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Short Cruise Report
RV MARIA S. MERIAN cruise MSM114

15.01. - 21.01.2023
Las Palmas (Spain) - Mindelo (Cape Verde),
Chief Scientist: Stefan Sommer
Captain: Ralf Schmidt



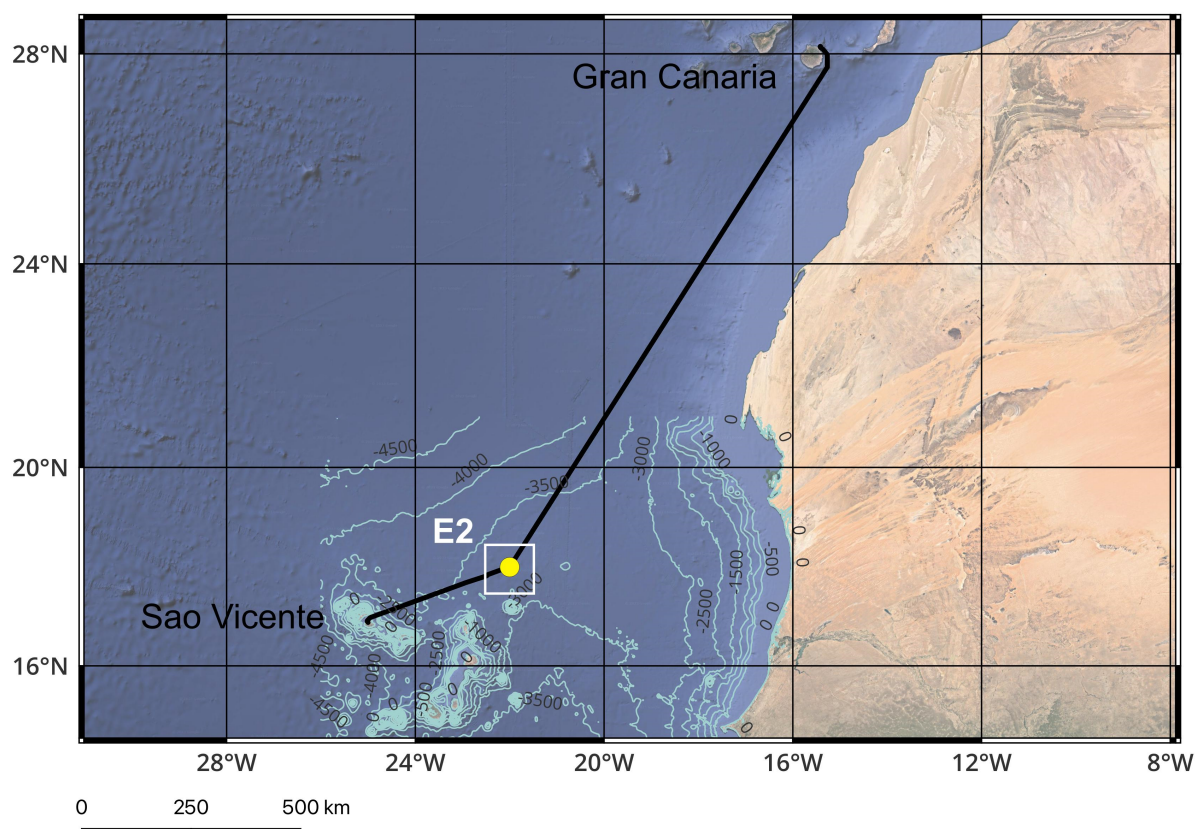
Ship track during RV MARIA S. MERIAN cruise MSM114

Fig. 1a: Ship track (black line) of RV MARIA S. MERIAN cruise MSM114 from Las Palmas (Gran Canaria, Spain) to the working area E2 and to the destination Mindelo (São Vicente, Cape Verde).

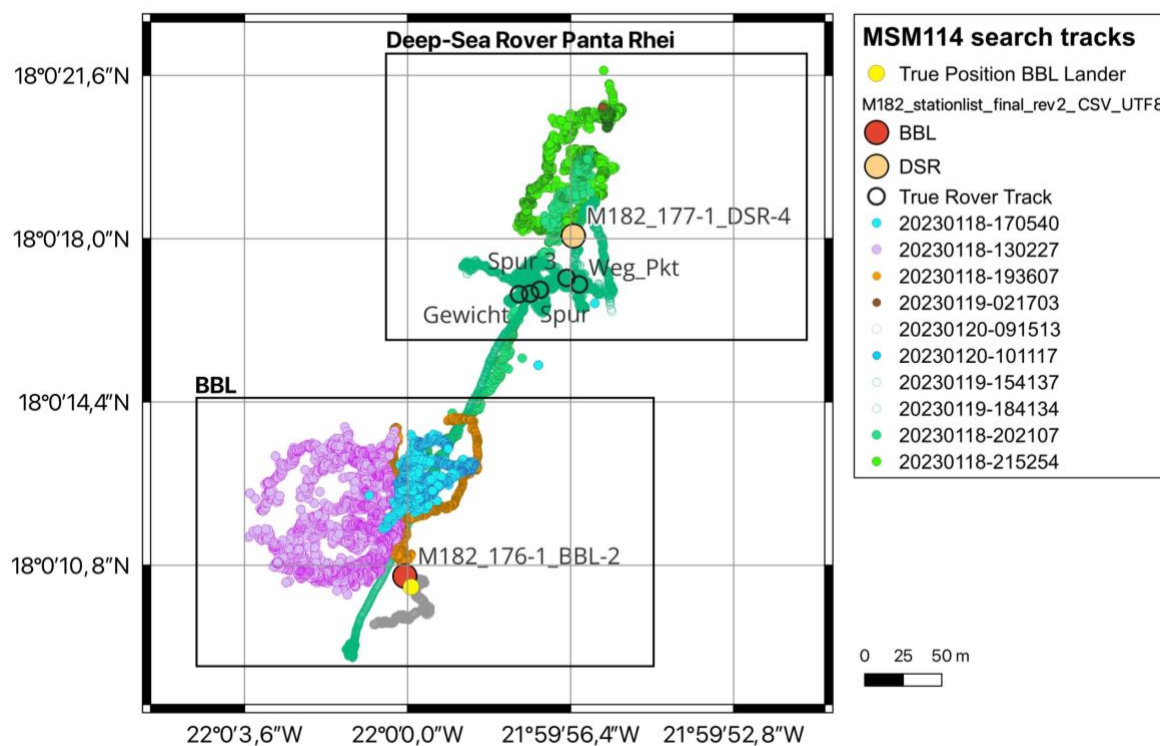


Fig. 1b: Detail of the ship track in the working area E2 for the search of the DOS Lander (BBL) and following the track left by Deep-Sea Rover Panta Rhei at the seafloor.

Objectives

The overarching goal of the RV MARIA S. MERIAN cruise MSM114 to the Cape Verde islands was to obtain a better quantitative understanding of the dynamics of mesoscale eddies with particular focus on CO₂ source/sink mechanisms and the biological carbon pump in eastern boundary upwelling areas as well as their effects to the oligotrophic periphery including the deep-sea floor. By trapping coastal waters of upwelling origin and transporting them westwards into the open ocean, eddies play an important role in the lateral mixing and the transport of physical-biogeochemical properties and thereby modulate biological productivity and material fluxes to the seabed.

Specific aim of the cruise MSM114 was to resolve changes of the organic carbon degradation in deep-sea sediments in relation to the passage of productive eddies at the sea surface. In order to record a time series of benthic oxygen consumption affected by elevated deposition of particulate organic carbon during the passage of an eddy, the Deep-Sea Rover (DSR) Panta Rhei and the stationary lander DOS (Deep Sea Observation System), also known as BBL Lander, (Benthic Boundary Layer Lander) has been placed at the seafloor in a water depth of 3300 m during the RV METEOR Expedition M182 (May/July 2022). The short cruise MSM114 was planned for the recovery of the DSR and the DOS Lander. Another aim was to visually map the section along which the Rover conducted the repeated oxygen flux measurements using the towed camera system OFOS (Ocean Floor Observation System). This cruise concludes the measurement campaigns M156 (July/Aug. 2019), M160 (Nov./Dec. 2019), M182 (May/July 2022), which were conducted within the projects REEBUS and MOSES funded by the Helmholtz Society and the German Ministry for Education and Research.

Narrative

The scientific crew embarked at the RV MARIA S. MERIAN on January 14, 2023 and started to establish the laboratories and to prepare the recovery of the Rover and the DOS Lander. On Sunday, January 15, we left the port of Las Palmas (Gran Canaria, Spain) and headed towards the working area E2 about 160 km northeast to the Cape Verdean island Sal. Due to the bad weather forecast for Thursday, January 19, which was planned for the recovery of the DOS lander and the DSR we decided to directly go to the working area with a slightly faster velocity to arrive at Wednesday, January 18. The scientific team consisted of two technicians, two biogeochemists and two data management persons of GEOMAR as well as three meteorologists, one of them being formerly at the Max-Planck Institute for Meteorology (MPI-M) in Hamburg and the Koninklijk Nederlands Meteorologisch Instituut (KNMI) in De Bilt. For the GEOMAR data management colleagues, this cruise was used as an opportunity to further develop the management of the various scientific devices in cooperation with the crew of RV MARIA S. MERIAN. Their main task was to comprehensively take an inventory of all permanently installed devices on board, to include them in a digital data base and to actualize their metadata. Furthermore, the integration of user specific maps into the internal ship data management system was tested, in order to support scientists with regard to their cruise planning. The aim of the meteorological team was taking air and reference samples for remote sensing using satellites, with particular focus on clouds, aerosols and water vapor. The data management team and the meteorologists were not part of the original participant list formulated in the cruise proposal and joined the cruise shortly before it started.

In the morning of Wednesday, January 18, we started with the recovery of the DOS lander. Yet, even after several trials and using different deck units and hydrophones to release the lander, it didn't respond. Hence, we interrupted the station program and started a search

campaign for the lander using the OFOS, which was equipped with four hooks for the retrieval of the lander, yet the search was not successful.

On Thursday, January 19, at 07:00 LT we started the recovery of the Rover, which was responding immediately. After an ascent to the sea surface of about 2 hours, the Rover was safely recovered back on deck. A brief analysis of the data revealed that over a time period of about three months the Rover was working well and successfully recorded oxygen data, which will allow to calculate a time series of the total benthic oxygen respiration rates. From the oxygen consumption, the organic carbon degradation of the deep-sea benthic community can be calculated, which ultimately depends on the deposition of organic carbon exported from the sunlit surface ocean to the deep-sea floor. We hope this unique data set will contribute to better understand and quantify the coupling of the benthic deep-sea ecosystem with processes at the surface ocean. During its deployment, the Rover covered a distance of about 43 m and performed 76 flux measurements in specially designed flux chambers located at the front of the Rover. After the recovery of the Rover, we mapped its tracks in order to relate the flux measurements to specific biological features such as worm holes, mounds or feeding tracks on the sediment surface. For the night hours we planned to continue our search for the lander. However due to a defect glass fiber connection between the ship and the OFOS this search survey was postponed for Friday morning.

At Friday morning, January 20, at 06:00 we continued with our OFOS search for the DOS lander. Due to our experience with the mapping of the rover track in relation to the ship and USBL position, we were able to strongly improve our search strategy and after two hours we found the ballast weights of the DOS lander. Apparently, the lander became detached from the ballast weights and got lost. Despite this unfortunate loss, we obtained a unique data set to better understand organic matter turnover of the deep-sea benthic ecosystem. At midday we concluded the scientific work program and headed towards Mindelo, Cape Verde arriving at Saturday, January 21, where we were allowed to stay one night at the pier for unloading the ship, after a brief time period being on roadstead, despite the harbor was full due to The Ocean Race 2023. On Sunday morning, January 22, we had a brief reception of the Cabo Verdean Minister of the Sea, two participants of the racing yacht team Malizia (The Ocean Race 2023) as well as the directors of GEOMAR Prof. Dr. Katja Matthes and Frank Spiekermann accompanied by Prof. Dr. Arne Körzinger, Cordula Zenk and Dr. Björn Fiedler. At 11:30, after a short introduction of the visitors to the Deep-Sea Rover Panta Rhei by Stefan Sommer, the GEOMAR scientific team of MSM114 disembarked RV MARIA S. MERIAN.

Acknowledgements

We very much thank Captain Ralf Schmidt, the officers and the entire crew of RV MARIA S. MERIAN for their excellent and professional support. The friendly atmosphere aboard is greatly acknowledged. We very much thank the Instituto Marítimo Português-IMP (Cabo Verde) for their support and the allowance to conduct research in Cape Verdian waters. We very much like to acknowledge the support of the German Ministry of Foreign Affairs. We further like to express our gratitude to the Review Panel German Research Vessels (GPF) and the German Research Fleet Coordination Centre (Universität Hamburg) for their help and support. The ship time of RV MARIA S. MERIAN and financial support for the logistics of the cruise was kindly provided by the German Research Foundation (DFG). The project REEBUS is funded by the German Federal Ministry for Education and Research (BMBF).

Participants

	Name	Discipline	Institution
1.	Sommer, Stefan	PI, Rover, Biogeochemistry	GEOMAR
2.	Dale, Andrew	Biogeochemistry	GEOMAR
3.	Tuinder, Olaf N. Eric	Meteorology	KNMI
4.	Glemser, Barbara	Data management	GEOMAR
5.	Kinne, Stefan	Meteorology	formerly MPI-M
6.	Petersen, Asmus	Rover/ Lander Mechanics	GEOMAR
7.	Sarpe, Dirk	Data management	GEOMAR
8.	Stammes, Pieter	Meteorology	KNMI
9.	Türk, Matthias	Rover/ Lander electronics	GEOMAR

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KNMI Koninklijk Nederlands Meteorologisch Instituut, Uterchtseweg 297, NL-3731 GA De Bilt, Netherlands

MPI-M Max – Planck – Institut für Meteorologie, Bundesstr. 53, 20146 Hamburg

Station List

Station #	Date-Time 2023	Device	Latitude N	Longitude W	Depth (m)	Remarks
MSM114_1-1	18.01. 08:00	DOS	18° 00,143'	022° 00,127'	3294	Recovery failed
MSM114_1-2	18.01. 11:43	OFOS #1	18° 00,234'	022° 00,066'	3300	DOS search ¹
MSM114_1-2	19.01. 01:02	OFOS #1	18° 00,365'	021° 59,940'	3296	DOS search, finished
MSM114_2-1	19.01. 07:58	DSR #4 *	18° 00,348'	021° 59,965'	3296	Recovery DSR,
MSM114_3-1	19.01. 12:53	OFOS #2	18° 00,295'	021° 59,957'	3296	Track survey DSR ¹
MSM114_3-1	19.01. 20:27	OFOS #2	18° 00,160'	022° 00,022'	3294	Track survey finished
MSM114_4-1	20.01. 07:08	OFOS #3	18° 00,171'	022° 00,020'	3294	Search DOS ballast ¹
MSM114_4-1	20.01. 10:45	OFOS #3	18° 00,179'	022° 00,006'	3294	Ballast weights found
MSM114_4-1	20.01. 12:35	OFOS #3	18° 00,186'	022° 00,007'	3294	OFOS finished

¹ Sonaryne USBL SL5m

Abbreviations of the different gears/Measured parameters

DOS: Deep-Sea Observation lander

DSR: Deep-Sea Rover Panta Rhei

OFOS: Ocean Floor Observation System