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CRUISE REPORT

Ocean acidification in the Barents Sea cruise:

West Barents Sea slope, Barents Sea, north Norway

on R/V Helmer Hanssen, May 26th – June 1st 2013

Tine L. Rasmussen & Katarzyna Zamelczyk

DEPARTMENT OF GEOLOGY, UNIVERSITY OF TROMSØ, N-9037 TROMSØ, NORWAY

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Bjørn Runar Olsen contributed with data processing and handling of acoustic equipment connected with this cruise. All cruise participants contributed to the collection of the data. They are all warmly thanked for their great contribution to make this cruise a great success.

This report was finalised on June 17th 2016.

1. Summary

From the morning of May 26th to the morning of June 1st 2013, the Department of Geology of the University of Tromsø, Norway, arranged a scientific cruise aimed at investigating the western Barents Sea margin and the western Barents Sea on R/V "Helmer Hanssen".
Investigated areas were (in order of visiting sites on the cruise): the western Barents Sea slope to northwest of Bjørnøya, and the western Barents and north Norway (for locations see Fig. 1). The scientific sampling was done within the framework of the ongoing project at the Department of Geology, University of Tromsø: "OAFS-Ocean Acidification Fram Strait" (see below).

A total of 3 gravity cores, 1 box-core, 5 multi-cores (with a total of 15 sub-cores retrieved), 13 plankton net casts and 13 CTD (conductivity-temperature-depth) casts were performed at the western Barents Sea slope, and the Barents Sea.

>17 chirp profiles and multibeam echo sounder lines were acquired during transits and during surveys of potential core sites.

2. Background

During the cruise, data were collected for the following project:

- **OAFS** ("**Ocean Acidification; Effects of ocean chemistry changes on planktic foraminifera in the Fram Strait: ocean acidification from natural to anthropogenic changes**"). The overall purpose of the project is to study the preservation patterns of planktic foraminifera (living, recently settled, subrecent and fossil) within and below Atlantic-, Arctic-, and Polar surface water along the Barents Sea-Svalbard margin and the Barents Sea compared to natural and anthropogenic variations in climate at present and in the past during the last 30,000 years BP. Focus is given on calculating the CO_2 concentration in the ocean and atmosphere compared to ocean circulation intensity, ocean acidity and paleoproductivity in past climate conditions during interglacials that were warmer than today and glacials that was colder than today and before human influence as well as during the most recent times of global warming. For the project we aim to collect gravity and multicores and plankton net samples and CTD records at several sites: the southwestern, the western Barents Sea slope, and the Barents off North Norway.

3. Objectives

The objectives of the cruise were:

- To collect gravity- and multicores cores in high-resolution, undisturbed sediments of the western Barents Sea slope and the Barents Sea to obtain sediments for paleostudies of ocean acification due to natural changes in the environment and climate
- To collect plankton samples and sediment-surface samples from the with the purpose of studying the content of living and sub-recent planktic foraminifera and the conditions of their shells in order to elucidate the effect of CaCO3 preservation on the living and recently dead planktic foraminifera in connection with recent and subrecent anthropogenic changes.
- To acquire swath-bathymetry, and chirp data, to form the basis for pin-pointing core sites

with undisturbed sediments.

4. Participants

Crew R/V "Helmer Hanssen":

Captain:	Hans R. Hansen
Vice captain:	Per-Kristian Langaune
Chief engineer:	Hjørtur Poulsen
Second engineer:	Sindre Myking
Boatswain:	Jan R. Dalsbø
Boatswain:	Jan A. Johansen
Able seaman:	Ronny Johansen
Able seaman:	Eivind Halnes
Able seaman:	Jan Erik Hansen
Stewart:	Børge Pedersen
Galley assistant:	Bente Mortensen
Navigation student:	Reidar Straumsgård

Scientific crew:

Participants	Affiliation
Rasmussen, Tine Lander (Professor; chief scientist)	UiT
Katarzyna Zamelczyk (post doc; co-chief scientist)	UiT Bjørn
Runar Olsen (Engineer)	UiT
Diane Groot, PhD student	UIT
Nikoline L. Rasmussen, BSc student	UIO
Rebekah Harries, MSc student	UIT
Manon Chaillan, BSc student	UIT
Kjetil Indrevær, PhD student	UIT

UiT = University of Tromsø, Norway UIO = University of Oslo

5. Equipment

Acoustic equipment

- Kongsberg Maritime EM 300 multibeam echo sounder
- EdgeTech 3300-HM hull-mounted sub-bottom profiler ("Chirp"); 4*4 arrays
- Kongsberg Maritime EK60 splitbeam echsounder (18, 38 and 120 kHz

Sediment sampling

- Gravity corer (total weight 1900 kg; 6 m steel barrel; inner diameter of steel barrel: 11 cm)
- Multi corer (MC) KC model 72.000 with 6 core liners (1 m length each)

Water properties:

- CTD (Seabird 911 Plus) with compact rosette with water samplers

Plankton net:

- Type WP-2 net from HydroBios

6. Methods

Sediment sampling
Gravity-cores were retrieved from the southwestern Barents Sea slope. Plastic liners with an outer diameter of 11 cm (inner diameter: 10 cm) were put into the steel barrel. After retrieval, the plastic liners were cut into sections of up to 100 cm length. They were covered with plastic caps, taped, labelled and stored at +4ºC.

Multi-cores cores were retrieved from the southwestern and western Barents Sea slope,. 6 plastic tubes with 10 cm inner diameter were intruded into the sediments. 1 or 2 tubes were subsequently sub-sampled in 1 cm and/or 0.5 cm intervals, respectively, to a depth of 5 or 10 cm. The samples were preserved in alcohol (96%) with Rose Bengal in order to stain the living foraminifera. One multicore were stored in the freezer for each station.

Plankton sampling
Plankton nets were cast at multi-core and CTD-stations for capture of planktic foraminifera for investigations at the southwestern and western Barents Sea slope, the Barents Sea including Djuprenna and Ingøydjupet, through Sørøysundet, Lopphavet to Nordvestbanken. Mesh size were 90 micron. Samples were preserved in 96% alcohol with Rosa Bengal and buffered with Disodium Hydrogen Phosphate and Sodium Hydrogen Phosphate. The tows were done at 50 m and 100 m.

Water properties
The water properties – temperature, salinity – were measured over the western Barents Sea slope, using a *Seabird 911 Plus* CTD. Data collection was performed during downcasts at a speed of approx. 1.0 m/s. The data of selected CTD stations were used for records of modern water mass properties records for the paleo-studies and studies of living planktic foraminifera and to calculate sound-velocity profiles for calibrating the multibeam echo sounder system.

Acoustic investigations
Seafloor mapping:
Swath-bathymetry surveys were carried out using a *Kongsberg Maritime EM 300 multibeam echo sounder*. Sound-velocity profiles of the water column for calibrating the equipment were recorded from CTD casts where necessary. Swath-bathymetry data was also collected during the transits between working areas and stations. The equipment worked well during the acquisition and the data are of good quality. Some preliminary data cleaning was performed using the software programme *Neptune* version 6.6.

Seismic profiling:
High-resolution seismic profiles (Chirp), using an *EdgeTech 3300-HM* hull-mounted sub-bottom profiler, were collected along the ship tracks during the swath-bathymetry data acquisition on the western Barents Sea margin and the Barents Sea as well as during transits. Pulse mode and shot rate were varied, depending on the water depth. The equipment worked well and the data are generally of good quality.
After the departures soft starts of the Chirp system were performed, starting with 1% of the total effect, followed by a doubling of the effect every minute. Marine mammals were observed Tuesday May 28th southeast of Bjørnøya 74.08N, 21.07E (both chirp and multibeam at the time were stopped because we were on station for CTD and coring (HH13-247stations).

7. Preliminary results and outcome of the cruise

Scientific goals:

In general, for the work on the slope, because of the generally good weather all planned stations were done with plankton net, multi-, or box- or gravity coring. We succeeded in getting all wanted CTD's and plankton net tows for the Ocean Acidification project with the required associated sediment sampling at all planned stations on the slope. In Djuprenna the weather was too rough for box- or multicoring, so we took a gravity core instead.

OA-Ocean Acidification

A total of 13 stations were visited and 12 CTD casts were done. A total of 13 plankton net tows with generally two casts at each station were performed (to 50 m water depth, and 100 m water depth in the water column). The content was sieved onboard and preserved in alcohol with RosaBengal and buffered with Disodium Hydrogen Phosphate and Sodium Hydrogen Phosphate. A total of five multi-cores and one box-core (three attempts at one station) were collected. The samples will be analysed at the Department of Geology, University of Tromsø by a post doc as part of ongoing research within the OA-program (financed by the NFR).

HH13-247-CTDstart	28.05-13	2015	Trough in South Spitsbergenbanken	74.08.416' 021.07.437'	335	Barents Sea southeast of Bjørnøya, for living planktic foram sampling
HH13-248-CTDstart	29.05-13	0040	Bjørnøya Trough	73.29.906' 021.09.884'	470	Barents Sea southeast of Bjørnøya, for living planktic foram sampling
HH13-249-CTDstart	29.05-13	1104	South Bjørnøya Trough	72.52.575' 026.17.237'	345	Barents Sea southeast (north of Djuprenna), for living planktic foram sampling
HH13-250-CTDstart	29.05-13	1900	Djuprenna-west	71.38.063' 026.29.867'	342	Barents Sea southeast (Djuprenna), for living planktic foram sampling
HH13-251-CTDstart	30.05-13	0732	Ingøydjupet	71.29.699' 022.45.718'	430	Barents Sea south (Ingøydjupet for living planktic foram sampling
HH13-252-CTDstart	30.05-13	1603	Sørøysundet	70.26.091' 022.39.198'	469	Sørøysundet for living planktic foram sampling –old HH12-436PN
HH13-253-CTDstart	30.05-13	1933	Lopphavet	70.33.387' 021.17.366'	411	Lopphavet for living planktic foram sampling –old HH12-438PN
HH13-254-CTDstart	31.05-13	0415	Håkjerringdjupet, south Nordvestbanken	70.44.186' 018.46.193'	378	Nordvestbanken depression for living planktic foram sampling

Table 4: Multi-corer stations.

Station	Date	Time (UTC)	Location	Latitude [N] Longitude [E]	Water depth [m]	Comments
HH13-243MC	27.05-13	0728	SW Barents Sea slope in BIS	71˚58.682' 014˚20.191'	1382	- Failed – did not reach bottom due to drift of ship
HH13-243MC2	27.05-13	0728	SW Barents Sea slope in BIS	71˚58.682' 014˚20.191'	1382	- 4 tubes, nearly full, 3 retrieved. 15 cm thick ox. Layer. A: surface sample0-10 in 0.5 cm intervals; B: 0-48.5 0.5 cm intervals; C: frozen. - Preservation in alcohol (96%) with Rose Bengal.
HH13-246MC	28.05-13	0719	W Barents Sea slope (75,14)	74˚59.933' 013˚58.967'	1700	- 4 tubes, 3 nearly full, 3 retrieved. 15 cm thick ox layer. A: surface sample0-10 in 0.5 cm intervals; B: 0-60.5 0.5 cm intervals; C: frozen. - Preservation in alcohol (96%) with Rose Bengal.
HH13-247MC	28.05-13	2051	Barents Sea SE of Bjørnøya	74.08.233' 021.06.277'	338	- Barents Sea, trough south Spitsbergenbanken, 5 tubes, 4 nearly full, top not horizontal. 3 retrieved. A: surface sample0-5 in 0.5 cm intervals; B: 0-57.5in 0.5 cm intervals 2 shells; C: frozen. - Preservation in alcohol (96%) with Rose Bengal
HH13-251MC	30.05-13	c.0904	Barents Sea Ingøydjupet	71.29.678' 022.45.852'	428	- Barents Sea, Ingøydjupet, 5 tubes, 3 nearly full, 3 retrieved. A: surface sample0-5 in 0.5 cm intervals; B: 0-50.5 0.5 cm intervals; C: frozen. - Preservation in alcohol (96%) with Rose Bengal

Table 5: Plankton net stations (Havtrekksstasjon)

HH13-242start Plankton net	26.05-13	1812	SW Barents Sea slope	70.44.529' 016.22.914'	1587	Living planktic foram sampling, 50 m and 100m
HH13-243start Plankton net	27.05-13	0637	SW Barents Sea slope BIS	71.58.573' 014.20.106'	1384	Living planktic foram sampling, 50 m and 100m

HH13-244start Plankton net	27.05-13	1607	SW Barents Sea slope BIF	72.53.109' 013.02.094'	1421	Living planktic foram sampling, 50 m and 100m
HH13-245start Plankton net	27.05-13	2242	SW Barents Sea slope BIF	73.57.100' 013.47.867'	1680	Living planktic foram sampling, 50 m and 100m
HH13-246start Plankton net	28.05-13	0650	W Barents Sea slope	74.59.609' 013.59.767'	1710	W Barents Sea slope, outside Kveithola (ca) living planktic foram sampling 50 m and 100m
HH13-247start Plankton net	28.05-13	2030	Barents Sea SE of Bjørnøya	74.08.403' 021.06.996'	335	Barents Sea trough south Spitsbergenbanken, living planktic foram sampling 50 m
HH13-248-plankton net	29.05-13	0103	Bjørnøya Trough	73.30.023' 021.09.495'	470	Barents Sea southeast of Bjørnøya, living planktic foram sampling 50 m
HH13-249-plankton net	29.05-13	1124	North of Djuprenna	72.52.577' 026.17.554'	344	Barents Sea southeast (north of Djuprenna), living planktic foram sampling 50 m and 100m
HH13-250-plankton net	29.05-13	1917	Djuprenna-west	71.38.125' 026.30.058'	342	Barents Sea southeast (Djuprenna), for living planktic foram sampling 50 and 100 m
HH13-251-plankton net	30.05-13	0752	Ingøydjupet	71.29.795' 022.45.689'	431	Barents Sea south (Ingøydjupet for living planktic foram sampling, 50 and 100 m
HH13-252-Plankton net	30.05-13	1624	Sørøysundet	70.25.982' 022.39.395'	470	Sørøysundet, living planktic foram sampling 50 and 100 m, –old HH12-436PN
HH12-253start Plankton net	30.05-13	1953	Lopphavet	70.33.471' 021.16.856'	414	Lopphavet, living planktic foram sampling 50 and 100 m, –old HH12-438PN
HH13-254-CTDstart	31.05-13	0434	Håkjerringdjupet, south Nordvestbanken	70.44.084' 018.46.484'	378	Nordvestbanken depression for living planktic foram sampling

Table 6: Acoustic line log

Ocean Acid / Paleocirkus projects cruise, 26. May-01. June. 2013 on R/V Helmer Hanssen

OceanAcidBjornoya2013.000	26. May	Arrival Slope	12:57	70°13.288	17°14.250	16:40	70°14.316	16°23.897	1	1,5-9; 40ms	10	None
OceanAcidBjornoya2013.001	26. May	SW Barents slope	21.05	70.42.6235	16.23.411	05:49	71°59.223	14°20.993	0.3	1,5-9; 40ms	10	001
OceanAcidBjornoya2013.002	27. May	SW Barents slope	09:41	71°57.444	14°18.080	15:10	72°52.838	13°00.275	0.3	1,5-9; 40ms	10	002
OceanAcidBjornoya2013.003	27. May	SW Barents slope	16:28	72°53.223	13°03.282	22.40	73°57.100	13°47.867	0.3	1,5-9; 40ms	10	003
OceanAcidBjornoya2013.004	27. May	WBarents slope	23.16	73°57.632	13°46909	05:38	74°59.031	14°01.283	0.3	1,5-9; 40ms	10	004
OceanAcidBjornoya2013.010	28. May	WBarents slope	08:02	75°00.357	13°57.707	20:15	74°08.388	21°06.837	1	1,5-9; 40ms	10	005
OceanAcidBjornoya2013.012	28. May	SE of Bjornoya	20:59	74°08.367	21°06.741	00:42	73°29.942	21°08.975	1	1,5-9; 40ms	10	006
OceanAcidBjornoya2013.014	29. May	Bjørnøy Renna	01:14	73°30.023	21°09.495	11:06	72°52.589	26°17.283	1	1,5-9; 40ms	10	007
OceanAcidBjornoya2013.016	29. May	N. for Djuprenna	11:47	72°51.296	26°17.623	19:00	71°38.080	26°29.715	1	1,5-9; 40ms	10	008
OceanAcidBjornoya2013.017	29. May	Djuprenna-Ingøyd	20:02	71°38.070	26°29.405	04:45	71°19.944	22°35.723	1	1,5-9; 40ms	10	009
OceanAcidBjornoya2013.019	30. May	Ingøydjupet	04:45	71°19.944	22°35.723	06:35	71°37.888	22°56.487	1	1,5-9; 40ms	10	010
OceanAcidBjornoya2013.020	30. May	Ingøydjupet	06:36	71°37.700	22°56.237	07:29	71°29.675	22°45.792	1	1,5-9; 40ms	10	011
OceanAcidBjornoya2013.021	30.May	Søroysundet	09:14	71°29.678	22°4.752							
OceanAcidBjornoya2013.022	30. May	Søroysundet	14:31	70°36.351	23°11.495	16:00	70°26.131	22°39.540	1	1,5-9; 40ms	10	
OceanAcidBjornoya2013.022	30.May	Lopphavet	16:50	70°25.982	22.39.395	19:33	70°33.382	21°17.358				