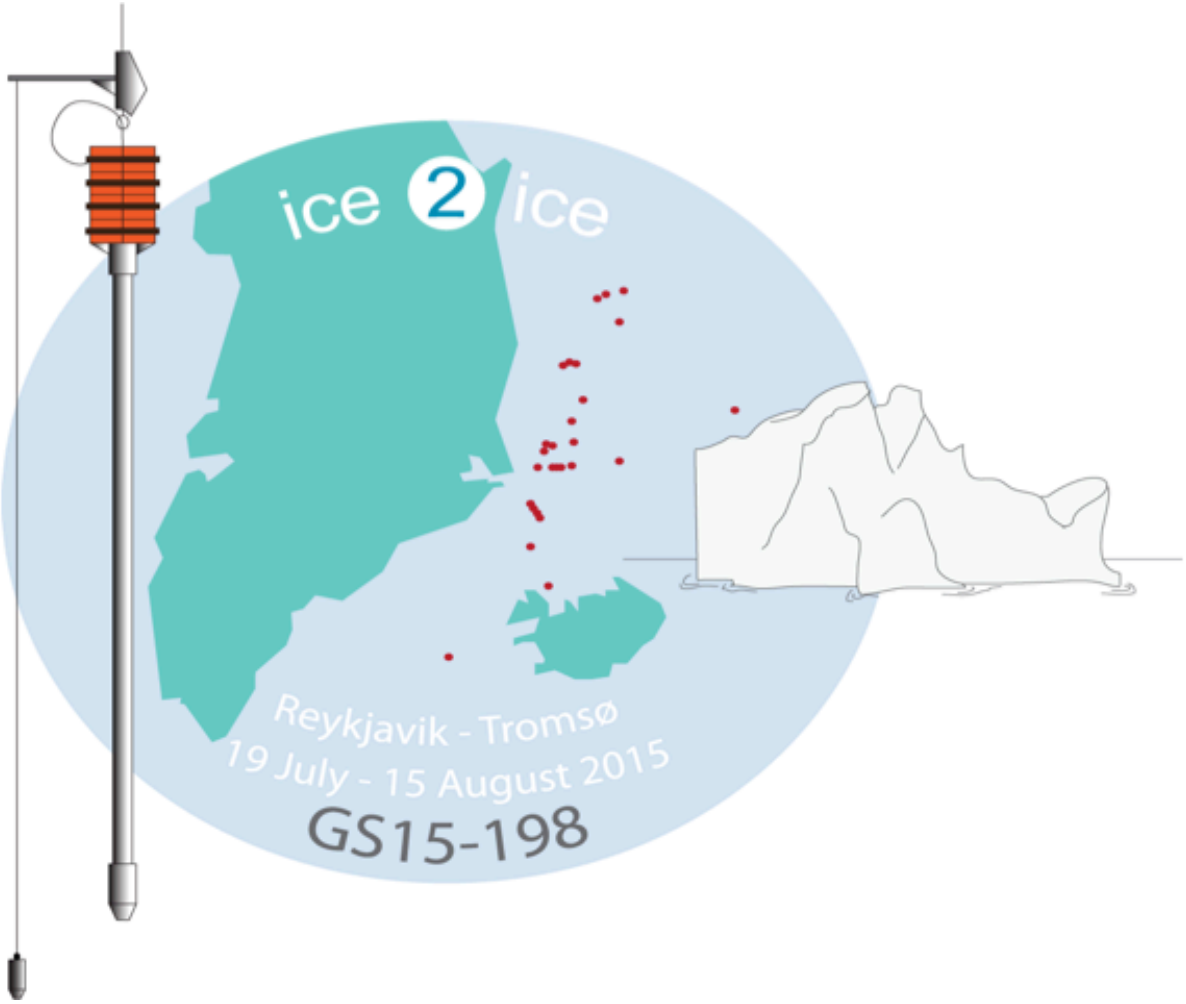
Cruise GS15-198

July 19 – August 15
2015



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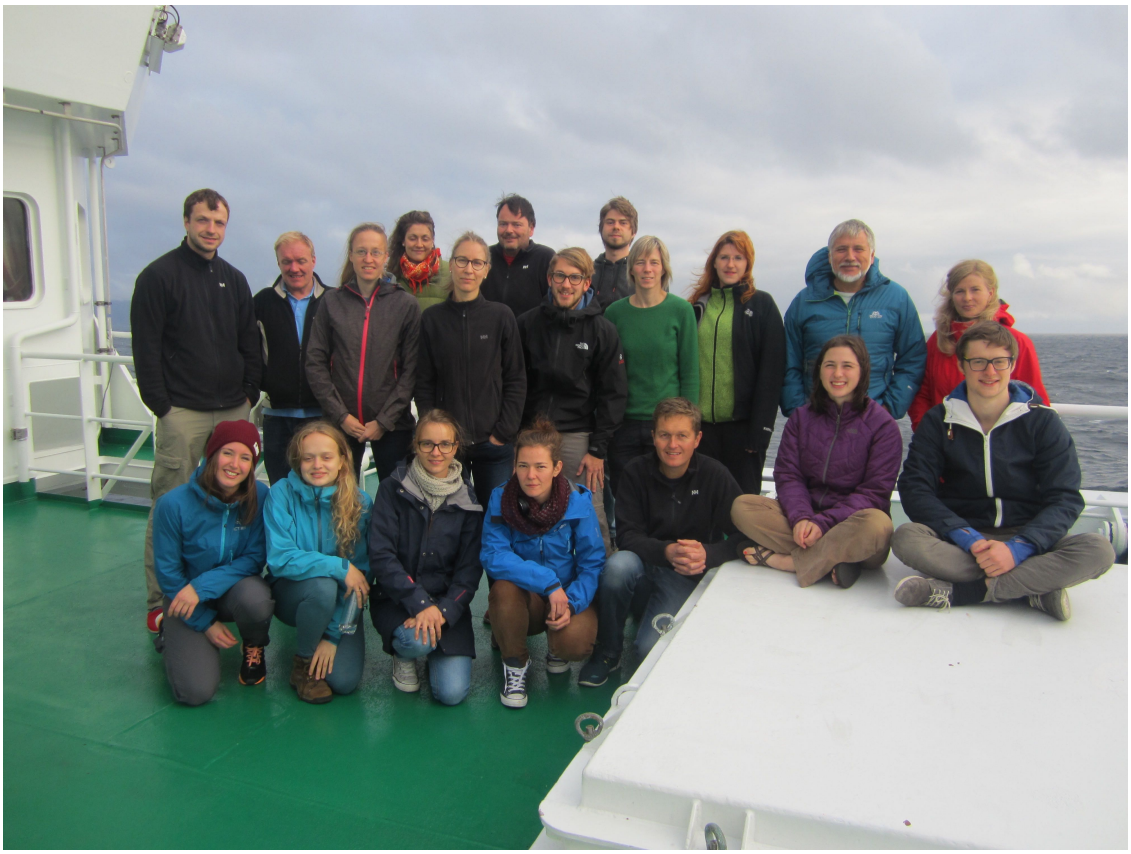
Preface

The cruise was funded by the European Research Council (ERC) by a Synergy Grant to the ice2ice project under the 7th Framework programme, and by internal funds from UiB and UNI Research. The operation of the GO Sars is handled by the Institute for Marine Research (IMR). We are extremely grateful for the support from Captain Ståle Fredriksen and the professional, dedicated and skilled crew on the ship who made this journey a great experience both scientifically and socially. The support staff from IMR in terms of shipboard instrument technicians and help with cruise logistics is truly appreciated and contributed a lot to the results.

Bergen August 20, 2015

Eystein Jansen
cruise leader



Science crew of the cruise. Back row l-r: Christian, Stig, Iben, Evangeline, Carin, Dag Inge, Mads, Henrik, Bjørg, Kerstin, Eystein, Margit. Front row l-r: Ida, Albertine, Amandine, Sarah, Jørund, Ashley, Flor

1. Summary

The ice2ice project is funded through an ERC-Synergy Grant under the 7th Framework Programme of the EU. The overarching goal is to understand the mechanims behind abrupt changes in high northern latidue climate during the last ice age, and assess the degree to which the current sea ice retreat may lead to similar instabilities with impacts on the dynamics of the Greenland ice sheet. In order to obtain material for reconstructions of ocean circulation and sea ice during the abrupt events of the past, a cruise onbioard RV OG Sars was conducted July-August 2015. This report describes the operations during the cruise, the material collected, and shipboard analyses and results on the collected material. The sediment material will be further analyzed in the laboratories in Bergen and be further compared with data from the new Renland ice core and other ice cores from Greenland.

2. ice2ice project overview

The cryosphere is in fast transition. The possibility that the ongoing rapid demise of Arctic sea ice may instigate abrupt changes on the Greenland Ice Sheet (GIS) is, however, not tackled by current research. Ice cores from the GIS show clear evidence of past abrupt warm events with up to 15 degrees warming in less than a decade, most likely triggered by rapid disappearance of Nordic Seas sea ice. At present, both Arctic Sea ice and the GIS are in strong transformation: Arctic sea-ice cover has been retreating during most of the satellite era and in recent years, Arctic sea ice experienced a dramatic reduction, and the extent was in 2012 half of the 1979-2000 average. Satellite data document an an increasing loss of GIS ice mass and temperatures since 1990 and temperatures have risen markedly at the GIS summit. Strong transient responses in both major Arctic cryospheric entities prompts the question: Is the dramatic decline in Arctic Sea Ice heralding a new phase of abrupt change, similar to those recorded in ocean sediments and ice cores? Such changes would have major consequences for the GIS mass balance and global climate, including accelerated sea level rise. There is currently no concerted research effort to assess this risk.

Ice2Ice approcahes this complex problem by integrating 4 PI teams from three Nordic world class research centres (Bjerknes Centre for Climate Research, Bergen, Norway; Centre for Ice and Climate of the Niles Bohr Institude (NBI), Copenhagen University, Denmark; and the Danish Meteorological Institute, comprising empiricists and dynamicists specialized in Arctic and Greenland atmospheric, oceanic and cryospheric sciences. Employing an innovative combination of synchronized records of GIS parameters, records of sea ice change as well as models ranging from global climate models to regional and process models, Ice2Ice will be the first concerted effort to tackle question of the cause and future implications of past abrupt climate change in Greenland, the main hypothesis being that that *Arctic and sub-Arctic sea ice cover excerts important controls on past and future Greenland temperature and ice sheet variations.* In Ice2Ice this will be done by:

- describing the nature, timing and extent of abrupt events across climate archives,
- resolving mechanisms behind the sudden demise of sea ice cover,
- identifying the risk that the ongoing rapid diminution of Arctic sea ice cover could give abrupt GIS changes in the future
- determining the impacts of such changes for the GIS and Arctic and global climate

The cruise tackles the first of these objectives, and aimes to provide material for detailed investigations of past rapid changes in sea ice cover and ocean circulation from areas off East Greenland.

In Ice2Ice we have assembled a strong interdisciplinary team, consisting of four PIs: two empiricists and two dynamicists and their teams of highly qualified scientists from three national centres of excellence. Two PIs are experienced scientists with long track records as research leaders of large multi-faceted projects and research groups, and two are talented early-to-mid career scientists with unique competence.

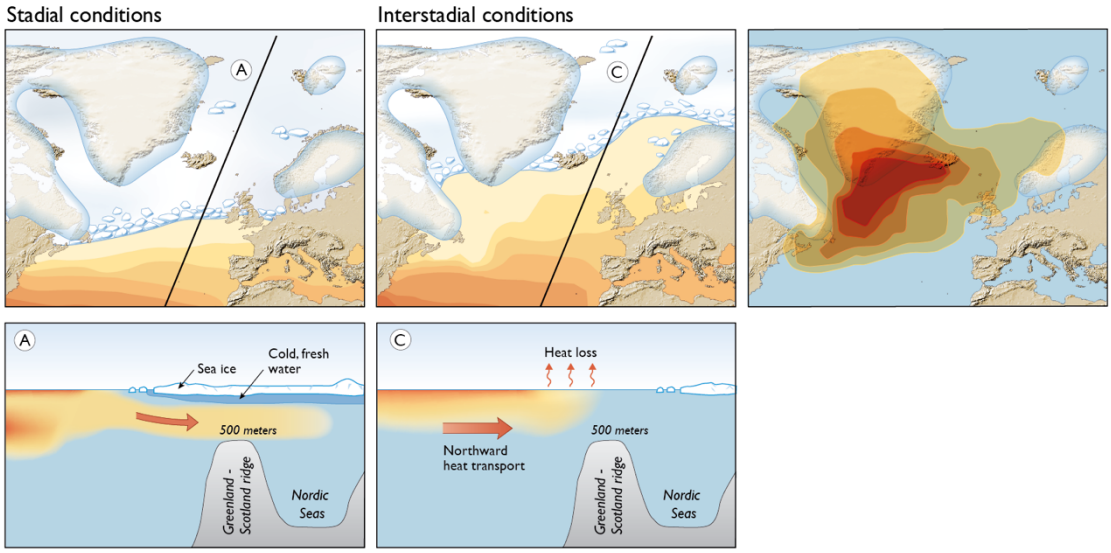


Figure 1:*Conceptual illustration of the role of sea ice in controlling Arctic, and Greenland, climate during DO events, based on marine sediment core data (Dokken et al, 2013) and simulations with ocean and atmospheric GCMs (Li et al., 2005). Upper left and middle panel shows the principle difference in sea-ice area between stadial (cold) and interstadial (warm) conditions. Upper right panel: Modeled change in surface temperature due to the sea ice change in the panels to the left (Li et al. 2005). Colour code is from 3oC (light yellow) to 15oC (dark red). Lower panels show likely change in ocean heat flux.*

When sea ice cover in the Nordic Seas is reduced in a glacial climate, models calculated an annual temperature increase of 7-8C on the summit of Greenland (Li et al. 2005). Despite evidence from sediment cores that the Nordic Seas was largely ice free during the warm interstadials (e.g.Dokken & Jansen, 1999, Dokken et al. (subm), but ice covered in between in the cold stadials, we do not know the mechanisms triggering the rapid loss of ice cover, nor the precise geographical extent of the change at the abrupt onset of the warmings, leading from stadial to interstadial climate. Evidence from proxy records and model simulations, as illustrated in figure 1, Evidence from proxy records and model simulations, as illustrated in Figure 1 indicate that during the cold (stadial) periods, relatively warm and salty Atlantic water was present and potentially accumulated under a cold and fresh surface layer with extensive sea ice cover, akin to the situation prevailing in the Arctic Ocean today. At a certain point the stratification was broken and the oceanic heat escaped to the atmosphere creating the large, rapid overshoot recorded in atmosphere and surface ocean temperature records. Recent studies of Arctic ocean stratification by our team members point to the possibility for storm induced mixing and enhanced impact of internal waves, further reducing the stratification when the ice cover disappears (Jochum et al. in press).

At present this is only a hypothesis. Ice core data across several abrupt changes show that at the onset of these changes, the atmospheric circulation changed from one year to the next (Steffensen et al. 2008). We will investigate if it is possible for large fractions of sea ice to disappear from one year to the next, simply by a reorganized wind system, and secondly if this mechanical removal may trigger large scale thermodynamic

changes involving the now exposed ocean surface, and thirdly if this change then may "lock" the atmospheric circulation in the new mode so that climate becomes “self-maintaining” in the new state.

3. Cruise objectives

The main objective of cruise GS15-198 was to retrieve sediments from the western part of the Nordic seas to document changes in ocean circulation and sea ice cover at times of abrupt changes. The cruise will complement the 2015 ice core drilling campaign done by the CIC team in ice2ice on the Renland ice cap in the Scoresbysund area on Eastern Greenland (RECAP drilling). The main focus is on MIS3 (40-30 ka), but there is also emphasis on documenting the last few millennia in detail, the entire Holocene, as well as obtaining sediment material for calibration of proxies.

For these purposes the ship carried three different coring systems: The Calypso piston coring system capable of retrieving up to 21m long cores, two mulitocorer systems for retrieving intact sediment surfaces and the uppermost sediment section, and a gravity corer to be able to document sections tht may be lost at the top of the piston cores and not sampled by the shallow multicores.

In order to add onto exisiting studies at the Bjerknes Centre and to aid in proxy calibration, water samples were also taken for O- and C-isotope analyses on shore.

The selection of sites was based on general knowledge of the area from previous coring campaigns and available literaure, and primarily based on previously cored sites where the area of those sites appear promising for the cruise objectives. The TOPAS profiling system would hopefully reveal potential sites in the vicinity where higher sedimentation rates may be obtained. In addition, the TOPAS system was used in an exploratory fashion between sites to identify potential new, promising sites.

As a sub-theme of cruise plan we dredged for long-lived bivalves off W Iceland. The purpose was to establish a sclerochronological time series of ocean variability with seasonal resolution in the Irminger Current inflow region.

4. Cruise track and operations

4.1 Station map

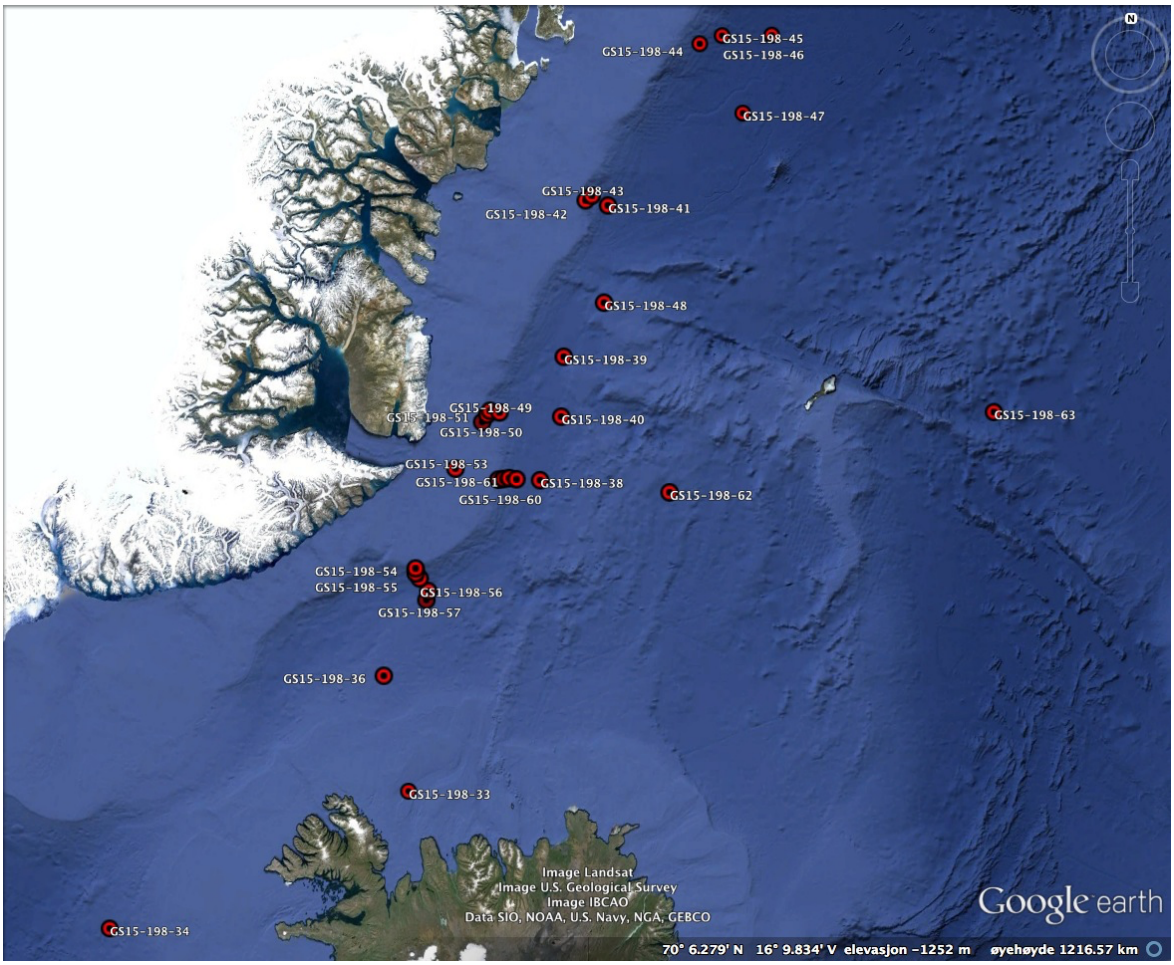


Figure 2: Coring stations of cruise GS15-198.

4.2 Operations

The ship left Reykjavik harbour on Monday July 21 after bringing onboard the coring systems and the associated supplies, but with a one day delay due to the necessity to upgrade the ship´s communications system and to fix some installation related errors on the winch system for the Calypso corer.

After leaving the port, scientific operations started immediately thereafter on the Faxafloi area due Nortwest of Reykjavik where an extensive 2-day program of dredging for Arctica islandica shells for sclerochronological work was performed. The dreging was very successful and brought a unique material of live and fossil shells probably capable of documenting changing environments of the Irminger Current on seasonal scales back beyond the instrumental record.

We then continued to the Vikarall area West of the NW part of Iceland, where a potential site in a trough extending towards the Denmark Strait had been identified. Profiling in the trough with the Topas and multibeam systems on board, did not provide, however,

information of a useful sediment sequence, and we decided to abandon the area and went to the area NE of the NW tip of Iceland where from previous coring during the Images V program an ultra-high resolution Holocene record had been produced. The purpose here was to obtain new material for extended analyses with new proxies.

We reached the site on July 22. After successful coring with all three coring systems, including a 20m Calypso core, the cruise proceeded to Isafjørdur in NW Iceland to drop off the film crew which was picked up by a local pick-up boat. The ship then continued to the southern part of the Denmark Strait for coring on the Snorri Drift. Topas profiling did not identify sites that looked to have a suitable sediment package. Attempts to core on July 24 documented, as expected sorted coarse grained sediments, apparently the currents on the drift are too strong for fine-grained sediments to accumulate. The area was then abandoned and the cruise continued to the Kangerlussuaq trough closer to SE Greenland, which we reached on July 25 and started site survey profiling. Unfortunately dense fog and sea ice made the planned site unaccessible, hence we had to turn away and cruised to the Northern stretches of the Denmark Strait.

On July 26 we occupied Site 36 and successfully retrieved nice cores with the three coring systems, including a 20m piston core in the vicinity of former site PS2644, after some hours of profiling with the TOPAS system to optimise the location for sedimentation rates. We then transited towards the lower parts of the Scoresbysund Fan. On the way, on July 27 we retrieved another set of nice cores a bit deeper and to the North of Site 36. After this we transited towards a planned depth transect on the southernmost part of the Scoresbysund Fan.

At the bottom of the transect we had another excellent coring site, Site 38, where we retrieved three cores including another 20m piston core. Further coring uplsope was prevented due to sea ice, but we managed to come back to the transit later on the cruise when the sea ice cover had significantly diminished. We then moved nortwards on the Scoresbuysund Fan, and on July 29 successfully cored another Site 39 including a 20m piston core. Again, sea ice conditions with dense fog made the uplsope areas inaccessible. Hence we moved to Site 40 the SE of Site 39 on July 30 where a potential excellent target had been identified with the TOPAS system.

When we had launched the multicorer to the sea floor, the Calypso corer winch which was used for all coring systems failed to a fault in the electronics of the whing engine inverter system. Several attempts to fix the problem failed. The ship´s crew was capable through a very skilled effort to retrieve the equipment from the bottom, but since the winch engine could not operate due to the inverter failure, the kevlar rope could not be spooled onto the winch and 1500m of rope had to be cut off as a result. Contacts over the next 24 hours with the supplier of the electronics components and KleyFrance, the winch manufacturer, clarified that no repair parts were available. We therefore had to terminate Calypso system operations for the remainder of the cruise, and no long cores could be taken. Also the operations of the gravity and multi corers were affected and launching them now had to be done from the aft of the ship from another winch. This worked out most of the time due to the nice weather with little waves we experienced for most parts of the remaining cruise.

July 31-August 2 we transited northwards in strong gale force northerly winds due to a passing system, and no operations were done until August 2. In the following days we cored and made CTD stations at a number of sites along the East Greenland Margin and in the deeper parts of the Greenland Sea as far north as 75^{o}N. As known from previous studies, this area is difficult due to extensive mass wasting, turbidites in the area. The quality of the material was therefore variable.

On August 6 we returned to the Scoresbysund area to attempt to sample the planned transects there. The strong winds of the previous week has significantly reduced the sea ice cover which now was confined to the nearshore areas. Hence we could execute coring with the gravity and multicores on three transects sampling sediments from deep waters and onto the shelf. A large number of good cores were retrieved.

After finishing coring on Site 40 which we had to abandon earlier in the cruise when the winch broke down, we moved eastwards towards Tromsø. In transit we cored on August 9 site 62 on the Iceland Plateau in order to retrieve a pelagic reference section for the region. Following the eastbound cruise track we cored site 63 on August 11. The site was located on a slightly elevated plateau at the Boundary between the Mohns Ridge and the Lofoten Basin. The purpose was to retrieve reference material for calibration studies from the Northern Norwegian Sea, and a long-term record of ocean variability from this region.

The ship then steamed eastward to reach Site 64 on August 12 located on the the deeper part of the North Norwegian Margin in the Lofoten Basin. Strong winds and large waves made it impossible to launch the CTD as planned. A new attempt was done the next day following a slight reduction of the sea state at somewhat shallower depths.

The ship then sailed through the fjords into Tromsø harbour where we docked at 0910 on August 14.

4.3 Coring and dredging equipment

Large dregdge for shell dredging

Figure 3: The dredge used for sclerochronological sampling

Multicorer

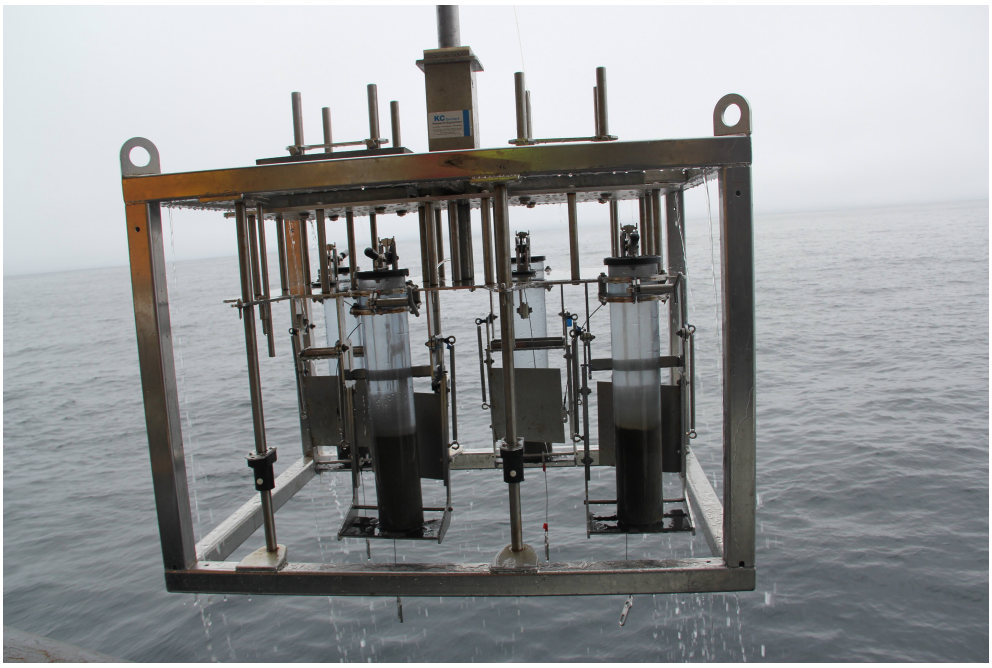


Figure 4: Retrieval of 4 multicores with undisturbed surface.

Gravity corer

Figure 5: A gravity core is retrieved and brought on board in near horizontal position.

Calypso piston corer

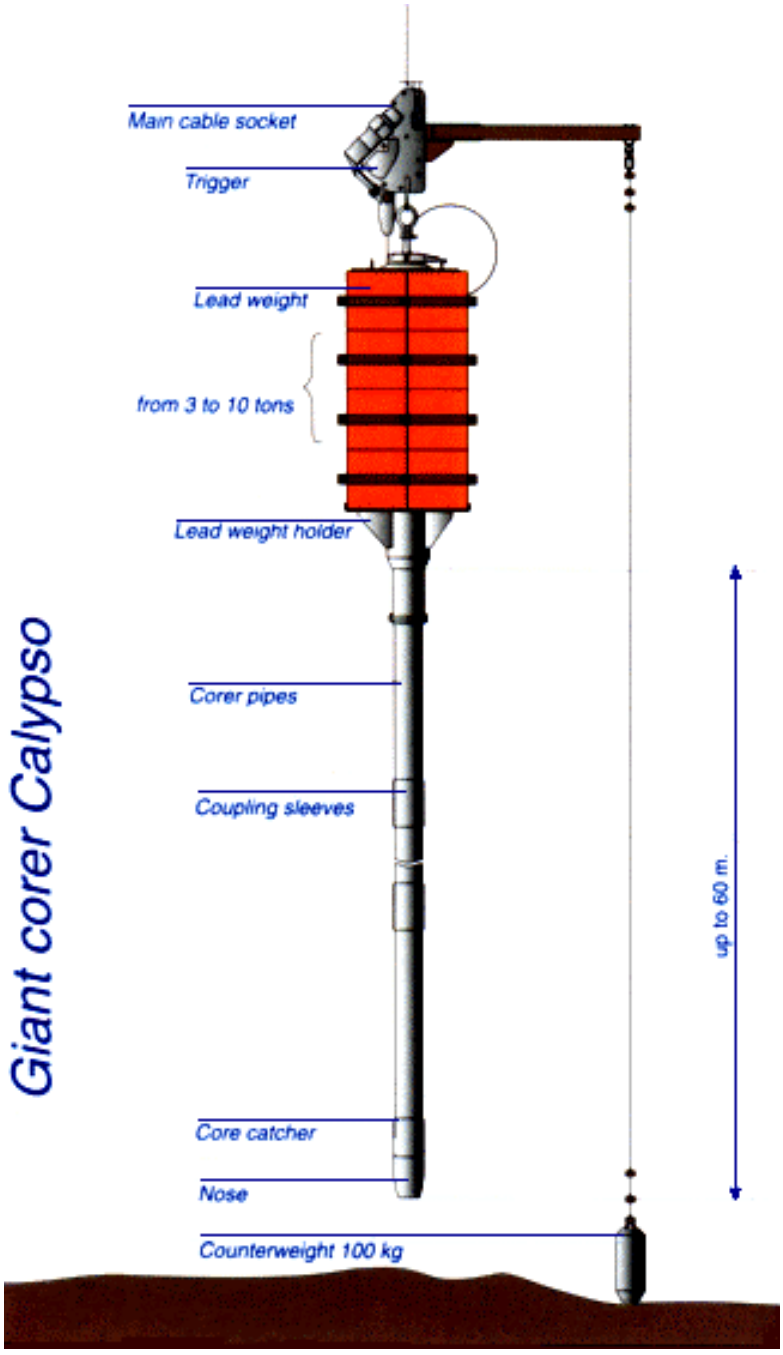


Figure 6: Principles of the Calypso coring system. A 20m long core barrel was used during the cruise.

5. Cruise participants

Scientific crew

		Nationality	Institution
Dahl, Carin Andersson	Scientist	Swedish	UNI Research
Tisserand, Amandine	Scientist	French	UNI Research
Simon, Margit	Scientist	German	UNI Research
Berben, Sarah	Scientist	Belgian	UiB
Dylmer, Christian	PhD student	Danish	UNI Research
Poulsen, Mads Bruun	Student	Danish	NBI Univ.Copenh
Olsen, Ida Synnøve	Student	Norwegian	UiB
Sessford, Evangeline	PhD student	Canadian	UiB
Sadatzki, Henrik	PhD student	German	UiB
Perner, Kerstin	Scientist	German	IOF Warnemunde
Braunthal, Ashley	Student	American	Fullbright stud. (UNI)
Vermassen, Flor	PhD student	Belgian	GEUS
Pegrum-Haram, Albertine	Student	Norwegian	Univ. Bristol
Koldtoft, Iben	PhD student	Danish	NBI/DMI
Risebrobakken, Bjørg	Scientist	Norwegian	UNI Research
Monsen, Stig	Technician	Norwegian	UiB
Strømsøe, Jørund Raukleiv	Scientist	Norwegian	UNI Research
Blindheim, Dag Inge	Technician	Norwegian	UNI Research
Jansen, Eystein	Cruise leader	Norwegian	UiB/ UNI Research

IMR Instrument technicians

Dahl, Martin	Technician	Norwegian	IMR
Sudmann, Åse Nina	Technician	Norwegian	IMR

Film team from AlongMekong 19.07-23.07

Lambert, Rolf	Producer	German
Götzmann, Alfred	Camera	German
Linke, Mannfred	Sound	German

IMR Ship Crew

	Rank	Nationality
Fredriksen, Ståle	Captain	Norwegian
By, Tor Eirik	Chief officer	Norwegian
Mæland, Ivar	1. Officer	Norwegian
Jørgensen, Lars J.	Chief Engineer	Norwegian
Sørøy, Ole. R.	1. Engineer	Norwegian
Golten, Ole	Electrician	Norwegian
Gjervik, Henning	Chief Steward	Norwegian
Sørensen, Sigve	Trawlmaster	Norwegian
Rong, Even	Netman	Norwegian
Moldskred, Tom	A.B.	Norwegian
Solsem, John Anders	A.B.	Norwegian
Johansen, Asbjørn	A.B.	Norwegian
Andreassen, Håkon	A.B.	Norwegian
Midttveit, Vibeke	Catering assistant	Norwegian
Moe, Bente Karin	Catering assistant	Norwegian

6. Station list, core and water sample information

6.1 Station information

Station	Area	Date	Time	Water depth	Latitude	Longitude	Device	Recovered length	Remarks
1	Faxafloi	20.07.15	16:21:38	35,86	64°12,18	220°9,04	DREDGE	*A. islandica*	
2	Faxafloi	20.07.15	16:42:26	35,72	64°12,31	22°09,39	DREDGE	*A. Islandica*	
3	Faxafloi	20.07.15	17:01:44	36,41	64°12,40	22°09,80	DREDGE	*A. islandica*	
4	Faxafloi	20.07.15	17:27:36	43,09	64°12,51	22°09,39	DREDGE	*A. islandica*	
5	Faxafloi	20.07.15	17:50:38	49,11	64°12,76	22°09,33	DREDGE	*A. islandica*	
6	Faxafloi	20.07.15	18:04:36	46,92	64°12,84	22°10,11	DREDGE	*A. islandica*	
7	Faxafloi	20.07.15	18:21:54	44,83	64°12,98	22°11,02	DREDGE	NA	
8	Faxafloi	20.07.15	19:57:10	47,44	64°12,42	22°09,12	DREDGE	*A. islandica*	
9	Faxafloi	20.07.15	20:12:47	43,35	64°12,64	22°09,85	DREDGE	*A. islandica*	
10	Faxafloi	20.07.15	20:37:16	47,37	64°13,00	22°10,99	DREDGE	*A. islandica*	
15	Faxafloi	21.07.15	00:07:28	56,92	64°21,76	22°51,15	DREDGE	*A. islandica*	
16	Faxafloi	21.07.15	00:24:32	75,82	64°21,49	22°52,57	DREDGE	NA	
17	Faxafloi	21.07.15	00:49:06	80,34	64°21,99	22°54,29	DREDGE	*A. islandica*	
18	Faxafloi	21.07.15	01:06:13	74,91	64°22,22	22°53,90	DREDGE	*A. islandica*	
19	Faxafloi	21.07.15	01:20:50	85,23	64°22,60	22°53,38	DREDGE	*A. islandica*	
20	Faxafloi	21.07.15	01:37:12	86,5	64°23,11	22°52,81	DREDGE	*A. islandica*	
21	Faxafloi	21.07.15	01:53:56	89,8	64°23,64	22°52,27	DREDGE	*A. islandica*	
22	Faxafloi	21.07.15	03:18:31	103,56	64°21,97	23°06,84	DREDGE	*A. islandica*	
27	Faxafloi	21.07.15	06:52:52	97,16	64°20,00	23°19,61	DREDGE	NA	
28	Faxafloi	21.07.15	07:38:32	95,31	64°19,91	23°15,46	DREDGE	*A. islandica*	
29	Faxafloi	21.07.15	08:26:43	106,12	64°21,99	23°05,89	DREDGE	*A. islandica*	
30	Faxafloi	21.07.15	08:49:58	105,53	64°22,21	23°05,84	DREDGE	*A. islandica*	
31	Faxafloi	21.07.15	09:06:23	104,86	64°22,01	23°07,64	DREDGE	*A. islandica*	
32	Faxafloi	21.07.15	09:26:29	105,19	64°21,84	23°09,52	DREDGE	*A. islandica*	

11	Faxafloi	21.07.15	22:15:10	56,92	64°20,15	22°35,85	DREDGE	NA	
12	Faxafloi	21.07.15	22:45:16	75,82	64°21,96	22°36,02	DREDGE	NA	
13	Faxafloi	21.07.15	23:12:31	80,34	64°21,99	22°40,42	DREDGE	NA	
14	Faxafloi	21.07.15	23:50:54	74,91	64°21,99	22°49,78	DREDGE	*A. islandica*	
23	Faxafloi	21.07.15	not recorded	102,66	64°21,97	23°07,45	DREDGE	*A. islandica*	
24	Faxafloi	21.07.15	not recorded	79,37	64°21,97	23°08,58	DREDGE	NA	
25	Faxafloi	21.07.15	not recorded	79,37	64°21,97	23°09,80	DREDGE	NA	
26	Faxafloi	21.07.15	not recorded	79,37	64°22,04	23°15,29	DREDGE	NA	
33	N Iceland	22.07.15	16:30	361	66°37,53	20°51,16	CTD	*Water*	CTD 316
		22.07.15	17:40	361	66°37,53	20°51,16	CC	2038	14 sections
		23.07.15	06:52	361	66°37,53	20°51,16	MC1	43	2,5 cores
		23.07.15	08:17	361	66°37,53	20°51,16	MC2	45	4 cores ABCD
		23.07.15	11:15	361	66°37,53	20°51,16	GC	407,5	3 sections, Work half of Sect 1 disturbed on board
34	Snorri drift	24.07.15	06:55	1053	65°25,43	28°22,35	CTD	Water	CTD 317
		24.07.15	08:12	1054	65°25,43	28°22,35	GC A	0	Broken core barrel
		24.07.15	09:15	1054	65°25,43	28°22,35	GC B	43	Lag deposit above diamicton
35	S Snorri Drift	24.07.15	19:04	1848	65°00,74	30°14,961	MC	0	Too hard ground
36	N Denmark Strait	26.07.15	08:15	770	67°51,655	21°52,898	CTD	Water	CTD 318
		26.07.15	10:37	770	67°51,655	21°52,898	MC1	25	4 cores ABCD
		26.07.15	11:00	770	67°51,655	21°52,898	GC	359,5	3 sections
		26.07.15	13:35	770	67°51,655	21°52,898	CC	1953	Near PS2647
		26.07.15	16:45	770	67°51,655	21°52,898	MC2	20,5	2 cores EF
37	S Scoresby-sund Fan/Iceland Plateau	27.07.15	07:27	1284	68°44,172	20°52,372	CTD	Water	CTD 319
		27.07.15	08:33	1284	68°44,172	20°52,372	MC	41	4 cores ABCD
		27.07.15	10:59	1284	68°44,172	20°52,372	GC	342,5	3 sections
		27.07.15	13:46	1284	68°44,172	20°52,372	CC	1926,5	14 sections - top short

38	Scoresby-sund Fan	28.07.15	07:06	1610	70°07,612	17°39,795	CTD	Water	CTD 320
		28.07.15	08:24	1610	70°07,613	17°39,791	MC	40	4 cores ABCD, one shorter
		28.07.15	10:44	1612	70°07,612	17°39,791	GC	446,5	3 sections
		28.07.15	13:30	1609	70°07,521	17°32,812	CC	1962,5	14 sections
39	E Greenland Margin	29.07.15	06:50	1699	71°28,261	17°04,957	CTD	Water	CTD 321
		29.07.15	08:11	1699	71°28,261	17°04,958	MC	40	4 cores ABCD
		29.07.15	10:45	1699	71°28,260	17°04,966	CC	1880	13 sections
		29.07.15	10:45	1699	71°28,261	17°04,959	GC	314	3 sections
40	Scoresby-sund Fan	30.07.15	07:03	1566	70°49,351	17°04,795	CTD	Water	CTD 322
41	E Greenland Margin	02.08.15	07:50	1988	73°08,282	15°40,746	CTD	Water	CTD 323
		02.08.15	07:50	1988	73°08,282	15°40,746	GC	357,5	3 sections
		02.08.15	07:50	1988	73°08,282	15°40,746	MC	41	4 cores ABCD
42	E Greenland Margin	02.08.15	17:39	825	73°11,252	16°31,254	CTD	Water	CTD 324
		02.08.15	20:02	826	73°11,252	16°31,254	GC	0	Core barrel broken
		02.08.15	20:02	826	73°11,252	16°31,253	MC	41	4 cores ABCD
43	E Greenland Margin	02.08.15	23:25	1251	73°14,529	16°17,762	CTD	Water	CTD 325
		03.08.15	00:32	1251	73°14,529	16°17,762	MC	42	4 cores ABCD
44	E Greenland Margin	03.08.15	15:20	1950	74°56,869	11°55,300	CTD	Water	CTD 326
		03.08.15	15:20	1950	74°56,869	11°55,302	GC	217	2 sections
		03.08.15	16:50	1950	74°56,869	11°55,300	MC	42	4 cores ABCD
45	Greenland Sea	03.08.15	21:45	2627	75°01,880	10°56,811	CTD	Water	CTD 327
		03.08.15	23:31	2628	75°01,880	10°56,811	MC	44,5	4 cores ABCD
		04.08.15	01:04	2628	75°01,880	10°56,811	GC	252	2 sections
46	Greenland Sea	04.08.15	07:55	3266	75°00,208	08°49,236	CTD	Water	CTD 328
		04.08.15	07:55	3266	75°00,208	08°49,238	GC A	288	2 sections
		04.08.15	07:55	3266	75°00,208	08°49,230	GC B	224	2 sections, core barrel broken
		04.08.15	07:55	3266	75°00,207	08°49,236	MC	38	4 cores ABCD

47	Greenland Sea	04.08.15	21:36	3046	74°08,373	10°20,454	MC	44	4 cores ABCD
		04.08.15	23:25	3046	74°08,373	10°20,455	GC A	0	5m core barrel broken at 1.2m beow top
		05.08.15	01:05	3046	74°08,373	10°20,455	GC B	295	3m barrel, 2 sections
48	Greenland Sea	05.08.15	16:40	1402	72°04,298	15°45,056	CTD	Water	CTD 329
		05.08.15	17:40	1402	72°04,298	15°45,056	MC	41,5	4 cores ABCD
		05.08.15	18:50	1402	72°04,298	15°45,056	GC	340	3 sectons
		06.08.15	04:32	1567	70°49,351	17°04,789	MC	44	4 cores ABCD
		06.08.15	06:13	1571	70°49,351	17°04,790	GC	340	3 sections
49	Scoresby-sund Fan	06.08.15	14:30	1292	70°49,671	19°16,760	CTD	Water	CTD 330
		06.08.15	15:40	1292	70°49,671	19°16,761	MC 1	40,5	New 2 tube MC 70cm tubes 2 cores AB
		06.08.15	16:56	1292	70°49,671	19°16,767	MC 2	40	4 cores ABCD (3 shorter)
		06.08.15	17:50	1292	70°49,671	19°16,761	GC	252	2 sections
50	Scoresby-sund Fan	06.08.15	20:53	942	70°50,350	19°25,900	MC	39,5	4 cores ABCD
		06.08.15	21:38	942	70°50,350	19°25,901	GC	0	Broken core barrel
51	Scoresby-sund Fan	07.08.15	00:50	712	70°47,760	19°30,537	MC	44	4 cores ABCD
52	Scoresby-sund	07.08.15	05:30	401	70°42,635	19°39,295	MC	26	4 cores ABCD
53	Scoresby-sund	07.08.15	09:40	312	70°11,012	20°22,717	CTD	Water	CTD 331
		07.08.15	09:59	311	70°11,011	20°22,718	MC1	40	3 cores ABC
		07.08.15	10:35	311	70°11,011	20°22,718	MC2	0	Used new MC, both tubes broken, stones on the bottom
		07.08.15	10:35	311	70°11,011	20°22,718	MC2	24,5	4 cores ABCD
		07.08.15	10:35	311	70°11,011	20°22,718	MC3	24,5	3 cores DEF
54	S Scoresby-sund Fan	07.08.15	19:43	660	69°03,866	21°17,644	CTD	Water	CTD 332
		07.08.15	20:15	660	69°03,867	21°17,644	MC	40	4 cores ABCD
55	S Scoresby-sund Fan	07.08.15	21:30	942	69°00,694	21°16,439	MC	42	4 cores ABCD
56	S Scoresby-sund Fan	07.08.15	23:23	1193	68°57,720	21°08,400	MC	42	4 cores ABCD
57	S Scoresby-	08.08.15	01:55	1454	68°50,320	20°50,514	CTD	Water	CTD 333

	sund Fan								
		08.08.15	02:52	1454	68°50,320	20°50,514	MC	41	4 cores ABCD
		08.08.15	03:43	1454	68°50,320	20°50,516	GC A	319	Used plastic core catcher unit
		08.08.15	06:08	1454	68°50,320	20°50,514	GC B	292,5	Used plastic core catcher unit
58	Scoresby-sund Fan	08.08.15	15:34	602	70°06,253	18°59,236	CTD	Water	CTD 334
		08.08.15	16:25	603	70°06,253	18°59,232	MC	38	4 cores ABCD
59	Scoresby-sund Fan	08.08.15	18:03	903	70°06,903	18°49,902	CTD	Water	CTD 335
		08.08.15	18:40	903	70°06,902	18°49,903	MC 1	36	3 cores ABC
		08.08.15	18:40	903	70°06,902	18°49,901	MC 2	41	3 cores DEF
60	Scoresby-sund Fan	08.08.15	21:08	1167	70°07,762	18°38,658	MC	40,5	4 cores ABCD
		08.08.15	22:00	1167	70°07,762	18°38,658	GC	331,5	3 sections
61	Scoresby-sund Fan	09.08.15	00:10	1423	70°07,351	18°24,779	CTD	Water	CTD 336
		09.08.15	01:02	1423	70°07,351	18°24,779	MC	41	4 cores ABCD
		09.08.15	02:00	1423	70°07,352	18°24,780	GC A	336	3 sections
		09.08.15	03:10	1423	70°07,351	18°24,779	GC B	362	4 sections incl 1 short with extra material hanging out of cc
		09.08.15	04:50	1423	70°07,351	18°24,779	GC C	416	3 sections
62	Iceland Plateau	09.08.15	16:10	1311	70°01,187	13°33,771	MC 1	44	4 cores ABCD
		09.08.15	17:08	1311	70°01,188	13°33,774	GC	0	Most likely double penetration, core discarded
		09.08.15	18:16	1312	70°01,188	13°33,770	GC	311,5	3 sections
		09.08.15	19:15	1312	70°01,188	13°33,772	CTD	Water	CTD 337
		09.08.15	20:08	1312	70°01,188	13°33,772	MC 2	46	2 cores EF (MC with two tubes)
63	Lofoten Basin	11.08.15	06:56	2995	70°31,655	02°45,333	CTD		CTD 338
		11.08.15	08:39	2995	70°31,654	02°45,335	MC	50,5	4 cores ABCD
		11.08.15	10:28	2995	70°31,655	02°45,331	GC A	311	3 sections
		11.08.15	12:27	2995	70°31,656	02°45,336	GC B	411	3 sections
64	Norwegian Margin	13.08.15	09:10	1195	69°45,441	16°31,020E	CTD	Water	CTD 339

6.2 Water sample handling

On nearly every station we obtained a CTD (conductivity, temperature, density) profile of the water column. Water samples (50 ml) were taken on different depths in order to analyse changes in oxygen and carbon isotopes with depth. Samples were preferably taken on 10, 20, 50, 100, 200, 400 m and then every 400 m below that. Additional water samples were taken for the CTD calibration at IMR.

7. Sediment core information

7.1 Onboard core handling and analyses

Three different coring devices were applied on this cruise, a Multicorer, a Gravity corer and a Calypsocorer. With the Multicorer we get four tubes of undisturbed surface sediment samples up to 50 cm long. With the Gravitycorer we recover the upper 3-5 meters of the sediments depending on the properties of the sediments and the ability to penetrate the sediments with the applied weight of the coring equipment and the length of the tube. When the Calypsocorer is applied we have the ability to recover 21, 5 meters of sediments.

Subsequent to the coring operation the cores were cut into sections, preferably 150 cm, and spilt into two equal halves, one for archive and one for work. Floral foam where put in the ends of the section for stabilisation of the sediments. The splitting was done with a handheld saw on a table designed for the operation. From each station one of the Multicores were drained and split.

After splitting, both halves of the cores were properly cleaned with a spatula. A lithological description (colour, grain-size, layering etc.) was made and u-channels were taken from each section on all the cores. Thin plastic film was put on the surface and the work section was subsequently measured for colour and magnetic susceptibility. High- resolution pictures were taken every 10 cm.

A hand-held Konica Minolta CM 600d spectrophotometer was used to measure the light reflectance of sediment core surfaces immediately after opening of the core. Any enclosed air-bubbles between the plastic foil and the sediment were carefully removed. Measurements were carried out every 1 cm by placing the device directly on the core surface. The spectrum of the reflected light is measured by a multi-segment light sensor, measuring at a 10 nm pitch between wavelengths of 400 to 700 nm

A hand-held Bartington MS3 Magnetic Susceptibility meter with a MS2E surface Scanning Sensor was used to measure the Magnetic Susceptibility of the sediments in the opened core. Measurements were carried out at either 1cm or 0.5 cm intervals of all cores.

Samples of sediments (10 g) for DNA-analysis were taken from both the fresh surface of the Multicore and from lower parts of the Gravity and Calypso corer. Samples were not taken on every station. See own chapter.

After processing all the core sections were enveloped in plastic, properly labelled and put in d-tubes for storage.

7.3 Core descriptions (See Appendix D)

8. Preliminary assesment of core material and dredging from shipboard analyses

8.1 Shell dredging at Faxaflói.

The aim of the dredging was to collect live-collected and sub-fossil specimens of bivalves that can be used for chronology building. The primary target for the dredging was the long-lived species *Arctica islandica*. The dredging started in a relatively shallow area (30-40 meter water depth) of Faxafloí were stock estimates had been carried out in the late 1980-ties. Until recently, the species *A. islandica* has been a commercially interesting species fished for export around Iceland. Today, commercial fishing of this species is only done on the north-eastern shelf of Iceland. We collected both living and sub-fossil specimens of *A. islandica* from this shallow location. Then we dredged at successively deeper water depth, the deepest station being located at 106 meters, to assure that we got specimens that lived in Atlantic waters, locations unaffected by any coastal waters. Live-collected and dead, sub-fossil, specimens were retrieved from the deeper areas as well, although, at first glance, there appears to be a gap in the distribution through time (i.e. geological age) at the deepest locations compared to the more shallow locations.

8.2 Continuity of recovered sediments

Core scanning documents that sites where a combination of mulicore, gravity core and Calypso cre where used, contains a continuous record with apparently no missing sections between the cores from the different gears.

8.3 Utility for MIS3 and MIS5-studies

Preliminary correlations to previous records of magnetic susceptibility from the region indicate that the long cores off Scoresbysund and N Denmark Strait (Cores 36,37, 38, 39) comprise sediments useful for detailed studies of MIS 3 and MIS5. Several of the Gravity Cores from the area apparently contain parts of or all of MIS3.

8.4 Utility for Holocene studies

Site 33 sontains an ultra-high resolution sediment sequence of the Holocene, which appears to be intact from the surface to about 8ka. The remaining cores have lower sedimentation rates of the Holocene, but in many cases higher than in the deep Nordic Seas.

8.5 Utility for proxy calibration

The mulicoring system worked well during the cruise and provides a unique material of undisturbed surfaces and recent sediments from almost all sites visted. Thus the material is ideal for calibration of proxies in the cold water areas.

Appendix A. Table of CTD stations and water sampling

Station	Area	Date	Time (UTC)	Water Depth	Latitude	Longitude (W)	Device	Samples	Remarks
33	N Iceland	21.07.11	16:30	361	66°37,53	20°51,16	CTD	*Water*	CTD 316
34	Snorri drift	23.07.11	06:55	1053	65°25,43	28°22,35	CTD	Water	CTD 317
36	N Denmark Strait	25.07.11	08:15	770	67°51,655	21°52,898	CTD	Water	CTD 318
37	Iceland Plateau	26.07.11	07:27	1284	68°44,172	20°52,372	CTD	Water	CTD 319
38	Scoresbysund Fan	27.07.11	07:06	1610	70°07,612	17°39,795	CTD	Water	CTD 320
39	E Greenland Margin	28.07.11	06:50	1699	71°28,261	17°04,957	CTD	Water	CTD 321
40	Scoresbysund Fan	29.07.11	07:03	1566	70°49,351	17°04,795	CTD	Water	CTD 322
41	E Greenland Margin	01.08.11	07:50	1988	73°08,282	15°40,746	CTD	Water	CTD 323
42	E Greenland Margin	01.08.11	17:39	825	73°11,252	16°31,254	CTD	Water	CTD 324
43	E Greenland Margin	01.08.11	23:25	1251	73°14,529	16°17,762	CTD	Water	CTD 325
44	E Greenland Margin	02.08.11	15:20	1950	74°56,869	11°55,300	CTD	Water	CTD 326
45	Greenland Sea	02.08.11	21:45	2627	75°01,880	10°56,811	CTD	Water	CTD 327
46	Greenland Sea	03.08.11	07:55	3266	75°00,208	08°49,236	CTD	Water	CTD 328
48	Greenland Sea	04.08.11	16:40	1402	72°04,298	15°45,056	CTD	Water	CTD 329
49	Scoresbysund Fan	05.08.11	14:30	1292	70°49,671	19°16,760	CTD	Water	CTD 330
53	Scoresbysund	06.08.11	09:40	312	70°11,012	20°22,717	CTD	Water	CTD 331
54	S Scoresbysund Fan	06.08.11	19:43	660	69°03,866	21°17,644	CTD	Water	CTD 332
57	S Scoresbysund Fan	07.08.11	01:55	1454	68°50,320	20°50,514	CTD	Water	CTD 333
58	Scoresbysund Fan	07.08.11	15:34	602	70°06,253	18°59,236	CTD	Water	CTD 334
59	Scoresbysund Fan	07.08.11	18:03	903	70°06,903	18°49,902	CTD	Water	CTD 335
61	Scoresbysund Fan	08.08.11	00:10	1423	70°07,351	18°24,779	CTD	Water	CTD 336
62	Iceland Sea	08.08.11	19:15	1312	70°01,188	13°33,772	CTD	Water	CTD 337
63	Lofoten Basin	10.08.11	06:56	2995	70°31,655	02°45,333	CTD	Water	CTD 338
64	Norwegian Margin	13.08.15	09:10	1195	69°45,441	16°31,020E	CTD	Water	CTD 339

Appendix B. Site survey TOPAS sections

PROFILE LIST						
STATION	**LINE NO.**	**FILE**		**LAT**	**LONG**	**DATE/TIME (UTC)**
33	1	20150722130538	**START**	66°37,04 N	20°12,95 W	22/07/2015 1:07:00 PM
			END	66°37,1042 N	20°52,17 W	22/07/2015 2:11:00 PM
34	1	201507240200027	**START**	65°36,203 N	27°19,800 W	24/07/2015 2:00:00 AM
			END	65°24,416 N	28°22,8645 W	24/07/2015 5:10:00 AM
34	2	20150724051539	**START**	65°23,667 N	28°28,173 W	24/07/2015 5:15:00 AM
			END	65°25,7644 N	28°28,048 W	24/07/2015 5:41:00 AM
34	3	20150724054329	**START**	65°25,796 N	28°28,00 W	24/07/2015 5:43:00 AM
			END	65°25,010 N	28°20,508 W	24/07/2015 6:17:00 AM
35	1	20150724111829	**START**			
			END	69°07,19 N	30°17,6 W	24/07/2015 3:45:00 PM
35	2	20150724155058	**START**	65°00,29 N	30°17,82 W	24/07/2015 3:50:00 PM
			END	65°01,21 N	30°17,88 W	24/07/2015 4:10:00 PM

36	1	20150725044451	**START**	66°33,88 N	31°15,01 W	25/07/2015 4:45:00 AM
			END	66°46,90 N	31°02,12 W	25/07/2015 6:15:00 AM
36	1	20150726013242	**START**	67°36,9830 N	23°42,1506 W	26/07/2015 1:34:00 AM
			END	67°52,3610 N	21°48,1643 W	26/07/2015 6:08:00 AM
36	2	201507260600958	**START**	67°52,3610 N	21°48,1643 W	26/07/2015 6:08:00 AM
			END	67°54,037 N	21°57,0477 W	26/07/2015 7:45:00 AM
36	3	20150726064725	**START**	67°54,037 N	21°57,0477 W	26/07/2015 7:45:00 AM
			END	67°50,640 N	21°51,019 W	26/07/2015 7:27:00 AM
37	1	20150726164007	**START**	67°55,375 N	21°48,317 W	26/07/2015 4:39:00 PM
			END	68°50,0032 N	20°49,307 W	26/07/2015 10:00:00 PM
37	2	20150726220156	**START**	68°50,089 N	20°49,267 W	26/07/2015 10:00:00 PM
			END	68°58,382 N	21°05,087 W	27/07/2015 12:13:00 AM
37	3	20150727001515	**START**	68°58,227 N	21°05,267 W	27/07/2015 12:14:00 AM
			END	68°55,342 N	21°02,732 W	27/07/2015 12:46:00 AM
37	4	20150727004825	**START**	68°55,317 N	21°02,446 W	27/07/2015 12:48:00 AM
			END	68°56,507 N	20°57,382 W	27/07/2015 1:27:00 AM

37	5	20150727015512	**START**	68°56,779 N	20°57,146 W	27/07/2015 1:53:00 AM
			END	68°58,579 N	20°49,097 W	27/07/2015 2:35:00 AM
37	6	20150727023700	**START**	68°58,534 N	20°48,864 W	27/07/2015 2:37:00 AM
			END	68°56,064 N	20°43,032 W	27/07/2015 3:10:00 AM
37	7	20150727031223	**START**	68°55,595 N	20°43,282 W	27/07/2015 3:12:00 AM
			END	68°50,180 N	21°05,449 W	27/07/2015 5:15:00 AM
37	8	20150727054538	**START**	68°48,944 N	21°03,341 W	27/07/2015 5:46:00 AM
			END	68°44,171 N	21°52,372 W	27/07/2015 6:45:00 AM
38	1	20150727155628	**START**	68°46,422 N	20°47,103 W	27/07/2015 3:57:00 PM
			END	70°12,340 N	17°31,901 W	28/07/2015 2:09:00 AM
38	2	20150728021144	**START**	70°12,344 N	17°31,699 W	28/07/2015 2:11:00 AM
			END	70°07,490 N	17°27,036 W	28/07/2015 3:05:00 AM
38	3	20150728030707	**START**	70°07,483 N	17°27,165 W	28/07/2015 3:07:00 AM
			END	70°07,237 N	17°42,280 W	28/07/2015 6:09:00 AM
39	1	20150728154258	**START**	70°07,729 N	17°32,376 W	28/07/2015 3:45:00 PM
			END	71°30,016 N	17°07,11 W	29/07/2015 3:20:00 AM

39	2	20150729032148	**START**	71°29,974 N	17°06,922 W	29/07/2015 3:22:00 AM
			END	71°28,292 N	17°04,854 W	29/07/2015 3:39:00 AM
39	3	20150729034012	**START**	71°28,268 N	17°04,901 W	29/07/2015 3:39:00 AM
			END	71°28,194 N	17°13,331 W	29/07/2015 4:43:00 AM
40	1	20150729152331	**START**	71°28,319 N	17°06,087 W	29/07/2015 3:23:00 PM
			END	71°29,772 N	18°33,850 W	29/07/2015 8:01:00 PM
40	2	20150729200350	**START**	71°29,580 N	18°33,740 W	29/07/2015 8:03:00 PM
			END	71°26,918 N	18°29,800 W	29/07/2015 8:25:00 PM
40	3	20150729202754	**START**	71°26,982 N	18°29,194 W	29/07/2015 8:28:00 PM
			END	71°31,459 N	18°23,644 W	29/07/2015 9:19:00 PM
40	4	20150729212226	**START**	71°31,483 N	18°23,00 W	29/07/2015 9:23:00 PM
			END	71°31,482 N	18°15,035 W	29/07/2015 9:47:00 PM
40	5	20150729214915	**START**	71°31,321 N	18°14,998 W	29/07/2015 9:49:00 PM
			END	71°29,212 N	18°16,770 W	29/07/2015 10:07:00 PM
40 new	1	20150729221116	**START**	71°28,777 N	18°16,347 W	
			END	70°50,268 N	17°13,849 W	30/07/2015 3:16:00 AM

40 new	2	20150730032402	**START**	70°49,346 N	17°13,971 W	30/07/2015 3:23:00 AM
			END	70°49,292 N	16°52,308 W	30/07/2015 4:36:00 AM
41	1	20150802033213	**START**	73°04,880 N	15°41,926 W	02.08.15 03:32 AM
			END	73°10,357 N	15°39,564 W	02.08.15 04:58 AM
41	2	20150802050236	**START**	73°10,351 N	15°38,778 W	02.08.15 05:02 AM
			END	73°07,344 N	15°31,174 W	02.08.15 05:50 AM
41	3	20150802055138	**START**	73°07,344 N	15°31,17 W	02.08.15 05:51 AM
			END	73°07,324 N	15°31,17 W	02.08.15 06:31 AM
42	1	20150802122440	**START**	73°08,261 N	15°40,749 W	02.08.15 12:24 PM
			END	73°08,662 N	16°42,758 W	02.08.15 03:24 PM
42	2	20150802152548	**START**	73°08,763 N	16°42,610 W	02.08.15 03:26 PM
			END	73°11,670 N	16°31,751 W	02.08.15 04:09 PM
42	3	20150802161103	**START**	73°11,670 N 16°31,751 W	16°42,610 W	02.08.15 04:10 PM
			END	73°07,990 N	16°31,297 W	02.08.15 04:46 PM
43	1	20150802212605	**START**	73°11,747 N	16°29,800 W	02.08.15 09:26 PM
			END	73°17,296 N	16°16,905 W	02.08.15 10:11 PM

43	2	20150802212605	**START**	73°17,070 N	16°16,838 W	02.08.15 10:14 PM
			END	73°13,877 N	16°18,054 W	02.08.15 10:49 PM
44	1	20150803011736	**START**	73°16,898 N	16°12,472 W	03.08.15 01:15 AM
			END	75°01,316 N	11°46,640 W	03.08.15 01:45 PM
45	1	20150803185846	**START**	74°56,722 N	11°56,110 W	03.08.15 07:00 PM
			END	74°59,715 N	11°04,154 W	03.08.15 08:10 PM
45	2	20150803201102	**START**	74°59,715 N	11°04,154 W	03.08.15 08:11 PM
			END	75°02,650 N	10°53,190 W	03.08.15 08:33 PM
46	1	20150804021402	**START**	75°01,546 N	10°45,847 W	04.08.15 02:14 AM
			END	75°00,333 N	8°34,459 W	04.08.15 05:33 AM
46	2	20150804053500	**START**	75°00,487 N	8°34,391 W	04.08.15 05:35 AM
			END	75°03,254 N	8°41,310 W	04.08.15 06:03 AM
46	3	20150804060359	**START**	75°03,254 N	8°41,310 W	04.08.15 06:04 AM
			END	75°00,476 N	8°48,615 W	04.08.15 06:36 AM
47	1	20150804154627	**START**	74°55,836 N	8°57,147 W	04.08.15 03:46 PM
			END	74°08,310 N	10°20,250 W	04.08.15 08:17 PM

48	1	20150805020754	**START**	74°06,080 N	10°24,414 W	05.08.15 02:08 AM
			END	73°20,641 N	11°29,602 W	05.08.15 06:21 AM
48	2	20150805062154	**START**	73°20,641 N	11°29,602 W	05.08.15 06:22 AM
			END	72°47,176 N	13°31,380 W	05.08.15 11:00 AM
48	3	20150805110026	**START**	72°47,176 N	13°31,380 W	05.08.15 11:00 AM
			END	72°04,297 N	15°45,056 W	05.08.15 04:00 PM
48	4	20150805181714	**START**	72°03,634 N	15°47,105 W	05.08.15 06:17 PM
			END	70°49,438 N	17°06,066 W	06.08.15 03:49 AM
49	1	20150806065950	**START**	70°49,345 N	17°04,610 W	06.08.15 07:00 AM
			END	70°51,657 N	19°06,293 W	06.08.15 12:21 PM
49	2	20150806122153	**START**	70°51,657 N	19°06,293 W	06.08.15 12:22 PM
			END	70°49,328 N	19°06,823 W	06.08.15 12:39 PM
49	3		**START**	70°48,980 N	19°07,030 W	06.08.15 12:41 PM
			END	70°48,806 N	19°11,955 W	06.08.15 12:54 PM
49	4	20150806125502	**START**	70°48,806 N	19°11,955 W	06.08.15 12:54 PM
			END	70°51,596 N	19°12,133 W	06.08.15 01:20 PM

50	1	20150806183621	**START**	70°49,684 N	19°06,727 W	06.08.15 06:36 PM
			END	70°49,426 N	19°22,235 W	06.08.15 07:21 PM
50	2	20150806192123	**START**	70°49,444 N	19°22,464 W	06.08.15 07:22 PM
			END	70°51,374 N	19°22,400 W	06.08.15 07:38 PM
50	3	20150806193838	**START**	70°51,440 N	19°22,540 W	06.08.15 07:39 PM
			END	70°48,880 N	19°26,030 W	06.08.15 08:05 PM
51	1	20150806220730	**START**	70°50,228 N	19°26,420 W	06.08.15 10:08 PM
			END	70°47,904 N	19°33,105 W	06.08.15 10:40 PM
51	2	20150806224124	**START**	70°47,948 N	19°33,196 W	06.08.15 10:41 PM
			END	70°52,190 N	19°32,292 W	06.08.15 11:21 PM
51	3	20150806232514	**START**	70°52,060 N	19°31,820 W	06.08.15 11:25 PM
			END	70°49,910 N	19°30,00 W	07.08.15 12:15 AM
52	1	20150807011734	**START**	70°47,717 N	19°30,978 W	08.07.15 01:17 AM
			END	70°44,237 N	19°44,663 W	08.07.15 02:13 AM
52	2	20150807021641	**START**	70°44,008 N	19°44,510 W	08.07.15 02:17 AM
			END	70°42,827 N	19°42,172 W	08.07.15 02:33 AM

52	3	20150807023528	**START**	70°42,770 N	19°41,841 W	08.07.15 02:34 AM
			END	70°42,537 N	19°37,512 W	08.07.15 02:53 AM
53	1	20150807034921	**START**	70°42,610 N	19°38,028 W	08.07.15 03:49 AM
			END	70°07,830 N	19°58,316 W	08.07.15 07:44 AM
53	2	20150807074427	**START**	70°07,830 N	19°58,316 W	08.07.15 07:44 AM
			END	70°11,619 N	20°25,415 W	08.07.15 09:09 AM
54	1	20150807111027	**START**	70°11,022 N	20°22,667 W	08.07.15 11:11 AM
			END	69°17,040 N	21°45,926 W	08.07.15 05:07 PM
54	2	20150807170829	**START**	69°16,856 N	21°45,619 W	08.07.15 05:08 PM
			END	69°04,200 N	21°18,770 W	08.07.15 06:33 PM
54	3	20150807183353	**START**	69°04,200 N	21°18,770 W	08.07.15 06:34 PM
			END	69°04,962 N	21°16,201 W	08.07.15 06:42 PM
54	4	20150807184209	**START**	69°04,962 N	21°16,201 W	08.07.15 06:43 PM
			END	69°04,342 N	21°14,435 W	08.07.15 06:51 PM
54	5	20150807185054	**START**	69°03,982 N	21°19,443 W	08.07.15 07:09 PM
			END	69°03,866 N	21°17,556 W	08.07.15 07:20 PM

55	1	20150807203835	**START**	69°03,859 N	21°17,571 W	08.07.15 08:38 PM
			END	69°01,283 N	21°13,440 W	08.07.15 08:46 PM
55	2	20150807204616	**START**	69°01,283 N	21°13,440 W	08.07.15 08:46 PM
			END	69°00,368 N	21°18,340 W	08.07.15 08:59 PM
56	1	20150807220445	**START**	69°00,662 N	21°15,397 W	08.07.15 10:04 PM
			END	68°58,051 N	21°06,794 W	08.07.15 10:29 PM
56	2	20150807223003	**START**	68°57,902 N	21°07,012 W	08.07.15 10:30 PM
			END			
57	1	20150808002952	**START**	68°53,932 N	20°57,470 W	08.08.15 12:30 AM
			END	68°50,393 N	20°49,541 W	08.08.15 12:57 AM
57	2	20150808005739	**START**	65°50,373 N	20°49,694 W	08.08.15 12:58 AM
			END	68°50,022 N	20°53,969 W	08.08.15 01:08 AM
58	1	20150808070345	**START**	68°51,701 N	20°48,875 W	08.08.15 07:04 AM
			END	70°07,078 N	19°01,220 W	08.08.15 02:48 PM
58	2	20150808144911	**START**	70°07,091 N	19°00,578 W	08.08.15 02:49 PM
			END	70°05,704 N	18°59,136 W	08.08.15 03:05 PM

59	1	20150808164156	**START**	70°06,216 N	18°59,217 W	08.08.15 04:42 PM
			END	70°07,467 N	18°49,634 W	
60	1	20150808194555	**START**	70°06,984 N	18°49,463 W	08.08.15 07:46 PM
			END	70°06,989 N	18°38,747 W	08.08.15 08:12 PM
60	2	20150808201257	**START**	70°06,989 N	18°38,747 W	08.08.15 08:13 PM
			END	70°08,144 N	18°38,618 W	08.08.15 08:28 PM
61	1	20150808224416	**START**	70°08,738 N	18°37,094 W	08.08.15 10:44 PM
			END	70°08,654 N	18°25,423 W	08.08.15 11:04 PM
61	2	20150808230856	**START**	70°08,487 N	18°25,150 W	08.08.15 11:09 PM
			END	70°06,228 N	18°24,901 W	08.08.15 11:26 PM
62	1	20150809064630	**START**	70°07,410 N	17°41,015 W	08.08.15 06:46 AM
			END	70°01,330 N	13°34,100 W	08.08.15 02:50 PM

Appendix C. Sediment coring and handling information

Ice2Ice			GS15-198									
Station	**Date**	**Water**	**Lat.**	**Long.**	**Device**	**Recovery**	**Sect.**	**From**	**To**		**Section length**	**Remarks**
		depth	(N)	(W)		(cm)		cm	cm			
GS15-198-33	2307/15	361	66°37,53	20°51,16	MC1		A	0	25,5		25,5	Sliced and subsampled by Kerstin Perner onboard
							B	0	45	Work	45	Split and sampled by Kerstin Perner onboard
								0	45	Work	45	Split and sampled by Kerstin Perner onboard
							C	0	39		39	
							D	0	43		43	
	2307/15	361	66°37,53	20°51,16	MC2		E	0	45		45	
							F	0	44,5		44,5	
							G	0	44,5		44,5	
	2307/15	361	66°37,53	20°51,16	GC	407,5	1	0	107,5	Work	107,5	Working part lost on board
										Archive		u-ch.
							2	107,5	258	Work	150,5	
										Archive		u-ch.
							3	258	407,5	Work	149,5	
										Archive		u-ch.
	2307/15	361	66°37,53	20°51,16	CC	20,38	1	0	109	Work	109	
										Archive		u-ch.
							2	109	258,5	Work	149,5	
										Archive		u-ch.
							3	258,5	401,5	Work	143	
										Archive		u-ch.

							4	401,5	551,5	Work	150	
										Archive		u-ch.
							5	551,5	702	Work	150,5	
										Archive		u-ch.
							6	702	851,5	Work	149,5	
										Archive		u-ch.
							7	851,5	997	Work	145,5	
										Archive		u-ch.
							8	997	1146,5	Work	149,5	
										Archive		u-ch.
							9	1146,5	1296	Work	149,5	
										Archive		u-ch.
							10	1296	1446,5	Work	150,5	
										Archive		u-ch.
							11	1446,5	1587,5	Work	141	
										Archive		u-ch.
							12	1587,5	1738	Work	150,5	
										Archive		u-ch.
							13	1738	1888	Work	150	
										Archive		u-ch.
							14	1888	2038	Work	150	
										Archive		u-ch.
GS15-198-34	2407/15	1054	65°25,43	28°22,35	GC	24	1	0	24	Work	24	one short section
										Archive		u-ch.
GS15-198-35	2507/15	1848	65°00,74	30°14,961								No coring
GS15-198-36	2607/15	770	67°51,655	21°52,898	MC		A	0	25	Work	25	Split and sampled by Kerstin Perner onboard

								0	25	Archive	25	
							B	0	23		23	
							C	0	23		23	
							D	0	23		23	
							E	0	20,5		20,5	
							F	0	23,3		23,3	
		770	67°51,655	21°52,898	GC	359,5	1	0	60	Work	60	
										Archive		u-ch.
							2	60	210	Work	150	
										Archive		u-ch.
							3	210	359,5	Work	149,5	
										Archive		u-ch.
		770	67°51,655	21°52,898	CC	1953	1	0	30,5	Work	30,5	
										Archive		u-ch.
							2	30,5	180	Work	149,5	
										Archive		u-ch.
							3	180	322,5	Work	142,5	
										Archive		u-ch.
							4	322,5	471	Work	148,5	
										Archive		u-ch.
							5	471	620	Work	149	
										Archive		u-ch.
							6	620	769	Work	149	
										Archive		u-ch.
							7	769	909,5	Work	140,5	
										Archive		u-ch.
Station	**Date**	**Water**	**Latitude**	**Longitude**	**Device**	**Recovered length**	**Section**	**From**	**To**		**section length**	**Remarks**

		depth	(N)	(W)		(cm)		cm	cm			
							8	909,5	1059	Work	149,5	
										Archive		u-ch.
							9	1059	1210	Work	151	
										Archive		u-ch.
							10	1210	1360,5	Work	150,5	
										Archive		u-ch.
							11	1360,5	1502	Work	141,5	
										Archive		u-ch.
							12	1502	1652,5	Work	150,5	
										Archive		u-ch.
							13	1652,5	1802,5	Work	150	
										Archive		u-ch.
							14	1802,5	1953	Work	150,5	
										Archive		u-ch.
GS15-198-37	2707/15	1284	68°44,172	20°52,372	MC		A	0	40		40	
							B	0	39,5		39,5	
							C	0	41	Work	41	Split and sampled by Kerstin Perner onboard
								0	41	Work	41	Split and sampled by Kerstin Perner onboard
							D	0	43,5		43,5	
		1284	68°44,172	20°52,372	GC	342,5	1	0	44	Work	44	
										Archive		u-ch.
							2	44	193	Work	149	
										Archive		u-ch.
							3	193	342,5	Work	149,5	
										Archive		u-ch.
		1284	68°44,172	20°52,372	CC	1926,5	1	0	4	Work	4	

										Archive		u-ch.
							2	4	153,5	Work	149,5	
										Archive		u-ch.
							3	153,5	294	Work	140,5	
										Archive		u-ch.
							4	294	443,5	Work	149,5	
										Archive		u-ch.
							5	443,5	593,5	Work	150	
										Archive		u-ch.
							6	593,5	743,5	Work	150	
										Archive		u-ch.
							8	884,5	1035	Work	150,5	
										Archive		u-ch.
							9	1035	1185	Work	150	
										Archive		u-ch.
							10	1185	1335	Work	150	
										Archive		u-ch.
							11	1335	1476,5	Work	141,5	
										Archive		u-ch.
							12	1476,5	1626,5	Work	150	
										Archive		u-ch.
							13	1626,5	1777,5	Work	151	
										Archive		u-ch.
							14	1777,5	1926,5	Work	149	
										Archive		u-ch.
GS15-198-38	2807/15	1610	70°07,612	17°39,795	MC		A	0	40,5	Work	40,5	Split and sampled by Kerstin Perner onboard
								0	40,5	Work	40,5	Split and sampled by Kerstin Perner onboard

							B	0	40		40	
							C	0	40		40	
							D	0	25		25	Sliced and subsampled by Kerstin Perner
		1610	70°07,612	17°39,795	GC	446,5	1	0	147	Work	147	
										Archive		u-ch.
							2	147	296,5	Work	149,5	
										Archive		u-ch.
							3	296,5	446,5	Work	150	
										Archive		u-ch.
		1610	70°07,612	17°39,795	CC	1962,5	1	0	47	Work	47	
										Archive		u-ch.
							2	47	196,5	Work	149,5	
										Archive		u-ch.
							3	196,5	336	Work	139,5	
										Archive		u-ch.
							4	336	485,5	Work	149,5	
										Archive		u-ch.
							5	485,5	635,5	Work	150	
										Archive		u-ch.
							6	635,5	786	Work	150,5	
										Archive		u-ch.
							7	786	927,5	Work	141,5	
										Archive		u-ch.
							8	927,5	1078	Work	150,5	
										Archive		u-ch.
							9	1078	1228,5	Work	150,5	
										Archive		u-ch.
							10	1228,5	1379	Work	150,5	

										Archive		u-ch.
							11	1379	1519,5	Work	140,5	
										Archive		u-ch.
							12	1519,5	1669,5	Work	150	
										Archive		u-ch.
							13	1669,5	1819,5	Work	150	
										Archive		u-ch.
							14	1819,5	1962,5	Work	143	
										Archive		u-ch.
GS15-198-39	2907/15	1699	71°28,261	17°04,957	MC		A	0	40		40	
							B	0	39,5		39,5	
							C	0	39,5		39,5	
							D	0	40	Work	40	Split and sampled by Kerstin Perner onboard
										Work		Split and sampled by Kerstin Perner onboard
		1699	71°28,261	17°04,957	GC	314	1	0	70,5	Work		
										Archive		u-ch.
							2	70,5	164	Work	93,5	
										Archive		u-ch.
							3	164	314	Work	150	
										Archive		u-ch.
		1699	71°28,261	17°04,957	CC	1880	1	0	106	Work		
										Archive		u-ch.
							2	106	246,5	Work	140,5	
										Archive		u-ch.
							3	246,5	396	Work	149,5	
										Archive		u-ch.
							4	396	545	Work		

										Archive		u-ch.
							5	545	695	Work	150	
										Archive		u-ch.
							6	695	836	Work	141	
										Archive		u-ch.
							7	836	986	Work		
										Archive		u-ch.
							8	986	1137	Work	151	
										Archive		u-ch.
							9	1137	1288,5	Work	151,5	
										Archive		u-ch.
							10	1288,5	1428	Work		
										Archive		u-ch.
							11	1428	1579	Work	151	
										Archive		u-ch.
							12	1579	1728,5	Work	149,5	
										Archive		u-ch.
							13	1728,5	1880	Work		
										Archive		u-ch.
GS15-198-40	3007/15	1566	70°49,351	17°04,795	CTD							0208/15 only CTD
					MC		A	0	42,5			went back to the station 0608/15 and took MC and GC
							B	0	43			
							C	0	34,5			
							D	0	44			
					GC	340	1	0	93,5	Work	93,5	
										Archive		u-ch.

							2	93,5	193,5	Work	100	
										Archive		u-ch.
							3	193,5	340	Work	146,5	
										Archive		u-ch.
GS15-198-41	0208/15	1992	73°08,282	15°40,746	MC		A	0	41			
							B	0	39,5			
							C	0	39,5			
							D	0	40			
					GC	357,5	1	0	58	Work	58	
										Archive		u-ch.
							2	58	207,5	Work	149,5	
										Archive		u-ch.
							3	207,5	357,5	Work	150	
										Archive		u-ch.
GS15-198-42	0208/15	826	73°11,252	16°31,254	MC		A	0	41		41	
							B	0	40,5		40,5	
							C	0	41,5		41,5	
							D	0	42		42	
					GC							barrel broken, no recovery
GS15-198-43	0208/15	1251	73°14,529	16°17,762	MC		A	0	41		41	no gravity core
							B	0	41		41	
							C	0	41		41	
							D	0	42		42	
GS15-198-44	0308/15	1950	74°56,869	11°55,300	MC		A	0	39		39	
							B	0	40,5		40,5	
							C	0	40		40	
							D	0	40		40	

					GC	217	1	0	67,5	Work	67,5	
										Archive		u-ch.
							2	67,5	217	Work	149,5	
										Archive		u-ch.
GS15-198-45	0308/15	2628	75°01,880	10°56,811	MC		A	0	44		44	
							B	0	43		43	
							C	0	44,5		44,5	
							D	0	41		41	
					GC	252	1	0	102	Work	102	
										Archive		u-ch.
							2	102	252	Work	150	
										Archive		u-ch.
GS15-198-46	0308/15	3266	75°00,208	8°49,236	MC		A	0	44		44	
							B	0	43		43	
							C	0	44,5		44,5	
							D	0	41		41	
					GC-A	288	1	0	139	Work	139	
										Archive		u-ch.
							2	139	288	Work	149	
										Archive		u-ch.
					GC-B	224	1	0	74	Work	74	barrel broken
										Archive		u-ch.
							2	74	224	Work	150	
										Archive		u-ch.
GS15-198-47	0308/15	3046	74°08,373	8°49,236	MC		A	0	44		44	
							B	0	42,5		42,5	
							C	0	42,5		42,5	
							D	0	41		41	

					GC	295	1	0	146	Work	146	
										Archive		u-ch.
							2	146	295	Work	149	
										Archive		u-ch.
GS15-198-48	0508/15	1402	72°04,298	15°45,057	MC		A	0	41,5		41,5	
							B	0	41,5		41,5	
							C	0	41,5		41,5	
							D	0	41,5		41,5	
GS15-198-49	0608/15	1292	70°49,674	19°06,761	MC		A	0	40,5		40,5	A+B: MC with 2x70cm tubes
							B	0	40,5		40,5	
							C	0	35		35	C-F: Normal MC 4x60cm tubes
							D	0	34		34	
							E	0	40		40	
							F	0	33,5		33,5	
					GC	252	1	0	102	Work	102	
										Archive		u-ch.
							2	102	252	Work	150	
										Archive		u-ch.
GS15-198-50	0608/15	942	70°50,350	19°25,901	MC		A	0	39,5		39,5	GC barrel broken
							B	0	39,5		39,5	
							C	0	39,5		39,5	
							D	0	28		28	
GS15-198-51	0708/15	712	70°47,760	19°30,537	MC		A	0	40,5		40,5	
							B	0	44		44	
							C	0	42		42	
							D	0	45,5		45,5	
GS15-198-52	0708/15	401	70°42,635	19°39,295	MC		A	0	24,5		24,5	

							B	0	26		26	
							C	0	25		25	
							D	0	22		22	
GS15-198-53	0708/15	311	70°11,718	20°22,718	MC		A	0	26,5		26,5	All normal MC 4x60cm tubes. Two takes.
							B	0	34		34	
							C	0	40		40	
							D	0	24,5		24,5	
							E	0	23,5		23,5	
							F	0	26,5		26,5	
GS15-198-54	0708/15	660	69°03,866	21°17,644	MC		A	0	38		38	
							B	0	38		38	
							C	0	40		40	
							D	0	37,5		37,5	
GS15-198-55	0708/15	942	69°00,694	21°16,439	MC		A	0	39,5		39,5	
							B	0	41		41	
							C	0	42		42	
							D	0	41,5		41,5	
GS15-198-56	0708/15	1193	68°57,720	21°08,400	MC		A	0	42,5		42,5	
							B	0	41,5		41,5	
							C	0	41,5		41,5	
							D	0	41,5		41,5	
GS15-198-57	0808/15	1454	68°50,320	20°50,514	MC		A	0	41		41	
							B	0	40,5		40,5	
							C	0	40,5		40,5	
							D	0	39,5		39,5	
					GCA	319	1	0	97,5	Work	97,5	
										Archive		u-ch.
							2	97,5	198	Work	100,5	

										Archive		u-ch.
							3	198	319	Work	121	
										Archive		u-ch.
					GCB	292,5	1	0	91,5	Work	91,5	
										Archive		u-ch.
							2	91,5	192,5	Work	101	
										Archive		u-ch.
							3	192,5	292,5	Work	100	
										Archive		u-ch.
GS15-198-58	0808/15	602	70°06,253	20°59,236	MC		A	0	27		27	
							B	0	38		38	
							C	0	36		36	
							D	0	37,5		37,5	
GS15-198-59	0808/15	903	70°06,903	18°49,902	MC		A	0	36		36	MCx2
							B	0	33,5		33,5	
							C	0	33,5		33,5	
							D	0	39		39	
							E	0	38		38	
							F	0	39		39	
GS15-198-60	0808/15	1167	70°07,762	18°38,658	MC		A	0	40,5		40,5	
							B	0	40		40	
							C	0	39		39	
							D	0	38,5		38,5	
					GC	331,5	1	0	76,5	Work	76,5	
										Archive		u-ch.
							2	76,5	184	Work	107,5	
										Archive		u-ch.
							3	184	331,5	Work	147,5	

										Archive		u-ch.
GS15-198-61	0808/15	1423	70°07,351	18°24,779	MC		A	0	40,5		40,5	
							B	0	41		41	
							C	0	40,5		40,5	
							D	0	40,5		40,5	
					GCA	336	1	0	86,5	Work	86,5	GC x 3
										Archive		u-ch.
							2	86,5	197	Work	110,5	
										Archive		u-ch.
							3	197	336	Work	139	
										Archive		u-ch.
					GCB	363	1	0	84	Work	84	
										Archive		u-ch.
							2	84	192	Work	108	
										Archive		u-ch.
							3	192	335	Work	143	
										Archive		u-ch.
							4	335	363	Work	28	this is material sliding out of the core, may be disturbed
										Archive		u-ch.
					GCC	416	1	0	142	Work	142	
										Archive		u-ch.
							2	142	293	Work	151	
										Archive		u-ch.
							3	293	416	Work	123	
										Archive		u-ch.
GS15-198-62	0908/15	1423	70°01,187	13°33,771	MC1		A	0	43,5		43,5	
							B	0	42		42	

							C	0	43		43	
							D	0	44		44	
					MC2		E	0	45		45	
							F	0	46		46	
					GC	311,5	1	0	69	Work	69	
										Archive		u-ch.
							2	69	165	Work	96	
										Archive		u-ch.
							3	165	311,5	Work	146,5	
										Archive		u-ch.
GS15-198-63	1108/15	2995	70°31,655	02°45,331	MC		A	0	49,5		49,5	
							B	0	50,5		50,5	
							C	0	49,5		49,5	
							D	0	49,5		49,5	
					GCA	311	1	0	60	Work	60	GC x 2
										Archive		u-ch.
							2	60	162,5	Work	102,5	
										Archive		u-ch.
							3	162,5	311	Work	148,5	
										Archive		u-ch.
					GCB	414	1	0	113,5	Work	113,5	
										Archive		u-ch.
							2	113,5	264	Work	150,5	
										Archive		u-ch.
							3	264	414	Work	150	
										Archive		u-ch.

APPENDIX D

VISUAL CORE DESCRIPTIONS AND SHIPBOARD MEASUREMENTS (MAGNETIC SUCEPTIBILITY AND COLOUR SCANNING)

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Data will be ported to the BCCR Data base