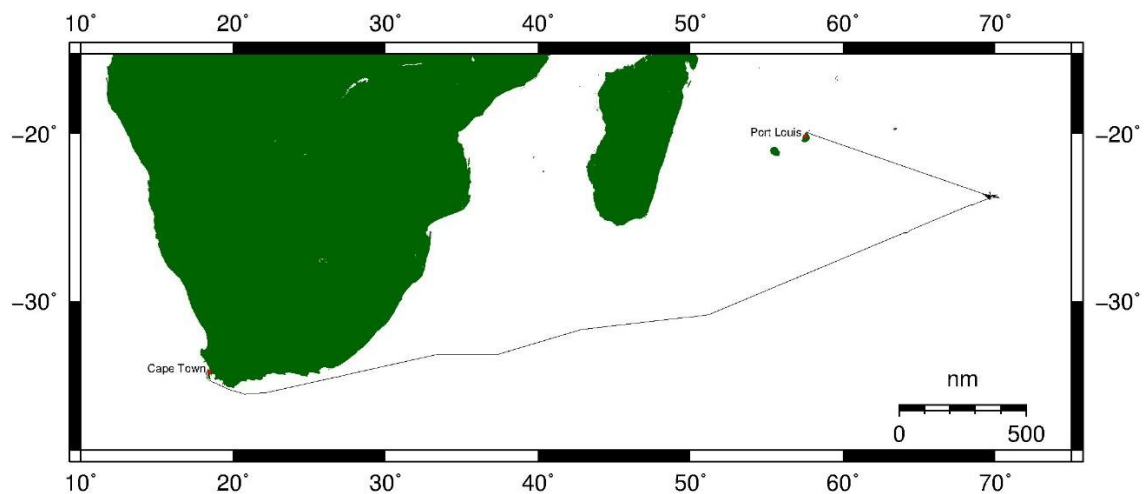


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Short Cruise Report
Maria S. Merian cruise MSM59/1
Cape Town (South Africa) – Port Louis (Mauritius)
28.10.2016 – 26.11.2016
Chief Scientist: Dr. Volkmar Damm
Captain: Ralf Schmidt



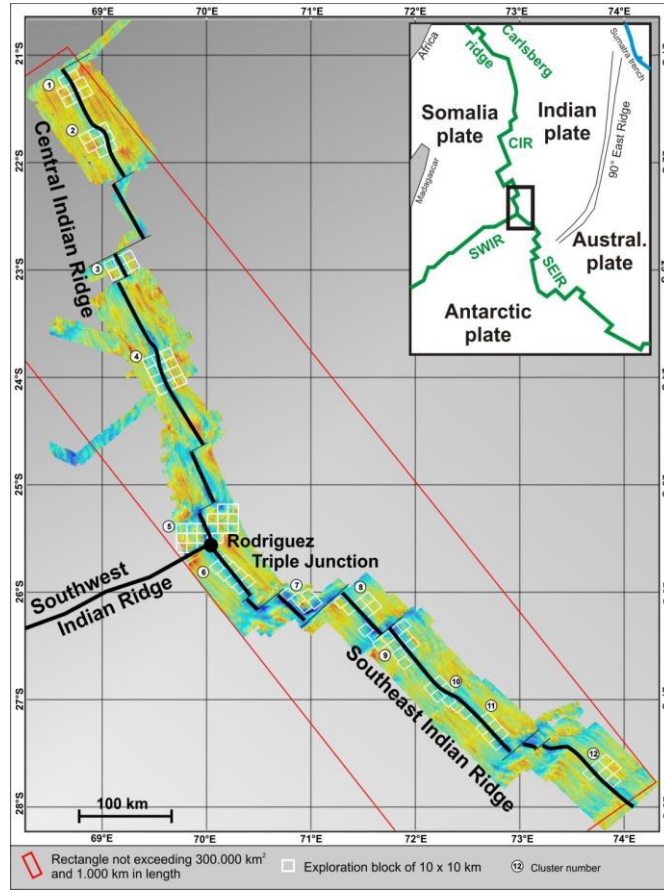
Cruise track MSM59 Leg 1

Objectives

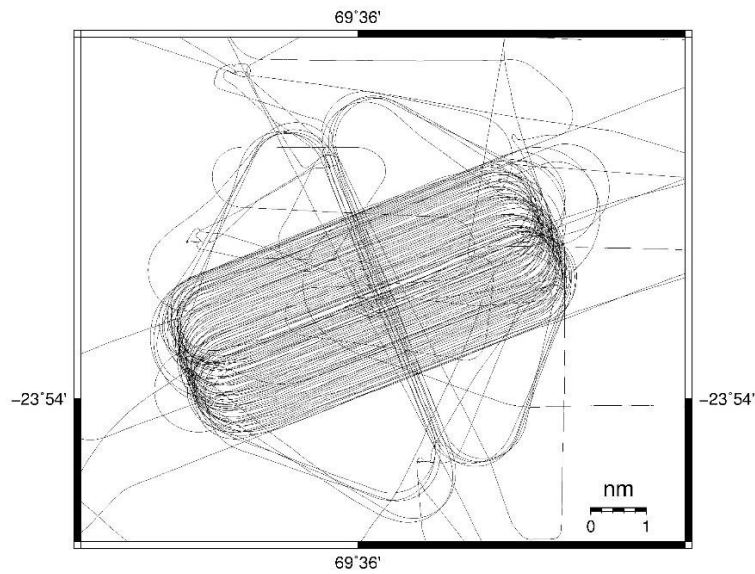
Research activities during MSM59 were part of BGR's exploration program within the framework of the license contract with the International Seabed Authority (ISA). On behalf of the Federal Ministry for Economic Affairs and Energy (BMWi), BGR holds an exploration license for polymetallic sulfides in an area of 10.000 km², subdivided into 100 so-called sulfide blocks each 10 x 10 km in size, in the southwestern Indian Ocean. Based on this contract with the ISA BGR has the obligation and permission to carry out a detailed exclusive resource-oriented exploration program in the dedicated license area southeast of Madagascar. The program includes the identification and outline of potential ore deposits and a resource assessment but also extensive and detailed base line studies for the sustainable protection of the marine environment. The license contract has a fifteen years lifetime and may allow the application for a subsequent mining license. The exploration license aims at the identification of inactive polymetallic sulfide deposits, formed below former discharge zones of hot hydrothermal fluids on the ocean floor ("black smoker"), by modern exploration techniques.

The goal of MSM59/1 was to image the massive sulfides by means of seismic methods. Under special focus were the lateral and vertical boundaries of the massive sulfide area in cluster 4. Additionally, we subsequently want to locate the migration paths of the circulation fluids by means of the processed 3D seismic data set. In order to address the small-scale geological structures, we choose a 3D seismic setup in combination with a high frequency seismic source. Because of the significant seafloor topography of the Central Indian Ridge, we planned for a two azimuth 3D seismic surveys, with one orthogonal to the ridge and one parallel to the ridge orientation of survey lines, respectively. In addition to the reflexion seismic survey, we deployed 9 ocean bottom seismometers (OBS) around and within the survey area.

BGR's exploration program is in full agreement with the International Law of the Sea and its environmental constraints. In order to meet all precautionary measures an airgun calibration was performed prior the survey to meet the limits for sound impact in German territorial waters preset by the German Hydrographic Service (BSH). Our precautionary measures also included having qualified and certified external marine mammal observers on board and to operate appropriate equipment for mammal detection in case of bad visibility and during night time. The 24/7 precaution activities during seismic operation are documented as part of the cruise reports.



The working area during cruise MSM59/1-2 (INDEX 2016_2) with FS MARIA S. MERIAN to the North of the Rodriguez Triple Junction along the southern Central Indian Ridge (working area see locations of the license cluster 4)



Track plot of acquired 3D seismic lines within the German license cluster 4 consisting of 100 lines in E-W direction and 10 lines in N-S direction.

Narrative

RV MARIA S. MERIAN berthed in Cape Town in the morning of October 25th and was ready for loading operations of the 8 BGR containers. Mobilisation of the 3D seismic equipment was conducted and widely completed until Thursday, October 27th. This also included welding operations and installation of the two streamer winches and other deck equipment.

RV MARIA S. MERIAN left Cape Town harbor in good weather conditions at noon October 28th heading for the survey area. A transit time of 9 days was planned for the 2900 nm transit to the survey area. Despite unfavorable weather conditions over the following week all installation work and preparation of the 3D data acquisition could be completed successfully and well in time. Before reaching the survey area in license cluster 4 we successfully completed on Sunday, November 6th a first test to launch and recover a paravan to be used for deflection of one of our two 1500 m long seismic streamer cables. The calibration of the seismic sources was on schedule for Monday, November 7th. In order to validate the modelled sound emission, a one day gun calibration of the single GI-guns was performed. For this purpose, two broad-band hydrophones were mounted below a buoy at 20 m and 750 m depth. The vessel was passing the buoy on several profiles for covering different azimuths and distances to the hydrophones. Sound pressure levels (SPL) and sound exposure levels (SEL) were recorded and computed for the deep water case to prove that the limits for sound impact preset by the German Hydrographic Service (BSH) for German territorial waters will met.

After arriving the survey area represented by the 10x10 km² extended license cluster #4 9 OBS were deployed inside and around the planned 3D survey area of 6x6 km². By means of these OBS we want to get additional information about deeper structures of the former active hydrothermal zone. Subsequently, we deployed all 3D seismic outboard systems. The two seismic streamers were towed in a distance of 50 m apart. Two single GI-guns in a distance of 25 m apart and operating in flip-flop mode were used as seismic sources. After careful calibration and verification of full 3D layout 3D seismic production commenced in late night, Wednesday, November 9th. Unfortunately, we had to interrupt seismic production next morning due to longline fishery in the area. We had to recover all outboard equipment since fishing lines interfered with the seismic streamers. After replacement of damaged sections and redeploying all seismic outboard equipment we re-commenced seismic production Thursday evening. Weather conditions and sea state changed for the worse over the weekend and continuous production had to be interrupted again on Monday, November 14th due to a broken towing rope. As a consequence we had to recover all seismic outboard equipment again before fixing the problem. After re-deploying the 3D seismic gear we continued with seismic production after 24 hours of interruption on Tuesday, November 15th. The 3D seismic survey was finally aborted at Monday noon, November 21st due to time shortage. The 3D seismic survey comprises in total 100 lines in E-W and 10 lines in N-S direction covering 25 km². After recovering the seismic streamers additional shooting for refraction seismic profiles was conducted for another 10 hours before recovery of OBS was commenced November 22nd. All OBS could be recovered without any problem until the same day evening and RV MARIA S. MERIAN headed for Port Louis around midnight. After 2.5 days of transit the vessel moored in Port Louis November 25th.

Acknowledgements

The cruise was put into practice based on an intergovernmental agreement between the Federal Ministry for Science and Education and the Ministry of Economy and Energy. For the first time BGR was provided a German research vessel to carry out exploration activities in the German license areas under this agreement. We thank the Ship Coordination Office (Leitstelle) at the Institute of Marine Science, Hamburg University and BRIESE research for their comprehensive support in logistic preparation of the cruise. On behalf of the scientific crew I would like to thank captain Ralf Schmidt and the ship's crew for their outstanding assistance and support during all survey operations.

Participants

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Station List

Station	Date	Time	SOL	SOL	Time	EOL	EOL	Profile
No.		[UTC]	Lat	Lon				
MSM59/729-2	09.11.2016	18:18	23° 50,64' S	69° 37,32' E	19:16	23° 52,04' S	69° 33,38' E	IDX022
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MSM59/729-3	19.11.2016	2:29	23° 51,03' S	69° 37,61' E	3:27	23° 52,45' S	69° 33,62' E	IDX090
MSM59/729-3	19.11.2016	4:11	23° 53,51' S	69° 34,64' E	5:09	23° 52,12' S	69° 38,57' E	IDX286
MSM59/729-3	19.11.2016	5:51	23° 51,03' S	69° 37,52' E	6:49	23° 52,43' S	69° 33,61' E	IDX094
MSM59/729-3	19.11.2016	7:35	23° 53,52' S	69° 34,58' E	8:33	23° 52,13' S	69° 38,47' E	IDX282
MSM59/729-3	19.11.2016	9:16	23° 50,99' S	69° 37,58' E	10:14	23° 52,38' S	69° 33,68' E	IDX082
MSM59/729-3	19.11.2016	12:16	23° 53,99' S	69° 37,25' E	13:15	23° 50,32' S	69° 35,68' E	IDX678
MSM59/729-3	19.11.2016	14:51	23° 53,11' S	69° 34,45' E	15:50	23° 51,67' S	69° 38,42' E	IDX222
MSM59/729-3	19.11.2016	17:16	23° 50,78' S	69° 35,87' E	18:15	23° 54,44' S	69° 37,44' E	IDX674
MSM59/729-3	19.11.2016	19:50	23° 51,49' S	69° 37,74' E	20:48	23° 52,95' S	69° 33,84' E	IDX162
MSM59/729-3	19.11.2016	20:49	23° 52,97' S	69° 33,77' E	23:41	23° 50,41' S	69° 35,67' E	IDX670
MSM59/729-3	20.11.2016	1:22	23° 53,32' S	69° 34,53' E	2:20	23° 51,91' S	69° 38,44' E	IDX254
MSM59/729-3	20.11.2016	3:55	23° 50,84' S	69° 35,81' E	4:53	23° 54,45' S	69° 37,35' E	IDX666
MSM59/729-3	20.11.2016	6:18	23° 52,01' S	69° 37,97' E	7:16	23° 53,47' S	69° 34,04' E	IDX242
MSM59/729-3	20.11.2016	8:52	23° 54,02' S	69° 37,10' E	9:50	23° 50,40' S	69° 35,60' E	IDX662
MSM59/729-3	20.11.2016	11:23	23° 53,03' S	69° 34,36' E	12:22	23° 51,56' S	69° 38,31' E	IDX206
MSM59/729-3	20.11.2016	13:51	23° 50,90' S	69° 35,80' E	14:47	23° 54,41' S	69° 37,27' E	IDX658
MSM59/729-3	20.11.2016	16:20	23° 51,85' S	69° 37,88' E	17:18	23° 53,29' S	69° 34,00' E	IDX222
MSM59/729-3	20.11.2016	18:52	23° 54,02' S	69° 37,05' E	19:50	23° 50,40' S	69° 35,51' E	IDX654
MSM59/729-3	20.11.2016	21:20	23° 52,35' S	69° 34,09' E	22:19	23° 50,96' S	69° 38,01' E	IDX098
MSM59/729-3	20.11.2016	23:43	23° 50,78' S	69° 35,66' E	0:41	23° 54,41' S	69° 37,22' E	IDX650
MSM59/729-3	21.11.2016	2:20	23° 51,69' S	69° 37,88' E	3:19	23° 53,10' S	69° 33,91' E	IDX194
MSM59/729-3	21.11.2016	5:00	23° 54,07' S	69° 37,00' E	5:59	23° 50,42' S	69° 35,44' E	IDX646
MSM59/729-3	21.11.2016	7:46	23° 53,78' S	69° 34,71' E	8:44	23° 52,40' S	69° 38,61' E	IDX326
MSM59/729-3	21.11.2016	10:22	23° 50,81' S	69° 35,61' E	11:21	23° 54,43' S	69° 37,14' E	IDX642
MSM59/730-1	22.11.2016	3:00	23° 48,31' S	69° 33,79' E	3:55	23° 44,33' S	69° 31,29' E	REF 4
MSM59/730-1	22.11.2016	4:09	23° 44,47' S	69° 31,61' E	8:08	24° 2,23' S	69° 41,70' E	REF 5

Station	Deployment Date	Time UTC	Position		Recovery Date	Time UTC	Position		OBS#
			LAT	LONG			LAT	LONG	
MSM59/720-1	07.11.2016	19:59	23° 56,89' S	69° 37,29' E	22.11.2016	10:20	23° 56,94' S	69° 37,36' E	OBS 1
MSM59/721-1	07.11.2016	20:29	23° 54,98' S	69° 37,16' E	22.11.2016	11:50	23° 54,99' S	69° 37,21' E	OBS 2
MSM59/722-1	07.11.2016	21:06	23° 52,30' S	69° 39,24' E	22.11.2016	13:24	23° 52,28' S	69° 39,43' E	OBS 3
MSM59/723-1	07.11.2016	21:38	23° 52,59' S	69° 36,27' E	22.11.2016	15:09	23° 52,70' S	69° 36,39' E	OBS 4
MSM59/724-1	07.11.2016	21:50	23° 52,43' S	69° 36,11' E	22.11.2016	15:30	23° 52,51' S	69° 36,26' E	OBS 5
MSM59/725-1	07.11.2016	22:15	23° 51,97' S	69° 35,86' E	22.11.2016	15:46	23° 51,99' S	69° 36,04' E	OBS 6
MSM59/726-1	07.11.2016	22:45	23° 51,55' S	69° 33,35' E	22.11.2016	17:22	23° 51,39' S	69° 33,31' E	OBS 7
MSM59/727-1	07.11.2016	23:13	23° 50,40' S	69° 35,51' E	22.11.2016	19:00	23° 50,25' S	69° 35,44' E	OBS 8
MSM59/728-1	07.11.2016	23:40	23° 48,94' S	69° 33,89' E	22.11.2016	19:36	23° 48,83' S	69° 33,89' E	OBS 9