CRUISE REPORT:

Arctic Marine Geology and Geophysics cruise to the northern Svalbard Margin and the Yermak Plateau, R/V Helmer Hanssen, July 23rd-August 1st, 2019

GEO-3144/8144 Marine geology and geophysics cruise

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1. Summary

From the evening of July 23rd to the morning of August 1st, the Department of Geosciences at UiT The Arctic University of Norway, arranged an educational cruise to the northern Svalbard Margin/Yermak Plateau (Figure 1) for the courses GEO-3144 and GEO-8144 (Marine geology and geophysics cruise). The main aim of the cruise was to introduce the students to work at sea, which included acquisition of marine geological data (acoustic data and sediment cores) and lab analyses of split gravity cores. The students worked 12-hour shifts during the cruise.

The prioritized study area for the cruise was the NW Svalbard continental margin, i.e., the Woodfjorden Trough, its associated trough mouth fan (TMF), and the southern part of the Yermak Plateau (Figure 1). This margin is of particular interest, as it is located in an area where the West Spitsbergen Current splits into two branches, one branching northwards following the topography of the Yermak Plateau, and the other turning eastwards, following the northern Svalbard continental slope. Furthermore, the morphology of the continental shelf clearly shows a seaward bulging fan in this area, resulting from glacial progradation of the northern Svalbard margin, initiated sometime during the Neogene. The onset of this TMF and thus the onset of large-scale glaciations in this area is poorly known, therefore tying this TMF to the already established chronology of the Yermak Plateau to the north is one of our priorities.

The scientific aims of the cruise were to:

1) Constrain the age of the glacial TMF north of Svalbard
2) Study the Neogene to present variability of ocean currents, and the interplay between ocean current deposition/erosion and glacigenic input to the slope
3) Reconstruct the dynamics of the Svalbard Ice Sheet during the Last Glacial Maximum and the final deglaciation
4) Constrain the chronology of deglacial events by recovering material for 14C-dating on the shelf

During the cruise the students were introduced to:

- Measurements of the physical properties of the water column in the study areas
- Mapping of the seafloor and sub-surface, for studying modern and past sedimentary processes and environments, and use these data to identify coring sites
- Collection of sediment cores, for studying modern and past sedimentary processes, as well as oceanographic and climatic changes
- Introduction to lab work with logging of sediment cores, including visual description and measurement of physical measurements

In total, we did nine CTD measurements, six box cores (five failed; push core samples from one) and eight gravity cores (one failed) (Tables 1-3). All students took part in the operations. In addition to this we acquired swath-bathymetry data, penetration echo sounder (CHIRP) profiles, and airgun seismic data in the study area (Figure 2 and Table 4).

The weather conditions were very good during almost the entire cruise, with winds less than 2-3 m/s and waves around less than 0.5 m. We had wind up to 18 m/s on the 29th of July, which resulted in some waves, but the conditions improved during the night shift.

Preliminary results:

- The acoustic data substantially increased the data coverage in Woodfjorden Trough. Several trough-transverse wedges and ridges are identified. These are interpreted to represent grounding zone wedges and moraines, most likely formed during the last deglaciation.

- We successfully acquired four 2D-seismic profiles from the shelf and upper slope. Sea ice conditions did not permit 2D-seismic data acquisition on the Yermak Plateau (we did not reach the ODP

borehole sites; Figure 1).

- The students analysed two gravity cores onboard: IG19-3-AMGG-HH-831-GC and IG19-3-AMGG-HH-815-GC. The analyses included visual description of the cores and x-rays, as well as measurements and analysis of shear strength and magnetic susceptibility.

- The students wrote cruise reports for the GEO-3144 and GEO-8144 courses. They here described the purpose of the cruise, study area, data acquisition methods/lab analyses and operations. The also presented preliminary analysis of marine geological data: multibeam bathymetry, CHIRP seismic and gravity cores. The students reconstructed the paleoenvironment in the Woodfjorden Trough and made suggestions for further work in the area.

- The acquired cores and acoustic data will be used in future courses at UiT. The data may also be analysed in master thesis projects.

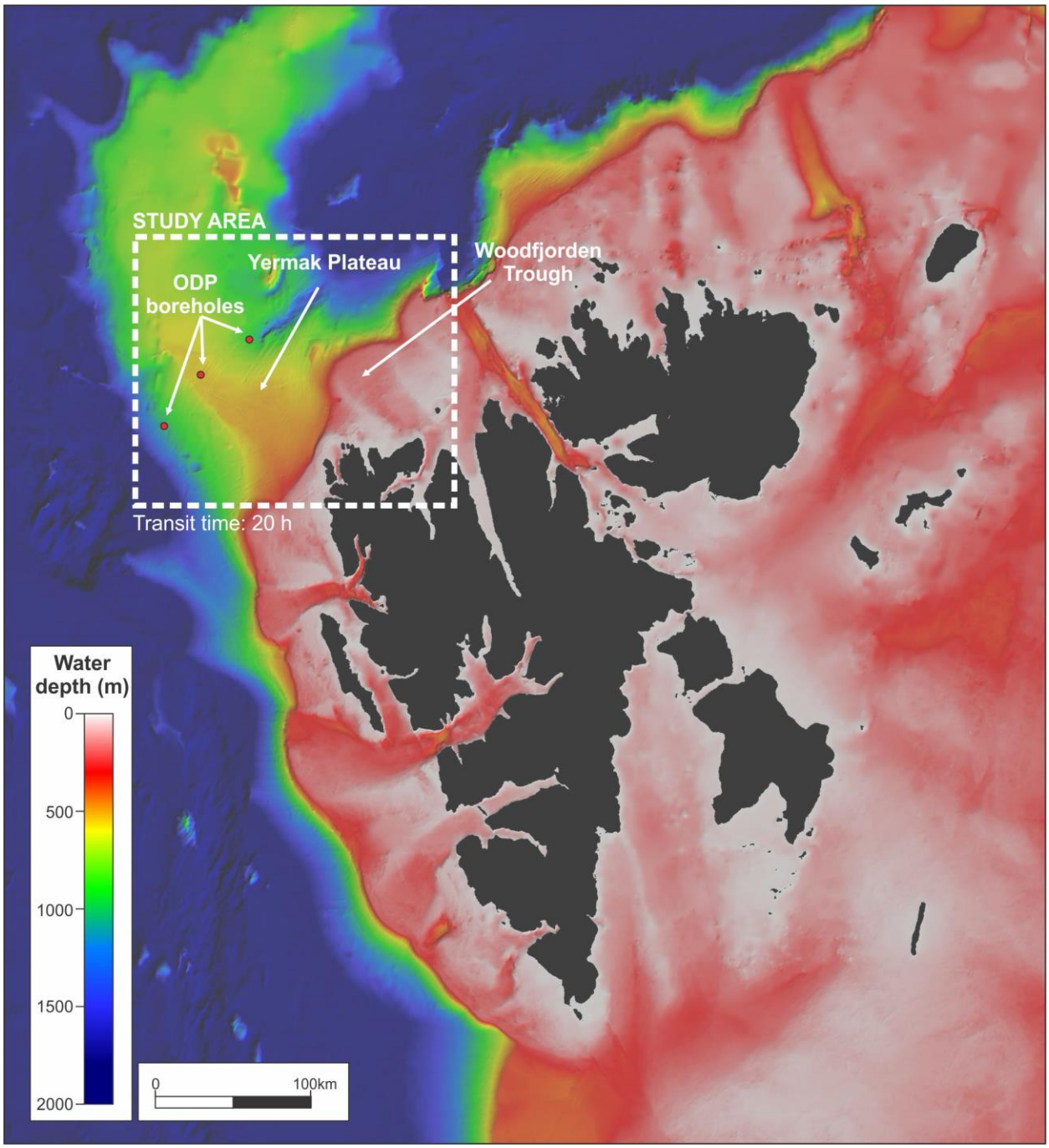

Figure 1: Overview map showing the location of the Woodfjorden Trough and the Yermak Plateau.

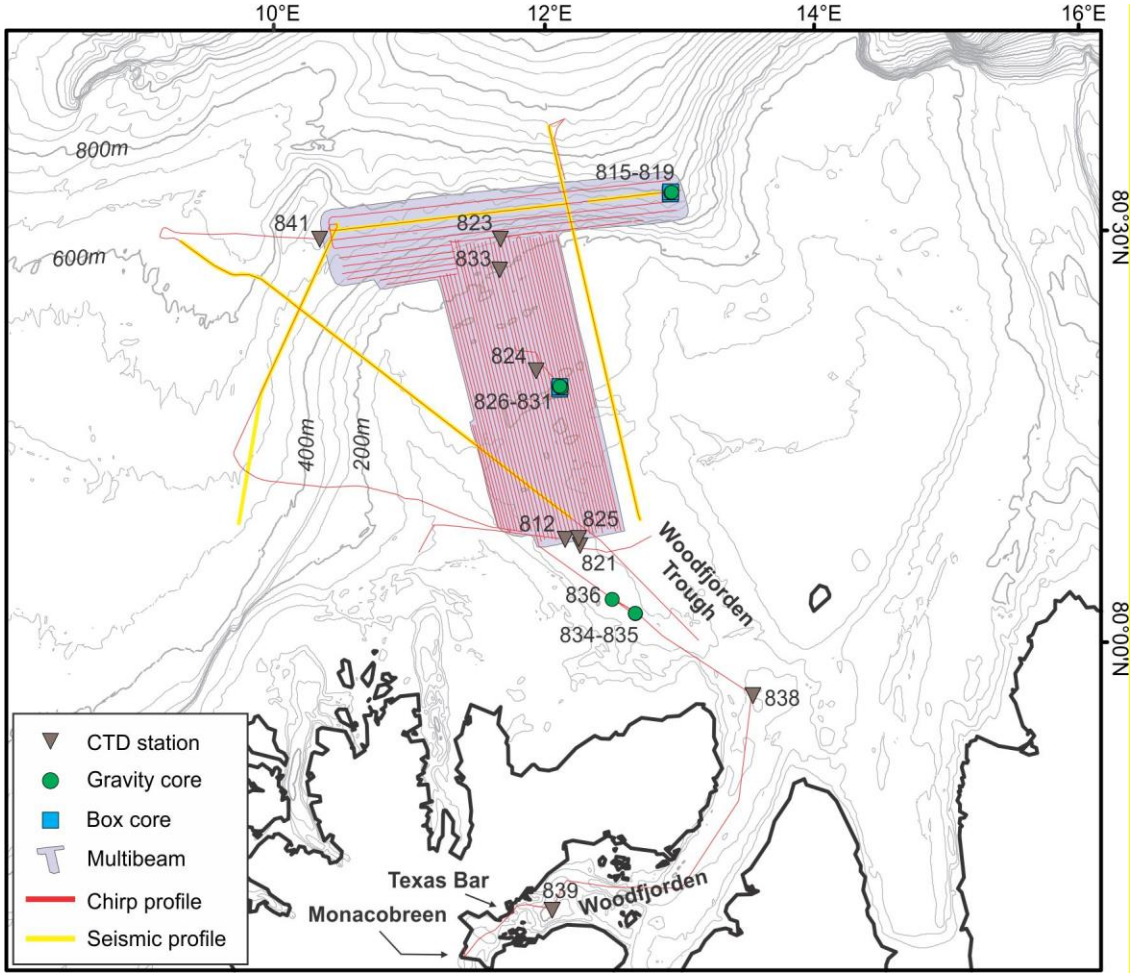

Figure 2: Data acquired during the cruise.

2. Equipment and methods

Acoustic investigations

Seafloor mapping: Swath bathymetry data were collected with a *Kongsberg Maritime EM 302 multibeam echo sounder*. Sound-velocity profiles of the water column for calibrating the equipment were recorded from CTD casts. The system consists of 432 beams which is sent out at an angle of 60˚ to each side (120˚ in total). With this system we can normally map three times the water depth. The operating frequency for the EM302 is 30 kHz. The equipment worked well during the acquisition and the data are of good quality. Surfaces of 5x5 m resolution were gridded from the collected data.

CHIRP seismic: High-resolution seismic profiles (CHIRP), using an *EdgeTech 3300-HM* hull-mounted sub-bottom profiler, were collected along the ship tracks during transits between coring stations and working areas. The CHIRP system uses a swept frequency from 1.5 to 9 kHz, usually allowing penetration of around 50 m of sediments. The equipment worked well during the acquisition and the data are of good quality, except for some profiles along the upper part of the slop; the data was lost here.

Airgun seismic: An airgun with a volume of 90 in3 was used. The equipment worked well, but the navigation (Seatrack) of the first seismic profile stopped working shortly after data acquisition started. The navigation from the cruise logger was therefore used for processing, which gives a margin of error for this profile.

Sediment sampling

The gravity core consists of a steel barrel with an inner plastic liner that has an outer diameter of 11 cm (inner diameter: 10 cm). After retrieval, the plastic liner was cut into sections of up to 100 cm length (some were a few cm longer). The sections were then covered with plastic caps, taped, labelled, and stored stored at +4ºC.

The box corer is a 50x50x50 cm box mounted within an outer framework. After retrieval, push cores were collected from the box sample.

Water properties

The water properties (temperature, and salinity) were measured on the slope, in the inner, middle, and outer Woodfjorden Trough, and in the inner part of Woodfjorden. This was done using a *Seabird 911 Plus* CTD. Data collection was performed during down- and up-casts at a speed of approx. 1.0 m/s. The data of selected CTD stations was used to identify water masses and to calculate sound-velocity profiles for calibrating the multibeam echo sounder system.

3. Participants

Scientific staff

Tom Arne Rydningen (associate professor, chief scientist)	UiT
Amando Lasabuda (researcher; co-chief scientist)	UiT
Rowan Romeyn (teaching assistant)	UiT
Bjørn Runar Olsen (engineer)	UiT
Truls Holm (engineer)	UiT

Students

Emma Marie Bender
Eleonora Fossile
Christine Tømmervik Kollsgård
Kevin Zoller
Marthe Marie Mathisen
Stine Bjordal Olsen
Øyvind Flataker Lien

4. Journal

The line log of CHIRP and swath-bathymetry data collection is found in Table 4. The journal below focuses on CTDs, sediment sampling stations, CHIRP seismic lines, and 2D-seismic profiles. All times are in UTC.

Protocol of July 23rd
~1745: Embarkation of the vessel at Gammelkaia in Longyearbyen (7 students).
1755: Safety brief with the first mate.
1830: General introduction by cruise leader.
1900: Evening meal. No more official program for the rest of the day.
2005: Departure for Woodfjorden Trough. Departure was delayed for five minutes due to missing software Dongles (Rowan had to retrieve them at Mary-Ann's Polarrigg). Weather conditions: overcast/sun, around 8˚C, calm sea.

Protocol of July 24th
1107: Start of multibeam and CHIRP survey. CHIRP line IG19-3_AMGG-HH000; steaming towards middle part of Woodfjorden Trough.
1221: CTD station HH19-812-CTDstart; 195 m water depth; Calibration of acoustic systems.
1231: CTD station HH19-812-CTDstop; 194 m water depth.
1242: CHIRP line IG19-3_AMGG-HH001 and multibeam survey towards the shelf break along the deepest part of the Woodfjorden Trough. Sea ice observed in the horizon; planned seismic profile across ODP site 911 had to be postponed.
1450: CHIRP line IG19-3_AMGG-HH.002 and multibeam survey parallel to previous line. Looking for coring sites; three sediment pockets observed (~2 meters of sediment). Decision was made to acquire a seismic profile along the 500 m-contour of the TMF.
1717: Transit to start of seismic profile. CHIRP line IG19-3_AMGG-HH003 and multibeam acquired along the way.

1950: Start seismic profile IG19-3_AMGG-HH-000-2D; direction north-northeast. Profile along the strike of the Woodfjorden Trough Mouth Fan. Seatrack stopped working at 2027; navigation from cruise logger ("toktlogger")/CHIRP is used for processing. Seatracker logged from 2130, even though screen is black.
2020: CHIRP line IG19-3_AMGG-HH004 along the 500 m-contour of the TMF.

Protocol of July 25th

----: The ship had to make a turn before continuing seismic acquisition. CHIRP line IG19-3_AMGG-HH.005 acquired during turn.
0047: Start seismic profile IG19-3_AMGG-HH-001-2D. Continued profile along the strike of the Woodfjorden Trough Mouth Fan; direction eastwards. Gun stopped working at 7940; it started up again shortly after.
0047: CHIRP line IG19-3_AMGG-HH.006. Continued profile along the 500 m-contour of the TMF.
0524: CHIRP line IG19-3_AMGG-HH.007; new file was created as the file size exceeded 500 MB. Continued profile along the 500 m-contour of the TMF. Crossing over stratified sediments with lense-shaped accumulations below; decided to acquire gravity and box cores here (coring stations 815 to 819).
0720: Gravity core station IG19-3_AMGG-HH-815-GC; Woodfjorden Trough Mouth Fan; 580 m water depth; 305 cm.
0920; Gravity core station IG19-3_AMGG-HH-816-GC; Woodfjorden Trough Mouth Fan; 579 m water depth; 332 cm.
1057: Box core station IG19-3_AMGG-HH-817-BC; Woodfjorden Trough Mouth Fan; 585 m water depth. Box core was only half-full; new try.
1143: Box core station IG19-3_AMGG-HH-818-BC; Woodfjorden Trough Mouth Fan; 582 m water depth. Box core was empty; most likely the box corer did not hit the seabed.
1209: Box core station IG19-3_AMGG-HH-819-BC; Woodfjorden Trough Mouth Fan; 580 m water depth. Two push cores collected: 19 and 16 cm.
---: CHIRP line IG19-3_AMGG-HH-100 along the 500 m-contour of the TMF; CHIRP name changed for some reason. Almost no data recorded on this line, possibly due to wrong record window (?). Transit to start of seismic profile IG19-3_AMGG-HH-002-2D.
1430: Start seismic profile IG19-3_AMGG-HH-002-2D; from the slope (~900 m water depth) to the middle part of the Woodfjorden Trough. Some hydrophone trouble near the end of the line; this did not affect the data quality.
1437: CHIRP line IG19-3_AMGG-HH-101; parallel to IG19-3_AMGG-HH-002-2D. Data was not recorded some places; possibly due to wrong record window (?).
2155: CHIRP line IG19-3_AMGG-HH-102. Transit to multibeam survey area.
2320: CHIRP line IG19-3_AMGG-HH-103. Start multibeam survey.

Protocol of July 26th

0138: CTD station HH19-823-CTDstart; 252 m water depth; calibration of acoustic systems; outer Woodfjorden Trough.
0151: CTD station HH19-823-CTDstop; 256 m water depth; calibration of acoustic systems.
0201: CHIRP line IG19-3_AMGG-HH-104. Multibeam survey Woodfjorden Trough.
0302: CTD station HH19-824-CTDstart; 186 m water depth; calibration of acoustic systems; middle Woodfjorden Trough
0311: CTD station HH19-824-CTDstart; 187 m water depth; calibration of acoustic systems.
0319: CHIRP line IG19-3_AMGG-HH-105. Multibeam survey Woodfjorden Trough.
0502: CHIRP line IG19-3_AMGG-HH-106. Multibeam survey.
0723: CHIRP line IG19-3_AMGG-HH-107. Multibeam survey.
0938: CHIRP line IG19-3_AMGG-HH-108. Multibeam survey.
1158: CHIRP line IG19-3_AMGG-HH-109. Multibeam survey.
1414: CHIRP line IG19-3_AMGG-HH-110. Multibeam survey.
1635: CHIRP line IG19-3_AMGG-HH-111. Multibeam survey.
1851: CHIRP line IG19-3_AMGG-HH-112. Multibeam survey.
2107: CHIRP line IG19-3_AMGG-HH-113. Multibeam survey.
2323: CHIRP line IG19-3_AMGG-HH-114. Multibeam survey.

Protocol of July 27th

0140: CHIRP line IG19-3_AMGG-HH-115. Multibeam survey.
0355: CHIRP line IG19-3_AMGG-HH-116. Multibeam survey.
0609: CHIRP line IG19-3_AMGG-HH-117/118. Transit to coring site; filling data gaps on the way. Line 117 is short.
0834: Box core station IG19-3_AMGG-HH-826-BC; Woodfjorden Trough; 209 m water depth. Box core was only half-full; the CHIRP indicated a hard seabed; moved to another location close by which looked more promising.
0900: Box core station IG19-3_AMGG-HH-827-BC; Woodfjorden Trough; 215 m water depth. Box core was only half-full; new try.
0925: Box core station IG19-3_AMGG-HH-828-BC; Woodfjorden Trough; 215 m water depth. Box core was only half-full; no push core samples. Light green calcareous clay with stones; stones are put in bags and labelled; sea cucumbers and snails.
0936: Gravity core station IG19-3_AMGG-HH-829-GC; Woodfjorden Trough; 215 m water depth; 203 cm.
1036: Gravity core station IG19-3_AMGG-HH-830-GC; Woodfjorden Trough; 219 m water depth; 61 cm; new try.
1116: Gravity core station IG19-3_AMGG-HH-831-GC; Woodfjorden Trough; 215 m water depth; 173 cm; opened and logged onboard by students.
1218: CHIRP line IG19-3_AMGG-HH-119. Multibeam survey.
1419: Filling data gaps in multibeam survey. 100-degree swath. No CHIRP data recorded.
1632: CHIRP line IG19-3_AMGG-HH-120. Multibeam survey.
1857: CHIRP line IG19-3_AMGG-HH-121. Short line to fill data gap in the northern part of the multibeam survey.
1912: CTD station HH19-833-CTDstart; 196 m water depth; calibration of acoustic systems; outer Woodfjorden Trough.
1923: CTD station HH19-833-CTDstop; 199 m water depth; calibration of acoustic systems.
1924: CHIRP line IG19-3_AMGG-HH-122. Multibeam survey.
1956: CHIRP line IG19-3_AMGG-HH-123. Multibeam survey.
2218: CHIRP line IG19-3_AMGG-HH-124. Multibeam survey.

Protocol of July 28th

0041: CHIRP line IG19-3_AMGG-HH-125. Multibeam survey.
0302: CHIRP line IG19-3_AMGG-HH-126. Multibeam survey.
0525: CHIRP line IG19-3_AMGG-HH-127. Multibeam survey.
0742: CHIRP line IG19-3_AMGG-HH-128. Leaving multibeam survey area; searching for coring sites in the inner parts of the Woodfjorden Trough.
0846: CHIRP line IG19-3_AMGG-HH-129. Recording on coring site.
0856: Gravity core station IG19-3_AMGG-HH-834-GC; inner Woodfjorden Trough; 187 m water depth; 68 cm.
0941: Gravity core station IG19-3_AMGG-HH-835-GC; inner Woodfjorden Trough; 187 m water depth; the core was short (~50 cm), and the liner was half empty; the core was discarded. Moved to a coring station a few kilometres to the northwest.
1027: Gravity core station IG19-3_AMGG-HH-836-GC; inner Woodfjorden Trough; 192 m water depth; 71 cm.
1055: CHIRP line IG19-3_AMGG-HH-130/131. Transit to Monaco Glacier in inner Woodfjorden for inspection of modern analogue.
1203: CTD station HH19-838-CTDstart; 157 m water depth; calibration of acoustic systems; outer Woodfjorden.
1212: CTD station HH19-838-CTDstop; 155 m water depth; calibration of acoustic systems.
1500: CTD station HH19-839-CTDstart; 200 m water depth; calibration of acoustic systems; inner Woodfjorden.
1510: CTD station HH19-839-CTDstart; 200 m water depth; calibration of acoustic systems.
1745: Visit to Texas Bar (on land); 12 participants from UiT and two from the crowd. All back on the ship at 2045.

2033: CHIRP line IG19-3_AMGG-HH-132. Transit line out through Woodfjorden Trough to start of seismic profile. Very little data is recorded on this line.

Protocol of July 29th

0016: CHIRP lines IG19-3_AMGG-HH-133. Transit line from inner to middle Woodfjorden Trough toward start of seismic line.
0215: Start seismic profile IG19-3_AMGG-HH-003-2D and CHIRP lines IG19-3_AMGG-HH-134; from the middle part of Woodfjorden Trough towards ODP site. Some channel problem during the start, but this was figured out. Had to make a turn to avoid sea ice drifts near the end of the line; line had to be terminated due to sea ice.
1055: CHIRP lines IG19-3_AMGG-HH-135. Transit to multibeam survey on the upper slope.
1250: CTD station HH19-841-CTDstart; 563 m water depth; calibration of acoustic system; upper slope.
1259: CTD station HH19-841-CTDstop; 571 m water depth; calibration of acoustic systems.
1303: CHIRP lines IG19-3_AMGG-HH-136. Multibeam survey upper slope.
1545: CHIRP lines IG19-3_AMGG-HH-137.
1850: CHIRP lines IG19-3_AMGG-HH-138. Multibeam survey upper slope; EK60 crashed shortly after start of line; this part of the line was not mapped.
2100: Wind speed around 15 m/s; starting to get some waves.
2135: CHIRP lines IG19-3_AMGG-HH-139. Some data lost at the start of the line; the sonar control depth was wrong.
2301: CHIRP lines IG19-3_AMGG-HH-140. Decision on doing multibeam mapping in the Woodfjorden Trough due to weather; data acquisition conditions are better when sailing in north-south direction.
0000: Weather starts calming down.

Protocol of July 30th

0155: CHIRP lines IG19-3_AMGG-HH-141.
0422: CHIRP lines IG19-3_AMGG-HH-142.
0751: CHIRP lines IG19-3_AMGG-HH-143. The CHIRP was recording following the turn; it was started about 15 km after the start of multibeam mapping.
0918: CHIRP lines IG19-3_AMGG-HH-144. Filling data gaps on the upper slope.
1019: CHIRP lines IG19-3_AMGG-HH-145. Multibeam survey Woodfjorden Trough. The CHIRP line and multibeam line 345 was started a bit late; parts of multibeam line 344 should be used for gridding of the seabed.
1235: CHIRP lines IG19-3_AMGG-HH-146.
1454: CHIRP lines IG19-3_AMGG-HH-147.
1716: CHIRP lines IG19-3_AMGG-HH-148.
1935: CHIRP lines IG19-3_AMGG-HH-149.
2038: CHIRP lines IG19-3_AMGG-HH-150.
2135: CHIRP lines IG19-3_AMGG-HH-151.
2238: CHIRP lines IG19-3_AMGG-HH-152.
2329: CHIRP lines IG19-3_AMGG-HH-153.

Protocol of July 31st

0016: CHIRP lines IG19-3_AMGG-HH-154.
0055: CHIRP lines IG19-3_AMGG-HH-155.
0257: CHIRP lines IG19-3_AMGG-HH-156.
0459: CHIRP lines IG19-3_AMGG-HH-157.
0707: CHIRP lines IG19-3_AMGG-HH-158.
~0900: CHIRP lines IG19-3_AMGG-HH-159.
~1100: CHIRP lines IG19-3_AMGG-HH-160.
~1200: CHIRP lines IG19-3_AMGG-HH-161.
~1300: End of survey. Start transit to Longyearbyen.

5. Tables of collected data

Table 1: Conductivity-temperature-depth (CTD) stations.

Station	Date	Time (UTC)	Location	Latitude [N] Longitude [E]	Water depth [m]	Comments
HH19-812-CTDstart	24.07.2019	1221	Middle Woodfjorden Trough	8003.189533 N 1241.650803 E	195	Calibration of acoustic systems and demonstration for students.
HH19-812-CTDstop	24.07.2019	12.31	Middle Woodfjorden Trough	8003.169726 N 1241.373124 E	194	-
HH19-821-CTDstart	25.07.2019	2256	Middle Woodfjorden Trough	8002.881366 N 1248.216450 E	180	-
HH19-821-CTDstop	25.07.2019	2306	Middle Woodfjorden Trough	8002.884011 N 1248.353231 E	182	-
HH19-823-CTDstart	26.07.2019	0138	Outer Woodfjorden Trough	8024.157328 N 1154.867727 E	252	-
HH19-823-CTDstop	26.07.2019	0151	Outer Woodfjorden Trough	8024.160915 N 1154.498394 E	256	-
HH19-824-CTDstart	26.07.2019	0302	Middle Woodfjorden Trough	8015.045091 N 1218.950602 E	186	-
HH19-824-CTDstop	26.07.2019	0311	Middle Woodfjorden Trough	8015.043881 N 1218.745661 E	187	-
HH19-825-CTDstart	26.07.2019	0443	Inner Woodfjorden Trough	8003.390673 N 1247.163100 E	192	-
HH19-825-CTDstop	26.07.2019	0455	Inner Woodfjorden Trough	8003.337088 N 1246.629663 E	190	-
HH19-833-CTDstart	27.07.2019	1912	Outer Woodfjorden Trough	8021.931350 N 1156.599937 E	196	-
HH19-833-CTDstop	27.07.2019	1923	Outer Woodfjorden Trough	8021.917967 N 1156.022867 E	199	-
HH19-838-CTDstart	28.07.2019	1203	Outer Woodfjorden	7953.672248 N 1408.306187 E	157	-
HH19-838-CTDstop	28.07.2019	1212	Outer Woodfjorden	7953.635247 N 1407.925906 E	155	-
HH19-839-CTDstart	28.07.2019	1500	Inner Woodfjorden	7936.240557 N 1257.710311 E	200	-
HH19-839-CTDstop	28.07.2019	1510	Inner Woodfjorden	7936.285158 N 1257.850809 E	200	-
HH19-841-CTDstart	29.07.2019	1227	Woodfjorden Trough Mouth Fan	8021.955788 N 1036.889835 E	563	-
HH19-841-CTDstop	29.07.2019	1250	Woodfjorden Trough Mouth Fan	8022.264345 N 1037.796304 E	571	-

Table 2: Box-core stations.

Station	Date	Time (UTC)	Location	Latitude [N] Longitude [E]	Water depth [m]	Comments
IG19-3-AMGG-HH-817-BC	25.07.2019	1057	Woodfjorden Trough Mouth Fan	8029.389278 N 1305.859468 E	585	Box core was half-empty. New try.
IG19-3-AMGG-HH-818-BC	25.07.2019	1143	Woodfjorden Trough Mouth Fan	8029.334657 N 1306.034142 E	582	Empty. Box core most likely did not hit the seabed.
IG19-3-AMGG-HH-819-BC	25.07.2019	1209	Woodfjorden Trough Mouth Fan	8029.223679 N 1305.944137 E	580	Two push core samples recovered; IG19-3-AMGG-HH-819-BCA=19 cm, IG19-3-AMGG-HH-819-BCB=16 cm.
IG19-3-AMGG-HH-826-BC	27.07.2019	0834	Woodfjorden Trough	8013.966465 N 1229.990280 E	209	Box core was only half-full; no push core samples; new try.
IG19-3-AMGG-HH-827-BC	27.07.2019	0900	Woodfjorden Trough	8014.170378 N 1230.047861 E	215	Box core was only half-full; no push core samples; new try.
IG19-3-AMGG-HH-828-BC	27.07.2019	0925	Woodfjorden Trough	8014.168594 N 1229.862130 E	215	Box core was only half-full; no push core samples. Light green calcareous clay with stones; stones are put in bags and labelled; sea cucumber.

Table 3: Gravity-core stations.

Station	Date	Time (UTC)	Location	Latitude [N] Longitude [E]	Water depth [m]	Storage	Recovery [cm]	Comments
IG19-3-AMGG-HH-815-GC	25.07.2019	0720	Woodfjorden Trough Mouth Fan	8029.339685 N 1306.503593 E	580	Opened (logged by students)	305	Top: dark green sandy clay. Base: dark green clay with some grains. Split in three sections: 0-100, 100-200, 200-305 cm. Shear strength measurements: 100 cm=2.5, 200 cm=2.6. Logged by students onboard.
IG19-3-AMGG-HH-816-GC	25.07.2019	0920	Woodfjorden Trough Mouth Fan	8029.295399 N 1306.347461 E	579	Stored	322	Top: dark grey/green clay. Base: dark gray/green clay with some grains. Core catcher was pushed in at the base of the core. Split in four sections: 0-100, 100-200, 200-280, 280-332. Shear strength measurements: 100cm=1,5, 200 cm=3.5 and 1.5 (human error?), 280cm=2.5.
IG19-3-AMGG-HH-829-GC	27.07.2019	0936	Woodfjorden Trough	8014.175762 N 1230.119323 E	215	Stored	203	Top: dark grey/green silty clay. Base: dark grey mud with some clasts (sand?). Shear strength measurements: 100cm=1.5 and 1.0.
IG19-3-AMGG-HH-830-GC	27.07.2019	1036	Woodfjorden Trough	8014.097476 N 1230.873356 E	219	Stored	61	-
IG19-3-AMGG-HH-831-GC	27.07.2019	1116	Woodfjorden Trough	8014.097476 N 1230.173042 E	215	Opened (logged by students)	173	Top: dark olive brown/greyish silt. High water content. Base: dark brown/reddish and very sticky mud with clasts. Broken shells. Shear strength measurements: 100cm=1.5 and 1.0. Logged by students onboard.
IG19-3-AMGG-HH-834-GC	27.07.2019	0856	Woodfjorden Trough	7958.514717 N 1315.323317 E	187	Stored	68	Top: green to grey mud. Base: brown-reddish sticky mud with clasts.
IG19-3-AMGG-HH-835-GC	27.07.2019	0941	Woodfjorden Trough	7958.494470 N 1315.507851 E	187	-	0	The core was short (~50 cm), and the liner was half empty; the core was discarded.
IG19-3-AMGG-HH-836-GC	27.07.2019	1027	Woodfjorden Trough	7959.319973 N 1304.832511 E	192	Stored	71	Top: greenish, gravelly mud with big clasts. High water content. Base: reddish/brownish sandy mud with clasts.

Table 4: Acoustic line logs.

Site/Area	Activity	Line Id	Date (UTC)	Start Time (UTC)	Latitude (start)	Longitude (start)	End Time (UTC)	Latitude (end)	Longitude (end)	Pulse Mode	Shot Rate (s)	Speed (kn)	Notes
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.000	24.07.2019	1107	80 00.75	11 41.60	1220	80 03.188	12 41.650	2-8 kHZ	1	10	MB lines 0-3.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.001	24.07.2019	1242	80 03.128	12 41.125	1444	80 21.791	11 57.172	2-8 kHZ	1	10	MBB lines 4-10.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.002	24.07.2019	1450	80 21.81	11 58.69	1649	80 03.369	12 42.555	2-8 kHZ	1	10	MBB lines 10-13.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.003	24.07.2019	1717	80 03.284	12 22.623	2020	80 05.689	10 17.368	2-8 kHZ	1	10	MBB lines 14-21.
Woodfjorden TMF	Airgun Seismic	IG19-3_AMGG-HH-000-2D (Line 1 in Petrel project)	24.07.2019	1950	~80 05	~10 17	0028	80 22.945	10 43.265		4	4-5	MBB lines 22-29. Seatrack stopped working at 2027. Navigation from cruise logger("toktlogger")/CHIRP used for processing. Injector delay=19. Seatrack appears to log w/black screen from approx 21:30; coordinates to be confirmed.
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.004	24.07.2019	2020	80 05.689	10 17.368	0028	80 22.945	10 43.265	2-8 kHZ	1	4-5	
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.005	25.07.2019	-	-	-	-	-	-	2-8 kHZ	1	-	Turn for seismic profile IG19-3_AMGG-HH-001-2D.
Woodfjorden TMF	Airgun Seismic	IG19-3_AMGG-HH-001-2D (Line 2 in Petrel project)	25.07.2019	0047	80 22.945	10 43.265	0625	~80 29	~13 04		4	4-5	MBB lines 31-44 (gun stopped working at about 7940 and then started again).
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.006	25.07.2019	0047	80 22.945	10 43.265	0524	80 29.583	13 10.519	2-8 kHZ	1	4-5	Core station 815-819 on this line. Stratified sediments, with lense-shaped accumulation below.
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.007	25.07.2019	0524	80 29.583	13 10.519	0645			2-8 kHZ	1	4-5	Line 6 exceeded 500 mb; new file created.
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.100	25.07.2019	-	-	-	-	-	-	2-8 kHZ	1	4-5	CHIRP name changed to 100. Almost no data recorded; wrong sonar control depth?
Woodfjorden TMF	Airgun Seismic	IG19-3_AMGG-HH-002-2D (Line 3 in Petrel project)	25.07.2019	14:30	80 32.111	12 08.666	2123	80 05.358	13 11.992		4	4-5	Hydrophone trouble near end of line.
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.101	25.07.2019	14:37	80 32.111	12 08.666	2124	80 05.358	13 11.992	2-8 kHZ		10	MBB lines 48-62. Data was not recorded some places; wrong sonar control depth?
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.102	25.07.2019	2155	80 04.310	13 17.620	2303	80 02.875	12 48.229	2-8 kHZ	1	10	Transit to start of multibeam survey. MBB lines 63-65.

Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.103	25.07.2019	2320	80 03.522	12 43.741	0135	80 23.921	11 55.332	2-8 kHZ	1	10	MBB lines 67-74.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.104	26.07.2019	0201	80 23.966	11 57.122	0301	80 15.044	12 18.922	2-8 kHZ	1	10	MBB Lines 75-77.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.105	26.07.2019	0319	80 15.188	12 18.422	0435	80 03.000	12 45.000	2-8 kHZ	1	10	MBB Lines 79-82.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.106	26.07.2019	0502	80 03.655	12 46 877	0719	80 20.343	11 58.054	2-8 kHZ	1	10	MBB Lines 84-88.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.107	26.07.2019	0723	80 24.151	12 00.436	0933	80 03.814	11 48.225	2-8 kHZ	1	10	MBB Lines 90-94.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.108	26.07.2019	0938	80 03.779	12 50.143	1158	80.24.160	12.04.231	2-8 kHZ	1	10	MBB Lines 96-100.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.109	26.07.2019	1158	80.24.160	12.04.231	1414	80.03.858	12.57.712	2-8 kHZ	1	10	MBB Lines 101-105.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.110	26.07.2019	1414	80.03.893	12.53.103	1629	80 24.400	12 04.933	2-8 kHZ	1	10	MBB Lines 107-111.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.111	26.07.2019	1635	80 24.455	12 06.611	1848	80 04-029	12 54.188	2-8 kHZ	1	10	MBB Lines 113-117.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.112	26.07.2019	1851	80 04.281	12 55.163	2104	80 24.647	12 07.413	2-8 kHZ	1	10	MBB Lines 119-123.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.113	26.07.2019	2107	80 24.623	12 08.869	2319	80 04.078	12 56.830	2-8 kHZ	1	10	MBB Lines 125-129.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.114	26.07.2019	2323	80 04.477	12 57.376	0135	80 24.666	12 10.211	2-8 kHZ	1	10	MBB Lines 131-135.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.115	27.07.2019	0140	80 24.677	12 11.800	0350	80 04.300	12 59.122	2-8 kHZ	1	10	MBB Lines 137-141.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.116	27.07.2019	0355	80 04.455	13 00.099	0609	80.24.900	12.12.470	2-8 kHZ	1	10	MBB Lines 143-147.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.117/118	27.07.2019	0609	80.24.900	12.12.470	0814	80 14.157	12 30.322	2-8 kHZ	1	10	MBB Lines 148-165 (transit, filler).
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.119	27.07.2019	1218	80 16.469	12 08.333	13:44	80 03.247	12 39.400	2-8 kHZ	1	10	MBB lines 168-170.
Woodfjorden T.	MB	-	27.07.2019	1419	80 07.911	12 38.077	1629	80 02.978	12 39.822	-	-	-	Filling multibeam data gaps. 100-degree swath. No CHIRP data acquired.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.120	27.07.2019	1632	80 03.033	12 37.966	1849	80 23.890	11 48.334	2-8 kHZ	1	10	MBB Lines 188-192.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.121	27.07.2019	1857	80 23.884	11 52.279	1911	80 21.982	11 56.515	2-8 kHZ	1	10	MBB Lines 194-195.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.122	27.07.2019	1924	80 21.944	11 55.786	1948	80 24.118	11 50.221	2-8 kHZ	1	10	MBB Lines 197-198.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.123	27.07.2019	1956	80 23.675	11 47.108	2212	80 03.106	12 36.345	2-8 kHZ	1	10	MBB Lines 200-204.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.124	27.07.2019	2218	80 03.128	12 34.550	0037	80 23.666	11 45.111	2-8 kHZ	1	10	MBB Lines 206-210.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.125	28.07.2019	0041	80 23.522	11 43.711	0256	80 02.911	12 33.188	2-8 kHZ	1	10	MBB Lines 212-216.
Woodfjorden T.	CHIRP /	IG19-3_AMGG-HH.126	28.07.2019	0302	80 02.799	12 31.688	0520	80 23.499	11 41.855	2-8 kHZ	1	10	MBB Lines 218-222.

	MB												
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.127	28.07.2019	0525	80 23.411	11 40.166	0742	80 02.464	12 30.839	2-8 kHZ	1	10	MBB lines 224-228.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.128	28.07.2019	0742	80 02.464	12 30.839	0837	79 58.209	13 17.154	2-8 kHZ	1	10	MBB lines 229-230. Leaving multibeam survey area; looking for coring site in the inner parts of the Woodfjorden T.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.129	28.07.2019	0846	79 58.553	13 13.624	1055	79 58.833	13 12.504	2-8 kHZ	1	1-10	Recording on coring site. MBB Lines 231.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.130/131	28.07.2019	1055	79 58.833	13 12.504	1754	79 32.702	12 25.313	2-8 kHZ	1	1-10	Transit to sightseeing in inner Woodfjorden/Liefdefjorden; Monaco Glacier and Texas Bar.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.132	28.07.2019	2033	79 36.466	12 45.800							Return from sightseeing. MBB Lines start at 254.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.133/134	29.07.2019	0016	79 57.255	13 42.477							MBB Lines 265.
Woodfjorden T.	Airgun Seismic	IG19-3_AMGG-HH-003-2D (Line 4 in Petrel project)	29.07.2019	0215	80 05.188	12 38.644	1055	80 19.896	09 29.857	2-8 kHZ	1	4-5	A bit of channel problem during the start, but it was ok. Stopped because of ice.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.135	29.07.2019	1055	80 19.896	09 29.857							Exploring?/Transit.
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.136	29.07.2019	1303	80 22.066	10 42.922	1534	80 28.688	13 06.744	2-8 kHZ	1	10	MBB Lines 293-298.
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.137	29.07.2019	1545	80 28.099	13 09.99	1850	80 23.798	10 43.558	2-8 kHZ	1	10	MBB Lines 300-307.
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.138	29.07.2019	1850	80 23.798	10 43.558	2112	80 30.118	13 04.965	2-8 kHZ	1	10	MBB Lines 308-312 (EK60 crashed small patch of bad data).
Woodfjorden TMF	CHIRP / MB	IG19-3_AMGG-HH.139	29.07.2019	2135	80 27.605	13 08.367	2255	80 25.237	12 14.386	2-8 kHZ	1	10	Some data lost at the start of the line; the sonar control depth was wrong. MBB Lines 314-316.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.140	29.07.2019	2301	80 24.498	12 14.472	0152	80 04.307	13 03.111	2-8 kHZ	1	8-10	MBB Lines 318-323.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.141	30.07.2019	0155	80 04.655	13 02.566	0417	80 24.966	12 15.499	2-8 kHZ	1	8-10	MBB Lines 325-329.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.142	30.07.2019	0422	80 25.055	12 16.877	0624	80 04.263	13 04.323	2-8 kHZ	1	10	MBB Lines 331-335.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.143	30.07.2019	0751	~80 13	~12 45	0911	80 25.160	12 24.000	2-8 kHZ	1	10	The CHIRP was not turned on following the turn; it was started about 15 km after start of multibeam recording. MBB Lines 338-340.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.144	30.07.2019	0918	80 25.361	12 17.653	1007	80 23.348	11 33.256	2-8 kHZ	1	10	Filling data gaps on the upper slope. MBB Lines 342-343.

Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.145	30.07.2019	1019	80 22.941	11 39.892	1232	80 03.333	12 27.050	2-8 kHZ	1	10	MBB Lines 345-349. The CHIRP and multibeam line 345 were started a bit late; parts of line 344 should be used for gridding of the seabed.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.146	30.07.2019	1235	80 03.440	12 25.390	1451	80 23.673	11 36.370	2-8 kHZ	1	10	MBB Lines 351-355.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.147	30.07.2019	1454	80 23.599	11 35.229	1710	80 03.322	12 24.122	2-8 kHZ	1	10	MBB Lines 357-362.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.148	30.07.2019	1716	80 32.255	12 22.788	1928	80 23.499	11 33.460	2-8 kHZ	1	10	MBB Lines 364-368.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.149	30.07.2019	1935	80 23.193	11 33.382	2030	80 20.850	10 46.621	2-8 kHZ	1	10	MBB Lines 370-371.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.150	30.07.2019	2038	80 20.287	10 48.815	2129	80 22.737	11 36.072	2-8 kHZ	1	10	MBB Lines 373-374.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.151	30.07.2019	2135	80 22.289	11 36.290	2231	80 19.741	10 48.956	2-8 kHZ	1	10	MBB Lines 376-377.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.151	30.07.2019	2238	80 19.437	10 52.168	2324	80 21.893	11 37.488	2-8 kHZ	1	10	MBB Lines 379-380.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.152	30.07.2019	2329	80 21.527	11 38.216	0010	80 19 737	11 05 802	2-8 kHZ	1	10	MBB Lines 382-383.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.154	31.07.2019	0016	80 19.554	11 09.445	0047	80 21.144	11 38.855	2-8 kHZ	1	10	MBB Lines 385-386.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.155	31.07.2019	0055	80 21.081	11 37.499	0253	80 03.299	12 21.100	2-8 kHZ	1	10	MBB Lines 390 – 393.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.156	31.07.2019	0257	80 03.266	12 19.744	0455	80 21.101	11 35.499	2-8 kHZ	1	10	MBB Lines 395-398.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.157	31.07.2019	0459	80 21.010	11 34.248	0707	80 04.239	12 14.499	2-8 kHZ	1	10	Forgot to change CHIRP and MBB lines at end of line. MBB Lines 400-404.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.158	31.07.2019	0707	80 04.239	12 14.499	0856	80 20.854	11 32.857	2-8 kHZ	1	10	MBB Lines 404-407.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.159	31.07.2019	0901	80 20.809	11 31.189	1106	80 03.299	12 15.517	2-8 kHZ	1	10	MBB Lines 409-413.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.160	31.07.2019	1109	80 03.325	12 14.314	1155	80 10.466	11 56.462	2-8 kHZ	1	10	MBB Lines 415-416.
Woodfjorden T.	CHIRP / MB	IG19-3_AMGG-HH.161	31.07.2019	1200	80 10.428	11 55.295	1248	80 03 250	12 13 200	2-8 kHZ	1	10	MBB Lines 418-420.