



AZORES DEEPSEA RESEARCH

**MAPGES 2023 CRUISE REPORT: EXPLORATION AND MAPPING OF
DEEP-SEA BIODIVERSITY IN THE AZORES ON BOARD RV ARQUIPÉLAGO**

AJUSTE DIRETO N.º 11/DRPM/2022 - CARACTERIZAÇÃO DOS HABITATS DE PROFUNDIDADE, COM VISTA AO SEU MAPEAMENTO ATÉ
AO LIMITE EXTERIOR DA SUBÁREA DOS AÇORES DA ZONA ECONÓMICA EXCLUSIVA PORTUGUESA

MAPGES 2023 CRUISE REPORT: EXPLORATION AND MAPPING OF DEEP-SEA BIODIVERSITY IN THE AZORES ON BOARD THE RV ARQUIPÉLAGO

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RESUMO EM PORTUGUÊS

O MapGES 2023 é a continuação da nossa estratégia de longo prazo para mapear a biodiversidade do mar profundo dos Açores e identificar áreas que se enquadrem nos critérios de Ecossistemas Marinhos Vulneráveis (VMEs) usando o sistema de imagens Azor drift-cam. Tal como noutros cruzeiros MapGES, os objetivos foram (i) mapear as comunidades bentónicas que habitam montes submarinos, cordilheiras e encostas insulares inexplorados, (ii) identificar novas áreas que se enquadrem na definição de Ecossistema Marinho Vulnerável da FAO, e (iii) determinar os padrões de distribuição da biodiversidade bentónica de profundidade nos Açores. Os resultados deste cruzeiro somaram-se aos anteriores para identificar os padrões ambientais que determinam a distribuição espacial da biodiversidade bentónica de profundidade nos Açores. Também fornece informações valiosas no contexto da avaliação do Bom Estado Ambiental (GES), do Ordenamento do Espaço Marinho (MSP) e a gestão sustentável dos ecossistemas do mar profundo.

A missão MapGES 2023 a bordo do NI Arquipélago foi composta por duas Legs. Na primeira, visitámos algumas áreas inexploradas como as estruturas geomorfológicas em torno do banco Princesa Alice e os montes submarinos a norte da Graciosa (Sedlo, Borda, João Leonardes e Gaillard) (centro dos Açores). Na segunda, visitámos, também, algumas áreas inexploradas como as estruturas geomorfológicas do Hard Rock Café (a norte da Ilha do Corvo), Kurchatov SE (no norte da dorsal médio Atlântica), Albatroz N, Ferraria N, Ferraria Mar, Sauerwein, Mar da Prata, Grande Norte (nos grupos central e oriental dos Açores), e Princesa Alice S, Princesa Alice SE e De Guerne (a sul da Ilha do Faial), e revisitamos algumas estruturas geomorfológicas que ainda não estavam completadas como, por exemplo, os montes submarinos Isolado, Kurchatov N, Kurchatov SW e Mar da Prata S.

Durante estas missões foram realizados **145 mergulhos** em 148 estações até 1 125 m de profundidade, cobrindo **85 km de fundo** do mar e produzindo mais de **141 horas de imagens** de vídeo. Estes mergulhos foram realizados em 28 áreas de amostragem, que incluíram 26 montes submarinos e 2 áreas na encosta da ilha de São Jorge. Nestas campanhas, explorámos pela primeira vez algumas áreas há muito esperadas, como os famosos montes submarinos Hard Rock-Café e Sedlo, para os quais ainda faltavam dados sobre as comunidades bentónicas para complementar outros conjuntos de dados que apoiaram a designação desta área como uma Área Marinha Protegida (AMP) do Parque Marinho dos Açores (PMA).

Esta campanha teve como principais destaques:

1. Foram visitadas dezoito estruturas geomorfológicas inexploradas na ZEE dos Açores listadas na avaliação de áreas substanciais lacunas de conhecimento
 - a. Leg1 - Sedlo W, Sedlo, Borda, São Jorge NE, Princesa Alice W (anteriormente parte do Princesa Alice), Princesa Alice SW (anteriormente Alberto do Mónaco), Picos S do Princesa Alice e mais duas áreas que não estavam listadas - o monte submarino Gaillard e uma área a Oeste do Picos S do Princesa Alice. Também visitámos algumas áreas que já tinham sido exploradas previamente, mas precisavam de dados de vídeo adicionais, como o João Leonardes, a Serreta Mar, o Mar da Fortuna e o São Jorge NW.
 - b. Leg 2 – Hard Rock Café, Kurchatov SE, Albatroz N, Ferraria N, Ferraria Mar, Sauerwein, Mar da Prata, Mar da Prata N, Grande Norte, e De Guerne. Também foram visitadas quatro áreas que já tendo sido exploradas previamente, careciam de dados de vídeo adicionais, como é o caso das estruturas geomorfológicas do Isolado, do Kurchatov N, do Kurchatov SW e do Mar da Prata S. Foi ainda visitada a área Perestrelo Bartolomeu, para a qual já existia alguma informação e a área Petrov, que afinal era mais profunda do que os mapas indicavam.
2. Durante o cruzeiro MapGES 2023 realizámos 143 transetos de vídeo subaquáticos, um dos quais o mergulho mais profundo realizado com a Azor drift-cam até à data, a 1 125 m de profundidade. Noutro, foi explorada a maior parede rochosa alguma vez filmada pela Azor drift-cam, com cerca de 230 m de altura. No total, capturamos cerca de 141 horas de novas imagens de vídeo subaquático dos habitats do fundo do mar. À semelhança dos anos anteriores, a presença de algumas linhas de pesca perdidas tornou desafiante a nossa exploração de algumas áreas do mar profundo. Alguns destes mergulhos revelaram ser dos mais complexos, tendo sido registadas várias situações em que as linhas de pesca prenderam a Azor drift-cam, sobretudo nos dois bancos na proximidade de São Miguel (Mar da Prata e Grande Norte) e no Kurchatov SE. Contudo, todos estes contratemplos foram ultrapassados com sucesso, tendo dos mesmos resultado apenas pequenos danos na Azor Drift-cam. Este impacto colateral da pesca poderá dificultar a aquisição de dados sobre a biodiversidade do mar profundo.
3. Finalmente conseguimos explorar o monte submarino Sedlo com a Azor drift-cam. De 2002 a 2005, o Sedlo foi foco de um projeto de investigação multidisciplinar da UE, OASIS (Oceanic Seamounts: An Integrated Study), que mostrou padrões hidrográficos altamente complexos com circulação anticiclónica em torno dos seus três cumes, impulsionados principalmente pela formação da coluna de Taylor. Especula-se que este monte submarino acomode um dos locais de desova mais importantes dos Açores para certas espécies de peixe (p. ex. peixe relógio e imperador).
4. As nossas explorações contribuíram com evidências de apoio para considerar o monte submarino Sedlo como um habitat essencial para peixes. Encontrámos áreas que albergam o peixe relógio *Hoplostethus atlanticus* e descobrimos que o monte Sedlo, e outros montes submarinos vizinhos, albergam um elevado número de espécies de tubarões de profundidade, algumas das quais raramente observadas nos Açores. Também descobrimos agregações do coral negro *Leiopathes expansa* no cume do Sedlo W, com a maioria dos espécimes de tamanhos relativamente pequenos. Esta área parece ser uma boa candidata a ser considerada um Ecossistema Marinho Vulnerável e deve ser mantida na lista de áreas prioritárias para conservação nos Açores.

5. Explorámos também os montes submarinos Borda, João Leonardes, e Gaillard, a norte da ilha Graciosa. Juntamente com Sedlo, estes montes submarinos parecem albergar comunidades bentónicas de profundidade únicas quando comparadas com outras áreas da ZEE dos Açores exploradas até agora com os corais negros *Leiopathes expansa* e *Parantipathes hirondelle*, o coral bambu *Acanella arbuscula*, estilasterídeos do género *Errina*, o ouriço-do-mar *Cidaridopsis cidaris* e esponjas lamelada do género *Phakellia* entre outros.
6. Começámos as explorações das unidades geomorfológicas ao sul do Princesa Alice. A maioria dos mergulhos cobriu áreas com sedimentos de areia e mistos com biodiversidade e abundância relativamente baixas, embora algumas áreas abrigassem densidades interessantes de *Narella bellissima* e *Narella versluysi*, enquanto outras eram dominadas por manchas de *Pheronema carpenteri* e outras esponjas (p. ex., *Asconema* sp.). Também observámos algumas colónias de outros corais de água fria como *Hemicorallium niobe*, *H. tricolor*, *Chrysogorgia* sp., cf. *Leptopsammia*, cf. *Candidella imbricata* e *Flabellum* sp., e algumas esponjas, como cf. *Regadrella*, e espécimes do género *Geodia*, juntamente com alguns camarões *Aristaeopsis edwardsiana*.
7. O monte submarino Hard Rock Café foi, finalmente, explorado com a Azor drift-cam. Este monte submarino foi mapeado pelo Instituto Hidrográfico em 2020, mas dada a sua localização a 210 milhas náuticas do ponto de partida natural das missões do MapGES (Horta) e o seu posicionamento a norte do arquipélago dos Açores (normalmente mais fustigado pelas condições meteorológicas adversas), a visita tem sido adiada por alguns anos. Depois de reunidas todas as condições, o Hard Rock Café foi visitado. Trata-se de uma estrutura geomorfológica que, pelas suas características, esteve desde o primeiro momento na lista das primeiras opções para a expansão do Parque Marinho dos Açores, daí ter surgido o redobrar de importância desta visita.
8. Visitámos, ainda, o monte submarino denominado Petrov pela primeira vez. Esta área ainda não possui levantamentos de batimetria de alta resolução, por isso tentámos prospetar a área à procura de um pico entre 300 m e 1.000 m de profundidade. No entanto, depois de lançar a Azor drift-cam à procura de um pico menos profundo não conseguimos atingir o fundo. Todos os sonares a bordo indicavam profundidades entre 1.900 m e 2.500 m de profundidade indicando que esta área é muito mais profunda do que as cartas náuticas atuais demonstram e realçando, mais uma vez, a importância de efetuar levantamentos de batimetria multifeixe na região dos Açores.
9. As nossas explorações com a Azor drift-cam contribuíram com evidências de apoio para considerar os montes submarinos Hard Rock Café e o Isolado como um habitat essencial para peixes. À semelhança do monte submarino Sedlo, encontrámos áreas que albergam o peixe relógio (*Hoplostethus atlanticus*), grandes cardumes de cherne (*Polyprion americanus*) e um elevado número de espécies de tubarões de profundidade, algumas das quais raramente observadas nos Açores. Embora estas áreas apresentem baixa abundância em termos de megafauna bentónica, detetámos algumas colónias dos corais negros de crescimento lento *Antipathes dichotoma* e *Leiopathes expansa*.
10. A maioria dos montes submarinos a caminho e ao redor da Ilha de São Miguel, como o Albatroz N, Ferrara N, Ferrara Mar, Mar da Prata e Grande Norte parecem albergar interessantes comunidades bentónicas de águas profundas, com abundantes jardins de coral de *Narella versluysi* e *Narella bellissima*, por vezes, em agregação com *Callogorgia verticillata*, *Acanthogorgia* sp., ou *Leiopathes expansa*. As áreas menos profundas foram caracterizadas principalmente por grandes

jardins de *Viminella flagellum*, algumas vezes associadas a *Callogorgia verticillata* e outras vezes a grandes e frequentes colónias de *Dentomuricea aff. meteor*.

11. A crista denominada de Sauerwein, entre as ilhas de São Miguel e Santa Maria, apresentou uma biodiversidade surpreendentemente baixa, realçando mais uma vez a necessidade de melhor compreender as razões que explicam os padrões de distribuição espacial das comunidades bentónicas para melhor informar a gestão e conservação destes ecossistemas vulneráveis.
12. Embora o monte submarino Grande Norte fosse claramente a zona com maior intensidade de pesca de fundo, onde observámos vários palangres de fundo perdidos, as comunidades bentónicas observadas pareciam estar em bom estado ambiental, exibindo grandes agregações de *Callogorgia verticillata*. Estas observações aumentam a evidência que a pesca de linha-e-anzol produz impactos muito menores quando comparando com outras artes de pesca.
13. Exploramos as estruturas morfológicas em torno da Princesa Alice, nomeadamente o De Guerne, onde observamos grandes áreas cobertas de sedimentos com biodiversidade e abundância relativamente baixas, com apenas alguns corais ocasionais das espécies *Acanella arbuscula*, *Parantipathes hirondelle* e *Elatopathes abietina*, e dispersos *Acanthogorgia sp.*

SUMMARY IN ENGLISH

MapGES 2023 is the continuation of our long-term strategy to map deep-sea biodiversity and identify Vulnerable Marine Ecosystems (VMEs) in the Azores using the Azor drift-cam imagery system. As in other MapGES cruises, the objectives were to (i) map benthic communities inhabiting unexplored seamounts, ridges, and island slopes, (ii) identify new areas that fit the FAO Vulnerable Marine Ecosystem definition; and (iii) determine distribution patterns of deep-sea benthic biodiversity in the Azores. The results of this cruise added to the previous contributions to identify the environmental drivers that determine the spatial distribution of deep-sea benthic biodiversity in the Azores. It also provides valuable information in the context of Good Environmental Status (GES), Marine Spatial Planning (MSP) and new insights on how to sustainably manage deep-sea ecosystems.

The MapGES 2023 RV Arquipélago cruise was composed of two Legs. In the first, we visited some unexplored areas such as the geomorphological structures around the Princesa Alice bank and the seamounts north of Graciosa (Sedlo, Borda, João Leonardes, and Gaillard) (central Azores). In the second, we also visited some unexplored areas such as the geomorphological structures of Hard Rock Café (northern of Corvo Island), Kurchatov SE (in the north mid Atlantic-ridge), Albatroz N, Ferraria N, Ferraria Mar, Sauerwein, Mar da Prata, Grande Norte (south of Faial Island), and the seamounts around Princesa Alice (Princesa Alice S, Princesa Alice SE, and De Guerne) and we revisited other geomorphological structures that needed complementary sampling efforts as, for example, Isolado, Kurchatov N, Kurchatov SW, and Mar da Prata South.

During the MapGES 2023 RV Arquipélago cruise, we performed **145 dives** in 148 stations down to 125 m depth, and covered about **85 km of seafloor**, resulting in more than **141 hours of video images**. These dives were conducted in 28 different sampling areas, including 26 seamounts and 2 island slopes around the island of São Jorge. During this cruise, we explored, for the first time, some areas such as the famous Hard Rock-Café and Sedlo seamounts. Data on the benthic communities

inhabiting these seamounts was lacking to complement existing information that supported the designation of these areas as Marine Protected Areas (MPA) of the Azores Marine Park (PMA).

This survey produced the following main achievements:

1. Eighteen unexplored geomorphological structures in the Azores EEZ were visited, being listed in the evaluation of areas with substantial knowledge gaps.
 - a. Leg1 – Sedlo W, Sedlo, Borda, São Jorge NE, Princesa Alice W (formerly part of Princesa Alice), Princesa Alice SW (formerly Alberto do Mónaco), Picos S do Princesa Alice-, plus two areas that were not listed - the Gaillard seamount and the an area West of Picos S do Princesa Alice. We also visited some areas that have already been explored but were in need of extra video data namely João Leonardes, Serreta Mar, Mar da Fortuna, and São Jorge NW.
 - b. Leg 2 – Hard Rock Café, Kurchatov SE, Albatroz N, Ferraria N, Ferraria Mar, Sauerwein, Mar da Prata, Mar da Prata N, Grande Norte and one seamount around Princesa Alice (De Guerne). We also visited four areas that have already been explored but needed extra video data namely the Isolado, Kurchatov N, Kurchatov SW, and Mar da Prata S. We also visited the Perestrelo Bartolomeu area, for which some information already existed, and the Petrov area, which turned out to be deeper than what the maps indicated.
2. During the MapGES 2023 cruise we accomplished 143 underwater video transects and the deepest dive to date performed with the Azor drift-cam, at 1 125 m depth. In total, we collected 141 hours of new underwater video footage of seabed habitats. As in previous years, the presence of some fishing lines made our deep-sea exploration challenging. After having the Azor drift-cam caught on several lines, mainly around São Miguel Island (Mar da Prata and Grande Norte seamount) and Kurchatov SE, we managed to get it free only with minor damages. This collateral fishing impact is hampering the acquisition of deep-sea biodiversity data to inform management deserve to be better quantified. Problems with the Outland lasers systems resulted in the lack of laser points the some of the images recorded.
3. We finally explored the Sedlo seamount with the Azor drift-cam. From 2002–2005, Sedlo was the focus of a multidisciplinary EU project, OASIS (Oceanic Seamounts: An Integrated Study), which showed highly complex hydrographical patterns with anticyclonic circulation around its three summits, driven principally by Taylor column formation. This seamount was speculated to accommodate one the Azores’ most important spawning ground for orange roughies and alfonsinos.
4. Deep-sea explorations with the Azor drift-cam contributed with supporting evidence to consider Sedlo seamount as an Essential Fish Habitat. We found areas that are home to the highly endangered deep-sea fish orange roughy *Hoplostethus atlanticus* and discovered that Sedlo and other neighbouring seamounts host a high number of deep-sea shark species, some of which rarely observed in the Azores. We also discovered large aggregations of the black coral *Leiopathes expansa* on the summit of the Sedlo W, with most specimens of relatively small sizes. This area seemed to be a good candidate for being considered a Vulnerable Marine Ecosystem and should be kept in the list of priority areas for conservation in the Azores.
5. We also explored Borda, João Leonardes, Gaillard seamount, north of Graciosa Island. Along with Sedlo, these seamounts seem to host slightly unique deep-sea benthic communities when

- compared to other areas in the Azores EEZ explored so far with black corals *Leiopathes expansa* and *Parantipathes hironnelle*, the bamboo coral *Acanella arbuscula*, stylasterids of the genus *Errina*, the sea urchin *Cidaris cidaris*, and lamellate sponges of the genus *Phakellia* among others
6. We started exploring the morphological features south of Princesa Alice peak. Most dives covered soft and mix sediments with relatively low biodiversity and abundance, although some areas hosted high densities of *Narella bellissima* and *Narella versluysi*, while others were dominated by patches of *Pheronema carpenteri* and other sponges (e.g., *Asconema* sp.). We also observed some sparse colonies of cold-water such as corals *Narella versluysi*, *Hemicorallium niobe*, *H. tricolor*, *Acanella arbuscula*, *Chrysogorgia* sp., cf. *Leptopsammia*, cf. *Candidella imbricata*, and *Flabellum* sp., and some deep-sea sponges such as cf. *Regadrella*, and specimens from the genus *Geodia*, along with some shrimps *Aristaeopsis edwardsiana*, sea-urchins *Cidaris cidaris* and deep-sea fishes such as *Mora moro*, *Synphobranchus kaupii*, *Helicolenus dactylopterus*, *Hoplostethus mediterraneus*, *Gephyroberix darwinii*, *Dalatias licha*, and one *Trachyscorpia cristulata*.
 7. The Hard Rock Café seamount was finally explored with the Azor drift-cam. The hydrographic Institute had mapped this seamount in 2020 but given its location at 210 nautical miles from the natural starting point of the MapGES cruises (Horta) and its position to the north of the Azores archipelago (usually more affected by adverse weather conditions), the visit to this seamount had been postponed for a few years. After all conditions were met, the Hard Rock Café was visited. It is a geomorphological structure that, due to its characteristics, was from the first moment on the list of the first options for the expansion of the Azores Marine Park, hence the increased importance of this visit.
 8. We also visited a seamount named Petrov. This area does not yet have high-resolution bathymetry data, so we tried to prospect the area looking for a peak between 300 m and 1,000 m depth. However, after launching the Azor drift-cam in search of a shallower peak we were unable to reach the bottom. All sonars on board showed depths between 1,900 m and 2,500 m deep, indicating that this area is much deeper than current nautical charts demonstrate and highlighting, once again, the importance of carrying out multibeam bathymetry surveys in the Azores.
 9. Deep-sea explorations with the Azor drift-cam contributed with supporting evidence to consider Hard Rock Café and Isolado, Essential Fish Habitats. We found that these areas were both home to the highly endangered deep-sea fish orange roughy (*Hoplostethus atlanticus*) and large schools of the wreckfish (*Polyprion americanus*). These areas also showed a high number of deep-sea shark species, some of which rarely observed in the Azores. Although these areas showed low abundances in terms of benthic megafauna, we detected some frequent colonies of the slow-growing black corals *Antipathes dichotoma* and *Leiopathes expansa*.
 10. Most seamounts on the way to and around São Miguel Island, such as Albatroz N, Ferrara N, Ferrara Mar, Mar da Prata and Grande Norte host interesting deep-sea benthic communities with the deeper areas demonstrating abundant coral gardens of both *Narella versluysi* and *Narella bellissima*, sometimes, in aggregation with *Callogorgia verticillata*, *Acanthogorgia* sp. or *Leiopathes expansa*. Shallower areas were mainly characterized by large gardens of *Viminella flagellum*, sometimes associated with *Callogorgia verticillata* and other times with frequent and large colonies of *Dentomuricea* aff. *meteor*.
 11. The Sauerwein ridge, between the islands of São Miguel and Santa Maria, had a surprisingly low biodiversity, highlighting once again the need to better understand the reasons that explain the

spatial distribution patterns of benthic communities to better inform management and conservation of these vulnerable ecosystems.

12. Although the Grande Norte seamount was clearly the area with the highest intensity of bottom fishing, where we observed several lost bottom longlines, the benthic communities observed appeared to be in good environmental condition, displaying large aggregations of *Callogorgia verticillata*. These observations add to the evidence that hook-and-line fishing produces much smaller impacts when compared to other fishing gear.
13. We continued exploring the morphological features around Princesa Alice, namely De Guerne. Most dives covered soft and mix sediments with relatively low biodiversity and abundance, with only some occasional corals of the species *Acanella arbuscula*, *Parantipathes hirondelle* and *Elatopathes abietina*, and dispersed *Acanthogorgia* sp.

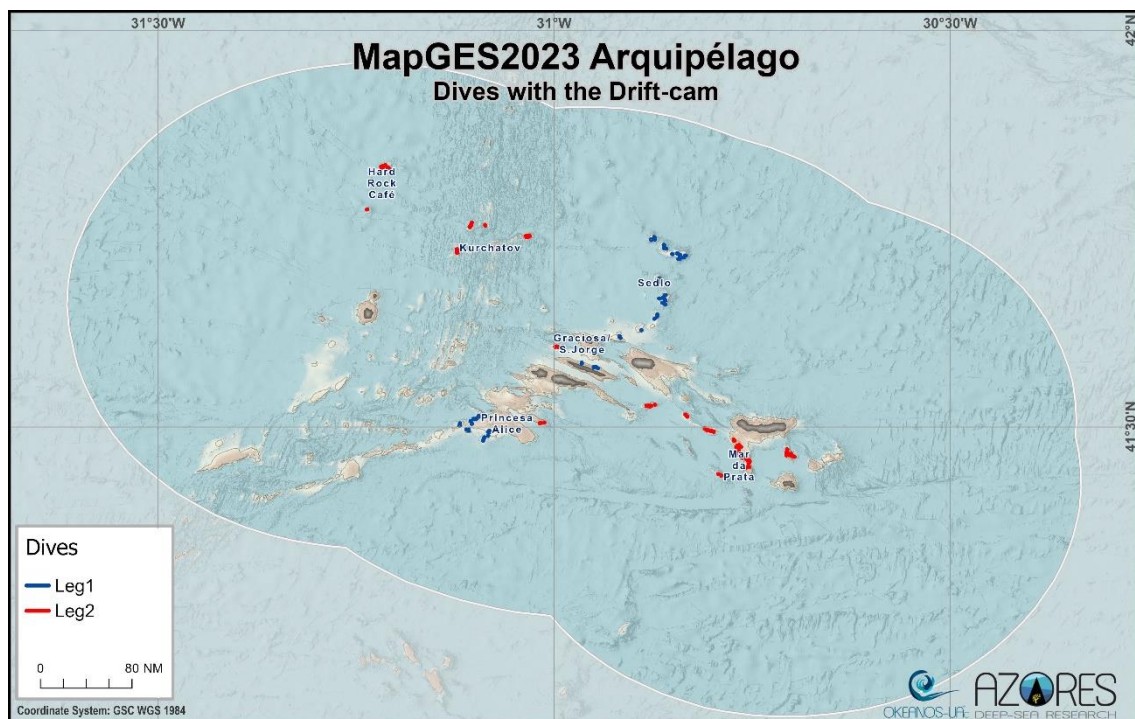


Figure 1. Location of the 148 stations transects carried out with the Azor drift-cam during the MapGES 2023 RV Arquipélago field activities.

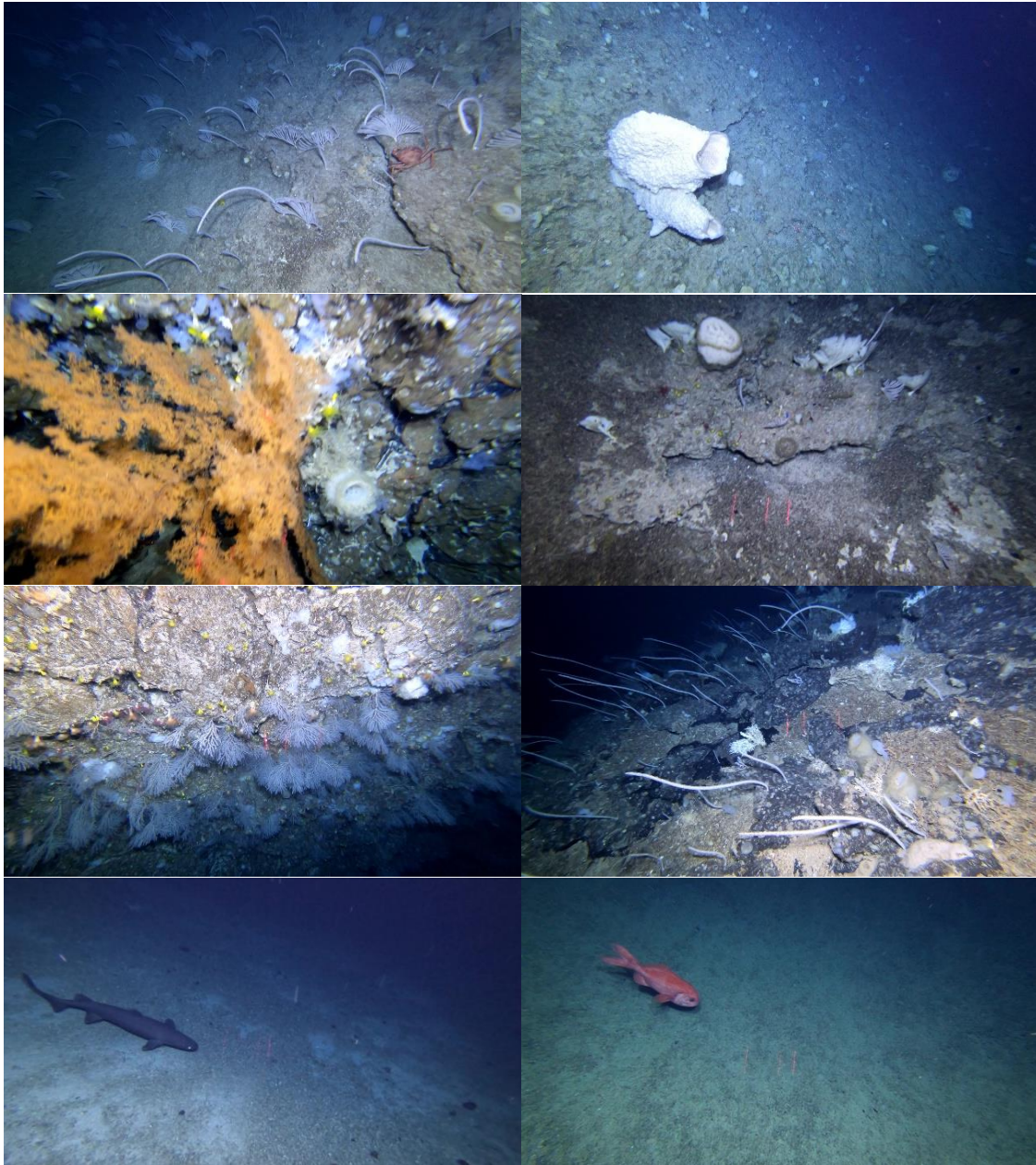


Figure 2. Screenshots taken from the footage recorded during MapGES 2023 cruise onboard the RV Arquipélago. (a) Steep slope colonized by a dense coral garden of the primnoids *Narella bellissima* and *Narella versluysi*; (b) Large sponge of the species *Haliclona magna*; (c) Black-coral *Leiopathes expansa* on a basalt vertical wall; (d) Bird's nest sponge *Pheronema carpenteri* together with other glass sponges; (e) Highest vertical wall ever filmed with Azor drift-cam covered with an extensive aggregation of corals of the genus cf. *Candidella* sp., *Desmophyllum dianthus*, *Dendrophyllia cornigera*, and various soft corals; (f) extensive gardens of *Narella bellissima*, *Narella versluysi*; (g, h) solitary *Dalatias licha* and orange roughy *Hoplostethus atlanticus*

1 MAPGES 2023 RV ARQUIPÉLAGO: EXPLORATION AND MAPPING OF DEEP-SEA BIODIVERSITY IN THE AZORES: Leg 1 - Princesa Alice Bank and Seamounts North of Graciosa.

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Date: 31 de julho 2023

1.1 RESUMO EM PORTUGUÊS

O MapGES 2023 é a continuação da nossa estratégia de longo prazo para mapear a biodiversidade do mar profundo dos Açores e identificar áreas que se enquadrem nos critérios de Ecossistemas Marinhos Vulneráveis (VMEs) usando o sistema de imagens Azor drift-cam. Neste cruzeiro, operámos a partir do RV Arquipélago e visitamos algumas áreas inexploradas como as estruturas geomorfológicas em torno do banco Princesa Alice e os montes submarinos a norte da Graciosa (Sedlo, Borda, João Leonardes e Gaillard) (centro dos Açores). Tal como noutros cruzeiros MapGES, os objetivos foram (i) mapear as comunidades bentónicas que habitam montes submarinos, cordilheiras e encostas insulares inexplorados, (ii) identificar novas áreas que se enquadrem na definição de Ecossistema Marinho Vulnerável da FAO, e (iii) determinar os padrões de distribuição da biodiversidade bentónica de profundidade nos Açores. Os resultados deste cruzeiro somaram-se aos anteriores para identificar os drivers ambientais que determinam a distribuição espacial da biodiversidade bentónica de profundidade nos Açores. Ele também fornece informações valiosas no contexto do Bom Estado Ambiental (GES), Ordenamento do Espaço Marinho (MSP) e novos dados que ajudem à gestão sustentável dos ecossistemas do mar profundo.

Esta Leg foi dividida em duas partes, que foram planeadas para visitar algumas áreas inexploradas ao redor do banco Princesa Alice e os montes submarinos ao norte da Graciosa (Sedlo, Borda e Gaillard) (Grupo Central dos Açores) (Figure 4, Table 1). Ao todo, foram realizados 64 mergulhos em 68 estações até 1 125 m de profundidade, cobrindo 36 km do fundo do mar e produzindo mais de 62 horas de imagens de vídeo do fundo do mar. Estes mergulhos foram realizados em 13 áreas de amostragem, que incluíram onze montes submarinos e 2 áreas na encosta da ilha de São Jorge. Durante a Leg 1a, de 8 a 11 de julho de 2023, realizamos 23 mergulhos bem-sucedidos com a Azor drift-cam. Esta parte da Leg 1 avaliou as comunidades bentónicas de profundidade que habitam as encostas das estruturas geomorfológicas ao sul do banco Princesa Alice, a bordo do navio de pesquisa Arquipélago. Durante a Leg 1b, de 14 a 21 de julho de 2023, realizámos 41 mergulhos bem-sucedidos com a Azor drift-cam. A Leg 1b, explorou pela primeira vez algumas áreas há muito esperadas, como o famoso monte submarino Sedlo, para o qual ainda faltavam dados sobre as comunidades bentónicas para complementar outros conjuntos de dados que apoiaram a designação desta área como uma Área Marinha Protegida do Parque Marinho dos Açores. A Leg 1b explorou as encostas dos montes submarinos a norte da Graciosa, nomeadamente Sedlo, Borda, João Leonardes e Gaillard e as encostas norte da ilha de São Jorge.

Esta campanha teve seis principais destaques:

1. Pudemos visitar oito estruturas geomorfológicas inexploradas na ZEE dos Açores listadas na Secção 8 do R1 “Avaliação de áreas com suficiente informação pré-existente e com substanciais lacunas de conhecimento” - Sedlo W, Sedlo, Borda, São Jorge NE, Princesa Alice W (anteriormente parte do Princesa Alice), Princesa Alice SW (anteriormente Alberto do Mónaco), Picos S do Princesa Alice e mais duas áreas que não estavam listadas - o monte submarino Gaillard e uma área a Oeste do Picos S do Princesa Alice. Também visitámos algumas áreas que já tinham sido exploradas previamente, mas precisavam de dados de vídeo adicionais, como o João Leonardes, a Serreta Mar, o Mar da Fortuna e o São Jorge NW.
2. Durante o cruzeiro MapGES 2023 #1 realizámos 64 transetos de vídeo subaquáticos e o mergulho mais profundo de sempre com a Azor drift-cam a 1 125 m de profundidade. Realizamos cerca de 62 horas de novas imagens de vídeo subaquático dos habitats do fundo do mar. À semelhança dos anos anteriores, a presença de algumas linhas de pesca tornou desafiante a nossa exploração de algumas áreas do mar profundo. Depois de termos ficado presos em várias linhas de pesca, conseguimos libertar apenas com pequenos danos. Este impacto colateral da pesca está a impedir a aquisição de dados sobre a biodiversidade do mar profundo.
3. Finalmente conseguimos explorar o monte submarino Sedlo com a Azor drift-cam. De 2002 a 2005, o Sedlo foi foco de um projeto de investigação multidisciplinar da UE, OASIS (Oceanic Seamounts: An Integrated Study), que mostrou padrões hidrográficos altamente complexos com circulação anticiclónica em torno de seus três cumes, impulsionados principalmente pela formação da coluna de Taylor. Especula-se que este monte submarino acomode um dos locais de desova mais importantes dos Açores para certas espécies de peixe (p. ex. peixe relógio e imperador).
4. As nossas explorações adicionaram evidências de apoio para considerar o monte submarino Sedlo como um habitat essencial para peixes. Encontrámos áreas que albergam o peixe relógio *Hoplostethus atlanticus* e descobrimos que Sedlo, e outros montes submarinos vizinhos, albergam um elevado número de espécies de tubarões de profundidade, algumas das quais raramente observadas nos Açores. Também descobrimos agregações do coral negro *Leiopathes expansa* no cume do Sedlo W, com a maioria dos espécimes de tamanhos relativamente pequenos. Esta área parece ser uma boa candidata a ser considerada um Ecossistema Marinho Vulnerável e deve ser mantida na lista de áreas prioritárias para conservação nos Açores.
5. Também explorámos os montes submarinos Borda, João Leonardes, e Gaillard, a norte da ilha Graciosa. Juntamente com Sedlo, estes montes submarinos parecem albergar comunidades bentónicas de profundidade únicas quando comparadas com outras áreas da ZEE dos Açores exploradas até agora com os corais negros *Leiopathes expansa* e *Parantipathes hirondelle*, o coral bambu *Acanella arbuscula*, estilasterídeos do género *Errina*, o ouriço-do-mar *Cidaridites cidaris* e esponjas lamelada do género *Phakellia* entre outros.
6. Começamos as explorações das unidades geomorfológicas ao sul do Princesa Alice. A maioria dos mergulhos cobriu áreas com sedimentos de areia e mistos com biodiversidade e abundância relativamente baixas, embora algumas áreas abrigassem densidades interessantes de *Narella bellissima* e *Narella versluysi*, enquanto outras eram dominadas por manchas de *Pheronema carpenteri* e outras esponjas (p. ex., *Asconema* sp.). Também observamos algumas colónias de outros corais de água fria como *Hemicorallium niobe*, *H. tricolor*, *Chrysogorgia* sp., cf. *Leptopsammia*, cf. *Candidella imbricata* e *Flabellum* sp., e algumas esponjas, como cf. *Regadrella*, e espécimes do género *Geodia*, juntamente com alguns camarões *Aristaeopsis edwardsiana*.

1.2 SUMMARY OF THE MAPGES 2023 RV ARQUIPÉLAGO LEG1

1.2.1 *Main objectives*

MapGES 2023 is the continuation of our long-term strategy to map deep-sea biodiversity and identify Vulnerable Marine Ecosystems (VMEs) in the Azores using the Azor drift-cam imagery system. In this cruise, we operated from the RV Arquipélago and planned to visit some unexplored areas such as the geomorphological structures around the Princesa Alice bank and the seamounts north of Graciosa (Sedlo, Borda, João Leonardes, and Gaillard) (central Azores). As in other MapGES cruises, the objectives were to (i) map benthic communities inhabiting unexplored seamounts, ridges, and island slopes, (ii) identify new areas that fit the FAO Vulnerable Marine Ecosystem definition; and (iii) determine distribution patterns of deep-sea benthic biodiversity in the Azores. The results of this cruise added to the previous contributions to identify the environmental drivers that determine the spatial distribution of deep-sea benthic biodiversity in the Azores. It also provides valuable information in the context of Good Environmental Status (GES), Marine Spatial Planning (MSP) and new insights on how to sustainably manage deep-sea ecosystems.

1.2.2 *Methodology*

We performed several underwater video transects along the seafloor with the Azor drift-cam, a low-cost drifting camera system designed and developed at IMAR & Okeanos (University of the Azores). It allows the recording of high-quality underwater video images of the seabed down to 1000 m depth. The system was deployed from the Research Vessel Arquipélago, owned by the Government of the Azores. In each of the areas or geomorphological structures to be explored, a representative number of dives (or transects) was carried out with a video camera system from a depth of about 1 000 m to the shallowest depth of each structure. The objective was to obtain underwater images to characterize the biodiversity along the entire bathymetric gradient and substrate types of each structure. The video transects were planned according to the best bathymetry available, so that the camera systems move from deeper to shallower areas. This methodology allows the collected images to always have the best possible quality, maximizing the area of incidence of light and avoiding its dissipation in the water column (in the case of descending transects). The transects carried out with the Azor drift-cam were planned to last approximately 60 min in the seafloor, with the system drifting over the benthic habitats at an approximate speed of 0.5 to 1 knots. Under normal oceanographic conditions, each working day allowed for 5 to 6 dives, corresponding to around 5 km of bottom explored per day.

Vessel

RV Arquipélago

Dates

08-21 July 2023

1.2.3 *Scientific team*

Leg 1a - Telmo Morato (chief scientist), Laurence Fauconnet, Gerald H. Taranto, João Balsa (Figure 3).

Leg 1b - Carlos Dominguez-Carrió (chief scientist), Luís Rodrigues, Laurence Fauconnet, Marc Pladevall, Inês Bruno, and Pepe Brix (media) (Figure 3).

1.2.4 Statistics

During the Leg 1 of the MapGES 2023 cruise, we performed 64 successful dives with the Azor drift-cam down to 1 105 m depth, covering 36 km of the seafloor and producing more than 62 hours of video footage of the seabed.



Figure 3. Scientific team on the RV Arquipelago that participated in the Leg 1a (left) and 1b (right) of MapGES 2023 Cruise

1.2.5 Cruise summary

The Leg 1 of the MapGES 2023 survey was divided into two parts, which were planned to visit some unexplored areas around the Princesa Alice bank and the seamounts north of Graciosa (Sedlo, Borda, João Leonardes, and Gaillard) (central Azores) (Figure 4, Table 1). Overall, 64 dives out of 68 stations were accomplished in 13 sampling areas, which include 11 seamount areas and 2 slopes areas around São Jorge Island. During **Leg 1a**, from 8th to 11th July 2023, we performed 23 successful dives with the Azor drift-cam. This part of Leg 1 surveyed the deep-sea benthic communities dwelling on the slopes of the geomorphological structures south of Princesa Alice bank on board of the research vessel Arquipelago. During the **Leg 1b**, from 14th to 21st July 2023, we performed 41 successful dives with the Azor drift-cam. Leg 1b of the MapGES 2023 cruise explored for the first time some long-awaited areas such as the famous Sedlo seamount, for which data on the benthic communities was still lacking to complement other datasets that supported the designation of this area as a Marine Protected Area. Leg 1b surveyed the slopes of the seamounts north of Graciosa, namely Sedlo, Borda, João Leonardes, and Gaillard and the northern slopes of São Jorge Island. During this survey we observed very diverse benthic and fish communities such as a steep slope colonized by a dense coral garden of the primnoids *Narella bellissima* and *Narella versluysi*, large sponges of the species *Haliclona magna*, black-corals *Leiopathes expansa* on a basalt vertical wall, bird's nest sponge *Pheronema carpenteri* together with other glass sponges, solitary *Dalatias licha*, and orange roughy *Hoplostethus atlanticus* (Table 2).

Table 1. Areas surveyed during each of the Legs of MapGES_2022 cruise, with information on the amount of underwater terrain explored and time of filming accomplished.

Leg	Dates	Areas explored	Dives	km	Bottom time (h)
1a	08-11 July	Geomorphological structures south of Princesa Alice bank	23	9.1	21:52
1b	14-21 July	Sedlo, Borda, João Leonardes, Gaillard and Mar da Fortuna seamounts and the northern slopes of São Jorge Island	41	26.9	40:21
Total			64	36.1	62:13

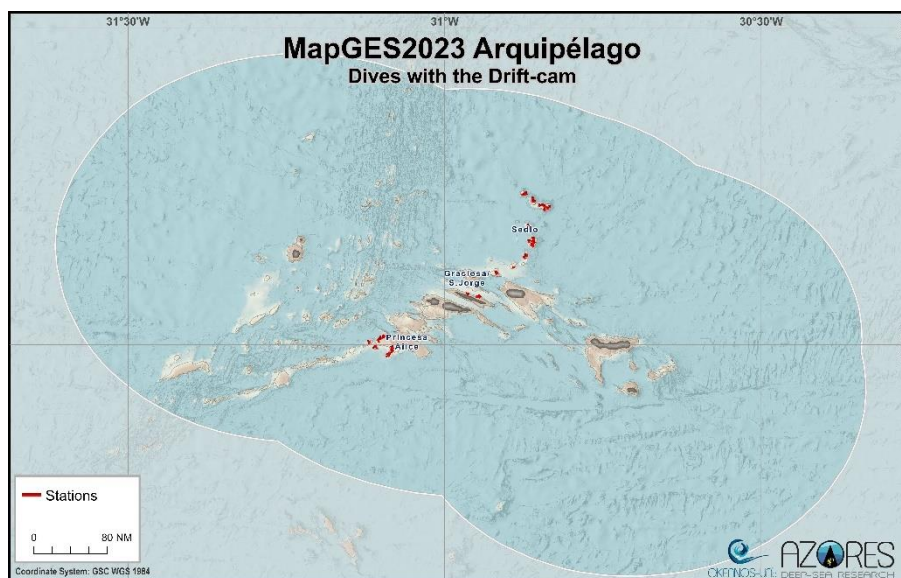


Figure 4. Location of the 62 video transects (black lines) carried out with the Azor drift-cam during Leg 1 of MapGES 2023 onboard the RV Arquipélago



Figure 5. Screenshots taken from the footage recorded during Leg 1 of MapGES 2023 cruise Leg 1 onboard the RV Arquipélago. (a) Steep slope colonized by a dense coral garden of the primnoids *Narella bellisima* and *Narella versluysi*; (b) Large sponge of the species *Haliclona magna*; (c) Black-coral *Leiopathes expansa* on a basalt vertical wall; (d) Bird's nest sponge *Pheronema carpenteri* together with other glass sponges; (e, f) solitary *Dalatias licha* and orange roughy *Hoplostethus atlanticus*

1.2.6 Main achievements

1. Eight unexplored geomorphological structures in the Azores EEZ were visited, being listed in the Section 7 “Evaluation of areas with sufficient pre-existing information and with substantial knowledge gaps” – Sedlo W, Sedlo, Borda, São Jorge NE, Princesa Alice W (formerly part of Princesa Alice), Princesa Alice SW (formerly Alberto do Mónaco), Picos S do Princesa Alice-, plus 2 areas that were not listed - the Gaillard seamount and the an area West of Picos S do Princesa Alice. We also visited some areas that had already been explored but needed extra video data, namely João Leonardes, Serreta Mar, Mar da Fortuna, and São Jorge NW.
2. During the MapGES 2023 #1 cruise we accomplished 64 underwater video transects and the deepest dive to date with the Azor drift-cam, at 1 125 m depth, adding up to around 62 hours of new underwater video footage of seabed habitats. As in previous years, the presence of some lost fishing lines made our deep-sea exploration challenging. After having the Azor drift-cam caught on several lines, we managed to get free with only minor damages. This collateral fishing impact is hampering the acquisition of deep-sea biodiversity data to inform management deserve to be better quantified. Problems with the Outland lasers systems resulted in the lack of laser points the some of the images recorded.
3. We finally explored the Sedlo seamount with the Azor drift-cam. From 2002–2005, Sedlo was the focus of a multidisciplinary EU project, OASIS (Oceanic Seamounts: An Integrated Study), which showed highly complex hydrographical patterns with anticyclonic circulation around its three summits, driven principally by Taylor column formation. This seamount was speculated to accommodate one the Azores’ most important spawning ground for orange roughy, with higher abundances between 1 000 and 1 200 m.
4. Deep-sea explorations with the Azor drift-cam contributed with supporting evidence to consider Sedlo seamount as an Essential Fish Habitat. We found areas that are home to the highly endangered deep-sea fish orange roughly *Hoplostethus atlanticus* and discovered that Sedlo and other neighbouring seamounts host a high number of deep-sea shark species, some of which rarely observed in the Azores. We also discovered large aggregations of the black coral *Leiopathes expansa* on the summit of the Sedlo W, with most specimens of relatively small sizes. This area seemed to be a good candidate for being considered a Vulnerable Marine Ecosystem and should be kept in the list of priority areas for conservation in the Azores.
5. We also explored Borda, João Leonardes, Gaillard seamount, north of Graciosa Island. Along with Sedlo, these seamounts seem to host slightly unique deep-sea benthic communities when compared to other areas in the Azores EEZ explored so far with black corals *Leiopathes expansa* and *Parantipathes hirondelle*, the bamboo coral *Acanella arbuscula*, stylasterids of the genus *Errina*, the sea urchin *Cidaris cidaris*, and lamellate sponges of the genus *Phakellia* among others.
6. We started exploring the morphological features south of Princesa Alice peak. Most dives covered soft and mix sediments with relatively low biodiversity and abundance, although some areas hosted high densities of *Narella bellissima* and *Narella versluysi*, while others were dominated by patches of *Pheronema carpenteri* and other sponges (e.g., *Asconema* sp.). We also observed some sparse colonies of cold-water such as corals *Narella versluysi*, *Hemicorallium niobe*, *H. tricolor*, *Acanella arbuscula*, *Chrysogorgya* sp., cf. *Leptopsammia*, cf. *Candidella imbricata*, and *Flabellum* sp., and some deep-sea sponges such as cf. *Regadrella*, and specimens from the genus *Geodia*, along with some shrimps *Aristaeopsis edwardsiana*, sea-urchins *Cidaris cidaris* and deep-sea fishes such as *Mora moro*, *Synaphobranchus kaupii*, *Helicolenus dactylopterus*, *Hoplostethus mediterraneus*, *Gephyroberix darwinii*, *Dalatias licha*, and one *Trachyscorpia cristulata*.

1.3 STATIONS SURVEYED DURING MAPGES 2023 RV ARQUIPÉLAGO LEG 1

In the Leg 1 of MapGES 2023 survey we conducted, 64 dives out of 68 stations in 13 sampling areas. Here we present a compilation of all the stations surveyed during this cruise (Table 2).

Table 2. Compilation of the stations surveyed during Leg 1 of MapGES 2023 cruise onboard the RV Arquipélago.

Station	Location	Date	Time		Start position		End position		Depth (m)		Dist. (m)
			Start	End	Lat. (N)	Long. (W)	Lat. (N)	Long. (W)	start	End	
St001	Princ. Alice	08/07/2023	08:20	10:08	37.65	-29.516	37.647	-29.517	960	890	290
St002	Princ. Alice	08/07/2023	10:37	11:11							
St003	Princ. Alice	08/07/2023	12:05	13:57	37.646	-29.514	37.645	-29.516	819	786	140
St004	Princ. Alice	08/07/2023	14:29	15:42	37.623	-29.524	37.625	-29.523	788	837	230
St005	Princ. Alice	08/07/2023	15:58	17:37	37.619	-29.525	37.617	-29.528	801	710	330
St006	Princ. Alice	08/07/2023	18:08	19:55	37.598	-29.532	37.602	-29.535	896	930	460
St007	Princ. Alice	09/07/2023	08:31	09:37	37.671	-29.463	37.669	-29.462	730	853	230
St008	Princ. Alice	09/07/2023	09:53	11:22	37.676	-29.463	37.676	-29.458	780	727	380
St009	Princ. Alice	09/07/2023	11:38	12:37	37.676	-29.462	37.675	-29.459	596	753	310
St010	Princ. Alice	09/07/2023	13:05	14:44	37.722	-29.44	37.726	-29.438	815	778	450
St011	Princ. Alice	09/07/2023	15:07	16:14	37.727	-29.455	37.73	-29.452	717	685	430
St012	Princ. Alice	09/07/2023	16:32	17:32	37.74	-29.452	37.743	-29.448	742	897	490
St013	Princ. Alice	09/07/2023	17:56	19:27	37.739	-29.45	37.741	-29.443	728	886	610
St014	SW Princ. Alice	10/07/2023	08:15	09:56	37.746	-29.746	37.745	-29.74	756	760	520
St015	SW Princ. Alice	10/07/2023	10:44	12:24	37.758	-29.776	37.761	-29.779	1045	1105	420
St016	SW Princ. Alice	10/07/2023	12:50	14:31	37.758	-29.747	37.762	-29.748	814	849	470
St017	SWW Princ. Alice	10/07/2023	15:47	17:46	37.818	-29.878	37.818	-29.871	870	851	640
St018	SWW Princ. Alice	10/07/2023	18:07	19:53	37.85	-29.872	37.852	-29.871	877	915	240
St019	SW Princ. Alice	11/07/2023	08:09	10:00	37.844	-29.701	37.845	-29.695	670	715	510
St020	SW Princ. Alice	11/07/2023	10:27	11:40	37.884	-29.716	37.882	-29.713	930	866	310
St021	SW Princ. Alice	11/07/2023	12:10	14:16	37.916	-29.675	37.916	-29.673	950	790	210
St022	SW Princ. Alice	11/07/2023	14:31	15:39	37.91	-29.659	37.914	-29.659	730	736	390
St023	SW Princ. Alice	11/07/2023	15:54	16:41	37.911	-29.635	37.915	-29.636	533	701	410
St024	SW Princ. Alice	11/07/2023	17:54	18:44	37.948	-29.591	37.952	-29.597	434	429	700
St025	São Jorge NW	14/07/2023	08:42	10:51	38.734	-28.103	38.728	-28.104	920	768	700
St026	São Jorge NW	14/07/2023	10:51	12:44	38.724	-28.1	38.718	-28.101	636	504	610
St027	São Jorge NE	14/07/2023	13:56	15:39	38.669	-27.929	38.662	-27.929	559	228	830
St028	São Jorge NE	14/07/2023	15:57	16:57	38.672	-27.893	38.67	-27.891	896	876	300
St029	São Jorge NE	14/07/2023	17:10	18:01	38.667	-27.896	38.665	-27.894	815	769	290
St030	São Jorge NE	14/07/2023	18:20	19:37	38.656	-27.875	38.649	-27.867	702	500	960
St031	Borda	15/07/2023	08:49	10:13	39.574	-26.893	39.575	-26.89	866	962	310
St032	Borda	15/07/2023	10:43	12:37	39.6	-26.932	39.597	-26.921	846	769	1040
St033	Borda	15/07/2023	13:07	14:05	39.635	-26.895	39.631	-26.89	572	623	520
St034	Borda	15/07/2023	14:22	15:46	39.648	-26.899	39.64	-26.893	634	468	970
St035	Borda	15/07/2023	16:05	17:25	39.653	-26.897	39.646	-26.894	637	520	830
St036	Borda	15/07/2023	17:48	18:52	39.668	-26.906	39.663	-26.904	668	659	590
St037	Borda	15/07/2023	19:10	20:35	39.675	-26.924	39.673	-26.923	626	590	320
St038	Sedlo W	16/07/2023	08:18	09:58	40.522	-27.097	40.515	-27.093	883	923	840
St039	Sedlo W	16/07/2023	10:36	12:22	40.554	-27.05	40.548	-27.045	984	945	770
St040	Sedlo W	16/07/2023	12:53	14:35	40.526	-27.04	40.518	-27.038	857	886	880
St041	Sedlo	16/07/2023	14:49	17:45	40.408	-26.907	40.402	-26.91	735	720	770
St042	Sedlo	16/07/2023	18:36	20:03	40.395	-26.912	40.391	-26.909	760	721	530
St043	Sedlo	17/07/2023	08:32	10:32	40.441	-26.912	40.437	-26.904	919	902	750
St044	Sedlo	17/07/2023	11:02	12:46	40.39	-26.887	40.387	-26.878	793	809	820
St045	Sedlo	17/07/2023	13:36	14:11	40.31	-26.787	40.31	-26.787	905	905	10
St046	Sedlo	17/07/2023	14:43	16:32	40.311	-26.788	40.307	-26.782	904	924	570
St047	Sedlo	17/07/2023	16:58	18:17	40.32	-26.719	40.319	-26.718	859	839	120
St048	Sedlo	17/07/2023	18:28	18:47							
St049	Sedlo	17/07/2023	18:54	20:22	40.316	-26.716	40.318	-26.711	828	847	420
St050	Sedlo	18/07/2023	08:09	10:06	40.287	-26.601	40.286	-26.593	973	961	730
St051	Sedlo	18/07/2023	10:40	12:17	40.26	-26.633	40.259	-26.622	928	1042	920

AJUSTE DIRETO N.º 11/DRPM/2022 - CARACTERIZAÇÃO DOS HABITATS DE PROFUNDIDADE, COM VISTA AO SEU MAPEAMENTO ATÉ AO LIMITE EXTERIOR DA SUBÁREA DOS AÇORES DA ZONA ECONÓMICA EXCLUSIVA PORTUGUESA

Station	Location	Date	Time		Start position		End position		Depth (m)		Dist. (m)
			Start	End	Lat. (N)	Long. (W)	Lat. (N)	Long. (W)	start	End	
St052	Sedlo	18/07/2023	12:54	14:47	40.238	-26.677	40.237	-26.683	1005	963	470
St053	Sedlo	18/07/2023	15:28	17:13	40.296	-26.685	40.295	-26.678	747	673	580
St054	Sedlo	18/07/2023	17:55	19:56	40.298	-26.678	40.299	-26.673	708	744	480
St055	Gaillard	19/07/2023	08:10	09:48	39.951	-26.979	39.95	-26.974	708	695	450
St056	Gaillard	19/07/2023	10:10	11:50	39.923	-26.997	39.926	-26.989	914	894	740
St057	Gaillard	19/07/2023	12:20	13:51	39.909	-26.962	39.913	-26.959	998	936	480
St058	Borda	19/07/2023									
St059	Borda	19/07/2023	15:53	17:34	39.709	-26.901	39.722	-26.885	695	689	1950
St060	Borda	19/07/2023	18:19	20:03	39.663	-26.979	39.663	-26.966	965	840	1120
St061	João Leonardes	20/07/2023	08:34	10:24	39.426	-27.006	39.433	-27.004	993	1008	770
St062	João Leonardes	20/07/2023	10:44	12:17	39.4	-27.009	39.404	-27.007	934	919	500
St063	João Leonardes	20/07/2023	14:46	16:12	39.368	-27.048	39.371	-27.045	970	952	420
St064	Serreta Mar	20/07/2023	18:16	20:00	39.201	-27.236	39.206	-27.236	946	856	550
St065	Mar da Fortuna	21/07/2023	09:49	11:29	39.109	-27.547	39.117	-27.555	878	886	1050
St066	Mar da Fortuna	21/07/2023									
St067	Mar da Fortuna	21/07/2023	12:06	12:39	39.091	-27.54	39.091	-27.54	755	755	10
St068	Mar da Fortuna	21/07/2023	13:08	14:37	39.105	-27.55	39.113	-27.552	801	875	970

1.4 CRUISE DIARY OF MAPGES 2023 RV ARQUIPÉLAGO LEG 1

03-07 July 2023

We were supposed to start the Leg 1 of MapGES 2023 onboard the RV Arquipélago on Monday 3rd of May. However, the vessel was not ready until the 6th and bad weather conditions forced us to stay on land on the 7th. We planned to leave Horta harbour at 00:00 on July 8th, 2023.

08 July 2023

The first day of Leg 1 of MapGES 2023 onboard the RV Arquipélago started at 00:00 when we left Horta towards an area of small volcanos south of Princesa Alice bank. The weather made the 70 nm trip quite choppy. We arrived at the first station at around 7:30 and were able to conduct 6 dives with the Azor drift-cam between 600 m and 1,000 m depth. As in many other Legs, the first day came with some issues. The old lasers were not working due to problems with the connecting cable, problems with the live view system forced us to abort the second dive, and small issues on the AV-HDMI adapter made us change this part. We decided to change from the old to the new cable on dive 3 and from the Azor drift-cam #1 to structure #3 on the 4th dive. This system uses the new Outland lasers but by looking at the video images it seems that there might be some issues with the scale. The wind dropped significantly during the day which made the drifts quite challenging. Most dives covered mix sediments with low biodiversity, although some areas hosted high densities of *Narella bellissima* and *Narella versluysi*, while others were dominated by patches of *Pheronema carpenteri* and other sponges (e.g., *Asconema* sp.). During the dives we also spotted some other species of cold-water coral including *Acanella arbuscula* and *Hemicorallium* (*H. niobe* and *H. tricolor*). During these dives we also observed some of bluemouth rockfish (*Helicolenus dactylopterus*), one monkfish (*Lophius piscatorius*), one kite fin shark (*Dalatias licha*), and one arrowhead dogfish (*Deania* cf. *profundorum*), one pink frogmouth fish (*Chaunax pictus*), one deep-sea crab (*Chaceon affinis*) and one tiny octopus. We stayed on this area to continue the surveys in the next day.

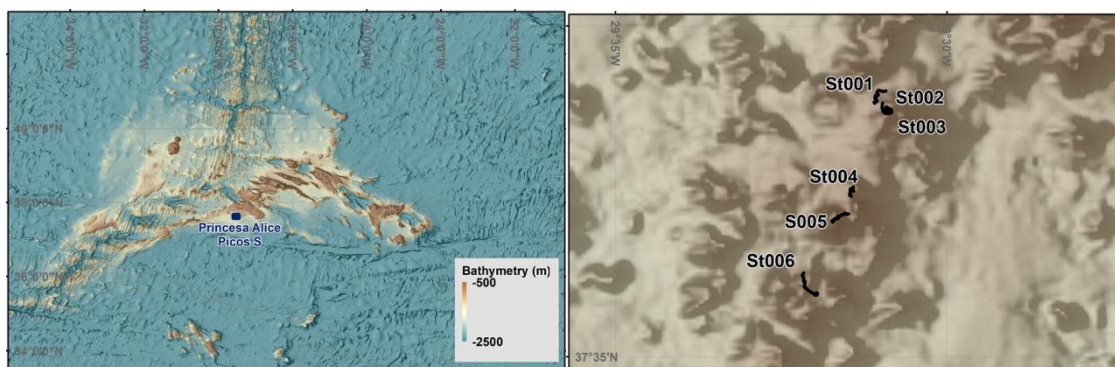


Figure 6. Bathymetric map showing the six dives conducted on the first day of Leg 1 of MapGES 2023 cruise in the peaks southern of Princesa Alice

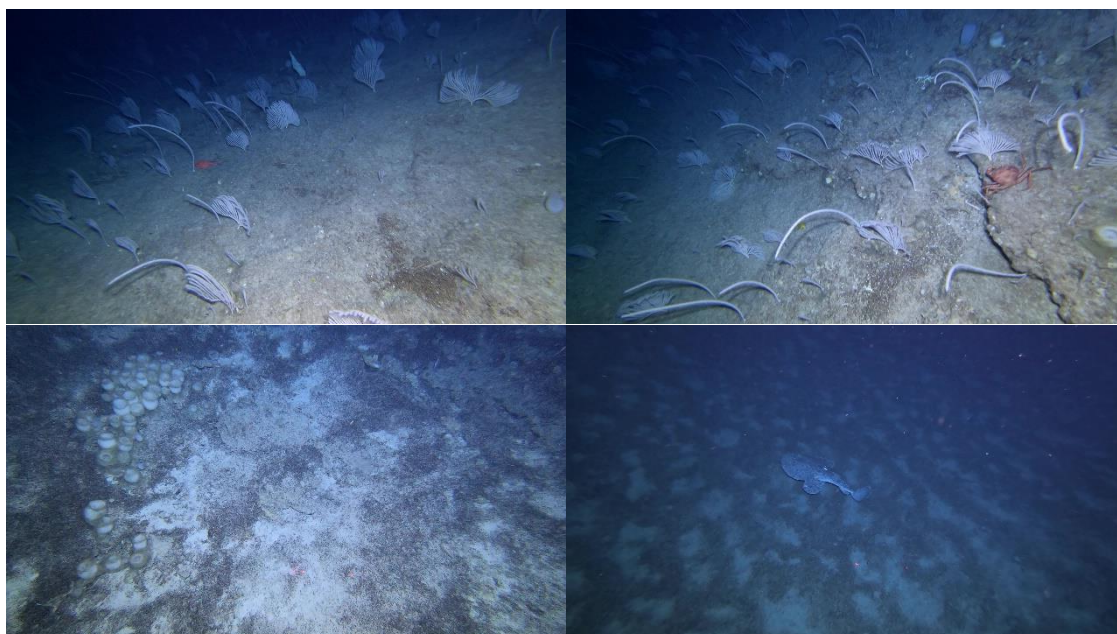


Figure 7. Screenshots taken from the video footage recorded during day 1 of Leg 1 of MapGES 2023 cruise in the peaks southern of Princesa Alice

09 July 2023

We stayed on the peaks southern of Princesa Alice to continue the deep-sea exploration with the Azor drift-cam. Like the previous day, the low wind intensity made the morning dives challenging due to the lack of drift. The last three dives of the day were conducted under stronger wind conditions and, thus, better drifts. We kept using the system with the new Outland lasers even though it seemed that there was something wrong with the scale. We confirmed that the 10 cm distance was correct when out of the water, but we were not sure this was the case underwater. During the day, we performed seven dives in four different small peaks between 600 and 950 m depth. Similarly to many other dives, it was difficult to cross over the top of the features, probably due to the strong circular currents around the seamount. The slopes of the surveyed peaks were mostly covered by soft sediments with abundant coral rubble and a few rocky areas. Throughout the day we observed low biodiversity and faunal abundance with common cold-water coral and sponge communities from these depths. The mixed substrates were dominated by sponges communities with *Pheronema carpenteri*, *Characella* sp., *Farrea occa*, and *Asconema*, among many other species. There were very few corals observed with a couple of *Hemicorallium niobe*, a small patch of *Narella bellissima* and *Narella versluysi*, and a few colonies of *Acanthogorgia armata*. We also observed some common fish and crab species from these depths including one *Dipturus intermedius*, *Helicolenus dactylopterus*, *Daenia* cf. *profundorum*, *Mora moro*, *Hoplostethus mediterraneus*, *Molva macrophthalma*, and one *Paramola cuvieri*, among others. We finished the last dive at around 19:30 and transited to the next area.

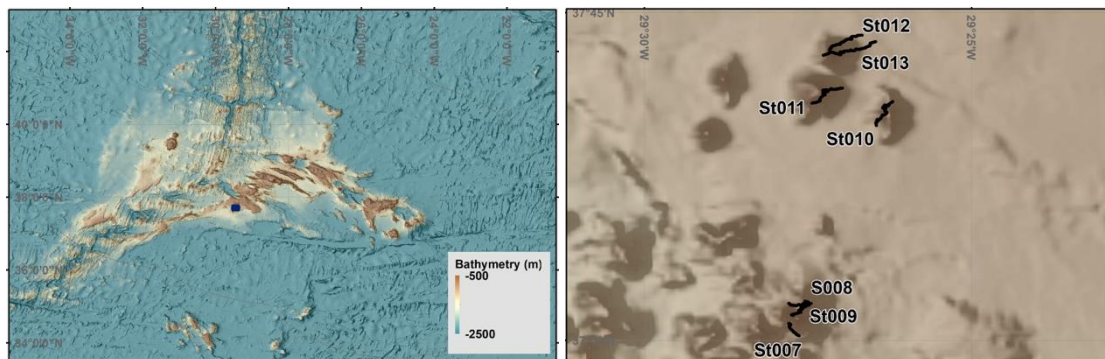


Figure 8. Bathymetric map showing the 7 dives performed in day 2 of Leg 1 of MapGES 2023 cruise in the peaks southern of Princesa Alice

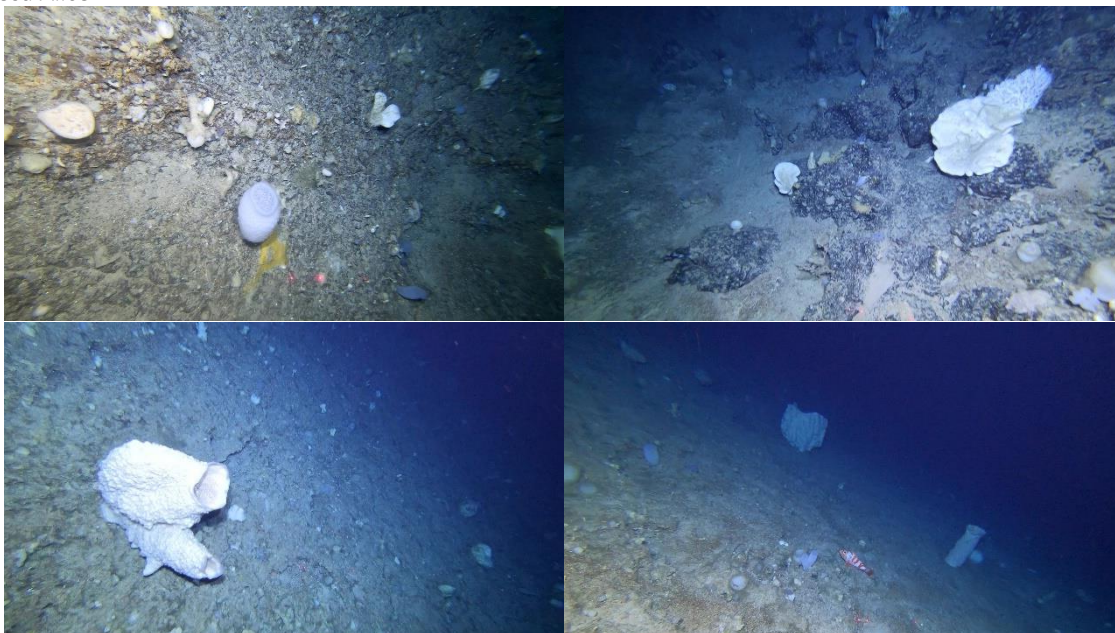


Figure 9. Screenshots taken from the video footage recorded during day 2 of Leg 1 of MapGES 2023 cruise in the peaks southern of Princesa Alice

10 July 2023

We changed back to the Azor drift-cam system #1 after having improved a few connections that allowed us to use the old Outland lasers. These lasers seem to work better at depth. We conducted the first three dives of the day on a deep plateau in Southwestern Princesa Alice. As in the previous days, the drift was very challenging, going in different directions in every dive. These three dives covered only soft bottom between 800 m and 1,100m depth (the deepest dive ever with the Azor drift-cam). In the second part of the day, we transited to another deep plateau, also in Southwestern of Princesa Alice but along the Albert of Monaco ridge. We conducted two dives with very poor drifts. In fact, we completely missed the targets defined for both dives. Here, we also drifted over mostly soft bottoms with low biodiversity and abundance of megabenthic species. We observed low abundances of megabenthic animals, with some sparse cold-water such as corals *Narella versluysi*, *Hemicorallium niobe*, *H. tricolor*, *Acanella arbuscula*, *Chrysogorgia* sp., cf. *Leptopsammia*, cf. *Candidella imbricata*, and *Flabellum* sp., and some deep-sea sponges such as *Pheronema carpenteri*, *Asconema*, cf. *Regadrella*, and specimens from the genus *Geodia*. During the day we spotted some shrimps *Aristaeopsis edwardsiana*, some sea-urchins *Cidaris cidaris* and deep-sea fishes such as *Mora moro*, *Synaphobranchus kaupii*, *Helicolenus dactylopterus*, *Hoplostethus mediterraneus*, *Gephyroberix darwini*, *Dalatias licha*, and one *Trachyscorpia cristulata*. We finished the last dive at around 20:00 and started transiting to the next area.

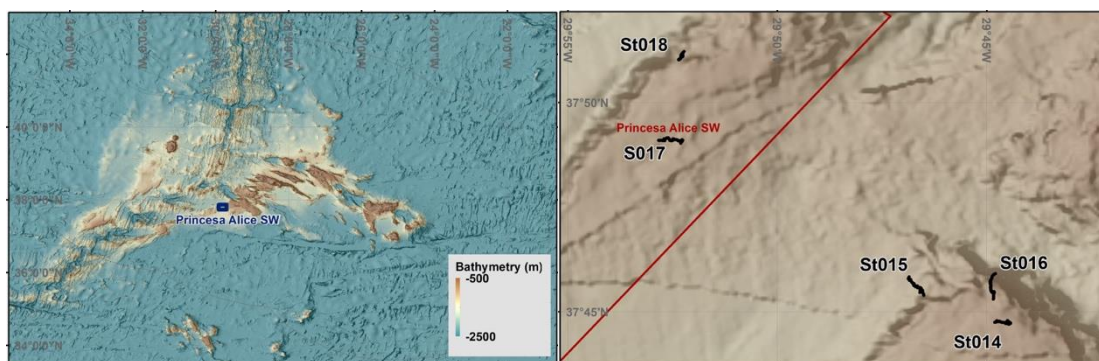


Figure 10. Bathymetric map showing the location of the 5 dives conducted during day 3 of the MapGES 2023 cruise in the southwestern slopes of São Jorge Island

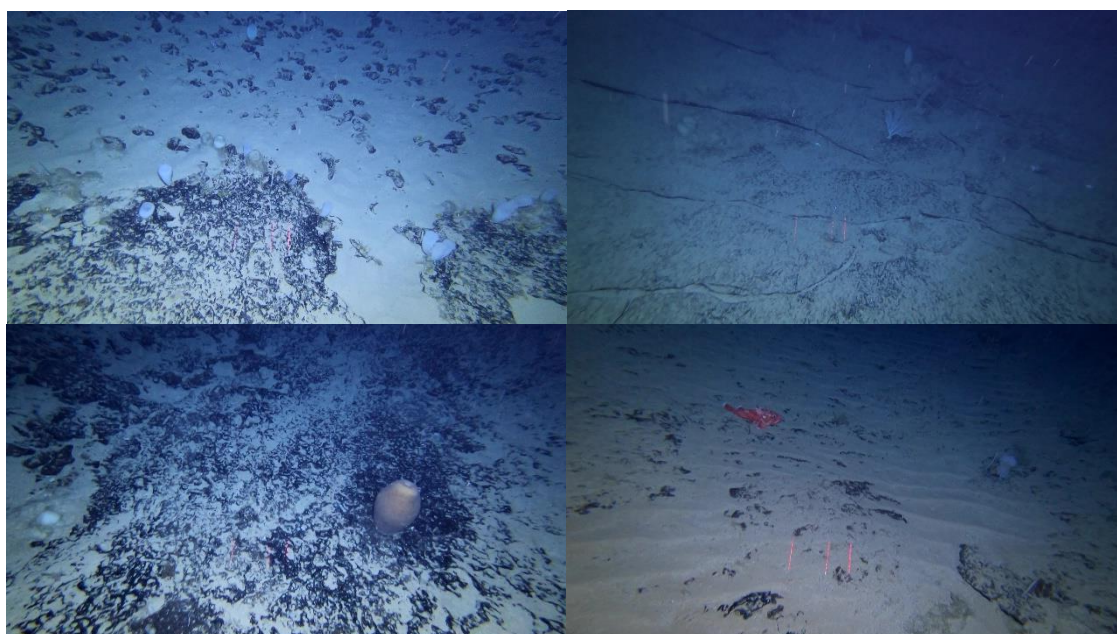


Figure 11. Screenshots taken from the video footage recorded during day 3 of Leg 1 of MapGES 2023 cruise in the deep plateau Southwestern of Princesa Alice

11 July 2023

We spent the night drifting around the southern tip of the Princesa Alice West area, with a displacement of only 2.5 nm. Because the overnight drift was so small, we decided to start the first dive of the day on the top of a small ridge to survey the benthic communities on this peak. We conducted 6 dives with a relatively good drift, especially in the morning, and used the Azor drift-cam structure #1 with the old Outland lasers mounted on. In the afternoon, the drifts were hard to predict, and the 4th dive was going towards the wrong direction. The 5th dive was cancelled due to the heavy rain that was entering the vessel's rear piloting box and the 6th dive was cancelled because of fishing lines, strong winds, and very fast drift.

The highlights of the day were one large back coral spotted on St020, some *Callogorgia verticillata* on st023, one six-gill shark on St024, and an interesting pattern on a sandy patch. The first dive (St019) was mostly conducted over soft bottoms covered by coral rubble while St020 drifted over a steep slope at around 900 m depth. Dives in St021 to St023 also drifted over soft bottoms with only a few rocky outcrops, while St024 drifted over mostly hard substrate with some areas of soft bottoms covered by coral rubble. Similarly to the previous

day, we observed low abundances of megabenthic animals, with some sparse cold-water such as corals *Acanthogorgia armata*, *Narella versluysi*, *N. bellissima*, *Leiopathes expansa*, cf. *Leptopsammia*, *Acanella arbuscula*, *Hemicorallium niobe*, *H. tricolor*, cf. *Candidella imbricata*, *Flabellum* sp., *Callogorgia verticillata*, cf. *Gersemia* sp., some deep-sea sponges such as *Pheronema carpenteri*, *Asconema*, and *Geodia* sp. We also spotted some shrimps *Aristaeopsis edwardsiana*, some sea-urchins (e.g., *Echinus melo*), some crabs and deep-sea fishes such as *Helicolenus dactylopterus*, *Dalatias licha*, *Beryx splendens*, *Synaphobranchus kaupii*, *Neocyttus helgae*, *Daenia profundorum*, *Chaunax pictus*, *Trachyscorpia cristulata*, Macrouridae, and *Hexanchus griseus*. We might have seen a silver scabbard fish *Lepidopus caudatus*. Right before dinner, we received a call from shore alerting for the bad weather coming towards us. We cancelled all the plans for the next day and started transiting to shore at around 20:00.

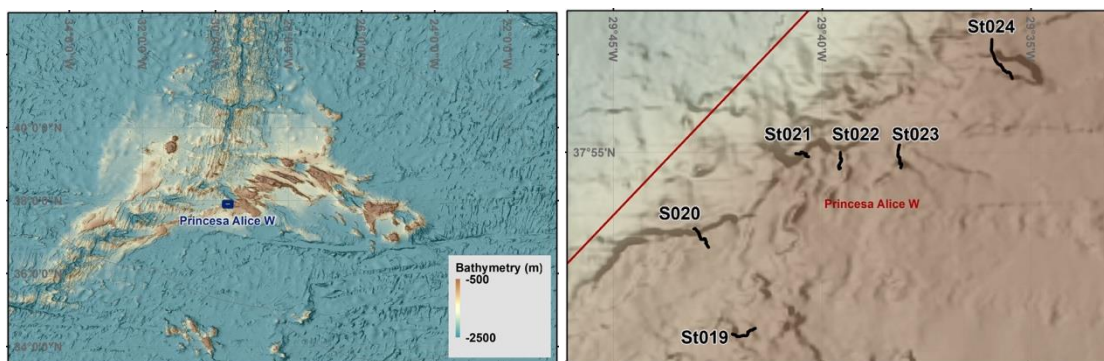


Figure 12. Bathymetric map showing the location of the six dives conducted from day 4 at the southern tip of the Princesa Alice West area

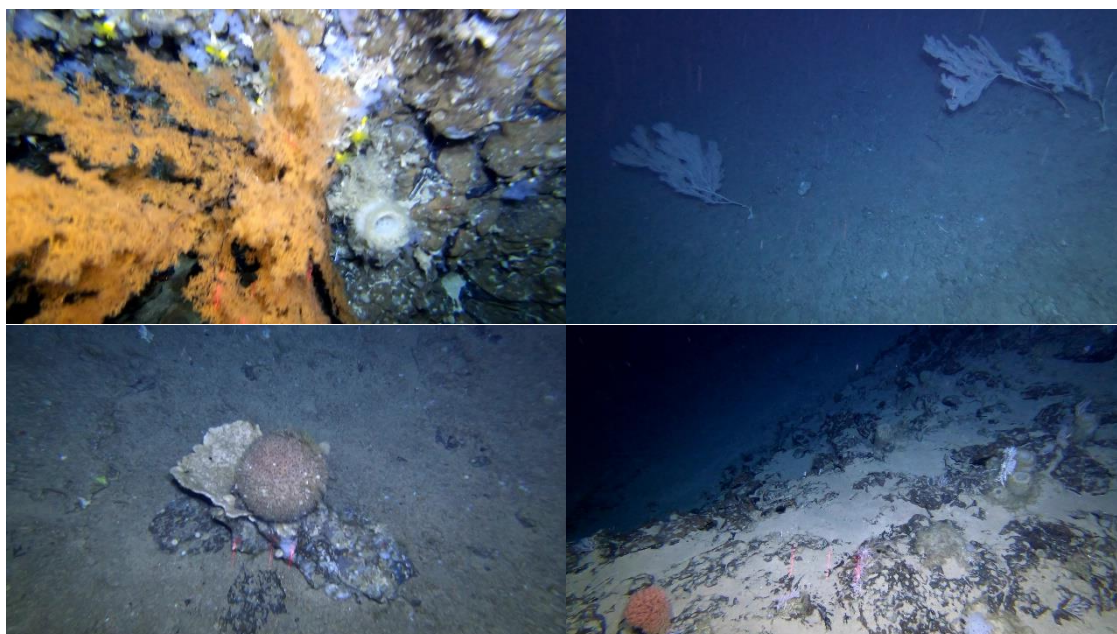


Figure 13. Screenshots taken from the video footage recorded on day 4 of MapGES 2023 survey in the southern tip of the Princesa Alice West area

12-13 July 2023

We arrived back at Horta harbour at around 02:00 on July 12th. We stayed in the harbour on the 12th and 13th of July due to the bad weather conditions, to change the scientific crew, and to prepare the vessel with fuel and food supplies before heading to distant locations for the second part of this 1st Leg.

14 July 2023

The second part of the 1st Leg of the cruise started on the 14th of July, leaving Horta harbour at around 4.00 am to start sailing towards the northern side of São Jorge Island, where the exploratory work was planned to start at 8:00 am. The objectives for the day were to visually evaluate areas on the NE slopes of São Jorge for which there was no previous information available. A total of 6 dives were carried out, with no incidents to be reported apart from some water going into the housing of the GitUp camera, but with no major damage. Dives St025 and St026 were performed on the eastern part of the study area, which was mainly characterized by sedimentary bottoms where little megabenthic fauna was observed besides some sea urchins. Where the rock outcropped, some sponges were reported (e.g., *Characella pachastrelloides*, encrusting sponges), generally in low abundances. The remaining 4 dives (St027 - St030) were conducted further to the east, covering a wide depth range between 250 and 800 m. The seabed in this area was also very sedimentary, hosting a larger number of species than in the previous dives, including different species of sea urchins and sea stars. When the rock outcropped, sponges were again the dominant group, including aggregations of the glass sponge *Phoronema carpenteri*, and other larger demospongia such as *Characella pachastrelloides*, *Maccandrewia azorica*, *Neophrisospongia nolitangere*, and *Leiodermatium* sp. Several species of fish were reported, including *Helicolenus dactylopetrus*, *Chaunax* sp., as well as some grenadiers, eel-like and flat fishes. The last dive finished at around 19:30, and with the Azor drift-cam on board of the vessel, we headed north towards Borda seamount to start the exploratory work on the next day. During the second part of Leg 1, the videographer Pepe Brix joined us onboard to record images of the team working with the Azor drift-cam to map the benthic communities found in the deep-sea of the Azores.

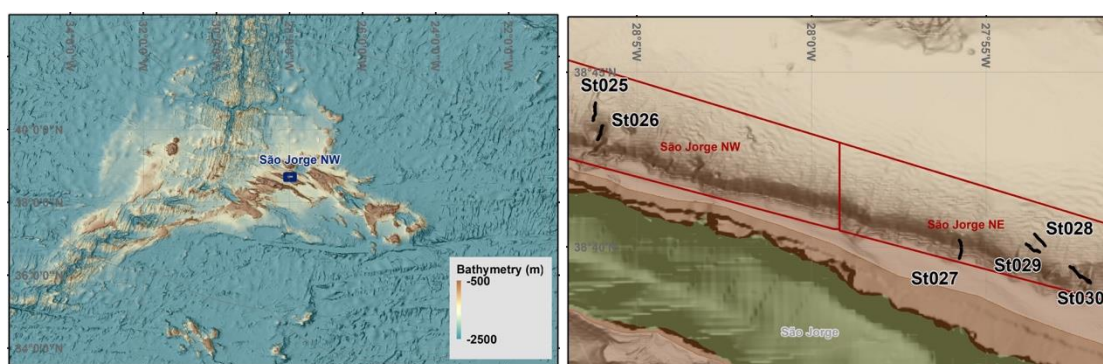


Figure 14. Bathymetric map showing the location of the six dives conducted from day 5 of Leg 1 of MapGES 2023 cruise on the northern slopes of São Jorge

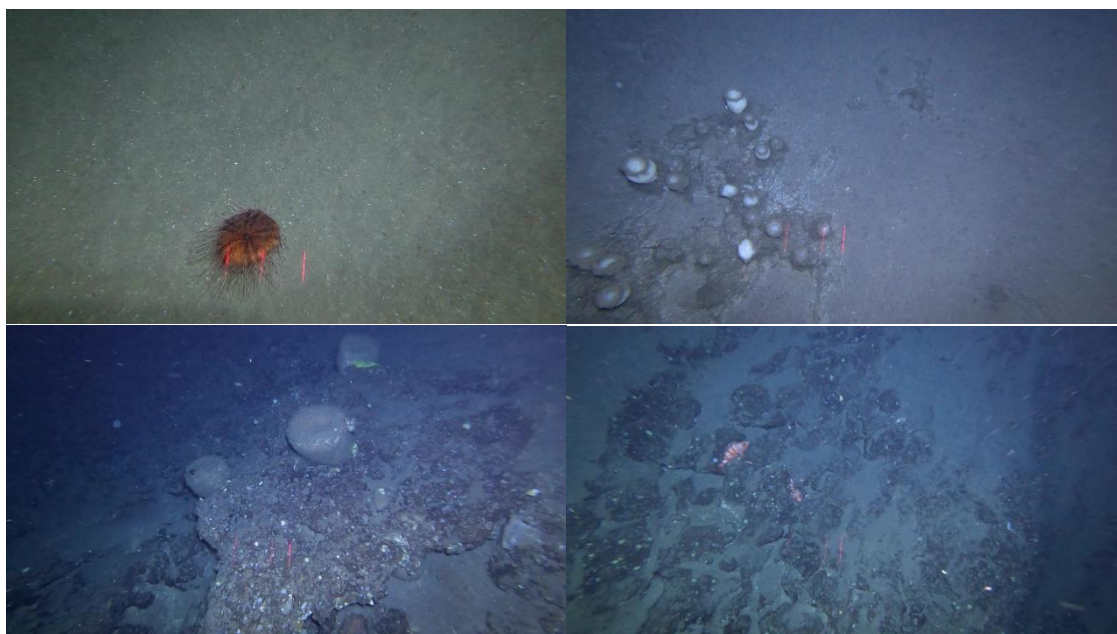


Figure 15. Screenshots taken from the video footage recorded on day 5 of MapGES 2023 survey on the northern slopes of São Jorge

15 July 2023

All dives performed on day 6 of Leg 1 were focused on the exploration of the deep-sea habitats of Borda seamount, a large geomorphological structure characterized by its flat and relatively deep summit. We expected most of the potential areas to be surveyed on the summit to be characterized by sedimentary substrates, and for that reason, locations with more complex relieves were targeted. A total of 7 dives were achieved during the day, covering both hard and soft bottoms. Dives visually explored a large depth range, between 480 and 1020m, with times at the seabed per dive ranging between 27 and 81 minutes. No major issues could be reported from the Azor drift-cam besides one of the USB connectors used to send the live-view signal from the Gitup to the surface having to be replaced due to some instability.

The soft-bottom areas on the deepest dives were characterized by the presence of the bamboo coral *Acanella arbuscula*, together with the cup coral *Leptopsammia formosa*, the hydrocoral *Cryptellia* sp., and the sea urchin *Cidaris cidaris*. Where the rock outcropped, some sparse black corals could be observed, mainly from the genus *Leiopathes* and *Phanopathes*. In shallower areas, the seabed was home to very little benthic fauna, including some octocorals of the genus *Acanthogorgia*, some crabs of the genus *Paromola*, sea stars, and small sponges. The Azor drift-cam was brought to the surface after the last dive at 20:15, the time when we headed even further north to start working on the next day in the Sedlo area.

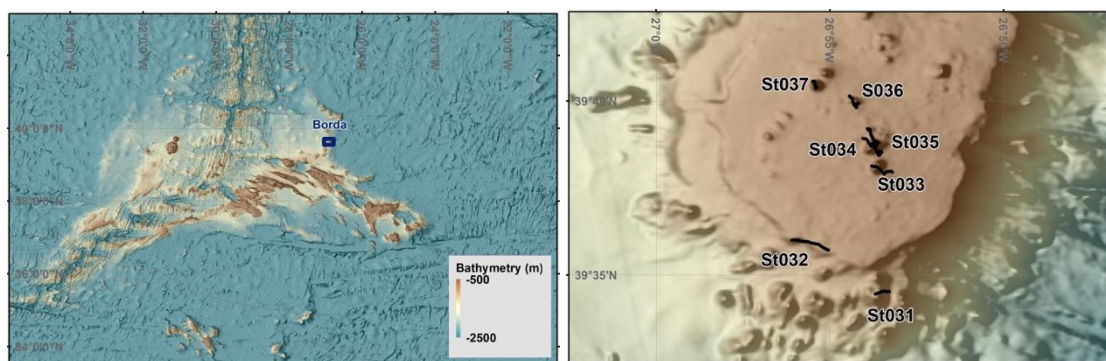


Figure 16. Bathymetric map showing the location of the seven dives conducted on the day 6 of Leg 1 of MapGES 2023 in Borda seamount

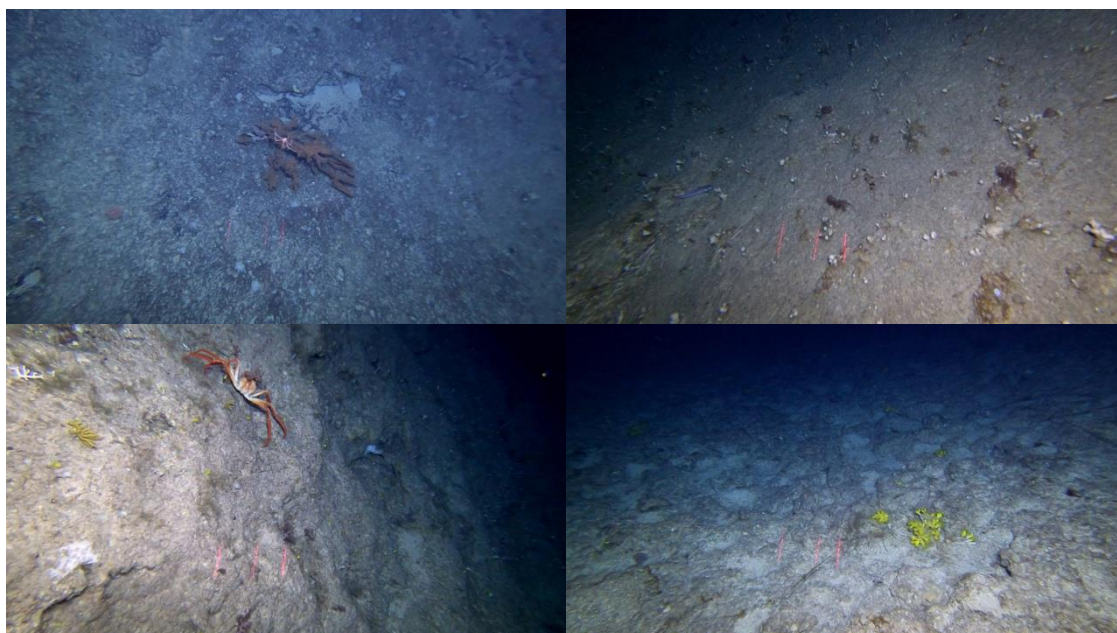


Figure 17. Screenshots taken from the video footage recorded on day 6 of MapGES 2023 survey in Borda seamount

16 July 2023

The 7th day of Leg 1 served to explore the northernmost areas of the cruise, specifically two seamounts of a flat morphology: Sedlo W and Sedlo. The first three dives were performed in Sedlo W (St038 – St040), where an aggregation of the black coral *Leiopathes expansa* was recorded, with most specimens of relatively small sizes. Most of the areas explored were of hard substrates, and the black corals were observed alongside the bamboo coral *Acanella arbuscula*, the glass sponge *Regadrella phoenix*, the sea urchin *Cidaris cidaris* and some large fan-shaped sponges likely from the genus *Phakellia*. After the third dive, we cruised for one hour towards Sedlo seamount, in order to make the most of the time available to explore all the seamounts north of Graciosa Island. Two more dives were performed in the afternoon, both in the central part of the seamount, where hard structures could be deduced from the bathymetry. The two last dives of the day were performed at shallower depths, in areas characterized by the presence of large deposits of coral rubble, where the primnoid corals *Narella versluysi* and *N. bellissima* were the most conspicuous species. Along the dives, other species were also reported as common, such as a hydrocoral likely from the genus *Errina*, large lamellate sponges of the genus *Phakellia* and the octocoral *Acanthogorgia* sp., among others. Interestingly, many crabs of the species *Chaceon affinis* were observed, as well as several large angler fishes and a few deep-sea sharks. During one of the dives,

water got inside the LED strip, breaking the lighting system and burning one of the batteries. The lasers also stopped working after the battery burnt, leaving one dive without the laser pointers as a reference for scale. Due to the memory of the depth/temp sensor being full when it was mounted on the structure, there was no environmental data recorded for dives St038-041. The last dive of the day ended at 19:40, and the vessel was left to drift to spend the night in the same area to start the exploration in Sedlo seamount on the next day.

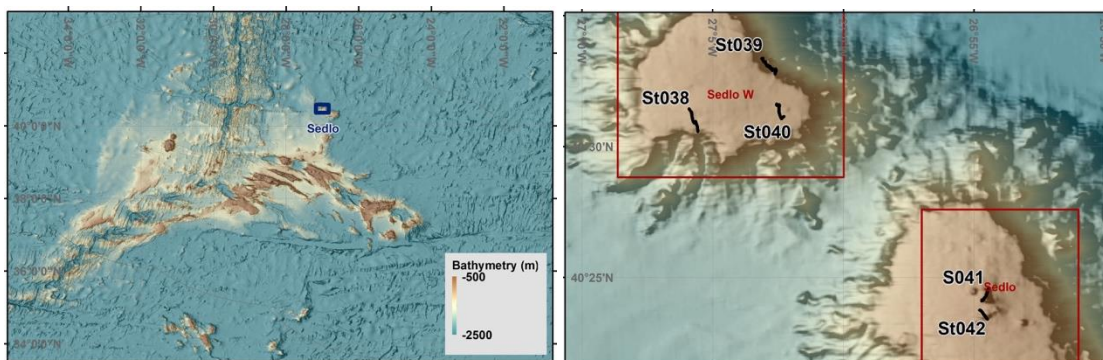


Figure 18. Bathymetric map showing the location of the five dives conducted on day 7 of Leg 1 of MapGES 2023 cruise on Sedlo and Sedlo W seamounts



Figure 19. Screenshots taken from the video footage recorded on day 7 of MapGES 2023 survey on Sedlo and Sedlo W seamounts

17 July 2023

The 8th and 9th days of the survey were spent in Sedlo seamount, with the objective of getting a good understanding of the benthic communities that live on this geomorphological structure tens of miles north from the central group. The first two dives were performed on the western part of the seamount, close to where the dives of the previous day were performed. The day started with some issues with the live-view system, which showed some interference on the TV screen at the surface. The problem seemed to be one of the female-to-female subcon cable, which had some connection issues. The problem was promptly resolved after

replacing the old cable with a new one. In the first two dives of the day (St043 – St044), the benthic community observed was diverse but there were not many species that showed high abundances. The deepest areas hosted some sparse bamboo corals of the species *Acanella arbuscula*, accompanied by the primnoid *Narella versluysi*, the black coral *Parantipathes hirondelle*, and some sea urchins of the species *Cidarid cidaris*. When the basaltic rock outcropped, the diversity observed was higher, with colonies of the black coral *Leiopathes expansa*, white hydrocorals, octocorals of the species *Paragorgia johnsoni* and many digitate-shaped sponges. Interestingly, in one section of the first dive, a large aggregation of a small white plexaurid coral was observed, with its species not yet determined.

After sailing for a few miles, the next 4 dives of the day focused on areas of the eastern side of Sedlo seamount, all of them located at the summit (St045-049). During dive St045, the electrical cable snapped after getting caught inside the wheels of the winch (lost live-view signal), which made us abort the dive to recover the structure. The cable was rapidly fixed on board during the following dive, and to avoid losing time while the cable was being fixed, a new umbilical was used during dive St046. The aspect of the benthic communities filmed in dives St045-049 was similar to the previous two dives, with a large number of shared species. Most of the areas explored were of hard substrates, but diversity seemed to be higher when the rock was composed of basalt. In those rocks, several large species were reported, including the black corals *Leiopathes expansa*, *Parantipathes hirondelle*, and *Bathypathes* sp., hydrocorals likely from the genus *Errina*, the lamellate sponge *Phakellia ventilabrum*, the glass sponges *Pheronema carpenteri* and *Regadrella phoenix*, among others. The Azor drift-cam was brought to the surface after the last dive at 20:00, and we stayed in Sedlo overnight to continue the exploratory work on the next day.

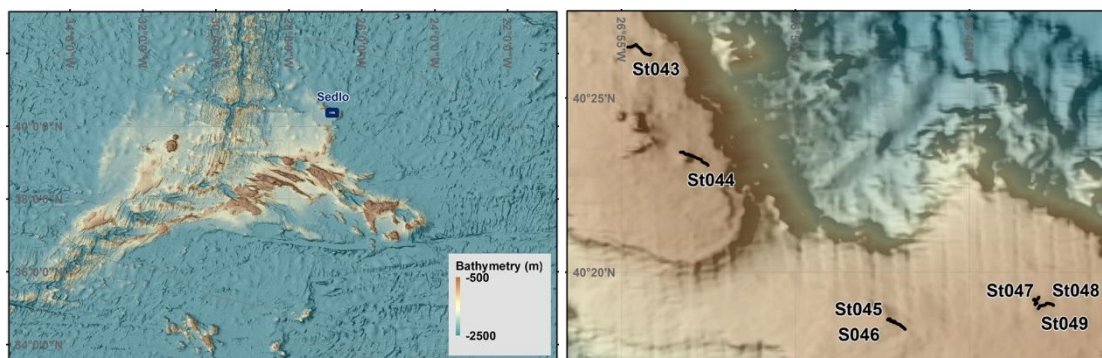


Figure 20. Bathymetric map showing the location of the seven dives conducted on day 8 of Leg 1 of MapGES 2023 cruise on Sedlo mountain

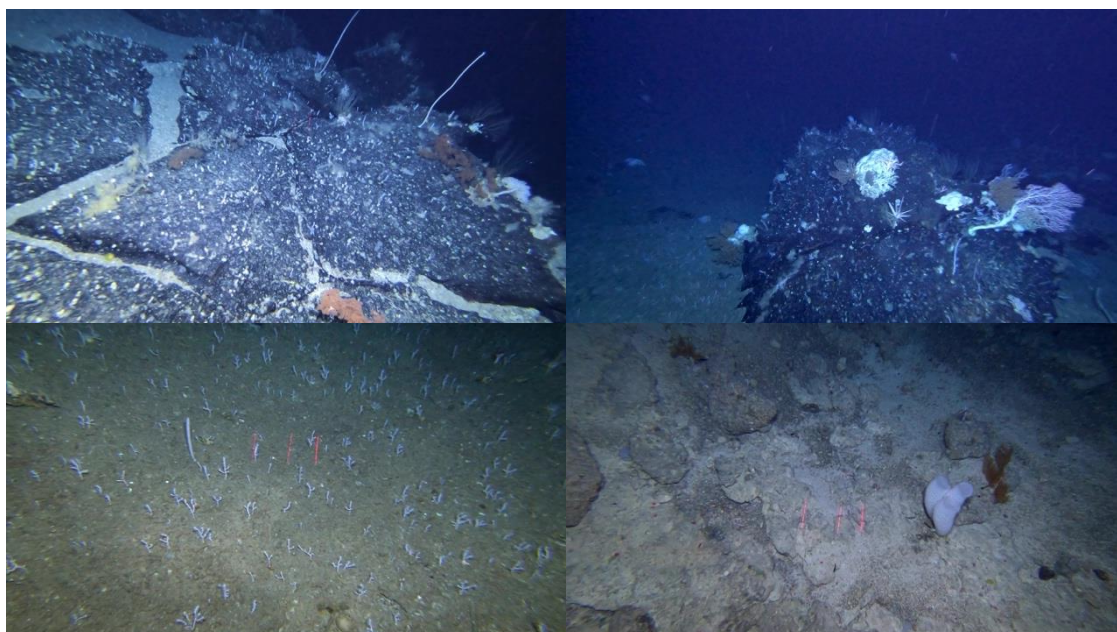


Figure 21. Screenshots taken from the video footage recorded on day 8 of MapGES 2023 survey in Sedlo seamount



Figure 22. The aspect of the electrical cable after getting trapped in the plates of the winch, and the team working to repair it whilst the Azor drift-cam was being deployed using the spare umbilical

18 July 2023

The 9th day of the cruise aimed to explore the easternmost parts of Sedlo seamount, with a total of 5 successful dives performed throughout the day. During dive 1 (St050), the Azor drift-cam got temporarily stuck on a vertical wall but was easily released just by giving and recovering some umbilical. No damage to the structure nor components was reported besides some marks on the edges of the steering wing. During some of the dives made in the afternoon, the low wind and sudden changes in surface currents generated a very bad drift, with the vessel going in circles and making it difficult to explore the seabed following a linear transect. There were also incidents with the cylinder that hosts the battery of the lasers/LED strip, which came up to the surface with

some water inside after two of the dives. No damage was observed on the batteries but those used were put aside for safety. After cleaning and changing the o-rings of the cylinder, the issue was not observed again.

The first three dives were planned to explore the slopes of the easternmost area of Sedlo seamount, with depths ranging from 950 to 1030 m. The fauna observed was very similar to that reported in previous dives done at those depths. Soft-bottom areas were generally poor with regard to large sessile species, but more diverse in the case of mobile fauna, such as crustaceans (e.g., *Aristaeopsis edwardsiana*) and eel-like and macrourid fishes. One chimaera of the genus *Hydrolagus* was filmed gently swimming below the camera. Interestingly, an aggregation of brachiopods was observed on sandy substrates, although it covered a very small area of the seabed. When the rock outcropped, the diversity of benthic species was much higher, although never observed in large abundances. Typical fauna observed were the black corals *Leiopathes expansa* and *Parantipathes hirondelle*, the bamboo coral *Acanella arbuscula*, the scleractinian *Madrepora oculata*, the hydrocoral *Cryptellia* sp. and lamellate sponges of the genus *Phakellia*. The last two dives aimed to explore the shallowest areas of the summit (650-750 m depth), where hard substrates could be inferred from the multibeam bathymetry due to a marked change in the slope. Those areas also showed little fauna, with some colonies of the octocorals *Narella Bellissima* and *Acanthogorgia* sp., hydrocorals of the genus *Errina* and some large barrel sponges likely of the genus *Characella*. With regards to mobile fauna, some crabs were observed of the species *Paramola cuvieri* and *Chaceon affinis*, a few species of large fishes such as monkfishes (*Lophius piscatorius*), wreckfishes (*Polypiron americanus*) and the Spanish ling *Molva macrophthalma*, as well as several species of deep-sea sharks, some of which were observed quite regularly throughout the dives. The Azor drift-cam was brought to surface after the last dive at 19:55, time when we started to sail south towards Gaillard seamount where the work of the next day would begin.

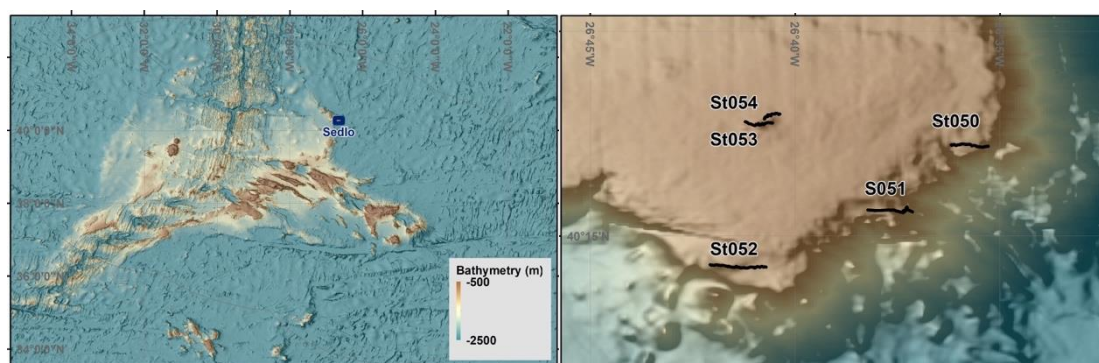


Figure 23. Bathymetric map showing the location of the five dives conducted on day 9 of Leg 1 of MapGES 2023 cruise on Sedlo seamount



Figure 24. Screenshots taken from the video footage recorded on day 9 of MapGES 2023 survey in Sedlo seamount

19 July 2023

The day was planned in two stages. During the morning, the dives would aim the summit of a small seamount named Gaillard, located just a few miles north of Borda seamount. Once those dives were finished, the exploratory work would move towards Borda seamount to complete those areas on the northern part that could not be explored on 15th July. The first dive was performed in a rocky area in the middle of the summit (720-787m depth), the second dive further south in the summit, in a deeper depth range (930-950m), and the third dive on the slopes, reaching depths of 1020 m. The soft-bottom areas of the summit were characterized by deposits of coral rubble, with little associated fauna besides some mobile species, such as the crab *Chaceon affinis*, eel-like fishes, and some deep-sea sharks. When the rock outcropped, the diversity of benthic fauna increased, characterized by the primnoid *Narella bellissima*, stylasterids of the genus *Errina* and some grey sponges for which identification to species level has not yet been possible. The areas explored on the slope hosted the typical fauna found in similar depths during previous dives in seamounts further north, with the black corals *Leiopathes expansa* and *Parantipathes hirondelle*, the bamboo coral *Acanella arbuscula*, stylasterids of the genus *Errina*, the sea urchin *Cidaris cidaris*, and lamellate sponges of the genus *Phakellia* among others. Some fishes of the species *Hoplostethus atlanticus* were spotted in the deepest sectors. During the last dive done in Gaillard, the Azor drift-cam got caught in a large crevice. After spending almost one hour trying to get the system free by repositioning the vessel towards the opposite direction and by giving/recovering umbilical, the crew of R/V Arquipélago managed to get the system disentangled and back to the surface. Fortunately, this incident produced no damage to any of the electronic components nor the metallic structure of the Azor drift-cam, although it made the electric cable to snap in several places due to the force produced by the winch during the recovery of the system. Almost 10m of umbilical were cut off, and the ends were rejoined by the team after the last dive of the day. In the meanwhile, and to avoid losing time, the spare umbilical was used.

The last dives of the day were used to explore the northern sector of the summit of Borda seamount. As in previous dives, the soft-bottom areas were characterized by deposits of coral rubble with little fauna, besides some aggregations of the sea urchin *Cidaris cidaris*. When the rock outcropped, the fauna observed was different but never showing large abundances, and included the bamboo coral *Acanella arbuscula*, the primnoid

Candidella imbricata, small colonies of the black coral *Leiopathes expansa*, the scleractinian *Madrepora oculata* and the cup coral *Leptopsammia sp.*, among others. The Azor drift-cam was brought to surface at 20:00, time when we started to sail towards João Leonardes seamount to continue the exploratory work the next morning.

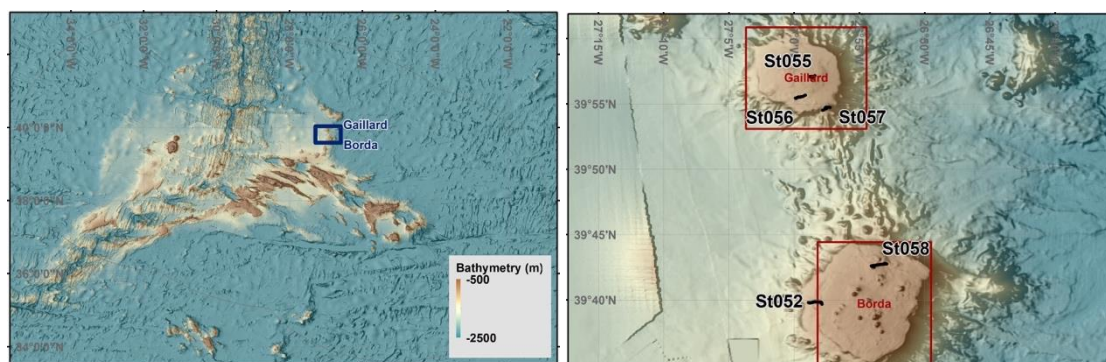


Figure 25. Bathymetric map showing the location of the five dives conducted on day 10 of Leg 1 of MapGES 2023 cruise in Gaillard and Borda seamounts

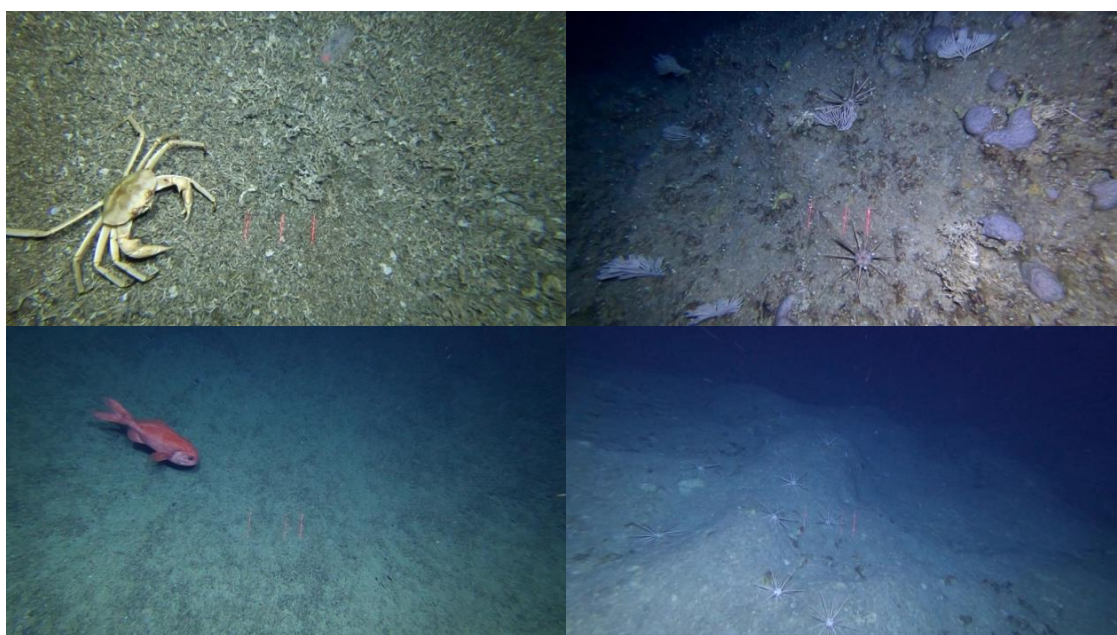


Figure 26. Screenshots taken from the video footage recorded on day 10 of MapGES 2023 survey in Gaillard and Borda seamounts

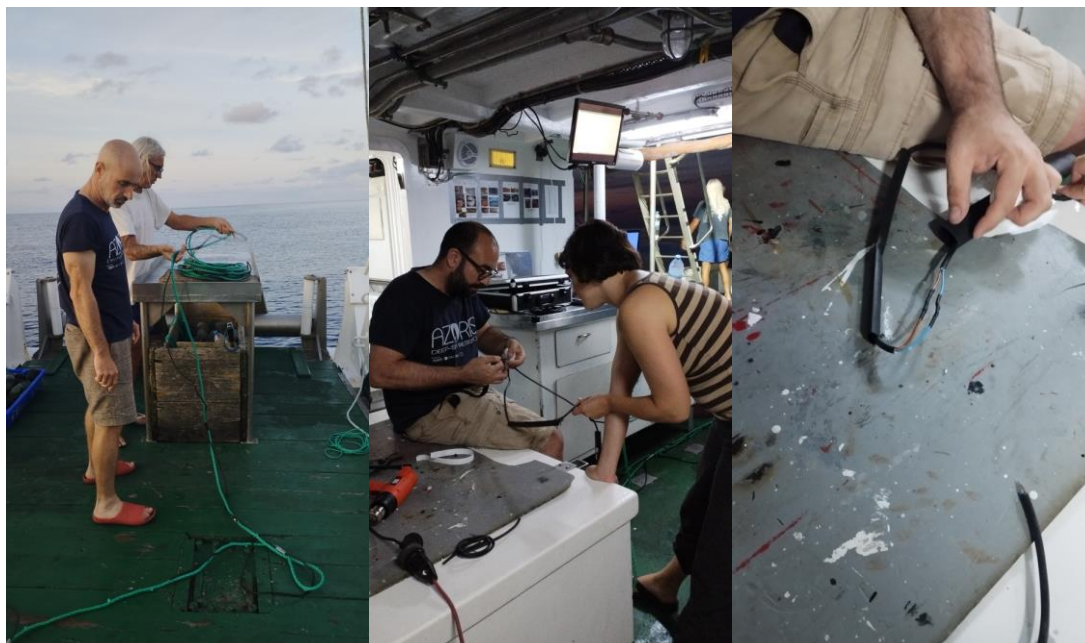


Figure 27. Part of the umbilical that got damaged during the recovery of the Azor drift-cam after getting entangled. Approximately 10 m had to be cut off due to the various parts that got damaged. The team joint the ends of the cable to have a fully functional umbilical ready for the following day

20 July 2023

The seamounts João Leonardes and Serreta Mar were previously explored during MapGES 2020 survey, although the depth range explored was relatively narrow and did not fully cover areas below 800m depth. For this reason, the dives planned for day 11 of the cruise aimed at improving our knowledge on the diversity of benthic fauna in deeper areas than those previously evaluated. The first three dives were performed on the eastern slopes of João Leonardes seamount and in the summit, mostly on hard substrates. All benthic species observed showed very low densities and appeared generally scattered along the seabed. The most conspicuous were the bamboo coral *Acanella arbuscula*, the octocoral *Chrisogorgia* sp. and a yellow lamellate sponge, as well as several small high-mobility fishes, of which a large part were from the macrouridae family. Some orange roughy *Hoplostethus atlanticus* were spotted throughout the dives. Just before the beginning of the third dive, there were some issues with the live-view feed that reached the surface, which delayed the start of the dive and limited the total amount of dives performed within the day to just four. The issue was fixed while at sea, although the live-view image remained very unstable throughout the whole day.

The last dive of the day was performed on the eastern slopes of Serreta Mar seamount, first on an area of soft-bottoms with little sessile fauna but some fishes, the crustacean *Aristaeopsis edwardsiana*, and even a squid. When the basaltic rock outcropped, the fauna observed was different but still not generating high-density patches. Rocks were mostly colonized by sponges, such as those from the genus *Asconema* and *Phakellia*, as well as several encrusting sponges of different colours. The Azor drift-cam was brought to surface at 20:00 to start moving towards Mar da Fortuna, where the last dives of the cruise would take place.

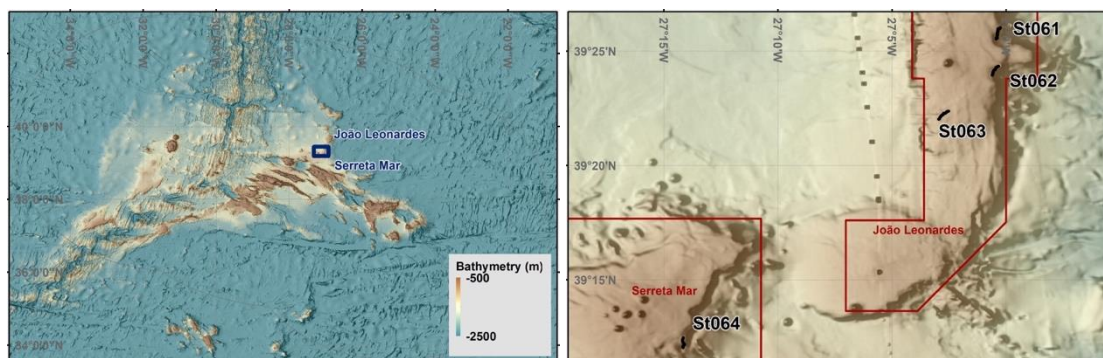


Figure 28. Bathymetric map showing the location of the five dives conducted on day 11 of Leg 1 of MapGES 2023 cruise in João Leonardes and Serreta Mar seamounts

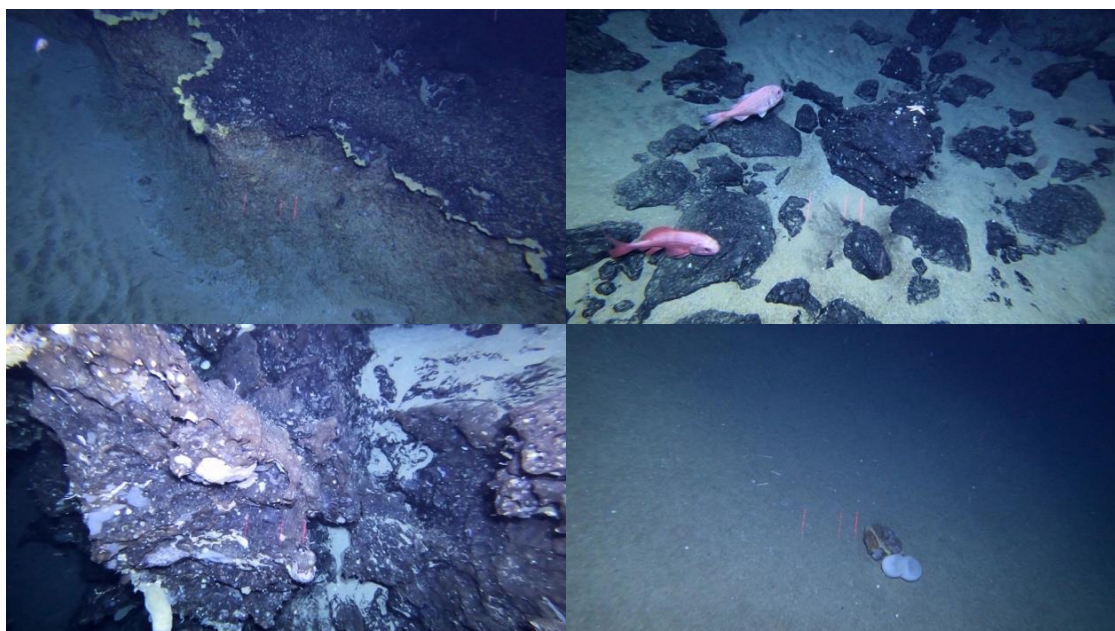


Figure 29. Screenshots taken from the video footage recorded on day 11 of MapGES 2023 survey in João Leonardes and Serreta Mar seamounts

21 July 2022

The last day of Leg 1 was planned to explore areas of Mar da Fortuna seamount at depths below the maximum reached during previous surveys (650 m depth, dives done in MapGES 2020 cruise) before heading back to Horta harbour in the afternoon. The aim was to perform four dives in areas located both on the eastern and western side of the seamount. Unfortunately, due to problems with the live view signal that reached the TV screen, only two successful dives were completed, both at depths between 875 and 755 m. Those dives surveyed seafloor areas that hosted very similar benthic communities, which were dominated by the whip coral *Narella versluysi*, accompanied by the corals *Narella bellissima* and cf. *Candidella imbricata*. Sporadically, some stylasterids, the bamboo coral *Acanella arbuscula* and the scleractinian *Leptopsammia formosa* were observed. The deepest areas were characterized by frequent and small aggregations of the bird's nest *Pheronema carpenteri*, together with other sponges such as *Phakellia ventilabrum* and large *Poecillastra compressa*. We drifted over some fish species such as a large angler fishes of the species *Lophius piscatorius* and *Trachyscorpia cristulata*. The Azor drift-cam was brought to surface for the last time of this Leg at 14:10, starting our journey back to harbour just some minutes after. We arrived at Horta at around 22:00, with all the equipment readily

packed to be unloaded and taken back to our imagery workshop. We plan to be back at the sea on August 14th for the Leg 2 of the MapGES 2023 cruise.

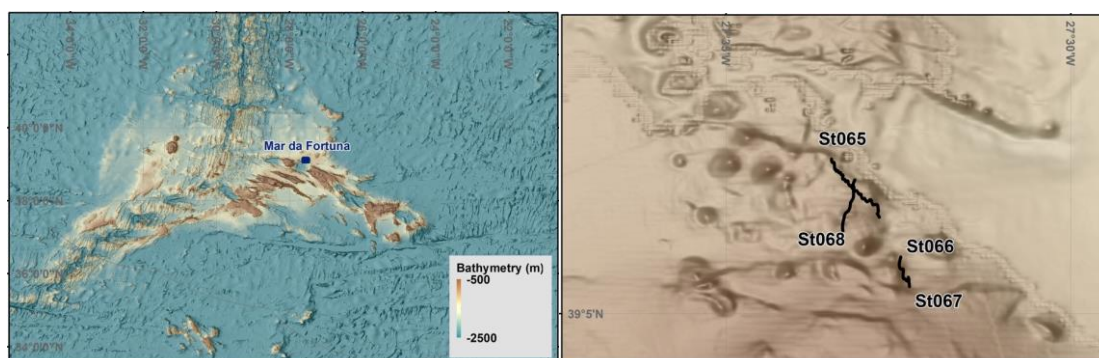


Figure 30. Bathymetric map showing the location of the four dives conducted on last day of Leg 1 of MapGES 2023 cruise in mar da Fortuna seamount

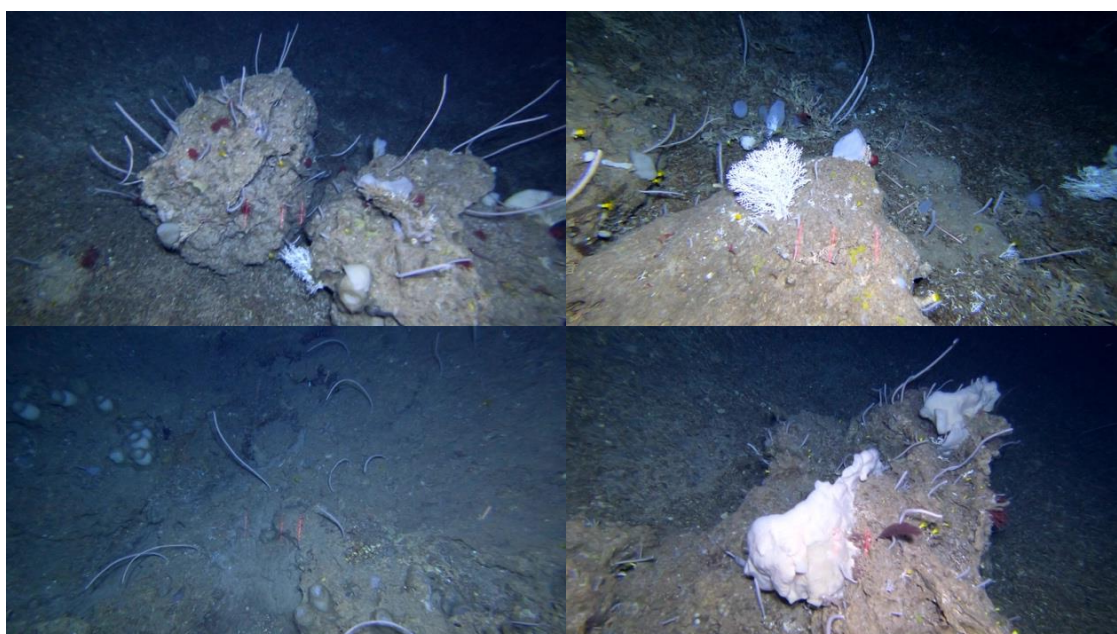
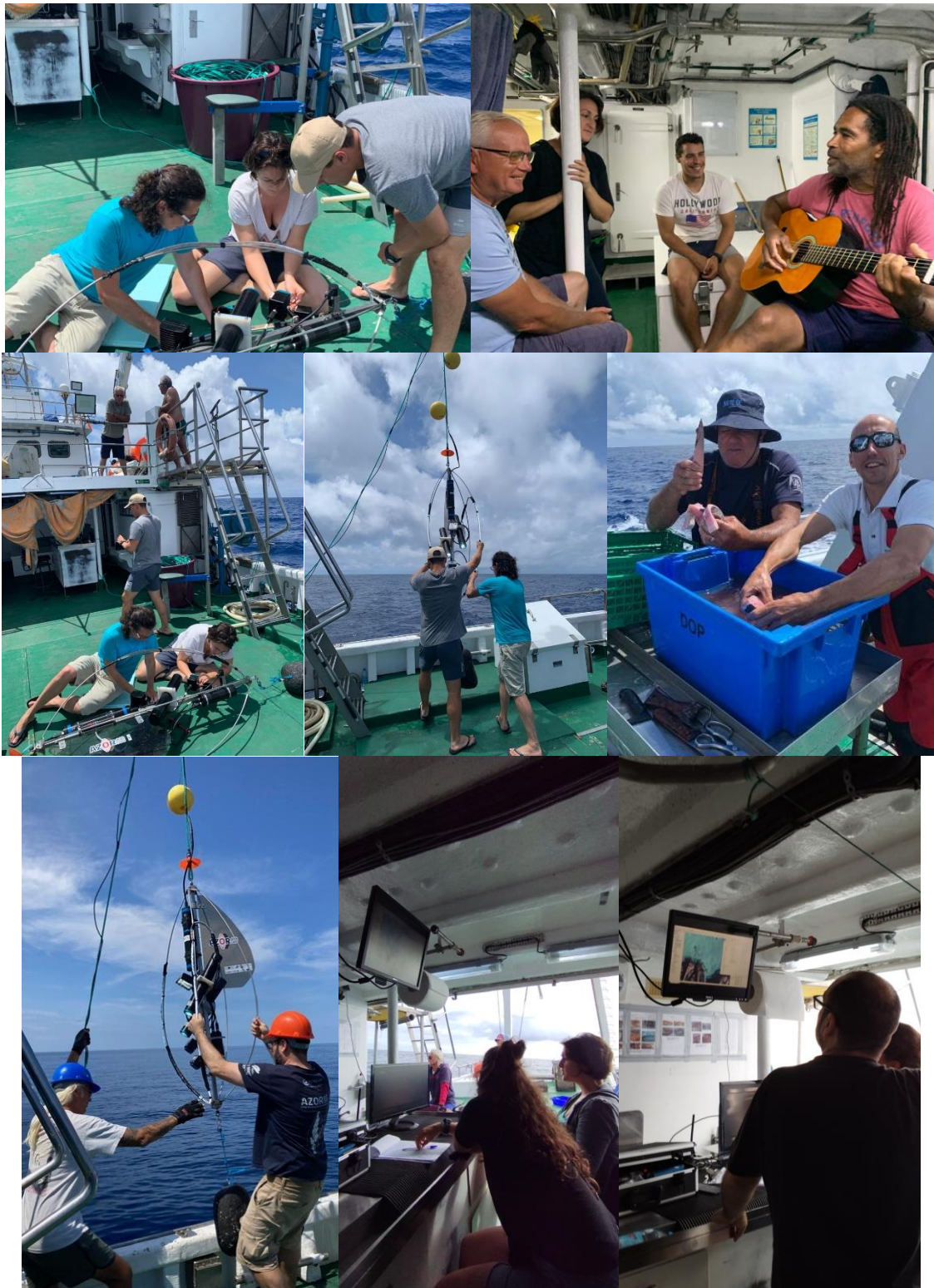
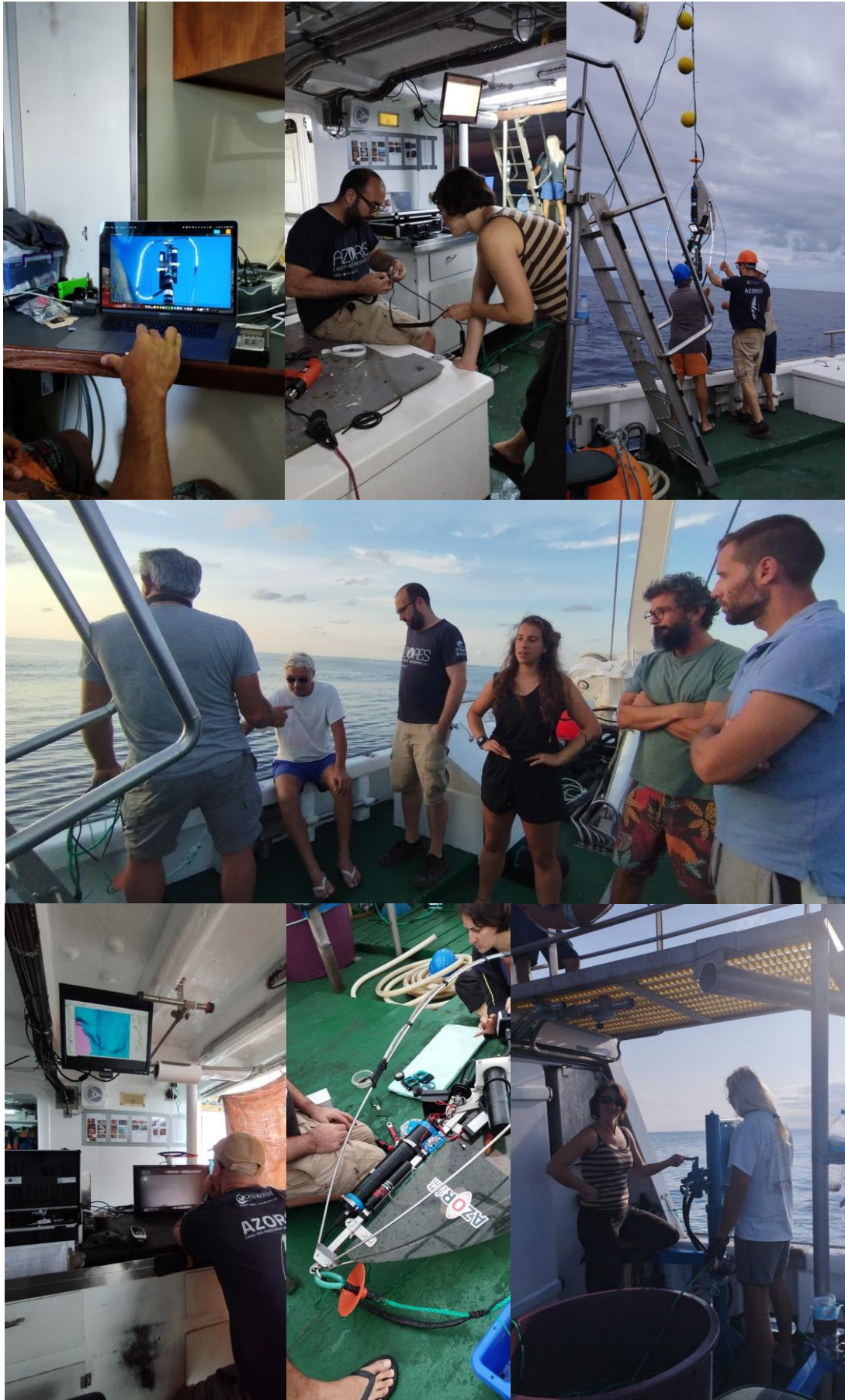


Figure 31. Screenshots taken from the video footage recorded in Mar da Fortuna seamount on the last day of Leg 1 of the MapGES 2023 survey

1.5 LIFE ON BOARD OF MAPGES 2023 RV ARQUIPÉLAGO LEG 1













2 MAPGES 2023 RV ARQUIPÉLAGO: EXPLORATION AND MAPPING OF DEEP-SEA BIODIVERSITY IN THE AZORES - Leg 2, Hard Rock Café, Kurchatov, and Seamounts in the Central and Eastern Azores

Authors: Luís Rodrigues, Guilherme Gonçalves, Gerald H. Taranto, Inês Bruno, Inês Carneiro, Diana Catarino, Nicolás Collazo, Galia Edery, António Godinho, Sérgio Gomes, Marc Pladevall, Marina Carreiro-Silva, Carlos Dominguez-Carrió, Telmo Morato

Date: 31 de outubro de 2023

2.1 RESUMO EM PORTUGUÊS

O MapGES 2023 é a continuação da estratégia de longo prazo do ADSR para mapear a biodiversidade do mar profundo dos Açores e identificar áreas que se enquadrem nos critérios de Ecossistemas Marinhos Vulneráveis (VMEs) usando o sistema de imagens Azor drift-cam. Neste cruzeiro, operámos a partir do RV Arquipélago e visitamos algumas áreas inexploradas como as estruturas geomorfológicas do Hard Rock Café (a norte da Ilha do Corvo), Kurchatov SE (no norte da dorsal médio Atlântica), Albatroz N, Ferraria N, Ferraria Mar, Sauerwein, Mar da Prata, Grande Norte (nos grupos central e oriental dos Açores), e Princesa Alice S, Princesa Alice SE e De Guerne (a sul da Ilha do Faial), e revisitamos algumas estruturas geomorfológicas que ainda não estavam completadas como, por exemplo, os montes submarinos Isolado, Kurchatov N, Kurchatov SW e Mar da Prata S. Tal como noutros cruzeiros MapGES, os objetivos foram (i) mapear as comunidades bentónicas que habitam montes submarinos, cordilheiras e encostas insulares inexplorados, (ii) identificar novas áreas que se enquadrem na definição de VME, e (iii) determinar os padrões de distribuição da biodiversidade bentónica de profundidade nos Açores. Os resultados deste cruzeiro somaram-se aos anteriores para identificar os padrões ambientais que determinam a distribuição espacial da biodiversidade bentónica de profundidade nos Açores. Ele também fornece informações valiosas no contexto do Bom Estado Ambiental (GES), Ordenamento do Espaço Marinho (MSP) e novos dados que ajudem à gestão sustentável dos ecossistemas do mar profundo.

A Leg 2 da missão MapGES 2023 NI Arquipélago dividida em três partes, planeadas para visitar o Hard Rock Café e as cristas da Dorsal Medio Atlântica em redor da depressão Kurchatov (Leg2 a), os montes submarinos entre as ilhas do Pico e de São Miguel, o Mar da Prata e o Grande Norte (Leg 2b) e, por fim, os montes submarinos em redor do banco Princesa Alice, a sul da Ilha do Faial (Leg 2c). Ao todo, foram realizados 79 mergulhos bem-sucedidos de entre 81 estações, até 1084 m de profundidade, cobrindo 47 km do fundo do mar e produzindo mais de 79 horas de imagens de vídeo do fundo do mar. Estes mergulhos foram realizados em 16 áreas de amostragem. Durante a Leg 2a, de 19 a 25 de agosto de 2023, realizámos 28 mergulhos com a Azor drift-cam, mas um, na área Petrov, não chegou ao fundo porque a zona era mais profunda do que os mapas indicavam. Esta parte da Leg 2 explorou, a bordo do navio de investigação Arquipélago, pela primeira vez algumas áreas há muito desejadas como o monte submarino Hard Rock Café e as cristas da Dorsal Medio Atlântica em redor da depressão Kurchatov. Durante a Leg 2b, de 29 de agosto a 9 de setembro de 2023, realizámos 51 mergulhos com a Azor drift-cam para avaliação das comunidades bentónicas de profundidade que habitam as encostas das estruturas geomorfológicas estudadas. A Leg 2b, explorou pela primeira vez algumas áreas há muito desejadas, como o Mar da Prata e o Grande Norte, sobretudo para aferir a pressão da atividade humana, dada a proximidade à maior ilha do arquipélago dos Açores. Na Leg 2c foram realizados apenas 2 mergulhos nas encostas de um monte submarino em redor do Princesa Alice, nomeadamente o De Guerne.

Esta campanha teve diversos destaques principais:

1. Visitaram-se dez estruturas geomorfológicas inexploradas na ZEE dos Açores listadas na Secção 8 do R1 “Avaliação de áreas com suficiente informação pré-existente e com substanciais lacunas de conhecimento” – Hard Rock Café, Kurchatov SE, Albatroz N, Ferraria N, Ferraria Mar, Sauerwein, Mar da Prata, Mar da Prata N, Grande Norte, and De Guerne. Também foram visitadas quatro áreas que já tendo sido exploradas previamente, careciam de dados de vídeo adicionais, como é o caso das estruturas geomorfológicas do Isolado, do Kurchatov N, do Kurchatov SW e do Mar da Prata S. Foi ainda visitada a área Perestrela Bartolomeu, para a qual já existia alguma informação e a área Petrov, que afinal era mais profunda do que os mapas indicavam.
2. Durante este cruzeiro foram realizados 79 transetos de vídeo subaquáticos, num dos quais foi descoberta a maior parede rochosa alguma vez filmada pela Azor drift-cam, com cerca de 230 m de altura. Realizaram-se cerca de 79 horas de novas imagens de vídeo subaquático dos habitats do fundo do mar. A presença de algumas linhas de pesca voltou a tornar desafiante a exploração de algumas áreas do mar profundo. Estes mergulhos revelaram-se os mais complexos, tendo sido registadas várias situações em que as linhas de pesca prenderam a Azor drift-cam, sobretudo nos dois bancos na proximidade de São Miguel (Mar da Prata e Grande Norte) e no Kurchatov SE. Contudo, os contratempos provocados pelas linhas de pesca foram ultrapassados com sucesso, tendo resultado daí apenas pequenos danos na Azor Drift-cam.
3. O monte submarino Hard Rock Café foi, finalmente, explorado com a Azor drift-cam. Este monte submarino foi mapeado pelo Instituto Hidrográfico em 2020, mas dada a sua localização a 210 milhas náuticas do ponto de partida natural das missões do MapGES (Horta) e dado o seu posicionamento a norte do arquipélago dos Açores (normalmente mais fustigado pelas condições meteorológicas adversas), a visita tem sido adiada há alguns anos. Depois de reunidas todas as condições, o Hard Rock Café foi visitado. Trata-se de uma estrutura geomorfológica que, pelas suas características, esteve desde o primeiro momento na lista das primeiras opções para a expansão do Parque Marinho dos Açores, daí surge o redobrar de importância desta visita.
4. Visitamos, ainda, o monte submarino denominado por Petrov pela primeira vez. Esta área ainda não possui levantamentos de batimetria de alta resolução, por isso tentámos prospectar a área à procura de um pico entre 300 m e 1.000 m de profundidade. No entanto, depois de lançar a Azor drift-cam à procura de um pico menos profundo não conseguimos atingir o fundo. Todos os sonares a bordo indicavam profundidades entre 1.900 m e 2.500 m de profundidade indicando que esta área é muito mais profunda do que as cartas náuticas atuais demonstram e realçando, mais uma vez, a importância de efetuar levantamentos de batimetria multifeixe na região dos Açores.
5. As nossas explorações com a Azor drift-cam contribuíram com evidências de apoio para considerar os montes submarinos Hard Rock Café e Isolado como habitats essenciais para peixes. À semelhança do monte submarino Sedlo, encontrámos áreas que albergam o peixe relógio (*Hoplostethus atlanticus*), grandes cardumes de cherne (*Polyprion americanus*) e um elevado número de espécies de tubarões de profundidade, algumas das quais raramente observadas nos Açores. Embora estas áreas apresentem baixa abundância em termos de megafauna bentónica, detetámos algumas colónias dos corais negros de crescimento lento *Antipathes dichotoma* e *Leiopathes expansa*.
6. A maioria dos montes submarinos a caminho e ao redor da Ilha de São Miguel, como o Albatroz N, Ferraria N, Ferraria Mar, Mar da Prata e Grande Norte parecem albergar interessantes comunidades bentónicas de águas profundas, com abundantes jardins de coral de *Narella versluysi* e *Narella bellissima*, por vezes, em agregação com *Callogorgia verticillata*, *Acanthogorgia* sp., ou *Leiopathes expansa*. As áreas menos

profundas foram caracterizadas principalmente por grandes jardins de *Viminella flagellum*, algumas vezes associadas a *Callogorgia verticillata* e outras vezes a grandes e frequentes colónias de *Dentomuricea* aff. *meteor*.

7. A crista denominada de Sauerwein, entre as ilhas de São Miguel e Santa Maria, apresentou uma biodiversidade surpreendentemente baixa, realçando mais uma vez a necessidade de melhor compreender as razões que explicam os padrões de distribuição espacial das comunidades bentónicas para melhor informar a gestão e conservação destes ecossistemas vulneráveis.
8. Embora o monte submarino Grande Norte fosse claramente a zona com maior intensidade de pesca de fundo, onde observámos vários palangres de fundo perdidos, as comunidades bentónicas observadas pareciam estar em bom estado ambiental, exibindo grandes agregações de *Callogorgia verticillata*. Estas observações reforçam a evidência que a pesca de linha-e-anzol produz impactos muito menores quando comparando com outras artes de pesca.
9. Explorámos as estruturas morfológicas em torno do Princesa Alice, nomeadamente a área De Guerne, onde observámos grandes áreas cobertas de sedimentos com biodiversidade e abundância relativamente baixas, com apenas alguns corais ocasionais das espécies *Acanella arbuscula*, *Parantipathes hirondelle* e *Elatopathes abietina*, e dispersos *Acanthogorgia* sp.

2.2 SUMMARY OF THE MAPGES 2023 ARQUIPÉLAGO LEG2

2.2.1 *Main objectives*

MapGES 2023 is the continuation of our long-term strategy to map deep-sea biodiversity and identify Vulnerable Marine Ecosystems (VMEs) in the Azores using the Azor drift-cam imagery system. In this cruise, we operated from the RV Arquipélago and planned to visit some unexplored areas such as the geomorphological structures of Hard Rock Café (northern of Corvo Island), Kurchatov SE (in the north mid Atlantic-ridge), Albatroz N, Ferrara N, Ferrara Mar, Sauerwein, Mar da Prata, Grande Norte (south of Faial Island), and the seamounts around Princesa Alice (Princesa Alice S, Princesa Alice SE, and De Guerne) and we revisited other geomorphological structures that needed complementary sampling efforts as, for example, Isolado, Kurchatov N, Kurchatov SW, and Mar da Prata South. As in other MapGES cruises, the objectives were to “(i) map benthic communities inhabiting unexplored seamounts, ridges, and island slopes, (ii) identify new areas that fit the FAO Vulnerable Marine Ecosystem definition; and (iii) determine distribution patterns of deep-sea benthic biodiversity in the Azores”. The results of this cruise added to the previous contributions to identify the environmental drivers that determine the spatial distribution of deep-sea benthic biodiversity in the Azores. It also provides valuable information in the context of Good Environmental Status (GES), Marine Spatial Planning (MSP) and new insights on how to sustainably manage deep-sea ecosystems.

2.2.2 *Methodology*

We performed several underwater video transects along the seafloor with the Azor drift-cam, a low-cost drifting camera system designed and developed at IMAR & Okeanos (University of the Azores). It allows the recording of high-quality underwater video images of the seabed down to 1,000 m depth. The system was deployed from the Research Vessel Arquipélago, owned by the Government of the Azores. In each of the areas or geomorphological structures to be explored, a representative number of dives (or transects) were carried out with a video camera system from a depth of about 1,000 m to the shallowest depth of each structure. The objective is to obtain underwater images to characterize the biodiversity along the entire bathymetric gradient and substrate types of each structure. The video transects were planned according to the best bathymetry available, so that the camera systems move from deeper to shallower areas. This methodology allows the collected images to always have the best possible quality, maximizing the area of incidence of light and avoiding its dissipation in the water column (in the case of descending transects). The transects carried out with the Azor drift-cam were planned to last approximately 60 min in the seafloor, with the system drifting over the benthic habitats at an approximate speed of 0.5 to 1 knot. Under normal oceanographic conditions, each working day allowed for 5 to 6 dives, corresponding to around 5 km of bottom explored per day.

Vessel

RV Arquipélago

Dates

Leg 2a: 19th to 25th August 2023

Leg 2b: 29th August to 9th September 2023

Leg 2c: 14th and 16th September 2023

2.2.3 *Scientific team*

Scientific team in Leg 2a: Luís Rodrigues (chief scientist Leg 2a), Sérgio Gomes, Inês Carneiro, Marc Pladevall.

Scientific team in Leg 2b: Luís Rodrigues (chief scientist Leg 2b), Sérgio Gomes, Marc Pladevall, Inês Bruno, Diana Catarino.

Scientific team in Leg 2c: Guilherme Gonçalves and Gerald H. Taranto (chief scientists Leg 2c), Inês Carneiro, Inês Bruno, Galia Edery, António Godinho, Nicolás Collazo.

2.2.4 *Statistics*

During the Leg 2 of the MapGES 2023 cruise onboard the RV Arquipélago we performed a total of 81 dives, covering about 48.46 km of the seafloor and producing 79:18 hours of video footage.

Leg 2a: We performed 28 dives with the Azor drift-cam down to 1080 m depth, covering 21.09 km of the seafloor and producing 26:08 hours of video footage.

Leg 2b: We performed 51 dives with the Azor drift-cam down to 990 m depth, covering 25.71 km of the seafloor and producing 50:23 hours of video footage.

Leg 2c: We performed 2 dives with the Azor drift-cam down to 890 m depth, covering 1.66 km of the seafloor and producing 02:47 hours of video footage.

2.2.5 *Cruise summary*

The Leg 2 of the MapGES 2023 RV Arquipélago survey was divided in three parts depending on the areas explored or the team involved, which planned to visit Hard Rock Café, the ocean crests on the Mid-Atlantic Ridge around Kurchatov (Leg 2a), the banks and seamounts between Pico and São Miguel Island, Mar da Prata and Grande Norte (Leg 2b), and lastly the seamounts around Princesa Alice (Leg 2c). Overall, 79 successful dives out of 81 stations were filmed, until 1084m depth, covering 47 km of bottom and producing around 79 hours of video. These dives were accomplished in 16 sampling areas. During Leg 2a from 19th to 25th August 2023, we performed 28 dives with the Azor drift-cam, but one, in the Petrov seamount, did not reach the bottom because the area was much deeper than the maps showed. In this part of Leg 2, we surveyed for the first-time areas as Hard Rock Café, and the ocean crests on the Mid-Atlantic Ridge around Kurchatov. It was the first time we visited an area so far north with Azor Drift-cam (210 nm from Faial Island and 110nm from Corvo island) using the RV Arquipélago, and the first-time exploring Petrov seamount, for which bathymetric data was still lacking, and where we decided to do a bit of prospective work. During the Leg 2b, from 29th August to 9th September 2023, we performed a total of 51 dives with the Azor drift-cam, where we surveyed and explored some seamounts and slopes on the way to, and around São Miguel Island; including Albatroz do Norte, Ferraria Norte, Ferraria do Mar, Sauerwein, Mar da Prata (S and N), and Grande Norte. These long awaiting sampling areas were especially interesting to gauge the impact of human activity, given the proximity to the largest island in the Azores archipelago. Finally, during Leg 2c we performed only two dives on the slopes of the seamount De Guerne, around Princesa Alice.

Table 3. Areas surveyed during Leg 2 of MapGES 2023 cruise, with information on the amount of underwater terrain explored and time of filming accomplished.

Leg	Dates	Areas explored	Dives (n)	Dist (km)	Bottom time (h)
2a	19/08/2023 -25/08/2023	Perestrela Bartolomeu, Kurchatov SE, Hard Rock Café, Petrov, Isolado, Kurchatov N, Kurchatov SW	28	21.09	26:08
2b	29/08/2023 -09/09/2023	Albatroz N, Ferraria N, Ferraria Mar, Sauerwein, Mar da Prata S, Mar da Prata, Mar da Prata N, Grande Norte	51	25.71	50:23
2c	14/09/2023 - 16/09/2023	De Guerne	2	1.66	02:47
Total			81	48.46	79:18

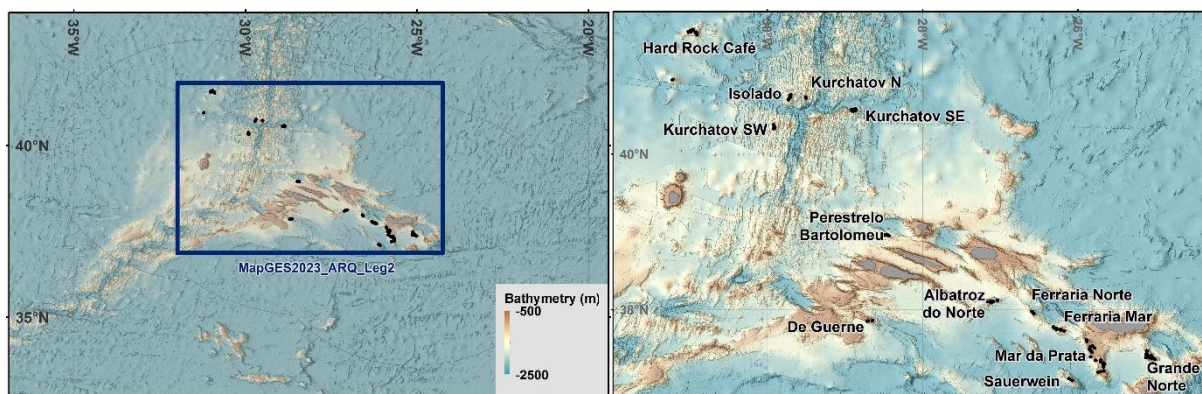


Figure 32. Location of the 81 video transects (black lines) carried out with the Azor drift-cam during Leg 2 of MapGES 2023 onboard the RV Arquipélago.



Figure 33. Screenshots taken from the footage recorded during Leg 2 of MapGES 2023 cruise onboard the RV Arquipélago. (a) Highest vertical wall ever filmed with Azor drift-cam covered with an extensive aggregation of corals of the genus *cf. Candidella* sp., *Desmophyllum dianthus*, *Dendrophyllia cornigera*, and various soft corals; (b) large schools of the wreckfish (*Polyprion americanus*); (c) large schools of the highly endangered deep-sea fish orange roughy (*Hoplostethus atlanticus*); (d) extensive gardens of *Narella bellissima*, *Narella versluysi*; (e) large gardens of *Viminella flagellum*, sometimes associated with *Callogorgia verticillata* and other times with frequent and large *Dentomuricea*; (f) large individuals from the complex *Characella pachastrelloides* with *Geodia* sp.

2.2.6 Main achievements

1. Were able to visit ten unexplored geomorphological structures in the Azores EEZ listed in the Section 8 of the R1 report “Evaluation of areas with sufficient pre-existing information and with substantial knowledge gaps” – Hard Rock Café, Kurchatov SE, Albatroz N, Ferraria N, Ferraria Mar, Sauerwein, Mar da Prata, Mar da Prata N, Grande Norte and one seamount around Princesa Alice (De Guerne). We also visited four areas that have already been explored but needed extra video data namely the Isolado, Kurchatov N, Kurchatov SW, and Mar da Prata S. We visited also the Perestrelo Bartolomeu area, for which some information already existed, and the Petrov area, which turned out to be deeper than the maps indicated.
2. During the MapGES 2023 Leg2 of the Arquipélago Cruise we accomplished 79 underwater video transects, in one of which we discovered the highest vertical wall ever filmed with Azor drift-cam, with about 230 m tall. This cruise added up to around 79 hours of new underwater video footage of seabed habitats. As in previous years, the presence of some fishing lines made our deep-sea exploration challenging, especially in the shallower dives performed around São Miguel Island (e.g., Mar da Prata and Grande Norte). However, after having the Azor drift-cam caught on several lines, we managed to successfully get free with only minor damages, and without losing any system.

3. The Hard Rock Café seamount was finally explored with the Azor drift-cam. The hydrographic Institute have mapped this seamount in 2020 but given its location 210 nautical miles from the natural starting point of the MapGES cruises (Horta) and given its position to the north of the Azores archipelago (normally more affected by adverse weather conditions), the visit to this seamount was being postponed a few years ago. After all conditions were met, the Hard Rock Café was visited. It is a geomorphological structure that, due to its characteristics, was from the first moment on the list of the first options for the expansion of the Azores Marine Park, hence the increased importance of this visit.
4. We also visited a seamount named Petrov. This area does not yet have high-resolution bathymetry data, so we tried to prospect the area looking for a peak between 300 m and 1,000 m depth. However, after launching the Azor drift-cam in search of a shallower peak we were unable to reach the bottom. All sonars on board indicated depths between 1,900 m and 2,500 m deep, indicating that this area is much deeper than current nautical charts demonstrate and highlighting, once again, the importance of carrying out multibeam bathymetry surveys in the Azores.
5. Deep-sea explorations with the Azor drift-cam added supporting evidence to consider Hard Rock Café and Isolado, Essential Fish Habitats. We found that these areas were both home to the highly endangered deep-sea fish orange roughy (*Hoplostethus atlanticus*) and both exhibited large schools of the wreckfish (*Polyprion americanus*). These areas also showed a high number of deep-sea shark species, some of which rarely observed in the Azores. Although these areas showed low abundances in terms of benthic megafauna, we detected some frequent colonies of the slow-growing black corals *Antipathes dichotoma* and *Leiopathes expansa*.
6. Most seamounts on the way to and around São Miguel Island, such as Albatroz N, Ferraria N, Ferraria Mar, Mar da Prata and Grande Norte host interesting deep-sea benthic communities with the deeper areas demonstrating abundant coral gardens of both *Narella versluysi* and *Narella bellissima*, sometimes, in aggregation with *Callogorgia verticillata*, *Acanthogorgia* sp. or *Leiopathes expansa*. Shallower areas were mainly characterized by large gardens of *Viminella flagellum*, sometimes associated with *Callogorgia verticillata* and other times with frequent and large colonies of *Dentomuricea* aff. *meteor*.
7. The Sauerwein ridge, between the islands of São Miguel and Santa Maria, had a surprisingly low biodiversity, highlighting once again the need to better understand the reasons that explain the spatial distribution patterns of benthic communities to better inform management and conservation of these vulnerable ecosystems.
8. Although the Grande Norte seamount was clearly the area with the highest intensity of bottom fishing, where we observed several lost bottom longlines, the benthic communities observed appeared to be in good environmental condition, displaying large aggregations of *Callogorgia verticillata*. These observations add to the evidence that hook-and-line fishing produces much smaller impacts when compared to other fishing gear.
9. We continued exploring the morphological features around Princesa Alice, namely De Guerne. Most dives covered soft and mix sediments with relatively low biodiversity and abundance, with only some occasional corals of the species *Acanella arbuscula*, *Parantipathes hironelle* and *Elatopathes abietina*, and dispersed *Acanthogorgia* sp.

2.3 STATIONS SURVEYED DURING MAPGES 2023 RV ARQUIPÉLAGO LEG 2

In leg 2 of the MapGES 2023 RV Arquipélago survey we conducted 81 dives out of 149 stations in 16 sampling areas. Here we present a compilation of all the stations surveyed during this cruise (Table 2).

Table 4. Metadata of the stations surveyed during Leg 2 of the MapGES 2023 cruise onboard the RV Arquipélago.

Station	Location	Date	Time		Start position		End position		Depth (m)		Dist. (m)
			Start	End	Lat. (N)	Long. (W)	Lat. (N)	Long. (W)	Start	End	
St069	Perestrelo Bartolomeu	19/08/2023	13:59:04	14:55:50	38,9558	-28,4388	38,9539	-28,4353	854	948	360
St070	Perestrelo Bartolomeu	19/08/2023	15:28:20	17:10:46	38,9667	-28,4585	38,9589	-28,4519	738	788	1030
St071	Perestrelo Bartolomeu	19/08/2023	17:34:15	19:13:52	38,9636	-28,4906	38,9589	-28,4890	942	904	540
St072	Kurshatov SE	20/08/2023	08:03:40	09:46:55	40,5788	-28,8604	40,5697	-28,8566	614	787	1060
St073	Kurshatov SE	20/08/2023	10:08:02	11:14:43	40,5802	-28,8703	40,5775	-28,8681	906	611	350
St074	Kurshatov SE	20/08/2023	11:52:42	13:28:42	40,5769	-28,8959	40,5747	-28,8908	943	463	490
St075	Kurshatov SE	20/08/2023	14:15:05	15:39:06	40,5699	-28,8699	40,5653	-28,8633	723	717	750
St076	Kurshatov SE	20/08/2023	16:06:41	16:58:40	40,5544	-28,8968	40,5523	-28,8899	509	721	620
St077	Kurshatov SE	20/08/2023	17:23:01	19:30:34	40,5677	-28,9169	40,5565	-28,9083	1030	943	1440
St078	HardRock Café	21/08/2023	08:25:50	10:26:52	41,5644	-30,9131	41,5543	-30,9061	765	835	1260
St079	HardRock Café	21/08/2023	10:54:30	12:22:46	41,5652	-30,9171	41,5589	-30,9095	789	806	940
St080	HardRock Café	21/08/2023	12:37:45	14:02:23	41,5399	-30,9104	41,5332	-30,9038	870	910	920
St081	HardRock Café	21/08/2023	14:28:09	16:02:00	41,5616	-30,9239	41,5511	-30,9170	782	808	1300
St082	HardRock Café	21/08/2023	16:39:52	18:02:40	41,5995	-30,9536	41,5925	-30,9532	980	928	770
St083	HardRock Café	21/08/2023	18:20:00	19:50:20	41,5895	-30,9857	41,5834	-30,9843	1048	926	680
St084	HardRock Café	22/08/2023	08:04:55	09:33:20	41,5725	-31,0156	41,5658	-31,0139	969	953	750
St085	HardRock Café	22/08/2023	09:56:50	11:39:18	41,5794	-30,9817	41,5708	-30,9844	878	904	980
St086	Petrov	22/08/2023	16:01:54	16:36:35							
St087	Kurshatov N	23/08/2023	08:23:50	10:21:40	40,7313	-29,5058	40,7206	-29,5012	910	943	1250
St088	Isolado	23/08/2023	11:51:35	13:30:22	40,7654	-29,6970	40,7596	-29,6987	825	775	660
St089	Isolado	23/08/2023	13:49:01	14:58:08	40,7551	-29,7044	40,7515	-29,7039	682	640	400
St090	Isolado	23/08/2023	15:07:45	16:59:16	40,7388	-29,7081	40,7340	-29,7071	771	736	540
St091	Isolado	23/08/2023	17:18:00	18:29:05	40,7289	-29,7116	40,7265	-29,7086	701	694	360
St092	Isolado	23/08/2023	18:49:01	19:58:06	40,7019	-29,7302	40,6982	-29,7257	834	789	550
St093	Kurchatov SW	24/08/2023	08:11:29	09:42:58	40,3794	-29,9162	40,3781	-29,9195	987	1084	310
St094	Kurchatov SW	24/08/2023	10:08:34	11:10:02	40,3603	-29,9108	40,3605	-29,9132	603	757	200
St095	Kurchatov SW	24/08/2023	11:36:05	13:16:18	40,3412	-29,9053	40,3402	-29,9129	646	660	650
St096	Kurchatov SW	24/08/2023	13:39:01	15:21:53	40,3303	-29,9048	40,3281	-29,9146	831	797	860
St097	Albatroz do Norte	29/08/2023	08:34:05	09:42:50	38,1036	-27,1615	38,1051	-27,1653	581	642	370
St098	Albatroz do Norte	29/08/2023	10:03:33	11:38:20	38,1035	-27,1336	38,1084	-27,1341	558	595	540
St099	Albatroz do Norte	29/08/2023	12:03:07	13:55:59	38,0928	-27,1117	38,0949	-27,1170	928	784	510
St100	Albatroz do Norte	29/08/2023	14:19:23	15:58:17	38,1061	-27,0903	38,1082	-27,0977	659	660	680
St101	Albatroz do Norte	29/08/2023	16:14:55	17:09:10	38,1058	-27,1030	38,1059	-27,1051	588	610	180
St102	Albatroz do Norte	29/08/2023	17:42:00	19:37:27	38,1218	-27,0346	38,1252	-27,0402	809	689	610
St103	Ferraria Norte	30/08/2023	08:16:25	10:00:34	37,9805	-26,5924	37,9793	-26,5984	828	824	540
St104	Ferraria Norte	30/08/2023	10:27:17	11:59:50	37,9532	-26,5737	37,9561	-26,5778	933	883	480
St105	Ferraria Norte	30/08/2023	12:19:05	13:33:50	37,9482	-26,5696	37,9530	-26,5710	696	993	540
St106	Ferraria Mar	30/08/2023	15:46:20	17:09:00	37,7730	-26,3164	37,7734	-26,3179	857	866	130
St107	Ferraria Mar	30/08/2023	17:31:20	19:33:47	37,7603	-26,2911	37,7651	-26,2966	784	544	720
St108	Ferraria Mar	31/08/2023	08:16:40	09:59:51	37,7777	-26,3121	37,7820	-26,3182	851	923	710
St109	Ferraria Mar	31/08/2023	10:45:58	12:41:11	37,7482	-26,2765	37,7591	-26,2791	823	779	1230
St110	Ferraria Mar	31/08/2023	13:08:53	14:24:22	37,7423	-26,2249	37,7468	-26,2225	865	892	540
St111	Ferraria Mar	31/08/2023	14:39:54	16:42:58	37,7424	-26,2308	37,7491	-26,2246	833	891	920
St112	Ferraria Mar	31/08/2023	17:08:24	19:24:32	37,7339	-26,1881	37,7299	-26,1854	745	874	500
St113	Sauerwein	01/09/2023	08:39:55	10:26:22	37,1151	-26,1156	37,1148	-26,1223	905	934	590
St114	Sauerwein	01/09/2023	10:54:56	12:43:45	37,0913	-26,0750	37,0939	-26,0795	930	950	490
St115	Mar da Prata S	01/09/2023	14:59:36	15:49:00	37,2014	-25,7443	37,2008	-25,7453	464	472	110
St116	Mar da Prata S	01/09/2023	16:08:55	17:25:10	37,2103	-25,7094	37,2111	-25,7099	332	316	90
St117	Mar da Prata S	01/09/2023	17:46:30	19:35:45	37,2177	-25,6705	37,2147	-25,6703	883	783	330
St118	Mar da Prata S	02/09/2023	08:21:09	09:54:55	37,2746	-25,6743	37,2672	-25,6796	530	520	940
St119	Mar da Prata S	02/09/2023	10:20:35	11:49:20	37,3007	-25,6622	37,3000	-25,6652	663	558	270

AJUSTE DIRETO N.º 11/DRPM/2022 - CARACTERIZAÇÃO DOS HABITATS DE PROFUNDIDADE, COM VISTA AO SEU MAPEAMENTO ATÉ AO LIMITE EXTERIOR DA SUBÁREA DOS AÇORES DA ZONA ECONÓMICA EXCLUSIVA PORTUGUESA

St120	Mar da Prata S	02/09/2023	12:24:44	13:21:56	37,2925	-25,6801	37,2967	-25,6833	381	377	540
St121	Mar da Prata S	02/09/2023	13:39:50	14:32:13	37,3145	-25,6742	37,3179	-25,6735	500	544	380
St122	Mar da Prata	02/09/2023	14:56:46	16:12:25	37,3329	-25,7168	37,3363	-25,7132	429	413	490
St123	Mar da Prata	02/09/2023	16:30:50	17:32:09	37,3572	-25,7134	37,3556	-25,7076	236	274	540
St124	Mar da Prata	02/09/2023	18:16:15	20:02:06	37,3550	-25,7820	37,3513	-25,7723	879	778	950
St125	Mar da Prata	03/09/2023	08:10:30	10:03:00	37,3980	-25,8370	37,3954	-25,8424	799	753	550
St126	Mar da Prata	03/09/2023	10:35:15	12:02:30	37,4566	-25,8214	37,4560	-25,8266	457	399	460
St127	Mar da Prata	03/09/2023	12:18:55	13:35:01	37,4806	-25,8401	37,4773	-25,8417	448	406	390
St128	Mar da Prata	03/09/2023	13:52:38	14:56:01	37,4977	-25,8556	37,4970	-25,8599	357	334	380
St129	Mar da Prata N	03/09/2023	15:15:01	16:30:41	37,5250	-25,8473	37,5254	-25,8488	542	530	130
St130	Mar da Prata N	03/09/2023	16:49:25	17:58:01	37,5376	-25,8164	37,5385	-25,8162	533	548	100
St131	Mar da Prata	03/09/2023	18:19:59	19:27:40	37,5099	-25,7923	37,5103	-25,7889	559	613	300
St132	Mar da Prata N	04/09/2023	12:20:19	13:46:10	37,6183	-25,8962	37,6147	-25,8934	302	317	470
St133	Mar da Prata N	04/09/2023	14:05:18	15:25:44	37,6021	-25,8959	37,5993	-25,8949	385	394	320
St134	Mar da Prata N	04/09/2023	15:40:59	16:44:17	37,5997	-25,8861	37,5961	-25,8858	251	189	400
St135	Grande Norte	07/09/2023	08:09:01	09:52:38	37,4759	-25,1232	37,4739	-25,1157	960	680	690
St136	Grande Norte	07/09/2023	10:19:12	11:30:09	37,4441	-25,1229	37,4423	-25,1191	636	582	390
St137	Grande Norte	07/09/2023	11:48:09	13:25:52	37,4283	-25,1328	37,4251	-25,1285	893	640	520
St138	Grande Norte	07/09/2023	13:47:20	14:03:50	37,4182	-25,1089	37,4182	-25,1089	332	332	0
St139	Grande Norte	07/09/2023	14:21:20	15:19:50	37,4190	-25,1078	37,4146	-25,1080	355	309	480
St140	Grande Norte	07/09/2023	15:34:15	16:29:30	37,4106	-25,0952	37,4103	-25,0952	269	269	30
St141	Grande Norte	07/09/2023	16:42:43	18:06:30	37,3999	-25,0879	37,3978	-25,0868	244	157	250
St142	Grande Norte	07/09/2023	18:36:23	19:52:10	37,4110	-25,0645	37,4062	-25,0611	623	487	610
St143	Grande Norte	08/09/2023	08:20:38	09:35:02	37,3714	-25,0159	37,3670	-25,0124	653	694	570
St144	Grande Norte	08/09/2023	10:16:50	11:26:30	37,3791	-25,0405	37,3736	-25,0400	448	349	610
St145	Grande Norte	08/09/2023	12:02:30	12:35:35	37,3816	-25,0626	37,3804	-25,0612	242	226	180
St146	Grande Norte	08/09/2023	13:13:28	14:01:56	37,3946	-25,0992	37,3920	-25,0965	127	149	370
St147	Grande Norte	08/09/2023	14:25:52	16:08:50	37,3892	-25,1318	37,3858	-25,1314	803	777	370
St148	De Guerne	14/09/2023	08:05:30	09:28:11	37,8593	-28,6483	37,8644	-28,6483	633	716	560
St149	De Guerne	14/09/2023	10:04:50	12:13:35	37,8541	-28,7127	37,8575	-28,7009	886	601	1100

2.4 REPORT OF THE RV ARQUIPÉLAGO LEG 2A

2.4.1 Summary of RV Arquipélago Leg 2a

Objective: to conduct a rapid appraisal of the deep-sea benthic communities dwelling in some unfinished areas already visited in the past (Perestrelo Bartolomeu, Kurchatov N and Kurchatov SW) and visited some unexplored areas for the first time (Kurchatov SE, Hard Rock Café, Petrov and Isolado). These dives aim to contribute to the overall goal of better understanding the composition and diversity of deep-sea benthic communities in the Azores, the distribution of Vulnerable Marine Ecosystems (VMEs) and commercial fish species, and to assess their environmental status.

Statistics: We performed 28 dives with the Azor drift-cam down to 1100 m depth, covering 21.09 km of the seafloor and producing 26:08 hours of video footage.

Vessel: RV Arquipélago

Dates: 19th – 25th August 2023

Scientific team: Luís Rodrigues (chief scientist Leg 2a), Sérgio Gomes, Inês Carneiro, Marc Pladevall.



Figure 34. Scientific team that participated in the Leg 2a of the MapGES 2023 Cruise on the RV Arquipélago.

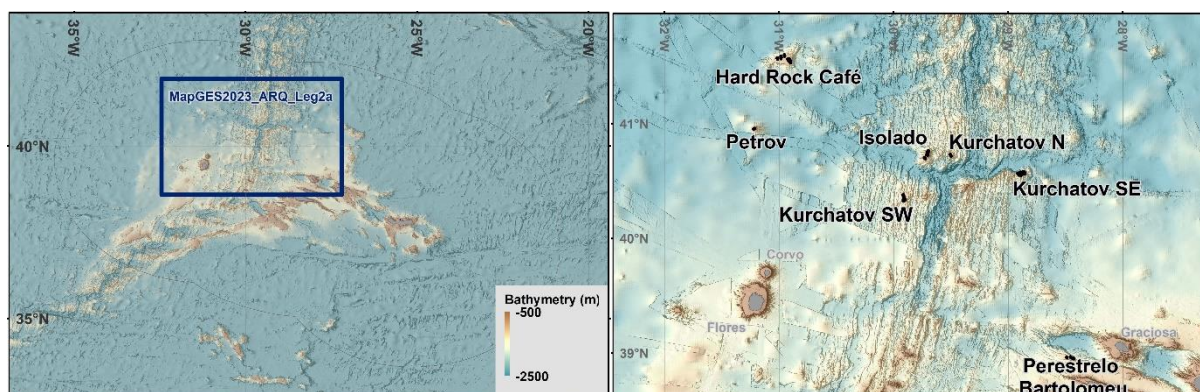


Figure 35. Location of the 28 video transects (black lines) carried out with the Azor drift-cam during Leg 2a of the MapGES 2023 onboard the RV Arquipélago.

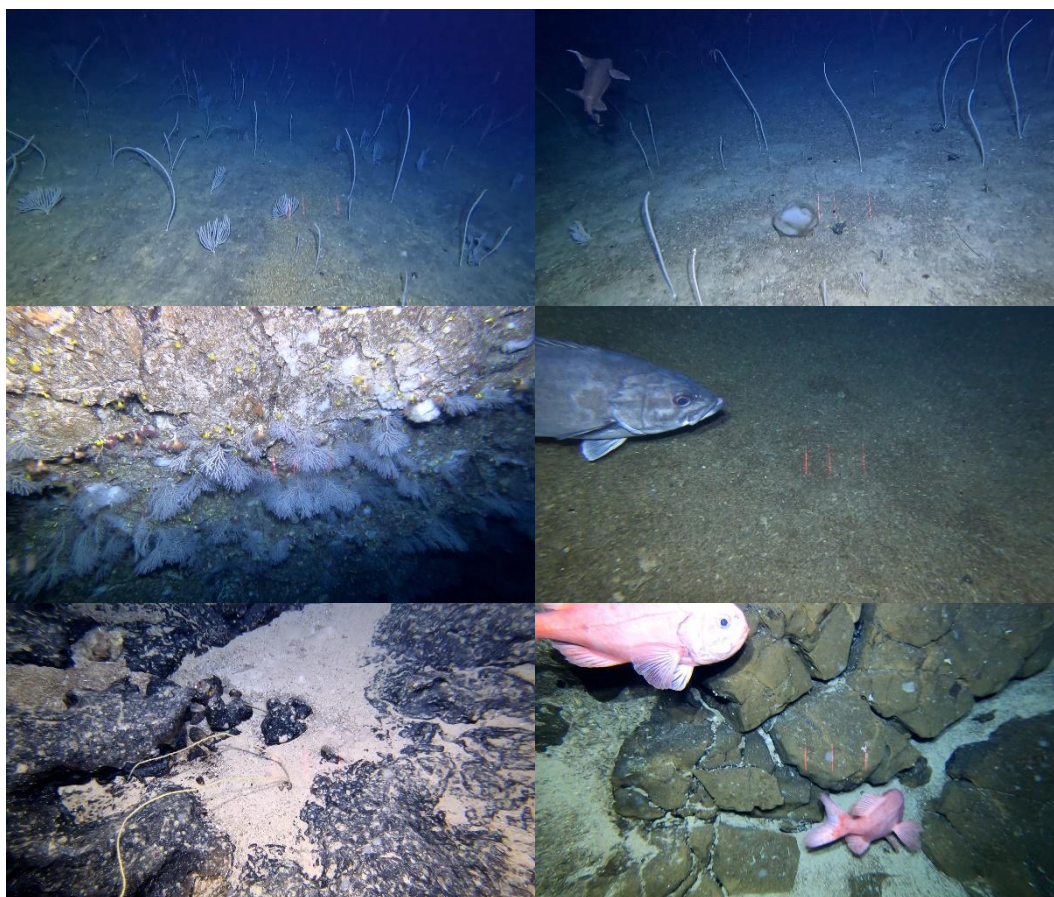


Figure 36. Screenshots taken from the footage recorded during RV Arquipélago Leg 2a of the MapGES 2023 cruise. (a) abundant coral gardens of both *Narella versluysi* and *Narella bellissima*; (b) observation of the rare deep-sea shark *Oxynotus paradoxus*; (c) tallest vertical wall ever filmed with Azor drift-cam covered with an extensive aggregation of corals of the genus *cf. Candidella* sp., *Desmophyllum dianthus*, *Dendrophyllia cornigera*, and various soft corals; (d) large schools of the wreckfish (*Polyprion americanus*); (e) frequent appearances of the black corals *Antipathes dichotoma*; (f) large schools of the longlived deep-sea fish orange roughy (*Hoplostethus atlanticus*).

2.4.2 Cruise diary of RV Arquipélago Leg 2a

17-19 August 2023

We were supposed to start the Leg 2a of the MapGES 2023 onboard the RV Arquipélago on Thursday 17th of August. However, the vessel was not ready until the 19th due to some technical issues related with the engine and because the food supplies were not ready on the 18th, which forced us to stay on land. We planned to leave Horta harbour at 09:00 on August 19th, 2023.

19 August 2023

The first day of Leg 2a of the MapGES 2023 onboard the RV Arquipélago, started at 10:30 when we left Horta towards Perestrelo Bartolomeu area. We left the harbour 1:30 H later than expected because the food truck took longer to deliver the food to the boat. We arrived at the first station around 13:40 and were able to conduct 3 dives with the Azor drift-cam between 730 m and 950 m depth. It was the first time we tested the GoPro 10 and its newly UAVISON waterproof case and it was a success. Despite the new trials, the first day was generally very smooth comparing with the first day of other legs, with no issues recorded. Along the day, the drifts were in general good, however it was difficult to cross over the top of the feature, probably due to the strong circular

currents around the seamount. During the first dive of the day, we had some trouble with the drift and had to bring the system to the surface earlier. We noticed by the video that the camera was going uphill but due to a strong drift we had to release a lot of umbilical to keep the camera close to the bottom. Due to the presence of vertical walls, it would be dangerous for the system to continue the transect.

Most dives were characterized by sedimentary bottom with coral rubble, some basaltic outcrops, and vertical walls. Throughout the day we observed generally low biodiversity and little fauna abundance, especially in the first dive where no corals were identified, and the sponges observed were mainly encrusting the rocks. On the last two dives, the coral communities recorded were composed by *Narella versluysi* and *Narella bellissima* aggregations (particularly extensive during St070), together with other more sporadic species such as *Leptosammia formosa*, *Hemicorallium niobe*, *Pliobothrus symmetricus*, the bamboo coral *Acanella arbuscula* and one *Callogorgia verticillata*. Some of the most frequently spotted sponge species included *Pheronema carpenteri* (generally in small, scattered aggregations), *Desmacella grimaldii*, and some individuals from the *Characella pachastrelloides* complex. We also observed some common fish and crab species from these depths including *Mora moro*, *Neocyttus helgae*, some eel-like fish and *Chaceon affinis*, as well as some deep-sea sharks. We also spotted some starfish (*Peltaster placenta*) and sea-urchins (*Cidaris cidaris*), the last appearing in small aggregations along the second dive. We finished the day around 19:00 and started transiting to a new area. During the trip heading to Kurchatov area we lost wi-fi and mobile phone signal, only being reachable by satellite communications.

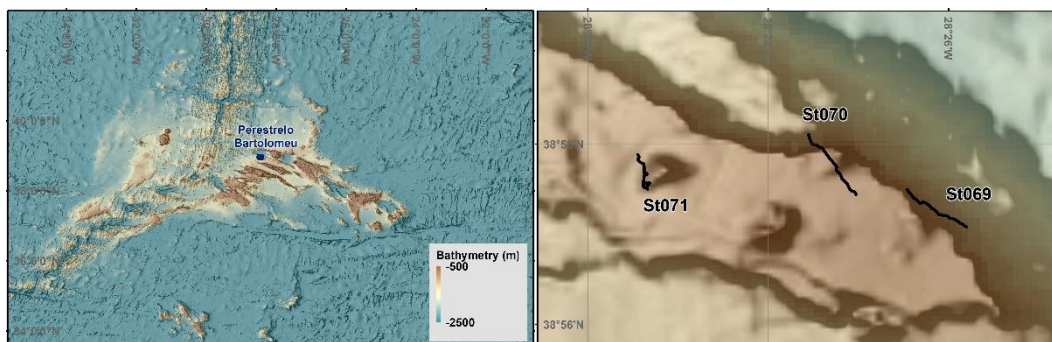


Figure 37. Bathymetric map showing the three dives conducted on the first day of Leg 2a of the MapGES 2023 cruise in Perestrelo Bartolomeu area.





Figure 38. Screenshots taken from the video footage recorded during August 19th of Leg 2a of the MapGES 2023 cruise in Perestrelo Bartolomeu area.

20 August 2023

The day started around 07:00, and after breakfast we began to prepare for the workday. We arrived to Kurchatov SE at 07:45 and deployed the Azor drift-cam around 08:00, starting the first dive of the day. During the day, we performed 6 dives between 460 m and 1030 m depth. The high density of lost fishing lines present in this area made our explorations challenging. During most of the dives we had to avoid fishing lines and in two dives the Azor drift-cam got stuck. In the second dive (St073), we brought the system up a few meters to try releasing it, but the electric cable broke and we lost the live view feed. We tried to fix the cable, but we were only able to recover the live view connection temporarily, and it got lost again. After some attempts and with the help of an experienced crew member, we managed to recover the Azor drift-cam with only minor damages on the led lights. Between the second and third dive, we adjusted the led lights, changed the GoPro 10 and the respective waterproof case back to the GoPro 7, and switched to a new umbilical. During the third dive (St074) we got stuck again on a fishing line again and decided to come up to try to release the system. While going up we noticed a huge vertical wall with several lost fishing lines, where we almost got stuck numerous times. The wall was about 230 m tall and it took around 12 minutes going up very fast to get to the top. We noticed a 4°C difference in the water temperature between the bottom and the top of the vertical; from 8.3°C to 11.2°C. Although we feared to lose the system, the wall was impressive, full of life in different colours. We successfully recovered the Azor drift-cam only losing its weight.

Three of the dives of the day (St072, St075, and St076) were performed between 500m and 700m, while the other three (St073, St074, and St077) were deeper. The slopes of the surveyed peaks were mostly of sedimentary origin, with some coral rubble and a few basaltic outcrops and vertical walls. Most of them hosted diverse benthic communities with patches of abundant coral gardens *Narella versluysi* and *Narella bellissima*. Sometimes *N. versluysi* occurred in aggregation with *Callogorgia verticillata*. Other frequent species also spotted along the day were *Leptopsammia formosa*, *Pseudoanthomastus* and some small and scattered aggregations either from the bamboo coral *Acanella arbuscula* or from the gorgonians of the genus *Acanthogorgia*. In lower densities we observed *Hemicorallium niobe*, cf. *Muriceides* sp., *Viminella flagellum* (only in St076), and the black corals *Leiopathes expansa* and *Parantipathes hirondelle*. On the vertical wall, in the dive St074, apart from some of the species already described we also identified some that were spotted exclusively on this wall, such as an extensive aggregation of corals of the genus cf. *Candidella* sp., *Desmophyllum dianthus*, *Dendrophyllia cornigera*, and various soft corals. Basaltic outcrops were mainly colonized by encrusting sponges, but we also noticed some occasional larger demospongia such as *Characella pachastrelloides*, *Maccandrewia azorica*, *Petrosia crassa*, *Haliclona magna*, and *Desmacella grimaldi*. Some dispersed glass sponges like *Pheronema carpenteri*, *Regadrella phoenix*, and *Gymnorette* sp. were also observed, as well as some lamellate sponges likely from the genus *Phakellia* (*P. ventilabrum* and *P. robusta*). We drifted

over a few sea-urchins (e.g., *Echinus melo* and *Cidaris cidaris*), some crabs (e.g., *Paromola cuivieri* and *Chaceon affinis*), and various deep-sea fish species such as: *Lophius piscatorius*, *Mora moro*, *Helicolenus dactylopterus*, shoals of *Hoplostethus mediterraneus*, *Neocyttus helgae*, among others. We finished the last dive at around 19:30 and transited to the next area (Hard Rock Café 109 nm away from Kurchatov SE).

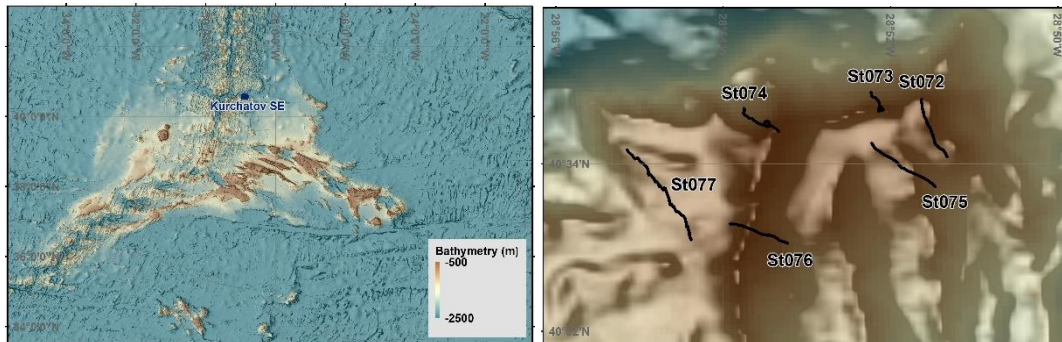


Figure 39. Bathymetric map showing the six dives performed on August 20th during Leg 2a of the MapGES 2023 cruise in Kurchatov SE.

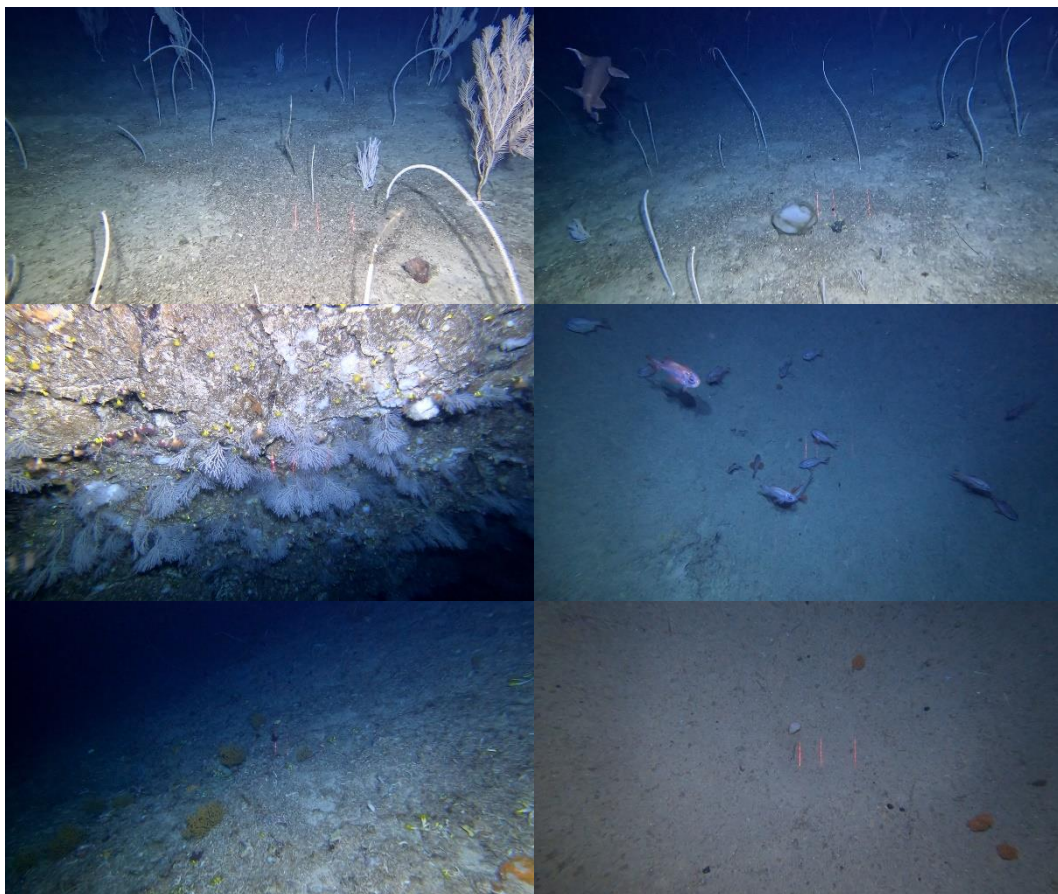


Figure 40. Screenshots taken from the video footage recorded on August 20th during the Leg 2a of the MapGES 2023 cruise in Kurchatov SE.



Figure 41. Screenshots taken from the video footage of some of the lost fishing longlines found on August 20th during the Leg 2a of the MapGES 2023 cruise in Kurchatov SE.

21 August 2023

We arrived at Hard Rock Café seamount (210 nm away from Faial, 110 nm away from Corvo) at 08:00 after almost 13 hours of sailing. It is the first time we explore this seamount to investigate the deep-sea benthic fauna using the Azor drift-cam. We conducted 6 dives and covered mainly sedimentary bottom with some rocky parts, between 760 m and 1,050m depth. After the 4th dive of the day, we transited further north to another deep plateau, still in Hard Rock Café area. It was the first time our team explored an area so far north using the RV Arquipélago and the Azor drift/cam. Since this area is not known to have intense fishing activities, neither for having a lot of vertical walls, all dives were very relaxed, with nice drifts and without any trouble.

Here, we drifted over soft bottoms with some coral rubble with generally low biodiversity and abundance of megabenthic species, and some basaltic outcrops generally with higher densities of sponges and corals. The unconsolidated substrates of the deep sector showed the typical fauna of such depths, including the bamboo corals *Acanella arbuscula* and *Chrysogorgia* sp., small and dispersed *Narella versluysi* and some aggregations of the black coral *Antipathes dichotoma*. Moving further up the slope, when reaching harder substrates, different coral species were recorded, such as *Hemicorallium niobe*, *Lophelia pertusa*, *Leiopathes expansa*, *Bathypathes* sp., *Acanthogorgia* sp., and some individuals belonging to the complex cf. *Paramuricea/Placogorgia*. Sponge communities were characterized by the presence of lamellate sponges such as *Desmacella grimaldi* and both *Phakellia ventilabrum* and *P. robusta*. Large demospongia like *Characella pachastrelloides*, *Petrosia crassa* and *Haliclona magna* were also identified but were generally few and disperse. Likewise, glass sponges such as *Pheronema carpenteri*, *Regadrella phoenix* and *Gymnorette* sp. were also observed, as well as some small and scattered *Asconema* sp. aggregations. Several fishes were recorded during the day including the deep-sea shark, some large *Polyprion americanus*, *Mora moro*, numerous *Neocyttus helgae*, and rarely recorded orange roughy (*Hoplostethus atlanticus*). Some crabs *Chaceon affinis* and *Bathynectes mavigna* also appeared, as well as a squid cf. *Mastigoteuthis* sp.

We finished the last dive at around 20:00 and started transiting north, to pass the night drifting south in direction to Hard Rock Café area.

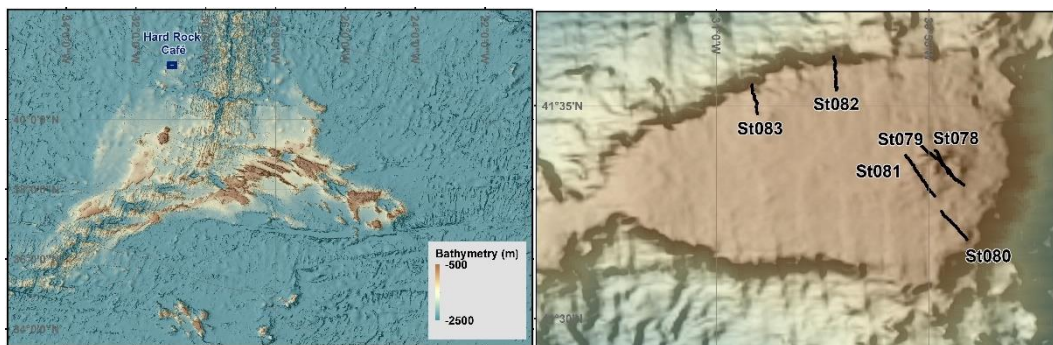


Figure 42. Bathymetric map showing the location of the six dives conducted in August 21st of Leg 2a of the MapGES 2023 cruise in Hard Rock Café area.

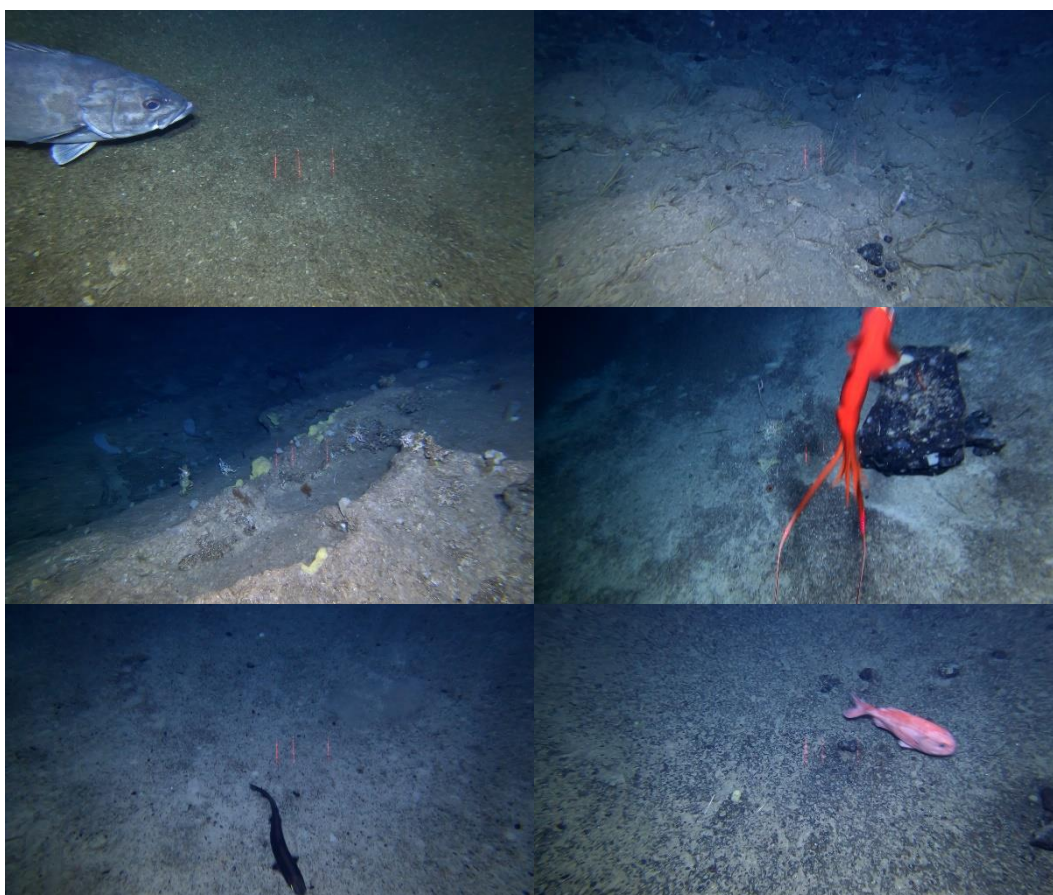


Figure 43. Screenshots taken from the video footage recorded on August 21st of Leg 2a of the MapGES 2023 cruise in Hard Rock Café area.

22 August 2023

We spent the night drifting around the northern tip of the Hard Rock Café area. Before waking up, the vessel adjusted the position and started navigating to the coordinates of the first dive of the day. We started the first dive of the day around 08:00. We conducted 2 dives (St084 and St085, signalled in blue in Figure 10) with a relatively good drift, in this area. The two dives performed in Hard Rock Café seamount showed similar characteristics as the dives performed there the day before. The sedimentary bottom with some basaltic outcrops was characterized by the frequent presence of the bamboo coral *Acanella arbuscula* and some occasional appearances of the black corals: *Antipathes dichotoma*, *Leiopathes expansa*, *Bathypathes* sp. and

Parantipathes hirondele. Large stylasterids as well as the scleractinian coral *Lophelia pertusa* were also observed. Regarding sponges the most frequently observed species were *Desmacella Grimaldi*, both *Phakellia ventilabrum* and *P. robusta*, *Pheronema carpenteri*, *Regadrella phoenix* and *Asconema* sp. But the highlight of the day was the large amount of orange roughy (*Hoplostethus atlanticus*) observed, a rarely spotted fish that seems to be abundant in this area. We also identified the deep-sea shark, *Mora moro*, *Neocyttus helgae* and some eel-like fish.

After this, we did a 4-hour transit to an area called Petrov. This area was out of our plans for this year, however, since we manage to gather the meteorological and the logistical conditions to visit this place, we decided to take the chance to explore it for the first time. The last dive of the day was on Petrov seamount, an area still lacking high resolution bathymetry. Before putting the Azor drift-cam in the water, our GIS information was indicating 800m depth. Based on that information, we decided it was safe to dive here. However, after having 900m of cable out in the water, without reaching the bottom, the boat sonar started to indicate 1900 m depth, so we aborted the dive and came back to the surface. This was the last dive of the day, after that we tried to prospect the area looking for a reachable seamount (between 300 m and 1,000 m depth), however all the sonars onboard indicated depths between 1,900 m and 2,500 m depth which made it impossible for us to deploy the Azor drift-cam. We finished the day a bit earlier (around 18:30) and started transiting back, this time to Kurchatov N area.

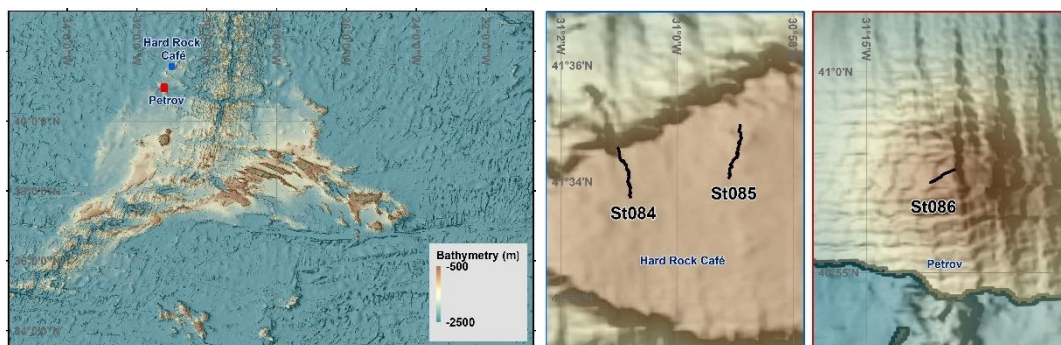


Figure 44. Bathymetric map showing the location of the 2 dives conducted on August 22nd of Leg 2a of the MapGES 2023 cruise at Hard Rock Café (in blue) and the dive aborted in Petrov area (in red).



Figure 45. Screenshots taken from the video footage recorded on August 22nd of Leg 2a of the MapGES 2023 cruise at Hard Rock Café and photos of the prospection in Petrov area.

23 August 2023

RV Arquipélago reached Kurchatov N area around 03:00, and we stayed there drifting for the rest of the night. We started the first dive of the day at 08:20. The first dive was long, since it was the only dive we expected to do in this area. After finishing the dive, we moved towards Isolado seamount (1 hour transit). During the afternoon the wind got strong, and the drift got a bit bad, with the vessel having to manoeuvre a lot during most of the dives to keep the umbilical close to the boat. This caused some difficulties in the navigation, with the Azor drift-cam moving very slowly.

During the first dive, in Kurchatov N, the seafloor was mostly covered by soft sediments with coral rubble, mainly characterized by dispersed *Acanella arbuscula*, *Chrysogorgia* sp., *Pleurocorallium johnsoni* and some cup corals. We also spotted some patches with occasional *Leiopathes expansa* and while approaching the top of the mount, the basaltic outcrops were covered with individuals from the complex cf. *Paramuricea/Placogorgia*, together with *Lophelia pertusa*, and some stylasterids. In low abundance, but also present were *Narella versluysi*, the black corals *Bathypathes* sp. and *Parantipathes hironnelle*, and a purple coral possibly from the genus *Paramuricea*. The sponge community was composed by the lamellate sponge *Desmacella grimaldi* and glass sponges from the complex *Aphrocallistes beatrix*, as well as *Regadrella phoenix* and small and scattered aggregations of the barrel sponge *Pheronema carpenteri*. In terms of mobile fauna, this area was impressive due to the abundant observation of *Hoplostethus atlanticus*. Other species such as, *Neocyttus helgae*, shoals of *Hoplostethus mediterraneus*, and several deep-sea sharks were also observed.

Similarly to Kurchatov N area, Isolado seamount was mostly sedimentary with some coral rubble. The dives were generally poor in terms of megabenthic fauna, showing low abundances when comparing with the first area. We identified very dispersed *Narella versluysi*, *Acanella arbuscula*, occasional cf. *Muriceides* sp., *Parantipathes hironnelle*, and some *Ceriantharia* sp., especially on the soft bottom areas. When basaltic boulders appeared, they were mainly colonized by *Leiopathes expansa*, with individuals from the complex cf. *Paramuricea/Placogorgia*, and *Lophelia pertusa*. *Leptopsammia formosa* and *Pseudoanthomastus* were also identified. Sponges were more common with some occasional large sponges such as *Characella pachastrelloides*, *Characella connectens*, *Petrosia crassa*, *Haliclona magna*, the lamellate sponges *Desmacella grimaldi*, and both *Phakellia ventilabrum* and *P. robusta*. Some small and dispersed aggregation of the glass sponge *Pheronema carpenteri* and *Regadrella phoenix* were also observed. In all dives we found the sea urchin *Cidaris cidaris* and spotted one octopus *Pteroctopus tetracirrhus*; while the most common fish were *Mora moro*, *Hoplostethus mediterraneus*, *Beryx splendens* and one monkfish (*Lophius piscatorius*), as well as the deep-sea sharks. But the highlight of the day was the high abundance of *Polyprion americanus* spotted in Isolado seamount during the third dive of the day. The last dive finished around 19:50, and with the Azor drift-cam on board, we passed the night in Isolado and left the vessel drifting to the south, in direction to Kurchatov SW to start working on the next day.

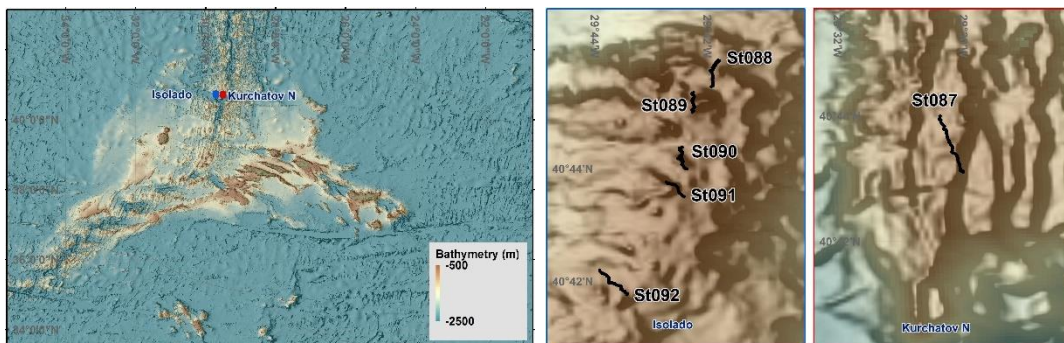


Figure 46. Bathymetric map showing the location of the dive conducted on August 23rd of Leg 2a of the MapGES 2023 cruise at Kurchatov N (in red) and the 5 dives in Isolado seamount (in blue).



Figure 47. Screenshots taken from the video footage recorded on August 23rd of Leg 2a of the MapGES 2023 cruise at Kurchatov N and in Isolado seamount

24 August 2023

The night was rough, drifting with heavy swell, and most of our team members could not sleep much. The day began in Kurchatov SW, we adjusted our position before starting to work at 08:00. During the day, the drifts were generally bad, it was hard to reach our drift targets (in most cases the drift was completely opposite to the intended), and the boat had to manoeuvre a lot to help to position the camera. When the Azor-drift cam was coming up after the first dive we spotted a curious shoal of juvenile *Coryphaena hippurus* following the camera.

All dives were mainly characterized by sedimentary rocky bottoms with coral rubble, where little abundance of benthic fauna was observed, even though there was some coral diversity, such as *Leiopathes expansa*, *Parantipathes hironelle*, *Elatopathes abietina*, *Hemicorallium tricolor*, cf. *Hemicorallium niobe*, and stylasterids. Both bamboo corals *Acanella arbuscula* and *Chrysogorgia* sp. were frequently spotted, together with *Lophelia pertusa*, *Acanthogorgia* sp., and some colonies belonging to the complex cf. *Paramuricea/Placogorgia*. Both *Narella versluysi* and *N. bellissima* were identified, although they were very few and dispersed. Where the rock outcropped, some sponges were reported (e.g., *Characella pachastrelloides*, *Characella connectens*, *Desmacella grimaldi*), generally in low abundances. There were also common *Phakellia robusta* and *P. ventilabrum*, as well as some small and sparse aggregations of *Pheronema carpenteri*, *Regadrella phoenix* and disperse *Asconema* sp. aggregations. Regarding mobile fauna, we observed several fish from the species: *Neocyttus helgae*, *Hoplostethus mediterraneus*, *Mora moro*, *Cyttopsis rosea*, *Lophius piscatorius*, one *Epigonus telescopus*, *Chaunax pictus* and *Phycis phycis*, and two species of deep-sea shark,s and one *Hexanchus griseus*. *Cidaris cidaris* where the most common echinoderms spotted along the dives, but there were also *Peltaster placenta* and some sea-stars belonging to the family Goniasteridae, especially on the rocks.

The last dive finished at around 15:30, and with the Azor drift-cam on board of the vessel, we started heading back to Faial. The weather conditions were supposed to get worse, with the wind getting stronger as well as the swell. The transit was expected to last at least 13 hours, so we are likely to arrive in Faial at around 04:00. We arrived back at Horta harbour at around 06:00 on August 25th.

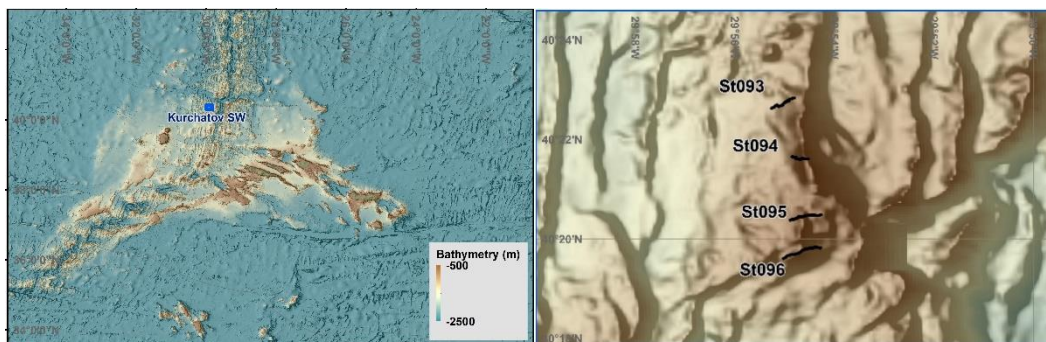


Figure 48. Bathymetric map showing the location of the 4 dives conducted on August 24th of Leg 2a of the MapGES 2023 cruise on the Kurchatov SW

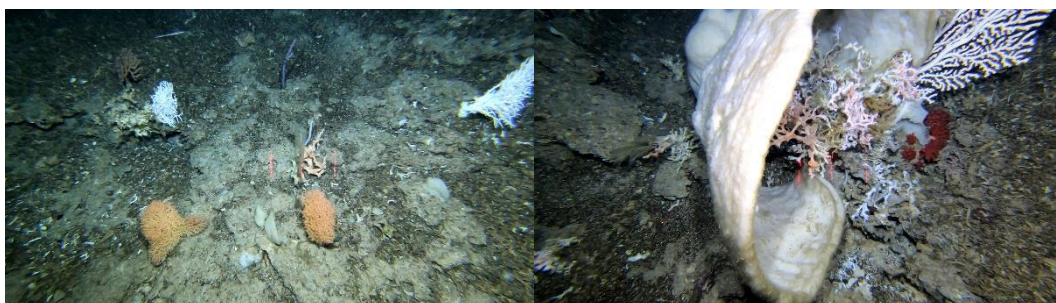




Figure 49. Screenshots taken from the video footage recorded on August 24th of Leg 2a of the MapGES 2023 cruise on the Kurchatov SW

2.5 REPORT OF THE RV ARQUIPÉLAGO LEG 2B

2.5.1 Summary of RV Arquipélago Leg 2b

Objective: to conduct a rapid appraisal of the deep-sea benthic communities on the banks and seamounts of some unexplored areas like Albatroz N, Ferraria N, Ferraria Mar, Sauerwein, Mar da Prata and Grande Norte; and to revisit other geomorphological structures that needed more work such as Mar da Prata S. These dives aim to contribute to the overall goal of better understanding the composition and diversity of deep-sea benthic communities in the Azores, the distribution of Vulnerable Marine Ecosystems (VMEs) and commercial fish species, and to assess their environmental status.

Statistics: We performed 51 dives with the Azor drift-cam down to 990 m depth, covering 25.71 km of the seafloor and producing 50:23 hours of video footage.

Vessel: RV Arquipélago

Dates: 29th August – 9th September 2023

Scientific team: Luís Rodrigues (chief scientist Leg 2b), Sérgio Gomes, Marc Pladevall, Inês Bruno, Diana Catarino.

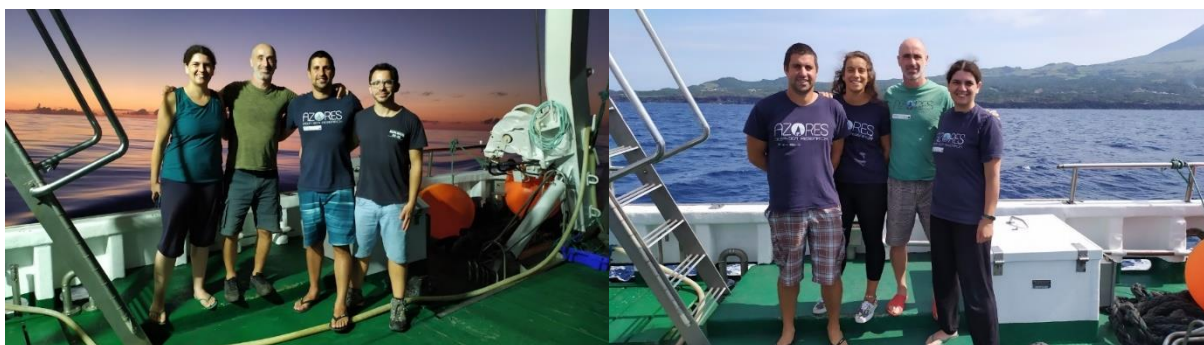


Figure 50. Both scientific teams that participated in the Leg 2b of the MapGES 2023 Cruise on the RV Arquipélago.

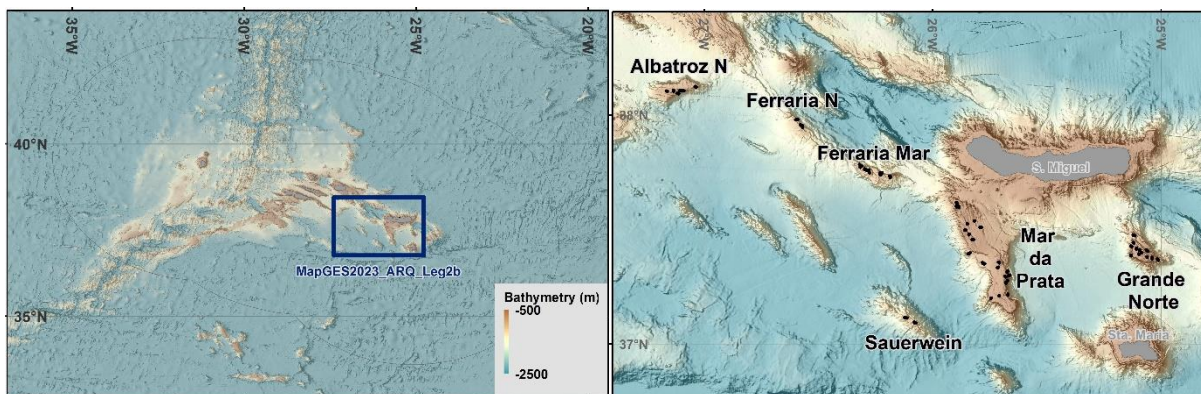


Figure 51. Location of the 51 video transects (black lines) carried out with the Azor drift-cam during Leg 2b of the MapGES 2023 onboard the RV Arquipélago.

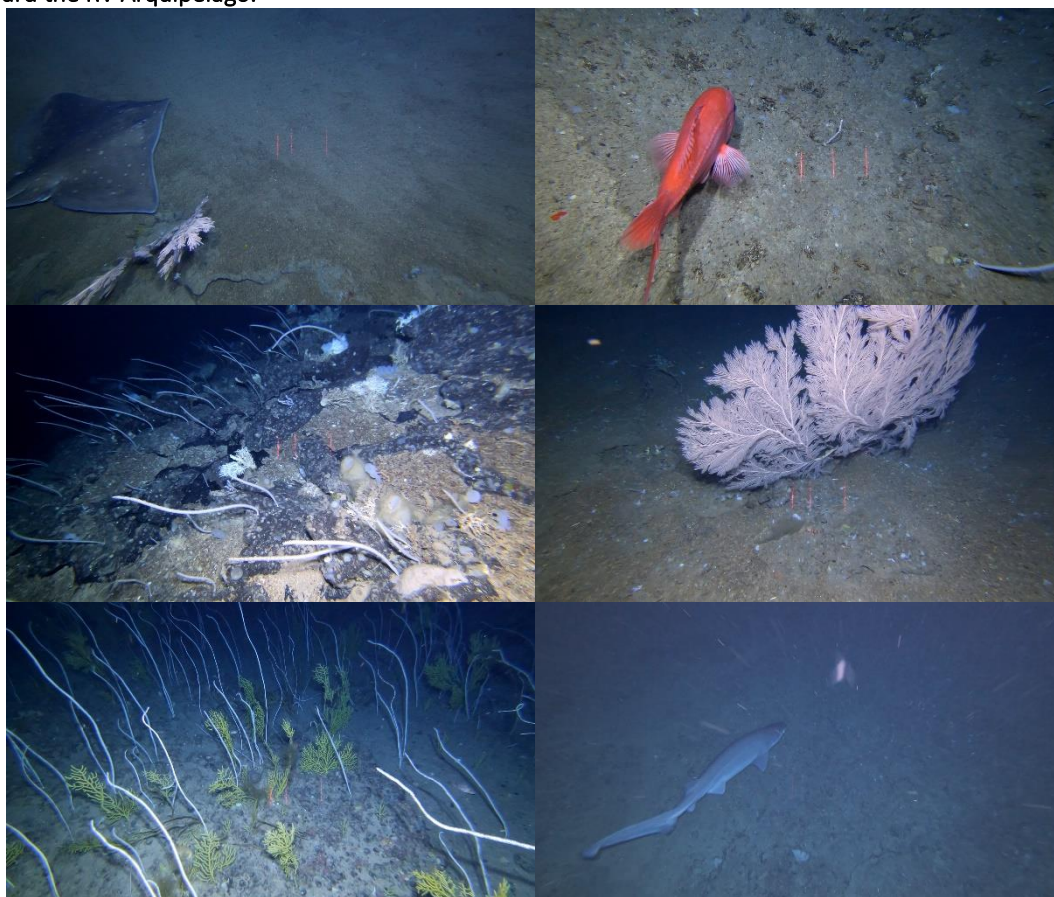


Figure 52. Screenshots taken from the footage recorded during Leg 2b of MapGES 2023 cruise. (a) *Dipturus intermedius*; (b) shoal of *Hoplostethus atlanticus*; (c) extensive gardens of *Narella Bellissima* and *Narella versluysi*; (d, e) large gardens of *Viminella flagellum*, sometimes associated with *Callogorgia verticillata* and other times with frequent and large *Dentomuricea*; (f) *Hexanchus griseus* deep-sea shark.

2.5.2 Cruise diary of RV Arquipélago Leg 2b

25-28 August 2023

We stayed in the harbour from the 25th to the 28th of August due to the bad weather conditions. During this time, we also changed one of the scientific crew members, and supplied the vessel with food before heading to São Miguel Island for the second part of this 2nd Leg. On the 28th of August we left Horta harbour at 23:00 as planned, ready for the next days of deep-sea explorations.

29 August 2023

RV Arquipélago reached Albatroz do Norte area around 08:00, and we started the first dive at 08:30. The first dive was shorter than usual (around 50min) due to a difficult drift. We managed to do 6 dives during the day with a time at bottom between 1:10 hour and 1:20 hour; the only exceptions being the first dive and the dive St101. In this dive (St101) we only recorded 00:28 minutes of bottom because the electrical cable got stuck on the winch and broke, so we lost the live view connection and decided to abort the dive to solve the problem. We managed to weld the electrical cable and got ready to do the last dive within a short period of time. During four of the six dives of the day, we spotted a lot of lost fishing lines and fishing weights. Fortunately, we managed to avoid any major damages to the Azor drift-cam.

Regarding benthic fauna, the first two dives of the day did not reveal very abundant corals and sponge communities, but from the third dive onwards, especially on the dive St100, the diversity and abundance of fauna increased considerably. The highlights of the day were some extensive aggregations of both *Narella versluysi* and *N. bellissima*, together with aggregations of *Pseudoanthomastus*. The black corals *Parantipathes hirondelle*, *Stichopathes graviera*, and *Leiopathes expansa* were also observed, as well as some small and occasional *Acanthogorgia* sp., *Callogorgia verticillata* and some patches of very small pink and white bubble gum corals (*Paragorgia* cf. *johnsoni*). We also sporadically spotted some *Viminella flagellum* and *Leptopsammia formosa*. We recorded large sponges as well, such as *Characella pachastrelloides*, *Petrosia* sp., *Desmacella grimaldi*, *Phakellia robusta*, cf. *Stryphnus*, and one *Craniella longipilis* in the last dive of the day. Some aggregations of *Pheronema carpenteri*, as well as other glass sponges were also identified. We drifted over a variety of fish, from which the most common were *Cyttopsis rosea*, *Chaunax* sp., *Neocyttus helgae*, *Trachyscorpia* sp., *Hoplostethus mediterraneus*, and from the families Macrouridae and Phycidae. We also identified one *Dipturus intermedius*, *Chimaera opalescens*, and some deep-sea sharks from the species *Deania calcea* and *Dalatias licha*. Lastly, we observed an orange round jellyfish probably *Poralia* cf. *rufescens*. After the last dive, RV Arquipélago started to transit to Ferrara Norte seamount around 19:40. We arrived at 23:00 and stayed near the area, drifting during the night.

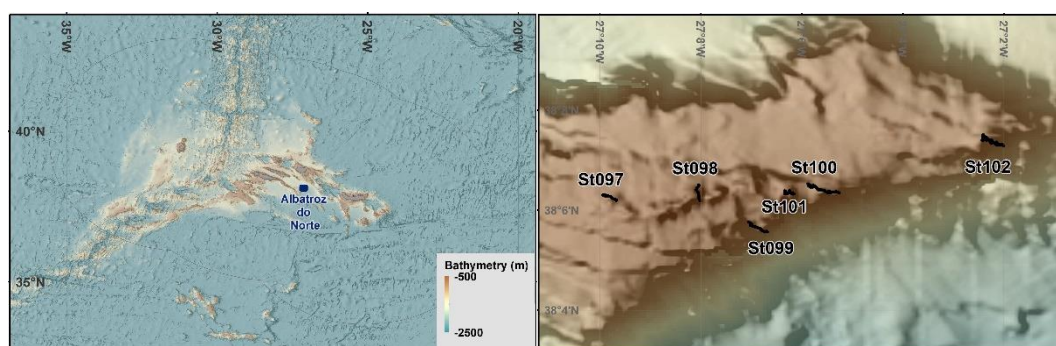


Figure 53. Bathymetric map showing the location of the 6 dives conducted on August 29th of Leg 2b of the MapGES 2023 cruise at Albatroz do Norte seamount.

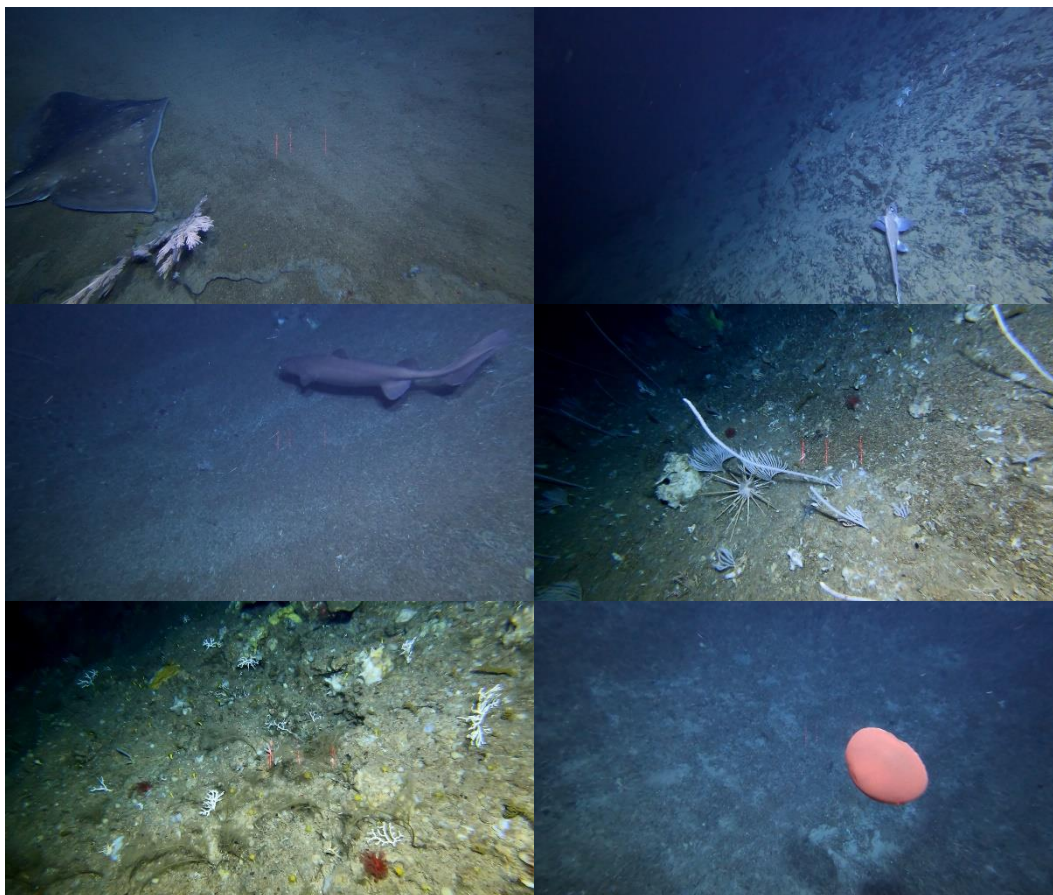


Figure 54. Screenshots taken from the video footage recorded on August 29th of Leg 2b of the MapGES 2023 cruise at Albatroz do Norte seamount.

30 August 2023

As we spent the night drifting near Ferrara Norte seamount, at around 07:30 the ship started to relocate to the point of the first dive of the day. By 08:00 we had the Azor drift-cam ready, and after checking the drift, we deployed the camera system and started the first dive at 08:16. We finished this dive at 10:00 and transited to another location in Ferrara Norte seamount where we performed two more dives. All the morning dives (St103, St104, St105) went well, with no technical incidents to report. We finished the morning dives at 13:35 and RV Arquipélago moved to Ferrara Mar seamount, where we performed two more dives after 1:30 hour of transit. The first dive started at 15:45, during which the ship had to do some small adjustments to help the navigation of the Azor drift-cam, due to a strong and variable drift. The result was a complicated dive (St106) with poor drift, navigation and biodiversity recorded. The last dive of the day (St107) was going well until we lost the live view connection, because the electrical cable got stuck on the winch (18:12). We decided to bring the system up from the bottom and quickly fixed the cable, while it was still in the water. With the cable repaired, the system returned to the bottom (18:30). At the end of the dive, the depth at bottom given by the bathymetry was 544 m, however we had 1000 m of cable in water. With the system onboard we checked the Aqualogger data and the real depth for the Azor drift-cam was 818m. This meant that the system was far behind the ship's track line at the moment it started going upslope. Despite the minor problems, this last dive was better than the previous ones.

Most of the dives of the day occurred mainly in sedimentary rocky areas with some coral rubble, so the fauna was very similar, even between the two different areas. Except for dives St104 and St106 that showed low

benthic fauna biodiversity with only some small encrusting sponges appearing, the other dives exhibited generally high diversity and density of corals and sponges. The highlights of the day were the extensive coral gardens of *Narella bellissima*, *Narella versluysi*, and *Candidella imbricata* recorded, sometimes together with *Acanthogorgia* sp. We also spotted Stylasterid aggregations, with some bamboo corals like *Acanella arbuscula* and *Chrysogorgia* sp. Black corals such as *Leiopathes expansa*, *Parantipathes hirondelle*, and one *Bathypathes* sp. were also identified. In terms of large sponges, we observed large extensions of seafloor that hosted *Poecillastra compressa*, *Phakellia robusta*, *Petrosia* sp., *Desmacella grimaldii*, *Neophrisospongia nolitangere*. Also, we spotted glass sponges such as *Asconema* sp. and small, scattered aggregations of *Pheronema carpenteri* and *Regadrella phoenix*. Regarding mobile fauna we drifted over both *Hoplostethus atlanticus* and *H. mediterraneus*, *Neocyttus helgae*, *Mora moro*, *Chaunax* spp., *Molva macrophthalmia* and eel-like fishes and Macrouridae; and some deep-sea sharks such as *Centroscymnus* cf. *owstonii*, *Deania* sp. and *Galeus murinus*.

We finished the last dive at 19:33 and, with the Azor drift-cam onboard of the vessel, we stayed for the night at Ferrara Mar seamount, drifting. The weather conditions were supposed to remain good, so we intended to continue the exploration of the seamount the day after.

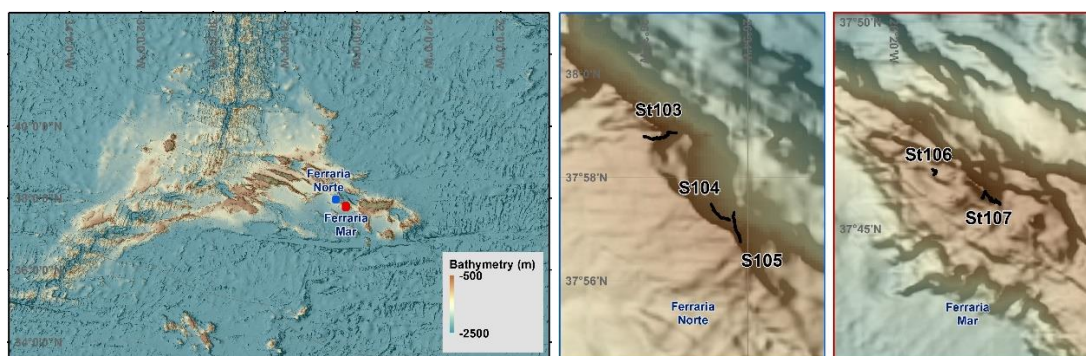


Figure 55. Bathymetric map showing the location of the dives conducted on August 30th of Leg 2b of the MapGES 2023 cruise at Ferrara Norte (in blue) and at Ferrara Mar (in red).



Figure 56. Screenshots taken from the video footage recorded on August 30th of Leg 2b of the MapGES 2023 cruise at Ferrara Norte and Ferrara Mar seamounts.

31 August 2023

We started the day drifting in Ferrara Mar. Around 07:30 the vessel began to adjust its position to the point of the first dive of the day. At 08:00 we had the system ready, and the first dive started at 08:16. We managed to do 5 dives during the day, between 745 m and 930 m depth, with a duration at bottom between 1:07 and 1:36, except for the third dive of the day (St110) that was shorter (00:39 at bottom).

The dives performed in Ferrara Mar were mainly characterized by their sandy bottom and some coral rubble, with a generally high biodiversity in terms of benthic megafauna (namely, corals, sponges, and mobile fauna). The highlights of the day were the extensive aggregations of *Narella bellissima*, *Narella versluysi*, and *Candidella imbricata*. We also spotted some extensions of small Stylasterids, with some bamboo corals like *Acanella arbuscula*. Gorgonians such as *Acanthogorgia* sp., a purple species from the genus *Paramuricea* and the following black corals: *Parantipathes hironelle*, *Leiopathes expansa* and *Bathypathes* sp. were also identified. Regarding sponges we only observed some small and dispersed aggregations of *Pheronema carpenteri*, *Regadrella phoenix*, *Asconema* sp. and *Farrea occa*, as well as the lamellate sponge *Desmacella grimaldi*. We drifted over some *Hoplostethus mediterraneus*, *Beryx splendens*, *Helicolenus dactylopterus*, *Trachyscorpia* sp., *Mora moro*, *Chaunax* spp., *Molva macrophthalma* and other eel-like fishes and Macrouridae, and some deep-sea sharks such as *Deania calcea* and *Dalatias licha*.

Similarly, to the previous day, we had to do some small corrections of the vessel to adjust the direction of the drift due to a strong and variable currents, especially during the afternoon. Despite the unpredictability of the drift, we managed to navigate the system in the intended direction. During the afternoon, while the Azor drift-

cam was coming up after the dive St111, we lost the live view connection because the electric cable got stuck on the winch and broke. We welded and repaired the cable before the next dive. We finished the day at 19:25 and decided to do a slight maintenance of the system's cable. The RV Arquipélago started to transit to the Sauerwein seamount, where we arrived after 4 hours, at 23:30.

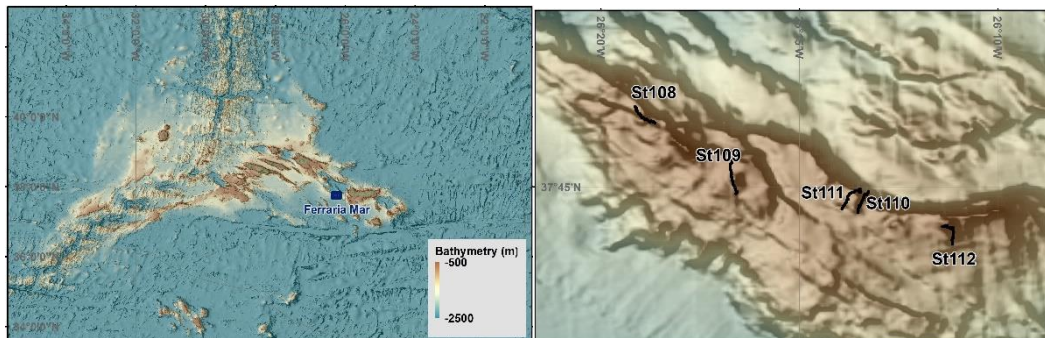


Figure 57. Bathymetric map showing the location of Ferraria Mar seamount and the 5 dives conducted on August 31st of Leg 2b of the MapGES 2023 cruise.



Figure 58. Screenshots taken from the video footage recorded on August 31st of Leg 2b of the MapGES 2023 cruise at Ferraria Mar seamount.

1 September 2023

We started the day drifting at Sauerwein seamount, and around 08:00 the RV Arquipélago got closer to the point of the first dive. The dive started at 08:39, a little bit later compared to the usual. The crew of the ship had to change the electrical generator, so we had to turn off all the electric devices, which delayed the start of

our work. The first two dives took place in the same seamount, both between 900 m and 950 m, mainly characterized by soft bottom with coral rubble and some basaltic outcrops. The diversity of megafauna in Sauerwein seamount was generally low, with only the corals *Acanella arbuscula*, *Chrysogorgya* sp., *Hemicorallium niobe*, *H. tricolori*, and small *Leiopathes expansa*, appearing in low densities. Sponges were also generally scarce showing only some small aggregations of *Pheronema carpenteri*, other glass sponges like *Regadrella phoenix* and *Asconema* sp. and some large sponges such as *Phakellia ventilabrum* and *Desmacella grimaldi*.

During lunch we navigated one hour to Mar da Prata S seamount where we performed three dives on the afternoon, between 300 m and 880 m. Along the afternoon dives, we spotted a lot of lost fishing lines, which was expected since Mar da Prata S seamount is known to be a fishing area. Luckily, we managed to escape them successfully, without getting trapped.

The first dive of the afternoon (St115) lasted only 00:30 because the site was mainly composed by sand and showed very low biodiversity with only some fish like *Beryx splendens*, *Helicolenus dactylopterus*, and some small macrouridae. In contrast, the last two dives of the day (St116 and St117) showed more diversity, especially on the basaltic outcrops with some *Leiopathes glaberrima*, some shallow coral species possibly belonging to the genus *Candidella*, occasional *Callogorgia verticillata* and *Dentomuricea*, and frequent *Viminella flagellum*; on the sand we also found *Chelidonisis aurantiaca*, *Flabellum* sp. and some ceriantharians. We drifted over some sponges such as *Petrosia* sp., *Characella pachastrelloides*, *Macandrewia azorica*, *Leiodermatium* sp. from both blue and white morphotypes, and some small aggregations of *Pheronema carpenteri*. In these two dives we also identified some fishes, like *Pagellus bogaraveo*, *Beryx* sp., *Anthias anthias*, *Mora moro*, *Hoplostethus mediterraneus* and *Chaunax* sp. The last dive finished at 19:36 and, with the Azor drift-cam on board, we spent the night drifting in Mar de Prata S, to continue the exploration of the seamount the day after.

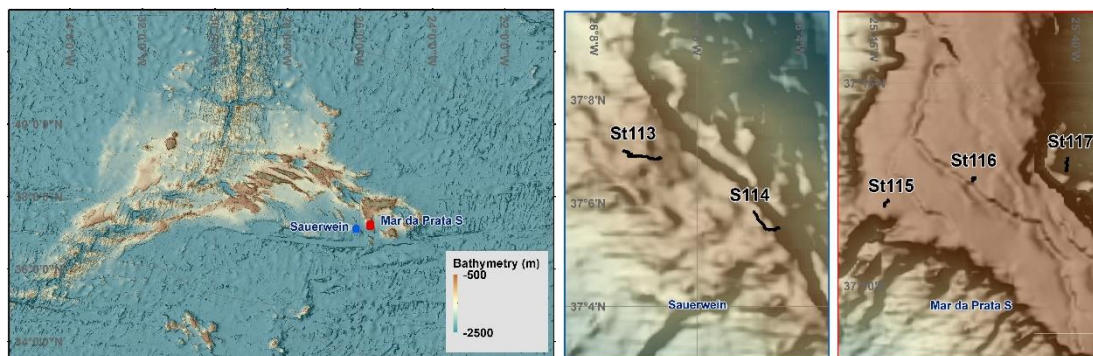


Figure 59. Bathymetric map showing the location of the 2 dives conducted on September 1st of Leg 2b of the MapGES 2023 cruise at Sauerwein (in blue) and the 3 at Mar de Prata S (in red).



Figure 60. Screenshots taken from the video footage recorded on day 4 on September 1st of Leg 2b of the MapGES 2023 cruise at Sauerwein and Mar de Prata S seamounts.

2 September 2023

We continued the exploration of Mar da Prata S seamount. The first dive started at 08:21, after the vessel adjusted its position. We managed to do 4 dives in this area, between 370m and 660m depth. During the second dive, we lost the live view connection 30 minutes into the start of the dive. The Azor drift-cam got stuck on a vertical wall, breaking the electric cable. We spent around fifty minutes trying to release the system, with the help of the crew manoeuvring the vessel. After a few attempts, we were able to recover it with some severe damages in the electric cable and some minor damages on the led lights. Between the second and the third dive we replaced the umbilical for a spare one brought to the vessel for these types of situations and continued working. During the morning dives, we spotted some lost fishing lines especially during St120 and St121, but fortunately we managed to avoid them.

The morning dives were characterized by basaltic outcrops covered with sand but were generally poor regarding corals and sponges. We observed some small aggregations of *Viminella flagellum*, occasional *Pliobothrus symmetricus*, *Leiopathes expansa* and *Acanthogorgia* sp., together with some aggregations of the barrel sponge *Pheronema carpenteri*, as well as small *Phakellia ventilabrum*, *Desmacella Grimaldi*, and *Geodia* sp.

After the end of the fourth dive in Mar da Prata S, the RV Arquipélago moved its position to the neighbour area, Mar da Prata seamount, with only a 10-minute transit. During the afternoon we performed 3 more dives in this area, between 230 m and 880 m depth, where the bottom was mainly sedimentary with coral rubble. Here we found gardens of *Viminella flagellum* with *Paracalyptrophora josephinae*, in the shallower areas, and small dispersed aggregations of *Narella versluysi* and *N. bellissima* together with *Callogorgia verticillata*,

Acanthogorgia sp., and *Leiopathes expansa* in deeper areas. The most common sponges in Mar da Prata S were *Characella pachastrelloides*, *Petrosia* sp., *Neophrisospongia nolitangere*, *Pheronema carpenteri* and *Asconema* sp.

During this day, we spotted several fish from different species, such as *Helicolenus dactilopterus*, *Hoplostethus mediterraneus*, *Chaunax* sp., *Capros aper*, *Cyttopsis rosea*, one *Conger conger*, *Beryx splendens*, *Pagellus bogaraveo*, *Pontinus kuhlii*, *Anthias anthias*, and *Mora moro*, among others. Regarding sharks, we only identified *Deania* cf. *calcea* during the first dive of the day.

Despite the problems we faced, we managed to complete 7 dives during this day, mainly because the dives were in general shorter, shallower (average depth 500 m), and no long transits were made during the day. The last dive finished at 20:02 and we spent the night drifting in Mar da Prata seamount, to continue the exploration the day after.

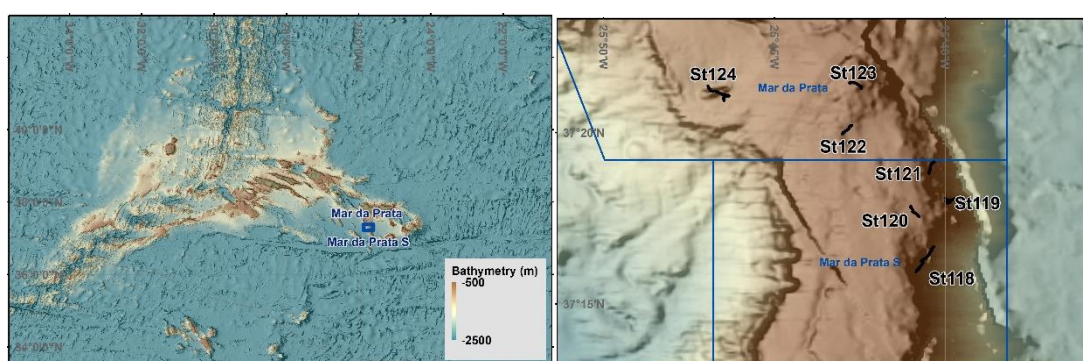


Figure 61. Bathymetric map showing the location of the 7 dives conducted on September 2nd of Leg 2b of the MapGES 2023 cruise at Mar da Prata S and Mar da Prata seamount.

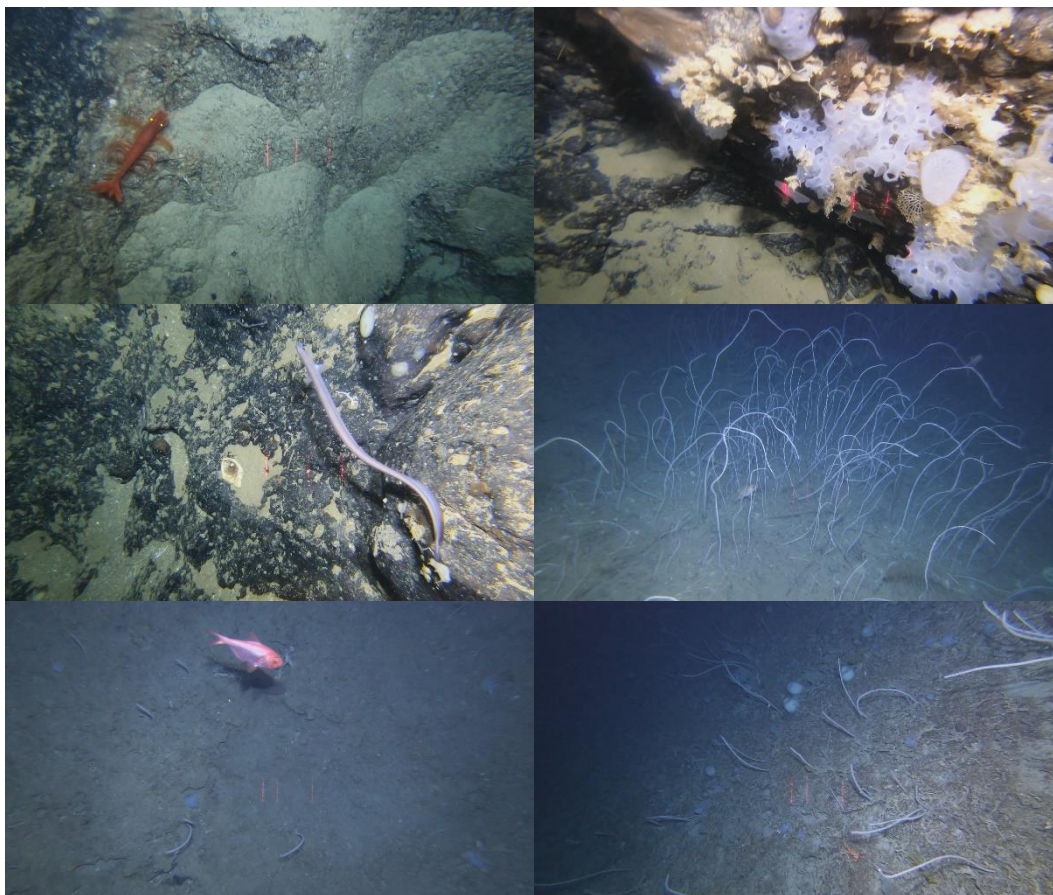


Figure 62. Screenshots taken from the video footage recorded on September 2nd of Leg 2b of the MapGES 2023 cruise at Mar da Prata S and Mar da Prata seamount.

3 September 2023

After spending the night in Mar de Prata, we started the first dive of the day around the usual time (08:10), after checking the drift. During this day, we managed to do 7 dives between 330 and 800m depth. To optimize the day, and do the minimum time in transit possible, the first 4 dives (St125-St128), as well as the last dive of the day (St131) occurred in Mar da Prata seamount, while the other 2 (St129 and St130) were performed in the south of Mar da Prata N. During most of the day, we had some problems with the drift, causing the system to remain static over the seabed or move at a very slow speed in most of the dives.

The bottom was mainly characterized by outcrops covered with soft sediments and some coral rubble. The deeper dives showed aggregations of *Narella versluysi* and *N. bellissima*, *Acanthogorgia* sp. and *Pliobothrus symmetricus*, while in shallower dives we spotted big aggregations of *Viminella flagellum*, sometimes with *Callogorgia verticillata* and other times with *Dentomuricea* aff. *meteor*. Regarding sponges, the most common species throughout the day were *Phakellia robusta* and *P. ventilabrum*. There were also other species such as *Characella pachastrelloides*, *Neophrisospongia nolitangere* and *Petrosia crassa*, *Leiodermatium* sp., *Geodia* sp. and some aggregations of *Pheronema carpenteri*. Along the day, we also recorded several fish species such as *Helicolenus dactylopterus*, *Mora moro*, *Hoplostethus mediterraneus*, some flatfish and one *Hexanchus griseus* deep-sea shark.

We finished the last dive at 19:28 and RV Arquipélago started heading to Ponta Delgada harbour, where we arrived at 21:25. We spent the night in the harbour waiting to refuel the boat in the morning before leaving to continue the work.

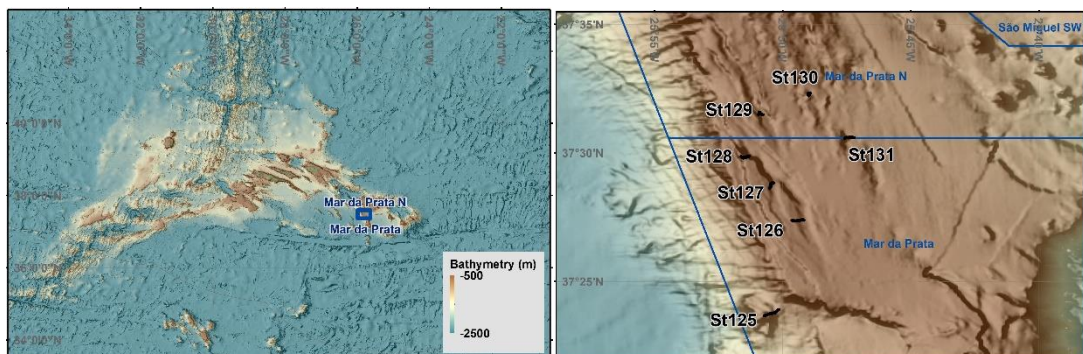


Figure 63. Bathymetric map showing the location of the 7 dives conducted on September 3rd of Leg 2b of the MapGES 2023 cruise at Mar da Prata and Mar da Prata N seamount.



Figure 64. Screenshots taken from the video footage recorded on day 4 on September 3rd of Leg 2b of the MapGES 2023 cruise at Mar da Prata and Mar da Prata N seamount.

4 September 2023

The day started a little bit later because the time to refuel was around 09:30, so RV Arquipélago only left Ponta Delgada harbour around 10:20, heading to Mar the Prata N seamount. The transit lasted around two hours and we arrived at the location of the first dive around mid-day. During the day we managed to do 3 dives shallower than usual (between 200-400m).

These dives were mainly characterized by sedimentary bottom, with some basaltic outcrops. Benthic megafauna in Mar da Prata N was very dense and diverse, with large gardens of *Viminella flagellum*, sometimes associated with *Callogorgia verticillata* and other times with frequent and large *Dentomuricea* aff. *meteor*.

Other corals spotted in lower densities included *Parantipathes hirondelle* and *Acanthogorgia* sp. Regarding sponges, we did not identify a large diversity of species, but we found a high density of *Phakellia ventilabrum*, big aggregations of *Neophrisospongia nolitangere*, and some *Leiodermatium* sp. We drifted over a large six-gill shark from the species *Hexanchus griseus*. Lastly, we observed big shoals of *Capros aper*, shoals of *Anthias anthias*, and *Trachurus trachurus*, as well as *Helicolenus dactylopterus* and some flat fish.

The weather conditions got worse comparing to the other days of cruise, with waves of 1.5m-2m, so the working conditions were challenging. Added to this, we were working on a fishing area, full of lost fishing gear. For these reasons, we decided to return to Ponta Delgada harbour after the third dive, where we arrived at 18:40. We spent the night sheltered in Ponta Delgada harbour waiting for better weather conditions.

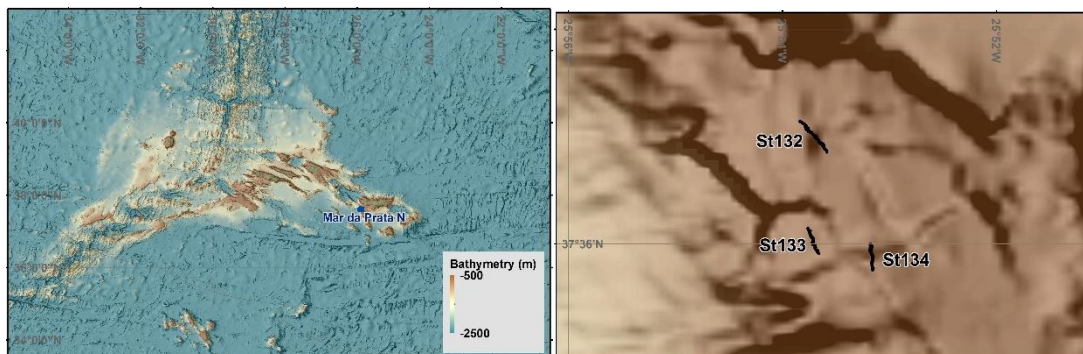


Figure 65. Bathymetric map showing the location of the 3 dives conducted on September 4th of Leg 2b of the MapGES 2023 cruise at Mar da Prata N seamount.



Figure 66. Screenshots taken from the video footage recorded on September 4th of Leg 2b of the MapGES 2023 cruise at Mar de Prata N seamount.

5 - 6 September 2023

The bad weather lasted for two days, as predicted by the weather forecast. With strong winds and waves of 3 m height there were no conditions to operate, so we stayed in Ponta Delgada harbour. During these days we reunited with the MT Physerter team, also working in São Miguel. By the end of September 6th, we swapped some team members, with Marc leaving RV Arquipélago to join the MT Physerter team and Inês Bruno joining RV Arquipélago team.

7 September 2023

After spending two days in Ponta Delgada due to bad weather conditions the RV Arquipélago left the harbour at 04:00 in the morning in direction to Grande Norte, a seamount 30 nm away from Ponta Delgada. We arrived at 08:00 and deployed the Azor drift-cam a few minutes after. The sea and weather conditions were not the ideal to operate, with the strong wind and waves of around 1.8 m height, but we still managed to perform 8 dives. In general, the drifts were good, with the boat drifting to the expected course; with the only exception being the dive St140, where the strong bottom currents made us navigate in circles instead of going up the ridge. During both dive St137 and dive St141, the system got entangled in some lost fishing lines, and we lost the weights.

All dives of the day were mainly characterized by soft sediments, with coral rubble patches and some basaltic boulders. Most of the dives presented high diversity and abundance, with large coral aggregations of *Viminella flagellum*, *Paracalyptrophora josephinae*, and one small unidentified species of Plexauridae, along with some large sponges such as *Phakellia ventilabrum*, *Poecillastra compressa*, *Macandrewia azorica*, and *Neophrissospongia nolitangere* (St139). It was also possible to observe large colonies of *Callogorgia verticillata*, one black coral *Bathypathes* sp. (St135) and an extensive aggregation of *Pheronema carpenteri* (St137). Regarding mobile fauna we spotted some deep-sea fishes such as *Hoplostenus mediterraneus*, *Helicolenus dactylopterus*, a shoal of *Anthias anthias*, specimens from the Macrouridae family, a big school of *Trachurus picturatus* (St142) and two exemplars of the ray *Tetronarce nobiliana* (St141 and St142). In the St141 dive, we also observed an encrusting organism still to be identified. We finished all dives around 20:00 but continued working on the report and video analysis.

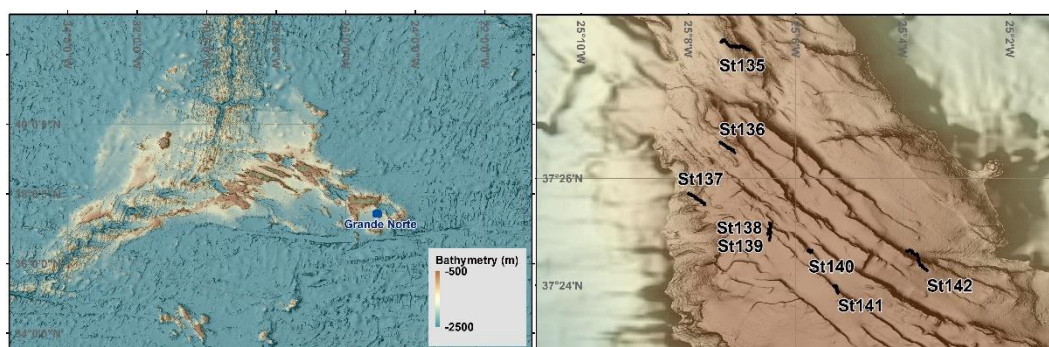


Figure 67. Bathymetric map showing the location of the dives conducted on September 7th of Leg 2b of the MapGES 2023 cruise at Grande Norte.

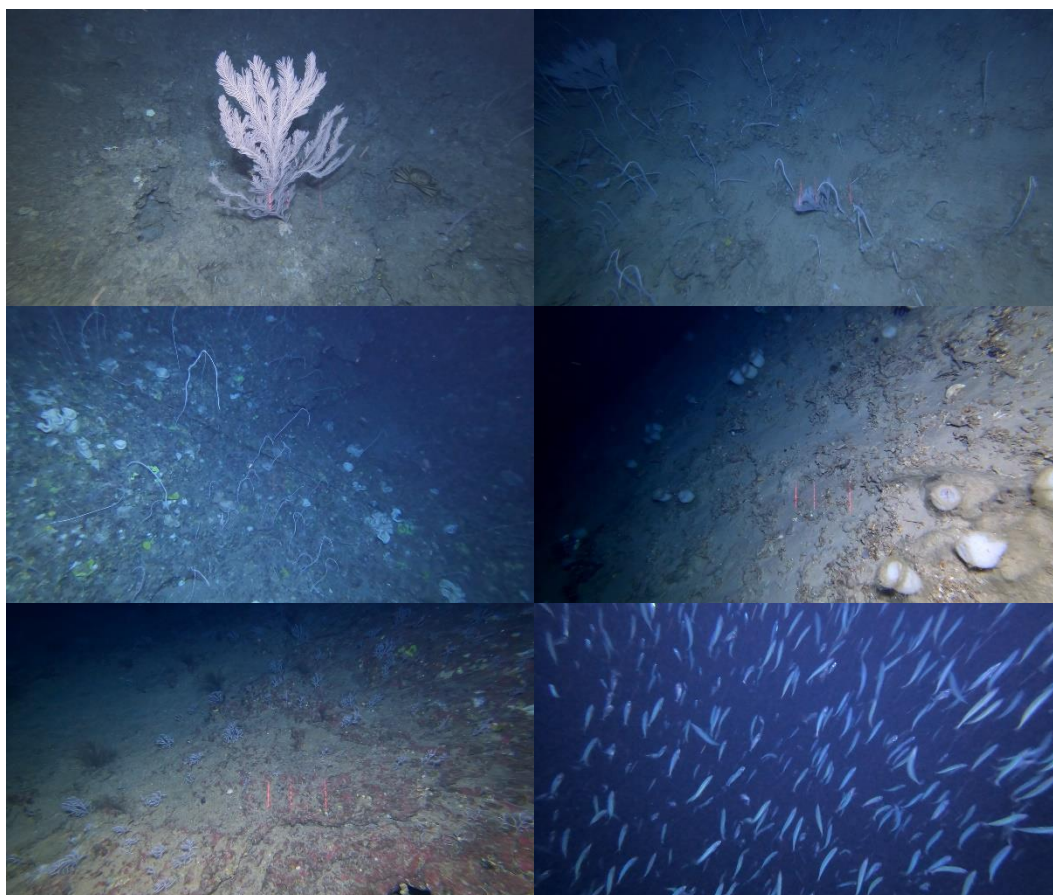


Figure 68. Screenshots taken from the video footage recorded on September 7th of Leg 2b of the MapGES 2023 cruise at Grande Norte.

8 September 2023

We spent the night drifting in the Grande Norte area. In the morning, we had to navigate a little to get closer to the point where we intended to perform the first dive, which took place at 08:20. During the day, the dives were performed within a depth range between 127m and 803 m. The sampled area was full of lost fishing gear, so Grande Norte happened to be a danger area to work on, but we were lucky enough not to get entangled in any fishing lines.

All dives showed various types of substrate, from areas with soft sediment, to ones covered in coral rubble or composed of rocky outcrops. Although this area was subject to intense fishing efforts, we found large aggregations of corals together with some sponges. The aggregations were formed by *Callogorgia verticillata* with *Leptopsammia formosa* and *Acanthogorgia* sp., with some glass sponges from the species *Farrea occa*. In one vertical wall in the dive St144 we found an extensive garden of the shallower coral species possibly from the genus *Candidella*. We also observed large gardens of *Viminella flagellum* together with some *Paracalyptophora josephinae* and *Dentomuricea* aff. *meteor*. The sponges' group was represented by some individuals from the complex *Characella pachastrelloides*, *Neophrissospongia nolitangere*, and *Geodia* sp. We also registered two impressive observations: one *Hexanchus griseus* and a large aggregation of sea-urchins probably from the species cf. *Centrostephanus longispinus*, which, if this identification is correct, it is the first *in situ* record we have from this species. The fifth and last dive finished at around 16:00. We ended this day earlier because we still had approximately 21 hours of navigation to Faial Island. There we intend to change the

scientific team, and the crew of RV Arquipélago will prepare the vessel with fuel and food supplies before we continue the work.



Figure 69. Bathymetric map showing the location of the dives conducted on September 8th of Leg 2b of the MapGES 2023 cruise at Grande Norte.

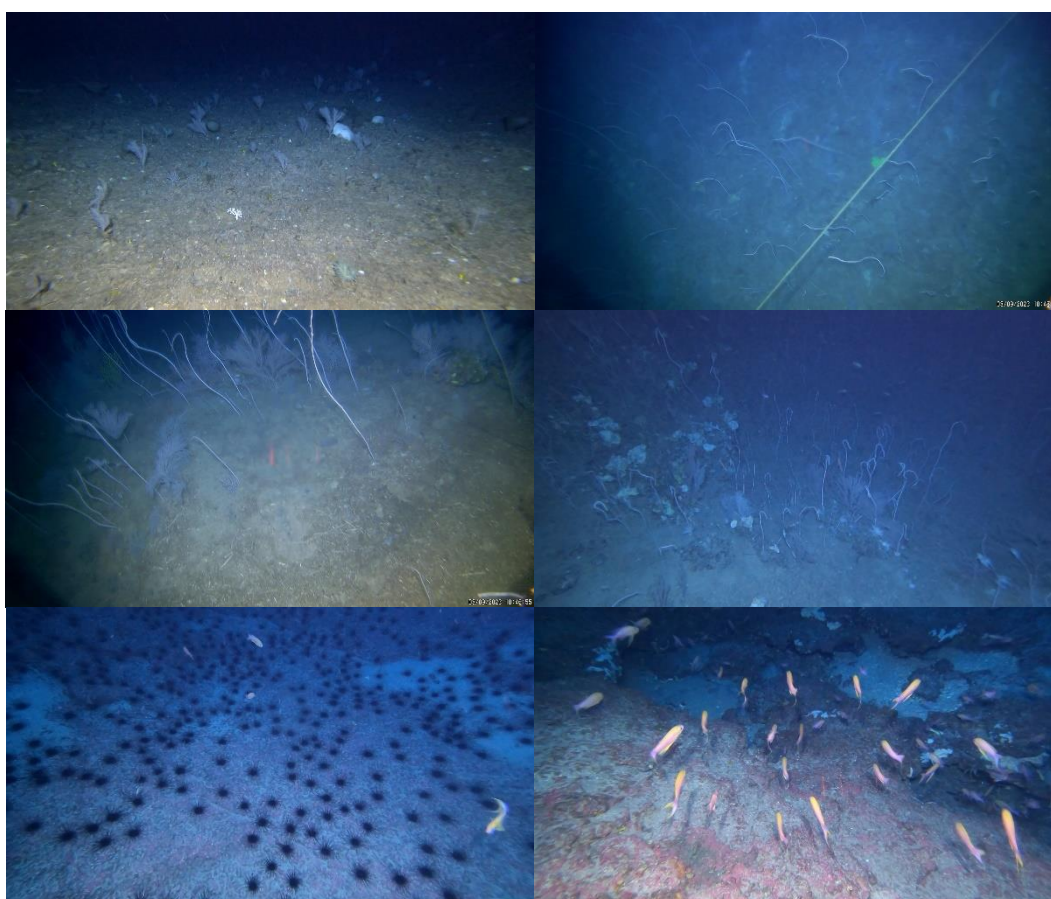


Figure 70. Screenshots taken from the video footage recorded on September 8th of Leg 2b of the MapGES 2023 cruise at Grande Norte.

9 September 2023

Still heading to Faial Island, the team spent the morning working on the report and on the data gathered during these last two days. We also checked the Azor Drift-cam and the rest of the gear to assess what could be missing and hence needed for the upcoming Leg, starting in a few days. We arrived in Horta harbour around 13:00, and left all the equipment in RV Arquipélago, ready for the next team to use.

2.6 REPORT OF THE RV ARQUIPÉLAGO LEG 2C

2.6.1 Summary of RV Arquipélago Leg 2c

Objective: to conduct a rapid appraisal of the deep-sea benthic communities dwelling on some of the unexplored seamounts around Princesa Alice (Princesa Alice S, Princesa Alice SE, and De Guerne). These dives aim to contribute to the overall goal of better understanding the composition and diversity of deep-sea benthic communities in the Azores, the distribution of Vulnerable Marine Ecosystems (VMEs) and commercial fish species and assess their environmental status.

Statistics: We performed only 2 dives with the Azor drift-cam down to 890 m depth, covering 1.6 km of the seafloor and producing about 2 hours of video footage.

Vessel: RV Arquipélago

Dates: 14th and 16th September

Scientific team: Guilherme Gonçalves and Gerald H. Taranto (chief scientists Leg 2c), Inês Carneiro, Inês Bruno, Galia Edrey, António Godinho, Nicolás Collazo.

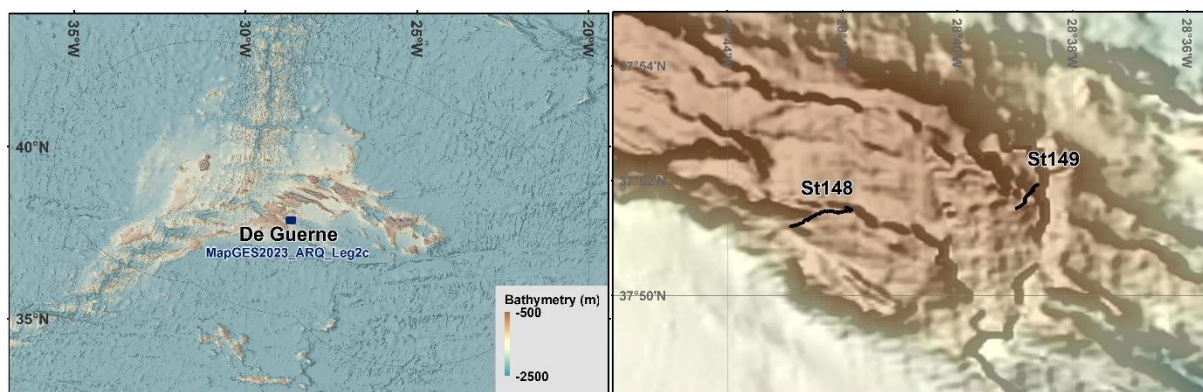


Figure 71. Location of the 2 video transects (black lines) carried out with the Azor drift-cam during Leg 2c of MapGES 2023 onboard the RV Arquipélago.

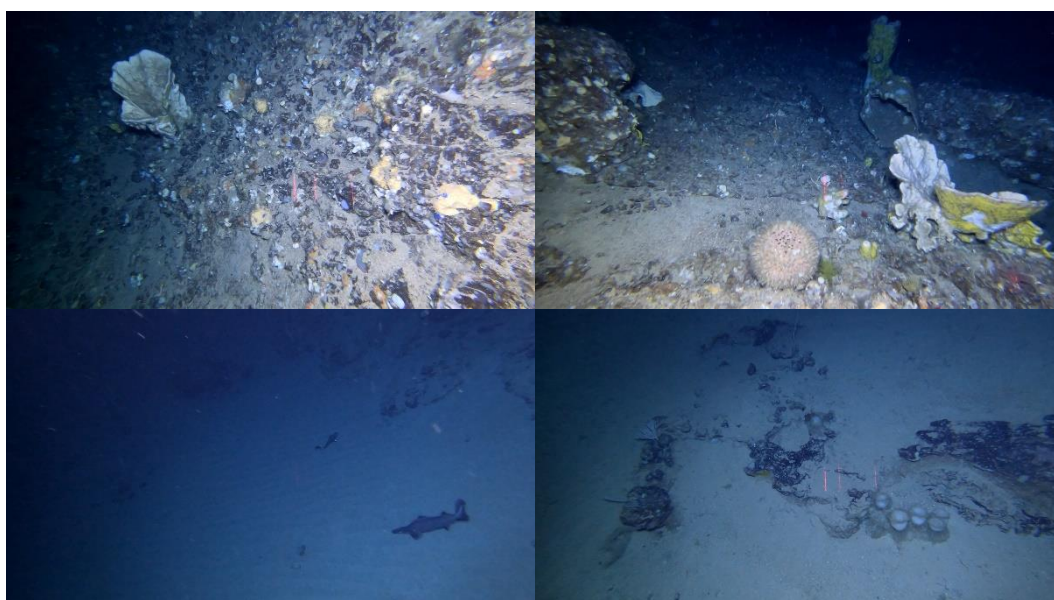


Figure 72. Screenshots taken from the footage recorded during Leg 2c of MapGES 2023 cruise. (a) large individuals from the complex *Characella pachastrelloides*; (b) sponges were common, especially *Geodia* sp.; (c) one deep-sea sharks of cf *Deania* sp.; (d) small and scattered aggregations of *Pheronema carpenteri*

2.6.2 Cruise diary of RV Arquipélago Leg 2 Part C

9-13 September 2023

We arrived back at Horta harbour at around 13:00 on August 9th. The new team was supposed to start working on the 10th but because the vessel crew got sick and had some logistic delays (mainly with the food supplies), we had to postpone our departure until the 14th at dawn. The new research team got in the RV Arquipélago on the 13th at 23:00, to sleep onboard. We started transiting to De Guerne seamount around 02:30 so we could start working early in the morning.

14 September 2023

We woke up at around 06:30 to prepare the equipment for the day and test all the gear. The RV Arquipélago was still transiting in direction to De Guerne seamount, where we arrived at 07:35. After checking the vessel drift, we started the first station of the day around 08:05 and were able to perform 2 dives with the Azor drift-cam between 800m and 690m depth. The drift of the first dive was quite fast and towards the expected direction, which allowed us to navigate over the top of the mount with only small vessel adjustments. During this dive, we encountered a basaltic vertical wall, followed by a fishing cable from which we escaped successfully.

Both dives of the day were characterized by sand bottom with some gravel and basaltic outcrops covered by soft substrate. Coral biodiversity was generally low, with only some occasional corals from the species *Acanella arbuscula*, *Parantipathes hirondelle*, and *Elatopathes abietina*, dispersed *Acanthogorgia* sp., some *Leptopsammia formosa*, and *Pseudoanthomastus*. We also identified at least one exemplar of each of the following gorgonians: *Narella versluysi*, *N. bellissima* and cf. *Muriceides* sp. By the end of the second dive, we also spotted a large area covered with small unidentified stylasterids. Sponges were common, especially *Geodia* sp. and some large individuals from the *Characella pachastrelloides* complex. We also observed other large sponges such as *Macandrewia azorica*, *Haliclona magna* and *Leiodermatium* sp. Small and scattered aggregations of *Pheronema carpenteri* were identified, as well as glass sponges such as *Asconema* sp., *Farrea occa* and individuals from the *Aphrocallistes beatrix* complex. Furthermore, *Stylocordyla pellita* and *Desmacella grimaldii* were frequently spotted. The soft substrate also presented some foraminifera *Syringamina fragilissima*. We managed to film several fish and deep-sea shark species, such as *Hoplostethus mediterraneus*, *Helicolenus dactylopterus*, *Chaunax pictus*, *Mora moro*, and several Macrouridae and eel-like fish. Regarding other mobile fauna, we drifted over one octopus still to identify, and some shrimps *Aristaeopsis edwardsiana*.

After the second dive of the day, an issue with the vessel's hydraulic pump delayed the start of our 3rd dive. As the RV Arquipélago crew members were not able to fix it, we were forced to cut the day short and started to return to shore at around 13:44. After 5 hours of transit, we arrived in Horta harbour at 18:15.

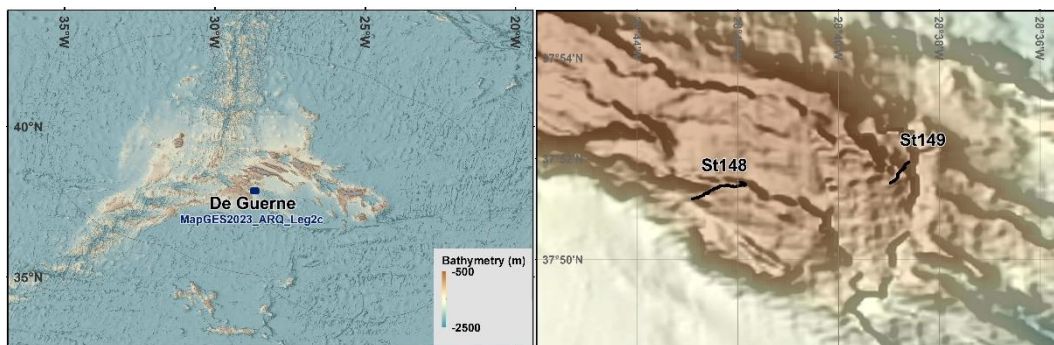


Figure 73. Bathymetric map showing the location of the 2 dives conducted on September 14th of Leg 2c of the MapGES 2023 cruise.

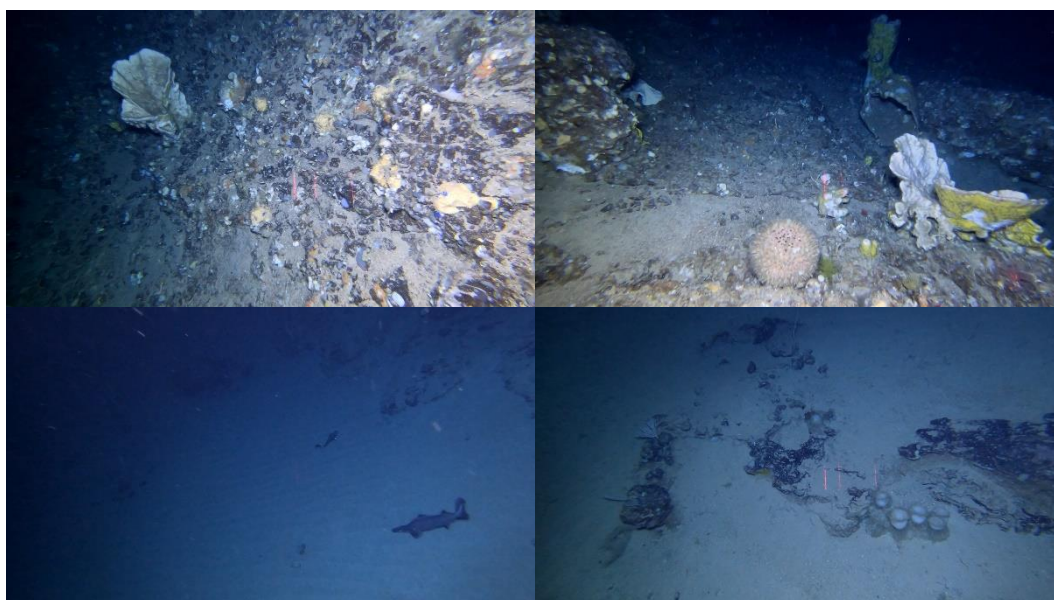


Figure 74. Screenshots taken from the video footage recorded on September 14th of Leg 2c of the MapGES 2023 cruise at De Guerne seamount.

15 September 2023

Due to the bad weather conditions, we were already planning to stay on land on September 15th and leave with the new research team in the early hours of the 17th. However, with the hydraulic pump failure on the day before, we had to wait for confirmation from the RV Arquipélago crew that the pump was fixed. During the afternoon of the 15th, we received green light from the RV Arquipélago, so we planned to leave Horta harbour at 02:30 on September 17th.

16-17 September 2023

The new research team got in the RV Arquipélago on the 16th between 22:00 and 23:00, to sleep onboard. The plan was to start transiting to Princesa Alice around 02:30 so we could start working early in the morning. However, when the RV Arquipélago crew initiated the manoeuvres to leave the harbour, they noticed the hydraulic pump was not working properly again. Around 03:00 the captain called the chief scientist to communicate the problem and warn him that it was impossible for the RV Arquipélago to leave in these conditions, so the work had to be cancelled until further news. The research team left RV Arquipélago around 04:00 to rest at home.

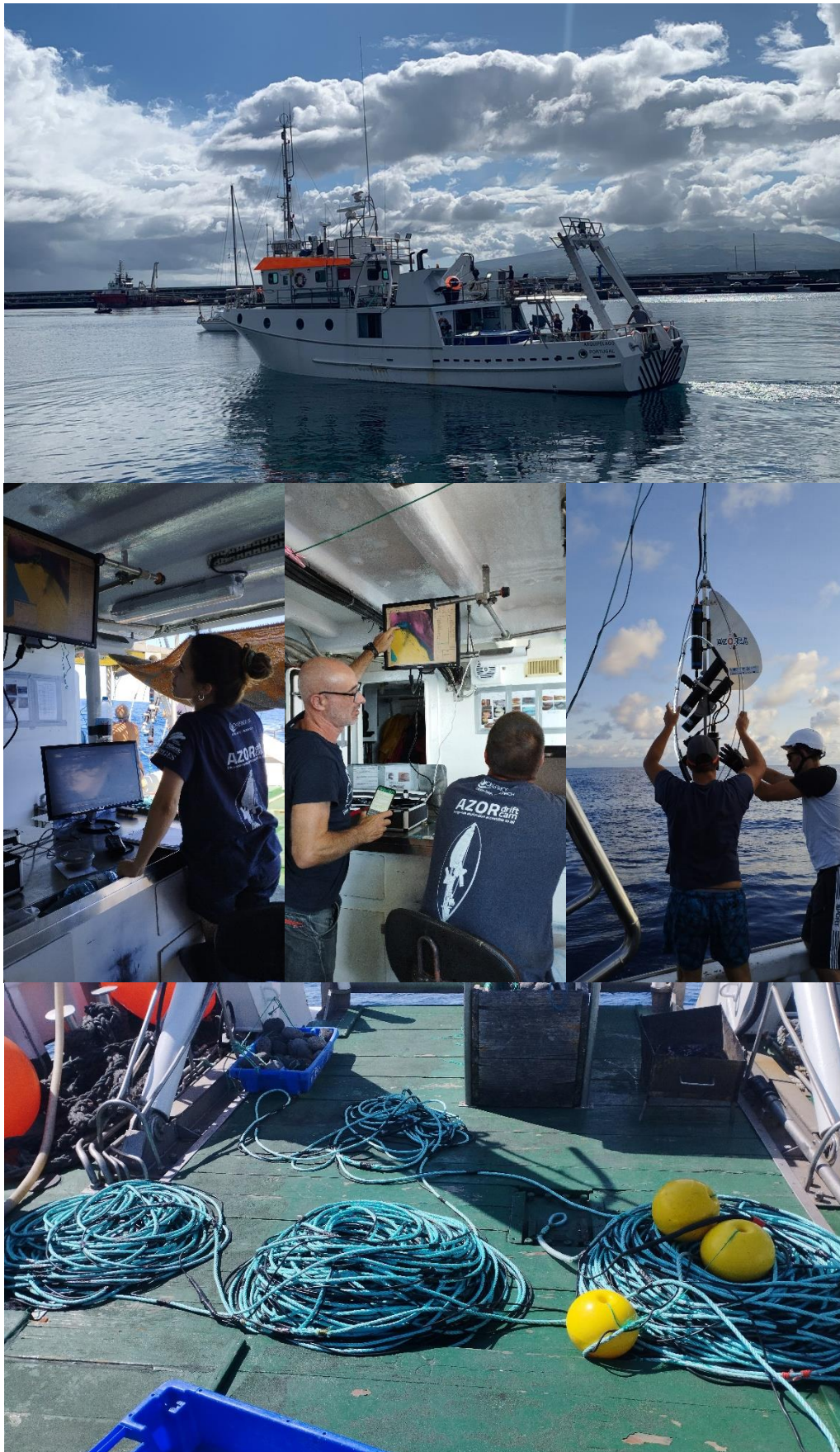
18-20 September 2023

During this week, the RV Arquipélago crew was focused on fixing the hydraulic pump, however they were waiting on the arrival of a piece from the mainland Portugal, to be able to continue with the repair. On the 20th of September, the captain of RV Arquipélago had a meeting with the chief scientist of this Leg and informed him that due to the delay on the arrival of that part, and since the weather conditions were supposed to be bad until our last day of mission, he advised us to cancel our work for the next days. Considering this information, the chief scientist decided to cancel the work planned for the rest of the week, marking the end of the mission in RV Arquipélago. The team planned to meet on the day after, to unload the vessel and take it back to the imagery office.

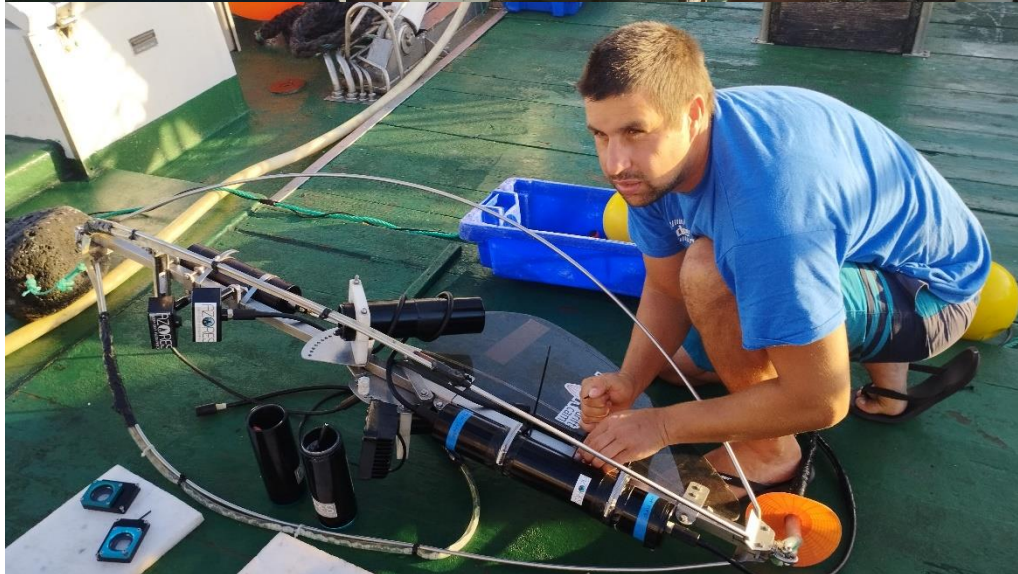
21 September 2023

At 10:00 in the morning, part of the scientific team gathered again on the vessel to transport all the equipment back to our imagery workshop located in the university facilities. In less than 2 hours we had everything out of the vessel and spent the remaining part of the day cleaning and organizing all the equipment.

2.7 LIFE ON BOARD OF RV ARQUIPÉLAGO DURING LEG 2 OF MAPGES 2023











3 ACKNOWLEDGEMENTS

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