

RV Pelagia cruise 64PE454: Rainbow hydrothermal vent and southern MAR 2019

- Hopper tow-cam video footage -
(24th of June to 4th of July 2019)

CRUISE REPORT *Date: 03/10/2019*

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Objectives: to improve the understanding on the sphere of influence of hydrothermal vents on the distribution of deep-sea megafauna around vent sites and the exploration of Sarda seamount to improve our knowledge on the distribution and abundance of large VME indicator species and deep-sea commercial fishes in the large Azores region.

Vessel: R/V Pelagia

Chief scientist: Sabine Gollner (NIOZ)

Scientific team: Carlos Dominguez-Carrió (IMAR), Sabine Gollner (NIOZ)

Main achievements:

1. Improvement of our understanding on the effects of hydrothermal vent plumes on the distribution of benthic megafauna
2. Identification of new VME areas in Sarda seamount, including glass sponge aggregations and dense cold-water coral assemblages

Cruise summary:

The Rainbow 2019 cruise on board of R/V Pelagia allocated 2 days of work to explore 2 different deep-sea areas of the Azores region using the Hopper tow-cam system: the Rainbow hydrothermal vent site and Sarda seamount. Overall, 6 successful video transects were carried out, generating more than 18 hours of seafloor images. These dives provided information along 17.8 km of seabed, at depths that ranged between 430 and 2,500 meters (Table 1).

One of the main objectives of the cruise was to contribute to the understanding of the spatial distribution patterns of benthic megafauna species around the Rainbow hydrothermal vent site, located south of the Azores EEZ (Fig. 1). Two high-definition video transects of 1.5 km long were performed at the hydrothermal vent site (Table 1), starting and ending at a distance larger than 500 m off the main active chimneys. Spatial changes in the structure of the benthic community will be visually evaluated to understand the potential effect of vent plumes on deep-sea megafauna. The total amount of bottom time recorded at Rainbow site was above 3 hours and 20 minutes, with all footage considered valid for annotation purposes.

Another main objective of the Rainbow 2019 cruise was to explore Sarda seamount, located on the western side of the MAR (Fig. 1). This geological structure stretches for more than 120 kilometres in length, and its summit can reach depths as shallow as 300 m. The 4 Hopper dives carried out at Sarda seamount aimed to obtain video footage from a wide bathymetric range, starting down to 1000 m depth all the way up to the summit. The 4 dives covered 14.8 km of seabed, generating over 15 hours of bottom time (Table 1).

Table 1. GPS positions of the deployments of the Hopper drop-cam system carried out at Rainbow hydrothermal vent site and Sarda seamount during the Rainbow 2019 cruise.

St.	Location	Date	Start-end bottom time	Start latitude	Start longitude	End latitude	End longitude	Length (m)	Start-end depth (m)
3	Rainbow	26/06/19	14:07-15:52	36°13.658' N	33°54.536' W	36°13.912' N	33°53.650' W	1420	2455-2145
4	Rainbow	26/06/19	17:42-19:18	36°13.606' N	33°54.478' W	36°14.070' N	33°53.626' W	1544	2435-2205
28	Sarda	01/07/19	08:50-10:50	37°13.747' N	33°20.404' W	37°15.034' N	33°21.022' W	2599	1140-455
29	Sarda	01/07/19	13:48-17:23	37°18.110' N	33°10.119' W	37°19.771' N	33°10.366' W	3256	965-430
30	Sarda	01/07/19	19:20-01:27	37°20.729' N	33°00.522' W	37°23.102' N	32°58.461' W	5626	1050-520
31	Sarda	01/07/19	08:26-11:49	37°22.601' N	32°55.121' W	37°23.983' N	32°53.869' W	3319	765-475

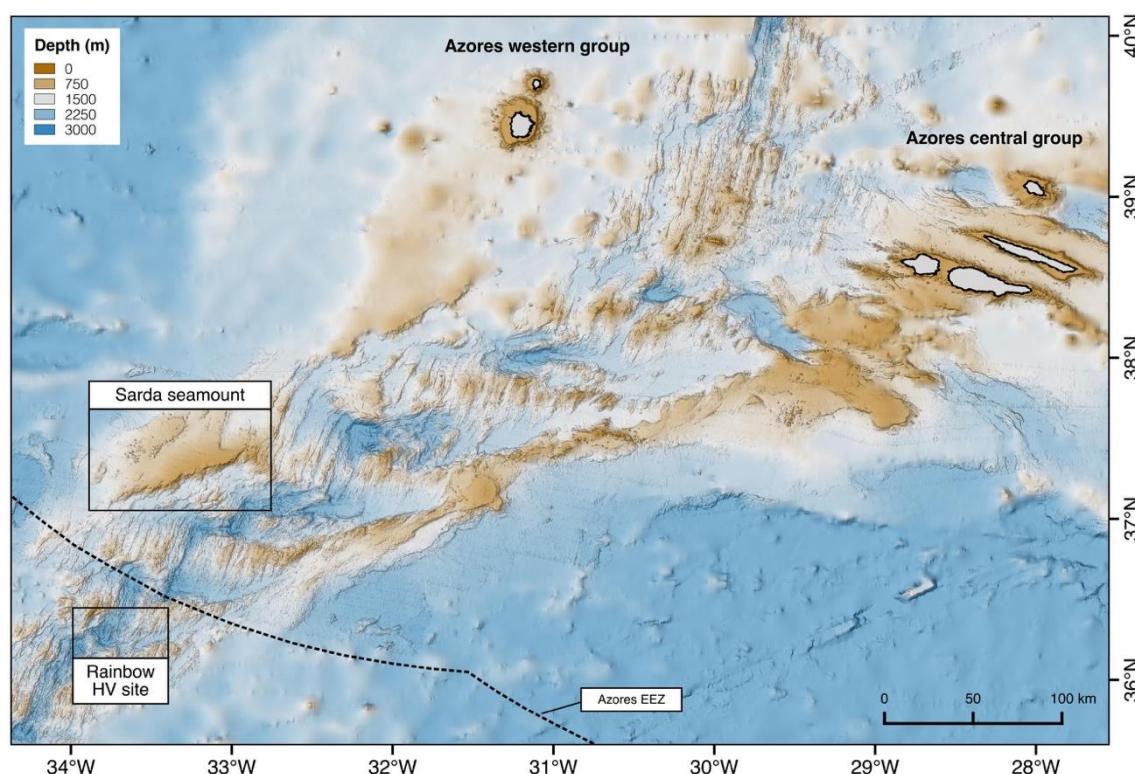


Fig. 1. Location of the two surveyed areas that were explored with the Hopper tow-cam system during the Rainbow 2019 cruise.

Site 1 | Rainbow hydrothermal vent

Two Hopper dives were carried out at the Rainbow hydrothermal vent site, at depths between 2100 and 2450 m. Both dives were performed following a similar path, starting at least 500 m southwest off the known active chimneys and following a path that aimed to cross the western group of vents (Fig. 2). Once the chimneys were passed, the Hopper frame was towed for another 500 m on the opposite side, aiming to identify changes in species composition and seabed features on both sides of the chimneys.

In terms of the geological composition of the seafloor, the Hopper images showed the existence of clear changes in the aspect, colour and texture of the substrate while approaching the vents. The initial part of both dives was characterized by very soft sediments, most likely a mixture between mud and sand, with some scattered gravels. Very few organisms were spotted on these initial sections,

with a dominance of a purple holothurian still to be identified to species level (Fig. 3a). In this area, it was also common to observe several Lebensspuren, sedimentary structures produced on the upper layers of the sediment by surficial bioturbation of benthic megafauna (Fig. 3b). According to the catalogue of Mid-Atlantic Ridge Lebensspuren proposed by Bell et al. (2013), the structures observed in the video images still have an indeterminate origin, with the species causing those marks not yet identified.

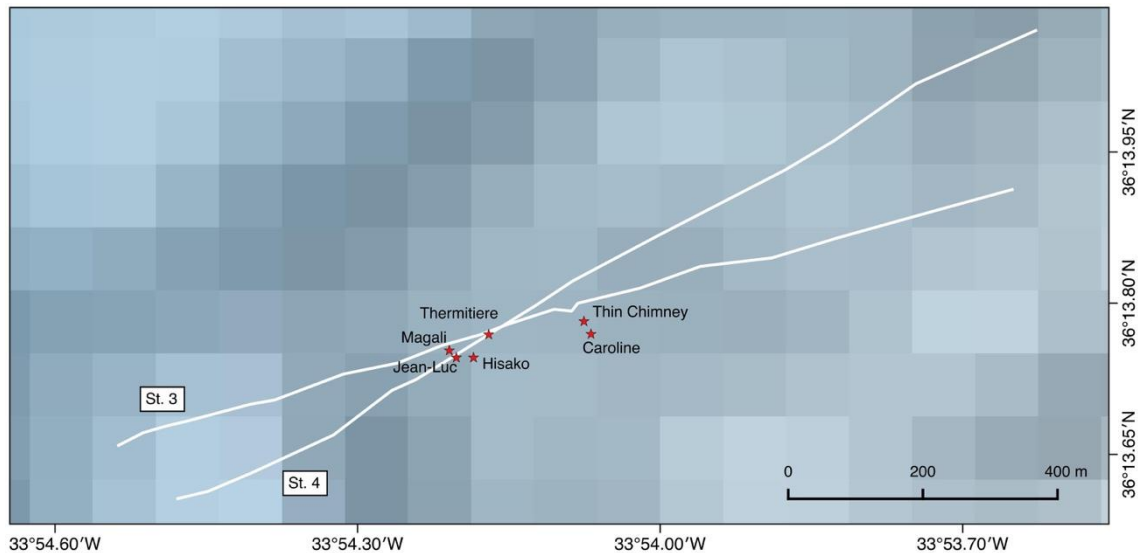


Fig. 2. Path of the two Hopper dives carried out at Rainbow hydrothermal vent, starting at around 500 m off vent and aiming to cross some of the known active chimneys. Red stars represent the active chimneys known to date at Rainbow hydrothermal vent site.

Once the Hopper frame started to approach the vent area, the number of stones and outcropping rocks started to increase, providing substrate for other sessile megafauna species. The abundance of such species was very low, and included stalked crinoids (Fig. 3c) and some cold-water corals, most likely gorgonian or bamboo corals, whose identification is still under way (Fig. 3d). While reaching the vent area, the colour of the substrate started to change towards darker tonalities, with a predominance of a red/brownish deposits (Fig. 3e). Some yellow deposits were also observed, although with a lesser extent.

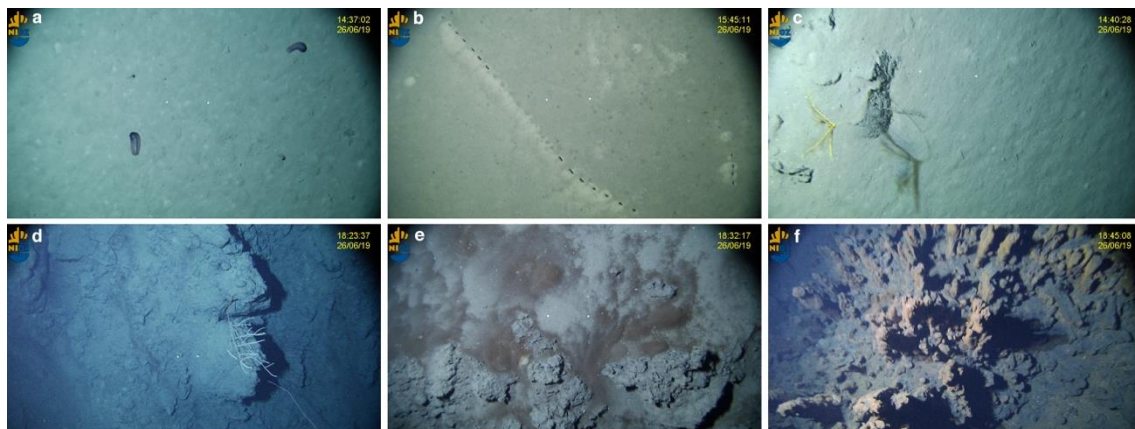


Fig. 3. Images obtained during the Hopper dives of stations 3-4. a) Deep-sea holothurians on soft sediments. b) Deep-sea Lebensspuren result of the bioturbation activity of undetermined burrowing fauna c) Stalked crinoid attached to a half-buried stone d) Two specimens of the few deep-sea corals observed e) Reddish coloration of the deep-sea sediment possibly as a result of hydrothermal vent activity f) Field of non-active hydrothermal vent chimneys.

During dive St. 3, two active smokers were crossed while dive St. 4 was characterized by the presence of inactive vents (Fig. 3f). The active vents of dive 3 produced very dense black smoke that lasted for a few minutes, providing an idea of the large extension that it covers. Once the Hopper was on the ground again after having passed both active sites, the substrate became very similar to that of the beginning of the dive, but with only Lebensspuren observed in the images.

Site 2 | Sarda seamount

Due to the large size of Sarda seamount, the characterization of its benthic communities required a survey design that maximised the coverage of its spatial and bathymetrical extension. Knowing that the summit area stretches for over 100 km in length, the 4 Hopper dives were carried out as spread as possible along the ridge, also surveying the small mound on the eastern side (Fig. 4). The three dives on the southern slope (St. 28-29-30) covered a wide bathymetrical range (450 to 1000 m depth), each of them extending for around 3 km. The last dive, on the eastern sector, had a smaller bathymetrical cover but also extended for over 3 km.

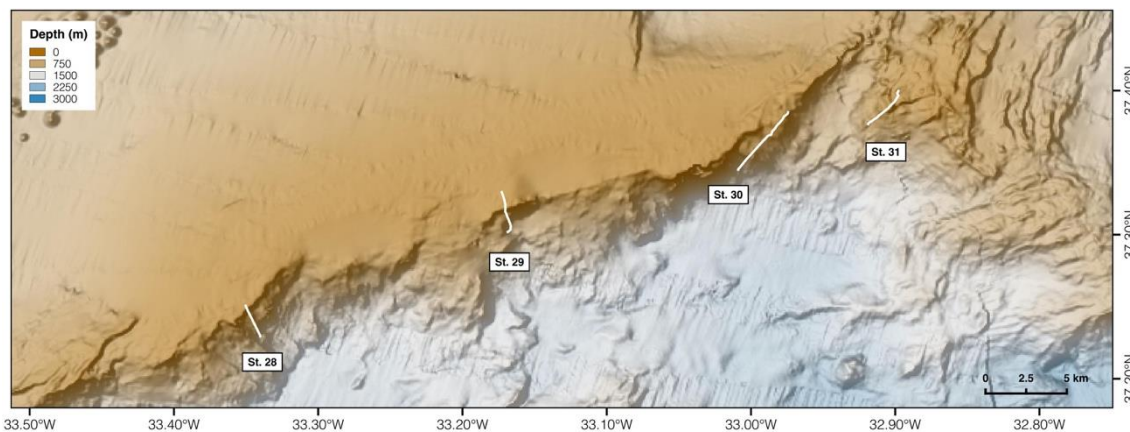


Fig. 4. Location of the 4 Hopper dives carried out at Sarda seamount. All dives aimed to cover a wide bathymetrical range, starting at depths of approx. 1000 m and finishing at the top of the seamount, at around 450 m.

The three dives carried out on the southern slope (St. 28-29-30) were very similar regarding the composition of its benthic communities, with some local variations. All three dives began at 1000 m depth, over flat areas composed of a mixture of mud, sand and gravels. In these deeper areas, different aggregations could be observed, including the glass sponge *Hyalonema* sp. (Fig. 5a) and the benthic foraminifera cf. *Syringammina fragilissima*. On the deepest part of the slope, where rocks began to outcrop and were covered with a fine layer of sediment, aggregations of the large glass sponge *Pheronema carpenteri* (Fig. 5b) were commonly observed, in some areas reaching relatively high densities. In dive 30, some patches with the gorgonian coral *Candidella imbricata* were also spotted. Moving towards shallower areas, on the middle part of the slope, a wide variety of large sponges was observed, in which to include cf. *Petrosia crassa*, cf. *Phakellia* sp. and *Charasella pachastrelloides* (Fig. 5d). In the summit area, the whip coral *Viminella flagellum* became the most abundant and conspicuous species of all, reaching some very high densities in some sectors. This gorgonian coral seldom appeared forming monospecific patches, and it was generally accompanied by a wide variety of species, in which to include the glass sponge *Asconema* sp., the fan coral *Acanthogorgia* sp. and the yellow cup coral *Leptopsammia formosa* (Fig. 5e) and large colonies of the primnoid *Callogorgia verticillata* (Fig. 5f). A few lithistid sponges were also observed accompanying the dense patches of *Viminella flagellum*, including cf. *Petrosia crassa*, cf. *Maccandrewia azorica*, cf. *Neophrissospongia nolitangere* and *Charasella pachastrelloides*, among others.

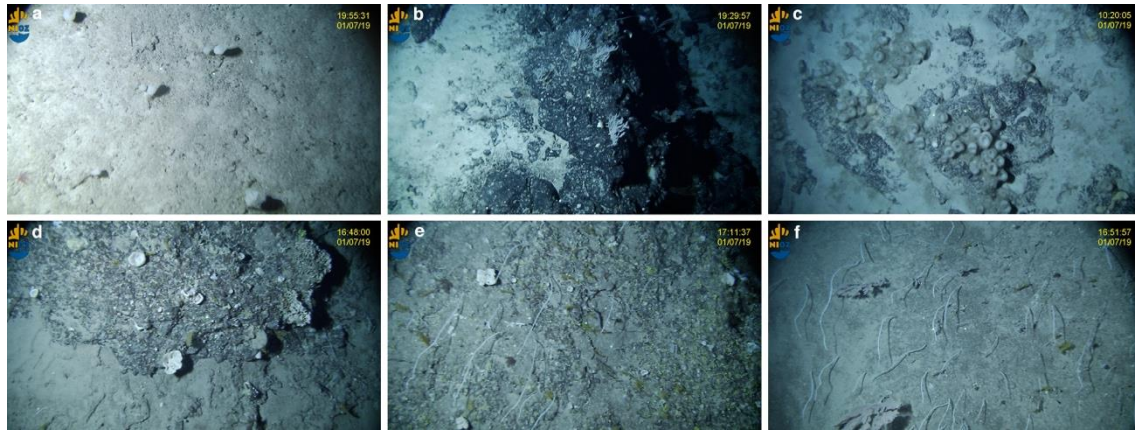


Fig. 5. Images obtained during the Hopper dives of stations 28-20-30. a) Field of the glass sponge cf. *Hyalonema* sp. on soft-bottom sediment. b) Aggregation of the gorgonian coral *Candidella imbricata* on rocky outcrops found on the deepest part of the seamount. c) High density of the glass sponge *Pheronema carpenteri* on the deepest parts of the slope d) Areas of high diversity of sponge species attached to rocky outcrops. e) Aggregation of the whip coral *Viminella flagellum*, gorgonians of the genus *Acanthogorgia* and the yellow cup coral *Leptopsammia formosa*. f) Aggregation of the whip coral *Viminella flagellum* and the large gorgonian *Callogorgia verticillata* on the summit area.

Dive 31 displayed a rather different composition regarding its benthic megafauna if compared to that observed in the previous 3 dives. Most of dive 31 displayed coral-dominated communities, in opposition to the sponge-dominated assemblages found on the western slopes of Sarda seamount. The deepest part of the dive was characterized by 4 different cold-water coral species, including *Narella bellissima* and *N. vershyni* (Fig. 6a), the large primnoid *Callogorgia verticillata* (Fig. 6b) and the yellow sea fan *Acanthogorgia* sp. (Fig. 6c), in all cases accompanied by the sponge cf. *Poecillastra compressa*. In shallower areas, an aggregation of large colonies of the coral *Paragorgia johnsoni* could be observed, which were surrounded by a large number of the small scleractinian *Leptopsammia formosa*. Towards the summit, the number of sponge species began to increase (Fig. 6e), to finally shift to a *Viminella flagellum* community (Fig. 6f), which was found in association with not only sponges such as *Leiodermatium* spp. and *Neophrissospongia nolitangere*, but also a large number of the yellow sea fan *Acanthogorgia* sp.

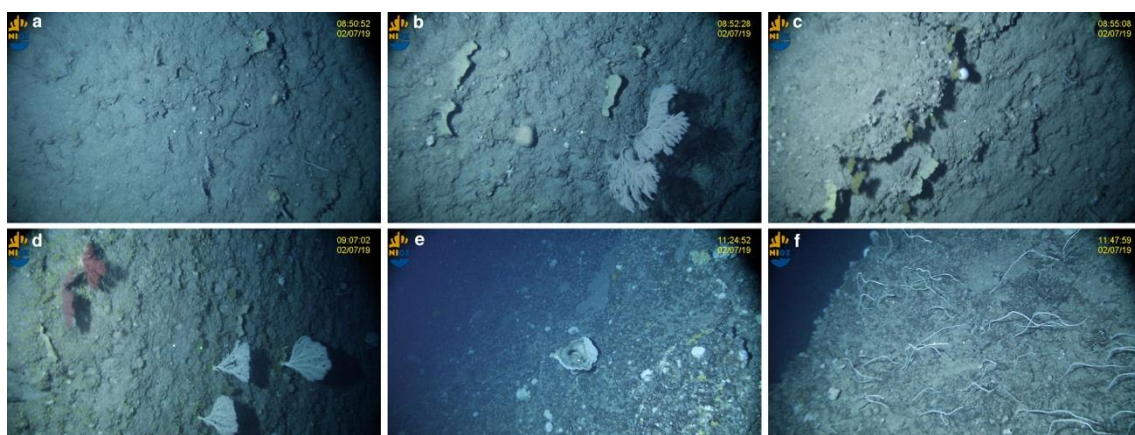


Fig. 6. Images obtained during the Hopper dive of station 31. a) Aggregation of the primnoid corals *Narella vershyni* and *Narella bellissima* on the deepest part of the dive. b) Large coral *Callogorgia verticillata* found in hard grounds with the laminate sponge cf. *Poecillastra compressa*. c) Aggregation of the yellow sea fan *Acanthogorgia* sp. with the sponge cf. *Poecillastra compressa*. d) Large gorgonian corals of the genus *Paragorgia* in areas where the cup coral *Leptopsammia formosa* reached high densities. e) High diversity of sponge species close to the summit. f) Dense aggregation of the whip coral *Viminella flagellum* on the shallowest part of the dive.

References

Bell, J.B., Jones, D.O.B. & Alt, C.H.S. (2013) Lebensspuren of the Bathyal Mid-Atlantic Ridge. *Deep Sea Research Part II: Topical Studies in Oceanography*, **98**, 341–351.