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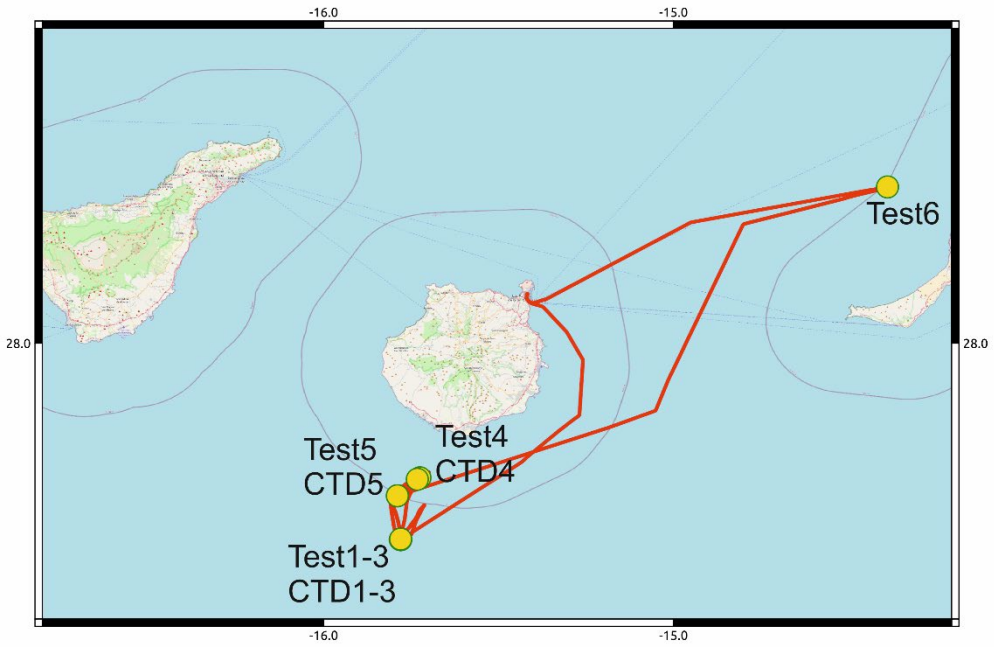
Short Cruise Report
R/V MARIA S. MERIAN
Cruise MSM127-1

Las Palmas – Las Palmas
March 08, 2024 – March 13, 2024
Chief Scientist: Tim Freudenthal
Captain: Ralf Peters



Map (open street map) of test area including cruise track (red) and locations of cable tests and CTD deployments (yellow)

Objectives

The deployment depth of heavy scientific gear – like the sea floor drill rigs MARUM-MeBo70 and MARUM-MeBo200 – is limited by the weight and strength of the steel-reinforced cable that is used to lift the underwater robot to and from the sea bed. The tensile strength of the so-called umbilical must not only be appropriate for the weight of the payload. The cable's own weight adds to the deployment loads. With increasing operation depth, more cable weight has to be accounted for.
In order to reduce the dead weight of the umbilical the Prysmian / Norddeutsche Seekabelwerke GmbH has developed a new concept of a hybrid armoured cable containing both aramide fibres and steel wires. The main objective of the MSM127-1 research expedition was to test this new type of cable design in order to prove the suitability and advantages of the hybrid umbilical for deep-sea research. Especially the torsional behavior at different load conditions, the elastic behaviour, non-linear couplings with ship movements and the resistance to so-called snap loads (short-term relief of the umbilical) were to be tested with long cable lengths under dynamic conditions at sea. The test results will be used for developing a concept to increase the possible deployment depth of the MeBo-systems from presently 2000 to 2700 m to more than 3500 m water depth.
The times between the umbilical tests were to be used for recording the accelaration signature of closing Niskin bottles on a CTD-rosette with an accelerometer. These recordings will be used for the development of a new type of bacteria sampler that is triggered by the closing signature in order to use the low-current conditions within the closed Niskin bottle.

Narrative

The hybrid umbilical to be tested was manufactured by NSW according to the specifications of the MeBo70 umbilical. In preparation of the expedition it was spooled onto the MeBo70-winch. A test frame with a weight of 6 tons manufactured complying the dimensions of the MeBo70 drill rig was equipped by MARUM with an energy distribution and telemetry system and several cameras, lights and sensors for monitoring depth and motions of the frame during the tests. Additional steel plates were manufactured that can be used to increase the test weight to 12 tons. In addition to umbilical and test frame, existing infrastructure belonging to the MeBo70-system of the MARUM Centre for Marine Environmental Research at the University of Bremen was used for the tests. Altogether the required equipment was shipped with six 20'containers to the port of Las Palmas, the start and end of expedition MSM127-1.

The mobilization of the equipment on the research vessel MARIA S. MERIAN started on the 4th of March 2024, and took four days. Mobilization included the assembly of the Launch and Recovery System (LARS) that is required for a safe deployment and recovery of the test frame. The winch was installed and connected to the vessel's power supply. The mechanical termination as well as fiber optic and electric termination of the hybrid umbilical was prepared before connecting the test frame to the system including MeBo70 control cabin and high voltage (1200 V for control power and 3000 V for the MeBo70 power packs) power cabinet. In addition, the MeBo70 workshop container and drill tool container were mounted on the working deck of RV MARIA S. MERIAN. The overboard sheave with 1.4 m wheel diameter was mounted on the A-frame of the vessel and the umbilical was inserted onto the sheave. After finishing the installation, the deployment and recovery of the test frame with the LARS was tested in the harbor and a first lifting test for the termination was conducted on the afternoon of the 7th of March.

In the morning of 8th of March we left the port at 8:30 am local time. The initial plan was to conduct the umbilical tests in an area located to the northeast of the Canary Islands at the Moroccan continental slope. Working in this area would have allowed to conduct multibeam mapping during night times, while the umbilical tests required daylight for the visual inspection of the umbilical armouring. However, wave heights of 3 – 4 m were predicted for that area. Since these conditions were too rough for a safe deployment of the heavy test frame and since we were still waiting for a research permit in Moroccan territory, we decided to test at an alternative site south of Gran Canaria – at the Lee side of the Canary Islands. We arrived at our test area south of Gran Canaria in the early afternoon where we experienced good weather conditions with wave heights of 1 – 2 m during the entire expedition.

We deployed the CTD rosette (CTD1) down to 2725 m water depth and did first recordings of the accelaration signature of closing Niskin bottles. Water samples were collected for comparison of the isotopic signature with deep ground water at the Moroccan coastal region - a project by the Moroccan observer. Afterwards we had a first deployment of the 6-tonnes test frame with the hybrid umbilical (Test1) down to 484 m water depth. By this one-and-a-half-hour short deployment we were able to successfully prove the functionality of the sensors, the energy distribution system and the pressure compensation for the electronic system at depth.

We started the next morning with a 2228 m deep deployment of the 6-tonnes test frame (Test2). The main aim was to increase the tension of the umbilical spooled on the drum before testing its deployment with maximum load. During hoisting the winch was stopped

each 250 m for a while in order to monitor the direct response to ship motions at different cable lengths. After a deployment time of 7 hours the test frame was recovered and we started with a second CTD (CTD2) in order collect additional recordings of the accelaration signature of closing Niskin bottles.

On the morning of 10th March, the third umbilical test was started. After adding steel plates, the previous test was repeated with the 12-tonnes test frame (Test3). After a deployment time of six and a half hours the test frame was recovered safely and another CTD profile (CTD3) was collected.

During the night we went to another test location with a water depth of roughly 1000 m and with gentle slope conditions according to the bathymetric map provided by our colleague Prof. Dr. Sebastian Krastel. The next morning, we deployed the 12-tonnes test frame for the next umbilical test (Test4). We added floats and two accelerometers to the first 90 m of the hybrid umbilical required for building up and monitoring a catenary. Afterwards we lowered the test frame onto the sea bed. Landing on the sea bed and lifting it again into the water column are critical moments for the integrity of the umbilical. With the drop of the tension during touch down the internal torque within the umbilical changes while the frame no longer can rotate in order to adjust. With slack in the cable, that is required for decoupling the frame from the ships motion, there is a risk of formation of loops in the umbilical. When lifting the frame from the sea bed, the tightening of a loop can result in a damage of the umbilical. Especially when lifting from muddy sediments, the suction of the sediment may result in a snap load with immediate relaxation as soon as the frame is lifted from the sea bed. During Test4 we landed three times in water depths of about 1100 m on the sea bed. The video cameras showed that the frame was set on hard ground, presumably volcanic rocks. No snap loads or indications of cable looping were observed. Visual inspection of the umbilical during recovery showed no abnormalities. After 7 hours of test duration another CTD was deployed. This time we collected again water samples in addition to the usual acceleration recordings.

The next morning the previous test was repeated at a location nearby in about 1900 m water depth (Test5). During this test we landed 2 times on the sea floor, that was covered by sediment. In both cases a snap load (215 kN maximum tension measured at the winch compared to an average tension of about 155 ± 15 kN when hanging above the sea bed) occurred, that did not have an impact on energy and data transmission through the umbilical. During recovery, we observed slight irregularities of the outer steel armour above the termination up to a cable length of about 70 m. After recovery we decided to unspool the critical section and to reorder the steel wires before preparing for a last umbilical test deployment. In the evening another CTD profile (CTD5) was collected. During the night we transited to another test site located west of the island Fuerteventura.

In the morning of 13th of March we started the last deployment of the 12-tonnes test frame. The test frame was lowered to about 200 m water depths and lifted again to sea surface in order to check the stability of the outer armour wiring that was adjusted the last day. Since no irregularities were observed, we attached floats and accelerometers to the first 90 m of the umbilical and lowered the test frame to the sea bed. The frame was landed two times on sediment in approx. 1900 m water depth. No snap loads were observed during lifting from the sea bed. Visual inspection of the umbilical during recovery showed that the armour was in good condition.

At about 2 pm station work was finished and RV MARIA S. MERIAN went back to the port of Las Palmas where expedition MSM127-1 ended in the evening of 13th March 2024.

Acknowledgements

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Participants list

1.	Tim Freudenthal	Fahrtleiter / *Chief Scientist*	MARUM
2.	Markus Bergenthal	MeBo70 Cable Test	MARUM
3.	Andreas Briese	Documentation	Journalist
4.	Christian Engler	MeBo70 Cable Test /CTD	MARUM/ETHZ
5.	Siefke Fröhlich	MeBo70 Cable Test	MARUM
6.	Mohammed Hssaioune	Observer Morocco	
7.	Barannya Kakaty	CTD	MARUM
8.	Erik Linowski	MeBo70 Cable Test	MARUM
9.	Guido Lünnemann	MeBo70 Cable Test	NSW
10.	Jens Renken	MeBo70 Cable Test	MARUM
11.	Michael Reuter	MeBo70 Cable Test	MARUM
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Station list

GeoB Nr.: Curation number of the MARUM core repository
Gear Abbreviations: CTD = Conductivity-temperature.density sensor and water sampler; MeBo = Test of hybrid armoured umbilical for the sea floor drill rig MARUM-MeBo70

GeoB Nr.	Gear	Date	Time (UTC)	Latitude (N)	Longitude (W)	Rope length (m)	Remarks
25901-1	CTD1	8.3.2024	14:09	27° 26,338'	15° 46,862'	2725	
25902-1	MeBo Test1	8.3.2024	17:24	27° 26,352'	15° 46,805'		start
			18:23	27° 26,351'	15° 46,806'	484	Max depth
			18:51	27° 26,352'	15° 46,805'		end
25903-1	MeBo Test2	9.3.2024	08:37	27° 26,327'	15° 46,777'		start
			11:15	27° 26,327'	15° 46,778'	2228	Max depth
			15:39	27° 26,355'	15° 46,810'		end
25904-1	CTD2	9.3.2024	17:32	27° 26,355'	15° 46,811'	2713	
25905-1	MeBo Test3	10.3.2024	08:54	27° 26,372'	15° 46,792'		start
			10:59	27° 26,372'	15° 46,792'	2251	Max depth
			16:18	27° 26,426'	15° 46,801'		end
25906-1	CTD3	10.3.2024	17:27	27° 26,427'	15° 46,800'	2696	
25907-1	MeBo Test4	11.3.2024	08:44	27° 36,922'	15° 43,482'		start
			10:21	27° 36,929'	15° 43,494'	1123	Landing 1
			11:03	27° 36,917'	15° 43,489'	1124	Landing 2
			13:59	27° 36,701'	15° 43,941'	1111	Landing 3
			15:44	27° 36,686'	15° 43,939'		end
25908-1	CTD4	11.3.2024	17:04	27° 36,686'	15° 43,939'	1069	
25909-1	MeBo Test5	12.3.2024	08:23	27° 33,848'	15° 47,369'		start
			10:23	27° 33,850'	15° 47,369'	1896	Landing 1
			11:14	27° 33,853'	15° 47,358'	1896	Landing 2
			14:17	27° 33,853'	15° 47,359'		end
25910-1	CTD5	12.3.2024	17:22	27° 33,853'	15° 47,359'	1841	
25911-1	MeBo Test6	13.3.2024	08:48	28° 26,812'	14° 23,271'		start
			11:08	28° 26,812'	14° 23,270'	1881	Landing 1
			11:27	28° 26,820'	14° 23,280'	1884	Landing 2
			13:34	28° 26,835'	14° 23,299'		end