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Short Cruise Report

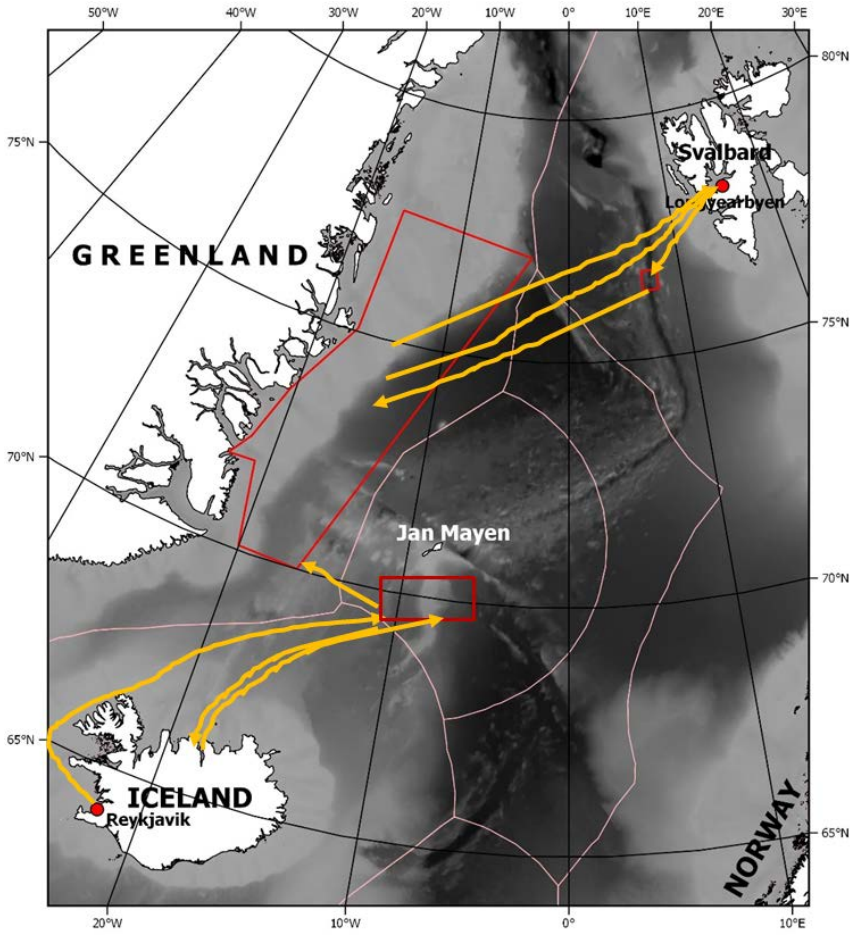
Maria S. Merian cruise MSM67

Reykjavik (Iceland) – Longyearbyen (Svalbard)

30.08.2017 – 04.10.2017

Chief Scientist: Dr. Volkmar Damm/Dr. Dieter Franke

Captain: Ralf Schmidt

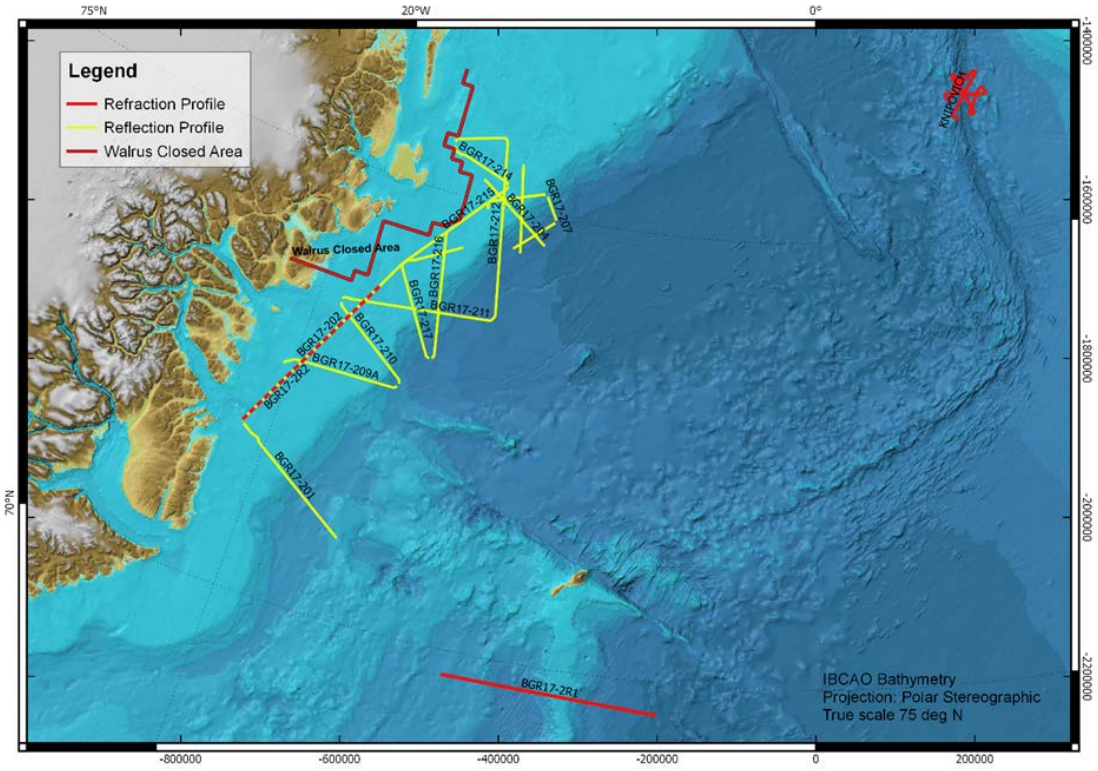


Cruise track and working areas during MSM 67

Objectives

Survey MSM67 SEGMENT was intended to study the architecture of the rifted continental margin off East Greenland around the Jan Mayen fracture zone. Key issues to be addressed were margin segmentation and the location of the continent-ocean transition (COT). Both subjects are highly debated. Symmetric segmentation of conjugate margins has significant implications on our general understanding of continental rifting processes, and a margin-parallel COT off East Greenland would indicate an N-S opening in the Norwegian/Greenland Sea. The latter challenging most publications on the early evolution of the North Atlantic. A major addressed question was also the timing, duration and distribution of magmatism that resulted in the formation of the North Atlantic large igneous province. Previous suggestions of very short (~3 Myr) periods of intense magmatism have been challenged and a much longer duration and/or a post-breakup origin are under discussion. Here, we try to establish the amount of post-breakup magmatism as evident in high-velocity lower crust and test the dependence of magmatism with distance from the proposed hot-spot under Iceland and the influence of major fracture zones on volcanism.

Multichannel seismic data was used to provide a structural image of the sediments and crustal architecture. Acquisition was done using BGR's reflection seismic instrumentation with a 4500-m-long digital streamer (360 channels). The BGR G-airgun array with a total volume of 3100 in^3 (51 Litres) were used as seismic source. The marine geomagnetic data acquisition was carried out with a towed marine gradient magnetometer of BGR consisting of two Overhauser sensors supplemented by a vector magnetometer. A KSS31M sea gravimeter was used for gravity measurements. The ship-borne multibeam bathymetry system and the parasound-system run during the entire cruise along all profiles and transit lines.
Wide-angle/refraction seismic data acquisition was done along two deep seismic refraction lines, each with 30 and 29 ocean bottom seismometers (OBS), respectively.



The working area during cruise MSM 67 (SEGMENT) with FS MARIA S. MERIAN to East Greenland and Jan Mayen Ridge (yellow lines – profiles with reflection seismics, magnetics, gravity; red lines – refraction seismic profiles and profiles for refraction seismic experiment KNIPAS)

Narrative

Research vessel MARIA S. MERIAN berthed in Reykjavik/Iceland harbor on Monday morning (August 28th). By Wednesday evening all installations of scientific equipment onboard R/V MARIA S. MERIAN were completed and the vessel departed from Reykjavik in the morning of August 31st, as scheduled.

Processing of our application for research permission by the Greenland authorities took longer than expected. Three days prior departure, a survey license was finally granted, however with some unforeseen requirements. Among others, we were requested not to commence our activities in Greenland waters before September 10th. Thus we had to plan for an alternative survey program for the first 10 days of the cruise. Fortunately, we had elaborated an alternative survey program for the area around the Norwegian Jan Mayen Island, situated 500 km east of Greenland. An appropriate application for research permission was submitted to the Norwegian authorities well in advance and approved within very short time. We therefore were able to spend the allocated ship time fully for our research goals.

After 550 nautical miles of transit we arrived in the working area south of Jan Mayen Island, early in the morning on Sep 2nd. Here we acquired a seismic crustal transect in an area of unknown crustal nature. The results will contribute to the question of how far the Jan Mayen microcontinent, which was separated from Greenland only 26 Mio years ago, extends westwards. The planned seaward refraction seismic profile across the Jan Mayen Fracture Zone offshore Greenland had to be canceled for timing reasons.

Starting in the night from Friday to Saturday 20 ocean bottom seismometers (OBS) of GEUS and 10 OBS of Geomar were deployed along a 260 km long W-E line. After deploying

airguns, magnetic sensors and a hydrophone for passive acoustic monitoring (PAM), we acquired refraction seismic data along this first profile from Sunday Sep. 3rd to Monday, Sep. 4th. On Wednesday, September 6th, all but one instrument were recovered.
Medical circumstances required to drop the chief scientist in the port of Akureyri/Iceland, before the research cruise continued toward the most remote areas of east Greenlandic waters. Since one of the OBS did not raise to the surface and we went back to the position of this instrument for the time of the automatic backup release set to September 9th at 7:00 am. However, all our efforts did not succeed and this instrument could not be retrieved.
After transit towards Greenland, we deployed all reflection seismic equipment next to the magnetometers and the passive acoustic marine mammal monitoring hydrophone (PAM) and geophysical data across the NE Greenland shelf commenced Sunday morning, Sept., 10th.
Bad weather encountered during the night from Tuesday to Wednesday (end Line 202, beginning Line 203) necessitated some maintenance on the outboard instruments. On Wednesday Sep. 13th, the weather improved and the outboard geophysical instruments were repaired. Problems with the streamer buoyancy induced by considerable movements of the vessel resulted in partly poor data quality on these two lines.
Profiling was again interrupted on early Thursday Sep. 14th morning due to drift ice. Strong winds over the last days had shifted the sea ice far south and the streamer end buoy was snapped off after contact. To recover the buoy, again all outboard equipment had to be taken in during Thursday morning. Around midnight we redeployed all instruments and restarted measurement. As the drift ice has since extended throughout the northern survey area, we skipped the investigation of this region.
On Saturday Sep. 16th, medical circumstances required again to drop one scientist in the port. Therefore, after retrieving the equipment, we were heading towards Longyearbyen on Spitsbergen. After overhanding the patient in the harbor on Monday Sep. 18th at 8:30, we arrived at the area of the KNIPAS experiment in the Norway-Greenland Sea by Tuesday Sep. 19th in order to support the interpretation of the passive seismic data, an active seismic refraction experiment. We started measurements on Tuesday at 07:00. The planned five airgun-lines were completed by Wednesday evening Sep. 20th and we sailed back to the working area off East Greenland.
After 1.5 days transit back to Greenland we deployed the OBS along the previously acquired line 202. Deployment started on Friday Sep. 22th, early morning and was finished by night time. Shooting the line took from Friday 22nd 20:30 to Sunday 24th 02:00. From there on, all the OBS were recovered until Monday Sep. 25th in the afternoon.
After two hours transit we redeployed the streamer and started geophysical profiling on Sep. 25th, at 22:30. Line 209 was completed by Sep. 26th at 11:00. A short interruption of acquisition was due to the presence of marine mammals. Line 210 was completed by Sep. 27th at 2:00, line 211 at 22:30. Stronger winds dominated during acquisition of line 212 until finalization on Thursday Sep 28th 22:00. However the vessel's course in wind direction enabled the acquisition of high-quality data. On Friday Sep. 29th, we had to go around floating icebergs, which occurred occasionally along lines 213 and 214. Geophysical profiles 215-217 were acquired without problems. Profiling was successfully finished on Sunday Oct. 1st. The scientific equipment was recovered and transit to Longyearbyen (SV) commenced 9 p.m.
During transit a faulty seaglider from Geophysical Institute, University of Bergen, Norway (P.I. Idar Hessevik) was recovered. The seaglider had a faulty pressure sensor and was unable/risky for further diving, and the University of Bergen was searching possibilities for assistance on recovery. The seaglider was recovered safely and without any damages on October 02nd 2017 at 15:10 UTC (Position 72°34.7930'N 1°33.0740'E). RV Maria S. Merian berthed in Longyearbyen (SV) on Oct. 4th as per schedule.

Acknowledgements

Many thanks go to Master Ralf Schmidt and the entire crew of RV Maria S. Merian for their great support during the cruise. Their experience and outstanding professional service contributed substantially to the final success of our survey.
Moreover, we highly appreciate the assistance by Briese Research for assistance and solving several unforeseen problems and we are finally grateful the Leitstelle Deutsche Forschungsschiffe for the coordination activities before and during the cruise.

Participants

Name	Discipline	Institution
Volkmar Damm	Geophysicist/Chief Scientist (until Sep. 8th)	BGR
Dieter Franke	Geophysicist/Chief Scientist (since Sep. 9th)	BGR
Udo Barckhausen	Geophysicist	BGR
Stephanie Barnicoat	MMO	Seiche
Thomas Behrens	Technician	BGR
Kai Berglar	Geophysicist	BGR
Anke Dannowski	Geophysicist	GEOMAR
Ümit Demir	Technician	BGR
Timo Ebert	Technician	BGR
Berenice Ebner	Student	AWI
Martin Engels	Physicist	BGR
Thomas Funck	Geophysicist	GEUS/GEUS
Boris Hahn	Technician	BGR
Peter Klitzke	Geophysicist	BGR
Andreas Madsen	Student	Univ. Aarhus
Lorenzo Scala	MMO	Seiche
Michael Schnabel	Geophysicist	BGR
Peter Steinborn	Technician	BGR
Martin Thorwart	Geophysicist	GEOMAR/CAU
Per Trinhammer	Technician	Univ. Aarhus/GEUS

AWI	Alfred Wegener Institute, Bremerhaven
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover
CAU	Christian-Albrechts-Universität zu Kiel
GEOMAR	Helmholtz-Zentrum für Ozeanforschung, Kiel
GEUS	Geological Survey of Denmark and Greenland, Copenhagen Denmark
Seiche	Seiche Ltd., Bradworthy, Holsworthy Devon, United Kingdom
Univ. Aarhus	Aarhus University

List of profiles acquired during MSM67

line	SEG-D filenb.	shotpoint P1 online	date	time (UTC)	latitude	longitude	course	length (km)
BGR17-2R1		1	2017.09.03	01:47:00	69.64849	-5.20281		
BGR17-2R1		2280	2017.09.04	12:02:30	69.73456	-12.05478	275°	264.25
BGR17-201-1	1	988	2017.09.10	08:30:07	70.88262	-16.53025		
BGR17-201-1	474	1491	2017.09.10	11:04:57	71.02206	-17.07468	308°	25.08
BGR17-200	1012	1011	2017.09.10	16:02:49	71.21214	-16.65331		
BGR17-200	1466	1464	2017.09.10	18:19:24	71.01876	-16.84441	198°	22.56
BGR17-201-2	1	1418	2017.09.10	18:53:47	71.00605	-16.98620		
BGR17-201-2	3395	4811	2017.09.11	12:04:40	71.82381	-21.00727	304°	168.85
BGR17-202	1	967	2017.09.11	12:08:27	71.82929	-21.01138		
BGR17-202	5604	6570	2017.09.12	16:29:54	74.07893	-17.20521	25°	278.86
BGR17-203		912	2017.09.12	16:33:39	74.08277	-17.18937		
BGR17-203	3338	4263	2017.09.13	09:52:50	74.81814	-12.30709	58°	166.72
BGR17-204	1	530	2017.09.13	17:53:55	74.67181	-11.68061		
BGR17-204	2201	2729	2017.09.14	05:11:41	75.23440	-14.79475	306°	109.41
BGR17-205	1	967	2017.09.15	01:41:22	75.49726	-13.30079		
BGR17-205	2260	3225	2017.09.15	13:39:59	74.49924	-12.65787	170°	112.41
BGR17-206	1	892	2017.09.15	14:38:34	74.51359	-12.93542		
BGR17-206	1353	2243	2017.09.15	21:42:52	74.96141	-11.38056	42°	67.4
BGR17-207	1	965	2017.09.15	21:47:41	74.96835	-11.38082		
BGR17-207	687	1651	2017.09.16	01:21:11	75.22595	-12.03298	327°	34.15
BGR17-208	1	971	2017.09.16	01:26:16	75.22841	-12.06087		
BGR17-208	1435	2404	2017.09.16	08:43:16	74.99802	-14.39240	250°	71.3
BGR17-209	1	971	2017.09.16	08:47:22	74.99256	-14.40240		
BGR17-209	117	1086	2017.09.16	09:25:07	74.93986	-14.37851	173°	5.9
BGR17-AWI		1	2017.09.19	07:12:00	76.81460	7.32797		
BGR17-AWI		2105	2017.09.20	18:16:00	76.37062	6.56840		
BGR17-2R2		1	2017.09.22	20:43:00	71.85406	-21.01365		
BGR17-2R2		1708	2017.09.24	01:10:00	73.77147	-17.79183	25°	237.76
BGR17-209A	1	567	2017.09.25	21:26:50	72.60235	-20.35198		
BGR17-209A	2856	3422	2017.09.26	12:08:31	72.72796	-16.07202	90°	142.33
BGR17-210	1	994	2017.09.26	12:48:52	72.78384	-16.00379		
BGR17-210	2458	3450	2017.09.27	01:15:15	73.43823	-19.05018	308°	122.26
BGR17-211	1	935	2017.09.27	02:04:51	73.50475	-19.04737		
BGR17-211	3779	4712	2017.09.27	21:07:08	73.73337	-13.10262	79°	187.91
BGR17-212	1	924	2017.09.27	21:10:44	73.73802	-13.09321		
BGR17-212	4543	5465	2017.09.28	20:16:32	75.74468	-14.36423	351°	226
BGR17-213	1	979	2017.09.28	20:22:06	75.74809	-14.39428		
BGR17-213	1249	2226	2017.09.29	02:54:53	75.57556	-16.53939	253°	62.05
BGR17-214	1	1104	2017.09.29	03:44:04	75.50603	-16.50066		
BGR17-214	1623	2721	2017.09.29	12:08:54	75.25893	-13.80214	109°	80.48
BGR17-215-1	1	988	2017.09.29	12:36:36	75.21956	-13.76263		
BGR17-215-1	1913	2900	2017.09.29	22:18:52	74.55113	-15.81670	220°	95.15
BGR17-216	1	969	2017.09.29	22:21:52	74.54679	-15.81898		
BGR17-216	3147	4114	2017.09.30	14:14:13	73.15506	-15.02603	171°	156.55
BGR17-217	1	1003	2017.09.30	14:50:22	73.13850	-15.19409		
BGR17-217	2427	3429	2017.10.01	03:07:32	74.06454	-17.20930	329°	120.73
BGR17-215-2	1	4274	2017.10.01	03:09:33	74.06759	-17.20892		
BGR17-215-2	1520	2754	2017.10.01	10:51:35	74.60824	-15.67593	37°	75.64