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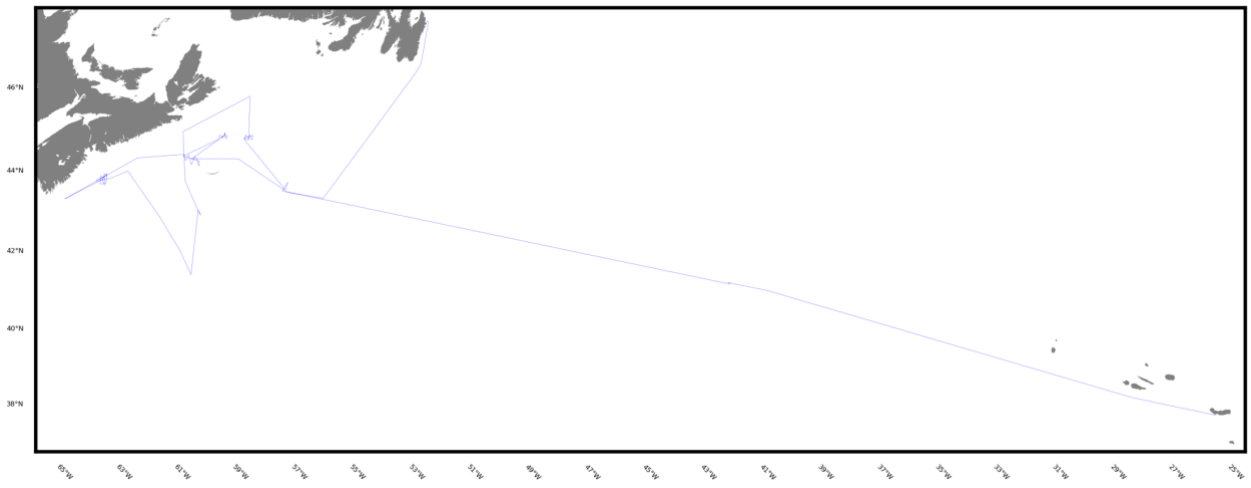
Short Cruise Report
RV MARIA S. MERIAN cruise MSM118

Ponta Delgada (Portugal) – St. John´s (Canada)
18.06.2023 – 04.07.2023
Chief Scientist: Prof. Dr. Ralph Schneider
Captain: Björn Maaß

Cruise track MSM118

NOVAMAR 2.0
Biogeochemistry and Paleoclimate and Nova Scotia Margin



Objectives

The Northwest Atlantic along the Scotian Shelf and Slope provides a unique environment to monitor modern and reconstruct past variability of critical components of the Atlantic Meridional Overturning Circulation (AMOC), including both surface and deep currents. It is not only a region of the world's ocean projected to be most dramatically affected by ongoing climate change but has changed markedly in the past as well. Hence, Expedition MSM118 executed a sampling program for water column and sediment biogeochemistry as well as for Deglacial to Holocene sediment sequences off Nova Scotia in order to understand past climate variability at high resolution and to investigate element fluxes between the water-column and underlying sediments. Sediment acoustic surveys along the shelf and upper slope of southeast Canada enabled us to identify proper locations for Deglacial to Holocene sediment sequences at the inner and outer shelf. For the sediment samples retrieved we will apply a suite of palaeoceanographic proxy methods at highest temporal resolution. All coring stations were accompanied by a set of multicores for gathering the true bottom-water sediment interface as well as the last few decades/centuries of the palaeorecord. We further sampled the water column for water samples and with plankton filtering in order to better relate the microfossil distribution, their elemental and isotopic composition, as well as the terrigenous and marine organic and inorganic particles to the modern pattern of oceanic water masses and the outflow from the large estuaries. For the post-cruise studies, we intend to investigate whether the reconstruction of water mass changes off Nova Scotia support the hypothesis of diminished Labrador Current and stronger North Atlantic Circulation influence associated with weakening of the AMOC during very warm climate intervals during the Holocene and parallel to Postglacial warming. In addition, we want to clarify how climate variability at decadal to centennial time scales off Nova Scotia relates to changes in the western Labrador Sea and to those documented for the Subtropical Polar Gyre in the western North Atlantic. With respect to the biogeochemical processes, we will investigate whether nutrient concentrations and water mass oxygenation are exclusively driven by ocean circulation and/or whether benthic or terrestrial nutrient fluxes exert a significant control on water column biogeochemistry in Nova Scotia Slope waters? Expedition MSM118 and the post-cruise studies was and will be part of a bilateral collaboration in marine science between Dalhousie and Kiel Universities together with GEOMAR.

Narrative

Expedition MSM118 started in the morning of Sunday, June 18th, by leaving the port of Ponta Delgada on the island of San Miguel belonging to the Azores, Portugal. The day before, the scientific crew embarked the vessel after all the scientific equipment was taken onboard. The first day on the North Atlantic was spent preparing the laboratories for the hydroacoustic surveys, for the shipboard geochemical analytical program, and for geological sampling. On Tuesday, June 20th, after leaving the Exclusive Economic Zone (EEZ) of Portugal, we begun profiling "en route data" surveys using the shipboard ADCP (Acoustic Doppler Current Profiler), seafloor multibeam swath bathymetry, and sediment echosounder systems. These survey data were transferred and stored directly into the data archive of the German Alliance for Marine Research (DAM) on the PANGAEA platform at the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven. The first sampling station 41°12´N / 042°17´W in the western deep Atlantic Basin was reached Wednesday, June 21st. Here, resampling with CTD casts and water column samples close to the former deep-sea GEOSECS station at 41°N / 41°W was achieved. This station was chosen also to sample deep into the NAMOC Channel at 5,000 m water depth, that was easily detected by the sea-floor mapping. This channel is a prominent feature that can be traced from the entrance of Hudson Strait to the abyssal plains of Labrador Sea and the western North Atlantic. Its origin stems from glacier debris

transported to the shelf break and subsequently excavating the seafloor like a deep-sea river by turbidites and high-density sediment flows for more than 4000 km.

Afterwards the transit to the continental margin of Nova Scotia was continued and on Saturday, June 24th, we entered the planned working area. Here we executed a first deep-sea hydroacoustic survey with the multibeam swath bathymetry and sediment echosounder systems in order to identify undisturbed glacial and postglacial sediment layers in between the canyon systems at about 3000 m water depth. Afterwards, during the night to Sunday, June 25th, the outer Nova Scotia shelf was surveyed for Holocene sediment deposits within glacier valleys. One of the identified contourite shaped sediment bodies was then sampled with the multi- and gravity corer. A second similar sampling station was executed in the Scaterie Basin on the inner shelf, deploying again the CTD as well as the multi- and gravity corer. Based on the temperature and salinity profiles from the water column, we were able to detect the inflow of cold and less saline waters from the Gulf of St. Lorenz.

During the second week, from June 25th to Sunday, July 2nd, we continued the hydroacoustic surveying, the sampling of the water column and near surface sediments along two additional cross-shelf to upper slope transects, that were complemented by 4 east-west transects across the inner shelf basins, namely the Canso, Emerald, LaHave, and Roseway Basins. This geological sampling with the multi- and gravity corers was dedicated to retrieve Holocene and Late Quaternary hemipelagic sediments. A total of 22 stations, distributed on the deeper continental margin, in glacier channels on the outer shelf, and in the near-coast inner shelf basins, were sampled for surface sediments and up to 11 m long sediment cores. These will serve the reconstruction of climate changes in the western North Atlantic for the last 25.000 years. Together with the sedimentary archives retrieved during MSM101 in 2021, a unique collection of marine climatic archives for palaeoceanographic studies is available now for the Nova Scotia Margin.

The second particular target of MSM118 on the inner shelf basins and at two upper slope stations, was the investigation of the relationship between the different water masses on the shelf and upper slope and the biogeochemical cycling of nutrient and gas fluxes into and out of the sediment, also in context with the elemental input by marine productivity and terrigenous matter. For this purpose, all stations were sampled with water bottles according to the CTD derived temperature, salinity, oxygen, and turbidity profiles, indicative of the different water masses from the surface to the deep ocean, as well as for pore waters and near-surface sediments. These water and sediment samples will be analyzed for nutrients and isotopic chemistry onshore.

With the last deep sampling station at the easternmost part of the Nova Scotian Margin, a glacier-formed distinct sea-floor feature close to the Laurentide Channel, the station work during MSM118 was successfully finished Sunday afternoon, July 2nd. The final destination, the harbor of St. John´s was reached Tuesday, July 4th, followed by an official reception onboard the MARIA S. MERIAN, Wednesday July, 5th by invitation of the German embassy in Canada.

Acknowledgements

On behalf of all scientific crew members I would like to thank all the authorities and the German Research Fleet Coordination Centre (Universität Hamburg), involved in the planning and execution of the cruise, as well as captain B. Maaß, the crew of RV MARIA S. MERIAN and BRIESE Research for their strong engagement and support, which has made cruise MSM118 a very successful scientific expedition.

Participant List, MSM118

1.	Schneider, Ralph	*Chief Scientist*	CAU
2.	Armstrong, Maria	Geochemistry	DAL
3.	Barrett, Rachel	Hydroacoustics	CAU
4.	Baumann, Lenya	Hydroacoustics	CAU
5.	Bleyer, Anke	Geochemistry	GEOMAR
6.	Dale, Andy	Geochemistry	GEOMAR
7.	deGelleke, Laura	CTD, oceanography	DAL
8.	Fraga Ferreira, Paula	Geochemistry	DAL
9.	Häger, Barnet	Geology, gear deployment	CAU
10.	Holler, Lena	Sediment sampling	CAU
11.	Igede, Felix	Sediment sampling	CAU
12.	Kienast, Markus	Paleoceanography	DAL
13.	Kolling, Henriette	Paleoceanography	CAU
14.	Morgenweck, Lea	Sediment sampling	CAU
15.	Muraoka, Wendy	Geochemistry	DAL
16.	Paul, Sophie	Geochemistry	GEOMAR
17.	Rakshit, Subhadeep	Geochemistry	DAL
18.	Rollwage, Luisa	Hydroacoustics	CAU
19.	Schnohr, Melanie	Geochemistry	GEOMAR
20.	Schmidt, Nicole	Sedimentology	CAU
21.	Scholz, Florian	Geochemistry	GEOMAR

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Station List

Station List Maria S. Merian cruise MSM118:

Hydroacoustics: ESV: EM122: Multibeam / P70: PARASOUND / ADCP38 or 75 kHz

Geological sampling, CTD: Conductivity, Temperatur, and Depth Sonde, Multicorer, and Gravity corer

Date / Time	Station Nr.	Sounding/Gear	Position	Position	Depth	Course	Remark
[UTC]	No.		Lat	Lon	[m]	[°]	
21.06.23 17:05	MSM118_1-1	CTD	41° 10,793' N	042° 15,634' W	5048	169	max depth/on ground
24.06.23 11:07	MSM118_2-2	EM122/P70/ADCP38,75	43° 28,049' N	057° 17,381' W	3714	282	profile start
24.06.23 15:54	MSM118_2-2	EM122/P70/ADCP38,75	43° 32,456' N	057° 26,910' W	3388	199	profile end
25.06.23 00:45	MSM118_3-3	EM122/P70/ADCP38,75	44° 45,424' N	058° 50,314' W	230	8	profile start
25.06.23 07:59	MSM118_3-3	EM122/P70/ADCP38,75	44° 47,499' N	058° 41,994' W	228	216	profile end
25.06.23 08:39	MSM118_4-1	CTD	44° 47,454' N	058° 42,041' W	239	244	max depth/on ground
25.06.23 09:03	MSM118_4-2	Multi Corer	44° 47,454' N	058° 42,040' W	224	232	max depth/on ground
25.06.23 09:43	MSM118_4-3	Gravity Corer	44° 47,454' N	058° 42,040' W	224	330	max depth/on ground
25.06.23 16:15	MSM118_5-1	CTD	45° 48,197' N	058° 39,702' W	283	6	max depth/on ground
25.06.23 16:49	MSM118_5-2	Multi Corer	45° 48,197' N	058° 39,703' W	283	69	max depth/on ground
25.06.23 17:12	MSM118_5-3	Gravity Corer 15m	45° 48,198' N	058° 39,703' W	283	170	max depth/on ground
26.06.23 07:12	MSM118_6-1	CTD	44° 57,605' N	060° 57,030' W	189	324	max depth/on ground
26.06.23 07:49	MSM118_6-2	Multi Corer	44° 57,604' N	060° 57,030' W	188	244	max depth/on ground
26.06.23 19:30	MSM118_7-1	EM122/P70	42° 59,649' N	060° 24,856' W	2201	160	profile start
26.06.23 20:11	MSM118_7-1	EM122/P70	42° 54,954' N	060° 20,813' W	2500	146	profile end
26.06.23 21:47	MSM118_8-1	Multi Corer	43° 01,363' N	060° 25,884' W	2132	16	max depth/on ground
26.06.23 23:15	MSM118_8-2	Gravity Corer 15 m	43° 01,363' N	060° 25,883' W	2128	296	max depth/on ground
27.06.23 01:04	MSM118_8-3	CTD	43° 00,881' N	060° 25,975' W	2177	217	max depth/on ground
27.06.23 12:39	MSM118_9-1	CTD	41° 24,509' N	060° 40,503' W	4639	305	max depth/on ground
27.06.23 19:45	MSM118_10-1	CTD	42° 01,827' N	061° 03,650' W	4096	241	max depth/on ground
28.06.23 00:42	MSM118_11-1	CTD	42° 21,797' N	061° 20,493' W	3417	358	max depth/on ground
28.06.23 06:01	MSM118_12-1	CTD	42° 50,995' N	061° 43,959' W	1032	235	max depth/on ground
28.06.23 14:34	MSM118_13-1	CTD	43° 59,920' N	062° 50,127' W	292	94	max depth/on ground
28.06.23 14:56	MSM118_13-2	Multi Corer	43° 59,921' N	062° 50,126' W	259	252	max depth/on ground
28.06.23 15:26	MSM118_13-3	Gravity Corer 15 m	43° 59,921' N	062° 50,126' W	260	265	max depth/on ground
28.06.23 18:28	MSM118_14-4	EM122/P70/ADCP38,75	43° 49,411' N	063° 25,477' W	162	260	profile start
29.06.23 08:45	MSM118_14-4	EM122/P70/ADCP38,75	43° 55,705' N	063° 32,916' W	240	5	profile end
29.06.23 09:56	MSM118_15-1	CTD	43° 50,438' N	063° 41,704' W	244	41	max depth/on ground
29.06.23 10:22	MSM118_15-2	Multi Corer	43° 50,438' N	063° 41,703' W	273	242	max depth/on ground
29.06.23 11:08	MSM118_16-1	Gravity Corer 15 m	43° 49,355' N	063° 38,075' W	264	278	max depth/on ground
29.06.23 17:54	MSM118_17-1	CTD	43° 18,907' N	064° 59,076' W	180	15	max depth/on ground
29.06.23 18:16	MSM118_17-2	Multi Corer	43° 18,908' N	064° 59,076' W	181	21	max depth/on ground
29.06.23 18:37	MSM118_17-3	Gravity Corer 15 m	43° 18,908' N	064° 59,077' W	171	175	max depth/on ground
30.06.23 07:10	MSM118_18-1	CTD	44° 19,230' N	062° 30,540' W	223	170	max depth/on ground
30.06.23 07:35	MSM118_18-2	Multi Corer	44° 19,230' N	062° 30,541' W	233	209	max depth/on ground
30.06.23 07:42	MSM118_18-2	Multi Corer	44° 19,230' N	062° 30,542' W	223	20	on deck
30.06.23 14:19	MSM118_19-1	EM122/P70/ADCP38,75	44° 24,508' N	060° 55,104' W	96	87	profile start
01.07.23 01:51	MSM118_19-1	EM122/P70/ADCP38,75	44° 21,786' N	060° 55,766' W	151	287	profile end
01.07.23 07:19	MSM118_20-4	EM122/P70/ADCP38,75	44° 46,412' N	059° 44,169' W	191	53	profile start
01.07.23 13:50	MSM118_20-4	EM122/P70/ADCP38,75	44° 50,037' N	059° 35,512' W	206	146	profile end
01.07.23 14:05	MSM118_21-1	CTD	44° 50,038' N	059° 35,513' W	206	274	max depth/on ground

Date / Time	Station Nr.	Sounding/Gear	Position	Position	Depth	Course	Remark
[UTC]	No.		Lat	Lon	[m]	[°]	
01.07.23 14:26	MSM118_21-2	Multi Corer	44° 50,039' N	059° 35,514' W	206	13	max depth/on ground
01.07.23 14:47	MSM118_21-3	Gravity Corer 15 m	44° 50,035' N	059° 35,510' W	206	227	max depth/on ground
01.07.23 20:29	MSM118_22-1	CTD	44° 17,980' N	060° 39,293' W	157	348	max depth/on ground
01.07.23 20:52	MSM118_22-2	Multi Corer	44° 17,980' N	060° 39,293' W	157	222	max depth/on ground
01.07.23 21:16	MSM118_22-3	Gravity Corer 15 m	44° 17,981' N	060° 39,293' W	157	274	max depth/on ground
02.07.23 13:12	MSM118_23-1	CTD	43° 28,918' N	057° 23,085' W	3413	180	max depth/on ground
02.07.23 15:28	MSM118_23-2	Multi Corer	43° 28,916' N	057° 23,084' W	3413	137	max depth/on ground