W | 2640 | 64PE275s20c3 | |
| 020 | 03 | ROS | 14-Sep-2007 | 19:56 | EN | 58 | 39.00 | N | 34 | 56.01 | W | 2640 | | |
| 020 | 04 | MB | 14-Sep-2007 | 20:04 | BE | 58 | 39.04 | N | 34 | 56.00 | W | 1085 | | |
| 020 | 05 | MB | 14-Sep-2007 | 20:15 | EN | 58 | 38.73 | N | 34 | 54.12 | W | 2664 | | |
| 021 | 01 | MB | 14-Sep-2007 | 23:40 | BE | 58 | 29.36 | N | 33 | 55.82 | W | 2203 | | |
| 021 | 02 | MB | 14-Sep-2007 | 23:50 | EN | 58 | 29.07 | N | 33 | 54.02 | W | 2101 | | |
| 021 | 03 | ROS | 15-Sep-2007 | 00:03 | BE | 58 | 29.01 | N | 33 | 53.96 | W | 2134 | | |
| 021 | 03 | ROS | 15-Sep-2007 | 00:33 | BO | 58 | 29.02 | N | 33 | 53.95 | W | 2134 | 64PE275s21c3 | |
| 021 | 03 | ROS | 15-Sep-2007 | 01:43 | EN | 58 | 29.02 | N | 33 | 53.94 | W | 2134 | | |
| 021 | 04 | MB | 15-Sep-2007 | 01:58 | BE | 58 | 29.12 | N | 33 | 54.55 | W | 2092 | | |
| 021 | 05 | MB | 15-Sep-2007 | 02:12 | EN | 58 | 28.74 | N | 33 | 51.98 | W | 2398 | | |
| 022 | 01 | MB | 15-Sep-2007 | 05:07 | BE | 58 | 20.37 | N | 33 | 01.81 | W | 1861 | | |
| 022 | 02 | MB | 15-Sep-2007 | 05:18 | EN | 58 | 20.08 | N | 32 | 59.93 | W | 1888 | | |
| 022 | 03 | ROS | 15-Sep-2007 | 05:31 | BE | 58 | 20.00 | N | 33 | 00.00 | W | 1800 | | |
| 022 | 03 | ROS | 15-Sep-2007 | 06:00 | BO | 58 | 20.01 | N | 32 | 59.99 | W | 1800 | 64PE275s22c3 | missed lowest 200 m |
| 022 | 03 | ROS | 15-Sep-2007 | 07:05 | EN | 58 | 20.00 | N | 33 | 00.01 | W | 1800 | | |
| 022 | 04 | MB | 15-Sep-2007 | 07:12 | BE | 58 | 20.00 | N | 33 | 00.01 | W | 1800 | | |
| 022 | 05 | MB | 15-Sep-2007 | 07:24 | EN | 58 | 20.00 | N | 33 | 00.01 | W | 1601 | | |
| 023 | 01 | MB | 15-Sep-2007 | 10:41 | BE | 58 | 10.32 | N | 32 | 02.78 | W | 1726 | | |
| 023 | 02 | MB | 15-Sep-2007 | 10:52 | EN | 58 | 10.02 | N | 32 | 01.03 | W | 2101 | | |
| 023 | 03 | ROS | 15-Sep-2007 | 11:02 | BE | 58 | 10.01 | N | 32 | 00.93 | W | 2083 | | |
| 023 | 03 | ROS | 15-Sep-2007 | 11:35 | BO | 58 | 09.98 | N | 32 | 00.97 | W | 2083 | 64PE275s23c3 | |
| 023 | 03 | ROS | 15-Sep-2007 | 12:43 | EN | 58 | 10.05 | N | 32 | 01.00 | W | 2101 | | |
| 023 | 04 | MB | 15-Sep-2007 | 12:43 | BE | 58 | 10.05 | N | 32 | 01.00 | W | 2101 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 024 | 01 | ROS | 15-Sep-2007 | 16:42 | BE | 58 | 00.92 | N | 31 | 06.95 | W | 1791 | | |
| 024 | 01 | ROS | 15-Sep-2007 | 17:06 | BO | 58 | 00.96 | N | 31 | 06.85 | W | 1810 | 64PE275s24c1 | |
| 024 | 01 | ROS | 15-Sep-2007 | 18:00 | EN | 58 | 00.94 | N | 31 | 06.80 | W | 1814 | | |
| 025 | 01 | ROS | 15-Sep-2007 | 21:50 | BE | 57 | 51.96 | N | 30 | 11.91 | W | 2194 | | |
| 025 | 01 | ROS | 15-Sep-2007 | 22:27 | BO | 57 | 51.98 | N | 30 | 12.00 | W | 2189 | 64PE265s25c1 | |
| 025 | 01 | ROS | 15-Sep-2007 | 23:40 | EN | 57 | 52.00 | N | 30 | 12.01 | W | 2189 | | |
| 026 | 01 | ROS | 16-Sep-2007 | 03:38 | BE | 57 | 41.98 | N | 29 | 13.95 | W | 2328 | | |
| 026 | 01 | ROS | 16-Sep-2007 | 04:12 | BO | 57 | 41.96 | N | 29 | 13.98 | W | 2324 | 64PE275s26c1 | |
| 026 | 01 | ROS | 16-Sep-2007 | 05:24 | EN | 57 | 41.99 | N | 29 | 13.95 | W | 2324 | | |
| 027 | 01 | ROS | 16-Sep-2007 | 09:04 | BE | 57 | 33.01 | N | 28 | 19.97 | W | 2365 | | |
| 027 | 01 | ROS | 16-Sep-2007 | 09:35 | BO | 57 | 32.98 | N | 28 | 19.89 | W | 2365 | 64PE275s27c1 | |
| 027 | 01 | ROS | 16-Sep-2007 | 10:51 | EN | 57 | 32.99 | N | 28 | 19.97 | W | 2365 | | |
| 028 | 01 | ROS | 16-Sep-2007 | 14:36 | BE | 57 | 26.99 | N | 27 | 24.03 | W | 2657 | | |
| 028 | 01 | ROS | 16-Sep-2007 | 15:22 | BO | 57 | 27.00 | N | 27 | 23.99 | W | 2657 | 64PE275s28c1 | |
| 028 | 01 | ROS | 16-Sep-2007 | 16:44 | EN | 57 | 27.01 | N | 27 | 24.00 | W | 2657 | | |
| 029 | 01 | LA | 16-Sep-2007 | 21:45 | DE | 57 | 27.09 | N | 27 | 54.53 | W | 2518 | | BOBO deployment |
| 030 | 01 | ROS | 17-Sep-2007 | 03:25 | BE | 57 | 22.01 | N | 26 | 32.95 | W | 2796 | | |
| 030 | 01 | ROS | 17-Sep-2007 | 04:05 | BO | 57 | 22.00 | N | 26 | 32.99 | W | 2796 | 64PE275s30c1 | |
| 030 | 01 | ROS | 17-Sep-2007 | 05:23 | EN | 57 | 21.99 | N | 26 | 32.98 | W | 2796 | | |
| 031 | 01 | ROS | 17-Sep-2007 | 09:12 | BE | 57 | 16.02 | N | 25 | 32.00 | W | 2754 | | |
| 031 | 01 | ROS | 17-Sep-2007 | 09:56 | BO | 57 | 16.01 | N | 25 | 31.98 | W | 2754 | 64PE275s31c1 | |
| 031 | 01 | ROS | 17-Sep-2007 | 11:21 | EN | 57 | 16.05 | N | 25 | 31.97 | W | 2754 | | |
| 030 | 02 | MC | 17-Sep-2007 | 16:15 | BE | 57 | 22.00 | N | 26 | 32.97 | W | 2796 | | |
| 030 | 02 | MC | 17-Sep-2007 | 16:51 | BO | 57 | 22.01 | N | 26 | 32.98 | W | 2796 | | |
| 030 | 02 | MC | 17-Sep-2007 | 17:27 | EN | 57 | 22.05 | N | 26 | 32.98 | W | 2796 | | |
| 032 | 01 | ROS | 18-Sep-2007 | 00:15 | BE | 57 | 11.01 | N | 24 | 37.92 | W | 2824 | | |
| 032 | 01 | ROS | 18-Sep-2007 | 00:54 | BO | 57 | 10.99 | N | 24 | 38.10 | W | 2819 | 64PE275s32c1 | |
| 032 | 01 | ROS | 18-Sep-2007 | 02:23 | EN | 57 | 10.87 | N | 24 | 37.97 | W | 2837 | | |
| 033 | 01 | ROS | 18-Sep-2007 | 05:49 | BE | 57 | 06.99 | N | 23 | 44.96 | W | 3027 | | |
| 033 | 01 | ROS | 18-Sep-2007 | 06:33 | BO | 57 | 06.99 | N | 23 | 44.95 | W | 3027 | 64PE275s33c1 | |
| 033 | 01 | ROS | 18-Sep-2007 | 08:01 | EN | 57 | 06.98 | N | 23 | 44.90 | W | 3027 | | |
| 034 | 01 | ROS | 18-Sep-2007 | 11:41 | BE | 57 | 00.99 | N | 22 | 48.98 | W | 3046 | | |
| 034 | 01 | ROS | 18-Sep-2007 | 12:24 | BO | 57 | 01.01 | N | 22 | 48.99 | W | 3046 | 64PE275s34c1 | |
| 034 | 01 | ROS | 18-Sep-2007 | 13:56 | EN | 57 | 00.98 | N | 22 | 49.02 | W | 3046 | | |
| 035 | 01 | ROS | 18-Sep-2007 | 15:59 | BE | 56 | 59.00 | N | 22 | 22.02 | W | 2657 | | |
| 035 | 01 | ROS | 18-Sep-2007 | 16:35 | BO | 56 | 59.01 | N | 22 | 21.98 | W | 2652 | 64PE275s35c1 | |
| 035 | 01 | ROS | 18-Sep-2007 | 17:56 | EN | 56 | 58.99 | N | 22 | 21.94 | W | 2652 | | |
| 035 | 02 | MB | 18-Sep-2007 | 18:14 | EN | 56 | 58.80 | N | 22 | 20.16 | W | 2625 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 036 | 01 | MB | 18-Sep-2007 | 19:35 | BE | 56 | 56.17 | N | 21 | 56.86 | W | 2291 | |
| 036 | 02 | ROS | 18-Sep-2007 | 19:59 | BE | 56 | 55.99 | N | 21 | 54.97 | W | 2273 | |
| 036 | 02 | ROS | 18-Sep-2007 | 20:28 | BO | 56 | 56.02 | N | 21 | 54.95 | W | 2273 | 64PE275s36c2 |
| 036 | 02 | ROS | 18-Sep-2007 | 21:36 | EN | 56 | 56.03 | N | 21 | 54.98 | W | 2273 | |
| 036 | 03 | MB | 18-Sep-2007 | 21:54 | EN | 56 | 55.83 | N | 21 | 53.18 | W | 2254 | |
| 037 | 01 | MB | 18-Sep-2007 | 23:14 | BE | 56 | 54.08 | N | 21 | 31.87 | W | 2125 | |
| 037 | 02 | ROS | 18-Sep-2007 | 23:32 | BE | 56 | 54.01 | N | 21 | 29.97 | W | 2101 | |
| 037 | 02 | ROS | 19-Sep-2007 | 00:02 | BO | 56 | 54.03 | N | 21 | 30.04 | W | 2106 | 64PE275s37c2 |
| 037 | 02 | ROS | 19-Sep-2007 | 01:12 | EN | 56 | 54.00 | N | 21 | 30.03 | W | 2101 | |
| 037 | 03 | MB | 19-Sep-2007 | 01:27 | EN | 56 | 54.00 | N | 21 | 28.16 | W | 2087 | |
| 038 | 01 | MB | 19-Sep-2007 | 02:54 | BE | 56 | 52.16 | N | 21 | 03.88 | W | 1939 | |
| 038 | 02 | ROS | 19-Sep-2007 | 03:16 | BE | 56 | 51.99 | N | 21 | 01.93 | W | 1935 | |
| 038 | 02 | ROS | 19-Sep-2007 | 03:46 | BO | 56 | 51.99 | N | 21 | 02.01 | W | 1935 | 64PE275s38c2 |
| 038 | 02 | ROS | 19-Sep-2007 | 04:48 | EN | 56 | 52.01 | N | 21 | 01.98 | W | 1935 | |
| 038 | 03 | MB | 19-Sep-2007 | 05:09 | EN | 56 | 51.87 | N | 21 | 00.15 | W | 1921 | |
| 039 | 01 | MB | 19-Sep-2007 | 08:02 | BE | 56 | 47.29 | N | 20 | 10.84 | W | 1199 | |
| 039 | 02 | ROS | 19-Sep-2007 | 08:23 | BE | 56 | 47.03 | N | 20 | 08.99 | W | 1138 | |
| 039 | 02 | ROS | 19-Sep-2007 | 08:40 | BO | 56 | 47.01 | N | 20 | 08.90 | W | 1138 | 64PE275s39c2 |
| 039 | 02 | ROS | 19-Sep-2007 | 09:24 | EN | 56 | 47.02 | N | 20 | 08.98 | W | 1138 | |
| 039 | 03 | MB | 19-Sep-2007 | 09:41 | EN | 56 | 47.07 | N | 20 | 07.16 | W | 1115 | |
| 040 | 01 | MB | 19-Sep-2007 | 12:38 | BE | 56 | 42.28 | N | 19 | 17.81 | W | 1472 | |
| 040 | 02 | ROS | 19-Sep-2007 | 13:13 | BE | 56 | 42.06 | N | 19 | 16.06 | W | 1458 | |
| 040 | 02 | ROS | 19-Sep-2007 | 13:24 | BO | 56 | 42.06 | N | 19 | 16.18 | W | 1458 | 64PE275s40c2 |
| 040 | 02 | ROS | 19-Sep-2007 | 14:29 | EN | 56 | 42.09 | N | 19 | 15.58 | W | 1453 | |
| 040 | 03 | MB | 19-Sep-2007 | 14:38 | EN | 56 | 41.91 | N | 19 | 14.18 | W | 1421 | |
| 041 | 01 | MB | 19-Sep-2007 | 17:31 | BE | 56 | 37.07 | N | 18 | 23.86 | W | 1310 | |
| 041 | 02 | ROS | 19-Sep-2007 | 17:58 | BE | 56 | 36.99 | N | 18 | 21.94 | W | 1305 | |
| 041 | 02 | ROS | 19-Sep-2007 | 18:17 | BO | 56 | 37.02 | N | 18 | 21.93 | W | 1305 | 64PE275s41c2 |
| 041 | 02 | ROS | 19-Sep-2007 | 19:04 | EN | 56 | 37.01 | N | 18 | 22.04 | W | 1305 | |
| 041 | 03 | MB | 19-Sep-2007 | 19:21 | EN | 56 | 36.84 | N | 18 | 20.19 | W | 1305 | |
| 042 | 01 | MB | 19-Sep-2007 | 22:16 | BE | 56 | 32.12 | N | 17 | 28.84 | W | 957 | |
| 042 | 02 | ROS | 19-Sep-2007 | 22:38 | BE | 56 | 32.05 | N | 17 | 27.04 | W | 890 | |
| 042 | 02 | ROS | 19-Sep-2007 | 22:49 | BO | 56 | 32.04 | N | 17 | 27.05 | W | 887 | 64PE275s42c2 |
| 042 | 02 | ROS | 19-Sep-2007 | 23:20 | EN | 56 | 32.01 | N | 17 | 27.01 | W | 890 | |
| 042 | 03 | MB | 19-Sep-2007 | 23:38 | EN | 56 | 31.97 | N | 17 | 25.19 | W | 814 | |
| 043 | 1 | MB | 20-Sep-2007 | 02:43 | BE | 56 | 27.28 | N | 16 | 33.82 | W | 542 | |
| 043 | 2 | ROS | 20-Sep-2007 | 03:04 | BE | 56 | 27.01 | N | 16 | 32.02 | W | 546 | |
| 043 | 2 | ROS | 20-Sep-2007 | 03:15 | BO | 56 | 27.03 | N | 16 | 32.01 | W | 546 | 64PE275s43c2 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 043 | 2 | ROS | 20-Sep-2007 | 03:41 | EN | 56 | 27.00 | N | 16 | 31.95 | W | 544 | |
| 043 | 3 | MB | 20-Sep-2007 | 03:53 | EN | 56 | 26.91 | N | 16 | 30.18 | W | 546 | |
| 044 | 1 | MB | 20-Sep-2007 | 06:39 | BE | 56 | 22.14 | N | 15 | 42.84 | W | 379 | |
| 044 | 2 | ROS | 20-Sep-2007 | 07:02 | BE | 56 | 22.02 | N | 15 | 40.85 | W | 361 | |
| 044 | 2 | ROS | 20-Sep-2007 | 07:08 | BO | 56 | 21.96 | N | 15 | 40.90 | W | 363 | 64PE275s44c2 |
| 044 | 2 | ROS | 20-Sep-2007 | 07:23 | EN | 56 | 22.01 | N | 15 | 40.94 | W | 361 | |
| 044 | 3 | MB | 20-Sep-2007 | 07:40 | EN | 56 | 21.75 | N | 15 | 39.25 | W | 373 | |
| 045 | 1 | MB | 20-Sep-2007 | 10:27 | BE | 56 | 17.09 | N | 14 | 49.97 | W | 226 | |
| 045 | 2 | ROS | 20-Sep-2007 | 10:45 | BE | 56 | 17.01 | N | 14 | 47.89 | W | 230 | |
| 045 | 2 | ROS | 20-Sep-2007 | 10:48 | BO | 56 | 17.01 | N | 14 | 47.89 | W | 228 | 64PE275s45c2 |
| 045 | 2 | ROS | 20-Sep-2007 | 10:59 | EN | 56 | 16.99 | N | 14 | 47.95 | W | 228 | |
| 045 | 3 | MB | 20-Sep-2007 | 11:14 | EN | 56 | 16.81 | N | 14 | 46.22 | W | 232 | |
| 046 | 1 | MB | 20-Sep-2007 | 13:55 | BE | 56 | 13.22 | N | 14 | 00.83 | W | -9 | |
| 046 | 2 | ROS | 20-Sep-2007 | 14:13 | BE | 56 | 12.99 | N | 13 | 59.06 | W | -9 | |
| 046 | 2 | ROS | 20-Sep-2007 | 14:45 | BO | 56 | 13.00 | N | 13 | 59.09 | W | -9 | 64PE275s46c2 |
| 046 | 2 | ROS | 20-Sep-2007 | 15:54 | EN | 56 | 13.25 | N | 13 | 59.02 | W | -9 | |
| 046 | 3 | MB | 20-Sep-2007 | 16:06 | EN | 56 | 12.91 | N | 13 | 57.21 | W | 1903 | |
| 047 | 1 | MN | 20-Sep-2007 | 18:56 | BE | 56 | 08.17 | N | 13 | 11.80 | W | 2535 | |
| 047 | 02 | ROS | 20-Sep-2007 | 19:19 | BE | 56 | 08.10 | N | 13 | 10.03 | W | 2545 | |
| 047 | 02 | ROS | 20-Sep-2007 | 19:57 | BO | 56 | 08.02 | N | 13 | 10.01 | W | 2545 | 64PE275s47c2 |
| 047 | 02 | ROS | 20-Sep-2007 | 21:16 | EN | 56 | 08.05 | N | 13 | 09.99 | W | 2545 | |
| 047 | 03 | MB | 20-Sep-2007 | 21:22 | EN | 56 | 08.15 | N | 13 | 09.79 | W | 2550 | |
| 048 | 01 | MB | 21-Sep-2007 | 00:17 | BE | 56 | 03.20 | N | 12 | 21.81 | W | 2709 | |
| 048 | 02 | ROS | 21-Sep-2007 | 00:36 | BE | 56 | 03.00 | N | 12 | 19.99 | W | 2709 | |
| 048 | 02 | ROS | 21-Sep-2007 | 01:16 | BO | 56 | 03.00 | N | 12 | 20.00 | W | 2714 | 64PE275s48c2 |
| 048 | 02 | ROS | 21-Sep-2007 | 02:38 | EN | 56 | 03.00 | N | 12 | 20.00 | W | 2709 | |
| 048 | 03 | MB | 21-Sep-2007 | 02:55 | EN | 56 | 02.99 | N | 12 | 18.19 | W | 2714 | |
| 049 | 01 | MB | 21-Sep-2007 | 05:36 | BE | 55 | 59.00 | N | 11 | 31.79 | W | 2693 | |
| 049 | 02 | ROS | 21-Sep-2007 | 05:58 | BE | 55 | 58.98 | N | 11 | 29.97 | W | 2683 | |
| 049 | 02 | ROS | 21-Sep-2007 | 06:35 | BO | 55 | 58.96 | N | 11 | 29.98 | W | 2683 | 64PE275s49c2 |
| 049 | 02 | ROS | 21-Sep-2007 | 07:56 | EN | 55 | 59.00 | N | 11 | 29.98 | W | 2683 | |
| 049 | 03 | B | 21-Sep-2007 | 08:12 | EN | 55 | 58.80 | N | 11 | 28.24 | W | 2678 | |
| 050 | 01 | MB | 21-Sep-2007 | 10:46 | BE | 55 | 54.92 | N | 10 | 43.87 | W | 2392 | |
| 050 | 02 | ROS | 21-Sep-2007 | 10:58 | BE | 55 | 55.01 | N | 10 | 42.98 | W | 2382 | |
| 050 | 02 | ROS | 21-Sep-2007 | 11:31 | BO | 55 | 54.98 | N | 10 | 42.89 | W | 2382 | 64PE275s50c2 |
| 050 | 02 | ROS | 21-Sep-2007 | 12:48 | EN | 55 | 54.94 | N | 10 | 43.08 | W | 2382 | |
| 050 | 03 | MB | 21-Sep-2007 | 13:02 | EN | 55 | 54.77 | N | 10 | 41.19 | W | 2367 | |
| 051 | 01 | NB | 21-Sep-2007 | 14:26 | BE | 55 | 52.38 | N | 10 | 18.63 | W | 2290 | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 051 | 02 | ROS | 21-Sep-2007 | 14:45 | BE | 55 | 52.04 | N | 10 | 16.98 | W | 2285 | |
| 051 | 02 | ROS | 21-Sep-2007 | 15:16 | BO | 55 | 52.02 | N | 10 | 16.92 | W | 2285 | 64PE275s51c2 |
| 051 | 02 | ROS | 21-Sep-2007 | 16:25 | EN | 55 | 52.02 | N | 10 | 16.96 | W | 2285 | |
| 051 | 03 | MB | 21-Sep-2007 | 16:41 | EN | 55 | 51.97 | N | 10 | 15.21 | W | 2280 | |
| 052 | 01 | MB | 21-Sep-2007 | 18:02 | BE | 55 | 50.26 | N | 09 | 52.73 | W | 2045 | |
| 052 | 02 | ROS | 21-Sep-2007 | 18:31 | BE | 55 | 50.05 | N | 09 | 51.03 | W | 2020 | |
| 052 | 02 | ROS | 21-Sep-2007 | 19:00 | BO | 55 | 49.99 | N | 09 | 51.12 | W | 2020 | 64PE275s52c2 |
| 052 | 02 | ROS | 21-Sep-2007 | 20:03 | EN | 55 | 50.01 | N | 09 | 50.90 | W | 2020 | |
| 052 | 03 | MB | 21-Sep-2007 | 20:20 | EN | 55 | 50.16 | N | 09 | 50.32 | W | 1954 | |
| 053 | 01 | MB | 21-Sep-2007 | 21:38 | BE | 55 | 47.28 | N | 09 | 27.68 | W | 914 | |
| 053 | 02 | ROS | 21-Sep-2007 | 21:56 | BE | 55 | 47.08 | N | 09 | 26.04 | W | 816 | |
| 053 | 02 | ROS | 21-Sep-2007 | 22:08 | BO | 55 | 46.99 | N | 09 | 26.13 | W | 819 | 64PE275s53c2 |
| 053 | 02 | ROS | 21-Sep-2007 | 22:39 | EN | 55 | 47.01 | N | 09 | 25.97 | W | 810 | |
| 053 | 03 | MB | 21-Sep-2007 | 22:55 | EN | 55 | 47.02 | N | 09 | 24.20 | W | 664 | |
| 054 | 01 | MB | 22-Sep-2007 | 00:15 | BE | 55 | 45.20 | N | 09 | 01.82 | W | 132 | |
| 054 | 02 | ROS | 22-Sep-2007 | 00:36 | BE | 55 | 45.00 | N | 09 | 00.10 | W | 125 | |
| 054 | 02 | ROS | 22-Sep-2007 | 00:39 | BO | 55 | 45.02 | N | 09 | 00.09 | W | 125 | 64PE275s54c2 |
| 054 | 02 | ROS | 22-Sep-2007 | 00:51 | EN | 55 | 45.04 | N | 09 | 00.07 | W | 123 | |
| 054 | 03 | MB | 22-Sep-2007 | 01:04 | EN | 55 | 45.25 | N | 08 | 58.27 | W | 122 | |
| 055 | 01 | MB | 22-Sep-2007 | 05:42 | BE | 55 | 51.12 | N | 08 | 11.40 | W | 176 | |
| 055 | 02 | MB | 22-Sep-2007 | 08:19 | EN | 55 | 51.55 | N | 08 | 08.01 | W | 179 | |