

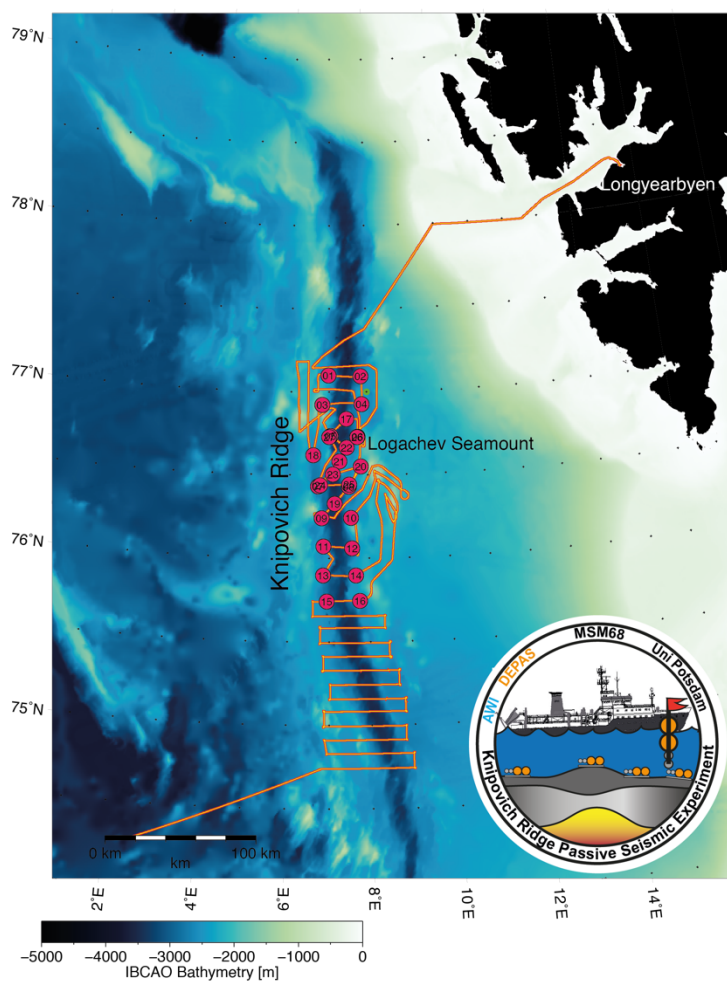
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Short Cruise Report MARIA S. MERIAN - MSM68

Longyearbyen - Emden
6.10.17 – 18.10.17

Chief Scientist: Vera Schlindwein
Captain: Ralf Schmidt



Objectives

KNIPAS is a dedicated state-of-the-art passive seismic survey that explores the still poorly known spreading processes at ultraslow spreading ridges, in particular Knipovich Ridge in the Norwegian-Greenland Sea. Ultraslow spreading ridges are characterized by pronounced variations in melt supply along axis. We want to understand how melts can travel to the widely spaced volcanic centres and force their way upwards through the cold, thick lithosphere. A topography of the lithospheric base has long been postulated allowing melts to travel along its slopes towards the volcanic centres. At other locations, the crust is thin or absent and extensive serpentinisation of mantle rocks evidenced by aseismic areas testifies to a deep reaching fluid circulation in the lithosphere. However, the extent of serpentinisation of the lithosphere remains poorly known.

We therefore instrumented a section of about 160 km of Knipovich Ridge centered around Logachev volcano. Our network of 27 Ocean Bottom Seismometers (OBS) extends from one volcanic centre to the next and represents the so far largest passive seismic network at a mid-ocean ridge. OBS were deployed by cruise PS100 of RV POLARSTERN in 2016. The OBS recorded local earthquake activity for a period of 10-13 months. Cruise MSM67 of MARIA S. MERIAN shot seismic refraction profiles across Logachev volcano to image its structure and magmatic plumbing system with unprecedented detail. For that purpose, 4 additional OBS were deployed by cruise PS109 to supplement 5 OBS that were still recording.

The aim of MARIA S. MERIAN cruise MSM68 is to recover all OBS. In addition, we also intend to acquire high resolution bathymetric maps of the rift valley and adjacent flanks to study in detail the magmatic and tectonic processes that form the rugged terrain. Off-axis seamounts are of particular interest, since their altitude and morphological appearance yields information on the temporal variability of melt production.

The comprehensive seismological dataset of KNIPAS will enable us to study for the first time spatial variations of seismicity, thermal structure and lithospheric thickness along an entire segment of an ultraslow spreading ridge. With the combination of velocity information provided by seismic refraction profiling and deformation mode as revealed by local seismicity, we want to explore the extent of serpentinisation in the shallow lithosphere. With modern passive seismic methods (receiver functions and ambient noise methods), that we will adapt for the special conditions of marine seismic surveys, we want to prove the existence of pronounced variations of lithospheric thickness to verify if melt redistribution along the lithospheric base is possible over the scale of entire segments.

We anticipate that the data set will further hold valuable information on the seasonal distribution and call rates of baleen whales in the Norwegian Greenland Sea and on the generation of microseismic noise in the North Atlantic.

Narrative

We embarked on MARIA S. MERIAN on October 5th, 2017 in Longyearbyen, Svalbard, and could immediately start preparing our equipment for the recovery of 27 ocean bottom seismometers (OBS). After bunkering we left port on the morning of October 6th in good weather conditions and reached our survey area late in the evening of October 6th starting with bathymetric surveying and deployment of an Argo float. We released the first ocean bottom seismometer around 05:30 on October 7th. Until the late evening, we recovered 9 OBS. As about 25% of the radio beacons and flash lights did not work immediately when reaching the sea surface and we therefore had to rely on eye sight to find the OBS, we decided against OBS recovery during the darkness hours. Instead we continued bathymetric surveying, closing gaps in existing bathymetric charts. From October 8th to October 10th, we always started OBS recovery around 07:30 in the morning and managed to recover 5, 6 and 5 OBS, respectively, until dusk in almost calm weather and wind conditions. The darkness period was spent extending the existing high-resolution bathymetric maps over the ridge flanks towards off-axis regions. On October 11th, we recovered the last two remaining OBS until noon time. Winds were already increasing and the sea got rougher such that further OBS operations would have been difficult. OBS had continuously been dismantled, cleaned and packed during the last days such that most equipment was stowed away until the evening of October 11th, leaving only data processing units behind. Data conversion and archiving proceeded at the same pace as recovery, such that raw and converted data were already safely copied by October 12th, when sea conditions deteriorated and made computer work unpleasant. Hydrosweep surveying of the rift flanks and valley to the south of our survey area started after the last OBS recovery and lasted for 48 hours until October 13th in the afternoon when we left the survey area to head for Emden. On the way, we deployed 2 more Argo floats along the 0° meridian.

Acknowledgements

We thank officers and crew of MARIA S. MERIAN for their professional and rapid OBS recovery performance that allowed effective use of the short weather window. We greatly acknowledge the entire crew of MARIA S. MERIAN for providing us with ideal working conditions during MSM68.

The 27 OBS were borrowed from the DEPAS pool. OBS deployment took place during cruises PS100 and PS109 for which we are indebted to the officers and crew of RV POLARSTERN and to the science team lead by T. Kanzow. We further thank the Federal Institute for Geosciences and Natural Resources, V. Damm and D. Franke, for performing airgun operations during MSM67 to acquire refraction seismic data around Logachev Seamount. Our dataset benefits from three additional OBS deployed by W. Czuba and T. Janik of the Institute of Geophysics Polish Academy of Sciences.

We thank the German Science Foundation for providing ship time for proposal MerMet15-98.

Teilnehmerliste

1. Vera Schlindwein	Fahrtleiter / <i>Chief Scientist</i>	AWI
2. Frank Krüger	Seismology	UP
3. Florian Schmid	Ocean bottom seismometer	AWI
4. Mechita Schmidt-Aursch	Ocean bottom seismometer	AWI
5. Jonah Geils	Bathymetry	AWI
6. Rouven Brune	Bathymetry	AWI
7. Rabea Sondershaus	Ocean bottom seismometer	AWI
8. Filip Elekes	Data processing	AWI
9. Florian Dorgerloh	Ocean bottom seismometer	UP
10. Henning Lilienkamp	Ocean bottom seismometer	UP
11. Malte Metz	Ocean bottom seismometer	UP
12. Gesa Petersen	Ocean bottom seismometer	UP

AWI Alfred-Wegener-Institute, Helmholtz-Zentrum für Polar- und Meeresforschung
UP Universität Potsdam, Institut für Erd- und Umweltwissenschaften

Stationsliste

Station	Time	Device	Action	Latitude	Longitude	Depth (m)	Comment
MSM68 1-1	06.10.17 15:27	Expandable Sound Velocimeter	max depth/on ground	77° 57,413' N	012° 34,487' E	2080.6	
MSM68 1-1	06.10.17 15:20	Expandable Sound Velocimeter	in the water	77° 57,413' N	012° 34,487' E	2039.7	
MSM68 2-1	06.10.17 16:55	MB	profile start	77° 22,528' N	007° 56,857' E	2408.6	
MSM68 2-1	07.10.17 02:39	MB	profile end	76° 40,289' N	007° 53,889' E	1979.3	
MSM68 3-1	06.10.17 23:47	Float	deployed	77° 00,083' N	008° 16,385' E	2083.2	
MSM68 4-1	07.10.17 04:16	OBS	on deck	76° 43,966' N	007° 44,286' E	2439.4	KNR26
MSM68 5-1	07.10.17 06:28	OBS	on deck	76° 43,962' N	007° 45,121' E	2450.6	KNR06
MSM68 6-1	07.10.17 08:40	OBS	on deck	76° 50,262' N	007° 27,259' E	3178.7	KNR17
MSM68 7-1	07.10.17 10:39	OBS	on deck	76° 43,767' N	007° 00,508' E	2353.8	KNR27
MSM68 8-1	07.10.17 11:44	OBS	on deck	76° 44,385' N	007° 02,074' E	2348.1	KNR05
MSM68 9-1	07.10.17 15:06	OBS	on deck	76° 39,957' N	007° 26,704' E	3135.5	KNR22
MSM68 10-1	07.10.17 16:55	OBS	on deck	76° 35,080' N	007° 16,193' E	0.0	KNR21
MSM68 11-1	07.10.17 18:58	OBS	on deck	76° 26,418' N	006° 46,506' E	2644.1	KNR24
MSM68 12-1	09.10.17 06:22	OBS	on deck	76° 26,043' N	006° 42,684' E	0.0	KNR07
MSM68 13-1	07.10.17 21:21	OBS	on deck	76° 26,628' N	007° 30,687' E	0.0	KNR25
MSM68 14-1	07.10.17 21:56	MB	profile start	76° 29,743' N	007° 40,190' E	2473.1	
MSM68 14-1	08.10.17 04:27	MB	profile end	77° 06,148' N	006° 43,890' E	2445.0	
MSM68 15-1	08.10.17 06:34	OBS	on deck	77° 06,024' N	006° 59,063' E	0.0	KNR01
MSM68 16-1	08.10.17 09:01	OBS	on deck	77° 05,771' N	007° 50,902' E	0.0	KNR02
MSM68 17-1	08.10.17 11:16	OBS	on deck	76° 55,667' N	007° 51,511' E	0.0	KNR04
MSM68 18-1	08.10.17 14:01	OBS	on deck	76° 55,442' N	006° 49,115' E	1806.9	KNR03
MSM68 19-1	08.10.17 16:56	OBS	on deck	76° 37,149' N	006° 35,237' E	2545.0	KNR18
MSM68 20-2	08.10.17 18:08	MB	profile start	76° 46,947' N	006° 27,057' E	2019.3	
MSM68 20-2	09.10.17 05:20	MB	profile end	76° 26,722' N	006° 43,739' E	2695.1	
MSM68 21-1	09.10.17 08:06	OBS	on deck	76° 30,358' N	007° 05,917' E	3282.5	KNR23
MSM68 22-1	09.10.17 09:53	OBS	on deck	76° 33,194' N	007° 49,421' E	2485.0	KNR20
MSM68 23-1	09.10.17 11:36	OBS	on deck	76° 25,969' N	007° 29,947' E	2657.7	KNR08
MSM68 24-1	09.10.17 13:40	OBS	on deck	76° 19,760' N	007° 08,625' E	3400.4	KNR19
MSM68 25-1	09.10.17 16:03	OBS	on deck	76° 14,603' N	006° 48,773' E	2566.8	KNR09
MSM68 26-1	09.10.17 16:14	MB	profile start	76° 14,529' N	006° 46,912' E	2564.2	
MSM68 26-1	09.10.17 16:34	MB	profile end	76° 16,263' N	006° 38,823' E	1641.3	
MSM68 27-1	09.10.17 17:19	Sound Velocity Profiler	in the water	76° 14,524' N	007° 07,989' E	0.0	
MSM68 27-1	09.10.17 19:15	Sound Velocity Profiler	on deck	76° 14,524' N	007° 07,980' E	0.0	
MSM68 28-1	09.10.17 19:22	MB	profile start	76° 14,678' N	007° 08,513' E	3445.9	
MSM68 28-1	10.10.17 05:24	MB	profile end	76° 14,621' N	007° 33,603' E	2578.5	
MSM68 29-1	10.10.17 06:18	OBS	on deck	76° 14,730' N	007° 33,216' E	0.0	KNR10
MSM68 30-1	10.10.17 08:48	OBS	on deck	76° 03,748' N	007° 34,137' E	2589.6	KNR12
MSM68 31-1	10.10.17 10:41	OBS	on deck	76° 04,305' N	006° 51,318' E	2581.8	KNR11
MSM68 32-1	10.10.17 13:10	OBS	on deck	75° 53,928' N	006° 50,708' E	2630.1	KNR13
MSM68 33-1	10.10.17 15:43	OBS	on deck	75° 53,954' N	007° 39,616' E	2767.3	KNR14
MSM68 34-1	10.10.17 15:45	MB	profile start	75° 53,954' N	007° 39,633' E	2603.1	
MSM68 34-1	11.10.17 05:29	MB	profile end	75° 44,569' N	007° 46,346' E	2662.8	
MSM68 35-1	11.10.17 07:07	OBS	on deck	75° 44,834' N	007° 45,185' E	0.0	KNR16
MSM68 36-1	11.10.17 09:23	OBS	on deck	75° 44,571' N	006° 56,232' E	2618.0	KNR15
MSM68 37-1	11.10.17 09:29	MB	profile start	75° 44,456' N	006° 56,300' E	2617.0	
MSM68 37-1	13.10.17 13:43	MB	profile end	74° 44,393' N	006° 49,825' E	2032.3	
MSM68 38-1	11.10.17 12:29	Expandable Sound Velocimeter	in the water	75° 39,260' N	007° 23,243' E	3354.8	
MSM68 38-1	11.10.17 12:35	Expandable Sound Velocimeter	max depth/on ground	75° 39,277' N	007° 25,389' E	3356.5	
MSM68 39-1	13.10.17 23:03	Float	deployed	73° 59,937' N	000° 00,035' E	3182.4	
MSM68 40-1	15.10.17 19:55	Float	deployed	66° 00,031' N	000° 00,260' E	3032.3	