

NOTIFICATION OF PROPOSED RESEARCH CRUISE**PART A: GENERAL**

1. NAME OF RESEARCH SHIP **RV POLARSTERN** CRUISE NO. **ARK XXV/3**
2. DATES OF CRUISE From **31.07.2010** To **10.10.2010**
3. OPERATING AUTHORITY:
Stiftung Alfred-Wegener-Institut für Polar-und Meeresforschung
Postfach 12 01 61
D-27515 Bremerhaven
- TELEPHONE: **0049 471 4831-0**
- TELEFAX: **0049 471 4831 1355**
- TELEX: **238 695 polar d**
4. OWNER (if different from no. 3)
5. PARTICULARS OF SHIP:
- | | |
|--|-------------------|
| Name: | POLARSTERN |
| Nationality: | GERMAN |
| Overall length: (in metres) | 117,91 |
| Maximum draught: (in metres) | 11,21 |
| Net tonnage: | 3.532,30 |
| Propulsion e.g. diesel/steam: | diesel |
| Call sign: | DBLK |
| Registration port and number
(if registered fishing vessel) | |
6. CREW
- | | |
|-----------------|-----------------|
| Name of master: | Uwe Pahl |
| Number of crew: | 43 |
7. SCIENTIFIC PERSONNEL
- | | |
|--|--|
| Name and address of scientist in charge: | Dr. Volkmar Damm
Bundesanstalt für Geowissenschaften und Rohstoffe
D-30655 Hannover |
| Tel/telex/fax no.: | +49-511-643-3226/ ... /+49-511-643-3663 |
| No. of scientists: | 49 |
8. GEOGRAPHICAL AREA IN WHICH SHIP WILL OPERATE (with reference to latitude and longitude)
Marine geophysical work and seabed sampling within the Baffin Bay between 68° N and 76° N
(please see map for detail).
The survey plan as outlined in Attachment 1 is subject to ice conditions and might have to deviate from the listed coordinates.
9. BRIEF DESCRIPTION OF PURPOSE OF CRUISE
The general purpose of the research cruise is to conduct geoscientific research in the northern Baffin Bay. The focus lies on the acquisition of deep seismic sounding data across the Canadian and Greenland margin, if ice conditions allow. The cruise will start in Reykjavik. Here, all ship sensors like gravity, magnetics etc will be switched on. Then the ship will transit via the southern tip of Greenland towards the Baffin Bay. At the approximate position of 68° N / 58° W we plan to enter the Canadian EEZ. All ship borne sensors (Gravity, Magnetic, Hydrosweep, Parasound, ADCP) will run during the whole stay in Canadian waters to gather continuously data. Along the 6 planned survey lines we want to acquire multichannel and refraction seismic data and magnetic data (with an extra towed magnetometer system). Additionally, we plan to measure heat flow of seabed sediments plus methane concentration within the water column and want to take bottom and water samples in the Baffin Bay and the Lancaster Sound, if interesting features can be identified. For detail please refer to Attachment 1 and 2.

10. DATES AND NAMES OF INTENDED PORTS OF CALL
None
ANY SPECIAL REQUIREMENTS AT PORTS OF CALL
None

NOTIFICATION OF PROPOSED RESEARCH CRUISE**1. PART B: DETAILS**

1. NAME OF RESEARCH SHIP CRUISE NO.
RV POLARSTERN **ARK XXV/3**

2. DATES OF CRUISE From To
31.07.2010 **10.10.2010**

3. a) PURPOSE OF RESEARCH

Marine Geophysics: Acquire magnetic, gravity data and seismic data along survey lines to decipher seabed structures and crustal evolution of the Baffin Bay,

Marine Geology: A few heat flow and methane probing and seabed sampling at selected stations in the Baffin Bay and Lancaster Sound to derive geological parameters for subsequent modelling of geological evolution

Bathymetry: Gather new data during the transit through the Canadian EEZ and along the survey lines.

Oceanography: ADCP

b) GENERAL OPERATIONAL METHODS (including full description of any fish gear, trawl type, mesh size, etc.)

To record data by multichannel seismics (e.g. 4500 m streamer, 48 l airgun system),

To record data by refraction seismics (e.g. 40 OBS, 64 l airgun system),

To record gravity data (e.g. shipborne gravity meter),

To record magnetic data (e.g. shipborne magnetometer and towed magnetometer with 900 m cable)

To record data by acoustic devices (e.g. Hydrosweep, Parasound)

To record heat flow of bottom sediments (e.g. heat flow probe with 3 m penetration)

To record methane concentration in the water column (e.g. methane probe and water samples)

To take bottom samples (e.g. gravity corer with 4 m penetration, multicorer)

4. ATTACH CHART showing (on an appropriate scale) the geographical area of intended work, positions of intended stations, tracks of survey lines, positions of moored/seabed equipment, areas to be fished

Attachment 1

OBS stations are planned to be deployed with a spacing of appr. 10 nm along the 3 outlined profiles (please see map Attachment 1- red lines).

Stations for heat flow measurements, methane and water analysis and bottom sampling will be defined along the refraction seismic lines based on identified features of special significance.

5. a) TYPES OF SAMPLES REQUIRED (e.g., geological/water/plankton/fish/radionuclide)

Bottom samples with a length of 50 cm (Multicorer) or 400 cm (Gravity corer)

Water samples in various water depth (CTD)

b) METHODS OF OBTAINING SAMPLES (e.g., dredging/coring/drilling/fishing, etc. When using fishing gear, indicate fish stocks being worked, quantity of each species required, and quantity of fish to be retained on board).

Gravity coring and coring using a multi corer

CTD and water sampling

6. DETAILS OF MOORINGS

<u>Dates</u>	<u>Recovery</u>	<u>Description</u>	<u>Depth</u>	<u>Latitude</u>	<u>Longitude</u>
<u>Laying</u>					
	none				

7. ANY HAZARDOUS MATERIALS (chemicals/explosives/gases/radioactives, etc.)
(Use separate sheet if necessary)

None-

- | | |
|---|---------------|
| a) <u>Type and trade name</u> | none |
| b) <u>Chemical content</u> (and formula) | none |
| c) <u>IMO IMDG code</u> (reference and UN no.) | none |
| d) <u>Quantity and method of storage on board</u> | none |
| e) <u>If explosives</u> give dates of detonation | no explosives |

8. DETAIL AND REFERENCE OF

- a) Any relevant previous/future cruises

Previous:

Canadian-German expedition to the Nares Strait in 2001 (NARES2001) using CCS Louis St. Laurent,
German expedition to the Davis Strait and Baffin Bay in 2008 (MSM09/3) using RV Maria S. Merian

Future cruises are planned.

None

- b) Any previously published research data relating to the proposed cruise

All cruise reports with detailed station lists are published in the series "Reports on Polar Research" by
Alfred-Wegener-Institute for Polar-und Marine Research, Bremerhaven.

9. NAMES AND ADDRESSES OF SCIENTISTS OF THE COASTAL STATE(S) IN WHOSE WATERS
THE PROPOSED CRUISE TAKES PLACE WITH WHOM PREVIOUS CONTACT HAS BEEN
MADE

Dr. Jacob Verhoef, and Dr. Gordon Oakey
Geological Survey of Canada, Atlantic Division, Natural Resources Canada, Bedford Institute of
Oceanography, P.O. Box 1006, Dartmouth,
Nova Scotia, B2Y 4A2

Thomas A. Brent
Geological Survey of Canada, Atlantic Division, Natural Resources Canada, Northern Canada Region,
3303 - 33rd Street N.W., Calgary, Alberta T2L 2A7

10. STATE

- a) Whether visits to the ship in port by scientists of the coastal state concerned will be acceptable
(Yes/No)

Yes

- b) Participation of an observer from the coastal state for any part of the cruise together with the dates
and the ports for embarkation and disembarkation

Yes,

Embarkation of scientist and observers of the coastal state is possible in the port of departure Reykjavik
and by using the ship based helicopters during ship's operations in the near coastal area off Grise Fiord
and Pond Inlet.

Disembarkation is possible at the same locations and the port of arrival Bremerhaven.

- c) When research data from the intended cruise are likely to be made available to the coastal state and by
what means

Data are available digitally within one year after the cruise. In addition, the data are published in the
Reports of Polar Research by AWI and in other reports, papers and in international scientific journals.

PART C. SCIENTIFIC EQUIPMENT

Complete the following table
using a separate page for
each coastal state

Coastal state**Canada**Port of call**None**Dates**between 5.8.2010 and 30.9.2010**

Indicate "YES" or "NO"

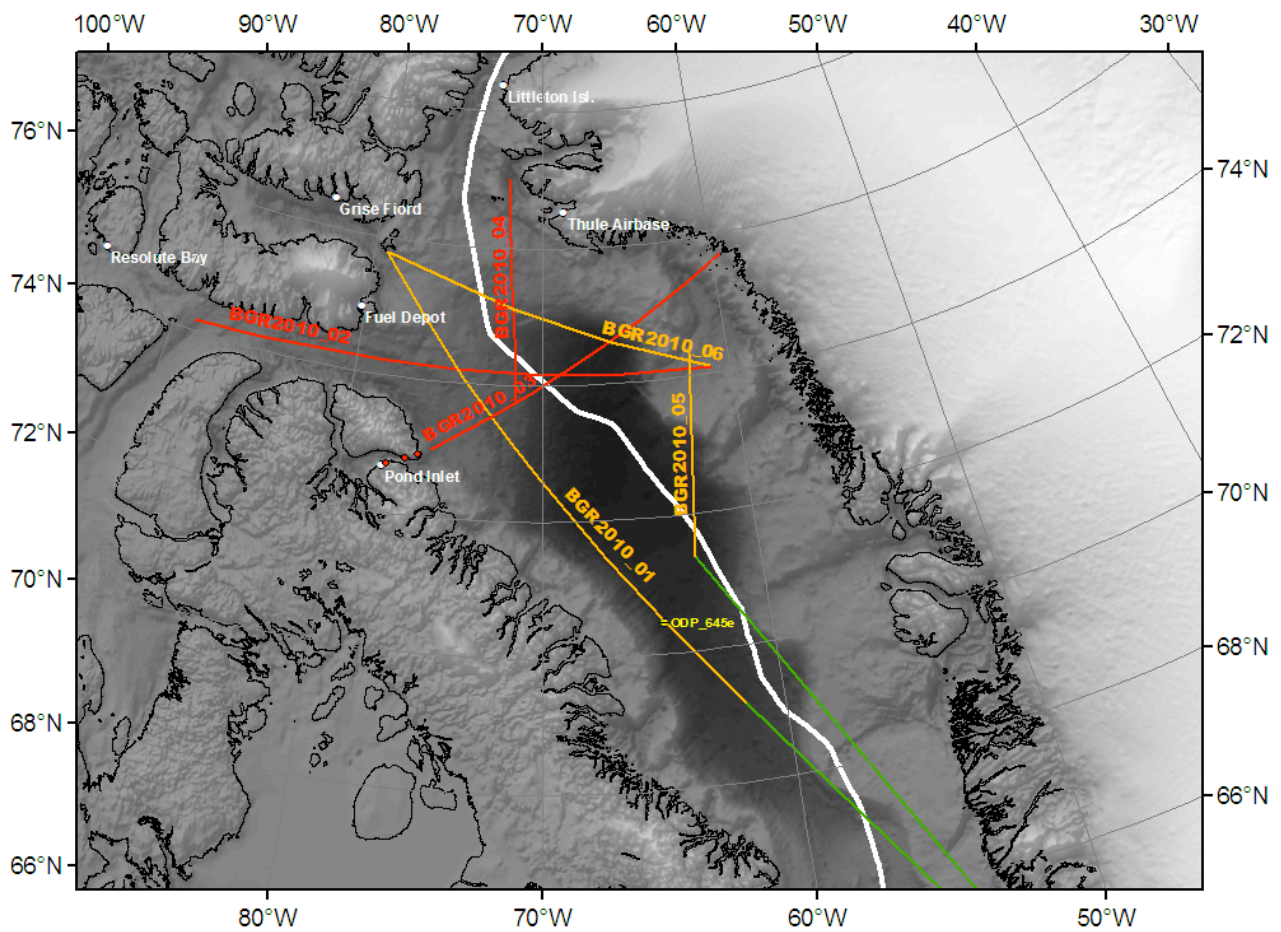
<u>List scientific work by function</u> e.g.	Water column including sediment sampling of the seabed	Fisheries research within fishing limits	Research concerning the natural resources of the continental shelf or its physical characteristics	DISTANCE FROM COAST		
				Within 4 nm	Between 4-12 nm	Between 12-200 nm
Magnetometry	no	no	yes	yes	yes	yes
Gravity	no	no	yes	yes	yes	yes
Diving	no	no	no	no	no	no
Seismics	no	no	yes	no	yes	yes
Seabed sampling	yes	no	yes	yes	yes	yes
Bathymetry	yes	no	yes	yes	yes	yes
Echo sounding	yes	no	yes	yes	yes	yes
Water sampling	yes	no	yes	yes	yes	yes
Trawling	no	no	no	no	no	no
Moored instr.	no	no	no	no	no	no
Air sampling	no	no	no	no	no	no
Water sampling	yes	no	no	yes	yes	yes
Sea-ice sampling	no	no	no	no	no	no
Snow sampling	no	no	no	no	no	no

(On behalf of the Principal Scientist)

Dated _____

NB IF ANY DETAILS ARE MATERIALLY CHANGED REGARDING DATES/AREA OF OPERATION AFTER THIS FORM HAS BEEN SUBMITTED, THE COASTAL STATE AUTHORITIES MUST BE NOTIFIED IMMEDIATELY

Attachment 1



- White line: Maritime boundary between Canada and Denmark in the Baffin Bay
- Green lines: Survey lines with gravity, magnetics, bathymetry
- Yellow lines: Survey lines with multichannel seismics in addition to the methods above
- Red lines: Survey lines with refraction seismics, heat flow, methane probing, bottom and water sampling in addition to all methods above
- ODP_645e: Location of ODP site 645

Attachment 2

Profiles

#	Date	Description	Start (Lat/Lon)	entering EEZ (Lat/Lon)	leaving EEZ (Lat/Lon)	End (Lat/Lon)
1	Aug 2010	transit		67°15'N 57°50'W	---	69°09'N 61°36'W
2	Aug 2010	BGR2010-01	69°09'N 61°36'W	---	---	75°47'N 79°15'W
3	Aug 2010	BGR2010-02	74°09'N 88°55'W	---	74°10'N 70°22'W	74°06'N 61°06'W
4	Aug 2010	BGR2010-03	75°42'N 59°28'W	74°02'N 69°48'W	---	73°00'N 75°36'W
5	Sep 2010	BGR2010-04	73°45'N 71°22'W	---	74°25'N 71°31'W	77°00'N 72°09'W
6	Sep 2010	BGR2010-05	74°20'N 62°02'W	71°47'N 62°54'W	---	71°23'N 63°00'W
7	Sep 2010	BGR2010-06	75°47'N 79°15'W	---	75°18'N 73°33'W	74°06'N 61°06'W
8	Sep 2010	transit	71°23'N 63°00'W	---	70°30'N 61°16'W	

Measurements

Gravity:	all profiles plus transit lines
Magnetic:	all profiles plus transit lines
Multi-channel seismic:	all profiles
Refraction seismic:	BGR2010-02, BGR2010-03, BGR2010-04

Addendum to Application of Research Cruise off East Canada and West Greenland

1) General information:

Name of research ship: RV *Polarstern* **Cruise:** ARK-XXV/3
Dates of cruise: 31 Jul - 10 Oct 2010
Geograph. area of research: East Canada/North Baffin Bay
Chief scientist:

Dr. Volkmar Damm
 Bundesanstalt für Geowissenschaften und Rohstoffe
 D-30655 Hannover
 Tel. +49-511-643-3226
 Fax +49-511-643-3663
 e-mail: Volkmar.Damm@bgr.de

2) Research project:

Crustal structure of the East Canada margin

3) Project aims:

The geodynamic evolution of the Eastern Canadian and West Greenland continental margins is very complex and still widely unknown. Several phases of Mesozoic and Cenozoic crustal thinning/rifting occurred to develop the oceanic basin, while simultaneously, counterclockwise rotation of the Greenland plate produced compression observed in the Eureka Fold Belt on Ellesmere Island. The geometry of the plate boundaries and the timing of the plate motions and basin development are disputed.

Thus, this project aims to enlarge the geophysical data base along the Eastern Canadian and West Greenland margins to allow a comparison of both margin structures and to constrain the opening history of the North Baffin Bay. The data will contribute to the understanding of regional tectonic processes and the development of the sedimentary basins of the Eastern Canadian and West Greenland Arctic continental margins.

The investigations include deep and shallow seismic investigations as well as magnetic, gravity and heat flow measurements plus sea floor sediment and water sampling. However, the description below will concentrate on the geophysical investigations only, which will be by far the main research activity during this cruise. If a more detailed description of the other projects and methods are needed, please contact us any time.

1.1 Current knowledge of the deeper structure off East Canada/North Baffin Bay

In 2001 during a collaborative marine geophysical program between BGR Hannover, GSC Calgary and Dartmouth and GEUS Copenhagen data were collected with the support of the Canadian Coast Guard icebreaker *Louis S. St. Laurent* to tie geophysical data to onshore geology to understand the deformation of the region. The investigations included multichannel reflection seismics, refraction seismics, an aeromagnetic survey and geodetic and geological field work onshore. The multi-fold marine seismic reflection data acquired as part of this 2001 Nares Strait geoscientific cruise totals 1200 kilometers. Marine reflection seismic acquisition parameters were varied due to operating limitations in high Arctic waters. Interpretation suggests a number of fault-bound NE-SW trending Tertiary rift basins containing at least 4 km of sediments subdivided into at least three stratigraphic

sequences. The limited data acquired in Nares Strait has shown no continuous fault (Wegener fault), which could explain crustal displacements in Baffin Bay.

The geophysical data available so far are insufficient to decipher the relative plate motion between Greenland and Canada, and to test a recently proposed “two-vector” model of relative plate motion between Greenland and Canada. This hypothesis suggests two distinct tectonic phases: (i) purely strike-slip motion along the Greenland – Canada (Ellesmere Island) boundary (Nares Strait) until magnetic chron 24, and (ii) a predominantly convergent motion having a uniform vector thereafter from chron 24 until the Eocene associated with the culmination of the intraplate Eurekan orogeny. This attractive hypothesis of two uniform and distinct styles of plate interaction between Greenland and Canada remain untested so far due to lack of data especially from two key areas. These areas are: The region of Smith Sound with the focus on Lancaster Sound, Jones Sound and North Baffin Bay. Coordinated airborne and marine geophysical data acquisition will provide basic information to prove or disprove the existence of a plate boundary and if a boundary is present, to quantify the offset of the basement structures.

There are numerous sedimentary basins of Cretaceous and younger age in the area. These include foreland basins, basins of half-graben type and of the circum Baffin continental margins developed in transtensional continental margin settings, and basins constructed on Paleogene oceanic crust. Most structures show remarkable sediment thicknesses and are partly formed by a combination of Cretaceous rifting and probable Paleocene-Eocene inversion. The entire region remains largely unexplored beyond the reconnaissance stage.

Geophysical data of the crustal structure in North Baffin Bay are essential for a better understanding of the relative plate motion between Greenland and Canada in space and time and to decipher the evolution of the thick sedimentary basins of this province.

To provide constraints to these topics the following experiments are planned:

- Three deep seismic profiles (refraction seismics) across the Eastern Canadian and West Greenland margins using OBS instruments. Up to 40 instruments with a spacing of 10-20 km will be used. The exact location of the profiles will strongly depend on the actual distribution of the sea ice cover.
- The three deep seismic profiles will be measured additionally by multichannel seismics, gravity and magnetics. The network will be supplemented by 3 more lines to connect to seismic lines which were measured during the previous survey MSM09/3 in 2008 (see below).
- In prolongation of line#03 towards Pond Inlet it is planned to deploy onshore 3 passive seismological stations to acquire data for a period of 10 days. Deployment and recovery of seismological station is planned to be done by the ship based helicopters.
- Along the three deep seismic lines sea bottom sediment sampling is planned and heat flow and methane concentration in seafloor sediments will be measured at selected sites to derive geological parameters for subsequent modelling of geological evolution
- Bathymetric data (Hydrosweep, Parasound) will be acquired during the transit (green lines in Fig.2) through the Canadian EEZ and along the survey lines to gather new data of the area.
- Contemporaneous to the marine operations an onshore airborne geophysical program will be in progress, which relies on the helicopters of the RV *Polarstern*. All onshore activities (including deployment/recovery of seismological stations) are comprehensively described in the obligatory documents submitted by the GSC to the Canadian and Nunavut authorities to obtain the mandatory research permissions. MOB/DEMOB of the helicopters and transfer of personnel for the airborne operations has to be done from RV *Polarstern* before and after completing the survey program.

4) Research methods used during cruise:

The scientific program of the cruise consists of the following geophysical methods:

1) Three deep crustal 2-D **seismic refraction/wide-angle reflection profiles** will be surveyed with ocean-bottom seismometers (OBS) and will be conducted along the deep crustal profiles #02, 03, 04. This method makes use of the seismic wave field, which is generated by towed airguns and travels sub-horizontally along geological layer boundaries, thereby penetrating the crust down to the uppermost mantle (Fig. 1). Up to 40 OBS will be deployed on the seafloor along each profile with a spacing of 10-20 km between OBS deployment locations. These OBS systems record the seismic wave field generated from the vessel by an airgun array of 64 litres total volume at a shot rate of 60 seconds. During airgun operation, the vessel moves with a speed of 5.0-5.5 kn. After the completion of each shot profile, the OBS systems will be collected and re-deployed along the next profile. The OBS systems sink to the seafloor by their own anchor weight. They will be released from their anchor by an acoustic signal and float to the surface for collection. The towing arrangement is not fixed, since it depends on the ice conditions.

2) **2-D multichannel seismic (MCS) reflection surveys** will be conducted along the profiles #01, 02, 03, 04, 05, and 06. The method is a standard seismic reflection technique, where the seismic wave field generated from airguns is reflected from sub-bottom geological layers/structures and recorded from a towed seismic streamer/cable (Fig. 1). The seismic system on this cruise consists of two single hydrophone streamers of 4500 m and 700m length, respectively, and will be used depending on ice conditions. Short streamer will be used in the most heavy ice conditions. The streamer records the seismic wave field generated by an airgun array of 48 litres total volume at a shot rate of 15 seconds. During airgun operation, the vessel moves with a speed of 5.0-5.5 kn. The airguns will be towed in a frame 6 m long and 2.5 m wide directly behind the ship at a depth of 7 m.

3) **Multibeam bathymetric recordings** will be conducted on all seismic profiles and transit tracks. The deep-sea multibeam system of RV Polarstern consists of an Atlas Hydrosweep system operating at a main frequency of 12 kHz..

4) **Sub-bottom profiling** will be conducted along all seismic profiles and transit tracks. The parametric sediment echo-sounder of RV Polarstern consists of an Atlas PARASOUND DS P-70 with the following operation specifications: primary frequencies 18 kHz and 22 kHz, secondary frequency range 2.5-5.5 kHz, pulse length 22 ms, emitting angle 4.5°.

5) **Magnetic surveying** will be conducted using fixed mounted fluxgate vector magnetometers installed in the craws nest of the vessel and along all survey lines by a towed magnetometer (gradiometer) systems connected to the vessel by a 900 m cable.

6) **Gravimetric surveying** will be conducted on all survey profiles and transit tracks in order to record variations in the gravity anomaly field. The marine gravity meter is installed on the vessel.

7) **Heat flow measurements** will be conducted at selected locations along the seismic profiles, while retrieving the OBS instruments. It consists of an up to 3 m long tube, which contains temperature sensors. After having penetrated the sediments it will record the earth's heat flow for approx. 10 minutes.

8) **Methane concentration** will be measured within the water column during deployment and recovery of the HF-equipment by means of a methane sensor mounted to the heat flow equipment. At selected positions water samples will be taken using a CTD sampler for additional high sensitive analysis of methane concentrations.

8) **Seafloor sediment sampling** will be conducted by a gravity corer with a tube of 9 cm in diameter which is able to penetrate up to 4 m into the uppermost sediment layers. Alternatively, a multi corer with short plastic liners is planned to be used.

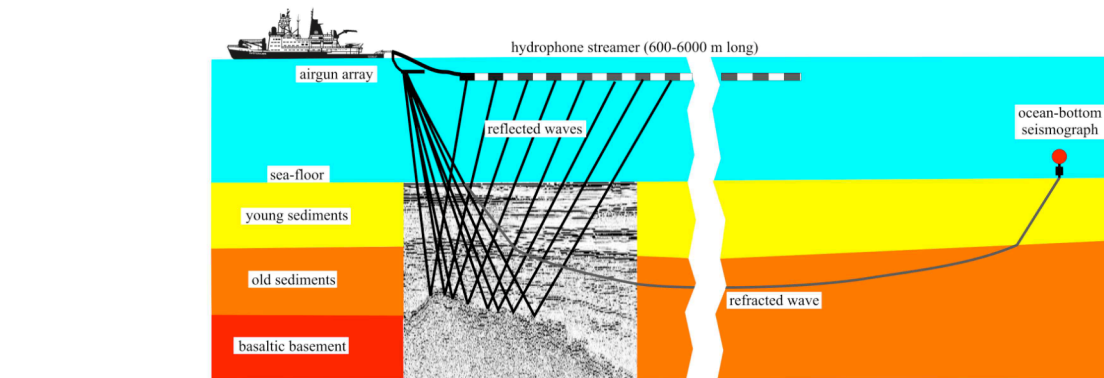


Fig. 1. Principles of seismic reflection and refraction/wide-angle reflection surveying.

5) Extent of data collection:

2-D multichannel seismic (MCS) reflection and refraction profiling:

The planned location of the lines for both methods is shown in Figure 2. Eventually, the programme will be adjusted to the ice conditions we will face in summer 2010. However, target area is the Eastern Canadian and West Greenland margin and the North Baffin Bay. Up to 40 ocean-bottom seismographs (OBSs) will be deployed along each refraction profile at spacing between 9 and 13 km. Three seismic land-recorders are planned to be deployed in extension of line#03 towards Pond Inlet.

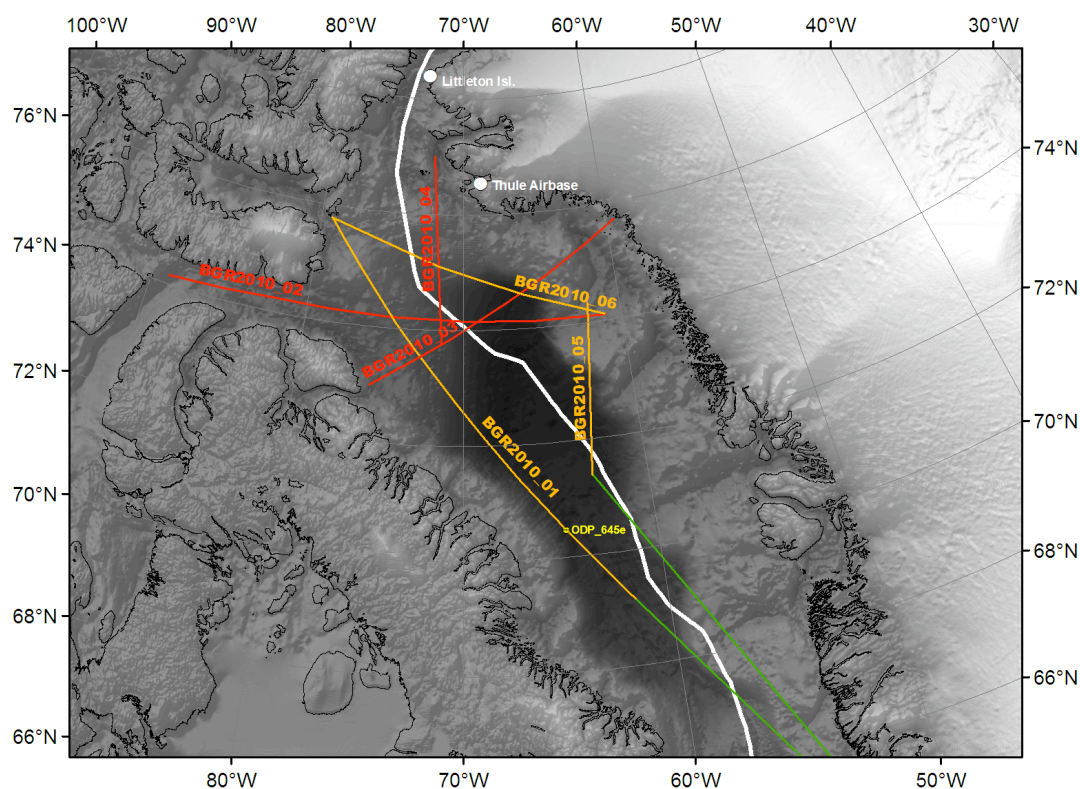


Fig. 2. Map of survey area (green lines: gravity, magnetics, bathymetry; yellow lines: same methods as along green lines plus MCS; red lines: same methods as along green lines plus MCS, wide angle seismics/refraction seismics, heat flow, sediment sampling, methane analysis)

BGR2010-1 (reflection seismics) extends from SE of ODP-645 well on the Baffin Shelf to Jones Sound. A portion of this line will be coincident with the GSC refraction line east of Devon Island, where the Continent-Ocean-Boundary (COB) has been identified. This line will provide direct correlation of the stratigraphy identified at the ODP well into the eastern end of the Lancaster Sound Basin.

BGR2010-2 (reflection and refraction) extends from the extinct spreading axis in northern Baffin Bay into the Lancaster Sound along the center of the suggested “failed” rift arm. This line will connect with line *BGR2010-1* to continue the stratigraphic correlations from the ODP-645 well.

BGR2010-3 (reflection and refraction) extends from normal Archean crust southward across the COB and crosses onto (presumably) Paleocene oceanic crust and continues across the extinct Eocene spreading axis. This line will establish whether the basins along the margin are underlain by oceanic crust, transitional crust, or attenuated continental crust.

BGR2010-4 (reflection and refraction) crosses North Baffin Bay from the coast of Bylot Island to the northern end of the Melville Bay Graben. This line will identify the COB positions for (nearly) conjugate sections of the Canadian and Greenland margins. The line will cross the extinct Eocene axis and regions of (presumably) Paleocene oceanic crust. This line is critical to understanding the highly asymmetric nature of the conjugate

continental margins and whether the basins along the margin are underlain by oceanic crust or attenuated continental crust.

BGR2010-5 (reflection only) extends from the central Melville Bay Graben on the West Greenland margin seaward across the COB and onto (presumably) Paleocene oceanic crust. This line will provide an improved cross-section of the Greenland margin to compare with the conjugate Baffin margin.

BGR2010-6 (reflection only) extends from Jones Sound on the East Canadian margin to the central Melville Bay Graben on the West Greenland margin across the COB and onto (presumably) Paleocene oceanic crust. This line is a connecting line to avoid transit without data acquisition. It will provide an additional cross-section of the North Baffin Bay and will be supplement the available data for seismostratigraphic correlation.

Previous work

The East Canadian margin was investigated by two geophysical expeditions in the years 2001 and 2008. While in the first expedition (Canadian-Danish-German expedition to the Nares Strait in 2001 - NARES2001) using CCS *Louis St. Laurent* the focus was on the Smith Sound, Kane Basin and Kennedy Channel, the interest in the last expedition (German-Danish expedition to the Davis Strait and Baffin Bay in 2008 - MSM09/3) using RV *Maria S. Merian* was shifted to investigate the southern Baffin Bay – Davis Strait region. However, additional results of other expedition will be incorporated into the crustal studies. All available seismic data, which were acquired in the North Baffin Bay will be analysed again in order to unify the crustal models of different interpreters.

6) Technical specification of airguns:

Two types of airgun configurations are planned to be used for the seismic survey of this cruise:

a) For the seismic multichannel data acquisition an airgun array consisting of 6 G-Guns[®] with a total airgun volume of the array is 48 liters. The airguns will be towed at 6 m water depths at an air pressure of 200 bar at a shot rate of 15 seconds. The source signal of the array has a spectral peak level of 30-60 Hz.

b) For the deep seismic profiling an airgun array consisting of the array described above plus 2 additional G.Guns[®] towed along-side off the G.Gun[®] sarray. The total airgun volume of the array is 64 liters (48 + 2x8 liters = 64 liters). The G.Guns will be towed at 6 m water depths. The array will operate with an air pressure of 130 bar at a shot rate of 60 seconds. The source signal of the G.Gun array is the same as above (Breitzke et al., 2008).

7) Possible impact of airgun operation on the environment:

The Alfred Wegener Institute has a research focus on the environment and climate of the polar regions and, thereby plays an active role in ecological studies which includes active research in the field of hydro-acoustics and their possible impact to marine life. We therefore pay particular attention to any new outcomes of this research.

Possible impact to the health and behaviour of marine life, in particular, of fish and marine mammals by seismic airgun operations have been controversially discussed in the last years. A number of scientific studies (e.g. Madsen et al., 2002, 2006; Southall et al., 2007) have shown that there is no indication for correlation between seismic surveys and any

impact to the health and behaviour of fish and marine mammals. Acoustic disturbance through operation of airguns in a 2-D survey layout is biologically insignificant with regard to migration, feeding and nurturing due to the shortness of the acoustic exposure. Our survey includes a total of only 30 days of airgun operation with several interruptions of up to 3 days each.

However, as a precautionary action and in accordance to international guidelines for seismic operations, we will comply with the following mitigation measures:

- At each start-up of an airgun operation, a 30-minute ramp-up procedure will be implemented. The procedure is conducted by a step-wise increase of the number of airguns included in the firing process of the airgun array, beginning with firing of a single airgun and subsequently adding one airgun after another within the ramp-up time until the full array is in operation.
- When operating in near coastal waters we will start the data acquisition at the near coastal area and shot towards the open sea to avoid any stranding of whales.
- The ships crew and the scientific team on board of RV *Polarstern* are instructed to constantly monitor for whales during seismic operations. The ramp-up procedure will only commence if no whales are within a radius of 500 m. If whales enter this radius, the ramp-up procedure or an ongoing airgun operation will be interrupted and will only be resumed when the whales leave the 500 m radius.

References:

- Breitzke, M., Boebel, O., El Naggar, S., Jokat, W. & Werner, B. (2008). Broad-band calibration of marine seismic sources used by R/V *Polarstern* for academic research in polar regions. *Geophys. J. Intern.*, doi: 10.1111/j.1365-246X.2008.03831.x.
- Madsen, P.T., Møhl, B., Nielsen, B.K. & Wahlberg, M. (2002). Male sperm whale behaviour during exposures to distant seismic survey pulses. *Aquatic mammals*, 28.3, 231-249.
- Madsen, P. T., Johnson, M., Miller, P.J.O., Soto, N.A., Lynch, J. & Tyack, P. (2006). Quantitative measures of air-gun pulses recorded on sperm whales (*Physeter macrocephalus*) using acoustic tags during controlled exposure experiments. *J. Acoustical Soc. America*, 120, 2366.
- Southall, B. L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. & Tyack, P.L. (2007). Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals*, 33, 411-521.