Cruise report CAGE 17-4

Recovery of observatory and water column survey offshore Svalbard

Longyearbyen – Longyearbyen 03-08-17 to 06-08-17

Photo: Manuel Moser

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1. INTRODUCTION AND OBJECTIVES

The cruise was conducted from August 3 to 5th 2017 as part of the Centre of Excellence for Arctic Gas Hydrate, Environment and Climate (CAGE) at UiT – The Arctic University of Norway.

The main goal of the cruise was to recover the observatory K-Lander 2 deployed in October 2016 offshore Svalbard, at the same location where OS2 was deployed in June 2015 and recovered in May 2016. The new deployment was at 78 33.815N 10 07.7455E).

The present cruise also aimed at continuing the water samples and CTD survey on the shallow shelf and the shelf edge presenting extensive flares western Svalbard. The addressed scientific topics include quantification of methane concentration in the water column, temperature and salinity (via CTD casts), echosounder and multibeam signals and current (amplitude and direction).

2. PARTICIPANT LIST

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3. STUDY AREAS AND LANDER LOCATION

Figure 1 shows the CTD stations in the shallow area offshore Prins Karls Forland (PKF, ~100m depth) and in the so-called MASOX area (~200-400m depth), along with the location of the K-lander and the three different survey areas we focused on. Known flares are also indicated.

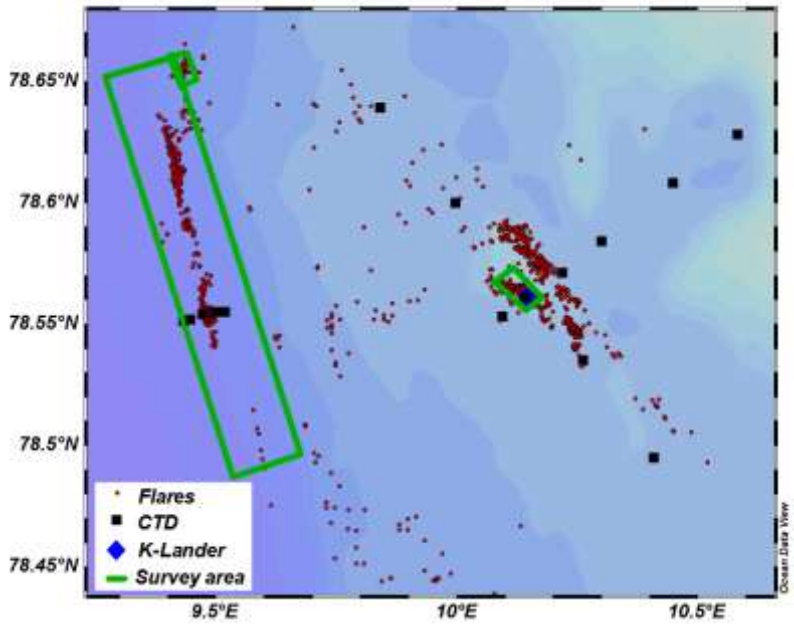

Figure 1. Maps of the areas with CTD stations (black squares) offshore Prins Karls Forland. Known flares locations are represented in red dots. The multibeam surveys were performed inside the green square, and the location of the observatory is shown as the blue diamond.

The first survey included the 1km^2 area close to Prins Karls Forland were OS2 was redeployed in October 2016 (blue diamond in Figure 1). Around this area, the depth is ~90 m on average and the seabed morphology is diverse with ridges and depressions distributed all over the shelf. We performed 14 multibeam lines in order to locate the exact position of the K-lander and the flares surrounding it (figure 1).

The second survey was performed around the area previously survey with the EK60 in May 2016. This time, only four lines were necessary to cover the same area. The third survey was performed in a limited area around the previously deployed OS1 in order to detect potential flare activity and pockmarks that could explain our results (figure 1).

4. METHODS AND PRELIMINARY RESULTS

➢ ECHOSOUNDER EK60 AND MULTIBEAM FOR FLARE OBSERVATION

Single beam echo sounders are common among all types of ships with the main purpose of detecting fish. Here, the Simrad EK60 scientific echosounder system was used at 18 KHz, 38 KHz and 120 KHz to identify active seeps. In a single beam echo sounder, the transducer projects a sound pulse through water in a controlled direction and the reflected wave is received. The depth is calculated from the travel time of the sound pulse. The multibeam was used with a 30° angle at a speed of 3kn during the small surveys (one and three), and with a 60° angle at a speed of 6kn for the larger area.

The echosounder was on during the entire cruise, and the multibeam was on during the specific surveys. The new data was used to identify active flares, expand the CAGE flares data set and compare with previous flares activity.

During the first survey, we manage to observe the lander on the sea floor, surrounded by flares (figure2).

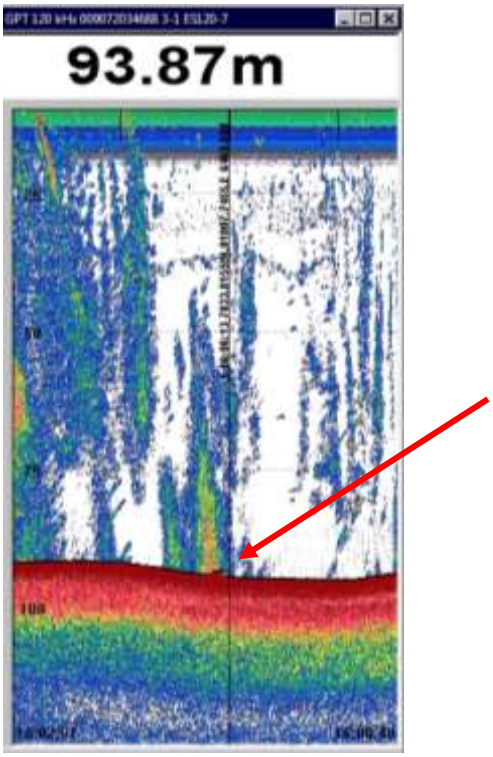

Figure2. Echousounder signal showing intense flare activity. Suspected lander location is marked

➢ ADCP

The ship is equipped with a traditional “Ocean Surveyor” Acoustic Doppler Current Profiler (ADCP) from Teledyne RD, operating at 75 kHz. The setup consists of an ADCP transducer / receiver mounted on the lowered keel, 7 meters below the sea surface, a deck unit, communicating with the device and a standard PC in the Instrument room. The ADCP provides current amplitude and direction, as well as backscatter information. The ADCP was off during multbeam surveys and turned back on during CTDs and transits.

➢ CTD

CTD (Conductivity, Temperature, Depth) sensors measure the physical properties of seawater. In addition to measuring the conductivity, temperature and pressure (from which depth is calculated), the CTD sensors can measure or calculate salinity of seawater, density, P-wave velocity, turbidity, fluorescence/chlorophyll, and oxygen content.

R/V Helmer Hanssen uses SBE 911plus CTD to produce vertical profiles of seawater properties. A winch is used to lower the CTD system into the water at 1 m/s. The CTD sensors record data at a rate of 24 samples per second.

A total of 12 × 5-liters Niskin bottles are attached to the CTD instrument set up to collect water samples from chosen depth. A single conductor cable supplies power to the system and transmits data from and to the CTD system in real time.

We collected CTD data and water sampling at 16 stations during the cruise and water samples from 8 discrete depths for methane concentration.

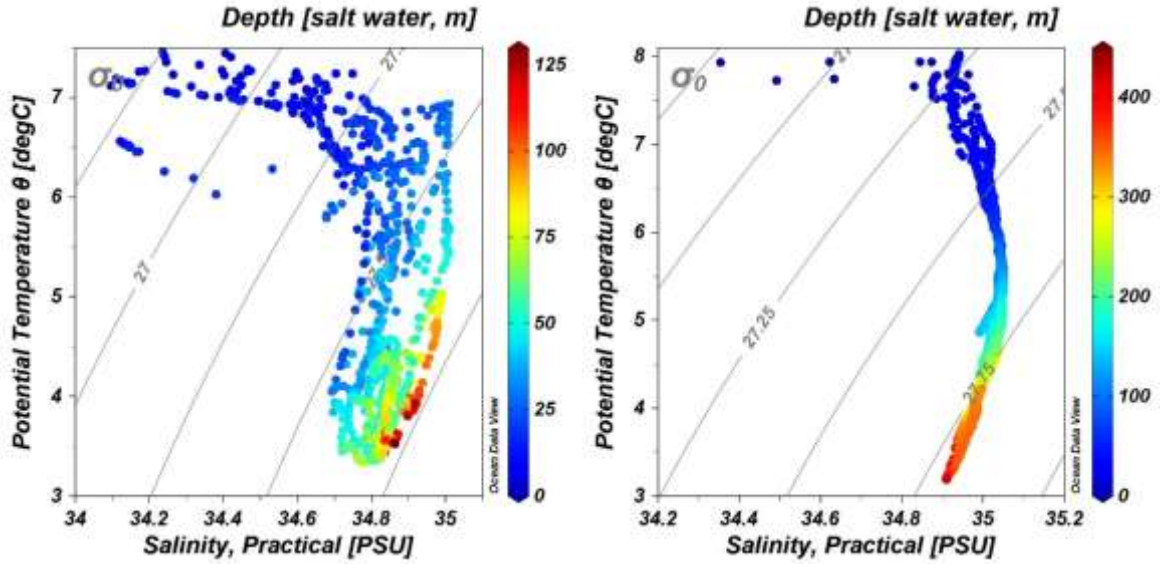

Figure 3. Temperature –Salinity diagram offshore Prins Karls Forland (left) and in the MASOX area (right), colored by the depth

Water masses are dominated by Atlantic water (~34.65 psu) offshore PKF with some Intermediate water at the surface, resulting in a mixing between Atlantic water and Arctic water along the shelf (Cottier et al. 2005) (Figure 3). Pure Atlantic water was found in the MASOX area. The water was stratified with a strong pycnocline around 30m in the shallow area and between 20 and 30m in the MASOX area.

➢ WATER SAMPLING FOR METHANE AT CTD LOCATION

To prepare water samples for measurements of methane concentrations we applied the conventional headspace gas extraction technique. Water samples were collected bubble free into 120 mL crimp seal bottles, and poisoned with 1 mL NaOH solution. We injected 5 ml of nitrogen through the rubber septa into with simultaneous removal of 5 mL of sample. By shaking the bottle for two minutes the headspace nitrogen equilibrated with the in situ water sample gas. Bottles were kept in the fridge (5 degrees C) until analysis back in Tromsø with the GC.

5. CRUISE NARRATIVE

Date	*Time (UTC)*	
03.08	00:10	Left Longyearbyen
	07:52	Start multibeam survey around the K-lander
	13:38	End of multibeam survey around the K-lander
	14:20	Beginning of CTD (number 1120)
	20:38	End of CTD (number 1130)
	22:22	Start multibeam survey around the MASOX area
04.08	06:17	End of multibeam survey including the smaller area
	07:00	Start CTD across the MASOX site
	09:34	End of CTD across the MASOX site
	09:50	Additional multibeam survey to the East of the previous large survey area
	11:10	End of line and head to lander site for recovery
	12:00	On the site, ready for safety briefing
	12:20	Call both c-nodes but it failed. Release button
	12:22	Visual of RRU (buoy)
	12:28	Dinghy by the RRU
	12:44	Lander rope connected to the winch
	12:45	RRU on deck
	12:57	Lander out of water
	13:06	Lander on deck
	13:30	Batteries disconnected
	14:00	Multibeam around the shallow and deeper sites to fill in the blank
05.08	00.00	Head back to Longyearbyen
		Anchor in Longyearbyen

ACKNOWLEDGEMENTS

We thank the engineers (Bjørn Runar Ølsen and Truls Holm), the captain and his crew of R/V Helmer Hanssen of the University of Tromsø for their excellent support before and during the oceanographic survey and the deployment of the landers. 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.

REFERENCE

Cottier F, Tverberg V, Inall M, Svendsen H, Nilsen F, Griffiths C (2005) Water mass modification in an Arctic fjord through cross-shelf exchange: The seasonal hydrography of Kongsfjorden, Svalbard Journal of Geophysical Research: Oceans 110

APPENDIX: STASJONSLAPPER

CruiseNr	Date (UTC)	Time (UTC)	Logg (nm)	Stasjonstype	StNr	Kommentar	Speed	Latitude	Longitude	Depth (m)	Water Temp (°C)	Wind Speed (m/s)	Humidity (%)	Wind dir (deg)	Sea	Weather	Clouds
03082017	03.08.2017	07:31:37	6548.79	CTD uten vann START	1118		0.2	7832.299165 N	01013.633027 E	125.26	7.2	2.39	88	325	1	2	2
03082017	03.08.2017	07:40:00	6548.80	CTD uten vann STOPP	1118		0.3	7832.290784 N	01013.622214 E	125.82	7.2	2.97	86	341	1	2	2
03082017	03.08.2017	08:33:56	6552.25	Multibeam survey START	1119		2.7	7833.702398 N	01008.071895 E	92.00	7.2	1.56	82	0	1	2	2
03082017	03.08.2017	13:42:03	6569.52	Multibeam survey STOPP	1119		4.4	7833.685060 N	01010.512406 E	81.17	7.3	3.30	78	334	1	2	2
03082017	03.08.2017	14:18:44	6574.49	CTD med vannhenter START	1120		0.2	7829.684275 N	01024.584808 E	106.75	7.6	3.20	75	322	1	2	2
03082017	03.08.2017	14:36:35	6574.51	CTD med vannhenter STOPP	1120		0.2	7829.687011 N	01024.815097 E	112.45	7.7	4.08	82	332	1	2	2
03082017	03.08.2017	15:08:21	6577.74	CTD med vannhenter START	1121		0.2	7832.110041 N	01015.668901 E	123.15	7.7	3.04	83	340	1	2	2
03082017	03.08.2017	15:17:19	6577.77	CTD med vannhenter STOPP	1121		0.3	7832.090288 N	01015.785185 E	119.23	7.5	4.48	84	311	1	2	2
03082017	03.08.2017	15:41:50	6580.29	CTD med vannhenter START	1122		0.4	7833.849467 N	01007.663754 E	94.91	7.6	3.37	83	313	1	2	2
03082017	03.08.2017	15:56:20	6580.43	CTD med vannhenter STOPP	1122		0.5	7833.767483 N	01007.940876 E	92.12	7.4	2.49	83	322	1	2	2
03082017	03.08.2017	16:30:43	6583.33	CTD med vannhenter START	1123		0.7	7835.970852 N	00959.793570 E	109.53	7.3	3.02	83	312	1	2	2
03082017	03.08.2017	16:40:57	6583.41	CTD med vannhenter STOPP	1123		3.1	7835.914050 N	00959.884402 E	110.61	7.3	2.55	83	351	1	2	2
03082017	03.08.2017	17:08:40	6586.71	CTD med vannhenter START	1124		0.3	7838.354797 N	00950.475042 E	128.62	7.4	1.86	84	293	1	2	2
03082017	03.08.2017	17:17:27	6586.78	CTD med vannhenter STOPP	1124		0.2	7838.312093 N	00950.525559 E	130.72	7.3	2.87	85	305	1	2	2
03082017	03.08.2017	18:13:24	6595.62	CTD med vannhenter START	1125		0.5	7837.637853 N	01034.305715 E	79.58	7.0	3.45	84	308	1	2	2
03082017	03.08.2017	18:23:29	6595.67	CTD med vannhenter STOPP	1125		0.3	7837.674535 N	01034.478008 E	79.11	7.0	3.99	85	311	1	2	2
03082017	03.08.2017	18:39:29	6597.57	CTD med vannhenter START	1126		0.8	7836.531864 N	01026.903070 E	118.84	7.1	4.17	87	301	1	2	2
03082017	03.08.2017	18:51:03	6597.65	CTD med vannhenter STOPP	1126		0.4	7836.539499 N	01027.055729 E	123.01	7.4	3.57	88	318	1	2	2
03082017	03.08.2017	19:09:28	6600.00	CTD med vannhenter START	1127		1.2	7835.053796 N	01017.987235 E	128.17	7.4	2.93	90	319	1	2	2
03082017	03.08.2017	19:22:17	6600.04	CTD med vannhenter STOPP	1127		0.4	7835.041832 N	01018.165836 E	128.51	7.3	2.70	89	310	1	2	2
03082017	03.08.2017	19:32:51	6601.39	CTD med vannhenter START	1128		1.3	7834.257272 N	01012.981931 E	142.11	7.3	2.90	90	306	1	2	2
03082017	03.08.2017	19:46:56	6601.45	CTD med vannhenter STOPP	1128		0.2	7834.238319 N	01013.172988 E	146.19	7.2	2.69	90	329	1	2	2
03082017	03.08.2017	19:58:02	6602.65	CTD med vannhenter START	1129		1.2	7833.667528 N	01008.582707 E	90.67	7.3	3.54	89	283	1	2	2
03082017	03.08.2017	20:11:47	6602.68	CTD med vannhenter STOPP	1129		0.2	7833.643082 N	01008.500526 E	90.93	7.1	3.73	90	269	1	2	2
03082017	03.08.2017	20:21:46	6603.53	CTD med vannhenter START	1130		2.4	7833.187837 N	01006.122473 E	111.77	7.4	2.41	90	262	1	2	2
03082017	03.08.2017	20:38:19	6603.70	CTD med vannhenter STOPP	1130		0.7	7833.245460 N	01005.651960 E	115.25	7.2	1.43	90	253	1	2	2
03082017	03.08.2017	21:47:25	6615.28	Multibeam survey START	1131		5.1	7838.905820 N	00916.899055 E	434.59	7.7	3.89	91	236	1	2	2
03082017	03.08.2017	21:51:29	6615.70	Multibeam survey STOPP	1131		3.2	7838.507406 N	00917.559607 E	443.68	7.7	1.87	91	202	1	2	2
03082017	03.08.2017	21:51:42	6615.72	CTD uten vann START	1132		2.3	7838.498978 N	00917.583210 E	444.32	7.7	2.59	91	198	1	2	2

03082017	03.08.2017	22:13:25	6615.77	CTD uten vann STOPP	1132		0.3	7838.534356 N	00917.513101 E	442.43	7.4	3.02	90	250	1	2	2
03082017	03.08.2017	22:21:55	6616.47	Multibeam survey START	1133		6.1	7838.838204 N	00917.072534 E	434.82	7.6	3.30	89	235	1	2	2
03082017	04.08.2017	06:17:30	6663.38	Multibeam survey STOPP	1133		2.6	7839.481940 N	00924.453349 E	263.48	7.4	3.54	89	155	1	2	2
03082017	04.08.2017	06:59:17	6669.86	CTD med vannhenter START	1134		2.3	7833.370964 N	00931.047641 E	364.15	7.6	3.01	88	213	1	2	7
03082017	04.08.2017	07:19:54	6670.06	CTD med vannhenter STOPP	1134		0.8	7833.399656 N	00931.586186 E	356.56	8.2	4.51	88	188	1	2	7
03082017	04.08.2017	07:32:15	6670.66	CTD med vannhenter START	1135		1.1	7833.326868 N	00929.845137 E	384.67	8.1	4.85	88	214	1	2	7
03082017	04.08.2017	07:53:37	6670.85	CTD med vannhenter STOPP	1135		0.7	7833.397336 N	00930.416490 E	376.85	8.1	4.14	89	202	1	2	7
03082017	04.08.2017	08:05:01	6671.47	CTD med vannhenter START	1136		1.0	7833.234446 N	00928.415595 E	393.23	8.0	4.26	89	182	1	2	7
03082017	04.08.2017	08:25:15	6671.66	CTD med vannhenter STOPP	1136		0.5	7833.242548 N	00929.125886 E	391.40	7.9	4.59	88	196	1	2	7
03082017	04.08.2017	08:38:33	6672.19	CTD med vannhenter START	1137		0.3	7833.153535 N	00926.835851 E	403.19	8.0	4.14	88	194	1	2	7
03082017	04.08.2017	08:56:42	6672.36	CTD med vannhenter STOPP	1137		0.5	7833.238752 N	00927.385265 E	403.99	8.2	5.14	89	235	1	2	7
03082017	04.08.2017	09:11:59	6672.82	CTD med vannhenter START	1138		0.6	7833.087170 N	00925.577295 E	425.46	8.1	3.09	87	211	1	2	7
03082017	04.08.2017	09:33:51	6673.01	CTD med vannhenter STOPP	1138		0.7	7833.096750 N	00926.390740 E	407.31	8.1	5.01	89	212	1	2	7
03082017	04.08.2017	09:50:03	6674.14	Multibeam survey START	1139		3.5	7832.895140 N	00922.929032 E	443.66	8.1	4.74	87	188	1	2	7
03082017	04.08.2017	11:09:59	6681.11	Multibeam survey STOPP	1139		9.9	7829.910724 N	00943.505501 E	196.54	7.7	4.51	87	182	1	2	7
03082017	04.08.2017	12:15:07	6687.61	Annen stasjon	1140	Lander recovery	0.2	7833.787019 N	01007.598368 E	93.53	7.4	3.64	85	196	1	2	7
03082017	04.08.2017	14:22:03	6693.99	Multibeam survey START	1141		5.5	7834.019519 N	01006.001110 E	86.52	7.3	2.23	85	182	1	2	7
03082017	05.08.2017	02:37:09	6791.23	Multibeam survey STOPP	1141		10.3	7808.907069 N	01231.868763 E	267.94	6.9	3.20	90	190	1	2	7