

Prof. Dr. Christian Hübscher
Institute of Geophysics, CEN - Center for Earth System Research and Sustainability
Bundesstrasse 55
20146 Hamburg

Tel.: +49 40 42838 5184
Fax: +49 40 42838 5441
email: Christian.Huebscher@uni-hamburg.de

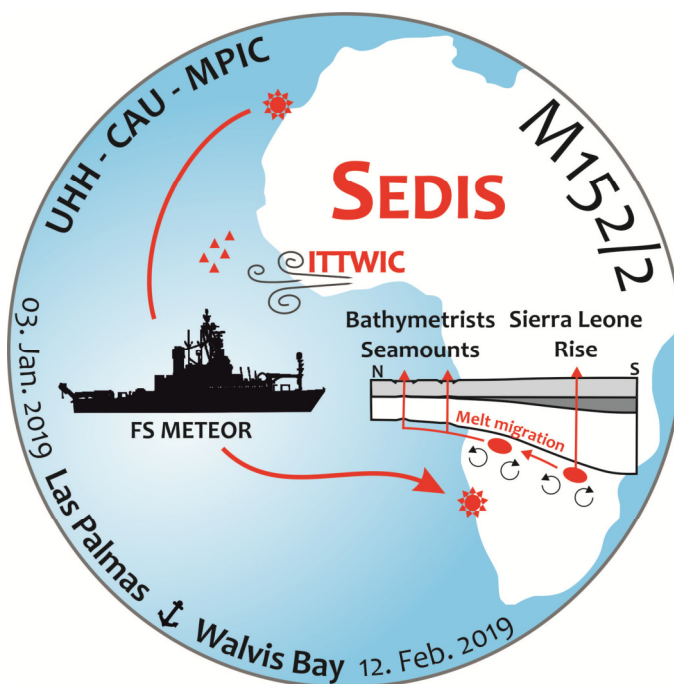
Short Cruise Report **RV Meteor M152/2**

Las Palmas (Spain) – Walvis Bay (Namibia)

January 3 – February 12, 2019

Chief Scientist: Christian Hübscher

Captain: Detlef Korte



Objectives

The RV METEOR cruise M152/2 strives for a better understanding of the life cycle of submarine volcanoes and their effect on the oceanic lithosphere in the oceanic intra-plate setting of the BSM (Fig. 3.1.1). The aims were:

- 1) to understand the interaction between crustal thickness, tectonics and volcanic phases,
- 2) to investigate the chronological evolution of individual seamounts and seamount chains,
- 3) to study the structural growth process of elongated seamounts,
- 4) to review slope failures and resulting mass flow processes,
- 5) to sample long-lived organic substances in water and air.

We addressed these objectives by high-resolution reflection seismic, parametric echosounder (PARASOUND), multi-beam (Kongsberg EM122), gravity and magnetic profiling, rock, water and air sampling.

Narrative

The scientific party arrived at RV METEOR in Las Palmas (Gran Canaria, Spain) on Wednesday, January 2nd, 2019 in the afternoon. Instantaneously we started with unloading the equipment from the containers and the installation on deck and in the labs with great support by Master Detlef Korte and his crew. After gravity tight measurements next morning in the harbour, the sea gravimeter was calibrated. Simultaneously, equipment installation proceeded and at 12:30 all scientific resorts reported ready to sail status. At 13:00 RV METEOR put to sea on schedule on a southbound track. We left the EEZ of the Cape Verdes on January 6 at 18:10 UTC and switched on the multi-beam for bathymetric and the acoustic Doppler current profiler (ADCP) for current-depth measurements. We further started water and air sampling.

The transit to our working area north of the Sierra Leone Rise (SLR), where volcano lineaments form the Bathymetrists Seamounts (BSM), lasted until January 7th in the morning. The 5 days of transit had been used for training the deck handling of the heavy gear and for educating younger scientists in the duties during the shifts. After arrival at the north-western tip of the BSM we deployed the digital streamer system, which lasted 2 hours because seven digitizer modules had to be installed in the streamer. After that we brought out the magnetometer (gradiometer). During the installation an observer carefully watched out for marine mammals. Since no mammals were spotted we deployed the seismic sources and started to ramp up the pressure during 30 minutes. The procedure of mammal observation and ramp up was repeated throughout the cruise after each seismic shut down. After synchronizing the sources we started regular geophysical profiling at 18:30 ship time, which included multi-channel seismics, parametric echo-sounding (PARASOUND), multi-beam (Kongsberg EM122), gravity and magnetic measurements. With the first profile we crossed the Annan volcano, a real giant being more than 60 km wide and 6 km high, with a base more than one kilometre beneath sea floor. A carbonate platform had developed on Annans top that is today in a water depth of ca. 200 m. Next morning on the 8th we started a profile west of the seamounts and across a fracture zone. We learned that Annan developed on the southern shoulder of the previously crossed fracture zone. A 2nd, cross-profile over Annan and other seamounts to the south taught us that profiles across the summits of the seamount provide just minor insight into their internal structure and possible underlying faults. Consequently, we designed the profile layout in a way that profiles cross either the lower seamount slopes or lay in between the seamounts. Around noon on the 9th we did some maintenance on the seismic source system and recommenced surveying after three hours. Until January 11th in the morning we

collected more profiles perpendicular to the presumed striking directions of underlying faults and fracture zones in the northern BSM area. Same day we collected a profile along the Guinea Fracture Zone, passing Kane Gap where the fracture zone narrows. Here, the Kiel group had dredged an interesting accumulation of manganese nodules one year before in the course of RV MARIA S. MERIAN cruise MSM70. With profiles across the fracture zone we strived for investigating those processes that controlled nodule accumulations, which lasted until the 12th late evening. The next two days we focussed on investigating possible faults that strike north-south, so we collected mainly west-east profiles which will help us later on to link the stratigraphy between the previously collected north-south going lines. January 14th we selected profiles for two days that linked the lower slopes of various seamounts, which are telling us about the relative order in which seamounts evolved. We used the following two days until January 16th for collecting three relatively closely spaced profiles along strike the non-volcanic area that separates the northern from the central seamount group. In the morning of January 18th we brought all gear on deck.

Based on the processing results we decided to continue our measurements around Kane Gap, so we travelled a fast transit of 10 hours, during which we did a close inspections and regular maintenance of all towed equipment. In the afternoon the same day, we deployed the equipment again and commenced profiling in the Kane Gap area. On the 19th before noon, the equipment was put on deck again. During the next ca. 18 hours four dredges were taken in order to test hypotheses about those processes that control manganese nodule growth. Two dredges included several nodules, one was empty as expected, and one was unexpectedly empty.

From noon on we transited on a southbound track to the central BSM where we arrived in the afternoon of January 20th. After deployment of the seismic and magnetic gear we started a profile along strike and in between the northeast-southwest striking volcano chains of the central BSM, in order to map faults that laterally offset the volcano chains. Next day we started measurements along a set of profiles which targeted on investigations the eastern Rebmann volcano, which lasted until January 22nd. During the following 24 hours profiles perpendicular to the strike of the volcano chains were taken in order to better understand possible fault systems that underlie the volcano lineaments. Along strike profiles measured from 22nd to 23rd imaged the syn- and post-volcanic sediments between the western and eastern volcano lineaments, followed by profiles in the transition zone between the southwest-northeast striking central BSM domain and the west-east striking southern domain. January 24th to 25th we collected profiles parallel and in close distance along-strike and within the central BSM, which will enable us to correctly identify individual faults systems imaged in the individual profiles. In the night from 25th to 26th we crossed the W-E striking and about 140 km long Webb-Gilg volcanic ridge. With the last profile, having a length of almost 300 km, we connected the southern BSM with DSDP Leg 41 Site 366 at the south-eastern SLR, where we arrived on January 27th in the morning. Here, the seismic and magnetic survey ceased, and at noon all towed gear was safely on deck.

For the following five days we investigated the SLR with multi-beam and dredge sampling. We chose those areas which showed on the low-resolution GEBCO bathymetry the most relief, which are only present on the south side. From the detailed multi-beam pre-site surveys we then determined locations which revealed high backscatter amplitudes (meaning hard ground) and slope gradients of $> 20^\circ$. On the 27th and 28th three dredges were taken on the south-eastern collapsed flank of the main plateau, at depths of 3000-4000 m. Two dredges included volcanic rock, one was empty. We dredged several potential volcanic cones on the rise from east to west and at a depth of ca. 2000 m on the 29th and 30th. The dredges returned carbonates, so we focused again on the deeper flanks of the plateau moving back towards the east. Two dredges caught chemically modified carbonates (phosphorite) in 3000 m water depth. One of the last dredges on February 1st returned volcanic samples from 3800 m water depth.

The scheduled station program ended around noon and RV METEOR immediately started the south-east bound transit with just the gravimeter, multi-beam and air and water sampler left active. Same evening, Triton showed up and announced equator baptism for the next day. The transit to the Namibian EEZ lasted until February 10, where multi-beam, air and water sampler were switched off. During this time, final data processing on board and rock descriptions were performed, as well as the packing of the equipment. The cruise finished on February 11, when RV METEOR completed her transit and berthed at Walvis Bay harbour.

Acknowledgements

The M152/2 scientific party wishes to thank Master Detlef Korte and his crew for their outstanding support throughout the cruise. We are further grateful for the support of German Research Fleet Coordination Centre and Briese Research.

Participants

Name	Discipline	Institution
Hübscher, Christian, Prof. Dr.	Geophysics, Chief Scientist	UHH
van der Zwan, Froukje, Dr.	Head Sampling	CAU
Grob, Henrik	Geophysics / Shift Leader	UHH
Häcker, Tobias	Geophysics	UHH
Hartge, Matthias	Geophysics	UHH
Huster, Hendrik	Geophysics / Shift Leader	UHH
Kretzschmann, Lisett	Head Chemistry	MPI / M
Lampridou, Danai	Geophysics	NKUA
Preine, Jonas	Head Magnetism / Shift Leader	UHH
Schäfer, Wiebke	Geophysics	UHH
Schade, Martin	Head Hydroacoustics	CAU
Seidel, Elisabeth	Geophysics / Interpretation	UHH
Warwel, Arne	Geophysics	UHH
Wehmeier, Lena	Geophysics	UHH
Winter, Sven	Technician (Geophysics)	UHH
Otte, Frank	Technician (Meteorology)	DWD
Raeke, Andreas	Technician (Meteorology)	DWD

CAU: Institute for Geology / Christian Albrecht University Kiel

DWD: Deutscher Wetterdienst, Geschäftsfeld Seeschifffahrt / Hamburg

MPI / M: Max Planck Institute for Chemistry, Mainz

NKUA: Department of Geology and Geoenvironment, National and Kapodistrian University of Athens

UHH: Institute for Geophysics / University of Hamburg

Station List

Station Number	Position (Start/End)	Date/ Time	Depth	MSC-	Dredge	Comment
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		(UTC) Start/End	(m)	Profile #	#	
M152/2_1 SEISTR	09° 20.9' /021° 03.8' 09° 28.7' /020° 32.4'	07.01.19; 19:33 11.01.19; 15:14	---	P01-P06	---	Multi-Channel-Seismic profiling
M152/2_2 MAG	09° 35.5' /020° 32.6' 09° 27.8' /020° 11.8'	11.01.19; 17:28 11.01.19; 20:19	---	---	---	Magnetometer/gradiometer profiling
M152/2_3 SEISTR	09° 35.0' /020° 07.0' 07° 59.9' /020° 20.3'	11.01.19; 22:36 18.01.19; 08:36	---	P07-P20	---	Multi-Channel-Seismic profiling
M152/2_4 MAG	08° 02.8' /020° 19.6' 08° 52.1' /020° 04.9'	18.01.19; 09:49 18.01.19; 15:37	---	---	---	Magnetometer/gradiometer profiling
M152/2_5 SEISTR	09° 05.2' /019° 52.3' 09° 28.4' /019° 41.1'	18.01.19; 18:22 19.01.19; 10:13	---	P21-P24	---	Multi-Channel-Seismic profiling
M152/2_6 DRG	09° 29.9' /019° 46.5' 09° 27.7' /019° 46.3'	19.01.19; 12:14 19.01.19; 15:18	4328 – 4270	---	6DR	>100 Mn nodules, 5-12 cm, round to irregular/combined nodules. Sediment traps collected + sediment from dredge
M152/2_7 DRG	09° 22.4' /019° 47.0' 09° 22.6' /019° 46.8'	19.01.19; 16:36 19.01.19; 19:26	4554 – 4545	---	7DR	± 50 Mn nodules, 4-8 cm. 1/4 consists of double-triple nodules. Small mineral fragments (partially coated) on bottom side
M152/2_8 DRG	09° 17.5' /019° 41.9' 09° 17.7' /019° 41.7'	19.01.19; 20:34 19.01.19; 23:37	4686 – 4683	---	8DR	Empty, sediment from traps
M152/2_9 DRG	09° 15.1' /019° 29.1' 09° 15.4' /019° 29.0'	20.01.19; 01:13 20.01.19; 04:32	4626 – 4603	---	9DR	Empty, sediment from traps
M152/2_10 SEISTR	07° 57.8' /020° 43.8' 07° 38.5' /019° 46.5'	20.01.19; 17:26 27.01.19; 09:26	---	P25-P43	---	Multi-Channel-Seismic profiling
M152/2_11 MB_PS	05° 45.5' /019° 47.5' 05° 18.1' /019° 22.3'	27.01.19; 12:44 27.01.19; 21:47	---	---	---	Multibeam- and Parasound-Profilng
M152/2_12 DRG	05° 18.0' /019° 22.3' 05° 18.2' /019° 22.3'	27.01.19; 21:56 28.01.19; 01:27	4230 – 4122	---	12DR	14 Volcanic rocks, blocky, with altered black, red, white surfaces (fault planes). Vesicular to dense, 1 highly porphyric sample with crystals up to 1 cm
M152/2_13 MB_PS	05° 15.2' /019° 39.8' 04° 57.5' /019° 45.3'	28.01.19; 03:53 28.01.19; 11:55	---	---	---	Multibeam- and Parasound-Profilng
M152/2_14 DRG	04° 57.6' /019° 45.3' 04° 57.9' /019° 45.3'	28.01.19; 12:05 28.01.19; 14:58	3120 – 2768	---	14DR	3 Manganese crusts with breccia fragments
M152/2_15 DRG	04° 53.9' /019° 53.1' 04° 54.1' /019° 53.2'	28.01.19; 16:32 28.01.19; 19:13	3495 – 3211	---	15DR	Empty, sediment from traps
M152/2_16 MB_PS	05° 01.1' /019° 50.2' 04° 49.1' /020° 42.1'	28.01.19; 20:11 28.01.19; 20:51	---	---	---	Multibeam- and Parasound-Profilng
M152/2_17 DRG	04° 48.0' /020° 42.5' 04° 49.1' /020° 42.7'	29.01.19; 09:36 29.01.19; 12:49	2125 – 2074	---	17DR	10+ Carbonates (reef) coated with Mn crust
M152/2_18 MB_PS	04° 49.6' /020° 42.9' 04° 21.9' /021° 08.8'	29.01.19; 13:26 29.01.19; 20:42	---	---	---	Multibeam- and Parasound-Profilng
M152/2_19 MB_PS	04° 21.7' /021° 08.8' 04° 33.1' /022° 09.6'	29.01.19; 20:44 30.01.19; 07:07	---	---	---	Multibeam- and Parasound-Profilng
M152/2_20 DRG	04° 30.0' /022° 04.4' 04° 30.2' /022° 04.5'	30.01.19; 08:02 30.01.19; 10:08	3032 – 1753	---	20DR	40-60 Carbonates, fossil corals, Mn crusts, biology (sponges, seastar, polip, coral?)
M152/2_21 MB_PS	04° 31.0' /022° 02.7' 03° 53.8' /021° 40.9'	30.01.19; 10:57 30.01.19; 21:42	---	---	---	Multibeam- and Parasound-Profilng
M152/2_22 DRG	03° 54.0' /021° 40.9' 03° 54.3' /021° 41.0'	30.01.19; 21:50 31.01.19; 00:37	3604 – 3377	---	22DR	8 Phosphorite, Mn-crusts and altered volcanic rocks/glass (?)
M152/2_23 MB_PS	03° 54.3' /021° 54.3' 03° 54.5' /021° 12.3'	31.01.19; 00:53 31.01.19; 06:54	---	---	---	Multibeam- and Parasound-Profilng
M152/2_24 DRG	04° 03.3' /021° 11.9' 04° 03.6' /021° 12.0'	31.01.19; 08:06 31.01.19; 10:43	3224 – 2945	---	24DR	40-60 Phosphorites, Mn crusts, heavily altered volcanic rocks
M152/2_25 MB_PS	04° 04.0' /021° 11.4' 04° 04.0' /020° 51.1'	31.01.19; 11:14 31.01.19; 15:13	---	---	---	Multibeam- and Parasound-Profilng
M152/2_26 DRG	04° 03.9' /020° 51.1' 04° 04.1' /020° 51.3'	31.01.19; 15:24 31.01.19; 18:06	3882 – 3751	---	26DR	Empty, sediment from traps
M152/2_27 DRG	04° 00.4' /020° 21.7' 04° 00.7' /020° 21.7'	31.01.19; 21:42 01.02.19; 00:47	3987 – 3670	---	28DR	10 Moderately to highly altered volcanic rocks, Mn crusts
M152/2_28 MB_PS	04° 00.8' /020° 21.5' 04° 38.8' /019° 50.6'	01.02.19; 01:10 01.02.19; 05:25	---	---	---	Multibeam- and Parasound-Profilng
M152/2_29 DRG	04° 30.9' /019° 58.3' 04° 31.3' /019° 58.3'	01.02.19; 07:10 01.02.19; 10:18	3811 – 3631	---	30DR	Empty, sediment from traps

Abbreviations: MSC:, Multi-Channel Seismics; MB: Multibeam; PS: Parasound; DR/DRG: Dredge

Map

The M152/2 track in the study area is shown as a red line.

