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FACULTY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF GEOSCIENCE

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# ARCTIC UNIVERSITY OF NORWAY cruise report

Tromsø – Longyearbyen 06-07-17 to 25-07-17

## R/V Helmer Hanssen

# Cruise CAGE-17-3

**Centre for Arctic Gas Hydrate, Environment and Climate (CAGE))**

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# INTRODUCTION AND OBJECTIVES

Cruise CAGE17-3 with UiT's research vessel R/V Helmer Hanssen is the 3rd of several cruises in 2017 that is carried out to collect cross-disciplinary data for addressing the objectives of the Norwegian Centre of Excellence for Arctic Gas Hydrate, Environment and Climate, CAGE.

The overall goal of cruise CAGE 17-3 is to collect seismic, multibeam and water column data in an area along the northern flank of the Bear island trough (Fig. 1) and on the W-Svalbard margin (Fig. 2). The objectives associated with the overall goal are to better understand the occurrence of gas hydrates and fluid leakage, the source of the gas in these systems, and seafloor expressions of fluid seepage. In order to address these objectives we plan to carry out:

- 2D and 3D P-Cable seismic and ocean-bottom seismic acquisition over a complex leakage and source-to-sink plumbing system in the Leirdjupet Fault complex in the SW Barents Sea;
- Recovery of one of CAGE's ocean floor observatory from the crater area at the northern flank of the Bear Island Trough;
- Repeat of P-Cable 3D seismic acquisition on the eastern segment of the Vestnesa Ridge for time-lapse seismic studies of fluid flow and gas hydrates dynamics;
- 2D multi-channel seismic for reconnaissance and stratigraphic correlation in the Molloy Ridge area;
- Multibeam mapping to fill in gaps and improve resolution of existing data using the upgraded EM302 system on R/V Helmer Hanssen.

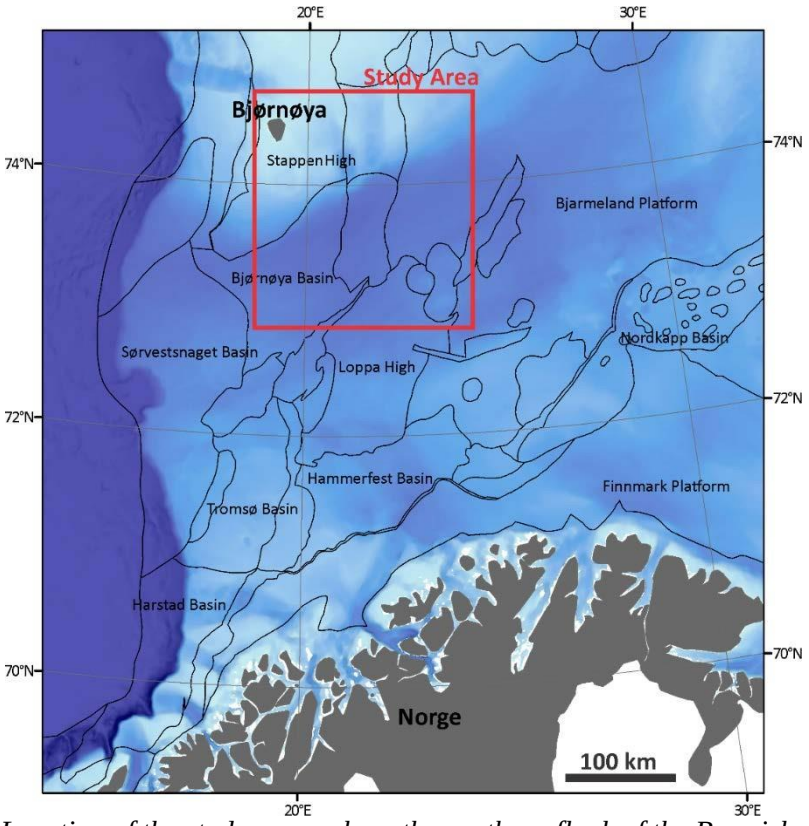



*Figure 1: Location of the study areas along the northern flank of the Bear island trough.*

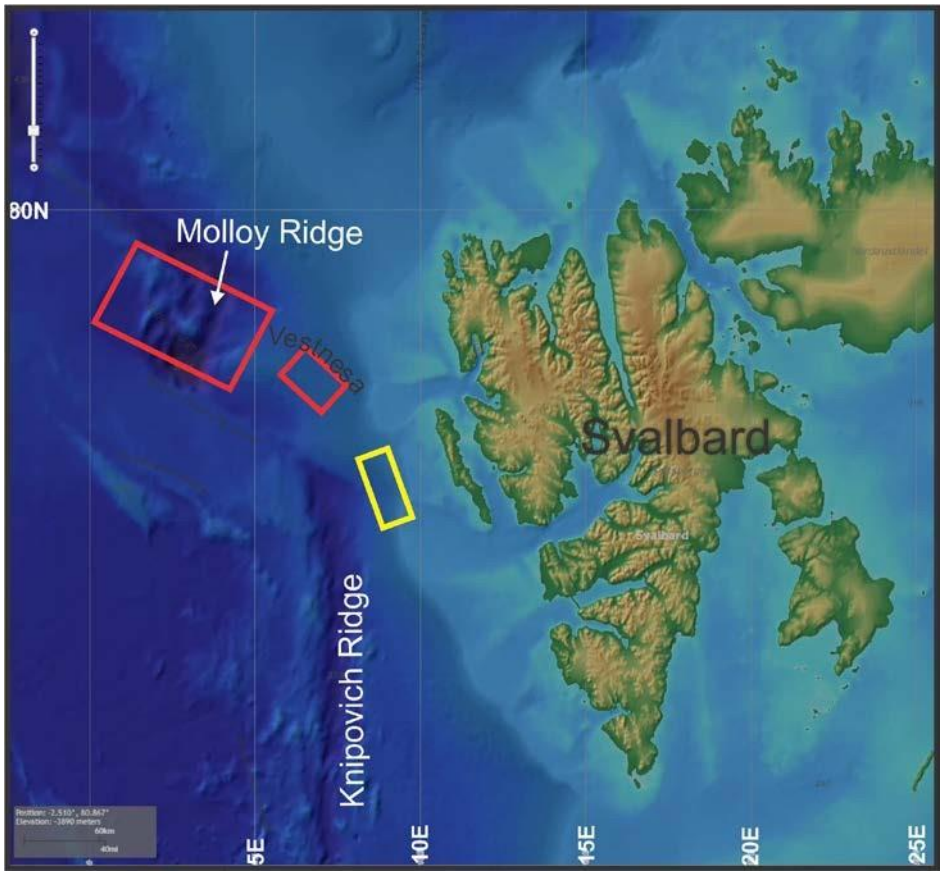



*Figure 2: Location of the study areas on the W-Svalbard margin.*

# METHODS

## Seismic methods

The high-resolution P-Cable 3D seismic system was used together with a Granzow high-pressure (210bar) compressor and one mini-GI gun (15/15 $in^3$) or one GI gun (45/45 $in^3$). Onboard seismic processing and QC of P-Cable seismic data provided preliminary 3D cubes and migrated 2D seismic sections for quality assessment and geofluid interpretations.

During this cruise we used the upgraded SIMRAD EM302 high-resolution multibeam system. The new EM302 improves seabed resolution greatly by increasing the number of beams from 135 to a possible maximum of 864 beams. In addition, the system allows mapping the water column in order to detect gas flares over active pockmarks.

Other acquisition systems that were partly used include SIMRAD EK 60 38 and 18 kHz echosounder, the Edgetech Discover penetration sub-bottom profiler and a CTD to extract information about different (T, S) properties of water masses to calculate the speed of sound for calibrating the EM302.

## The P-Cable 3D (2D) seismic system

The P-Cable 3D high-resolution seismic system consists of a seismic cable towed perpendicular (cross cable) to the vessel's steaming direction (Figure 3 and 4). An array of multi-channel streamers is used to acquire many seismic lines simultaneously, thus covering a large area with close in-line spacing in a cost efficient way. The cross cable consists of two 62,5-m long and one 87,5-m long section with a total of 14 streamers attached to it. Including lead-in cables, the cross cable has a total length of 233 m between paravanes (doors) (Figure 2). The cross-cable is spread by two paravanes that due to their deflectors attempt to move away from the ship. The paravanes itself are towed using R/V Helmer Hanssen's large trawl winches. The spacing between the streamers is 12.5 m but due to curvature of the cross-cable, the effective spacing between the streamers may be shortened in cross line direction to about 6-12 m. Each digital streamer is 25 meters long and consists of an A/D-module and 8 channels. New Geometrics solid state streamers are used that are much less affected by sea swell and hence provide data with significantly less noise. The A/D-module converts the analogical signal from the channels to digital signals. The group spacing of channels along the streamer is of 3.125 m.

A 300-m long signal cable is run off the P-Cable winch and connects to the starboard termination of the cross cable (Figure 3). It contains wiring for power and data transmission. The data is transferred via Ethernet protocol. Ethernet-to-Coax switches at the ends of the signal cable allow data transmission over long distances. The digital data is recorded using Geometrics GeoEel software.

The P-Cable system can be reconfigured to a multi-channel 2D seismic streamer. During this cruise we used 12 or 8 streamer sections for a 300 m and respectively 200 m long active hydrophone cable with 96 (64) channels at a receiver spacing of 3,25 m (Figure 5). The lead-in cable to the active streamer had a length of 80 m behind the ship. The streamer cable was towed at a depth of 3 m controlled by either one or two Digibirds rented from an exploration supplier in the UK.

Details on the acquisition parameters like recording length, sampling rates, etc. can be found in the seismic line log in the Appendix of this report.

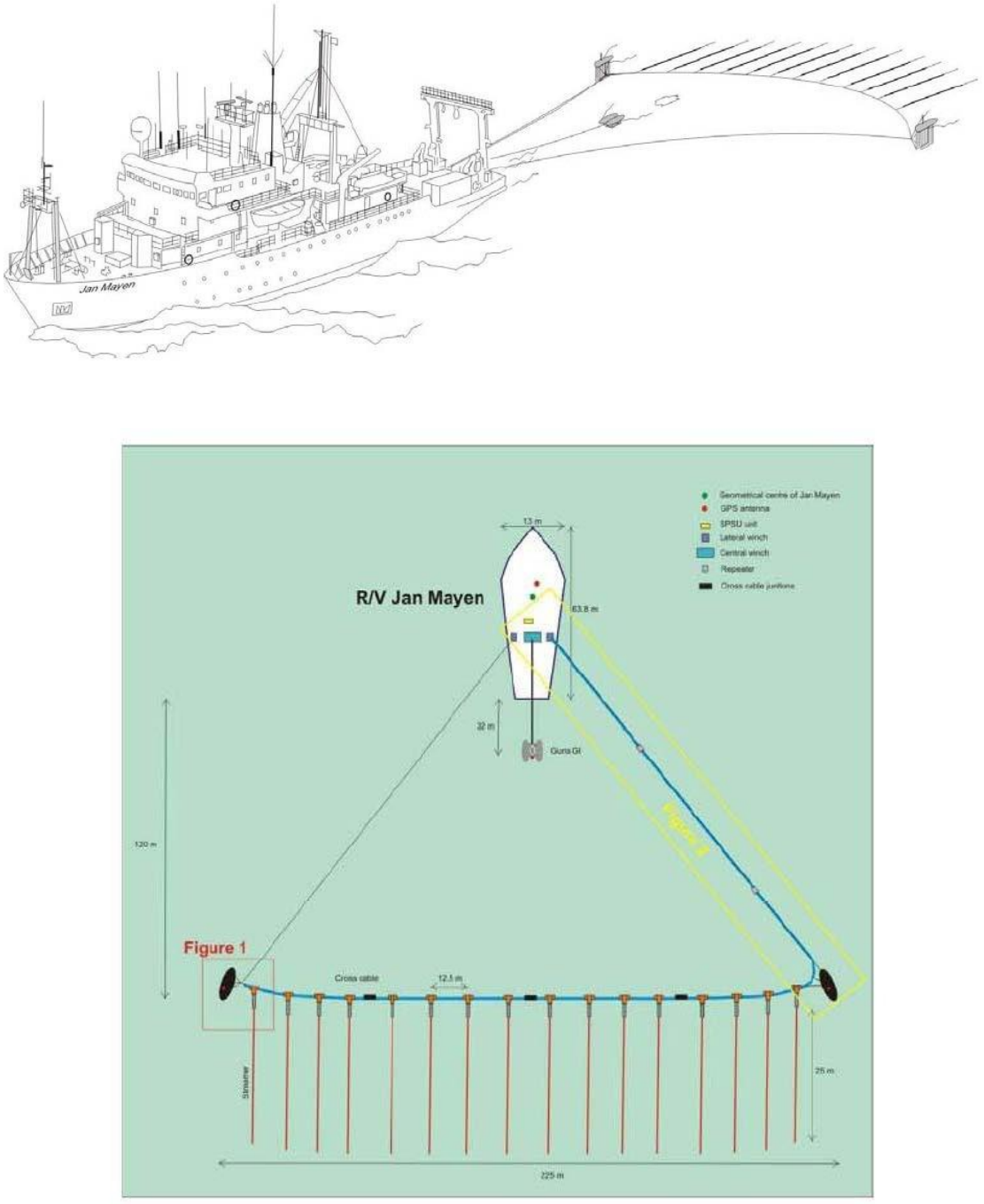



*Figure 3: Schematic sketch (top) and technical drawing (bottom) of the P-Cable high-resolution 3D seismic system.*

*Figure 4: Images of the P-Cable system during deployment and recovery. Top left: the cross cable is being deployed, streamer sections are connected during deployment; top and bottom right: The cross cable is recovered and spooled back on the winch while streamers as disconnected from the cross cable. The small winch next to the cross cable holds the signal cable; bottom left: inspection of cross cable junction boxes during deployment and recover.*

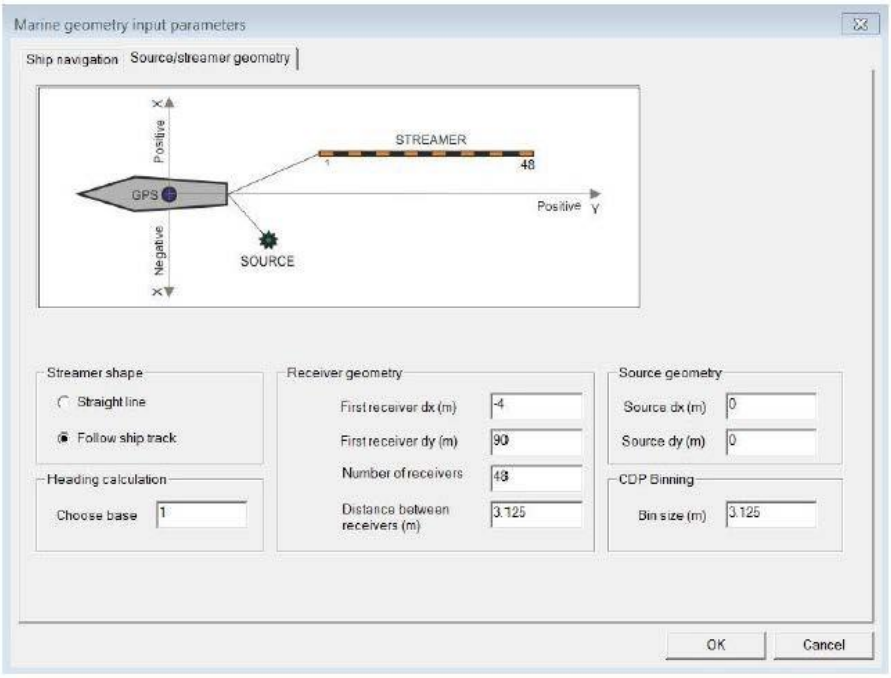



*Figure 5: Figure 7 – Typical parameters used to describe the 2D seismic acquisition system as defined during shipboard processing in RadexPro 2016.2.*

## Multi-component ocean bottom seismometer (OBS)

Multi-component Ocean Bottom Seismometer (OBS) were deployed to record compressional and shear wave velocities. 2 OBS were prepared for an active source seismic experiment coincident with the P-Cable 3D seismic acquisition in the Leirdjupet Fault complex.

The OBS systems used represent two design types that serve the same purpose (Figure 6). They are autonomous sea floor recording platforms, designed to record both, compressional and shear waves reflected and refracted through the sediments. It consists of a titanium frame with buoyancy made of syntactic foam, a KUMQUAT acoustic release system, and a digital data recorder in a separate pressure case[1]. A hydrophone and a 3-component geophone are used to record the seismic wavefield. The Tromsø OBS has a 4.5 Hz geophone attached. While the hydrophone is fixed to the frame of the OBS, the geophone is detached from it. This design insures that the geophone is mechanically decoupled from the frame, to avoid noise generated by the frame being recorded by the geophone. The whole system is rated for a water depth of up to 6000 m.

The OBS is attached to a ground weight via the acoustic release system, to make it sink to the sea floor after deployment. When the seismic experiment is completed, the OBS is released from its ground weight by sending an acoustic code and it rises to the sea surface by its buoyancy.

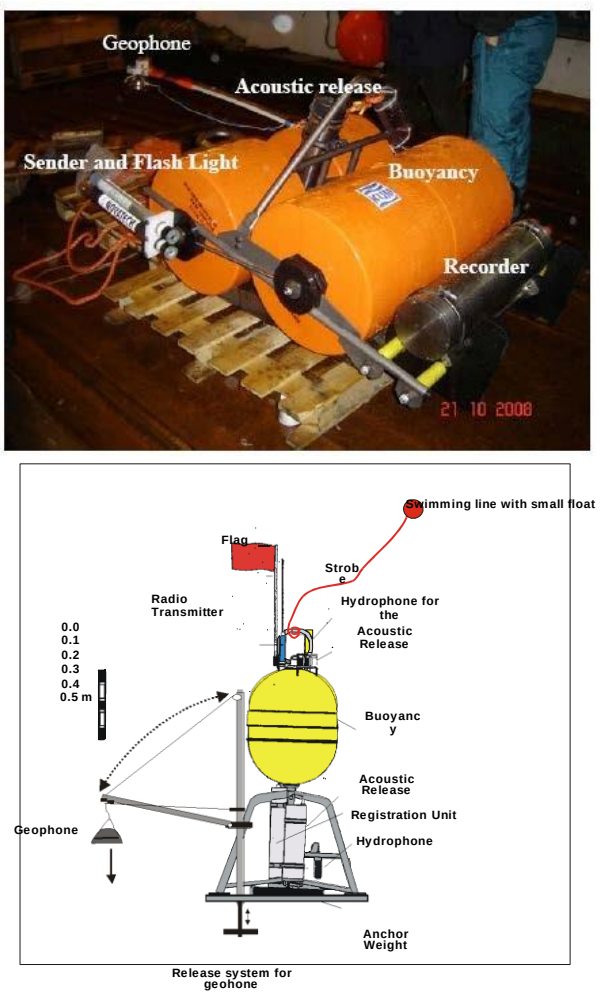



*Figure 6: The old (bottom) and the new (top) Ocean Bottom Seismometer (OBS) system (UiT).*

The OBS systems were prepared and programmed prior to deployment. The first channel records the hydrophone data, while channel two, three and four are connected to horizontal and vertical components of the geophone. The locations were selected based on seismic anomalies in the 3D seismic data and previously acquired OBS data. The station list is given in the appendix.

## NARRATIVE OF THE CRUISE

Times in this report are given in local time (local time -2 hrs = UTC), seismic data are logged in UTC time and ship logs are given in UTC time. Weather conditions throughout the cruise were mostly good in the Barents Sea with sea state and wave heights not significantly above 1 m. Weather at Svalbard was rather poor this summer with periods of 3m sea. Air temperatures were between 1 °C and 8 °C. We started to prepare the cruise in Tromsø on July 5 with assembling of the equipment.

**Wednesday, 05.07.2017**
We started to prepare lab areas and to assemble the equipment. Loading of scientific equipment for subsequent cruises lasted the whole day. RV Helmer Hanssen left Tromsø at midnight.

**Thursday, 06.07.2017**
Steaming towards the working area at the Leierdjupet Fault Complex.

**Friday, 07.07.2017**
Arrivel in the working area early in the morning at 06:00. We acquired a CTD in order to constrain sound velocity in water to update multibeam and echosounder systems. After that the 2D seismic system is prepared for deployment. Some issues with the configuration of the birds delay the deployment. One bird was not responding and a second one had to be re-initiated. At about 12:00 we deploy the 2D seismic cable and conduct a small test program for birds, streamer and airguns. A 13:45 we start a large 2D seismic survey consisting of 45 individual lines across the LFC and a tie line southward. The seismic lines of the LFC grid are being acquired from North to South, 35 lines in WNW – ESE direction and two tie lines connecting these lines in north-south direction. We start the acquisition with one GI gun firing every 5 sec. There are two fishing trawlers in the area going mostly in WSW-ENE direction through the middle of our survey grid. We communicate with the trawlers but they don’t see a problem with us continuing our survey

**Saturday, 08.07.2017**
At the beginning of the day, 7 2D seismic lines are completed. Wind and sea conditions are good. There are now 4 fishing trawlers in the area. However, we are still able to navigate around them when they are passing through our survey grid.

**Sunday, 09.07.2017**
We have completed 19 2D seismic lines. Conditions are unchanged. We have seen several water column echoes on the single-beam echosounder and on the multibeam indicating gas seepage into the water column.

**Monday, 10.07.2017**
33 2D seismic lines have been completed. For lines 40 – 45 we have changed to firing with both GI guns (45/45 + 105/105) testing the seismic energy penetration with the added source but also as we have a tie line southward in the Bear Island Trough. Additional fish trawlers have come to this area. This area seems to be an attractive fishing ground at this particular time. We still manage to avoid any conflict with the fish trawlers by extending turns and timing the passing.

**Tuesday, 11.07.2017**
The 2D seismic survey at LFC concludes at 07:30 early in the morning. The original survey plan was to acquire a 3D high-resolution seismic data set over a designated area with intense flaring. However, there are now 11 fish trawlers in the area, and most of them are passing exactly through the small area designated for the 3D seismic acquisition. It is impossible to start the 3D seismic survey and we decide to steam eastward for a 2D seismic survey in the Wisting area. At 11:45, we start the 1$^{st}$ of three long tie lines in the Wisting area.

**Wednesday, 12.07.2017**
The last of the three Wisting lines is completed at about 06:00 in the morning. It is still impossible to acquire the 3D seismic data at LFC due to the trawlers. So we decide to use the excellent sea conditions to recover the CAGE observatory at the crater site further east. We arrive at the observatory at about 14:00 and immediately release the recovery pod. Despite a few communication issues with the release system on the observatory, the recovery pod surfaces after only a few minutes. The recovery of the observatory happens without any problem and the observatory is on deck after less than an hour after release. Subsequently, we conduct 6 CTD stations with water bottles for oceanographic measurements. Then we decide to go back to the LFC area in order to see if the trawling activity has ceased and whether it would be possible to acquire a 3D seismic survey.

**Thursday, 13.07.2017**
At 08:00, we are back at the LFC site and recognize that there are still up to 10 fish trawler in the area. After communicating with some of the trawlers it becomes clear that they will not leave the area for a number of days. Unfortunately, we have to give up on the 3D survey at LFC. Communicating with DEA Norge has provided us with additional 2D seismic lines in the Wisting/Sandspollen area. We acquire a CTD station in the Wisting area at 20:00. Afterwards, the 2D seismic cable is deployed again and at 22:15 we start another short 2D seismic survey.

**Friday, 14.07.2017**
5 2D seismic lines have been completed over night and the system is recovered at about 10:00. We then reconfigure from 2D to 3D seismic in order to shoot a short 3D seismic survey over one of the shallow gas targets in the Sandspollen area. This short survey will provide crucial data for evaluating potential future 3D acquisition in this area. At about 14:30 we start deploying the P-Cable 3D seismic system. Deployment is completed without major problems and the system is not showing any leakage. Problems with the 3D streamer configuration (reset/detect) delay the start of the survey. After a number of detect cycles and system reboot, the software finally finds all 14 streamers on the 3D array and we can commence the survey with a warm-up phase at about 18:00. 3D seismic line 1 then starts at 19:20. Winds are below 10 m/s and waves around 1 m.

**Saturday, 15.07.2017**
At 07:30 in the morning, 8 3D seismic acquisition lines have been completed. Weather has worsened overnight and the data shows significantly more noise. Also, tension on paravan wires and signal cable are higher. With even worse weather coming up, we decide to recover the P-Cable system. This completes the survey in the Barents Sea and we steam northward towards for a port call in Longyearbyen to drop off the observatory and pick up new mini-GI guns.

**Sunday, 16.07.2017**
We have a few hours to spare before our planned arrival in Longyearbyen at 08:00 the next morning. So we are running a few infilling multibeam lines in the Pingo area at the outer Storfjorden.

**Monday, 17.07.2017**
We arrive in Longyearbyen at 08:00 and start the logistics related to observatory and seismic equipment. At 18:00 we depart again from Longyearbyen and steam out to the Vestnesa Ridge working area. The departure is delayed in Isfjorden as there is a bad weather front moving west of Svalbard. We aim at being in the working area in early afternoon the following day when weather is supposed to cease.

**Tuesday, 18.07.2017**
We arrive at the Vestnesa ridge area at around 15:30 and run a CTD for calibration of the multibeam system. We deploy one OBS in the Vestnesa 3D area infilling a crucial location of ocean-bottom seismic data. Then we start deploying the P-Cable 3D seismic system and at 21:30 we start to acquire the Vestnesa 3D/4D time-lapse survey.

**Wednesday, 19.07.2017**
Due to deteriorated weather, we have to interrupt the 3D seismic survey at 21:30 about halfway through completion. The last lines of the survey make sure that the OBS is directly covered by an acquisition line. At 23:00, the system is back on deck. We sail towards the location of the OBS in order to recover it.

**Thursday, 20.07.2017**
Shortly after midnight, the OBS is released from its anchor weight. At 01:20 it is safe back on deck. Waves of around 2-3 m make seismic acquisition difficult and noisy. So we decide to acquire multibeam data south of Vestnesa and across the Molloy Transform infilling existing multibeam coverage. Early in the morning, one CTD station is conducted for calibration of sound speed in water. Multibeam surveying continues until about midnight and we sail back to the 3D area on the Vestnesa Ridge.

**Friday, 21.07.2017**
At 08:00, we deploy the P-Cable again and continue acquisition of the Vestnesa Time-lapse survey. The 3D seismic survey is completed at 22:30 and we successfully recover the P-Cable. The seismic configuration is then changed to a 100 m long 2D multichannel seismic cable.

**Saturday, 22.07.2017**
At 01:20, we start a 2D seismic survey over interesting features at a location where the Vestnesa sediment drift changes its direction from NW to W, and at a location south of Vestnesa, where a depression and strong fluid flow indicators have been identified in previous

data. The survey lasted until about 10:30 when we had to stop due to deteriorating weather. In this case sea swell of over 3 m are forecasted. The circumstances force us to move into Kongsfjorden to wait out the bad weather front. In the early evening hours inside Kongsfjorden we observe large dark clouds passing west of Svalbard.

**Sunday, 23.07.2017**
Early in the morning we sail back out to Vestnesa and continue the 2D seismic survey. Ice conditions limit us in our designed survey. We can't recall any cruise in the last 10 years where ice has come so far south on the Vestnesa Ridge and Molloy Transform.

**Monday, 24.07.2017**
The 2D seismic survey is completed at 07:00 early in the morning and we sail back to the Vestnesa Ridge. There is too little time left on the cruise to start a completely new 3D seismic survey. So we have designed another repeat survey on the Vestnesa Ridge. This survey covers only the two most prominent pockmarks, Lunde and Lomvi and is run perpendicular compared to the previous 4D seismic surveys. It should give interesting results with regards to the impact of the acquisition geometry for P-Cable time-lapse seismic studies.

**Tuesday, 25.07.2017**
The 3D/4D seismic survey is completed at 01:00 and at 02:30, the P-Cable system is successfully recovered.
18:00: Arrival in Longyearbyen. End of cruise.

# Preliminary results

## Data Acquisition at the LFC

CAGE cruise CAGE17-3 acquired 2D and 3D seismic data, multibeam and water-column imagery in the vicinity of the LFC, FB, southern Bjarmeland Platform and Hoop Fault complex (Figure 7). Data acquisition started with the acquisition of a dense grid of seismic lines across the LFC along the western flank of the FB. Line spacing was selected in order to achieve full multibeam and water column coverage of a potential prospect of a horst structure along the LFC. Subsequently, several 2D seismic tie lines where acquired south of the LFC and further to the East in the area of the southern Bjarmeland Platform and Hoop Fault Complex (Figure 7). A small 3D seismic cube was acquired at the southern Bjarmeland Platform bordering the Loppa High in order to map shallow gas accumulations identified in the 2D reconnaissance lines, and to test imaging capabilities of UiT's P-Cable system in this area.

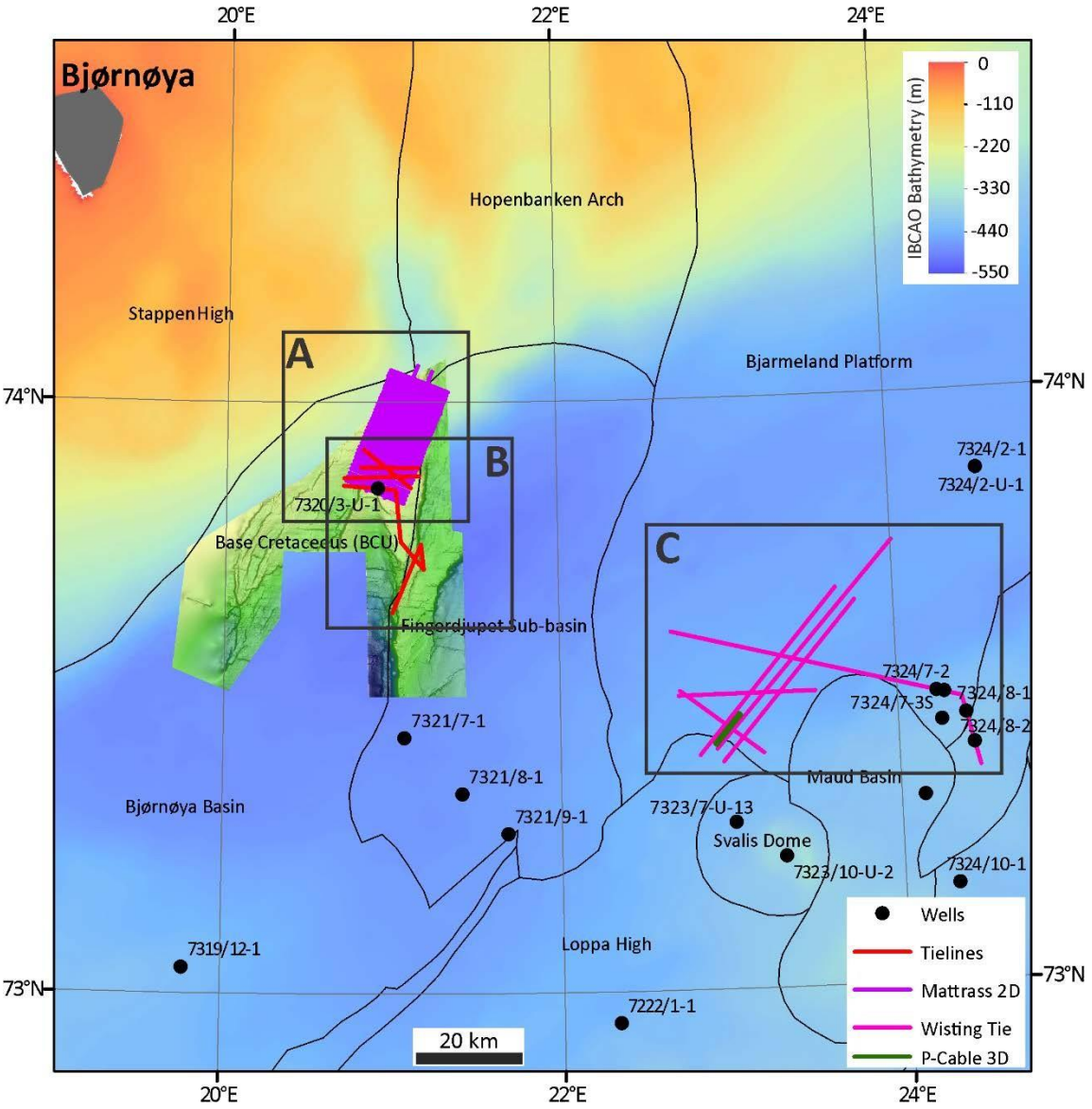



*Figure 7: Detailed overview of the study area in the Barents Sea showing the seismic data that has been acquired.*

The Kongsberg MBES EM302 on R/V Helmer Hanssen acquired bathymetric and water column data continuously during the 2D seismic surveys. A particular aim was to achieve complete coverage of the LFC horst structure in order to detect gas-seep related features on the seafloor and in the water column. Multibeam and water column data was processed with the QPS Qimera and QPS Fledermaus Midwater softwares.

The bathymetric image of the seafloor shows a high density of glacial structures (ploughmarks, mega-scale glacial lineations, prodmarks) in the LFC area, which appears comparably more often than in other sites in the Barents Sea (Figure 8). We haven't identified any seafloor features related to the seepage of gas (e.g. pockmarks, small mounds, etc.) from the subsurface. However, water-column imagery clearly detected a total number of 65 gas flares in the survey area along the LFC (Figure 8 and 9) clearly indicating that this area is actively seeping gas from the subsurface, and may be likely the most active leakage area in the whole SW Barents Sea.

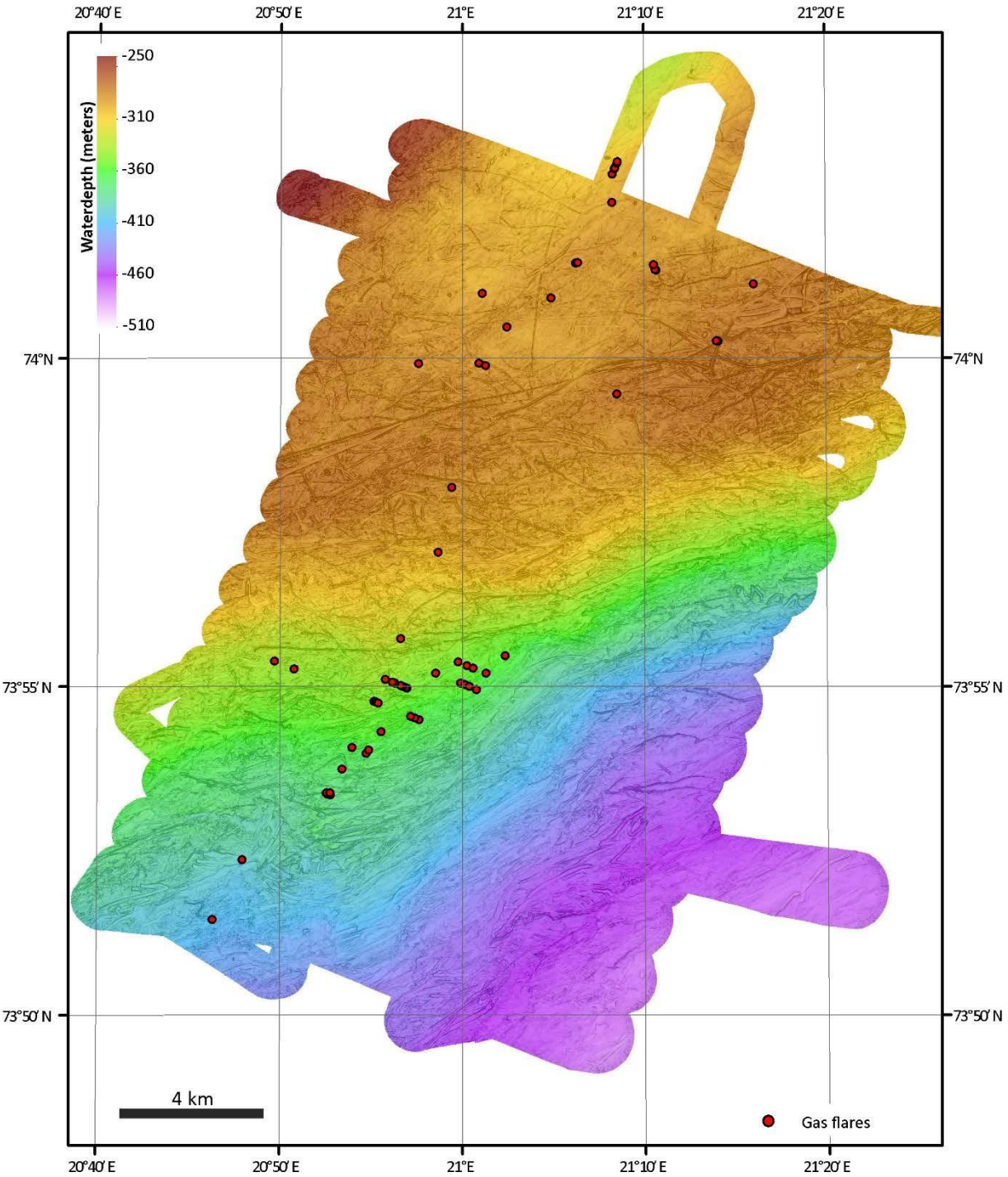



*Figure 8: Multibeam bathymetric map acquired at the LFC during the R/V Helmer Hanssen cruise. Red dots indicate location of gas flares identified in the water column data.*

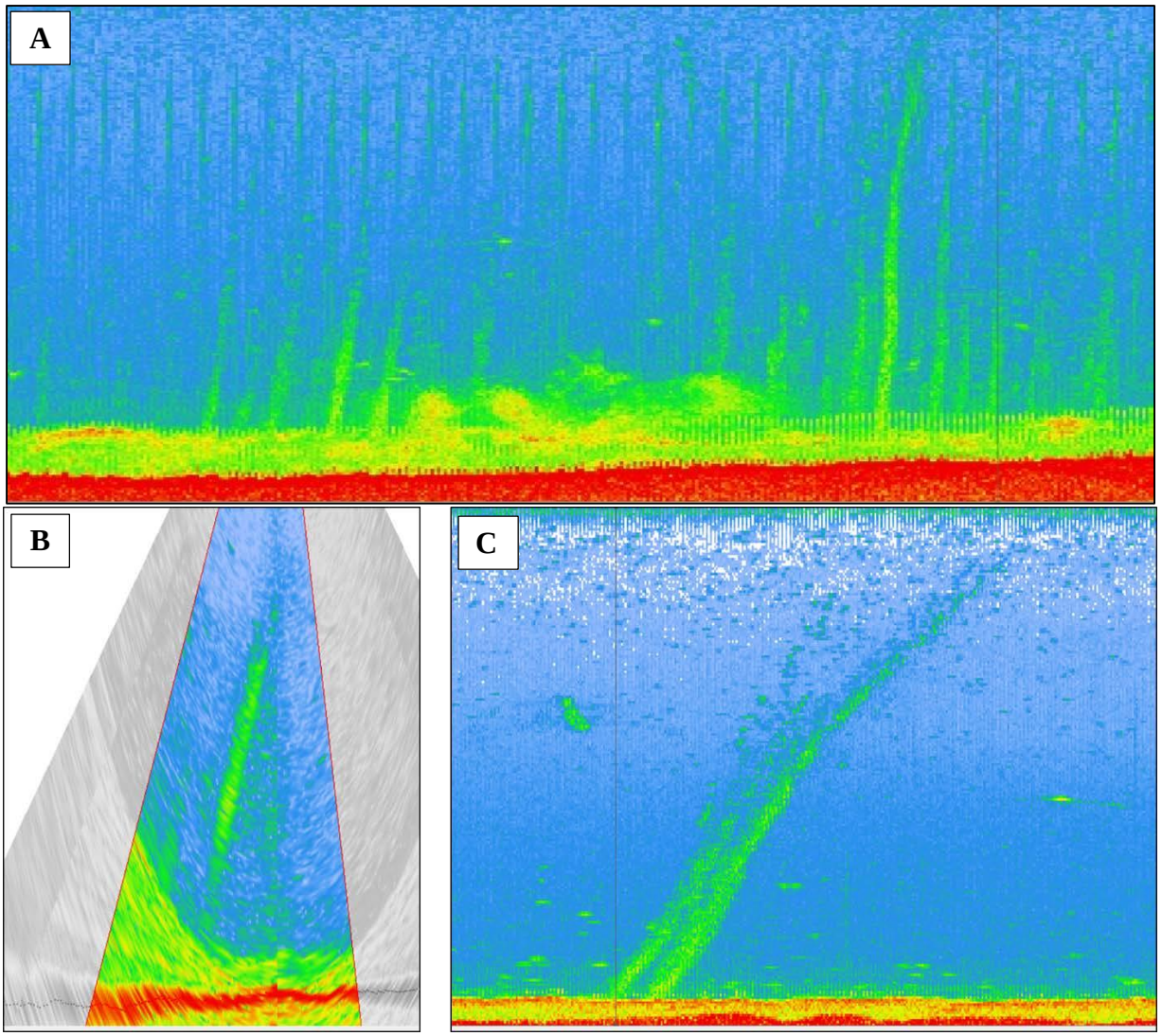



*Figure 9: Examples of gas flares in the water column imaged with the EM302 MBES during the 2D seismic survey over the LFC. Examples A and B are imaged during 2D seismic line 25;*
*example C is from seismic line 6. See Figure 7 for seismic line location.*

## 2D seismic acquisition at Leirdjupet Fault Complex

A total of 37 2D seismic lines were acquired in the LFC (Figure 7). Line spacing was designed to provide full multibeam and water column coverage of the seafloor in this area as seafloor gas seepage was suspected. 35 seismic lines were acquired in approximately WNW – ESE direction, and 2 lines were acquired in NNE – SSW direction connecting all 2D lines. The start of the 2D seismic acquisition was shifted to the northern end of the survey area as there were two fishing vessels trawling in the southern half. In addition 2 more lines (lines 38 and 39) were acquired to tie in with previous seismic acquisitions in this area (Figure 8). Line 40 is a transit line in E-W direction.

2D seismic acquisition started with a 300 m long streamer, depth-controlled by two Digibirds. However, the first acquisition lines showed significant noise on the last 4 streamer sections. We also recognized that the bird at the end of the streamer was having difficulties to keep its assigned depth of 3 m. Using binoculars we could see the last streamer sections partly surfacing explaining the increased noise levels and lowered seismic amplitudes. Therefore, we interrupted acquisition, recovered the streamer and reduced its length to 200 m (Figure 10). Only one bird was used for depth control at the 3rd of 8 streamer sections. The second bird went into maintenance. Immediately, data quality improved considerably. Real-time QC processing of the incoming data showed significantly reduced noise levels, better Signal-to-Noise ratio and stable spectral components across all channels.

The detailed survey parameters for this survey are given in the table below:

| **Survey parameters** | |
|---|---|
| Deployment / recovery | 1 - 3 hrs |
| Survey speed | 5 kt |
| Turn time | 30-60 min |
| | |
| Source | 1 GI gun at 45/45 $in^3$ |
| Shooting rate | 5 s |
| Shooting pressure | 160 bar |
| Towing depth | 3 m |
| Dominant frequeny (bandwidth) | 100 Hz (20-250 Hz) |
| Positioning | GPS transponder on gun raft |
| | |
| Streamer length | 380 / 280 m |
| Active section | 300 / 200 m |
| Number of channels | 96 / 64 |
| Receiver group spacing | 3.125 m |
| Streamer towing depth | 3 m |
| | |
| Sampling rate / interval | 4000 Hz / 0.25 ms |
| Recording length | 1.5 s |
| | |
| | |

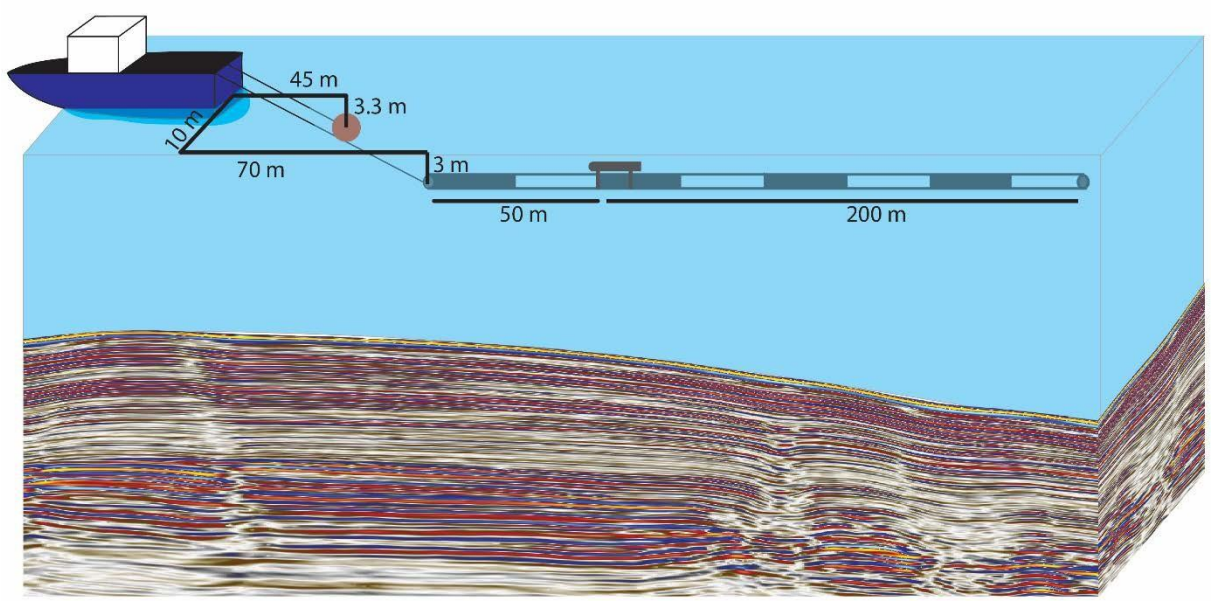



*Figure 10: Acquisition geometry of the 2D multi-channel seismic streamer.*

## 2D and 3D seismic acquisition in the southern Bjarmeland Platform and Hoop Fault Complex

Several 2D seismic lines (lines 47 – 53) have been acquired in the southern Bjarmeland Platform as well as tying lines towards the Wisting discovery and related wells in the Hoop Fault Complex (Figure 7). Survey parameters for these line are similar to those shot in the LFC area. In addition, a small 3D seismic cube was acquired at the southern boundary of the Bjarmeland Platform. The location of the 3D cube was based on observation on 2D seismic lines 49 – 53 and covers a highly faulted area and potential flat spot anomaly. Distance between acquisitions lines was 65 m ensuring enough overlap for the coverage. Due to limited time and deteriorated weather conditions towards the end of the survey, this cube is only ~4 $km^2$ but demonstrates the imaging capabilities of the P-Cable 3D seismic system in this area.

## Data Acquisition at the Vestnesa Ridge

Data acquisition at the Vestnesa Ridge was unfortunately hampered by poor weather conditions and a surprisingly southward reaching sea ice. However, one of our main goals, the repetition of the Vestnesa 3D seismic data was successfully completed in two steps where wind and sea conditions allowed. We used some of the poor weather for acquiring multibeam data infilling existing coverage. We also were able to acquire a few more 2D seismic lines across the southern Vestnesa Ridge and the Molloy transform fault as far as ice conditions allowed.

## ACKNOWLEDGEMENT

We thank the captain and his crew of R/V Helmer Hanssen of the University of Tromsø for their excellent support during the 3D and multicomponent seismic survey. This part of the cruise was conducted under the framework of the Centre of Excellence on Gas Hydrates, Environment and Climate (CAGE) (Norwegian Research Council (NFR) project number 223259/F5 at the University of Tromsø.

# APPENDIX

# 2D seismic log CAGE17-3

**R/V Helmer**

| Hanssen Station number | Line Id | Date (UTC) | Time (UTC) | Latitude (N) | Longitude (E) | End Time (UTC) | Latitude (end) (N) | Longitude (end) (E) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 981 | CAGE_17_3_HH_001_2D | 07.07.2017 | 13:42 | 74,016 | 21,350 | 15:06 | 74,057 | 20,975 | Several bad channels, Gun failure, lost pressure at shots 549 - 593 |
| 982 | CAGE_17_3_HH_002_2D | 07.07.2017 | 15:22 | 74,051 | 20,972 | 16:45 | 74,010 | 21,354 | |
| 983 | CAGE_17_3_HH_003_2D | 07.07.2017 | 17:04 | 74,004 | 21,345 | 18:28 | 74,027 | 20,567 | Seatemp: 6,9, Air 4.8, wind:7.4 |
| 984 | CAGE_17_3_HH_004_2D | 07.07.2017 | 18:40 | 74,039 | 20,967 | 20:01 | 73,999 | 21,348 | Seatemp: 7,4, Air 5,3, wind:9,3 |
| 985 | CAGE_17_3_HH_005_2D | 07.07.2017 | 20:24 | 73,993 | 21,331 | 22:00 | 74,037 | 20,934 | Seatemp: 6,9, Air 5,7, wind:14,55; !!!!!!!!!! recovered streamer due to ongoing problems with depth and noise on sections 9-11. Removed 4 last sections. Test shots fired on this line after redeployment starting shot number 5623. |
| 986 | CAGE_17_3_HH_006_2D | 07.07.2017 | 23:30 | 74,034 | 20,914 | 01:02 | 73,980 | 21,327 | Seatemp: 6,6, Air 5,7, wind:10,4 Starting acquisition with 8 streamers (64 channels) |
| 987 | CAGE_17_3_HH_007_2D | 08.07.2017 | 01:34 | 73,980 | 21,337 | 03:06 | 74,027 | 20,927 | Seatemp: 6,6, Air 5,2, wind:12,42 |
| 988 | CAGE_17_3_HH_008_2D | 08.07.2017 | 03:19 | 74,022 | 20,924 | 04:46 | 73,979 | 21,318 | Seatemp: 6,7, Air 5,7, wind:11,56 Consistant random noise on channel 34 |
| 989 | CAGE_17_3_HH_009_2D | 08.07.2017 | 05:15 | 73,973 | 21,310 | 06:41 | 74,015 | 20,920 | Seatemp: 7,3, Air 6, wind:8,3 |
| 990 | CAGE_17_3_HH_010_2D | 08.07.2017 | 06:55 | 74,011 | 20,908 | 08:17 | 73,970 | 21,289 | Sea temperature 6.6 degrees celcius, air temperature 5.5 degrees celcius. Wind speed 9-10 meters per second. Noisy channel 34. |
| 991 | CAGE_17_3_HH_011_2D | 08.07.2017 | 08:40 | 73,964 | 21,289 | 10:11 | 74,007 | 20,876 | Sea temperature 7.3 degrees celcius, air temperature 6.5 degrees celcius. Wind speed 8-9 meters per second. Noisy channel 34. |
| 992 | CAGE_17_3_HH_012_2D | 08.07.2017 | 10:19 | 74,001 | 20,896 | 11:44 | 73,958 | 21,285 | Sea temperature 6.6 degrees celcius, air temperature 6.8 degrees celcius. Wind speed 10-11 meters per second. Noisy channel 34, 46, 47, 54, 58, 60 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 993 | CAGE_17_3_HH_013_2D | 08.07.2017 | 12:03 | 73,951 | 21,298 | 13:41 | 73,996 | 20,880 | Sea temperature 7.3 degrees celcius, air temperature 7.4 degrees celcius. Wind speed 11-12 meters per second. Noisy channel 34, 46, 47, 54, 58, 60 |
| 994 | CAGE_17_3_HH_014_2D | 08.07.2017 | 13:52 | 73,990 | 20,880 | 15:17 | 73,949 | 21,270 | Sea temperature 7.1 degrees celcius, air temperature 7.0 degrees celcius. Wind speed 9-10 meters per second. Noisy channel 34, 46, 47, 54, 58, 60 |
| 995 | CAGE_17_3_HH_015_2D | 08.07.2017 | 15:36 | 73,941 | 21,278 | 17:08 | 73,985 | 20,875 | Sea temperature 7.3 degrees celcius, air temperature 7.1 degrees celcius. Wind speed 10-11 meters per second. Noisy channel 34, 46, 47, 54, 58, 60 |
| 996 | CAGE_17_3_HH_016_2D | 08.07.2017 | 17:21 | 73,980 | 20,875 | 18:47 | 73,938 | 21,254 | Sea temperature 7.4 degrees celcius, air temperature 7.1 degrees celcius. Wind speed 8-9 meters per second. Noisy channel 34, 46, 47, 54, 58, 60 |
| 997 | CAGE_17_3_HH_017_2D | 08.07.2017 | 19:09 | 73,936 | 21,230 | 20:32 | 73,975 | 20,865 | Sea temperature 7.4 degrees celcius, air temperature 7.2 degrees celcius. Wind speed 9.5 meters per second. Noisy channel 10,34, 46, 47, 54, 58, 60 . Shooting stopped for about 5 minutes. |
| 998 | CAGE_17_3_HH_018_2D | 08.07.2017 | 20:42 | 73,971 | 20,853 | 22:11 | 73,929 | 21,239 | Sea temperature 7.5 degrees celcius, air temperature 7.4 degrees celcius. Wind speed 7.4 meters per second. Noisy channel 10,34, 46, 47, 54, 58, 60 . |
| 999 | CAGE_17_3_HH_019_2D | 08.07.2017 | 22:34 | 73,925 | 21,211 | 00:04 | 73,966 | 20,833 | Sea temperature 7.4 degrees celcius, air temperature 7.3 degrees celcius. Wind speed 7.7 meters per second. Noisy channel 10,34, 46, 47, 54, 58, 60 . |
| 1000 | CAGE_17_3_HH_020_2D | 09.07.2017 | 00:32 | 73,959 | 20,847 | 01:38 | 73,917 | 21,216 | |
| 1001 | CAGE_17_3_HH_021_2D | 09.07.2017 | 01:59 | 73,911 | 21,216 | 03:27 | 73,954 | 20,828 | Sea temperature 7.5 degrees celcius, air temperature 7.7 degrees celcius. Wind speed 7.9 meters per second. Noisy channel 10,11,34, 46, 47, 54, 58, 60 . |
| 1002 | CAGE_17_3_HH_022_2D | 09.07.2017 | 03:40 | 73,949 | 20,831 | 05:07 | 73,907 | 21,213 | Sea temperature 7.3 degrees celcius, air temperature 7.5 degrees celcius. Wind speed 7.9 meters per second. Noisy channel 10,11,34, 46, 47, 54, 58, 60 . Potential seep around 23046-23050 |
| 1003 | CAGE_17_3_HH_023_2D | 09.07.2017 | 05:24 | 73,899 | 21,207 | 06:55 | 73,945 | 20,804 | Sea temperature 7.6 degrees celcius, air temperature 7.7 degrees celcius. Wind speed 8,1 meters per second. Noisy channel 10,11,34, 46, 47, 54, 58, 60 |
| 1004 | CAGE_17_3_HH_024_2D | 09.07.2017 | 07:04 | 73,939 | 20,811 | 08:40 | 73,897 | 21,211 | Sea temperature 7.6 degrees celcius, air temperature 7.5 degrees celcius. Wind speed 6,5 meters per second. Noisy channel 10,11,34, 46, 47, 54, 58, 60 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1005 | CAGE_17_3_HH_025_2D | 09.07.2017 | 08:55 | 73,891 | 21,175 | 10:24 | 73,789 | 20,78 | Sea temperature 7.3 degrees celcius, air temperature 7.7 degrees celcius. Wind speed 6,36 meters per second. Noisy channel 10,11,34, 46, 47, 54, 58, 60 |
| 1006 | CAGE_17_3_HH_026_2D | 09.07.2017 | 10:36 | 73,926 | 20,804 | 12:00 | 73,884 | 21,181 | Sea temperature 7,7 degrees celcius, air temperature 7,8 degrees celcius. Windspeed 5,14 meters per second. |
| 1007 | CAGE_17_3_HH_027_2D | 09.07.2017 | 12:17 | 73,879 | 21,163 | 13:46 | 73,922 | 20,775 | |
| 1008 | CAGE_17_3_HH_028_2D | 09.07.2017 | 13:59 | 73,915 | 20,776 | 15:23 | 73,873 | 21,158 | Sea temperature 7,2 degrees celcius, air temperature 7,3 degrees celcius. Windspeed 5,8 meters per second. |
| 1009 | CAGE_17_3_HH_029_2D | 09.07.2017 | 15:44 | 73,867 | 21,145 | 17:11 | 73,909 | 20,768 | Sea temperature 7,8 degrees celcius, air temperature 7,7 degrees celcius. Windspeed 4,8 meters per second. |
| 1010 | CAGE_17_3_HH_030_2D | 09.07.2017 | 17:22 | 73,903 | 20,756 | 18:52 | 73,86 | 21,143 | Sea temperature 7,8 degrees celcius, air temperature 7,7 degrees celcius. Windspeed 4,8 meters per second. Check flares |
| 1011 | CAGE_17_3_HH_031_2D | 09.07.2017 | 19:16 | 73,854 | 21,108 | 20:40 | 73,896 | 20,738 | Sea temperature 7,9 degrees celcius, air temperature 7,2 degrees celcius. Windspeed 3,7 meters per second. |
| 1012 | CAGE_17_3_HH_032_2D | 09.07.2017 | 20:51 | 73,888 | 20,75 | 22:16 | 73,846 | 21,12 | Sea temperature 7,8 degrees celcius, air temperature 7,0 degrees celcius. Windspeed 4,01 meters per second. |
| 1013 | CAGE_17_3_HH_033_2D | 09.07.2017 | 22:44 | 73,842 | 21,096 | 00:10 | 73,884 | 20,722 | Sea temperature 7,9 degrees celcius, air temperature 7,3 degrees celcius. Windspeed 2,3 meters per second. |
| 1014 | CAGE_17_3_HH_034_2D | 10.07.2017 | 00:24:01 | 73,876 | 20,723 | 01:50 | 73,834 | 21,094 | Sea temperature 7,8 degrees celcius, air temperature 6,9 degrees celcius. Windspeed 3,7 meters per second. |
| 1015 | CAGE_17_3_HH_035_2D | 10.07.2017 | 02:17 | 73,828 | 21,079 | 03:42 | 73,870 | 20,706 | Sea temperature 7,9 degrees celcius, air temperature 7 degrees celcius. Windspeed 5 meters per second. |
| 1016 | CAGE_17_3_HH_036_2D | 10.07.2017 | 04:25 | 73,850 | 20,845 | 07:28 | 74,067 | 21,169 | Sea temperature 7,9 degrees celcius, air temperature 7 degrees celcius. Windspeed 7,6 meters per second. |
| 1017 | CAGE_17_3_HH_037_2D | 10.07.2017 | 08:02 | 74,055 | 21,247 | 11:18 | 73,834 | 20,934 | Sea temperature 7,8 degrees celcius, air temperature 7,5 degrees celcius. Windspeed 8,04 meters per second. |
| 1018 | CAGE_17_3_HH_038_2D | 10.07.2017 | 12:11 | 73,852 | 21,130 | 13:37 | 73,923 | 20,817 | **MCG1 Tie** - Sea temp 7.9 deg, air temp 7.3 deg, wind 8.5 m/s from NE |
| 1019 | CAGE_17_3_HH_039_2D | 10.07.2017 | 14:30 | 73,89 | 20,782 | 15:54 | 73,889 | 21,181 | **Jostein Tie Line** - |
| 1020 & | CAGE_17_3_HH_040_2D | 10.07.2017 | 18:21 | 73,869 | 21,335 | 20:24 | 73,872 | 20,690 | Shot interval changed to 10s. Both guns firing 45/45 105/105. kompressor can't keep up pressure, shot interval changed to 11 sec. Vessel speed reduced to 4 kn. |
| 1021 | CAGE_17_3_HH_041_2D | 10.07.2017 | 20:53 | 73,860 | 20,691 | 22:21 | 73,852 | 21,042 | PL 721 tie line startes here, in segments of individual lines 41 - 45. Sea temperature 7,7 degrees celcius, air temperature 6,8 degrees celcius. Windspeed 10,58 meters per second. |
| 1022 | CAGE_17_3_HH_042_2D | 10.07.2017 | 22:46 | 73,854 | 21,023 | 00:04 | 73,764 | 21,055 | Same seatrack file as line 43 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1023 | CAGE_17_3_HH_043_2D | 11.07.2017 | 00:04 | 73,764 | 21,055 | 00:58 | 73,714 | 21,201 | Same seatrack file as line 42 |
| 1024 | CAGE_17_3_HH_044_2D | 11.07.2017 | 01:37 | 73,432 | 21,118 | 02:27 | 73,459 | 21,103 | Off by 38 m last part. Maybe 2D crooked line |
| 1025 | CAGE_17_3_HH_045_2D | 11.07.2017 | 02:54 | 73,464 | 21,113 | 04:50 | 73,382 | 20,594 | |
| 1026 | CAGE_17_3_HH_046_2D | 11.07.2017 | 05:31 | 73,655 | 20,954 | 06:33 | 73,649 | 21,211 | pick up seismic equipment, steam to Wisting |
| 1027 | CAGE_17_3_HH_047_2D | 11.07.2017 | 09:46 | 73,610 | 22,502 | 16:30 | 73,477 | 24,401 | **Wisting tie line** , startet line 2 nm before designated start point, warm-up phase, shooting with one gun 45/45 every 5 sec; wind 2 m/s from NE, air temp 6.5, started logging Nav at shot 47196; |
| 1028 | CAGE_17_3_HH_048_2D | 11.07.2017 | 16:56 | 73,485 | 24,375 | 18:34 | 73,356 | 24,479 | **Wisting tie line** ;wind 6 m/s from NW, air temp 7.2 |
| 1029 | CAGE_17_3_HH_049_2D | 11.07.2017 | 22:22 | 73,411 | 22,939 | 03:49 | 73,753 | 24,020 | **Wisting tie line** |
| 1036 | CAGE_17_3_HH_050_2D | 13.07.2017 | 20:18 | 73,242 | 22,533 | 23:01 | 73,401 | 23,398 | **Sanspollen 2D line,** wind 11.22 m/s, airtemp 5.4, seatemp 7.6; noisy channels 16,45,46,64 up to 1 meter heave and roll |
| 1037 | CAGE_17_3_HH_051_2D | 13.07.2017 | 23:42 | 73,391 | 23,471 | 04:15 | 73 23,09 | 22 57,23 | |
| | CAGE_17_3_HH_051a_2D | 14.07.2017 | 04:30 | 73 23,068 | 23 01,55 | 05:10 | 73 23,661 | 23 14,20 | Transit line towards line 52 |
| 1038 | CAGE_17_3_HH_052_2D | 14.07.2017 | 05:17 | 73 24,0986 | 23 13,236 | 07:26 | 73 30.702 | 22 42.062 | |
| | CAGE_17_3_HH_053_2D | 14.07.2017 | 07:43 | 73 30,039 | 22 42,622 | 10:32 | 73 30,129 | 23 32,24 | wind 3 m/s from W, air temp 7 deg, sea temp 7 deg. |
| | CAGE_17_3_HH_054_2D | 7/22/2017 | 0:58 | 78.927 | 7.108 | 1:15 | 78.947 | 7.169 | **Vestnesa 2D Line:4 streamers, MiniGI, both guns firing 30/30 and 15/15 at 170 bar. Dead/noisy channels: 2,4,14,16,22,23** OBS line, wind 12 m/s, airtemp 5.6, seatemp 7.0 Gun stopped shooting from shot 836. Stopped survey for gun recovery at shot 937 02:05 UTC. Airhose broken on gun 1. Repaired at 03:45 UTC. Resuming line 55, starting shot no. 938. Line stopped due to proximity of sea ice |
| 1058 | CAGE_17_3_HH_055_2D | 7/22/2017 | 1:22 | 78.954 | 7.143 | 5:37 | 79.060 | 6.495 | wind 14 m/s, airtemp 5.6, seatemp 6.0, waveheight 0.6-0.9m, |
| 1059 | CAGE_17_3_HH_056_2D | 7/22/2017 | 5:59 | 79.050 | 6.467 | 6:41 | 79.055 | 6.760 | wind 15 m/s, airtemp 6, seatemp 6.7, waveheight 0.9-2m, |
| 1060 | CAGE_17_3_HH_057_2D | 7/22/2017 | 7:07 | 79.057 | 6.653 | 7:44 | 79.007 | 6.720 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1061 | CAGE_17_3_HH_058_2D | 7/22/2017 | 7:46 | 79.006 | 6.737 | 10:08 | 79.002 | 7.724 | wind 15-16 m/s, airtemp 6, seatemp 6.8, waveheight 0.9-2m, Stopped survey, increasing waveheight and wind |
| 1062 | CAGE_17_3_HH_059_2D | 7/23/2017 | 13:29 | 78.682 | 8.656 | 14:57 | 78.693 | 8.023 | Wind 10-11 m/s, airtemp 4.5, seatemp 7.0, waveheight 1-1.5 m |
| 1063 | CAGE_17_3_HH_060_2D | 7/23/2017 | 15:28 | 78.663 | 8.127 | 16:13 | 78.696 | 8.387 | Wind 6-7 m/s, airtemp 4.3, seatemp 7.1, waveheight 1-1.5 m |
| 1064 | CAGE_17_3_HH_061_2D | 7/23/2017 | 16:54 | 78.71 | 8.167 | 17:43 | 78.649 | 8.296 | Wind 7-8 m/s, airtemp 4.6, seatemp 7, waveheight 1-1.5 m |
| 1065 | CAGE_17_3_HH_062_2D | 7/23/2017 | 18:17 | 78.675 | 8.310 | 23:28 | 78.443 | 6.487 | Wind 7-8 m/s, airtemp 5.5, seatemp 7, waveheight 1-1.5 m. The ship was a bit off course at the beginning of the line, back on line at 18:24 (0.3 nm in). Inceased sampling interval (record length) from 3 to 4 seconds at shot 8794 (20:34:14); shooting rate changed to 6 sec at shot # 9463 due to increasing water depth; recording length up to 5 sec and samplings interval down to 0.5 msec at shot # 9527 due to increasing water depth; |
| 1066 | CAGE_17_3_HH_063_2D | 7/24/2017 | 0:30 | 78.476 | 6.095 | 3:37 | 78.715 | 6.615 | Wind 6-7 m/s, airtemp 5.7, seatemp 6.8, waveheight 1 m shooting rate 5sec record length 4 sec sampling rate 0.25ms 11227 incomplete datafile missing sections 2,3,4 |
| 1067 | CAGE_17_3_HH_064_2D | 7/24/2017 | 4:25 | 78.667 | 6.549 | 7:04 | 78.764 | 5.53 | Stopped due to ice |

## CTD stations

| Date | Time | | Station number | Latitude | Longitude | Depth [m] |
|---|---|---|---|---|---|---|
| 07.07.2017 | 9:13:50 | CTD uten vann START | 980 | 7346.476205 N | 02112.701966 E | 495.88 |
| 12.07.2017 | 15:09:23 | CTD med vannhenter START | 1031 | 7454.983701 N | 02746.143892 E | 328.32 |
| 12.07.2017 | 15:50:50 | CTD med vannhenter START | 1032 | 7454.932212 N | 02746.019245 E | 328.11 |
| 12.07.2017 | 16:31:32 | CTD med vannhenter START | 1033 | 7454.872097 N | 02745.800864 E | 348.96 |
| 12.07.2017 | 17:11:55 | CTD med vannhenter START | 1034 | 7454.801375 N | 02745.669832 E | 346.33 |
| 12.07.2017 | 17:54:52 | CTD med vannhenter START | 1035 | 7454.735720 N | 02745.533644 E | 334.35 |
| 13.07.2017 | 18:21:51 | CTD med vannhenter START | 1036 | 7324.205791 N | 02249.898625 E | 427.13 |
| 13.07.2017 | 23:45:38 | CTD med vannhenter START | 1037 | 7338.884517 N | 02346.592157 E | 440.45 |
| 16.07.2017 | 6:05:23 | CTD uten vann START | 1048 | 7609.170754 N | 01606.158356 E | 332.9 |
| 18.07.2017 | 15:55:31 | CTD uten vann START | 1050 | 7900.738497 N | 00652.099716 E | 1198.73 |
| 20.07.2017 | 11:06:59 | CTD uten vann START | 1055 | 7841.345543 N | 00605.845768 E | 2195.08 |

# 3D seismic line log

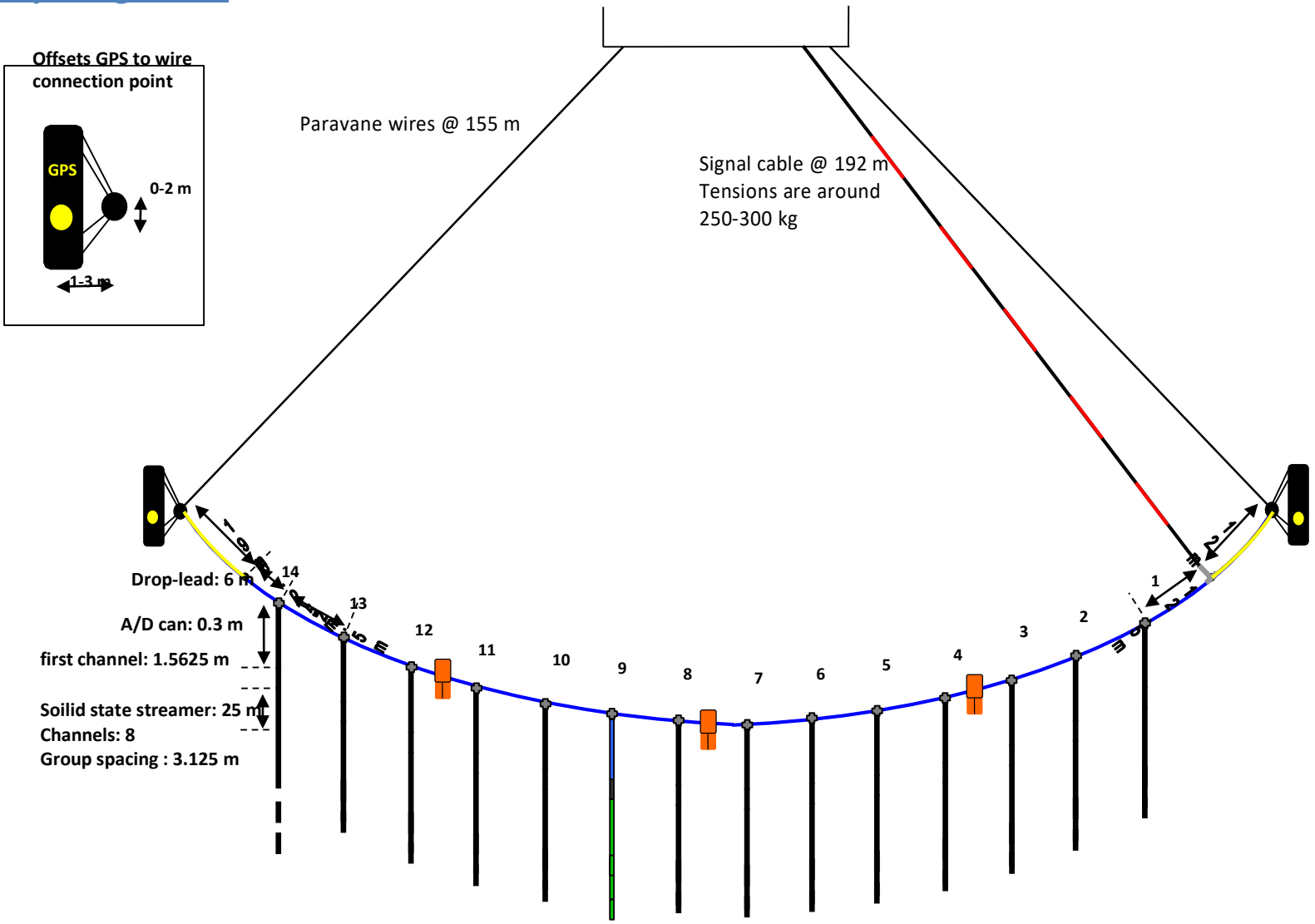
Expedition: Helmer Hanssen CAGE_17_3 July 2017 Survey: Barents Sea, WistingWest3D 14.07 – 15.07
Sheet #: 1 - 4

Survey configuration: see end of document Times are UTC

| 3D line number: | Date: Start - end | Time (UTC): Start - end | Shot point number First - last | Shot point number when crossing planned start and end of line | Comments (sailing direction, ship speed, depth sensor, wind speed, air temperature downtime, etc.) |
|---|---|---|---|---|---|
| 00 | 14.07-14.07 | 15:51 - 17:18 | 1 - 900 | N/A | Ship speed: 4 kn Wind: 2.3 m/s Wind dir: 122 deg. Noisy channels: 22,58,62,96. Channel 8 intermittently noisy |
| 01 | 14.07-14.07 | 17:19-18:22 | 901 -1650 | 945 - ~1600 | Ship speed: 4 kn Wind: 3.5 m/s Wind dir: 112 deg. Noisy channels: 22,58,62,96. Channel 8 intermittently noisy |
| 02 | 14.07- 14.07 | 18:50 – 18:57 | 1651-2448 | 1694 - 2400 | Ship speed: 4 kn Wind: 7 m/s Wind dir: 112 deg. Noisy channels: 22,58,62,96. Channel 8 intermittently noisy |
| 03 | 14.07- 14.07 | 20:22-21:22 | 2449-3160 | 2482-3121 | Ship speed: 4.1 kn Wind: 6 m/s Wind dir: 87 deg. Noisy channels: 22,58,62,96. Channel 8 intermittently noisy |
| 04 | 14.07- 14.07 | 21:49-22:59 | 3161-4002 | 3246-3963 | Ship speed: 4 kn Wind: 10 m/s Wind dir: 94 deg. Noisy channels: 22,58,62,96. Channel 8 intermittently noisy |
| 05 | 14.07-15.07 | 23:24-00:29 | 4003-4777 | 4051-4747 | Sailing SW Ship speed: 4 kn Wind: 10 m/s Wind dir: 94 deg. Noisy channels: 22,58,62,96. Channel 8 intermittently noisy |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | **Port paravane GPS not working from ~23:14 UTC** |
| 06 | 15.07-15.07 | 01:05-02:12 | 4778-5579 | 4821-5528 | ~~Seatrack restarted at 00:30 UTC. Port still not responding.~~ **No Port paravane location for the rest of the survey**. Sailing NE Ship speed: 4 kn Wind: 11.6 m/s Wind dir: 97 deg. |
| 07 | 15.07-15.07 | 02:40-03:49 | 5580-6404 | 5630- | ~~Sailing NE Ship speed: 4 kn Wind: 13 m/s Wind~~ dir: 97 deg. More waves. Heave up to 1.25m |
| 08 | 15.07-15.07 | 04:18-05:26 | 6405-7218 | 6490-7181 | Sailing NE Ship speed: 4 kn Wind: 13 m/s Wind dir: 97 deg. More waves. Heave up to 1.25m. Shots 6986 to 7050 ish have a lot of very noisy/spikey channels probably due to the tension on the data cable which appears to be between 289-356 and average of 315. Has probably increased because wind and waves have also increased. Actually, the whole last half of this line is very very noisy and spikey. Decision to wait to the end of the line and reassess whether datacable tension is problematic. |

## Survey configuration:




Observed spread of paravanes: 160 -165 m

Observed distance between gun and paravanes: 98 – 113 m, deviations between distances to both paravanes up to 5 m

Ship's speed: 4 kn ± 0,3 kn
Gun system: 1 GI (45/45 $in^3$)
Shooting pressure: 160 bar
Shooting interval: 5 sec
Recording window: 1.5 sec
Recording delay: 0 sec
Sampling interval: 0.25ms
Streamer depth: 2m

| Switch no | 6013 | 6196 | 6031 | 6012 | 6017 | 6028 | 6011 | 6030 | 6183 | 6034 | 6033 | 6187 | 6022 | 6019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth reading on deck after survey (m) | | | | | | | | | | | | | | |

Yellow: kind of okay
Red: Wrong. Recalibration

## 3D seismic line log Vestnesa 4D

The log of the Vestnesa 3D/4D Repeat survey has unfortunately been deleted.

# 3D seismic line log

Expedition: Helmer Hanssen CAGE_17_3 July 2017 Survey: Vestnesa 24.07 – Sheet #: 1 - 5

Repeat of 3D seismic over Lunde and Lomvi pockmarks; line direction perpendicular to previous surveys.

Survey configuration: see end of document Times are UTC

| 3D line number: | Date: Start - end | Time (UTC): Start - end | Shot point number First - last | Shot point number when crossing planned start and end of line | Comments (sailing direction, ship speed, depth sensor, wind speed, air temperature downtime, etc.) |
|---|---|---|---|---|---|
| 0000 | 24.07-24.07 | 10:43 – 12:00 | 1-232 | N/A | Pre-survey warm-up and test<br>Sailing NE, sea temp is 1.5 C, about 8 m/s windspeed, wave height about 1.5 m. As per previous surveys, spike channels are 7,56,49,62,52 and static channels are 21,22,17,33,96. Apparently more static channels in this survey than the last. |
| 0001 | 24.07-24.07 | 12:01-12:19 | 233-500 | 290-480 | Sailing SW, sea temp is 5.2C, windspeed is about 7.5-8m/s, wave hight about 1.5m. |
| 0002 | 24.07-24.07 | 12:42-13:12 | 501-920 | 627-829 | Sailing NE, Sea temp is 1.9 C, windspeed is ~7m/s, wave height ~1m |
| 0003 | 24.07-24.07 | 13:20-13:44 | 921-1289 | 987-1192 | Sailing SW, sea temp 4.8, windspeed ~8.5, wave height ~1m |
| 0004 | 24.07-24.07 | 13:52-14:21 | 1290-1731 | 1406-1610 | Sailing NE, sea temp 1.4C, windspeed ~8.5m/s, wave height ~1m |
| 0005 | 24.07-24.07 | 14:29-14:53 | 1732-2099 | 1816-2012 | |

| | | | | | |
|---|---|---|---|---|---|
| 0006 | 24.07-24.07 | 15:04-15:32 | 2100-2529 | 2227-2441 | Sailing SW, sea temp 4.2C, windspeed ~8m/s, wave height ~0.5-1m |
| 0007 | 24.07-24.07 | 15:44-16:11 | 2530-2924 | 2627-2823 | Sailing NE, sea temp 1.5C, windspeed ~9m/s, wave height 0.5-1m |
| 0008 | 24.07-24.07 | 16:20-16:46 | 2925-3313 | 3036-3236 | Sailing SW, sea temp 3.2, windspeed ~8m/s, wave height 0.5-1m |
| 0009 | 24.07-24.07 | 17:00-17:25 | 3314-3678 | 3390-3590 | Sailing NE, sea temp 2.6C, windspeed ~5m/s, wave height 0.5-1m. Some channels appear to be degrading unfortunately. 7 is still intermittent, but I've noticed at least a spike on most of the channels |
| 0010 | 24.07-24.07 | 17:34-18:01 | 3679-4072 | 3772-4000 | Sailing SW, sea temp 3.1, windspeed ~6m/s, wave height 0.5m |
| 0011 | 24.07-24.07 | 18:13-18:36 | 4073-4423 | 4135-4326 | Sailing NE, sea temp 1.5-3.5, windspeed ~4m/s, wave height 0.2m. Gun closer to PRT than STB paravane 103/114m respectively. Deviated 8m left of line around shot 4175. |
| 0012 | 24.07-24.07 | 18:45-19:07 | 4424-4759 | 4502-4710 | Sailing SW, sea temp 2.5-3.7, windspeed 4m/s, wave height 0.2m. Speed over ground 3.9kn. Similar gun to paravane ranges: STB-GUN 105-107m, PRT-GUN109-111m, shot 4693 autonav turned off before end of line. |
| 0013 | 24.07-24.07 | 19:20-19:45 | 4760-5128 | 4829-5024 | Sailing NE, sea temp 3.6-1.4, windspeed 2.5-0.5m/s, wave height 0.1m, speed over ground 4.3kn. STB-GUN 105-107m, PRT-GUN109-111m |
| 0014 | 24.07-24.07 | 19:54-20:17 | 5129-5477 | 5204-5408 | Sailing SW, sea temp 3.2, windspeed 0.5m/s, wave height 0.2m quite a lot of course correcting still at start of line. STB-GUN 106m, PRT-GUN110m |
| 0015 | 24.07-24.07 | 20:30-20:54 | 5478-5835 | 5556-5754 | Sailing NE, sea temp 2.8-1.7, windspeed 2-2.6m/s, wave height 0.2m, speed over ground 4.1kn. |

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| 0016 | 24.07-24.07 | 21:03-21:25 | 5836-6176 | 5908-6115 | Sailing SW, sea temp 2.6-3.8, windspeed 3m/s, wave height 0.2m, speed over ground 4.0kn. STB-GUN 105m, PRT-GUN110m |
| 0017 | 24.07-24.07 | 21:40-22:05 | 6177-6559 | 6272-6467 | Sailing NE, sea temp 3.9-2.9, windspeed 3.5m/s, wave height 0.1m, speed over ground 4.2kn. STB-GUN 108m, PRT-GUN108m at start of line. Lost AFT position around shot 6399, pretty noisy track before but ok after coming back 6408. |
| 0018 | 24.07-24.07 | 22:17-22:38 | 6560-6884 | 6610-6819 | Sailing SW, sea temp 3.1, windspeed 4m/s, wave height 0.2m, speed over ground 3.9kn. STB-GUN 106m, PRT-GUN108m |
| 0019 | 24.07-24.07 | 22:51-23:11 | 6885-7188 | 6923-7112 | Sailing NE, sea temp 4.6, windspeed 4m/s, wave height 0.1m, speed over ground 4.3kn. STB-GUN 106m, PRT-GUN110m |
| 0020 | 24.07-24.07 | 23:20-23:42 | 7189-7520 | 7253-7462 | Sailing SW, sea temp 2.7, windspeed 5m/s, wave height 0.3m, speed over ground 3.8-3.9kn. STB-GUN 105-107m, PRT-GUN110-109m. AFT position quite noisy (GUN is much more stable). |
| 0021 | 24.07-25.07 | 23:57-00:22 | 7521-7898 | 7603-7808 | Sailing NE, sea temp 3.5-4.3, windspeed 2.7m/s, wave height 0.1m, speed over ground 4.0kn. STB-GUN 106-107m, PRT-GUN109-108m |
| 0022 | 25.07-25.07 | 00:31-00:55 | 7899-8260 | 7965-8179 | Sailing SW, sea temp 4.7, windspeed 2.2m/s, wave height 0.1m, speed over ground 4.1kn. STB-GUN 106m, PRT-GUN110m |
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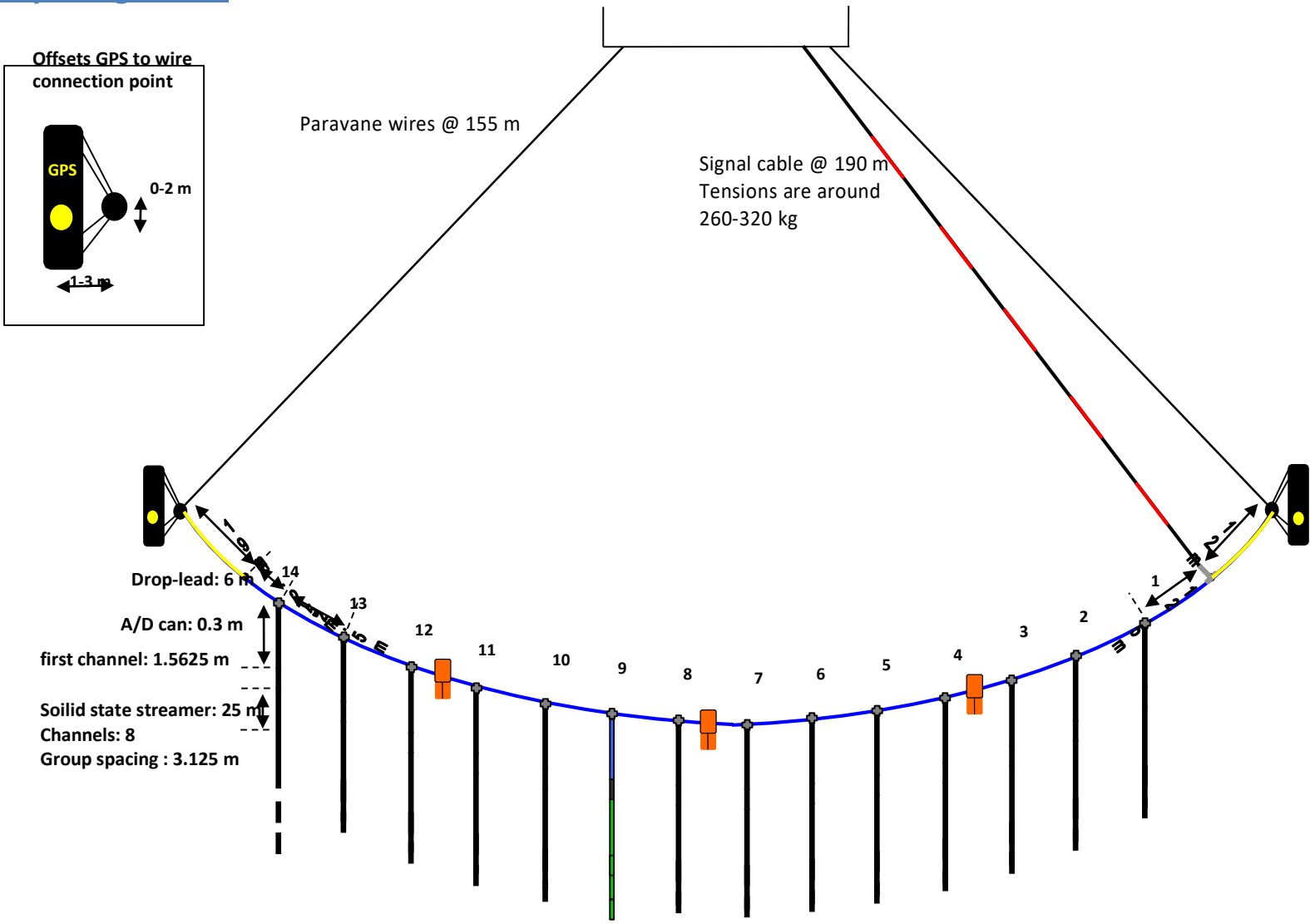
## Survey configuration:




Observed spread of paravanes: 160 -165 m

Observed distance between gun and paravanes: 98 – 113 m, deviations between distances to both paravanes up to 5 m

Ship's speed: 4 kn ± 0,3 kn
Gun system: mini-GI (15/15 $in^3$)
Shooting pressure: ~170-180 bar
Shooting interval: 4 sec
Recording window: 3 sec
Recording delay: 0 sec
Sampling interval: 0.25ms
Streamer depth: 1.5m

| Switch no | 6013 | 6196 | 6031 | 6012 | 6017 | 6028 | 6011 | 6030 | 6183 | 6034 | 6033 | 6187 | 6022 | 6019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth reading on deck after survey (m) | | | | | | | | | | | | | | |

Yellow: kind of okay
Red: Wrong. Recalibration required