Cruise report

R/V Arni Fridriksson
A 2004 **13**

6-17 September 2004

(Foto: F. Goncalves)

Akureyri-Reykjavík

C. Riedel
University of Hamburg

Cruise report

R.V. Arni Fridriksson — Cruise No. A2004 13

Cruise dates: **06/09/04– 18/09/04**

Subject of research: **Earthquake studies and multibeam bathymetry in North Iceland**

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Chief Scientist: Dr. C. Riedel

Number of scientific crew members: 8

Project: **„Tjörnes Fracture Zone Seismic Tomography Experiment"**
(TJOSTE 2004) – part of the NICExperiment,
DFG-project Da 478/13-1, Ri 1220/2-1

Contents:

1. Crew, list and affiliation

Position	Name	Affiliation
Chief Scientist	Carsten Riedel	Inst. für Geophysik Hamburg
Scientists	Bryndís Brandsdóttir	Háskola Íslands Reykjavík
	Martin Hensch	Inst. für Geophysik Hamburg
	Barbara Hofmann	Inst. für Geophysik Hamburg
	Marcus Thölen	Inst. für Geophysik Hamburg
Technicians	Fernando Goncalves	GeoPro
	Andrei Martinienko	GeoPro
	Björn Sigurðsson	Hafrannsóknastofnun
	Sven Winter	Inst. für Geophysik Hamburg
Scientific support onshore	Ragnar Stefanson	Veðurstofa Íslands
	Ari Tryggvason	Uppsala Universitet

Figure 1: The complete crew including the ship's crew in the port of Akureyri.

2. Introduction

Geophysics enjoys a long history at Hamburg and in early times people involved in earthquake research at the observatory became interested in North Iceland, the target area for this survey. Thoroddsen (1925) mentioned that in 1908, the Hamburg seismic station, a Wiechert instrument, registered an event of intensity 3 on the Mercalli scale near Akureyri (Fig. 1) shortly before 6 h on the 26th of December. However, this is not visible on the stored carbon copies of 1908 at the observatory in Harburg.

This event, as we know today, probably occurred in a 120 km wide belt joining two segments of the mid ocean ridge system, Kolbeinsey Ridge in the north and the North Volcanic Zone of Iceland in the south. Frequent seismicity (Rögnvaldsson et al., 1998), recent ultramafic volcanism (Devey et al., pers. comm.) and gas venting (Botz et al., 1999) go along with this unique geodynamic situation, which was first described as a transform zone by Sykes et al. (1967) and is actually situated between the Iceland plume and an ultra-slow spreading ridge. It is nowadays known as the Tjörnes Fracture Zone (TFZ), see Fig. 2.

From time to time seismicity endangers the life conditions of man, their cattle and infrastructure in the TFZ. The last disastrous (local earthquake magnitude 6.4) event happened in 1934 around Dalvik (Thorarinsson, 1937) and was described by a Mercalli scale intensity of 10 - houses broke down and many men were injured between Hofsos on Skagafjördur and Akureyri, the secret capital of the icelandic north.

Although stress is usually transferred from ridge movement to the transform zone, most of the faulting near the surface occurs in north-west orientation (Riedel et al., 2000), thus, they represent so called Riedel faults of the shearing system. *b*-values indicate that fluid movement plays a vital role for the rupture of these faults (Riedel et al., 2003).

Both its unique geodynamic situation and hazard assessment make this area a prime target for seismic observations. The permanent icelandic SIL network has operated 13 3-component-stations with 20 s sensors from Lennartz in the icelandic north (Fig. 3). Their setup, however, suffers from a major disadvantage. Since most of the events in the TFZ occur offshore and their seismic stations are mainly operating on the icelandic mainland, an expansion towards the offshore part using ocean bottom seismometers (OBS) appears to be logical.

During the last cruise of R/V Dröfn in June/July 2004 a set of 14 ocean bottom seismometers/hydrophones was deployed within the area of frequent seismicity. During the cruise that is described here, number 13 in 2004, but still a lucky one, these 14 ocean bottom seismometers were recovered plus a temporary land station which was installed on Lágey, an island just north of Tjörnes peninsula.

The active structure of the TFZ is mirrored in the morphology of the seafloor , i.e. bathymetry. So a detailed study of the TFZ and adjacent areas was performed to get a better grip on environmental parameters for a thorough revision of the geodynamic situation of the transform region.

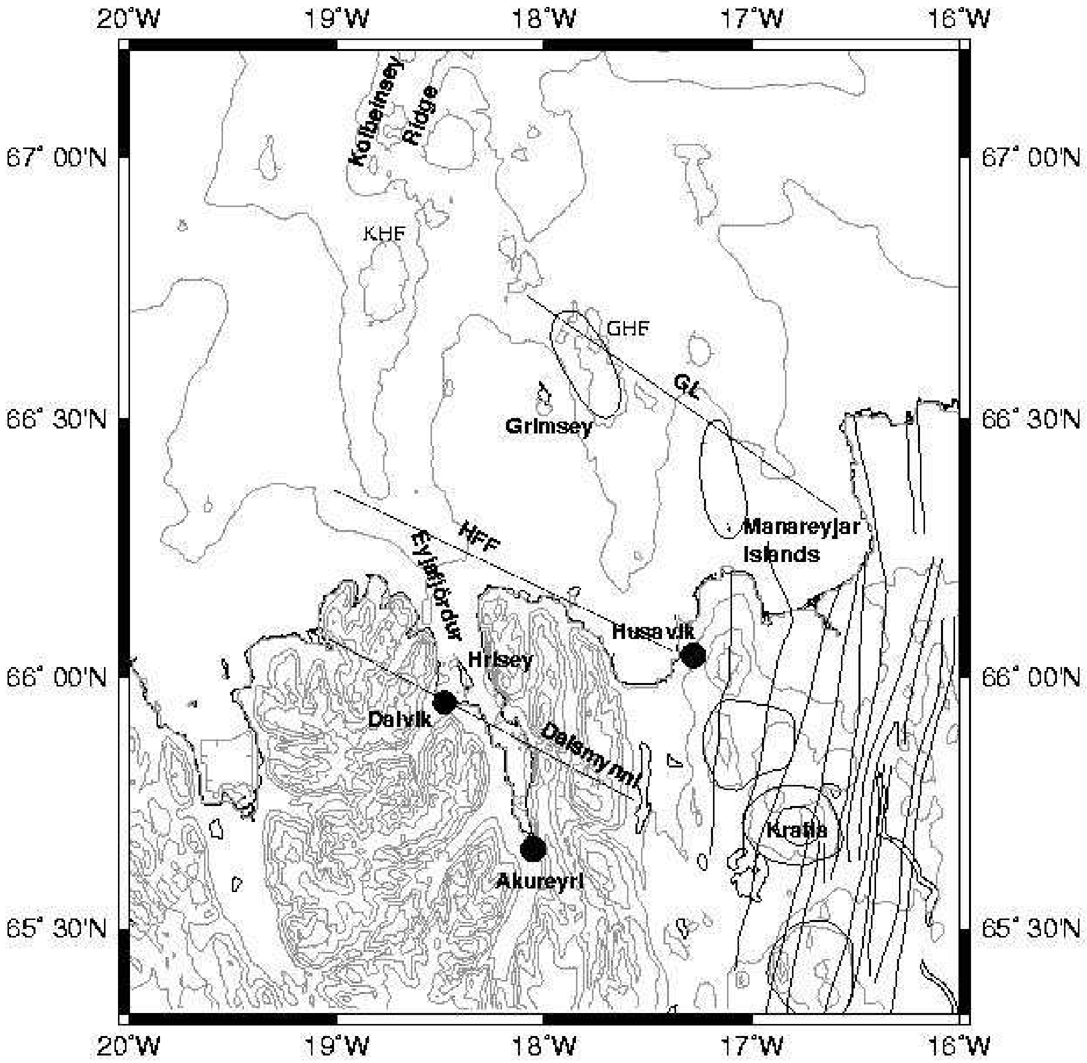

Figure 2: The topography/bathymetry (in grey contours) of the Tjörnes Fracture Zone as it was known before the beginning of multibeam bathymetry is shown on the map. Geographic names of interest and the three most important towns, Akureyri, Husavik and Dalvik have been marked. The hydrothermal field at the islands Kolbeinsey (KHF) and Grimsey (GHF) are also marked. Seismicity is focussed along 2 seismic lineaments offshore, the Grimsey Lineament (GL) and the Husavik-Flatey fault (HFF), and a virtual lineament through the town of Dalvik and Dalsmynni valley, often termed the Dalvik lineament.

3. Research program

In a common approach with the meteorological office in Iceland, the University of Hamburg installed a temporary seismic network offshore North Iceland and tested both the temporary setup and the permanent SIL setup of the meteorological office by dynamite explosions during the cruise of R/V Dröfn. At the same time the land network was expanded by further stations from the University of Uppsala (Sweden). This combined approach is called NICE (North ICeland Experiment). Between end of June 2004 and mid September 2004 the NICE experiment registered local earthquakes on 38 3-component stations (see Fig.3). While writing this report data exchange has already occurred.

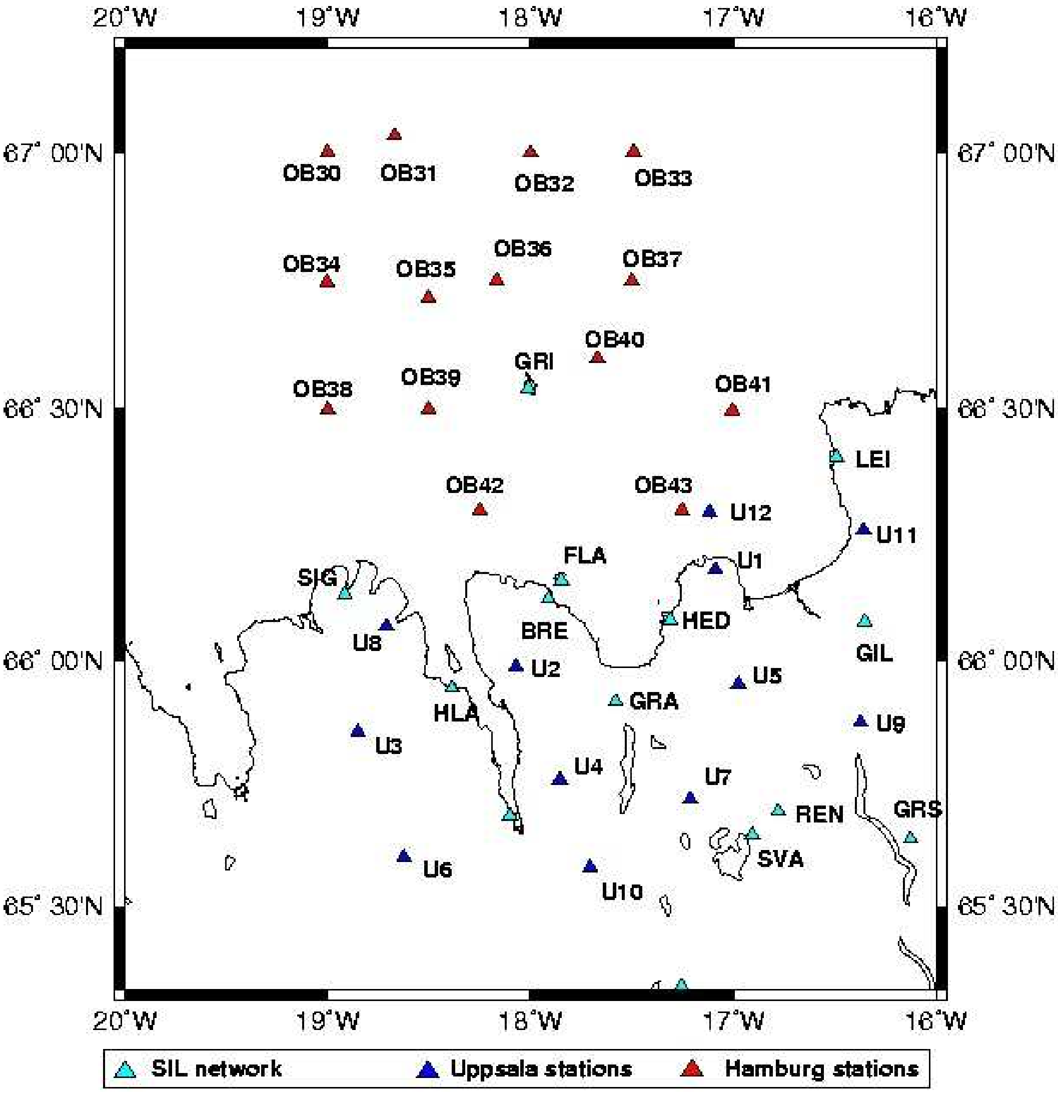

Figure 3: The station setup for the whole NICE experiment, this cruise report only deals with the deployment of the OB stations of Hamburg and station U11 that was already recovered during this cruise (attention: new OB numbers assigned !).

The recovery of 14 ocean bottom (OB) stations and 1 land station (U11 on Fig.3) will be documented on the following pages as well as any technical requirement stemming from observations during the recovery phase on the Arni Fridriksson and in the cooperation with the land crew.

4 of the OB stations are ocean bottom hydrophones from the University of Hamburg (OB30-OB33) and 10 of the OB stations are ocean bottom seismometer/hydrophone combinations from the company GeoPro (OB34-OB43). The land station was actually an island station and positioned on Lágey (U11). An EarthData logger and a Lennartz 20s seismometer operated there.

More than 2300 nautical miles of multibeam bathymetry lines were recorded and these were complemented by 12 conductivity-temperature-depth (CTD) logs to be able to determine the local sound velocity-depth profile. The data need to be adjusted accordingly.

On top, within a volcano crater which is located southeast of Kolbeinsey island and covered by the presented multibeam survey, dredging was performed. However, in contrast to the fresh looking edifice morphology no fresh lavas were discovered.

! Note: For this cruise report other numbers for the OB stations were assigned than during the Dröfn cruise. The numbers here are those which need to be addressed when accessing data !

4. Cruise diary and technical report

The following cruise diary is split into 4 parts, which will be headlined in the following:
I) the recovery operation for the OBHs of the University of Hamburg,
II) the recovery operation for the OBSs of the company GeoPro,
III)a multibeam bathymetry survey coupled to dredging,
IV)and finally a rescue operation for an island station of the University of Uppsala.

05/09/04 Arrival of the scientific crew from the University of Hamburg and GeoPro in Akureyri after flying from Reykjavik with Air Iceland. This was a much more relaxed intro than last time and it is not much more expensive if flights are booked early enough. Accomodation in „Guesthouse Akureyri" for one night (check-in: 22:30 h), which is far more professional and, unfortunately, less exciting than Dalvik. Andrei and Sven who took a flight via Amsterdam lost their baggage but Icelandair promises to deliver the baggage to Akureyri in time.

06/09/04 **Preparation**

After a call in the morning Ragnar Stefansson arrives at 9:30 h to deliver the boxes we stored in Dalvik. The rest of our equipment is easily spotted in a container at the local EIMSKIP store. They tell us that the research vessel will not arrive at 08:00 h as scheduled but at 13:00 h to 13:15 h only.

At around 13:00 h the lost baggage is brought to EIMSKIP by a courier from Icelandair. This was particularly important because the Benthos releaser board unit for the GeoPro stations was part of the set.

Finally, R/V „Arni Fridriksson" arrives at 14:10 h. Bryndis is already onboard and welcomes us before heading towards the center of town for a quick communication. The captain welcomes us, as well, and the first officer requires a list of all people of our crew. This is something which could have been easily arranged before stepping on the ship, but we forgot it anyhow. This list must all contain all the passport numbers and should be prepared for further cruises.

Cruise (Part I)

After embarking and checking into the cabins and discussing the strategy for the following days with Bryndis and the Captain, the ship leaves towards the position of OB33 at 15:30 h. The multibeam sounder is turned on directly after starting the ship so that we can investigate the bottom morphology by one swath including the Brimsnes area which we investigated during the Dröfn cruise in July.

Since it takes too much time to reach the position of OB33 in daylight, the plan is to arrive on position at around 8:00 h in the morning of the next day. Carsten tries to instruct the crew on how we want to recover the single OBSes, i.e. the University OBHs by a long stick and the GeoPro OBSes by a small boat. As it turns out the crew is really happy about using the boat in contrast to what we thought. It is also valuable to know that the crew would like photos from the instruments so that they know what instruments they actually have to recover so that they are easier to spot. Information on size and color is also important.

Cruise Part (III)

Multibeam survey began at 18:30 h. Two lines were surveyed across the geothermal field offshore Brimnes. The vessel stopped for a first CTD attempt north of Olafsfjörður. Unfortunately, the computer screen malfunctioned and had to be exchanged, so the attempt was prevented.
Finally, a CTD (No. 298) was performed at 21:39 h in southernmost Skjálfandadjúp. A new survey (A200413_E1) was started at 19:03 when we surveyed a N-S line east of the Skjálfandadjúp 2002 map (Brandsdottir et al., 2002) on the way to 67°N latitude. For positions of CTDs look at tables in the appendix.

07/09/2004 **Cruise (Part I continued)**

We enjoy excellent weather throughout the day.

After a nice breakfast prepared by a funny and friendly cook (including cod liver oil) we are preparing the Mors releaser board unit, GPS antenna and a laptop computer (SONY VAIO PCG F 801 running under Windows 98) for skewing the flash disks in the GEOLON logger. The 4 pin cable connected by 9 pin serial interfaces, described in figure 4 is used for connection between computer and data logger. A GPS cable is used between antenna and data logger. The action will record the position and time of recovery and flush all data to disk.

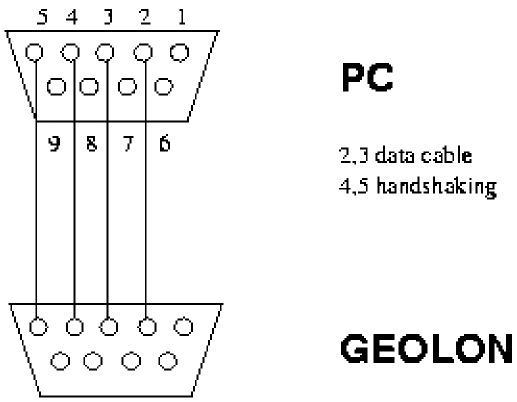

Figure 4: Link from PC to Geolon.

The task plan for the scientific crew is the following:
- Carsten will skew and read out GEOLONs, communicate with boatman and captain and coordinate actions,
- Marcus and Sven help during recovery at the ship's side,
- Martin is responsible for the releaser board unit,
- and Barbara helps on the bridge to record coordinates and spot the OBHs.

Further more, Marcus cleans the instruments with clear water to get rid of the salt and Martin, Marcus, Sven and Barbara dismount the parts from the frame. During dismount somebody removed the preamplifiers from the pressure cylinders. This should not happen in the future, because that makes it hard to decide which preamplifier belonged where. The serial number of the preamplifiers should be noted on the OBH Station form. As the last action, the empty batteries of releaser, pressure cylinder, flash beacon and radio transmitter, are all thrown into a trash bag by Sven, Martin and Marcus. The battery packs cannot be emptied before because the GEOLON must be kept linked to the battery pack until the disks are skewed. So please remove carefully from pressure cylinders in upcoming surveys !

At 8:25 h, i.e. 10 minutes before the scheduled arrival on position, the captain slows down the ship and stops the engine after moving it into the position of the main current, following Marcus' suggestion.
Martin sends the release command via the board unit and the releaser returns a relase signal immediately, because water depth is less than 500 m. 5 minutes later the captain spots the OBH in front of the ship quite far away. So we decide to stop on position next time rather than 10 minutes ahead.

At 8:40 h, we arrive next to the OBH, which is moving on the waves. Our construction, a 5 m long stick with a closing hook at the end (see Fig. a) is not working very well, so instead the boatman tapes a hook triangle (see Fig. b) to the 5 m long stick and this works much better.

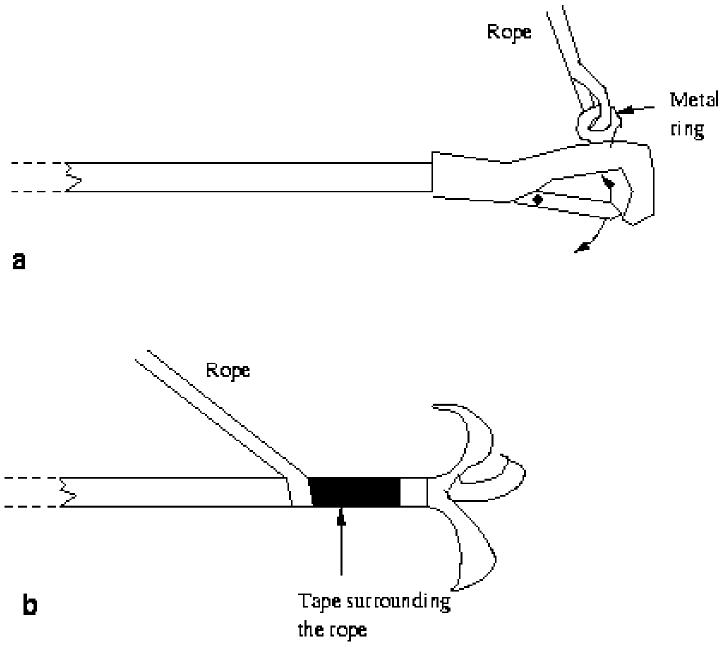

Figure 5: Instead of the (a) flexible hook in the top image we used (b) a triangular staff with 3 hooks as that in the bottom image.

Wave action and salt water corrosion left no particular traces on the OBH components and the flash disks are easily skewed, because there is a good GPS signal. 1.5 GByte have been recorded on the instrument during recording and a deviation of 15 ms occurred. Further parameters on all recovery operations are listed in tables in the appendix.

At 9:57 h, we arrrive on position OB32, the ship is moved into direction of the preferential currents and the engine turned off. Its releaser reacts to our board unit signal directly. With the radio receiver of the ship we detect the direction of the OBH, once it turns up subaerially at 10:00 h. However, only after we informed the captain that R/V Bjarni Saemundsson has a receiver to detect our frequencies he is open to believe that R/V Arni Fridriksson possesses the a radio receiver for the right frequency range, as well. Our own mobile radio receiver is not capable of receiving a strong radio signal at all.

At 10:19 h, the OBH is hauled onboard. Only now we realize that everything we marked on the frames, papers etc. is still readable, i.e. the printed adresses on A4 paper covered by plastic foil, which were already torn apart during deployment, and the numbers on the tape that we wrote using an Edding pen. However, at the bottom of the pressure cylinder, corrosion is visible. So destruction of metals seems to go on much faster than the destruction of ink in seawater. Marcus believes this to be an effect of electrolysis, but internally no damage is visible.
Flash disks can be skewed with a time deviation of 20 ms, and about 1.5 GByte were registered here, too.

At 11:57 h, after lunch, the 3rd OBH (OB31) is released, however it does not react to Mode B commands as recorded on the station form, but to Mode A instead. When the instrument is hauled up, the antenna of the radio transmitter is destroyed by the crane. As the other pressure cylinders before, „Heimaey“ is opened and a black layer of gum occurs between the pressure cylinder and its cap, a sign of corrosion or heating ?
The flash disks contain about 1.5 GByte of data and are skewed with a deviation of 303 ms.

At 13:03 h, we are on position for our last OBH, OB30. OB30 is released after switching to Mode B on the releaser board unit, again contrary to what we noted on the station forms. What is going on ??

At 13:10 h, the radio receiver notes a signal from OB30 and Barbara and the captain spot it easily. During the transport phase towards the instrument Carsten checks if all flash beacons and radio transmitters were turned off and emptied, which is the case. At 13:20 h, the instrument is hauled onboard. The cap of the pressure cylinder is damaged at the edges.
The flash disks contain only 300 MByte and are skewed. This is a first information that something is different from the rest and, probably, that means problems must have occurred during recording time. The deviation of -99 ms is apparently normal as I am told by people more experienced in that business. An idea occurs that hot water may have been in the area, because that would accelerate the internal clock.

At 13:38 h, flash beacons and radio transmitters are packed into their according boxes after being emptied from batteries. Sven turns the switches all on, because this reduces tension on the switches in that case.

A first summary:

Two of the university instruments are slightly damaged (i.e. Odense and Göteborg) on the outer surface and should be restored, one is dirty from sealing gum between cap and cylinder (Heimaey) and should be cleaned. Maybe the high temperatures that we expect in the surroundings (hydrothermal field) had an influence on the seal. However, there was no damage on the outer cap. One hydrophone did not record as much data as the rest, which indicates a lower dynamic range during recording, so probably these data are flawed.
It was much easier to spot the OBHs when the radio receiver of the ship could detect the signal of the radio transmitter. The mobile receiver does not work well and without a receiver aboard it is hard to find a small instruments in the waves of the ocean even when the sea is quiet.
The data for one hydrophone in only two months time are so large that it is of no use to bring a CD writer in order to save the data insitu. A laptop with a DVD writer would be helpful for such tasks.

Cruise (Part II)

After all University OBH have been assembled, GeoPro is taking over to recover their OBSes.

At 15:15 h, the first GeoPro OBS (OB34) is recovered by boat. Two crew men in a small zodiac are deployed onto the sea surface and move towards the OBS when it is less than some hundred meters away (Fig. 6). One of them keeps it in his arms and the other one steers the boat back to the ship's side. First the OBS is lifted on board by crane, then the boat with the two men.

Figure 6: Two crew men move a small boat towards the OBS and draw it back to the ship.

There seem to be minor problems with the Benthos transponder during the release part. Somebody has to check the computer screen the whole time during the rise of the instrument. This is work intensive and not comparable in quality to the Mors releasers.

At 16:50 h, OB35 is lifted into the ship and the boatman needs to make space for more OBSes on the cargo deck and thus moves the frames of the university OBSes. After consultation with the 1st officer, it is decided that 2 more OBSes (OB36, OB37) will be recovered during the day. This task ends at 19:35.

Cruise (Part III - continued)

Using the multibeam instrument we surveyed a line along northeastern margin of the 2002 map and between OB 32 and OB 33 during the night. Between all the OB positions swaths were surveyed, i.e. west along 67°N, south along 19°W and east along 66.75°N. After retrieving OB37, we surveyed north to OB33 and west to Stóragrunn, a submarine volcano southwest of Kolbeinsey island, before returning south along the eastern margin of the map and to OB40 the next morning. A CTD instrument (No. 300) was deployed at 23:14 h.

08/09/04 Excellent weather throughout the day.

Cruise (Part II -continued)

The early bird catches the worm, so at 8:45 h, the next OBS (OB 40) is already on board.
Up until 18:08 h, all remaining OBSes of GeoPro (OB38, OB39, OB41, OB42, OB43) are caught without problem. Including transfer between the station it nevers takes longer than 1h45min. So, we really enjoy a stroke of luck and have retrieved all submarine stations during the day.

Cruise (Part III – continued)

The multibeam task for the day was a survey along the northeastern margin of the 2002 map (Brandsdottir et al., 2002), between Stóragrunn and OB 32 and 33. After retrieving the OBSes of GeoPro we transited north along western margin of 2002 map.
Two CTD records were acquired during deployment at CTD300 (66°30 N, 19°W) at 17:42 and CTD301 (66°54N, 19°15W) at 20:54 h. During the night, the west of Kolbeinsey Ridge is surveyed and we reach 19°W around midnight.

09/09/04 **Cruise (part II -continued)**

Only now the GeoPro stations are opened so that a time drift is determined. It turns out that two of the OBSes will probably not deliver data (OB35 , OB37), one because 1.5 l water penetrated the sphere and the other, because the hard disk was mechanically destroyed by pressure.

Cruise (part III – continued)

During good weather conditions the survey of the southern part of Kolbeinsey Ridge is continued. A further CTD302 for sound speed control is deployed at 67°30N and 19°W around 02:07 h and CTD303 at 67°30N and 18°42W at 22:59 h.

Cruise (Part IV)

During the day we get the „go ahead“ from A. Tryggvason to recover the land station from Lágey

10/09/04 **Cruise (part III – continued)**

The weather gets a little rougher during the day. Carsten decides to try Skopoderm transdermal plasts to get rid of the upcoming sea sickness and they work like wonder. The experience of many people seems to be that one should not use them longer than 3-5 days, because they change the visual perception of a person, but during this campaign they work really well and do not show any side effects.

Figure 7: Dredging aboard Arnif Fridriksson.

During the day the survey of southernmost KR is completed and the focus is switched to Stóragrunn volcano. Because the top of the submarine volcano is so shallow it takes a long time to acquire the data of the expected crater. However, it turns out that the crater is not really a crater, but rather a dome.

A further CTD measurement (CTD304) is acquired at 67°02 N and 18°24 W starting 21:20. h

At 21:47 h, the „so-called“ crater of Stóragrunn is dredged only to obtain gravel, iceberg rafted material and a lot of stinking green organic stuff (Fig.7). Most of the rocks are not bigger than hand-size, well rounded and clearly of volcanic origin. A further dredge along the “lavas” on the eastern flanks of Stóragrunn, at 22:16 h, tears the sampling net of the dredging instrument. Any samples that might have been collected were thus lost. So, unfortunately, no new and fresh lavas were recovered.

11/09/04 **Cruise (part IV – continued)**

The day starts at 08:05 h with a transit to an adventure not seen before on this cruise. The plan is to return a seismic land station from Lágey (Fig. 8).

Figure 8: Lagey, one of the Manareyjar islands, home to station U12.

If possible, the EarthData logger shall be flushed, but we do not have a key for the seismic station, so if not possible the station is to be taken against all odds. Carsten decides by throwing a coin, who is going to follow Martin on the island. The toss of the coin is won by Marcus.

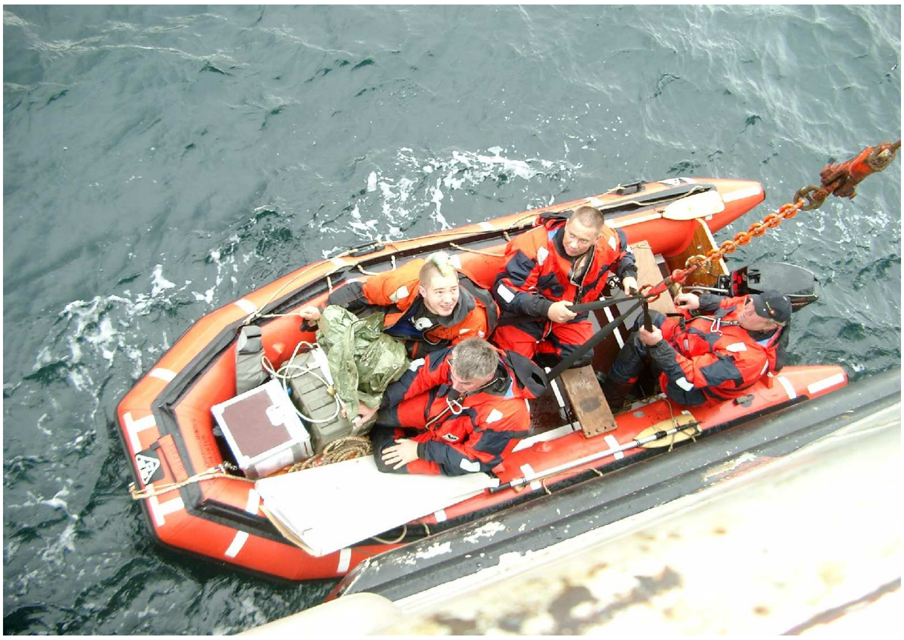

Figure 9: The crew for the land station „rescue“ operation in their zodiac boat after retrieving the station.

So when the research ship stops near the island at 11:43 h, the adventurers prepare for the „rescue“ operation, because Ari did not succeed on the days before. Bad weather prevented ships of any size from reaching the island.

Marcus and Martin are joined by two men of the crew of Arni Fridriksson and are put aboard the zodiac about 1 mile from the island (Fig. 9). Propelled by its engine they move towards the island and find the small rope ladder leading to its plateau, where bird nests prevail surrounding a small hut. Marcus and Martin sign in the guestbook of the hut and get the transport equipment which is deposited there. They move towards the station and carry the batteries, seismometer, Earth Data logger and solar panels back to the rope ladder, before putting it on the zodiac and returning to the Arni Fridriksson. The whole operation takes 1 h 29 minutes. The captain presses on the horn of the ship in between to remind people to come back as fast as possible. Bad weather conditions have been predicted.
Unfortunately, the EarthData logger was locked and Martin and Marcus are incapable of flushing the disks. (As Ari reports later, this costed us about 3 weeks of data, but it still was the better choice, since it might have costed us the whole station otherwise.)

Cruise (part III – continued)

CTD307 at 66°16'N 16°52'W at 14:07 h followed by surveying along the eastern margin of Tjörnesgrunn. Weather conditions worsened during the day. Aborted this Axarfjörður survey at midnight (sea conditions wind from NE at Beaufort scale 8) and started transit survey (A200413_T4) to Eyjafjörður.
12/09/04 **Cruise (part III – continued)**

In transit to Eyjafjörður we began surveying lines along Látraströnd around 4 a.m. We surveyed most of the region between Látur, Grenivík and Hrísey before heading towards Akureyri at 14:33 h and docked at 16:04 h. Carsten, Marcus and Sven left the ship at Akureyri, the container was nearly packed at that point with only a couple of things from GeoPro left to put in it.
B.Brandsdottir takes over responsibility for cruise leadership during the next part of the cruise. M. Hensch is installed as vice leader.
The vessel leaves again at 19:58 h and we survey the Strýtur geothermal field (65°50' N, 18°06'W) until 21:00 h. Two CTD deployments were carried out, CTD308 at 65°49'N and 18°08'W, and CTD309 at 65°54'N and 18°17'W. Finally, we surveyed another line along Brimnes and north along the tracks west of Hrísey, followed by a few lines in the mouth of Eyjafjörður before heading east back to Axarfjörður.

13/09/04 **Cruise (part III – continued)**

At 1:12 h we carried out the last CTD measurement before surveying in Axarfjörður began at 06:46 h. At 21:35 h, we headed north along the Álkantur eystri to finish mapping east of Kolbeinsey Ridge.

14/09/04 **Cruise (part III – continued)**

A multibeam survey along western margin of Skjálfandadjúp straight up north to Kolbeinsey Ridge was finished by 11:20 h. In the following, another dredge attempt was made on the eastern flank of Stóragrunn. The dredging equipment was lost during this attempt - it was torn off the wire holding it- but got a small sample in the loop holding the wire. The crew said we did not have the proper dredge equipment and that we need something called “Gassi”. The day concluded with two extra lines at Álkantur eystri, before we transited to station OB 43, headed north and over towards station OB40 and, finally, resuming the Axarfjörður survey at 22:30 h.

15/09/04 **Cruise (part III – continued)**

Bathymetric surveying in Axarfjörður lasted until 15:18 h, before another last survey area is opened up. The region northwest of Tjörnesgrunn near Grimsey Hydrothermal field, was explored.

16/09/04 **Cruise (part III – continued)**

The region northwest of Tjörnesgrunn was finished during the day and we began transit along survey lines towards Reykjavík. The weather was fairly good to begin with but wind picked up during the morning and strong winds and high waves occurred along the northwestern peninsula of Iceland.

17/09/04 The ship docked in Reykjavik at 11:00 h.

5. Scientific equipment

Technical details of the scientific equipment are described in other reports. It is important to note the instruments we deployed. On locations OB30 to OB33 we used the Hamburg-type ocean bottom hydrophones (OBH on Fig. 13) with Geolon dataloggers, the exact specifications of the deployed instruments is noted in the Appendix. These stations use Mors OCEANO acoustic releasers.

Figure 10: The Hamburg type OBH with two glass spheres covered by orange plastic, which are mounted on a GFK frame. The datalogger is stored in the red pressure cylinder made of aluminium. The silver aluminium housing covers the hydrophone.

On locations OB34 to OB42 we used GeoPro double sphere seismometers with a hydrophone, Sedis III dataloggersand Benthos acoustic releasers. Further informaton on these stations are given in detail by the company GeoPro.

Figure 11: The GeoPro type OBS with two glass spheres, one for the releaser unit and the other for the seismometer unit.

The multibeam bathymetry survey was carried out with a high-resolution, 30kHz

Simrad EM300 multibeam echo sounder, installed on R/V Arni Fridriksson. The EM300 transmits 135, two degree beams over an arc of 150 degrees. The angular coverage sector and beam pointing angles vary automatically with depth, maximizing the number of usable beams. Real-time positioning and vessel motion (roll pitch and yaw) were tracked using the Seapath 200/Seatex software which utilizes differential GPS. The EM300 system has a depth span of 5-5000 m, with a maximum swath width around 120 m at 100 m depth increasing to approximately 1200 m at 1000 m depth. CTD (conductivity, temperature, depth), measurements were carried out using Seabird SBE 911 plus sensors. The swath of sea floor covered on each survey line was typically three to five times the water depth.

6. Preliminary results

6.1. Seismic data

First of all, as stated in the diary, all seismometers were successfully deployed and no problems occurred during the deployment phase. A small problem, concerning the coupling and recovery of the Geopro stations, was mentioned. However, a first glimpse on the data cannot confirm this idea. The design of the Hamburg OBHs shows some minor points which can be improved. These improvement have been noted in the technical report.

The preliminary scientific results section deals primarily with data quality. The data of the NICE seismic experiment originate from 4 different sources, the two types of OB stations listed in this report , the Uppsala EarthData loggers and the permanent SIL network. During the time span of this cruise not all stations delivered data. So, we list those that did not record data:

Recording problems and quality

OB 30 of the University of Hamburg did not record anything but 3 of the explosions in July 2004, because one day after the station was deployed on the 29th of June 2004, the signal amplitude suddenly increases to reach the maximum of the recording range at the day break to the 1st of July. The reason is unclear at this point in time. But, a basic consequence is that only one day of data has been recorded near Kolbeinsey. The daily recording of the 30th of June 2004 is displayed in Fig.12.

OB 35 and OB 37 did not record anything because their hard disks were destroyed due to water penetration or respectively excess pressure.

U01 was only installed for a couple of days, before it was used as a mobile recorder for the explosions aboard R/V Drofn and last but not least relocated to U12 (see also report of land campaign).

U12, the island station on Lagey, did only record data unto the 18th of August 2004, because the disk was not flushed during recovery (see technical report).

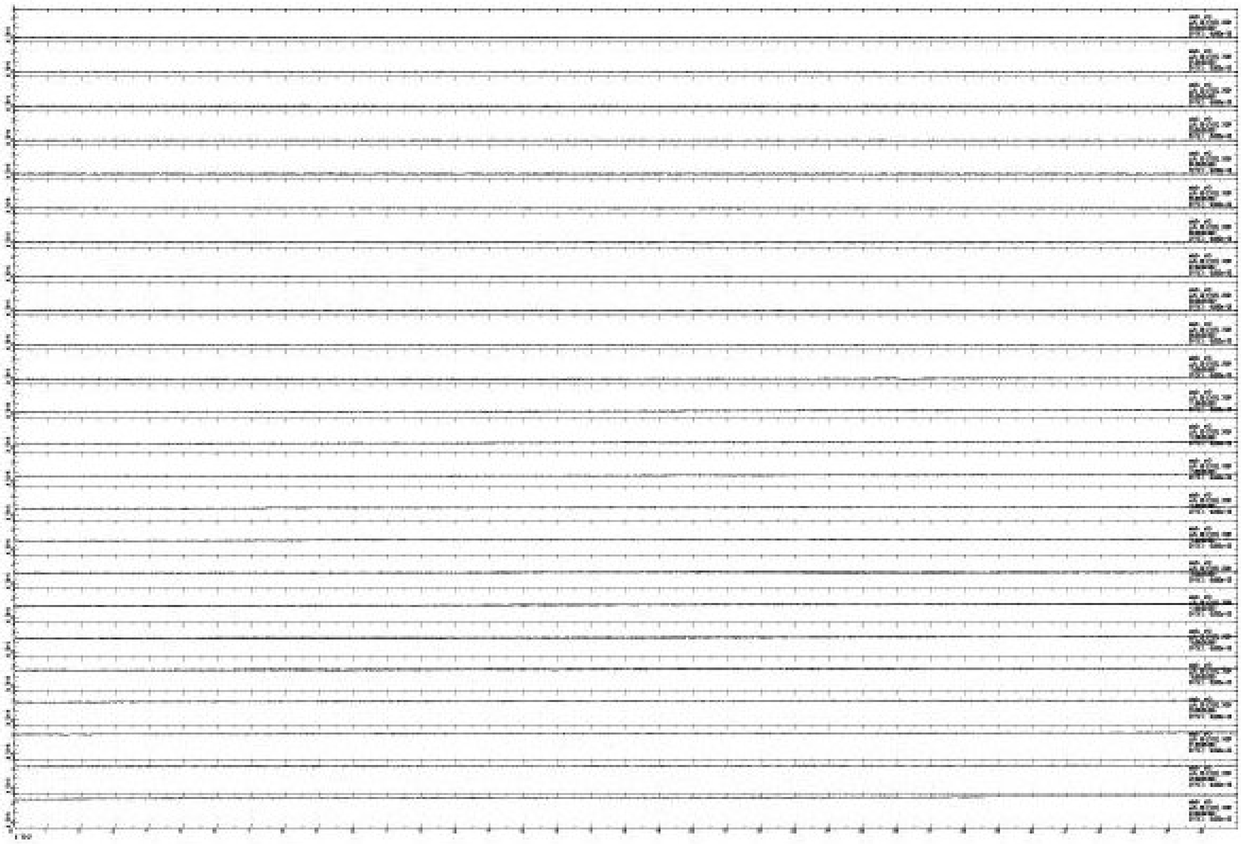

Figure 12: Daily plot for 30/06/04 on hydrophone recorder of station OB30, vertical scale ranges from -50000 to 300000 counts for all lines. Every hour is displayed as single plot starting with 0:00 h at the top left and finishing off with 24 h:00 at the bootom right.

Creating a database

The data from all stations has been converted to GSE cm 6 (6 bit compressed format) using various programs: the University OBHs were converted using *mlsconv*, the GeoPro OBSes were converted using GeoPro software and *codeco3* (Kradolfer et al.,), the SIL data were converted using *bctool* from the Meteorological Office and subroutines of *codeco3* for checksum calculation of GSE and, finally, the data from the EarthData logger were converted using *ham* (Del Prete, 2003) conversion to sac binary and *codeco3* afterwards (see Fig. 13).

So far, all the data are available in GSE cm 6 format on DVD, while on disk they are stored in SEISAN (Havskov et al.,) format, but this will addressed in the near future and changed to GSE. *Wavetool* from SEISAN was used to convert the data to SEISAN format.

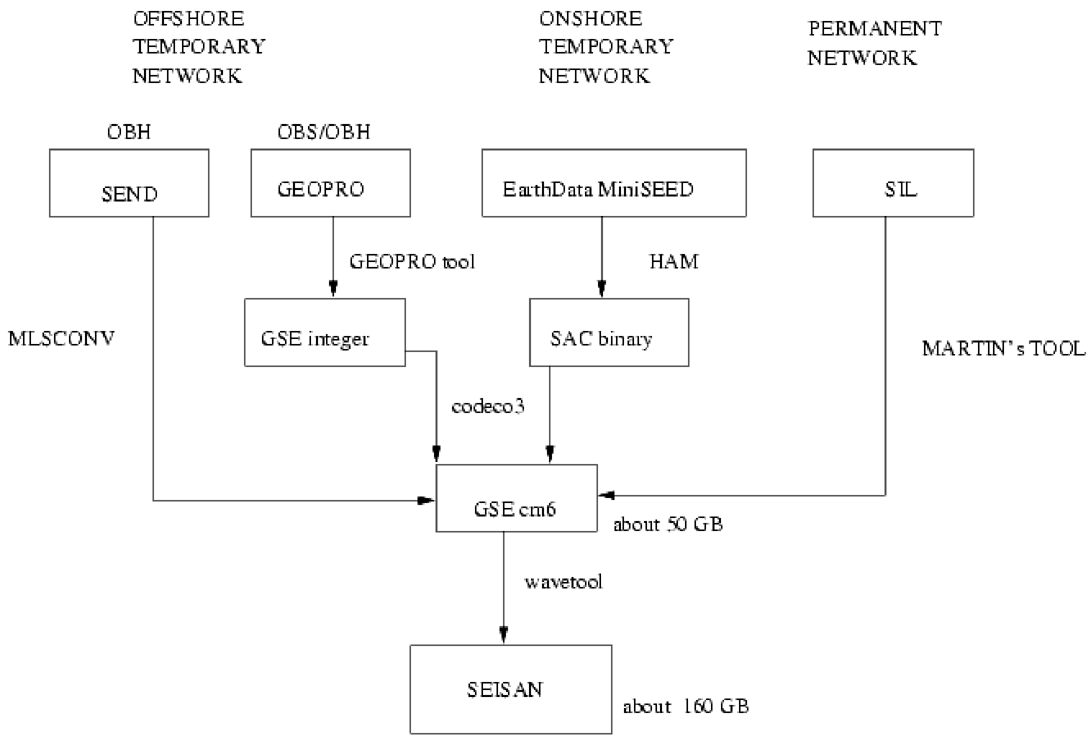

Figure 13: Conversion routines used for building a database structure.

Data characteristics

Since we think it is unnecessary to present all the seismic data and their variety in a cruise report, we restrict ourselves to typical displays of the ocean bottom recordings here in order to document basic features. We will display the results of 1 explosion (05/07/2004 on Fig.14), the largest passive event recorded (12/08/2004 on Fig.15) during our deployment and a local magnitude 1 event (13/07/2004 on Fig.16).

Whereas the explosion is not easily visible on all recordings, the largest magnitude event and its onset can be recognized throughout the region. A typical feature, however, is the large amplitude occurring about 10 s after the event on the ocean bottom recordings. In a water depth of around 500 m, this is not the water multiple, it could, howeve, be a T-wave which travelled through the water between coast and receiver (with up to 50 km this should appear at up to 17 seconds after the original onset) or a surface wave.
Commonly, an S-Phase cannot be distinguished in the recordings of events and explosions.

The broad band hydrophones register oscillations between 3 s and 10 s period, which are also visible on the island stations from the icelandic network. However, commonly local events with magnitude between 4 and 12 Hz can be easily visualized by filtering or even only zooming into the record.

The event of magnitude 1 can be detected on the ocean bottom seismometers, but not easily on the hydrophones, but the largest event causes the seismometer to reach the upper and lower range limits, so, unfortunately, the signals on some stations are cut off on some seismometers.

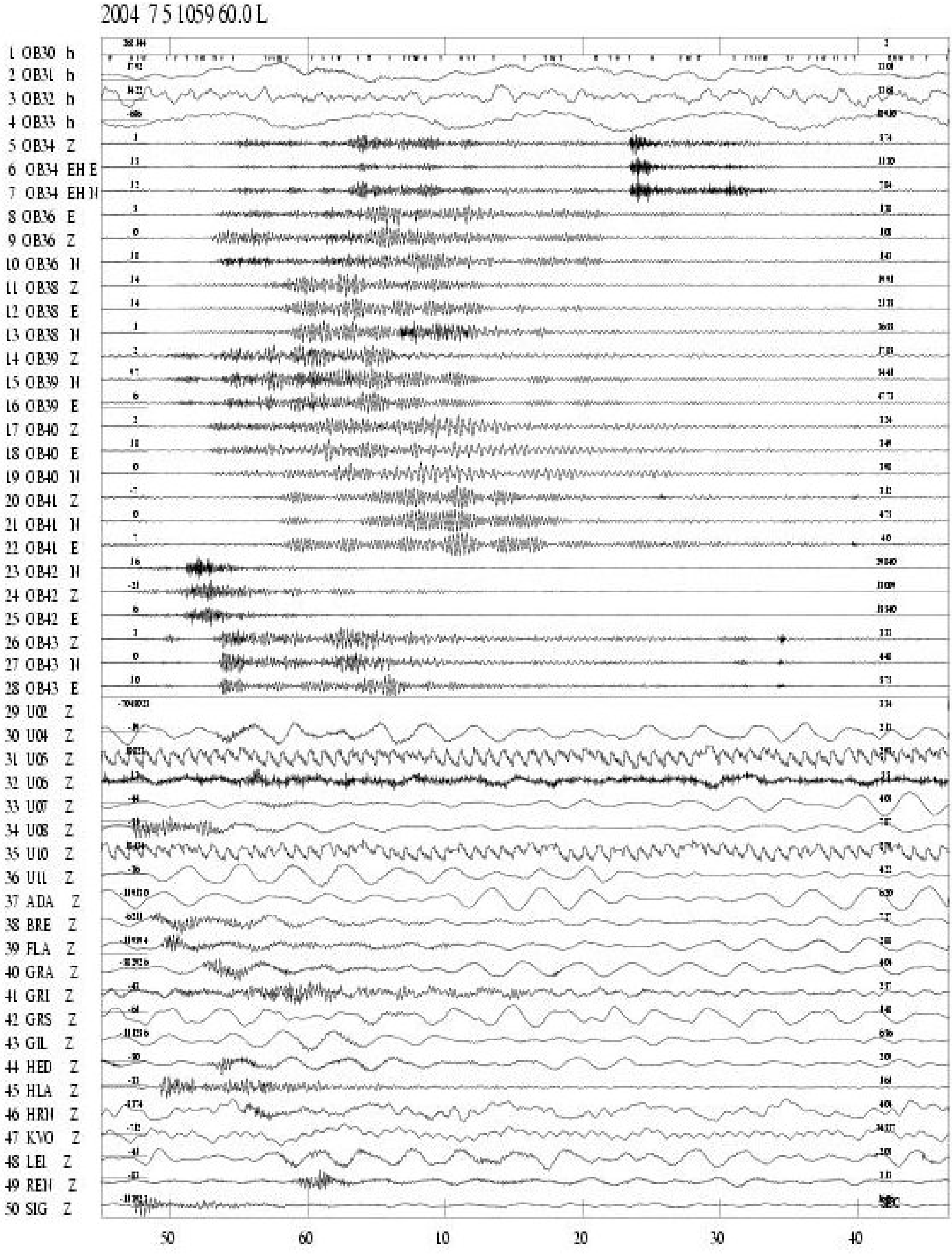

Figure 14: An explosion recording.

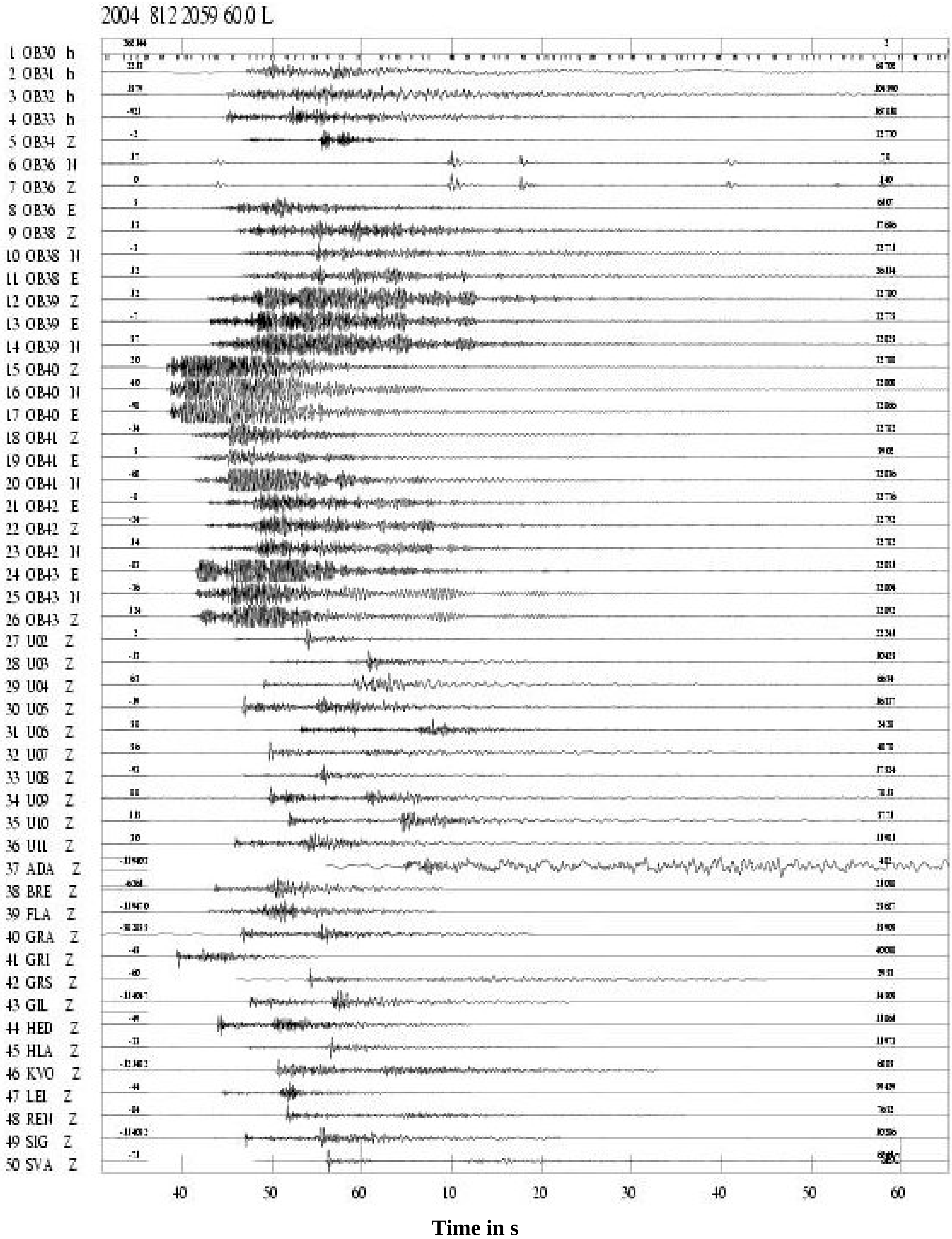

Figure 15: Recording of the largest event occurring during deployment phase.

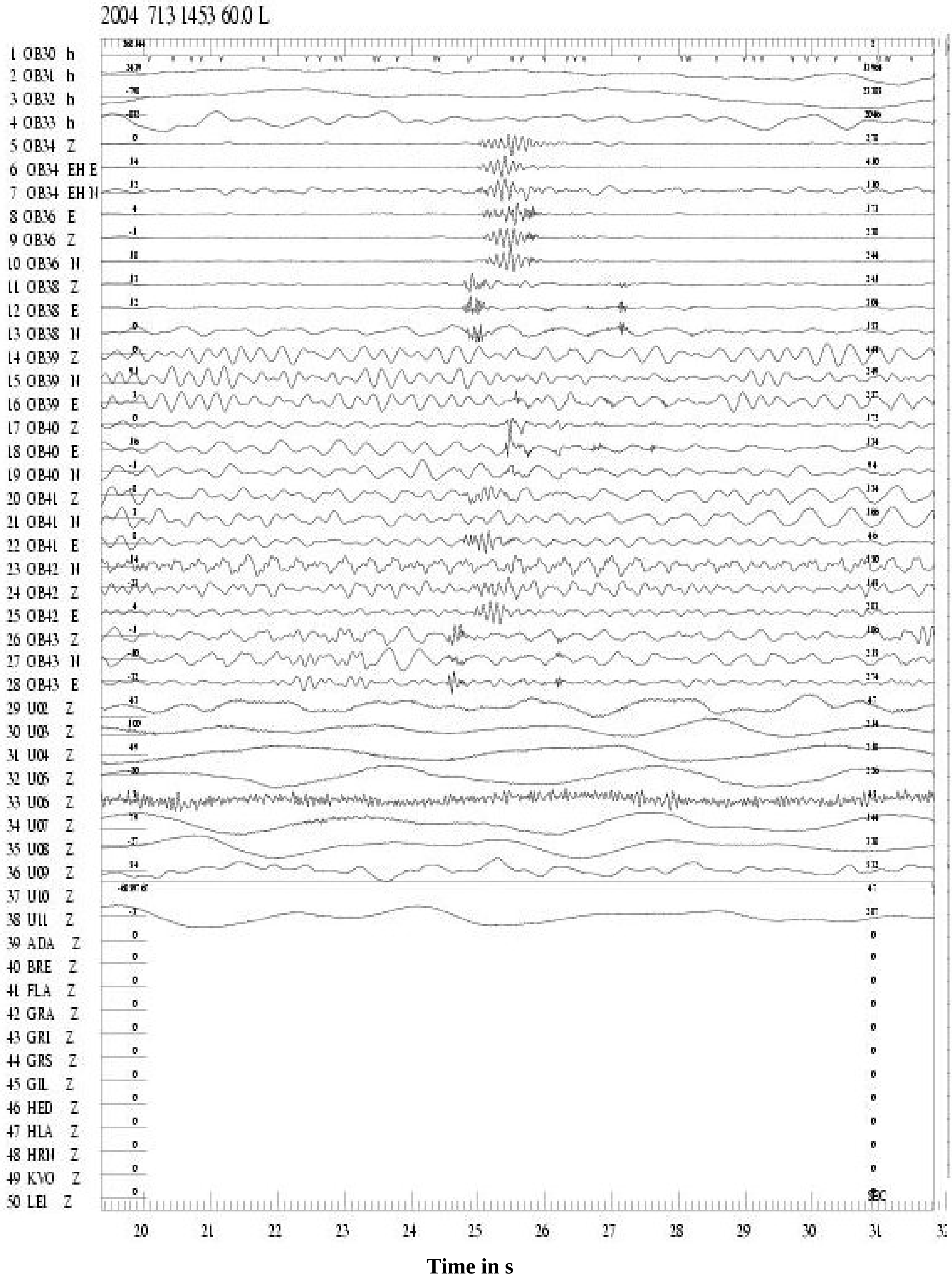

Figure 16: Recording of local magnitude 1 event.

Further analysis ???

6.2.Multibeam data and dredging

The multibeam bathymetry data acquired during this cruise is displayed on Fig. 16. In fornt of all, the region north of 67°N was recorded during this cruise, but also the investigation in Axarfjördur (i.e. east of 17°30'W) was mainly driven by our investigations.

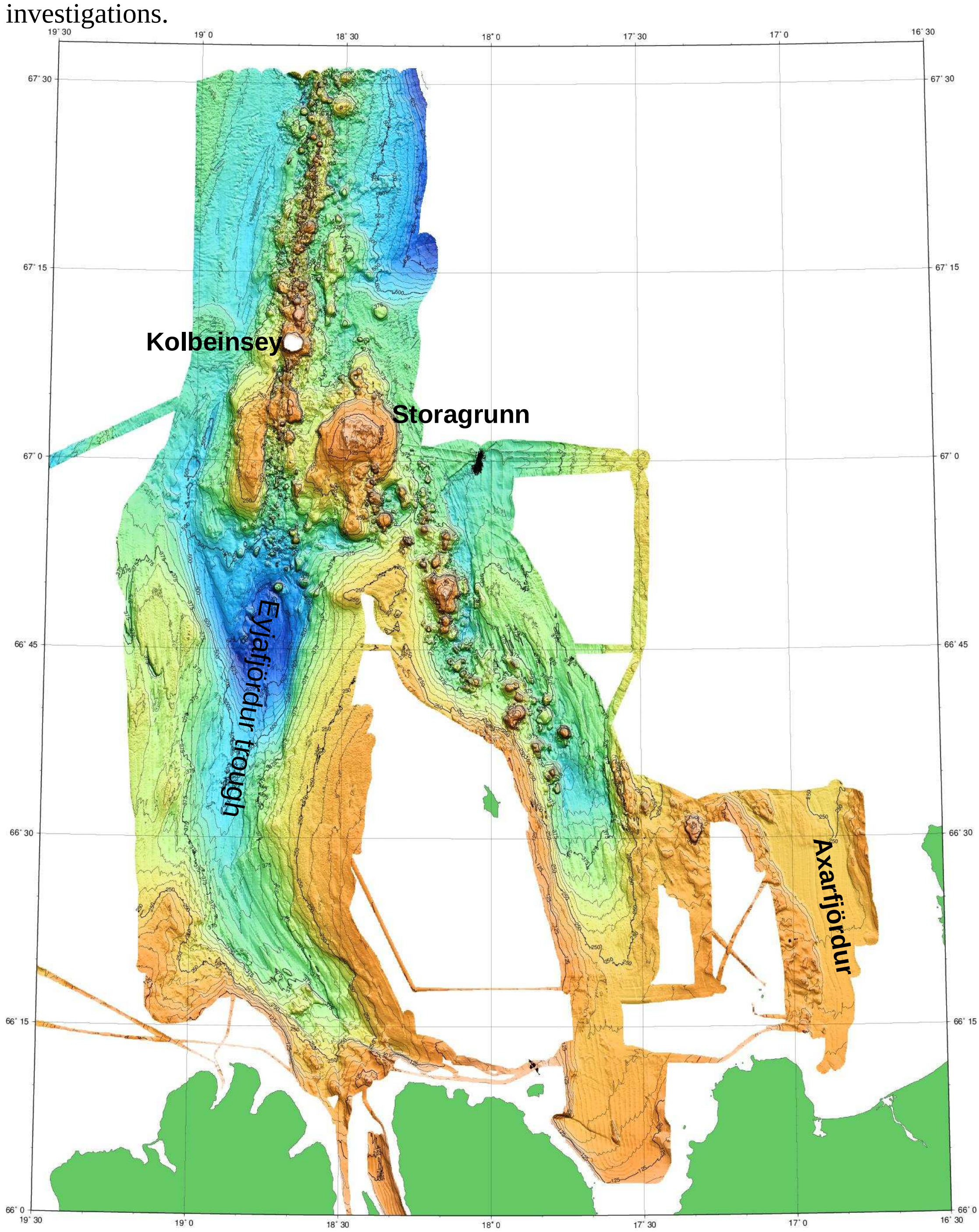

Figure 16: Bathymetry of the survey area which was recorded during this and earlier surveys.

During earlier cruises, the flanks of the submarine volcano Storagrunn (Fig. 16) were analysed and a crater was proposed for the summit. However, investigations during this curise show a ragged top, which indicates a dome at the top. In this regard, Storagrunn is similar to Kolbeinsey islet, a ragged top which is subaerial and towers above a circular structure with similar flanks as Storagrunn.
Dredging of Storagrunn did not proviode unequivocal evidence for recent volcanism, gravel and mud dominated the summit.

... analysis of Bryndis ??? ....

A further interesting structural investigation comprises the southernmost part of Kolbeinsey Ridge (Fig. 17). Single circular tops dot an elongated submarine mountain chain without a central rift valley. South of Kolbeinsey islet this is joined with the graben of Eyjafjördur.
The distribution of bathymetric highs is far more chaotic north of Kolbeinsey in contrast to Eyfjordur trough, where they are roughly aligned in N-S direction.

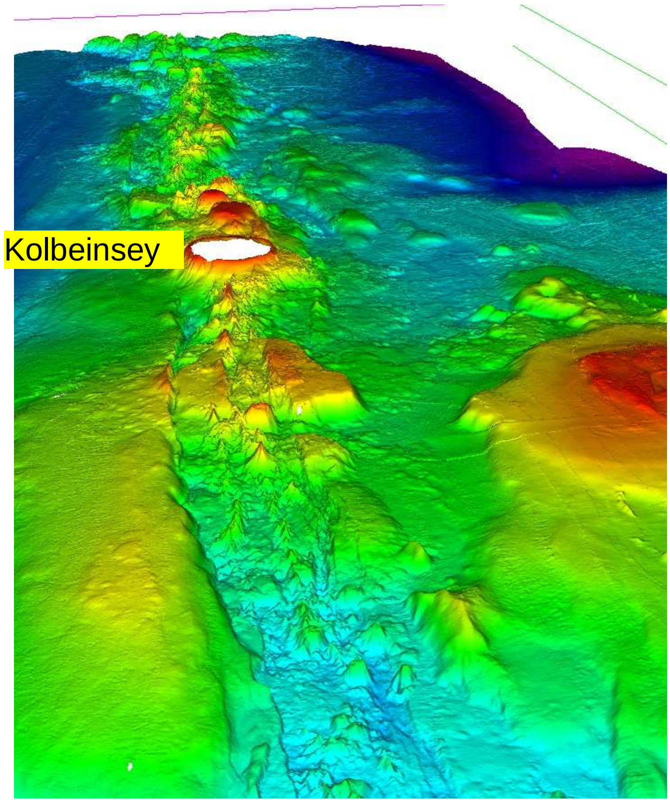

Figure 17: A 3D view on the bathymetry of Kolbeinsey Ridge (view from south towards Kolbeinsey Islet northwards).

An elongated mound structure trends from Storagrunn to Kolbeinsey Ridge ans has not been highlighted in earlier 1D surveys. Here we clearly see an enhancement of our image of the plume-ridge transition in contrast to earlier surveys. Since this ridge is very likely connected to a magmatic system as e.g. a fissure swarm, this must be related to the overall history of the TFZ.

7. Appendix

In this appendix we list the ocean bottom station protocols and charts and coordinates of stations and shots.

Shot recording times on mobile hydrophone (Picks in SAC)

Shot number	*File starting at*	*Seconds after*
1	11:00, 05/07/2004	342.18
2	12:30	1634.30
3	16:30	385.88
4	17:00	1153.36
5	17:30	1037.22
6	18:00	1337.40
7	18:30	1497.76
8	19:00	1761.31
9	20:00	481.30
10	21:00	481.14
11	21:30	840.84
12	22:30	660.92
13	08:30, 06/07/2004	361.13
14	09:30	1440.71
15	11:30	930.78
16	13:00	1090.79

Ocean Bottom instrument positions (corrected version)

Name	*North*	*West*	*Depth from echo sounder*
OB30	67°00.09	19°00.01	521 m
OB31	67°01.984	18°40.175	264 m
OB32	66°59.976	17°59.896	447 m
OB33	67°00.12	17°29.48	279 m
OB34	66°44.948	19°00.015	345 m
OB35	66°45.062	18°30.055	296 m
OB36	66°45.113	18°09.973	427 m
OB37	66°45.085	17°23.955	279 m
OB38	66°29.948	18°59.957	380 m
OB39	66°30.055	18°30.212	193 m
OB40	66°35.977	17°40.11	395 m
OB41	66°29.822	17°00.127	238 m
OB42	66°17.92	18°14.843	120 m
OB43	66°17.99	17°15.017	155 m

Table A1: Positions of the OBHs (OB30-OB33) and OBSes (OB34-OB43).

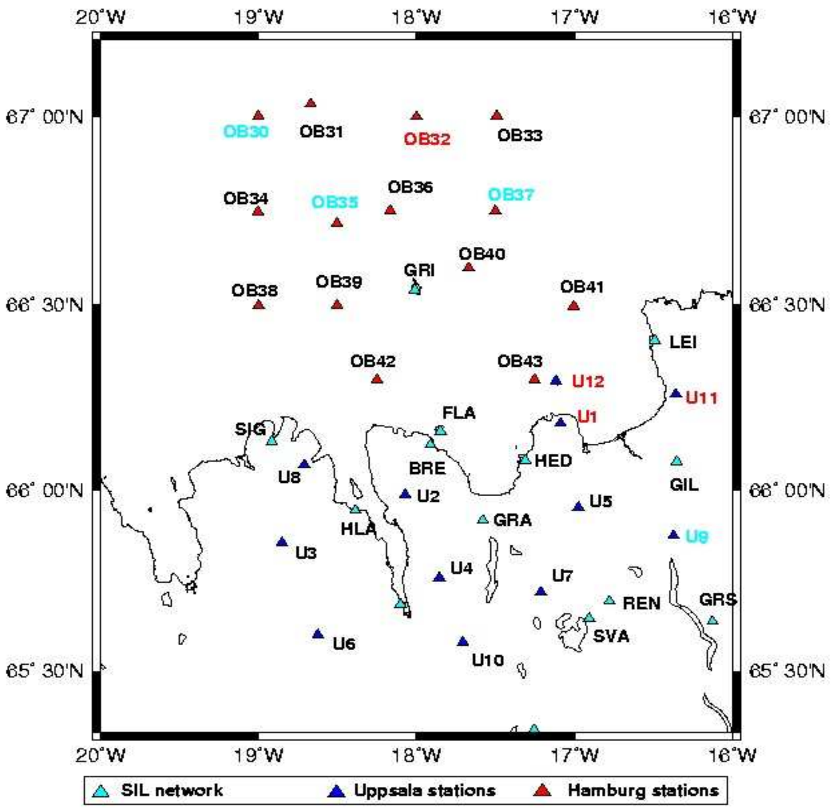

Figure A1: Map of ocean bottom instrument positions. The yellow triangles mark the stations.

Shot onset times on recording stations

Shot 1

```
2004  7 5F1105 41.5 LE 66.233 -18.751  0.0F UHH 27 0.9                        1
 GAP= 81        3.86       9.5    22.8  0.0 -0.3595E+01  0.0000E+00  0.0000E+00E
 2004  7 5 1105 41.5 LE 66.249 -18.503  0.1  UHH                             E13
 CHARGE(T):    0.023 Shot no.1                                               EC3
 ACTION:UP  04-12-16 16:19 OP:CARO STATUS:              ID:20040705110541 L   I
 2004-07-05-1105-33S.NSN___049                                                6
 STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
 KVO  Z  EP        11 6 14.08
 SIG  Z  IP        11 5 47.40                               31     2.810 13.5 213
 U08  Z  IP        11 5 47.33                               31     2.010 18.5 174
 OB42 Z  IP        11 5 46.54                               31     0.410 23.7  72
 OB42 E  IP        11 5 46.69                               31           23.7  72
 OB42 N  IP        11 5 46.70                               31           23.7  72
 OB38 Z  EP        11 5 49.97                               28     2.710 31.7 340
 OB38 N  EP        11 5 50.07                               28           31.7 340
 OB38 E  EP        11 5 50.43                               28           31.7 340
 OB39 Z  EP        11 5 48.73                               28     1.510 31.8  20
 OB39 N  EP        11 5 49.05                               28           31.8  20
 OB39 E  EP        11 5 49.26                               28           31.8  20
 HLA  Z  IP        11 5 49.22                               28     1.310 36.2 153
 BRE  Z  IP        11 5 48.56                               28     0.210 39.8 108
 FLA  Z  IP        11 5 49.28                               28     0.710 41.5 101
 GRI  Z  EP        11 5 50.05                               28     0.610 47.7  44
 OB34 Z  EP        11 5 53.55                               28     2.5 9 58.6 349
 OB40 Z  IP        11 5 52.33                               28     0.7 9 63.3  49
 OB40 E  EP        11 5 52.38                               28           63.3  49
 OB40 N  EP        11 5 52.93                                            63.3  49
 OB36 E  EP        11 5 52.88                               28     1.2 9 63.4  24
 OB36 Z  EP        11 5 52.88                               28           63.4  24
 OB36 N  EP        11 5 52.93                                            63.4  24
 HRN  Z  IP        11 5 55.17                               28     3.5 9 63.4 258
 GRA  Z  IP        11 5 52.39                               28     0.7 9 63.7 123
 U04  Z  EP        11 5 53.37                               28     1.2 8 66.7 142
 HED  Z  IP        11 5 52.56                               28     0.3 8 67.2 104
 OB43 N  EP        11 5 53.04                               28     0.7 8 67.8  83
 OB43 Z  EP        11 5 53.12                               28           67.8  83
 OB43 E  EP        11 5 53.27                               28           67.8  83
 OB41 Z  EP        11 5 56.00                               28     1.5 7 83.6  69
 OB41 N  EP        11 5 56.07                               28           83.6  69
 OB31 h  EP        11 5 56.81                               28     1.5 6 89.3   2
 U07  Z  IP        11 5 56.23                               28     0.8 6 90.5 129
 LEI  Z  EP        11 5 57.70                               28     0.4 5  103  78
 REN  Z  EP        11 5 58.82                               28     1.0 4  106 127
 U11  Z  EP        11 5 58.27                               28     0.4 4  108  87
 GIL  Z  EP        11 5 58.97                               28     0.8 4  110  98
 SVA  Z  EP      C 11 6  1.68                               28     1.8 3  121 145
 GRS  Z  EP        11 6  3.16                               28     1.1 1  137 118
```

Shot 2

```
2004  7 5F1257 14.2 LE 66.536 -18.770  0.0F UHH 25 0.5                        1
GAP= 89        2.36        5.9     14.1  0.0  0.7434E+01  0.0000E+00  0.0000E+00E
2004  7 5 1257 14.23LE 66.502 -18.669  0.1  UHH                              E13
CHARGE(T):    0.023 Shot no.2                                                EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:              ID:20040705125714 L   I
2004-07-05-1254-59S.NSN___049                                                 6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB38 E  EP       1257 18.77                              43     1.910 11.0 248
OB38 N  EP       1257 18.81                              49           11.0 248
OB38 Z  EP       1257 18.81                              49           11.0 248
OB39 Z  EP       1257 17.20                              31     0.110 12.5 108
OB39 E  EP       1257 17.23                              95           12.5 108
OB39 N  EP       1257 17.44                              95           12.5 108
OB34 Z  EP       1257 21.04                              31     1.910 25.9 337
GRI  Z  EP       1257 20.36                              28     0.110 33.8  89
OB42 Z  EP       1257 20.98                              28     0.510 35.3 138
OB42 N  EP       1257 21.15                              45           35.3 138
OB42 E  EP       1257 21.22                              28           35.3 138
OB36 Z  EP       1257 21.40                              28     0.910 36.0  48
OB36 N  EP       1257 21.52                              45           36.0  48
OB36 E  EP       1257 21.57                              45           36.0  48
SIG  Z  IP       1257 22.39                              28     0.510 45.4 188
OB40 Z  EP       1257 22.88                              28     0.510 49.4  81
OB40 E  EP       1257 23.04                              45           49.4  81
OB40 N  EP       1257 23.38                                           49.4  81
U08  Z  EP       1257 23.26                              28     0.510 52.2 177
OB31 h  EP       1257 24.37                              28     1.1 9 55.6   5
FLA  Z  IP       1257 24.26                              28     0.5 9 58.8 135
BRE  Z  IP       1257 24.22                              28     0.3 9 60.0 140
OB32 h  EP       1257 25.19                              28     1.0 9 61.9  33
HLA  Z  EP       1257 25.62                              28     0.6 8 68.1 165
OB43 Z  EP       1257 26.31                              28     0.6 8 72.8 110
OB43 E  EP       1257 26.72                              45           72.8 110
OB43 N  EP       1257 26.72                              45           72.8 110
HRN  Z  EP       1257 27.44                              28     1.2 7 77.0 233
OB41 Z  EP       1257 27.42                              28     0.9 7 78.8  92
OB41 N  EP       1257 27.67                              45           78.8  92
OB41 E  EP       1257 27.69                              45           78.8  92
GRA  Z  EP       1257 27.92                              28     0.2 6 87.3 142
U04  Z  EP       1257 29.94                              28     1.0 5 95.9 154
LEI  Z  EP       1257 30.37                              28     0.5 5  103  97
U11  Z  EP       1257 31.62                              28     0.4 4  112 105
U07  Z  EP     D 1257 31.58                              28     0.0 3  115 142
GIL  Z  EP       1257 32.80                              28     0.5 3  120 114
SVA  Z  EP       1257 37.27                              28     0.6 0  150 152
ADA  Z  EP     C 1257 48.70                              27     1.8 0  224 138
```

Shot 3

```
 2004  7 5F1636 25.8 LE 67.058 -19.352  0.0F UHH 14 0.8                        1
 GAP=255        1.69       8.7    17.3  0.0  0.8433E+02  0.0000E+00  0.0000E+00E
 2004  7 5 1636 25.81LE 66.999 -19.165  0.1  UHH                             E13
 CHARGE(T):    0.023 Shot no.3                                               EC3
 ACTION:UP  04-12-16 16:19 OP:CARO STATUS:               ID:20040705163625 L   I
 2004-07-05-1636-13S.NSN___049                                                 6
 STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
 OB30 h  EP        1636 30.97                              31     1.710 16.6 112
 OB31 h  EP        1636 30.82                              28    -0.510 29.8  95
 OB34 Z  EP        1636 32.28                              28    -0.110 37.7 156
 OB32 h  EP        1636 35.31                              28    -0.1 9 59.3  96
 OB36 Z  EP        1636 35.40                              28    -0.4 9 62.1 123
 OB36 N  EP        1636 35.44                                           62.1 123
 OB36 E  EP        1636 35.45                             103           62.1 123
 OB38 Z  IP        1636 36.53                              28     0.4 9 64.2 166
 OB33 h  EP        1636 38.34                              28    -0.1 7 81.3  94
 GRI  Z  EP        1636 37.89                              28    -0.8 7 82.5 134
 OB40 E  EP        1636 38.18                              28    -1.5 6 89.9 124
 OB40 Z  EP        1636 38.31                                           89.9 124
 OB40 N  EP        1636 39.27                                           89.9 124
 OB42 N  EP        1636 40.49                              28    -0.3 5 97.7 150
 OB42 E  EP        1636 41.14                              93           97.7 150
 OB42 Z  EP        1636 41.46                                           97.7 150
 SIG  Z  EP        1636 41.00                              28    -0.8 4  105 169
 HRN  Z  EP        1636 43.33                              28     0.7 4  111 198
 LEI  Z  EP        1636 47.64                              28     0.1 0  146 119
 U11  Z  EP        1636 49.84                              28     0.4 0  159 122
```

Shot 4

```
 2004  7 5F1719 13.2 LE 67.038 -19.048  0.0F UHH  9 1.2                        1
 GAP=274        2.90      10.8    28.9  0.0  0.1449E+03  0.0000E+00  0.0000E+00E
 2004  7 5 1719 13.2 LE 67.002 -18.961  0.1  UHH                             E13
 CHARGE(T):    0.023 Shot no.4                                               EC3
 ACTION:UP  04-12-16 16:19 OP:CARO STATUS:               ID:20040705171913 L   I
 2004-07-05-1717-59S.NSN___049                                                 6
 STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
 OB30 h  IP        1719 14.55                              43     0.010 4.61 153
 OB31 h  IP        1719 16.63                              31    -0.110 16.5  92
 OB34 Z  EP        1719 19.28                              28     0.310 32.3 176
 OB32 h  IP        1719 21.30                              28     0.410 45.9  95
 OB36 Z  EP        1719 21.76                              28     0.210 50.1 129
*OB36 E  EP        1719 21.81                              28           50.1 129
*OB36 N  EP        1719 21.98                                           50.1 129
 OB38 Z  EP        1719 23.52                              28     0.6 9 60.2 178
*OB38 N  EP        1719 24.43                                           60.2 178
*OB38 E  EP        1719 24.86                              28           60.2 178
 OB39 Z  EP        1719 23.91                              28     0.4 9 64.5 158
*OB39 E  EP        1719 24.10                              28           64.5 158
*OB39 N  EP        1719 24.11                              28           64.5 158
 OB33 h  EP        1719 25.39                              28     1.4 8 68.0  93
 OB40 E  EP        1719 21.64                              28    -3.8 7 77.9 128
```

Shot 5

```
2004  7 5F1747 17.1 LE 67.022 -17.819  0.0F UHH 12 6.8                      1
GAP=230       16.13      53.5    127.3  0.0 -0.8512E+03  0.0000E+00  0.0000E+00E
2004  7 5 1747 17.15LE 67.000 -18.831  0.1  UHH                             E13
CHARGE(T):    0.023 Shot no.5                                               EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:           ID:20040705174717 L   I
2004-07-05-1744-59S.NSN___049                                                 6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB32 h  IP       1747 23.96                              43      4.810 8.23 252
OB36 N  EP       1747 20.69                              28     -2.410 33.8 207
OB36 E  EP       1747 20.77                              28            33.8 207
OB36 Z  EP       1747 20.90                                            33.8 207
OB31 h  IP       1747 19.48                              28     -4.110 37.1 272
OB40 Z  EP       1747 17.04                              28     -8.010 47.6 172
OB40 E  EP       1747 17.19                              28            47.6 172
OB40 N  EP       1747 17.19                                            47.6 172
OB30 h  IP       1747 22.22                              28     -3.410 51.6 268
OB34 Z  EP       1747 22.95                              28     -3.9 9 60.1 240
OB41 N  EP       1747 15.09                                            68.7 148
OB41 Z  EP       1747 15.09                              28    -12.9 8 68.7 148
OB41 E  EP       1747 15.11                              28    -12.9 8 68.7 148
OB38 E  EP       1747 26.05                              28     -3.3 7 78.2 222
OB42 E  EP       1747 31.14                              28      1.1 7 82.9 193
OB42 Z  EP       1747 31.14                                            82.9 193
OB42 N  EP       1747 31.38                              28            82.9 193
OB43 N  EP       1747 39.01                              28      8.8 7 84.4 162
OB43 Z  EP       1747 39.04                              28      8.8 7 84.4 162
OB43 E  EP       1747 39.19                              28            84.4 162
U11  Z  EP       1747 41.33                              28      8.0 4  107 142
U07  Z  EP       1747 41.33                              28      2.2 0  148 169
```

Shot 6

```
2004  7 5F1822 17.3 LE 67.078 -18.722  0.0F UHH  9 0.9                      1
GAP=260        1.55       5.5     18.5  0.0  0.3947E+02  0.0000E+00  0.0000E+00E
2004  7 5 1822 17.33LE 67.000 -18.661  0.1  UHH                             E13
CHARGE(T):    0.023 Shot no.6                                               EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:           ID:20040705182217 L   I
2004-07-05-1819-59S.NSN___049                                                 6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB31 h  IP       1822 18.82                              43      0.010 5.52 156
OB32 h  IP       1822 23.21                              28      0.010 32.7 105
OB34 Z  EP       1822 23.80                              28     -0.210 38.7 199
OB33 h  EP     D 1822 26.73                              28      0.510 54.2  98
OB38 E  EP       1822 29.31                              28      1.5 8 65.7 191
GRI  Z  EP       1822 27.17                              28     -0.9 8 67.5 152
OB40 E  EP       1822 28.69                              28      0.2 8 70.6 139
OB42 E  EP       1822 29.12                              28     -2.0 6 89.4 166
U08  Z  EP       1822 36.09                              28      1.7 4  113 180
```

Shot 7

```
2004  7 5F1854 57.7 LE 67.075 -18.415  0.0F UHH 21 1.0                       1
GAP=214        2.20        6.0    18.2  0.0  0.6191E+01  0.0000E+00  0.0000E+00E
2004  7 5 1854 57.69LE 67.000 -18.511  0.1  UHH                             E13
CHARGE(T):    0.023 Shot no.7                                               EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:           ID:20040705185457 L   I
2004-07-05-1854-59S.NSN___048                                                 6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB31 h  EP        1855  3.11                             43      2.610 12.1 247
OB32 h  IP        1855  2.65                             31      0.910 20.0 115
OB36 Z  EP        1855  4.01                             28     -0.310 37.7 163
OB36 N  EP        1855  4.07                             28            37.7 163
OB36 E  EP        1855  4.14                                           37.7 163
OB33 h  EP        1855  6.17                             28      1.410 41.0 101
OB34 Z  IP        1855  4.69                             28     -0.510 44.5 215
GRI  Z  IP        1855  7.24                             28     -0.5 9 62.1 163
OB40 Z  IP        1855  8.01                             28      0.3 9 62.3 148
OB40 N  IP        1855  8.05                             28            62.3 148
OB40 E  EP        1855  8.31                                           62.3 148
OB39 Z  EP        1855  7.48                             28     -0.5 9 64.2 184
OB39 E  EP        1855  7.57                             28            64.2 184
OB39 N  EP        1855  7.62                             28            64.2 184
OB38 Z  IP        1855  8.35                             28     -0.3 8 69.2 202
OB38 E  EP        1855  8.59                             28     -0.1 8 69.2 202
OB38 N  EP        1855  8.59                             28            69.2 202
OB42 E  EP        1855 10.44                             28     -0.7 6 86.9 175
OB42 Z  EP        1855 10.45                             28     -0.7 6 86.9 175
OB42 N  EP        1855 10.48                             28            86.9 175
OB41 Z  EP        1855 12.61                             28      1.1 6 89.6 135
OB43 N  EP        1855 13.45                             28             101 149
OB43 Z  EP        1855 13.45                             28             101 149
OB43 E  EP        1855 13.45                             28      0.4 5  101 149
FLA  Z  EP        1855 12.89                             28     -0.8 4  105 166
BRE  Z  EP        1855 13.62                             28     -0.6 4  109 168
LEI  Z  IP        1855 15.45                             28      0.6 4  113 130
HED  Z  EP        1855 15.37                             28     -0.6 3  121 156
U11  Z  EP        1855 17.85                             28      0.8 2  129 134
GRA  Z  EP        1855 18.01                             28      0.2 2  134 164
GIL  Z  EP        1855 19.85                             28      0.6 1  144 140
U07  Z  EP        1855 20.84                             28     -0.6 0  161 160
SVA  Z  EP        1855 26.60                             28     -0.6 0  201 164
```

Shot 8

```
2004  7 5F1929 21.2 LE 67.072 -18.380  0.0F UHH 22 0.9                       1
GAP=210        1.53       4.6     13.9  0.0  0.9304E+01  0.0000E+00  0.0000E+00E
2004  7 5 1929 21.2 LE 67.000 -18.34   0.1  UHH                            E13
CHARGE(T):    0.046 Shot no.8                                              EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:           ID:20040705192921 L   I
2004-07-05-1928-59S.NSN___048                                                6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB31 h  IP       1929 24.51                              31      0.310 13.3 251
OB32 h  IP       1929 25.01                              31      0.010 18.5 116
OB36 Z  EP       1929 27.00                              28     -0.710 36.9 165
OB36 E  EP       1929 27.13                              69            36.9 165
OB36 N  EP       1929 27.23                                            36.9 165
OB33 h  EP     D 1929 28.17                              28      0.110 39.5 101
OB34 Z  IP       1929 28.71                              28     -0.110 45.1 217
OB40 Z  EP       1929 30.88                              28     -0.2 9 61.2 149
OB40 N  EP       1929 31.39                                            61.2 149
OB40 E  EP       1929 31.43                              69            61.2 149
GRI  Z  IP       1929 30.29                              28     -0.8 9 61.3 164
OB39 N  EP       1929 31.24                              28     -0.2 9 63.9 185
OB39 E  EP       1929 31.31                              69            63.9 185
OB38 Z  IP       1929 32.23                              28      0.0 8 69.4 203
OB38 E  EP       1929 32.25                              69            69.4 203
OB38 N  EP       1929 33.36                                            69.4 203
OB41 Z  EP       1929 35.33                              28      0.5 6 88.2 136
OB41 N  EP       1929 35.86                              69            88.2 136
OB43 E  EP       1929 37.33                              28      0.9 5 99.5 149
OB43 Z  EP       1929 45.83                                            99.5 149
FLA  Z  EP       1929 40.71                              28      3.6 5  104 167
SIG  Z  EP       1929 37.05                              28     -0.5 4  107 193
BRE  Z  EP       1929 38.99                              28      1.4 4  108 169
LEI  Z  EP       1929 38.61                              28      0.5 4  112 131
U08  Z  EP       1929 40.73                              28      2.4 4  113 188
HED  Z  EP       1929 38.86                              28     -0.5 3  120 156
HLA  Z  EP       1929 39.61                              28     -0.5 2  126 180
HRN  Z  EP       1929 40.42                              28     -0.6 2  132 217
GIL  Z  EP       1929 43.42                              28      0.9 1  143 140
REN  Z  EP       1929 26.42                              28    -20.3 0  172 157
SVA  Z  EP       1929 52.95                              28      2.3 0  200 165
```

Shot 9

```
2004  7 5F2008  1.2 LE 67.040 -18.237  0.0F UHH 16 1.2                        1
GAP=189        2.32       9.5    19.2  0.0  0.2663E+02  0.0000E+00  0.0000E+00E
2004  7 5 2008  1.23LE 66.993 -18.175  0.1  UHH                             E13
CHARGE(T):    0.023 Shot no.9                                               EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:            ID:20040705200801 L   I
2004-07-05-2006-59S.NSN___049                                                 6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB32 h  IP        20 8  4.17                             43      0.310 11.3 113
OB31 h  EP        20 8  6.32                             31      1.310 18.9 268
OB33 h  EP        20 8  7.85                             28      0.810 32.7  97
OB34 Z  IP        20 8  9.94                             28      0.910 46.6 226
OB38 Z  EP        20 8  9.57                             28     -2.6 8 69.0 209
OB38 E  EP        20 8 13.52                             45            69.0 209
OB38 N  EP        20 8 13.92                                           69.0 209
OB41 Z  EP        20 8 14.62                             28      0.7 7 81.4 138
OB41 E  EP        20 8 14.80                             45            81.4 138
OB41 N  EP        20 8 14.89                                           81.4 138
OB42 E  EP        20 8 15.18                             28      1.1 7 82.7 180
OB42 N  EP        20 8 15.65                                           82.7 180
OB43 E  EP        20 8 13.80                             28     -1.8 6 93.3 152
OB43 Z  EP        20 8 14.26                                           93.3 152
OB43 N  EP        20 8 14.45                             45            93.3 152
FLA  Z  EP        20 8 15.76                             28     -0.7 5 99.5 170
BRE  Z  EP        20 8 18.12                             28      1.2 5  103 172
LEI  Z  EP        20 8 17.58                             28      0.4 5  105 132
SIG  Z  EP        20 8 17.51                             28      0.2 4  106 197
HED  Z  EP        20 8 18.82                             28      0.3 4  115 159
GRA  Z  EP      D 20 8 21.31                             28      0.8 2  129 167
GIL  Z  EP      D 20 8 22.85                             28      1.3 1  136 141
U07  Z  EP        20 8 25.50                             28      1.4 0  154 162
```

Shot 10

```
2004  7 5F2108  4.0 LE 67.076 -17.755  0.0F UHH 11 1.4                        1
GAP=222        3.56      12.7    35.5  0.0 -0.1246E+03  0.0000E+00  0.0000E+00E
2004  7 5 2108  4.07LE 67.002 -17.840  0.1  UHH                             E13
CHARGE(T):    0.023 Shot no.10                                              EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:            ID:20040705210804 L   I
2004-07-05-2107-20S.NSN___049                                                 6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB32 h  EP        21 8  6.93                             31     -0.110 13.6 231
OB33 h  EP        21 8  8.72                             31      1.610 14.2 126
OB31 h  EP        21 8 11.44                             28      0.510 40.1 264
OB36 E  EP        21 8 11.52                             28      0.610 40.4 207
OB36 N  EP        21 8 11.53                                           40.4 207
OB40 E  EP        21 8 13.81                             28      1.010 53.3 176
OB40 N  EP        21 8 13.87                                           53.3 176
OB34 Z  EP        21 8 14.88                             28      0.4 8 65.6 237
OB39 Z  EP        21 8 15.54                             28      0.1 8 72.1 208
OB39 N  EP        21 8 15.86                                           72.1 208
OB39 E  EP        21 8 15.91                             69            72.1 208
OB41 Z  EP        21 8 12.68                             28     -2.8 8 72.6 152
OB38 Z  EP        21 8 17.29                             28      0.2 7 84.5 221
OB38 E  EP        21 8 17.94                             69            84.5 221
OB38 N  EP        21 8 18.85                                           84.5 221
OB42 N  EP        21 8 14.32                             28     -3.5 6 89.4 194
OB42 Z  EP        21 8 14.35                                           89.4 194
OB42 E  EP        21 8 14.36                             69            89.4 194
U07  Z  EP        21 8 27.03                             28      0.3 0  153 171
```

Shot 11

```
 2004  7 5F2144  0.6 LE 67.115 -17.593  0.0F UHH 22 0.5                        1
 GAP=248        1.11       3.4     12.9  0.0 -0.1218E+02  0.0000E+00  0.0000E+00E
 2004  7 5 2144  0.6 LE 67.001 -17.672  0.1  UHH                               E13
 CHARGE(T):    0.023 Shot no.11                                                EC3
 ACTION:UP  04-12-16 16:19 OP:CARO STATUS:             ID:20040705214400 L   I
 2004-07-05-2142-59S.NSN___049                                                 6
 STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
 OB33 h  IP       2144  4.09                             31      0.510 13.4 161
 OB32 h  IP       2144  5.11                             31      0.210 21.8 234
 OB36 E  EP       2144  8.18                             28     -0.410 47.6 212
 OB36 N  EP       2144  8.94                                            47.6 212
 OB36 Z  EP       2144 25.30                                            47.6 212
 OB31 h  EP       2144  9.24                             28      0.710 47.7 259
 OB40 E  EP       2144  9.31                             28     -0.7 9 57.6 183
 OB40 Z  EP       2144  9.70                                            57.6 183
 OB40 N  EP       2144 16.15                                            57.6 183
 GRI  Z  IP       2144 10.61                             28     -0.6 8 66.5 196
 OB41 N  EP       2144 13.07                             28      0.9 8 73.7 159
 OB41 Z  EP       2144 13.09                                            73.7 159
 OB41 E  EP       2144 13.41                             69             73.7 159
 OB39 Z  EP       2144 12.70                             28     -0.3 7 79.3 211
 OB39 N  EP       2144 13.04                                            79.3 211
 OB39 E  EP       2144 13.26                             69             79.3 211
 OB43 N  EP       2144 15.34                             28      0.5 6 92.2 170
 OB38 Z  EP       2144 15.04                             28      0.2 6 92.4 223
 LEI  Z  IP       2144 15.29                             28      0.4 6 92.8 148
 OB42 Z  EP       2144 15.35                             28      0.1 5 95.5 198
 OB42 N  EP       2144 15.55                                            95.5 198
 OB42 E  EP       2144 15.65                             69             95.5 198
 FLA  Z  EP       2144 16.55                             28     -0.3 4  107 186
 BRE  Z  IP       2144 17.06                             28     -0.5 4  111 187
 HED  Z  EP       2144 18.11                             28     -0.1 3  116 174
 GIL  Z  IP       2144 20.19                             28      0.3 2  128 154
 GRA  Z  EP     D 2144 20.52                             28     -0.1 2  134 180
 HLA  Z  EP       2144 22.63                             28      1.8 1  135 195
 U07  Z  IP       2144 23.82                             28      0.0 0  157 174
 HRN  Z  EP       2144 24.16                             28      0.1 0  158 226
 GRS  Z  EP     C 2144 29.95                             28      3.1 0  177 158
 SVA  Z  EP       2144 32.87                             28      3.0 0  199 175
```

Shot 12

```
2004  7 5F2241  0.9 LE 67.079 -17.254  0.0F UHH 19 0.7                        1
GAP=250        0.99       3.9     10.4  0.0 -0.1640E+02  0.0000E+00  0.0000E+00E
2004  7 5 2241  0.85LE 67.000 -17.339  0.1  UHH                               E13
CHARGE(T):    0.046 Shot no.12                                                EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:               ID:20040705224100 L   I
2004-07-05-2239-59S.NSN___049                                                  6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB33 h  IP       2241  3.63                              31    -0.310 13.4 230
OB32 h  EP       2241  7.20                              28     0.310 33.6 255
OB36 E  EP       2241  9.54                              28    -0.210 54.1 228
OB36 Z  EP       2241  9.65                                           54.1 228
OB36 N  EP       2241  9.86                                           54.1 228
OB31 h  EP       2241 11.22                              28     0.4 9 61.8 266
OB41 Z  EP       2241 11.92                              28     0.5 8 65.8 170
OB41 E  EP       2241 12.28                              45           65.8 170
OB41 N  EP       2241 12.38                                           65.8 170
GRI  Z  IP       2241 11.42                              28    -0.4 8 68.5 209
LEI  Z  EP       2241 13.93                              28     0.2 7 82.2 155
OB34 Z  EP       2241 14.35                              28     0.3 7 84.8 245
OB43 Z  EP       2241 14.80                              28     0.4 6 86.9 180
OB43 N  EP       2241 14.90                                           86.9 180
OB43 E  EP       2241 14.93                              45           86.9 180
OB42 E  EP       2241 16.20                              28     0.4 5 97.4 207
OB42 N  EP       2241 16.66                                           97.4 207
U11  Z  EP       2241 16.04                              28    -0.1 5 99.5 156
FLA  Z  EP       2241 14.97                              28    -2.0 4  106 195
BRE  Z  EP       2241 17.57                              28    -0.1 4  110 196
HED  Z  IP       2241 17.74                              28    -0.1 4  111 181
GIL  Z  EP       2241 19.28                              28     0.4 3  119 160
GRA  Z  EP       2241 22.90                              28     2.4 2  130 187
HLA  Z  EP       2241 23.84                              28     2.6 1  136 202
U07  Z  EP     C 2241 23.27                              28    -0.2 0  152 179
GRS  Z  EP       2241 29.68                              28     3.8 0  168 162
```

Shot 13

```
2004  7 6F0836  1.1 LE 66.966 -17.175  0.0F UHH 17 1.0                        1
GAP=227        1.82       6.7     16.3  0.0 -0.1882E+02  0.0000E+00  0.0000E+00E
2004  7 6 0836  1.06LE 66.872 -17.400  0.1  UHH                              E13
CHARGE(T):    0.023 Shot no.13                                               EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:           ID:20040706083601 L   I
2004-07-06-0835-18S.NSN___049                                                 6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB33 h  IP        836  5.57                              31      1.310 14.4 287
OB32 h  EP        836  7.66                              28      0.210 36.1 276
OB40 Z  EP        836  8.74                              28     -0.110 46.2 208
OB40 E  EP        836  9.00                             110            46.2 208
OB40 N  EP        836  9.16                                            46.2 208
OB36 Z  IP        836  8.68                              28     -0.710 49.6 242
OB36 N  IP        836  8.73                                            49.6 242
OB36 E  EP        836  8.75                             109            49.6 242
OB36 N  EP        836  8.75                                            49.6 242
OB41 Z  EP        836 10.60                              28      0.810 52.8 172
OB41 E  EP        836 10.82                             105            52.8 172
OB41 N  EP        836 10.89                                            52.8 172
LEI  Z  IP        836 12.87                              28      0.8 8 69.3 154
OB39 Z  EP        836 12.81                              28     -0.5 7 78.2 229
OB39 N  EP        836 13.24                                            78.2 229
OB39 E  EP        836 13.25                              99            78.2 229
OB34 Z  IP        836 13.99                              28     -0.1 7 83.6 254
FLA  Z  EP        836 15.62                              28      0.0 6 94.6 199
OB38 Z  EP        836 15.10                              28     -0.7 5 95.8 238
OB38 E  EP        836 16.91                              97            95.8 238
HED  Z  EP        836 15.94                              28     -0.3 5 98.8 184
BRE  Z  EP     C  836 16.01                              28     -0.3 5 99.4 199
GIL  Z  IP        836 17.71                              28      0.5 4  106 159
SIG  Z  EP        836 16.47                              28     -2.9 3  121 221
HLA  Z  EP     D  836 24.02                              28      4.0 2  126 206
GRS  Z  EP        836 25.51                              28      1.3 0  155 162
SVA  Z  EP     C  836 30.77                              28      2.8 0  182 181
```

Shot 14

```
2004  7 6F0954  0.6 LE 66.661 -17.498  0.0F UHH 23 3.2                         1
GAP=121        7.93       18.9       52.0  0.0 -0.1088E+03  0.0000E+00  0.0000E+00E
2004  7 6 0954  0.64LE 66.702 -17.523  0.1  UHH                               E13
CHARGE(T):    0.023 Shot no.14                                                EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:              ID:20040706095400 L   I
2004-07-06-0952-59S.NSN___049                                                   6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
KVO  Z  EP        954 31.12
OB40 E  EP        953 52.94                               43   -10.110 10.2 228
OB40 Z  EP        953 53.23                                            10.2 228
OB40 N  EP        953 54.14                                            10.2 228
GRI  Z  IP     C  954  6.83                               31     1.210 26.3 240
OB41 Z  EP        954  0.87                               28    -5.010 28.6 130
OB41 E  EP        954  9.08                               28           28.6 130
OB41 N  EP        954  9.09                                            28.6 130
OB36 Z  EP        954  7.31                               28     1.010 31.2 289
OB36 N  EP        954  7.34                                            31.2 289
OB36 E  EP        954  7.39                               28           31.2 289
OB33 h  EP        954  7.90                               28     0.710 38.0   0
OB43 N  EP        954 10.45                               28     2.710 41.8 165
OB43 E  EP        954 10.46                               28           41.8 165
OB32 h  EP        954  8.58                               28     0.610 43.7 330
OB39 Z  EP        954 10.59                               28     2.010 48.0 249
OB39 N  EP        954 10.74                                            48.0 249
OB39 E  EP        954 11.22                               28           48.0 249
OB42 Z  EP        954 11.46                               28     2.210 52.4 220
LEI  Z  IP        954 11.16                               28     1.810 53.1 122
FLA  Z  EP     D  954 12.36                               28     2.3 9 58.0 196
BRE  Z  EP        954 12.71                               28     2.0 9 62.7 197
HED  Z  IP        954 12.99                               28     1.9 8 65.3 172
OB34 Z  EP        954 14.17                               28     2.9 8 67.0 279
OB38 E  EP        954 12.49                               28     0.9 8 69.0 255
GIL  Z  EP        954 15.63                               28     2.1 7 82.9 141
GRA  Z  EP        954 15.67                               28     2.1 7 83.0 183
U08  Z  EP        954 15.69                               28     1.8 6 85.5 220
HLA  Z  EP        954 15.75                               28     1.3 6 89.3 207
U07  Z  IP        954 18.72                               28     2.0 4  106 173
GRS  Z  EP        954 24.86                               28     4.7 2  130 151
SVA  Z  EP        954 25.25                               28     2.5 0  148 176
```

Shot 15

```
2004  7 6F1145 30.7 LE 66.493 -17.396  0.0F UHH 16 1.8                         1
GAP= 92        4.85      13.3    32.3  0.0  0.4974E+02  0.0000E+00  0.0000E+00E
2004  7 6 1145 30.71LE 66.453 -17.698  0.1  UHH                              E13
CHARGE(T):    0.023 Shot no.15                                               EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:            ID:20040706114530 L   I
2004-07-06-1143-59S.NSN___049                                                  6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
OB40 E  EP       1145 35.13                             31      0.910 17.0 315
OB40 Z  EP       1145 35.13                                           17.0 315
OB40 N  EP       1145 35.53                                           17.0 315
OB41 Z  EP       1145 29.13                             31     -5.210 17.5  88
OB41 N  EP       1145 29.14                             31            17.5  88
GRI  Z  EP       1145 35.04                             28     -0.910 27.8 282
LEI  Z  IP       1145 40.96                             28      3.110 41.6 103
FLA  Z  EP       1145 37.86                             28     -0.110 42.2 209
OB42 E  EP       1145 36.70                             28     -1.410 43.8 241
OB36 Z  EP       1145 38.44                             28      0.210 44.7 311
OB36 N  EP       1145 38.54                                           44.7 311
OB36 E  EP       1145 38.70                             28            44.7 311
HED  Z  EP       1145 39.24                             28      0.810 46.1 175
BRE  Z  EP     D 1145 38.44                             28     -0.210 47.2 209
OB33 h  EP       1145 41.28                             28      1.3 9 56.9 356
OB32 h  EP       1145 41.82                             28      1.1 9 62.4 335
GRA  Z  IP       1145 42.05                             28      1.0 9 64.7 187
GIL  Z  EP       1145 43.57                             28      2.3 8 65.9 134
OB38 Z  EP       1145 41.60                             28     -0.4 8 71.4 271
OB38 E  EP       1145 42.29                             28            71.4 271
OB38 N  EP       1145 42.39                                           71.4 271
HLA  Z  EP       1145 42.33                             28     -0.3 7 75.7 217
OB34 Z  EP       1145 42.53                             28     -0.2 7 76.6 293
```

Shot 16

```
2004  7 6F1318 10.7 LE 66.235 -17.803  0.0F UHH 16 1.7                         1
GAP= 63        5.01      13.3    35.4  0.0 -0.2478E+02  0.0000E+00  0.0000E+00E
2004  7 6 1318 10.72LE 66.250 -17.839  0.1  UHH                              E13
CHARGE(T):    0.023 Shot no.16                                               EC3
ACTION:UP  04-12-16 16:19 OP:CARO STATUS:            ID:20040706131810 L   I
2004-07-06-1315-59S.NSN___049                                                  6
STAT SP IPHASW D HRMM SECON CODA AMPLIT PERI AZIMU VELO AIN AR TRES W  DIS CAZ7
KVO  Z  EP       1318 30.11
FLA  Z  IP       1318 13.98                             43      1.110 8.55 193
BRE  Z  IP       1318 14.70                             31      1.010 13.4 201
OB43 E  EP       1318 15.99                             31      0.410 25.9  74
OB43 N  EP       1318 16.15                                           25.9  74
OB43 Z  EP       1318 16.17                                           25.9  74
HED  Z  EP       1318 17.01                             28      1.010 28.1 127
OB40 Z  EP       1318 18.71                             28      1.010 41.1   8
OB40 E  EP       1318 19.16                             69            41.1   8
HLA  Z  EP       1318 19.02                             28      1.210 41.8 219
OB39 E  EP       1318 23.75                             28      5.710 43.1 314
U08  Z  EP       1318 19.25                             28      1.010 44.9 246
OB38 E  EP       1318 18.26                             28     -2.3 9 61.1 299
LEI  Z  EP       1318 24.54                             28      3.9 9 61.9  71
U07  Z  IP       1318 22.06                             28      1.2 9 63.6 155
GIL  Z  IP       1318 23.09                             28      1.6 8 67.8 104
OB34 Z  EP       1318 24.09                             28      1.1 7 78.2 318
OB32 h  EP       1318 24.01                             28      0.0 6 85.7 354
HRN  Z  EP       1318 28.01                             28      1.2 4  106 263
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Multibeam tracks logbook

Date	Point number	Time	Ship's velocity in nm/h	Angular coverage left/right	Average depth in m	Sound speed in water next to ship	Location in ° min N ° min W	Remarks
06/09/04	1	19:03:00		63/63	140	1491.5	66 10 18 27	
	2	20:01:00					66 13 18 27	
	3	21:01:00					66 10 18 27	brl2/brl3
	3	21:39:00		63/63	223	1490.2	66 13 17 41	Station: CTD298
	4	22:18:00			221	1490.1	66 13 17 43	
	5	23:19:00	7.5	63/63	234	1489.5	66 16 17 35	401,5 nm at midnight
07/09/04	6	00:19:00	8		223	1490.5	66 22 17 29	brl2/brl4
	7	01:19:00	7.5		223	1487.8	66 30 17 29	
	8	02:19:00	8		300	1487.8	66 37 17 35	
	9	03:19:00					66 44 17 44	brl2/hægv.
	10	04:19:00	8	63/63	378	1484.3	66 52 17 53	
	11	05:19:00	8.6		447	1484.2	66 59 18 01	
	12	06:19:00	7.4	63/63	420	1484.1	66 55 17 57	brl2/SSA3
	13	07:19:00	8.6		402	1484.4	67 00 17 49	
	13	08:02:00	6.8	63/63	283	1484.6	67 00 17 33,5	stopped log at 08:02
	14	08:45:00	4.7		271	1484.5	67 00 17 29	start log after retrieval of OB33, SA2/S3
	15	09:45:00	11.3	63/63	438	1485	67 00 17 56	
	16	09:51:00			447		67 00 17 59	stopped log just north of OB32
	17	10:23:00	11.2			1484.5	67 00 18 01	start log, depth had to be adjusted
	17	11:24:00	10.9		88		67 01 18 29	line statistics file not found
	17	11:46:00	3.5		299		67 02 18 39	logging off, SA2/SA5
	1	12:29:00	11.8	63/63	360	1484.9	67 1,5 18 46	new transit survey from OB31
	1	13:00:00	11.8	63/63	494	1485.6	67 00 18 59	stop line at OB30
	2	13:13:00	11.8	63/63	504	1485.6	67 00 19 00	start log
	3	14:13:00	11.8	63/63	455	1482.7	66 50 19 00	new line

	3	14:48:00	0	63/63	343	1483.1	66 45 19 00	stop line at OB 36
	4	15:18:00	0	63/63	354	“	66 45 19 00	start log, skoða hljóðhraða, S2/SA3
	5	16:18:00	6.3	63/63	300	1485.4	66 45 18 31	new line
	5	16:22:00	6.3	63/63		1485.6	66 45 18 30	stop line at stöð OB38
	6	16:46:00	6.3	63/63	286	1485.7	66 45 18 29	start log
	6	17:26:00	6.3	63/63	410	1486.1	66 45 18 11	stop line at stöð OB39
	7	17:49:00	6.3	63/63	413	1486	66 45 18 10	start log, brl2/hægv
	8	18:49:00	6.3	63/63	358	1484.6	66 45 17 42	new line
	8	19:13:00	6.3	63/63	286	1483.9	66 45 17 30	stop line at stöð OB41
		18:48:00			281		66 45 17 30	Station: CTD299
	1	20:06:00	6.3	63/63	286	1485.2	66 45 17 30	new survey A200413_E2
	2	21:07:00	8.2	65/65	263	1486.6	66 53 17 29	new line, brl2/hægv
	3	22:07:00	8	65/65	293	1484	67 00 17 33	new line
	4	23:07:00	7.9	65/65	431	1484.6	67 01 17 53	new line
	4	23:14:00	7.9	65/65	433	1484.6	67 01 17 56	Station: CTD300
	5	23:53:00	7.9	65/65	428	1484.5	67 01 17 54	start log, svd300, brl2/brl2
08/09/04	6	00:53:00	8.2	65/65	448	1484.5	66 59 18 08	583 nm at midnight
	7	01:53:00	8.5	65/65	215	1485.1	66 58 18 27	
	8	02:53:00	9.3	65/65	415	1484.7	66 59 18 09	brl2/SV3
	9	03:53:00	9.8	65/65	354	1484.2	66 59 17 44	
	10	04:52:00	8.6	65/65	289	1485.2	66 59 17 31	
	11	05:52:00	9	65/65	291	1485	66 50 17 30	-/hægv
	12	06:52:00	8.2	65/65	305	1485	66 42 17 34	
	13	07:40:00	2.2	65/65	388	1487.9	66 36 17 40	stop line at OB40
		08:52:00		65/65	425		66 36 17 39	smábútur á A200413_E2
	14	08:54:00	11.1	65/65	424	1487.9	66 36 17 39	A200413_T2 af stað, brl/brl2
		09:53:00		65/65			66 31 17 11	

		10:25:00	0.4	65/65	236	1490.7	66 30 17 00	stop at OB41
		10:51:00	11.7	65/65	240		66 29 17 01	start log, svp 299
		11:52:00	10.5	65/65	150	1490.3	66 20 17 14	stop at OB43
		12:03:00	10.5	65/65	157	1490.5	66 18 17 15	logg af stað, brl2/brl2
		12:20:00	10.5	65/65	157	1490.4	66 18 17 15	new line
		13:20:00		65/65			66 18 17 43	new line
		14:20:00	11.8	65/65	102	1490.6	66 18 18 12	stop line at OB42
		14:29:00	11.8	65/65	121	1490.8	66 18 18 15	stop line
		14:42:00	11.8	65/65	129	1490.8	66 18 18 15	new line, SA2/SA4
		15:42:00	12.3	65/65	164	1491.4	66 28 18 28	stop line at OB41
		15:59:00		65/65	197	1490.8	66 30 18 30	start log
		16:17:00	12.3	65/65	193	1490.6	66 30 18 30	
		17:10:00	11	65/65	467	1484.5	66 30 18 55	svp300
		17:27:00	11	65/65	380	1486.8	66 30 19 00	stop line at OB38
	1	17:42:00		65/65	379	1486.8	66 30 19 00	start log, A200413_E3 svp300, brl2/hægv
	2	18:42:00	10.2	65/65	318	1485.7	66 36 19 12	new line
	3	19:42:00	8	65/65	345	1482.7	66 44 19 13	new line
	4	20:42:00	8.6	65/65	382	1481.9	66 52 19 15	new line
	4	20:53:00	8.6	65/65	389	1482.2	66 54 19 15	Station: CTD#301, S2/S3
	5	21:31:00	8.6	65/65	384	1482.3	66 53 19 15	stop CTD
	6	22:32:00	8.9	65/65	456	1483.4	67 01 19 05	new line
	7	23:31:00	8.1	65/65	431	1484.2	67 09 19 00	new line, 784,3 nm at midnight
09/09/04	8	00:31:00	8.3	65/65	458		67 16 19 00	new line, SV4/SV14
	9	01:31:00	7.8	65/65	415	1483.6	67 26 19 00	new line
	10	02:07:00	7.8	65/65	413	1482.3	67 30 19 00	Station: CTD#302
	10	02:52:00	7.6	65/65	402	1482.9	67 30 18 58	new line towards southwestern Kolbeinsey Ridge, SV5/SV7

	11	03:52:00	7.2	65/65	430	1483.4	67 23 18 58	
	12	04:52:00	6.7	65/65	461	1484.3	67 16 18 58	
	13	05:52:00	6	65/65	439		67 09 18 58	SV5/SV8
	14	06:52:00	8.4	65/65	465	1483.9	67 06 18 56	
	15	08:00:00	8.4	65/65	454	1484.3	67 16 18 55	enginn gluggi á enda línu
	16	09:02:00	10.9	63/63	428	1483.1	67 26 18 56	“, V5/V9
	17	09:53:00	8.7	63/63	446	1483.7	67 27 18 54	“
	18	11:01:00	19.5	63/63	475	1484.3	67 16 18 53	
	19	11:52:00	10.5	63/63			67 08 18 53	new line. SSV4/SSV9
	20	12:52:00	11.7	64/64	480	1484.5	67 15 18 51	new line
	21	13:52:00		64/64			67 26 18 52	new line
	21	14:19:00	11.7	64/64	454	1484.2	67 30 18 49	snúið á enda línu
	22	14:52:00	11.7	64/64	466	1484	67 25 18 49	new line. SV3/SV4
	23	15:52:00	10.9	64/64	460	1485.2	67 14 18 48	new line
	23	16:31:00	10.9	64/64	332	1484.7	67 07 18 49	snúið á enda línu
	24	16:52:00	11.4	68/68	336	1484.4	67 10 18 47	new line
	25	17:52:00	11	65/65	472	1484.7	67 21 18 48	new line, SV2/SV4
	25	18:45:00	8	64/64	456	1484.4	67 30 18 47	snúið á enda línu
	26	18:52:00		64/64			67 31 18 45	new line
	27	19:52:00		64/64			67 20 18 44	new line
	27	20:44:00	7.3	64/64	333	1485.1	67 14 18 37	fyllt í göt á enda línu, SSV2/SSV3
	28	21:52:00		64/64			67 20 18 42	new line
	29	22:52:00		64/64			67 30 18 42	new line
	29	22:59:00		64/64	454	1484	67 30 18 42	Station: CTD#303
	30	23:39:00		64/64	464	1484.1	67 30 18 41	brl2/brl2
10/09/04	1	00:39:00		64/64			67 22 18 40	new line, 976,7 nm at midnight
	33	01:03:00	5	65/65	237	1484.8	67 20 18 40	Line number changed
	34	02:03:00	10.4	65/65	436	1484.5	67 29 18 38	óreglulegt landslag, breytileg geislabr.
	35	03:03:00	11.1	66/65	248	1484.4	67 22 18 37	“, SV3/SV6

	36	04:03:00	10.5	68/65	258	1484.5	67 20 18 37	“
	37	05:03:00	10.6	65/65	341	1484.5	67 31 18 33	new line í snúningi á enda mælilínu
	38	06:03:00	10.6	66/66	333	1484.6	67 20 18 35	V3/V4
	39	07:03:00	10.6	70/64	371	1484.4	67 26 18 33	
	40	08:03:00	10.5	67/67	421	1484.3	67 26 18 30	
	41	09:03:00	11	66/70	320	1484.3	67 15 18 32	SV2/SV2
	42	10:03:00	10.1	67/67	425	1484.7	67 09 18 31	
	43	11:03:00	10.7	67/67	419	1484.8	67 09 18 32	
	44	12:03:00	10.9	67/67	458	1484.5	67 23 18 28	SV2/SV2
	45	13:03:00	11.3	67/67	447	1484.6	67 28 18 26	new line
	46	14:03:00	11.3	67/67	443	1483.8	67 16 18 28	
	47	15:03:00	11	67/67	266	1484.6	67 05 18 28	
	48	16:03:00	6	67/67	85	1485.2	67 01 18 30	
	49	17:03:00	10.4	65/65	74	1485.2	67 02 18 28	
	50	18:03:00	7.2	66/66	94	1484.6	67 02 18 25	SA2/SA2
	51	19:03:00	6	64/65	75	1485.4	67 03 18 27	new line
	52	20:03:00	10	66/66	68	1485.2	67 03 18 27	new line
	53	21:03:00	8.2	66/66	104	1485	67 02 18 25	new line, br2/brl2
		21:22:00			104		67 02 18 25	Station: CTD#304
	53	21:37:00		66/66	108	1485.2	67 02 18 24	stop line and ship
	1	21:40:00	2.8	66/66	84	1485.1	67 02 18 24	new survey A200413-E4
	2	22:39:00	9.3	66/66	208	1485.2	67 03 18 20	
	3	23:40:00			495		67 11 18 26	brl2/brl2
11/09/04	4	00:40:00	11.4	62/62	495	1484.3	67 21 18 24	1180,5 nm at midnight
	5	01:40:00	11.2	66/67	532	1484.4	67 30 18 20	new line
	6	02:40:00	12.1	66/67	520	1484	67 18 18 22	
	7	03:40:00	11.7	68/67	220	1484.8	67 06 18 26	brl2/hægv.
	8	04:40:00	11	65/70	362	1485.2	67 07 18 26	by eastern margin and Stóragrunn
	9	05:40:00	10.9	67/67	404	1485.1	67 01 18 03	
	10	06:40:00	8.1	67/67	150	1484.2	66 59 18 28	A2/A3
	11	07:40:00	11.1	67/67	256	1481.7	66 52 18 19	
	12	08:02:00	12	67/67	278	1482.7	66 48 18 17	

	1	08:05:00	11.9	65/65	279	1483.3	66 48 18 16	new survey A200413_T4, transit to Lágey
	2	09:04:00	11.8	65/65	222	1488.9	66 38 17 54	A2/A8
	3	10:04:00	11.2	65/65	352	1488.4	66 30 17 34	
	4	11:04:00	11.6	67/67	149	1488.9	66 22 17 15	
	5	11:42:00	0.3	67/67	80	1490.2	66 18 17 06	A2/A7
	6	13:58:00	10.8	63/63	195	1489.9	66 16 16 58	Disk space problems
	6	14:07:00	10.8	63/63	199	1489.9	66 16 16 52	Station: CTD#307
	1	14:33:00	9.7	63/63	196	1489.8	66 15 16 53	start log, new survey A200413_A1 svp307
	2	15:32:00	11.4	67/67	166	1489.5	66 22 17 02	A2/A5
	3	16:32:00	9.7	67/67	235	1489.2	66 32 17 08	
	4	17:32:00	7.2	66/67	187	1489.2	66 32 17 10	
	5	18:32:00	7.5	68/68	143	1489.1	66 32 17 14	A3/A8
	6	19:32:00	6.6	65/65	154	1489	66 32 17 11	
	7	20:32:00	8.5	65/65	179	1489.6	66 27 17 04	
	8	21:32:00	9.9	65/65	181	1489.3	66 18 17 01	A3/A10
	9	22:32:00	7.6	60/60	146	1488.9	66 20 17 00	
	10	23:32:00	7.6	60/60	168	1488.7	66 20 17 00	ANA4/ANA 14
12/09/04		00:20:00	10.7	60/60	165	1489.9	66 15 17 02	Axarfjördur survey aborted due to weather
								1407,3 nm (midnight)
	11	00:20:00	10.7	60/60	165	1489.9	66 15 17 02	Survey A200413_T4
	12	01:19:00	11	62/62	200	1490.3	66 12 17 26	Transit to Eyjafjörður
	13	02:19:00	12.1	62/62	65	1490.3	66 12 17 52	
	14	03:12:00			148	1490.3	66 14 18 14	svp 299
	15	04:10:00	8.8	62/62	56	1489.5	66 07 18 22	NA5/NA14
	15	04:34:00	9.2	64/64	56	1488.6	66 04 18 20	Ping mode in manual and shallow
	16	05:10:00	9.6	74/61	74	1488.8	65 59 18 15	
	17	06:10:00	8.9	69/66	56	1488.8	66 04 18 20	N3/NA5
	18	07:10:00	8.2	68/67	105	1489.6	66 01 18 18	

	19	08:10:00	8.9	71/64	108	1489.1	66 00 18 18	line statistics file not found
	20	09:10:00	8.4	67/67	124	1489.7	66 05 18 22	A3/A12
	21	10:11:00	4.7	67/67	99	1489	65 57 18 14	
	22	11:11:00	10.5	67/67	123	1489.6	66 05 18 22	
	23	12:11:00		65/65		1490	65 58 18 17	A2/A3
	24	13:11:00					66 03 18 23	
	25	14:11:00					66 00 18 21	
	25	14:33:00	11.7	65/66			65 56 18 14	Transit to Akureyri
	26	15:11:00						
	26	16:05:00					65 41 18 04	Docked at Akureyri
	27	19:45:00		65/65				Restart from Akureyri
	28	20:58:00					65 50 18 06	new line
	29	21:00:00		68/66		1489.7	65 50 18 06	Surveying geothermal spire, in southern fjord NA32/NA3
	29	21:10:00		68/68		1489.6	65 49 18 08	
		21:13:00			81		65 49 18 08	Station: CTD#308
	30	21:43:00		68/68	87	1489.6	65 49 18 08	start line, svp 308
	30	22:59:00		68/68	97	1488.5	65 54 18 17	stop line, CTD309
	31	23:17:00	0.9	68/68	95	1488.6	65 54 18 14	start line, svp 309
13/09/04	32	00:17:00	12.3	70/65	61	1489.2	66 00 18 27	NA32/NA3, 1587 nm at midnight
	32	01:05:00	-	67/67	180	1488.9	66 08 18 29	stop line, Station: CTD#310
	33	01:28:00	-	67/67	178	1488.7	66 08 18 29	start line, svp 310
	34	02:30:00	10.3	67/67	137	1489.2	66 09 18 28	NA3/NA6
	35	03:27:00	10	67/67	105	1489.8	66 13 18 08	
	36	04:27:00	11.2	65/65	169	1489	66 13 17 45	
	37	04:55:00	11.2	67/68	298	1488.9	66 13 17 33	while trying to change svp mouse froze

									connection problems? line 38 lost
	39	06:05:00	6.1	67/68	78	1488.2		66 15 17 05	Resumed Axarfjördur survey NA4/NA6
								66 17 16 58	stop survey A2004_T4
	40	06:46:00	9.7	67/68	179	1487.7		66 17 16 58	Resume survey A2004_A1
	41	07:43:00	9.8	67/68	200	1488		66 27 17 03	
	42	08:43:00	9.6	69/67	238	1487.5		66 31 17 03	NA4/NA7
	43	09:43:00	10.4	67/68	167	1488.3		66 22 18 59	Sound speed from profile, probe not w.
									Computers restarted
	15	11:54:00		68/68	185	1488		66 23 17 00	Logging resumed, NA4/NA5
	16	12:53:00	11.2	68/69	198	1486.9		66 16 16 59	
	17	13:53:00	11.1	68/67	239	1488.3		66 26 17 00	
	18	14:53:00	12.4	68/67	239	1488		66 27 16 58	NA4/NA5
	19	15:54:00	~12	67/67	200	1488.5		66 16 16 55	
	20	16:54:00	9.8	67/67	177	1488.2		66 21 16 56	
	21	17:54:00	10.9	67/67	233	1487.7		66 31 16 58	NA4/NNA4
	22	18:54:00	10.6	67/67	201	1488		66 31 17 17	
	23	19:54:00	10.8	67/67	151	1489.2		66 20 17 17	
	24	20:54:00	10.3	67/67	211	1489		66 18 17 26	N4/N6
	1	21:35:00	11.5	67/67	172	1488.9		66 18 17 44	new survey A200413_E5
	2	22:35:00	11	67/67	172	1488.1		66 29 17 49	
	3	23:35:00	11.9	67/69	150	1487.6		66 38 18 01	1812,5 nm at midnight
14/09/04	4	00:35:00	10.7	67/67	265	1487.8		66 46 18 18	NA4/NA9,
		01:07:00	10.8	67/67	239	1486.8		66 51 18 21	svp 303
	6	02:06:00	9.9	67/67	348	1481.1		67 00 18 18	
	7	03:05:00	10.3	67/67	393	1482.1		67 05 18 18	NNA3/NNA 6
	8	04:05:00	10.2	67/67	529	1479.2		67 14 18 22	
	9	05:06:00	10.4	65/64	545	1481.2		67 24 18 18	
	10	06:06:00	11.1	65/65	810	1479.3		67 27 18 15	N3/N3
	11	07:06:00	12.3	64/67	624	1479.8		67 16 18 18	

	12	08:06:00	9.8	67/67	393	1478.7	67 06 18 20	
	13	09:06:00	10.2	67/67	565	1479.5	67 14 18 16	NA3/NNA5
	14	10:06:00	11.1	64/64	440	1478.4	67 11 18 16	
	15	11:05:00	6.1	66/66	379	1480.1	67 01 18 18	
	16	11:20:00	6.3	66/66	145	1480.2	67 01 18 21	stop logging,
								Dredging at Stóragrunn, plowbag lost
	16	11:55:00	11.8	66/66	152	1481.3	67 01 18 22	Logging resumed, brl2/brl2
	17	12:55:00	11.2	67/67	239	1486.9	66 49 18 23	
	19	13:55:00	11.5	67/67	246	1488.9	66 41 18 11	
	19	14:55:00	11.6	67/68	146	1488	66 32 17 53	brl3/A2
	20	15:55:00	11.7	66/68	133	1488.9	66 22 17 46	
	21	16:55:00	11.3	68/68	95	1487.9	66 24 17 49	
	22	17:55:00	11.1	68/67	101	1487.8	66 26 17 50	N2/N3
	23	18:55:00	10	68/68	196	1489.2	66 17 17 41	
	24	19:27:00	10.1	68/68	218	1488	66 17 17 29	svp 310
	25	20:27:00	11.4	68/68	185	1486.6	66 23 17 18	
	26	21:27:00	11	68/68	194	1487.4	66 33 17 23	N2/N3
	27	22:27:00	10.2	68/68	217	1488	66 33 17 20	
	28	23:27:00	10.2	68/68	236	1487.6	66 32 16 58	2061,5 nm at midnight
15/09/04	29	00:27:00	11.3	68/68	225	1486.5	66 22 16 54	brl2/brl2
	30	01:27:00	9	67/67	160	1486.2	66 11 16 55	No sound speed probe values for a few mins
	31	02:30:00	11	67/67	226	1486.7	66 22 16 53	
	32	03:31:00	8.7	67/67	239	1487.4	66 33 16 58	No window at beg. of line brl 3/NA3
	33	04:19:00	11.7	67/67	232	1486.7	66 25 16 53	svd 307
	34	05:19:00	11	67/67	183	1485.9	66 14 16 51	Sound probe complaints near end of line
	35	06:19:00					66 19 16 50	
	36	07:19:00	10.7	67/67	245	1487.4	66 30 16 53	
	37	08:18:00	10.4	67/67	236	1486	66 26 16 51	
	38	09:18:00	10.7	67/67	221	1486.4	66 21 16 48	
	39	10:19:00	10.2	67/67	243	1487	66 31 16 50	

	40	11:19:00	10	67/67	221	1487.1	66 27 16 48	
	41	12:19:00	10.9	67/67	221	1487.2	66 25 16 47	
	42	13:19:00	11.5	67/67	158	1487.3	66 31 16 47	
	43	14:19:00	11.5	67/67	209	1487.8	66 23 16 44	
	44	15:18:00	11.1	68/67	190	1486.8	66 33 16 46	Heading west towards last survey area
	45	16:19:00					66 33 17 15	
	46	17:19:00					66 29 17 19	
	47	18:19:00	8	66/67	170	1488.4	66 18 17 19	
	50	21:21:00	9.8	67/67	199	1487.6	66 29 17 22	
	51	22:19:00	8.8	67/67	204	1487.5	66 29 17 23	
16/09/04	53	00:19:00	10	67/66	249	1487.2	66 33 17 26	
	54	01:19:00	10.9	67/70	225	1487.5	66 30 17 27	
	56	03:37:00	11.3	68/69	229	1488.4	66 18 17 37	
	57	04:37:00	11.7	67/67	43	1487.9	66 12 17 50	
	58	04:19:00	11.8	67/67	123	1488.7	66 13 18 11	new line, no window popup
		04:24:00						stop logging A200413_E5
	1	04:26:00	12	67/67	168	1488.8	66 13 18 14	new survey A200413_T3 svp 310 by Hedins-fjördur
	2	06:30:00	11.4	75/67	87	1489.3	66 11 18 39	
	3	07:26:00	11.5	65/65	119	1488.6	66 14 19 03	
	4	08:26:00	11.2	63/63	210	1489.5	66 16 19 29	

Table A2: Multibeam logbook including stops for CTD and OBses**.**

Abbreviations used: **svp**: changed to **s**ound **v**elocity **p**rofile
CTD: Conductivity**, T**emperature and **D**epth measurement to probe sound speed

CTD positions/times

CTD No	*Latitude N*	*Longitude W*	*Deployment time*
298	66°13.07	17°40.85	21:46:01, 06/09
299	66°45.17	17°30.08	19:48:38, 07/09
300	67°01.17	17°55.65	23:22:47, 07/09
301	66°53.67	19°14.53	20:59:50, 08/09
302	67°30.24	18°59.67	02:19:41, 09/09
303	67°30.08	18°41.82	23:07:27, 09/09
304	67°01.90	18°24.82	21:20:47, 10/09
307	66°15.84	16°51.46	14:13:50, 11/09
308	65°49.35	18°07.76	21:17:12, 12/09
309	65°53.93	18°13.64	23:05:06, 12/09
310	66°07.68	18°29.50	01:12:35, 13/09

Table A3: Map of CTD positions and deployment times and dates.

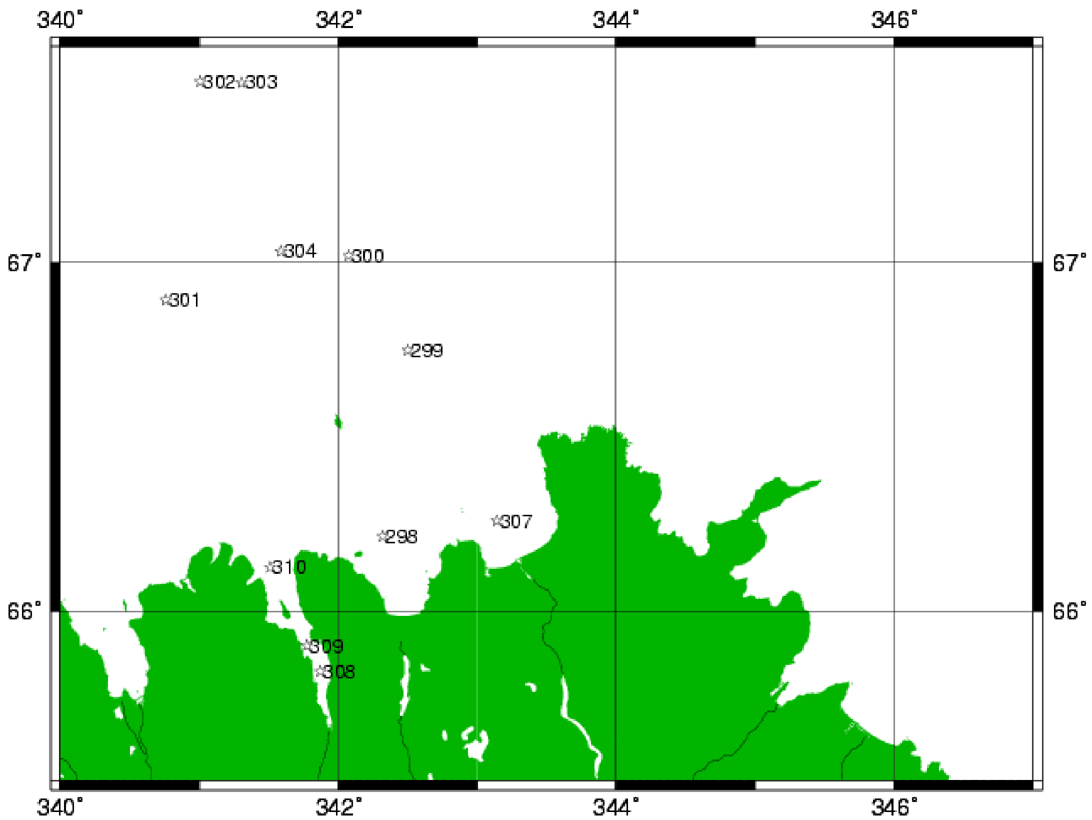
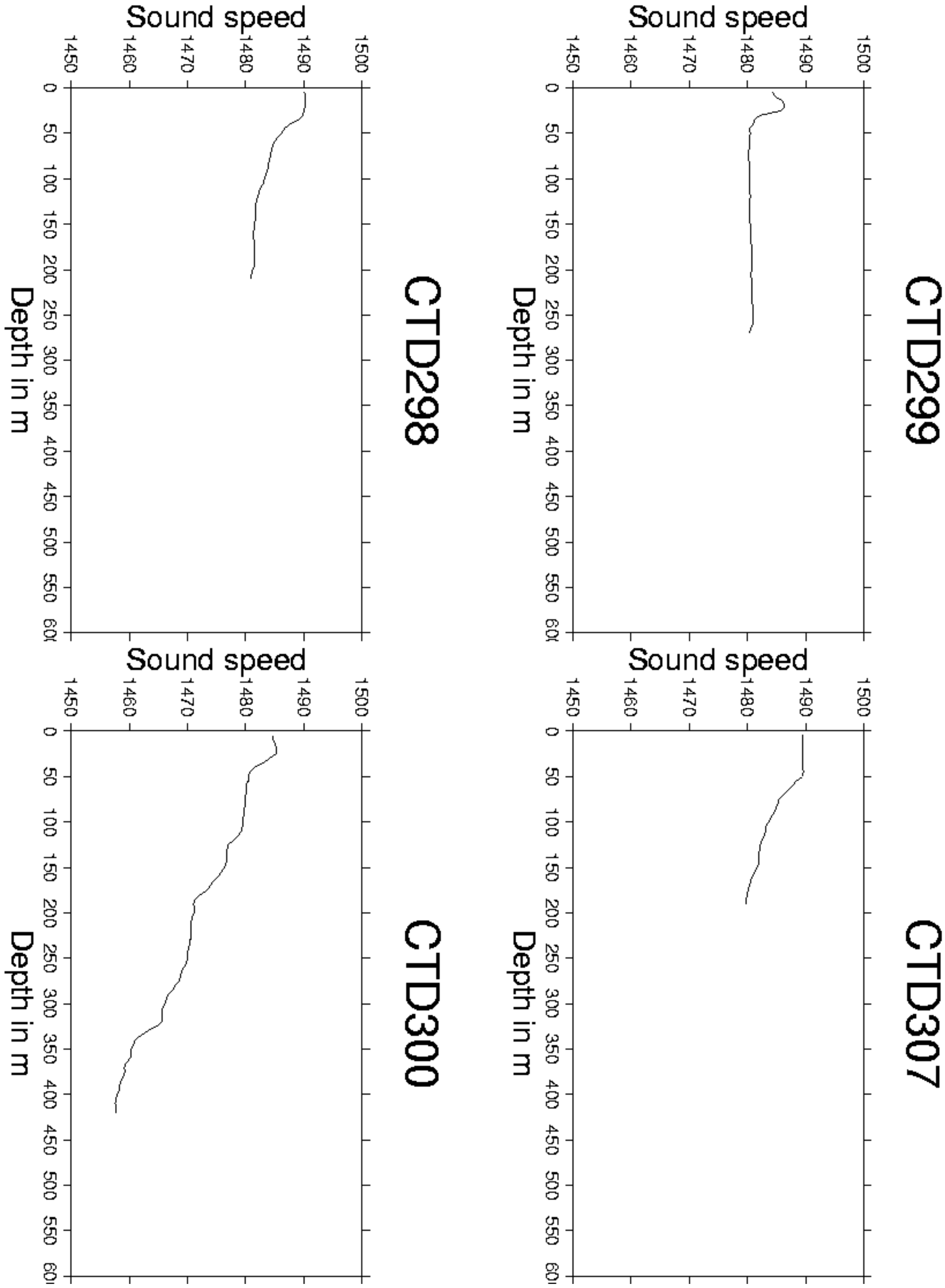
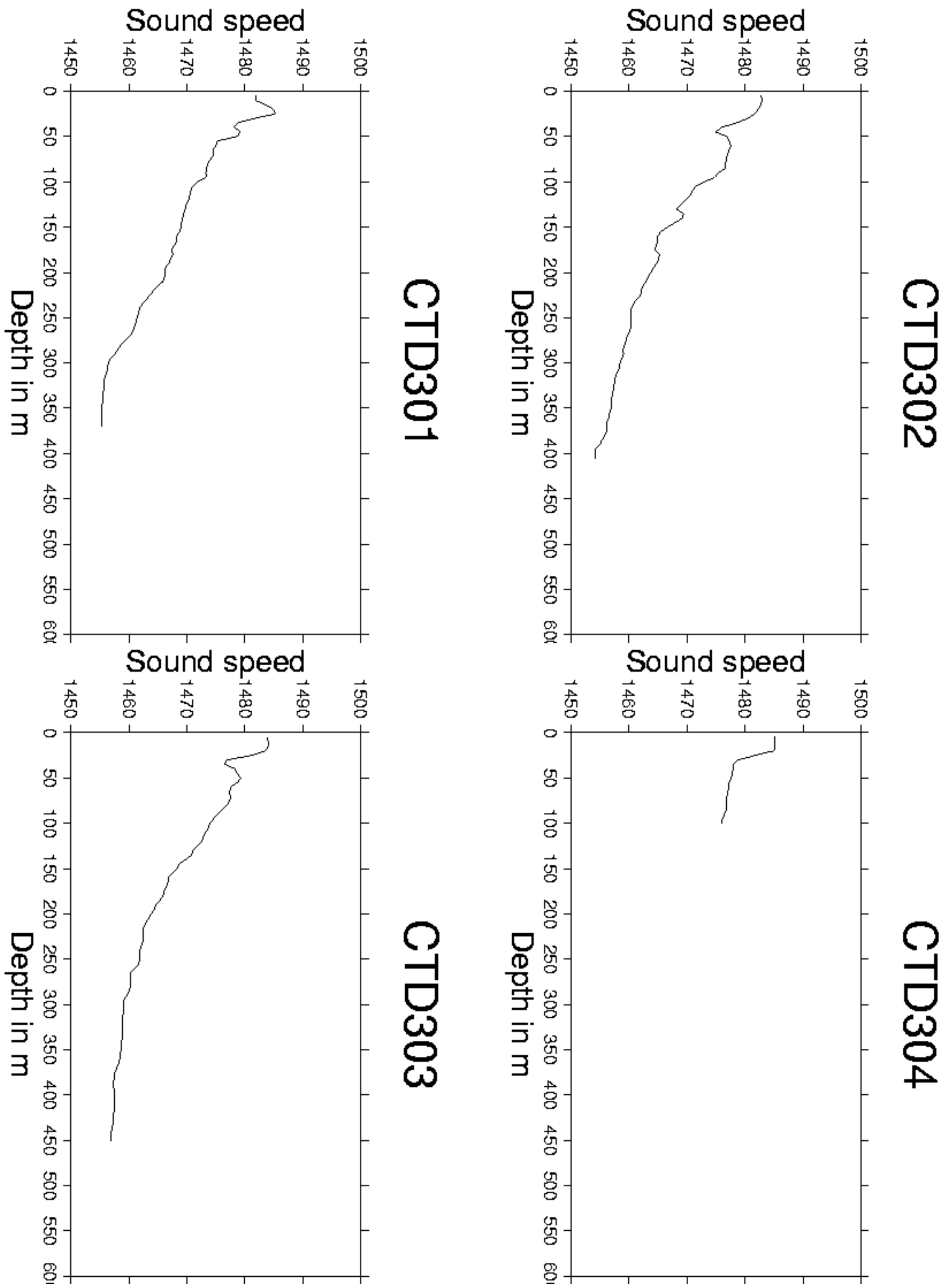


Figure A3: Map of CTD positions north of Iceland which will be used for calibrating the multibeam recordings.

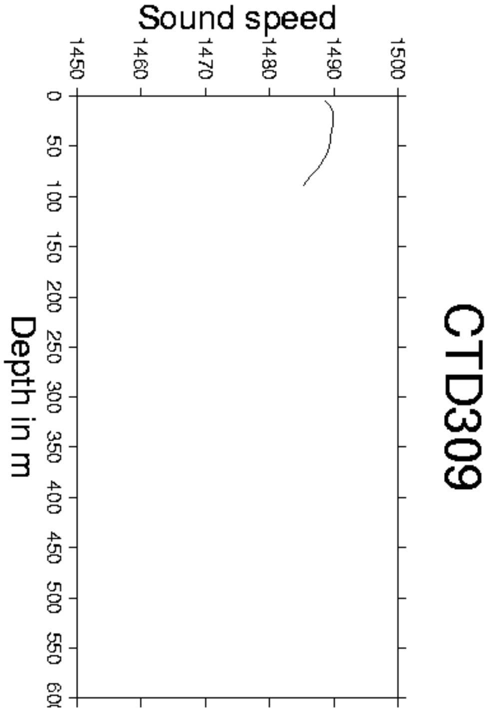
Sound speed in water profiles in (m/s) from Conductivity-Temperature-Depth measurements

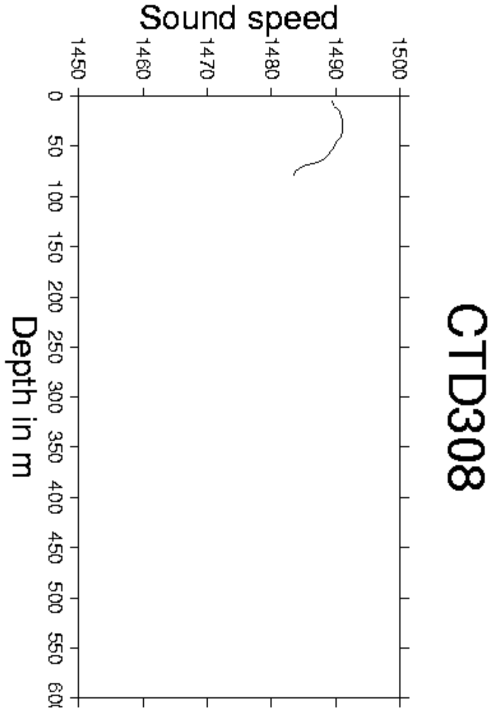


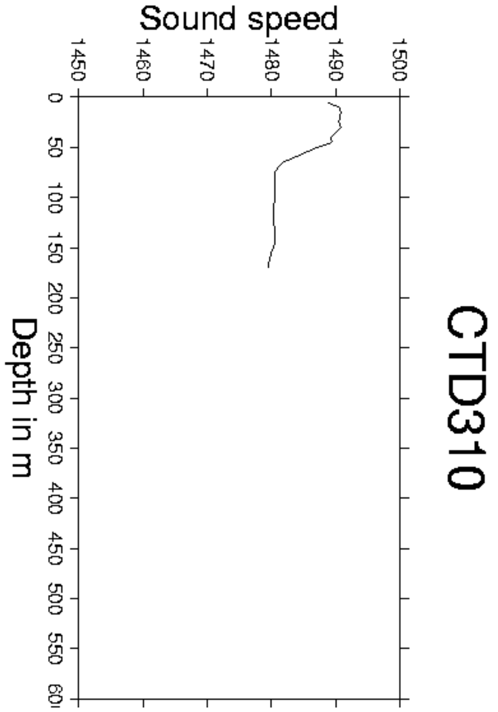
East of Grimsey



West of Grimsey







Eyjafjörður

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