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CRUISE REPORT

CAGE-PWC April Cruise to the western Svalbard margin

on R/V Helmer Hanssen, April 22nd April – May 1st, 2016

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This report was finalised on June 14th, 2016.

1. Summary

From the afternoon of April 22nd to the early morning of May 1st 2016, CAGE at the Department of Geology Uit, the Arctic University of Norway, arranged a scientific cruise aimed at investigating sediment cores and porewater, water masses, and planktonic faunas, at the western Svalbard margin and western Barents Sea slope, also visiting methane seep sites off Vestnesa Ridge, Prins Karls Forland (PKF) and in Storfjorden Trough on R/V “Helmer Hanssen”. Investigated areas were (in order of visiting sites on the cruise): PKF, Vestnesa Ridge, PKF again, Storfjorden Trough and Storfjorden (Figs. 1 and 2). This cruise can be regarded as a continuance of the previous cruise February 8-15, 2016, where all seep sites at Vestnesa Ridge and PKF were abandoned because of bad weather conditions. In April we hope to reach Vestnesa and PKF to get the cores we missed in February. The scientific sampling was done within the framework of ongoing project at the Department of Geology, University of Tromsø: “CAGE - Centre for Arctic Gashydrate, Environment and Climate”, in which the sub-project Ocean Acidification are included.

A total of 10 gravity cores, 3 multinet casts and 14 CTD (conductivity-temperature-depth) casts were performed along the western Svalbard margin (Vestnesa and PKF). Data were also collected in Storfjorden Trough and Storfjorden, no brine overflow detected in April either.

Chirp profiles and multibeam lines were acquired during transits and in small surveys at potential core sites over outer Vestnesa, PKF and in Storfjorden filling previous gaps in records from earlier cruises.

2. Background

During the cruise as in February, data were collected for the following project:

- **“CAGE – Centre of Arctic Gashydrate, Environment and Climate”, including “Ocean Acidification; Effects of ocean chemistry changes on planktic foraminifera in relation to methane release.** The overall purpose is to study and reconstruct the emission of methane through time in relation to past climate change. In addition to the February cruise the majority of gravity cores are aimed to get pore water and sediment samples for sulphate-methane and TOC measurements on sites of previously investigated cores with stable isotope records. The purpose is also to study the preservation of calcareous planktic foraminifera in relation to acidification of the water column and methane release, sediment surface in the present in relation to anthropogenic influence and in the past under natural climate variability. We aim to collect gravity and boxcores and plankton net samples and CTD records and water samples at various locations: Vestnesa Ridge, shallow slope off PKF, Storfjorden Trough, and Storfjorden.

3. Objectives

The objectives of the cruise were:

- To collect plankton samples and CTD and water samples from the entire planned study areas with the purpose of studying the content of living and subrecent planktic foraminifera and the conditions of their shells in order to elucidate the effect of CaCO₃ preservation (ocean acidification) on the living and recently dead planktic foraminifera. Water samples and CTD

for water properties and chemistry. In Storfjorden also brine overflow will be studied by CTD and water sampling.

- To retrieve gravity-cores from active pockmarks of methane gas seepage in order to study the pore water and sediment records at new and previously investigated sites, at new sites to investigate foraminiferal-fauna assemblages in past and present environments affected by release of methane and reconstruct variations in activity of methane seeping in relation to climate and oceanographic change.
- Plankton net sampling above flares on the shelf off PKF, Vestnesa and in Storfjorden Trough to record effects of seeping on planktic foraminifera and their shells and on productivity of planktic organisms in general.
- To study the brine formation in Storfjorden during winter conditions with CTD and water sampling (not much sea ice in Storfjorden this year) - part of ongoing projects since 2002.

4. Participants

Scientific crew:

Name	Affiliation
Rasmussen, Tine Lander (Professor; chief scientist)	UiT
Tove Nielsen (co-chief scientist)	GEUS
Troels Laier (co-chief scientist)	GEUS
Bjørn Runar Olsen (Engineer)	UiT
Mohamed Ezat (post doc)	UiT
Julie Meilland (Post doc)	Univ. Nantes, UiT
Siri Ofstad (phd-student)	UiT
Elena Nystedt (MSc, technician)	HI
Evelyn Pecori (Photo-journalist)	xx

UiT = Uit, the Arctic University of Norway

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 echosounder (18, 38 and 120 kHz)

Sediment sampling

- Gravity corer (total weight 1900 kg; 6 m steel barrel; inner diameter of steel barrel: 11 cm)
- Giant box corer (50*50*50 cm³)

Water properties:

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

Plankton net:

- Type WP-2 net from HydroBios, mesh-size 64 microns
- MultiNet type Midi-25 m² from HydroBios, mesh-size 64 microns

6. Methods

Sediment and pore water sampling

Sediment sampling was done by gravity coring to retrieve surface samples and sub-recent samples. Core liners were prepped for pore water sampling by drilling holes every 10 cm in upper 3 m and every 25 cm at bottom 3 m (photo). Sediment were sampled at core ends and through the drilled holes with syringes. The first sample for methane analyses (also GEUS labs), and a second sediment sample for TOC, TC and S (Tromsø lab) in each hole. Pore water was sampled at regular intervals with Rhizon filters to measure content of sulphate at GEUS labs. Box-coring was abandoned in the beginning due to poor weather conditions and later due to lack of time.

Plankton sampling

Plankton nets were cast at previous multi-core/box core stations and CTD-stations for capture of planktic foraminifera for investigations of ocean acidification and for fauna studies. Mesh size were 90 or 64 micron. Samples were preserved in 96% alcohol with Rosa Bengal. Experiments were done with un-buffered samples and samples buffered with Disodium Hydrogen Phosphate and Sodium Hydrogen Phosphate.

Water properties

The water properties – temperature, salinity – were measured at every sampling station and at regular intervals 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 and nutrient records for the paleo-studies and studies of living planktic and benthic foraminifera and to calculate sound-velocity profiles for calibrating the multibeam echo sounder system. Water samples were taken on a regular basis for water chemistry analyses in Uit/Hi labs. Samples were also taken for stable isotope analyses.

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. The multibeam was started late on day two after the first CTD for calibration. Weather had not permitted a CTD to be taken before that time.

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 during transits. Pulse mode and shot rate were varied, depending on the water depth. Soft start of the chirp was performed well out over the shelf edge on day two, starting with 1% of the total effect, followed by a doubling of the effect every minute. The equipment worked well and the data are generally of good quality.

Echo-sounder flare observation

The echo-sounder installed on RV Helmer Hanssen was planned to be used to detect gas bubbles rising from seep sites at the seafloor off PKF, Vestnesa and in Storfjorden Trough.

7. Preliminary results and outcome of the cruise

Scientific goals:

In general, because of poor weather conditions stations initially from PKF and Vestnesa were abandoned, but re-visited later in better conditions. During the wait for better conditions for sampling, small chirp and multibeam surveys were performed, first in Vestnesa and later in PKF. In Storfjorden Trough part of the program was postponed because of bad weather. Instead, we did a small survey of a part of Storfjorden Trough and later Storfjorden with chirp and multibeam, as well as doing CTD at former stations to search for brine overflow. We found quite similar conditions in the water column as in February 2016 indicating that brine overflow has not taken place or is very minor. Despite the poor weather conditions both in the north and in Storfjorden Trough, we managed in the end to sample several gravity cores and sample these for pore water and sediment; more than 700 samples were taken out for further analyses on land.

CAGE projects:

In essence, despite the poor weather conditions, we obtained most of the planned samples. 14 CTD casts were performed, 3 multinet tows, and 10 gravity cores were retrieved in total for the projects. CTD and water samples were taken to analyse water properties and chemistry at plankton stations and gravity core stations for pore water and sediment samples for sulphate-methane and TOC for the CAGE-OA-project. Plankton samples were taken to study the impact of ocean acidification on the shells of the planktonic foraminiferal specimens and to study seasonal changes in species distribution and depth habitats as well as estimate productivity of other planktonic organisms.

The collected material will be analysed at the Department of Geology, UiT, the Arctic University of Norway, as part of ongoing research (seniors, researchers, Post docs, Phds) and also form a basis for future master, PhD and post doc studies a.o. Pore water samples and sediment samples will be analysed for pore water chemistry at the Geological Survey of Denmark and Greenland (GEUS, Copenhagen, while TOC and S will be done in Tromsø.