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Short Cruise Report

RV MARIA S. MERIAN-CRUISE MSM47

St. John’s – Ponta Delgada, 30.09.2015 - 30.10.2015

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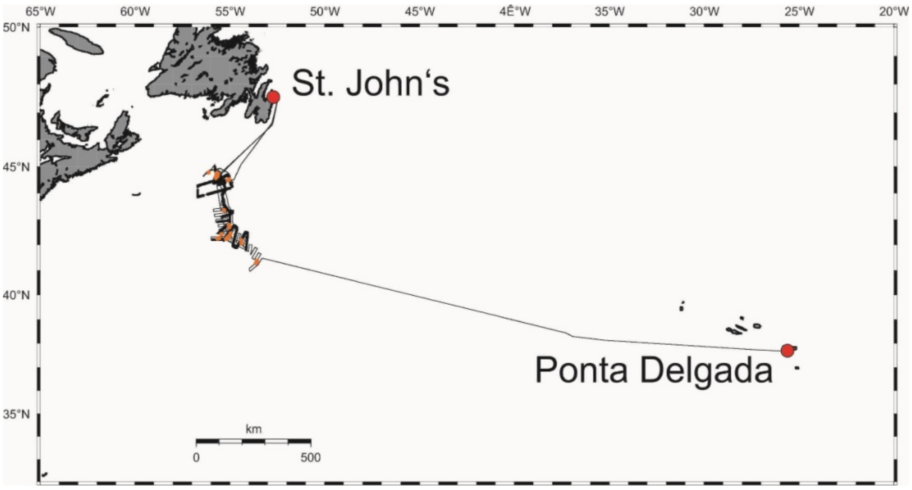

Fig 1: Track chart Cruise MSM47 (St. John’s – Ponta Delgada).

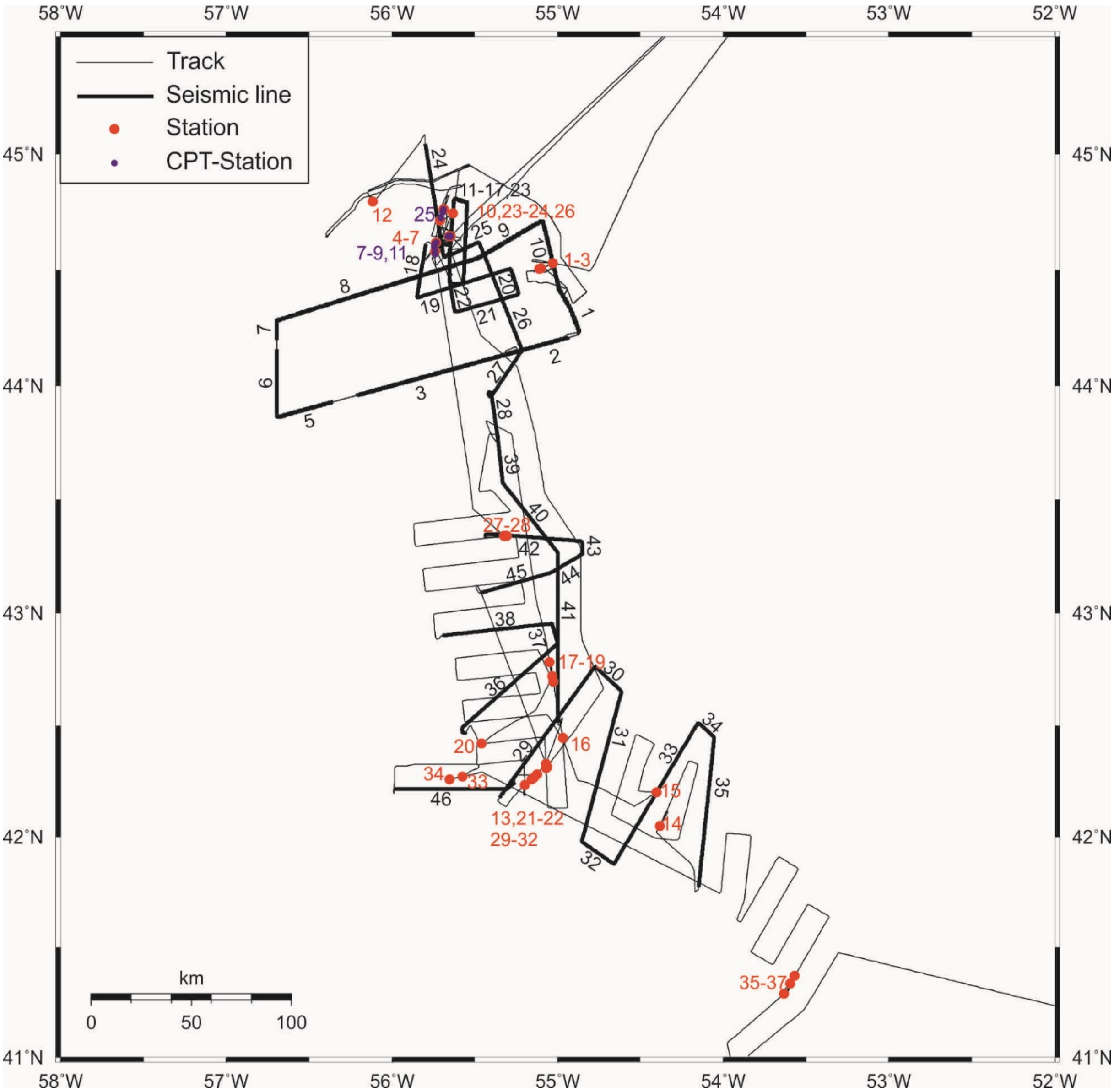

Fig 2: Detailed track chart of the MSM47 working area.

Objectives

The 1929 Grand Banks event was the first proven evidence of the natural occurrence of turbidity currents, through the severing of underwater cables. Most submarine landslides are thought to have been triggered by earthquakes and it is speculated (and supported by numerical simulations) that rapid displacement of sediment by underwater mass failure can generate tsunamis. The 1929 event, however, is still the only clearly documented occurrence of an earthquake-generated submarine landslide that resulted in a tsunami. This fact alone makes it worthwhile to study the details of the geology concerning this event in order to understand the processes and to recognize conditions elsewhere in the World that may lead to similar styles of failure with similar consequences. Available data showed small escarpments (~20 m vertical) throughout the region; some of which may have been created in the 1929 event. Remarkably, the seafloor imagery is not different than other regions of the Nova Scotian margin or than many continental margins around the globe for that matter. In other words, there is no evidence of a major submarine landslide – scar or deposit - such as the Storegga Slide off Norway. This para-dox leads to a number of research questions.

1) What are the dimensions of the failed material (area and volume) recognized in surficial sediments?

2) What are the geologic / geotechnical processes of failure?

3) What are the properties of the sediment prior to failure, i.e., what are the preconditioning factors that made the sediment susceptible to failure in the earthquake?

4) What are deeper structural controls? Are there faults, stratigraphic factors (unconformities, decollements), underlying salt bodies, and or gas hydrate that contributed to the mass failure?

5) Can the documented surficial failures generate a tsunami? If so, at what stage in the failure process would the tsunami be generated?

6) What is the frequency of these types of failure?

The main methods used during Cruise MSM47 were hydroacoustics (Multibeam and Parasound), multichannel reflection seismics, gravity/giant box coring and CPT (Cone Penetrating Testing) measurements. The high-resolution seismic system consisted of 2 GI-Guns and a 176-channel 300 m-long digital Geometrics GeoEel streamer.

Work was carried out on the St. Pierre slope and the Laurentian Fan. The St. Pierre slope is considered as the main failure area of the 1929 landslide. We filled data gaps in this area and collected cores for sedimentological and geotechnical investigations. Three CPT transects were carried out across different failure scarps. The main aim for the Laurentian Fan was the identification of the 1929 deposits. This area was not mapped before. Hence, hydroacoustic mapping was followed by geological sampling. High-resolution reflection seismic data were collected for investigating the evolution of channels in this area and stratigraphic work.

Narrative

The scientific party arrived in St. John's on September 28th and 29th. All science team members boarded RV MARIA S. MERIAN on the 29th. RV MARIA S. MERIAN left the port of St. John's on September 30th at 16:00h after bunkering at very pleasant weather conditions (sunny skies and calm seas). During departure, we had some spectacular views of the Newfoundland coastline.

The scientific crew of Cruise MSM47 included 10 scientists from the Christian-Albrechts-Universität zu Kiel, 3 scientists from the MARUM (Bremen University), 2 scientists from the Baltic Sea Research Institute (Warnemünde), and one scientist each from Bedford Institute of Oceanography (Dartmouth), Dalhousie University (Halifax), University College Dublin, the University of Leeds, the Institut de Ciències del Mar Barcelona, and the University of New Hampshire. The transit in the working area was very short and the scientific program started on September 1st at 02:00h local time with switching on the hydroacoustic systems. We headed to the eastern flank of the Grand Banks Valley in order to collect a sound velocity profile (SVP) for the multibeam systems and for taking a first gravity core followed by a CPT deployment. Based on the Parasound data, we chose a location with good penetration about 500 m above the thalweg of the Grand Banks Valley (Station MSM47_01). The SVP deployment worked without any problems. The first 6 m long gravity corer over penetrated and a second longer core brought up 810 cm of sediments. Several drop stones as well as undisturbed shells and shell fragments were found in the core. The gravity corer showed an interlayering of greenish and reddish sediments with quite some bioturbation. The reddish layers show a very sharp partly erosive contact at their base and are interpreted as turbidites. They most likely originate from the St. Pierre Slope, where reddish sediments are widespread while the greenish sediments represent the sediments deposited east of the Grand Banks Valley. A prominent sand layer in ca. 50 cm subbottom depth is clearly visible in the core. This layer is mechanically weak, which was confirmed by a CPT deployment at the same location. The seismic equipment was deployed immediately after station work was finished in the evening of October 1st. We started with two long slope parallel profiles in order to characterize the general setting of the wider working area. Unfortunately, wind speed picked up significantly on October 3rd (gusts up to beaufort 8) but the sea state still allowed to continue the seismic survey though noise levels increased significantly. The seismic equipment was recovered on October 4th at 07:00h. The data showed that the western part of the proposed failure area has not significantly contributed to the landslide allowing us to focus on the central working area.

October 4th was used to sample lower terraces near core MSM47_01. A short hydroacoustic survey showed a terrace only about 20 m above the thalweg. A box-corer (MSM47_02), however, was almost empty and hence we moved one terrace further up (MSM47_03 ~80 m above the thalweg). Recovery in the box-corer was again very low. The sediments were very stiff. The box corer was followed by a gravity corer, which resulted in 256 cm recovery of very stiff greenish sediments. It seems that the turbidity currents were purely erosive at this location and have not left any deposits behind.

We deployed the seismic gear around 19:00h in the evening of October 4th but quickly realized that the sea state was too rough for collecting seismic data. Hence, we changed plans and started a hydroacoustic survey of the shelf break in order to check for scarps close to the shelf break. The distal deposits of the Grand Banks landslide are known to contain coarse sands and gravel; the shelf break is a potential source of such material. The survey showed several scour marks of icebergs and small failures but no major scarps. The survey was not including the French EEZ of St. Pierre, because entry to the French EEZ needed to be announced well in advance (usually 36h).

October 5th was a good coring day across a prominent 20-30 m high morphological step at a mid-slope position. The hydroacoustic data indicated young debrite deposits beneath the morphological step. The first station targeted the distal deposits of the debrites (Station MSM47_04). A box corer showed very thin (~4 cm) soft sediments on top of a muddy debrite. The base of the debrite was sampled with a gravity corer, which is very good for geotechnical work. The second core (MSM47_05) targeted background sediments. Total recovery was 787 cm but the core also contains some debrite deposits in the upper 1.5 m. A re-assessment of the Parasound data indeed showed a very thin debrite lobe at this location.

The seismic gear was deployed after coring on October 5th at 21:00h. We shot two lines crossing proposed listric faults in a mid-slope position. One hypothesis for the tsunami generation during the 1929 event proposes movement along these faults as major contribution to the tsunami. The new seismic data show that the lower of these proposed faults is not a fault but an area of stacked headwalls. An upper area with proposed faulting needs further data processing in order to judge on the existence of a fault. Two additional stations were sampled on October 6th slightly above the morphological step at the mid-slope location. Both cores (MSM47_06 and 07) targeted debris tongues, which were successfully sampled.

Station work had to be interrupted on October 6th at 18:42h local time (20:42 UTC) due to a medical evacuation of one scientist. We were heading full speed to the port of St. John's where we arrived on October 7th at 13:00h local time (15:00h UTC). We left port again already at 13:48h local time (15:48h UTC) and headed back to the working area. We continued our program on October 8th at 08:06h local time (10:06h UTC) with a short hydroacoustic survey in order to define final locations for a CPT transect across a headwall in about 1800 m water depth. This transect started around 10:00h (Station MSM47_08). We had to stop the profile around 18:00h because the battery of the CPT was empty. The night was used to collect two along slope seismic profiles in an area, which was only sparsely surveyed with airgun seismics before. The seismic gear was retrieved on October 9th around 9:00h. Afterwards we continued the CPT transect, which was interrupted the day before (Station MSM47_09). For a better understanding of the distribution of the debrite identified in the previous cores, we headed upslope in order identify the origin of the widespread debrite. Another set of prominent scarps is found in ~1000 m water depth. The debrite can be easily traced to these scarps based on hydroacoustic profiles but correlation becomes tricky upslope of the scarps. Hence, we took a giant box core and a gravity core (MSM47_10, 768 cm recovery) upslope of the scarps in an area, which looks undisturbed. The core is indeed undisturbed. Hence, the scarp area in about 1000 m water depth was formed recently or was at least reactivated recently, possibly during the 1929 event.

Another short CPT transect targeting different debrite lobes was collected in the evening of October 9th (MSM47_11). The rest of the night was used for mapping the shelf break in the French EEZ. We can now exclude a major failure of the shelf break as source for the 1929 landslide based on our new data. A large number of small and very fresh looking scarps are found beneath the shelf break in about 700 m water depth. We took a core beneath one of these scarps (MSM47_12) in the morning of October 10th. We sampled debrite deposits but the debrite is overlain by about 250 cm of background sediments indicating that these failures are much older than the 1929 event.

On October 10th at 13:00h, we started to collect a long seismic profile to the south, where indications of the deposits of the 1929 event have been reported before. Around noon on October 11th, one of the airguns stopped shooting due to a break in a firing line. As repairs took a bit longer, we continued with hydroacoustic mapping. The focus was a postulated bifurcation point of the Eastern Channel. This bifurcation point was reconstructed based on single beam echo sounder profiles and bathymetric mapping showed that no bifurcation point is present at the proposed location but two separate channels.

A first core in the southern working area was taken on October 12th in the morning on an outer bend of the mapped channels in about 4440 m water depth (Station MSM47_13). A gravity corer was filled with 775 cm of sediments. The upper most part (ca. 1 m) showed a strange succession of relatively stiff sediments on top of homogeneous greyish sediments. The greyish unit is underlain by reddish mud with a large number of spill over turbidites. Coring was followed by a seismic survey across different sections of the channel system beneath the postulated bifurcation point of the Eastern Channel. Seismic surveying was continued until October 14th around 17:00h.

A gravity core of the canyon thalweg (MSM47_14) was taken in the evening of October 14th. The backscatter data showed relatively low values indicating potentially soft sediments at the seafloor. However, the gravity corer bounced at the seafloor. A bit of silty sediments were found at the weight of the gravity corer. The night was used for further mapping of the channel system. Based on the available maps, two stations were sampled on October 15th. Both stations were located at the morphological high beneath the two channel branches visible in the bathymetric data. Both cores (MSM47_15 and 16) show a very thin soft sediment layer on top of stiff sediments. A small sand layer was found between the fluffy surface sediments and the stiff sediments beneath. The night was used for further hydroacoustic mapping. During this mapping, we provided the final proof that the bifurcation point is not existing at the proposed location but further upslope. October 16th was used for further coring. The first gravity core (MSM47_17) was taken on a terrace about ~200 m above the thalweg of the Northern Canyon. This core bounced but some sand was found on the core barrel. Hence, we moved to a location, which was about 100 m higher above the thalweg compared to the previous station (MSM47_18). This core showed the meanwhile well-known succession of sediments including relatively stiff surface sediments and abundant turbidites of varying color. However, no major sandy turbidite was found close to the surface. Hence, we took another core between the two previous cores (MSM47_019). This core bent but still included 190 cm of sediments. A massive (~30 cm) sandy turbidite was found close to the surface, but it seemed to be overlain by ~10 cm of undisturbed sediments. It is, therefore, unlikely that it represents the 1929 event. Another core was taken at an elevated area, which looks fully undisturbed (MSM47_020). The core had a length of 770 cm and shows a remarkably similar succession of sediments of reddish turbidites in the lower part, interlayered reddish and greenish turbidites in the middle part, which are overlain by bioturbated undisturbed sediments. A thin soft layer with a different color was found on top of the bioturbatet sediments. This thin layer was identified in other cores as well and caught our attention. We noted that i) it is overlying sediments, which show a clear oxidation front but the soft surface layer shows very different colors, ii) it usually has an erosive contact to the underlying sediments and iii) it contains material clearly coming from an shelf/upper slope environment (e.g., angular sand grains, glauconite). Hence, we interpret this unit as deposits of the 1929 event. The deposits are mainly characteristic for a bypass facies; this facies is very widespread in the working area.

Coring was followed by two additional reflection seismic profiles across the canyons. The seismic data suggest that the locations of the canyons are structurally controlled. The seismic was retrieved on October 17th in order to map the canyon at higher speeds with the hydroacoustic systems. This mapping showed that the canyon merge further upslope. Mapping was completed on October 18th in the early morning. The day and the following night was used to continue the seismic profile connecting the northern and southern working area, which was interrupted earlier during the cruise. Seismic profiling was continued until October 19th early morning. We planned to take a coring transect across the Southern Channel at different heights above the thalweg on October 19th. We started with a box corer (MSM47_21) about 170 m above the thalweg. Unfortunately, the box corer did not trigger. In the following gravity corer, we sampled a ~20 cm thick fluffy layer right at the surface representing a soupy graded turbidite sand to sandy mud. This unit is thicker than at previous locations. This is consistent with our interpretation of these deposits as 1929 turbidite. A second core (MSM47_22) was located on a small terrace just 80 m above the thalweg in an inner bend. The core bent but gravel was found in the core catcher. Hence, the coarse grained part of the 1929 turbidite had a height of at least 80 m. At this point, we had to terminate coring activities due to strong winds.

We started a long line filling in gaps in the bathymetry to the northern working area because wind conditions were forecasted to be better further to the north. We arrived at a morphological step interpreted as headwall in the early morning of October 20th. A first core (MSM47_23) was taken in a transparent layer interpreted to be debrite based on the hydroacoustics data. The core showed debrite deposits but they are covered by undisturbed hemipelagic sediments; hence the debrite is not very young. Another core (MSM47_ 24) was taken upslope of the morphological step at an almost identical location as Core MSM47_10, which sampled undisturbed deposits. We planned to duplicate Core MSM47_10 for geotechnical measurements but had to move the location slightly to the east due to fishing activities in this area. Coring was followed by a CPT-transect across the morphological step. Two additional cores were taken afterwards. The first core was taken upslope of cores MSM47_06 and 07, and this core (MSM47_26) showed again debrite deposits close to the surface proofing that the morphological step in about 900 m water depth was at least partially reactivated in the recent past. A second core was a duplicate of Core MSM47_04 for geotechnical measurements.

The night was used for a transit to an area slightly downslope of the joining point of the Grand Banks Valley and the Eastern Channel. Parasound profiles showed promising coring locations at this location. A first gravity core about 250 m above the thalweg bounced but a box core recovered coarse sand and gravel without a drape (MAM47_27). A gravity core 20 m further up at greater distance to the channel (MSM47_28) recovered almost 5 m of sediments with the same turbidite recovered at the box corer but background sediments beneath. Coring was followed by seismic reflection profiling until early morning of September 22nd. We collected two long slope parallel profiles for stratigraphic work at the lower slope. September 22nd was an intense coring day (Cores MSM47_29 -32). These cores completed a transect across the Southern Channel. Varying deposits of the 1929 event were sampled at different heights above the channel thalweg, allowing to reconstruct the trim line of the 1929 event.

In order to estimate the importance of the Western Channel, we collected a seismic line and additional hydroacoustic data of the Western Channel during the night and the morning of September 23rd. Landsliding of the canyon walls is extremely widespread at the Western Channel. The seismic data show thick debrite deposits at the canyon floor. We took a first core at a terrace about 100 m above the thalweg of the Western Channel (MSM47_33), which allowed us to sample the 1929 turbidte. A box corer from the canyon thalweg ((MSM47_34) was similar to a box corer of the Southern Channel.

In order to characterize the boundary from mainly bypassing through depositional, we mapped the Southern Channel further downslope. The channel spreads over a larger area with increasing water depth and flow structures become visible on the backscatter map. We tried to collect another coring transect in the night to September 25th at relatively rough weather conditions. A box corer from the canyon thalweg (MSM47_35) did not trigger. A first gravity core (MSM47_36) on the southern canyon margin penetrated into the sediments but the core catcher was sheared-off, most likely due to a large boulder. The corer bounced at this location in a second try. Core MSM47_37 was taken a bit further away from the canyon axis. The core bounced as well but contained ~40 cm of coarse gravel documenting deposition of the turbidite in this area. A seismic profile was planned for the day but the sea state was too rough for deploying the seismics; hence we collected additional hydroacoustic data. We started our transit to Ponta Delgada at 16:42 h local time on October 25th, which was the end of the research program of Cruise MSM47. We arrived in Ponta Delgada at 08:50h local time on October 30th.

RV MARIA S. MERIAN-Cruise MSM47 was a great success, despite the fact that we lost about 1.5 days due to a medical evacuation. Weather was reasonable and research activities were always possible though we had to adjust our program to the weather conditions. In summary, we collected about 1500 km of seismic 2D-lines in exceptional quality. Hydroacoustic data were collected during designated surveys as well as along all seismic profiles and transits (total of ~5000 km); widespread previously unknown areas were mapped. We collected gravity cores at 28 stations with a total core length of 130 m. We took box cores at 18 stations. Coring was not always easy due to the thick widespread sandy base of the 1929 turbidite but we managed to sample and characterize the 1929 Grand Banks landslide and turbidite from a bypassing region to its more depositional part. Two cores were duplicated for geotechnical measurements. Additional geotechnical data were collected along 3 CPT transects. The new data will allow an in depth investigation of the morphology, processes and geohazards of the Grand Banks area including the tsunami generation capacity of the 1929 Grand Banks landslide.

Acknowledgements

The scientific party of RV MARIA S. MERIAN Cruise MSM47 gratefully acknowledges the very friendly and most effective cooperation with Captain Schmidt and his crew. Their great flexibility and their perfect technical assistance substantially contributed to make this cruise a scientific success. We also appreciate the valuable support by the Leitstelle Deutsche Forschungsschiffe at the University of Hamburg. The expedition was funded by the Deutsche Forschungsgemeinschaft.
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Participants

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UNH	University of New Hampshire
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MSM47-Station List

BC: Giant Box Core, CPT: Cone Penetrating Testing, GC: Gravity Core
MB+PS: Multibeam and Parasound, SEISREFL: Seismic Reflection,
SVP: Sound Velocity Profile, XSV: Sippican Extended SVP

Station No.		Date	Gear	Time	Lat	Long	Water Depth	Remarks/Recovery
MERIAN MSM47/	CAU, MSM47_	2015		[UTC]	[°N]	[°W]	[m]	
478-1	01-1	1.10.	SVP	14:21	44°31.83	55°01.84	2437	
478-1	01-2	1.10.	GC	15:48	44°31.83	55°01.83	2438	overpenetration
478-1	01-3	1.10.	GC	17:55	44°31.81	55°01.82	2441	810 cm recoverry
478-1	01-4	1.10.	CPT	19:45	44°31.81	55°01.82	2442	
479-1		1.10.	SEISREFL	21:42				several profiles
481-1	02-1	4.10.	BC	12:42	44°30.31	55°06.74	3004	
482-1	03-1	4.10.	BC	15:18	44°30.46	55°06.11	2948	with Posidonia
482-2	03-2	4.10.	GC (3m)	17:44	44°30.46	55°06.10	2950	256 cm recovery
487-1	04-1	5.10.	BC	16:24	44°34.80	55°44.54	1783	with Posidonia
487-2	04-2	5.10.	GC (11m)	18:01	44°34.81	55°44.53	1782	395 cm recovery
488-1	05-1	5.10.	GC (5m)	20:08	44°37.19	55°44.12	1571	overpenetration
488-2	05-2	5.10.	GC (12m)	21:26	44°37.19	55°44.10	1566	787 cm recovery
488-3	05-3	5.10.	BC	22:20	44°37.19	55°44.10	1566	
489-1		5.10.	SEISREFL	23:47				several profiles
490-1	06-1	6.10.	BC	13:42	44°38.71	55°38.72	1487	
490-2	06-2	6.10.	GC (8m)	15:04	44°38.71	55°38.73	1487	630 cm recovery
491-1	07-1	6.10.	GC (8m)	17:22	44°38.77	55°39.49	1467	645 cm recovery
491-2	07-2	6.10.	CPT	19:28	44°38.77	55°39.48	1467	
492-1		8.10.	MB+PS	10:10	44°31.32	55°44.31	2194	several profiles
493-1	08-1	8.10.	CPT	12:43	44°37.19	55°44.09	1566	
493-1	08-2	8.10.	CPT	14:15	44°36.89	55°44.30	1587	
493-1	08-3	8.10.	CPT	15:15	44°36.75	55°44.40	1608	
493-1	08-4	8.10.	CPT	15:56	44°36.69	55°44.43	1625	
493-2		8.10.	XSV	16:24	44°36.69	55°44.44	1627	
493-1	08-5	8.10.	CPT	16:57	44°36.59	55°44.50	1645	
493-1	08-6	8.10.	CPT	17:57	44°36.38	55°44.62	1665	
494-1		8.10.	SEISREFL	19:36	44°36.70	55°47.80	1613	several profiles
495-1	09-1	9.10.	CPT	12:33	44°36.06	55°44.62	1702	
495-1	09-2	9.10.	CPT	15:04	44°34.79	55°44.54	1784	

495-1	09-3	9.10.	CPT	16:34	44°34.11	55°44.50	1862	
496-1		9.10.	MB+PS	17:26	44°34.21	55°44.55	1851	
497-1	10-1	9.10.	BC	19:39	44°45.72	55°41.30	818	
497-2	10-2	9.10.	GC (8m)	20:20	44°45.72	55°41.29	821	recovery 768 cm
498-1		9.10.	MB+PS	21:16	44°45.80	55°40.09	1271	
499-1	11-1	9.10.	CPT	22:26	44°38.71	55°38.76	1481	
499-1	11-2	9.10.	CPT	23:46	44°38.73	55°39.18	1465	
499-1	11-3	10.10.	CPT	00:51	44°38.77	55°39.78	1482	
500-1		10.10.	MB+PS	02:03	44°38.97	55°45.57	1476	
501-1	12-1	10.10.	BC	11:37	44°47.66	56°06.95	791	
501-2	12-2	10.10.	GC (5m)	12:25	44°47.67	56°06.95	792	500 cm recovery, surface may be missing
502-1		10./11.10	SEISREFL	15:50			86	several profiles
503-1		11.10.	MB+PS	17:32	43°50.30	55°25.87	3433	
504-1	13-1	12.10.	BC	15:49	42°14.01	55°11.94	4439	did not trigger, empty
504-2		12.10.	XSV	16:04	42°14.01	55°11.94	4439	
504-3	13-2	12.10.	GC (8m)	18:59	42°14.01	55°11.94	4452	recovery 775 cm
505-1		12.10.	SEISREFL	22:46				several profiles
506-1	14-1	14.10.	GC (5m)	20:43	42°02.933	54°22.99	4909	no recovery
507-1		15.10.	MB+PS	00:58	42°03.35	54°22.68	4904	
508-1	15-1	15.10.	GC (10m)	12:20	42°11.98	54°24.18	4705	recovery 563cm
509-1		15.10.	MB+PS	15:13	42°11.96	54°24.23	4869	
510-1	16-1	15.10.	BC	18:19	42°26.69	54°58.16	4449	
510-2	16-2	15.10.	GC (10m)	21:28	42°26.60	54°58.17	4447	recovery 597cm
511-1		16.10.	MB+PS	00:13	42°32.86	55°04.25	4425	
512-1	17-1	16.10.	GC (10m)	11:45	42°41.57	55°01.68	4503	no recovery
513-1	18-1	16.10.	GC (10m)	14:48	42°46.91	55°02.93	4412	recovery 791 cm
514-1	19-1	16.10.	GC (10m)	17:24	42°43.09	55°02.02	4481	recovery 190 cm
515-1	20-1	16.10.	GC (10m)	22:08	42°25.05	55°27.72	4159	recovery 770 cm
516-1		17.10.	SEISREFL	00:36				several profiles
517-1		17.10.	MB+PS	17:25	42°53.68	55°44.35	3698	
518-1		17.10.	XSV	18:36	43°00.74	55°37.36	4209	
517-1		17.10.	MB+PS	20:34	43°02.51	55°12.48	4262	
519-1		18.10.	SEISREFL	12:11			3504	several profiles
520-1	21-1	19.10.	BC	09:06	42°19.70	55°04.29	4653	did not trigger, empty
520-2	21-2	19.10.	GC (5m)	12:23	42°19.76	55°04.25	4641	recovery 395cm
521-1	22-1	19.10.	GC (5m)	15:11	42°18.42	55°04.23	4713	bent, two subsample from CC
522-1		19.10.	MB+PS	17:41	42°18.46	55°04.19	4706	
523-1	23-1	20.10.	GC (10m)	10:09	44°42.82	55°42.67	1114	recovery 660 cm

524-1	24-1	20.10.	GC (10m)	11:47	44°45.70	55°41.42	825	recovery 337 cm
525-1	25-1	20.10.	CPT	13:06	44°45.69	55°41.42	828	
525-1	25-2	20.10.	CPT	14:42	44°45.18	55°41.58	870	
525-1	25-3	20.10.	CPT	15:30	44°44.99	55°41.69	899	
525-1	25-4	20.10.	CPT	16:58	44°43.72	55°42.37	1070	
525-1	25-5	20.10.	CPT	18:04	44°43.28	55°42.53	1086	
526-1	26-1	20.10.	BC	20:25	44°44.70	55°38.00	1054	
526-2	26-2	20.10.	GC(10m)	21:22	44°44.69	55°38.02	1051	recovery 704 cm
527-1	04-3	20.10.	GC (5m)	23:16	44°34.80	55°44.36	1786	recovery 337 cm
528-1	27-1	21.10.	GC (5m)	08:04	43°20.42	55°19.42	3975	no recovery
529-1	28-1	21.10.	GC (5m)	10:23	43°20.48	55°18.43	3947	recovery 480cm
530-1	27-2	21.10.	BC	12:05	43°20.47	55°18.43	3946	
531-1		21.10.	SEISREFL	15:49				several profiles
532-1	29-1	22.10.	GC (3m)	13:20	42°18.86	55°03.90	4669	no recovery
533-1		22.10.	MB+PS	15:22	42°18.87	55°03.93	4670	
534-1	30-1	22.10.	GC (3m)	16:58	42°15.43	55°09.59	4577	recovery 290cm
535-1	31-1	22.10.	BC	19:26	42°16.80	55°07.45	4814	
536-1	32-1	22.10.	BC	23:07	42°15.92	55°08.79	4661	
537-1	31-2	23.10.	GC (3m)	02:30	42°16.79	55°07.46	4813	recovery 40 cm
538-1		23.10.	SEISREFL	05:23				several profiles
539-1		23.10.	MB+PS	14:30	42°19.05	55°58.70	4151	
540-1	33-1	23.10.	GC (3m)	17:30	42°16.25	55°34.53	4505	recovery ~ 150 cm
541-1	34-1	23.10.	BC	20:00	42:15.48	55°39.17	4608	
542-1		23.10.	MB+PS	23:24	42°15.49	55°39.32	4603	
543-1		24.10.	XSV	16:12	41°32.57	53°47.27	4933	
542-1		24.10.	MB+PS	17:23	41°25.45	53°42.58	4970	
544-1	35-1	24.10.	BC	23:28	41°22.25	53°34.20	5037	
545-1	36-1	25.10.	GC (5m)	03:38	41°17.31	53°38.00	5016	no recovery
546-1	37-1	25.10.	GC (5m)	06:21	41°20.13	53°35.80	5012	recovery 45cm
547-1	36-2	25.10.	GC (5m)	09:16	41°17.32	53°38.02	5012	no recovery
548-1		25.10.	MB+PS	11:40	41°17.32	53°37.99	5017	