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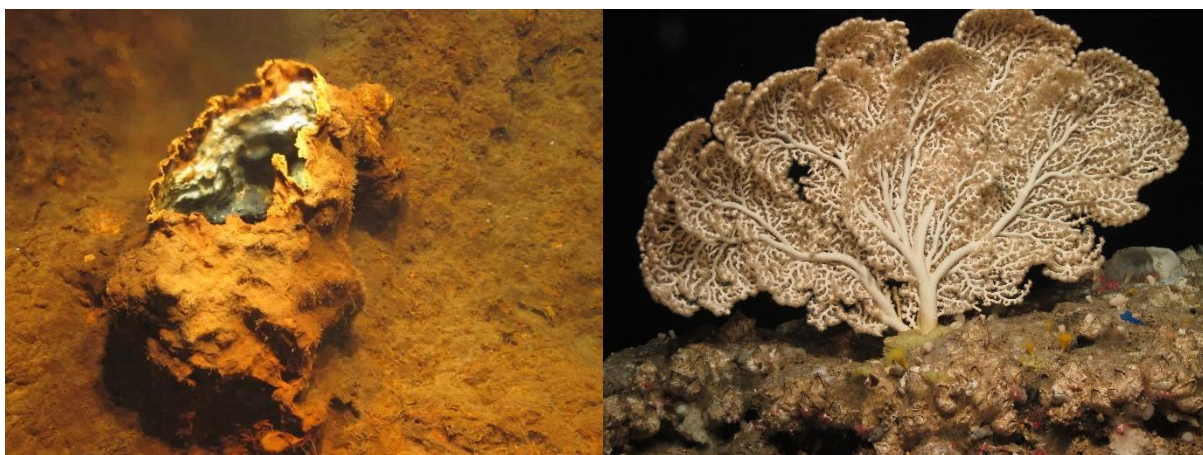
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BLUE AZORES PROGRAM: EXPEDITION 2018 ON BOARD THE NRP GAGO COUTINHO

(1st Leg, 3rd to 9th June 2018; 2nd leg, 14th to 24th June 2018)

CRUISE REPORT *Date: 27/06/2018*



A new hydrothermal vent field discovered on June 16th 2018; named "Luso". To our knowledge this is the first deep hydrothermal vent field discovered on a Portuguese expedition, led by a Portuguese scientific team, on a Portuguese vessel, and using a Portuguese ROV and ROV team. Portugal should be proud of this discovery; as we are. On the right image there is an example of an exuberant Paragorgia johnsoni, which forms dense coral gardens also in the Gigante area.



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BLUE AZORES PROGRAM: EXPEDITION 2018

(NRP Almirante Gago Coutinho)

CRUISE REPORT *Date: 27/06/2018*

Partners: Blue Azores Program of the Oceano Azul Foundation, in cooperation with the Waitt Foundation, and in the collaboration with National Geographic, the EU ATLAS project and the FRCT MapGES project, and through a partnership with the Regional Government of the Azores.

Objectives: to conduct an expedition to some unexplored areas of the deep Azores using the Portuguese ROV “Luso” and the vessel “NRP Almirante Gago Coutinho”. The sampling strategy that was designed to identify Vulnerable Marine Ecosystems and report the deep-sea benthic biodiversity using the ROV Luso also aimed to (i) map benthic communities inhabiting unexplored seamounts in the Central (Gigante complex) and Western (Cachalote complex) part of the Azores Region, (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, evaluating at the same time the role played by the Mid-Atlantic Ridge as a barrier between the western and the eastern parts. 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.

Vessel: NRP Almirante Gago Coutinho

Chief scientist: Telmo Morato and Marina Carreiro-Silva

Scientific team: Telmo Morato, Gerald H. Taranto, Carlos Dominguez-Carrió, Manuela Ramos, Noelia Ríos, Laurence Fauconnet, Oscar Ocaña Vicente

ROV Luso team: António Calado, Andreia Afonso, Bruno Ramos, Miguel Souto, Renato Bettencourt

Main achievements:

1. Benthic communities inhabiting previously unexplored seamounts were mapped
2. Discovery of a new hydrothermal vent field at 570 m depth
3. Discovery of potentially new species and new biotopes, some of them that may fit the FAO vulnerable marine ecosystems (VME) definition
4. Identification of 3 to 5 new areas that fit the FAO VME definition
5. A total of 13 ROV dives, summing up more than 58 hours of bottom time
6. Reporting of, at least, 14 different benthic habitats/communities
7. More than 140 biological samples collected, together with sediment and water samples from almost all the areas explored
8. 21,500km² of new multibeam bathymetry data

Cruise summary

(Azores local time; UTC time similar to Azores summer time)

Table 1. Scientific team on board of the “NRP Almirante Gago Coutinho”.

Member of the team	Speciality and main duties during the cruise	Leg 1: Horta-Horta (3-9 Jun)	Leg 2: Horta-Horta (13-23 Jun)
Telmo Morato (PhD)	Deep-sea fishes; eDNA; ROV dive planning	X	X
Gerald Taranto (PhD student)	Video annotation; benthic fauna; biological sampling	X	X
Manuela Ramos (PhD student)	Video annotation; benthic fauna; biological sampling	X	X
Laurence Fauconnet (PhD)	Deep-water sharks	X	X
Noelia Ríos (Technician)	Marine litter	X	X
Carlos Dominguez-Carrió (PhD candidate)	Video annotation; benthic fauna; biological sampling		X
Oscar Ocaña Vicente (PhD)	Taxonomy of cold-water corals	X	X

Table 2. Summary of all sampling stations during the Blue Azores 2018 expedition.

St.	Date	T0	T1	Activity/ gear	Num.	Site	Lat. 0	Lon. 0	Lat. 1	Lon. 1	Depth0	Depth1
1	03/06/2018	08:38	08:53	VS	1	NP	38.5790	-28.4960	38.5780	-28.4530		
2	03/06/2018	08:57	09:12	VS	2	NP	38.5770	-28.4440	38.5760	-28.4040		
3	03/06/2018	15:00	18:23	ROV	2	NP6	38.4964	-28.1733	38.4947	-28.1747	870	724
4	04/06/2018	07:43	07:53	VS	3	NP	38.4969	-28.1975	38.5086	-28.2139		
5	04/06/2018	09:05	13:00	BRUV	1	NP	38.8278	-28.3258	38.8278	-28.3258	525	525
6	04/06/2018	11:00	11:40	ROV	TV	NP5	38.8372	-28.3167	38.4967	-28.0281		
7	04/06/2018	11:51		ROV	3	NP5	38.8372	-28.3167	38.4967	-28.0281	870	437
8	04/06/2018	20:12	20:34	VS	4-5	NP	38.5108	-28.2117	38.5258	-27.8878		
9	05/06/2018	08:05	08:27	VS	6-7	NSJ	38.8500	-27.8931	38.8133	-27.8975		
10	05/06/2018	14:04	14:14	VS	8	NSJ	38.7841	-28.2043	38.5813	-27.7685		
11	05/06/2018	16:00	16:10	VS	9	NSJ	-	-	38.6664	-27.9843		
12	06/06/2018	08:00	08:10	VS	10	SSJ	38.5292	-27.9105	38.5472	-27.9341		
13	06/06/2018	08:12	08:22	VS	11	SSJ	38.5500	-27.9381	38.5657	-27.9576		
14	06/06/2018	10:39	14:50	ROV	4	SSJ	38.4964	-28.1947	38.6069	-28.0689	655	271
15	06/06/2018	17:02	18:12	BRUV	TEST	SSJ	38.6072	-28.0694	38.6072	-28.0694	320	320
16	07/06/2018	08:00	08:58	VS	12-13-14	PS	38.5500	-27.9381	38.3237	-28.2291		
17	07/06/2018	12:39	20:00	ROV	5	PS	38.3456	-28.2794	38.3570	-28.2675	1098	500
18	07/06/2018	21:11	21:21	VS	15	PS	38.3084	-28.4410	38.3015	-28.4659		
19	08/06/2018	08:08	08:18	VS	16	G127	38.7953	-30.1389	38.7259	-30.0550		
20	08/06/2018	10:56	16:01	ROV	6	G127	38.8194	-30.0139	38.7208	-30.0147	612	308
21	08/06/2018	19:57	20:07	VS	17	G127	38.6405	-29.9203	38.6201	-29.8916		
22	08/06/2018	20:14	20:24	VS	18	G127	38.6087	-29.8998	38.5893	-29.9148		
23	09/06/2018	08:10	08:20	VS	19	G-SWF	38.9006	-29.7691	38.8825	-29.7717		
24	09/06/2018	13:19	13:29	VS	20	SWF	38.6026	-29.1716	38.5964	-29.1479		
25	09/06/2018	14:20	14:30	VS	21	SWF	38.5618	-29.0248	38.5556	-29.0014		
26	09/06/2018	15:23	15:38	VS	22	SWF	38.5169	-28.8682	38.5065	-28.8318		
26	09/06/2018	15:23	15:38	VS	22	SWF	38.5169	-28.8682	38.5065	-28.8318		
27	14/06/2018	12:08	17:27	ROV	7	GE	38.9969	-29.84056			825	684
28	14/06/2018	18:38	18:48	VS	23	GE	38.5048	-28.82547	38.9625	-29.7432		
29	14/06/2018	19:58	20:08	VS	24	GE	39.1836	-29.6603	39.2219	-29.6947		
30	14/06/2018	19:20	15:00	MB Oscar		Transit						
31	15/06/2018	07:44	07:54	VS	25	MAR	39.0829	-29.6543	39.1745	-29.6026		



32	15/06/2018	09:02	09:13	VS	26	MAR	39.0637	-29.6549	39.0541	-29.6787		
33	15/06/2018	11:01	11:11	VS	27	MAR	38.9421	-29.7045	38.9326	-29.6818		
34	15/06/2018	14:40	14:51	VS	28	MAR	39.0564	-29.5775	39.0758	-29.5695		
35	16/06/2018	08:15	08:25	VS	29	GE	39.0164	-29.8196	39.0014	-29.8171		
36	16/06/2018	10:03	16:54	ROV	8	GE	38.9859	-29.8374	38.9832	-29.8364	730	562
37	16/06/2018	20:10	20:20	VS	30	GE	39.0874	-29.9534	39.0876	-29.9529		
38	17/06/2018	12:46	/	ROV	9	G127-NW	38.7480	-30.0444	/	/		
39	17/06/2018	18:03	18:13	VS	31	G127-NW	38.6908	-30.1284	38.6786	-30.1469		
40	17/06/2018	19:45	19:55	VS	32	G127-NW	38.5569	-30.3305	38.5442	-30.3497		
41	18/06/2018	07:43	07:53	VS	33	G127-NW	38.7889	-30.1134	38.6939	-30.0966		
42	18/06/2018	08:41	08:51	VS	34	G127-NW	38.7470	-30.0447	38.7479	-30.0451		
43	18/06/2018	17:22	22:29	ROV	10	G127-NW	38.7484	-30.0452	38.7385	-30.3643	680	329
44	19/06/2018	08:56	09:06	VS	35	G127ENE	38.7374	-30.0990	38.7361	-30.0775		
45	19/06/2018	13:38	18:20	ROV	11	G127ENE	38.7383	-30.0476	38.7198	-29.9644		
46	20/06/2018	08:06	08:16	VS	36	GNW	39.0869	-30.0754	39.0792	-30.0537		
47	20/06/2018	14:36	14:46	VS	37	GNW	38.9315	-29.8618	38.9424	-29.8497		
48	20/06/2018	14:50	15:00	VS	38	GNW	38.9392	-29.8199	38.9624	-29.8384		
49	20/06/2018	19:26	19:36	VS	39	GNW	39.1119	-29.8676	39.1311	-29.8692		
50	21/06/2018	08:58	14:44	ROV	12	GS	38.9694	-29.8535	38.9795	-29.8520	742	364
51	21/06/2018	17:39	19:19	ROV	13	G127-NW	38.9842	-29.8343	38.9840	-29.8347	585	547
52	21/06/2018	20:29	20:39	VS	40	GNW	38.9641	-29.8041	38.9471	-29.7910		
53	22/06/2018	08:12	08:22	VS	41	GNW	38.9436	-29.7867	38.9608	-29.8560		
54	22/06/2018	11:01	18:02	ROV	14	GNW	39.0412	-29.9292	38.9989	-29.9206	760	398
55	22/06/2018	19:48	19:58	VS	42	GNW	39.0395	-30.0588	39.0413	-30.0849		
56	22/06/2018	20:00	20:10	VS	43	GNW	39.0417	-30.0900	39.0494	-30.1146		
57	23/06/2018	09:34	16:27	ROV	15	GAS	38.7089	-30.1898	38.6995	-30.2301	590	440
58	23/06/2018	18:41	18:51	VS	44	GAS	38.5969	-30.1898	38.5839	-30.1696		

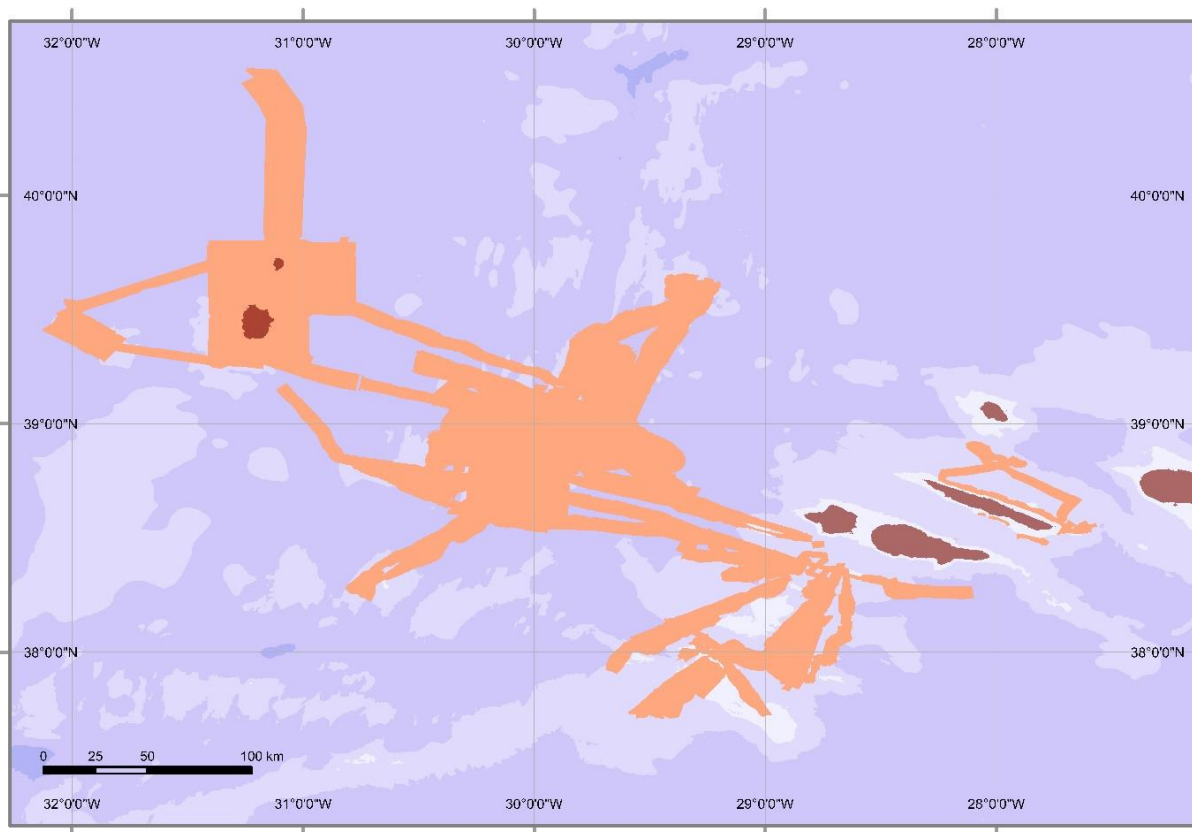


Figure 1. Summary of the 21,500km² multibeam bathymetry data collected by the IH during the Blue Azores 2018 Expedition.



Blue Azores 2018: ROV dives

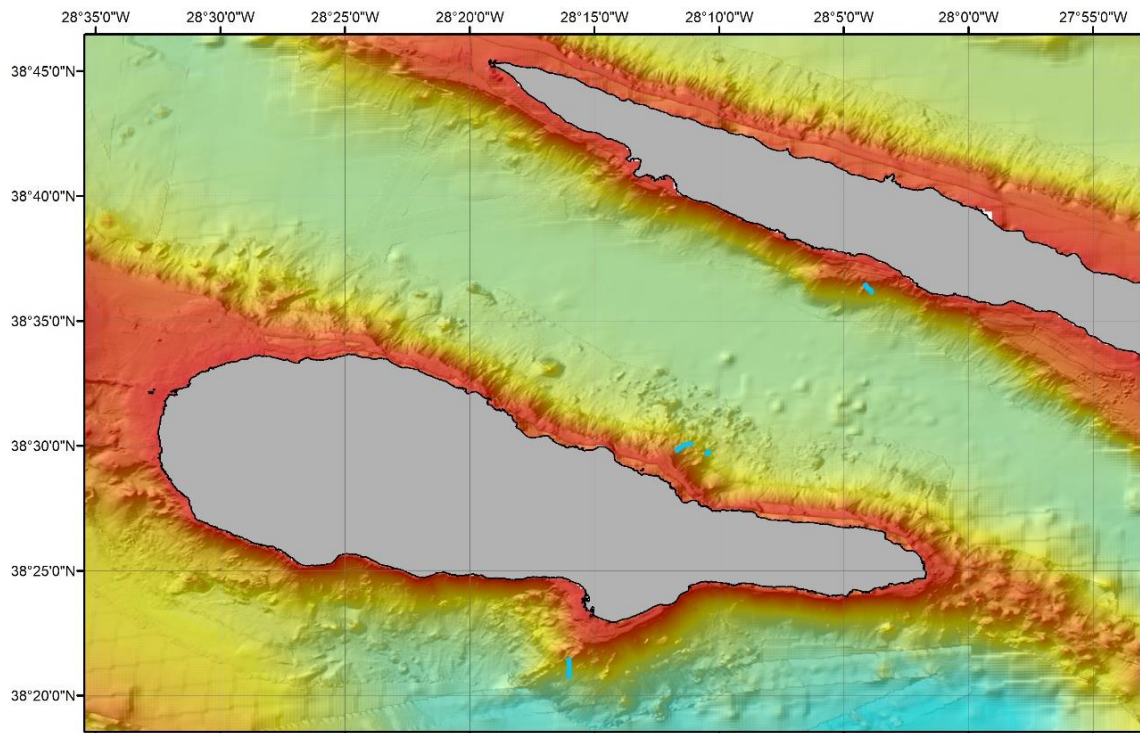


Figure 2. Map showing the location of the ROV Luso dives (blue lines) in Pico and São Jorge island slopes.

Blue Azores 2018: ROV dives

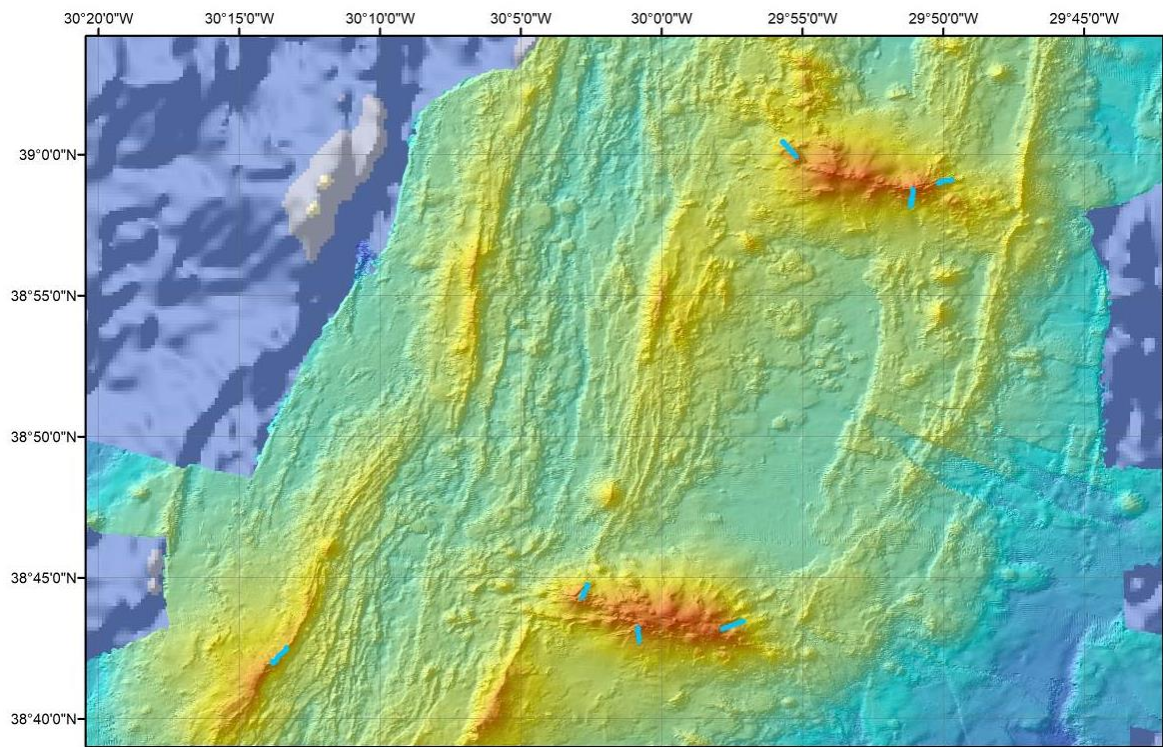


Figure 3. Map showing the location of the ROV Luso dives (blue lines) in Gigante seamount complex area.



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Table 3. Summary of the 13 dives performed with ROV Luso during the Blue Azores 2018 Expedition, covering a total distance of 10,980 m and a mean distance of 845m per dive.

Station	Date	Dive code	Location	Lat. 0	Lon. 0	Dist (m)	Depth 0	Depth 1	Bottom time
3	03/06/2018	Baz_2018_D2	North Pico	38.4964	-28.1733	190	870	724	02:34
7	04/06/2018	Baz_2018_D3	North Pico	38.8372	-28.3167	1020	870	437	04:27
14	06/06/2018	Baz_2018_D4	South São Jorge	38.4964	-28.1947	670	655	271	03:26
17	07/06/2018	Baz_2018_D5	South Pico	38.3456	-28.2794	1270	1098	500	05:42
20	08/06/2018	Baz_2018_D6	Gigante 127	38.8194	-30.0139	930	612	308	04:20
27	14/06/2018	Baz_2018_D7	Gigante	38.9969	-29.84056	100	825	684	03:30
36	16/06/2018	Baz_2018_D8	Gigante	38.9859	-29.8374	770	730	562	06:25
43	18/06/2018	Baz_2018_D10	Gigante 127	38.7484	-30.0452	940	680	329	04:44
45	19/06/2018	Baz_2018_D11	Gigante 127	38.7383	-30.0476	1200	772	378	04:03
50	21/06/2018	Baz_2018_D12	Gigante	38.9694	-29.8535	1150	742	236	05:15
51	21/06/2018	Baz_2018_D13	Gigante	38.9842	-29.8343	70	585	547	01:08
54	22/06/2018	Baz_2018_D14	Gigante	39.0412	-29.9292	1170	760	398	06:23
57	23/06/2018	Baz_2018_D15	Ridge SW	38.7089	-30.1898	1500	590	440	06:32



Cruise diary

03/06/2018 – North Pico island; ROV dive D2, visual surveys and multibeam bathymetry

Departure from Horta harbour on-board NRP Almirante Gago Coutinho at 7:30. Because of the intense SE winds, we steamed towards the north of Pico Island. The marine litter team performed two 15-minute visual surveys at around 8:40 to identify litter and marine turtles, with the objective of finding the best place on the ship to conduct the visual surveys and to practice the methodology. We arrived to the ROV diving site PN6 at 9:00, but a problem with the ROV and the weather conditions delayed the deployment. We started BAz_2018_ROV_D02 (Sampling station 3) at around 15:00 and reached the bottom at 870 m depth at 15:49.

ROV D2 was characterised by a bathyal soft-bottom habitat dominated by sponges, corals, ramified bryozoa and bivalve reefs. Remarkably, an assemblage of cf. *Neopycnodonte zibrowii* and cf. *Cyathidium foresti* (a living fossil community) was observed underneath a bedrock overhang. In the soft bottom areas we found a characteristic foraminifera (cf. *Syringamina fragilissima*). There were also small white Hexactinellid sponges and the conspicuous *Pheronema carpenteri*. From 700 meters up, cf. *Petrosia* was also observed. Hydrocorals were also abundant (cf. *Errina* sp.), together with the small gorgonian *Nicella granifera* as well as the solitary scleractinian *Leptopsammia formosa*. Only a few fish species were sighted, including a few Macrouridae, *Mora moro* and *Conger conger*. The ROV was off bottom at 18:23, at 731 m depth.

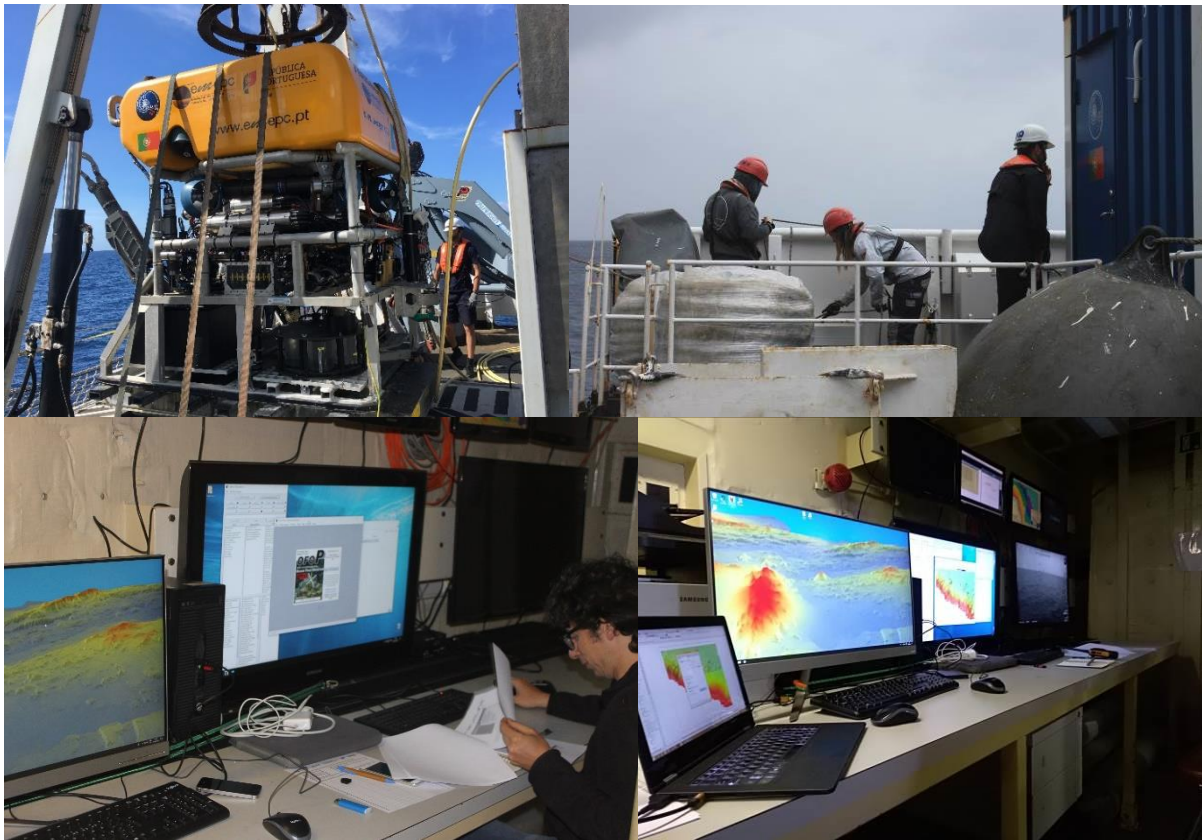


Figure 4. ROV LUSO, the pilots, scientists and maps ready for the first deployment.

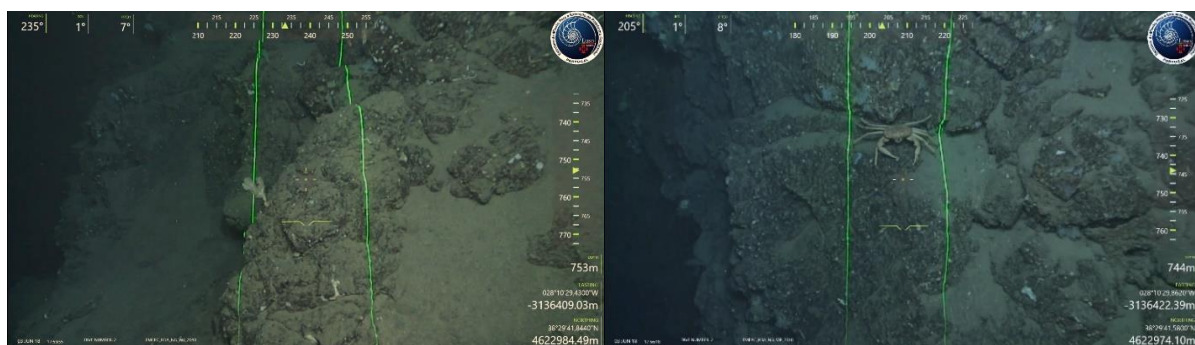


Figure 5. The steep rocky slopes found on the northern side of Pico Island, between 870 m and 730 m depth.

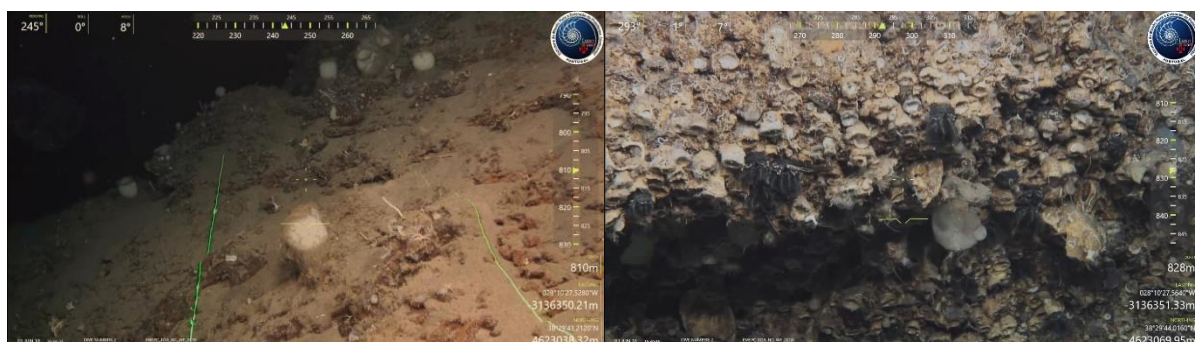


Figure 6. The first sponge ground observed was composed of *Pheronema carpenteri* (left). The living-fossil community of composed of crinoids (cf. *Cyathidium foresti*) and deep-sea oysters (cf. *Neopyncnodonte zibrowii*) underneath a bedrock overhang (right). These two species are also found as 60 million years' fossils.

During the ROV dive, two sediment samples were collected using the push corer (STO3_SED 1, STO3_SED 3; #2 did not work). Four biological sampling events were performed, where the following specimens were collected: two Demospongiae, a Hydrozoa, a Bryozoa and cf. *Farrea* sp. Additionally, 2 water sampling events using Niskin bottles were carried out; 2 bottles (WS1; bottles 3 and 4, 16:59, 810 m depth) were closed near a cf. *Pheronema* sp. sponge ground (identification to be confirmed). Water was collected for eDNA, nutrients and POM. 2 more water samples (18:15) were also attempted close to an area characterized by glass sponges (cf. *Farrea* sp.), other sponges, and encrusting fauna. These last 2 bottles did not close and were discarded. Physical-chemical data (temperature, salinity, oxygen, turbidity, fluorescence, and density) was measured *in situ* using the ROV sensors. Once the ROV was on-deck, all samples were photographed, labelled and stored. At night, multibeam surveys were performed along the south slopes and the eastern tip of São Jorge.

04/06/2018 – North Pico island; outreach, ROV dive D3, visual surveys and multibeam

The day started at 7:40 with a 10-minute visual survey with no sightings of litter or marine turtles. A Baited Remote Underwater Video (BRUV) was deployed at around 9:00 at 500 m depth for one hour and recovered by the small vessel Pintado of the University of the Azores, after a failed attempt to recover it with the NRP Gago Coutinho. In the morning, the media team (NG, RTP) from the vessel Santa Maria Manuela visited our vessel, taking video footage of the scientific operations on the NRP Gago Coutinho vessel. Several interviews with scientist, the captain and the ROV team were also conducted.



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Figure 7. Media day. Underwater footage of the ROV Luso recorded by the NG team (left) and some interviews to the scientific crew (right).

We started the ROV dive BAZ_2018_ROV_D03 (PN5) at 13:00 (Smpling station 7) at around 12:00 and reached the bottom at 740 m depth at 12:45. The bathyal habitat was dominated by soft sediment and several vegetal debris from land. This habitat was characterized by sponges, corals and soft-bottom species. In the soft-bottom zones, there was a characteristic foraminifera (cf. *Syringamina fragilissima*) and different unidentified burrowing invertebrates. Two species of Actiniaria were observed: one pink Actinostolidae and the common *Bolocera* cf. *tuediae*, which is typically distributed from the circalitoral to the deep-sea habitats. On the few rocky outcrops *Nicella granifera* and *Acanthogorgia* cf. *armata* were the most common gorgonian species. Among the sponges, *Petrosia* cf. *crassa*, *Leiodermatium* cf. *pfeifferae*, *Neophrissospongia nolitangere*, *Macandrewia azorica*, an Hexactinellid and an unidentified tubular yellow sponges were the most common. The hydrocoral *Pliobothrus* sp. was also common on the rocky bottoms. Only a few fish species were sighted, including *Hoplostethus mediterraneus*, *Helicolenus dactylopterus*, a few Macrouridae (including cf. *Coelorinchus caelorhincus*), cf. *Chlorophthalmus agassizii*. The ROV was off bottom at 17:15, 436 m depth.

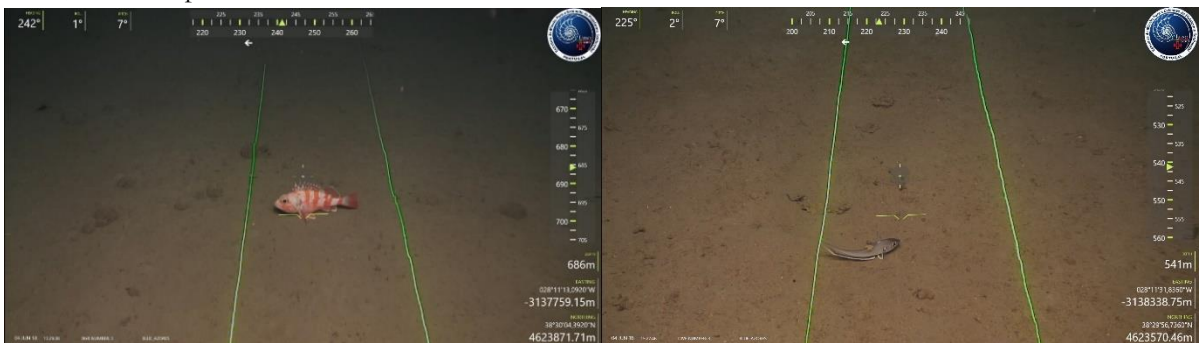


Figure 8. A bluemouth rockfish (*Helicolenus dactylopterus*) and a Macrouridae (cf. *Coelorinchus caelorhincus*) resting on the seafloor.

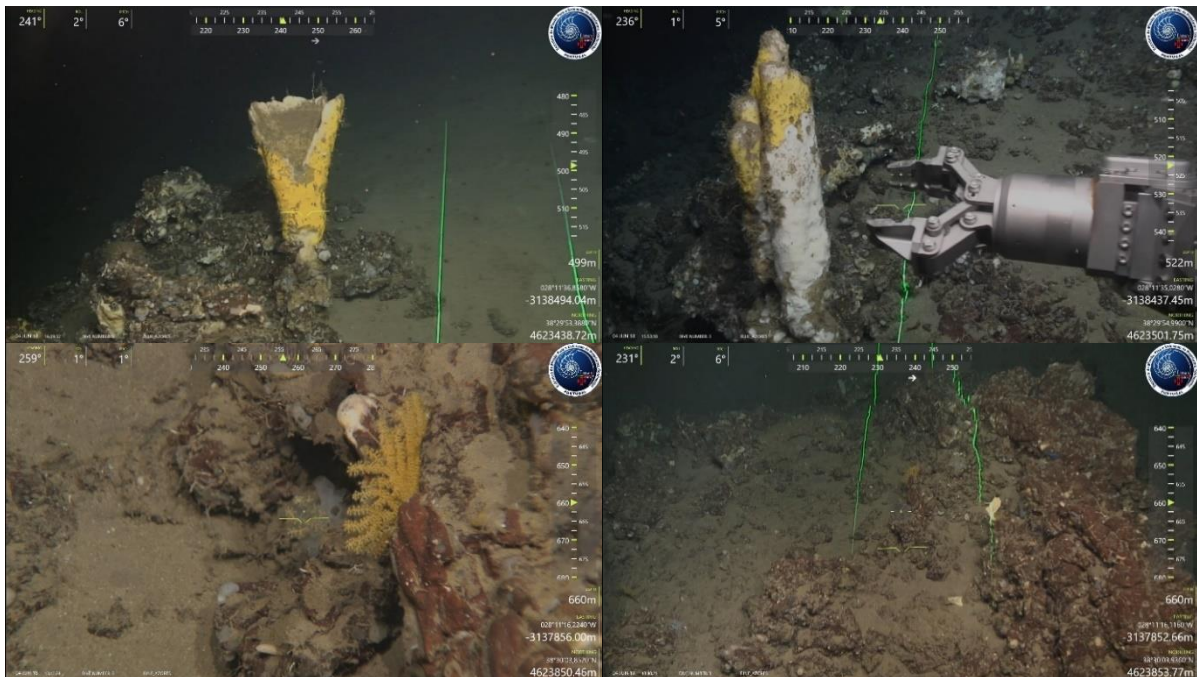


Figure 9. Several massive sponges (top) and *Acanthogorgia* sp. (bottom). Some specimens were collected by the ROV to confirm species identification, carry out other biological tests and study symbiotic communities living on deep-sea sponges.

Three sediment samples were collected using the push corer (STO7_SED 1-3) at 740 m depth and about 4 biological sampling events were completed (*Acanthogorgia*, sp., a massive sponge and a white gorgonian). Additionally, 1 water sampling was performed at 522 m depth with the Niskin bottles, close to small sponges. Water will be used for eDNA, nutrients, alkalinity and POM. At 17:06, one fishing trap was observed, close to the end of the transect. Physical-chemical data (temperature, salinity, oxygen, turbidity, fluorescence, and density) was collected *in situ* with the ROV sensors. After the ROV was on deck, all samples were photographed, prepared, labelled and stored. During the night, multibeam surveys were performed along the south slopes and the eastern tip of São Jorge. Before dusk (at 20:12 and 20:34) two visual transect were performed, with no occurrences of litter or marine turtles. During the night, we steamed to the north shores of São Jorge and performed multibeam surveys on the Ilha Azul and along the north slopes of São Jorge.

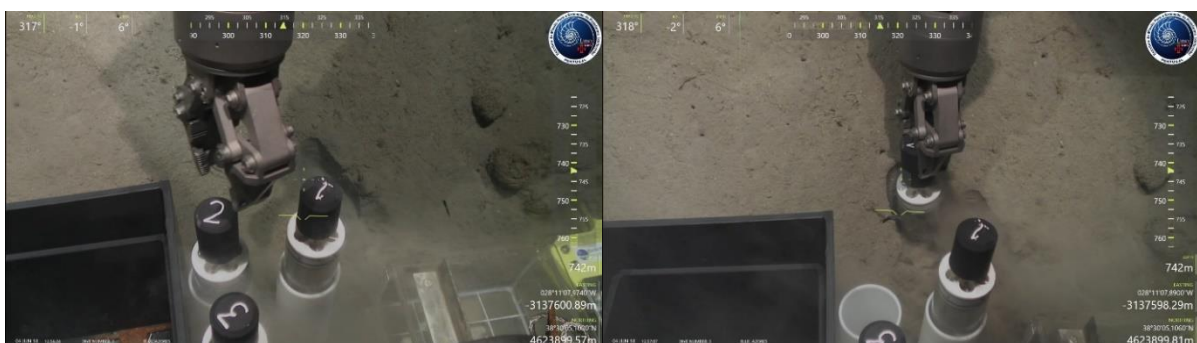


Figure 10. Sediment sampling to analyse infauna communities and microplastics density

05/06/2018 – North São Jorge island; multibeam

The weather conditions worsened because of the strong S/SE winds ($100 \text{ km}\cdot\text{h}^{-1}$) but we found shelter on north shores of São Jorge. The ROV dive were cancelled for the day and multibeam bathymetry was



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conducted along the northern slopes of São Jorge. During the day, five visual surveys were conducted at 8:05, 8:20 (one sea turtle), 10:00, 14:00 and 16:00. The ROV team fixed the Rosette.

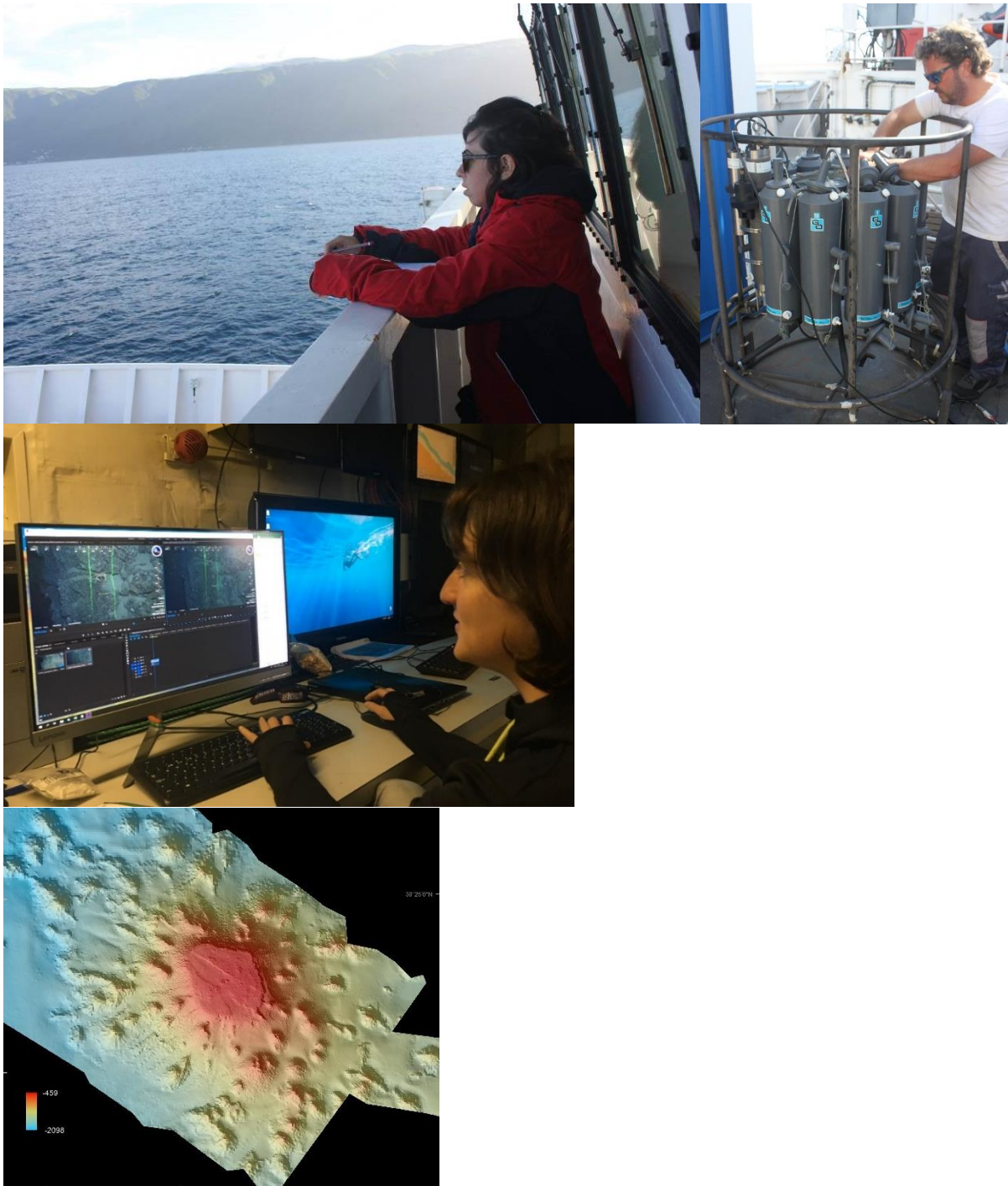


Figure 11. It was impossible to dive with the ROV due to weather conditions. Meanwhile, Noelia Ríos (top left) conducted visual surveys for floating marine litter and Renato Bettencourt (top right) fixed the Rosette. Our scientist Laurence Fauconnet (bottom left) was processing videos from the previous dives and others were preparing the maps for recently collected multibeam data (Cachalote -*sperm whale*-seamount).

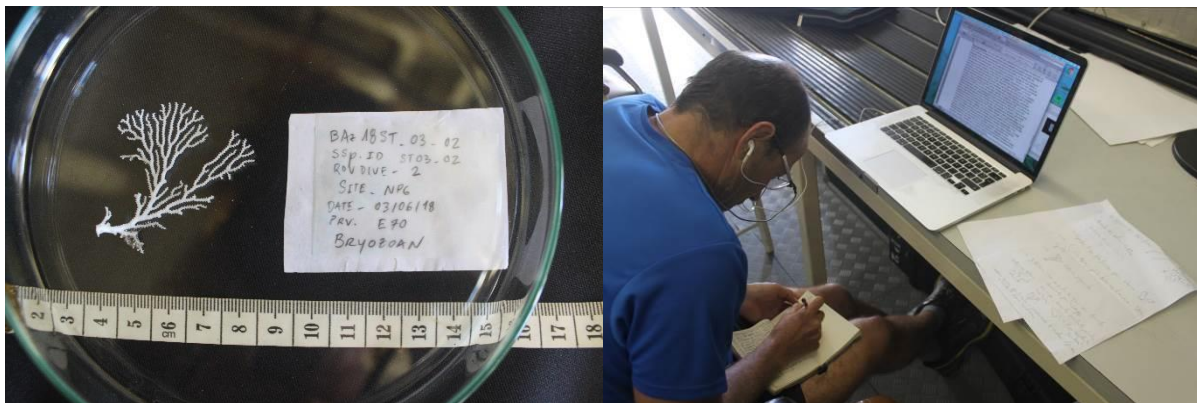


Figure 12. A Bryozoan specimen collected during the ROV Dive 2 (left). Taxonomist at work: Oscar Ocaña (right) taking notes of specimens collected and communities seen during previous ROV dives.

06/06/2018 – South of São Jorge; ROV dive D4, visual surveys and multibeam bathymetry

During the early hours, a problem with a vessel engine delayed the transit and the plans were adjusted to visit the steep slopes of South São Jorge island. The day started at 08:00 with two 10-minutes visual surveys in SE São Jorge. We started the ROV dive BAZ_2018_ROV_D04 (SJ7, adjusted to SJ9) at 10:30 (Sampling station 14) at 11:00 and reached the bottom at 655 m depth.



Figure 2. Preparations for another dive (left). The pilots' room in action (right).

The ROV dive D4 was on slopes between 650 m and 290 m dominated by soft sediment. The bathyal soft-bottom habitat was characterized by different sponge species. The scarce rocky outcrops covered by sediments presented a thin (not identified) white mucous sponge and also some tubular sponges with a yellow cortex. White *Petrosia* sp., blue sponges (cf. *Hymedesmia* sp.), *Leiodermatium* cf. *pfeifferae*, *Neophrissospongia nolitangere* and *Macandrewia azorica* were sighted. The most dense sponge concentrations were observed at about 350 m depth. Corals were distributed sporadically along the whole transect, mainly *Nicella granifera*, *Muriceides* sp., *Swiftia* sp., Caryophylliidae and also *Acanthogorgia* cf. *hirsuta* and white sea urchin *Echinus melo*. The only hydrocoral observed was cf. *Errina dabneyi* and a plate-like bryozoan was



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noticed. In the deeper areas (700 m) and at around 400m depth, assemblages of cf. *Neopycnodonte zibronii* and cf. *Cyathidium foresti* were observed. Lots of myctophids followed the ROV during the descend. Once again, not many fish species were observed during the dive. Among those, *Hoplostethus mediterraneus*, Macrouridae, *Helicolenus dactylopterus*, cf. *Armoglossus rueppelli* and maybe cf. *Chlorophthalmus agassizi*. The ROV had difficulties moving against the current since one of the propellers was not working properly. It was off bottom at 14:20, at 292 m depth.

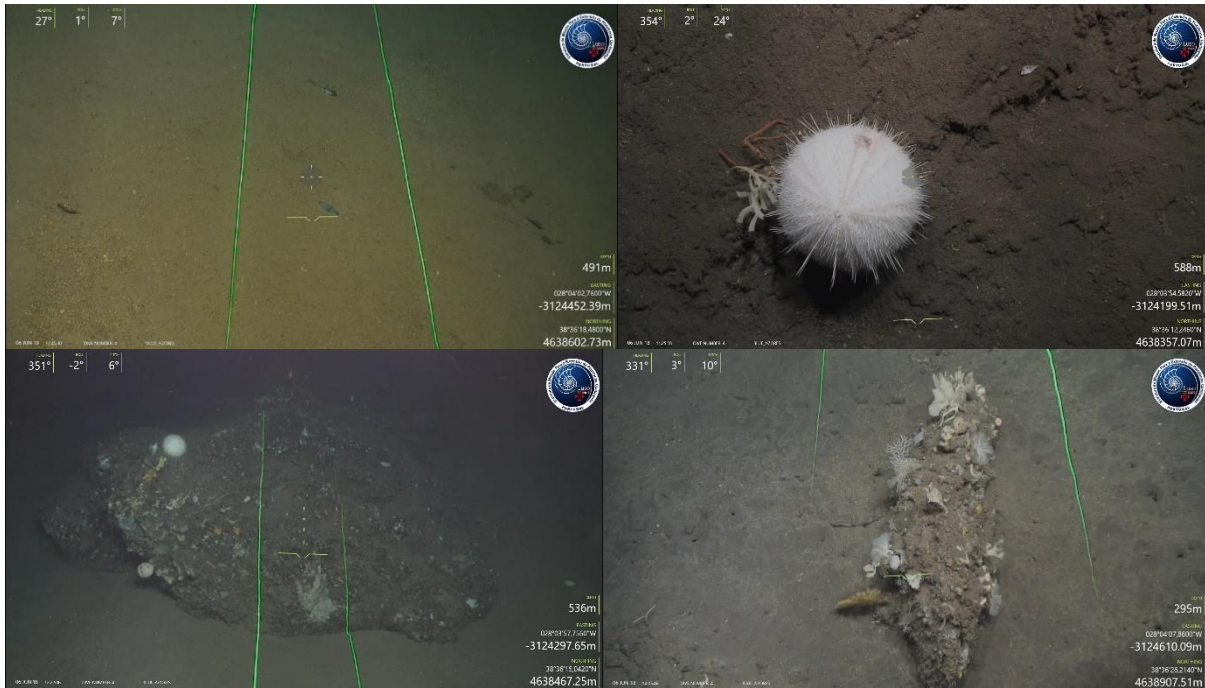


Figure 3. . Third dive with the ROV was characterized by soft bottom, however every rock was an oasis for life.



Figure 4. Encrusting and massive (Lithistids) sponge communities on deep-sea rocks



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During ROV D4, we completed two sediment samples with the push corer (ST014_SED1-2) at 571 m depth and 2 biological sampling events (tubular sponges and Plexauridae). No water samples were collected in D4 since no habitat of interest for eDNA was found. After the ROV was on deck, all samples were photographed, prepared, labelled and stored. A test deployment of the BRUV was made between 17:00 and 18:00 at around 320 m depth with the box corer winch. The BRUV was not stable at the bottom and it was difficult to haul it because of the lack of weight. Although the Rosette was fixed and running there was no appropriated winch in the vessel to perform the sampling. At night, multibeam bathymetry was performed along the southern slopes of Pico island, including Baixo de São Mateus.



Figure 5. Another experimental deployment of the BRUV (without bait) in South of São Jorge to a depth of 325 m. Although it was a very short deployment without bait, it interested a lot a curious octopus walking around to see this new lighted neighbour.

07/06/2018 – South of Pico island; ROV dive D5, visual surveys and multibeam bathymetry

The day started at 08:00 with three visual surveys for litter and marine turtles, where two pieces of floating litter were registered. We arrived to the ROV diving site P1 at 9:00 but a problem with the collection chamber carousel delayed the dive BAz_2018_ROV_D05 until 12:40. The ROV reached the seabed at around 13:00 at 1100 m depth. Previous explorations of the area suggested the presence of *Pheronema* grounds and living patches of *Lophelia* or *Madrepora*.



Figure 6. The ROV pilots room (left) when the ROV was flying over a beautiful sponge ground of *Pheronema carpenteri* (right).

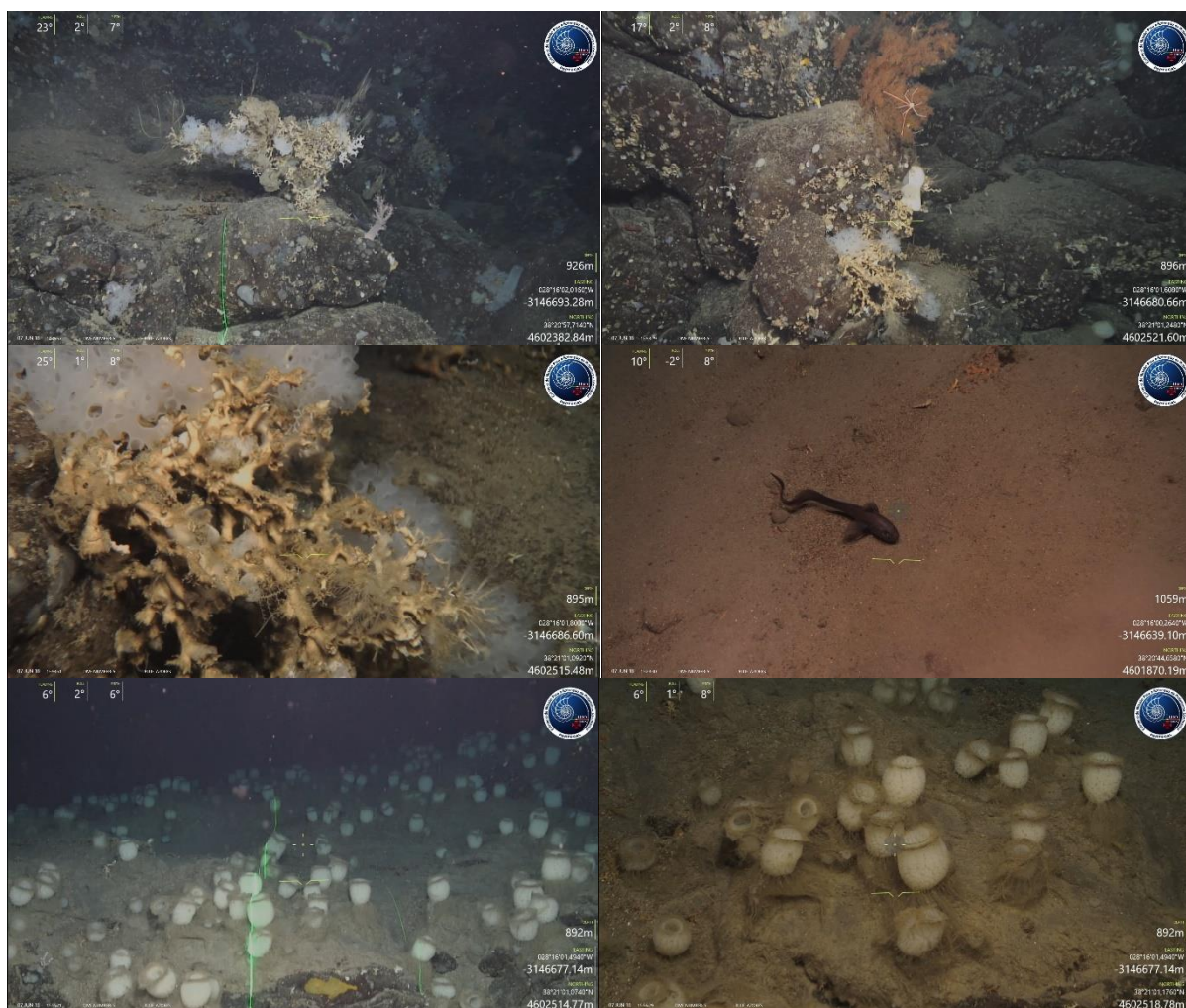


Figure 7. Some highlights of the D5 including dead (and probably live) stony corals, black corals, Macrouridae fish, and sponge grounds.

D5 covered a wide depth range, from 1000 m to 500 m. The deeper habitats (1000-800 m depth) were a hotspot of cold-water corals. Large areas were covered with coral debris of dead *Lophelia pertusa*¹ together with live *Desmophyllum dianthus* growing on the dead colonies. Debris of *Dendrophyllia cornigera* and *Dendrophyllia* sp. were also observed among those of *L. pertusa* skeletons. On soft dominated bottoms, *S. fragilissima*, *Cidaris cidaris*, *Deltocyathus* cf. *moseleyi* and *Bolocera* cf. *tuediae* were common species. On rocky slopes we found dead colonies of *L. pertusa* with abundant populations of cf. *Leptopsammia formosa* and other *Caryophylliidae*. Numerous gorgonians were observed on boulders along the walls (*Paramuricea* sp., *Bebryce* cf. *mollis*, *Placogorgia* sp., *Chrysogorgia* sp., *Anthomastus* cf. *grandiflorus* and unidentified *Nidaliidae*). Hydrocorals were also common, mostly *Errina* cf. *dabneyi*, *Pliobothrus* sp. and tiny specimens of *Crypthelia* sp., but also an Actiniaria of the family Actinostolidae. On top of the rocky outcrops large sponge fields of *Pheronema carpenteri* were observed. The slope soft sediment bathyal habitat from 800 to 500 meters was mainly colonized by sponges: *Petrosia* cf. *crassa*, *Petrosia* sp., *Macandrenia azoria*, *Neophrissospongia nolitangere*, *Leiodermatium pfeifferae* and possibly *Craniella longipilis*. Small colonies of hydrocorals (*Errina* cf. *dabneyi*) and the yellowish black coral *Elatopathes* cf. *abietina* were also observed. Large specimens of *E. melo* were identified along the transect. Several fish were sighted, mostly *Chaunax pictus*, Macrouridae, probably

¹ For the time being, we still consider *Lophelia pertusa* as the valid name for what WoRMS now refers to as *Desmophyllum pertusum*



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Synphobranchus kaupii (and other eel/conger like species), *Trachyscorpia cristulata*, *Hoplostethus mediterraneus*, *Helicolenus dactylopterus* and unidentified Scorpaenidae. The ROV was off bottom at 19:04, at 500 m depth.

During dive D5, we completed two sediment samples with the push corer (ST014_SED1-2) at 914 m depth close to a *Pheronema* field. A portion of the sediment was stored in ethanol with Bengal rose colorant. Seven biological sampling events were completed in which the following species were collected (some identifications still to be carried out): Foraminifera, a yellow gorgonian, *Pheronema* sp., globular sponge, *Errina* sp. and Antipatharia. During the dive we also collected sediment from around and inside a *Pheronema* field. Water samples were collected close to *Pheronema* grounds at 15.08 (WS1) and at 16.11 (WS2). To finish the day, a last visual survey was conducted at 21:10. During the night we transited to Gigante seamount complex while performing multibeam bathymetry.

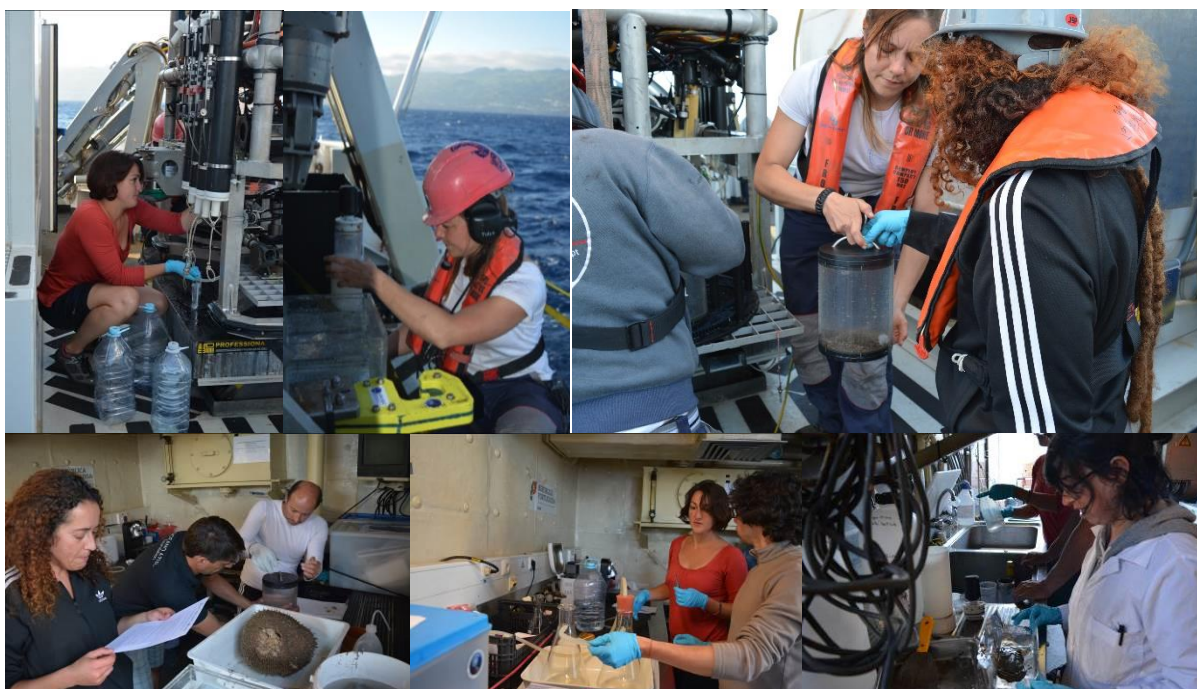


Figure 8. Collecting the samples extracted by the ROV and processing the material at the wet lab (photos kindly shared by the NRP Gago Coutinho crew).

08/06/2018 – Gigante complex, 127; ROV dive D6, visual surveys and multibeam bathymetry

We arrived at Gigante 127 seamount early in the morning. A visual survey was done at 8.08 with nothing to report. We started the ROV dive BAz_2018_ROV_D06 (G2, adjusted to G2b) at around 11:00 and reached the seabed at 612 m depth at around 11:30. This is probably the first ROV dive ever performed in this area (to be confirmed).

ROV dive D6 covered a small depth range, from 600 to 300 m. The deep detrital bottoms were colonized by two solitary corals (*Flabellum (Flabellum) chunii* and *Flabellum* cf. (*Ulocyathus*) *macandrewi*) and sparse specimens of a rounded Porifera (possibly cf. *Thenea schmidtii*). At around 400 m depth, in rocky bottoms, *E. melo* and *Viminella flagellum* were quite common. Tubular sponges with yellow cortex and white *Petrosia* sp. were observed on the stones. In a valley-like area, the rocky habitats were more evident and the benthic assemblages were more complex and diverse, including *Nemertesia* sp., tiny specimens of *V. flagellum*, other unidentified Plexauridae, *Placogorgia* sp., white *Paramuricea* sp., *Alcyonium* cf. *maristenebrosi* and



some isolated colonies of the hydrocoral *Errina dabneyi*. Two different species of black corals were also observed (*Elatopathes* cf. *abietina* and colonies of Aphanipathidae). At the upper slope, around 360 m depth, a kitefin shark (*Dalatias licha*) aggregation with potentially pregnant females was observed. Other fish species were observed during the dive, mainly Macrouridae, *Helicolenus dactylopterus*, cf. *Chlorophthalmus agassizi*, *Synchiropus phaeton* (14:55), unidentified Scorpaenidae (15:08), and many Gadiformes (probably *Phycis*, *Physiculus*, or *Gadella*; 13:02, 16:46). The ROV was off bottom at 15:52, at 315 m depth.

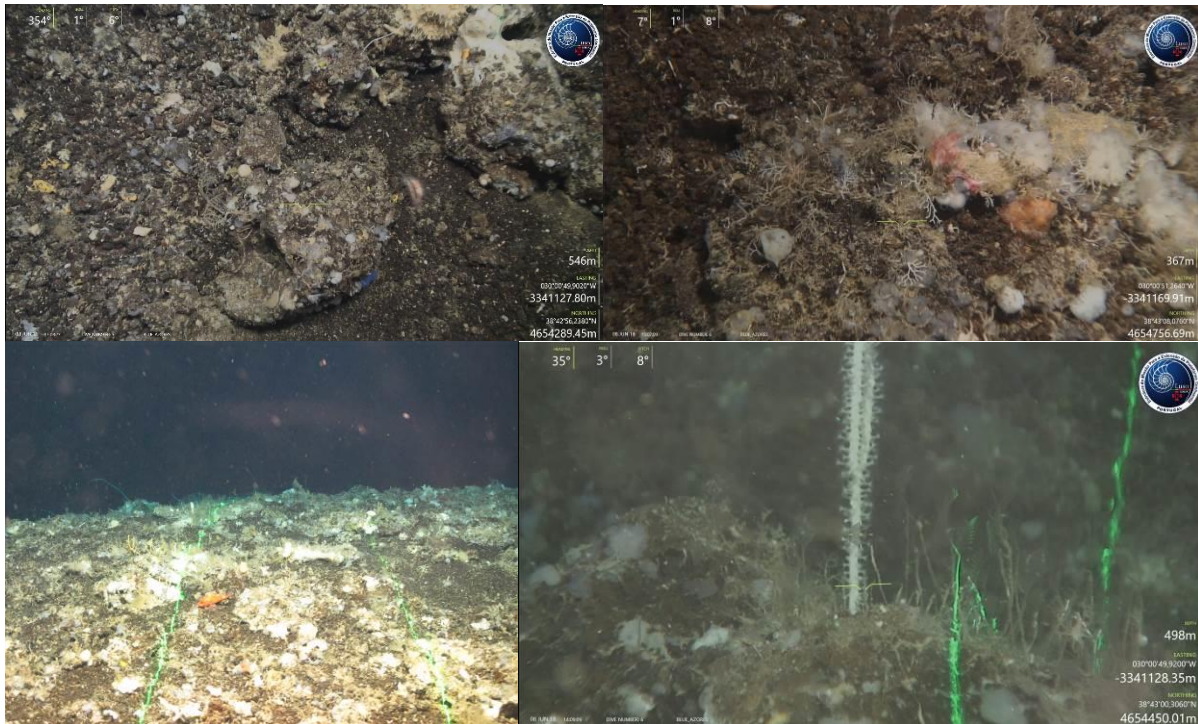


Figure 20. Several unidentified species were spotted throughout the dive in Gigante 127.

During dive D6, we completed three replicates of sediment samples at 614 m with the push corers (ST020_SED1-3). A portion of the sediment was stored in ethanol with Bengal rose colorant (ST020_SEDBiologico). Twelve biological sampling events were completed, with specimens collected from several species: *Flabellum* (B1), small corals growing attached to rocks (B2), Porifera and *Stylocordyla* sp. (B3), Antipatharia and sponges (B4), Plexauridae (B5), *Viminella* flagellum (B6), white gorgonians (B7), a yellow sponge (B8), a yellow Antipatharia (B9), a whip coral (B10), a yellow Plexauridae (B11), Antipatharia (B12). Most species were very difficult to identify to species level, with some maybe new to the region or even to Science. Water samples were collected close to sparse *Viminella*, encrusting sponges and gorgonians at 15.13 (W1). After the ROV was on deck, all samples were photographed, prepared, labelled and stored.



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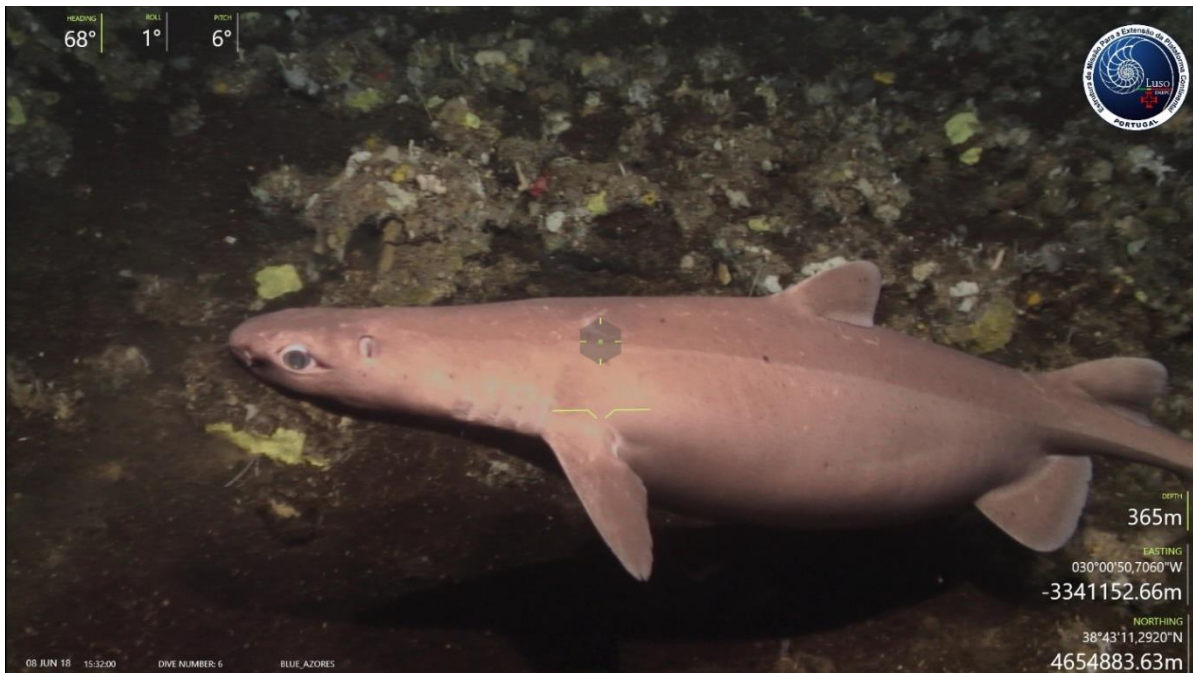


Figure 21. Seamounts are important habitat for demersal species. In this dive, we witnessed an aggregation of kitefin sharks (*Dalatias licha*). Several of them seemed to be pregnant females.

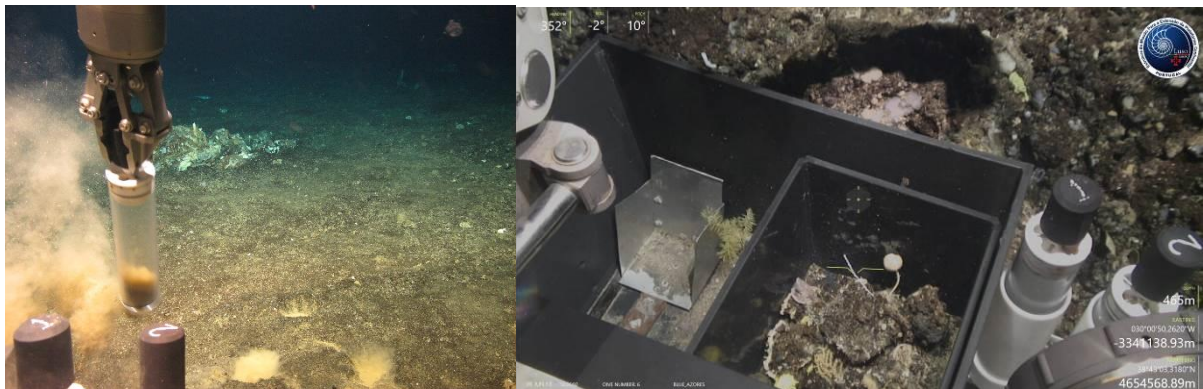


Figure 22. Sampling “yellowish” sediment with the push corer (left) and the biobox full of collected organisms and rock samples (right).



During the operation to recover the pole that holds the GPS receiver, one of the ropes was sucked by the ship propeller and the pole hit the hull of the ship. The system suffered massive damage and the expedition had to be put on hold. Several options were discussed, all of them requiring going back to Horta harbor. There was a strong feeling of disappointment since the previous ROV dives were very successful and lots of new habitats and species were spotted in our first exploratory dive on Gigante (127 area). To finish the day and before steaming back to Horta, multibeam bathymetry was performed on the areas that remained to be surveyed in Gigante and two visual survey were conducted.

Figure 9. Inspecting the broken pole.



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09/06/2018 – Transit from Gigante to Horta

We started transiting back to Horta at around 8:00, arriving in the harbor at around 18:00. During the transit two visual surveys for litter and turtles were conducted (8:10, 13:19).



Figure 10. On the way back to Horta to fix the pole and the beacon.

10/06/2018 – 13/06/2018 – Horta harbour

We stayed at Horta waiting for Instituto Hidrográfico (IH) to ship the required equipment. After not being sent on Monday 11th and Tuesday 12th, it finally arrived safely in Horta on the 13th of June. The beacon was mounted and tested and everything was ready at around 16:00. An engine failure kept the Gago Coutinho crew busy and delayed the departure until 23:30. We left the harbour at 01:00 on the 14th of June and steamed back to Gigante.

14/06/2018 Gigante; ROV dive D7, visual surveys and multibeam

We arrived at Gigante early in the morning but the ROV dive BAz_2018_ROV_D07 (G8, adjusted to G8a) only started at around 12:00 because additional tests were needed for the new beacon. We reached the bottom at 822 m depth at 13:05. This was probably the first ROV dive ever performed on this seamount (to be confirmed).

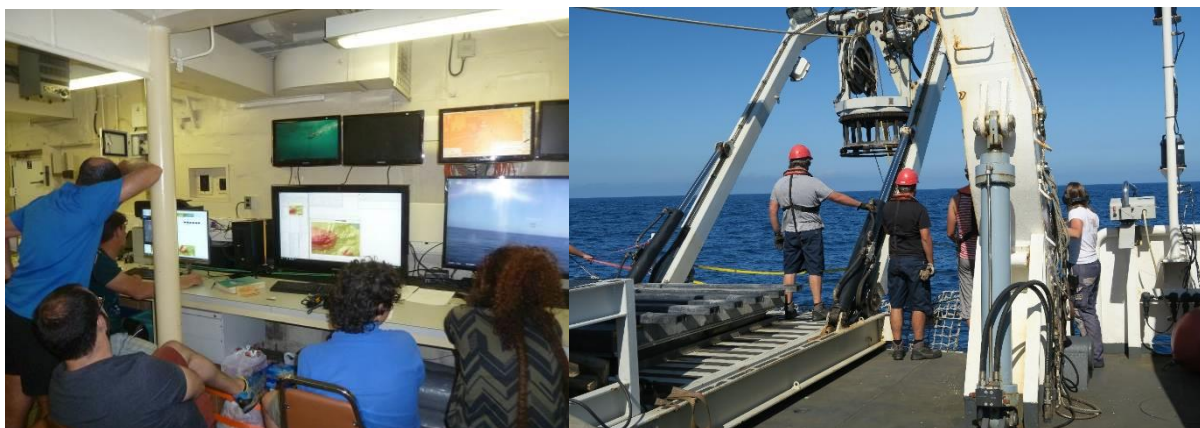


Figure 11. Everything is ready to start exploring the Gigante seamount again.



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D7 site appeared very rich and interesting, but unfortunately the new ROV positioning system was not working properly, having trouble to send real-time positions of the ROV when underwater. In any case, we managed to explore a small portion of the eastern flank of the Gigante seamount. Deep detrital bottoms were found alternating with rocky outcrops that were colonized by different species of corals and sponges. On the soft-bottom areas, no solitary corals were observed. A bathyal sea urchin (cf. *Cidaris cidaris*) was commonly distributed along the transect while *Acanthogorgia* sp. colonized the rocky outcrops. Small live *L. pertusa* colonies were also observed. A red *Anthomastus* cf. *agaricus*, with large red polyps and a white cf. Nephtheidae species were abundant and commonly observed on the rocky bottoms. Extensive areas with *Narella* cf. *regularis* formed interesting assemblages with the less common *Narella* cf. *vershynsi* and medium sized *Viminella flagellum* colonies. These areas may be considered cold-water coral gardens and maybe classified as VMEs. The small and spiral yellow *Stichopathes* cf. *gravieri* and solitary Dendrophylliidae were common in the crevices of the volcanic landscape. Unidentified Flabellate sponges and *Pheronema carpenteri* were also observed on these areas. One spot with living fossil reefs formed by cf. *Neopycnodonte zibronii* and cf. *Cyathidium foresti* was observed. Some fish were sighted throughout the transect, mostly *Hoplostethus mediterraneus*, *Helicolenus dactylopterus* and Gadiformes (still to be identified). With constant failures in the positioning system and problems in the ROV propeller system, the dive was cancelled and the ROV was brought on board from 684 m depth; leaving the sea bottom at 16:30. The ROV team worked during the rest of the day trying to fix all the problems encountered.

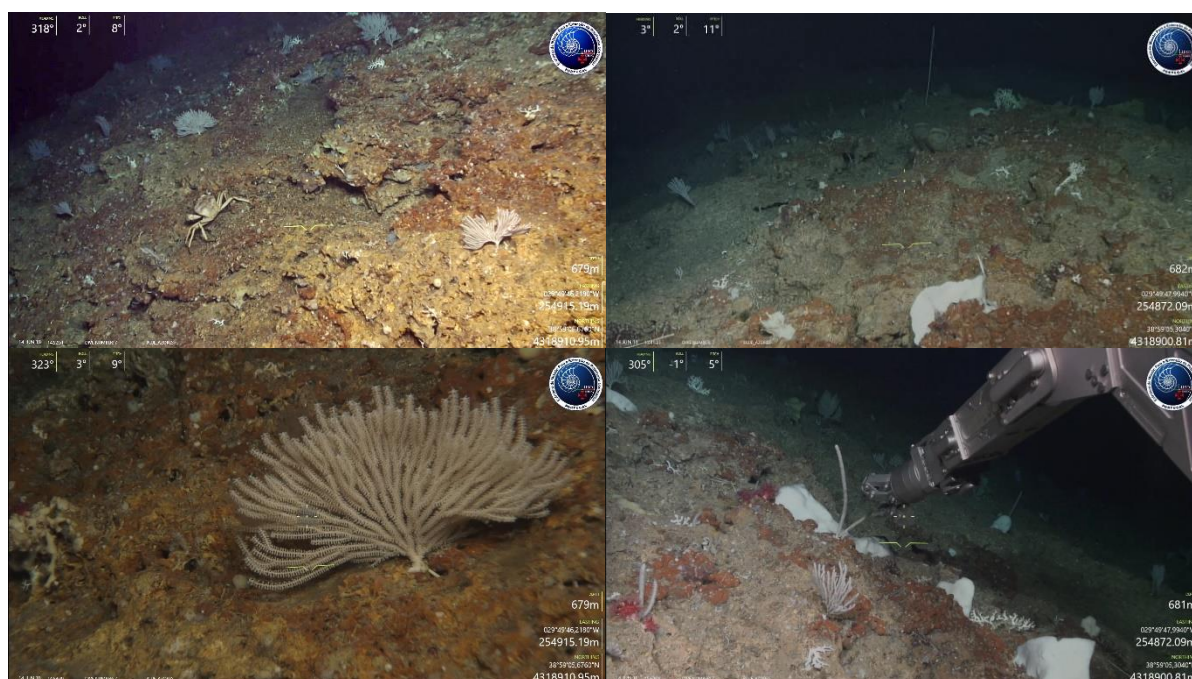


Figure 12. An extensive *Narella* cf. *regularis* garden with some large flabellate sponges dwelling on hard bottoms.

During dive D7, no sediment samples were collected since no soft sediment was found apart from the first few minutes of the dive. Only one biological sampling event was completed, collecting specimens of *Anthomastus* sp., *Narella* spp., sponges, Alcyonacea and a whip coral. Water samples were collected close to the extensive *Narella* cf. *regularis* garden with large sponges at 680 m depth. (15:52, WS1). Two visual surveys were conducted at around 18:30. During the afternoon and night, multibeam bathymetry was performed on the Ridge, north of Gigante.



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Figure 13. When the ROV is back to the surface, samples are processed by the scientific team to uncover more mysteries of the deep-sea of the Azores.

15/06/2018; visual surveys and multibeam

During the whole morning, the ROV team kept working on the positioning system and decided to build a new connection between the position beacon and the ROV. The connector was ready by 14:00 and was left to dry for 8 hours. The ROV dive had to be cancelled. Two visual surveys were done at 7:45 and at 9:02, where 2 pieces of floating plastic were spotted. During the rest of the day and overnight, we conducted multibeam bathymetry along the Ridge, north of Gigante, all the way to Oscar seamount.

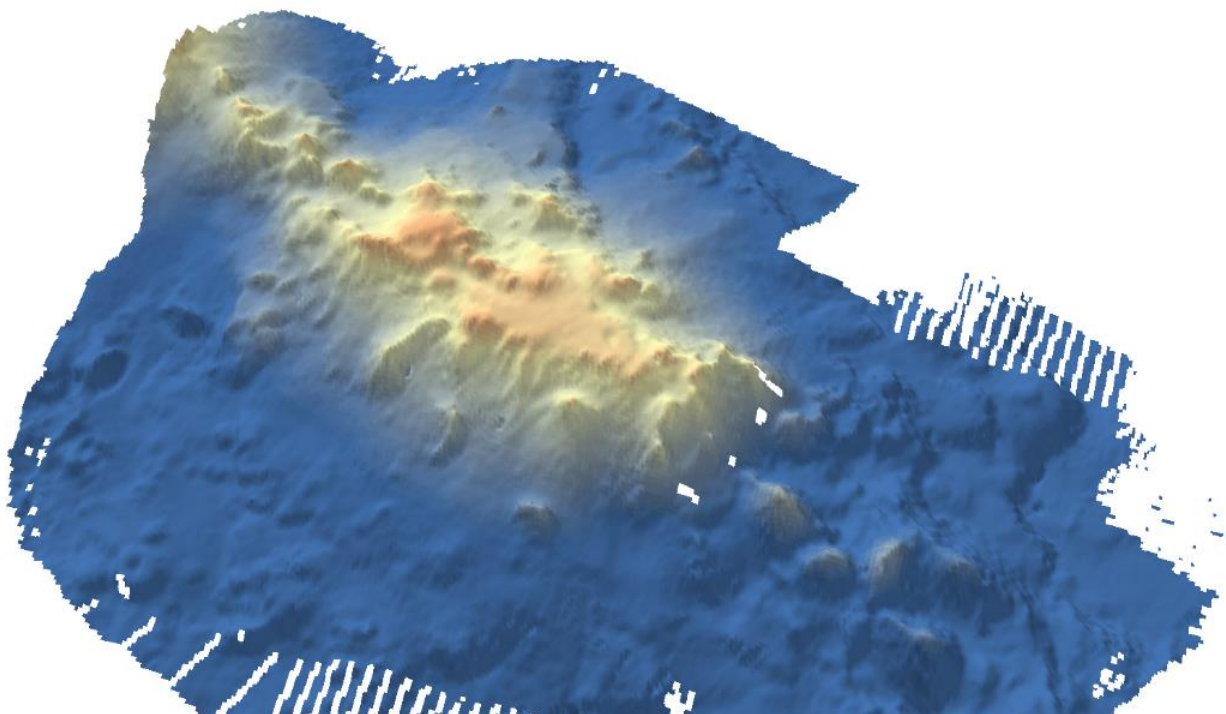


Figure 14. The first multibeam bathymetry ever conducted on Oscar seamount.



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16/06/2018 Gigante; ROV dive D8, visual surveys and multibeam

We arrived at Gigante from Oscar seamount early in the morning. A visual transect was done at 8:15 and some litter was spotted. We started the ROV dive BAz_2018_ROV_D08 (G8, adjusted to G8a) at around 10:00 and reached the seabed at 734 m depth at around 10:50. When the ROV arrived to the seabed, a large wreckfish was attracted to the light.



Figure 15. Starting the ROV dive with a special visit of a curious wreckfish (*Polyprion americanus*)

The dive begun on a small patch of soft-bottom sediment and rapidly entered into a distinct hard-bottom sloping area. These deep detrital areas with scarce rocky outcrops were colonized by different species of corals and sponges. On the soft bottoms, some solitary cup corals were observed (cf. *Flabellum* sp.). The typical bathyal sea urchin cf. *Cidaris cidaris* was commonly distributed along these bottoms too. On the distinct hard bottom area, different types of corals were very abundant. At 680 m we found a change in the substrate type to a kind of reddish bottom, possibly of some sort of iron formation. A cold-water coral garden or forest of “crystalline gorgonians” (as defined by Oscar Ocaña) was discovered, composed of *Narella* spp., *Callogorgia verticillata*, *Corallium johnsoni*, *Paragorgia johnsoni* and *Paragorgia arborea*. This area may well fit the FAO criteria as VME, although it is possibly strongly affected by fishing practises. At 13.08, a long fishing line was spotted and the ROV had to change direction to avoid it. Also characteristic of this area were a large soft coral of the family Nidaliidae, *Stichopathes* cf. *gravieri* and isolated colonies of *Parantipathes* cf. *hirondelle*. Along a large crevice, a dense group of large unimpacted by fishing Plexauridae gorgonians (cf. *Placogorgia* sp.) and a reddish Caryophylliidae were observed, forming a very interesting community to be revisited. Besides the wreckfish (*Polyprion americanus*) spotted at the beginning of the dive, some other fish were seen throughout the transect, mostly *Helicolenus dactylopterus*, *Hoplostethus mediterraneus*, *Conger conger*, *Lophius* sp. and some Gadiformes still to be identified.



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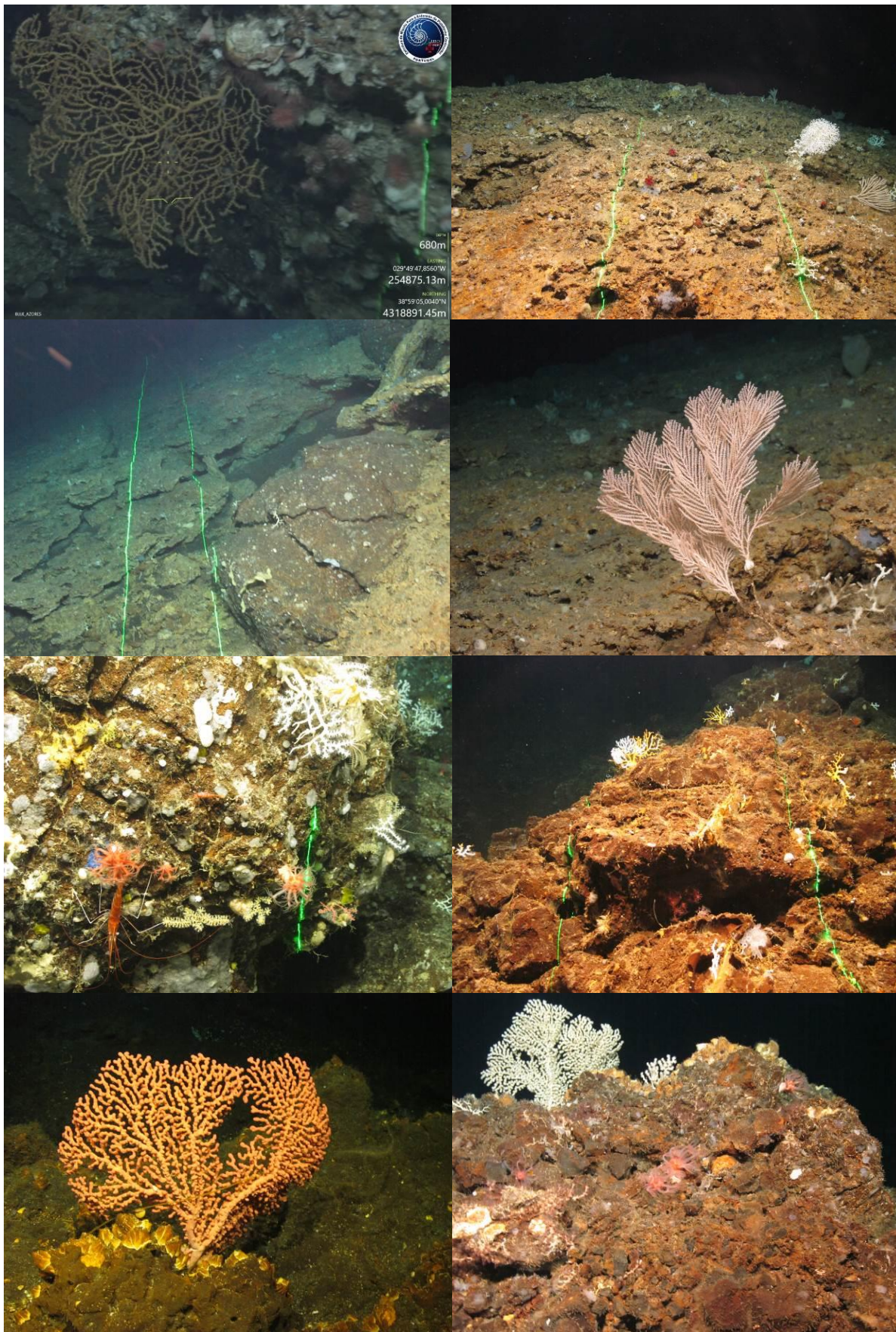


Figure 30. Some highlights of Dive 8.



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Some time into the dive, both the scientific and the ROV team were astonished in front the screen. A new hydrothermal vent field was discovered today at 14:48 Azores time on the slope of Gigante seamount, in the Mid-Atlantic Ridge half way between Pico and Kurchatov fracture zones. To our knowledge, this is the first deep hydrothermal vent field discovered on a Portuguese expedition, led by a Portuguese scientific team, on a Portuguese vessel, and using a Portuguese ROV and a ROV team. For this reason, the hydrothermal vent field was named “Luso”. It was uncovered at 570 m depth and it is composed of multiple chimney-like structures of different sizes, with orifices up to about 40 cm in diameter. Hydrothermal fluids are transparent but well noticeable from the distance. ROV probes detected a slight increase in the water temperature (about 0.5°C), a strong CO₂ increase and no signal on CH₄ levels in the vicinity of the edifices. The interiors of some venting orifices were covered with white bacterial mats and bacteria like filaments (to be confirmed) were found in areas influenced by the fluid’s discharge. Signals of sulphide precipitation were found in a large portion of the seamount. No typical hydrothermal vent fauna was noticed. However, the possible influence of such phenomenon on the presence of the cold-water coral garden of “crystalline gorgonians” should not be discarded. Finally, a peculiar community of deep-water reddish-yellowish Cirripedia (cf. *Balanomorpha suborder*) was observed. With the constant difficulty in maintaining the ROV on the bottom, the dive was ended and the ROV brought on board from 550 m depth. Off bottom time was set at 16:45.

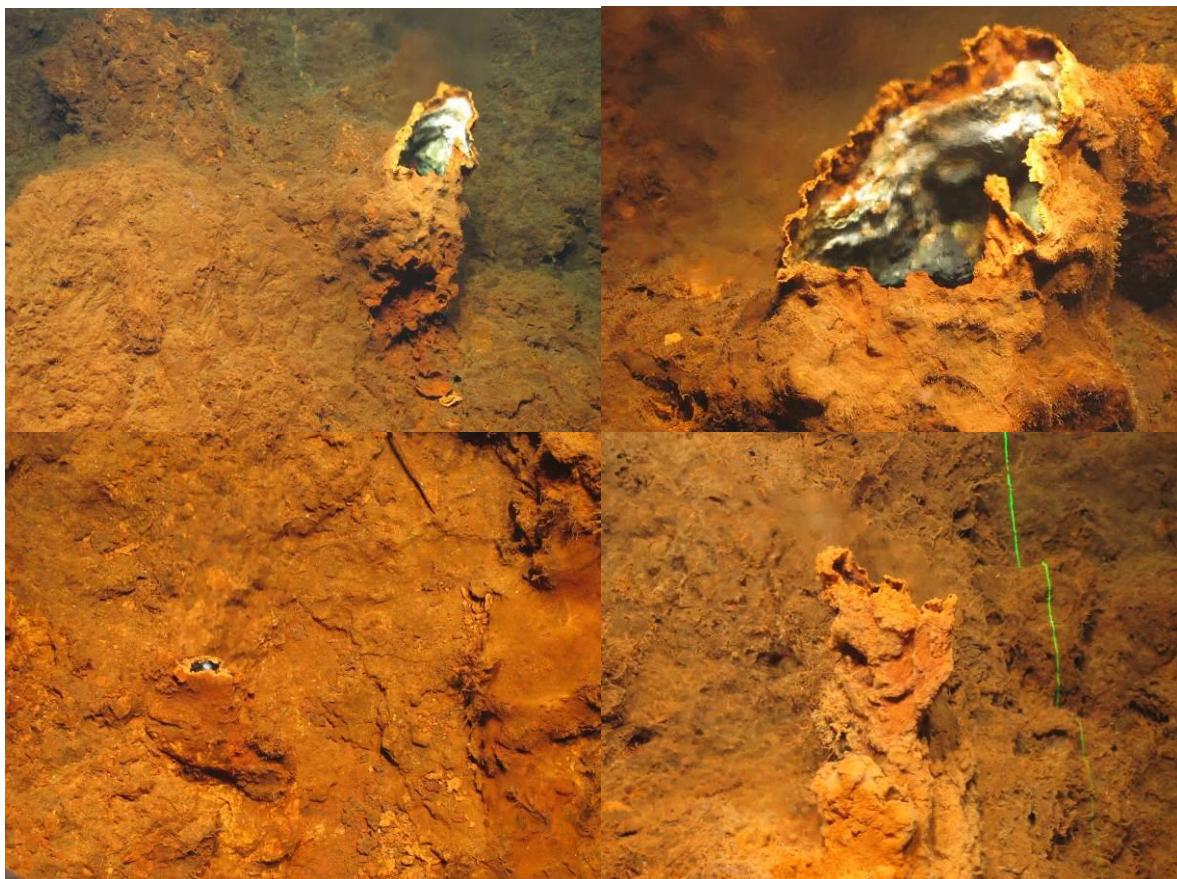


Figure 16. Images of one of the edifices of the hydrothermal vent field discovered and named “Luso”. It was found on 16/06/2018 at 14:48 Azores time.



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During D8, we completed three replicates of sediment samples with the push corer (ST036_SED1-3) at 734 m and collected three samples of sedimentary rocks (Baz2018_ST36_R1-R3). A portion of the sediment was stored in ethanol with Bengal rose colorant (St36_SED_BIO). Six biological sampling events were completed including a yellow gorgonian and a globular sponge (BS1), a cup sponge (BS2), *Callogorgia* sp. (BS3), black coral *Parantipathes* sp. (BS4), white gorgonian specimen, probably *Corallium* cf. *johnsoni* (BS5) and cf. Cirripedia and *Paragorgia johnsoni* (BS6). As usual in Gigante, most species were very difficult to identify from the video images and there exists the possibility that some collected organisms may be new to the region or even to Science. Water samples were collected close to the hydrothermal vent field at 14:55 (WS1). After the ROV was on-board, all samples were photographed, prepared, labelled and stored. One visual survey was conducted at around 20:10 where some litter was spotted, including a large floating object collected by the crew. During the night, multibeam bathymetry was performed on western side of the Ridge.



Figure 17. A memorable day with lots of good samples and happy scientists.

17/06/2018; Gigante; ROV D9; Multibeam bathymetry

With winds blowing from South, we decided to explore the northern flank of Gigante 127. Everything was ready for the ROV deployment when a failure on the deployment system cancelled this first attempt. The ROV team solved the problem and a second deployment was attempted at around 12:30. When the ROV was at 340 m depth, a failure in the propulsion system of the vessel aborted ROV D9 descend. The ROV was safely brought to deck at around 14:30. The propulsion system was fixed at around 15:30 but for safety reasons, it was decided not to dive again until the next day. After some extra checks on the vessel, multibeam bathymetry was carried out towards the Bicuda and Cavala seamounts, south of the Gigante complex. Two visual transects were conducted at around 18:00 and 19.45, where marine litter was observed.



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Figure 18. Coral taxonomist Oscar Ocaña evaluating the samples collected in previous dives under the stereoscope.

18/06/2018; Gigante 127; ROV dive D10, visual surveys and multibeam

The wind was still blowing from South conditioning our choice on diving on the the eastern side of northern flank of Gigante 127. Two visual transects were done at around 7:45 and 8:44. Everything was ready for the ROV deployment when the captain and the ROV team decided to postpone deployment until 14:00 because wind gusts of 15-20 knots. After a new evaluation of the weather conditions, the dive was again postponed to 16:30. The ROV dive BAz_2018_ROV_D10 started at 17:20 and reached the bottom at 680 m depth at 17:45.

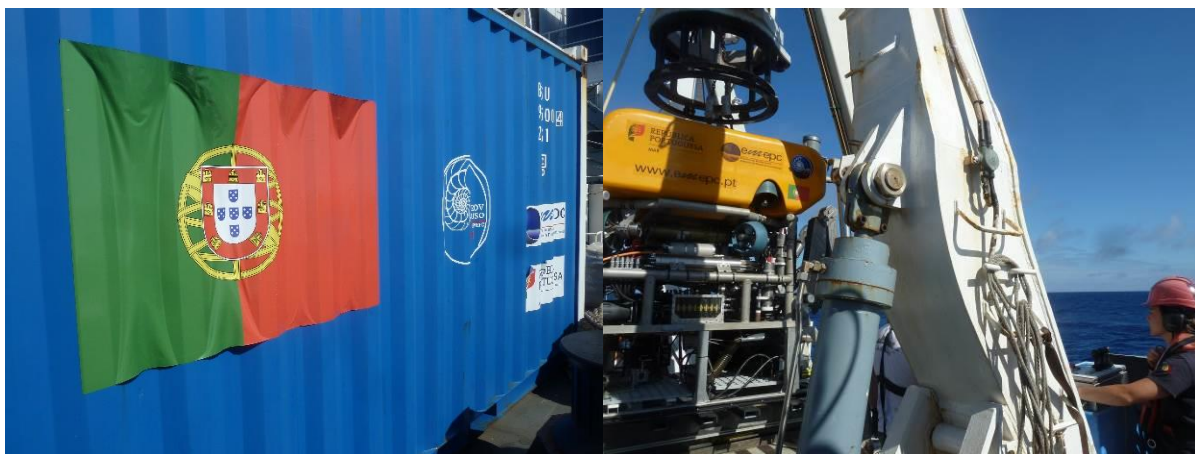


Figure 19. The ROV team getting ready for the Blue Azores 2018 “Luso” dive number 10.

ROV dive D10 was mostly on hard substrates composed of pillow lava, found at depths from 680 to 330 m. The deep detrital bottoms with rocky outcrops were colonized by some species of corals and sponges. On the deeper bottoms we found what seemed recent unstable pillow lava outcrops with corals *Corallium johnsoni*, *Anthomastus* cf. *agaricus*, unidentified Primnoidae species, *Stichopathes* cf. *gravieri*, *Parantipathes hirondelle*, unidentified Nidaliidae species, *Acanthogorgia* sp., some small *Viminella flagellum* and the rare Actiniaria *Actinoscyphia* cf. *aurelia*. The bathyal sea urchin cf. *Cidaris cidaris* was commonly observed on these bottoms. On the soft bottoms, there were no solitary corals but some occurrences of *Flabellum* sp. were observed, along with *Cidaris* cf. *cidaris* and *Echinus melo* (from the base to the summit). From 400 m depth to the top, we observed what can be considered a gorgonian coral hotspot, with encrusting sponges and large *Viminella flagellum*. Other corals were observed in the benthic assemblages: white Aphanipathidae, *Elatopathes* cf. *abietina*, another unidentified orange large coral, *Placogorgia* sp. and a tiny



Plexauridae. We found extensive aggregations of the fish *Hoplostethus mediterraneus* that did not move away from the ROV. Some other fish species were seen throughout the transect, mostly *Helicolenus dactylopterus*, *Chaunax pictus*, *Beryx decadactylus*, *Molva dipterygia*, and unidentified Gadiformes, Macrouridae and Scorpanidae (maybe a juvenile of *Pontinus kublii*). The ROV received an unexpected visit of a cf. *Hexanchus griseus*. Dive D10 ended on the top of the seamount, at 330 m depth at about 22:30.

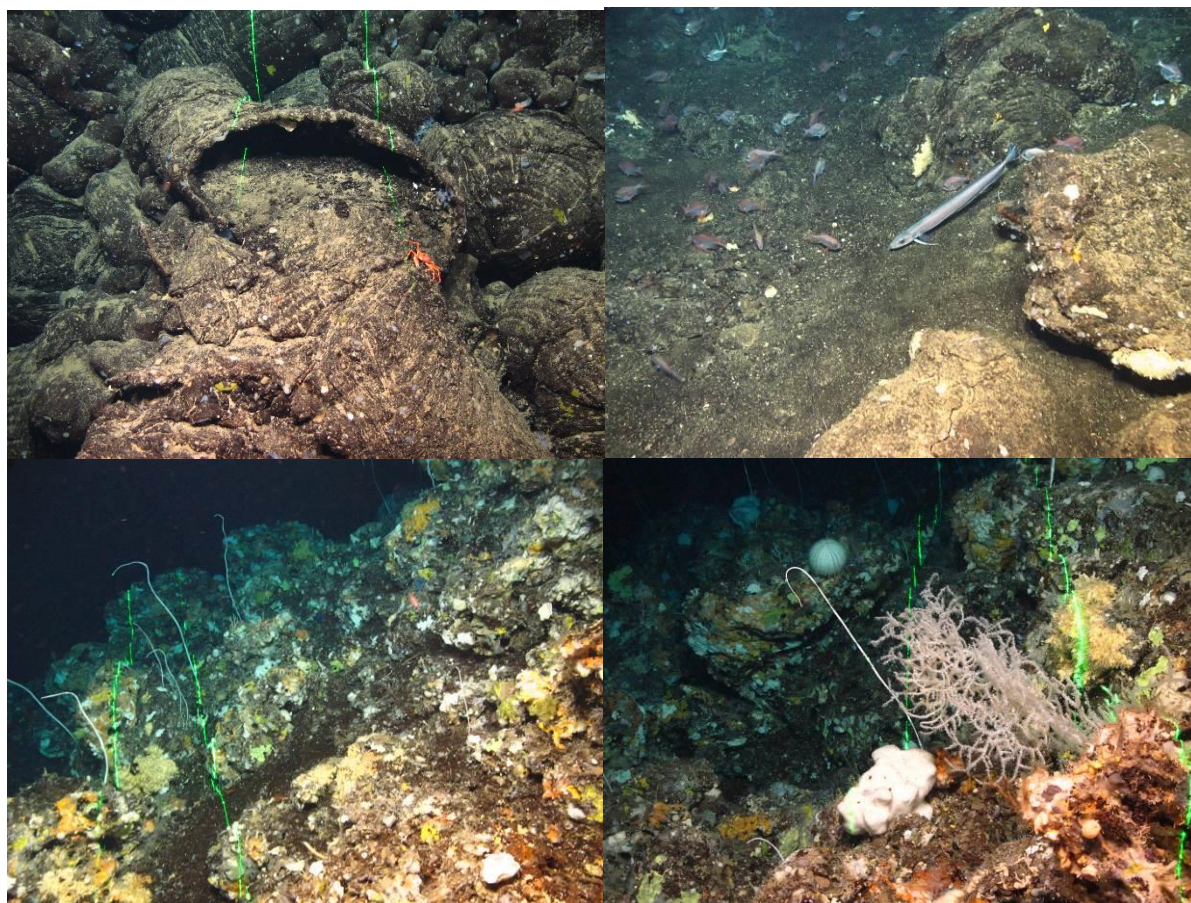


Figure 20. Exuberant benthic landscape and communities found in Gigante 127.

No sediment samples were collected during this dive since the sediment layer was so thin that all the three trials in different locations failed. Two rock samples were collected and 7 biological sampling events were completed, which included the collection of a flabellate yellow sponge and *Corallium* sp. (BS1), a large Nidaliidae (BS2), *Acanthogorgia* sp. (BS3), *Flabellum* sp. (BS4), a yellow Asteroidea and *Viminella* sp. (BS5), yellow black coral and *Acanthogorgia* sp. (BS6) and *Placogorgia* sp. (BS7). Water samples were collected close to the fish aggregation of *Hoplostethus mediterraneus* at 526 m depth (WS1) and close a coral garden full of *Acanthogorgia* sp. and *Antipatharia* at 427 m depth (WS2). These samples will be used for eDNA, nutrients, alkalinity and POM. During the night, multibeam bathymetry was conducted on the Ridge around the Gigante seamount complex.

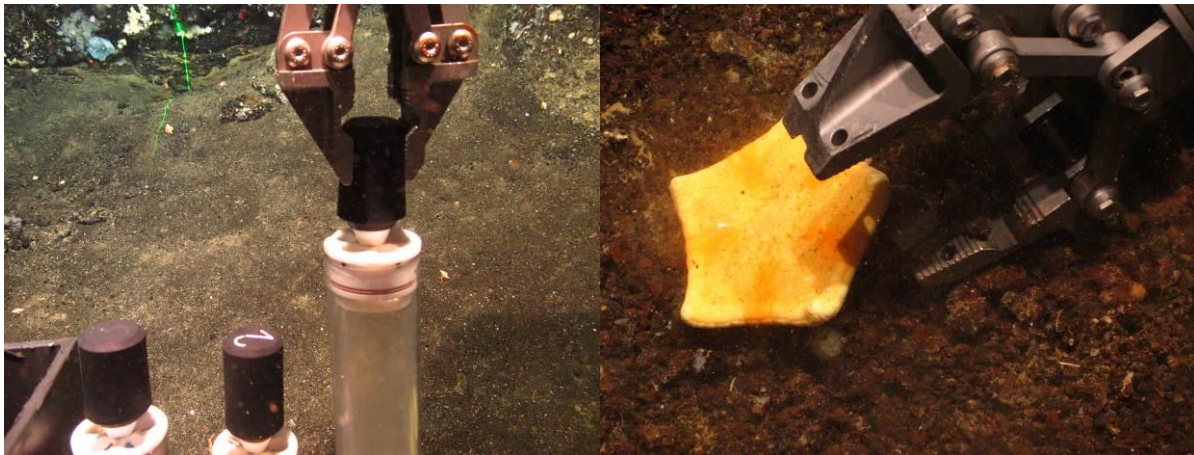


Figure 21. Push corer collecting sediment samples for microplastic analyses (left) and a sea-star being collected for identification purposes (right).

19/06/2018; Gigante 127; ROV dive D11, visual surveys and multibeam

The wind was picking up and the ROV dive had to be postponed until after lunch. Meanwhile, one visual transect was done at around 9:00. After evaluating the sea conditions, mostly the relatively high pitch angle, the ROV dive BAz_2018_ROV_D11 started at 13:40 and reached the bottom at 772 m depth at 14:17.

Most of the dive was on soft bottoms with very sparse rocky outcrops. *Flabellum* spp. and *Deltocyathus* sp. were representative species on the soft-bottom areas, while *Acanthogorgia* cf. *armata*, *Acanthogorgia* sp., *Parantipathes hironelle* and one tiny Caryophylliidae were common on the scarce rocky outcrops. Some small species were also noted, namely *Swiftia* sp., small *Viminella flagellum*, one white Plexauridae and one dark violet Alcyonacea with a strong armature of sclerites. On the top of the seamount, large *Viminella flagellum*, *Callogorgia* cf. *verticillata*, and *Candidella* cf. *imbricata* were the most conspicuous species of the hard substrates, which seemed to be strongly affected by fisheries activity. Several fish species were observed throughout the transect, namely Macrouridae to be identified, *Raja* cf. *batis*, *Helicolenus dactylopterus*, *Pagellus bogaraveo*, *Hoplostethus mediterraneus*, *Lophius* sp., *Cyttopsis rosea* and *Chaunax pictus*. Some litter items were found, mostly fishing lines and a glass bottle. The ROV dive finished at 18:20 at 364 m depth after almost 5 hours of bottom time.





Figure 22. One octopus and some of the fish species observed in ROV dive D11.

During dive D11, we completed three replicates of sediment samples with the push corer (ST045_SED1-3) at 758 m depth. A portion of the sediment was stored in ethanol with Bengal rose colorant (St45_SED_BIO). Five biological sampling events were completed, including: *Flabellum* sp. (BS1), an identified yellow gorgonian and *Acanthogorgia* sp. (BS2), *Viminella* flagellum and *Swiftia* sp. (BS3), a small Anthozoa (BS4), *Candidella* sp. and *Callogorgia* sp. *verticillata* (BS5). Water samples were collected close to *Viminella* flagellum fields, where massive sponges and *Callogorgia verticillata* were also observed, at 21:48 (WS1). After the ROV was on deck, all samples were photographed, prepared, labelled and stored. One visual survey was conducted at around 20:10 where some litter was spotted, including a large floating object collected by the crew. At around 18:00 Emanuel Gonçalves from the Fundação Oceano Azul and the NG team visited the NRP Gago Coutinho to know more about the discovery of the hydrothermal vent, to take some video footage, to conduct some interviews and to take some of the high-resolution videos with them. They prepared a press release for Portuguese and international media. During the night, additional multibeam bathymetry was conducted on the Ridge.



Figure 23. Emanuel Gonçalves (Fundação Oceano Azul) and the NG team visited the NRP Gago Coutinho to learn more about the discovery of the hydrothermal vent.

20/06/2018; visual surveys

The wind decreased during the night but the swell was picking up and was producing a pitch on the vessel between 5-7°. At around 12:00, the ROV team decided to cancel the dive for the day. During the rest of the day, four visual surveys were done at around 8:00, 14:30, 15:00, and 19:30. During the night multibeam bathymetry was performed in the Gigante area.



Figure 24. Waiting for the swell to decrease we spotted a group of dolphins swimming close to the vessel.

21/06/2018; Gigante S; ROV dive D12 and D13, visual surveys and multibeam

After an early meeting on the bridge to agree on the diving plan for the day, we steamed to the south flank of Gigante. We started the ROV dive BAZ_2018_ROV_D12 at around 09:00 and reached the seabed at 742 m depth at around 09:30. No visual surveys were done in the morning.



Figure 25. Early meeting in the bridge to agree on the diving plan for the day.

Dive D12 started with a soft bottom composed of sand and gravel. In the deeper areas around 700 m depth, detrital beds were colonized mainly by *Flabellum* sp., while the sparse rocky outcrops showed diverse coral assemblages of moderate diversity; including Caryophylliidae; *Anthomastus* cf. *agaricus*, a tiny whitish stolonifera (*Clavularia* sp.), *Parantipathes hironelle*, pink *Swiftia* sp., and white *Muriceides* sp. Some *Pheronema carpenteri* fields were observed around 600 m depth. *Antipathes* sp. and *Elatopathes* cf. *abietina* were common on the vertical sides of the rocks. From 350 m to the summit, cold-water coral abundance increased with assemblages of four different families of gorgonians were observed: Plexauridae, Primnoidae, Ellisellidae, and Acanthogorgiidae. The gorgonians belonged to the species *Callogorgia*



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verticillata, *Candidella* cf. *imbricate*, *Dentomuricea* sp., *Muriceides* sp., *Acanthogorgia* cf. *hirsuta*, *Viminella flagellum* and *Viminella* sp. This area can be considered a cold-water coral hotspot and probably a VME. Several fish species were observed during this dive including *Chaunax pictus* and Macrouridae (still to be identified in the deeper areas) and *Helicolenus dactylopterus*, *Anthias anthias*, *Pontinus kublii*, many Gadiformes to be identified (probably *Phycis*, *Physiculus*, or *Gadella*), *Phycis phycis*, *Lappanella fasciata* and *Capros aper*. The ROV dive finished at 14:44 at 235 m depth.

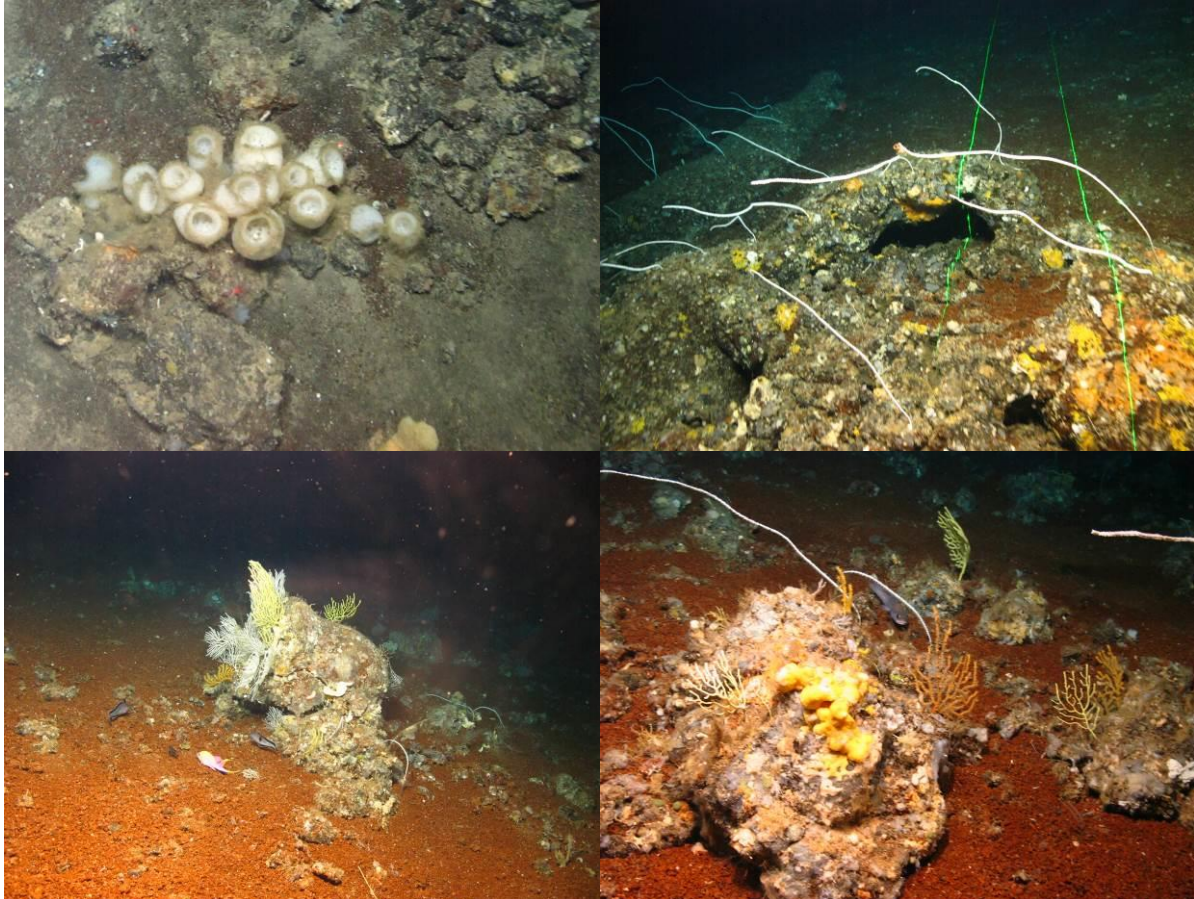


Figure 26. Some highlights of the ROV dive 14, including *Pheronema carpenteri*, *Viminella flagellum*, *Dentomuricea* sp. and *Acanthogorgia* cf. *hirsuta*.

During dive D12, we completed two replicates of sediment samples with the push corer (ST050_SED1-2) at 702 m depth, and one rock sample. A portion of the sediment was stored in ethanol with Bengal rose colorant (St50_SED_BIO). Nine biological sampling events were completed, in which the following organisms were collected: *Swiftia* sp. (BS1), *Pheronema* cf. *carpenteri* (BS2), a black coral (BS3), a blue and a yellow sponge (BS4), another yellow sponge (BS5), a *Muriceides* sp. and a yellow gorgonian (BS6), two *Acanthogorgia* sp. (BS7), a yellow tubular sponge, a white gorgonian *Candidella* sp. (BS8), and an orange whip coral (BS9). Water samples were collected close to *Pheronema carpenteri* fields at 10:36 (WS1) and to *Acanthogorgia* sp. aggregations (WS2). After the ROV was on-board, all samples were photographed, prepared, labelled and stored.



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Figure 27. Another day sampling the deep-sea in the Azores.

We decided to make a second dive to revisit and sample the hydrothermal vents discovered during dive D8. We started the ROV dive BAz_2018_ROV_D13 at around 17:40 and reached the seabed at 585 m depth at around 18:10. We may have found two new small orifices but did not manage to reach to main chimneys since the current was very strong impeding the pilots to fly toward the target direction. At 19:20 the ROV dive was ended with no samples to process. At 20:30 one visual transect was performed to finish the long day of work.

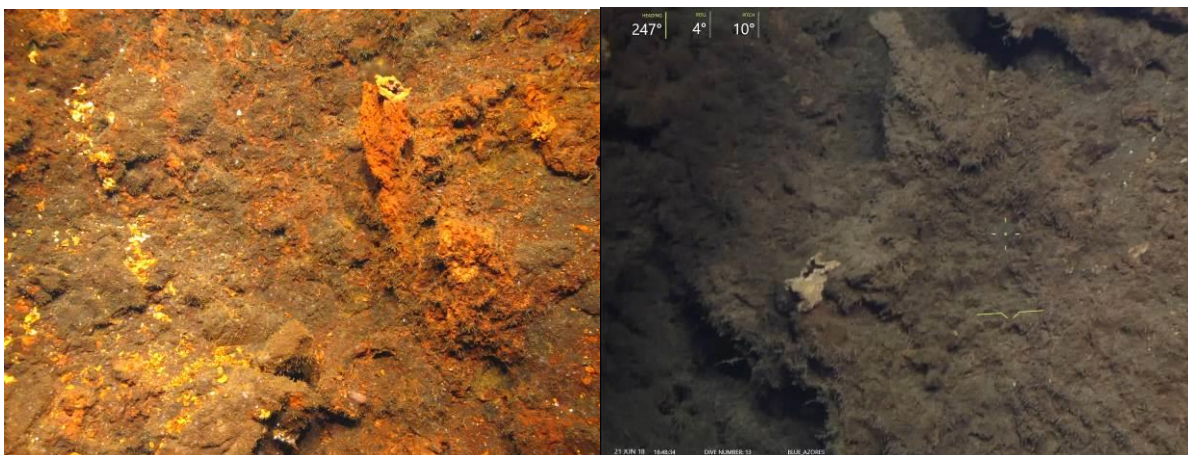


Figure 28. Two new small hydrothermal orifices found during ROV dive D13.



22/06/2018; Gigante NW; ROV dive D14, visual surveys and multibeam bathymetry

Early in the morning we had to adjust the ROV dive location because of the direction of the current. We moved the ROV dive to the north-western flank of the Gigante seamount. One visual transect was performed at around 8:10 with no records of marine litter or turtles. We started the ROV dive BAz_2018_ROV_D14 at around 11:00 and reached the seabed at 720 m depth at around 11:30.



Figure 29. The day usually starts at 7:00 evaluating the weather and sea conditions and planning the ROV dive locations.

The ROV dive D14 was extremely diverse with a substrate dominated by a mixed detrital rocky bottom (perhaps formed by a process of lithification of the carcasses of and skeletal debris). In the deeper portion of the dive at around 700 m depth, Primnoidae formed the main coral assemblages (*Narella* spp.; *Corallium* cf. *tricolor*; *Acanthogorgia* sp.; *Paranthipathes hirondelle*) with some sparse *Pheronema carpenteri* sponges. From 500 m upwards, species diversity increased with a benthic community composed of *Anthomastus* spp., *Nicella granifera*, *Bebryce* cf. *mollis*, *Viminella flagellum*, *Acanthogorgia* cf. *hirsuta*, *Stichopathes* cf. *gravieri*, *Corallium* spp., *Elatopathes* cf. *abietina*, and included some large species of hydrozoans of the family Plumulariidae. The cold-water coral species were even more diverse from 400 m to the summit and large gardens of gorgonians were observed. *Viminella flagellum* and *Dentomuricea* sp. were the most abundant species but many others were part of this benthic community, including *Enallopsammia* cf. *rostrata*, *Alyonium* spp., *Anthomastus* spp., *Acanthogorgia* cf. *hirsuta* and many of those mentioned above. Very conspicuous tubular sponges with yellow cortex and massive sponges for what can be considered a cold-water coral and sponges hotspot or a VME like area. Many fishing lines (>10) were sighted along the part of the transect shallower than 500m depth, where many corals and sponge grounds seemed to be affected. Only a few fish species were observed during the dive, mostly *Helicolenus dactylopterus*, Gadiformes and Macrouridae to be identified, *Chaunax pictus*, cf. *Pagellus bogaraveo*, *Conger conger*, cf. *Lepidopus caudatus*, *Cyttopsis rosea*, and a deep-sea shark (probably *Dalatias licha*). The ROV dive D14 finished at 18:00 at 398 m depth.



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Figure 30. It feels like winter in the live ROV annotation room.

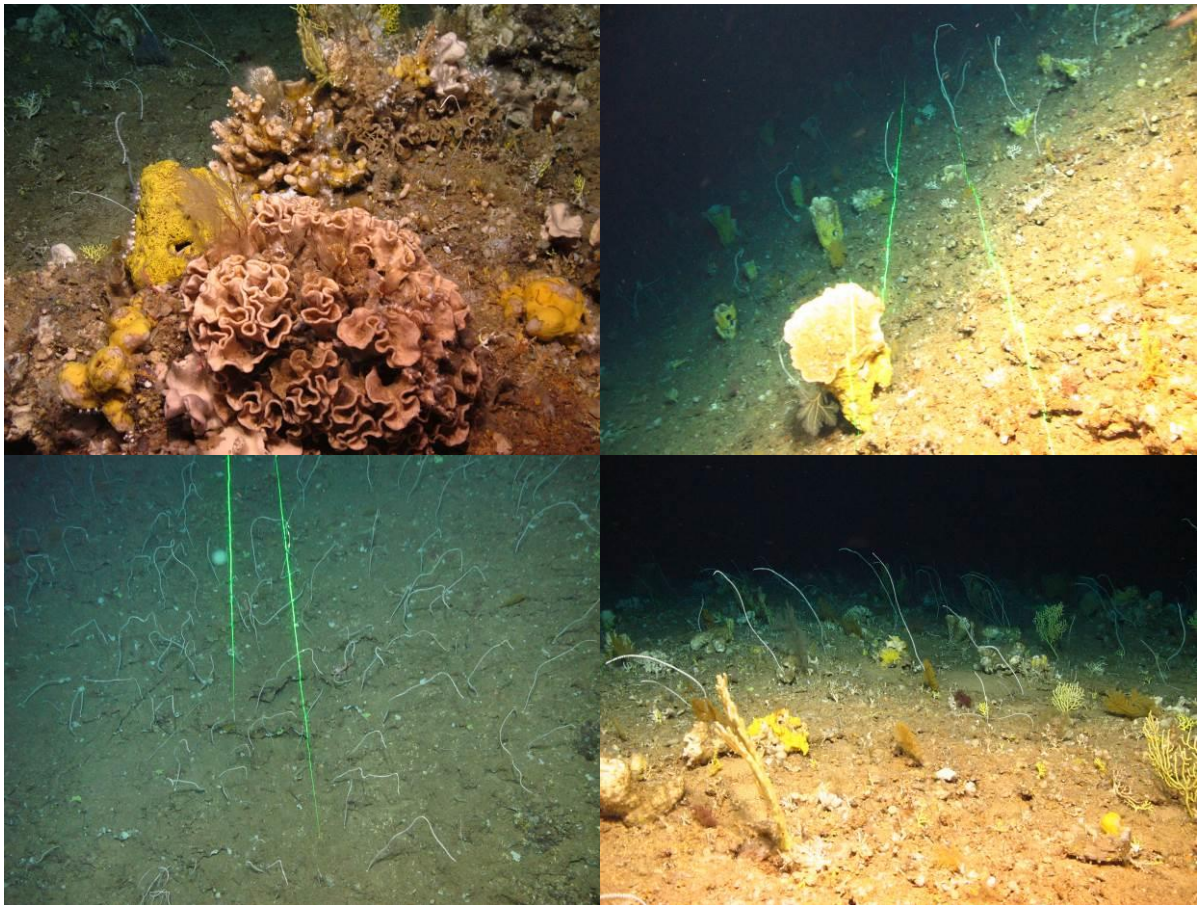


Figure 31. Some highlights of ROV dive 15, including four different types of *Viminella flagellum* gardens (with massive sponges -mid left-, monospecific -mid right-, with *Acanthogorgia* sp. -bottom left- and with *Dentomuricea* sp. -bottom right-).

During dive D14, we completed two replicates of sediment samples with sand and coral rubble (ST054_SED1-2) at 582 m depth. A portion of the sediment was stored in ethanol with Bengal rose colorant (St54_SED_BIO). During the transect, nine sampling events were successfully completed, namely Primnoidae and Nidaliidae (BS1), *Stichopathes* sp. (BS2), Primnoidae (BS3), *Corallium* cf. *tricolor* and Plumulariidae (BS4), *Acanthogorgia* sp. and *Anthomastus* sp. (BS5), *Nicella* cf. *granifera* (BS6), *Caryophyllia cyathus* (BS7), *Enallopsammia* cf. *rostrata* and Nidaliidae purple (BS8), and a yellow and an orange gorgonian, *Acanthogorgia* sp., large white sponges and more *Acanthogorgia* sp. (BS9). Water samples were



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collected at 512 m close to *Viminella* and *Acanthogorgia* gardens (WS1) and at 402 m close to large *Dentomuricea* sp. gardens (WS2). Two extra visual transects were done in the afternoon at 19:50 and 20.00, again with no records of marine litter. During the night we conducted a bit more multibeam bathymetry on the Gigante area.



Figure 32. Happy scientist with new and rare samples of the deep-sea fauna of the Gigante seamount area.

23/06/2018; SW Ridge; ROV dive D15, visual surveys and multibeam

For the last dive in the Gigante seamount complex area, we decided to visit the Ridge west of Gigante 27, on the American plate. As in previous days, we had to adjust the ROV dive location because of the direction of the current. No visual surveys were done in the morning. We started the ROV dive BAz_2018_ROV_D15 at around 09:30 and reached the seabed at 580 m depth at around 10:00.



Figure 33. Everything is ready for the last dive of the Blue Azores Expedition 2018.



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During ROV dive D15 we found the most impressive cold-water coral gardens of *Paragorgia arborea* and *Paragorgia johnsoni* ever seen by our team. The transect was mainly on a detrital soft bottom (perhaps formed by a process of lithification of the carcasses of and skeletal debris), and coral debris with some rocky outcrops. There were two main different cold-water coral assemblages: one formed by Scleraxonia gorgonians, in deeper waters, and the other by Holaxonia, in shallower and more intensively fished areas. Facies of *Anthothela* sp., *Swiftia* sp., and small solitary yellow corals and *Acanthogorgia* spp. were observed. The sediments showed a lot of coral debris and debris of *Corallium johnsoni* and *Paragorgia johnsoni*. At 530 m depth and impressive coral garden of *Paragorgia* spp. was observed, although some areas were highly impacted by fishing. This community then shifted to a *Viminella flagellum* and *Acanthogorgia* spp. dominated garden, with *Nicella granifera*, other yellowish small gorgonian (*Bebrice* cf. *mollis*), *Elathopathes* cf. *abietina*, Leiopathidae, *Dentomuricea* sp. *D ndrophyllia* sp. was also observed from 430 m. Massive sponges were also observed throughout the transect. This area can also be considered a cold-water coral and sponges hotspot or a VME like area. Many fishing lines were sighted along the part of the transect shallower than 500m depth, where many corals and sponge grounds seemed to be affected. Only a few fish species were observed during the dive, mostly *Helicolenus dactylopterus*, Gadiformes and Macrouridae to be identified, *Chaunax pictus*, cf. *Pagellus bogaraveo*, *Conger conger*, *Capros aper*, cf. *Epigonus telescopus*, and *Lophius* sp. The ROV dive D15 finished at 16:30 at 436 m depth.

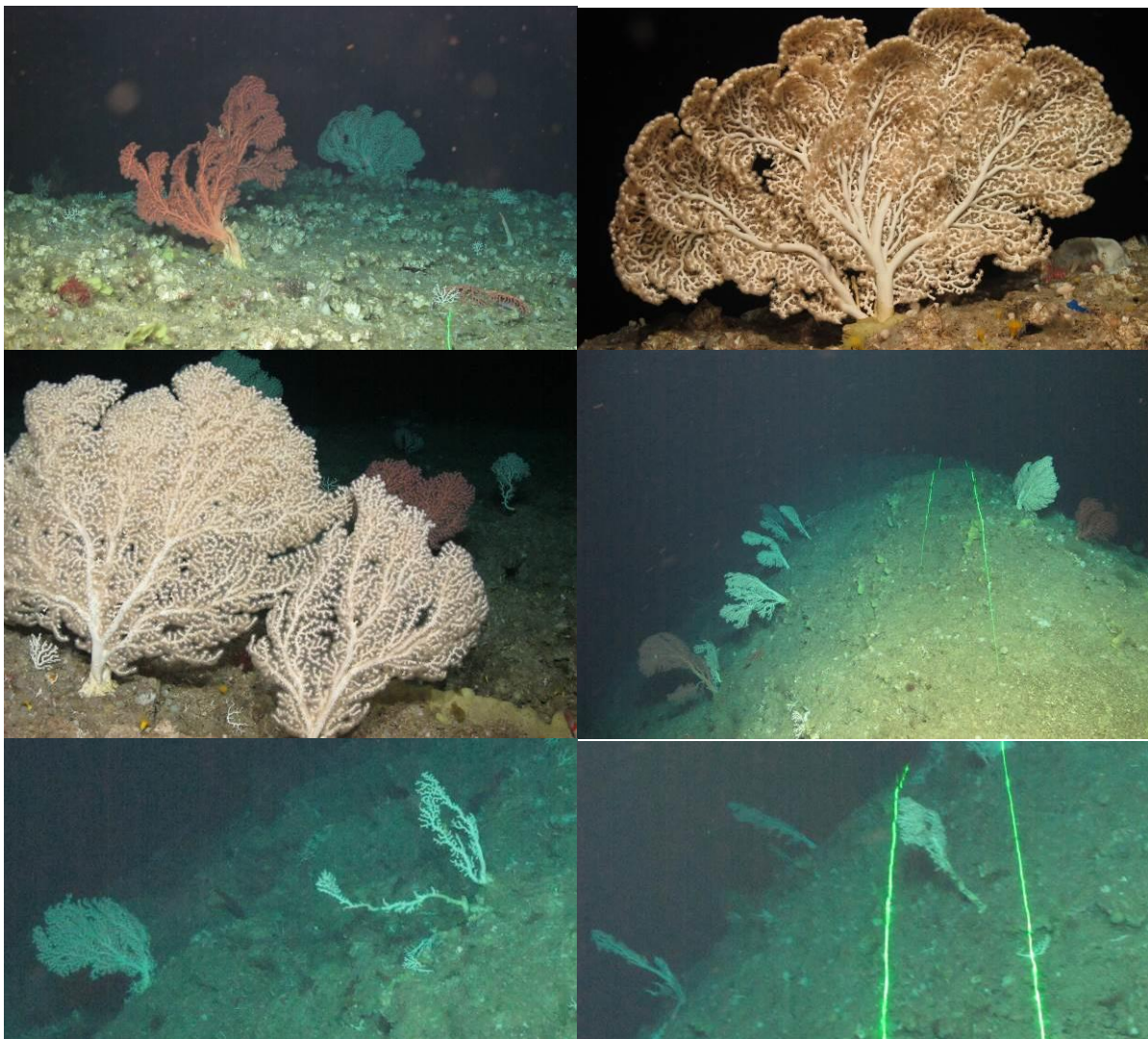


Figure 34. An extensive *Paragorgia* spp. garden, with substantial portions seriously impacted by fishing.

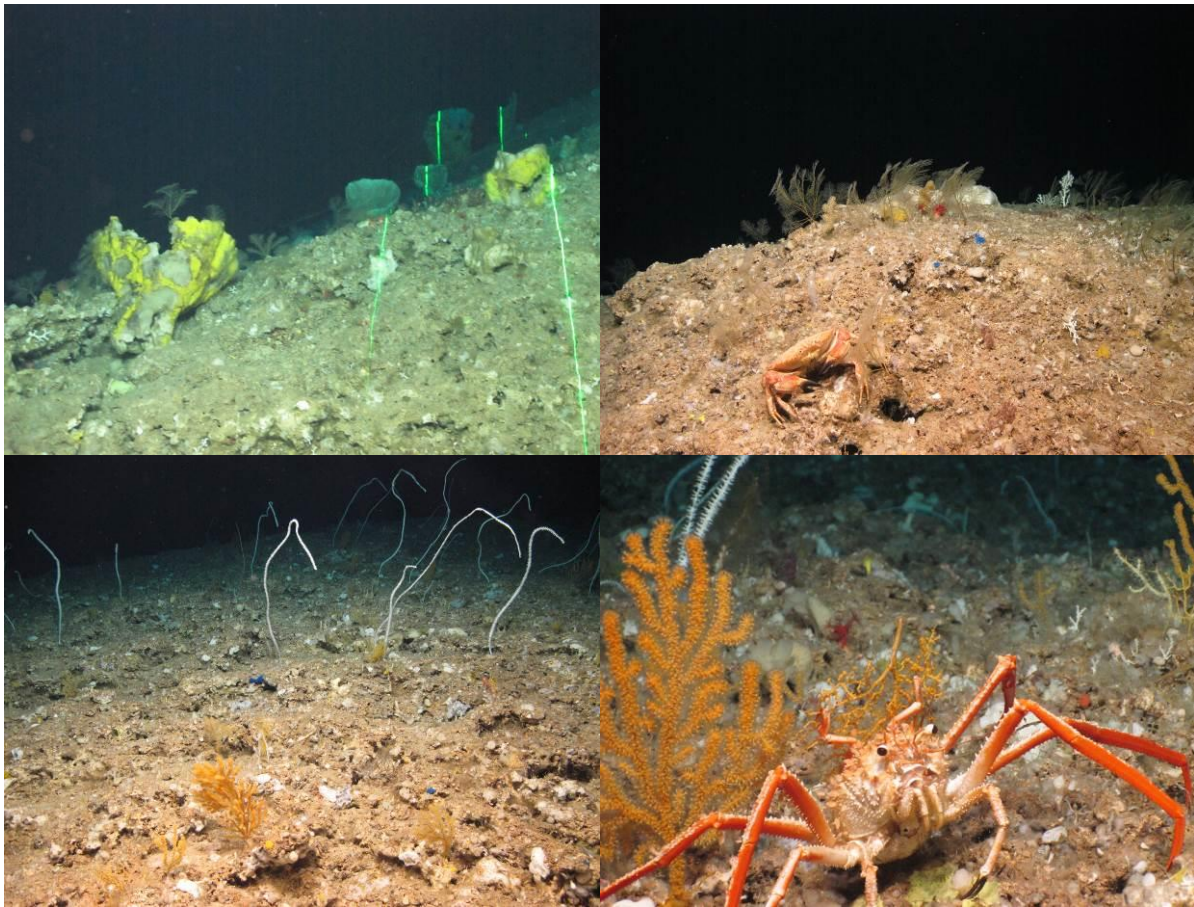


Figure 35. Other habitats found on the top of the ridge.

During dive D15 we completed only two replicates of small sediment samples with sand and coral rubble (ST054_SED1-2) at 440 m depth. During the transect, eight successful sampling events were completed, namely *Anthomastus* sp., *Stichopathes* cf. *gravieri*, *Paragorgia* cf. *johnsoni* (BS1), Dendrophylliidae, Alcyoniidae (BS2), *Paragorgia* cf. *Arborea*, *Paragorgia* cf. *johnsoni* (BS3), Anthothelidae, *Corallium* sp. (BS4), Yellow lamellate sponge (BS5), *Acanthogorgia* sp., *Acanthogorgia* cf. *armata*, Aphanipathidae (BS8), Dendrophylliidae (BS9), and *Nicella* cf. *granifera*, *Viminella* sp., and a white sponge (BS10). Water samples were collected at 557 m close to the *Paragorgia* spp. coral garden (WS1) and at 440 m close to *Viminella* flagellum and *Acanthogorgia* spp. coral garden (WS2). After the ROV was on-board, all samples were photographed, prepared, labelled and stored. One last visual transect was done in the afternoon at 18:45 before start heading back to Horta. During the transit some more multibeam data was acquired.

24/06/2018; End of the expedition, and celebration day

NRP Gago Coutinho docked in in Horta harbour at 8:00 after a night of work to finalize all the task and prepare all the files of the Blue Azores 2018 Expedition. The BlueAzores_2018 folder in our PC has now 18,340 files and it is 471GB in size, excluding the high-resolution ROV videos. Carlos spent the all the morning and part of the afternoon preparing the videos for the afternoon celebration.



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Figure 36. The scientific team just after docking in Horta. From left to right, Laurence Fauconnet, Noelia Ríos, Carlos Dominguez-Carrió, Telmo Morato, Oscar Ocaña Vicente, Gerald H. Taranto, and Manuela Ramos. Marina Carreiro-Silva could not join the cruise but was a co-leader of the expedition.

Only now, when in land, we realized how much impact our expedition had and in particular the discovery of new VMEs and the hydrothermal vent field. Everyone is very proud of having been part of this great adventure.

In the afternoon, everyone met for the closing ceremony and cocktail reception of the Oceano Azul 2018 Expedition along with the people embarked on the Santa Maria Manuela who were doing the coastal and pelagic surveys of the expedition. It was a great opportunity to learn more about their achievements and to summarise ours.



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Figure 37. The closing ceremony of the Blue Azores 2018 expedition where Telmo Morato (IMAR-UAz), Tenente Agostinho (IH), António Calado and Renato Bettencourt (ROV Luso Team) shared with the audience the main highlights of the expedition.



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Figure 38. Group photo with the scientific team, the ROV Luso Team and some members of the NRP Gago Coutinho Crew.

25/06/2018; Packing

It's time to pack all our gear and take the new samples to our lab. Just before saying goodbye to the captain of the NRP Gago Coutinho, we were offered the “coat-of-arms” of the vessel. We were really proud of this offer.



Figure 39. Proudly receiving the “coat-of-arms” by the captain of the NRP Gago Coutinho