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# CRUISE REPORT

## iMAR: Integrated assessment of the distribution of Vulnerable Marine Ecosystem along the Mid-Atlantic Ridge in the Azores region

RV Pelagia, Cruise No. 64PE487, Eurofleets+ iMAR cruise

18/05/21 – 02/06/21, Horta (Portugal) – Horta (Portugal)


AZORES DEEP-SEA RESEARCH

iAtlantic INTEGRATED ASSESSMENT OF ATLANTIC MARINE ECOSYSTEMS IN SPACE AND TIME

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# 1 Summary

The iMAR cruise "The Integrated assessment of the distribution of Vulnerable Marine Ecosystem along the Mid-Atlantic Ridge (MAR) in the Azores region" took place aboard the Research Vessel Pelagia of the Royal Netherlands Institute for Sea Research between May 18th and June 2nd 2021. This expedition was funded by the SEA OCEANS program of Eurofleets+ and the H2020 European project iAtlantic, and was led by the University of the Azores (Portugal) in collaboration with the Hydrographic Institute and University of Porto (Portugal), the University of Aarhus (Denmark), the National Oceanography Center (United Kingdom), GEOMAR (Germany), the University Museum of Bergen (Norway), the PP Shirshov Institute of Oceanology (Russia), and the University of Vale do Itajaí (Brazil). We explored under-visited portions of the northern MAR in the Azores region and associated ridges and seamounts between 300 and 1,200 m depth (Figure 1): (1) South Chaucher, (2) unnamed seamount coded as D12, (3) the Kurchatov fracture zone area, including Isolado and D10 seamounts and ridges complex, (4) unnamed seamount West of Oscar seamount coded as D5, (5) the Gigante seamount and ridges complex, and (6) Cavala seamount. On most sampling locations, we collected multibeam data, CTD measurements, water and sediment samples, and tow camera transects to survey deep-sea coral and sponge communities. Water samples will be used for biodiversity analyses through eDNA methods and the characterization of water masses properties (nutrients and physical-chemical parameters). Sediment samples (collected at 1,000 m depth) will be used for biodiversity analyses through faunal studies and eDNA methods, microplastics, granulometry analyses, and physical-chemical studies.

Although the data has yet to be analysed in detail, this expedition revealed some surprising discoveries. The iMAR expedition identified new areas that fit the definition of Vulnerable Marine Ecosystems, and compiled valuable scientific information to inform the development of policies that promote the preservation of the natural heritage, ensuring the sustainable use of the deep sea, minimizing negative impacts on these vulnerable ecosystems. The video work that aimed to characterize the benthic communities revealed the largest aggregation of black corals (or black coral gardens) ever seen in the Azores and perhaps across the Atlantic. These corals are very slow growing and can live for several thousands of years and, therefore, the gardens that form can be considered as the equivalent of the redwood forests (oldest trees on the planet) that still persist, for example, in the United States of America. We also discovered, in the northern portion of the MAR explored, several areas with formations of deep-sea coral thickets that have an important role as carbon reservoirs and in mitigating climate change. Some of these corals, but also sponges, are habitat structuring species, functioning as refuge areas for several other species including commercially important deep-sea fish, and thus enhancing the total biodiversity associated with these habitats. We also found aggregations of orange roughy and cardinalfish, which in a way confirm that the trawl ban within the Azores EEZ, declared in 2005, has had positive effects for these species and the habitats they are associated with. The multibeam bathymetric surveys revealed several locations in the northern part of the Azores EEZ

that are much shallower than previously thought. One of these areas reaches depths susceptible to be fished (less than 600 meters), but since it has remained unknown it can be considered intact. These areas are fundamental for understanding what ecosystems looked like before they were impacted by fishing activities and may be considered as reference sites and priority areas for conservation.

These new discoveries will contribute with scientific information to the development of policies that promote the preservation of the natural heritage, ensuring the sustainable use of the deep sea, minimizing the negative impacts on these very vulnerable ecosystems. The expedition contributed significantly to the Instituto Hidrográfico (IH) program (Mapping the Portuguese Sea) and to the international initiative and the United Nations Decade of Ocean Science for Sustainable Development (2021-2030).

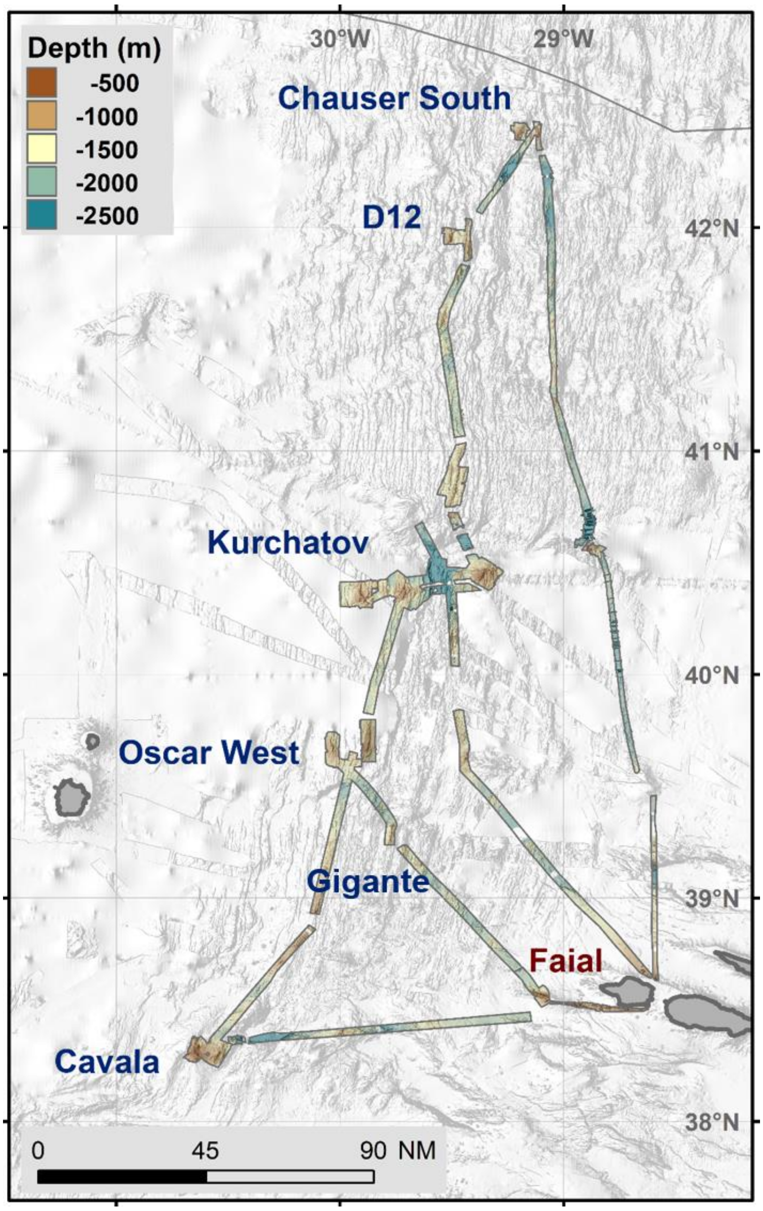



**Figure 1 - Working area and track chart of R/V PELAGIA Cruise 64PE847 / iMAR. Bathymetry from Okeanos UAz and Emodnet Bathymetry.**

***Cruise statistics***: 11 full days of work spread over 16 days at the sea, 2,500 km of transits, 6 areas visited, 5,500 km$^2$ of mapped seabed (mainly in the North portion of the MAR in the Exclusive Economic Zone around the Azores), 19 dives with the NIOZ video system that resulted in 54 hours of deep-sea images over 48 km of the seabed, 13 stations for the analysis of water mass properties and to collect sediments, which resulted in 380 samples for environmental DNA, 280 samples for nutrient analyses, 27 sediment samples for geological analyses, 24 for microplastic analyses, 10 samples for bacteriological, and 10 samples meiofauna analyses.

## 2 Research Programme/Objectives

The Mid-Atlantic Ridge (MAR) is the most prominent ocean seafloor feature in the Atlantic Ocean, dividing it into eastern and western deep basins. The unique setting of the Azores, at the triple junction of the European, American and African plates and in close proximity to the ridge, offers an exceptional opportunity to survey the role of the MAR in shaping the distribution of deep-sea megabenthic communities, mostly those considered Vulnerable Marine Ecosystems (VME). The diverse geomorphology and complex oceanography patterns surrounding the Azores has generated an extraordinary diversity of benthic organisms, making this area a hotspot for cold-water corals in the North Atlantic. Latitudinal gradients and dissimilarities between the deep-water coral fauna on both sides of the MAR were noted at local and wider scale studies, raising the question on whether the MAR can represent a boundary for the biological dispersion between the East and West Atlantic. However, there has been considerably few explorations on seamounts, ridges and other topographic features along the MAR.

The iMAR cruise aimed to evaluate the role of the Mid-Atlantic Ridge in shaping the latitudinal and trans-Atlantic patterns in deep-sea biogeography, connectivity and spatial distribution patterns of deep-sea megafauna. Additionally, the cruise aimed to (i) map and characterize deep-sea coral and sponge communities inhabiting unexplored seamounts and ridges in the MAR in the Azores Region; (ii) identify new areas that fit the FAO's VME definition; (iii) add to the existing knowledge on the environmental drivers that determine the spatial distribution of deep-sea benthic biodiversity in the MAR and finally (iv) determine the condition of benthic communities by looking at evidence of fishing damage to fauna, presence of lost fishing gear and marine litter.

The iMAR cruise proposed to last for 18 days and visit 11 different areas along the MAR. Survey sites have been selected along a latitude gradient of the MAR section within the Portuguese EEZ around the Azores, between 42° and 36° N. We suggested to explore some under-visited portions of the MAR and associated ridges and seamounts between 300 and 1,500 m depth. Tentative areas to explore include from N to S: (1) South Chaucher, (2) unnamed seamount coded as D12, (3) the Kurchatov fracture zone area, including Isolado and D10 seamounts and ridges complex, (4) unnamed seamount West of Oscar seamount coded as D5, (5) the Gigante seamount and ridges complex, (6) Cavala seamount, (7) uncharted area SW of Flores island, and (8) Menez Gwen ridges, (9) unnamed seamount coded as A3, (10) the Cavalo ridges, and (11) Farpas ridge.

On each sampling area, we collected multibeam data for seabed mapping, together with tow camera transects to identify deep-sea benthic communities, water samples for biodiversity analyses through eDNA methods, and sediment samples for biodiversity analyses through faunal studies and eDNA methods, microplastics and analyses of granulometry and physical-chemical studies. Water mass properties were also characterized by sampling seawater and measuring physical-chemical parameters.

The research plan included a sampling methodology that combines (1) the collection of detailed multibeam and backscatter data for seabed mapping, (2) the analysis of water mass properties using CTD data, seawater samples collected with Niskin bottles in a Rosette, and measurements of physical-chemical parameters, (3) the collections of seawater samples for biodiversity analyses through eDNA, (4) the collection of sediment samples with a box-corer for biodiversity analyses through faunal studies and eDNA methods, microplastics and analyses of granulometry, physical-chemical studies, and bacterial growth, and (5) the recording of high-definition video images of the seabed using the Hopper towed camera system of R/V Pelagia, accompanied by ADCP data, to identify deep-sea benthic communities.

The results of this exploration contribute to the aims of the H2020 iAtlantic project to understand the factors that control the distribution, stability and vulnerability of deep-sea ecosystems and better inform sustainable management throughout the Atlantic in an era of unprecedented global change. The iMAR cruise also aimed to enhance the predictive capabilities for VMEs, and to inform Good Environmental Status (GES), Marine Spatial Planning (MSP) and provide new insights on how to sustainably manage deep-sea ecosystems in the Mid-Atlantic Ridge. Finally, this cruise contribute to the SEAMAP 2030 (Mapping the Portuguese Sea) program of the Portuguese Hydrographic Institute and to the international Seabed 2030 initiative and the United Nations Decade of Ocean Science for Sustainable Development (2021-2030).

# 3 Narrative of the Cruise

***May 17th 2021 – Preparation day***

RV *Pelagia* arrived to Horta Harbour on May 17th at around 08:00. In the afternoon, the scientific team started moving the equipment/sampling gear to the vessel. After a COVID-19 rapid test we were able to put our gear on board the vessel. One journalist from the National TV channel SIC joined the operations. In the evening, we participated in a press conference organized by the OMA that counted with a recorded message from the Portuguese Minister for Sea affairs, Ricardo S. Santos, and from the new president of the Regional Government of the Azores, Manuel Bolieiro (Figure 2). In the Porto Pim Old Whale Factory, the press conference started with a message from the President of the Okeanos Research Center, Dr Gui Menezes, followed by a message from the Mayor of the Horta, José Leonardo Silva, and from the Regional Secretary for Culture, Science and Digital Transition (Suzete Amaro). The press conference finished with an explanation of the iMAR cruise objectives. The press conference was broadcasted live.


**Figure 2 - Press conference to launch the iMAR/iAtlantic Eurofleets+ cruise at the Whale Factory Station, Horta, Faial Island.**

The press conference was widely disseminated in the main news, including the Portuguese News Agency Lusa, TV channels SIC and RTP, newspapers (Público, Visão, Açoriano Oriental, Dinheiro Vivo, País ao minuto, Diário da Lagoa, Praia Expresso, Agricultura e Mar), radio news (Rádio Renascença) and other websites (Instituto Hidrográfico, Portal of the Government of the Azores).

### *May 18th 2021 – Departure from Horta and transit to South Chaucer (Area# 1)*

The scientific team board the RV Pelagia at around 9:00 and transferred the last pieces of equipment (Figure 3). Right after that, all the team tested negative for COVID-19 and participated in a familiarization event that included all safety procedures. Before departure, all gear was safely placed inside the two containers allocated for the cruise (acclimatized seawater and sediment labs) and the video room from where the hopper video operations are monitored. The RV Pelagia left the Horta harbour at 13:30 and an "abandon ship" drill was performed right after we passed Ribeirinha. We started transit to South Chaucher with the multibeam system on (st001; Figure 3). After dinner we presented the goals and objectives of the cruise to the Captain and crew of the RV Pelagia (Figure 4).

The weather was quite rough with 70-90 km winds and 4 to 5 m waves during the night. Even though, a Sound Velocity Profile (SVP) was performed right before the first quick multibeam survey (st002, st003) in the on António Freitas small seamount, NW of Graciosa Island, (21:30-22:45). We continued transit to the North during the night towards our first area of work (st004) in the middle of a mild storm.


**Figure 3 - Images extracted from the SIC news piece showing the preparation before departure and an image of the safety drill conducted on-board. Example of the multibeam survey (st001) conducted while transiting to the north stations.**

**Figure 4 – Short briefing about the goals and objectives of the iMAR cruise to the Captain and crew of the RV Pelagia (left). The first Sound Velocity Profile (SVP) performed before the first quick multibeam survey.**

### *May 19th 2021 - Transit to South Chaucer (Area# 1)*

We crossed the unnamed seamount, East of D2, on our way to the North and stopped (06:10-10:00) for a while to perform an SVP (st005) and a short multibeam survey (st006). The weather conditions made the survey difficult and the quality of the data very poor (Figure 5). We continued the transit (st007) until the South Chaucer sampling area, where we arrived at 22:30. After another SVP (st008) and a quick multibeam survey in the eastern ridge of the area (st009), a detailed bathymetry survey (st010) was performed in the western ridge (Figure 6). These surveys informed the location of the first hopper video dives.

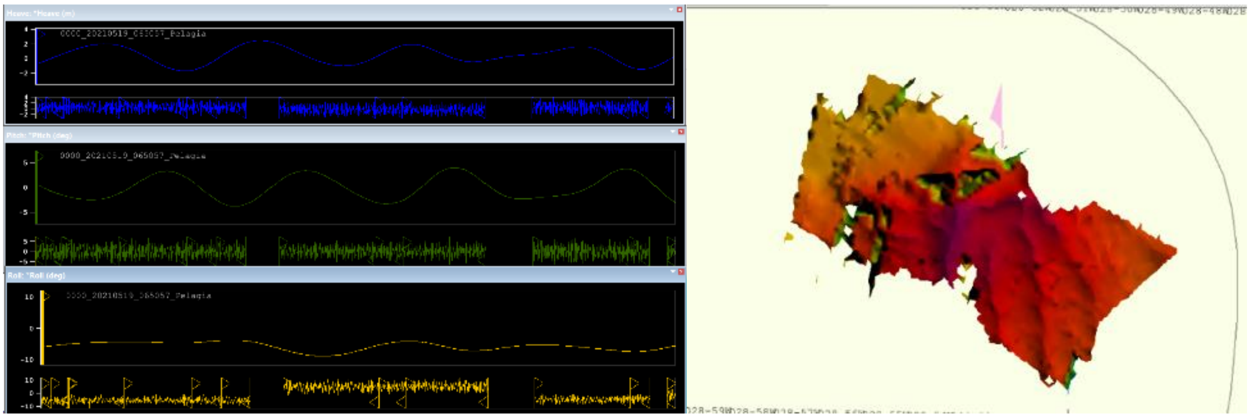


**Figure 5 – Multibeam survey (st006) as the unnamed seamount, East of D2, under rough weather conditions that made the survey difficult and the quality of the data very poor.**

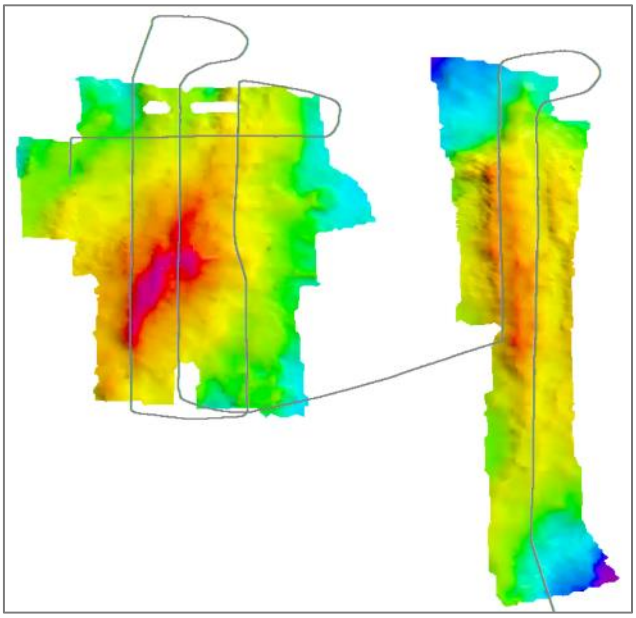


**Figure 6 – Multibeam survey in the South Chaucer Area (st009 and st010).**

***May 20th 2021 - South Chaucer (Area #1)***

The first real day of work (Figure 7) started with a hopper video survey (st011; 08:00) on the western ridge of the South Chaucer area (Figure 8). In this video track (1050-725 m depth), we observed the first colonies of black corals (*Leiophates* sp., *Bathypathes* sp.) along with area with high densities of bamboo corals (*Acanella* sp.), stylasterids and scleractinian corals, and several sponges species (cf. *Phakellia* sp., *Pheronema* sp.). Live reefs of scleractinian corals were observed in small portions of the transect. Some deep-sea fish species including deep-sea sharks were observed along the video transect. Unfortunately, the positioning system of the hopper frame was not working properly. The vessel mounted ADCP was successfully started but as the multibeam was also on, the data come with lots of noise. After the dive, we selected the stations and performed a Rosette/CTD cast (st012; 13:00) at about 930m and a blind box corer (st013; 16:00) at around 900m depth, as the TV guided system was not operational. The box corer arrived to deck with lots of coral rubble but not much sediment. All water (pH, nutrients, and eDNA) and sediment (fauna, eDNA, microplastics, granulometry, and bacteria) samples were successfully collected and processed. We then transited to the eastern ridge of the area, where we performed a short hopper video dive (st014; 18:00) between 880 and 1250 m depth, with the ACDP turned on (Figure 8). This area contained one of the richest diversities of cold-water corals (black corals – *Leiopathes* sp.-, bamboo corals –*Acanella* sp., *Keratoisis* sp.-, sea pens - Pennatulacea), reaching high densities in some areas.

**Figure 7 – Getting ready for the first sampling stations. Pelagia crew (top left), preparing the camera systems (top right), launching the first box-core (bottom left) and the hopper frame (bottom right).**

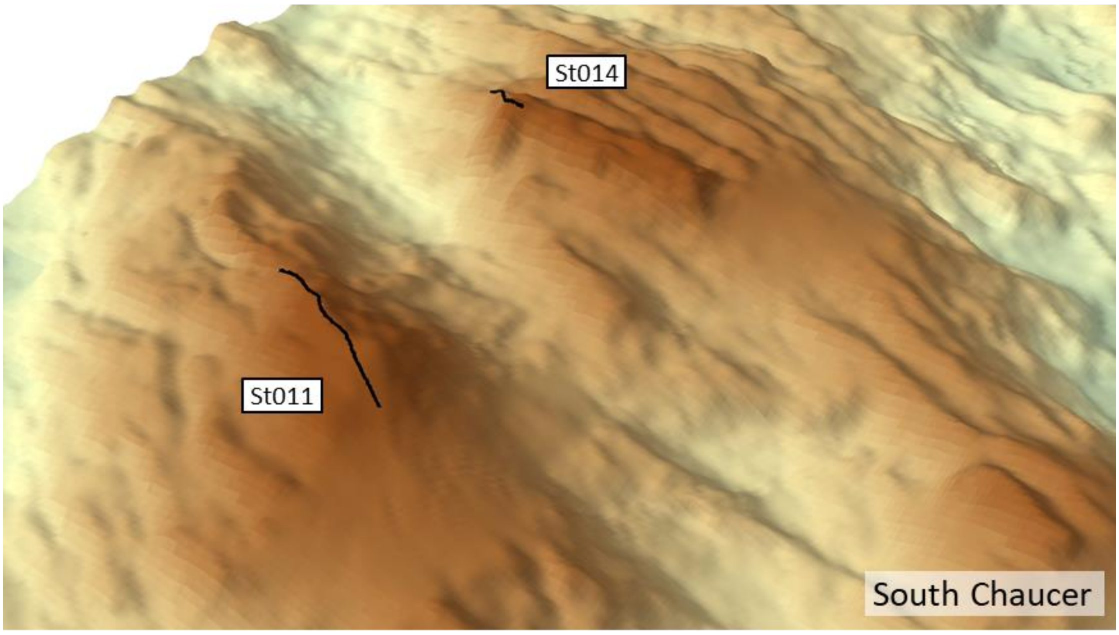



**Figure 8 - Track of the hopper video dives st011 and st014 in the Area #1 South Chaucer**

After the hopper dive, we transited to the unnamed ridges coded D12 with the multibeam system on (st015; 20:30). Upon arrival to the area, we performed a detailed bathymetry survey (st016; 23:30-07:40) of both eastern and western ridges (Figure 9). This surveys revealed some amazing sloppy and long ridges; much shallower than previously known. The western ridge of D12, is one of the few - now-known - areas inside the Azores EEZ shallower than 800m depth with no records of past bottom fishing. These areas are crucially important to provide information baseline information on what a pristine ecosystem should look like.

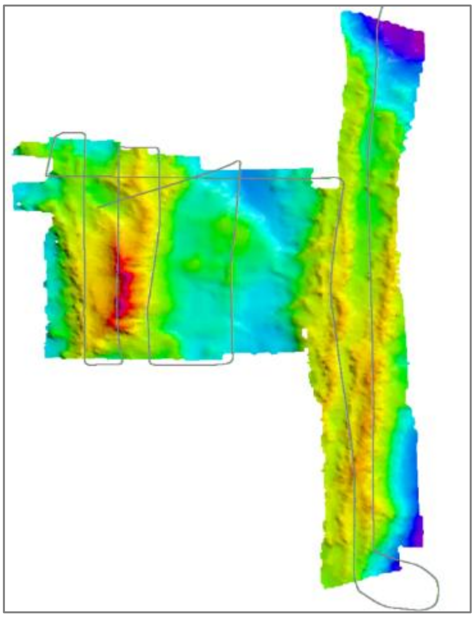


**Figure 9 – Multibeam bathymetry survey (st016) on several ridges of the unnamed area coded as D12.**

***May 21st 2021 – Unnamed ridges coded as D12 (Area #2)***

After looking at the multibeam surveys performed during the night we have selected the locations for the hopper video surveys (st017/018; 08:00) on the western ridge of the D12 area (Figure 10). During the st017, the winch stopped working twice and the hopper frame hit the seafloor several times. The lightening system rotated slightly affecting the quality of the image. The hopper frame was brought to deck, the lights were adjusted, and hopper video st018 started immediately. The positioning system of the hopper frame was still not working. The vessel mounted ADCP was successfully started with the multibeam turned off. The benthic fauna observed during these video transects (1120-600 m depth), were similar to those observed in South Chaucer but in smaller densities. Some small patches revealed high diversity of coral species of small sizes. The most common benthic species observed were the bamboo corals (*Acanella* sp., *Keratoisis* sp.), octocorals (*Thouarella* sp., *Narella* sp., *Paramuricea* sp.), black corals (*Leiophates* sp.). Here, we observed several deep-water sharks and fish, including some wreckfish (*Polyprion americanus*).

After the hopper dive, we selected the next sampling stations and performed a Rosette/CTD cast (st019; 13:20) at about 900m and a blind box corer (st020; 16:30) at around 990m depth, as the TV guided system was still not operational. We then transited to a ridge on the east side of the area D12 and performed a hopper video transect (st021; 16:40) between 860 and 990 m depth, with the ACDP turned on (Figure 10). This ridge contained the densest aggregation of large and small black corals (*Leiopathes* sp., cf. *Tylopathes* sp., *Bathypates* sp.) ever seen in the Azores and was also highly populated with live Scleractinian corals. This area may contain very high diversity and high densities of long-lived corals species. During this dive we also observed an aggregation of cardinal fish (*Epigonus telescopus*) and some orange roughy (*Hoplostethus atlanticus*).

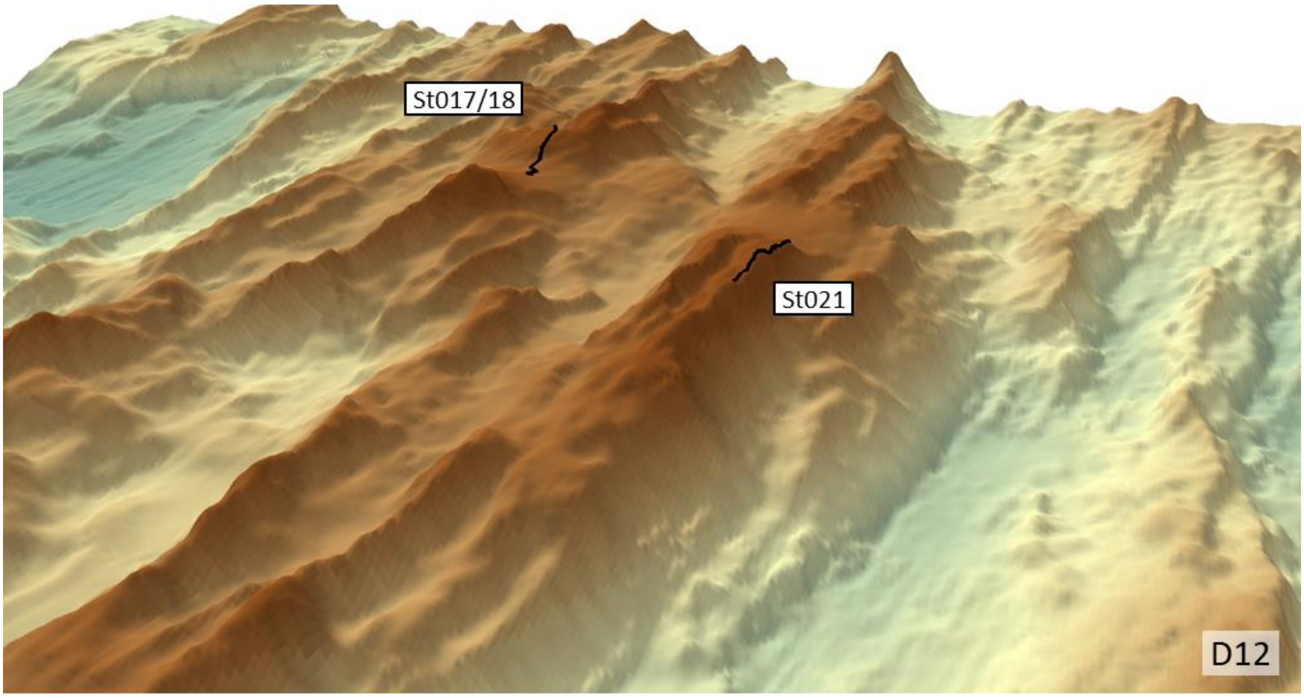



**Figure 10 - Track of the hopper video dives st017/18 and st021 in the Area #2 D12**

After the hopper dive, we transited to the Kurchatov area (NW, Isolado seamount) with the multibeam system on (st022; 21:00). Before arriving to the area, we performed a detailed bathymetry survey (st023; 02:30-07:20) of some ridges located just outside the eastern side of the Kurchatov area (Figure 11). The Kurchatov NW, Isolado seamount, area has been surveyed by the IH in 2020 and, therefore, no bathymetry was collected in the sampling area.

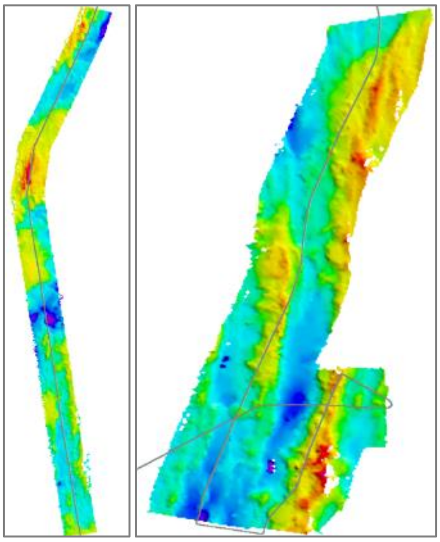


**Figure 11 - Multibeam bathymetry survey while transiting to the Kurchatov area (st022; left) and detailed bathymetry survey (st023; ridges) of some ridges located just outside the eastern side of the Kurchatov area.**

### *May 22nd 2021 Kurchatov NW, Isolado seamount (Area #3)*

We performed a short hopper video dive on the eastern side of the Isolado seamount in the NW of the Kuchatov area (st024; 08:45), with no USBL positioning system but with the vessel mounted ADCP on (Figure 12). This seamount has a gentle slope from about 1200 m depth to the summit at around 700 m depth. Most of the transect was over soft sediments with only limited benthic or fish fauna. This transect was mostly characterized by the presence of several sponge species (e.g. *Asconema* sp., *Phakellia* sp., *Pheronema* sp.) with only sporadic observation of cold-water corals (e.g. *Acanella* spp., *Narella* sp., *Paranthipathes* sp.). After the hopper dive, we selected a sampling stations and performed a Rosette/CTD cast (st025; 11:20) (Figure 13). After lunch time (13:00) the Captain decided to transit back to Horta to seek medical assistance for one crew member. The box-corer and the video planned for the afternoon were, therefore, cancelled. During the transit we left the multibeam on (st026) and crossed over an uncharted portion of the Oscar seamount (Figure 14).

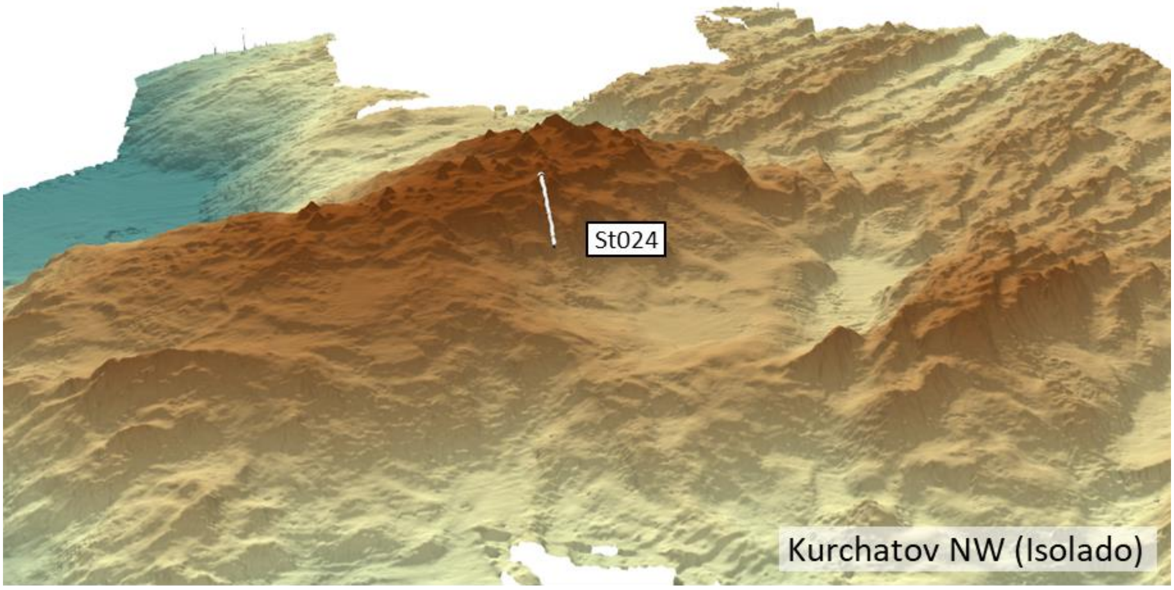



**Figure 12 - Track of the hopper video dives st024 in the Area #3 Kurchatov**

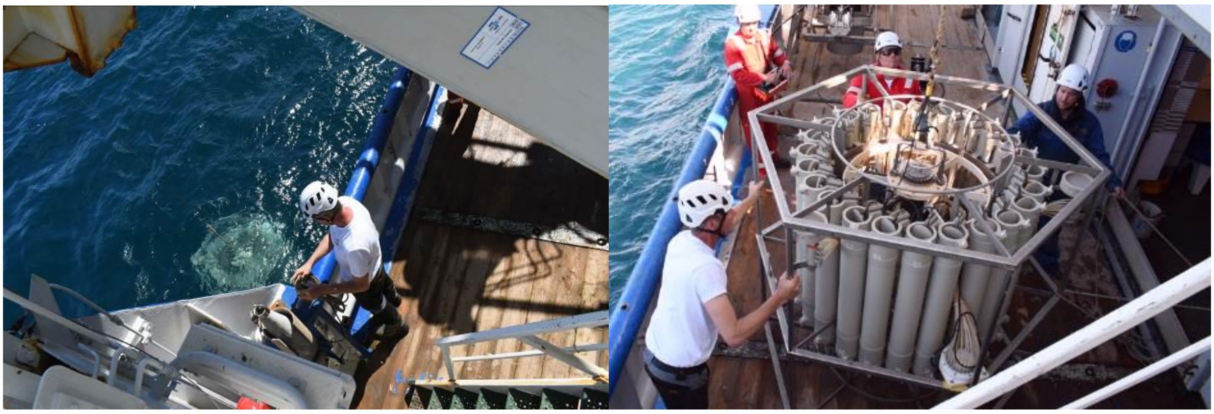


**Figure 13 – Deployment of the Rosette/CTD cast in the Kurchatov area (st025).**

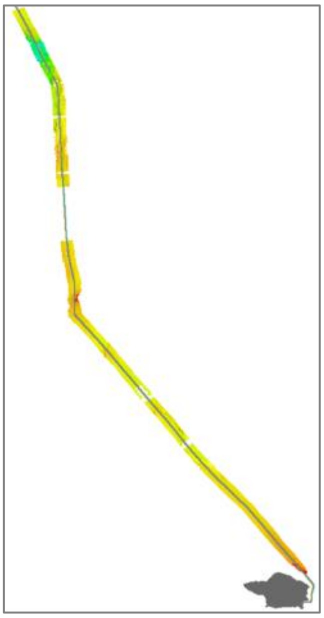


**Figure 14 –Multibeam survey (st026) while transiting to Horta, crossing over an uncharted portion of the Oscar seamount.**

***May 23rd 2021 Horta***

We arrived to Horta harbor at around 8:30 and stay on the vessel organizing the data collected during the first few days of the cruise. Just before lunch time we were informed that we could resume the cruise at around 15:30. Since we had lost almost 2 days at sea and the weather conditions were forecasted to deteriorate in the northern part of the study area, we were forced to re-plan the whole cruise. After a careful look at the weather transit times, task to be performed and the priority areas to be surveys, we decided to head South towards the Cavala seamount and then to Gigante, before heading back to the Kurchatov area. This plan may be revisited again. We left Horta harbor at around 16:00 and transited directly to the Cavala seamount with the multibeam on (st027). One hour before arriving to the Cavala seamount, we performed an SVP (st028) to calibrate the multibeam system. We continued transiting with the multibeam logging in (cont. st027). We arrived to Cavala seamount at 1:30 and started a multibeam survey targeting some ridges eastern of Cavala seamount (st029; 1:30-07:30) (Figure 16).

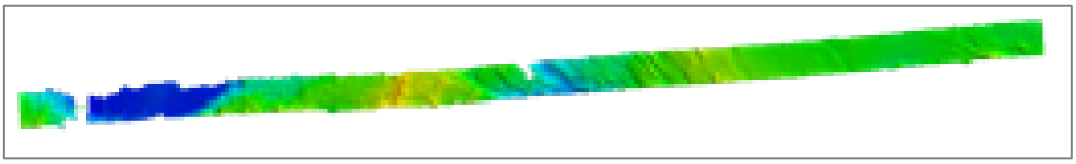


**Figure 15 - Multibeam survey targeting some ridges eastern of Cavala seamount (st027).**

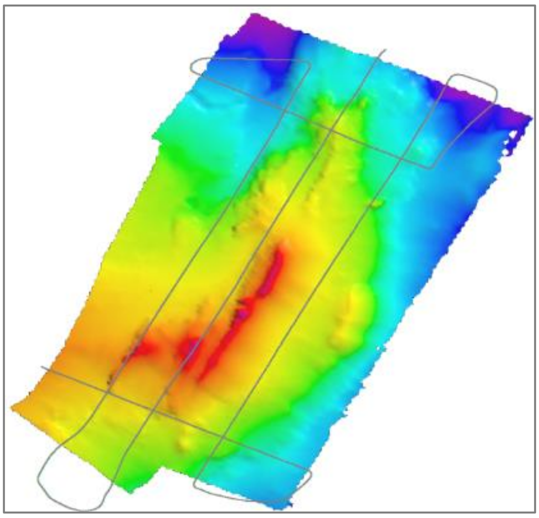


**Figure 16 - Multibeam survey (st029) targeting some ridges eastern of Cavala seamount.**

***May 24th 2021 Cavala Seamount***

We then transited to the valley separating the two peaks of the seamount and preformed a hopper video transect between 930 and 645 m depth (st030; 08:30-12:00) (Figure 17). This dive started on a northern end of the canyon on a flat area covered by soft sediment. In instances, we could observe orange-like substrate resembling the substrate type on the Gigante seamount, where the Luso hydrothermal vent was discovered in 2018. This dive was not very rich in diversity or fauna abundance, but uncovered some dense patches of deep water sponges (*Phakellia* sp., *Asconema* sp.) and sea-urchins (*Cidaris cidaris*). At around 700 m depth, some rocky outcrops revealed some patches of living cf. *Lophelia pertusa* associated with *Phakellia* sp. sponges. During this dice we observed several individual of the fish species *Mora moro*, as well as some cf. orange roughy (*Hoplostethus* sp.), bluemouth rockfish (*Helicolenus dactylopterus*), and deep-sea sharks (e.g., *Pseudotriakis microdon*).

We then moved to the next sampling station and performed a box-core at around 860m depth (st031; 13:00-13:50). The box-core did not close very well and some sediment was lost on the way to the surface. We decided to move to the next station to keep the planned activities for the day. We transited to the ridges eastern of the Cavala seamount summit and performed a hopper video transect (st032; 15:30) covering areas from about 900 to 650 m depth (Figure 17). Although the bottom was mostly hard, we did not observe diverse or abundant cold-water corals communities. Instead, this area revealed a great variety of sponges but of which form considerably large patches/aggregations (e.g., *Pheronema* sp., *Macandrewia* sp.). The top of the ridge was populated with dense patches of cf. *Narella bellissima* and cf. *Narella versluysi*. During this dive we spotted some deep-sea fishes (e.g., *Mora moro*, *Helicolenus dactylopterus*, *Trachyscorpia* sp., cf. *Synaphobranchus kaupii* and unidentified Macrouridae). After the dive, we performed a Rosette/CTD cast (st033; 19:20). From about 20:00 to 02:30, we continued the multibeam survey (st034) in Cavala seamount and then transited to Gigante area with the multibeam system on (st035).

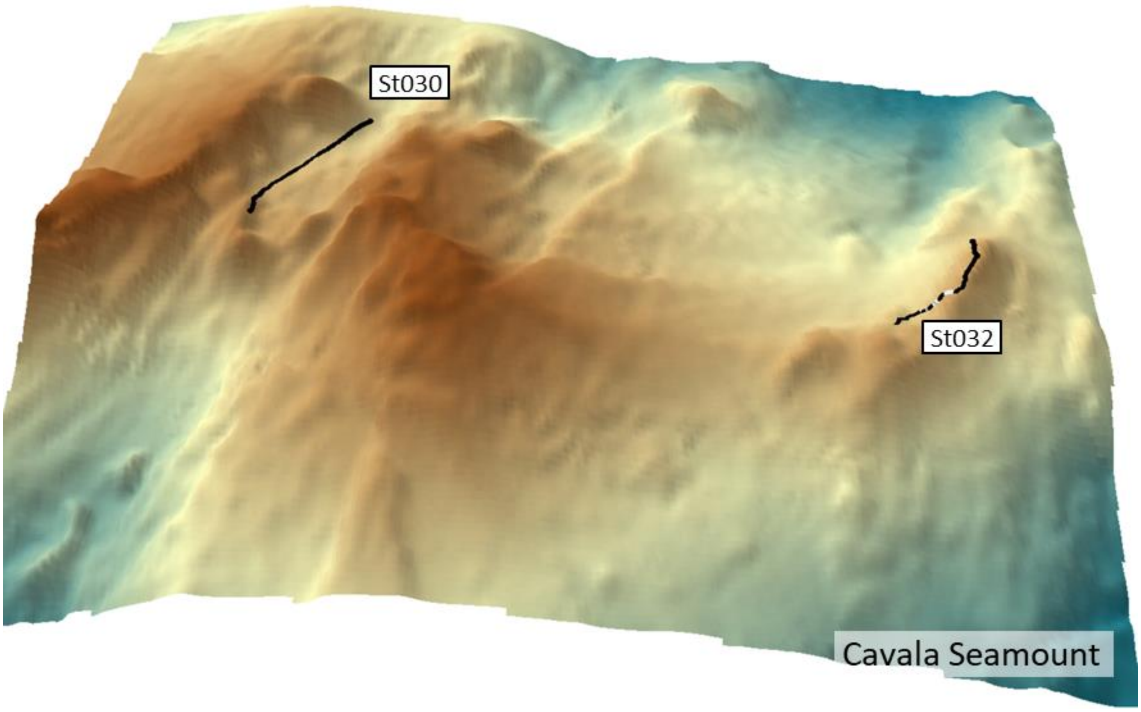



**Figure 17 – Hopper video transects on the valley between the two Cavala seamount summits (st030) and on a small ridge in the eastern side of the area (st032).**

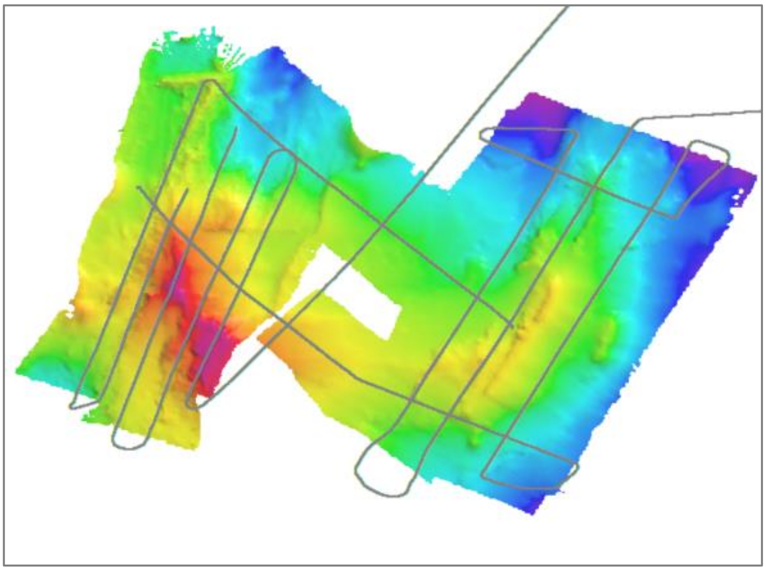


**Figure 18 – Map of the whole area surveyed with multibeam (st029 and st034) in Cavala seamount.**

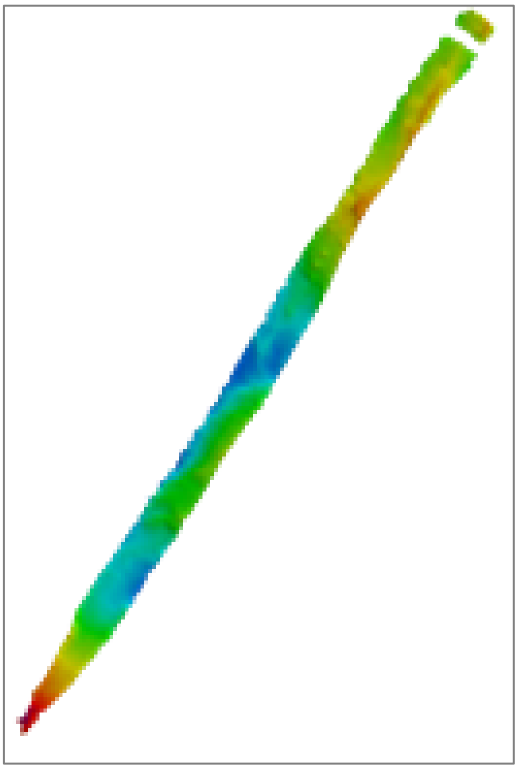


**Figure 19 – Multibeam survey during the transit to Gigante area (st35).**

### *May 25th 2021 Gigante Seamount*

We started the day with a hopper video dive (st036; 08:00-10:40) in the south part of the Gigante NW ridge between 804 and 1100m depth (Figure 20). The dive was performed along the crest of the ridge, sometimes falling down the vertical wall on the eastern side, sometimes dropping along the gentle slope on the eastern side. The gentle western slope was mostly composed of soft sediments with sparse rocks. Along this portion of the transect, we could observe some records of the bamboo coral *Acanella* sp., sometimes reaching high densities, stylasterid *Errina* cf. *atlantica*, octocoral cf. *Corallium Niobe*, and some fields of cf. *Phakellia* sp. sponge. The crest and the vertical wall were colonized by dense patches of the octocoral *Paragorgia* cf. *johnsoni*, black coral *Leiopahtes* sp., scleractinian corals, among many other species of cold-water corals. After the hopper dive we selected one location at around 1,000m depth to deploy the Rosette/CTD cast (st037; 11:25) close to octocorals and black corals colonies.

We then transited to the north portion of this ridge and performed a box-core at around 1,000 m depth (st038; 13:30-14:30). We surveyed this area with the hopper video system (st039; 15:00-19:10) between 1,000 m and 600 m depth (Figure 20) and found both large area of soft biogenic substrate as well as large patches of hard rocky bottom However, we didn't find exuberant large cold-water coral communities as those observed in the northern ridges. Nevertheless, this area contained some of the highest densities of the octocoral *Hemicorallium tricolor* observed so far in the Azores region. Here we also observed few large octocorals *Paragorgia* cf. *johnsoni*, some fields of the bamboo coral *Acanella* sp., some field of laminate and glass sponges and some deep water sharks, like the kitefin shark *Dalatias licha*. After the dive, we transited back to the Kurchatov NW area with the multibeam system on (st040; 19:50) (Figure 21).

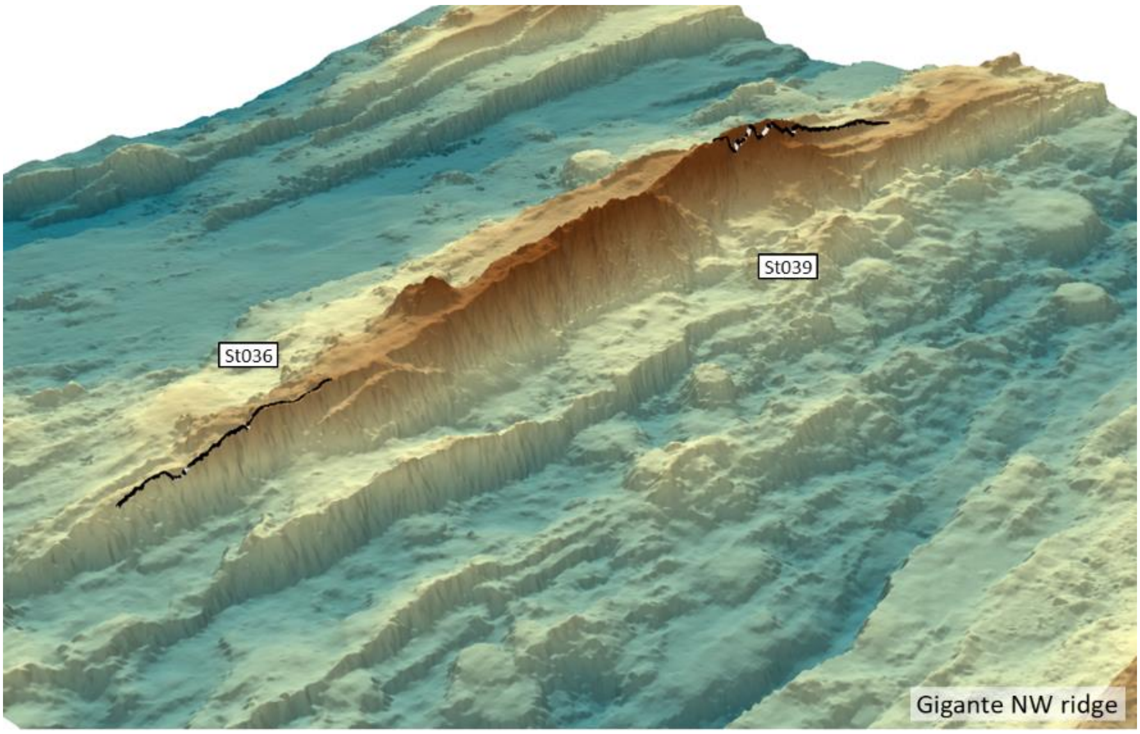



**Figure 20 – Location of the hopper video transects (st036, st039) along a ridge in the Gigante NW area.**

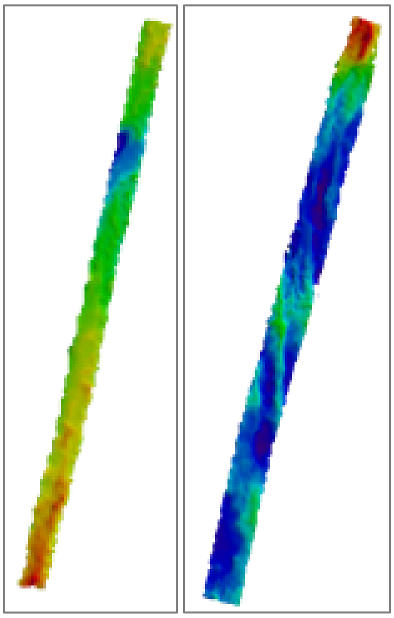


**Figure 21 - Multibeam survey (st040) when transiting back to the Kurchatov NW area.**

### *May 26th 2021 Kurchatov NW/NE*

After arriving back to the Kurchatov area we finalized the work on the NE peak (Isolado seamount) with a box-core (st041; 08:40) at around 1,000m depth. We then transited to the NE portion of this area and performed a hopper video transect (st042; 10:30) between 900 and 1,000 m depth (Figure 22c). In this transect we observed the presence of scleractinian corals in small patches and black corals of the genus *Leiopathes*, along with several other species of the genus *Acanella*, *Paramuricea*, *Keratoisis*, among many others. The plan for the day included another hopper dive (st043; 15:00) but, unfortunately, a general failure in the video system forced us to abort this dive (st043; 15:00). No one could tell if the system could be repaired or how many hours could it take, but the engineers started working on it right away. In order to take advantage of being in a new area, we decided to perform one blind Rosette/CTD cast (st044; 16:00) at about 1000m depth. When finished, we moved slightly north to finish the multibeam survey (st045; 17:00) in some ridges outside the eastern side of the Kurchatov area (st023). We then transited to the SE area of the Kurchatov where we performed a SVP (st046; 20:00) and multibeam surveys (st047; 21:30) until the early hours (Figure 23). We finally moved to the Kurchatov Fracture Zone where some we performed some multibeam transect lines (st048; 04:09) (Figure 24).

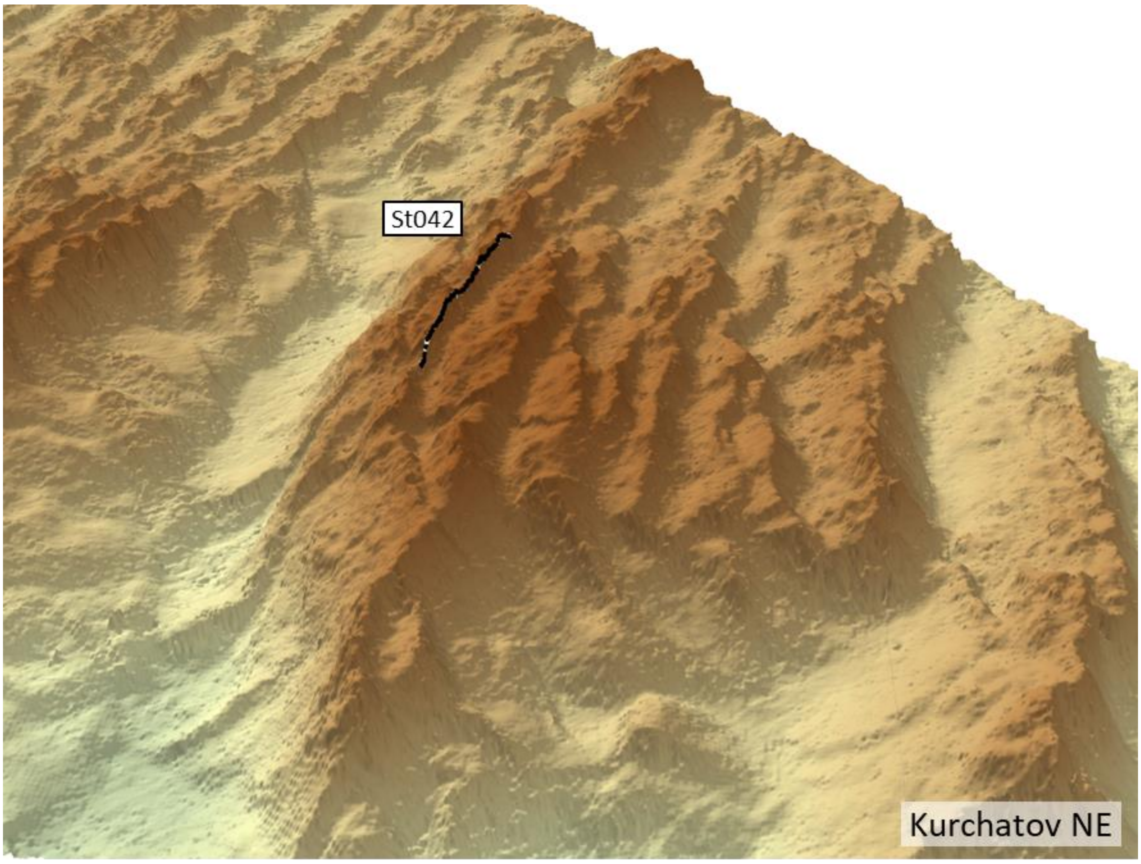



**Figure 22 - Location of the hopper video transect (st042) along one ridge in the Kurchatov area. The second hopper dive (st043) was cancelled due to a general failure of the system.**

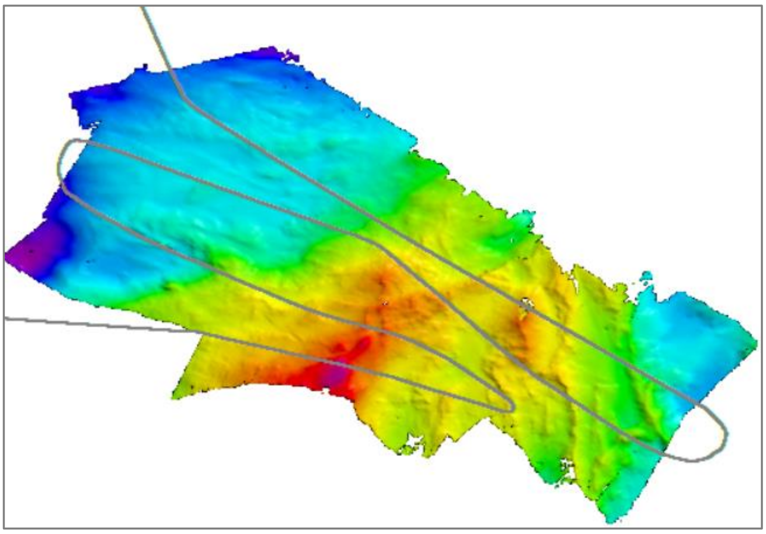


**Figure 23 - Map of the first night of multibeam surveys (st047) in SE portion of the Kurchatov area.**

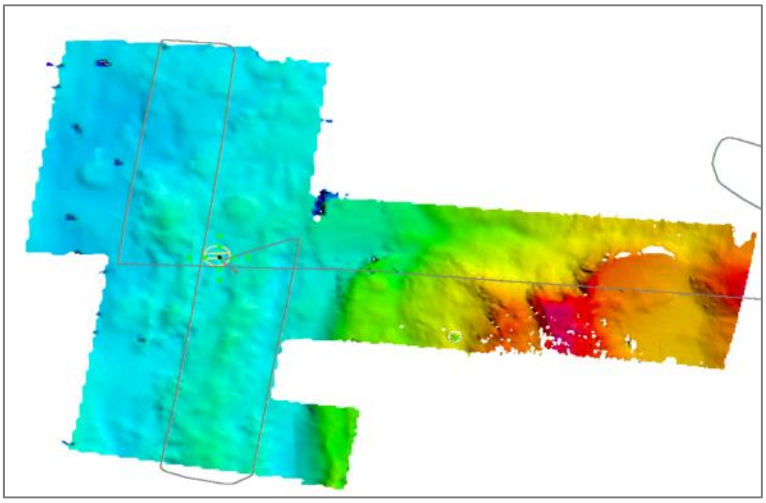


**Figure 24 – Map of the multibeam survey (st048) in the middle of the Kurchatov Fracture Zone**

***May 27th 2021 Kurchatov SE and Fracture Zone***

The engineers spent the whole day trying to solve the problems of the hopper video system but, despite all the efforts and dedication, with limited success. We therefore, dedicated a large portion of day to conducting Rosette/CTD yo-yo casts (st049; 08:30) to look for anomalies on the water column that could point to the present of hydrothermal activity. Although some anomalies were detected in some sensors, including turbidity and temperature, we could not infer that this was related to a potential plume. We collected some water samples for laboratory analyses. We performed a box-core in the area (st050; 16:15) at about 3,000 m depth but the corer didn't close correctly and all the sediment was lost on the way to the surface. We then, made some quick multibeam lines in the FZ area and moved back to the SE portion of the Kurchatov and continued the multibeam surveys (st052; 20:20) in the area (Figure 25).

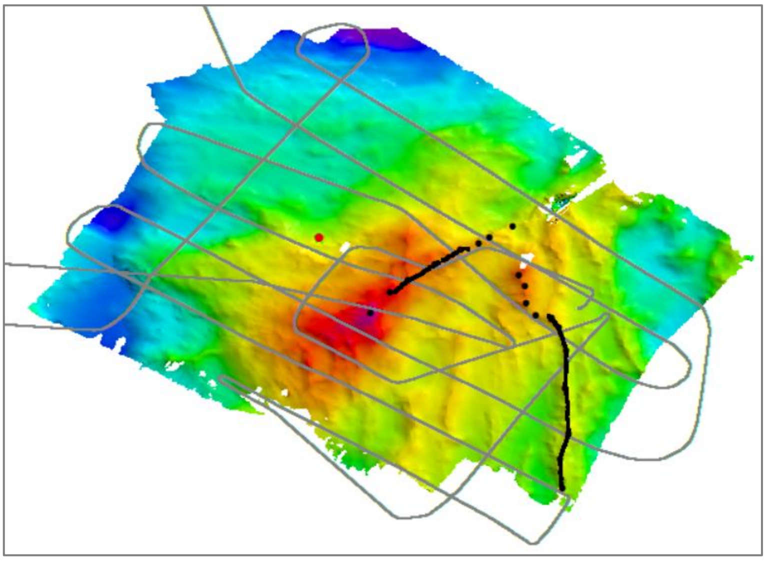


**Figure 25 – Final of multibeam surveys (st047, st052) in SE portion of the Kurchatov area.**

**May 28th 2021 Kurchatov SE**

The engineers continued working hard to fix the video system but it seemed that it would take some more time. We decided to keep working on the planned areas but with no video transects. We started the day performing one box-core in the SE area of the Kurchatov (st053; 09:10) but it arrived with very little sediment. We then repeated the core (st054; 10:10) with success. Since the video system was still not working we performed a blind Rosette/CTD cast (st055; 11:40) at around 1,000m depth in an area with a small ridge where we guessed we could find cold-water corals (Figure 26). By lunch time we received some promising news from the engineers, who believed they found the problem and the solution. Since it would still take some of their time, we moved back to the Kurchatov Fracture Zone to repeat the box-core in the same area of the previous day (st056; 14:30) and to perform another CTD (st057; 17:19) in a small peak revealed by the bathymetry. During the night we completed the multibeam surveys in the SW portion of the Kurchatov area (st058; 19:01) (Figure 27). By the end of the day, we received the news that the video system was repaired and mounted back on the hopper.

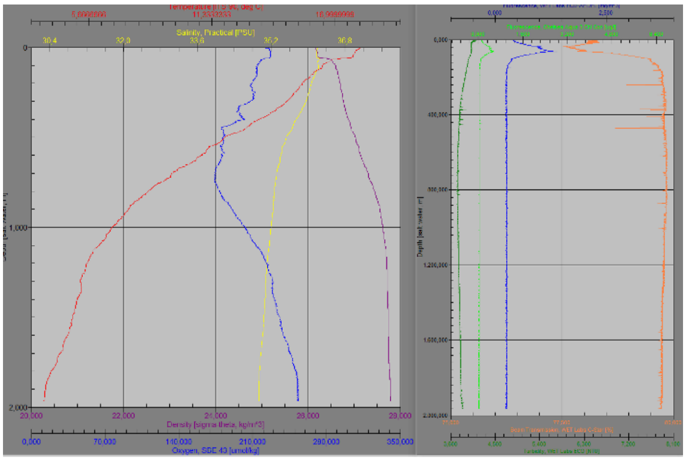


**Figure 26 – Screenshot of the CTD data (st055) in the SE of the Kurchatov area.**

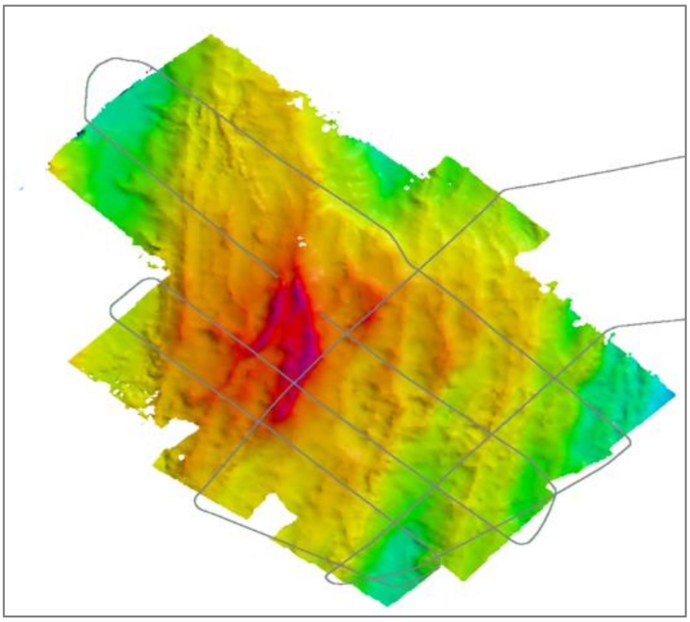


**Figure 27 – First multibeam survey (st058) in the SW portion of the Kurchatov area.**

**May 29th 2021 Kurchatov SE**

Following the successful repair of communication to the hopper, we started the day with one hopper video dive (st059, 08:26) on the same area were the blind Rosette/CTD cast (st055) was conducted in the previous day (Figure 28). The first video dive revealed the presence of scleractinian corals, together with the octocorals and areas covered with dead coral framework. We observed some squids and octopus, as well as cardinal fishes and a rarely observed deep-sea shark of the species *Pseudotriakis microdon*. We then decided to try another dive on the shallowest part of this area (st060; 16:26) but the video frame got caught on a fishing line and the dive was aborted. The hopper was bought to the surface to check the cable but since it was OK we continued the dive. This last video dive (st061, 17:29) was aborted prematurely when the hopper frame got entangled in another fishing line (Figure 28). When the hopper was retrieved to deck, there was considerable damage to the cable. The cable had to be cut to get rid of the damaged part and mounted back on the frame. Stations 60 and 61 revealed hard substrates covered with coral rubble, with the presence of the primnoids, glass sponges and several large octocorals of the species *Callogorgia verticillata*. An aggregation of the silver roughy *Hoplostethus mediterraneus* was observed, together with a large kitefin shark of the species *Dalatias licha*. After a deep breath, we moved to the SW2 area to perform a SVP (st062; 21:30) and conduct more multibeam surveys (st063; 22:30) in this area (Figure 29).

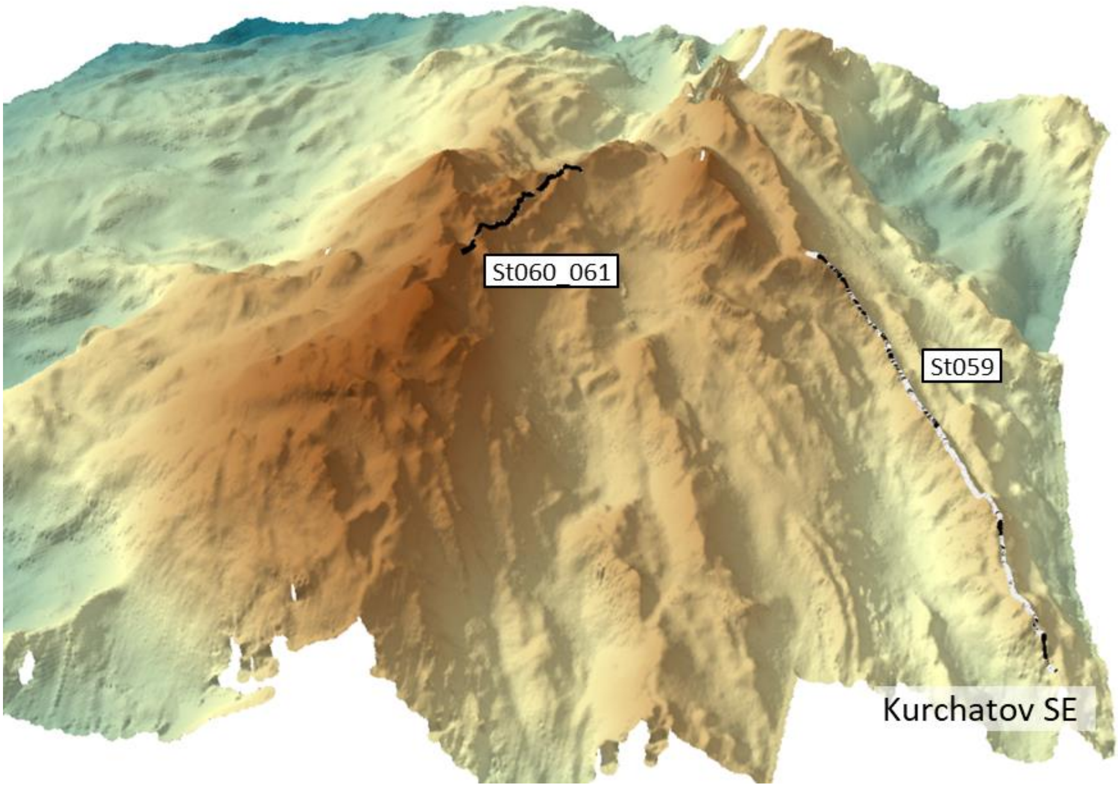



**Figure 28 –Location of the hopper video transect (st059) along eastern ridge of the SE Kurchatov area, and the second hopper dive (st060 and st061) where the system got caught twice in fishing lines.**

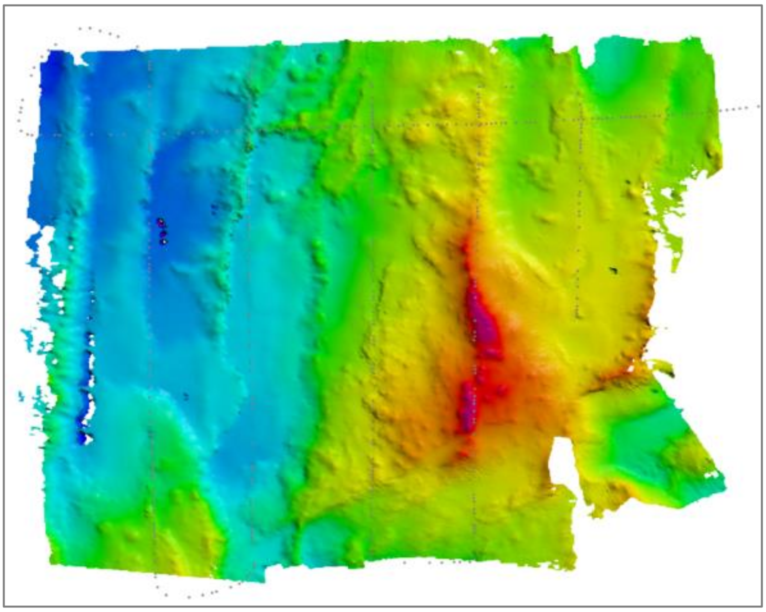


**Figure 29 – Last multibeam survey (st063) in the SW2 portion of the Kurchatov area.**

**May 30th 2021 (Kurchatov SW)**

While we were waiting for the umbilical to be repaired, we performed a blind CTD (st064; 08:11) at the Kurchatov SW2 area to 1000 m, followed by a box corer (st065; 09:16) in flat bottoms at 965 m depth. Whilst samples from the CTD and box corer were being processed in the labs, we carried out a short multi-beam transect (st066; 10:07) to finalize surveying a missing portion of the area. At 13:30 another blind CTD Rosette (st067; 13:40) to 970 m was deployed at the Kurchatov SW. Water samples from 5m, 30 m, 400 m, 800 m and 977 m were taken for eDNA measurements, nutrient and pH analysis. In the afternoon, following the successful repair of the umbilical, the hopper was tested (st068; 17:12) but the system shut down at 100 m depth. After a short repair we deployed the video system (st069; 17:50) again for a short transect along a ridge (Figure 30) until late hours (22:00). Most of the dive was dominated by black corals together with several other species of octocorals and dead coral framework. Some of the soft bottom areas found along the dive were also colonized by the octocoral *Acanella arbuscula*. After the dive we started transiting to the West Oscar area with the multibeam on (st070; 21:10). After arrival, we conducted a multibeam survey (st071; 01:06) of the area, so we could plan the sampling station for the next day (Figure 31).

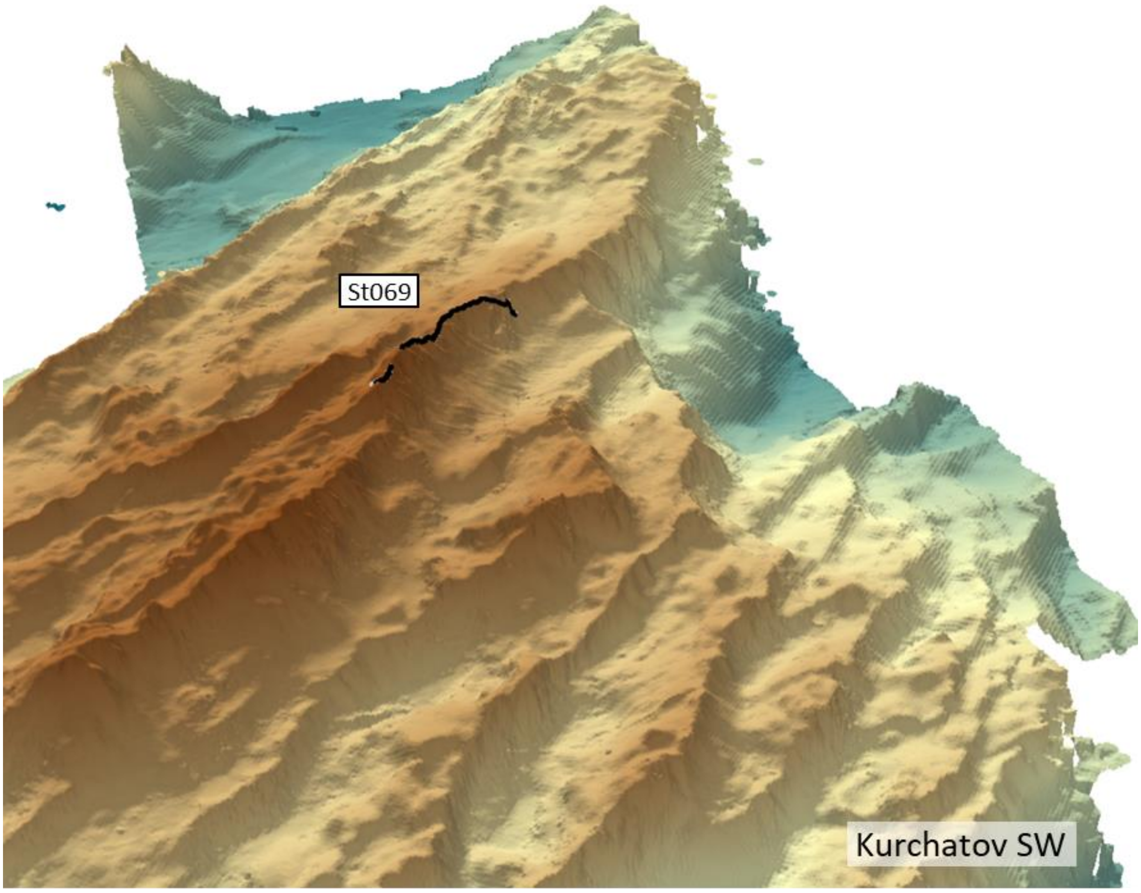



**Figure 30 – Location of the video transect (st069) conducted at the Kurchatov SW area.**

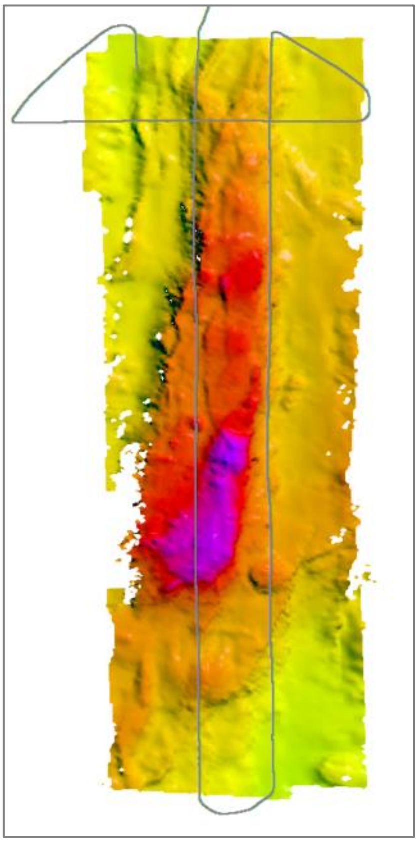


**Figure 31 – Multibeam survey (st071) in a Ridge structure located West of the Oscar seamount.**

**May 31st 2021 (W Oscar)**

After having a detailed look at the multibeam data collected during the night, we started a video transect dive (st072; 09:38). This time, we lost signal of the down looking camera and the dive was aborted and the frame brought to the surface. The crew decided to replace the down-looking camera with the top-looking camera. This camera has much lower quality and can't auto focus. Nevertheless, we decided to continue with the video surveys and made a dive in the same location (st073; 10:50) (Figure 32). Here, we observed high densities of large black corals of the genus *Leiopathes*, octocorals *Acanella arbuscula*, *Chrysogorgia* sp., *Paragorgia* sp. and other Plexauridae. During the dive, the crew tried to repair the faulty camera. After the dive, we performed a Rosette/CTD cast (st074; 14:15) in an area identified in the video transect that contained some black corals. We then moved to a flat area with about 1,000 m depth and performed one box core (st075; 15:30). The box-core didn't close because the cable got entangle in the top of the structure. We repeated the deployment (st076; 16:13) but with no success. The crew repaired the cable and we moved to a nearby flat area where we successfully perform the box-core (st077; 17:22). It was late when we finished this operation but we decided to conduct a short video survey (st078; 19:13) on the western side of this ridge (Figure 32). Not much fauna was observed throughout this dive. After the dive, we started the multibeam surveys (st079) in the west Oscar ridge, then on transit to a small ridge northeast of Gigante seamount, and then one the ridge itself (Figure 33).

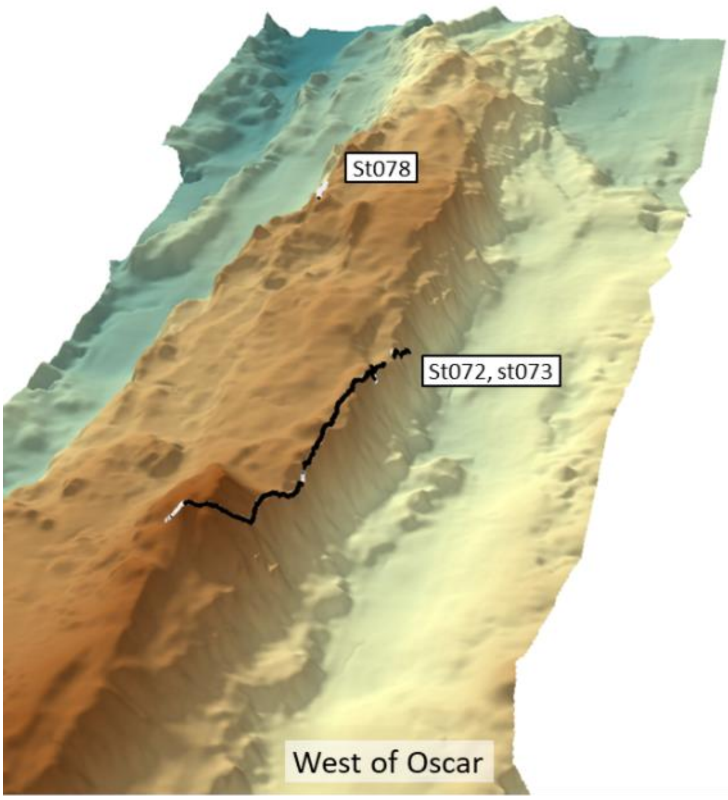



**Figure 32 – Location of the hopper video transects on the eastern (st072, 73) and western side of a small ridge West of Oscar seamount.**

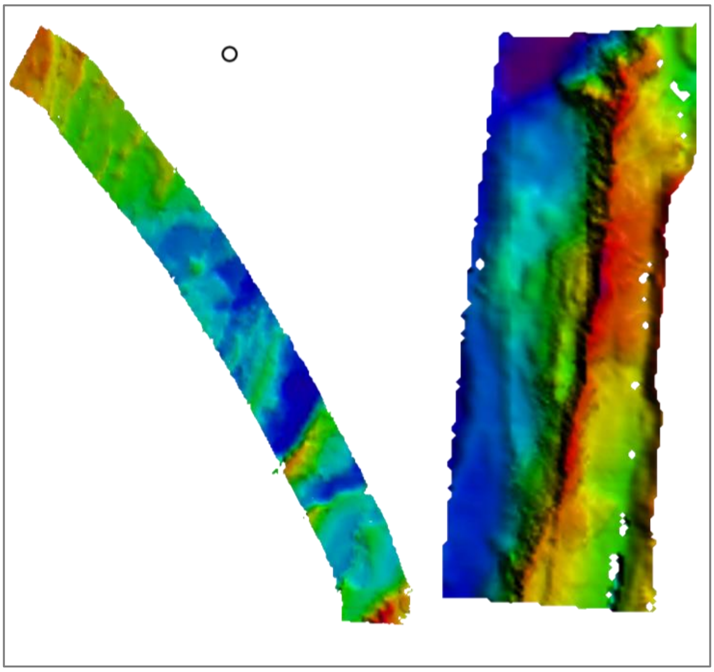


**Figure 33 - Multibeam survey (st079) on transit to a small ridge northeast of Gigante seamount and on the ridge itself.**

## June 1st 2021 (NE Gigante)

We started the day with a video transect (st080; 08:07) on the long ridge north-eastern of Gigante seamount (Figure 34). This area was mostly covered by soft sediment and was poor in benthic fauna. However, towards the end of the dive the abundance and diversity of species increased, and a dense aggregation of the stylasterid *Errina atlantica* was observed. *Hoplostethus atlanticus* and kitefin sharks of the species *Dalatias licha* were also observed along the dive. After lunch, we performed a Rosette/CTD cast (st081; 13:15) in an area along the video transect line with stylasterids, *Acanella* sp. and sponges. We then performed the last hopper dive (st082; 14:50) of the cruise at another ridge in the same area (Figure 34). The benthic community observed throughout the dive was very similar in terms of species composition, with the octocorals *Acanella arbuscula* and *Chrisogorgia* sp. as the most common species of the megafauna. Several orange roughy *Hoplostethus atlanticus* were also observed along the dive. At around 17:50, we started transiting back to Horta with the multibeam system on (st083) and performed a couple of transect lines on top of Condor seamount, an area of high seismic activity in the recent months.

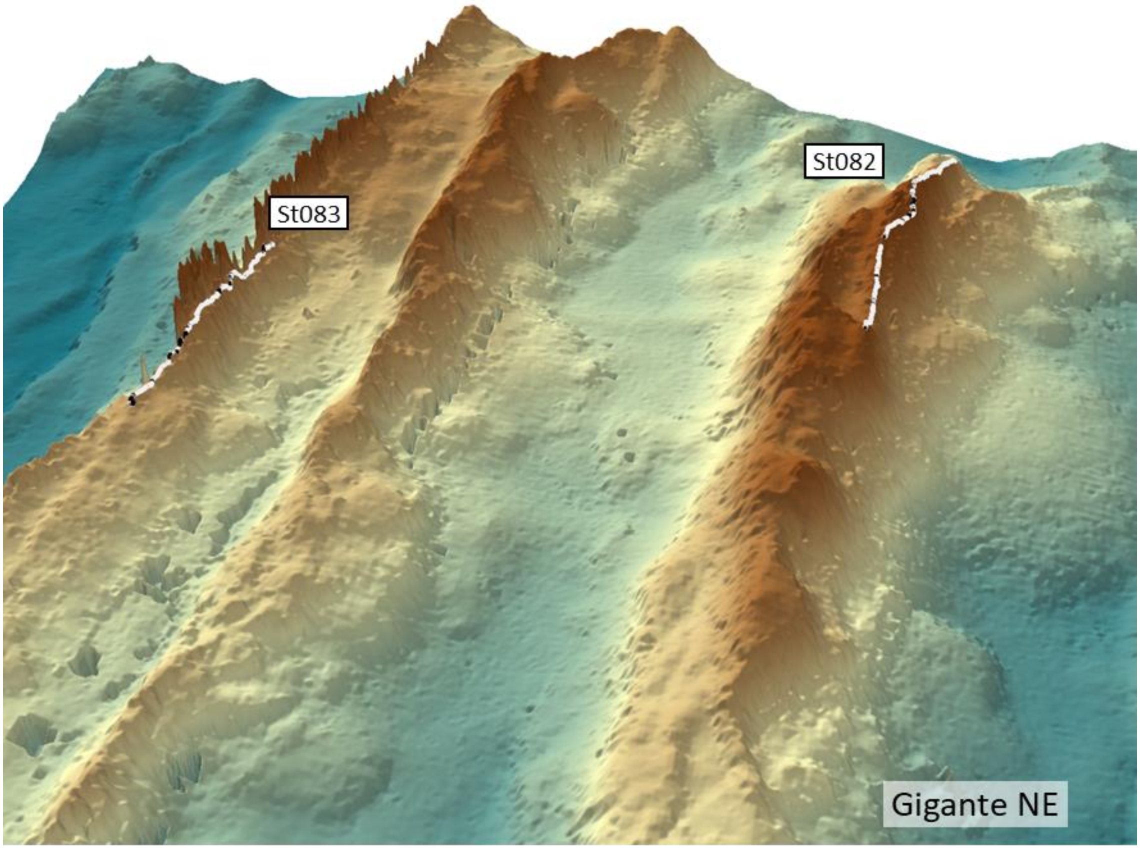



**Figure 34 – Location of the last two video transects (st081, st082) in some ridges in the north east of the Gigante area.**

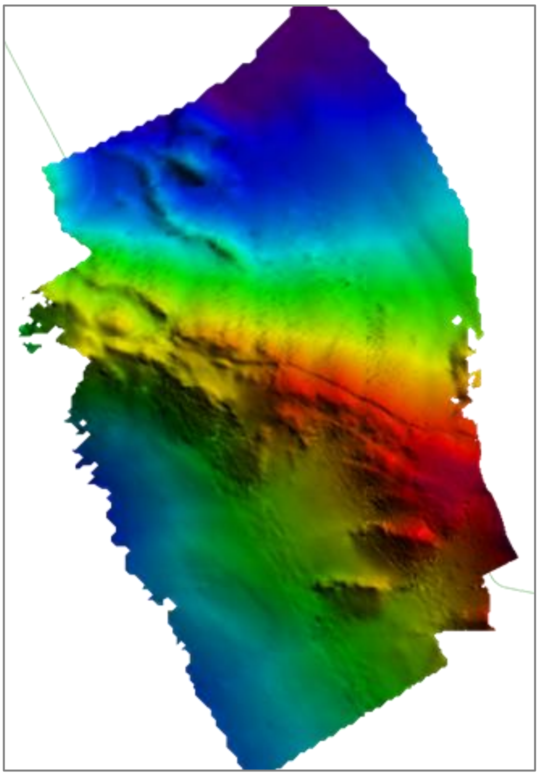


**Figure 35 - Multibeam survey (st083) on top of the Condor seamount, an area of high seismic activity in the recent months.**

**June 2nd 2021 (Horta)**

We arrived back to Horta Harbour at around 08:30. This morning was dedicated to packing all the samples and gear, copy all the files and cleaning the cabins. We left the RV Pelagia at around 13:30 local time. During the afternoon we unpack everything at the University of the Azores lab with the exception of the eDNA samples that staying on board at -80°C. These samples will be offloaded at Texel and sent to Southampton in August.


**Figure 36 – RV Pelagia docked at Horta harbor after the successful iMAR cruise, next to one of the most modern research vessels in the world these days; OceanX.**

**June 3rd 2021 (Horta)**

In the afternoon we presented the preliminary results of the Eurofleets+ iMAR cruise to the National and Regional Governments, to the media and to the general public. The press conference, organized by the OMA, counted with the presence of the Portuguese Minister for Sea affairs, Ricardo S. Santos, Regional Secretary for Culture, Science and Digital Transition, Suzete Amaro (Figure 37). In the Porto Pim Old Whale Factory, the press conference started with short presentation of the main preliminary results of the iMAR cruise, followed by a message from the President of the Okeanos Research Center, Dr Gui Menezes, followed by a message from the Portuguese Minister for Sea affairs.

**Figure 37 - Press conference to present the preliminary results of the iMAR/iAtlantic Eurofleets+ cruise at the Whale Factory Station, Horta, Faial Island.**

The press conference was widely disseminated in the main news, including the Portuguese News Agency Lusa, TV channels RTP and SIC, newspapers (Público, Correio da Manhã, Diário de Notícias, Visão, Euronews, Observador, Correio dos Açores, Açoriano Oriental, Diário Insular, Incentivo, Jornal Açores 9), radio news (Rádio Renascença) and other websites (Eurofleets, SAPO, University of the Azores).

# 4 Preliminary Results

## Multibeam surveys

During the iMAR cruise we performed 28 stations for multibeam surveys, summing 171:30 hours of surveys, 5,500 km² of mapped seabed (mainly in the North portion of the MAR in the Exclusive Economic Zone around the Azores), in 8 main areas and during many of the 2,500 km of transits (Figure 38).

The multibeam bathymetric surveys covered some of the least mapped areas of the Azores EEZ, and were crucial to the planning of the cruise activities. These surveys revealed several locations in the northern part of the Azores EEZ that are much shallower than previously thought. One of these areas reaches depths susceptible to be fished (less than 600 meters), but since it has remained unknown it can be considered intact. These areas are fundamental for understanding what ecosystems looked like before they were impacted by fishing activities and may be considered as reference sites and priority areas for conservation.

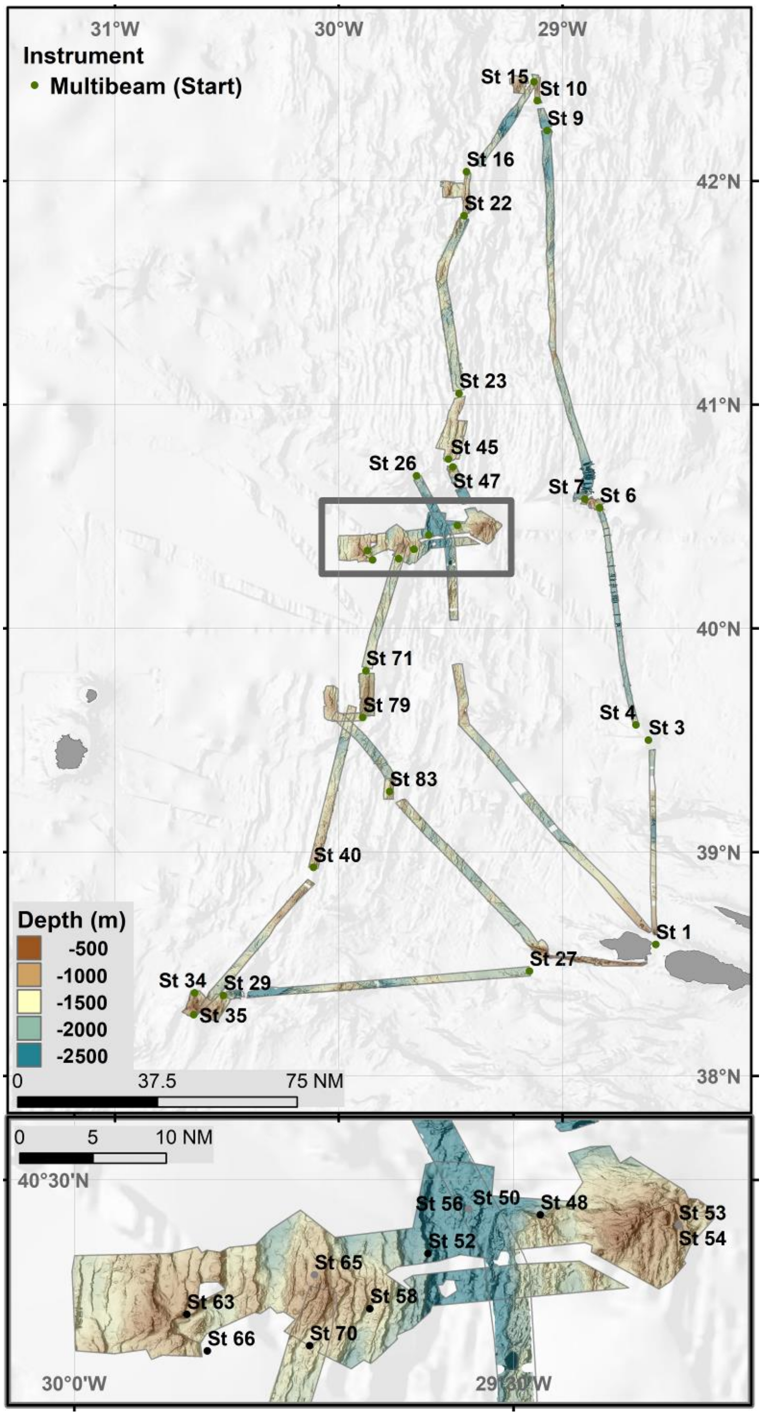
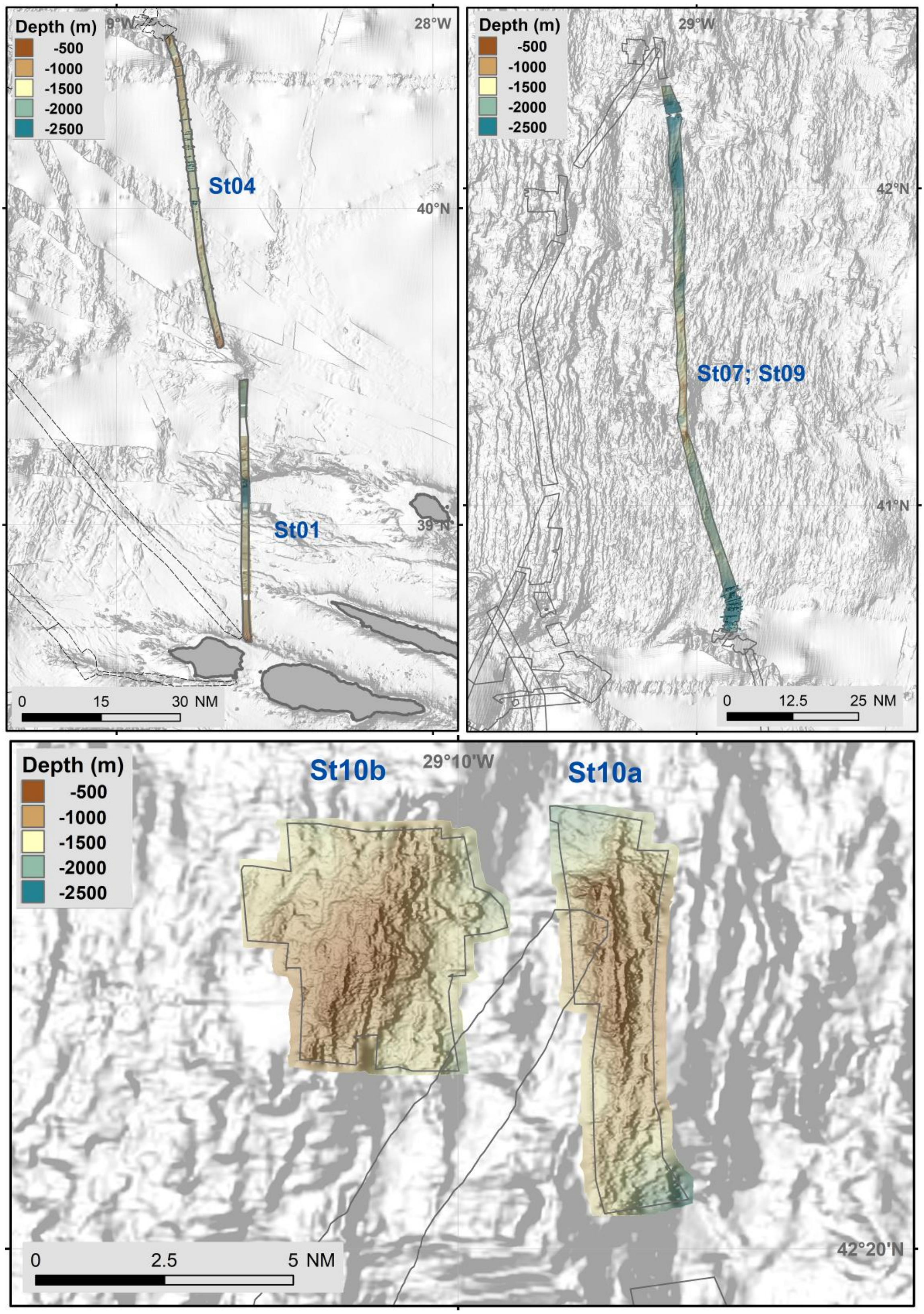
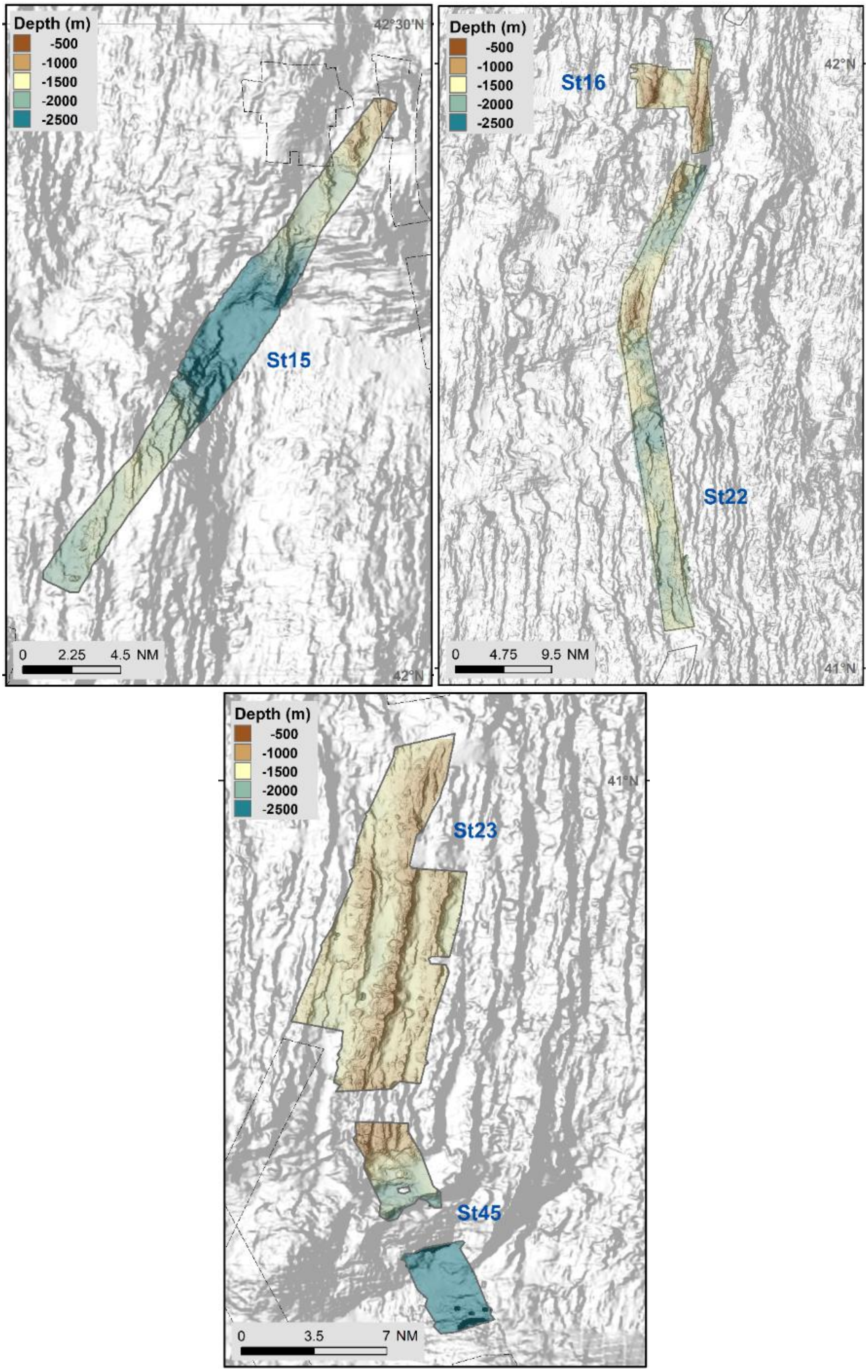
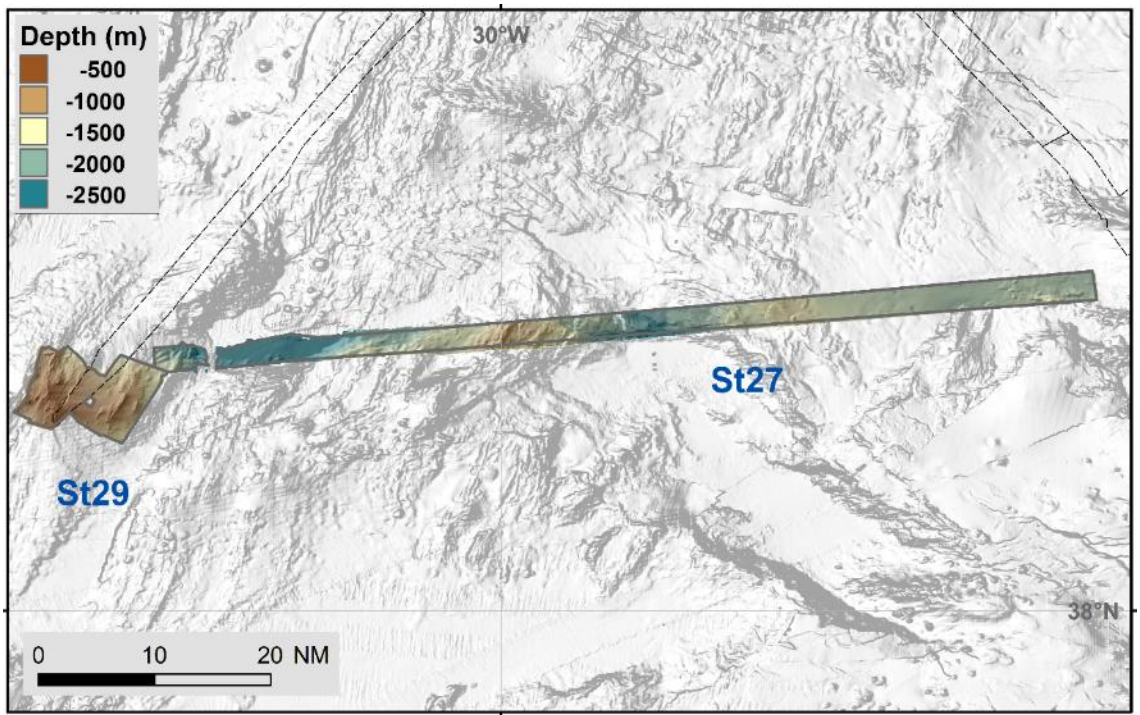


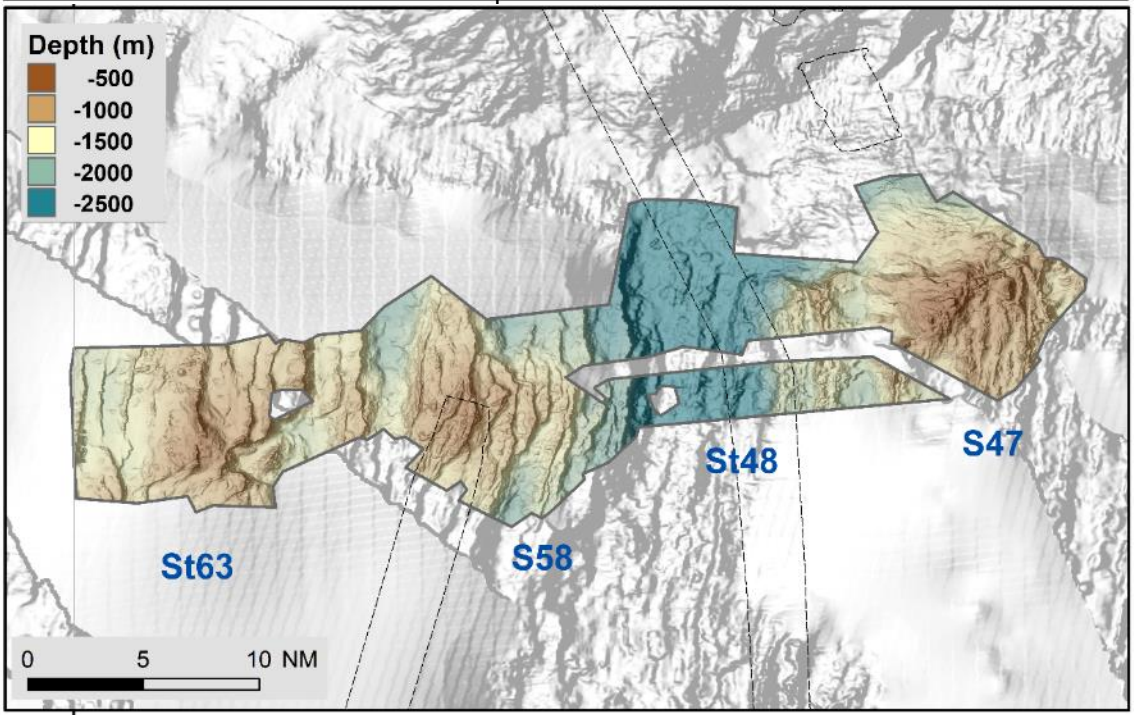

**Figure 38 – Multibeam surveys conducted during the Eurofleets+ iMAR 2021 cruise.**

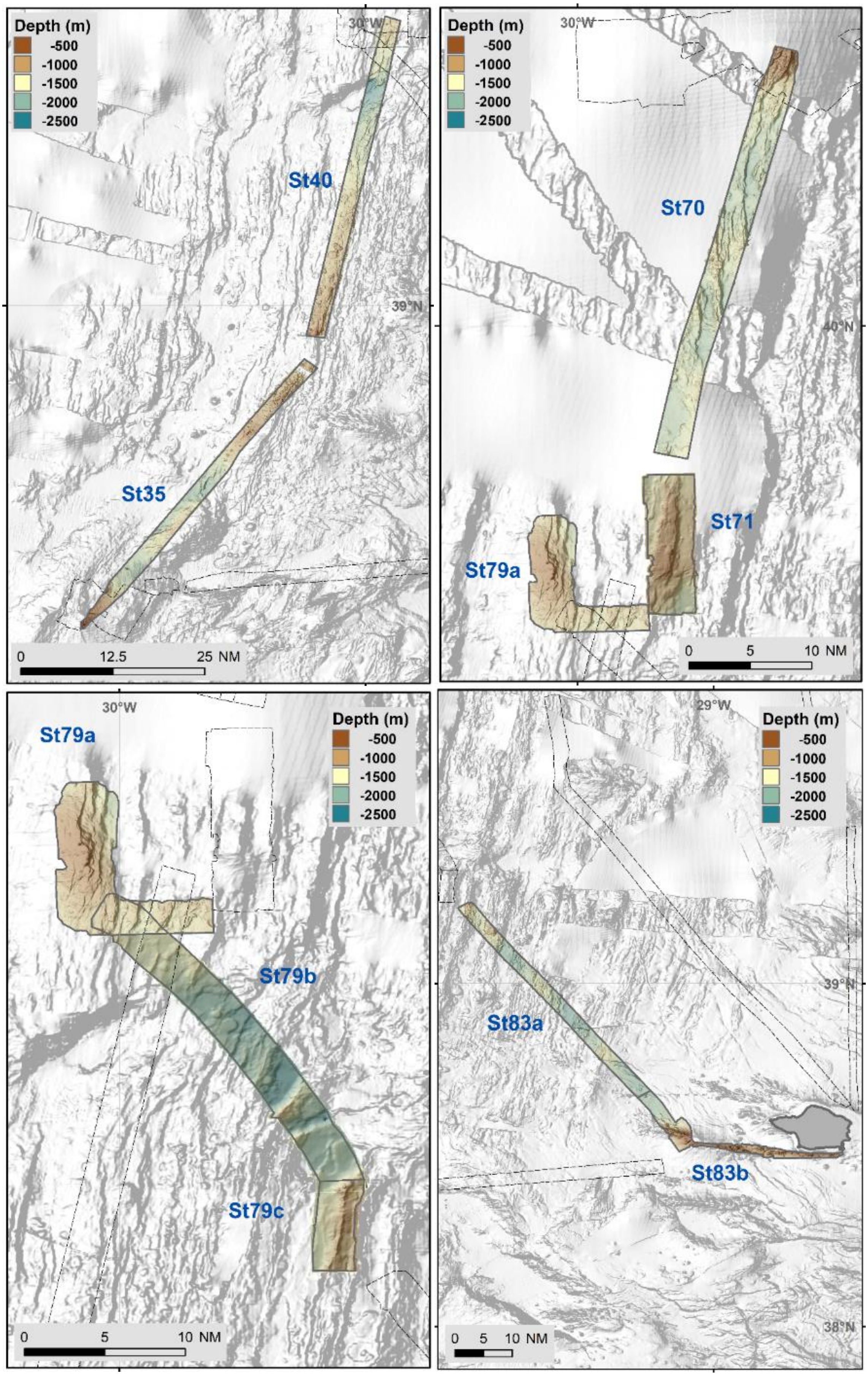
The main results of the bathymetry work, is presented as maps of the data that undergone a preliminary cleaning and post-processing procedure.


Depth (m)
-500
-1000
-1500
-2000
-2500
28°W
40°N
39°N
St04
St01
0 15 30 NM
Depth (m)
-500
-1000
-1500
-2000
-2500
29°W
42°N
41°N
St07; St09
0 12.5 25 NM
Depth (m)
-500
-1000
-1500
-2000
-2500
St10b
29°10'W
St10a
42°20'N
0 2.5 5 NM


Depth (m)
-500
-1000
-1500
-2000
-2500
42°30'N
St15
0 2.25 4.5 NM
42°N
St16
42°N
St22
0 4.75 9.5 NM
41°N
41°N
St23
St45
0 3.5 7 NM


Depth (m)
-500
-1000
-1500
-2000
-2500
30°W
St27
St29
38°N
0 10 20 NM


Depth (m)
-500
-1000
-1500
-2000
-2500
St48
S47
St63
S58
0 5 10 NM


Depth (m)
-500
-1000
-1500
-2000
-2500
30°W
St40
39°N
St35
0 12.5 25 NM
30°W
St70
40°N
St71
St79a
0 5 10 NM
30°W
St79a
St79b
St79c
0 5 10 NM
29°W
39°N
St83a
St83b
38°N
0 5 10 NM

## CTD and Water samples

During the iMAR cruise we performed 13 stations for the analysis of water mass properties which resulted in 275 pH measurements, 288 samples for nutrients analyses, and 213 samples for environmental DNA (eDNA). This stations were complemented with 7 stations for generating sound velocity profiles (SVP) (Figure 39).

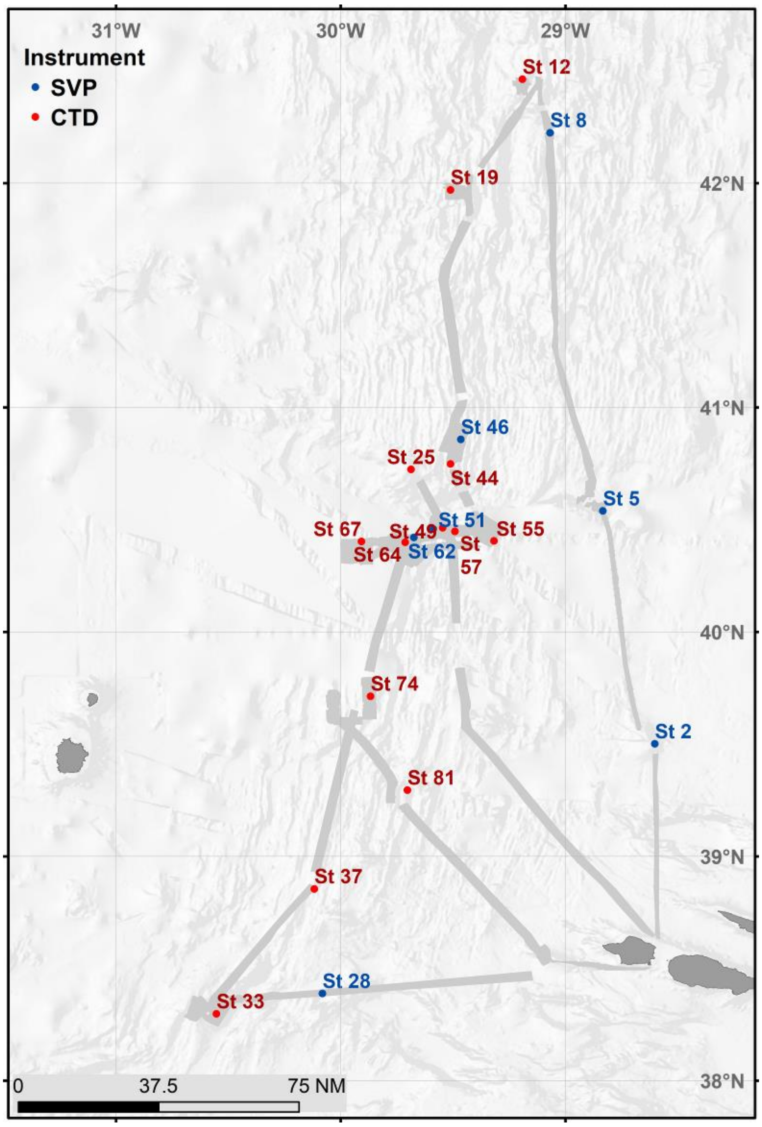



**Figure 39 – Location of the stations for the analysis of water mass properties and sound velocity profiles (SVP).**

### Water eDNA samples

Throughout the cruise, seawater from a variety of depths was collected from a total of 13 sampling areas using a CTD-rosette equipped with 24 x 10 L sampling bottles. Where possible, water samples for eDNA analysis were collected from a pre-defined location identified during a video transect. Following retrieval of the CTD, triplicate seawater samples (~4L) were filtered through 0.2 µm Sterivex™ filters using a peristaltic pump in a 10°C temperature-controlled laboratory. The eDNA on the filter was immediately preserved using RNA-later preservative and then stored at -80°C onboard.

Once the filter units are transported to the UK, eDNA in the samples will be analyzed in a dedicated clean lab using both DNA metabarcoding (multiple markers) and for targeted single species detection using quantitative PCR (qPCR) with species-specific primers. The specific qPCR assays conducted will be largely informed using information from the towed video transects and based on species of interest and importance e.g. the Black cardinal fish (*Epigonus telescopus*) or the orange roughy *(Hoplostethus atlanticus*). For the metabarcoding approach, eDNA will be extracted from all samples and gene fragments will be amplified and sequenced (paired end) using an Ilumina MiSeq system. 4 DNA markers from four gene regions (cytochrome c oxidase I, 18S rRNA, 12S rRNA, and 16S rRNA) will be used to assess biodiversity in these samples. The raw sequence reads will be demultiplexed, quality filtered and then clustered into operational taxonomic units (OTUs). The OTUs will be denoised and taxonomically assigned to the best possible taxonomic resolution using several sequence databases.

The results from both multiple marker and single marker analysis will be used to assess biodiversity at the sample areas. As the deepest water samples were taken as close to the seabed as possible, these samples will provide valuable information about both pelagic and benthic communities in the form of presence/absence data which will be compared to the video surveys. Between sampling areas, the number of OTUs detected and number of unique OTUs for each metabarcoding marker will be compared to give an indication of deep-sea community composition at each sampling area.

## Box corer

During the iMAR cruise we performed 10 successful box-corer stations and collected 171 samples for environmental DNA, 280 samples for nutrient analyses, 27 sediment samples for geological analyses, 24 for microplastic analyses, 10 samples for bacteriological studies, and 10 samples meiofauna analyses (Figure 40).

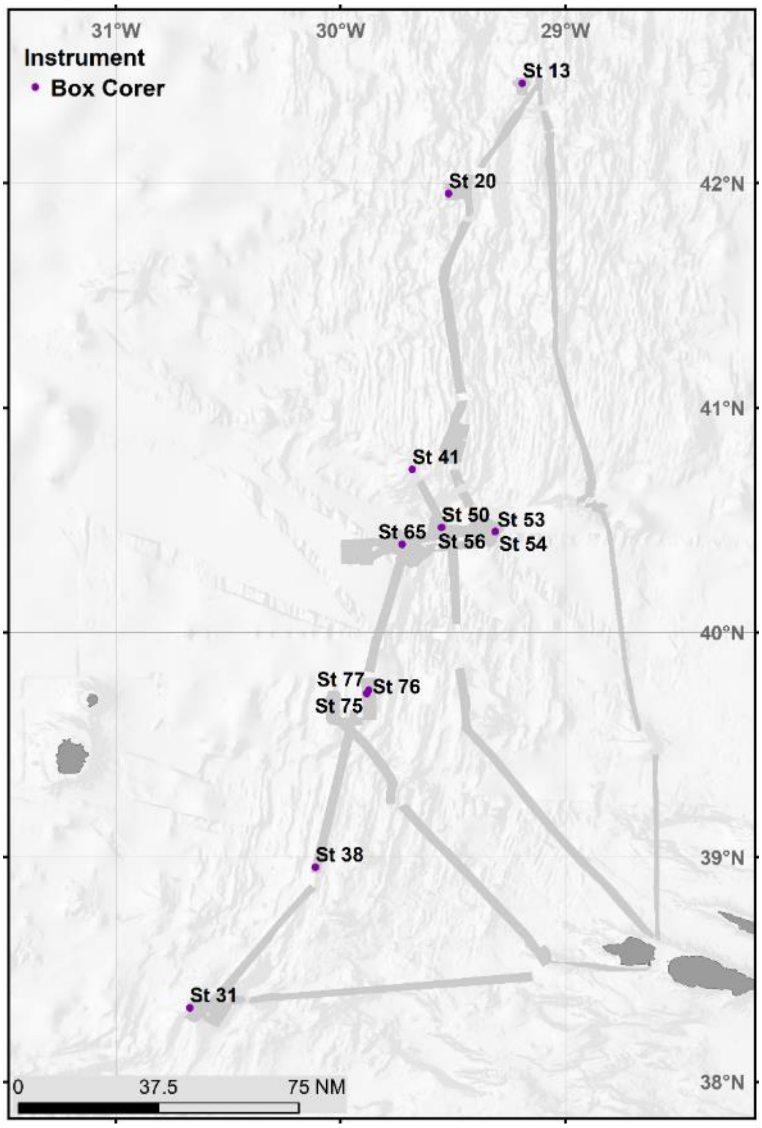



**Figure 40 – Location of the box-corer samples**

### Sediment eDNA

Following the transport of the frozen sediment samples on dry ice to the laboratory, DNA will be extracted from a subsample of each sediment sample (~20g) from all sampled layers. Short DNA fragments will be amplified using several metabarcoding primers. The exact metabarcoding markers have to be finalized but it is expected that it will likely include the cytochrome c oxidase I (COI) subunit gene and potentially a hypervariable region of both 18S and 16S genes. Following the construction of Illumina amplicon libraries and sequencing, a metabarcoding pipeline for prokaryotes and eukaryotes will be applied.

The metabarcoding results will be presented as OTUs or amplicon sequence variants (ASVs). The results will be used towards deep-sea biodiversity assessment of the marine eukaryotic and prokaryotic communities in sediment from 0-30 cm depth from each sampling area. Close attention will be paid to any identical/matching OTUs also present in the water eDNA datasets depending on the proximity of the exact sampling area.

**Bacterial analyses**

Marine scientists have explored the nature and extent of subseafloor life through scientific ocean drilling and sampling, in various oceanographic settings. Marine sediment covers 70% of Earth's surface and harbours as much biomass as seawater. However, the global taxonomic diversity of marine sedimentary communities, and the spatial distribution of that diversity remain unclear. With modern "omics" technologies now widely in use, microbial composition and taxonomic diversity, of microbes present in marine sediments, have been assessed. However, marine bacterial metabolic profiles have remained elusive and are mostly inferred from metadata analyses based on gene prediction and annotations from reconstructed genomes. To better understand the metabolically diverse microorganisms, in deep-sea sediments sampled along the Mid-Atlantic Ridge, in the Azores region, we will attempt to grow and isolate marine bacteria colonies, present in sediment corers, using marine-agar culture plates, in the laboratory. Bacterial colonies will contribute to a growing marine bacterial collection at our Institute, while bacterial physiological activities are envisaged to address the question of bacterial adaptation to fluctuating environmental conditions and activities which might reveal interesting enzymes with biotechnological applications such as the discovery of antibacterial activity against know pathogen and new protease activities of interest for biomass transformation, e.g. lignocellulosic activity. In addition, we will also look into the ability of deep-sea marine bacteria to synthesize structurally diverse classes of bioactive secondary metabolites with high biotechnological potential.

## Shipboard (S-) ADCP

Shipboard (S-) ADCP data were collected continuously throughout the entire survey period. On-station and underway current velocities and relative acoustic backscatter data were collected with a 75-kHz Teledyne RD Instruments (RDI) Ocean Surveyor system mounted in the ship's hull along with ancillary data of ship position, pitch and roll and heading. The software RDI VmDAS was used to configure instrument setup, data communication (ship position, ship heading) and data acquisition. The vertical bin size was set to 8 m (first bin at 16 m) and the total sampling range was 100 bins (800 m). The transducer offset relative to the ship's keel was set to 45°. Repeated ADCP surveys were largely conducted on-station at different hopper video stations.

After the cruise, single ping ADCP data will be post-processed using the Common Oceanographic Data Access System (CODAS) from the University of Hawaii following the GO-SHIP guidelines for shipboard ADCP measurements (Figure 41). The main CODAS processing steps will include time-averaging of single ping data into 120 second ensembles, water track calibration to estimate any remaining transducer offset and calculating absolute current velocities by removing the ship velocity from the ADCP ensemble velocities. The final dataset will include the following variables: Time, depth (m), u-velocity (m/s), v-velocity (m/s), acoustic backscatter (echo amplitude in raw counts).

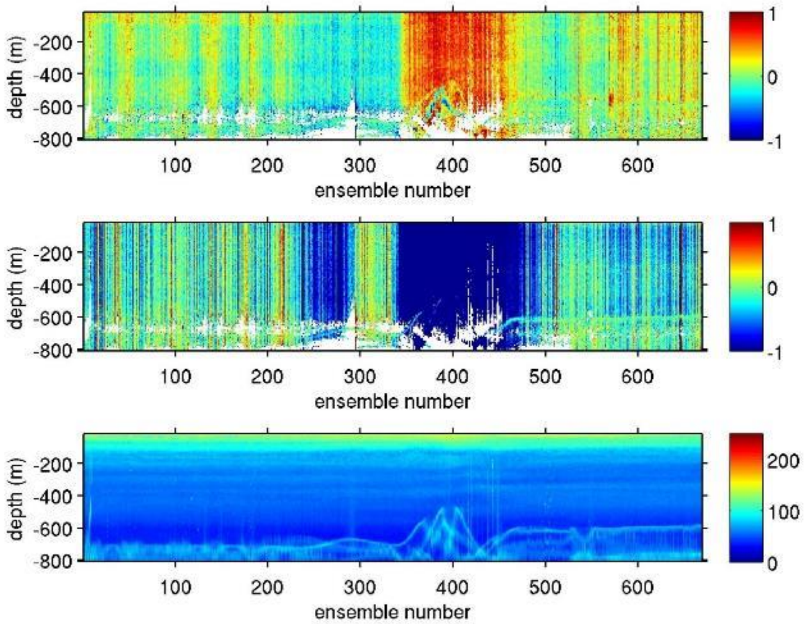



**Figure 41 - Time series of raw, single-ping S-ADCP profiles of u-velocity (E-W, TOP), v-velocity (N-S, MIDDLE) and relative backscatter intensity (BOTTOM) at station 60. Velocity units are in m/s, echo intensity unit is in dB. Please note, that the velocity data still contain ship speed and ship motion. The deep relative backscatter maximum indicates the sea bottom echo.**

## Video surveys: Deep-sea benthic communities

The iMAR cruise aimed to evaluate the role of the Mid-Atlantic Ridge in shaping the latitudinal and trans-Atlantic patterns in deep-sea biogeography, connectivity and spatial distribution patterns of deep-sea megafauna. To achieve this goal, during the iMAR cruise we mapped and characterize deep-sea coral and sponge communities inhabiting unexplored seamounts and ridges in the MAR in the Azores Region; identified new areas that fit the FAO's VME definition; and added valuable information to the existing knowledge on the environmental drivers that determine the spatial distribution of deep-sea benthic biodiversity in the MAR. Finally the cruise contributed with data to determine the condition of benthic communities by looking at evidence of fishing damage to fauna, presence of lost fishing gear and marine litter. All these objectives, were achieved with a detailed sampling programme with the video hopper system developed by NIOZ. During the iMAR Cruise we conducted 19 dives with the hopper system that resulted in 54 hours of deep-sea images over 48 km of the seabed (Figure 42).

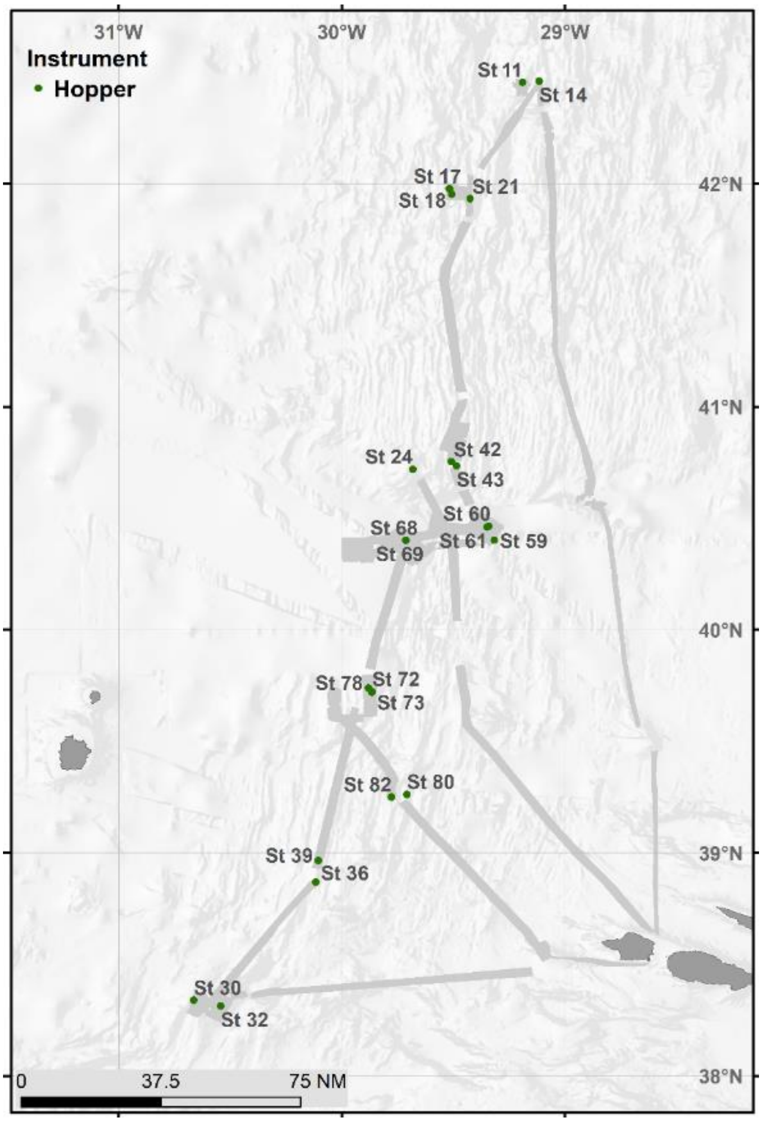



**Figure 42- Location of the Hopper video dives conducted during the Eurofleets+ iMAR cruise.**

## East of Chaucer South

Station 11 corresponded to the first dive of the iMAR cruise carried out with the Hopper system. The transect was performed in an elongated ridge found in an area named Chaucer, for which no previous information regarding the composition of its deep-sea benthic communities was available. This area is also the northernmost sector explored during the iMAR cruise, found only several miles away from the northern limit of the Azores EEZ. The Hopper reached the seabed at 8:30 and left the bottom at 11:45. The transect lasted around 3 hours and 15 minutes and covered approximately 3.7 km of seabed. The dive was performed following a north-to-south direction, always moving up the slope, starting at almost 1050 m depth and reaching the shallowest point at 725 m depth (Figure 43). The dive started in an area with accumulations of coral rubble, with the presence of the glass sponge *Phronema carpenteri* and the bamboo coral *Acanella arbuscula*. Some Macrouridae fishes and a deep-sea shark were observed during the first minutes of the dive. As soon as the rock began to outcrop, the number of benthic species identified increased significantly. In those hard grounds, it was common to observe coral framework produced by scleractinian corals, some of which with signs of alive polyps. Several other coral species were identified within these patches, especially remarkable was the presence of black corals of the genus *Leiopathes* and *Bathypathes*, as well as octocorals of the genus *Paramuricea* and stylasterids of the species *Errina atlantica*. This community composition was frequently observed throughout the whole dive, especially in areas of hard substrates. Where the seabed had more a flat nature, accumulations of coral rubble were common, which was associated to a lower set of species. In these cases, the bamboo coral *Acanella arbuscula* and the glass sponge *Pheronema carpenteri* were the most conspicuous species.

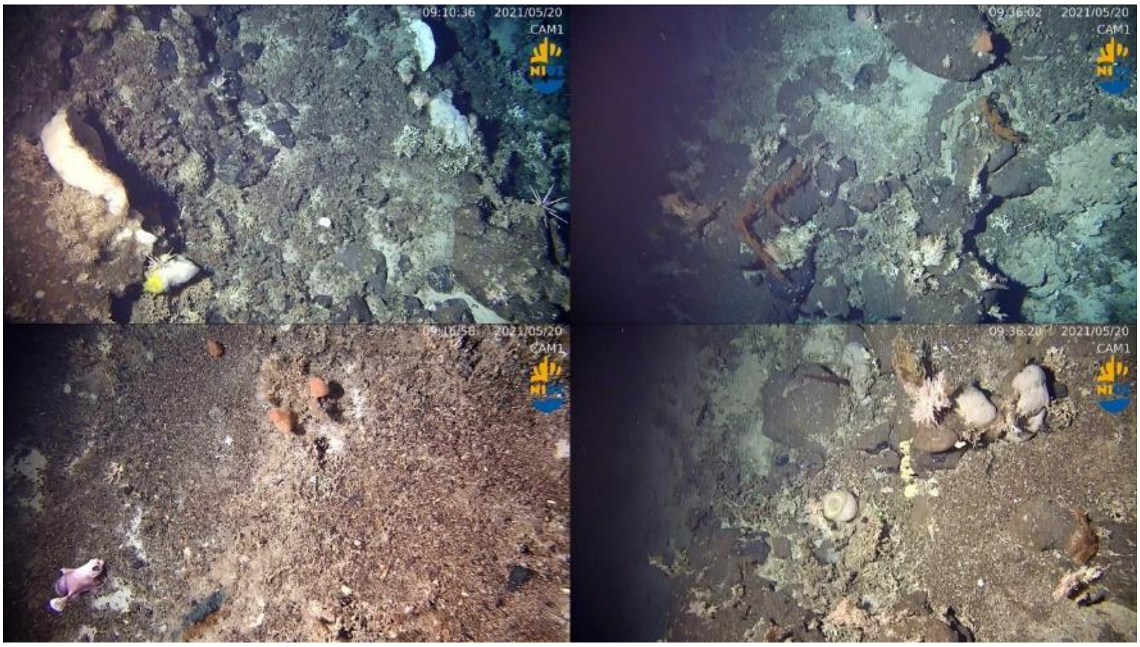



**Figure 43 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 11.**

### West of Chaucer South

Station 14 aimed to complement the information gathered during the previous dive in Chaucer South. This second dive of the cruise was performed in a different ridge, located just 3 nm from the previous Hopper station. The Hopper reached the seabed at 18:15 and left the bottom at 20:00. The transect lasted around 1 hour and 45 minutes and covered approximately 1.45 km of seabed. Again, the dive was performed following a north-to-south direction, always moving up the slope, starting at 1250 m depth and reaching the shallowest point at 880 m depth (Figure 44). As expected, the composition of the benthic fauna was very similar to that of the previous dive. The transect started in an area of hard substrates with large laminate sponges (likely from the genus *Phakellia*), balck corals of the genus *Leiopathes,* octocorals of the genus *Paramuricea* and bamboo corals of the genus *Acanella* and *Keratoisis*. This set of characteristic species appeared throughout the whole dive, with their densities varying in different sectors of the dive. From the beginning, the steepness of some rocky areas was higher than that reported in the previous dive, and the density and size of black corals and octocorals was highest in those areas.


**Figure 44 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 14. Top: Large laminate sponges accompanied by black corals and octocorals. Bottom left: A large bamboo coral of the genus *Keratoisis* next to a large colony of the black coral *Leiopathes*. Bottom right: High diversity and abundance of corals on the upper part of a cliff, where current conditions are best for the development of these suspension feeders.**

## East of D12

Station 17 was performed in a deep elongated ridge found in an area named D12, for which no previous information regarding the composition of its deep-sea benthic communities was available. The Hopper reached the seabed at 8:30 and left the bottom at 11:55. The transect lasted around 3.5 hours and covered approximately 2.75 km of seabed. The dive was performed following a north-to-south direction, always moving up the slope and covering a relatively large bathymetric range, starting at almost 1250 m depth and reaching the shallowest point at 650 m depth (Figure 45). The composition of the benthic community was very similar to that observed on the previous two dives, especially for the deepest section of the transect. Most hard substrates in this part of the dive had patches of dead coral framework generated by scleractinian corals, with some tips likely alive as determined by their orange coloration. In those areas, it was common to observe colonies of the black coral *Leiopathes*, although reaching smaller sizes that those reported in the previous dive. Other common species identified were the bamboo coral *Acanella arbuscula* and *Keratoisis* sp., and some octocorals of the genus *Paramuricea* and *Paragorgia,* this last species with some very large colonies. At around 800 m depth, the benthic community started to show a change in its composition, First, some colonies of the primnoid coral *Narella versluysi* and *Narella bellissima* started to appear, and then it changed completely to a dense aggregation of yellow/orange Plexauriade octocorlas, whose identification is still being determined. It was in this area where several Atlantic wreckfishes *Polyprion americanus* were observed gently swimming in front of the camera. At this point, some problems with the winch made the Hopper to hit the seabed a few times, which ended up in some of the lights moved from their correct position. To overcome this situation, the Hopper was brought to surface to check for any damages and to reposition the lights.

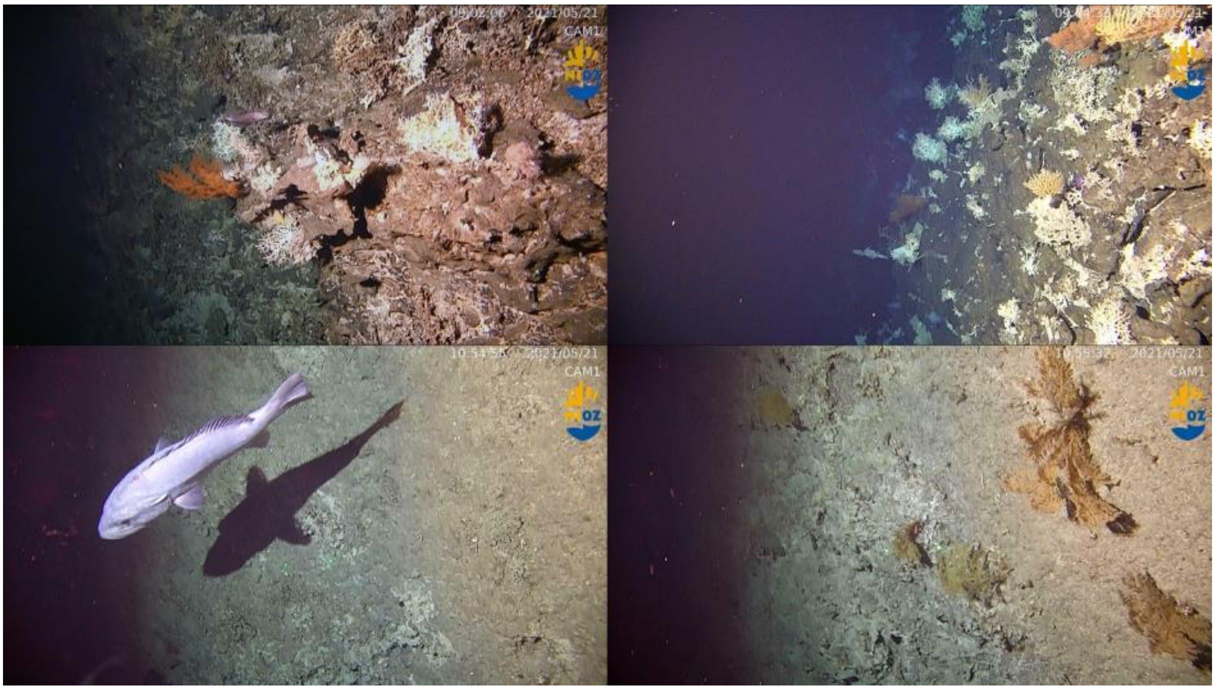


**Figure 45 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 17. Top: Scleractinian corals on hard substrates with some small colonies of black corals and Plexauridae. Bottom left: One of the several wreckfishes *Polyprion americanus* observed in the last part of the dive. XX. Bottom right: Aggregation of yellow/orange Plexauridae still to be identified to species level.**

Station 18 corresponds to the descent of the Hopper to the same location of the end of the previous dive once the system was checked on surface and the lights were correctly positioned. The dive lasted only 10 minutes before bringing the Hopper back to surface. All dive occurred within a patch of coral rubble.

Station 21 aimed to complement the information gathered during the previous dives in D12 area. This dive was performed in a different ridge, located just 5 nm west from the previous Hopper station. The Hopper reached the seabed at 16:45 and left the bottom at 19:40. The transect lasted around 3 hours and covered approximately 2.9 km of seabed. Again, the dive was performed following a north-to-south direction, and in this case keeping a relatively stable depth range, between approximately 860 and 1000 m depth (Figure 46). As expected, the composition of the benthic fauna was very similar to that of the first part of the previous dive, although the densities and sizes of the black corals of the genus *Leiopathes* were significantly higher. The number of dense patches of black corals observed was large, and they kept appearing almost throughout the whole dive. Higher densities were usually registered in areas of steeper slopes and rock overhangs, generally associated to a high diversity of benthic species, including coral framework formed by scleractinan corals, other black coral species such as *Bathypathes patula* and *Paranthipathes hirondelle*, large Plexauridae and other octocorals such as *Acanella arbuscula* and *Chrysogorgia* sp.


**Figure 46 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 21. Top left: A large Bathypathes observed at the beginning of the dive. Remaining images: Aspect of the rich benthic community observed in this dive, with several aggregations of large black corals, as well as coral framework formed by scleractinian corals, with a rich associated fauna.**

**Kurtchatov northwest; Isolado**

Station 24 was performed in the seamount named Isolado, located on the north-western sector of the Kurchatov fracture zone. There was no previous information regarding the composition of deep-sea benthic communities in this seamount. The Hopper reached the seabed at 8:45 and left the bottom at 10:40. The transect lasted around 2 hours and covered approximately 1.9 km of seabed. The dive was performed following a southeast-to-northwest direction, starting at almost 1200 m depth and reaching the top of the seamount at around 690 m depth. The aim of the dive was to explore the whole bathymetric gradient of this seamount below 1200 m depth, to identify the main benthic communities found on its slopes (Figure 47). Although the transect developed as planned, this was one of the least diverse dives, with most of the soft- and hard-bottom areas explored showing low numbers of megabenthic species. During the first part of the dive, a series of flat areas characterized by sand and mud appeared throughout, in most cases with not much fauna to be reported besides *Lebensspuren* marks on the seafloor and several sea urchins of the species *Cidaris cidaris*. Deep-sea fishes, some belonging to Macrouridae family, were filmed in those sedimentary areas. In most cases, the presence of boulders on these flat sedimentary areas did not significantly increase the diversity reported, although some bamboo corals such as *Acanella arbuscula* and *Keratoisis grayii* were identified attached to the rocks. As the Hopper moved up the slope, the composition of the benthic communities started to change, with the presence of aggregations of Asconema sponges as well as the community formed by the glass sponge *Pheronema carpenteri* and the primnoids *Narella* spp., generally in low abundances.

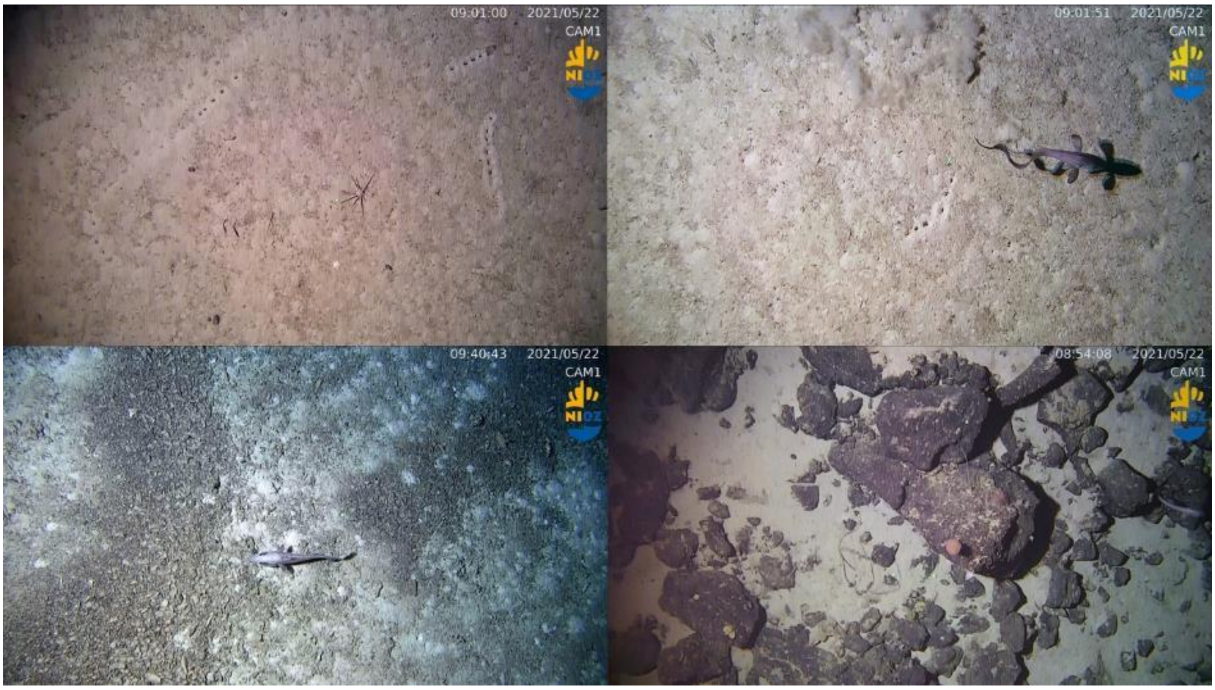



**Figure 47 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 24. Top: Soft-bottom areas with the presence of *Lebensspuren* marks on the seafloor. Bottom left: Accumulations of coral rubble on the soft-bottom areas, with one of the few Macrouridae fish observed along the dive. Bottom right: Boulders with bamboo corals.**

## Cavala seamount

Station 30 was performed in a depression area that divides Cavala seamount in two. There existed relevant information regarding the composition of deep-sea benthic communities that inhabit shallower areas of Cavala seamount, but this deeper sector had never been explored in the past. The Hopper reached the seabed at 8:55 and left the bottom at 12:00. The transect lasted around 3 hours and covered approximately 3.65 km of seabed. The dive was performed following a north-to-south direction, covering a rather wide bathymetric range, starting at 930 m and finishing at 645 m depth (Figure 48). The dive started on an area of mixed sediments, with the presence of the octocoral *Acanella arbuscula*, some colonies of stylasterids of the species *Errina atlantica*, soft corals of the genus cf. *Anthomastus* and several sponge species, such as those from the genera cf. *Phakellia* and *Asconema*, among others. As expected, the flat areas found on the middle part of the canal were mostly of a soft-sedimentary nature, and occurred for several hundreds of meters during the first part of the dive. The currents on the canal are likely to be of certain strength, as it could be inferred from the marks (sand ripples) observed on the sand. The abundance of megabenthic species in this sector was, however, relatively low. Some deep-sea sharks passed in front of the camera during this part of the transect. At around 800 m depth, the presence of rocky outcrops began to be more common, together with an increase in the number of species observed. In these hard grounds, large aggregations of white laminate sponges were observed (likely from the genus *Phakellia*, but species ID yet to be confirmed), which generally appeared in association with other invertebrate species. Some remarkable formations made by scleractinian corals were reported within this sponge aggregation, in which certain portions appeared to have alive colonies. The diversity and abundance of benthic species appeared to be higher within these coral formations. Some of the species reported correspond to octocorals such as *Paramuricea* sp. and *Pleurocorallium johnsoni,* a relatively cosmopolitan vase-like sponge (likely

*Asconema*), as well as a yellow laminate sponge, likely of the genus *Poecillastra* and the ever present sea urchin *Cidaris cidaris*. Regarding the mobile fauna, and besides some species of deep-sea sharks (e.g. *Pseudotriakis microdon*), some silver scabbardfishes (*Lepidopus caudatus*) and blue-mouth rockfishes (*Helicolenus dactylopterus*) were reported, as well as a squid swimming in front of the forward-facing camera.

**Figure 48 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 30. Top left: Aspect of the soft-sedimentary areas encountered during most of the first section of the dive. Top right. Aggregation of white laminate sponges. Bottom left: Hihd density of the glass sponge *Asconema* sp. Bottom right: Coral framework produced by scleractinian corals, with some alive portions. The diversity of benthic species on these areas was highest.**

Station 32 was also performed in Cavala seamount, on the eastern sector, where less information was available. The Hopper reached the seabed at 15:35 and left the bottom at 18:30. The transect lasted around 3 hours and covered approximately 2.55 km of seabed. The dive was performed following a north-to-south direction, covering a smaller bathymetric range than the previous dive, between 700 and 880 m depth (Figure 49). The community observed along this transect differed significantly from what was reported in the previous dive, and was mostly dominated by the association between the Primnoids *Narella versluysi* and *Narella bellissima* and the glass sponge *Pheronema carpenteri*. Those 3 species appeared almost throughout the whole dive, with local densities varying in the different sectors. In some parts of the dive, the abundance and diversity of lithistid sponges was higher, with some fields of *Maccandrewia azorica* reported, as well as the presence of tubular-shaped sponges of very large sizes.


**Figure 49 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 32. Top left: Flat areas with the sea urchin *Cidaris cidaris*. Top right. The glass sponge *Pheronema carpenteri*. Bottom left: High densities of the primnoid *Narella versluysi.* Bottom right: Some of the very large sponges observed.**

### Gigante seamount complex; Western ridge

Station 36 was performed on an elongated ridge found on the north-western side of the Gigante seamount complex. Previous dives performed in several seamounts and ridges inside the Gigante area had provided relevant information regarding the composition of its deep-sea benthic communities. However, this specific ridge had never been explored before and no data was yet available. The Hopper reached the seabed at 8:35 and left the bottom at 10:40. The transect lasted 2 hours and 15 minutes and covered approximately 2.6 km of seabed. The dive was performed following a north-to-south direction, staying at a similar depth range along the whole dive at around 900-1000 m (Figure 50). The benthic community encountered was similar to that observed in previous dives performed during the cruise at similar depths, with a relatively stable community that had alternating dominant species throughout. The most widespread coral species was the bamboo coral *Acanella arbuscula*, which in certain areas generated gardens of relatively high densities. When the rock outcropped, it was common to observe small bioconstructions made by scleractinian corals and lace corals of the species *Errina atlantica*. In those areas, several Plexauridae corals were observed, most of them not yet identified to species level. Towards the second part of the dive, the rocky outcrops (especially if creating overhangs) were colonized by large colonies of the black coral *Leiopathes*. In those areas, some large colonies of the sea fan *Paragorgia* sp. were also observed, together with other coral species such as *Hemicorallium tricolor, Paramuricea* sp. and *Paragorgia* sp. The very last part of the dive had a very pronounced relief, with several vertical walls encountered, some of which even forming narrow canyons with rocks on both sides. The community at this point was the most diverse, with scleractinians, black corals and several species of octocorals, but the likelihood of entanglement due to the presence of overhangs was key to decide the dive had reached its end.

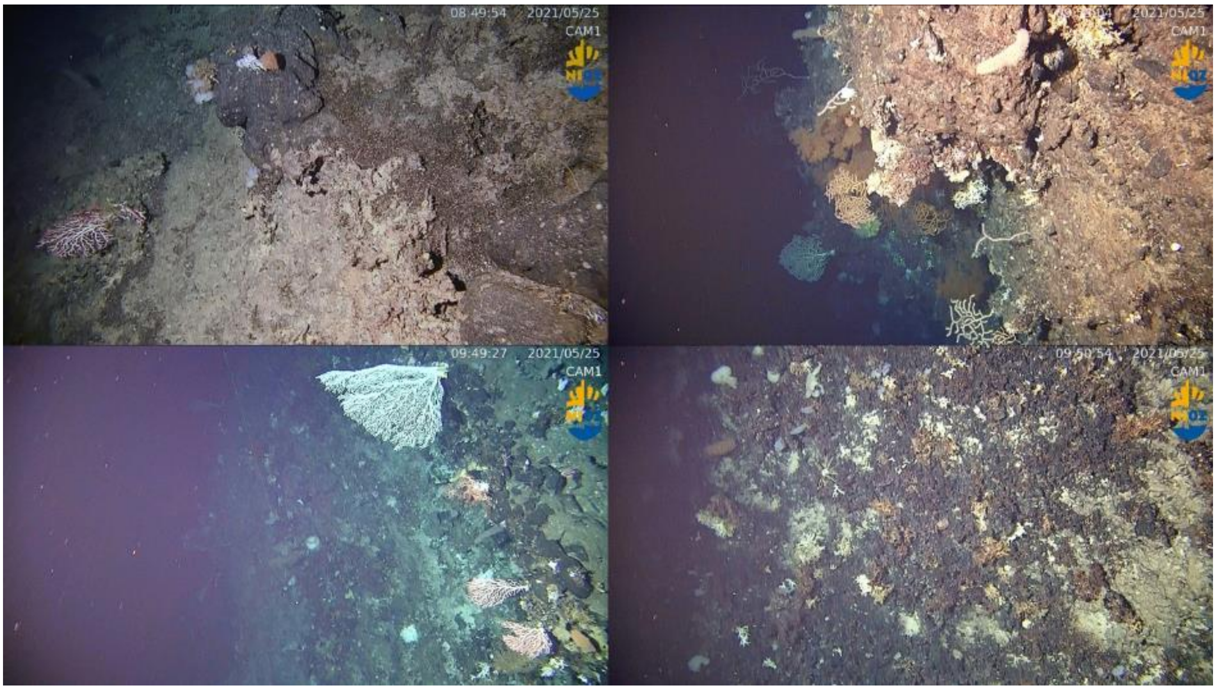



**Figure 50 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 36. Top left: Rocky areas at the beginning of the dive, where only a few coral species were observed. Top right. Areas with high relief with the presence of large black corals, in association with other octocoral species. Bottom left: Some of the few large *Paragorgia* sp. encountered throughout the dive. Bottom right: Dead coral framework with *Acanella arbuscula* and *Cidaris cidaris*.**

Station 39 was also performed on an elongated ridge found on the northwestern side of the Gigante seamount complex, aiming to complement the information gathered in the previous dive. The Hopper reached the seabed at 15:23 and left the bottom at 19:15. The transect lasted 3 hours and 50 minutes and covered approximately 4 km of seabed. The dive was performed following a north-to-south direction, covering a wider bathymetric range if compared to the previous dive, starting at around 1000 m depth and moving up towards shallower areas until reaching depths of 600 m (Figure 51). This amplitude in the depths explored also determined the benthic communities observed, which showed a larger diversity than in the previous dive.

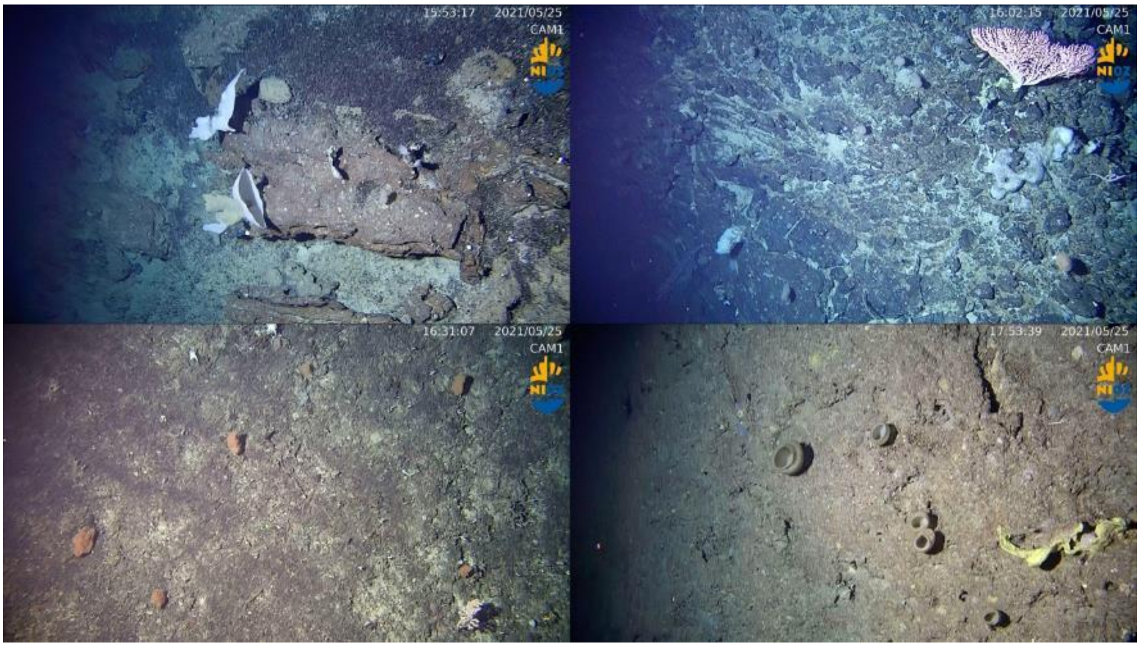


**Figure 51 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 39.**

### Kurchatov, North-west

Station 42 was performed on the north-western sector of the Kurchatov area, where only one of the ridges was explored. The Hopper reached the seabed at 10:46 and left the bottom at 14:15. The transect lasted 3 hours and 30 minutes and covered approximately 3.4 km of seabed. The aim of the dive was to explore the summit area and adjacent slope of the ridge following a north-to-south direction, staying at a similar depth range along the whole dive around 1000 m (Figure 52). Although the dive lasted for several kilometres, the benthic communities observed along the dive were relatively stable in terms of species composition, alternating their presence throughout the dive based on substrate typology and seafloor slope. The dive started in an area of rocky outcrops with the presence of sclerctinian corals in small patches and black corals of the genus *Leiopathes*. These two species commonly appeared throughout the whole dive, especially on areas of complex relief dominated by rocky outcrops. Several other species were found in this community, including octocorals of the genus *Acanella*, *Paramuricea*, *Keratoisis*, *Chrysogorgia*, among many others. Some parts of the dive, with a smoother relief, were characterized by deposits of coral rubble, with a lower number of megabenthic species identified.

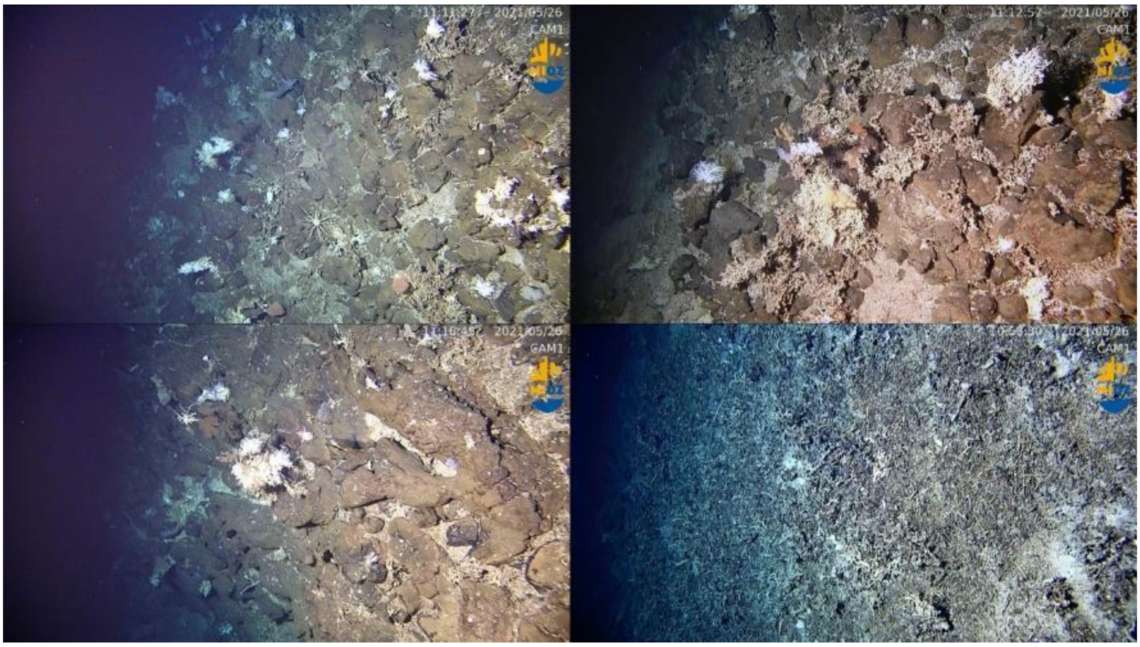


**Figure 52 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 42. Top and bottom left: Several images of the most common benthic community observed, with dead and alive patches of scleractinia and small/medium-sized black corals, as well as many other accompanying species. Bottom right: Large deposits of coral rubble.**

**Kurchatov; South-east**

Station 59 was performed on the south-eastern sector of the Kurchatov area, in an elongated ridge east of the main seamount summit. The Hopper reached the seabed at 8:50 and left the bottom at 15:00. Hence, this was the longest transect of the iMAR cruise, lasting just over 6 hours and covering more than 5 km of seabed. The aim of the dive was to explore the summit of the ridge following a south-to-north direction, covering a depth range between 700 and 1000 m (Figure 53). Although the dive lasted for several kilometers, the benthic communities observed along the dive were relatively stable in terms of species composition, alternating their presence throughout the dive based on substrate typology and seafloor slope. The dive started in an area of rocky outcrops with the presence of scleractinian corals, together with the octocorals *Acanella arbuscula* and *Hemicorallium tricolor*. As the dive progressed, some areas started to show higher percentage cover of coral framework, most of it dead but with some alive tips, identified by their orange color. When the seabed had a complex relief, with outcropping rocks creating overhangs and small vertical walls, the diversity of coral species was highest, with the presence of black corals, especially that of the genus *Leiopathes*, but also other octocoral species from the genus *Paramuricea*, *Paragorgia*, *Acanella* and *Lepidisis* sp., among others. It is interesting to point out that around 11.50, several large ophiouroids of the genus *Gorgonocephalus* were observed living on top of the coral framework. In areas where the relief was smoother, and hence with softer bottoms which were most of the time covered in coral rubble, the dominant species were the octocorals *Acanella arbuscula* and *Chrysogorgia* sp., together with the sea urchin *Cidaris cidaris*. In terms of mobile fauna, some squids and octopus were filmed, as well as cardinal fishes of the genus *Epigonus* and interestingly a rarely observed deep-sea shark of the species *Pseudotriakis microdon*.


**Figure 53 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 59. Top left: Large octocoral of the genus *Paragorgia* on top of a large boulder on sloping terrain. Top right. Coral framework, with some alive portions, with several black corals found in its proximity. Bottom left: Black corals growing on top of large boulders on sloping terrain Bottom right: Deposits of coral rubble with barely any megafauna detectable.**

Station 60 was performed on the southeastern sector of the Kurchatov area, aiming to explore a shallower area than that of the previous dive. The Hopper reached the seabed at 16:25 and got caught on a fishing line at 16:55, leaving the bottom at 17:05 to be brought to surface for inspection. Due to this incident, the transect over the seafloor lasted only 40 minutes and covered merely 540 m of seabed. The Hopper moved upslope throughout the whole dive, covering a relatively narrow bathymetric range, with a starting depth at around 690 m and finishing at 600 m depth (Figure 54). The dive started in an area of hard substrates covered with coral rubble, with the presence of the primnoid *Narella versluysi* and the glass sponge *Pheronema carpenteri*, both generally found in relatively low numbers. After some meters, several large octocorals of the species *Callogorgia verticillata* started to be observed, generally in a good conservation status. At 630 m depth, an aggregation of the silver roughy *Hoplostethus mediterraneus* was observed, together with a large deep-sea shark of the species *Dalatias licha*. The last part of the dive, minutes before getting entangled, the seabed was flat and covered with coral rubble. No signs of the fishing line in which the system was caught could be observed previous to the incident. Once on deck, the Hopper was visually examined, but no external damage was observed neither on the structure nor the umbilical.


**Figure 54 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 60. Top left: Primnoids of the species *Narella versluysi* in the first part of the dive. Top right. A large coral *Callogorgia verticillata*. Bottom left: A deep-sea shark passing under the *Hopper system*. Bottom right: Coral rubble on a flat area towards the end of the dive.**

Station 61 was performed on the south-eastern sector of the Kurchatov area, continuing the path started during the previous dive, which had to be aborted due to an entanglement in a fishing line. The Hopper reached the seabed at 17:30 and left the bottom at 19:15. Overall, the transect over the seafloor lasted 1 hour and 45 minutes and covered 1.3 km of seabed. The Hopper moved upslope throughout the whole dive, covering a relatively shallow bathymetric range, with a starting depth at around 600 m and finishing at 500 m depth (Figure 55). The dive started in a rocky area with the presence of the white octocoral *Pleurocorallium johnsoni* and the yellow laminate sponge cf. *Poecillastra compressa*. This community was dominant throughout the first half of the dive, mostly appearing in consolidated substrates and rocky outcrops. In this sector, several aggregations of the silver roughy *Hoplostethus mediterraneus* were observed, always with the fishes laying still very close to the seabed while the camera moved above them. Around 560 m depth, the community started to change to that dominated by the octocorals *Viminella flagellum* and *Acanthogorgia* sp., in some areas with this last species reaching very high densities. Some fishes were observed in this coral garden, such as the deep-sea shark *Dalatias licha* and the monkfish *Lophius piscatorius*. It was also on this second part of the dive where the number of abandoned longlines registered was very high. In most cases, those lines were found lying flat over the seabed, but unfortunately at 19:05 the Hopper towed camera system got entangled in a fishing line suspended on the water column, which passed unnoticed to the winch operators. After some time trying to get the Hopper free, it was retrieved back to surface at 19:25. The entanglement affected the last few meters of the umbilical, which had to be removed by the vessel's crew for the next dive.


**Figure 55 - Still images obtained from the footage recorded with the down-facing camera of the Hopper towed camera system during dive St. 61. Top left: The white coral *Pleurocorallium johnsoni* and the yellow laminate sponge cf. *Poecillastra compressa*. Top right. Aggregation of the silver roughy *Hoplostethus mediterraneus* at 580 m depth. Bottom left: Coral garden with *Acanthogorgia* sp. and *Viminella flagellum*. Bottom right: One of the several abandoned fishing lines observed.**

### Kurchatov; South-west

Station 69 was performed on the south-western sector of the Kurchatov area, with the Hopper following a north-to-south path along the seabed. The Hopper reached the seabed at 18:11 and left the bottom at 20:53. Overall, the transect over the seafloor lasted 2 hours and 40 minutes and covered almost 2.5 km of seabed. This dive had a relatively large bathymetric range, starting at 1065 m and finishing at 630 m depth, that being the shallowest point of the dive (Figure 56). In terms of species composition, this was one of the most interesting dives of the cruise, mainly due to the large aggregations of back corals of the genus *Leiopathes* encountered, which appeared from the beginning of the dive until around 800 m depth. The dive started on a rocky area below 1000 m, in an area where several large vase-like glass sponges were observed. The size of these vase-like sponges was strikingly large, but their presence was restricted to just a few patches at the beginning of the dive. Conversely, the black coral *Leiopathes* was rather ubiquitous until 800 m depth, with high local densities in areas of outcropping rocks that generated a complex relief. In most situations, these black corals were found together with several other species, such as octocorals, but also with the remaining of what seemed to be dead coral framework. It should be noted that although most part of this coral framework related to the coral skeleton, some alive colonies could be identified within these structures. Where the relief was smoother, the seabed was covered by broken coral pieces, likely originated from the observed coral framework. In these areas, the diversity was lower, generally characterized by deposit feeders such as the sea urchin *Cidaris cidaris*. Some of the soft bottom areas found along the dive were also colonized by the octocoral *Acanella arbuscula*, in some sectors reaching fairly high densities. The last part of the dive, between 800 and 630 m depth, was relatively poor in terms of species composition. Some fishing lines were observed in this last sector, together with some Atlantic wreckfishes *Polyprion americanus*.

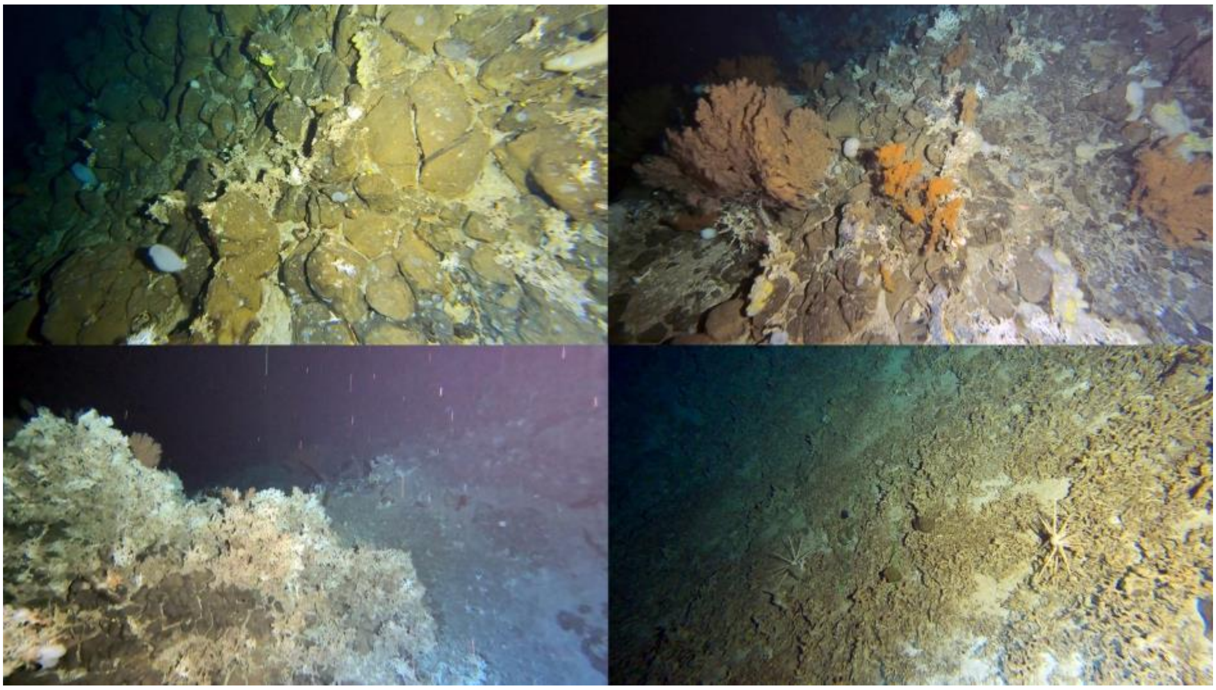


**Figure 56 - Still images obtained from the footage recorded with the GoPro cameras mounted on the Hopper towed camera system during dive St. 69. Top left: Aspect of the seabed on the first part of the dive, with the presence of glass sponges. Top right. High densities of the black coral of the genus *Leiopathes*, together with several other species of octocorals and sponges. Bottom left: One of the several large coral frameworks observed in this dive, with some alive colonies identified by their orange color. Bottom right: Deposits of coral rubble with the presence of the sea urchin *Cidaris cidaris*.**

### Ridges west of Oscar seamount

Station 72 was extremely short due to problems in the transmission of the image from the HD downward-facing camera to the surface, which occurred just a few minutes after the Hopper reached the seabed. Once the image was lost, the dive had to be aborted to bring the Hopper to surface again to identify the source of the problem. The Hopper reached the seabed at 8:38, on a rocky area located at 1062 m depth, and the dive was aborted at around 9:10, when the image could not be recovered. Overall, the amount of seafloor footage useful for annotation and community characterization lasted just 16 minutes, covering only 265 m of seabed (Figure 57). During those few minutes, the images revealed an area of a complex relief, with rock-dominated habitats that were home to the octocoral *Acanella arbuscula* and some small black corals of the genus *Leiopathes*.

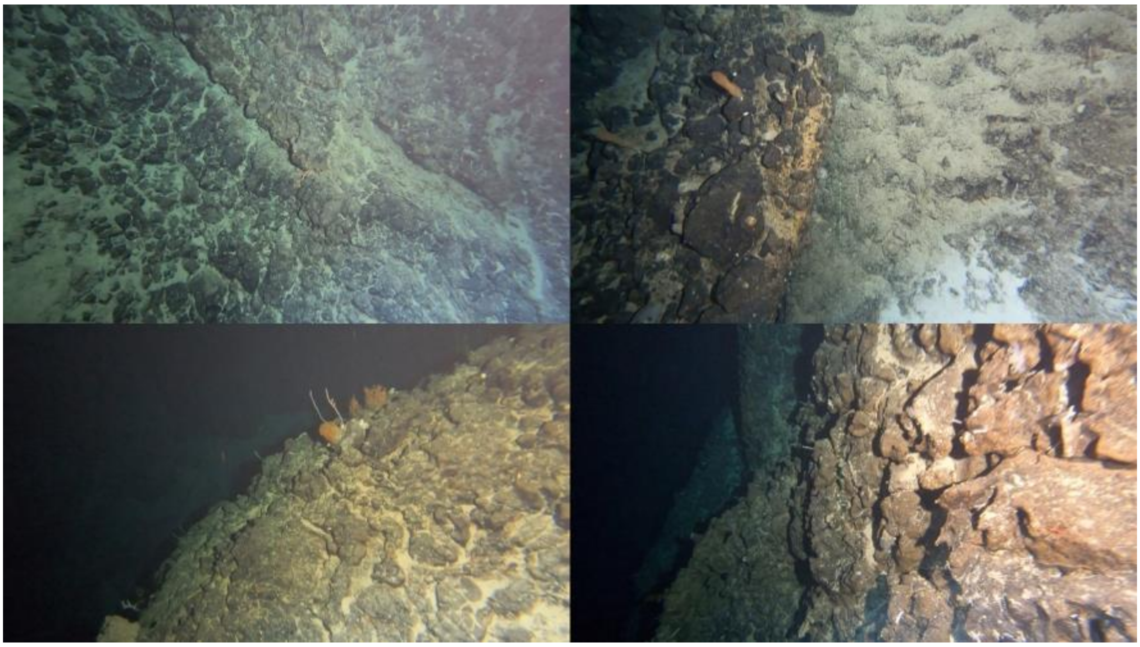


**Figure 57 - Still images obtained from the footage recorded with the GoPro cameras mounted on the Hopper towed camera system during dive St. 72. All images recorded showed rocky outcrops with little fauna, besides *Acanella arbuscula* (top right) and some small *Leiopathes* (bottom left).**

Station 73 was performed in one of the several ridges found west of Oscar seamount, with the Hopper following a south-to-north path along the seabed. Due to the loss of signal from the downward-facing camera during the previous dive, this camera was replaced by the upwards-facing camera, with the consequent loss of quality in receiving video image. The Hopper reached the seabed at 10:53 and left the bottom at 13:40. Overall, the transect over the seafloor lasted around 2.75 hours and covered approximately 3.3 km of seabed. The Hopper moved upslope throughout the whole dive, covering a relatively wide bathymetric range, with a starting depth at around 1015 m and finishing just below 675 m depth (Figure 58). The dive began in rocky areas of high relief, with not much fauna besides some *Acanella arbuscula* and large vase-like sponges. As the dive progressed, the diversity and abundance of species, especially corals, increased significantly. Remarkably, this dive hosted several areas with high densities of large black corals of the genus *Leiopathes*, some of which lasted several tens of meters. Highest densities were generally observed in areas of rocky outcrops and complex relieves, where the corals had a suitable substrate to attach to. In between these high-relief areas, where softer sediments were recorded, other species were dominant, such as the octocorals *Acanella arbuscula, Chrysogorgia* sp., Paragorgia sp. and other Plexauridae, the black coral Bathypates patula, different stylasterids and soft hydrozoans, and a different sponge species, such cf. *Phakellia* and *Asconema* sp. Towards the end of the dive, the community dominated by the primnoid *Narella versluysi* and the glass sponge *Pheronema carpenteri* was registered. Interestingly, several orange roughy *Hoplostethus atlanticus* were reported throughout the dive.

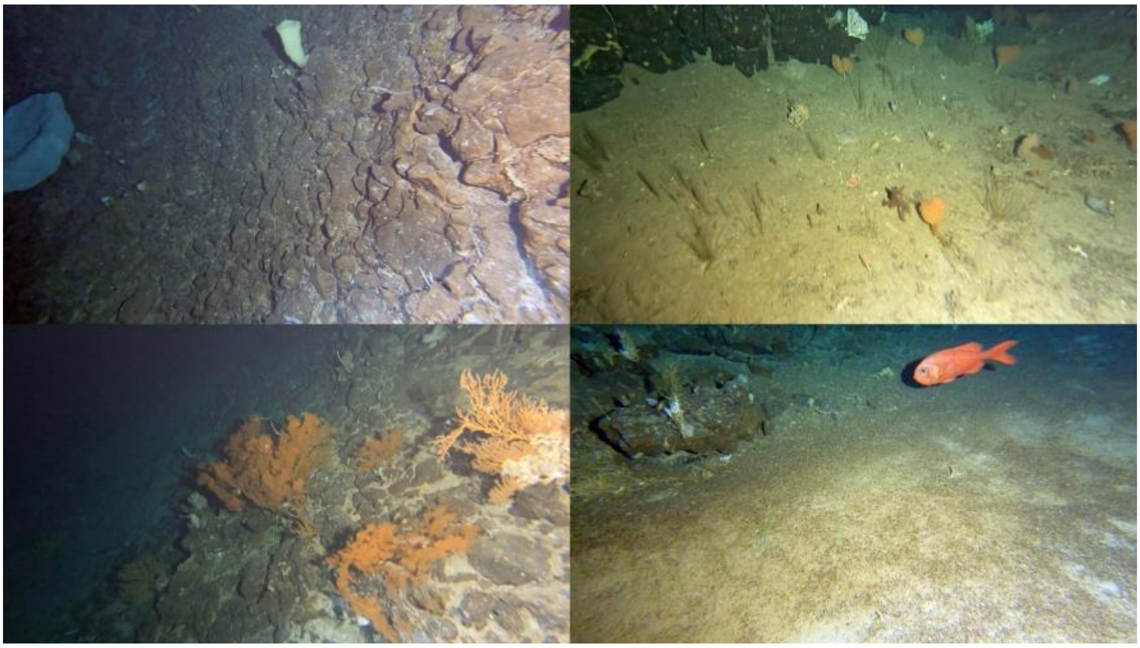


**Figure 58 - Still images obtained from the footage recorded with the GoPro cameras mounted on the Hopper towed camera system during dive St. 73. Top left: Aspect of the seabed on the first part of the dive, with the presence of large vase-like sponges. Top right. Mixed community with high densities of hydroids in an area with several species of octorals, including *Acanella arbuscula*, *Chrysogorgia* sp. and *Paragorgia* sp. Bottom left: One of the several aggregations of black corals encountered throughout the dive. Bottom right: An orange roughy *Hoplostethus atlanticus* gently swimming in front of the camera.**

Station 78 was also performed on the ridges west of Oscar seamount. Due to time restrictions, the dive only lasted around 30 minutes and merely covered 450 m of seabed. The Hopper reached the seabed at 19:13 and left the bottom at 19:46. As it occurred in the previous dive, the HD downward-facing camera was not operational and still replaced by the upwards-facing camera, with the consequent loss of quality in receiving video image. The Hopper stayed always at a similar depth range, between 885 and 940 meters (Figure 59). Not much fauna was observed throughout this dive, with flat characterized by the presence of sand and coral rubble mixed with other areas of small and medium-sized boulders. The soft-bottom areas hosted very few species, and only some eel-like fishes and some orange roughy *Hoplostethus atlanticus* were reported. When the substrate was of a rocky nature, *Acanella arbuscula* became the most commonly observed benthic species, accompanied by some Plexauridae, stylasterids and large laminated sponges.

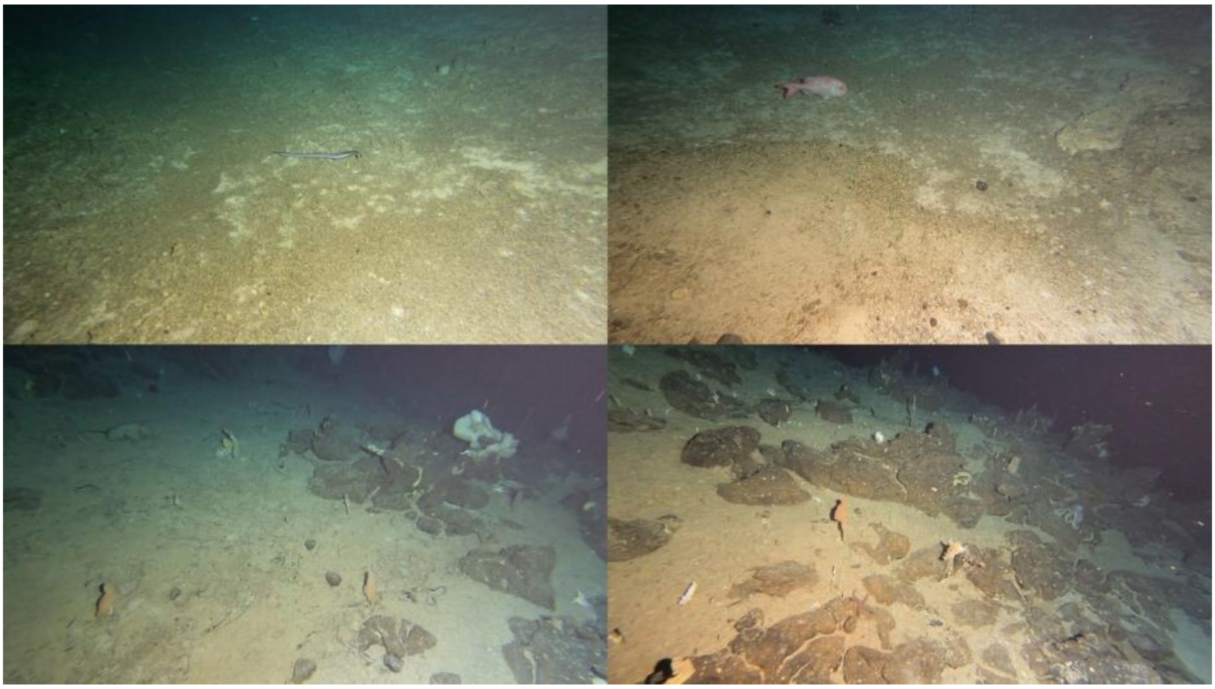


**Figure 59 - Still images obtained from the footage recorded with the GoPro cameras mounted on the Hopper towed camera system during dive St. 78. Top: Flat areas with coral rubble where several eel-like fishes (left) and orange roughy *Hoplostethus atlanticus* (right) were observed. Bottom. Boulders with a higher diversity of benthic fauna.**

**North-east of the Gigante seamount complex**

Station 80 was performed on an elongated ridge (D6) located on the northeastern side of the Gigante seamount complex area, with the Hopper following a south-to-north path along the seabed. As it occurred in the previous dive, the HD downward-facing camera was not operational and still replaced by the upwards-facing camera, with the consequent loss of quality in receiving video image. The sonar used to detect hazards ahead also stopped working, but the crew agreed to continue since the relieve of the dive determined from the multibeam bathymetry seemed fairly smooth along the whole dive. The Hopper reached the seabed at 08:24 and left the bottom at 11:56. Overall, the transect over the seafloor lasted around 3.5 hours and covered approximately 3.85 km of seabed. The Hopper performed a relatively shallow dive compared to some of the previous transects, starting at 815 m and moving up the slope towards the shallowest point at 760, where it descended again until reaching the deepest point of the dive at 925 m depth (Figure 60). The benthic community observed was relatively poor in terms of species composition and abundance during the first part of the dive, but these values improved significantly towards the final hundreds of meters. The first part of the dive was characterized by flat or low-sloping areas with soft-bottom sediments and relatively flat rocks, where several sea urchins of the genus *Cidaris* and hydroids of the genus cf. *Pliobothrus* were identified*,* this last species generating some dense aggregations throughout the dive. In this part of the dive, the octocoral *Acanella arbuscula* was also commonly observed, together with other small Plexauridae and several sponge species. Some other parts were characterized by the presence of consolidated sediments with a high quantity of accumulated coral rubble, which was colonized by several species of small sponges. Towards the end of the dive, in areas of hard substrates, the abundance and diversity of species increased significantly, especially relevant was the dense aggregations of the stylasterid

*Errina atlantica*, accompanied by several species including the octocoral *Acanella arbuscula*, the sea urchin *Cidaris cidaris* and a few glass sponges. A few orange roughy *Hoplostethus atlanticus* and deep-sea sharks of the species *Dalatias licha* were observed along the dive.

**Figure 60 - Still images obtained from the footage recorded with the GoPro cameras mounted on the Hopper towed camera system during dive St. 80. Top left: High-density aggregation of the stylasterid cf. *Pliobothrus* sp. with *Acanella arbuscula* and other Plexauridae yet to be identified to species level. Top right. Consolidated substrates with the presence of coral rubble. Bottom left and bottom right: Aspect of the last few hundred meters of the dive, with sloping areas characterized by the presence of the stylasterid *Errina atlantica* together with glass sponges and the ubiquitous *Acanella arbuscula*.**

Station 82 was not only the last station of the iMAR cruise, but also the last dive with the Hopper towed camera system. This last dive was performed on an elongated ridge located on the northeastern side of the Gigante seamount complex area, with the Hopper following a south-to-north path along the seabed. As it occurred in the previous dive, the HD downward-facing camera was not operational and still replaced by the upwards-facing camera, with the consequent loss of quality in receiving video image. The sonar used to detect hazards ahead also stopped working, but the crew agreed to continue since the relieve of the dive determined from the multibeam bathymetry seemed fairly smooth along the whole dive. The Hopper reached the seabed at 15:12 and the dive ended at 17:48. Overall, the transect over the seafloor lasted around 2.5 hours and covered approximately 2.5 km of seabed. The Hopper stayed at a similar depth throughout the whole dive, beginning just below 1000 m and finishing at 972 m depth (Figure 61). The benthic community observed throughout the dive was very similar in terms of species composition, with the octocorals *Acanella arbuscula* and *Chrisogorgia* sp. as the most common species of the megafauna. In fact, these two species reached in some areas the highest densities recorded throughout the whole cruise. As observed previously, the two species occurred both on soft and hard substrates, either on the top of the crest and on the adjacent slopes. Several other species of corals were generally observed along the dive as accompanying fauna, always in low numbers, such as black corals of the genus *Leiopathes* and octocorals of the genus *Paragorgia*, *Lepidisis*, *Corallium* and several other Plexauridae yet to be identified to species level. Also interesting was the number of glass sponges observed throughout the dive, including species from the genus *Farrea*, *Pheronema* and *Asconema*, among others. Although further analyses should be conducted, it seemed like the diversity of megabenthic species observed in this dive was higher on the top of the crest than in the adjacent slopes. Several orange roughy *Hoplostethus atlanticus* were observed along the dive.

**Figure 61 - . Still images obtained from the footage recorded with the GoPro cameras mounted on the Hopper towed camera system during dive St. 82. Top left: Dense garden of *Acanella/Chrysogorgia* on the top of the ridge. Top right. Aggregation of hydroids yet to be identified to species level. Bottom left: Some of the accompanying species observed in the *Acanella/Chrysogorgia* gardens, including *Paragorgia* and *Lepidisis*. Bottom right: Some *Corallium niobe* colonies on hard substrates.**

# 5 Data and Sample Storage / Availability

This cruise collected and generated four main types of data: multibeam bathymetry data, CTD and ADCP data, water and sediment samples, and video images of the seafloor. Multibeam bathymetry data is being used to characterize the geomorphology of the seamounts and ridges surveyed during the cruise and to produce GIS layers of bathymetry. CTD and water samples are being used to characterize the water mass properties of the different areas along the Mid-Atlantic Ridge (MAR). Towed camera video data is being used to characterize and map the benthic communities inhabiting different portions of the MAR, some of which are Vulnerable Marine Ecosystems. Water and sediment samples will be used for eDNA analyses contributing to the understanding of the distribution of the biodiversity along the MAR. Sediment samples will also be used for the quantification of micro-plastics. Since the iMAR cruise is embedded into the Horizon 2020 iAtlantic project which, in turn, is participating in the H2020 Open Research Data Pilot (ORD), we will strictly follow iAtlantic and ORD Data Management Standards and comply with FAIR data approach to make data produced Findable, Accessible, Interoperable and Reusable.

All datasets produced during the cruise will be made openly available under creative commons licences. However, in order to give enough time for data analyses and preparation of publications derived from the study of deep-sea benthic habitats along the Mid-Atlantic Ridge, an embargo of a maximum of two years will be requested. This complies with timelines set by the iAtlantic Data Policy.

As defined in the Eurofleets+ Data Management guidelines for cruise and programme applicants and grantees, the raw data and metadata produced during the cruise will be provided within the following timelines:

- Metadata of the cruise (SeaDataNet Cruise Summary Report): within two weeks after the Cruise: done;
- Metadata of the datasets of the cruise: within two months after the cruise ;
- En-route data: via EARS, automatically;
- CTD data and data of deployed devices: within two months after the results are obtained;
- "manual" data, e.g. observations and/or measurements on samples: within two months after the result is obtained to allow lab analyses.

All digital data and metadata derived from the iMAR cruise will also be published through PANGAEA (or other trusted repository from the iAtlantic DMP) within 12 months after the end of the cruise. After DOI registration, data layers, standardized to be INSPIRE3-compliant, will be uploaded from PANGAEA to the iAtlantic web-GIS platform (GEONODE) and likewise harvested by EMODnet for wider dissemination. In compliance with H2020's Open Research Data Pilot, the listed repositories/platforms will ensure that data sets are archived and preserved using a reference and name (i.e. authors, year, title, DOI or accession number), a description (i.e. targeted use, geolocation, methods, link to related articles), and community standards and metadata (i.e. parameter semantics, formats, units, and use of ontologies and registries). All data will be open access after the embargo.

In the case of eDNA data, the project will make use of the workflow established between ENA and PANGAEA for this type of data. To ensure that environmental data with relevance for the interpretation of the eDNA data (e.g. temp, currents, salinity etc.) remain linked to the sequence data, ENA and PANGAEA embed reciprocal links between the two repositories in the dataset metadata. Thereby, ENA users can directly discover and access the relevant environmental data in PANGAEA through links in the metadata. Discovery and access of eDNA sequence data linked to environmental data in PANGAEA is also possible starting from PANGAEA metadata.

# 6 Participants

| No. | Name | Early career | Gender | Affiliation | On-board tasks |
|---|---|---|---|---|---|
| 1 | Telmo Morato | N | M | UAZ | iMAR cruise PI. Overall coordination of operations |
| 2 | Carlos Dominguez-Carrió | N | M | UAZ | Coordination of the towed camera system operations. Co-PI of the cruise |
| 3 | Tenente Laura Neves de Sousa* | Y | F | IH | Coordination of the Multibeam surveys |
| 4 | Susan Evans* | Y | F | NOC | Coordination of the CTD/water sampling work |
| 5 | Gerald H. Taranto | Y | M | UAZ | Coordination of the box-core and sediment sampling work |
| **Remote participants** | | | | | |
| 6 | Marina Carreiro-Silva | N | F | UAZ | Standing by for iMAR cruise PI |
| 7 | Manuela Ramos | Y | F | UAZ | Standing by for the scientific crew |
| 8 | Christian Mohn | N | M | AAU | Physical oceanography of the North Atlantic |
| 9 | Timm Schoening | N | M | GEOMAR | Development of semi-automated methods for video analyses |
| 10 | Tina Molodtsova | N | F | P.P. Shirshov | Identification of deep-sea corals species from video images |
| 11 | Joana Xavier | N | F | UP | Identification of deep-sea sponge species from video images |
| 12 | J. Angel Perez | N | M | UNIVALI | Benthic community ecology expert |
| 13 | Christopher K. Pham | N | M | UAZ | Video analyses for marine litter and fisheries impacts |
| 14 | Julie Robidart | N | F | NOC | Molecular ecologist |
| 15 | Luís Rodrigues | N | M | UAZ | Processing of multibeam bathymetry data and derivates |
| 16 | Manuel A. Malaquias | N | M | UIB | Identification of deep-sea sediment infauna |

* Travel of these participants funded by EUROFLEETS+

| | |
|---|---|
| UAZ | University Azores, Portugal |
| IH | Portuguese Hydrographic Institute |
| NOC | National Oceanography Centre, UK |
| AAU | Aarhus University |
| GEOMAR | GEOMAR Helmholtz Centre for Ocean Research, Germany |
| P.P. Shirshov | P.P. Shirshov Institute of Oceanology, Russian |
| UP | University of Porto, Portugal |
| UNIVALI | University of Vale do Itajaí, Brazil |
| UIB | University Museum of Bergen, Norway |

# 7 Station List

| Station No. | Date | Time | Latitude | Longitude | WaterDepth | Gear | Remarks/Recovery |
|---|---|---|---|---|---|---|---|
| | 2021 | [UTC] | [°N] | [°W] | [m] | | |
| | 17/05/2021 | 14:00 | | | | | Loading all the necessary gear |
| 1 | 18/05/2021 | 13:11 | 38.5868 | -28.5822 | - | Multibeam | Transit to Chaucer |
| 2 | 18/05/2021 | 20:42 | 39.5012 | -28.6018 | 500 | SVP | 500m; 1300m bottom depth |
| 3 | 18/05/2021 | 21:25 | 39.5005 | -28.6150 | - | Multibeam | Transit to Chaucer |
| 4 | 18/05/2021 | 22:45 | 39.5682 | -28.6707 | - | Multibeam | Transit to Chaucer |
| 5 | 19/05/2021 | 06:13 | 40.5392 | -28.8333 | 500 | SVP | 500m; 1600m bottom depth |
| 6 | 19/05/2021 | 06:55 | 40.5392 | -28.8333 | - | Multibeam | Bathymetry in East D2 |
| 7 | 19/05/2021 | 10:05 | 40.5773 | -28.8995 | - | Multibeam | Transit to Chaucer |
| 8 | 19/05/2021 | 22:30 | 42.2242 | -29.0680 | 500 | SVP | 500m; 2400m bottom depth |
| 9 | 19/05/2021 | 23:00 | 42.2242 | -29.0680 | - | Multibeam | Transit to Chaucer |
| 10 | 20/05/2021 | 01:10 | 42.3578 | -29.1117 | - | Multibeam | Chaucer |
| 11 | 20/05/2021 | 08:08 | 42.4535 | -29.1897 | 1050 | Hopper | No USBL |
| 12 | 20/05/2021 | 13:14 | 42.4628 | -29.1911 | - | CTD | 4, 30, 400, 800, 932 m |
| 13 | 20/05/2021 | 15:58 | 42.4450 | -29.1914 | 899 | BoxCorer | eDNA, fauna, bacteria, microplastics, geology |
| 14 | 20/05/2021 | 18:15 | 42.4590 | -29.1152 | 1250 | Hopper | No USBL |
| 15 | 20/05/2021 | 20:30 | 42.4388 | -29.1248 | - | Multibeam | Transit S Chaucer to D12 |
| 16 | 21/05/2021 | 23:35 | 40.1872 | -29.4205 | - | Multibeam | D12 |
| 17 | 21/05/2021 | 08:03 | 41.9767 | -29.5177 | 1120 | Hopper | No USBL |
| 18 | 21/05/2021 | 11:30 | 41.9530 | -29.5074 | 600 | Hopper | No USBL |
| 19 | 21/05/2021 | 13:25 | 41.9695 | -29.5115 | 900 | CTD | 5, 25, 400, 800, 890 m |
| 20 | 21/05/2021 | 14:40 | 41.9535 | -29.5205 | 990 | BoxCorer | eDNA, fauna, bacteria, microplastics, geology |
| 21 | 21/05/2021 | 16:40 | 41.9325 | -29.4255 | 990 | Hopper | No USBL |
| 22 | 21/05/2021 | 21:08 | 41.8442 | -29.4398 | 0 | Multibeam | Transit to Kurchatov |
| 23 | 22/05/2021 | 02:24 | 41.0497 | -29.4623 | 0 | Multibeam | Ridges NE of Kurchatov |
| 24 | 22/05/2021 | 08:30 | 40.7197 | -29.6813 | 1180 | Hopper | No USBL |
| 25 | 22/05/2021 | 11:20 | 40.7238 | -29.6869 | 950 | CTD | 5, 35, 400, 800, 932 m |
| | 22/05/2021 | 13:30 | 0.0000 | 0.0000 | 0 | 0 | Back to Horta Harbour for medical reasons |
| 26 | 22/05/2021 | 14:00 | 40.7272 | -29.6802 | 0 | Multibeam | Transit Kurchatov-Horta |
| 27 | 23/05/2021 | 16:30 | 38.4958 | -28.6797 | 0 | Multibeam | Leaving Horta harbour. Transit Horta-Cavala |

| Station No. | Date | Time | Latitude | Longitude | WaterDepth | Gear | Remarks/Recovery |
|---|---|---|---|---|---|---|---|
| | 2021 | [UTC] | [°N] | [°W] | [m] | | |
| 28 | 23/05/2021 | 22:30 | 38.3887 | -30.0813 | 1500 | SVP | 1600m |
| 29 | 23/05/2021 | 01:30 | 38.3593 | -30.5152 | 0 | Multibeam | Ridge E of Cavala |
| 30 | 24/05/2021 | 08:23 | 38.3388 | -30.6633 | 900 | Hopper | No USBL |
| 31 | 24/05/2021 | 13:15 | 38.3288 | -30.6710 | 850 | BoxCorer | eDNA, fauna, bacteria, microplastics, geology |
| 32 | 24/05/2021 | 15:37 | 38.3130 | -30.5417 | 860 | Hopper | No USBL |
| 33 | 24/05/2021 | 19:00 | 38.2975 | -30.5525 | 850 | CTD | 5, 66, 400, 800, 858 m |
| 34 | 24/05/2021 | 20:10 | 38.3707 | -30.6433 | 0 | Multibeam | Cavala East summit |
| 35 | 25/05/2021 | 02:25 | 38.2728 | -30.6480 | 0 | Multibeam | Transit Cavala to Gigante |
| 36 | 25/05/2021 | 08:35 | 38.8682 | -30.1158 | 0 | Hopper | No USBL |
| 37 | 25/05/2021 | 11:25 | 38.8545 | -30.1167 | 1000 | CTD | 5, 50, 400, 800, 996 m |
| 38 | 25/05/2021 | 13:26 | 38.9550 | -30.1120 | 1000 | BoxCorer | eDNA, fauna, bacteria, microplastics, geology |
| 39 | 25/05/2021 | 15:00 | 38.9655 | -30.1042 | 1000 | Hopper | No USBL |
| 40 | 25/05/2021 | 19:52 | 38.9312 | -30.1122 | 0 | Multibeam | Transit from Gigante to Kurchatov NW |
| 41 | 26/05/2021 | 08:41 | 40.7257 | -29.6820 | 1000 | BoxCorer | eDNA, fauna, bacteria, microplastics, geology |
| 42 | 26/05/2021 | 10:30 | 40.7535 | -29.5093 | 1000 | Hopper | No USBL |
| 43 | 26/05/2021 | 15:00 | 40.7345 | -29.4857 | 0 | Hopper | Aborted |
| 44 | 26/05/2021 | 15:56 | 40.7478 | -29.5110 | 933 | CTD | |
| 45 | 26/05/2021 | 17:00 | 40.7557 | -29.5095 | 0 | Multibeam | Ridges NE of Kurchatov. Finnish previous survey |
| 46 | 26/05/2021 | 20:02 | 40.8577 | -29.4655 | 500 | SVP | 500m; 1400m bottom depth |
| 47 | 26/05/2021 | 21:28 | 40.7570 | -29.4865 | 0 | Multibeam | Kurchatov SE |
| 48 | 27/05/2021 | 04:09 | 40.4603 | -29.4695 | 0 | Multibeam | Kurchatov FZ |
| 49 | 27/05/2021 | 08:30 | 40.4635 | -29.5458 | 2900 | CTD | |
| 50 | 27/05/2021 | 16:15 | 40.4675 | -29.5512 | 0 | BoxCorer | no samples |
| 51 | 27/05/2021 | 19:15 | 40.4579 | -29.5886 | 1300 | SVP | 1300m |
| 52 | 27/05/2021 | 20:22 | 40.4163 | -29.5973 | 0 | Multibeam | Kurchatov FZ + SE; Trouble with MRU |
| 53 | 28/05/2021 | 09:10 | 40.4483 | -29.3122 | 1010 | BoxCorer | fauna, bacteria |
| 54 | 28/05/2021 | 10:10 | 40.4493 | -29.3122 | 1045 | BoxCorer | eDNA, fauna, bacteria, microplastics, geology |
| 55 | 28/05/2021 | 11:40 | 40.4052 | -29.3170 | 981 | CTD | |
| 56 | 28/05/2021 | 14:30 | 40.4673 | -29.5510 | 2950 | BoxCorer | eDNA, fauna, bacteria, geology |
| 57 | 28/05/2021 | 17:19 | 40.4473 | -29.4915 | 1990 | CTD | |

| Station No. | Date | Time | Latitude | Longitude | WaterDepth | Gear | Remarks/Recovery |
|---|---|---|---|---|---|---|---|
| | 2021 | [UTC] | [°N] | [°W] | [m] | | |
| 58 | 28/05/2021 | 19:01 | 40.4425 | -29.5175 | 0 | Multibeam | Kurchatov SW all |
| 59 | 29/05/2021 | 08:26 | 40.4015 | -29.3165 | 1040 | Hopper | No USBL |
| 60 | 29/05/2021 | 19:46 | 40.4640 | -29.3420 | 691 | Hopper | No USBL |
| 61 | 29/05/2021 | 17:29 | 40.4603 | -29.3487 | 598 | Hopper | No USBL |
| 62 | 29/05/2021 | 21:30 | 40.4207 | -29.6748 | 1200 | SVP | 1200m; 1900m bottom depth |
| 63 | 29/05/2021 | 22:30 | 40.4423 | -29.5143 | 0 | Multibeam | Kurchatov SW2 |
| 64 | 30/05/2021 | 08:11 | 40.3995 | -29.7128 | 0 | CTD | |
| 65 | 30/05/2021 | 09:16 | 40.3920 | -29.7265 | 965 | BoxCorer | eDNA, fauna, bacteria, microplastics, geology |
| 66 | 30/05/2021 | 10:07 | 40.3933 | -29.7252 | 0 | Multibeam | Kurchatov SW2 (filing missing bits) |
| 67 | 30/05/2021 | 13:40 | 40.4027 | -29.9078 | 984 | CTD | |
| 68 | 30/05/2021 | 17:12 | 40.4010 | -29.7127 | 0 | Hopper | Aborted |
| 69 | 30/05/2021 | 17:50 | 40.4008 | -29.7130 | 1065 | Hopper | No USBL |
| 70 | 30/05/2021 | 21:11 | 40.3769 | -29.7161 | 0 | Multibeam | Transito to West Oscar |
| 71 | 30/05/2021 | 01:06 | 39.8100 | -29.8777 | 0 | Multibeam | West Oscar |
| 72 | 31/05/2021 | 09:38 | 39.7227 | -29.8648 | 1062 | Hopper | Aborted |
| 73 | 31/05/2021 | 10:50 | 39.7198 | -29.8653 | 965 | Hopper | No USBL; down looking camera SD; no focus |
| 74 | 31/05/2021 | 14:15 | 39.7132 | -29.8672 | 920 | CTD | |
| 75 | 31/05/2021 | 15:30 | 39.7278 | -29.8842 | 1010 | BoxCorer | no samples |
| 76 | 31/05/2021 | 16:13 | 39.7282 | -29.8840 | 1010 | BoxCorer | no samples |
| 77 | 31/05/2021 | 17:22 | 39.7425 | -29.8753 | 930 | BoxCorer | eDNA, fauna, bacteria, microplastics, geology |
| 78 | 31/05/2021 | 19:13 | 39.7387 | -29.8808 | 884 | Hopper | No USBL; down looking camera SD; no focus |
| 79 | 31/05/2021 | 20:13 | 39.7406 | -29.8703 | 0 | Multibeam | Transit West Oscar to Gigante NE ridges |
| 80 | 01/06/2021 | 08:07 | 39.2617 | -29.7087 | 818 | Hopper | No USBL; down looking camera SD; no focus |
| 81 | 01/06/2021 | 13:12 | 39.2943 | -29.7032 | 900 | CTD | |
| 82 | 01/06/2021 | 14:52 | 39.2498 | -29.7777 | 1009 | Hopper | |
| 83 | 01/06/2021 | 17:50 | 39.2707 | -29.7722 | 0 | Multibeam | Transit back to Horta |
| | 02/06/2021 | 08:30 | | | | | Arrival in Horta harbour |
| | 02/06/2021 | 14:00 | | | | | Off-loading all gear |

# 8 Acknowledgements

This research cruise contributes to the overarching scientific mission statement of the Azores Deep-sea research group at the Okeanos research centre of the University of the Azores: Deepen our understanding on the natural diversity, ecosystem structure, function, connectivity and resilience of deep-sea communities in the Azores EEZ in a changing planet, while informing for a sustainable use of natural resources for current and future generations. RV Pelagia ship-time was provided free of charge for the iMAR survey, as part of a project which received funding from the European Union's H2020 Research & Innovation Programme under grant agreement No. 824077 (EUROFLEETS+). We would like to thank the Royal Netherlands Institute for Sea Research (NIOZ) for making the RV Pelagia available to Eurofleets+ and to our team in particular. The Azores Deep-sea research group is funded by the European Union's Horizon 2020 (H2020) programme under grant agreement No 678760 (ATLAS), No 689518 (MERCES) and No 818123 (iAtlantic), by the Fundação para a Ciência e Tecnologia (FCT) under the plurennial strategic project (UIDB/05634/2020) granted to Okeanos, the Program Stimulus of Scientific Employment (CCCIND/03345/2020 and CCCIND/03346/2020) and the PhD grant (PD/BD/111953/2015), by the Azores Government and PO2020 Açores under the MapGES (Acores-01-0145-FEDER-000056) and DeepWalls (ACORES-01-0145-FEDER-000124) projects as well as the PhD grant (M3.1.a/F/052/2015). We would like to thank the captain and crew of the RV Pelagia for their committed work during the whole iMAR cruise.