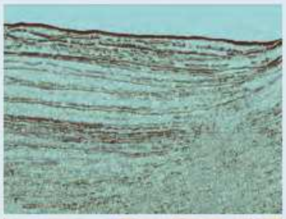
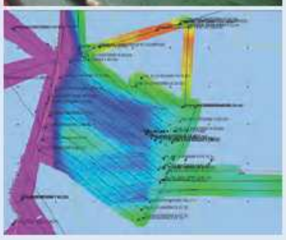
ISTITUTO NAZIONALE DI OCEANOGRAFIA E DI GEOFISICA SPERIMENTALE
RIMA, OGA, BIO and GDL Departments

International Polar Year





Research Project:

EGLACOM

Evolution of a GLacial Arctic COntinental Margin: the southern Svalbard ice stream - dominated sedimentary system

Cruise Report

r/v OGS Explora, 08.07.08 - 04.08.08

Authors:

F. Zgur, A. Caburlotto, D. Deponte, C. De Vittor, R. De Vittor, L. Facchin, C. Pelos, I. Tomini

Edited by

Michele Rebesco (Chief Scientist)

REL. OGS 2008/111

INDEX

1. INTRODUCTION

R/V OGS-EXPLORA in the port of Kristiansund (NO) - 08th July 2008

1.1 Foreword

The EGLACOM project is an Italian contribution to the International Polar Year (IPY). The cruise was entirely supported by OGS with its institutional funds provided by the Ministero dell'Istruzione, Università e Ricerca (MIUR) and with funds derived from service for private companies. The acquisition plan, co-ordinated by Michele Rebesco of the OGS department RIMA (development of Marine and technology Research), was enriched by the contributions from other OGS departments: OGA (Oceanography), BIO (Biological Oceanography) and GDL (Geophysics of the Lithosphere).

The EGLACOM project contributes to IPY activity 367 NICE-STREAMS (Neogene ice streams and sedimentary processes on high- latitude continental margins) proposed by Karin Andreassen (University of Trømso) and now co-ordinated by Angelo Camerlenghi (Istitució Catalana de Recerca i Estudis Avançats and University of Barcelona). It is also connected to PLATES & GATES (IPY activity 77), BIPOMAC (IPY activity 130) and to POLAREARTH (IPY EoI 104). Finally, it is synergic with the StarBar (Stability and decay of the former Barents Sea Ice Sheet) proposal submitted to the Norwegian Research Council by Karin Andreassen (University of Trømso), to which we are ready to collaborate.

A particularly intense co-operation was established with the SVAIS project (leaded by Angelo Camerlenghi), which is the Spanish IPY contribution to NICE-STREAMS activity. OGS was responsible for the single channel seismic (SCS) profiles acquired during the SVAIS cruise onboard the R/V Hesperides (29/7 –18/8/2007) and for the post-cruise multi-sensor core-logging and radiographs of the SVAIS cores. SVAIS and EGLACOM datasets were planned to be complementary and EGLACOM acquisition plan took into consideration the location of SVAIS data-set.

This report is co-authored by the scientific/technical participants to the EGLACOM Cruise, since they all contributed not only to data acquisition but also to the drafting. The report, drafted during the cruise, was edited by Michele Rebesco.

The realization of this cruise was made possible by the support of the Head of the RIMA Department (Riccardo Ramella), that we acknowledge. We also acknowledge the logistic support given by the Data Acquisition and Technologic Development group (coordinated by Giorgio Gelsi), by the Seismic Data Processing group (coordinated by Nigel Wardell), by the Environmental Geophysics group (Diego Cotterle for the GIS database), by the Administrative Support group (coordinated by Mauro Jerman) and by the many other colleagues from OGS, including Daniela Accettella and Andrea Cova for the suggestions on the swath bathymetry data, Laura De Santis, Lorenzo Petronio, Marina Lipizer, Paola Del Negro, Alessandro Crise for the scientific and technical suggestions.

We wish to thank the captains Franco Sedmak and Carmine Teta and the crew of R/V OGS-Explora for their collaborative and effective assistance throughout the cruise.

1.2 Objectives and acquisition plan

The main objective of EGLACOM is the geophysical and stratigraphic high-resolution study of an ice stream dominated marine depositional system of the Arctic margin in order to reconstruct the margin evolution locally from the Pliocene to the recent-most deglaciation, and to define the sedimentary architecture and seafloor morphology as it changed through time since the onset of glacial conditions. The target study area is the southern margin of Svalbard, and in particular the glacial sedimentary system fed by the ice stream once occupying the Storfjiorden glacial trough in the northern Barents Sea. Building on the experience that OGS gained in 20 years of geophysical investigation of Antarctic margin stratigraphy and glacial sedimentary systems, we will use the results of this cruise for comparison with Antarctic systems that evolved from temperate to fully polar conditions.

Additional objectives are:

1) Study of oceanographic processes connected to the Polar front and hydrologic characterization of Storfjorden dense water plumes. This objective will be pursued by mean of integrated seismic oceanography: identification of the acoustic interfaces in the water column along the multichannel seismic (MCS) reflection profiles and calibration with conventional oceanographic data: continuous thermosalinograph (TSG) and ADCP data, surface water sampling (spilled from TSG pipeline) along transit transect, XBT (during MCS acquisition), and deep water sampling carousel (WSC) of bottles, on which CTD and SVP (Sound Velocity Probe) were fastened.

2) Study of the organic carbon utilization, degradation and transformation processes along the water column in order to estimate the efficiency of biological pumps in the sequestration and export of CO_2; calibration of the biochemical composition of organic matter as paleoenvironmental proxy, by assessing biopolymers concentration in the sediment cores and its relationship with production/degradation processes.

3) Detailed analysis of sound velocity and of the variation of the wavelet shape along a MCS profile close to the area of the geophysical investigation carried out within the EU HYDRATECH project.

4) Geological characterization of fluid flow systems in the area (potential identification of seabed seepage, mud volcanoes, pockmarks, Bottom Simulating Reflectors connected to the presence of gas hydrates).

The acquisition plan was to collect:

1) MCS profiles, several in direction orthogonal to the margin and one long strike tie, in the area between Isfjorden and Bjorn Island, partly superposed to SVAIS SCS profiles, to cross ODP site 986 and DSDP site 344;
2) MultiBeam EchoSounder (MBES) data to complement the SVAIS MBES dataset;
3) sub-bottom profiles (SBP) during both MCS and MBES data acquisition (at about 4 and 10 knots, respectively).
4) XBT data during the MCS acquisition;
5) CTD data along with deep WSC cast (one per day of MBES data acquisition);
6) TSG and ADCP data continuously recording;
7) shallow water samples along a transect from 65° to 78° N.

1.3 Personnel

1.3.1. Scientific Crew List

Position	Name	Institute (Dept.)	Dates
Party Chief	Fabrizio Zgur	OGS (RIMA)	07/07 – 04/08 2008
Chief Scientist	Michele Rebesco	OGS (RIMA)	07/07 – 04/08 2008
Physical Oceanography	Davide Deponte	OGS (OGA)	07/07 – 04/08 2008
Bio Oceanography	Cinzia De Vittor	OGS (BIO)	07/07 – 04/08 2008
Surveyor & MBES Acquisition	Lorenzo Facchin	OGS (RIMA)	07/07 – 04/08 2008
	Isabella Tomini	OGS (RIMA)	07/07 – 04/08 2008
Digital Engineer	Gabriele Perissinotto	FUGRO OCEANSISMICA	07/07 – 25/07 2008
	Nicola Ferrante	FUGRO OCEANSISMICA	07/07 – 25/07 2008
Gun Mechanics	Emiliano Di Curzio	FUGRO OCEANSISMICA	07/07 – 25/07 2008
	Roberto De Vittor	OGS (RIMA)	07/07 – 04/08 2008
SBP Operator & Interpreter	Andrea Caburlotto	OGS (RIMA)	07/07 – 04/08 2008
SBP Operator & Seismic QC	Claudio Pelos	OGS (RIMA)	07/07 – 04/08 2008

1.3.2. IMO Crew List

Rank	Name	Company	Dates
Master	Franco Sedmak	Diamar	07/07 – 26/07 2008
Master	Carmine Teta	Diamar	25/07 - 04/08 2008
Chief Officer	Marco Galletti	Diamar	07/07 – 04/08 2008
2nd Officer	Robert Cace	Diamar	07/07 – 04/08 2008
3rd Officer	Tommaso Savorgnani	Diamar	07/07 – 04/08 2008
Chief Engineer	Filipovic Ljubinko	Diamar	07/07 – 04/08 2008
2nd Engineer	Radomir Ivanov	Diamar	07/07 – 04/08 2008
3rd Engineer	Salvatore Colandrea	Diamar	07/07 – 15/07 2008
3rd Engineer	Franko Valencic	Diamar	15/07 – 04/08 2008
A.B.(A)	Pasquale Lubrano	Diamar	07/07 – 04/08 2008
A.B.(B)	Raffaele Iavarone	Diamar	07/07 – 04/08 2008
A.B.(C)	Gioacchino Costagliola	Diamar	07/07 – 04/08 2008
A.B.	Nunzio Limonio	Diamar	07/07 – 04/08 2008
Deck Boy	Domenico Illiano	Diamar	07/07 – 04/08 2008
Deck Boy S.N.	Ciro Onorato	Diamar	07/07 – 04/08 2008
Deck Boy	Giovanni Live	Diamar	07/07 – 04/08 2008
Motorman	Giuseppe Cammareri	Diamar	07/07 – 04/08 2008
Eng. boy	Raffaele Lucci	Diamar	07/07 – 04/08 2008
Electrician S.N.	Sinica Ciganovic	Diamar	07/07 – 04/08 2008
Cook	Aldo Guida	Diamar	07/07 – 04/08 2008

1.4 Glossary

ADCP	Acoustic Doppler Current Profiler
CDP	Common Depth Point
Chl*a*	Chlorophyll *a*
CRP	Central Reference Point
CTD	Conductivity Temperature Depth
DIC	Dissolved Inorganic Carbon
DOC	Dissolved Organic Carbon
DIN	Dissolved Inorganic Nitrogen (NH_4^+ + NO_3^- + NO_2^-)
DON	Dissolved Organic Nitrogen
DIP	Dissolved Inorganic Phosphorous (PO_4^{3-})
DOP	Dissolved Organic Phosphorous
DSP	Digital Signal Processor
EOL	End of Line
HPA	Heterotrophic Prokaryotes Abundances
MBES	Multi Beam Echo Sounder
MCS	Multi Channel Seismic
MPHYTO	Microphytoplankton
MZOO	Microzooplankton
NMO	Normal Move Out
ODP	Ocean Drilling Program
PBA	Phototrophic Bacterial Abundances
Phaeo	Phaeopigments
PN	Particulate Nitrogen
POC	Particulate Organic Carbon
RESP	Planktonic community respiration
RQ	Respiratory Quotient (= $\_CO_2/\_O_2$)
SBES	Single Beam Echo Sounder
SBP	Sub Bottom Profiler
SCS	Single Channel Seismic
SOL	Start of Line
SP	Shot Point
SSS	Side Scan Sonar
SVP	Sound Velocity Probe
TSG	Thermosalinograph
USB	Universal Serial Bus
WD	Water Depth
WSC	Water Sampling Carousel
XBT	Expendable Bathythermograph

1.5 Data in numbers and ship time percentage

4125 nm sailed
1,071 km of MultiChannel Seismic profiles
16,744 kmq of Multibeam bathymetry (without including transits)
4,079 km of SubBottom Profiles
>4,000 nm (>500 hours) of ADCP data
>4,000 nm (>500 hours) of Thermosalinograph data
60 XBT launched
6 CTD casts
4 Cores for a total of 9.23 m of sediment
3 Water Sampling Carousel (WSC) casts for a total of 17 water samples
18 sites of surface water sampling (from TSG)
532 water subsamples prepared for offshore analyses
171 km of MultiChannel Seismic data processed

Activity	Time	Time	Percentage	Sum
	(hh.mm)	(dd.00)	%	%
MCS Survey *°	178.11	7.42	27.77	57.5
MBES+SBP °	164.42	6.86	25.67	
Stations °	18.51	0.79	2.94	
Coring °	07.07	0.30	1.11	
Transit *°	201.16	8.54	31.95	42.5
Port call	64.54	2.70	10.12	
Stand-by °	02.49	0.12	0.44	
TOTAL	637.50	26.73	100.00	

* MBES and SBP recording ALSO during MCS and part of the transit
° ADCP and TSG recording during ALL these times

1.6 Location map

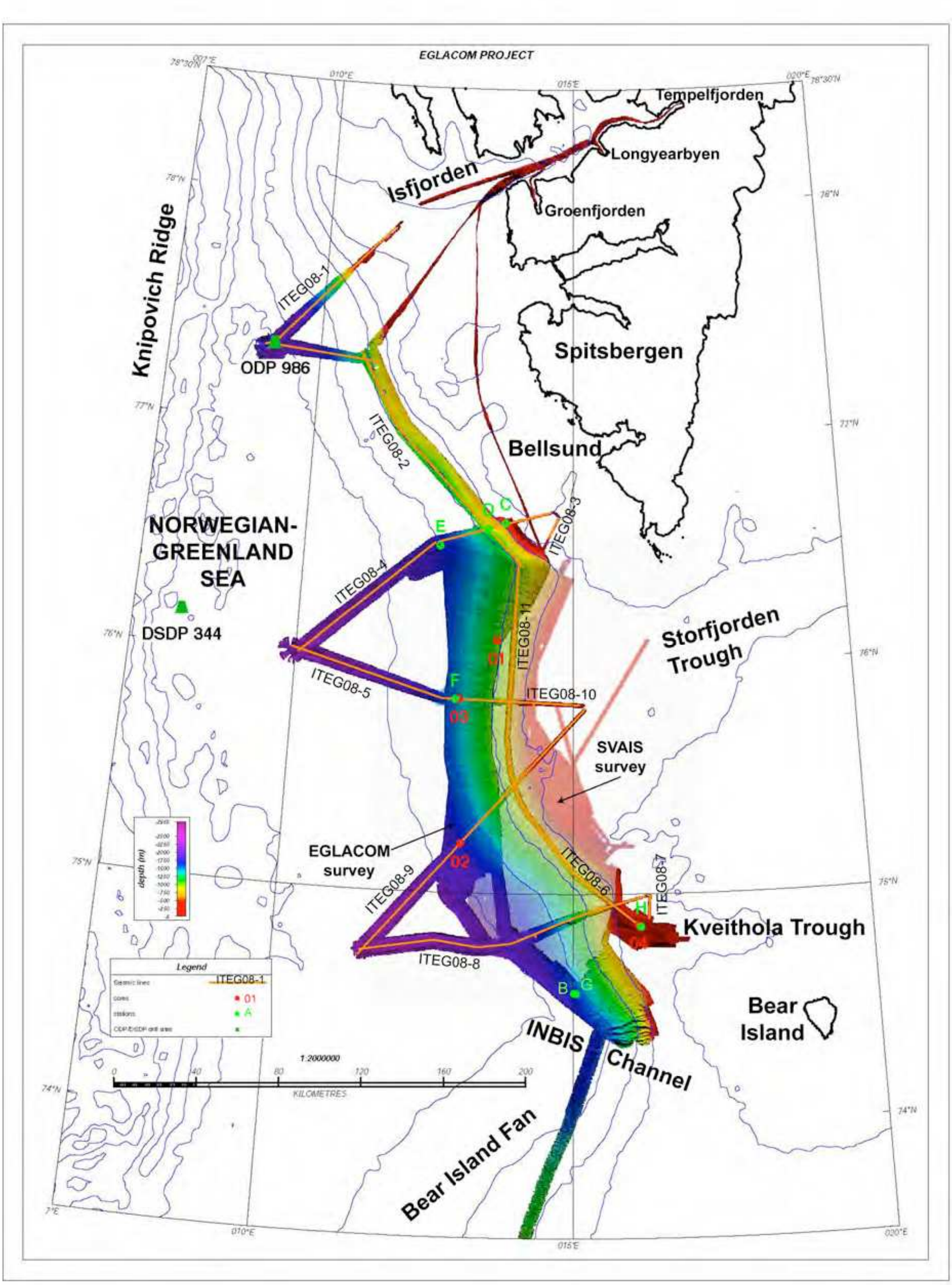


Fig. 1.6.1 Location map

1.7 Cruise diary

NB: Hours are in GMT (= local time -2); for location see map at page 9

7 July. Kristiansund Port: Mobilization-Demobilization
06:00 Operational meeting and duty sharing. De-mobilization of OGS sleeve guns and FUGRO instruments and installation (bio lab set up, MBES PDS200 software upgrade, CTD and WSC: electrical and mechanical connections, subcomm cable and adapters, acquisition station; TSG pipeline test and maintenance; seismic Vista and Petrosys software, …).
8 July. Kristiansund Port: completing instrument software installation.
In particular, CTD-WSC system mechanical set up, test of CTD-WSC acquisition at 3m depth in port; guns preparation, OYO recorder installation, TSG software check and gps interface,, PDS2000project loading, …).
20:10 The ship leaves the dock.
21:08 Start surface Conductivity and Temperature data acquisition from TSG.
22:52 Start ADCP data acquisition.
9 July. Transit toward Svalbard *(wind N 3/4, sea N 3 swell 1.5)*
08:00 Safety and onboard life meeting.
Surface water samples from TSG every 30' of latitude (at hours 09:02, 11:58, 14:54, 17:50, 21:02) and partial processing.
10:00 Beginning of acquisition shifts.
15:30 Plenary meeting with scientific introduction and welcome.
20:06- 21:28 MBES 8111 logging test.
22:27- 23:31 MBES 8150 logging test.
10 July. Transit toward Svalbard *(wind N 4/5, sea N 3 swell 2)*
The sea conditions, with long swell of over 2 m, do not allow to perform the planned CTD/WSC/SVP stations.
06:09 Only an SVP calibration (SVP01) was than performed at about 2000 m WD at the NW edge of the Voring Plateau (Station A).
07:09 SVP at bottom.
07:52 SVP on board.
The updated version of the MBES software presents some problems, regarding the remote visualization on the bridge, and continuity of snippets and pseudo-SideScan Sonar (SSS) data.
The SBP record included a structured noise whose remained undetermined (after having excluded interferences with ADCP, echosounders and MBES).
Some electric cables of the gun power supply were found interrupted and were substituted.
Surface water samples at 09:55, 14:28,17:27 and 23:15 and partial processing.
11:30-12:48 ADCP header alignment test.
23:31 Start SBP data recording.
11 July. Transit toward Svalbard *(wind NW 2/3, sea NW 2 swell 1.5)*
Surface water samples at 05:13, 11:35 and 17:51 and partial processing.
2:30 Start SBP data printing on EPC.
02:17-02:28 Snippets acquisition test
07:54-08:19 Snippets + SSS acquisition test
11:30 Technical meeting to define gun test, signature, MCS acquisition parameter, and MCS survey plan.
12:30 Technical meeting on the back to define CTD/WSC gear deployment and recovery procedure.
13:30 Set up and test of the XBT acquisition system with GPS interface and dedicated pipeline for the probe launcher 19:06 start 8150 acquisition.
12 July. Southern Storfjorden Fan: Station B. *(wind NW 2, sea NW 2 swell 1.5)*
Surface water samples (00:09, 17:17 and 23:49) and partial processing.

05:31 Arrival on the southern end of the Storfjorden Fan in the site (Station B, about 1600 m) of the first deployment of the CTD/WSC/SVP gear; operations on the back to prepare the deployment.
06:36 Start of downcast.
07:17 CTD at the bottom (stop at 1583 m depth), start upcast; 6 Niskin bottles closed at 1580, 1200, 750, 400, 100, 5 m.
08:02 CTD onboard; water sampling from WSC.
08:42 Start MBES and SBP acquisition while waiting for.gun test.
10:59 guns deployment and test.
16:10 Start transit to Longyearbyen acquiring MBES data at the eastern (deep) edge of the SVAIS survey.
19:00 Completed GPS interface with CTD acquisition system
13 July. Transit to Longyearbyen *(wind WSW 2, sea W <2 swell <1.5)*
Water samples from TSG (05:41 and 11:26) and partial processing.
02:17 Switch from 8150 to 8111 (because of shallower depth close to shelf edge).
15:16 Drop anchor in Longyearbyen fjord.
15:19 Stop ADCP and TSG data acquisition.
16:00 Visit of OGS president prof. I. Marson and RIMA director R. Ramella.
18:00 Zodiac ride for free evening in Longyearbyen.
14 July. Port call in Longyearbyen *(calm wind and sea, no swell)*
All day for cleaning and preparation for diplomatic visit.
06:00-12:00 Set up of Fugro sleeve guns on the back.
12:00-13:30 Scuba inspection to clean SVP(?) and routinely hull check.
18:00-24:00 Official reception of the Norwegian-Italian delegation in occasion of the 80° anniversary of the Nobile's expedition and visit to the labs.
15 July. Tour in Tempelfjorden *(calm wind and sea, no swell)*
Crew change (2nd engineer).
07:54 Start TSG data acquisition.
07:57 Start ADCP data acquisition.
09:00 Visit of OGS president prof. I. Marson and RIMA director R. Ramella. It was confirmed that captain Sedmak, supposed to be replaced and disembark, will remain onboard being his successor not available yet. A replacement may be foreseen in some days.
09:30-10:15 Phone interview (Marson, Ramella, Rebesco and Sedmak) with Daniela Picoi (and L. De Santis and G. Gelsi) from RAI studio in Trieste during radio broadcast.
12:00 Zodiac ride to Reddson Hotel in Longyearbyen (Fabrizio and Davide) for e-mail download (since satellite connection on board hindered by steep fjord's flaks) and for crest assemblage (Lorenzo).
14:00 The ship moves for a tour in along Isfjorden, Sassenfjorden and Tempelfjorden for visual observation of glacial morphologies and to acquire video images of the ship with glaciers in the background.
14: 08 Start MBES and SBP recording.
20:00 Fixed problem with the pump of TSG pipeline.
21:02 End of MBES and SBP recording.
21:10 Stop in Longyearbyen to drop prof. I. Marson and R. Ramella.
21:40 Transit toward Isfjorden exit and start of MBES and SBP recording.
16 July. Isfjorden Fan: MCS line 01 *(wind NE4, sea NNE 3, swell 2.5 S)*
03:05 Arrival at way-point (about 78°N 12°E) and start deploying MCS gear.
05:10 Start of test line.
05:26 Launch of XBT 001.
05:43 End of MCS and MBES line and guns on board to check guns 1 and 3.
06:04 Start of MBES and SBP acquisition waiting for the guns.

07:00 Since the guns were ready after the starting point of the MCS line was passed, we deployed the guns and made a loop to go back the start of the line. We also decided to deploy additional 45 m of streamer to increase the offset to 100 m.
08:52 Start MCS line 01. In this area north of the Storfjorden Fan, shoot interval was 12.5 m, record length 5 s.
09:11 Launch of XBT 002.
9:44-09:48 Streamer recovered by 30 m because too deep, resulting in an offset of 70 m.
09:52 Launch of XBT 003.
10:58 Launch of XBT 004.
11:30 Stop MCS acquisition since the air hose of the guns was loosing air (and pressure). Guns recovered on deck, failure fixed, and deployed again.
13:16 Start MCS line 01A.
14:22 Launch of XBT 005.
14:25-34 Switch on of 8150 and off of 8111.
15:10 TSG data timeout. Stop data acquisition for instrument check.
16:25 Launch of XBT 006.
19:25 Launch of XBT 007.
19:35 Problems with GPS resulting in wrong gun firing.
19:42 Re-boot of the PDS2000 navigation system to solve the problem.
19:47 GPS OK and resumption of seismic recording (shooting never stopped).
19:54 gun controller malfunction and stop of shooting and recording.
20:04 Resumption of seismic acquisition after re-boot of gun controller.
20:12 Re-start TSG data acquisition.
21:45 Launch of XBT 008.
22:22 End of line 01A after crossing ODP Site 986 and start of the long loop (on the left, without recovering the guns) to reach the starting point of the next line.
17 July. Bellsund Fan: MCS lines 02A and 02B *(wind NE3, sea NE 3, swell 1 SW)*
01:12 Start of MCS line 02.
01:28 Acquisition fault caused by the navigation system.
01:33 Start of MCS line 02A after re-boot of the navigation system.
04:54 Launch of XBT 009.
07:36 Launch of XBT 010.
08:27 End of MCS line 02A, data back-up during the loop.
10:15 Start of MCS line 02B (the long segmented strike tie line).
16:24 Launch of XBT 011.
18 July. Bellsund Fan: MCS line 03 + dip line 04 *(wind E3 and sea E 3, swell 1.5 E)*
01:28 Launch of XBT 012.
02:18 GPS “jumping” for one minute caused shooting malfunctioning.
05:15 End of line 02B, loop and transit, initially only with MBES and SBP acquisition, to reach the start of line 04. Guns on deck for maintenance (replaced a spring found broken; protected an air hose casing found worn out but not damaged). Air hose replacement in the gun shack.
07:26 MBES 8111 switched on.
09:06 Start of (short, transfer) line 03 after gun deployment. From this line onward (within the Storfjorden Fan), shoot interval 25m, record length 10 s.
09:15 MBES8150 switched off.
10:33 Start loop to reach the start of line 04; MCS acquisition continued.
10:59 Launch of XBT 013.
11:14 End of line 03 (MCS acquisition system re-start).
11:18 Start of line 04, when the streamer was in line.
12:42 Launch of XBT 014.
14:01 MBES 8150 switched on.
14:08 Launch of XBT 015.
14:10 MBES8111 switched off.

18:00 The captain informed that a low pressure with strong winds and rough sea was forecasted for the 22 of July. This suggested that a couple of day of MCS acquisition may be compromised. In addition, the captain confirmed that a replace for him was finally found and he may disembark the 24 or 25 July in Longyearbyen. Considering these news implying a reduction in the ship time available for acquisition, we decided a reduction in the MCS acquisition plan. After consultation of available data, including the seismic atlas of western Svalbard (Norsk Polarinstitut, 1994), we decided to drop the plan to reach Site DSDP 344 because of the limited chances of direct correlation of the stratigraphic record of this site with the MCS record of the Storfjorden fan. We decided to change course on the ongoing line (04), pointing to intersect the next line in a landward position (about 76°N 10°E).
18:14 Launch of XBT 016.
18:44 Reached the way-point for course change, switched file of MBES and SBP recording, whereas MCS acquisition continued.
22:14 Launch of XBT 017.
19 July. Storfjorden Fan: Dip MCS line 05 *(wind E3 and sea E 2, swell 0.5 NE)*
01:20 PC of SBP acquisition re-started because no navigation data.
01:36 Launch of XBT 018.
05:24 Launch of XBT 019.
05:35 End of MCS line 04.
05:41 Start recovering guns for maintenance and loop to start next MCS line.
06:15 Re-start of navigation and MCS acquisition systems. Snippets acquisition does not work afterwards.
06:20 MCS acquisition ready and starting point reached. Since a delay would have required a loop of at least one hour (without the certainty to solve the problem in the meantime) and considering the acquisition of the snippets not essential during the MCS acquisition (while mandatory during the MBES survey), we decided to continue without snippets for this line.
07:25 Guns in water and start shooting.
07:31 Start of MCS line 05.
12:18 Launch of XBT 020.
16:19 Launch of XBT 021.
19:08 Launch of XBT 022.
21:14 Launch of XBT 023.
21:28 End of MCS line 05 and start of loop.
21:38 Gun recovery for maintenance. Iron casing needs some welding.
22:18 Resumed the MBES acquisition after scanning for possible virus of PDS2000 PC. Snippets acquisition working correctly on both 8111 and 8150. Remote presentation on PC01 and 10 removed.
23:08 Deployment of guns and start of shooting test.
23:17 Start of MCS line06.
20 July. Storfjorden Fan: long tie MCS line 06 *(wind SE4 and sea SE 3, no swell)*
01:42 (fix837) the ship slowed down for changing bearing from (from 183 to 174°). No switch on files.
03:50 (fix1465) bearing change (from 174 to 162°). No switch on files.
04:12 Launch of XBT 024.
05:50 (fix2062) bearing change (from 162 to 150°). No switch on files.
07:00 (fix2431) bearing change (from 150 to 143°). No switch on files.
07:15 (fix2507) bearing change (from 143 to 142°). No switch on files.
09:06 Launch of XBT 025.
10:00 Celebration with lunch buffet and distribution to all personnel of the certificate of crossing the Arctic Circle (20:10 GMT of 9 July: 66°33'N 008°04'E).
11:28 (fix3848) bearing change (from 142 to 128°). No switch on files.
13:50 Launch of XBT 026.
14:21 MBES8111 switched on.

15:06 MBES8150 switched off.
16:42 End of MCS line 06 and start of the loop. An unusual (for the shelf) deep penetration (about 20 ms) was showed by SBP just before the end of the line. We take note of this as a possible coring site).
16:48 Launch of XBT 027.
17:47 Guns recovery and check (passed).
17:03 Compressor check in engine room.
17:40 Compressors OK and guns deployed.
17:50 Start acquisition of MCS line 07 during transit to next line.
19:08 Start turning to get the start of next MCS line.
19:22 Launch of XBT 028.
19:23 End of MCS line 07.
19:34 Start of MCS line 08.
19:46 Launch of XBT 029.
20:47 Launch of XBT 030.
21:08 MBES8150 switched on.
21:50 MBES8150 switched off.
22:44 Launch of XBT 031.
21 July. Storfjorden Fan: dip MCS lines 08 and 09 *(wind S2 and sea S 1, no swell)*
00:28 Launch of XBT 032.
02:38 Launch of XBT 033.
02:25 MCS acquisition system temporarily not recording: stop of acquisition on line 08 and start of line 08B.
02:49 Problems with GPS.
04:11 Launch of XBT 034.
04:52 PDS2000 very slow in logging, updating DTM and responding to commands: SSS MBES8150 switched off.
05:03 Stop of PDS2000.
05:04 Re-start logging MCS line, MBES8150 switched on, DTM, SSS and snippets working correctly.
09:51 Launch of XBT 035.
10:55 Safety drill for crew and technicians.
13:42 Launch of XBT 036.
13:52 End of line 08B.
14:00 Gun recovery.
14:09 Re-start of PDS2000.
15:05 Gun deployment.
15:25 Shooting test.
15:34 Start MCS line 09.
18:40 GPS problem.
20:15 Launch of XBT 037.
22 July. Storfjorden Fan: Extra MCS lines 10-11 *(wind NE3 and sea NE3, swell NE2)*
01:34 Launch of XBT 038.
03:42 Launch of XBT 039.
03:45 Launch of XBT 040.
04:49 Crossing of strong northward-flowing surface current.
05:45 Launch of XBT 041.
07:10 MBES8111 switched on (with SSS and snippets).
07:42 SBP resetting after it stopped pinging.
08:36 Launch of XBT 042.
08:48 Launch of XBT 043.
09:06 MBES8150 switched off.
09:30 Satellite phone interview (Michele) with Claudia Di Giorgio on Radio Rai3 Science broadcast.
10:49 Launch of XBT 044.

12:19 End of line 09 and re-start of PDS2000 that was very slow.
12:28 Launch of XBT 045.
12:33 Start MBES logging.
12:52 Start of line 10. Some noise on MCS data due to swells from NE.
14:06 Launch of XBT 046.
15:19 Launch of XBT 047.
15:46 GPS jumps (about 100m along line).
16:13 MBES8150 switched on.
16:41 Problem with gun 2. Stop of MCS acquisition line 10. MBES8111 switched off.
16:56 Loop to get back and resume MCS line. Stop of MBES8150 acquisition.
16:58 Gun recovery, check and substitution of Gun 2.
18:26 Start logging MBES8150.
18:36 Gun deployment.
18:47 Start of MCS line 10A.
19:29 Launch of XBT 048.
19:45 End of MCS line 10A, and loop to start the next line.
20;40 Start of MCS line 11.
21:54 Problem with guns. Stop of MCS acquisition line 11.
22:05 Gun recovery, check. Air fitting of Gun 2 found unlocked.
22:19 Loop to get back and resume MCS line. Stop of MBES8150 acquisition.
23:30 Gun deployment.
23:41 Start of MCS line 11A.
23 July. Southern Bellsund Fan: MBES survey *(wind NW2, sea NNW2, swell NNW2)*
02:56 Launch of XBT 049.
07:18 Launch of XBT 050.
07:30 End of MCS line 11A and of MCS survey.
07:37 Stop of MBES acquisition and complete back up.
07:55 Gun recovered and start of streamer recovery.
09:30 Streamer recovered.
09:33 MBES8111 switched on.
09:44 Start of MBES and SBP acquisition on line 12.
09:47 MBES8150 switched off.
10:08 End of line 12.
10:17 MBES8150 switched on.
10:27 MBES8111 switched off.
10;46 Start of line 13.
14:12 End of line 13.
14:37 Start of line 14.
16:52 Strong bottom current recorded by ADCP.
17:00 Celebration of the end of MCS survey with dinner buffet and inauguration of new crests in the lounge.
17:52 End of line 14.
18:13 Start of line 15.
19:00 MBES8111 switched on.
19:41 MBES8111 switched off.
20:53 End of line 15.
21:15 Start of line 16.
22:10 End of line 16.
22:14 Start of line 17.
22:12 Surface water samples and partial processing.
22:14 MBES8111 switched on.
22:31 MBES8150 switched off.
22:37 End of line 17.
23:44 Start of line 18.
24 July. Southern Bellsund Fan: MBES survey *(wind S3 and sea S2, swell SW2)*

00:58 End of line 18.
01:04 Start of line 19.
02:17 End of line 19.
02:18 Start of line 20.
02:36 MBES8150 switched on.
02:39 MBES8111 switched off.
03:17 End of line 20.
03:18 Echosounder EA600 communication problem: no output to PDS2000 and SBP; Stop MBES+SBP acquisition and re-start of PDS2000.
03:26 MBES+SBP acquisition resumed, but no EA600 output to SBP.
03:30 Stop acquisition to reboot navigation PC.
04:20 Start of line 21.
07:31 Hull-mounted SVP problems, disconnected from top side.
07:44 End of line 21.
08:20 Start of line 22.
10:26 End of line 22.
10:55 Start of line 23.
13:59 End of line 23 and move to the coring site (EGLACORE 01).
14:20 Corer in water.
14:40 Corer at the bottom.
14:59 Corer on board, core handling operations, move to start point of line 24.
16:37 Start of line 24.
20:24 End of line 24.
20:51 Start of line 25.
21:01 GPS jumps.
25 July. Port call in Longyearbyen *(calm wind and sea, no swell)*
01:46 End of line 25.
01:50 Start transit to Longyearbyen and start of (transit) MBES+SBP line 26.
02:26 MBES 8111 switched on and MBES 8150 switched off.
06:13 End of line 26.
07:25 Stop of MBES acquisition.
09:30 Mobile phone interview (Fabrizio) with Cristina Cimato (Milano Finanza) for an article on the magazine “Class”.
12:10 Anchor dropped in Longyearbyen fjord.
12:30 Embarked the replacing master Carmine Teta. New estimated departure time at 22:30 to wait for the lost luggage of the replacing master, expected with the 21:35 flight.
15:00 Zodiac ride to retire from the agent the hydrophones arrived from Kristiansund and free time in Longyearbyen.
17:00 Disembarked FUGRO technicians (Emiliano Di Curzio, Gabriele Perissinotto, Nicola Ferrante).
22:10 Arrival of the lost luggage and disembarkment the former master Franco Sedmak.
22:40 Start MBES (only) recording and move toward the exit of the Isfjorden.
26 July. Storfjorden Fan: MBES + Stations C-D *(wind S4 and sea S3, swell SW1)*
01:39 Hull-mounted SVP problems, serial port disconnected on MBES 8111.
06:59 MBES8150 switched on.
07:01 MBES8150 switched off.
07:20 Start of MBES and SBP line 27 in transit to working area.
07:36 Serial port of hull-mounted SVP reconnected (sound velocity read: 1469 m/s).
08:03 SVP values not reliable. Serial port disconnected.
14:00 End of MBES and SBP line 27 and move toward Station C (at about 435 m WD along MCS line 04) to deploy the CTD/WSC gear. SVP for MBES calibration, not considered essential for this depth range, postponed to the next site (Station D).
14:32 Start deploying CTD/WSC gear.

14:47 stop of CTD/WSC gear at 15 m above the seafloor, upcast start and bottle firing. Five Niskin bottles closed at 420, 250, 100, 40, 5 m.
14:52 Launch of XBT051.
15:01 WSC on board and start water sampling and subsequent partial processing.
15:27 Start of MBES (either 8150 and 8111) and SBP line 28 and move to following Station (D). SVP added to CTD/WSC gear.
15:52 MBES8111 switched off.
15:59 End of MBES and SBP line 28 and positioning on Station D (about 1000 m along MCS line 04).
16:49 CTD/WSC gear deployment.
16:53 CTD sensor malfunction. Wait to start recovery.
17:00 Sensor now working: start descending.
17:21 Stop of CTD/WSC gear at 25 m above the bottom.
17:25 Launch of XBT052.
17:26 Start rising CTD/WSC gear. WSC command malfunction: bottle firing impossible. Upcast continued without any water sampling. At 450 m WD malfunction of CTD: no temperature.
17:55 CTD/WSC gear recovered on board. Inspection to identify the problem with WSC. Junction on communication cable found not completely insulated, and repaired.
18:03 Move toward next MBES and SBP line.
18:24 Start of (long, southward) MBES and SBP line 29.
27 July. Storfjorden Fan: MBES + Station E *(wind W3 and sea W2, swell SW1.5)*
05:07 End of MBES and SBP line 29.
05:29 Start of (long, northward) MBES and SBP line 30.
07:00 Check of WSC communication. After several attempts without success, it was decided for the next Station (E) to deploy the WSC/CTD gear without bottles (without sampling the water).
16:07 End of MBES and SBP line 30.
16:30 Start of (westward) MBES and SBP line 31 to reach Station E (about 1700 m WD adjacent to the south to XBT016 site along MCS line 04).
17:28 End of MBES+SBP line 31.
17:45 Start deploying CTD/WSC gear (without bottles) with SVP.
17:53 Start downcast.
17:56 CTD malfunction (alert from touch-down sensor when CTD was lowered at normal speed). Start recovering.
18:00 CTD on deck. Touch-down sensor fixed.
18:04 CTD deployment. Stop at 10 m WD. General malfunction.
18:08 Reboot of CTD deck unit.
18:13 CTD not working while lowered to 25 m WD.
18:21 CTD operation aborted. Start recovery.
18:25 CTD on deck. SVP removed.
18:42 SVP deployed from portside frame.
19:32 SVP at bottom.
20:15 SVP on deck.
20:25 Move to resume MBES + SBP line after nearly 3 mile of northward drifting.
20:54 Start of MBES+SBP line 31A
22:03 End f line 31A
22:23 Start of eastward MBES+SBP line 32
28 July. Storfjorden Fan: MBES + Cores 02-03 *(wind W3, sea WSW2, no swell)*
00:08 End of MBES+SBP line 32
00:19 Start of long, southward MBES+SBP line 33
07:00 check of all electric connections of the CTD and WSC; CTD sensors removed from WSC structure and tested on the deck in a tank filled with sea water. Acquisition test in tank for few hours: the CTD sensors work without any problem. Conversely,

the WSC was not working: it did not control the firing of the bottles. It was hence decided to re-assemble the CTD on the WSC structure (which protects the CTD from bumps) without bottles. Testing of CTD in the sea was postponed to the following day since coring operations were already planned for this day. It was decided that MBES/SBP segment (composed by lines 34-36) will be the last northward one and that with the subsequent southward one we will follow the southern edge of the existing MBES dataset to reach the southernmost part of the Strofjorden Fan close to the INBIS Channel.
10:48 End of MBES+SBP line 33.
11:20 Start of northward MBES+SBP line 34 up to the next core site, planned at the crossing with MCS line 09.
12:41 End of MBES+SBP line 34 and positioning on the site for Core 02.
13:07 Corer in water.
13:32 Corer at the bottom.
13:56 Corer on board.
14:24 Start of northward MBES+SBP line 35 up to the next core site, planned at the crossing with MCS line 05.
18:59 End of MBES+SBP line 35 and positioning on the site for Core 03.
19:15 Corer in water.
19:38 Corer at the bottom.
20:02 Corer on board.
20:29 Start of northward MBES+SBP line 36.
29 July. Storfjorden Fan: MBES + Stations F, G *(wind W4 and sea NW3, no swell)*
00:45 End of MBES+SBP line 36.
01:13 Start of long, southward MBES+SBP line 37.
03:20 Fix to SBP from navigation found missing.
03:22 Interruption of PDS2000 and disconnection of Com Port 04. Line 37 ended at fix 134.
03:29 Reconnection of Com Port 04 and resumption of PDS2000. Line 37A started at fix 99.
05:43 Stop of MBES+SBP line 37A (at fix 131) at the crossing with MCS line 05 (Station F), and positioning for CTD downcast.
06:29 Start of CTD test down to 60 m WD. CTD properly working also during upcast.
06:42 Start CTD downcast (05) at Station F in about 1500 m WD.
07:20 CTD at bottom.
07:59 CTD on board.
08:29 Start of long, southward MBES+SBP line 37A (fix 132).
08:39 GPS jump.
9:00 After the regular performance of the CTD, the problem of the WSC was addressed in depth. After a series of preliminary check (that required uninstalling and reinstalling of the CTD from the WSC gear) it was deduced that the problem was likely a water leakage into the WSC unit. This problem will be addressed the following day (when only MBES and SBP was planned) since it require some hours only to dismount and remount the WSC unit, whereas a CTD + SVP (installed on the WSC structure for protection, but without bottles) was planned for the evening.
14:10 End of MBES+SBP line 37A.
14:11 Start of MBES+SBP line 38.
18:25 End of MBES+SBP line 38 and start of MBES+SBP line 39.
19:41End of MBES+SBP line 39.
19:43 Positioning on Station G (the same of Station B).
20:24 CTD + SVP (installed on the WSC structure, but without bottles) in water.
21:11 Gear at bottom.
21:49 Gear on board.
21:55 Moving to the start of MBES +SBP line 39A.
22:11 Start of southeastward MBES +SBP line 39A.

30 July. North INBIS Channel: MBES survey *(wind NW5 and sea NW4, swell NW2)*
00:22 End of MBES +SBP line 39A once the northward tributaries of the INBIS Channel were reached. It was decided that the subsequent lines (up to line 48 included) of the MBES survey, will follow a NW-SE trend, to fill the gap between the INBIS Channel and the SVAIS MBES survey.
00:41 Start of Southwestward MBES +SBP line 40.
03:11 End of MBES +SBP line 40.
03:31 Start of MBES +SBP line 41.
06:16: End of line MBES +SBP line 41.
06:30 Start of the work (Davide and Roberto) to verify and possibly solve the problem of the WSC. During the day it will be clear that a minimal, but possibly long-lasting leakage has produced a short circuit within the WSC unit. All the circuits were polished and all the system remounted. Late in the evening the WSC was mounted and apparently working.
06:31 Start of MBES +SBP line 42.
06:57 Rough sea and consequent poor quality data. Speed reduced from 8.5 knots to less than 7 knots. The same will be applied for subsequent northwestward lines.
07:21 Crash of PDS2000 and stop of MBES +SBP line 42.
07:25 Start of MBES +SBP line 42A.
09:29 End of MBES +SBP line 42A.
09:48 Start of MBES +SBP line 43.
12:25 End of MBES +SBP line 43.
12:37 Start of MBES +SBP line 44.
12:38 MBES 8111 switched on.
12:58 SVP disconnected from MBES 8111, manual input was 1488 m/s.
13:00 MBES 8111 switched off.
14:26 Speed reduction to turn off the engines.
14:32 Engines turned on and speed increased to 6 knots.
16:38 End of MBES +SBP line 44.
16:40 Engines turned off.
17:58 Engines turned on.
18:17 Start of MBES +SBP line 45.
20:28 MBES 8111 switched on.
21:14 End of MBES +SBP line 45.
21:25 Start of MBES +SBP line 46.
22:54 MBES 8111 switched off.
31 July. Kveithola: MBES, Station H, core 04 *(wind NW4 and sea NW3, no swell)*
01:34 End of MBES +SBP line 46.
01:54 Start of MBES +SBP line 47.
03:54 MBES 8111 switched on.
04:47 End of MBES +SBP line 47.
04:59 Start of MBES +SBP line 48.
05:46 MBES 8111 switched off.
07:42 End of MBES +SBP line 48. At this point, the gap between the INBIS Channel and the SVAIS MBES survey was not completely filled due to the time lost in consequence to either the rough sea (initially) and to the engines stops (successively). It was hence decided to skip part of the survey on the upper continental slope and to head northward, following the southeastern edge of the SVAIS MBES survey, up to its landward limit on the continental shelf. This decision was taken in order to allow enough time (the last 36 hours) for the MBES/SBP survey of the continental shelf, at the mouth of the Kveithola Trough.
07:43 Start of MBES +SBP line 49.
08:30 MBES 8111 switched on.
08:43 MBES 8150 switched off.
10:14 End of MBES +SBP line 49.

10:20 Start of southward MBES +SBP line 50 (with this and the following line we reach Station H, where we planned a CTD/WSC deployment and core 04 at about 350 m WD. This site was chosen at the end of MCS line 06, on the base of the SBP profile, which showed a nearly 100 m deep hollow at the mouth of the Kveithola Trough, with an unusually deep penetration for the shelf: about 20 ms).
11:22 End of MBES +SBP line 50.
11:41 Start of MBES +SBP line 51.
12:46 End of MBES +SBP line 51 and move for positioning on Station H.
13:19 CTD/WSC/SVP gear in water.
13:34 Gear at bottom.
13:40 During the upcast some problems occurred: the pump of the salinity sensor stops a couple of times and bottle firing was uncertain. As a result, only six of the 12 planned water sampling were successful.
13:50 Gear on board and moving to extend by a couple of lines the MBES survey on the hollow while we give to Cinzia the time to spill the water from WSC and to Roberto and the crew the time to prepare the corer.
14:09 Start of MBES +SBP line 52.
15:10 End of MBES +SBP line 52.
15:30 Start of MBES +SBP line 53.
16:37 End of MBES +SBP line 53 and positioning for core 04. The coring site was moved about 1 km norhtwestward along MCS line 06, This choice was made to centre the site in deepest part of the hollow, the on the base of the MBES and SBP data just collected. These data also show very nice lineations at the bottom of the hollow, on which we decide to focus the following MBES survey.
17:07 Corer in water.
17:18 Corer at the bottom.
17:26 Corer on board.
17:53 Start of MBES +SBP line 54 (to complete, with this and the following lines, the MBES survey of the basin).
18:23 End of MBES +SBP line 54.
18:31 Start of MBES +SBP line 55.
18:55 End of MBES +SBP line 55.
19:06 Start of MBES +SBP line 56.
19:31 GPS jumps.
19:41 End of MBES +SBP line 56.
19:44 Start of MBES +SBP line 57.
20:50 End of MBES +SBP line 57.
20:59 Start of MBES +SBP line 58.
22:09 End of MBES +SBP line 58. We decide at this point to run an MBES line toward east, to explore the morphology to the east of the hollow.
22:14 Start of MBES +SBP line 59.
23:38 End of MBES +SBP line 59. After having crossed a slight depression also showing some lineations at the seafloor we decide to choose this site for the last coring and CTD/WSC operations for the following day. We hence plan to complete during the night the MBES/SBP survey of the system composed by hollow and depression.
23:46 Start of MBES +SBP line 60.
1 August. Kveithola Trough: MBES survey *(wind NNW6 and sea NW5, no swell)*
02:31 End of MBES +SBP line 60.
02:49 Start of MBES +SBP line 61.
03:43 End of MBES +SBP line 61.
03:51 Start of MBES +SBP line 62.
04:50 End of MBES +SBP line 62.
04:58 Start of MBES +SBP line 63.
05:58 End of MBES +SBP line 63.

06:04 Start of MBES +SBP line 64.
06:26 End of MBES +SBP line 64.
06:29 Start of MBES +SBP line 65.
07:00 Considering the short time left before we need to left the area of operation, and upon the news that the WSC was not working any more, it was decided to collect just one core (at about 10:00) and to spend the remaining time in MBES survey of the mouth of the Kveithola Trough.
07:25 End of MBES +SBP line 65.
07:34 Start of MBES +SBP line 66.
08:29 End of MBES +SBP line 66.
08:39 Start of MBES +SBP line 67.
09:21 End of MBES +SBP line 67.
09:29 Start of MBES +SBP line 68.
09:35 Beginning of eclipse of sun.
10:00 Suddenly, when we were ready for coring, a strong wind (up to 30 knots) rose up and prevents core operations. We decided to continue MBES till the end of the time left before we needed to start the transit for Kristiansund.
10:11 End of MBES +SBP line 68.
10:20 Start of MBES +SBP line 69.
10:24 Launch of XBT0 053.
10:30 End of eclipse of sun.
10:35 Launch of XBT0 054.
10:42 Launch of XBT0 055.
10:53 Launch of XBT0 056.
11:00 Launch of XBT0 057. At this point we decide to go south and add a line on the southern edge of the MBES survey of the hollow at the mouth of Kveithola Trough.
11:01 End of MBES +SBP line 69.
11:09 Start of MBES +SBP line 70.
11:32 End of MBES +SBP line 70.
11:35 Start of MBES +SBP line 71.
11:45 We understood that, due to the worsening of the sea condition coming from NW, the last planned line toward NW would have been too noisy. We were hence forced to abandon and we hence decided to acquire the last eastward line (72) before the time to end the operation.
12:50 End of MBES +SBP line 71.
12:59 Start of MBES +SBP line 72.
13:10 Start of ADCP calibration.
13:56 End of MBES +SBP line 72.
14:04 Start logging line for ADCP calibration going backward along line 72.
14:33 End of EDCP calibration, and start transit to Kristiansund.
2 August. Transit toward Kristiansund *(wind NNE4 and sea NE3, swell NE1.5)*
Acquisition shifts were terminated. The work was organized to prepare backups, to store samples and material to be disembarked, to assemble the cruise report and a poster for the 33° International Geological Congress in Oslo.
3 August. Transit toward Kristiansund *(wind NE4 and sea NE4, swell NE1)*
03:41 Launch of XBT0 058 on the lower Lofoten margin.
04:40 Launch of XBT0 059 on the mid Lofoten margin
06:11 Launch of XBT0 060 in correspondence of the Norwegian Atlantic current on the upper Lofoten margin.
4 August. Arrival in the port of Kristiansund *(wind NNE4 and sea NE3, swell NE1.5)*
An almost complete draft of the cruise report was prepared and the poster for the 33° IGC was plotted.
An identical backup copy was stored in two different hard disks (one travelling with Michele and one with Claudio).
13:42 Berthed at the dock in the port of Kristiansund.

2. DATA ACQUISITION

Gun deployment operations

2.1 Navigation

Navigation system, PDS2000 (Reson), is connected and communicates with all other acquisition instruments (except XBT) present on board (see annex B.1). Before leaving Kristiansund harbour a new release (V 3,3,0,10) of navigation software was installed on navigation workstation (WS17). Some part of the software and some interconnections with the other instruments were not working properly at the beginning. We hence requested and obtained from the producer new drivers that once installed allowed the system started to run properly. The instruments interfaced with PDS2000 include two MBES (RESON - 8111 for shallow water and 8150 for deep water), MCS acquisition system (SERCEL), Singlebeam echosounder (SIMRAD - EA600), Subbottom profiler (SwanPro), Currentometer ADCP (RDI) and Thermosalinograph (SBE).
The operators of the navigation takes also care of the MBES system and of the master log, where all ship operations are registered. The control stations of many instruments are in the same laboratory of the navigation/MBES workstation. Moreover, the operators of the navigation strictly communicate (by phone or radio) either with the operators of the other instruments and with the bridge to adjust vessel track and speed according to the circumstances. Before leaving, the PDS2000 project was created drawing the chart of working area with the MCS and the MBES lines, the XBT launching waypoints and all the information useful for the survey such as the morphobathymetric data (geotiff) and SCS tracklines acquired during the SVAIS cruise.
The list of the acquisition lines is reported in Annex C.1

During the MCS survey we shot at fixed distance, with position (fix) sent to the MCS acquisition system by PDS2000. For the first MCS lines in the northern part of the survey (from IT-EG_01 to IT-EG_02B) the shooting interval was 12.5 m while from line IT-EG_03 it was 25m.

Sometimes unexpected "jumps" (loss of positioning) of GPS created troubles such as a sudden increase in fixes sent to MCS and SBP acquisition systems (see chapter 2.10: Problems and remedies). All these events were registered on the Master log to help, later on, people involved in data processing. Additionally, waypoints (start event - end event) were added in the PDS2000 data to highlight the event. This way of registering 'external events' was used for everything strictly connected with navigation and acquisition. Another problem that has occurred, was a slow updating of DTM on PDS2000 that forced to stop logging and to re-start both pc and software of acquisition. This operation has temporarily solved the problem (see chapter 2.10 Problems and remedies).

2.2 Swath (MBES) bathymetry

For bathymetry survey two RESON MBES were employed, the MB8111 and the MB8150 (see Annex B.2.2); the former for shallow water (up to 400m WD) and the latter for deep water (up to full ocean depth). Both the systems were calibrated during the preceding cruises, and there was no need for new calibration lines.

During the transfer to working area 1036 km^2 of MBES data were collected. Inside the Isfjorden going to Longyearbyen and back to working area, additional 324 km^2 were collected.

The list of the MBES acquisition lines is shows in Annex C.1.

During the first part of the survey the main objective was the MCS acquisition. The MBES acquisition was always active during the MCS survey. The first SVP was measured during the transit and the second upon arrival in the working area (see Annex C.2). However, since the ship cannot be stopped while the MCS gear is deployed, and since every recovery+deployment operation takes over 2 hours, the collection of SVP measures during the MCS survey was not feasible.

During the acquisition of the dip (east-west) MCS lines the water depth changed from 100m to 2300m, so we had to switch from a MB system to the other one, with some overlap. In accordance with the Party chief it was decided to acquire always bathymetric and snippets data, while the SSS data acquisition was stopped during the time of overlap with both systems switched on. The purpose was to avoid to an excessive flow of data and to prevent a possible crash down for overload of the acquisition software.

At the beginning of MCS line 05 (06:15 of 19 July) the snippets data acquisition failed, but considering the acquisition of the snippets not essential during the MCS acquisition we decided to continue without snippets for this line since a delay would have required a loop of at least one hour (without the certainty to solve the problem in the meantime).

At the end of line 05 the acquisition software was rebooted and checked for viruses. From start of line 06 (23:17 of 19 July) the acquisition of snippests was reactivated and worked properly.

After many hours of uninterrupted acquisition the large amount of data acquired generated some memory problem, and all of the functions were slowed down. The problem happened the first time at 04:52 of 21 July. A part from that, the MBES and acquisition software didn't have any problem. The PC was rebooted during loops between the seismic lines just to avoid slow down of the software.

Small problems occurred with GPS signal. The jumps periods were always very short, so the simplest solution was waiting few minutes.

At 07:37 of 23 July the seismic survey was completed, and started the MBES and SBP survey. All the acquisition lines were planned to have about 30% of overlap. The first target was to cover an area close to the Shelf edge between the northern part of the Storfjorden Fan and the Bellsund Fan. The water depth changed from 200m to 1000m, so both the systems was used. Then we proceeded toward deep water, acquiring lines in North-South direction. At the end of Line 23 the ship stopped for the first coring. After the coring we start to move to Longyearbyen for crew change, and than MBES acquisition re-started. The last line acquired in this area was on 29 July.

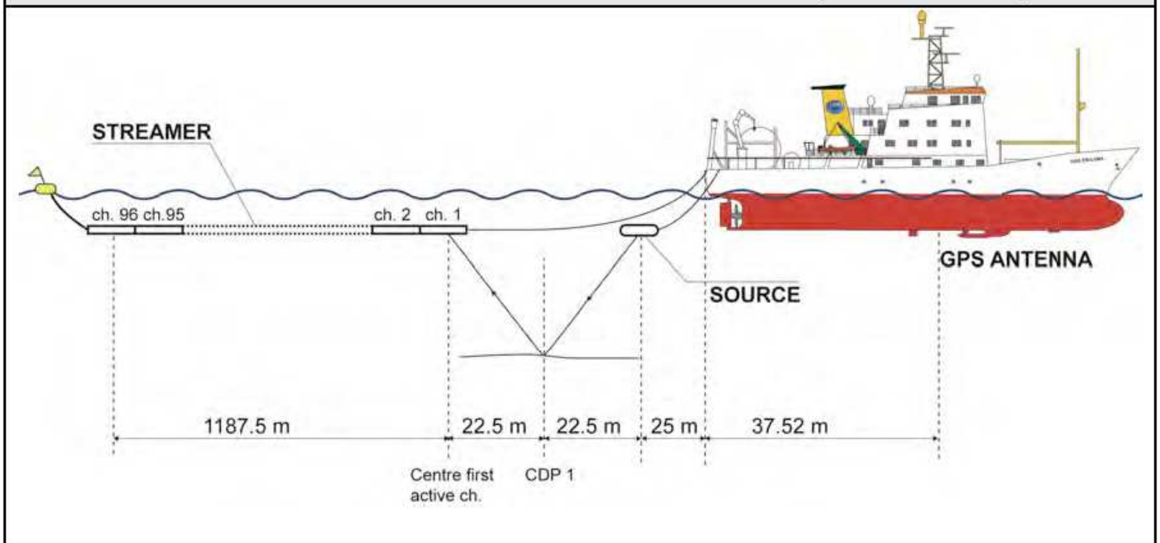
Then we move to the southern part of the Storfjorden Fan, close to the INBIS channel where WD was variable from 200m to 1500m. The lines was acquired in NW-SE direction for the deepest part, and then we followed the morphology to obtain full coverage and overlap 30%. During this part of the survey the sea conditions were not good as the days before. The lines in SE-NW direction were noisy even though acquired at 6 Knots. After surveying the slope, we moved to the shelf to survey the Kveithola fan. The MBES survey ended on the 1st August at 14:37.

2.3. MultiChannel Seismic (MCS) Acquisition

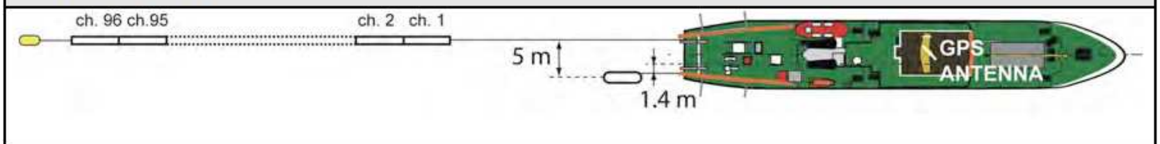
2.3.1. Seismic Acquisition parameters

The choice of the acquisition parameters was driven by the needing of a good compromise between resolving power (to fully discriminate the shallower reflectors) and penetration (to reach the acoustic basement). When possible, both the source and the streamer were kept at a depth of 3 m, with a theoretical notch in the emitted and received energy spectrum at a frequency of 250 Hz (corresponding to wavelengths of approximately 6 m and resolving limit in the order of 1.5 m). With bad weather conditions, in order to prevent the data to be too severely affected by noise, the streamer was lowered to 4 m depth (notch at about 190 Hz).
The acquisition parameters are summarized in the Fig. 2.3.1 and Table 2.3.1 A more detailed description of MCS seismic equipment can be found in the Annex B.2.4)

FIG. 2.3.1. R/V OGS EXPLORA SEISMIC EQUIPMENT LAYBACK (NOT TO SCALE).



LATERAL VIEW



PLAN VIEW

The source consisted of 4 Sleeve air guns with a total volume of 160 cu.in. Since reflected energy could be seen up to 4.5 sec in the line IT-EG_01 and IT-EG_02, the recording length was lengthen from 5 sec to 10 sec, starting from line IT-EG_03, in an attempt to search for deeper signals. Consequently, the shot point interval was brought from 12.5 m to 25 m, decreasing the fold from 48 to 24. This solution was considered reasonable given the overall good quality of the data, and also allowed the vessel speed to be increased from 4 kn to 4.5 kn with consequent time spare. During the operations the guns were retrieved on board for general inspection and maintenance at the end of each profile.
The sample rate was set at 1 ms, largely sufficient to record data whose spectrum is in any case confined by the notch at 250 Hz. The record length, as explained above, was initially set to 5 sec for the first lines and successively increased to 10 sec after verifying the good penetration guaranteed by the sleeve guns. The recorded data were logged on the acquisition workstation hard disk and real time shifted on a

remote PC. Back up copies were stored at the end of each line on an external USB hard disk.

Table 2.3.1. ACQUISITION PARAMETERS

SOURCE		**STREAMER**		**RECORDER**	
Type	Sleeve Airguns	Type	Sercel Seal	Type	Sercel Seal 2000
Array Volume	160 cu ins	Active length	1200 m	Sampling rate	1.0 ms
Source depth	2.5m ± 0.5 m	Groups No.	96	Recording length	5 sec / 10 sec
SP interval	12.5 m / 25 m	Group interval	12.5 m	Filters	3 Hz (Low cut); 400 Hz (High cut)
SYSTEM TIMING		Towing depth	3.0 m ± 0.75 m	Auxiliary channels	Channel 1 near -field phone
Controller	RTS Hot Shot	Near offset	45 m	No. of channels	96
Delay Rec-TB	100 ms	Fold coverage	48 / 24	Coverage	48 / 24 fold

2.3.2. Acquisition history

The seismic acquisition started on July 16th after the two days stop in the Longyearbyen bay and ended on July 23rd. Over a time span of 7.4 days, a total length of 1078.38 km of seismic profiles was recorded. In the following paragraphs, a brief resume of the operations is reported (see also the cruise diary). Refer to the map in Fig. 2.3.2 for further details on the location of the profiles. In the Annex D.1 the general statistics are summarized.

Profile IT-EG-01 and IT-EG_01A

Seismic operations started on July 16th right after westward trespassing the longitude of 12°E (corresponding to the offshore border of the Svalbard Islands natural park area). Latitude was about 78°, the bearing NE-SW. MSC gear was deployed starting from 03.05. Shooting test on guns and noise test on streamer started at 05.10, but the guns had soon to be retrieved on board due to a malfunction of guns No 1 and 3. After proper maintenance (replacement of solenoid valves) the gun could be deployed again and the acquisition regularly started at 08.52. Meanwhile, the distance between the source and the streamer was extended to 100 m. After about 1 hr, the near offset had to be shortened again to 45 m (70 m from the stern) because of bad buoyancy (the firs channels were sinking too deep).

At 11.30 acquisition had to be stopped again because of an air hose air leakage. After replacement (and having the ship recovered the last SP position) the acquisition could re-start (naming the new line 01A) at 13.16. At 19.35 some problems with GPS mispositioning resulted in wrong controller firing commands. After re-booting both the navigation (at 19.42) and the gun controller system (at 20.04), with the GPS looking ok, the line could start again. This time it was decided not to run a loop, so that part of the planned profile was definitely lost during this stop. At 22.22 the acquisition along the line ended and the ship started the loop towards the SOL of the second profile.

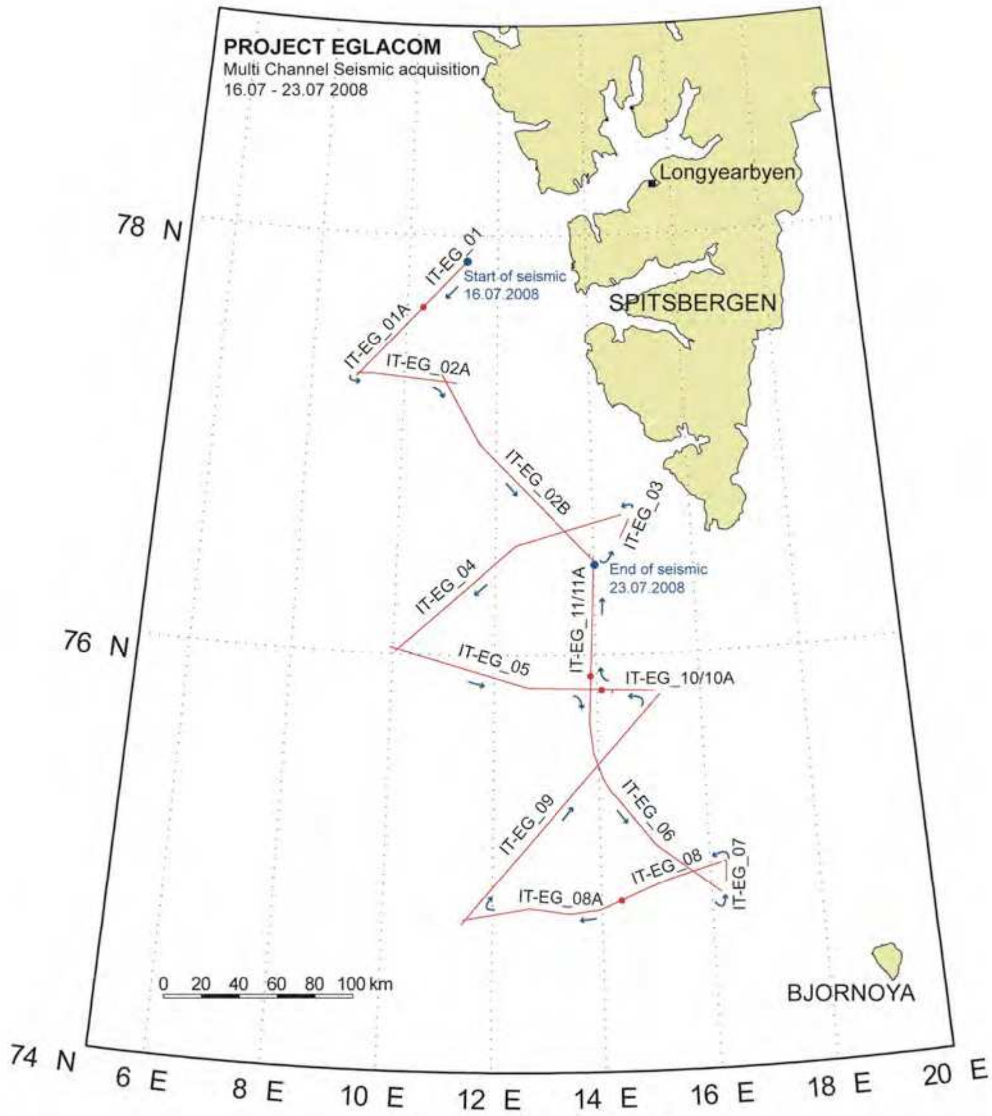


Fig. 2.3.2. Location of the seismic profiles (in red). Blue arrows show the courses of the ship.

Profiles IT-EG_02, IT-EG_02A and IT-EG_02B

The profile IT-EG-02 started on July 17th at 01.12. After 16 min the recording was interrupted due to a navigation failure. The acquisition re-started at 01.33 (no loop was requested) along the profile, renamed as IT-EG_02A.

Profile IT-EG_02B (the long crooked strike tie line, running parallel to the Spitsbergen Island shore) started at 10.15. Apart from a GPS positioning jumping problem that affected the acquisition for about a minute around 02.18, the acquisition proceeded regularly until the end of the profile, on July 18th at 05.15.

Profile IT-EG_03

This line was not part of the original acquisition plan; however, taking into account that the transfer to line IT-EG_03 at 10 knots plus the operations of retrieving and redeploying the seismic gear would have taken the same time as proceeding on at 4.5 knots, it was decided to shot this additional profile whilst moving towards the next line's SOL. The acquisition started at 09.06 and ended at 11.14. From this line onward (within the Storfjorden Fan), the parameters was SP interval 25 m and record length 10 s.

Profile IT-EG_04
The line started on July 18th at 11.18. Initially planned to reach Site DSDP 344, its length was eventually shortened and its course changed to intersect the next line in a landward position (about 76°N 10°E). Course change occurred at 18.44. The acquisition ended on July 19th at 05.35.

Profile IT-EG_05
The line started on July 19th at 07.31 and ended that same day at 21.28.

Profile IT-EG_06
This profile was planned as part of the long southward tie line that, according to the initial plan, should have started at the end of profile *IT-EG_02B.* Taking into account the excellent weather forecasts in the southern part of the investigated area over the following few days, it was eventually decided to immediately move southward and split this long tie-line into two segments, the first one named *IT-EG_06* and bearing southward in the first half and bending to SE in the second one.
Acquisition started at 23.17 and ended on July 20th at 16.42.

Profile IT-EG_07
Following the same reasoning already applied between lines IT-EG_02B and IT-EG_04, this transfer profile was recorded whilst northward transiting between lines IT-EG_06 and IT-EG_08. It started July 20th at 17.50 and ended less than two hours later, at 19.23, when almost on the next profile.

Profile IT-EG_08 and IT-EG_08A
The profile, running in W-SW direction, started at 19.34. Due to a failure in the communication between navigation and recording systems, the profile had to be temporarily stopped on July 21st at 02.25. The acquisition re-started immediately, naming the profile IT-EG_08A. At 05.03 the navigation system PDS2000 had to be switched off because too slow in updating MBES DTM; one minute later, after re-booting, the profile could proceed on until the end of acquisition, at 13.52.

Profile IT-EG_09
The course of this profile was changed with respect to the original plan so as to tie to line ---- and avoid long transfer without acquiring data. The profile, bearing in SW-NE direction, started at 15.34 on July 21st and ended at 12.19 on July 22nd.

Profile IT-EG_10
This line, running in E-W direction, represents the easternmost segment of the profile Profile IT-EG_05, which was abandoned on July 19th at 07.31 at 21.28 to move southward along profile IT-EG_06 (see above). It started at 12:52 and, was characterized by some noise due to swells from NE. Due to a problem with the gun No. 2, the line had to be stopped at 16.41. After gun recovery and maintenance and a long loop, the acquisition re-started at 18.47 along the new line
IT-EG_10A, which ended at 19.45.

Profile IT-EG_11 and IT-EG_11A
According to the plan this profile was part of the long southward tie line that was decided to split into two segments (the first being named IT-EG_06 and recorded in southward direction between July 19th and July 20th). Profiles IT-EG_11 and IT-EG_11A were recorded in northward direction until crossing the profile IT-EG_02B, were seismic operations definitely ended. IT-EG_11 segment started on July 22th at 20.40 and ended at 21.54, the interruption due to an air leakage. Once retrieved the guns and fixed the problem, the acquisition could re-start at 23.41 along the new line IT-EG_11A, which ended at 07.30 on July 23th.

See chapter 3.1 regarding the on board processing of the SEGD raw data.

2.4. Sub-bottom

OGS Explora is equipped with a Chirp Sub Bottom Profiler Benthos CAP-6600 (see Annex B.2.3).
It consists of 16 keel mounted AT 471 transducers and a top side unit, composed of an analogic amplifier and a data logger. The A/D conversion is performed by a 16 bits DSP card. Sweeps range between 2 and 7 kHz. This configuration assures full ocean depth investigations. SwanPro (by Communication Technology) acquisition software was used to collect the data, which were real-time plotted on an EPC thermal printer. Data were acquired in XTF format and subsequently stored either in XTF or SEG Y format. Navigation is extracted from SEG Y files through running Seispro software, and mapped in Petrosys (along with MCS navigation). The SBP survey was run in parallel with either MBES and MCS surveys (see Annex C). At set space or time intervals, fix events generated by the navigation software were delivered to the acquisition system and recorded within the SBP data headers, resulting in a coupling of MBES and SBP data. During the cruise, the events were sent to the SBP every 300 m when acquiring MBES data. Conversely, during MCS survey, there was a fix in correspondence to each shot point (every 12.5 m to 25 m, according to MCS shooting).
SBP data acquisition started as soon as possible after leaving Kristiansund, during the transit to the study area. The SBP lines (always acquired along with MBES, and during MCS survey from 01 to 11) are listed in Annex C.1 and located in Fig. 2.4.1.
Sub-bottom profiles 09, 29 and 42A were not registered because of a problem with SwanPro acquisition software (doesn't start recording). For these lines we have only the plot on EPC printer.

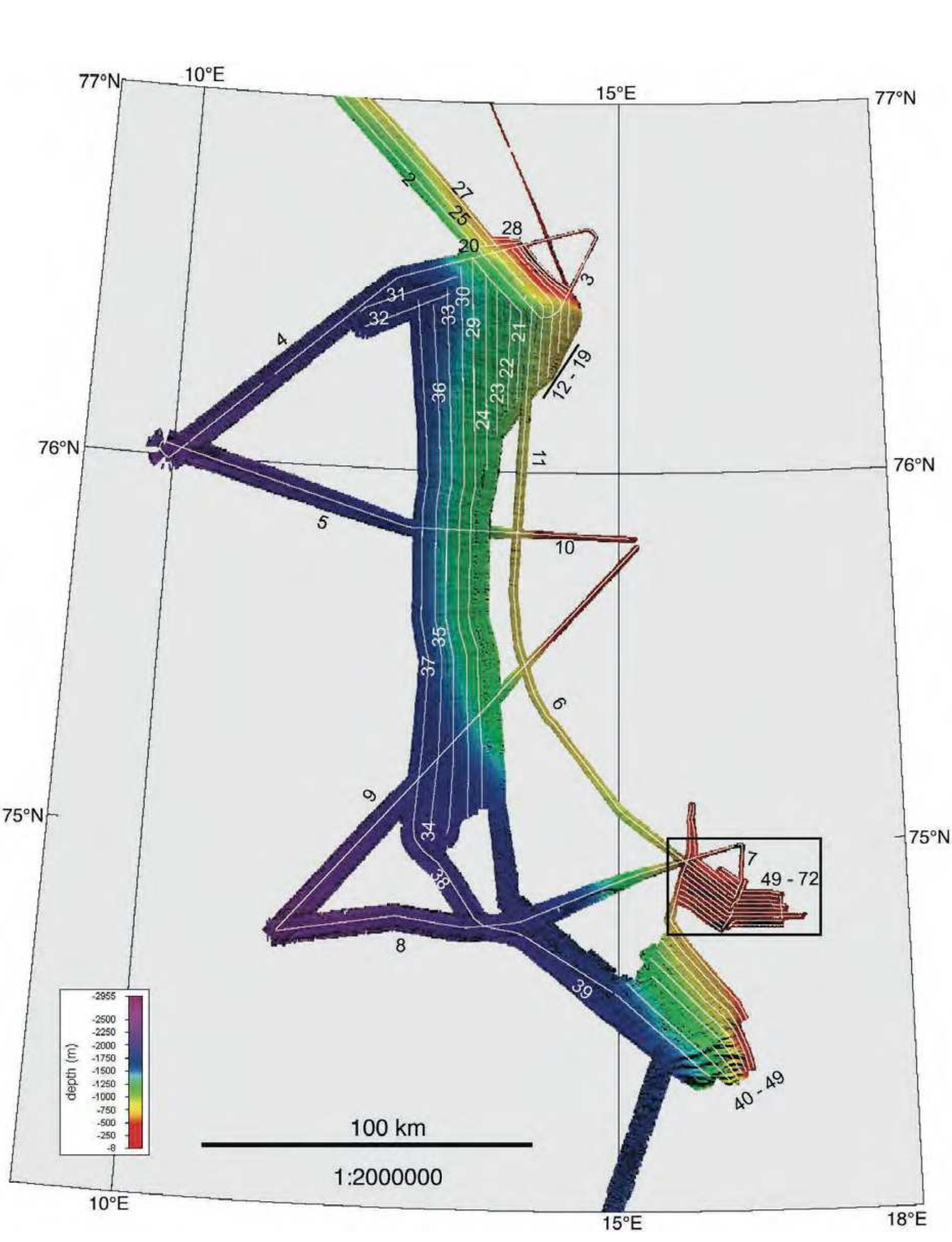


Fig. 2.4.1 Location map of SBP (CHIRP) lines

2.5. CTD and Water Sampling Carousel (WSC)

A CTD/Carousel system SBE 911plus was installed onboard for this cruise to measure the phisical and chimical/biological parameters in the water column.
OGS-Explora is a geophysical vessel, and CTD/Carousel have never been employed onboard before (with the exception of a auto-recording CTD unit). The two small side frames (generally used to tow the guns) cannot be employed for this scope.
A winch with 3,000 m of 11.6 mm iron-armored coaxial cable (employed in the preceeding cruise to tow a Side Scan Sonar) was used for the mechanical and electric (power, data transfer) connections. Two mechanical doglegs through snatch-blocks were necessary to employ the stern frame (to bypass a crane in between the path allowing a correct winding angle). The operations were a little bit more complicted than usual due to the limited space and the presence of the corer and the seismic gear, but could be performed in safety.
The system consists of a deckunit SBE 11plus and an underwater unit SBE9plus with the following sensors:
Pressure, Digiquartz [db]
Conductivity [mS/cm]
Temperature [ITS-90, deg C]
Oxygen Beckman/YSI [uA]
Fluorescence, Chelsea Aqua 3 Chl Con [ug/l]
Optical Backscatter, Seatech LS6000
During the transfers, the sensors (CT) were preserved in distilled water to uneffect them with salt deposits. The temperature sensor was calibrated on the 10 June 2008, and were checked every 6 months. Upon next calibration, should the measure be included within a range equivalent to the double of the sensor's accuracy (deviation lower than 0.004 °C in temperature and 0.006 mS/cm in conductivity), the acquired data are accepted, otherwise a drift factor will be calculated and applyied to the data.
The CTD is fastened to the seabird SBE32 Carousel for firing 12 10-liter Niskin bottles during the upcast phase. In addition, the SVP (Sound Velocity Probe) for calibration of the MBES was fastened to the CTD/WSC gear. With this system, water sampling, CTD and SVP measures can be conducted in a single cast. In case of non optimal sea conditions, only SVP can be opearted from the side frame.

The planned CTD/WSC/SVP stations (one at each degree along a NNW transect from 68°N to 74°N, integrated by XBT launches every half degree) along the transit toward the Svalbard were not executed due to the sea conditions. Hence only an SVP calibration (SVP01) was than performed the 10 July at about 2000 m WD in correspondence of the Norwegian Atlantic current at NW edge of the Voring Plateau – SW margin of the Lofoten Island (Station A).
The first, completely successful operation of the CTD/WSC gear was performed on the 12 July, upon arrival in the study area, on the southern end of the Storfjorden Fan at about 1600 m WD. In this site (Station B,) the whole CTD/WSC/SVP gear was operated (SVP02, CTD01, WSC01). It stopped at 1583 m depth and 6 Niskin bottles were closed at 1580, 1200, 750, 400, 100, and 5 m.
The CTD/WSC gear was not operated during the following days, till the end of the seismic survey and the beginning of the MBES survey.
On the 26 July, in the northern part of the Storfjorden Fan, the CTD/WSC gear was operated in two stations (C and D). In Station C (CTD02 and WSC02), at about 435 m WD along MCS line 04, the CTD/WSC gear was stopped at 15 m above the seafloor, and 5 Niskin bottles were closed at 420, 250, 100, 40, 5 m. SVP for MBES calibration, not considered essential for this depth range, was postponed to the next site. In Station D, at about 1000 m along MCS line 04, a breakdown of the WSC prejudiced the following operations and required many days of tests and and careful

work to identify and fix the problem (see chapter 2.10, Problems and remedies). After an initial malfunction, the CTD recorded a complete CT profile during downcast to 25 m above seafloor (CTD03). SVP as well was performed (SVP03). Conversely, WSC refused to close the bottles and than the tempeature sensor stopped working.
On the 27 July, Station E (northern Storfjorden Fan, at about 1700 m WD adjacent to the south to XBT016 site along MCS line 04) CTD cast was selected for a test (using the WSC structure for protection against possible bangs with the hull, but without the bottles). The CTD malfunctioned (conductivity remained zero in the sea water, preventing the start of the pump) and the opeartion aborted. Only an SVP (SVP04) was performed in that station.
On the 29 July, in Station F (central Storfjorden Fan, at about 1500 m WD at the crossing between MBES+SBP line 37A and MCS line 05) a CTD cast was operated (with WSC structure, but without bottles). CTD04 was recorded down to nearly 1500 m WD without any malfunctioning (evidently the problem was generated by an electric breakdown to the system of bottle firing). While waiting for the solution of the WSC problem (see chapter 2.10 Problems and remedies), a CTD+SVP cast (CTD05, SVP05) was operated in Station G (the same of Station B, at the southern margin of the Storfjorden Fan).
On the 31 July, the CTD/WSC/SVP gear was operated in Station H (Kveithola Trough, about 350 m WD). The CTD sensors worked properly during downcast (CTD06 and SVP06). During the upcast some problems occurred. As a result, only six of the 12 planned water sampling were successful (WSC03) and bottle firing was uncertain. The depth of the bottle firing, will be verified in laboratory through salinity analisys from the water samples taken from all bottles.
A last CTD/WSC was initially planned in the Kveithola Trough. However, upon the news that the WSC was not working any more, it was decided to renounce and devote the remaining time to other operations.

In conclusion, replicate water samples along water column were collected in three stations (see Annex C.2) and prepared for biological post-cruise analysis (see chapter 3.4 and Annex D.4). At each site, five to ten discrete sampling depths from surface to bottom were selected according to the hydrological features of the water column. At each depth of every station, dissolved oxygen was determined and analyzed within a few hour after collection. Samples for DIC, inorganic nutrients, DOC, DON, DOP, POC, PN, chl *a* and phaeo, HPA, PBA, planktonic community respiration, prokaryotic community structure, quantitative and qualitative analysis of microphytoplankton and microzooplankton were collected at selected depths.

2.6. Thermosalinograph (TSG) and surface water sampling

A seabird SBE 21 thermosalinograph (TSG) is installed on the ship, in the bow hold, to record temperature and conductivity of surface waters (see Annex B.3.2). The bow sea-water intake, through to a pump brings the water to TSG, allowing to collect water samples for chemical/biological analysis. In correspondence of the bow sea-water intake an additional thermometer (SBE38) allows an accurate measure of sea surface temperature with minimal thermal contamination from the interior of the ship.
Salinity and derived properties (density and sound velocity) can be calculated from the values measured with the SBE 21 sensors. The georeferentiation of TSG data was obtained through a NMEA port, which is interfaced with the main GPS. Sampling interval was 5 seconds, and data stored in the internal memory were acquired and plotted in real time with seasave software (see chapter 3.3 and the list of converted files Annex D.3).
After maintainance operations at the beginning of the cruise, TGS worked properly with the exception of two interruptions (see chapter 2.10, problems and remedies), from the afternoon to 18:00 of the 15 July and from 13:10 to 15:12 of the 16 July.

By means of the pump connected to the TSG, replicate surface seawater were collected every degree or half degree (latitudinal section) along a south-to-north transect from 65° to 78°N (see the list in Annex C.3) and prepared for post-cruise biological analysis (see chapter 3.4 and Annex D.4). At each site, samples were taken for chemical analysis of dissolved inorganic carbon (DIC), dissolved inorganic nutrients (ammonium, nitrite, nitrate, phosphate and silicate) dissolved organic carbon, nitrogen and phosphorous (DOC, DON, DOP), particulate organic carbon and nitrogen (POC, PN) and chlorophyll *a* (chl *a*) and phaeopigments (phaeo). At same sites, samples for the count of heterotrophic (Heterotrophic Prokaryotes Abundances - HPA) and phototrophic (Phototrophic Bacterial Abundances - PBA) picoplankton, for planktonic community respiration measurement and for prokaryotic community structure analyses were also collected. Samples for quantitative and qualitative analysis of microphytoplankton and microzooplankton were taken only every degree.

2.7 XBT

An expendable bathythermograph (XBT) system is installed on board to measure the temperature in the sea water column without stopping the ship, hence suitable to its use during e.g. the seismic survey.
The system consits of a PC interfaced with the CSIRO (Australian division of Marine and Atmospheric Research in conjunction with the Australian Bureau of Meteorology) acquisition card controlled by software Devil UI (version 2.05) XBT Launch Quality control and Transmission program. The system is interface with a GPS that generates a fix with the position in the moment that the XBT probe is launced. For the probe launch a dedicated pipeline was mounted near the winch control cabin where the control PC is installed. For this scope a corer liner (6 m long, 8 cm diameter) was employed. It allows to separate by 1.5-2 m the launch point from the hull and to lower the fall to 3.7 m. In this way the risk of contact with the hull or with the seismic gear is reduced.
Three different XBT types were launched with reference to water column depth:
XBT T-10 (speed up to 10 kts, and WD up to 208 m depth),
XBT T-6 (speed up to 15 kts, and WD up to 460 m depth) and
XBT T-5 (speed up to 6 kts, and WD up to 1830 m depth).

The list of the 60 XBTs launches during the cruise is shown in Annex C.4

The acquired data were not processed on board. They were only converted in ACII format, without the use of the processing utilities provided by the Devil software. Row data include time (since the beginning of the acquisition) and temperature. On the base of the known sinking velocity curve (according to the various types of probe) the depth is than calculated from the time. Additional corrections will be performed during the post-cruise analisys when the calculated depth of the spike usually shown close to the sea floor will be matched with the depth measured by the MBES.

2.8 ADCP

An Acoustic Doppler Current Profiler (ADCP) RDI Ocean surveyor 75 KHz is mounted on the hull (see Annex B3.1), which allows a measure of the currents down to a maximum depth of about 700 m (according to environmental conditions). The ADCP receive the navigation directly from the main GPS and heading, pitch and roll data from the Phins inertial system through the navigation system PDS2000. The sytem was configured with 8-16 m cells ranging from 480 to 1000 m in broadband or wideband modality, according to maximum depth, ship's speed and environmental conditions.

ADCP data were converted to perform a a preliminary analisys (see chapter 3.4). The list of the files with details about data and hour of start/end and coordinates is shown in Annex D.5.

On the 12 July (since file 19) the driver controlling the output of heading information to ADCP was changed. Moreover, heading information in all ADCP data needs also to be corrected during post-cruise laboratory analisys according to the aligning test performed at the end of the cruise (see chapter 2.10, Problems and remedies).

On 24 July at 06:50 VmDas software stops (likely due to a problem with the PC system software). The system is resetted and once restarted does not show any anomaly.

2.9 Cores

Four sediment cores (Annex C.5) were collected using a gravity corer. The length of the pipe is 183 cm. The cable was stopped at about 30-40 meters above the seafloor to allow verticality and to wait the ship drift to the target.
Once onboard, the cores were cut in sections of about 90 cm (Annex C.6) and stored in the refrigerator at 4°C.
Surface sediment subsamples of core EGLACORE 01 were frozen (-20°C) in order to compare the biological data obtained from different storing systems.
Due the length of the corer, the core location was decided in order to penetrate at least the upper Holocene stratigraphic sequence.
Core EGLACORE 01 sampled a sequence at 1069 meters WD, were we expected a continuous and relatively expanded stratigraphic record. The corer penetrated beneath the seafloor more than the corer length, so we recovered the upper part of the record from the corer head.
Cores EGLACORE 02 and EGLACORE 03 sampled the stratigraphic sequence in front of the Storfjiorden trough-mouth system. Based on the sub-bottom profiles they could have sampled the same stratigraphic record sampled by core 01 but more condensed (since in more distal and deep settings).
Core EGLACORE 02 penetrated beneath the seafloor more than the corer length, so we recovered the upper part of the record from the corer head, but we lost the water-sediment interface.
Core EGLACORE 03 also penetrated more than the corer length, but we recovered the upper part of the record up to the water-sediment interface from the corer head.
Core EGLACORE 04 sampled a sequence within the shelf basin at the mouth of the Kveitola Trough. The corer penetrated 105 cm beneath the seafloor.

2.10 Problems and remedies

We decided to assemble in this chapter the description of most of the problems we had to face during the cruise. Without any pretence to be exhaustive, we considered that a chapter of this kind may be useful for those that in the future will need to deal with the same instruments or with similar issues, beside those that will need to process the data.

2.10.1 Navigation and MBES system

Communication PDS2000-MBES

At the very beginning of the MOB, with the ship still berthed, there was no communication between the MBES 8150 and the workstation running PDS2000, whose network connection appeared tremendously slow. Switching off and on and removing some temporary files did not improve the situation, which was eventually solved by replacing a wire and switching among the ports in the hub located in the back of the MBES cabinet (navigation room).

General software issues

PDS2000 2.0.0 version formerly running was upgraded to 3.3.0.10 version during transfer. With respect to the former one, the latest version can handle both pseudo-SideScan Sonar (SSS) and Snippets simultaneous acquisition even with both of MBES switched on (WD 400-600 m), without any crash of the system. However, in few occasions the acquisition of snippets and/or SSS data failed. This problem was solved with a restart of the system. Timeout messages concerning EA600 and SSS acquisition were often shown, apparently without any consequences. After innumerable attempts to avoid this, it was decided to ignore them. In some cases, though excessively slow DTM calculation, no data appeared to have been lost. The possibly most frustrating problem was that of the GPS "jumps". Nothing could be done about this but waiting for normalization of the positioning system, which usually took some seconds.

Sound Probe

The hull mounted SVP stopped working correctly at least twice in a month. The first time – on July 10th - yielding anomalous low values (1350 m/s). The problem was initially overcome by manually inserting the values deducted after the TSG. Later on the speed values turned OK without any technically explainable reason. After cleansing whilst at bay in Longyearbyen (Svalbard), the probe worked about a week before starting failing again (11/07 and 24-26/07) every few hours. We hence worked with SVP disconnected from MBES, in which we manually inserted the last correct sound velocity value from the hull mounted SVP. The problem was neither solved nor it was possible to give an explanation to it. A general check-up is recommended.

PDS2000-Sercel communication

Before starting the operations, REMED provided OGS Explora with a driver designed to send out a string from PDS2000 to the Seal Sercel Recorder. This string, named SPECTRA (Spectra navigation log [out].dev), contains the fix number (corresponding to the shot point position) and some basic navigation information that should be stored within the SEGD MCS data header. Although the serial communication between PDS2000 and Sercel appeared correct (with the SPECTRA string properly received and displayed by the recorder), only the fix numbers were eventually stored within the headers. According to the Fugro Personnel, this also used to happen with their own navigation system Starfix. We concluded that the problem was caused by the Sercel system, not by the PDS2000 driver.

PDS2000-SwanPro communication

After the PDS2000 upgrade, the driver used to send the navigation string to the SwanPro (properly working with the former software version) was not loaded by the PDS2000 Equipment Manager, even if no error messages appeared. It was later discovered that the problem was related to the square brackets contained within the driver filename. Once contacting REMED and changing the filename, the driver could be loaded and the string sent out.

The navigation was correctly received by the SwanPro, but the depth was not. It was then arranged to send the depth values directly from the EA600 SBES, in order to bypass the navigation system.

Remote presentation

No remote presentation of the navigation was running on the bridge during the cruise. Network communication appeared to be good, but on the remote PC located on the bridge the presentation did not appear. The problem was bypassed by splitting the video VGA output to the bridge, where basic navigation information, Hellmmans and plan view were displayed. The pilot, differently from the past, was not allowed to change the bridge PC visualization parameters. However, after a suitable visualization was agreed on, this turned out not to be a problem. Moreover, this option is not affected by potential network failures. It is hence highly desirable to leave this configuration as it is.

2.10.2 Sub Bottom Profiler

Below 0.500 sec ping rate, the system became unstable and the signal shut down. It was necessary to switch off both the software and the transceiver and then switch them on.

The clock did not show the same time of PDS2000. There was a difference of about 50 minutes (forward) with respect to the right PDS 2000 time (GMT time). This problem was not solved.

Sometimes the acquisition software didn't start to record. It was necessary to switch file or exit the software and the source and then switch them on again.

The thermal plotter (EPC) stopped plotting in a couple of occasions. This was related to a sliding of the dragging roll of the paper. The problem was finally solved by opening the EPC and substituting the rubber band.

2.10.3 Petrosys

During the installation of VISTA and PETROSYS software on the Seismic Quality Control PC, we had a problem related to the license of PETROSYS. For each program, the license was installed on a USB disk and supported by the control software SENTINEL. However the software version of SENTINEL was different for the two programs, with the one for PETROSYS older than that for VISTA. Initially, we installed first PETROSYS and than VISTA. However, the two versions of SENTINEL conflicted and prevented the correct identification of the password for PETROSYS, impeding the start of that software. The problem was resolved by un-installing the two programs and re-installing them, VISTA first and than PETROSYS. In this way both program used the recentmost version of SENTINEL (the one of VISTA) and the identification of both passwords as correct.

Later on, after we installed an anti virus software, we had another problem with the correct identification of the password for PETROSYS. The F-Secure anti virus software we installed for security reason produced somehow a modification of the password for PETROSYS. This fact prevented again the start of the program, due to incorrect identification of the license password. It took more than a day to understand the origin of the problem (we were sure to use the correct password), but the remedy was again quite easy. we solved the problem by un-installing PETROSYS and re-installing it and setting a new password.

2.10.4 Thermosalinograph

A series of test were performed during the MOB operations. Once the correct functioning was verified, the acquisition started.
The pumping system to collect water samples did not show any anomaly. However, the spout of the taps were severely rusted and almost plugged. Maintenance allowed the normal functioning.
The pump stopped on 15 July afternoon. The entire hydraulic system was washed with fresh water before restart.
The system stopped on 16 July afternoon, when the acquisition software showed a timeout message and the communication with TSG was missed. Communication was still missing after a restart. Electronics, connections and cables (power and data transfer) of the deck unit were de-assembled and checked. Communication with TSG was obtained with a direct link, bypassing the acquisition software. Normal functioning was resumed after a reset of the internal memory and the internal clock.

2.10.5 CTD and WSC

On the 26 July, after a downcast to 25 m above seafloor at about 1,000 m depth, the carousel failed to close the bottle, as the communication with the deck unit was lost. After a further rise of 15 m for safety reasons, a number of subsequent attempts resulted unsuccessful. During the upcast (without further water sampling attempts) the temperature sensor stopped working, displaying the maximum negative value. During a visual inspection after the CTD/WSC gear was onboard, the synthetic resin between the iron armour and the sub 6-pole connectors was found to be damaged. Remains of water were found, but without apparent damage to the electric contacts. After a new vulcanization was performed, the system was tested on the deck. As a result, the CTD (with all sensors) properly worked, but the WSC still did not communicate with the deck unit. After the unsuccessful test on 27 July, the entire system was disassembled, all the connections verified and the sensors tested on the deck within a water tank in which the salinity was progressively increased. All the system properly worked, acquiring plausible data, with the pump regularly starting and working for more than a hour without any detectable problem.
After the subsequent cast (Station F, 29 July) when the CTD operated down to nearly 1500 m depth without any malfunctioning, it became evident that the problem was generated by an electric breakdown to the system of bottle firing.
Fixing of the electronics of the WSC (whose case is guaranteed down to 6600 m depth) is a long and unpredictable operation (only rarely can an instrument be repaired on board in case of water leakage). For this reason, the entire power/connection system (PC-serial interface-serial cable-deck and unit-sea cable-CTD-WSC cable) was tested beforehand to exclude a problem there. These connections resulted OK.
The option to continue to perform CTD operations without WSC (to avoid possible prejudice to subsequent CTD measures) was discussed on board. However, considering the significance of at least a further water sampling, an emergency repair

was attempted notwithstanding the remote possibility of success. The case was disassembled and opened and the presence of about 100-150 cc of water was detected. The electronic circuits showed evidence of corrosion and burning. Likely, water leakage occurred from one of the o-rings (either the two main ones or the 12 smaller ones). The circuits were fixed, rebuilding the damaged parts, and tested in the laboratory. At the end the system was working, with some minor defects in the ordering of the bottles. This problem was resolved by changing the order of the bottles. Once the system was re-assembled with all mechanical parts, it was successfully tested many times on the deck, and the sequence of firing of the bottles clarified.
During the subsequent station (31 July) the CTD/WSC gear was operated. The CTD sensors worked properly during downcast, but during the upcast some problems occurred. The pump of the salinity sensor stopped a couple of times and bottle firing was uncertain. As a result, only 6 out of 12 bottles were properly closed during upcast.
To independently verify the depth of the bottle firing, water samples from all bottles were taken for subsequent salinity analyses in laboratory.

2.10.6 ADCP

At the start of the acquisition, being the intensity of ADCP data out of scale, an aligning test was planned. The test was performed on the 10 July, from 09:35 to 10:49, during this time span the same track was sailed in opposite directions. A correction factor, according to the measured offset, was hence applied to the acquired data. However, this was not enough to completely solve the problem. In fact, after a closer inspection, it was found that erroneous heading data were sent to the ADCP by the PDS2000 driver. It was hence modified and re-installed in PDS2000 on the 12 July.
The heading of ADCP data from file 19 onward were hence already corrected. All the previous heading data (from the beginning of the cruise in Kristiansund to the 12 July) were exported from pds2000 to proceed, during post-cruise laboratory analisys, to the corrections of ADCP data before 12 July.
A second aligning test (with the modified driver and hence with the correct heading information) was performed at the end of the operation in the study area on the 01 August, from 12:00 to 12:35. The results of this second test will be processed during post-cruise laboratory analyses.

3. ONBOARD PROCESSING AND PRELIMINARY RESULTS

Men at work

3.1 Seismic profiles (MCS)

The SEGD raw data were processed on a dedicated workstation by means of Vista Seisimage package. The quality control was performed both on single shots and on the whole profiles by screen display and plotting of the near trace section (Fig. 3.1.1).

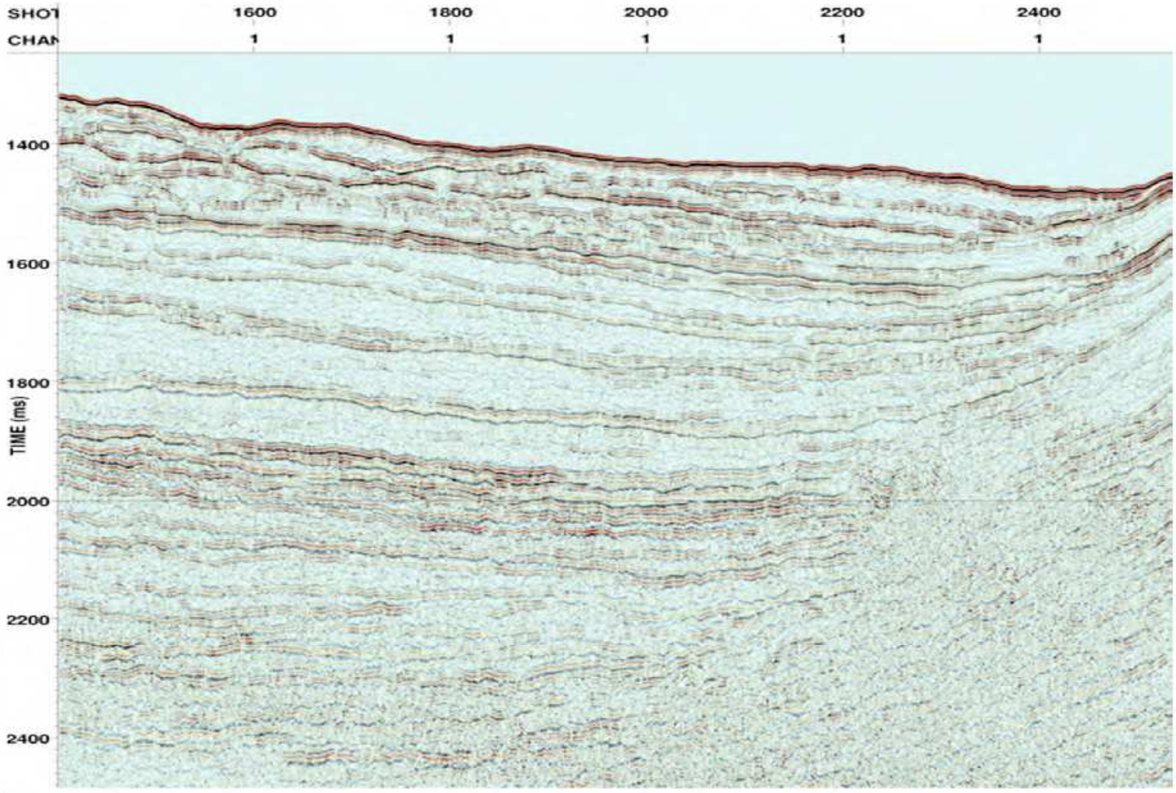


Fig. 3.1.1. An example of near trace section. Only the first recorded channel of each shot was displayed. This visualization is useful for both general data quality check and interpretation.

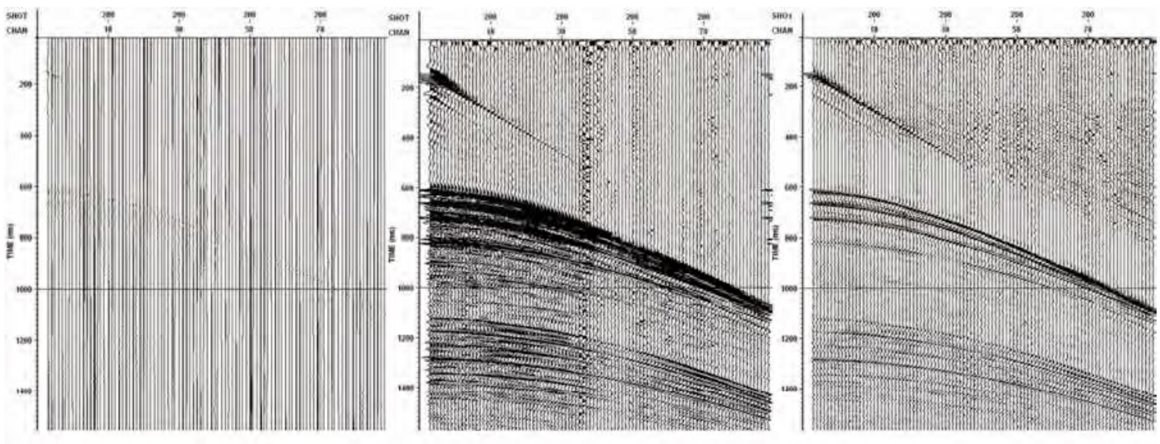
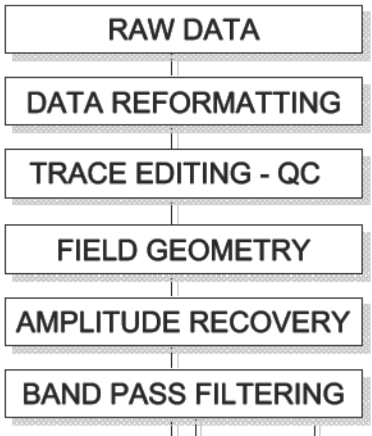
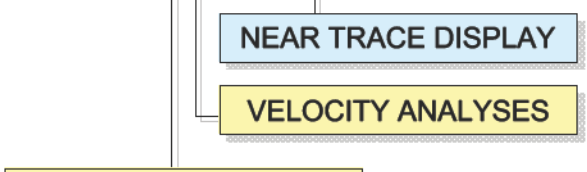
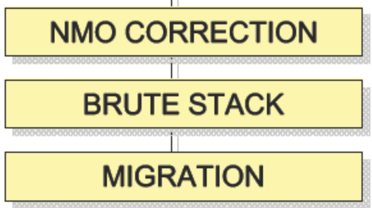


Fig. 3.1.2. Example from three steps of the processing sequence: raw data (on the left hand side); wide band pass filtered -15/30 – 100/200 (centre); filtered and with an AGC applied - 500 ms wide window (right hand side).

A basic processing sequence was applied to the data (Figs. 3.1.2 and 3).







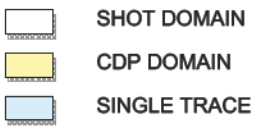


Fig. 3.1.3. Basic processing sequence.

The raw data were first transferred from the external USB back up hard disk to the processing workstation and loaded and reformatted by means of the Vista processing package.

The overall quality of the raw data was first checked and single traces edited. Noisy traces, traces with transient glitches, or monofrequency signals were deleted; polarity reversals were corrected.

Field geometry was incorporated with the seismic data. Based on surveying information, co-ordinates of shot and receiver locations for all traces were stored on trace headers.

Where necessary, changes in shot and receiver locations were properly handled based on the information available in the observer's log.

In case of no shot or misfires, the dataset was padded with fake shots.A gain recovery was applied on the data to correct for the amplitude effects of wavefront (spherical) divergence and absorption.

At this stage of processing, a simple AGC function (500 ms wide window) was chosen.Before velocity analyses and near trace visualization, a wide band-pass filter (Butterworth Low cut 15/30 – High cut 100/200) was applied so as to remove unwanted low and high frequency noise from the data.

Prior to the velocity analyses, the data were CDP sorted, which involved a co-ordinates transformation from shot-receiver to midpoint-offset. The groups of traces arranged in this way are called common depth point (or CDP) gathers, each of them containing the seismic signals recorded from rays incident at different angles upon a particular subsurface.
Velocity analysis (Fig. 3.1.4) were performed on selected CDP gathers, the output from this operation representing some measure of signal coherency along the hyperbolic trajectories governed by velocity, offset, and traveltime.
Velocity spectra analyses were used together with the Constant Velocity Stack (CVS) method (data were stacked with a range of constant velocities, and the constant-velocity stacks themselves were used in picking velocities) and supergather normal move out correction (a supergather is formed by two or three adjacent CDPs).
Velocity analyses eventually provided a velocity field that was used in normal moveout (NMO) correction of CDP gathers. As a result of moveout correction, traces were stretched in a time-varying manner, causing their frequency content to shift toward the low end of the spectrum. Frequency distortion increases at shallow times and large offsets (see below). To prevent this from happen, a mute function was applied that removed the upper part of the far offset record.

Following the NMO correction the single CDP traces were combined to improve the signal-to-noise ratio. This process, involving the sum of the single traces of a CDP gather after the reflected signals was aligned by the NMO correction, is known as stack (Fig. 3.1.5).
The most promising stack section passed through the process of migration, which is a process used to place dipping reflections in their correct spatial location. Migration in fact is used to diminish dip effects by moving sub-surface data points updip to their true locations, whilst collapsing diffraction hyperbolas generated by rough topography or geological structures such as fault planes (Fig. 3.1.6).

For all profiles, the near trace records were produced and plotted (see Annex D.1). Part of the data were stacked (see Annex D.2)

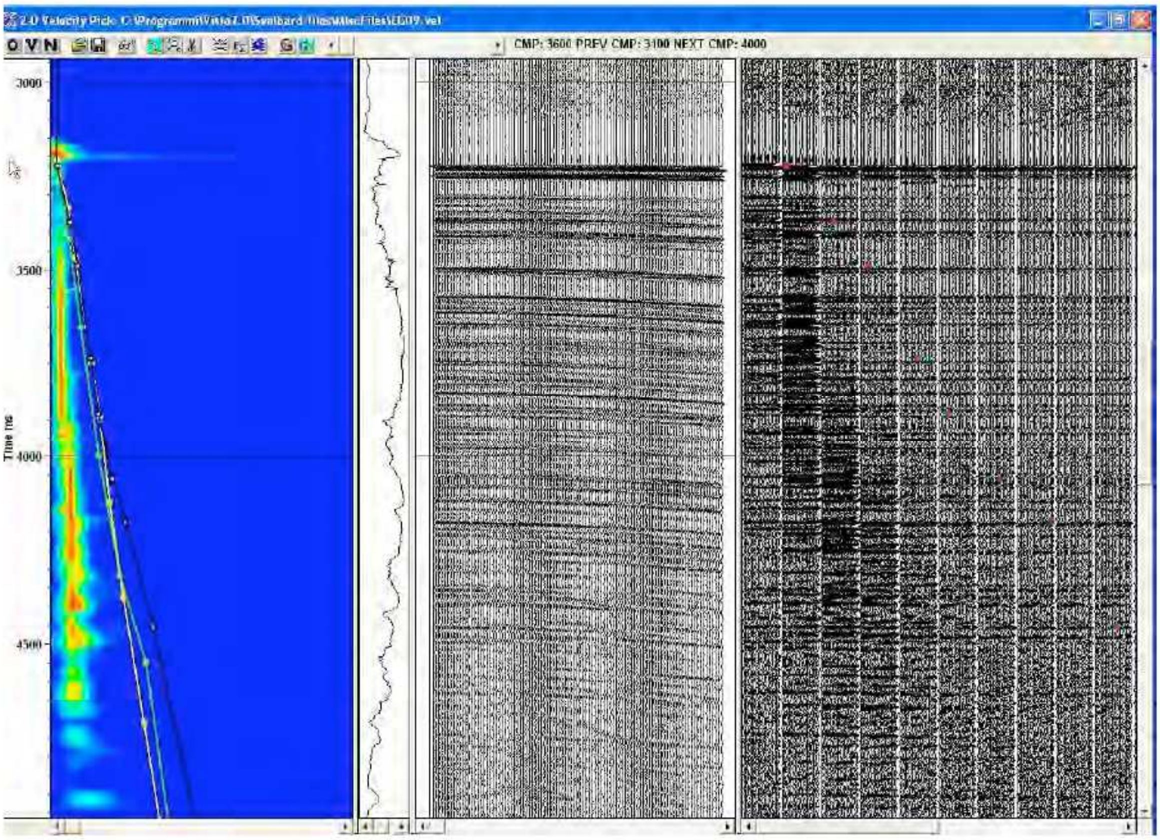


Fig. 3.1.4. Velocity analyses: velocity spectra (left hand side); supergather CDP with NMO correction applied (center); Constant Velocity Stack panel (right hand side): the data were stacked with a range of constant velocities, and the constant-velocity stacks themselves were used in picking velocities.

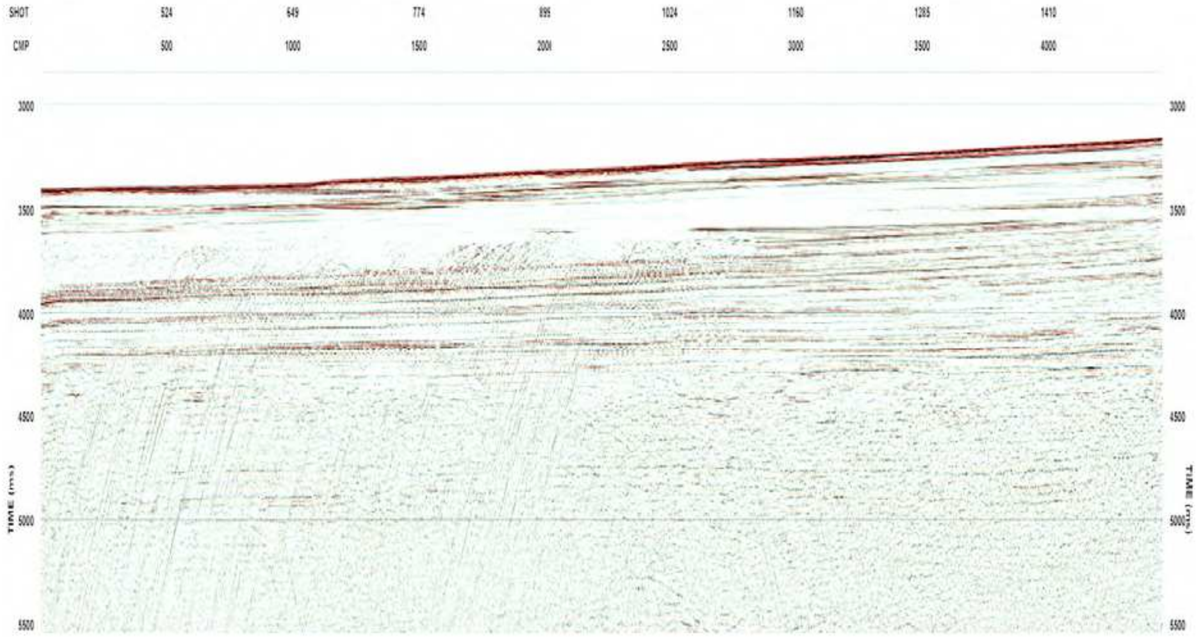


Fig. 3.1.5. Stack Profile EG-IT_09. The body of a huge slide is clearly imaged between 3.4 sec and 3.8 sec up to SP 1160. The presence of noise and diffractions (steep leftward dipping), affecting the data quality down to 5 sec is evident.

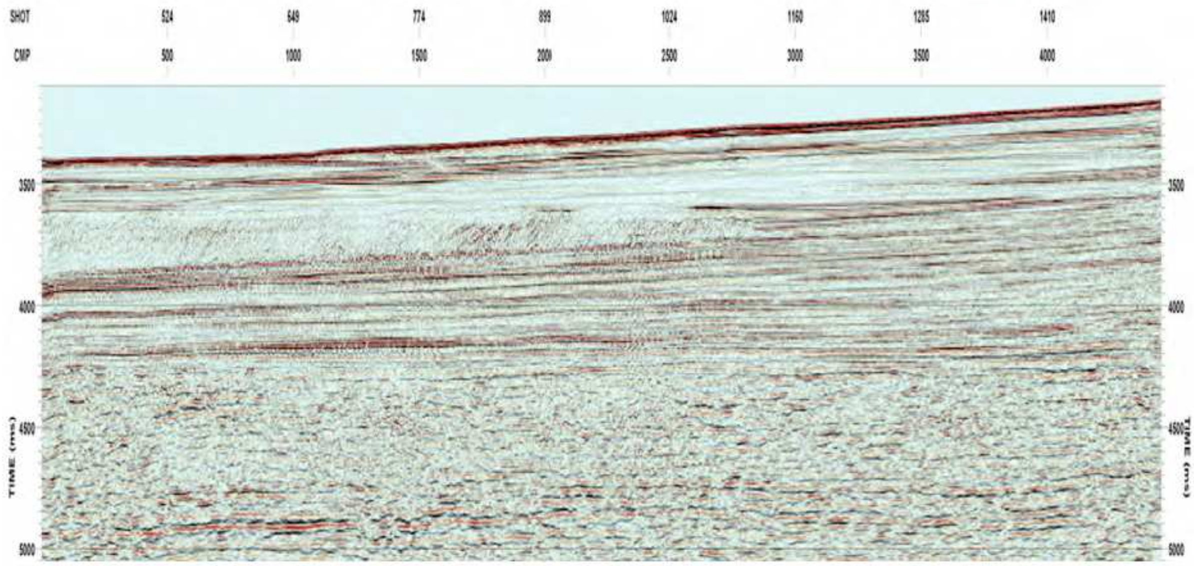


Fig. 3.1.6. Migration on profile le EG-IT_09. Diffraction noise was fairly well attenuated and some high amplitude, low frequency reflectors are now clearly visible at 4.8 – 5.0 sec.

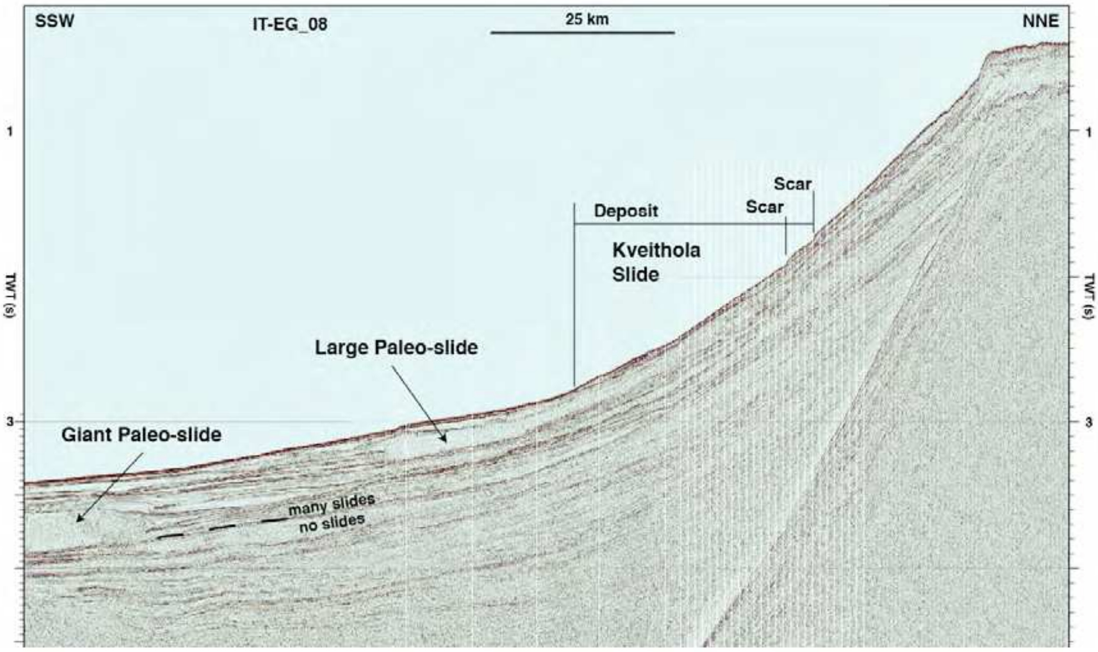


Fig. 3.1.7. MCS line 08 showing a number of slides (including the already known Kveithola Slide) in the souithern part of the Storfjorden Fan.

The very preliminary result that became evident on board from the seismic data is essentially that the occurrence of slides in the Storfjorden Fan is not evenly distributed in space and time. In the northern and central parts, essentially only debris flow deposits are present. Conversely, large slides are present in the southern part. The already known Kveithola Slide is shown in line 08 (Fig. 3.1.7) close to the seafloor. Many other slides are present in the upper part of the sedimentary succession. Beneath a giant paleo-slide, however, no major slides were detected in the lower part of the sedimentary succession (Figs. 3.1.7 and 8).

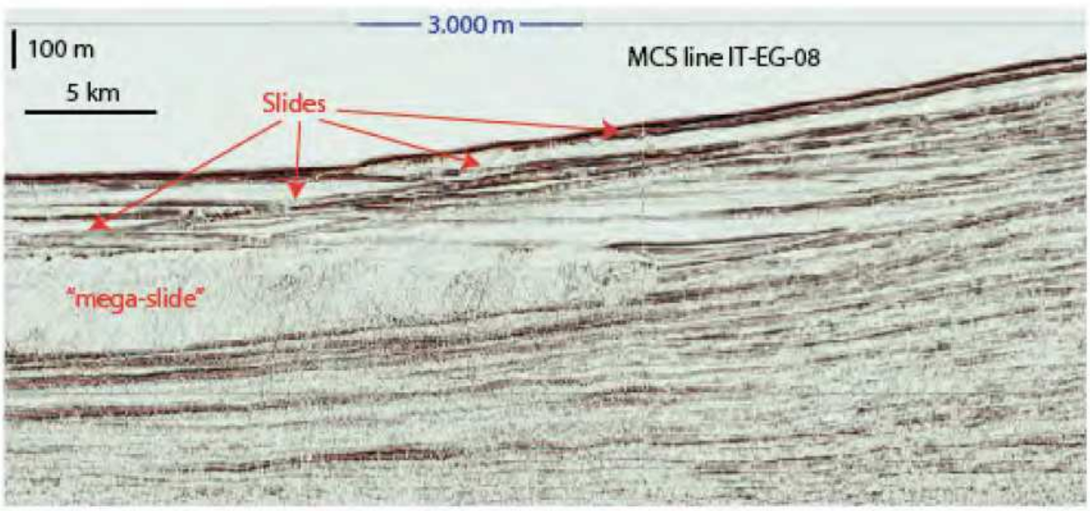


Fig. 3.1.8. MCS line 09 showing the giant paleo-slide and other slides in the upper part of the sedimentary succession.

3.2 Morphobathymetry (MBES) and sub-bottom (SBP)

MBES and SBP data were not processed on board. At the end of the acquisition in the study area a grid was generated with the raw (unprocessed) MBES data. This was used to produce a DTM that served as a base for the location map of the acquired data. Part of the same grid was also used to produce some 3D views.
The northern part of the grid (Fig. 3.2.1) shows the relatively smooth seafloor of the northern and central Storfjorden Fan, where the relief of a number of debris flow deposits is clearly visible.

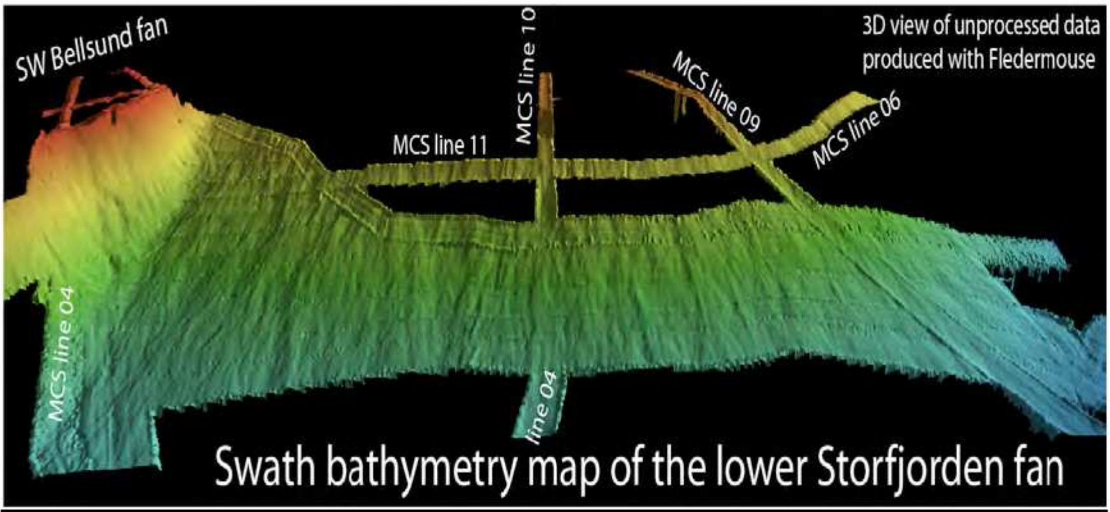


Fig. 3.3.1 3D view of the unprocessed data acquired in the northern and central Storfjorden Fan.

On the continental shelf, two superposed systems of E-W trending glacial lineations were identified within the Kveithola Trough. These are visible only in water depths larger than that reached by the keel of the icebergs, by which they were destroyed elsewhere.

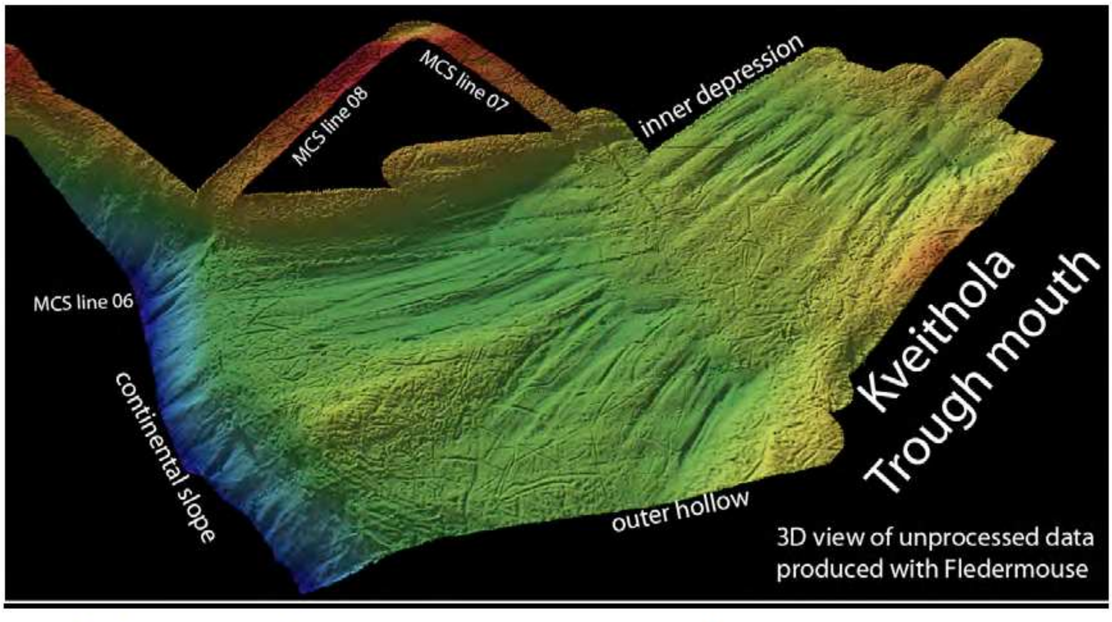


Fig. 3.3.2 3D view of the unprocessed data acquired in the Kveithola Trough

Sub-bottom profile data were not re-plotted on board. However, the plots on thermal paper produced during acquisition were examined essentially only to identify the core sites. In addition some profiles were loaded into the SeisPro software and observed on the screen for quality control.
The profiles collected on the outer continental shelf areas show generally little or no penetration, except in an area located at the mouth of the Storfijorden trough, where it shows a penetration that averages 10-20 ms TWT. The profiles show hyperbolic diffraction in correspondence of "ice scours" seen on MBES data. On the upper-middle continental slope usually there is no penetration and/or few millisecond penetration. The SBP data is characterized by superficial and buried debris flows/gravity flows (transparent to chaotic on the SBP data), the latter sometime underlying a thin semitransparent upper layer (10 ms TWT c.a.). In the lower continental slope, data show generally good penetration, up to 50-60 ms TWT, with the sub seafloor being characterized by bedded and generally parallel layers.
The data quality was very good throughout the cruise, though sometime disturbed by frontal swell over 1,5 m. In these cases white stripes were visible on the profiles, due to frequent loosing of the signal.
In the Kveitola Trough area, the SBP profiles show no penetration in correspondence of the probable till delta. In the 2 basins eastward and westward the till delta, the sub-bottom profiles show a 10-15 ms of bedded sediments overlying a hard soil, where it is possible to see lineations produced by the flow of an ice stream.

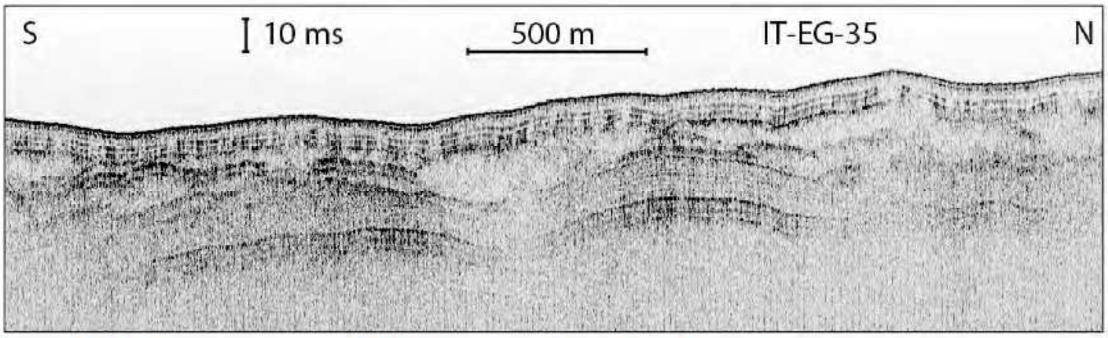


Fig. 3.2.3. An example of CHIRP profile showing debris flow deposits.

3.3 Oceanography

TSG data were converted in ascii format for a preliminary analysis, and main derivable parametres were calculated. However, no corrections were applied since these were postponed to subsequent post-cruise analyses.
Converterd and calucalted parameters were the followings:
name 0 = timeJ: Julian Days
name 1 = latitude: Latitude [deg]
name 2 = longitude: Longitude [deg]
name 3 = t090C: Temperature [ITS-90, deg C]
name 4 = t3890C: Temperature, SBE 38 [ITS-90, deg C]
name 5 = c0mS/cm: Conductivity [mS/cm]
name 6 = sal00: Salinity [PSU]
name 7 = density00: Density [density, Kg/m^3]
name 8 = sigma-é00: Density [sigma-theta, Kg/m^3]
name 9 = svCM: Sound Velocity [Chen-Millero, m/s]
name 10 = svDM: Sound Velocity [Delgrosso, m/s]
name 11 = svWM: Sound Velocity [Wilson, m/s]
name 12 = prM: Pressure [db]
Satellite-derived SST (Sea Surface Temperature) data (sent via e-mail by Corrado Fragiacomo) were coupled with TSG data, allowing a real time view of surface water masses and the trend of their movements (Fig. 3.2.1). Unfortunately, the cloudy conditions during most of the cruise prevented to obtain larger maps.

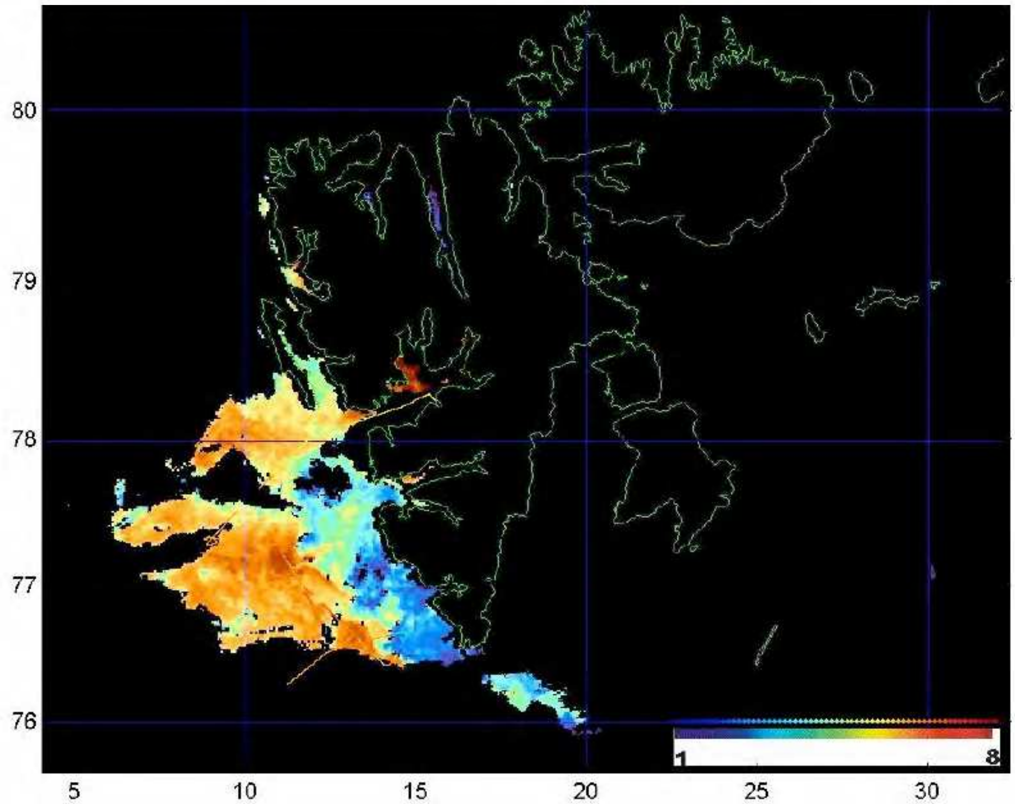


Fig. 3.2.1. TSG data acquired between 16 and 18 July superposed to satellite-derived SST data west of the Svalbard (colour scale = SST).

Spikes generated by pitching during rough sea will be edited during post-cruise processing. The list of recorded files (with start/end data/time and coordinates is shown in Annex D.3.

CTD data were converted into physical units using the pre-cruise calibration coefficients. The first cycles (in air or when the pump was not running) were removed. The various sensors were aligned (in time) with the depth sensor. The cell thermal mass was corrected. A median filter was applied to remove spikes. Pressure was monotonized. Oxigen was calculated. Mean values at 1m depth intervals were calculated. Salinity, density and sound velocity were also calculated.

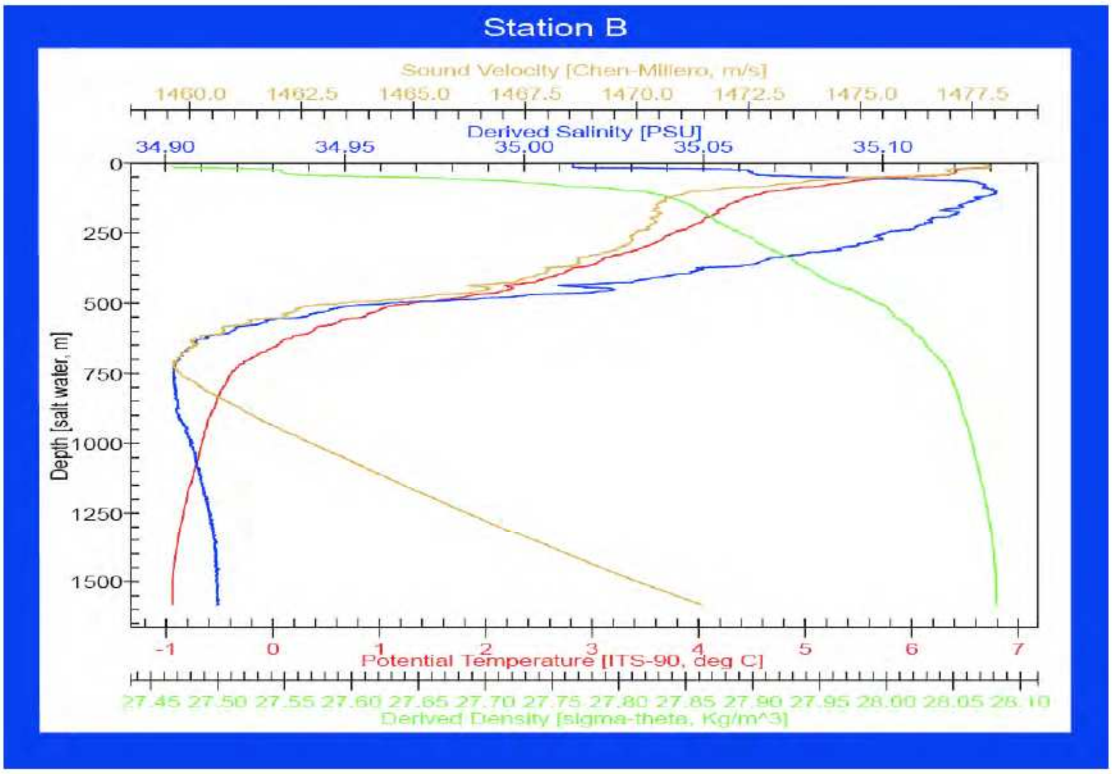


Fig. 3.2.2. Example of CTD data as shown by the acquisition software.

ADCP data were converted in matlab format and a preliminary analisys was performed. The methodology for correcting the raw data was calibrated using a first part of the data (see chapter 2.10 Problems and remedies). The next phases of processing will be performed during the subsequent post-cruise laboratory analises.

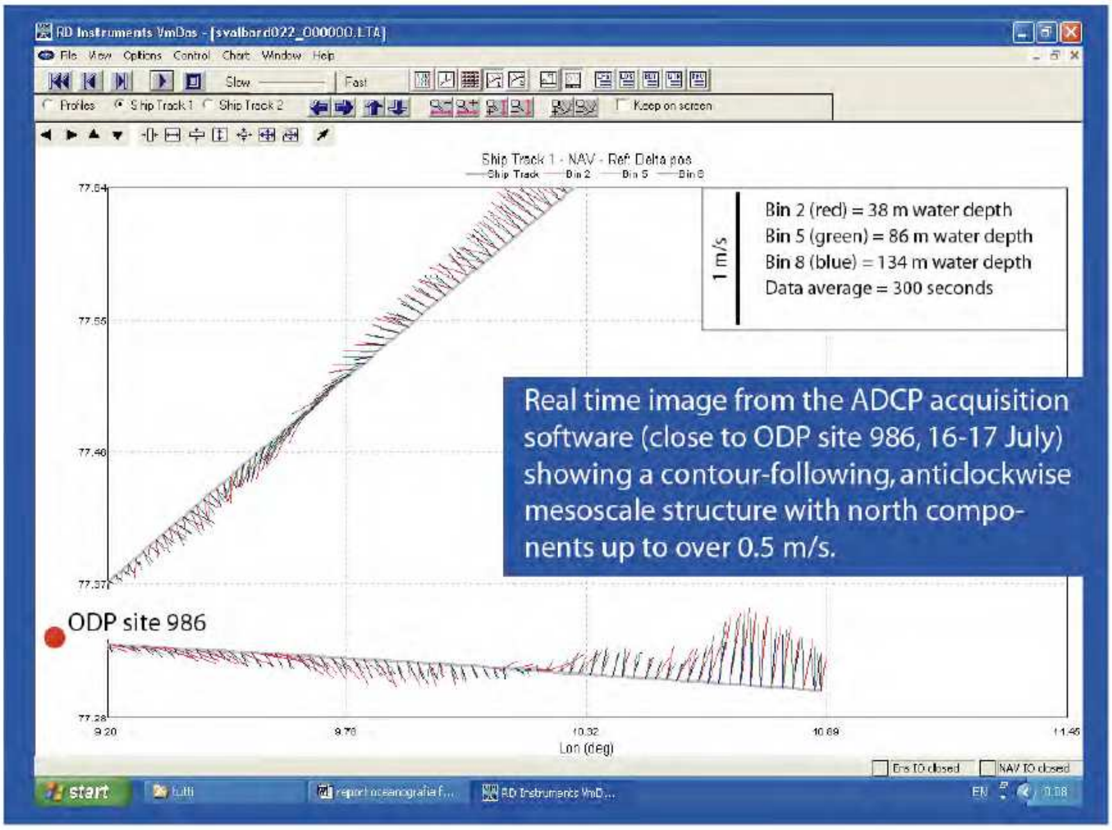


Fig. 3.2.3. Example of ADCP data shown in real time by the acquisition software (location of ODP site and legend inserted with a drawing software).

3.4 Biology

Surface (TSG) and deep (WSC) water samples were sub-sampled for subsequent onshore laboratory analysis (see Annex D.3).

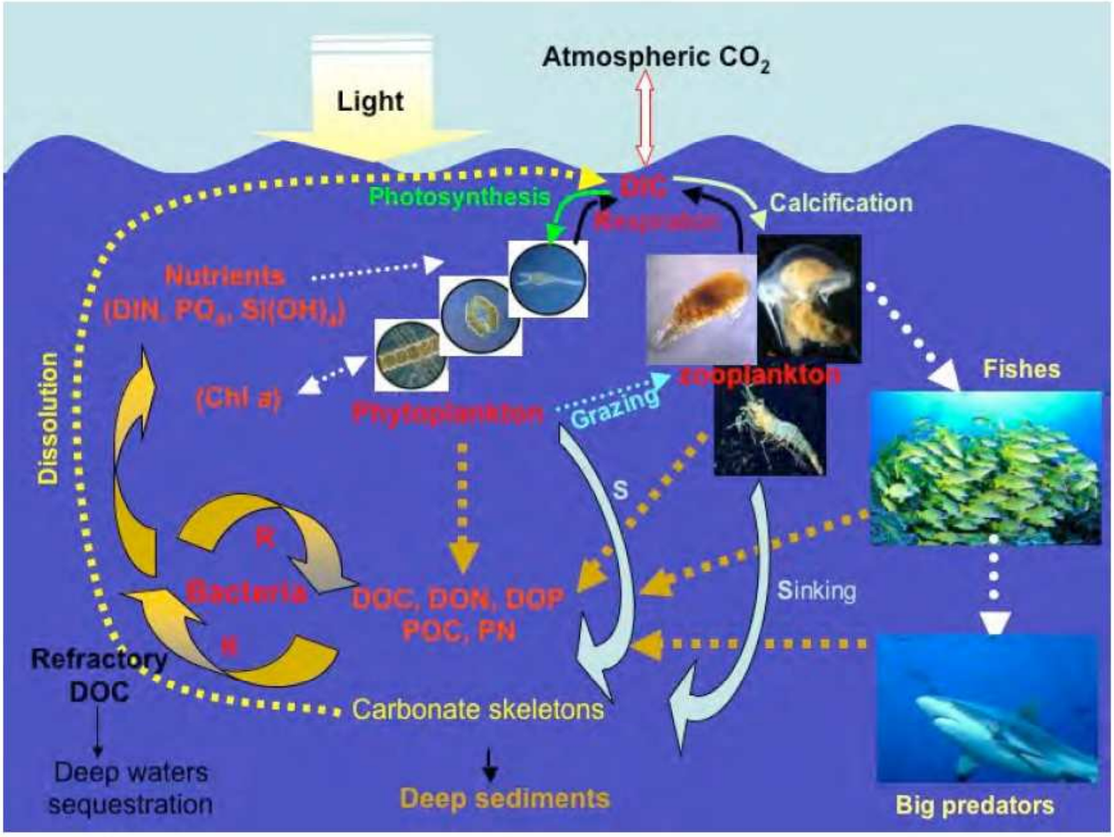


Fig. 3.4.1 Schematic structure of a classic food web. Studied parameters are labeled in red.

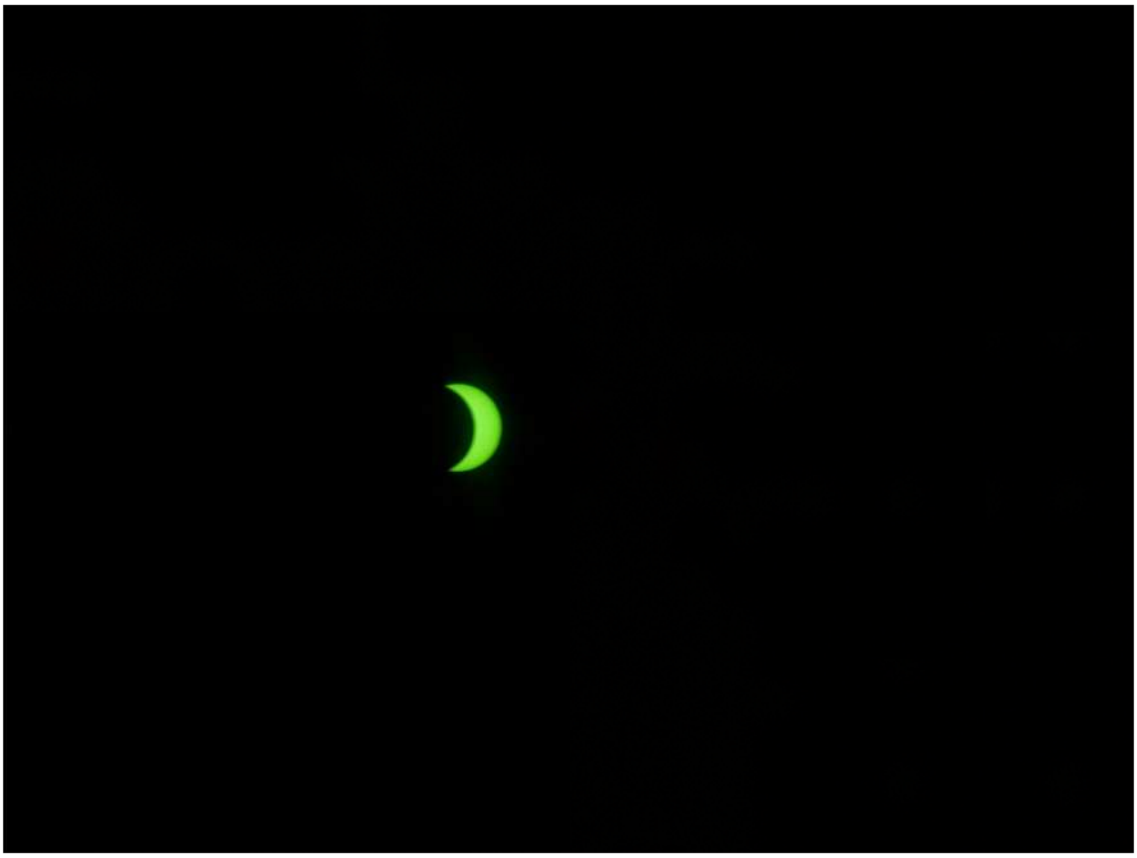
Samples for DIC analysis were collected in 250-ml glass bottle and 2.5 mL of 2 mM $HgCl_2$ was added as preservative directly after sampling.
Samples for the analyses of inorganic nutrients were filtered on board through Whatman GF/F fibre filters (0.7 µm nominal pore size - 47 mm diameter) and stored frozen (-20°C).
Samples for DOC, DON and DOP analyses were filtered on board, through precombuste (4h at 480°C) Whatman GF/F glass fibre filters (25 mm diameter). Filtration was performed using a self-refilling glass syringe (SOCOREX) and a filter holder in order to prevent atmospheric contamination. To 15 mL DOC samples, 100 µL of 2 mM $HgCl_2$ were added before storing at 4°C until laboratory analysis. DON and DOP water samples were stored frozen (-20°C).
For POC and PN determination 250 mL seawater samples were filtered on board onto precombuste GF/F glass fibre filters (25 mm diameter) under low vacuum and filters were stored frozen (-20°C).
For chlorophyll analysis, 2 L seawater samples were filtered on board through Whatman GF/F filters (45 mm diameter) and filters were immediately frozen (-20°C) until analysis that will be performed within 40 days.
Samples for determination of HPA (10 mL) and of PBA (50 mL) were fixed with 2% final concentration borate-buffered formalin (pre-filtered through a 0.2 µm Acrodisc filter) and stored at 4 °C.

For prokaryotic community structure analysis 1 L aliquots seawater samples were filtered onto 47 mm diameter, 0.2 µm pore size polyethersulfone membrane filters (Supor 200, PALL Corporation) and the filters were frozen at –20°C until DNA extraction.
Plankton community respiration was measured on board by following changes in dissolved oxygen in sealed bottles during 24 h incubation. Water samples were incubated in acid clean (10 % HCl) and distilled water rinsed 50 – 70 mL BOD bottles in the dark at in situ temperature (± 1 °C). Oxygen concentrations were determined in triplicate bottles at the beginning and at the end of the incubation. Dissolved oxygen was measured with a Titrino Mettler titrator for automated Winkler titration based on potentiometric end point detection. Carbon respiration was estimated from rates of oxygen consumption assuming a respiratory quotient (RQ = _CO2/_O2) of 1 (Chin-Leo & Benner 1992).
For quantitative and qualitative analysis of microphytoplankton, 250 mL samples were fixed with $Ca(HCO_3)_2$ buffered formaldehyde (2 % final concentration).
For quantitative and qualitative analysis of microphytoplankton, 5L of water were collected, concentrated on 20 mm mesh, and reduced to 250 cc. Samples were preserved with 4% formaldehyde solution buffered with sodium tetraborate.

References

Chin-Leo G, Benner R (1992) Enhanced bacterioplankton production and respiration at intermediate salinities in the Mississippi River plume. Mar Ecol Progr Ser 87:87-103.

Sun eclipse on the 1st of August



ANNEX A: Vessel's characteristics

A.1. General characteristics

The Vessel	
Built by	Elsflether Werft A.G., Germany, 1973
Owner	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS
Flag	Italy
Classification	Scientific, technological research RINA 100-A-1.1 IAQ-1; Ice Class B
LOA	65.42 m
Beam / Draft	11.8 m / 6.55 m
Gross tonnage	1408 T
Workboat	Zodiac Ribo 600 (6m, 70 Hp)
Endurance	50 days
Propulsion	2 x 1294.5 Kw (1780 Hp)
Cruising speed	13 Knots
Accomodation	12 technician 17 crew 1 doctor

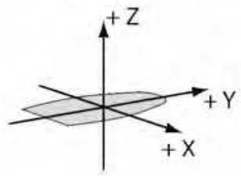
Maritime Navigation & Communication	
VHF	2 VHF SKANTI 1000 DSC (GMDSS A4)
Immarsat	Inmarsat C SKANTI Scansat (GMDSS A4) Immarsat B-M NERA SATURN Immarsat Fleet77 Thrane
Radars+ARPA	FR2117 FURUNO + AIS TM 340AM SPERRY X band Bridgemaster DECCA
Gyro Compass	3 Gyro Star II Anshutz
Autopilot	1 Naviplot AP50 FURUNO
Echo sounder	1 EA600 Simrad
Log	1 Dopplerlog EML500 Yokogawa
GPS	1 GPS Acquarius 1 GPS GB500 TOPCON 1 LANDASTAR Veripos 1 RS500 SHIPMATE (maritime only)
Magnetic Comp.	Navipol II Plath
Network	Ethernet
Network speed	100 Mb / sec

Safety	
MOB	Rescue boat PESBO BSC (40 m)
Lifeboat	Rescue boat PESBO BSC (42 people)
Life Rafts	5 x 25, 1 x 20, 1 x 6 (156 people)
Survival suits	48
Fire Fighting	Hydrants, hoses and nozzles (3 fire pumps + 1 emergency fire pump) 58 portable fire extinguishers (6 kg – 9 lt – 5 kg) 5 fire estiguisher 50 kg
Engine Room	CO_2
Compressor Room	Estinguisher + fixed fire CO_2

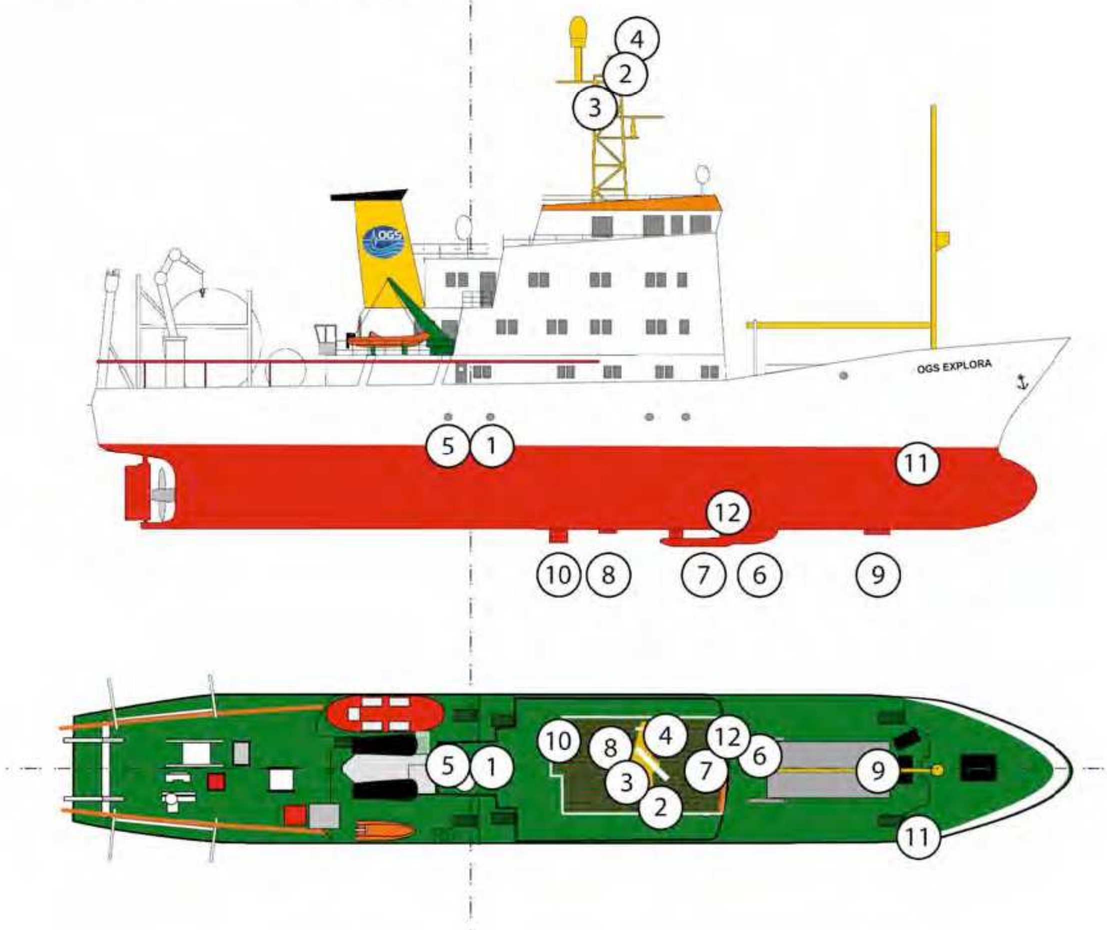
A.2. Vessel offsets

	OFFSET	X (m)	Y (m)	Z (m)
1	CRP	0.00	0.00	0.00
2	GPS TOPCON	2.69	8.60	20.36
3	GPS AQUARIUS	2.24	8.20	20.00
4	GPS VERIPOS	-2.13	8.63	20.28
5	PHINS	-0.28	-0.76	0.25
6	MBES 8111	-0.29	17.89	-4.82
7	MBES 8150	0.00	16.49	-4.50
8	SBP	-0.63	6.93	-4.32
9	SBES	-0.63	27.23	-4.46
10	ADCP	-0.73	3.75	-4.92
11	THERM. INTAKE	0.87	30.08	-3.75
12	THERM. SENSOR	0.83	16.32	-4.49

SIGN CONVENTION



(Offset referred to Central Reference Point - CRP)



ANNEX B: Equipment

B.1. Positioning and navigation

B.1.1. GPS and inertial navigation system

The vessel is equipped with three GPS systems: an Ashtec Aquarius works as primary GPS, a Topcon GB-500 as secondary GPS (GPS + GLONASS); also available is a Landstar MK Veripos that can work as DGPS.
All of them are interfaced to the IXSEA Phins Inertial Navigation Sytem (INS), which delivers heading and attitude information, as well as position and speed, to the navigation system and to the MBES. The heart of the system, which is also used as a gyrocompass, is the inertial measurement units, consisting of three high class (0.01 deg/h) fibre optic gyroscopes (FOG) and three high precision pendulum-type accelerometers.
Apart from its Inertial Motion Unit, PHINS contains a complete navigation algorithm based on Kalman Filtering. This structure enables PHINS to work either as a black box or to be connected to external sensor systems (GPS, Doppler velocity log, Depth sensor, acoustic positioning systems…).
The GPSs, the Phins MRU-Inertial Navigation System and the PDS2000 Navigation System are all interfaced according to the attached sketch. The data are real time displayed both in the navigation room and on the bridge. All the data from the sensors are stored by the navigation system in the PDS2000 format and can be retrieved either in CVS, XLS and ASCII format.

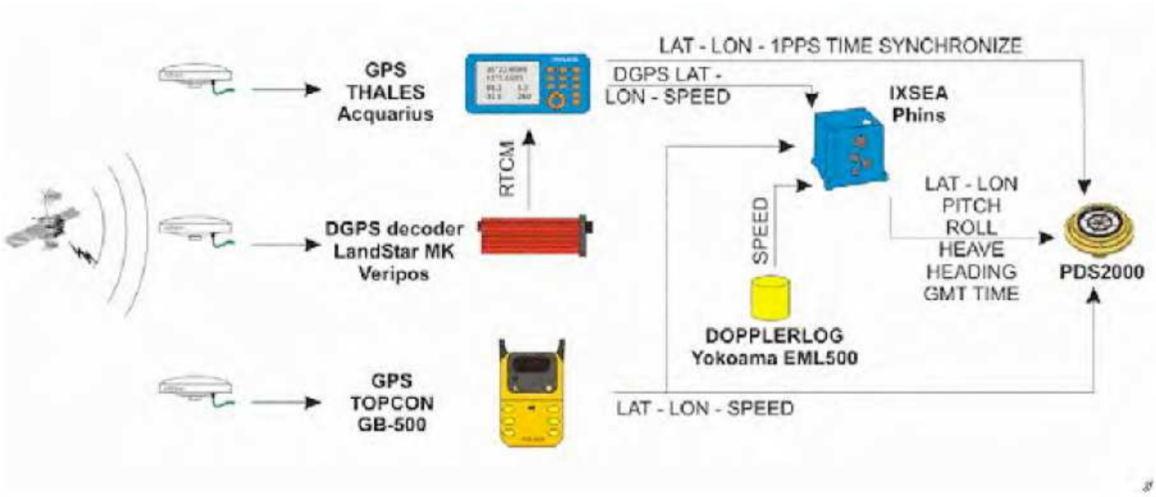


Fig. B. 1: Positioning and navigation general sketch.

B.1.2. Navigation software

Navigation is provided by the software PDS2000, which is also used to run MBES data acquisition. Other capabilities offered by the navigation software are: data acquisition from sensors, computations, presentation, quality control, vessel guidance, output messages, data storage and event generation (shot command to the gun controller and fix position to the sub bottom profiler acquisition software in particular).

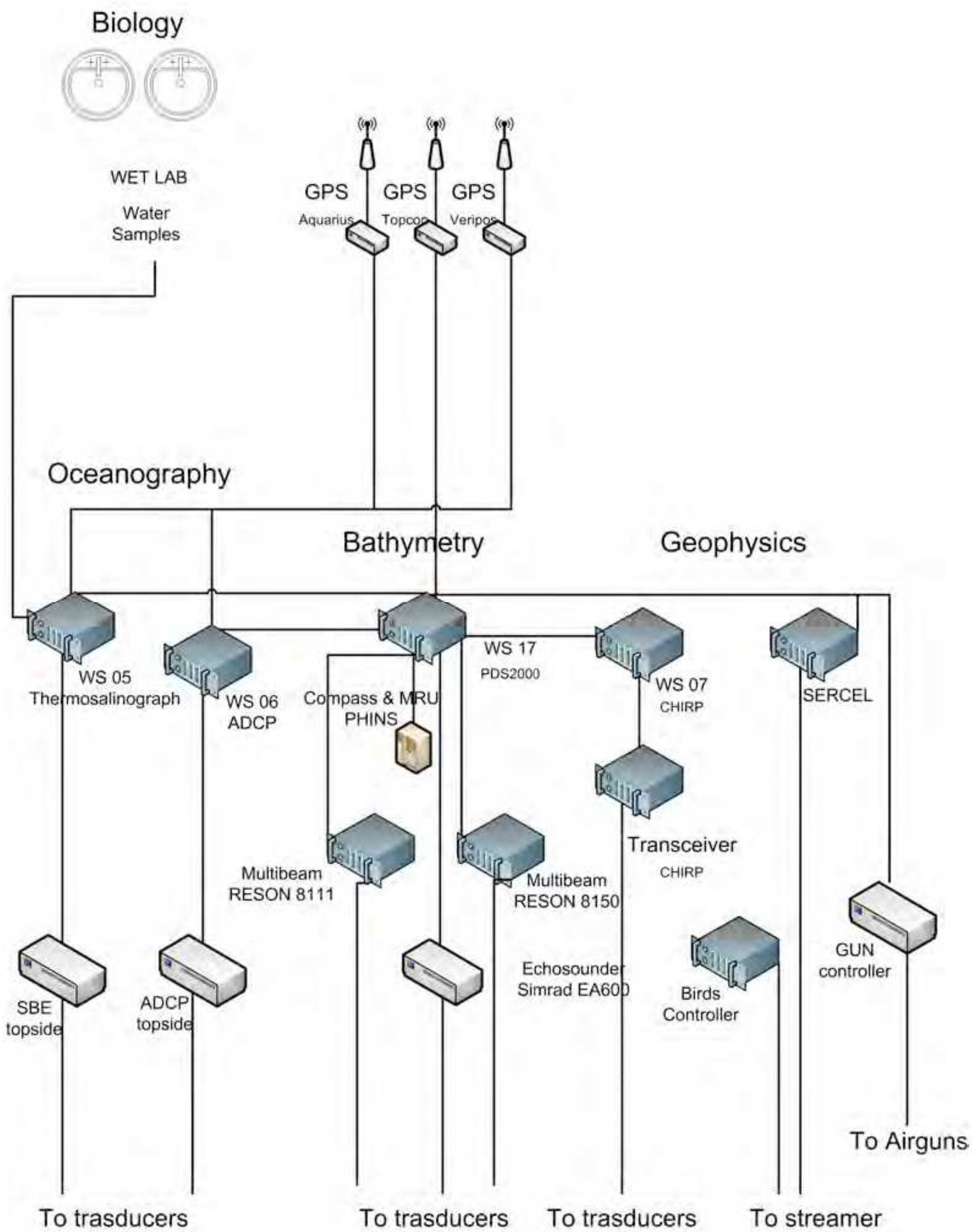


Fig. B. 2: General equipment block diagram-

B.2. Geophysics

B.2.1. Single Beam Echo Sounder

The Simrad EA600 Oceanic Depth Echosounder, manufactured by Kongsberg Maritime, is a Single Frequency 18kHz system, with a maximum power of 2kW, 160dB of dynamic range and a transducer 12-16-60 with 16° circular, 60° passive beams.
Depth values are logged by the main navigation system (PDS2000) via the RS-232 serial connection. The depth data are also real time delivered to the SBP acquisition software SwanPro to provide reference depth in case of multiping acquisition.

EA600 FEATURES AND TECHNICAL SPECIFICATIONS	
Manufacturer Model Installation	Simrad Kongsberg EA600 Hull mounted
Transducer type Frequency Pulse duration Beam angle Beam width Transmit power Range bottom	18-11 18 kHz 8 ms 11° 382 Hz 2000 W 7000
Gain function Ping rate Start depth and range Bottom detector	20 log TVG, 30 log TVG, 40 log TVG, or none Adjustable 5 to 15.000 m in manual or auto range Software tracking algorithm

Tab.B1

B.2.2. Multi Beam Echo Sounder

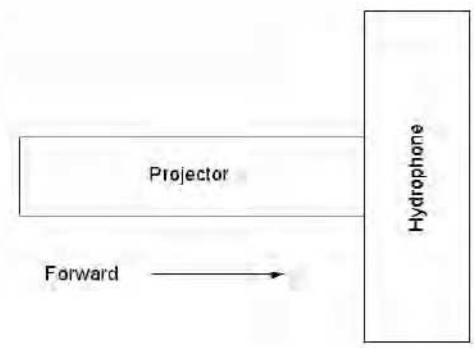
The R/V OGS Explora is equipped with 2 Reson Multibeam Echosounders, Reson Seabat 8111 for shallow water (up to 500 m WD) surveys and Reson Seabat 8150 for deep water surveys. They are both keel mounted.

B.2.2.1 Intermediate and shallow depth (shelf) surveys

The SeaBat 8111, operating at a frequency of 100 kHz, reaches the maximum swath width (7.5 times the water depth) when working in less than 150 metres of water. The 8111 system illuminates a swath on the sea floor that is 150º across track by 1.5º along track. The maximum selectable range scale is 1400 metres. The swath consists of 101 individual 1.5º by 1.5º beams with a bottom detection range resolution of 3.7cm.
The 8111 system employs Pitch Stabilization to steer the transmitted beam so that it remains vertical through pitch angles of ±10 degrees.

SEABAT 8111 FEATURES AND TECHNICAL SPECIFICATIONS	
Manufacturer	Reson
Model	SeaBat 8111
Installation	Hull mounted
Number of beams	101
Beamwidth across track	1.5°
Beamwidth along track	1.5°
Center-to-center beam separation	1.5°
Max Swath	150°
Max swath coverage	7.4 x water depth
Operating frequency	100 kHz
Pulse length	Variable, operator selectable
Depth range	600 m (max scale 1400 m)
Max ping rate	35 swaths per second
Max vessel speed	20 knots
Stabilization	Pitch stabilization within +/- 10°
Sound probe	Reson SVP 25
Acquisition software	PDS2000
Processing software	PDS2000

SEABAT 8111 SYSTEM CONFIGURATION



Head orientation

The keel mounted reson SeaBat 8111.

Tab.B2

B.2.2.2. Deep water surveys

The SeaBat 8150, operating at a frequency of 12 kHz, is a full Ocean Depth Multibeam Echo Sounder System. The maximum selectable range scale is 15000 metres; however, maximum swath width typically occurs in water depths of

approximately 6000 metres. The 8150 system forms 234 receiver beams across a sector up to 150° wide. The 8150 Sonar Processing unit performs initial signal processing, time delay beamforming, and bottom detection. The beamforming process is equi-angle. Equi-angle beamforming uses the same beam angle spacing for all beams. The 8150 employs both Pitch and active Roll Compensation to steer the receiver beams so that the nadir beam remains vertical through roll angles of ±10 degrees. Pitch, Roll and heading values are provided by the Inertial Navigation System PHINS.
Continuous velocity values used to perform the dynamic beam steering are provided by the keel mounted Navitronic SVP71 sound velocity probe. The data are acquired and stored by the navigation software PDS2000.

Fig. B.3: Navigation room. The surveyor also operates the MBES by means of PDS2000 suite. Monitors shown in the photo: real time navigation and acquisition control (1 & 2), MBES control (3 & 4)

B.2.2.3. Sound velocity profiling

Sound velocity profile measurements needed for real time correction of the incoming raw water depth data. They are supplied on a daily basis by means of a Sound Velocity Probe SVP-24, which also logs temperature measures along the water column. The probe is operated by a winch located on the second deck and placed in the sea by hanging it on to the portside lateral frame pulley. Alternatively, it can be deployed together with the CTD / WSC system.

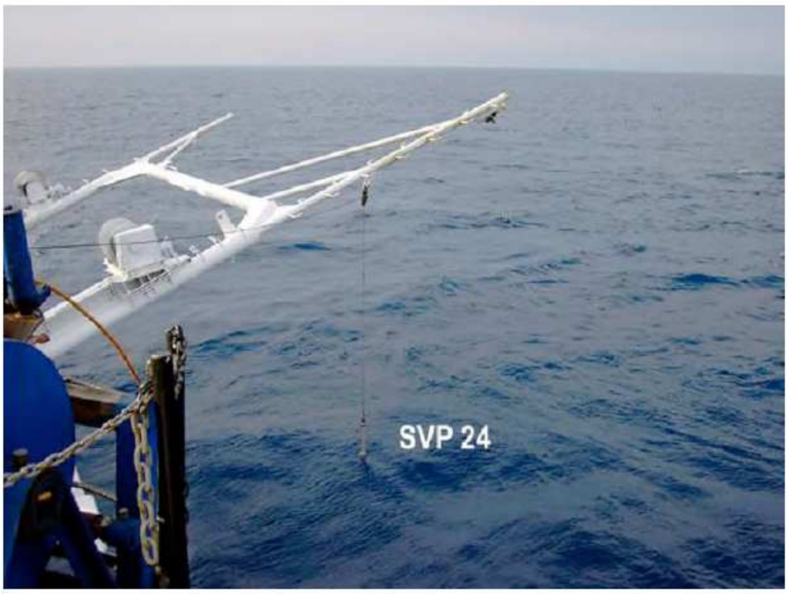
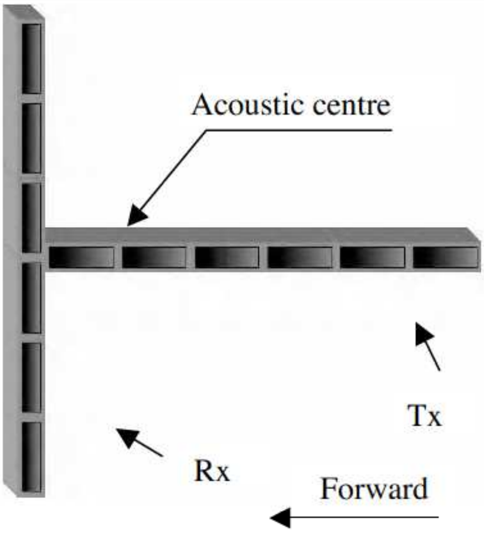


Fig.B. 4: The Sound Velocity Probe is usually deployed by lowering the portside frame.

SEABAT 8150 FEATURES AND SPECIFICATIONS	
Manufacturer	Reson
Model	SeaBat 8150
Installation	Hull mounted
Number of beams	234
Number of transmitters (Tx)	6 - configuration B
Number of receivers (Rx)	6 - configuration B
Beam width	2 x 2°
Max swath coverage	5 x water depth
Operating frequency	12 kHz
Pulse length	0.5 – 20.4 ms
Depth range	12000 m
Max update rate	15 swaths per second
Update rate	Range dependent
Pitch motion compensation	+/- 10°
Roll motion compensation	+/- 10°
Sound probe	Reson SVP 25
Acquisition software	PDS2000
Processing software	PDS2000

SEABAT 8150 - B CONFIGURATION



The keel mounted Reson Seabat 8150 .

Tab.B3

B.2.3. Sub Bottom Profiling

OGS Explora is equipped with a Chirp Sub Bottom Profiler Benthos CAP-6600. It consists of 16 keel mounted AT 471 transducers and a top side unit, composed of an analogic amplifier and a data logger. The A/D conversion is performed by a 16 bits DSP card. Sweeps range between 2 and 7 kHz.
Either Chirp II (by Benthos) or SwanPro (by Communication Technology) acquisition software can be used to collect the data, which can be real-time plotted on a EPC thermal printer. A LAN connection ensures real time data access.
At set space or time intervals, fix events generated by the navigation software are delivered to the acquisition system and recorded within the SBP data headers, so as to easily coupled MBES data to SBP data. Depth information is delivered by the SBES via serial port.

SBP FEATURES AND TECHNICAL SPECIFICATIONS	
Manufacturer	Benthos
Model	Chirp II
Installation	Hull mounted
Number of transducers	16
Transducers type	AT 471
Signal generator / DSP	CAP-6600 Chirp II Workstation
DSP Sonar Signal Processing	16 bit A/D, continuous FFT
Operating sweep frequency	2 – 7 kHz
Ping rate	Variable, operator selectable (max 12 ping/sec)
Sweep Length	Variable, operator selectable
Multiping option	yes
Gain	Automatic gain control
Bottom tracking	Interactive
Navigation / Annotation	NMEA 0183
Data format	XTF or SEG Y
Real time printer	EPC
Acquisition software	SwanPRO / ChirpScan II
Processing software	Swan PRO
BENTHOS CHIRP II	
The system consists of sixteen hull mounted AT 471 transducers	

Tab.B4

B.2.4. Multichannel Seismic

The system employed during the EGLACOM project was rented and run from the Company FUGRO Oceansismica Roma.
The energy was provided by an array of four sleeve guns triggered by a RTS Hot Shot gun controller. The data were collected by a 1200 m long digital streamer and recorded by a 96 channel Sercel Seal Recorder.
The time break signal (a TTL pulse) was delivered at regular space intervals by the navigation system PDS2000, and splitted towards the recorder and the controller respectively, with the lattest one firing with 100 ms delay. Navigation string (SPECTRA) containing basic information suche as Shot Point number, position etc.), was sent to the recorder via serial communication port at 1 sec rate. See block diagram in Fig. B.5 for further details.
The streamer operating depth was guaranteed by nine remotely operated Digicourse birds.

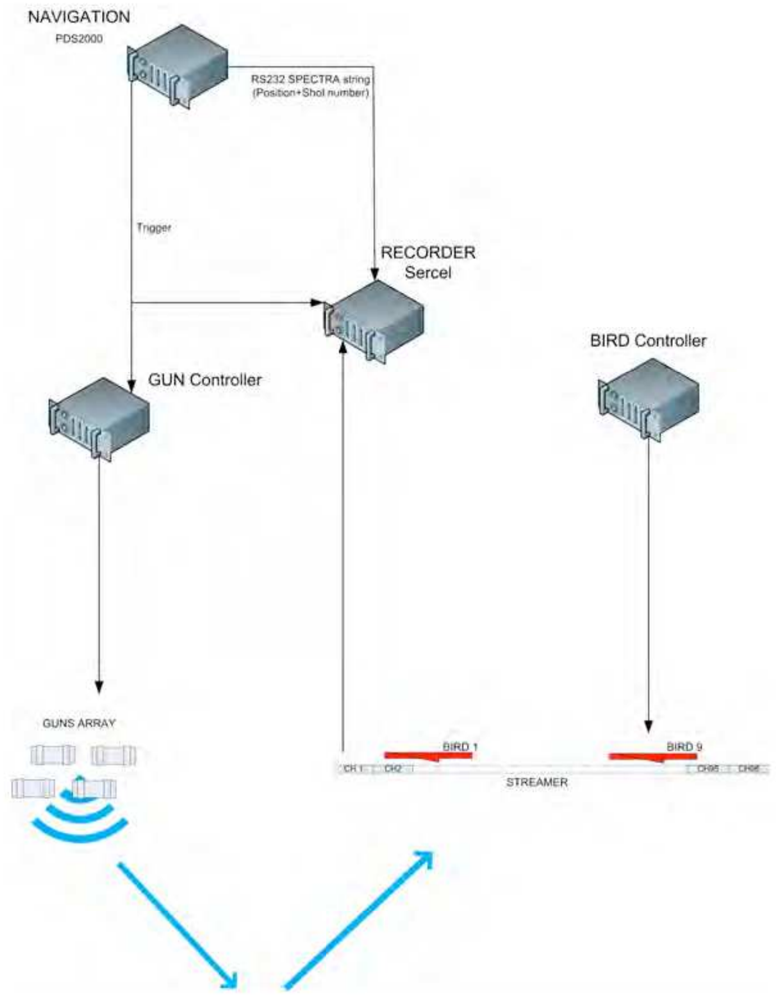
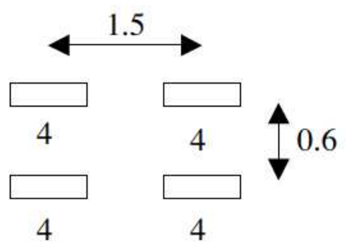


Fig.B. 5: General seismic acquisition block diagram.

B.2.4.1. Source

SOURCE	
Type	Sleeve Airguns
Array Volume	160 cu in (2.6 l)
Array Composition	4x40cu ins
Energy	2000 psi (140 bar)
Source depth	2.5m ± 0.5 m
Shot point interval	12.5 m / 25 m

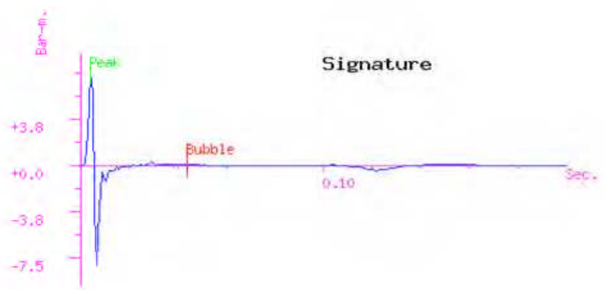
SOURCE CONFIGURATION

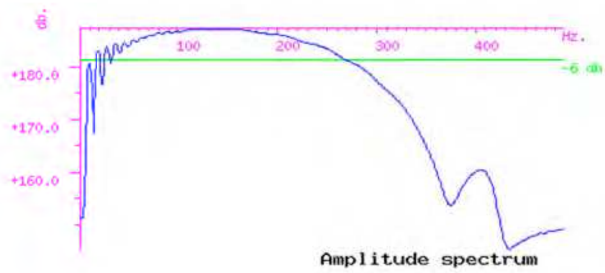


The four guns are mounted on a metal frame. Shock absorption is provided by 6 springs.

THEORETICAL SIGNATURE AND SPECTRUM

No of guns	4
Total volume	160 cu.in
Peak to peak	15.7 bar –m 1.57 MPa 244 db re 1 microPa at 1 m
Zero to peak	7.54 bar –m 0.754 MPa 238 db re 1 microPa at 1 m
Primary to bubble	33.9
Bubble period to first peak	0.04 sec.
Filters	Lo/slope -8.0 / 18.0 Hi/slope - 412 / 350
Position	Infinite vertical far field





Note:
Signature and spectra modelled by GUNDALF array modelling suite and provided by Fugro Oceansismica.

Tab.B5

B.2.4.2. Gun Controller

FEATURES AND TECHNICAL SPECIFICATIONS	
Manufacturer	Realt Time systems
Model	Hot Shot
Number of guns	4
Gun types	Bolt, Sleeve, G and G.I.
Timing resolution	0.1 msec
Record out	100 msec closure (programmable time)
Predicted fire out	5 ms TTL high going
Field Time Break Out	Summed sensor or hydrophone signal
Sensors and hydrophone signature	16 bit D / A
Aim Point	25 – 75 msec after trigger
Fire pulse width	1 -80 msec
Delta error Q / C limits	0.1 – 5.0 msec
Auto-fire detect level	0 – 10 Volts
Sensor detection look window	2 – 40 msec
Sensor peak threshold	0 – 10 Volt
Sensor peak type	Threshold, Peak or Zero Cross

Real time monitoring of guns synchronization. Each near field gun hydrophone output is displayed on the left hand side.
The resulting near field signature is shown on the bottom.
On the right hand side the delta quality history is displayed. Green histogram means that the shot time is within the desired tolerance (± 1 ms).

Tab.B6

B.2.4.3. Streamer

STREAMER	
Manufacturer	Sercel
Active streamer length	1200 m
Number of groups	96
Active group length	12.5 m
Hyrophones per group	16
Streamer sensitivity	17.4 V/bar
Streamer towing depth	3.0 m ± 1 m
Source to 1st channel offset	60 m
DEPTH CONTROL	
Manufacturer	Digicourse
Model	Digibird5000
Number of birds	9
	

Tab.B7

B.2.4.4. Recorder

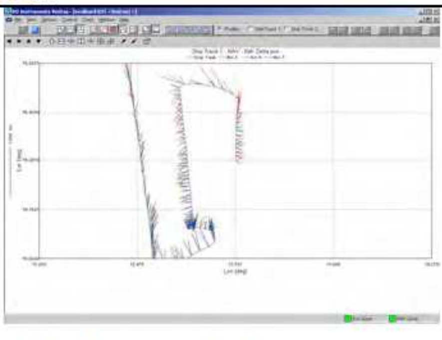
RECORDER	
Type	Sercel Seal CMXL 2000
Sampling rates	4 – 2 – 1 – 0.5 – 0.25
Word size	24 bits
Offset	0 (digitally zeroed=
Low cut filet	Analog 3 Hz
High cut filte	0.8 F_N (linear or minimum phase)
Stop band attenuation	> 120 dB (above Nyquist)
System dynamic range	136 dB
Instant dynamic range	124 dB
Distortion	- 105 dB
A/D conversion	24 bits
Gain accuracy	< 0.1 %
Data Format	SEG D 8058

Tab.B8

B.3. Physical Oceanography

B.3.1. Water acoustic profiling

ADCP FEATURES AND TECHNICAL SPECIFICATIONS		
Manufacturer Model Installation	RDI OS 75 Hull mounted	
Profile Parameters	Velocity accuracy (typical): ± 1.0%, ± 0.5 cm/s Velocity range: -5 to 9 m/s No of depth cells: 1-128 Max ping rate: 75 kHz	
Bottom track	Maximum altitude (precision < 2 cm/s): 75 kHz 950 m Range accuracy:=< ± 2%	
Echo intensity profile	Dynamic range: 80 dB Precision: ± 1.5 dB	
Transducer and hardware	Beam angel: 30° Configuration: 4 – beam phased array Communication: RS-232 or RS-422	
Standard sensors	Temperature (mounted on transducer) - Range: -5 °C to 45 °C - Precision: ± 0.1 °C - Resolution: 0.03 °C	
Long Range Mode		
Vertical resolution cell size	Max Range (m)	Precision (cm s^{-1})
8 m	520 - 650	30
16 m	560 - 700	17
High Precision Mode		
Vertical resolution cell size	Max Range (m)	Precision (cm s^{-1})
8 m	310 - 430	12
16 m	350 - 450	9



Real time current profiles monitoring

The transducers are permanently located on the vessel's keel (on the left in the picture)

Tab.B9

The R / V OGS Explora is equipped with an ADCP OS 75 kHz which obtain water velocity profiles by transmitting sound of known frequency into the water and measuring the Doppler shift of reflections from scatterers (small particles or plankton in the water), assumed to be passively moving in the water. The permanent mounting on the ship's keel allows real time current profiles and structures to be measured.

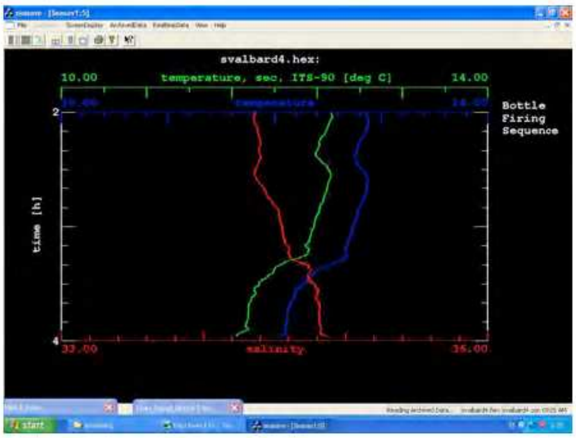
The instrument consists of a transducer and an electronic chassis. This contains all of the interfaces to and from the transducer, the data logger, the gyrocompass, the motion reference unit (PHINS) and the navigation system (PDS2000).

B.3.2. Water physical properties

B.3.2.1. Thermosalinograph

The vessel is equipped with a SBE21 thermosalinograph which measures real time sea surface temperature and conductivity. The SBE21 is connected to an AC powered interface box that contains a NMEA port for appending navigation to the data stream. The sensors are mounted in a PVC metal jacket. The platinum electrode in its glass conductivity cell is stored inside. The cell is also supplied with an anti-foulant devices and a thermistor temperature anti shock sensor, which is stable and immune to vibrations.
The system is provided with an optional SBE38 temperature sensor to be interfaced with SBE21. It is installed at the sea-water intake and measures sea surface temperature with minimal thermal contamination from the ship's hull.

THERMOSALINOGRAPH FEATURES AND TECHNICAL SPECIFICATIONS			
Manufacturer	Sea Bird electronics		
Model	SBE21 Seacat		
Installation	Hull mounted		
	Range	**Accuracy**	**Resolution**
Conductivity (S/m)	0 -7	0.001	0.0001
Temperature, primary (°C)	-5 to +35	0.01	0.001
Temperature, SBE remote (°C)	-5 to +35	0.001	0.0003
Sample interval	3 sec. or longer in steps of 1 sec.		
Water jacket	Approx. 5 liters		
Recommended flow rate	Approx. 1 lt/sec.		
Water jacket pressure limit	3.45 x 105 decibars (50 psi)		



Real Time monitoring of water physical parameters

The thermosalinograph is located in the hold of the ship

Tab.B10

B.3.2.2. Expendable Bathythermograph

On board is available an XBT system that provides temperature and sound velocity profile along the water column for oceanographic and geophysical studies.
The XBT system consists of an expendable probe, a data processing / recording system, and a launcher. An electrical connection between the processor / recorder is realized when the canister containing the probe is placed within the launcher and the launcher breech door is closed. Following launch, wire dreels probe as it descends vertically into the water.
As soon as the nose of the expendable probe makes contact with water, the circuit is complete and temperature or sound velocity data can be telemetered to the ship board unit. Data are recorder and displayed in real time as the probe falls.
When the probe reaches its rated depth, the profile is completed and the system is ready for another launch.
The XBT contains a precision thermistor located in the nose of the probe. Changes in water temperature are recorded by changes in the resistance of the thermistor as the XBT falls through the water.

MK21 SYSTEM FEATURES AND TECHNICAL SPECIFICATIONS			
Manufacturer		Sippican	
Model		MK21	
Probe type		XBT	
Sampling rate		10 Hz	
Vertical resolution		60 cm	
System accuracy		± 0.2 °C	
Temperature resolution		0.01 °C	
Temperature range		-2 to 35 °C	
Probe specifications			
Probe	**Applications**	**Max depth**	**Rated ship speed**
T-4	Standard	460 m	30 kn
T-5	Deep ocean	1830 m	6 kn
Fast Deep	Max depth max speed	1000 m	20 kn
T-6	Oceanographic applications	460 m	15 kn
T-7	Sonar prediction	760 m	15 kn
Deep blue	Increased launch speed	760 m	20 kn
T-10	Commercial fisheries applications	200 m	10 kn
T-11	High resolution (US navy)	460 m	6 kn

The pipeline (made of a corer liner and mounted near the winch control cabin) dedicated to XBT probe launch.

Tab.B11

B.3.2.3. CTD and Carousel water sampling system

The vessel is equipped with a SBE911plus CTD system composed by a 9plus underwater unit and a 11plus deck unit (see Tab.12 below).
A winch with 3,000 m of 11.6 mm iron-armored coaxial cable (employed in the preceeding cruise to tow a Side Scan Sonar) was used for the mechanical and electric (power, data transfer) connections. Two mechanical doglegs through snatch-blocks were necessary to employ the stern frame (to bypass a crane in between the path allowing a correct winding angle).

SBE 9plus underwater unit

The standard SBE 9plus underwater unit has an aluminium housing rated to 6800 meters (22,300 ft), and is supplied with one conductivity and one temperature sensor (fitted with a TC Duct and constant-flow pump), and an internally mounted, temperature-compensated Paroscientific Digiquartz pressure sensor for 6800 meter (10,000 psia) full scale range. Input channels and bulkhead connectors are provided for an optional second (redundant) pair of temperature and conductivity sensors. Other standard features include an 8-channel, 12-bit A/D converter with differential inputs and low pass filters, and high-power capability for support of commonly used auxiliary sensors.
In our configuration CTD was interfaced with an SBE13 beckman dissolved oxygen sensor, a Chelsea MKIII fluorometer, a Seatech LS6000 OBS and to a bottom contact switch.
The system was also interfaced via modem channel to a SBE32 12 positions Carousel sampler with 12 10-litre Niskin bottles.

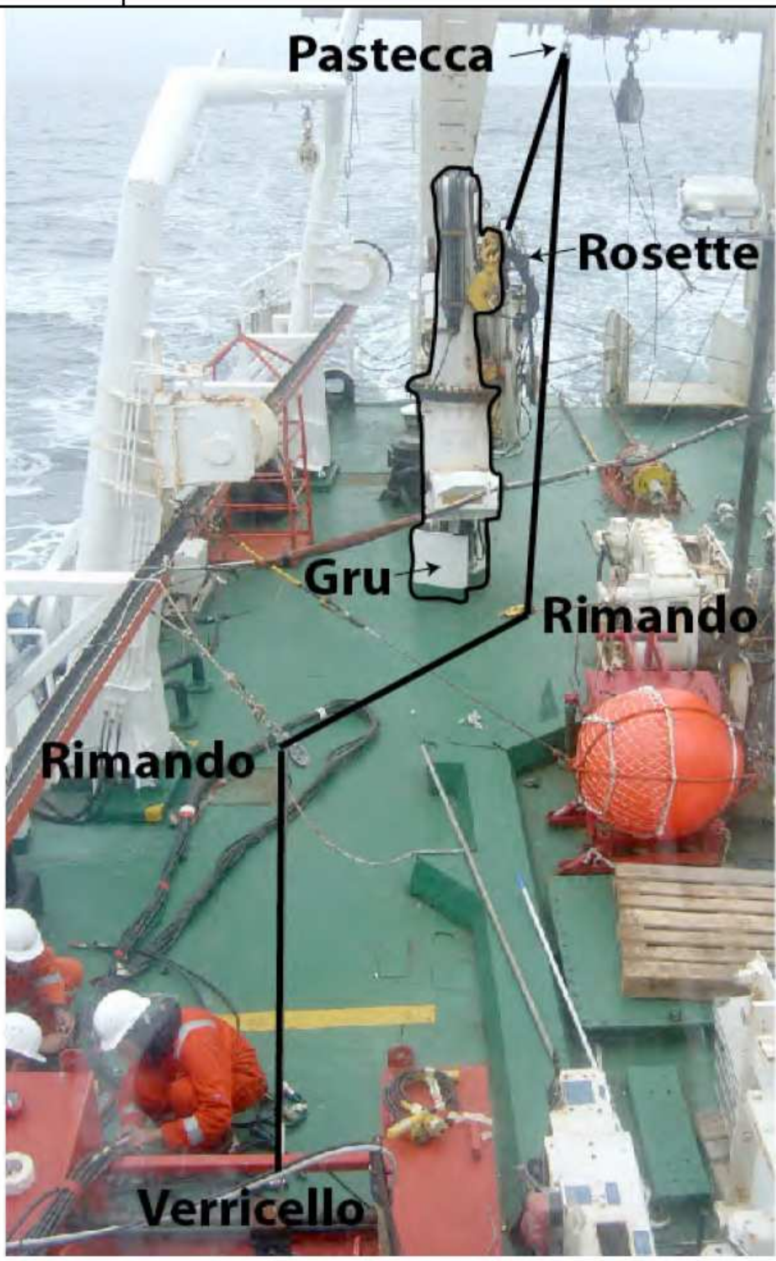
SBE 11plus Deck Unit

SBE 11plus Deck Unit includes RS-232 and IEEE-488 computer interfaces, a modem channel for real-time water sampler control (including water sampler control push buttons and status lights), NMEA 0183 interface for adding GPS position to CTD data, switch-selectable 115/230 VAC operation, audio tape interface (data backup), LED readout for raw data, and audible bottom contact (or altimeter) alarm. The deck unit convert provide power supply to the underwater unit and convert the raw data to the serial output.

CTD FEATURES AND TECHNICAL SPECIFICATIONS			
Manufacturer	Sea Bird electronics		
Model	SBE911plus		
	Range	Accuracy	Resolution
Conductivity (S/m)	0 -7	0.0003	0.00004
Temperature (°C)	-5 to +35	0.001	0.0002
Pressure	0 – 6800m	0.015% fs	0.001% fs
A/D Inputs	0-5 v	0.005 v	0.0012 v

The system adopted on board to deploy the Carousel sampler (“**Rosette**”) coupled with the CTD and SVP probes.

Two mechanical doglegs (“**Rimando**” and “**Rimando**”) through snatch-blocks were necessary to employ the snatch-block (“**Pastecca**”) on the stern frame (to bypass a crane (“**Gru**”) in between the path allowing a correct winding angle).



Tab.B12

B.4. Bio Oceanography

B.4.1. Chemical-biological laboratory

The chemical-biological laboratory fit out during the present cruise is equipped with two filtration ramps with 8 and 3 supports for 47 mm and 25 mm diameter filters respectively, a vacuum pump and a Mettler Toledo DL21 titrator. Eppendorf micropipettes, disposable pipettes, BOD bottles, various volumes vials, test tubes and self-refilling syringe, various porosity meshes, and essential glassware and reagents are also available. Refrigerator and freezer for adequate samples storing are provided.
For all chemical reagents utilized during samples processing security schedules are supplied.
All toxic wastes produced are collected in appropriate container and will be taking back at onshore laboratory for adequate disposal.

TITRATOR FEATURES AND TECHNICAL SPECIFICATIONS	
Manufacturer Model	METTLER TOLEDO DL21
Measuring system	End point indication - potentiometric
Amplification range	± 3000 mV
Resolution	0.1 mV, 0.001 pH
Accuracy	± 0.02 pH within the pH range 0-14
Burette volumes	1, 5, 10, 20 mL
Resolution	1/2000 of burette volume
Accuracy	Better than 0.3% for consumption greater or equal 30% of burette volume
Titration types	To first equivalence point Equivalence point corresponding to steepest inflection in titration curve All equivalence points To preselected end point To two preselected end points pH-stating TAN/TBN (acid or base number)
Reagent addition	Dynamic or with constant volume steps
Measured value acquisition	Equilibrium controlled or timed increment
Result calculation	automatic
	Titrator installed in the chemical-biological laboratory

Tab.B13

Annex C - Acquired data inventory

Annex C.1. Acquisition lines (always MBES +SB; MCS from 01 to 11)

Line		Day	Time (GMT)	Water Depth (m)	FIX N°	Latitude N	Longitude East	Heading
01test	Start	16/7	05:10	109	100	77°54'24.19"	011°26'42.08"	226
	End	16/7	05:44	94	394	77° 52'53.18"	011° 19'56.76"	226
01	Start	16/7	08:52	84	100	77°52'35.03"	011°18'39.04"	226
	End	16/7	11:52	283	1655	77°44' 58.90"	010°45'30.87"	225
01A	Start	16/7	13:16	218	100	77°45'44.54"	010°48'47.39"	226
	End	16/7	22:22	2074	7305	77°18'40.13"	008°57'42.88"	222
02A	Start	17/7	01:33	2078	100	77°19'55.97"	009°02'43.86"	99
	End	17/7	08:27	839	4273	77°17'33.51"	011°08'23.58"	97
02B	Start	17/7	10:14	1164	100	77°19'51.48"	010°48'50.86"	154
	End	18/7	05:15	961	10735	76°25'37.74"	014°04'23.47"	138
03	Start	18/7	09:06	153	100	76°33'17.34"	14°33'19.47"	26
	End	18/7	10:33	213	520	76°38'18.51"	014°43'58.87"	26
04	Start	18/7	11:17	208	100	76°39'42.09"	014°35'24.81"	255
	End	19/7	05:35	2292	5842	76°00'46.89"	010°03'03.32"	231
05	Start	19/7	07:31	2280	100	76°01'52.20"	009°56'18.08"	109
	End	19/7	21:28	703	4575	75°50'09.54"	013°56'47.31"	94
06	Start	19/7	23:17	775	100	75°50'35.67"	013°52'42.98"	183
	End	20/7	16:42	365	5510	74°51'36.13"	016°06'55.62"	128
07	Start	20/7	17:49	310	100	74°53'43.30"	016°16'12.99"	3
	End	20/7	19:08	258	516	74°59'15.87"	016°17'33.38"	3
08	Start	20/7	19:34	230	100	74°59'21.54"	016°12'14.91"	253
	End	21/7	02:25	1724	2233	74°50'15.36"	014°27'38.59"	247
08B	Start	21/7	02:25	1724	100	74°50'12.39"	014°27'11.76"	247
	End	21/7	13:52	2440	3740	74°44'09.35"	011°27'44.04"	262
09	Start	21/7	15:34	2443	100	74°42'56.49"	011°26'31.84"	43
	End	22/7	12:19	380	6630	75°48'22.88"	015°13'10.05"	43
10	Start	22/7	12:52	375	100	75°49'22.56"	015°06'26.99"	273
	End	22/7	16:41	605	1290	75°50'06.77"	014°02'19.29"	273
10A	Start	22/7	18:46	556	100	75°50'04.21"	014°04'50.61"	273
	End	22/7	19:45	848	400	75°50'13.88"	013°48'20.89"	273
11	Start	22/7	20:40	775	100	75°50'03.98"	013°52'37.01"	4
	End	22/7	21:54	786	482	75°55'08.65"	013°53'39.73"	4
11A	Start	22/7	23:41	793	100	75°54'41.34"	013°53'34.40"	4
	End	23/7	07:30	983	2546	76°27'23.79"	013°59'56.64"	4
12	Start	23/7	09:44	256	99	76°30'25.39"	014°00'49.92"	324
	End	23/7	10:08	270	104	76°37'00.51"	013°48'01.04"	324
13	Start	23/7	10:46	785	99	76°36'12.79"	013°30'50.76"	137
	End	23/7	14:12	848	139	76*14'12.85"	014°04'30.20"	184
14	Start	23/7	14:34	784	100	76°15'37.85"	014°11'17.15"	4
	End	23/7	17:52	653	189	76°36'16.72"	013°38'31.27"	316

Line		Day	Time (GMT)	Water Depth (m)	FIX N°	Latitude N	Longitude East	Heading
15	Start	23/7	18:13	484	100	76°36'17.44"	013°45'23.22"	137
	End	23/7	20:53	753	175	76°19'22.42"	014°18'06.21"	184
16	Start	23/7	21:19	729	100	76°22'06.35"	014°25'03.00"	1
	End	23/7	22:10	512	123	76°27'54.96"	014°25'28.95"	1
17	Start	23/7	22:14	500	100	76°28'48.75"	014°23'11.74"	310
	End	23/7	23:32	277	142	76°36'43.51"	013°48'59.28"	310
18	Start	23/7	23:44	214	100	76°37'02.39"	013°50'51.72"	144
	End	24/7	00:58	303	140	76°29'31.45"	014°23'36.65"	128
19	Start	24/7	01:04	234	100	76°30'02.02"	014°24'49.47"	307
	End	24/7	02:17	209	140	76°37'29.79"	013°52'26.03"	307
20	Start	24/7	02:18	209	100	76°37'37.40"	013°51'34.22"	263
	End	24/7	03:18	1062	129	76°36'23.78"	013°14'58.99"	263
21	Start	24/7	04:20	1174	99	76°34'52.78"	013°17'20.07"	140
	End	24/7	07:44	965	139	76°11'22.41"	13°50'30.97"	140
22	Start	24/7	08:20	1026	100	76°10'10.20"	013°44'34.66"	1
	End	24/7	10:26	1160	125	76°27'22.01"	013°44'57.04"	1
23	Start	24/7	10:55	1232	100	76°29'32.91"	013°35'18.46"	179
	End	24/7	13:59	1060	188	76°05'56.14"	013°37'43.98"	179
24	Start	24/7	16:37	1133	100	76°00'26.77"	013°31'01.23"	359
	End	24/7	20:24	1261	217	76°31'50.74"	013°27'05.08"	359
25	Start	24/7	20:51	779	100	76°36'45.14"	013°28'10.04"	318
	End	25/7	01:46	1046	323	77°20'22.84"	010°56'10.73"	334
26	Start	25/7	01:50	1007	100	77°21'11.79"	010°57'58.34"	38
	End	25/7	06:13	176	188	78°00'54.00"	013°05'47.58"	38
27	Start	26/7	07:20	920	100	77°21'44.00"	011°01'20.14"	156
	End	26/7	14:00	678	207	76°36'36.54"	013°35'06.14"	140
28	Start	26/7	15:27	220	100	76°38'00.36"	013°51'21.18"	271
	End	26/7	15:59	617	108	76°37'57.59"	013°30'48.48"	271
29	Start	26/7	18:24	1178	100	76°34'54.47"	013°17'25.07"	179
	End	27/7	05:07	1728	268	75°05'28.86"	013°33'39.15"	180
30	Start	27/7	05:29	1822	100	75°03'54.30"	013°25'16.81"	2
	End	27/7	16:07	1354	267	76°33'22.49"	013°09'42.71"	358
31	Start	27/7	16:29	1445	100	76°31'38.63"	013°06'45.23"	251
	End	27/7	17:28	1699	114	76°28'53.44"	012°35'41.95"	251
31A	Start	27/7	20:54	1693	100	76°29'01.76"	012°37'02.17"	251
	End	27/7	22:02	1885	117	76°25'14.89"	012°00'41.72"	251
32	Start	27/7	22:23	1868	100	76°22'55.67"	012°04'26.51"	69
	End	27/7	00:08	1506	127	76°28'44.34"	013°02'22.05"	69
33	Start	28/7	00:19	1523	100	76°29'30.98"	013°00'38.27"	178
	End	28/7	10:48	1952	265	75°01'06.79"	013°11'44.54"	179
34	Start	28/7	11:20	2013	100	75°01'16.03"	013°00'50.12"	6
	End	28/7	12:41	1722	121	75°12'51.46"	013°04'19.55"	6

Annex C.1 (continued)

Line		Day	Time (GMT)	Water Depth (m)	FIX N°	Latitude N	Longitude East	Heading
35	Start	28/7	14.24	1729	99	75°12'30.34"	013°04'36.00"	3
	End	28/7	18.59	1428	171	75°50'37.37"	012°58'02.35"	360
36	Start	28/7	20.29	1430	100	75°50'25.70"	012°58'04.78"	360
	End	29/7	00.45	1596	168	76°26'56.68"	012°51'18.44"	360
37	Start	29/7	01.12	1671	100	76°27'38.53"	012°40'37.27"	176
	End	29/7	03.22	1553	134	76°09'29.99"	012°47'59.84"	176
37A	Start	29/7	03.29	1545	99	76°08'22.18"	012°48'27.65"	176
	End	29/7	05.43	1523	131	75°50'46.32"	012°49'03.94"	176
37B	Start	29/7	08.28	1519	132	75°50'44.90"	012°49'06.20"	176
	End	29/7	14.10	2032	223	75°02'32.87"	012°50'15.11"	186
38	Start	29/7	14.11	2032	98	75°02'32.87"	012°50'15.11"	175
	End	29/7	17.25	1996	149	74°44'48.02"	014°01'06.41"	127
39	Start	29/7	17.25	1996	98	74°44'48.02"	014°01'06.41"	130
	End	29/7	19.41	1737	134	74°32'17.27"	014°56'54.85"	130
39A	Start	29/7	22.11	1741	100	74°33'03.32"	014°54'36.01"	130
	End	30/7	00.22	1351	134	74°21'06.02"	015°48'09.83"	130
40	Start	30/7	00.41	1280	100	74°21'58.23"	015°54'40.33"	306
	End	30/7	03.11	1627	137	74°35'31.74"	014°57'52.52"	306
41	Start	30/7	03.31	1455	100	74°37'14.83"	015°04'39.40"	134
	End	30/7	06.17	865	142	74°21'22.36"	016°06'41.14"	134
42	Start	30/7	06.31	713	100	74°21'55.18"	016°11'05.27"	321
	End	30/7	09.29	1300	137	74°37'02.89"	015°16'34.28"	321
43	Start	30/7	09.48	1220	100	74°39'05.68"	015°17'42.86"	133
	End	30/7	12.25	640	142	74°22'29.56"	016°14'10.82"	150
44	Start	30/7	12.37	436	100	74°22'49.72"	016°16'45.99"	335
	End	30/7	16.38	1143	145	74°41'15.30"	015°19'34.45"	314
45	Start	30/7	18.17	1035	100	74°42'29.46"	015°23'55.34"	136
	End	30/7	21.14	377	146	74°23'03.57"	016°19'00.99"	163
46	Start	30/7	21.25	336	100	74°23'14.74"	016°21'33.81"	343
	End	31/7	01.34	947	148	74°44'12.80"	015°26'17.74"	317
47	Start	31/7	01.54	837	100	74°45'40.80"	015°29'22.07"	141
	End	31/7	04.47	409	135	47°30'50.96"	016°15'14.95"	153
48	Start	31/7	04.59	325	100	74°31'16.23"	016°17'49.06"	333
	End	31/7	07.42	733	137	74°47'25.66"	015°32'04.96"	325
49	Start	31/7	07.43	723	99	074°46'26.34"	015°32'03.92"	14
	End	31/7	10.14	234	134	75°06'08.63"	015°45'46.36"	359
50	Start	31/7	10.20	224	99	75°06'08.52	015°47'12.62"	181
	End	31/7	11.22	390	115	74°57'55.01"	015°47'45.18"	178
51	Start	31/7	11.41	443	100	74°56'58.81"	015°45'05.30"	128
	End	31/7	12.46	337	117	74°51'13.37"	016°12'31.97"	128
52	Start	31/7	14.09	340	119	74°52'03.33"	016°13'16.21"	308
	End	31/7	15.10	341	134	74°57'20.41"	015°49'00.81"	308

Annex C.1 (continued)

Line		Day	Time (GMT)	Water Depth (m)	FIX N°	Latitude N	Longitude East	Heading
53	Start	31/7	15.30	449	100	74°55'52.28"	015°42'37.49"	128
	End	31/7	16.37	344	117	74°50'05.87"	016°09'58.82"	128
54	Start	31/7	17.53	338	100	74°52'43.27"	016°14'37.96"	308
	End	31/7	18.23	297	107	74°55'16.76"	016°03'02.89"	308
55	Start	31/7	18.31	278	100	74°55'46.71"	016°04'34.06"	125
	End	31/7	18.55	318	106	74°53'40.28"	016°15'16.12"	125
56	Start	31/7	19.06	302	100	74°53'37.64"	016°18'51.64"	199
	End	31/7	19.41	343	111	74°49'29.79"	016°09'54.05"	216
57	Start	31/7	19.44	351	100	74°49'22.86"	016°08'42.32"	307
	End	31/7	20.50	429	116	74°55'00.70"	015°41'27.63"	307
58	Start	31/7	20.59	473	100	74°54'27.87"	015°39'20.24"	127
	End	31/7	22.09	341	118	74°48'28.62"	016°08i57.07"	126
59	Start	31/7	22.14	335	99	74°48'39.21"	016°09'50.34"	90
	End	31/7	23.38	289	120	74°48'14.53"	016°54'24.86"	90
60	Start	31/7	23.46	281	100	74°47'43.29"	016°52'40.10"	260
	End	1/8	02.31	455	139	74°53'17.97"	015°39'33.34"	307
61	Start	1/8	02.40	475	100	74°52'26.74"	015°38'25.48"	113
	End	1/8	03.43	353	116	74°47'05.03"	016°06'05.17"	129
62	Start	1/8	03.51	336	100	74°46'33.37"	016°03'56.09"	306
	End	1/8	04.51	513	115	74°51'33.16"	015°37'41.92"	308
63	Start	1/8	04.58	524	100	74°50'52.00"	05°36'55.26"	121
	End	1/8	05.58	304	115	74°45'49.70"	016°03'03.54"	126
64	Start	1/8	06.02	307	99	74°46'02.72"	016°04'25.52"	34
	End	1/8	06.26	336	106	74é49'05..81"	016°10'49.96"	34
65	Start	1/8	06.30	333	99	74°49'21.88"	016°11'42.32"	90
	End	1/8	07.26	288	114	74°48'59.71"	016°42'14.52"	90
66	Start	1/8	07.34	283	99	74°49'33.19"	016°43'00.20"	272
	End	1/8	08.29	331	114	74°50'02.59"	016°12'58.02"	270
67	Start	1/8	08.39	333	100	74°50'38.29"	016°14'24.39"	90
	End	1/8	09.21	317	111	74°50'21.54"	16°37'41.11"	90
68	Start	1/8	09.29	319	100	74°50'59.35"	016°38'22.01"	276
	End	1/8	10.11	329	110	74°51'18.70"	016°16'41.02"	269
69	Start	1/8	10.20	333	100	74°51'58.08"	016°15'41.09"	88
	End	1/8	11.02	315	111	74°51'33.88"	016°39'53.93"	93
70	Start	1/8	11.09	305	100	74°50'57.94"	016°40'30.89"	174
	End	1/8	11.32	310	106	74°47'24.34"	016°41'15.67"	174
71	Start	1/8	11.35	310	99	74°47'00.97"	016°40'36.31"	270
	End	1/8	12.50	307	116	74°46'12.43"	016°07'47.79"	270
72	Start	1/8	12.59	310	100	74°46'31.35"	016°09'01.25"	90
	End	1/8	13.56	285	116	74°46'18.73"	016°41'45.14"	90

Annex C.1 (continued)

Annex C.2. Stations (CDT/WSC/SVP)

Station	SVP	CTD	WSC	Day	Time (bottom)	Latitude N	Longitude E	Seafloor depth (m)
A	SVP01	-	-	10-07-08	07:09	67°46'40.90"	008°27'10.09"	2045
B	SVP02	CTD01	WSC01	12-07-08	07:17	74°33'57.59"	015°02'40.29"	1612
C	-	CTD02	WSC02	26-07-08	14:47	76°36'46.51"	013°44'20.47"	425
D	SVP03	CTD03	-	26-07-08	17:21	76°35'13.17"	013°25'26.57"	1000
E	SVP04	-	-	27-07-08	19:32	76°30'31.75"	012°31'26.47"	1728
F	-	CTD04	-	29-07-08	07:20	75°50'31.42"	012°54'05.72"	1471
G	SVP05	CTD05	-	29-07-08	21:11	74°34'05.59"	015°01'10.31"	1610
H	SVP06	CTD06	WSC03	31-07-08	13:34	74°51'25.97"	016°08'04.48"	358

Annex C.3. Point of surface water sampling

WP	Day	Time	Lat.	Long.
C1	9-07-2008	9.07	65°00'68.18"N	007°36'3129"E
C2	9-07-2008	11.58	65°30'00.49" N	007°45'11.57" E
C3	9-07-2008	14.54	66°00'07.23" N	007°54'11.98" E
C4	9-07-2008	17.50	66°30'00.49" N	008°03'10.19" E
C5	9-07-2008	21.02	67°00'31.25" N	008°14'45.79" E
C6	10-07-2008	09.55	68°00'01.94" N	008°25'49.06" E
C7	10-07-2008	14.28	68°30'03.48" N	008°39'21.44" E
C8	10-07-2008	17.27	69°00'00.47" N	009°06'47.91" E
C9	10-07-2008	23.15	70°00'01.18" N	010°11'58.38" E
C10	11-07-2008	05.13	71°00'00.44" N	011°10'01.44" E
C11	11-07-2008	11.35	72°00'00.33" N	012°21'39.73" E
C12	11-07-2008	17.51	73°00'00.69" N	013°36'39.37" E
C13	12-07-2008	00.09	74°00'04.55"N	014°56'15.91"E
C14	12-07-2008	17.17	74°59'00.27" N	013°47'25.00" E
C15	12-07-2008	23.49	76°06'37.07" N	013°38'49.76" E
C16	13-07-2008	05.41	77°00'00.52" N	013°27'42.82" E
C17	13-07-2008	11.26	78°00'00.30" N	013°05'03.57" E

Annex C.4. XBT launches

Launch	XBT type	Day	Time (GMT)	Latitude N	Longitude E	Depth (m)	Outcome
1	T10	16-07	5:26:31	77°53.836	11°24.183	104	OK
2	T10	16-07	9:11:18	77°51.798	11°15.187	86	OK
3	T10	16-07	9:52:16	77°49.816	11°06.467	113	spike 112 m
4	T10	16-07	11:00:06	77°46.459	10°51.865	213	OK
5	T6	16-07	14:23:44	77°42.401	10°34.417	413	OK
6	T5	16-07	16:25:14	77°36.178	10°08.267	1288	spike 1242 m
7	T5	16-07	19:06:46	77°28.023	9°34.876	1870	OK
8	T5	16-07	21:45:52	77°20.422	9°04.595	2056	OK
9	T5	17-07	4:52:05	77°18.907	10°03.633	1729	OK
10	T5	17-07	7:37:44	77°17.890	10°53.541	1124	OK
11	T5	17-07	16:24:43	77°00.008	11°39.799	980	OK
12	T5	18-07	1:29:12	76°35.188	13°25.576	1018	OK
13	T10	18-07	11:00:13	76°39.635	14°40.058	220	OK
14	T10	18-07	12:43:03	76°38.113	14°09.450	200	OK
15	T6	18-07	0:00:01	76°36.580	13°45.310	450	OK
16	T5	18-07	18:15:12	76°31.805	12°33.950	1720	OK
17	T5	18-07	22:15:26	76°21.453	11°37.962	2002	OK
18	T5	19-07	1:37:29	76°12.145	10°54.303	2138	OK
19	T5	19-07	5:25:32	76°01.329	10°05.466	2283	OK
20	T5	19-07	12:18:52	75°56.521	11°18.056	2140	OK
21	T5	19-07	16:18:26	75°51.604	12°26.956	1722	OK
22	T5	19-07	19:09:36	75°50.458	13°16.344	1255	OK
23	T5	19-07	21:15:39	75°50.194	13°52.666	785	OK
24	T5	20-07	4:12:57	75°31.143	13°55.695	818	OK
25	T5	20-07	9:07:54	75°13.599	14°36.128	750	OK
26	T5	20-07	13:51:08	74°59.362	15°29.863	765	OK
27	T6	20-07	16:48:16	74°51.412	16°07.857	360	OK
28	T10	20-07	19:23:13	74°59.605	16°15.361	260	OK
29	T10	20-07	19:47:07	74°59.146	16°09.189	223	OK
30	T6	20-07	0:00:00	74°58.020	15°53.560	267	OK

Launch	XBT type	Day	Time (GMT)	Latitude N	Longitude E	Depth (m)	Outcome
31	T5	20-07	22:45:41	74°55.766	15 22.858	852	OK
32	T5	21-07	0:35:12	74°53.273	14 55.250	1354	broken 949 m
33	T5	21-07	2:39:05	74°49.920	14 24.556	1752	OK
34	T5	21-07	4:12:51	74°47.282	14 01.050	1975	OK
35	T5	21-07	9:53:06	74°47.107	12 31.527	2307	OK
36	T5	21-07	13:42:41	74°44.291	11 30.561	2440	OK
37	T5	21-07	20:16:13	74°57.962	12 14.538	2238	OK
38	T5	22-07	1:35:48	75°14.885	13 11.399	1627	OK
39	T5	22-07	3:44:55	75°21.744	13 35.311	1252	failed
40	T5	22-07	3:46:42	75°21.837	13 35.647	1244	OK
41	T5	22-07	5:46:47	75°28.431	13 59.099	815	OK
42	T6	22-07	8:37:44	75°37.271	14 31.339	389	OK
43	T6	22-07	8:59:37	75°38.372	14 35.413	383	OK
44	T6	22-07	10:50:17	75°43.930	14 56.232	380	broken 312 m
45	T6	22-07	12:29:05	75°48.956	15 13.263	370	OK
46	T6	22-07	14:07:14	75°49.646	14 45.570	375	OK
47	T6	22-07	15:20:34	75°49.881	14 25.429	375	OK
48	T5	22-07	19:31:03	75°50.198	13 52.843	775	OK
49	T5	23-07	2:57:33	76°08.630	13 56.281	863	OK
50	T5	23-07	7:20:29	76°26.683	13 59.810	1015	OK
51	T6	26-07	14:54:02	76°36.828	13 44.036	424	OK
52	T5	26-07	16:14:25	76°35.830	13 23.450	987	broken 823 m
53	T10	1-08	10:25:35	74°51.973	16 17.630	330	OK
54	T10	1-08	10:37:01	74°51.974	16 24.396	340	broken 26 m
55	T6	1-08	10:42:00	74°51.980	16 27.130	348	OK
56	T10	1-08	10:54:52	74°51.827	16 35.022	340	OK
57	T10	1-08	11:02:23	74°51.584	16 39.470	323	OK
58	T5	3-08	3:41:19	68°37.554	10 33.207	2463	OK
59	T5	3-08	4:50:18	68°27.647	10 19.401	2134	OK
60	T5	3-08	6:11:15	68°15.825	10 04.845	1384	OK

Annex C.4 (continued)

ANNEX C.5 Sediment cores

Core	Latitude	Longitude	WD (m)	Day		Length (cm)
1	76° 06' 12.08"	13° 37' 37.48"	1069	24-07-2808	14.40	220.5
2	75° 12' 54.44"	13° 04' 35.26"	1722	28-07-2008	13:32	305.5
3	75° 50' 36.92"	12° 58' 21.23"	1432	28-07-2008	19:38	291.5
4	74° 51' 53.78"	16° 05' 36.02"	374	31-07-2008	17:18	105.00

ANNEX C.6 Sections of the sediment cores

Core	Sections (cm)	Notes
1	Corer head: 37.5 (0-37.5); SEC I: 90 (35.7-127.5); SEC II: 93 (127.5-220.5)	Upper part recovered from the corer head. Core top disturbed.
2	SEC. I (corer head): 122.5 (0-122.5); SEC. II: 90 (122.5-212.5); SEC. III: 93 (212.5-306.5)	Section 1 corresponds to the corer head. Core top lost.
3	SEC. I (corer head): 106.5 (0-106.5); SEC. IA: 2 (106.5- 108.5); SEC. II: 90 (108.5-198.5); SEC. III: 93 (198.5-291.5)	Sec 1 corresponds to corer head; sec 1/A (2 cm) between sec 1 and sec 2 disturbed.
4	SEC. I: 105 (0-105)	

Annex D - Processed data inventory

Annex D.1 MCS lines processed up to near-trace stage

N.	Line	from SP	to SP	SP int.	Km	N. Plot
1	**IT-EG01**	100	1653	12.5	19.425	1
2	**IT-EG01A**	100	7303	12.5	90.050	3
3	**IT-EG02**	100	255	12.5	1.950	1
4	**IT-EG02A**	100	4266	12.5	52.088	3
5	**IT-EG02B**	100	10677	12.5	132.225	6
6	**IT-EG03**	100	720	25	15.525	1
7	**IT-EG04**	100	2367	25	56.700	2
8	**IT-EG04A**	2425	5841	25	85.425	2
9	**IT-EG05**	100	4567	25	111.700	3
10	**IT-EG06**	100	5500	25	135.025	3
11	**IT-EG07**	100	591	25	12.300	1
12	**IT-EG08**	100	3661	25	89.050	2
13	**IT-EG09**	100	6593	25	162.350	4
14	**IT-EG10**	100	1270	25	29.275	1
15	**IT-EG10A**	100	401	25	7.550	1
16	**IT-EG11**	100	481	25	9.550	1
17	**IT-EG11A**	100	2547	25	61.200	2
					1071.388	**37**

Annex D.2 MCS data processed up to brute-stack stage

N.	Line	from SP	to SP	SP int.	CDP	Km
1	**IT-EG01A**	1501	2000	12.5	1096	6.850
2	**IT-EG01A**	3501	3900	12.5	896	5.600
3	**IT-EG02A**	201	800	12.5	1296	8.100
4	**IT-EG03**	100	720	25	2578	16.113
5	**IT-EG04**	1801	2367	25	2362	14.763
6	**IT-EG05**	100	1200	25	4498	28.113
7	**IT-EG05**	3000	3600	25	2498	15.613
8	**IT-EG06**	3800	4600	25	4898	30.613
9	**IT-EG08**	700	1900	25	3298	20.613
10	**IT-EG11**	100	481	25	1622	10.138
11	**IT-EG11A**	2000	2546	25	2282	14.263
						170.775

Annex D.3 Thermosalinograph data

File Name	Start time	Start Latitude (N)	Start Longitude (E)	End time	End Latitude (N)	End Longitude (E)	Total hours	Total Distance [nm]	Mean Velocity [kn]
01.cnv	08-Jul-08 21:08:57	63°6.824'	7°44.214'	09-Jul-08 08:50:02	64°49.472'	7°32.695'	11.68	108.93	9.32
02.cnv	09-Jul-08 07:57:40	64°49.706'	7°32.770'	09-Jul-08 11:40:00	65°26.737'	7°44.093'	3.71	37.35	10.08
03.cnv	09-Jul-08 11:41:49	65°27.049'	7°44.190'	09-Jul-08 15:05:49	66°2.020'	7°54.830'	3.40	35.25	10.37
04.cnv	09-Jul-08 15:16:05	66°3.790'	7°55.442'	10-Jul-08 12:50:00	68°14.044'	8°24.070'	21.57	145.22	6.73
05.cnv	10-Jul-08 12:50:46	68°14.003'	8°23.900'	13-Jul-08 15:19:46	78°13.795'	15°38.994'	74.48	692.75	9.30
06.cnv	15-Jul-08 07:54:38	78°13.813'	15°37.356'	15-Jul-08 20:05:58	78°21.557'	15°39.058'	12.19	54.04	4.43
07.cnv	15-Jul-08 20:06:24	78°21.524'	15°38.698'	16-Jul-08 15:08:04	77°40.124'	10°24.838'	19.03	107.69	5.66
09.cnv	16-Jul-08 18:10:30	77°30.794'	9°46.129'	18-Jul-08 15:13:30	76°35.208'	13°24.251'	45.05	178.31	3.96
10.cnv	18-Jul-08 15:14:02	76°35.198'	13°24.094'	19-Jul-08 11:06:32	75°57.949'	10°57.023'	19.88	81.69	4.11
11.cnv	19-Jul-08 11:06:58	75°57.941'	10°57.145'	19-Jul-08 19:59:03	75°50.364'	13°30.832'	8.87	38.71	4.36
12.cnv	19-Jul-08 19:59:34	75°50.363'	13°30.972'	21-Jul-08 13:37:44	74°44.354'	11°31.895'	41.64	175.37	4.21
13.cnv	21-Jul-08 13:38:10	74°44.351'	11°31.794'	22-Jul-08 20:45:00	75°50.262'	13°52.674'	31.11	128.17	4.12
14.cnv	22-Jul-08 20:45:32	75°50.298'	13°52.682'	23-Jul-08 16:52:47	76°30.534'	14°2.405'	20.12	104.74	5.21
15.cnv	23-Jul-08 16:53:23	76°30.587'	14°2.180'	23-Jul-08 22:36:48	76°30.281'	14°15.472'	5.72	43.79	7.65
16.cnv	23-Jul-08 22:37:13	76°30.313'	14°15.310'	24-Jul-08 10:48:13	76°29.807'	13°39.432'	12.18	97.01	7.96
17.cnv	24-Jul-08 10:48:39	76°29.802'	13°39.215'	25-Jul-08 17:22:14	78°13.972'	15°35.634'	30.56	232.79	7.62
18.cnv	25-Jul-08 22:12:16	78°14.015'	15°35.636'	27-Jul-08 12:33:11	76°2.920'	13°15.547'	38.35	313.43	8.17
19.cnv	27-Jul-08 12:33:42	76°2.992'	13°15.538'	28-Jul-08 14:54:32	75°16.199'	13°4.780'	26.35	189.28	7.18
20.cnv	28-Jul-08 14:55:04	75°16.264'	13°4.781'	29-Jul-08 23:27:24	74°26.272'	15°24.718'	32.54	234.20	7.20
21.cnv	29-Jul-08 23:27:51	74°26.234'	15°24.889'	30-Jul-08 21:29:41	74°23.468'	16°21.410'	22.03	161.68	7.34
22.cnv	30-Jul-08 21:30:07	74°23.525'	16°21.362'	31-Jul-08 21:28:02	74°52.237'	15°50.280'	23.97	170.73	7.12
23.cnv	31-Jul-08 21:28:28	74°52.204'	15°50.449'	01-Aug-08 13:30:48	74°46.421'	16°25.745'	16.04	132.35	8.25
24.cnv	01-Aug-08 13:31:19	74°46.420'	16°26.032'	01-Aug-08 14:37:14	74°46.387'	16°27.868'	1.10	8.60	7.83
25.cnv	01-Aug-08 14:37:39	74°46.366'	16°27.677'	04-Aug-08 12:57:34	63°6.356'	7°44.800'	70.33	744.57	10.59

ANNEX D.4 Water samples (either from WSC and thermosalinograph)

Sample	Depth (m)	O	DIC	DOC	DON	DOP	NUT	POC/ PN	CHLA	PBA	HPA	Resp	Com	M PHYTO	M ZOO
1	3		x	x	x	x	x	x	x	x	x	x	x	x	x
2	3		x	x	x	x	x	x	x	x	x	x	x	x	x
3	3		x	x	x	x	x	x	x	x	x	x	x	x	x
4	3		x	x	x	x	x	x	x	x	x	x	x	x	x
5	3		x	x	x	x	x	x	x	x	x	x	x	x	x
6	3		x	x	x	x	x	x	x	x	x	x	x	x	x
7	3		x	x	x	x	x	x	x	x	x	x	x	x	x
8	3		x	x	x	x	x	x	x	x	x	x	x	x	x
9	3		x	x	x	x	x	x	x	x	x	x	x	x	x
10	3		x	x	x	x	x	x	x	x	x	x	x	x	x
11	3		x	x	x	x	x	x	x	x	x	x	x	x	x
12	3		x	x	x	x	x	x	x	x	x	x	x	x	x
13	3		x	x	x	x	x	x	x	x	x	x	x	x	x
WSC01	3-4	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	100	x	x	x	x	x	x	x		x	x	x	x		
	400	x	x	x	x	x	x	x			x		x		x
	750	x	x	x	x	x	x								
	1200	x	x	x	x	x	x	x			x	x	x		x
	1580	x	x	x	x	x	x								
14	3		x	x	x	x	x	x	x	x	x	x	x	x	x
15	3		x	x	x	x	x	x	x	x	x	x	x	x	x
16	3		x	x	x	x	x	x	x	x	x	x	x	x	x
17	3		x	x	x	x	x	x	x	x	x	x	x	x	x
WSC02	5	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	40	x	x	x	x	x	x	x	x	x	x		x	x	
	100	x	x	x	x	x	x	x			x	x	x		x
	250	x	x	x	x	x	x	x			x		x		
	420	x	x	x	x	x	x	x			x	x	x		x
WSC03	3	x	x	x	x	x	x	x	x						
	30	x	x	x	x	x	x	x	x						
	250	x	x	x	x	x	x	x							
	300														
	365	x	x	x	x	x	x	x							

Annex D.5 ADCP data

File	Pings Per Ens	N° bin	Bin Size [m]	Start time	Start coordinates	End time	End Coordinates	Total hours	Total Distance [nm]	Mean Velocity [kn]
03	10	60	8	08/07 22:29	63°18.631'N 7°32.661'E	08/07 22:42	63°20.260'N 7°29.900'E	0.21	2.05	9.80
04	13	60	8	08/07 22:43	63°20.302'N 7°29.828'E	08/07 22:44	63°20.521'N 7°29.465'E	0.03	0.27	10.68
05	13	60	8	08/07 22:45	63°20.581'N 7°29.368'E	08/07 22:46	63°20.727'N 7°29.124'E	0.02	0.18	10.96
06	13	60	8	08/07 22:47	63°20.816'N 7°28.979'E	09/07 07:06	64°39.236'N 7°28.337'E	8.32	78.89	9.48
07	13	60	8	09/07 07:52	64°48.911'N 7°32.504'E	10/07 06:12	67°46.804'N 8°27.371'E	22.33	179.40	8.04
08	13	60	16	10/07 06:20	67°46.768'N 8°27.301'E	10/07 07:40	67°46.382'N 8°27.047'E	1.33	0.90	0.67
09	13	60	16	10/07 07:47	67°46.346'N 8°26.955'E	10/07 11:28	68°14.058'N 8°24.054'E	3.68	28.02	7.61
10	13	60	16	10/07 11:28	68°14.104'N 8°24.049'E	10/07 12:49	68°14.091'N 8°24.094'E	1.34	11.77	8.77
11	13	60	16	10/07 12:50	68°14.034'N 8°24.054'E	10/07 14:57	68°34.835'N 8°43.839'E	2.13	22.38	10.53
12	13	60	16	10/07 16:07	68°46.989'N 8°55.221'E	10/07 17:44	69°2.100'N 9°8.814'E	1.61	15.89	9.88
13	13	60	16	10/07 17:46	69°2.308'N 9°9.015'E	10/07 19:58	69°25.783'N 9°35.729'E	2.20	25.32	11.50
14	13	60	16	10/07 19:44	69°25.957'N 9°35.943'E	10/07 23:03	69°57.928'N 10°9.620'E	3.06	34.05	11.13
16	13	60	16	10/07 23:15	69°59.955' N10°11.906'E	12/07 11:02	74°45.732'N 14°15.600'E	35.77	328.05	9.17
17	13	60	16	12/07 11:02	74°45.742'N 14°15.548'E	12/07 14:52	74°48.143'N 13°51.991'E	3.83	9.80	2.56
18	13	60	16	12/07 14:54	74°48.142'N 13°52.016'E	12/07 15:14	74°48.135'N 13°52.464'E	0.34	0.12	0.36
19	13	60	16	12/07 15:15	74°48.134'N 13°52.467'E	13/07 09:52	77°43.778'N 13°2.863'E	18.62	184.84	9.92
20	13	60	8	13/07 09:53	77°43.873'N 13°2.878'E	13/07 15:19	78°13.799'N 15°39.001'E	5.43	54.53	10.05
21	13	60	8	15/07 07:57	78°13.814'N 15°37.364'E	16/07 15:30	77°39.007'N 10°20.120'E	31.55	162.91	5.16
22	13	60	16	16/07 15:31	77°38.973'N 10°19.981'E	17/07 07:33	77°17.918'N 10°52.314'E	16.04	66.53	4.15
23	13	60	16	17/07 07:34	77°17.916'N 10°52.396'E	17/07 11:24	77°16.105'N 10°58.537'E	3.84	16.29	4.24
24	13	60	16	17/07 11:25	77°16.082'N 10°58.599'E	17/07 12:59	77°10.950'N 11°11.828'E	1.57	5.91	3.77
25	6	60	16	17/07 13:00	77°10.915'N 11°11.918'E	18/07 11:13	76°39.738'N 14°36.323'E	22.22	80.53	3.62
26	13	60	8	18/07 11:14	76°39.732'N 14°36.095'E	18/07 14:31	76°36.048'N 13°37.090'E	3.28	14.14	4.32
27	6	60	16	18/07 14:32	76°36.034'N 13°36.907'E	20/07 14:08	74°58.585'N 15°33.618'E	47.61	197.40	4.15
28	6	60	16	20/07 14:09	74°58.554'N 15°33.763'E	20/07 14:49	74°56.791'N 15°42.259'E	0.66	2.82	4.28
29	9	60	8	20/07 14:50	74°56.767'N 15°42.375'E	20/07 21:37	74°57.067'N 15°40.433'E	6.79	28.56	4.20
30	7	100	8	20/07 21:38	74°57.051'N 15°40.237'E	21/07 09:38	74°47.274'N 12°35.523'E	11.99	51.54	4.30

File	Pings Per Ens	N° bin	Bin Size [m]	Start time	Start coordinates	End time	End Coordinates	Total hours	Total Distance [nm]	Mean Velocity [kn]
31	9	125	8	21/07 09:38	74°47.269'N 12°35.392'E	22/07 20:44	75°50.243'N 13°52.670'E	35.10	144.66	4.12
32	6	125	8	22/07 20:45	75°50.264'N 13°52.674'E	23/07 16:51	76°30.465'N 14°2.698'E	20.11	104.58	5.20
33	6	125	8	23/07 16:52	76°30.492'N 14°2.584'E	24/07 08:17	76°10.044'N 13°44.521'E	15.42	120.39	7.81
35	6	125	8	24/07 09:09	76°16.525'N 13°44.503'E	25/07 17:21	78°13.972'N 15°35.635'E	32.21	244.79	7.60
36	9	125	8	25/07 22:11	78°14.015'N 15°35.637'E	27/07 14:47	76°22.133'N 13°12.051'E	40.60	332.28	8.18
37	9	125	8	27/07 14:48	76°22.204'N 13°12.033'E	28/07 14:53	75°16.065'N 13°4.768'E	24.08	169.65	7.04
38	9	125	8	28/07 14:54	75°16.128'N 13°4.770'E	29/07 23:28	74°26.154'N 15°25.256'E	32.58	233.87	7.18
39	9	125	8	29/07 23:29	74°26.130'N 15°25.368'E	30/07 21:29	74°23.410'N 16°21.455'E	22.00	161.06	7.32
40	9	125	8	30/07 21:29	74°23.446'N 16°21.427'E	30/07 23:31	74°34.808'N 15°57.820'E	2.13	13.26	6.24
41	9	125	8	31/07 21:23	74°52.672'N 15°48.118'E	01/08 13:33	74°46.480'N 16°16.394'E	15.85	130.43	8.23
42	9	125	8	01/08 13:14	74°46.477'N 16°16.543'E	01/08 14:28	74°46.393'N 16°28.231'E	1.36	10.96	8.07
43	9	125	8	01/08 14:37	74°46.393'N 16°28.102'E	01/08 19:55	73°52.756'N 15°28.816'E	5.30	56.33	10.63
44	6	125	8	01/08 20:01	73°51.647'N 15°28.966'E	04/08 12:58	63°6.364'N 7°44.793'E	64.93	685.36	10.55

Annex D.5 (continued)