

NICO Cruise Leg 12, Hopper dives on board of R/V Pelagia

(16th to 26th of July 2018)

CRUISE REPORT *Date: 16/09/2018*



Two unexplored seamount in the Azores were visited with camera systems for the first time ever. A new Vulnerable Marine Ecosystem (VME) area were identified in Cavalo seamount (left) composed of large Paragorgia johnsoni and Paragorgia arborea when approaching the summit of the seamount. In São Jorge de Fora (right) we found some aggregation of gorgonians Callogorgia verticillata on the rocky outcrops close to the summit, and aggregations of Narella bellissima and Narella versluysi at ca. 700 m.

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Objectives: to explore deep-sea areas of the Azores EEZ to better understand the distribution patterns of large VME species and commercial fishes. Specifically, IMAR/ATLAS objectives in the cruise were to (i) characterize benthic communities inhabiting unexplored seamounts, such as Cavalo and São Jorge de Fora seamounts, (ii) identify new areas that fit the FAO vulnerable marine ecosystems definition; and (iii) determine distribution patterns of deep-sea benthic biodiversity in the Azores. The results of this cruise will also contribute to identify the environmental drivers that determine the spatial distribution of deep-sea benthic biodiversity in the Azores region. It will also provide valuable information in the context of Good Environmental Status (GES), Marine Spatial Planning (MSP) and provide new insights on how to sustainably manage deep-sea ecosystems. The information gathered in this cruise was obtained by means of the Hopper tow-cam system, an HD video platform specially designed to be operated on board of the R/V Pelagia.

Vessel: NIOZ R/V Pelagia

Scientific team: Carlos Dominguez-Carrió, Sabine Gollner, Fleur Visser, Telmo Morato

Summary: Table 1 provides a list of the Hopper dives performed during Nico Leg 12 in the Azores archipelago. The position of these dives is represented in Fig. 1. At the end of leg 12a, on the transit to Terceira island, one dive was performed in Cavalo seamount, where until that moment no data was available regarding the composition of its invertebrate megafauna. During leg 12b three dives were performed in the southern part of Terceira island. Two of these dives were carried out on the slope, at depths between 800 and 500 m, at a small distance of the shoreline. The third dive was conducted further ashore, in the seamount named São Jorge de Fora, where the Hopper transect was designed to cross from one side to the other of the seamount, exploring the changes in species composition from the deepest part of the mount all the way to the summit.

Table 1. Characteristics of the Hopper dives performed during Leg 12 of the Nico expedition.

Leg	St.	Location	Start latitude	Start longitude	Bottom time (hh:mm)	Length (m)
12a	26	Cavalo seamount	36.8031 °N	32.5580 °W	02:19	1950
12b	5	South of Terceira island	38.6603 °N	27.3505 °W	00:49	780
12b	15	South of Terceira island	27.3145 °N	38.6330 °W	01:12	980
12b	31	Sao Jorge de Fora seamount	27.43815 °N	38.5521 °W	04:11	5700

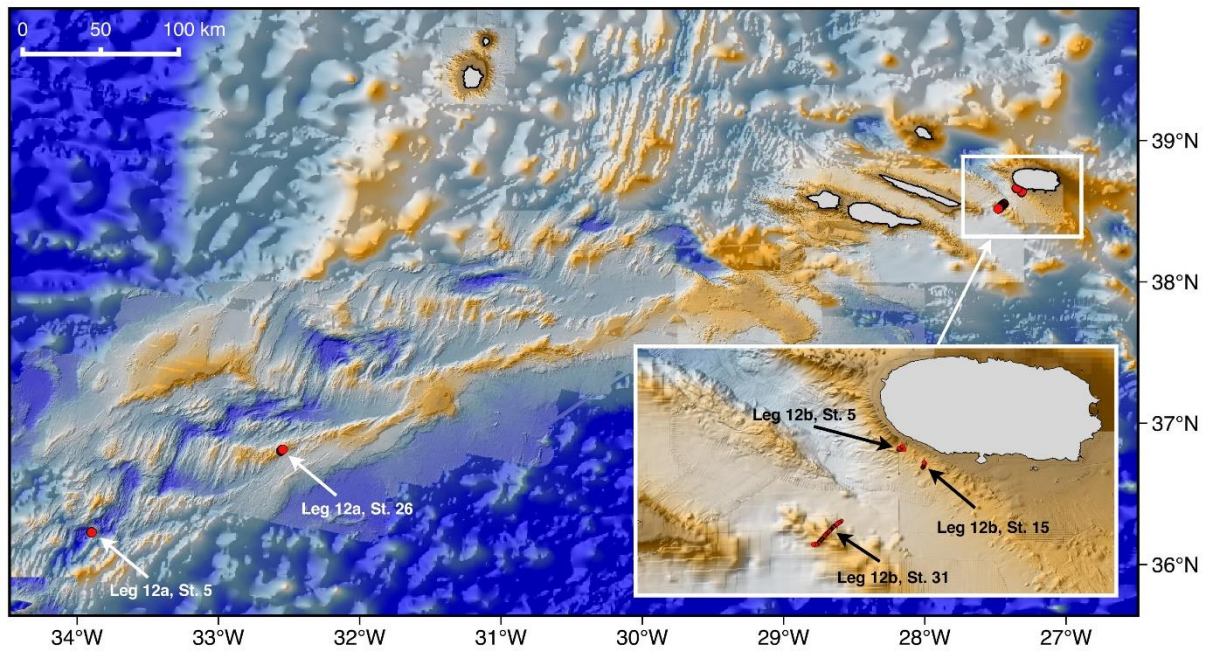


Fig. 1. GPS location of all Hopper dives that aimed to explore the benthic communities during Leg 12.

Leg 12a, Station 26

21st July 2018. *Cavalo Seamount*

Start time at bottom	End time at bottom	Start depth (m)	End depth (m)
01:26	03:45	630	595

The Hopper tow cam system was deployed in the middle of the Cavalo Seamount, at a depth of 630 m. The dive covered a distance of almost 2 km along the seabed, always trying to keep a linear track following the summit of the seamount (Fig. 7). The maximum depth reached during the dive was 675 m, and the dive ended at around 595 m depth.

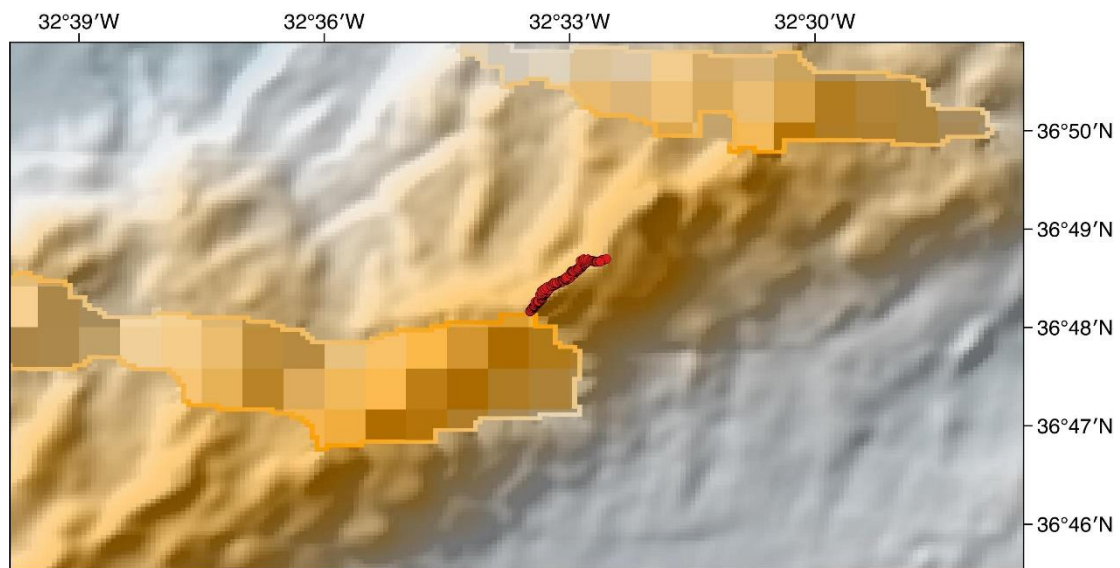


Fig. 7. GPS location of the dive carried out at Cavalo seamount, an unexplored seamount northeast of the Rainbow hydrothermal vent site.

Upon arrival at the seabed, the images showed an area of hard substrate gently sloping towards the summit of the seamount. The main structuring organisms of the megafauna were two Primnoidae species of the genus *Narella* (most possibly *Narella bellissima* and *Narella versluysi*), both found in rather high densities (Fig. 8). Those two species were accompanied by a wide range of other large gorgonian species, such as *Paragorgia arborea*, *Paragorgia johnsoni*, *Corallium* cf. *johnsoni* and *Callogorgia verticillata*, together with a few massive and laminate sponges. The anthozoan *Anthomastus* cf. *agaricus* and the sea urchins *Cidaris cidaris* and *Echinus* sp. were also commonly observed throughout the video footage.

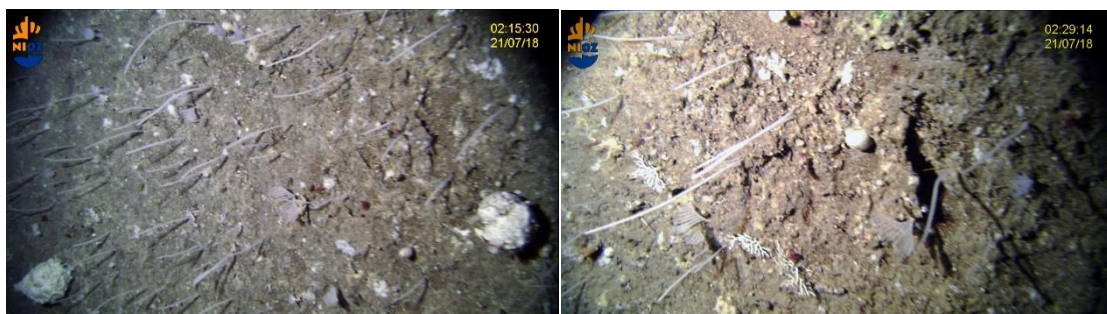


Fig. 8. Images of the area where the Hopper was deployed at the Cavalo seamount. The main megafauna species observed were the primnoids *Narella cf. versluysi* and *Narella cf. bellissima*.

The Hopper was towed following a similar depth range along the whole dive, initially increasing the depth explored towards the 700 m and then slowly moving towards the shallowest area of the summit, at around 600 m. The benthic community observed was very similar along most of the dive, with areas of very high densities of the whip coral *Narella cf. versluysi*, as it was observed in the forward facing camera of the Hopper. In certain areas close to the summit of the seamount, a narrow band along the seabed could be observed, where the typology of the mother rock changed drastically. In those situations, a large variety of encrusting sponges was observed colonizing this substrate, generating a different benthic community (Fig. 9).

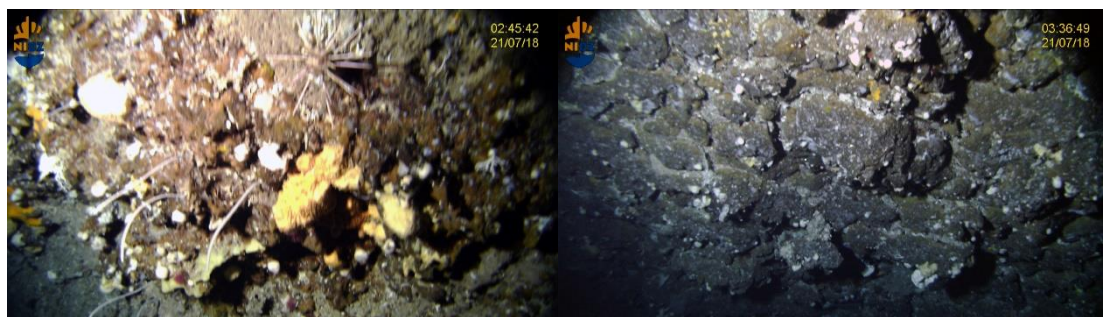


Fig. 9. Images of the narrow band where the mother rock had a different aspect, generating a change in the benthic community.

When approaching the shallowest area of the summit, some larger *Paragorgia arborea* and *Paragorgia cf. johnsoni* started to appear. The position of the camera makes size estimations very difficult, but some specimens seemed to measure at least 60 cm in height (Fig. 10, top images). In the shallowest part of the summit, at the very end of the dive, the community changed completely and was dominated by the yellow gorgonian *Acanthogorgia* sp. and very large colonies of the gorgonian species *Callogorgia verticilata*, with some small *Paragorgia* spp. also found as accompanying species (Fig. 10, bottom images).





Fig. 10. Images of the large *Paragorgia johnsoni* (top left) and *Paragorgia arborea* (top right) observed when approaching the summit of the seamount. The bottom two images represent the community at the shallowest part of the seamount, dominated by *Acanthogorgia* sp. and very large cf. *Callogorgia verticilata*.

Even though there is knowledge of some fishing activity taking place at Cavalo seamount, not many signs of marine litter were observed throughout the video footage, besides two fishing lines found laying abandoned over the seabed and the remaining of a fishing weight (Fig. 11).



Fig. 11. A long line observed laying over the seabed (left) and one of the weights used to keep the long lines still at the bottom when fishing (right).

Leg 12b, Station 5

23rd July 2018. *South Terceira*.

Start time at bottom	End time at bottom	Start depth (m)	End depth (m)
09:57	10:46	830	490

Dive performed on the southern coast of Terceira island, aiming to identify the main benthic communities dwelling on the slope, between 800 m and 500 m depth (Fig 12). The dive lasted a bit more than 45 minutes and covered a distance of 785 meters, always moving towards shallower areas.

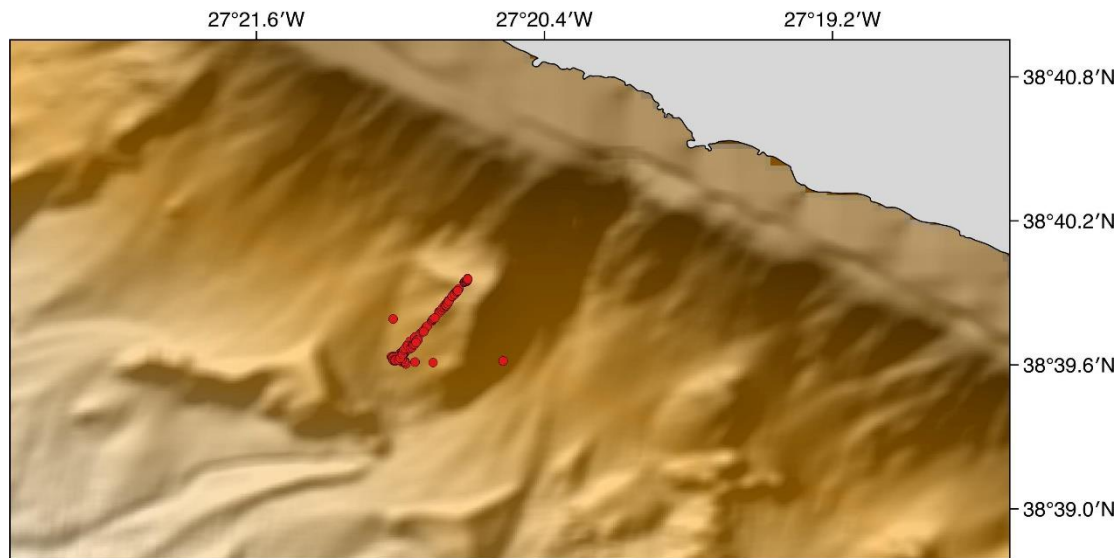


Fig. 12. GPS position of dive 5, performed south of Terceira island.

The Hopper landed in an area of soft sediment, mostly colonized by what seemed to be the foraminifera cf. *Syringamina fragilissima* (Fig. 13, left). Not many species of invertebrates could be observed in the images during the first part of the dive, besides some sponges and some gorgonians attached to the sparse boulders that appeared in between the soft sediment (Fig. 13, right). A few fish species could be identified in the soft bottom area, being the bluemouth rockfish (*Helicolenus dactylopterus*) the most abundant of all. When the Hopper reached the 675 m depth, the substrate became coarser with many more rocky outcrops being observed in the images. The number of invertebrate megafauna species started to increase together with the available hard surface. Some areas were characterized by the presence of the white gorgonian cf. *Corallium johnsoni* and the anthozoan *Anthomastus* cf. *agaricus* (Fig. 14, left), together with the white sea-urchin *Echinus melo* and some sponge species. As the Hopper reached the shallowest part of the dive, large colonies of the whip coral *Viminella flagellum* started to appear, finally becoming the most abundant coral species.



Fig. 13. The deepest section of dive 5 was characterized by soft substrates (mostly muds and fine sands) with some small boulders found scattered along the transect. The area seemed to hold very low diversity values overall, with very few megafauna species of large sizes. The soft substrate was colonized by the foraminifera cf. *Syringamina fragilissima* (left) and the boulders had some sponges attached to them, such as *Leiodermatium pfeifferae* (right).



Fig. 14. Images of the community associated with the rocky outcrops observed in the second part of the dive. Not many megafauna species could be identified besides some cf. *Corallium johnsoni* (left) and the whip coral *Viminella flagellum* (right), all of them displaying very low densities overall.

Leg 12b, Station 15

24 July 2018. *South of Terceira.*

Start time at bottom	End time at bottom	Start depth (m)	End depth (m)
03:38	04:50	835	635

Dive performed on the southern coast of Terceira island, very close to dive 5, and covering a very similar depth range, between 830 m and 630 m depth (Fig 15). The dive lasted over one hour and covered a distance of 965 meters, always moving towards shallower areas.

The Hopper landed in an area of soft substrates, mostly muds and fine sands, characterized by the presence of the foraminifera cf. *Syringamina fragilissima*, which in certain sections reached relatively high densities (Fig. 16, left). As the Hopper moved upwards, the mother rock started to outcrop, together with some very large boulders, in most cases colonized by the yellow cup coral cf. *Leptopsammia formosa*, which reached relatively high densities (Fig. 16, right). The rocks were always covered by a layer of mud/sand, which possibly limited the capacity of other fauna to colonize. Nonetheless, a few other species could be observed in between the yellow corals, such as *Anthomastus* cf. *agaricus*, cf. *Corallium johnsoni* and a few small sponge species, in all cases in very low numbers. A few specimens of the frogmouth fish *Chaunax* sp. could also be observed resting over the seabed as the Hopper passed by.

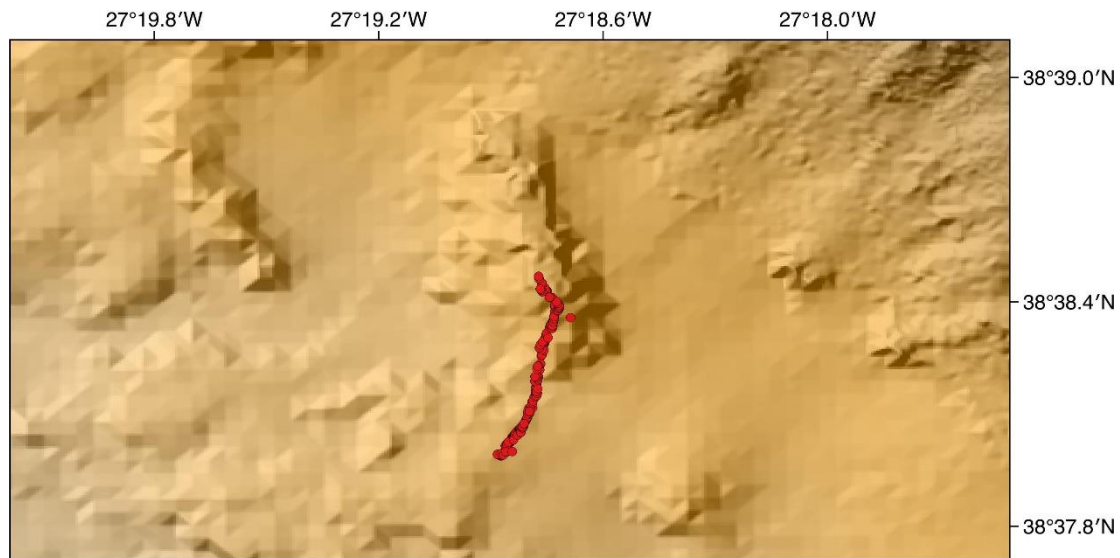


Fig. 15. GPS position of dive 15, south of Terceira island.

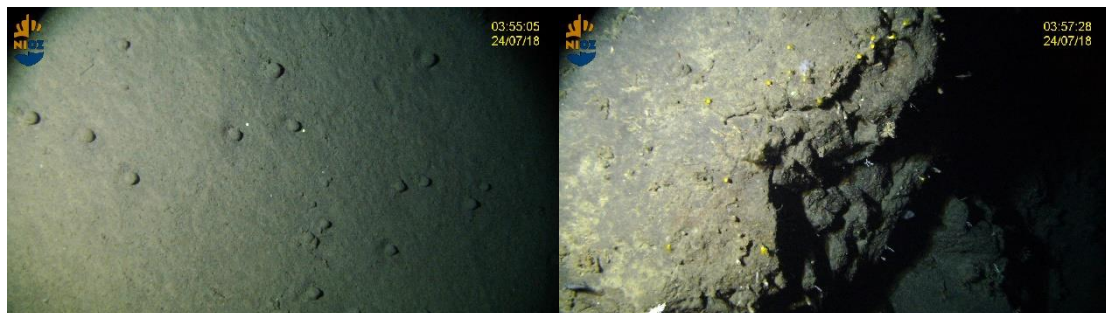


Fig. 16. Images of the soft sediment area where the Hopper landed in dive 15, colonized by the foraminifera cf. *Syringammina fragilissima* (left). As the rock started to outcrop, relatively dense aggregations of the yellow coral cf. *Leptopsammia formosa* started to appear (right).

At 770 m depth, after crossing another patch of mud and sand colonized by the foraminifera cf. *Syringammina fragilissima*, we found an area of large rocky outcrops that generated a very steep slope. In this case, the number of megafauna species still remained low, but large deposits of dead corals could be observed, generating the so-called *coral rubble* (Fig. 17, top left). Due to the distance to the seabed kept by the Hopper, the images do not allow for an accurate identification of the species that generated the coral rubble, although it is very likely that the dead skeletons belonged to the cold-water coral *Lophelia pertusa*. Some sparse organisms could be identified in between the coral rubble, in which the yellow gorgonian *Acanthogorgia* sp. and the sponge *Pheronema carpenteri* were the most abundant (Fig. 17, top right). Towards the end of the dive, the diversity and abundance of organisms attached to the rocky outcrops increased, with relatively higher numbers of *Anthomasus* cf. *agaricus*, *Acanthogorgia* sp., cf. *Lytocarpia myriophyllum* or different laminate sponges. Towards the 650 m depth range, the presence of some large gorgonians of the species *Paragorgia johnsoni* and *Paragorgia arborea* was noticeable (Fig. 17, bottom left), some of them showing signs of being affected by the fishing activity (Fig. 17, bottom right). In this regard, some fishing lines were observed lying over the seabed, mostly during the second part of the dive.

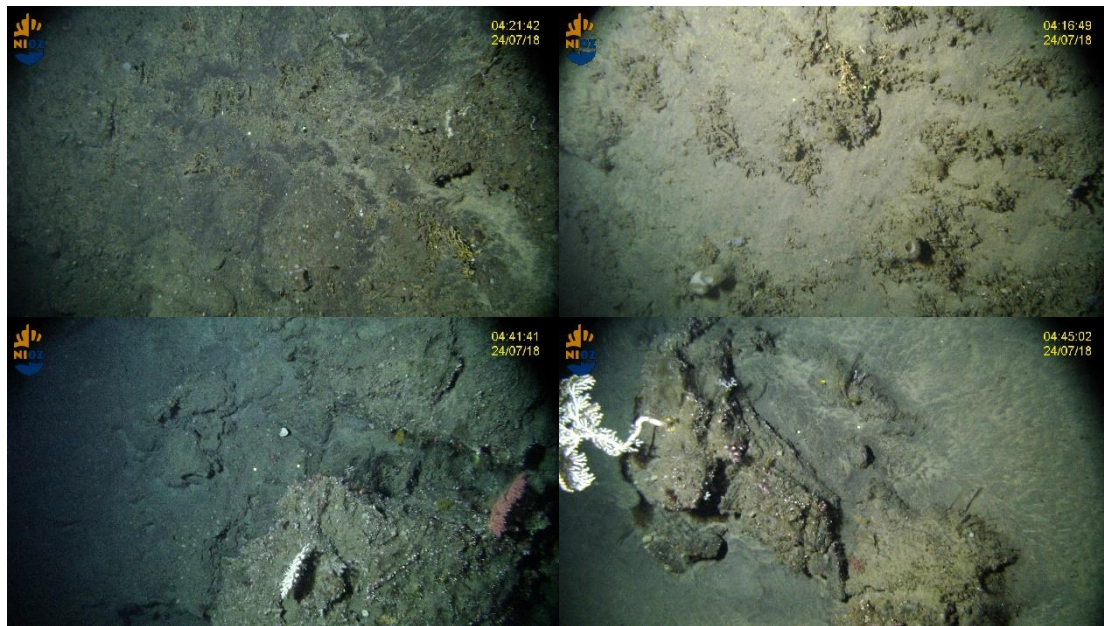


Fig. 17. Images of the aspect of the coral rubble observed in dive 15 (top images), which was mostly found between 775 and 740 m depth. A few large *Paragorgia* specimens were observed towards the shallowest part of the dive, at 650 m.

Leg 12b, Station 31

25th July 2018. *São Jorge de Fora* seamount.

Start time at bottom	End time at bottom	Start depth (m)	End depth (m)
09:11	13:27	1310	1015

Dive performed across *São Jorge de Fora* seamount, located 20 kilometres southwest of Terceira island. The dive covered a total distance of 5700 meters, starting on the deepest side northeast of the seamount, crossing its summit at 560 m depth and finishing on the south-western part of the seamount, at 1000 depth (Fig. 18). Bottom time of this dive lasted over 4 hours, providing information of all habitats located along a very strong depth gradient, on both sides of the seamount.

The Hopper landed on the north-eastern side of the seamount, at 1300 m depth, in an area of a flat topography characterised by the presence of muds and fine sands with the foraminifera cf. *Syringamina fragilissima*. Not many megafauna species could be identified in the images, besides some sea urchins (*Cidaris cidaris*) and sparse gorgonians of the species *Acanella arbuscula* (Fig. 19, left), together with some large crustaceans (Fig. 19, right). A large amount of eel-like fishes could also be observed in the images, some of them displaying rather active swimming behaviour. At 1170 m depth, a band of black rocks appeared on the image, lasting until 1065 m depth. Although quite impoverished in general, the rocks generated very steep slopes in some areas. Only a few yellow laminate sponges and some *Acanella arbuscula* could be identified attached to their surfaces, together with other sponge species (Fig. 20).

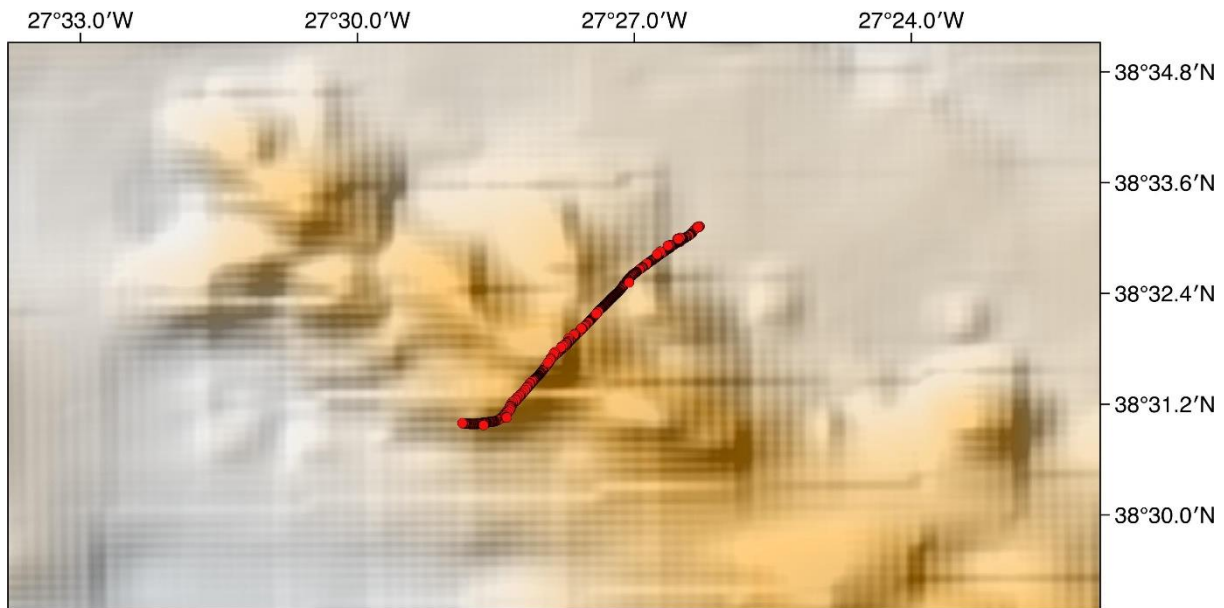


Fig. 18. GPS position of dive 31, in São Jorge de Fora seamount, southwest of Terceira island.

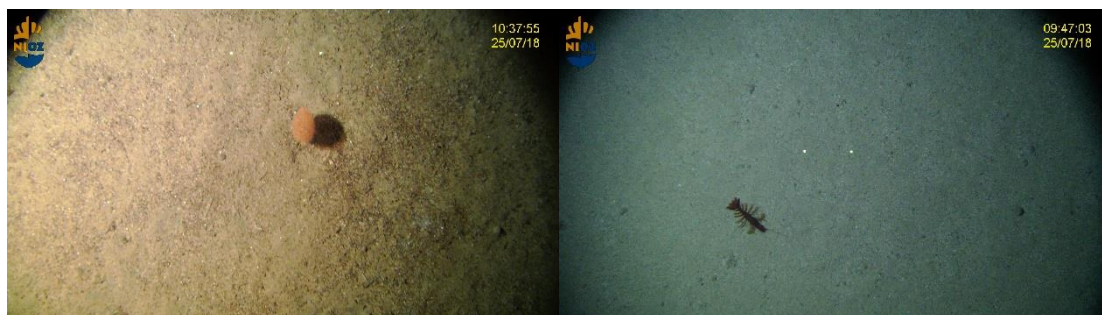


Fig. 19. Images of the deepest area explored, where some solitary gorgonians of the species *Acanella arbuscula* (left) and some very large crustaceans could be observed (right).



Fig. 20. Laminate sponge observed in the deep rocks on the northern side of the seamount (left) accompanied with the gorgonian *Acanella arbuscula* and other sponge species (right).

After crossing a long band of soft sediment dominated by the foraminifera cf. *Syringammina fragilissima* and the gorgonian *Acanella arbuscula*, some aggregations of an unidentified white gorgonian could be observed, at 930 m depth (Fig 21, top left). This white gorgonian species initially appeared as a monospecific patch, but later shared its habitat with some whip corals of the species *Narella versluysi*. The number of *Narella* individuals slowly increased, fully replacing the white gorgonian, with areas of a certain density (Fig. 21, top right). Other species were also found accompanying the *Narella* aggregation, such as the sea urchins *Cidaris cidaris* and *Echinus melo*, the yellow cup coral

Leptosammia formosa, the large sponge *Pheronema carpenter* and the primnoid gorgonian *Narella bellissima* (Fig. 21, bottom left). It was at this point that a deep-sea shark appeared on the image, swimming slowly very close to the seabed (Fig. 21, bottom right).

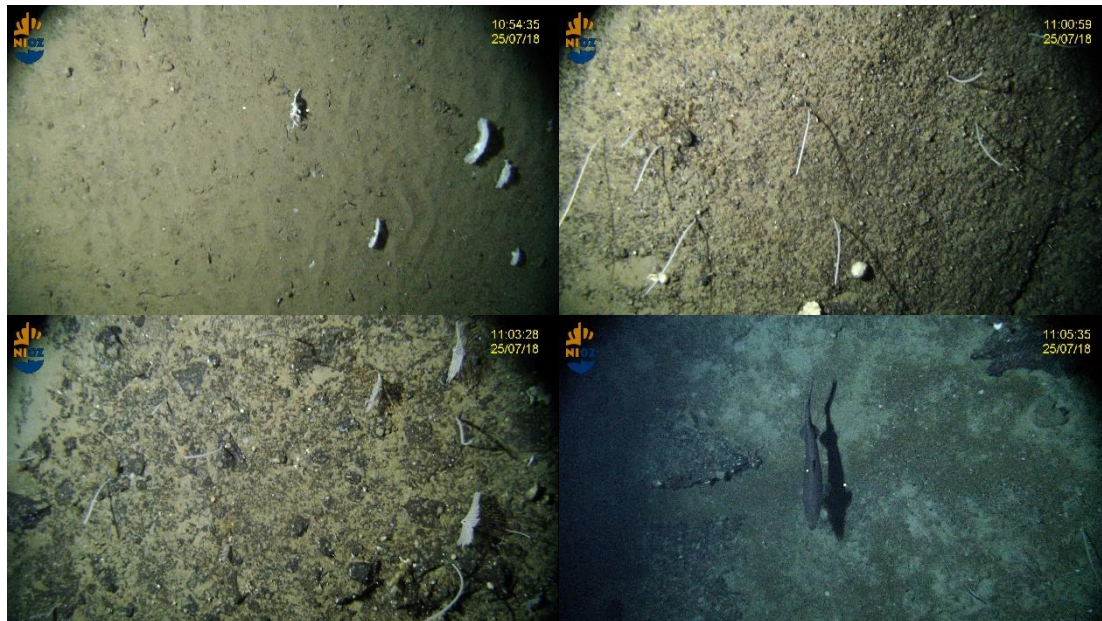


Fig. 21. Unidentified white gorgonians dwelling on soft sediment at ca. 900 m depth (top left), which were also found in the same area as the whip coral of the Primnoidae family *Narella versluysi* (right). The species *Narella versluysi* and *Narella bellissima* were observed sharing the same habitat (bottom left). A deep-sea shark swimming in front of the camera in the *Narella* aggregation, at ca. 720 m depth.

After crossing an area of large outcropping rocks only colonized by encrusting sponges, the Hopper started to cross a section full of dead biogenic material, some of which clearly corresponded to the skeletons of cold-water corals (Fig. 22, left). The distance of the camera to the seabed might complicate the identification of the species that formed this coral rubble. At 550 m depth, mixed between the bands of coral rubble, the hard substrate started to be colonized by gorgonians of the species *Viminella flagellum*, which were accompanied by other corals such as *Paranthipathes larix*, *Anthomastus cf. agaricus* and *Acanthogorgia* sp., the white sea urchin *Echinus melo* and many encrusting sponges. This species composition, mixed in between areas full of coral rubble and biogenic detritus, was found all the way until the summit of the seamount, at 515 m depth, and kept towards the side of the seamount.

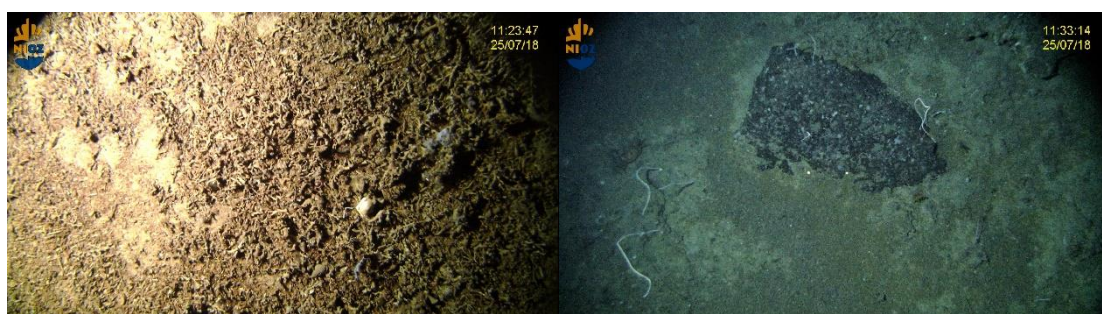


Fig. 22. Biogenic detritus composed of dead coral skeletons and the carapaces and spikes of sea urchins, at 560 m depth (left) and hard substrates colonized by the whip coral *Viminella flagellum* (right).

During the descent, at around 595 m depth, an aggregation of large gorgonians of the species *Callogorgia verticillata* was observed (Fig. 23, left). Gathered in patches, their densities reached relatively high numbers in some areas, with a distribution that lasted several tens of meters. The monospecific patches of *Callogorgia* soon started to become multispecific, with the presence of other gorgonians of the species *Narella bellissima* and *Narella versluysi*. As depth increased, these two species of Primnoids became dominant, generating some dense patches, in which the presence of the sponge *Pheronema carpenteri* was also very common (Fig. 23, right). The presence of *Narella* species spread for a few hundreds of meters, down to 830 m depth. After this point and down to 960 m depth, the seabed was mostly characterized by sands and gravels, some of which of a biological origin, with little megafauna species to be reported, besides of a small rocky outcrop with some *Narella* specimens.



Fig. 23. Aggregation of gorgonians of the species *Callogorgia verticillata* on the rocky outcrops close to the summit, on the southern side of the seamount (left). Aggregation of *Narella bellissima* and *Narella versluysi* at ca. 700 m, together with various specimens of the sponge *Pheronema carpenteri*.

At 1000 m depth, not many rocky outcrops could be observed in the images. Those that were encountered were characterized by the presence of the yellow cup coral cf. *Leptopsammia formosa*, together with an unidentified white gorgonian and a yellow laminate sponge (Fig. 24, left). After that point, the substrate was mostly composed of sands and gravels, the majority of them of a biogenic origin (Fig. 24, right). Not many megafauna species were observed in the last few meters of the dive. It is important to point out that this area was full of eel-like fishes, as it was observed on the other side of the seamount.



Fig. 24. Rocky outcrop at 1000 m depth, with many colonies of the yellow cup coral *Leptopsammia formosa* (left). Biogenic gravels observed in the last section of the Hopper dive.