RV Meteor | Expedition M205 "RUBBLE"

Las Palmas de Gran Canaria – Fortaleza

04.11.2024 – 10.11.2024

3rd Weekly Report (04.11.2024 — 10.11.2024)

Short Summary Sampling Areas SA2 and SA3

In the third week of the RUBBLE expedition M205, the revision of the station planning was finalised, taking into account the local bathymetric and weather conditions for the entire expedition (**Figure 1**). The station work in the sampling areas SA2 and SA3 was finalised and the transit to SA4 was carried out (**Figure 1**). Area SA2 (**Figure 2**) included 2 successful OFOS deployments, multiple sampling of pelagic *Sargassum*, several plankton samples collected, 5 successful BC deployments (out of a total of 12 deployments), two successful MUC deployments, 2 successful EBS deployments, 5 successful drone flights. Work on SA2 was completed on 05/11/2024 around 13:45 UTC. Several BC missions were unsuccessful. In some cases, the device returned in a cocked state (not triggered), in others the BC was triggered but empty. After numerous attempts to obtain at least three BC samples, the SA2-B sampling site was ultimately completed unfinished, as a solution to the problems had to be sought first and the schedule should not be jeopardised.

In area SA3, an identical equipment sequence was planned and deployed almost unchanged. In this area, 2 successful OFOS deployments, another sampling of the pelagic *Sargassum*, several plankton hauls, 6 successful BC deployments (out of a total of 11 deployments), two successful MUC deployments, 2 successful EBS deployments and 6 successful drone flights were carried out. Work on SA3 was completed on 9 November 2024 at around 21:30 UTC. Despite numerous attempts to rectify the numerous failures of the BC by partially replacing components or varying the mission protocol, there was once again a sobering number of failures, meaning that extensive repairs ultimately had to be carried out. Nevertheless, the SA2 and SA3 areas were overall successes.

In the area of public relations, 3 posts and 2 stories were published on Instagram in the past week. In addition, there was a live broadcast at the annual celebration of the Academy of Sciences and Literature in Mainz and interactions with visitors to the Senckenberg Museum in Frankfurt.

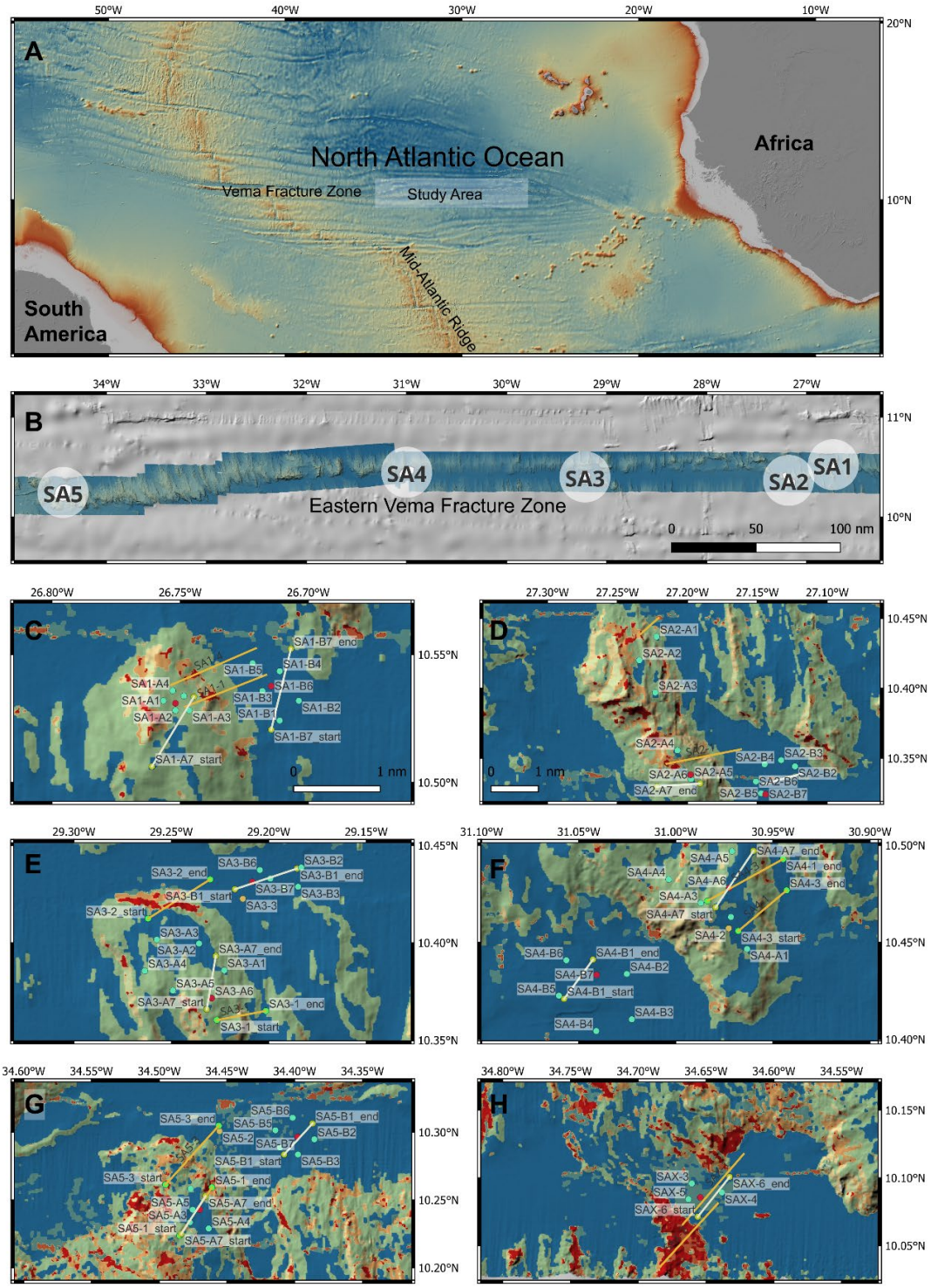

Figure 1. Sampling areas of the 205th voyage of the research vessel METEOR. A. *Overview map of the tropical North Atlantic with highlighted target area of the expedition with relief based on GEBCO.* ***B.*** *Eastern Vema Fracture Zone with the 5 sampling areas SA1–SA5. The bathymetry data obtained during the RV SONNE expedition SO237 are shown in colour, outside areas are based on GEBCO and shown in greyscale.* ***C-H.*** *The RUBBLE sampling areas. The coloured seabed shows the distribution of different habitats (modified after Riehl et al., 2020). Due to their surface roughness and hardness, represented by yellow-red tones, mountains and hills (Sites A) on the seabed have a high potential for rocky habitats. They are more or less surrounded and separated by shallow sediment plains (Sites B).* ***C.*** *Sampling area SA1.* ***D.*** *Sampling Area SA2.* ***E.*** *Sampling Area SA3.* ***F.*** *Sampling Area SA4.* ***G.*** *Sampling Area SA5.* ***H.*** *Extra Sampling Area SAX. Map: Dr Torben Riehl, SENCKENBERG, chief scientist M205.*

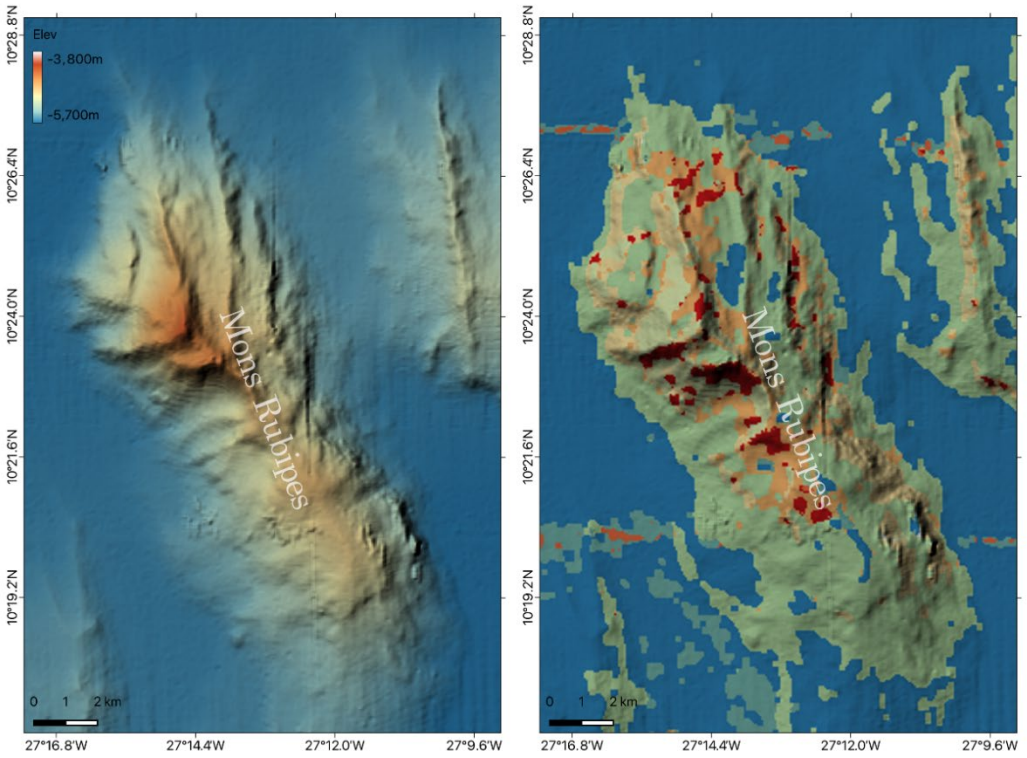

Figure 2. The deep-sea mountain Mons Rubipes at sampling area SA2: *Bathymetric relief map (left) and choropleth map of the habitat distribution (hard substrate potential according to Riehl et al. (2020); right). The Seeberg is a basaltic abyssal hill with an extension of 18.3 km in north-south direction and 12.3 km in east-west direction. Its axis is orientated NNW. The highest elevation is in the north-western part of the massif at 10° 23.7941' N, 27° 14.5946' W and with a sea depth of 4234 m approx. 1478 m above the deepest surrounding seabed at 5712 m. Maps: Dr Nico Augustin, GEOMAR.*

Narrative SA2

The work in the SA2 (**Figure 2**) sampling area was characterised by a series of unsuccessful BC operations. On several occasions, the ship's wire was wrapped around the BC, causing damage to the release and tensioning mechanism as well as the wire rope. Even after replacing the BC wire rope with a new replacement rope, the BC deployment remained problematic.

In the SA2-B area, there was a whole series of unsuccessful BC (**Figure 3**) deployments in which the device returned to the surface without sediment. Possible causes discussed included the movement of the ship due to the weather, the nature of the sediment, the device deployment protocol and a persistent technical defect. A sub-optimal condition of the replacement rope was also discussed as a cause. Unfortunately, no clear cause could ultimately be identified. After four out of five missions were unsuccessful, it was decided on 4 November 2024 to continue with MUC and MB surveys first to give the BC team a necessary break before continuing with BC missions at 06:00 on 5 November 2024.

Figure 3. Box Corer (BC) deployment from RV METEOR during its 205th voyage, the "RUBBLE" expedition.

The BC on St. SA2-B5, which was launched shortly after 6 a.m. on 5 November, came back on deck at around 09:06 and this time brought a sediment sample from the deep sea. In close and exemplary co-operation between scientists, technicians and crew, every effort was made to adapt the sampling and recovery of the sample to the sea state and the relatively strong rolling motion of the ship. However, the sediment core contained in the box was strangely deformed or incomplete and only filled about 2/3 of the surface of the box - an occurrence that could not be conclusively explained.

The unsuccessful deployments of the previous day also remained largely unexplained. A detailed inspection of the BC and a check of its release mechanism revealed no anomalies. For this reason, the system was moved to St. SA2-B6 and the BC was operated again with an identical protocol. To enable the data to be analysed statistically, at least three good samples must be available from each sampling site.

However, as none of the deployments then carried out were 100% successful, the station work in this area was ultimately cancelled incompletely. After 18 hours of bathymetric mapping, we finally reached the coordinates of SA3 on 6 November 2024 at 7 a.m. shipboard time, where two OFOS deployments were initially planned.

Narrative SA3

In the early morning of 6 November 2024, we reached the first station of sampling area SA3. The OFOS went into the water at around 07:20 board time. With a wind force of 5 Bft, 2 m swell from the northeast and 1 m swell from the southeast, a relatively strong rolling motion of the METEOR made the OFOS survey difficult. Nevertheless, the St. SA3-1 was the first perfect OFOS deployment in which, in addition to the standard OFOS cameras, two experimental cameras developed in-house also worked as planned. The experience gained during the previous missions enabled Linus Budke and his team (Pedro Martínez Arbizu, Mats Henseler and Nico Augustin) to obtain high-quality photo and video data from the seabed using four cameras. For the first time, an experimental camera system developed by Pedro Martínez, which uses a glass sphere instead of a metal pressure housing, also delivered high-quality image data (**Figure 4**). If the system works reliably from now on, it would be a suitable prototype for a cost-effective alternative to conventional systems that use much more expensive metal housings.

In the sampling sites SA3-A and SA3-B, the BC also failed to trigger several times or triggered but was not filled with sediment. At SA3-A, in the heterogeneous deep-sea hill country, the BC initially worked perfectly again. As the guide cable was replaced again in addition to the relocation of the deployment area, no conclusive statement can be made about the causes of the numerous failed BC deployments in the previous sampling area. Nevertheless, the deployments were not without problems: SA3-A2 again suffered a crack on the box of the BC, so that the METEOR's deck fitter had to be asked for help with the repair. On SA3-A3, the BC came back from the depths empty - apparently because it was set down on uneven terrain and slipped when it was released.

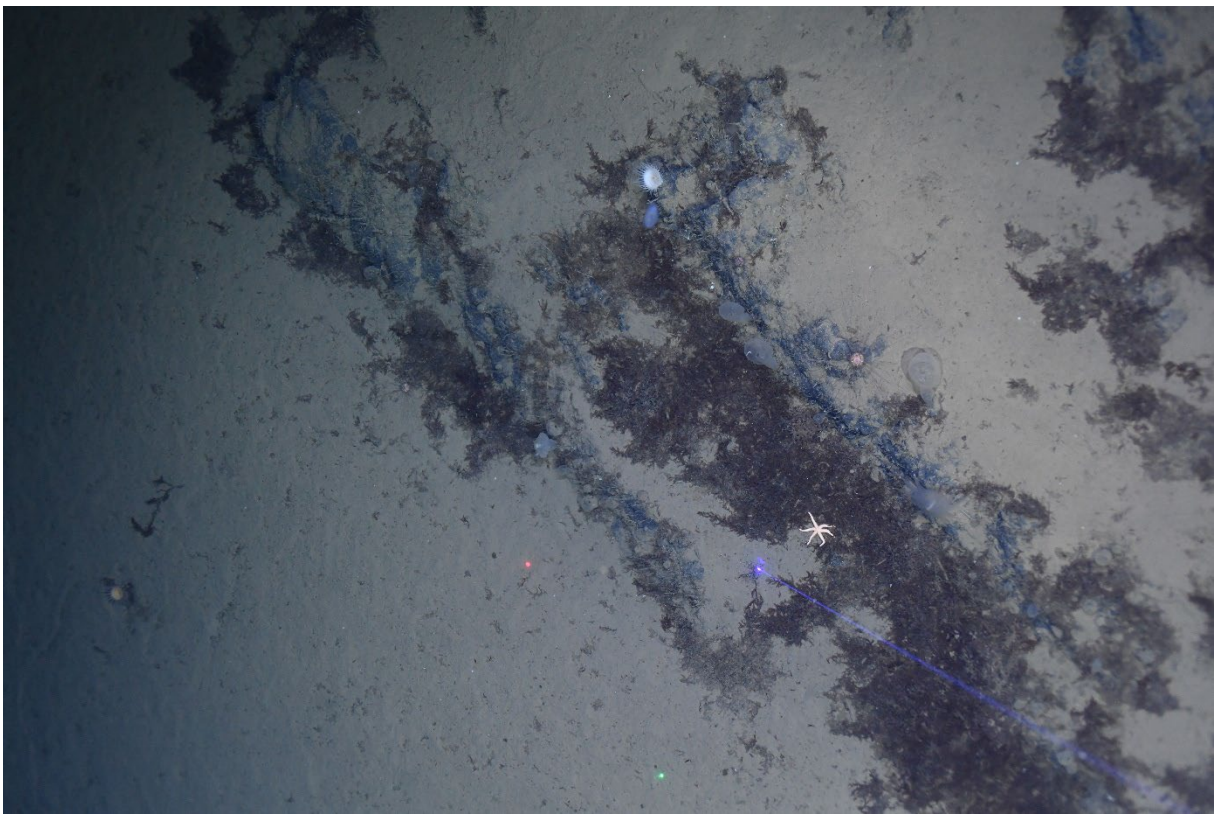

Figure 4. Rock reef in the abyssal of the Vema Fracture Zone at station SA3-1. *Terraced rock, probably basalt covered with a manganese crust. Numerous organisms can be seen colonising the hard substrate, including sea squirts, anemones and carnivorous sponges. In addition, a relatively abundant vagile fauna can be recognised, for example starfish, sea cucumbers and numerous traces of life. Sargassum has accumulated in the current-calmed areas. Figure: Pedro Martínez Arbizu & Linus Budke, SENCKENBERG.*

After St. SA3-A4 and SA3-A5 were successful, the first deployment in SA3-B (St. SA3-B2) again resulted in a loop forming in the ship's wire, which affected the BC's suspension and release mechanism. At about 00:00 h shipboard time on 9 November 2024, the BC came back on deck entangled in the wire, triggered but not closed, with damage to several relevant components of the tensioning mechanism. The deployment of the MUC was brought forward in order to gain time for a preliminary repair by the responsible scientists. After a perfect MUC returned to deck at 04:00 on 9 November 2024 (20 cores with an undamaged surface), the provisionally repaired BC was deployed again and returned on board at around 07:45 — again triggered but not closed.

The research work with the BC was then interrupted for its fundamental repair. The entire upper part of the release mechanism, including the wire, was removed and partly replaced and partly repaired by the deck fitter and bosun. After the speedy repair, a dry test was first carried out on deck. Once this had been successfully completed and there was no longer any obvious damage to the BC, it could be used again at around 10.30 a.m. shipboard time. To everyone's relief, the first BC deployment after its major overhaul (SA3-B4 rep), from 10:30 to 13:20 on 9 November 2024, was successful. After another inexplicably unsuccessful St. SA3-B5, the next BC, and thus the last deployment in the SA3 sampling

area, SA3-B6, was a success to everyone's relief and thus the target for the third sampling area was met.

Compared to the original station plan, a time delay of approx. 6 hours has now accumulated due to failed deployments and repairs, which must be compensated for by cutting back on the station planning for the following sampling areas. During the repair period, benthos samples continued to be sorted and a new collection method for Saharan dust was tested using a drone-mounted sticky trap at altitudes of up to 400 metres.

As far as long-term planning is concerned, it is planned in consultation with the scientists on board to use the entire repertoire of research equipment in at least 5 sampling areas, so that the originally planned sixth sampling area (SAX, **Figure 1**) serves as a time buffer to compensate for unexpected time delays.

In focus: public engagement and outreach

Modern science communication and science-focussed outreach have recognised that communicating dry and overly detailed content is hardly successful, as it quickly overwhelms the often non-specialist audience. Previous communication strategies for expeditions relied on blogs, dedicated websites and dedicated social media channels, which could only attract a very small readership. For this expedition, we have therefore decided to focus the communication of digital content mainly on Instagram, using existing channels (@oceanspecies, @senckenbergworld). Long-lasting posts on Instagram consist of images and videos that present research work (equipment, scientists, goals, initial results). Short-lived stories report on everyday life on board (leisure activities, highs and lows, crew members, work areas on the ship). The tone used in the stories is humorous, but remains fact-orientated. The posts convey more complicated content using open and inviting language.

At the same time, an exhibition corner was created in the Senckenberg Nature Museum to report on this expedition. Visitors can also leave their questions there, which we will then answer live from on board. This will be done in writing and we are currently working on a circuit for a live interview.

Abbreviations

ABBREVIATION (ENGL)	TERM (ENGL)	ABBREVIATION (GER)	TERM (GER)
EBS	Epibenhic Sledge	EBS	Epibenthosschlitten
BC	Box Corer	GKG	Großkastengreifer
MB	EM122 Multibeam	MB	EM122 Fächerecholot
MUC	Multicorer	MUC	Multicorer
OFOS	Ocean-Floor Observation System	OFOS	Tiefsee-Kamerasystem
SA	Sampling Area	SA	Probenahmegebiet
ST	Station	St	Station
VFZ	Vema Fracture Zone	VFZ	Vema-Bruchzone

Acknowledgements

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References

Riehl T, Wölfl A-C, Augustin N, Brandt A, Devey CW (2020) Discovery of widely available abyssal rock patches prompts rethinking origins of deep-sea biodiversity. Proceedings of the National Academy of Science 117: 15450–15459. https://doi.org/10.1073/pnas.1920706117

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