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Short Cruise Report

R/V MARIA S. MERIAN cruise MSM125

Algeciras (Spain) – Funchal (Portugal)

30.01.2024 - 06.02.2024

Chief Scientist: Dr. Christian Borowski

Captain: Sören Janssen

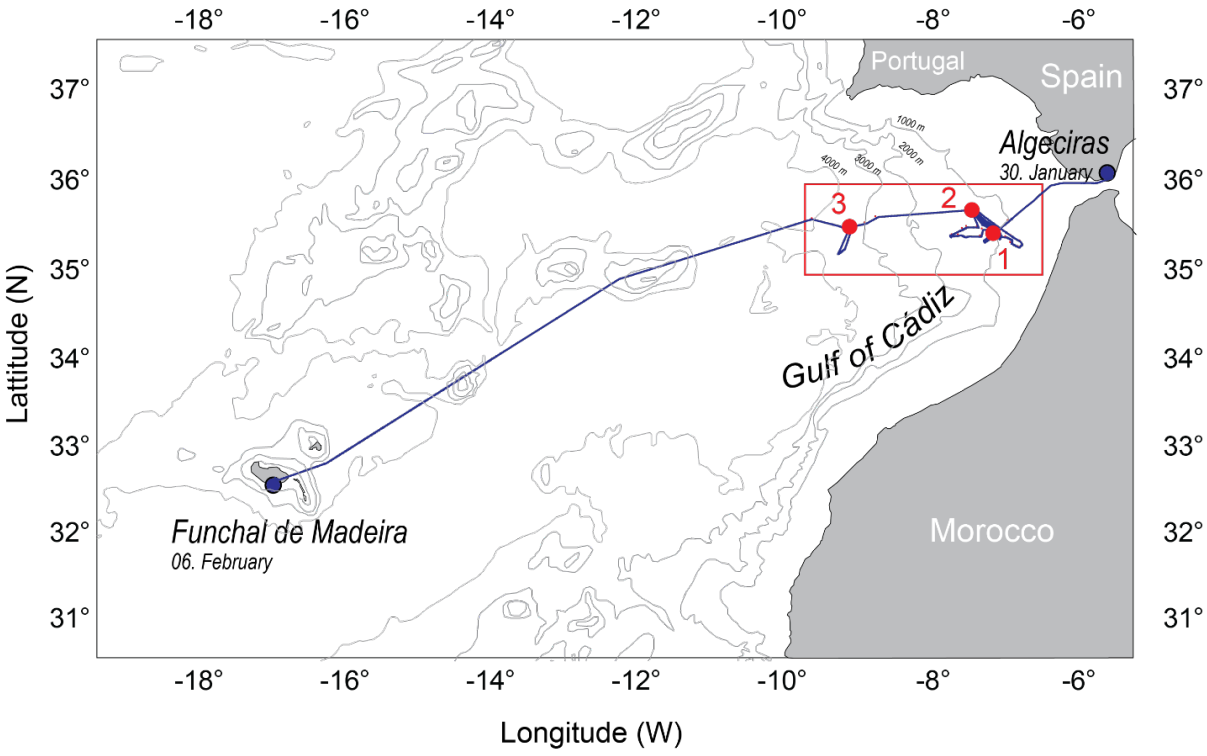

Figure 1: Cruise track R/V MARIA S. MERIAN cruise MSM127. Red box: Working are with the main targets. 1: Al Gacel Mud Volcano, 2: Captain Arutyunov Mud Volcano, 3: Bonjardim Mud Volcano.

Objectives

MSM125 was a short cruise of only four working days to test deep-sea research devices developed at MARUM at the University of Bremen and the Max Planck Institute for Marine Microbiology, Bremen (MPIMM), as part of the Cluster of Excellence "The Ocean Floor - Earth's Uncharted Interface" in in-situ operation so that they can be used in future research expeditions. One of these devices is the In-situ Mass Spectrometer (in-situ MS), which is used with Remotely Operated Vehicles (ROVs) and measures dissolved gases (e.g. CH_4, H_2S, CO_2, O_2) at deep-sea hydrothermal vents and cold seeps at depths of up to 4500 m and temperatures of up to 350°C. The in-situ MS was previously used during the RV METEOR cruise M190 with the ROV MARUM-QUEST. The purpose of this cruise was to test further technical developments and to integrate it as a heavy payload into the much smaller ROV MARUM-SQUID, with which this device can also be used in the future with smaller research vessels that have less capacity, e.g. for deck space, container stowage or accommodation for scientific personnel.

The second device is the Dynamic Autoclave Piston Corer (DAPC), with which the cores of gas-rich sediments can be recovered from the depths under in-situ pressure without suffering a loss of the free gas phase during ascent. Only pressure cores guarantee the exact quantification of dissolved or free gases or gas hydrates in supersaturated deep-sea sediments.

Two other technical tests were planned for the ROV MARUM-SQUID dives: (i) A new senor for fluorescent dissolved organic matter (fDOM) that can be operated with ROVs or CTD/rosette casts was tested in conjunction with the in-situ MS setup, and (ii) a 3D model for the volume of the ROV lights for the quantification and illustration of the light quality distribution on the seafloor.

Finally, a mobile telepresence system developed at MARUM should be tested. The aim is to ultimately obtain transportable and low-cost telepresence e.g. for livestream transmissions of ROV dives without requiring extra personnel.

Narrative

The R/V MARIA S. MERIAN left Algeciras according to plan on the morning of January 30th, 2024. The transit to our working area in the Moroccan EEZ of the Gulf of Cádiz between 35°45‘ N, 008°00‘ W and 35°12‘ N, 006°33‘ W took only a few hours. At 15:30, we stopped north of the Tangier Mud Volcano (MV) and recorded a sound velocity profile in the 800-m deep water column with the first CTD cast. We spent the rest of the day and the following night with bathymetric mapping and subbottom profiling at Al Gacel and the neighboring mud volcanos Tangier, Jesús Baraza, Atlas, Captain Arutyunov, and Student, using the Kongsberg EM122 and PARASOUND P70 echosounders.

On January 31st, the sea state was unfortunately too high for ROV diving. We therefore transited to the Captain Arutyunov MV at 1300 m water depth. We probed

with the gravity corer at two locations on the seafloor that according to our mapping results or information from the literature appeared promising for a deployment of the Dynamic Autoclave Piston Corer. The second gravity core contained traces of gas hydrates and this location was chosen for an initial test of the DAPC in roughly 1320 m water depth. The first deployment of the DAPC was successful: The core was recovered under pressure and it contained gas and gas hydrates. We stayed on the position and continued our work with a CTD cast over Captain Arutyunov MV. The evening and the following night were filled with echosounder mapping across the mud volcanos Shouen, Chueca, El Cid, Madrid, Almanzor, Maimonídes, Yuma, and Ginsberg.

On February 1st the sea state was appropriate for ROV diving at the Al Gacel MV, but a deployment of the ROV MARUM-SQUID in the morning had to be aborted at the sea surface due to a line insulation fault of the vehicle. The second deployment around noon time was successful. This time, however, the communication between the in-situ mass spectrometer (in-situ MS) and the vehicle failed and we aborted the dive after only two hours of bottom time. We decided to continue with DAPC coring and relocated to the Captain Arutyunov MV where we successfully deployed this instrument in the late evening. In the night we resumed mapping the mud volcanos Adamastor, Mercator, Fiuza, Gemini, Pen Duick Ridge, and an unnamed one.

February 2nd started with a regular ROV MARUM-SQUID dive. Due to the technical and weather challenges of the preceding days and an overall short time frame, we had to abandon initial plans for two tests in different water depths, and the decision on a diving location fell again for Al Gacel MV. The technical challenges had been overcome and the tests performed successfully. Traversing the mud volcano from south to north, the dive encountered different environments, such as areas of previous fluid-flow activity as indicated by accumulations of dead mussel shells, active fluid seepage as indicated by small assemblages of living chemosynthetic mussels sitting on carbonate crusts, inactive sediment areas characterized by scattered sponges and corals, and a site with massive bubble emissions on the upper northern flank. After the recovery of the ROV, we relocated once more to Captain Arutyunov MV and dedicated the late evening to another DAPC deployment. In the night, we transited to the Bonjardim MV in 3000 m water depth and passed the two mud volcanoes Olenin and Bamboca.

Station work at Bonjardim started on the morning of February 3rd with a CTD cast on top of the mud volcano and it continued during the day with 3 gravity-corer deployments to probe for a suitable DAPC deployment location. The first deployment of the DAPC was not successful as the instrument was recovered unpressurized. Because the night had already fallen, we continued with mapping three small mud volcanoes south of Bonjardim and resumed DAPC coring with a successful deployment in the early morning hours of February 4th. The station work at Bonjardim ended at 08:00 and we started our transit to Madeira with a small swerve over the Porto Mud Volcano while recording underway echosounder data. We reached our destination Funchal de Madeira on the morning of February 6th, 2024.

Acknowledgements

We are grateful to Captain Soeren Janssen and the extremely supportive crew of R/V MARIA S. MERIAN cruise MSM125, whose competent assistance at all levels helped us to achieve a very successful cruise. Ship time was granted by the German Research Foundation (DFG). DAPC III was designed and developed by Corsyde GmbH, Berlin, Germany, in cooperation with MARUM. Its development was funded by the Bremen Cluster of Excellence EXC 2077/0 “The Ocean Floor - Earth's Uncharted Interface" and the MARUM research group ‘General Geology - Marine Geology’. The development of the in-situ MS and the expedition costs for cruise MSM125 such as transport costs for scientific equipment and samples, daily allowances for the ROV MARUM-SQUID, and travel expenses were also funded by the Cluster of Excellence “The Ocean Floor - Earth's Uncharted Interface" and the Max Planck Society.

Participant List MSM125

1	Borowski, Christian	Biology / Chief Scientist	MPIMM
2	Kleint, Jan	In-situ MS	MARUM
3	Meyer, Volker	In-situ MS	MPIMM
4	Pape, Thomas	DAPC, GC, Geology	MARUM
5	Anders, Erik	DAPC	Corsyde
6	Mai, Hoang Anh	DAPC, GC	MARUM
7	Dehning, Klaus	DAPC, GC	MARUM
8	Henn, Ramona	DAPC, GC	MARUM
9	Malnati, Janice	Gas analysis	MARUM
10	Marcon, Yann	Hydroacoustics	MARUM
11	Römer, Miriam	Hydroacoustics	MARUM
12	Nowald, Nicolas	ROV SQUID	MARUM
13	Schillai, Sophia	ROV SQUID	MARUM
14	Vittori, Vincent	ROV SQUID	MARUM
15	Leymann, Tom	ROV SQUID	MARUM
16	Schiller, Elena	ROV SQUID, Telepresence	MARUM
17	Colaço, Ana	Biology	UAz
18	Reddad, Hanane	Geology, Observer Morocco	UHII

MARUM

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Station List MSM125

Overall Station List

Station No.			Date	Gear	Time	Latitude	Longitude	Water Depth	Remarks
MSM125-	GeoB	ROV#	2024		[UTC]	[°N]	[°W]	[m]	
1 Profiles	--	--	30.01.	EM122, PARASOUND	12:17	35° 55.856	006° 15.590	111	Start Profile
2 CTD	25702-1	--	30.01.	CTD/Rosette	15:51	35° 34.167	006° 46.984	807	Max depth. sound velocity profile
1 Profiles	--	--	30.01.	EM122, PARASOUND	16:44	35° 34.187	006° 46.940	827	Resume profile
1 Profiles	--	--	31.01.	EM122, PARASOUND	06:34	35° 26.625	006° 58.722	856	Resume profile
3 GC	25703-1	--	31.01.	Gravity corer	10:23	35° 39.693	007° 20.005	1321	On ground
4 GC	25704-1	--	31.01.	Gravity corer		35° 39.722	007° 19.987	1323	On ground
5 DAPC	25705-1	--	31.01.	Dynamic Autoclave Piston Corer	12:03	35° 39.722	007° 19.990	1323	On ground
6 CTD	25706-1	--	31.01.	CTD/Rosette	15:23	35° 39.723	007° 19.992	1326	Max depth. sound velocity profile
1 Profiles	--	--	31.01.	EM122, PARASOUND	15:56	35° 39.721	007° 19.982	1327	Resume profile
7 ROV	--	--	01.02.	ROV SQUID	07:40	35° 26.681	006° 58..331	855	Launch ROV
8 ROV	25708-1	87	01.02.	ROV SQUID	10:44	35° 26.684	006° 58.334	853	Launch ROV
1 Profiles	--	--	01.02.	EM122, PARASOUND	15:45	35° 26.642	006° 58.339	835	Resume profile
9 DAPC	25709-1	--	01.02.	Dynamic Autoclave Piston Corer	19:23	35° 39.723	007° 20.003	1324	On ground
1 Profiles	--	--	01.02.	EM122, PARASOUND	20:50	35° 39.726	007° 19.795	1345	Resume profile
1 Profiles	--	--	02.20	EM122, PARASOUND	07:20	35° 26.835	006° 58, 283	849	Resume profile
10 ROV	25710-10	88	02.02.	ROV SQUID	10:25	35° 26.677	006° 58.325	852	Launch ROV
1 Profiles	--	--	02.02.	EM122, PARASOUND	18:06	35° 26.517	006° 58.221	808	Resume profile

Station No. MSM125-	GeoB	ROV#	Date 2024	Gear	Time [UTC]	Latitude [°N]	Longitude [°W]	Water Depth [m]	Remarks
1 Profiles	--	--	02.02.	EM122, PARASOUND	22:30	35° 39.618	007° 19.832	1330	Resume profile
12 CTD	25712-1	--	03.02.	CTD/Rosette	09:23	35° 27.775	009° 00.103	3082	Max depth. sound velocity profile
13 GC	25713-1	--	03.02.	Gravity corer	11:32	35° 27.680	009° 00.055	3061	On ground
14 GC	25714-1	--	03.02.	Gravity corer	13:45	35° 27.650	009° 00.031	3061	On ground
15 GC	25715-1	--	03.02.	Gravity corer	15:52	35° 27.603	008° 59.840	3057	On ground
16 DAPC	25716-1	--	03.02.	Dynamic Autoclave Piston Corer	18:16	35° 27.595	008° 59.842	3058	On ground
1 Profiles	--	--	03.02.	EM122, PARASOUND	20:50	35° 30.890	008° 59.949	3236	Resume profile
17 DAPC	25717-1	--	04.02.	Dynamic Autoclave Piston Corer	06:32	35° 27.595	008° 59.842	3062	On ground
1 Profiles	--	--	04.02.	EM122, PARASOUND, ADCP	08:05	35° 27.823	008° 59.480	3140	Resume profile

Profile Station List

(All profiles were conducted under the station name ‘1 Profiles’; see Overall Station List)

Date / Time	Device*	Lattitude [N]	Longitude [W]	Depth [m]	Course [°]	Comment
30.01.2024 12:17	1, 2	35° 55,856'	006° 15,590'	111	230	Start profile
30.01.2024 15:21	1, 2	35° 34,138'	006° 47,030'	815	9	Intermit profile
30.01.2024 16:44	1, 2	35° 34,187'	006° 46,940'	827	227	Resume profile
31.01.2024 06:34	1, 2	35° 26,625'	006° 58,722'	856	121	Intermit profile
31.01.2024 15:56	1, 2	35° 39,721'	007° 19,982'	1327	86	Resume profile
01.02.2024 06:20	1, 2	35° 27,165'	006° 57,655'	863	256	Intermit profile
01.02.2024 15:45	1, 2	35° 26,642'	006° 58,339'	835	206	Resume profile
01.02.2024 18:12	1, 2	35° 39,072'	007° 19,589'	1420	317	Intermit profile
01.02.2024 20:50	1, 2	35° 39,726'	007° 19,795'	1345	80	Resume profile
02.02.2024 06:25	1, 2	35° 23,982'	006° 56,096'	784	326	Intermit profile
02.02.2024 07:20	1, 2	35° 26,835'	006° 58, 283'	849	259	Resume profile
02.02.2024 09:48	1, 2	35° 26,675'	006° 58,336'	853	1	Intermit profile
02.02.2024 18:06	1, 2	35° 26,526'	006° 58, 226'	809	333	Resume profile
02.02.2024 20:20	1, 2	35° 39,643'	007° 20,102'	1330	350	Intermit profile
02.02.2024 22:30	1, 2	35° 39,618'	007° 19,832'	1330	291	Resume profile
03.02.2024 07:50	1, 2	35° 28,107'	009° 00,446'	3195	183	Intermit profile
03.02.2024 20:50	1, 2	35° 30,890'	008° 59,949'	3236	205	Resume profile
04.02.2024 04:52	1, 2	35° 26, 223'	009° 01,472'	3156	21	Intermit profile
04.02.2024 08:05	1, 2, 3	35° 27,823'	008° 59,480'	3140	315	Resume profile
04.02.2024 10:55	1, 2, 3	35° 33,955'	009° 31,338'	3963	287	Profile end

* Device:
1 = Kongsberg EM122 Deep-Sea Multibeam (no data recorded)
2 = Parasound P70
3= ADCP