4th Weekly Report M209 Mindelo - Ponta Delgada 07.04. - 13.04.2025



During M209 we aim to perform similar stations and instrument deployments to make a comparable dataset, and to identify potential differences or similarities between the island slopes, and the water column above it. This week included 4 working days off the island of Fogo and 3 working days off Santiago. The pelagic ROV dives off Fogo were impressive with cephalopods of the family Mastigoteutidae and two encounters of cirrate octopods. We also observed a vampire squid *Vampyroteuthis infernalis*. The pelagic ROV dives also allowed the sampling of delicate gelatinous fauna which will serve our diversity and foodweb studies.



Figure 1: The vampire squid Vampyroteuthis infernalis, as observed in situ by ROV KIEL 6000 off Fogo.

During the benthic ROV dives off Fogo we observed biological zonations with indicator species such as the pencil sea urchin marking the 800 and 900 m depth contour. Also two species of tripod fishes were encountered, each with their own depth distribution. The Fogo slope was characterized by high sedimentation, steep slopes, fine grained sediment and steep ridges. We performed three XOFOS transects, one following the slope of the CTD stations where we collect eDNA. Two other XOFOS dives provided crucial baseline data for the management of marine ecosystems in the Fogo region. One of these was done off the coast of Sao Filippe and revealed an area with significant marine pollution, with visible trash in the deep waters. This site also showed low biodiversity of species. These findings will be important for informing management of waster runoff in Fogo particularly during the rainy season. In contrast, the XOFOS survey in water around Brava on April 10 revealed a pristine location that was rich in biodiversity. The images documented a wide variety of corals, sponges, and fish species. This was the first baseline data of an underwater survey available in that region. This data will be important to add to the proposal that is being prepared and coordinated by Projecto Vito to protect this specific area.

In the night of 10.4. we transited to Santiago and performed multibeam surveys to create detailed seafloor maps for the ROV benthic dives. We deployed the ROV on the morning of 11.4., performed photographic surveys, also to make photomosaic reconstructions, and we collected coral samples for foodweb studies as well as specific crustaceans for biodiversity studies.

The following day was a special day for the RV METEOR and team M209. The president of Cabo Verde, His Excellency José Maria Neves and Minister of the Sea Mr. Jorge Santos visited the RV METEOR, together with a delegation and a group of journalists. Together with the officers and GEOMAR staff we prepared a program that started with a visit to the bridge, where we watched the launch of the ROV together. After the bridge visit, METEOR officers guided us on a tour to the different parts of RV METEOR including mapping room and hospital. We ended in the ship's mess where we had a joint lunch with the whole scientific team and the delegation. During a meeting in the conference room, both Cabo Verde scientists and the chief scientist presented the cruise objectives and first results. The presentations were followed by a discussion with the President and Minister of the Sea, and important topics were covered including marine conservation, exchange of data and information and collaboration between Germany and Cabo Verde in marine

science. After the presentations in the conference room, the President and the Minister of the Sea went to the ROV control room, where they received an introduction to ROV operations by ROV team lead James Taylor and chief engineer Martin Pieper. The pilots flew the ROV to an impressive wall of corals, allowing a direct view in the pristine deep coral reefs that exist off Santiago. The visit ended in the ship's Geolab where Captain Detlef Korte handed over a gift to the President. All in all, the atmosphere on board was very positive and around 14.30 the President and associated press and visitors left RV METEOR. The visit was covered in different Cabo Verde news outlets including the evening news.



Figure 2: His Excellency José Maria Neves on board RV METEOR and receiving a gift from Captain Detlef Korte as memory of his day on RV METEOR. The gift plate was prepared by RV METEOR crew member Gerrit Ubben.

During M209 we also perform AUV missions. At the beginning of the week, the pressure housing of the camera flash, certified for depths over 1000 m, failed during a pressure test when being mounted to the ship's CTD and lowered to 950 m. The lids were deformed by at least 5 mm, making safe operations impossible. As no aluminum in the required dimensions was available, we worked with the onboard metalworker and decided to build new lids from PVC. Supported by FEM simulations, it was estimated that the PVC lids could withstand up to 75 bar, making an implosion at 500 m unlikely. However, the lids failed, and the entire housing imploded at a depth of 750 m. We then tested a spare camera system rated for 500 m depth on AUV Kalle, which had never been used on this AUV before.

The next dive was planned as a sidescan and multibeam survey. Due to the depth of over 700 m, we used the launcher system for deploying the AUV. This system provides two major advantages. 1) Saving battery on the descent as the thrusters don't have to actively bring the positively buoyant AUV to the seafloor, thus increasing mission time and 2) increasing the safety, as the navigation of the AUV has to be stabilized during the descent, where the DVL does not have a bottom log, by sending absolute position information in the form of USBL fixes.



Figure 3: AUV KALLE being deployed off RV METEOR with the dedicated launcher, to reduce battery consumption during deep deployments

By bringing the AUV down to the seafloor with the launcher in a controlled manner, the AUV can start its programmed mission after making sure the navigation matches its true position. The mission itself ran smoothly, but during the ascent, the positioning by the USBL system was interrupted, and as a result, the navigation of the AUV began to drift and surfaced quite far away from the planned waypoint. Using the radio and iridium beacon, AUV Kalle was quickly located several hundred meters on the port side of RV Meteor and steered back to the ship with the radio controller. For the following dive on the same day, the mission was planned in fixed-depth mode instead of fixed altitude mode, expecting fewer depth corrections and thus better data quality. The main challenge was estimating the correct depths for the mission track during planning - if the AUV can not reach the set depth due to the set safety altitude limit, it will not reach the waypoint. The mission was completed successfully with no issues during recovery.

Besides underwater surveys, above-water megafauna observations from the top deck of the Meteor are also included in this cruise. For this, the daily protocol includes using the Logger software to begin sighting efforts, which records start/end time of the efforts, position of the ship, and search/transit effort. The instruments used to perform this task includes binoculars and cameras. Since the expedition began, our efforts have allowed us to observe about eleven different species of seabirds, including four species or subspecies endemics to Cabo Verde, one terrestrial bird that feeds on fish, five different cetaceous species, two fishes, a shark and a ray. These observations have been important in identifying the biodiversity in these regions.



Figure 4: Brown Boobie, Sula leucogaster taken on March 29, 2025 at Baia do Tarrafal.

It is currently our second day in Santiago, and we have already had some great sightings. Yesterday, a humpback whale with a calf and today many dolphins have passed by our vessel. Some of the cetaceans we have observed during this cruise are directly connected to the deep sea, as these animals forage at great depths. For example, pilot whales, spotted several times in the Bay of Tarrafal and Fogo, are known to dive up to a depth of 1000 meters. Maybe we will catch a glimpse of them in Santiago, too.

We are starting the final days of the research program of M209. We are sad that it is the beginning of the end of the expedition but also grateful for the amount of data and samples we have been able to collect, and the little scientific time loss we have encountered. The atmosphere on board is still very good and the collaboration between the science team and the RV METEOR crew and officers is excellent.

On behalf of the M209-team

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Photo: Humpback Whale, Megaptera novaeangliae on April 11, 2025 at Baia do Inferno.