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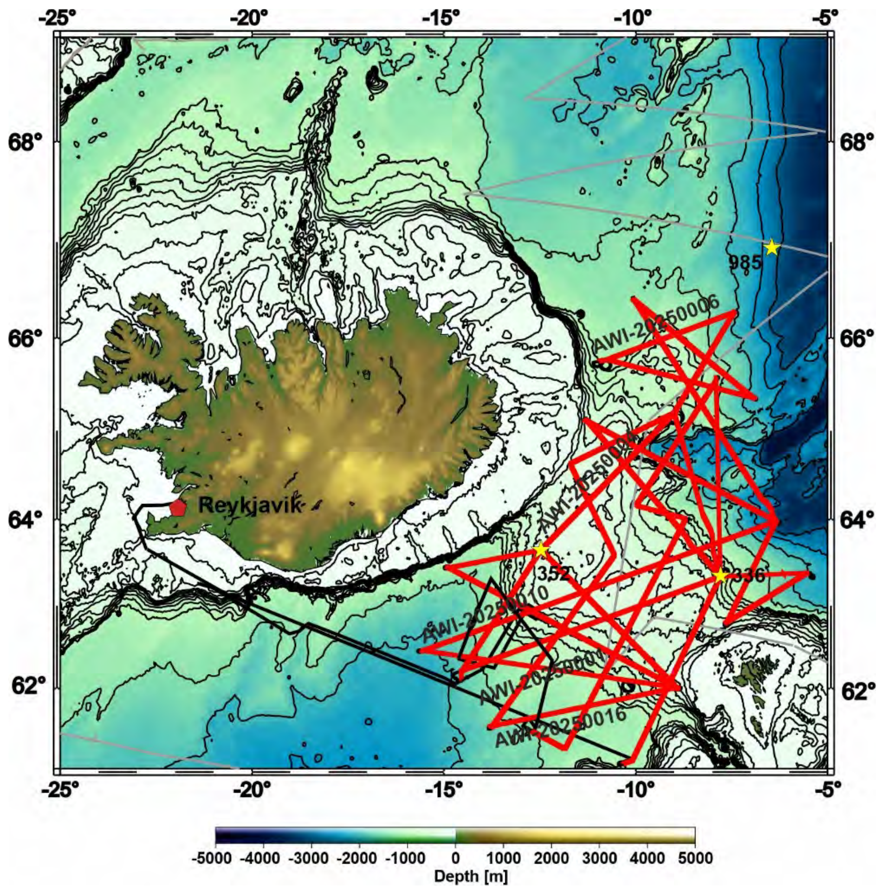
Short Cruise Report
R/V MARIA S. MERIAN cruise MSM138

Reykjavik, Iceland – Reykjavik, Iceland
16.6.2025 – 22.7.2025
Chief Scientist: Dr. Gabriele Uenzelmann-Neben
Captain: Klaus Bergmann



Objectives

The overarching goal of cruise MSM138 has been to study variations in flow paths and intensities of Iceland Strait Overflow Water (ISOW) in response to a) uplift/subsidence of the Greenland Scotland Ridge (GSR), and b) climate variability; this has been the major focus of the cruise. An additional aim will be the compilation of an input dataset for the numerical simulation of the overflow. The collected data and their interpretation may further form the base for an IODP[3] proposal to supplement information on the detailed development of the ISOW in relation to the dynamics of the Iceland plume and climate variability.

Hypothesis 1: Variations of flowpath and intensitiy of ISOW document uplift/subsidence of IFR

The Mid Piacenzian Warm Phase (MPWP, ~3.3-3 Ma) is the most recent interval in which global temperatures reached and remained at levels (2-3°C warmer on global average than at present) similar to those projected for the near future. Despite Pliocene land-sea configurations and ocean circulation having been very similar to today globally averaged temperatures and distribution of heat were different with modern/near future atmospheric CO_2 concentrations. Using numerical simulations Robinson et al. (2011) could best reproduce the increase in Arctic warmth as reported by proxies for the MPWP when lowering the IFR by 800 m. A lowering of the IFR further resulted in increased northward flow of surface currents bringing warm surface water into the Arctic Ocean, which melted sea ice and changed the albedo. The deep water formation region lay northwards from today. Even though deep water temperatures were ~1°C higher than today the deeper IFR allowed an increased NCW export. When lowering the DS or both DS and IFR by 800 m the increase in Arctic warmth simulated was not as strong. They thus suggest that bathymetric modifications of the IFR have the strongest effect on the overflow of cold and dense deep water from the Nordic seas, which is why we intend to concentrate on that part of the GSR. Rapid deepening or uplift in response to thermal perturbation within the conduit feeding the Iceland plume are suggested to have restricted /enabled increased overflow. Modelling studies suggest that the GSR overflow magnitude influences the structure and strength of Atlantic Meridional Overturning Circulation (AMOC) as well as the North Atlantic climate.

Hypothesis 2: ISOW over IFR was reduced during cold climate conditions

The analysis of seismic reflection data collected at the Eirik Drift south Greenland provided indications for an intensified WBUC flow at that location during periods with warm climate (19-10, 8.1-7.5, 4.5-2.5 Ma) while the flow was reduced during cold climates (10-8.1, 7.5-5.6, < 2.5 Ma). Müller-Michaelis and Uenzelmann-Neben (2014) hypothesised that an enhanced sea ice cover during cold climates inhibited the ocean-atmosphere interaction with less or no deep water formation in the Greenland Sea but a re-location of the deep water formation region from the Nordic Seas into the Norwegian Sea. This then would have weakened the IFR overflow with an increased deep water flow via FBC directly southwards. Numerical simulations predict a change of deep water formation to water depths > 3000 m and a relocation of the deep water formation region. Two periods (7.5-5.6 Ma, < 2.5 Ma onset of Northern Hemisphere Glaciation) have been suggested to particularly document this modification in deep water flowpath. A weaker ISOW would have resulted in the formation of more extensive depo centres contrasting earlier enhanced erosion and channel formation under a strong ISOW as well as a relocation of sediment drifts.

Narrative

The final preparations for cruise MSM138 were carried out on board R/V Maria S Merian17 scientists embarked in Iceland on June 15. Loading of the containers and the streamer winch had already been carried out on June 13 after arrival of the vessel in port. Unloading of the containers and set up of the equipment thus could start immediately after embarkment. In the morning of June we carried out a safety manoeuvre, after which the installation of the equipment continued. We left port on June 16 18:00 and transited into the area of investigation.

The hydroacoustic acquisition was started after leaving the Icelandic EEZ at 17th June 07:00 UTC. The transit speed to the study area was ~ 10 kn. The recording of profiles started at 18th June 21:27 UTC the survey speed was decided based on what is necessary for the seismic survey. This led to a cruise speed of approximately 5 kn.

On June 17 at 7:00 UTC the recording of EM 124 and Parasound commenced. After arrival in the working area an SVP was deployed to collect a sound profile for the calibration of both the multibeam system EM 124 and Parasound (June 18, 14:48). Streamer and GI-guns were deployed, and seismic profiling commenced on June 18 at 20:06 UTC. We continued seismic profiling across the Iceland Faroe Ridge until July 18, 13:00 UTC, when the seismic equipment was retrieved. Two SVPs and one CTD as well as seven XSVs were deployed across the ridge to adjust the velocity profile for the calibration of the EM 124 and Parasound. After the seismic survey ended the cruise speed was 8 kn for additional hydroacoustic profiles. The last profile ended at 20th July 14:35 UTC. The transit was surveyed with 2-13 kn until reaching Icelandic EEZ at 15:11 July 21 UTC.

On July 22, 8:00 we came back into the port of Reykjavik. The scientists disembarked on June 22 (the Seismic group) and 23 (Hydroacoustics and MMOs).

Acknowledgements

We like to thank Captain Klaus Bergmann, his officers and crew of RV *Maria S. Merian* for their professional and enthusiastic engagement and service to the scientific programme of this leg. This cruise Leg MSM138 has primarily been funded within the core program METEOR/MERIAN provided by the Deutsche Forschungsgemeinschaft (DFG) under grant No GPF 18-1/029. Additional funding has been provided by the Alfred-Wegener-Institut. We gratefully acknowledge all this support.

Teilnehmerliste

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5.	Luo, Lingyan	Seismics	AWI
6.	Mühlberger-Krause, Timo	Seismics	AWI
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14.	Kahler, Liisi Merit	Hydroacoustics	CAU
15.	Edwards, Matthew	Marine Mammal Observer	SFF
16.	Nikitin, Sergey	Marine Mammal Observer	SFF
17.	Wylie, Gary Comrie	Marine Mammal Observer	SFF

Institutes

AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven
CAU	Christian-Albrechts-Universität zu Kiel
SFF	Marine Environmental Solutions Limited, Aberdeen

Seismic profiles

PROFILE # AWI-…	Start / End	DATE	TIME (UTC)	LATITUDE	LONGITUDE
20250001	start end	18.06.25 20.06.25	20:06:00 01:04:00	61.062356 63.365103	-10.322669 -7.7701639
20250002	start end	20.06.25 21.06.25	02:57:00 18:54:12	63.3696083 62.2094694	-7.6267278 -14.5693694
20250003	start end	21.06.25 22.06.25	22:06:00 20:40:22	62.115633 63.648931	-14.537989 -12.472814
20250004	start end	22.06.25 23.06.25	20:43:42 23:23:53	63.652261 65.193475	-12.4661361 -8.9975083
20250005	start end	23.06.25 24.06.25	23:26:52 16:26:15	65.196794 66.283433	-8.9921222 -7.4234861
20250006	start end	24.06.25 25.06.25	16:59:33 09:19:21	66.271033 65.763053	-7.436597 -10.804822
20250007	start end	25.06.25 26.06.25	12:11:00 13:55:00	65.754153 65.352358	-10.951681 -6.881028
20250008	start end	26.06.25 27.06.25	13:09:27 08:35:38	65.356864 66.413769	-6.935903 -10.078383
20250009	start end	27.06.25 28.06.25	09:17:57 18:29:04	66.401239 63.959764	-10.028664 -6.3099889
20250010	start end	28.06.25 01.07.25	19:33:24 00:23:25	63.981089 62.450567	-6.318608 -15.586625
20250011	start end	01.07.25 02.07.25	01:26:08 08:00:02	62.463878 62.096842	-15.592261 -10.178564
20250012	start end	02.07.25 02.07.25	16:20:20 22:45:08	62.096542 62.007831	-10.174636 -8.876444
20250013	start end	02.07.25 04.07.25	23:42:50 09:47:01	62.008456 63.457147	-8.920919 -14.924056
20250014	start end	04.07.25 04.07.25	10:57:29 23:15:13	63.442167 63.647367	-14.882675 -12.471978
20250015	start end	04.07.25 06.07.25	23:17:01 01:36:14	63.646172 61.988803	-12.466611 -8.884253
20250016	start end	06.07.25 07.07.25	02:40:39 07:55:01	62.013258 61.528956	-8.913844 -13.811408
20250017	start end	07.07.25 08.07.25	08:53:43 12:38:02	61.518469 63.591400	-13.759464 -10.557728
20250018	start end	08.07.25 09.07.25	12:40:00 02:49:47	63.593811 64.631586	-10.558431 -11.698825
20250019	start end	09.07.25 09.07.25	02:51:58 17:42:46	64.634336 65.206528	-11.694314 -8.9370194
20250020	start end	09.07.25 10.07.25	18:49:07 17:41:27	65.204572 63.341600	-8.993936 -7.777908
20250021	start end	10.07.25 11.07.25	02:51:58 17:42:46	63.341233 63.384319	-7.770722 -5.473578
20250022	start end	11.07.25 11.07.25	08:51:20 21:40:35	63.383419 62.787906	-5.533694 -7.672775
20250023	start end	11.07.25 12.07.25	22:45:36 13:41:13	62.794800 63.980094	-7.624508 -6.358636
20250024	start end	12.07.25 13.07.25	13:43:13 16:50:17	62.794800 63.980094	-7.624508 -6.358636
20250025	start end	13.07.25 14.07.25	17:28:39 20:54:21	65.115347 63.311397	-11.276331 -7.7469889
20250026	start end	14.07.25 15.07.25	21:24:16 22:59:31	63.328494 65.581664	-7.793892 -7.902147
20250027	start end	15.07.25 16.07.25	23:45:27 17:12:31	65.549600 64.165231	-7.896758 -9.969858
20250028	start end	16.07.25 16.07.25	17:16:53 23:20:17	64.159261 64.009167	-9.960508 -8.706808
20250029	start end	16.07.25 18.07.25	23:22:21 07:37:33	64.005678 61.252719	-8.704344 -11.846669
20250030	start end	18.07.25 18.07.25	07:39:49 13:00:12	61.252314 61.468803	-11.853650 -12.691583

Hydroacoustic profiles acquired in addition to profiles that are similar to the seismic survey lines.

Profil-Nr. MSM138	Date Start	Time Start UTC	Date End	Time End UTC	Latitude Start xx° xx.x‘	Longitude Start xx° xx.x‘	Latitude End xx° xx.x‘	Longitude End xx° xx.x‘
P131	18.07.2025	16:07	18.07.2025	16:44	61°34.77	012°52.48	61°38.16	012°47.46
P132	18.07.2025	17:58	18.07.2025	19:06	61°38.07	012°47.20	61°30.89	012°36.52
P133	18.07.2025	19:11	19.07.2025	01:14	61°31.01	012°36.43	62°20.21	012°10.82
P134	19.07.2025	01:22	19.07.2025	10:35	62°21.19	012°11.53	63°18.43	013°45.33
P135	19.07.2025	10:46	19.07.2025	18:50	63°17.98	013°47.07	62°21.93	014°36.91
P136	19.07.2025	19:00	19.07.2025	22:08	62°21.93	014°36.91	62°15.48	013°42.98
P137	19.07.2025	22:14	20.07.2025	04:34	62°15.21	013°41.13	63°00.22	012°47.54
P138	20.07.2025	04:37	20.07.2025	05:41	63°00.25	012°46.86	62°55.77	012°30.99
P139	20.07.2025	05:44	20.07.2025	06:26	62°55.47	012°30.88	62°50.34	012°35.26
P140	20.07.2025	06:29	20.07.2025	08:13	62°50.31	012°35.97	62°57.42	013°01.76
P141	20.07.2025	08:16	20.07.2025	14:35	62°57.39	013°02.69	62°14.42	013°58.98

Station list of sound velocity profiles for processing multibeam data (CTD, XCTD, SVP and XSV)

Station Name	Type	Lat	Lon
MSM138_1-1	SVP	61° 07.090' N	010° 04.411' W
MSM138_3-1	XSV	63° 23.765' N	007° 44.222' W
MSM138_4-1	XSV	62° 06.980' N	014° 40.596' W
MSM138_5-1	XSV	64° 49.783' N	009° 50.033' W
MSM138_6-1	XSV	63° 29.458' N	010° 42.600' W
MSM138_7-1	XSV	64° 33.374' N	011° 37.505' W
MSM138_8-1	XCTD	64° 55.656' N	008° 49.134' W
MSM138_9-1	XSV	63° 27.742' N	009° 20.531' W
MSM138_10-1	XSV	62° 40.574' N	010° 15.132' W
MSM138_11-1	CTD/SVP	61° 38.141' N	012° 47.392' W